Historic Timber-built Seacoast Piers of Eastern England: Technological, Environmental and Social Contexts

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Abstract

The aim of this thesis is to initially establish the existence of a class of monument, the timber-built seacoast pier, which has heretofore received virtually no investigation by archaeologists and been merely briefly referred to by a handful of historians. Data sources for this topic are diverse and include documentary sources, material remains, cartographic and pictorial evidence, coastal geomorphology and place-names. Investigation is perforce multi-disciplinary. This study will show that such structures were once quite widespread within the study area of eastern England, and indeed further afield. These structures were far from identical and the varying technical forms of the piers are determined and explanations sought to account for these. The physical backdrop to these piers was the varied and dynamic coastal environment of the eastern seaboard of the North Sea and it is not possible to gain a broad understanding of the piers without reference to this environment.

Timber-built seacoast piers required enormous resources to construct. They were regularly subject to damage and destruction and they were costly to maintain. Given such circumstances, communities often struggled to maintain their piers. Occasionally, their resources expended, this battle was lost. More often they limped on, saved by appeal to the wider community, county or crown. The lengths to which communities were prepared to go in order to safeguard their piers demonstrates the enormous value attached to them by the communities and bodies to whom they belonged. Piers came to be important items of infrastructure that were essential to the well being of many local economies and in the meshing together of these with wider economies, regional, national and international. Whilst the technology of seacoast piers is of some intrinsic interest, perhaps the greatest potential of this topic lies in the social and economic spheres.

Contents (Volume 1)

Contents (Volume 2): Individual case study notes

List of Figures

*Note that sources for Figures are given at the end of each caption. Where no source is credited the origin is with the author.

List of Tables

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Much kindness has been shown to me during my research journey by many individuals in archives, museums, galleries and Historic Environment Record Offices across the country, and to them I extend my thanks.

A final thanks go to my long-suffering family – for their forebearance.

In memoriam mea vel parentum meorum Neil et Elizabeth Johnson

Author's Declaration

I certify that any material in this thesis which is not my own work is identified and acknowledged. Less detailed elements of the case studies of Scarborough, Filey, Flamborough, Bridlington and Hornsea were submitted by me within a dissertation entitled: 'Historic Timber-Built Coastal Piers: an Exploration of their Technology and Social Context, with particular reference to Bridlington, East Riding of Yorkshire' for the degree of Master of Arts, Archaeology, University of York, in 2008. That work formed a pilot study for this thesis. This thesis has not previously been submitted for any other degree at this or any other university.

Chapter 1: Introductory

1.0 Introduction

This study is an examination of the timber-built seacoast piers of eastern England, from the Scottish border in the north to Hastings in the south and from the earliest recorded evidence of the 13th-century to their final demise in the 20th-century. The subject is addressed in six chapters. Chapter 1 examines the intellectual agenda to the study and sets forth the research framework. The results of analysis are presented thereafter. Chapter 2 examines the piers as technical works and elucidates their various forms. Chapter 3 considers the environmental context of the piers, namely the levels of contemporary knowledge of coastal processes and the manner in which these were successfully, and unsuccessfully, addressed by the pier builders. The social context of the piers, including their contexts of origin and the mechanisms of their ownership, control and funding, is explored in Chapter 4. The demise of timber-built piers and their replacement by piers in other materials is examined in Chapter 5. Finally, in Chapter 6, evidence is presented demonstrating that the timber-built seacoast piers of England are part of a wider, and unexplored, north European phenomenon.

Timber-built piers will be shown to form a distinct class of field monument, to have been important items of infrastructure and to have formed some of the largest timber structures ever built in England. The piers were integral to the institutions and communities responsible for them and within the span of the many centuries of their existence the profound changes that shaped the modern western world took place. Amongst these transformations we may consider the demise of feudal obligation, the reformation, the rise of capitalism and the industrial revolution. In ways far greater than might be anticipated, the changing ownership, control and funding of the piers can be seen to be reflective of these important shifts. As such, the piers inform us directly of these major processes of societal change. Such piers also provide evidence, in all its complexity, for major and prolonged human intervention within dynamic coastlines. Surprisingly perhaps, this study forms the first significant archaeological consideration of timber-built seacoast piers.

The selection of the east coast of England as the focus of study is the product of several factors. In many regards the east coast and the overseas lands of the North Sea basin can be viewed as a distinct economic and trade zone with communication and exchange between England and the Low Countries, Northern Germany, Scandinavia and the Baltic taking place across this arena over a prolonged span of time (Carver 1990; Clarke 1979, 155). This activity is widely attested throughout the medieval period, particularly in English state papers, as well as throughout the post-medieval period where it is documented in numerous and diverse sources.

The North Sea itself formed the gateway and conduit through which the peoples of those lands bordering the sea maintained international contact. In addition to such matters as trade, the cultural impacts of this communication have been considerable. Whilst this North Sea nexus of contact did not bring an all pervasive homogenising of the lands bordering it, influences ranging from the widespread use of brick and architectural style to the movement of peoples, are well attested in material and historic terms. From the migrations of the 'Dark Ages' and Viking period to Flemings in the Middle Ages and Dutch protestants in the post-medieval period, influxes of 'England's cousins' have all affected the wider cultural makeup of the east coast. One particular aspect of this movement of people which is of very direct relevance to this study is the role played by a number of experts in 'water works' from the Low Countries and northern Germany engaged in the construction of piers within the study area. This also serves to remind us that certain levels of shared environmental processes exist across the North Sea basin.

From a pragmatic perspective the limitation of the area of study to the east coast of England has created in a manageable body of data that permits the pier sites to be studied at a level of resolution far greater than that of a larger study area. In spite of this geographical limitation, occasional use of certain information from timber-built pier sites beyond the study area is made where it is felt that such can illuminate, or add to, particular aspects of this enquiry.

1.1 Earlier studies of waterfront archaeology

A considerable amount of excavation centred around former port facilities has taken place in Britain and the continent since the 1970s, including over 100 excavations and

observations in London alone. The term ‘waterfront archaeology’ is generally used to describe these investigations and usage of the term serves to emphasise that it is perceived as a distinct area of study within the wider sphere of archaeological enquiry. ‘Maritime archaeology’, ‘nautical archaeology’ and ‘archaeology underwater’ can also be seen as related topics. The term maritime archaeology has been defined as the study through material evidence of all aspects of seafaring such as vessels and cargoes, as well as the study of the economic systems within which they were operating (Muckleroy 1998, 24-26). Within this all embracing field of maritime archaeology the specific study of maritime technology forms a specialism, generally termed nautical archaeology. The term archaeology underwater, has certain areas of overlap with maritime and nautical archaeology, but as much of this field is concerned with such matters as inundated landscapes and the study of remains generated on what was formerly dry land, there are also obvious areas of digression.

Excavation of waterfront sites has for the most part been an archaeological response to urban redevelopment schemes (Herteig, 1985, 9). Whilst the volume of modern waterfront archaeology excavations broadly mirrors the expansion of professionally organised non-waterfront fieldwork generally, it has long been recognised that waterfront excavations have the potential to be especially productive. Such ‘productivity’ is often betokened by the survival of structural timberwork and other organic remains whose preservation is owed primarily to anaerobic conditions, a normal accompaniment to sub-surface water-logging that tends to be less common on non-waterfront sites.

The results of many waterfront investigations have been described and discussed within individual site reports as well as in lengthy collections of conference papers e.g. (Milne and Hobley 1981; Herteig 1985; Good et al 1991; Bill and Clausen 1999). The topic has also seen a number of spatially defined works of synthesis. The most significant of these is arguably Gustav Milne’s ‘Timber Building Techniques in London c.900-1400’ (Milne 1992). In drawing together the results of waterfront excavations in London, Milne was able to demonstrate the technological development of medieval waterfront structures and draw a number of other significant conclusions. It could be shown, for example, that the timber-built waterfronts of London were the product of carpenters, not specialist waterfront builders. Further, the developing techniques employed in the riverside structures could be seen to closely reflect the developing techniques of timber buildings in

London. In this respect Milne's work is also of considerable importance to buildings archaeologists.

In northern Europe the study of successive sequences of medieval and post-medieval waterfront structures, built overwhelmingly of timber until well into the post-medieval period, has permitted the recognition of regional chronological developments of form. These are again best understood in London where three basic techniques, 'earth-fast post', 'stave' and 'frame-built', are represented (Milne1992, 80-82). Earth-fast post construction is represented from the 10th-century to the end of the 13th-century and was a technique in which the principal posts were driven into the ground with planking being affixed to these uprights. Stave constructed waterfront structures span the 11th – 15th centuries and were comprised of conjoined vertical timbers. The earliest stave walls were earth-fast, the later ones commonly set in base-plates. Frame-built waterfronts appear in the early 13th-century and here all principal posts were set in base-plates. In this technique the individual elements of the waterfront were entirely interlocked by mortise and tenon joints and the structure relied on its site for nothing more than the support of its weight. Many of the London waterfronts were braced, either by raking braces to the front or by braces to the back, landward, sides.

A substantial amount of the reporting on these structures has tended to be of a descriptive nature. There appear to be two principal reasons for this. Firstly, descriptive accounts are the common product of professional archaeological field units, a factor sometimes owed to resource restrictions. Secondly, the appearance of waterfront structures in archaeology as new structural forms, demanded their concise description as the pre-requisite of further study. Beyond the descriptive, functionalist stances have dominated interpretations of these features, both in terms of the individual structures themselves and the wider context of their socio-economic settings. As such, formal landing facilities, that is artificial structures such as wharfs, quays, etc, tend to be seen simply as an accompaniment to the growth of towns that, with the increased tonnage of vessels, allowed for a more efficient transference of cargoes between ships and dry land (Hutchinson 1994, 105). It seems unquestionable that a direct linkage did exist between the provision of various formal port facilities and levels of ship building technology, and that both of these aspects had connections to the nature of settlement, the wider economy and environmental factors. It may be legitimately questioned however, as to whether such structures were intended solely to ease the transportation of goods in expanding centres of market. It is surely

possible that such structures can also be viewed in a wider perspective in which other, perhaps more symbolic factors, in which control, identity and authority, also figure?

Similar criticism of purely functionalist approaches has come to be voiced by other workers in relation to related branches of maritime archaeology, particularly the study of boats and shipwrecks where the emphasis has largely, but by no means exclusively, been concentrated on the technical and evolutionary aspects of ships (Breen and Lane 2004, 469-70). To some degree these functionalist approaches have been counterpoised in recent years by historical maritime archaeologists who are also increasingly moving away from the perceived *"descriptive and empirical focus of most maritime archaeology"* and adopting coherent research strategies within a multidisciplinary approach to maritime studies (Flatman and Stainforth 2006, 172). This has been accompanied by a move to examining terrestrial sites, structures and landscapes such as port constructions, whaling stations and lighthouses (Flatman and Stainforth 2006, 168).

Another recent trend has become the study of what have been termed as 'maritime landscapes', 'coastal landscapes' and 'seascapes'. Such approaches place greater emphasis on human relations with the constantly changing 'other world' of the sea and how this relationship enabled coastal communities to *"actively create their identities, sense of place and histories"* (Cooney 2004, 323). To some degree this can be seen as a shift in emphasis rather than as a new branch of thought as it has long been recognised that seafaring and fishing folk have long formed a distinct sub-culture (Muckleroy 1998, 24). Nonetheless, in looking beyond the technology of the ship, seascape studies have re-orientated the emphasis towards social aspects of maritime archaeology, even to the extent of considering the cosmological and religious significance of the sea. In essence, seascape studies can be viewed as a maritime post-processualism.

1.2 The absence of previous study of timber seacoast piers

The topic of timber-built seacoast piers rightly belongs within the wider study of waterfront archaeology. To date the topic has been a neglected field of archaeological enquiry, with very few archaeologists, including buildings archaeologists, even aware of the existence of such piers. Yet these were very substantial structures whose scale dwarfed that of contemporary buildings and whose study has much to say of the dynamics

of past societies. In view of this lack of awareness, it is not surprising therefore that there is little in the archaeological literature of such structures, indeed the overwhelming bulk of the publications in which these structures are referred to is the work of local historians (see 1.6 Literature Review).

Within the archaeological literature only two articles and a note, relating directly to timber seacoast piers, have been located; there are no works of synthesis. The two articles are individual site studies concerning material remains at Flamborough (Johnson 1988) and Filey (Johnson 1998), both located on the coast of eastern Yorkshire. In each case the sites were surveyed, presented with some basic documentary research and interpreted on the evidence of both data sets. These studies demonstrated that the remains of timber-built seacoast piers have the potential to survive and be successfully studied. The note, an entry in a local archaeological publication, briefly describes the finding of piles thought to relate to an Elizabethan pier during works to extend the Parade at Hastings (Ray 1932). An MA dissertation, prepared by the present writer, considered the timber-built seacoast piers of Yorkshire, with particular reference to Bridlington (Johnson 2008). This dissertation built upon and expanded the groundwork of the Flamborough and Filey case studies, as well as drawing on some evidence from beyond the county. This work forms a pilot study for the present investigation (see 1.6 Literature Review).

Timber-built seacoast piers represented key elements of regional infrastructure. They are technologically significant, were amongst the largest timber structures ever built in England and have much light to shed on past socio-economic conditions. The near total omission of study of this class of monument appears remarkable therefore. There are a number of reasons, many inter-related, that account for this.

Foremost amongst these is the simple, and already stated fact, that very few archaeologists are aware that such structures existed. No historic timber-built piers survive as upstanding monuments and only a few sparse and fragmentary material remains survive. Unlike many other forms of historic buildings and structures which still survive in some numbers, there is little to be familiar with. This lack of awareness is general and extends from field archaeologists to academics and to the curators of Historic Environment Records (HER) offices who are responsible for compiling lists of the country's archaeological material remains. There is awareness in some HERs that certain

extant stone and concrete piers had predecessors of timber but their form and technical characteristics are not understood.

It is only since the later 1980s that survey and research of archaeological remains in inter-tidal zones has been taken up by archaeologists on any scale. This attention arose in part to an increased recognition of remains in these zones (Fulford et al 1997, 17). Recent archaeological surveys of coastlines have massively increased the number of known and recorded archaeological remains, for example that of parts of the north-east coast of England (Buglass 1994). National coverage of the English coastline has recently been completed through a series of regionally based surveys, the Rapid Coastal Zone Assessments, sponsored by English Heritage and made publicly available via the internet (English Heritage RCZAS). Although these coastal surveys have provided a baseline of information for the management of the coastal heritage they have added little to the study of timber piers. This is owed principally to the physical remains being few and scanty and to the archival investigations that accompanied the surveys seemingly being drawn from historic mapping and readily available published sources, rather than less accessible and unpublished primary sources and topographic indicators.

The importance of such coastal survey has been heightened in recent years by a greater awareness of accelerating rates of coastal erosion and rising sea levels as part of wider processes of climate change (English Heritage 2003; 2008). One outcome of coastal erosion is an increasing loss of vulnerable seacoast archaeological remains, particularly along the coast of eastern England. Along the Holderness coast of Yorkshire, for example, it is estimated that the coast recedes at a mean average of around 1.24m per year and that a strip of land several kilometres wide has been lost since the Roman period (Eurosion 2008; Ostler 2007). Within this area then, there are, unsurprisingly, no physical remains in the inter-tidal zone for the historic pier at Hornsea which became redundant over 400 years ago. Similarly, the medieval town and port of Ravenser, which lay to the east of the present Spurn point, and may have had a timber pier, was lost to the sea at an even earlier date. Even in those areas of the coastline where erosion is minimal access to the diminishing material remains is restricted to low tides.

Where remains have survived at identified pier sites these consist of little more than spreads of un-worked stone or lines of timber piles. Whilst spatial patterning within such stone spreads is normally present it is by no means glaringly obvious and these spreads

could easily either go un-noticed or be assumed to be of 'natural' origin, for example, as a tidal cranch or deposit of stone and shingle accumulated by the action of tide and current.

As already noted, a number of these historic sites lie in locations that are presently occupied by existing working harbours. It was not uncommon for the predecessor timber piers, or parts thereof, to be removed prior to, or during, the construction of the replacement piers. Combined with this destructive factor are the dredging regimes that have been in place at most of the pier sites for centuries. At many of these locations then, there is only limited potential for the survival of timber remains within the harbour basins and useful material data in many cases may be limited to indirect evidence, for example, topographic study of the existing natural and built environments.

Aside from material remains all the known historic timber pier sites do have further non-physical evidence. Documentary sources appear to be ubiquitous, topographic indicators and place-names are also normally present whilst in a number of cases cartographic and pictorial evidence is also available. This range of data sources presents the more traditional practice of archaeology, namely that focussed heavily on material remains, with some difficulties, and may have been a factor militating against study in the past. Of necessity, this wide range of sources demands any investigation to be multi-disciplinary requiring either teamwork by a number of specialists or the acquisition, by the lone-worker, of a range of methodological and interpretive skills relevant to each discipline.

1.3 The provision of landing places

Landing places can be defined as locations where vessels can transfer goods and people, be that on a coast, estuary, river or other waterway. Such places have been classified as falling into two basic groups, 'informal' and 'formal' (Mc Grail 1985, 12-13). Informal landing places are locations where a vessel is simply run ashore or else anchored or moored just offshore. At most, such informal landing places were provisioned with a hard-standing, typically of parallel timbers laid over soft mud, onto which a vessel could be hauled. A formal landing place is one which is provisioned with more substantial landing facilities. This may be in the form of structures that either hug the waterside or project out into the water thereby permitting a vessel to moor against it. Informal landing places have been used since prehistoric times and on the foreshore of the River Humber at

Ferriby one such has been dated to the 2nd millennium BC (McGrail 1983, 41-43). The use of informal landing places continued throughout the historic periods, though in locations that tended to be marginal in terms of economy and volumes of shipping. Within northern Europe formal landing places appear within the context of Roman imperial expansion and Roman technology. The most fully examined Roman waterfront in England is that of London where quaysides constructed of tiered, large, squared baulks of oak, jointed with lap and dovetail joints, have been examined in a number of excavations (Milne 1985, 55-67). These were typically built to a plan-form resembling a series of conjoined boxes, the interiors of which were infilled with earth. Such structures became redundant in the post-Roman period.

In the post-Roman era the widespread provision of formal landing places in north-western Europe does not appear to have begun until the later 10th-century (Unger 1980, 95), though the adoption of such facilities appears to have been reached earlier in some regions than in others (McGrail 1985, 12). The earliest waterfronts seem to have been built in the 9th-century AD whilst most regions appear to have had at least one by the 12th-century AD (McGrail 1985, 12-13). The rationale for the appearance of formal waterfronts in the medieval period is owed primarily to the re-emergence of densely populated waterside settlements, or towns.

Such towns were typically characterised by complex economic organisation and technological specialisation (McGrail 1985, 12). This growth in urban settlement was also accompanied by increases in production and exchange (Britnell 1993, 5-28). Such exchange was frequently focussed through markets and fairs, the numbers of which increased throughout the medieval period, the 13th-century in particular witnessing a considerable growth of numbers (Schofield and Vince 2003, 26). Markets were generally of short duration, typically a day, but regularly held, and tended to service local economic needs. By contrast, fairs were usually held once a year, had a duration of between three days and several weeks, were centres for foreign wares and often attracted traders from great distances. It has been argued that such increases in exchange at these focal points, which were frequently located on navigable waterways *"could be best satisfied by vessels of larger capacity and greater draught which could not be efficiently loaded and unloaded at informal landing places"* (McGrail 1985, 12). Deeper water alongside waterfronts provided with formal facilities could enable the more effective cargo handling of these larger vessels. The evidence for increases in the cargo capacity of ships after

1000 AD is provided by ship finds, and more particularly through documentary sources (Milne 2003, 70; Nedkvitne 1985, 94-98).

Evidence provided by this study will suggest that on the seacoasts of eastern England the provision of formal landing facilities in the form of piers was a development that lagged somewhat behind that of estuarine and riverine settlements. This factor is likely to relate to the lack of relative importance of the seacoast sites, to the increased levels of resources required for the construction of piers, and possibly to the technical difficulties inherent in building such structures into the sea.

The location and relative scale of formal landing places in England correlates to a large extent with the significance of settlements. As such many of the major historic towns of the country were also ports, and most commonly their landing places were situated on the banks of rivers or estuaries rather than directly on exposed sea coasts. In many of the settlements often perceived as being coastal towns the historic provision of formal port structures was not in fact in the form of coastal piers. The facilities of the medieval ports of Newcastle upon Tyne and Kingston upon Hull, for example, were located on the rivers Hull and Tyne respectively.

Another factor that needs registering is that nearly all the seacoast pier sites within the study area were recorded as ports before they were recorded as possessing piers. There is little reason to suppose that this factor is a misleading product created by increased levels of documentation at later dates. In many cases the documentary sources make it clear that piers were being built for the first time.

1.4 Definitions and terminology

This study examines piers, whose principal construction material was timber, along the eastern seacoast of England. This excludes estuaries and rivers. There is some discrepancy, even amongst geographers, of the precise definition of the terms ‘coast’ and ‘coastal’. For most, it is the interface between land and sea and excludes estuaries and rivers. Others consider it to be the strip of land, often undefined in width, adjacent to the sea and not necessarily excluding estuaries or indeed lower tidal reaches of watercourses. Because of these discrepancies the term ‘seacoast’, which is arguably a more self-evident term, is used.

The terminology of landing places and other items of maritime infrastructure, be they on a seacoast, estuary or river, is again subject to a variety of definitions. This discrepancy of term usage is common to both historic and modern usage (Dyson 1981, 37-38). To take just two modern definitions of the term 'pier' for example, those of the Oxford English Dictionary and English Heritage's thesaurus of monuments, we can see considerable differences in usage.

Oxford English Dictionary (abbreviated) Pier:

"A horizontal projection. A man-made structure of stone, earth, etc. reinforced with piles, extending into the sea or a tidal river to protect or partially enclose a harbour and form a landing place for vessels; a breakwater, or mole. Also a landing stage in the sea or a river or lake, consisting of a platform supported on pillars and open beneath; (in later usage) esp. A similar platform extending out to sea and used as a promenade or as a venue for entertainments." (OED)

English Heritage: Pier:

"A structure of iron or wood, open below, running out into the sea and used as a promenade or landing stage." (EH Thesaurus)

For the Oxford English Dictionary then a pier has been, and remains, many things, be they related to the form of the structure, its function and its geographic location. For English Heritage it is essentially a 19th or 20th-century pleasure pier and little more. In view of this lack of a precise and single meaning, a definition of the term seacoast pier as it is employed in this study is presented here:

Seacoast pier: A structure extending from the shoreline out into the sea, constructed principally of timber and having enclosed sides.

This definition excludes structures along estuaries and rivers and those that 'hug', as opposed to 'project' from, the shore. It also excludes piers of stone and concrete, pleasure piers and other open sided structures projecting into the sea. The term pier (most common variant forms *'peer'*, *'peere'*, *'pere'*) has been chosen because this was the term that historically was most commonly, but by no means exclusively, applied to the defined structural form. 'Quay', (most common variant forms *'key'*, *'kay'*) was a term often applied to at least some piers on the Yorkshire coast whilst jetty (most common variant

forms *'jettie', 'jetie', 'juttie'*) finds some usage in East Anglia and south-eastern England. At some sites the past usage of these terms was one of considerable inter-changeability.

To a lesser extent there is multiplicity of meaning of two other terms that commonly occur in this study: 'breakwater' and 'groyne'. Accordingly, the usage of these is also defined for the purposes of this study. A breakwater is considered to be a structure that breaks the force of waves and is normally constructed to protect a harbour. By contrast, a groyne is a structure projecting into the sea and designed primarily to limit the movement of sediment – effectively a barrier to limit erosion. Groyne is a term first recorded at Dover in 1582 (OED). However, the term 'locker', appears sometimes to have been used as an equivalent until the 18th-century. The terms 'harbour', 'haven' and 'port' which were, and are still, applied to pier sites do not necessarily imply the provision of formal facilities.

The overt purpose of seacoast piers was for the mooring, and/or shelter, of ships. They were involved in national and international trade and, to varying degrees, the inshore and offshore fishing industries. In the later post-medieval period some piers became popular seasonal places for promenading, indeed the concept for the pleasure pier was almost certainly drawn from its more robust cousin the working pier.

1.5 The legal and regulatory context of ports

Historically the coast was divided, for fiscal purposes, into sections. Each section was known as a port, and based for administrative purposes, in what was typically the principal harbour town of that section (Jarvis, 1958-9). The status of port was assigned by the crown. Any vessel in overseas trade was required to use the appointed harbour of the port where customs could be applied. Theoretically at least, a system evolved of appointed ports engaging in overseas and national shipping with other places confined solely to national shipping. This eventually developed into a system of head-ports, member-ports (under the authority of deputies) and other places in which overseas trade was not permitted. Accordingly, for example, the port of Bridlington was established as a customs port in 1559 as a member of the port of Hull and only after this time was it permitted to engage in overseas trade (Neave 2000, 57-8). This general arrangement of

ports was not entirely fixed or static and, as in the case of Bridlington, the status of individual ports was subject to some change over time.

Systems of trade operating within this framework were constrained by a number of factors which may include, for example, tight regulations on the export of certain commodities from specific ports only. Naturally these could dramatically affect the relative prosperity of individual ports. Perhaps the best example of this was the requirement that all overseas transactions in wool be transacted at certain 'staple ports' (Ashley 1948, 68). The principal motive behind the controlled regulation of the staple system appears to be that it enabled the crown to more effectually levy taxation. The export of grain became the subject of tight regulation under the Tudors, though the source of this constraint was largely the fear of insurrection that it was felt may be fuelled by a shortage of bread. During periods of general prohibition of grain export exemption could only be gained by the granting of licences to export stated quantities from specific ports. Such export licences were often granted to individual ports with the proviso that profits were used for the repair or rebuilding of port infrastructure. The related matter of monopolies could also affect the fortunes of ports. Such monopolistic rights to export and produce certain commodities were largely a product of the 16th and 17th centuries and were most commonly granted to specific companies or individuals (Richardson 2002, 20-23).

Port rivalries and confederations could result in what may be termed 'institutionalised preference'. The clearest example of this was the differential rates and duties payable by ships to the ports of the Cinque Ports (e.g. Lord Warden 1693). Typically these charges were in three bands such that a vessel entering a head or member port of the Cinque Ports would pay at a low level if that vessel were from a Cinque port, at a middle level if it were from elsewhere in England and at a high level if it were from overseas. In return for regular naval service to the crown the Cinque Ports also benefitted from a number of other privileges that gave them an economic advantage. This included exemption of most forms of taxation and trading dues. Indeed it appears to have been these privileges, combined with other legal advantages enjoyed by Portsmen, including their right to regulate the Great Yarmouth herring fair, that led to centuries of dispute, interspersed with episodes of de facto warfare between the Cinque Ports and the port of Great Yarmouth (Heebolm-Holm 2013, 69).

Occasionally we hear of particular ports agreeing to mutually waive rights to rates and duties to each other's vessels, for example the 17th-century agreement between Great Yarmouth and Scarborough (NRO Y/C34/3). Two cases are known where one port, Scarborough, used its influence to effectively temporarily stifle the development of others. In the earlier case a mid 13th-century charter of Scarborough stated that the crown, nor anyone else, was to suffer a harbour to be made between Scarborough and Ravensrod (mouth of the Humber estuary) (Neave 2000, 29). In the later case Scarborough's corporation refused to support nearby Whitby's 17th-century proposal to build a new pier (Binns 2000, 188-9).

Ports were always regulated places. At the higher level of the crown and bodies of government such regulation was focussed around taxation, security and what may be loosely termed the 'national interest'. At the more local level of confederation and individual ports the focus was on prosperity and survival. The mechanisms of regulation that were applied by the state, by confederated bodies and by individual ports towards these ends, meant that the field upon which the port histories were played out was never a level one.

1.6 Pier related literature review

Only two articles and a note dealing with the material remains of timber piers have been located within the archaeological literature and each of these are site specific; there are no works of synthesis. The two articles concern material remains on the coast of eastern Yorkshire (Johnson 1988; 1998). Both of these studies, of Flamborough and Filey, adopted a multi-disciplinary approach but were very much site specific. The note, a short entry in a local archaeological publication, briefly described the finding of piles thought to relate to an Elizabethan pier during works to extend the Parade at Hastings (Ray 1932).

An MA dissertation, which formed a pilot study for this investigation, considered some of the timber-built seacoast piers of Yorkshire, with particular reference to Bridlington (Johnson 2008). This dissertation built upon and expanded the groundwork of the Flamborough and Filey case studies, as well as drawing on some evidence from beyond the county. Attempts to elucidate the precise nature of the technology of the timber piers within this study were only partially successful for earlier pier forms though a later form

could be comprehensively described and technically explained. A point of interest within the dissertation was the recognition that virtually all the Yorkshire piers originated within the context of large medieval estates where the control of timber resources and tenant labour services was seen as a key factor in their establishment and maintenance. The breaking up of many of these estates at the time of the reformation was initially followed by massive investments in the piers by the crown. Subsequently, attempts were made by the crown to lease the pier sites to groups of yeomen. This met with only limited success and a number of the piers became redundant in the 16th and 17th centuries. The survival of the remaining Yorkshire pier sites was owed to renewed state intervention from the late 17th-century, principally because they were recognised as important items of national infrastructure.

The only other sources of published information regarding the piers are within works of local history. Here, the sites tend to appear as items within the wider context of town or regional histories and typically little attempt has been made to understand the sites as built structures. Virtually all the pier sites within this present study appear in at least one such historical work and in some instances within several works. The quality of relevant local history works is of enormous variability. Some histories present information that was, or is, entirely new, typically from previously un-transcribed documents. Sometimes this is well referenced to original source material, at other times not. At the opposite end of the scale there is a tendency for some works, typically those written some time after earlier more substantial publications, merely to reproduce the selected results of previous historians rather than making new contributions.

Three of the sites have short publications dealing with their piers, Cromer (Pipe 1998), Broadstairs (Simmonds, 2006) and Hastings (Manwaring Baines 1946). That for Cromer deals largely with the modern pleasure pier and although reference is made to the earlier timber-built pier this draws largely on previously published sources. The bulk of Simmonds' eccentric tome for Broadstairs is a consideration of 19th and 20th-century activity in and around the pier that is irrelevant to this study. It does however, provide a neat potted history of the pier, some of which is drawn from previously un-recounted sources. Manwaring Baines, a custodian of the local museum, wrote extensively on all aspects of Hastings. Curiously he wrote more on the pier in his major history of the town 'Historic Hastings' (Manwaring Baines 1963), than he did in his booklet about the pier, much of which was concerned with post-medieval schemes that never came to fruition. It

would also appear, judging by pencilled notes in the margins of the first Hastings 'Corporation Record Book' of 1595-1620 which appear likely to be his, that he knew more of the pier than he ever published (ESRO C/A (a) 1).

Within the umbrella term of local history are publications that are essentially transcriptions of documents relating to an individual, an authority/institution or a town. Most commonly these 'themed' documents have been transcribed from English, though occasionally from Latin, and since the 19th-century are most commonly the work of historical societies who produced series of such volumes. Modern commentaries often accompany the transcriptions. These may be brief and merely explain the origin or context of the documents, or be more extensive and present modern analysis and interpretation. Such works permit relatively easy access to reliable, referenced, transcriptions of considerable bodies of information and are of enormous utility. In relation to this study the works of this genre that have proved to be particularly valuable sources of data include, amongst many others, four volumes of transcriptions by the Royal Historical Society and Norfolk Record Society of the papers of the Elizabethan Norfolk magistrate Nathaniel Bacon (RHS 1915; 1936; NRS 1978-9; 1982-3), J. S. Purvis's 'Bridlington Charters, Court Rolls and Papers' (Purvis 1926) and M. E. Ingram's 'The Manor of Bridlington and its Lords Feoffees' (Ingram 1977).

Within the same genre must be included the works of a number of historians of previous generations, writing as early as the cusp of the 16th-17th centuries but most commonly in the 18th-century. Amongst the foremost of these we must figure Thomas Damet (alias Henry Manship senior) (published by: Palmer 1847), Henry Manship junior (published by: Palmer 1854) and Henry Swinden *(Great Yarmouth)* (Swinden 1772), Thomas Gardner *(Southwold /Walberswick /Dunwich)* (Gardner 1754), William Boys *(Sandwich)* (Boys 1792) and John Lewis *(Margate)* (Lewis 1724/1736). Although all these works devote some attention to weaving a historical narrative for the town with which they were concerned the core of their works was the publication of transcribed documents directly relevant to those towns. In some instances these publications were carried out with the full blessing of the town authorities. The labours of Henry Manship junior at Great Yarmouth in the early years of the 17th-century, for example, were ordered by the corporation to be recorded in a book which should be *"engrossed by Henry Manship, and delivered into the assembly; to be disposed of according to their pleasure"* (Palmer (ed) 1854, ii-iii). Manship juniors' work can be regarded as a quasi legal document in so far as

one of its purposes was to record the rights and privileges of the town as attested by the documents in its possession. In some ways these older transcriptions are more significant than the later works as it is known that many of the documents transcribed by these writers have been lost whilst others no longer exist. To refer again to Henry Manship juniors' work, it has been said that *"with the exception of the Charters and Borough Rolls, almost every document enumerated in it, is now destroyed or lost"* (Palmer (ed) 1854, iii). Expressed on a more quantative basis, the Historical Manuscript Commission in their report of 1883 state that of the two hundred and ninety two writings mentioned in Manship's inventory only twenty eight remained with the corporation in 1883 (HMC 1883, 300).

It would be wrong to consider the vexed issue of document loss merely as a phenomenon of neglect in times long past. In this present, 'heritage conscious' age girded by regulation and protocols, losses and near misses continue. In the course of research for this thesis it has been learnt that during a process of local government reorganisation several historic account books of Broadstairs harbour were retrieved from a skip. Again, only three out of eighteen rare books and manuscripts, said to be housed in certain libraries in the south-east of England by two county council published historical source material guides, as well as by other publications – including a PhD thesis of the late 1980s, can be located by those libraries, who now consider the remaining material as lost. A large quantity of town records of Hartlepool are also known to have gone missing since the later 19th-century, quite probably in the 1960s.

1.7 Research framework: Theory

This is a multidisciplinary study and draws on a range of documentary, pictorial, cartographic, place-name, topographic and material remains evidence. All the pier sites are known to have at least some documentary evidence, and typically indications from one or more of the other evidence categories. In some instances sites can draw on evidence from all categories. The evidence is drawn from archival, library, museum and site sources at the national, regional and local levels.

It is widely held that fields of study progress through a succession of defined stages of enquiry. According to Jane Grenville this can be expressed as follows. Firstly there is the

recognition of the subject as a field of study. Secondly data is collected and attempts are made to order it. Thirdly, attempts are made to explain the data patterns. Fourthly, the discipline develops a variety of theoretical standpoints and research begins to take its direction from theoretical propositions rather than empirical observation (Grenville 1997, 13-14). Within this perspective the wider subject of waterfront archaeology may be seen to hover around Grenville's third stage.

The literature review unambiguously points towards the archaeological study of timber-built seacoast piers as still being very much in its infancy. Whilst the topic can be identified as a legitimate field of study there yet remain a number of basic technical facts to be established and ordered. Inevitably then, a part of this study is concerned with the collection of technically relevant data, the ordering of this data and attempts to explain it. These early elements of the study can be broadly correlated with Grenville's stages 1 – 3. This baseline of knowledge needs to be established as a precursor to the asking of 'higher order' questions beyond the purely functional. In other words, it is firstly necessary to establish exactly what it is, that is the object/s in question, that questions are being asked of. The subsequent questions can be equated with Grenville's stages 3 - 4. The initial stage of this present enquiry then, can be viewed as the systemization of data with later sections attempting to place this ordered data within the wider social contexts of their origin and of the communities responsible for them. Accordingly, a diversity of approaches to the data is adopted in this study.

Increasingly over the past fifty years 'theory' has come to be consciously seen by mainstream academic archaeology as central to the study of the past. Although one could cite the likes of Gordon Childe (e.g. Childe 1936) and the archaeologist/polymath R.G. Collingwood (e.g. Collingwood 1946) as explicit in their use of theory in the earlier 20th-century, it was the New, or processual, Archaeology, of the 1960s that brought the application of theory to the forefront of the discipline. Although much castigated at the time of its emergence, as it commonly is now, the New Archaeology, in all its guises, brought a new science-orientated rigour to the study of the past. Like most new movements the New Archaeology developed into an amalgam of diverse, and even conflicting, ideas and concepts. In broad scope however, processualism can be equated with a number of key tenets of which hypothesis testing, emphases on cultural evolution, systems thinking, and the use of middle range theory as an interpretive bridge between past and present, form some of the most significant. Although its polemic appeared in

some senses revolutionary, elements of more traditional archaeological practice were retained within processualist work. Classification, which attempts to define different artefact or structure types, and forms an element of the present study, may be cited as a case in point. Long practised by earlier generations of archaeologists, such study remained in common practice with the New Archaeologists, albeit often within less intuitive, more mathematically based frameworks.

As its name implies, post-processualism arose as a critical response to perceived flaws in processualism. Principal amongst these we may consider a processual concern with cross-cultural anthropology at the expense of historical context (Hodder, 2005, 207) and a tendency to view deductive reasoning as intrinsically more valid than inductive. Like the New Archaeology, post-processualism can be considered as a bundle of diverse approaches. If there is a single focal point around which post-processualism orbits it would probably be *"that material culture is meaningfully constituted"* (Hodder 1982, 190). As such considerable emphasis is given to the active and dynamic role played by material culture within societies. Themes that unite post-processualists tend towards the social and symbolic aspects of life and material culture with less emphasis being placed on technological, environmental and economic factors.

Despite there being a long standing inter-disciplinary approach by archaeologists in historic periods the use of archaeological data sets in combination with documentary history was beset by considerable and contentious disagreement in the late 20th-century. 'The New Medieval Archaeology' propounded by, amongst others, Philip Rahtz (Rahtz 1981), articulated the sentiments of a spectrum of medieval archaeologists who sought to downplay the role of textual history and apply new processualist approaches that had largely been developed in the discipline of anthropology and which laid an emphasis on supposed 'scientific' method. For those of this mindset processualism appeared to offer the release of archaeology from its perceived role as the subordinate 'handmaid of history'. There can be little doubt that some historians have sought to assert the primacy of documents. According to Grierson, for example, *"archaeology substitutes inference for explanation"* (Grierson 1959, 129) whilst in considering the relationship between archaeology and history Sir Moses Finley considered that *"the contribution of archaeology to history is, in a rough way, inversely proportional to the quantity and quality of the available written sources"* (Finley 1986, 93).

Since the 1990s the post-processualist movement has challenged many of the precepts of the New Archaeology, including that of text by the New Medieval Archaeology. This has led to something of a rapprochement between material culture and text. In terms of categories Anders Andren sees texts and artefacts as different, the former being a representation of speech, the latter as three dimensional and representative of highly complex human activity (Andren 1998, 145). As objects however, Andren sees artefacts and text as the same; both have physical form and both are the product of human action and culture.

Under the umbrella of post-processualism Contextual archaeologists use text as a metaphor for material culture. As such, archaeological remains and artefacts can be seen as a form of text, not mute or illegible objects, and the application of techniques and theory of modern archaeology enable us to understand, or read, their meaning in the past. For John Moreland people in the past *"made and manipulated objects (and texts) as projections of their views about themselves and their place in the world" ... "they were actively used in the production and transformation of identities"* (Moreland 2001, 80). These opinions are widely held in modern historical archaeology and there is presently a broad recognition that text and objects represent equally valid forms of evidence.

Within the parameters of its most common definition, namely the presence of written documents in the society investigated, this study falls within the realm of historical archaeology (Hicks and Beaudry 2006, 2). Most historical archaeology enquiries are in effect multidisciplinary as common accompaniments to literate western societies are cartographic materials and various forms of depictions. The greatest strength of historical archaeology is the broad range of evidence forms it can muster and bring to bear on the interpretive process. Accordingly, through such study *"archaeological interpretations offer perspectives and understandings of the past not possible through single lines of evidentiary analysis"* (Wilkie 2006, 13). There are inherent difficulties in dealing with multiple data sources and perhaps the greatest of these is in recognising the different levels of resolution, or detail/completeness, that each may offer, with this more often than not having a temporal dimension. Beyond this, further challenges of the interpretive process within historical archaeology relate to the understanding of the relationship between, and making of connections between, the different evidence forms, as well as the drawing together of these. There are no ready answers to these difficulties, each form of evidence is what it is. We may try to understand each strand within its wider context of

generation and preservation but correlation is not always possible and contradiction sometimes present. Similar arguments also apply to the combining of archaeological and historical data with evidence from environmental studies.

1.8 Research questions

The parameters of the research agenda are established by the range of questions principally posed under the three broad headings which form the core chapters of this study.

Technology

The technological questions are primarily concerned with trying to establish the physical form of the piers in terms of constituent materials, how they were constructed and assembled, and of their appearance. Whether or not there were any regional, as well as temporal variations will also be explored and explanations for any such variance will be sought within the environmental and social fields. The form of ancillary structures such as rock armour, sluices and scouring devices, and the manner in which these articulated with the piers themselves are also considered. The relationship of pier technology is also compared and contrasted with other contemporary timber-built structural forms in order to determine whether any, and if so which, technological connections exist. The range of crafts and skills involved in pier construction is examined in order to determine whether any pier building specialisations in the workforces are evident. Consideration is also given to the nature of any design processes that may have been involved in construction. Additionally, it is intended to examine why, within the study area, the earliest piers appear exclusively to be built of timber and why replacement of this technology, with stone and later still with concrete, did not begin until the 16th-century and was not completed until the 20th-century.

Environment

The piers examined in this study represent impingements on the geomorphologically dynamic coastline of eastern England. As such these structures had to contend with a variety of powerful natural forces and hindrances. Such impingement, which was intended to produce favourable results in terms of port infrastructure, often produced

unpredicted, and unfavourable, outcomes, such as increased rates of sedimentation and erosion. However, the presence of certain pier forms in particular environmental settings suggests a degree of understanding of the workings of the natural environment and how best to respond to these. The assessment of such contemporary levels of understanding, and perhaps misunderstanding, of coastal processes will be addressed with reference to recorded pier works and be determined by the levels of success, and failure, of these works. The impact of the emerging profession of engineer within pier building projects is to some degree central to these questions and will be examined both in relation to individuals of practical experience and in the adoption of scientific approaches to problem solving within the environment.

Social context

Within the pilot study the socio-economic context of origin of the piers of the Yorkshire coast and the nature of their ownership, control and funding, including changes to these factors through time has, to some degree, already been explored. In this earlier study the piers were seen in many regards to be reflective of the organisational changes within the institutions and communities responsible for them. It is here intended to expand this knowledge of the Yorkshire sites and to determine these matters for the remaining pier sites in the wider study area. It is known that there are disparities in this regard between various pier sites in northern England when contrasted with those in the south and explanations for such differences needs to be sought within divergent forms of socio-economic, and arguably religious, organisation within those communities and institutions. The meanings and use of the piers, in a non-functionalist sense, for example as regulatory devices, as expressions of various rights and as symbols of corporate identity, are also sought. Attempts are also to be made to assess the character of the organisation of pier building projects in terms of worker and managerial hierarchies and responsibilities, and in determining the motives behind known cases of inter-port disputes.

1.9 Methodology

It has been seen that traditional archaeological approaches have dominated the study of waterfronts with much effort in particular being expended on consideration of the development of their changing form, in seeking parallels to these structural forms, and in

determining the nature of the craftsmen involved in their building. To some degree such functionalist stances may relate to the recent emergence of waterfront archaeology as a field of enquiry, to the newness of the exposed and unfamiliar structural forms and to the need to describe these.

Within this present multidisciplinary study, the documentary, pictorial, cartographic, place-name, topographic and material remains evidence are all considered to form core data with no one source held to be inherently superior, or more reliable, than another. Needless to say, all these data sets are subject to varying levels of survival and intelligibility. No individual category of evidence is entirely complete, nor entirely verifiable and each often only provides a narrow range of evidence. Harnessed together however, the employment of multiple categories enables a broad range of data to be applied to the answering of research questions. In this study, this is held to be essential if we are to extract as much information as is feasible. Within this view degrees of reliability can be seen as enhanced when one form of evidence is supported by another, or others. Naturally, the interpretation of each category of evidence requires the exercise of established cautions and conventions relevant to that particular discipline.

Were this study of timber-built piers to be written on the basis of extant material remains alone there would be little to say, it would run to very few pages and would be accompanied by a few pictures of barely intelligible piles of rocks and lumps of wood. Given this paucity of material remains a multidisciplinary approach is not only desirable it is absolutely essential. For technological aspects the non material remains sources of evidence provide a wealth of data that allow us to reconstruct and understand that materiality. Without these additional windows to illuminate our study we would be clutching at straws. A similar argument holds true for the social aspects of the piers, it being almost exclusively the body of documentary evidence that provides the key to understanding in this regard. Much the same could be said for the environmental side of the study, particularly with respect to human responses.

This study follows a range of approaches, elements of which can be seen to be shared by various of the schools of archaeological thought, from those of the earlier 20th-century tradition, of processualism and of post-processualism. Within this ‘pick n’ mix’ approach functionalist and non-functionalist approaches sit side by side with their adoption being determined solely in accordance with the particular questions asked by this study.

The ordering of the technological details of the piers in Chapter 2 is considered within an entirely functionalist framework. They are considered as feats of craftsmanship best understood with reference to the principles of engineering, with these ultimately being based on the laws of physics. The primary concern of this section is with determining the various forms and appearances of the timber piers, the range and type of the constituent materials and the manner in which these were articulated. As such this part of the study can be considered as an exercise in classification, an attempt to transform *"the unmanageable mass of individual units that form the basic archaeological record into a coherent body of information"* (Doran and Hodson 1975, 158).

It is necessary to classify the timber piers into different types according to the nature of their structure. Timber-built piers have seen minimal study, we have little idea of what they were in physical terms, nor how they may have varied through time and regionally. Classification then seeks to establish these facts, to determine exactly what it is that we shall go on to ask higher order questions of.

In considering the environmental and social and cultural parameters of the pier structures in Chapters 3 and 4 much, but not all, of the evidence is drawn from documentary and pictorial sources. It would of course be possible to conceptualise classificatory sets for the pier sites that were focussed around environmental circumstances or even orientated towards social and economic factors rather than being technically based. Examples of the former could be based on geomorphological settings, whilst examples of the latter could be into sets such as major and minor ports, this being determined by such matters as the 'head' and 'limb' status of the ports, the different rights these possessed, their forms of ownership and control or even the volumes of trade associated with each. Such non-technical classification may even find some correlation with the physical size of the piers, and indeed with the varying longevity of particular pier sites. However, it is known that the environmental and broad social context of the pier sites is highly nuanced and the shoe-horning of these aspects into rigid sets is unlikely to prove particularly informative. Accordingly, alternative and more considered discursive approaches are adopted.

There is only limited potential to draw on theoretical approaches recently employed by archaeologists in the study of buildings. Throughout much of the 19th and 20th centuries the archaeological study of buildings was largely devoted to stylistic and classificatory studies. Whilst this early work established, and brought order to this field of enquiry,

particularly in terms of providing relative chronologies and the development of techniques, it did little to fully address the social meanings of buildings. Today this imbalance is being redressed. One approach has been the use of the concept of space syntax and the analytical tool of access analysis which can be used by archaeologists to analyse the configuration of space in terms of levels of accessibility, visibility and integration (Hillier and Hanson 1984). There seems to be only limited scope for such approaches within this study as piers appear simple, unadorned, relatively open and undivided. The few structures and items that we know occasionally to have been constructed upon the piers, such as workshops or stores, capstans and occasionally artillery batteries, are known almost exclusively from a limited number of relatively un-detailed plans. The only significant exception to this is a single still extant building on one pier.

It is clear that piers were highly regulated spaces. Again much of our evidence for this has to be drawn from documentary sources though topographic, cartographic and material remains have some contribution to make. If we are to look for wider social meanings for these structures then much of our search for this will inevitably lie beyond the purely physical entities themselves, in other words, within the communities and institutions responsible for them. Accordingly, Chapter 3 draws heavily on documentary sources and considerable attention is given to the organisation of the institutions and communities responsible for these piers.

Much of the stated contemporary reasoning for the construction of these structures would lead one to believe that they were simply items of port infrastructure intended to better facilitate the efficient handling of vessels and their cargoes, boost trade, assist in national defence and provide safe mooring in adverse conditions. Yet there is a social dimension of the piers that extends beyond the purely functional. We can see piers as regulatory devices, as expressions of various rights to claims and ownership, and as symbols of civic and institutional enterprise, identity and pride. In many ways in fact, this study will argue that the piers are as a mirror unto the communities and institutions responsible for them. In moving beyond the purely technical aspects of the piers and exploring their social dimensions we can address these matters through approaches that may be considered broadly post-processual or contextual. In this sense there is a degree of commonality of approach with some seascape studies, for example Aidan O'Sullivan's study of estuarine

fish weirs which places emphasis on the social, economic and environmental contexts of these structures in Britain and Ireland (O'Sullivan 2004).

The research presented within this thesis is drawn from twenty pier sites that have been positively identified within the study area. From north to south these are: Newbiggin by the Sea, Hartlepool, Whitby, Scarborough, Filey, Flamborough, Bridlington, Hornsea, Sheringham, Cromer, Great Yarmouth, Southwold, Margate, Broadstairs, Ramsgate, Dover, Rye, Folkestone and Hastings, whilst the proposed pier site of Sandwich is also considered (see Figure 1, Distribution map). Each of these sites has formed an investigated 'case study' and these effectively form the core data for this thesis. Individual case study notes have been written up in some detail and contain far more information on each site than can be conveyed in Volume 1. This body of data appears in the Appendix, Volume 2. It appears almost certain that a small number of additional timber-built pier sites once existed within the study area. One of these is likely to have been at the town of Ravenser Odd on the northern bank of the mouth of the River Humber which was lost to the sea in the 14th-century. This was a town and port of some significance and although there is no direct reference to a pier here it is known to have had port facilities referred to as a 'quay' whilst its topographic setting suggests the likelihood that one was once present (Cal. Pat. Rolls 1310). Another may have been present at St Margaret at Cliffe, Kent, where a single reference in a secondary source suggests a short-lived 16th-century pier, perhaps of timber (Hasted 1800, vol 9, 412).

Figure 1, Distribution of timber-built pier sites within the study area (red), probable sites (blue), proposed site (green)

1.10 Glossary of terms

Breakwater: Historically, commonly timber-built and constructed to reduce the intensity of wave action. Normally built some distance to seawards of the object they are intended to defend.

Groyne: A rigid narrow linear structure, normally of timber and commonly extending from the upper foreshore seawards. Intended to interrupt the water flow and limit the movement of sediment.

Locker and sunken locker: First recorded in the mid 16th-century and known to be timber-built, the precise form of these structures is uncertain. The context of term usage implies that they formed a protective defence between the main body of the sea and a pier and that they could be built to either the same height as the pier or else lower (sunken) and presumably submerged at high water.

Revetment: A sloping structure placed on the upper foreshore and historically timber-built of planks laid against wooden frames. They absorb the energy of incoming waves and serve to limit coastal erosion. Particularly common in the 19th and earlier 20th centuries.

Rock armour: Also commonly known as rip-rap, was rock deposited to protect shoreline structures from scour. Most commonly utilised as linear spreads preventing the undermining of the toes (buried lower parts) of the outer faces of piers and seawalls

Seawall (and foreshore waterfront): In England historically constructed of a single or double line of upright timber posts with plank between; in the latter case generally with an infill of stone between the two lines. At pier sites designed principally to protect adjacent low lying areas. In some instances they were also utilised to form a quay as part of a port's infrastructure.

Sluice (clowes): A sluice gate, probably always located within a dam wall. Water from a stream was collected and held behind the dam wall and released at low tide to scour a harbour basin.

Stade: A defined area of hard standing for the berthing of vessels on the upper foreshore above the high water mark. Normally equipped with winches for the hauling up of boats. Can occur as stand-alone infrastructure or in combination with pier/pier-like structures.

Warp: A method of moving a vessel by hauling on a line attached to a fixed point. Commonly used to haul a vessel in and out of a harbour, where a shallow bar was present, in a controlled manner.

Chapter 2: Technology

2.0 Preamble

This chapter considers the technology of timber-built seacoast piers and matters related closely thereto. Firstly the varied nature of their constructional form is detailed within traditional classificatory groups and a summary of the evidence for each investigated pier site presented. Thereafter follows a discussion which seeks to find explanation for the variation of pier form. Finally a series of short sections consider design, prefabrication, pier buildings, craftsmen, experts and organisation, timber and its supply and related structural forms.

2.1 Classification of pier forms

One of the aims of this study is to establish the structural forms of historic timber-built seacoast piers in material terms. In an attempt to better comprehend these forms the piers are classified into different types according to the nature of their structure. Such piers have not previously been studied to any extent nor their data systematised. Consequently, there is little idea of what these structures were in physical terms, whether these forms varied regionally and chronologically, and what the implications of any such differences may have been. This exercise therefore, seeks to establish these baseline facts, to determine exactly what it is that we are dealing with before moving on to consider higher order questions in subsequent chapters.

It could be argued that each pier is individual, and this is inevitably the case should we choose to consider the precise details of, for example, size/scale, or small technical details. Traditionally, archaeological classification is carried out on the basis of sets whose parameters are broad enough to permit such degrees of variation. It is argued here that it is the broad correspondence of significant elements, or 'attributes', rather than the points of finer detail, that suggest technical commonality. Whereas the latter may be unique and owed to a variety of local factors ranging from environmental conditions to levels of funding and available resources, the former are shared with a number of sites

and can be held as indicative of shared technological traditions. Such unique detail may, for example, relate to the proportions of a pier, or to the use of certain carpentry joints. By contrast, the shared attributes that serve to define a set or 'type' of pier, are held to be indicative of an acknowledged, and normally recurring, system of pier construction.

Accordingly, the piers are classified into broad 'types' on the basis of elementary structural attributes. Variations within the type groups are considered within individual site descriptions.

Within this study there are a number of cases where the evidence is such that we can be certain that a pier at a given site was timber-built but where that evidence is not sufficiently detailed for the pier's principal attributes to be identified. In such cases that pier cannot be confidently placed within a given 'form type' but must reside simply within the all embracing and overarching class of 'timber-built pier'. There is evidence from certain sites with a succession of replacement piers, for those later piers to be of different typological form to their predecessors. Where this is the case these appear within separate groups. The site descriptions that follow in this chapter are necessarily brief, fuller descriptions are available in the individual case study notes of the Appendix Volume.

2.2 The typological groups defined:

1. Piers with walls of close-piling

The defining attributes of the piers of this group are walls of close-piled timbers, that is, the walls of the piers are formed of edge to edge piles driven into the ground or seabed. It would be possible for this group to be broken into sub-sets, for example, those that are vertically walled, those that are angle walled, those with square section piles and those that employ piles of rectangular section. Equally however, the group could be divided into sub-sets on the grounds of complexity of internal bracing, or indeed on the basis of internal ballast characteristics. As such sub-division could result in the creation of as many sub-sets as there are pier examples there seems little benefit in pursuing this course. It is also the case that in many instances characteristics such as vertical or angled walls

are known but the precise form of internal bracing is not. Known variation of technical detail associated with this type is detailed in this consideration.

2. Piers with an earth-fast frame

This group of piers are characterised by a framework of earth-fast piles or posts. Gaps separate the individual piles, unlike those of Group 1 where they are driven edge to edge. It is believed that the piles of these piers were in all instances connected laterally by tie-beams and longitudinally by further beams. Collectively, these elements form an earth-fast frame to which the walls and deck of the pier were affixed. It seems fairly clear that each of the known examples of this group bear some technical differences.

3. Piers with a freestanding frame

Unlike the other pier types, the piers of this group are formed of a frame of timber that appears to lack elements that are secured directly into the ground or seabed. In essence these piers are comprised of one, or a series of connected, timber boxes infilled with a stone ballast. Such boxes may be regarded as forming a freestanding frame. Given that only stone ballast, and no timber remains, are known at any of the pier sites of this type, this form is entirely speculative and founded on the premise of negative evidence.

The pier sites by type

All the timber-built piers of the east coast that can be identified by type are described and considered below. Those that cannot are considered under a separate heading at the end of this section.

2.3 Piers with walls of close-piling

2.3.1 Bridlington: early 16th-century - 1719

The earliest definitive reference to a pier at Bridlington is in 1537, though one may well have been in existence by 1446 when a grant of quayage was made (Cal. Chart Rolls 1446). In 1537 it was determined that "*it* (the pier) *should be made with timber and stone together as before"* (L. & P. Henry VIII 1537a).

We are fortunate in that an extensive exchequer account of 1539 relating to the rebuilding of the 'key' provides some indication of the scale and nature of these works (TNA E 101/622/29). The workforce consisted of five principal groups: carpenters, sawyers, labourers, tenants of crown (formerly monastic) holdings performing labour services and others providing miscellaneous services. The most commonly identified task of those performing manorial labour service was described as *"fylling of the key wt stones"*. The miscellaneous group included a number of local craftsmen who were supplying equipment and materials to the harbour works, much of which related to the *"rames"* (pile-drivers). A number of individuals were also involved in the felling and squaring of *"gret tymber trees"*. An almost identical picture detailing the payment of carpenters and labourers, local craftsmen and those performing manorial labour service is presented in two further exchequer accounts relating to the mid 1540s (TNA E 101/459/5; E 101/459/6).

"The State of the Kaie at Bridlington" was *"Surveied the xith of Decembre"* 1554 (TNA E 101/459/7). This stated that the north pier was *"rent* (broken) *of 10 rowmes cont 110 foote"* and that *"certein other roums of the same pere were sore shaken and brosed"*. A rowme or roum was a bay division within the pier and these bays were seemingly of an 11 foot (3.35m) width. The repairs for the north pier were estimated by carpenters to require *"120 trees, so that every tree bene a foot square and 24 in length, and so after the rate"*.

When the crown leased out the manor and piers of Bridlington in 1566 the harbour was said to be in *"great decay"* and the lessees were required by Exchequer appointed commissioners to rebuild and repair it (Cal. Pat. Rolls 1566). By way of inducement the crown offered *"all old timber, stones, iron and other things belonging to the old pere, with all old stones at the site of the monastery not yet sold, also 100l and 120 suitable oak or other timber trees in the adjacent woods"*.

There was a succession of groups of lessees at Bridlington and Exchequer documents (TNA E 133/6/920; E 178/2714) are both inquisitions of 1590 examining the state of the piers. E 133/6/920 describes the harbour as consisting of a north and south pier with each

pier being composed of a series of *"rooms or bayes"*, at least some of which were *"of 4 yards a roome"* (3.65m). The north pier is said to be *"but 27 rooms or bayes & by ye articles ther ought to be 29"*. Using the bay width stated above, this would give the north pier a length of 108 yards (98.75m) when it ought to have been 116 yards (106.07m). These are impressive statistics when it is considered that the gently sloping nature of the seabed will have demanded a greater length for the south pier. A considerable number of the constituent bays were in a dilapidated state, as it was claimed that *"ye wood workes be in great decay, for ye ground work is worne away, ye stone falleth owt of them: & they want dv-* (diverse) *planks & cross barres"*. The 'planks and crosse barres' appear to refer to the walling or deck of the piers and to tie-beams respectively, with the tie-beams serving to connect one timber wall to the other. This and other passages in E 133/6/920, provide unequivocal evidence for the 'bayes' being filled with a ballast of stone. In referring to the timberwork this document also states that *"And yf it be not pvented & these repaired, ye water will still work undr them & in the end ov throw them"*. Additionally, numerous bays in both piers were said to require filling for heights of between 1 and 3 yards (0.91m-2.74m).

Inquisition E 178/2714 confirms and reiterates the essential points highlighted by inquisition E 133/6/920 whilst providing some additional information. It is stated, for example, that there were *"three Beer-heads, or crosse-pieces lackinge in the south peere"*. These items are the probable equivalents of the 'cross barres', or tie-beams mentioned in E 133/6/920. Reference is also made to decayed bay units and their dimensions *"towe Rowmes of the Peere nedefull to be buylded conteyninge xxviii fote"* and elsewhere that *"ther are three Rowmes conteyninge by estymacon xl fote"*.

The various bay measurements indicate that these units at the piers were not of an 'exact' standard size. In 1554 we have mention of 10 bays measuring 110 feet (33.5m) giving an average of 11 feet (3.35m). In a document of 1580, (S.P. online 1; Purvis 1926, 168-9), there is a mention of *"fower roomes of the north pere con. in all a xlvi foote newlie maide"* which gives an average of 11 feet 6 inches (3.50m) per bay. E 133/6/920 describes a bay of 12 feet (3.65m) whilst the widths of bays recorded in E 178/2714 is of 14 feet (4.27m) and 13 feet 4 inches (4.06m). It is possible these differences may relate to separate building and repair programmes and, in the case of bays eroded adjacent to the shore, a requirement for these units to fill non-standard gaps.

The only known drawing of the old system of piers at Bridlington is an ink on paper sketch by Francis Place, Figure 2. This drawing was made around 1700 shortly before a radically different system of piers was built. The view is looking north, with the south pier in the foreground and part of the north pier just visible above the eastern end of the south pier. The inner and outer walls of the south pier are depicted as formed of vertically set timbers, almost certainly piles, whilst an infill between the walls is also evident. A series of projections can be seen extending beyond the outer wall of the pier. These are arranged in two horizontal rows and seemingly represent tie-beams. Mortises cut close to the end of the tie-beams held rails, or locking bars, that run between the tie-beams along the outer face of the pier. The tie-beam/locking bar arrangement will have served to stiffen the walls and prevent movement in an outward direction. Internally, the pier was filled with stones. This functioned as ballast providing weight and stability against the forces of wave, current and wind, and prevented any tendency for the plank walls to fall inwards.

Other than the tie-beams there is only limited evidence for the physical separation of one bay from the next. What limited evidence there is in support of this comes solely from the tenor of the Elizabethan descriptions where reference is made to certain bays that require varying amounts of in-filling.

The inner and outer walls of the piers depicted in the Francis Place drawing were of close-driven pile type and this is likely to have been the case since the 16th-century at least. We know from the Henrician documentation that a number of pile-drivers (*rames*) were used during construction at any one time (TNA E 101/622/29). Further, the survey of 1554 lists the timber requirements for repairs to a 110 foot (33.5m) stretch of the damaged north pier as being 120 timbers, each being a foot (0.3m) square and 24 feet (7.3m) in length. The cross sectional timber size mirrors that of the driven piles that formed the walls of the piers at Great Yarmouth.

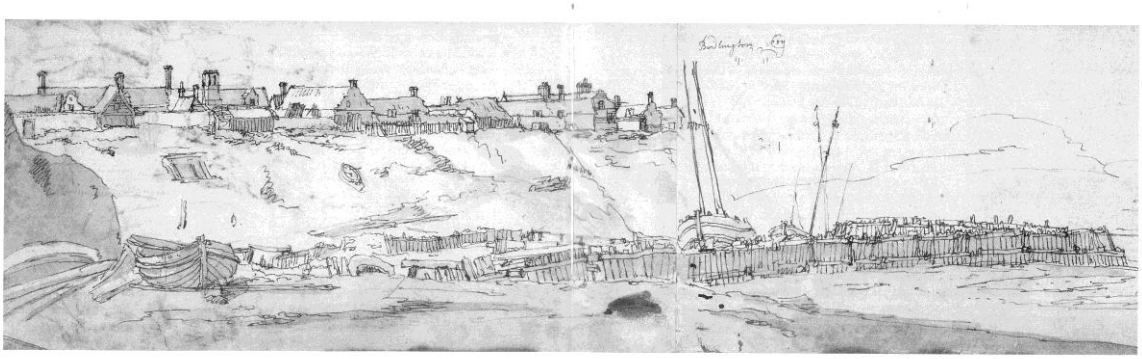


Figure 2, The south pier at Bridlington c. 1700 as drawn by Francis Place (reproduced from Neave 2000; original held by British Library)

2.3.2 Sheringham: 1580s-90s

Pier Reeves are known at Sheringham by 1583 when state aid enabled the building of a large system of piers to create a harbour and replace an earlier system of groyne-like piers (Cal. Pat. Rolls 1583; Hughes and Larkin ii 1969, 435-8). A document headed *"The whole accountes of the peerereves of Sheryngham and Beston concerninge their sommes of money desbursed for the reedifienge of the same decayed peares as followeth"* appears within the Bacon Papers of 1585-1595 and, theoretically at least, are those of an entire programme of pier building (NRS 1987 &1988, 17-19).

This document records the "*Fellinge, cuttinge sawinge and carrynge"* of 1,450 oaks between 1582 and 1585. There are several entries dealing with payments for *"wourkmanshipp"*. Amongst these we hear of three men, two *"goinge in the crane and the thirde to guyde the piles and unlose the bettles"*, of four men *"for breakinge of tymber fitt for the wourkmens hands"*, and of *"three payer of tryces and all thinges therto belonging"* possibly relating to ropes and running gear for machinery. Beneath these entries it states *"Whiche workemanship extended the west peere two hundredth and threescore foote"* (i.e. 79.25m). Following on from this it is stated *"the carriage of stone and fillinge of every ten foote whereof amounting to 40s -- £52"*. This probably indicates a stone ballast for every 10 foot (3.05m) bay, the bay length of the west pier therefore being 26 bays. Further in the document there is reference to *"also finished* (blank) *footes in breakwaters at the west pere"*.

The document also lists works to a south pier. These include payments to three men driving piles. Linked to these entries is the statement *"Whiche workemanship extended the est peere one hundredth fourscore foote"* (54.85m). Following on from this it is stated *"the carriage of stone and fillinge therof in parte cost £28"*. Many of the entries relate to machinery *"great ropes for the crane and beetles, and other ropes nedefull for the wourke of the peere"*, *"Iron wourke occupied aboute the crane, beetles and peeres"* together with *"brasse wourke in shyves and other necessaries belonging to the betels and crane"*.

The east and west piers at Sheringham were structures that presumably extended at 90 degrees to the shoreline straight out to sea. One document also mentions a north pier though how this latter was configured in relation to the other two piers is uncertain (NRS 1990, 211-4).

There is a strong emphasis throughout the descriptions of the pier building programme on bettels (a ramming instrument), cranes, equipment relating to them, and even to the guiding of piles. The balance of evidence suggests that the piers constructed at Sheringham during the late 16th-century had walls of close-piles whilst there is reference to the filling of the piers with a ballast of stone. The works at Sheringham were marred by controversy over corruption and also their effectiveness. Whilst the piers were used for the accommodation of vessels there appears to have been as much, if not more, concern over the protection of the town from coastal erosion and by 1601 the large pier system was replaced by a multiple jetty system of groynes (NRS 1990, 206; NRS 2000, 232; Day 1888, 234).

2.3.3 Great Yarmouth: mid 16th – mid 20th centuries

The earliest known reference to what was probably an existing pier at Great Yarmouth occurs in an estimate for new piers in 1560. This structure was described as *"the old jettie"* and was probably some sort of bulwark at the interface of a newly cut channel from Great Yarmouth and the sea. The itemised and costed estimates for the new piers, which were intended to replace the old jettie, provide significant structural information (Swinden 1772, 416-7). The piers themselves do not appear to have been built until 1567 (NRO Y/C28/1). The costings state:

Imprimis there must be a mayne jettye made in the sowth side of this haven into the sea from the old jettie which must be in length XLV roddes, XX foot to the rodd (i.e. 274.32m)*, to which jetty there must be XVIII hundred piles the one half of them XXX foot long* (9.14m) *and the other half XXXV foot long* (10.67m) *and to beare a foot square every which pile will cost with carriage to the towne by estimation XXs. The pece which amountith to 1800l.*

Item there must be to the saide peere for the bynding of the same 100 trees of XX (6.10m) *and XXX* (9.14m) *foote long valued by estimation with the charges 100l.*

Item there muste be a jettie made into the sea on the north side of the haven which must be in length XXX roddes (182.9m) *and must be further into the sea than thither by II roddes which jettie must have XII hundred piles of the like length and squarenes as is mentioned before which will coste with the charges of the carriage XXs. The pece which amountith to 1200l.*

Item there muste be to both thes jetties XXm foot of oken plank of III ynches thicke valewed at VIIl. Xs. The thousand which is 150l.

Item these II forsaid jetties must be XL foot (12.19m) *wide beneth and above XXXVI foot* (10.97m) *and the filling of the same II jetties with stone and other provision will cost by estimation 600l.*

Item the dryving of every pyle into the said jetties esteemed at Vis. VIIId. The pece amountith to 100l.

Item the yron worke for both thes jetties will cost by estimacion 500l.

Sum totalis 5510l.

This document describes a two pier entrance to the haven, the south pier being longer than the north pier. The lateral profile of both piers were intended to be the same and tapered slightly from the base to the top. That the pier was to be 900 feet long and to be built of 1800 piles each a foot square suggests that the walls were formed of two lines of edge to edge driven one foot square piles. The reference to timber for *"bynding"* probably relates to beams for bracing the pier walls and may have involved tie-beams. If so these must have been composite arrangements as the *"bynding"* timbers are listed as shorter than the overall width of the piers. The intended function of the 3 inch (76mm) oak

boards is less certain. This may have been affixed as a cladding to the pile walls, or used for constructing a decking. A stone (and other) ballast within the shell of the pier is clearly referred to. The sum for the iron-work is considerable and on the basis of slightly later documentation is likely to have been not just for bolts and spikes but also for pile shoes. It will be noted that the terms pier and jetty are used interchangeably in this document.

Great Yarmouth's First Haven Account Book provides some detail on the resources utilised in the construction of the piers between 1567–1597 (NRO Y/C28/1). These confirm the considerable expenditure on smithing this being a result of both fabrication and the raw material, "*Tunnes of Spanys Iron"*. The recorded maundes, baskets, ropes and shulves (shovels?) no doubt represent some of the basic equipment being used during the works. Although engines for driving piles are not mentioned their presence can be inferred from other documents (NRO Y/C28/1).

Estimates for the extensions of both piers were prepared in 1580 (Swinden 1772, 442-3). These state:

The north mayne peere is to be made LX yards (54.9m) *further into the sea for the two sides and the head wherof is requisyte to have XXtie score piles of oak betwene XXX* (9.14m) *and XL fote* (12.19m) *in length and twelve ynches brode which to be laid redye by the workes to be occupied will cost XXs. a peece CCCCli.*

Item to that peere is nedfull to be occupied beames everey one XXIIII fote (7.31m) *in length XVII or XVIII ynches square XXs. a peece LXli.*

Item to every beame thre brasinges valued at Vis. VIIId. a peece LXli.

Item eyther syde of the said peere is to have five longers of tenne or XII ynches brode and V or VII ynches thick ronnynge all the length of the works vid't two within and III without the peece estemed at IIId. a fott XXli.

Item the fott of this worck throughe which all the said piles shalbe drevyn being for the fowndacyon therof is XL fott (12.19m) *brode and LX yards* (54.9m) *longe which is to be made and wrought of brushwode and is estemed will cost the wode Cli.*

Item there is to be dryven thre tier of piles somewhat shorter to be substanciallye bound with beames langtres and brasinges and the north side of the said mayne peere which

shalbe fylled with great rockes and stone to breake the force of the sea from that mayne peere which tymber is estemed will cost CCli.

There is also one other tier of piles to be dryven on the south side of the said mayne peere all the length therof to fortifye the same and will take about CCCC piles with beames longtres and brasinges valewed at CCCCli.

Item three ynche planke to make this northe peere close on both sides with yron to shoe the piles and to make boltes to bolte the same together estemed at CC li.

Item brush faggottes to fill the same pier Cli.

Item rockes and stones for this peere CCli.

Item the workmanshippe of all this peere MCCli.

The somme of the chardge of this north peere M M VIII XL (£2,840)

The south peere is to be made and carried forthe into the sea XX yardes (18.3m) *with the like workes of tymber brushe rockes and stone and is estemed will cost the somme of Mli. The south mayne jettye beinge in lenghte XVII score yards* (310.9m) *is to be fortifyed with great piles betwene XXX* (9.14m) *and XL* (12.19m) *fet longe and will take to doe it about XII(C)* – (1200) *piles and beames and longtres estemed will cost M CC li.*

Item the workmanshippe therof CCCCli

Also the fynyshinge of two breake waters within the haven to break the force of the currant from the said sowthe mayne jettie will cost with the workmanshippe CCli.

Summa totalis is juste V M VI XL or 5640

This document again shows the pier walls as formed of lines of close-driven piles. The reference to beams was presumably for securing the walls of the piers whilst there were also "*thre brasinges"* (bracings) to each beam. It is possible to suggest that the beams were the lateral members between the pier walls and that the three bracings were the three lines of longitudinal members. The term *"longer"* appears in the document and is defined by the OED as *"a long pole or piece of timber used for fencing … etc"*, a term first recorded in 18th-century Canada. It is likely that the longers were heavy-duty battens that served to secure the plank cladding to the pile walls.

A foundation, running for the full length of the proposed pier extension and through which the piles are driven, is clearly described. This is said to be of brushwood, probably heavy wattle work. Such work also lined the haven's channel adjacent to the piers, indeed this area became known as the 'brush'.

The documented three tiers of short piles bound with beams and bracings and filled with rock and stone located on the north side of the north pier is explicitly stated to be a break-water. The other tier of piles to be driven on the south side of the pier, along with its beams and bracings, may have served a similar break-water function or been intended to provide additional support to the wall of this side of the pier. The quantity of piles involved together with the considerable expense suggests that this was intended to run the full length of pier and extension combined.

The wording referring to the 3 inch planking argues for this forming a cladding to the pier whilst there is unambiguous reference to iron shoes for the piles. The recorded brush faggots to fill the pier also occur in later documents at Yarmouth. The precise use of the rocks and stones is not mentioned, though it is tempting to see them as also forming part of the fill of the timber shell.

Henry Manship junior recorded dimensions of the north and south piers in the early years of the 17th-century (Palmer (ed) 1854, 96). The north pier was described as:

"235 yards in length (214.9m); *the breadth, at the foundation, is 40 feet* (12.19m)*, and at the upper part 20 feet* (6.09m)*; artificially built of mighty timber trees, joined together very cunningly, rampired with brush, millstone, and shingle: it hath three tiers of piles, bound with beams and iron wicker, to break the force of the sea from the pier itself."*

The south pier was said to be:

"340 yards long (310.9m), *and 10 yards broad* (9.14m)*; and is in depth from the top to the bottom, 36 feet* (10.97m)*; whereof 24 feet* (7.31m) *is under water at every tide."*

Manship junior's length for the south pier matches exactly the sum of the 1560 estimates and 1580 estimates for extension combined, though the north pier appears around 27m longer than the combined sums, this discrepancy perhaps being owed to post 1580 extension? The *"joined together very cunningly"* seems likely to relate to the internal framework and the rampiring perhaps to a form of toe armour. The three tiers of piles

match the description of the breakwater of the 1580 document. The dimensions of the width imply pier sides that tapered upwards.

Figure 3, Town of Great Yarmouth with the piers shown to the left. Stated to originate around 1570, this picture map is perhaps more likely to date to the time of the proposals of 1560 (British Library, Cotton Augustus l.i. f.74)

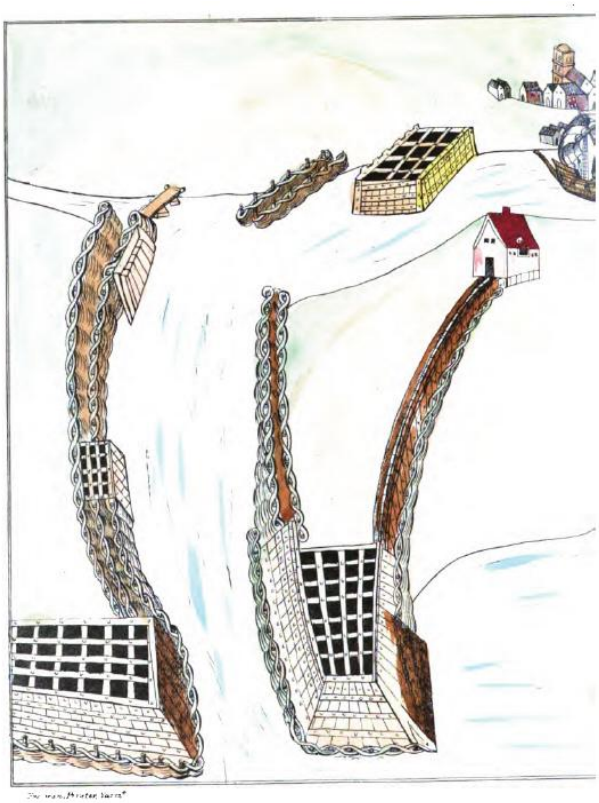


Figure 4, Detail of Figure 3 (reproduced from Palmer (1854)

The depictions, (Figure 3 and Figure 4: detail), show the quay with its various riverside facilities on the west side of the town. Both sides of the channel are depicted as being stoutly revetted, mostly with wattle-work, whilst some vertical timber-work is also evident. This lining to the newly cut channel was to secure its course and prevent the waters straying. Two projecting works, one of brushwood and one of timber, are shown on the west side of the bend of the river adjacent to the channel. The primary function of these was probably to deflect the southwards current of the river thereby assisting the waters flow into the channel. The north and south piers have the appearance of short bulwarks rather than the long piers of the documentary sources. This may be the result of artistic impression or could even represent an early intention. However, the depiction of their structural detail does not appear to contradict the documentary sources of the 1560 and 1580 estimates. Both structures appear slightly wider at the base than the top whilst three rows of what may be *"longers"* are shown on the exterior faces of the piers. These are affixed against upright timbers that are either a cladding of the three inch planks or the walling of piles. The brushwood around the base of the piers accords well with the "*worck throughe which all the said piles shalbe drevyn being for the fowndacyon therof"* of the 1580 estimate. An interesting detail of the depiction concerns the framework of lateral timbers and three rows of longitudinal timbers within the pier itself. Correlation for such in a documentary context may be the "*bynding"* of the 1560 estimate. This arrangement also accords well with the *"beames"* of the 1580 document equating to the lateral members and the "*to every beame thre brasinges"* representing the longitudinal members.

Details provided by antiquarian writers of the earlier 19th-century indicate that the structural aspects of the piers were unchanged though they were now somewhat longer (Preston 1819, 157-8). More informative are the reports of a succession of engineers brought in to address problems at the haven from the mid 18th-century onwards. Correspondence of the engineer William Jessop, dating between 1798-1808 indicates that repairs at the piers continued to be carried out using the established methods of close-piling (NRO Y/PH 101). Broadly similar techniques were again used by William Teasdel in 1867 (NRO Y/PH 115).

A number of engineers reports were produced by Sir John Coode. His report of 1873 provides information of considerable importance to the understanding of the structural development of the historic piers (NRO Y/PH 120a). In considering work to the south

pier Coode stated that *"this Pier is a formidable mass of old timber Piling, in some parts there are as many as eleven tiers of longitudinal oak Piles, and from two to four skins or faces of timber sheeting on the Sea and Harbour sides, the hearting, or centre, consisting of marl, shingle, and small chalk stones, and the whole resting upon a sand and shingle bottom"*. What Coode is describing in his *"eleven tiers"* is the successive re-casing of the pier, rather in the manner of a Russian doll, as decay and damage necessitated repair. Coode produced a number of detailed measured sections through the piers, one of which, dating to 1902, through the south pier and showing the multiple encasings is reproduced as Figure 5 (NRO Y/PH 1360). This shows a multiple series of angle driven piles connected at a high level by transverse members or tie-beams. The innermost sets of piles are of earlier date and those towards the exterior later. Between many of the successive walls of driven piles there are horizontal timbers that are almost certainly 'wales'. In many instances successive pile walls were secured to the older body of the pier by short struts. One consequence of successive re-sheathing of the piers is that their width became ever greater. Such multiple re-cladding implies the likelihood of considerable antiquity for the earliest components – possibly as far back as the original piers of the 16th-century?

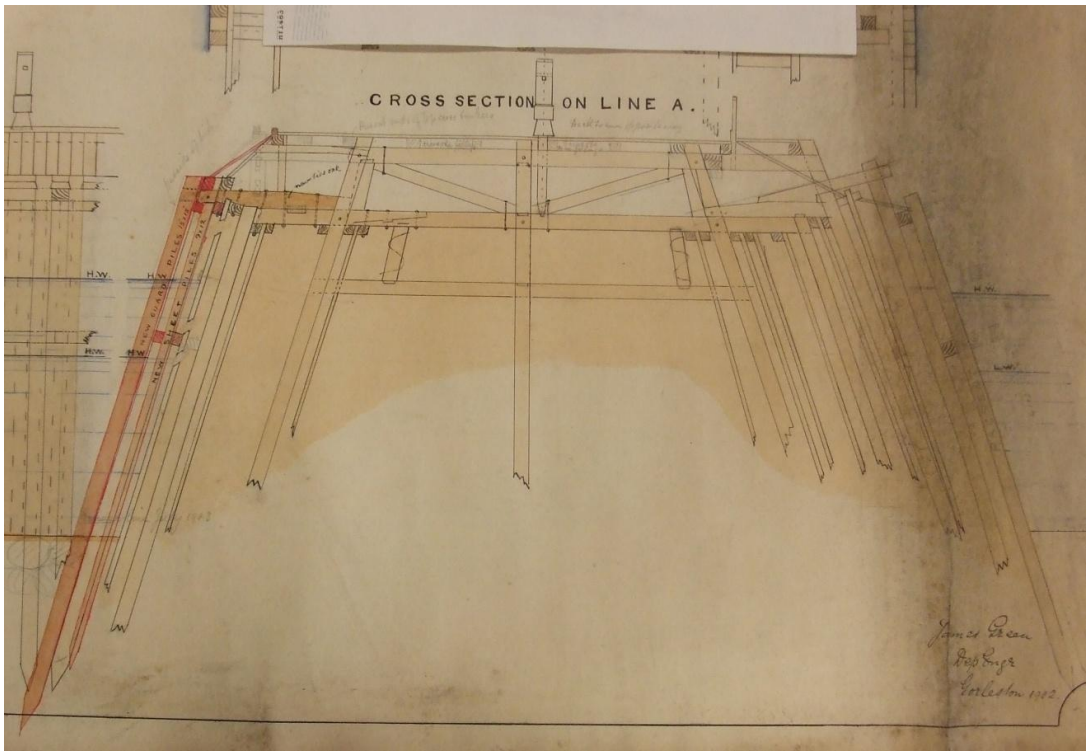


Figure 5, Section through Great Yarmouth north pier by John Coode,1902, (NRO Y/PH 1360). Note the multiple re-facings

A report by Coode dating to 1885 (NRO Y/PH 120c) is accompanied by a plan of the piers in which the principal elements of the north pier are visible in outline, Figure 6. This shows the walls of the pier with their interior spaces as being divided by a series of transverse lines representing lateral bracing or tie-beams that partition the pier into a series of bays. Further reports by Coode of 1896 (NRO Y/PH 120d) provides similar detail as does an 1865 drawing of Joseph Cubitt (NRO Y/PH 1199).

