Design for Deconstruction: An Appraisal

Supporting Appendices

Appendix A
Supporting information for Chapter 5, Feasibility Studies

Appendix B
Supporting information for Chapter 6, Development of Sakura

Appendix C
Supporting Information for Chapter 7, Case Studies

Table of Contents

Design of Bays 2
Embodied carbon of pre-tensioned reinforcement strand 3
SimaPro model of partially composite bay 5
Embodied carbon of a suspended ceiling 7
Intellectual property disclaimer 9
Questionnaire about Sakura 10
Stadium Case Study 14
Foundations 14
Ground Floor Beams 49
Ground Floor Slabs 103
Columns 104
Beams 115
Upper floor slabs 141
Roof Structure 155
Using Sakura 164
Warehouse Case Studies 167
Warehouse 1, steel frame 167
Material Masses 167
Screenshots from Sakura 168
Warehouse 2, concrete & timber frame 171
Material Masses 171
Screenshots from Sakura 172
School Case Studies 176
School 1, steel frame 176
Material Masses 176
Screenshots from Sakura 177
School 2, concrete frame 181
Masses 181
Screenshots from Sakura 181
School 3, composite steel frame 185
Masses 185
Screenshots of Sakura 186
Office Case Studies 190
Office 1 190
Material Masses 190

Screenshots from Sakura 191
Office 2 194
Material Masses 194
Screenshots from Sakura 195
Supermarket Case Studies 199
Supermarket 1, steel frame 199
Material Masses 199
Screenshots from Sakura 199
Supermarket 2, timber frame 203
Material Masses 203
Screenshots from Sakura 204

List of Figures

Appendix A2:

Figure 1: Process flow of pre-tensioned strand as modelled in SimaPro 3
Figure 2: Summary of processes the impact on the final reinforcement strand 4
Figure 3: Embodied carbon per m of strand 4

Appendix C1:

Figure 1: Stadium, initial information input 164
Figure 2: Stadium, foundation specification 164
Figure 3: Stadium, ground floor slab and superstructure specification 165
Figure 4: Stadium, the upper floor systems specification 165
Figure 5: Stadium, roof structure specification 166

Appendix C2:

Figure 1: Warehouse 1, initial information input 168
Figure 2: Warehouse 1, foundation specification 168
Figure 3: Warehouse 1, ground floor specification 168
Figure 4: Warehouse 1, superstructure specification 169
Figure 5: Warehouse 1, upper floor slab specification 169
Figure 6: Warehouse 1, roof specification 170
Figure 7: Warehouse 1, embodied energy results 170
Figure 8: Warehouse 1, embodied carbon results 171
Figure 9: Warehouse 2, initial information input 172
Figure 10: Warehouse 2, foundation specification 172
Figure 11: Warehouse 2, ground floor slab specification 173
Figure 12: Warehouse 2, superstructure specification 173
Figure 13: Warehouse 2, upper floor slab specification 173
Figure 14: Warehouse 2, roof specification 174
Figure 15: Warehouse 2, embodied energy results 174
Figure 16: Warehouse 2, embodied carbon results 175

Appendix C3:

Figure 1: School 1, Initial information input 177
Figure 2: School 1, Foundation information 178
Figure 3: School 1, Ground Floor Slab information 178

Figure 4: School 1, Superstructure information 178
Figure 5: School 1, Upper floor slab information 179
Figure 6: School 1, Roof information 179
Figure 7: School 1, Embodied energy results 180
Figure 8: School 1, Embodied carbon results 180
Figure 9: School 2, initial information input 182
Figure 10: School 2, foundation specification 182
Figure 11: School 2, ground floor slab specification 182
Figure 12: School 2, superstructure specification 183
Figure 13: School 2, upper floor slabs specification 183
Figure 14: School 2, roof specification 184
Figure 15: School 2, embodied energy results 184
Figure 16: School 2, embodied carbon results 185
Figure 17: Initial information input 186
Figure 18: School 3, foundation specification 187
Figure 19: School 3, ground floor slab specification 187
Figure 20: School 3, superstructure specification 187
Figure 21: School 3, upper floor slabs specification 188
Figure 22: School 3, roof specification 188
Figure 23: School 3, embodied energy results 189
Figure 24: School 3, embodied carbon results 189
Appendix C4:
Figure 1: Office 1, initial information input 191
Figure 2: Office 1, foundation specification 191
Figure 3: Office 1, ground floor specification 192
Figure 4: Office 1, superstructure specification 192
Figure 5: Office 1, upper floor slab specification 192
Figure 6: Office 1, roof specification – this only includes reinforcement from composite floor slab 193
Figure 7: Office 1, embodied energy results 193
Figure 8: Office 1, embodied carbon results 194
Figure 9: Office 2, initial information input 195
Figure 10: Office 2, foundation specification 196
Figure 11: Office 2, ground floor specification 196
Figure 12: Office 2, superstructure specification 196
Figure 13: Office 2, upper floor slab specification 196
Figure 14: Office 2, roof specification - this only includes reinforcement from composite floor slab 197
Figure 15: Office 2, embodied energy results 197
Figure 16: Office 2, embodied carbon results 198
Appendix C5:
Figure 1: Supermarket 1, initial information input 200
Figure 2: Supermarket 1, foundation specification 200
Figure 3: Supermarket 1, ground floor specification 200
Figure 4: Supermarket 1, superstructure specification 201
Figure 5: Supermarket 1, upper floor slab specification 201
Figure 6: Supermarket 1, roof specification 202
Figure 7: Supermarket 1, embodied energy results 202
Figure 8: Supermarket 1, embodied carbon results 203
Figure 9: Supermarket 2, initial information input 204
Figure 10: Supermarket 2, foundation specification 204
Figure 11: Supermarket 2, ground floor specification 205

Figure 12: Supermarket 2, superstructure specification 205
Figure 13: Supermarket 2, upper floor slab specification 206
Figure 14: Supermarket 2, roof specification 206
Figure 15: Supermarket 2, embodied energy results 207
Figure 16: Supermarket 2, embodied carbon results 207

List of Tables

Appendix B1:
Table 1: Embodied Energy and Carbon calculation for a suspended ceiling 8
Appendix B3:
Table 2: Answers to questions 1-8 11
Table 3: Responses to Question 9 11
Table 4: Responses to Question 10 11
Appendix C1:
Table 1: Concrete in piles information for the west stand 19
Table 2: Reinforcement information for piles in the West Stand 24
Table 3: Concrete information for the piles in the North Stand 27
Table 4: Reinforcement information for the piles in the North Stand 30
Table 5: Concrete information for the piles in the South Stand 34
Table 6: Reinforcement information for the piles in the South Stand 37
Table 7: Concrete information for the piles in the East Stand 41
Table 8: Reinforcement information for the piles in the East Stand 45
Table 9: Quantities of Piles Caps within Stadium 45
Table 10: Mass of concrete in pile caps 46
Table 11: Mass of reinforcement in Pile Caps 48
Table 12: Quantities and sizes of Ground Beams 53
Table 13: Mass of concrete in Ground Beams 56
Table 14: Mass of reinforcement in Ground Beams in the East Stand 59
Table 15: Mass of reinforcement in Ground Beams in the North & South East corners 65
Table 16: Mass of reinforcement in Ground Beams in the South Stand 69
Table 17: Mass of Reinforcement in Ground Beams in the North Stand 72
Table 18: Mass of reinforcement in Ground Beams in the South West Corner 78
Table 19: Mass of reinforcement in Ground Beams in the North West Corner 84
Table 20: Mass of reinforcement in Ground Beams in the West Stand 96
Table 21: Mass of reinforcement in Ground Beams around the perimeter 102
Table 22: Mass of concrete in the ground floor slabs 103
Table 23: Mass of reinforcement in the ground floor slabs 103
Table 24: Column Quantities in Stadium Case Study 108
Table 25: Mass of steel in columns 111
Table 26: Mass of concrete in Composite Columns 113
Table 27: Mass of reinforcement within the Composite Columns 114
Table 28: Quantities of Steel Beams in Lower Concourse Level 122
Table 29: Mass of Steel Beams in Lower Concourse Level 128
Table 30: Quantities of Steel Beams in Lower Terracing Level 130
Table 31: Mass of Steel Beams in Lower Terracing Level 131
Table 32: Quantities and mass of steel beams in Hospitality Level 133
Table 33: Quantities and mass of steel beams in Upper Concourse Level 136
Table 34: Quantities and mass of steel beams in Plant Room Level 137
Table 35: Quantities and mass of steel beams in Upper Tier Terracing Level 139
Table 36: Quantities and mass of steel beams in Stair Towers 140

Table 37: Mass of Concrete in Lower Concourse Slabs 141
Table 38: Mass of A142 Mesh in Lower Concourse Slabs 142
Table 39: Mass of metal deck in Lower Concourse Slabs 142
Table 40: Mass of U-bars in Lower Concourse Slabs 142
Table 41: Quantity of Shear Studs in the South Stand (same number for the North Stand) 143
Table 42: Quantity of Shear Studs in the South West Corner (same number for the North West Corner) 143
Table 43: Quantity of Shear Studs in the West Stand 144
Table 44: Quantity of Shear Studs in the North East Corner (same number for the South East Corner) 145
Table 45: Quantity of Shear Studs in the East Stand 146
Table 46: Summary table of Shear Stud quantities and masses 146
Table 47: Quantity and masses of reinforcement in the South Stand Slab (same quantities for the North Stand) 147
Table 48: Quantity and masses of reinforcement in the South West Corner slab (same quantities for the North West Corner) 147
Table 49: Quantities and masses of reinforcement in the West Stand slab 148
Table 50: Quantities and masses of reinforcement in the North East Corner slab (same quantities for the South East Corner) 148
Table 51: Quantities and masses of reinforcement in the East Stand slab 149
Table 52: Mass of Concrete in the West Stand Upper Level Slabs 149
Table 53: Mass of A142 Mesh in the West Stand Upper Level Slabs 149
Table 54: Mass of Metal Deck in the West Stand Upper Level Slabs 149
Table 55: Quantity of Shear Studs in the Hospitality level slab 150
Table 56: Quantity of Shear Studs in the Upper Concourse level slab 151
Table 57: Quantity of Shear Studs in the Plant Room level Slab 152
Table 58: Summary table showing quantities and masses of shear studs in the upper levels of the West Stand 152
Table 59: Quantities and masses of U-bars in the upper level slabs in the West Stand 152
Table 60: Quantities and masses of reinforcement in the hospitality level slab 153
Table 61: Quantities and masses of reinforcement in the upper concourse level slab 154
Table 62: Quantities and masses of reinforcement in the plant room level slab 154
Table 63: Quantities and masses of roof beams 161
Table 64: Quantities and masses of roof purlins 163
Appendix C2:
Table 1: Warehouse 1, structural material masses 167
Table 2: Warehouse 2, structural material masses 172
Appendix C3:
Table 1: School 1, material masses 177
Table 2: School 2, material masses 181
Table 3: School 3, material mass breakdown 186
Appendix C4:
Table 1: Office 1, structural material masses 191
Table 1: Office 1, structural material masses 195
Appendix C5:
Table 1: Supermarket 1, structural material masses 199
Table 2: Supermarket 2, structural material masses 204

Appendix A

Supporting Information for Chapter 5, Feasibility Studies

Appendix A1: Design of bays

Appendix A2: Embodied carbon of a pre-tensioned reinforcement strand

Appendix A3: SimaPro model of partially composite bay

Appendix A1: Design of bays

Elements within the bay designs were preliminary sized for strength and deflection. A number of assumptions were made for the bay designs, these are as follows:

- All beams and columns constructed from S275 steel
- All concrete 25/30 MPa
- A variable office loading of 2.5KN/m^2 plus 1KN/m^2 for partitions was assumed, therefore 3.5KN/m^2 variable load was designed for
- Wind loading was not considered
- Substructure and roof structure was not included in the studies

The following references were used for the bay design:

- Way, A.G.J., Cosgrove, T.C., Brettle, M.E. 2007. Precast Concrete Floors in Steel Framed Buildings, SCI publication P351, Ascot, The Steel Construction Institute
- Lawson, R.M., Chung, K.F. 1994. Composite Beam Design to Eurocode 4, SCI publication 121, Ascot, The Steel Construction Institute
- Brown, D.G., King, C.M., Rackham, J.W., Way, A. 2004. Design of multi-storey braced frames, SCI publication P334, Ascot, The Steel Construction Institute
- Hicks, S. J., Lawson, R.M. 2003. Design of Composite Beams using precast concrete slabs, SCI publication P287. Ascot, The Steel Construction Institution
- SCI, BCSA. 1998. Joints in Steel Construction: simple connections – the Green Book, SCI publication P213

Appendix A2: Embodied carbon of a pre-tensioned reinforcement strand

Section 5.3.4 in Chapter 5 identified the lack of reliable embodied carbon data for pre-tensioned reinforcement strand. A single strand was therefore modelled within the LCA software, SimaPro, to ascertain a more reliable guideline. It was modelled using the following assumptions:

- Pre-tensioned reinforcement strand has a 12.5mm diameter
- A single strand consists of 7 individual wires
- A 1m length of strand was modelled to obtain an embodied carbon value per m
- Start point of SimaPro model was a steel billet
- The yield from Steel Billet to wire rod taken as 82% [1]
- 100% yield assumed from drawing the wire
- Density of steel taken to by 7850 kg/m^3

The following images show screenshots of SimaPro, this information could be used as a starting point for further study to gain a complete picture of the embodied impacts of reinforcement strand.

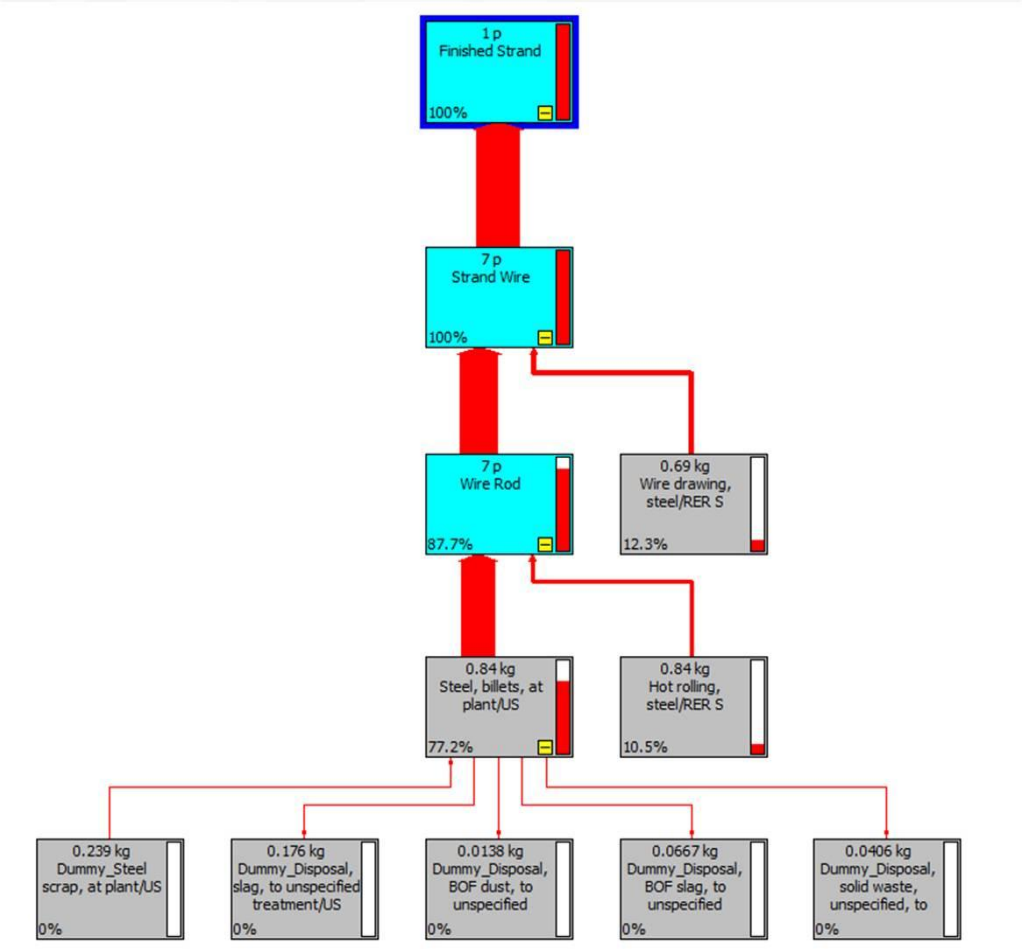
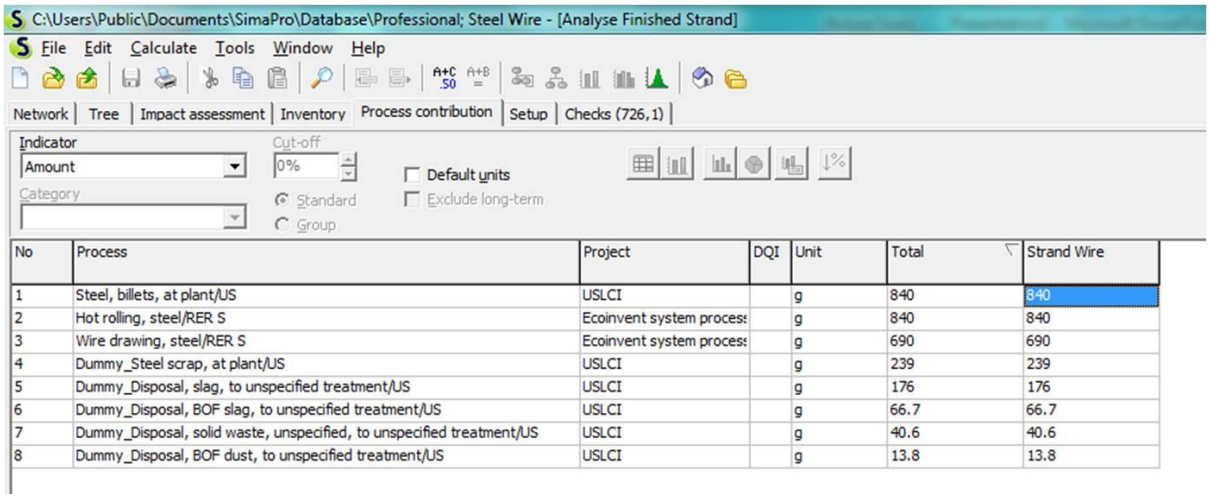


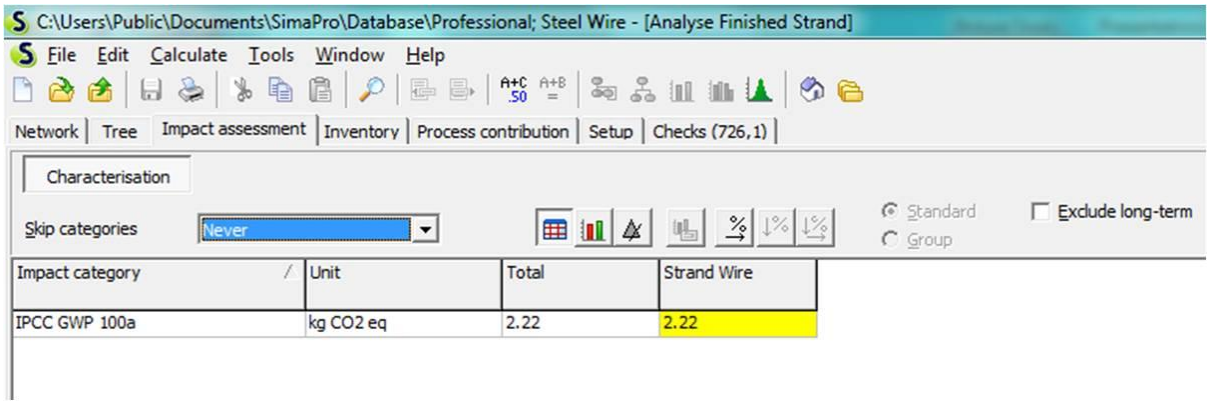
Figure 1: Process flow of pre-tensioned strand as modelled in SimaPro

[1] This assumption was made on the basis of work done by WellMet 2050, Going on a metal diet, available at: <http://www.lcmp.eng.cam.ac.uk/wp-content/uploads/T2-Report-web.pdf> [accessed 28/09/12]



No	Process	Project	DQI	Unit	Total	Strand Wire
1	Steel, billets, at plant/US	USLCI		g	840	840
2	Hot rolling, steel/RER S	Ecoinvent system proces:		g	840	840
3	Wire drawing, steel/RER S	Ecoinvent system proces:		g	690	690
4	Dummy_Steel scrap, at plant/US	USLCI		g	239	239
5	Dummy_Disposal, slag, to unspecified treatment/US	USLCI		g	176	176
6	Dummy_Disposal, BOF slag, to unspecified treatment/US	USLCI		g	66.7	66.7
7	Dummy_Disposal, solid waste, unspecified, to unspecified treatment/US	USLCI		g	40.6	40.6
8	Dummy_Disposal, BOF dust, to unspecified treatment/US	USLCI		g	13.8	13.8

Figure 2: Summary of processes the impact on the final reinforcement strand



Impact category	Unit	Total	Strand Wire
IPCC GWP 100a	kg CO2 eq	2.22	2.22

Figure 3: Embodied carbon per m of strand

Due to insufficient information, several processes after the wire drawing process could not be modelled, these should be included for a complete study, they are as follows:

- Stranding process
- Energy required for pre-stress
- Any transport of materials between processes that may be required
- A stabilizing process which involves heat treatment

Appendix A3: SimaPro model of partially composite bay

This shows the output exported to an excel table for the model of the partially composite bay in SimaPro.

SimaPro 7.3	Impact assessment	Date:	7/27/2011	Time:	10:19 AM
Project	Partially Composite bay				

Title:	Analysing 1 p '6x6m bay' Global warming gases /
Method:	Standard
Indicator:	Characterisation
Skip categories:	Never
Relative mode:	None
Exclude infrastructure processes:	No
Exclude long-term emissions:	No

Impact category	Unit	Total	Primary beam 1	Primary beam 2	Composite beam	Columns	Composite Deck	Connection
Carbon dioxide emissions	**$kgCO_2$**	4685.928	793.094	793.094	145.159	1607.742	1178.030	168.808
Methane emissions	**$KgCO_2e$**	87.549	11.936	11.936	2.185	24.196	33.647	3.650
Nitrous Oxide emissions	**$kgCO_2e$**	43.069	9.540	9.540	1.746	19.339	2.777	0.127
Total		4816.546	814.570	814.570	149.089	1651.278	1214.454	172.585

133.79296 $kgCO_2e/m^2$

Appendix B

Supporting Information for Chapter 6, Development of Sakura

Appendix B1: Embodied carbon of a suspended ceiling

Appendix B2: Intellectual Property Disclaimer

Appendix B3: Questionnaire about Sakura

Appendix B1: Embodied Carbon of a Suspended Ceiling

A suspended ceiling could have a significant impact on designs, both in embodied and operational carbon, it is therefore included within Sakura. Without a suspended ceiling if there is sufficient concrete in the floor slab it could be used as thermal mass, which may reduce the operational energy of the building. Embodied carbon data specifically for suspended ceilings is not available and has therefore been estimated. The estimate was made over a $36m^2$ bay and then divided down so the result was per m^2. The Inventory of Carbon and Energy dataset was used for the calculations, the typical world value taken for galvanised steel. The calculation can be seen in Table 1. The following references were used:

- For the density of plasterboards: Sound Service, Soundproofing to Shout About, 2011. Available at: http://www.soundservice.co.uk/acoustic_plasterboard.html [accessed 08/09/12]
- For the density of steel: SImetric, specific gravity of metals, 2011. Available at: http://www.simetric.co.uk/si_metals.htm [accessed 08/09/12]
- Hammond, G., & Jones, C. (2011). *Inventory of Carbon and Energy, version 2.0*. Retrieved 02 17, 2011, from http://www.bath.ac.uk/mech-eng/sert/embodied/

Component	Cross-sectional Area (mm^2)	Quantity	Material	Total required		Density kg/m^3	Mass kg	EE MJ/kg	Total EE MJ	EC kg CO_2e/kg	Total EC kg CO_2e
U-channel	38.5	1m per m of perimeter of system	galvanised steel	924	mm^3	7850	0.0073	28.5	0.207	2.03	0.015
Channel intersection connector	39	1.1 per m2 of ceiling	likely galvanised steel too	42.9	mm^3	7850	0.0003	28.5	0.010	2.03	0.001
C-Channel	44.55	1.67m per m2 of wall lining	galvanised steel	743.985	mm^3	7850	0.0058	28.5	0.166	2.03	0.012
Strap Hanger	0.55 gauge	8?, 0.5m suspension	likely galvanised steel too	55000	mm^3	7850	0.4318	28.5	12.305	2.03	0.876
Ceiling tile	15000	2400mm length (12.5 tiles needed in bay)	Plasterboard	187.5	m^3	0.14375	26.9531	6.75	181.934	0.39	10.512
								Total	**194.621**		**11.415**
								Total per m^2	**5.406**		**0.317**

Table 1: Embodied Energy and Carbon calculation for a suspended ceiling

Appendix B2 – Intellectual Property Disclaimer

The Sakura Demonstrator – Terms and Conditions of Use

This website makes available for use of the Sakura Demonstrator.

The Demonstrator software is made available for research purposes only and is available free of charge. By using the Demonstrator you agree that your use will be subject to the terms and conditions of use.

The Demonstrator is made available for research purposes only and is available free of charge but is conditional upon the acceptance of the following terms and conditions and completion of Licensees details in respect of the following:

Name and Address and point of contact

Research Purpose

By clicking on the "Register" button below you agree to the terms and conditions which will bind you and your employees. If you do not agree to the terms and conditions, you will not be permitted to download the demonstrator.

Should you wish to use the Demonstrator for any purposes other than those set about in the terms and conditions of use, then please contact:

Danielle Densley Tingley
Department of Civil and Structural Engineering
University of Sheffield
d.densleytingley@sheffield.ac.uk

Terms & Conditions

1. This page tells you the terms of use on which we (The University of Sheffield) are permitting you to make use of the Demonstrator. Please read these terms of use carefully before you start to use the Demonstrator. By using the Demonstrator you indicate that you accept these terms of use and that you agree to abide by them. If you do not agree to these terms of use, please refrain from using the Demonstrator.

2. We may amend or change these terms and conditions of use from time to time at our sole discretion by posting updated terms and conditions. Your continued access or use of the Demonstrator constitutes your acceptance of any such changes. Your access to and use of Demonstrator is always subject to the most up-to-date terms and conditions.

3. You agree only to use the Demonstrator for your own internal research and teaching purposes. For the avoidance of doubt you may not use the Demonstrator on behalf of any third party for projects or for any purpose which results in commercial gain for you or any third party.

4. You agree not to copy, decompile, transmit, disassemble, distribute, modify, adapt, link to, frame, create derivative works based on or reverse engineer the Demonstrator in whole or in part.

5. You agree that the Demonstrator is made available to you for facilitating research and teaching. We cannot be responsible for any use of the Demonstrator by you. Accordingly no representations, conditions, warranties or other terms of any kind are given in respect of Demonstrator. All conditions, warranties or other terms which might have effect between the parties or be implied or incorporated into these terms and conditions or any collateral contract, whether by statute, common law or otherwise, are hereby excluded, including, without limitation, the implied conditions, warranties or other terms as to satisfactory quality, fitness for purpose or the use of reasonable skill and care. Without prejudice to the generality of the above we do not warrant that the use of the Demonstrator in accordance with these terms and conditions of use will not infringe the intellectual property rights of any third party.

6. Save for death and personal injury caused by our negligence, we shall have no liability of any kind to you in respect of your use of the Demonstrator.

7. Without prejudice to clause 7 we shall have no liability for any losses or damages which may be suffered by the you whether the same are suffered directly or indirectly or are immediate or consequential, which fall within the following categories:

a) special damage even though we were aware of the circumstances in which such special damage could arise;
b) loss of profits, anticipated savings, business opportunity or goodwill; and
c) any data loss or corruption. You agree that you have sole responsibility for protecting your data during your use of the Demonstrator.

8. In the event that we shall be found liable to you for any reason other than death or personal injury caused by our negligence, the sums payable to you in respect of such liability shall not exceed £10,000.

9. The exclusions of liability in these terms and conditions shall apply to the fullest extent permissible at law, but we do not exclude liability for death or personal injury caused by our negligence or our officers, employees, contractors or agents for fraud, or any other liability which may not be excluded by law.

10. You shall, at all times, indemnify and keep indemnified us against all or any costs, claims, loss, damages or expenses incurred by us or for which we may become liable as a result of any breach by you of these terms and conditions and/or use by you of the Demonstrator.

11. All of your information, images and/or data that you use in relation to the Demonstrator shall not be confidential information or trade secrets owned by you or any other party. There may be security, transmission or other risks associated with use of the Demonstrator and you expressly assume any and all such risks.
12. By using your information, images and/or data in relation to the Demonstrator you represent and warrant that you own or otherwise control all of the intellectual property rights to such information, images and/or data and in using such information, images and/or data you are not infringing the intellectual property rights of any third party
13. The Demonstrator is for demonstration purposes only. We do not guarantee accuracy or reliability of the results derived from the Demonstrator.

14. If any provision of these terms and conditions of use is judged to be illegal or unenforceable, the continuation in full force and effect of the remainder of the provisions shall not be prejudiced.
15. No forbearance or delay by either party in enforcing its rights shall prejudice or restrict the rights of that party and no waiver of any such rights or of any breach of any contractual terms shall be deemed to be a waiver of any other right or of any later breach.
16. We may withdraw the use of the Demonstrator at any time and without notice and you shall have no right to continue to use it.
17. This Agreement shall be governed by and construed in accordance with English law and each party hereby submits to the non-exclusive jurisdiction of the English courts.
18. Should you wish to use the Demonstrator for any purposes other than those set about above, then please contact:

Danielle Densley Tingley
Department of Civil and Structural Engineering
University of Sheffield
d.densleytingley@sheffield.ac.uk

Appendix B3: Questionnaire about Sakura

Sakura was piloted within the Civil and Structural Engineering Department by a group of third year students as part of an integrated design project. It was used to calculate the embodied carbon of their designs and to explore the benefits of design for deconstruction within the projects. After the students used Sakura they were asked to complete a brief questionnaire in order to assess their views on it. Ten questions were asked, these were as follows:

1. Before you used Sakura had you included design for deconstruction within your design?
2. If no, after using Sakura did you (or would you if sufficient time) include design for deconstruction within your design?
3. What type of structure did you model using Sakura? Multi-storey, supermarket, bridge
4. What was the embodied carbon of the design per m^2? If you modelled more than one structure please enter both values, eg. MSB: 300 kg CO^2e/m^2, supermarket: 350 kg CO_2e/m^2
5. Did you calculate the embodied carbon of your project using any other means? Yes, No
6. If yes, what did the embodied carbon per m^2 work out to be? As before, if more than one structure was modelled please enter all information.
7. How useful is Sakura? Extremely useful, very useful, moderately useful, slightly useful or not at all useful
8. How likely are you to recommend Sakura to others? Extremely likely, very likely, moderately likely, slightly likely, not at all likely
9. Did you have any problems using Sakura or was there anything that wasn't clear?
10. Any other comments regarding Sakura?

Seven students completed the questionnaire, the results can be seen below.

1. Before you used Sakura had you included design for deconstruction (DfD) within your design?		
	Response Percent	**Response Count**
Yes	71.4%	5
No	28.6%	2
2. If no, after using Sakura did you/would you include DfD within your design?		
	Response Percent	**Response Count**
Yes	100%	2
No	0%	0
3. What type of structure did you model using Sakura?		
	Response Percent	**Response Count**
Multi-storey	57.1%	4
Supermarket	14.3%	1
Bridge	28.6%	2
4. What was the embodied carbon of the design?		
	Embodied carbon	**Structure**
Response 1	600 tonnes CO_2e	Bridge
Response 2	233 kg CO_2e/m^2	Multi-storey
Response 3	182 kg CO_2e/m^2	Multi-Storey Building
Response 4	227 kg CO_2e/m^2	Multi-storey Building
Response 5	83 kg CO_2e/m^2	Multi-storey Building
Response 6	85 kg CO_2e/m^2	Supermarket

5. Did you calculated the embodied carbon of your project using any other means?		
	Response Percent	**Response Count**
Yes	42.9	3
No	57.1	4
6. If yes, what did the embodied carbon per m^2 work out to be?		
	Embodied Carbon	Structure
Response 2	190 kg CO_2e/m^2	Multi-Storey
Response 5	105 kg CO_2e/m^2	Multi-Storey
Response 6	103 kg CO_2e/m^2	Supermarket
7. How useful is Sakura?		
	Response Percent	**Response Count**
Extremely useful	0%	0
Very useful	57.1%	4
Moderately useful	42.9%	3
Slightly useful	0%	0
Not at all useful	0%	0
8. How likely are you to recommend Sakura to others?		
	Response Percent	**Response Count**
Extremely likely	0%	0
Very likely	71.4%	5
Moderately likely	28.6%	2
Slightly likely	0%	0
Not at all likey	0%	0

Table 2: Answers to questions 1-8

Questions 9 and 10 were open questions, allowing any answer length that was felt to be appropriate. The answers to question 9 can be seen in Table 3, and answers to question 10 can be seen in Table 4.

9. **Did you have any problems using Sakura or was there anything that wasn't clear?**	
Response 2	I had problems accessing the projects that I had previously calculated
Response 3	No, everything seemed pretty clear and well set out.
Response 4	If the software was calculating the embodied carbon per floor. I was not sure whether to put in total weights or weights per floor
Response 5	The only issue was with my own familiarity with what the value should be. As there was no point of reference I didn't know whether the value was high or low.
Response 6	Initially when modelling using total material weights, the beam/columns gave a huge estimation. The comparison between my own estimation and the Sakura estimation for the embodied carbon for the concrete in the foundations was wildly overestimating using Sakura.
Response 7	Using Sakura was relatively straightforward, however some of the input terms could have been made clearer.

Table 3: Responses to Question 9

10. Any other comments regarding Sakura?	
Response 2	Would be good to include cladding and roof materials. Also transport distances.
Response 3	I am sure this tool will be very useful for future work and I am glad that I have been given the opportunity to discover it.
Response 4	Make it so you can save everything at once. I typed everything in and presses save and it only saved the first section. Possibly have a KN option
Response 7	Sakura seems to be best used for the analysis of straightforward structures and for this it works well.

Table 4: Responses to Question 10

It should be noted that the students in question had already been lectured on the benefits of design for deconstruction (DfD) which may be why the positive response rate to question 1 was so high. However, it seems that Sakura is effective in demonstrating the benefits of design for deconstruction as both of those respondents who hadn't included DfD within their projects said they would after having used Sakura.

Overall the responses regarding the usefulness of Sakura were positive and all the students were at least moderately likely to recommend it to others. The issues with the program that were mentioned in response to questions 9 and 10 have since been dealt with and should no longer pose a problem. The inclusion of cladding and roof materials would potentially be a useful addition to Sakura, but a decision has been made to focus on the structural elements for the time being.

Appendix C

Supporting Information for Chapter 7, Case Studies

Appendix C1: Stadium Case Study Information

Appendix C2: Warehouse Case Study Information

Appendix C3: School Case Study Information

Appendix C4: Office Case Study Information

Appendix C5: Supermarket Case Study Information

Appendix C1: Stadium Case Study Information

Stadium Case Study

Foundations

Information for the piles was taken from the construction drawings; in addition to this some assumptions were made:

- Average pile length of 16.3m
- RC30 concrete used
- Density of concrete is taken to be 2400kg/m^3
- Minimal reinforcement required: vertical, 1 central bar and 6 perimeter bars, H12; horizontal, H10 bars at 300mm spacing, 70mm cover assumed so 310mm diameter of link, link length estimated at 974mm

For spreadsheet calculations on the masses of concrete and reinforcement in the piles see Table 5 through to Table 12.

Pile caps were also included within the study, an inventory of the quantity and different types can be seen in Table 13, the spreadsheet calculations for the masses of concrete and reinforcement in the pile caps can be seen in Table 14 and Table 15. To account for reinforcement lapping, 10% of the length of reinforcement was added onto the calculated length.

Drawings detailing the reinforcement for pile caps PC5, and PC7 could not be found, therefore the following assumptions have been made:

- PC5 is assumed to have similar reinforcement to PC4 but a great quantity due to the larger size of the cap:
  - T20 bars at B2 & B1 levels, at 125mm spacing, resulting in 20 bars each level
  - T16 bars at T2 & T1 levels, also 125mm spacing, 20 bars each level
  - 4 T12 bars vertically
- PC7 reinforcement was designed assuming similar conditions to PC3, quantities are given below:
  - T20 bars at B2 & T2 levels, 200mm spacing, 12 bars on each level
  - T20 bars at B1 & T1 levels, 200mm spacing, 14 bars on each level
  - 5T12 bars vertically, at 250mm spacing

The mass of the reinforcement was taken from the following sources:

- Lee Metal Group, Steel Reinforcement Bars, available at: http://www.leemetalgroup.com/index.php?option=com_content&task=view&id=18 [accessed 20/08/12]
- Denmay Steel, Mesh and Rebar, available at: http://www.denmaysteel.co.uk/files/Download/Mesh%20%26%20Rebar%20Information.pdf [accessed 20/08/12]

Concrete in Piles in West Stand								
Ref	**Diameter (m)**	**Depth (m)***	**Cut off level**	**Total Pile Length**	**Volume (m^3)**	**Mass (kg)****	**Quantity**	**Total Mass (kg)**
A1	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
A/B1	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B1	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
C1	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D1	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
D/E 1	0.45	16.3	1.4	17.7	2.815	6756.152	1	6756.152
E lo	0.45	16.3	0.55	16.85	2.680	6431.704	1	6431.704
F lo	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A2	0.45	16.3	0.765	17.065	2.714	6513.770	5	32568.852
A/B2	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B2	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
C2	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D2	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E2	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F2	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A3	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
A/B3	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B3	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
C3	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
D3	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E3	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F3	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A4	0.45	16.3	0.765	17.065	2.714	6513.770	5	32568.852
A/B4	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B4	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
C4	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
D4	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E4	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648

F4	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A5	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
B5	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
C5	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D5	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E5	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F5	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A6	0.45	16.3	0.765	17.065	2.714	6513.770	5	32568.852
B6	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
C6	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
D6	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E6	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F6	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A7	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
B7	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
C7	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
D7	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E7	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F7	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A8	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
B8	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C8	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D8	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E8	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F8	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A9	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
C9	0.45	16.3	0.45	16.75	2.664	6393.534	3	19180.601
D9	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E9	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F9	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512

A 9a	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
A/C 10	0.45	16.3	0.45	16.75	2.664	6393.534	2	12787.067
C3/10	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
D10	0.45	16.3	0.9	17.2	2.736	6565.300	2	13130.601
E10	0.45	16.3	0.675	16.975	2.700	6479.417	1	6479.417
F10	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A 10a	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C3/11	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
D11	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E11	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F11	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A 63a	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C3/63	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
D63	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E63	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F63	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A 64 a	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
C3/64	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
B/C1 64 3	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
D64	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E64	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F64	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A65	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
C65	0.45	16.3	0.45	16.75	2.664	6393.534	3	19180.601
D65	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E65	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F65	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A66	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
B66	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C66	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216

D66	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E66	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F66	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A67	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
B67	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
C67	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
D67	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E67	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F67	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A68	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
B68	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
C68	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
D68	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E68	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F68	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A69	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
B69	0.45	16.3	1.19	17.49	2.782	6675.994	7	46731.960
C69	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D69	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E69	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F69	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A70	0.45	16.3	0.765	17.065	2.714	6513.770	5	32568.852
A/B 70	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B70	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
C70	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
D70	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E70	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F70	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A71	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
A/B 71	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250

B71	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
C71	0.45	16.3	1.09	17.39	2.766	6637.824	4	26551.296
D71	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E71	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F71	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A72	0.45	16.3	0.765	17.065	2.714	6513.770	5	32568.852
A/B72	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B72	0.45	16.3	1.19	17.49	2.782	6675.994	7	46731.960
C72	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D72	0.45	16.3	1.05	17.35	2.759	6622.556	2	13245.112
E72	0.45	16.3	1.05	17.35	2.759	6622.556	2	13245.112
F72	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
E72a	0.45	16.3	0.55	16.85	2.680	6431.704	1	6431.704
F72a	0.45	16.3	0.15	16.45	2.616	6279.023	1	6279.023
Az various	0.45	16.3	0	16.3	2.592	6221.767	32	199096.549
S0 various	0.45	16.3	1.19	17.49	2.782	6675.994	23	153547.870
Total Mass of concrete in piles in West Stand								**2383215**

Table 5: Concrete in piles information for the west stand

Reinforcement in Piles in West Stand													
		Vertical Reinforcement, H12 bars					**Horizontal Reinforcement, H10 bars, 300mm spacing**						**Total Mass, all**
Ref	**Total Pile Length (m)**	**Mass (kg/m)**	**Quantity of rebar**	**Mass per pile (kg)**	**Quantity of piles**	**Total mass (kg)**	**Mass (kg/m)**	**Link Length (m)**	**Mass per Link (kg)**	**Quantity of links**	**Mass per pile (kg)**	**Total Mass (kg)**	**Reinforcement (kg)**
A1	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.832	139.327	**571.712**
A/B1	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.332	35.332	**144.983**
B1	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.832	139.327	**571.712**
C1	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.732	104.195	**427.551**

D1	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
D/E 1	17.7	0.888	7	110.023	1	110.023	0.617	0.974	0.601	59	35.457	35.457	**145.480**
E lo	16.85	0.888	7	104.740	1	104.740	0.617	0.974	0.601	56	33.754	33.754	**138.493**
F lo	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A2	17.065	0.888	7	106.076	5	530.380	0.617	0.974	0.601	57	34.184	170.922	**701.303**
A/B2	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B2	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
C2	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D2	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E2	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F2	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A3	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
A/B3	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B3	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
C3	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
D3	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E3	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F3	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A4	17.065	0.888	7	106.076	5	530.380	0.617	0.974	0.601	57	34.184	170.922	**701.303**
A/B4	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B4	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
C4	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
D4	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E4	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F4	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A5	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
B5	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
C5	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D5	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E5	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**

F5	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A6	17.065	0.888	7	106.076	5	530.380	0.617	0.974	0.601	57	34.184	170.922	**701.303**
B6	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
C6	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
D6	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E6	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F6	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A7	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
B7	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
C7	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
D7	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E7	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F7	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A8	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
B8	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C8	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D8	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E8	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F8	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A9	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
C9	16.75	0.888	7	104.118	3	312.354	0.617	0.974	0.601	56	33.553	100.660	**413.014**
D9	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E9	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F9	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A 9a	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
A/C 10	16.75	0.888	7	104.118	2	208.236	0.617	0.974	0.601	56	33.553	67.107	**275.343**
C3/10	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
D10	17.2	0.888	7	106.915	2	213.830	0.617	0.974	0.601	57	34.455	68.910	**282.740**
E10	16.975	0.888	7	105.517	1	105.517	0.617	0.974	0.601	57	34.004	34.004	**139.521**
F10	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**

A 10a	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C3/11	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
D11	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E11	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F11	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A 63a	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C3/63	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
D63	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E63	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F63	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A 64 a	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
C3/64	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
B/C1 64 3	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
D64	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E64	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F64	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A65	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
C65	16.75	0.888	7	104.118	3	312.354	0.617	0.974	0.601	56	33.553	100.660	**413.014**
D65	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E65	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F65	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A66	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
B66	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C66	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D66	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E66	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F66	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A67	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
B67	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
C67	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**

D67	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E67	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F67	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A68	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
B68	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
C68	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
D68	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E68	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F68	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A69	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
B69	17.49	0.888	7	108.718	7	761.025	0.617	0.974	0.601	58	35.036	245.251	**1006.276**
C69	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D69	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E69	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F69	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A70	17.065	0.888	7	106.076	5	530.380	0.617	0.974	0.601	57	34.184	170.922	**701.303**
A/B 70	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B70	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
C70	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
D70	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E70	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F70	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A71	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
A/B 71	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B71	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
C71	17.39	0.888	7	108.096	4	432.385	0.617	0.974	0.601	58	34.836	139.342	**571.727**
D71	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E71	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F71	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A72	17.065	0.888	7	106.076	5	530.380	0.617	0.974	0.601	57	34.184	170.922	**701.303**

A/B72	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B72	17.49	0.888	7	108.718	7	761.025	0.617	0.974	0.601	58	35.036	245.251	**1006.276**
C72	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D72	17.35	0.888	7	107.848	2	215.695	0.617	0.974	0.601	58	34.755	69.511	**285.206**
E72	17.35	0.888	7	107.848	2	215.695	0.617	0.974	0.601	58	34.755	69.511	**285.206**
F72	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
E72a	16.85	0.888	7	104.740	1	104.740	0.617	0.974	0.601	56	33.754	33.754	**138.493**
F72a	16.45	0.888	7	102.253	1	102.253	0.617	0.974	0.601	55	32.953	32.953	**135.206**
Az various	16.3	0.888	7	101.321	32	3242.266	0.617	0.974	0.601	54	32.652	1044.866	**4287.131**
S0 various	17.49	0.888	7	108.718	23	2500.510	0.617	0.974	0.601	58	35.036	805.825	**3306.335**
Total mass of reinforcement				**Vertical**		**38810**				**Horizontal**		**12507**	**51318**

Table 6: Reinforcement information for piles in the West Stand

Concrete in Piles in North Stand								
Ref	**Diameter (m)**	**Depth (m)***	**Cut off level**	**Total Pile Length**	**Volume (m^3)**	**Mass (kg)**	**Quantity**	**Total Mass (kg)**
A47a	0.45	16.3	0.94	17.24	2.742	6580.568	2	13161.137
C47	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
D47	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E47	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F47	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A48	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C48	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
D48	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E48	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F48	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A49a	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
B/C 49	0.45	16.3	1.49	17.79	2.829	6790.505	1	6790.505
C49	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
D49	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238

E49	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F49	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A50	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
C50	0.45	16.3	0.45	16.75	2.664	6393.534	3	19180.601
D50	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E50	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F50	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A51	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
C51	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D51	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E51	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F51	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A52	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B/C 52	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
C52	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
D52	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E52	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F52	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A53	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B53	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C53	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D53	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E53	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F53	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A54	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B54	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C54	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D54	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E54	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F54	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512

A55	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B55	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C55	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D55	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E55	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F55	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A56	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B56	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C56	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D56	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E56	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F56	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A57	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B57	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C57	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D57	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E57	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F57	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A58	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
B/C 58	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
C58	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
D58	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E58	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F58	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A59	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
C59	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D59	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E59	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F59	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A60	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216

C60	0.45	16.3	0.45	16.75	2.664	6393.534	3	19180.601
D60	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E60	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F60	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A 60a	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C3/61	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
D61	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E61	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F61	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A 61a	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C3/62	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
D62	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E62	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F62	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A 62a	0.45	16.3	0.89	17.19	2.734	6561.483	3	19684.450
Total Mass of concrete in piles in North Stand								**1014087**

Table 7: Concrete information for the piles in the North Stand

Reinforcement in Piles in North Stand													
		Vertical Reinforcement, H12 bars					**Horizontal Reinforcement, H10 bars, 300mm spacing**						**Total Mass, all**
Ref	**Total Pile Length (m)**	**Mass (kg/m)**	**Quantity of rebar**	**Mass per pile (kg)**	**Quantity of piles**	**Total mass (kg)**	**Mass (kg/m)**	**Link Length (m)**	**Mass per Link (kg)**	**Quantity of links**	**Mass per pile (kg)**	**Total Mass (kg)**	**Reinforcement (kg)**
A47a	17.24	0.888	7	107.164	2	214.328	0.617	0.974	0.601	57	34.535	69.070	**283.398**
C47	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
D47	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E47	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F47	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**

A48	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C48	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
D48	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E48	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F48	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A49a	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
B/C 49	17.79	0.888	7	110.583	1	110.583	0.617	0.974	0.601	59	35.637	35.637	**146.219**
C49	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
D49	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E49	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F49	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A50	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
C50	16.75	0.888	7	104.118	3	312.354	0.617	0.974	0.601	56	33.553	100.660	**413.014**
D50	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E50	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F50	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A51	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
C51	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D51	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E51	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F51	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A52	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B/C 52	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
C52	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
D52	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E52	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F52	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A53	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B53	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C53	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**

D53	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E53	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F53	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A54	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B54	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C54	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D54	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E54	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F54	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A55	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B55	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C55	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D55	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E55	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F55	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A56	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B56	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C56	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D56	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E56	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F56	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A57	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B57	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C57	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D57	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E57	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F57	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A58	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
B/C 58	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
C58	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**

D58	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E58	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F58	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A59	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
C59	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D59	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E59	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F59	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A60	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
C60	16.75	0.888	7	104.118	3	312.354	0.617	0.974	0.601	56	33.553	100.660	**413.014**
D60	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E60	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F60	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A 60a	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C3/61	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
D61	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E61	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F61	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A 61a	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C3/62	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
D62	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E62	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F62	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A 62a	17.19	0.888	7	106.853	3	320.559	0.617	0.974	0.601	57	34.435	103.305	**423.864**
Total mass of reinforcement				**Vertical**		**16514**				**Horizontal**		**5322**	**21836**

Table 8: Reinforcement information for the piles in the North Stand

Concrete in Piles in South Stand								
Ref	**Diameter (m)**	**Depth (m)***	**Cut off level**	**Total Pile Length**	**Volume (m^3)**	**Mass (kg)****	**Quantity**	**Total Mass (kg)**

A 11o	0.45	16.3	0.89	17.19	2.734	6561.483	3	19684.450
C 3/12	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
D12	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E12	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F12	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A 12a	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C3/13	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
D 13	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E 13	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F 13	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A 13a	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
A 14	0.45	16.3	1.05	17.35	2.759	6622.556	3	19867.668
C14	0.45	16.3	0.45	16.75	2.664	6393.534	3	19180.601
D14	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E14	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F14	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A15	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
C15	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D15	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E15	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F15	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A16	0.45	16.3	1.05	17.35	2.759	6622.556	3	19867.668
A/C 16	0.45	16.3	1.43	17.73	2.820	6767.603	1	6767.603
C16	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
D16	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E16	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F16	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A17	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B17	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C17	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216

D17	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E17	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F17	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A18	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B18	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C18	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D18	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E18	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F18	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A19	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B19	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C19	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D19	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E19	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F19	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A20	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B20	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C20	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D20	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E20	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F20	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A21	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B21	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C21	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D21	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E21	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F21	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A22	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B22	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C22	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216

D22	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E22	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F22	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A23	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
C23	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D23	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E23	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F23	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A24	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
C24	0.45	16.3	0.45	16.75	2.664	6393.534	3	19180.601
D24	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E24	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F24	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A24a	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
A25a	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
A/C25	0.45	16.3	1.49	17.79	2.829	6790.505	1	6790.505
C25	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
D25	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E25	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F25	0.45	16.3	0.15	16.45	2.616	6279.023	1	6279.023
A26a	0.45	16.3	0.94	17.24	2.742	6580.568	2	13161.137
C26	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
D26	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E26	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F26	0.45	16.3	0.15	16.45	2.616	6279.023	1	6279.023
A27a	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C27	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
D27	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E27	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F27	0.45	16.3	0.15	16.45	2.616	6279.023	1	6279.023

Total Mass of concrete in piles in South Stand	1040886

Table 9: Concrete information for the piles in the South Stand

Reinforcement in Piles in South Stand													
		Vertical Reinforcement, H12 bars					Horizontal Reinforcement, H10 bars, 300mm spacing						Total Mass, all
Ref	Total Pile Length (m)	Mass (kg/m)	Quantity of rebar	Mass per pile (kg)	Quantity of piles	Total mass (kg)	Mass (kg/m)	Link Length (m)	Mass per Link (kg)	Quantity of links	Mass per pile (kg)	Total Mass (kg)	Reinforcement (kg)
A 11o	17.19	0.888	7	106.853	3	320.559	0.617	0.974	0.601	57	34.435	103.305	**423.864**
C 3/12	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
D12	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E12	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F12	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A 12a	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C3/13	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
D 13	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E 13	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F 13	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A 13a	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
A 14	17.35	0.888	7	107.848	3	323.543	0.617	0.974	0.601	58	34.755	104.266	**427.809**
C14	16.75	0.888	7	104.118	3	312.354	0.617	0.974	0.601	56	33.553	100.660	**413.014**
D14	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E14	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F14	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A15	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
C15	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D15	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**

E15	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F15	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A16	17.35	0.888	7	107.848	3	323.543	0.617	0.974	0.601	58	34.755	104.266	**427.809**
A/C 16	17.73	0.888	7	110.210	1	110.210	0.617	0.974	0.601	59	35.517	35.517	**145.726**
C16	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
D16	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E16	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F16	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A17	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B17	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C17	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D17	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E17	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F17	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A18	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B18	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C18	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D18	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E18	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F18	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A19	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B19	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C19	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D19	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E19	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F19	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A20	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B20	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C20	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D20	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**

E20	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F20	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A21	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B21	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C21	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D21	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E21	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F21	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A22	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B22	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C22	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D22	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E22	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F22	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A23	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
C23	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D23	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E23	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F23	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A24	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
C24	16.75	0.888	7	104.118	3	312.354	0.617	0.974	0.601	56	33.553	100.660	**413.014**
D24	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E24	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F24	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A24a	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
A25a	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
A/C25	17.79	0.888	7	110.583	1	110.583	0.617	0.974	0.601	59	35.637	35.637	**146.219**
C25	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
D25	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E25	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**

F25	16.45	0.888	7	102.253	1	102.253	0.617	0.974	0.601	55	32.953	32.953	**135.206**
A26a	17.24	0.888	7	107.164	2	214.328	0.617	0.974	0.601	57	34.535	69.070	**283.398**
C26	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
D26	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E26	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F26	16.45	0.888	7	102.253	1	102.253	0.617	0.974	0.601	55	32.953	32.953	**135.206**
A27a	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C27	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
D27	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E27	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F27	16.45	0.888	7	102.253	1	102.253	0.617	0.974	0.601	55	32.953	32.953	**135.206**
Total mass of reinforcement				**Vertical**		**16951**				**Horizontal**		**5463**	**22413**

Table 10: Reinforcement information for the piles in the South Stand

Concrete in Piles in East Stand								
Ref	**Diameter (m)**	**Depth (m)***	**Cut off level**	**Total Pile Length**	**Volume (m^3)**	**Mass (kg)****	**Quantity**	**Total Mass (kg)**
A28a	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
A/C 28	0.45	16.3	1.49	17.79	2.829	6790.505	1	6790.505
C28	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
D28	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E28	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F28	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A29	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
C29	0.45	16.3	0.45	16.75	2.664	6393.534	3	19180.601
D29	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E29	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F29	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A30	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
C30	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216

D30	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E30	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F30	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A31	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B/C 31	0.45	16.3	1.49	17.79	2.829	6790.505	1	6790.505
C31	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D31	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E31	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F31	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A32	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B32	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C32	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D32	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E32	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F32	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A33	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B33	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C33	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D33	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E33	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F33	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A34	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B34	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C34	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D34	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E34	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F34	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A35	0.45	16.3	1.09	17.39	2.766	6637.824	1	6637.824
B35	0.45	16.3	1.125	17.425	2.771	6651.184	2	13302.367
C35	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216

D35	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E35	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F35	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A36	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B36	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C36	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D36	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E36	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F36	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A37	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B37	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C37	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D37	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E37	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F37	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A38	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B38	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C38	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D38	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E38	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F38	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A39	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B39	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C39	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D39	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E39	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F39	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A40	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B40	0.45	16.3	1.34	17.64	2.806	6733.250	2	13466.500
C40	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216

D40	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E40	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F40	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A41	0.45	16.3	1.34	17.64	2.806	6733.250	1	6733.250
B41	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C41	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D41	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E41	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F41	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A42	0.45	16.3	1.49	17.79	2.829	6790.505	1	6790.505
B42	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C42	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D42	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E42	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F42	0.45	16.3	-0.145	16.155	2.569	6166.420	1	6166.420
A43	0.45	16.3	1.49	17.79	2.829	6790.505	1	6790.505
B/C 43	0.45	16.3	1.49	17.79	2.829	6790.505	1	6790.505
C43	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D43	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E43	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F43	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A44	0.45	16.3	1.49	17.79	2.829	6790.505	1	6790.505
C44	0.45	16.3	1.04	17.34	2.758	6618.739	3	19856.216
D44	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
E44	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
F44	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A45	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
A45a	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C45	0.45	16.3	0.45	16.75	2.664	6393.534	3	19180.601
D45	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238

E45	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F45	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
A46a	0.45	16.3	1.09	17.39	2.766	6637.824	2	13275.648
C46	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
D46	0.45	16.3	0.5	16.8	2.672	6412.619	2	12825.238
E46	0.45	16.3	0.9	17.2	2.736	6565.300	1	6565.300
F46	0.45	16.3	-0.15	16.15	2.569	6164.512	1	6164.512
Total Mass of concrete in piles in East Stand								**1275468**

