



The
University
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The Behaviour of Cold-Formed Steel Built-up Structural Members

(Volume II)

By:

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Appendix A

Stub Columns Tensile Coupons

Appendix A contains the results obtained from the tensile coupons extracted from the flat and corner regions of the component sections used to assemble the stub columns. The results are presented in the form of stress-strain curves, and include the static and dynamic engineering stresses, as well as the static true stresses. Further details about these coupon tests are included in Section 3.3 of the main text.

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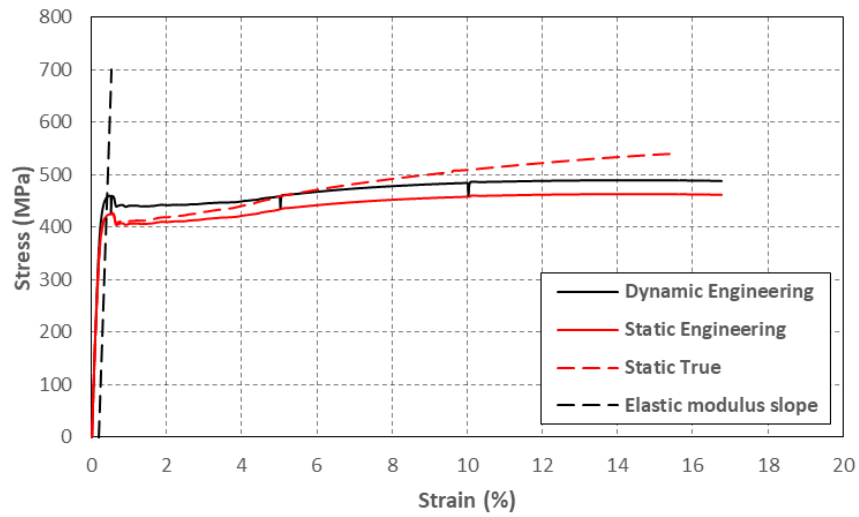


Figure A.1: P20024a Flat coupon test results

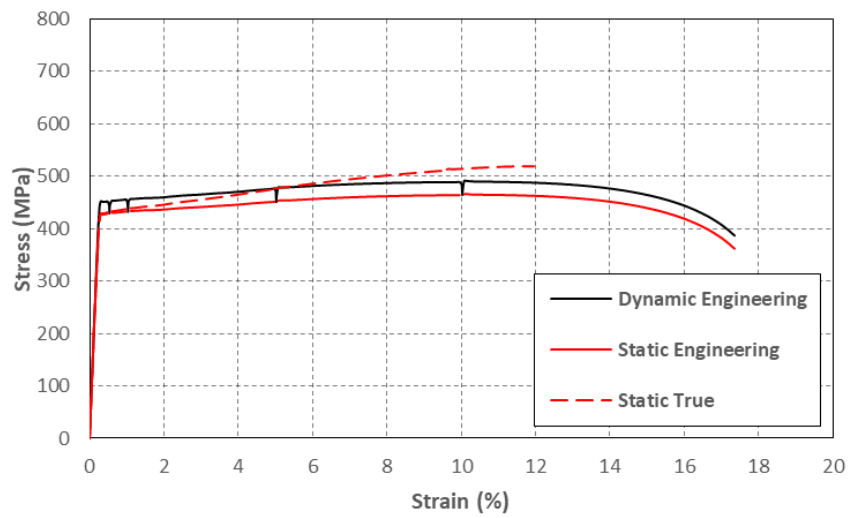


Figure A.2: P20024b Flat coupon test results

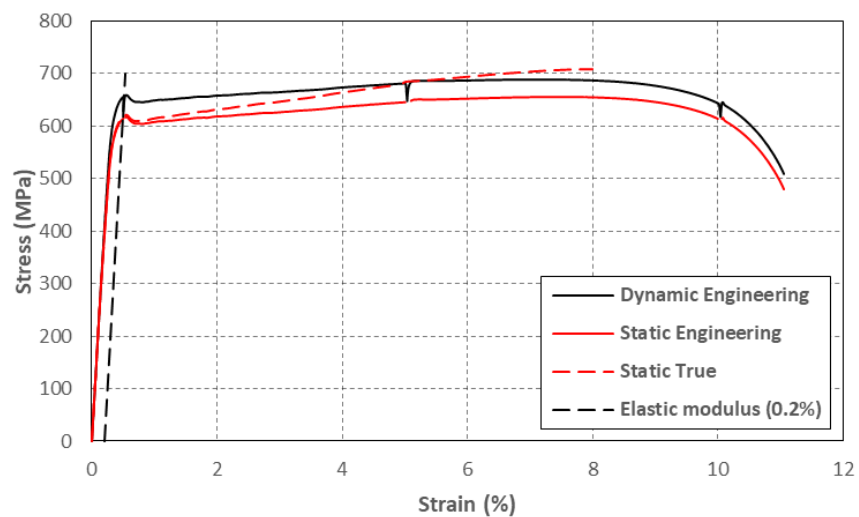


Figure A.3: T15414a Flat coupon test results

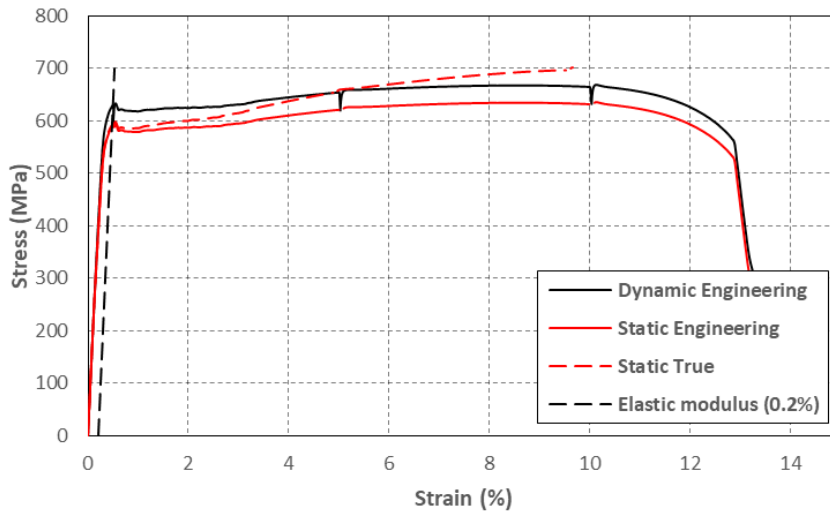


Figure A.4: T15414b Flat coupon test results

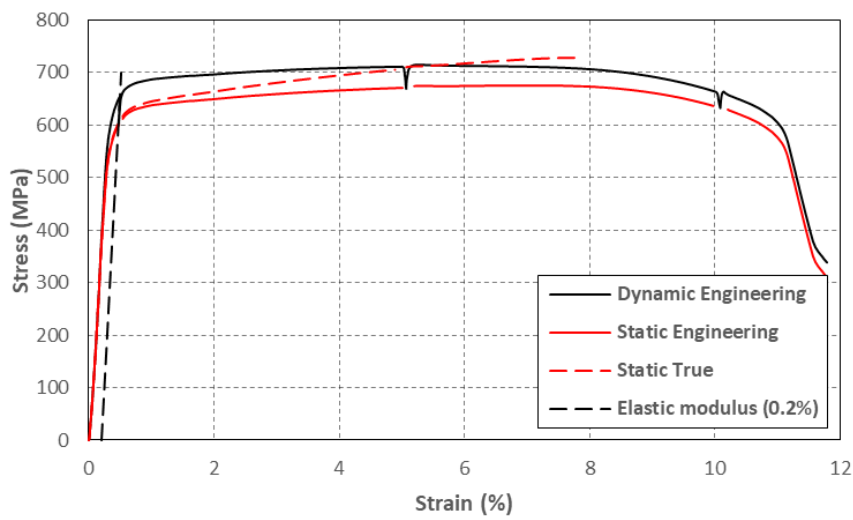


Figure A.5: T15414 Corner coupon test results

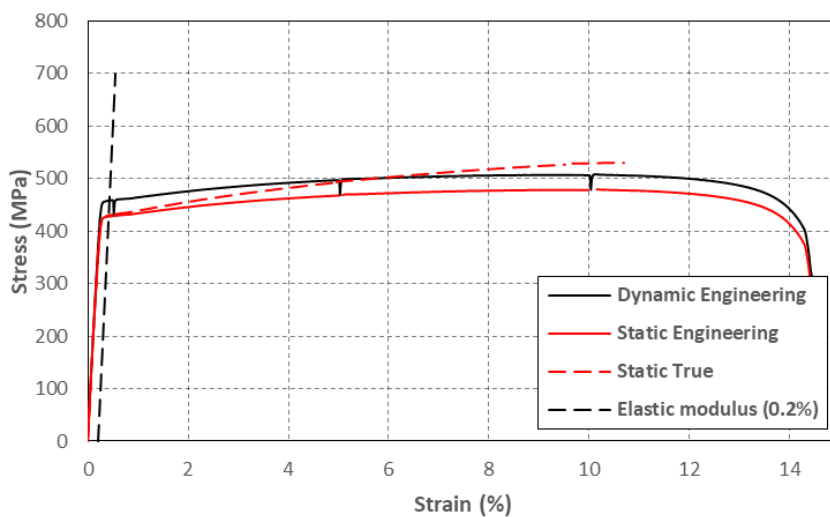


Figure A.6: T7912a Flat coupon test results

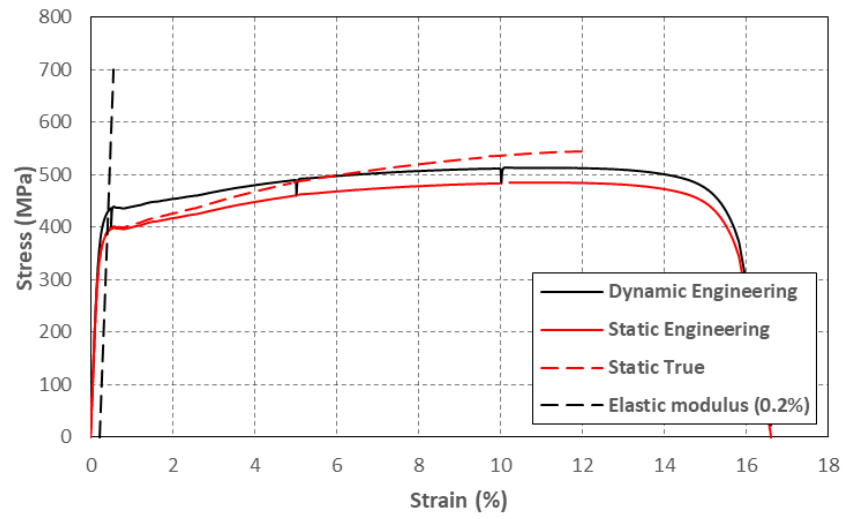


Figure A.7: T7912b Flat coupon test results

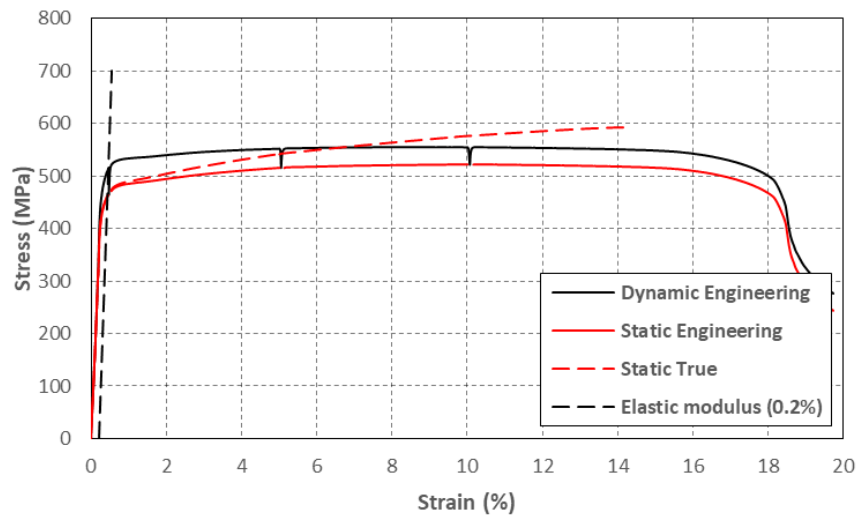


Figure A.8: T7912 Corner coupon test results

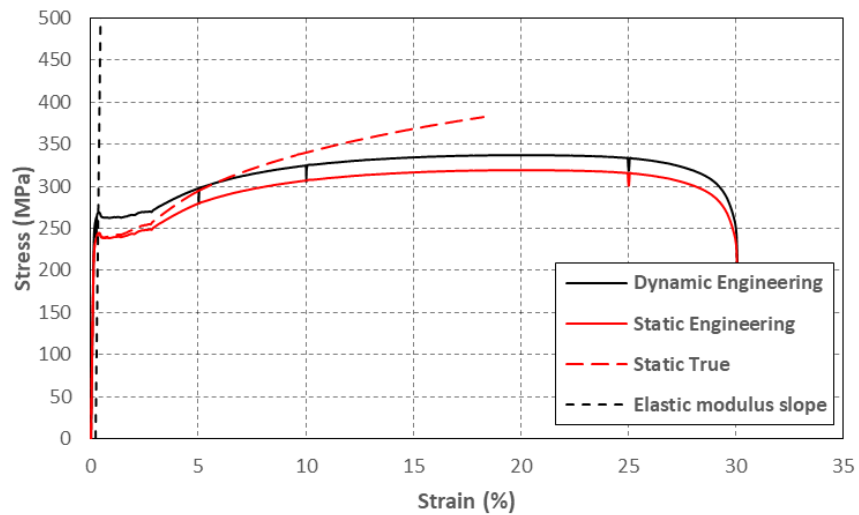


Figure A.9: T12012a Flat coupon test results

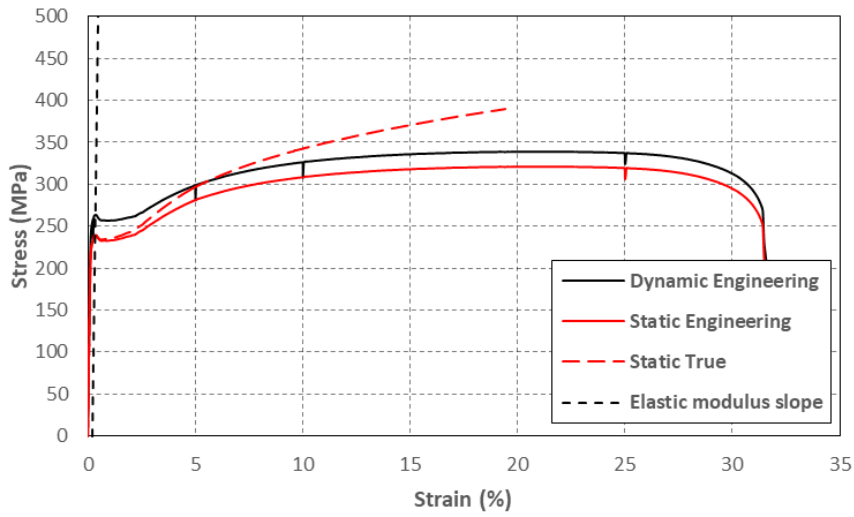


Figure A.10: T12012b Flat coupon test results

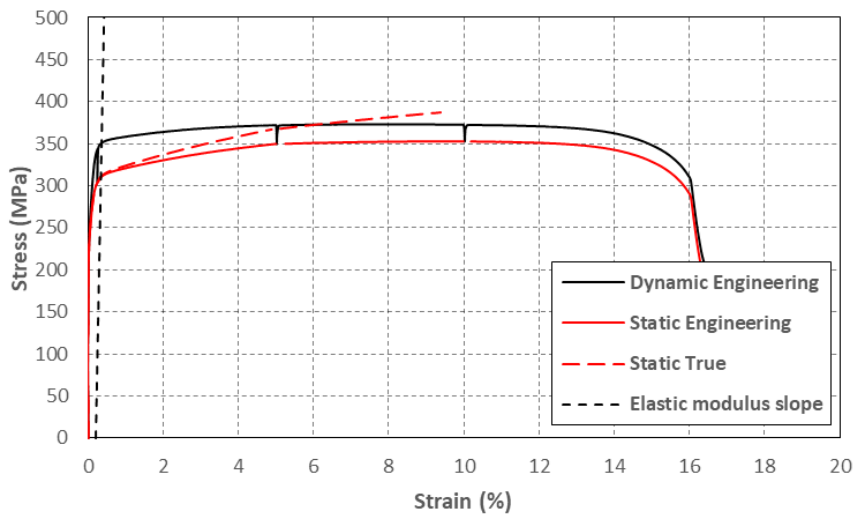


Figure A.11: T12012 Corner coupon test results

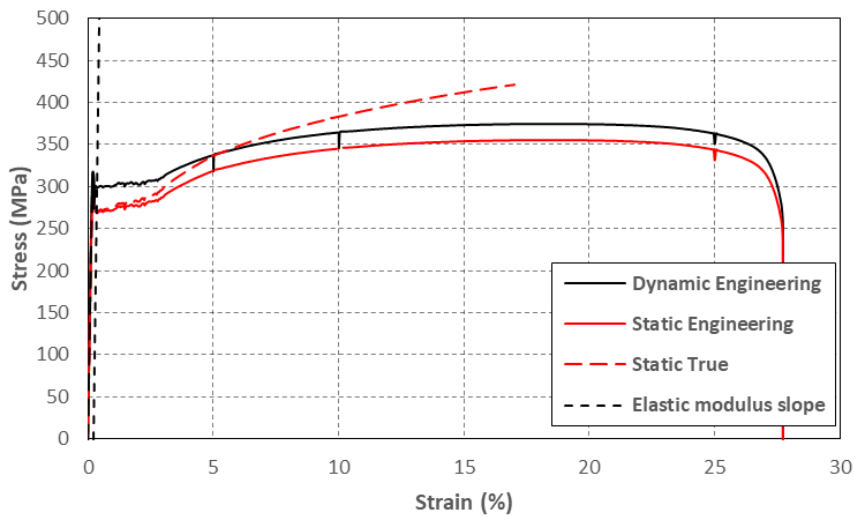


Figure A.12: S11012a Flat coupon test results

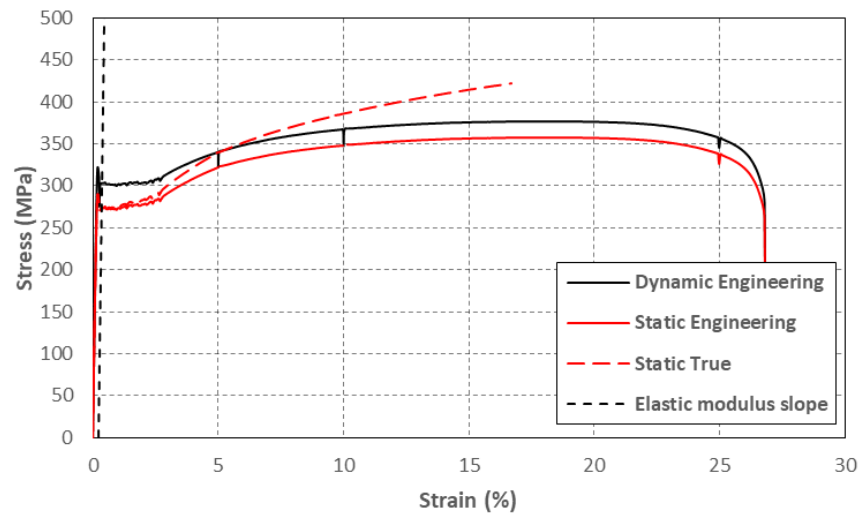


Figure A.13: S11012b Flat coupon test results

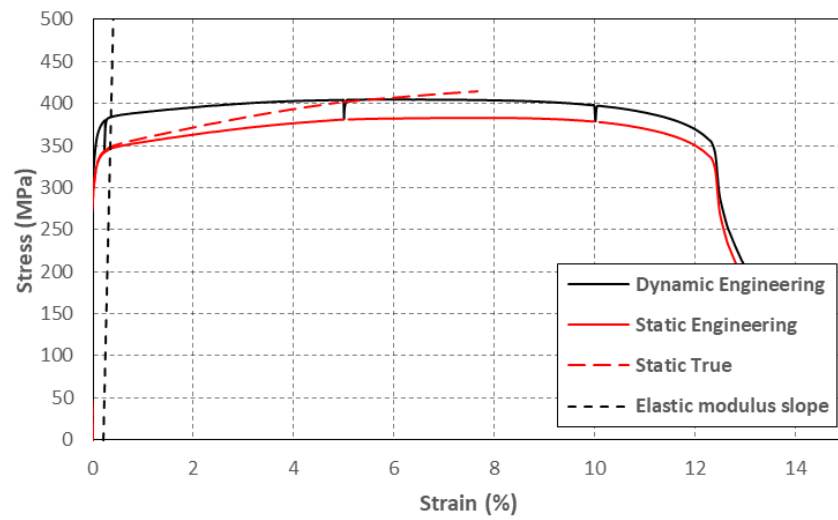
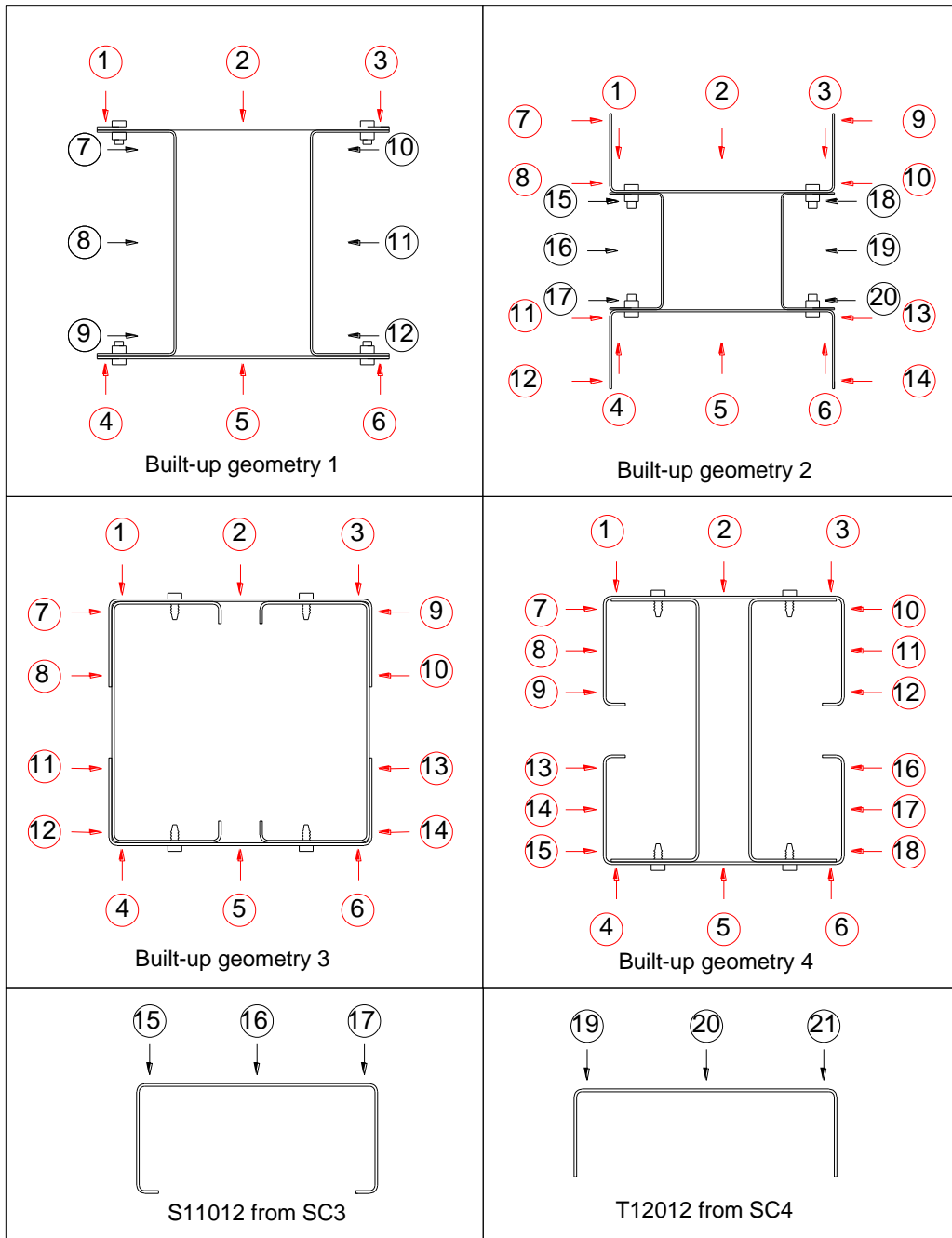


Figure A.14: S11012 Corner coupon test results

Appendix B

Stub Columns Geometric Imperfections

Appendix B contains the geometric imperfections recorded on the components of the stub columns after they were assembled into their final configurations. In addition, for geometries SC3 and SC4, the imperfections recorded on channels S11012 and T12012 before they were assembled are also included. In the figures, the coordinate along the length of the column is normalized by dividing it by the measured length, while the vertical dashed black lines indicate the location of the connectors along the column. The location of each measuring line is represented in the diagram included in the next page for each built-up geometry, as well as for channels S11012 belonging to columns SC3 and T12012 channels belonging to columns SC4. The relevant cross-sectional imperfections computed from the readings taken along the measuring lines are also included. Positive readings indicate imperfections in the opposite direction to the arrows included in the diagram. Further details about the imperfections recorded on the stub columns are included in Section 3.6 of the main text.



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B.1. Built-up geometry 1 (SC1)

B.1.1 SC1-2a

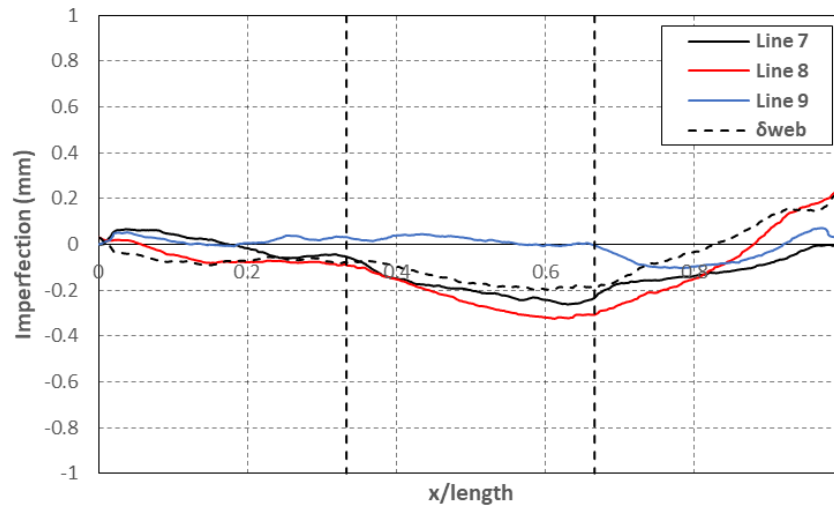


Figure B.1: Imperfections web channel T15414-1

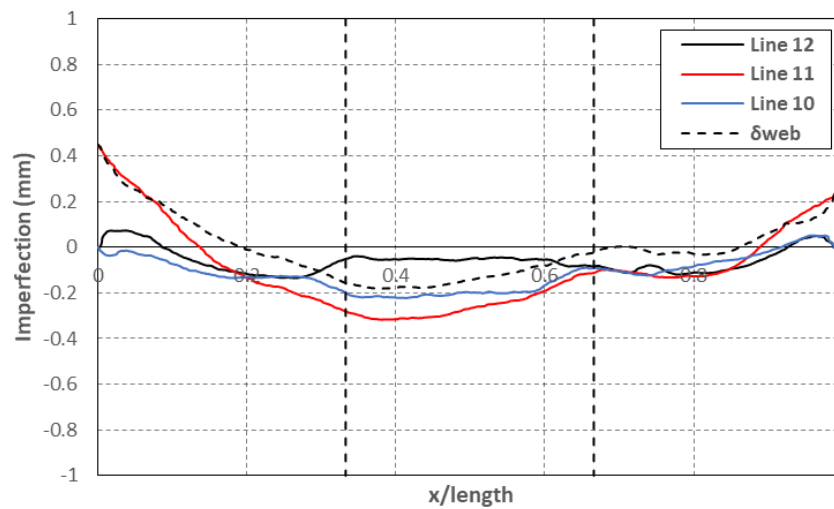


Figure B.2: Imperfections web channel T15414-2

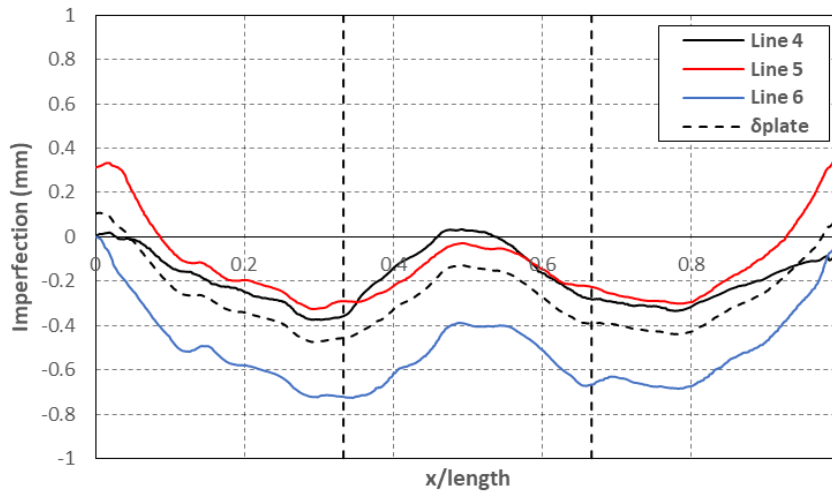


Figure B.3: Imperfections plate P20024-1

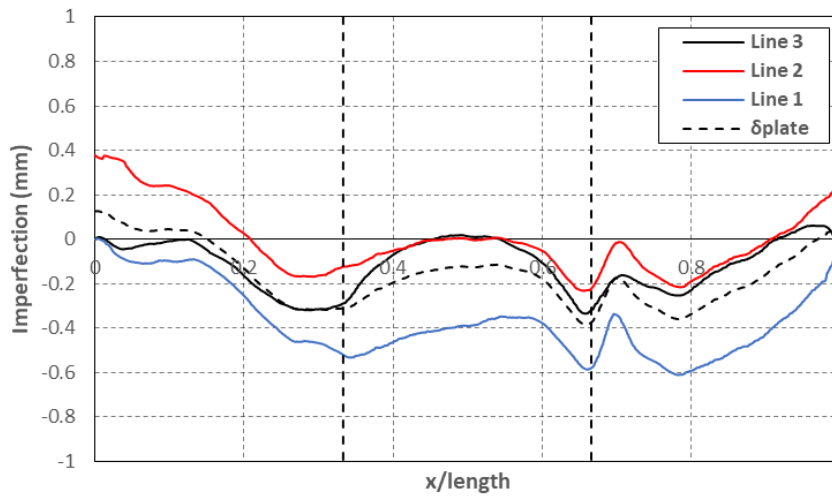


Figure B.4: Imperfections plate P20024-2

B.1.2 SC1-2b

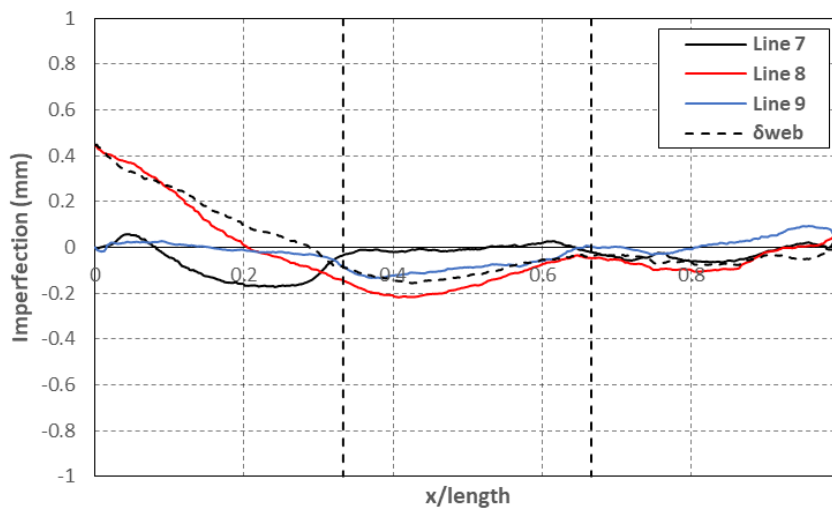
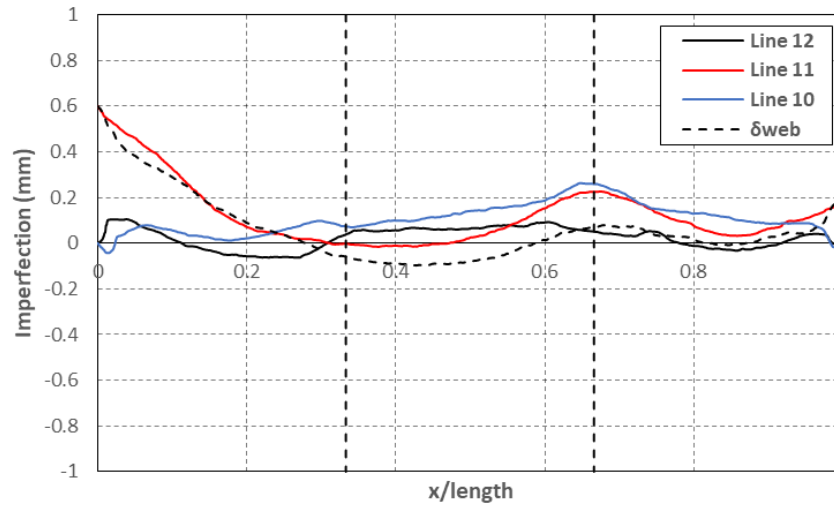
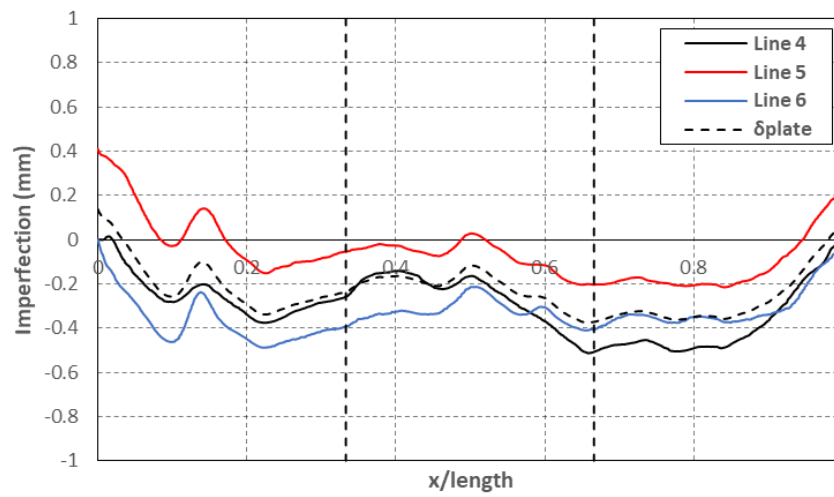
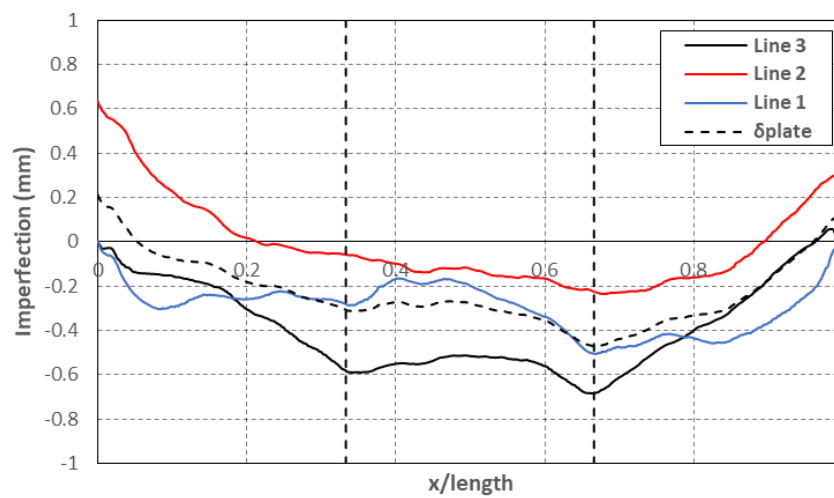


Figure B.5: Imperfections web channel T15414-3

**Figure B.6: Imperfections web channel T15414-4****Figure B.7: Imperfections plate P20024-3****Figure B.8: Imperfections plate P20024-4**

B.1.3 SC1-3a

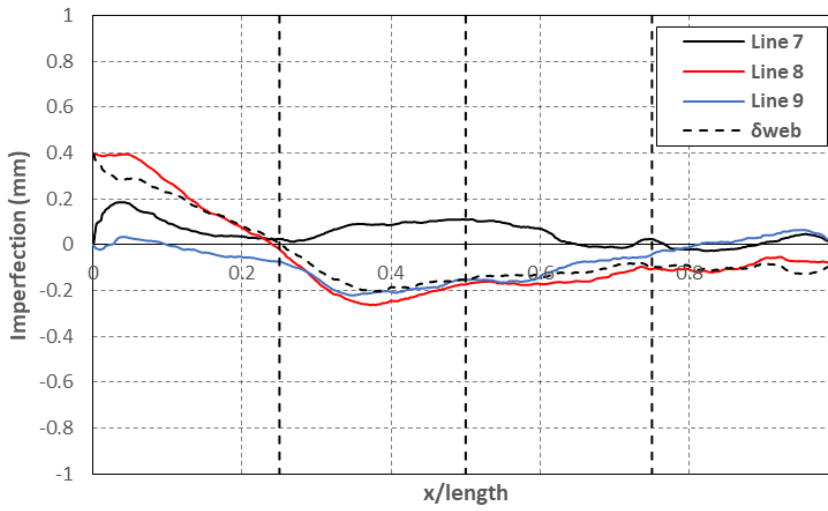


Figure B.9: Imperfections web channel T15414-5

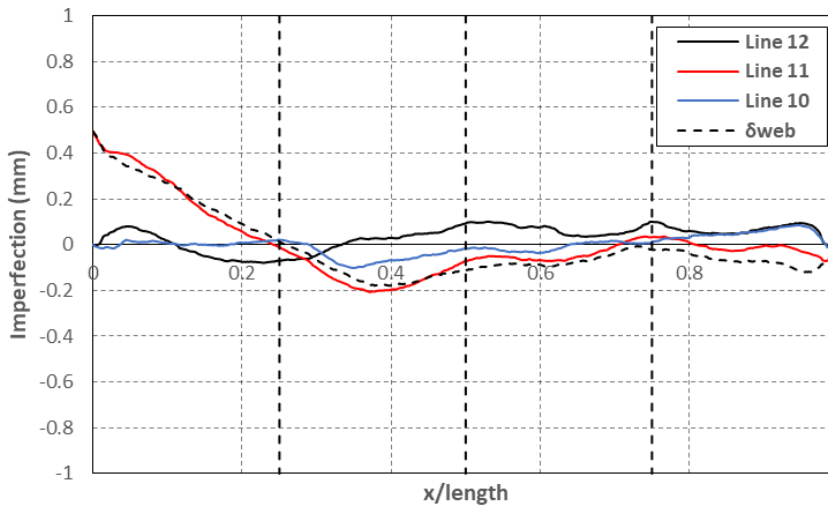


Figure B.10: Imperfections web channel T15414-6

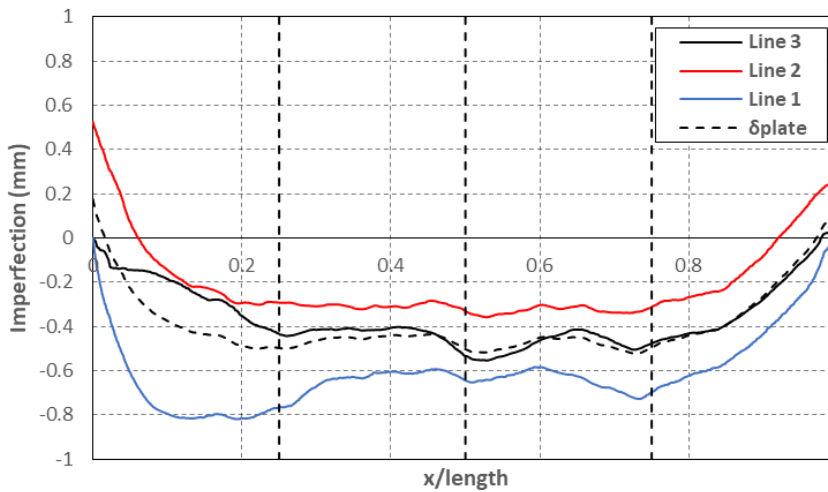


Figure B.11: Imperfections plate P20024-5

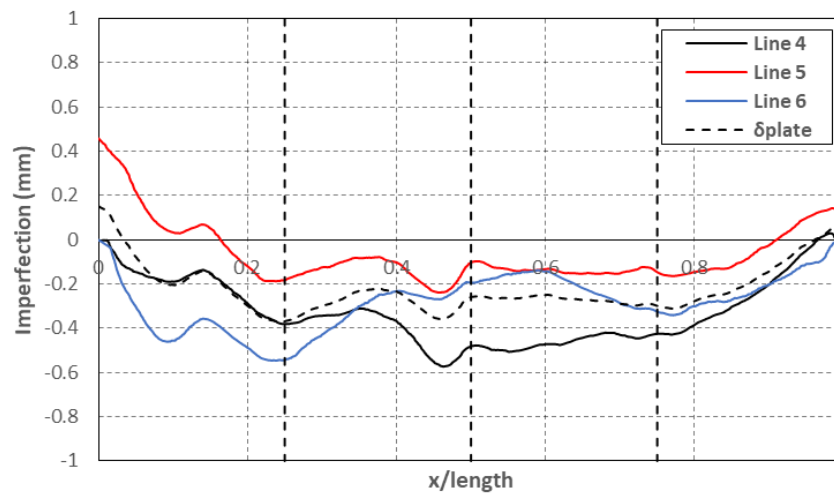


Figure B.12: Imperfections plate P20024-6

B.1.4 SC1-3b

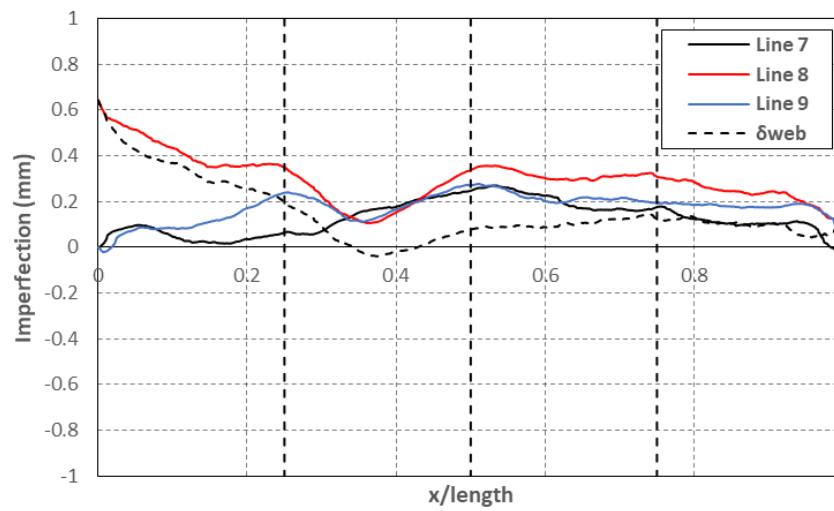


Figure B.13: Imperfections web channel T15414-7

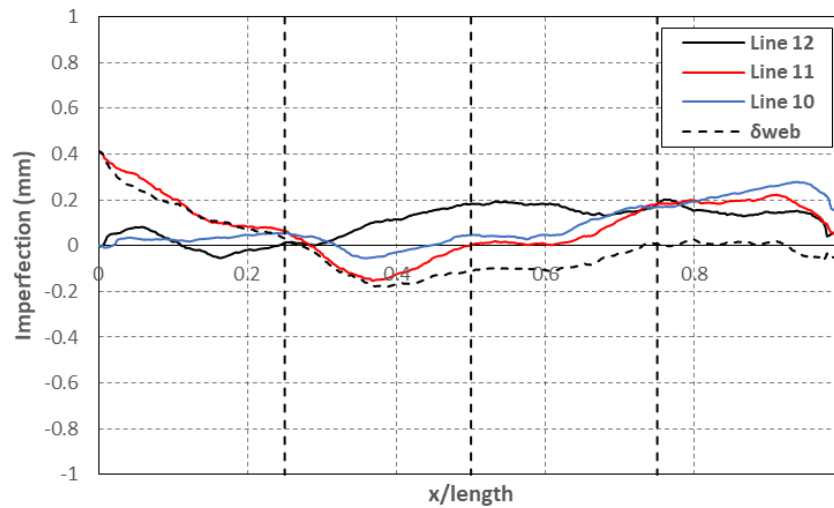


Figure B.14: Imperfections web channel T15414-8

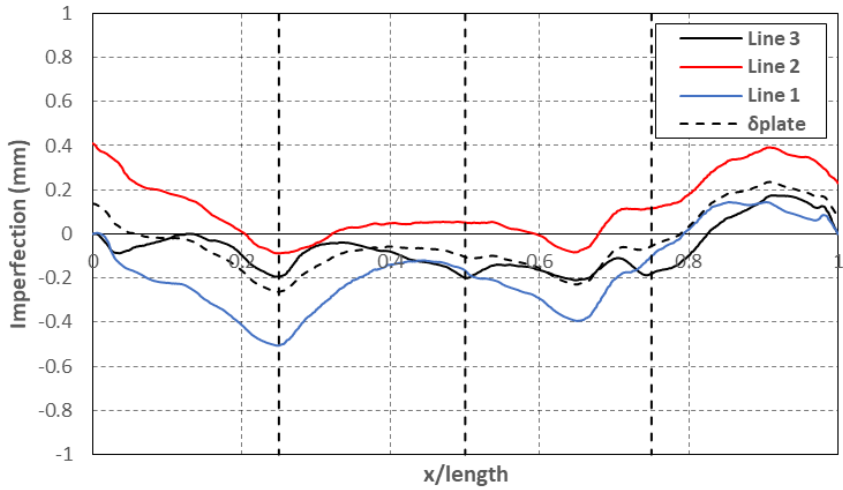


Figure B.15: Imperfections plate P20024-7

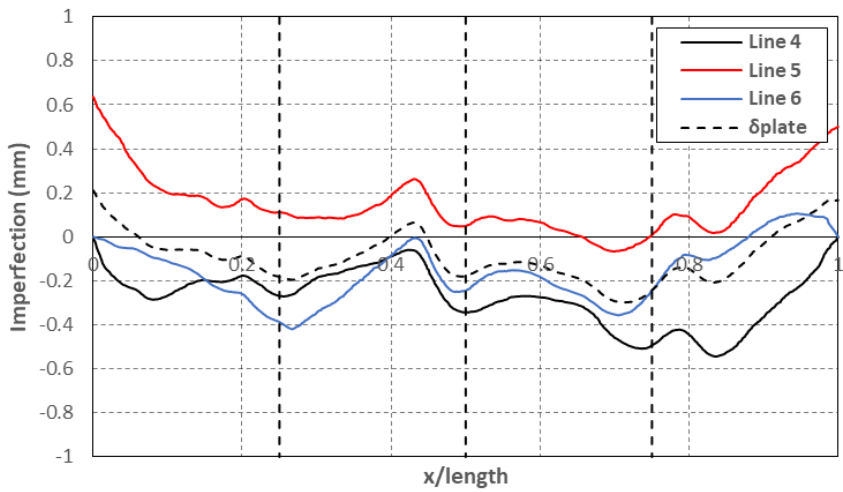


Figure B.16: Imperfections plate P20024-8

B.1.5 SC1-5a

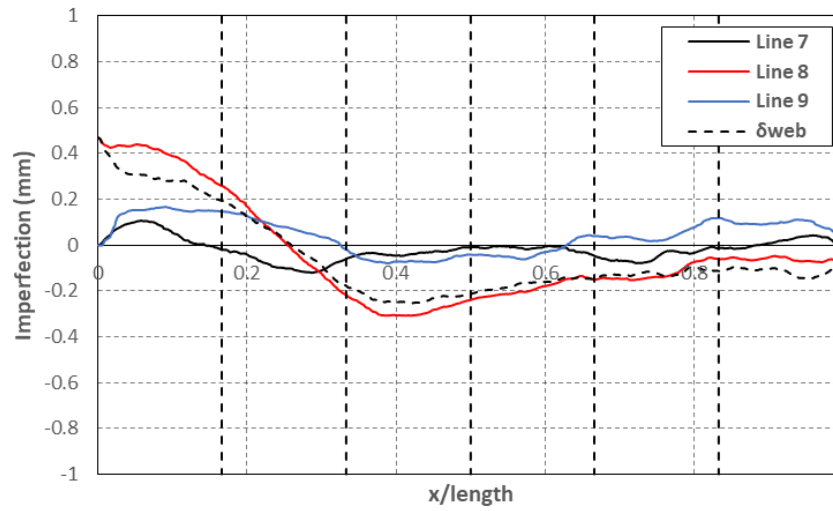


Figure B.17: Imperfections web channel T15414-9

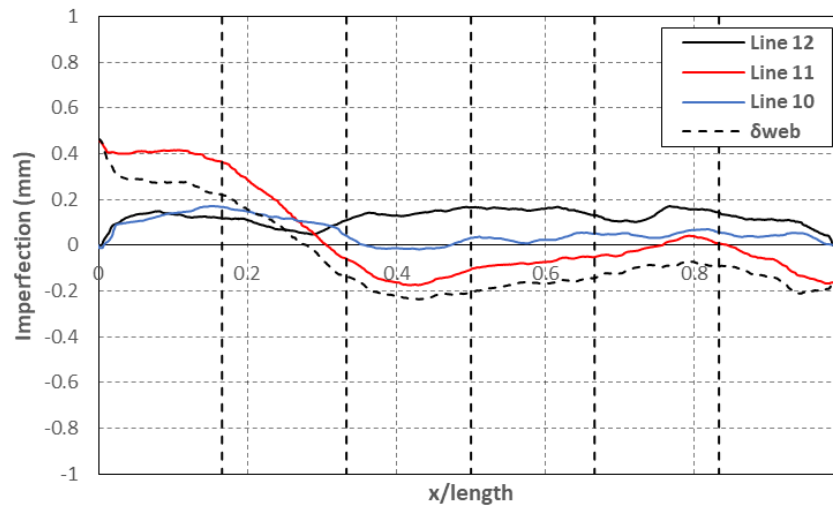


Figure B.18: Imperfections web channel T15414-10

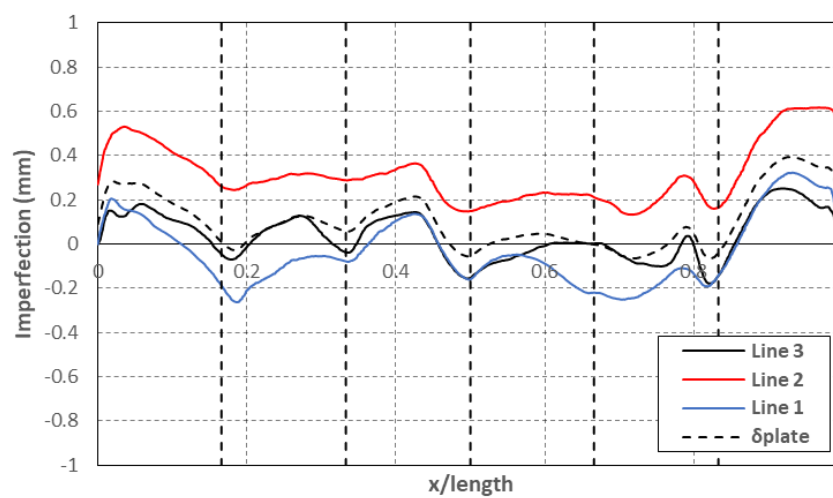


Figure B.19: Imperfections plate P20024-9

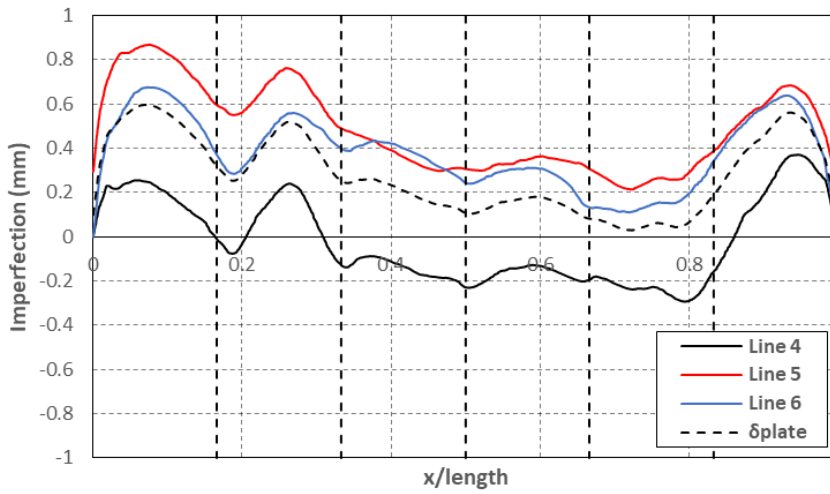


Figure B.20: Imperfections plate P20024-10

B.1.6 SC1-5b

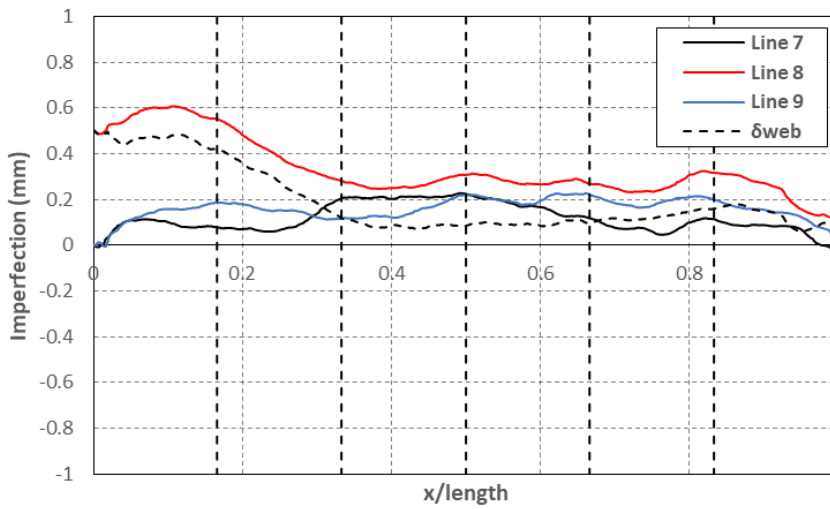


Figure B.21: Imperfections web channel T15414-11

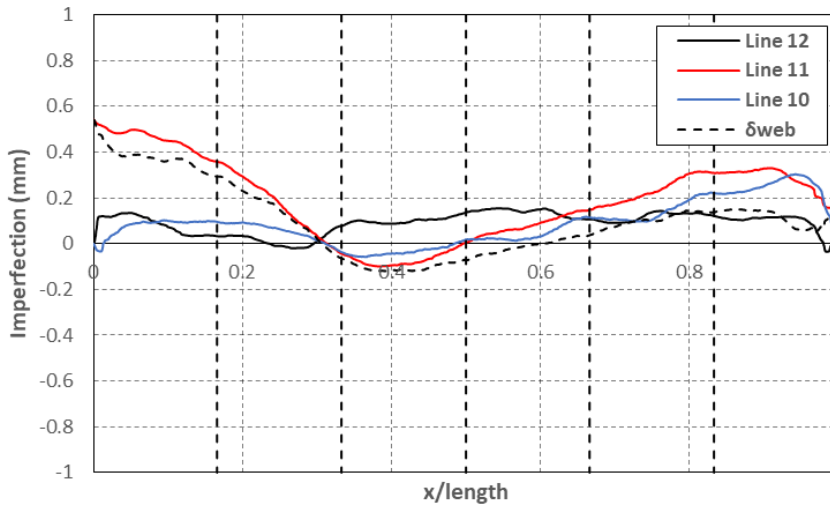
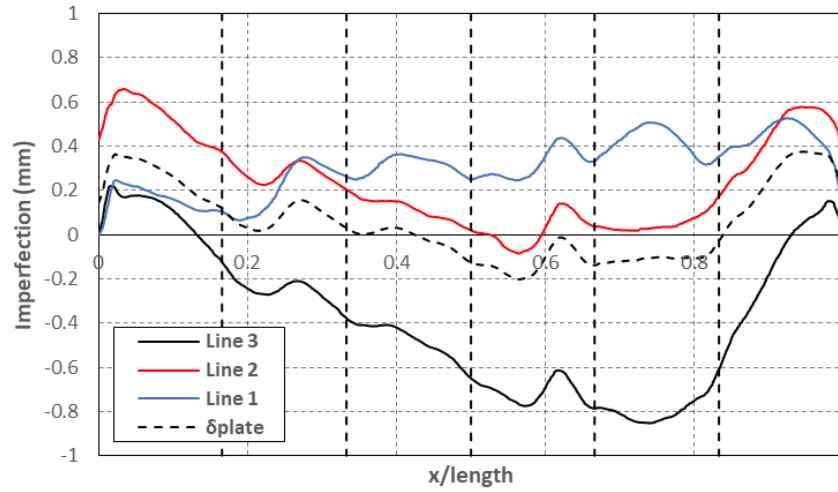
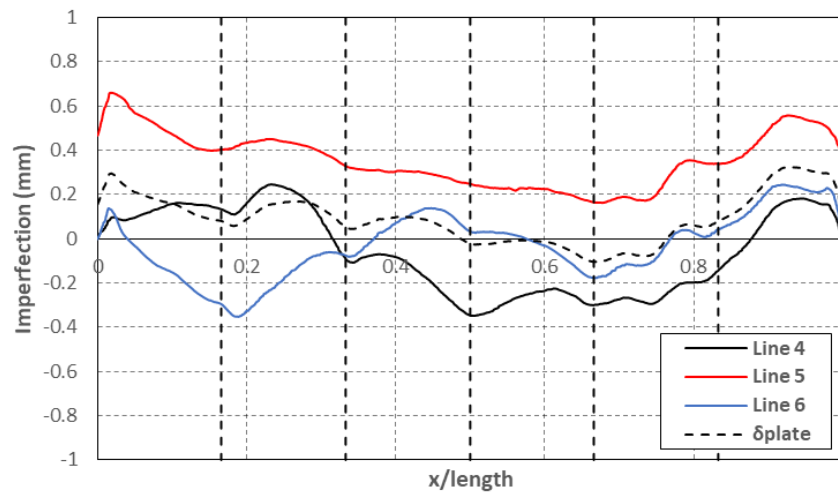