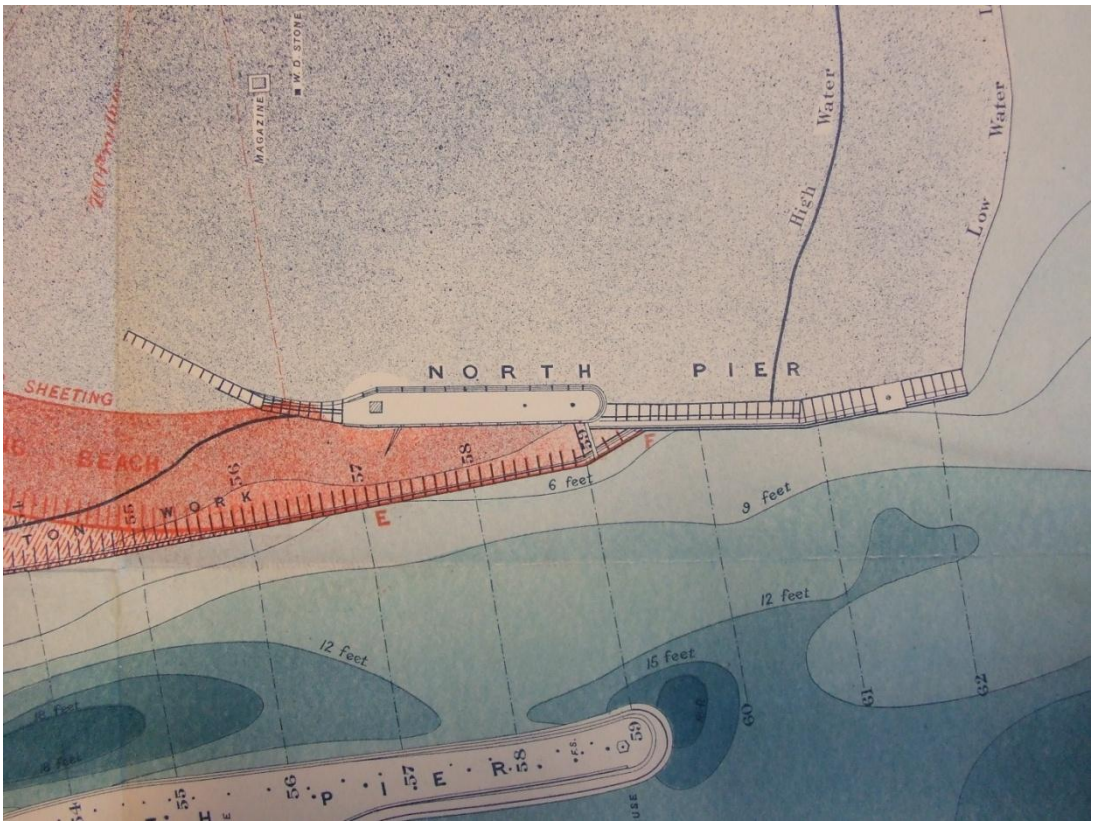


Figure 6, Plan of Great Yarmouth north pier by John Coode, 1885, showing lateral divisions within (NRO Y/PH 120c)

A report of 1870 by Joseph Cubitt details re-piling to the sides of the piers and notes of the south pier that *"the surface of the sand being now only between 6 and 7 feet above the feet of the piles"*. This observation suggests that the piles must normally have been driven deeper than 2m below surface level (NRO Y/PH 119).

Photographs of the mid 20th-century and earlier show parts of the timber piers that accord well with the 18th – 19th-century descriptions and drawings, Figure 7. Great Yarmouth's

timber-built piers were demolished in the 1960s and replaced by similar structures in modern materials.

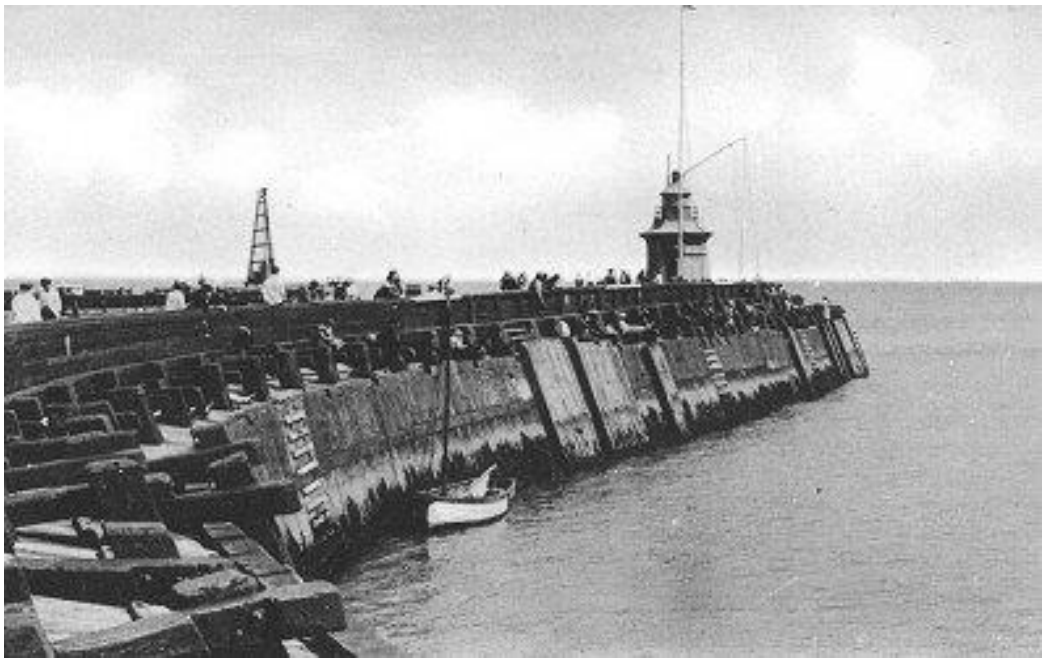


Figure 7, Photograph of Great Yarmouth north pier, earlier 20th-century (Norfolk Online Access to Heritage website)

2.3.4 Southwold: early 18th-century – early 20th-century

The Assembly minutes of Southwold Corporation for the early years of the 18th-century contain a number of references to the *"digging of a new haven*" and the resolution *"that two jettyes should be built out into the sea in such places and in such manner as the bailiffs and chamberlaine shall think proper"* (S. Assembly Bk. 42, 53). In 1731, 30 loads of timber were bought for the repair of the jetty whilst there are further references in the same year and in 1736 (S. Assembly Bk. 84, 85, 107). These references indicate that the corporation of Southwold built some sort of timber-built seacoast pier/s at the mouth of the River Blyth in the earlier part of the 18th-century.

Following the first Act of Parliament for the improvement of Southwold harbour in 1747 a new north pier was built in 1749 with this being followed by a south pier in 1752 (Gardner 1754, 41; Jenkins 1907, xi; SRO HA11/B1/12/16). The north pier was built

following a survey by a Mr Reynolds whilst the south pier was built under a contract with the same surveyor (Maggs 1842, xi). The north pier was replaced in 1780 by one to a plan of a Mr Hayward (SRO HA11/B7/2, 14), and in 1806 the south pier was extended, with later additions being made at other times (SRO HA11/B1/12/16). It proved necessary to extend the piers inland in the late years of the 18th-century whilst breakwaters to parts of the exterior sides were also added. The core of the 1780 north pier and that of the extended south pier of 1752 survived until the earliest years of the 20th-century. Their appearance in 1830 is shown in Figure 8. This plan indicates the north pier to be around 40 yards (35.5m) long by around 5 yards (4.6m) wide and the south pier to be around 60 yards (55m) long by around 8 yards (7.3m) wide. The ends of the piers appear as somewhat rounded. The north-west end of the north pier splays out slightly, at an angle similar to that of the breakwater which abuts it. A breakwater at a similar splayed angle is also evident to the south side of the south pier. From the western ends of both piers timber revetting to the sides of the channel constraining the River Blyth extends some way upstream. In 1841 the engineer James Walker described the piers as being nearly parallel to each other, and 115 feet (35m) apart at the entrance (SRO HA/11/B7/4, 6).

Figure 8, Extract of 1830 plan of Southwold harbour by T.W. Ellis. North is to the left. (S R O: B15082.23)

Excepting plans the earliest depiction of Southwold piers is an engraving of 1822 which shows its basic form of construction, Figure 9. The inner wall of the north pier is shown as close-piled whilst the profile of the end of the pier suggests these to have been driven at a steep, but not vertical, angle. Towards the top of the pier a stout horizontal wooden rail can be seen. This appears to have helped retain the pile sides in alignment and is likely to have been connected internally to a series of tie-beams or other structural members. Visible areas of decking are all of laterally lain planks.

Figure 9, Engraving of Southwold piers, 1822, looking north (reproduced from a print in Southwold Museum)

'Weekly Labour Books', for the period 1867-73 provide some technical information (SRO 491/20E/4). These detail the preparing and fitting of iron shoes to piles and sheet piles, drawing old piles, driving sheet piles at the piers, fixing lower and upper wale planks and repairing the engines (piling equipment).

A number of 19th-century engineers produced reports on Southwold harbour and provide brief descriptions of the piers. In one of these the north pier is said to be *"close piled on both sides"* and the south pier to be *"close piled on the north, or harbour side only"* (SRO HA/11/B7/4, 16).

2.3.5 Sandwich: a later 16th-century proposal

As an entirely riverine port Sandwich never possessed seacoast piers. However, in an attempt to improve the qualities of its port facilities a number of grandiose schemes involving lengthy cuts to the sea, and sometimes piers, were formulated in the 16th – 18th centuries. One of the earliest of these was by the military engineer John Rogers. A map of Sandwich and the Isle of Thanet dating to 1548 was commissioned as part of the Rogers' proposals, Figure 10. Although the precise technical details of this proposal are not known the map shows a pier arrangement at the juncture of cut and sea (Skelton and Summerson 1971, 48).

Figure 10, Map of 1548 showing Rogers' proposed cut of across Sandwich Marsh to the sea. Note the pier arrangement at the cut – sea interface. This is also the earliest known depiction of the timber piers of Ramsgate, Broadstairs and Margate. North is to the bottom of the map. (British Library, Cotton Augustus l.i. f.54)

Another scheme proposing the construction of timber piers, was that of the Dutch engineer Andrian Andrison who in 1572 prepared costed estimates for the works (Boys 1792, 679-740). This scheme proposed to create a channel to the south of that of Rogers', in a similar position to that suggested by an engineer named Jacobson some thirteen years previously. This cut was to be 12,000 feet (3.658km) long, 20 feet (6.096m) deep, at the top 200 feet (60.96m) wide and at the base 100 feet (30.48m) wide.

At the head of the channel twin piers were proposed. The costings for the piers, which are detailed below, suggest the use of the close-piling technique.

Jutties

Item, there must be two juttie heddes towards the sea, thone towarde the south of xxx roddes longe and xl foote broade, and thodre towardes the northe of xxv roddes longe and xl foote broade, and every of them xxii foote depe above the grounde: for the which wilbe requyred mm.c. peces of tymber for pyles conteyninge in length xl fote, which being worthe by estimacion every pece viii s. Amounteth to viii c.cl. li

Item, more for the yron worke and for carpenters wages about thiese ii jutties, and for fyllynge of the same with bolder stone, M li

Item, xl m. Of iii ynche plancke for the saide jutties at c s. The M. – cc li

And so is the chrge of the said jutties mm. xl li

These costings clearly describe a twin, timber-built seacoast pier arrangement. The length of the *rodde* (rod) is stated within the document to be 20 feet. Using this distance, the south pier was intended to be 600 feet (183m) long, the north pier 500 feet (152.4m), whilst each pier was to be 40 feet (12.2m) wide. At 40 feet (12.2m) long the 2,100 piles are of considerable length. In calculating the given number of piles and lengths/widths of the pier, there can be little doubt that the piers were intended to be built in close-piled technique, with each pile being in the region of 1 foot (0.3m) square. Some idea of the depth to which it was intended to drive the piles can be gained from the wording which

states that the 40 foot piles were to project 22 feet (6.7m) above the ground i.e. were to be driven to a depth of 18 feet (5.5m). The requirement for 3 inch (76mm) planking is likely to have been for the pier decking, though perhaps, given the itemised quantities, also for sheathing, or partial sheathing of the pile walls of the piers. An infill of stone ballast is explicitly stated as is the use of ironwork – presumably for pile shoes, spikes and bolts.

2.3.6 Hastings: mid 16th - mid 17th centuries

The earliest reference to a pier at Hastings is in 1546 when money for its repair is mentioned (Manwaring Baines 1963,106-7). It is entirely possible that there was a pier at the town from the earlier 16th-century, if not before, as Letters Patent granted in 1578 state that the *"town hath of long time had a pier or harbour made of timber and other things set and placed in the sea"* (Hughes & Larkin 1969, 426-431). The latest reference to a pier is in 1656-7 when notice was given that anyone who had saved any of the pier's timber, planks or bolts should bring these to the pier wardens for their salvage (Cooper & Ross 1862, 96). All references appear to relate to a single pier.

The first entry concerning the pier in the earliest surviving Hastings Corporation Record Book was an insertion written in 1597 lamenting the town's failed recent experiments with piers built predominantly of stone. This refers to *"the tymber woorke of theold peere"* implying that there had been a predecessor constructed of timber (ESRO C/A(a) 1, both sides p 12).

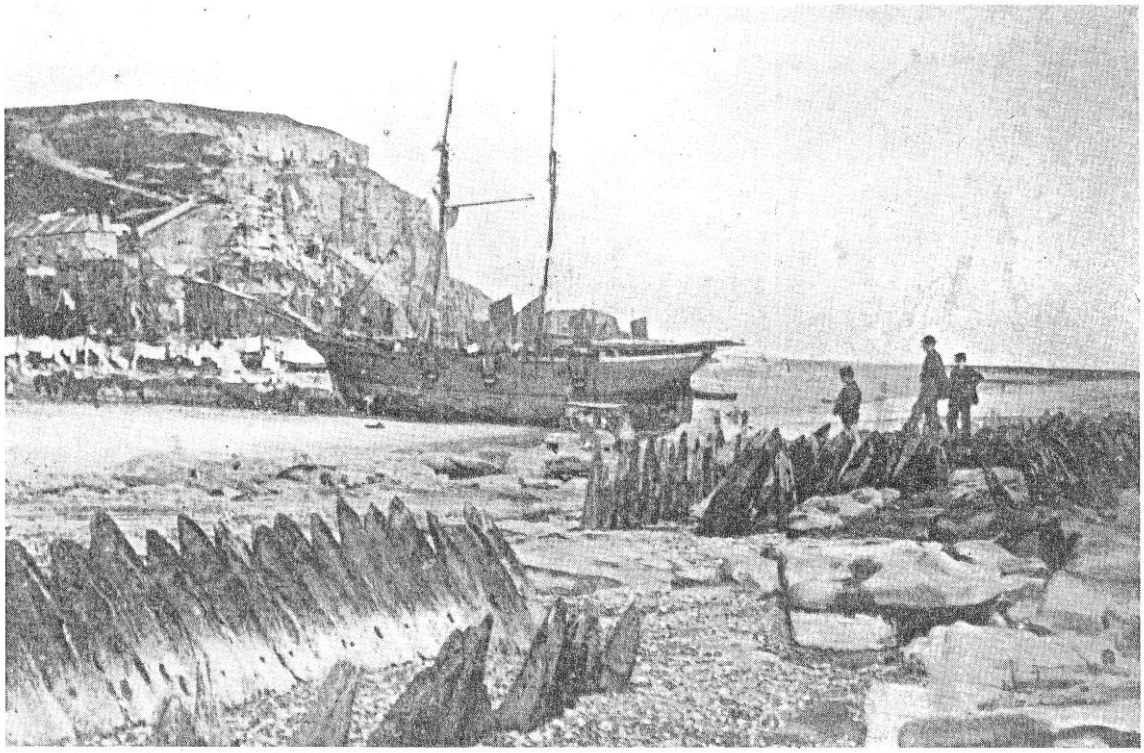
The town records do not mention the pier again until 14th April 1611 when it is stated *"Peere to be repaired"* and within the same entry there is reference to the intention of *"buying of Tymber"* (ESRO C/A (a) 1 p 151). Later in the same year the Assembly assented to the purchase of *"C* (100) *toonnes of tymber"* and made reference to a *"carpenter and other skilfull workmen"* (ESRO C/A (a) 1 p 154). There are a number of references in the town records concerning money for the pier, including on 26th May 1617 *"to the use of & towards the better maintennce & repacons of the peere"* (ESRO C/A (a) 1 p 200).

In 1621 it was mentioned that *"the carpenters have fixed the head* (the seaward end of the pier) *wch is alreddy framed unto that new woorke wch is sett downe"* (ESRO C/A (a) 2 p 2). A reference for the following year refers to the *"finishing of the woork now in hand*

about the new peer" and makes mention of debts owed for timber and iron, the latter probably for pile shoes, spikes and bolts (ESRO C/A (a) 2 p 9). This work may in part have been funded with money raised by a brief for collection, the printed form of which actually describes the work as a *"Peere into the sea with Timber and Rocks"* and that *"the said Peere for want of reparations is fallen down and quite destroyed"* (Sovereign 1620).

There is again no mention of the pier until 22nd January 1635 when the Assembly was called specifically *"to consider of the decaie of the peere of this Towne"* (ESRO C/A (a) 2 p 4). This is the last reference to the pier at Hastings and it is probable that shortly after this date it ceased to exist.

Material remains of pier structures were visible at Hastings until the later 19th-century. Four 19th-century images of these remains, including one photograph of c. 1870, are known, Figure 11. These show the remains of *"pier rocks"* and of timber piles. The photograph of the pier remains is particularly informative in that it shows at least five rows of driven piles. A number of large rocks, relating to the ballast, are also to be seen in the right foreground. The piles show three aspects of especial interest. Firstly, the multiple rows argue for at least two or more phases of construction. Secondly, whilst one row of piles appears vertically set the others are set at an angle. It is probable therefore that at different times the pier was constructed with vertically driven walls and at others with angled walls. Thirdly, the rows of piles are set edge to edge, indicating the walls to have been close-piled, no doubt strengthened within by *"braces"* and *"crosse dogs"* referred to within the documentary sources.



WOODEN PILES OF THE ELIZABETHAN HARBOUR, *c.*1870

Figure 11, Photograph of c1870, showing timber pier remains at Hastings. (from: Manwaring Baines, J. 1946)

2.4 Piers with an earth-fast frame

2.4.1 Bridlington: 1719 - circa1815+

Costings for a totally new south pier and for repairs and lengthening of the north pier at Bridlington were drawn up in 1717 and constructed shortly thereafter (ERRO QSV /1/2, 64-5). The works to the north pier may have resulted in complete, or near complete, replacement. The core of this new system of earth-fast piers survived until the earlier part of the 19th-century (Goodrick 1814, 9). Although the topographic setting of the new piers and their spatial relationship were similar to what had gone before, the design details of the new works diverged considerably. A number of detailed depictions together with highly informative documentary evidence and a plan exist for the new piers and these

provide a wealth of information regarding their structural characteristics. Figures 12 and 13 provide an overall impression of the appearance of the new piers.

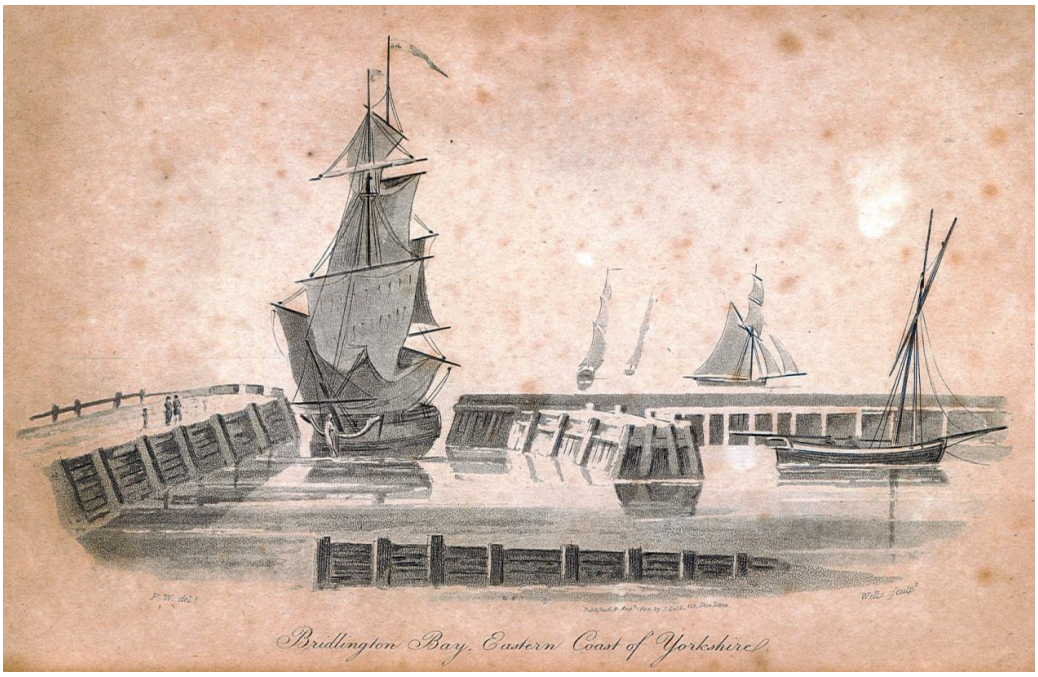


Figure 12, Bridlington harbour mouth with the new timber piers of 1719, looking south, early 19th-century (East Riding Museums Service)

Figure 13, View of Bridlington south pier, looking west (East Riding Museums Service)

Although bay division is not mentioned in the 18th and 19th-century documentary sources the pictorial evidence indicates that this was indeed present. These bay units were defined by opposed pairs of angle set piles, and, using the scaling on the engineer Goodrick's plan of 1814, Figure 14, we can determine an average bay width of around 4.40 yards (4.02m) (Goodrick 1814). Although there is no documentary reference for internal lateral division between bays, some evidence for this is apparent in Figure 15, which shows lateral planking within part of the inner side of the dilapidated north pier.

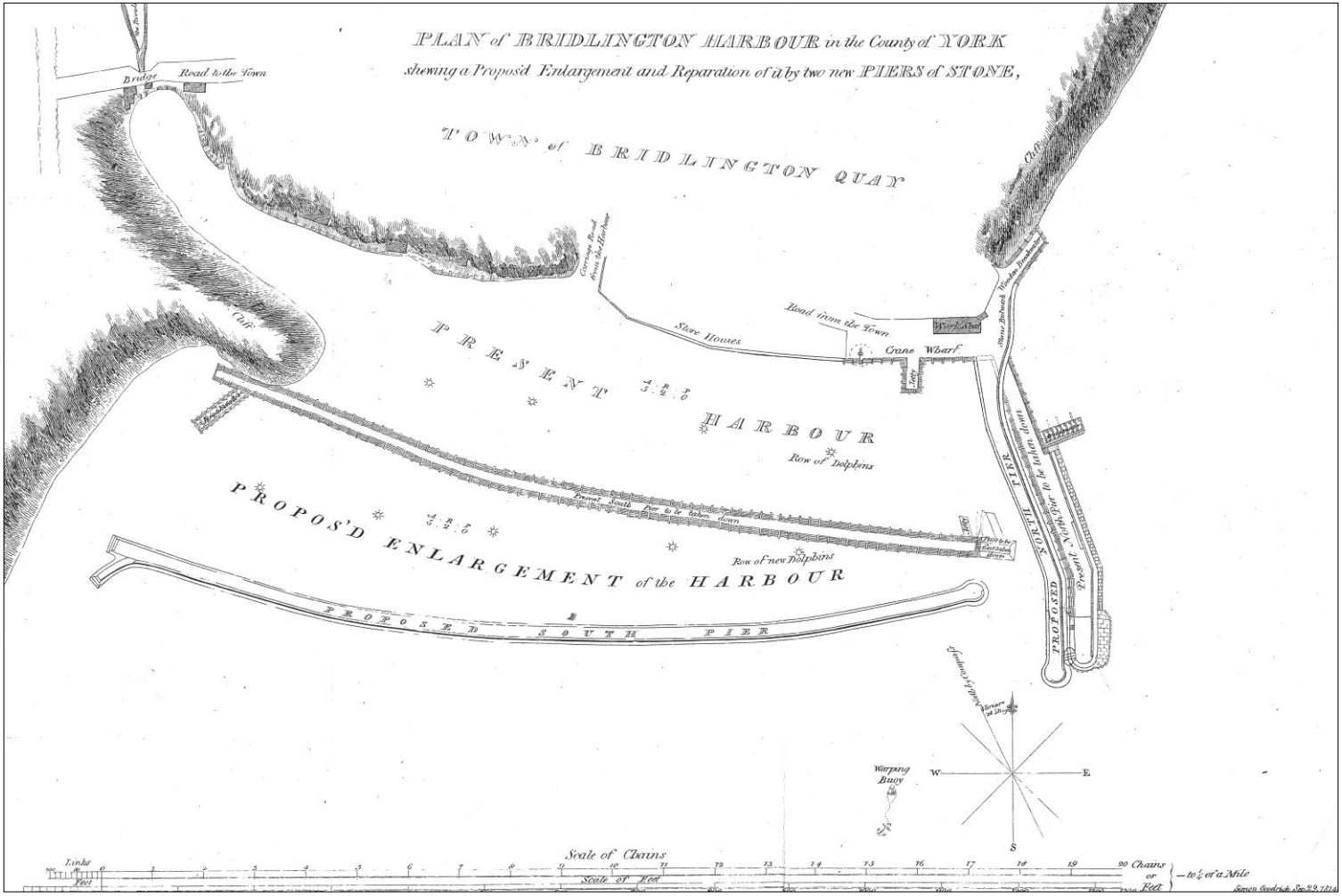


Figure 14, Simon Goodrick's plan of Bridlington piers, 1814 (reproduced from Goodrick 1814)

Figure 15, Inner face of Bridlington north pier in the early 19th-century showing lateral division within the pier (East Riding Museum Service)

Figure 16, of c.1810 shows that two rows of tie-beams extended across the width of the north pier. This situation can be seen with greater clarity in Figure 17. Although this latter figure depicts a breakwater-type structure that abutted the northern end of the north pier its structural characteristics of angle driven piles, tie-beams, horizontal timber cladding and timber decking indicate that it was constructed along the same lines as the piers. Because this structure was built to reduce the force of waves rather than stop them, it was constructed without external cladding in its upper parts. We can with some degree of reliability therefore, use this visible additional detail to inform us of the construction of the piers themselves. Reconstruction drawings of a single bay unit are presented in Figure 18.

Figure 16, Exterior of Bridlington north pier, looking south-south-west (East Riding Museums Service)

Figure 17, Breakwater adjacent to Bridlington north pier, looking north, early 19th-century (Bayle Museum, Bridlington)

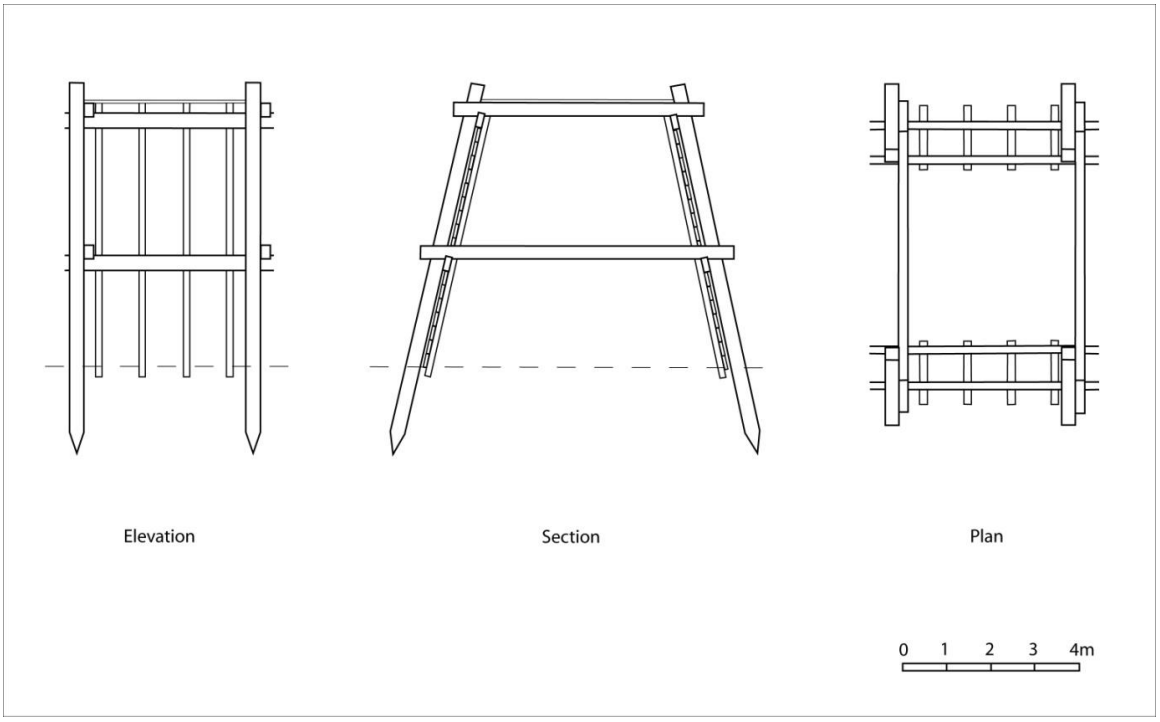


Figure 18, Reconstruction of a typical bay unit, post 1719 piers, Bridlington: elevation, section and plan (for ease of visual clarity the horizontal timber plank cladding is omitted from the elevation and plan) (From Johnson 2008)

These depictions indicate that on both sides of the pier two horizontal rails extended from bay to bay, one set mid way down the piles the other towards the top. It appears that the connection between piles and rails was by lap joints. Tie-beams extended laterally across the piers at the points of junction between the piles and sets of rails. The joints used to secure tie-beams to the rails were halved lap joints, whilst those between tie-beams and piles were lap joints. A series of studs extended from top to bottom of the piers and were secured to the inner faces of the horizontal rails, again probably by lap joints. This framework was clad with horizontally lain planks, these being secured to the studs. The piers were decked with planks. These are predominantly shown as running longitudinally with the piers and so must have lain on laterally set joists. It is clear from the observations of one engineer that the spacing between the piles was reduced towards the piers seaward ends, presumably for purposes of strength (Smeaton 1778, 3). Stone is recorded as the principal infill ballast, some of this being described as chalk (Goodrick 1814, 9) with sand also being mentioned (Smeaton 1778, 4).

The dimensions of the end of the north pier, that is the tallest part of either of the piers, is given by Smeaton in 1778 as *"thirty Feet at Bottom, and from sixteen to seventeen Feet at Top, and about thirty Feet in Height"* (9.14m, 4.87m-5.18m, 9.14m), (BL 52:67: Smeaton correspondence). Whilst the height of the pier was lower closer to the shore owing to the rising seabed, the various depictions indicate that the angled profile was constant fully along both piers. The new timber piers were larger than their predecessors. At the time of Goodrick's report the timber part of the north pier (the outer side had lately been clad in stone and the southern end extended in stone) measured around 365 feet long (111.25m). The south pier had a length of 1108 feet (337.72m).

2.4.2 Cromer: 1732 - 1820

A legal agreement of 1732 details the plan for constructing a new pier of timber at Cromer (NRO COL 2/56). There are a few accounts pertaining to the construction of the pier and to works there, though these mostly cover workforce expenditure (NRO COL2/58/4; NRO COL/2/58/3; NRO COL/1/58/1). Only one document, a receipt for £17 18s *"for Iron work for the Peir at Cromer"*, presumably in the form of spikes, engine parts and possibly bolts, provides technical information (NRO COL/2/58/2).

The most informative indicators of the structural form of this 18th-century pier come from three depictions dating to around the cusp of the 18th-19th centuries. All three show the same basic technical details of slightly angled pier walls formed of regularly spaced earth-fast posts with horizontal planking behind. The best detailed of these is that by Samuel Prout which shows the pier in a slightly dilapidated state, Figure 19. Judging by the human scale, this depiction would suggest a spacing between the posts of around 1m or less and the presence of a two bar hand rail around 1m tall. What appears to be a stone and earth fill between the walls is evident to the extreme left of the depiction, rather than a decking of timber, though such could have been present further along the pier. A prop can be seen providing supporting towards the end of the pier, this presumably being a rudimentary repair.

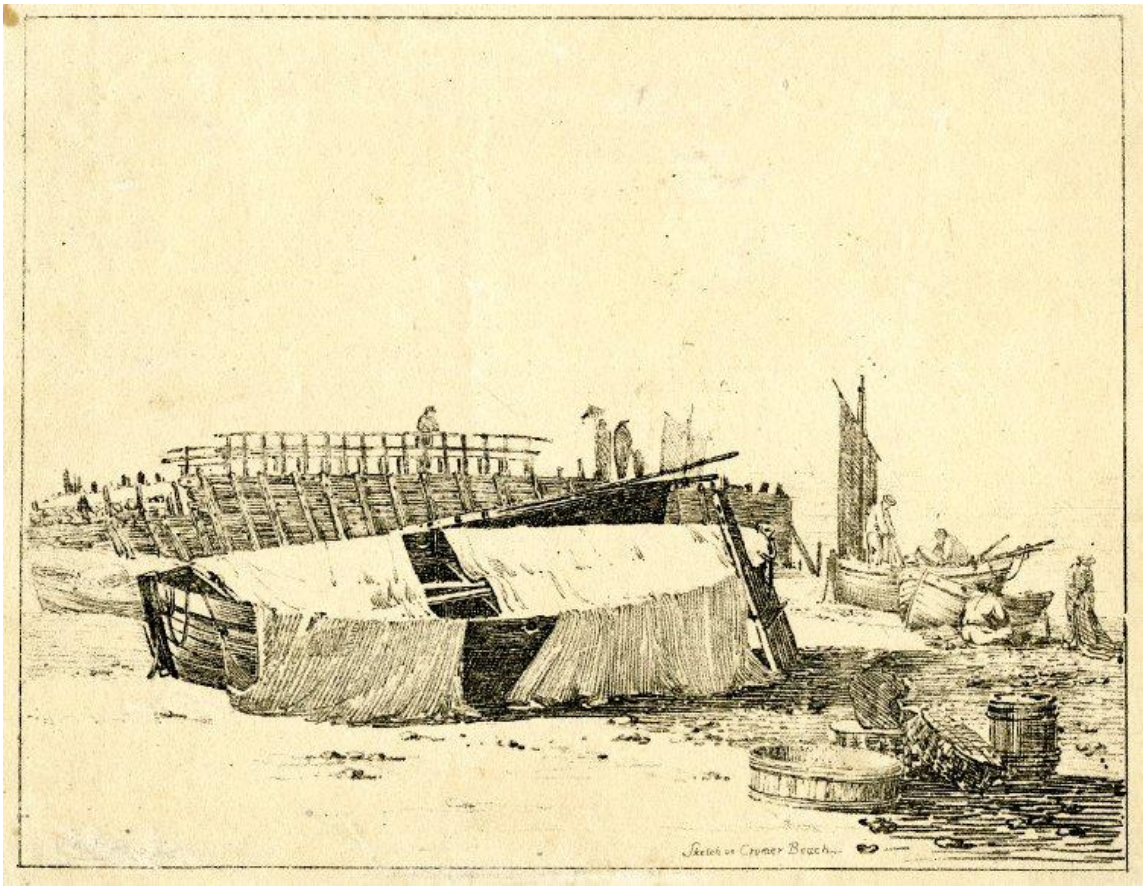


Figure 19, The pier at Cromer circa 1813-1821 as depicted in a print by Samuel Prout. (British Museum, reg. Number 1890,1013.78)

The pier appears to have been destroyed in 1820 as according to a Mr Walcott writing in 1861 *"An earlier jetty was swept away, March 1820"* (Walcott 1861, 101). There have been a succession of piers at Cromer subsequent to that of the 1730s. A jetty of open ironwork under a timber decking was constructed in 1822. The form of the landward 30 yards of this structure harked back to earlier exemplars, it having planked sides and being filled with a stone ballast. This pier was lost in a storm in 1845. (Pipe 1998, 19-42).

2.4.3 Southwold: early 20th-century

A series of plans, elevations and sections drawn for the early 20th-century rebuilding of Southwold's earlier piers (see 2.3.4) survive as do a number of photographs depicting the works in progress. A sample of these appear as Figures 20, 21, and 22. It is clear from

notes on these drawings that at least some of the landward parts of the older existing piers were retained during the initial works. The heart of the pier system was comprised of three parallel lines of metal shod piles, the central line driven vertically and those to the sides driven at an angle. These 'main piles' were each 1 foot (0.3m) square and 36 feet (11m) long – a significant proportion of which was driven into the sediment. The longitudinal distance between each of these piles was 10 feet (3.m). Within the upper part of this arrangement there were three sets of tie-beams, referred to as *"cross walings"*, whilst two pairs of *"cross braces"* reinforced this. These subsidiary elements were each of a cross section of 12 inches (0.3m) x 6 inches (0.15m). Against the outer sides of this framework two parallel sets of horizontal timbers referred to as *"waling"* and of a cross section of 12 x 6 inches, were constructed. Driven hard against these, and at the same angle as the outer main piles, were the 'sheet piles' that formed the outer skin of the pier. These were of a size 12 inches x 6 inches x 24 feet (7.31m) long and were close-driven i.e. butted edge to edge. The only elements external to the sheet piles were two lines of outer waling – directly opposite the inner waling.

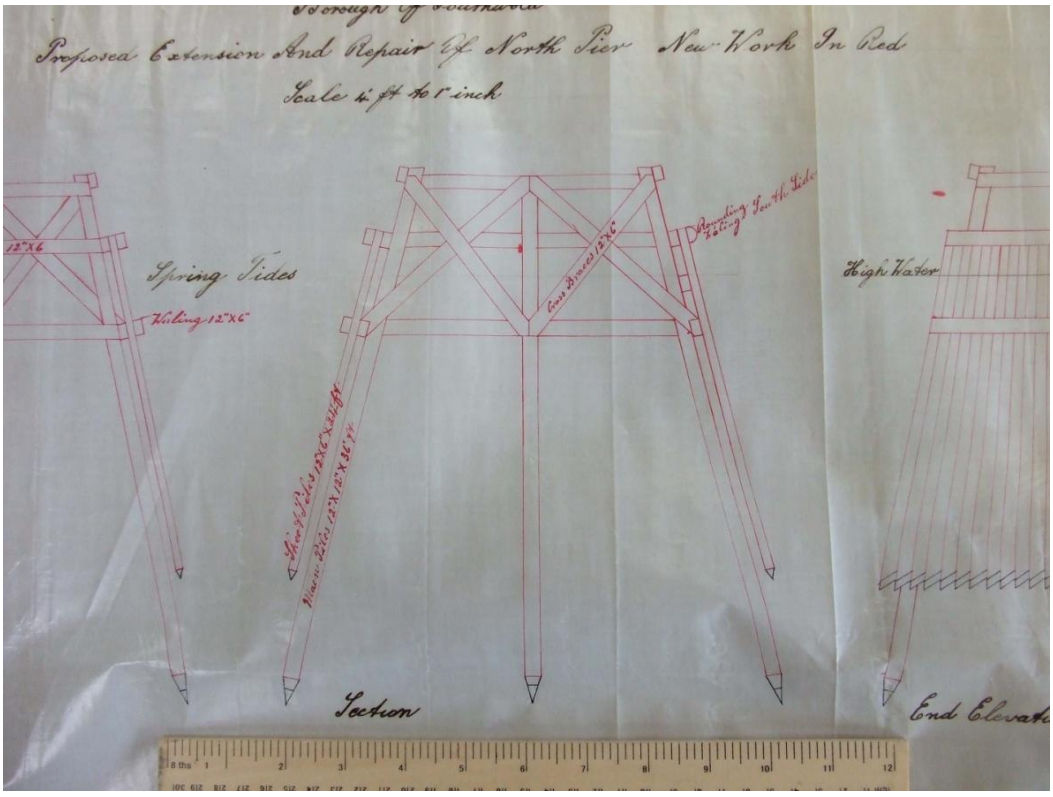


Figure 20, Southwold, section drawing of 1902 North Pier rebuilding (SRO 1312/6/8)

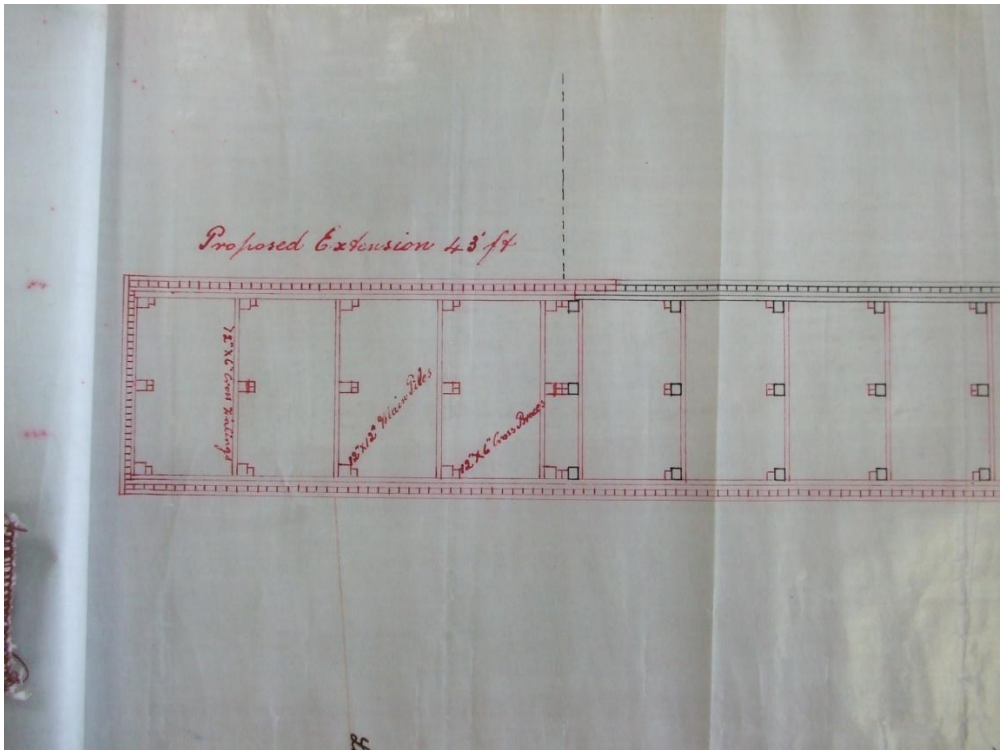


Figure 21, Southwold, plan of 1902 North Pier rebuilding/extension showing bay divisions (SRO 1312/6/8)

Figure 22, Photograph of rebuilding of Southwold North Pier, early years of 20th-century. Looking West (copyright Southwold Museum)

The early 20th-century rebuild of the piers at Southwold can be seen as something of a hybrid. The three lines of ‘main piles’ together with the ‘cross walings’, ‘cross braces’ and ‘walings’ clearly form an earth-fast frame divided into regular bay units. However, the walls of angle driven close-piling being driven for some depth below the ground surface clearly formed something more than a mere cladding.

Since the 1930s the piers at Southwold have been built of steel and concrete. However, adjacent to the existing work a palimsest of posts and close-piled remnants of timber piers, seemingly dating from the older pier as well as that of the early years of the 20th-century survive, Figures 23 and 24.

Figure 23, Photograph of extant timber-built pier remains, Southwold. The existing south pier is to the left. Remains to the right relate to elements of the south piers originating in both the later 18th and 20th centuries. Looking East

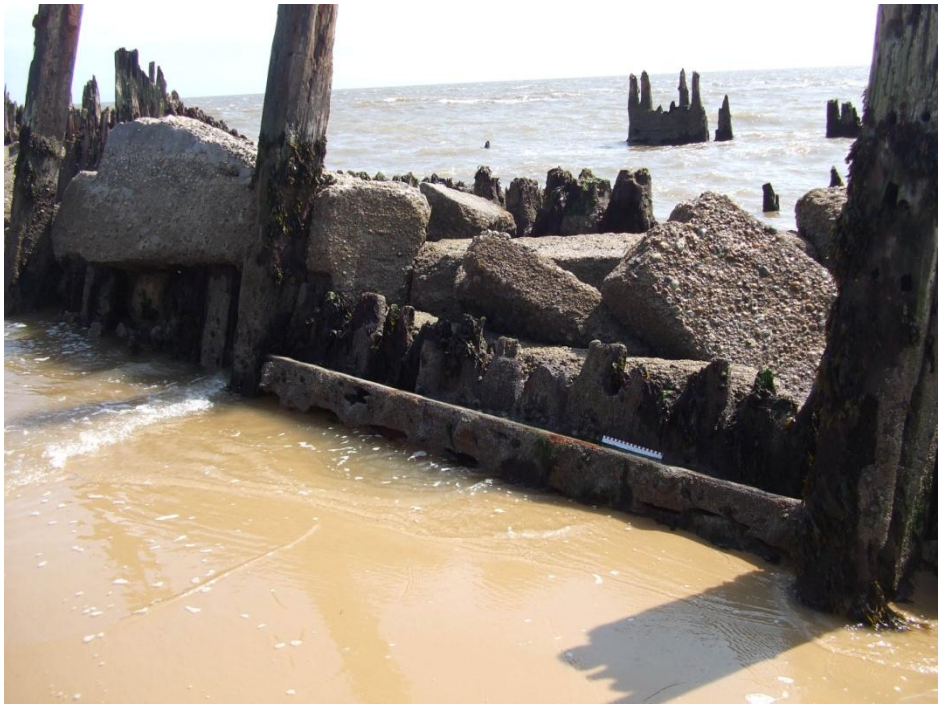


Figure 24, Photograph detail of extant pier remains, Southwold. In the foreground early 20th-century work of the north side of the south pier at its point of junction with older pier remains behind. Tall angle driven main piles can be seen. Between these are edge to edge driven timber sheet piles bolted between 'waling' to front and rear. The large blocks behind are in fact concrete with that directly behind the timber being cast directly against it. Looking South-east

2.4.4 Margate: early 16th-century – circa 1810

The earliest definite reference to a pier at Margate is in the late 1530s – early 1540s when the settlement is described in John Leland's 'Itinerary' as *"a village"* with *"a peere for shyppes, but now sore decayed"* (Leland, vol 4, 61). At what date a pier was first constructed at the town is uncertain. The pier is depicted in two versions of a map of north-east Kent of 1548 (Skelton and Summerson 1971, 48-9; British Library, Thanet.). These, and all later depictions and descriptions indicate that Margate always had just a single pier of slightly curvilinear form extending from the shore at the east, westwards into a small bay. A description of the pier from 1757 describes it as *"of timber and filled with chalk and stones in the form of a crescent"* (MPL Anonymous 1757).

There are few additional references to the pier in the 16th-century and these do not provide technical details (Cal. S.P. Dom. 1584a). Although there are more references to the pier in the 17th-century, these again tend to provide little technical information. One of these however, Item 26 of the 'Orders, Decrees and Rates' (Margate Pier), states that *"no Vessel shall moor or fasten any Rope or Fasting unto the Braces of the Peer"* (MPL Lord Warden 1693). The *"Braces of the Peer"* are unlikely to relate to anything other than a timber-built structure.

It is recorded in 1646 that the shoreline jetties, which formed a sea-wall protecting the town in the lee of the pier, were constructed of timber, whilst in 1724 the pier is also described as such (Lewis 1724/1736, 87). A depiction of both the pier and jetties was published in 1736 and this unambiguously identifies the structural characteristics of Margate's pier, Figure 25. The broad landward end of the structure is depicted as tapering to form a narrow slightly curvilinear pier, the head of which out-turns at an acute angle. The pier in this view does not have a wall of close-piling but appears to be of earth-fast frame type. Steeply angled posts are clearly shown, whilst behind these are walls of horizontal planks. These were presumably secured to vertical battens, with the latter being affixed to horizontal rails or beams extending between the posts. Two sets of ladder steps are evident close to the pier head, with another set on the inner face of the pier close to the landward end.

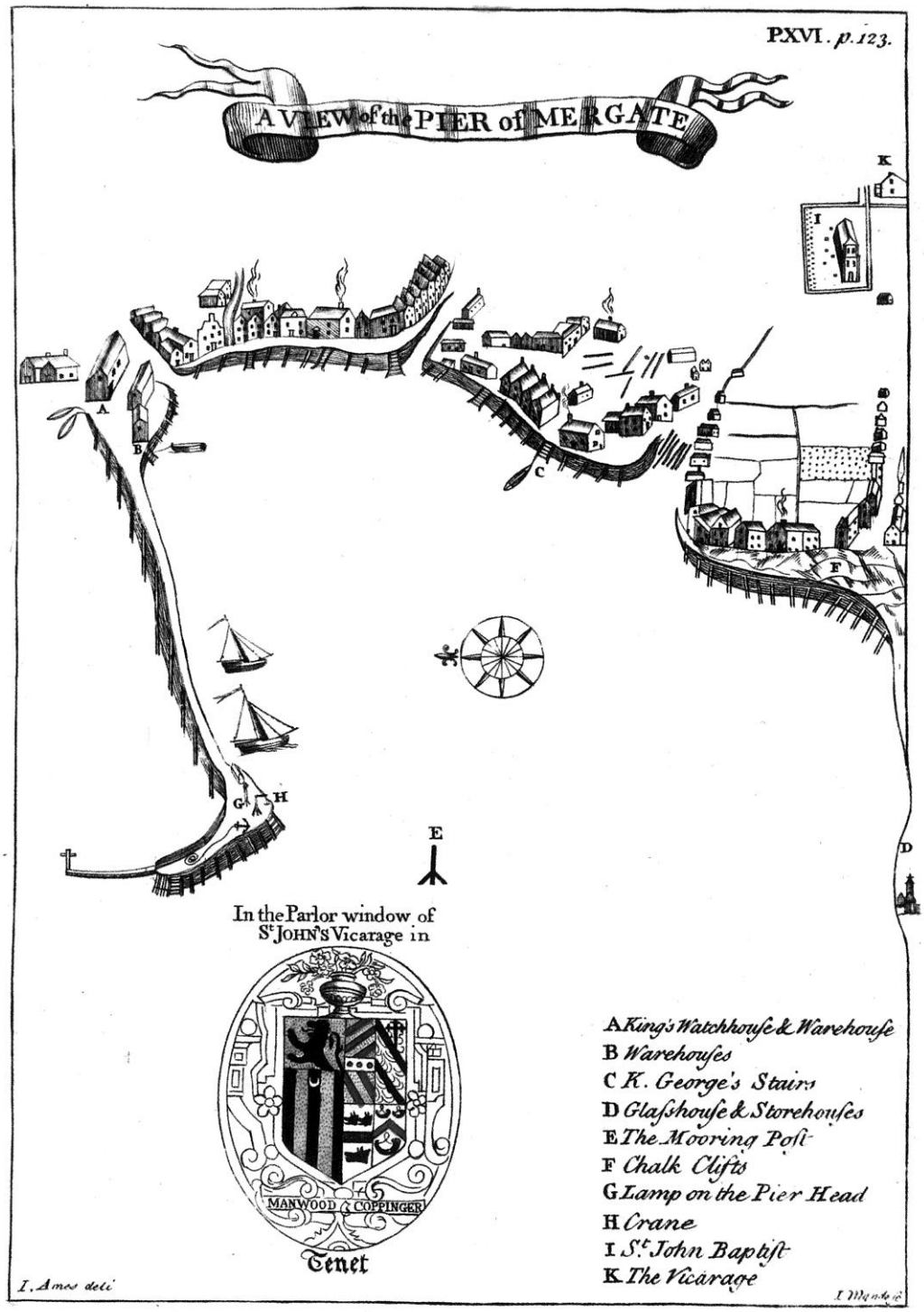


Figure 25, View of the pier and part of the town of Margate (reproduced from John Lewis's 2nd edition history of 1736)

Support for the structural interpretation of this view can be found in a detailed picture of 1790, Figure 26. The 1736 and 1790 depictions show close resemblances between the pier and shoreline sea-wall, the implication being that they were constructed along similar lines. The more detailed later depiction clearly shows the timber sea-wall to be constructed of planks set behind vertical posts. Lewis's view of 1736 shows this sea-wall as comprised of three sets of walling interrupted by three lanes running down to the shore. Several sets of steps are also shown extending from the tops of the sea-walls to the shore. There are a number of mid 17th-century documentary sources relating to carpentry options for replacing these sea-walls (J.H.L. 1647; Cal. S.P. Dom 1649; Cal. S.P. Dom 1650). It was estimated that 55 rods of work were required with 5.5 tons of timber being needed for each rod if carried out as single work, with so much more needed if carried out as double work. It is assumed that single work was comprised of vertical timber piles retaining a single plank wall, with double work being two such walls laid in parallel; presumably connected by tie-beams/braces and with an infill occupying the space between the walls. Such a structure would of course resemble an earth-fast frame pier.

Figure 26, The 'defended' shoreline west of the pier, Margate 1790 (British Library KTOP17 4-d)

There are a number of 18th-century references to the poor state of the pier. In 1766 the foot (lowest part) of the outward side of the pier was decayed, rotten and worm eaten for a distance of approximately 250 feet (76.2m) (MPL White undated). Apparently, this part of the pier had already been *"footed, double footed and patched"* and it was therefore proposed to widen this part of the pier at an estimated cost of £700-800. Later documentation informs us that much work was carried out, but this was destroyed by the sea a few months later (MPL White undated).

An Act of Parliament in 1787 provided the legal authority for taking down the old wooden pier (Act of Parliament, Margate, 1787). In actual fact, shortly after the passing of the Act an unsuccessful attempt was made to encase the timber pier in stone (Hasted 1800, 10, 312-355; Nichols 1793, 26). The scale drawing of 1811, Figure 27, indicates that the stone clad old pier was fractionally under 500 feet (152.4m) long and around 50 feet (15.24m) in width. The clad pier was badly damaged in a storm of 1808 and the all new stone pier was built shortly afterwards (English Heritage 2007, 70).

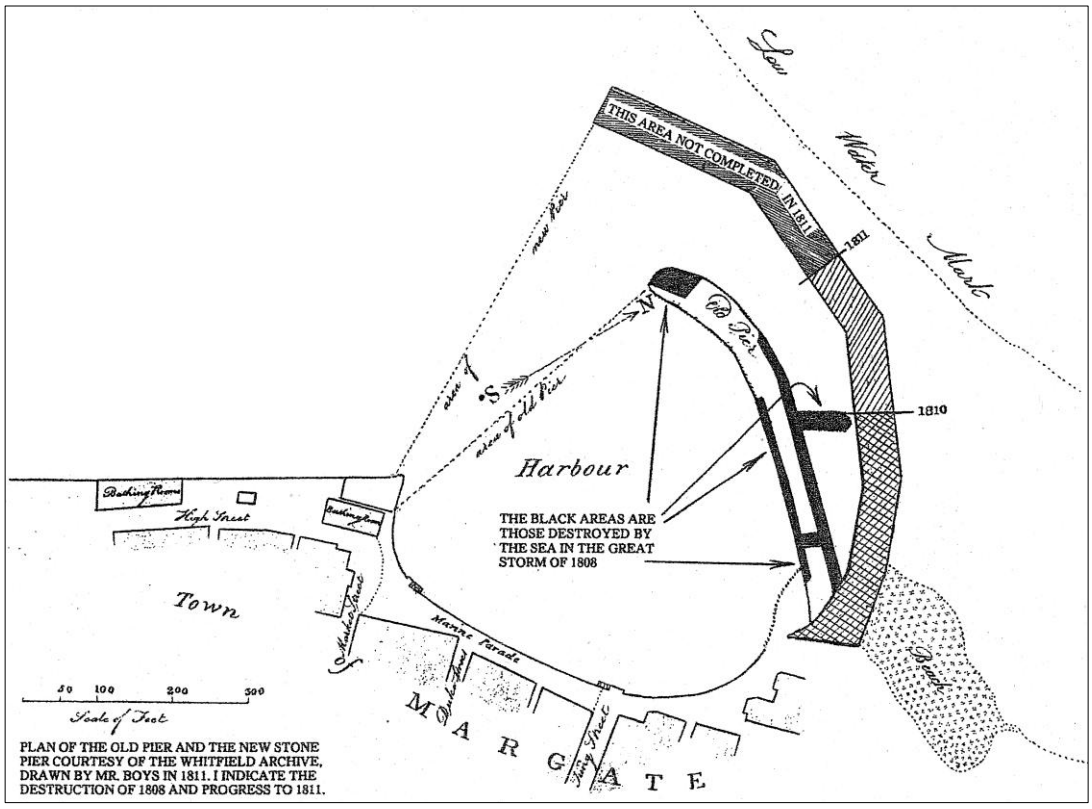


Figure 27, Margate. Boy's map of 1811 showing outline of smaller stone-clad timber pier and new larger stone pier beyond (reproduced from Twyman 2006)

2.4.5 Broadstairs: early 16th-century - present

The first indicator of a pier at Broadstairs is on maps of 1548 (Skelton and Summerson 1971, 48-9; Brit Lib, Thanet.). Although there is little documentary evidence for the pier in the 16th and 17th centuries legal agreements of the 1560s and 1580s do record the *"framing of timber etc. for the repair of the pier"* (Lewis 1736, 165). All available data indicates that Broadstairs had a single pier with a plan-form describing a gentle arc extending from the shore at the north, southwards into a small bay.

Our earliest indicators of the form of the pier come from a number of engravings, drawings and sketches dating from the later 18th to later 19th centuries and from records within a collection of 18th – 20th-century Pier Books. Figure 28, is a view looking southwards along the outer face of the pier at a low state of tide. This shows the outer walling to be of horizontal planking, this supported by several tie-plates probably affixed to an internal framework. Several timber-built groynes extend out into the sea from the pier wall and in places a number of small timber walls extend from groyne to groyne. The upper part of the outer wall forms a parapet above the pier deck. An opening in the parapet provides access via a small flight of steps to a low, timber-built pier-like structure with solid walls, apparently a breakwater known as the 'grid iron'. From here a further flight of steps lead to the shore.

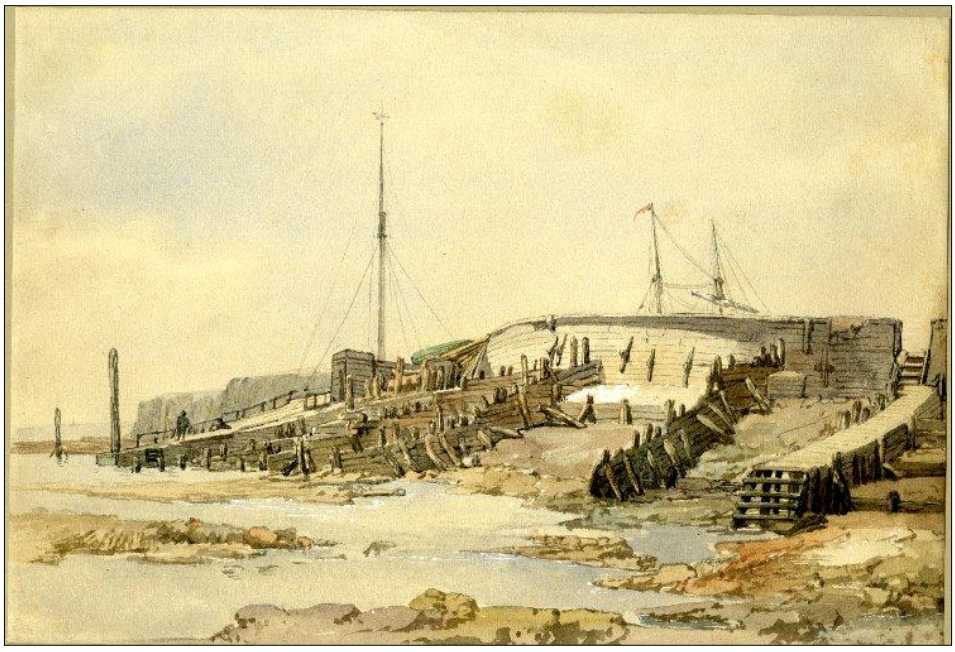


Figure 28, Mid 19th-century view of part of the outer face of Broadstairs pier, looking south. By George Clarkson Stanfield (source: British Museum: 1889,0603.262)

Figure 29, is a view of the head of the pier looking along its length and shows an unusual arrangement. The inner wall of the pier is clearly visible. This is of horizontal planking and appears to be strengthened by a number of tie-rod arrangements. Immediately to the right of the inner wall is a further wall set at a slightly elevated level. It is probable that the lower wall represents an 'added on' re-facing of the inner wall. Alternatively, this inner wall may be a parapet. The outer wall of the pier is also visible and although few details can be discerned groynes extend from this out into the sea. Perhaps the most unusual element in this view is the slipway extending from the pier top down to the sea, an arrangement which appears to be unique to Broadstairs.

Figure 29, Mid 19th-century view of part of the head of Broadstairs pier, looking north. (source: National Maritime Museum: 23646)

The most detailed description we have of pier works at Broadstairs is given in the report of an engineer, John Norrissey, in 1872 (EKA UD/BS (uncat.) Box 10 1870-1880). This letter recommends:

"that timber piles 12 inches (0.3m) *square should be driven outside of the present timber work 8 feet* (2.44m) *apart and secured at the tops by longitudinal timbers around 9 inches* (0.225m) *square of such length that each piece shall pass from the outside to the inside*

timber work and bolted on the main timbers two of the longitudinal timbers to be secured to each main pile, one at the top, the second midway down where the main piles have been driven, inside planking 3 inches (75mm) *thick to be placed against the piles on the inside, closely jointed and spiked thereto, as the planking is secured it is to be backed with solid chalk if this work be done I consider that pier will be well repaired".*

This letter is detailing a proposed method of repair to a damaged face of the pier. The intention was to drive a line of piles parallel to, and in front of, the damaged face, these piles being spaced 8 feet apart. Each of the piles was to be attached to the main body of the pier by two horizontal braces. Horizontal planking was then to be spiked to the inner face of the line of new piles. Finally, the space between the new wall of piles and planking and the body of the damaged pier was to be in-filled with chalk. In effect, part of the old pier was being re-faced. It is probable that this system of earth-fast frame repair broadly mirrored the form of construction of the pier. What looks like a similar kind of repair can be seen in Figure 29.

A view of damage at the pier in 1897 is shown in the photograph, Figure 30. Here, a crowd are stood on the head of the older part of the pier and the timber work in the foreground is the remains of an 'added on' east – west aligned pier end. Cartographic and pictorial evidence suggests that this addition was probably of mid 19th-century date. The photograph indicates that this was of earth-fast frame type, seemingly a complex one in which there are six parallel lines of driven posts across its width. Strewn around the remnants of the frame are what appear to be the spread remnants of its stone infill.

Figure 30, Broadstairs. Pier frame exposed by storm damage, 1897. (reproduced from: Simmonds 2006)

Maps of the mid 19th to later 20th centuries show changes to the pier in the recent past, Figures 31and 32. The earlier maps show the pier to have been much narrower than today and on its eastern side a series of short, close spaced breakwaters were arranged. The length of the pier can be seen as around 100m and its width around 9m. At the head of the pier the east-west extension is present. The rebuilding of this extension after the destruction of 1897, in a slightly different form, directly overlay several of the breakwaters. Later maps show the pier to have been progressively widened.

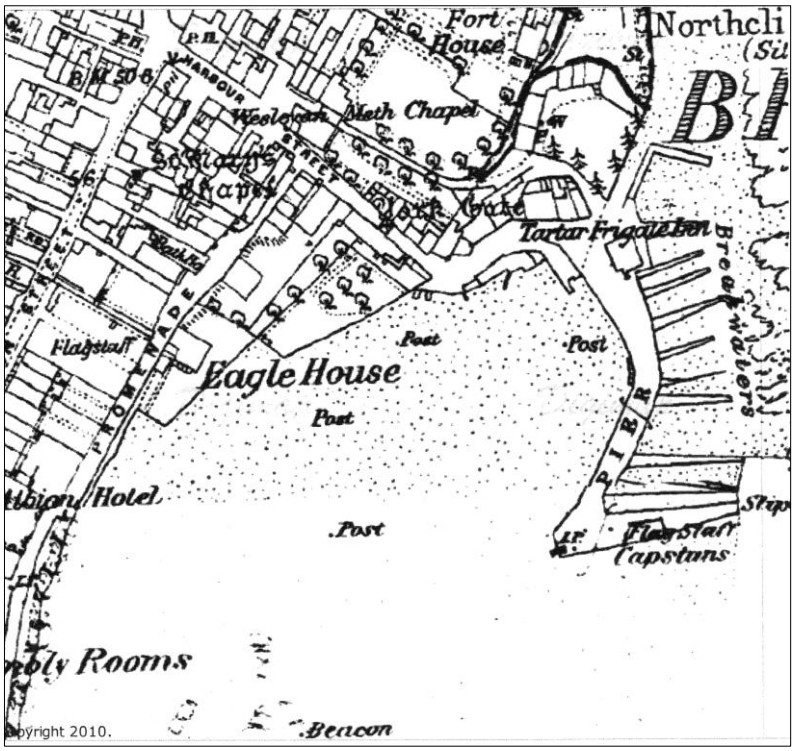


Figure 31, Ordnance Survey map of Broadstairs pier, 1870s (source: Edina)

Figure 32, Ordnance Survey map of Broadstairs pier, 2010 (source: Edina)

Site inspection shows that the 1870s map line of the old eastern limit of the pier is presently marked by a narrow, slightly angled wall. This is built in sections defined by

steel stanchions between each of which the walls are of concrete cast between planked shuttering, Figure 33. As well as marking the old eastern limit of the pier the concrete walling resembles the parapet shown in Figure 28. The existing arrangement accurately reflects the old arrangements, but in modern materials. Site inspection also confirms that a small stretch of timber-work, albeit of 20th-century date, survives on the inner face of the pier towards the head, Figure 34. This is seemingly the last piece of 'active' timber-built seacoast pier on the east coast.

Figure 33, Broadstairs. Photograph detail of elevated walling (in position of former outer face of pier) now in concrete

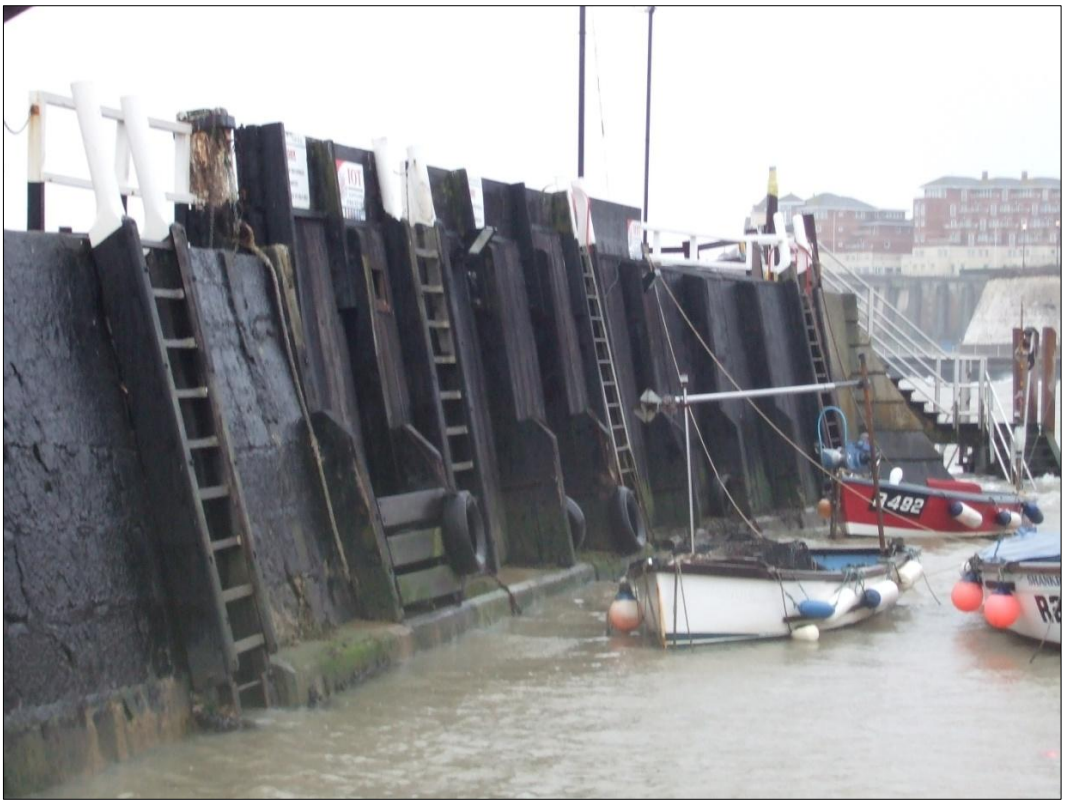


Figure 34, Broadstairs. Photograph of timber to inner wall of pier adjacent to head

2.4.6 Dover: 1535 - later 19th-century

Although undoubtedly serving as a port since prehistoric times the first definitive record of a pier at Dover was one constructed of stone in the earliest years of the 16th-century (Colvin 1982, 729-731). An altogether more ambitious scheme of timber-built piers within the context of a large state sponsored project was begun in 1535 and continued in development until the 1550s (Colvin 1982, 731-755). Beset with severe environmental difficulties the Henrician works at Dover were regularly adapted and added to in attempts to counter altering environmental conditions. The final mish-mash form of the protracted harbour works is shown in Figure 35.

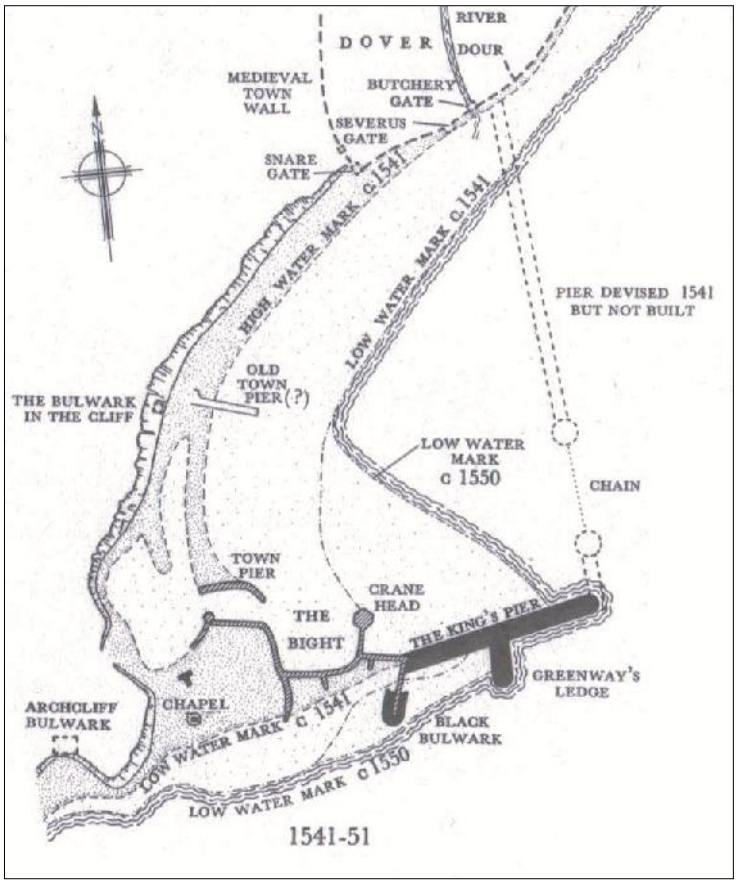


Figure 35, Modern plan of the Henrician pier works at Dover 1541-51 (reproduced from Colvin (ed) 1982)

The bare bones of the Henrician technique of pier construction at Dover was described by a near contemporary chronicler as being:

"compiled of two rowes of maine posts, or great piles of five or six and twentie foot long, set at each side clost together, which were let downe and put in certeine holes hewed in the great rocks, laid for that purpose: but some of those piles were shod with iron, and driven into the maine rocke of chalk, with a great engine called a ram. These posts and piles were combined and held together with iron bolts, and were filled with mightie stones of chalk as also with beach, and other earth: but the bottome (i.e. foundation) *consisted altogether of great rockes of stone, which if they had not beene brought thither by a speciall devise, must needs have beene extreame chargeable: for manie of them were of twentie tun a piece, and few under"* (Scot 1587).

This is a critical description with the structure of the pier itself described as comprised of two rows of clusters of close-spaced piles set within holes in a purpose laid bedding of rocks. Some of these piles, shod with iron, were driven below the bedding and into bedrock below, presumably for additional stability. The posts and piles were then joined together with timbers secured by iron bolts and the pier fiinally in-filled with ballast. However, a foundation of great rocks is also described. It was necessary to provide this bedding into which piles could be set because of the depth of water and the high tidal range at Dover. In other words the relative shortness of the timber (up to 26 feet long (fractionally under 8m)) could be overcome by the provision of a foundation. Reference to such a foundation is to date unique to Dover. The foundations were constructed by attaching large floats to rocks amassed on the shoreline at the low water mark with chains. Upon the rising tide the floats and rocks were towed to the site for deposition and there released (Lyon 1813, 155-6). Finer manoeuvrability could be gained at the deposition site by the use of cranes.

There are a number of depictions of the Henrician harbour of Dover harbour. Figure 36 shows the state of the works as they appeared around 1540 and gives a good technical impression of the general character of the piers. The pier walls are steep-sided and the toes of these lie within the foundation of deposited stone, effectively utilising it as rock armour. There is a low parapet to the top of the walls and regularly spaced upright timbers appear to form bay divisions. The timberwork between the uprights is of horizontally lain planks whilst angled uni-direction bracing extending from upright to upright is evident to the exterior of each bay. Other near contemporary depictions show the internal ballast of stone and later additions of stone filled timber-built groynes to the outside of parts of the piers.

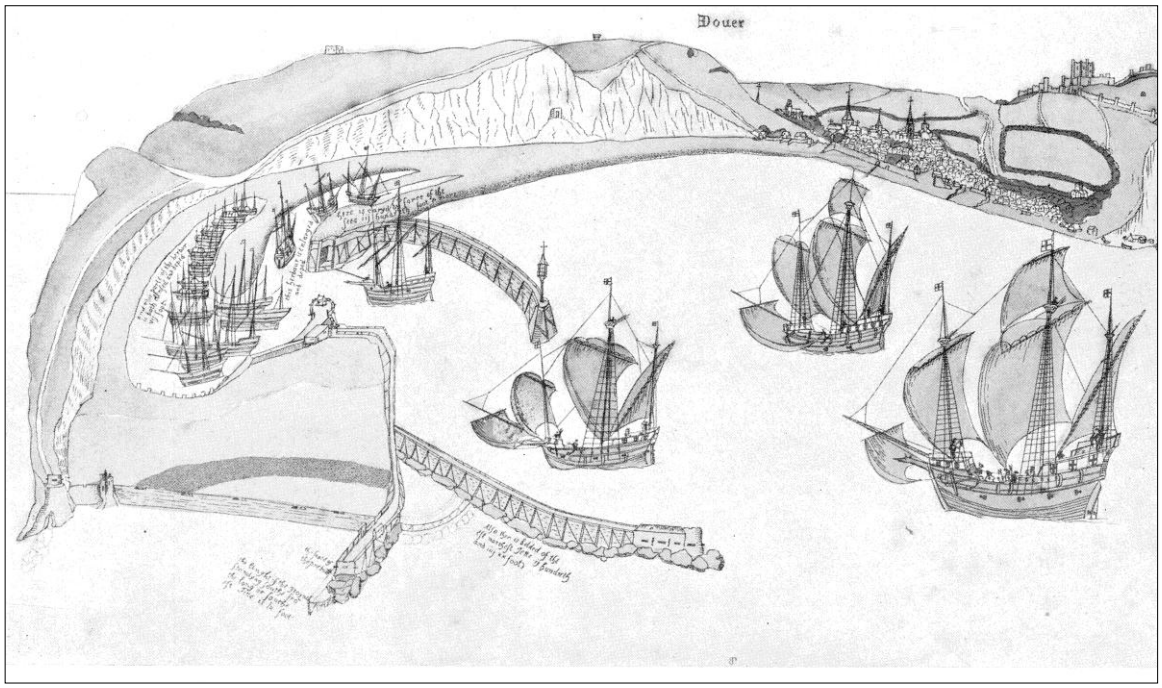


Figure 36, Dover harbour c.1540. (reproduced from Minet, 1922)

The Flemish artist Anton Wyngaerde drew a view of Dover harbour as seen from the sea and this is again likely to date to some time around 1540, Figure 37. The pier works are shown as ongoing and provide some technical detail. The southern (left) end of the pier can be seen as an empty shell yet to be filled with ballast. What are almost certainly principal vertical timbers are visible and these are laterally connected to one another by large tie-beams. To the outer face of the pier walls some vertical timbers are present whilst between these are what appears to be horizontal planking.

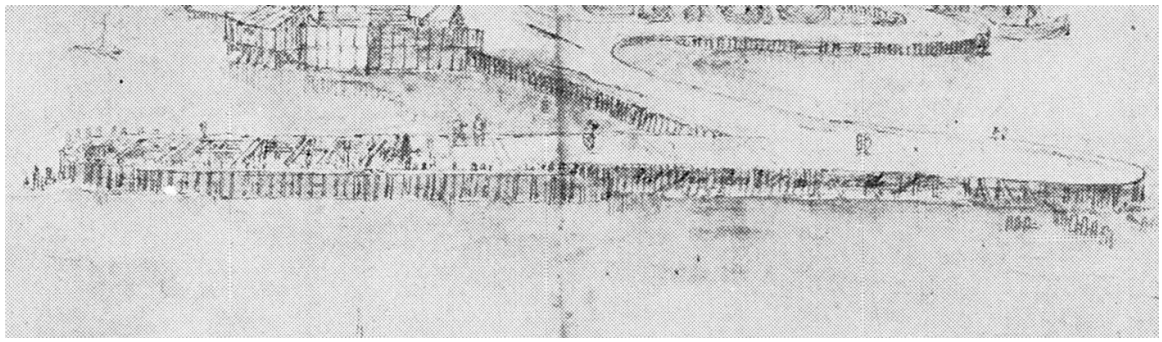


Figure 37, Extract from Anton Wyngaerde's 'Dover from the Sea' c. 1540 (reproduced from Minet 1922)

The prevailing environmental conditions at Dover (see 3.2.6) resulted in the Henrician works becoming a costly failure. An altogether more successful scheme was brought to fruition between the early 1580s and later 1590s (Ash 2000). Such was the triumph of these works that the essential layout of Dover's harbour remained largely unchanged until the later 19th-century. The best known elements of these Elizabethan works at Dover, the long seaward wall and cross-wall of the inner harbour known as the Great Pent were constructed of a mix of earth and stone rather than timber. However, timber-built piers did form the entrance to the harbour. These can be seen in Figure 38, which dates to 1595, a time by which the Elizabethan works had more or less been completed. Interesting details within this plan are walls of posts with horizontal planking between, lateral tie-beams and internal rows of longitudinal timbers.

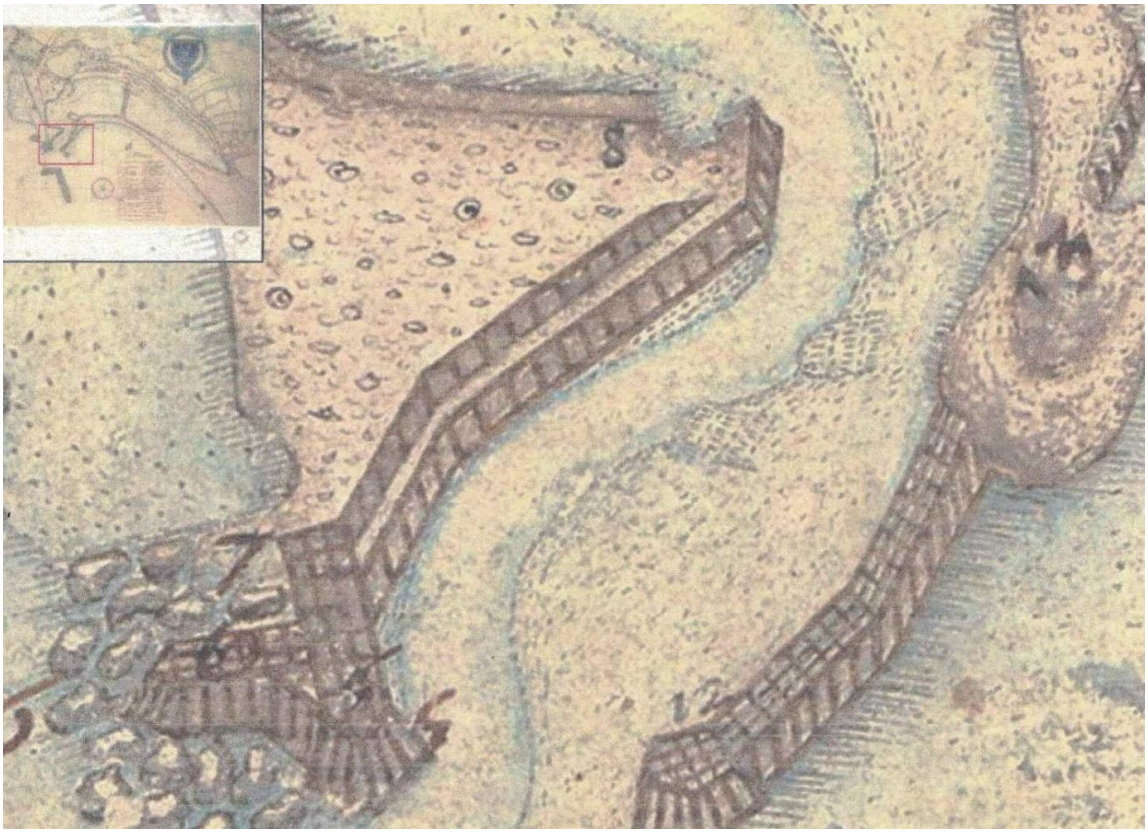


Figure 38, Detail of the piers of Dover harbour in 1595 by Thomas Digges. (full plan in inset) (British Library: Cott Aug I.i.46.)