Table 11: Concrete information for the piles in the East Stand

Reinforcement in Piles in East Stand													
		Vertical Reinforcement, H12 bars					**Horizontal Reinforcement, H10 bars, 300mm spacing**						**Total Mass, all**
Ref	**Total Pile Length (m)**	**Mass (kg/m)**	**Quantity of rebar**	**Mass per pile (kg)**	**Quantity of piles**	**Total mass (kg)**	**Mass (kg/m)**	**Link Length (m)**	**Mass per Link (kg)**	**Quantity of links**	**Mass per pile (kg)**	**Total Mass (kg)**	**Reinforcement (kg)**
A28a	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
A/C 28	17.79	0.888	7	110.583	1	110.583	0.617	0.974	0.601	59	35.637	35.637	**146.219**
C28	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
D28	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E28	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F28	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A29	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
C29	16.75	0.888	7	104.118	3	312.354	0.617	0.974	0.601	56	33.553	100.660	**413.014**
D29	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E29	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F29	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A30	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
C30	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**

D30	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E30	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F30	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A31	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B/C 31	17.79	0.888	7	110.583	1	110.583	0.617	0.974	0.601	59	35.637	35.637	**146.219**
C31	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D31	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E31	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F31	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A32	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B32	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C32	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D32	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E32	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F32	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A33	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B33	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C33	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D33	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E33	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F33	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A34	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B34	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C34	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D34	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E34	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F34	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A35	17.39	0.888	7	108.096	1	108.096	0.617	0.974	0.601	58	34.836	34.836	**142.932**
B35	17.425	0.888	7	108.314	2	216.628	0.617	0.974	0.601	58	34.906	69.811	**286.439**
C35	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**

D35	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E35	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F35	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A36	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B36	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C36	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D36	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E36	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F36	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A37	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B37	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C37	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D37	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E37	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F37	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A38	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B38	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C38	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D38	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E38	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F38	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A39	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B39	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C39	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D39	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E39	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F39	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A40	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B40	17.64	0.888	7	109.650	2	219.300	0.617	0.974	0.601	59	35.336	70.673	**289.973**
C40	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**

D40	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E40	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F40	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A41	17.64	0.888	7	109.650	1	109.650	0.617	0.974	0.601	59	35.336	35.336	**144.987**
B41	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C41	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D41	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E41	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F41	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A42	17.79	0.888	7	110.583	1	110.583	0.617	0.974	0.601	59	35.637	35.637	**146.219**
B42	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C42	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D42	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E42	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F42	16.155	0.888	7	100.419	1	100.419	0.617	0.974	0.601	54	32.362	32.362	**132.781**
A43	17.79	0.888	7	110.583	1	110.583	0.617	0.974	0.601	59	35.637	35.637	**146.219**
B/C 43	17.79	0.888	7	110.583	1	110.583	0.617	0.974	0.601	59	35.637	35.637	**146.219**
C43	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D43	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E43	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F43	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A44	17.79	0.888	7	110.583	1	110.583	0.617	0.974	0.601	59	35.637	35.637	**146.219**
C44	17.34	0.888	7	107.785	3	323.356	0.617	0.974	0.601	58	34.735	104.206	**427.562**
D44	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
E44	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
F44	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A45	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
A45a	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C45	16.75	0.888	7	104.118	3	312.354	0.617	0.974	0.601	56	33.553	100.660	**413.014**
D45	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**

E45	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F45	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
A46a	17.39	0.888	7	108.096	2	216.192	0.617	0.974	0.601	58	34.836	69.671	**285.864**
C46	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
D46	16.8	0.888	7	104.429	2	208.858	0.617	0.974	0.601	56	33.654	67.307	**276.165**
E46	17.2	0.888	7	106.915	1	106.915	0.617	0.974	0.601	57	34.455	34.455	**141.370**
F46	16.15	0.888	7	100.388	1	100.388	0.617	0.974	0.601	54	32.352	32.352	**132.740**
Total mass of reinforcement				**Vertical**		**20771**				**Horizontal**		**6694**	**27465**

Table 12: Reinforcement information for the piles in the East Stand

Pile Caps			**Quantity**								
Ref	**Type**	**Notes**	**N. Stand**	**N.E. Corner**	**E. Stand**	**S.E. Corner**	**S. Stand**	**N.W. Corner**	**W. Stand**	**S.W. Corner**	**Total**
PC1	750 x 750 x 750 mm		11	4	17	2	10	1	38	1	**84**
PC1A	750 x 750 x 750 mm	Tension rebar in top face	8	0	15	0	8	0	2	0	**33**
PC2	750 x 2100 x 1000 mm		20	15	41	15	25	18	31	18	**183**
PC2A	750 x 2100 x 1000 mm	Tension rebar in top face	5	0	0	0	0	0	0	0	**5**
PC3	2100 x 1950 x 1050 mm		7	2	4	2	2	5	14	5	**41**
PC3A	2100 x 1950 x 1050 mm	Tension rebar in top face	1	0	11	0	6	1	0	1	**20**
PC4	2100 x 2100 x 1000 mm		0	0	0	0	0	0	21	0	**21**
PC5	2700 x 2700 x 1325 mm		0	0	0	0	0	0	4	0	**4**
PC6A	750 x 11829 x 900 mm	Curved pile cap	0	1	0	1	0	1	0	1	**4**
PC6B	750 x 19840 x 600 mm	Curved pile cap	0	1	0	1	0	1	0	1	**4**
PC7	3100 wd x 1500 mm dp	Hexagonal pile cap	0	0	0	0	0	0	2	0	**2**
Total Number of Pile Caps			**52**	**23**	**88**	**21**	**51**	**27**	**112**	**27**	**401**

Table 13: Quantities of Piles Caps within Stadium

Mass of Concrete in Pile Caps					
		Volume m^3	Mass kg	Quantity	Total Mass kg
Ref	**Type**				
PC1	750 x 750 x 750 mm	0.422	1012.5	84	85050.0
PC1A	750 x 750 x 750 mm	0.422	1012.5	33	33412.5
PC2	750 x 2100 x 1000 mm	1.575	3780.0	183	691740.0
PC2A	750 x 2100 x 1000 mm	1.575	3780.0	5	18900.0
PC3	2100 x 1950 x 1050 mm	4.300	10319.4	41	423095.4
PC3A	2100 x 1950 x 1050 mm	4.300	10319.4	20	206388.0
PC4	2100 x 2100 x 1000 mm	4.410	10584.0	21	222264.0
PC5	2700 x 2700 x 1325 mm	9.659	23182.2	4	92728.8
PC6A	750 x 11829 x 900 mm	7.985	19163.0	4	76651.9
PC6B	750 x 19840 x 600 mm	8.928	21427.2	4	85708.8
PC7	3100 wd x 1500 mm dp	12.48	29952.0	2	59904
Total Mass of Concrete in Pile Caps					**1995843**

Table 14: Mass of concrete in pile caps

Mass of Reinforcement in Pile Caps										
		Rebar Type	Mass (kg/m)	R Length (m)	Mass per bar (kg)	Rebar Quantity	Mass all bars (kg)	Mass in PC (kg)	Pile Cap Quantity	Total Mass (kg)
Ref	**Size**									
PC1 & PC1A	750 x 750 x 750 mm	T25	3.854	0.66	2.544	16	40.698			
		T12	0.89	0.66	0.587	6	3.524	44.223	117	5174.049
PC2 & PC2A	750 x 2100 x 1000 mm	T25	3.854	2.145	8.267	8	66.135			
		T25	3.854	0.66	2.544	28	71.222			
		T12	0.89	0.66	0.587	8	4.699	142.056	188	26706.483
PC3 & PC3A	2100 x 1950 x 1050 mm	T20	2.466	1.98	4.883	8	39.061			
		T20	2.466	1.128	2.780	4	11.122			

		T20	2.466	1.508	3.719	4	14.876			
		T20	2.466	1.890	4.660	4	18.641			
		T20	2.466	2.308	5.692	8	45.539			
		T20	2.466	0.66	1.628	2	3.255			
		T20	2.466	0.876	2.160	2	4.320			
		T20	2.466	1.108	2.732	2	5.465			
		T20	2.466	1.338	3.300	2	6.599			
		T20	2.466	1.569	3.869	2	7.738			
		T20	2.466	1.95	4.809	2	9.617			
		T12	0.89	6.835	6.084	4	24.334	190.568	61	11624.652
PC4	2100 x 2100 x 1000 mm	T20	2.466	2.145	5.290	32	169.266			
		T16	1.579	2.145	3.387	32	108.383			
		T12	0.89	8.58	7.636	4	30.545	308.194	21	6472.066
PC5	2700 x 2700 x 1325 mm	T20	2.466	2.805	6.917	40	276.685			
		T16	1.579	2.805	4.429	40	177.164			
		T12	0.89	11.22	9.986	4	39.943	493.792	4	1975.169
PC6A	750 x 11829 x 900 mm	T16	1.579	2.214	3.496	10	34.959			
		T16	1.579	1.15	1.816	15	27.238			
		T16	1.579	6.642	10.488	5	52.439			
		T16	1.579	11.829	18.678	4	74.712			
		T16	1.579	5.535	8.740	10	87.398			
	Links	R12	0.89	2.7	2.403	164	394.092	670.837	4	2683.348
PC6B	750 x 19840 x 600 mm	T20	2.466	3.818	9.415	5	47.076			
		T20	2.466	7.636	18.830	10	188.304			
		T16	1.579	1.15	1.816	20	36.317			
		T16	1.579	19.84	31.327	2	62.655			
		T16	1.579	5.727	9.043	10	90.429			
		T16	1.579	7.636	12.057	5	60.286			
	Links	R12	0.89	2.1	1.869	272	508.368	993.435	4	3973.740
PC7	3100 wd x 1500 mm dp	T20	2.466	1.79	4.414	16	70.626			

		T20	2.466	0.366	0.903	8	7.220			
		T20	2.466	0.172	0.424	8	3.393			
		T20	2.466	1.713	4.224	4	16.897			
		T20	2.466	1.908	4.705	4	18.821			
		T20	2.466	2.103	5.186	4	20.744			
		T20	2.466	2.298	5.667	4	22.667			
		T20	2.466	2.494	6.150	4	24.601			
		T20	2.466	2.689	6.631	4	26.524			
		T20	2.466	2.884	7.112	4	28.448			
	Vertical	T12	0.89	9.84	8.758	5	43.788	283.730	2	567.460
Total Mass of Reinforcement in Pile Caps										**59177**

Table 15: Mass of reinforcement in Pile Caps

Ground Floor Beams

Sizes of beams assessed from plans and sections, see

Ground Beams - quantities and sizes									
	(w x dp)			Quantity					
Ref	Type	Notes	Length	N. Stand	N.E. Corner	E. Stand	S.E. Corner	S. Stand	N.W. C
GB1	300 x 600 mm		All	18	12	30	12	18	1
		section 1-10, 13-25, 28-29	5.19	9	4	15	4	9	4
		section 1-29	5.25	9	8	15	8	9	8
			4.815	0	0	0	0	0	0
		estimated	2.1	0	0	0	0	0	0
			3.525	0	0	0	0	0	0
GB2	450 x 600 mm		All	24	16	43	17	23	2
		section 1-6	6.795	0	0	11	0	0	0
		section 1	4.05	0	0	1	0	0	0
		section 2	3.975	0	0	2	0	0	0
		section 3	3.75	0	0	2	0	0	0
		section 4	3.375	0	0	2	0	0	0
		section 5	2.851	0	0	2	0	0	0
		section 6	2.175	0	0	2	0	0	0
		estimated	2	0	0	1	0	0	0
		section 7	9.27	0	0	2	0	0	0
		section 8-9, 14	7.17	0	2	2	2	0	0
			7.5	11	0	16	0	10	0
		section 10, 28	3.948	0	1	0	1	0	1
		10, 28 estimated	3.25	0	1	0	1	0	1
		11-12, estimated	2.1	0	2	0	2	0	2
		11-12, estimated	4	0	2	0	2	0	2
		11-13, 25 estimated	3.25	0	3	0	3	0	1
		section 13, 25	3.955	0	1	0	1	0	1
		estimated	7	0	2	0	2	0	0
		estimated	6.25	0	1	0	0	0	0
		estimated	5.25	0	1	0	0	0	0
		estimated	5.05	0	0	0	2	0	0
		estimated	6.5	0	0	0	1	0	0
		section 16-21, 24	7.17	7	0	0	0	7	1
		section 16,	2.375	2	0	0	0	2	0
		section 17, 21	3.114	1	0	0	0	1	0
		section 18, 20	3.181	2	0	0	0	2	0
		section 19	3.329	1	0	0	0	1	0
		section 26, est	6.45	0	0	0	0	0	2
		section 29, 33	5.25	0	0	0	0	0	1
			6.75	0	0	0	0	0	2
		stairs - estimated	2.8	0	0	0	0	0	2
		stairs	14.532	0	0	0	0	0	4
		stairs	6.25	0	0	0	0	0	1

		estimated	7.5	0	0	0	0	0	2
		estimated	3	0	0	0	0	0	1
		section 30	6.075	0	0	0	0	0	0
		section 30	1.217	0	0	0	0	0	0
		section 31-32	4.95	0	0	0	0	0	0
		section 31	2.96	0	0	0	0	0	0
		section 32	5.013	0	0	0	0	0	0
		section 33, 36	4.9	0	0	0	0	0	0
		section 33	6.26	0	0	0	0	0	0
		section 33	5.46	0	0	0	0	0	0
		section 34-35	4.5	0	0	0	0	0	0
		section 34-35	4.125	0	0	0	0	0	0
		section 36,37	5.4	0	0	0	0	0	0
			6.75	0	0	0	0	0	0
			2.702	0	0	0	0	0	0
			5.1	0	0	0	0	0	0
			5.4	0	0	0	0	0	0
			2.49	0	0	0	0	0	0
GB3	600 x 600 mm		All	11	13	19	12	11	1
		section 1-9, 14-23	7.045	9	2	15	2	9	1
			7.5	0	0	1	0	0	0
		estimated	2.851	0	0	1	0	0	0
		estimated	2.585	0	0	2	0	0	0
		section 10-11, 28	5.393	0	2	0	2	0	1
		section 12, 26	5.39	0	1	0	1	0	1
		section 13, 25	5.392	0	1	0	1	0	1
		estimated	7	0	4	0	4	0	0
		estimated	6.25	0	2	0	1	0	0
		estimated	6.5	0	1	0	0	0	0
		estimated	5.8	0	0	0	1	0	0
		section 23	7.683	2	0	0	0	2	0
			6.45	0	0	0	0	0	1
		section 27	5.389	0	0	0	0	0	1
			6.45	0	0	0	0	0	1
		section 29	7.855	0	0	0	0	0	1
			6.75	0	0	0	0	0	7
		section 30	7.765	0	0	0	0	0	0
			5.1	0	0	0	0	0	0
			5.4	0	0	0	0	0	0
			6.9	0	0	0	0	0	0
			5.4	0	0	0	0	0	0
GB4	450 x 450mm	estimated	2.1	0	0	0	0	0	0
GB5	750 x 600mm		All	2	0	0	0	2	0
		section 22	2.375	1	0	0	0	1	0
		section 22	7.17	1	0	0	0	1	0
		section 34	7.082	0	0	0	0	0	0

		section 34	6.407	0	0	0	0	0	0
		section 35	6.959	0	0	0	0	0	0
		section 35	7.934	0	0	0	0	0	0
		section 36	7.269	0	0	0	0	0	0
		section 36	7.769	0	0	0	0	0	0
		section 37	8.239	0	0	0	0	0	0
			6.75	0	0	0	0	0	0
Stair tower	600 x 750 mm		All	0	0	0	0	0	0
			6.25	0	0	0	0	0	0
			4.78	0	0	0	0	0	0
Stair tower	450 x 450 mm		6.25	0	0	0	0	0	0

Table 16 for details. The calculations of the mass of concrete in the ground beams can be found in Table 17. The reinforcement detailing was taking from RC detailed drawings and from the reinforcement schedule, in places the length of reinforcement had to be estimated, where possible this was done using the number of links within the beam and the spacing at which these were placed. In addition to this, no details could be found for the reinforcement detailing of the ground beams in the stair towers, these were assumed to be similar in design to the perimeter beams and the reinforcement designed accordingly. The drawings were split into different areas of the stadium, for ease the data was collated into tables following these areas. The calculations for the mass of reinforcement can be found from Table 18 to Table 25.

Ground Beams - quantities and sizes												
	(w x dp)			Quantity								
Ref	Type	Notes	Length	N. Stand	N.E. Corner	E. Stand	S.E. Corner	S. Stand	N.W. Corner	W. Stand	S.W. Corner	Total
GB1	300 x 600 mm		All	18	12	30	12	18	12	33	12	147
		section 1-10, 13-25, 28-29	5.19	9	4	15	4	9	4	14	4	63
		section 1-29	5.25	9	8	15	8	9	8	14	8	79
			4.815	0	0	0	0	0	0	2	0	2
		estimated	2.1	0	0	0	0	0	0	2	0	2
			3.525	0	0	0	0	0	0	1	0	1
GB2	450 x 600 mm		All	24	16	43	17	23	24	38	24	209
		section 1-6	6.795	0	0	11	0	0	0	0	0	11
		section 1	4.05	0	0	1	0	0	0	0	0	1
		section 2	3.975	0	0	2	0	0	0	0	0	2
		section 3	3.75	0	0	2	0	0	0	0	0	2
		section 4	3.375	0	0	2	0	0	0	0	0	2
		section 5	2.851	0	0	2	0	0	0	0	0	2
		section 6	2.175	0	0	2	0	0	0	0	0	2
		estimated	2	0	0	1	0	0	0	0	0	1
		section 7	9.27	0	0	2	0	0	0	0	0	2
		section 8-9, 14	7.17	0	2	2	2	0	0	0	0	6
			7.5	11	0	16	0	10	0	0	0	37
		section 10, 28	3.948	0	1	0	1	0	1	0	1	4
		10, 28 estimated	3.25	0	1	0	1	0	1	0	1	4
		11-12, estimated	2.1	0	2	0	2	0	2	0	2	8
		11-12, estimated	4	0	2	0	2	0	2	0	2	8
		11-13, 25 estimated	3.25	0	3	0	3	0	1	0	1	8
		section 13, 25	3.955	0	1	0	1	0	1	0	1	4
		estimated	7	0	2	0	2	0	0	0	0	4
		estimated	6.25	0	1	0	0	0	0	0	0	1

		estimated	5.25	0	1	0	0	0	0	0	0	1
		estimated	5.05	0	0	0	2	0	0	0	0	2
		estimated	6.5	0	0	0	1	0	0	0	0	1
		section 16-21, 24	7.17	7	0	0	0	7	1	0	1	16
		section 16,	2.375	2	0	0	0	2	0	0	0	4
		section 17, 21	3.114	1	0	0	0	1	0	0	0	2
		section 18, 20	3.181	2	0	0	0	2	0	0	0	4
		section 19	3.329	1	0	0	0	1	0	0	0	2
		section 26, est	6.45	0	0	0	0	0	2	0	2	4
		section 29, 33	5.25	0	0	0	0	0	1	1	1	3
			6.75	0	0	0	0	0	2	0	2	4
		stairs - estimated	2.8	0	0	0	0	0	2	0	2	4
		stairs	14.532	0	0	0	0	0	4	0	4	8
		stairs	6.25	0	0	0	0	0	1	0	1	2
		estimated	7.5	0	0	0	0	0	2	1	2	5
		estimated	3	0	0	0	0	0	1		1	2
		section 30	6.075	0	0	0	0	0	0	2	0	2
		section 30	1.217	0	0	0	0	0	0	2	0	2
		section 31-32	4.95	0	0	0	0	0	0	4	0	4
		section 31	2.96	0	0	0	0	0	0	2	0	2
		section 32	5.013	0	0	0	0	0	0	2	0	2
		section 33, 36	4.9	0	0	0	0	0	0	2	0	2
		section 33	6.26	0	0	0	0	0	0	1	0	1
		section 33	5.46	0	0	0	0	0	0	1	0	1
		section 34-35	4.5	0	0	0	0	0	0	2	0	2
		section 34-35	4.125	0	0	0	0	0	0	2	0	2
		section 36,37	5.4	0	0	0	0	0	0	2	0	2
			6.75	0	0	0	0	0	0	3	0	3
			2.702	0	0	0	0	0	0	1	0	1
			5.1	0	0	0	0	0	0	5	0	5

			5.4	0	0	0	0	0	0	4	0	4
			2.49	0	0	0	0	0	0	2	0	2
GB3	600 x 600 mm		All	11	13	19	12	11	15	34	15	130
		section 1-9, 14-23	7.045	9	2	15	2	9	1	0	1	39
			7.5	0	0	1	0	0	0	0	0	1
		estimated	2.851	0	0	1	0	0	0	0	0	1
		estimated	2.585	0	0	2	0	0	0	0	0	2
		section 10-11, 28	5.393	0	2	0	2	0	1	0	1	6
		section 12, 26	5.39	0	1	0	1	0	1	0	1	4
		section 13, 25	5.392	0	1	0	1	0	1	0	1	4
		estimated	7	0	4	0	4	0	0	0	0	8
		estimated	6.25	0	2	0	1	0	0	0	0	3
		estimated	6.5	0	1	0	0	0	0	0	0	1
		estimated	5.8	0	0	0	1	0	0	0	0	1
		section 23	7.683	2	0	0	0	2	0	0	0	4
			6.45	0	0	0	0	0	1	0	1	2
		section 27	5.389	0	0	0	0	0	1	0	1	2
			6.45	0	0	0	0	0	1	7	1	9
		section 29	7.855	0	0	0	0	0	1	0	1	2
			6.75	0	0	0	0	0	7	0	7	14
		section 30	7.765	0	0	0	0	0	0	15	0	15
			5.1	0	0	0	0	0	0	2	0	2
			5.4	0	0	0	0	0	0	4	0	4
			6.9	0	0	0	0	0	0	4	0	4
			5.4	0	0	0	0	0	0	2	0	2
GB4	450 x 450mm	estimated	2.1	0	0	0	0	0	0	2	0	2
GB5	750 x 600mm		All	2	0	0	0	2	0	8	0	12
		section 22	2.375	1	0	0	0	1	0	0	0	2
		section 22	7.17	1	0	0	0	1	0	0	0	2
		section 34	7.082	0	0	0	0	0	0	1	0	1

		section 34	6.407	0	0	0	0	0	0	1	0	1
		section 35	6.959	0	0	0	0	0	0	1	0	1
		section 35	7.934	0	0	0	0	0	0	1	0	1
		section 36	7.269	0	0	0	0	0	0	1	0	1
		section 36	7.769	0	0	0	0	0	0	1	0	1
		section 37	8.239	0	0	0	0	0	0	1	0	1
			6.75	0	0	0	0	0	0	1	0	1
Stair tower	600 x 750 mm		All	0	0	0	0	0	0	12	0	12
			6.25	0	0	0	0	0	0	4	0	4
			4.78	0	0	0	0	0	0	8	0	8
Stair tower	450 x 450 mm		6.25	0	0	0	0	0	0	2	0	2

Table 16: Quantities and sizes of Ground Beams

Mass of Concrete in Ground Beams						
Ref	**Type**	**Length (m)**	**Volume (m3)**	**Mass (kg)**	**Quantity**	**Total Mass (kg)**
GB1	300 x 600 mm	All			147	
		5.19	0.934	2242.08	63	141251.040
		5.25	0.945	2268	79	179172.000
		4.815	0.867	2080.08	2	4160.160
		2.1	0.378	907.2	2	1814.400
		3.525	0.635	1522.8	1	1522.800
GB2	450 x 600 mm	All			209	
		6.795	1.835	4403.16	11	48434.760
		4.05	1.094	2624.4	1	2624.400
		3.975	1.073	2575.8	2	5151.600
		3.75	1.013	2430	2	4860.000
		3.375	0.911	2187	2	4374.000

		2.851	0.770	1847.448	2	3694.896
		2.175	0.587	1409.4	2	2818.800
		2	0.540	1296	1	1296.000
		9.27	2.503	6006.96	2	12013.920
		7.17	1.936	4646.16	6	27876.960
		7.5	2.025	4860	37	179820.000
		3.948	1.066	2558.304	4	10233.216
		3.25	0.878	2106	4	8424.000
		2.1	0.567	1360.8	8	10886.400
		4	1.080	2592	8	20736.000
		3.25	0.878	2106	8	16848.000
		3.955	1.068	2562.84	4	10251.360
		7	1.890	4536	4	18144.000
		6.25	1.688	4050	1	4050.000
		5.25	1.418	3402	1	3402.000
		5.05	1.364	3272.4	2	6544.800
		6.5	1.755	4212	1	4212.000
		7.17	1.936	4646.16	16	74338.560
		2.375	0.641	1539	4	6156.000
		3.114	0.841	2017.872	2	4035.744
		3.181	0.859	2061.288	4	8245.152
		3.329	0.899	2157.192	2	4314.384
		6.45	1.742	4179.6	4	16718.400
		5.25	1.418	3402	3	10206.000
		6.75	1.823	4374	4	17496.000
		2.8	0.756	1814.4	4	7257.600
		14.532	3.924	9416.736	8	75333.888
		6.25	1.688	4050	2	8100.000
		7.5	2.025	4860	5	24300.000
		3	0.810	1944	2	3888.000

		6.075	1.640	3936.6	2	7873.200
		1.217	0.329	788.616	2	1577.232
		4.95	1.337	3207.6	4	12830.400
		2.96	0.799	1918.08	2	3836.160
		5.013	1.354	3248.424	2	6496.848
		4.9	1.323	3175.2	2	6350.400
		6.26	1.690	4056.48	1	4056.480
		5.46	1.474	3538.08	1	3538.080
		4.5	1.215	2916	2	5832.000
		4.125	1.114	2673	2	5346.000
		5.4	1.458	3499.2	2	6998.400
		6.75	1.823	4374	3	13122.000
		2.702	0.730	1750.896	1	1750.896
		5.1	1.377	3304.8	5	16524.000
		5.4	1.458	3499.2	4	13996.800
		2.49	0.672	1613.52	2	3227.040
GB3	600 x 600 mm	All			130	
		7.045	2.536	6086.88	39	237388.320
		7.5	2.700	6480	1	6480.000
		2.851	1.026	2463.264	1	2463.264
		2.585	0.931	2233.44	2	4466.880
		5.393	1.941	4659.552	6	27957.312
		5.39	1.940	4656.96	4	18627.840
		5.392	1.941	4658.688	4	18634.752
		7	2.520	6048	8	48384.000
		6.25	2.250	5400	3	16200.000
		6.5	2.340	5616	1	5616.000
		5.8	2.088	5011.2	1	5011.200
		7.683	2.766	6638.112	4	26552.448
		6.45	2.322	5572.8	2	11145.600

		5.389	1.940	4656.096	2	9312.192
		6.45	2.322	5572.8	9	50155.200
		7.855	2.828	6786.72	2	13573.440
		6.75	2.430	5832	14	81648.000
		7.765	2.795	6708.96	15	100634.400
		5.1	1.836	4406.4	2	8812.800
		5.4	1.944	4665.6	4	18662.400
		6.9	2.484	5961.6	4	23846.400
		5.4	1.944	4665.6	2	9331.200
GB4	450 x 450mm	2.1	0.425	1020.6	2	2041.200
GB5	750 x 600mm	All			12	
		2.375	1.069	2565	2	5130.000
		7.17	3.227	7743.6	2	15487.200
		7.082	3.187	7648.56	1	7648.560
		6.407	2.883	6919.56	1	6919.560
		6.959	3.132	7515.72	1	7515.720
		7.934	3.570	8568.72	1	8568.720
		7.269	3.271	7850.52	1	7850.520
		7.769	3.496	8390.52	1	8390.520
		8.239	3.708	8898.12	1	8898.120
		6.75	3.038	7290	1	7290.000
Stair tower	600 x 750 mm	All			12	
		6.25	2.813	6750	4	27000.000
		4.78	2.151	5162.4	8	41299.200
Stair tower	450 x 450 mm	6.25	1.266	3037.5	2	6075.000
Total Mass of Concrete in the ground Beams						**1872130**

Table 17: Mass of concrete in Ground Beams

Mass of Reinforcement in Ground Beams in East Stand								
Found on Grid Lines:	**Rebar Type**	**Mass (kg/m)**	**Length (m)**	**Mass of Bar (kg)**	**Rebar Quantity**	**Mass all Bars (kg)**	**Quantity of ground beams**	**Total Mass (kg)**
31 & 43	T32	6.313	9.269	58.515	4	234.061	2	468.122
30,31,43,44	T25	3.854	1.75	6.745	4	26.978	4	107.912
30,31,43,44	T20	2.466	1.75	4.316	4	17.262	4	69.048
30,31,43,44	T16	1.579	1.625	2.566	2	5.132	4	20.527
31 & 43	T25	3.854	9.269	35.723	4	142.891	2	285.782
30,31,43,44	T16	1.579	1.25	1.974	2	3.948	4	15.790
30,31,43,44	T20	2.466	1.8	4.439	4	17.755	4	71.021
30,31,43,44	T25	3.854	1.975	7.612	4	30.447	4	121.786
31 & 43	T16	1.579	10.019	15.820	2	31.640	2	63.280
30-44	T25	3.854	1.975	7.612	6	45.670	15	685.049
30-44	T16	1.579	1.25	1.974	2	3.948	15	59.213
30-44	T32	6.313	2.225	14.046	6	84.279	15	1264.178
30-44	T32	6.313	7.045	44.475	6	266.851	15	4002.758
30-44	T40	9.864	7.045	69.492	6	416.951	15	6254.269
30-44	T16	1.579	7.045	11.124	2	22.248	15	333.722
30-44	T32	6.313	2.025	12.784	4	51.135	15	767.030
30-44	T25	3.854	1.775	6.841	4	27.363	15	410.451
30-44	T16	1.579	2	3.158	2	6.316	15	94.740
30-44	T32	6.313	1.175	7.418	2	14.836	15	222.533
30-44	T25	3.854	0.925	3.565	2	7.130	15	106.949
30-44	T32	6.313	5.25	33.143	2	66.287	15	994.298
30-44	T16	1.579	5.25	8.290	2	16.580	15	248.693
30-44	T40	9.864	5.25	51.786	2	103.572	15	1553.580
30-44	T32	6.313	3.1	19.570	2	39.141	15	587.109
30-44	T16	1.579	2	3.158	2	6.316	15	94.740
30-44	T25	3.854	2.6	10.020	2	20.041	15	300.612
30-44	T32	6.313	5.94	37.499	2	74.998	15	1124.977

30-44	T40	9.864	5.19	51.194	2	102.388	15	1535.825
30-44	T16	1.579	5.19	8.195	2	16.390	15	245.850
30-44	T25	3.854	1.675	6.455	2	12.911	15	193.664
30-44	T16	1.579	1.375	2.171	2	4.342	15	65.134
30-44	T32	6.313	1.925	12.153	2	24.305	15	364.576
30 & 44	T32	6.313	8.295	52.366	4	209.465	2	418.931
30 & 44	T25	3.854	8.295	31.969	4	127.876	2	255.751
30 & 44	T16	1.579	9.045	14.282	2	28.564	2	57.128
30-44	T12	0.89	1.2	1.068	26	27.768	15	416.520
30-44	T12	0.89	1.2	1.068	26	27.768	15	416.520
30-44	T12	0.89	2.2	1.958	70	137.060	15	2055.900
31 & 43	T12	0.89	1.5	1.335	42	56.070	2	112.140
30 & 44	T12	0.89	1.5	1.335	42	56.070	2	112.140
32-42	T20	2.466	1.5	3.699	4	14.796	11	162.756
32-42	T16	1.579	1.25	1.974	2	3.948	11	43.423
32-42	T25	3.854	1.85	7.130	4	28.520	11	313.716
32-42	T25	3.854	6.795	26.188	4	104.752	11	1152.269
32-42	T16	1.579	6.795	10.729	2	21.459	11	236.045
32-42	T32	6.313	6.795	42.897	4	171.587	11	1887.461
32-42	T20	2.466	2.25	5.549	4	22.194	11	244.134
32-42	T16	1.579	2	3.158	2	6.316	11	69.476
32-42	T25	3.854	2.6	10.020	4	40.082	11	440.898
32-42	T12	0.89	1.5	1.335	34	45.390	11	499.290
32-42	T20	2.466	1.5	3.699	4	14.796	11	162.756
32-42	T25	3.854	1.5	5.781	4	23.124	11	254.364
32-42	T16	1.579	1.375	2.171	2	4.342	11	47.765
32 & 42	T16	1.579	2.175	3.434	2	6.869	2	13.737
33 & 41	T16	1.579	2.852	4.503	4	18.013	2	36.026
34 & 40	T16	1.579	3.375	5.329	4	21.317	2	42.633
35 & 39	T16	1.579	3.75	5.921	4	23.685	2	47.370

36 & 38	T16	1.579	3.976	6.278	4	25.112	2	50.225
37	T16	1.579	4.05	6.395	4	25.580	1	25.580
32 & 42	T25	3.854	2.175	8.382	4	33.530	2	67.060
33 & 41	T25	3.854	2.852	10.992	4	43.966	2	87.933
34 & 40	T25	3.854	3.375	13.007	4	52.029	2	104.058
35 & 39	T25	3.854	3.75	14.453	4	57.810	2	115.620
36 & 38	T25	3.854	3.976	15.324	4	61.294	2	122.588
37	T25	3.854	4.05	15.609	4	62.435	1	62.435
32 & 42	T32	6.313	2.175	13.731	4	54.923	2	109.846
33 & 41	T32	6.313	2.852	18.005	4	72.019	2	144.037
34 & 40	T32	6.313	3.375	21.306	4	85.226	2	170.451
35 & 39	T32	6.313	3.75	23.674	4	94.695	2	189.390
36 & 38	T32	6.313	3.976	25.100	4	100.402	2	200.804
37	T32	6.313	4.05	25.568	4	102.271	1	102.271
32 & 42	T12	0.89	1.5	1.335	11	14.685	2	29.370
33 & 41	T12	0.89	1.5	1.335	14	18.690	2	37.380
34 & 40	T12	0.89	1.5	1.335	17	22.695	2	45.390
35 & 39	T12	0.89	1.5	1.335	19	25.365	2	50.730
36 & 38	T12	0.89	1.5	1.335	20	26.700	2	53.400
37	T12	0.89	1.5	1.335	21	28.035	1	28.035
Total mass of reinforcement in ground beams in the East Stand								**34029**

Table 18: Mass of reinforcement in Ground Beams in the East Stand

Mass of Reinforcement in Ground Beams in North & South East corners								
Found on Grid Lines:	**Rebar Type**	**Mass (kg/m)**	**Length (m)**	**Mass of Bar (kg)**	**Rebar Quantity**	**Mass all Bars (kg)**	**Quantity of ground beams**	**Total Mass (kg)**
24, 25, 28, 29, 45, 46, 49, 50	T32	6.313	1.925	12.153	2	24.305	8	194.440
24, 25, 28, 29, 45, 46, 49, 50	T16	1.579	1.375	2.171	2	4.342	8	34.738
24, 25, 28, 29, 45, 46, 49, 50	T25	3.854	1.675	6.455	2	12.911	8	103.287

24, 25, 28, 29, 45, 46, 49, 50	T32	6.313	5.19	32.764	2	65.529	8	524.232
24, 25, 28, 29, 45, 46, 49, 50	T16	1.579	5.19	8.195	2	16.390	8	131.120
24, 25, 28, 29, 45, 46, 49, 50	T40	9.864	5.19	51.194	2	102.388	8	819.107
24, 25, 28, 29, 45, 46, 49, 50	T32	6.313	3.1	19.570	2	39.141	8	313.125
24, 25, 28, 29, 45, 46, 49, 50	T25	3.854	2.6	10.020	2	20.041	8	160.326
24, 25, 28, 29, 45, 46, 49, 50	T16	1.579	2	3.158	2	6.316	8	50.528
24, 25, 28, 29, 45, 46, 49, 50	T32	6.313	5.25	33.143	2	66.287	8	530.292
24, 25, 28, 29, 45, 46, 49, 50	T40	9.864	5.25	51.786	2	103.572	8	828.576
24, 25, 28, 29, 45, 46, 49, 50	T16	1.579	5.25	8.290	2	16.580	8	132.636
24, 25, 28, 29, 45, 46, 49, 50	T32	6.313	1.55	9.785	2	19.570	8	156.562
24, 25, 28, 29, 45, 46, 49, 50	T16	1.579	1	1.579	2	3.158	8	25.264
24, 25, 28, 29, 45, 46, 49, 50	T25	3.854	1.3	5.010	2	10.020	8	80.163
24, 25, 28, 29, 45, 46, 49, 50	T25	3.854	1.3	5.010	4	20.041	8	160.326
24, 25, 28, 29, 45, 46, 49, 50	T16	1.579	1	1.579	2	3.158	8	25.264
24, 25, 28, 29, 45, 46, 49, 50	T32	6.313	1.55	9.785	4	39.141	8	313.125
24, 25, 28, 29, 45, 46, 49, 50	T12	0.89	1.2	1.068	26	27.768	8	222.144
24, 25, 28, 29, 45, 46, 49, 50	T12	0.89	1.2	1.068	26	27.768	8	222.144
24, 29, 45, 50	T40	9.864	8.244	81.319	6	487.913	4	1951.652
24, 29, 45, 50	T32	6.313	8.244	52.044	6	312.266	4	1249.065
24, 29, 45, 50	T16	1.579	8.244	13.017	2	26.035	4	104.138
24, 29, 45, 50	T16	1.579	1.375	2.171	2	4.342	4	17.369
24, 29, 45, 50	T25	3.854	1.85	7.130	6	42.779	4	171.118
24, 29, 45, 50	T32	6.313	2.375	14.993	6	89.960	4	359.841
24, 29, 45, 50	T25	3.854	1.675	6.455	4	25.822	4	103.287
24, 29, 45, 50	T16	1.579	1.375	2.171	2	4.342	4	17.369
24, 29, 45, 50	T20	2.466	1.5	3.699	4	14.796	4	59.184
24, 29, 45, 50	T16	1.579	6.795	10.729	2	21.459	4	85.834
24, 29, 45, 50	T25	3.854	6.795	26.188	4	104.752	4	419.007
24, 29, 45, 50	T32	6.313	6.795	42.897	4	171.587	4	686.349
24, 29, 45, 50	T16	1.579	1.375	2.171	2	4.342	4	17.369

24, 29, 45, 50	T20	2.466	1.675	4.131	4	16.522	4	66.089
24, 29, 45, 50	T25	3.854	1.675	6.455	4	25.822	4	103.287
24, 29, 45, 50	T10	0.617	1.5	0.926	32	29.616	4	118.464
24, 29, 45, 50	T12	0.89	1.8	1.602	70	112.140	4	448.560
25, 28, 46, 49	T16	1.579	5.388	8.508	2	17.015	4	68.061
25, 28, 46, 49	T32	6.313	5.388	34.014	6	204.087	4	816.347
25, 28, 46, 49	T40	9.864	5.388	53.147	6	318.883	4	1275.534
25, 28, 46, 49	T25	3.854	1.3	5.010	6	30.061	4	120.245
25, 28, 46, 49	T16	1.579	1	1.579	2	3.158	4	12.632
25, 28, 46, 49	T32	6.313	1.55	9.785	6	58.711	4	234.844
25, 28, 46, 49	T25	3.854	1.3	5.010	4	20.041	4	80.163
25, 28, 46, 49	T20	2.466	1.125	2.774	4	11.097	4	44.388
25, 28, 46, 49	T16	1.579	1	1.579	2	3.158	4	12.632
25, 28, 46, 49	T16	1.579	7.456	11.773	2	23.546	4	94.184
25, 28, 46, 49	T25	3.854	7.456	28.735	4	114.942	4	459.767
25, 28, 46, 49	T32	6.313	7.456	47.070	4	188.279	4	753.116
25, 28, 46, 49	T25	3.854	2	7.708	4	30.832	4	123.328
25, 28, 46, 49	T20	2.466	1.5	3.699	4	14.796	4	59.184
25, 28, 46, 49	T16	1.579	1.5	2.369	2	4.737	4	18.948
25, 28, 46, 49	T10	0.617	2.1	1.296	4	5.183	4	20.731
25, 28, 46, 49	T10	0.617	1.5	0.926	37	34.244	4	136.974
25, 28, 46, 49	T12	0.89	1.8	1.602	52	83.304	4	333.216
beam adj to 26, 27, 47, 48	T25	3.854	1.775	6.841	2	13.682	4	54.727
beam adj to 26, 27, 47, 48	T16	1.579	1.375	2.171	2	4.342	4	17.369
beam adj to 26, 27, 47, 48	T32	6.313	2.025	12.784	2	25.568	4	102.271
beam adj to 26, 27, 47, 48	T16	1.579	5.25	8.290	2	16.580	4	66.318
beam adj to 26, 27, 47, 48	T32	6.313	5.25	33.143	2	66.287	4	265.146
beam adj to 26, 27, 47, 48	T40	9.864	5.25	51.786	2	103.572	4	414.288
beam adj to 26, 27, 47, 48	T16	1.579	1.375	2.171	2	4.342	4	17.369
beam adj to 26, 27, 47, 48	T25	3.854	1.675	6.455	2	12.911	4	51.644

beam adj to 26, 27, 47, 48	T32	6.313	1.925	12.153	2	24.305	4	97.220
beam adj to 26, 27, 47, 48	T12	0.89	1.2	1.068	26	27.768	4	111.072
26, 27, 47, 48	T32	6.313	2.025	12.784	4	51.135	4	204.541
26, 27, 47, 48	T16	1.579	1.375	2.171	2	4.342	4	17.369
26, 27, 47, 48	T25	3.854	1.6	6.166	4	24.666	4	98.662
26, 27, 47, 48	T32	6.313	5.19	32.764	4	131.058	4	524.232
26, 27, 47, 48	T40	9.864	5.19	51.194	4	204.777	4	819.107
26, 27, 47, 48	T16	1.579	5.19	8.195	2	16.390	4	65.560
26, 27, 47, 48	T16	1.579	1	1.579	2	3.158	4	12.632
26, 27, 47, 48	T25	3.854	1.3	5.010	4	20.041	4	80.163
26, 27, 47, 48	T32	6.313	1.55	9.785	4	39.141	4	156.562
26, 27, 47, 48	T20	2.466	1.2	2.959	26	76.939	4	307.757
26, 27, 47, 48	T25	3.854	1.3	5.010	2	10.020	4	40.082
26, 27, 47, 48	T16	1.579	1	1.579	2	3.158	4	12.632
26, 27, 47, 48	T32	6.313	1.55	9.785	2	19.570	4	78.281
26, 27, 47, 48	T16	1.579	5.25	8.290	2	16.580	4	66.318
26, 27, 47, 48	T25	3.854	5.25	20.234	2	40.467	4	161.868
26, 27, 47, 48	T40	9.864	5.25	51.786	2	103.572	4	414.288
26, 27, 47, 48	T32	6.313	1.55	9.785	2	19.570	4	78.281
26, 27, 47, 48	T16	1.579	1	1.579	2	3.158	4	12.632
26, 27, 47, 48	T25	3.854	1.3	5.010	2	10.020	4	40.082
26, 27, 47, 48	T32	6.313	1.55	9.785	4	39.141	4	156.562
26, 27, 47, 48	T16	1.579	1	1.579	2	3.158	4	12.632
26, 27, 47, 48	T25	3.854	1.3	5.010	4	20.041	4	80.163
26, 27, 47, 48	T16	1.579	5.388	8.508	2	17.015	4	68.061
26, 27, 47, 48	T32	6.313	5.388	34.014	6	204.087	4	816.347
26, 27, 47, 48	T40	9.864	5.388	53.147	6	318.883	4	1275.534
26, 27, 47, 48	T32	6.313	1.55	9.785	2	19.570	4	78.281
26, 27, 47, 48	T16	1.579	1	1.579	2	3.158	4	12.632
26, 27, 47, 48	T25	3.854	1.3	5.010	2	10.020	4	40.082

26, 27, 47, 48	T25	3.854	1.3	5.010	4	20.041	4	80.163
26, 27, 47, 48	T20	2.466	1.125	2.774	4	11.097	4	44.388
26, 27, 47, 48	T16	1.579	1	1.579	2	3.158	4	12.632
26, 27, 47, 48	T16	1.579	6.2	9.790	2	19.580	4	78.318
26, 27, 47, 48	T25	3.854	6.2	23.895	4	95.579	4	382.317
26, 27, 47, 48	T32	6.313	6.2	39.141	4	156.562	4	626.250
26, 27, 47, 48	T20	2.466	1.5	3.699	4	14.796	4	59.184
26, 27, 47, 48	T16	1.579	1.5	2.369	2	4.737	4	18.948
26, 27, 47, 48	T25	3.854	2.25	8.672	4	34.686	4	138.744
26, 27, 47, 48	T10	0.617	2.25	1.388	4	5.553	4	22.212
26, 27, 47, 48	T10	0.617	1.5	0.926	31	28.691	4	114.762
26, 27, 47, 48	T12	0.89	1.8	1.602	52	83.304	4	333.216
26, 27, 47, 48	T12	0.89	1.2	1.068	26	27.768	4	111.072
Between 23 & 25, 49 & 51	T10	0.617	1.8	1.111	2	2.221	4	8.885
Between 23 & 25, 49 & 51	T20	2.466	1.65	4.069	4	16.276	4	65.102
Between 23 & 25, 49 & 51	T20	2.466	1.65	4.069	4	16.276	4	65.102
Between 23 & 25, 49 & 51	T16	1.579	1.05	1.658	4	6.632	4	26.527
Between 23 & 25, 49 & 51	T25	3.854	6.8	26.207	4	104.829	4	419.315
Between 23 & 25, 49 & 51	T20	2.466	6.8	16.769	4	67.075	4	268.301
Between 23 & 25, 49 & 51	T16	1.579	6.8	10.737	2	21.474	4	85.898
Between 23 & 25, 49 & 51	T20	2.466	1.3	3.206	4	12.823	4	51.293
Between 23 & 25, 49 & 51	T16	1.579	1	1.579	4	6.316	4	25.264
Between 23 & 25, 49 & 51	T16	1.579	1.125	1.776	4	7.106	4	28.422
Between 23 & 25, 49 & 51	T10	0.617	1.5	0.926	34	31.467		0.000
Between 23 & 25, 49 & 51	T20	2.466	1.3	3.206	4	12.823	2	25.646
Between 23 & 25, 49 & 51	T16	1.579	1	1.579	2	3.158	2	6.316
Between 23 & 25, 49 & 51	T16	1.579	1.125	1.776	4	7.106	2	14.211
Between 23 & 25, 49 & 51	T16	1.579	5	7.895	2	15.790	2	31.580
Between 23 & 25, 49 & 51	T20	2.466	5	12.330	4	49.320	2	98.640
Between 23 & 25, 49 & 51	T25	3.854	5	19.270	4	77.080	2	154.160

Between 23 & 25, 49 & 51	T16	1.579	1.05	1.658	2	3.316	2	6.632
Between 23 & 25, 49 & 51	T16	1.579	1.225	1.934	4	7.737	2	15.474
Between 23 & 25, 49 & 51	T20	2.466	1.325	3.267	4	13.070	2	26.140
Between 23 & 25, 49 & 51	T20	2.466	1.5	3.699	25	92.475	2	184.950
On line C3	T16	1.579	1.375	2.171	2	4.342	3	13.027
On line C3	T20	2.466	1.5	3.699	5	18.495	3	55.485
On line C3	T32	6.313	1.925	12.153	5	60.763	3	182.288
On line C3	T16	1.579	9.6	15.158	2	30.317	3	90.950
On line C3	T25	3.854	9.6	36.998	5	184.992	3	554.976
On line C3	T40	9.864	9.6	94.694	5	473.472	3	1420.416
On line C3	T16	1.579	1.375	2.171	2	4.342	3	13.027
On line C3	T20	2.466	1.5	3.699	5	18.495	3	55.485
On line C3	T32	6.313	1.925	12.153	5	60.763	3	182.288
On line C3	T10	0.617	1.8	1.111	48	53.309	3	159.926
Between 28 & 29	T16	1.579	1.05	1.658	2	3.316	1	3.316
Between 28 & 29	T16	1.579	1.225	1.934	4	7.737	1	7.737
Between 28 & 29	T20	2.466	1.375	3.391	4	13.563	1	13.563
Between 28 & 29	T20	2.466	5	12.330	4	49.320	1	49.320
Between 28 & 29	T25	3.854	5	19.270	4	77.080	1	77.080
Between 28 & 29	T16	1.579	5	7.895	2	15.790	1	15.790
Between 28 & 29	T16	1.579	1.375	2.171	2	4.342	1	4.342
Between 28 & 29	T16	1.579	1.225	1.934	4	7.737	1	7.737
Between 28 & 29	T20	2.466	1.525	3.761	4	15.043	1	15.043
Between 28 & 29	T10	0.617	1.2	0.740	25	18.510	1	18.510
Between 45/C2 & 47/C3	T16	1.579	1.375	2.171	3	6.513	1	6.513
Between 45/C2 & 47/C3	T16	1.579	1.375	2.171	2	4.342	1	4.342
Between 45/C2 & 47/C3	T25	3.854	1.975	7.612	3	22.835	1	22.835
Between 45/C2 & 47/C3	T16	1.579	5.8	9.158	2	18.316	1	18.316
Between 45/C2 & 47/C3	T16	1.579	5.8	9.158	3	27.475	1	27.475
Between 45/C2 & 47/C3	T32	6.313	5.8	36.615	3	109.846	1	109.846

Between 45/C2 & 47/C3	T16	1.579	1.375	2.171	3	6.513	1	6.513
Between 45/C2 & 47/C3	T16	1.579	1.375	2.171	3	6.513	1	6.513
Between 45/C2 & 47/C3	T25	3.854	1.975	7.612	3	22.835	1	22.835
Between 45/C2 & 47/C3	T20	2.466	1.5	3.699	5	18.495	1	18.495
Between 45/C2 & 47/C3	T16	1.579	1.25	1.974	2	3.948	1	3.948
Between 45/C2 & 47/C3	T32	6.313	1.925	12.153	5	60.763	1	60.763
Between 45/C2 & 47/C3	T16	1.579	5	7.895	2	15.790	1	15.790
Between 45/C2 & 47/C3	T25	3.854	5	19.270	5	96.350	1	96.350
Between 45/C2 & 47/C3	T40	9.864	5	49.320	5	246.600	1	246.600
Between 45/C2 & 47/C3	T16	1.579	1.25	1.974	2	3.948	1	3.948
Between 45/C2 & 47/C3	T20	2.466	1.5	3.699	5	18.495	1	18.495
Between 45/C2 & 47/C3	T32	6.313	2.225	14.046	5	70.232	1	70.232
Between 45/C2 & 47/C3	T10	0.617	1.8	1.111	25	27.765	1	27.765
Between 45/C2 & 47/C3	T10	0.617	1.2	0.740	29	21.472	1	21.472
25A, 27A, 46A, 48A	T10	0.617	2	1.234	6	7.404	4	29.616
25A, 27A, 46A, 48A	T16	1.579	1.375	2.171	2	4.342	4	17.369
25A, 27A, 46A, 48A	T20	2.466	1.2	2.959	4	11.837	4	47.347
25A, 27A, 46A, 48A	T25	3.854	1.95	7.515	4	30.061	4	120.245
25A, 27A, 46A, 48A	T16	1.579	6.2	9.790	2	19.580	4	78.318
25A, 27A, 46A, 48A	T25	3.854	6.2	23.895	4	95.579	4	382.317
25A, 27A, 46A, 48A	T32	6.313	6.2	39.141	4	156.562	4	626.250
25A, 27A, 46A, 48A	T20	2.466	1.05	2.589	4	10.357	4	41.429
25A, 27A, 46A, 48A	T10	0.617	1.2	0.740	2	1.481	4	5.923
25A, 27A, 46A, 48A	T10	0.617	1.8	1.111	31	34.429	4	137.714
Total mass of reinforcement in perimeter beams in the North and South East Corners								**31464**

Table 19: Mass of reinforcement in Ground Beams in the North & South East corners

Mass of Reinforcement in Ground Beams in South Stand								
Found on Grid Lines:	**Rebar Type**	**Mass (kg/m)**	**Length (m)**	**Mass of Bar (kg)**	**Rebar Quantity**	**Mass all Bars (kg)**	**Quantity of ground beams**	**Total Mass (kg)**
15 & 23	T16	1.579	1.5	2.369	2	4.737	2	9.474
15 & 23	T25	3.854	1.65	6.359	6	38.155	2	76.309
15 & 23	T32	6.313	1.8	11.363	6	68.180	2	136.361
15 & 23	T32	6.313	8.132	51.337	6	308.024	2	616.048
15 & 23	T40	9.864	8.132	80.214	6	481.284	2	962.569
15 & 23	T16	1.579	8.132	12.840	2	25.681	2	51.362
15 & 23	T16	1.579	1.3	2.053	2	4.105	2	8.211
15 & 23	T25	3.854	3.4	13.104	6	78.622	2	157.243
15 & 23	T16	1.579	1.3	2.053	2	4.105	2	8.211
15 & 23	T32	6.313	3.9	24.621	6	147.724	2	295.448
15 & 23	T32	6.313	7.045	44.475	6	266.851	2	533.701
15 & 23	T16	1.579	7.045	11.124	2	22.248	2	44.496
15 & 23	T40	9.864	7.045	69.492	6	416.951	2	833.903
15 & 23	T12	0.89	1.8	1.602	82	131.364	2	262.728
15 & 23	T12	0.89	1.8	1.602	70	112.140	2	224.280
15 - 23	T25	3.854	1.3	5.010	2	10.020	9	90.184
15 - 23	T16	1.579	1	1.579	2	3.158	9	28.422
15 - 23	T32	6.313	1.55	9.785	4	39.141	9	352.265
15 - 23	T16	1.579	1	1.579	2	3.158	9	28.422
15 - 23	T25	3.854	1.3	5.010	2	10.020	9	90.184
15 - 23	T32	6.313	1.55	9.785	2	19.570	9	176.133
15 - 23	T32	6.313	5.25	33.143	2	66.287	9	596.579
15 - 23	T40	9.864	5.25	51.786	2	103.572	9	932.148
15 - 23	T16	1.579	5.25	8.290	2	16.580	9	149.216
15 - 23	T32	6.313	3.1	19.570	2	39.141	9	352.265
15 - 23	T16	1.579	2	3.158	2	6.316	9	56.844
15 - 23	T25	3.854	2.6	10.020	2	20.041	9	180.367

15 - 23	T32	6.313	5.19	32.764	2	65.529	9	589.760
15 - 23	T16	1.579	5.19	8.195	2	16.390	9	147.510
15 - 23	T40	9.864	5.19	51.194	2	102.388	9	921.495
15 - 23	T25	3.854	1.5	5.781	2	11.562	9	104.058
15 - 23	T16	1.579	1.5	2.369	2	4.737	9	42.633
15 - 23	T32	6.313	3.1	19.570	2	39.141	9	352.265
15 - 23	T12	0.89	1.2	1.068	26	27.768	9	249.912
15 - 23	T12	0.89	1.2	1.068	26	27.768	9	249.912
16	T20	2.466	1.5	3.699	6	22.194	1	22.194
16	T16	1.579	1.25	1.974	3	5.921	1	5.921
16	T25	3.854	1.975	7.612	6	45.670	1	45.670
16	T25	3.854	3.572	13.766	6	82.599	1	82.599
16	T16	1.579	3.572	5.640	2	11.280	1	11.280
16	T32	6.313	3.572	22.550	6	135.300	1	135.300
16	T16	1.579	2	3.158	2	6.316	1	6.316
16	T20	2.466	2.25	5.549	6	33.291	1	33.291
16	T25	3.854	2.6	10.020	6	60.122	1	60.122
16	T25	3.854	4.397	16.946	6	101.676	1	101.676
16	T32	6.313	4.397	27.758	6	166.550	1	166.550
16	T16	1.579	4.397	6.943	2	13.886	1	13.886
16	T16	1.579	2	3.158	2	6.316	1	6.316
16	T25	3.854	2.6	10.020	6	60.122	1	60.122
16	T32	6.313	3.1	19.570	6	117.422	1	117.422
16	T12	0.89	2.1	1.869	36	67.284	1	67.284
16	T12	0.89	2.1	1.869	44	82.236	1	82.236
16	T32	6.313	7.87	49.683	6	298.100	1	298.100
16	T40	9.864	7.87	77.630	6	465.778	1	465.778
16	T16	1.579	7.87	12.427	2	24.853	1	24.853
16 - 22	T12	0.89	1.8	1.602	78	124.956	7	874.692
17-22	T32	6.313	7.045	44.475	6	266.851	6	1601.103