Figure B.22: Imperfections web channel T15414-12

**Figure B.23: Imperfections plate P20024-11****Figure B.24: Imperfections plate P20024-12**

B.2. Built-up geometry 2 (SC2)

B.2.1 SC2-2a

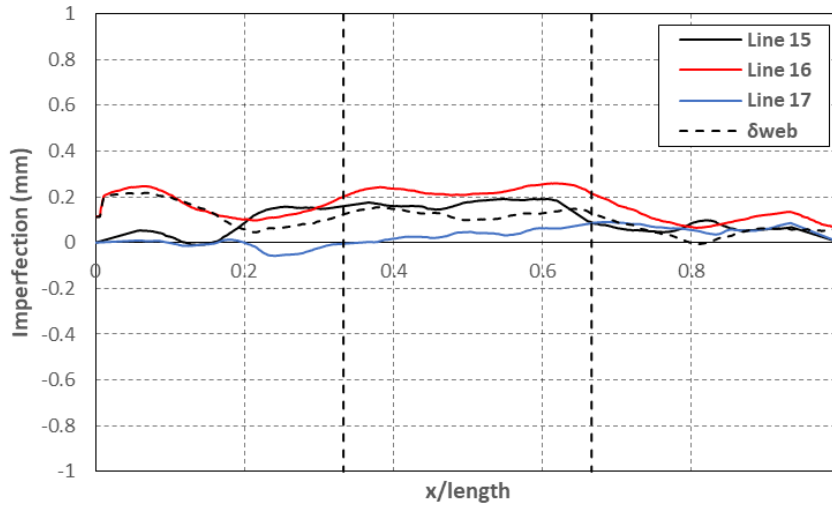


Figure B.25: Imperfections web channel T7912-1

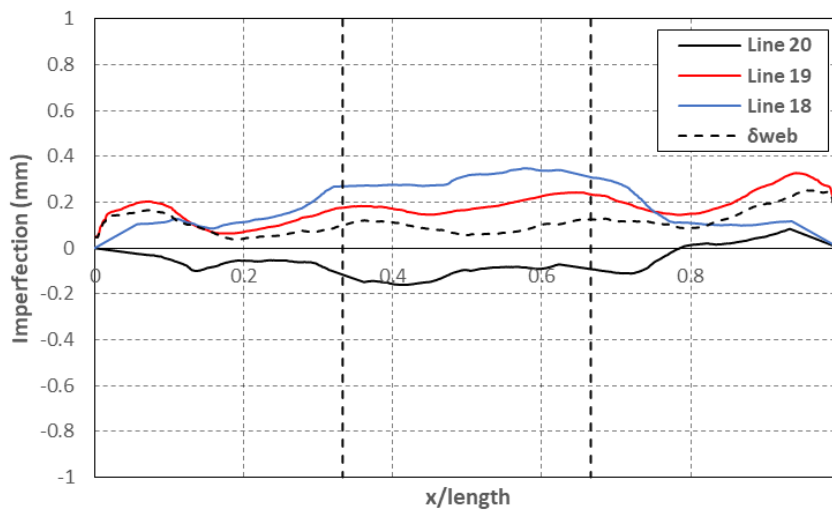
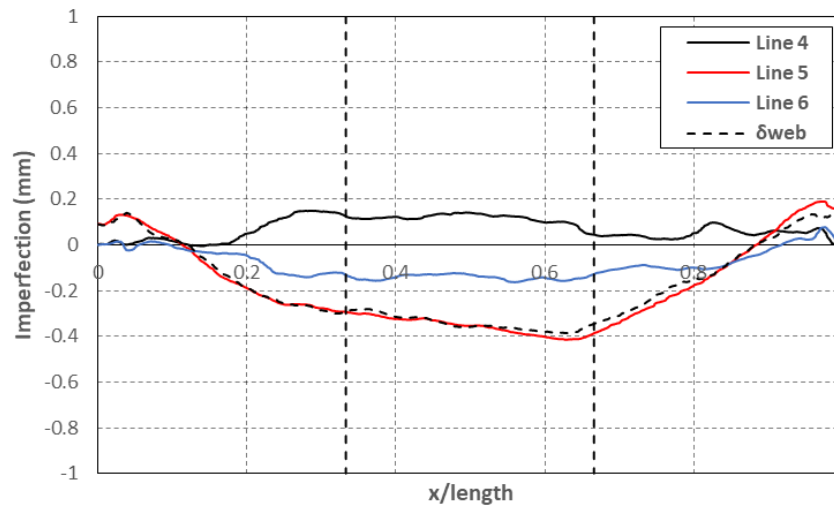
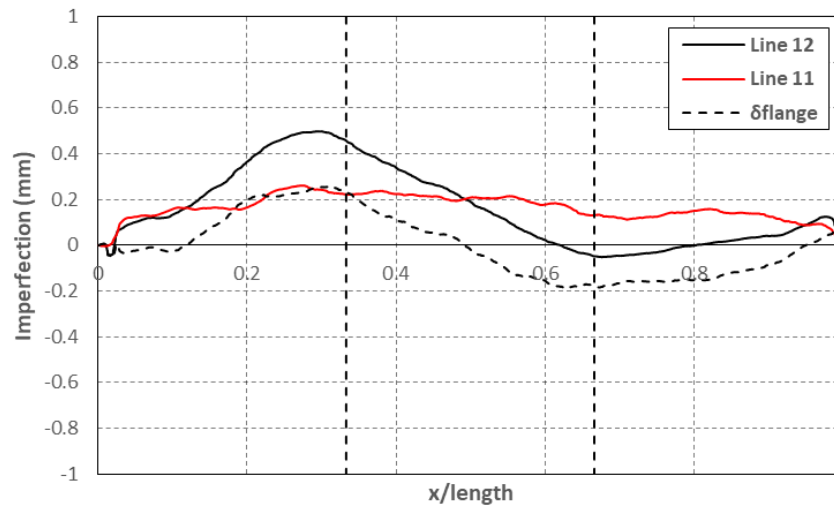
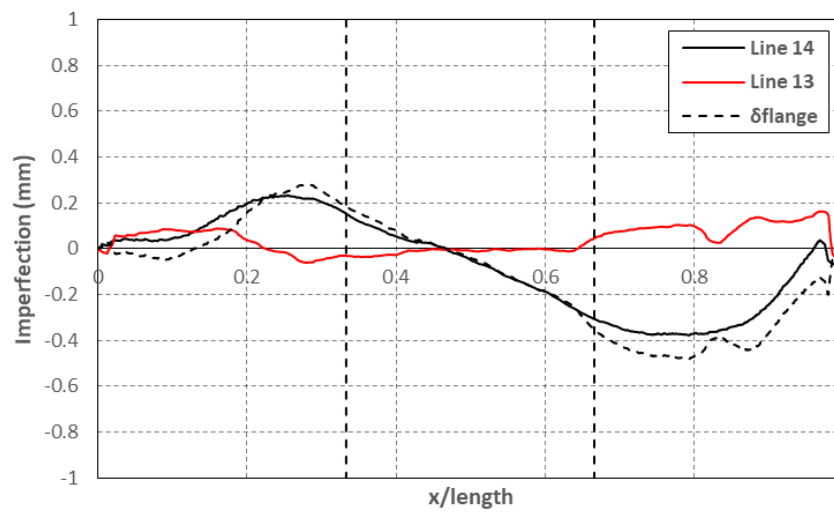


Figure B.26: Imperfections web channel T7912-2

**Figure B.27: Imperfections web channel T15414-1****Figure B.28: Imperfections left flange channel T15414-1****Figure B.29: Imperfections right flange channel T15414-1**

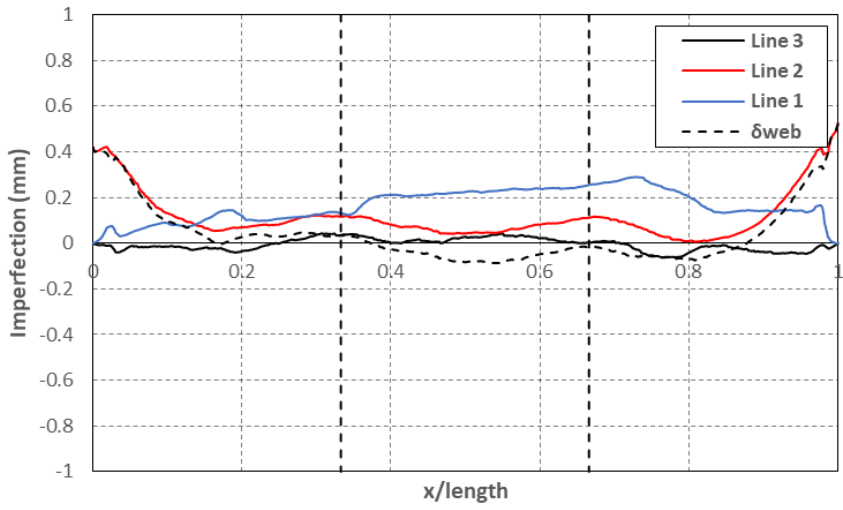


Figure B.30: Imperfections web channel T15414-2

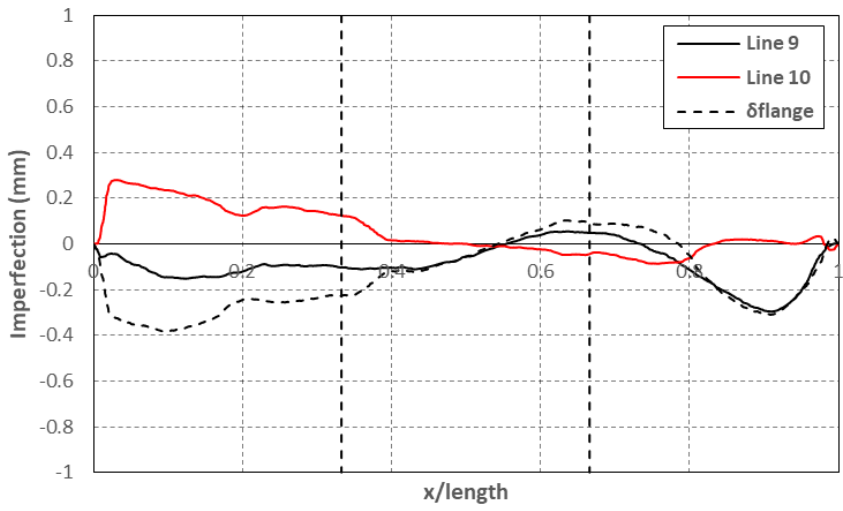


Figure B.31: Imperfections left flange channel T15414-2

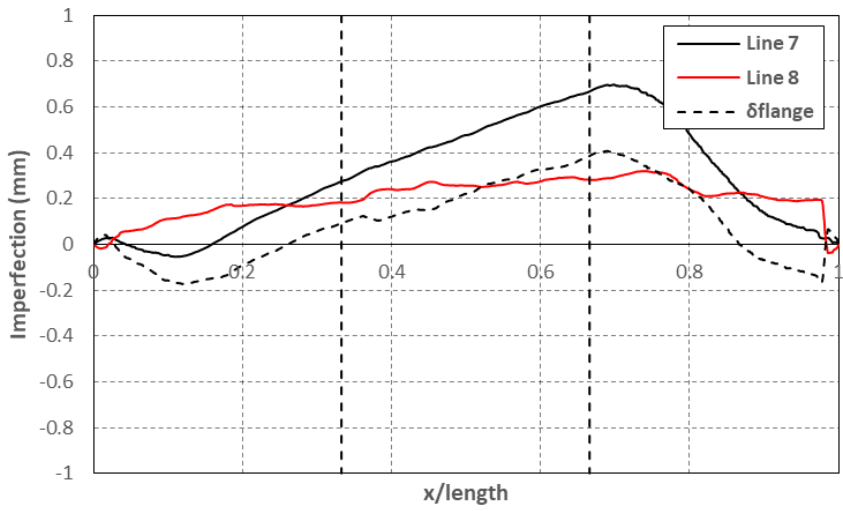
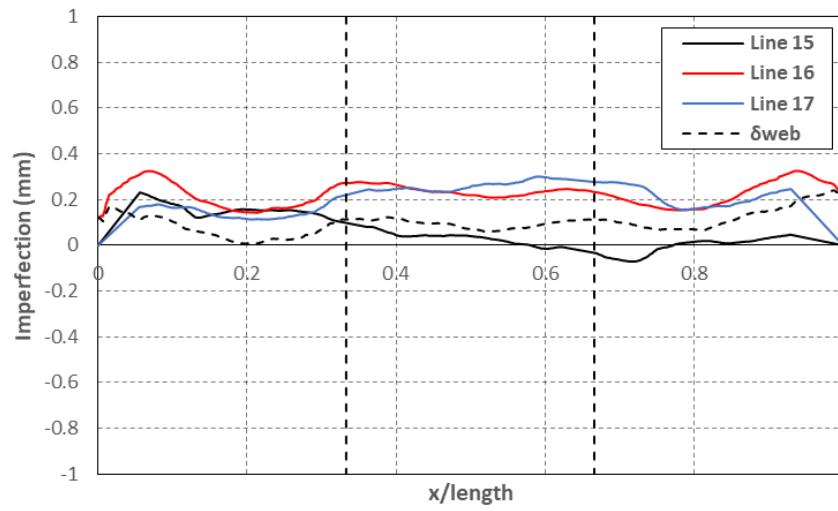
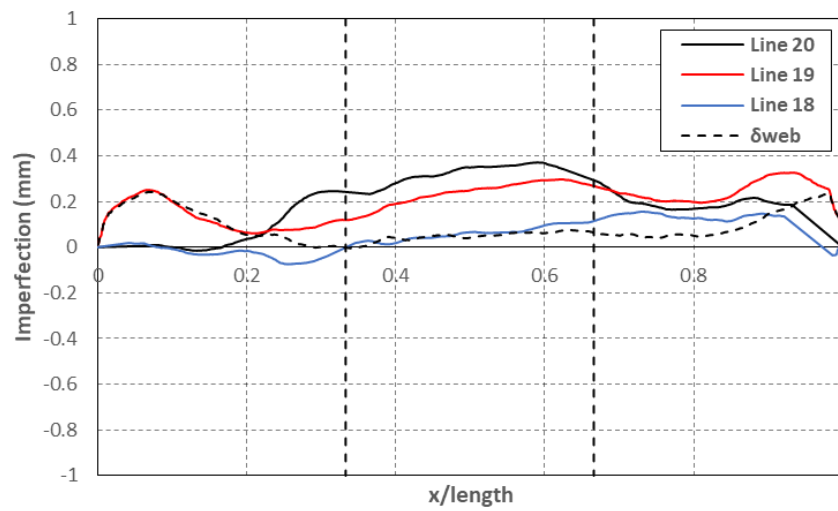


Figure B.32: Imperfections right flange channel T15414-2

B.2.2 SC2-2b**Figure B.33: Imperfections web channel T7912-3****Figure B.34: Imperfections web channel T7912-4**

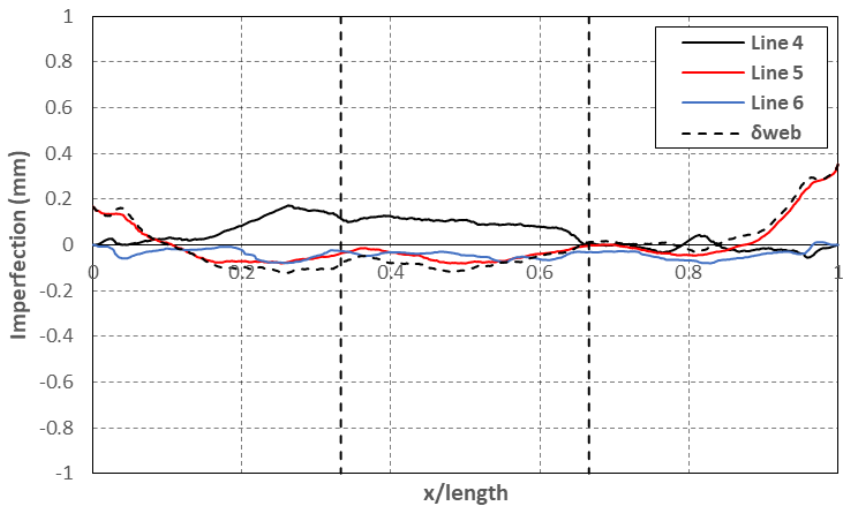


Figure B.35: Imperfections web channel T15414-3

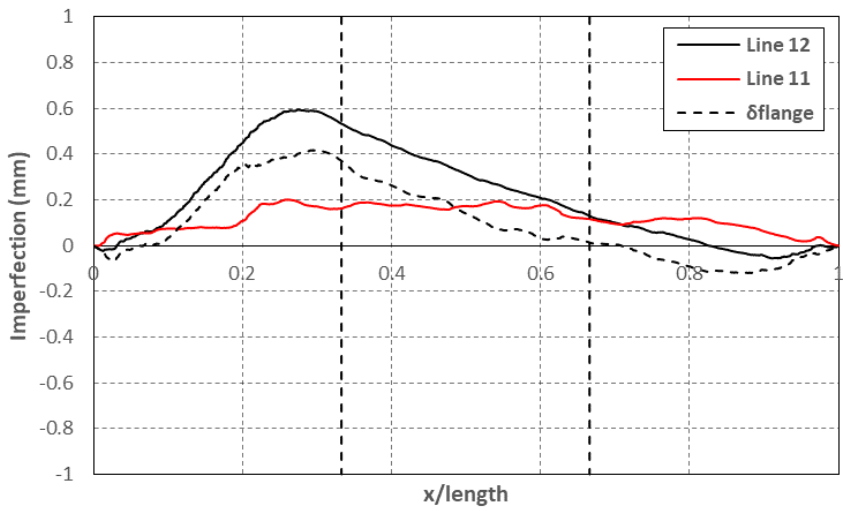


Figure B.36: Imperfections left flange channel T15414-3

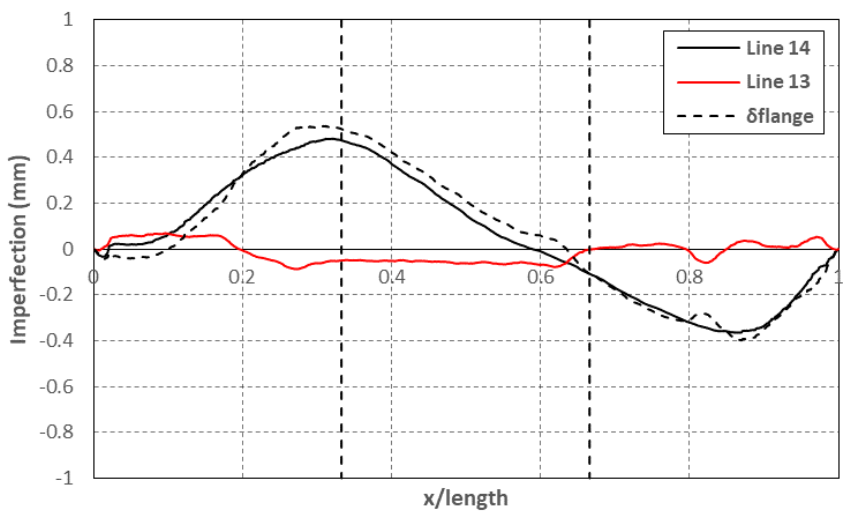


Figure B.37: Imperfections right flange channel T15414-3

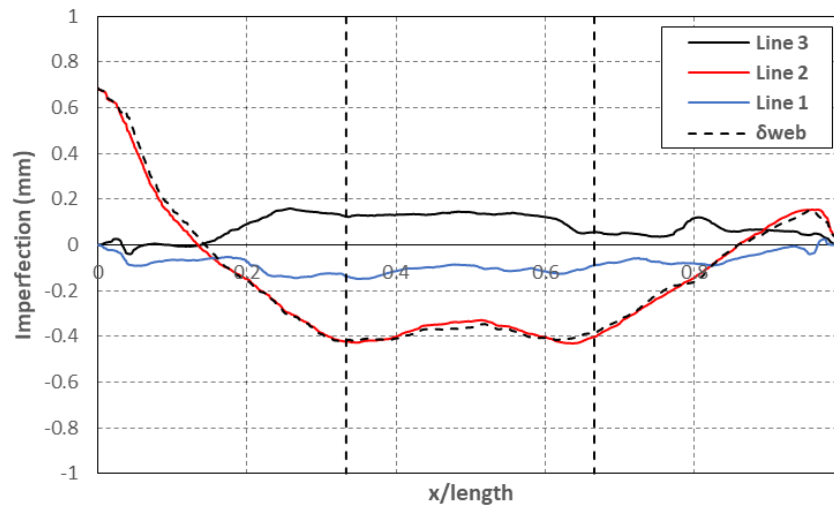


Figure B.38: Imperfections web channel T15414-4

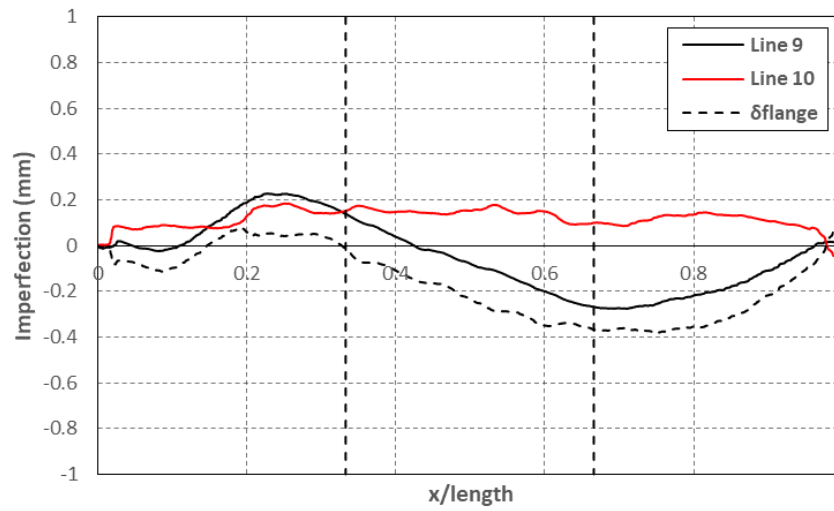


Figure B.39: Imperfections left flange channel T15414-4

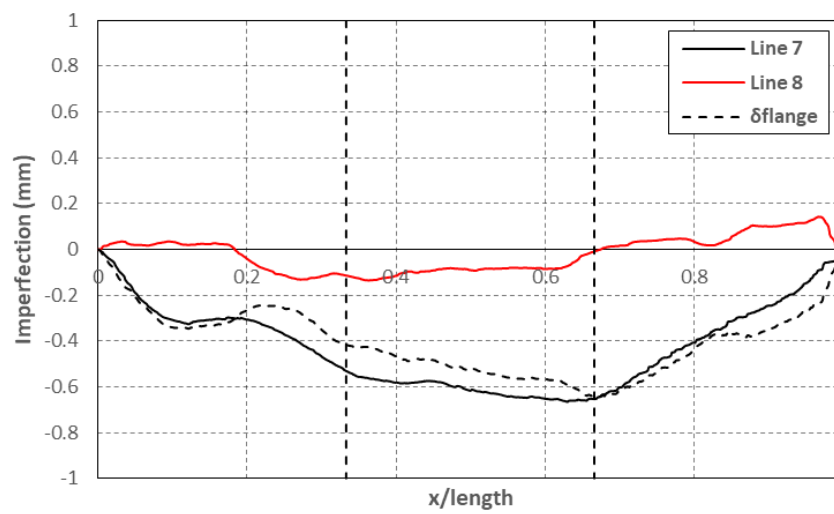
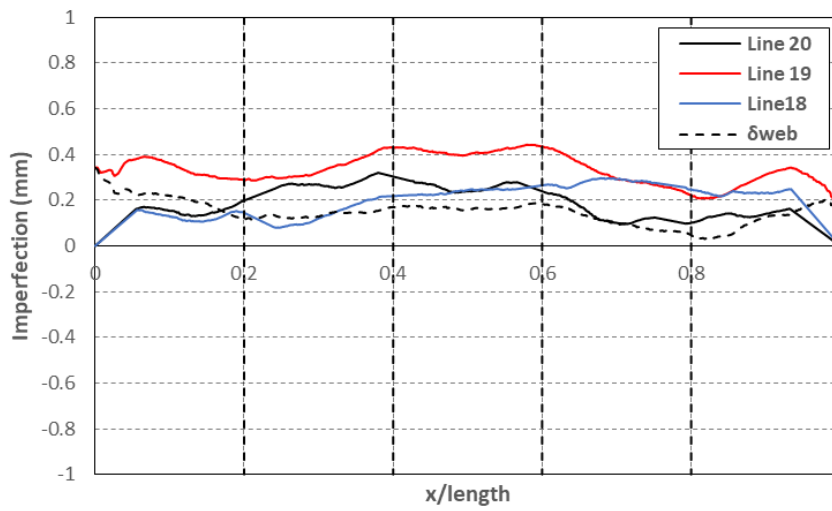
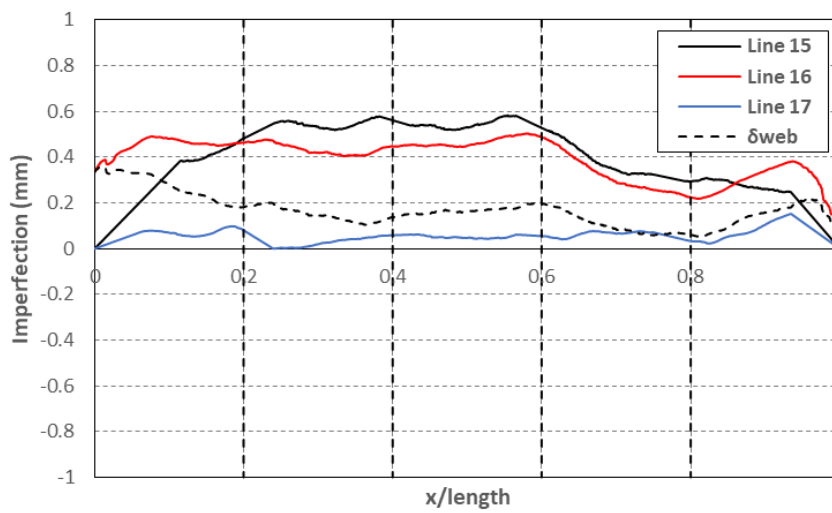
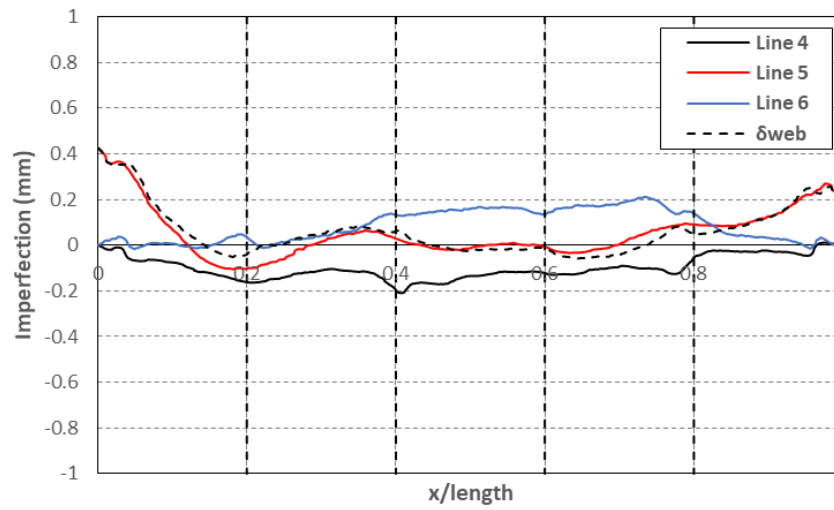
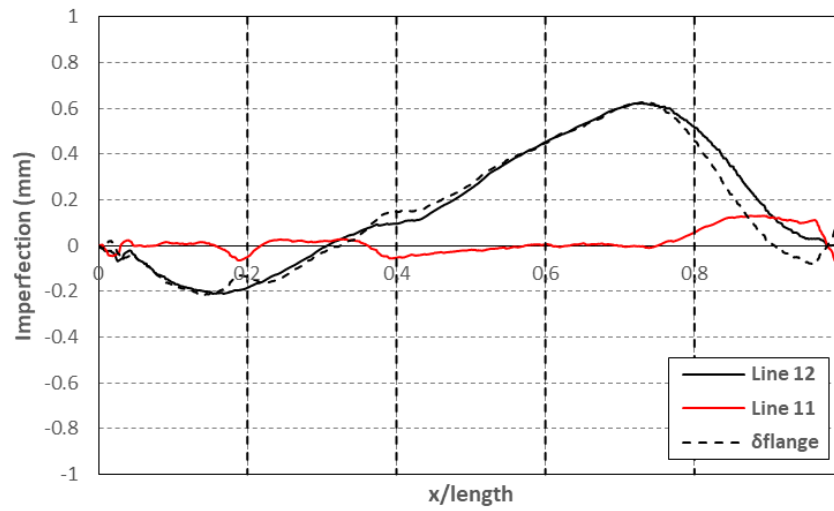
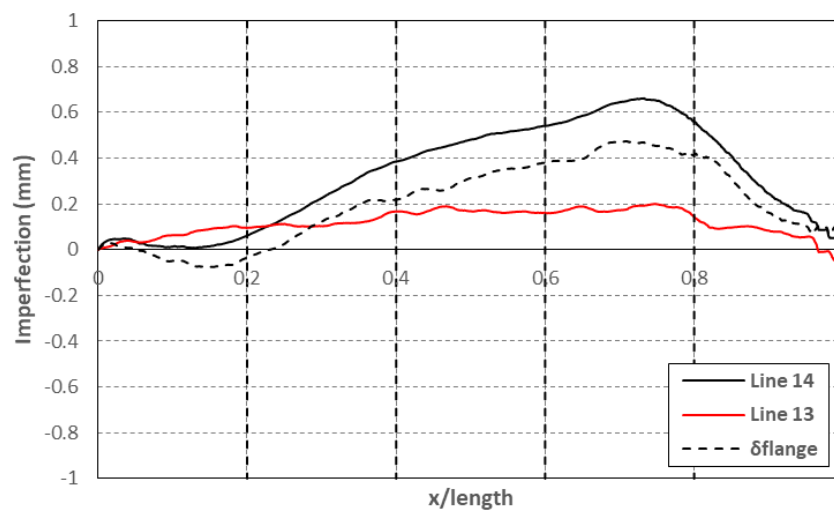


Figure B.40: Imperfections right flange channel T15414-4

B.2.3 SC2-4a**Figure B.41: Imperfections web channel T7912-5****Figure B.42: Imperfections web channel T7912-6**

**Figure B.43: Imperfections web channel T15414-5****Figure B.44: Imperfections left flange channel T15414-5****Figure B.45: Imperfections right flange channel T15414-5**

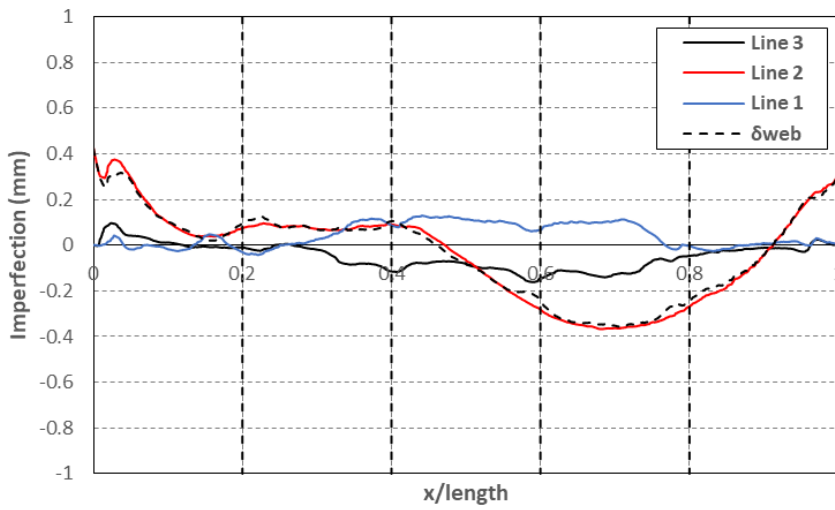


Figure B.46: Imperfections web channel T15414-6

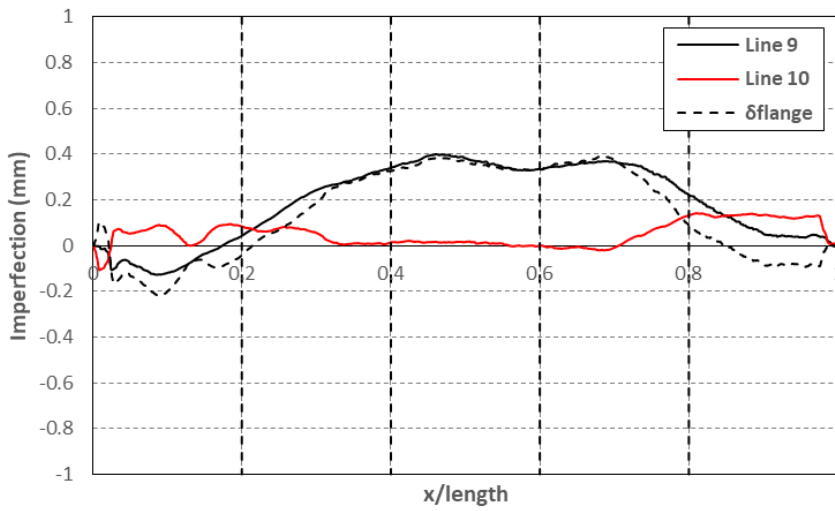


Figure B.47: Imperfections left flange channel T15414-6

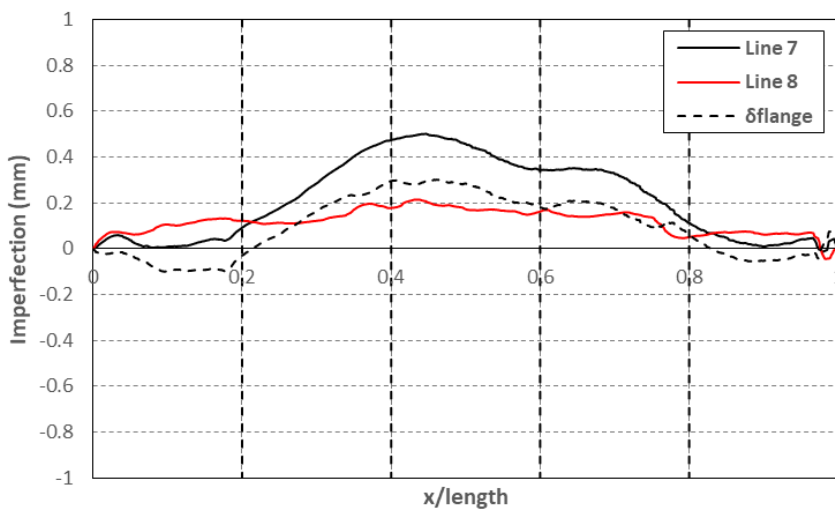
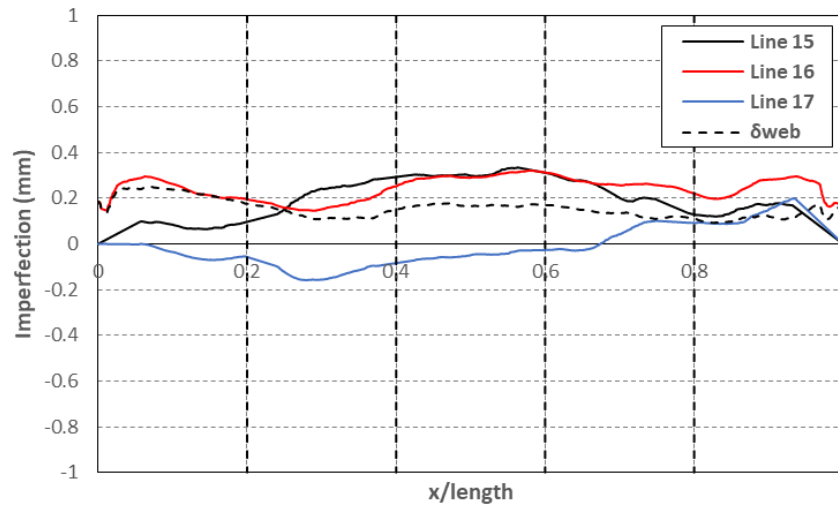
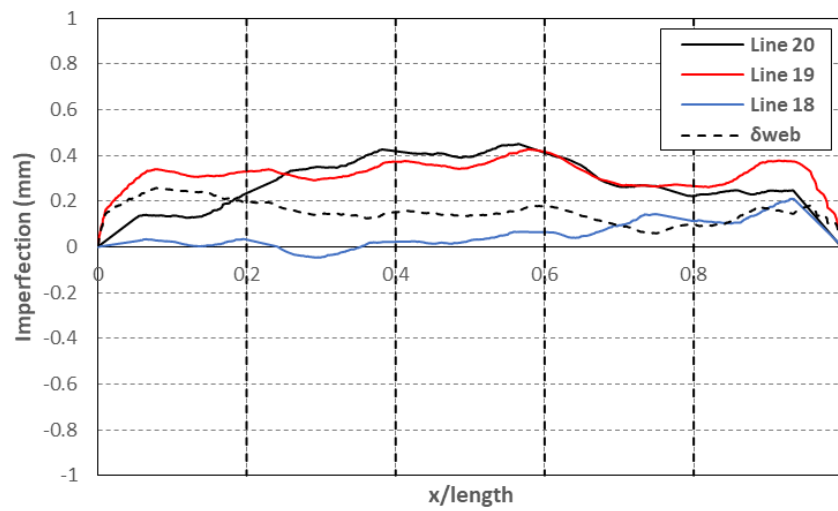


Figure B.48: Imperfections right flange channel T15414-6

B.2.4 SC2-4b**Figure B.49: Imperfections web channel T7912-7****Figure B.50: Imperfections web channel T7912-8**

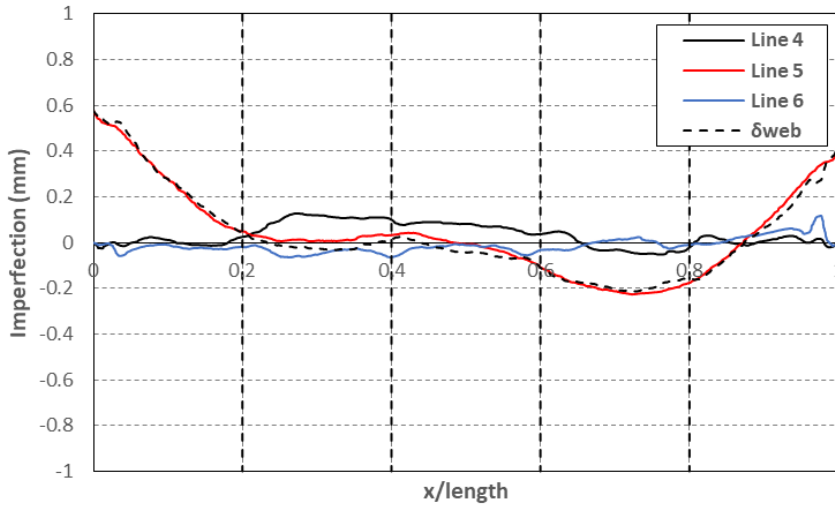


Figure B.51: Imperfections web channel T15414-7

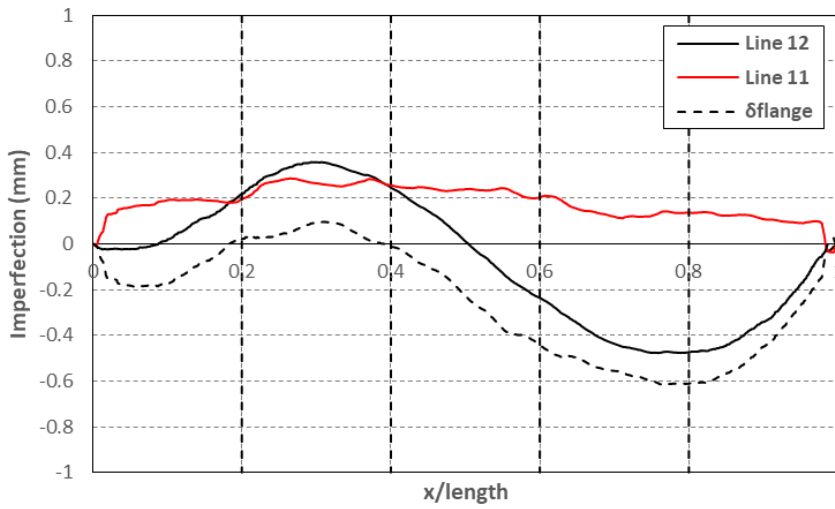


Figure B.52: Imperfections left flange channel T15414-7

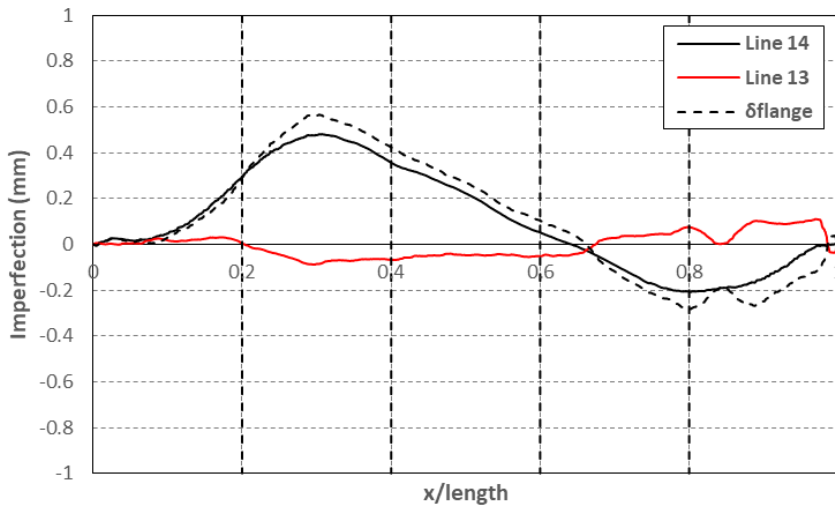
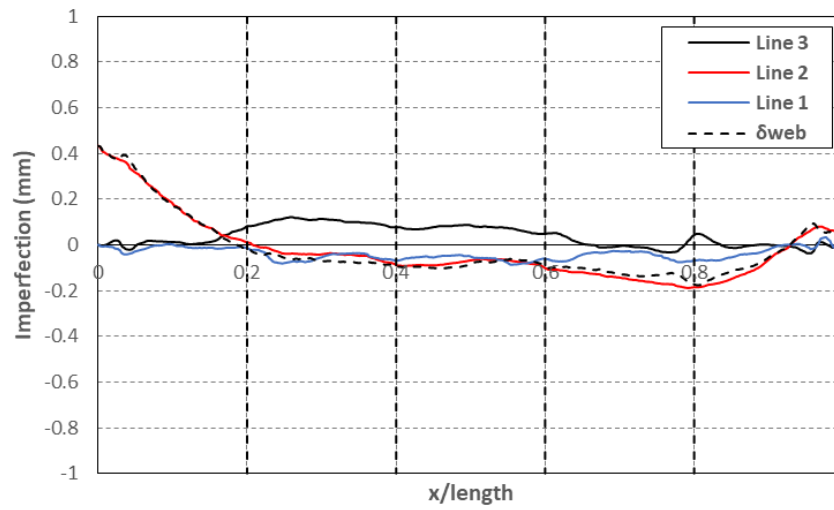
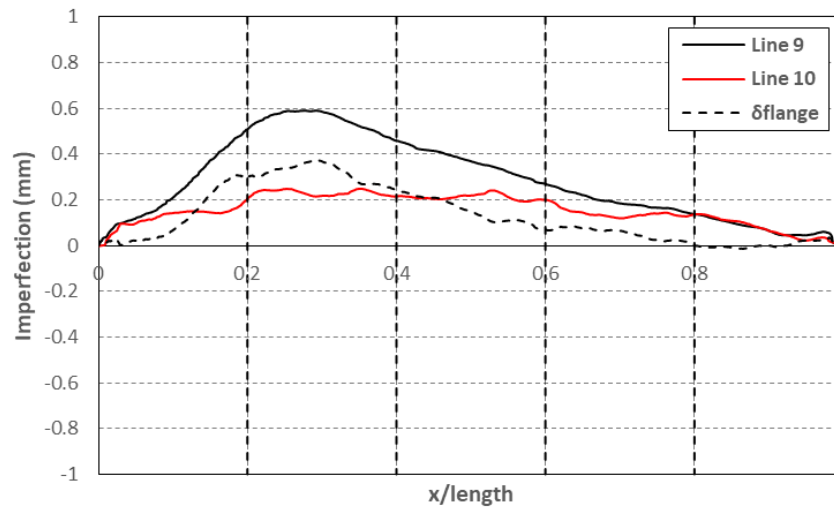
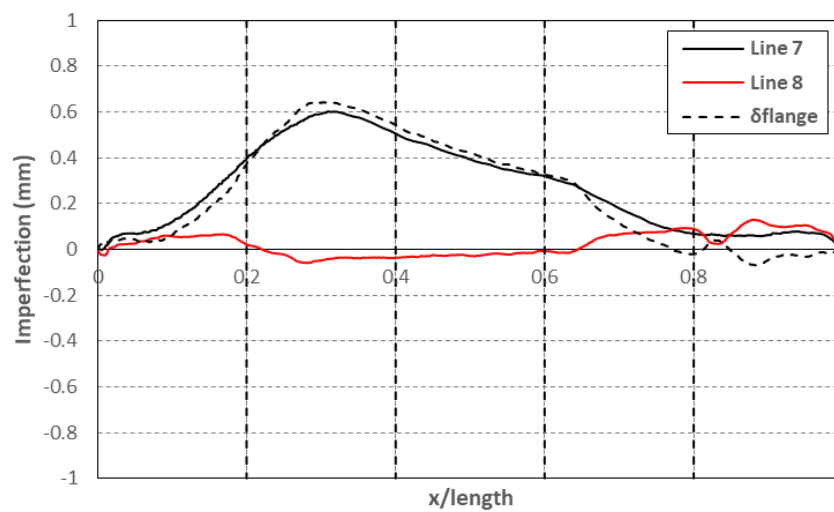


Figure B.53: Imperfections right flange channel T15414-7

**Figure B.54: Imperfections web channel T15414-8****Figure B.55: Imperfections left flange channel T15414-8****Figure B.56: Imperfections right flange channel T15414-8**