Within the 16th-century an island pier was constructed immediately outside the harbour and a depiction of 1661 shows this to have a timber-built pier superstructure, Figure 39. In all likelihood it provided a deep water mooring for larger ships unable to gain entry to the harbour under certain conditions of tide. This feature is absent in 18th-century maps and was presumably lost by this time.

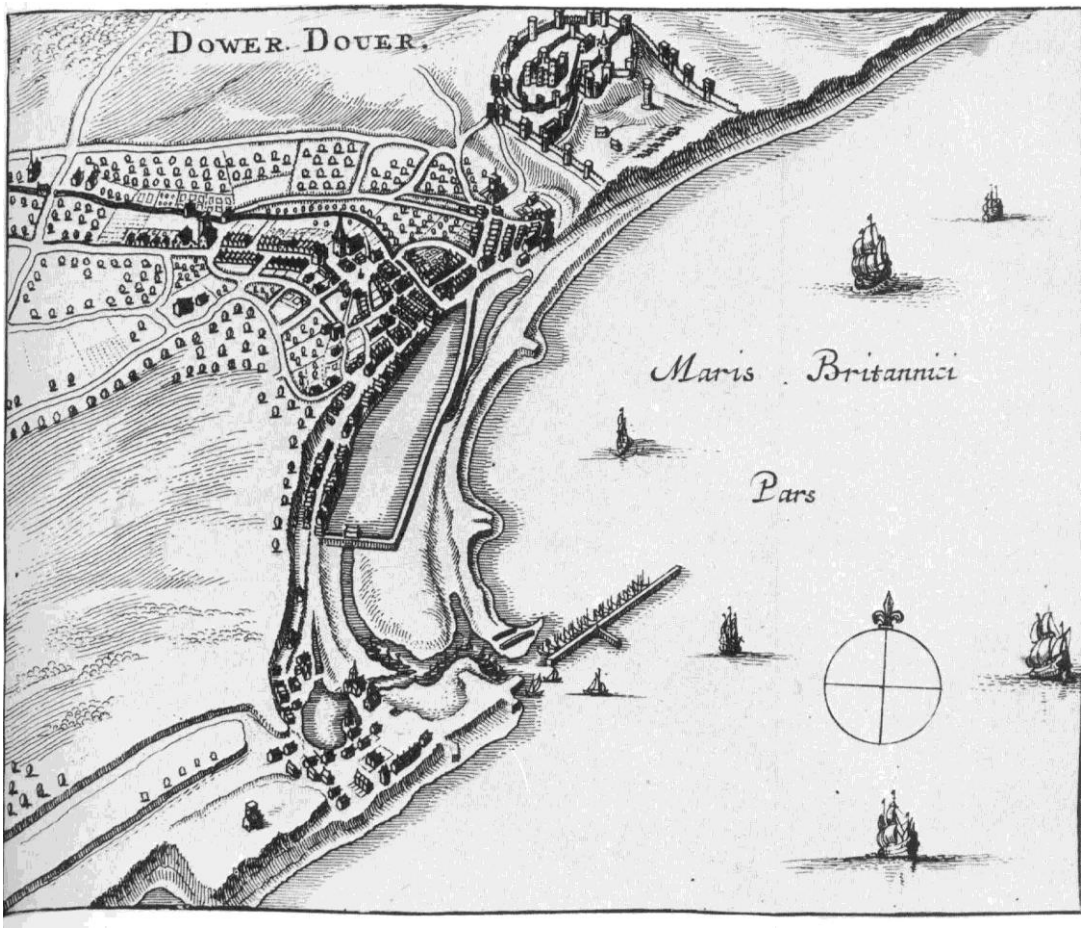


Figure 39, Dover Harbour, 1661, by Rutger Hermannides. The form of the Elizabethan harbour remained little changed until the later 19th-century. (Britannia Magna (1661))

There are references to extensive repairs, rebuilding and reconfiguration works to the entrance piers of Dover harbour in the 17th, 18th and 19th centuries by which time their Elizabethan form was largely lost (J. H. L. 1646; Leach 2005). They continued to be of timber construction however and are shown in a number of 19th-century depictions, Figures 40, 41 and 42. The walkways can be seen to be of longitudinally lain planks

whilst parts of the internal stone ballast can also be seen in Figure 40. The walls of the piers are shown to be comprised of steeply angled timbers which John Smeaton described in the 18th-century as piles and which were probably of square section (Smeaton 1769). Horizontal rails can be seen to be present to the exterior of the walls. Figures 40 and 41 show the walls of the piers to rise up above the level of the walkways thereby forming a safety parapet capped off with large baulks of timber. Bracing between the parapet and walkway is also evident in Figure 40. At the head of the south pier a small, tall, timber-built lookout can be seen. The flag apparatus affixed to this was used to signal when access to the harbour was possible by vessels of larger draught.

Figure 40, View of the head of the south pier, Dover, early 19th-century looking south-east (National Maritime Museum: PU 7779)

Figure 41, View of the pier heads at the entrance to Dover Harbour in 1851, looking south (National Maritime Museum: PUO 982)

Figure 42, Pier heads at Dover harbour in the 2nd half of the 19th-century by William Wyllie, looking north. (National Maritime Museum: PU 9038)

2.4.7 Folkestone: 16th? – early 19th centuries

There are several mid – late 16th-century references to the harbour at Folkestone though a pier is not specifically mentioned until the earlier 17th-century (Mackie 1856, 27, 48; Mackie 1883, 268; Jenkins 1876, lxxvii). A *"stade"* is also mentioned in the later 16th-century (Mackie 1856, 27, 48). This stade was an area of gently sloping ground immediately above the high water mark upon which boats were drawn by capstans. Both stades and piers were intended to provide security from the sea, with stades generally being utilised in the absence of a pier. However, at Folkestone it known that from the earlier 17th-century, at least, there was a small timber-built pier-like 'jettee' system used in combination with the stade.

The first specific reference to a pier is in 1629 when the town was petitioning for permission to build a new *"peare and harbour"* (Cal. S.P. Dom 1629a). It is stated that two named individuals *"had with others assisted to take up the timber of the old pier or head"* this implying the presence of a pier prior to this date (Cal. S.P. Dom 1629b). An order from the corporation of 1654 suggests that any pier/s that may have been built in 1629 had now become the subject of occasional thefts of materials *"the said heads, by daylie experience, it is found, are very usefull and helpfull to preserve the stade of the said towne: and that of late time divers persons, not well considering the use and benefit of them, have taken away many stones, rockes and other materials from the same, which in time of necessity must inevitablie be the overthrow of the said stade"* (Mackie 1856, 63).

A multi-jettee system of piers developed at Folkestone and in 1703 it was intended *"that the fixing of 3 works between high & low water mks to be made with timber and stones"* (EKA AM1/2 1703). A petition of 1766 describes *"Large jettees or Heads, one at the East, and the other at the West end of the town"* i.e. to either side of the stade (J H C 1766, 544).

Suggestions regarding the technical form of the jettees can be made on the basis of cartographic, pictorial and documentary evidence. The earliest cartographic depiction of a jettee is in a plan of 1782, the structure being around 150 feet (45.7m) long and located to the west of the Pent, a stream that flowed into the sea adjacent to the stade (Wilson, 2001). A more detailed picture of the jettee system is shown in a plan dating to around 1806, Figure 43. Intended to show proposals for a large stone harbour at the town, this

illustrates the then existing arrangements on the foreshore, including three jettees as well as the outflow of the Pent. The jettee to the east of the Pent and that to its immediate west are indicated by double rows of posts, the jettee to the extreme west as a single row. All the jettees appear to be of short length, not even extending to the low water mark.

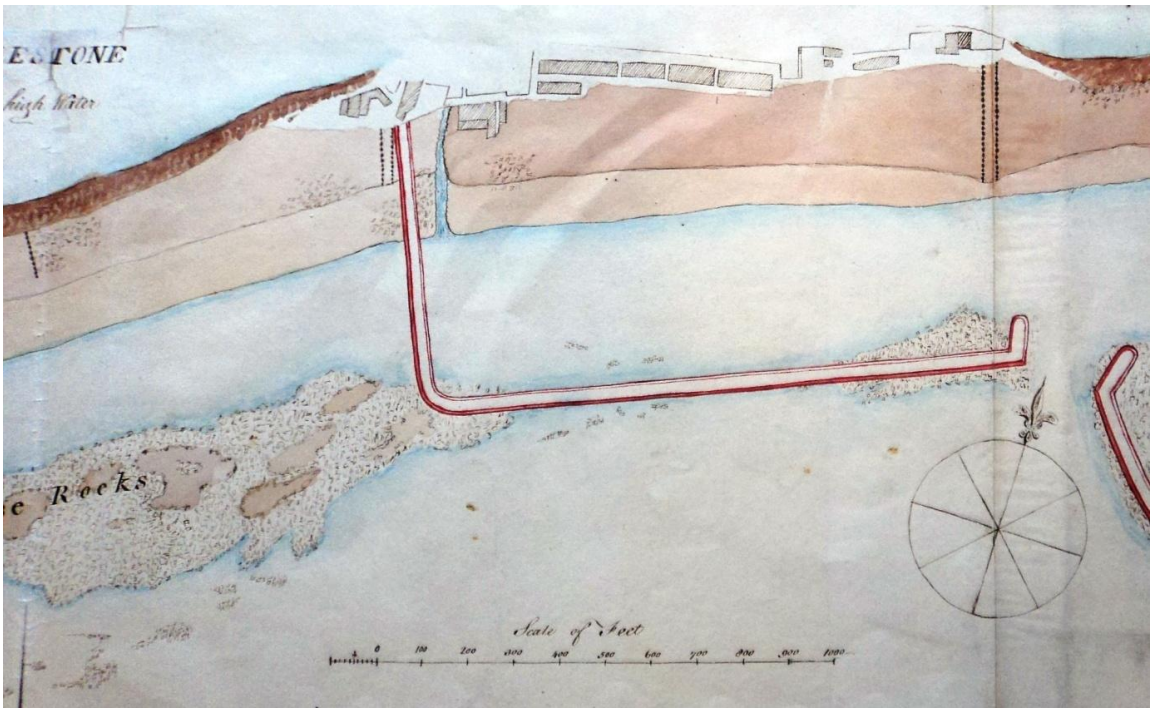


Figure 43, Folkestone. Extract of plan c. 1806 by William Jessop and showing three timber 'jettees' and the mouth of the Pent. North is indicated. The Stade lies between the double post row jettees. (Folkestone Public Library)

A fairly clear idea of the nature of the Folkestone jettees is provided by a later 18th-century picture that shows the stade, foreshore and lower part of the town, with jettees to either side of the stade, Figure 44. Identifiable elements of the jettees include posts with horizontal planking behind, whilst an upper horizontal timber is also present. A considerable concordance of the physical characteristics of the jettees to that of a nearby shoreline revetment is evident in a view of 1790, Figure 45.

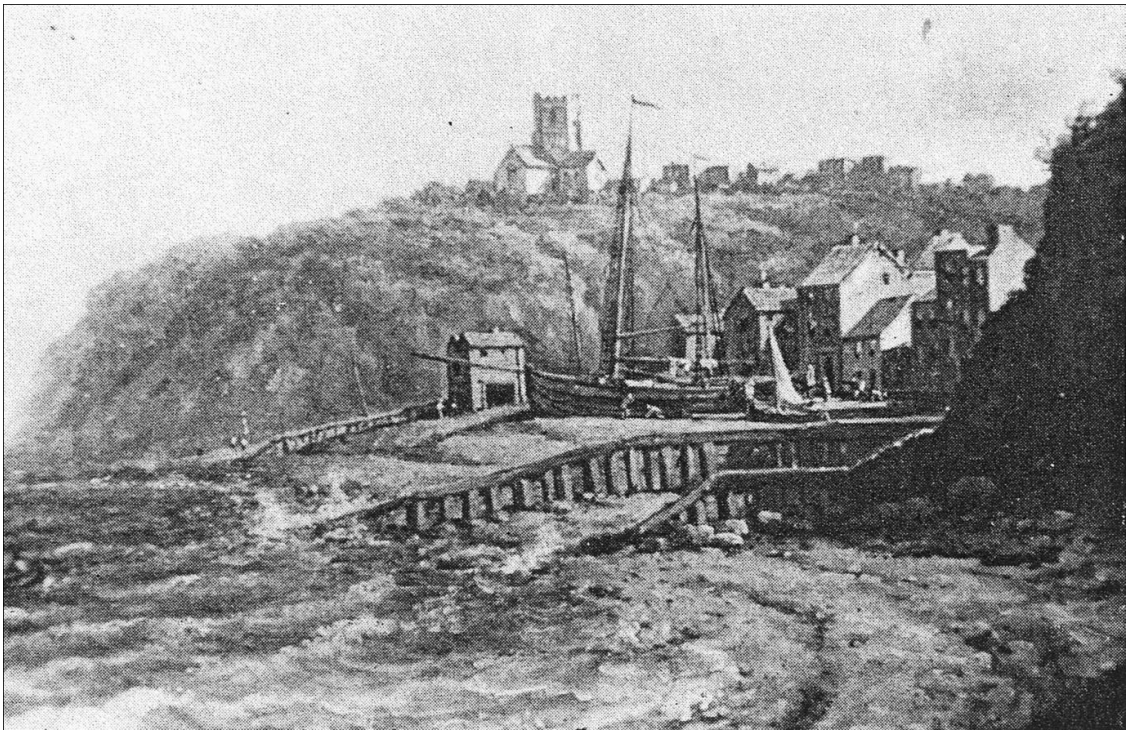


Figure 44, Folkestone. West Cliff and the Stade c. 1785 showing jettees (reproduced from Bishop 1973)

Figure 45, Folkestone. View near the Stade, looking east. Note the timber revetting work comprised of posts with horizontal planking behind. 1790 (British Library: kotp XVI, 55e)

A series of accounts, spanning the 18th - early 19th centuries, known as 'Jettee Books' list just four types of timber employed: posts, cells/sells, braces and 3 inch (75mm) plank (EKA Fo/AUj1/1; FUj1/1; FUj1/2). The posts were vertically set opposed pairs of driven piles. The cells/sells appear likely to equate with a type of sill/s. However, rather than serving as basal foundations they probably functioned as horizontal timbers secured to the inner sides of the posts. Figure 44, also shows that horizontal timbers extended along the top of the jettees. The braces are likely to have formed lateral ties whilst the 3 inch plank would appear to have been affixed to the inner sides of the posts and have functioned as a facing. Whether or not the jettees had a decking is uncertain. There is very little direct reference to stone as infill within the jettee books though such is described at earlier dates.

There appears always to have been a minimum of two jettees, one to either side of the stade, and occasionally others beside. The small scale of the jettees is indicated by several factors. Firstly, their cost is very small compared to the thousands of pounds generally expended at pier sites. As late as 1799 for example an entirely new jettee was *"computed will cost upward of £500"* (EKA Fo/AUj1/1). Secondly, documentary evidence from the earliest years of the 18th-century, as well as the plan of 1806, suggest that the jetteess generally extended little beyond the low water mark (EKA AM1/2 1703). Thirdly, the length of the timber posts forming the vertical members of the jettees were never more than 13 feet (3.96m) long. Given that a proportion of this length will have been driven into the ground it is probable that only 9 feet (2.74m), or less, stood above ground level. Given the mean spring tidal range in this locality of between 6 – 7m, then any parts of the jettees towards the low water mark must have been submerged at high water. These points indicate that the jettees were related as much to anti-erosion measures and protecting the stade as they were to providing a safe haven for vessels within pier walls.

2.4.8 Rye: mid – late 18th-century

Rye was a port of some significance throughout the medieval and post-medieval periods with the town being reached from the sea via riverine channels (VCH 1937, 39). In an 18th-century scheme involving the cutting of an artificial channel from the town to the sea a twin pier arrangement was erected (Meryon 1841; Smeaton 1763, 105-6; Skempton 2002, 522). Initially constructed of stone these piers were heightened and extended in

timber. No contemporary description of the timber piers is known and plans of the period are of insufficient scale to provide any structural detail. However, some material remains do survive, Figure 46. Both piers were comprised of regularly spaced vertically driven piles of square section, mostly spaced less than 1m apart and for the most part arranged in three parallel rows. Both piers were of earth-fast frame type. Given the relatively close spacing of the vertical piles, the remainder of the walls were in all probability comprised of either horizontal, or vertical, planking affixed to the piles by longitudinal wales. The inner rows of piles suggest the likely presence of both cross-waling and cross-braces for the purposes of lateral stability. The presence of an adjacent and unlimited supply of shingle raises the likelihood that this was utilised as an internal ballast within the piers.

Figure 46, Rye. Photograph of the mouth of the 18th-century harbour between two pier extensions of timber, looking south-east (later groynes also present) (Photograph reproduced from ASE 2008)

2.5 Piers with a free-standing frame

2.5.1 Filey: 16th? – 17th centuries

The first specific indicator of a pier at Filey is provided by Lucas Waghenaer's pilot book and chart of 1588, Figure 47 (Waghenaer 1588). By the 1630s it was recorded that Filey's *"ancient pier is defaced and ruined"* (Cal. S.P. Dom. 1637). Although there are depictions on two further charts, (British Library 1; Bleau 1625), two associated place-names (Old Quay Rocks and Quay Hole) and a handful of documents that refer to the pier, none of these sources inform us of the nature of its construction.

However, the material remains themselves provide clues that permit an interpretation to be postulated, Figures 48, 49 and 50. The mass of stone known as Old Quay Rocks is located some 70m south of the west central portion of the southern cliffs of Carr Naze at a height fractionally above that of mean low water. The remains consist of a slightly curvilinear concentration of boulders and stones aligned approximately north-east to south-west. These measure around 28m in length and have a core width of 4.5m – 6m, with a less concentrated spread a few metres to either side of this. At their north-east end the remains have a height above the immediate surroundings of approximately 1.3m, this height tailing off progressively towards the south-west end where the remains stand little above 0.5m. The boulders have a maximum size of 1.3m (in any direction) most being somewhat smaller than this and are of types local to Carr Naze together with a number of what are probably glacial erratics. No coursing or ordered laying of the boulders is apparent. The north-eastern end of the remains lay directly over bedrock, the remainder on/within sand beneath which the bedrock extends. No timber remains or postholes have been observed at this site.

It is considered highly unlikely that the remains at Old Quay Rocks form the remnants of a stone-built pier. The jumbled characteristics of the stone remains themselves, as well as the tradition of timber-built piers on the east coast, argue against this. The construction of pier walls of close-piling may have been difficult on a bedrock site such as this as it would have required the cutting of deep, continuous trenches that may never have provided the stability of driven piles. An earth-fast frame may have been easier to construct but even this would have had similar attendant difficulties. Perhaps the most suitable method of constructing a small pier with an internal ballast of stone in such a location would have been one comprised of one, or a series, of connected timber boxes. Such boxes may be regarded as forming a freestanding frame. Such a form of construction must be considered speculative although technical parallels for such an

arrangement may be found in structures such as the 12th – 13th-century medieval dock at Southgate, Hartlepool (Young 1987).

Figure 47, Extract of Lucas Waghenaer's chart of part of the east coast of England of 1588. Filey and its pier are to the centre, piers are also depicted at Bridlington, Flamborough and Scarborough. A navigation aid is depicted at the end of the Brigg. North is towards top right. (National Maritime Museum: PBD8264(25))

Figure 48, Filey. Old Quay Rocks, between tides, looking S.W.

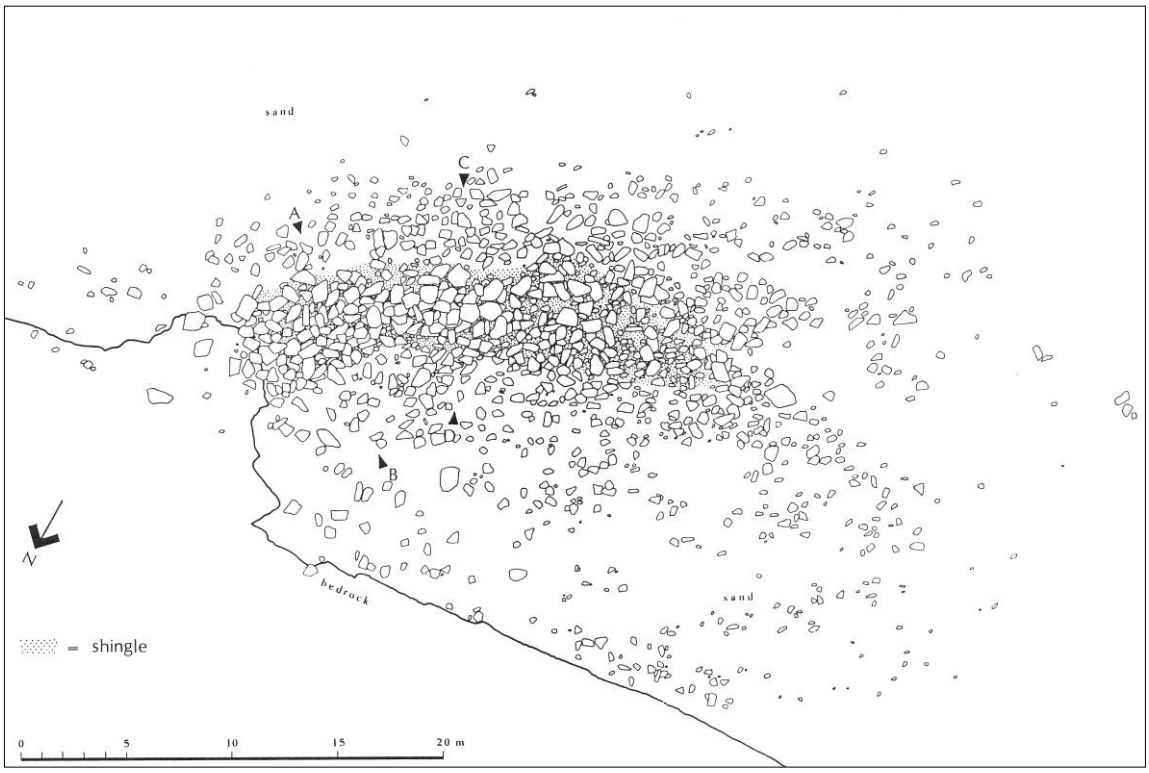


Figure 49, Plan of material remains, Old Quay Rocks, Filey (from Johnson 1998)

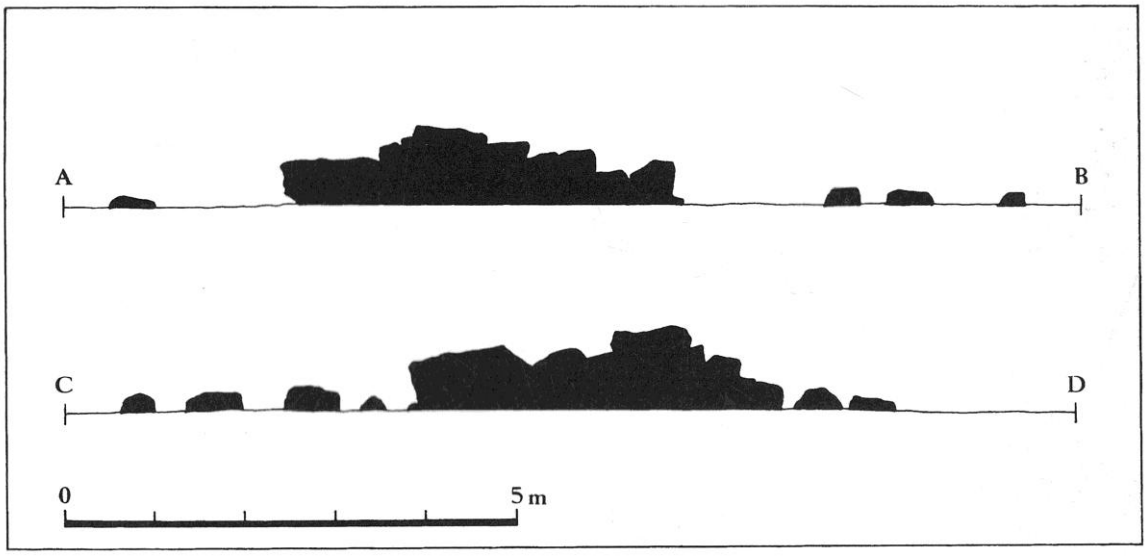


Figure 50, Profiles across Old Quay Rocks, Filey (from Johnson 1998)

2.5.2 Flamborough: early 15th? – early 17th centuries

The first mention of port facilities was in 1400-01 when Robert Constable, the Lord of Flamborough, bequeathed £40 for the maintenance of one *"kay"* in the sea (Test. Ebor. 1836, 264-5). It is again referred to in 1473 (Cal. Pat. 1473a) whilst in 1531 the Lord of the Manor, reaffirmed his accustomed right of way between his two manors, in particular for carts carrying timber to repair the pier (YSCP III 1914, 25).

A series of documents and accounts dating from the later 1540s to 1570 provide important information regarding programmes of what was probably repair, rather than rebuilding, of the pier. The most informative of these are Exchequer accounts that detail works carried out in the first half of the 1540s (TNA E/101/463/17; 18; 19; 20). These refer to the work of carpenters and labourers, the latter commonly recorded as *"karyng stones"*, probably internal ballast. There is also regular reference to the carriage of timber to the site. Although precise technical details are scant there is reference to *"emendyng the slot lockers and heyd"*, this particular task perhaps refering to repairs to individual bay units and the pier head. A lease of the manor and pier of 1570 makes reference to timber, walls and *"rommes"* (bay divisions) of a proposed new pier (TNA E310/29/173). This intended pier was to have eight feet of water at the pier head during a neap tide and as such will have been dry at low water.

The first cartographic evidence for the pier complex at Flamborough is provided by Lucas Waghenaer's chart of 1588 (see Figure 47), though it also appears on charts of 1595, Figure 51, and 1625 (Waghenaer 1588; British Library 1; Bleau 1625).

Figure 51, Extract of manuscript map of 1595. Flamborough Head is bulbously depicted. The pair of piers directly to the south of the head are at Flamorough whilst south of this lie Bridlington's piers. A pier is also shown at Filey to the north side of the bay above. The piers at Scarborough and Hornsea are depicted at the extreme north and south of the map respectively. North is towards top. (British Library, Royal. MS. 18. D. 111, f.63)

The plan, Figure 52, shows the features that collectively form the material remains at South Landing, Flamborough. These are located between the high and low water marks and lie on and partially in a ground surface made up of sand and shingle with an underlying chalk bedrock that in places breaks through to the surface. The remains consist of three clearly discernable features, numbered from north-east to south-west as 1 to 3. Each is made up of clusters of a large number of stones/boulders of varying concentrations. F1 is basically a loose scatter of boulders, whilst detectable spatial patterning is observable in the more concentrated cluster of F2 in the form of a deeply embedded circular shaped feature at its northern extremity, and particularly so in F3 where two almost parallel rows of large boulders predominantly set on their sides are evidenced, Figure 53. No exposed timber or postholes have been observed at the site.

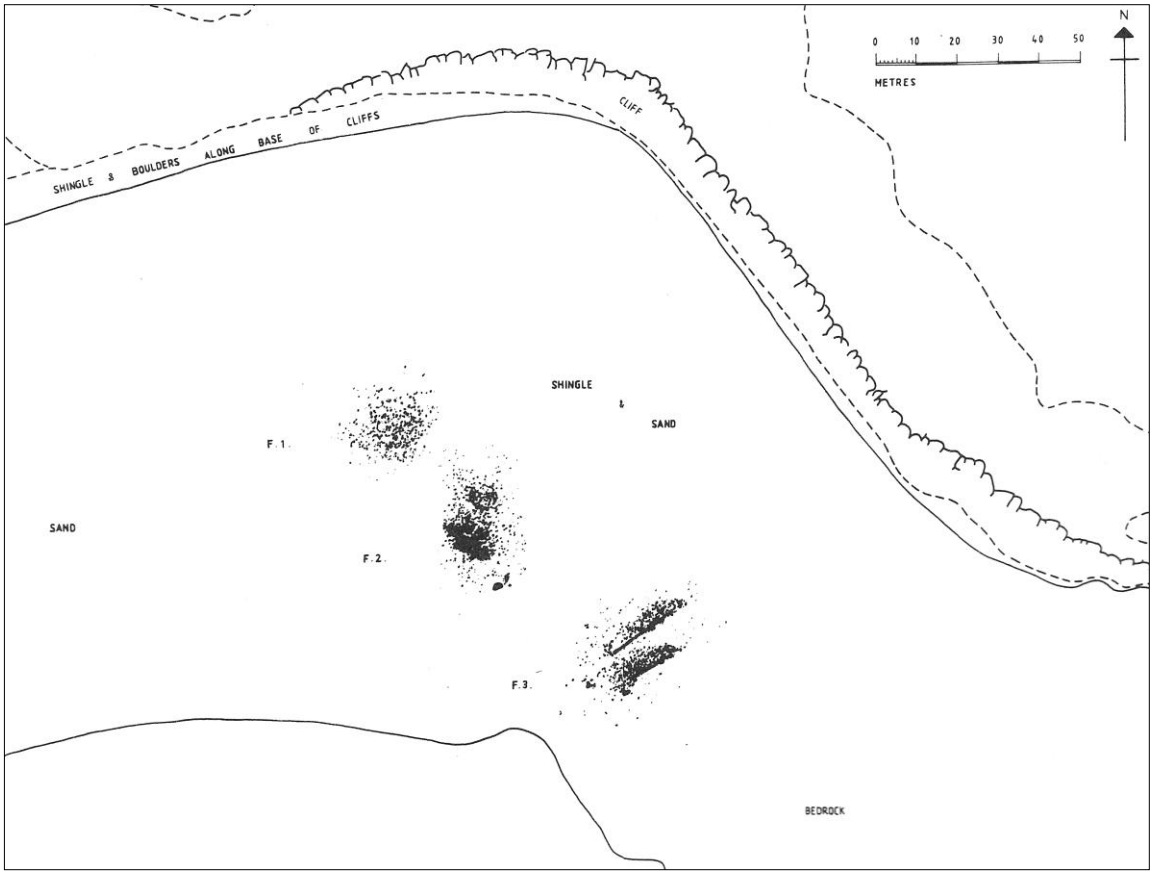


Figure 52, Plan of material remains at South Landing, Flamborough (Johnson 1988)

Figure 53, Part of the N.W. arm of Feature F3 at Flamborough – probable 'rock armour' for a pier toe. Remains of part of Feature F2 towards upper right. Looking south.

Earlier reporting on the remains at Flamborough interpreted Features F1-F3 as forming stone in-fills to wooden pier systems (Johnson 1988). It is suggested here that F1 and F2 may in fact have formed three features, not two, and represent timber-built mooring points, not piers.

The spread of stone that forms F1 measures little over 20m across and yet has the appearance of being both thin and scattered though it may be that this was once of more concentrated and of smaller proportions The same argument can also be posited for the southern part of F2, which also appears to be spread. The scattered nature of the remains in both cases is suggested as being owed to initial collapse and slumping at the time of dereliction, subsequently followed by 'natural' action of the elements and human disturbance. The northern extremity of F2, which is almost separated from that part to the south, contains a circular setting a little over 6m across and may well form an entirely separate entity. It is tentatively suggested that the remains of F1 and F2 at Flamborough may originally have formed small island type, mooring features, perhaps akin to dolphin

posts. The deeply embedded ring-like circular boulder setting forming the northern part of F2 is reminiscent of the linear settings of F3 and may represent toe rock armour designed to protect the lower part of the timber-work of a dolphin from wave, current and scour.

Whilst the original interpretation of the stone spreads of F3 as a pier is still broadly held, the two lines of embedded edge set boulders, set around 9.5m apart (outer edge to outer edge) and delimiting the sides of this feature are curious. This may represent rock armour set at the lower exterior sides of the pier thereby affording vital protection to the vulnerable toe of the pier walls.

As at Filey, the construction of a pier with walls of close-piling may have been difficult to construct at F3 as this is particular part of the site is located on bedrock. In such a location the most suitable method of constructing a pier with an internal ballast of stone may have been a freestanding one composed of a series of connected timber boxes.

It is not readily possible to relate the observed material remains at Flamborough to specific phases of development, including those historically attested episodes of building, though the spatial closeness of certain elements suggests they may form a palimpsest rather than being contemporary.

2.6 Other known timber-built piers

The following sites are known, or believed, to have possessed timber-built piers but there is insufficient data to determine their precise form.

2.6.1 Newbiggin by the Sea: early 14th? – mid 14th? centuries

Documentary evidence for Newbiggin's medieval pier rests on three sources, of 1316, 1335 and 1352 respectively. Collectively these span a mere 36 years and whilst the pier may well pre and post-date the earliest and latest references their tight clustering suggests that any such extended life may not have been of considerable duration.

There are only two pieces of information that provide clues to the form of the 14th-century pier. The first of these is the stated use of oak timber in the repair of the pier (Hodgson 1902, 74). The second is the mid 18th-century observation of material remains which are

described as *"stones and some of the piles of wood"* (Wallis 1769, 340). Taken together the documentary and observational sources strongly suggest a timber-built pier with an internal fill of stone. The precise form of the pier, e.g. with walls of close-piling or of earth-fast frame is uncertain though the early date may point towards the former.

2.6.2 Hartlepool: early 14th? – early 17th centuries?

Operating as a port from at least the mid 12th-century, the early focus of maritime activity at Hartlepool seems to have been in the Southgate area and did not involve the use of a pier (Daniels 2010, 144). Here a succession of dock-like structures was constructed within a small natural inlet known as the inner harbour, the earliest of which date from at least the early 13th-century (Sharp 1851, 150; Daniels 1988; Daniels 2010, 144-167). The construction of a pier to the east of the inner harbour created a deeper water refuge known as the outer harbour. Both harbours, including the pier are shown in Dromslawer's depiction of the mid 16th-century, Figure 54.

Figure 54, Picture map of Hartlepool as depicted by Robert Dromeslawer c 1540-9. Note the docks of the inner harbour enclosed by defences to centre left and the pier to lower right. North runs diagonally from lower left to upper right. (reproduced from: Daniels 2010)

The first mention of a pier at Hartlepool is in 1318 and refers to *"victuals bought on their pier by one Roberd de Musgrave"* (TNA SC 8/51/2537). The next reference to a pier is over 150 years later in 1473 when the Bishop of Durham addressed letters, within his see, appealing for contributions as the *"mayor, burgesses and commonality of Hartlepool"* intended to *"erect a certain pier near the walls on the south part of the town,..."* (Sharp 1851, translation p. 156, transcription Appendix p. ii-iii). The wording implies that this was a complete build rather than a repair of an earlier pier, perhaps even a replacement for that detailed in 1318? The described location of the pier is in the same area as that depicted by Dromslawer in the mid 15th-century.

Dromeslawer's picture map of the mid 16th-century (Figure 54 and Figure 55 (detail) shows a pier and associated island pier, in the lee of a small projection to the headland. Both structures are vertically sided and, judging from the detail of their upper surfaces, appear to be stone filled. The sides are depicted in a lattice effect, containing a number of vertical members and at least two that are horizontal. The vertical elements project upwards beyond the level top of the structures. As only timber could so project, it can be argued that the lattice is entirely of timberwork. Whilst the vertical timbers could be interpreted as rubbing posts, this is unlikely to be the case with the horizontal members. It is likely therefore that this relates to an external timber framework that was in-filled with stone. Whilst the piers were probably of earth-fast frame type, this cannot be conclusively proved. Two crosses, that are probably navigational markers, are depicted on this picture map, one on the island and the other adjacent to it.

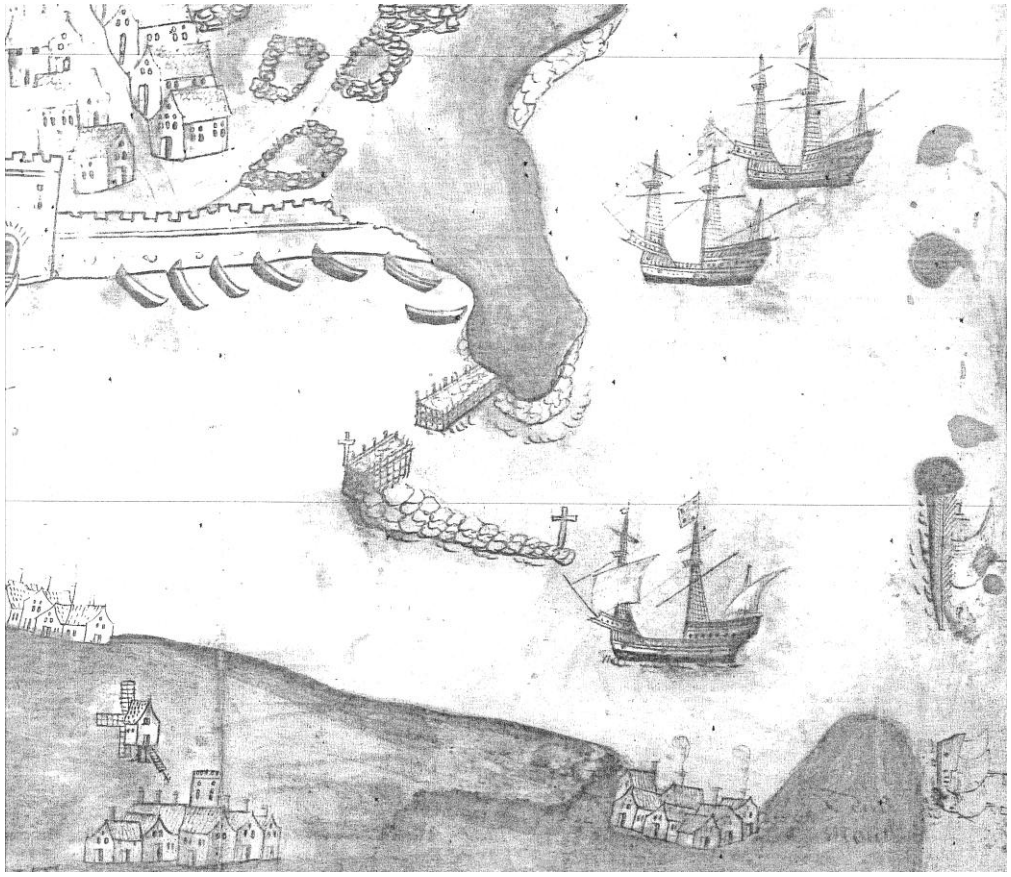


Figure 55, Detail of pier from Dromeslawer's picture-map of Hartlepool, mid 16th-century. (reproduced from Skelton and Summerson 1971)

There is brief reference to the pier in a survey of 1565 which states that it was in decay (Cal. S.P. Dom, 1565a) It may have been as a consequence of this decay that in 1588 an Act (for repairing the pier of Hartlepool) was read three times in Parliament. (J.H.L. 1588, 151-2). In his examination of the corporation records the antiquarian Cuthbert Sharp noted that *"Whenever the pier wanted repairs, the mayor issued his orders to the inhabitants, who brought what loose stones they could find"* (Sharp 1851, 157). Such loose stone is likely to have been for ballast within the timber shell of the pier. There are a number of 17th-century references to the pier, mostly concerning attempts to raise money for its repair, though these provide no further clues to its precise technical form (Cal. S.P. Dom. 1657; Cal. S. P. Dom. 1662; JHC 1665, 602). It is known that the pier was dry at low water (Bleau 1643).

It is uncertain precisely when a stone pier was first built at Hartlepool, though it was so by 1693 (Greenville Collins 1693, 11).

2.6.3 Whitby: 1307? - 17th-century?

Although referred to as a seaport from the 11th-century the first substantive indications of a pier at the town relate to grants of quayage in 1307, 1341, 1411 and 1424 (Cal. Pat. Rolls 1307; 1341; 1411; 1424). The earlier of these refers to a *"quay"*, *"newly to be constructed"*, *"for the security of ships there henceforth arriving"*. That of 1341 states that the quay is *"decayed and broken down by the force of the sea"*, whilst that of 1411 indicates the quay to be *"much decayed and broken down, to the great peril and damage as well of alien merchants as of denizens wishing to arrive and rest in that port with their ships"*. The later grant again refers to its parlous condition. We cannot be absolutely certain that the grants of quayage relate to a pier rather than a waterfront quayside, though clearly a projecting pier has a greater ability to provide shelter and 'security' than does a waterfront mooring.

The first specific mention of a pier is in 1520 though this reference provides no specific detail of its construction (Pybus 2009). John Leland's reference to the pier in the early-mid 16th-century similarly lacks detail (Toulmin Smith 1907, 51, 61). The first, and indeed only, document to refer to the nature of the pier is one of c. 1545 which remarks that *"it is verye necessarye that all the Woods within the Parishe of Whitbye or elce where nere thereunto be reservyde for the mayntenaunce of the Kyyngs Tenements and cottages in Whitbye and at Robynhood baye, and of the Peyr against the Sea at Whitbye where the Kyngs Majestie hath adredye imployed great somes of Money."* (Young 1817, ii, 530). This clearly indicates an episode of investment at the pier by the crown after its seizure from Whitby Abbey during the reformation. Despite this investment, records of the mid-late 16th-century indicate that the pier and harbour were already decayed (L. & P. Henry VIII 1544; S.P. online 2; JHC 1597, 567). The pier was still described as *"much decayed and likely to be ruined in a short time"* in 1626 (Binns 2000, 188-9).

The available evidence indicates that a single timber-built pier was almost certainly present at Whitby during the 16th-century and that there may well have been one as early as 1307. Historical consensus suggests that this structure was located at the site of the present stone-built Burgess Pier. This extant pier may originate in the 17th-century and could conceivably be the direct replacement of the 'decayed', and almost certainly timber-built, pier of the 1630s (RCZAS).

2.6.4 Scarborough: 1252? – late 16th-century

Scarborough is referred to as a port from the middle of the 12th-century though its use as such may date back considerably further (Pearson 2001, 91). Early port usage probably involved little more than utilisation of the open beach and one excavation near the foreshore has revealed a setting of stones directly over the natural ground surface. This was interpreted as a rudimentary slipway and may relate to early informal port infrastructure (Pearson 2005, 60).

The earliest secure reference to substantial infrastructure at the port is in 1252 when a grant was made to "*to strengthen a new port with stones and timbers against the sea where all ships may enter and leave without danger, as well at the beginning of the flood of the seas as at full flood"* (Cal. Pat. Rolls 1252). It is known from a number of documentary sources that by the early 14th-century Scarborough's port was comprised of both a pier and an adjoining waterfront that followed the curve of the bay eastwards of the pier (see Figure 56). What is less certain is if one of these elements developed before the other. The wording of the grant of 1252 implies a clear intention to construct a deep water port accessible at all states of the tide. This could not have been achieved by the construction of a waterfront hugging the shore, though could have with the construction of a pier projecting from the land out into the sea. The building of this, *"with stones and timbers"* implies the likelihood of a braced timber walled structure with an internal ballast of stone, much as is documented at a later date.

An account of works at the harbour around 1320 indicate that timber, with an infill of stone, were the primary elements in the quay and for much of the works carpenters and labourers were engaged in the *"removal and repositioning of stones and timber"* (TNA E101/482/3). The works were clearly a major repair and replacement exercise. The document makes it clear that much of this was to shoreline waterfront. However, the presence of a pier is attested by reference to *"the mending of the quay by The Peereende"*. It is probable that the pier referred to originated with the grant for a deep water port of 1252, this perhaps being an improvement to a pre-existing shoreline waterfront.

There are further references to a pier at the town from the mid 14th-century onwards and although no significant technical details are provided until the 16th-century, timber is

recorded as being provided for the repair of both it and the shoreline waterfront (Cal. Pat Rolls 1362; Turton 1894, 122; L. & P. Henry VIII 1541).

The first detailed description of the pier at Scarborough is in a petition of 1565 (Cal. S. P. Dom. 1565b, transcribed in Rowntree 1931, 204-7). In this document the existing pier is described as:

"all the owte sides made of Tymber framed like two house sides filled within with stones and stondithe upright as brode at the top as at the bothome so that when the Tymber faylythe which longe cannot contynewe agaynste the ragynge of the sea then the stones fallithe doune on bothe sides and so the breake is made". This was a timber structure of some proportions as: *"The lengthe of the peare is eight hundred foote* (244m) *and the girth thereof is twentie foot* (6.1m) *or thereabowts"*.

The structure described is unambiguously a vertically sided timber-built pier and although its precise method of construction is not certain the fact that it is described as 'framed like two house sides' may suggest that the Elizabethan pier was of earth-fast frame type.

A birds eye view of the town, dated to 1538-9 shows the timber-built pier and shoreline waterfront at Scarborough as it then appeared, Figure 56 and Figure 57 (detail).

Figure 56, Birds eye view, Scarborough 1538-9 (British Library, Cotton Augustus l.ii, f.1)

The infrastructure of the port in this view can be seen to be comprised of three principal elements, a single pier that extended from the headland, an arc of waterfront lining the bay that extended seamlessly to the pier and an island pier situated between the two. The clearest structural members visible are a series of regularly spaced vertically set timbers that are present to all three elements. The only other structural members that can be identified with any certainty are a number of regularly spaced horizontals visible in the upper surface of the pier and almost certainly tie-beams extending between the inner and outer walls of the pier. Between these horizontals are what may be an internal ballast of stones or other infill. That the vertical timbers of the pier are depicted as regularly spaced,

rather than as a continuous line of edge to edge timbers may suggest that construction at this date was of earth-fast frame type. The same is likely to apply to the island pier.

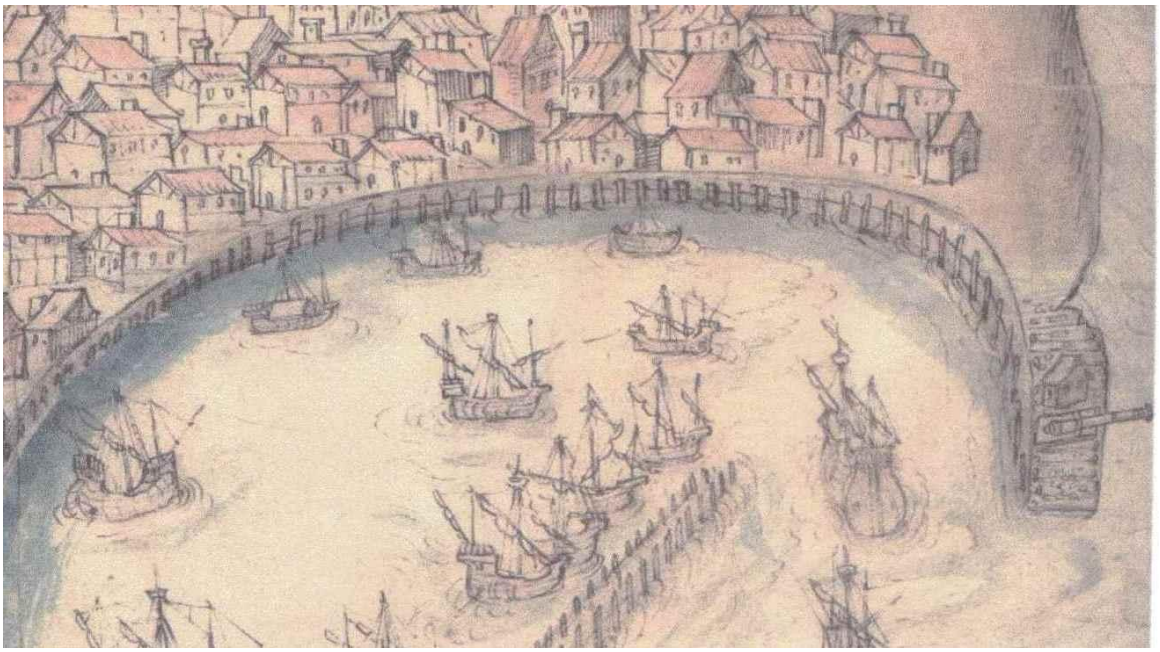


Figure 57, Detail of Scarborough harbour within Figure 56

The pier and foreshore waterfront formed an integrated entity. Pearson suggests that the earliest waterfront development, probably of 12th-century date, is likely to have been focussed on a 100m stretch of shoreline between East and West Sandgate, these being the main routes from the foreshore into the Old Borough (see Figure 9). This location lies on a narrow strip of foreshore just outside the speculated southern course of the town's defences and beyond the base of a steep slope that represents a former natural cliff-line. The route-ways of Quay Street and The Bolts are likely to have developed as an access road for the early harbour that extended from the pier right up to West Sandgate. A number of lanes extending from Quay Street southwards to the foreshore waterfront are attested in 14th-century documentary sources, some of which still survive (see for example 24B, 34C, 40D in Jeayes 1914). There are a number of 14th and 15th-century documentary references to the foreshore quay and works related to it (TNA E101/482/3; and see 10B, 16C, 55A, 21B, 26D in Jeayes (1914).

The extension of the line of the waterfront further to the west is thought to have been a later development (Pearson 2001, 92). A western part of the medieval timber and stone waterfront, located at the base of the boulder clay cliff and sealed by pottery dating to the first half of the 16th-century, was excavated at Blands Cliff in 1975 (Farmer 1976, 97-10) (Figures 58 and 59). The rear, landward, part of this was comprised of vertical oak posts to the front of which oak boarding was secured. Seaward of this a wall foundation of roughly hewn blocks and glacial erratics supported a walling of better dressed stone, this being fronted by oak posts spaced at roughly 1m intervals. Both structural elements were interpreted as forming a single waterfront entity, the rear timber element forming a cliff revetment, the stone and timber structure in front of this the quay wall and the area between representing a pathway. Whilst this may have been the case, it is stratigraphically possible that the rear timber element formed an early waterfront and the stone and timber one a later replacement.

It is known that the entire foreshore waterfront at Scarborough was progressively extended southwards, i.e. encroaching into the area of the harbour. Detailed consideration is given to this process in Chapter 3.

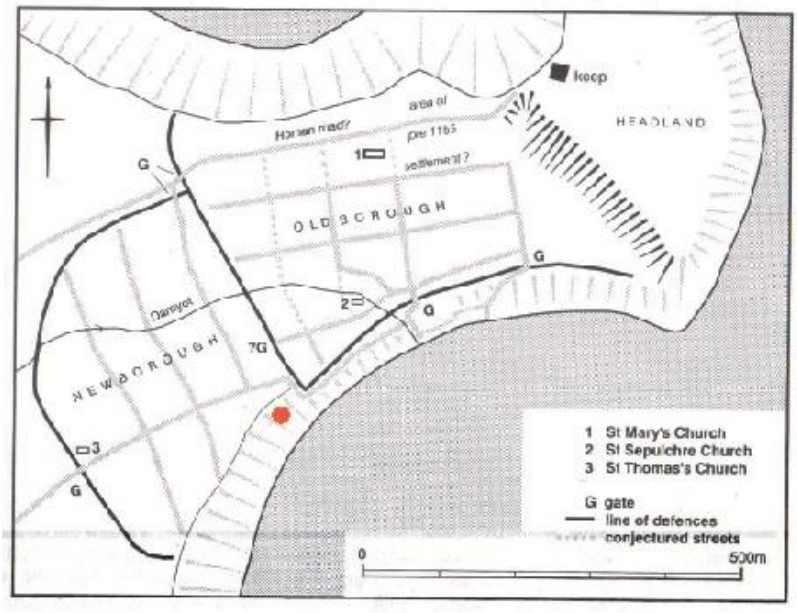


Figure 58, Scarborough. Location of Blands Cliff quay site (red) (map source Crouch and Pearson 2001)

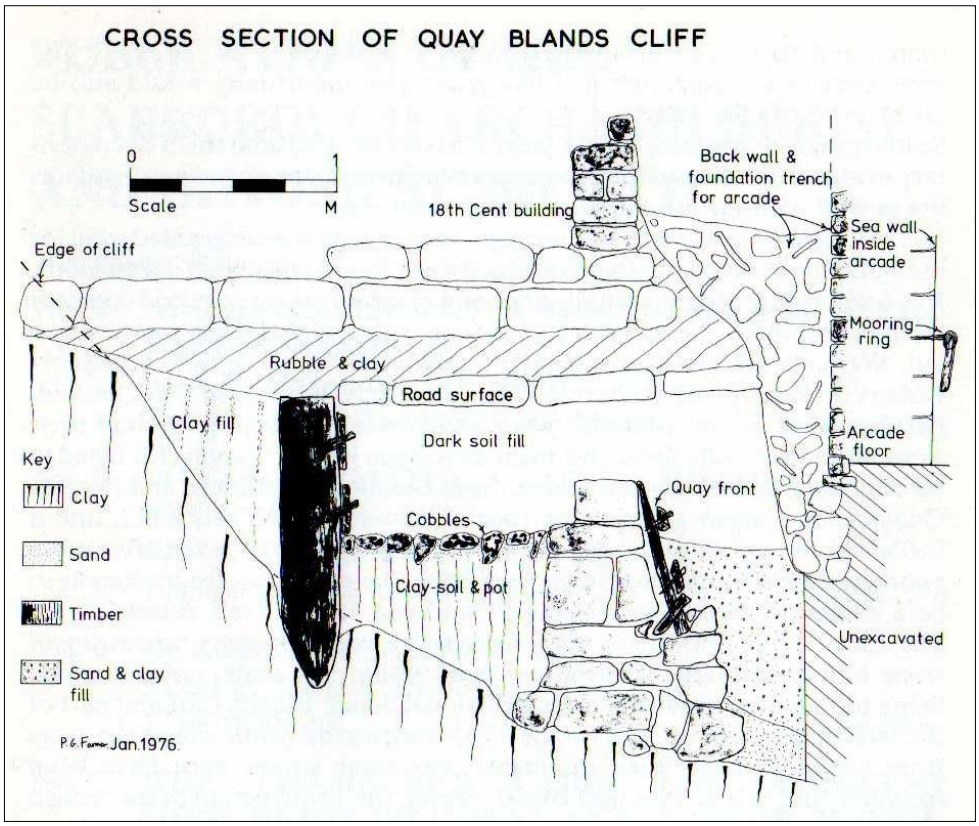


Figure 59, Section through the Blands Cliff excavation showing two elements of ?related waterfront structure. The thick deposit marked 'Dark soil fill', which overlays the waterfront structures, produced pottery of the first half of the 16th-century. A layer of cobbles below this may have formed a pathway. What is interpreted as a later sea-wall, complete with mooring ring, is located to the upper right, whilst to the rear of this lie the remains of an 18th-century building. (source: Farmer 1976)

There was one other component of the waterfront at Scarborough that is little understood, that of 'stadia' (plural). These are recorded in several 14th-century sources and their descriptions indicate them to be located in the area of the quay and sands (see 26D, 21B, 29B, 31A, 39D in Jeayes 1914). The term has been translated as possibly meaning 'standing' and Pearson suggests they were probably jetties or else stands for boat-building. In at least two instances such stadia are recorded as being privately owned. Perhaps these stadia were indeed small jetty-like structures projecting from the waterfront into the harbour that acted as private moorings? Such privately owned stretches of waterfront and jetties are well known at medieval riverine ports but their occurrence at a coastal pier site appears to be very unusual, if not unique.

2.6.5 Hornsea: 15th-century? – late 16th-century

A pier at Hornsea is first positively recorded in 1537, though documentary evidence does infer its existence at an earlier date, seemingly in the 15th-century (L. & P. Henry VIII 1537b; Purvis 1949, 69-73). The last indicator we have is its depiction in a map of 1595 (British Library 1), (Figure 60). The first record of construction materials is in 1556 when we are informed of *"xx tonne of tymber & two lytell pecs of tymber* (at Hull Bridge) *wch was the Kinge & Quenes tymber And was pr*(ov)*ided to have repaired the pere at horneseye"* which was seemingly stolen (ERRO DDCC 139/65).

Two inquisitions subsequent to the demise of the pier shed a little light on its form. The earlier of these (TNA E 178/160) is of 1602/3 and enquires into works at the pier carried out in the reign of Queen Mary. That this was believed to have been a timber-built pier is clear from the enquiry's pre-arranged questions that were posed and which were concerned with the amounts of timber, and iron that were used in the pier. Quantities of timber are mentioned throughout the document as is the matter of *"working framing and setting up of the said tymber and wood at Hornsey peere"*. Iron was a significant component within timber piers, almost certainly for pile shoes, spikes and nails. Although *"loads of stones"* and *"carrijing stones"* are mentioned so is the term *"fillinge"* and it would seem probable that the stone formed infill ballast within a framework of a timber pier. The later inquisition (TNA E 178/4813) is of 1609 and its primary concern was with coastal erosion. Timber was mentioned in connection with the former pier and its role in restricting the rate of erosion acknowledged. It was also stated that the building of a new pier would be likely to require around 2500 trees.

The documentary evidence for Hornsea refers to a pier (singular). However, the map of 1595 does suggest the possibility that the arrangement at Hornsea may have been a twin 'enclosing' pier configuration, much like those depicted at Bridlington and Flamborough on the same map. The information within the available sources gives no real clue as to the typological form of Hornsea's pier though the presence of a contemporary pier at nearby Bridlington of 'piled wall type' raises the possibility that such may have been the case here. It is worth noting that on the manuscript map of 1595 the wording *"warpe in and owte"* appears next to the pier itself. In nautical parlance 'to warp' is to move a vessel by means of ropes (warps) fixed to a secure point such as a pier, anchor or buoy, and the presence of shallow waters is implied.

Figure 60, Extract of manuscript map of 1595 showing the pier at Hornsea. There are distinct suggestions of a double pier arrangement with a large pier to the north of the stream of Hornsea Beck and a smaller pier to the south. (British Library, Royal. MS. 18. D. 111, f.63)

2.6.6 Cromer: 1390 - later 17th-century

A pier is first mentioned at Cromer in 1390 and there are thereafter a number of references until the later 17th-century (Cal. Pat. Rolls 1390). Few of these provide significant technical detail. The earliest reference in this regard is one of 1483, to the placing of *"great stones"* for the pier's support (Rye 1889, 51). This would appear to refer to 'rock armour' shielding the lower, most vulnerable, part of the pier from the sea.

There is an interesting reference to *"peeres"* in a petition for relief for the town in 1551 (Duchy of Lancaster Pleadings, transcribed in Rye 1889, 57-8). This document recalls the loss of land and property to the sea and that the *"Inhabytantes hathe to ther grete & importunate charges defended the same by making of grete peeres & are daylye putte to insatiable charges"*. This document makes a specific connection between coastal erosion and the function of these piers. All preceding documentary sources mention a pier

(singular) whereas this document states *"grete peeres"* (plural). It can be suggested that the situation may have been one of a pier together with adjacent groynes/breakwaters. Such 'piers' may have had affinities to the earlier and later Sheringham piers which functioned as much as anti-erosion devices as they did port facilities. A petition in a similar vein of 1607 states that the sea *"hath utterly decaied a peere wch was built not long since of tymber with great chardge"* (RHS 1915, 124-126). The petition proposed two options. The first would consist of a single *"great peere"*, the second several *"smalle peeres or jetties"*. The second option was the preferred as it was thought more likely to be manageable in terms of quantities of timber, construction costs and subsequent maintenance.

The first evidence for the pier proper at Cromer being constructed of timber with a ballast of stone relates to the late 16th-century. This is a single page account of one of the Pier Reeves detailing the monies paid out by him for repairs (NRO MS20403 12x6). In terms of timber, *"plankes"* and *"spares"* (spars) are mentioned, with *"a shippe wh was Bought for plankes for ye peare"* indicating that some of the planks used in the pier were recycled from an old vessel. The use of bay construction would seem to be implied by a payment *"for fillinge fower huches in the peare"*. Derived from the Latin, 'huch/a' was a term used in the medieval period for a booth, whilst the related term 'hutch' was the word used for the town chest in neraby Great Yarmouth (Latham 1965; Palmer (ed) 1854, ii). It seems reasonably certain that the term *huches* was being used to describe compartments or spaces just as the terms *rowmes*, *roumes* and *rooms* were used at Bridlington to describe individual bay divisions at a roughly contemporary date. The only other mention of equipment is to *"hempe to make a rope for the fframe"*. Precisely what the 'fframe' was is uncertain, but it may have formed part of an engine or piling rig rather than refer to framing in the carpentry sense.

One other account for construction work, for parts of March and April 1588/9, is known (NRO MC 934/1 800X5). Timber and plank is again referred to as is the carrying of stone, presumably for ballasting. The only other materials mentioned are *"ii bolt feten"*. One so far unidentified set of entries are those referring to *"spekes"* and *"spekes maken"*, presumably some sort of fabricated item for use in, or at, the pier during construction.

2.6.7 Ramsgate: early 16th-century – late 18th-century

The earliest reference to the pier at Ramsgate is of the late 1530s – early 1540s when John Leland noted in his 'Itinerary' that "*Ramesgate a iiii myles in Thanet, wher as is a smaul peere for shyppis"* (Leland, 1964 vol. 4, 61). The pier also appears on a map of the Isle of Thanet of 1548 and is depicted as a single curved pier extending from the shore at the north, southwards into a small bay, Figure 10. Reference to *"Ramsgate pier"* is common in the 17th-century state papers, but no technical description is provided.

The historian John Lewis provides some our first descriptions of the timber-built pier and indicates that around the early years of the 18th-century it had been enlarged *"At the Eastern Part of the Town is built a Pier of Timber to make a Harbour for Shipping, and defend the Town against the Ocean. ... a few Years ago this Pier was considerably enlarged, and the Harbour thereby rendered more commodious"* (Lewis 1736, 175). In his historical report on Ramsgate harbour in 1791 the engineer John Smeaton stated that the pier had been lengthened in 1715 (Smeaton 1791, 10-11). It would appear likely that the extensions to which Lewis and Smeaton referred were one and the same.

John Lewis produced a plan in 1736 which depicts the town and pier in some detail (Lewis 1736, between pages 174 & 175), Figure 61. This map shows the pier to be essentially linear, though with a few angular kinks along its length and to measure a maximum of just under 350 feet (107m) and with a width of around 20 - 25 feet (6.1-7.62m). To the outer side of the pier a series of five curvilinear lines between 150 – 220 feet (45.72-67.05m) long are evident and these curve outwards towards the north-east, stopping a little way short of the low water mark. These are groynes designed to attract a build-up of sediment thereby providing protection to the pier, particularly its foot.

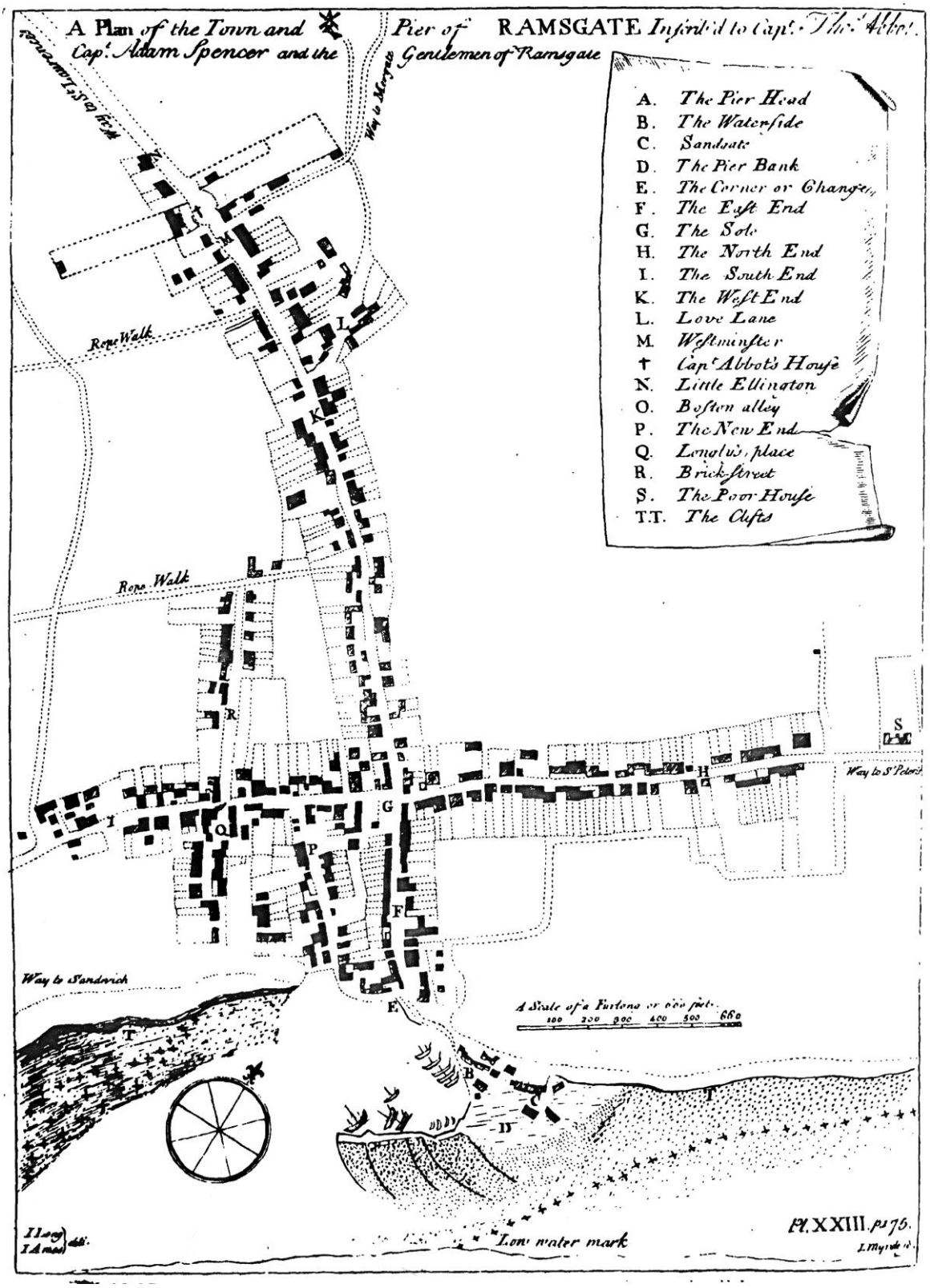


Figure 61, Map of Ramsgate and its pier, (from: Lewis 1736)

Perhaps the most detailed of the maps showing the old timber-built pier at Ramsgate is that surveyed in 1755, which shows new pier works constructed around the old timber-built pier, Figure 62. It seems fairly certain that the inner face and head of the pier was of a steep sided timber wall. On the outer side however, the groynes extend into the pale coloured area parallel to the inner face where they appear to be joined to a wall parallel to that of the inner wall. It is probable that this outer wall does in fact represent the outer wall of the pier and that the white area beyond this represents a permanent accretion of sediment above mean high water. A 'dock' depicted in the angle between the old and new piers, is thought to be a creation of the new works.

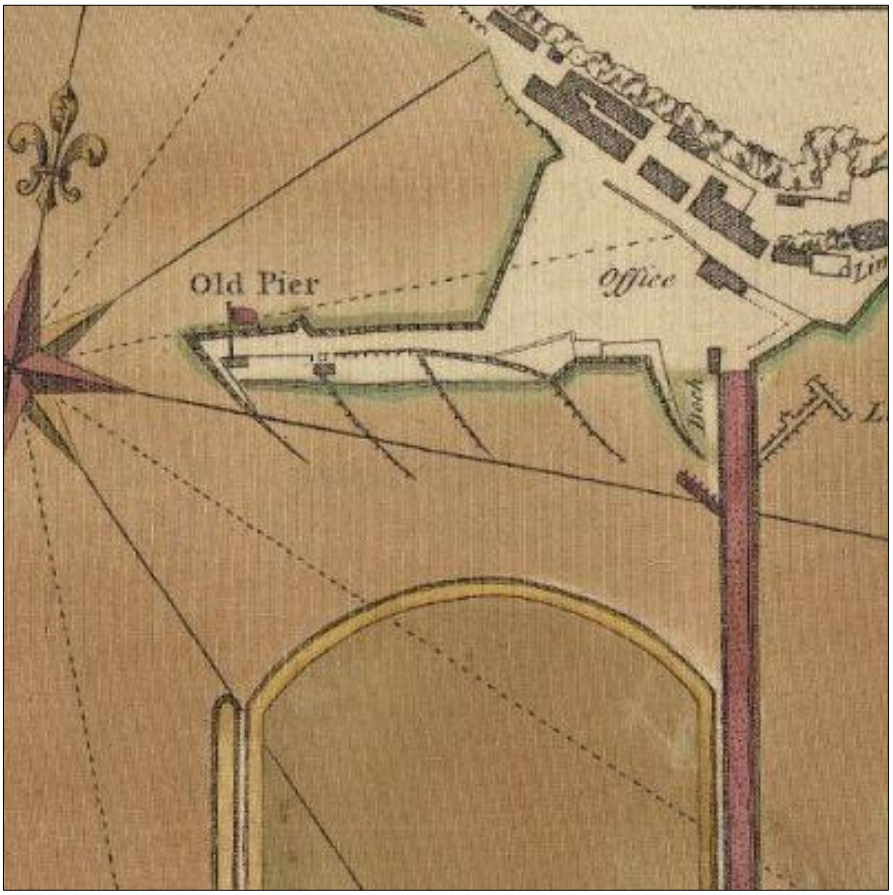


Figure 62, Ramsgate. Detail of the 1755 plan showing old timber pier - apparently left intact until around the 1770s. (National Maritime Museum G218:6/13)

The old timber-built pier survived surrounded by the new Ramsgate harbour until at least the mid 1770s, it being depicted intact on a plan of 1774 (Matkin 1976-7, 57). Insufficient

evidence exists to determine the precise structural form of the timber pier. A curious post-script to old timber pier is that when the new harbour was built controversial and unsuccessful attempts were made to construct its west pier with timber. Little is known of the form of these later timber-works.

2.7 Pier forms: discussion

The evidence for piers of close-piled and earth-fast frame types is unambiguous. That for free-standing frames remains theoretical, unproven and at the present time cannot be discussed further. Despite the technical differences between the close-piled and earth-fast forms certain aspects appear common and constant to both. In both cases piles were utilised, and lateral internal bracing of various forms and complexity was present. This latter was commonly accompanied by external walings and occasionally by external locking bars. The bracing is significant in that it divided the piers into a series of bays, sometimes referred to by this term and sometimes by others, e.g. room/e, roume, rowme, huche. A timber-built pier then was simply a certain number of replicated modular units

2.7.1 The evidence for chronological and regional variation

Table 1 and Figure 63 below summarise the evidence for variation of technical form in relation to date range, geographical distribution and ownership/controlling authorities.

SITE	TYPE	DATE RANGE	OWNERSHIP/CONTROL
Bridlington 1	Close-piled	E 16th century - 1719	Monastic-estate/Crown/lessees/ municipal/commissioners
Sheringham	Close-piled	L 16th century	Municipal?
Great Yarmouth	Close-piled	M 16th – mid 20th century	Municipal/Commissioners
Southwold 1	Close-piled	E 18th – E 20th century	Municipal/Commissioners
Sandwich	Close-piled	M-L 16th century	Municipal (not built) (CP)
Hastings	Close-piled	M 16th – M 17th century	Municipal (CP)
Bridlington 2	Earth-fast frame	1719 - E 19th century	Commissioners
Cromer 2	Earth-fast frame	M 18th century	Shareholders
Southwold 2	Earth-fast frame	E 20th century	Private/Municipal
Margate	Earth-fast frame	E 16 – E 19th century	Municipal/Commissioners (CP)
Broadstairs	Earth-fast frame	16th century - present	Private/Municipal/Commissioners (CP)
Dover	Earth-fast frame	1535 – L 19th century	Crown/Municipal/Commissioners (CP)
Folkestone	Earth-fast frame	E 17 – E 19th century	Municipal (CP)
Rye	Earth-fast frame	M – L 18th century	Commissioners (CP)
Filey	Free-standing frame?	16 – 17th century?	Manorial
Flamborough	Free-standing frame?	E 15 – 17th centuries	Manorial/crown/lessees
Newbiggin- Sea	Unknown	E - M 14th century	Municipal?
Hartlepool	" " (poss e.fast frame)	E 14 – E 17th century?	Municipal
Whitby	Unknown	1307? – 17th century	Municipal/monastic/crown/manorial
Scarborough	" " (poss e.fast frame)	1252? – L 16th century	Municipal
Hornsea	Unknown	E - L 16th century	Monastic/crown
Cromer 1	Unknown	1390 – L 17th century	Municipal
Ramsgate	Unknown	E 16 - L 18th century	Municipal/Commissioner (CP)

Table 1, The pier sites, their classificatory form, and their earliest date of technical information that determines their form (E = early, M = mid, L = late, CP = member of Cinque Ports)

Figure 63, Geographical distribution of the pier sites by typology. Red = close-piled, Blue = earth-fast frame, Green = free-standing frame, Black = not determined

Inevitably, our data in terms of precise dates of origin and full technical detail are not complete. However, the piers for which we have earliest recorded technical details are of the 16th-century and of these five are of close-piled form and three of earth-fast frame. Moving through time we can see that by the 18th-century newly constructed piers were overwhelmingly of earth-fast frame type (four) rather than close-piled (one). Whilst the

sample may be numerically small, the evidence does point towards a tendency for earlier piers to be of close-piled form and for later piers to be overwhelmingly of earth-fast frame. Piers that may have had free-standing frames possibly appear in the 15th-century. In geographical terms the distribution of piers of close-piled and earth-fast frame forms do not appear to indicate meaningful regional groupings. Only in the case of the two piers postulated as having free-standing frames is there a geographical correlation, the spatial gap of separation between them being 16 km.

2.7.2 Explaining variation of pier form

The evidence demonstrates a changing trend in the structural form of piers, in particular the increasing use earth-fast framed techniques. The use of any particular technology – including that of a pier, the arrangement of space within a building or even the decorative pattern on a pot are, somewhere along the line, all the result of choices. Why not another technology, a different arrangement of space or a different pattern? In short, how do we explain the identified change in the forms of piers?

There is no evidence to suggest that the observed chronology of pier forms can be related to technological innovation over time. The technologies of close-piled and earth-fast piers share certain common traits with timber building techniques. Close-piled piers bear a degree of affinity with earth-fast stave buildings whilst earth-fast frame piers have some similarities to timber framed buildings in which the 'main posts' of the piers broadly equate to principal posts in a building, with lesser infill between. Yet as technologies of land building, earth-fast stave construction was redundant centuries prior to our first attested close-piled piers. Similarly, timber framed buildings have an origin in the 12th-century, if not earlier, long before our first attested earth-fast framed piers. These observations for timber-built seacoast piers contrast sharply with surveys of the medieval and post-medieval waterfront structures of London by Gustav Milne (Milne 1992). Milne has presented compelling evidence for the proposition that the construction of contemporary timber buildings and waterfront structures utilised the same range of techniques. Further than this, Milne convincingly demonstrates that changes in waterfront construction broadly mirror changes in building construction. It could be argued that the extensive material remains that form the bulk of Milne's data provide a more concise picture than the more incomplete data for piers that lack the same range of material

remains. Whilst this may be the case, the overall pattern does seem reasonably clear. That the technology of piers does not appear to reflect the technical changes in buildings in the same manner as the waterfronts studied by Milne is unlikely to be the result simply of technical conservatism on the part of their builders. Rather, this may be owed to the harsher, more demanding, environment of the sea that served to limit the range of possibilities of the use of timber.

There is no evidence to suggest that the occurrence of a particular pier form can be equated with different forms of ownership, control or social organisation. Close-piled piers occur in the context of estates, crown custody, municipal and commissioner owned piers. Earth-fast frame piers occur within municipal, commissioner and privately owned spheres and the putative free-standing frame piers within manorial and crown custody contexts. There is scant evidence then to suggest any correlation between form and these social factors. The trend towards piers of stone from those of timber may have some connection with social factors, in particular the desire to create large impressive structures in whose glory a town or body of commissioners may bask. But even here the picture is ambiguous and also reflects a host of third factors including geological distribution, technological distrust, cost and technological innovation (see Chapter 5).

This apparent lack of a connection between the technology of piers and particular social factors may be divergent within the realm of much infrastructure generally. Town walls, or at least those in stone, can for example, convey socially relevant information in their scale, quality, elaboration, detail and magnificence of their gateways. Bridges, or at least those in stone can do likewise. Even a road may be elaborated, paved and widened, particularly in certain urban areas where such could be used to signify status. It would seem unlikely that the nature or characteristics of timber prevents the overt and physical reflection of social factors and messages. One has only to look at such structures as Scandinavian stave churches to appreciate that timber is a versatile material quite capable of doing so.

Although there is little to suggest that social factors played an implicit role in the form, or even elaboration of piers. A possible exception to this may be factors of scale. Whilst the scale of a structure, including a pier, may be one manner in which importance could be conveyed, it could equally relate to entirely functional requirements such as that for deep water. The provision of piers was a matter of considerable importance to the institutions

and communities who owned and controlled them. They can be seen as regulatory devices, as expressions of various rights and privileges and as objects of community and institutional achievement, identity and pride. In this sense they may be regarded as reflective of social factors, but seemingly one that was not determined by typological form.

One further peculiarity of form merits highlighting. Many piers of both earth-fast frame and close-piled type appear commonly to have had walls that to some degree were angled whilst some others had vertically set walls. There are two significant advantages to angled walled systems. Firstly, the reduced angle of repose of the internal ballast lessens the tendency for outwards slumpage which in turn exerts less pressure on the timber structure. Secondly, the angled wall serves to reduce wave impact, as sloping walls dissipate more energy than vertical ones (Thomas and Hall 1992, 134-5). One may have anticipated that once the system of angle walled piers had been devised and established its superior qualities would have ensued the eventual demise of vertical walls, yet there is no evidence to support this view. Pictorial and photographic evidence indicates that angle walled piers of close-pile form were built at Great Yarmouth and Hastings in the 16th-century whilst other examples of early date have vertical walls. However, the piers at Bridlington are known to have still been vertically walled until 1719 whilst at Rye vertical walled piers were being constructed in the mid 18th-century. This enigmatic situation presently defies explanation.

With the presently available evidence the most convincing explanations for the technological change in timber-built pier forms from close-piled to earth-fast framed are economic and environmental factors. The most significant may have been the difficulty and expense of obtaining large timbers in bulk. Piers with walls of close-piling could demand thousands of piles, each typically of 1 foot (0.3m) square cross section and often in excess of 12m long. By contrast piers with earth-fast frames clearly required much less great timber, such piles being required only at the points of bay division. Timbers between the bay division piles were of far smaller scantling, such as could be derived from smaller trees or as by products of squaring great trees. Further validation of this suggestion can be provided by evidence indicating shortages of large timber.

It is has long been commonly held that demand for timber by the Royal Navy led to shortages, particularly in the 18th and 19th centuries. This opinion became more deeply

embedded by the documentary researches of Robert Albion who considered that this demand stripped the landscape of wooded resources (Albion 1926). Albion's influential research long commanded adherence by historians and only since the 1970s have arguments refuting the case been aired. Foremost amongst these has been Oliver Rackham (Rackham 1976/1990). Rackham contends *"The 'tradition' that it destroyed woods is implausible"* (Rackham 1990, 96). He lays stress on the regenerative nature of trees and of the ability of well managed woodland to cope with the demands placed on them. Divergent arguments about this matter still continue. Greater clarity has perhaps been recently provided by Patrick Melby who suggests that the navy's demand may not have lead to whole-scale removal of woodlands, instead he sees the mainstay of ship-building, large and suitable oak, as being used at a rate that outpaced regeneration (Melby 2012). Melby's cogent argument is of relevance to this study as great oaks can also be viewed as the mainstay material of close-piled piers.

Perceived problems with the supply of timber long pre-dates the great expansion of the Royal Navy between the 17th – 19th centuries. Legislation of 1482, albeit permissive, sought to encourage regeneration of woodland after felling, whilst the Timber Preservation Act of 1543 effectively made this compulsory. The Act required that twelve timber trees per acre to be left intact after felling and required the enclosing of coppices to protect new growth from grazing (Nail 2008, 23). As shall be seen below, further legislation of 1558 for the protection of woodlands related overwhelmingly to maritime concerns. Later Acts of 1581 and 1585 attempted to prevent the wasteful usage of timber by the iron industry (Burlinson 2006, 185).

The earliest recorded case of difficulties with the supply of timber for pier building was at the state sponsored works at Dover in 1538, it being recorded that *"The west pier goes meanly forward for want of timber, which is difficult to get"* (L. & P. Henry VIII 1538). Given the massive scale of the Dover works the shortages in this particular instance may even be primarily owed to the wholly exceptional demands for such huge quantities.

There were extensive claims for timber shortage, including great timbers for piers, in mid 16th-century Sussex. Here a newly burgeoning iron industry was developing and this was having a considerable and unsustainable impact on the traditional woodlands of the region. In 1548-9 a commission of enquiry was set up to examine this issue (Cal. Cecil Papers 1915, 8-27). This concluded that the 53 iron mills were consuming vast amounts

of timber that were leading to shortages for a multitude of uses including *"the aforesaid towns of Hastings and Rye which are at a daily charge in making of 'jutties' and piers* (riverine and seacoast) *for defences of safeguard against the seas shall not be able to have in the country nigh by reason of the iron mills timber sufficient to maintain their piers and 'jutties."* One recommended outcome was the suggestion that *"we think there may no iron mills and furnaces conveniently continue and remain within the space of 20 miles of the sea"*. Due to cases like this a Timber Act was passed by Parliament in 1558 (Act of Parliament 1558). Although excluding parts of the country, including Sussex, the Act forbade the felling of timber of a *"Breadth of one Foot square at the Stub"* for use in iron production within fourteen miles of the sea or commonly used navigable rivers. It is difficult not to conclude that this Act was to some degree concerned with the maintenance of sufficient timber for use at piers and other waterfront installations.

This was not the end of the case as far as parts of Sussex were concerned as in 1578 the Privy Council ordered investigation about timber shortages and iron works. Shortly after, in 1580, the two Members of Parliament for Rye were instructed to have a Bill drawn up for a statute for the preservation of woods in several parishes near the town (RYE/47/24/13). The problem was again the damage to woodland by iron forges and glass works. The glass works in particular were seen as *"very hurtful for as the woods about them decay so the glass houses remove and follow the woods"*. The loss of timber was viewed as causing shortages for many important uses, again including *"timber to maintain piers, harbours, groynes, jetties"*.