17-22	T40	9.864	7.045	69.492	6	416.951	6	2501.708
17-22	T16	1.579	7.045	11.124	2	22.248	6	133.489
17-22	T25	3.854	1.85	7.130	6	42.779	6	256.676
17-22	T16	1.579	1.25	1.974	2	3.948	6	23.685
17-22	T32	6.313	2.35	14.836	6	89.013	6	534.080
17-22	T20	2.466	1.85	4.562	4	18.248	6	109.490
17-22	T16	1.579	1.25	1.974	2	3.948	6	23.685
17-22	T25	3.854	2.1	8.093	4	32.374	6	194.242
17-21	T25	3.854	6.795	26.188	4	104.752	5	523.759
17-21	T32	6.313	6.795	42.897	4	171.587	5	857.937
17-21	T16	1.579	6.795	10.729	2	21.459	5	107.293
17-21	T12	0.89	1.5	1.335	32	42.720	5	213.600
17-21	T25	3.854	2.6	10.020	4	40.082	5	200.408
17-21	T16	1.579	2	3.158	2	6.316	5	31.580
17-21	T20	2.466	2.25	5.549	4	22.194	5	110.970
17-21	T20	2.466	1.6	3.946	4	15.782	5	78.912
17-21	T16	1.579	1.25	1.974	2	3.948	5	19.738
17-21	T20	2.466	1.6	3.946	4	15.782	5	78.912
17 & 21	T25	3.854	2.363	9.107	4	36.428	2	72.856
17 & 21	T32	6.313	2.363	14.918	4	59.670	2	119.341
17 & 21	T16	1.579	2.363	3.731	2	7.462	2	14.925
17 & 21	T12	0.89	1.5	1.335	12	16.020	2	32.040
18 & 20	T25	3.854	2.805	10.810	4	43.242	2	86.484
18 & 20	T32	6.313	2.805	17.708	4	70.832	2	141.664
18 & 20	T16	1.579	2.805	4.429	2	8.858	2	17.716
18 & 20	T12	0.89	1.5	1.335	14	18.690	2	37.380
19	T25	3.854	2.954	11.385	4	45.539	1	45.539
19	T16	1.579	2.954	4.664	2	9.329	1	9.329
19	T32	6.313	2.954	18.649	4	74.594	1	74.594
19	T12	0.89	1.5	1.335	15	20.025	1	20.025

22	T25	3.854	9.169	35.337	4	141.349	1	141.349
22	T32	6.313	9.169	57.884	4	231.536	1	231.536
22	T16	1.579	9.169	14.478	2	28.956	1	28.956
22	T20	2.466	1.6	3.946	4	15.782	1	15.782
22	T25	3.854	1.6	6.166	4	24.666	1	24.666
22	T16	1.579	1.25	1.974	2	3.948	1	3.948
22	T12	0.89	1.5	1.335	42	56.070	1	56.070
Total mass of reinforcement in ground beams in the South Stand								**21368**

Table 20: Mass of reinforcement in Ground Beams in the South Stand

Mass of Reinforcement in Ground Beams in North Stand								
Found on Grid Lines:	**Rebar Type**	**Mass (kg/m)**	**Length (m)**	**Mass of Bar (kg)**	**Rebar Quantity**	**Mass all Bars (kg)**	**Quantity of ground beams**	**Total Mass (kg)**
51 & 59	T25	3.854	1.6	6.166	6	36.998	2	73.997
51 & 59	T16	1.579	1.25	1.974	2	3.948	2	7.895
51 & 59	T25	3.854	1.85	7.130	6	42.779	2	85.559
51 & 59	T32	6.313	8.132	51.337	6	308.024	2	616.048
51 & 59	T40	9.864	8.132	80.214	6	481.284	2	962.569
51 & 59	T16	1.579	8.132	12.840	2	25.681	2	51.362
51 & 59	T25	3.854	3.85	14.838	6	89.027	2	178.055
51 & 59	T16	1.579	1.4	2.211	4	8.842	2	17.685
51 & 59	T32	6.313	4.35	27.462	6	164.769	2	329.539
51 & 59	T32	6.313	7.045	44.475	6	266.851	2	533.701
51 & 59	T40	9.864	7.045	69.492	6	416.951	2	833.903
51 & 59	T16	1.579	7.045	11.124	2	22.248	2	44.496
51 & 59	T12	0.89	1.8	1.602	82	131.364	2	262.728
51 & 59	T12	0.89	1.8	1.602	70	112.140	2	224.280
51 - 59	T25	3.854	1.3	5.010	4	20.041	9	180.367
51 - 59	T16	1.579	1	1.579	2	3.158	9	28.422

51 - 59	T32	6.313	1.55	9.785	4	39.141	9	352.265
51 - 59	T16	1.579	1	1.579	2	3.158	9	28.422
51 - 59	T25	3.854	1.3	5.010	2	10.020	9	90.184
51 - 59	T32	6.313	1.55	9.785	2	19.570	9	176.133
51 - 59	T32	6.313	5.25	33.143	2	66.287	9	596.579
51 - 59	T40	9.864	5.25	51.786	2	103.572	9	932.148
51 - 59	T16	1.579	5.25	8.290	2	16.580	9	149.216
51 - 59	T16	1.579	2	3.158	2	6.316	9	56.844
51 - 59	T25	3.854	2.25	8.672	2	17.343	9	156.087
51 - 59	T32	6.313	2.6	16.414	2	32.828	9	295.448
51 - 59	T32	6.313	5.19	32.764	2	65.529	9	589.760
51 - 59	T16	1.579	5.19	8.195	2	16.390	9	147.510
51 - 59	T40	9.864	5.19	51.194	2	102.388	9	921.495
51 - 59	T25	3.854	1.6	6.166	2	12.333	9	110.995
51 - 59	T16	1.579	1.25	1.974	2	3.948	9	35.528
51 - 59	T32	6.313	1.775	11.206	2	22.411	9	201.700
51 - 59	T12	0.89	1.2	1.068	52	55.536	9	499.824
58	T20	2.466	1.5	3.699	6	22.194	1	22.194
58	T16	1.579	1.25	1.974	2	3.948	1	3.948
58	T25	3.854	1.85	7.130	6	42.779	1	42.779
58	T25	3.854	3.572	13.766	6	82.599	1	82.599
58	T32	6.313	3.572	22.550	6	135.300	1	135.300
58	T16	1.579	3.572	5.640	2	11.280	1	11.280
58	T16	1.579	2	3.158	2	6.316	1	6.316
58	T20	2.466	2.25	5.549	6	33.291	1	33.291
58	T25	3.854	2.6	10.020	6	60.122	1	60.122
58	T25	3.854	4.397	16.946	6	101.676	1	101.676
58	T32	6.313	4.397	27.758	6	166.550	1	166.550
58	T16	1.579	4.397	6.943	2	13.886	1	13.886
58	T16	1.579	2	3.158	2	6.316	1	6.316

58	T25	3.854	2.6	10.020	6	60.122	1	60.122
58	T32	6.313	3.1	19.570	6	117.422	1	117.422
58	T12	0.89	2.1	1.869	80	149.520	1	149.520
52 & 58	T40	9.864	7.87	77.630	6	465.778	2	931.556
52 & 58	T16	1.579	7.87	12.427	2	24.853	2	49.707
52 & 58	T32	6.313	7.87	49.683	6	298.100	2	596.200
52 & 58	T12	0.89	1.8	1.602	78	124.956	2	249.912
52	T20	2.466	1.425	3.514	4	14.056	1	14.056
52	T16	1.579	1.3	2.053	2	4.105	1	4.105
52	T25	3.854	1.425	5.492	4	21.968	1	21.968
52	T25	3.854	4.397	16.946	4	67.784	1	67.784
52	T32	6.313	4.397	27.758	4	111.033	1	111.033
52	T16	1.579	4.397	6.943	2	13.886	1	13.886
52	T16	1.579	2	3.158	2	6.316	1	6.316
52	T25	3.854	2.6	10.020	4	40.082	1	40.082
52	T20	2.466	2.25	5.549	4	22.194	1	22.194
52	T25	3.854	4.397	16.946	4	67.784	1	67.784
52	T32	6.313	4.397	27.758	4	111.033	1	111.033
52	T16	1.579	4.397	6.943	2	13.886	1	13.886
52	T20	2.466	1.125	2.774	4	11.097	1	11.097
52	T16	1.579	1	1.579	2	3.158	1	3.158
52	T25	3.854	1.3	5.010	4	20.041	1	20.041
52	T25	3.854	1.125	4.336	6	26.015	1	26.015
52	T16	1.579	1	1.579	2	3.158	1	3.158
52	T32	6.313	1.3	8.207	6	49.241	1	49.241
52	T12	0.89	1.5	1.335	44	58.740	1	58.740
53-57	T40	9.864	7.045	69.492	6	416.951	5	2084.756
53-57	T32	6.313	7.045	44.475	6	266.851	5	1334.253
53-57	T16	1.579	7.045	11.124	2	22.248	5	111.241
53-57	T25	3.854	1.85	7.130	6	42.779	5	213.897

53-57	T16	1.579	1.25	1.974	2	3.948	5	19.738
53-57	T32	6.313	3.275	20.675	6	124.050	5	620.252
53-57	T20	2.466	1.5	3.699	4	14.796	5	73.980
53-57	T16	1.579	1.25	1.974	2	3.948	5	19.738
53-57	T25	3.854	1.85	7.130	4	28.520	5	142.598
53-57	T25	3.854	6.795	26.188	4	104.752	5	523.759
53-57	T32	6.313	6.795	42.897	4	171.587	5	857.937
53-57	T16	1.579	6.795	10.729	2	21.459	5	107.293
53-57	T20	2.466	2.25	5.549	4	22.194	5	110.970
53-57	T16	1.579	2	3.158	2	6.316	5	31.580
53-57	T25	3.854	2.6	10.020	4	40.082	5	200.408
53-57	T12	0.89	1.5	1.335	32	42.720	5	213.600
53-57	T20	2.466	1.6	3.946	4	15.782	5	78.912
53-57	T16	1.579	1.25	1.974	2	3.948	5	19.738
53-57	T20	2.466	1.6	3.946	4	15.782	5	78.912
53 & 57	T25	3.854	2.363	9.107	4	36.428	2	72.856
53 & 57	T16	1.579	2.363	3.731	2	7.462	2	14.925
53 & 57	T32	6.313	2.363	14.918	4	59.670	2	119.341
53 & 57	T12	0.89	1.5	1.335	12	16.020	2	32.040
54 & 56	T25	3.854	2.805	10.810	4	43.242	2	86.484
54 & 56	T32	6.313	2.805	17.708	4	70.832	2	141.664
54 & 56	T16	1.579	2.805	4.429	2	8.858	2	17.716
54 & 56	T12	0.89	1.5	1.335	14	18.690	2	37.380
55	T25	3.854	2.954	11.385	4	45.539	1	45.539
55	T16	1.579	2.954	4.664	2	9.329	1	9.329
55	T32	6.313	2.954	18.649	4	74.594	1	74.594
55	T12	0.89	1.5	1.335	15	20.025	1	20.025
Total mass of reinforcement in ground beams in the North Stand								**20792**

Table 21: Mass of Reinforcement in Ground Beams in the North Stand

Mass of Reinforcement in Ground Beams in South West Corner								
Found on Grid Lines:	**Rebar Type**	**Mass (kg/m)**	**Length (m)**	**Mass of Bar (kg)**	**Rebar Quantity**	**Mass all Bars (kg)**	**Quantity of ground beams**	**Total Mass (kg)**
9, 10, 13, 14	T25	3.854	1.775	6.841	2	13.682	4	54.727
9, 10, 13, 14	T16	1.579	1.25	1.974	2	3.948	4	15.790
9, 10, 13, 14	T32	6.313	2.025	12.784	2	25.568	4	102.271
9, 10, 13, 14	T32	6.313	5.19	32.764	2	65.529	4	262.116
9, 10, 13, 14	T40	9.864	5.19	51.194	2	102.388	4	409.553
9, 10, 13, 14	T16	1.579	5.19	8.195	2	16.390	4	65.560
9, 10, 13, 14	T25	3.854	1.85	7.130	2	14.260	4	57.039
9, 10, 13, 14	T16	1.579	1.25	1.974	2	3.948	4	15.790
9, 10, 13, 14	T32	6.313	2.35	14.836	2	29.671	4	118.684
9, 10, 13, 14	T32	6.313	5.25	33.143	2	66.287	4	265.146
9, 10, 13, 14	T40	9.864	5.25	51.786	2	103.572	4	414.288
9, 10, 13, 14	T16	1.579	5.25	8.290	2	16.580	4	66.318
9, 10, 13, 14	T25	3.854	1.3	5.010	2	10.020	4	40.082
9, 10, 13, 14	T25	3.854	1.3	5.010	4	20.041	4	80.163
9, 10, 13, 14	T16	1.579	1	1.579	2	3.158	4	12.632
9, 10, 13, 14	T16	1.579	1	1.579	2	3.158	4	12.632
9, 10, 13, 14	T32	6.313	1.55	9.785	2	19.570	4	78.281
9, 10, 13, 14	T32	6.313	1.55	9.785	4	39.141	4	156.562
9, 10, 13, 14	T12	0.89	1.2	1.068	52	55.536	4	222.144
9 & 14	T16	1.579	7.045	11.124	2	22.248	2	44.496
9 & 14	T32	6.313	7.045	44.475	6	266.851	2	533.701
9 & 14	T40	9.864	7.045	69.492	6	416.951	2	833.903
9 & 14	T16	1.579	1.25	1.974	2	3.948	2	7.895
9 & 14	T25	3.854	1.85	7.130	6	42.779	2	85.559
9 & 14	T32	6.313	2.375	14.993	6	89.960	2	179.921
9 & 14	T20	2.466	1.5	3.699	4	14.796	2	29.592
9 & 14	T16	1.579	1.25	1.974	2	3.948	2	7.895

9 & 14	T25	3.854	1.675	6.455	4	25.822	2	51.644
9 & 14	T16	1.579	6.795	10.729	2	21.459	2	42.917
9 & 14	T25	3.854	6.795	26.188	4	104.752	2	209.503
9 & 14	T32	6.313	6.795	42.897	4	171.587	2	343.175
9 & 14	T16	1.579	1.25	1.974	2	3.948	2	7.895
9 & 14	T20	2.466	1.5	3.699	4	14.796	2	29.592
9 & 14	T25	3.854	1.85	7.130	4	28.520	2	57.039
9 & 14	T10	0.617	1.5	0.926	30	27.765	2	55.530
9 & 14	T12	0.89	1.8	1.602	70	112.140	2	224.280
10 & 13	T16	1.579	5.388	8.508	2	17.015	2	34.031
10 & 13	T32	6.313	5.388	34.014	6	204.087	2	408.173
10 & 13	T40	9.864	5.388	53.147	6	318.883	2	637.767
10 & 13	T16	1.579	1	1.579	2	3.158	2	6.316
10 & 13	T25	3.854	1.3	5.010	2	10.020	2	20.041
10 & 13	T32	6.313	1.55	9.785	2	19.570	2	39.141
10 & 13	T16	1.579	1	1.579	2	3.158	2	6.316
10 & 13	T25	3.854	1.125	4.336	4	17.343	2	34.686
10 & 13	T32	6.313	1.325	8.365	4	33.459	2	66.918
10 & 13	T16	1.579	7.456	11.773	2	23.546	2	47.092
10 & 13	T25	3.854	7.456	28.735	4	114.942	2	229.883
10 & 13	T32	6.313	7.456	47.070	4	188.279	2	376.558
10 & 13	T16	1.579	1.25	1.974	2	3.948	2	7.895
10 & 13	T20	2.466	1.25	3.083	4	12.330	2	24.660
10 & 13	T25	3.854	1.7	6.552	4	26.207	2	52.414
10 & 13	T10	0.617	1.6	0.987	4	3.949	2	7.898
10 & 13	T10	0.617	1.2	0.740	38	28.135	2	56.270
10 & 13	T12	0.89	1.8	1.602	54	86.508	2	173.016
11 & 12	T25	3.854	1.775	6.841	4	27.363	2	54.727
11 & 12	T16	1.579	1.375	2.171	2	4.342	2	8.685
11 & 12	T32	6.313	2.025	12.784	4	51.135	2	102.271

11 & 12	T32	6.313	5.19	32.764	4	131.058	2	262.116
11 & 12	T40	9.864	5.19	51.194	4	204.777	2	409.553
11 & 12	T16	1.579	5.19	8.195	2	16.390	2	32.780
11 & 12	T16	1.579	1.25	1.974	2	3.948	2	7.895
11 & 12	T25	3.854	1.5	5.781	4	23.124	2	46.248
11 & 12	T32	6.313	1.875	11.837	4	47.348	2	94.695
11 & 12	T25	3.854	1.3	5.010	2	10.020	2	20.041
11 & 12	T16	1.579	1	1.579	2	3.158	2	6.316
11 & 12	T32	6.313	1.55	9.785	2	19.570	2	39.141
11 & 12	T16	1.579	5.25	8.290	2	16.580	2	33.159
11 & 12	T32	6.313	5.25	33.143	2	66.287	2	132.573
11 & 12	T40	9.864	5.25	51.786	2	103.572	2	207.144
11 & 12	T16	1.579	1	1.579	2	3.158	2	6.316
11 & 12	T25	3.854	1.3	5.010	2	10.020	2	20.041
11 & 12	T32	6.313	1.55	9.785	2	19.570	2	39.141
11 & 12	T32	6.313	1.55	9.785	4	39.141	2	78.281
11 & 12	T16	1.579	1	1.579	2	3.158	2	6.316
11 & 12	T25	3.854	1.3	5.010	4	20.041	2	40.082
11 & 12	T16	1.579	5.388	8.508	2	17.015	2	34.031
11 & 12	T32	6.313	5.388	34.014	6	204.087	2	408.173
11 & 12	T40	9.864	5.388	53.147	6	318.883	2	637.767
11 & 12	T25	3.854	1.3	5.010	2	10.020	2	20.041
11 & 12	T16	1.579	1	1.579	2	3.158	2	6.316
11 & 12	T32	6.313	1.55	9.785	2	19.570	2	39.141
11 & 12	T16	1.579	1	1.579	2	3.158	2	6.316
11 & 12	T25	3.854	1.125	4.336	4	17.343	2	34.686
11 & 12	T32	6.313	1.325	8.365	4	33.459	2	66.918
11 & 12	T16	1.579	7.456	11.773	2	23.546	2	47.092
11 & 12	T25	3.854	7.456	28.735	4	114.942	2	229.883
11 & 12	T32	6.313	7.456	47.070	4	188.279	2	376.558

11 & 12	T16	1.579	1.375	2.171	2	4.342	2	8.685
11 & 12	T20	2.466	1.375	3.391	4	13.563	2	27.126
11 & 12	T25	3.854	1.7	6.552	4	26.207	2	52.414
11 & 12	T10	0.617	1.6	0.987	4	3.949	2	7.898
11 & 12	T20	2.466	1.2	2.959	26	76.939	2	153.878
11 & 12	T12	0.89	1.2	1.068	26	27.768	2	55.536
11 & 12	T12	0.89	1.8	1.602	54	86.508	2	173.016
11 & 12	T10	0.617	1.5	0.926	32	29.616	2	59.232
Adj to 12A	T20	2.466	1.375	3.391	4	13.563	1	13.563
Adj to 12A	T10	0.617	1.3	0.802	2	1.604	1	1.604
Adj to 12A	T16	1.579	7	11.053	2	22.106	1	22.106
Adj to 12A	T32	6.313	7	44.191	4	176.764	1	176.764
Adj to 12A	T25	3.854	7	26.978	4	107.912	1	107.912
Adj to 12A	T16	1.579	1.25	1.974	2	3.948	1	3.948
Adj to 12A	T20	2.466	1.25	3.083	4	12.330	1	12.330
Adj to 12A	T25	3.854	1.35	5.203	4	20.812	1	20.812
Adj to 12A	T10	0.617	1	0.617	2	1.234	1	1.234
Adj to 12A	T10	0.617	1.8	1.111	35	38.871	1	38.871
Adj to D	T16	1.579	0.85	1.342	2	2.684	1	2.684
Adj to D	T16	1.579	0.925	1.461	4	5.842	1	5.842
Adj to D	T20	2.466	0.925	2.281	4	9.124	1	9.124
Adj to D	T20	2.466	5	12.330	4	49.320	1	49.320
Adj to D	T16	1.579	5	7.895	2	15.790	1	15.790
Adj to D	T25	3.854	5	19.270	4	77.080	1	77.080
Adj to D	T16	1.579	1.275	2.013	4	8.053	1	8.053
Adj to D	T20	2.466	1.1	2.713	4	10.850	1	10.850
Adj to D	T20	2.466	1.1	2.713	4	10.850	1	10.850
Adj to D	T10	0.617	1.3	0.802	2	1.604	1	1.604
Adj to D	T10	0.617	1.5	0.926	25	23.138	1	23.138
C3	T16	1.579	1.25	1.974	2	3.948	2	7.895

C3	T20	2.466	1.5	3.699	5	18.495	2	36.990
C3	T32	6.313	2.35	14.836	5	74.178	2	148.356
C3	T16	1.579	4.8	7.579	2	15.158	2	30.317
C3	T25	3.854	4.8	18.499	5	92.496	2	184.992
C3	T40	9.864	4.8	47.347	5	236.736	2	473.472
C3	T16	1.579	1.25	1.974	2	3.948	2	7.895
C3	T20	2.466	1.5	3.699	5	18.495	2	36.990
C3	T32	6.313	2.35	14.836	5	74.178	2	148.356
C3	T10	0.617	1.8	1.111	48	53.309	2	106.618
Adj to 10A	T20	2.466	1.825	4.500	4	18.002	1	18.002
Adj to 10A	T10	0.617	1	0.617	2	1.234	1	1.234
Adj to 10A	T25	3.854	6.2	23.895	4	95.579	1	95.579
Adj to 10A	T16	1.579	6.2	9.790	2	19.580	1	19.580
Adj to 10A	T32	6.313	6.2	39.141	4	156.562	1	156.562
Adj to 10A	T25	3.854	1.85	7.130	4	28.520	1	28.520
Adj to 10A	T20	2.466	0.925	2.281	4	9.124	1	9.124
Adj to 10A	T16	1.579	1.55	2.447	2	4.895	1	4.895
Adj to 10A	T10	0.617	1.825	1.126	6	6.756	1	6.756
Adj to 10A	T10	0.617	1.8	1.111	31	34.429	1	34.429
Adj to D	T16	1.579	0.9	1.421	4	5.684	1	5.684
Adj to D	T20	2.466	1.3	3.206	4	12.823	1	12.823
Adj to D	T20	2.466	1.8	4.439	4	17.755	1	17.755
Adj to D	T10	0.617	1.2	0.740	2	1.481	1	1.481
Adj to D	T16	1.579	6.8	10.737	2	21.474	1	21.474
Adj to D	T20	2.466	6.8	16.769	4	67.075	1	67.075
Adj to D	T25	3.854	6.8	26.207	4	104.829	1	104.829
Adj to D	T16	1.579	1.75	2.763	2	5.527	1	5.527
Adj to D	T16	1.579	1.75	2.763	4	11.053	1	11.053
Adj to D	T20	2.466	1.95	4.809	4	19.235	1	19.235
Adj to D	T16	1.579	4.8	7.579	2	15.158	1	15.158

Adj to D	T20	2.466	4.8	11.837	4	47.347	1	47.347
Adj to D	T25	3.854	4.8	18.499	4	73.997	1	73.997
Adj to D	T25	3.854	0.925	3.565	4	14.260	1	14.260
Adj to D	T16	1.579	0.925	1.461	4	5.842	1	5.842
Adj to D	T16	1.579	0.725	1.145	2	2.290	1	2.290
Adj to D	T10	0.617	1.5	0.926	58	53.679	1	53.679
E	T16	1.579	1.25	1.974	4	7.895	1	7.895
E	T16	1.579	1.25	1.974	2	3.948	1	3.948
E	T20	2.466	1.675	4.131	4	16.522	1	16.522
E	T16	1.579	5.8	9.158	2	18.316	1	18.316
E	T20	2.466	5.8	14.303	4	57.211	1	57.211
E	T25	3.854	5.8	22.353	4	89.413	1	89.413
E	T16	1.579	1.45	2.290	6	13.737	1	13.737
E	T20	2.466	1.55	3.822	4	15.289	1	15.289
E	T10	0.617	1.5	0.926	29	26.840	1	26.840
Total mass of reinforcement in ground beams in the South West Corner								**14414**

Table 22: Mass of reinforcement in Ground Beams in the South West Corner

Mass of Reinforcement in Ground Beams in North West Corner								
Found on Grid Lines:	**Rebar Type**	**Mass (kg/m)**	**Length (m)**	**Mass of Bar (kg)**	**Rebar Quantity**	**Mass all Bars (kg)**	**Quantity of ground beams**	**Total Mass (kg)**
60, 61, 64, 65	T32	6.313	1.925	12.153	2	24.305	4	97.220
60, 61, 64, 65	T25	3.854	1.675	6.455	2	12.911	4	51.644
60, 61, 64, 65	T16	1.579	1.375	2.171	2	4.342	4	17.369
60, 61, 64, 65	T32	6.313	5.19	32.764	2	65.529	4	262.116
60, 61, 64, 65	T16	1.579	5.19	8.195	2	16.390	4	65.560
60, 61, 64, 65	T40	9.864	5.19	51.194	2	102.388	4	409.553
60, 61, 64, 65	T32	6.313	3.1	19.570	2	39.141	4	156.562
60, 61, 64, 65	T25	3.854	2.6	10.020	2	20.041	4	80.163

60, 61, 64, 65	T16	1.579	2	3.158	2	6.316	4	25.264
60, 61, 64, 65	T32	6.313	5.25	33.143	2	66.287	4	265.146
60, 61, 64, 65	T40	9.864	5.25	51.786	2	103.572	4	414.288
60, 61, 64, 65	T16	1.579	5.25	8.290	2	16.580	4	66.318
60, 61, 64, 65	T16	1.579	1.25	1.974	2	3.948	4	15.790
60, 61, 64, 65	T25	3.854	1.3	5.010	2	10.020	4	40.082
60, 61, 64, 65	T32	6.313	1.55	9.785	2	19.570	4	78.281
60, 61, 64, 65	T25	3.854	1.3	5.010	4	20.041	4	80.163
60, 61, 64, 65	T16	1.579	1.25	1.974	2	3.948	4	15.790
60, 61, 64, 65	T32	6.313	1.55	9.785	4	39.141	4	156.562
60, 61, 64, 65	T12	0.89	1.2	1.068	52	55.536	4	222.144
65	T16	1.579	8.215	12.971	2	25.943	1	25.943
65	T32	6.313	8.215	51.861	6	311.168	1	311.168
65	T40	9.864	8.215	81.033	6	486.197	1	486.197
65	T25	3.854	1.85	7.130	6	42.779	1	42.779
65	T16	1.579	1.25	1.974	2	3.948	1	3.948
65	T32	6.313	2.35	14.836	6	89.013	1	89.013
65	T25	3.854	2.35	9.057	4	36.228	1	36.228
65	T16	1.579	1.25	1.974	2	3.948	1	3.948
65	T20	2.466	1.5	3.699	4	14.796	1	14.796
65	T25	3.854	5.25	20.234	4	80.934	1	80.934
65	T16	1.579	5.25	8.290	2	16.580	1	16.580
65	T32	6.313	5.25	33.143	4	132.573	1	132.573
65	T20	2.466	1.5	3.699	4	14.796	1	14.796
65	T16	1.579	1.25	1.974	2	3.948	1	3.948
65	T25	3.854	1.85	7.130	4	28.520	1	28.520
65	T10	0.617	1.5	0.926	26	24.063	1	24.063
65	T12	0.89	1.8	1.602	78	124.956	1	124.956
61 & 64	T20	2.466	1.5	3.699	4	14.796	2	29.592
61 & 64	T16	1.579	1.5	2.369	2	4.737	2	9.474

61 & 64	T25	3.854	1.925	7.419	4	29.676	2	59.352
64	T16	1.579	7.42	11.716	2	23.432	1	23.432
64	T25	3.854	7.42	28.597	4	114.387	1	114.387
64	T32	6.313	7.42	46.842	4	187.370	1	187.370
61 & 64	T16	1.579	1.25	1.974	2	3.948	2	7.895
61 & 64	T25	3.854	1.85	7.130	4	28.520	2	57.039
61 & 64	T32	6.313	1.925	12.153	4	48.610	2	97.220
61 & 64	T16	1.579	1.25	1.974	2	3.948	2	7.895
61 & 64	T25	3.854	1.85	7.130	2	14.260	2	28.520
61 & 64	T32	6.313	1.925	12.153	2	24.305	2	48.610
61 & 64	T16	1.579	5.388	8.508	2	17.015	2	34.031
61 & 64	T32	6.313	5.388	34.014	6	204.087	2	408.173
61 & 64	T40	9.864	5.388	53.147	6	318.883	2	637.767
61	T10	0.617	1.5	0.926	34	31.467	1	31.467
61 & 64	T12	0.89	1.8	1.602	54	86.508	2	173.016
64	T16	1.579	7.456	11.773	2	23.546	1	23.546
64	T25	3.854	7.456	28.735	4	114.942	1	114.942
64	T32	6.313	7.456	47.070	4	188.279	1	188.279
64	T10	0.617	1.5	0.926	38	35.169	1	35.169
60	T16	1.579	7.045	11.124	2	22.248	1	22.248
60	T25	3.854	7.045	27.151	6	162.909	1	162.909
60	T32	6.313	7.045	44.475	6	266.851	1	266.851
60	T16	1.579	1.25	1.974	2	3.948	1	3.948
60	T25	3.854	1.85	7.130	6	42.779	1	42.779
60	T32	6.313	2.35	14.836	6	89.013	1	89.013
60	T16	1.579	1.25	1.974	2	3.948	1	3.948
60	T25	3.854	1.5	5.781	4	23.124	1	23.124
60	T32	6.313	1.85	11.679	4	46.716	1	46.716
60	T16	1.579	5.97	9.427	2	18.853	1	18.853
60	T25	3.854	5.97	23.008	4	92.034	1	92.034

60	T32	6.313	5.97	37.689	4	150.754	1	150.754
60	T16	1.579	1.25	1.974	2	3.948	1	3.948
60	T20	2.466	1.5	3.699	4	14.796	1	14.796
60	T25	3.854	1.85	7.130	4	28.520	1	28.520
60	T10	0.617	1.5	0.926	30	27.765	1	27.765
60	T12	0.89	1.8	1.602	70	112.140	1	112.140
Adj to 61A	T16	1.579	1.25	1.974	2	3.948	1	3.948
Adj to 61A	T20	2.466	1.4	3.452	4	13.810	1	13.810
Adj to 61A	T25	3.854	1.6	6.166	4	24.666	1	24.666
Adj to 61A	T10	0.617	0.8	0.494	2	0.987	1	0.987
Adj to 61A	T16	1.579	7	11.053	2	22.106	1	22.106
Adj to 61A	T25	3.854	7	26.978	4	107.912	1	107.912
Adj to 61A	T32	6.313	7	44.191	4	176.764	1	176.764
Adj to 61A	T20	2.466	1.6	3.946	4	15.782	1	15.782
Adj to 61A	T10	0.617	0.8	0.494	2	0.987	1	0.987
Adj to 61A	T10	0.617	1.8	1.111	35	38.871	1	38.871
63A	T10	0.617	1.5	0.926	6	5.553	1	5.553
63A	T16	1.579	1.25	1.974	2	3.948	1	3.948
63A	T20	2.466	1.5	3.699	4	14.796	1	14.796
63A	T25	3.854	1.5	5.781	4	23.124	1	23.124
63A	T16	1.579	6.2	9.790	2	19.580	1	19.580
63A	T25	3.854	6.2	23.895	4	95.579	1	95.579
63A	T32	6.313	6.2	39.141	4	156.562	1	156.562
63A	T20	2.466	1.5	3.699	4	14.796	1	14.796
63A	T10	0.617	1.5	0.926	2	1.851	1	1.851
63A	T10	0.617	1.8	1.111	31	34.429	1	34.429
62 & 63	T10	0.617	1.8	1.111	4	4.442	2	8.885
62 & 63	T16	1.579	1.25	1.974	2	3.948	2	7.895
62 & 63	T20	2.466	1.25	3.083	4	12.330	2	24.660
62 & 63	T25	3.854	1.8	6.937	4	27.749	2	55.498

62 & 63	T16	1.579	1.25	1.974	4	7.895	2	15.790
62 & 63	T25	3.854	1.85	7.130	6	42.779	2	85.559
62 & 63	T32	6.313	1.925	12.153	6	72.915	2	145.830
62 & 63	T16	1.579	5.388	8.508	2	17.015	2	34.031
62 & 63	T32	6.313	5.388	34.014	6	204.087	2	408.173
62 & 63	T40	9.864	5.388	53.147	6	318.883	2	637.767
62 & 63	T16	1.579	1	1.579	4	6.316	2	12.632
62 & 63	T25	3.854	1.3	5.010	6	30.061	2	60.122
62 & 63	T32	6.313	1.55	9.785	6	58.711	2	117.422
62 & 63	T16	1.579	5.25	8.290	2	16.580	2	33.159
62 & 63	T32	6.313	5.25	33.143	2	66.287	2	132.573
62 & 63	T40	9.864	5.25	51.786	2	103.572	2	207.144
62 & 63	T16	1.579	1	1.579	2	3.158	2	6.316
62 & 63	T25	3.854	1.3	5.010	6	30.061	2	60.122
62 & 63	T32	6.313	1.55	9.785	6	58.711	2	117.422
62 & 63	T32	6.313	5.19	32.764	4	131.058	2	262.116
62 & 63	T16	1.579	5.19	8.195	2	16.390	2	32.780
62 & 63	T40	9.864	5.19	51.194	4	204.777	2	409.553
62 & 63	T25	3.854	1.45	5.588	4	22.353	2	44.706
62 & 63	T16	1.579	1.25	1.974	2	3.948	2	7.895
62 & 63	T32	6.313	1.85	11.679	4	46.716	2	93.432
62 & 63	T20	2.466	1.5	3.699	26	96.174	2	192.348
62 & 63	T12	0.89	1.8	1.602	80	128.160	2	256.320
63	T16	1.579	6.36	10.042	2	20.085	1	20.085
63	T25	3.854	6.36	24.511	4	98.046	1	98.046
63	T32	6.313	6.36	40.151	4	160.603	1	160.603
63	T10	0.617	1.5	0.926	36	33.318	1	33.318
62	T16	1.579	6.4	10.106	2	20.211	1	20.211
62	T25	3.854	6.4	24.666	4	98.662	1	98.662
62	T32	6.313	6.4	40.403	4	161.613	1	161.613

62	T10	0.617	1.5	0.926	32	29.616	1	29.616
C3 (63-64)	T16	1.579	1.25	1.974	2	3.948	1	3.948
C3 (63-64)	T20	2.466	1.5	3.699	5	18.495	1	18.495
C3 (63-64)	T32	6.313	2.35	14.836	5	74.178	1	74.178
C3 (63-64)	T16	1.579	4.8	7.579	2	15.158	1	15.158
C3 (63-64)	T25	3.854	4.8	18.499	5	92.496	1	92.496
C3 (63-64)	T40	9.864	4.8	47.347	5	236.736	1	236.736
C3 (63-64)	T16	1.579	1.25	1.974	2	3.948	1	3.948
C3 (63-64)	T20	2.466	1.5	3.699	5	18.495	1	18.495
C3 (63-64)	T32	6.313	2.4	15.151	5	75.756	1	75.756
C3 (63-64)	T10	0.617	1.8	1.111	48	53.309	1	53.309
D (64-65)	T16	1.579	1.25	1.974	2	3.948	1	3.948
D (64-65)	T16	1.579	1.25	1.974	4	7.895	1	7.895
D (64-65)	T20	2.466	1.5	3.699	4	14.796	1	14.796
D (64-65)	T16	1.579	3.3	5.211	2	10.421	1	10.421
D (64-65)	T20	2.466	3.3	8.138	4	32.551	1	32.551
D (64-65)	T25	3.854	3.3	12.718	4	50.873	1	50.873
D (64-65)	T16	1.579	1.25	1.974	2	3.948	1	3.948
D (64-65)	T16	1.579	1.25	1.974	4	7.895	1	7.895
D (64-65)	T20	2.466	1.5	3.699	4	14.796	1	14.796
D (64-65)	T10	0.617	1.5	0.926	17	15.734	1	15.734
Between 60/C2 & 62/C3	T16	1.579	1.5	2.369	2	4.737	1	4.737
Between 60/C2 & 62/C3	T16	1.579	1.25	1.974	3	5.921	1	5.921
Between 60/C2 & 62/C3	T25	3.854	1.5	5.781	3	17.343	1	17.343
Between 60/C2 & 62/C3	T16	1.579	6.6	10.421	2	20.843	1	20.843
Between 60/C2 & 62/C3	T16	1.579	6.6	10.421	3	31.264	1	31.264
Between 60/C2 & 62/C3	T25	3.854	6.6	25.436	3	76.309	1	76.309
Between 60/C2 & 62/C3	T16	1.579	1.25	1.974	4	7.895	1	7.895
Between 60/C2 & 62/C3	T16	1.579	1.5	2.369	8	18.948	1	18.948
Between 60/C2 & 62/C3	T25	3.854	2.35	9.057	8	72.455	1	72.455

Between 60/C2 & 62/C3	T16	1.579	4.8	7.579	2	15.158	1	15.158
Between 60/C2 & 62/C3	T25	3.854	4.8	18.499	5	92.496	1	92.496
Between 60/C2 & 62/C3	T40	9.864	4.8	47.347	5	236.736	1	236.736
Between 60/C2 & 62/C3	T16	1.579	1.25	1.974	2	3.948	1	3.948
Between 60/C2 & 62/C3	T20	2.466	1.5	3.699	5	18.495	1	18.495
Between 60/C2 & 62/C3	T32	6.313	2.35	14.836	5	74.178	1	74.178
Between 60/C2 & 62/C3	T10	0.617	1.5	0.926	33	30.542	1	30.542
Between 60/C2 & 62/C3	T10	0.617	1.8	1.111	48	53.309	1	53.309
Adj to D (59-60)	T16	1.579	1	1.579	4	6.316	2	12.632
Adj to D (59-60)	T20	2.466	1.2	2.959	4	11.837	2	23.674
Adj to D (59-60)	T20	2.466	1.6	3.946	4	15.782	2	31.565
Adj to D (59-60)	T16	1.579	6.8	10.737	2	21.474	2	42.949
Adj to D (59-60)	T20	2.466	6.8	16.769	4	67.075	2	134.150
Adj to D (59-60)	T25	3.854	6.8	26.207	4	104.829	2	209.658
Adj to D (59-60)	T16	1.579	0.75	1.184	2	2.369	2	4.737
Adj to D (59-60)	T16	1.579	1.175	1.855	4	7.421	2	14.843
Adj to D (59-60)	T20	2.466	1.175	2.898	4	11.590	2	23.180
Adj to D (59-60)	T10	0.617	1.5	0.926	34	31.467	1	31.467
E	T16	1.579	0.925	1.461	2	2.921	1	2.921
E	T16	1.579	0.925	1.461	4	5.842	1	5.842
E	T20	2.466	1.3	3.206	4	12.823	1	12.823
E	T16	1.579	5.8	9.158	2	18.316	1	18.316
E	T20	2.466	5.8	14.303	4	57.211	1	57.211
E	T25	3.854	5.8	22.353	4	89.413	1	89.413
E	T16	1.579	0.925	1.461	2	2.921	1	2.921
E	T16	1.579	0.925	1.461	4	5.842	1	5.842
E	T20	2.466	1.125	2.774	4	11.097	1	11.097
E	T10	0.617	1.5	0.926	29	26.840	1	26.840
Total mass of reinforcement in ground beams in the North West Corner								**14554**

Table 23: Mass of reinforcement in Ground Beams in the North West Corner

Mass of Reinforcement in Ground Beams in West Stand								
Found on Grid Lines:	**Rebar Type**	**Mass (kg/m)**	**Length (m)**	**Mass of Bar (kg)**	**Rebar Quantity**	**Mass all Bars (kg)**	**Quantity of ground beams**	**Total Mass (kg)**
72	T16	1.579	1.3	2.053	2	4.105	1	4.105
72	T25	3.854	2	7.708	6	46.248	1	46.248
72	T20	2.466	1.6	3.946	6	23.674	1	23.674
72	T25	3.854	3.8	14.645	6	87.871	1	87.871
72	T16	1.579	3.8	6.000	2	12.000	1	12.000
72	T32	6.313	3.8	23.989	6	143.936	1	143.936
72	T16	1.579	2.05	3.237	2	6.474	1	6.474
72	T20	2.466	2.35	5.795	6	34.771	1	34.771
72	T25	3.854	2.75	10.599	6	63.591	1	63.591
72	T25	3.854	3.8	14.645	6	87.871	1	87.871
72	T16	1.579	3.8	6.000	2	12.000	1	12.000
72	T32	6.313	3.8	23.989	6	143.936	1	143.936
72	T20	2.466	1.6	3.946	6	23.674	1	23.674
72	T16	1.579	1.3	2.053	2	4.105	1	4.105
72	T25	3.854	2	7.708	6	46.248	1	46.248
72	T10	0.617	2.5	1.543	76	117.230	1	117.230
69, 72	T20	2.466	1.6	3.946	4	15.782	2	31.565
69, 72	T16	1.579	1.3	2.053	2	4.105	2	8.211
69, 72	T25	3.854	2	7.708	4	30.832	2	61.664
69, 72	T25	3.854	4.8	18.499	4	73.997	2	147.994
69, 72	T16	1.579	4.8	7.579	2	15.158	2	30.317
69, 72	T32	6.313	4.8	30.302	4	121.210	2	242.419
69, 72	T20	2.466	1.6	3.946	4	15.782	2	31.565
69, 72	T16	1.579	1.3	2.053	2	4.105	2	8.211
69, 72	T25	3.854	2	7.708	4	30.832	2	61.664
69, 72	T12	0.89	1.5	1.335	24	32.040	2	64.080
1, 2, 5, 8, 66, 69, 72	T25	3.854	2	7.708	6	46.248	7	323.736

1, 2, 5, 8, 66, 69, 72	T16	1.579	1.3	2.053	2	4.105	7	28.738
1, 2, 5, 8, 66, 69, 72	T32	6.313	2.45	15.467	6	92.801	7	649.608
1, 2, 5, 8, 66, 69, 72	T12	0.89	1.8	1.602	82	131.364	7	919.548
1, 2, 5, 8, 66, 69, 72	T32	6.313	8.2	51.767	6	310.600	7	2174.197
1, 2, 5, 8, 66, 69, 72	T16	1.579	8.2	12.948	2	25.896	7	181.269
1, 2, 5, 8, 66, 69, 72	T40	9.864	8.2	80.885	6	485.309	7	3397.162
2-8, 66-72	T25	3.854	1.365	5.261	8	42.086	14	589.200
2-8, 66-72	T16	1.579	1.025	1.618	4	6.474	14	90.635
2-8, 66-72	T32	6.313	1.6	10.101	8	80.806	14	1131.290
2-8, 66-72	T12	0.89	1.2	1.068	27	28.836	14	403.704
2-8, 66-72	T32	6.313	5.4	34.090	2	68.180	14	954.526
2-8, 66-72	T16	1.579	5.4	8.527	2	17.053	14	238.745
2-8, 66-72	T40	9.864	5.4	53.266	2	106.531	14	1491.437
2-8, 66-72	T25	3.854	2.75	10.599	2	21.197	14	296.758
2-8, 66-72	T16	1.579	2.05	3.237	2	6.474	14	90.635
2-8, 66-72	T32	6.313	3.2	20.202	2	40.403	14	565.645
2-8, 66-72	T12	0.89	1.2	1.068	27	28.836	14	403.704
2-8, 66-72	T32	6.313	5.4	34.090	2	68.180	14	954.526
2-8, 66-72	T16	1.579	5.4	8.527	2	17.053	14	238.745
2-8, 66-72	T40	9.864	5.4	53.266	2	106.531	14	1491.437
2-8, 66-72	T25	3.854	1.85	7.130	2	14.260	14	199.637
2-8, 66-72	T16	1.579	1.3	2.053	2	4.105	14	57.476
2-8, 66-72	T32	6.313	2.075	13.099	2	26.199	14	366.785
1 & 2	T12	0.89	1.8	1.602	82	131.364	2	262.728
1 & 2	T32	6.313	8.2	51.767	6	310.600	2	621.199
1 & 2	T16	1.579	8.2	12.948	2	25.896	2	51.791
1 & 2	T40	9.864	8.2	80.885	6	485.309	2	970.618
1 & 2	T25	3.854	2	7.708	6	46.248	2	92.496
1 & 2	T16	1.579	1.3	2.053	2	4.105	2	8.211
1 & 2	T32	6.313	1.45	9.154	6	54.923	2	109.846

1 & 2	T20	2.466	1.6	3.946	4	15.782	2	31.565
1 & 2	T16	1.579	1.3	2.053	2	4.105	2	8.211
1 & 2	T25	3.854	2	7.708	4	30.832	2	61.664
1 & 2	T12	0.89	1.5	1.335	27	36.045	2	72.090
1 & 2	T25	3.854	5.4	20.812	4	83.246	2	166.493
1 & 2	T16	1.579	5.4	8.527	2	17.053	2	34.106
1 & 2	T32	6.313	5.4	34.090	4	136.361	2	272.722
1 & 2	T20	2.466	1.6	3.946	10	39.456	2	78.912
1 & 2	T16	1.579	1.3	2.053	4	8.211	2	16.422
1 & 2	T25	3.854	2	7.708	10	77.080	2	154.160
1	T10	0.617	2.5	1.543	42	64.785	1	64.785
1	T25	3.854	4.2	16.187	6	97.121	1	97.121
1	T16	1.579	4.2	6.632	2	13.264	1	13.264
1	T32	6.313	4.2	26.515	6	159.088	1	159.088
1	T20	2.466	2.35	5.795	6	34.771	1	34.771
1	T16	1.579	2.05	3.237	2	6.474	1	6.474
1	T25	3.854	2.75	10.599	6	63.591	1	63.591
1	T10	0.617	2.5	1.543	42	64.785	1	64.785
1	T25	3.854	4.2	16.187	6	97.121	1	97.121
1	T16	1.579	4.2	6.632	2	13.264	1	13.264
1	T32	6.313	4.2	26.515	6	159.088	1	159.088
1	T20	2.466	1.6	3.946	6	23.674	1	23.674
1	T16	1.579	1.3	2.053	2	4.105	1	4.105
1	T25	3.854	2	7.708	6	46.248	1	46.248
1	T25	3.854	1.175	4.528	8	36.228	1	36.228
1	T16	1.579	1.025	1.618	4	6.474	1	6.474
1	T32	6.313	1.375	8.680	8	69.443	1	69.443
1	T12	0.89	1.2	1.068	27	28.836	1	28.836
1	T32	6.313	4.05	25.568	2	51.135	1	51.135
1	T16	1.579	4.05	6.395	2	12.790	1	12.790

1	T40	9.864	4.05	39.949	2	79.898	1	79.898
1	T25	3.854	1.85	7.130	2	14.260	1	14.260
1	T16	1.579	1.3	2.053	2	4.105	1	4.105
1	T40	9.864	2.075	20.468	2	40.936	1	40.936
1	T12	0.89	1.2	1.068	3	3.204	1	3.204
1	T20	2.466	1.2	2.959	2	5.918	1	5.918
2	T10	0.617	2.5	1.543	40	61.700	1	61.700
2	T25	3.854	4	15.416	6	92.496	1	92.496
2	T16	1.579	4	6.316	2	12.632	1	12.632
2	T32	6.313	4	25.252	6	151.512	1	151.512
2	T20	2.466	2.35	5.795	6	34.771	1	34.771
2	T16	1.579	2.05	3.237	2	6.474	1	6.474
2	T25	3.854	2.75	10.599	6	63.591	1	63.591
2	T10	0.617	2.5	1.543	40	61.700	1	61.700
2	T25	3.854	4	15.416	6	92.496	1	92.496
2	T16	1.579	4	6.316	2	12.632	1	12.632
2	T32	6.313	4	25.252	6	151.512	1	151.512
2	T20	2.466	1.6	3.946	6	23.674	1	23.674
2	T16	1.579	1.3	2.053	2	4.105	1	4.105
2	T25	3.854	2	7.708	6	46.248	1	46.248
3, 4, 6, 7, 67, 68, 70, 71	T12	0.89	1.8	1.602	80	128.160	8	1025.280
3, 4, 6, 7, 67, 68, 70, 71	T32	6.313	8	50.504	6	303.024	8	2424.192
3, 4, 6, 7, 67, 68, 70, 71	T16	1.579	8	12.632	2	25.264	8	202.112
3, 4, 6, 7, 67, 68, 70, 71	T40	9.864	8	78.912	6	473.472	8	3787.776
3, 4, 6, 7, 67, 68, 70, 71	T25	3.854	2	7.708	6	46.248	8	369.984
3, 4, 6, 7, 67, 68, 70, 71	T16	1.579	1.3	2.053	2	4.105	8	32.843
3, 4, 6, 7, 67, 68, 70, 71	T32	6.313	1.45	9.154	6	54.923	8	439.385
3, 4, 6, 7, 67, 68, 70, 71	T20	2.466	1.6	3.946	4	15.782	8	126.259
3, 4, 6, 7, 67, 68, 70, 71	T16	1.579	1.3	2.053	2	4.105	8	32.843
3, 4, 6, 7, 67, 68, 70, 71	T25	3.854	2	7.708	4	30.832	8	246.656

3, 4	T12	0.89	1.5	1.335	26	34.710	2	69.420
3, 4	T25	3.854	5.2	20.041	4	80.163	2	160.326
3, 4	T16	1.579	5.2	8.211	2	16.422	2	32.843
3, 4	T32	6.313	5.2	32.828	4	131.310	2	262.621
3, 4	T20	2.466	1.6	3.946	10	39.456	2	78.912
3, 4	T16	1.579	1.3	2.053	4	8.211	2	16.422
3, 4	T25	3.854	2	7.708	10	77.080	2	154.160
3	T10	0.617	2.5	1.543	40	61.700	1	61.700
3	T25	3.854	4	15.416	6	92.496	1	92.496
3	T16	1.579	4	6.316	2	12.632	1	12.632
3	T32	6.313	4	25.252	6	151.512	1	151.512
3	T20	2.466	2.35	5.795	6	34.771	1	34.771
3	T16	1.579	2.05	3.237	2	6.474	1	6.474
3	T25	3.854	2.75	10.599	6	63.591	1	63.591
3	T10	0.617	2.5	1.543	40	61.700	1	61.700
3	T25	3.854	4	15.416	6	92.496	1	92.496
3	T16	1.579	4	6.316	2	12.632	1	12.632
3	T32	6.313	4	25.252	6	151.512	1	151.512
3	T20	2.466	1.6	3.946	6	23.674	1	23.674
3	T16	1.579	1.3	2.053	2	4.105	1	4.105
3	T25	3.854	2	7.708	6	46.248	1	46.248
4	T10	0.617	2.5	1.543	34	52.445	1	52.445
4	T25	3.854	3.4	13.104	6	78.622	1	78.622
4	T16	1.579	3.4	5.369	2	10.737	1	10.737
4	T32	6.313	3.4	21.464	6	128.785	1	128.785
4	T20	2.466	2.35	5.795	6	34.771	1	34.771
4	T16	1.579	2.05	3.237	2	6.474	1	6.474
4	T25	3.854	1.75	6.745	6	40.467	1	40.467
4	T10	0.617	2.5	1.543	34	52.445	1	52.445
4	T25	3.854	3.4	13.104	6	78.622	1	78.622

4	T16	1.579	3.4	5.369	2	10.737	1	10.737
4	T32	6.313	3.4	21.464	6	128.785	1	128.785
4	T20	2.466	1.6	3.946	6	23.674	1	23.674
4	T16	1.579	1.3	2.053	2	4.105	1	4.105
4	T25	3.854	2	7.708	6	46.248	1	46.248
5	T20	2.466	1.6	3.946	4	15.782	1	15.782
5	T16	1.579	1.3	2.053	2	4.105	1	4.105
5	T25	3.854	2	7.708	4	30.832	1	30.832
5	T12	0.89	1.5	1.335	27	36.045	1	36.045
5	T25	3.854	5.4	20.812	4	83.246	1	83.246
5	T16	1.579	5.4	8.527	2	17.053	1	17.053
5	T32	6.313	5.4	34.090	4	136.361	1	136.361
5	T20	2.466	3.4	8.384	4	33.538	1	33.538
5	T16	1.579	1.3	2.053	4	8.211	1	8.211
5	T25	3.854	3.4	13.104	4	52.414	1	52.414
5	T12	0.89	1.5	1.335	33	44.055	1	44.055
5	T25	3.854	6.6	25.436	4	101.746	1	101.746
5	T16	1.579	6.6	10.421	2	20.843	1	20.843
5	T32	6.313	6.6	41.666	4	166.663	1	166.663
5	T20	2.466	1.6	3.946	4	15.782	1	15.782
5	T16	1.579	1.3	2.053	2	4.105	1	4.105
5	T25	3.854	2	7.708	4	30.832	1	30.832
Adj to E	T12	0.89	1.2	1.068	16	17.088	1	17.088
Adj to E	T25	3.854	3.95	15.223	2	30.447	1	30.447
Adj to E	T16	1.579	3.95	6.237	2	12.474	1	12.474
Adj to E	T20	2.466	3.95	9.741	2	19.481	1	19.481
Adj to E	T16	1.579	1	1.579	9	14.211	1	14.211
72A & A1	T16	1.579	1.2	1.895	9	17.053	2	34.106
72A & A2	T16	1.579	2.6	4.105	2	8.211	2	16.422
72A & A3	T12	0.89	1.2	1.068	7	7.476	2	14.952

72A & A4	T25	3.854	1	3.854	2	7.708	2	15.416
72A & A5	T32	6.313	1.225	7.733	2	15.467	2	30.934
72A & A6	T32	6.313	5.4	34.090	2	68.180	2	136.361
72A & A7	T16	1.579	5.4	8.527	2	17.053	2	34.106
72A & A8	T40	9.864	5.4	53.266	2	106.531	2	213.062
72A & A9	T25	3.854	1.95	7.515	2	15.031	2	30.061
72A & A10	T16	1.579	1.3	2.053	2	4.105	2	8.211
72A & A11	T25	3.854	2.375	9.153	2	18.307	2	36.613
72A & A12	T12	0.89	1.2	1.068	27	28.836	2	57.672
Adj to D	T16	1.579	1.3	2.053	4	8.211	4	32.843
Adj to D	T16	1.579	1.3	2.053	2	4.105	4	16.422
Adj to D	T20	2.466	1.4	3.452	4	13.810	4	55.238
Adj to D	T16	1.579	6.4	10.106	2	20.211	4	80.845
Adj to D	T16	1.579	6.4	10.106	4	40.422	4	161.690
Adj to D	T25	3.854	6.4	24.666	4	98.662	4	394.650
Adj to D	T16	1.579	1.3	2.053	2	4.105	4	16.422
Adj to D	T16	1.579	1.3	2.053	4	8.211	4	32.843
Adj to D	T20	2.466	1.4	3.452	4	13.810	4	55.238
Adj to D	T10	0.617	1.8	1.111	32	35.539	4	142.157
D	T16	1.579	1.3	2.053	2	4.105	6	24.632
D	T16	1.579	1.3	2.053	4	8.211	6	49.265
D	T20	2.466	1.4	3.452	4	13.810	6	82.858
D	T16	1.579	5	7.895	2	15.790	6	94.740
D	T16	1.579	5	7.895	4	31.580	6	189.480
D	T25	3.854	5	19.270	4	77.080	6	462.480
D	T16	1.579	1.3	2.053	2	4.105	6	24.632
D	T16	1.579	1.3	2.053	4	8.211	6	49.265
D	T20	2.466	1.4	3.452	4	13.810	6	82.858
D	T10	0.617	1.8	1.111	25	27.765	6	166.590
E	T16	1.579	1.22	1.926	2	3.853	2	7.706

E	T16	1.579	1.22	1.926	4	7.706	2	15.411
E	T20	2.466	1.5	3.699	4	14.796	2	29.592
E	T16	1.579	4.8	7.579	2	15.158	2	30.317
E	T16	1.579	4.8	7.579	4	30.317	2	60.634
E	T25	3.854	4.8	18.499	4	73.997	2	147.994
E	T16	1.579	1.22	1.926	2	3.853	2	7.706
E	T16	1.579	1.22	1.926	4	7.706	2	15.411
E	T20	2.466	1.5	3.699	4	14.796	2	29.592
E	T10	0.617	1.8	1.111	24	26.654	2	53.309
Adj to A (1-2)	T16	1.579	1.25	1.974	2	3.948	4	15.790
Adj to A (1-2)	T16	1.579	1.25	1.974	5	9.869	4	39.475
Adj to A (1-2)	T32	6.313	1.85	11.679	5	58.395	4	233.581
Adj to A (1-2)	T20	2.466	6.8	16.769	6	100.613	4	402.451
Adj to A (1-2)	T16	1.579	6.8	10.737	2	21.474	4	85.898
Adj to A (1-2)	T40	9.864	6.8	67.075	5	335.376	4	1341.504
Adj to A (1-2)	T16	1.579	1.25	1.974	2	3.948	4	15.790
Adj to A (1-2)	T16	1.579	1.25	1.974	5	9.869	4	39.475
Adj to A (1-2)	T32	6.313	1.85	11.679	5	58.395	4	233.581
Adj to A (1-2)	T12	0.89	1.8	1.602	34	54.468	4	217.872
C1	T16	1.579	1.2	1.895	2	3.790	1	3.790
C1	T16	1.579	1.2	1.895	4	7.579	1	7.579
C1	T20	2.466	1.5	3.699	4	14.796	1	14.796
C1	T16	1.579	5	7.895	2	15.790	1	15.790
C1	T16	1.579	5	7.895	4	31.580	1	31.580
C1	T25	3.854	5	19.270	4	77.080	1	77.080
C1	T16	1.579	1.2	1.895	2	3.790	1	3.790
C1	T16	1.579	1.2	1.895	4	7.579	1	7.579
C1	T20	2.466	1.5	3.699	4	14.796	1	14.796
C1	T10	0.617	1.8	1.111	25	27.765	1	27.765
B	T16	1.579	1.2	1.895	4	7.579	1	7.579