B.2.5 SC2-6a

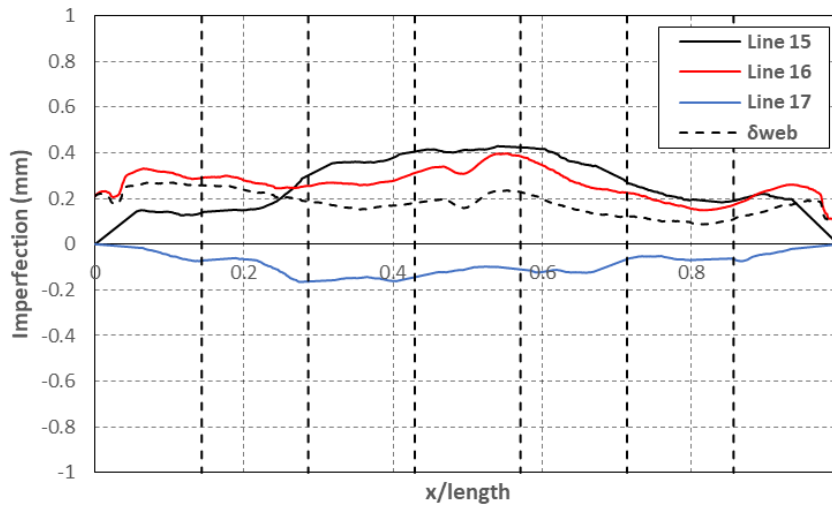


Figure B.57: Imperfections web channel T7912-9

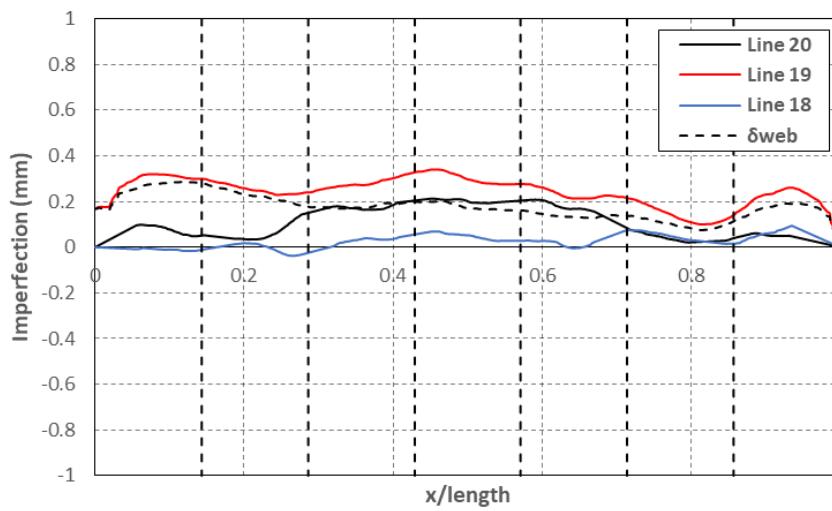


Figure B.58: Imperfections web channel T7912-10

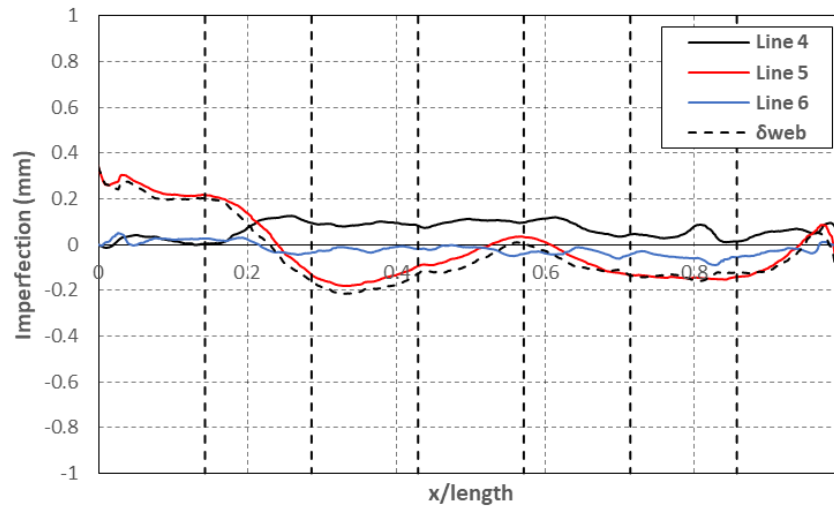


Figure B.59: Imperfections web channel T15414-9

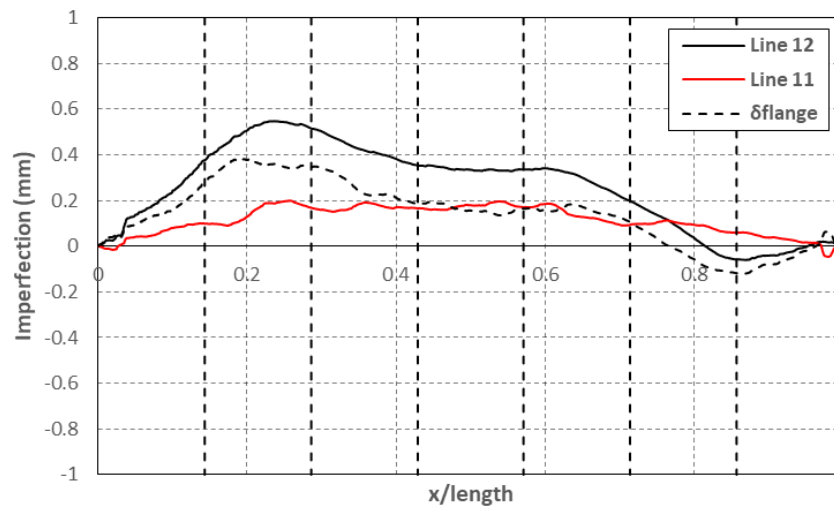


Figure B.60: Imperfections left flange channel T15414-9

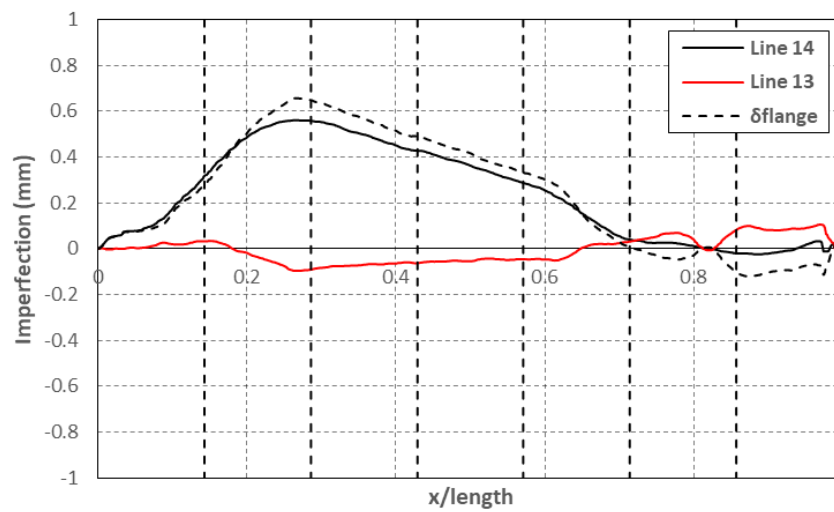


Figure B.61: Imperfections right flange channel T15414-9

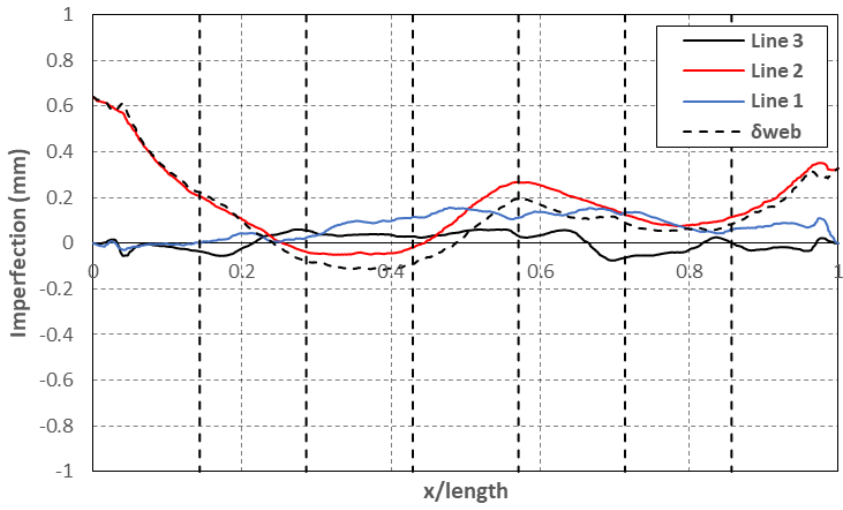


Figure B.62: Imperfections web channel T15414-10

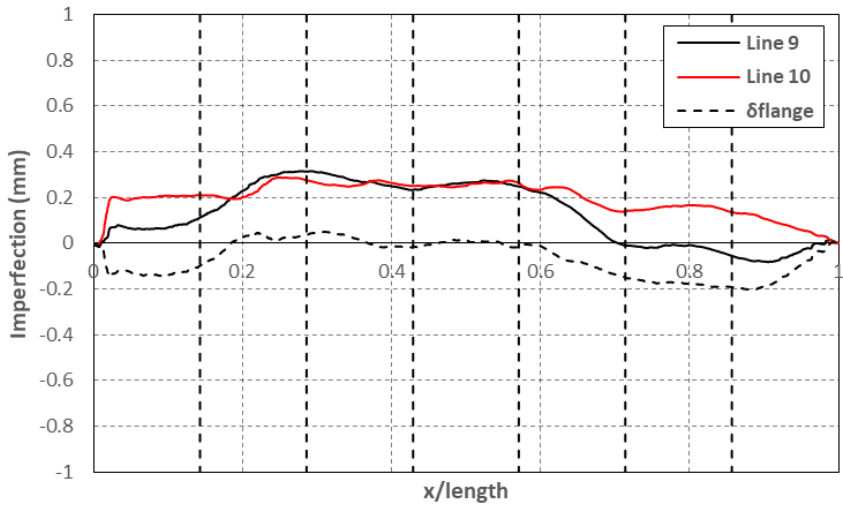


Figure B.63: Imperfections left flange channel T15414-10

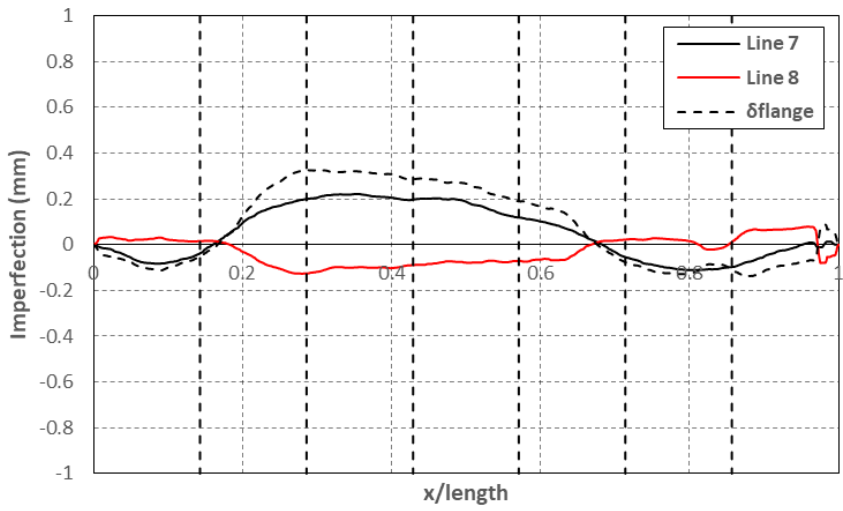
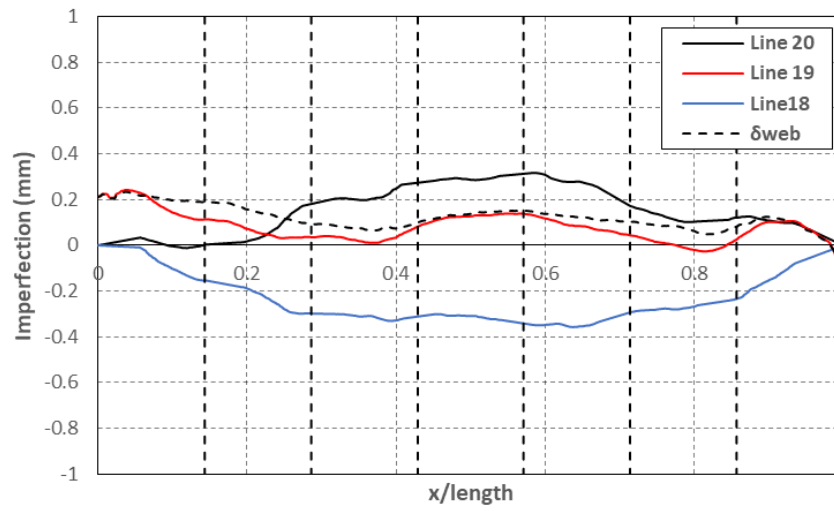
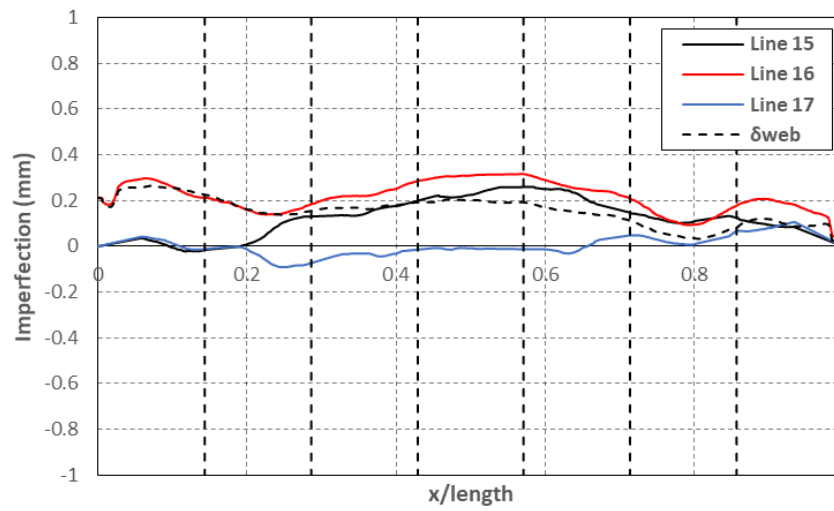


Figure B.64: Imperfections right flange channel T15414-10

B.2.6 SC2-6b**Figure B.65: Imperfections web channel T7912-11****Figure B.66: Imperfections web channel T7912-12**

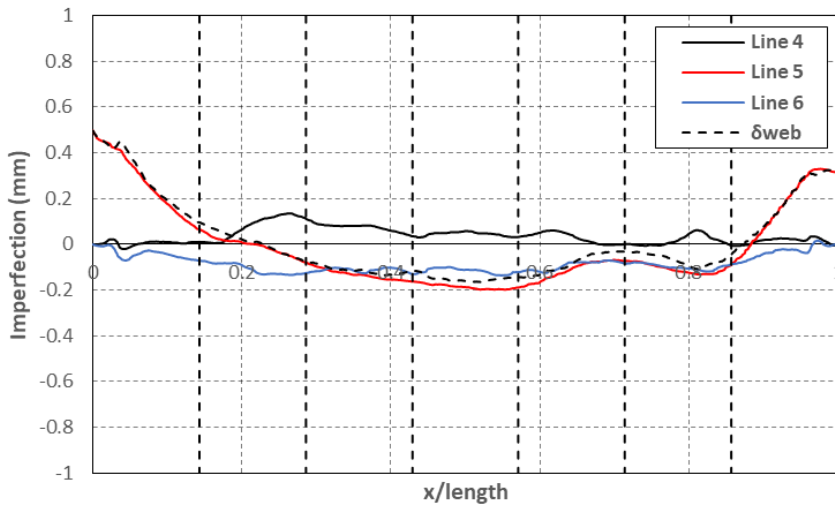


Figure B.67: Imperfections web channel T15414-11

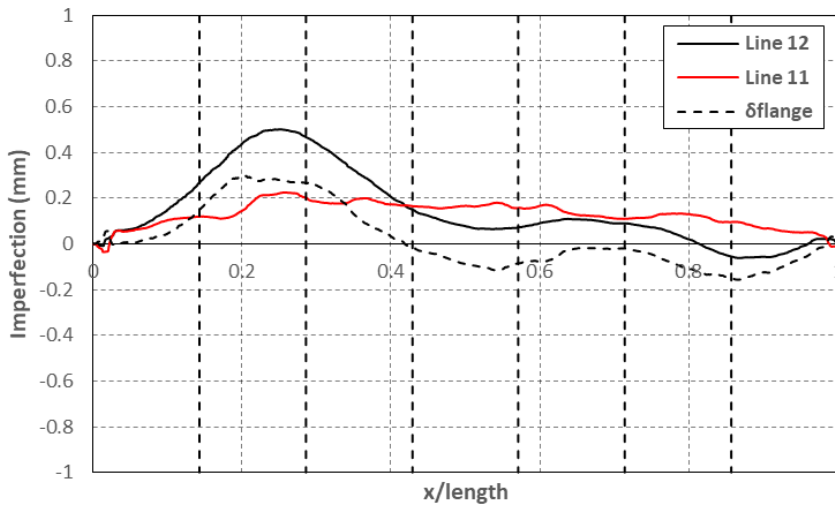


Figure B.68: Imperfections left flange channel T15414-11

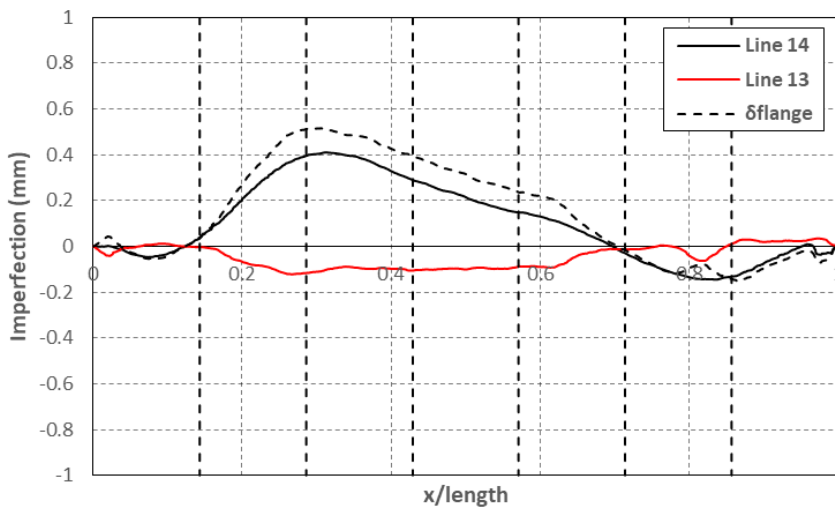


Figure B.69: Imperfections right flange channel T15414-11

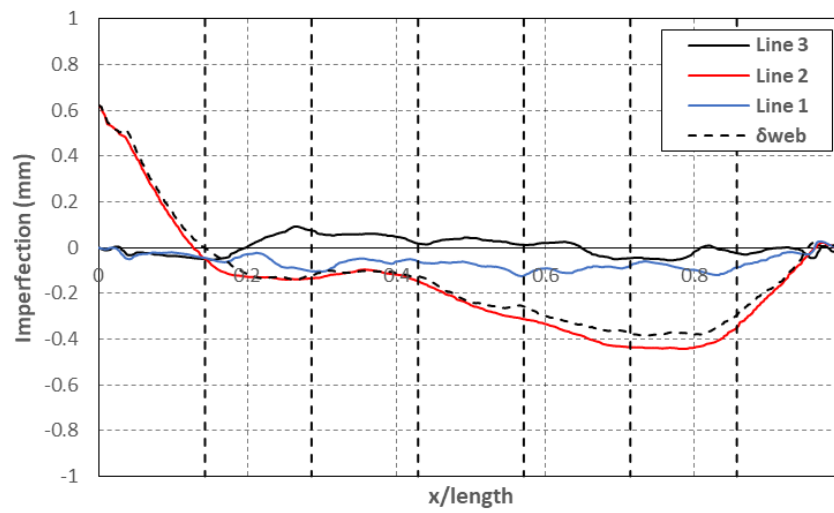


Figure B.70: Imperfections web channel T15414-12

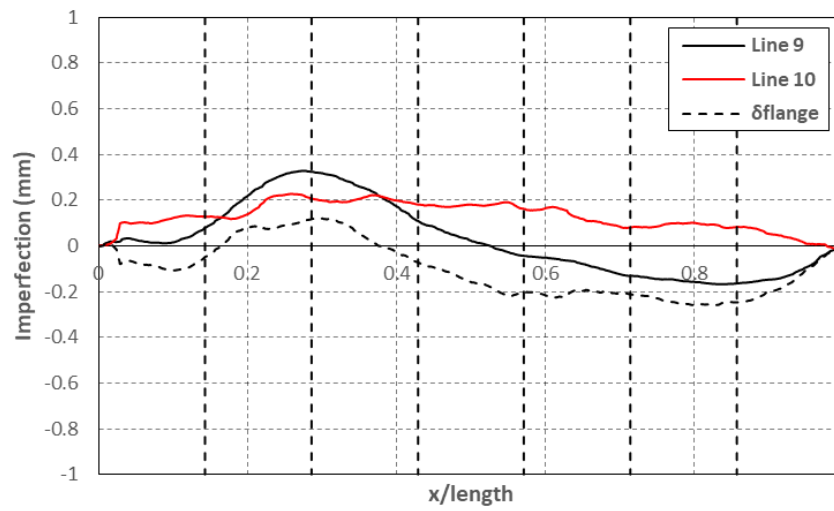


Figure B.71: Imperfections left flange channel T15414-12

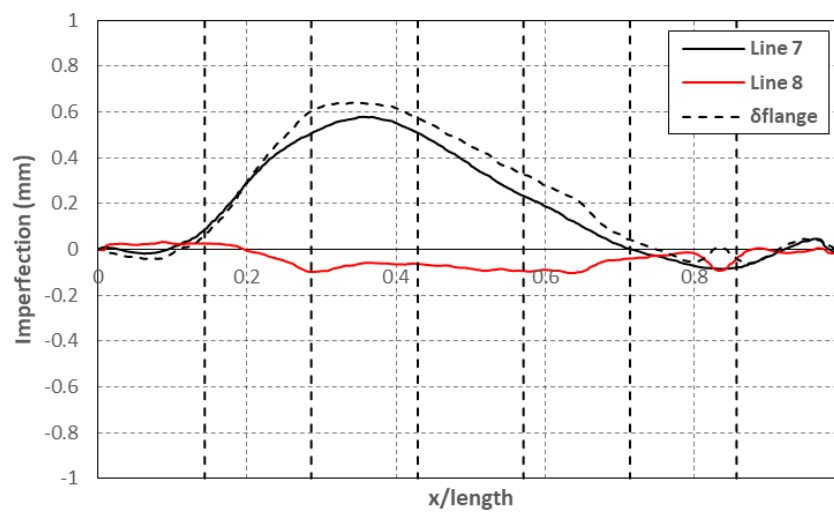


Figure B.72: Imperfections right flange channel T15414-12

B.3. Built-up geometry 3 (SC3)

B.3.1 SC3-2a

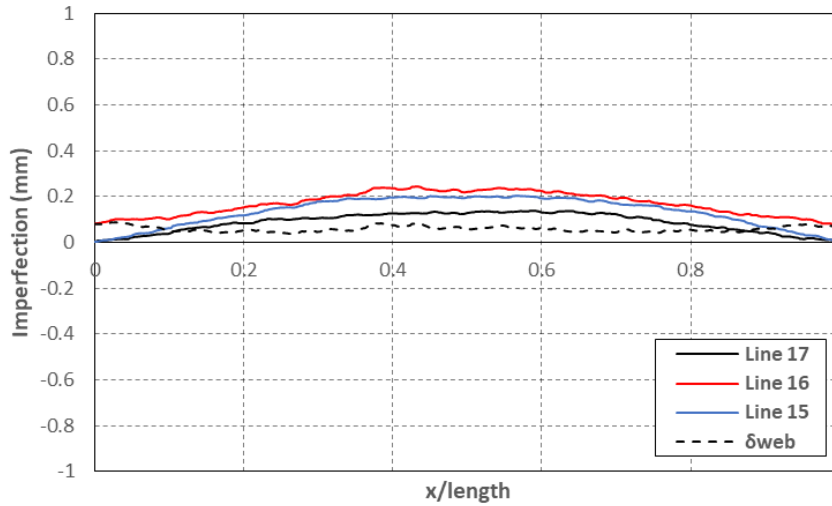


Figure B.73: Imperfections web channel S11012-1

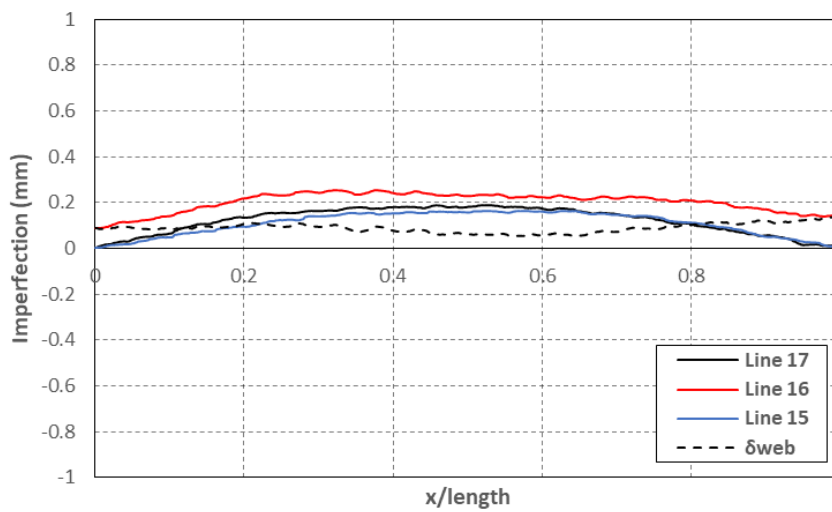


Figure B.74: Imperfections web channel S11012-2

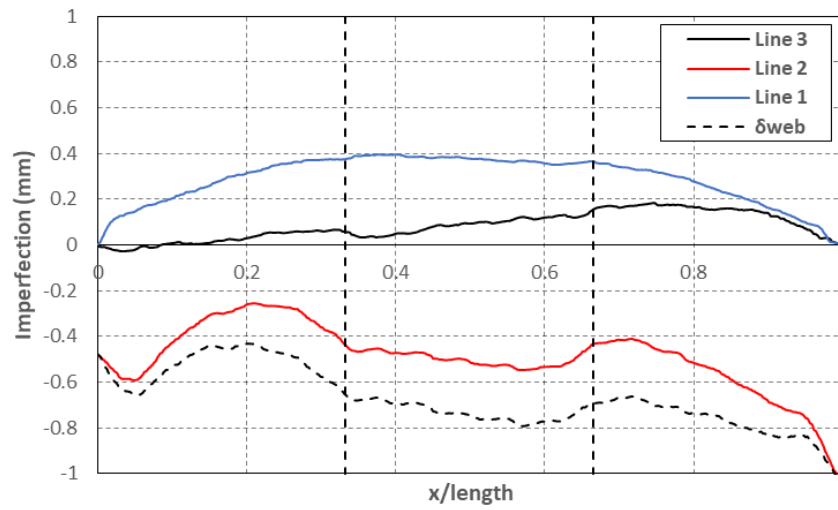


Figure B.75: Imperfections web channel T12012-1

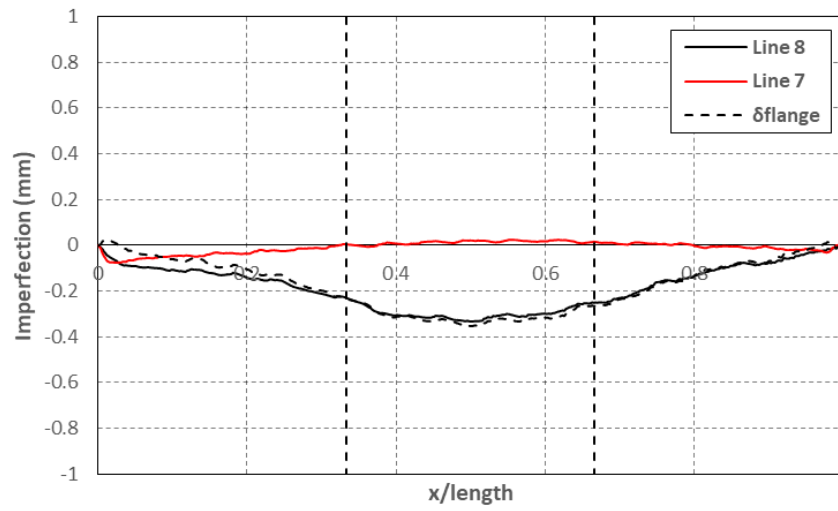


Figure B.76: Imperfections left flange channel T12012-1

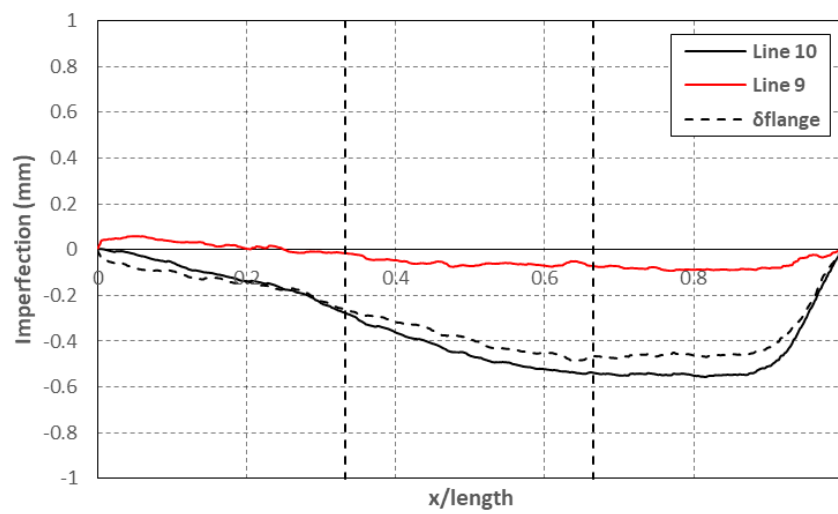


Figure B.77: Imperfections right flange channel T12012-1

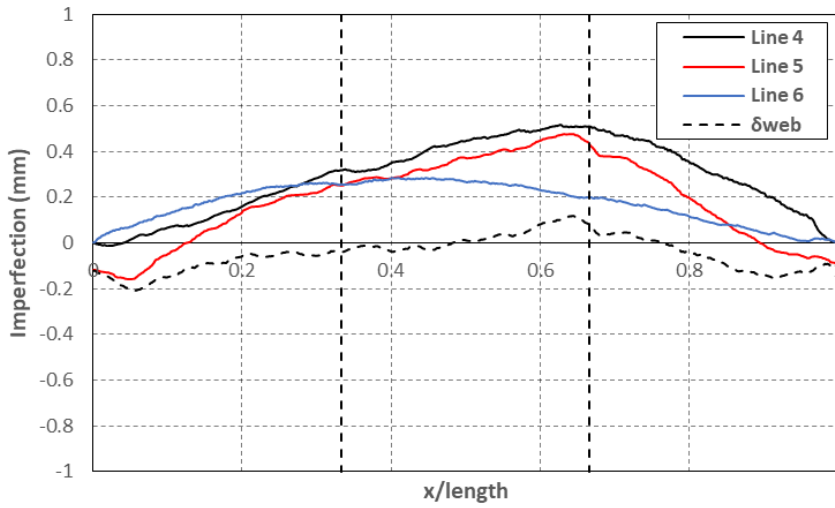


Figure B.78: Imperfections web channel T12012-2

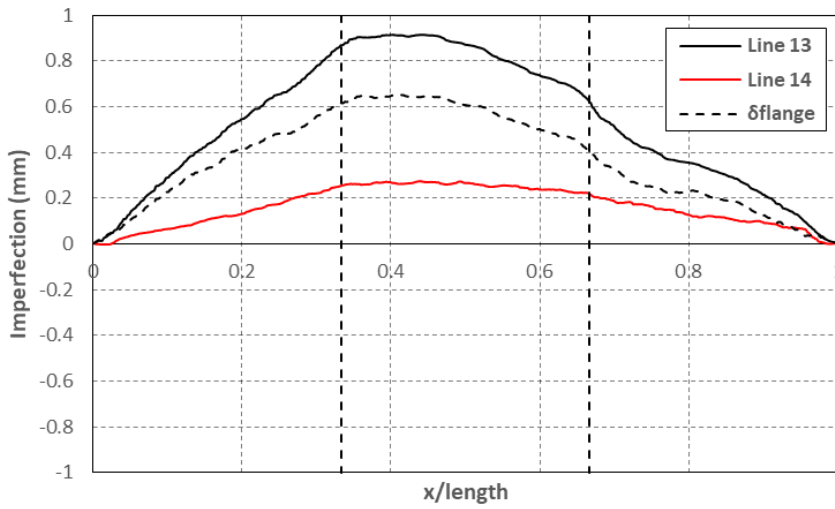


Figure B.79: Imperfections left flange channel T12012-2

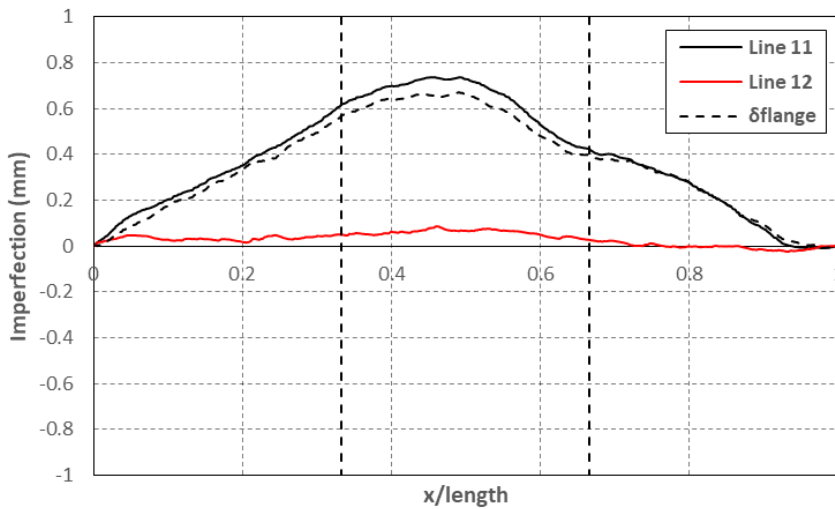
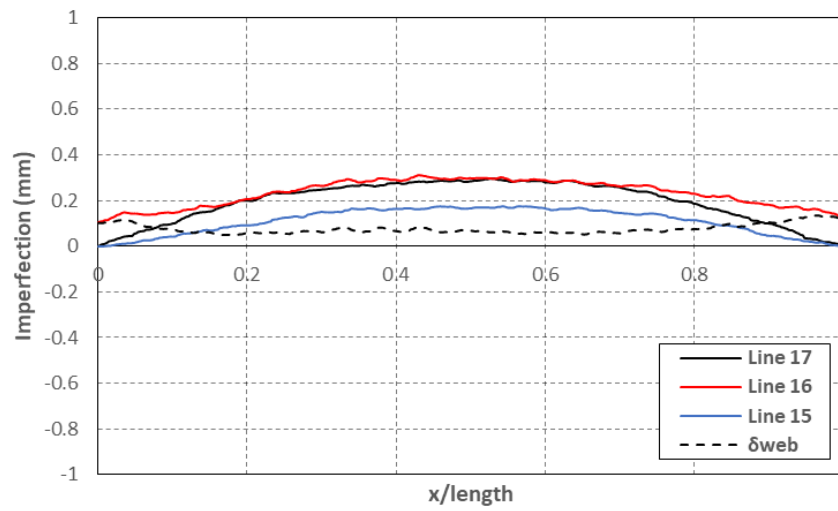
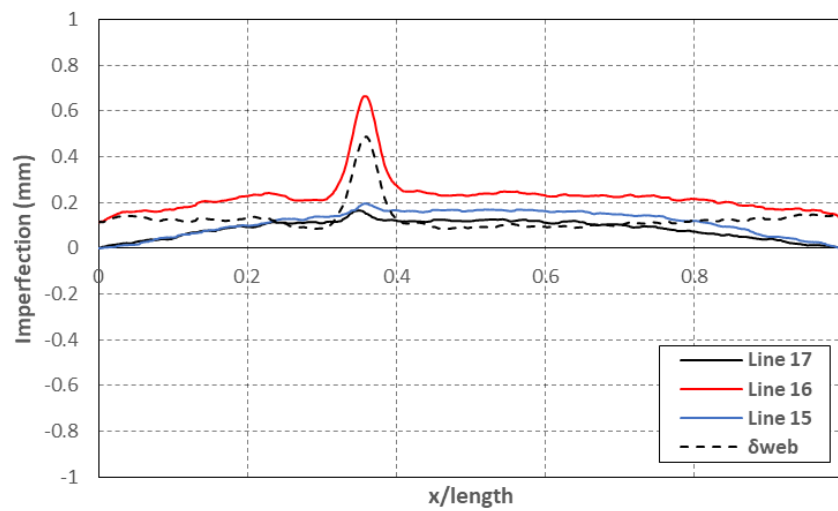


Figure B.80: Imperfections right flange channel T12012-2

B.3.2 SC3-2b**Figure B.81: Imperfections web channel S11012-3****Figure B.82: Imperfections web channel S11012-4**

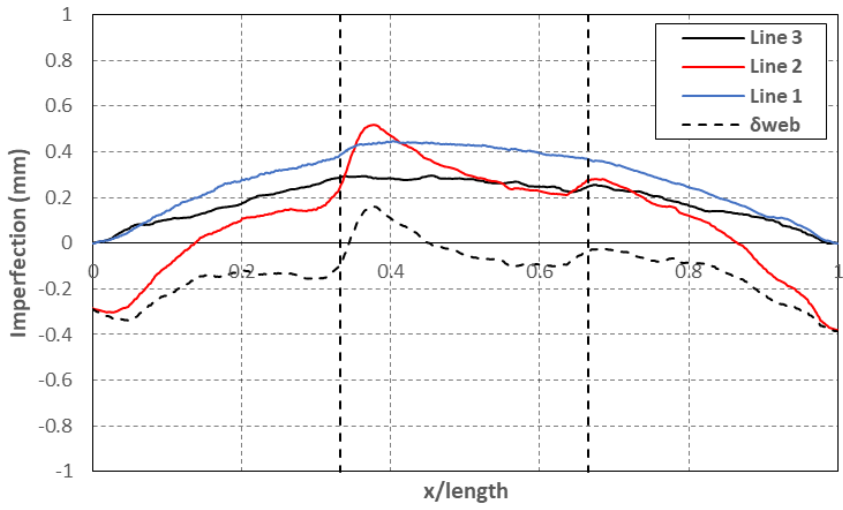


Figure B.83: Imperfections web channel T12012-3

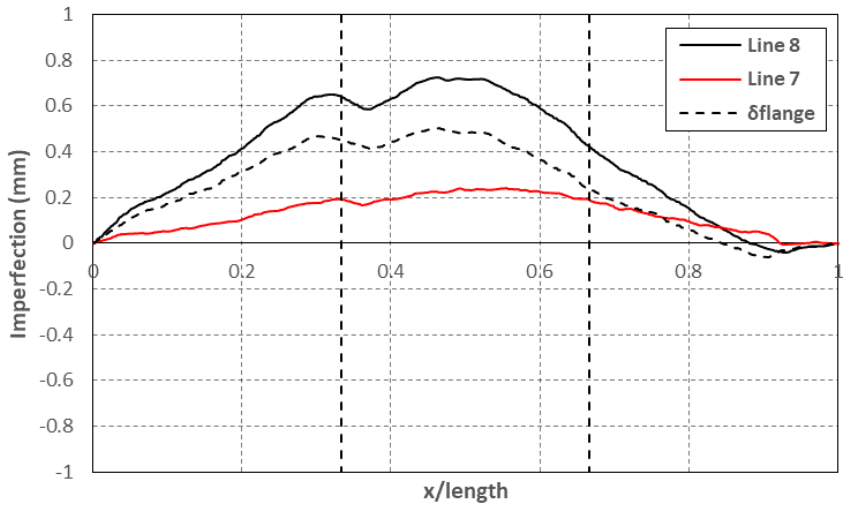


Figure B.84: Imperfections left flange channel T12012-3

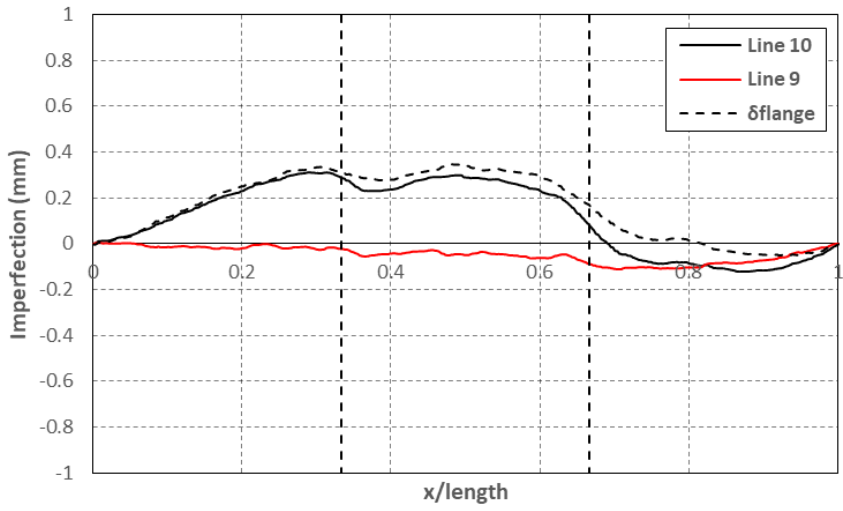
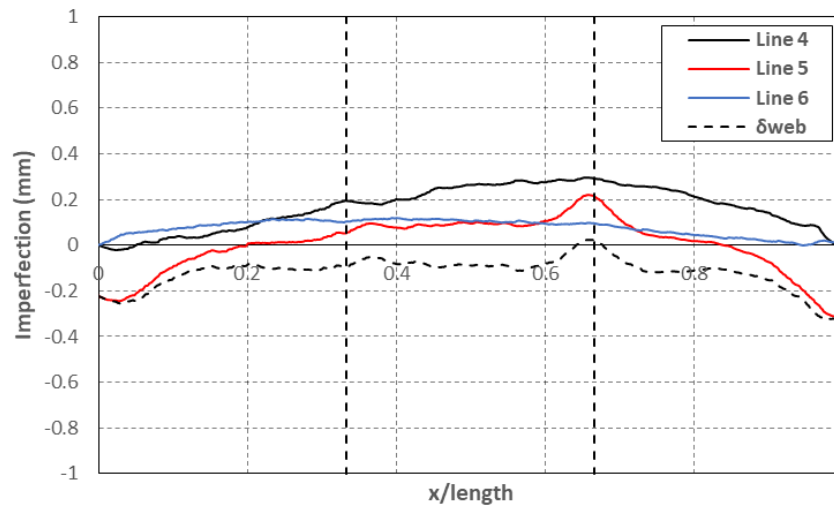
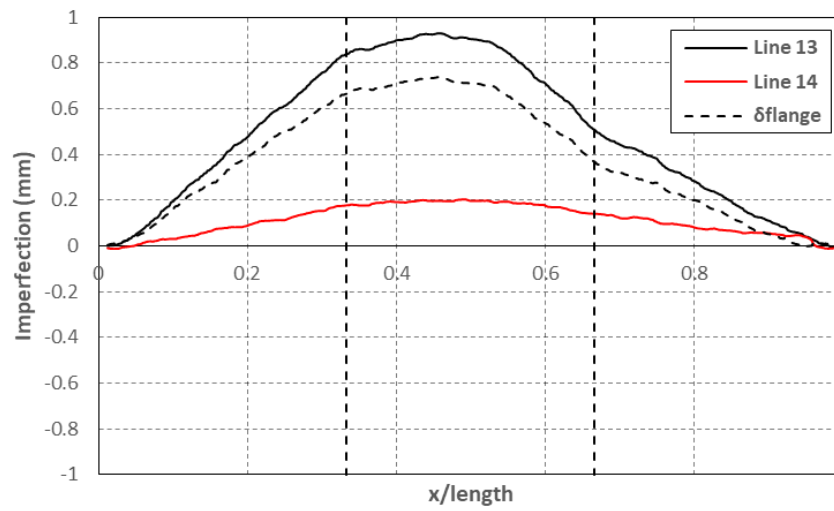
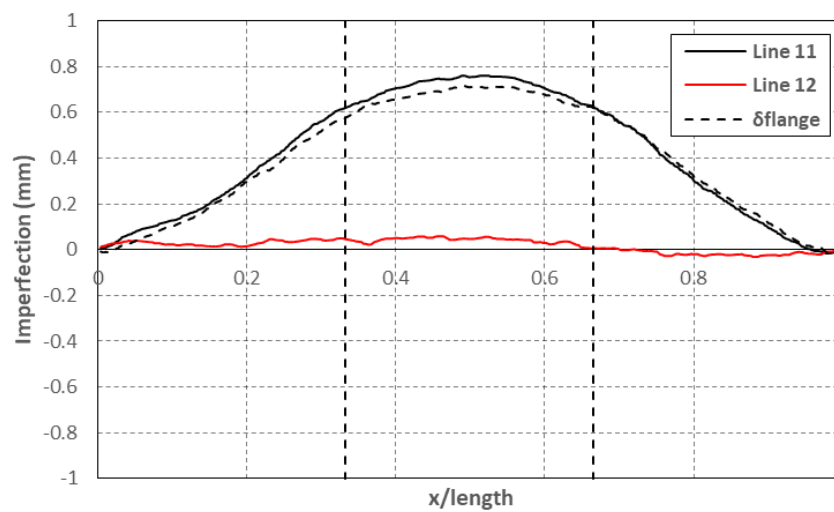


Figure B.85: Imperfections right flange channel T12012-3

**Figure B.86: Imperfections web channel T12012-4****Figure B.87: Imperfections left flange channel T12012-4****Figure B.88: Imperfections right flange channel T12012-4**

B.3.3 SC3-5a

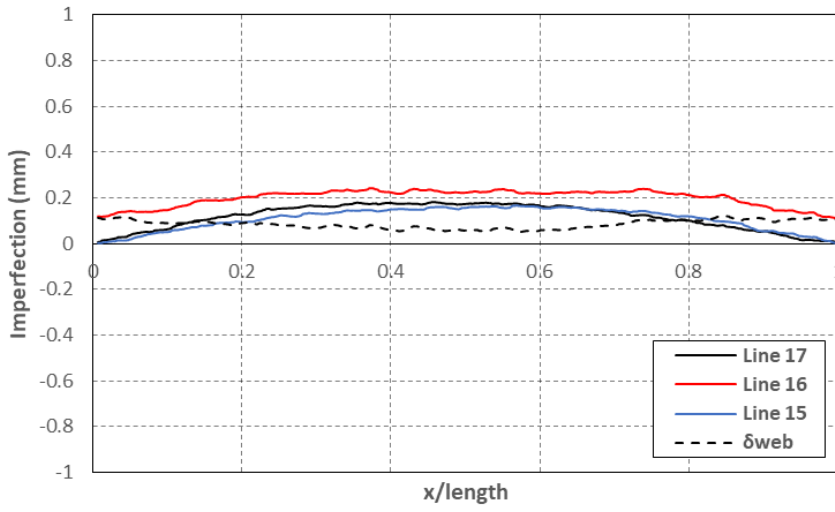


Figure B.89: Imperfections web channel S11012-5

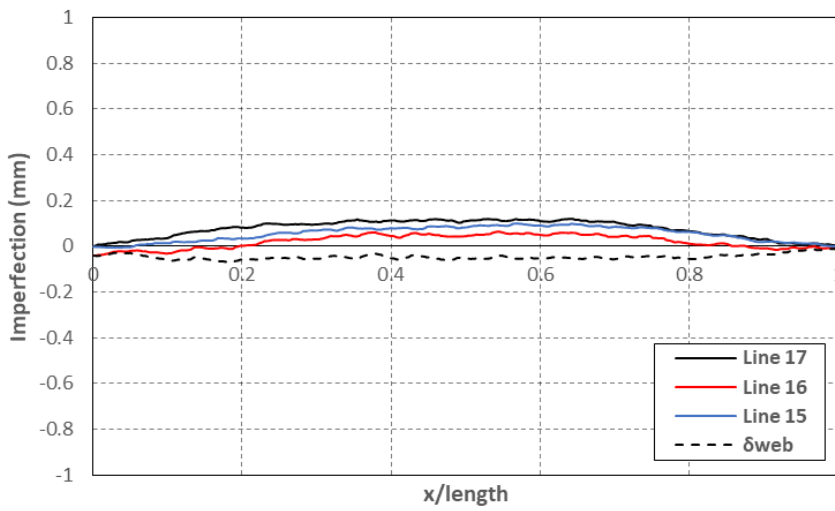


Figure B.90: Imperfections web channel S11012-6

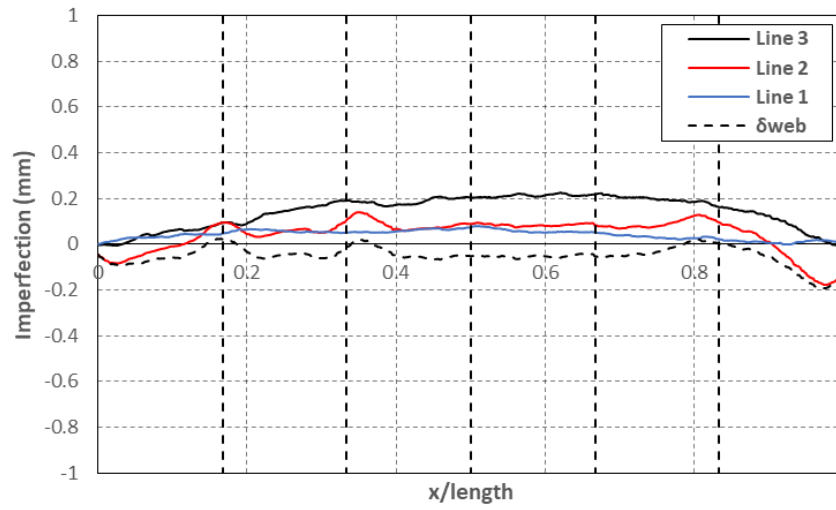


Figure B.91: Imperfections web channel T12012-5

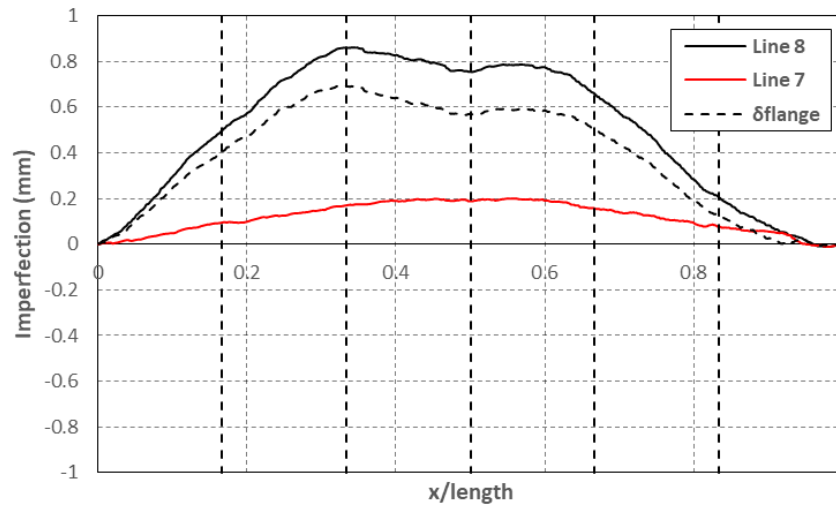


Figure B.92: Imperfections left flange channel T12012-5

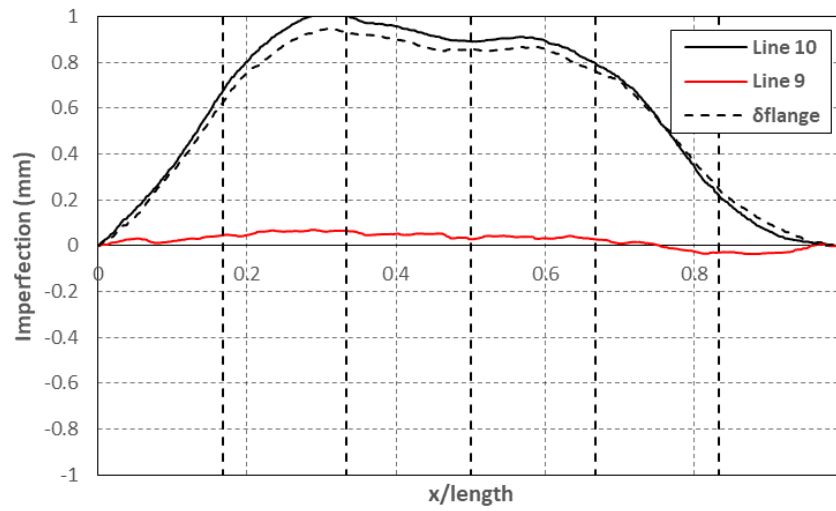


Figure B.93: Imperfections right flange channel T12012-5

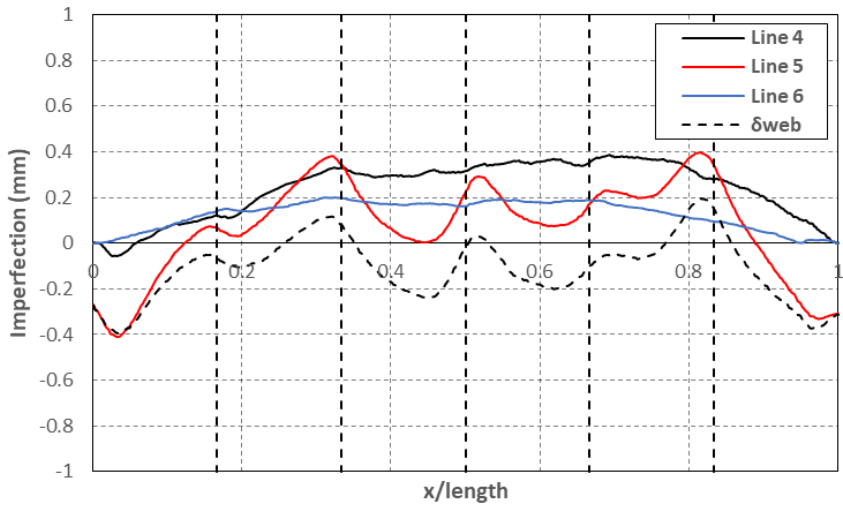


Figure B.94: Imperfections web channel T12012-6

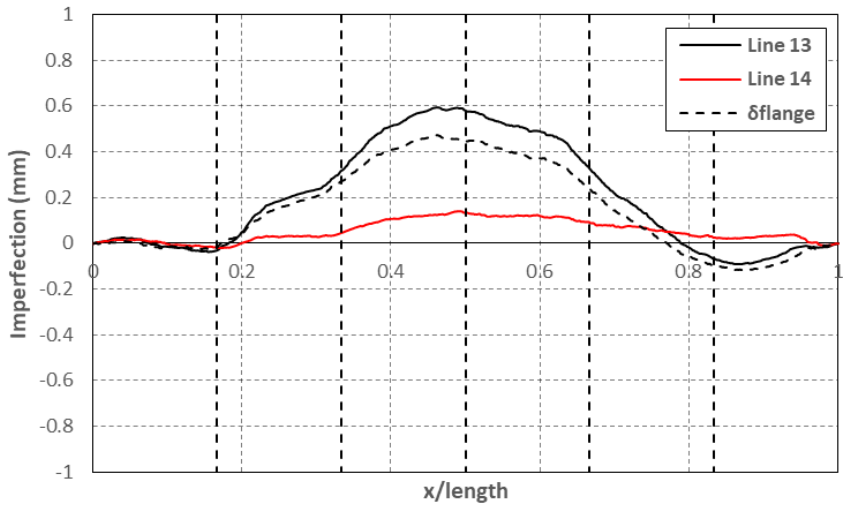


Figure B.95: Imperfections left flange channel T12012-6

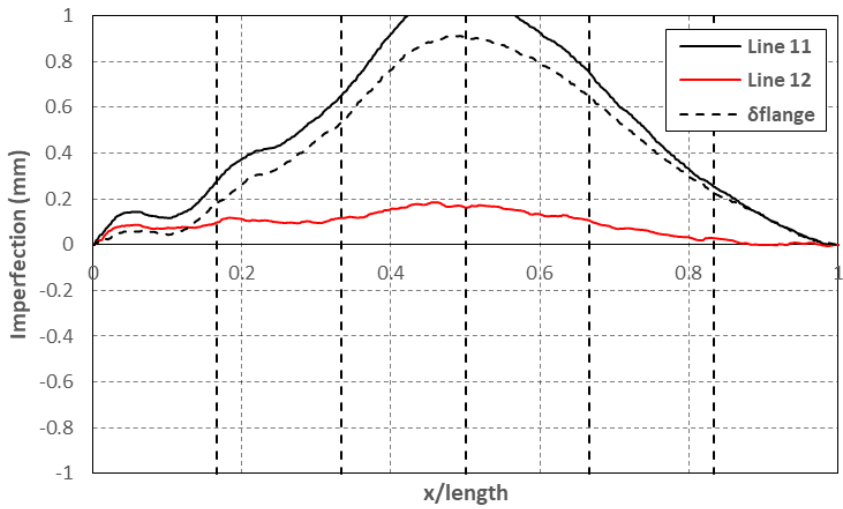
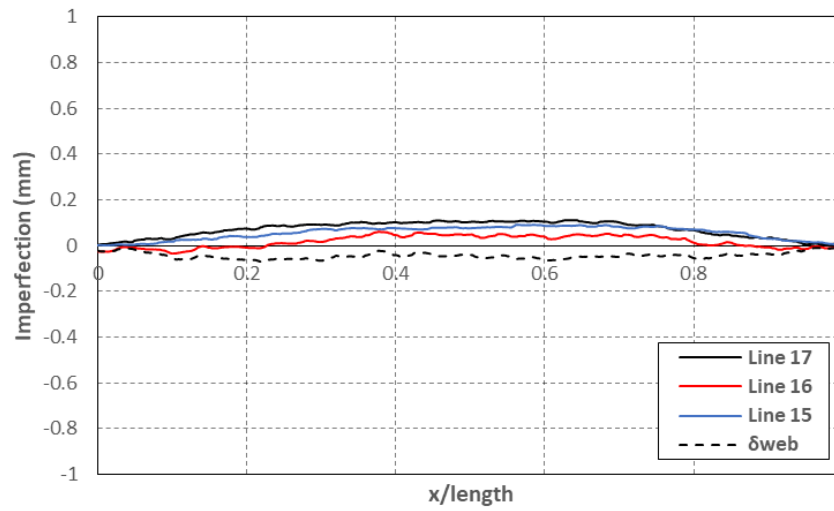
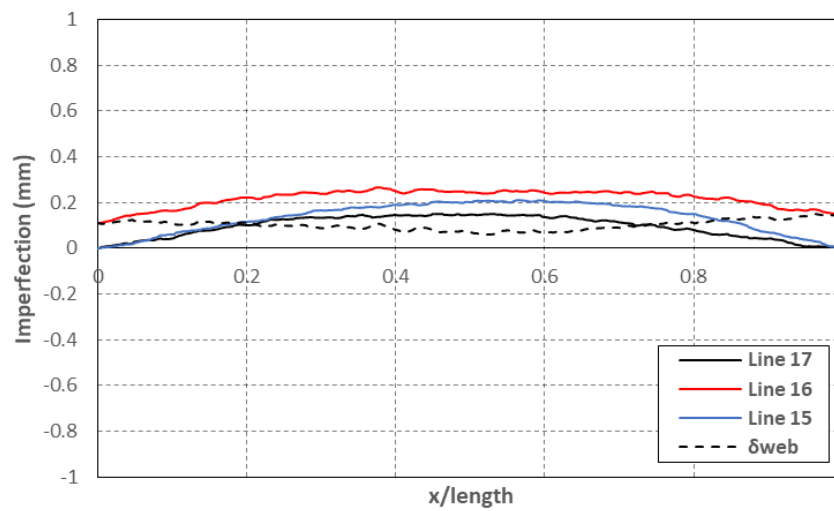