Perhaps a key issue raised by the foregoing is not so much that woodland was being totally destroyed but that it was being inappropriately managed, in particular suffering from the removal of large timber trees leading to a shortage of such. That this becomes an issue recorded after the reformation is interesting. One concomitant of the reformation was a large-scale change of land ownership, more particularly the transference of former ecclesiastic lands to private and crown ownership. Once areas of woodland became withdrawn from established estates within which they had been efficiently and sustainably managed they are likely to have come under new pressures, including those of a more 'commercial' nature. An example of this may be at Bridlington where one of the conclusions reached in an inquisition of the crown lessees of the piers and town in 1590 recorded that they had failed to plant *"younge okes and ashes in lewe of those that have beyn cutt for reedifienge of the peare"* (TNA E 133/6/920).

The recorded use of considerable quantities of a variety of imported timbers, from at least the 18th-century, is considered below (Timber Supply) and indicates that required timber could often be obtained more reasonably than home produced material. This argument for importation can be taken back to at least 1607 when, for the pier at Cromer, it was suggested that not only could suitable timber be obtained more cheaply from overseas but that it would also be of less loss to the woodlands of the kingdom (RHS 1915, 124-126).

Difficulties in obtaining the right timber, predominantly large oak in sufficient quantities, are likely to have been a significant factor in the shift from piers with walls of close-piling to those of a 'more timber efficient' earth-fast frame type. Such difficulties seemingly emerging with increased demand being placed on traditional woods and their management by burgeoning industrial demand from at least the 16th-century. Increases in demand for naval usage, especially from the 18th-century seem likely to have only exacerbated an existing problem.

2.7.3 The Question of Design

A timber-built pier was in essence a replicated series of modular bay units utilising technologies and techniques drawn from the repertoire of long-standing traditional carpentry practices. The basic design of the pier structure itself, be that initially either an entirely mental construct or drawn hard copy, is likely therefore to have formed the most straightforward element of any particular scheme. The most testing part of the design process seems likely to have been focussed on the nuanced understanding of the configuration and placing of such piers within the demanding environment of the sea. Whilst such levels of understanding are dealt with in Chapter 3, the matter of physical platts, or plans, is registered within this section.

There were a number of significant developments within the field of cartography during the 16th-century and the use of maps, plans and charts became increasingly common. In the national context this was encouraged by the Privy Council which made it clear that local authorities were expected to submit maps and plans of their proposals where appropriate. This led to cartography becoming embedded in government by the late 16th-century (British Library). Whilst such platts, sometimes annotated, were being seen as a medium of recording and putting forward proposals there were no general conventions

regarding their preparation. Accordingly, their appearances were often quite diverse. The platts listed below relate to those believed to have been created as part of design and development proposals at pier sites. A number of further views and plans of towns and piers are known, such as the Henrician examples of Hartlepool, Figure 54 and Scarborough, Figure 56. Informative as these latter are, their intention was to depict wider existing situations rather than promote proposals.

There are references to development platts at: Hornsea (1549) (Acts of P. C. 1547-50, 396), Hastings (1562) (Cooper & Ross 1862, 83) and Southwold (1747, 1780) (HA11/B7/2, 14). It is thought that these are no longer extant. Platts prepared as part of the development process known to have survived are those for Sandwich, Great Yarmouth and Dover. That for Sandwich of 1548 was commissioned as part of the Rogers' proposals and was delivered to the Privy Council whose assistance was sought. This platt, Figure 10, shows the proposed harbour works as well as earlier works and whilst the level of technical detail is minimal the principal outlines of the proposal are reasonably clear. The platt incorporates a wide geographical area and this must have been deemed to be of some relevance. The platt of Great Yarmouth depicts the piers and town and bears the borough's coat of arms, Figure 3. According to the British Library this may have been derived from an earlier plan made in 1539-40 which perhaps adorned the town hall (British Library 2). The purpose of this platt, which does convey detailed technical information, is again said to have been to demonstrate the proposed harbour works to the Privy Council. A date of around 1570 has been attributed to the platt, though as has been argued above, it could have originated closer to 1560.

By far the most numerous and detailed set of platts are those relating to the large scale Henrician and Elizabethan harbour works at Dover. Several platts survive for the state funded Henrician works and in many ways they are typical of their age and genre. These are commonly perspective views which emphasise topographic detail and often have little emphasis or relationship to scale. Commonly, what already existed and that which was proposed are conflated, with distinction between the two often not being explicitly made. Items within these sets of plans, such as ships, are often shown in fine detail despite in many senses being immaterial to the proposals.

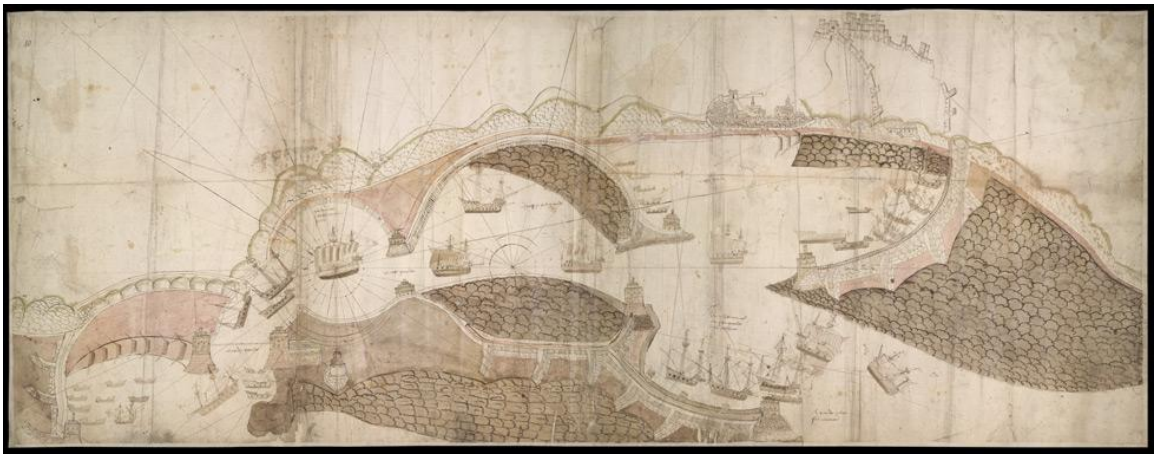


Figure 64, "A grounde platt for Dovour" by Richard Cavendish, 1541-44. Very much in a pictorial style this depiction shows a mixture of existing and proposed works. This contrasts quite markedly with the more modern style of cartography used at Dover at the end of the 16th-century (see Figure 38 by Thomas Digges)(British Library, Cotton Augustus l.ii. F.10)

The platts associated with the Elizabethan harbour works at Dover have been discussed at length by Stephen Johnston (Johnston 1994, Ch. 5). Johnston reports that at least eleven surviving depictions showing all or most of Dover harbour, as well as a number of detail drawings, survive. Further, references in extant documentation make it clear that others also once existed. Johnston's detailed consideration of the Elizabethan plans demonstrates that there was a move towards greater levels of accuracy and standardisation of form and representation, all of which were rooted in mathematical measurement and practical geometry. This also included, for the first time, measured bathymetric information. That these concepts came to the fore at these particular works is likely to have been owed to the embedded presence within the Elizabethan project of mathematicians and learned men.

It seems certain that other earlier post-medieval pier sites will also have had development platts prepared. Such drawings were de rigueur for all later post-medieval pier works and have been noted for Folkestone, Rye and Southwold. Given that there are many studies of engineering works and practitioners of the 18th-century and onwards these are not considered here.

2.7.4 Prefabrication

It was the norm for substantial parts of timber framed buildings to be fabricated and test assembled, taken apart and finally reassembled on site (Brunskill 1994, 34). Such test-assembly commonly took place in the carpenters yard or 'framing ground' (Harris 2004, 15). This practice permitted much of the carpentry to be prepared in conditions and circumstances of the carpenters choosing and enabled confident and rapid erection once the materials were delivered to the site. The correct assembly of the component parts of the building was facilitated by their being incised with numbers. There is also archaeological and documentary evidence for the prefabrication of substantial parts of many of the waterfront structures in London (Milne 1992). In the context of working in submerged or inter-tidal zones the need for rapid final assembly has self-evident advantages.

It has been seen that a pier was built as a series of identical, or near identical, modular bay units with each bay being comprised of a number of similar component parts, each of a certain pattern and size. Theoretically at least, it should therefore have been possible to prefabricate parts of a timber-built pier prior to its final assembly. Additional advantages of such a methodology would include the potential to create large numbers of identical units, some of which could be stockpiled until required as well as the facility to interchange parts. Both factors would seem to have advantages given the susceptibility of timber-built piers to damage and decay and the need for frequent repairs and rebuilding.

There are a number of references to framing at pier sites. At Hornsea an inquisition of 1602/3 into works carried out during Queen Mary's reign refers to *"working framing and setting up of the said tymber and wood at Hornsey peere"* (TNA E 178/160). Writing of Broadstairs in 1736 John Lewis recounts legal agreements of the 1560s and 1580s which record the *"framing of timber etc. for the repair of the pier"* (Lewis 1736, 165). Similarly, at Folkestone in 1786 there is reference to the use of a field belonging to the mayor for *"framing"* (EKA Fo/AUj1/1). Whilst these references intimate the likelihood of an element of prefabrication the degree of this generally is uncertain.

At a step removed from prefabrication, there is unambiguous evidence for the partial preparation of timber in the woods in which it was felled. At Bridlington in 1539 for example there is specific reference, within the woods, to the squaring of *"gret tymber trees"* whilst the sawyers preparing the timber for the carpenters were actually operating

at the site of the pier (TNA E 101/622/29). During construction of the piers at Sheringham in 1582-5 the evidence intimates that *"Fellinge, cuttinge, sawinge"* was again being carried out in the woods (NRS 1990, 17-19). Within the broader contemporary building industry the basic preparation of timber at the site of felling and subsequent conversion elsewhere was standard practice (Salzman 1966, 237).

At a later date, timber for piers was frequently purchased ready-cut to the appropriate scantling. This was largely the norm from the 18th-century though the earliest known instance of this is reference to the purchase of a large quantity of planks at Great Yarmouth in the later 16th-century (NRO Y/C28/1). In 1717, at Bridlington, planks and treenails were purchased from London (ERRO QSV /1/2, 64-5). At Folkestone in the 18th-century it was normal to purchase ready-cut posts, planks and other timbers (EKA Fo/AUj1/1, 1767-1819). Again, during the 18th – 20th centuries at Broadstairs sawn timber, plank, beams, baulks, posts, piles, split deal, whole battins, amongst other materials, were all received at the pier (EKA UD/BS (uncat.)1769-1807; UD/BS (uncat.) Box 1, 1792-1807; UD/BS (uncat.) Box 14 1831-1841; UD/BS (uncat.) 1842-1852).

2.8 Buildings and piers

There is considerable documentary and cartographic evidence for buildings upon, and adjacent to, a number of timber-built piers. These span the 16th – 20th centuries and in many instances the purpose or function of these is explicitly stated, most commonly as material stores.

The earliest building for which we have evidence is that at Scarborough depicted in the drawing of 1538-9, Figure 56. This shows a single storey building with pitched roof. The close proximity of this to pier mounted artillery suggests that it may have formed a residence/store for the gunner/s rather than a harbour store. A further early depiction is the single storey, with attic, pitched roof building located at the landward end of the north pier shown on the Great Yarmouth platt of c.1560, Figure 3. The building may equate with a Haven House mentioned in 1564 that measured some 20 feet (6.1m) by 16 feet (4.88m) and was built of lime and stone. This building functioned as a store for tools and shelter for the workmen and labourers and was located to the south side of the haven's mouth (Manship: in Palmer (ed) 1854, 92-3). At Bridlington in 1539 there is reference to

"wyndes-s (windlass) *Rames and other things from the howse that they lay in"* which implies some sort of store (TNA E 101/622/29). Later in the 16th-century one of the *"Articles to be enquired of"* in an inquisition of 1590 at Bridlington concerned the provision of a storehouse (TNA E 178/2714). It was claimed that the lessees of the piers had *"no store house not synce the grauntinge of this lease"*; such a storehouse was presumably a stipulation laid down by commissioners of the crown.

The only known reference to a store in the 17th-century is in a petition to Charles II by the town of Bridlington where it is claimed that a warehouse valued at £400 and containing timber and materials for the repair of the pier had been burnt, this seemingly referring to an incident during the civil war (Ingram 1977, 53; Neave, 2000, 86).

There is considerably more evidence for pier buildings in the 18th – 20th centuries. The 1736 illustration of Margate pier shows three buildings at its landward end, Figure 25. Two of these are warehouses, the other the Kings watchhouse and warehouse that presumably served a customs-like role. The 1736 plan of Ramsgate also depicts a cluster of buildings at the landward end of the pier one of which was again probably the Kings Warehouse, Figure 61. The 1755 plan of Ramsgate again depicts buildings in this area, one described as an office, whilst to the immediate southern side of the pier two small unidentified structures are present, Figure 62. There are occasional references to a storehouse at Folkestone in the 'Jettee Books' of 1767-1819. Unusually, this appears to have belonged to an individual rather than the commissioners responsible for the piers (EKA Fo/AUj1/1).

A case brought before the East Riding Quarter Sessions in 1717 intimates the likely presence of a store at Bridlington (ERRO QSF 39/C/13; QSF 39/C/14). A store was certainly present there in the earlier part of the 19th-century as a 'Work Shed' is marked on a plan of 1814 close to the landward end of the north pier, Figure 14 (Goodrick 1814). 'Haven House's' are shown behind both piers on the 1830 plan of Southwold harbour, Figure 8. Two smaller structures on the same plan may indicate additional pier buildings. The Southwold 'Weekly Labour Books' for the period 1867-73 refer to both a tool house and a shed for the protection of timber and materials (SRO 491/20E/4). 19th-century maps and plans of Great Yarmouth depict a number of pier related structures. These were comprised of a Pier Master's house, an Engineers house, a number of structures entitled 'sheds', a harbour works yard, a Pilots house/lookout and the Hope and Anchor public

house (NRO Y/PH 1170). At the head of Dover's south pier a small, tall, timber-built lookout is shown in 19th-century depictions, Figures 40, 41 and 42. A flag apparatus affixed to the lookout was used to signal when access to the harbour was possible by vessels of deeper draught.

There is but one building that stood on a timber-built pier that survives, that known as the Boathouse at the landward end of Broadstairs pier, Figures 65, 66 and 67. Timber built with weatherboarding and presently roofed with slate, this structure probably dates to the late 18th-century. It is of two storeys and, of two parallel ranges with hipped roofs though the northern end of the east range has a gabled roof aligned at 90 degrees to the others. To the west side there is a single storey extension with lean-to roof. There are external staircases leading to the first floor at both north and south ends. The arrangement of doors to the ground floor is irregular, as are the window arrangements to both floors. Internally, the building is presently divided into a number of mostly small spaces and the building clearly has a complex structural history. There are a number of depictions and references to this building, from the late 18th – 20th centuries, particularly in the 'Broadstairs Pier Books' (CKS Q/Rum 389B; EKA UD/BS (uncat.) Box 2 1843-1853; UD/BS (uncat.) Box 8 1912-1923). At various times this building, or parts thereof, have served as a Harbour Masters office and lookout, a store, boat store and shop. Given the small size of Broadstairs pier this building's useage may always have been multi-functional.

Figure 65, Photograph. Broadstairs Look-out and Stores/Boathouse, looking East.

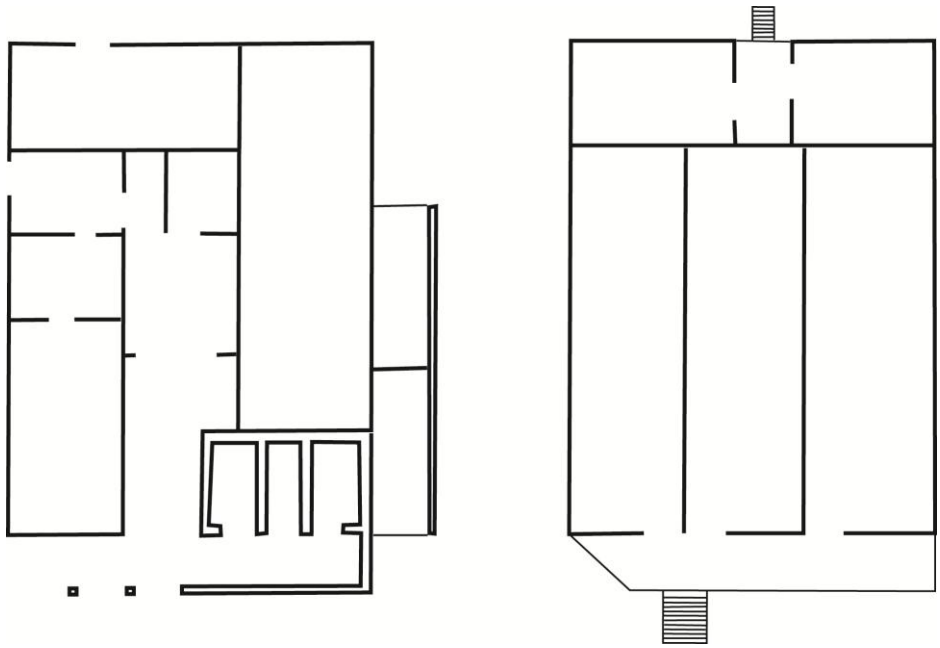


Figure 66, Broadstairs. Plan of interior of the Boathouse in 1947(ground floor to left, first floor to right) (overdrawn from a figure in Simmonds 2006)

Also at Broadstairs, a plan of 1856 shows the 'Droit House' where the collectors of tolls had their office on the east side of the harbour, Figure 67 (CKS Q/Rum 389B). This building is also mentioned in the 'Commissioners Pier Books', e.g. (EKA UD/BS (uncat.) Box 2 1843-1853). A handful of further small buildings, all of timber, are known to have stood on Broadstairs pier and are thought to have served principally as stores and a lookout, Figures 28, 29 and 67.

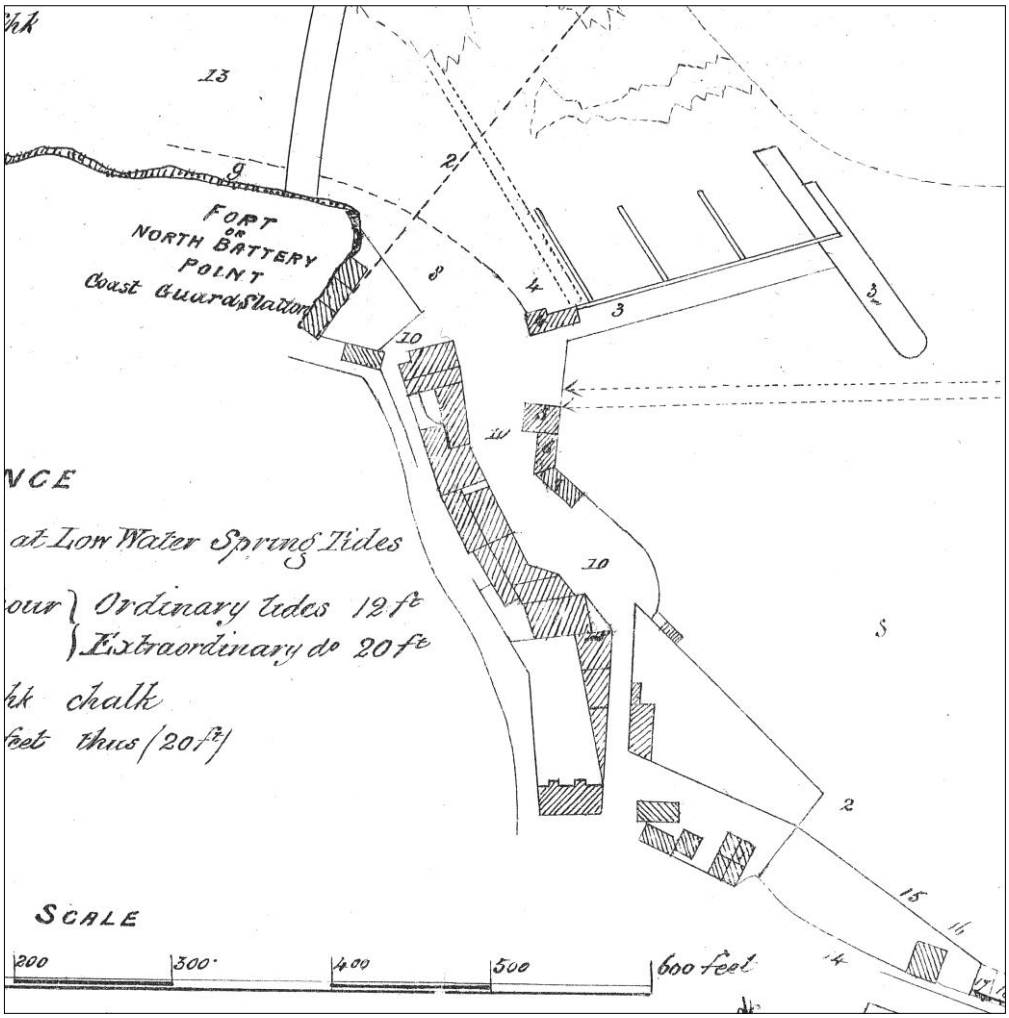


Figure 67, Plan of Broadstairs pier in 1856. 4= Pier House (Boathouse), 5 = Droit House (CKS Q RUM 389B)

The known buildings on and adjacent to piers clearly served a variety of roles. The most common of these was as stores, typically for the materials and equipment relating to pier maintenance and construction. Warehouses were also present at a number of sites. Administration and regulation are represented by customs and toll related buildings, Harbour Masters offices and lookouts. The location of these buildings tended to be at the landward ends of piers. Whilst such location seems likely to relate largely to security from the sea these positions also permitted the control of access to the piers. It is known from various ordinances, Acts of Parliament, bye-laws and miscellaneous accounts that considerable powers could be vested in Pier Wardens, Collectors and Harbour Masters, these powers ranging from entry to the harbour, berthing, the taking of money, fines and

even the distraining of goods. The nature and locations of many of these buildings reinforces the notion that piers could be highly regulated places.

Timber seems on occasion to have been stockpiled in the open, especially during programmes of construction. At Bridlington certain of the Henrician Exchequer accounts frequently detail *"caryed tymber from the hyll to the key"* (TNA E 101/622/29; E 101/459/5). The hill referred to is almost certainly Beck Hill which lies close to the western end of the harbour on elevated ground.

There is one other frequently recurring correlation between buildings/structures and piers, namely that of defensive military installations. England's coasts have often loomed large with threats from the powers of continental Europe and foreign privateers and whilst the sea may have formed the country's natural moat the coastline was perforce its front-line. Such coastal installations of all periods have been widely researched and reported on and the intention here is merely to highlight their correlation with piers rather than expand on this work. On occasion artillery is known to have been sited on piers themselves, such as at Scarborough, Margate and Dover though where this is indicated it was often of short duration or a temporary expedient. The castles of Scarborough and Dover, which both served military functions into the later post-medieval period, have always directly overlooked the havens below them. A number of pier towns, Hastings, Dover, Great Yarmouth, Scarborough and Hartlepool possessed defensive walls whilst Broadstairs also had rudimentary defences on its seaward side. However, the construction of defensive military works adjacent to piers as part of concerted strategic policies really originates during the reign of Henry VIII and has continued into the modern era.

Henrician fortifications are known at Folkestone where an artillery fort was built in 1539-40 to the west side of the town (ADS 3) whilst in 1545 "*certain bulwarks"* were promised to Great Yarmouth (L. & P. Henry VIII 1545). The most thoroughly defended Henrician port was, unsurprisingly, Dover (Colvin 1982). There may have been a fort at this time at Bridlington where *"Ordenaunce and Munition"* was certainly present in 1547-48 (Kenyon 1982, 107). All of these sites maintained forts into the 19th-century and, in the case of Dover, beyond. Defensive ordnance was recorded at Flamborough at the same time though as there was no fortification here it may well have been mounted on the cliffs above the port (Kenyon 1982, 205).

In the later 16th-century at Sheringham there was *"a blockhowse upon the clyffe of lyme and stone with a roof thearunto with porche meete for our great ordynaunce"* together with *"new carriages made for the same ordynaunce"* (NRS 1990, 17-19). Ordnance was mounted at Margate by the early years of the 17th-century and a fort subsequently built there (Cal. S.P. Dom. 1627-8; Anonymous 1757, 25). There is a suggestion that a gun battery, which was washed away by the sea in 1763, may have been located on Margate's pier (City Remembrancer 1769, 230). This notion is supported by later reference to a militia *"magazine stores on the pier"* in 1808 (Brayley 1817, 38-9). A fort at Hastings was located adjacent to the site of the pier. It is known to have been re-built in the mid 18th-century, some time after the pier ceased to exist (ADS 2). Other pier sites with adjacent defended gun batteries constructed in the 18th-century were Broadstairs, Ramsgate and Rye (CKS Q/Rum 389B; ADS 4; Fisher 1799, 288; British Library 4).

Although it may superficially appear that the pier sites of eastern England were heavily defended bastions the available sources intimate that this was ordinarily not the case. The defensive works were built to confront perceived specific threats and, more often than not, as soon as these threats receded, the defences had their garrisons reduced or withdrawn, ordnance was often recalled and the establishment was either moth-balled or abandoned. New threats were met by re-garrisoning, re-arming and repairs to the defensive works. Between threats there was often a reluctance to fund even maintenance work and many of the defensive works fell into such decay that large scale, and sometimes total, re-building eventually became necessary.

2.9 Craftsmen, Experts and organisation

Referring to the 16th-century Stephen Johnston considers that *"there was no corps of established harbour engineers"* (Johnston, 1994, 219). In similar vein Gustav Milne has concluded that it was carpenters who constructed the historic waterfront structures of London, there being little evidence to suggest that this was ever the work of specialists. Milne also musters a limited amount of documentary evidence that indicates that certain named carpenters worked on both waterfront structures and buildings (Milne 1992, 11).

By and large the seacoast pier data collected in this study supports both notions. The evidence indicates that timber-built piers were essentially the products of carpenters

utilising general carpentry practice. These were men who engaged themselves in construction on land, as well as in the sea and were not specialists in the sense that fellow woodworking boat-builders or coopers were. Other crafts and workers recorded as involved in construction at pier sites in the contemporary documents are sawyers, labourers, pilers, carriers, operators of cranes, smiths and various providers of material and equipment.

The earliest reference to carpenters are at Scarborough in the early 14th-century (TNA E101/482/3). There are thereafter many references to carpenters working at the piers of Bridlington, Flamborough, Great Yarmouth, Southwold, Margate, Broadstairs, Dover, Folkestone and Hastings. Sawyers are referred to at Bridlington, Flamborough, Cromer, Great Yarmouth, Southwold, Margate, Broadstairs and Dover. Reference to labourers is equally widespread. Whilst it appears that ordinarily the workers engaged in pier construction work were present of their own volition, workers could be impressed where such work was deemed to be of national significance.

In 1398 the great carpenter Hugh Herland, and others, were called upon to impress labour for the works at the new harbour of Great Yarmouth, though this was prior to the construction of piers (Harvey 1954, 130; Cal. Pat. Rolls 1398). At the time of construction of those piers in 1568 commission for three years was granted to the town *"to take up only for the repair of the haven of the Town in the counties of Norfolk and Suffolk stone, timber, underwood and other necessaries and carriage for the same at reasonable prices, and to take up in the counties of Norfolk, Suffolk, Essex and Kent masons, carpenters and labourers to work on the haven at reasonable wages"* (Cal. Pat. Rolls Elizabeth I 1568b). This patent would seem to be authorising the impressment of both materials and labour. Impressed labour was utilised at Dover's harbour during the Tudor building campaigns and the same still held true there in the mid 17th-century when *"boatmen, carpenters, etc."* are referred to in this context (Cal. S. P. Dom. 1653). (See Appendix 1, individual case study sites for more detailed data on each category of these workers)

The use of piles and of the engines with which to drive them, are recorded at many of the pier sites although pilers themselves are referred to, directly and indirectly, only at Bridlington (e.g. TNA E 101/622/29), Great Yarmouth (Swinden 1772, 443), Dover (Scot 1587) and Sheringham (NRS 1990, 17-19), in the 16th-century, and in the 19th-century at

Southwold (SRO 491/20E/4). Carriers, or carters, were employed during the Henrician works at Dover and at Bridlington for the carriage of stone for the infilling of the timber pier shell (Colvin 1982, 734; TNA E 101/622/29). Crane operators, in connection with piling, are referred to at Sheringham in the 16th-century (NRS 1987 &1988, 17-19).

Smiths supplying ironwork and providers of materials, the latter ranging from cable, rope, grease, food and other sundries find mention at Dover, Bridlington, Great Yamouth and Sheringham in the 16th-century (e.g. Colvin 1982, 734; TNA E 101/622/29; NRO Y/C28/1; NRS 1990, 17-19), Margate in the 18th-century, (EKA EK/U1453/053/2) and at Southwold in the 19th-century (SRO HA11/B1/88; HA11/B7/10). The 'knock-on effects' of such infrastructure projects, with their demand for quantities of raw materials and finished products, must have acted as a stimulus to a wide variety industries, from those related to the production of iron to quarrying and food. It is difficult to accurately guage the degree or impact of these knock-on effects, and clearly they must have been dependent upon the scale and duration of the individual projects. To some extent we can see the effect that the requirement to use thick stone foundations for the piers at Dover had on a variety of crafts. Such foundations involved the transportation of huge stones from the shore to the point of deposition via a towed flotation system. This operation in itself necessitated the employment coopers, tunmen, mariners, hoymen and shipwrights (Colvin 1982, 734).

One other group often accounting for part of the workforce were manorial and estate tenants performing labour service and townsfolk of pier towns called out for the same by their ruling authorities. In both cases members of these groups were not receiving direct payment for their work and appear to have been principally engaged in labouring rather than in more specialised roles. Further discussion of this group is presented in Chapter 4.

There is clear indication of ranking within the body of carpenters at a number of sites. During the Henrician works at Bridlington, for example, the rates of carpenters' pay varied, two normally being paid 8d per day, around half the remainder 7d per day and the rest 6d (TNA E 101/622/29). These differentials may relate to degrees of experience and responsibility. There are also a number of references suggesting gangs of men under what may be an employer. Thus at Sheringham we find payments *"unto Pasfelde and his men"* and *"to Richard Newman and his 4 men"* (NRS 1990, 17-19). A craftsman or "*Master Workman"* is referred to in the late 16th-century at Hastings and he is known to have been

in charge of the workforce, of the day to day running of the project and to have had some input in the technical aspects of the structure (ESRO C/A(a) 1, both sides p 12). The same Master would seem likely to have been instructing the men of the town called to perform labour at the pier (ESRO C/A (a) 1, p 15). Again at Hastings, in 1611 a "*Surveyor & Mr woorkman of the woorke of the Pere"* was appointed (ESRO C/A(a) 1, p 154). Larger projects may have benefitted from the services of professional administrators and at Bridlington in the mid 16th-century a paid Clerk of Works appears to have fulfilled this role (L. & P. Henry VIII 1539).

Appointed and elected officials, typically Pier Wardens/Reeves and Collectors, were often responsible for the organisation and administration of repair and maintenance works at their piers. The earliest references for this are the building accounts of the Collectors at 14th-century Scarborough (TNA E101/482/3) whilst in the later 16th-century we have building accounts of one of the Pier Reeves at Cromer (NRO MS20403 12x6). From at least the 18th-century at Broadstairs a Harbour Master and assistant were appointed and one role of these offices was maintenance of the pier. This included inspections and reporting of faults, sourcing materials and paying for labour and wages. (EKA UD/BS (uncat.) Box 2 1792-1814; UD/BS (uncat.) Box 2 1853-1869; UD/BS (uncat.) Box 10 1890-1899).

Posts pertaining to the administrative side of large pier building projects were commonly appointed by members of the governing authorities of pier towns and in those towns enjoying self governance many of the roles were fulfilled by such members, often at their own expense. At Bridlington the Steward of the Manor played a role in the administration of the Henrician pier building (L. & P. Henry VIII 1537a) as did Robert Laycye and Umfrayd Chalner the bailiff and a yeoman of the crown who were both described as *"surveyors of the works at the piers"* (TNA E 101/459/6). In the 1540s at Flamborough Rychard Robynson, who was the bailiff of the manor, appears to have being overseeing the works and was certainly keeping its building accounts (e.g. TNA E101/463/17). At Great Yarmouth a clerk of the Check was appointed to the haven works in 1560s whilst a paymaster of the haven is also mentioned. It was the clerks job to *"give knowledge unto the paymaster of the haven work of everyone's default, and to make an abatement of one penny for every hour defaulting from labour"* (Manship: in Palmer (ed) 1854, 93). At the same town *"overseers"* were also appointed as was a *"Provider of Wood and Timber"* (Manship: in Palmer (ed) 1854, 97; NRO Y/C28/1, (also) 2,3,4,5).

References from Hastings in 1596-7 point towards a more hands on approach by local officials. One entry within the First Corporation Record Book states that the workmen at the pier were to *"continue their labor so long as it shalbe thought expedient by the survey & direction of Mr Maio (Mr/Master Mayor) & his brethren".* Another that *"The survey of the work of the pere is by this Assembly comitted to Mr fferrys* (a jurat on the town assembly) *until Allhallows die next who as comptroller shall command & controll not only the woorkmen therof but also the wholl towne by wards & companys as hath byn accustomed"* (ESRO C/A (a) 1, p 16, 34).

Those responsible for existing piers or ongoing works commonly sought the opinions and services of 'experts'. This seems to have especially been the case with new build developments. In some instances advice was sought from local craftsmen. At Bridlington in 1537 for example, a representative of the crown was accompanied by, *"the best mason and carpenters here"*, to survey the pier with a view to its repair. Their recommendation "*that it should be made with timber and stone together as before"* resulted in a large re-building programme (L. & P. Henry VIII 1537a). A document concerning Hornsea pier in 1549 stated that *"must send thither summe man of skill to consider what stuff is there toward the reparacion of the pere, and what more shalbe nedfull, and what may be the charges therof, and therupon to certifye"* (Acts of P. C. 1549). Technical expertise was sought at Hastings in 1578 when Letters Patent noted that the opinions of *"divers artificers very cunning and skilful in that kind of faculty"* had been obtained for the proposed new haven (Hughes & Larkin 1969, 426-431). At Sheringham in the later 16th-century investigators were required to view *"by your selves and some men of skill and knowledge"* the works at Sheringham in order to determine the state of the haven. (Acts of P. C. 1591).

As a result of particularly difficult environmental conditions at the town's haven Great Yarmouth had long sought the opinions of the knowledgeable, even prior to its first attested use of piers. The earliest known of these was Hugh Herland, the great carpenter, in 1398 (Harvey 1954, 130; Cal. Pat. Rolls 1398). Thereafter followed a host of experts amongst whom were the Master of Mettingham College in the 1520s (Suckling 1846, 168-183) and John Thompson, formerly of Dover harbour in 1548 (Swinden 1772, 400). Perhaps the greatest of the town's experts was the Dutchman Joas Johnson described as "*a conninge workman well knowen to be verrye skylfulle in suche waterworks"* who was responsible for the *"two great mayne peeres"* of the 1560s (Swinden 1772, 412).

Whilst much is known, and published, on the great figures of engineering from the 18th-century, none of whom played a significant role with timber piers, much less is known is known of their predecessors, particularly those involved in pier building. In his masterly survey of historic engineering Alec Skempton asserts that, with one exception, prior to the 17th-century there were no 'professional' British engineers and that when situations demanded it was the usual procedure to employ engineers from the Netherlands or Germany (Skempton 2002, xviii). Unsurprisingly perhaps a significant proportion of the experts whose services were called upon originated in the Low Countries and Northern Germany, lands that not only had to contend with water related problems but, as shall be seen in Chapter 6, also possessed timber-built piers. Amongst these overseas experts was Joas Johnson, an un-named man of Emden called to Great Yarmouth in the late 16th-century (HMC 1883, 315), and Henrique Jacobson and Andrian Andrison at 16th-century Sandwich (Boys, 1792). Considerable numbers of experts were recruited from the Low Countries to work on the 16th-century harbours at Dover, with advice from this quarter still being sought in the 17th-century (Colvin 1982, 755-7; Skempton 2002, 67-69, 175-6).

The key craftsmen in the construction process were undoubtedly the carpenters, but at no point in any of the documentation is there any conclusive indication that these people were exclusively pier builders. Indeed two documents of the 1540s relating to Flamborough indicate that one of the carpenters, and probably a second, were working at the pier and also undertaking carpentry work at the local court house (TNA E 101/463/17; E 101/463/18). The craft skills of these two men was clearly one of general carpentry. As has been seen, in many senses the piers were not complex structures, merely a replicated series of bays. Whilst specific knowledge may have been helpful it may be that any skilled carpenter could, whatever their background experience, successfully repair or rebuild pier bays, provided they had access to upstanding work for reference.

The payment of carpenters at the piers, by the day and sometimes by the tide, suggests that they were employed to accomplish specific tasks and ceased to be employed once these had been done. Indeed security of employment for carpenters, and other workers, at pier sites was probably slender. In 1535, for example, we are informed that sixty men were discharged at Dover. Some were said to be idle, the sin of the remainder was to be old (L. & P. Henry VIII, 1535).

This is not to say that certain carpenters did not build up an important body of knowledge regarding the specifics of pier building. The volume of documentation concerning the requirement for regular maintenance and repair of timber piers would argue that the services of local carpenters are likely to have been regularly called upon. This will have built up a set of theoretical and practical pier related knowledge within that body of carpenters involved. In this context perhaps we can see a 'degree of specialism' on the part of some individuals. A number of the carpenters working at Bridlington harbour also worked at Flamborough and these men can perhaps be seen in this light. An important individual in the Henrician works at Bridlington was *"John Sykes thelder"*, who was almost certainly the father of one of the senior, 8d, carpenters *"John Sykes the younger"*. Sykes senior is recorded as *"Ryding to the wodds and brydlington key 13 days at sundry tymes for setting forthe of tymber at the woods by measures necessary having for hys costs and chargs by the day 12d"* (TNA E 101/622/29). The enhanced rate of pay and what appears to be a background in carpentry may imply a significant role; perhaps this was a man who was recognised as having valuable knowledge and experience of work at the piers. Further than that, we can perhaps in this instance catch a glimpse of such a 'degree of specialism' being passed from father to son.

The clearest picture we get of experts in pier building are the careers of William Lelum at Bridlington and John Reynolds at Southwold. We first hear of William Lelum in 1717 when he is described as a carpenter (ERRO QSF 39/C/14). In same year Lelum drew up itemised estimates for a new south pier and for repairs to the north pier, together with charges for wages for himself and the workmen. He is also described in this document as *"surveyor of Bridlington Peers"* (ERRO QSV/1/2 p 64-5). At a later date Lelum left the town to work on stone piers elsewhere (Neave 2000, 108; Binns 2001, 154, 185). John Reynolds was again from a carpentry background and by the 1730s had acquired a reputation for his expertise in timber work associated with river and harbour improvements (Skempton 2002, 571-4). In 1747 the commissioners of Southwold harbour advertised for *"persons to survey the haven and river, and to give in plans of the manner of improving the same"*. (SRO HA11/B7/2, 14). The north pier was built following a survey by John Reynolds who subsequently built the south pier also (Maggs 1842, xi). In the absence of professional British harbour engineers much before the 18th-century it is probable that indigenous expertise was largely the preserve of knowledgeable carpenters, in the ilk of Lelum and Reynolds, who were familiar with sea work. In this context it is

worth noting that high levels of technical knowledge and an ability to readily calculate complex mathematical problems were certainly matters possessed within the carpentry profession (Johnston 2005, 1-4).

The use of experts, management and the role of the Privy Council in the 16th-century Dover harbour works have already been considered by a number of writers to whom the reader is referred (see: Johnston 1994; Ash 2000; Ash 2004; Mock 2004).

In the pilot study for this thesis an attempt was made to reconstruct the range and hierarchy of various layers of 'management' and grades of 'worker' during the Henrician pier rebuilding works at Bridlington in the late 1530s – 1540s. The reconstruction was principally generated from State Papers. Subsequent investigation has shed further light and the revised reconstruction is presented in the Appendix, Case study 7: Bridlington.

2.10 Timber and its Supply

The case studies within Appendix 1 contain considerable information relating to the sources of timber, its supply, utilised species and scantlings. In some case studies no information on timber sources was encountered, in others, there is an immense profusion. This was particularly so with Great Yarmouth where the large volumes of 'Haven Account Books' spanning the 16th – 19th centuries contain vast quantities of data from the 'Provider's of Wood and Timber' (NRO Y/C28/1, (also) 2,3,4,5). Here the data is so extensive that these volumes could only be sampled. Whilst there remains considerable potential to elucidate more on this subject that data gleaned to date does permit a number of generalisations to be made.

Within the context of estate owned piers timber is known to have been sourced internally to those estates. Thus in 1531 Sir Robert Constable, Lord of the Manor at Flamborough, reaffirmed his accustomed right of way between his manors of Flamborough and Holme on Spalding Moor, in particular for carts carrying timber to repair the pier (YSCP III 1914, 25). In like fashion it is probable that the other estate owned piers, monastic and secular, at Hornsea, Bridlington, Filey and Whitby, all within Yorkshire, drew upon such resources internally. Again, at Bridlington the crown is known to have drawn on the vast areas of woodlands it acquired in various seizures during the reformation; both monastic

and manorial (L. & P. Henry VIII 1538b; TNA E 101/622/29; E 101/459/6). A similar course of action applied at Whitby (Young 1817, ii, 530). It is not known if the huge quantities of oak from east and central Kent and utilised in the Henrician works at Dover were from a similar source (Colvin 1982, 735).

Whilst estates may have had direct access to woods and timber within their own internal economies this was not the case for communities, lessees or commissioners who held piers. They were perforce required to obtain timber by other means. Normally this was by purchase although there are a number of instances of the granting of timber by the crown, for example at Scarborough in 1489 and 1565-6, and Bridlington in 1566 (Turton 1894, 122; VCH 1923; Cal. Pat. R. 1566). A more novel tack was adopted at Margate in 1641 when the expenditor of the sea-works adjacent to the pier, who was unable to raise funds, suggested to parliament that timber be taken from the lands of a delinquent royalist; alas to no avail (Smith 1646). There are many instances of bequests in wills towards the maintenance of piers although in just one instance, at Scarborough during the 16th-century, did a burgess leave timber, namely *"one great tree lying in Raynclif"* to the pier. In another instance a burgess left *"2xxs, or else in timber"* (Rowntree 1931, 379, 384).

In a number of accounts it is stated from whom timber was purchased. The earliest such references are of 1320 at Scarborough when a number of named individuals sold timber, often in fairly small quantities, for repairs to the harbour (TNA E/101/482/3). No information for purchase has been found for the 15th-century though in the 16th-century there are references for Sheringham and Great Yarmouth. In both cases the purchases were principally from titled individuals, lay gentry and ecclesiastics, though a number of purchases by Great Yarmouth were from individuals more simply titled Mr's (NRS 1987 &1988; NRO Y/C28/1 & 2). What is perhaps more interesting is that at Great Yarmouth the town had appointed *"Providers of Wood and Tymber"* whose role was that of purchasing timber with monies forwarded by the corporation and the keeping of accounts for the same. There is even evidence indicating that the town was purchasing woods, felling, converting the timber within the woods and selling on the by-products of conversion in the form of bark and prepared faggots (NRO Y/C28/1 & 2).

The surviving documentation indicates that until the 18th-century most timber purchases were made locally and regionally with carriage often being referred to as a costed item. Occasionally transportation by river was possible as at Great Yarmouth in the later 16th-

century (NRO Y/C28/1). By the early 17th-century, if not before, eyes were being cast further afield and in 1607 it was suggested that for the pier at Cromer *"this timber cut as scantlings for that purpose maie be provided wth lesse losse to the Kingdome out of Norwaie and wth lesse chardge, then in Englande"*. (RHS 1915, 124-126). During the course of the 18th and 19th centuries it is clear that much of the timber being used at piers was derived from overseas and was being purchased via timber merchants. Most of the pier sites with relevant records have indicators for distant sources of timber. To take just one example, that of Southwold, the 'Surveyors Books' of the commissioners commonly list: Riga fir, American pine or fir, American birch, and Norway fir. Lesser amounts of Memel fir, Baltic fir, Dantzic fir, Petersburg deals and yellow pine are also mentioned (SRO 491/20c/17). It is also clear that from at least the 18th-century these purchases were ready cut as planks, beams, treenails etc. of the required scantling; though the case of Cromer above suggests that this may have happened at a much earlier date.

One further source was from re-use and recycling. There are a number of references to the re-use of timbers from piers, for example at Bridlington in the mid – late 16th-century (L. & P. Henry VIII 1537a; TNA E 101/459/7; Cal. Pat. Rolls 1566). The use of recycled ships timbers at Cromer in the 1590s is implied by reference to *"a shippe wh was Bought for plankes for ye peare"* (NRO MS20403 12x6). The use of ship timber is referred to as late as 1792 at Broadstairs when it was *"Resolved that the Harbour Master shall or may Buy such old Ship Timber... for the use of the Pier"* (EKA UD/BS (uncat.) Box 2 1792-1814).

Mention of timber species is made within the documentary sources in a number of instances, all the earliest of which are to oak. The first non-oak reference is to fir and ash at Bridlington in 1539 and 1590 respectively (TNA E 101/622/29; E 133/6/920). There are no known non-oak references thereafter until the 18th-century. This is the very time when timber is known to be imported in bulk from overseas for use at pier sites, predominantly of northern species of fir. This accords with a number of engineer's reports of timber-built piers from the 18th-century onwards who refer to its presence.

2.11 Related Structural Forms

From conversion from tree to finished product, examination of the known elements of timber-built seacoast piers indicates that there is little, if anything, that is genuinely unique to them alone. Rather, the technologies and techniques used to fabricate these structures were drawn entirely from the repertoire of long-standing traditional carpentry practices. This goes beyond the recognition of the wider craft being typified by the employment of timber of uniform scantling that enabled the use of precision close fitting joints formed with sharp tools (Milne 1992, 80; Hewett 1980, 34) and extends to individual component parts. Thus we can see the use of driven piles, including close-piling used in a variety of contexts from building foundations to foundations and supports for bridge abutments and starlings (Salzman 1967, 84-86; Watson et al 2001). Again, the use of tie-beams in roofs was extremely common and almost universal in timber framed buildings. Bay division was as integral to timber-built piers as it was to timber buildings. Some similarities are even apparent between assembled parts of earth-fast piers and that of roofs, albeit in a somewhat inverted manner and examination of Figures 17 and 18 of Bridlington illustrates this well. Here, the angle driven piles and tie-beams forming the bay divisions could be regarded as equivalents of trusses, the horizontal rails as purlins, the vertical rails as rafters and the planking as roof covering.

Not only is there little that is original in timber-built piers, in comparison to the wider world of carpentry generally the technologies utilised in pier building, superficially at least, appear conservative and somewhat antiquated. Coarse similarities between close-piled piers and earth-fast stave buildings and between free-standing frame piers and timber framed buildings have already been noted. It has likewise been observed that close-piled piers were being built centuries after the technology of earth-fast stave buildings was redundant whilst timber framed buildings appeared centuries before the first attested earth-fast framed pier. There are likely good reasons why this was so. Established pier building technologies had proven track records, they did work – even if only just, they were expensive yet fragile, perhaps something not ordinarily to be experimented with.

Regarding other structural forms there are a number of parallels for techniques that appear in timber-built piers. Some of the closest of these are, unsurprisingly, to be found in other waterfront structures. Gustav Milne's publications of London waterfronts in particular

detail a number of structures that contain aspects of considerable similarity. Although Milne does not use the term ‘bay’, technically these occur in some of the London waterfronts, see for example: TX 3, TL 10 (Milne 1992, 50-52, 72-3). Systems of locking bars connected to braces and retaining vertically set plank walling can be found in a few of the London sites, see for example BG10, TX 3 (Milne 1992, 28-9), Figure 68, and TL7 (Milne and Milne 1982, 21-4, Figure 21). This closely mirrors arrangements depicted in the early depiction of Bridlington, Figure 2, and further afield that at Carrickfergus, Figure 98. There are also a number of waterfronts comprised of driven posts supporting horizontal planking, for example BG 14 (Milne 1992, 32-5) and the waterfront at Kingston (Potter 1991, 143-6). In 12th - 13th-century Hartlepool the Period 1, Phase 2 sea defences in Area B at Southgate were of timber box construction with stone infill (Young 1987, 20-1, 27). Here the box work was comprised of a series of uprights with horizontal planking to the sides.

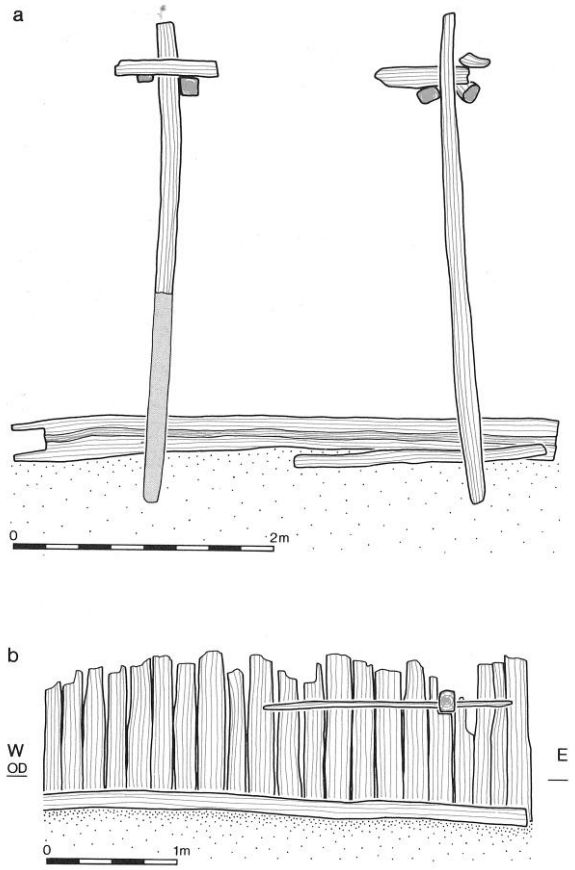


Figure 68, Waterfront structure BG10 (Billingsgate, London), mid – late 12th-century. Plan to top, elevation below. Note the rail/locking bar arrangement retaining wall of vertical planking. (reproduced from Milne 1992)

Bays as the basic unit of construction are common to a variety of medieval and post-medieval timber structures, from buildings to mill and fish pond dams. Of these the closest in form to piers appear to be the dams. John Harvey details the rebuilding of part of a mill pond dam at York in a contract of 1377. The works detail the rebuilding of timber bays and infilling with stones and clay, much like the internal ballast within piers (Harvey 1975, 193-4). In his consideration of documentation relating to medieval dams and water control Christopher Currie again finds evidence for bays which he considers to be timber frameworks (Currie 1992, 85-90). A similar picture appears in an examination of documentary sources relating to dams in West Yorkshire where a timber box framework between rows of piles is suggested. (Faull and Moorhouse 1981, 712-5).

Whilst the technology of timber-built piers was drawn entirely from traditional carpentry practices, the use of this on such large scales and their actual placing within harsh marine environments was original and can justly be viewed as audacious.

Chapter 3: Environmental Context

Having examined, and established a number of aspects pertaining to the technology of timber-built seacoast piers within Chapter 2, this chapter considers the placing of these structures within coastal environments. The environmental conditions of the England's east coast were, and remain, quite varied. Equally varied were the strategies involved in the placing of the piers within these environments, as well as the 'natural' responses of coastal processes to these intrusive structures.

Briefly explored in the first section of this chapter is the overall provision of ports within eastern England and a number of factors pertinent to this. Subsequent sections consider the coastal geomorphology of eastern England and the environmental context of the individual pier sites within defined geomorphological zones. This is followed by a section of concluding discussion which draws together the character of the principal environmental issues facing pier builders and their active and reactive responses to these. Finally, consideration is given to the pier builders themselves, particularly in regards to their technical backgrounds, the levels of environmental knowledge they possessed and how these changed through time.

3.1 The location and provision of medieval and post-medieval ports

An initial factor to register in this section is that ports with seacoast piers have always formed a minority of ports at any given time. Throughout the medieval and post-medieval periods most ports were located on either estuaries or rivers and seacoast pier sites can be regarded very much as the exception rather than the rule. If we look at medieval port lists for Yorkshire, for example, only fractionally under 15% of these had coastal piers at some point during their lives. The proportions for other eastern areas are not dissimilar from this mark.

The distribution of coastal pier sites shows a tendency for them to be located away from the mouths of navigable rivers. This appears to be owed to the fact that 'idealised ports', in economic terms at least, were better located on navigable rivers and estuaries than on seacoasts. The suggested rationale for the inland location of most ports is that being surrounded by land they can draw on wider hinterlands, with this effectively being

extended by navigable river systems. Further, comparatively benign riverine environments enabled them to support port infrastructure for a fraction of the material and monetary expenditure of seacoast piers. The only significant exceptions to this distribution are the pier sites of Hartlepool, located c. 6km north of the mouth of the River Tees and Great Yarmouth at the mouth of the River Yare. As we shall see, in both of these cases there were unique and particular circumstances accounting for this.

One further point that should be made about the location of a number of earlier pier sites and the small settlements associated with them is that they sometimes formed one part of a polyfocal settlement pattern, in which the other part, typically larger, lay some distance inland. This situation applies to Scarborough (probably), Bridlington, Hornsea, Sheringham, Margate, Broadstairs and Ramsgate. In these cases the smaller pier settlement was typically engaged in fishing and maritime activity and the larger most commonly in agriculture. The precise nature of the relationships between the larger and smaller settlements was varied (see Appendix 1). In all these cases subsequent expansion of the individual settlements has led to the physical merging of the two parts.

In terms of usage and function coastal and inland ports performed broadly equivalent functions. These were principally trade, the shipping of goods and people, though many coastal ports were additionally the bases for fishing fleets and sometimes the foci of military activity. As a result of their uniquely challenging and harsh environmental settings the physical character of seacoast pier infrastructure was significantly different from that of other port sites on estuaries and rivers. Timber-built seacoast piers were commonly large, tall, structures, built out into the sea, susceptible to damage on all sides and confronted by changeable and often extreme wave, tide and current conditions. Gustav Milne has observed that on certain historic waterfronts in London the greatest areas of decay occurred between the high and low water marks, this being a result of twice daily immersion and drying out (Milne 1992, 79). Given that tidal range extremes are greater at coasts than estuaries and rivers we must imagine that such effects are also likely to have been greater at pier sites. A further negative concomitant of tidal ranges is likely to have been the changing effects of water pressure on the stone filled timber shell of a pier at different states of the tide. Further than this, and since the mid 18th-century if not before, the common shipworm (*Teredo Navalis*) has been an active agent of timber decay in saline conditions (defra website). Within the study area the shipworm is known to be present in East Anglia and the south-east though is widely thought to be present

around all British coasts. Another saline dependent timber burrowing crustacean is the gribble (various species of marine isopod of the family *Limnoriidae*). Certain gribble may be native species and 'the worm' causing damage to the piers at Bridlington in the later 18th-century, reported on by John Smeaton, was almost certainly gribble (Smeaton 1778).

By contrast, inland ports were normally characterised by relatively simple riverside revetments and occasionally by fairly slight projecting jetties that seldom faced the extremes of the natural elements encountered at coastlines. A survey of the considerable literature for medieval and post-medieval inland port infrastructure indicates that these were again predominantly timber-built though there was an increasing tendency for the use of stone in the post-medieval period, particularly from the 18th-century onwards (Milne and Hobley 1981; Herteig 1985). A direct consequence of the environmental setting of seacoast piers was the required, and frequently regular, expenditure of large quantities of resources and money on their construction, maintenance and repair. Above this, the harsher marine environment necessitated the employment of timber of larger cross section than that often utilised at inland ports as well as they being of greater length, this latter being dictated by the extremes of tidal ranges. Whilst certain broad technical parallels have been drawn between seacoast piers and inland waterfront revetments in Chapter 2 the particular technical details of such inland waterfront constructions display a considerable amount of variation. Milne's masterly survey of London waterfronts has demonstrated that here the variability reflects changes and developments in vernacular building practice, including the transition from earth-fast forms to full timber framing (Milne 1992, 6, 11). As has been seen, such variation in timber-built seacoast pier construction is not as extensive and appears to owe little to developments in dry land carpentry and building practice. It would appear that the relatively benign environmental conditions at inland ports permitted a wide range of solutions to waterfront construction, namely that of the prevailing carpentry traditions of the time, whilst the range of choices at seacoasts was constrained by environmental conditions that limited technical options and always demanded that piers be 'built big'. As shall be seen in Chapter 4 one implication of these factors were forms of ownership, management and funding that were significantly different from those ports without seacoast piers.

If we accept that inland locations were in many ways preferable to seacoasts for port sites, why then are there coastal ports that ultimately required the provision of difficult, costly and maintenance heavy piers? To a considerable degree the answer appears to be one that

was environmentally determined. Extensive stretches of the eastern seaboard of England lack navigable access to the interior via estuaries and rivers. Where this was the case all shipping requirements of these areas were obliged to either travel considerable distances overland, or, utilise coastal sites.

Empirical observation suggests that historically all parts of England were to some extent 'occupied', and even leaving navigable waterways aside, the greatest density of settlement was arguably in those areas enjoying more favourable environmental conditions. This would of course include areas in which pier sites came to exist. Further, it is also widely acknowledged that the nature and relatively small size of early seagoing vessels up to, and beyond, the 10th-century ensured their easy beaching and a requirement for little in the way of port infrastructure (McGrail, 1985, 12-13). Whilst pier structures would provide additional security to such beached vessels in conditions of rough seas and high tides it is probable that the real impetus for the provision of piers was a growth in the size of seagoing vessels that could less easily be drawn up on a beach as well as by an increase in trade leading to a multiplication in the number and use of such vessels. In many locations it may be the presence of certain suitable aspects of the coastal environment that encouraged the success of coastal settlements prior to the construction of piers. We can see an example of this in a cluster of five Yorkshire examples, Whitby, Scarborough, Filey, Flamborough and Bridlington which all originated long before their first recorded piers. All were situated in locations that provided an enhanced degree of natural shelter, permitted the beaching of vessels and ready access to those beaches from the land. Such settings can be seen as favourable to both the use of early seagoing vessels as well as for bases for fishing. It is likely to have been the combination of the shelter and access attributes together with the presence of the settlements themselves, particularly where they enjoyed levels of economic strength, that ultimately encouraged the 'improvement' of these sites by the provision of piers.

Setting environmental determinism aside, there were a range of more socially orientated factors that encouraged the development of coastal ports. These were rooted in particular social and economic contexts and in some cases ultimately led to the provision of coastal piers. One of these factors was probably a desire for port ownership within and by large estates as parts of their 'internal socially-embedded economies' in which broad control of a conduit of exchange could be established. Such estates could also draw on their own sources of timber and of cheap labour-forces through owed labour services. Other factors

may have been civic prestige and the relative ease of regulating restricted spaces. In more overtly economically orientated examples it was the benefits in trade that could be accrued that spurred pier development, and in an inverted sense this could even include political opposition by one town against port and pier development by another. Such socially and economically orientated aspects of port development are explored within Chapter 4.

In environmental terms it was the natural coastal landscape that formed the backdrop to pier building enterprises. At the coastal ports it was the eventual unsuitability of these existing landscapes to satisfactorily serve developing maritime needs that motivated the building of piers in order to provide more suitable, enhanced, ports. The provision of coastal piers then only enters the equation where 'ideal' natural locations, or largely natural, harbours are absent and where infrastructure is demanded by specific maritime needs. There were of course preferred natural locations along stretches of coast, most typically leeward of headlands. Whilst these could provide shelter, a degree of protection from longshore drift and meet the limited maritime requirements of small ships, they provided only a fraction of the range of facilities ordinarily desired of a good port capable of serving the needs of numbers of large ships. 'Upgrading' the maritime capabilities of these locations commonly required the provision of piers, a process that in the study area seemingly begins by the mid 13th-century.

This chapter will show that piers were intrusions into existing environmental conditions and such intrusions commonly resulted in 'environmental reactions' that had not been foreseen and in many cases were detrimental to human aims and goals. This often necessitated additional response or countermeasures such as the use of rock armour, breakwaters, sluices, scouring devices, pier extensions etc. that had not formed parts of original intentions. Throughout this we can see that bodies of environmental knowledge could be built up and acted on, particularly in the cases of certain individuals and groups. Finally, research at a number of the case study sites indicates that piers were often concerned with defending the land from erosion as much as they were for providing harbour facilities. In a handful of instances it is simply not possible to separate the two, or indeed suggest that one function had primacy over the other.

The quality and quantity of pertinent environmental data for the historic timber-built pier sites is highly variable with this being owed to a combination of evidence survival and

existing environmental data. Those pier sites for which this information is richest have the potential to better inform us of human interactions with the environment and of the levels of contemporary understanding of coastal processes. This chapter does perforce focus on those examples. Definition and explanation of a number of technical terms is provided by the Glossary of Terms in Chapter 1. Most of the aerial imagery displaying the setting of the historic piers within this chapter has been taken from Google Earth. In all these cases north is to the top.

3.2 The coastal geomorphology of eastern England

Since the last glaciation of c.110,000 - 12,000 years ago changes in sea level along the eastern seaboard of England have been determined by two principal factors. The first of these is isostatic change, in essence rises and falls of the land mass due to glacial rebound. During the last glaciations considerable volumes of ice overlay the land mass of northern Britain, the most southerly parts being relatively unaffected. The melting of the ice resulted in the slow and continuing process of glacial rebound, that is the rising of the land mass subsequent to the retreat of the ice (Shennan et al 2006). This process is uneven and north of an imaginary line between the River Tees and Dee estuary slight rises are known whilst to the south of this point the evidence indicates slight falls (www.climatenortheast.com). The reason for these varied changes is owed to northern Britain being covered by ice for a longer period as a consequence of which the increased level of rise in this area is causing a tilting of the land mass resulting in an overall fall in southern Britain. The second factor is eustatic changes, principally a rise in sea level as a result of melting ice, mostly towards the polar regions. This is exacerbated by thermal expansion of the sea resulting in its occupying a larger area.

The mean, or average position, of sea level is widely thought to have been relatively stable for around the last 6,000 years (www.climatenortheast.com). Between 600 – 800 AD sea levels may have been a little below that of the present. Levels are thought to have risen in the region of 0.4m – 0.5m above those of present around 1000 AD with further lesser rises to around 1300 – 1400 AD. Thereafter, the colder climatic conditions of the 'Little Ice Age' are believed to have led to slight reductions in sea level up to the 19th-century after which time they have again very slowly risen (Lamb 1991, 16). Such relative stability implies that the piers considered within this study were built with respect

to sea levels that were broadly similar to those of today. As a result of this the footprints of several historic timber-built piers are now occupied by post-medieval and modern successors.

Matters of greater relevance to timber-built piers in relation to modern coastlines are the erosion and accretion of sediments caused by various coastal processes that are considered below. These have wrought far reaching transformations and have significantly affected the fortunes and fates of many historic pier sites, with at least half of those examples south of Flamborough being heavily impacted on. Such transformations were commonly localised, highly varied and best considered on a case by case basis. The result of the placement of piers in areas of such ongoing processes often resulted in various degrees of undesired and unpredicted outcomes. This in turn led to revised schemes and the introduction of countermeasures. It is these human interventions and the associated levels of understanding, knowledge and expertise that drove them that form a core element of this chapter.

3.2.1 Zone 1: Newbiggin by the Sea to Flamborough

(Newbiggin by the Sea, Hartlepool, Whitby, Scarborough, Filey, Flamborough)

This zone is characterised by a cliffed rocky coastline and slow erosion. Extant stone-built post-medieval piers occupy what are believed to be the same footprints of their timber-built predecessors at Hartlepool, Whitby and Scarborough. That such spatial continuity is possible is owed to the placement of additional works around the landward ends of the piers rather than to an absence of erosion processes along the coast. Remains of the pier structures at Filey and Flamborough have never been subject to such defence and their remains now lay a little over 50m from the base of existing cliff lines.

The pier sites within this zone predominantly lie to the southern sides of substantial headlands in whose lee they are sheltered. Protected from the prevailing elements from the north-east a number of documentary sources make it clear that these sites were most susceptible to damage by strong winds from the east and south-east. This will have especially been the case when such conditions coincided with spring tides. The mean spring tidal range for these sites is around 5.8m at Newbiggin, Hartlepool and Whitby and up to 6.4m at Scarborough, Filey and Flamborough. In the cases of Hartlepool and

Scarborough the construction of piers was intended to create deep water harbours accessible by shipping at all, or most, states of the tide. Documentary sources however, indicate these pier sites were, or became, dry at low water; almost certainly as a result of silting subsequent to the construction of piers.

The pier at Newbiggin appears likely to have had a life-span restricted to the early – mid 14th-century, Figure 69. Visible pier remains were present in the mid 18th-century though were absent by the 20th-century (Cal. Pat. Rolls 1316; Hodgson 1832, 216, 219; Hodgson 1902, 74, 216, 219; Wallis 1769, 340). The reason for this later absence of material remains is believed to relate to post-medieval coal mining that has locally served to lower the seabed and led to increased rates of coastal erosion (Atkins 2004, 12-13).

Figure 69, Newbiggin by the Sea and its sheltered bay. The medieval pier is believed to have been located in the area of the northern headland and probably extended into the sea in a south or south-westerly direction – perhaps in the same location as a modern stone mole. Probable pier site shown in red. (source: Google Earth)

It has already been mentioned that Hartlepool lies just 6km to the north of the River Tees which was navigable beyond the inland medieval and post-medieval port of Yarm some

20km from the coast, Figure 70. There was ecclesiastical occupation of the headland at Hartlepool between the 7th-century and at least 10th centuries and this seems likely to have been the spur for secular occupation. The existing layout of the town owes much to its planned establishment as a 'new town' and port in the 12th-century by the de Brus family (Daniels 2010). The port of Hatlepool's proximity relatively close to a navigable river therefore appears to be owed to pre-existing settlement patterns and the boost provided by 'new town' establishment. Serving as an entrepot to Durham also helped to foster the port, whilst its location as one of the northern ports close to the Scottish border was key to its role as a major transport and supply port for English armies during the Anglo-Scottish wars (Daniels 2010). These particular factors go some way, at least, in explaining the location of the port of Hartlepool so close to a navigable river. A significant decline in the town's fortunes at the end of the wars perhaps reinforces this view.

Figure 70, Headland of Hartlepool and mouth of the River Tees to the south. The historic pier (red) lay to the south of the headland (see also Figure 54) (source: Google Earth)

The earliest port facilities at Hartlepool were a series of docks built within a small natural inlet at the south-western side of the headland known as the inner harbour, Figures 54 and

55. Parts of these docks have been seen in a number of antiquarian observations and modern excavations and their earliest parts date from the beginning of the 13th-century, if not before, whilst they continued in use until the early 19th-century (Sharp 1851, 150; Daniels 1988; Daniels 2010, 144-167). Over the centuries these structures were progressively built ever westwards with the area of older structures behind being in-filled and reclaimed.

On the basis of height data in conjunction with the known modern tidal range it has been suggested that there would have been only c. 0.8m of water in parts of the excavated medieval docks at mean spring high tide. This situation had almost certainly changed by the mid 16th-century as Robert Dromeslawer's depiction shows the vessels within the chained-off open inner harbour to be of some size whilst in c. 1800 Sharp records the inner harbour as containing 6 – 10 feet of water at high tide. It would appear then that the westward shifting pattern of docks is likely to be owed to process of silting, followed by land reclamation that encouraged reconstruction in the deeper water to the west.

The construction of a pier at Hartlepool, seemingly by 1318, created an outer harbour whose building may have been prompted by a desire for a deep water haven untroubled by the silting problems of the inner harbour. Bleau's navigation chart and accompanying text indicate that by the early 17th-century however the area adjacent to the pier was dry at low water, an observation that was verified by Greenville Collins at the end of that century (Bleau 1643; Greenville Collins 1693, 11). The stated intentions of building a pier to create a deep water harbour, only for this subsequently ceasing to be so, is a recurring theme at pier sites generally and this is likely to have been the situation at Hartlepool. This general phenomenon will be considered in greater detail in a number of better documented sites within this section. However, the nub of the issue in this instance is likely to have been that sediment in suspension was deposited on the western, leeward, side of the pier during the ebb tide.

The slightly anomalous member within Zone 1 is Whitby whose timber-built pier lay at the western side of the mouth of the River Esk, though even here a degree of protection was afforded by the east and west cliffs, Figure 71. The historic lower harbour of Whitby lay on the upriver side of the pier. Although located at the mouth of the esturine Esk this watercourse was only navigable a little way to the south of the town and only then at

higher states of the tide. There are few records relating to the early pier at Whitby and none concerning historic environmental issues.

Figure 71, The likely location of Whitby's timber-built pier (red) in relation to coastline and River Esk (source: Google Earth)

The planned town of Scarborough lies at the northern end of Scarborough Bay and nestles on the southern slope of the neck of land that connects to the tall headland, Figure 72. The port was comprised of both a pier, extending from the south-east end of the headland, and an adjoining waterfront below a former cliff-line, that followed the curve of the bay eastwards of the pier. Whilst both elements, together with an island pier, functioned as an integrated entity it is uncertain if one of these elements developed as a formal structure before the others. An entry in the Patent Rolls for 1252 authorised the building of a new port at Scarborough and a stated aim was to create a deep water harbour "*where all ships may enter and leave without danger, as well at the beginning of the flood of the seas as at*

full flood" (Cal. Pat. Rolls 1252). It is probable that this could only be achieved by the construction of a pier and one was certainly present around 1320 (TNA E/101/482/3).

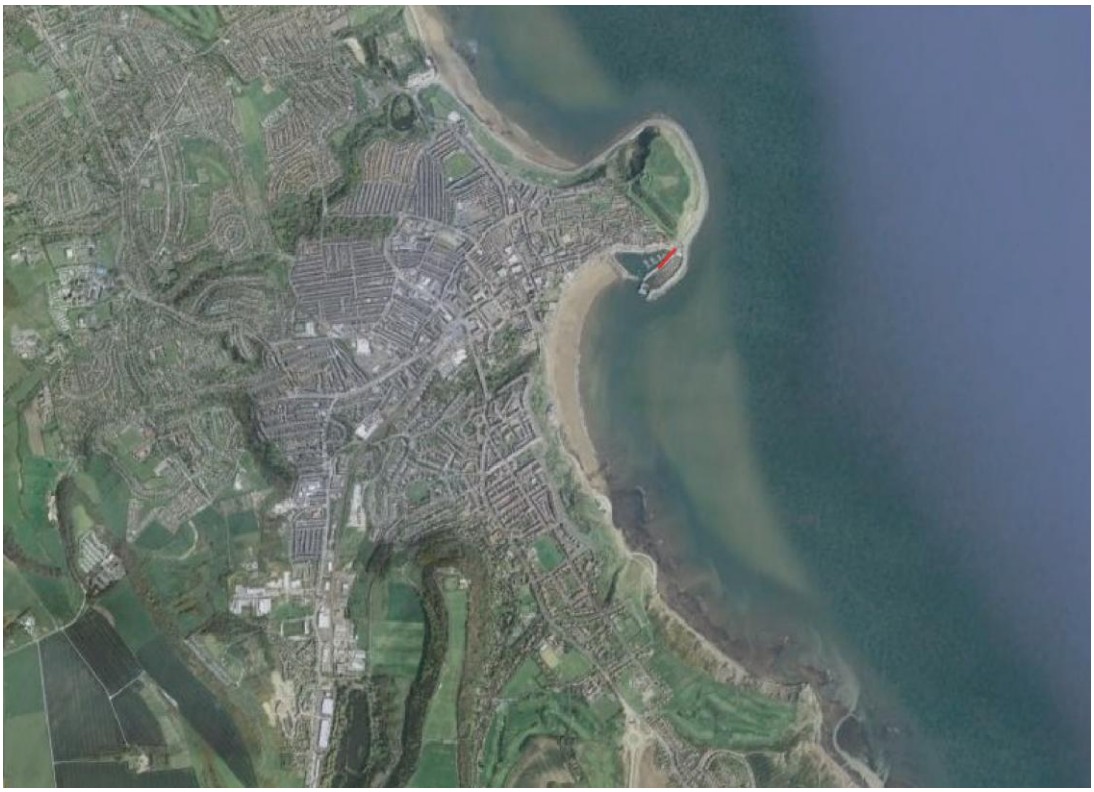


Figure 72, The setting of the medieval pier at Scarborough (red) in relation to coast, headland and town (source: Google Earth)

The archaeological, documentary, topographic and cartographic evidence indicate that since the medieval period Scarborough's shoreline quayside has progressively shifted seaward, for a distance of up to 70m. Although the pier appears to have retained its general position and alignment, its length seawards, at least in the post-medieval period, was also increased. It seems reasonably certain that the progressive seaward shift of both foreshore waterfront and pier relate primarily to silting within the harbour rather than to calculated land reclamation. As such, the maintenance of a sufficient depth of water suitable for shipping appears to have been the driving factor in this movement. This situation was summarised by the harbour's engineer William Chapman *"shallowness of harbour always followed the completion of works, which occasioned the necessity of their farther extension; which was again succeeded by the sand following these additional*

works." (Chapman 1800, 11). It is clear from 18th-century documentary sources that it was known and understood that harbour works were at least in part responsible for silting within the harbour and that these had, perforce, been progressively advanced seawards. The latter point, and perhaps the former, must always have been known and presumably represented what was considered to be the most convenient solution to the problem. Despite the documented intentions for a deep water harbour, throughout much of its history it appears that vessels of large burden were only able to enter Scarborough's harbour at full tide (Hinderwell 1798, 165).

Writing in 1800 the engineer William Chapman believed the primary cause of historic silting within Scarborough's harbour was owed to the tranquillity of the water at this northern extremity of Scarborough bay, shielded as it was to north and west by land and to the east by the pier (Chapman 1800, 11). Sediment in suspension brought into the area of harbour by the tide was here deposited and accumulated. The tidal current that flows in the direction of the harbour from the south-west, from half flood to nearly low water, appears generally to have been insufficient to create much effective scour. This was almost certainly exacerbated by the presence of an island pier to the southern side of the harbour that is known to have been in existence from at least the 1530s. The likelihood is that this island pier, which will have been intended to provide protection and mooring, hindered both the flow of the tidal current into the harbour as well as the egress of sediment at the ebb. A small watercourse flowing into the bay was too small and located too far south to have been utilised for scouring the harbour. (Hinderwell 1798, 165).

There is some documentary evidence that alludes to the processes of excessive sediment deposition clogging up the medieval harbour. As early as 1298 it was stated that *"The quay and Port of Scardeburgh require repairs and cleansing to the amount of 300l. and 400 marks"* (Cal. Inq. Misc. 1298). The 'cleansing' almost certainly refers to the need to be rid of excessive sediment. In the post-medieval period there was occasional employment of gangs of people to dig out such sediment and this may well have been the case at an earlier date. There is also some evidence to suggest that as new shoreline waterfronts were advanced accumulated sediment within the harbour was dug out and deposited on its landward side. Dumps of sand dating to the medieval period encountered during excavations seem likely to relate to such processes (Pearson 1987, 32; Scarb. Arch. Gazetteer). There is reason to believe that the low lying reclaimed land behind the quayside will have been vulnerable to inundation by the sea during storm surges as it was

recorded in 1275 that *"the said quay has entirely fallen into decay, and many of the said houses have in consequence been destroyed by the sea"* (Cal. Pat. Rolls 1275). The proximity of buildings to the quay suggests that it was the foreshore waterfront that was referred to. We can therefore see an additional role of this waterfront as a defensive seawall.

In the post-medieval period a number of methods were devised to prevent sediment build-up within the stone piers. These ranged from different configurations of the pier heads to the use of low set apertures in the pier wall that admitted the inflow of water additional to that through the pier heads. This lessened the calmness of the water and increased sediment suspension some of this then flowing out of the harbour during the tides ebb. Whether any such methods were attempted for the earlier timber-built piers, here or elsewhere, is not known.

The settings of the piers at Filey, Figure 73, and Flamborough, Figure 74, differ from most others along the east coast, being located over 1km from their associated settlements situated on higher ground with access being via ravines. The importance of precise topographic location in the siting of these structures, directly in the lee of headlands, is highlighted by the observation that access to each required the traversing of around 200m plus of foreshore. It may be the relative isolation of these sites that permitted the survival of material remains as well as associated place-names (Quay Rocks and Quay Hole – Filey and Key Hole – Flamborough) Both sites lie a little over 50m from existing cliff faces. This proximity demonstrates the relatively slow rates of erosion at both sites. As befits the scale of their related settlements Filey and Flamborough were both small piers accessible by vessels only at higher states of tide, and originated in manorial contexts. Neither survived beyond the earlier part of the 17th-century.

Figure 73, The setting of the pier remains at Filey (red) in relation to Filey Brigg and town (source: Google Earth)

Figure 74, The location of the historic port infrastructure at Flamborough (red) in relation to Flamborough head and village (source: Google Earth)

3.2.2 Zone 2: Holderness

(Bridlington, Hornsea)

This stretch of coast is characterised by low, soft boulder clay cliffs, generally around 15m tall, fronted by narrow beaches and subject to severe coastal erosion, Figure 75. The sea is continually able to reach the base of the cliffs and the greatest incidences of land-loss occur due to the action of storm waves and tidal surges. The process responsible for the removal of eroded cliff is commonly known as longshore drift in which the waves arrive at an angle to the beach, in line with the dominant north-east to south-west current, and progressively move sediment in a southerly direction (Bird 2008, 162). The tidal range along this stretch of coast is up to 6m.

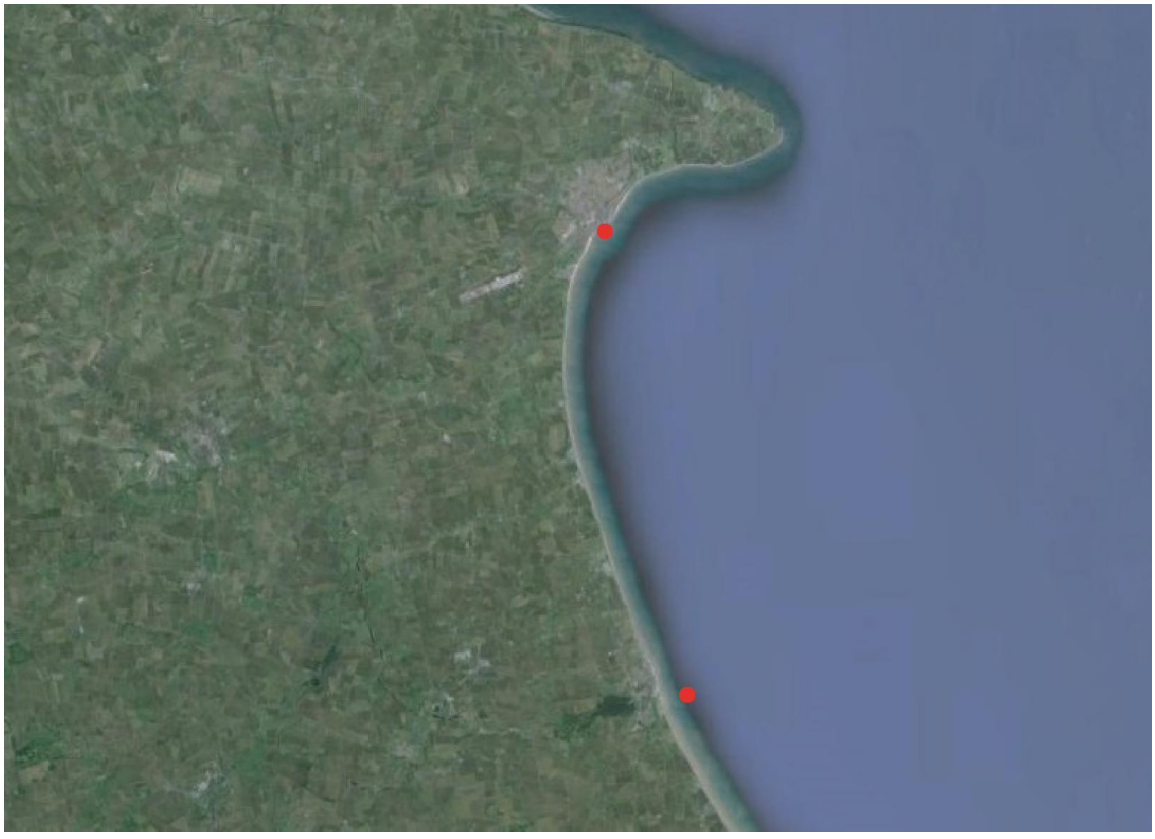


Figure 75, The timber-built pier sites of Bridlington (upper) and Hornsea (lower) in relation to the rapidly eroding Holderness coastline (source: Google Earth)

From at least the 16th-century the harbour at Bridlington was formed of a north pier and a longer south pier between which a small stream flowed. Although documentary material for Hornsea refers to a pier (singular), late 16th-century cartographic evidence does suggest the possibility that the arrangement may have been a twin 'enclosing' pier arrangement, much like that at Bridlington though on a smaller scale (British. Library. 1). Again like Bridlington, a small stream flowed into the sea immediately to the south of the north pier. Both harbours are believed to have been dry at low tides.

Widely considered to be the fastest eroding coastline in Europe the coast of Holderness has long formed a focus of study by geographers and is today one of the most intensely monitored. Accordingly, there is considerable data relating to processes and rates of erosion as well as beach profiles. Historically, the rates of erosion are known with considerable precision for the last 150 or so years. Prior to this there is some data relating to specific periods of observation. Since 1852 the mean rate of erosion has been 1.24m per year with recent observation suggesting that the rate is roughly twice as great in the southern part of the area than the northern (urbanrim.org.uk/Holderness) It is commonly supposed that these rates of erosion broadly hold true for the last millennium or more and that a strip of land several kilometres wide has been lost since the Roman period (Eurosion 2002; Ostler 2007). The scale of erosion can be demonstrated by comparison of the pier at Hornsea with that of the broadly contemporary Flamborough, a little over 21km to the north in Environmental Zone 1. Whereas the surviving material remains at Flamborough presently lay little more than 50m from the foot of the cliff the site of Hornsea's pier now lays over 0.5km out to sea. Bridlington has been subject to a far lower rate of erosion than areas to the south of the town and this is owed to two factors. Firstly it lies immediately south of the point of transition from chalk to boulder clay cliffs and is afforded protection by Flamborough Head. Secondly, areas to either side of the piers have been subject to various protective works for in excess of at least 350 years (Purvis 1926, 190). Such defence works now exist at a number of locations south of Bridlington and have been conclusively demonstrated to result in higher rates of erosion immediately to their south (urbanrim.org.uk/Holderness).