B	T16	1.579	1.2	1.895	8	15.158	1	15.158
B	T20	2.466	1.5	3.699	8	29.592	1	29.592
B	T16	1.579	5.2	8.211	2	16.422	1	16.422
B	T16	1.579	5.2	8.211	4	32.843	1	32.843
B	T25	3.854	5.2	20.041	4	80.163	1	80.163
B	T10	0.617	1.8	1.111	26	28.876	1	28.876
Adj to A (1-72)	T16	1.579	1.6	2.526	4	10.106	1	10.106
Adj to A (1-72)	T20	2.466	1.2	2.959	8	23.674	1	23.674
Adj to A (1-72)	T25	3.854	1.85	7.130	8	57.039	1	57.039
Adj to A (1-72)	T16	1.579	6.6	10.421	2	20.843	1	20.843
Adj to A (1-72)	T25	3.854	6.6	25.436	4	101.746	1	101.746
Adj to A (1-72)	T32	6.313	6.6	41.666	4	166.663	1	166.663
Adj to A (1-72)	T10	0.617	1.5	0.926	33	30.542	1	30.542
Diagonals	T16	1.579	1.8	2.842	6	17.053	2	34.106
	T10	0.617	1.2	0.740	9	6.664	2	13.327
6, 7, 67, 68	T20	2.466	1.6	3.946	4	15.782	4	63.130
6, 7, 67, 68	T16	1.579	1.2	1.895	2	3.790	4	15.158
6, 7, 67, 68	T25	3.854	2	7.708	4	30.832	4	123.328
6, 7, 67, 68	T25	3.854	5.4	20.812	4	83.246	4	332.986
6, 7, 67, 68	T16	1.579	5.4	8.527	2	17.053	4	68.213
6, 7, 67, 68	T32	6.313	5.4	34.090	4	136.361	4	545.443
6, 7, 67, 68	T20	2.466	1.755	4.328	8	34.623	4	138.491
6, 7, 67, 68	T16	1.579	1.2	1.895	4	7.579	4	30.317
6, 7, 67, 68	T25	3.854	1.955	7.535	8	60.277	4	241.106
6, 7, 67, 68	T12	0.89	1.5	1.335	27	36.045	4	144.180
66 & 8	T20	2.466	1.755	4.328	8	34.623	2	69.245
66 & 8	T16	1.579	1.2	1.895	4	7.579	2	15.158
66 & 8	T25	3.854	1.955	7.535	8	60.277	2	120.553
66 & 8	T25	3.854	6.075	23.413	4	93.652	2	187.304
66 & 8	T16	1.579	6.075	9.592	2	19.185	2	38.370

66 & 8	T32	6.313	6.075	38.351	4	153.406	2	306.812
66 & 8	T20	2.466	2.35	5.795	4	23.180	2	46.361
66 & 8	T16	1.579	1.95	3.079	2	6.158	2	12.316
66 & 8	T25	3.854	2.6	10.020	4	40.082	2	80.163
66 & 8	T25	3.854	1.217	4.690	4	18.761	2	37.523
66 & 8	T16	1.579	1.217	1.922	2	3.843	2	7.687
66 & 8	T32	6.313	1.217	7.683	4	30.732	2	61.463
66 & 8	T20	2.466	1.6	3.946	4	15.782	2	31.565
66 & 8	T16	1.579	1.2	1.895	2	3.790	2	7.579
66 & 8	T25	3.854	2	7.708	4	30.832	2	61.664
66 & 8	T12	0.89	1.5	1.335	36	48.060	2	96.120
7 & 67	T20	2.466	1.755	4.328	8	34.623	2	69.245
7 & 67	T16	1.579	1.2	1.895	4	7.579	2	15.158
7 & 67	T25	3.854	1.955	7.535	8	60.277	2	120.553
7 & 67	T25	3.854	2.81	10.830	4	43.319	2	86.638
7 & 67	T16	1.579	2.81	4.437	2	8.874	2	17.748
7 & 67	T32	6.313	2.81	17.740	4	70.958	2	141.916
7 & 67	T12	0.89	1.5	1.335	14	18.690	2	37.380
6 & 68	T20	2.466	1.6	3.946	8	31.565	2	63.130
6 & 68	T16	1.579	1.2	1.895	4	7.579	2	15.158
6 & 68	T25	3.854	2	7.708	8	61.664	2	123.328
6 & 68	T25	3.854	5	19.270	4	77.080	2	154.160
6 & 68	T16	1.579	5	7.895	2	15.790	2	31.580
6 & 68	T32	6.313	5	31.565	4	126.260	2	252.520
6 & 68	T12	0.89	1.5	1.335	25	33.375	2	66.750
69	T20	2.466	1.6	3.946	8	31.565	1	31.565
69	T16	1.579	1.2	1.895	4	7.579	1	7.579
69	T25	3.854	2	7.708	8	61.664	1	61.664
69	T25	3.854	5.76	22.199	4	88.796	1	88.796
69	T16	1.579	5.76	9.095	2	18.190	1	18.190

69	T32	6.313	5.76	36.363	4	145.452	1	145.452
69	T12	0.89	1.5	1.335	28	37.380	1	37.380
70 & 71	T20	2.466	1.6	3.946	4	15.782	2	31.565
70 & 71	T16	1.579	1.3	2.053	2	4.105	2	8.211
70 & 71	T25	3.854	2	7.708	4	30.832	2	61.664
70 & 71	T25	3.854	5.775	22.257	4	89.027	2	178.055
70 & 71	T16	1.579	5.775	9.119	2	18.237	2	36.475
70 & 71	T32	6.313	5.775	36.458	4	145.830	2	291.661
70 & 71	T20	2.466	1.175	2.898	4	11.590	2	23.180
70 & 71	T16	1.579	1.025	1.618	2	3.237	2	6.474
70 & 71	T25	3.854	1.75	6.745	4	26.978	2	53.956
70 & 71	T20	2.466	1.175	2.898	6	17.385	2	34.771
70 & 71	T16	1.579	1.025	1.618	2	3.237	2	6.474
70 & 71	T25	3.854	1.75	6.745	6	40.467	2	80.934
70 & 71	T12	0.89	1.5	1.335	28	37.380	2	74.760
70 & 71	T20	2.466	2.35	5.795	6	34.771	2	69.541
70 & 71	T16	1.579	2.05	3.237	2	6.474	2	12.948
70 & 71	T25	3.854	2.75	10.599	6	63.591	2	127.182
70	T10	0.617	2.5	1.543	40	61.700	1	61.700
70	T25	3.854	4	15.416	6	92.496	1	92.496
70	T16	1.579	4	6.316	2	12.632	1	12.632
70	T32	6.313	4	25.252	6	151.512	1	151.512
70	T10	0.617	2.5	1.543	34	52.445	1	52.445
70	T25	3.854	3.4	13.104	6	78.622	1	78.622
70	T16	1.579	3.4	5.369	2	10.737	1	10.737
70	T32	6.313	3.4	21.464	6	128.785	1	128.785
71	T10	0.617	2.5	1.543	46	70.955	1	70.955
71	T25	3.854	4.6	17.728	6	106.370	1	106.370
71	T16	1.579	4.6	7.263	2	14.527	1	14.527
71	T32	6.313	4.6	29.040	6	174.239	1	174.239

71	T10	0.617	2.5	1.543	40	61.700	1	61.700
71	T25	3.854	4	15.416	6	92.496	1	92.496
71	T16	1.579	4	6.316	2	12.632	1	12.632
71	T32	6.313	4	25.252	6	151.512	1	151.512
Total Mass of reinforcement in ground beams in the West Stand								**49262**

Table 24: Mass of reinforcement in Ground Beams in the West Stand

Mass of Reinforcement in Ground Beams around the perimeter									
Beam Ref	**Stand**	**Rebar Type**	**Mass (kg/m)**	**Length (m)**	**Mass of Bar (kg)**	**Rebar Quantity**	**Mass all Bars (kg)**	**Quantity of ground beams**	**Total Mass (kg)**
A	west	T25	3.854	2	7.708	8	61.664	3	184.992
A	west	T20	2.466	1.5	3.699	8	29.592	3	88.776
A	west	T16	1.579	1.3	2.053	4	8.211	3	24.632
A	west	T25	3.854	5.2	20.041	4	80.163	3	240.490
A	west	T16	1.579	5.2	8.211	2	16.422	3	49.265
A	west	T20	2.466	5.2	12.823	4	51.293	3	153.878
A	west	T10	0.617	1.5	0.926	25	23.138	3	69.413
A1	west	T25	3.854	2	7.708	8	61.664	2	123.328
A1	west	T20	2.466	1.5	3.699	4	14.796	2	29.592
A1	west	T16	1.579	1.3	2.053	8	16.422	2	32.843
A1	west	T32	6.313	5.2	32.828	4	131.310	2	262.621
A1	west	T25	3.854	5.2	20.041	4	80.163	2	160.326
A1	west	T16	1.579	5.2	8.211	2	16.422	2	32.843
A1	west	T10	0.617	1.5	0.926	25	23.138	2	46.275
B	west	T32	6.313	2	12.626	8	101.008	2	202.016
B	west	T20	2.466	1.5	3.699	8	29.592	2	59.184
B	west	T16	1.579	1.3	2.053	4	8.211	2	16.422
B	west	T40	9.864	5.2	51.293	4	205.171	2	410.342
B	west	T32	6.313	5.2	32.828	4	131.310	2	262.621

B	west	T16	1.579	5.2	8.211	2	16.422	2	32.843
B	west	T10	0.617	1.8	1.111	25	27.765	2	55.530
B1	west	T32	6.313	2	12.626	8	101.008	2	202.016
B1	west	T25	3.854	1.5	5.781	8	46.248	2	92.496
B1	west	T16	1.579	1.3	2.053	4	8.211	2	16.422
B1	west	T40	9.864	5.4	53.266	4	213.062	2	426.125
B1	west	T32	6.313	5.4	34.090	4	136.361	2	272.722
B1	west	T16	1.579	5.4	8.527	2	17.053	2	34.106
B1	west	T10	0.617	1.8	1.111	27	29.986	2	59.972
C	west	T25	3.854	2	7.708	8	61.664	4	246.656
C	west	T20	2.466	1.5	3.699	8	29.592	4	118.368
C	west	T16	1.579	1.3	2.053	4	8.211	4	32.843
C	west	T32	6.313	5.4	34.090	4	136.361	4	545.443
C	west	T25	3.854	5.4	20.812	4	83.246	4	332.986
C	west	T10	0.617	1.5	0.926	27	24.989	4	99.954
C	west	T16	1.579	5.4	8.527	2	17.053	4	68.213
D	west	T32	6.313	2	12.626	8	101.008	2	202.016
D	west	T25	3.854	1.5	5.781	8	46.248	2	92.496
D	west	T16	1.579	1.3	2.053	4	8.211	2	16.422
D	west	T40	9.864	5.4	53.266	4	213.062	2	426.125
D	west	T32	6.313	5.4	34.090	4	136.361	2	272.722
D	west	T16	1.579	5.4	8.527	2	17.053	2	34.106
D	west	T10	0.617	1.8	1.111	27	29.986	2	59.972
E	west	T32	6.313	2	12.626	8	101.008	2	202.016
E	west	T25	3.854	1.5	5.781	8	46.248	2	92.496
E	west	T16	1.579	1.3	2.053	4	8.211	2	16.422
E	west	T40	9.864	5.8	57.211	4	228.845	2	457.690
E	west	T32	6.313	5.8	36.615	4	146.462	2	292.923
E	west	T16	1.579	5.8	9.158	2	18.316	2	36.633
E	west	T10	0.617	1.8	1.111	29	32.207	2	64.415

F	N & S	T32	6.313	2	12.626	8	101.008	6	606.048
F	N & S	T25	3.854	1.5	5.781	8	46.248	6	277.488
F	N & S	T16	1.579	1.3	2.053	4	8.211	6	49.265
F	N & S	T40	9.864	6.4	63.130	4	252.518	6	1515.110
F	N & S	T32	6.313	6.4	40.403	4	161.613	6	969.677
F	N & S	T16	1.579	6.4	10.106	2	20.211	6	121.267
F	N & S	T10	0.617	1.8	1.111	32	35.539	6	213.235
G	N & S	T32	6.313	2	12.626	8	101.008	2	202.016
G	N & S	T25	3.854	1.5	5.781	8	46.248	2	92.496
G	N & S	T16	1.579	1.3	2.053	4	8.211	2	16.422
G	N & S	T40	9.864	7	69.048	4	276.192	2	552.384
G	N & S	T32	6.313	7	44.191	4	176.764	2	353.528
G	N & S	T16	1.579	7	11.053	2	22.106	2	44.212
G	N & S	T10	0.617	1.8	1.111	35	38.871	2	77.742
H	N & S	T25	3.854	2	7.708	8	61.664	2	123.328
H	N & S	T20	2.466	1.5	3.699	8	29.592	2	59.184
H	N & S	T16	1.579	1.3	2.053	4	8.211	2	16.422
H	N & S	T32	6.313	6.8	42.928	4	171.714	2	343.427
H	N & S	T25	3.854	6.8	26.207	4	104.829	2	209.658
H	N & S	T16	1.579	6.8	10.737	2	21.474	2	42.949
H	N & S	T10	0.617	1.5	0.926	34	31.467	2	62.934
J1	N & S	T25	3.854	2	7.708	8	61.664	2	123.328
J1	N & S	T20	2.466	1.5	3.699	8	29.592	2	59.184
J1	N & S	T16	1.579	1.3	2.053	4	8.211	2	16.422
J1	N & S	T32	6.313	6	37.878	4	151.512	2	303.024
J1	N & S	T25	3.854	6	23.124	4	92.496	2	184.992
J1	N & S	T16	1.579	6	9.474	2	18.948	2	37.896
J1	N & S	T10	0.617	1.5	0.926	30	27.765	2	55.530
J	N & S	T25	3.854	2	7.708	8	61.664	4	246.656
J	N & S	T20	2.466	1.5	3.699	8	29.592	4	118.368

J	N & S	T16	1.579	1.3	2.053	4	8.211	4	32.843
J	N & S	T32	6.313	6	37.878	4	151.512	4	606.048
J	N & S	T25	3.854	6	23.124	4	92.496	4	369.984
J	N & S	T16	1.579	6	9.474	2	18.948	4	75.792
J	N & S	T10	0.617	1.5	0.926	30	27.765	4	111.060
K	N & S	T25	3.854	2	7.708	8	61.664	6	369.984
K	N & S	T20	2.466	1.5	3.699	8	29.592	6	177.552
K	N & S	T16	1.579	1.3	2.053	4	8.211	6	49.265
K	N & S	T32	6.313	6.8	42.928	4	171.714	6	1030.282
K	N & S	T25	3.854	6.8	26.207	4	104.829	6	628.973
K	N & S	T16	1.579	6.8	10.737	2	21.474	6	128.846
K	N & S	T10	0.617	1.5	0.926	34	31.467	6	188.802
K1	N & S	T25	3.854	2	7.708	8	61.664	2	123.328
K1	N & S	T20	2.466	1.5	3.699	8	29.592	2	59.184
K1	N & S	T16	1.579	1.3	2.053	4	8.211	2	16.422
K1	N & S	T32	6.313	6.8	42.928	4	171.714	2	343.427
K1	N & S	T25	3.854	6.8	26.207	4	104.829	2	209.658
K1	N & S	T16	1.579	6.8	10.737	2	21.474	2	42.949
K1	N & S	T10	0.617	1.5	0.926	34	31.467	2	62.934
K2	N & S	T25	3.854	2	7.708	8	61.664	2	123.328
K2	N & S	T20	2.466	1.5	3.699	8	29.592	2	59.184
K2	N & S	T16	1.579	1.3	2.053	4	8.211	2	16.422
K2	N & S	T32	6.313	6.8	42.928	4	171.714	2	343.427
K2	N & S	T25	3.854	6.8	26.207	4	104.829	2	209.658
K2	N & S	T16	1.579	6.8	10.737	2	21.474	2	42.949
K2	N & S	T10	0.617	1.5	0.926	34	31.467	2	62.934
L	N & S	T32	6.313	2	12.626	8	101.008	2	202.016
L	N & S	T25	3.854	1.5	5.781	8	46.248	2	92.496
L	N & S	T16	1.579	1.3	2.053	4	8.211	2	16.422
L	N & S	T40	9.864	6.6	65.102	4	260.410	2	520.819

L	N & S	T32	6.313	6.6	41.666	4	166.663	2	333.326
L	N & S	T16	1.579	6.6	10.421	2	20.843	2	41.686
L	N & S	T10	0.617	1.8	1.111	33	36.650	2	73.300
M	N, S & E	T25	3.854	2	7.708	8	61.664	6	369.984
M	N, S & E	T20	2.466	1.5	3.699	8	29.592	6	177.552
M	N, S & E	T16	1.579	1.3	2.053	4	8.211	6	49.265
M	N, S & E	T32	6.313	6.8	42.928	4	171.714	6	1030.282
M	N, S & E	T25	3.854	6.8	26.207	4	104.829	6	628.973
M	N, S & E	T16	1.579	6.8	10.737	2	21.474	6	128.846
M	N, S & E	T10	0.617	1.5	0.926	34	31.467	6	188.802
M1	east	T25	3.854	2	7.708	8	61.664	2	123.328
M1	east	T20	2.466	1.5	3.699	8	29.592	2	59.184
M1	east	T16	1.579	1.3	2.053	4	8.211	2	16.422
M1	east	T32	6.313	6.6	41.666	4	166.663	2	333.326
M1	east	T25	3.854	6.6	25.436	4	101.746	2	203.491
M1	east	T16	1.579	6.6	10.421	2	20.843	2	41.686
M1	east	T10	0.617	1.5	0.926	33	30.542	2	61.083
N	N, S & E	T32	6.313	2	12.626	8	101.008	8	808.064
N	N, S & E	T25	3.854	1.5	5.781	8	46.248	8	369.984
N	N, S & E	T16	1.579	1.3	2.053	4	8.211	8	65.686
N	N, S & E	T40	9.864	7	69.048	4	276.192	8	2209.536
N	N, S & E	T32	6.313	7	44.191	4	176.764	8	1414.112
N	N, S & E	T16	1.579	7	11.053	2	22.106	8	176.848
N	N, S & E	T10	0.617	1.8	1.111	35	38.871	8	310.968
P	east	T25	3.854	2	7.708	8	61.664	1	61.664
P	east	T20	2.466	1.5	3.699	8	29.592	1	29.592
P	east	T16	1.579	1.3	2.053	4	8.211	1	8.211
P	east	T32	6.313	6.6	41.666	4	166.663	1	166.663
P	east	T25	3.854	6.6	25.436	4	101.746	1	101.746
P	east	T16	1.579	6.6	10.421	2	20.843	1	20.843

P	east	T10	0.617	1.5	0.926	33	30.542	1	30.542
P1	east	T25	3.854	2	7.708	8	61.664	1	61.664
P1	east	T20	2.466	1.5	3.699	8	29.592	1	29.592
P1	east	T16	1.579	1.3	2.053	4	8.211	1	8.211
P1	east	T32	6.313	6.6	41.666	4	166.663	1	166.663
P1	east	T25	3.854	6.6	25.436	4	101.746	1	101.746
P1	east	T16	1.579	6.6	10.421	2	20.843	1	20.843
P1	east	T10	0.617	1.5	0.926	33	30.542	1	30.542
Q	east	T32	6.313	2	12.626	8	101.008	1	101.008
Q	east	T25	3.854	1.5	5.781	8	46.248	1	46.248
Q	east	T16	1.579	1.3	2.053	4	8.211	1	8.211
Q	east	T40	9.864	6.6	65.102	4	260.410	1	260.410
Q	east	T32	6.313	6.6	41.666	4	166.663	1	166.663
Q	east	T16	1.579	6.6	10.421	2	20.843	1	20.843
Q	east	T10	0.617	1.8	1.111	33	36.650	1	36.650
R	east	T25	3.854	2	7.708	8	61.664	10	616.640
R	east	T20	2.466	1.5	3.699	8	29.592	10	295.920
R	east	T16	1.579	1.3	2.053	4	8.211	10	82.108
R	east	T32	6.313	6.6	41.666	4	166.663	10	1666.632
R	east	T25	3.854	6.6	25.436	4	101.746	10	1017.456
R	east	T16	1.579	6.6	10.421	2	20.843	10	208.428
R	east	T10	0.617	1.5	0.926	33	30.542	10	305.415
R1	east	T25	3.854	2	7.708	8	61.664	1	61.664
R1	east	T20	2.466	1.5	3.699	8	29.592	1	29.592
R1	east	T16	1.579	1.3	2.053	4	8.211	1	8.211
R1	east	T32	6.313	6.6	41.666	4	166.663	1	166.663
R1	east	T25	3.854	6.6	25.436	4	101.746	1	101.746
R1	east	T16	1.579	6.6	10.421	2	20.843	1	20.843
R1	east	T10	0.617	1.5	0.926	33	30.542	1	30.542
Stair Beam 1		T32	6.313	2	12.626	8	101.008	8	808.064

Stair Beam 1		T25	3.854	1.5	5.781	8	46.248	8	369.984
Stair Beam 1		T16	1.579	1.3	2.053	4	8.211	8	65.686
Stair Beam 1		T40	9.864	6.25	61.650	4	246.600	8	1972.800
Stair Beam 1		T32	6.313	6.25	39.456	4	157.825	8	1262.600
Stair Beam 1		T16	1.579	6.25	9.869	2	19.738	8	157.900
Stair Beam 1		T10	0.617	2.1	1.296	31	40.167	8	321.334
Stair Beam 2		T32	6.313	2	12.626	8	101.008	16	1616.128
Stair Beam 2		T25	3.854	1.5	5.781	8	46.248	16	739.968
Stair Beam 2		T16	1.579	1.3	2.053	4	8.211	16	131.373
Stair Beam 2		T40	9.864	4.78	47.150	4	188.600	16	3017.595
Stair Beam 2		T32	6.313	4.78	30.176	4	120.705	16	1931.273
Stair Beam 2		T16	1.579	4.78	7.548	2	15.095	16	241.524
Stair Beam 2		T10	0.617	2.1	1.296	23	29.801	16	476.818
Stair Beam 3		T25	3.854	2	7.708	8	61.664	4	246.656
Stair Beam 3		T20	2.466	1.5	3.699	8	29.592	4	118.368
Stair Beam 3		T16	1.579	1.3	2.053	4	8.211	4	32.843
Stair Beam 3		T32	6.313	6.25	39.456	4	157.825	4	631.300
Stair Beam 3		T25	3.854	6.25	24.088	4	96.350	4	385.400
Stair Beam 3		T16	1.579	6.25	9.869	2	19.738	4	78.950
Stair Beam 3		T10	0.617	1.2	0.740	31	22.952	4	91.810
Total mass of reinforcement in perimeter and stair ground beams									**50769**

Table 25: Mass of reinforcement in Ground Beams around the perimeter

Ground Floor Slabs

Information on the ground floor slabs was gathered from ground floor slab drawings, sections and ground beam drawings. 200mm deep pre-cast units were used throughout. The areas of the slab were calculated and from this the mass of concrete could be calculated, see

Mass of Concrete in Ground Floor Slabs			
Stand	**Area of slab (m^2)**	**Mass (kg/m^2)**	**Mass (kg)**
South	2576.400	298.106	768041.323
Corners	2180.840	298.106	650122.356
East	3089.683	298.106	921054.269
North	2576.400	298.106	768041.323
West	3596.874	298.106	1072251.151
Total mass of concrete			**4179510**

Table 26 for details.

Mass of Concrete in Ground Floor Slabs			
Stand	**Area of slab (m^2)**	**Mass (kg/m^2)**	**Mass (kg)**
South	2576.400	298.106	768041.323
Corners	2180.840	298.106	650122.356
East	3089.683	298.106	921054.269
North	2576.400	298.106	768041.323
West	3596.874	298.106	1072251.151
Total mass of concrete			**4179510**

Table 26: Mass of concrete in the ground floor slabs

The quantity of reinforcement within the precast units was estimated, no specific information could be found for the bison units that were specified, but details from another manufacturer were used and assumed to be similar. 9 x 12.5mm strand assumed to be found within 1200mm length. This assumption was made using the following manufacturer's details:

- Hanson Hollowcore Planks, 2008. Available at: http://www.hanson.com.au/LinkClick.aspx?fileticket=XniuefiAvGM%3D&tabid=328 [accessed 10/09/12]

The volume of steel within a strand was estimated, the mass of a single strand calculated assuming a density of 7850 kg/m^3. The mass per m^2 was then calculated. The estimation for the whole stadium can be seen in Table 27.

Mass of Reinforcement in Ground Floor			
Stand	**Area of slab (m^2)**	**Mass (kg/m^2)**	**Mass (kg)**
South	2576.400	7.704	19848.586
Corners	2180.840	7.704	16801.191
East	3089.683	7.704	23802.918
North	2576.400	7.704	19848.586
West	3596.874	7.704	27710.317
Total mass of reinforcement			**108012**

Table 27: Mass of reinforcement in the ground floor slabs

Columns

Column details were taken from plans and sections, in places heights has to be estimated using trigonometry. Details and calculations can be seen from Table 28 to Table 30. The majority of columns are steel sections, however external perimeter columns are predominately composite, as noted within the tables. Masses of the sections were taken from:

- Engineering ToolBox, UC British Universal Columns, available at: http://sketchup.engineeringtoolbox.com/uc-british-universal-colums-c_3.html [accessed 10/08/12]
- Britfil SteelFab LTD, Universal Steel Columns, available at: http://www.britfilsteelfab.co.uk/universal-steel-columns/ [accessed 10/08/12]

For the calculation of the mass of concrete, the density of concrete was taken to be 2400kg/m3. The volume was calculated using a square area and the estimated volume of the steel column within this was not subtracted from it as it was considered that the difference would be negligible.

Information about the reinforcement in the composite columns was taken from detailed drawings on concrete reinforcement, for the calculations see ???, the masses of the reinforcement were taken from:

- Franklin Steel plc, Reinforcing Bar, available at: http://www.franklinsteelplc.co.uk/steel/reinforcing.htm [accessed 27/08/12]
- Lee Metal Group, Steel Reinforcement Bars, available at: http://www.leemetalgroup.com/index.php?option=com_content&task=view&id=18 [accessed 27/08/12]

Columns				Quantity				
Ref	**Section size**	**Length (m)**	**Concrete**	**N. Stand**	**W. Stand**	**S. Stand**	**E. Stand**	**Total**
A	152 x 152 x 23 UC	1.583		10	0	9	13	**32**
B	152 x 152 x 30 UC	1.583		8	14	9	4	**35**
C	254 x 254 x 73 UC	4.192		3	0	4	2	**9**
D	203 x 203 x 60 UC	4.192		11	0	10	15	**36**
E	203 x 203 x 46 UC	4.192		4	0	4	0	8
		4.355		4	0	4	0	**8**
F	254 x 254 x 73 UC	4.192		0	8	0	0	**8**
G	203 x 203 x 71 UC	4.192		2	5	2	0	**9**
J	254 x 254 x 89 UC	4.192		0	2	0	0	**2**
N	305 x 305 x 97 UC	13.758		0	0	0	3	**3**
		13.759		0	0	0	2	**2**
		13.783		0	0	0	2	**2**
		13.814		0	0	0	2	**2**
		13.856		0	0	0	2	**2**
		13.91		0	0	0	2	**2**
		13.974		0	0	0	2	**2**
		14.045		0	0	0	2	**2**
		14.147		1	0	1	0	**2**
		14.263		1	0	1	0	**2**
		14.389		1	0	1	0	**2**
		14.534		1	0	1	0	**2**
		14.707		1	0	1	0	**2**
		14.871		1	0	1	0	**2**
		15.043		1	0	1	0	**2**
		15.230		1	0	1	0	**2**
		15.432		1	0	1	0	**2**
		15.65		1	0	1	0	**2**

		15.883		1	0	1	0	**2**
		16.127		1	0	1	0	**2**
		18.358		1	0	1	0	**2**
		18.450		1	0	1	0	**2**
P	356 x 368 x 177 UC	12.250		0	6	0	0	**6**
R	356 x 368 x 153 UC	12.250		1	5	1	0	**7**
T	356 x 368 x 177 UC	12.250		0	2	0	0	**2**
V	203 x 203 x 46 UC	4.355		5	0	5	11	**21**
W	356 x 368 x 202 UC	16.501		0	2	0	0	**2**
	356 x 365 x 129 UC	16.434		0	2	0	0	**2**
X	356 x 368 x 177 UC	8.430		0	1	0	0	**1**
	356 x 368 x 129 UC	8.004		0	1	0	0	**1**
	356 x 368 x 177 UC	4.355		0	3	0	0	**3**
Y	356 x 368 x 202 UC	8.430		0	2	0	0	**2**
	356 x 368 x 129 UC	8.071		0	2	0	0	**2**
Z	356 x 406 x 235 UC	8.430		0	2	0	0	**2**
	356 x 368 x 153 UC	8.004		0	2	0	0	**2**
AA	305 x 305 x 97 UC	17.454	Encase in RC40 conc, 0.6m dia	1	0	1	0	**2**
		17.546	Encase in RC40 conc, 0.6m dia	1	0	1	0	**2**
BB	203 x 203 x 46 UC	12.854	Encase in RC40 conc, 0.6m dia	0	0	0	3	**3**
		12.855	Encase in RC40 conc, 0.6m dia	0	0	0	2	**2**
		12.879	Encase in RC40 conc, 0.6m dia	0	0	0	2	**2**
		12.91	Encase in RC40 conc, 0.6m dia	0	0	0	2	**2**
		12.952	Encase in RC40 conc, 0.6m dia	0	0	0	2	**2**
		13.006	Encase in RC40 conc, 0.6m dia	0	0	0	2	**2**
		13.07	Encase in RC40 conc, 0.6m dia	0	0	0	2	**2**
		13.141	Encase in RC40 conc, 0.6m dia	0	0	0	4	**4**
		13.243	Encase in RC40 conc, 0.6m dia	1	0	1	0	**2**
		13.359	Encase in RC40 conc, 0.6m dia	1	0	1	0	**2**
		13.485	Encase in RC40 conc, 0.6m dia	1	0	1	0	**2**

		13.63	Encase in RC40 conc, 0.6m dia	2	0	2	0	**4**
		13.803	Encase in RC40 conc, 0.6m dia	1	0	1	0	**2**
		13.967	Encase in RC40 conc, 0.6m dia	1	0	1	0	**2**
		14.139	Encase in RC40 conc, 0.6m dia	1	0	1	0	**2**
		14.326	Encase in RC40 conc, 0.6m dia	1	0	1	0	**2**
		14.528	Encase in RC40 conc, 0.6m dia	1	0	1	0	**2**
		14.746	Encase in RC40 conc, 0.6m dia	1	0	1	0	**2**
		14.979	Encase in RC40 conc, 0.6m dia	1	0	1	0	**2**
		15.223	Encase in RC40 conc, 0.6m dia	1	0	1	0	**2**
CC	254 x 254 x 89 UC	12.25	Encase in RC40 structural conc, 1.2m dia	0	6	0	0	6
	203 x 203 x 46 UC	13.606	Encase in RC40 structural conc, 1.2m dia	0	2	0	0	**2**
		17.22	Encase in RC40 structural conc, 1.2m dia	0	2	0	0	**2**
		17.602	Encase in RC40 structural conc, 1.2m dia	0	2	0	0	**2**
DD	356 x 368 x 153 UC	12.250	Encase in RC40 conc, 0.8m dia	1	4	1	0	**6**
	254 x 254 x 73 UC	8.151	Encase in RC40 conc, 0.8m dia	1	0	1	0	**2**
		12.028	Encase in RC40 conc, 0.8m dia	0	2	0	0	**2**
		13.111	Encase in RC40 conc, 0.8m dia	0	2	0	0	**2**
FF	533 x 210 x 82 UB	17.744	Encase in RC40 conc, 0.8m dia	1	0	1	0	**2**
		18.056	Encase in RC40 conc, 0.8m dia	1	0	1	0	**2**
		18.648	Encase in RC40 conc, 0.8m dia	1	0	1	0	**2**
		19.24	Encase in RC40 conc, 0.8m dia	1	0	1	0	**2**
		21.269	Encase in RC40 conc, 0.8m dia	2	0	2	0	**4**
GG	356 x 368 x 202 UC	12.250	Encase in RC40 conc, 0.8m dia	0	2	0	0	**2**
	305 x 305 x 97 UC	10.210	Encase in RC40 conc, 0.8m dia	0	2	0	0	**2**
HH	254 x 254 x 89 UC	12.250	Encase in RC40 structural conc, 1.2m dia	0	2	0	0	**2**
	203 x 203 x 46 UC	13.137	Encase in RC40 structural conc, 1.2m dia	0	2	0	0	**2**
KK	356 x 368 x 202 UC	12.250		0	2	0	0	**2**
LL	356 x 406 x 287 UC	8.430		0	2	0	0	**2**
	356 x 406 x 235 UC	8.004		0	2	0	0	**2**
MM	254 x 254 x 73 UC	12.079		0	2	0	0	**2**

NN	193.7 x 6.3 CHS	16.850		0	16	0	0	**16**
PP	356 x 368 x 153 UC	12.250		0	1	0	0	**1**
	254 x 254 x 73 UC	13.302		0	2	0	0	**2**
QQ	254 x 254 x 73 UC	7.351		1	0	1	0	**2**
		8.430		1	0	1	0	**2**
		7.351		1	0	1	0	**2**
RR	254 x 254 x 89 UC	6.927		2	0	2	0	**4**
SS	305 x 305 x 137 UC	19.674		1	0	1	0	**2**

Table 28: Column Quantities in Stadium Case Study

Columns - Masses							
Ref	**Section size**	**Weight kg/m**	**Length (m)**	**Composite**	**Mass per beam (kg)**	**Quantity of beams**	**Total Mass (kg)**
A	152 x 152 x 23 UC	23	1.583		36.409	32	1165.088
B	152 x 152 x 30 UC	30	1.583		47.49	35	1662.15
C	254 x 254 x 73 UC	73	4.192		306.016	9	2754.144
D	203 x 203 x 60 UC	60	4.192		251.52	36	9054.72
E	203 x 203 x 46 UC	46.1	4.192		193.2512	8	1546.0096
		46.1	4.355		200.7655	8	1606.124
F	254 x 254 x 73 UC	73	4.192		306.016	8	2448.128
G	203 x 203 x 71 UC	71	4.192		297.632	9	2678.688
J	254 x 254 x 89 UC	89	4.192		373.088	2	746.176
N	305 x 305 x 97 UC	97	13.758		1334.526	3	4003.578
		97	13.759		1334.623	2	2669.246
		97	13.783		1336.951	2	2673.902
		97	13.814		1339.958	2	2679.916
		97	13.856		1344.032	2	2688.064

		97	13.910		1349.270	2	2698.54
		97	13.974		1355.478	2	2710.956
		97	14.045		1362.365	2	2724.73
		97	14.147		1372.259	2	2744.518
		97	14.263		1383.511	2	2767.022
		97	14.389		1395.733	2	2791.466
		97	14.534		1409.798	2	2819.596
		97	14.707		1426.579	2	2853.158
		97	14.871		1442.487	2	2884.974
		97	15.043		1459.171	2	2918.342
		97	15.230		1477.31	2	2954.62
		97	15.432		1496.904	2	2993.808
		97	15.65		1518.05	2	3036.1
		97	15.883		1540.651	2	3081.302
		97	16.127		1564.319	2	3128.638
		97	18.358		1780.726	2	3561.452
		97	18.450		1789.650	2	3579.300
P	356 x 368 x 177 UC	177	12.250		2168.250	6	13009.500
R	356 x 368 x 153 UC	152.9	12.250		1873.025	7	13111.175
T	356 x 368 x 177 UC	177	12.250		2168.250	2	4336.500
V	203 x 203 x 46 UC	46.1	4.355		200.766	21	4216.076
W	356 x 368 x 202 UC	201.9	16.501		3331.552	2	6663.104
	356 x 365 x 129 UC	129	16.434		2119.986	2	4239.972
X	356 x 368 x 177 UC	177	8.430		1492.110	1	1492.110
	356 x 368 x 129 UC	129	8.004		1032.516	1	1032.516
	356 x 368 x 177 UC	177	4.355		770.835	3	2312.505
Y	356 x 368 x 202 UC	201.9	8.430		1702.017	2	3404.034
	356 x 368 x 129 UC	129	8.071		1041.159	2	2082.318
Z	356 x 406 x 235 UC	235.1	8.430		1981.893	2	3963.786
	356 x 368 x 153 UC	152.9	8.004		1223.812	2	2447.623

AA	305 x 305 x 97 UC	97	17.454	Yes	1693.038	2	3386.076
		97	17.546	Yes	1701.962	2	3403.924
BB	203 x 203 x 46 UC	46.1	12.854	Yes	592.569	3	1777.708
		46.1	12.855	Yes	592.616	2	1185.231
		46.1	12.879	Yes	593.722	2	1187.444
		46.1	12.91	Yes	595.151	2	1190.302
		46.1	12.952	Yes	597.087	2	1194.174
		46.1	13.006	Yes	599.577	2	1199.153
		46.1	13.07	Yes	602.527	2	1205.054
		46.1	13.141	Yes	605.800	4	2423.200
		46.1	13.243	Yes	610.502	2	1221.005
		46.1	13.359	Yes	615.850	2	1231.700
		46.1	13.485	Yes	621.659	2	1243.317
		46.1	13.63	Yes	628.343	4	2513.372
		46.1	13.803	Yes	636.318	2	1272.637
		46.1	13.967	Yes	643.879	2	1287.757
		46.1	14.139	Yes	651.808	2	1303.616
		46.1	14.326	Yes	660.429	2	1320.857
		46.1	14.528	Yes	669.741	2	1339.482
		46.1	14.746	Yes	679.791	2	1359.581
		46.1	14.979	Yes	690.532	2	1381.064
		46.1	15.223	Yes	701.780	2	1403.561
CC	254 x 254 x 89 UC	89	12.25	Yes	1090.250	6	6541.500
	203 x 203 x 46 UC	46.1	13.606	Yes	627.237	2	1254.473
		46.1	17.22	Yes	793.842	2	1587.684
		46.1	17.602	Yes	811.452	2	1622.904
DD	356 x 368 x 153 UC	152.9	12.250	Yes	1873.025	6	11238.150
	254 x 254 x 73 UC	73.1	8.151	Yes	595.838	2	1191.676
		73.1	12.028	Yes	879.247	2	1758.494
		73.1	13.111	Yes	958.414	2	1916.828

FF	533 x 210 x 82 UB	82.2	17.744	Yes	1458.557	2	2917.114
		82.2	18.056	Yes	1484.203	2	2968.406
		82.2	18.648	Yes	1532.866	2	3065.731
		82.2	19.24	Yes	1581.528	2	3163.056
		82.2	21.269	Yes	1748.312	4	6993.247
GG	356 x 368 x 202 UC	201.9	12.250	Yes	2473.275	2	4946.550
	305 x 305 x 97 UC	97	10.210	Yes	990.370	2	1980.740
HH	254 x 254 x 89 UC	88.9	12.250	Yes	1089.025	2	2178.050
	203 x 203 x 46 UC	46.1	13.137	Yes	605.616	2	1211.231
KK	356 x 368 x 202 UC	201.9	12.250		2473.275	2	4946.550
LL	356 x 406 x 287 UC	287.1	8.430		2420.253	2	4840.506
	356 x 406 x 235 UC	235.1	8.004		1881.740	2	3763.481
MM	254 x 254 x 73 UC	73.1	12.079		882.975	2	1765.950
NN	193.7 x 6.3 CHS	29.1	16.850		490.335	16	7845.360
PP	356 x 368 x 153 UC	152.9	12.250		1873.025	1	1873.025
	254 x 254 x 73 UC	73	13.302		971.046	2	1942.092
QQ	254 x 254 x 73 UC	73	7.351		536.623	2	1073.246
		73	8.430		615.390	2	1230.780
		73	7.351		536.623	2	1073.246
RR	254 x 254 x 89 UC	88.9	6.927		615.810	4	2463.241
SS	305 x 305 x 137 UC	137	19.674		2695.338	2	5390.676
Total Mass of Steel in columns							**280710**

Table 29: Mass of steel in columns

Mass of concrete in Composite Columns, all RC40						
Ref	**Size**	**Height (m)**	**Volume (m3)**	**Mass (kg)**	**Quantity**	**Total Mass (kg)**
AA	0.6 x 0.6 m	17.454	6.283	15080.256	2	30160.512

	0.6 x 0.6 m	17.546	6.317	15159.744	2	30319.488
BB	0.6 x 0.6 m	12.854	4.627	11105.856	3	33317.568
	0.6 x 0.6 m	12.855	4.628	11106.720	2	22213.44
	0.6 x 0.6 m	12.879	4.636	11127.456	2	22254.912
	0.6 x 0.6 m	12.91	4.648	11154.240	2	22308.48
	0.6 x 0.6 m	12.952	4.663	11190.528	2	22381.056
	0.6 x 0.6 m	13.006	4.682	11237.184	2	22474.368
	0.6 x 0.6 m	13.07	4.705	11292.480	2	22584.96
	0.6 x 0.6 m	13.141	4.731	11353.824	4	45415.296
	0.6 x 0.6 m	13.243	4.767	11441.952	2	22883.904
	0.6 x 0.6 m	13.359	4.809	11542.176	2	23084.352
	0.6 x 0.6 m	13.485	4.855	11651.040	2	23302.08
	0.6 x 0.6 m	13.63	4.907	11776.320	4	47105.28
	0.6 x 0.6 m	13.803	4.969	11925.792	2	23851.584
	0.6 x 0.6 m	13.967	5.028	12067.488	2	24134.976
	0.6 x 0.6 m	14.139	5.090	12216.096	2	24432.192
	0.6 x 0.6 m	14.326	5.157	12377.664	2	24755.328
	0.6 x 0.6 m	14.528	5.230	12552.192	2	25104.384
	0.6 x 0.6 m	14.746	5.309	12740.544	2	25481.088
	0.6 x 0.6 m	14.979	5.392	12941.856	2	25883.712
	0.6 x 0.6 m	15.223	5.480	13152.672	2	26305.344
CC	1.2 x 1.2 m	12.25	17.640	42336.000	6	254016
	1.2 x 1.2 m	13.606	19.593	47022.336	2	94044.672
	1.2 x 1.2 m	17.22	24.797	59512.320	2	119024.64
	1.2 x 1.2 m	17.602	25.347	60832.512	2	121665.02
DD	0.8 x 0.8 m	12.250	7.840	18816.000	6	112896
	0.8 x 0.8 m	8.151	5.217	12519.936	2	25039.872
	0.8 x 0.8 m	12.028	7.698	18475.008	2	36950.016
	0.8 x 0.8 m	13.111	8.391	20138.496	2	40276.992
FF	0.8 x 0.8 m	17.744	11.356	27254.784	2	54509.568

	0.8 x 0.8 m	18.056	11.556	27734.016	2	55468.032
	0.8 x 0.8 m	18.648	11.935	28643.328	2	57286.656
	0.8 x 0.8 m	19.24	12.314	29552.640	2	59105.28
	0.8 x 0.8 m	21.269	13.612	32669.184	4	130676.74
GG	0.8 x 0.8 m	12.250	7.840	18816.000	2	37632
	0.8 x 0.8 m	10.210	6.534	15682.560	2	31365.12
HH	1.2 x 1.2 m	12.250	17.640	42336.000	2	84672
	1.2 x 1.2 m	13.137	18.917	45401.472	2	90802.944
Total Mass of Concrete in composite columns						**1995186**

Table 30: Mass of concrete in Composite Columns

Mass of Reinforcement in Ground Beams in East Stand								
Columns	**Rebar Type**	**Mass (kg/m)**	**Length (m)**	**Mass of Bar (kg)**	**Rebar Quantity**	**Mass all Bars (kg)**	**Number of columns**	**Total Mass (kg)**
A2 & A72	T8	0.395	4.4	1.738	8	13.904	2	27.808
A2 - A11A, A72 - A62A	T8	0.395	4.4	1.738	30	52.140	12	625.680
A2 & A72	T25	3.854	2	7.708	14	107.912	2	215.824
A2 - A11A, A72 - A62A	T25	3.854	4.95	19.077	14	267.082	12	3204.986
A2 - A11A, A72 - A62A	T25	3.854	4.62	17.805	14	249.277	12	2991.321
A2 - A11A, A72 - A62A	T8	0.395	4.4	1.738	28	48.664	12	583.968
A2 - A9A, A72 - A64A	T8	0.395	4.4	1.738	28	48.664	10	486.640
A2 - A9A, A72 - A64A	T40	9.864	4.62	45.572	14	638.004	10	6380.035
A2 - A8, A72 - A66	T40	9.864	4.62	45.572	14	638.004	8	5104.028
A2 - A8, A72 - A66	T8	0.395	4.4	1.738	28	48.664	8	389.312
A2 & A72	T8	0.395	4.4	1.738	60	104.280	2	208.560
A2 & A72	T40	9.864	9.9	97.654	14	1367.150	2	2734.301
A2 & A72	T16	1.579	2	3.158	14	44.212	2	88.424
A4 & A70	T8	0.395	4.4	1.738	8	13.904	2	27.808

A4 & A70	T25	3.854	2	7.708	14	107.912	2	215.824
A4 & A70	T40	9.864	7.59	74.868	14	1048.149	2	2096.297
A4 & A70	T8	0.395	4.4	1.738	46	79.948	2	159.896
A4 & A70	T16	1.579	2	3.158	14	44.212	2	88.424
A8 & A66	T8	0.395	4.4	1.738	8	13.904	2	27.808
A8 & A66	T25	3.854	2	7.708	14	107.912	2	215.824
A8 & A66	T40	9.864	5.61	55.337	14	774.719	2	1549.437
A8 & A66	T16	1.579	2	3.158	14	44.212	2	88.424
A8 & A66	T8	0.395	4.4	1.738	34	59.092	2	118.184
A9A & A64A	T8	0.395	4.4	1.738	8	13.904	2	27.808
A9A & A64A	T25	3.854	2	7.708	14	107.912	2	215.824
A9A & A64A	T8	0.395	4.4	1.738	46	79.948	2	159.896
A9A & A64A	T40	9.864	7.59	74.868	14	1048.149	2	2096.297
A9A & A64A	T16	1.579	2	3.158	14	44.212	2	88.424
A11A & A62A	T8	0.395	4.4	1.738	8	13.904	2	27.808
A11A & A62A	T25	3.854	2	7.708	14	107.912	2	215.824
A11A & A62A	T8	0.395	4.4	1.738	58	100.804	2	201.608
A11A & A62A	T40	9.864	9.57	94.398	14	1321.579	2	2643.157
A11A & A62A	T16	1.579	2	3.158	14	44.212	2	88.424
Total mass of reinforcement in the composite columns								**33394**

Table 31: Mass of reinforcement within the Composite Columns

Beams

Steel beams where inventoried from structural steel layout drawings, steelwork elevations and sections. If dimensions where not given for the size of the beam trigonometry was used to calculate the length or as a last resort, measurements were taken by scaling off the drawing. In places there was conflict between the different drawings, generally regarding the beam type specified, in these cases the structural steel layout drawings were taken to be correct. The beams were inventoried according to level, and the mass of steel worked out for each level. The levels are listed below, along with the corresponding tables showing quantities and calculations.

- Lower Concourse Level:
  - Quantities, Table 32
  - Mass, Table 33
- Lower Terracing Level:
  - Quantities, Table 34
  - Mass, Table 35
- Hospitality Level, quantities & mass: Table 36
- Upper Concourse Level, quantities & mass: Table 37
- Plant Room Level, quantities & mass: Table 38
- Upper Tier Terracing Level, quantities & mass: Table 39
- Stair Towers, quantities & mass: Table 40

The masses for the steel sections of different types where taken from a number of different sources:

- The Engineering ToolBox, British Universal Columns and Beams, available at: http://www.engineeringtoolbox.com/british-universal-steel-columns-beams-d_1316.html [accessed 17/08/12]
- The Engineering ToolBox, UC British Universal Columns, available at: http://sketchup.engineeringtoolbox.com/uc-british-universal-colums-c_3.html [accessed 17/08/12]
- The Engineering ToolBox, UK Circular Hollow Sections, available at: http://sketchup.engineeringtoolbox.com/UK-CHS-Circular-Hollow-Sections-c_98.html [accessed 17/08/12]
- The Engineering ToolBox, Rectangular Hollow Hot Formed Sections, available at: http://sketchup.engineeringtoolbox.com/rectangular-hollow-hot-formed-sections-c_50.html [accessed 17/08/12]
- The Engineering ToolBox, UK PFC = British U-profile with Parallel Flanges, available at: http://sketchup.engineeringtoolbox.com/PFC-british-channels-c_37.html [accessed 17/08/12]
- The Engineering ToolBox, Square Hollow Hot Formed Sections, available at: http://sketchup.engineeringtoolbox.com/suare-hollow-hot-formed-sections-c_49.html [accessed 17/08/12]
- The Engineering ToolBox, Flat Sections, available at: http://sketchup.engineeringtoolbox.com/UK-flat-structural-sections-c_99.html [accessed 17/08/12]
- Masteel, Hot Rolled Steel Angles, available at: http://www.masteel.co.uk/hot_rolled_steel_angles.htm [accessed 17/08/12]
- MetalSupplies, Mild Steel Round Bars, available at: http://www.metalsupplies.com/mild-steel-rounds.html [accessed 17/08/12]

Steel Beams - Lower Concourse								
				Quantity				
Ref	**Section type**	**Notes**	**Length**	**S. Stand**	**N. Stand**	**E. Stand**	**W. Stand**	**Total**
A	686 x 254 x 125 UB		All	3	3	0	10	16
		section 16, 2	10.295	2	2	0	0	4
		section 29	8.355	1	1	0	0	2
		section 32	6.813	0	0	0	2	2
		section 33	8.36	0	0	0	2	2
		section 34	9.557	0	0	0	2	2
		section 35	10.409	0	0	0	2	2
		section 36	10.919	0	0	0	2	2
B	457 x 191 x 67 UB		All	8	8	0	18	34
		estimated	8.5	4	4	0	0	8
			7.5	4	4	0	0	8
		section 31-37	7.2	0	0	0	15	15
		section 31	4.91	0	0	0	2	2
		section 37	1.769	0	0	0	1	1
C	610 x 229 x 101 UB		All	19	19	17	15	70
		section 1-12, 15-24	7.906	14	14	17	0	45
		section 13, 25-28 - est	5.000	5	5	0	0	10
		section 30-37	8.355	0	0	0	15	15
E	356 x 127 x 33 UB		All	30	30	23	10	93
			7.5	6	6	17	4	33
			3.271	0	0	6	0	6
		section 10, 13, 25, 28 est	4.000	4	4	0	0	8
			3.935	2	2	0	6	10
		estimated	8.000	7	7	0	0	14
			6.125	2	2	0	0	4
			4.503	6	6	0	0	12

		estimated	6.500	3	3	0	0	6
F	406 x 140 x 39 UB		All	78	76	107	124	385
		section 1	4.8	0	0	1	0	1
		section 2	4.725	0	0	2	0	2
		section 3	4.5	0	0	2	0	2
		section 4	4.125	0	0	2	0	2
		section 5	3.601	0	0	2	0	2
			7.5	66	66	98	106	336
		section 18	3.556	1	0	0	0	1
		section 19	3.704	1	0	0	0	1
		estimated	8	6	6	0	8	20
			6.5	3	3	0	2	8
			4.93	1	1	0	0	2
		estimated	1.4	0	0	0	1	1
			2.345	0	0	0	3	3
			1.421	0	0	0	1	1
			2.324	0	0	0	2	2
		estimated	3.52	0	0	0	1	1
G	254 x 102 x 22 UB		All	63	57	51	56	227
			2.318	9	9	26	0	44
			1.8	9	9	8	0	26
			2.65	0	0	2	0	2
			2.335	3	3	2	2	10
			1.6	10	10	4	5	29
			0.74	1	1	4	0	6
			2.22	0	0	4	0	4
			2.45	0	0	1	0	1
			1.19	3	3	0	0	6
		estimated	2	2	2	0	0	4
			0.772	2	0	0	0	2

			2.167	1	0	0	0	1
			2.046	2	2	0	0	4
			2.4	1	1	0	0	2
			1.7625	4	4	0	0	8
			3.09	1	0	0	0	1
			1	2	0	0	0	2
			2.95	1	1	0	2	4
			1.38	2	2	0	0	4
			2.33	2	2	0	0	4
			2.27	1	1	0	0	2
			1.981	1	1	0	0	2
			2.54	1	1	0	0	2
			1.622	2	2	0	0	4
			0.5	2	2	0	0	4
			1.5	1	1	0	0	2
			2.678	0	0	0	16	16
			1.968	0	0	0	12	12
			2.1	0	0	0	6	6
		estimated	1.2	0	0	0	2	2
			2.63	0	0	0	1	1
			2.567	0	0	0	2	2
			1.74	0	0	0	1	1
			2.202	0	0	0	1	1
			1.175	0	0	0	1	1
		estimated	2	0	0	0	1	1
			1.09	0	0	0	1	1
			3.152	0	0	0	2	2
		estimated	3.52	0	0	0	1	1
H	457 x 152 x 52 UB		All	7	5	3	0	15
			7.5	1	1	3	0	5

			4.859	1	1	0	0	2
		estimated	5.8	1	1	0	0	2
			8	1	1	0	0	2
			5.619	1	1	0	0	2
			5.42	2	0	0	0	2
J	457 x 152 x 60 UB		All	1	1	0	6	8
			9.351	1	1	0	0	2
			8	0	0	0	6	6
K	254 x 102 x 25 UB		All	10	8	0	0	18
		estimated	3.5	2	2	0	0	4
		estimated	3	1	1	0	0	2
		estimated	2.27	1	1	0	0	2
		estimated	2	1	1	0	0	2
		estimated	2.335	2	2	0	0	4
			2.47	2	1	0	0	3
		estimated	4	1	0	0	0	1
AA	457 x 191 x 74 UB		All	7	7	17	6	37
		section 1-6, 17-21	7.92	5	5	11	0	21
			7.5	2	2	6	4	14
		estimated	8	0	0	0	2	2
BB	254 x 146 x 31 UB		All	10	13	4	5	32
		section 6	2.925	0	0	2	0	2
			2.64	0	0	2	0	2
		section 17, 21	3.114	2	2	0	0	4
		section 18, 20	3.556	1	2	0	0	3
		section 19	3.704	0	1	0	0	1
		estimated	4.56	4	4	0	0	8
		estimated	4.54	4	4	0	0	8
			3.58	0	0	0	3	3
			3.52	0	0	0	2	2

CC	533 x 210 x 82 UB		All	2	2	2	0	6
		section 8	7.92	0	0	2	0	2
		section 15, 23	9.258	2	2	0	0	4
DD	533 x 210 x 92 UB		All	16	16	2	0	34
		section 9, 14, 24	7.92	2	2	2	0	6
		section 11-12-est	6.3	2	2	0	0	4
		section 26-27, 29	7.2	3	3	0	0	6
		estimated	8	7	7	0	0	14
		estimated	9	2	2	0	0	4
EE	203 x 203 x 86 UC		All	1	1	0	2	4
			4	1	1	0	0	2
			2.642	0	0	0	2	2
GG	406 x 140 x 46 UB		All	19	19	5	4	47
			7.5	4	4	5	4	17
			8	3	3	0	0	6
			10	7	7	0	0	14
			4.5	4	4	0	0	8
			8.5	1	1	0	0	2
HH	457 x 152 x 52 UB		7.5	0	0	0	2	2
LL	230 x 90 x 32 PFC		All	10	9	6	6	31
			1.8	6	6	6	0	18
			1.817	2	2	0	0	4
			2.1	2	1	0	6	9
& LL	150 x 90 x 10 RSA			10	9	6	6	31
			1.8	6	6	6	0	18
			1.817	2	2	0	0	4
			2.1	2	1	0	6	9
MM	254 x 102 x 22 UB		All	4	4	0	2	10
			2.55	2	2	0	0	4
			2.335	2	2	0	2	6

TT	610 x 305 x 179 UB	Non-composite -est	8	1	1	0	0	2
UU	139.7 dia x 5.0 CHS		All	9	9	6	4	28
			7.5	5	5	6	4	20
			5.42	4	4	0	0	8
WW	254 x 146 x 37 UB			3	3	0	0	6
			5.847	2	2	0	0	4
		estimated	6.2	1	1	0	0	2
XX	254 x 254 x 73 UC		5.42	1	1	0	0	2
YY	457 x 191 x 74 UB			9	9	0	0	18
		estimated	8	4	4	0	0	8
		estimated	6	5	5	0	0	10
ZZ	686 x 254 x 125 B	S355, section 7	9.3	0	0	2	0	2
Other	300 x 200 x 8 RHS		7.5	0	0	2	0	2
	100 x 65 x 7 RSA		1.55	0	0	0	2	2
	356 x 127 x 33 UB		4	2	2	2	0	6
P Bracing	193 x 5.0 CHS	estimated	8.5	4	4	0	0	8
	168 x 5.0 CHS		All	15	15	0	0	30
		estimated	4.5	8	8	0	0	16
		estimated	6	5	5	0	0	10
		estimated	7	2	2	0	0	4
E Bracing								
X/A	139.7 x 5.0 CHS		All	0	0	8	6	14
		Ele A, C	8.717	0	0	8	0	8
		Ele D	7.583	0	0	0	6	6
X/B	114.3 x 5.0 CHS		All	6	4	0	0	10
		Ele C	8.717	2	0	0	0	2
		Ele D	7.583	4	4	0	0	8
X/C	150 x 10mm THK Flats	Ele A, C	All	4	8	0	6	18
			8.570	0	0	0	4	4
			8.717	0	4	0	2	6