Figure B.96: Imperfections right flange channel T12012-6

B.3.4 SC3-5b**Figure B.97: Imperfections web channel S11012-7****Figure B.98: Imperfections web channel S11012-8**

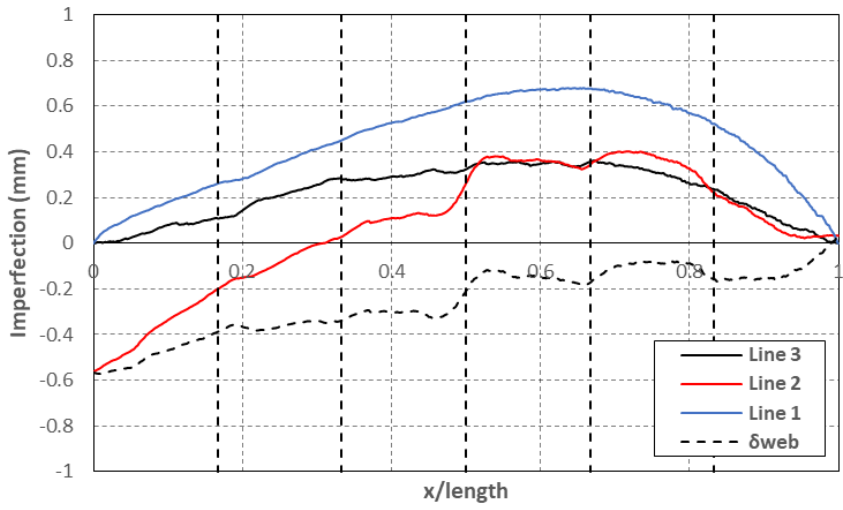


Figure B.99: Imperfections web channel T12012-7

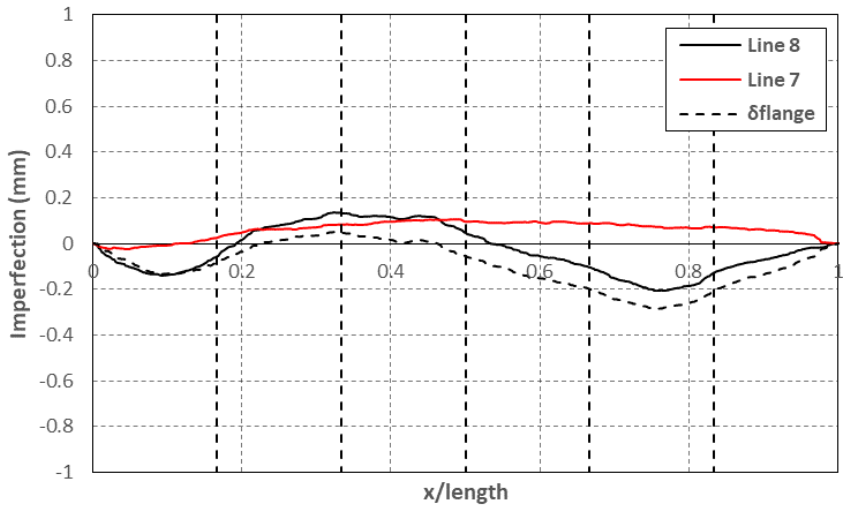


Figure B.100: Imperfections left flange channel T12012-7

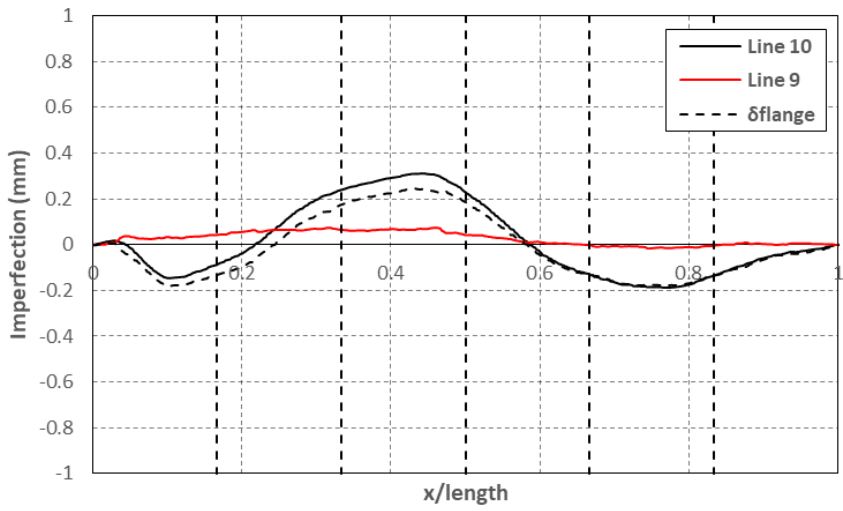
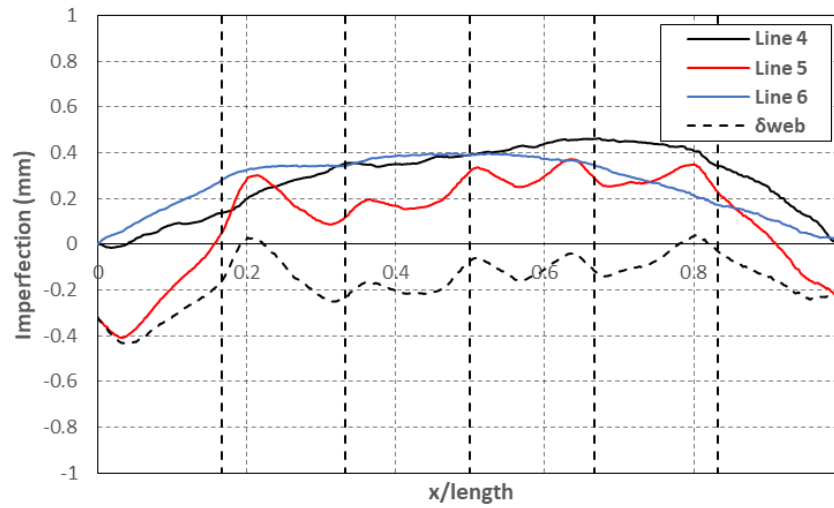
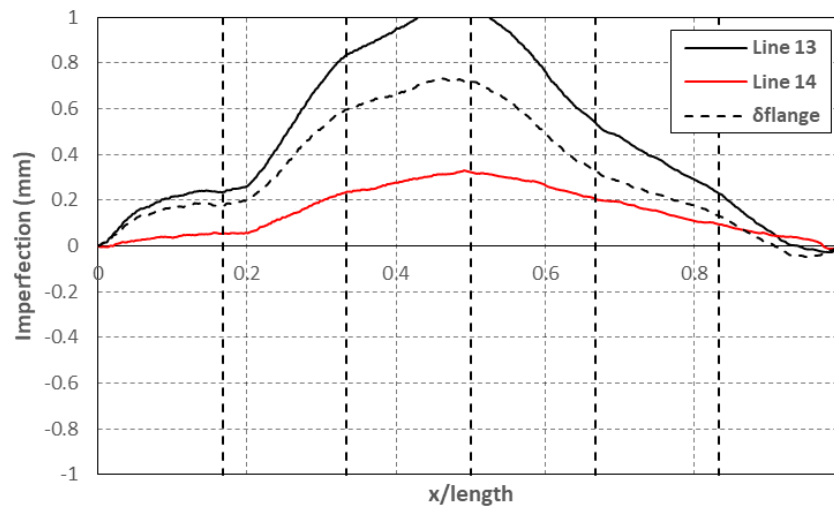
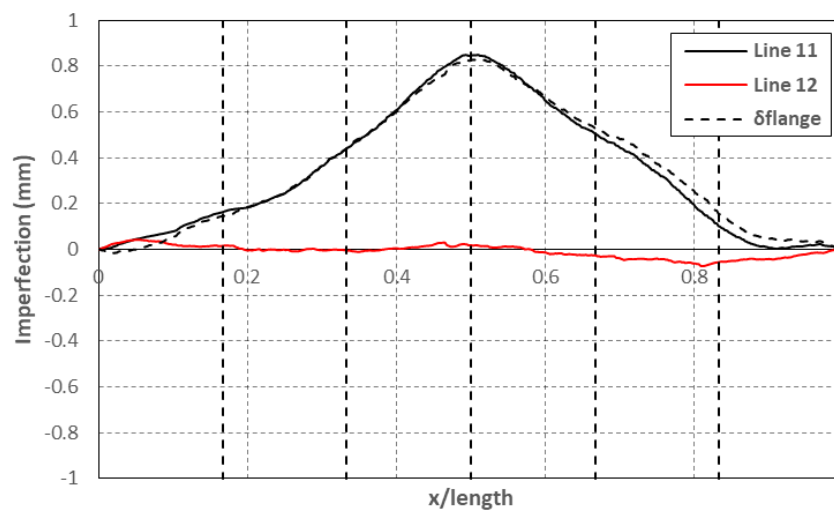


Figure B.101: Imperfections right flange channel T12012-7

**Figure B.102: Imperfections web channel T12012-8****Figure B.103: Imperfections left flange channel T12012-8****Figure B.104: Imperfections right flange channel T12012-8**

B.4. Built-up geometry 4 (SC4)

B.4.1 SC4-2a

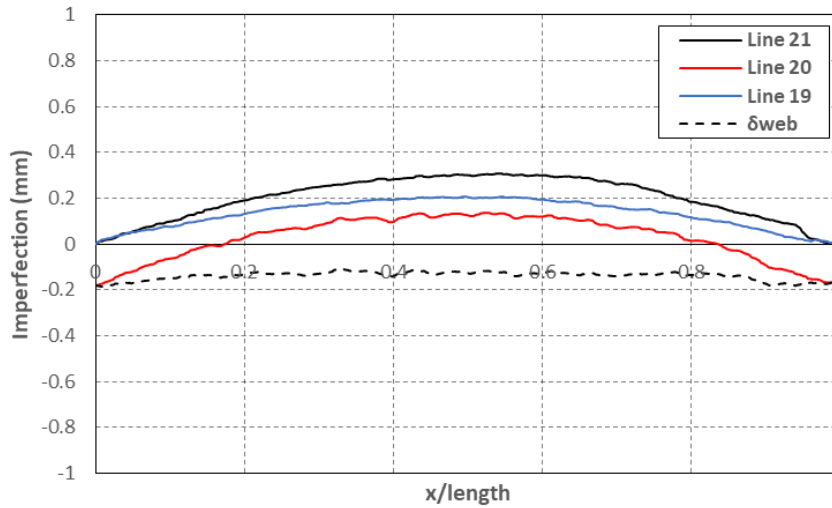


Figure B.105: Imperfections web channel T12012-9

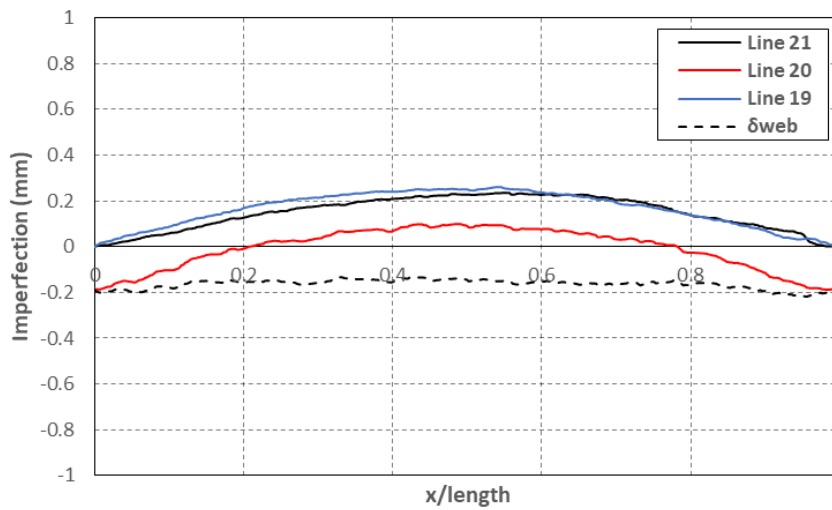


Figure B.106: Imperfections web channel T12012-10

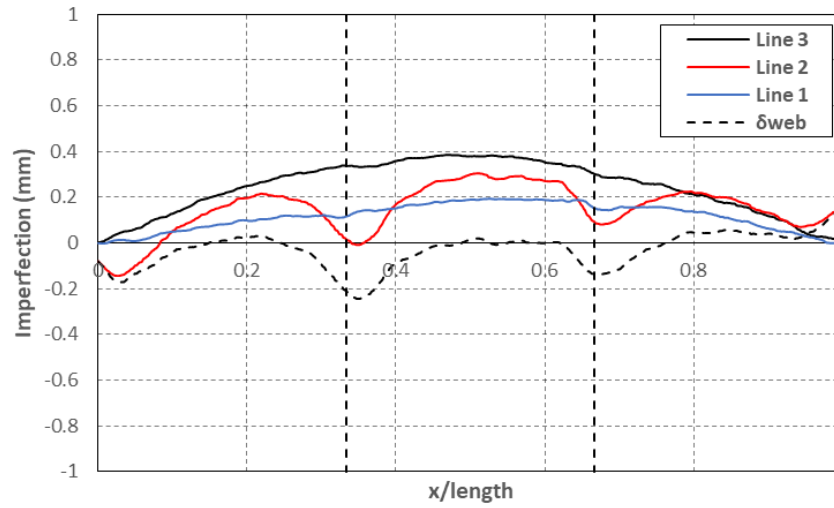


Figure B.107: Imperfections web channel S11012-9

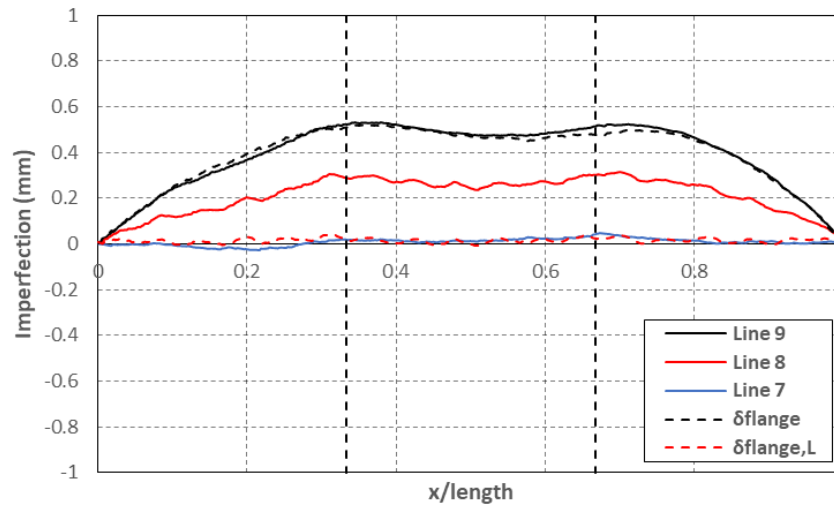


Figure B.108: Imperfections left flange channel S11012-9

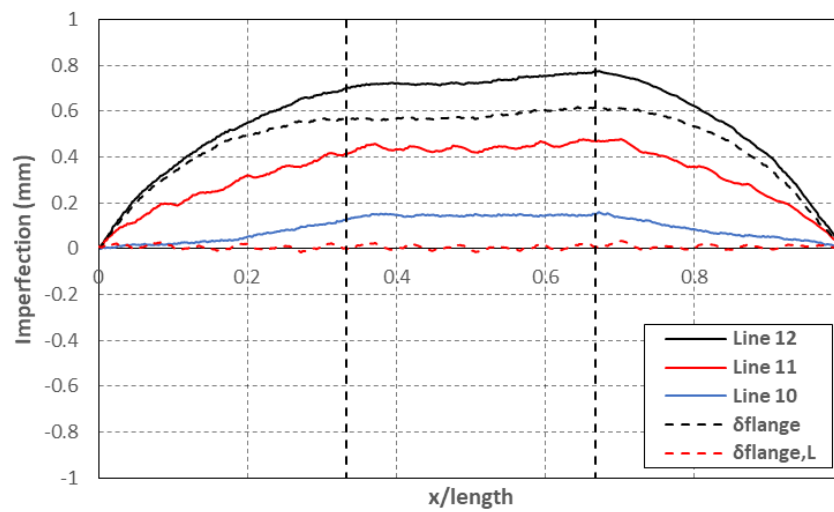


Figure B.109: Imperfections right flange channel S11012-9

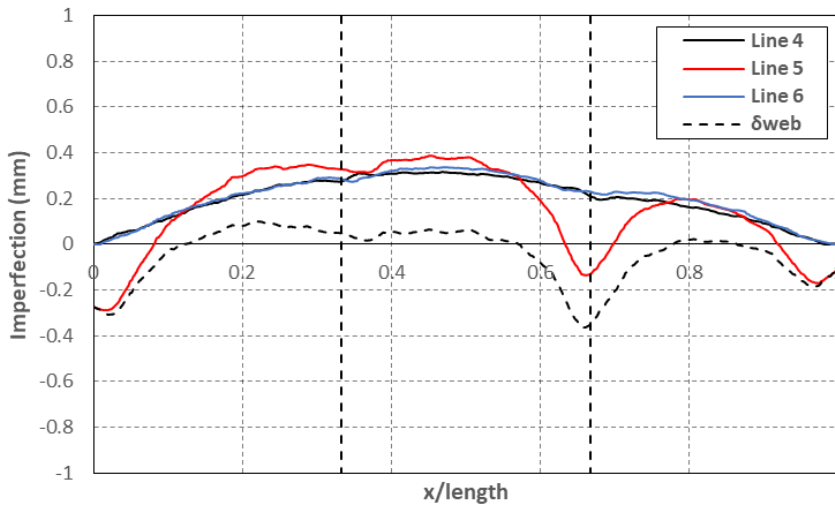


Figure B.110: Imperfections web channel S11012-10

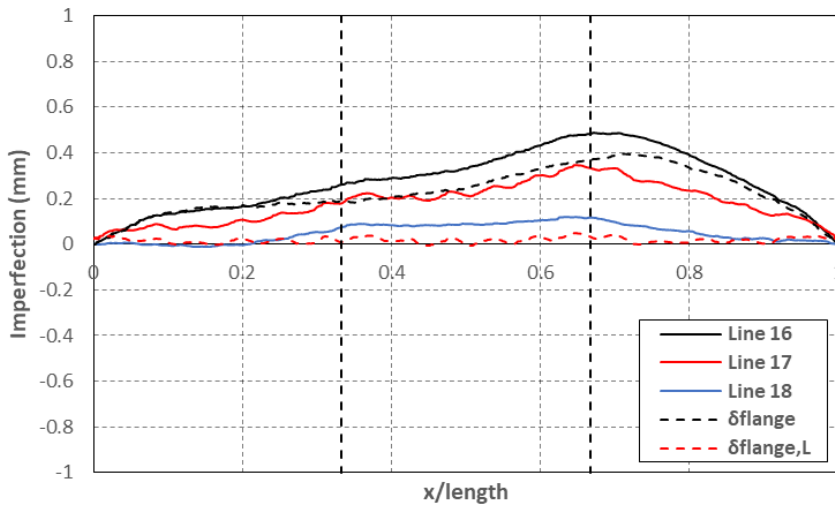


Figure B.111: Imperfections left flange channel S11012-10

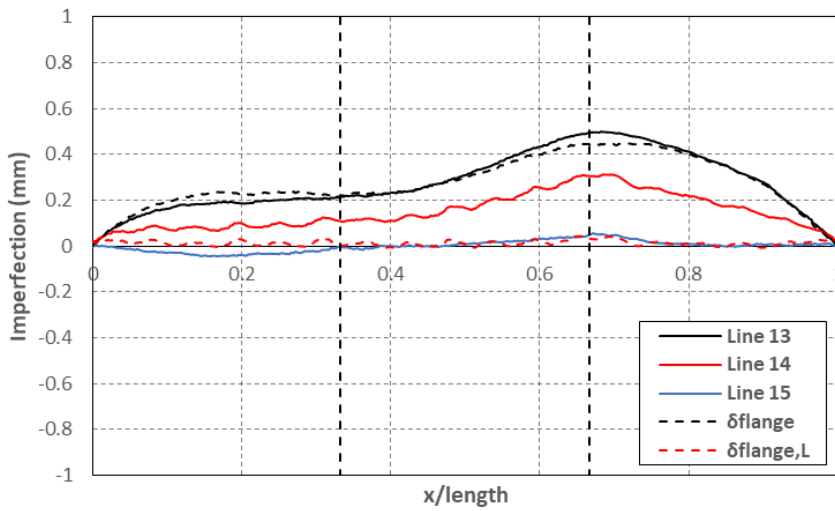


Figure B.112: Imperfections right flange channel S11012-10

B.4.2 SC4-2b

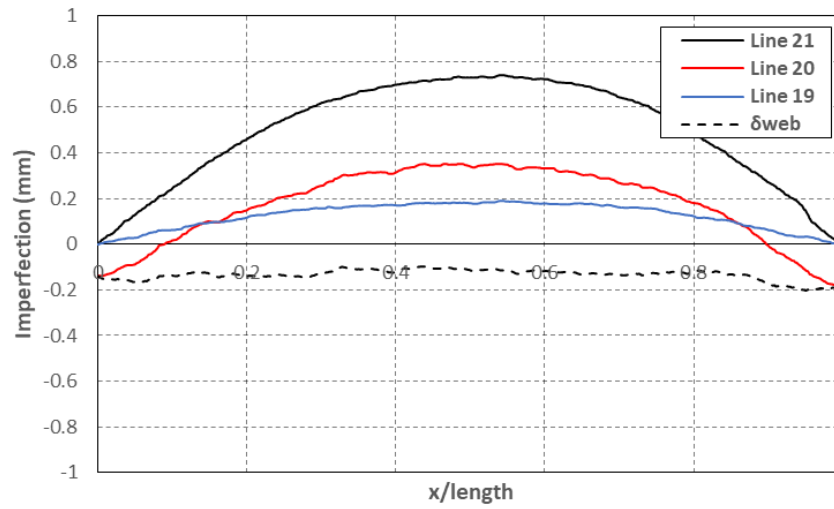


Figure B.113: Imperfections web channel T12012-11

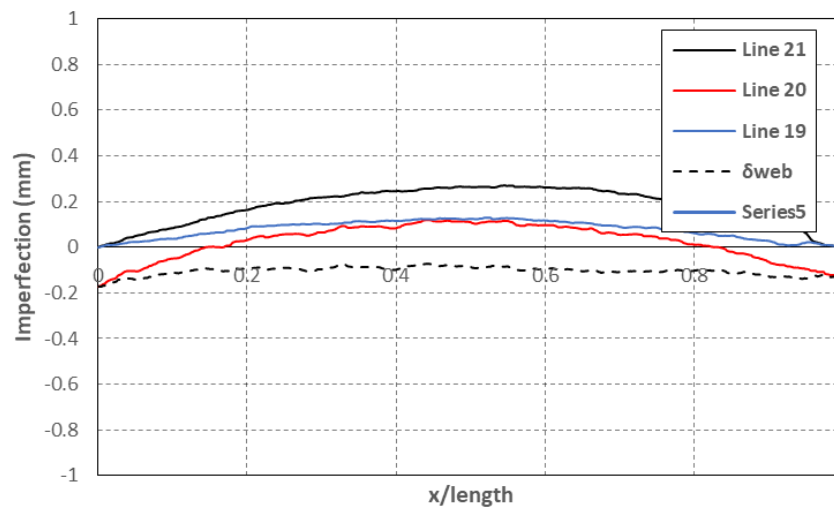


Figure B.114: Imperfections web channel T12012-12

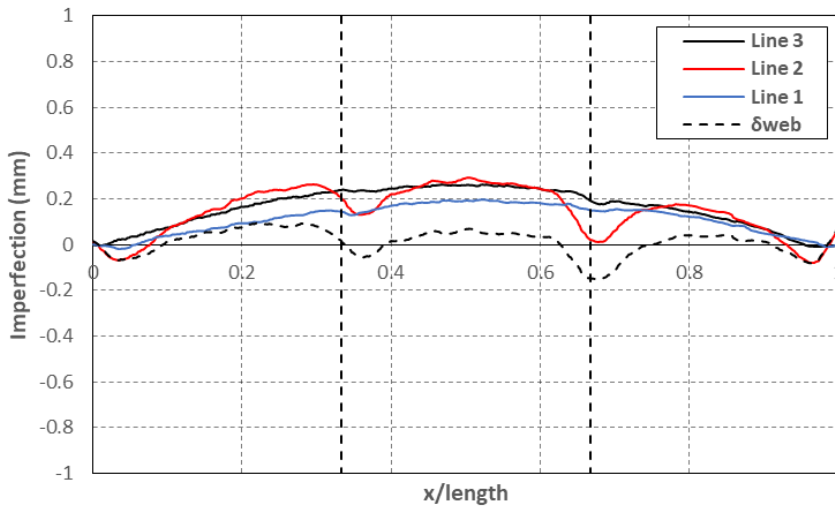


Figure B.115: Imperfections web channel S11012-11

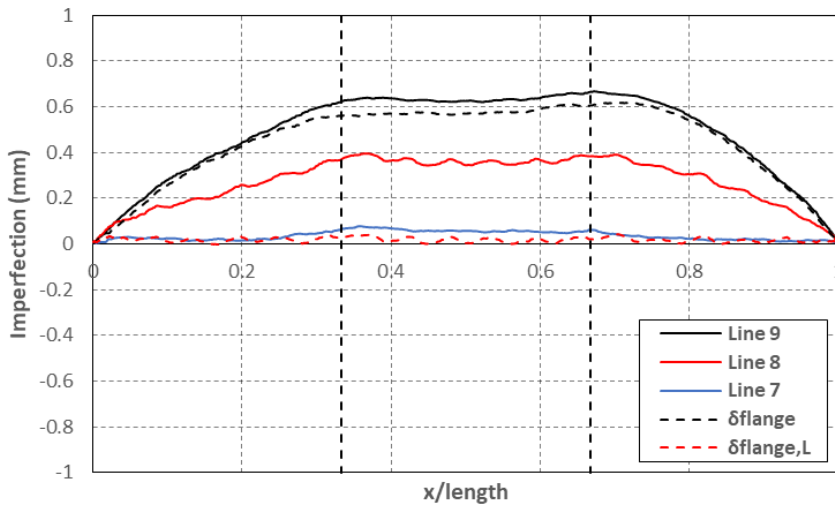


Figure B.116: Imperfections left flange channel S11012-11

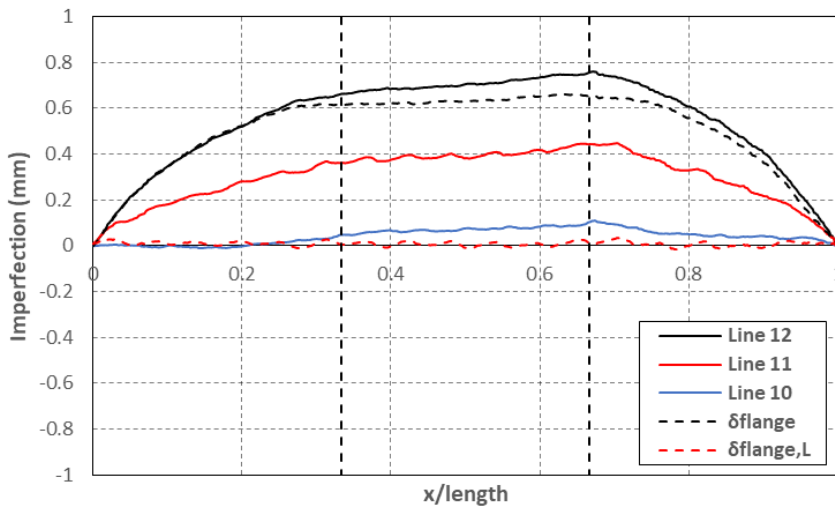


Figure B.117: Imperfections right flange channel S11012-11

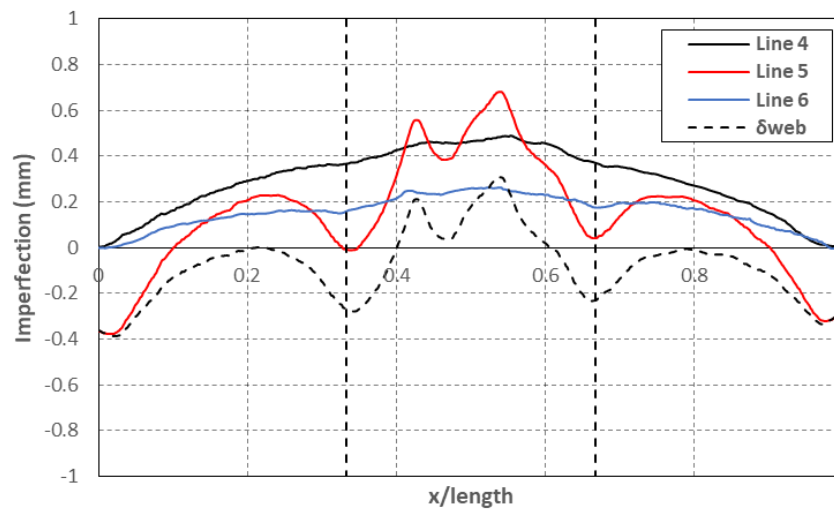


Figure B.118: Imperfections web channel S11012-12

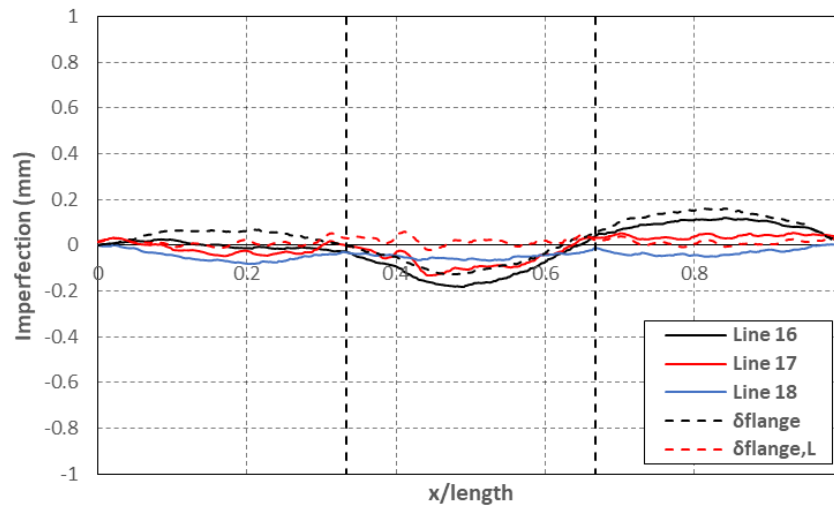


Figure B.119: Imperfections left flange channel S11012-12

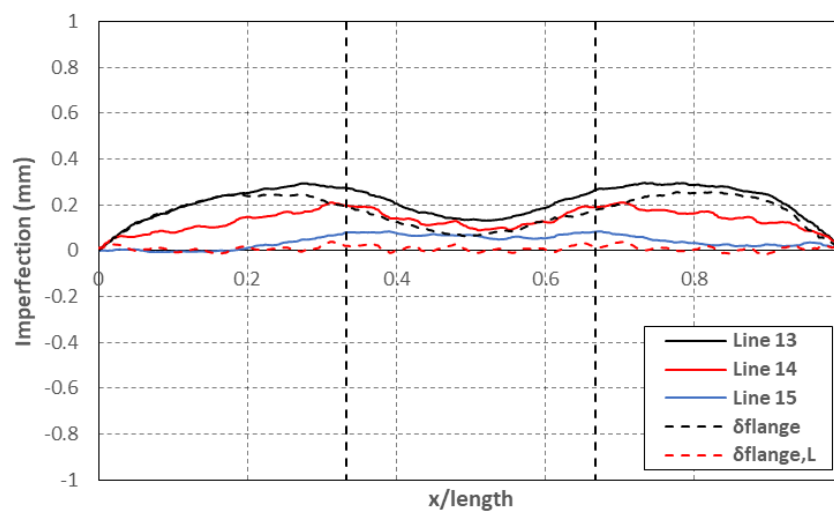


Figure B.120: Imperfections right flange channel S11012-12

B.4.3 SC4-5a

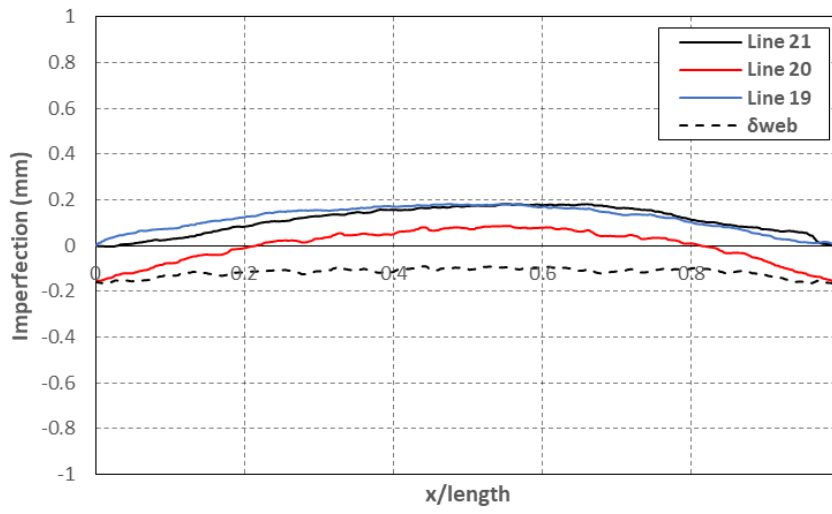


Figure B.121: Imperfections web channel T12012-13

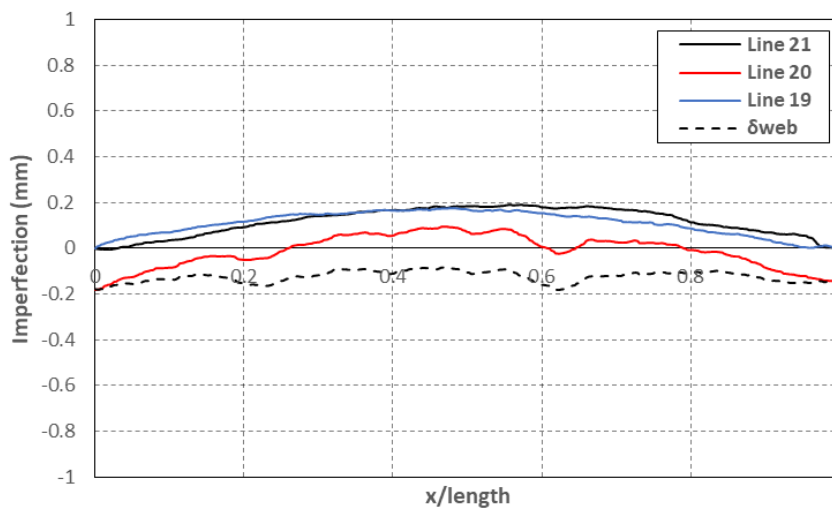


Figure B.122: Imperfections web channel T12012-14

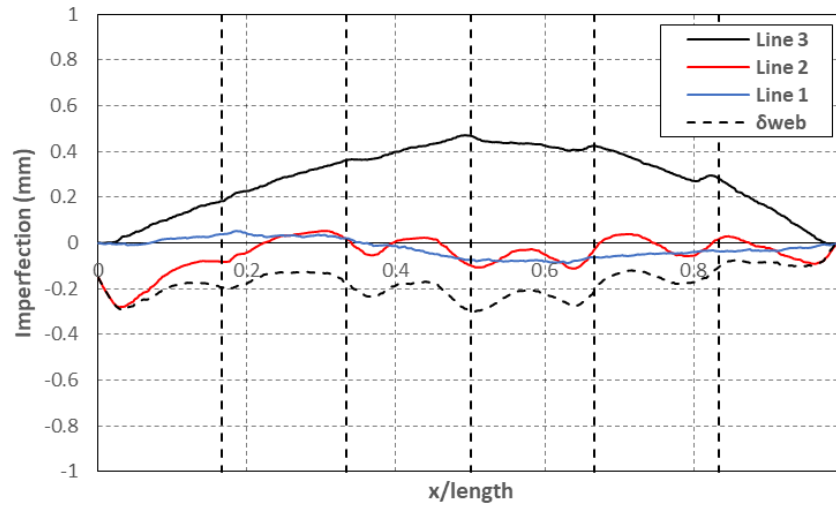


Figure B.123: Imperfections web channel S11012-13

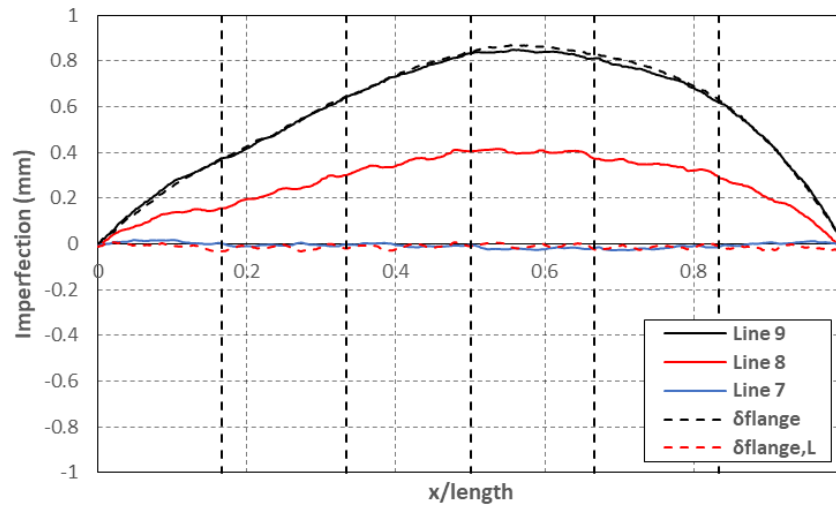


Figure B.124: Imperfections left flange channel S11012-13

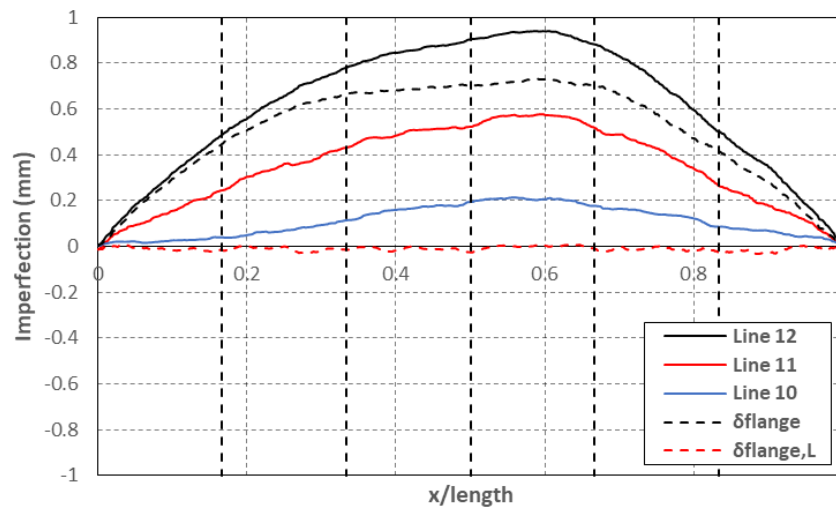


Figure B.125: Imperfections right flange channel S11012-13

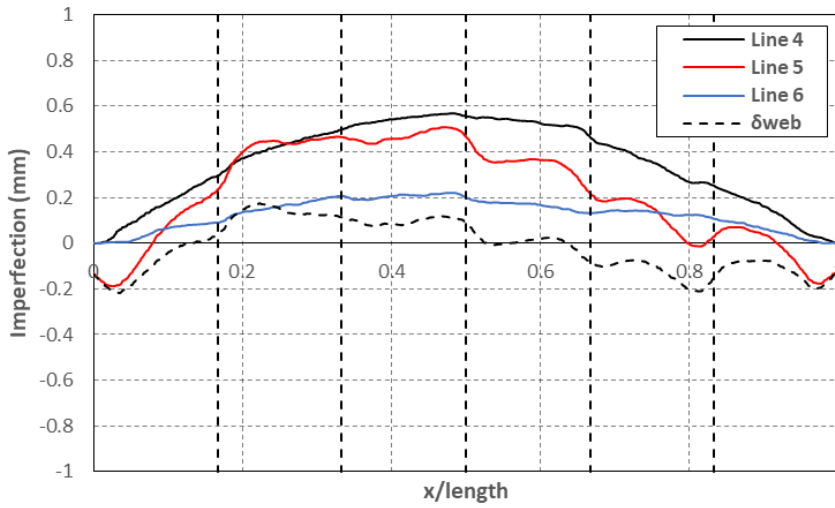


Figure B.126: Imperfections web channel S11012-14

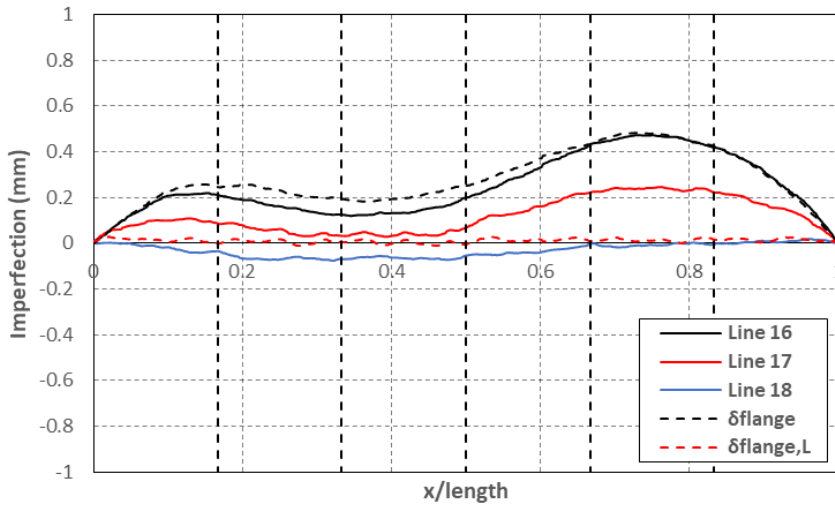


Figure B.127: Imperfections left flange channel S11012-14

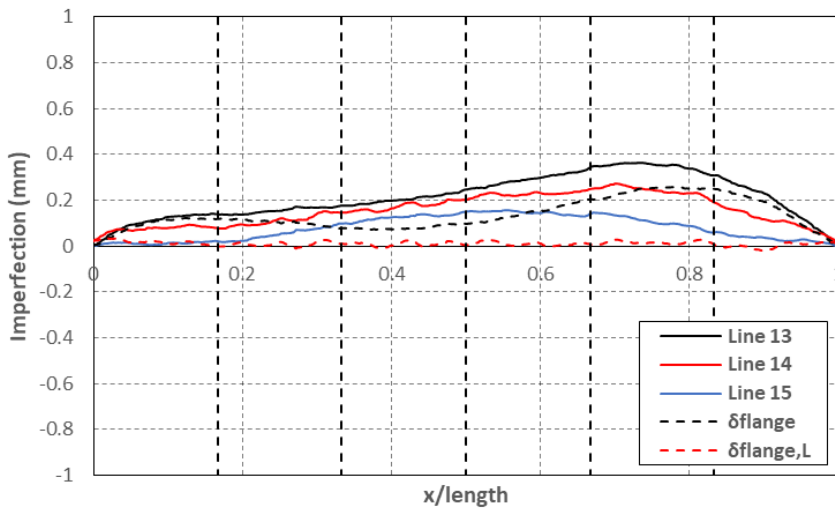
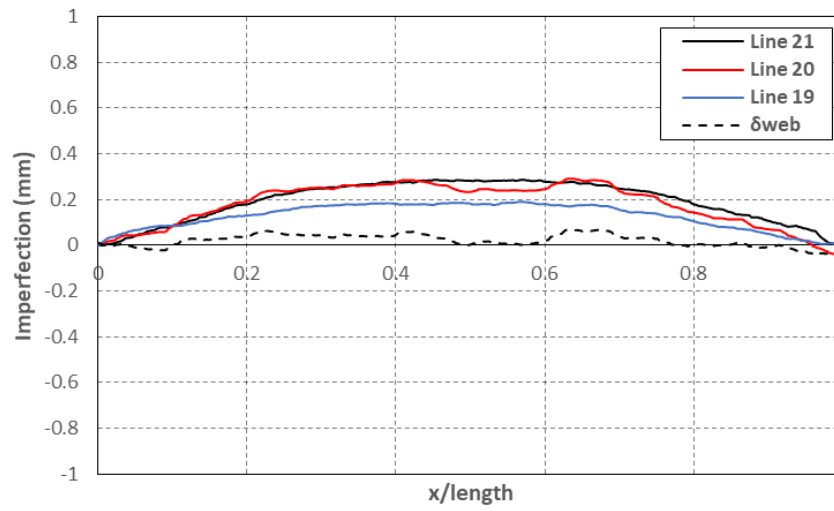
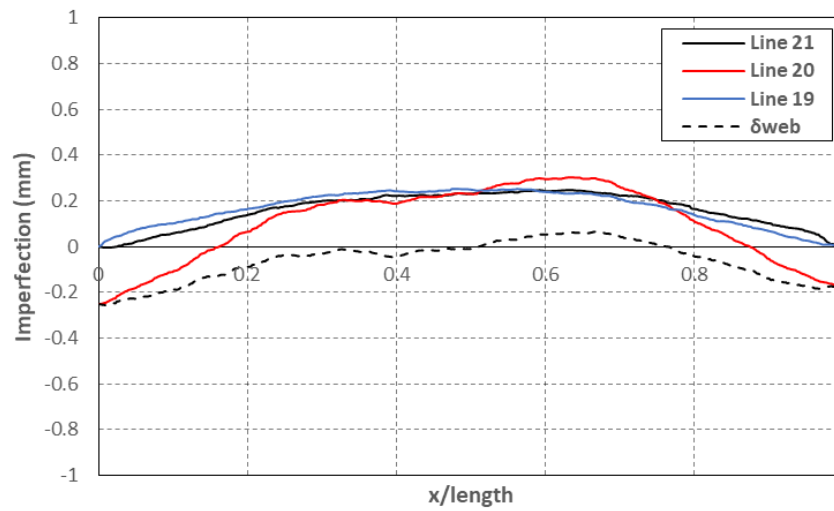


Figure B.128: Imperfections right flange channel S11012-14

B.4.4 SC4-5b**Figure B.129: Imperfections web channel T12012-15****Figure B.130: Imperfections web channel T12012-16**

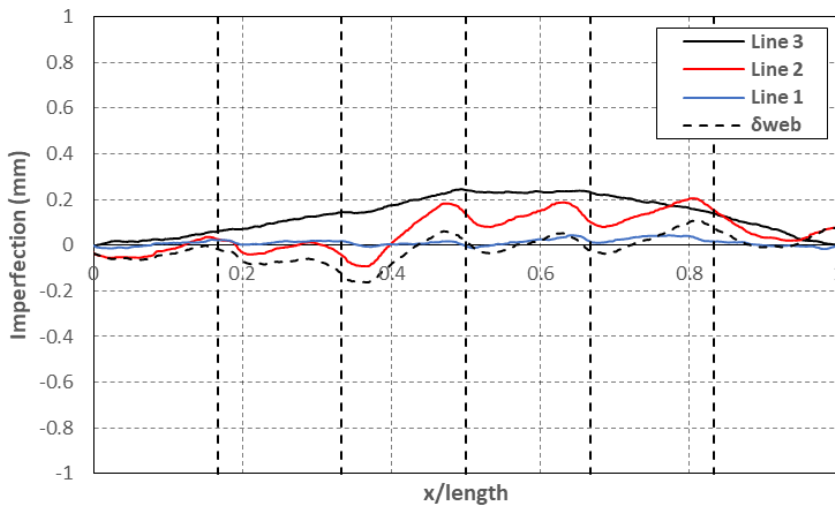


Figure B.131: Imperfections web channel S11012-15

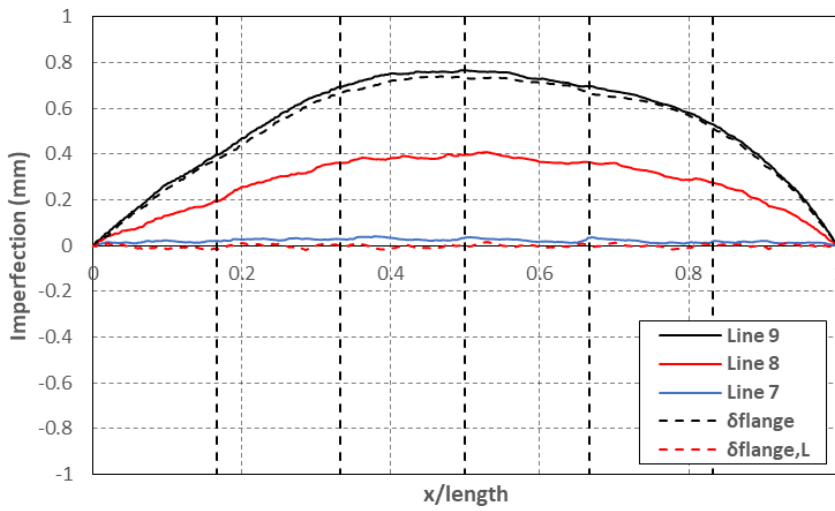


Figure B.132: Imperfections left flange channel S11012-15

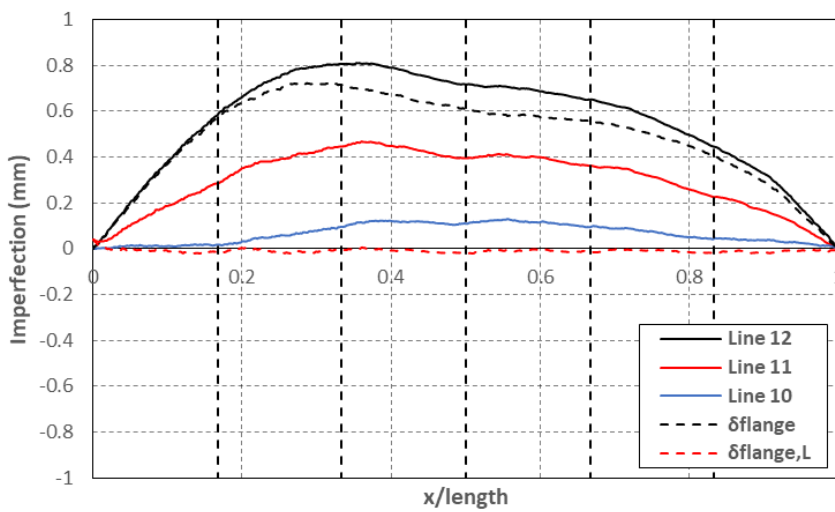


Figure B.133: Imperfections right flange channel S11012-15

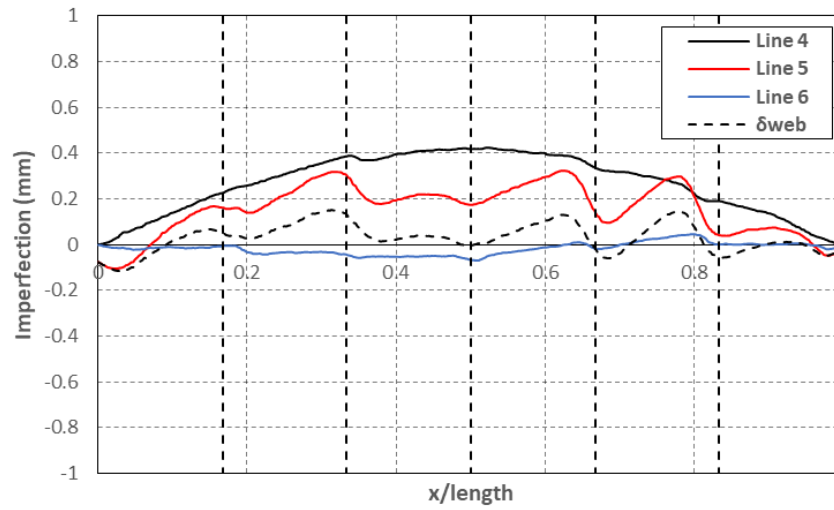


Figure B.134: Imperfections web channel S11012-16

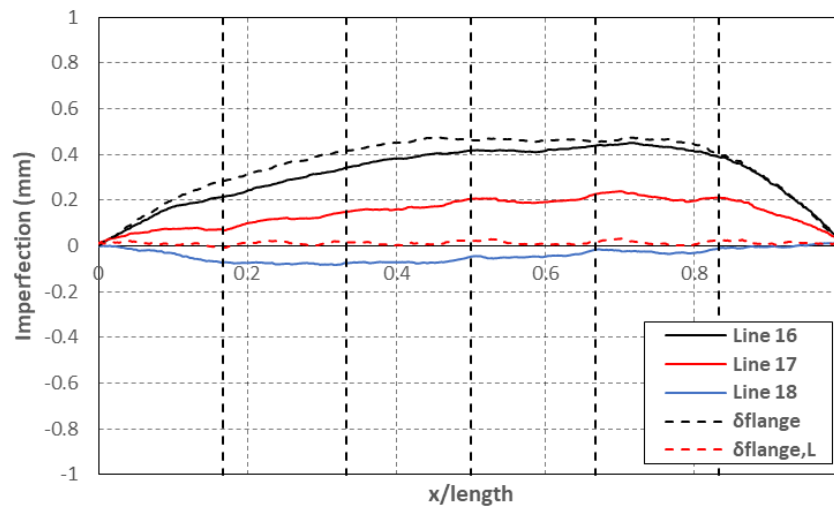


Figure B.135: Imperfections left flange channel S11012-16

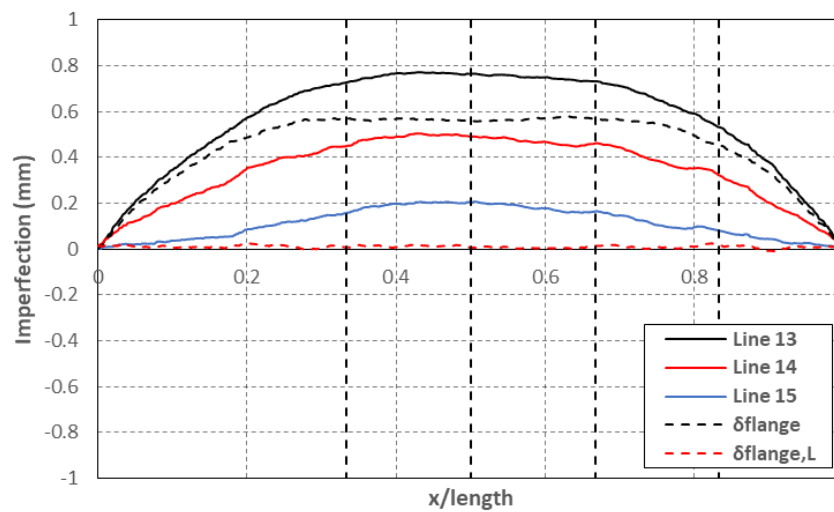


Figure B.136: Imperfections right flange channel S11012-16

Appendix C

Stub Columns Test Results

Appendix C contains the results obtained from the stub column tests. The results are presented in the form of load vs. axial shortening curves, including the dynamic and static load, and load vs. lateral deformation curves obtained for each test specimen. Further details about the stub column test results are included in Section 3.8 of the main text.