Concern over erosion along this coast has been voiced since at least the 14th-century by local communities (Ostler, 2007) and as early as the mid 16th-century documentary sources imply a recognised connection between the decay of piers at Bridlington and Hornsea and the loss of land to coastal erosion. In a letter of 1562, for example, the

Marquis of Winchester commented on the state of decay of the port at Bridlington and the consequent erosion this caused (Purvis 1926, 167-8). It is noteworthy that Purvis's examination of the documentary sources for Bridlington refers to coastal erosion eight times and in all but one of these cases reference is made in this context to the piers (Purvis 1926, 41, 93, 114, 167, 187-8, 190, 192, 207). Typical of such references is a petition of the 1660's which states *"That since the peere was broken downe the Sea hath washed away much of the maine Land and if it be not repaired will in short time wash away that part of the towne called the Keye"* (Purvis 1926, 188).

At Bridlington the worst effects of storms and erosion appear to have often taken place at the junction of the north pier with the land (Purvis 1926, 190). The documentary evidence indicates that any breach here led to the silting up of the basin and in one such incident in the 1670s, the depth of water within the harbour was reduced from 12 feet (3.66m) to less than 6 (1.83m) (Purvis 1926, 187). A sluice system (clowes), almost certainly built within a dam wall, regulated the flow of the stream into the harbour and was intended to prevent excessive accumulation of sediment. A sluice was already present in 1539, when money was paid for *"Amending of the clowes"* (TNA E 101/622/29). In such a system the closing of the sluice before high tide would back up the flow of the stream whilst the opening of the sluice on the ebb would release a large flow of water to scour the basin. It is believed that the clowes system became obsolete at Bridlington around 1769 as an entry in the Harbour Minute Book for 24th June of that year records *"Ordered that the clough* (clowe) *at the Upper End of the Harbour be sold by publick sale and the Materials thereof taken away at the Expense of the Buyer or Buyers"* (BL 52:67). Quite why this sluice system was abandoned at Bridlington is uncertain.

Erosion could also take place at the landward end of Bridlington's south pier. In 1590 three rooms were said to be worn away at this point and this had prevented the channel from *"wuarkinge"* (working/scouring the harbour basin). It appears that the normal course of the stream, flowing into the harbour, had been disrupted, possibly forging a channel through the decayed landward end of the pier. This problem with the stream was exacerbated by the fact that *"The clowes* (sluices) *be in great decay"* and so *"they have not skow'red* (scoured) *yt as they ought, of long tyme as yt should seame for yt is full of great sand beds"* (TNA E 133/6/920). Erosion at the landward end of the piers seems to have resulted in the overall length of the piers increasing by their being added to in these areas rather than at their heads.

Measures to prevent such incidences of damage to the piers are known to have been put in place from at least the mid 16th-century. *"Sonke/n joties/lockers"* are mentioned on a number of occasions in the Marian and Elizabethan documentation for Bridlington (e.g. TNA E 101/459/7; Cal. Pat. Rolls 1566; TNA E 133/6/920). Where the location of these features is referred to, it is in relation to the north pier, presumably as this is where the most corrosive of the natural elements tended to impact. It seems reasonably clear that these devices were used to prevent or minimize the effects of damage by breaking the force of wave and current. Thus it was said "*sunken joties which be moost necessary defences between the mayne pere and the surge of the see"* (TNA E 101/459/7). The term 'sunken' presumably implies that at high tide the lockers were submerged.

In relation to Bridlington's later piers there is a reference to lockers, not sunken lockers, in 1728 when it is said that following damage to the north pier *"it is absolutely necessary to build lockers or jetty's to preserve the same"* (ERRO QSF/80/E/25). Again, in 1770, the Harbour Minute Book for Bridlington records a *"locker on the outside of the north pier"* and that it *"be made the same height of the said North Pier"* (BL 52:67 Extracts from General Minute Book 1765-89). The height of these later lockers, certainly that of the latter reference at least, indicates that these were no longer 'sunken'. Whilst it is tempting to see these late structures simply as breakwaters it is interesting to note that elsewhere in both document QSF/80/E/25 and the Harbour Minute Book, reference is also made to breakwaters. The implication here is that such structures were not the same and that contemporary distinctions, albeit not presently understood, were made.

There is evidence from Bridlington for erosion at the pier toe, that is that part that terminates the base of the pier on its seaward side. As such it is located in the critical zone where the rigid structure meets the mobile material of the foreshore. Unsurprisingly *"Toe erosion is the most common cause of seawall failure"* (Thomas and Hall 1992, 163). In modern structures this vulnerable area is normally protected by a line of deep set sheet piles or by the provision of an apron, typically either in concrete or in a linear spread of large rocks – 'toe rock armour' or 'rip-rap' that serves to lessen wave impact (Thomas and Hall 1992, 134-5, 163-7). In 1590 it was stated that *"ye wood workes be in great decay, for ye ground work is worne away, ye stone falleth owt of them"* (TNA E 133/6/920). Whilst it is quite probable that the sunken lockers at Bridlington detailed above may have functioned to protect the toe areas of the pier walls, there is no documentary evidence of rock armour until 1773. At this time stones were instructed to

be laid at the outside of the north pier *"as well to protect the Pier from the violence of the Seas as from the Worms"* (BL 52:67 Extracts from General Minute Book 1765-89). One other point worthy of mention is that in his description of the harbour the engineer Smeaton noted that towards the pier heads the spacing of piles narrowed, this increased provision presumably providing additional strength in a potentially more vulnerable area (Smeaton 1778, 3).

Equally explicit linkages between a pier and coastal erosion are to be found for Hornsea. The earliest reference we have to the pier here states that it also had the effect of functioning "*for the defence of the country* (locality)*"*, that is in preventing coastal erosion (L. & P. Hen. VIII, 1537). Not that many years after the loss of the pier it was very much local opinion that Hornsea's pier played a key role in minimising the effets of coastal erosion. An inquisition of 1609 tried to quantify the scale of land loss (TNA E178/4813). It was said that since 1546 thirty eight houses and their gardens had been washed away and that a strip of land some 240 yards (219.5m) wide had gone beneath the waves. The local inhabitants giving testimony referred to the former presence of a pier *"during the continuance whereof the decay was very little"*. Further, they concluded that the *"remedye be had eyther in the reedification of a Peer or some other suche lyke defence be maide for the same"*.

Given what we know of the erosion at Bridlington's piers, the principal difficulty at Hornsea may again have been perpetually maintaining a continuous land link at the landward end of the pier. Hornsea's location further down the Holderness coast meant that its pier would have been more susceptible to such erosion than Bridlington's, though the result of such breaches, namely the infilling of the harbour with sediment would have been the same. Whether such structural countermeasures as the jetties and toe armour at Bridlington were ever constructed at Hornsea is not known. In all likelihood it was the unwillingness of any body or group to shoulder the burden of continuously maintaining the pier in such challenging environmental conditions at Hornsea that ultimately led to its loss (see Chapter 4).

There is a sandbank, known as the Canch, which lies just beyond the mouth of the present Bridlington harbour. The earliest reference to this feature however is in an inquisition of 1590 when it is said that *"ye slues is in great decaie and doethe nott hold water to dryve ye kanshe awaie"* (TNA E 133/6/920). The document goes on to inform us of the

difficulties in maintaining a channel between the Canch and the south pier. Clearly then the Canch has for centuries formed just outside the harbour mouth and in the past waters from the stream that flow into the harbour have been used to control the sandbank's accretion. Modern hydrodynamic study has shown how the Canch has been, and still is, formed. On the flood tide some sediment passes along the north pier supplying the shoal area of the Canch whilst locally strong easterly currents running along the south pier and past the end of the north pier tend to sweep sediment away from the structures, leaving the canch as a remote submerged feature on the seabed separated from the north pier by a shallow channel known as the Gyle (Wallingford 2009, 18). The formation of the Canch then is a result of human intervention, specifically the imposition of a twin pier system. The builders of the original harbour were almost certainly ignorant of the fact that the configuration of their pier system would produce such a sandbank and the clowes system that was utilised to minimise problems with sedimentation is likely to have been a secondary development.

The evidence for a twin pier system at Hornsea on the manuscript map of 1595 has already been outlined. Adjacent to the harbour on the same map appears the wording *"warpe in and owte".* In nautical parlance to 'warp' is to move a vessel by means of ropes (warps) fixed to a secure point such as a pier, anchor or buoy. The implication of this instruction is that either the harbour was exceedingly shallow or a sand bar or bank lay close to the pier head/s. In either case such sedimentation would appear likely to have been an unpredicted outcome of the construction of the pier/s. Warping can be seen simply as a response to this difficulty. If we assume that Hornsea did have a twin pier arrangement it may be that the problem was an external sandbank that had formed as a result of similar processes to those that created the Canch at Bridlington.

3.2.3 Zone 3: Eastern North Norfolk

(Sheringham, Cromer)

The north Norfolk coast in the area of Sheringham and Cromer is of soft cliffs generally under 40m tall and composed predominantly of thick, soft, clays, silts, sands and gravels overlaying cretaceous chalk, Figure 76, (BGS). The upper surface of the chalk is sometimes exposed on the foreshore at Sheringham but is permanently sealed by

overlying deposits at Cromer. This area lacks the creeks and inlets characteristic of the stretch of coast that lies to its west. The tidal range at these sites is between 4-5m. The area is subject to coastal erosion that has been estimated historically to average around 0.5-0.75m per year (Wallingford 2003). The bulk of this erosion is cyclical rather than gradual and continuous, this primarily being the result of cliff landslip, caused by water saturation, followed by a period of stabilisation during which time the fallen material is eroded and transported by wave action. Incomplete records of major landslips date back to the early 17th-century. Longshore drift affects both sites, though interestingly in different manners owing, it is thought, to the angle of the coast and the dominant direction of wave approach. Sheringham lies at a boundary and to the west of the town the net longshore movement of sediment is to the west whilst east of the town it is to the east (northnorfolkflag.org.uk). At Cromer movement of sediment is exclusively to the east.

Figure 76, The timber-built pier sites of Sheringham (left) and Cromer (right) (source: Google Earth)

An appeal of 1578 drafted on behalf of the inhabitants of Sheringham and Beeston Regis bemoaned their lack of a *"convenient Harboroughe"* (Day 1888, 226-8). Ill fated

attempts to create a harbour by the building of a system of large piers began in the early 1580s and a number of accounts pertaining to these survive (Day 1888, 247; NRS 1990, 17-20). These involved the construction of north, east and west piers as well as at least one breakwater. The patent that permitted and funded these works actually stated that funds were *"to be employed in repairing the piers and protecting the townships of Sheringham and Beeston Regis from the violence of the sea"* (Cal. Pat. Rolls 1583). A further patent of the same year was addressed to the Pier Reeves and inhabitants of Sheringham and Beeston Regis (Cal. Pat. Rolls 1583B). Points of interest of these patents are that they make it clear that piers already existed and that they were employed in the protection of the coastline, that monies were intended to be expended on repair and that Pier Reeves as functionaries were holding office by the early 1580's. The precise articulation of the three large piers in relation to the coastline is uncertain but it may be that they all ran out to sea at approximately 90 degrees to the shoreline.

The on-going works at Sheringham were subject to investigations on behalf of the Privy Council, both with regard to financial irregularities and the effectiveness of the piers themselves (APC 1591). The inquiry concluded that the new works were having adverse effects, it being said in 1592 that:

"the peere being built somewhat into the sea doth cause the byllowe of the sea somtymes to breake and doth indanger therbie their boates coming with their men to land. The peere also being built so lowe (far) *into the sea hath been cause that a small channel nere unto the lande, wherinto their boates did often come & lande, is now silted up and therbie thei are lett from landing their boates so nere unto the shoare as thei were wont and are forced to come wading in the water a great waie from the shoare"* (Day 1888, 246).

Further, it was considered that all, or most, of the north pier be lifted and that *"a greate parte of that plucked downe to the sea warde which is already built upon the east and west peere"*. It was suggested that this timber, together with other timber not yet employed, should be used *"to builde smale jetties or peeres from the mayne towards the sea for the saftie of their towne, over and besides those thre peeres which thei have already"*. In other words a few great piers were to be replaced by a system of multiple short piers, probably little more than glorified groynes.

This negative view of the new works was not unanimous and a local petition of 1593 stated that *"The pier building on that coast is preventing the further washing away of*

houses there by the rage of the sea, and if finished, would be a great safeguard for ships" (Cal. S.P. Dom. 1593; Rye 1889, lxi-lxiv). It was being argued that *"till it be finisshed the wourke cannot be perfect"*, and that *"and finisshed all the commodities aforesaid will consequently ensue"*. This view did not hold much sway and the source of funding for the pier works ceased the same year. The inquiry's detailed descriptions of the environmental changes that accompanied the new works are likely to have been accurate and certain unstated problems were in fact acknowledged by the petition. These environmental changes appear to have impacted negatively on usage of the piers for harbour purposes and not as measures against coastal erosion.

Whilst in this locality the term pier could refer to a harbour work or a groyne-like structure, it seems reasonably clear that the works of the 1580s at Sheringham, like the smaller structures both before and after, related as much to anti erosion measures as they did to a harbour. Dual function was indeed articulated *"the making uppe of a pere or harboroughe aswell for shippinge as for the defence of the same townes"* (NRS 1990, 208). The documentary sources indicate that boats operated in relation to both systems and much of this usage is known to have been by sizeable vessels engaged in the Iceland fishery. The recorded problems with the large piers suggest that within the span of a decade or less their considerable length is likely to have trapped such volumes of sediment between them that this resulted in the silting up of a former channel and in such a lessening of gradient of beach profile that vessels could not get close to the shore. This was described by one witness at the inquiry of 1592 who *"affirmeth the length of the west peer to stoppe the sweepe wherbie the deepe is silted up"*, in other words the length of the pier was preventing scour and formerly deep water was now silted up (Day 1888, 234). Resolution of these problems was by a return to a system of *"small jettyes of verie small charge as it hath ben used in former times"* (NRS 1990, 206). By 1601 the large piers had gone and small jetties been substituted for them (NRS 2000, 232; Day 1888, 234). The rationale for this decision was perhaps both financial and environmental.

Like Sheringham, Cromer has long suffered from coastal erosion and the loss of substantial tracts of land and houses has been periodically recorded since 1336 (Cal. Pat. Rolls 1336). The establishment of 'Protection Commissioners' in the first half of the 19th-century and the building of substantial coastal defence works since then have virtually halted erosion in the immediate vicinity of the town (Savin 1937, 91-92).

Although the authorisation for assistance with funding for Cromer's first recorded pier in 1390 refers only to "*the safety and defence of ships and boats touching at the cape called Crowemere"* it did have benefits in minimising erosion (Cal. Pat. Rolls 1390). In 1607, for example, it was stated by a group of worthies that *"in tymes past" ... "it dyd save the towne from wastynge by the* seas" (Saunders 1915, 124). The pier will have assisted in the prevention of erosion by interrupting the process of longshore drift adjacent to the town. The pier itself seems likely to have been victim to erosion as in 1483 a townsman left a legacy to *"place great stones for the pier's support"* (Rye 1889, 51). It is probable that this material either formed rock armour protecting the toe of the pier wall or protection for the landward end of the pier thereby securing its connection to the land.

Whilst the documentary sources provide little in the way of specific detailed information regarding Cromer's pier and its precise role in preventing erosion it is clear that a single pier, probably extending seawards at 90 degree to the shoreline, was the principle element of the small harbour. Until the mid 16th-century all the documentary references, including at least twenty four bequests in wills between 1453 – 1535, are to such a single pier (Rye 1889, 53). However, after this date there are references to multiple piers. In 1551 for example it was said that *"rages and surges of the sea"* had *"swallowed uppe and drownded"* a number of properties and that the *"Inhabytantes hath to ther grete & importunate charges defended the same by making of grete peeres"* (Rye 1873, 37-8). It appears that what probably originated as a single pier system in the late 14th-century was coming to an end. Two piers are mentioned in the 1580s, one *"a peere wch was built not longe since"* and the other an *"olde peere"* (Saunders 1915, xxxiii-xxxiv). Later still, in 1607, the specific question of building either a new pier, or multiple piers, was brought to consideration (Saunders 1915, 124-6). It was stated that *"The helpe must be eyther in making a great peere, wch maie be the safety both of the towne and small ships, or in making severall smalle peeres or jetties wch can only succour ye towne."* This statement is particularly significant in that it implies that whereas a single great pier would provide protection from erosion and serve the needs of shipping, multiple small piers would protect the town, perhaps providing little benefit for ships. The recommended choice, owing principally to financial consideration, was for small multiple piers. This was probably the outcome as little more is heard of Cromer's harbour and pier until a new initiative of the early 18th-century (NRO COL 2/56).

There is surprisingly little documentation for this new 18th-century pier or its environmental impact (See Figure 19) though during its construction in 1732 it was reported that *"every great sea doth them considerable damage"* (Ketton-Cramer 1951, 81) whilst it appears to have been *"swept away"* in 1820 (Walcott 1861, 101).

There are obvious parallels between Cromer and Sheringham environmentally, technically, chronologically and with the issue of whether to opt for large piers or multiple small piers. Both towns sought to minimise problems with coastal erosion as well as to have harbours convenient for shipping. The developments of the later 16th and earlier 17th centuries highlight the conflicting approaches to resolving these intertwined issues.

3.2.4 Zone 4: Norfolk/Suffolk borders

(Great Yarmouth, Southwold)

Great Yarmouth and Southwold lay on the coastal lowlands of East Anglia and are characterised by dynamic post-glacial coastal geomorphologies that have undergone constant and considerable change. Both localities have struggled to maintain ports during the course of the last millenium and although the specifics of their environmental contexts differed they shared a number of common problems and often attempted to resolve these in similar manners. In both cases it was the imposition of piers that stabilised the locations and fabrics of their ports, though this was realised at considerable cost. The tidal range in the area of Great Yarmouth seldom exceeds 3m whilst at Southwold it is generally little more than 2m.

Great Yarmouth is located on a north – south aligned spit formed of sands and gravels bounded to the east by the North Sea and to the west and south by waters issuing from Breydon Water, Figure 77. The rivers Bure, Yare and Waveley drain much of the lands and Broads inland from Great Yarmouth. Only to the north does the town have uninterrupted land access to its surroundings. In recent years the potential of offshore sandbank systems to support wind farms and marine aggregate extraction has encouraged the comprehensive study of the geomorphical evolution of the area. The broadest overview of the current state of knowledge has been that of Hannah Evans from which much of the next paragraph has been drawn (Evans 2010).

A wide east-west palaeovalley, in excess of 4km across, occupied the area where Great Yarmouth, the River Bure and Breydon Water now stand and formed the mouth of a great estuary. The spit on which Great Yarmouth sits lays across the mouth of this former estuary and was formed as a result of sediment deposition since the last Ice Age, by a current running from north to south. This all but closed off the estuary leaving only a small channel, Grubbs Haven, between Great Yarmouth and Caister on Sea, and forcing the River Yare to run southwards, against the western side of the spit and thence into the sea at a point several km south of the town. Around the 11th-century Grubbs Haven became fully blocked and since the later 16th-century the Yare's outflow has been through the town's piers (Ecclestone & Ecclestone 1959, 92).

Figure 77, Great Yarmouth and its immediate setting (source: Google Earth)

Historically Great Yarmouth is said to have had seven havens, nine if one were to include the 'natural' outflows of Grubbs Haven and the early course of the River Yare. The succession of Havens 1-7 were actually artificial channels, cut at different times and places, across the spit from the River Yare to the sea. These were first documented by Thomas Damet and Henry Manship younger in the late 16th and early 17th centuries and based upon various documents then held by the town and to which they had direct access (Palmer (ed) 1847, 1854). More recently the succession of havens has been detailed by 20th-century historians (Ecclestone & Ecclestone 1959). Crown consent, and financial aid, for many of these works are recorded in the Patent Rolls from the early 15th-century. Although there is no evidence to suggest that any but the final, 7th, haven had piers to the seaward ends of their channels the study of Yarmouth's piers cannot readily be divorced from the wider haven of the town nor its historical and environmental setting. The positions of the historic havens, as depicted by Ecclestone and Ecclestone, are shown in Figure 78.

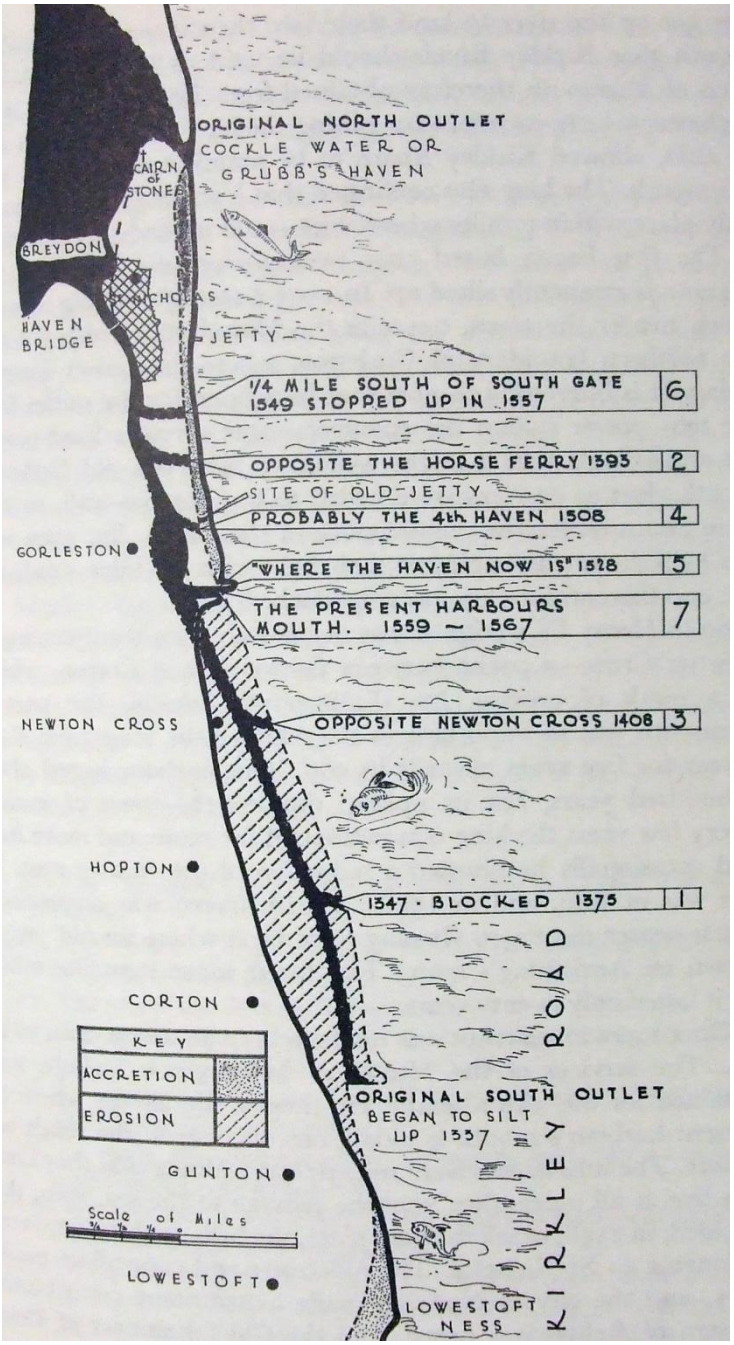


Figure 78, Location of the Great Yarmouth's succession of 'haven channels' (from Ecclestone & Ecclestone, 1959)

The early course of the River Yare exited to the sea within a natural channel around 7km south of its present position until silting caused it to be impassable by the mid 14th-century. A new channel, the First Haven, was cut to the sea at Corton, some 6km to the south of the present channel in 1347. This channel became dammed up with silt necessitating that ships to and from Great Yarmouth were obliged to draw up on the

beach. In an attempt to remedy this Letters Patent for the Second Haven were issued in 1392 with the new channel being cut in a position not far distant from the existing entrance to the harbour. Again, by 1408 this was said to be 'decaying'. A Third Haven cut near Newton Cross, probably around 3km south of the existing piers, fared somewhat better and with considerable efforts towards its maintenance remained viable for around a century. The Fourth Haven, constructed closer to Yarmouth survived until 1528 when it was replaced by a Fifth Haven channel close to the existing entrance. The mouth of this haven is said to have choked up and again been replaced with a new cutting, the Sixth Haven, closer still to the town around 1548. Works for the Seventh Haven, with twin piers, began in 1559-60 under the direction of the Dutch engineer Joas Johnson. Since that time the location of the Yarmouth's haven has remained unchanged with a twin pier arrangement also being a constant accompaniment.

The succession of historic havens at Great Yarmouth attest the difficulties of maintaining a port in such a geomorphologically dynamic setting. The available documentary evidence suggests that the first six of the documented havens failed because of the choking up of their mouths due to the north - south drift of sediment along the spit. Long-term channel stability was finally achieved by the building of the seventh haven with piers. To contemporaries, it was accepted that the success of the seventh haven was due almost entirely to the piers and their related works. In all likelihood the piers were constructed far enough into the sea to counteract the worst effects of longshore drift induced sediment blockage whilst the channelling of the River Yare up to and through the piers deterred sediment build-up. However, it is known that by 1695 a bar had formed across the mouth of the haven (Evans 2010, 27) and that this did sometimes necessitate the warping in of vessels by pier mounted capstans (Preston 1819, 151-156). Late 17th-century attempts to cut a channel through the bar may have had only limited success (Palmer 1854, 290). Success in stabilising the location of the seventh haven came at an enormous cost, aside from the constant expenditure of pier maintenance. This cost was the removal of around 10km of spit to the south of the piers by erosion which can be *"attributed to interruption and transferral further offshore of the sediment drift patterns by these structures* (the piers)*"* (Evans 2010, 24). In other words the piers prevented the supply of new sediment to the spit whilst continuing erosion resulted in its eventual removal. At this final stage it eventually became necessary to build works to protect the landward end of the southern pier itself, Figure 79.

Figure 79, Topographic setting of Great Yarmouth haven, 19th-century. The River Yare flows between the mainland and spit, turning sharply to reach the sea between the piers. The spit south of the haven had long disappeared by this date and groynes had been placed to prevent further erosion. (Norfolk Online Access to Heritage website)

It seems inconceivable that at the commencement of works on the 7th haven the eventual loss of the spit south of the piers, all as a direct consequence of human intervention, was realised or even predictable. Nevertheless, whilst today this would be viewed as an environmental catastrophe Joas Johnson did, by and large, fulfil his remit of securing a permanent haven.

The piers and principal elements of the related works at Great Yarmouth have been touched upon in Chapter 2 and are depicted in the contemporary depiction, Figure 3. From the outset, protection of the piers and the newly cut channel were conceived as essential components of the scheme. That this was so reveals an understanding of at least some of the likely environmental outcomes resultant upon the impingement of the works. In other words, it was predicted that the waters of the Yare would try to force a channel of its own and that unless protected the piers would succumb to erosion; only the employment of countermeasures from the outset could prevent this. Consequently, the piers were protected by woven brushwood and breakwaters whilst by the early years of the 17th-century it was also rampired with millstone and shingle. The sides of the newly

cut channel for diverting the Yare were lined with stout woven brushwood and planks to secure its new course. Two projecting works, one of brushwood and one of timber, are depicted on the west side of the bend of the river adjacent to the new channel. The primary function of these structures was almost certainly to deflect the southwards current of the river thereby assisting the waters flow into the new channel and out between the piers. At what point the restricted old southerly course of the Yare was finally and totally blocked up is uncertain, though this event seems likely to relate to a requirement to force all waters through the new channel to reduce sediment accumulation, perhaps when it became apparent that a bar was forming across the mouth of the haven.

Historically recorded extensions of the piers almost certainly relate to attempts to resolve the problem of the sediment bar near the harbour mouth though these do not appear to have led to any significant reduction. On occasion this bar is known to have blocked the entrance for all but the smallest vessels for weeks on end and the requirement to warp vessels into port was common. Wind and current are recorded as affecting the prominence of the bar, prolonged easterly winds being especially responsible for accretion. It was also recognised that at least part of the cause of the problem was owed to north – south drift and that once sediment had accumulated against the outer side of the north pier additional driven sediment served to feed the bar. This was exacerbated by the dropping of sediment suspended within the river when the flow reached the sea, a problem recognised by at least 1747 (Labelye 1747, 19). Whilst one intention of the constraining of the river by the channel seems likely to have been to create scour this appears to have had only limited effect and in the 18th and 19th centuries attempts were made to increase the velocity and efficiency of flow by reducing the channel's width, and altering its angle. (Labelye 1747, 43, 57; Preston 1819, 152). The presence of wharfs within the harbour were also recognised as forming sediment traps leading to increased sedimentation within the harbour and in order to minimise this problem recommendations were made to reduce their number and to join them together in single arcing sweeps avoiding awkward angles (Labelye 1747, 49-53).

The geomorphology of the stretch of coastline occupied by the medieval and post-medieval ports of Dunwich, Walberswick and Southwold, Figure 80, was every bit as dynamic as that of Great Yarmouth. The fall of the once great town of Dunwich and the

rise of Walberswick and Southwold were directly owed to coastal processes and the oft changing courses of the Rivers Blyth and Dunwich rather than to the conflicting claims of their bitterly rival authorities.

The solid geology of this flat low-lying part of the Suffolk coastal region is of Pleistocene sediments and weakly cemented sedimentary rocks with a Holocene drift comprised mainly of alluvium. The drift deposits are concentrated in valleys and former small estuaries that were formed during the period of the last glaciation. The inland course of the River Blyth, the principal watercourse in the area, flows through such a valley. Sediment transport along the coastline is again southwards and it is primarily this factor that has led to the closure of the small estuaries and wrought the considerable geomorphological changes of the last two millenia (Environment Agency 2007, 39). Geological investigation has demonstrated changes in sea level since the last Ice Age, both transgressive and regressive, whilst within the past 2000 years variations in weather and climate are known to have affected sediment transport patterns, local sediment budgets and morphological responses. The tidal range in this area is small with a spring tidal range at Southwold of only around 2.0m (French and Burningham 2003, 2).

Figure 80, The setting of Southwold piers (red). Walberswick lies on the south side of the River Blyth and Dunwich towards the bottom of the figure (source: Google Earth)

Geomorphological changes to the coastline over the past 2000 years have been studied by Pye and Blott (Pye and Blott, 2006). Employing historic maps, air photographs and bathymetric and lidar data they have produced a series of maps showing the evolution of the coast from Southwold to Dunwich, Figure 81. It can be seen that the Dunwich River once flowed into a large estuary, as the River Blyth may also have done, this being deflected by the kneck of land known as Kingsholme. Within the earlier medieval and medieval periods there was considerable loss of land to erosion on the open coast for which documentary references abound, whilst the southward drift of sediment also produced a lengthening of Kingsholme. It was during this time that Dunwich developed into one of England's greatest port towns, with the port being located within the estuary on the northern side of the town (Bailey 1992, 3-4). A great storm in 1328 finally blocked the haven of Dunwich with shingle, this extending the spit of Kingsholme fully to the northern side of Dunwich. As a consequence the Dunwich River created a northerly route to join the River Blyth which itself forced a new channel to the sea further to the north. A number of human attempts to cut a new channel to the sea near Dunwich failed, almost certainly due to shallowing and blockage caused by sediment drift, whilst at the same time the town entered a period of progressive decline (Cal. Pat. Rolls 1300; Gardner 1754, 39-41).

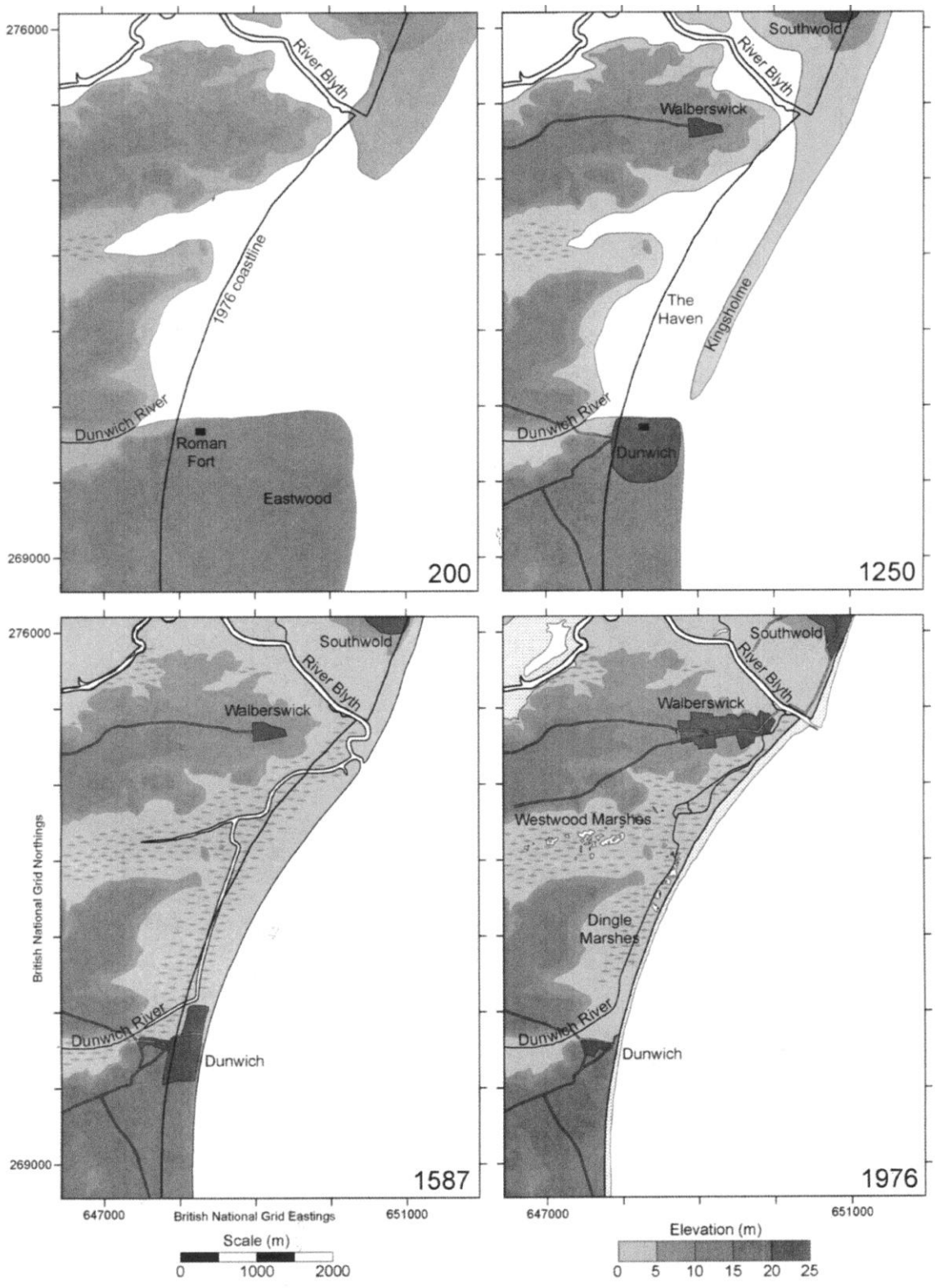


Figure 81, Geomorphological change in the Southwold, Walberswick, Dunwich area (from Pye and Blott, 2006)

The River Blyth now enters the sea through what is an artificial cut adjacent to Walberswick and close to Southwold with the initial works in this area being carried out around 1589. The 18th-century historian Thomas Gardner examined the documentary evidence for port facilities in the locale, subsequent to the loss of Dunwich's direct access to the sea and up to the mid 18th-century. All of these were riverine and did not utilise seacoast piers. The location of these, together with the contemporary river and coast alignments of c. 1754 are shown in Figure 82.

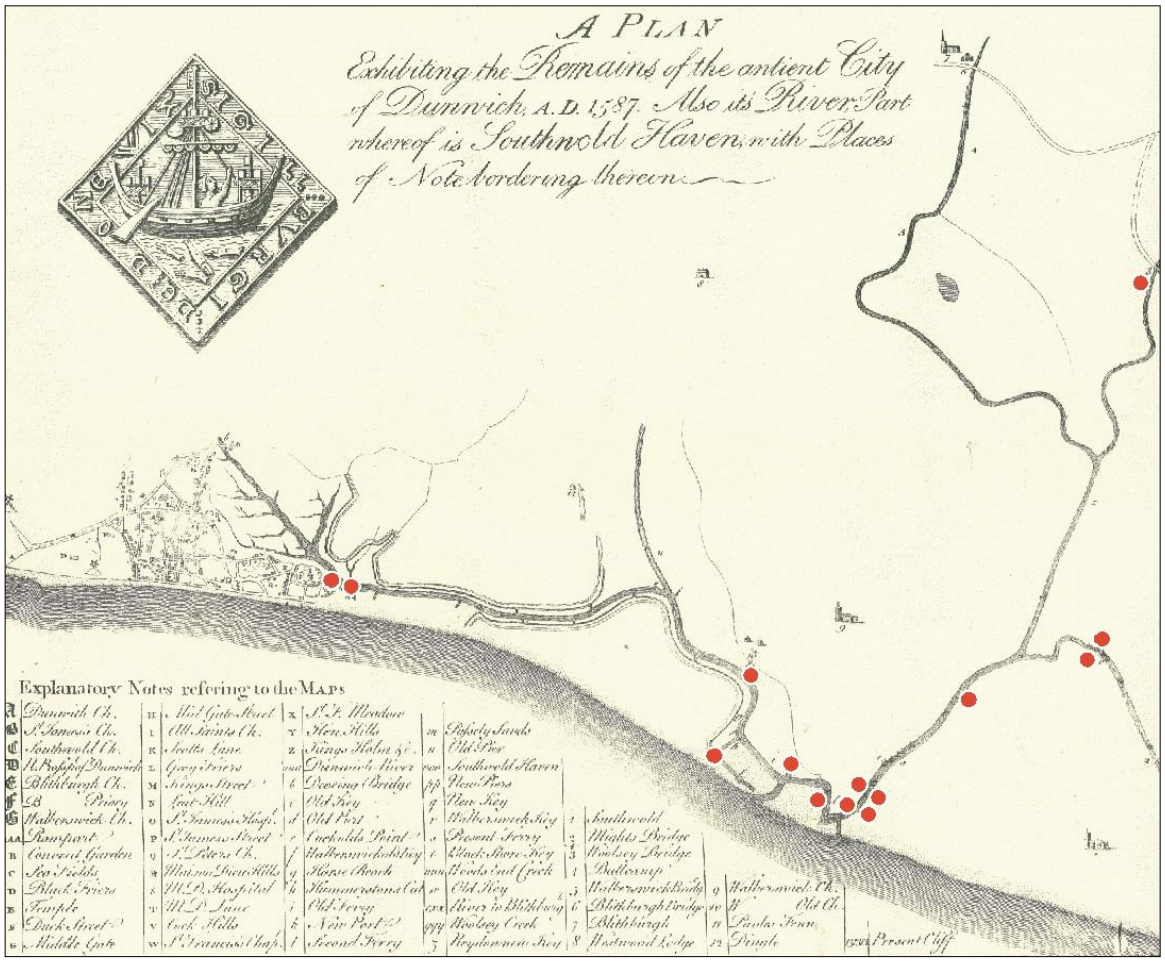


Figure 82, Thomas Gardner's map of 1754 showing port structures mentioned by him. Dunwich is to the left, Walberswick by the church to centre right, Southwold by church to lower right. North is to right. The River Blyth is to the right, the River Dunwich to the left. (from Gardner 1754)

There are two references in the State Papers to works at the port of Dunwich in the century prior to the blockage of the haven when the spit of Kingsholme is likely to have been fairly close to the northern side of the town (Cal. Close Rolls 1250; Cal. Close Rolls 1253). Neither reference refers to a pier or piers, though the construction of such structures would have had the potential to prevent blockage of the channel. The only references to a pier at Dunwich occur within a time span limited to 34 years in the 16th-century (SROI IC/AA2/5/219; NRO, NCC will register, Spyltymber 303; SROI IC/AA2/14/406; East Anglian 1886, 188). The documents provide no clues to the pier's materials or methods of construction though do state that it was for the "*Defence of the churche and thole towne".* (East Anglian 1886, 188). There seems little reason to question the purported function of this pier and as such it does not technically form a pier in the same sense as the other piers within this study, i.e. as part of a port. Rather, it appears purely to have formed a defence against erosion.

The first mention of a proposal for a seacoast pier in the locality is in a pamphlet of 1614 that was addressed to a Privy Counsellor (Harleian Miscellany 1745, 378-392). This appeal relates to the new channel of 1589 and states that *"men of this Place are greatly undone, by Reason their Haven is so bad, and in a Manner often stopped up with Beach and Chingle-stone, that the Wind, and the Tide, and the Sea do beat thither"*. The natural processes described in this document were clearly resultant from longshore drift, whilst the suggested means of preventing the stopping up of the channel was by the construction of a pier. Further efforts to facilitate works to stabilise the new cut were made in 1619 when it was stated that *"by reason of the northerne and northeast winds, and by the violence of the great tydes which have driven the said haven to the southwards many rods, for want of sufficient peering and pyling to stay the same"* (EEBO 1). Longshore drift was again recognised as the causal problem and was having the effect of moving the mouth of the cut southwards. This was effectively 'bending' the course of the channel, as depicted in Gardner's map of 1754. The text also expresses the belief that a pier or piers, perhaps together with revetting of the sides of the channel leading to the sea, would stabilise the haven – just as it had at Great Yarmouth around half a century previously in broadly similar circumstances. There is no firm evidence to indicate that any works involving the construction of seacoast piers took place at this time.

For the early years of the 18th-century there are a number of references to *"stopping up"* of the haven and the *"digging of a new haven"* (S. Assembly Bk. p.10, 42). Such works

no doubt involved redefinition of the 1589 channel of the Blyth where it meets the sea. In 1726 the Corporation resolved *"that two jettyes should be built out into the sea in such places and in such manner as the bailiffs and chamberlaine shall think proper"* (S. Assembly Bk. p. 53), whilst in 1731 it was resolved that *"an engineer to be sent for from Yarmouth to consult on the best and most proper means for the repair of the jetty"* (S. Assembly Bk. p.85). An Act of Parliament for improving the harbour of Southwold was passed in 1747 followed by the construction, in 1749, of a north pier at the mouth of the Blyth, this being followed by a south pier in 1752 (Gardner 1754, 41; Jenkins 1907, xi; SRO HA11/B1/12/16). There followed various rebuilds and seaward extensions of the piers whilst erosion to the landward side required extension here also, as well as the placing of breakwaters (Maggs 1842, xi; SRO HA11/B7/2, 14; HA11/B1/12/16).

Although the building of the piers and partial lining of the Blyth did regularise the flow of water to the sea, this did not in the longer term, prevent blockages to the harbour mouth, a fact evident from a number of engineers reports and other observations. In the period 1808 - 1827 alone there were thirteen reported blockages of the mouth, whilst there were other instances both before and after this date. (Bottomly 1983, 65). Some, including the engineer Ellis suggested that the piers did *"not appear by the result that they ever tended to prevent the blocking up of the entrance"* (SRO HA11/B7/2, 10). Engineers reports are unanimous in their understanding of why this was so. In essence, once the piers were built sediment progressively accumulated against the northern side of the north pier. This build-up started at the landward end and over time extended seawards, Figure 83. Once the build-up reached the end of the pier further sediment was deposited to the south side of the head creating a bar between and beyond the ends of both piers. In situations where a river runs through the piers to the sea, as at Southwold, their respective flows are to some degree rendered neutral at their point of junction and sediment that was once in suspension is more readily deposited. Southwold was clearly experiencing problems very similar to those of Great Yarmouth. Extensions to both piers were only temporary expedients as the sediment would merely repeat its earlier pattern. This was succinctly expressed by Ellis:

"When piers are extended in a moving soil, the space fills up on either side, shoaling the water at the extremity and carrying the bar further out, thus frustrating the object sought to be obtained. The extension of piers in such a case to obtain deep water at the end of

them is a delusion; for in proportion as the piers are carried out to sea, in that proportion will the bar be removed from them" (SRO HA11/B7/2, 12).

The instances of near total blockages of the harbour mouth, as opposed to the permanent presence of the bar (which itself could shift slightly depending upon the direction of the prevailing wind), were most commonly caused by gales and winds from the east and north-east (SRO HA11/B7/2, 11-12). Although such obstructions could, and were, removed by human effort significant alterations in the wind, particularly south and west winds, could also 'naturally' clear parts of such blockages (Bottomly 1983, 65). The net result of such sedimentation, exacerbated by the low tidal range, was to create occasions when vessels of deeper draught were denied access into the haven and had to rely on a lighter to transfer goods (Maggs 1842, xii).

There was an additional problem at Southwold, namely the successive intakes and embanking of adjacent saltmarsh for agrarian purposes and tidal saltings. Such embankments excluded the inflow of tidal waters up the Blyth, the return of which to the sea had the potential for scouring the harbour of sediment and obstructions. This problem appears to have been recognised as early as 1634 when the Privy Council instituted an enquiry into heading banks and sluices that had been constructed for private gain (Trinity House 1634; Cal. S.P. Dom. 1634). By the early 19th-century this problem was being quantified by engineers. The Tidal Harbours Commission stated that the spring tide waters of the Blyth formerly covered an area of around 2000 acres and that by the earlier 19th-century this had been reduced to around 450 acres by successive embanking. This embanking effectively excluded around 4,500,000 tons of water at each tide which represented an enormous loss of scour (Tidal Harbours Commission 1846, 13). It was equally recognised that there was doubt about the lawfulness of attempting to remove such enclosures and that proposals to do so would be subject to opposition from the landed classes (SRO HA/11/B7/4, 21).

Whilst engineers were agreed on the causes of the problems at Southwold there was disagreement over the form and lengths of piers that may have resolved these. Rennie considered that the piers were probably of the correct length, whilst in 1812 Smith considered that they already *"extend beyond the proper range"* and further that they were *"trumpet mouthed"* and *"do not stand in the right direction"* (SRO HA11/B7/2, 17, 15). In his report of 1841 James Walker considered that the gap between the piers was too

great for the current to keep it clear, but that were it to be narrowed this would entail considerable expense and make it too narrow for vessels to enter in rough weather. Walker summarised the range of opinions on the length of the piers *"some arguing for the extension of the south pier; others for adding to the north pier; some for the extension of both piers; and others for their entire removal"* (SRO HA/11/B7/4, 12). Walker himself favoured the extension of both piers at equal length into slightly deeper water. Edward Calver, an admiralty surveyor, proposed the extension of both piers with two walls of close piling, one extending from the north pier, the other from the south pier, Figure 84. These would extend the length of the piers by around 130 feet, have tapered towards the mouth and would have been orientated in a slightly more northerly direction than the piers themselves. As it happened there was no significant work to the piers after 1806, most works being restricted to the channel of the river, and so the conflicting ideas and theories were never tested. Instead, it proved to be increased technical efficiency, rather than enlightened design, that resolved some of Southwold's problems, particularly the steam dredger which could deepen the channel of the Blyth from some distance upstream to the haven mouth.

Figure 83, Oblique aerial photograph of Southwold harbour piers, looking NE. The stepped nature of shore to either side of the harbour show the effects of longshore drift (source: http://www.eadt.co.uk/photos)

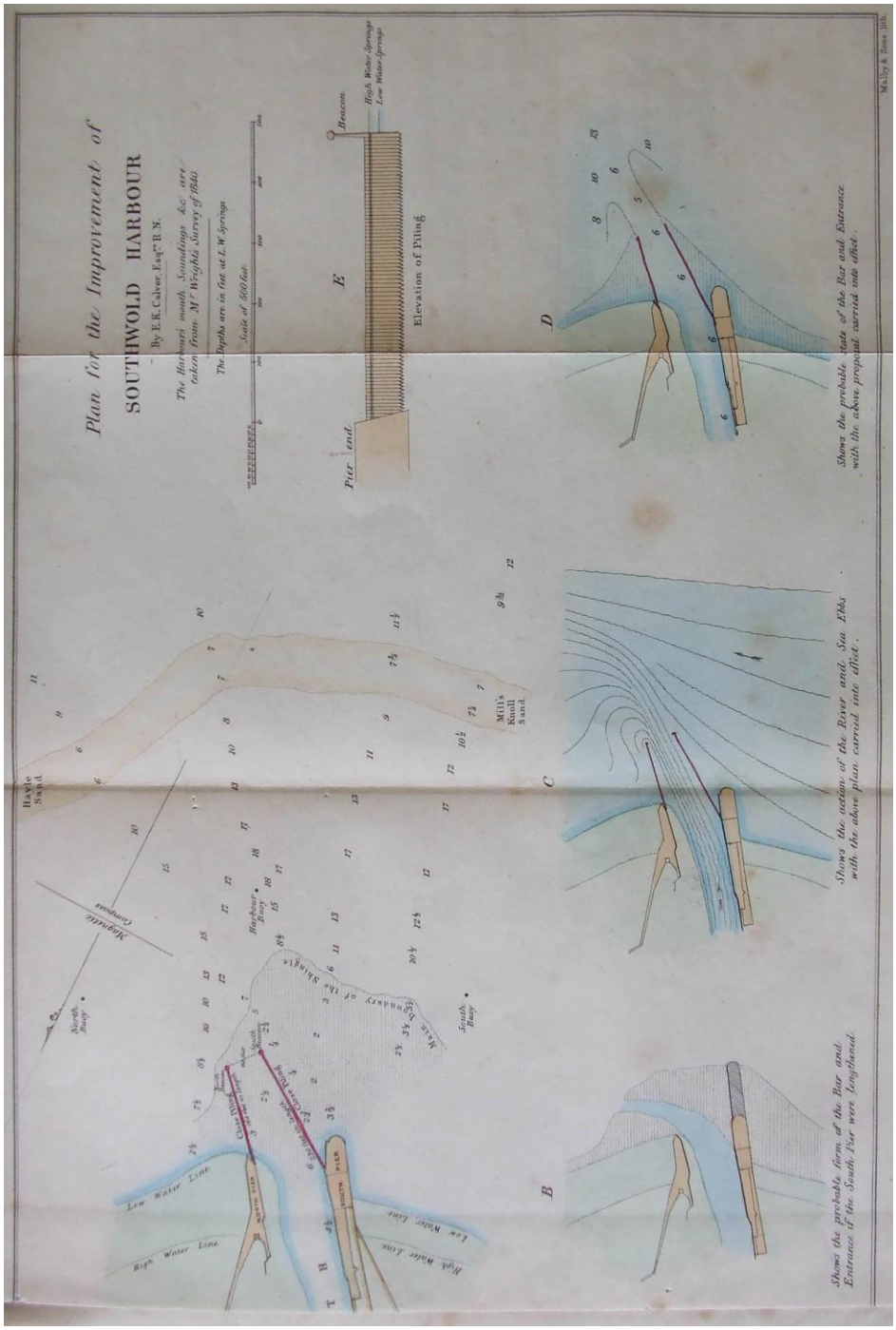


Figure 84, Southwold. Calver's proposals of 1844 for extending the piers with walls of close piling. Note the drawings suggesting different bathymetric outcomes with various pier arrangements (SRO B15082.23)

Parallels can be drawn between a number of the environmental aspects at Great Yarmouth and the Southwold locale. Both sites shared comparable geologies and topographic settings and were subject to similar patterns of longshore drift. This resulted in the creation, by entirely natural means, of long spits that drastically hindered the operation of the ports. The full development of the spit to the north of Dunwich was ultimately one of the principal causes of the town's decline. A succession of channels were cut through both spits in order to maintain access to the sea though these were successful in only the very short term and before long succumbed to blockage. Only the construction of piers at the mouths of newly constructed channels and the constraining and revetting of rivers succeeded in stabilising access to the sea. Whilst the piers largely succeeded in their intended tasks, they also, in combination with the effects of longshore drift, introduced problems associated with the formation of sediment bars close to the pier heads. This was clearly an undesired outcome, albeit one that could be worked around by the warping of vessels and the use of lighters. At Great Yarmouth the loss of several miles of spit south of the piers can now also be seen to be resultant upon their construction. This appears to have engendered little contemporary comment and what to modern eyes seems an environmental disaster may have been differently perceived in the past.

3.2.5 Zone 5: Isle of Thanet

(Margate, Broadstairs, Ramsgate)

The three pier sites of Margate, Broadstairs and Ramsgate are all located within small bays just a few kilometres from each other on the Isle of Thanet, Kent, Figure 85. Margate is located on the northern part of the Isle, Broadstairs the east and Ramsgate to the south-east. The solid geology at all three sites is of Cretacious chalk and the shoreline landscape is characterised by chalk cliffs subject to erosion that for the last century has been estimated as around 0.25m per year (Cosgrove, Bennett and Doyle 1998, 310). In a number of places on the Isle short narrow valleys cut through the chalk down to the shore and it is at the mouths of such valley's, which provide ready access to the sea, that the towns are located. In the past watercourses ran through the valley's and superficial deposits of quaternary clays and silts now occupy the basal parts of these.

Figure 85, Location of the Isle of Thanet pier sites within their small bays (red). Clockwise from the top: Margate, Broadstairs and Ramsgate (source: Google Earth)

The tidal range around the Isle of Thanet is generally between 4m – 5m, being very slightly higher on the Isle's southern side. Strong tidal currents run around the north and east coasts of the Isle. At Margate this flow is eastwards and westwards into and out of the Thames estuary whilst at Broadstairs and Ramsgate the flow is alternately in northerly and southerly directions. The mouth of the valley in which much of historic Margate lays is particularly low-lying, parts of it at heights of less than 3m OD, whilst the parts of Broadstairs and Ramsgate lying closest to the shore are located on slightly higher ground. As a consequence, the town of Margate has long been subject to inundation, the worst effects of this being felt during tidal surges and storms. Broadstairs and Ramsgate were less susceptible to inundation though their piers were recognised as providing protection from the sea (Petition 1808; Lewis 1736, 175).

Inundation by the sea is first recorded at Margate in 1322 when a legal dispute concerned the *"breaking and carrying away barriers ... set up against the inroad of the sea"* (MPL

Rowe MS). There are a number of further documentary sources referring to episodes of severe flooding, these being particularly well documented from the 17th-century onwards. In 1621, for example, innundation resulted in the loss of 18 houses and imperilled 74 more together with 350 acres of land (Cal. S.P. Dom. 1621). Further losses are recorded at a number of later dates (e.g. Cal. S.P. Dom. 1688; Twyman 2006, 16). In order to limit the effects of inundation a system of 'jetties', actually a long timber-built seawall interrupted by a number of slipways, was built to the southern side of the pier some time prior to the early years of the 17th-century (Cal. S.P. Dom. 1622). It seems probable that the barrier recorded in 1322 was a precursor to this system. This jetty system is depicted in Figures 25 and 26.

During the 17th-century the configuration of Margate's pier itself was often held to be responsible for flooding of the town (Egerton 2584, 1621; Smith 1646). The circumstances in which this was so were in cases of rough seas from the north-west which became funnelled between the pier and the shore and concentrated in the low lying area immediately to the pier's south (Cal. S.P. Dom. 1691). Whenever these conditions coincided with high spring tides there was a likelihood of inundation. The flooding of 1621 was thought to have been exacerbated by "*a peece of work added to the said Peer of Margate, which had proved very advantagious for the Peer, but desperately ruinous for part of the said Town"*. (Smith 1646). Whilst the effects of foul weather from the north-west on the low lying parts of the town appear to have been made worse by the pier there is every reason to suppose that the same pier protected the town from weather from other directions. An anonymous writer of 1757 states that one of the roles of the pier was *"to defend the bay from the surge of the sea"* (anonymous 1757, 23). Further, *"were it not for the pier the town would soon be demolished by the sea"*.

Although the detailed documentary sources are lacking, it seems reasonable to assume that episodes of inundation at Broadstairs and Ramsgate may likewise have been at their worst when the effects of storms were channelled between the piers and land. Cartographic evidence suggests that areas of what may be seawall between the piers and land, though on a less extensive scale, were also present at Broadstairs and Ramsgate.

The Thanet piers themselves were subject to erosive processes and at Broadstairs and Ramsgate extensive and highly elaborate systems of 'groynes' and 'lockers' were constructed on their seaward sides (See Figures 28, 31 and 61, 62). These structures

served to both reduce the impact of waves and trap sediment against the toe and lower parts of the pier wall. Judging from these depictions the prolonged effects of their utilisation was the creation of elevated areas of sediment at the toe of the outer sides of the pier walls.

Whilst the overall effects of coastal processes at Thanet were essentially ones of erosion the presence of piers could cause localised sedimentation within the harbour basins. At Margate the outcome of a legal case in the second half of the 17th-century, that involved the digging of gravel, chalk and ballast from the grounds, lands and shore adjoining the pier, concluded that such ancient custom was necessary for the maintenance, preservation and cleansing of the pier and harbour (Hull 1966, 524; Lewis 1724, 88). At Broadstairs large deposits of sand are known historically to have accumulated in the northern part of the bay and within the harbour basin. This is said to be as there is little current within the area of the harbour itself and so sand held in suspension falls (Simmonds 2006, 66-68). Although this is a long-standing problem modern observation suggests it has been exacerbated by the construction of Broadstairs promenade in the mid 20th-century. These works removed a slipway at the seaward side of the landward end of the pier which formerly permitted the sea to wash over the landward end of the pier and create scour. It may be more than coincidence that the depiction of the pier in Figure 28 shows a gap in the parapet on the seaward side of the pier in a similar location. Perhaps this enabled controlled scour to lessen blockages? Resultant of this problem there are late 18th-century references to *"labourers to take the beach out of the pier"* (EKA UD/BS (uncat.) Box 1, 1792-1807).

There are frequent mentions at Broadstairs of payments to "*labourers working at the bank"* (EKA UD/BS (uncat.) Box 1, 1792-1807). This may refer to a bar of sand near the harbour mouth. A bar, around forty yards (36.6m) across, is known to have formed at Ramsgate by the mid 18th-century. It was speculated that this may have resulted from a lengthening of the pier in 1715, though the commencement of works to construct a new, larger harbour, shortly after this date appear to have left this question unresolved (Smeaton 1791, 10-11). The harbours at Margate and Broadstairs are known to have been dry at low tide, as Ramsgate may have been also (Newberry and Bristow 1763, 10). This may have been as a result of sedimentation and was certainly held to impose limits on their usage by vessels of large burden.

3.2.6 Zone 6: South-east coast

(Dover, Folkestone, Rye, Hastings)

The geological and geomorphological setting of the sites within this zone are varied but all are characterised by environmental problems that have historically led to severe difficulties with their piers, Figure 86. The shoreline along this stretch of the eastern end of the south coast is predominantly composed of sand and shingle with movement of this sediment by waves and currents in a unilinear, west to east direction (Jennings, S. and Smyth, C. 1990). There is a tidal current up the English Channel from the south-west, but also a further tidal current from the North Sea flowing in the opposite direction. These opposing currents converge near Dover Bay. Tidal ranges are between 6m – 7m for Dover and Folkestone and between 7m – 8m for Rye and Hastings.

Figure 86, Locations of pier sites (from right to left) of Dover, Folkestone, Rye and Hastings (red) (source: Google Earth)

Dover is located at the mouth of a valley, in an indentation within adjacent tall chalk cliffs and through which the small watercourse of the River Dour flows. Modern rates of erosion of the cliffs between Dover and nearby Folkestone are stated as up to 0.75m per year (Harris 1996, 82). However, given that there have been reductions in the supply of

shingle along this stretch of coast in recent years past rates of erosion may have been slower (DDC). The converging tidal currents in Dover Bay create a series of tidal eddies which slow the waters and permit sediment in suspension to fall to the seabed. Because of the funnel-like shape of the English Channel adjacent to Dover the ebb tide flows more slowly than the flood and consequently sediment scour is less effective than sediment supply. This effect is heightened by the prevailing winds which are also from the south-west. As a direct consequence of these particular marine environmental conditions Dover has historically been a very difficult place in which to build a workable harbour, the tendency has always being for it to choke up with sediment. Conditions of sediment accumulation have also hampered the ports to the west of Dover.

From the early 16th-century Dover's strategic proximity to the continent necessitated the investment of government resources, direct and indirect, in the development and maintenance of Dover's port. Sometimes referred to as the 'key to the Kingdom' the town's port came to be perceived as a national object, not the exclusive prerogative of the town (Lewis 1848, 79).

The earliest large-scale timber pier works at Dover were those of the state funded Henrician works commencing in 1535 and continuing to the 1550s (Colvin et al 1982, 729-755). These harbour works were unable to follow a fixed plan but were obliged to develop, adapt and expand in the face of environmental changes wrought by the impingement of successive piers. Each stage of the Henrician works therefore became necessary because of the failure of its predecessor.

The first elements of the Henrician works were the clearing of the existing haven of its clogging beach material followed by the construction of a south pier, with a stone mole seaward of this, and a north pier and south-west jetty. Natural processes were not long in catching up. Sediment accumulated along the back of the south pier and around the head eventually causing a blockage of the mouth. Quickly built attempts to prevent the movement of shingle with additional works failed to halt its progress. It was widely considered that extensions of the piers would overcome these problems. These sentiments proved to be ill-founded, the sedimentation processes were not halted, though it did come to be recognised "*that as the peere was built out, so the banckes of beach also beganne to growe, and lay farder out as the peere was farder built"*. In other words beach followed pier in an unremitting cycle. A succession of re-configurations of the piers did little to

improve the harbour. The most ambitious were proposals for massive north and south piers, of which only the southern was built. This again proved a costly failure. The convoluted structural character of the succession of Henrician harbour works can be gauged from Figure 35.

The intention at Dover had always been to provide a harbour accessible at all states of the tide. To provide piers of the required vertical stature, particularly given the locally high tidal range and the finite lengths in which large quantities of timber were available, required stone foundations onto which the timber piers could be constructed. For the massive southern pier of the last element of the Henrician works this required a foundation of 3 ½ fathoms depth (nearly 6.5m) at low water. Dover represents the only known instance of the use of such foundations to overcome the difficulties of building a timber pier in deep water.

Whereas the Henrician works at Dover were ultimately a costly failure the Elizabethan works would prove to be a success. Ironically, it was the environmental impacts of the earlier failed works that would provide the key (Colvin et at 1982, 755-764; Johnston 1994, 218-286; Ash 2000). Much of the eastern parts of the Henrician southern pier works and the shingle accumulated against them came to be washed away whilst in the area to the north of what remained of the south pier and the town a linear bar of beach, dry even at high water, developed. The material that formed this bar was washed around the truncated south pier, its movement north of the bay being checked by the tidal currents from the north and east. The formation of the bar created a lagoon to its landward side that was fed by the River Dour. The genius of the Elizabethan works was to utilise this bar to support a harbour wall. A cross-wall divided the lagoon into two parts with water held in the upper part, known as the Pent, being released at low tide via a sluice system to scour the lower harbour and prevent the worst excesses of blockage. The only timber elements to this scheme were two piers at the harbour entrance, Figure 87. The proof of the success of the Elizabethan scheme was that the layout of Dover's harbour remained relatively unchanged until the later 19th-century. Although the problem of partial blockages by sediment would periodically recur the controlled release of water from the Pent did much to minimise this.

Figure 87, Dover harbour in 1595, by Thomas Digges. Controlled release of water via a sluice in the internal cross-wall of the harbour served to scour the lower basin and harbour mouth. North is to the right (British Library Cotton Augustus I.i.46)

Folkestone lies just over 10km to the south-west of Dover, is also situated at the mouth of a small valley and contains a stream known as the Pent. By the early 17th-century a system of pier-like structures, known locally as jettee's, together with a stade were in use at Folkestone. This dual system may have been fully formed in the 16th-century, with the stade probably being the oldest element (Cal. S.P. Dom. 1629a). There appears always to have been a minimum of two jettee's, one to either side of the stade, with the Pent flowing between the western jettee and stade (see Figure 43). A small tidal inlet at the mouth of the Pent may also have been utilised as part of the harbour (Wilson 2001). The western side of this inlet was lined by a pile and plank revetment of oak, dendrochronologically dated to around 1625-1655. It has been suggested that this structure may have formed part of a quayside, though by the later 18th-century much of this area had already been built upon.

Folkestone suffered from both erosion and sedimentation, this largely the result of its location forming a slight bulge into the English Channel rather than an embayment. There is considerable documentary reference to erosion and the jettees/piers were seen to perform a role in minimising the effects of this. In 1703 for example, it was intended, upon expert advice *"that the fixing of 3 works between high & low water mks to be made with timber and stones"* would provide security for the stade, church and town (EKA AM1/2 1703). Considerable damage to these structures is recorded in 1724 and a programme of repair was put in place (Mackie 1856, 63-73; EKA AM1/3 1725). A Parliamentary Act of 1766 explicitly states that *"the continual flowing of the tide and raging of the sea"* threatened to wash away the parish church, lower part of the town and the beach (stade) upon which the fishermen drew up their boats (Act of Parliament 1766). It is said that the lower part of the town and beach had been preserved from the sea *"by two large jettees or heads one at the east and the other at the west end of the said town"*. At this time these jettees were described as *"ruinous and out of repair"* and it was held that *"should they to go utterly to decay"* then the beach and lower part of the town would be carried away by the sea. This was not the first instance of threat from erosion as a petition to build a pier by the town in 1629 makes clear (Cal. S.P. Dom. 1629a). On this occasion it was stated that *"the sea hath fetched in and carried awaie their ancient stade or station where their vessels were used to be layd up in safeity"*. There are further references to the protection afforded the stade and town by the jettee's in the 17th-century (Bishop1973, 59; EKA AM1/2 1699). It is in the context of erosion that a timber-built shoreline revetment was constructed by at least the 18th-century (see Figure 45).

The jettee system at Folkestone was principally concerned with the protection of the stade and town. 18th and 19th-century evidence indicates that each jettee extended at 90 degrees from the shore with the head barely reaching the low water mark and cost a fraction of the price normally associated with piers (EKA Fo/AUj1/1). Further, the length of the timber posts forming the vertical members of the jetties were never more than 13 feet (3.96m) long, with a significant proportion of this being driven into the ground (EKA Fo/AUj1/1). Given the high tidal range in this locality, any parts of the jettees towards the low mean water level will have been submerged at high water. This point is unique in relation to conventional timber-built pier sites and highlights the fact that in so far as these small jettees provided a safe haven for vessels this was via safeguarding the stade.

The issue of sedimentation at Folkestone was an inflow of sediment between the jettee's that could choke up the harbour, i.e. the stade between them. The calling out of the populace to clear such obstruction is recorded in an entry in the town records of 1635 (Jenkins 1876, lxxxiii). Effort was to be directed *"towards cleaning and expulsing of the beach from the haven or harbour"*. The stream name 'Pent' raises the possibility that attempts may have been made to utilise the outflow of the watercourse for purposes of scour. One definition of the word is: *'A place in which water is pent up; a reservoir or enclosed pool"*, a definition said to be regional, in particular of south-eastern England (OED). The damming up of a watercourse for scouring is of course attested at nearby Dover. It is conceivable that the pile and plank earlier 17th-century 'possible quayside' found at the western edge of the Pent may even have formed part of a lining to the edge of an area utilised for retaining a body of water, rather than forming a quay.

Located at the confluence of three rivers in a former estuarine system, for almost all of its life as a port the town of Rye had no piers. The coastline to the south and east of the town has been subject to very considerable geomorphological transformations over the last two millennia. The most recent and detailed study examining this development is Yates and Triplet's 'Changes in Rye Bay' (Yates and Triplet 2000). Around 300-400 AD the line of Rye Bay was somewhat to the seaward of its present position and was comprised of a shingle barrier that may have survived to the 11th-century. Breaches of the barrier resulted in the creation of a broad estuary that was enlarged by a succession of 13th-century storms. Subsequent to these events there has been a process of sediment accumulation and a long history of land reclamation within the adjacent marshes that has resulted in the coastline extending in a southerly direction and the tidal inlets to the sea becoming little more than narrow channels. The geomorphological development of the coastline between the 16th – 18th centuries can be illustrated by comparison of the historic maps, Figures 88 and 89.

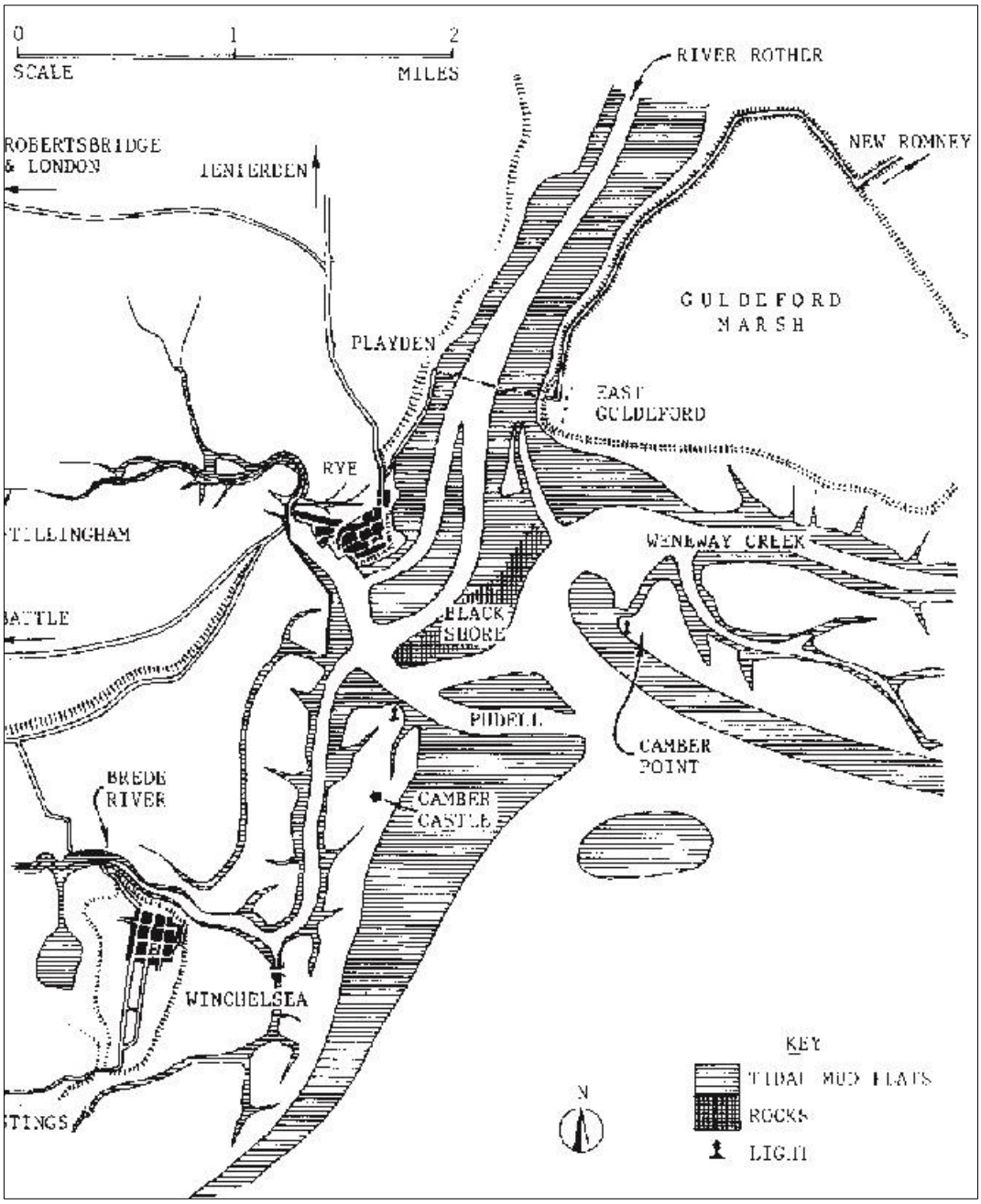


Figure 88, Rye. Map based on those by Prowze 1572 and Symondson 1594. Tidal flats are shown shaded. (Yates and Triplet, 2000)

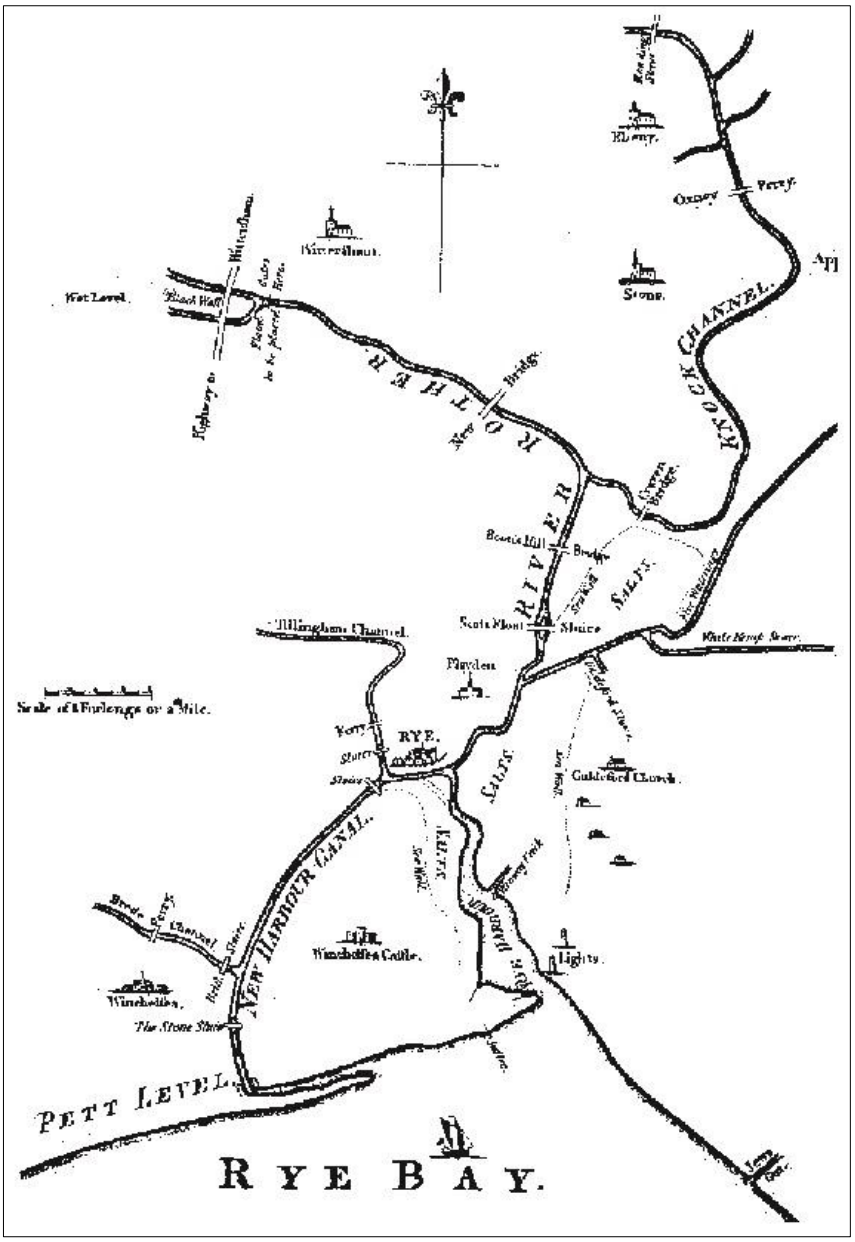


Figure 89, Rye. Jackson's map of 1797. Note how a spit of shingle has already developed across the site of the new harbour mouth and piers (Yates and Triplet, 2000)

One of the principal problems facing the tidal waterways around Rye was a lack of scour on the ebb tide due largely to land reclamation. Reclamation of land by enclosing with sea-banks, much of it unauthorised, was being be-moaned as early as the 17th-century and the impact of this was recognised (Anonymous 1677). The effect of reclamation was to reduce the volumes of water entering the waterways at high tide and thus also the egress, the outward flow of which had a scouring effect.

An Act of Parliament of 1724 enabled a new harbour to be constructed (Collard 1985). The route of this harbour from Rye to the sea was via a channel running south-south-west and known as the New Harbour Canal, Figure 89. Parts of the channel were entirely new cuts, other parts canalisation of existing waterway, whilst regulation of water flows and heights was via a system of sluices. The head of the harbour was to be formed of two piers, initially built of stone (Skempton 2002, 522). Shortly after construction the eastwards drift of shingle accumulated against the western pier and around its head. In order to prevent a blockage it was ordered to heighten this structure with timber, to extend it for 210 feet (64m) with timber and also to build groynes from the west pier (Meryon 1841; Smeaton 1763). These attempts to slow down and minimize the effects of sediment drift would not prove successful as the developing spit in Figure 89 shows. These costly harbour works proved to be something of a white elephant and within a few months of its opening the landed interests of the Commissioners of Levels, unfoundedly fearful of the effects the harbour may have on their properties, successfully petitioned for the new harbour's closure.

The historic core of Hastings is located in a valley that cuts through a solid geology of sandstones (BGS). To either side of the town the sandstone forms steep cliffs up to 60m tall and whose present rate of erosion is believed to be in excess of 0.3m per year. The shoreline is composed of shingle with some sand lower down the foreshore. Movement of the shingle is unilinear, in a west to east direction. The town is known to have had a timber-built pier between at least the 16^{th} – 17^{th} centuries and to have possessed just a stade after this date. Today the stade is protected by concrete groynes to east and west that have largely halted shingle movement in this area. An unusual aspect of the historic pier is that its alignment was not the more usual one of 90 degrees to the shore but was almost certainly directed towards the south-east, probably at an angle of around 45 degrees (Lewis, 1848, 435-441; Ray 1932, 206), Figure 90. The prevailing coastal regime would indicate that the eastern side of the pier was the sheltered side which formed the haven whilst shingle and sediment will have accumulated against the western side. The modern large mole-like groyne to the west of the stade is of similar alignment. It is not entirely certain why the historic pier was so aligned.

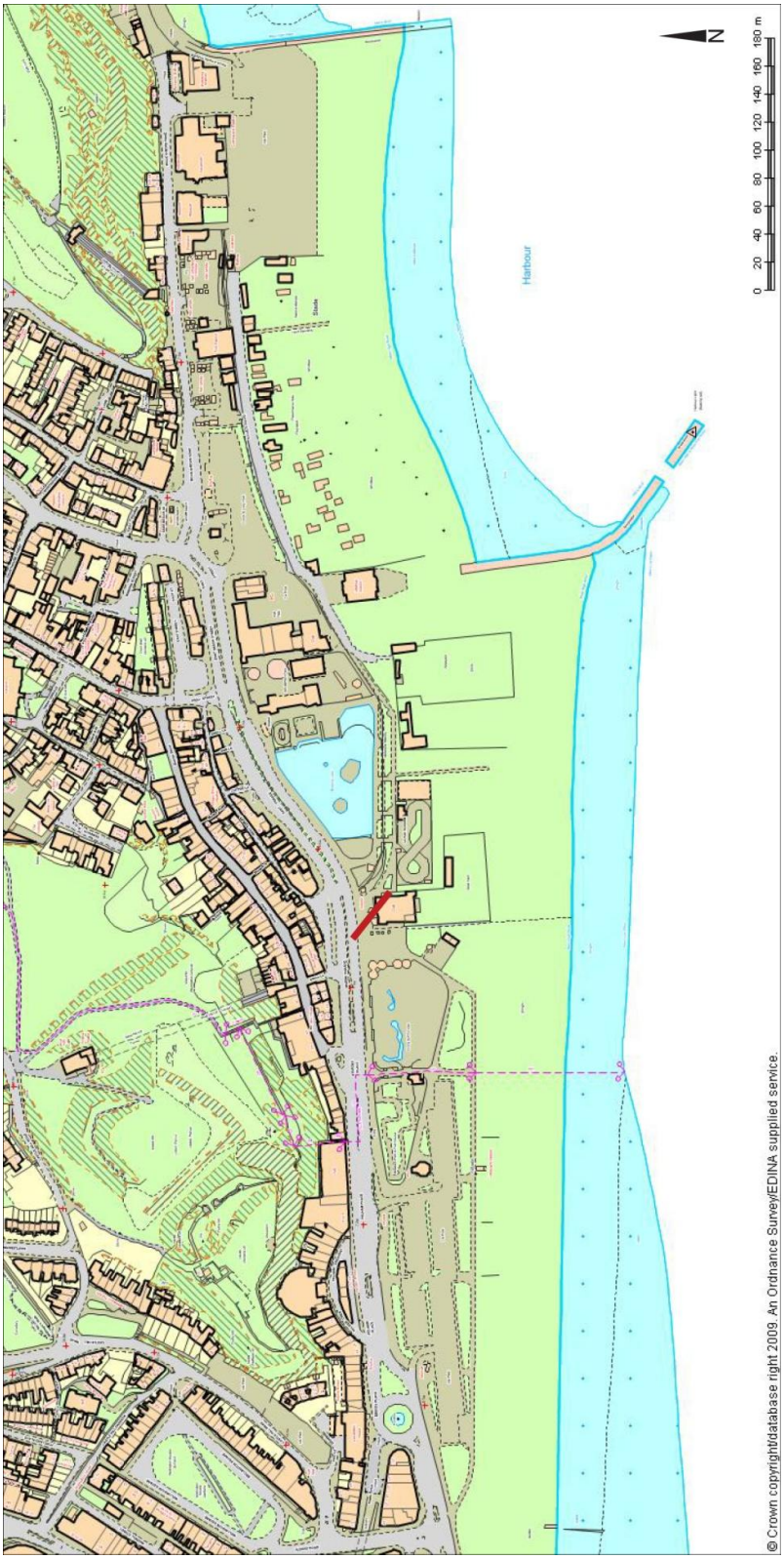


Figure 90, Plan of part of Hastings with approximate position of pier remains indicated by red line. That the remains now lie beyond the high water mark is owed to modern works at the seafront. (source: Edina)

The evolution of the gravel coastline of East Sussex has been studied by Jennings and Smyth who suggest that the transference of sediment from offshore to shore largely ceased around 300 BP (Jennings, S. and Smyth, C. 1990). Such cessation of the regime resulted in movement of sediment becoming one almost entirely alongshore. As a result of all this the shoreline is becoming progressively depleted of the gravels which historically have served to dissipate wave action and minimize cliff erosion. An additional outcome of these processes is said to be a deepening of the nearshore zone.