		Ele D	7.583	4	4	4		12
X/D	168.3 x 5.0 CHS		All	12	8	7	14	41
		Ele A, B, D	8.717	12	8	7	8	35
		Ele B	8.570	0	0	0	6	6
X/E	193.7 x 5.0 CHS	Ele D	8.717	1	1	2	0	4
X/F	200 x 100 x 10 RHS	Ele C	8.717	0	2	0	6	8
X/G	50mm Dia Bar	Ele A	8.717	0	0	0	2	2
X/H	60mm Dia Bar	Ele A	All	0	0	0	6	6
			5.705	0	0	0	4	4
			5.705	0	0	0	2	2

Table 32: Quantities of Steel Beams in Lower Concourse Level

Steel Beams - Lower Concourse Level - Mass of Steel						
Ref	**Section**	**Length (m)**	**Mass (kg/m)**	**Mass per beam (kg)**	**Quantity**	**Total Mass (kg)**
A	686 x 254 x 125 UB	All			16	
		10.295	125	1286.875	4	5147.5
		8.355	125	1044.375	2	2088.75
		6.813	125	851.625	2	1703.25
		8.36	125	1045	2	2090
		9.557	125	1194.625	2	2389.25
		10.409	125	1301.125	2	2602.25
		10.919	125	1364.875	2	2729.75
B	457 x 191 x 67 UB	All			34	
		8.5	67.1	570.35	8	4562.8
		7.5	67.1	503.25	8	4026
		7.2	67.1	483.12	15	7246.8
		4.91	67.1	329.461	2	658.922
		1.769	67.1	118.700	1	118.700
C	610 x 229 x 101 UB	All			70	

		7.906	101.2	800.084	45	36003.79473
		5.000	101.2	506	10	5060
		8.355	101.2	845.5248	15	12682.87202
E	356 x 127 x 33 UB	All			93	
		7.5	33.1	248.25	33	8192.25
		3.271	33.1	108.269	6	649.615
		4.000	33.1	132.4	8	1059.2
		3.935	33.1	130.249	10	1302.485
		8.000	33.1	264.8	14	3707.2
		6.125	33.1	202.738	4	810.95
		4.503	33.1	149.049	12	1788.592
		6.500	33.1	215.15	6	1290.9
F	406 x 140 x 39 UB	All			385	
		4.8	39	187.2	1	187.2
		4.725	39	184.275	2	368.55
		4.5	39	175.5	2	351
		4.125	39	160.875	2	321.75
		3.601	39	140.439	2	280.878
		7.5	39	292.5	336	98280
		3.556	39	138.684	1	138.684
		3.704	39	144.456	1	144.456
		8	39	312	20	6240
		6.5	39	253.5	8	2028
		4.93	39	192.27	2	384.54
		1.4	39	54.6	1	54.6
		2.345	39	91.455	3	274.365
		1.421	39	55.419	1	55.419
		2.324	39	90.636	2	181.272
		3.52	39	137.28	1	137.28
G	254 x 102 x 22 UB	All			227	

		2.318	22	50.996	44	2243.824
		1.8	22	39.6	26	1029.6
		2.65	22	58.3	2	116.6
		2.335	22	51.37	10	513.7
		1.6	22	35.2	29	1020.8
		0.74	22	16.28	6	97.68
		2.22	22	48.84	4	195.36
		2.45	22	53.9	1	53.9
		1.19	22	26.18	6	157.08
		2	22	44	4	176
		0.772	22	16.984	2	33.968
		2.167	22	47.674	1	47.674
		2.046	22	45.012	4	180.048
		2.4	22	52.8	2	105.6
		1.7625	22	38.775	8	310.2
		3.09	22	67.98	1	67.98
		1	22	22	2	44
		2.95	22	64.9	4	259.6
		1.38	22	30.36	4	121.44
		2.33	22	51.26	4	205.04
		2.27	22	49.94	2	99.88
		1.981	22	43.582	2	87.164
		2.54	22	55.88	2	111.76
		1.622	22	35.684	4	142.736
		0.5	22	11	4	44
		1.5	22	33	2	66
		2.678	22	58.916	16	942.656
		1.968	22	43.296	12	519.552
		2.1	22	46.2	6	277.2
		1.2	22	26.4	2	52.8

		2.63	22	57.86	1	57.86
		2.567	22	56.474	2	112.948
		1.74	22	38.28	1	38.28
		2.202	22	48.444	1	48.444
		1.175	22	25.85	1	25.85
		2	22	44	1	44
		1.09	22	23.98	1	23.98
		3.152	22	69.344	2	138.688
		3.52	22	77.44	1	77.44
H	457 x 152 x 52 UB	All			15	
		7.5	52.3	392.25	5	1961.25
		4.859	52.3	254.1257	2	508.2514
		5.8	52.3	303.34	2	606.68
		8	52.3	418.4	2	836.8
		5.619	52.3	293.8737	2	587.7474
		5.42	52.3	283.466	2	566.932
J	457 x 152 x 60 UB	All			8	
		9.351	59.8	559.1898	2	1118.3796
		8	59.8	478.4	6	2870.4
K	254 x 102 x 25 UB	All			18	
		3.5	25.2	88.2	4	352.8
		3	25.2	75.6	2	151.2
		2.27	25.2	57.204	2	114.408
		2	25.2	50.4	2	100.8
		2.335	25.2	58.842	4	235.368
		2.47	25.2	62.244	3	186.732
		4	25.2	100.8	1	100.8
AA	457 x 191 x 74 UB	All			37	
		7.92	74.3	588.456	21	12357.576
		7.5	74.3	557.25	14	7801.5

		8	74.3	594.4	2	1188.8
BB	254 x 146 x 31 UB	All			32	
		2.925	31.1	90.9675	2	181.935
		2.64	31.1	82.104	2	164.208
		3.114	31.1	96.8454	4	387.3816
		3.556	31.1	110.5916	3	331.7748
		3.704	31.1	115.1944	1	115.1944
		4.56	31.1	141.816	8	1134.528
		4.54	31.1	141.194	8	1129.552
		3.58	31.1	111.338	3	334.014
		3.52	31.1	109.472	2	218.944
CC	533 x 210 x 82 UB	All			6	
		7.92	82.2	651.024	2	1302.048
		9.258	82.2	761.0076	4	3044.0304
DD	533 x 210 x 92 UB	All			34	
		7.92	92.1	729.432	6	4376.592
		6.3	92.1	580.23	4	2320.92
		7.2	92.1	663.12	6	3978.72
		8	92.1	736.8	14	10315.2
		9	92.1	828.9	4	3315.6
EE	203 x 203 x 86 UC	All			4	
		4	86	344	2	688
		2.642	86	227.212	2	454.424
GG	406 x 140 x 46 UB	All			47	
		7.5	46	345	17	5865
		8	46	368	6	2208
		10	46	460	14	6440
		4.5	46	207	8	1656
		8.5	46	391	2	782
HH	457 x 152 x 52 UB	7.5	52.3	392.25	2	784.5

LL	230 x 90 x 32 PFC	All			31	
		1.8	32.2	57.96	18	1043.28
		1.817	32.2	58.5074	4	234.0296
		2.1	32.2	67.62	9	608.58
& LL	150 x 90 x 10 RSA				31	
		1.8	18.2	32.76	18	589.68
		1.817	18.2	33.0694	4	132.2776
		2.1	18.2	38.22	9	343.98
MM	254 x 102 x 22 UB	All			10	
		2.55	22	56.1	4	224.4
		2.335	22	51.37	6	308.22
TT	610 x 305 x 179 UB	8	179	1432	2	2864
UU	139.7 dia x 5.0 CHS	All			28	
		7.5	16.6	124.5	20	2490
		5.42	16.6	89.972	8	719.776
WW	254 x 146 x 37 UB				6	
		5.847	37	216.339	4	865.356
		6.2	37	229.4	2	458.8
XX	254 x 254 x 73 UC	5.42	73.1	396.202	2	792.404
YY	457 x 191 x 74 UB				18	
		8	74.3	594.4	8	4755.2
		6	74.3	445.8	10	4458
ZZ	686 x 254 x 125 UB	9.3	125	1162.5	2	2325
Other	300 x 200 x 8 RHS	7.5	60.3	452.25	2	904.5
	100 x 65 x 7 RSA	1.55	8.77	13.5935	2	27.187
	356 x 127 x 33 UB	4	33.1	132.4	6	794.4
P Bracing	193 x 5.0 CHS	8.5	23.3	198.05	8	1584.4
	168 x 5.0 CHS	All			30	
		4.5	20.1	90.45	16	1447.2
		6	20.1	120.6	10	1206

		7	20.1	140.7	4	562.8
E Bracing						
X/A	139.7 x 5.0 CHS	All			14	
		8.717	16.6	144.699	8	1157.588
		7.583	16.6	125.880	6	755.278
X/B	114.3 x 5.0 CHS	All			10	
		8.717	13.5	117.677	2	235.353
		7.583	13.5	102.372	8	818.976
X/C	150 x 10mm THK Flats	All			18	
		8.570	11.78	100.958	4	403.834
		8.717	11.78	102.684	6	616.102
		7.583	11.78	89.329	12	1071.949
X/D	168.3 x 5.0 CHS	All			41	
		8.717	20.1	175.207	35	6132.254
		8.570	20.1	172.264	6	1033.581
X/E	193.7 x 5.0 CHS	8.717	23.3	203.101	4	812.404
X/F	200 x 100 x 10 RHS	8.717	43.1	375.693	8	3005.546
X/G	50mm Dia Bar	8.717	15.41	134.326	2	268.651
X/H	60mm Dia Bar	All			6	
		5.705	22	125.503	4	502.013
		5.705	22	125.503	2	251.006
Total Mass of Steel Beams in Lower Concourse Level						**357210**

Table 33: Mass of Steel Beams in Lower Concourse Level

Steel Beams - Lower Terracing								
				Quantity				
Ref	**Section type**	**Notes**	**Length**	**S. Stand**	**N. Stand**	**E. Stand**	**W. Stand**	**Total**
A	HE 800 M		All	21	21	17	15	74
		sections 9-27	9.591	19	19	17	0	55
		section 28	6.835	1	1	0	0	2

		section 29	10.392	1	1	0	0	2
		All in west stand	9.340	0	0	0	15	15
B	533 x 210 x 82 UB		All	36	36	34	29	135
		sections 9-10, 13-25, 28, 29 1st beam	6.477	17	17	17	14	65
		sections 9-25, 28,29: 2nd beam	6.543	19	19	17	15	70
C	254 x 146 x 31 UB		7.5	16	15	16	0	47
D	139.7 dia 5.0 CHS		All	28	26	16	14	84
		Taken from paper not drawings	7.5	20	20	16	14	70
		Assumed half size of above	3.75	8	6	0	0	14
S	305 x 165 x 46 UB		7.5	0	0	0	4	4
T	914 x 419 x 343 UB	Cranked beam	2.461	1	1	0	0	2
P Bracing	168.3 dia 5.0 CHS		All	19	18	6	8	51
		by B beams (L from trig)	10.254	4	4	4	4	16
		at edges	7.5	3	2	2	0	7
		scaled off drawing	6	12	12	0	0	24
		Worked out using trig	12.465	0	0	0	4	4
P Bracing	273 dia x 6.3 CHS	L worked out using trig	10.628	0	0	0	2	2
P Bracing	193.7 dia 5.0 CHS	plan bracing by A beam (L from trig)	12.698	2	2	0	0	4
P Bracing	193.7 dia 8.0 CHS	Off bay size	7.5	1	1	0	0	2
P Bracing	254 x 254 x 73 UC	Off bay size	7.5	0	5	0	0	5
EB X/A	139.7 x 5.0 CHS	C elevation	8.570	0	0	4	0	4
EB X/B	114.3 x 5.0 CHS	C elevation	7.935	2	2	0	0	4
EB X/C	150 x 10mm THK. Flats	C elevation	7.935	0	4	0	0	4
EB X/D	168.3 x 5.0 CHS	C elevation, by col RR	7.935	2	0	0	0	2
		C elevation, normal	8.620	2	2	0	0	4

		C elevation, west stand	8.570	0	0	0	4	4
		B elevation	8.570	0	0	0	4	4

Table 34: Quantities of Steel Beams in Lower Terracing Level

Steel Beams - Lower Terrace Level - Mass of Steel						
Ref	**Section**	**Length (m)**	**Mass (kg/m)**	**Mass per beam (kg)**	**Quantity**	**Total Mass (kg)**
A	HE 800 M	All			74	
		9.591	317	3040.229	55	167212.612
		6.835	317	2166.604	2	4333.208
		10.392	317	3294.170	2	6588.339
		9.340	317	2960.780	15	44411.700
B	533 x 210 x 82 UB	All			135	
		6.477	82.2	532.427	65	34607.787
		6.543	82.2	537.806	70	37646.389
C	254 x 146 x 31 UB	7.5	31.1	233.250	47	10962.750
D	139.7 dia 5.0 CHS	All			84	
		7.5	16.6	124.500	70	8715.000
		3.75	16.6	62.250	14	871.500
S	305 x 165 x 46 UB	7.5	46	345.000	4	1380.000
T	914 x 419 x 343 UB	2.461	343	844.255	2	1688.510
P Bracing	168.3 dia 5.0 CHS	All			51	
		10.254	20.1	206.112	16	3297.798
		7.5	20.1	150.750	7	1055.250
		6	20.1	120.600	24	2894.400
		12.465	20.1	250.553	4	1002.214
P Bracing	273 dia x 6.3 CHS	10.628	41.4	440.009	2	880.019
P Bracing	193.7 dia 5.0 CHS	12.698	23.3	295.856	4	1183.424

P Bracing	193.7 dia 8.0 CHS	7.5	36.6	274.500	2	549.000
P Bracing	254 x 254 x 73 UC	7.5	73	547.500	5	2737.500
EB X/A	139.7 x 5.0 CHS	8.570	16.6	142.267	4	569.070
EB X/B	114.3 x 5.0 CHS	7.935	13.5	107.123	4	428.493
EB X/C	150 x 10mm THK. Flats	7.935	11.78	93.475	4	373.899
EB X/D	168.3 x 5.0 CHS	7.935	20.1	159.494	2	318.989
		8.620	20.1	173.269	4	693.074
		8.570	20.1	172.264	4	689.054
		8.570	20.1	172.257	4	689.028
Total Mass of Steel beams in lower terrace level						**335779**

Table 35: Mass of Steel Beams in Lower Terracing Level

Steel Beams - Hospitality level - West Stand Only							
Ref	**Section**	**Notes**	**Length (m)**	**Mass (kg/m)**	**Mass per beam (kg)**	**Quantity**	**Total Mass (kg)**
A	686 x 254 x 125 UB		All			5	
			8.36	125	1045	2	2090
			10.409	125	1301.125	2	2602.25
			11.089	125	1386.125	1	1386.125
B	762 x 267 x 134 UB		All			4	
			9.557	134	1280.638	2	2561.276
			10.919	134	1463.146	2	2926.292
C	406 x 140 x 39 UB					90	
			7.5	39	292.5	87	25447.5
		estimated	7	39	273	2	546
		estimated	3.75	39	146.25	1	146.25
E	254 x 102 x 22 UB					10	
			2.63	22	57.86	1	57.86

			1	22	22	2	44
			1.5	22	33	1	33
			3.141	22	69.102	1	69.102
		estimated	1.75	22	38.5	4	154
		estimated	3.8	22	83.6	1	83.6
F	457 x 191 x 67 UB		All			9	
			4.91	67.1	329.461	2	658.922
			7.2	67.1	483.12	7	3381.84
G	533 x 210 x 82 UB		7.2	82.2	591.84	10	5918.4
H	152 x 152 x 30 UC		2.642	30	79.26	2	158.52
J	457 x 152 x 52 UB					12	
		estimated	5	52.3	261.5	2	523
			8.5	52.3	444.55	4	1778.2
			7.5	52.3	392.25	4	1569
		estimated	8	52.3	418.4	2	836.8
K	406 x 140 x 46 UB		7.5	46	345	2	690
S	254 x 146 x 31 UB					8	
			3.52	31.1	109.472	2	218.944
			3	31.1	93.3	1	93.3
		estimated	1.96	31.1	60.956	2	121.912
		estimated	3.8	31.1	118.18	1	118.18
		estimated	1.5	31.1	46.65	1	46.65
			3.52	31.1	109.472	1	109.472
T	610 x 229 x 101 UB		6.813	101.2	689.4756	2	1378.9512
W	406 x 178 x 60 UB		7.5	60.1	450.75	1	450.75
X	203 x 133 x 30 UB		1.911	30	57.33	2	114.66
Y	610 x 229 x 140 UB	estimated	8.5	139.9	1189.15	2	2378.3
Other	254 x 254 x 73 UC	estimated	8	73	584	2	1168
AA	610 x 229 x 125 UB	estimated	8.5	125.1	1063.35	2	2126.7
BB	406 x 140 x 46 UB	estimated	8	46	368	4	1472

CC	457 x 152 x 82 UB		7.5	82.1	615.75	2	1231.5
DD	457 x 191 x 82 UB		7.5	82	615	2	1230
EE	406 x 178 x 67 UB		7.5	67.1	503.25	2	1006.5
FF	406 x 178 x 54 UB		7.5	54.1	405.75	4	1623
GG	406 x 178 x 74		7.5	74.2	556.5	2	1113
P bracing							
	168.3 dia x 5 CHS					6	
		estimated	7.5	20.1	150.75	2	301.5
		estimated	5	20.1	100.5	2	201
		estimated	7	20.1	140.7	2	281.4
	120 x 120 x 8.0 SHS					8	
			2.245	27.6	61.962	4	247.848
			3.617	27.6	99.8292	4	399.3168
	150 x 100 x 6.3 RHS		2.245	23.1	51.860	4	207.438
E Bracing							
X/C	150 x 10mm THK					6	
			8.511	11.78	100.256	2	200.51104
			8.8	11.78	103.664	2	207.328
			9.5	11.78	111.910	2	223.82
X/F	200 x 100 x 10 RHS		8.5107	43.1	366.809	4	1467.237
S bracing	250 x 150 x 10 RHS	section 29-36	8.1813	58.8	481.058	16	7696.9261
	250 x 150 x 6.3 RHS	section 34	10.306	38	391.647	2	783.29328
		section 36	11.578	38	439.957	2	879.91377
Total Mass of steel beams in hospitality level							**82761**

Table 36: Quantities and mass of steel beams in Hospitality Level

Steel Beams - Upper Concourse level - West Stand Only							
Ref	**Section**	**Notes**	**Length (m)**	**Mass (kg/m)**	**Mass per beam (kg)**	**Quantity**	**Total Mass (kg)**
A	686 x 254 x 125 UB					5	
		section 35	10.409	125	1301.125	2	2602.25
		section 37	11.089	125	1386.125	1	1386.125
		section 33	8.36	125	1045	2	2090
B	762 x 267 x 173 UB					4	
		section 34	9.557	173	1653.361	2	3306.722
		section 36	10.919	173	1888.987	2	3777.974
C	406 x 140 x 39 UB					67	
			7.5	39	292.5	60	17550
		estimated	8.5	39	331.5	2	663
		estimated	9	39	351	2	702
		estimated	6.5	39	253.5	2	507
		estimated	2	39	78	1	78
D	356 x 127 x 33 UB					24	
			2.31	33.1	76.461	8	611.688
			2.542	33.1	84.140	7	588.981
			7.5	33.1	248.25	9	2234.25
E	254 x 102 x 22 UB					22	
			2.49	22	54.78	1	54.78
			1.332	22	29.304	2	58.608
		estimated	1	22	22	3	66
		estimated	4.5	22	99	2	198
			2.337	22	51.414	4	205.656
			2.31	22	50.82	5	254.1
			1.4	22	30.8	4	123.2
			4.634	22	101.948	1	101.948
F	533 x 210 x 82 UB					16	

		Section 29 -36	7.2	82.2	591.84	14	8285.76
		section 31	4.91	82.2	403.602	2	807.204
G	610 x 229 x 101 UB					5	
		section 35-37	7.2	101.2	728.64	3	2185.92
		section 32	6.813	101.2	689.476	2	1378.951
H	203 x 203 x 60 UC	section 30	2.642	60	158.52	2	317.04
J	457x 152 x 52 UB					18	
		section 28	4.467	52.3	233.641	2	467.282
			7.500	52.3	392.25	6	2353.5
		estimated	8.000	52.3	418.4	8	3347.2
		estimated	6.200	52.3	324.26	2	648.52
Q	254 x 146 x 31 UB					7	
			4.634	31.1	144.117	1	144.117
		2 estimated	2.245	31.1	69.820	4	279.278
			3.52	31.1	109.472	3	328.416
R	203 x 102 x 23 UB	estimated	1.4	23.1	32.34	1	32.34
T	457 x 191 x 67 UB		7.5	67.1	503.25	8	4026
V	457 x 191 x 74 UB		7.5	74.2	556.5	10	5565
W	230 x 90 x 32 PFC		1.8	32.2	57.96	8	463.68
	150 x 90 x 10 RSA		1.8	18.2	32.76	8	262.08
X	254 x 102 x 25 UB					16	
			2.47	25.1	61.997	8	495.976
			3.617	25.1	90.787	8	726.294
Y	139.7 Dia x 5 CHS		7.5	16.6	124.5	4	498
Z	168.3 Dia x 5 CHS	estimated	8.2	20.1	164.82	2	329.64
AA	356 x 368 x 202 UC		7.5	202	1515	3	4545
BB	178 x 102 x 19 UB					16	
			2.31	19	43.89	8	351.12
			2.17	19	41.23	8	329.84
Other	406 x 140 x 46 UB		7.5	46	345	4	1380

	610 x 229 x 113 UB		9	113	1017	2	2034
Plan Bracing	114.3 x 5 CHS		5.885	13.5	79.444	4	317.778
	139.7 x 5 CHS	estimated	7.500	16.6	124.5	2	249
S Bracing	250 x 150 x 10 RHS	section 28 -est	5.5	58.8	323.4	2	646.8
E Bracing	150 x 10mm thk flats	A elevation	8.626	11.78	101.618	4	406.473
	406 dia x 25 CHS	B elevation	8.626	235	2027.190	2	4054.381
	168.3 x 5.0 CHS	B elevation	8.626	20.1	173.389	2	346.779
Total Mass of Steel Beams in Upper Concourse Level							**84764**

Table 37: Quantities and mass of steel beams in Upper Concourse Level

Steel Beams - Plant room level - West Stand Only							
Ref	**Section**	**Notes**	**Length (m)**	**Mass (kg/m)**	**Mass per beam (kg)**	**Quantity**	**Total Mass (kg)**
A	406 x 140 x 39 UB	composite	All			14	
			7.5	39.1	293.25	12	3519
			1.98	39.1	77.418	2	154.836
B	686 x 254 x 170 UB	composite	All			5	
		section 37	11.089	170	1885.13	1	1885.13
		section 36	10.919	170	1856.23	2	3712.46
		section 35	10.409	170	1769.53	2	3539.06
C	686 x 254 x 140 UB	composite	All			6	
		section 34	9.557	140	1337.98	2	2675.96
		section 33	8.36	140	1170.4	2	2340.8
		section 32	6.813	140	953.82	2	1907.64
E	457 x 152 x 52 UB	non-composite	7.5	52.3	392.25	4	1569
F	457 x 152 x 52 UB	non-composite	7.5	52.3	392.25	2	784.5
G	406 x 140 x 46 UB	non-composite	7.5	46	345	16	5520
H	254 x 146 x 31 UB	non-composite	All			4	
			2.245	31.1	69.8195	2	139.639

			3.52	31.1	109.472	2	218.944
J	139.7 Dia x 5.0 CHS	non-composite	7.5	16.6	124.5	7	871.5
K	168.3 Dia x 5.0 CHS	non-composite	All			6	0
			7.5	20.1	150.75	4	603
			5	20.1	100.5	2	201
Other	356 x 406 x 393 UC	non-composite	7.5	393	2947.5	3	8842.5
	459 x 191 x 74 UB	non-composite	7.2	74	532.8	2	1065.6
	254 x 146 x 102 UB	non-composite	All			4	
			5.121	102	522.342	2	1044.684
			1.332	102	135.864	2	271.728
	150 x 90 x 10 RSA	non-composite	All			4	
			1.65	18.2	30.03	2	60.06
			7.5	18.2	136.5	2	273
	250 x 150 x 10 RHS	non-composite	7.5	58.8	441	2	882
Total Mass of Steel Beams on Plant Room Level							**42082**

Table 38: Quantities and mass of steel beams in Plant Room Level

Steel Beams - Upper Tier Terracing level - West Stand Only							
Ref	**Section**	**Notes**	**Length (m)**	**Mass (kg/m)**	**Mass per beam (kg)**	**Quantity**	**Total Mass (kg)**
A	440 WD x 100 DP fabricated beam		All			9	
	(mass estimated)	section 33	9.864	50	493.2	2	986.4
		section 34	11.353	50	567.65	2	1135.3
		section 35	12.466	50	623.3	2	1246.6
		section 36	13.071	50	653.55	2	1307.1
		section 37	13.272	50	663.6	1	663.6
B	HE 700B					40	
		section 28	5.297	241	1276.577	2	2553.154
		front row, est	4	241	964	19	18316

		section 29-37	7.912	241	1906.792	17	32415.464
		section 32	5.225	241	1259.225	2	2518.45
C	457 x 152 x 60 UB		All			4	
		section 30	3.133	59.8	187.353	2	374.707
		section 31	5.822	59.8	348.156	2	696.311
D	254 x 146 x 31 UB		7.5	31.1	233.25	2	466.5
E	203 x 133 x 30 UB		All			18	
			7.5	30	225	16	3600
			8.5	30	255	2	510
G	139 dia x 5.0 CHS		7.5	16.6	124.5	13	1618.5
M	457 x 152 x 60 UB		All			4	
			7.5	59.8	448.5	2	897
			8	59.8	478.4	2	956.8
R	457 x 191 x 67 UB		8	59.8	478.4	16	7654.4
P Bracing	168.3 x 5.0 CHS					6	
		est	9	20.1	180.9	4	723.6
		est	10	20.1	201	2	402
P Bracing	138.7 x 5.0 CHS				0	6	0
		estimate	7.5	16.6	124.5	2	249
		estimate	6	16.6	99.6	2	199.2
S Bracing	168.3 x 5.0 CHS		All			14	
		section 34	3.946	20.1	79.3146	2	158.6292
		section 34, est	2.5	20.1	50.25	2	100.5
		section 35	4.799	20.1	96.4599	2	192.9198
		section 35, est	3	20.1	60.3	2	120.6
		section 36	5.309	20.1	106.7109	2	213.4218
		section 36, est	3.5	20.1	70.35	3	211.05
		section 37	5.478	20.1	110.1078	1	110.1078
E Bracing							
X/C	150 x 10 mm THK Flats		All			31	

		Ele A, south, north	16.850	11.78	198.489	7	1389.424
		Ele A, south, north	13.684	11.78	161.201	4	644.806
		Ele A, south, north	12.878	11.78	151.707	4	606.830
		Ele A, south, north	12.406	11.78	146.139	4	584.556
		Ele A, east	11.964	11.78	140.935	2	281.871
		Ele A, east	11.7967	11.78	138.965	10	1389.652
X/G	50 mm Dia Bar	Ele A, west, est	8.5	15.41	130.985	8	1047.88
Total Mass of Steel Beams in Upper Tier Terracing							**86542**

Table 39: Quantities and mass of steel beams in Upper Tier Terracing Level

Steel Beams & internal columns - within stair towers adjacent to the West Stand						
Section	**Notes**	**Length (m)**	**Mass (kg/m)**	**Mass per beam (kg)**	**Quantity**	**Total Mass (kg)**
305 x 165 x 40 UB		7	40.3	282.100	2	564.200
250 x 150 x 6.3 RHS	Laid flat	All			37	
		7	38	266.000	13	3458.000
		3.333	38	126.654	8	1013.232
		4.255	38	161.690	8	1293.520
		3.471	38	131.898	8	1055.184
305 x 165 x 46 UB		7	46.1	322.700	4	1290.800
100 x 10 flat	bracing	7.288	11.78	85.853	4	343.411
25mm dia mild steel		All			12	
	bracing	8.15	3.85	31.378	6	188.265
		4.265	3.85	16.420	4	65.681
		3.708	3.85	14.276	2	28.552
120 x 60 x 5 RHS	post	3	13.1	39.300	2	78.600
203 x 203 x 46 UC	internal column	16.647	46.1	767.427	4	3069.707
457 x 191 x 67 UB		7	67.1	469.700	9	4227.300

305 x 165 x 46 UB		7	46.1	322.700	1	322.700
178 x 102 x 19 UB		3.333	19	63.327	3	189.981
Total Mass for Single Stair Tower						**17189**
Mass for all 4 Stair Towers						**68757**

Table 40: Quantities and mass of steel beams in Stair Towers

Upper floor slabs

The upper floors are all composite construction, and so are made up of six different components: concrete, mesh, metal decking, u-bars, shear studs and reinforcement. The calculations were split up into these components within the different stands and levels. The list below shows which table refers to which components.

- Lower Concourse Slab details from Table 41 to Table 55
- Upper level slabs in the West Stand: Hospitality level, upper concourse level and plant room level details from Table 56 to Table 66

A number of assumptions were made during these calculations, they were as follows:

- When calculating the area of the slab in places the shape was simplified, for example in the inner edge of the slab where it is a slight arc this was taken to be a straight line
- All U-bars have the following dimensions: 700 x 400 x 700mm
- All shear studs at 19mm x 195mm length, the density of steel is taken to be 7850kg/m^3 to work out the mass of these, therefore a single stud is calculated to be 0.434kg
- The density of concrete is taken to be 2400k/m3, and the volume of concrete within the deck is taken from manufacturers details: KingSpan Multideck 60-V2, available at: http://www.kingspanstructural.com/literature/pdf/MD_V60.pdf [accessed 24/08/12]
- The mass of the metal deck is also taken from the manufacturers details, as above
- A142 mesh was used throughout, the mass of this was taken from BRC Reinforcement, available at: http://www.brc-reinforcement.co.uk/pdfs/bar_and_fabric.pdf [accessed 24/08/12]
- Masses for the reinforcement were taken from the same sources as for the ground beam reinforcement, see section 0 for more details

Mass of Concrete in Lower Concourse Slabs				
Stand	**Area of slab (m^2)**	**Volume (m^3/m^2)**	**Total Volume (m^3)**	**Mass (kg)**
South	1396.350	0.095	132.653	318367.800
S/E Corner	311.328	0.095	29.576	70982.784
East	2173.977	0.095	206.528	495666.756
N/E Corner	311.328	0.095	29.576	70982.784
North	1396.350	0.095	132.653	318367.800
N/W Corner	311.328	0.095	29.576	70982.784
West	2595.224	0.095	246.546	591711.072
S/W Corner	311.328	0.095	29.576	70982.784
Total mass of concrete in lower concourse slabs				**2008045**

Table 41: Mass of Concrete in Lower Concourse Slabs

Mass of A142 Mesh in Lower Concourse Slabs			
Stand	**Area of slab (m^2)**	**Mass (kg/m^2)**	**Mass (kg)**
South	1396.350	2.22	3099.897
S/E Corner	311.328	2.22	691.148
East	2173.977	2.22	4826.229
N/E Corner	311.328	2.22	691.148

North	1396.350	2.22	3099.897
N/W Corner	311.328	2.22	691.148
West	2595.224	2.22	5761.397
S/W Corner	311.328	2.22	691.148
Total mass of Mesh in LC slabs			**19552**

Table 42: Mass of A142 Mesh in Lower Concourse Slabs

Mass of metal deck in LC Slabs			
Stand	**Area of slab (m^2)**	**Mass (kg/m^2)**	**Mass (kg)**
South	1396.350	10.37	14480.150
S/E Corner	311.328	10.37	3228.471
East	2173.977	10.37	22544.141
N/E Corner	311.328	10.37	3228.471
North	1396.350	10.37	14480.150
N/W Corner	311.328	10.37	3228.471
West	2595.224	10.37	26912.473
S/W Corner	311.328	10.37	3228.471
Total mass of deck in LC slabs			**91331**

Table 43: Mass of metal deck in Lower Concourse Slabs

Mass of U-bars in Lower Concourse Slabs					
Stand	**Rebar Type**	**Quantity**	**Length (m)**	**Mass (kg/m)**	**Mass (kg)**
South	T10	361	1.800	0.617	400.927
	T12	199	1.800	0.89	318.798
S/E Corner	T10	322	1.800	0.617	357.613
	T12	121	1.800	0.89	193.842
East	T10	746	1.800	0.617	828.508
	T12	216	1.800	0.89	346.032
N/E Corner	T10	322	1.800	0.617	357.613
	T12	121	1.800	0.89	193.842
North	T10	361	1.800	0.617	400.927
	T12	199	1.800	0.89	318.798
N/W Corner	T10	332	1.800	0.617	368.719
	T12	121	1.800	0.89	193.842
West	T10	774	1.800	0.617	859.604
	T12	327	1.800	0.89	523.854
S/W Corner	T10	332	1.800	0.617	368.719
	T12	121	1.800	0.89	193.842
Total		**4975**			**6225**

Table 44: Mass of U-bars in Lower Concourse Slabs

South Stand shear studs		
Grid Line	Length of deck (m)	Quantity
24	15.826	106
23	17.164	114
22	18.201	121
21	18.94	126
20	19.382	129
19	19.53	130
18	19.382	129
17	18.94	126
16	18.201	121
15	17.164	114
14	15.826	106
Adj C	60	400
Adj C	47.2	315
Total Shear Studs		**2038**

Table 45: Quantity of Shear Studs in the South Stand (same number for the North Stand)

S/W Corner shear studs		
Grid Line	Length of deck (m)	Quantity
14	15.826	106
Adj 13A	3.5	23
12	14.206	95
11A	6.5	43
Adj C1	4	27
11	10	67
stairs	12	80
stairs	8	53
10	3.5	23
9	15.7	105
Adj C1	7.5	50
9	2.3	15
13	2.3	15
stairs	12	80
stairs	8	53
Adj C1	7.5	50
Total Shear Studs		**886**

Table 46: Quantity of Shear Studs in the South West Corner (same number for the North West Corner)

West Stand shear studs		
Grid Line	Length of deck (m)	Quantity

9	15.555	104
8	18.197	121
65	15.555	104
66	18.197	121
7	20.465	136
67	20.465	136
6	18.788	125
68	18.788	125
5	23.915	159
69	23.915	159
4	25.112	167
70	25.112	167
3	25.964	173
71	25.964	173
2	26.474	176
72	26.474	176
1	17.324	115
1	17.324	115
Adj D	5.4	36
C3	7.5	50
Adj D	4.55	30
C3	7.5	50
C3	7.5	50
Adj D	5.4	36
C3	15	100
Adj D	10.8	72
Adj D	5.4	36
C3	7.5	50
C3	7.5	50
Adj D	4.55	30
Adj D	5.4	36
C3	7.5	50
Void Edge	16	107
68-69	7.5	50
68-69	7.5	50
72-1	7.5	50
1-2	7.5	50
2-3	7.5	50
Void Edge	16	107
Total Shear Studs		**3697**

Table 47: Quantity of Shear Studs in the West Stand

N/E Corner shear studs		
Grid Line	**Length of deck (m)**	**Quantity**

45	15.826	106
Adj 45A	3.5	23
46	3	20
46A	4	27
Adj C2	5	33
47	10	67
stairs	8	53
stairs	8	53
C2	5	33
48	10	67
48a	4	27
stairs	8	53
stairs	8	53
49	3.5	23
49	3	20
Adj C2	3.5	23
50	15.826	106
Total Shear Studs		**788**

Table 48: Quantity of Shear Studs in the North East Corner (same number for the South East Corner)

East Stand shear studs		
Grid Line	**Length of deck (m)**	**Quantity**
45	15.826	106
29	15.826	106
30	16.951	113
44	16.951	113
31	17.926	120
43	17.926	120
32	18.751	125
42	18.751	125
33	19.427	130
41	19.427	130
34	19.951	133
40	19.951	133
35	20.326	136
39	20.326	136
36	20.551	137
38	20.551	137
37	20.626	138
44-43	7.5	50
44-43	5.4	36
41-40	7.5	50
41-40	4.55	30
40-39	7.5	50

40-39	5.4	36
38-36	15	100
38-36	10.8	72
35-34	7.5	50
35-34	5.4	36
33-32	7.5	50
33-32	4.55	30
31-30	7.5	50
31-30	5.4	36
32-31	7.5	50
Total Shear Studs		**2860**

Table 49: Quantity of Shear Studs in the East Stand

Summary of Shear Studs		
Stand	**Quantity**	**Mass (kg)**
South	2038	885
S/W Corner	886	384
West	3697	1605
N/W Corner	886	384
North	2038	885
N/E Corner	788	342
East	2860	1241
S/E Corner	788	342
Perimeter	9950	4318
Total	**23931**	**10386**

Table 50: Summary table of Shear Stud quantities and masses

Reinforcement in deck of the South Stand					
Type	**Mass (kg/m)**	**Length (m)**	**Mass (kg)**	**Quantity**	**Total Mass (kg)**
T12	0.89	14.5	12.905	48	619.440
T12	0.89	7	6.230	53	330.190
T12	0.89	7	6.230	57	355.110
T12	0.89	7	6.230	59	367.570
T12	0.89	7	6.230	41	255.430
T12	0.89	7	6.230	59	367.570
T12	0.89	7	6.230	57	355.110
T12	0.89	7	6.230	39	242.970
T12	0.89	7	6.230	48	299.040
T16	1.579	11.4	18.001	2	36.001
T16	1.579	11.8	18.632	2	37.264
T16	1.579	11.4	18.001	2	36.001
T16	1.579	10.6	16.737	2	33.475
Total mass of reinforcement in South Stand					**3335**

Table 51: Quantity and masses of reinforcement in the South Stand Slab (same quantities for the North Stand)

Reinforcement in deck of the South West Corner					
Type	**Mass (kg/m)**	**Length (m)**	**Mass (kg)**	**Quantity**	**Total Mass (kg)**
T12	0.89	8	7.120	20	142.400
T12	0.89	8	7.120	20	142.400
T16	1.579	6	9.474	22	208.428
T12	0.89	6	5.340	50	267.000
T12	0.89	6	5.340	50	267.000
T10	0.617	2	1.234	12	14.808
T10	0.617	2	1.234	12	14.808
T12	0.89	8	7.120	20	142.400
T20	2.466	5	12.330	2	24.660
T10	0.617	8	4.936	20	98.720
T12	0.89	6	5.340	50	267.000
Total mass of reinforcement in South West Corner					**1590**

Table 52: Quantity and masses of reinforcement in the South West Corner slab (same quantities for the North West Corner)

Reinforcement in deck of the West Stand					
Type	**Mass (kg/m)**	**Length (m)**	**Mass (kg)**	**Quantity**	**Total Mass (kg)**
T10	0.617	2	1.234	12	14.808
T12	0.89	7.5	6.675	51	340.425
T12	0.89	7.5	6.675	63	420.525
T12	0.89	7.5	6.675	53	353.775
T12	0.89	7.5	6.675	79	527.325
T12	0.89	7.5	6.675	86	574.050
T10	0.617	2	1.234	12	14.808
T12	0.89	7.5	6.675	90	600.750
T12	0.89	7.5	6.675	46	307.050
T12	0.89	7.5	6.675	25	166.875
T20	2.466	2.4	5.918	4	23.674
T20	2.466	2	4.932	2	9.864
T12	0.89	7.5	6.675	84	560.700
T12	0.89	7.5	6.675	90	600.750
T12	0.89	7.5	6.675	53	353.775
T10	0.617	2	1.234	6	7.404
T10	0.617	2	1.234	12	14.808
T12	0.89	7.5	6.675	34	226.950
T12	0.89	7.5	6.675	53	353.775
T12	0.89	7.5	6.675	63	420.525
T12	0.89	7.5	6.675	51	340.425

T10	0.617	2	1.234	12	14.808
T12	0.89	7.5	6.675	30	200.250
Total mass of reinforcement in West Stand					**6448**

Table 53: Quantities and masses of reinforcement in the West Stand slab

Reinforcement in deck of the North East Corner					
Type	**Mass (kg/m)**	**Length (m)**	**Mass (kg)**	**Quantity**	**Total Mass (kg)**
T12	0.89	8	7.120	20	142.400
T12	0.89	8	7.120	20	142.400
T12	0.89	6	5.340	50	267.000
T12	0.89	6	5.340	50	267.000
T12	0.89	8	7.120	20	142.400
T10	0.617	8	4.936	20	98.720
Total mass of reinforcement in North East Corner					**1060**

Table 54: Quantities and masses of reinforcement in the North East Corner slab (same quantities for the South East Corner)

Reinforcement in deck of the East Stand					
Type	**Mass (kg/m)**	**Length (m)**	**Mass (kg)**	**Quantity**	**Total Mass (kg)**
T16	1.579	2.1	3.316	2	6.632
T12	0.89	7.5	6.675	47	313.725
T12	0.89	7.5	6.675	52	347.100
T16	1.579	2.95	4.658	2	9.316
T12	0.89	7.5	6.675	56	373.800
T12	0.89	7.5	6.675	41	273.675
T12	0.89	7.5	6.675	41	273.675
T16	1.579	2.1	3.316	2	6.632
T12	0.89	7.5	6.675	64	427.200
T12	0.89	7.5	6.675	65	433.875
T16	1.579	2.1	3.316	2	6.632
T12	0.89	7.5	6.675	85	567.375
T12	0.89	7.5	6.675	65	433.875
T12	0.89	7.5	6.675	64	427.200
T12	0.89	7.5	6.675	41	273.675
T16	1.579	2.1	3.316	2	6.632
T16	1.579	2.1	3.316	2	6.632
T12	0.89	7.5	6.675	41	273.675
T12	0.89	7.5	6.675	56	373.800
T12	0.89	7.5	6.675	52	347.100
T16	1.579	2.95	4.658	2	9.316
T12	0.89	7.5	6.675	47	313.725
T16	1.579	2.1	3.316	2	6.632

T16	1.579	2.21	3.490	2	6.979
T10	0.617	2.21	1.364	7	9.545
T16	1.579	7.5	11.843	2	23.685
T16	1.579	3.5	5.527	2	11.053
T16	1.579	3.5	5.527	2	11.053
T16	1.579	7.5	11.843	2	23.685
Total mass of reinforcement in East Stand					**5512**

Table 55: Quantities and masses of reinforcement in the East Stand slab

Mass of Concrete in West Stand Upper Level slabs				
Level	**Area of slab (m^2)**	**Volume (m^3/m^2)**	**Total Volume (m^3)**	**Mass (kg)**
Hospitality	1794.539	0.095	170.481	409154.892
Upper Concourse	1254.289	0.095	119.157	285977.892
Plant Room	632.433	0.095	60.081	144194.724
Total mass of concrete in West Stand upper level slabs				**839328**

Table 56: Mass of Concrete in the West Stand Upper Level Slabs

Mass of A142 Mesh in West Stand Upper Level slabs			
Level	**Area of slab (m^2)**	**Mass (kg/m^2)**	**Mass (kg)**
Hospitality	1794.539	2.22	3983.877
Upper Concourse	1254.289	2.22	2784.522
Plant Room	632.433	2.22	1404.001
Total mass of mesh in upper level slabs			**8172**

Table 57: Mass of A142 Mesh in the West Stand Upper Level Slabs

Mass of Metal Deck in West Stand Upper Level slabs			
Level	**Area of slab (m^2)**	**Mass (kg/m^2)**	**Mass (kg)**
Hospitality	1794.539	10.37	18609.369
Upper Concourse	1254.289	10.37	13006.977
Plant Room	632.433	10.37	6558.330
Total mass of deck in upper level slabs			**38175**

Table 58: Mass of Metal Deck in the West Stand Upper Level Slabs

Hospitality shear studs		
Grid Line	**Length of deck (m)**	**Quantity**
10	5	33
64	5	33
9	7.2	48

65	7.2	48
8	9.842	66
66	9.842	66
7	12.11	81
67	12.11	81
6	14.013	93
68	14.013	93
5	15.56	104
69	15.56	104
4	16.757	112
70	16.757	112
3	17.609	117
71	17.609	117
2	18.119	121
72	18.119	121
1	18.289	122
Edge	7.5	50
B	7.5	50
Edge	5.2	35
Adj C1	7.5	50
Lift	7.5	50
Lift	7.5	50
Edge	7.5	50
Edge	8.5	57
Total		**2063**

Table 59: Quantity of Shear Studs in the Hospitality level slab

Upper Concourse shear studs		
Grid Line	**Length of deck (m)**	**Quantity**
10	4.467	30
64	4.467	30
9	7.2	48
65	7.2	48
8	9.842	66
66	9.842	66
7	12.11	81
67	12.11	81
6	14.013	93
68	14.013	93
5	15.56	104
69	15.56	104
4	16.757	112
70	16.757	112
3	17.609	117

71	17.609	117
2	18.119	121
72	18.119	121
1	18.289	122
Edge	5.29	35
Edge	5.29	35
Adj C1	7.5	50
Adj C1	7.5	50
Adj C1	7.5	50
Edge	5.29	35
B	7.5	50
Edge	8.5	57
Void	6	40
Void	6	40
Adj C1	7.5	50
Edge	5.29	35
Adj C1	15	100
Edge	10.58	71
Adj C1	5.29	35
Edge	7.5	50
Adj C1	5.29	35
Edge	7.5	50
Void	6	40
Void	6	40
B	7.5	50
Edge	8.5	57
Edge	7.5	50
Adj C1	5.29	35
Edge	7.5	50
Adj C1	5.29	35
Total		**2890**

Table 60: Quantity of Shear Studs in the Upper Concourse level slab

Plant Room shear studs		
Grid Line	**Length of deck (m)**	**Quantity**
6	6.813	45
68	6.813	45
5	8.36	56
69	8.36	56
4	9.557	64
70	9.557	64
3	10.409	69
71	10.409	69
2	10.919	73

72	10.919	73
1	11.089	74
Edge	6.5	43
Edge	5.5	37
Edge	6.5	43
Edge	5.5	37
Total		**848**

Table 61: Quantity of Shear Studs in the Plant Room level Slab

Summary of Shear Studs		
Level	**Quantity**	**Mass (kg)**
Hospitality	2890	1254
Upper Concourse	1455	631
Plant Room	661	287
Perimeter	5542	2405
Total	**10548**	**4578**

Table 62: Summary table showing quantities and masses of shear studs in the upper levels of the West Stand

Mass of U-bars					
Stand	**Rebar Type**	**Quantity**	**Length (m)**	**Mass (kg/m)**	**Mass (kg)**
Hospitality	T10	448	1.8	0.617	497.549
	T12	207	1.8	0.89	331.614
Upper Concourse	T10	1171	1.8	0.617	1300.513
	T12	284	1.8	0.89	454.968
Plant Room	T10	266	1.8	0.617	295.420
	T12	395	1.8	0.89	632.790
Total		**2771**			**3513**

Table 63: Quantities and masses of U-bars in the upper level slabs in the West Stand

Reinforcement in the slab of the Hospitality Level					
Type	**Mass (kg/m)**	**Length (m)**	**Mass (kg)**	**Quantity**	**Total Mass (kg)**
T10	0.617	2	1.234	12	14.808
T12	0.89	7.5	6.675	38	253.650
T10	0.617	2	1.234	12	14.808
T12	0.89	7.5	6.675	51	340.425
T12	0.89	7.5	6.675	63	420.525
T12	0.89	7.5	6.675	53	353.775
T12	0.89	7.5	6.675	79	527.325
T12	0.89	7.5	6.675	86	574.050
T12	0.89	7.5	6.675	90	600.750
T10	0.617	2	1.234	12	14.808
T12	0.89	7.5	6.675	46	307.050
T12	0.89	7.5	6.675	26	173.550

T20	2.466	2	4.932	2	9.864
T12	0.89	7.5	6.675	93	620.775
T12	0.89	7.5	6.675	90	600.750
T12	0.89	7.5	6.675	86	574.050
T12	0.89	7.5	6.675	30	200.250
T12	0.89	7.5	6.675	34	226.950
T12	0.89	7.5	6.675	53	353.775
T12	0.89	7.5	6.675	63	420.525
T12	0.89	7.5	6.675	51	340.425
T10	0.617	2	1.234	12	14.808
T12	0.89	7.5	6.675	38	253.650
T10	0.617	2	1.234	12	14.808
T10	0.617	2	1.234	12	14.808
T10	0.617	2	1.234	12	14.808
T12	0.89	2	1.780	6	10.680
Total mass of reinforcement in Hospitality Level					**7266**

Table 64: Quantities and masses of reinforcement in the hospitality level slab

Reinforcement in the slab of the Upper Concourse Level					
Type	**Mass (kg/m)**	**Length (m)**	**Mass (kg)**	**Quantity**	**Total Mass (kg)**
T10	0.617	2	1.234	12	14.808
T12	0.89	7.5	6.675	20	133.500
T10	0.617	2	1.234	12	14.808
T12	0.89	7.5	6.675	39	260.325
T12	0.89	7.5	6.675	43	287.025
T12	0.89	7.5	6.675	43	287.025
T12	0.89	7.5	6.675	56	373.800
T12	0.89	7.5	6.675	56	373.800
T12	0.89	7.5	6.675	66	440.550
T12	0.89	7.5	6.675	68	453.900
T10	0.617	2	1.234	12	14.808
T12	0.89	7.5	6.675	14	93.450
T10	0.617	2	1.234	12	14.808
T20	2.466	2	4.932	2	9.864
T12	0.89	7.5	6.675	68	453.900
T12	0.89	7.5	6.675	66	440.550
T12	0.89	7.5	6.675	56	373.800
T12	0.89	7.5	6.675	14	93.450
T10	0.617	2	1.234	12	14.808
T12	0.89	7.5	6.675	56	373.800
T12	0.89	7.5	6.675	43	287.025
T12	0.89	7.5	6.675	43	287.025
T10	0.617	2	1.234	12	14.808
T12	0.89	7.5	6.675	39	260.325

T12	0.89	7.5	6.675	31	206.925
T10	0.617	2	1.234	12	14.808
Total mass of reinforcement in Upper Concourse					**5594**

Table 65: Quantities and masses of reinforcement in the upper concourse level slab

Reinforcement in the slab of the Plant Room Level					
Type	**Mass (kg/m)**	**Length (m)**	**Mass (kg)**	**Quantity**	**Total Mass (kg)**
T12	0.89	7.5	6.675	12	80.100
T10	0.617	2	1.234	6	7.404
T12	0.89	7.5	6.675	22	146.850
T12	0.89	7.5	6.675	46	307.050
T12	0.89	7.5	6.675	49	327.075
T10	0.617	2	1.234	12	14.808
T20	2.466	2	4.932	2	9.864
T12	0.89	7.5	6.675	49	327.075
T12	0.89	7.5	6.675	46	307.050
T12	0.89	7.5	6.675	22	146.850
T12	0.89	7.5	6.675	26	173.550
Total mass of reinforcement in Plant Room Slab					**1848**

Table 66: Quantities and masses of reinforcement in the plant room level slab

Roof Structure

The roof structure is split into the main beams (including bracing) and roof purlins, this is because the input for Sakura keeps these two separate. Information was taken from roof layouts, sections and 3D images of the A-frame. In many cases the lengths of the beams had to be estimated as lengths weren't provided. A number of assumptions were made, these are as follows:

- It was stated that the majority of purlins to the North, East and South stands could be either 200 x 100 x 6.3 RHS or 200 x 150 x 5 RHS, all these purlins are taken to be the former
- Within the stair towers the purlins in the roof are stated to be 'Wards' P300/300, it is not clear what this meant, it is therefore assumed that these purlins at Z purlins 300mm dp, 75mm flange and thickness of 3mm, mass: 10.97 kg/m, this was taken from literature: Albion Sections, available at: http://www.albionsections.co.uk/doc/38.pdf [accessed 26/08/12]
- The masses for the RHS sections were taken from the following literature: Engineering Toolbox, Rectangular Hollow Hot Formed Sections, available at: http://sketchup.engineeringtoolbox.com/rectangular-hollow-hot-formed-sections-c_50.html [accessed 26/08/12] and POLSTEEL, RHS - rectangular hollow section, available at: http://polsteel.co.uk/steel-guide/steel-sections/rhs/ [accessed 26/08/12]
- Masses for the Circular Hollow Sections were taken from The Engineering ToolBox, available at: http://sketchup.engineeringtoolbox.com/UK-CHS-Circular-Hollow-Sections-c_98.html [accessed 27/08/12]
- For large CUB sections where standard masses could not be found, the last number in the specification is taken to be the mass as this is normally the case, give or take 0.1, for example for a 914 x 305 x 289 CUB 289kg/m is taken to be the mass
- Masses for the Square Hollow Hot Formed Sections were taken from The Engineering ToolBox, SHS – Square Hollow Hot Formed Sections, available at: http://sketchup.engineeringtoolbox.com/suare-hollow-hot-formed-sections-c_49.html [accessed 27/08/12]
- Masses for the UC sections were taken from The Engineering ToolBox, UC British Universal Columns, http://sketchup.engineeringtoolbox.com/uc-british-universal-colums-c_3.html [accessed 27/08/12]
- Masses for the UB sections were taken from The Engineering ToolBox, British Universal Columns and Beams, http://www.engineeringtoolbox.com/british-universal-steel-columns-beams-d_1316.html [accessed 27/08/12]
- Fabricated box sections are taken to be constructed in 10mm plate, 1200mm deep and 300mm wide, the end of these tapers, therefore the mass is reduced by 10% to account for this. As these are fabricated sections the mass per meter had to be calculated:
    - Volume of steel in section per m calculated: $0.0488m^3$
    - This was multiplied by the density of steel: $7850kg/m^3$
    - Mass taken to be: 383.08 kg/m
- There are a number of bracing beams within the roof drawings that are labelled B or T at each end, it is assumed that this stands for bottom and top with regards to which side of the main structural beam the bracing is attached to, these sections are assumed to be 219 dia x 5.0 CHS as other bracing beams
- There are two non-standard section sizes that have been specified: 349 dia x 25 CHS and 368 dia x 32 CHS, as these are non-standard mass information could not be found for them. Therefore data either side of them was interpolated to estimate a mass of these sections, see Table 67 for where these beams have been specified and the estimated masses. Standard masses were taken from: Continental Steel Pte LTD, Products Handbook, Structural Steel, available at: http://www.consteel.com.sg/catalog.pdf [accessed 28/08/12]

The calculations and details for the roof beams can be seen in Table 67 and for the roof purlins in Table 68.