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Figure C.39: Axial load vs axial displacement SC4-5bC-23
Figure C.40: Axial load vs lateral displacement SC4-5bC-23

C.1. Built-up geometry 1 (SC1)

C.1.1 SC1-2a

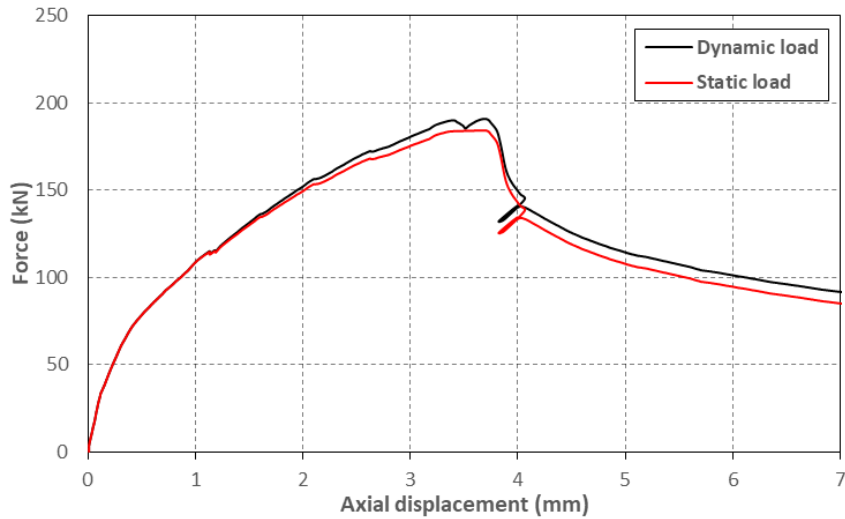


Figure C.1: Axial load vs axial displacement SC1-2a

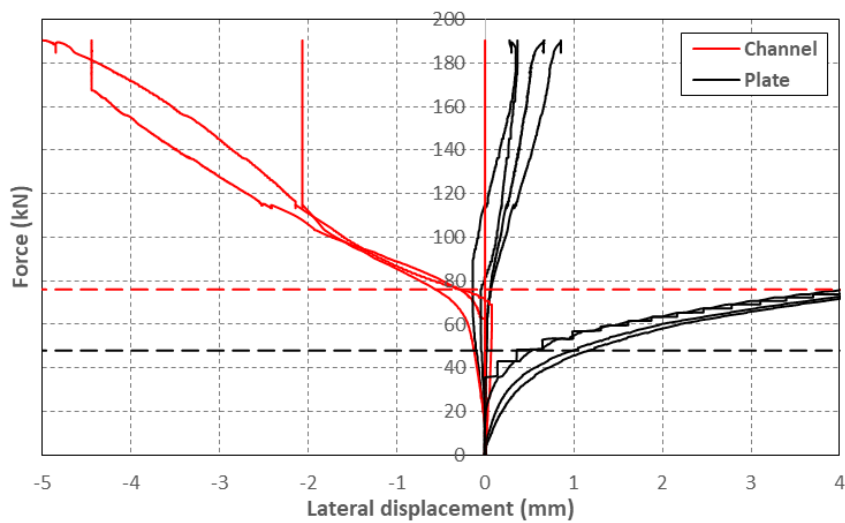


Figure C.2: Axial load vs lateral displacement SC1-2a

C.1.2 SC1-2b

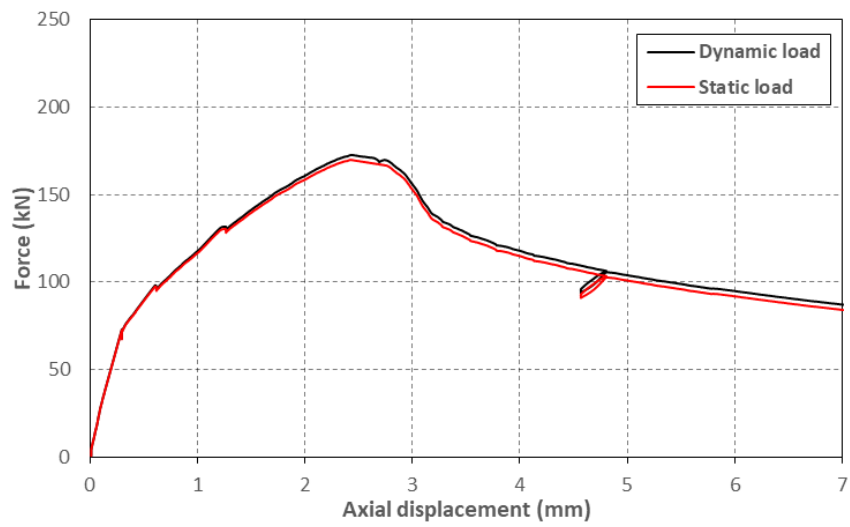


Figure C.3: Axial load vs axial displacement SC1-2b

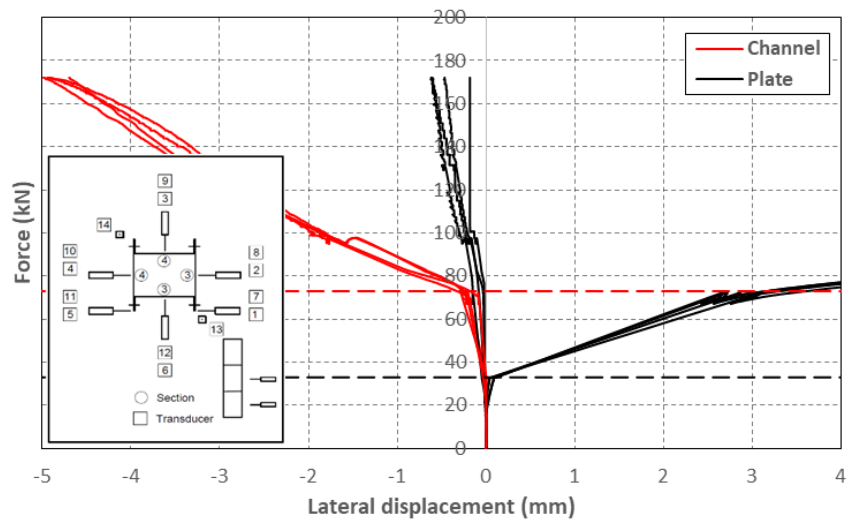


Figure C.4: Axial load vs lateral displacement SC1-2b

C.1.3 SC1-3a

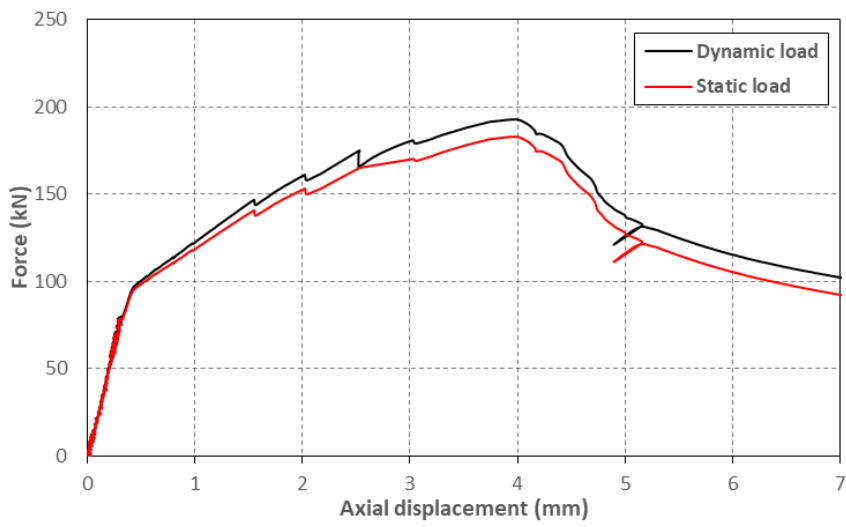


Figure C.5: Axial load vs axial displacement SC1-3a

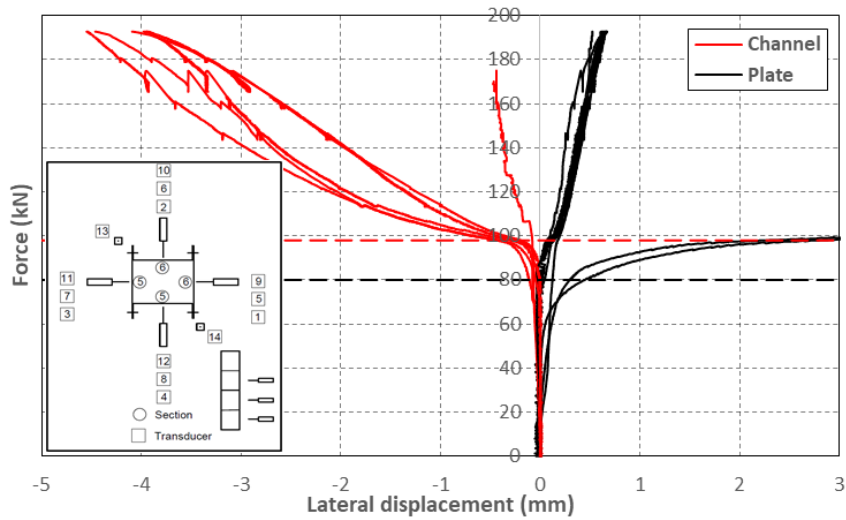


Figure C.6: Axial load vs lateral displacement SC1-3a

C.1.4 SC1-3b

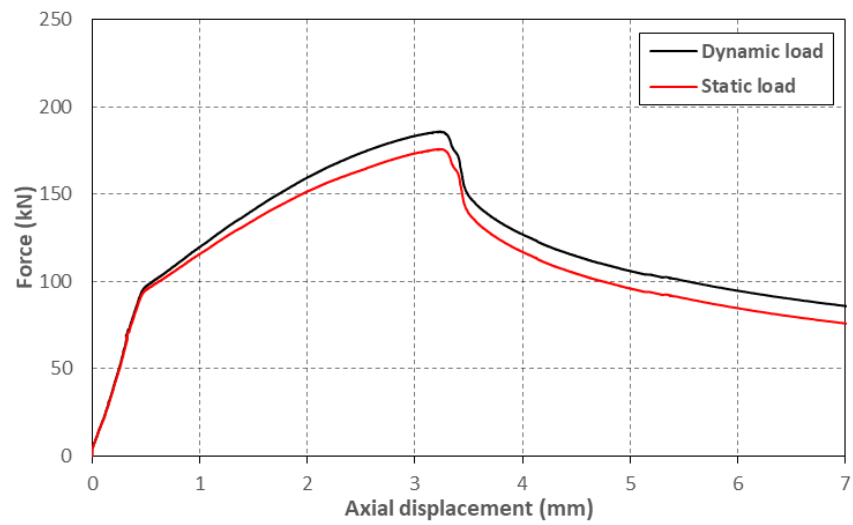


Figure C.7: Axial load vs axial displacement SC1-3b

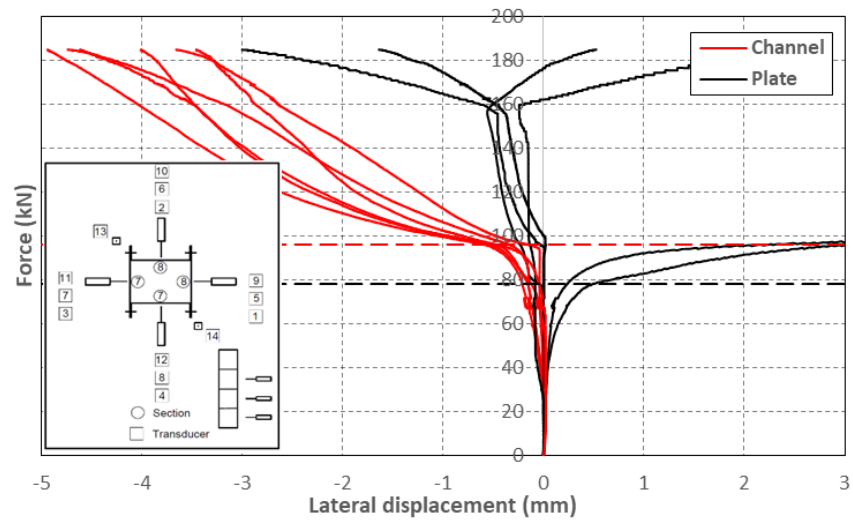


Figure C.8: Axial load vs lateral displacement SC1-3b

C.1.5 SC1-5a

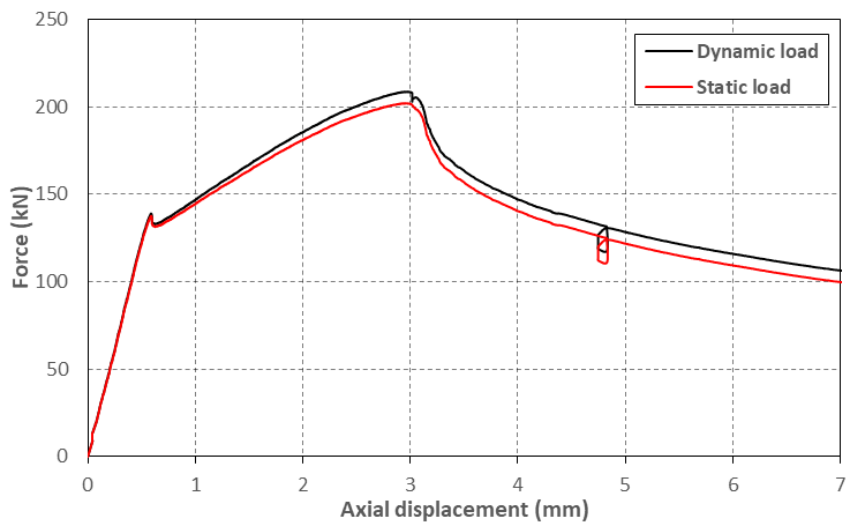


Figure C.9: Axial load vs axial displacement SC1-5a

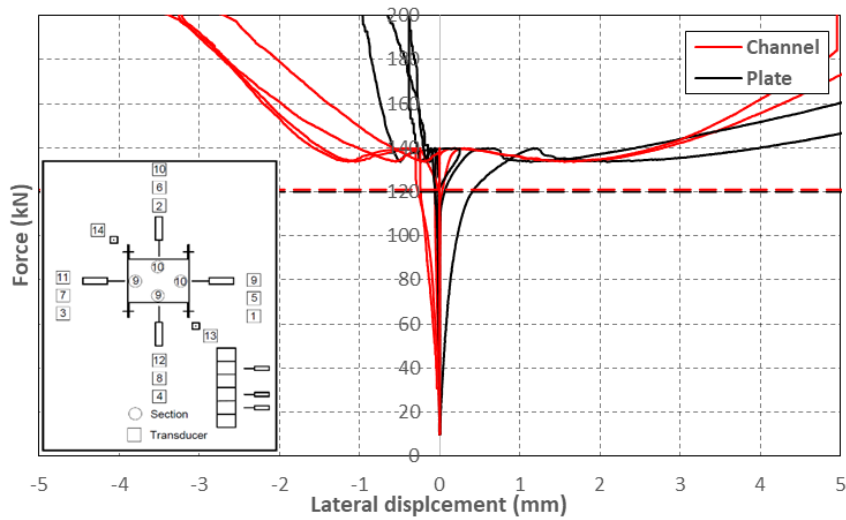
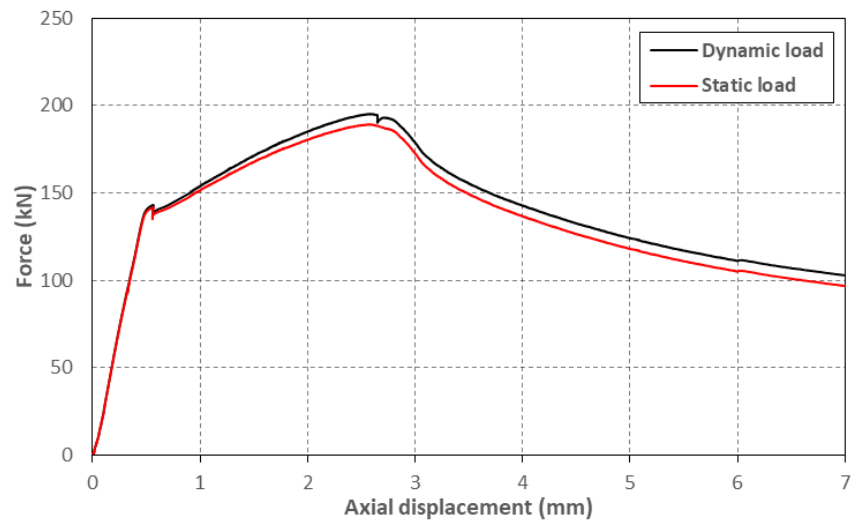
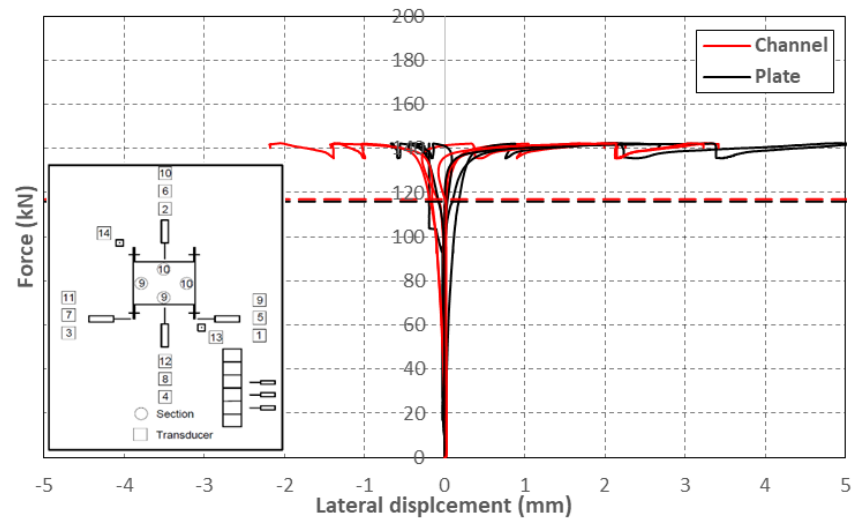


Figure C.10: Axial load vs lateral displacement SC1-5a

C.1.6 SC1-5b**Figure C.11: Axial load vs axial displacement SC1-5b****Figure C.12: Axial load vs lateral displacement SC1-5b**

C.2. Built-up geometry 2 (SC2)

C.2.1 SC2-2a

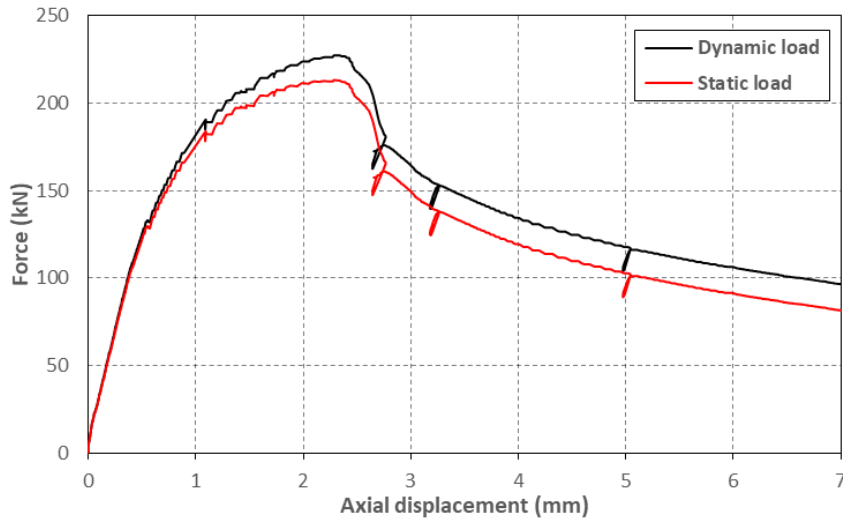


Figure C.13: Axial load vs axial displacement SC2-2a

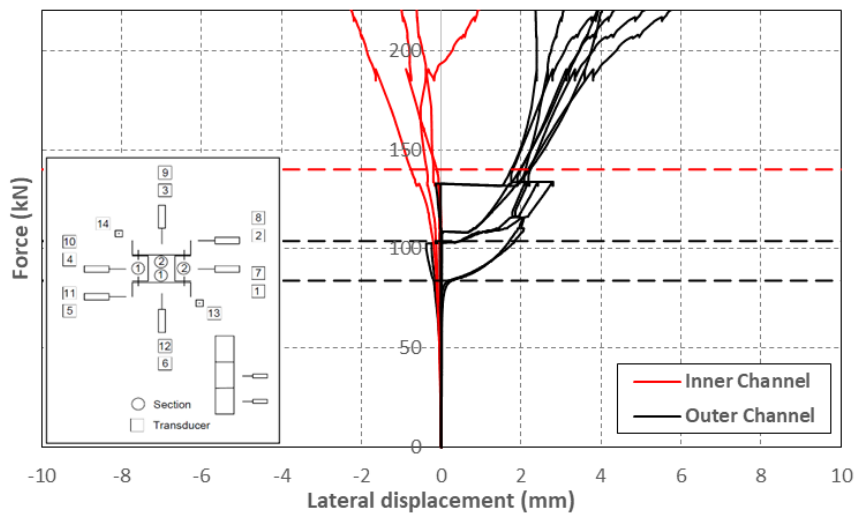


Figure C.14: Axial load vs lateral displacement SC2-2a

C.2.2 SC2-2b

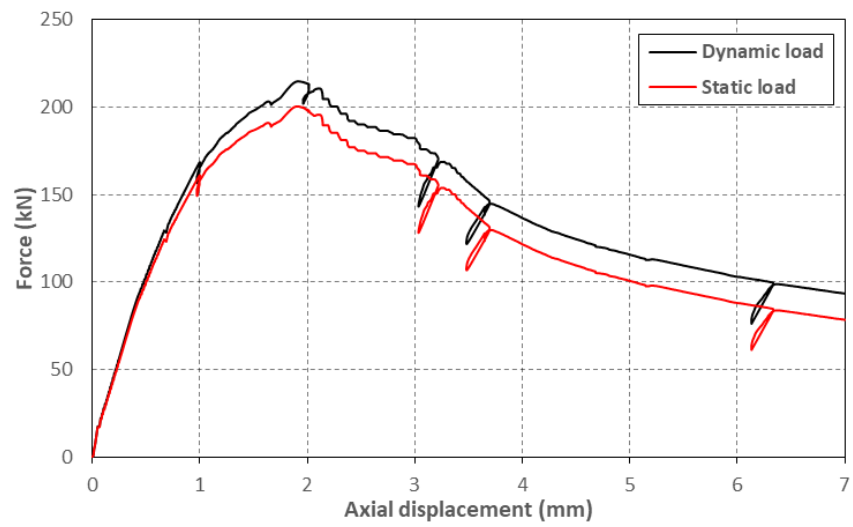


Figure C.15: Axial load vs axial displacement SC2-2b

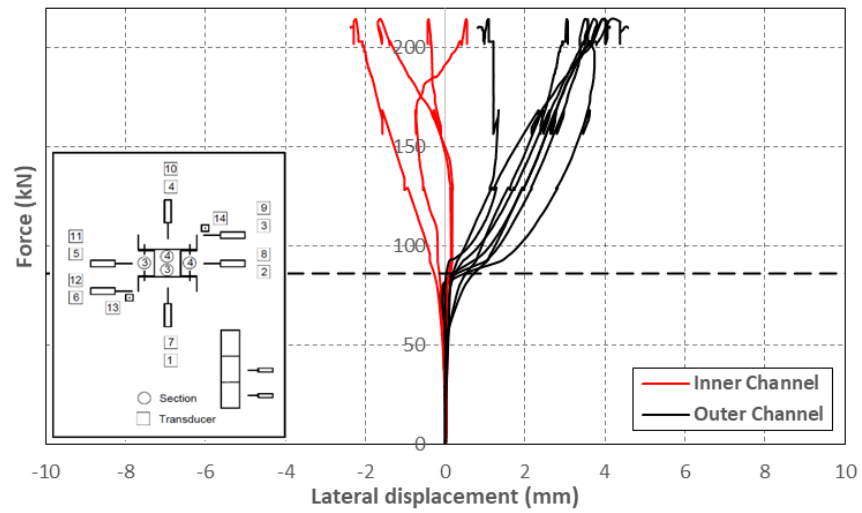


Figure C.16: Axial load vs lateral displacement SC2-2b

C.2.3 SC2-4a

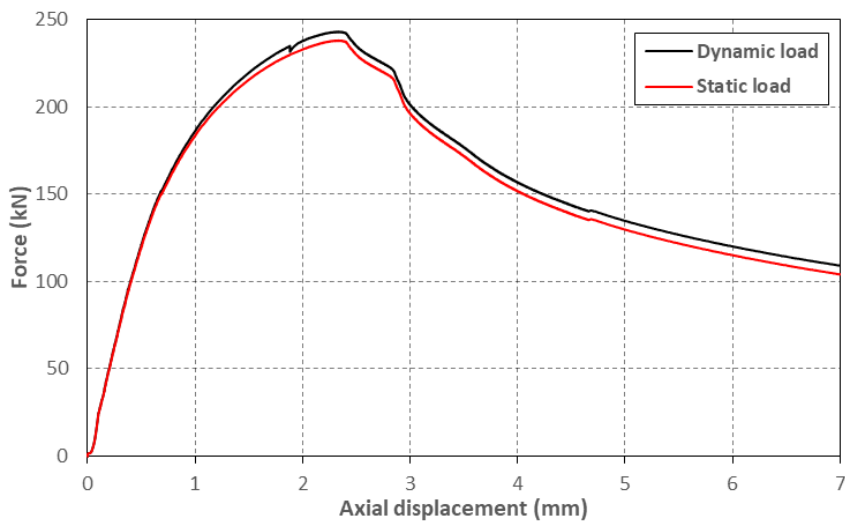


Figure C.17: Axial load vs axial displacement SC2-4a

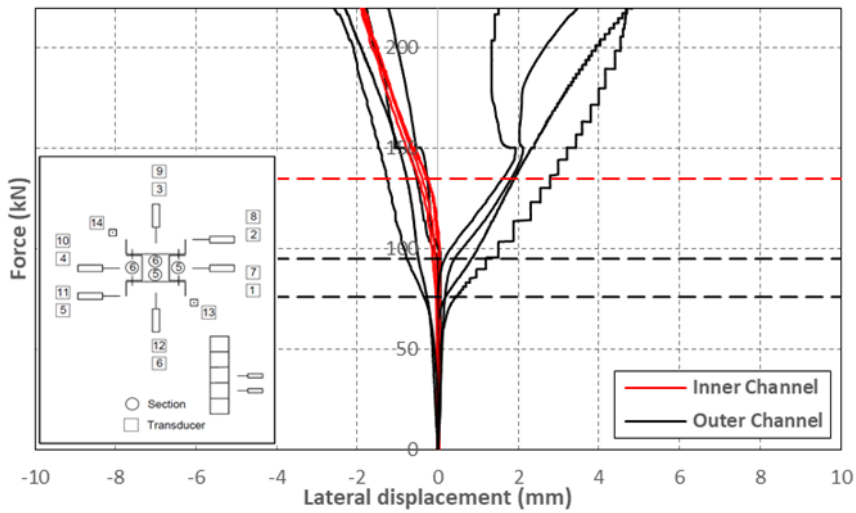
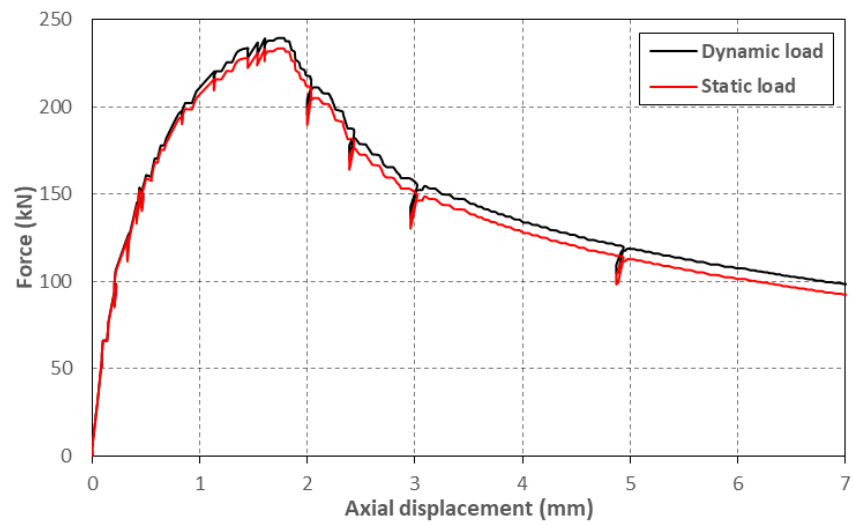
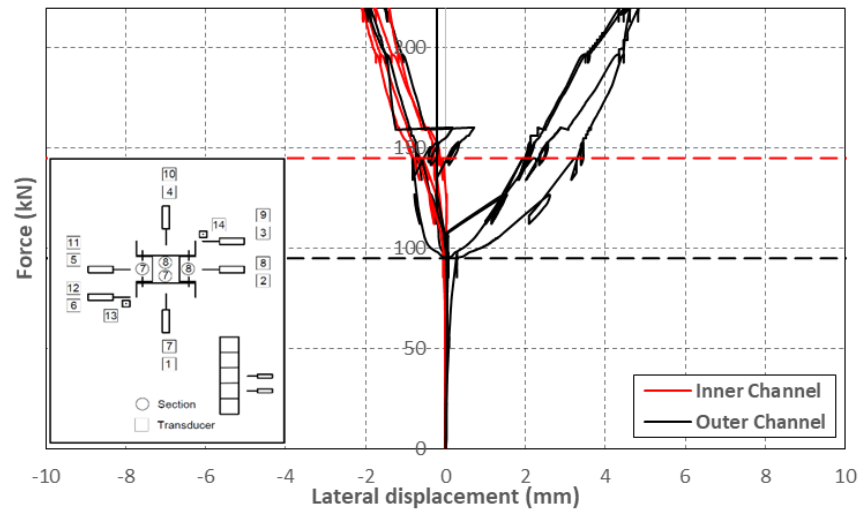


Figure C.18: Axial load vs lateral displacement SC2-4a

C.2.4 SC2-4b**Figure C.19: Axial load vs axial displacement SC2-4b****Figure C.20: Axial load vs lateral displacement SC2-4b**

C.2.5 SC2-6a

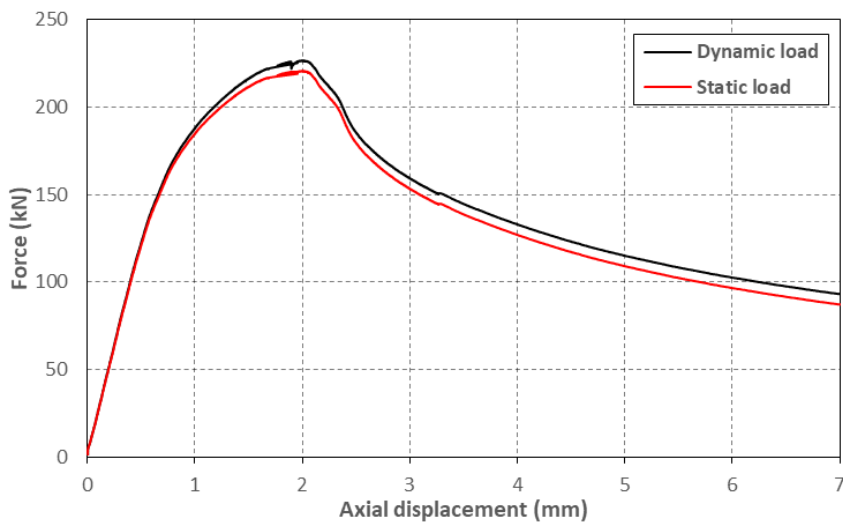


Figure C.21: Axial load vs axial displacement SC2-6a

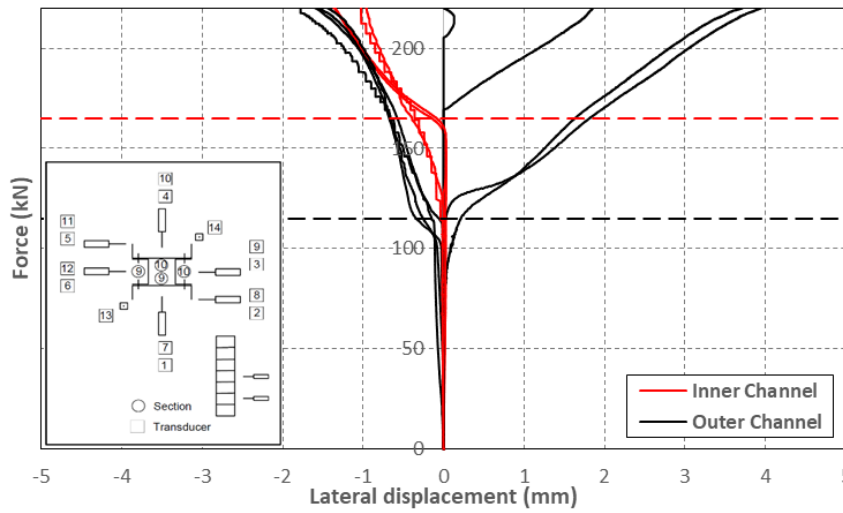


Figure C.22: Axial load vs lateral displacement SC2-6a

C.2.6 SC2-6b

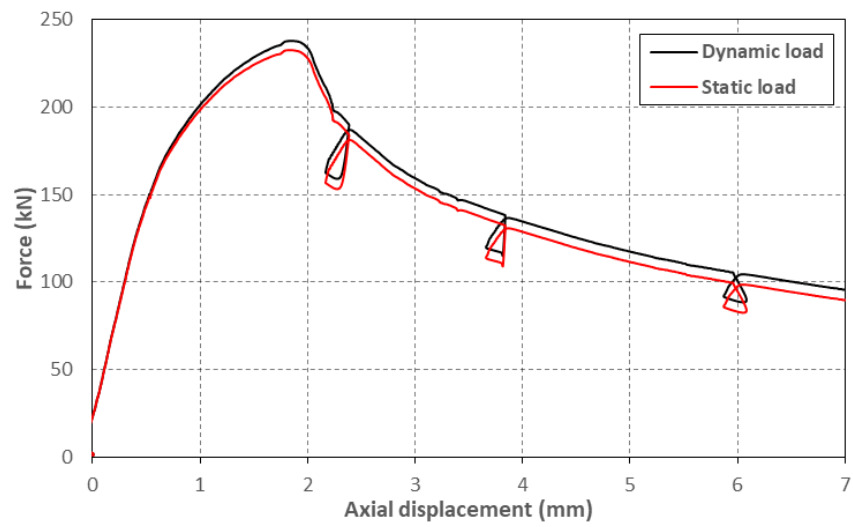


Figure C.23: Axial load vs axial displacement SC2-6b

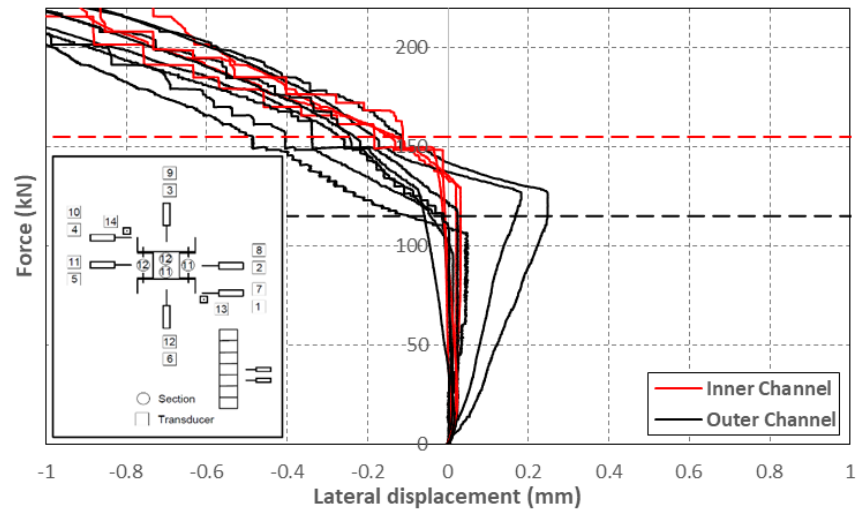


Figure C.24: Axial load vs lateral displacement SC2-6b

C.3. Built-up geometry 3 (SC3)

C.3.1 SC3-2a

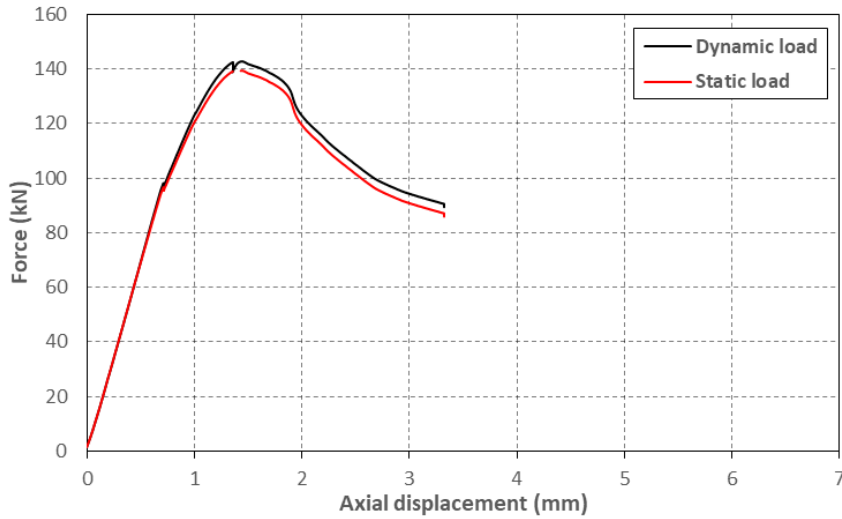


Figure C.25: Axial load vs axial displacement SC3-2a

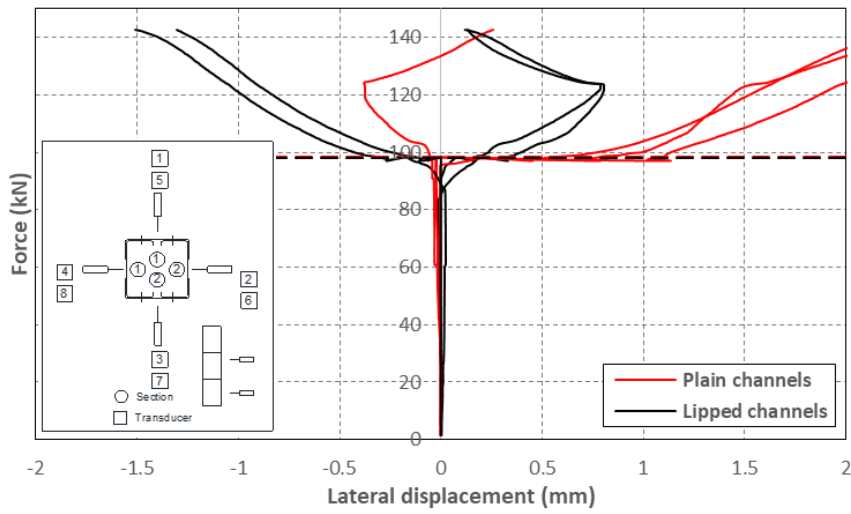


Figure C.26: Axial load vs lateral displacement SC3-2a

C.3.2 SC3-2b

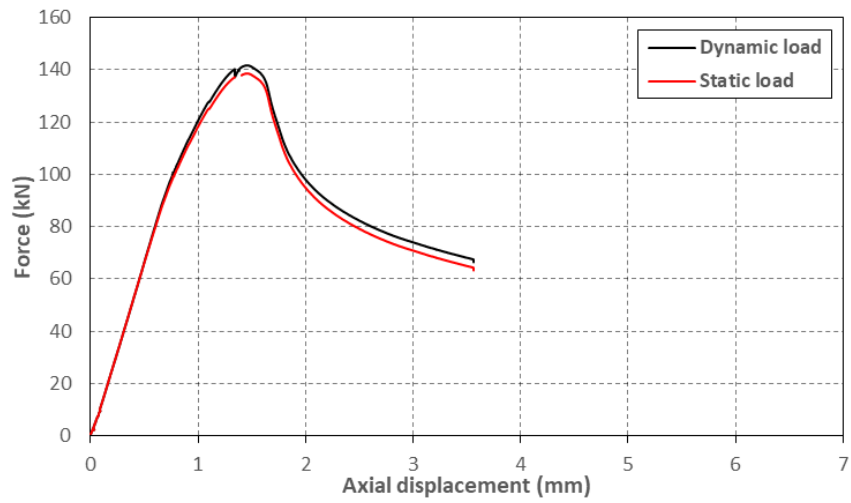


Figure C.27: Axial load vs axial displacement SC3-2b

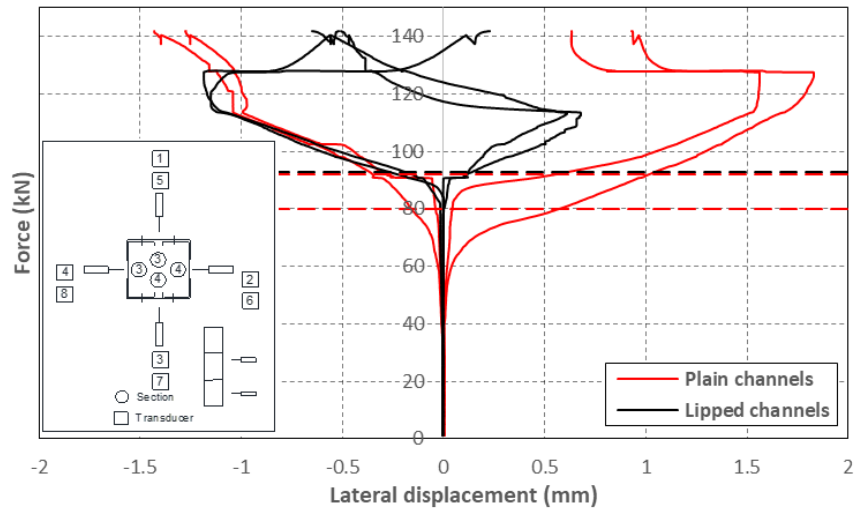


Figure C.28: Axial load vs lateral displacement SC3-2b

C.3.3 SC3-5a

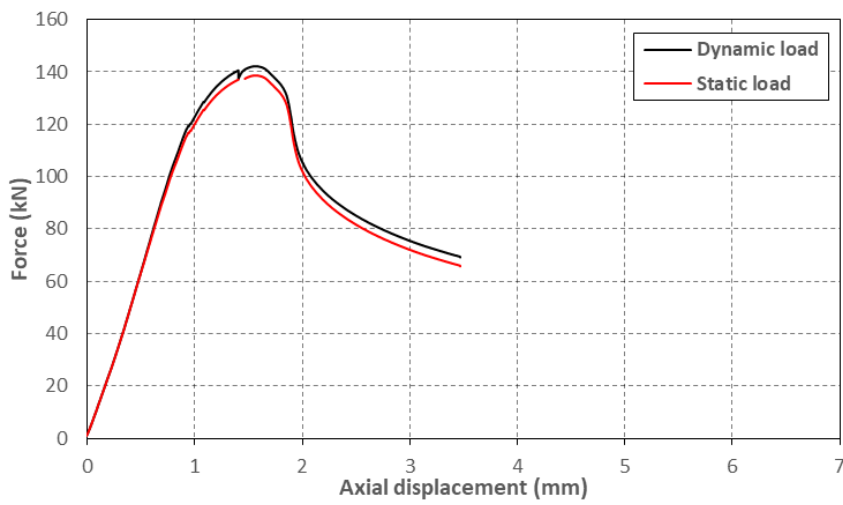


Figure C.29: Axial load vs axial displacement SC3-5a

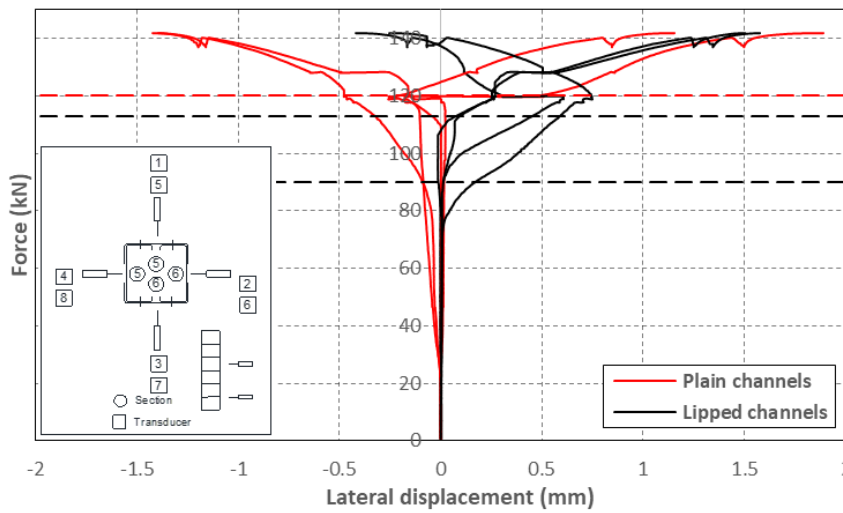


Figure C.30: Axial load vs lateral displacement SC3-5a

C.3.4 SC3-5b

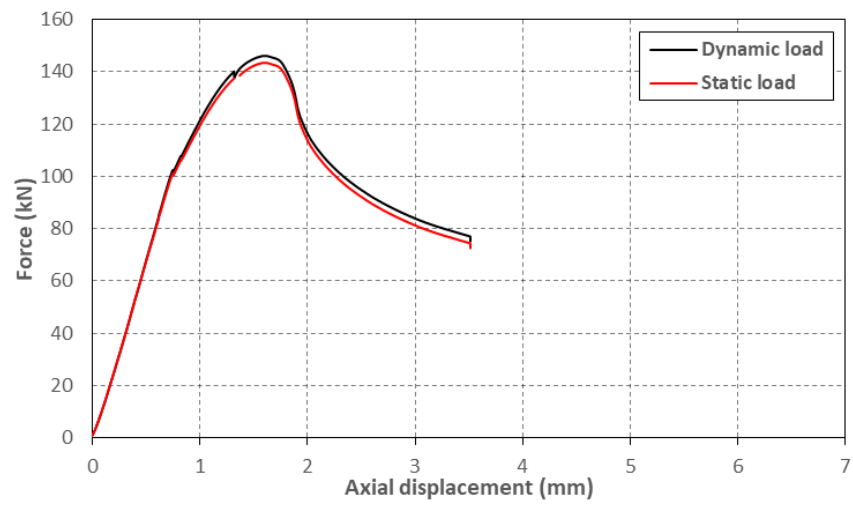


Figure C.31: Axial load vs axial displacement SC3-5b

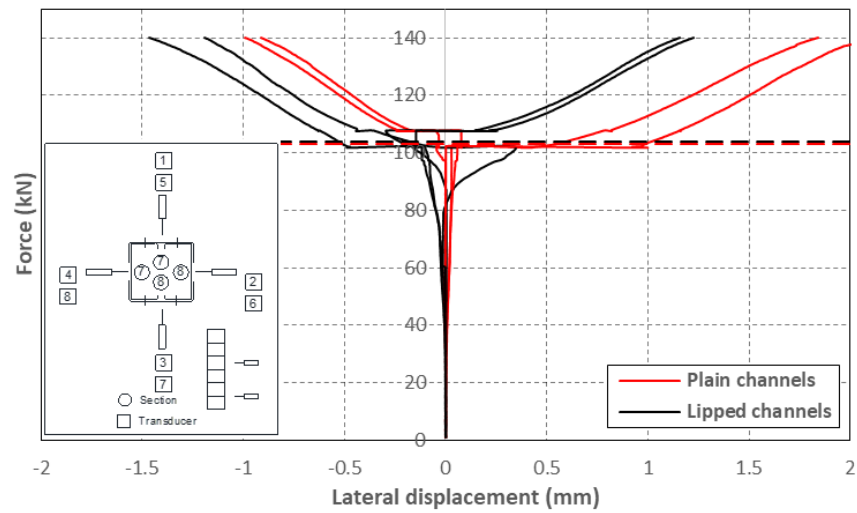


Figure C.32: Axial load vs lateral displacement SC3-5b

C.4. Built-up geometry 4 (SC4)

C.4.1 SC4-2a

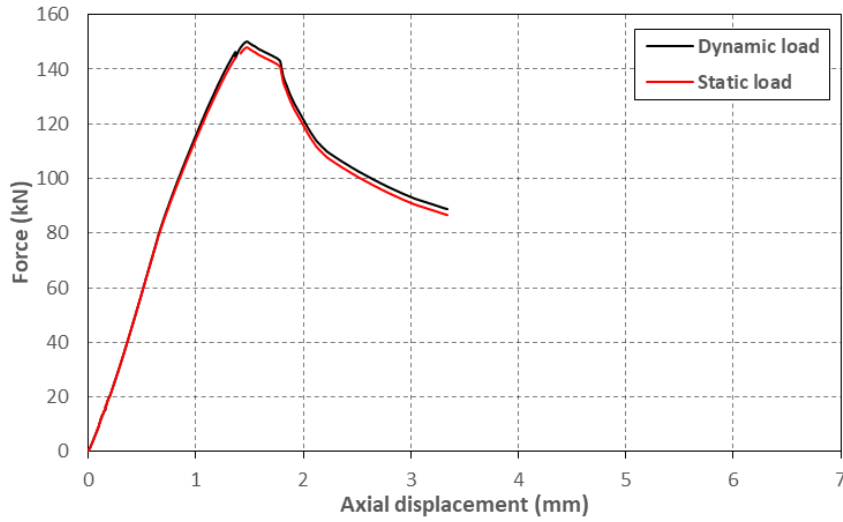


Figure C.33: Axial load vs axial displacement SC4-2a

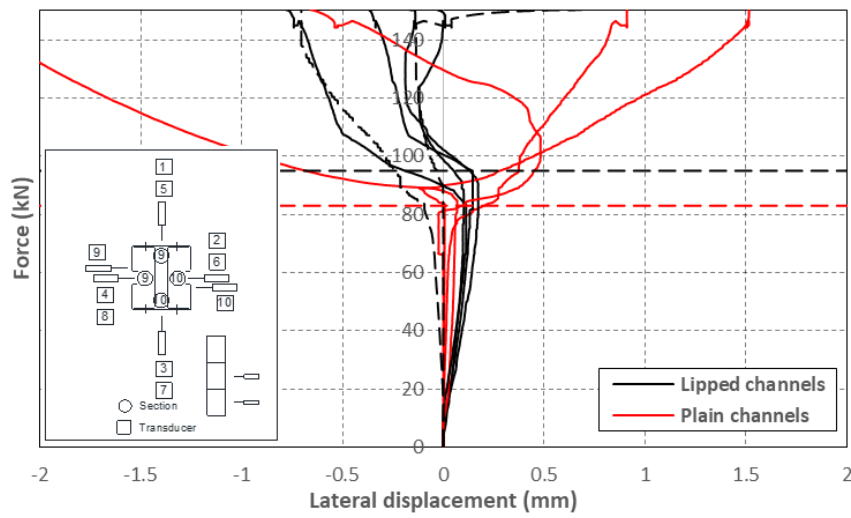


Figure C.34: Axial load vs lateral displacement SC4-2a

C.4.2 SC4-2b

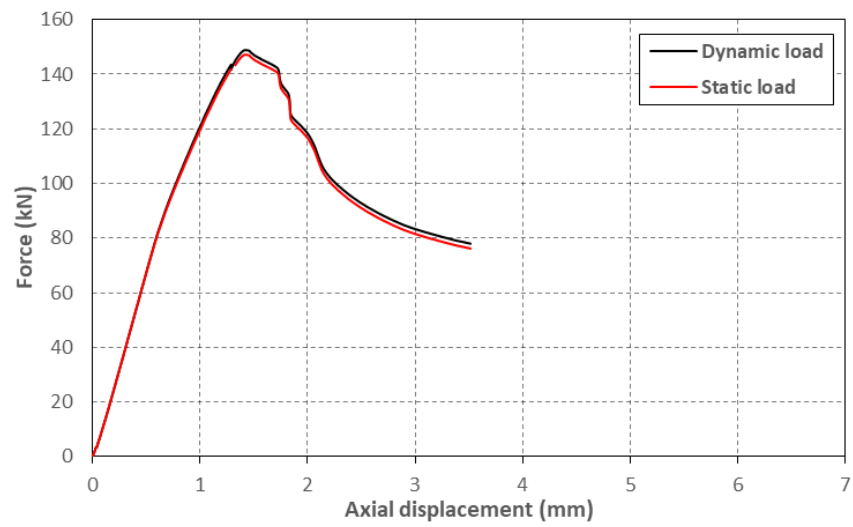


Figure C.35: Axial load vs axial displacement SC4-2b

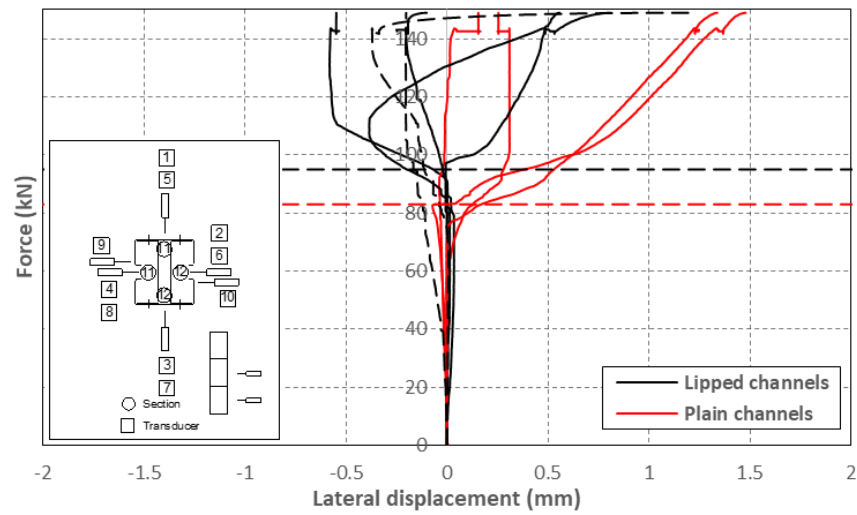


Figure C.36: Axial load vs lateral displacement SC4-2b

C.4.3 SC4-5a

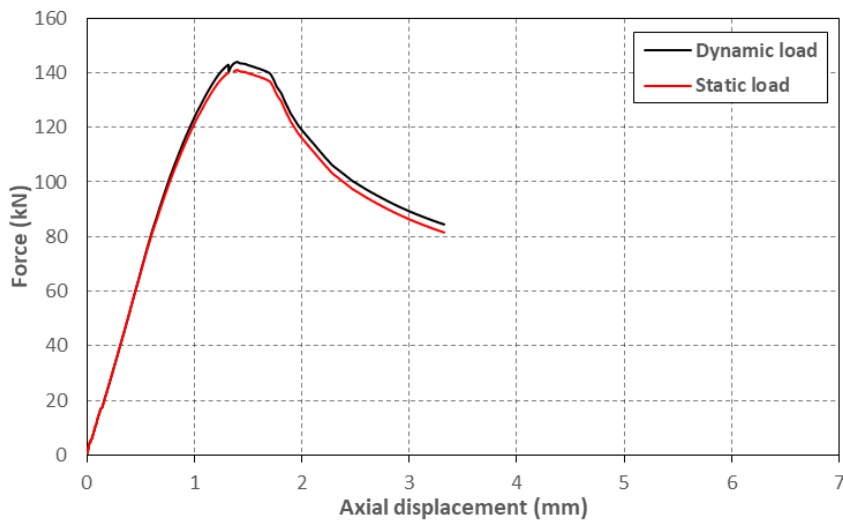


Figure C.37: Axial load vs axial displacement SC4-5a

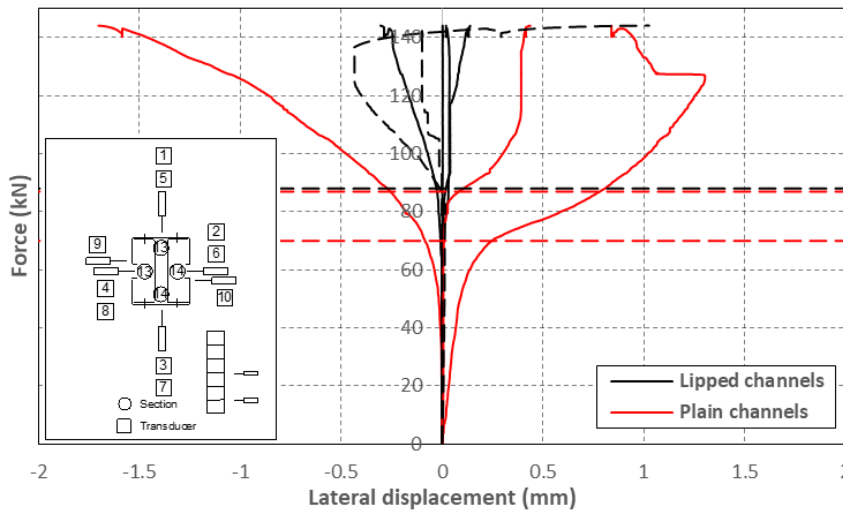


Figure C.38: Axial load vs lateral displacement SC4-5a

C.4.4 SC4-5b

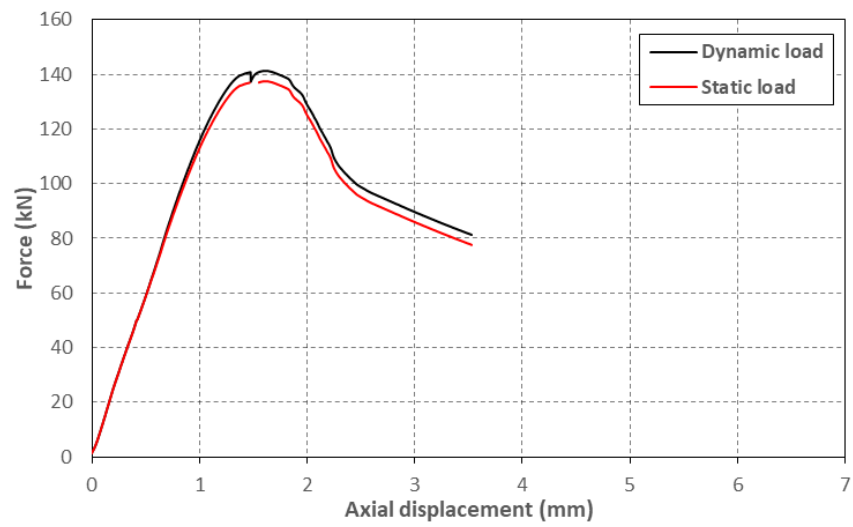


Figure C.39: Axial load vs axial displacement SC4-5b

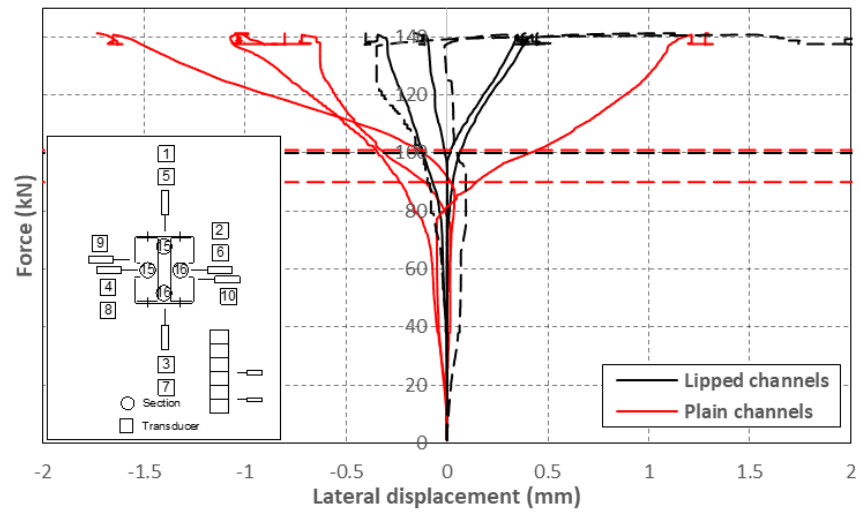


Figure C.40: Axial load vs lateral displacement SC4-5b

Appendix D

Beams Tensile Coupons

Appendix D contains the results obtained from the tensile coupons extracted from the flat and corner regions of the component sections used to assemble the beams. The results are presented in the form of stress-strain curves, and include the static and dynamic engineering stresses, as well as the static true stresses. Further details about these coupon tests are included in Section 4.3 of the main text.