The deepening of the nearshore zone, may have resulted in larger waves of more destructive potential. There are detailed descriptions of the destruction of Hasting's pier in 1595 and 1597 and it was finally abandoned in the earlier part of the 17th-century (ESRO C/A (a) 1, both sides p 12; ESRO C/A (a) 2 p 4). It is possible that a connection between these two phenomenon existed. The histories of many pier towns demonstrates that erosion and other environmental difficulties can be overcome, albeit at a cost, providing the economic base and local will permit. It may have been a lack of these factors, combined with the rise of the port of Dover that prevented further attempts to resolve Hasting's problems.

3.3 DISCUSSION

As reasoned in Section 3.1, timber-built piers were constructed primarily to meet the needs of required port infrastructure. An additional role, as devices to counteract erosion, was also important at a number of sites. In the cases of Sheringham and Folkestone this factor appears to have been as important as the provision of port facilities. At Bridlington, Hornsea, Cromer and Hastings their beneficial role in minimising the effects of erosion was also recognised as such at the time. It is in the context of erosion prevention that the small, multiple, groyne-like piers at Folkestone, those at Sheringham – both before and after the experiment of the great piers, and those at Cromer after the demise of the medieval pier, can be best explained. At Bridlington and Hornsea the available evidence indicates that the anti-erosion benefits were clearly recognised but suggests that this was a secondary benefit and probably never a prime factor in initial construction. In the case of Hastings one of the principal functions of the pier seems to have been to prevent erosion and damage to the stade which may have formed the most important element of the port infrastructure at the town.

Consideration of the environmental context of timber-built seacoast piers in the preceding section highlights the fact that although these structures were placed in locations with varied topographic settings and with different ongoing geomorphological processes many of the problems they subsequently encountered were common at most sites. More often than not the problems encountered at the piers related to changes in environmental circumstances that occurred as a direct consequence of the construction of those piers. Only rarely is there evidence to suggest that such 'secondarily occurring foreseen problems' were 'designed out' from the outset. The implication of this is that knowledge of the finer subtleties of the natural environment were, to some degree, limited. In many ways it would have been remarkable had it been otherwise. The three most common environmental problems faced at the pier sites were ***silting***, ***storm damage*** and ***erosion***.

3.3.1 Environmental problems: solutions, active and reactive

Human resolutions to unfavourable environmental responses at the pier sites can, arguably, be broken down into two categories. The first could be termed 'reactive expedients' as they represent ways of working around a particular problem, rather than attempting to solve its root cause. As such, the digging out of sediment from a harbour basin would fall into this category as a response to silting. The second category could be termed 'solutions' as they represent designed attempts to remove a particular problem at, or close to, its root. Using the same example of accumulated sediment a 'solution' could be the use of sluices that controlled a body of stored water to regularly scour a harbour basin and prevent sediment accumulation.

3.3.2 Silting of the harbour areas created by piers is recorded, or alluded to, at the majority of the pier sites, there being direct reference to this in the cases of Hartlepool, Scarborough, Bridlington, Hornsea, Sheringham, Great Yarmouth, Southwold, Margate, Broadstairs, Ramsgate, Dover, Rye and Folkestone. It is entirely possible that this problem affected other pier sites but for which no recorded evidence has been found. It is noteworthy that quite a number of sites that suffered from harbour silting also suffered from erosion, the former process most commonly affecting the sheltered harbour basins whilst the latter affected parts of the pier walls and adjacent coastline. Silting then, as it

affected pier sites, was entirely as a result of the imposition of the artificial structure of a pier/s in areas of active foreshore processes. The effects of such sedimentation can conveniently be broken down into two productions, silted basins and bars.

To a greater or lesser degree pier harbours act as silt traps. Sediment in suspension within the sea is ordinarily transported as a result of current and wave. The imposition of piers interrupts this process by creating sheltered areas of calm water within which the sediment can fall. Over time this leads to a progressive shallowing within the basin that can impede shipping. New harbour works were sometimes explicitly stated as being constructed to provide deep water facilities accessible to ships at all states of the tide, the earliest example of this being at Scarborough in 1252. Yet in nearly all cases the timber-built piers were in fact dry harbours, inaccessible to all but the smallest of vessels at low tide. Such were the effects of progressive sedimentation that this included those sites that were originally intended to be deep water ports. Damage, particularly breaches in pier walls of enclosed pier systems could also allow a very rapid inflow of sediment, as was the case for example at Bridlington in the 1670s.

The creation of bars of sediment close to harbour mouths was again as a result of the introduction of artificial structures within areas of active coastal processes and the cases of Bridlington, Hornsea, Great Yarmouth, Southwold and Dover provide the best evidence for this. Such bars were normally created where the affects of longshore drift encouraged firstly an accumulation of sediment against the outer wall of a pier, after which further sediment was commonly deposited just beyond the pier head. The creation of bars could also be encouraged in situations where a river flowed through a harbour and into the sea. In such cases the flow of the river, where it met the sea, was to some degree rendered neutral and sediment within the flow became more liable to fall. The effects of wave and current could often either exacerbate bar accumulation or assist in its removal, this being entirely dependent upon the direction and strength of the elements.

Against the negative impact of silting it needs to be acknowledged that sedimentation processes could also be exploited to protect piers by the use of further artificial structures, typically groynes, to trap this material at the base of pier walls. The best examples of this were probably the Thanet sites of Broadstairs and Ramsgate. The use of such devices is considered elsewhere in this discussion.

The most common ‘reactive expedients’ to the difficulties caused by sedimentation were manual digging out, warping and the use of lighters. Cleansing or manual digging out is recorded at Scarborough, Great Yarmouth, Southwold, Margate, Broadstairs, Dover and Folkestone, though was probably carried at many other sites. From the 18th-century onwards this practice was increasing replaced by the use of mechanical dredging devices. Warping is specifically recorded at Hornsea and Great Yarmouth whilst the transference of goods via lighter is mentioned at Southwold and Dover. Prior to the introduction of efficient machine powered mechanical dredgers in the 19th-century warping is known to have been a common practice and it may well be that it was utilised at many of the other pier sites.

Attempted ‘solutions’ to the problem of sedimentation were twofold, pier extensions and realignments - sometimes in combination with the extension of related foreshore quaysides, and the utilisation of watercourses for scouring, typically via sluice systems and channel improvements. Many of the timber-built piers were subject to lengthening at their seaward ends of which the best documented examples are perhaps Scarborough, Great Yarmouth, Southwold, Ramsgate, Dover and Rye. The impetus for such lengthening was the reaching of deeper water; yet in the longer term this always proved unattainable. The well documented cases of Scarborough, Southwold and Dover clearly show that where the imposition of a pier, or piers, introduced an accretion of sediment or a bar near its head, then the works of lengthening did not halt the process, they merely moved it further out. In the cases of Scarborough and Dover the foreshore waterfronts forming one side of the harbours were also pushed forward, this mirroring the lengthening of the piers. Whilst the intent of such works was certainly to solve a particular problem for the long term, in the known documented cases it appears that accretion always followed extension. This was understood, by some constructors at least, in the 18th-century and possibly the 16th.

The question of the precise alignment of the seaward ends of piers came, during the 18th and 19th centuries, to be considered as fundamental to the question of sedimentation and to bar formation in particular. By far the most thoroughly documented case was that of Southwold where a broad variety of opinions and proposals, often in contradiction to one another, were made. Alas, the encountered evidence for variation in pier head alignment does not readily permit accurate opinion to be formed on the success, or otherwise, of this issue.

In cases where a watercourse flowed to sea through a harbour this provided the potential for its utilisation to maximise scouring. This was achieved at Bridlington and Dover by the use of sluices within dam walls, behind which water could be stored and released at low tide to scour away sediment. Although conclusive evidence is lacking it is possible that such a system was also used at Hornsea and Folkestone. Such watercourses could also be constrained within tightened and lined channels, with angular lines and other flow retarding and obstructing elements being removed. Such works, that increased both the velocity of water flow and scour, are particularly well attested at Great Yarmouth and Southwold.

3.3.3 ***Erosion*** as a motive in the construction of small, multiple, groyne-like piers at Sheringham, Cromer and Folkestone has been touched upon in Section 3.2 above. At other pier sites erosion was also a widely recorded problem and the outcome of this process cannot always be readily separated from that of storm damage; indeed in some instances storm damage was merely a concentrated part of the erosion process. Again, it was generally the landward ends of piers that were affected and reactive expedients and solutions to erosion were most commonly rock armour, breakwaters, sunken jetties, groynes, revetments and seawalls. The most extensive seawalls were those at Margate and Folkestone whilst the foreshore waterfront at Scarborough can, arguably, also be considered as such. These structures almost certainly played a role in preventing erosion whilst they are also indicated by documentary sources as serving as defences against inundation. A less extensive seawall/revetment adjacent to the landward ends of the piers is known at Bridlington. Bridlington also provides an instance of piers having to be extended landwards, as opposed to seawards, as a result of erosion. As has already been noted, piers were commonly stated in the contemporary sources as helpful in preventing erosion, though in areas of rapid erosion the difficulties in maintaining connection with the land at their landward ends appears sometimes to have been considerable. Such difficulty may even have been instrumental in the demise of the pier at Hornsea.

3.3.4 ***Storm damage*** is regularly attested at nearly all timber-built pier sites and to some degree was an inevitable outcome of such relatively fragile timber structures being placed in harsh marine environments. The principal points of weakness appear more often than

not to have been the outer toes of pier walls and the angled points of junction between the landward ends of piers at their point of connection with the land. This latter weakness appears to relate to the acute angle of junction concentrating the force and pressure of incoming sea. Attempted solutions to these problems were via the use of rock armour, breakwaters, sunken jetties, revetments and ultimately, improved pier design.

The use of rock armour to protect pier toes is first attested in the 15th-century and is known to have been used at Bridlington, Cromer, Great Yarmouth, Dover, and perhaps elsewhere. The use of breakwaters, sunken lockers/jetties and revetments, most commonly at the landward ends of piers, was more widespread and whilst not recorded until the 16th-century may well have been used prior to this date. It is clear that in some instances the above solutions to storm damage were secondary to original construction. That is, they were placed subsequent to the building of a pier and in the light of recognised weaknesses. In other cases, most notably Great Yarmouth and Dover they were part of original designs. As such these areas of potential weaknesses were identified prior to construction and effectively 'designed out' from the outset. Such forethought has obvious implications for levels of knowledge of coastal processes on the part of some constructors.

It was likewise probably levels of knowledge that led to a move towards constructing pier walls at an angle, as opposed to vertically sided, this being founded on the understanding that angled walls better deflect and dissipate wave action than vertical walls whilst at the same time such an angled shell permitted the internal ballast to lie at a more stable angle of repose. Angled walls are first positively attested at Dover in the earlier 16th-century and their use after this date appears to have been widespread. Likewise, the closer spacing of piles in more vulnerable areas of the piers was clearly a strategy intended to add strength and minimise damage. Although only specifically known at Bridlington in the 18th-century this may again have been a common practice. 'Beefing up' of identified areas of weakness subsequent to storm damage and decay is also fairly well attested and no doubt accounts for the regular re-claddings evidenced at Great Yarmouth (see Figure 5). Repairs to specific damaged areas of piers was commonly recorded and the outcome of such prolonged and multiple repairs and claddings no doubt accounts for the unusual appearance of Broadstairs pier in the mid 19th-century (see Figure 29).

It may be anticipated that major storm events in the North Sea basin would coincide with instances of damage and destruction at pier sites. The most destructive of such storm events are storm surges. At its simplest a storm surge is a change in sea level caused by a storm. Within the North Sea such storm surgess tend to originate with deep depressions tracking eastwards from the Atlantic. The lower pressure associated with these depressions causes the sea level to rise and on reaching the relatively shallow North Sea the increased volumes of water are forced southward. As the water cannot escape quickly through the narrow straights of Dover the water piles up in the southern North Sea (metoffice.gov.uk). When such conditions coincide with high spring tides and strong winds generating large waves the sea will commonly break over the land and can result in significant alterations to the coastal landscape. There are many historically attested destructive storms within the North Sea basin, particularly its southern parts. Areas most affected are the low lying parts of England, Belgium, the Netherlands, parts of northern Germany and Denmark (Lamb 1991).

Although the systematic creation of date lists for all attested incidents of storm damage at pier sites has not formed a primary aim of data collection for this study, the dates of around twenty such events are known for seven of the individual case study pier sites. There is an additional difficulty in that there is no truly comprehensive or definitive list of storm events, including storm surges, for the North Sea. Nonetheless, some correlation between well known storm surge events and pier damage does seem evident as the following examples demonstrate. The town of Ravenser and its potential timber pier was destroyed by a storm surge in 1362, this corresponding with the ‘Grote Mandrenke’ which is believed to have claimed 25,000 lives in the North Sea basin (Murphy 2011, 184; Fagan 2000, 65-66). The tempest that destroyed the stone-clad timber pier at Margate and damaged that at Broadstairs in 1808 appears to equate to a storm surge in the southern North Sea whilst it was again a storm surge that wreaked havoc at Broadstairs pier in 1897, Figure 30 (Watson 1993, 516; Pelteret 2010, 25). The potential exists for future work to identify further dateable incidents of storm damage to piers within the study area and to correlate these to known storm events.

3.3.5 Further environmental consideration One cause of decay briefly touched upon in Section 3.1 was the action of the shipworm mollusc and the gribble crustacean that are

attested at a number of pier sites. There are few recorded instances of active measures taken against this problem though at Bridlington John Smeaton proposed sheathing the timberwork of the piers with sheet copper, rather in the manner that ships hulls sometimes were. The coating of timberwork at Broadstairs with coal tar may relate to anti-worm preventative measures, whilst a similar case may apply at Southwold.

Whilst consideration of the technical form of pier construction has been considered within Chapter 2 this did not include purview of pier alignment, multiple small piers and enclosed pier systems, the varied provision of which appears fundamentally to have been owed to environmental circumstance.

The alignment of a pier was owed to two principal factors, immediate land topography and prevailing direction of the natural elements. Regarding topography, one common determinant was the presence of a coastal headland within areas of embayment. The piers at Newbiggin, Hartlepool, Scarborough, Filey, Flamborough, Margate, Broadstair, Ramsgate and Bridlington, and to some degree that at Whitby also, were all afforded protective shelter from the prevailing direction of elements by such headlands on their northern sides. The deliberate siting of these piers in the lee of headlands had obvious consequences for their alignment, this being principally determined by the degree of shelter afforded within each specific setting, just as it was at the remaining pier sites. The provision of multiple small piers has been discussed above and was seen to relate to environmental circumstances in which the protection of specific areas of land from erosion, by the interruption of longshore drift, was as significant a factor as the presence of sheltered port facilities.

Enclosed pier systems can be regarded as those in which more than one pier served to largely enclose, and shelter, a body of water and as such afforded maximum protection to vessels within. Bridlington, Great Yarmouth, Southwold, Dover, Rye and possibly Hornsea were all enclosed pier systems. The pier and island pier at Scarborough could also, arguably, be said to belong within this group as could Folkestone. It is noteworthy that all the enclosed pier sites are at locations in which watercourses capable of providing scour are also present. Indeed of all the pier locations there was only one other, Whitby, that had such a watercourse. The absence of an enclosed system here can be explained by the specific topographic setting in which comparable enclosed shelter was provided by a broad estuary. The correlation between enclosed system and watercourse then was very

significant. As we have seen, to varying degrees piers act as silt-traps. The enhanced levels of still water facilitated by an enclosed pier system, in which the ingress and egress of water is confined to a narrow aperture, both encourages the dropping of sediment in suspension and limits the potential for its removal by tide and current. The presence of a watercourse with the potential to provide scour in such circumstances can be seen as fundamental to the success of an enclosed system. It is within this context that we have a considerable body of evidence for the lining and improvement of watercourses and the provision of sluice systems.

The attempts at resolution of environmental difficulties at pier sites were met with varying degrees of success and failure. That they were not more successful is likely to be owed to several factors. As we have seen in Chapter 2, until the 18th-century there was in England no recognisable group, or body of harbour engineers. Up to this time pier works were essentially the product of empirically gained knowledge, generally with limited recourse to scientific fact or theory. As such any bank of knowledge from which correct methods could be drawn was limited. Such knowledge and skill as there was appears commonly to have lain with experienced carpenters, some of whom are likely to have regularly worked on a pier, or piers, during their working lives. Much of this knowledge gained of experience was no doubt passed on and maintained by later generations of carpenters. This probably included technical details of construction and the knowledge that angled walls were preferable to verticals ones. Transmission of such knowledge does not appear to have been via written accounts and a lack of institutional structure for the preservation and advancement of knowledge may well have stifled progression. There were other indigenous 'experts' whose opinions were sought and acted on. These were sometimes skilled craftsmen or gentlemen scholars, such as Thomas Digges. The expertise of these men appears often to have been limited to isolated cases of which Dover forms the best example.

The biographer of civil engineering Alec Skempton considers that there were no civil engineers in England until the 17th-century and that prior to this date an engineer would ordinarily be engaged from Holland or Germany. Substantial areas of these lands faced far-reaching water related problems, and their resolution, was often of great national importance. Unsurprisingly then, the greatest knowledge store of engineering in testing watery environments appears to have resided in such continental experts.

At the upper end of the knowledge spectrum we can see the works of the Dutchman Joas Johnson at Great Yarmouth. His understanding of the complex environmental problems there enabled him to construct great twin piers with a system of designed-in defences at the mouth of a river whose course he successfully constrained. Johnson's achievement was such that with periodic maintenance and a little adaptive work his harbour retained its form for centuries. Despite Johnson's considerable achievements it must surely be doubted that even he was aware that one direct outcome of his works would be the loss of several kilometres of spit to the south of the piers. At the opposite end of the knowledge spectrum the short-lived and failed works at Sheringham suggest a picture of piers built with little real understanding of coastal processes. This project was steered by seemingly corrupt individuals whose motivations were directed more towards their own profits than a successful pier system. In this particular instance it appears that only the critics, predominantly local boatmen, had any real understanding of the environmental causes at the heart of this failure.

Within the 18th-century it is possible to see the professionalization of engineering in Britain and the increased use of mathematics and science in addition to observation. These techniques were applied in the solving of environmental problems at pier sites. At Great Yarmouth, for example, in the mid 18th-century Charles Labelye was measuring tidal movements, the speed, volumes and movement of water, as well as examining the potential of hydrostatic pressure (Labelye 1747, 7-32). Such approaches were further developed at pier sites by the like of John Smeaton and William Chapman as well as the succeeding generation of 19th-century engineers. From the 18th-century engineers regularly produced thoughtfully structured written reports built upon a knowledge base. These typically begin by explaining the problems and their history, recounting previous attempts to resolve these and finally by expounding their own solution/s and the rationale behind them.

One of the fundamental problems with timber-built piers was, barring the costly foundations at Dover, the limitation of their usage within relatively shallow waters. The physical lengths at which large baulks of timber can be obtained is finite and hence can only be used in nearshore zones. This proved to be one of the central strands in the demise of timber-built piers and is a matter that is considered in Chapter 5.

Site	Vertical pier wall	Angled pier wall	Rock armour	Groynes	Breakwater	Locker, sunken locker	Sluice	Seawall	Intended deep water	Dry	Erosion	Silting	Warping/lighter	Cleansing	Inundation	River constraining	Tight piling	watercourse	Enclosed pier system
Newbiggin- Sea										?									
Hartlepool	●								●	●		●							
Whitby										?								●	
Scarborough	●							●	●	●		●		●	●				o
Filey										●									
Flamborough										●									
Bridlington	●	●18c	●		●	●	●	●		?	●	●		●			●	●	●
Hornsea							?			?	●		●					?	?
Sheringham				e& l	●					?	●	●							
Cromer		●18c	●	Occ						?	●								
Great Yarmouth		●	●	●	●						●	●	●	●		●		●	●
Southwold		●			●					?	●	●	●	●		●		●	●
Margate		●						●		●		●		●	●				
Broadstairs		●		●	●	●		●		●		●		●	●				
Ramsgate				●				●		?		●	?		●				
Dover	●	●	?	●			●		●			●	●	●				●	●
Folkestone	?						?	●		?	●	●		●	●				
Rye	●			●								●				●		●	●
Hastings	?	●								●									

Table 2, Showing piers sites, aspects of environmental circumstances and character of human intervention. ? = suspected, 18c = 18th-century, e & l = earlier and later (in relation to the 16th-century piers), occa = occasionally recorded. The presence and absence of markers reflects the amassed historical data, i.e. absence of a marker does not preclude an attribute having once been present

Chapter 4: The Social Context

This chapter explores matters associated with three principal aspects of the social context of timber-built piers: ownership, control and funding, and how the precise nature and form of these changed through time. In doing so this chapter grounds the piers in the perspective of those bodies and individuals who built and bore responsibility for them. The time span of these piers extends from the medieval to modern worlds and formed an epoch witnessing considerable societal transformations, aspects of which were reflected in the social settings of seacoast piers. Although ownership, control and funding were intertwined, for ease of comprehension each is considered under respective headings.

4.1 Ownership

At any one time all the piers within the study area were in one of six ownership forms: by manors or estates; by the crown; by lessees of the crown; by local communities; by bodies of commissioners and; very rarely, privately owned. Throughout their operational lives the form of ownership of nearly all piers changed, this directly reflecting far reaching national institutional and organisational changes within broader society. The only instances in which the ownership of piers did not change were those examples which were short-lived.

4.1.1 Estate and manorial ownership

Within the study area ownership by estates or manors is only attested in northern England, almost all in Yorkshire. Within such bodies ownership could be by either secular or ecclesiastical authorities. At Filey and Flamborough the piers were held within secular manors, whilst at Whitby, Bridlington and Hornsea they were held as part of much larger ecclesiastic holdings until the reformation. Estate and manorial ownership tended to be early, none being recorded beyond the first half of the 17th-century. For a brief period within the early 17th-century Bridlington and its piers came into secular

manorial ownership whilst Whitby, and possibly its pier, also did from the mid 16th-century.

Secular

Filey is first mentioned as a port in the 13th-century though it was not until 1588 that a pier was first recorded (*Rotuli Hundredorum* cited in VCH 1974, 142; Waghenaer 1588). The last reference to a pier here is in 1648/9, though it was already said to be ruinous by 1637 (ERRO DDHU/9/60; Cal. S. P. Dom. 1637). All relevant documentary sources pertaining to the port indicate that its ownership was rooted in the manors of Hunmanby and Filey before, during and after the life of the pier (ERRO DDHU/9/32; DDHU/9/55; DDHU/9/60; DDHU/3/28). The very small scale of the pier works at Filey seem likely to reflect the fact that the township of Filey, within the manor of Hunmanby, was never of any great size or economic might. Never holding more than a weekly market and a two day annual fair the limited economic base of the town probably also explains the short life of the pier.

The pier works at Flamborough originated within the manor of Flamborough, which itself formed part of the East Yorkshire holdings of the Constable family. First mentioned as a port in 1323, a *"Kay"* in the sea is documented in 1400-01 (Cal. Close Rolls 1323; Test. Ebor. 1836, 264-5). Such infrastructure is thereafter recorded on a number of occasions, including in 1473 when the lord of the manor reaffirmed his right of way between the Constable manors of Holme Upon Spalding Moor and Flamborough, in particular for carts carrying timber to repair the pier (YSCP III 1914, 25). The end of ownership of the manor of Flamborough by the Constable's came in 1537. In that year Sir Robert Constable chose to rise against King Henry VIII in the Pilgrimage of Grace. He paid the ultimate price, losing both the family estates – which were escheated to the crown, and his head (Y.A.S. XLVIII 1912, 38-9). The family's former holdings were returned by 1582, though the last documentary reference to the pier is in 1570 (TNA E310/29/173). Cartographic evidence suggests that the pier may have survived until the early 17th-century (British Library 1; Bleau 1625).

It was noted above that the manor of Whitby came into secular hands shortly after the reformation. In 1550 Whitby was granted by the crown to the Earl of Warwick who conveyed it to a supporter, Sir John Knight. Shortly thereafter Knight sold it to Sir Richard Cholmley who was already its lessee (VCH 1923, 502). This holding may have

included the timber-built pier though the only known references to it in the later 16th and early 17th centuries are comments on its poor condition and it appears to have been replaced in stone in the 17th-century (S.P. online 2; JHC 1597, 567; RCZAS 2008). After a period of crown and lessee ownership (see below), the manor and piers of Bridlington reverted to the crown around 1611 (Neave 2000, 45). In 1623 James I granted them to a favourite, John Ramsey, Baron of Kingston upon Thames and Earl of Holderness and upon his death they passed to his brother Sir George (Purvis 1926, 52-65). It may have been the cost of maintaining the port that prompted Ramsey to sell Bridlington to its inhabitants in 1630, see Section 4.1.4 (Purvis 1926, 65-123).

Ecclesiastic

Although the seaports of Whitby, Bridlington and Hornsea all originated within secular holdings prior to the early 13th-century there is no evidence to suggest that they possessed piers at that time (Charlton 1779, 67; Cronne and Davis 1968, 46; Poulson 1841, 317). These holdings were later granted to monastic institutions and the piers that subsequently emerged at these sites developed within the estates of the large monasteries of Whitby Abbey, Bridlington Priory and St Mary's Abbey, York, respectively (Charlton 1779, 67; Neave 2000, 7-9; VCH 2002, 286). These institutions became enormously wealthy holding extensive estates and possessions across Yorkshire and beyond (Charlton 1779; Wiles and Burton 1988, 3; Lancaster 1912).

At Whitby the rights and privileges of both the Benedictine abbey and townsmen were sometimes contested. Burgage in the town had been granted to the abbey by 1128 though this right was then given to the burgesses of the town by abbot Richard in the 1180s. At a later date, and after prolonged dispute, this was successfully reclaimed by the abbey in 1351 (Barker 2007, 16; VCH 1923; Charlton 1779, 144-5). Nonetheless, one of the few survivals of the townsmens' former freedoms was a burgess court and this apparently retained certain rights in the harbour (Barker 2007, 19). This anomaly no doubt explains the early 15th-century grants of quayage that were unusually addressed *"to the abbot and proved men of Whiteby"* (Cal. Pat. Rolls 1411; Cal. Pat. Rolls 1424). Prior to this grants of quayage had been variously addressed to either the *"abbot"* or *"bailiffs and good men of the town"* this variation seemingly depending upon who held sway in the port at that time (Cal. Pat. Rolls 1307; Cal. Pat. Rolls 1341). Whitby Abbey was dissolved in 1539,

the entirety of its possessions and holdings passing immediately to the crown (L. & P. Henry VIII 1539a).

The Augustinian Priory at Bridlington was founded c. 1113 as a result of a grant from the Gant family. Further grants to the Priory by the Gant's resulted in the Prior's of Bridlington becoming the de-facto lords of the manor (Lancaster 1912). From 1200 the Priory enjoyed rights to a weekly market and annual fair, whilst in 1446 grants were made for three additional fairs (Neave 2000, 24). A number of Bridlington ships are recorded in the medieval period, including those belonging to the Prior in the 13th and 14th centuries (Neave 2000, 27-28).

The first descriptive reference to existing timber-built works at the quay of Bridlington is in 1537 though a pier, or piers, at the town were probably present by 1446 when grants to anchorage, quayage and groundage in the port were made (L. & P. Henry VIII 1537a; Cal. Chart. Rolls 1446). In all likelihood piers may have originated before this date. Bridlington remained under the governance of the Priory until the reformation, the monastery being dissolved in 1537 and the manor seized by the crown (Neave 2000, 33-36).

Hornsea's pier was located at Hornsea Beck, a part of the manor of Hornsea which was granted, together with the tithe of fish, to the Benedictine Abbey of St Mary's, York, in the late 11th-century (EYC iii 1916, 26). A port is first recorded in 1228 and there are a number of references to fishermen, shipmen and to tolls on merchandise from the early 13th-century onwards (Poulson 1841, 317; Cal. Pat. Rolls 1364; VCH 2002, 286). St Mary's Abbey was granted the right to a weekly market at Hornsea in 1257 and for an annual fair in 1275. Permission for a second annual fair was granted in 1358 (VCH 2002). The market and fairs together with the port seem likely to have stimulated mercantile activity in the locale.

The date of origin of Hornsea's pier is not known and the first mention of an existing pier, or *"key"*, does not occur until 1537. In that year correspondence between William the Abbot of St Mary's, York and Lord Thomas Cromwell states *"Are at more charges some years by a key there than the whole of the lordship is worth by year"* (L. & P. Henry VIII 1537b). On the surface at least, it appears that this pier was something of an economic loss maker. St Mary's Abbey and its possessions were surrendered to the crown in 1539 with the manor of Hornsea being retained by the crown until 1665 (VCH 2002, 273-295).

Discussion

Up to the reformation of the 1530s the overwhelming majority of the northern pier sites, excepting only Newbiggin, Hartlepool and Scarborough, are characterised by origin and ownership within manorial units or larger estate holdings. This factor is quite at variance with the evidence from elsewhere along the eastern seaboard of England and one is tempted to consider it as something of a north – south divide. This variation clearly relates to regional differences in social and economic organisation.

With regards to the secular manors, the pier sites of Filey and Flamborough were characterised by works of small scale, as befits the modest manorial economic units of which they were appurtenances. The very small scale of the pier at Filey leads to the suggestion that it may have been as much a symbolic physical expression of the manorial ownership of rights to tolls and profits, which are well attested in the early – mid 17th-century, as it was a workaday functional item of infrastructure (ERRO DDHU/9/32; DDHU/9/55; DDHU/9/60). Accordingly, it would be here that vessels were obliged to moor and where the payment of tolls could not be avoided. In this way the trade of the port could be formalised and regulated.

At Flamborough, the bequest of Robert Constable in 1400-01 for the maintenance of a *"kay"* sheds another dimension on the role of piers within manorial communities. In one sense this bequest could be seen as a charitable legacy by a wealthy man intended to support an item of infrastructure that was perceived as being of communal benefit. Such acts were common throughout the medieval period and are well attested at a number of pier sites. What appears slightly unusual in this case is that the pier was a component of the manor of which the Constables were lords (VCH 1974, 158). At first sight this appears a little like giving one's self a gift, a mere passing of coins from the left hand to the right. An alternative reading may be that although the pier did indeed belong to the Constable's it was an important asset to the community as a whole, but like piers elsewhere it was essentially a 'loss-maker'. Robert's legacy could therefore be seen as an expression of Constable concern and loyalty, a preparedness to leave a gift for the benefit of the tenantry, many of whom gained their livings through interaction with the sea. The reference of 1531 to the carriage of timber for the repair of the pier between the Constable manors of Flamborough and Holme on Spalding Moor is also of some interest, indicating that the family transferred resources between their East Riding manors. Whilst the pier

complex may not have been of great direct profit to the Constables it did generate some income, the anchorage of ships at the pier forming part of the manorial revenue in the early 16th-century (TNA E310/31/185 no21: quoted in VCH 1974, 158).

The piers of Whitby, Bridlington and Hornsea originated within the context of extensive ecclesiastical estates rather than small manorial units. They were also located within larger settlements of greater economic importance than those belonging to the secular manors. It is equally probable that these piers were of larger scale than those at Filey and Flamborough, though this cannot be proven. In the case of Bridlington, at least, ships engaging in trade were owned by the monastic institution and like the secularly owned piers enjoyed the profits and tolls their ports generated, though this was to some degree offset by the expense of pier maintenance.

Looking at these matters in greater detail we can view ownership within such large holdings as providing major conduits for the economic activity of their parent estates; regulated locations for estate imports and exports and as bases for estate tenant fishermen. The construction and sustaining of the piers may well have represented acts of estate policy. We can also see the estate resources of timber, labour and coin from rents and profits as fundamental to the development of the pier sites. Timber was the basic raw material for the structure of the piers and the large estates possessed areas of woodland within their various holdings. Despite the lack of much early documentation, there is the reference to the drawing of timber from woodland within one part of an estate for use in its piers at Flamborough in 1531. The use of labour services, as part of the extractive relationship between lord and tenant, is one of the characteristics of the socially-embedded medieval economy and there is some pre-reformation evidence for the use of such services in the repairs at the harbour at Bridlington (VCH 1974, 98). As will be seen, the later Henrician works at Bridlington drew heavily on the labour services of tenants and these from up to several miles around the town. Such arrangements by the crown reflected the traditional practices of the pre-reformation era at the town. These arrangements may also have been mirrored at other piers within estate and manorial holdings. Cash payments, though not in lieu of labour service, are evidenced at Hornsea where a system of "*dolles"* (doles) were paid by fishermen to St Mary's Abbey, for the maintenance of the pier (Purvis, 1949, 69-71).

Whilst estate tenants could perform labour services at the piers later evidence indicates that this was primarily labouring and that the skilled work of carpenters and sawyers had to be paid for. Such payment for skilled services may have been the case prior to the reformation also. Even allowing for this, however, access to timber and labour that did not require the direct payment of coin no doubt bestowed certain economic advantages on piers within large estates. For a pier within a small manorial unit there is compelling evidence from Bridlington, albeit of slightly later date, which indicates that the resources within a single manor unit may have been insufficient to sustain a pier of any size. This factor perhaps goes a long way in explaining the relatively small scale of the works at both Filey and Flamborough.

In contrast to the manorial/estate ownership of the Yorkshire pier sites the overwhelming majority of pre-reformation, and indeed later, pier sites within the study area were municipally owned. All of these, with the exceptions of Newbiggin, Hartlepool and Scarborough, were located in the southern half of the country. As will be seen, the majority of the manorial/estate owned northern piers ceased to exist within a century of the reformation, only Whitby and Bridlington surviving, with the latter coming to be municipally owned. In one sense then, the manorial and estate based pre-reformation social and economic organisation relating to the northern pier sites could already be seen as archaic. The breaking up of these large holdings and the socio-economic transformation that this wrought presented challenges that for most pier sites could not ultimately be overcome.

4.1.2 Crown ownership

In the consent for construction, support with appeals for aid and in the enactment of assisting legislation, the role of the crown was pivotal for seacoast piers. Whilst the crown possessed many manors and properties across the country it did not normally own piers. The reformation would change that and impart a permanent legacy. One early outcome was sole crown control of the Yorkshire piers seized by Henry VIII with most being held by his heirs until the course of Elizabeth I's reign. The unique case of Dover provides an early example of direct state intervention in what was perceived as a work of 'national interest'.

The direct social and economic consequences of Henry VIII's religious reforms impacted nationally and permeated, to varying degrees, through all levels of society. The monasteries of Whitby, Bridlington Priory and St Mary's Abbey, York, with their vast estates, including the piers at Whitby, Bridlington and Hornsea, were surrendered to the crown in the late 1530s. These estates were fragmented, with parts of the lands and possessions being redistributed through sale and gift and the remainder retained by the crown. The pier and manor of Flamborough, part of the secular estate of the Constable family, suffered a similar fate when Sir Robert Constable rebelled against the King in 1537. It is a point of great significance, that in all four of these cases the manors and piers of Whitby, Bridlington, Hornsea and Flamborough were retained by the crown.

The crown chose to invest considerable sums of money and vast quantities of materials in these piers. At Whitby, around 1545 it was stated that great sums of money had already been spent by the crown on the pier and that timber would need to be reserved for *"it is verye necessarye that all the Woods within the Parishe of Whitbye or elce where nere thereunto be reservyde for the mayntenaunce of the Kyyngs Tenements and cottages in Whitbye and at Robynhood baye, and of the Peyr against the Sea at Whitbye where the Kyngs Majestie hath adredye imployed great somes of Money."* (Young 1817, ii, 530). These works were also witnessed by the antiquary John Leland (Toulmin Smith 1907, 51, 61).

The most extensive of Yorkshire's crown construction programmes was at Bridlington with several campaigns in the later 1530s and 1540s in which directly employed on-site work forces in excess of 40 individuals were engaged (see for example (TNA E101/622/29; E101/459/5; E101/495/6) and a number of entries in the Letters and Papers Henry VIII, especially for 1539 and 1540 respectively). Of especial note with regard to crown ownership of Bridlington Priory's estate was the utilisation of the rights and resources that had formerly been associated with it. As such, the tenants of Bridlington and surrounding townships were called upon to perform labour services at the harbour. Further, the essential supply of timber was drawn from woodlands newly in crown ownership, not just from the woodlands that had been owned by Bridlington Priory, but also from those previously belonging to the Cistercian Abbey of Meaux Abbey, East Yorkshire, those formerly of the Constable family at Holme Upon Spalding Moor, as well as from elsewhere. Manorial officials, such as the steward, were also drawn into the works alongside a range of crown officers such as the General Receiver of Possessions, a

King's General Surveyor, and a clerk of works. Even ministers of the crown, including Henry's Principal Secretary and Chief Minister Thomas Cromwell and the Duke of Norfolk played distant roles. The character and extent of these works are detailed at some length in Appendix, Case study 7, Bridlington.

Programmes of work at the key at Flamborough are also attested in the early 1540s, although these did not approach either the scale or duration of those at Bridlington (TNA E101/463/17; E101/463/18; E101/463/19; E101/463/20). Rather, these works appear to relate to significant repairs followed by maintenance. None of the records relating to the pier work at Flamborough indicate manorial labour service and it may be that such specific service had never been customary here. However, the names of some of the carpenters and labourers working at the key and receiving payment do appear in lists of tenants of the manor indicating that they were local. At a managerial level it is probable that the manorial bailiff of Flamborough was overseeing the works, certainly some, if not all, of the building accounts at the key were written by, or on the instruction of, this official. At the highest level, albeit that considerably abstracted, we can again detect the interest of Thomas Cromwell and the Duke of Norfolk, with this being represented on the ground by the inspections of the same King's General Surveyor involved at Bridlington. (L. & P. Henry VIII 1537; Y.A.S. XLVIII, 47).

There are no records of any works the crown may have carried out at Hornsea's pier immediately after its seizure, and it may be that none were necessary at that time. Despite the claims of the abbot of St Mary's in 1537 to the effect that the cost of maintaining the pier was more than the lordship was worth, the crown did see fit to invest. In 1549 the pier was declared to be ruined and consideration was given to its repair and projected costs (Acts of P. C. 1547-50, 396). Shortly after this date, in 1553, it was directed that a warrant for the defrayment of monies be issued, with this being further to the £1000 already bestowed about the pier by the king (Acts of P. C. 1552-4, 255). Further works may have been in progress in 1556 when we are informed of *"xx tonne of tymber & two lytell pecs of tymber"* (at Hull Bridge) *"wch was the Kinge & Quenes tymber And was pr*(ov)*ided to have repaired the pere at horneseye"*, which was seemingly stolen (ERRO DDCC 139/65). Post-reformation religious changes permitted the sale of Hornsea's church plate and other materials in the 1550s *"for the repaire and buildinge of the peire of Hornesey"* whilst the doles that had been locally paid towards the maintenance of the pier are referred to in 1578 and may have continued to be paid towards the same end

(Surtees Soc. 1896, 49-50; Cal. S. P. Dom. 1578). The last documentary reference to an extant pier at Hornsea is in 1558 though a map, attributed a date of 1595 by the British Library, suggests that it survived until the late 16th-century (Poulson 1841, 317). Some consideration of the loss of this pier is given in Section 4.1.3.

The massive and costly programme of Henrician harbour works at Dover received its initial impetus from the petition of representatives of the town (Colvin 1982, 731). However, once adopted by the Privy Council and king the entire momentum, funding and developing form of the works was shouldered by these central authorities and their representatives (Colvin 1982, 731-764). The king made at least five visits to the ongoing works, received correspondence and platts and played an influential role in the project over a period of many years. Aspects of the works are even known to have been adopted in line with his suggestions. Thomas Cromwell took on the role of both encourager and berater of the officials entrusted with its construction whilst other members of the Council likewise concerned themselves in its affairs. In many ways the crown's role at Dover mirrored that at the Yorkshire pier sites that came into its custody. However, the scale of the works at Dover were such that the few thousands of pounds invested at the Yorkshire sites proved to be tens of thousands at Dover. Likewise, the dozens employed at the Yorkshire pier sites became hundreds at Dover. The money invested at Dover came from crown coffers, much derived from Acts of Subsidy passed by Parliament with some perhaps coming from the spoils of reformation seizure. Whether or not the utilised timber came from seized resources is uncertain. The context of the Dover works during Henry's reign was essentially one of a national project funded by the state and in its de-facto ownership. Following these works responsibility for Dover's harbour was transferred by the crown to the town authorities in 1556 (Colvin 1982, 754).

Discussion

The behaviour of the crown towards the Yorkshire piers it had seized, as well as at Dover where it intervened, provides firm evidence for crown strategic thinking. The government's policy appears decidedly pro-active and not simply reactive. Following their seizure, all the northern pier sites were retained by the crown rather than being sold or gifted. Decisions to invest massively in the port infrastructure were taken and a range of government officials were drafted in to deal with matters, and not just as single isolated cases. Regarding the havens of Bridlington and Flamborough, and at the highest

ministerial level, the Duke of Norfolk commented on the state of both piers to Lord Cromwell. Further down the scale Richard Pollard, one of the King's General Surveyors, dealt with matters at Bridlington and at Flamborough. A few of the individual carpenters named in the building accounts were also working at both Bridlington and Flamborough, though arguably this may relate to individual employment opportunities rather than to overall planning at a higher level. It is also notable that timber from seized woodlands, both monastic and from the Constable's, was utilised at piers that required it and not necessarily piers within its former estate. Thus former Constable timber was used at Bridlington and timber from Meaux, which had never had a connection with any pier, was likewise used at Bridlington. Whilst the crown was obliged to directly employ and pay large workforces, as well as related providers of services, it was also anxious to continue the traditional use of manorial labour services at those sites where this was established custom. Clearly the crown operated in earnest and set about its investment programme with some eye to efficiency.

The decision to retain and invest in these sites may reflect the wider interests of Henry VIII generally in matters maritime. The state policy of increased investment in naval forces and the provision of a variety of coastal defences form the best known strands of this governmental action, whilst more passive measures included the commission for maps of coastal towns and defences. The large scale harbour works initiated at Dover and the works at Whitby, Flamborough, Bridlington and Hornsea clearly form part of this greater vision. In an inflated manner the investment at these sites by the crown mirrors the policies of investment in individual pier sites by the large estates of the pre-Reformation period. The major differences during the Reformation were principally ones of scale, several piers, and resources on a monumental scale. This can be seen as the policy of the ultimate estate, that of the crown and kingdom. The evidence indicates that official thinking on pier related matters extended beyond the old manorial and estate boundaries; that it was strategic and looked both at the bigger picture and towards the future. Henry's policy was continued by his heirs with work, and intended work, at Bridlington and Hornsea being indicated during Mary's reign.

4.1.3 Lessee ownership

The leasing of piers by the crown was a practice limited in time from the mid 16th-century to the very early years of the 17th-century and restricted to Yorkshire alone.

The piers seized by the crown during the reformation continued to be held into the reign of Elizabeth I when a change of direction in government policy became apparent. The first evidence for this appears in a letter of 1562, in which the Marquis of Winchester commented on the state of decay of the ports at Bridlington and Robin Hoods Bay, the consequent erosion of the coast and the costs of this burden to the crown. Winchester went on to suggest that these issues might be resolved by the leasing of the entire manors (Purvis 1926, 167-8). By doing so the intention was that the piers would be repaired and maintained at no expense to the crown who would still receive rents from them (Ingram 1977, 21). As a result of such official thinking the manor and piers of Bridlington were leased as a single unit in 1566 (Cal. Pat. Rolls 1566, 447-9; Purvis 1926, 37-8). The manor and key of Flamborough were similarly leased at the behest of Treasurer Winchester, possibly as early as 1562 and extended in 1570 (VCH 1974, 158). At both sites the leases were made out to 12 named individuals, one of whom, Thomas Wayfarer, was a lessee of both.

The Bridlington lessees have been the subject of some research by David Neave and they are known to have been drawn from the town's elite and *"were linked by an intricate pattern of connections formed through friendship, business and marriage"* (Neave 2000, 41). Essentially all were yeomen and mostly had local roots. Many owned land and property, two were butchers, another a master mariner, at least one other had shares in a ship whilst one was a schoolmaster. It seems that these men of modest social origin were actively taking advantage of the new economic circumstances wrought by the fragmentation of the former estate of Bridlington Priory. The opportunities afforded to certain members of this class at Bridlington in the 1560s would seem unlikely to have materialised without the seizure of monastic property in the 1530s.

The lessees were taking on risks as they were required to both rebuild and maintain the piers to the satisfaction of commissioners appointed by the Exchequer. It was perhaps in recognition of this that the lease came with a number of inducements, in particular all old materials of the pier, 120 suitable trees from the adjacent woods, 120l in money and the

use of the site of the monastery as a source of stone for infilling the timber pier bays (Cal. Pat. Rolls 1566). It is possible that the establishment of Bridlington as a customs port, as a member of the port of Hull, in 1559 (Neave 2000, 57-8) may have served as an additional sweetener, as this allowed trade to be carried out internationally. The charging of pier rates, a levy on the local inhabitants for the maintenance of the piers, was permitted under the lease from at least as early as 1580 (S.P. online 1; Purvis 1926, 169-170). There is no definitive evidence that the lessees were permitted to demand labour services from the tenants of the manor, though aspects of this practice were considered customary in 1636 (Purvis 1926, 96).

This first group of lessees also had to contend with opposition from a member of the local gentry, Sir Thomas Boynton, who craved the lease to the manor for himself. Sir Thomas was the son of Mathew Boynton who had been appointed steward of the manor after its seizure by the crown in 1537. Sir Thomas wrote a series of three specious letters to the Chief Minister Lord Burghley in which he denigrated the efforts of the yeomen tenants and appears to have grounded his own case for possession on little more than *"the generall Love I bear unto my countryemen and neyghboures"*; alas to no avail (Purvis 1926, 170-5).

Inquisitions into the state of the manor and piers at Bridlington indicated a number of shortcomings in management and repair (TNA E133/6/920; E178/2714) and this first lease ran for only 25 of its intended 40 years. Before this date the struggling, surviving, lessees had already suffered goods distrained and at least one had served time in goal (Ingram 1977 24-5). Following a number of legal actions finalised in 1592 the lessees were found not to have broken the terms of the 1566 lease but it was voided anyway on the grounds of defaulting of payment of rents in 1585 (Neave 2000, 44). A new lease was drawn up in 1591, prior to the conclusion of the original lessees legal case, this time in favour of John Stanhope, a Gentlemen of the Privy Chamber (Thompson 1821, 77) and member of the Council of the North (Neave 2000, 44; Purvis 1926, 38-40). Apart from a copy of the lease nothing more is known and it is possible that it may never have been taken up before a new lease was prepared in 1595.

The lease of 1595 was intended to be in the names of thirteen individuals though this was finalised at ten. The terms were the same as those of 1566 (Neave 2000, 44-5). Socially, less is known of these lessees but one was termed a gentleman and the others yeomen.

One is known to have been a mercer, another a woollen draper. Again this lease did not run its intended course of 41 years and may have terminated by 1611 (Neave 2000, 45), perhaps again through an inability of the lessees to meet their obligations (Ingram 1977, 28).

Prior to 1551 the manor house and demesne at Flamborough were leased by the crown to a named individual and in 1559 to another person (VCH 1974, 154). However, this need not have included the pier which probably remained, along with the tenanted lands, in the hands of the crown. In fact it appears that by 1551 the pier was in a parlous state, a rental document of the manor stating *"and now the peer is dyfaceyd and brokyn downe by the see"* (TNA SC11/732).

In 1562 the manor was leased to a group of twelve inhabitants of Flamborough, with Robert Puckering seemingly the lead figure (ERRO DX/131/h). This lease was in similar form to contemporary leases of the manor and piers at Bridlington and included the farm of the anchorage of ships and small vessels *"in the port called the peare"*. Robert Puckering is listed as a tenant with extensive holdings in the manor and in 1540-1 had served as the crown's bailiff (TNA SC11/732; VCH 1974, 154). The Puckering family of Flamborough appear to have been on the rise at this time. One member of the family, John Puckering, entered Lincoln's Inn in 1559, became a Member of Parliament and Speaker of the House of Commons. He was knighted by Elizabeth in 1592 and buried in Westminster Abbey in 1596 (Fisher 1894, 88-90). Another member of the lessees was Thomas Waferer, presumably the same Thomas Waferer who became a crown lessee of the manor and piers at Bridlington. It is probably reasonable to assume that like the lessees at Bridlington the individual member lessees at Flamborough were men taking advantage of opportunities for advancement offered by the break-up of old orders during the reformation.

The lease of 1562 was renewed in 1570 and required the lessees to *"matntayne a peare there, whiche peare beinge well and substancyally buylded was by force of vehement and outragiouse rage of the sea and storme of weather utterly overthrowne, broken, and spoyled sythence meichelmas last past"* (TNA E310/29/173). This is an interesting sentence as it tells us that the lessees were responsible for maintaining the pier and that prior to its destruction in 1569, it was substantially built – whether by the lessees, or the earlier work of the crown in the 1540s is uncertain. The lease of 1570, which was

intended to be for twenty one years, states that the lessees meant "*to buylde another peare in a more convenyent place, than the other was"*. Further the lessees were hoping *"to have towards the same newe peare in consideracon of their greate losses and chardges some tymber trees by yor honors warraunte"*. This new pier was intended to have *"at the mouth therof viii fote of water in depth at the head of a neape tyde"* (presumably at mean high water of a neap) and *"the same to be done wthn the space of iiii years next"*. The terms of the lease specifically recognised that as the costs of maintaining the port were uncertain the lessees were permitted to levy an annual rate on the manor's tenants.

Discussion

The Elizabethan policy of leasing at Bridlington and Flamborough ultimately failed and this raises a number of interesting issues. The drawing up of leases for individual pier sites and their manors stands in marked contrast to the earlier policy of direct crown control and investment initiated by King Henry. The new system was very much one of indirect control, with the regulatory work being carried out by Exchequer-appointed commissioners. The motives behind this shift seem clear in Winchester's correspondence and were essentially those of cost-cutting, a characteristic of much of Elizabeth's fiscal policy (Starkey 2000). The system of leasing, with inducements attached, seemed to provide opportunities, and these were taken up by men of yeoman status, a class that is generally perceived as containing elements eager for improvement, ambitious, prepared to muddy their hands and willing to take risks. Ultimately, it seems inconceivable that these 'opportunities' would have arisen had it not been for the effects of the reformation, which resulted in the fragmentation of monastic estates and the redistribution of their wealth and resources.

However, for the lessees, the bloom of what may once have appeared as a rosy future soon faded. With hindsight the reasons for this seem readily evident. Within the old systems of estates to which the piers of Bridlington and Flamborough originally belonged, access to extensive resources of timber, labour and money ensured their proper provision within the policies of those estates. Upon seizure by the crown the pier sites continued to thrive, this time owing to a combination of state policy and the crown's access to a massive windfall of former monastic lands, including of course, timber, labour and money. The problem for the lessees was that they were now required to rebuild and maintain the piers with only the resources of single manorial units. Quite simply, the

incomes and material resources from such relatively small individual economic units were insufficient to maintain piers, particularly when on the scale of those at Bridlington.

Subsequent to the foreclosing of the third lease at Bridlington the manor and piers reverted to the crown and in 1623 James I granted them to a favourite, John Ramsey, (Purvis 1926, 52-65). At Flamborough the lease of 1570 marks the latest documentary reference to the pier and by 1582 the manor had been fully returned to the Constables. The indicating of the pier on an English map of around 1595 and on a Dutch chart of 1625 suggests that the pier may have survived into the early 17th-century. The fate of Hornsea is less certain. An inquisition of 1602/3 indicates works at Hornsea's pier in the time of Queen Mary (TNA E178/160). There is no documentary evidence for the pier during Elizabeth's reign and it seems to have been lost around the end of the 16th-century.

There are no explicit documentary statements regarding the loss of the pier sites at Hornsea and Flamborough and we must hypothesise or rely on circumstantial evidence in order to explain their disappearances. Ultimately, the control of Hornsea rested in the hands of the crown and so it seems reasonable to surmise that had the crown been committed to the survival of its pier as a working entity then survive it would, either through subsidy or direct intervention. It is entirely likely that the crown would have attempted to save itself the expense of maintaining the pier by leasing it in similar manner to those at Bridlington and Flamborough. However, had this ever happened it would have been referred to in the inquisition of 1602/3. Given the experiences at Bridlington and Flamborough and the environmental difficulties of Hornsea's location (See 3.2.2 Chapter 3) it may be that no one was prepared to take up a lease that required maintenance of the pier and that by default it remained in the hands of the crown? It would appear, given the near permanently insurmountable environmental problems, that the crown was simply not prepared to continually throw good money after bad. The loss of the pier at Flamborough appears to have occurred during the earlier years of the return of the manor to the Constable family and after the failure of a succession of leases to keep the key in good working order. It was probably an inability of the key to adequetly 'pay for itself' within a manorial context that led to its loss.

Documentation from the 16th-century onwards indicates that pier sites generally were perceived, both at local and governmental levels, as being economic assets to their towns and local communities (Purvis 1926, 187-93). Above that, some piers at least, were

considered to be of particular national significance as havens of refuge for ships. At a local level of consideration the loss of the piers at Hornsea and Flamborough would have some effect on their settlements and immediate hinterlands but this would not have prevented all seaborne trade or fishing. Historically, both had fewer annual fairs or market days than Bridlington which was a centre of greater significance. Arguably, Flamborough may have felt any effects less as it lies less than 6km from the port of Bridlington (in fact the distance between all three ports is less than 20km). As a haven of refuge, neither site was of especial importance. Hornsea lacked the protective shelter of a headland whilst the small scale of the key at Flamborough could never have accommodated more than a few vessels, though it did at least benefit from shelter from Flamborough Head. Perhaps Flamborough's greatest weakness in this regard was its proximity to the large pier system at Bridlington to which vessels in the area could generally resort.

4.1.4 Municipal ownership

The piers of Newbiggin by the Sea, Hartlepool, Scarborough, Sheringham, Cromer, Great Yarmouth, Southwold, Margate, Ramsgate, Folkestone and Hastings all originated, and developed, within an ownership context of the communities of their associated towns (see Appendix case-studies). We can be certain of municipal ownership at these sites as permissions and grants regarding the piers were commonly addressed to the communities as a body whilst town records, appeals and other communication frequently refer to the piers as belonging to them. As has been seen, the burgesses of Whitby also enjoyed a brief period of ownership of their pier though this subsequently fell under the authority of Whitby Abbey, later still the crown and eventually private manorial hands. The piers of Bridlington eventually came under direct community ownership after a prolonged period of mixed fortunes under the authority of Bridlington Priory, the crown, lessees and private manorial ownership successively. The circumstances of Bridlington's shift towards community ownership are particularly interesting and considered towards the end of this section. The pier of Broadstairs came into municipal ownership in the later 16th-century, seemingly after a period of private ownership by a local family. The medieval port of Dover functioned as a municipal enterprise though the first timber-built piers for which we have definitive evidence here originated in the context of crown works, these then passing to the town in 1556. For failing to maintain this nationally important harbour, and

possibly misusing its funds, direct intervention by the state resulted in authority over the port being transferred to a 'Harbour Board', effectively a body of commissioners (Burrows 1888, 208-9; Leach 2005, 38).

Municipal ownership was by far the most common framework within which seacoast piers came into existence and were held. It was also the most long-lived, its currency extending in time from the foundation of the earliest recorded piers of Scarborough, Hartlepool, Newbiggin and Cromer of the 13th and 14th centuries, through to that not founded until the 18th-century at Southwold, and was only progressively replaced by commissioner ownership from the later 17th-century onwards.

Many of the towns owning piers were chartered, or otherwise of borough status. This applies to Newbiggin, Hartlepool, Scarborough, Great Yarmouth, Southwold, Dover, Folkestone and Hastings all of which, excepting Newbiggin, were towns of some significance in the medieval and post-medieval periods, though the fortunes of some later waned (see Appendix case-studies). All possessed well established systems of internal self governance. Power and corporate decision making within these communities, including in relation to the piers, was ordinarily in the hands of those bodies representing the towns. It was often these authorities that were responsible for appointing the public officials responsible for everyday control and management of the piers and for organising attempts to provide aid and funding. Such authorities were normally composed of the upper echelons of their communities and elected via quasi-democratic means with limited franchise. The precise form and makeup of these bodies varied from town to town and commonly altered over time. A number of these towns had a mayor, others a bailiff or bailiffs whilst a form of council, comprised of varying numbers and known by different names, was ubiquitous. Municipal decisions and actions regarding their piers were commonly entered into town records and a number of these survive for various of the towns.

The remaining pier owning towns of Sheringham, Cromer, Margate, Broadstairs, Ramsgate and eventually Bridlington tended to be smaller centres and whilst they did not posses officially sanctioned rights of self governance they nonetheless legally held their piers and were responsible for them (see Appendix case-studies). In the cases of Margate, Broadstairs and Ramsgate membership of the confederation of Cinque Ports provided an alternative form of governance. At Margate there is also record of decision making about

the pier being taken at public vestry assemblies and intimations of the same at Broadstairs (MPL White, undated; Lewis 1736). The role of the Cinque Ports is considered below, as is the exceptional case of Bridlington. The two Norfolk cases of Sheringham and Cromer are therefore unusual. The pier at Cromer originated as early as 1390 and the entry in the Patent Rolls granting permission for the community to levy tolls in aid of its construction was addressed to *"the good men of Shipden"* (archaic name for Cromer) (Cal. Pat. Rolls 1390). Subsequent documentation clearly indicates that the piers belonged to the townships, not to manorial units or lords. Cromer in particular looked to the county and crown for various means and schemes for funding their pier and commonly used the north Norfolk gentry and other important figures as intercessors between themselves and the crown (Duchy of Lancaster Pleadings, transcribed in Rye 1889, 57-8; Hassell-Smith 1974, 235-6). This sometimes entailed the drawing up of appeals and presentation of cases, but its ownership and control remained in the hands of the community. Hassell-Smith considers that *"Norfolk had a higher proportion of freeholders than most other English counties, while a fragmented manorial structure, where one lord rarely controlled the social and economic life of an entire community, tended to weaken landlord domination"* (Hassell-Smith 1974, 1). Perhaps the structure of much of Norfolk society goes some way to explaining the organisational differences seen in the county.

The majority of municipally owned piers were owned, operated and functioned individually as the port of their town, the exceptions being those ports belonging to the confederation of Cinque Ports. There are a number of histories and publications relating to the Cinque Ports (Burrows 1888; VCH 1932) and the following is merely a summary providing context for this thesis. Margate, Broadstairs, Ramsgate, Dover, Folkestone and Hastings were all members of the Cinque Ports, a confederation of maritime towns on the south-east coast of England that was first positively recorded around 1155 though may have had origins in the immediate pre-Norman Conquest period. For some centuries the Ports were required to supply ships and crews for 14 days service each year when notified by the king, with service beyond this being paid for. As such, the Ports formed the core of medieval England's naval forces. In return for this service the Ports were exempted from most taxes and trading dues, a valuable privilege resented by many other towns, and permitted to carry canopies over the king and queen at coronation processions and afterwards, at banquet, to sit at the right hand of the king. Although not en-nobled the freemen of the Ports were commonly called 'Barons' and had the right of pleading and

being tried only within their own courts. Although often a largely figurehead role, the confederation of Ports was headed by a Lord Warden who was normally an important and influential personage. The importance of the Ports declined significantly in the later medieval and post-medieval periods.

The important member towns of the Cinque Ports were chartered and shared many similarities of internal governance. Government of the Ports chartered towns was carried out by a mayor or bailiff assisted by jurats, these being drawn from the ranks of freemen whose numbers were restricted. Freedom of one of the Ports meant admission to the freedom of them all. Margate, Broadstairs and Ramsgate were all limbs of major members of the confederation of Ports. Margate and Broadstairs were limbs of Dover to whom they were subject in all matters of civic jurisdiction and whose mayor appointed one of the inhabitants of each town to be his Deputy there. Ramsgate was similarly subject to Sandwich. None of the three towns possessed 'legal quays' for foreign trade and so each was obliged to obtain paperwork from the Port of Sandwich before such material could be handled.

The freedom of action which forms a recurring pattern in the history of the Ports, be that engaging in de-facto war with Great Yarmouth, certain cities of the continent and even on one occasion allying themselves to the French (until bribed by the English king to attack their former friends), owed much to their relative independence as a confederation. Only two of the Port's settlements had mediate lords between themselves and the king and so their governance was largely their own affair. They enjoyed many immunities and privileges and the tight-knit nature of the 'brotherhood' provided a large family which would protect the freeman if need be against the demands of any other town or person.

Inter-port rivalry, normally rooted in a desire to protect and, where possible extend, trading and seaborne interests, finds some reference in the contemporary sources and has been briefly touched on. The most famous and longest running of these rivalries was between the confederation of Cinque Ports and Great Yarmouth. One of the Port's privileges was a regulatory role in the Great Yarmouth herring fair, to which they sent bailiffs each year. This was a bone of considerable contention and seemingly formed one of the principal causes of the regular outbreaks of violence that occurred between the men of the Ports and those of Great Yarmouth. Ships and crews of the rivals were commonly molested and at various times a state of de-facto war existed between the two parties. On

one occasion when both Great Yarmouth and the Ports had fleets on military service in France they attacked one another (despite a warning from the king not to do so) and it was reported that Yarmouth alone lost 200 men in the engagement. Enormous fines were at some point/s levied against Great Yarmouth men for aggressive acts against the Ports. The often violent nature of the rivalry only really came to an end with the political and economic decline of the Ports.

Another early instance of port rivalry occurs in a charter granted to Scarborough in 1253. This explicitly prohibited the making of a harbour or quay, by the king or anyone else, between Scarborough and Ravensrod (Spurn Point, mouth of the River Humber) (Neave 2000, 29). This may well have served to stifle development of the piers at Filey, Flamborough, Bridlington and Hornsea. At the later date of 1613 Scarborough also entered into an unusual arrangement with Great Yarmouth by which it was agreed that each port would acquit the other of tolls and dues (NRO Y/C34/3). The precise motive for this is uncertain. It may have simply been a financial arrangement beneficial to both parties, though as it is known that the Cinque Ports engaged in the herring fishery at Scarborough in some sort of capacity this act could represent the showing of a united front against the Ports? Shortly after this date, in 1621, Scarborough opposed development of the port at neighbouring Whitby. Sir Richard Cholmley, effective owner of Whitby and recently returned as Member of Parliament for Scarborough unsuccessfully approached Scarborough's Corporation to support the erection of a new pier at Whitby (Hist. Parl. 1). Sir Richard's son, Sir Hugh Colmley, who also sat in Parliament as member for Scarborough made a similar request to the bailiffs of Scarborough in 1626; again to no avail and despite thinly veiled threats by Sir Hugh (Hist. Parl. 2; Binns 2001, 188-9). Scarborough was clearly unwilling to support a neighbouring port, and potential rival, in the provision of a new pier.

The municipally owned piers of towns were widely seen by their communities as essential to their economic survival and prosperity and it is in this context that inter-port rivalry occurred. Piers were often the most important item of infrastructure the communities possessed and key to the fortunes of local ship-owners, mariners, fishermen, merchants and producers. Some indication of the lengths that the owning communities were prepared to go to in order to ensure their survival is recounted in Section 4.3. An example of a particular community determined to see that its piers survived and prospered is afforded by the case of Bridlington.

As has been seen the manor and piers at Bridlington had a varied ownership history, originating in an ecclesiastic estate, being seized by the crown during the reformation and directly held so until a shift in crown policy saw them being leased on three successive, and failed, occasions. Reverting again to the crown, they were gifted in 1623 to John Ramsey and inherited by his brother, Sir George Ramsey in 1625.

It may have been the cost of maintaining the port within a single manorial holding, just as it had been for the earlier lessees, that prompted Ramsey to sell Bridlington in 1630. The purchasers were thirteen local individuals, all prosperous yeomen, but representing the tenants of the manor (Purvis 1926, 65-123). The purchase price of £3,260 was raised by communal subscription. One of those prominent in the community buy-out was William Hustler who had been one of the lessees of 1595. Hustler took an active part in the negotiations for purchase with Ramsey and even loaned money towards the expenses that this incurred. At least four more of the original thirteen prime movers behind the community purchase are likely to have been direct descendants of former leaseholders. In 1636 these men and a significant proportion of the town's populace drew up a document known as the 'Great Town Deed' (Purvis 1926, 86-105).

Edward Ingram sees the Deed as being composed of two sections, one dealing with the constitution of the towns' new governing body, the Lords Feoffees, and the second with regulating the affairs of the manor (Ingram 1977, 37-9). The constitutional aspects of the Deed are of especial interest in that they are an early example of a democratic constitution. The governing body of Lords Feoffees was, and indeed still is, composed of two bodies, the first of thirteen Lords, the second of twelve assistants. When the number of Lords has been reduced by death to six, replacements to re-make up the number to thirteen are drawn from the body of assistants. The numbers of the assistants are in turn replenished, this time by election of the tenants and freeholders of the manor. Of the aspects of the Deed dealing with the regulation of the manor those of most direct relevance to this study concern the requirement for the tenants to perform day works at the harbour when called upon (labour services), and that to pay an amount of money (pier rates) to maintain the piers. As we have seen, both of these practices had precedents at the town. A requirement to use common bake-houses again has roots in earlier precedent. All profits of the manor were to be used for the common good – in practice probably absorbed by expenses at the harbour. Overall, the Deed is a very purposeful document, and was presumably so structured to ensure the survival of the town and its port.

David Neave considers that the initiative for the communal purchase of the manor may have come from the merchant community, who had an interest in improving the port (Neave 2000, 46). This may be so, and whilst merchants and a master mariner were amongst the original thirteen purchasing Lords, many of their number appear to have been farmers with no obvious direct mercantile connections; unless of course such connections were through family, marriage or an interest in the export of agricultural produce. The loss of the piers would certainly have been a major economic blow to the town. The livelihoods of the populace of Bridlington Quay, that part of the town that lay some 1.5km distant from the remainder of the town, were largely dependent upon the port and the loss of the piers would have been likely to remove the livings from nearly all but a few fishermen.

4.1.5 Commissioner ownership

From the 17th-century there was a slow, but distinct, trend for the ownership of piers to be transferred to bodies of commissioners. The first instance of this was at Dover in 1606, followed by Great Yarmouth in 1670, and Bridlington in 1697. Southwold was taken over by commissioners in 1747 and Folkestone in 1766. The Thanet ports of Ramsgate, Margate and Broadstairs followed suit in 1749, 1787 and 1792 respectively. These sites represent all of the timber-built piers still surviving at the end of the 18th-century with the sole exception of the privately owned pier at Cromer. Prior to their hand over to bodies of commissioners each of these piers had been under the direct authority of their communities. Transference from community to commissioners was facilitated by Royal Charter in the case of Dover and by Acts of Parliament at the remaining sites.

The term commissioner is generally the title given to a member of a commission that has been given legal charge or authority to perform a certain duty or role. With regard to timber-built piers we have already encountered commissioners at 16th-century Bridlington who were overseeing the activities of its lessees. Bridlington's 16th-century commissioners however, were not the custodians or owners of the port, merely overseers; much was also the case at Elizabethan Dover. The bodies of commissioners considered in this section were de-facto owners, all authority and rights with the port infrastructure being vested in them. This was however, an ownership of entrustment, the ports were not

theirs to sell and their remit was to see to its finances, to keep it in good order and well run for the benefit of its users and local community.

Something of a forerunner to the setting up of these bodies of commissioners can be found as early as 1545 at Scarborough. Shortly prior to this date the town's pier is recorded as being in a state of decay, which it was claimed, had led to the impoverishment of the town. Accordingly, the burgesses of Scarborough appealed to the crown for assistance (L. & P. Henry VIII 1538c; L. & P. Henry VIII 1541). The most significant outcome of this was an Act of Parliament of 1545 (Act of Parliament 1545).

Under the terms of this Act the town's Bailiffs, Coroners and Searchers were empowered to elect two honest local inhabitants as the Masters or Keepers of the harbour for a term of three years. Refusal to hold office was punishable by a fine of 40s. One of the office's duties was the levying of a rate on property within the town and its liberties, this being a $1/5^{th}$ part of its annual rental value. Failure to pay could be punishable by distraining of goods. In cases of *"fraude, gyle, coven doubte or ambyguytie"* by rate payers the Masters had recourse to the Lord Chancellor for determination. Another role of office was to order, oversee and govern works at the harbour. This included the hiring of workmen and the purchase of materials. At the end of their term of office the Masters were required to account for the receipt and expenditure of the rates, these being scrutinised by the bailiffs, Coroners and Searchers of the town.

It is significant that the terms of this Act took day to day responsibility for the port away from the larger administrative body at Scarborough and placed it in the hands of two individuals. A degree of separation between the regular administrative body of the town and the *"Maisters of the Pere"* is indicated by their being referred to as a *"corporacon or body politike"* with their own *"Comon Seale"* as well as their stated freedom of action. At the same time the corporation of Pier Masters remained rooted within the community's ruling body who both elected them and scrutinised their accounts. There is no evidence to suggest that the authorities at Scarborough felt at all aggrieved by the Act which may even have been formulated at their instigation. In wider perspective, the Act represented an intention by both state and community to ensure the survival of Scarborough's port by putting its administration and funding on a firm, and legally watertight, basis. Given that Henry VIII invested heavily in pier infrastructure at those Yorkshire seaports that came

into crown custody at the time of the reformation it need engender little surprise that this influential initiative originated during his reign.

We have seen how both Henry VIII and Elizabeth respectively funded and facilitated massive harbour building programmes at the important port of Dover. Subsequent to Henry's investment responsibility for the port was transferred to the town whilst state appointed commissioners during Elizabeth's works were effectively overseeing facilitators, not owners. Following the Elizabethan works there was suspicion that the town's corporation was not spending the port's income wisely nor managing the harbour adequately and so a committee was established by James I to investigate the matter in 1604 (Leach 2005, 38). The upshot of these enquiries led to the corporation's rights at the harbour being surrendered and vested in a 'Harbour Board'. This Board and its members, which was established by Royal Charter in 1606, can broadly be equated with a body of commissioners. Its membership was comprised of the Lord Warden of the Cinque Ports, his Lieutenant and seven assistants – who were not to be residents of Dover (Burrows 1888, 208-9). Subsequent changes to the Board's membership permitted greater representation of the town.

The commissioner concept was further developed at Great Yarmouth in 1670. The town's corporation, finding themselves greatly in debt owing to the borrowing of money to maintain their haven, decided at an assembly in 1667 to appoint a committee to consider ways for maintaining and repairing their piers (Swinden 1772, 896). Within the same year they had representatives in London petitioning Parliament to procure an Act to this end. Parliamentary committees examined the entire issue of the town's haven: its legal standing, costs of repair, to whose benefit it was and whether the town alone was able to burden its costs. The outcome was *"An Act for repairing the Haven and Peers of Great Yarmouth"* 1670 (Swinden 1772, 905-8). To run for ten years, the purpose this Act was to enable repair of the port within and for a specific time period, not to set up a new system of ownership. Monies were to be raised via duties at the port. In administrative terms, duties were to be collected by Collectors who had powers to distrain. These officers were chosen by the bailiffs and collected monies were to be forwarded to the Chamberlain. Two bodies of Commissioners were required to be formed. The first of these was to consist of eight commissioners, two chosen by Great Yarmouth, two by Norwich and four more appointed by the Justices of the counties of Norfolk and Suffolk. Their role was to inspect the accounts of receipts and disbursements of income and, if necessary, call the

Collectors before them. The second body, of ten commissioners, again represented Norfolk, Suffolk, Norwich and Great Yarmouth, and their role was to inspect the piers, provide authority for works and contract for the same. That both sets of commissioners were drawn from across the counties of Norfolk and Suffolk emphasises the importance of the port to the wider region and not just the town.

The Act of 1670 successfully met its remit but such short-term measures could not resolve repair and maintenance in the longer term. Accordingly, the first Act was followed by a series of successor Acts (Swinden 1772). These operated along similar, though developing, lines in which greater responsibilities accrued to the commissioners. The regular monitoring of the haven by engineers, the increasing formalisation of procedures for its maintenance and the appointment of a pier master and sub engineer who controlled a team of workmen all set the port on a more stable footing.

It will be recalled that the townsfolk of Bridlington purchased their town in 1630 and that one of their principal intents was the preservation of its harbour. The harbour's position deteriorated as a result of action during the Civil War (Ingram 1977, 53). The town sought assistance from Parliament, and after the restoration from the crown, but to no result (Purvis 1926, 184-191). A further petition was sent to the crown in 1672. This contained a certification of the value of the port signed by local and non local merchants, including twenty two of London. Also contained were abstracts of customs records, statements testifying to the value of the port to the Navy and further fine words requesting £4000, all penned by local Justices of the Peace and gentlemen (Purvis 1926, 184-193). This time the crown responded favourably, permitting the full sum to be raised piecemeal by a small toll on every ship lading in the ports of Sunderland and Newcastle. As much as anything, this was de facto recognition that the internal resources of the town were not sufficient to support its piers, a lesson that had taken over a century to re-learn; the only solution to this contradiction was the injection of external resources.

Despite the foregoing, Bridlington's piers were again in a dangerous state after storm damage in 1696 (TNA ADM106/482/335). This time further arrangements for funding construction and maintenance of the piers were put in place and formalised by a succession of Acts of Parliament, the first of 1697 (Act of Parliament 1697). Following the precedent of 1672, this Act again raised money by the levying of duties on coals in all member ports of Newcastle upon Tyne. Significantly, the Act set up a body of fifteen

individuals, a forerunner of the modern Harbour Commissioners, to oversee affairs and this body absorbed many of the roles at the pier that were formerly the responsibility of the Lords Feoffees. All monies were required to be expended upon the piers, books were to be kept and these were to be open for inspection by Justices of the East Riding. Addition powers of the Act permitted local assessment for pier rates and the right to mortgage the duties to raise money. Interestingly, one of the commissioners was a Sir William Hustler, presumably a descendant of the earlier William Hustler who played a significant role in earlier developments at the piers. Further parliamentary Acts followed. An Act of 1718 extended the duties of the 1697 Act and it was the influx of this new found money that enabled a new system of timber piers to be built in 1717-19 (Act of P. 1718). Another member of the Hustler family, James, is listed as a commissioner in an Act of 1747 (Act of Parliament, Bridlington 1747). These Acts, in viewing a local problem within the perspective of a national overview, finally resolved what had been a centuries old dilemma of funding the piers. The success of these Acts enabled a larger stone-built harbour to be built in the middle years of the 19th-century.

Southwold's piers had originally been built by the town's corporation in the early 18th-century. An Act of Parliament of 1747 vested control of these and the harbour in a body of appointed commissioners, amongst whom were the bailiff's of Southwold (Act of Parliament, Southwold 1747). The corporation voted £50 towards obtaining this Act and shortly thereafter twice voted £50 towards the building of new north and south piers (S. Assembly Bk. p. 170, 184, 192). This generosity may have been encouraged by the fact that the town had some representation within the body of commissioners whose accounts were to be available to them for inspection. More importantly, it may also have been felt that any loss of control was compensated for by avoidance of direct financial responsibility and outlay. In addition to new piers, further investment followed. A station of the Free British Fishery, a government sponsored and supported venture to expand the national fishing industry was established at the town, whilst the upper reaches of the River Blyth were also canalised to better aid export of agricultural produce from inland areas via Southwold harbour (Harris 1999).

The commissioners were responsible for maintenance and construction works, and for the appointment of harbour masters and engineers. Income was primarily from duties with no goods being allowed to clear customs until duties had been paid. Importantly, The Act also enabled the commissioners to borrow money at interest for harbour works on the

security of future profits. There is much archival evidence for this taking place with both Southwold Corporation and private individuals (Wake 1839, 132; SRO 491/20C/19; 20;21;22;24). The majority of the commissioners were drawn from the landed classes and normally included several titled individuals. Criteria for becoming a commissioner included residency within the county and a minimum income level. Upon the death or retirement of a commissioner the remainder selected a replacement; they were effectively a self perpetuating oligarchy. As at other harbour sites such Acts ran for specific time periods, most commonly 21 years, though were always replaced by new Acts. Replacement Acts tended to replicate the same powers and occasionally expand them, particularly in light of new or changed circumstances. By the time of the 1809 Act the list of harbour officers that could be appointed by the commissioners had grown to treasurer and clerk, collector/s, surveyor/s, haven master/s as well as any other such officers as they thought fit whilst the power to enable bye-laws was also within their remit (Act of Parliament 1809).

The Thanet piers of Margate, Broadstairs and Ramsgate were all converted from municipal to commissioner ownership in the mid – late 18th-century. The changes at Margate and Ramsgate were directly associated with plans to replace existing piers of timber with larger ones of stone. An Act of Parliament of 1749 provided the legal authority for building the new large stone-built harbour of refuge at Ramsgate with construction of this beginning almost immediately (Bill 1749). Authority over this new harbour was vested in a body of Trustees, or commissioners.

An Act of 1787 for Margate provided the legal authority for a new pier, intended to be of stone, as well as dealing with other matters of civic improvement (Act of Parliament 1787). Authority over the existing pier, and the building of a new one, was vested in the hands of 34 commissioners, amongst whose number were included the existing pier wardens, knights of the shire, members of parliament and officials of the town of Dover. The commissioners, who were required to qualify for office on the basis of income or estate, were responsible for both the pier and the town improvements. They had the right to employ collectors, surveyors and other officers as they deemed necessary. The Act continued the office and role of annually elected pier warden's according to old custom; presumably the wardens continued in their established role of practical day to day supervision and repair of the pier, albeit subservient to the commissioners. The old system of income generating powers, 'droits, and duties' was replaced by a new set of powers

and charges. These bore considerable similarity to the old system but were additionally boosted by a duty on coals, coke and cinder. In order to better enable the commissioners to 'improve' the town and build a stone pier they were permitted by the Act to borrow up to £14,000.

A new Act of 1799 amended that of 1787 (Act of Parliament 1799). This Act acknowledged progress by the commissioners to date and allowed them to borrow larger sums and revised the system of duties. After a failed attempt at cladding the timber pier in stone an all new stone pier was built in the early years of the 19th-century.

At Broadstairs an Act of Parliament, of 1792, was obtained for the better maintenance and running of its harbour (Act of Parliament 1792). The Act saw the appointment of a body of commissioners and a robust set of harbour dues together with rights of enforcement that replaced an ineffectual system of droits. The commissioners were drawn from the ranks of civic and governmental worthies/officials together with a large body of named townsmen. This body was self perpetuating in so far as at the death or retirement of a commissioner, the remaining commissioners were to elect a new one. Qualification for the office was dependent upon their being a particular civic or governmental post-holder, or else of having a certain level of income. The commissioners were required to meet regularly and were permitted to appoint salaried officers, which included a treasurer, clerk, collectors and surveyors. Records, both of proceedings and financial matters were required to be kept, with these being annually open to inspection by the inhabitants. The Act permitted the commissioners to raise money through various forms of loans. This included borrowing money at interest, mortgaging future income from rates and by granting annuities for life upon the receipt of sums of money. Certain of the records of the commissioners record such dealings, e.g. (EKA UD/BS (uncat.) Box 2 1792-1814; UD/BS (uncat.) Box 2 1814-1824).

A further Act of Parliament for Broadstairs pier was enacted in 1805 (Act of Parliament 1805). This Act acknowledged the progress made by the commissioners, enabled them to borrow further monies and introduced a new system of rates. Further powers within the Act enabled the commissioners to make bye-laws for the better regulation of the harbour. A new Bill was passed in 1882 that authorised various improvements and permitted the commissioners to borrow up to £25,000 (Bill 1882). In 1909 the pier passed into the

hands of the Broadstairs and St Peter's Urban District Council and in the 1970s to the custody of the Thanet District Council (CKS C/A3/9B/1; Simmonds 2006, 19).

Folkestone provides an unusual example of commissioners. An Act of Parliament of 1766 was purposed to remove the financial liability for the jettees from the impoverished fishermen and community (Act of Parliament 1766). It did this by providing funding derived from a levy on coal brought into the town. The monies, collected by appointed collector/s, were to be paid to the Mayor, Jurats and Commonality of the town. An additional post of Treasurer/s was required by the Act, with this post-holder being appointed by the corporation. The town authorities were to meet at least annually at the Guildhall where they were to call before them the collector/s and treasurer/s and examine their accounts. Further, the Act enabled the corporation to borrow money at interest and upon the credit of the rates or duties, for use at the jettees.

The only appointed officials mentioned in the Act of 1766 were collectors and treasurers. Yet commissioners were appointed and their minutes extend back to 1767 (EKA Fo/AUj1/1). These minutes provide an insight into the workings of the commissioners who regularly met in the guildhall. One of their roles was to carry out surveys of the jettees and give directions respecting their repair, and when occasion demanded, order the construction of new jettees. In all probability these commissioners were appointed by the mayor and jurats and probably drawn from the same body. As such they were corporation men and did not form an independent body in the sense that other harbour commissioners did. This anomaly may find cause in the unusual small-scale jettee piers at Folkestone which were inexpensive to build. The relatively small sums involved may not have warranted, or even attracted, men of status and financial worth to act as harbour commissioners in the conventional manner. It would seem that in this case 'commissioner' was merely a term for a corporation appointee whose role was primarily dedicated to safeguarding the jettees.

Discussion

In understanding the shift to ownership of piers by bodies of commissioners it is necessary to firstly consider the former position of their being municipally owned. Timber-built piers were very repair and maintenance heavy, to the extent of which corporations and communities frequently struggled to keep them in working order. Money expended on piers was ordinarily limited to that which could be raised internal to

that community. Much of this money was derived from duties imposed at the harbours though even the legal position of these was on occasion questioned whilst powers to enforce payment were sometimes considered ineffectual (Act of Parliament 1792). Town corporations also had other concerns and responsibilities that required expenditure and their piers inevitably had to compete with such alternative demands.