Roof Beams							
Ref	**Section**	**Notes**	**Length (m)**	**Mass (kg/m)**	**Mass per beam (kg)**	**Quantity**	**Total Mass (kg)**
Stair tower	356 x 171 x 57 UB	U section	7	57	399.000	1	399.000
Stair Tower	203 x 133 x 25 UB	R section	7	25.1	175.700	1	175.700
Stair tower	356 x 171 x 57 UB		7	57	399.000	1	399.000
Stair tower	203 x 133 x 25 UB		All				
			11.364	25.1	285.236	2	570.473
			8.141	25.1	204.339	1	204.339
			9.282	25.1	232.978	2	465.956
Stair tower	114 x 3.6 CHS	bracing	7.815	9.83	76.821	1	76.821
			7.755	9.83	76.232	1	76.232
			8.192	9.83	80.527	1	80.527
Roof/C	914 x 305 x 289 CUB	Grid 37	38.276	289	11061.764	1	11061.764
Roof/C	914 x 305 x 289 CUB	Grid 36 & 38	38.269	289	11059.741	2	22119.482
Roof/C	914 x 305 x 289 CUB	Grid 35 & 39	38.25	289	11054.250	2	22108.500
Roof/C	914 x 305 x 289 CUB	Grid 34 & 40	38.217	289	11044.713	2	22089.426
Roof/D	914 x 419 x 343 CUB	Grid 33 & 41	38.172	343	13092.996	2	26185.992
Roof/D	914 x 419 x 343 CUB	Grid 32 & 42	38.115	343	13073.445	2	26146.890
Roof/D	914 x 419 x 343 CUB	Grid 31 & 43	38.044	343	13049.092	2	26098.184
Roof/E	914 x 419 x 388 CUB	Grid 30 & 44	37.959	388	14728.092	2	29456.184
Roof/E	914 x 419 x 388 CUB	Grid 29 & 45	37.253	388	14454.164	2	28908.328
Roof/A	914 x 305 x 201 CUB	Grid 28 & 46	36.783	201	7393.383	2	14786.766
Roof/A	914 x 305 x 201 CUB	Grid 27 & 47	35.797	201	7195.197	2	14390.394
Roof/A	914 x 305 x 201 CUB	Grid 26 & 48	35.72	201	7179.720	2	14359.440
Roof/A	914 x 305 x 201 CUB	Grid 25 & 49	36.606	201	7357.806	2	14715.612
Roof/E	914 x 419 x 388 CUB	Grid 24 & 50	39.264	388	15234.432	2	30468.864
Roof/D	914 x 419 x 343 CUB	Grid 23 & 51	36.523	343	12527.389	2	25054.778

Roof/D	914 x 419 x 343 CUB	Grid 22 & 52	36.227	343	12425.861	2	24851.722
Roof/C	914 x 305 x 289 CUB	Grid 21 & 53	36.02	289	10409.780	2	20819.560
Roof/C	914 x 305 x 289 CUB	Grid 20 & 54	35.907	289	10377.123	2	20754.246
Roof/C	914 x 305 x 289 CUB	Grid 19 & 55	35.885	289	10370.765	2	20741.530
Roof/C	914 x 305 x 289 CUB	Grid 18 & 56	35.957	289	10391.573	2	20783.146
Roof/C	914 x 305 x 289 CUB	Grid 17 & 57	36.124	289	10439.836	2	20879.672
Roof/C	914 x 305 x 289 CUB	Grid 16 & 58	33.967	289	9816.463	2	19632.926
West 10	2100 x 300 x 10 mm	Grid 16 & 58	3.663	240	879.12	2	1758.24
S Bracing	457 dia x 10 CHS	Grid 16 & 58	12.603	110	1386.330	2	2772.66
Roof/D	914 x 419 x 343 CUB	Grid 15 & 59	34.337	383.08	13153.82	2	26307.636
S Bracing	323 Dia x 12.5 CHS	Grid 15 & 59	10.091	96	968.736	2	1937.472
S Bracing	323 Dia x 12.5 CHS	Grid 15 & 59	10.392	96	997.632	2	1995.264
West 9	2100 x 300 x 10 mm	Grid 15 & 59	10.972	383.08	4203.154	2	8406.3075
Post	168 x 8 CHS	Support above - est	3.5	20.1	70.350	2	140.700
Roof/E	914 x 419 x 388 CUB	Grid 14 & 60	34.824	388	13511.712	2	27023.424
West 8	2100 x 300 x 10 mm	Grid 14 & 60	17.522	383.08	6712.328	2	13424.656
West 7	2100 x 300 x 10 mm	Grid 14 & 60	22.296	383.08	8541.152	2	17082.303
Post	168 x 8 CHS	Grid 14 & 60 -est	3.5	20.1	70.350	2	140.700
CHS Post	168 x 8 CHS	Grid 14 & 60 - est	4.5	20.1	90.450	2	180.900
West 7	2100 x 300 x 10 mm	Grid 13 & 61	23.296	383.08	8924.232	2	17848.463
West 6	2100 x 300 x 10 mm	Grid 11 & 63	31.936	383.08	12234.04	2	24468.086
West 5	2100 x 300 x 10 mm	Grid 10 & 64	37.049	383.08	14192.73	2	28385.462
West 4	2100 x 300 x 10 mm	Grid 8 & 66	39.78	383.08	15238.92	2	30477.845
West 3	2100 x 300 x 10 mm	Grid 6 & 69	42.192	383.08	16162.91	2	32325.823
West 2	2100 x 300 x 10 mm	Grid 4 & 70	43.683	383.08	16734.08	2	33468.167
West 1	2100 x 300 x 10 mm	Grid 2 & 72	44.489	383.08	17042.85	2	34085.692
BT1	219 dia x 5 CHS	east stand	8.5	26.4	224.400	12	2692.8
P Bracing	150 x 150 x 5 SHS	Vertical bracing	7.5	22.6	169.500	4	678.000
P Bracing	219 dia x 5 CHS	Bracing - east	11.323	26.4	298.927	8	2391.418
P Bracing	168 x 5 CHS	Bracing - east	8.5	20.1	170.850	2	341.700

P Bracing	168 x 5 CHS	east stand	7.794	20.1	156.659	2	313.319
	203 x 203 x 60 UC	east corners	7.5	71	532.500	2	1065.000
	219 dia x 5 CHS	east corners-est	11	26.4	290.400	4	1161.600
	219 dia x 5 CHS	east corners-est	10	26.4	264.000	4	1056.000
	168 dia x 5 CHS	east corners-est	7.5	20.1	150.750	4	603.000
	219 dia x 5 CHS	east corners-est	11.5	26.4	303.600	4	1214.400
BT2	219 dia x 5 CHS	east corners-est	7.5	26.4	198.000	4	792.000
BT3	219 dia x 5 CHS	east corners-est	5.5	26.4	145.200	4	580.800
BT4	219 dia x 5 CHS	east corners-est	4	26.4	105.600	4	422.400
P Bracing	100 x 100 x 5 SHS	east corners-est	8.5	14.7	124.950	2	249.900
	400 x 200 x 10 RHS	east corners-est	8.5	90.2	766.700	4	3066.800
	168 dia x 5 CHS	south & north	8.479	20.1	170.428	2	340.856
	168 dia x 5 CHS	south & north	7.794	20.1	156.659	2	313.319
	219 dia x 5 CHS	south & north	10.899	26.4	287.734	6	1726.402
	168 dia x 5 CHS	south & north - est	10	20.1	201.000	2	402.000
BT5	219 dia x 5 CHS	south & north - est	7.7	26.4	203.280	6	1219.68
Curved	300 x 200 x 8 RHS	south & north - est	9	60.3	542.700	4	2170.800
	150 x 150 x 5 SHS	south & north - est	8	22.6	180.800	6	1084.800
BT6	219 dia x 5 CHS	south & north - est	8	26.4	211.200	10	2112.000
BB1	219 dia x 5 CHS	south & north - est	8	26.4	211.200	10	2112.000
P Bracing	219 dia x 5 CHS	south & north	10.899	26.4	287.734	4	1150.934
	219 dia x 5 CHS	south & north	17.504	26.4	462.106	2	924.211
	219 dia x 5 CHS	south & north -est	15	26.4	396.000	2	792.000
	400 x 400 x 8 SHS	perim - west stand	7.5	97.9	734.250	20	14685.000
	400 x 400 x 8 SHS	perim - west stand	8	97.9	783.200	2	1566.400
	400 x 400 x 20 SHS	perim - west stand	15	235	3525.000	5	17625.000
	533 x 210 x 92 UB	West Stand	7.5	92.1	690.750	2	1381.500
Dia bracing	168 dia x 5 CHS	West Stand -est	10	20.1	201	10	2010.000
Dia bracing	168 dia x 5 CHS	West Stand -est	8.5	20.1	170.85	4	683.400
A-frame	323 dia x 16 CHS	far element -est	13.5	121	1633.5	2	3267.000

	323 dia x 16 CHS	far element -est	14.5	121	1754.5	2	3509.000
	323 dia x 16 CHS	far element -est	15.5	121	1875.5	2	3751.000
	457 dia x 20 CHS	middle elements - est	13.5	216	2916	4	11664.000
	457 dia x 20 CHS	middle elements - est	14.5	216	3132	4	12528.000
	457 dia x 25 CHS	middle elements - est	15.5	266	4123	4	16492.000
	349 dia x 25 CHS	inner element -est	27.536	200.164	5511.716	4	22046.864
	349 dia x 25 CHS	inner element -est	33.387	200.164	6682.875	4	26731.502
	368 dia x 32 CHS	inner element -est	33.767	271.66	9173.143	4	36692.573
	457 dia x 20 CHS	plan element - est	12	216	2592	12	31104.000
	355 dia x 25 CHS	To hospitality level	21.519	204	4389.876	4	17559.504
	355 dia x 16 CHS	To hospitality level	19.099	204	3896.196	4	15584.784
	355 dia x 12.5 CHS	To hospitality level	16.115	204	3287.460	4	13149.840
Dia bracing	273 dia x 5.0 CHS	to middle towers -est	16	33.05	528.8	3	1586.4
	219 dia x 5 CHS	to middle towers -est	15	26.4	396.000	2	792.000
	400 x 200 x 12 RHS	Centre of west stand	13	107	1391.000	1	1391.000
Truss, 'b'	150 x 100 x 5.0 RHS	Join w & n, w & s	4.15	18.6	77.190	2	154.380
Truss, 'b'	150 x 100 x 5.0 RHS	Join w & n, w & s	3.95	18.6	73.470	2	146.940
Truss, 'd'	200 x 100 x 6.3 RHS	Join w & n, w & s	3.524	28.1	99.024	2	198.049
Truss, 'a'	200 x 100 x 6.3 RHS	Join w & n, w & s	3.524	28.1	99.024	2	198.049
Truss, 'e'	70 x 70 x 5 SHS	Join w & n, w & s	2.648	9.99	26.454	4	105.814
Truss, 'c'	150 x 100 x 4.0 RHS	Join w & n, w & s	3.524	15.1	53.212	2	106.425
Truss, 'd'	200 x 100 x 6.3 RHS	Join w & n, w & s	3.302	28.1	92.786	8	742.290
Truss 'a'	200 x 100 x 6.3 RHS	Join w & n, w & s	3.302	28.1	92.786	8	742.290
Truss, 'c'	150 x 100 x 4.0 RHS	Join w & n, w & s	3.302	15.1	49.860	8	398.882
Truss, 'b'	150 x 100 x 5.0 RHS	est	3.85	18.6	71.61	3	214.830
Truss, 'b'	150 x 100 x 5.0 RHS	est	3.75	18.6	69.75	1	69.750
Truss 'e'	70 x 70 x 5 SHS		2.461	9.99	24.585	16	393.366
Truss 'a'	200 x 100 x 6.3 RHS		3.406	28.1	95.709	4	382.834
Truss 'c'	150 x 100 x 4.0 RHS		3.406	15.1	51.431	4	205.722
Truss 'd'	200 x 100 x 6.3 RHS		3.406	28.1	95.709	4	382.834

Truss 'b'	150 x 100 x 5.0 RHS	est	3.7	18.6	68.820	2	137.640
Truss 'b'	150 x 100 x 5.0 RHS	est	3.5	18.6	65.100	2	130.200
Truss 'e'	70 x 70 x 5 SHS		2.367	9.99	23.646	8	189.171
Truss 'a'	200 x 100 x 6.3 RHS		3.4	28.1	95.540	4	382.160
Truss 'c'	150 x 100 x 4.0 RHS		3.4	15.1	51.340	4	205.360
Truss 'd'	200 x 100 x 6.3 RHS		3.4	28.1	95.540	4	382.160
Truss 'b'	150 x 100 x 5.0 RHS	est	3.3	18.6	61.380	2	122.760
Truss 'b'	150 x 100 x 5.0 RHS	est	3.2	18.6	59.520	2	119.040
Truss 'e'	70 x 70 x 5 SHS		2.294	9.99	22.917	8	183.336
Truss 'a'	200 x 100 x 6.3 RHS		3.663	28.1	102.930	4	411.721
Truss 'c'	150 x 100 x 4.0 RHS		3.663	15.1	55.311	4	221.245
Truss 'd'	200 x 100 x 6.3 RHS		3.663	28.1	102.930	4	411.721
Truss 'b'	150 x 100 x 5.0 RHS	est	3	18.6	55.800	2	111.600
Truss 'b'	150 x 100 x 5.0 RHS	est	2.8	18.6	52.080	2	104.160
Truss 'e'	70 x 70 x 5 SHS		2.292	9.99	22.897	8	183.177
Truss 'b'	150 x 100 x 5.0 RHS	est	2.8	18.6	52.080	2	104.160
Truss 'b'	150 x 100 x 5.0 RHS	est	2.6	18.6	48.360	2	96.720
Truss 'e'	70 x 70 x 5 SHS		2.981	9.99	29.780	2	59.560
Truss 'a'	200 x 100 x 6.3 RHS		3.078	28.1	86.492	2	172.984
Truss 'd'	200 x 100 x 6.3 RHS		3.078	28.1	86.492	2	172.984
Truss 'e'	70 x 70 x 5 SHS		3.315	9.99	33.117	2	66.234
Total Mass of Steel Roof Beams							**1076281**

Table 67: Quantities and masses of roof beams

Roof Purlins							
Ref	**Section**	**Notes**	**Length (m)**	**Mass (kg/m)**	**Mass per beam (kg)**	**Quantity**	**Total Mass (kg)**
Edge Purlin	200 x 100 x 6.3 RHS	South Stand	7.5	28.1	210.75	9	1896.750
		East corners	8	28.1	224.8	2	449.600

		East Stand	7.5	28.1	210.75	16	3372.000
		North Stand	7.5	28.1	210.75	9	1896.750
Internal Purlin	200 x 100 x 10 RHS	Top end NS & SS	7.5	43.1	323.25	58	18748.500
Internal Purlin	200 x 100 x 6.3 RHS	N & S Stands	7.5	28.1	210.75	168	35406.000
		NE & SE Corner	8	28.1	224.8	40	8992.000
		NE & SE Corner	7.5	28.1	210.75	10	2107.500
		NE & SE Corner	6.5	28.1	182.65	10	1826.500
		NE & SE Corner	5.5	28.1	154.55	10	1545.500
		NE & SE Corner	4.5	28.1	126.45	10	1264.500
		NE & SE Corner	3.5	28.1	98.35	10	983.500
		NE & SE Corner	2.5	28.1	70.25	10	702.500
		East Stand	7.5	28.1	210.75	176	37092.000
Edge Purlin	300 x 200 x 6.3 RHS	West Stand	11.25	47.9	538.875	5	2694.375
			12.25	47.9	586.775	2	1173.550
			13	47.9	622.7	4	2490.800
			8.5	47.9	407.15	2	814.300
			5	47.9	239.5	4	958.000
			7.5	47.9	359.25	6	2155.500
Internal Purlin	300 x 200 x 6.3 RHS	West, for translucent	11.25	47.9	538.875	25	13471.875
			11.75	47.9	562.825	10	5628.250
			12.5	47.9	598.75	10	5987.500
			13	47.9	622.7	10	6227.000
			7.5	47.9	359.25	8	2874.000
Internal Purlin	400 x 200 x 8 RHS	For metal roof	13	72.8	946.4	10	9464.000
			13.5	72.8	982.8	8	7862.400
			14	72.8	1019.2	16	16307.200
			15	72.8	1092	18	19656.000
Stair Tower	300dp x 75mm	Z purlin	3.333	10.97	36.563	20	731.260
			4.256	10.97	46.688	20	933.766
			3.471	10.97	38.077	20	761.537

Total Mass of Steel Purlins in the Roof Structure	**216475**

Table 68: Quantities and masses of roof purlins

Using Sakura

A series of screenshots were taken as information was input into Sakura, these are shown from Figure 4 to Figure 8. Several assumptions were made during the inputting of information, these are as follows:

- All concrete 100% Portland cement, RC 28/35 MPa strength
- All steel is sourced from within Europe
- Rafters and purlins are all cold rolled
- Floor area varies depending on the level, total floor area was estimated then this split over 3 storeys for input into Sakura

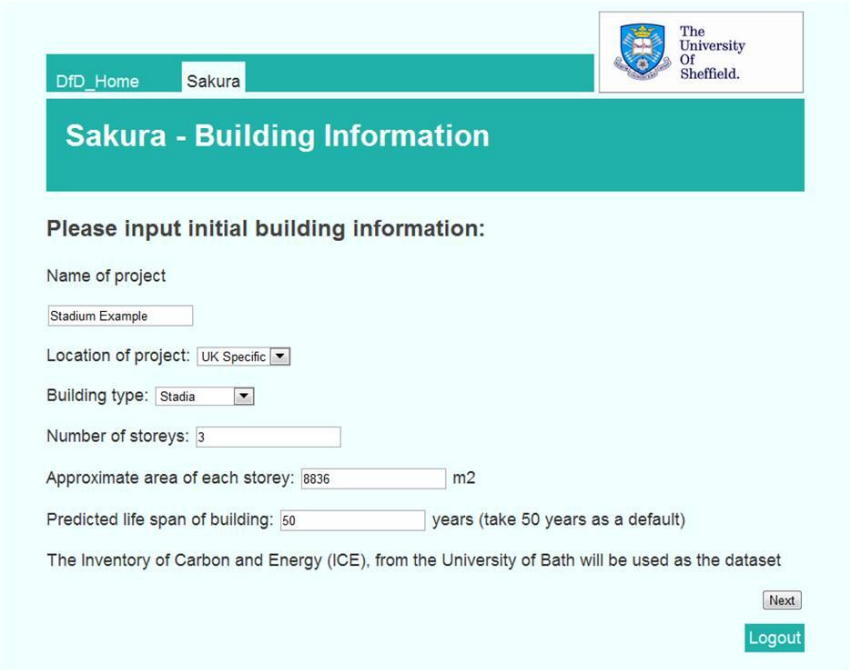


Figure 4: Stadium, initial information input

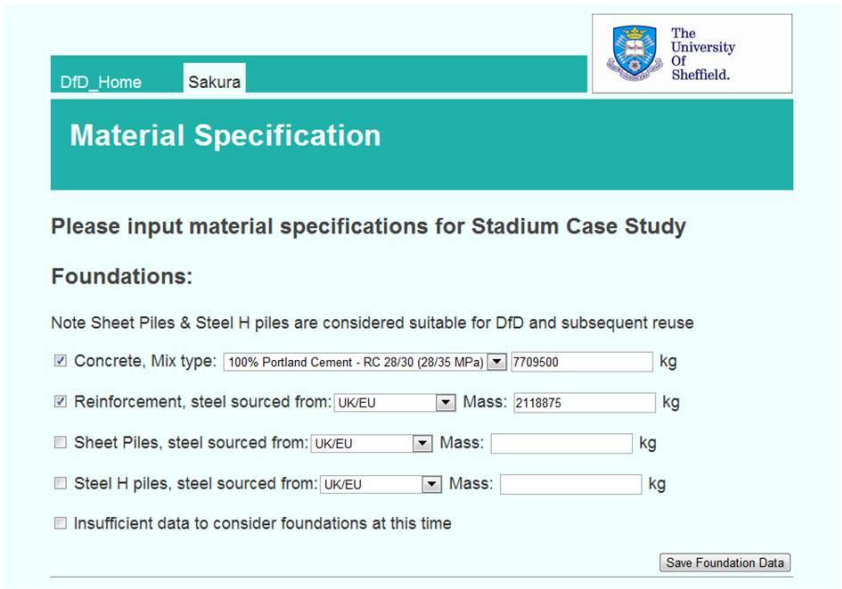


Figure 5: Stadium, foundation specification

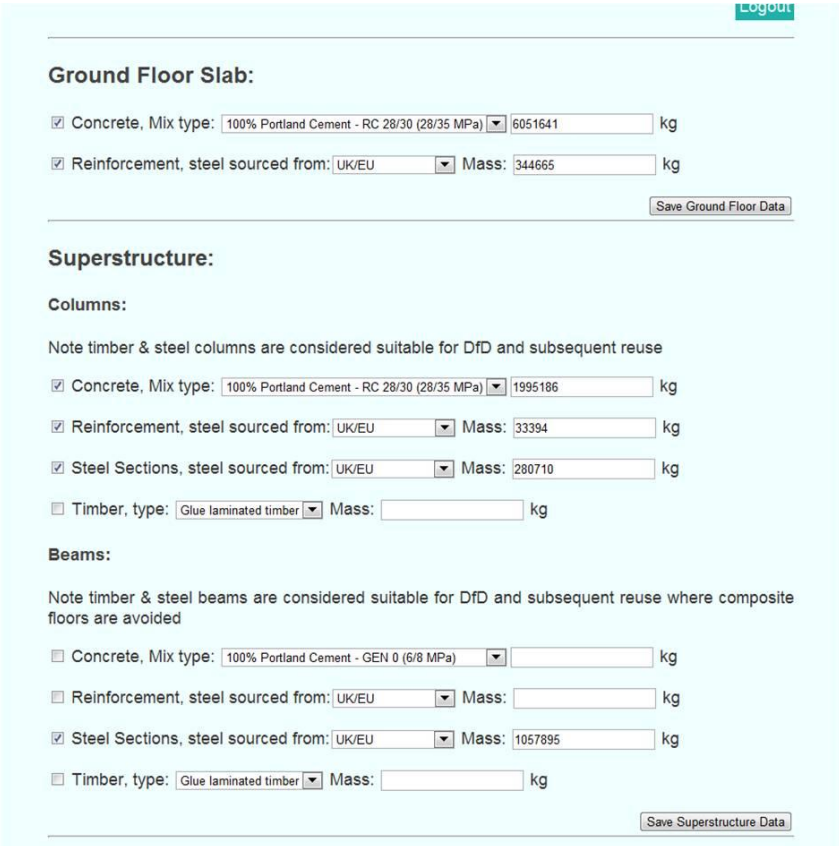


Figure 6: Stadium, ground floor slab and superstructure specification

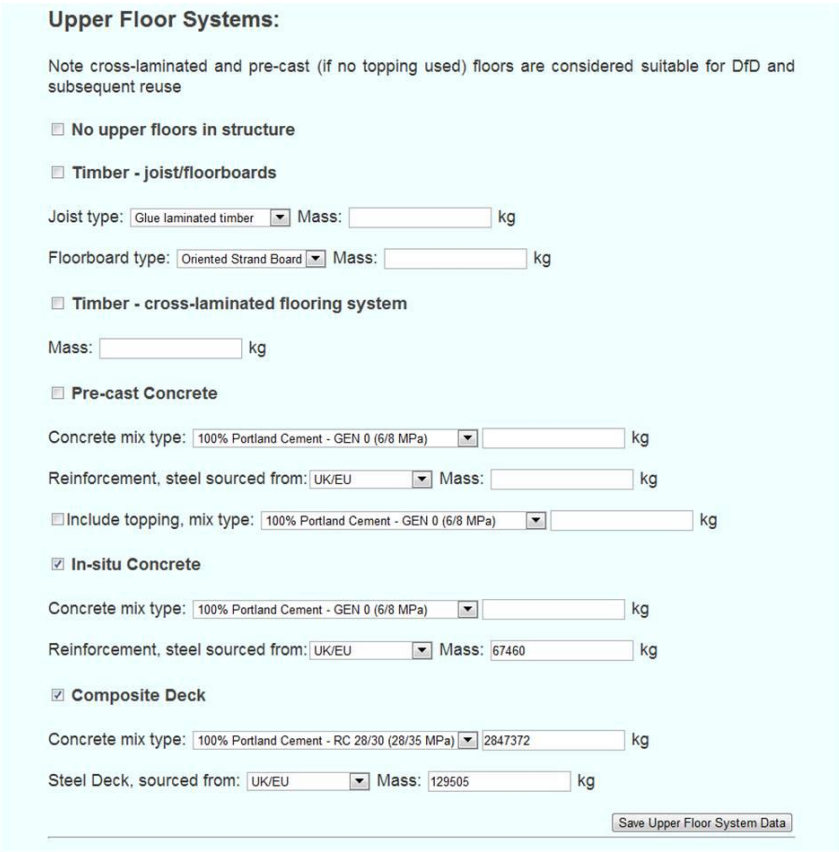


Figure 7: Stadium, the upper floor systems specification

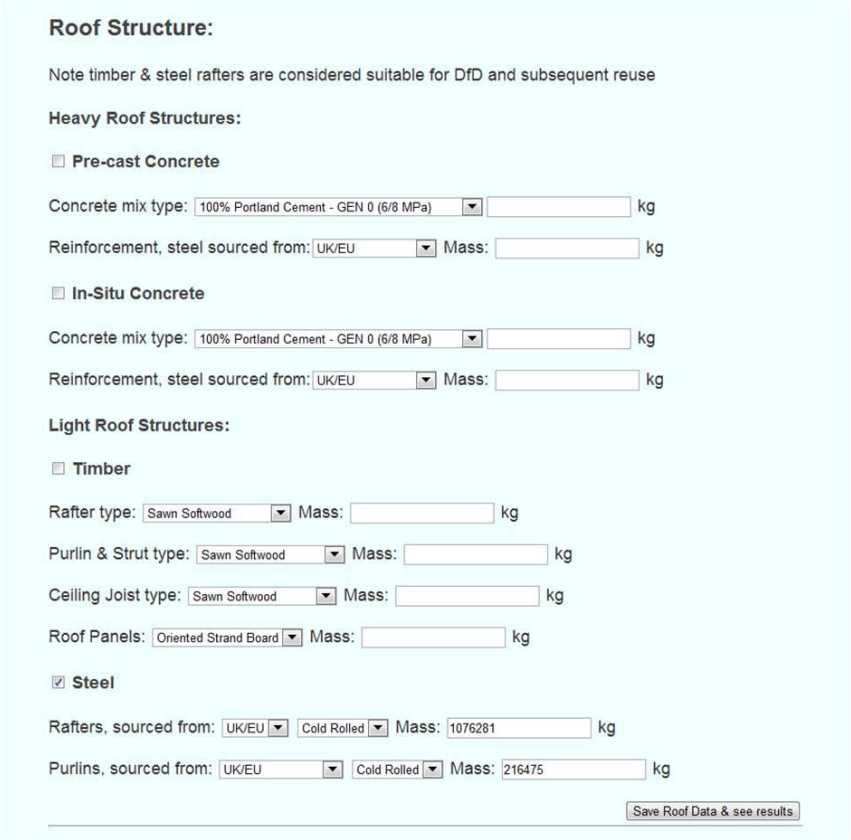


Figure 8: Stadium, roof structure specification

Appendix C2: Warehouse Case Study Information

Warehouse Case Studies

Warehouse 1, steel frame

Several assumptions were made during the mass estimation and input into Sakura, these are as follows:

- All steel is sourced from within the EU
- No breakdown was given for the steel frame, so it was assumed half of the mass was columns and the other half the beams

Material Masses

The material masses input into Sakura can be found in Table 69. These were extracted from spreadsheets supplied by the BSCA.

Warehouse Option 1			
Element	**Material**	**Mass (kg)**	**Notes**
Pad Foundations	concrete	1379717.268	C 32/40
	reinforcement	44041.153	
Ground Slab	concrete	13846152.600	RC 40
	reinforcement	77508.960	
Edge toe to GS	concrete	159817.425	RC 40 (this is included in GS)
	reinforcement	8313.000	
Ground Slab total	concrete	14005970.025	
	reinforcement	85821.960	
Steel Frame, warehouse		833417.018	
	Roof	416708.509	Estimated at 1/2 the total mass
	Columns	416708.509	Estimated at 1/2 the total mass
Steel Frame, office		38586.025	
	Roof	12862.008	
	Beams	12862.008	
	Columns	12862.008	
Steel Frame, Total			
	Roof	429570.517	
	Beams	12862.008	
	Columns	429570.517	
Hollowcore planks, office		225021.000	Hanson hollowfloor A200, mass incl rebar
	concrete	219628.200	
	reinforcement	5392.800	

Table 69: Warehouse 1, structural material masses

Screenshots from Sakura

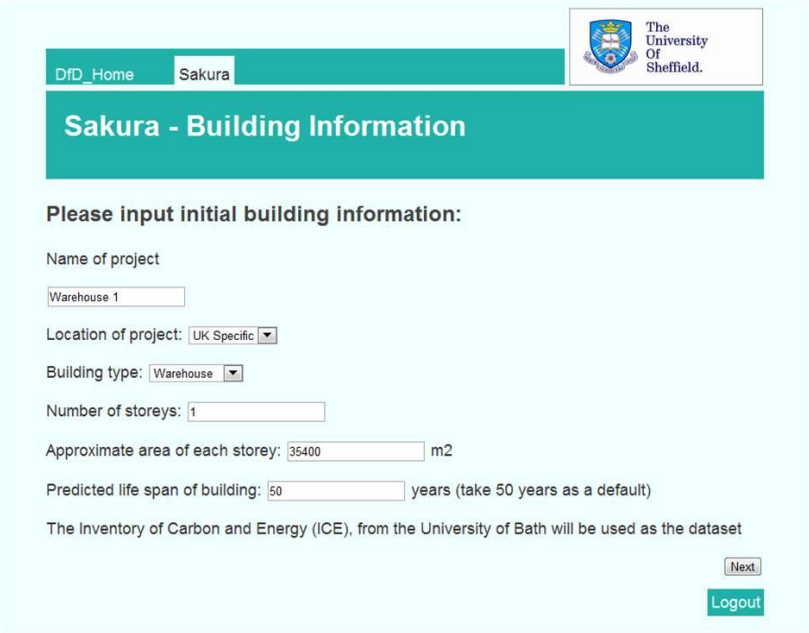


Figure 9: Warehouse 1, initial information input

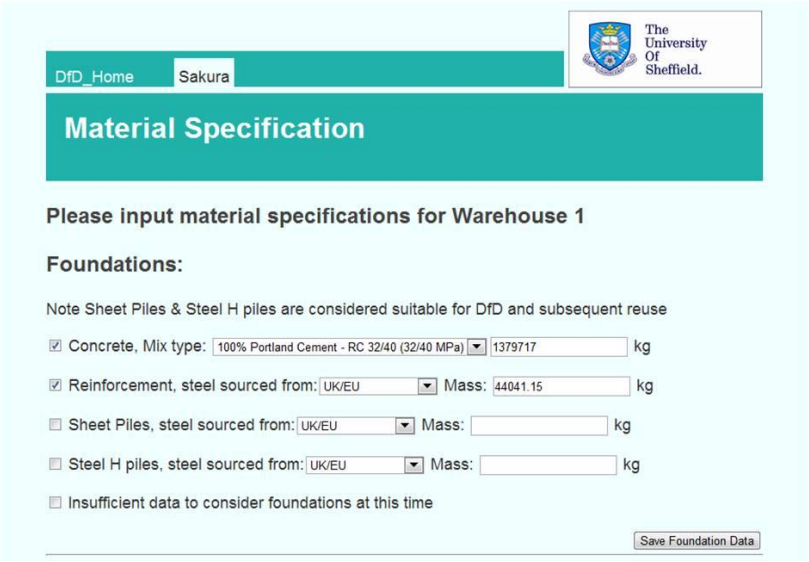


Figure 10: Warehouse 1, foundation specification

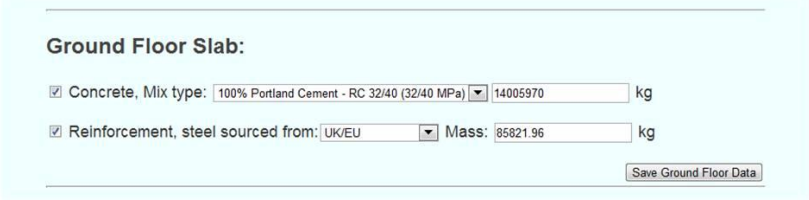


Figure 11: Warehouse 1, ground floor specification

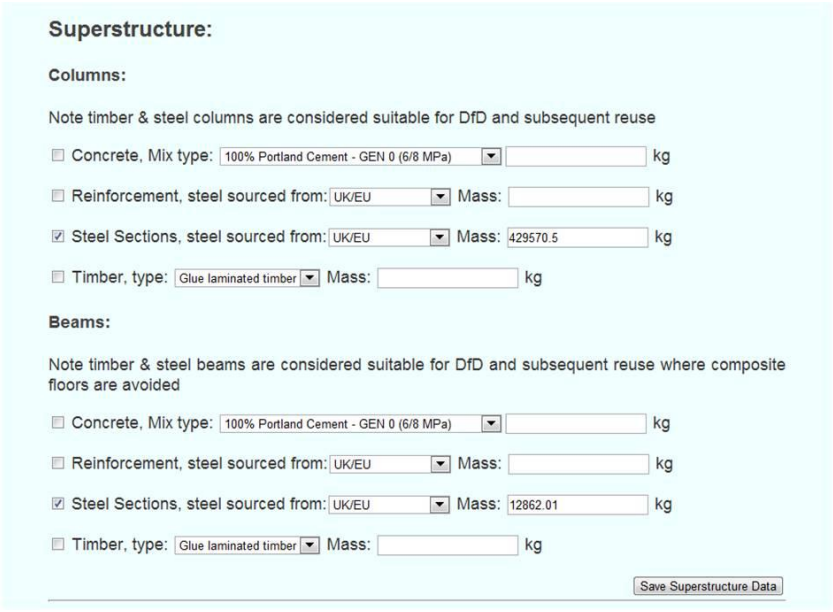


Figure 12: Warehouse 1, superstructure specification

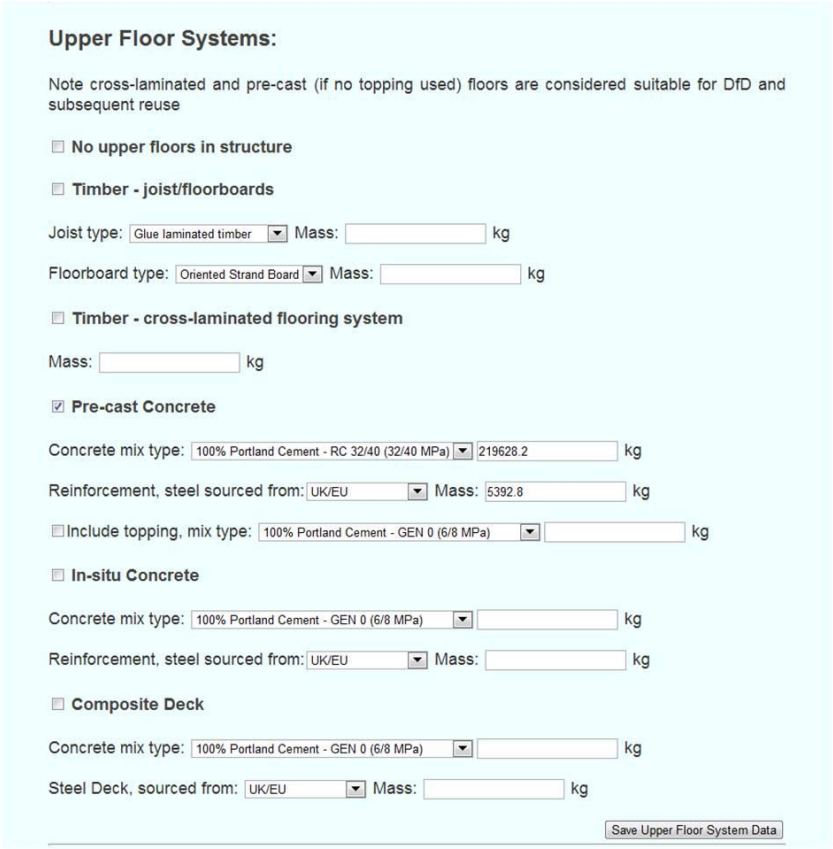


Figure 13: Warehouse 1, upper floor slab specification

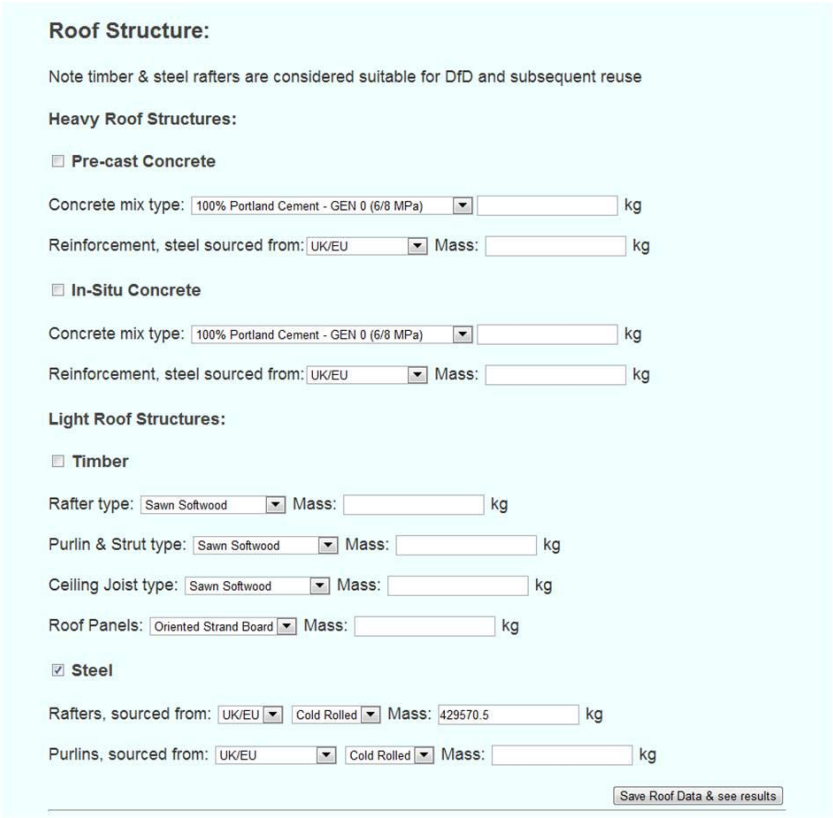


Figure 14: Warehouse 1, roof specification

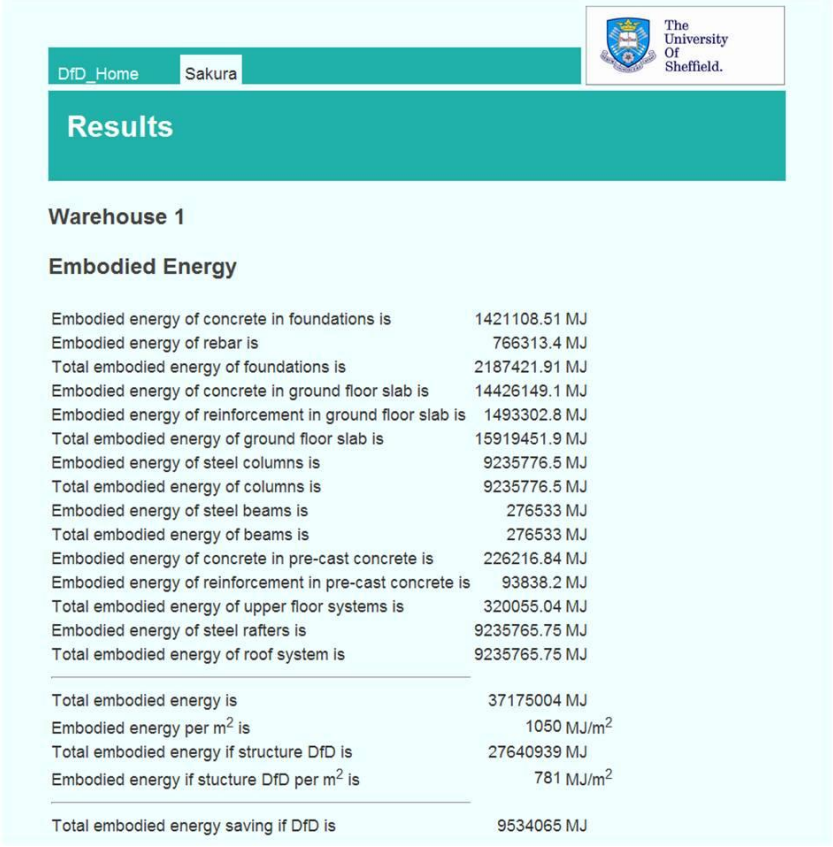


Figure 15: Warehouse 1, embodied energy results

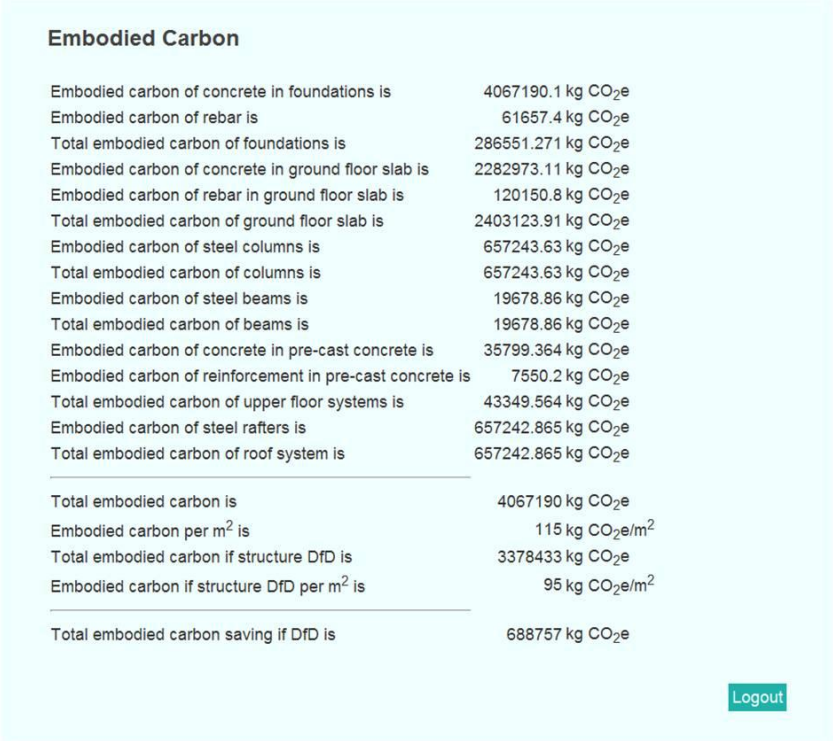


Figure 16: Warehouse 1, embodied carbon results

Warehouse 2, concrete & timber frame

Several assumptions were made during the course of this study, these are as follows:

- All steel was sourced from the EU
- No breakdown between the reinforcement and concrete was given for the precast columns and beams. The reinforcement within the floor makes up 2.5% of the total mass, it is thought that columns and beams would have more reinforcement so it is estimated to contribute 5% to the total mass .

Material Masses

The material masses input into Sakura can be found in Table 70. There were extracted from spreadsheets provided by the BSCA.

Warehouse Option 2			
Element	**Material**	**Mass (kg)**	**Notes**
Pad Foundations	concrete	2002587.89	C 45
	reinforcement	56507.961	
Ground Slab	concrete	13846152.6	RC 40
	reinforcement	77508.96	Same as option 1
Edge toe to GS	concrete	159817.425	Same as option 1
	reinforcement	8313	Same as option 1
Ground Slab total	concrete	14005970.03	Same as option 1
	reinforcement	85821.96	Same as option 1
PCC Columns		1327951.014	Grade C50? Incl reinforcement
	concrete	1261553.464	
	reinforcement	66397.551	
PCC beams		60731.775	Grade C50? Incl reinforcement

	concrete	57695.186	
	reinforcement	3036.589	
Hollowcore planks, office		225021	Hanson hollowfloor A200, mass incl reinforcement
	concrete	219628.2	As option 1
	reinforcement	5392.8	As option 1
Glulam roof beams		1481369.837	

Table 70: Warehouse 2, structural material masses

Screenshots from Sakura

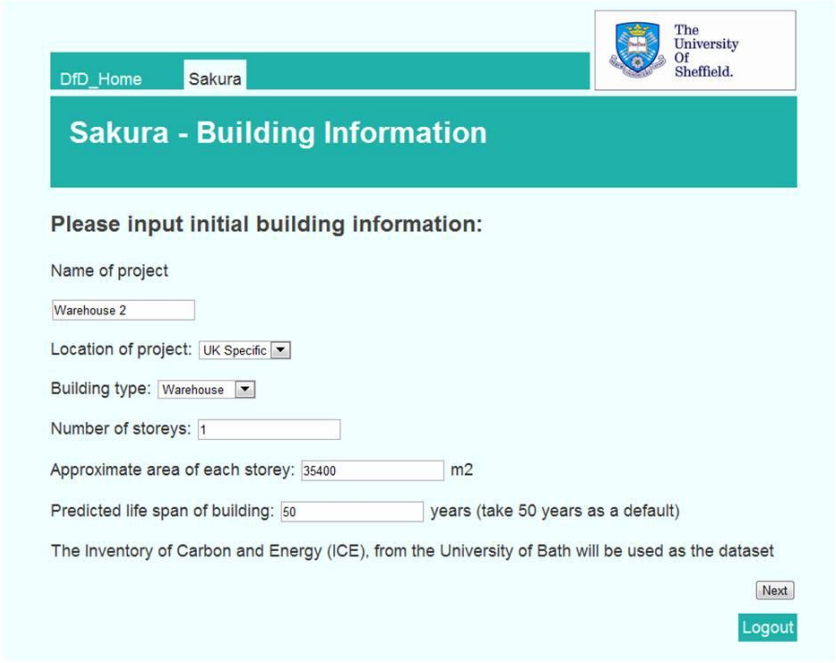


Figure 17: Warehouse 2, initial information input

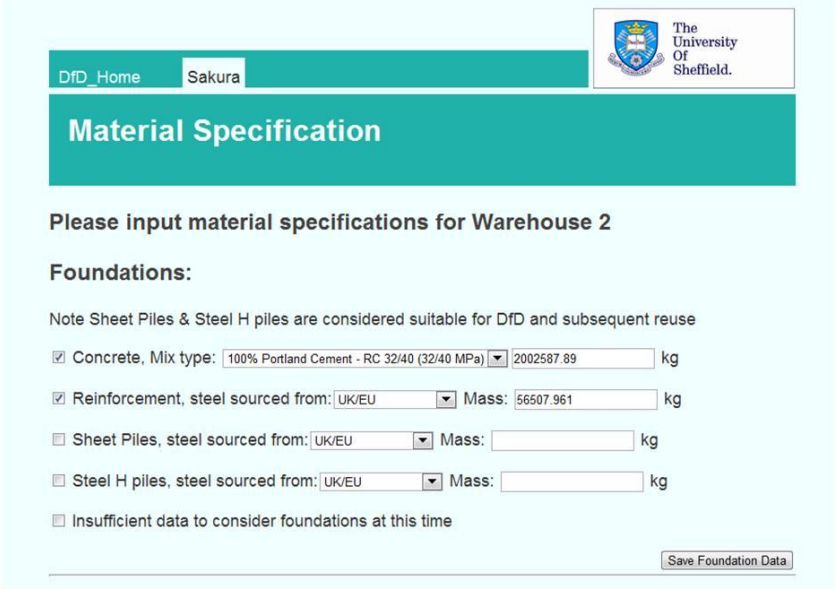


Figure 18: Warehouse 2, foundation specification

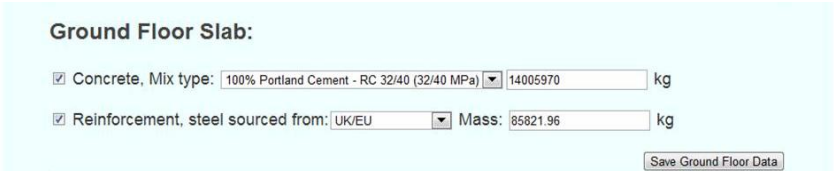


Figure 19: Warehouse 2, ground floor slab specification

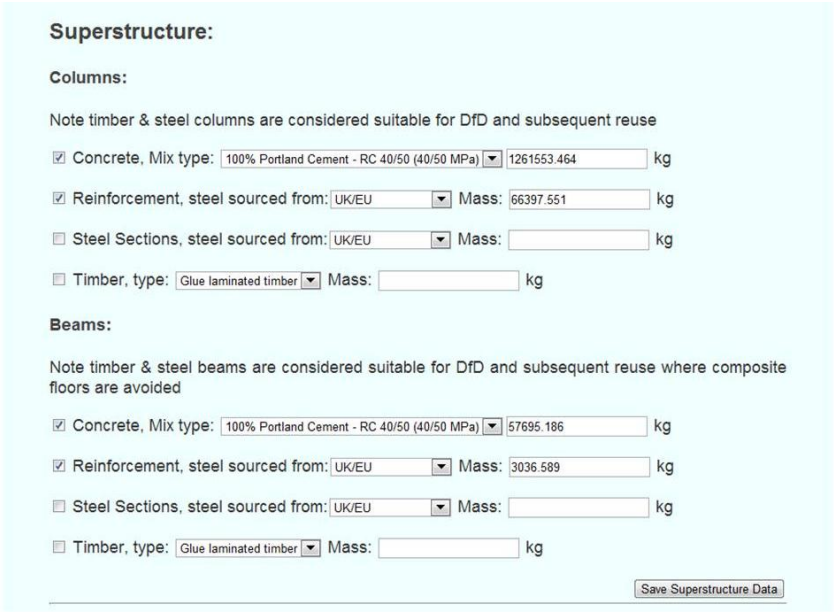


Figure 20: Warehouse 2, superstructure specification

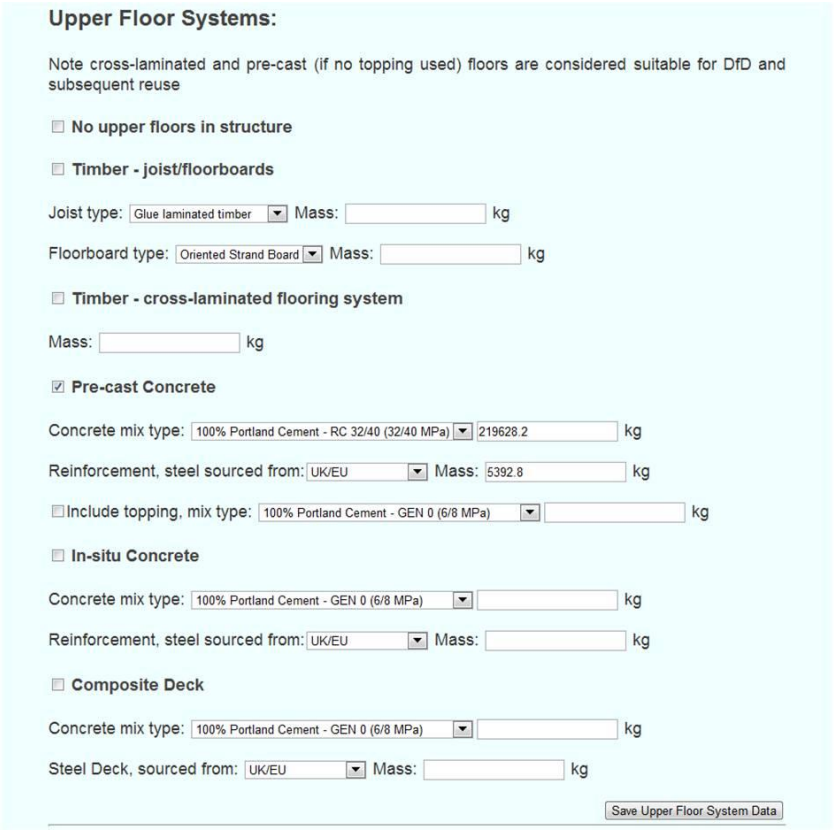


Figure 21: Warehouse 2, upper floor slab specification

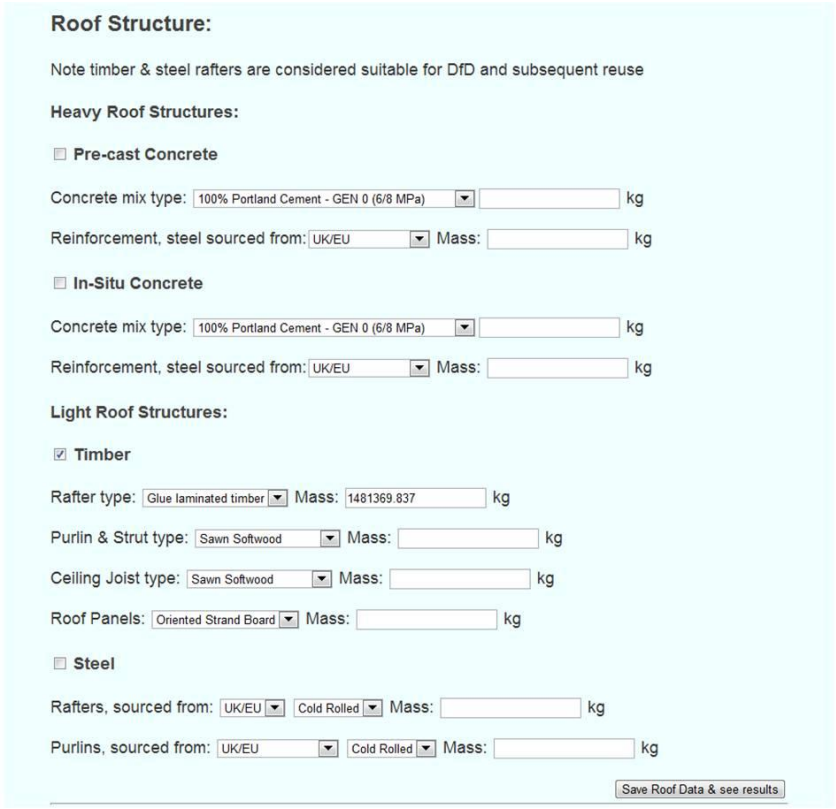


Figure 22: Warehouse 2, roof specification

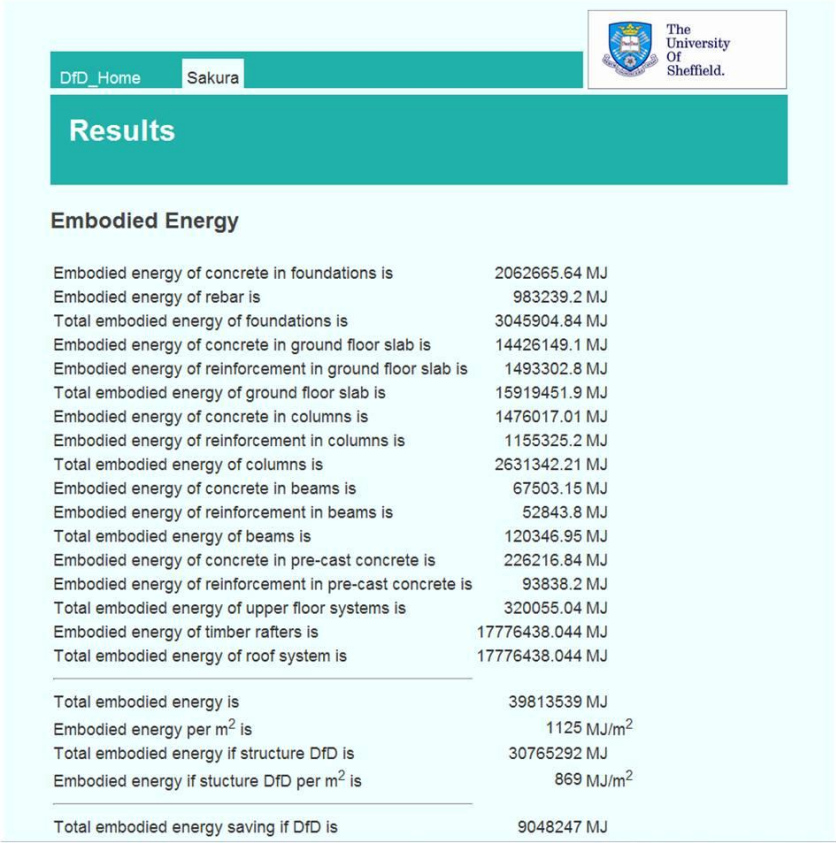
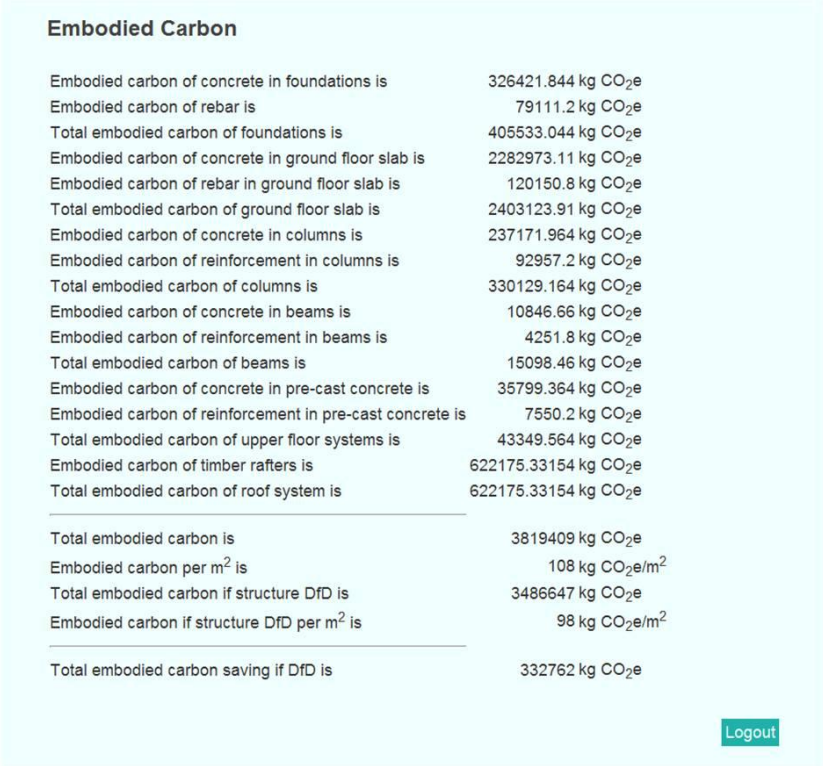


Figure 23: Warehouse 2, embodied energy results



Embodied Carbon

Embodied carbon of concrete in foundations is	326421.844 kg CO_2e
Embodied carbon of rebar is	79111.2 kg CO_2e
Total embodied carbon of foundations is	405533.044 kg CO_2e
Embodied carbon of concrete in ground floor slab is	2282973.11 kg CO_2e
Embodied carbon of rebar in ground floor slab is	120150.8 kg CO_2e
Total embodied carbon of ground floor slab is	2403123.91 kg CO_2e
Embodied carbon of concrete in columns is	237171.964 kg CO_2e
Embodied carbon of reinforcement in columns is	92957.2 kg CO_2e
Total embodied carbon of columns is	330129.164 kg CO_2e
Embodied carbon of concrete in beams is	10846.66 kg CO_2e
Embodied carbon of reinforcement in beams is	4251.8 kg CO_2e
Total embodied carbon of beams is	15098.46 kg CO_2e
Embodied carbon of concrete in pre-cast concrete is	35799.364 kg CO_2e
Embodied carbon of reinforcement in pre-cast concrete is	7550.2 kg CO_2e
Total embodied carbon of upper floor systems is	43349.564 kg CO_2e
Embodied carbon of timber rafters is	622175.33154 kg CO_2e
Total embodied carbon of roof system is	622175.33154 kg CO_2e
Total embodied carbon is	3819409 kg CO_2e
Embodied carbon per m^2 is	108 kg CO_2e/m^2
Total embodied carbon if structure DfD is	3486647 kg CO_2e
Embodied carbon if structure DfD per m^2 is	98 kg CO_2e/m^2
Total embodied carbon saving if DfD is	332762 kg CO_2e

Logout

Figure 24: Warehouse 2, embodied carbon results

Appendix C3: School Case Study Information

School Case Studies

School 1, steel frame

Several assumptions were made as this work was carried out, they are as follows:

- All steel is sourced from within the EU
- Reinforcement masses for precast hollowcore planks calculated based on 9 strands per 1200mm plank at 150mm deep and 7 strands in 1200mm plank at 250mm deep, based on Hanson typical section drawing
- No of masses breakdown was given for the components of the steel frame, it was therefore assumed that half the mass was beams and the other half columns

Material Masses

Table 71 shows the material masses that were input into Sakura. These were taken from spreadsheets provided by the BCSA.