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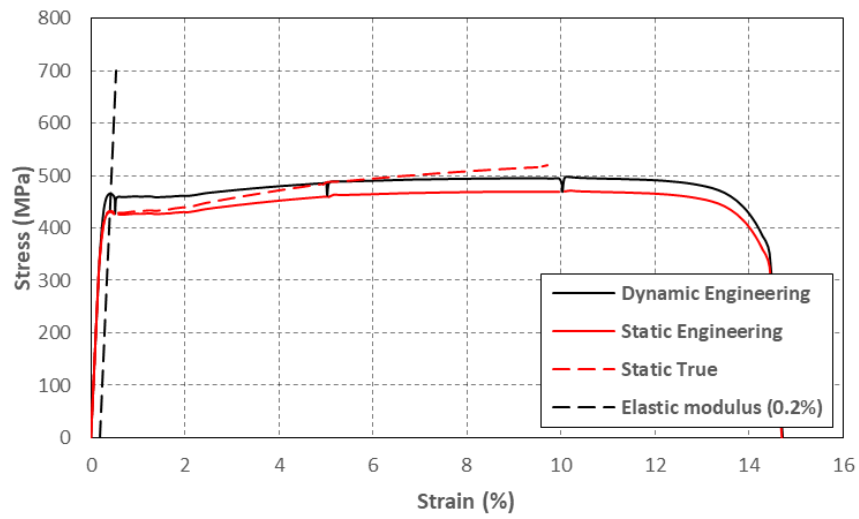


Figure D.1: T10412a Flat coupon test results

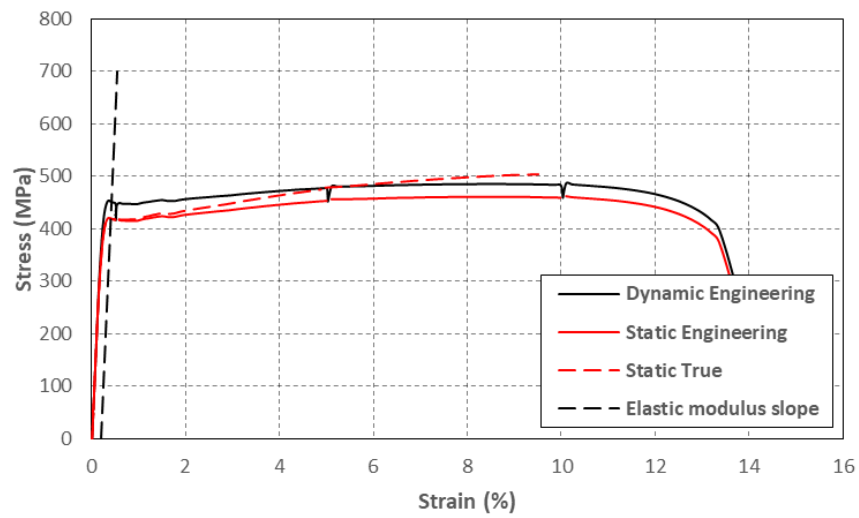


Figure D.2: T10412b Flat coupon test results

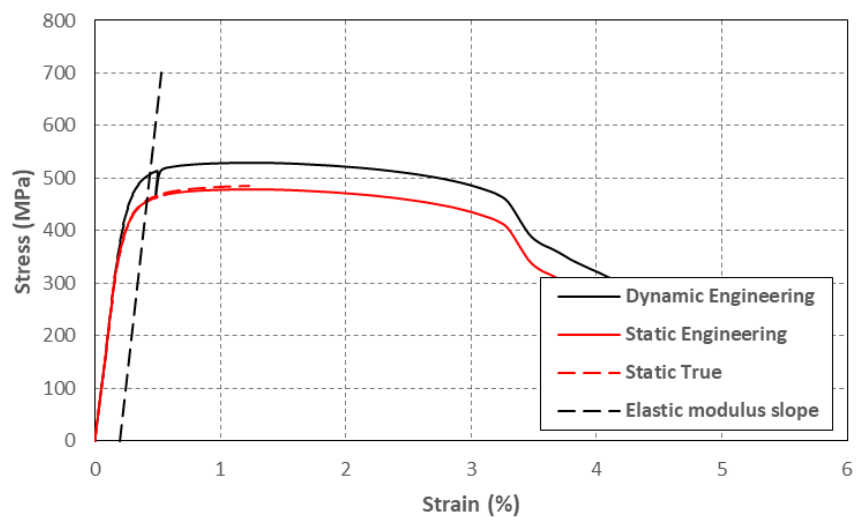


Figure D.3: T10412 Corner coupon test results

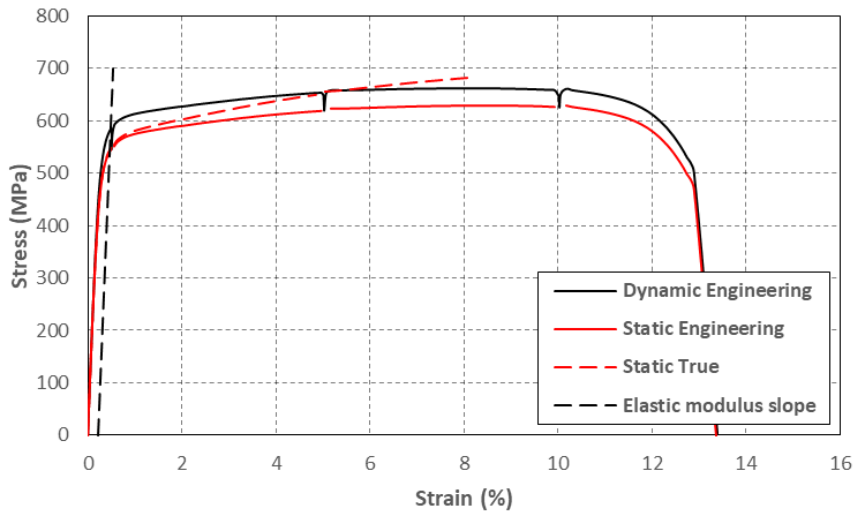


Figure D.4: T12915a Flat coupon test results

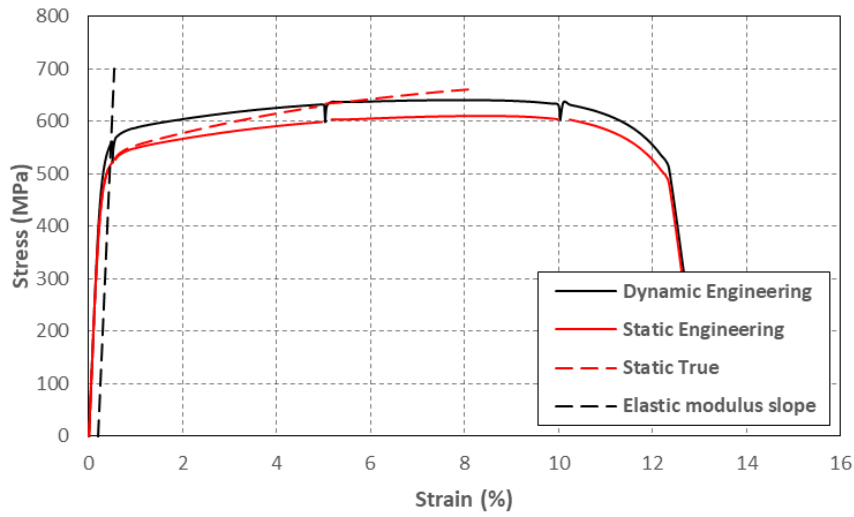


Figure D.5: T12915b Flat coupon test results

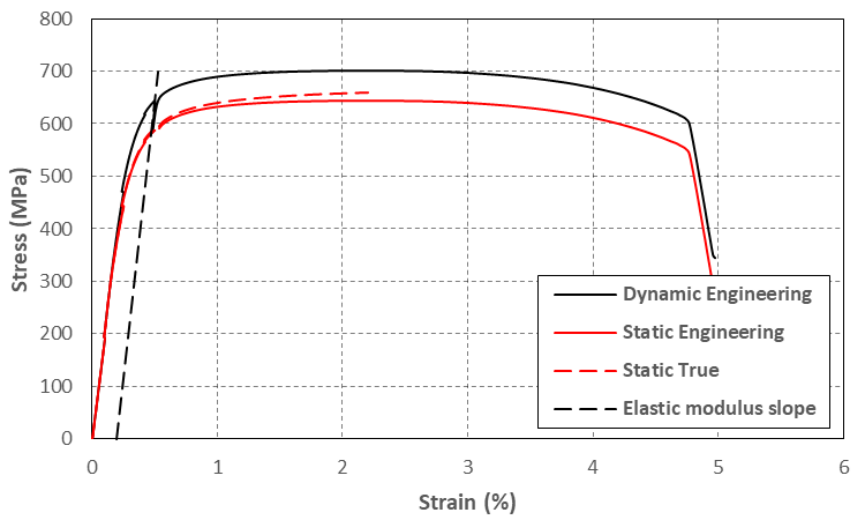
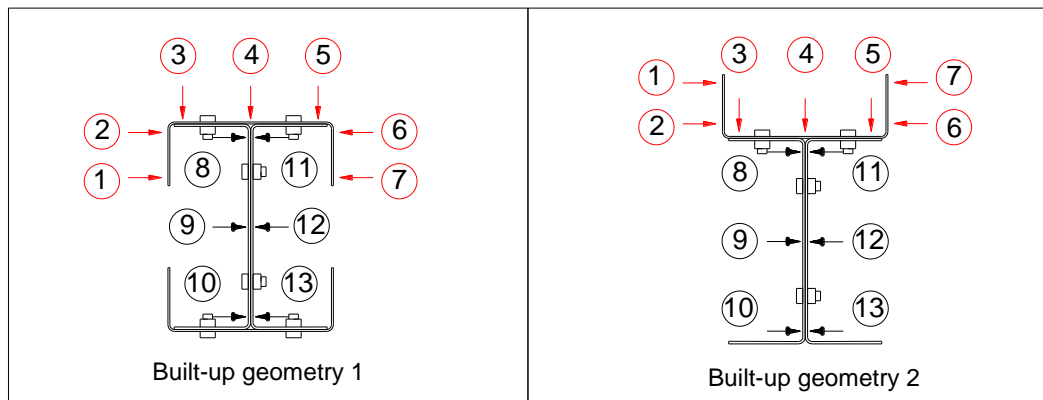


Figure D.6: T12915 Corner coupon test results

Appendix E

Beams Geometric Imperfections

Appendix E contains the geometric imperfections recorded on the components of the beams after they were assembled into their final configurations. The imperfections were only recorded within the constant moment span. In the figures, the coordinate along the length of the beam is normalized by dividing it by the measured length, while the vertical dashed black lines indicate the location of the connectors along the constant moment span. The location of each measuring line is represented in the diagram below for each built-up geometry. The relevant cross-sectional imperfection computed from the readings taken along the measuring lines are also included. Positive readings indicate imperfections in the opposite direction to the arrows included in the diagram. Further details about the imperfections recorded on the beams are included in Section 4.6 of the main text.



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E.1. Built-up geometry 1 (B1)

E.1.1 B1-0a

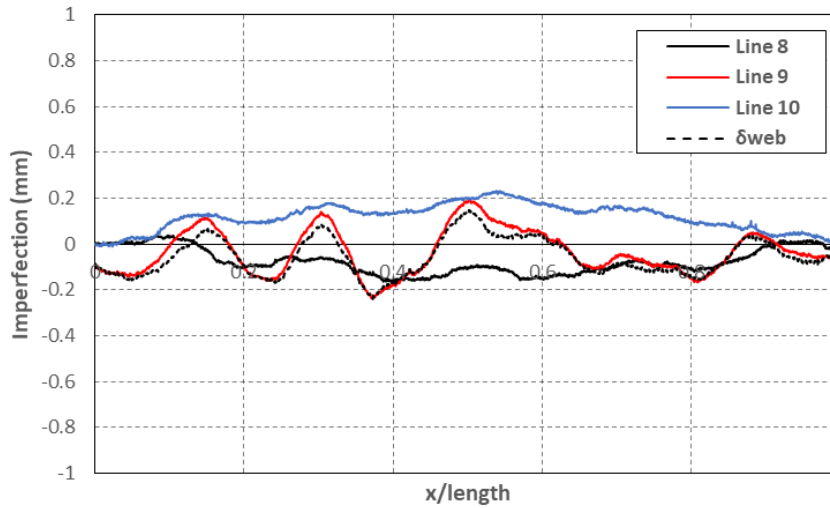


Figure E.1: Imperfections web channel T12915-1

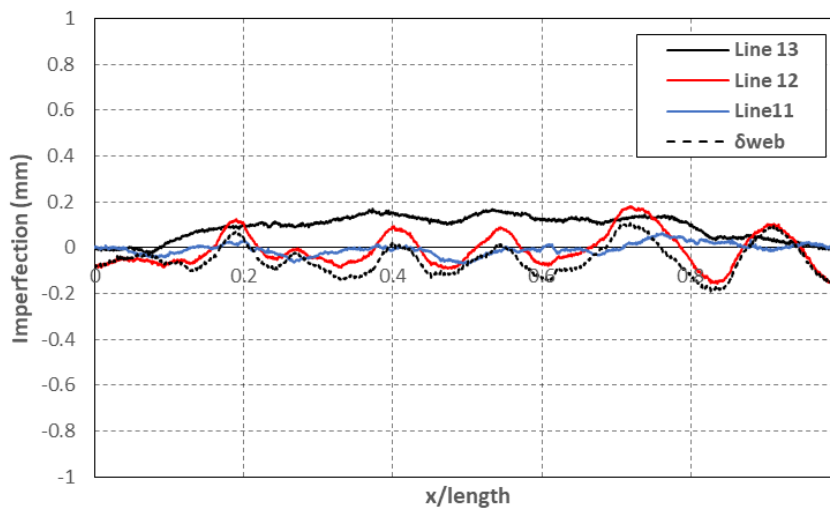


Figure E.2: Imperfections web channel T12915-2

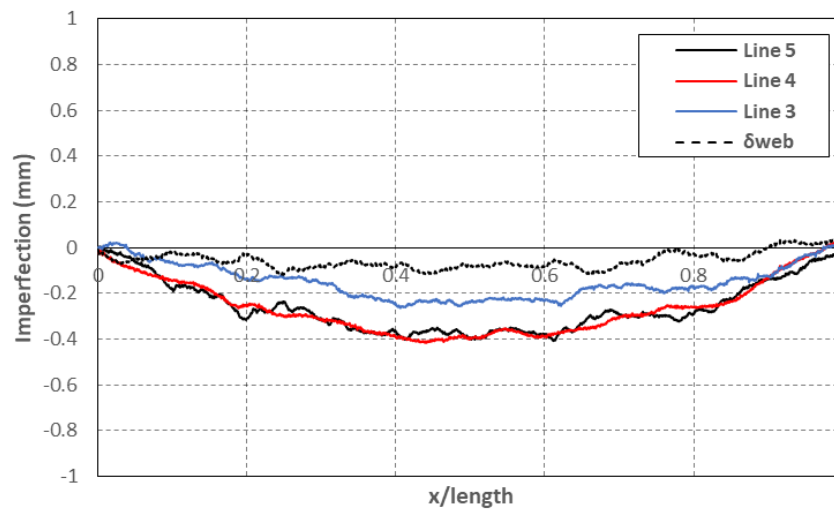


Figure E.3: Imperfections web channel T10412-1

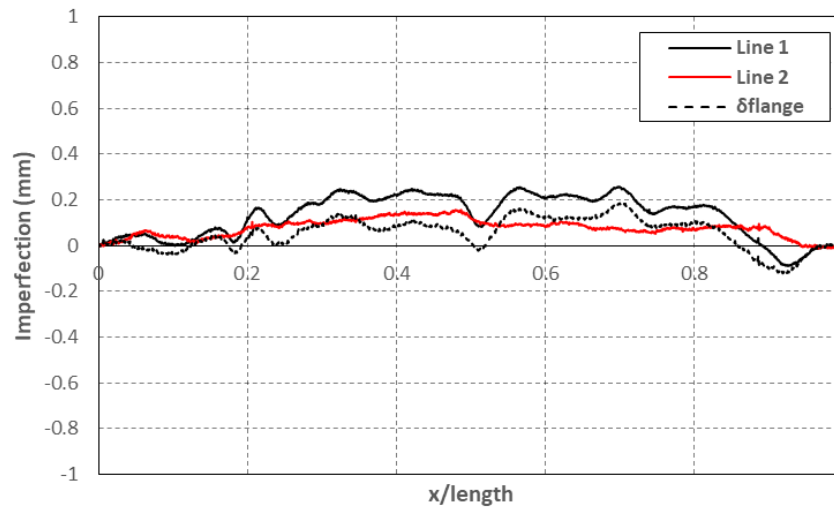


Figure E.4: Imperfections left flange channel T10412-1

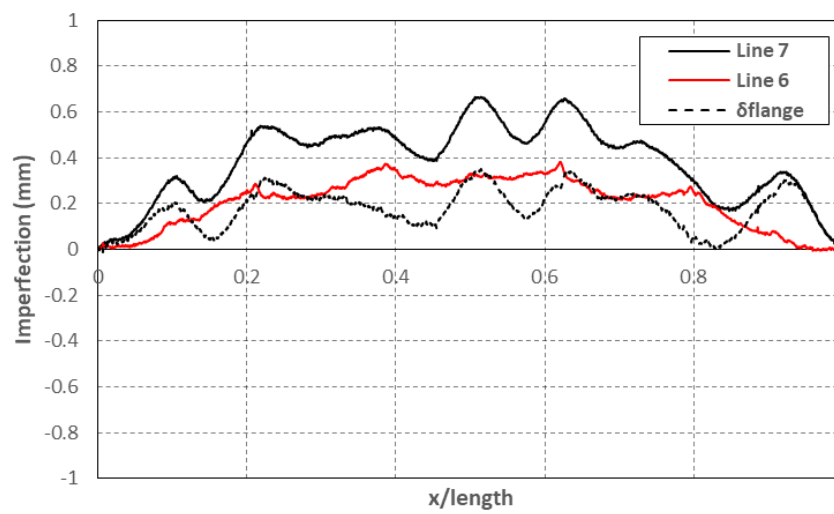


Figure E.5: Imperfections right flange channel T10412-1

E.1.2 B1-0b

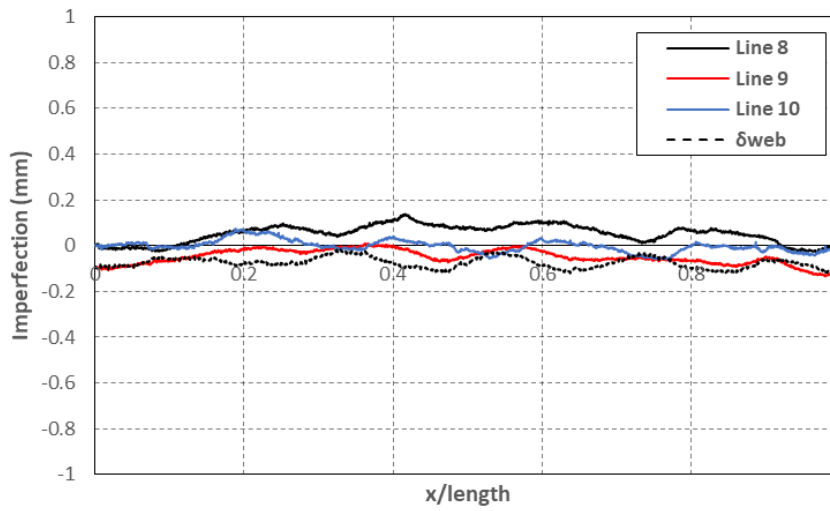


Figure E.6: Imperfections web channel T12915-3

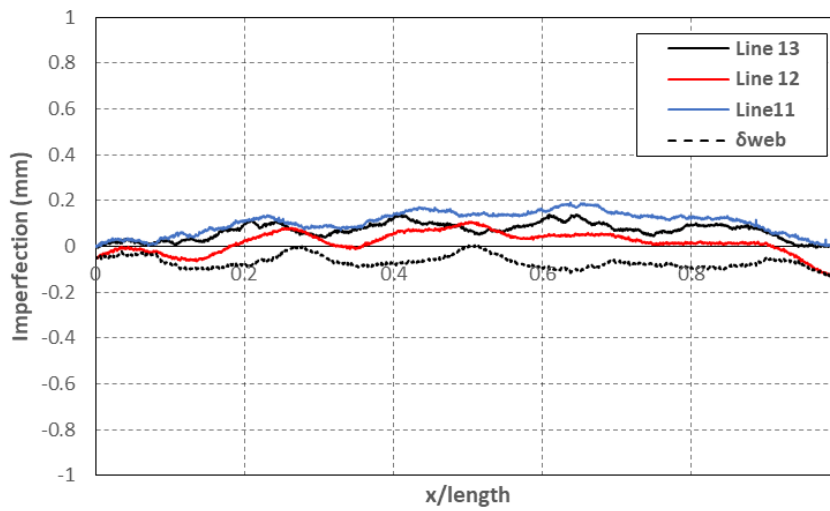


Figure E.7: Imperfections web channel T12915-4

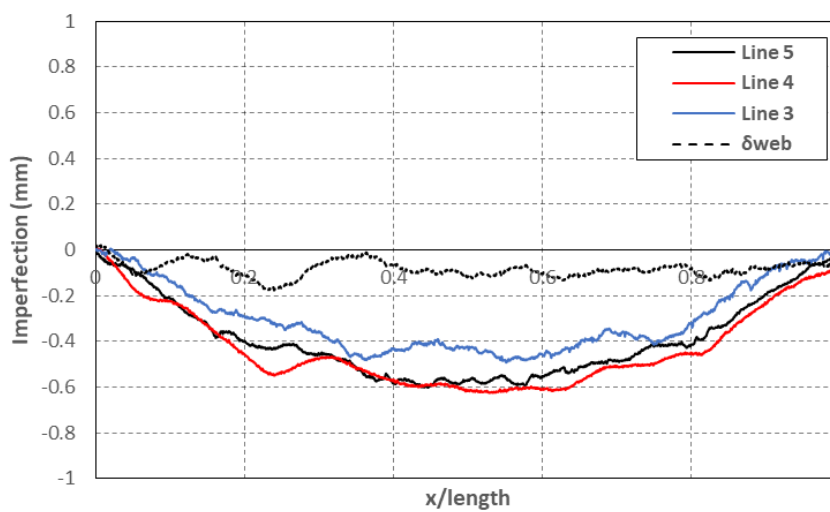


Figure E.8: Imperfections web channel T10412-3

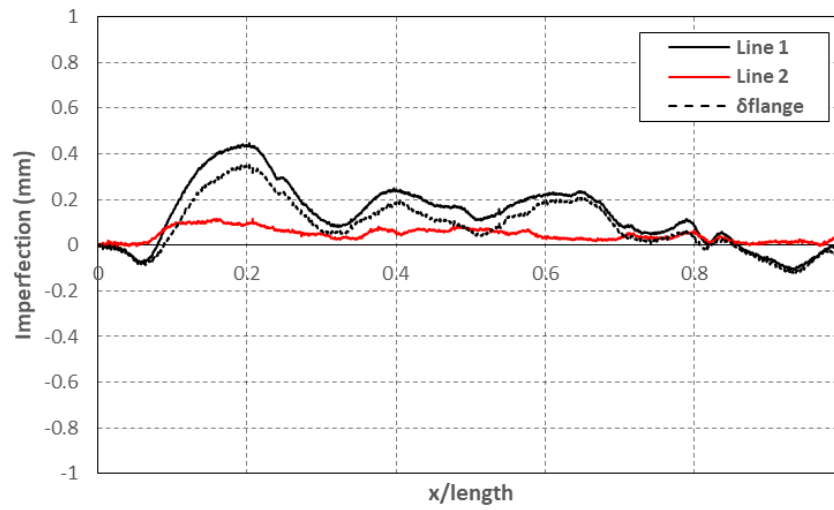


Figure E.9: Imperfections left flange channel T10412-3

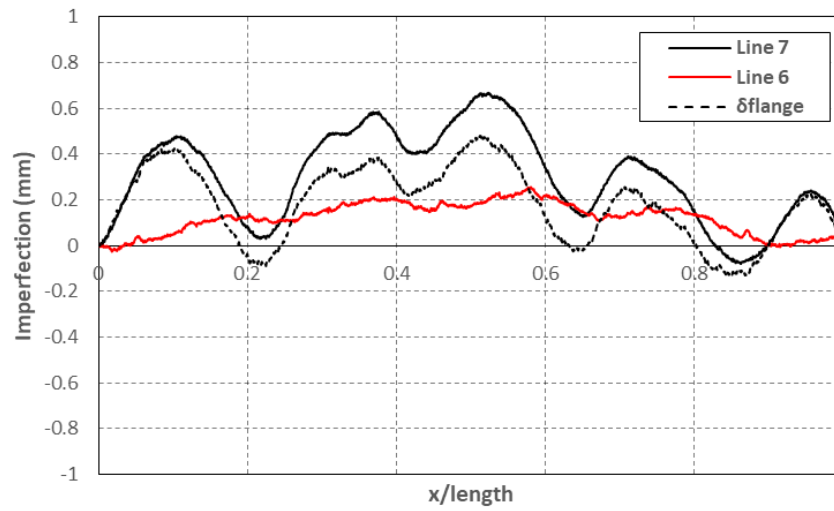


Figure E.10: Imperfections right flange channel T10412-3

E.1.3 B1-2a

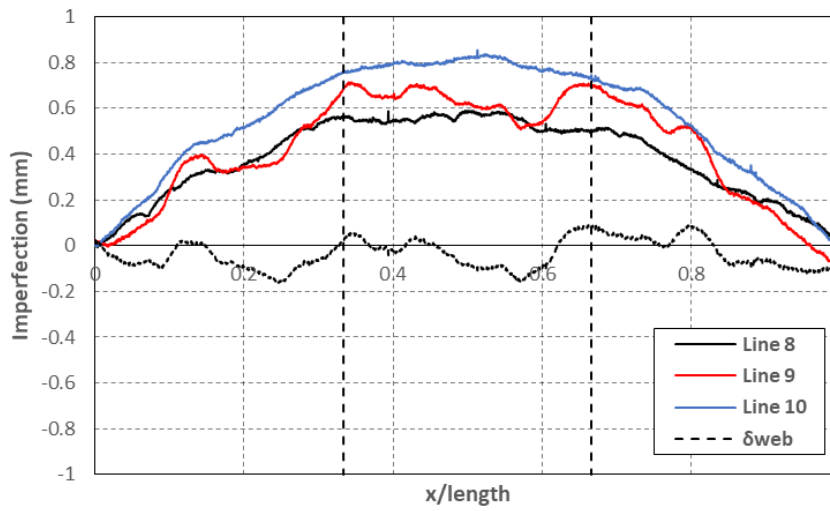


Figure E.11: Imperfections web channel T12915-5

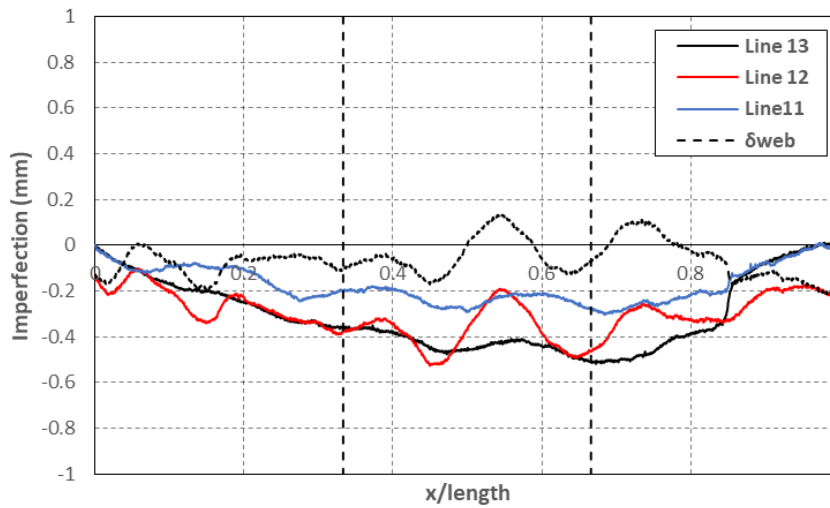


Figure E.12: Imperfections web channel T12915-6

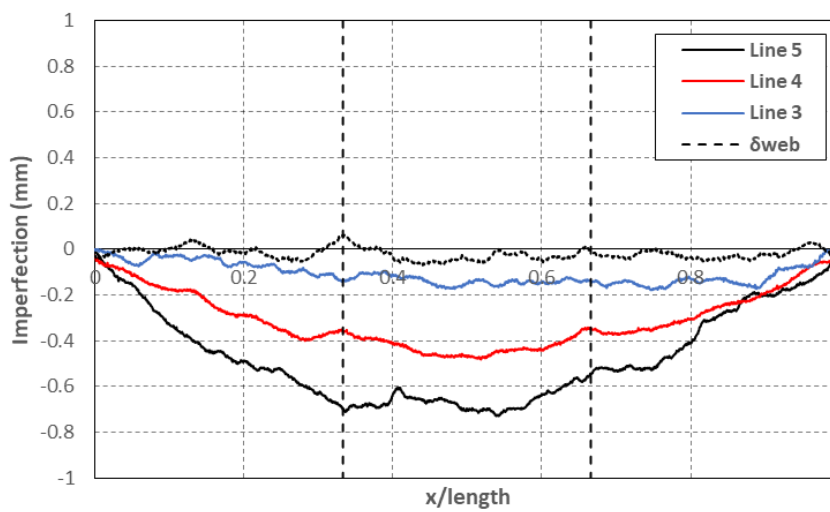


Figure E.13: Imperfections web channel T10412-5

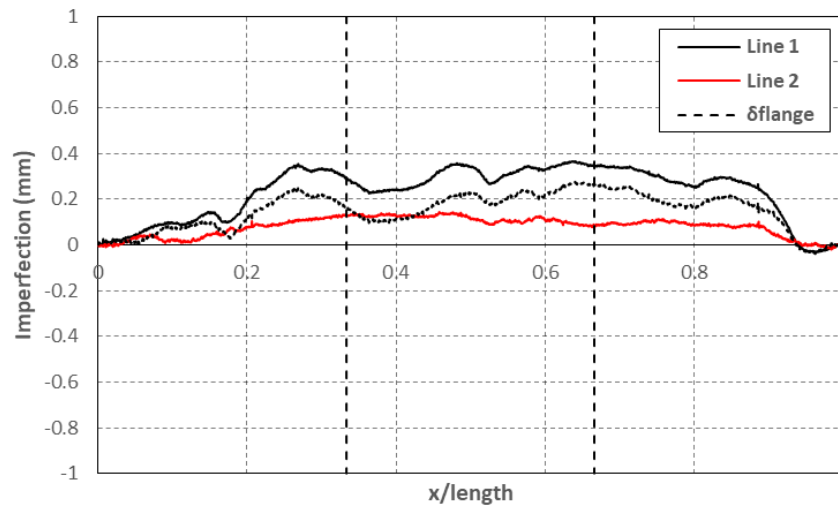


Figure E.14: Imperfections left flange channel T10412-5

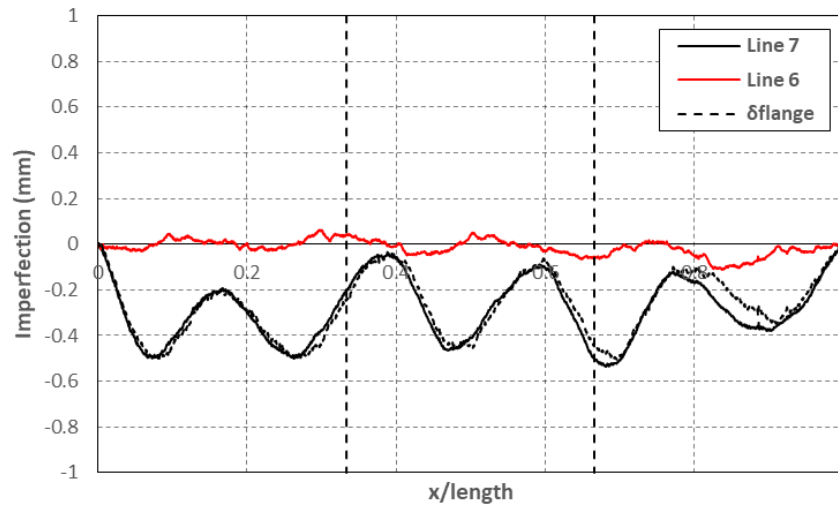


Figure E.15: Imperfections right flange channel T10412-5

E.1.4 B1-2b

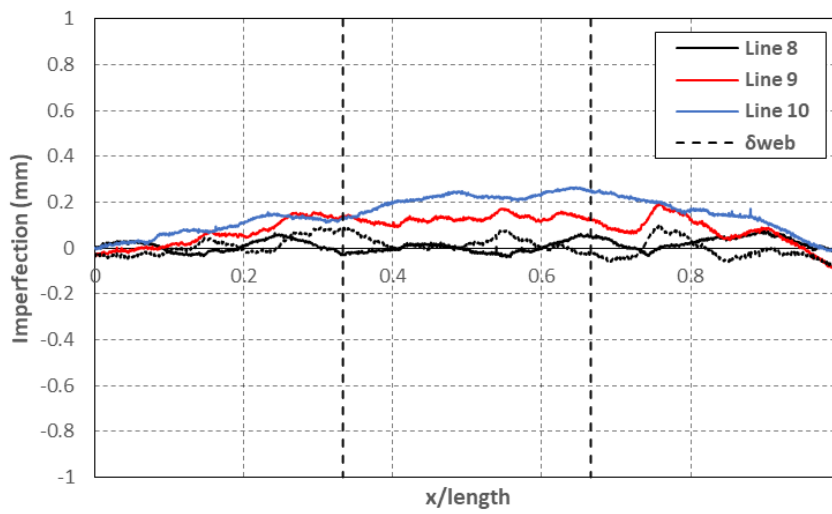


Figure E.16: Imperfections web channel T12915-7

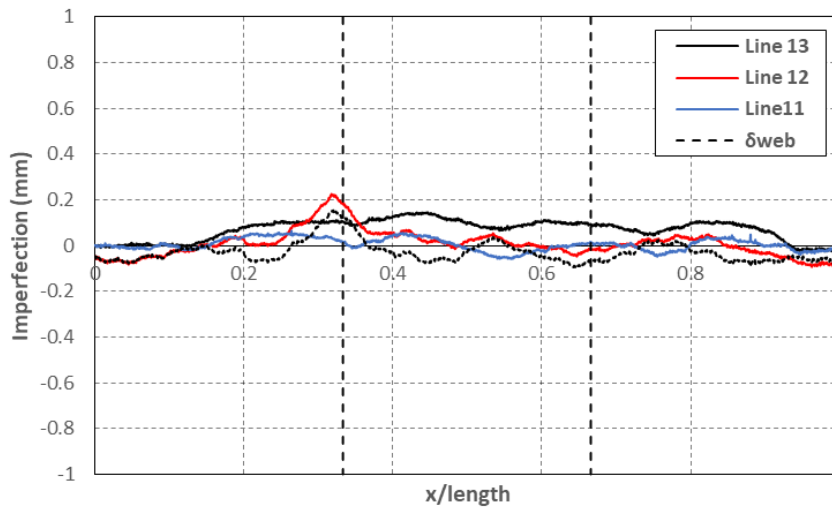


Figure E.17: Imperfections web channel T12915-8

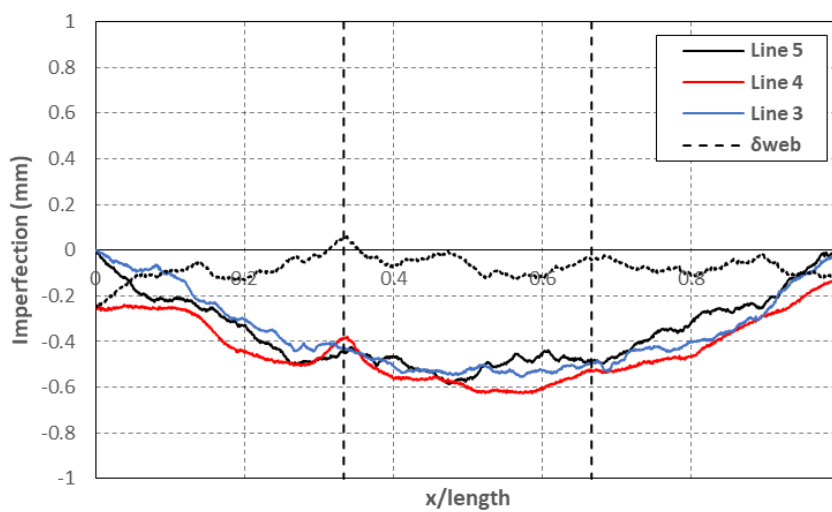


Figure E.18: Imperfections web channel T10412-7

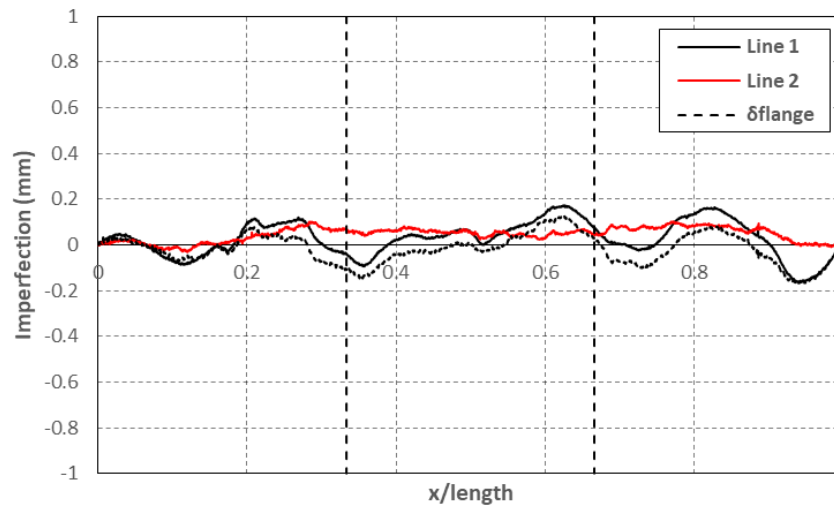


Figure E.19: Imperfections left flange channel T10412-7

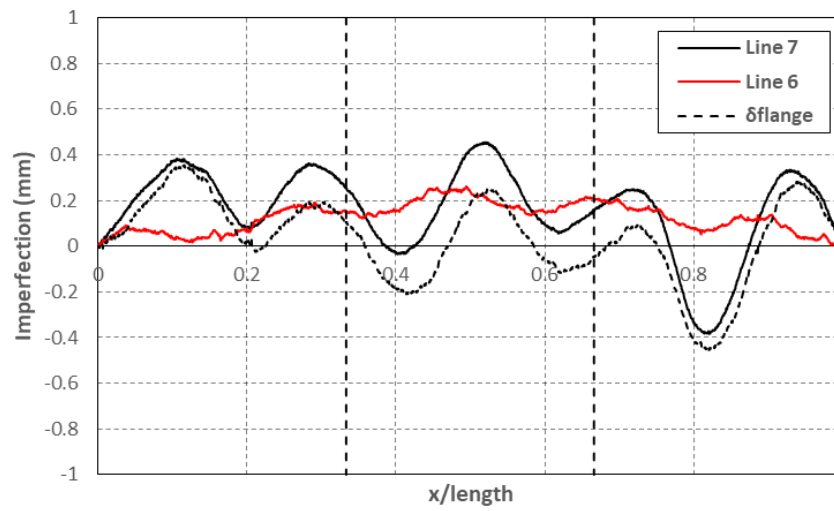


Figure E.20: Imperfections right flange channel T10412-7

E.1.5 B1-3a

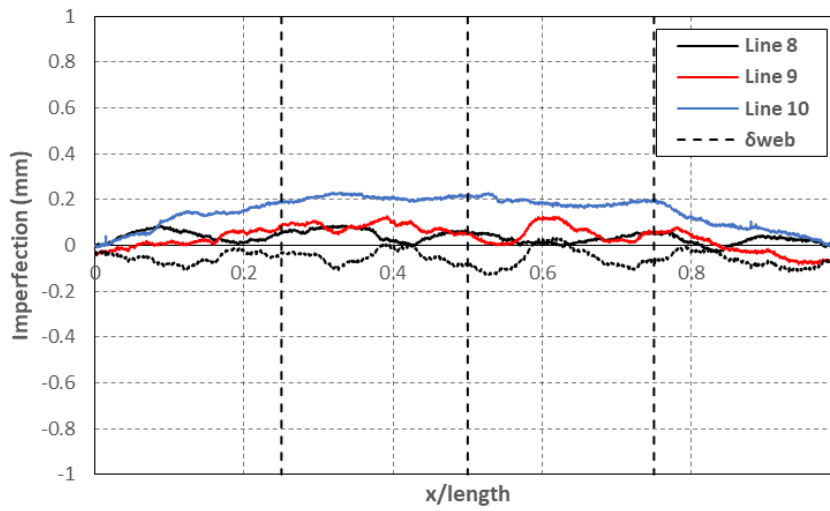


Figure E.21: Imperfections web channel T12915-9

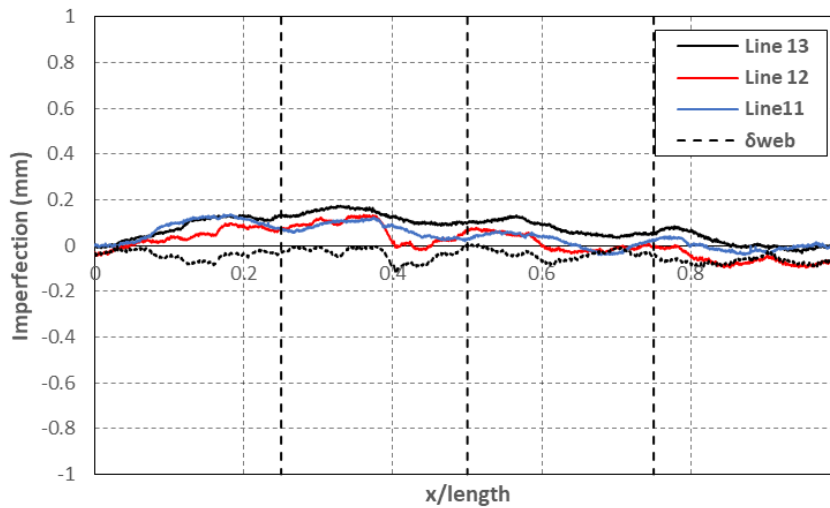


Figure E.22: Imperfections web channel T12915-10

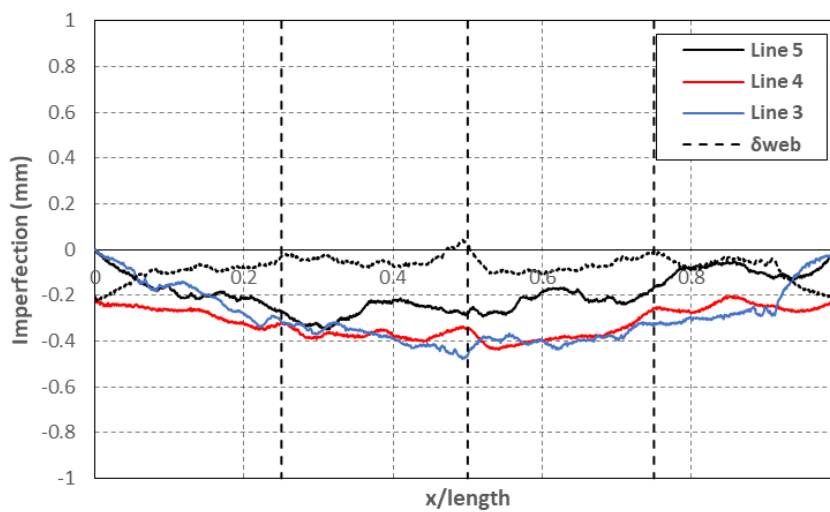


Figure E.23: Imperfections web channel T10412-9

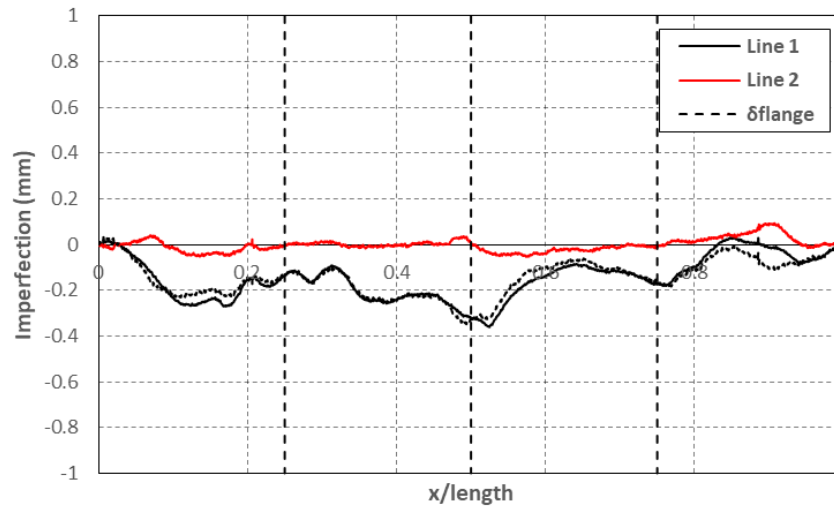


Figure E.24: Imperfections left flange channel T10412-9

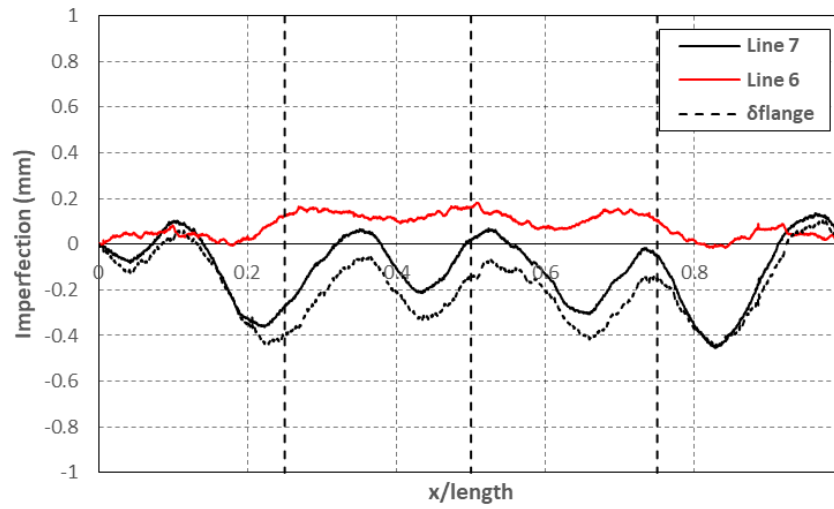


Figure E.25: Imperfections right flange channel T10412-9

E.1.6 B1-3b

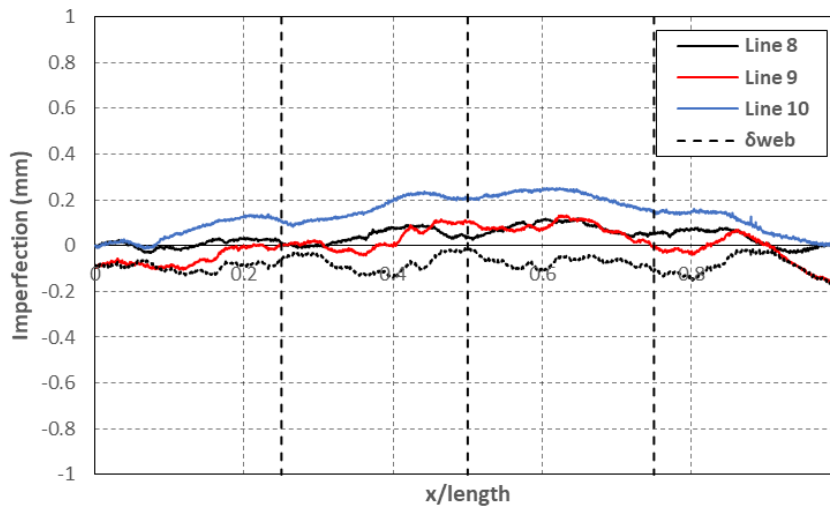


Figure E.26: Imperfections web channel T12915-11

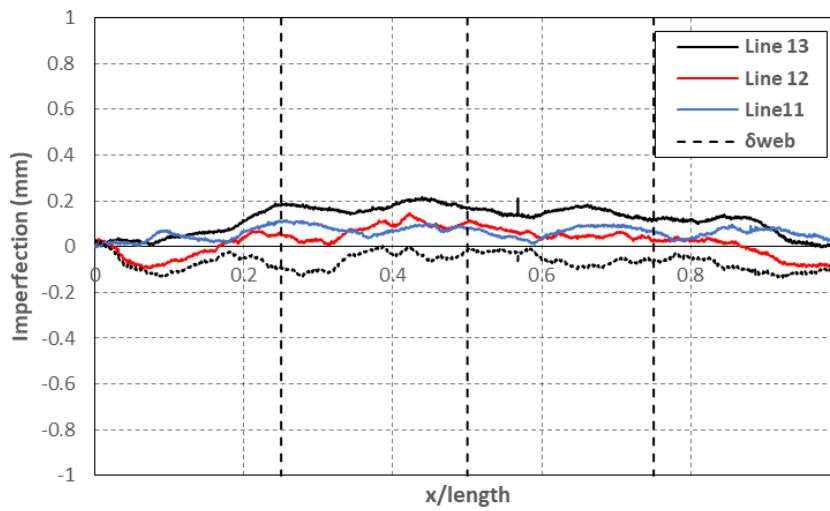


Figure E.27: Imperfections web channel T12915-12

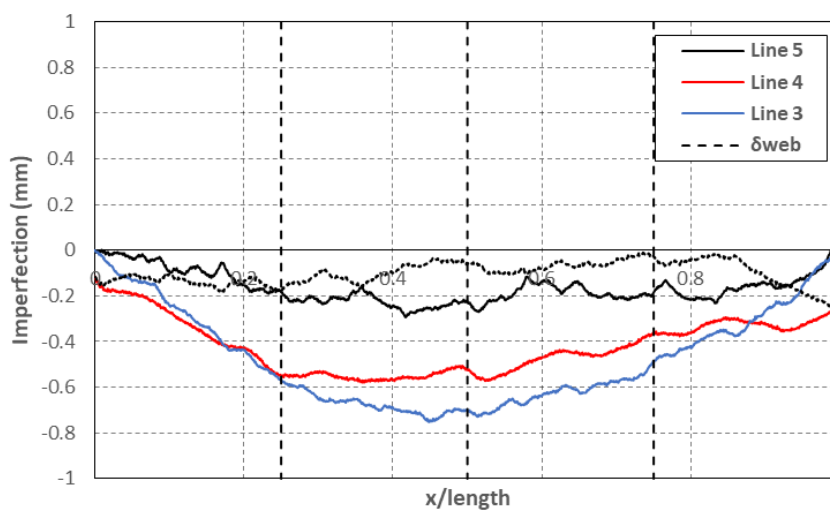


Figure E.28: Imperfections web channel T10412-11

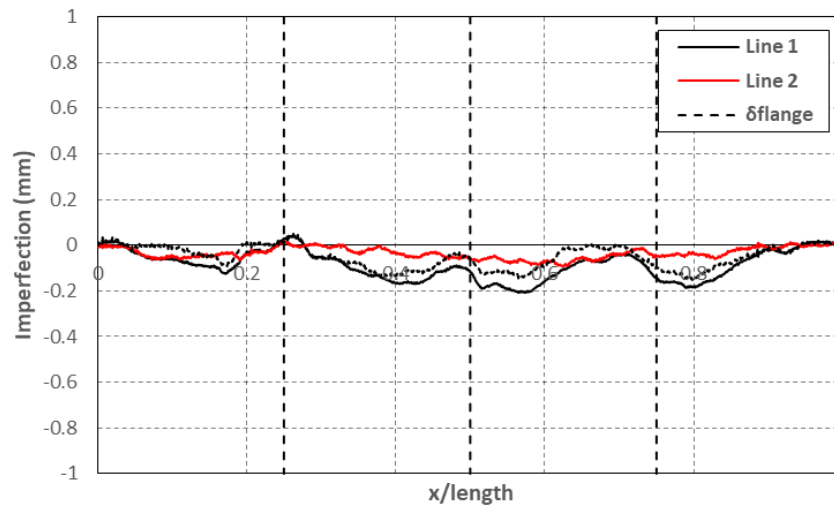


Figure E.29: Imperfections left flange channel T10412-11

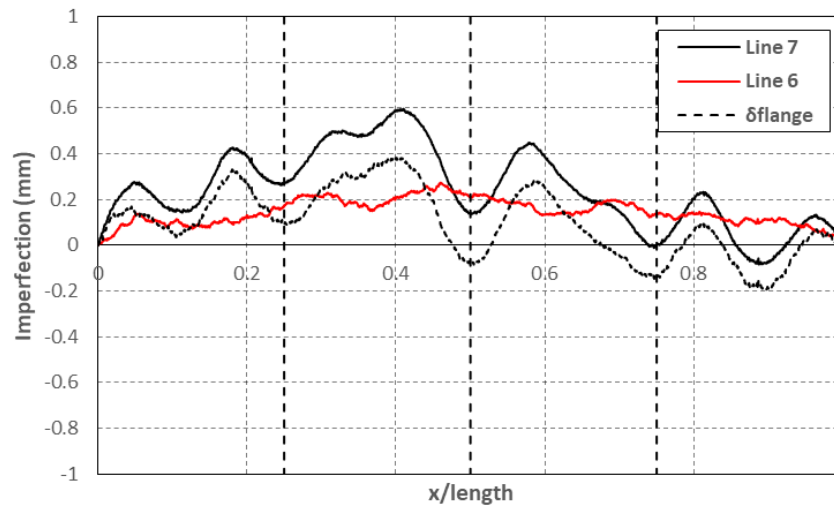


Figure E.30: Imperfections right flange channel T10412-11

E.2. Built-up geometry 2 (B2)