Set against this background, and from the 17th-century onwards, there was an increasing trend within broader society towards the setting up of Trusts and Commissioner bodies, with these bodies concerning themselves with matters such as roads, sewers, and town improvement. Such administrative bodies were normally established by Acts of Parliament, armed with strong indisputable powers of money collection and, equally importantly, tasked with a single purpose that was geared towards improvement. Whilst membership of a commissioner body tended to be restricted to civic and county worthies and members of the upper echelons with independent means, such bodies may well have been less fractious than many corporations. It may also be that the income levels commonly demanded of a commissioner, together with the sometimes stated requirement for avoiding conflicts of interest, made that person less liable to petty theft; occasional such cases being found under municipal ownership (see Appendix case studies 4: Scarborough, 9: Sheringham, 10: Cromer, 13: Margate, 20: Hastings). Amongst the legally enacted powers of commissioners it was common to find rights to board and inspect vessels, powers to distrain goods and non-clearance of customs until payment was made. The precise geographic limits of the rights of the harbour were also often defined within specific Acts and could be a matter of some financial import. Large sums of money could also be borrowed for investment in infrastructure against future income and, as has been seen, this investment was often geared towards the building of new harbours of stone.

Whilst it might on the surface seem lamentable that piers should be taken from their communities and handed over to unelected commissioners this does not seem to have been the contemporary experience, indeed it seems that the initiative for these transformations sometimes came from the communities themselves. The change was not without advantage to them. Their usage of the piers could not be removed, they could no more be sold by the commissioners than they could by themselves, whilst representatives of the town commonly enjoyed membership of the body and often had rights of

inspection of their accounts. The financial burden of the piers no longer had to be shouldered by the towns alone whilst their access to them remained essentially unaltered.

4.1.6 Private ownership

Within the study area private ownership of a pier, external to a manorial holding, was very rare and attested only at Broadstairs in the 16th-century, at Cromer in the 18th-century and very briefly at Southwold in the early 20th-century.

The historian John Lewis quotes two indentures, one dating from 1564, the other 1586 that indicate the pier at Broadstairs, and the road leading to it, as being in the ownership of the Culmer family who were wealthy shipbuilders and owners (Lewis 1736, 164-5). It was sold by them to the inhabitants of the town for the sum of £10 on condition that the accustomed dues for its maintenance were paid to the pier wardens. The Culmer family wove into the agreement conditions that permitted them lesser payments though granted the inhabitants room on Culmer land to frame timber etc. for the repair of the pier. If any damage to the pier was not repaired within two years then the agreement was to be forfeited. It has not proved possible to locate the original documents quoted by Lewis and they may no longer even be extant. However, an abstract of their contents also appears at the back of the 1843-1853 committee minute book under the title *"A list of Ancient deeds and documents relating to the Pier, and Harbour of Broadstairs, presented to the commissioners by Mr Robt. Covell, October 1st 1850"* (EKA UD/BS (uncat.) Box 2 1843-1853).

At Cromer a legal agreement of 1732 detailed the plan for constructing a pier for the safe riding and lodging of ships and for the importation and exportation of goods. Once built, a toll by way of tonnage was to be levied for maintaining and keeping the pier (NRO COL 2/56). The management of the undertaking was by four local men and money was raised via subscription, with voting rights being allotted on the basis of one vote for every £20, or multiples thereof, invested. This was not a communal enterprise undertaken by the inhabitants of the town, solely for the benefit of the town. Rather, we can see this as more of a 'commercial venture' under the captaincy of four individuals with the clear backing of local gentry. The lead role in management was taken by Richard Ellis, an attorney and manorial steward. The other three men appear to have been of some local significance. The backing of the gentry was financial, at least, with three of these individuals investing

£100 each, five times as much as any other individual subscribers. Investment on this scale clearly gave these backers considerable voting power. There was local scepticism about this project from the start and eventually it only attracted thirteen subscribers (NRO RYE MS 17/1 (f.234v)). The pier was built, although was fairly short-lived, apparently being swept away in 1820 (Walcott 1861, 101).

A slump in trade during the late 19th-century led to a decline at Southwold harbour that was not arrested by its commissioners. Anxious not to loose the haven the Corporation of Southwold stepped into the breach and by Act of Parliament of 1898 temporarily re-assumed control of the haven (Act of Parliament 1898). In order to reinvigorate the haven, and with the support of the Board of Trade, the harbour was sold to the Southwold Harbour Company, with details being set down in an Act of Parliament of 1907 (Act of Parliament 1907). The new harbour company was owned by the Fasey brothers of Essex, successful public works contractors, who agreed to spend at least £45,000 on improving the harbour – though with substantial parts of these costs coming from government grants. This transference to subsidised private enterprise did result in the piers being rebuilt, in timber again, and for a short while trade did increase. However, prior to World War I the harbour was once again in a dilapidated state and the corporation was obliged to intervene. An Act of Parliament of 1932 facilitated the re-purchase of the harbour by the corporation for a nominal sum from the long bankrupt harbour company (Act of Parliament 1932). Administration of the haven was now by a Harbour Committee. Southwold's piers were largely rebuilt in 1936 with reinforced concrete (Becker 1948, 66).

4.1.7 Ownership summary

Table 3, below, diagrammatically displays the changing ownership form of all the pier sites through time. This shows a number of trends to be readily apparent. Manorial and estate owned sites tended to be early, not extending into the second half of the 17th-century, whilst none of those within the context of ecclesiastical ownership survived the reformation. Nearly all instances of crown ownership of pier sites occurred within a narrow time-band and are owed to seizure during the reformation. The custody of some of these sites in the hands of lessees in the wake of the reformation related to a new

economic policy of the crown to rid itself of the burden of their expense. For most pier sites foundation and ownership within a municipal context was the norm until the 17th – 18th-century when ownership by bodies of commissioners became the predominant form. Private ownership was always rare, tended to be of short duration and typically occurred at small sites.

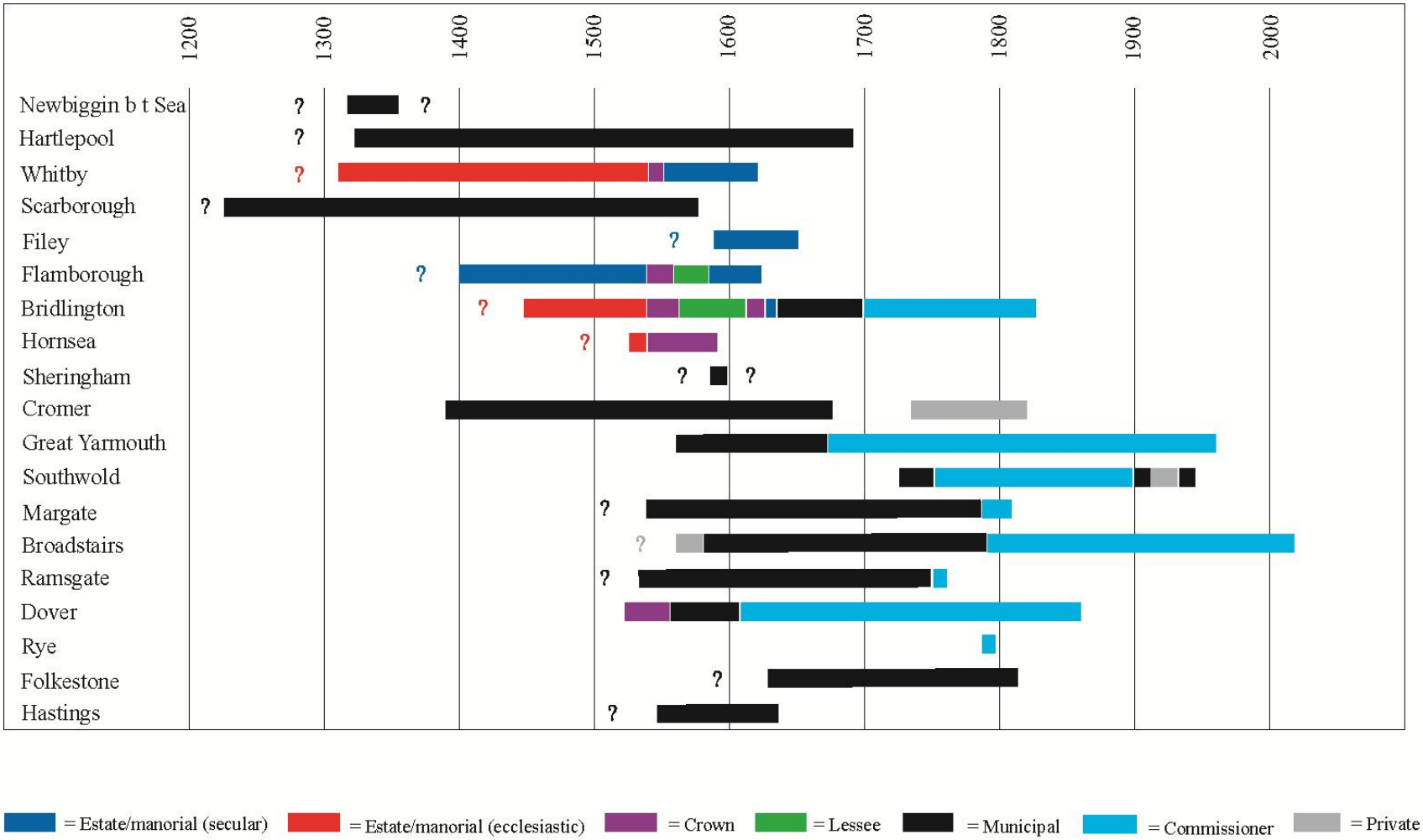


Table3, Forms of pier ownership through time

4.2 Control

Having examined forms of ownership, this section looks at the means by which the controlling rights and duties that accompanied ownership were exercised in the day to day running of the piers. For the most part this entails exploration of the various offices that were charged with the administration of the port, engaged in the collection of duties and tolls, in the organisation of maintenance and repair and in the purchase of materials. Whilst it may seem overly obvious, it is worth pointing out that one over-arching influence in the control of piers tended to be their owners, there being a strong correlation between ownership forms and form of control.

It is not until the 16th-century that we have a volume of detailed documentary sources that spell out the range of offices engaged in the control of seacoast piers. However, prior to that date there are a number of 'circular' letters addressed to ports within the realm by the crown. These were typically concerned with matters likely to be prejudicial to the state, such as enforcing certain travel restrictions, e.g. (Cal. Close Rolls 1323). In some instances the letters were addressed to the 'bailiffs', presumably of the town; in other instances they were addressed to the 'keeper of the port'. The term 'Keeper' may actually be a catch-all title used by the crown to identify whoever was in charge at the port rather than being a specific office.

A significant exception to this paucity of early evidence is Scarborough where there are records for officials at what was almost certainly a pier. When the king granted permission to Scarborough to build a new port in 1252 he also provided a means of funding its repair and maintenance, namely through the imposition of tolls known as 'quayage'. The original grant of quayage was specified for five years, though this right continued to be granted on a regular basis throughout the medieval period (Daniell and Bould 2001, 33). Normally the grants were addressed to the Bailiff and named burgesses though occasionally to specified individuals. It is clear from a number of entries that accounts of receipt and expenditure were expected to be kept by the collectors and that these were liable be inspected (Cal. Pat. Rolls 1316b). There is also evidence of collector embezzlement at the town (Cal. Pat. Rolls 1325). One embezzlement case indicates that it was sometimes the king, not the community, who assigned guardians and bailiffs to collect quayage. These people were not answerable to the commonality and it was therefore requested by the town that quayage be put in the hands of the community, as

had been done before, so that they could assign persons and oversee the correct usage of money at the harbour (Cal. Pat. Rolls 1324; Rowntree 1931, 168). The granting of quayage was itself apparently not without cost as we read that in 1312 *"Aquittance for the burgesses of the town of Scardeburgh for 100 marks paid by them into the Wardrobe to Ingelard de Warle, king's clerk, Keeper of the Wardrobe, for a fine which they made with the king for confirmation of their charters, and for a grant of quayage"* (Cal. Pat. Rolls 1312). It has been noted that expenditure accounts were expected of Scarborough's collectors, as well as those for income, they had therefore some role in the organisation and management of works at the harbour. Indeed Robert Waweyn a collector of quayage, left itemised accounts for just over six months of construction work at the harbour around 1320 (TNA E101/482/3).

For those sites held within a secular manorial context the piers appear to have been regarded as a manorial appurtenance, just as for example, a mill often was. At Flamborough in the early 16th-century the anchorage of ships at the pier formed part of the manorial revenue (TNA E310/31/185 no21: quoted in VCH 1974, 158). The 1531 record of Sir Robert Constable reaffirming his accustomed right of way between his manors of Flamborough and Holme on Spalding Moor for carts carrying timber to repair the pier likewise indicates that its repair was a responsibility of the manorial lord (YSCP III 1914, 25). In this case it must have been a manorial officer who collected tolls and made arrangements for repairs. Certainly we know that the bailiff of the manor was drawing up accounts for pier repairs at Flamborough during the port's period of crown ownership and this may well have been a continuation of former practices. Although we lack conclusive evidence, it is probably a reasonable assumption that it was also manorial officers who were controlling the pier at Filey. The same probably also applied at Whitby, after the brief period of tenure by the crown, and during the equally brief holding of Bridlington as a secular manor by the Ramseys.

Although the evidence is scant, what indications there are suggest that the exercise of control at piers held within ecclesiastical estates and manors followed similar lines to that within secular manorial hands. Grants of quayage are recorded for the 14th and 15th centuries at Whitby and by implication there must have been officials acting as collectors. As Whitby's abbey more often than not dominated the pier and town such officials were presumably their representatives, though it is possible that rights of the burgesses at the port may have included a role in its administration (Barker 2011, 19). Little is known of

the piers at Bridlington prior to the reformation though a grant of quayage clearly necessitated an agent of Bridlington Priory to perform a collector-like role (Cal. Chart. Rolls 1446). There is some pre-reformation evidence for the use of labour services by the Priory's tenants in the repairs at the harbour at Bridlington though which monastic official was responsible for organising this is not known (VCH 1974, 98). The use of tenant labour services was subsequently continued by the crown (TNA E101/622/29; L. & P. Henry VIII 1539).

Monks from St Mary's Abbey, York, are known to have undertaken administrative roles at their pier at Hornsea. One witness in a tithe dispute of 1551 was a former monk and holder of an office known as 'Master of the Manors'. In his evidence he stated that he *"used to go at certeyn tymes aboute xviii yeres ago to Hornesey and see the keye at Hornesey and pay the workmen for workynge of the same by the space of two yeres"* (Purvis 1949, 69-73). Whilst Hornsea's pier was securely in the abbey's hands aspects of policy regarding its maintenance were susceptible to external influence. In the early 16th-century the pier was in a ruined condition and Abbot and Convent put off the repair on account of the cost. This proved to be a great inconvenience to the fishermen and in an attempt to overcome this and alter the abbey's policy, the fishermen at their own initiative and free will "*promised to the Abbot and Convent and to their proctors and deputies these Dolles or Cadolles"* (Purvis 1949, 69-73).

Thanks to record keeping by the Exchequer during programmes of extensive construction works, some of the character of crown administrative control at the seized Yorkshire pier sites is better understood than that of earlier years. This is certainly the case at Bridlington and Flamborough for which extensive records survive, though less so at Whitby and Hornsea where the records are more meagre. Some evidence for crown control during works at Bridlington and Flamborough has already been discussed. What these records highlight is that whilst guiding and overseeing 'senior management' was brought in for the construction programmes the crown continued to exercise the old local manorial rights for free labour. As such we see both senior ministers and government managers advising and steering the programmes whilst at the local level of management the stewards and bailiffs of the manors were drawn into involvement. At Bridlington at least, the crown continued to require the tenants of the manor to perform labour services. Nothing is known of the management during the day to day running of the harbours in crown control though it may be that quayage and tolls as well as collecting officials

continued established former practices. Such officials at Bridlington may have been Key (pier) Wardens, whose office was certainly in existence at the town in the later 16th-century.

Key Wardens came to play a significant role in the day to day running of Bridlington's piers, seemingly both in the collection of dues and organisation of maintenance. The first specific reference naming this post is in an inquisition of 1590 that relates to the lessees of the manor (TNA E178/2714). This document states *"The rates & taxations, so much as could be collected has bene usuallie gathered by the key wardens for the tyme beinge and bestowed upon the saide Peere accordinglie"*. The lessees and wardens did not have carte blanche with pier rate levying as the lease of 1566 contained built-in protection for the tenants of the manor, the lessees being required to *"appoint and associate themselves with 24 other more discreet tenants of the manor, who shall assess the tenants fairly"*. In cases of disagreement matters were to be referred to the commissioners (Cal. Pat. Rolls 1566). It must be assumed that either the lessees took on the role of key wardens or that they appointed individuals to this role. Although later Acts of Parliament at the town do not make reference to wardens they are recorded in local 17th and 18th-century court rolls being referred to as pier wardens by this time. One entry for October 1697 indicates that they played an active role during programmes of works *"Peer wardens chosen De Novo in regard of the p'sent necessity of the rebuilding and repairing of the peere and the necessary constant attendance on that great work"* (Purvis 1926, 288).

The office of key warden at Bridlington had many similarities to that of the pier masters at Scarborough whose role was outlined in the Act of 1545 (See 4.1.5 above), though probably without the same degree of independence from other authorities. The role of Key Wardens appears to be synonymous with that of Pier Masters, Pier Wardens and Pier Reeves, the variation of office title seemingly being little more than regional term usage. Thus we had Pier Masters at Hartlepool and Scarborough in the north and Pier Wardens elsewhere, excluding Norfolk where the preferred term was Pier Reeve. It is not possible to state when these offices first originated though their role in the collection of income and expenditure on pier works does find parallel with the Collectors recorded at Scarborough in the 13th-century.

The first reference to a pier master is at Scarborough in 1545, with that at Hartlepool being in 1599 (Act of Parliament 1545; Sharp 1856, 157). Pier reeves are first recorded at

Cromer and Sheringham in 1582 and 1583 respectively (Cal. Pat. Rolls 1582; Cal. Pat. Rolls 1583b). As noted above pier wardens find first mention at Bridlington in 1590 though seem certain to have held office from at least 1566, whilst at Ramsgate they held office prior to 1575 (TNA E178/2714; Lewis 1736, 176). Later references to pier wardens occur at Margate in 1609, Broadstairs in 1616 and Hastings in 1615 (Lewis 1736, 125, 164; ESRO C/A(a)1, p185). In the case of the Thanet piers there are early 18th-century claims that such offices were in existence in Elizabeth I's reign (Lewis 1736).

It was normal for there to be several pier master/warden/reeve office holders at any one time. Master is used in the plural at Hartlepool though a number not specified whilst at Scarborough the Act of 1545 at Scarborough stipulated two (Sharp 1856, 157; Act of Parliament 1545). At Sheringham there were multiple reeves, whose total number are not recorded, and whilst three reeves are mentioned by name at Cromer in a document of 1590 it is possible that there may have been more (Cal. Pat. Rolls 1583b; NRO MS20403 12x6). It is known that in the 16th-century there were six key wardens at Bridlington (TNA E178/2714). Margate had two wardens as well as two Deputy Pier Wardens with the latter standing in for the wardens should they be absent at any time (MPL Lord Warden 1693). Broadstairs likewise had two wardens, though there is no reference to deputies, whilst at Ramsgate the office is again referred to in the plural (Lewis 1736, 164, 176). Two wardens are recorded at Hastings (ESRO Hastings notes).

Where known, the manner in which the office of master/warden/reeve was assumed was by election. At Scarborough the Act of 1545 specified that it was the limited franchise of the Bailiffs, Coroners and Searchers who were empowered to elect two honest local inhabitants as the masters or keepers of the harbour. This was for a term of three years and refusal to hold office was punishable by a fine of 40s. Wardens may have come to be elected at Bridlington, though the term 'chosen' used in the late 17th-century leaves this ambiguous (Purvis 1926, 288). It is clear however, that neglecting the office was punishable by a fine (Purvis 1926, 286). We cannot be certain of the precise manner of election of the reeves at Cromer though they are said to have been chosen by the inhabitants according to ancient custom (Rye 1889, 59).

The method of electing pier wardens at Margate was laid out in some detail (MPL Lord Warden 1693). The mayor of Dover's appointee in Margate was to call the parishioners to assemble on May Day and both wardens and deputy wardens were to be elected by those

present. Tenure of office was for a period of one year and failure to take up office was punishable by a fine of £5. At the time of election the old pier wardens were required to hand over to the new post-holders all such books and accounts they had received from their predecessors. Within a space of twenty further days they were to deliver up to the new wardens and inhabitants a true note and perfect account of all the collections and receipts they had gathered in office, the same for the money they bestowed on the pier, with any remaining money to be handed over. According to the historian John Lewis, in a decree of the Lord Warden of the Cinque Ports authorised in 1616 the inhabitants of Broadstairs were entitled to annually elect for themselves two pier wardens (Lewis 1736, 164-5). Quoting an earlier now lost document, Lewis states that the two wardens were to be chosen each year at the parish church and that at least one was to be a fisherman. For Ramsgate Lewis declared that from time to time orders and decrees had been given by the Lord Warden of the Cinque Ports whereby the Inhabitants were to choose wardens (Lewis 1736, 176). The wardens at Hastings were elected each year on the Monday after the third Sunday after Easter (ESRO Hastings notes).

In all cases the pier masters/wardens/reeves appear to have been the principal officers responsible for the piers. In nearly all cases of which we know the posts occurred within the context of municipal ownership, the only exception being the lessee arrangement at Bridlington. The post-holders were therefore public officers, acting on behalf of the communities that ordinarily elected them and ultimately held them answerable. These officers had two principal roles. The first entailed the collection of monies due to the pier, typically tolls/duties and rate assessment. The second involved the disbursement of monies on works to the fabric of the piers. We have already seen much of the available evidence for their roles at Scarborough and Bridlington.

More detailed evidence is available for the reeves at Sheringham and Cromer. At Sheringham it was the reeves who were granted a valuable ten year licence for the exporting of grain from the port (Cal. Pat. Rolls 1583b). During the last years of the 16th-century Sheringham's reeves also produced an extensive document entitled *"The whole accountes of the peerereves of Sheryngham and Beston concerninge their sommes of money desbursed for the reedifienge of the same decayed peares as followeth"* (NRS 1990, 17-19). This document is essentially an itemised and costed account of an entire pier building programme and implies that the role of these pier reeves extended from the purchasing, felling, conversion and carriage of timber through to control of the

construction work. Cromer was also granted a licence for the export of corn, for seven years commencing in 1582, with this licence being sold by intermediaries and the proceeds paid to the reeves (Cal. Pat. Rolls 1582). Parts of two accounts of Cromer's pier reeves are known to survive, one of 1588/9 and one of the 1590s (NRO MC934/1 800X5; NRO MS20403 12x6). The single page of the latter is shown in Figure 91 and can be seen to detail the monies paid out by pier reeve George England for repairs to the pier. This document details expenditure on materials and labour as well as naming two more of the reeves.

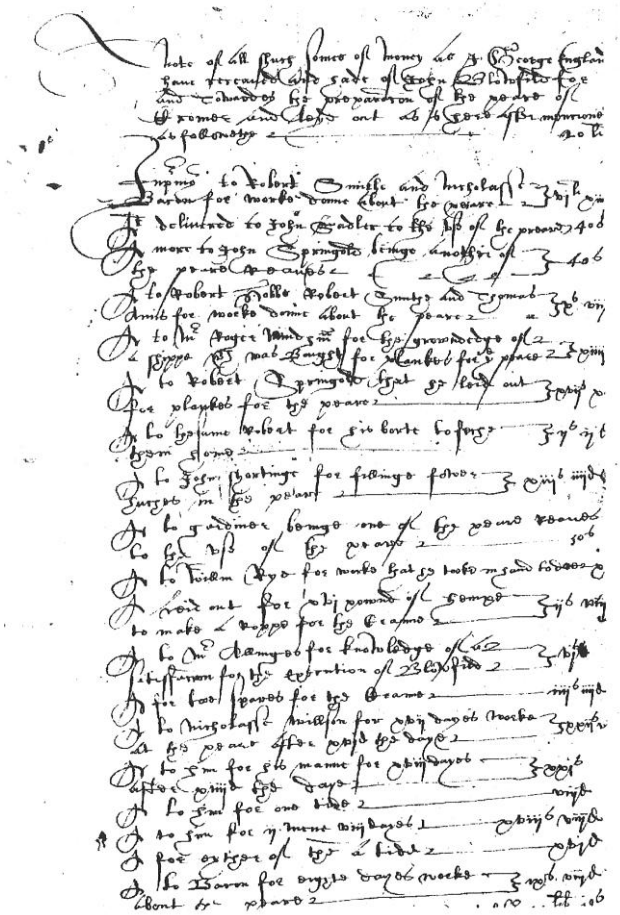


Figure 91, Account of George England, Pier Reeve of Cromer (1590s)

A detailed description of the role of pier wardens at Margate was given in an 'Order and Decree of the Lord Warden of the Cinque Ports' in 1693 (MPL Lord Warden 1693). The pier wardens were required to collect monies and carry out necessary works for repair and maintenance, both income and expenditure being accounted for in books. They were

prohibited from setting up any new works costing more than £5 without the joint consent of the deputy and parishioners. This measure was presumably intended to stifle maverick ambition and minimise financial irregularities. The Orders and Decrees did however, vest considerable discretionary powers in the office of pier warden, these including such matters as determining where vessels shall berth, rights to distrain goods and having the final say on the scale of payment rates. The wardens also had authority over parcels of the land and shore adjacent to the harbour, and, with the consent of the deputy and parishioners, had the right to lease these grounds. There is some evidence to suggest financial irregularities in the dealings of Margate's pier wardens in 1662 (Letter of Col. Strood, 1662, transcription in Lewis 1736). The Governor of Dover Castle demanded the appearance of five named wardens together with *"Writings and Orders concerning the said Peere, and your Accountes of receites and disbursements for the said Peere, to the end the affaires thereof may be settled according to Right"*. (Un-named captain, 1662, transcription in Lewis 1736).

Some indication of the day to day work of pier wardens at Broadstairs in the later 18th-century is given in a surviving book of accounts (EKA UD/BS (uncat.) 1769-1807). The entries are of two types, receivings and disbursements, with itemised entries being arranged on a day by day basis. Amongst the disbursements are payments to labourers and carpenters as well as pier warden's fees and collectors expenses. At the end of the pier wardens annual term of office the accounts are summarised and signed off by a number of witnessing inhabitants.

John Lewis recorded that at Ramsgate Orders and Decrees had been issued by the Lord Warden of the Cinque Ports whereby the pier wardens were *"to look after the Repairs of the said Pier, and to collect such Droits or rates, as by the said decrees and antient immemorial Custom are payable for Shipping and Goods brought into this Pier"* (Lewis 1736, 176). Collecting monies owed to the harbour does not always appear to have been straightforward however, as Lewis also records that *"By a Paper among the Writings of this Pier it appears, that in 1575 the Payment of these Rates was disputed by some contentious Persons; but on the Pier-Wardens applying themselves to Henry Howard, Earl of Northampton, at that time Lord warden, they obtained his Injunction for their Payment"* (Lewis 1736, 176). One confirmation of the *"Decrees Orders Rates etc to the Pier Wardens"*, dated 1726 and issued by a Lord Warden, survives (EKA CPW/RO2). The document ends with a stated requirement for all present and future pier wardens to:

"put the sd Decrees Orders and Rates in due effectual Execution and that for their better performance thereof you the sd Mayor Jurats & other of hi Maty's Officers be unto them therein diligently aiding & assisting wherein you nor they may fail as you will answer the contrary at yr peril".

At Hastings the pier wardens were responsible for the maintenance of the Stade, and lighthouses as well as the pier (ESRO Hastings notes; Cooper & Ross 1892, 96). The collection of money from duties at the pier and from the Yarmouth herring voyage also fell within their remit (ESRO C/A(a)1, p185).

The balance of evidence would suggest that persons fulfilling pier warden-like roles were generally drawn from the middling sort with perhaps a number originating above this level. Given that the role involved book-keeping, arithmetic and an ability to read and write, the very basic requirements for office must have been numeracy and literacy. Post-holders were normally elected, accountable to the community and required to contract for works. We can therefore see the role of pier warden as a civic post of some importance. All of these criteria perhaps favoured a candidate from society's middle orders. The earliest detailed evidence we have for the status of pier wardens is that of the collector Robert Wawayn at Scarborough who was carrying out a role more or less identical to that of later wardens. Although Wawayn was to be accused of abusing his post, he was described in 1319 as a burgess of Scarborough and the king's bailiff; clearly a man of some local importance (Cal. Pat. Rolls 1319). The later requirement for Scarborough's 'Pier Maisters' to be 'discrete and honest persons' and to be elected by the bailiffs and corporation's senior officers again highlights the importance attached to the role. The two 'Maisters' were afterall, responsible for the well being of the town's port and for the operation of the rates system. Gentlemen are recorded as holding warden's roles at Margate, which it will be recalled was subject to Dover in matters of civic jurisdiction (Seymour 1776, 555-6; Hasted 1800, vol. 10, 312). A town lacking a corporation may have limited the ambitions of any would be ruling class and it is entirely possible that a warden's post may here have provided a vehicle for the aspirant. It will also be recalled that when the Culmer family sold Broadstairs pier to the community around the mid 16th-century this was subject to certain conditions, one of which was that one of the two wardens was to be a fisherman (Lewis 1736, 164-5). This insistence may have been primarily directed to ensuring that at least one of the warden's was nautically au fait. It does not necessarily follow however, that this post-holder was without learning or wealth.

Great Yarmouth adopted a system of control with a greater degree of connectivity between the town's governing corporation and its officers at the port until control was vested in a body of commissioners in 1670. A series of large volumes of Haven Books for the town survive and these provide information on the range of offices that controlled affairs at the piers (NRO Y/C28/1; 2; 3; 4). In particular, much is known of those officials engaged during major programmes of pier construction through their accounts in the Haven Books. These included a Paymaster and Overseers who were seemingly unpaid and perhaps members of the corporation (Manship: in Palmer (ed) 1854, 97). There were also Providers of wood and timber, sundry Surveyors providing materials, a Clerk of Works and a Clerk of the Check (NRO Y/C28/1; Manship: in Palmer (ed) 1854, 97). The accounts of these officials were subject to inspection by appointed auditors. In the day to day running of the port Searchers and Collectors were appointed to ensure the payment of doles, a gradated scale of tolls with the income ostensibly expended on the maintenance of the haven (Rutledge 1970).

The role of pier masters/wardens/reeves gradually came to an end with the demise of municipal ownership and the acquisition of the piers by bodies of commissioners. The only known exceptions for continuance of the role under commissioners, for some time at least, were at Bridlington and Margate. We have seen how the conversion to ownership of pier sites by commissioners was by Acts of Parliament that equipped the new owners with strong indisputable legal powers and enhanced abilities to raise capital. The change of ownership coincided with a new professionalism of approach that was perhaps largely derived from the sole role of the commissioners being the maintenance and improvement of their harbours rather than the demands of governance of entire towns. It may also be wondered if the commissioners themselves, drawn almost exclusively from society's upper echelons, brought a wider view more attuned to possibilities and potentials in a country on the verge of industrial revolution. One of the hall-marks of the new professionalism of approach was the engagement of a range of specialist workers and engineers.

There was a diversity of new posts at Great Yarmouth after an Act of 1670 which included Collectors and Receivers (Raithby 1819, 651-3). Collectors, as was normal elsewhere, took up office after taking an oath and were required to keep account books. They held strong legal powers and worked on a commission basis, retaining a small fraction of the monies they collected. Works carried out at the pier were arranged on a

contractual basis with suitably skilled persons/engineers, this being a requirement of successive Acts (Acts of Parliament 1699; 1750). This included a number of well known engineers. Great Yarmouth came to employ a pier master and engineer, both of whom were allocated buildings on the pier (NRO Y/PH 1170).

At Bridlington the Act of 1697 makes references to the offices of Customer, Collector, Receiver of Entreys of Ships, Comptroller, Surveyor, Searcher and Waiter (Act of P. 1697). Bridlington's commissioners also called upon the consulting services of engineers (Smeaton 1778; Goodrick 1814). It is probable that the commissioners also retained a workforce for repair and maintenance, certainly they had a work-shed and stockpiles of material (Goodrick 1814; ERRO QSF/39/C/13; QSF/39/C/14).

The commissioners at Southwold appointed Collectors and a Treasurer who produced yearly accounts (Act of Parliament, Southwold 1747; SRO HA11/B1/88; HA11/B7/10). By the time of Southwold's 1809 Act the list of harbour officers that could be appointed by the commissioners had grown to Treasurer and Clerk, Collector or Collectors, Surveyor or Surveyors, Haven Master or Haven Masters as well as any other such officers as they should think fit whilst the power to enable bye-laws was also within their remit (Act of Parliament 1809). A small workforce was employed by the commissioners for general repair work (SRO 491/20E/4; 491/20C/20).

The income gathering role of elected pier wardens at Margate and Broadstairs came to be replaced by the post of appointed 'Droit Collectors' after the establishment of their commissioner bodies (Lewis 1724, 87). Like collectors elsewhere their income was formed of a fraction of their takings. Under the Act of 1792 Broadstairs' commissioners were also permitted to appoint salaried officers, which included a Treasurer, Clerk, Collectors and Surveyors. Records, both of proceedings and financial matters were required to be kept, with these being open to annual inspection. A Harbour Master and assistant to the Harbour Master are mentioned from the late 18th-century and they appear to have been charged with its proper running and also involved themselves with some repair work (EKA UD/BS (uncat.) Box 2 1792-1814). The commissioners commonly contracted for works to be carried out though reference to works carried out by *"self"* may suggest a small core of regular pier employees (EKA UD/BS (uncat.) Box 1, 1792-1807).

From the perspective of both the efficient running of a pier and the collection of monies owed to them, piers were necessarily regulated places. The authority and powers vested by custom, Acts of Parliament, bye-laws and Decrees and Ordinances demonstrate the considerable powers vested in pier wardens, collectors and harbour masters that made such regulation possible. To some degree this notion of regulated space finds expression in the customs and toll related buildings, harbour masters offices and lookouts on and adjacent to piers that were outlined in Section 2.8, Chapter 2. Most commonly these buildings were situated at the landward ends of piers that permitted the control of access to and from the harbours.

4.3 Funding

"twoe thinges have moste cheiflie and principallye happened sondrye tymes that is to saye the prosperitye of the saide Towne by reason of a good haven and harborroughe and the decaye thereof by reason of a evell haven and harborrowe" (Great Yarmouth: Henry Manship early 17th-century: in Palmer 1854, 1-2).

'Through the whole story, the harbour appears as a burden to the community' (Bridlington: Purvis 1926, 164).

It is important to recognise that historic seacoast piers often did not generate enough income to cover the expense of their repair, maintenance and occasional necessary reconstruction. In this sense piers mirrored other items of non-profit making infrastructure such as roads and bridges, although these latter at least often had the benefit of legal obligations for their funding and repair, which was not the case with piers. David Harrison's study of bridges indicates that there are a number of close parallels that can be drawn between bridges and piers in terms of funding mechanisms and their management (Harrison 2004, 184-220). Such are the similarities that one could justly consider both topics under a single heading of 'infrastructure archaeology'. Piers, roads and bridges were vital to historic society and more particularly its economy, not as direct generators of wealth, but as enablers, or facilitators, of wealth generation. Such infrastructure permitted the movement of goods, people, and ideas that lay at the core of the economy.

Without piers national and overseas trade would have been hampered, fishing fleets would have been less extensive, elements of national security would have been weaker and substantial stretches of the coastline would provide little security for vessels in foul weather. One could extend this 'negative list' considerably further.

In exploring the question of funding this section inevitably diverges into two strands. Firstly, there is the matter of the recurring ordinary manner in which income was generated by the pier sites. In essence this was money to which the piers, in their everyday operation, were legally entitled and was intended to form the core of profits which could be expended upon their repair and maintenance. Secondly, there are the extra-ordinary strategies that were adopted when normal income was not enough or when catastrophe struck. This second strand often involved appeals for assistance, both material and monetary, to local and wider communities, high ranking individuals, parliament and the crown. If appeals such as these were to stand a chance of success they needed to be justified and preferably be backed by influential individuals. Justificatory statements were therefore common and it is instructive to briefly consider these as they shed some light on contemporary opinions and attitudes. Detailed examples of these, and their supporters, can be found in the individual case studies within the Appendix.

Perhaps the most commonly stated justification was that piers provided safe havens for all shipping in time of storm as well as bolt holes for evading enemy ships and pirates. Such statements had the advantage of appearing selfless. Equally so were alleged advantages to the navy, both as a port, and in their role as providing a nursery ground for seamen to man the navy's vessels. As such a port could be portrayed as playing a role in the defence of the realm and of the coasts in particular. The stated function of piers in minimising inundation and coastal erosion to towns and coasts was also widely stated in appeals and has been considered in Chapters 2 and 3. Closer to the heart of the matter were statements to the effect that claimed economic depression within a town or district could be alleviated by the repair of a pier. It was felt that this would assist regeneration by boosting trade and fishing. There would be advantages to merchants, travellers and be generally profitable to the 'common-wealth'. A successful appeal then was one that tended to emphasise the advantages to both local and national interests.

The chances of an appeals success could be enhanced by enlisting the support of high ranking and influential individuals to further their cause in decision making circles. At a

local and regional level we often see local Justice's, members of the gentry and church figures appearing in such roles whilst statements by officers of Trinity House and the navy could further underpin a case. Above this, figures in the national life of the country such as members of the Privy Council, important peers, bishops and high ranking naval officers could be recruited to a particular cause. In the case of the Cinque Ports, they could ordinarily expect to rely on the support of their Lord Warden who was invariably a figure of national standing. A variation of this tack could be groups of lower ranking individuals who were nonetheless prominent in the economic life of the country. A particular example of this would be the forty two merchants who put their name to a petition in support of Bridlington, included amongst whom were twenty two from far off London (Purvis 1926,188-189).

The role of supporting influential figures is best attested at Great Yarmouth during the port's period of direct control by the town's corporation. The towns supporting figures included two of the Dukes of Norfolk, Robert Earl of Leicester and the Vice Admiral of England Sir William Woodhouse, all holders of high office with equally high placed contacts. The corporation often choose members of the nobility to fill the largely honorific post of High Steward, for example the dukes of Norfolk and Northumberland in the 16th-century and the earls of Dorset and Clarendon and Lord Henry Cromwell in the 17th-century (Hassell-Smith 1974, HMC 1883). The role of such people appears often to have been pivotal in facilitating successful outcomes for the town and whilst such relationships were mutually beneficial, in the case of the regionally powerful Duke of Norfolk we can see this as in the mould of patron and client. Gifts by Great Yarmouth to Secretary Cecil, the Earl of Leicester, the Lord Admiral, the Lord Keeper and the Master of the Rolls as well as the monarch can be seen as means of gaining favour or political stock (Hassell-Smith 1974, 29-30; Swinden 1772, 474-5; Parkin, 1776, 53). In seeing favours exchanged the Earl of Dorset recommended an individual to represent the town in parliament whilst the Earl of Leicester requested the post of water bailiff for another man (HMC 1883, 311, 317).

4.3.1 Recurring ordinary income

The most common forms of recurring income flows were rights to 'quayage', other customarily applied charges, including 'Droits' at the Cinque Ports and 'Doles'. Quayage was a tax or duty levied on goods landed or loaded at a quay, or on ships using a quay (OED online). As such this could be a simple fee for the berthing of a vessel or alternatively a rated charge on specific items within a berthed vessel. The terms 'groundage' or 'anchorage' were sometimes used instead of quayage and though these words were sometimes used for a pier site it was equally applicable to sites without piers. Quayage could also be chargeable at inland ports as well as those on the coast. Grants of quayage were the gift of those who held suzerainty over the area concerned, most commonly the crown. Grants of quayage were typically for a set number of years and were commonly recorded in the Patent Rolls. Such grants could be addressed to the community or to individuals and it was understood that collected monies were to be applied for the benefit of the fabric of the port. The earliest recorded grant of quayage was that for Scarborough in 1252 and around 20 such grants are recorded for the town throughout the medieval period (Cal. Pat. Rolls 1252; Daniell and Bould 2001, 33). (Cal. Pat. Rolls 1331). Whitby received its first grant of quayage in 1307, with later grants following (Cal. Pat. Rolls 1307; 1341; 1411; 1424) whilst Newbiggin was granted the same privilege in 1316 (Cal. Pat. Rolls, 1316). Grants to anchorage, quayage and groundage at Bridlington was granted in 1446 (Cal. Chart. Rolls 1446).

Charges seemingly identical to quayage, though omitting the term, could also be authorised. Thus at Cromer in 1390 the town was permitted *"for five years levy certain dues in aid of the construction of a pere newly begun by them"* (Cal. Pat. Rolls 1390). Charges, or tolls, are known to have been payable at other pier sites and seem to have become accepted rights through customary usage. Thus at Filey a document of 1600 states *"The groundage of every ship landed ffilowe peere, with for every ship vid and of every cole ship two bushel coles to the Bayliffe for finding of the bushel measures"* (E.R.R.O. DDHU/9/32). Again, at Flamborough the anchorage of ships at the pier formed part of the manorial revenue in the early 16th-century (TNA E310/31/185 no21: quoted in VCH 1974, 158). Harbour dues are known to have been received at Hartlepool and early in the town's history the lord of the adjacent manor claimed tolls on vessels mooring within the port (Daniels 2010, 35; Hutchinson 1823, 25). The corporation of Hartlepool

did come to receive harbour dues though precisely when this right was asserted is uncertain (VCH 1928).

Duties on ships levied within piers of the confederation of Cinque Ports were known as 'Droits' and can be regarded as authorised customarily applied charges. Monies raised were intended to fund repair and maintenance. Orders specifying these rates were periodically issued by the Lord Warden of the Ports and whilst the oldest of the Warden's decrees dates only to 1615, they were already said to be *"time out of mind"* (MPL Lord Warden 1693; EKA CPW/RO2; Hasted 1800 vol. 10; Lewis 1736, 164). Some indication for earlier precedent survives in abstracts of some *"ancient deeds"* at the back of a minute book for Broadstairs (EKA UD/BS (uncat.) Box 2 1843-1853). One of these, No 3 states: *"A parchment of the Indenture, of covenant, between John Sprackling and others, and George Culmer, for setting Rates, and diverse rules, for the Maintaining, the Harbour of Broadstairs. Dated the May 1st Eliz-th 33rd 1591"*. Another, No 4 states: *"A parchment, the Lord Wardens precept, for the better recovering the Rates, and Duties, payable to Broadstairs Pier, Dated the 26th Decem-r 1593"*. This can be taken back in time further still as according to Lewis evidence from the: *"Writings of this* (Ramsgate) *Pier"* indicate *"that in 1575 the Payment of these Rates was disputed by some contentious Persons; but on the Pier-Wardens applying themselves to Henry Howard, Earl of Northampton, at that time Lord warden, they obtained his Injunction for their Payment"* (Lewis 1736, 176).

The rates of the droits, which were payable to the pier wardens, varied according to commodity and quantity and whether the goods were being transported within England or beyond. Lesser rates were required to be paid by vessels belonging to 'Portsmen' (members of the Cinque Ports) than by 'Shiremen' (Englishmen not of the Cinque Ports) whilst 'Strangers or Aliens' (non Englishmen) were required to pay yet more. Most rates for fishing vessels were based around a separate seasonal formula. Ships using the harbours solely for refuge were to make small one-off payments, these varying according to vessel tonnage. Droit rates were sometimes insufficient to maintain a pier and in the case of Margate in 1690, which was £200 in debt, it was requested that a new schedule of harbour dues be issued (Andrews 1953, 38). Part of the problem was the difficulty in collecting droits and this ineffectiveness was specifically referred to in the Acts of Parliament that set up commissioner bodies at Margate, Broadstairs and Ramsgate (Act of Parliament 1724; Act of Parliament 1792; Bill 1749). As we have seen these Acts provided the commissioners, and their agents, with strong legal powers for enforcing

collection with this role coming to reside in the hands of appointed Droit Gather's or collectors rather than pier wardens.

'Doles', which were generally paid from the profits of fishing are attested at Hornsea, Great Yarmouth and at Hastings where they were known as 'shares'. The 16th-century evidence for Hornsea, has already been touched upon. Here, the payment of such doles was said to have been an initiative of the fishermen themselves, devised in order to encourage the pier owners, St Mary's Abbey, York, to properly maintain the pier (Purvis 1949, 69-73). At Great Yarmouth the payment of doles was again by the fishing fleet with a proportion of the income ostensibly being expended on the maintenance of the haven. Searchers and collectors were appointed to ensure the working of the system. Such doles continued to be levied until late in the post-medieval period and find common mention in the town records (Swinden 1772; Rutledge 1970; Gruenfelder 1998). There are late 16th-century records of Hastings fishermen granting *"wholl shares"* towards the pier, these shares seemingly being derived from the lucrative North Sea herring fishery (ESRO C/A(a) 1, p16; 24).

The regular payment of rates/assessments, a levy on the local inhabitants for the maintenance of the piers, is attested at Scarborough, Flamborough and Bridlington and has been touched on above. Similar assessments were periodically applied at other sites and are considered below in Section 4.3.2. As has been seen, under the Act of 1545 Scarborough's pier masters levied a rate on property within the town and its liberties, this being a 1/5th part of its annual rental value. Failure to pay was punishable by distraining of goods whilst in cases of uncertainty the Masters had recourse to the Lord Chancellor for determination.

The terms of the 1570 lease of Flamborough specifically recognised *"that the charges of the said pere ys so uncertain that the same muste from tyme to tyme be assessed as need shall require"* (TNA E310/29/173). The final section of the lease states *"and bynding evy souche tenant to all repacons of the tente and closes in his holding and also bynding evy souche tenant to beare yerely and from tyme to tyme souche some and somes of money towarde the mayntenance of the said pere and sea walls and there appertenances as in forme aforesaid shall be assessed from tyme to tyme"*. This clearly relates to an annual rate levied on the tenants for the maintenance of the pier. The lessees of Bridlington were similarly permitted to charge pier rates from at least 1580 (S.P. online 1; Purvis 1926,

169-170). There is no definitive evidence that the Bridlington lessees were permitted to demand labour services from the tenants of the manor, though aspects of this practice were still considered customary in 1636 (Purvis 1926, 96).

The most successful means of generating income for pier sites were various forms of what became known as 'passing tolls'. These were effectively a tax on shipping, or goods therein, lading or unlading in specific ports. Acts of Parliament were required to establish these tolls, which normally ran for a set number of years, though once granted were often renewed on a regular basis. Such passing tolls tended to be granted only occasionally and typically in instances where a port was deemed to be of 'national interest' but generated little recurring income. Unsurprisingly, the first known instance of this was at Dover in 1581 when all shipping to and from the realm was required to make payment (Lane 2013). Bridlington received similar favour in 1672 when parliament permitted the sum of £4,000 to be raised piecemeal by a small toll on every coal ship lading in the ports of Sunderland and Newcastle (Purvis 1926, 190-191). Following this precedent the winning formula of levying a duty on coals was adopted by an Act for Bridlington of 1697 which also established the towns harbour commissioners (Act of Parliament 1697).

4.3.2 Extra-ordinary income

The majority of unusual means of generating funding were almost certainly much more common than the individual instances detailed below whose presentation is owed to both documentary survival and their being encountered within archives.

Sale of certain 'church related' goods and assets at reformation

The reformed ideology and practices that accompanied the break with the Church of Rome made a range of former church materials redundant. During the reign of Edward VI in particular, the sale of these materials was common-place and was at least partially motivated by a desire to be rid of Romish baubles. The money raised by such sales was sometimes spent on causes beneficial to local communities. Amongst these causes was investment in port infrastructure. At Great Yarmouth the assets of the charnel were sold to finance the new harbour mouth, likewise assets of the church guilds in 1546 (Rutledge 1970, 19). Church plate, bell metal, vestments and other ornaments were *"by the hoole assent and common concent of the assemble house were these parcelles hereafter*

particularly solde in the open house for & towardes the buyldyng of the newe haven" in 1548 (Rutledge 1970, 71-2: Assembly Minutes *fo. 55V – 57V*). A further sale of vestments was held in 1550 (Rutledge 1970, 75: Assembly Minutes *fo. 57V*).

In 1552 the government ordered an inventory of church goods and the entry for Hornsea survives (Surtees Soc. 1896, 49-50). It is recorded that the churchwardens *"with the consent of all the inhabitants"* sold the church plate and other materials to provide funds *"for the repaire and buildinge of the peire of Hornesey"*. This sale apparently raised the sum of £22 6s 8d. At Scarborough the lead from two steeples of St Mary's church was sold in 1555 whilst lead was also stripped from the chapels of St Thomas and St Sepulchre in 1564 (Rushton 2008, 252).

Materials from redundant ecclesiastical buildings could also be utilised in the building and repair of piers. The crown used cart-loads of stone from the site of Bridlington Priory during its construction campaigns of the late 1530s onwards (TNA E101/622/29). Later still this formed one of the perquisites offered to the lessees at Bridlington in 1566 (Cal. Pat. R. 1566). At Great Yarmouth stone from the church of St Mary Ultra Pontem, which was demolished in 1548, was used in the constructing and repairing of the haven and piers and further church stone was used in 1650 (Palmer 1854, 435).

Granting of export licences and monopolies

Under the Tudors the export of corn was tightly regulated so as to ensure an adequate domestic supply. During Elizabeth's reign this tight regulation appears to have *"become a fiscal device which the crown used to support public works or reward courtiers"*. (Hassell Smith 1974). As the gift of crown and government, licences for the export of grain, typically for a set number of years and in specific volumes, could be granted. The pier sites of Cromer, Sheringham and Great Yarmouth were all granted licences in the 16th-century.

Great Yarmouth was granted licence for the exportation of 18,000 quarters of wheat, barley and malt in 1567, which sale generated £1407. A further licence was granted in 1576 for the exportation of 30,000, another for 30,000 quarters in 1580 and a fourth for 40,000 quarters in 1584. (Cal. Pat. Rolls 1568a, 1576, 1580, Manship junior: in Palmer

1854, 30-32). The town also received licence in the later 16th-century to export quantities of herring in foreign rather than English ships (Parkin 1776, 49).

Cromer received a licence to export grain in 1578, the Letters Patent being addressed to the *'Peerriefes and Inhabitantes'* (NRS 1982 & 1983, 30). The town's cause was sponsored at court by Thomas Sydney, a cornmonger with important connections through his brother in law Sir Francis Walsingham. The town appointed a magistrate, Sir Thomas Heydon, to sell the licence (Hassell-Smith 1974, 235-6). There was some irregularity in this sale, which involved Thomas Sydney and some thirty years later the town was still trying to recover money (RHS 1915, 126–9; RHS 1936). A further licence, for 7 years, was granted to Cromer in 1582 with the profits being *"delivered to the pier reeves of Cromer and employed in continuing the rebuilding of the pier there"* (Cal. Pat. Rolls 1582). The working of this grant proved to be as corrupt as the first. There were irregularities with the agent's selling of the grant whilst some sums of money appeared to have remained in the hands of several pier reeves. These irregularities came to the attention of the Privy Council who were explicit about their suspicion of abuse of trust and commissioned an enquiry into the matter (Acts of P. C. 1587-1588, 289-90, 395-6). Although some documentation relating to these investigations survives, the final legal outcomes are not known (TNA E133/6/886; E134/35Eliz/East19).

At nearby Sheringham a licence for 10 years for the exporting of quantities of grain was granted to the pier reeves and inhabitants in 1583 (Cal. Pat. Rolls 1583b). Again the profits were to be employed towards the rebuilding of the piers of the town.

Dover was granted granted export licences in 1580/1, whilst a charter confirming the town's monopoly on cross-channel passenger travel was issued by Edward VI, this following earlier statutes dating back to the later 15th-century (Colvin 1982, 756; Hasenson 1980; Lyon 1813, 152).

Remittance of fee farm and other dues

The earliest known example of remittance of debts to aid a pier is at Scarborough in 1357. The Patent Rolls record that *"the quay of the town is so decayed that the town is likely to be laid waste and destroyed by the sea in brief space and they on account of their need cannot repair it".* As a result of the burgesses petitioning the crown the same document

records that the king agreed that the fines owed to him by the town should be spent *"in aid of the repair of the quay"*. There is a long history of release and reduction by the crown of payment of both the fee-farm and of fifteenths and tenths at Great Yarmouth, principally due to the costs of the town in maintaining its haven. Release was formalised by the issue of Letters Patent, many of which granted remittance for periods of many years, see for example: (Cal. Pat. Rolls 1463; 1466; 1471; 1473b; 1482; 1483; 1488; 1502).

Granting of fiscal privileges and exemptions

In return for forming the core of medieval England's naval forces one of the privileges granted to the Cinque Ports was exemption from most taxes and trading dues, a factor that must have given the Ports enormous trading advantage. The Cinque Ports rival, Great Yarmouth, also received some royal favour. Around 1387 Richard II granted £100 out of the customs and subsidies of the port towards the building of the haven as did Henry IV (Cal. Pat. Rolls 1409, 1412). Several such gifts were granted during the reign of Elizabeth (Henry Manship: in Palmer 1854, 16,17,33). The favouring of the town by restrictions imposed upon other ports in the region could also benefit the haven. Henry IV for example granted that the shipping of wool, hides and skins, which previously took place at Lynn and Ipswich, together with the packing and weighing of wool, should henceforth within Norfolk and Suffolk, only take place at Great Yarmouth (Henry Manship: in Palmer 1854, 19). In the early 17th-century licences were issued to Great Yarmouth for the exportation of beer free of custom (HMC 1883, 307; NRO Y/C36/6/2).

The corporation records of Hastings for 29th July 1621 state that *"Nathaniell Lasher is Appointed to travell to Chichester ther to conferr wth the mayor Aldermen & other offecers concerning the favoring of the customes & subsedyes of this port from the kings ma(tie) according to his highnes gracious pleasure & according to their L-s in that behalf"* (ESRO C/A(a)2, p 4). These few lines form part of a larger entry referring to the pier and although it's precise meaning is not entirely clear it may relate to the town trying to obtain some financial benefit from customs duties.

The granting of the 'cocket seal' in 1320 to Scarborough, thereby enabling the export of wool from the port, could also be construed as a trading privilege given that the ports through which this trade could be conducted were highly restricted (Daniell and Bould

2001, 34). In similar context the establishment of Bridlington as a customs port in 1559 permitted the town to trade on an international basis (Neave 2000, 57-8).

Briefs for public collections

A 'brief' was a legally authorised appeal for money to be raised for a specific object or cause. Such authorisation was the gift of the crown and government and Letters Patent were normally issued by the sovereign as Head of the Church, licensing the collection in churches throughout England or within particular counties. The earliest known brief for collection in aid of port works occurs at Dover in the 1550s when the town was granted Letters Patent to collect money throughout all England for a period of two years, towards the repair of their haven (Lyon 1813, 156). Great Yarmouth followed suite in 1573 when authorising letters were directed to the Bishop of Norwich and Justices of the Peace of Norfolk and Suffolk, with some £503 9s 5d being collected from the two counties (Parkin 1776, 48). In 1622 Letters Patent were again issued for a general collection throughout the kingdom for the benefit of Great Yarmouth's haven and piers (Parkin 1776, 51; NRO Y/C36/6/2).

Another early collection was that for Hastings with Letters Patent being granted in 1578 (Hughes & Larkin 1969, 426-431; Acts of P. C. 1578, 419-420). Some of the monies collected under this brief appear to have been *"quickly converted into private purses, and the public good neglected"* (William Camden, quoted in: Manwaring Baines 1946, 6). An arrest warrant of the Lord Warden was sent out to apprehend John Jeffery a Jurat of Hastings who was one of the collectors of money and a surveyor of work at the haven (Hughes & Larkin 1969, 426-431). A number of entries in the Acts of the Privy Council for 1579 seem certain to relate to these events. It was reported that money gathered in Kent was done so *"uppon pretence that the same should be employed for the haven of Dover"* and that sums of money were still in private hands (Acts of P. C. 1579, 261, 308-9). The town petitioned for a further collection for the *"repair of the pier of their harbour, destroyed by a great tempest"* in 1590. This appeal appears to have been unsuccessful (Cal. S.P. Dom. 1590). A more successful outcome was had in 1620 when Letters Patent for a collection were issued (Sovereign 1620).

During the Interregnum the mayor and burgesses of Hartlepool sought from Parliament a brief for collection towards the building of their pier in 1657 (Cal. S.P. Dom. 1657).

Shortly after the restoration of the monarchy, in 1662, a similar petition for a brief was drawn up and was referred to the Lord Chancellor (Cal. S. P. Dom. 1662). Both appeals appear to have been unsuccessful. An appeal by Cromer in 1664 achieved its goal and the church register of the small village of Tissington in land-locked Derbyshire, records *"collected then towards the repair of the pier and the parish church of Cromer in the county of Norfolk, the sum of four shillings and four pence"* (Tissington 1996, 15). The latest known appeal for a brief for collection for pier works was at Broadstairs when in the wake of *"very great damage in the storm of 1763"* the inhabitants made their petition for a public collection (Remembrancer 1769, 229). The same source informs us that their request was rejected.

Proceeds of the Hemp and Flax Acts

An Act, originally of Henry VIII, but maintained and amended by Elizabeth in 1578 required a proportion of arable land in larger holdings to be cultivated for the growing of hemp and flax with failure to comply being penalised by fines (Hughes and Larkin ii 1969, 435-8). Amassed penalties could be utilised for various causes.

The pier construction works at Sheringham became recipient to the penalties payable in the counties of Norfolk and Suffolk and was probably the largest single provider of the project's funds. The patent authorising this action named eight individuals led by a Robert Kyrke (Cal. Pat. Rolls 1583). It has been suggested that the reason why the crown was amenable to the diversion of funds to Sheringham, which would otherwise have accumulated to the royal coffers, was that following the attainment of the Duke of Norfolk in 1572 Sheringham was escheated to the crown (Day 1888, 228). This finds some parallel with the cases of the crown investing in the piers that came into their hands at the reformation. Hassell-Smith indicates that the patentees had influential supporters, amongst them Sir William Heydon and Henry Lord Cromwell who were chosen by the Justices of Assize to act as commissioners to ensure the correct use of the money (Hassell-Smith 1974, 248). Whilst the patentees did commence a grandiose pier scheme at Sheringham it is also clear that they were guilty of embezzlement and in many ways abused their authority, seemingly with the connivance of the commissioners. There followed a number of drawn out investigations which are considered in detail in the Sheringham case study notes within the Appendix.

Donations (monetary and material)

Crown favour could be expressed in the form of pier materials as well as in money, licences and privileges. Thus at Scarborough in 1489 the crown gave three hundred oaks, for the repair of its port infrastructure (Turton 1894, 122). Again in 1541 the *"Men of Scarborough who sued for certain wood to repair their haven and pier had answer that one should be sent to view both haven and woods"* (L. & P. Henry VIII 1541). Further royal favour was given in 1565-6 when Scarborough's pier was so ruinous that the queen granted £500, 100 tons of timber and 6 tons of iron (VCH 1923). In what appears to have been an inducement to certain men of Bridlington to take up a lease of the manor and piers the crown offered *"all old timber, stones, iron and other things belonging to the old pere, with all old stones at the site of the monastery not yet sold, also 100l and 120 suitable oak or other timber trees in the adjacent woods"* (Cal. Pat. Rolls 1566). The 1570 lessees at Flamborough were likewise hoping *"to have towards the same newe peare in consideracon of their greate losses and chardges some tymber trees by yor honors warraunte"*. (TNA E310/29/173). The donation of materials for pier building was not restricted to the crown. The use of timber for repairing Newbiggin's pier in 1335 was facilitated by the ministers of the Countess of Pembroke (Hodgson 1902, 74; Cal. Pat. Rolls 1331).

Over eighty individuals gave money towards the building of a new haven at Great Yarmouth in 1549, many being members of the town's corporation and the sums ranged from 10s to £40 (Rutledge 1970, Appendix C: Assembly Minutes *fo. 56V – 57R*). In similar tack it was agreed at assembly that for a space of ten weeks the senior members of the corporation would pay 2s. per week and the junior members 1s. per week towards these works (Rutledge 1970, 75). In the later 16th-century the Duke of Norfolk, a powerful friend of the town, contributed timber from his own estates, gave generously to a harbour fund and persuaded the Norwich aldermen to vote 200 marks towards the haven (Hassell-Smith 1974, 28-9). Around 1622 the city of Norwich made a further contribution of 100 marks (Parkin 1776, 51). In 1579 even the Cinque Ports made a small donation towards the haven (Swinden 1772, 435-6). Great Yarmouth itself was a contributor to the construction works at Sheringham piers, making a donation of a few tens of pounds in the late 16th-century.

Broadstairs' pier suffered *"very great damage in the storm of 1763"* and its financing was resolved in 1774 when the towns of Great Yarmouth, Dover, Hythe, and Canterbury, the East India Company and Trinity House contributed £2,000 towards its rebuilding (Simmonds 2006, 6; Whyman 1980). The East India company's interest in preserving the pier at Broadstairs may have been prompted by Whites shipbuilding yard at the town which is known to have supplied a number of the company's ships.

Loans

The borrowing of money by municipal authorities to fund building and repair works to piers was quite widespread, with the money coming from diverse sources. It was recorded in Hastings Corporation Record Book in July 1596 that the town was in debt owing to the charges of the pier. Accordingly *"xx li* (was) *borrowed of All Sts Church towards the Pere"* (ESRO C/A (a) 1, p 15). Less than a year later the Assembly of the town acknowledged that *"the towne standeth indetted to the workmen* (at the pier) *therof in divers great somes"* (ESRO C/A (a)1, p 32). Perforce, another *"xx li* (was) *borrowed of the Town to the Pere"*, this money coming from the chamberlain. In order to obtain a speedy supply of money for finishing works at the pier in 1622 the Assembly agreed that *"mony shalbe borrowed of such psons as will and can be procured & intreated to lend"* and *"that such psons shalbe timely repaid their sevall somes so lent"* (ESRO C/A (a)2, p 9). It may be that such repayment was intended to be funded by the money raised from the brief for collection issued in the same year. There are a number of references around the cusp of the 16th and 17th centuries in the Hastings Corporation Record Book to the *"pier stock"*, seemingly a fund of money devoted entirely to the use of the pier e.g. (ESRO C/A (a)1, p 151, 154; C/A (a)2, p 9). Frequently the reserves within this stock were insufficient and additional money had to be drawn from elsewhere. Sometimes this was from within the corporation itself. Accordingly, we hear of additional money *"to be supplyed by order of a comon Assembly"* (ESRO C/A (a) 1, p 151), and *"shalbe borne & paid viz out of the Peere stock L li and xii li x s residue out of the Chamber of the towne"* (ESRO C/A (a)1, p 154). This may relate to 'internal shuffling' of monies within a number of corporation funds.

Great Yarmouth was able to utilise the kingdom's greatest fulcrum of leverage during Elizabeth's reign when at the behest of the crown itself the City of London lent the town £2000 for bestowing upon the haven (Henry Manship: in Palmer 1854, 31), By 1667 the town was again said to be in difficulties owing to the *"borrowing, and paying interest for great sums of money"* (Swinden 1772, 896).

Margate's pier required repairs costed at an estimated £700-800 in 1766. At a *"publick vestry assembly"* it was decided to borrow the money from subscribers at a rate of 4% per annum (MPL White undated). £450 was raised from nine subscribers, each putting in £50. It is probable that these individuals were local as three of the subscribers were signatories to the vestry assembly. Several months later, in 1767 when much of the work had been carried out, all was lost to the sea. Shortly afterwards a further £850 was raised from fifteen subscribers, this time at an interest rate of 5% per annum. Three of the fifteen subscribers were amongst the original group of the loan of the previous year. A letter of 1778 concerning pier shares owned by an individual suggests there may have been yet further share sales (EKA EK/U1453/B3/15/1888).

As was discussed in Section 4.1.5, the Acts of Parliament setting up bodies of commissioners at Bridlington, Great Yarmouth, Margate, Broadstairs and Ramsgate all contained clauses permitting them to borrow money at interest, on the security of future duties/income. There is evidence for such borrowing at Southwold, Margate and Broadstairs, principally from individuals (Wake 1839, 132; EKA EK/U1453/053/2; UD/BS (uncat.) Box 2 1792-1814; UD/BS (uncat.) Box 2 1814-1824; Act of Parliament 1805).

Wills and bequests

Charitable bequests within medieval wills were common-place. There are a number of instances in which willed monies were left for the repair, maintenance and construction of piers. A pier was clearly seen as a suitable recipient for such gifting and formed a conscious selection on the part of the testator.

The earliest known bequest, which has already been considered, was that of Robert Constable at Flamborough who left £40 for the maintenance of one *"kay"* in the sea in 1400-01 (Test. Ebor. 1836, 264-5). Such charitable giving prepondered at piers in municipal ownership, presumably as they were perceived to have been of wide communal benefit. For Scarborough Rowntree lists seven such wills in the 15th-century and six in the 16th-century whilst at 15th and 16th-century Cromer Walter Rye has identified twenty five such bequests (Rowntree 1931, 379, 384; Rye 1873, 38-9; Rye1889). Palmer records a number 16th and 17th-century benefactors who left money for the maintenance of the haven at Great

Yarmouth whilst a number of later legacies are also recorded in the Haven Account Books. (Palmer 1854, 283-4, 415; NRO Y/C28/1;2;3;4;5). Two pre-reformation 16th-century bequests in wills are known at Whitby and reinforces the notion of townsmen having rights, as well as interests, at Whitby's pier during the period of monastic control. The value of known monetary bequests to piers ranged from 12d to tens of pounds though on occasion included timber materials and property (Rowntree 1931). The exception to this value, which also forms the latest known harbour legacy, is at Dover in 1720 when a wealthy individual instructed that his entire estate be used for its benefit (Leach 2005).

The social status of those recorded testators at Great Yarmouth was very high whilst at Scarborough the overwhelming majority were individuals described as burgesses or merchants. In the case of the latter they and their families may have had a vested interest in the port.

Assessments – particularly at local and county level

We have seen how systems of regular assessments, or rates, were payable by local inhabitants towards the upkeep of piers at Scarborough, Flamborough and Bridlington. Irregular, or occasional, assessments were also made at other towns their occurrence normally being determined by the severity of required pier works.

At the end of Great Yarmouth's Haven Account Book of 1549-97 is a copy of an assessment *"towards the buylding of greate Yarmouthe haven"* levied within the county (NRO Y/C28/1). Further occasional assessments followed. In the early 17th-century the town sought an assessment on adjacent lands as it was claimed that that the building of the haven had greatly improved their drainage and permitted imports and exports to be made more easily (Cal. S.P. Dom. 1621). When *"a great part of the pier was beaten down"* at Margate in 1688 the repairing thereof was estimated at £250 and the town drew up an assessment praying *"his majesty to confirm it and empower the collectors to collect it"* (Cal. S.P. Dom. 1688).

An extensive series of references to local taxation (scott/shott) specifically for funds for the pier are to be found in the Hastings Corporation Record Book. The first is of 1596 when, faced with insufficient funds for the pier, the Assembly agreed to *"a common charge of the Towne"* (ESRO C/A9A01, p 16). This charge may relate to the shott for

"xL li or upwards not exceeding L li to be ympose upon the better sorte of the Inhabitants of the towne" (ESRO C/A (a)1, p 24). An entry of 1597 regarding collection of *"the shott lately graunted"* may again relate to this particular charge (ESRO C/A a)1, p 24). In 1611, and again for the use of the pier, the Assembly *"graunted a shott of L li to be patly assessed upon all Inhabitants of this towne after their abilities"* (ESRO C/A (a)1, p 154). A slightly different tack was adopted in 1617 when the Assembly decreed that a tax on beer with *"half of the said profit of xii d upon the toonn of beere so drawen & sold for this next following yere only to the use of & towards the better maintennce & repacons of the peere"* (ESRO C/A (a)1, p 200). There is mention of a shott in aid of the pier in 1622 when any shortfall of debt repayment by the town for monies raised for pier work was to be raised by a *"genall shott"* (ESRO C/A (a)2, p 9). The final reference for a shott for the haven is in 1637 (HMC 1892, 362).

Income from property, rentals and sales

A source of income for Scarborough's harbour in the 13th-century were returns on property investments made by the community. This was highlighted by a complaint made in 1275 when the Sheriff of York had taken these incomes, as well as the fee farm, into the king's hands (Cal. Pat. Rolls 1275). The Rolls state that *"whereas they* (the inhabitants) *had built there with their own money certain houses and a mill, from which great part of the issues and of other issues from the drying of their nets in their own ground and common pasture were received by them and employed at their will in the support of the quay of their port by the assent of the whole commonality"*.

At Dover a clause within the charter of 1606 establishing a board of quasi commissioners stated that any reclaimed land resultant upon earlier harbour works should belong to the Harbour Board (Leach 2005, 28). This proved to provide a source of income for the board as houses built for rent were constructed on parts of this land.

In times of particular stress it could prove necessary for a town to sell off some of its assets. Thus at Great Yarmouth, and in the wake of an unsuccessful appeal to Lord Protector Cromwell for financial aid in 1656, the corporation sold the town's gunpowder that year for £100 (Parkin 1776, 53). The following year they sold the island of Cobham

together with the houses and lands called the 'Grey Friers'. This raised £3,130, all of which is said to have gone to support the haven and piers (Parkin 1776, 53).

The presence and role of buildings on piers has already been discussed in Section 2.8, Chapter 2. Income could be derived from surplus buildings or of space therein and there are a number of later post-medieval records of renting a store house on Broadstairs pier. (EKA UD/BS (uncat.) Box 8 1912-1923; UD/BS (uncat.) Box 7 1914-1922). There is some information regarding property 'attached' or belonging to the pier at Margate in the Act of 1787 (Act of P. 1787). This included buildings on the pier, the beach behind the pier and the right to hold a regular market on a piece of land known as pier green. Licence for this market, in the name of two pier wardens was granted in 1776 (TNA C202/164/21). Money generated from these sources was to be employed at Margate's pier.

Lottery

Incredible as it may seem, in 1567, and for the benefit of the haven, the corporation of Great Yarmouth solicited fortune's favour with a gamble on the Virginia State Lottery – and lost. A similar course was followed in 1614, again to no avail (Parkin 1776, 46, 50).

Indulgences

At Newbiggin by the Sea the Bishop of Durham sought to recruit God to the aid of its pier, granting in 1352, an indulgence for forty days to all persons within his diocese who, by will or otherwise, would contribute assistance to the repairs and maintenance of the pier (Hodgson 1832, 246). Some doubt must be cast on the engagement of the Almighty in this particular instance however, as it forms the last known reference to the pier.

Proceeds of Compositions of Delinquency

During and after the 17th-century civil wars parliament seized the estates of many of those who had fought against them. A 'Committee for Compounding for the Estates of Royalists and Delinquents' was established whereby those estates could be recovered by payment of fines provided that they pledged not to take up arms against parliament again. At Dover during the interregnum monies *"out of the compositions of delinquents"* were utilised at the harbour (Cal. S. P. Dom. 1649b).

Community labour

The most extensive records for mandatory community labour at a pier site are those for tenant labour services at Bridlington both before and after the reformation, which have already been considered. When the town's community drew up The Great Town Deed in 1636 following their purchase of the manor, clauses within the document committed the populace to continue this practice at the piers which remained in force until at least the 1690s (Purvis 1926, 86-105, 205).

Parkin records that at Great Yarmouth in 1562 it was decreed at a common assembly *"That one quarter of the towne shall be callyd owte by the constables every day to go to the haven"* (Parkin 1776, 45). At a later date Palmer states that obstruction of the mouth of the haven by a sand bar in the late 17th-century was dealt with by voluntary action *"the dangerous condition of the haven was made known by beat of drum, and the voluntary coming in of the inhabitants was desired, to cut and dig a gut or trench through the bar"* (Palmer 1854, 290).

At Hartlepool a statute of the town's corporation for the year 1599 stated *"that whatsoever inhabytante of this town fyndethe nott a suffyceyent able man in his or theire watche, or to the peare, when and as often as they shall be commanded thereunto by the constables, or peare masters, shall pay for every time soe doeinge xiid."* (Sharp 1856, 157). Fines for non attendance for community labour were also laid at Hastings. The first reference to this being in 1596 when it was recorded that *"yt is also agreed for the better stewarding of the woork at the Pere that all men by wards when they shalbe thereunto called & commanded shall make ?put repair to the said peere to doe as they shalbe appointed according to anncyent use in the like"* and that all *"upon such calling shall faile to come accordingly shall forfeit to the use and benefit of the said pere vi d for evry tyme"* (ESRO C/A(a) 1, p 15). There is further reference to the organisation of labour at the pier in the following year by *"the wholl towne by wards & companys as hath byn accustomed"* (ESRO C/A(a)1, p 34). The latest record for community labour at Hastings was in 1611 when it was ordered *"that inhabitants refusing to labour at the pier are to forfeit 12 d"* (HMC 1892, 360).

Reference at Folkestone to two named individuals who *"had with others assisted to take up the timber of the old pier or head"* may relate to community labour (Cal. S.P. Dom.

1629b). Amongst Jenkins' transcriptions of the town's records there is an entry of 1635 that required every householder to provide free labour:

"towards cleaning and expulsing of the beach from the haven or harbour, from henceforth upon the call or beat of the drum, or any sufficient warning, all and every householder within the said town and liberty, either by themselves, or by some other fit and able person, shall repair to the said harbour, furnished with shovels or other fitting and meet tools or instruments, for the cleansing, scouring, and expulsing of the said beach out of the said haven, and to bestow their best endeavours, labours and pains to that end, and to abide and continue their said labour, as the Mayor or his deputy shall conceive to be fitting and meet" (Jenkins 1876, lxxxiii).

Failure to perform this task resulted in a fine of 6d. A further order for community labour at the decayed pier was issued in 1699 (EKA AM1/2 1699). In this latter case we are informed that, by order of civic seniority, members of the community were to act as supervisors of the works.

Another late dated example of community labour was at Dover in 1676 when, to the sound of a drum, the townspeople turned out to clear the harbour mouth of shingle (Leach 2005, 28).

4.4 Summary

This chapter demonstrates that throughout the centuries of their existence seacoast piers were viewed by the institutions and communities who constructed and bore responsibility for them as assets fundamental to the economic well being of their related settlements and inhabitants. It is in this context particularly that the variety and inventiveness of the non-recurring extra-ordinary forms of income can be best understood. The currency of timber-built piers spans the medieval to modern worlds and the observed changes in their forms of ownership, control and funding do reflect, and inform us, of the major transformations occurring throughout wider society.

Thus across parts of the north we witness the emergence of piers within medieval manors and estates, both lay and ecclesiastic, and upon which the longer term impacts of impending reformation would fall heavily, eventually leading to some losses. Yet in these

same parts the new world created by the reformation also came to afford opportunities to some. Across much of the rest of the study area piers would originate and develop along different lines, principally within municipal ownership. Once out of crown protection this would become a model to which the former estate piers would either adopt, or simply not survive.

Few, if any, of the east coast timber-built piers could have survived without the occasional successful appeal for external assistance, most commonly from the crown and county.

As we move into the post-medieval period we can detect a new preparedness on the part of the state for intervention, much of this, but not all, of a legislative nature. Coastal pier sites came to be recognised as important facilitators of a developing economy and key to the defence of the realm. One strand of state intervention became the establishment of bodies of commissioners with secure recourse to income. As we shall see, this would ultimately prove to be one of the significant factors in the demise of timber-built piers.

Chapter 5: The demise of timber-built piers

5.1 Balanced technological, environmental and social connections?

The foregoing Chapters 2, 3 and 4 have presented the technological, environmental and social contexts of timber-built seacoast piers. Whilst these have been considered separately for ease of explanation and comprehension it is of fundamental importance to stress that there was an elemental interplay between each of these aspects. Such piers originated and developed as a direct consequence of the relationships between technology, environment and people/social organisation. These three aspects were all subject to variation and change, never being entirely identical, but operating within broad parameters. As such we have seen differences and developments within the technologies, considerable variation in environmental circumstances and a number of different social settings in which the piers could be established and operated. We have also seen how significant alteration to any of these three aspects could lead to difficulties, and how often, but not always, these could be overcome. For example, worsening environmental circumstances as a result of pier building could often be ameliorated by breakwaters, groynes, digging out, pier re-configuration, etc. Similarly, impacts within the social realm could often be resolved by appeals to the wider community or even state intervention. Again, the technology of timber piers seems likely to have adapted to altering circumstances. Thus the shift in design from walls of close-piling to those of earth-fast frame to lessen the volume of necessary timber. For the seven centuries of their currency then, timber-built seacoast piers operated within the balanced networks of connection of the technological, environmental and social spheres. It is within this framework that Chapter 5 will argue that gross imbalance came to be introduced and that over a protracted period of time timber pier construction ceased to be viable and came to an end.

We have established that since at least the mid 13th-century timber-built seacoast piers had been constructed along the east coast of England. These remained the normal form of pier construction throughout the medieval and earlier post-medieval periods, only being progressively replaced by stone and other materials from the later 16th – mid 20th centuries. As will be seen, the demise of these piers was multi-causal and owed to a number of technical factors and particularly to administrative and legal reorganisations

that transformed their economic circumstances. In examining the causes for the demise of timber-built piers it is worthwhile firstly to briefly consider why it was that timber was originally used.

5.2 The case for timber: for and against

For much of the medieval and post-medieval periods the construction of a wide spectrum of land-based and marine structures was most commonly in timber. This included most housing, many bridges, a significant proportion of large municipal and institutional buildings and even many town walls. The restriction of the use of stone primarily to churches, castles and various high status structures was, to a considerable extent, rooted in the economic realm. The extraction and working of suitable stone was costly and its use made further prohibitive by the expense of transportation, particularly in areas devoid of good stone.

Although no comparative timber and stone costings for a pier are known, such information for bridges has been examined by David Harrison. Whilst much was dependent upon specific circumstances, in broad terms it appears that bridges of timber were generally in the region of one-third to one-half the cost of those in stone. Some individual estimates suggest that the cost in stone could even be up to five, or more times, as much (Harrison 2004, 171-83)

As late as the mid 18th-century the use of timber instead of stone in the new harbour at Ramsgate was proposed, partly on the grounds of *"the saving expence"* (Trustees 1755, 8). In the case of timber-built piers economic cost is a factor that should not be underestimated. As we have seen in Chapter 4, until the later 17th – 18th centuries most piers were under the control of communities with limited resources. These communities frequently struggled to maintain their piers in reasonable order and were obliged time and again to make appeals for external support. Only at later dates, and generally in the context of commissioner ownership, did greater levels of funding generally become available. There is then, a compelling argument to be presented that economic factors played a significant role in the choice of timber as the building material for the piers of the east coast. Again as we have seen in Chapter 4, those piers under estate or manorial

control may have found it advantageous to build piers in timber, they being able to draw on supplies from their own woodlands and on workforces through owed labour services.

In some regards the use of stone to build piers provides a more complex picture than the use of stone on land. Suitable stone for piers needs to be both very large and resistant to rapid erosion. As such, stone of the proportions commonly used in buildings and walls was far too small whilst many stone types, including most limestone's, were too soft. This was emphatically highlighted at Bridlington in 1537 when an inspection was made of the *"key"* with *"the best mason and carpenter that be in these parts"* and also of *"such stone and timber of the monastery* (recently dissolved) *there as was thought should be meet and convenient for the amending of the said key and haven"* (L. & P. Henry VIII 1537a). However, it was declared that the *"stones were too small to withstand and abide the surges and tempests of the sea"*. It was considered that even if the *"stones were laid and couched with rossell and pitch and also bound together with iron and lead"... "the stone be so little and soft that every high tide will burst them up and tear them asunder"*. In light of these opinions it was advised that the pier *"should be made with timber and stone together as before"*.

Whilst the right size and hardness of stone was imperative it need not, depending upon the method of stone pier construction, necessarily be dressed or even roughly hewn into regular shape. The flotation and dropping method detailed at Scarborough in 1565 and 1800, and described below, was such a system. However, this system may also have been very costly and have required rare knowledge and skill. In contrast to this, piers could readily be built of timber using the established traditional practices of carpentry. The necessary skill sets were available in abundance and although timber of the large scantling required was clearly of some value it always appears to have been obtainable, even if from afar. Timber then, was both cheaper and easier to obtain than the requisite stone, whilst its correct working, within a marine environment was also understood. There was also a geological distribution dimension regarding suitable stone. Large swathes of the eastern seaboard lack such suitable stone and it is noteworthy that the early attempts at building stone piers within this coastal region occurred where this stone was most readily available. As such we see early use of such stone from local or close sources at Dover and Scarborough in the 16th-century and at Whitby in the 17th-century. In similar vein much of south-west England possesses stone suitable for pier building and mid 16th-century cartographic sources do indeed indicate stone-built piers in this area (British Library 3).

We may reasonably conclude therefore that along the eastern seaboard the economic, social, geological, technological and knowledge base conditions all favoured the use of timber over that of other materials. One may equally posit that it was changes in these baseline conditions that would usher the decline and ultimate demise of the timber-built piers.

Whilst building seacoast piers in timber was in many regards economically and technically easier than in stone its use did have significant drawbacks. The foregoing chapters and particularly the individual case study notes in the Appendix provide numerous documentary sources that paint a picture of frequent damage to timber piers and a requirement for heavy repair and maintenance. Some reflection of the heavy maintenance requirement of timber piers may again be found in the case of timber bridges. Harrison indicates that timber bridges required constant attention and cites a mid 18th-century source which estimated the cost of repairing a well made timber bridge over a period of fifty years as being equal to its being rebuilt twice over (Harrison 2004, 180). The impression of these timber-built piers is often that in a technical sense they worked – but only just so, whilst their construction and maintenance was an enormous burden to coastal communities. Nonetheless, these factors themselves underscore one of the basic tenets of this thesis, namely, of how important seacoast piers were to these coastal communities, these forming the lynch-pins that held together their economic activities.

The use of timber piers also had another significant drawback, namely the limited depth of water in which these could be built, with such limit being determined by the maximum length of individual piles. For any given pier the piles need to be of a length that takes into account, and be the sum of, the tidal range, the depth of water required at low water (unless intended to be dry at low water), the amount of pier freeboard required at high water and the amount of pile required to be sunk into the seabed (normally around a 1/3rd of entire pile length). At Southwold, with a very small tidal range of around 2m, the length of piles in the early 20th-century was 36 feet (10.97m) whilst at Great Yarmouth, again with a small tidal range of around 3m, in 1580 piles up to 40 feet in length (12.19m) were required (SRO 1312/6/8; Swinden 1772). A number of pier sites in the study area have tidal ranges in excess of 6m and any attempt to create a harbour accessible at low water would have required piles with a length of around 15m. The historically attested increase in the draught of vessels and the need to berth these will only have exacerbated this issue over time. Timber is of course only available in finite lengths and it would seem

that there comes a point when obtainable lengths are no longer sufficient for the creation of deep water harbours. It was probably within this context that we find explanation of the abandonment of one timber arm of the new harbour constructed at Ramsgate in the mid 18th-century. Here the east pier was built of stone whilst the west pier was intended to be of timber. However, the constructors of the timber pier were unable to advance from some point around the low water mark, the remaining seaward part in deep water being constructed in stone; the whole being unsympathetically described as a *"ridiculous medley of timber and stone"* (Trustees 1755, 22).