School Option 1			
Element	**Material**	**Mass (kg)**	**Notes**
Piles	pre-cast	347813.125	Incl reinforcement, 235 x 235
	concrete	313276.620	
	reinforcement	34536.505	
Pile Caps	concrete	430569.252	RC 32/40
	reinforcement	22396.320	
Foundation, total	concrete	743845.872	piles + pile caps
	reinforcement	56932.825	piles + pile caps
Ground Beams	concrete	215112.985	RC 32/40
	reinforcement	11189.232	
Ground Slab	concrete	1695829.560	RC 32/40
	reinforcement	10879.199	Mesh
Edge toe to GS	concrete	100360.867	RC 32/40
	reinforcement	5220.331	
GS Total	concrete	2011303.413	GS, ground beams & edge toe
	reinforcement	27288.762	GS, ground beams & edge toe
Structural Steel Frame		652300.000	Sections
Beams		326150.000	1/2 total mass
Columns		326150.000	1/2 total mass
Hollowcore planks 1		1747680.000	Incl reinforcement, 250
	concrete	1717661.077	
	reinforcement	30018.923	
Hollowcore planks 2		9477.000	Incl reinforcement, 150
	concrete	9178.570	
	reinforcement	298.430	

Screed Topping	concrete	864270.000	RC 25/30
	reinforcement	6508.700	mesh
Roof, hollowcore planks		93720.000	Incl reinforcement, 250
	concrete	92110.226	
	reinforcement	1609.774	
Roof, hollowcore planks		262440.000	Incl reinforcement, 150
	concrete	254175.734	
	reinforcement	8264.266	
Screed for Roof	concrete	220968.000	Assumed same as other screed, RC 25/30
	reinforcement	1664.080	mesh

Table 71: School 1, material masses

Screenshots from Sakura

This section shows screenshots for all the information input into Sakura and the resulting output from Sakura.

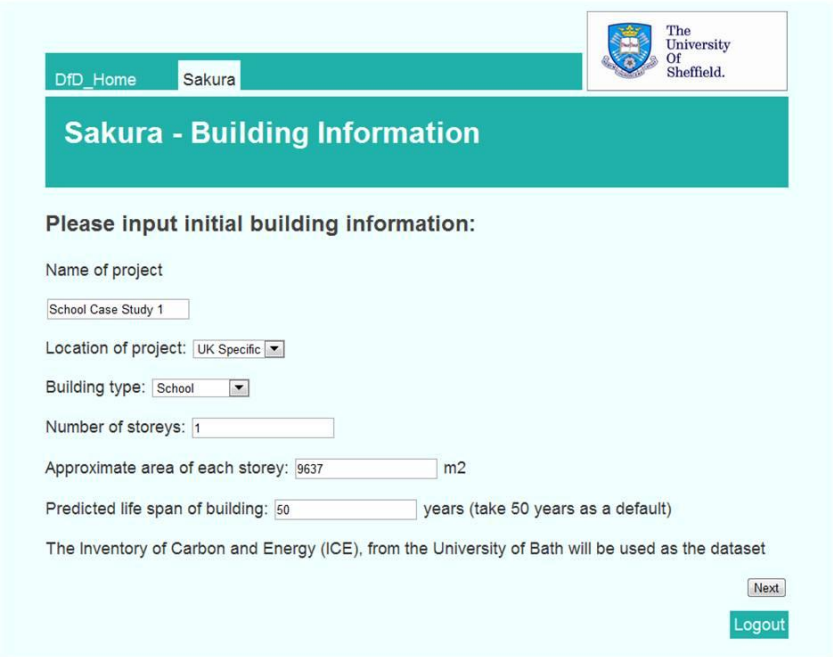


Figure 25: School 1, Initial information input

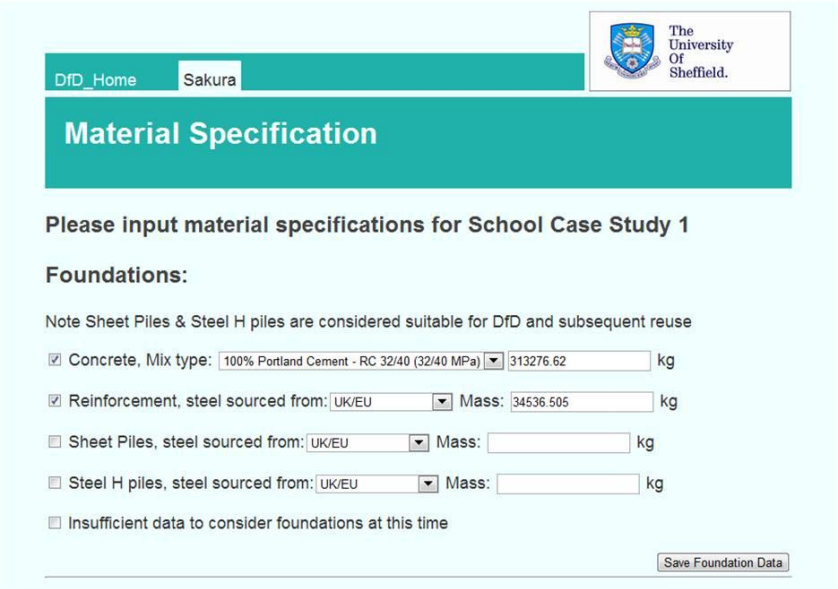


Figure 26: School 1, Foundation information

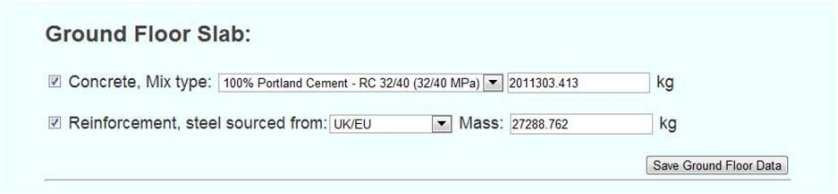


Figure 27: School 1, Ground Floor Slab information

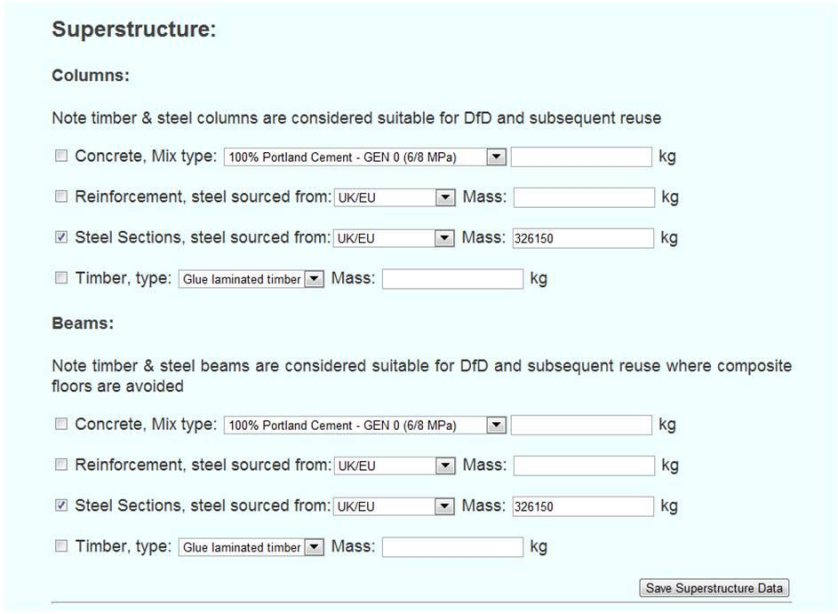


Figure 28: School 1, Superstructure information

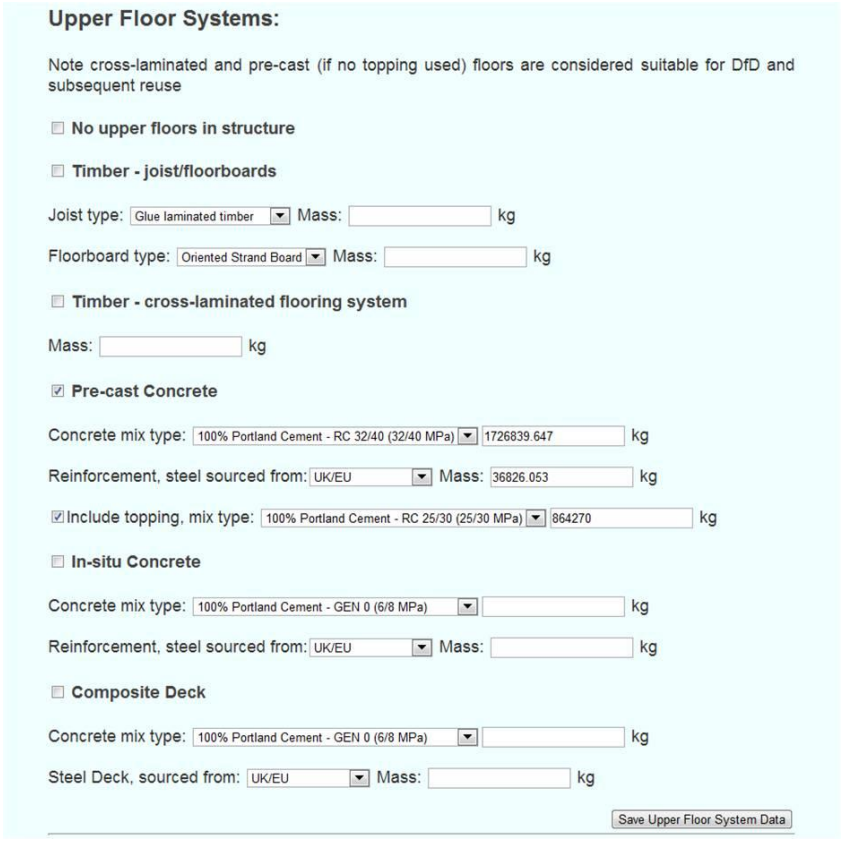


Figure 29: School 1, Upper floor slab information

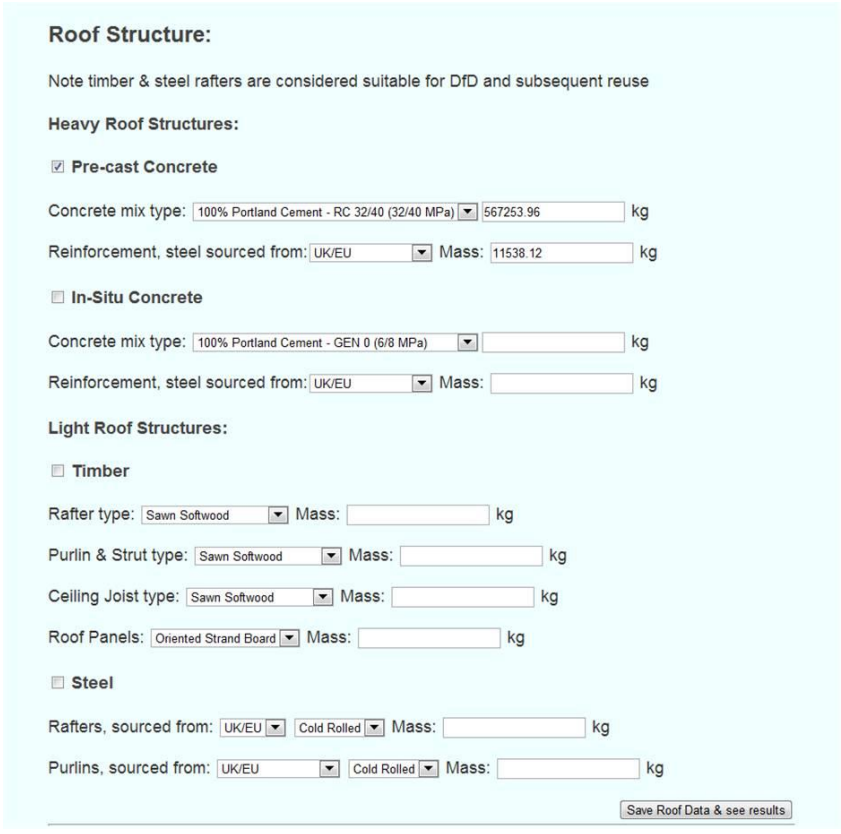


Figure 30: School 1, Roof information

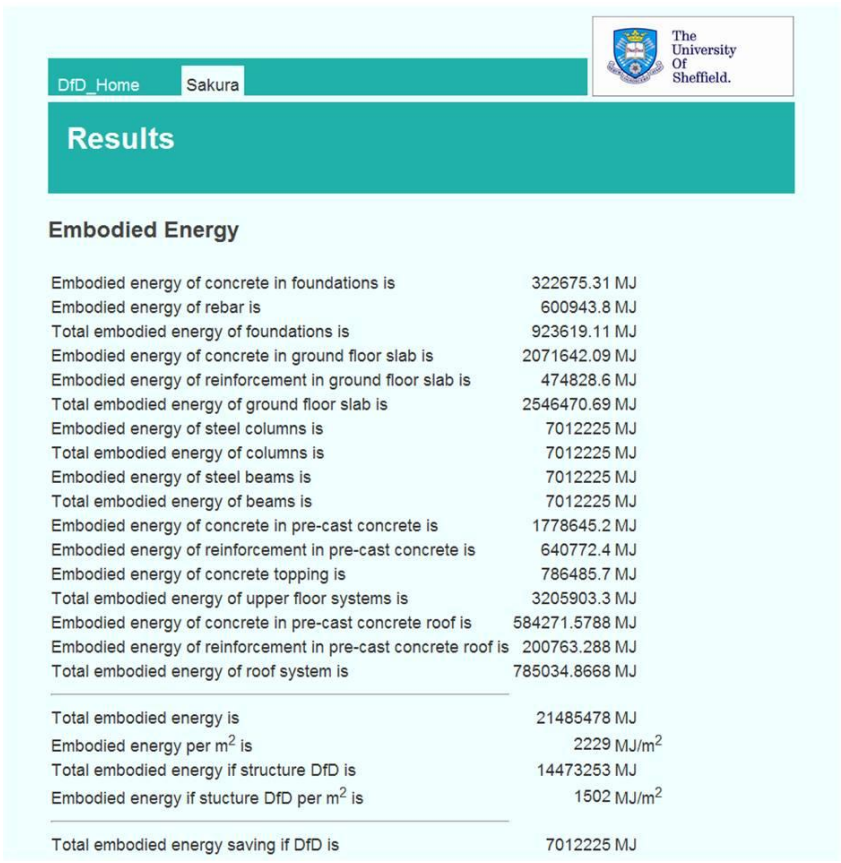


Figure 31: School 1, Embodied energy results

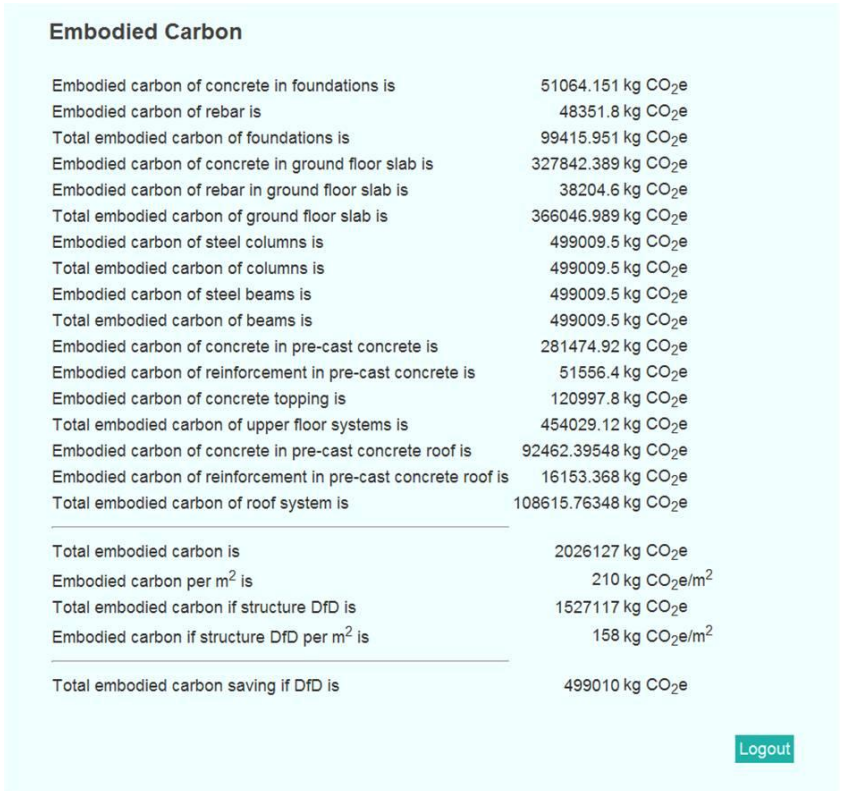


Figure 32: School 1, Embodied carbon results

School 2, concrete frame

Several assumptions were made during the course of this study, they are as follows:

- All steel was sourced from the EU
- Half of the total structure steel frame mass is attributed to beams and the other half to columns as no specific breakdown was given

Masses

Information on the masses of the structural components was gathered from a spreadsheet provided by the BCSA, these masses are shown in Table 72.

School Option 2			
Element	**Material**	**Mass (kg)**	**Notes**
Piles	pre-cast	529767.945	Incl reinforcement, 270 x 270
	concrete	477784.332	
	reinforcement	51983.613	
Pile Caps	concrete	578266.779	
	reinforcement	32426.709	
Foundation, total	concrete	1056051.111	Piles + pile caps
	reinforcement	84410.322	
Ground Beams	concrete	224240.400	
	reinforcement	16524.000	
Ground Slab	concrete	1695829.560	
	reinforcement	12741.404	
Edge toe to GS	concrete	100360.867	
	reinforcement	5220.331	
GS Total	concrete	2020430.827	GS, ground beams & edge toe
	reinforcement	34485.735	GS, ground beams & edge toe
Structural Steel Frame		320100.000	Sports hall?
Beams		160050.000	1/2 total mass
Columns		160050.000	1/2 total mass
Concrete Frame, in-situ concrete			
Columns	concrete	244542.000	
	reinforcement	27120.000	
Slab, 350	concrete	5114619	
	reinforcement	243920	
Beams	concrete	211609.575	
	reinforcement	43251.300	Attached to slab
Roof, composite in-situ slab			
Concrete Slab	concrete	119964.000	200mm
	reinforcement	35533.160	

Table 72: School 2, material masses

Screenshots from Sakura

The screenshots of information input into Sakura and the results are shown in this section.

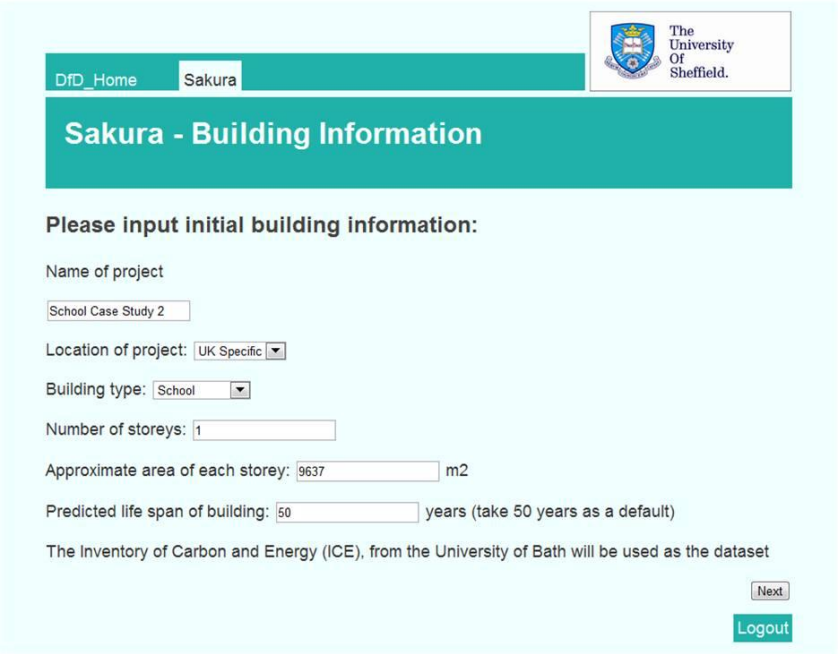


Figure 33: School 2, initial information input

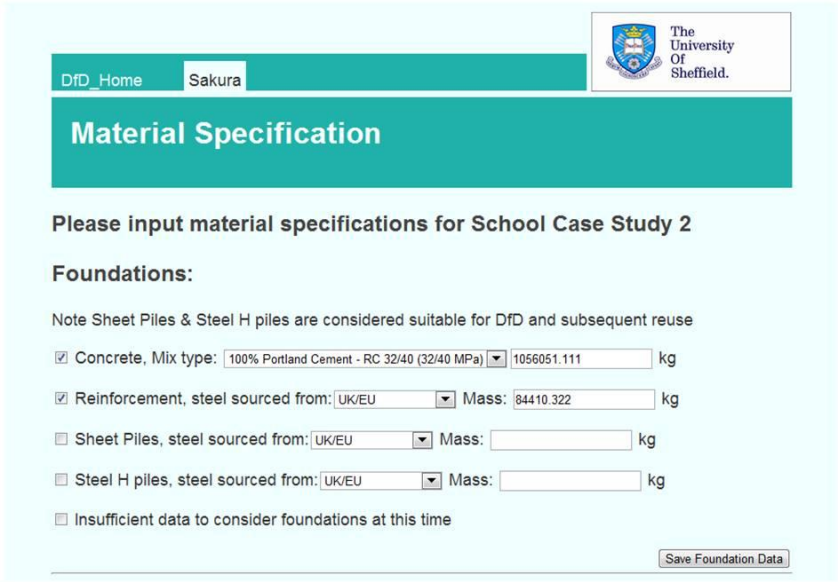


Figure 34: School 2, foundation specification

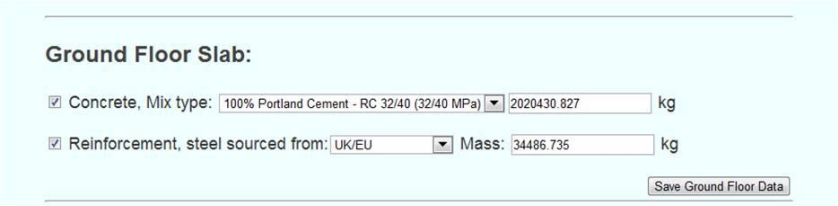


Figure 35: School 2, ground floor slab specification

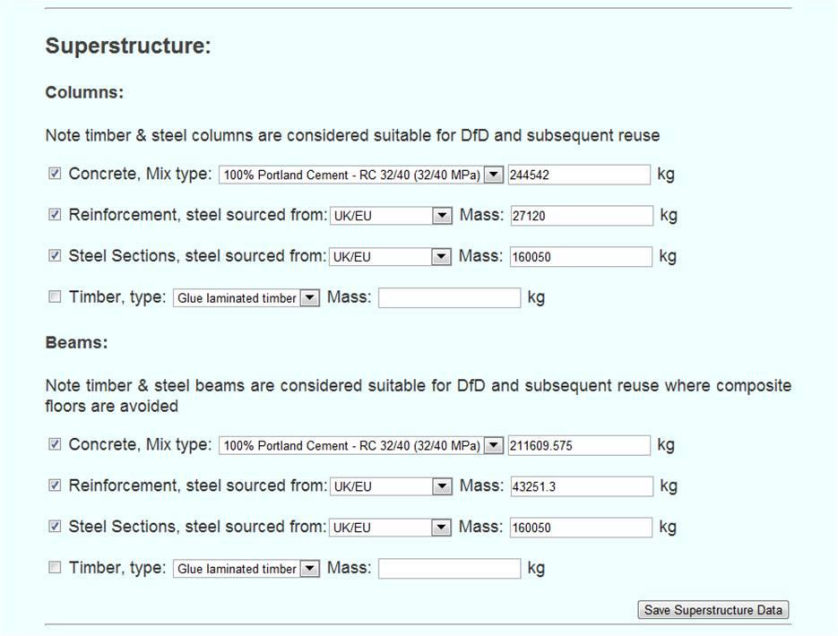


Figure 36: School 2, superstructure specification

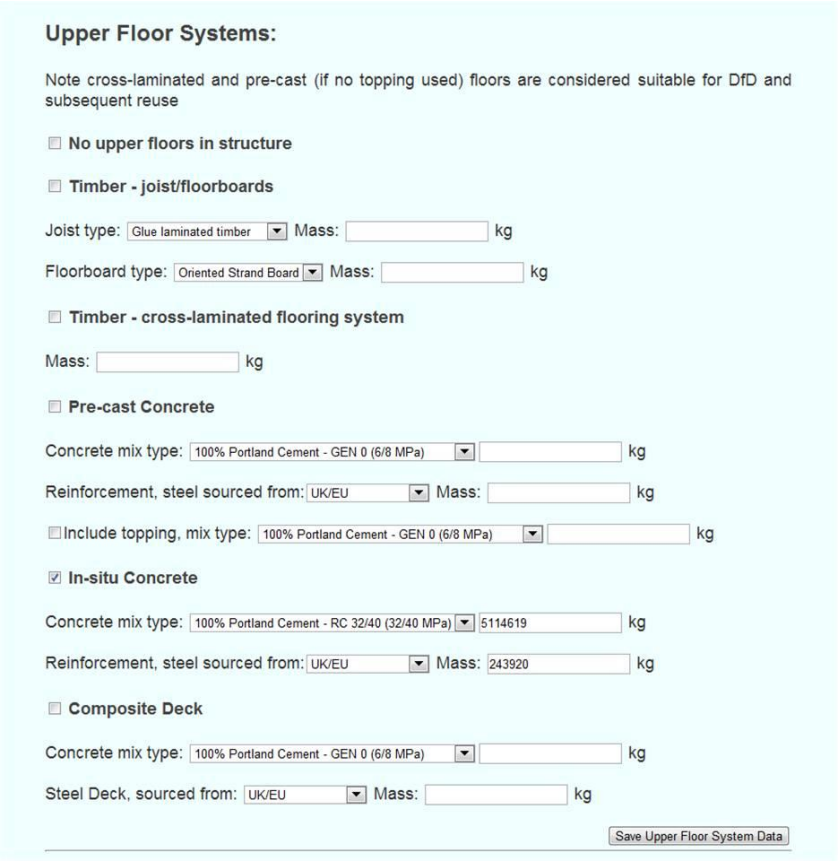


Figure 37: School 2, upper floor slabs specification

Roof Structure:

Note timber & steel rafters are considered suitable for DfD and subsequent reuse

Heavy Roof Structures:

☐ **Pre-cast Concrete**

Concrete mix type: 100% Portland Cement - GEN 0 (6/8 MPa) kg

Reinforcement, steel sourced from: UK/EU Mass: kg

☑ **In-Situ Concrete**

Concrete mix type: 100% Portland Cement - RC 32/40 (32/40 MPa) 119964 kg

Reinforcement, steel sourced from: UK/EU Mass: 35533.16 kg

Light Roof Structures:

☐ **Timber**

Rafter type: Sawn Softwood Mass: kg

Purlin & Strut type: Sawn Softwood Mass: kg

Ceiling Joist type: Sawn Softwood Mass: kg

Roof Panels: Oriented Strand Board Mass: kg

☐ **Steel**

Rafters, sourced from: UK/EU Cold Rolled Mass: kg

Purlins, sourced from: UK/EU Cold Rolled Mass: kg

Save Roof Data & see results

Figure 38: School 2, roof specification

Embodied Energy

Embodied energy of concrete in foundations is	1087732.53 MJ
Embodied energy of rebar is	1468734 MJ
Total embodied energy of foundations is	2556466.53 MJ
Embodied energy of concrete in ground floor slab is	2081043.93 MJ
Embodied energy of reinforcement in ground floor slab is	600073.8 MJ
Total embodied energy of ground floor slab is	2681117.73 MJ
Embodied energy of concrete in columns is	251878.26 MJ
Embodied energy of reinforcement in columns is	471888 MJ
Embodied energy of steel columns is	3441075 MJ
Total embodied energy of columns is	4164841.26 MJ
Embodied energy of concrete in beams is	217958.3 MJ
Embodied energy of reinforcement in beams is	752567.4 MJ
Embodied energy of steel beams is	3441075 MJ
Total embodied energy of beams is	4411600.7 MJ
Embodied energy of concrete in in-situ concrete is	5268057.57 MJ
Embodied energy of reinforcement in in-situ concrete is	4244208 MJ
Total embodied energy of upper floor systems is	9512265.57 MJ
Embodied energy of concrete in in-situ concrete roof is	123562.92 MJ
Embodied energy of reinforcement in in-situ concrete roof is	618276.984 MJ
Total embodied energy of roof system is	741839.904 MJ
Total embodied energy is	24068132 MJ
Embodied energy per m^2 is	2497 MJ/m^2
Total embodied energy if structure DfD is	20627057 MJ
Embodied energy if stucture DfD per m^2 is	2140 MJ/m^2
Total embodied energy saving if DfD is	3441075 MJ

Figure 39: School 2, embodied energy results

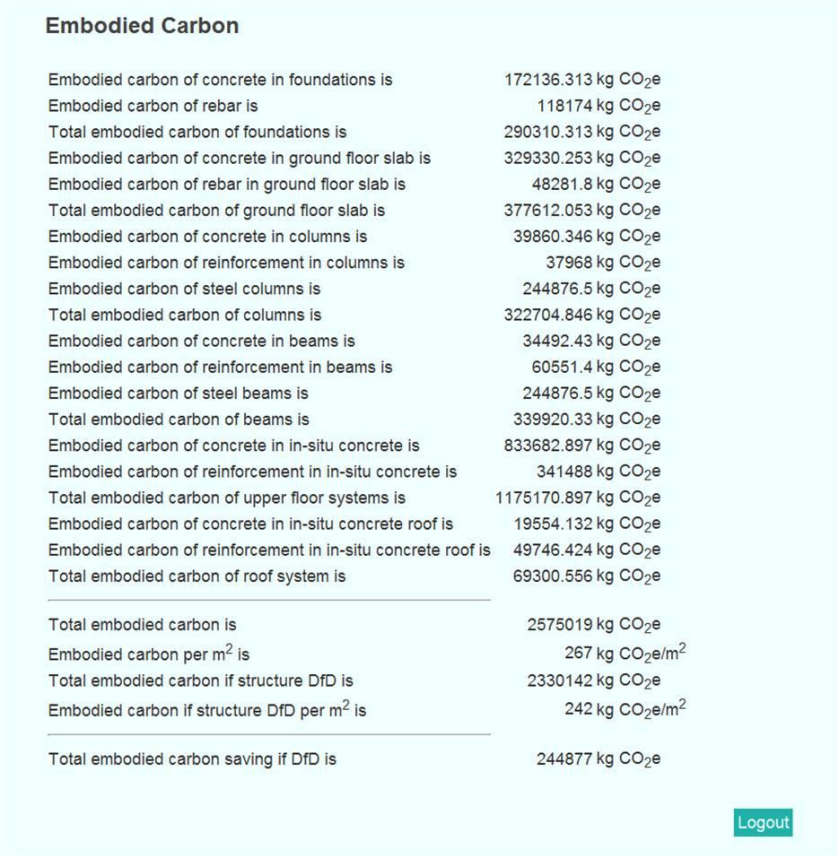


Figure 40: School 2, embodied carbon results

School 3, composite steel frame

A number of assumptions were made during this case study, these are as follows:

- All steel was sourced within the EU
- All timber sourced from sustainably managed forests
- Half of the total steel frame mass contributes to beams and the other half to the columns, as no specific breakdown was provided

Masses

The breakdown of masses that were input into Sakura can be seen in Table 73, these were extracted from a spreadsheet provided by the BCSA.

School Option 3			
Element	**Material**	**Mass (kg)**	**Notes**
Piles	Steel	136507.800	193 dia x 12.5 tubular
Pile Caps	concrete	444202.238	
	reinforcement	16726.592	
Ground Beams	concrete	232130.340	
	reinforcement	17105.400	
Ground Slab	concrete	1695829.560	150mm thick
	reinforcement	10879.199	
Edge toe to GS	concrete	100360.867	
	reinforcement	5220.331	
GS Total	concrete	2028320.767	GS, ground b, edge toe

	reinforcement	33204.930	
Structural Steel Frame		664767.647	
Beams		332383.824	1/2 mass
Columns		332383.824	1/2 mass
Composite insitu slabs			
	concrete	1900091.340	130mm
	mesh	14063.700	A142
	Deck	90590.500	1.2mm thick
Roof insitu slab	concrete	119964.000	200mm
	reinforcement	35533.16	
Glulam Beams	timber	22524.7635	softwood, sports hall

Table 73: School 3, material mass breakdown

Screenshots of Sakura

This section contains screenshots of all the information input into Sakura and the results that were output.

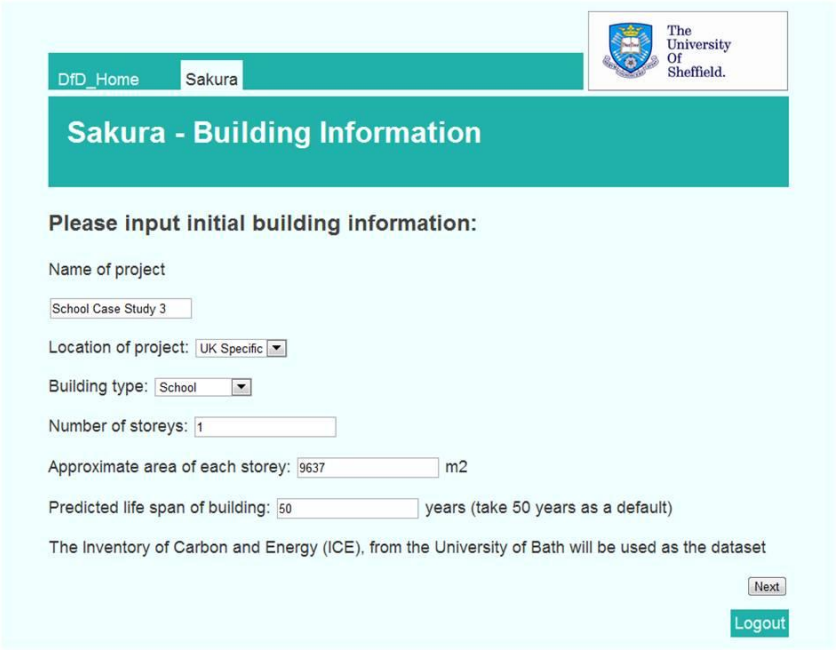


Figure 41: Initial information input

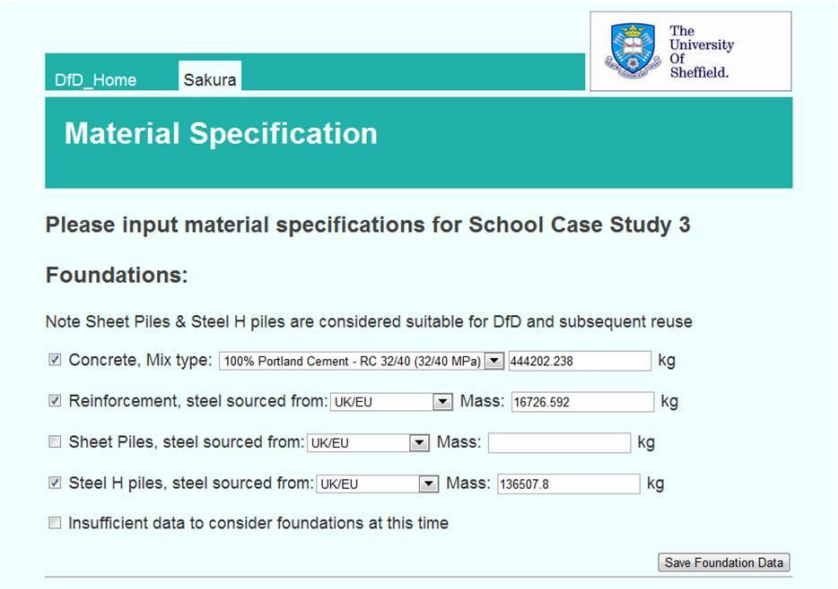


Figure 42: School 3, foundation specification

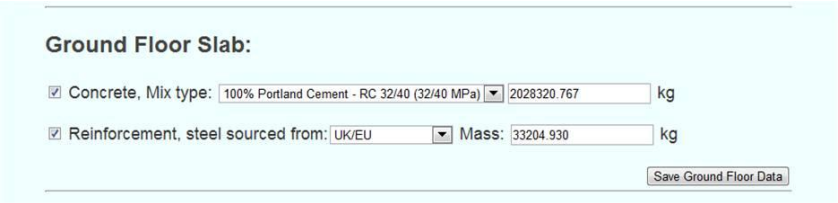


Figure 43: School 3, ground floor slab specification

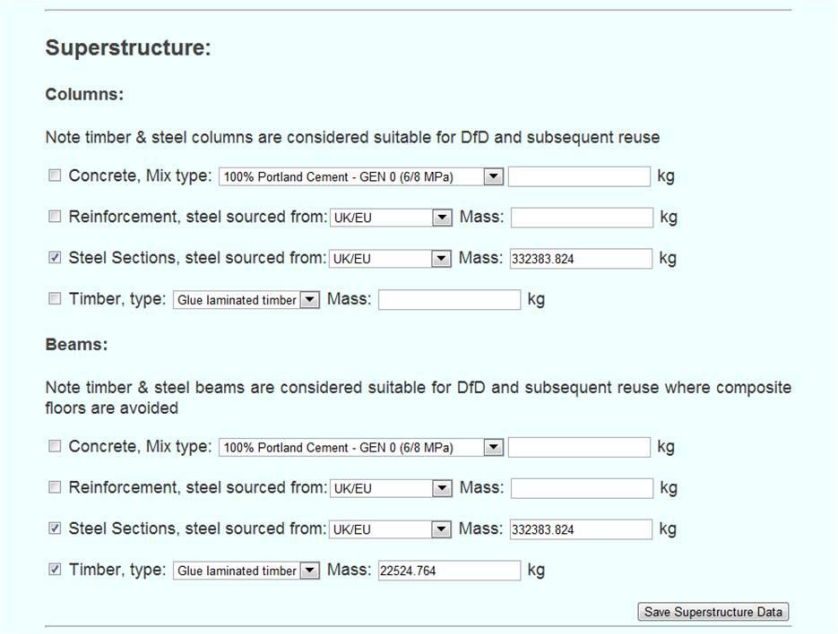


Figure 44: School 3, superstructure specification

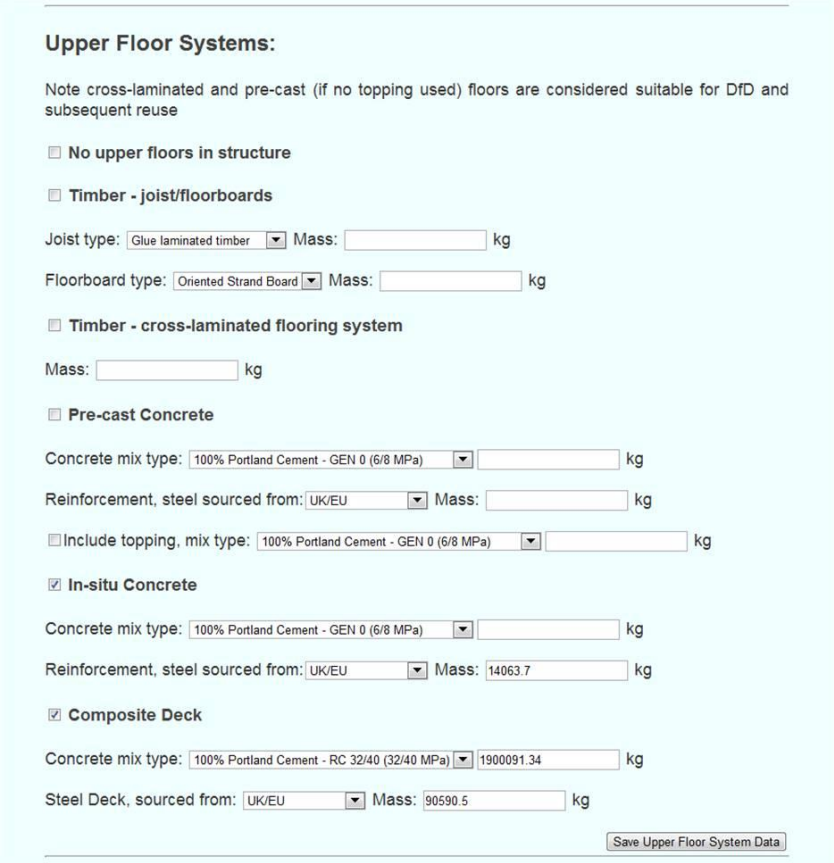


Figure 45: School 3, upper floor slabs specification

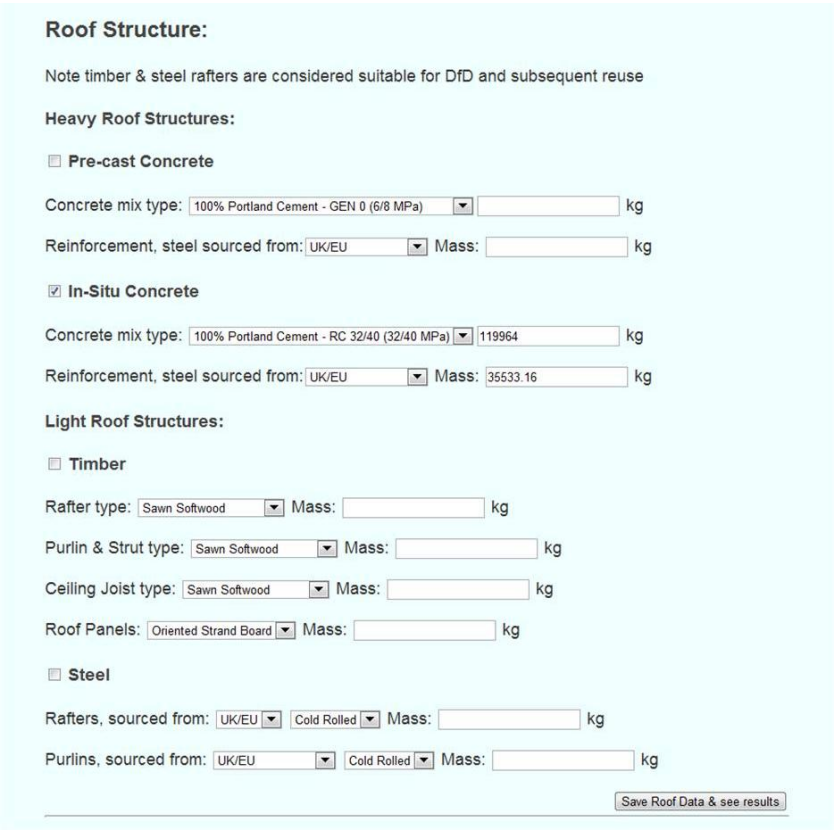


Figure 46: School 3, roof specification

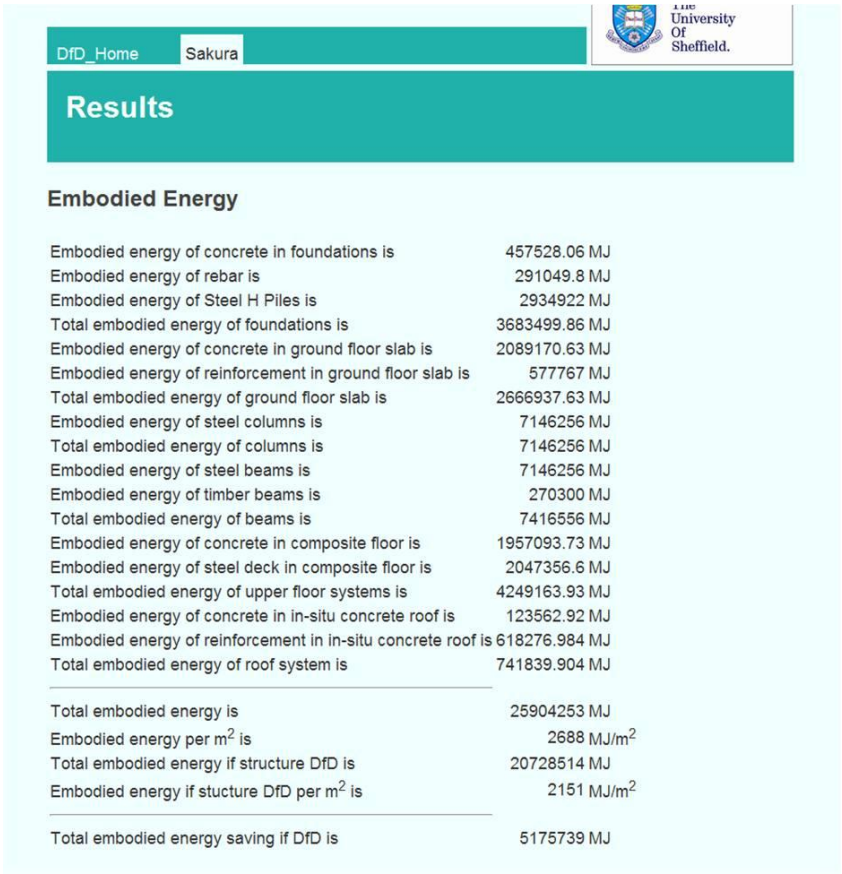


Figure 47: School 3, embodied energy results

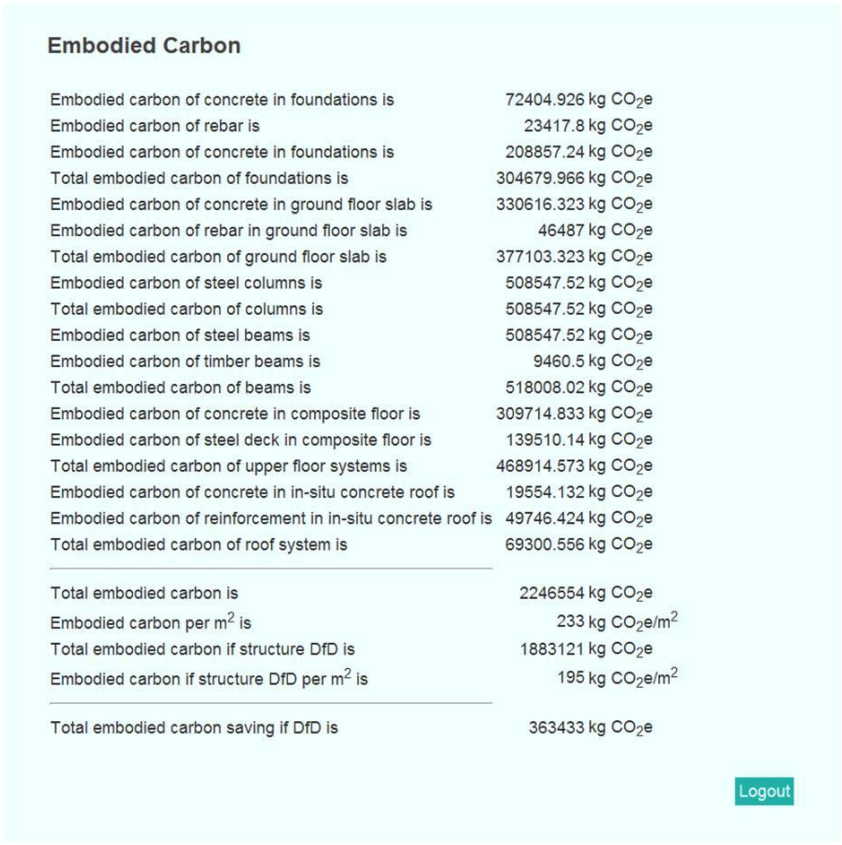


Figure 48: School 3, embodied carbon results

Appendix C4: Office Case Study Information

Office Case Studies

Office 1

A number of assumptions were made, these are as follows:

- Podium structure is included as part of the ground floor slab
- As the material masses for the pile caps and ground beams are given as one figure these are both integrated within the ground floor slab input (standard practice has been to include the pile caps within the foundations)
- Level of edge beams is not stated – it is assumed these are higher than ground floor and these are included as normal beam input
- The concrete core masses are input as a floor slab as Sakura does not currently have an option to input for structural walls, this is shown within the output as in-situ slab, but is relabelled correctly in the main body of the thesis
- The upper floor slabs and the roof deck are given as one figure, these are therefore included within the upper floor slab input
- The roof input section includes the reinforcement for the composite slab as there is no section for this, it has now been altered

Material Masses

The material masses input into Sakura can be seen in Table 74. These were extracted from spreadsheets provided by the BCSA.

Office Option 1			
Element	**Material**	**Mass (kg)**	**Notes**
Piles	**Concrete**	2765186.679	750mm dia, 25m length, C40 concrete
	Reinforcement	10848.000	
Pile caps & ground beams			
	Concrete	3707349	C32/40
	Reinforcement	194000	
Podium	**Concrete**	1852521	250mm thick, C32/40
	Reinforcement	19798.24	mesh
Total Ground Floor			
	Concrete	5559870	Ground beams & podium included, C32/40
	Reinforcement	213798.24	
Edge Beam	**Concrete**	85359	C32/40
	Reinforcement	16000	Bar
Columns	**Steel sections**	626104.172	
Beams	**Steel sections**	2358469.9	Bridge link steelwork also included here
Concrete Core	**Concrete**	3582771	Input as in-situ floor, closest match to wall, C30/37
	Reinforcement	281000	Input as in-situ floor, closest match to wall
Upper Floor slabs & roof deck			

	Concrete	11864901	C30/37
	Reinforcement	427441.04	Bar + mesh
	Steel Deck	555906	Holorib & ribdeck

Table 74: Office 1, structural material masses

Screenshots from Sakura

This shows the information that was input into Sakura and the results.