E.2.1 B2-0a

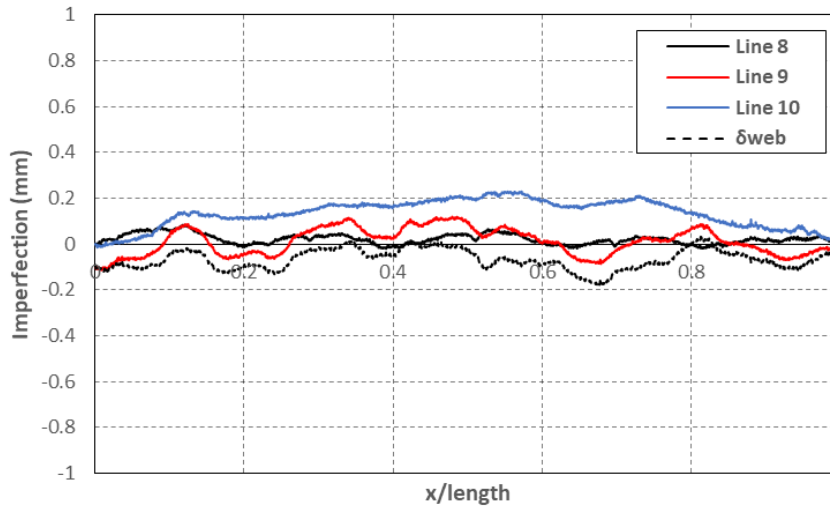


Figure E.31: Imperfections web channel T12915-1

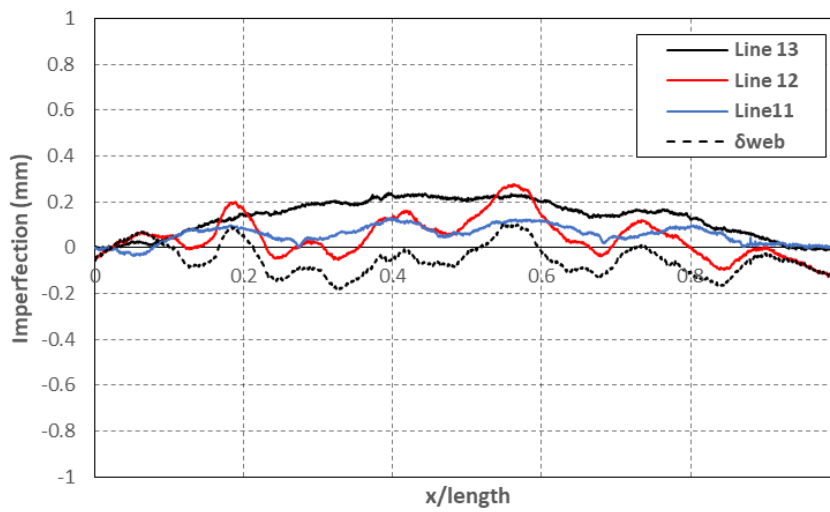


Figure E.32: Imperfections web channel T12915-2

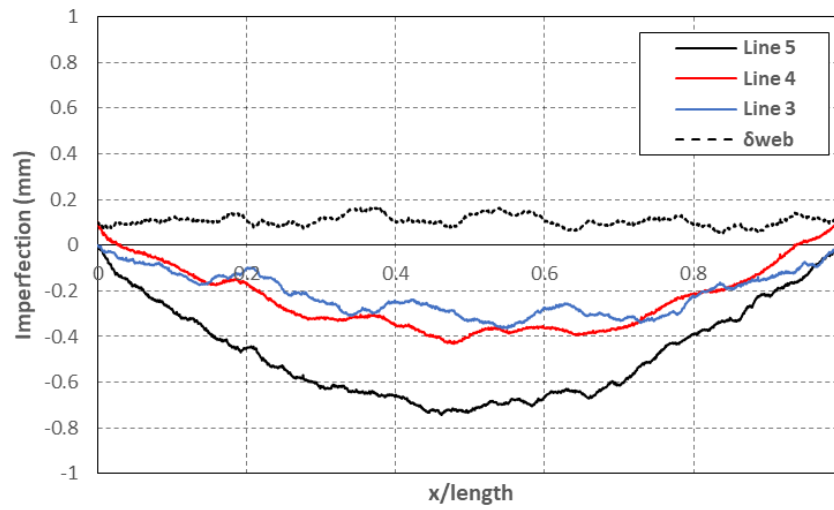


Figure E.33: Imperfections web channel T10412-1

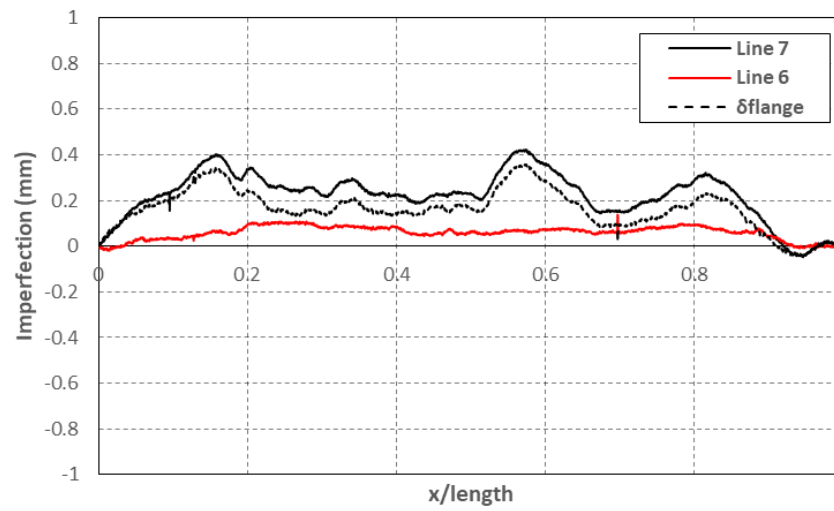


Figure E.34: Imperfections left flange channel T10412-1

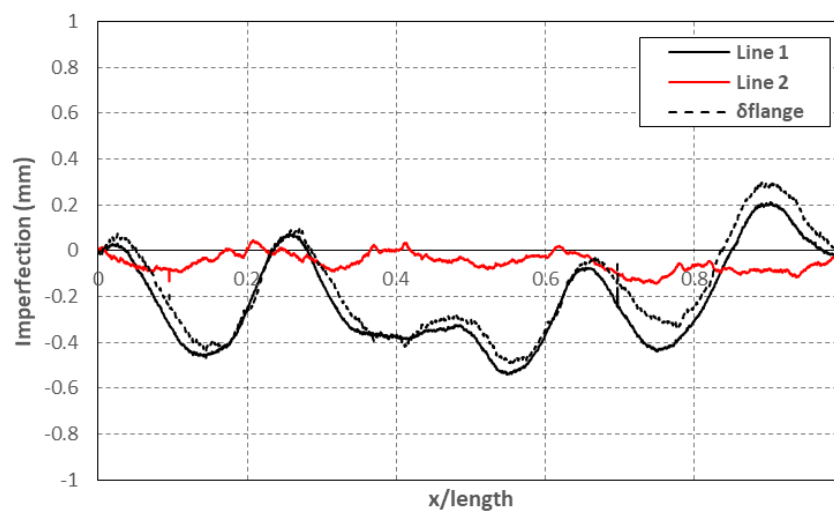


Figure E.35: Imperfections right flange channel T10412-1

E.2.2 B2-0b

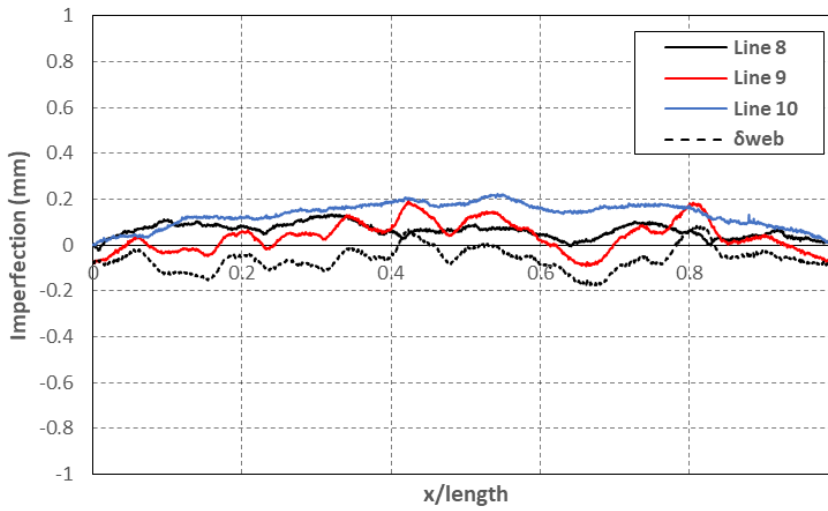


Figure E.36: Imperfections web channel T12915-3

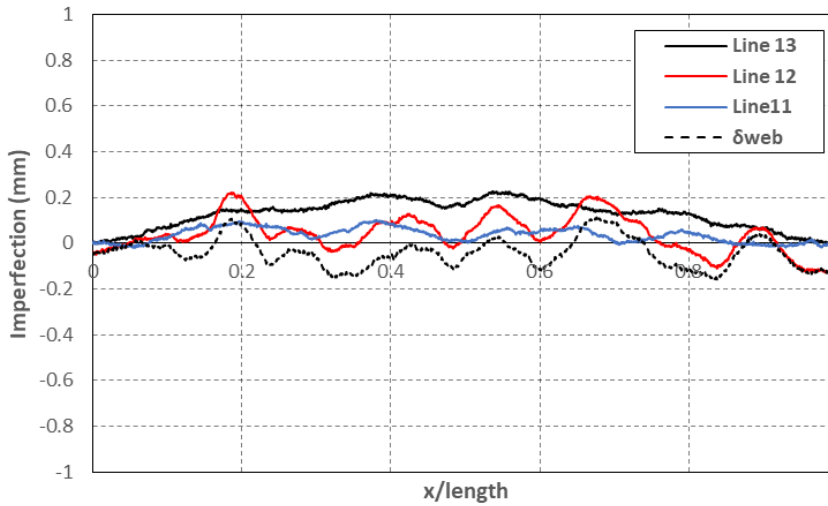


Figure E.37: Imperfections web channel T12915-4

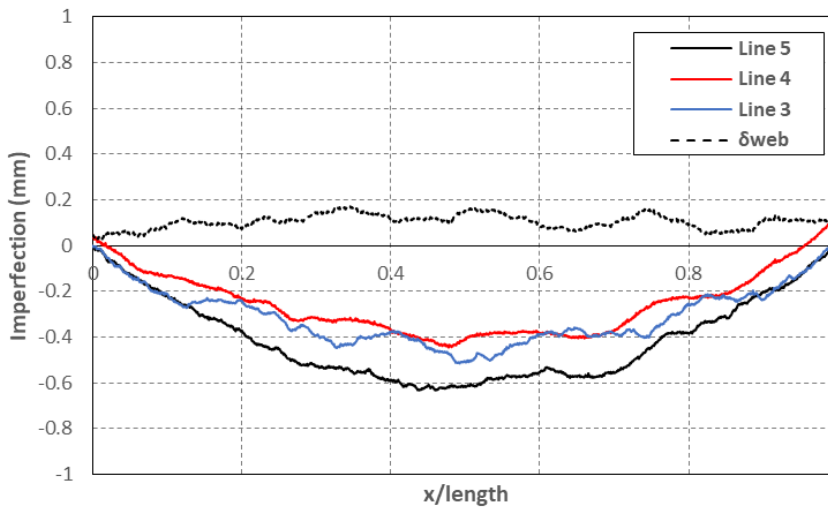


Figure E.38: Imperfections web channel T10412-2

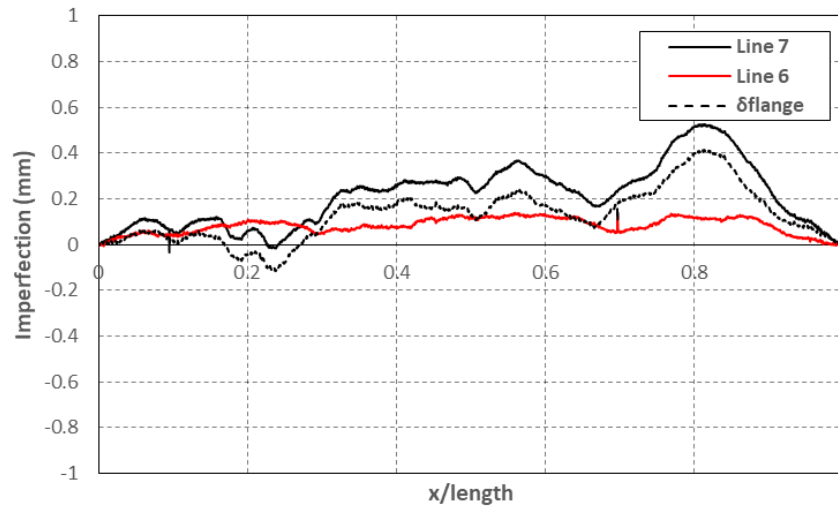


Figure E.39: Imperfections left flange channel T10412-2

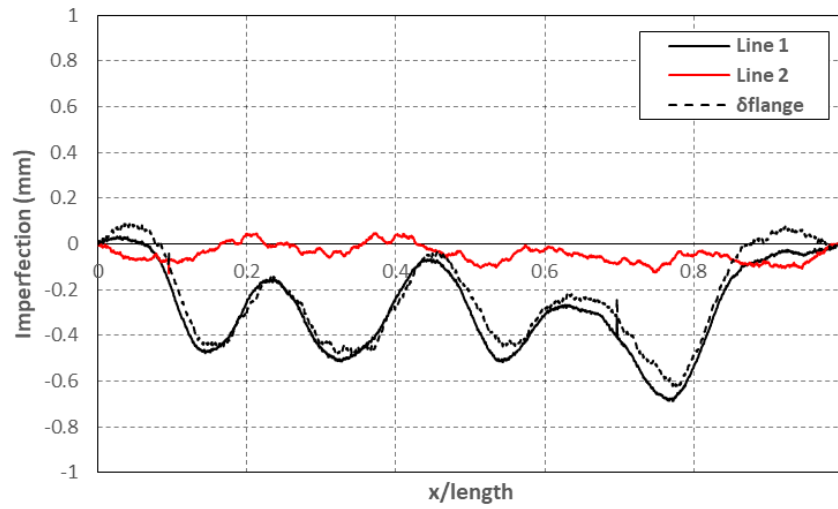


Figure E.40: Imperfections right flange channel T10412-2

E.2.3 B2-2a

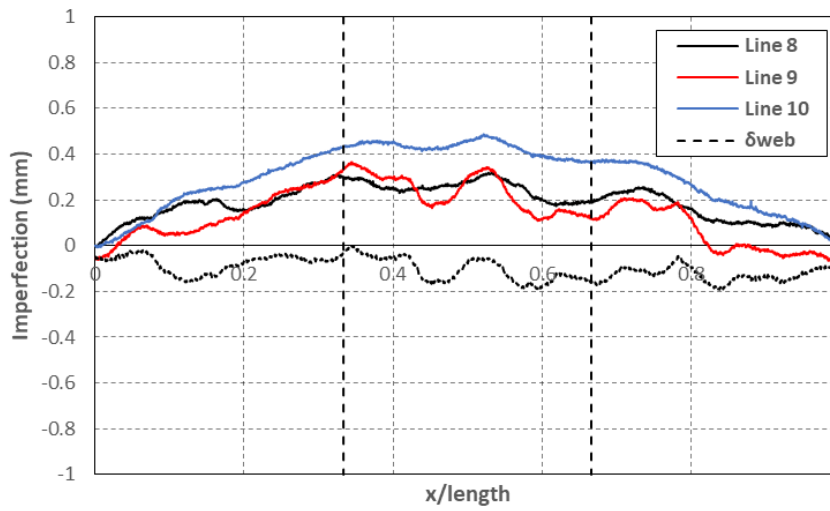


Figure E.41: Imperfections web channel T12915-5

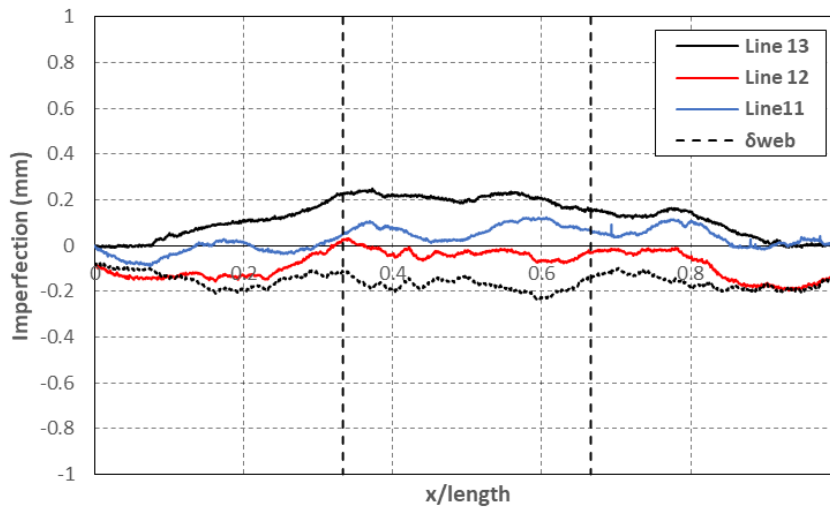


Figure E.42: Imperfections web channel T12915-6

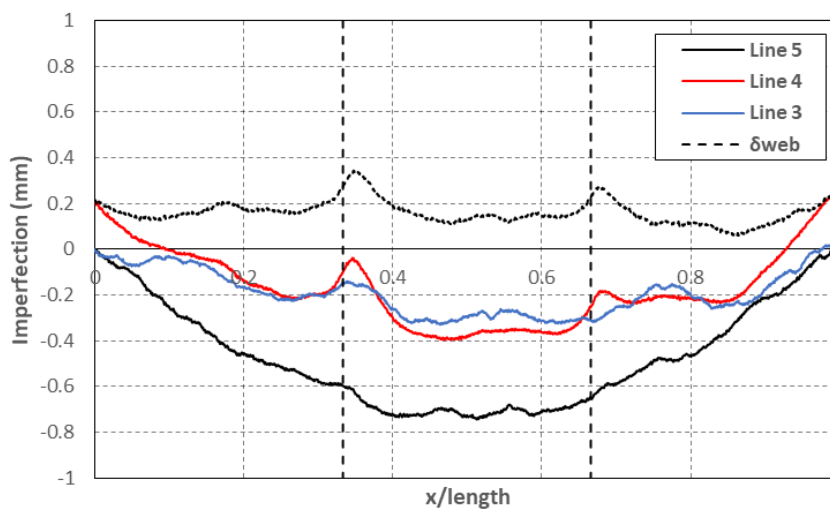


Figure E.43: Imperfections web channel T10412-3

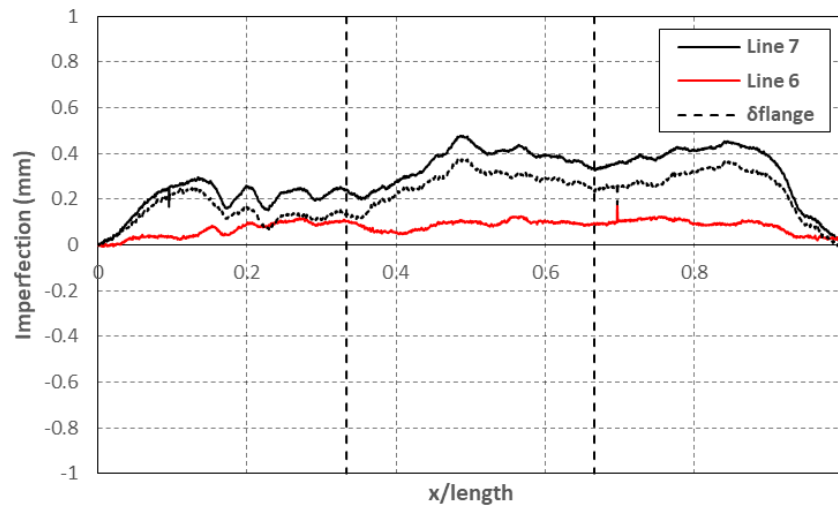


Figure E.44: Imperfections left flange channel T10412-3

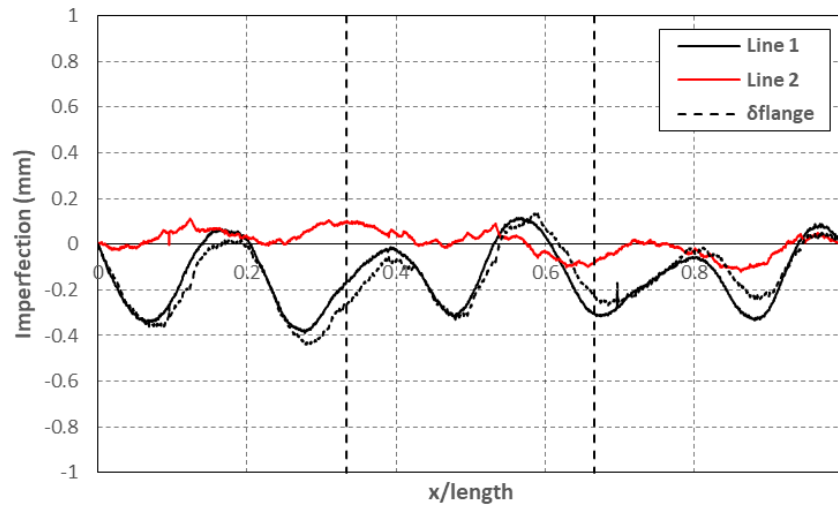


Figure E.45: Imperfections right flange channel T10412-3

E.2.4 B2-2b

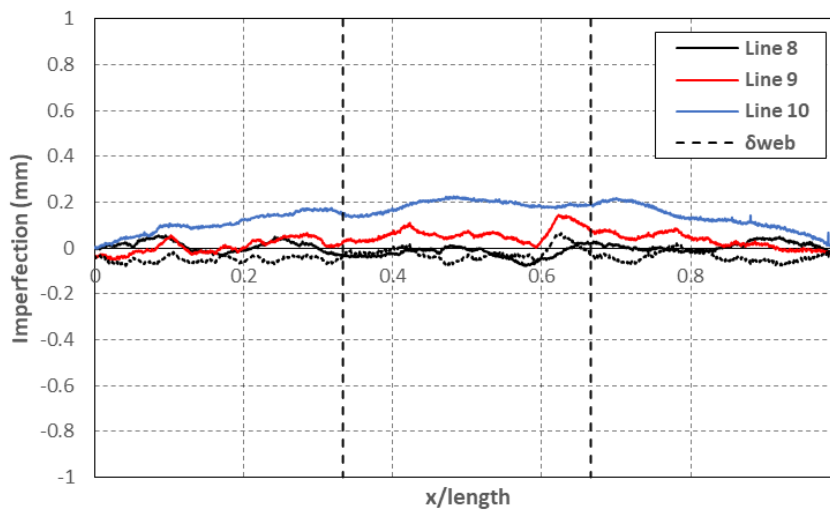


Figure E.46: Imperfections web channel T12915-7

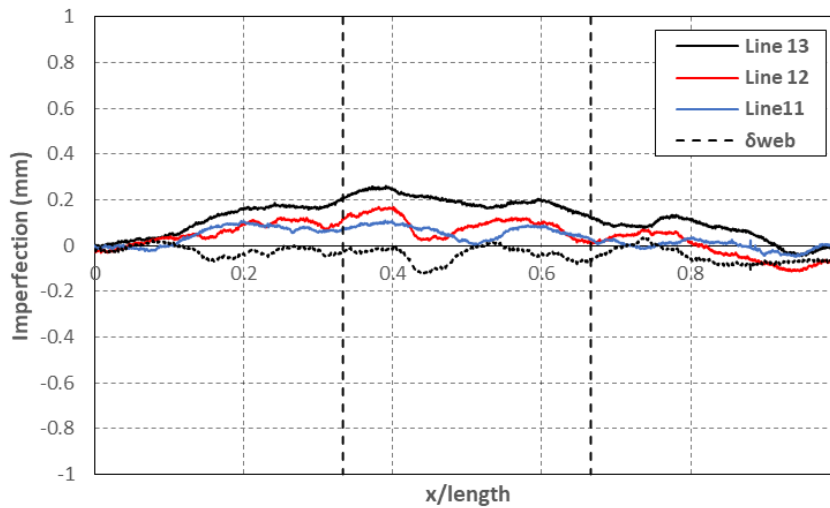


Figure E.47: Imperfections web channel T12915-8

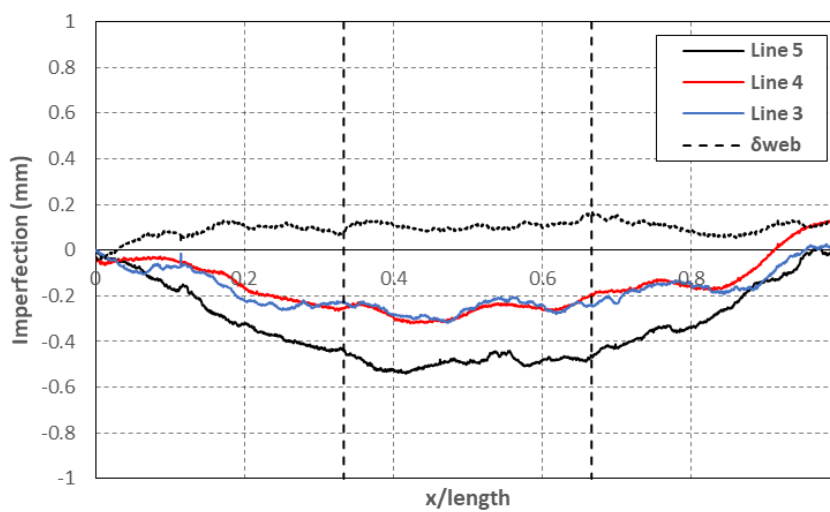


Figure E.48: Imperfections web channel T10412-4

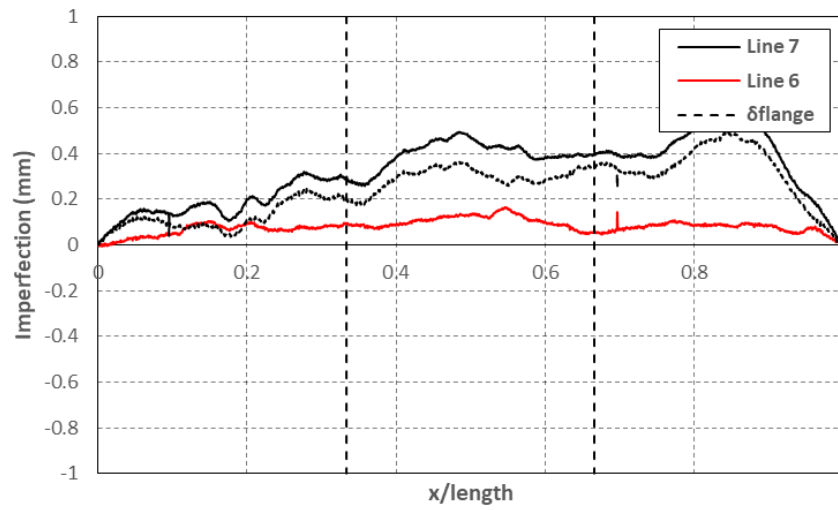


Figure E.49: Imperfections left flange channel T10412-4

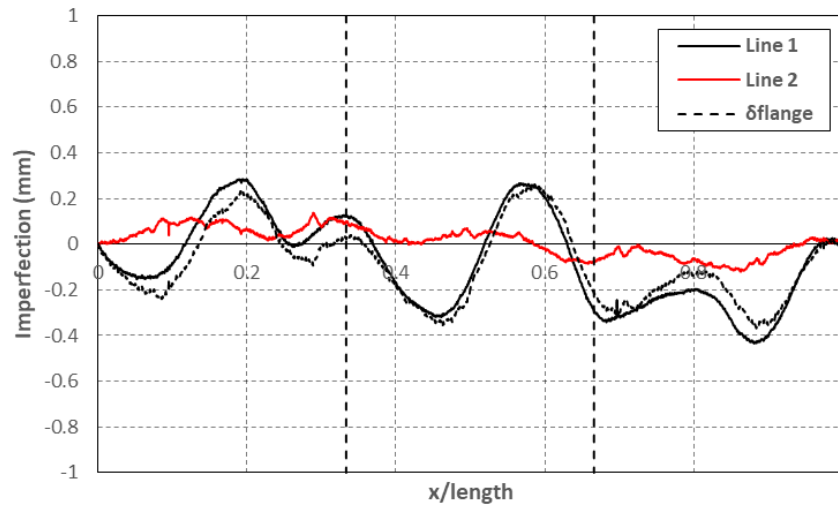


Figure E.50: Imperfections right flange channel T10412-4

E.2.5 B2-3a

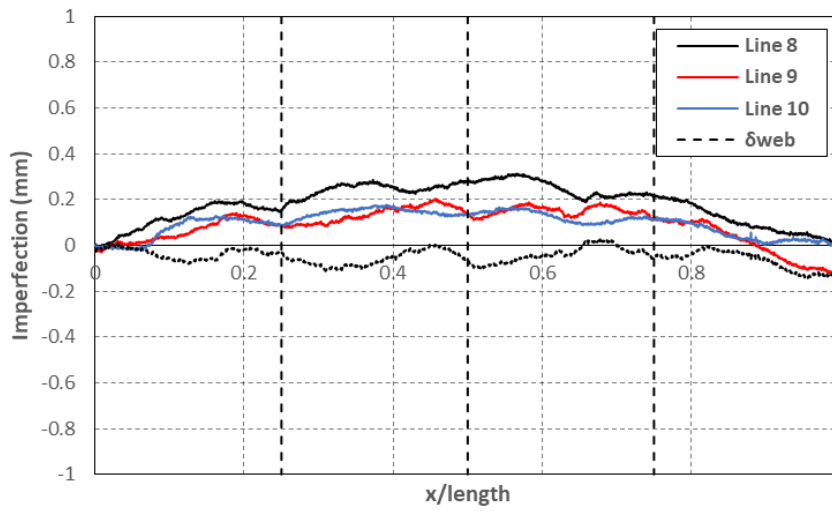


Figure E.51: Imperfections web channel T12915-9

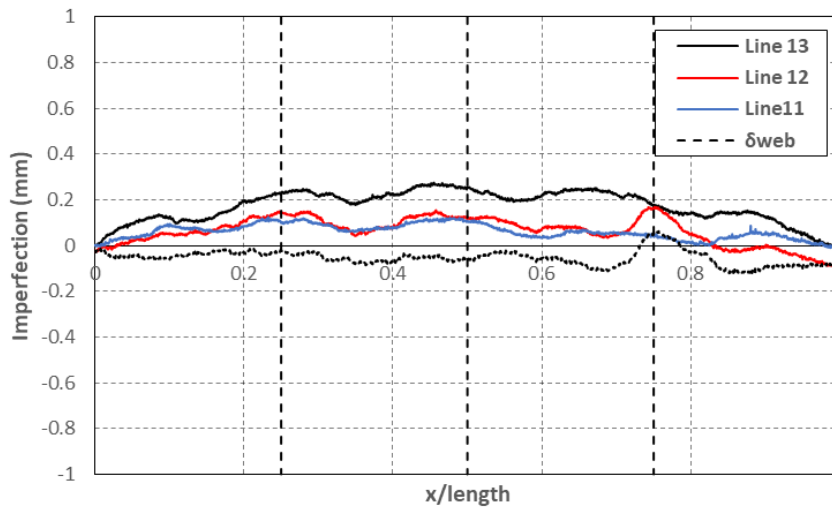


Figure E.52: Imperfections web channel T12915-10

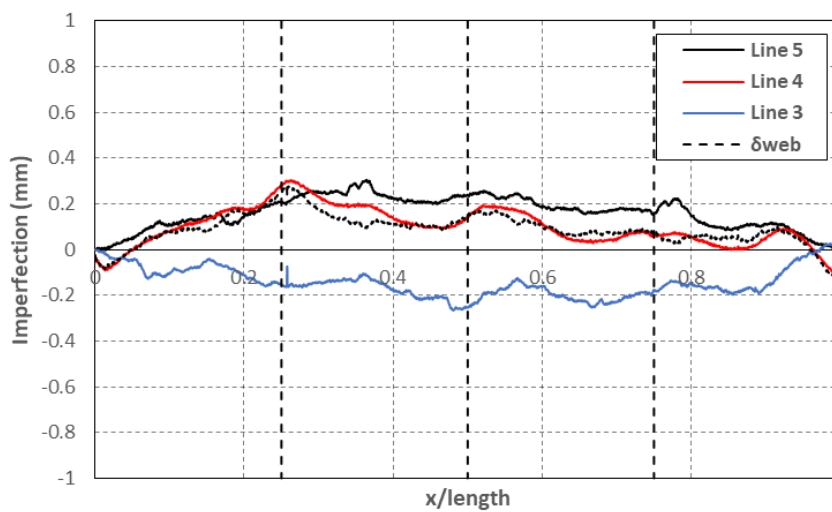


Figure E.53: Imperfections web channel T10412-5

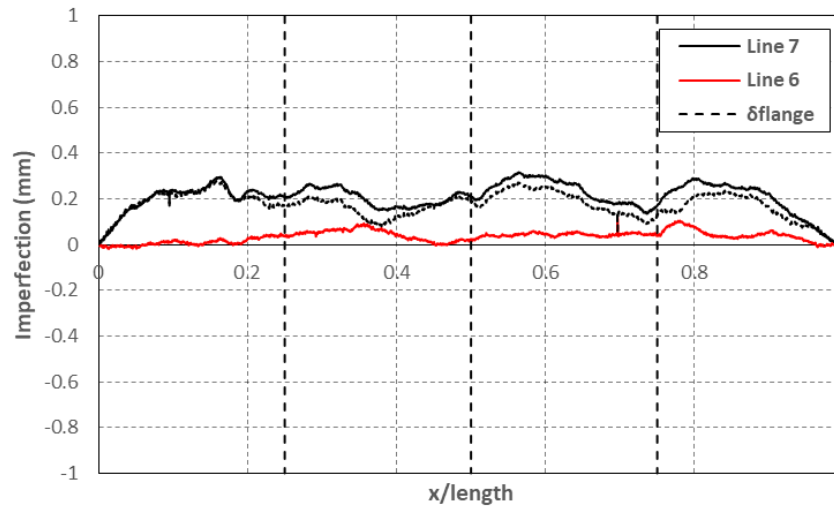


Figure E.54: Imperfections left flange channel T10412-5

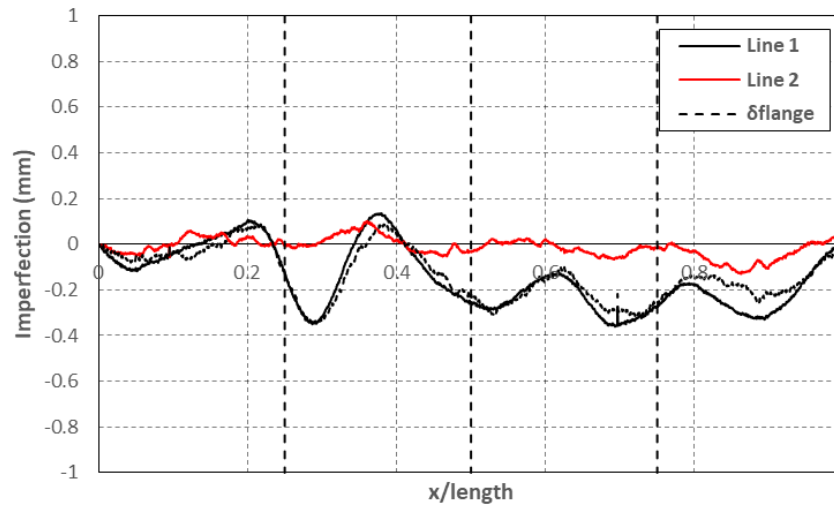


Figure E.55: Imperfections right flange channel T10412-5

E.2.6 B2-3b

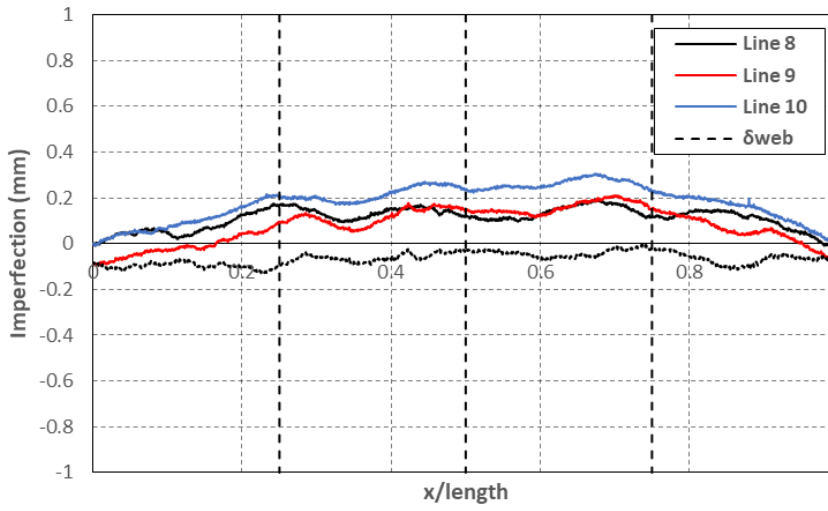


Figure E.56: Imperfections web channel T12915-11

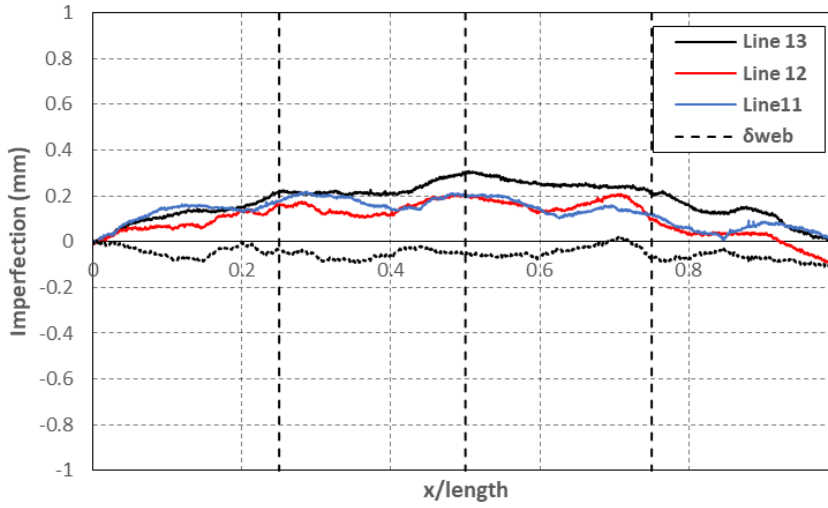


Figure E.57: Imperfections web channel T12915-12

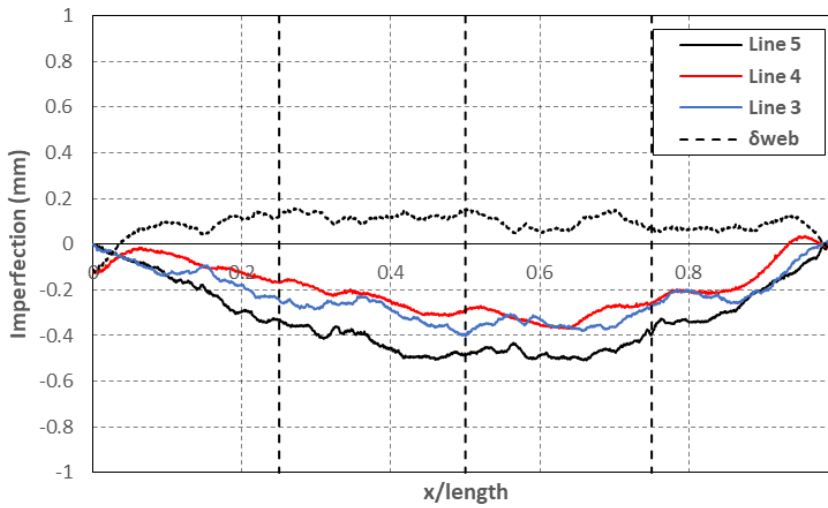


Figure E.58: Imperfections web channel T10412-6

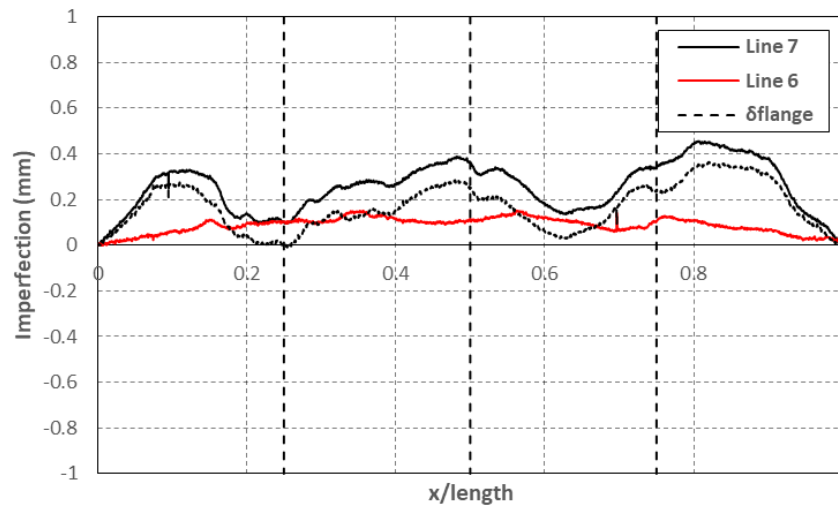


Figure E.59: Imperfections left flange channel T10412-6

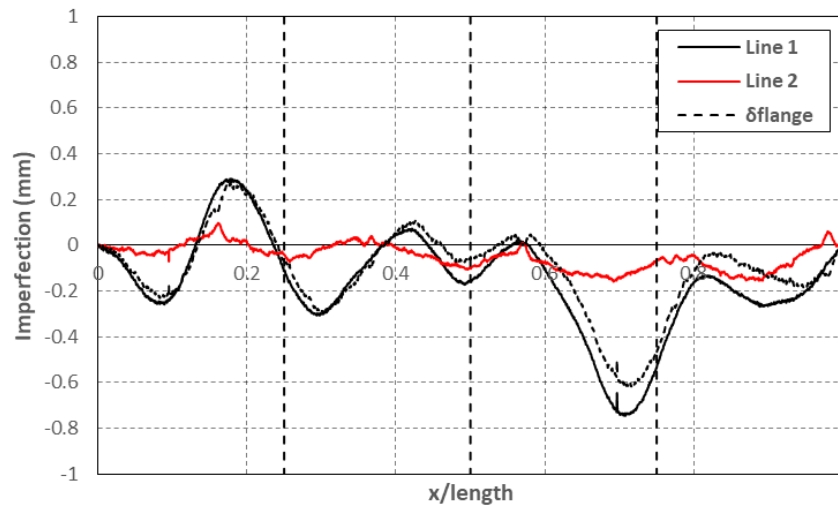


Figure E.60: Imperfections right flange channel T10412-6

Appendix F

Beams Test Results

Appendix F contains the results obtained from the beam tests. The results are presented in the form of moment vs. mid-span deflection curves, including the dynamic and static moment, and load vs. lateral deformation curves obtained for each test specimen. Further details about the beams test results are included in Section 4.8 of the main text.