The only recourse in overcoming this dilemma of timber and deep water was the use of stone foundations. This appears to have been very expensive and the only encountered evidence for the use of such was at 16th-century Dover. Its occurrence here is perhaps explained by the uniqueness of the enormous funds made available by the state.

There is also evidence that clearly indicates a technical mistrust of the use of stone, at least in some quarters between the 16th and 18th centuries. This viewpoint was borne of failed experiment and perhaps also a conservatism brought about by the observation that timber did at least work – a wariness of the new-fangled?

The exemplar of failed experiment with stone is provided by the case of Hastings where an insertion of 1597 in the first Corporation Record Book tells a unique story. This insertion is presented in full:

"Memorand that about the .2. of march 1595 The peere of hastings was begonne to be reedified by certen westerne men sent for of purpose from the Cobb of Lyme. And by them was built a huge woorke wthout thold pere full south al of huge rocks artificially pyled edglong one close by another of a great hight but wthout any Tymber yet to mens iudgemt unremoveable it grew to so huge a pile But not wthstanding the first winter flow overthrew it in a moment and dispersed the huge rocks lyke thin plancks And so that cost was lost But the next yere after other woorkmen of better knowledge as was thought were called thence and by consent the lyke peice of woorke was begun to be againe built wth the like huge rocks And for more surety by advise of the Mr (master) *workman it was thought best (because they iudged the decay of the formr was for want of some tymber) to lay the foundacon of thys new woorke wthin the tymber woorke of theold peere and so to continue wth tymber braces and barres crosse dog & such like to the top. And this woork was wth singular industry and arte brought above the full and by all ? hall outyde? 1597*

well nere finished vis xxx foote high & C foote long at least, bewtyfull to beholde huge invincible and unremoveable in the iudgmt of all the beholders Amounting to a great charge, wherunto the whole shire & divs beholders were contributaryes of benevolence beside the Townes great expences But behold when men were most secure and thought the woorke to be ppetuall, on all Sts daie 1597 appeared the mighty force of god, who wth the finger of his hand at one great & exceding high spring tyde wth a southeast wynd overthrew this huge woorke in lesse than an hower to the great terro & abashmt of all beholders, to the great discredit of the like woorke hereafter wth the contry & to the manifest undoing of the Towne wch by reason therof was left greatly indetted By theis psesidents let the posterity (for whoeme I recoed this) beware they never attempt to build them a pere wth rocks only wthout a myghty frame of Tymber to be seled & then balasted wth rocks Alwayes remembring that about such woorke Tymber must not be spared" (ESRO C/A(a) 1, both sides p 12)

This document describes a failed experiment with a stone pier adjacent to an existing timber one. A second stone pier built within the timberwork of the original timber pier, and which employed at least some further timber, also failed. The writer's heartfelt sentiments about how a pier should be built i.e. with a sealed frame of timber and ballasted with stone were clearly founded on the town's bitter, and very costly, experiences with stone.

A further example of conservatism in pier building can be found over 150 years later at Ramsgate where a new harbour of refuge was being built *"One of the Trustees, who has the Care of a neighbouring Pier which is constructed with Timber, insisted upon building the Piers at Ramsgate with the same Materials, offering to conduct the Work himself. The Reasons alledged were the saving Expence, and that no stone-Work could be made to resist the Force of the Sea"* (Trustees 1755, 8). As it turned out, in this case it was the timber element of this pier that proved the weakness and it was replaced by stone a few years later (Oulton 1820, 92). Nonetheless, the opinions of our informants from Hastings and Ramsgate do undisputedly reflect one strand of the contemporary attitudes towards the use of timber versus stone in the building of seacoast piers.

It would come to be proved that stone could successfully be made to build coastal piers, and more durably so than timber. However, the classic 18th and 19th-century stone-built piers constructed of large durable blocks, with substantial foundations, protected at its toe

with a neat apron of rock armour and sometimes with a curve profiled outer wall to deflect the sea, did not emerge fully fledged. Rather, the emergence of this form was a result of the failure, and partial success, of earlier efforts in stone, some of which utilised timber in their construction.

5.3 Early forms of stone piers

The first example of a stone-built pier in the study area for which we have a detailed technical description, and pre-dating the attempts at Hastings detailed above, was at Berwick upon Tweed in 1577 (Cal. Bord. Pap. 1577). Not totally finished at the date of description this work was intended to be slightly over 140m in length.

"This worke is facyoned lyke unto a brode wall. Both the sydes thereof are sett and faced with broched stones, hewen in the joyntes and beddes only, and not on the perlym^{t}*, close cowched and well backed, and herein we trust that by there rowghnes, good backe, and fast byndynge, they shall lye more surely then other stones layd in lome or hadder, or yet stones of huge weight, beynge like cobles and bounde with pynnes, whose mocion, by there owne weight, shall easilye brust there pynnes, and stirre there neighbours with shake and overthrowe of their whole worke, withowt contynuall repayre. It is filled with weighty stones, roughe burres and peable, sett home, and backynge the sayd broched stones layd in the face of the worke, and byndynge fast togyther the whole masse and fillynge. On ether side within the fillynge, arise postes of tymber surely fastened, and evenly sett, distant viij foote, one from an other, and in places nedefull, they stand more neare. Betwixt the sayd postes, and overthwart the worke, the fyllynge is arched and bounde with mighty stones fast pynned togyther, to bynde fast the same postes, and tye the whole fillynge togyther to the toppe. On the toppe there is layd a wall plate of tymbre lyinge alonge the sydes of the worke, and on the hight of the broched stones. Wherin is cowpled a longe beame, layd overthwart the worke and toppe, which beame is sounke in, and, fastened to the sayd postes and wall plates, to bynde and holde the whole masse togyther, as no parte is lyke hastilye to faile, withowt the overthrowe of the mayne and whole bodye hereof. The toppe is armed and covered with broched flagges, closely arched and sett in stronge claye, well rammed and layd under the flagges, to save the fillynge*

from the flashe and fall of the billowe and water, that in stormes will bownce over the worke.

In measure at the foundacion nighe the banke, it is in bredthe xxij foote, and on the toppe xviij foote, and increasynge like a taper, it is brought to xxx^{tie} foote brode in the bottome, and xxij foote on the toppe, at which pitche it shall stand untill it be caryed on vj roodes beyond the bowght or elbowe, whereupon the greatest force of the sea will beat. It is advanced iiij foote above the full sea marke at sprynge tyde.

By the strengthe of this worke, appearynge in partes fynished, and the good effectes hitherto shewed, it is hoped that it shall well and longe stande, withowt chardgeable repayre, and sufficiently performe the purposes intended. The successe whereof I commend to better proofe."

This document describes a pier with angled sides and of tapered plan-form. The outer walls were built of rough stone with tight joints, it had an internal fill of stone and pebble and was capped off with a flagged walkway. Within the internal fill however, was a wooden frame. This was comprised of posts along both sides and mostly spaced 8 feet apart and on top of which ran a wall plate. Beams, more properly tie-beams, extended laterally from post to post tying the posts and wall-plates together. Jointing together of the posts, wall-plate and tie-beams is precisely what occurs in a timber-framed building and it is probable that these points of junction were identical, or very similar, to lap dovetail joints. Like the pier at Hastings of 1597, in some ways this remarkable construction can be viewed as something of a halfway house, being built with both stone and timber and, theoretically at least, dependent upon both materials in combination for its strength. Alas the hopes for this being a relatively maintenance free pier were not to be realised as large sums of money were spent on its repair throughout the remaining years of the 16th-century, with 9 bays being described as broken in 1591 (Cal. Bord. Pap. 1. 164, 733, 897).

A pier built at Whitby in the 1630s shared some of the characteristics recorded at Berwick. This was essentially a stone pier with timber bracing and aspects of its construction were described by the son of its constructor, Sir Hugh Cholmley, thus:

"and in building this pier, was experienced several inventions to make it secure; for, being exposed to a violent sea, which beat upon the side all the length, for about two

hundred yards, it could not stand after the common way of building, merely with loose rocks, heaped the one upon the other; nor yet, when the same was repaired, and strongly bound with great pieces of wood, let into the foundation, and cross bound with others, let into the stone, and bolted with iron, so that the whole seemed one entire work" (Cholmley 1787, 48).

An alternative method of building a stone pier, entirely without timber, was the floatation and dropping method, referred to in 1565 and described by Cholmley and Chapman (Cal. S. P. Dom. 1565, transcribed in Rowntree 1931, 204-7; Cholmley 1787, 48; Chapman 1800, 17). This method, essentially creating mole-like structures out of loose stone, was almost certainly responsible for the piers at Scarborough depicted in the later 16th-century plan, Figure 92. In this system chains attached to tons/tuns (large barrel-like floats), were slung around large stones on the shoreline at low tide, the whole being fastened with release devices. On the incoming tide the floats were towed by boat to the site of the pier works and dropped. If required, such dropped stones could then be manoeuvred to their correct place by the use of engines. Variations on this method included the use of floats (barges) that could lift stones onboard, and even suspend exceptionally heavy stones over their sides, the floats then dropping their load on the ongoing works. Writing in the later 18th-century Cholmley stated that this system was particularly common in western England, though its origins almost certainly lie at Dover in the earlier 16th-century Henrician works. Here, a similar system was used to create foundations for the timber piers and its inventor, a local fisherman who was rewarded for his ingenuity by the king with a pension of 4d a day for life (Lyon 1813, 155-6) (See Chapter 2, 2.4.6; also Dover case study 17 in Appendix,). By 1584 the men engaged in building and maintaining the new pier at Scarborough were considered the experts in this technology and came, ironically enough, to be employed in the Elizabethan harbour works at Dover (Cal. S. P., 1584b; S.P. online 3).

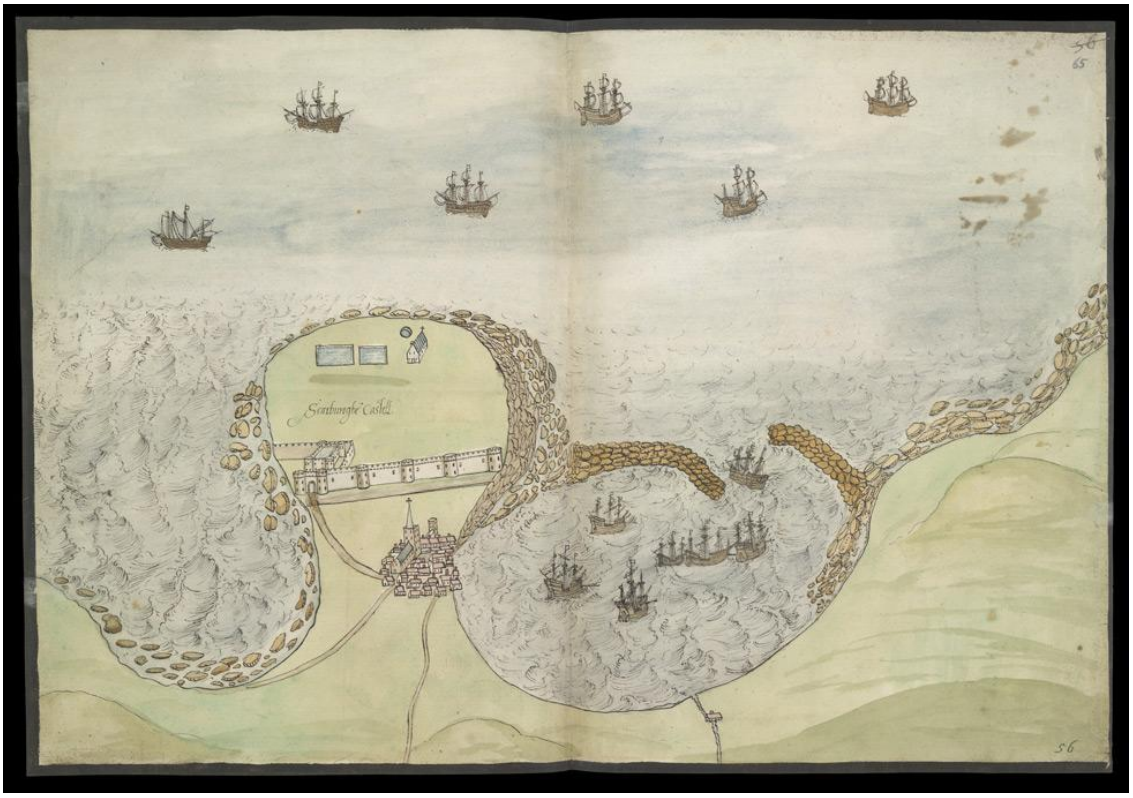


Figure 92, Plan of Scarborough, 1595, showing entirely stone-built piers constructed of loose stone by the floatation and dropping method. (British Library, Royal MS. 18. D.III f.65)

A more belt and braces approach to the replacement of timber by stone was the encasement or cladding of a timber pier, or part thereof, with stone. It is appropriate to draw a distinction between encasement and cladding. Instances of encasement can be regarded as ones where a stone pier completely encapsulated a timber predecessor, the older element coming to form but a small part of the interior core of the new. By contrast, cladding formed merely an additional stone skin to what essentially remained a timber structure. There is evidence for encasement at Scarborough and Broadstairs and for cladding at Margate and Bridlington.

The earliest evidence for encasement of a timber pier is in the petition of 1565 for building an all stone pier at Scarborough in replacement of its timber-shell pier (Cal. S. P. Dom. 1565, transcribed in Rowntree 1931, 204-7). The replacement pier was constructed of loose stone with the floatation and dropping method described above. However, parts of the old timber-built pier seem likely to have survived this programme of works by

being encased as the petition stated that "*In such place of the peere as yet stondethe maye stand still and have on both sides stones layde thereonto of slope which will cause it stand still"*. Given the stone-building technique employed at Scarborough this instance can be regarded as encasement rather than cladding.

At Broadstairs costings for encasing the entire pier with stone were drawn up in 1808 (Petition 1808) whilst forty years later it was proposed to case the pier with *"flint and cement"* (EKA UD/BS (uncat.) Box 2 1843-1853). On neither occasion did these plans reach fruition, though the pier was finally encased, predominantly in concrete, in the late 19th – early 20th-century. Some evidence for this was presented in Chapter 2, (Section 2.4.5) where it was shown that a significant and progressive widening of the pier, particularly on its seaward, side took place between the 1890s and 1930s, though its original seaward side was still cartographically demarcated by a line. Site inspection shows that this line is now a narrow, slightly angle set, concrete wall that perpetuates the alignment of the parapet wall of the old timber-built pier. It has also been seen that the extant 'boathouse' building on the pier was constructed when the pier was entirely of timber and that the cartographic evidence indicates that this structure is in the same place as it was in the mid 19th-century. Taken together, this evidence strongly suggests that the timber-built pier has been encased.

At Margate an Act of Parliament of 1787, which revised the financial system of maintenance of the pier, provided the legal authority for taking down the old wooden pier, this was to be *"entirely taken down, and a new stone head built in its room"* (Act of Parliament 1787). However, writing shortly after this date the historian Edward Hasted noted that instead *"the old wooden pier has begun to be cased* (clad) *on both sides with stone, and extended, and the whole is now completely finished"* (Hasted vol. 10, 1800). This observation was also recorded by another contemporary writer (Nichols 1793, 26). The stone clad timber pier proved to be a short-lived arrangement, it largely being destroyed by a storm in 1808, Figure 93, and the existing all stone pier was built shortly thereafter (English Heritage 2007, 70).

Figure 93, The stone clad pier at Margate destroyed by storm in 1808 (British Library, Ktop XVII 4-f-2)

At Bridlington, between 1802 – 1808, the outer side of the north pier is known to have been clad in stone some 7 feet (2.13m) thick and for a length of 240 feet (73.15m). The southern end of the same pier was extended exclusively in stone prior to this in 1792 (Goodrick 1814, 6). The engineer Simon Goodrick found that the cladding was actually exacerbating problems with the pier. He noted that the lower part of the stonework was bulging and slipping outwards and that this was causing cracks and derangement and disjunction of the courses above. In this condition incoming waves were able to force entry to the interior of the structure through voids and create large internal cavities whilst with the retreat of waves the water gushed out through lower voids with great force thereby weakening the foundation (Goodrick 1814, 6-8). Although Goodrick attributed many of these failings to poor technique one wonders if, when laid together, the varied structural properties of a mortar bonded stone wall and an old decaying timber structure was a combination destined to fail. As it turned out this was to prove a temporary expedient, the entire pier system was progressively replaced in stone and on a larger scale, being entirely finished in the 1840s.

On the basis of just two examples of encasement and two of cladding some caution should be exercised in the drawing of conclusions on the rates and nature of success and failure of these techniques. However, the whole-scale encapsulation resultant on encasement can in many regards be seen as representing replacement rather than strengthening and appears to have provided satisfactory and long lasting results. Contra-wise, cladding can be viewed as an attempt to strengthen, and not replace, an existing structure and in both known cases did not prove to be particularly successful. Cladding was a product of the late 18th – mid 19th centuries, a date by which durable, well engineered all stone-built piers were already present on the eastern seaboard. The intention of stone cladding appears to have been to reap the benefits of a stone-built pier but without the expense of de novo all stone construction.

The earlier parts of this chapter have examined and described why timber was originally used and how stone came to replace timber in terms of building techniques. We must now consider why it was increasingly possible, in terms of economics, social organisation and changing land-based technologies, to construct in stone instead of timber.

5.4 New administrative and technical contexts enabling change

We have explored the variety of ownership forms of timber-built piers in Chapter 4 and how most of those examples that survived into the 17th and 18th centuries were under the control of, and received their funding from, the local communities who built and used them. We have also seen that from the 18th-century the powers of ownership, control and funding were increasing removed from communities and transferred to unelected bodies of commissioners. This control shift was predominantly by agreement and formalised by Acts of Parliament.

One constantly recurring strand within Chapter 2 was the struggle many communities underwent in order to build and maintain their costly piers. The powers of pier wardens/reeves were frequently limited, sometimes doubted, and they seldom had recourse to large sums of money or materials. Despite the resourcefulness often displayed by communities in raising funds few piers, if any, could have survived without the occasional successful appeal for external financial and material assistance. Whilst the loss of grassroots democratic control may be lamented the placing of the piers in the hands of

nominated commissioners, in which one can see the guiding hand of the state, was not without benefits. The Acts of Parliament establishing bodies of commissioners armed them with strong, indisputable legal powers which the elected wardens/reeves had not enjoyed. Their sources of income were greater, more secure, and they were permitted to borrow large sums of money against the surety of this income.

These increased powers enabled investment in large pier projects that were previously not possible – they could build big, costly, and with recourse to durable materials; namely stone. This shift to control by commissioners, and to a large extent replacement of timber by stone, coincides with the main thrust of the Industrial Revolution and was accompanied by increased levels of export and import trade, investment in infrastructure generally, state intervention; and seemingly even a preparedness of communities to yield up democratic rights for enhanced prosperity. Some parallel in contemporary infrastructure to the case of piers may be found in the burgeoning number of new canal systems and in particular Turnpike Trusts, which were again essentially not-for-profit enterprises established to maintain and improve the road system. Pope and Swann consider there to be a very clear connection between the expansion of port facilities and economic development and indicate that programmes of substantive port improvements begin in earnest in the late years of the 17th-century and progressively increase thereafter (Pope and Swann 1960, 33). Such is the scale of infrastructure construction and improvement that these writers term it a *"minor transport revolution"* (Pope and Swann 1960, 36).

Prior to the setting up of bodies of pier commissioners any external funding was channelled through the communities themselves, or occasionally via appointees. Such local, small-scale and internal systems have been seen in a number of case studies, at some point or other, to have been subject to 'occasional financial irregularities'. Whilst critical comments were made about certain bodies of commissioners, typically about favouring some interests over others, no obvious cases of corruption or theft have been encountered. This may be because the Acts were specific about required avoidance of conflicts of interest for commissioners. Perhaps even the income requirement for a post of commissioner insulated them against the need to engage in low-level misappropriation of funds?

The Industrial Revolution was a time of rapid expansions, including for example, population, production of goods, trade, road systems and canals. Whilst the prime movers for the revolution can be held to relate to organisational changes within society, it was the expansion of the extractive industries, such as coal, stone and various minerals, that provided the fuel and raw materials for this development. This included the supply of stone to meet the increased demands for a wide variety of purposes, from building stone, to road stone to grindstones. Largely as a result of this the number and size of stone quarries increased. Whilst there is apparently little to differentiate methods of quarrying between the medieval and earlier post-medieval periods the industrial revolution did usher significant developments relating to enhanced efficiency of production. An important development was the introduction of the plug and feather arrangement (metal pins between two metal plates) inserted into pre-drilled holes and used to split rock (MPP 1996, 19). This system replaced the use of wood and metal wedges and may even originate as early as the 17th-century (MPP 1996, 19). The greatest technological changes in the industry occurred from the early 19th-century onwards with the increasing adoption, and refinement, of explosives and the mechanisation of various processes. This included the use of water and steam power, powered drills and saws and enhanced intra-quarry infrastructure (MPP 1996, 17-21).

The expansion and increased sophistication of parts of the quarrying industry seems to have led to the situation in which large blocks of stone suitable for building piers became more readily available whilst improvements to overland infrastructure, both roads and canals, lessened the costs of its transportation. When we ally these circumstances to the shortcomings of timber in the building of piers and to the new administrative system of bodies of pier commissioners flush with access to money then the replacement of timber with stone was perhaps just a matter of time.

The replacement of timber-built piers by piers of stone is summarised on an individual site basis in Table 4 below.

Site	Demise/replacement	In other materials	Comments
Newbiggin b t Sea	Mid-late 14th century		Not replaced
Hartlepool	17th century	●	Replaced by stone pier
Whitby	Late 17th century?	●	Replaced by stone pier
Scarborough	Later 16th century	●	Replaced by successive stone piers
Filey	Mid 17th century		Not replaced
Flamborough	Early 17th century		Not replaced
Bridlington	Early 19th century	●	Replaced by stone piers
Hornsea	Late 16th century		Not replaced
Sheringham	Early 17th century		Replaced by multiple groynes
Cromer	Mid 16th century (early pier)		Early pier replaced by multiple groynes, later pier seemingly so
Great Yarmouth	Progressively 19th – mid 20th century	●	Replaced in steel and concrete
Southwold	Mid 20th century	●	Replaced in steel and concrete
Margate	Late 18th – Early 19th century	●	Late 18th century clad in stone, destroyed 1808, then rebuilt in stone
Broadstairs	Late 19th – Early 20th centuries	●	Largely encased in concrete
Ramsgate	Mid 18th century	●	Replaced by stone and timber piers (later all stone)
Dover	Later 19th century	●	Replaced by stone
Folkestone	Early 19th century	●	Replaced by stone
Rye	Late 18th century		Not replaced
Hastings	Mid 17th century	●	19th-century concrete groyne-like pier to protect stade

Table 4, Demise of timber-built piers and their replacement in stone/other materials

Chapter 6:

Timber–built seacoast piers: a European context

Previous chapters of this thesis have been concerned with exploring a number of base-line aspects relating to timber-built seacoast piers along the eastern seaboard of England. During the course of research evidence has also come to light for similar structures elsewhere in England, within the wider British Isles and along parts of the northern coasts of the European mainland. The nature of the evidence thus far encountered is almost exclusively pictorial and cartographic and has been assembled from a number of books, online galleries of museums, libraries and art collections, both British and continental. With the exception of brief reference at Trevaunance Cove, Cornwall, no publications or studies relating specifically to timber-built piers were encountered during a rapid literature search.

This short chapter is intended to provide little more than brief proof of the existence of timber-built piers elsewhere. Although some evidence is presented for their distribution, form, date, ownership, control and funding such data has yet to be systematically collected. The evidence is firstly presented from south and south-western England, then in Scotland and Ireland. The continental evidence is thereafter presented under national headings relating to modern, not historical, political boundaries. All sites are numbered in brackets and can be corresponded to the distribution map, Figure 118. Finally, the contextual framework in which future wider study, of what is clearly a broader European phenomenon, may fruitfully take place is briefly outlined.

6.1 Known examples

South and south-western England

Along the south and south-western coasts of England historic timber-built piers are known to have been present at Littlehampton (1), Bridport (2), Lyme Regis (3) and Trevaunance Cove (4), whilst another, at Ottermouth Haven (5), is known to have been

proposed around 1540. Several other timber-pier sites are suspected but have yet to be confirmed. Those at Lyme Regis and Ottermouth Haven are both shown on a map drawn c. 1540 that once formed part of a large collection of maps belonging to the Elizabethan statesman William Cecil, Figure 94. The pier at Lyme is depicted as an unusual 'L' shaped arrangement whilst the haven at Ottermouth is of twin pier form. The piers at both sites appear to have walls constructed of vertically driven timbers. The technical details, including the internal stone infill, at Lyme can be better comprehended in a picture map of 1539, Figure 95. It is thought that Lyme's pier, which was under the control of the local community, may have originated in the 12th-century, whilst a manuscript of 1313 details a structure of a timber outer casing with an internal fill of large stones (Wilson et. al. 2007). The extant stone pier at Lyme is commonly, but erroneously, held to be medieval, there probably being little, if any, in-situ fabric earlier than the 18th-century.

Figure 94, Map of c. 1540 showing the timber-built pier at Lyme Regis (right) and the proposed piers at Ottermouth Haven (left) (British Library: Royal MS. 18. D.111 f.10)

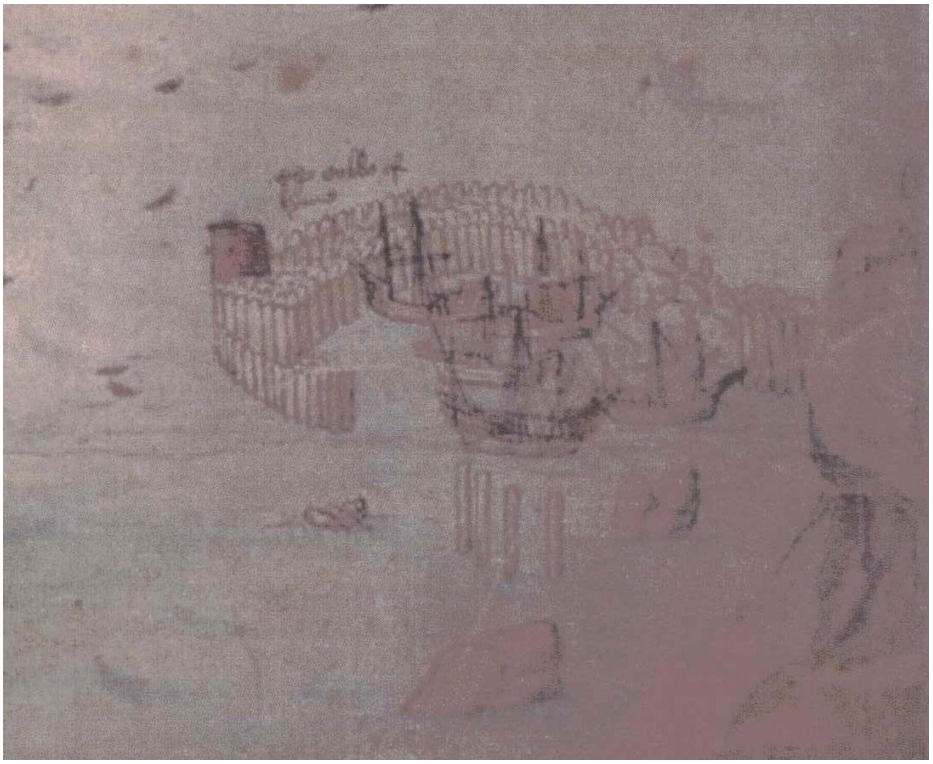


Figure 95, Map of c. 1539 showing the timber-built pier at Lyme Regis (British Library: Cotton Augustus l.i. f.31)

The timber-built pier at Trevaunance Cove was a private venture initiated by a member of the local gentry and built around 1699. It is described as having walls made of huge baulks of timber cramped together with great iron bars and driven deep into the sand, the whole suitably braced and internally filled with stones, lias and terrass (Redfearn 1984, 5).

The piers at Bridport and Littlehampton were both twin pier arrangements through which river channels flowed, Figures 97 and 97. Both pier systems are believed to have been built in the 18th-century. That at Bridport was seemingly constructed by the 1740s, though possibly within the 17th-century if not before (Symonds 1912, 184-7). Sluices are also recorded at Bridport, presumably to ensure scour within the harbour and limit the nuisance of a bar near the harbour mouth (Symonds 1912; Hannah 1986, 29). At Littlehampton an earlier 19th-century depiction shows the pier to be constructed of slightly angled, close set piling with horizontal rails part way down the wall.

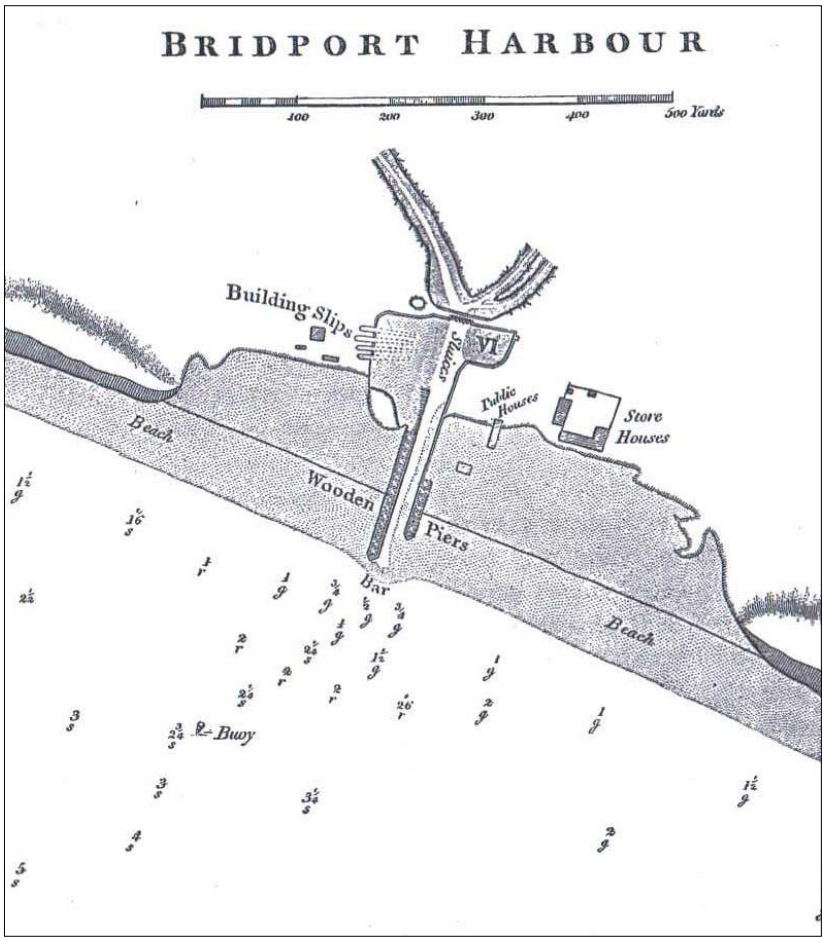


Figure 96, Plan of the piers at Bridport 1787 (from Symonds 1912)

Figure 97, Piers at Littlehampton, 1823. Constructed of slightly angled close set piling with horizontal rails part way down the wall (National Maritime Museum: PU1052)

Scotland

A timber-built pier on the eastern side of the river known as the 'Water of Leith' seems to have been present at the town Leith (6) from the mid 16th-century (RCAHMS). The eastern pier at Leith was still of timber in the early 18th-century. There is reference, in a navigation guide of 1703, to the former presence of a *'Peir of Timber'* at Fisherraw (7) to the west side of Musselburgh on the Firth of Forth (Adair 1703, 7).

Ireland

An especially fine illustration of a timber pier is shown at Carrickfergus (8) in a picture map dating to around 1560, Figure 98. The pier is depicted with walls of vertical close piles and an internal ballast of stone. The walls are laterally braced by tie-beams let

through the walls and secured by a locking rail arrangement that extends fully along the pier sides. The proximity of the pier to a castle and other buildings of the crown indicates that this was almost certainly a state sponsored venture of the English. Interestingly, a map of 1612 shows a proposed new pier system at Carrickfergus, to be built essentially of stone but with some timber bracing (British Library: Cotton Augustus l.ii. f.41). This later system again appears to find parallels with early stone piers of roughly contemporary date in eastern England (see Chapter 5). It is probable that there were other timber-built piers in Ireland that have not been identified.

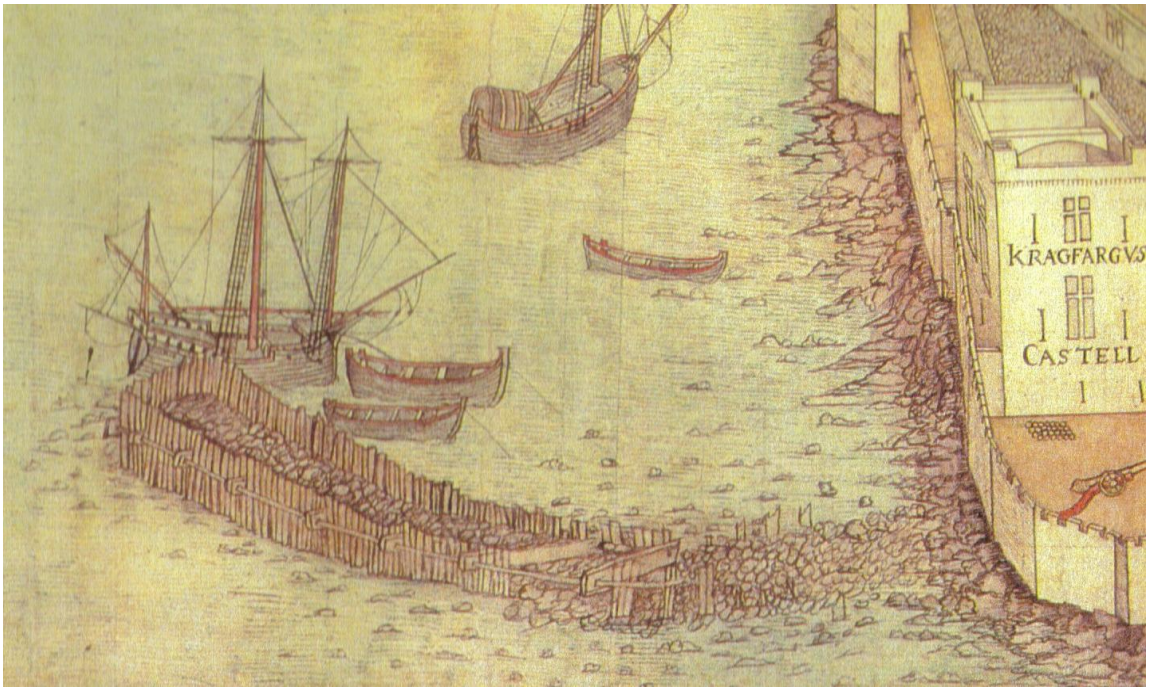


Figure 98, Pier at Carrickfergus 1560s. Constructed with walls of vertically set close piling, an internal stone ballast with lateral stability provided by tie-beams externally secured by locking bars. (British Library: Cotton Augustus l.ii. f.42)

North-eastern France

There is a wealth of pictorial and cartographic evidence confirming the existence of a succession of timber-built piers at Calais (10). Such piers almost certainly existed at Gravelines (11) and Dunkirk (12) also whilst another may have been present at Dieppe

(9). Calais was formerly an English territory whilst Gravelines and Dunkirk lay within the historic entity of Flanders.

Whilst its timber piers are believed to have been present by the early 16th-century the earliest known view of the works at Calais dates to 1545 and shows an extensive twin pier system (British Library, Cotton Augustus l.ii. f 57B). A more detailed map of 1545-50 shows the pier system and two small jetties together with other defensive works, Figure 99. These works were the result of investment in its continental foothold by the English crown. At least part of the west pier was recorded as being built of English timber framed in Bettingham's Wood in the Weald of Kent whilst both piers had an infill of chalk rubble (Colvin 1975, 346-8). Sluices are known to have been used for scouring the harbour (Colvin 1975, 357). The detail of the latter manuscript map is particularly fine with walls of near vertical piles, external rails and raking external braces - probably at points of bay division, all being evident. Analysis of a large scale copy of this image has the potential to elucidate much fine structural detail.

The English are known to have carried out other harbour works in the Pale of Calais (Colvin et al, 1975). Whether these involved the construction of other timber-built piers is presently uncertain.

Figure 99, Piers at Calais, 1545-50 (British Library, Cotton Augustus l.ii. f 57)

There are a considerable number of later images of the timber-built piers at Calais after it ceased to be an English possession, such piers being maintained until well in to the 19th-century, Figure 100.

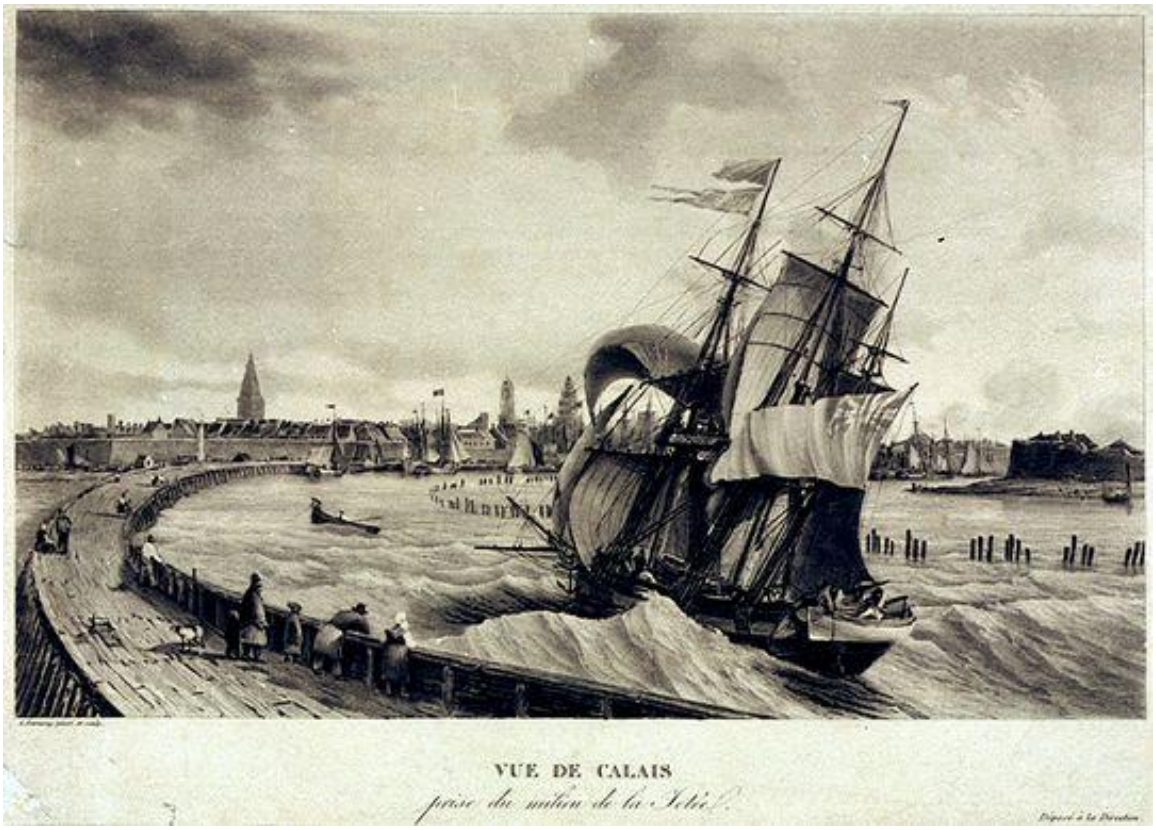


Figure 100, Piers at Calais, 19th-century (National Maritime Museum, Greenwich: NMM PU1601)

An arrangement of long, parallel aligned, twin piers is shown in a mid 18th-century map of Gravelines (National Maritime Museum, Greenwich: PAD1597). A system of very similar form is depicted on a number of maps of Dunkirk from the 17th-century onwards, Figure 101. It is believed, though yet to be conclusively demonstrated, that these were timber-built. This particular form of piers through which rivers run 'canal-like' bears striking resemblance to later arrangements at Calais and elsewhere in the Low Countries and may owe much to particular environmental circumstances.

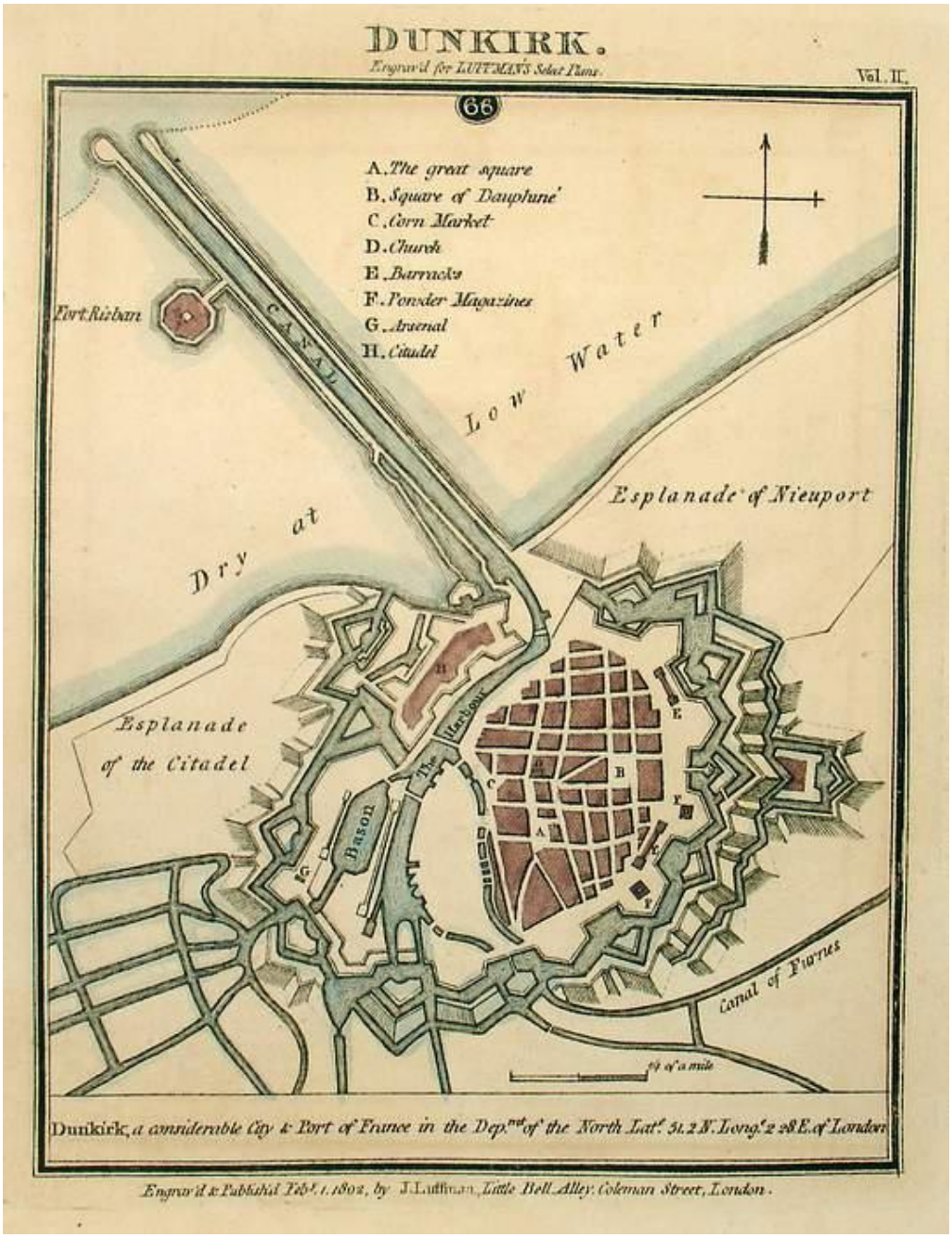


*Figure 101, Piers at Dunkirk, as depicted in 1801 (*http://www.historygallery.com/maps*)*

Belgium

A number of early 17th-century historic maps of Ostende (13) depict an arrangement of timber piers, including a long island pier with a stone infill, Figure 102.

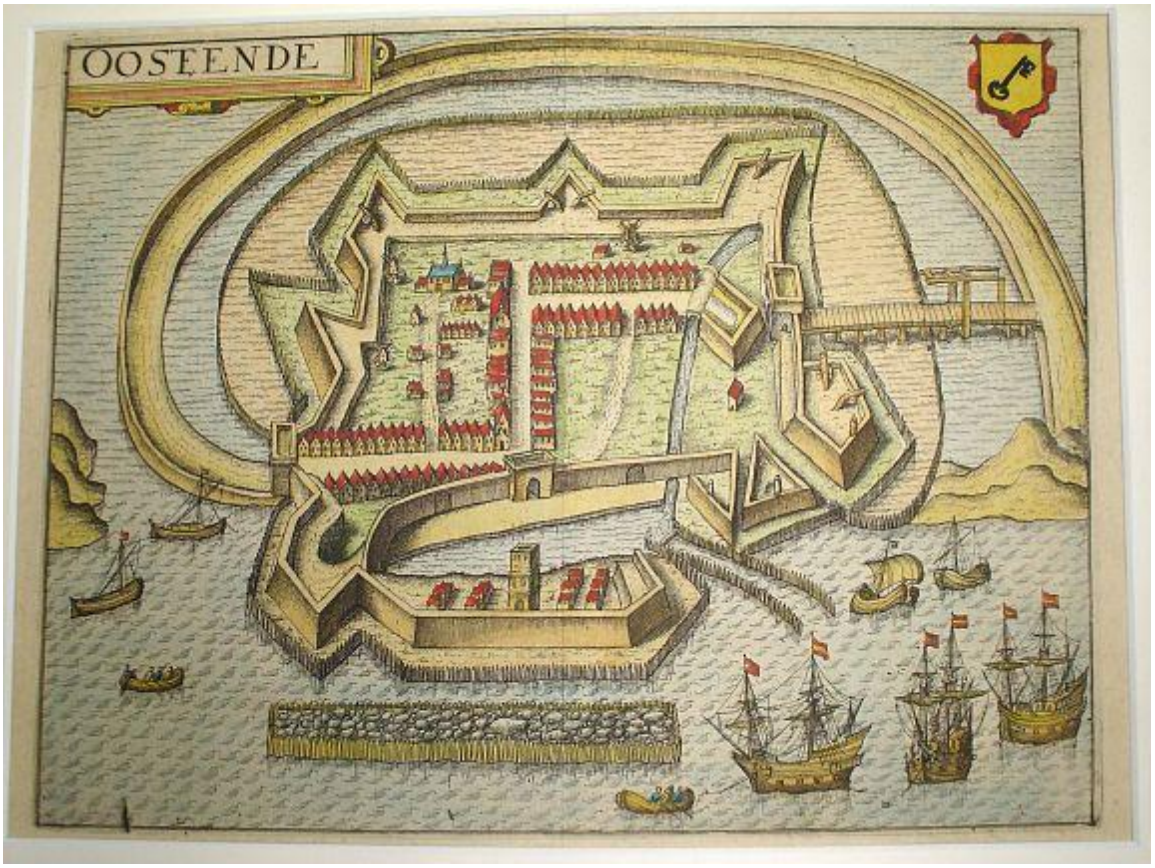


Figure 102, Timber-built piers and island pier, Oostende 1612 (from: Beschrijving van alle de Nederlanden, by Guicciardini, (ed) J, Bleau, 1612)

Netherlands

There are many depictions of timber-built seacoast piers in the Netherlands, where these structures appear to have been quite common. The location of a number of the depictions have not been identified though such piers are known to have been present at Vlissingen (14), at the mouth of the River Scheldt (15), Dordrecht (16), Texel (18), Harlingen (19) and at Edam – formerly on the Zuiderzee saltwater inlet (17).

There are a number of historic views of Vlissingen. One of the earliest of these, dating to 1585, depicts twin piers through which a channel flows and which provides access to docks in the heart of the town, Figure 103. One of the principal elements of the walls of the piers are shown to be wide spaced vertically driven piles, probably with timber planking behind, whilst tie-beams are also evident. A number of lesser piers to either side appear to be glorified groynes. On the basis of a painting of 1669 these lesser piers

provided additional port facilities, Figure 104. This later image is also interesting in that the town walls, gateways and tall timber walls would have enabled access to the piers to be tightly regulated. A later engraving of 1809 shows an island pier at Vlissingen constructed of narrow spaced angle driven piles secured with a high level horizontal rail, and seemingly with horizontal planking behind, and an infill of stone, Figure 105.

Figure 103, Piers at Vlissingen 1585. A map by Robert Adam (from; Skelton and Summerson 1971)

Figure 104, Piers at Vlissingen in 1669, painting by Petrus Segaers (Zeeus Maritiem Muzeeum)

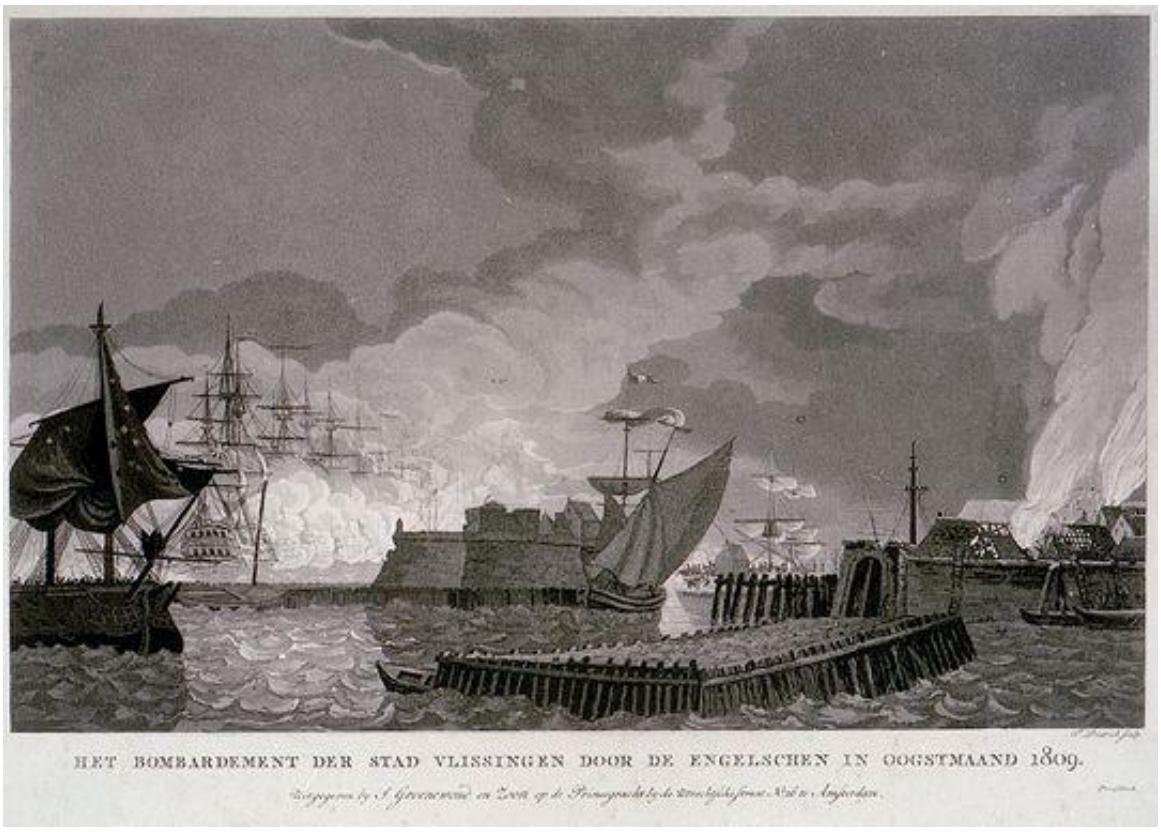


Figure 105, Island pier at Vlissingen 1809. (National Maritime Museum, Greenwich: PU5784 NMM)

A painting of 1652 depicts a somewhat dilapidated and patched-up pier near the mouth of the River Scheldt, Figure 106. This can be seen to be constructed of narrow spaced, slightly angle driven piles, a high level external timber rail and a decking of timber.

Figure 106, Pier near the mouth of the Scheldt, detail of a painting by Bonaventura Peters, 1652 (www.rijksmuseum.nl)

What is almost certainly a timber pier is shown in an engraving at Dordrecht in 1575, Figure 107. Insufficient detail is shown for its precise technical form to be established.

Figure 107, Piers at Dordrecht in 1575. (from: Braun and Hogenburg, Civitates Orbis Terrarum, volume II, 1575)

The head of part of a timber-built pier at Texel is shown in an engraving of 1783, Figure 108. This pier has angled walls of timber, a high level external timber rail and shows evidence for a number of patching repairs.

Figure 108, Pier at Texel, 1783. (National Maritime Museum, Greenwich: PA7561)

A late 18th-century engraving of a twin pier arrangement at Harlingen with a narrow canal-like channel between bears some similarity to the form seen at Dunkirk and Gravelines, Figure 109. At Harlingen the walls can be seen to be of narrow spaced timber piles with horizontal planking behind. The walkways are not of timber and so an infill of solid material is implied.

Figure 109, Twin piers at Harlingen, 1781. (National Maritime Museum, Greenwich: PW7388)

A timber-built pier at the port of Edam on the Zuider Zee is depicted in an engraving of 1780, Figure 110. This pier has wide spaced vertically set piles, a high level external rail and raking timber bracing. The walls behind the piles were probably of horizontal timber planking. It is likely that this pier was of earth-fast frame type.

Figure 110, Pier, De Haven van Edam 1780 (National Maritime Museum, Greenwich: NMM PW7378)

The National Maritime Museum, Greenwich possesses a number of images which show Dutch timber-built piers, the locations of which are not known. A selection of these is reproduced below, Figures 111, 112, 113 and 114. The first two are of interest in that they both show angled external bracing, a feature not observed in the English study area examples. The latter two are of angled and vertical close-piled form.

Figure 111, Unidentified pier, Dutch 1654 (National Maritime Museum, Greenwich: BHC0896)

Figure 112, Unidentified pier, Dutch 1665 (National Maritime Museum, Greenwich: PY1732)

Figure 113, Unidentified pier, Dutch 1733, (National Maritime Museum, Greenwich: PU0255)

Figure 114, Unidentified pier, Dutch 1856, (National Maritime Museum, Greenwich: PY8382)

Denmark

A number of small timber-built piers are depicted at Helsingor (20) in 1598, on the western side of the Øresund Sound between Denmark and Sweden, Figure 115. Although their scale mirrors that of riverine jetties, Helsingor technically speaking does lie on a seacoast whilst their solid walls with internal fill define them as piers.

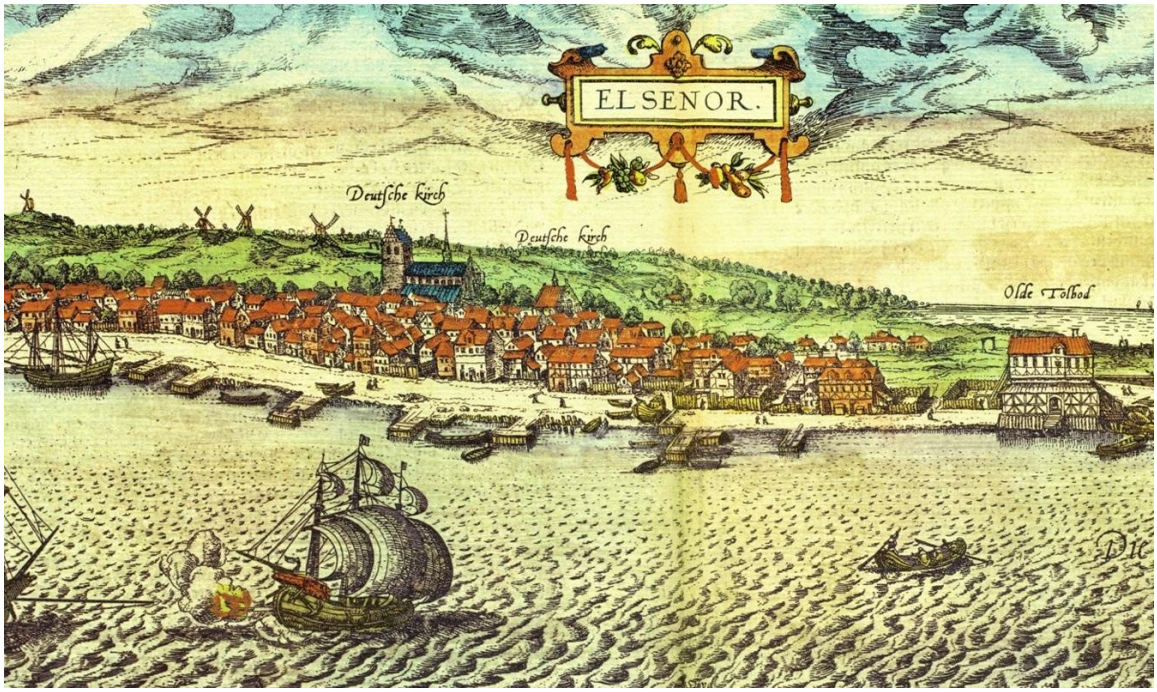


Figure 115, Piers at Helsingor 1598, (Braun and Hogenburg, Civitates Orbis Terrarum, volume V, 1598)

Sweden

On the eastern side of the Øresund Sound, opposite Danish Helsingor, the Swedish town of Helsingborg (21) is shown in a depiction of 1588 as possessing a single timber-built pier, Figure 116.

Figure 116, Piers at Helsingborg 1588, (Braun and Hogenburg, Civitates Orbis Terrarum, volume IV, 1588)

Also on the Øresund Sound, what is probably a timber-built pier appears in an image of Landskrona (22) dated to 1588. A detailed depiction of 1598 of the town of Visby (23) on the island of Gotland, Sweden, within the Baltic Sea, shows an arrangement of widely spaced curvilinear piers enclosing a harbour, Figure 117. Clearly visible in this image are arrangements of regularly spaced paired posts connected by tie-beams at walk-way level and walls of horizontally laid timbers interior to the posts. An internal fill appears to be of stone. These characteristics identify these piers as of earth-fast frame type.

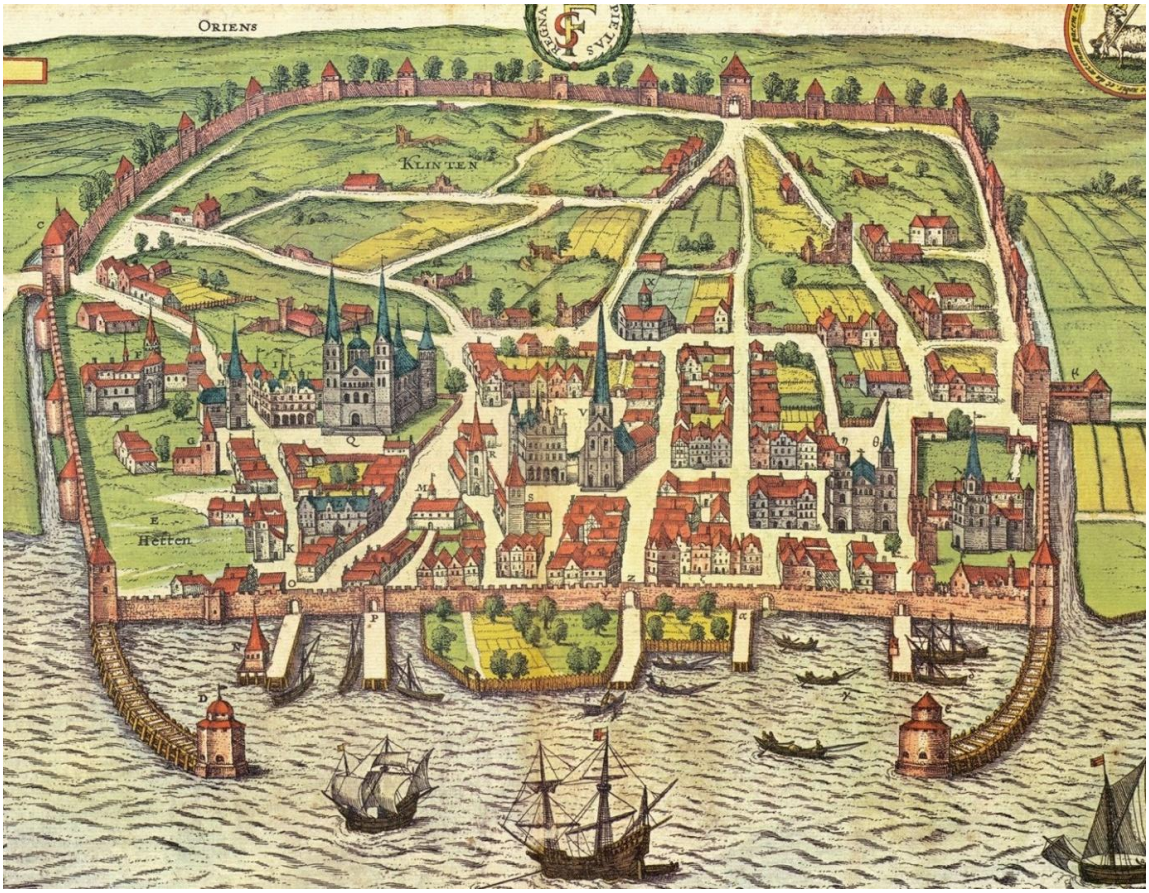


Figure 117, Piers at Visby1598, (Braun and Hogenburg, Civitates Orbis Terrarum, volume IV, 1588)

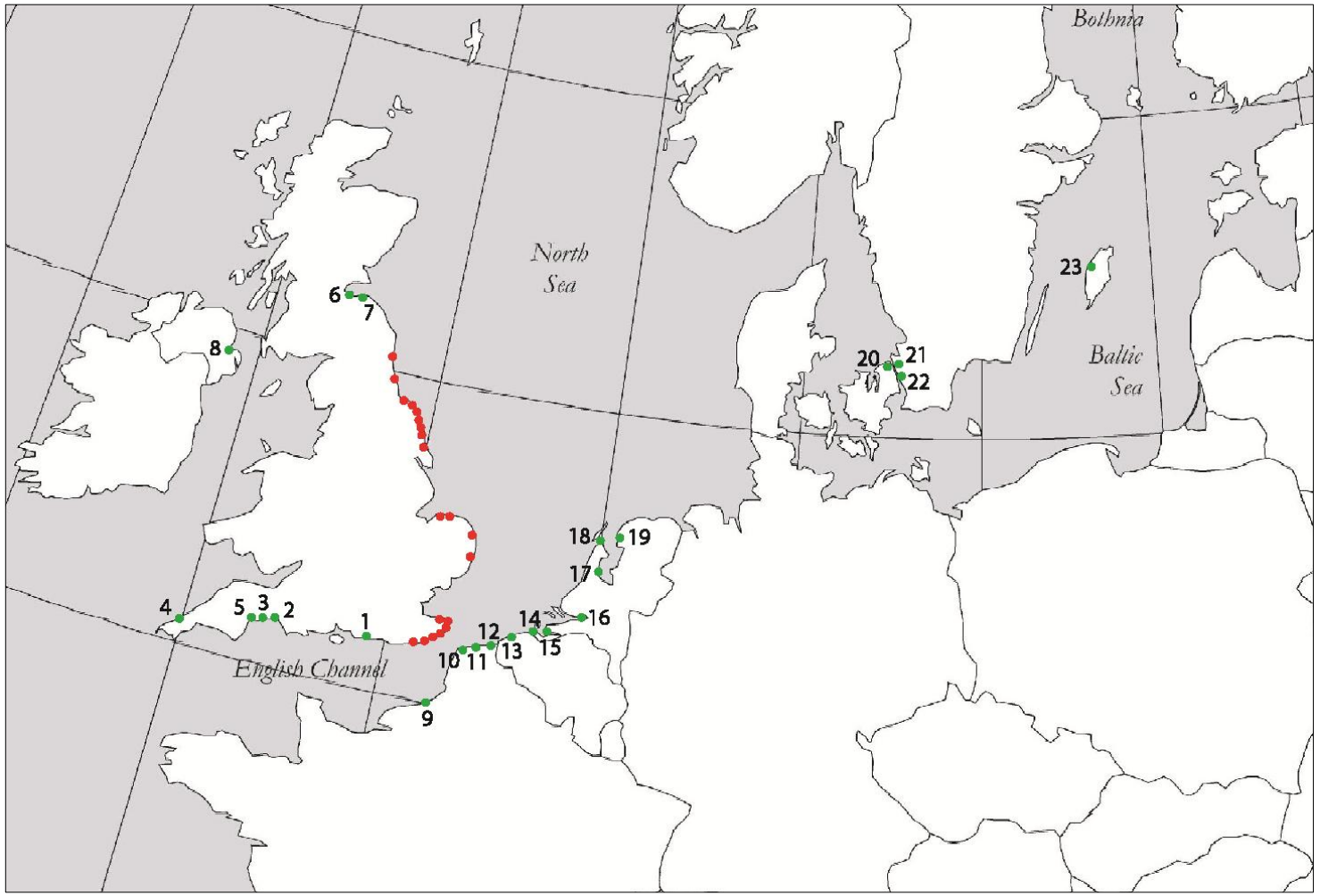


Figure 118, Distribution of timber-built pier sites (green) beyond those of the Study Area (red)

6.2 Some conclusions and the scope for broader European study

The rapid survey of this chapter unambiguously indicates that the phenomenon of timber-built seacoast piers, now identified and largely understood in eastern England from the 13th – 20th centuries, also existed elsewhere in the British Isles and northern Europe. When we consider the occasional role of engineers from the Low Countries and Northern Germany in the building of piers in eastern England and the role of English builders in former European possessions then the presence of timber piers elsewhere need engender little surprise. Quantification of the number of such sites across northern Europe can presently only be made on the basis of educated guesswork. Around a hundred sites, and quite possibly more, may not be too far off the mark. Technically, there are clear parallels between the English and European examples, yet also subtle differences. For example, the use of external bracing (though this is attested at some English inland waterfront sites), what may be an earlier use of earth-fast frames and the canal-like form of close spaced parallel pier arrangements, all appear to find greater emphasis on the continent. Such similarities infused with subtle differences also applies to other aspects of built material culture across northern Europe of which timber framed buildings would serve as a particular exemplar.

In many regards the history of medieval and post-medieval Europe is a dichotomy of division and unity. On the one hand the era was characterised by national and ethnic rivalries and conflicts in which borders and influences were subject to continuous change whilst internal to societies and communities various social classes engaged in struggles for improvement and supremacy. On the other hand, the divided European groupings were united by significant cultural milieux. We can see the prominence of the church, similarities in social organisation and much commonality at all levels of material culture. As such, there are many degrees of correspondence in areas such as architectural style, technology, pots, pans, dress and so on. In some instances it is possible to identify the location of origin of particular items, styles and elements of material culture as well as the manner of their diffusion, though the significant point here is that these things came to be shared. This is no less a truism in maritime matters. Across a broad swathe of northern Europe mariners sailed the same shared seas in similar vessels guided by identical navigational practices and from the 16th-century even utilised charts of the same editions. Just as the great churches of northern Europe represented shared ideas, beliefs and styles,

so within a similar framework do the timber-built seacoast piers of northern Europe define elements of our common, shared maritime heritage.

Within a larger picture, it is even probable that the great explorations, exploitation and settlement of 'new worlds' by Europeans was to some degree even facilitated through the port infrastructure of such piers. Rapid provisional internet searches for historic depictions do indeed suggest their likely presence in the East Indies and North America by the 17th-18th centuries and this serves to broaden the scope and implications of any future research.

The study of timber-built seacoast piers clearly holds intrinsic archaeological and historic interest, particularly in the technological, social, economic and environmental fields. Beyond this historic interest, there is also an increasing awareness that the current age is one of rising sea-levels and coastal change and amongst those areas being progressively affected is northern Europe. It seems certain that communities will increasingly need to make decisions as to how best to respond to such changes. Amongst the criteria that such decisions will be based upon must surely be a knowledge and understanding of the context of mankind's past interventions in the coastal environment. There is then an additional value to the further study and understanding of historic seacoast piers.

7. Conclusions

The aim of this thesis was to provide evidence for, and to explore, the phenomenon of timber-built seacoast piers along the seaboard of eastern England. Such structures had not previously seen any systematic or detailed study and therefore provided a propitious opportunity to create, and disseminate, totally new information. Through consideration of the technological, environmental and social contexts of these structures we have been able to go a considerable way in answering the research questions advanced in Chapter 1, 1.8, and can draw a number of significant conclusions and generalisations.

At the most fundamental level, and underpinning all other conclusions that can be drawn, is the evidence that unambiguously testifies the former existence of timber-built seacoast piers. Further, the evidence permits us to state that in constructional terms there were at least two basic forms. The simplest of these had walls of close-piled timbers, typically of squared section, that were secured laterally by tie-beams and sometimes provided with further internal bracing. A slightly more complex form was the pier with an earth-fast frame in which paired main posts and a network of beams and tie-beams provided the skeleton onto which timber walls of lesser scantling were affixed. In both these forms the basic unit of construction was the bay, a pier simply being a replicated series of bays. Again in both cases, walls could be either vertical or slightly angled whilst in both cases the timber shell was in-filled and stabilised with a stony ballast. The existence of a further, speculative form, that of a free-standing frame, has not been proven.

The available evidence suggests an increasing trend through time towards construction of earth-fast frame piers. This does not appear to relate directly to social factors, nor as a result of technological innovation, or even to geographical distribution. Rather, this change seems likely to have been driven by economic and environmental factors. Earth-fast frame piers utilised lesser quantities of large timber than those of close-piled form and there is a body of contemporary testimony suggesting that timber of large scantling became increasingly difficult, and expensive, to source. Construction of timber-built piers was the labour of carpenters, not a discreet specialist branch of the wood-working crafts and there is indeed documentary evidence for certain named carpenters working on both piers and land buildings. This is not to deny that there may well have been carpenters

who regularly worked on these maintenance heavy structures and such individuals may well have built up, and passed on, a store of pier building knowledge. From at least the 16th-century the services of individuals of knowledge and engineers was called upon. Many of the latter were drawn from the Low Countries and northern Germany where prevailing environmental conditions encouraged the emergence of a group of specialists familiar with solving water orientated problems.

This study has shown that it is only possible to gain a fuller understanding of seacoast piers by considering their environmental contexts. There was a distinct tendency for piers to be located away from the mouths of major navigable rivers. The 'idealised port' was located upon such rivers where a larger hinterland could be drawn upon and where relatively benign riverine conditions permitted port infrastructure to be more readily built and with the expenditure of fewer resources. Seacoast piers then principally serviced those areas which lacked extensive inland navigable waterways. The construction of piers was intended to improve the capabilities of seaports by providing shelter and enhancing cargo transfer. The placing of these structures within areas of dynamic coastal processes however, often brought about undesired and unpredicted environmental results, most commonly the silting of harbour basins and increased levels of erosion in adjacent areas. At a cost, such problems could be overcome, either by short term reactive expedients or by solutions designed to resolve the particular problem at its root cause. The available evidence of pier location and design suggests that some understanding of coastal processes was always present. However, this understanding was variable, and even when understood in broad outline the technical answers were not always forthcoming. The Henrician scheme at Dover provides a good example of this, whilst even the technically outstanding 16th-century design at Great Yarmouth resulted in the loss of much land to its south. The application of 'scientific approaches' in harbour works particularly from the later 17th-century onwards undoubtedly advanced the understanding of coastal processes. It seems only reasonable to mention that the unpredictability of human intervention was again highlighted at Great Yarmouth as late as the 1960s when changes to pier design resulted in the loss of much beach immediately to the south (Holmes and Parkin 1996, 37).

We can assert that within the study area at least twenty timber-built piers were formerly present, though it is possible there were originally a handful more than this. The available evidence points towards a number of the piers being in existence around the mid 13th-

century. At precisely what date timber-built piers first appeared is not certain though their origin could lie in the 12th-century if not before. Such piers then certainly existed for over 700 years; they were the norm along the east coast from the medieval period into the industrial age. A very slow and tentative process of replacement of timber with stone, and later by modern materials, started to take place from the later 16th-century, really only gaining momentum in the 18th and 19th centuries. Even so, at Great Yarmouth and Southwold substantial elements of timber-built piers survived in 'operational usage' into the 20th-century whilst a few pieces of plank-work yet survive at Broadstairs.

Seacoast piers could originate and operate within the context of estates, both lay and ecclesiastic, very occasionally in private hands, whilst we have also seen that under certain circumstances they operated, albeit not very successfully, in the hands of crown lessees. Above all however, the story of these seacoast piers is that of origin and operation within municipal hands. That is they were built, owned, managed and funded by the communities to whom they belonged. The examined evidence points towards the important and often central role that such piers held within these communities. For many towns this was their chief possession and one viewed as central to their economic success. Whilst seaport owning communities were complex stratified aggregates the well being of their piers was beneficial to all members, from the wealthy merchants and the servants they employed, to the ship-owner and humble fisherman. All ranks of port societies contributed towards the piers, financially and through self labour and whilst the threat of penalties for non contribution may indicate occasional reluctance there is considerable evidence suggesting that these piers served to galvanise communities towards a shared goal.

Yet timber-built piers were costly to build and maintain, they were susceptible to damage, to decay and in the space of a few unlucky hours could be completely thrown down by the sea. Communities with custody of a pier often portrayed them as burdensome, something beyond their collective means to support yet key to their well-being. Enormous lengths were gone to in order to square this circle. Communities taxed themselves, imposed labour duties upon themselves, invested their surpluses to provide a return for funding in hard times, sold off community assets and left legacies in their wills. When such internal means were insufficient the only recourse was to appeals for external assistance, most commonly to the county and crown. These appeals were legion, sometimes meeting with success, sometimes not. Influential 'friends', the gentry, nobility

and holders of high office, lay and ecclesiastic, could sway such decisions and there is some evidence for communities actively allying themselves with such people. If fortunate, a brief for collection might be authorised, remittance of fee-farm or customs duties may be allowed whilst neighbouring communities benefitting from the port may themselves even contribute. Amongst the more unusual means in which money and materials might be raised was the granting of indulgences, proceeds from specific taxes and even the lottery!

The widespread transference of ownership from communities to bodies of commissioners from the 17th-century onwards marked a watershed in the story of timber-built piers. Whilst it might seem curious to us that a community would willingly hand over control and decision making of its property and principal asset to a body of the unelected drawn from the higher ranks of society this appears to have happened without even a recorded whimper. That this was so appears to be owed to the facts that the community's use of the infrastructure remained unchanged, that they were not wholly excluded from decision making and that the financial dealings were open to their scrutiny. Above all else however, this transference largely guaranteed the continued existence of the piers, which the state became particularly keen to encourage, and removed the overwhelming bulk of financial responsibility from their shoulders. Thanks to the introduction of new means of funding such was the income accruing to the commissioner held piers that this was largely instrumental in their demise, the controllers could now think big, and permanent; stone not timber was the future.

Timber-built piers were feats of technology that were sited within the coastal environment and operated within the prevailing socio-economic parameters of their times. These structures emerged and developed as a direct consequence of the interplay and relationships between technology, the environment and socio-economic organisation. Although these aspects were ever subject to variation and changed through time, as long as they remained within broad parameters, then these piers were viable propositions. Even unfavourable alterations of technological, environmental and social circumstances could often, though not always be overcome; witness, for example, such matters as the increased adoption of earth-fast frames as opposed to close-piling, pier reconfigurations, digging out of sediment, warping, rock armour, appeals to the county or crown for assistance, and so on. Only when gross imbalance between the technological, environmental and social spheres began to enter the equation did timber-built piers

slowly start to become less viable. The available evidence suggests that this demise was multi-causal. Perhaps the three most significant factors leading to this demise were firstly, the increased depth of harbours, this becoming difficult to achieve with timber being available in only finite lengths. Secondly, the greater availability of large stone of suitable quality for pier building, this being the result of the greater scale of quarrying and technological advances during the industrial revolution. Thirdly, the trend towards control by commissioners equipped with new powers and considerably greater incomes – and therefore able to build more permanently in stone. This commissioner and revenue factor was particularly important and we can clearly detect the role of the state within this.

It is the authors belief that this class of monument and its environmental and social implications have now been broadly established for eastern England. We also know that these structures existed elsewhere in England, Britain and northern Europe and that, continent wide, some variation of form seems evident. Quantatively, and in terms of environmental influences and social implications we know little of their role in this wider area.

Brief mention of the role of timber-built piers in the settlement of lands by the great north European powers is merited. To take firstly Ireland, we have already seen an informative detailed extract of the pier at Carrickfergus, the 'bigger picture' itself however, is equally interesting, Figure 119. Here we can see the pier nestled directly under the castle which defends, dominates and regulates it. The castle, from which the cross of St George flys, was a work of immense strength and came to be a key administrative centre of English control whilst the town periodically became a focus of encouraged English and Scottish settlement. Beyond the castle we can see a broad street fronted by multi-storeyed buildings, presumably the residences of settlers and the better-off. On the periphery of the town lie a plethora of domed shaped huts with single entrances, these presumably being the 'rude dwellings' of native inhabitants. The specific details of this picture, of which the pier is clearly a part, charge it with a political and social content that resonates through to the modern age in much the same way as it must in the 16th-century. For long the pre-eminent town in Ulster the harbour of Carrickfergus played a significant role in the logistics of English hegemony.

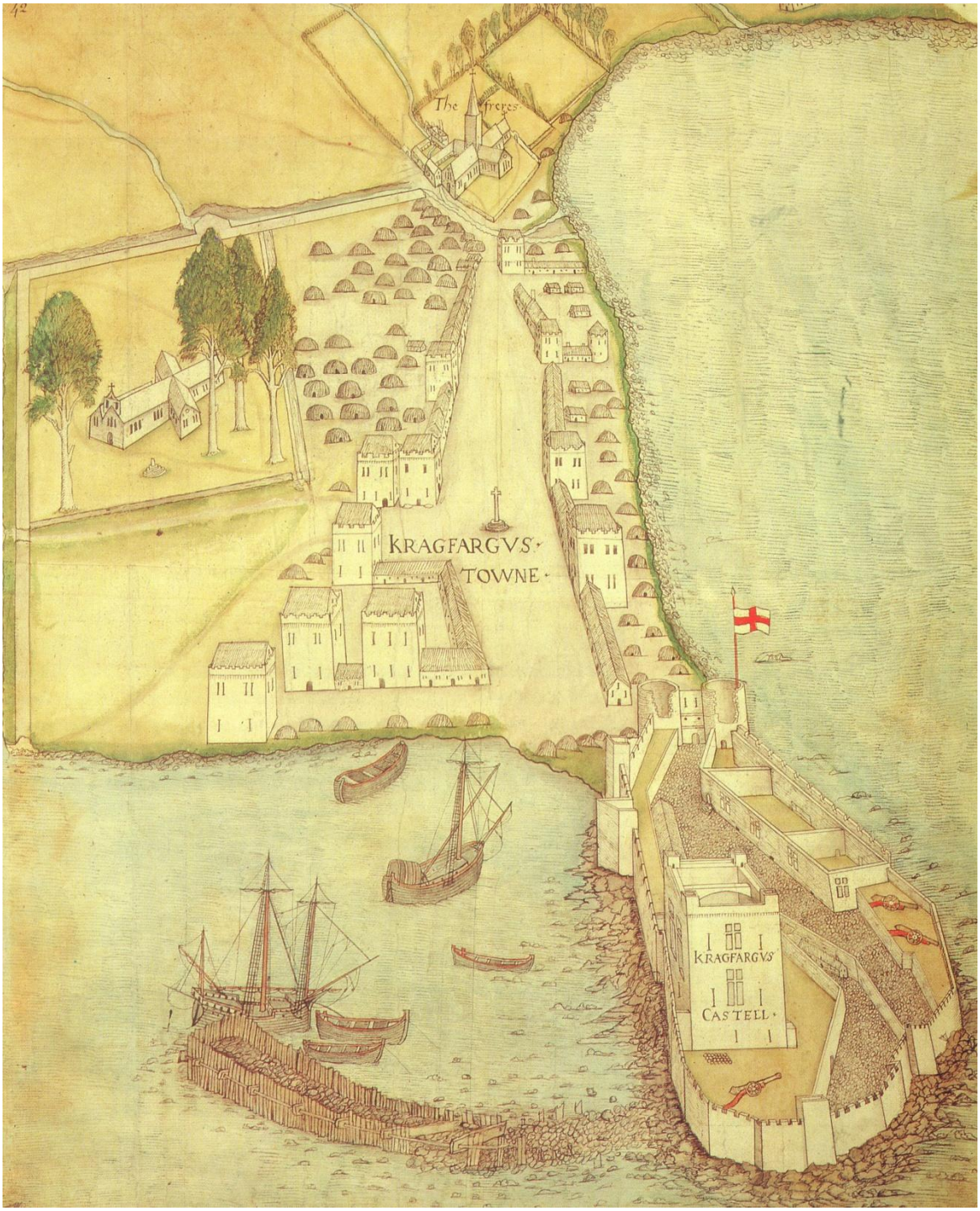


Figure 119, Town of Carrickfergus, 1560s (British Library: Cotton Augustus I.ii. f.42)

The currency of timber-built piers also extends across that period of time that witnessed the exploration, settlement and exploitation of new worlds, much of it by north Europeans. These were essentially maritime ventures that proved in the fullness of time to transform the world. Did such piers become active enabling tools within this

undertaking across the oceans, did they oil the cogs of these world changing processes? Preliminary investigation suggests this was indeed so. Timber-built piers were not just a quirk of England's eastern seaboard nor merely one item of northern Europe's maritime landscape. In the wider global context these structures may not have changed the world in themselves, but they may have helped facilitate that change. There remains then, much that merits further investigation with such research of necessity being multi-disciplinary.

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