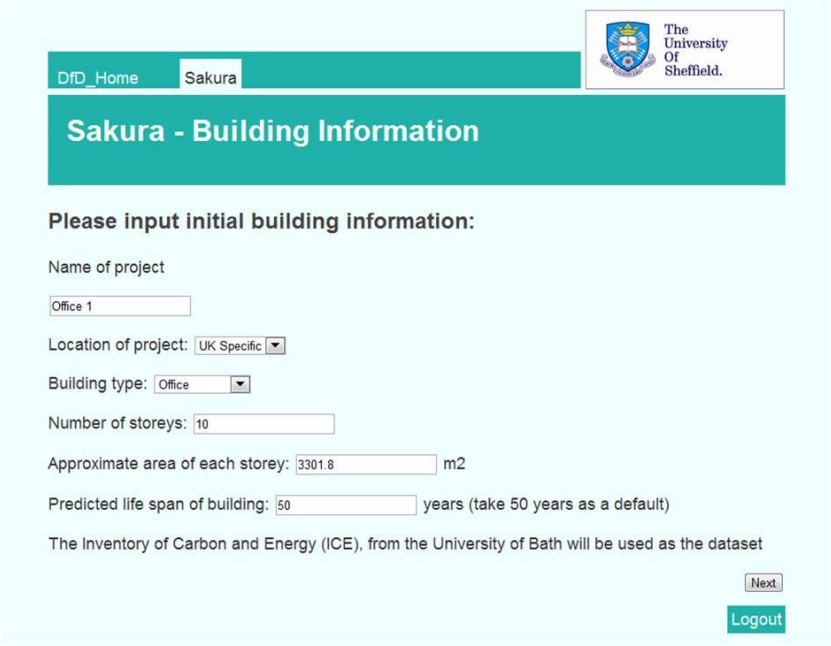


Figure 49: Office 1, initial information input

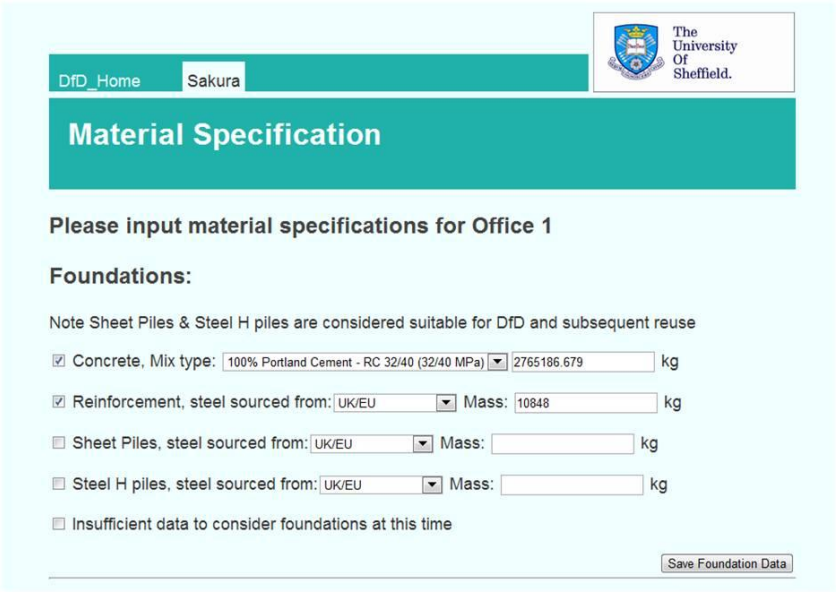


Figure 50: Office 1, foundation specification

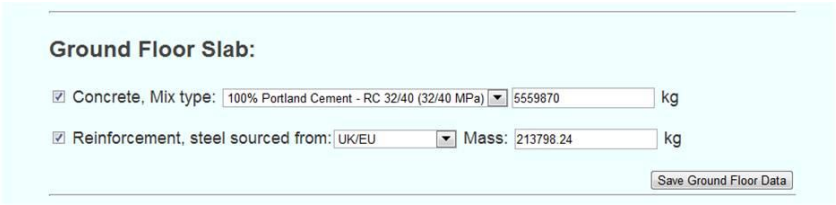


Figure 51: Office 1, ground floor specification

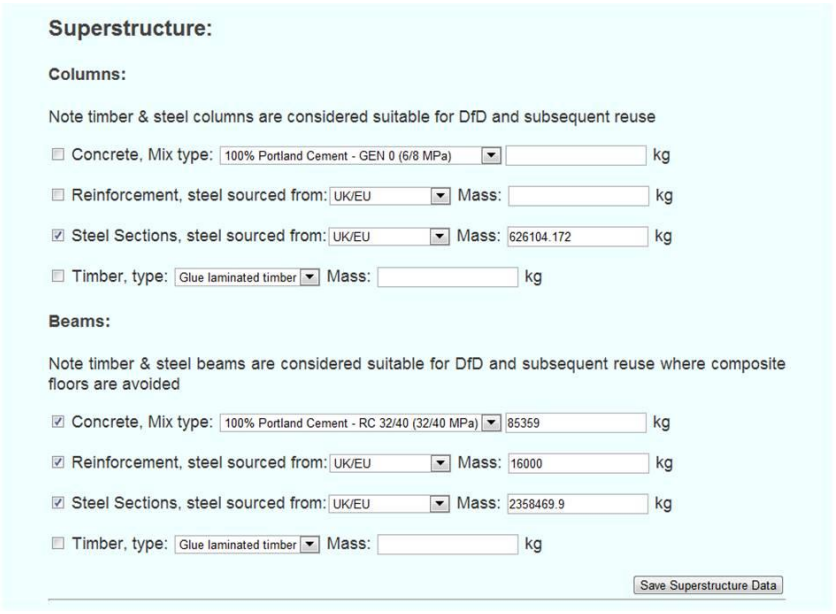


Figure 52: Office 1, superstructure specification

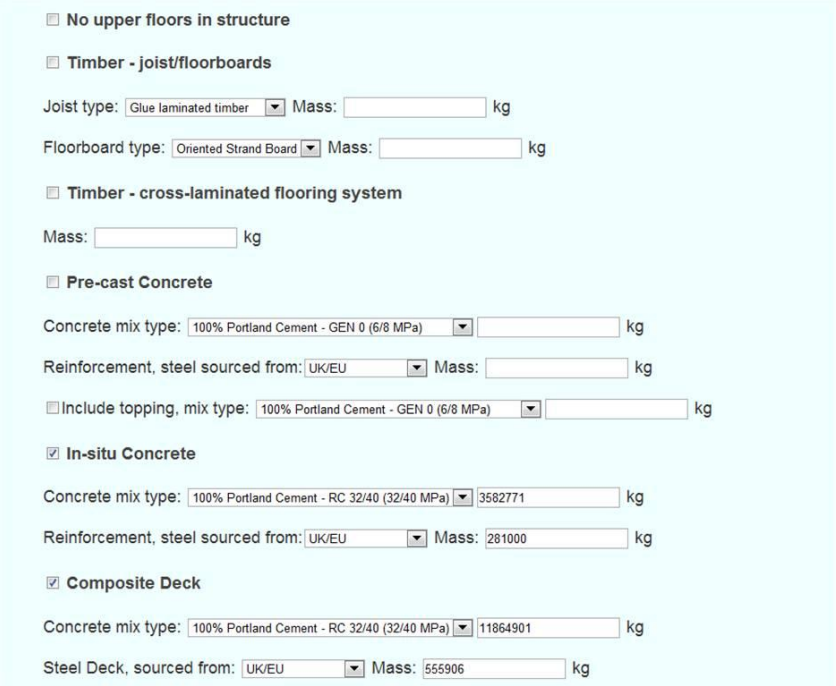


Figure 53: Office 1, upper floor slab specification

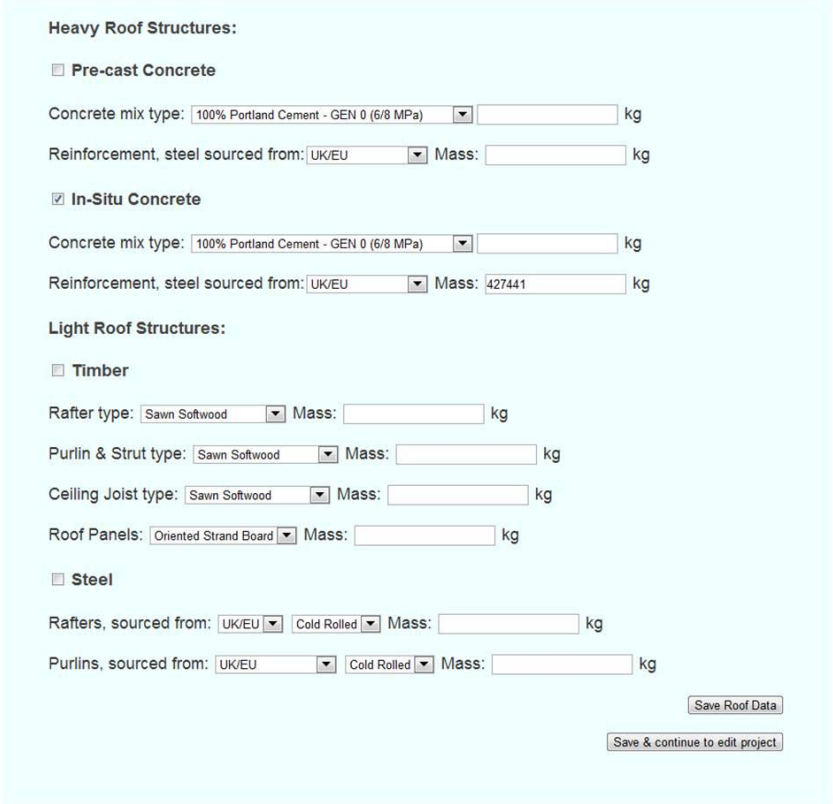


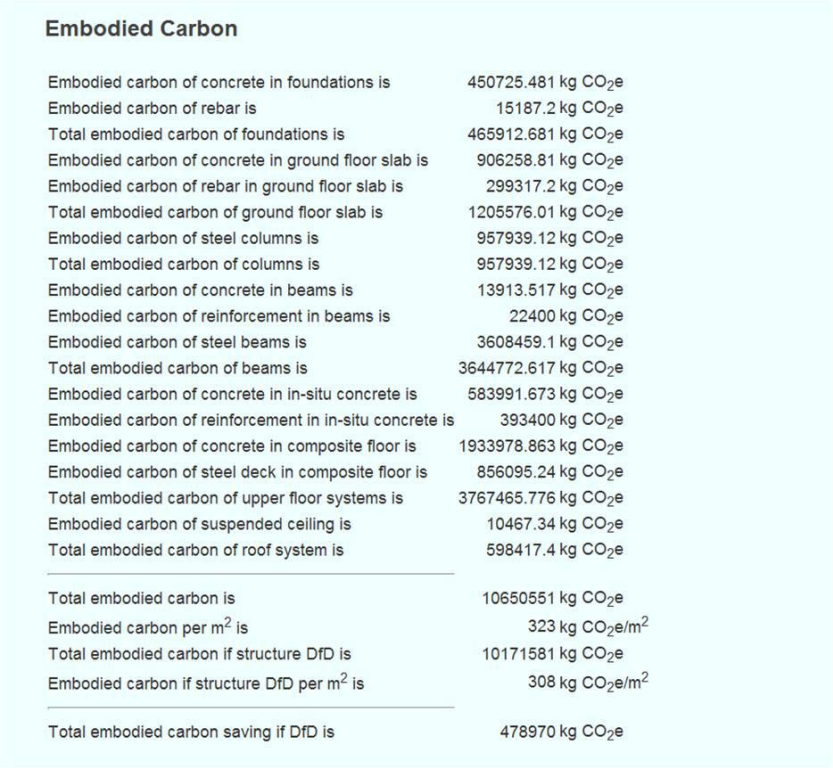
Figure 54: Office 1, roof specification – this only includes reinforcement from composite floor slab

Office Option 1

Embodied Energy

Embodied energy of concrete in foundations is	2848142.61 MJ
Embodied energy of rebar is	188755.2 MJ
Total embodied energy of foundations is	3036897.81 MJ
Embodied energy of concrete in ground floor slab is	5726666.1 MJ
Embodied energy of reinforcement in ground floor slab is	3720085.2 MJ
Total embodied energy of ground floor slab is	9446751.3 MJ
Embodied energy of steel columns is	13461236 MJ
Total embodied energy of columns is	13461236 MJ
Embodied energy of concrete in beams is	87919.77 MJ
Embodied energy of reinforcement in beams is	278400 MJ
Embodied energy of steel beams is	50707105 MJ
Total embodied energy of beams is	51073424.77 MJ
Embodied energy of concrete in in-situ concrete is	3690254.13 MJ
Embodied energy of reinforcement in in-situ concrete is	4889400 MJ
Embodied energy of concrete in composite floor is	12220848.03 MJ
Embodied energy of steel deck in composite floor is	12563475.6 MJ
Total embodied energy of upper floor systems is	33363977.76 MJ
Embodied energy of suspended ceiling is	178506.12 MJ
Total embodied energy of roof system is	7437473.4 MJ
Total embodied energy is	117998267 MJ
Embodied energy per m^2 is	3574 MJ/m^2
Total embodied energy if structure DfD is	111267649 MJ
Embodied energy if stucture DfD per m^2 is	3370 MJ/m^2
Total embodied energy saving if DfD is	6730618 MJ

Figure 55: Office 1, embodied energy results



Embodied Carbon

Embodied carbon of concrete in foundations is	450725.481 kg CO_2e
Embodied carbon of rebar is	15187.2 kg CO_2e
Total embodied carbon of foundations is	465912.681 kg CO_2e
Embodied carbon of concrete in ground floor slab is	906258.81 kg CO_2e
Embodied carbon of rebar in ground floor slab is	299317.2 kg CO_2e
Total embodied carbon of ground floor slab is	1205576.01 kg CO_2e
Embodied carbon of steel columns is	957939.12 kg CO_2e
Total embodied carbon of columns is	957939.12 kg CO_2e
Embodied carbon of concrete in beams is	13913.517 kg CO_2e
Embodied carbon of reinforcement in beams is	22400 kg CO_2e
Embodied carbon of steel beams is	3608459.1 kg CO_2e
Total embodied carbon of beams is	3644772.617 kg CO_2e
Embodied carbon of concrete in in-situ concrete is	583991.673 kg CO_2e
Embodied carbon of reinforcement in in-situ concrete is	393400 kg CO_2e
Embodied carbon of concrete in composite floor is	1933978.863 kg CO_2e
Embodied carbon of steel deck in composite floor is	856095.24 kg CO_2e
Total embodied carbon of upper floor systems is	3767465.776 kg CO_2e
Embodied carbon of suspended ceiling is	10467.34 kg CO_2e
Total embodied carbon of roof system is	598417.4 kg CO_2e
Total embodied carbon is	10650551 kg CO_2e
Embodied carbon per m^2 is	323 kg CO_2e/m^2
Total embodied carbon if structure DfD is	10171581 kg CO_2e
Embodied carbon if structure DfD per m^2 is	308 kg CO_2e/m^2
Total embodied carbon saving if DfD is	478970 kg CO_2e

Figure 56: Office 1, embodied carbon results

Office 2

A number of assumptions were made, these are the same as those for Office 1, and can be seen in section 0.

Material Masses

The material masses input into Sakura can be seen in Table 74. These were extracted from spreadsheets provided by the BCSA.

Office Option 2			
Element	**Material**	**Mass (kg)**	**Notes**
Piles	**Concrete**	3071070.161	C40 concrete
	Reinforcement	12048	
Pile caps & ground beams			
	Concrete	4016487	C32/40
	Reinforcement	258505	
Podium	**Concrete**	85359	C32/40, 250mm thick
	Reinforcement	7135.08	mesh
Total Ground Floor			
	Concrete	4101846	ground beams & podium
	Reinforcement	265640.08	
Edge Beam	**Concrete**	85359	C32/40
	Reinforcement	16000	Bar
Columns	**Steel sections**	106721.559	
	Concrete	2763786	C30/37
	Reinforcement	212000	
Beams	**Steel sections**	245384.093	incl bridge links

	Concrete	2034774	C30/37
	Reinforcement	249000	
Concrete Core	**Concrete**	3582771	C30/37, input as in-situ floor
	Reinforcement	281000	
Upper Floor slabs & roof deck			
	Concrete	24064317	C30/37
	Reinforcement	854693.52	Bar + mesh
	Steel Deck	54908.1	

Table 75: Office 1, structural material masses

Screenshots from Sakura

This sections shows the information input into Sakura and the results that are output.

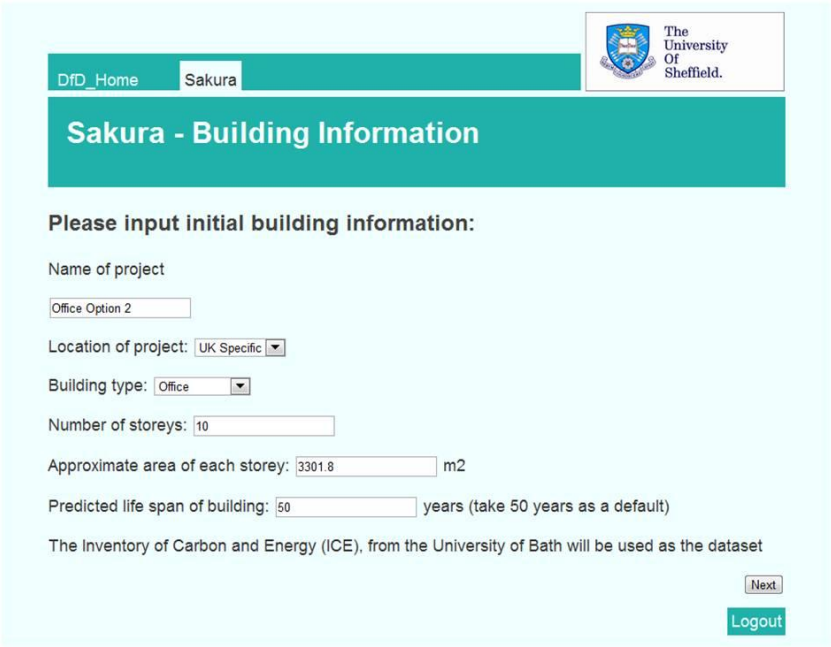


Figure 57: Office 2, initial information input

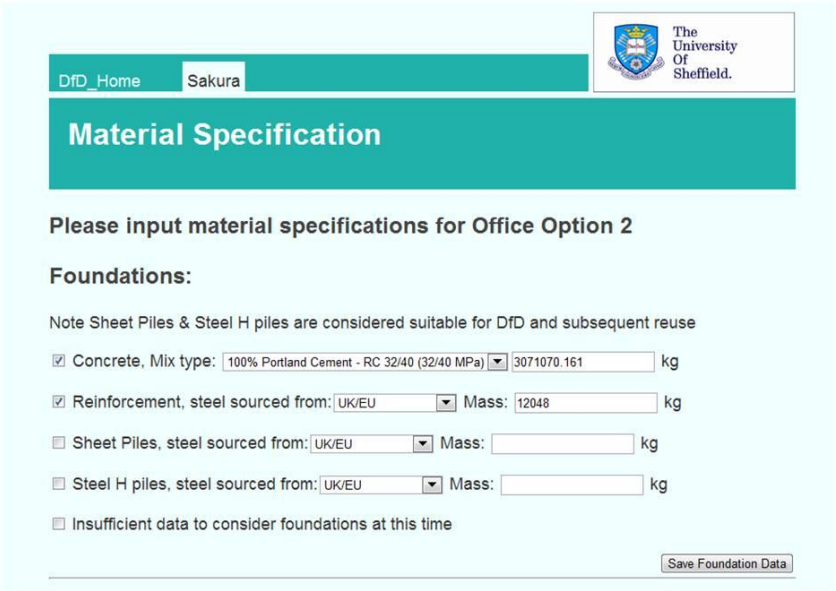


Figure 58: Office 2, foundation specification

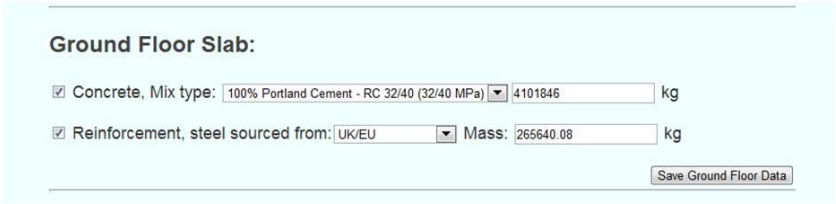


Figure 59: Office 2, ground floor specification

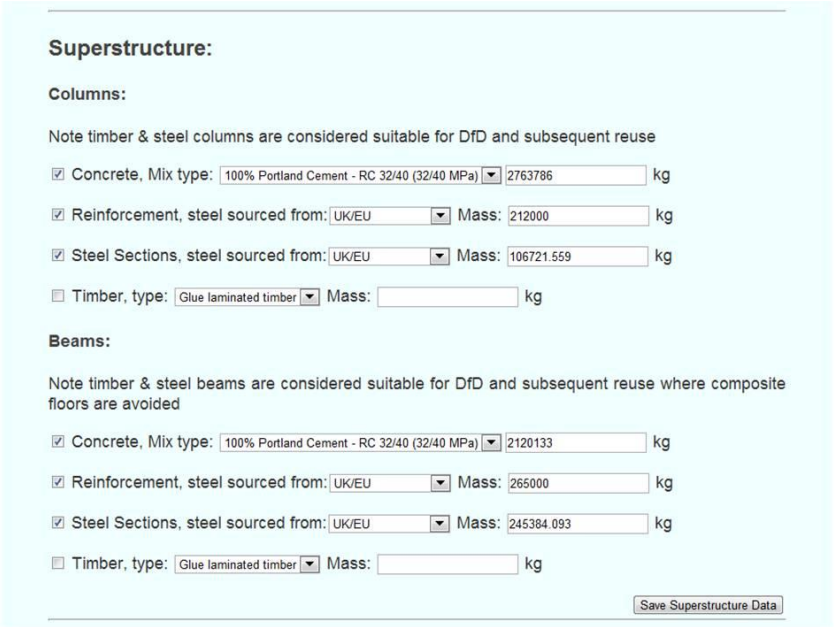


Figure 60: Office 2, superstructure specification

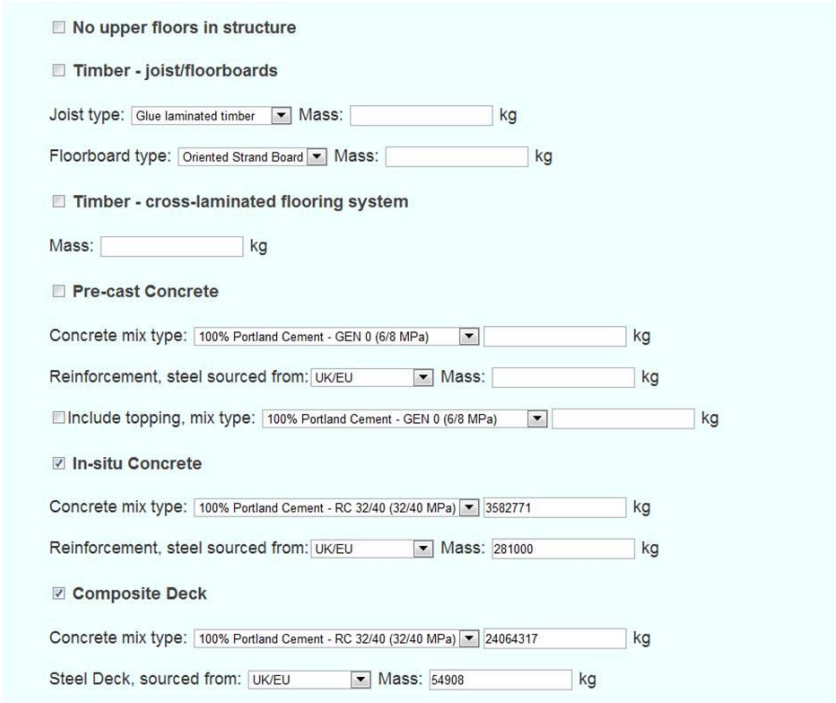


Figure 61: Office 2, upper floor slab specification

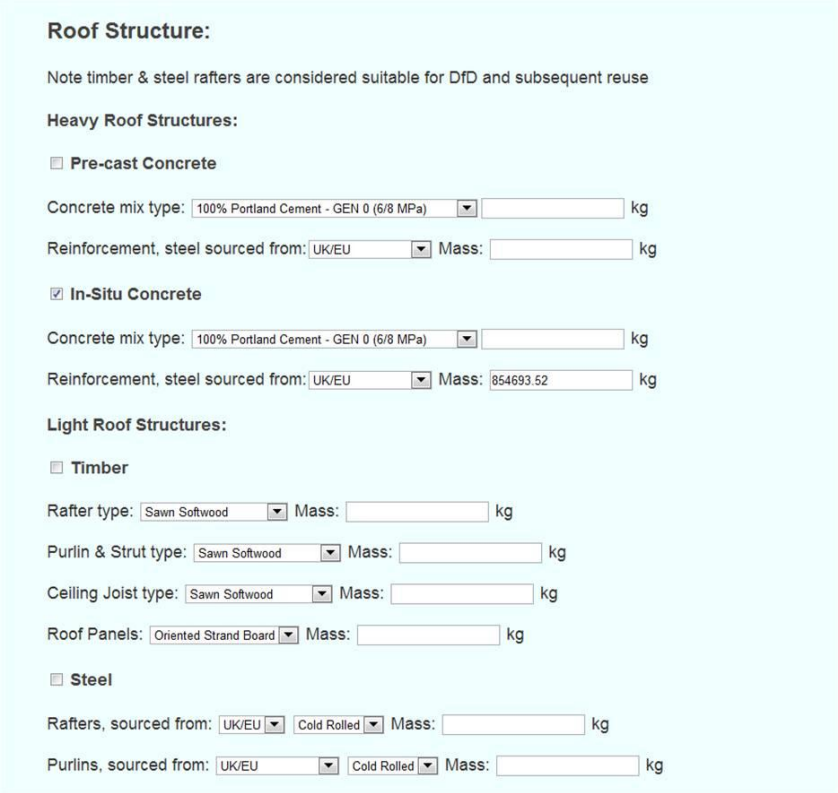
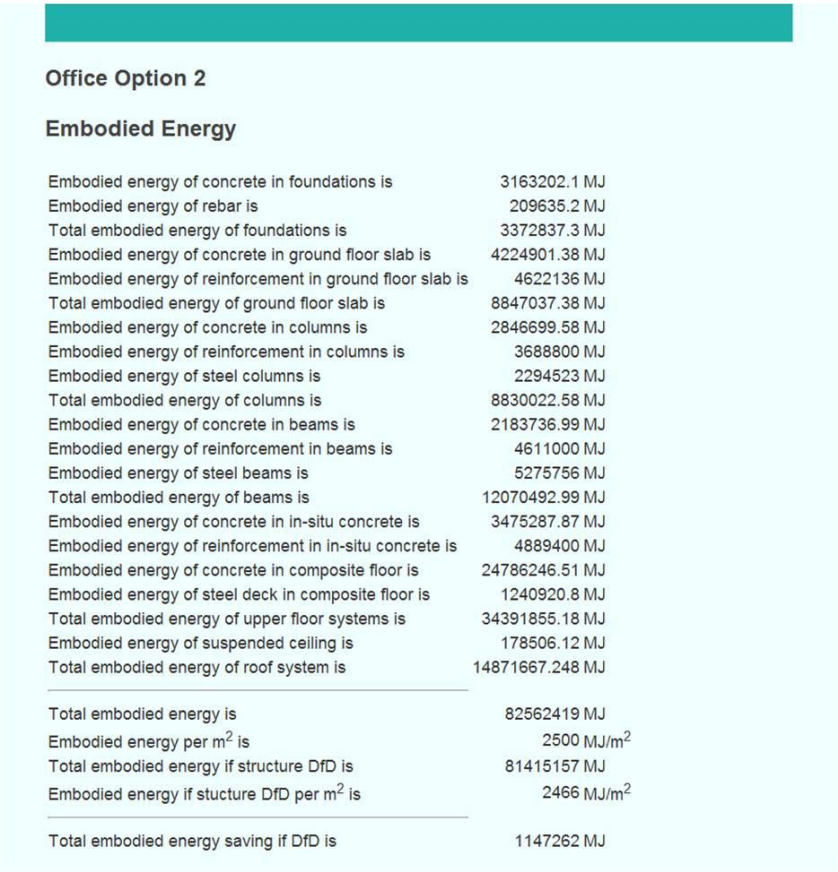


Figure 62: Office 2, roof specification - this only includes reinforcement from composite floor slab



Office Option 2

Embodied Energy

Embodied energy of concrete in foundations is	3163202.1 MJ
Embodied energy of rebar is	209635.2 MJ
Total embodied energy of foundations is	3372837.3 MJ
Embodied energy of concrete in ground floor slab is	4224901.38 MJ
Embodied energy of reinforcement in ground floor slab is	4622136 MJ
Total embodied energy of ground floor slab is	8847037.38 MJ
Embodied energy of concrete in columns is	2846699.58 MJ
Embodied energy of reinforcement in columns is	3688800 MJ
Embodied energy of steel columns is	2294523 MJ
Total embodied energy of columns is	8830022.58 MJ
Embodied energy of concrete in beams is	2183736.99 MJ
Embodied energy of reinforcement in beams is	4611000 MJ
Embodied energy of steel beams is	5275756 MJ
Total embodied energy of beams is	12070492.99 MJ
Embodied energy of concrete in in-situ concrete is	3475287.87 MJ
Embodied energy of reinforcement in in-situ concrete is	4889400 MJ
Embodied energy of concrete in composite floor is	24786246.51 MJ
Embodied energy of steel deck in composite floor is	1240920.8 MJ
Total embodied energy of upper floor systems is	34391855.18 MJ
Embodied energy of suspended ceiling is	178506.12 MJ
Total embodied energy of roof system is	14871667.248 MJ
Total embodied energy is	82562419 MJ
Embodied energy per m^2 is	2500 MJ/m^2
Total embodied energy if structure DfD is	81415157 MJ
Embodied energy if stucture DfD per m^2 is	2466 MJ/m^2
Total embodied energy saving if DfD is	1147262 MJ

Figure 63: Office 2, embodied energy results

Embodied Carbon

Embodied carbon of concrete in foundations is	500584.41 kg CO_2e
Embodied carbon of rebar is	16867.2 kg CO_2e
Total embodied carbon of foundations is	517451.61 kg CO_2e
Embodied carbon of concrete in ground floor slab is	668600.898 kg CO_2e
Embodied carbon of rebar in ground floor slab is	371896 kg CO_2e
Total embodied carbon of ground floor slab is	1040496.898 kg CO_2e
Embodied carbon of concrete in columns is	450497.118 kg CO_2e
Embodied carbon of reinforcement in columns is	296800 kg CO_2e
Embodied carbon of steel columns is	163284.66 kg CO_2e
Total embodied carbon of columns is	910581.778 kg CO_2e
Embodied carbon of concrete in beams is	345581.679 kg CO_2e
Embodied carbon of reinforcement in beams is	371000 kg CO_2e
Embodied carbon of steel beams is	375437.52 kg CO_2e
Total embodied carbon of beams is	1092019.199 kg CO_2e
Embodied carbon of concrete in in-situ concrete is	544581.192 kg CO_2e
Embodied carbon of reinforcement in in-situ concrete is	393400 kg CO_2e
Embodied carbon of concrete in composite floor is	3922483.671 kg CO_2e
Embodied carbon of steel deck in composite floor is	84558.32 kg CO_2e
Total embodied carbon of upper floor systems is	4945023.183 kg CO_2e
Embodied carbon of suspended ceiling is	10467.34 kg CO_2e
Total embodied carbon of roof system is	1196570.928 kg CO_2e
Total embodied carbon is	9712611 kg CO_2e
Embodied carbon per m^2 is	294 kg CO_2e/m^2
Total embodied carbon if structure DfD is	9630969 kg CO_2e
Embodied carbon if structure DfD per m^2 is	292 kg CO_2e/m^2
Total embodied carbon saving if DfD is	81642 kg CO_2e

Figure 64: Office 2, embodied carbon results

Appendix C5: Supermarket Case Study Information

Supermarket Case Studies

Supermarket 1, steel frame

A number of assumptions were made, these are as follows:

- An overall mass was given for the steel structural frame, a breakdown was needed for the beams and columns, it is assumed that the beams account for 50% of the mass and the columns the remanding 50%
- All steel is sourced from the EU
- Where concrete strength is not given it is assumed to be 32/40 MPa, 100% Portland cement
- Supermarkets are assumed to have a shorter life span than other buildings, twenty years is assumed
- All timber is sourced from sustainably managed forests

Material Masses

The material masses input into Sakura can be seen in Table 74. These were extracted from spreadsheets provided by the BCSA.

Supermarket 1, Steel Frame			
Element	**Material**	**Mass (kg)**	**Notes**
Foundations	**Concrete**	4050715.656	25N/mm^2
	Reinforcement	60457.600	
Pile Caps	**concrete**	484192.007	32/40
	Reinforcement	18515.290	
Tie Beams	**concrete**	164858.220	
Ground Slab	**concrete**	3269019.000	32/40
	Reinforcement	81839.050	mesh
	Screed	1149367.010	30/37
	Screed Rein	14746.972	
Composite Metal Slab	**Concrete**	247725.660	
	Metal Deck	9527.700	
	Mesh	2020.200	
Edge Beams	**concrete**	128998.789	
Steel Frame	**Steel Sections**	311470.046	
	Beams	155735.0232	1/2 of total steel frame mass taken
	Columns	155735.0232	1/2 of total steel frame mass taken
Floor Decking	**Plywood**	50608.8	
Cold Galvanised Steel joists		23824.560	

Table 76: Supermarket 1, structural material masses

Screenshots from Sakura

This shows the information that was input into Sakura and the results.

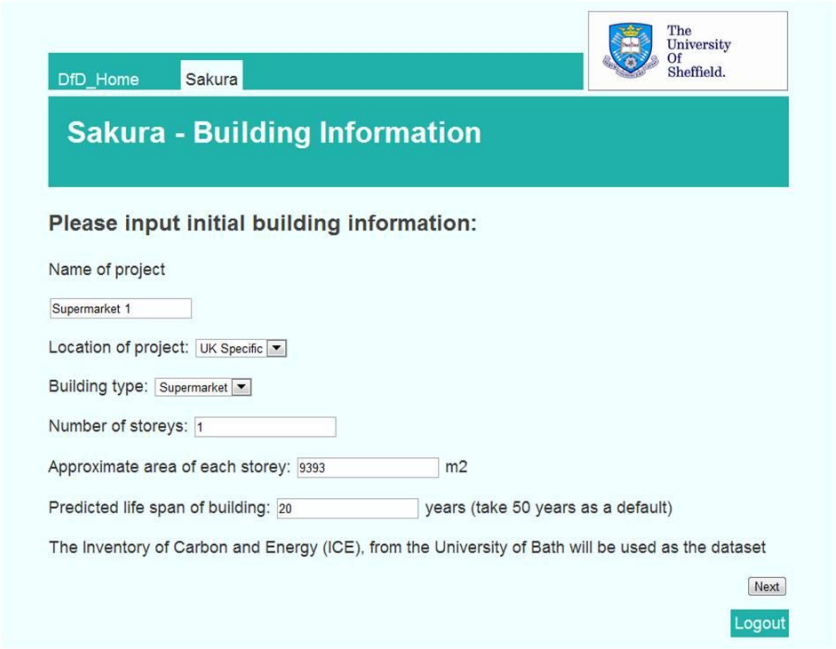


Figure 65: Supermarket 1, initial information input

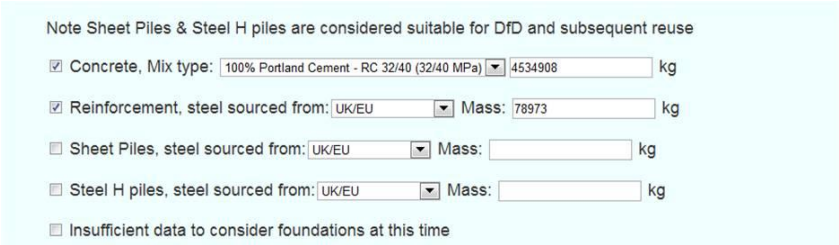


Figure 66: Supermarket 1, foundation specification

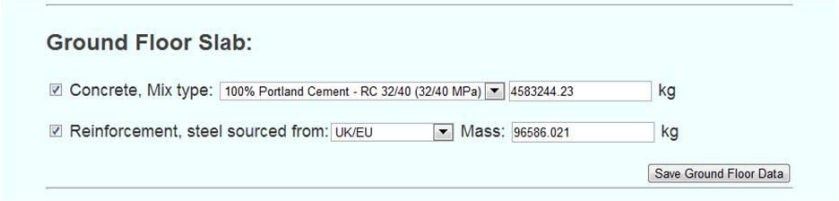


Figure 67: Supermarket 1, ground floor specification

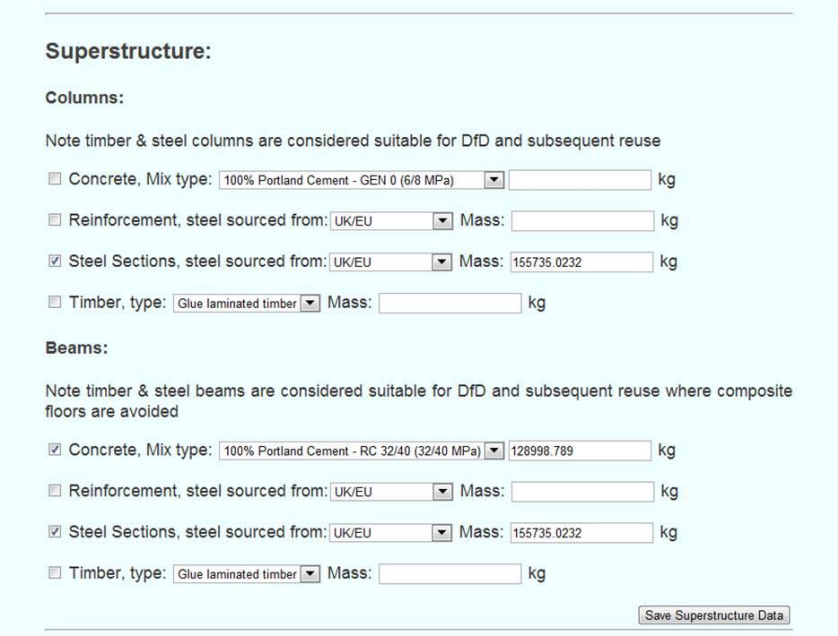


Figure 68: Supermarket 1, superstructure specification

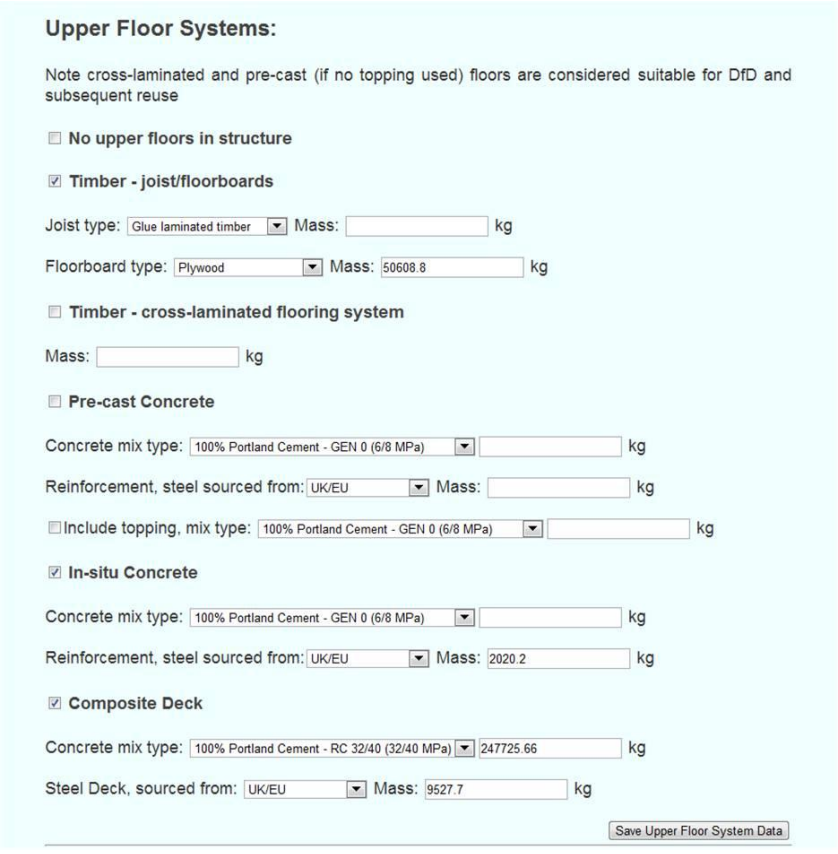


Figure 69: Supermarket 1, upper floor slab specification

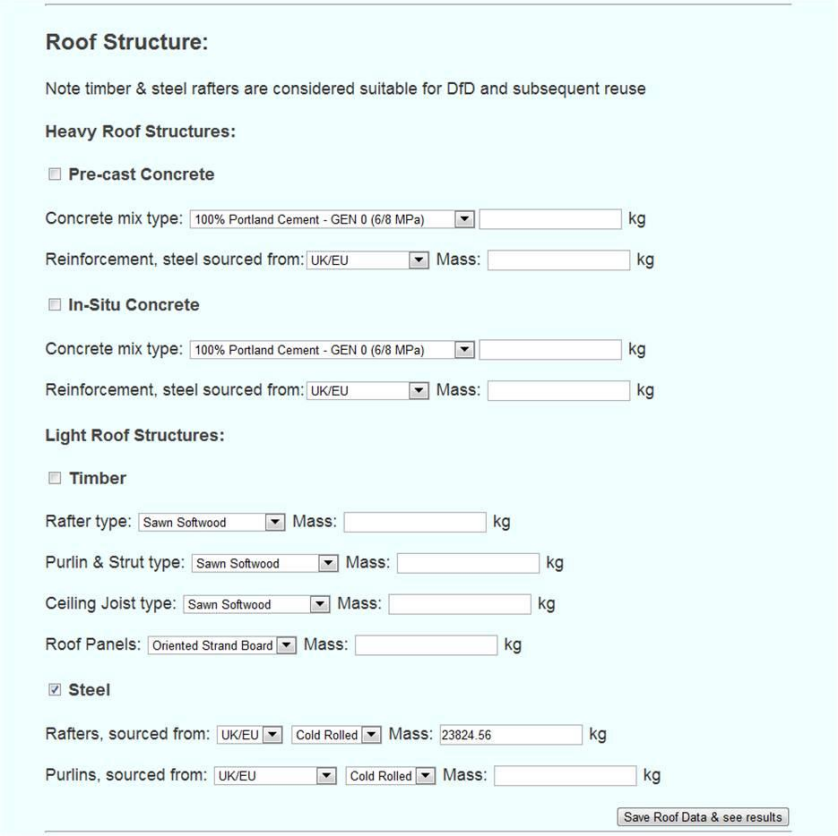


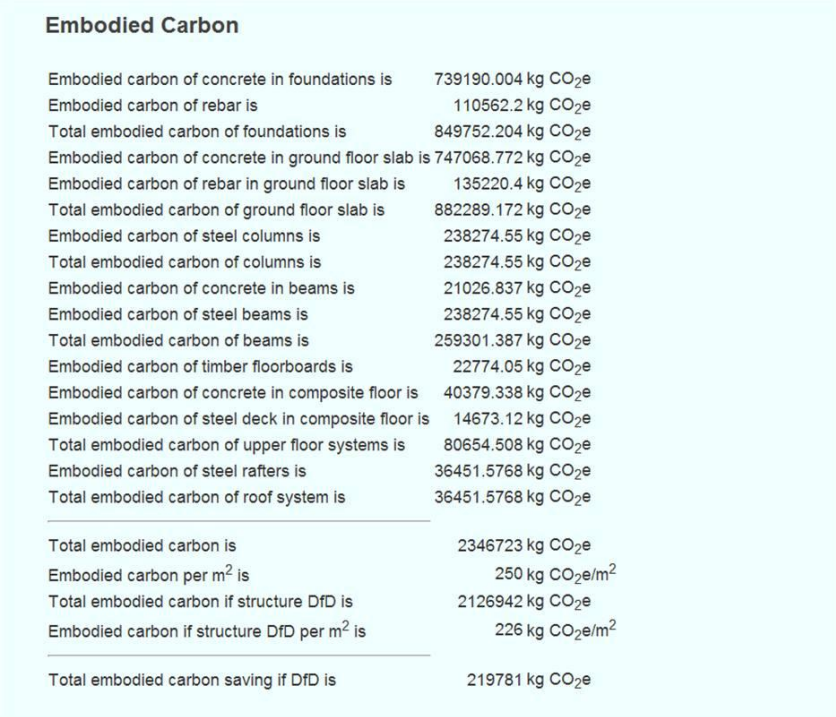
Figure 70: Supermarket 1, roof specification

Supermarket 1

Embodied Energy

Embodied energy of concrete in foundations is	4670955.24 MJ
Embodied energy of rebar is	1374130.2 MJ
Total embodied energy of foundations is	6045085.44 MJ
Embodied energy of concrete in ground floor slab is	4720741.32 MJ
Embodied energy of reinforcement in ground floor slab is	1680596.4 MJ
Total embodied energy of ground floor slab is	6401337.72 MJ
Embodied energy of steel columns is	3348302.5 MJ
Total embodied energy of columns is	3348302.5 MJ
Embodied energy of concrete in beams is	132868.97 MJ
Embodied energy of steel beams is	3348302.5 MJ
Total embodied energy of beams is	3481171.47 MJ
Embodied energy of timber floorboards is	759135 MJ
Embodied energy of concrete in composite floor is	255157.78 MJ
Embodied energy of steel deck in composite floor is	215332.8 MJ
Total embodied energy of upper floor systems is	1264773.58 MJ
Embodied energy of steel rafters is	512228.04 MJ
Total embodied energy of roof system is	512228.04 MJ
Total embodied energy is	21052899 MJ
Embodied energy per m^2 is	2241 MJ/m^2
Total embodied energy if structure DfD is	17964474 MJ
Embodied energy if stucture DfD per m^2 is	1913 MJ/m^2
Total embodied energy saving if DfD is	3088424 MJ

Figure 71: Supermarket 1, embodied energy results



Embodied Carbon

Embodied carbon of concrete in foundations is	739190.004 kg CO_2e
Embodied carbon of rebar is	110562.2 kg CO_2e
Total embodied carbon of foundations is	849752.204 kg CO_2e
Embodied carbon of concrete in ground floor slab is	747068.772 kg CO_2e
Embodied carbon of rebar in ground floor slab is	135220.4 kg CO_2e
Total embodied carbon of ground floor slab is	882289.172 kg CO_2e
Embodied carbon of steel columns is	238274.55 kg CO_2e
Total embodied carbon of columns is	238274.55 kg CO_2e
Embodied carbon of concrete in beams is	21026.837 kg CO_2e
Embodied carbon of steel beams is	238274.55 kg CO_2e
Total embodied carbon of beams is	259301.387 kg CO_2e
Embodied carbon of timber floorboards is	22774.05 kg CO_2e
Embodied carbon of concrete in composite floor is	40379.338 kg CO_2e
Embodied carbon of steel deck in composite floor is	14673.12 kg CO_2e
Total embodied carbon of upper floor systems is	80654.508 kg CO_2e
Embodied carbon of steel rafters is	36451.5768 kg CO_2e
Total embodied carbon of roof system is	36451.5768 kg CO_2e
Total embodied carbon is	2346723 kg CO_2e
Embodied carbon per m^2 is	250 kg CO_2e/m^2
Total embodied carbon if structure DfD is	2126942 kg CO_2e
Embodied carbon if structure DfD per m^2 is	226 kg CO_2e/m^2
Total embodied carbon saving if DfD is	219781 kg CO_2e

Figure 72: Supermarket 1, embodied carbon results

Supermarket 2, timber frame

A number of assumptions were made, these are as follows:

- All steel is sourced from within Europe
- A mass for the total structural steel frame was given, no breakdown, half of the total mass was taken to be in the columns and the other half made up in the beams
- All concrete assumed to be 100% Portland cement unless stated otherwise
- If concrete strength not stated it is assumed to be 32/40MPa
- All timber is sourced from sustainably managed forests

Material Masses

The material masses input into Sakura can be seen in Table 74. These were extracted from spreadsheets provided by the BCSA.

Supermarket Option 2			
Element	**Material**	**Mass (kg)**	**Notes**
Piles	**concrete**	4050716	
	reinforcement	60457.6	
Pile caps	**concrete**	484192	C32/40
	reinforcement	18515.29	
Total Foundations	**concrete**	4534908	
	reinforcement	78972.89	
Tie Beams	**concrete**	164858.2	300 x 450deep
Ground Slab	**concrete**	3269019	RC32/40
	reinforcement	81839.05	
GS screed	**concrete**	1149367	RC 30/37
	reinforcement	14746.97	mesh

Total GFS	**concrete**	4583244	Tie beams, gs & screed
	reinforcement	96586.02	Tie beams, gs & screed
PCC edge beams	**concrete**	128998.8	450x 525 deep L shaped, C50
Structural Steel Frame		16547.3	Warehouse
Columns	**Steel**	8273.65	1/2 of total steel frame mass
	Glulam	46741.44	Based on Spruce
Beams	**Steel**	8273.65	1/2 of total steel frame mass
	Glulam	173970	mezzanine floor
Purlins	**Glulam**	1392.3	In upper floors
Joists	**Softwood**	37294.59	In upper floors
Decking	**Plywood**	53838.53	In upper floors
Composite Metal Slab			In upper floors
	concrete	247725.7	
	Metal Deck	9527.7	
	Reinforcement	2020.2	
Roof	**Glulam**	160743.9	

Table 77: Supermarket 2, structural material masses

Screenshots from Sakura

This section shows the information input into Sakura and the results that are output.

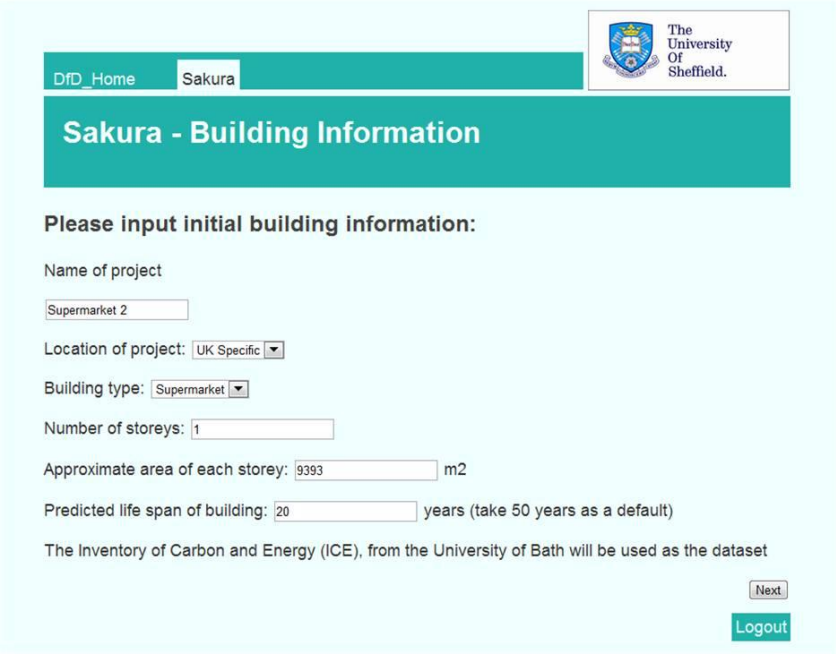


Figure 73: Supermarket 2, initial information input

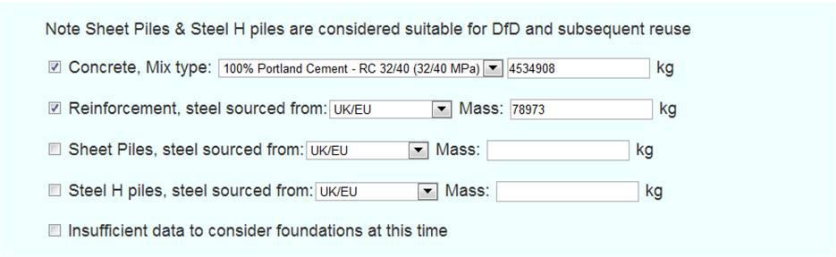


Figure 74: Supermarket 2, foundation specification

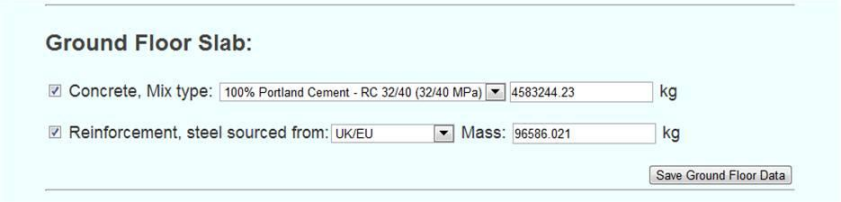


Figure 75: Supermarket 2, ground floor specification

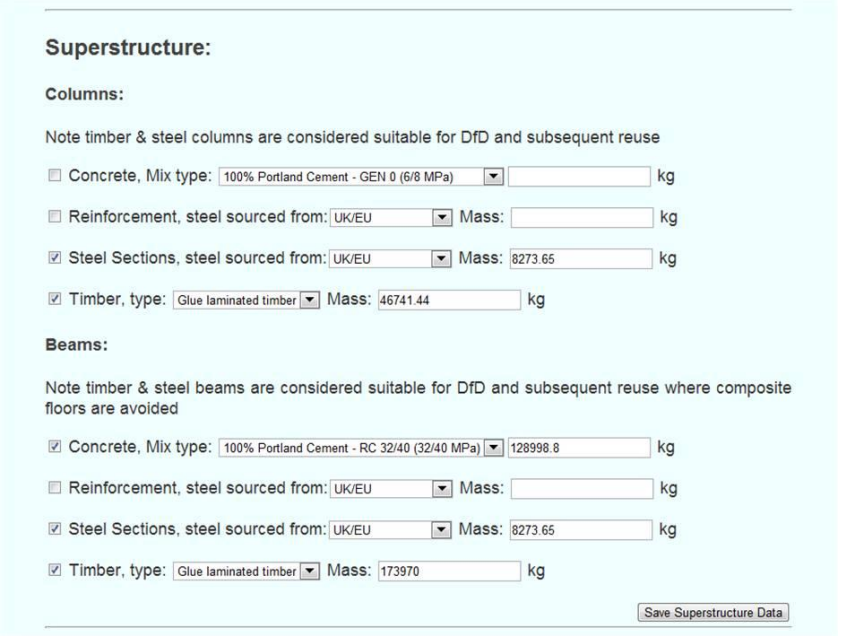


Figure 76: Supermarket 2, superstructure specification

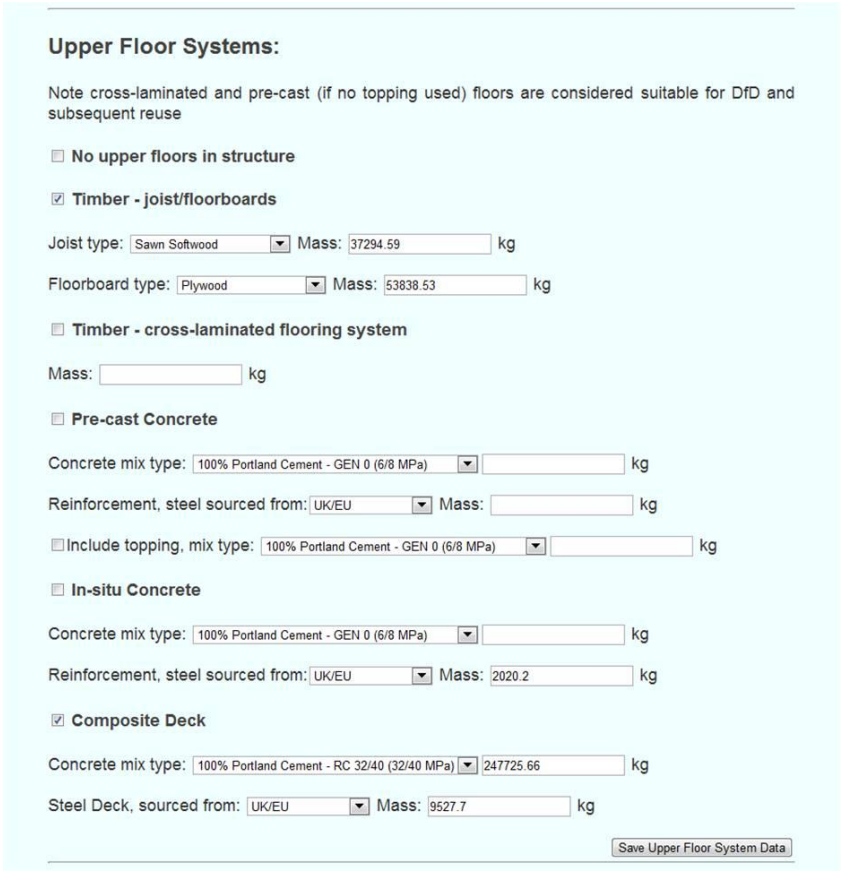


Figure 77: Supermarket 2, upper floor slab specification

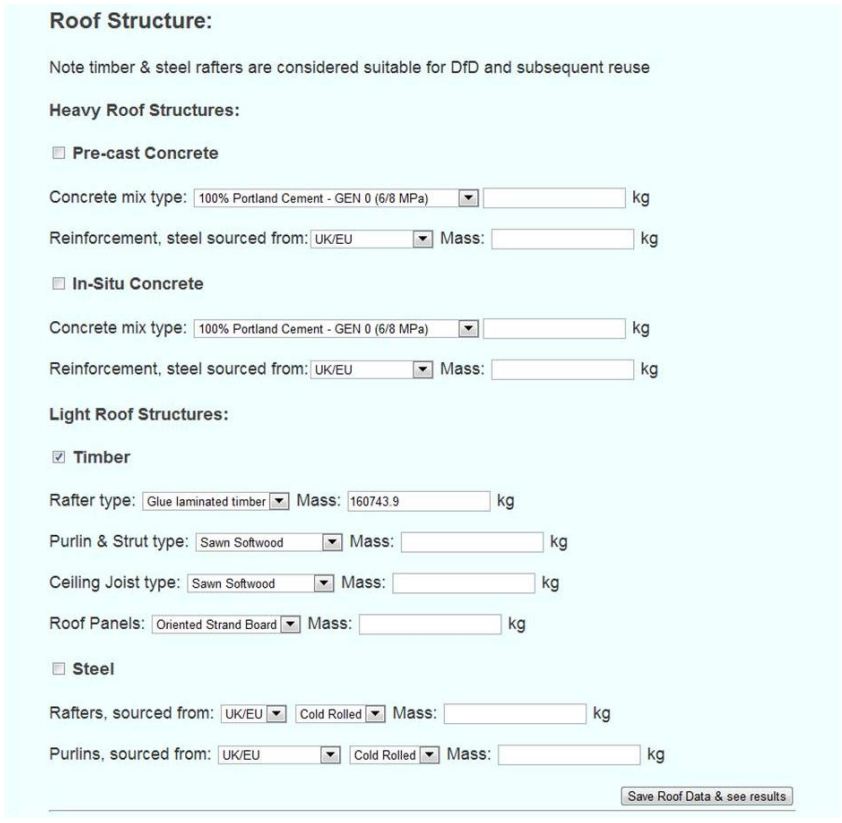


Figure 78: Supermarket 2, roof specification

Supermarket 2

Embodied Energy

Embodied energy of concrete in foundations is	4670955.24 MJ
Embodied energy of rebar is	1374130.2 MJ
Total embodied energy of foundations is	6045085.44 MJ
Embodied energy of concrete in ground floor slab is	4720741.32 MJ
Embodied energy of reinforcement in ground floor slab is	1680596.4 MJ
Total embodied energy of ground floor slab is	6401337.72 MJ
Embodied energy of steel columns is	177891 MJ
Embodied energy of timber columns is	560892 MJ
Total embodied energy of columns is	738783 MJ
Embodied energy of concrete in beams is	132868.97 MJ
Embodied energy of steel beams is	177891 MJ
Embodied energy of timber beams is	2087640 MJ
Total embodied energy of beams is	2398399.97 MJ
Embodied energy of timber joists is	275983 MJ
Embodied energy of timber floorboards is	807585 MJ
Embodied energy of concrete in composite floor is	255157.78 MJ
Embodied energy of steel deck in composite floor is	215332.8 MJ
Total embodied energy of upper floor systems is	1589206.58 MJ
Embodied energy of timber rafters is	1928926.8 MJ
Total embodied energy of roof system is	1928926.8 MJ
Total embodied energy is	19101740 MJ
Embodied energy per m^2 is	2034 MJ/m^2
Total embodied energy if structure DfD is	15297460 MJ
Embodied energy if stucture DfD per m^2 is	1629 MJ/m^2
Total embodied energy saving if DfD is	3804280 MJ

Figure 79: Supermarket 2, embodied energy results

Embodied Carbon

Embodied carbon of concrete in foundations is	739190.004 kg CO_2e
Embodied carbon of rebar is	110562.2 kg CO_2e
Total embodied carbon of foundations is	849752.204 kg CO_2e
Embodied carbon of concrete in ground floor slab is	747068.772 kg CO_2e
Embodied carbon of rebar in ground floor slab is	135220.4 kg CO_2e
Total embodied carbon of ground floor slab is	882289.172 kg CO_2e
Embodied carbon of steel columns is	12659.22 kg CO_2e
Embodied carbon of timber columns is	19631.22 kg CO_2e
Total embodied carbon of columns is	32290.44 kg CO_2e
Embodied carbon of concrete in beams is	21026.837 kg CO_2e
Embodied carbon of steel beams is	12659.22 kg CO_2e
Embodied carbon of timber beams is	73067.4 kg CO_2e
Total embodied carbon of beams is	106753.457 kg CO_2e
Embodied carbon of timber joists is	7459 kg CO_2e
Embodied carbon of timber floorboards is	24227.55 kg CO_2e
Embodied carbon of concrete in composite floor is	40379.338 kg CO_2e
Embodied carbon of steel deck in composite floor is	14673.12 kg CO_2e
Total embodied carbon of upper floor systems is	89567.008 kg CO_2e
Embodied carbon of timber rafters is	67512.438 kg CO_2e
Total embodied carbon of roof system is	67512.438 kg CO_2e
Total embodied carbon is	2028165 kg CO_2e
Embodied carbon per m^2 is	216 kg CO_2e/m^2
Total embodied carbon if structure DfD is	1889868 kg CO_2e
Embodied carbon if structure DfD per m^2 is	201 kg CO_2e/m^2
Total embodied carbon saving if DfD is	138296 kg CO_2e

Figure 80: Supermarket 2, embodied carbon results