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F.1. Built-up geometry 1 (B1)

F.1.1 B1-0a

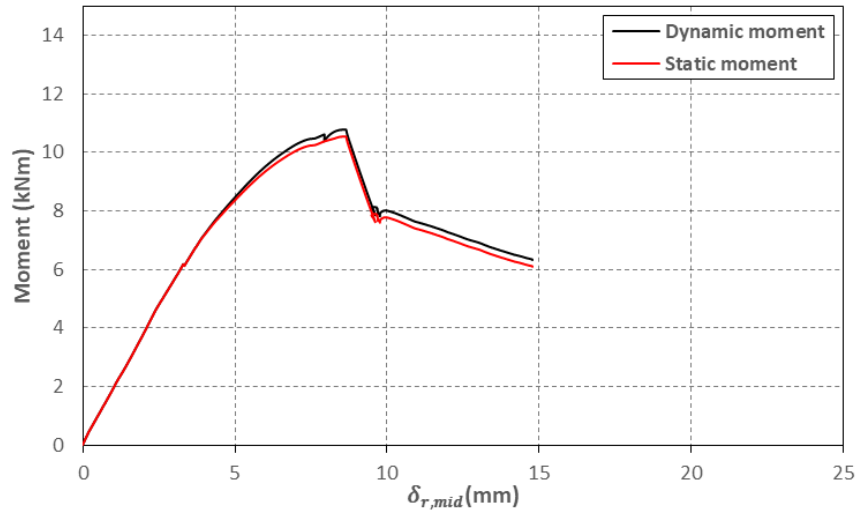


Figure F.1: Moment vs mid-span deflection B1-0a

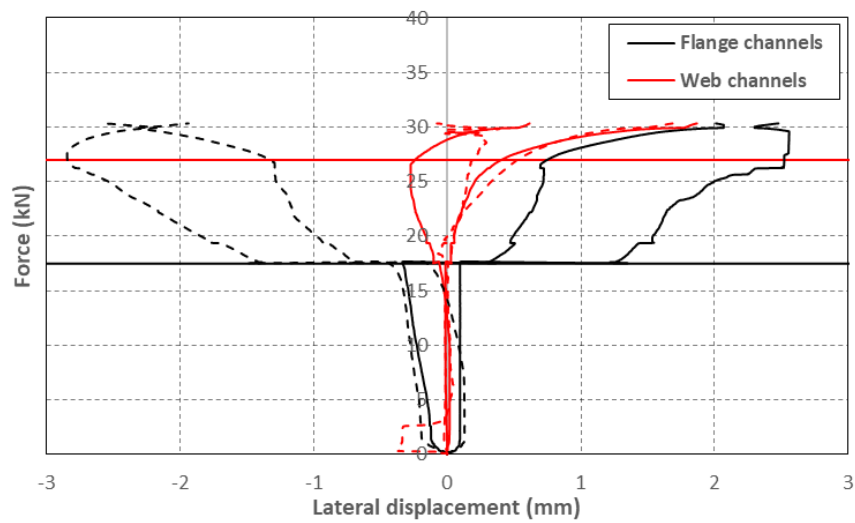


Figure F.2: Load vs lateral displacement B1-0a

F.1.2 B1-0b

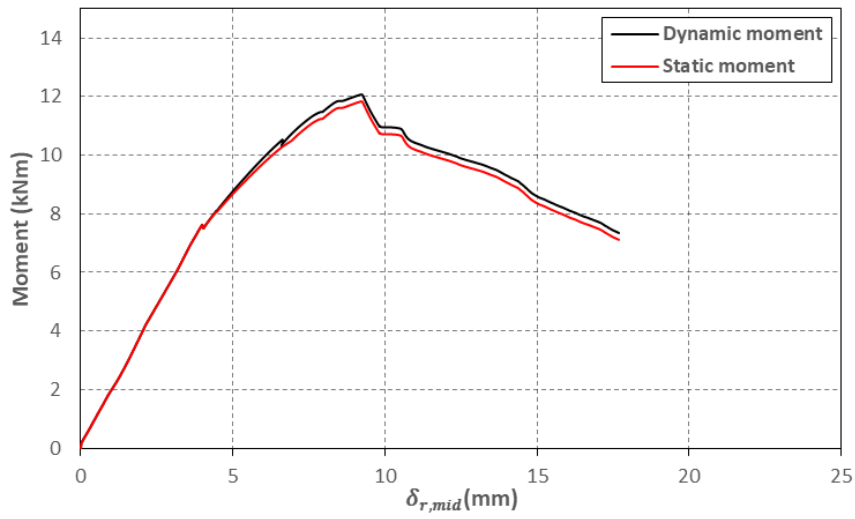


Figure F.3: Moment vs mid-span deflection B1-0b

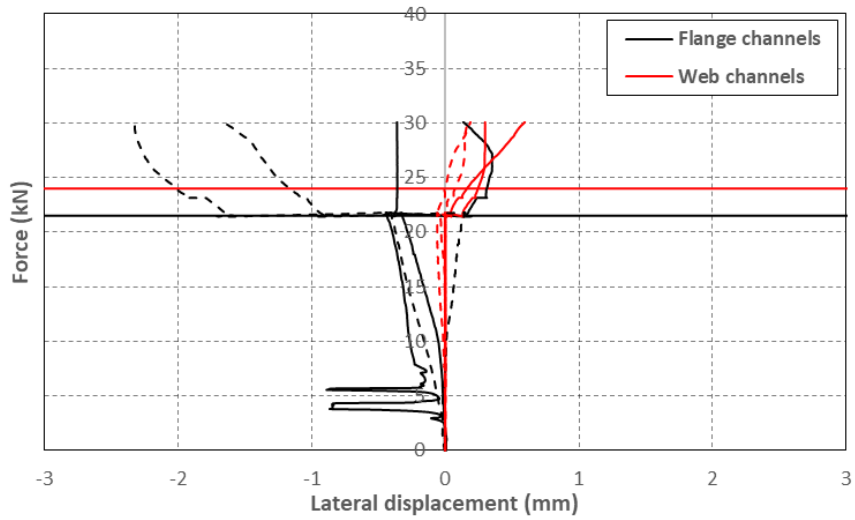


Figure F.4: Load vs lateral displacement B1-0b

F.1.3 B1-2a

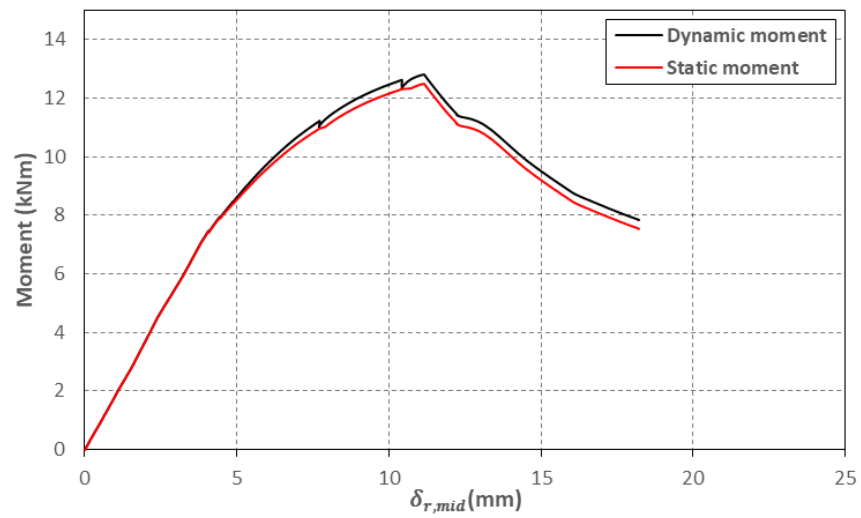


Figure F.5: Moment vs mid-span deflection B1-2a

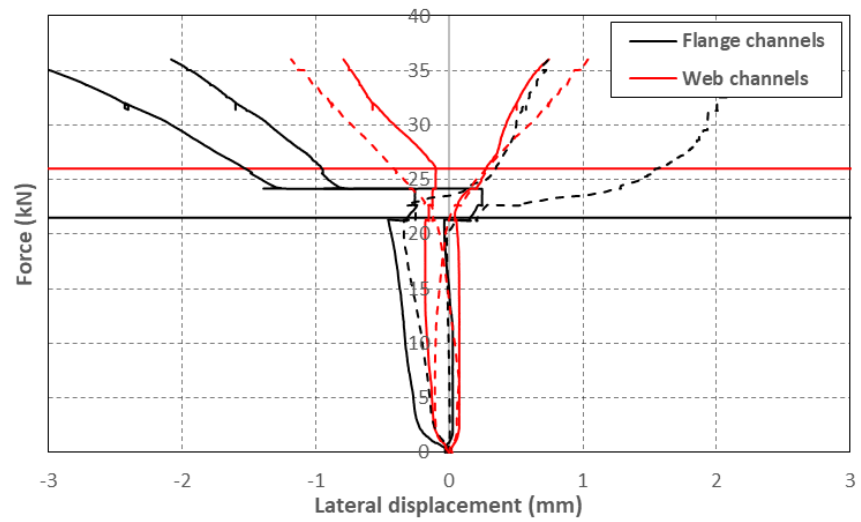


Figure F.6: Load vs lateral displacement B1-2a

F.1.4 B1-2b

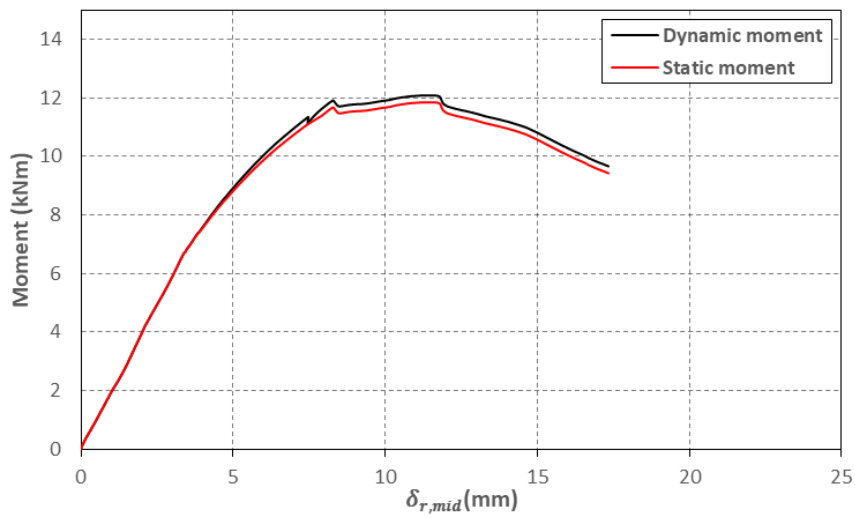


Figure F.7: Moment vs mid-span deflection B1-2b

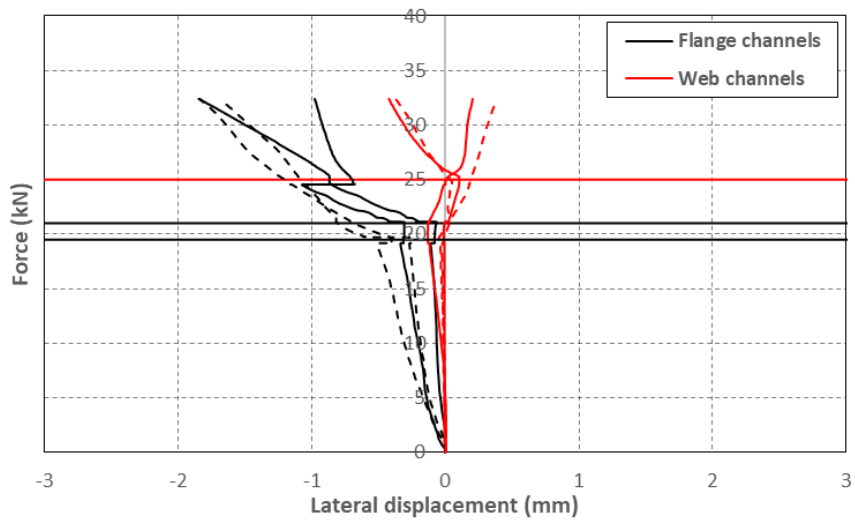
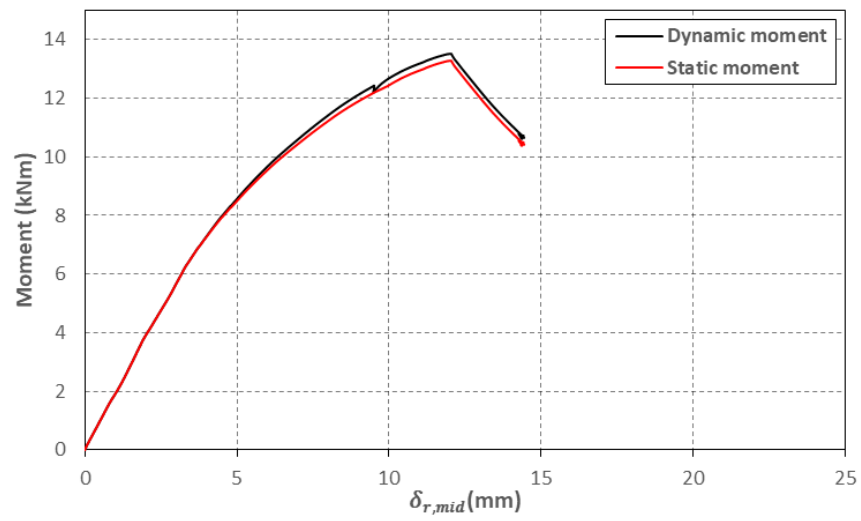
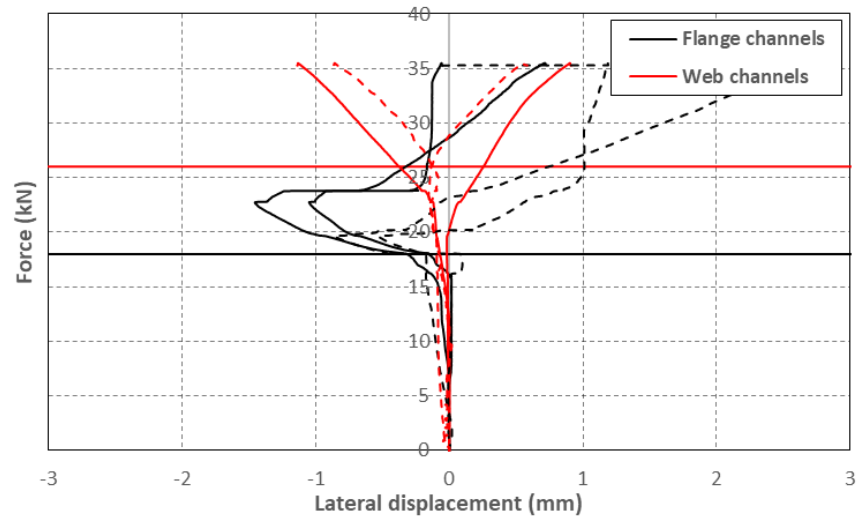


Figure F.8: Load vs lateral displacement B1-2b

F.1.5 B1-3a**Figure F.9: Moment vs mid-span deflection B1-3a****Figure F.10: Load vs lateral displacement B1-3a**

F.1.6 B1-3b

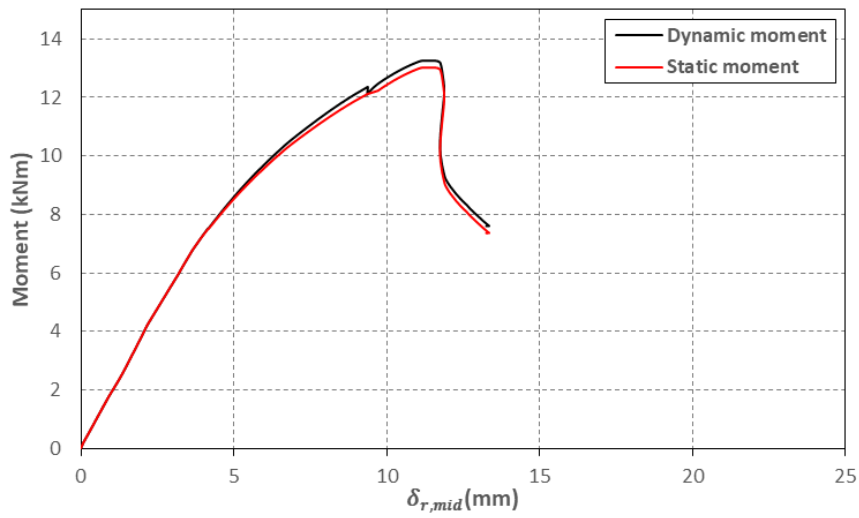


Figure F.11: Moment vs mid-span deflection B1-3b

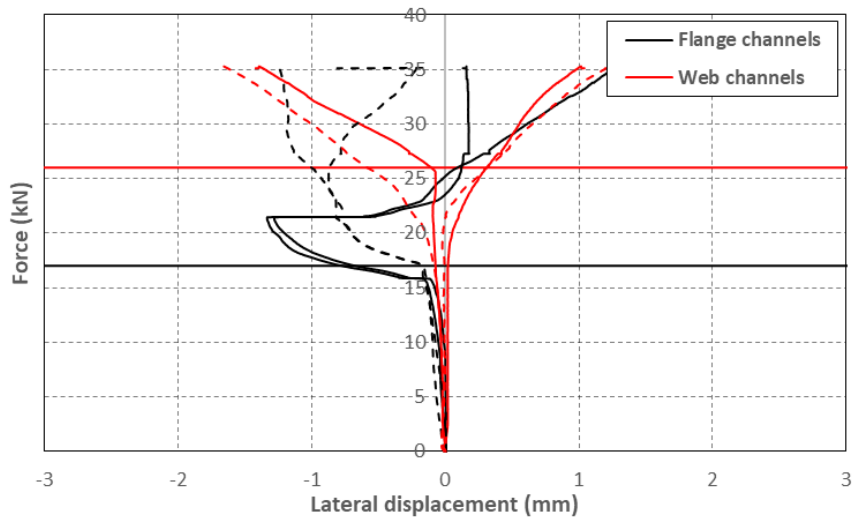


Figure F.12: Load vs lateral displacement B1-3b

F.2. Built-up geometry 2 (B2)

F.2.1 B2-0a

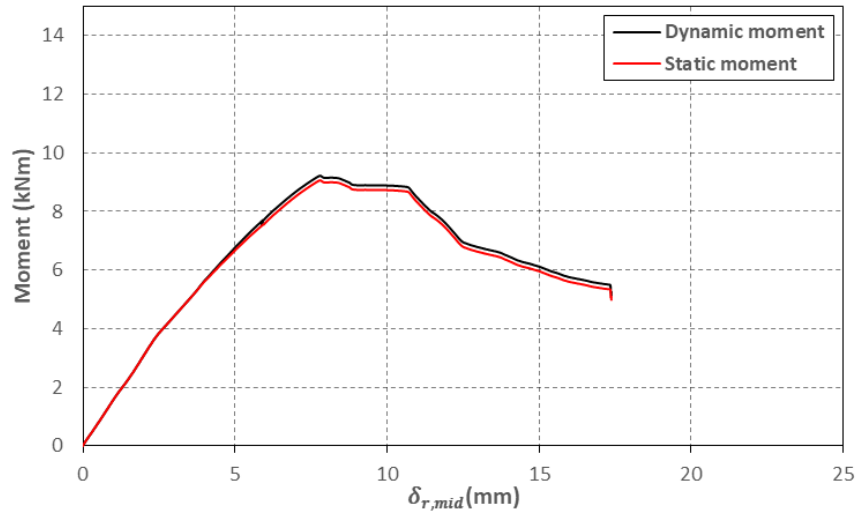


Figure F.13: Moment vs mid-span deflection B2-0a

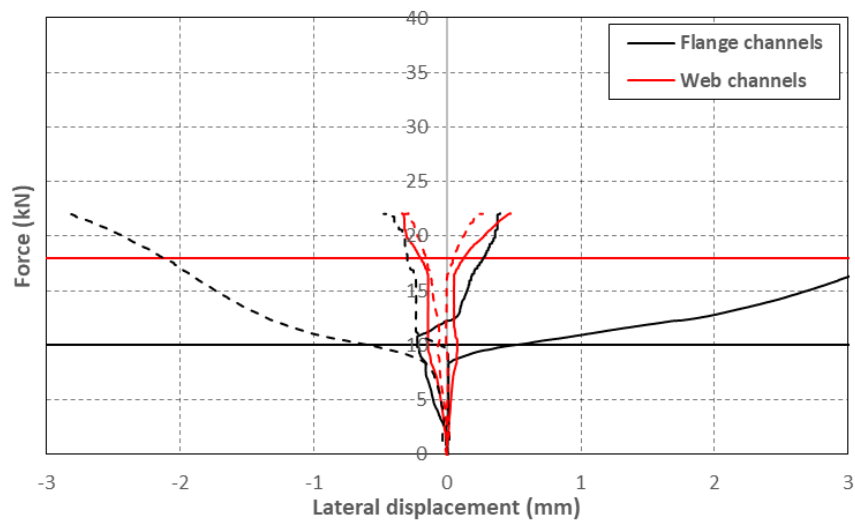


Figure F.14: Load vs lateral displacement B2-0a

F.2.2 B2-0b

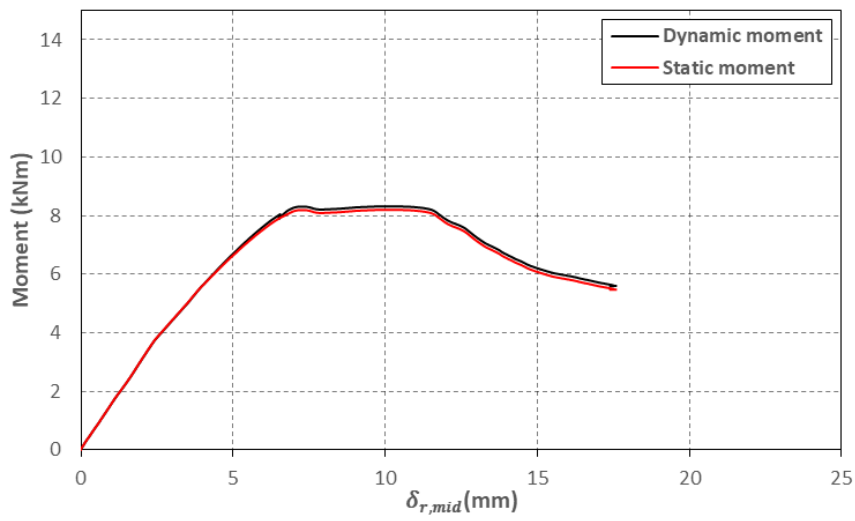


Figure F.15: Moment vs mid-span deflection B2-0b

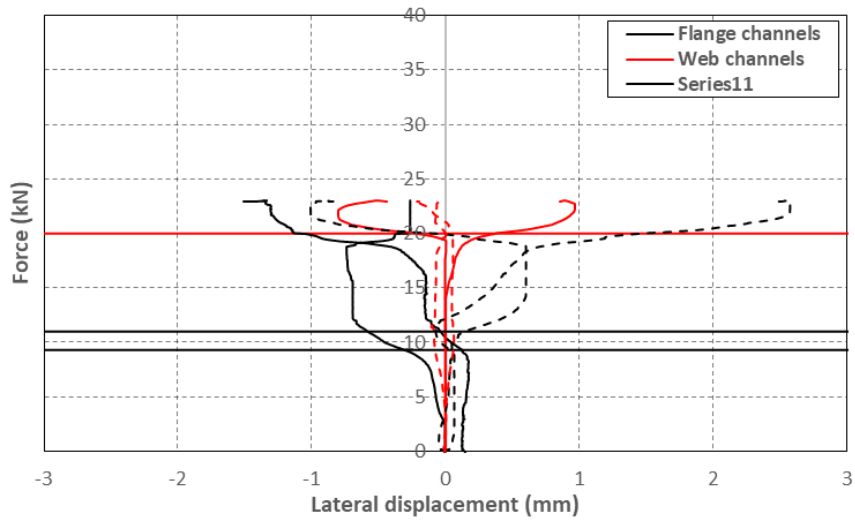


Figure F.16: Load vs lateral displacement B2-0b

F.2.3 B2-2a

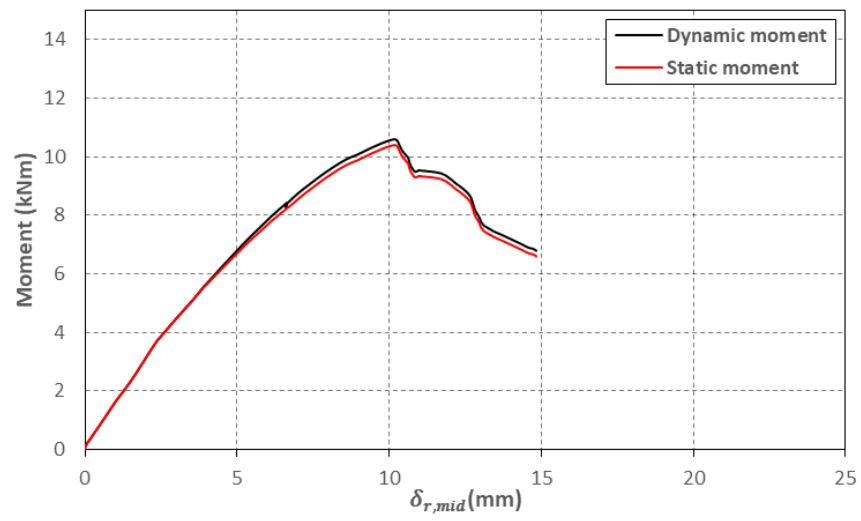


Figure F.17: Moment vs mid-span deflection B2-2a

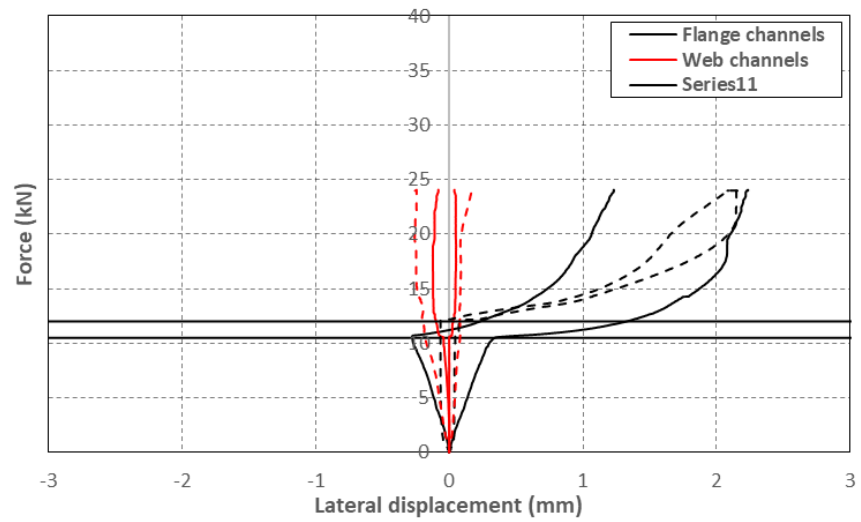


Figure F.18: Load vs lateral displacement B2-2a

F.2.4 B2-2b

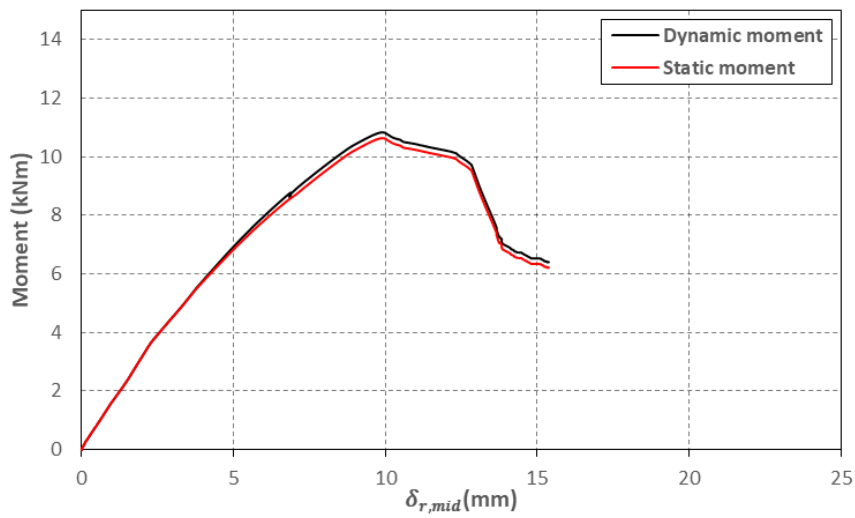


Figure F.19: Moment vs mid-span deflection B2-2b

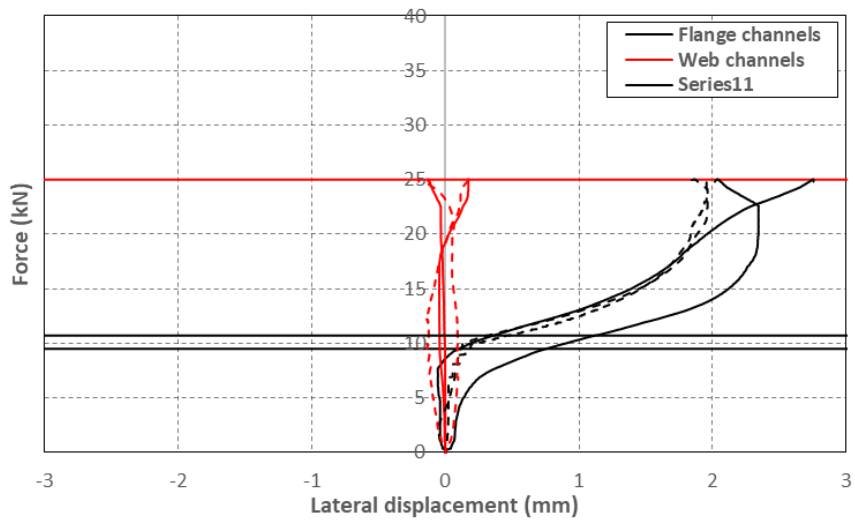


Figure F.20: Load vs lateral displacement B2-2b

F.2.5 B2-3a

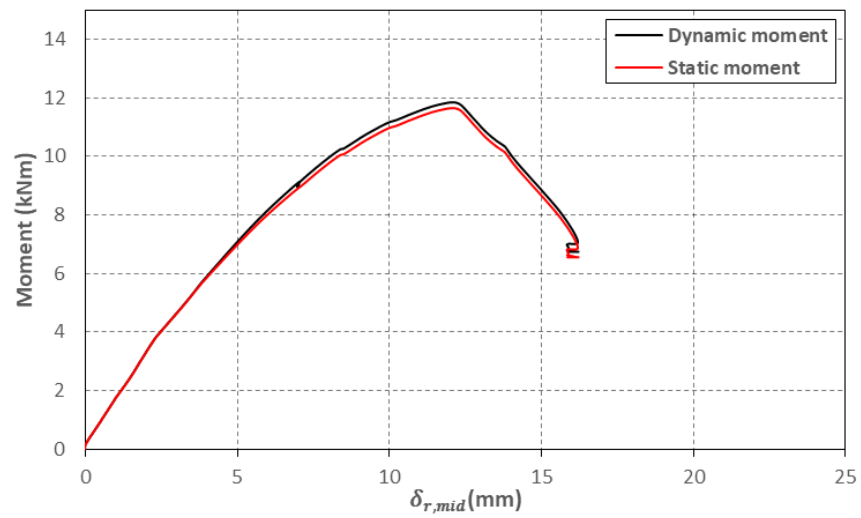


Figure F.21: Moment vs mid-span deflection B2-3a

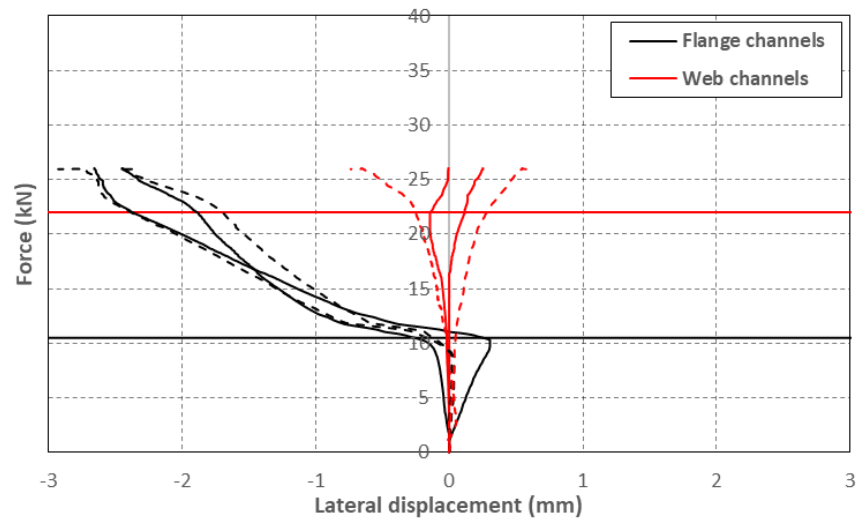


Figure F.22: Load vs lateral displacement B2-3a

F.2.6 B2-3b

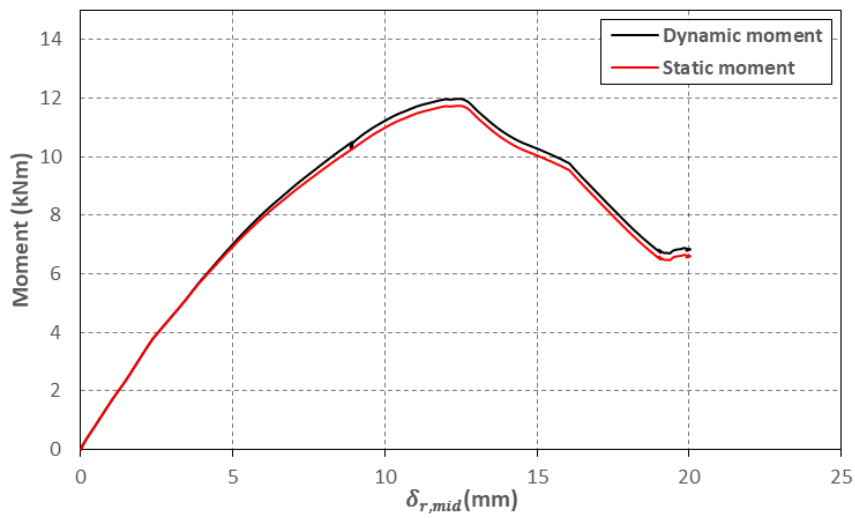


Figure F.23: Moment vs mid-span deflection B2-3b

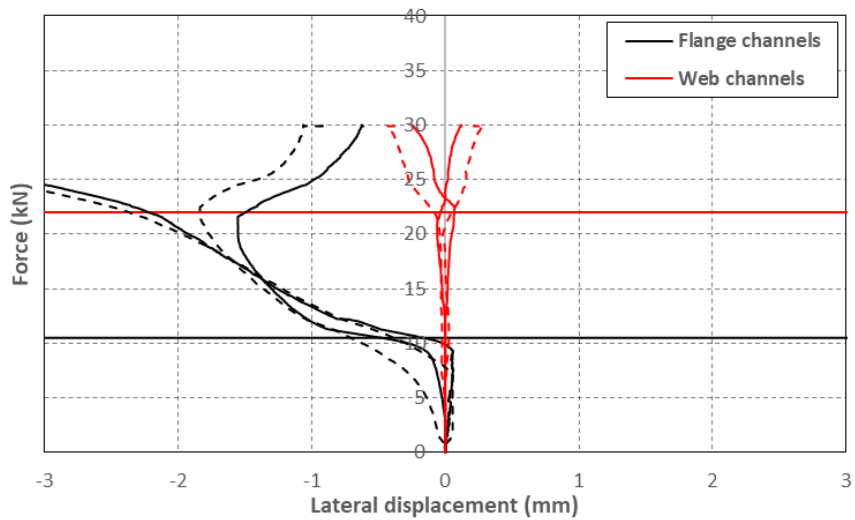


Figure F.24: Load vs lateral displacement B2-3b

Appendix G

Long Columns Tensile Coupons

Appendix G contains the results obtained from the tensile coupons extracted from the flat and corner regions of the component sections used to assemble the long columns. The results are presented in the form of stress-strain curves, and include the static and dynamic engineering stresses, as well as the static true stresses. The coupon results for sections T12012 and S11012, which were used to assemble the long columns with geometries LC3 and LC4, are the same as those included in Appendix A presenting the tensile coupons for the stub column, as these sections had identical cross-sectional dimensions and were fabricated from steel sheets belonging to the same batch to those sections. Those coupon tests results are repeated here for completeness. Further details about the coupon tests for the long columns are included in Section 5.3 of the main text.

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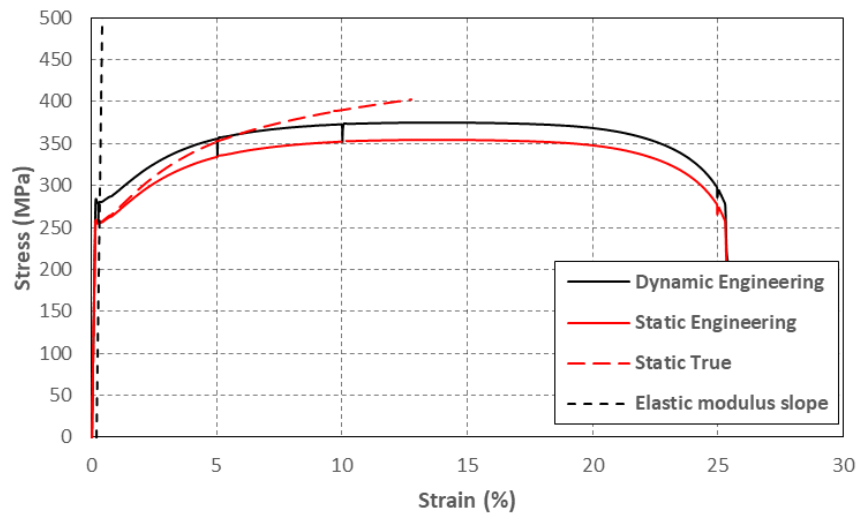


Figure G.1: P15020a Flat coupon test results

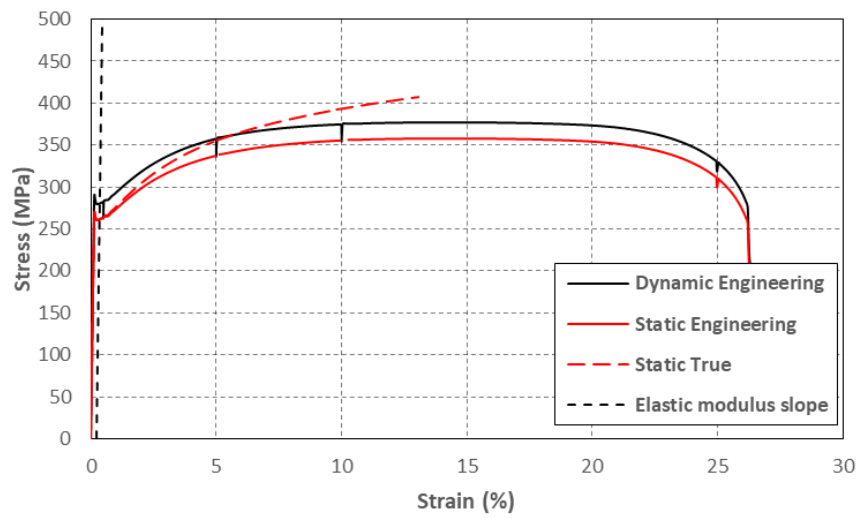


Figure G.2: P15020b Flat coupon test results

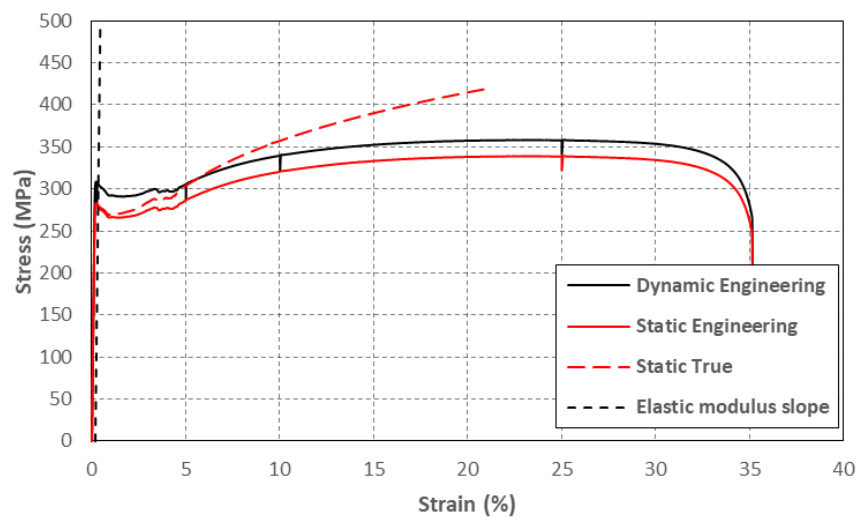


Figure G.3: T13014a Flat coupon test results

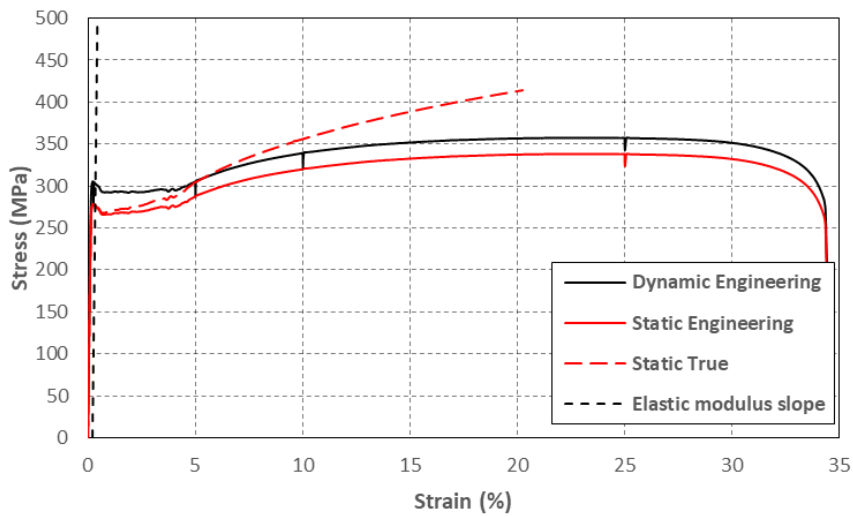


Figure G.4: T13014b Flat coupon test results

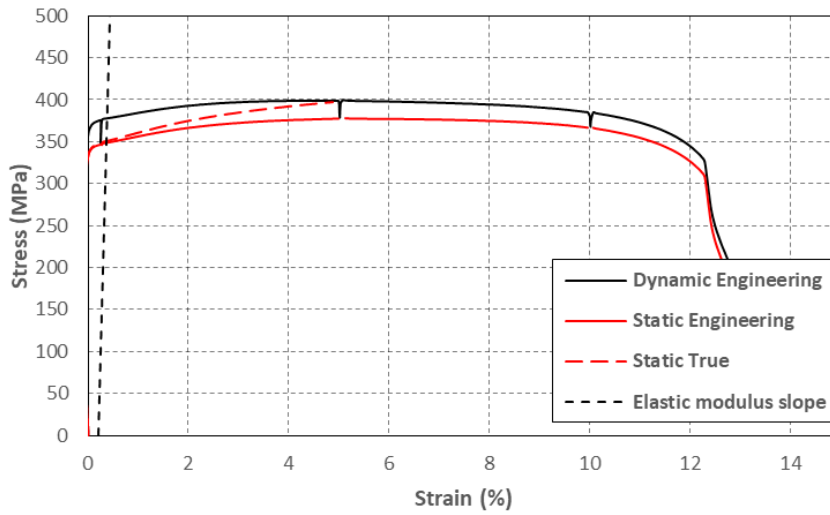


Figure G.5: T13014 Corner coupon test results

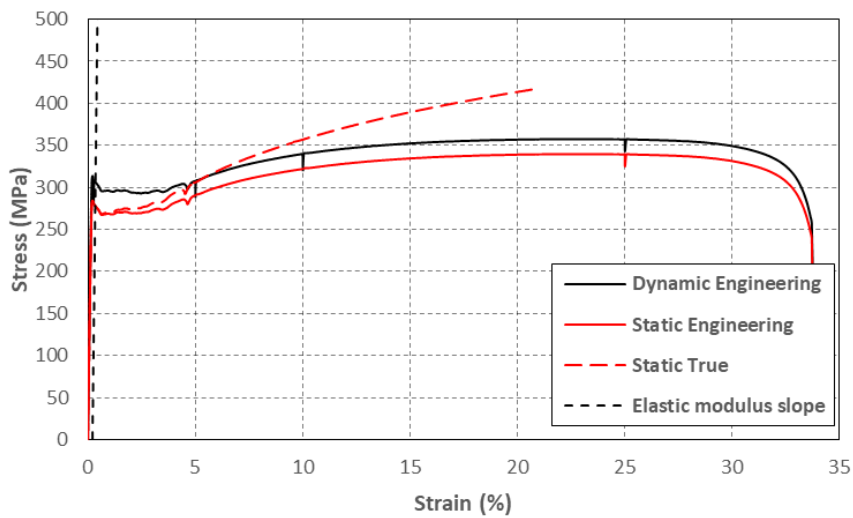


Figure G.6: T7914a Flat coupon test results

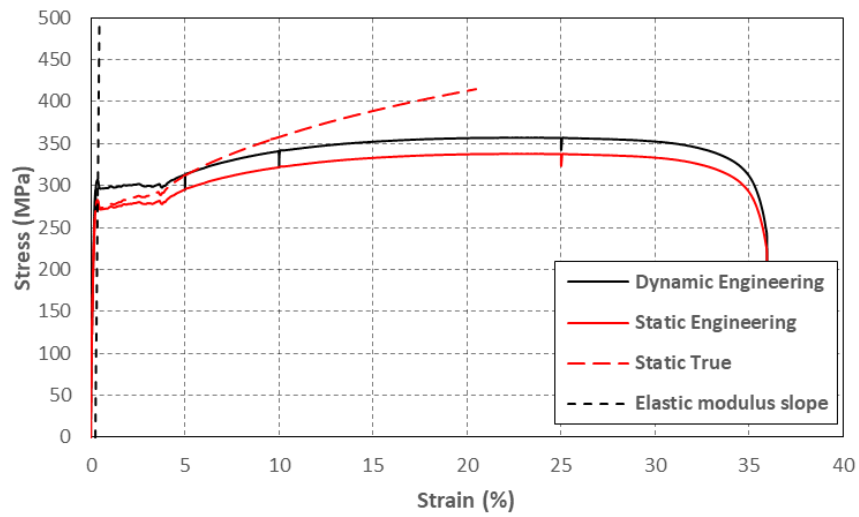


Figure G.7: T7914b Flat coupon test results

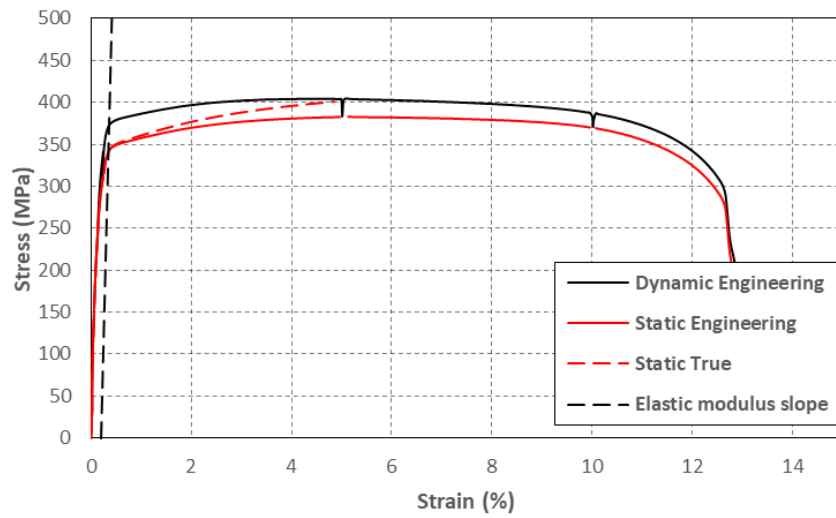


Figure G.8: T7914 Corner coupon test results

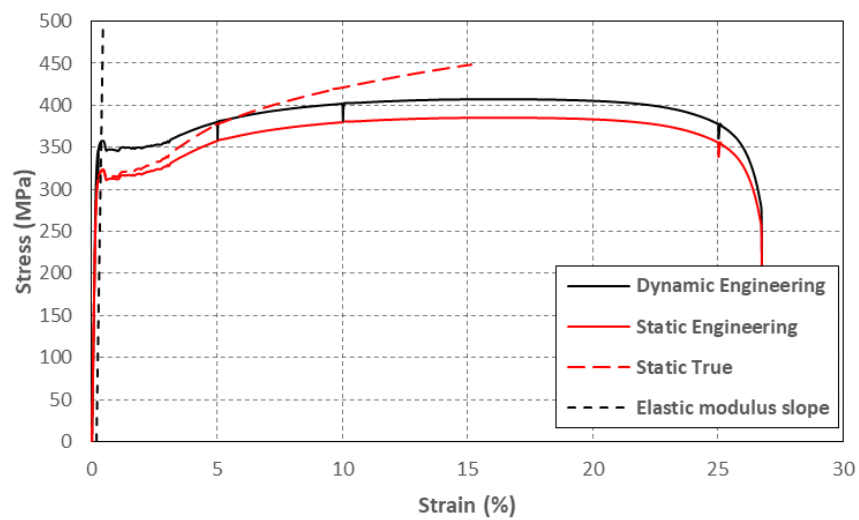


Figure G.9: T15414(l)a Flat coupon test results

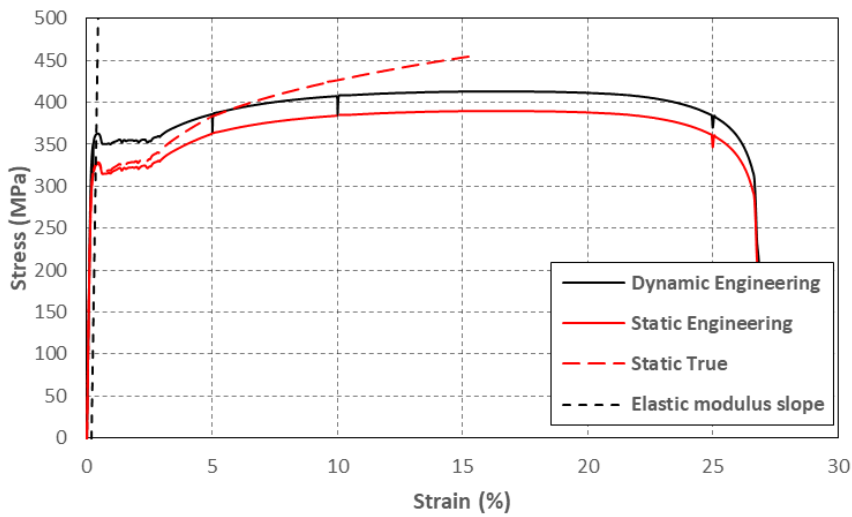


Figure G.10: T15414(l)b Flat coupon test results

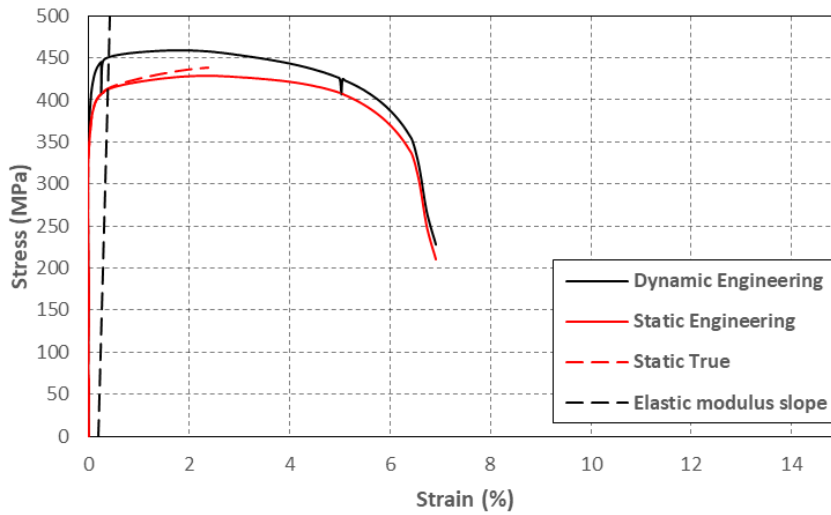


Figure G.11: T15414(l) Corner coupon test results

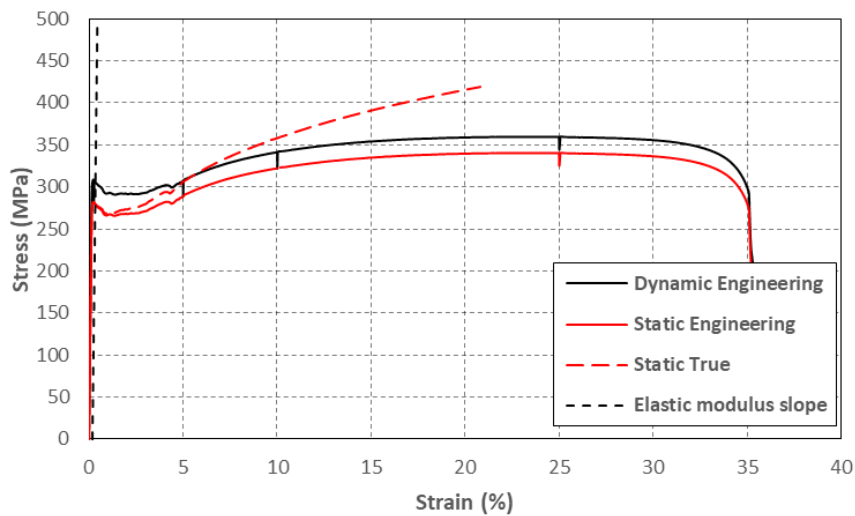
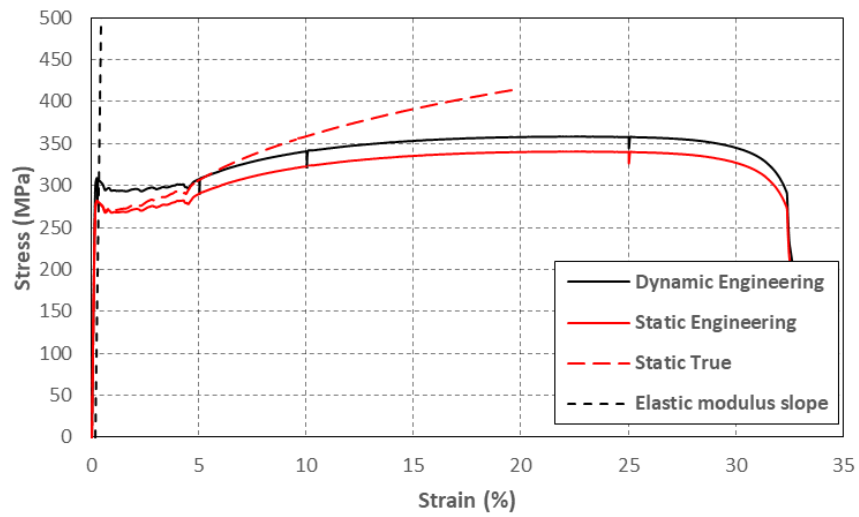
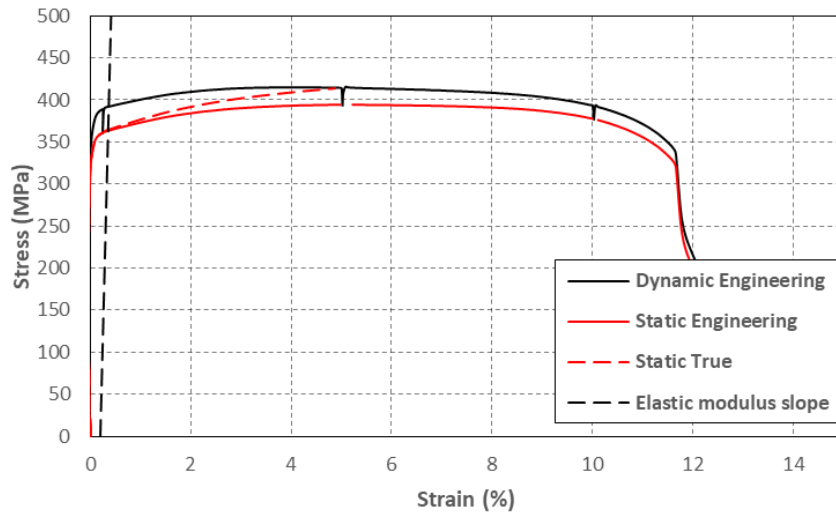
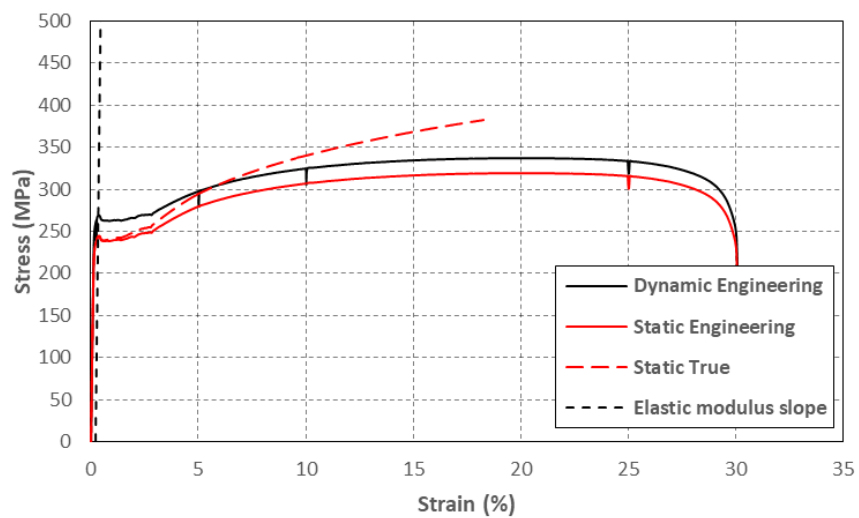


Figure G.12: T15414(s)a Flat coupon test results

**Figure G.13: T15414(s)b Flat coupon test results****Figure G.14: T15414(s) Corner coupon test results****Figure G.15: T12012a Flat coupon test results**

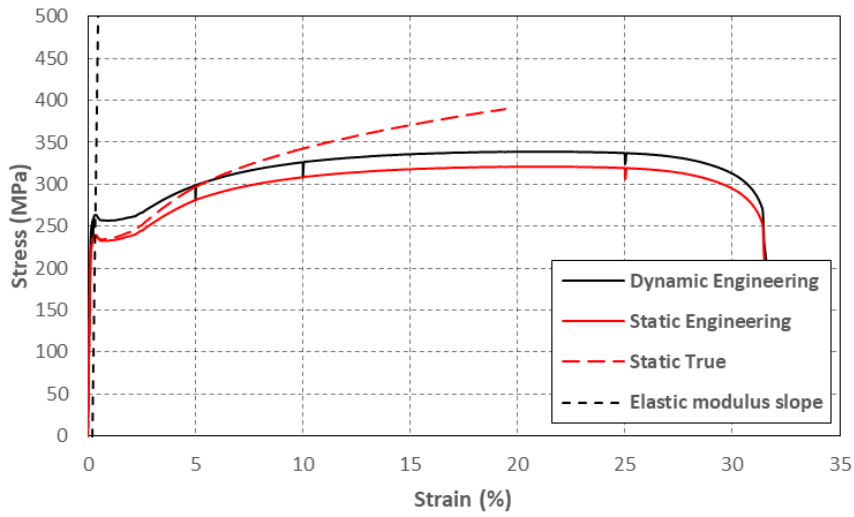


Figure G.16: T12012b Flat coupon test results

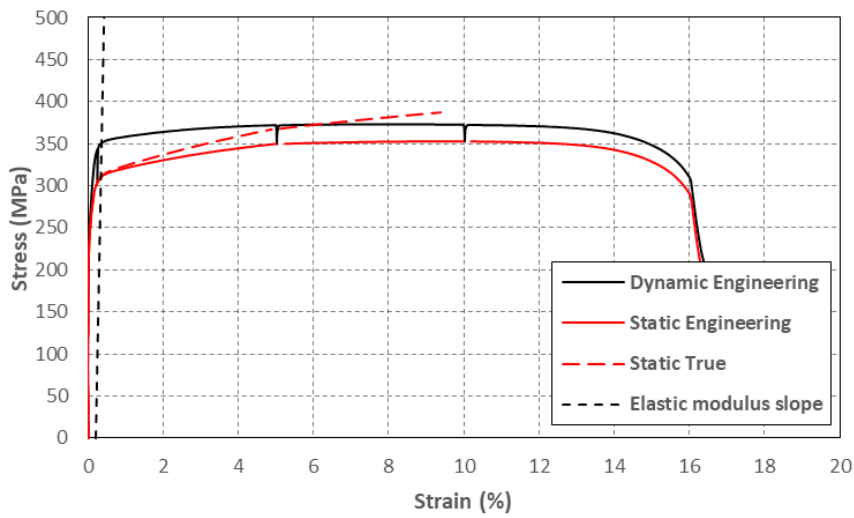


Figure G.17: T12012 Corner coupon test results

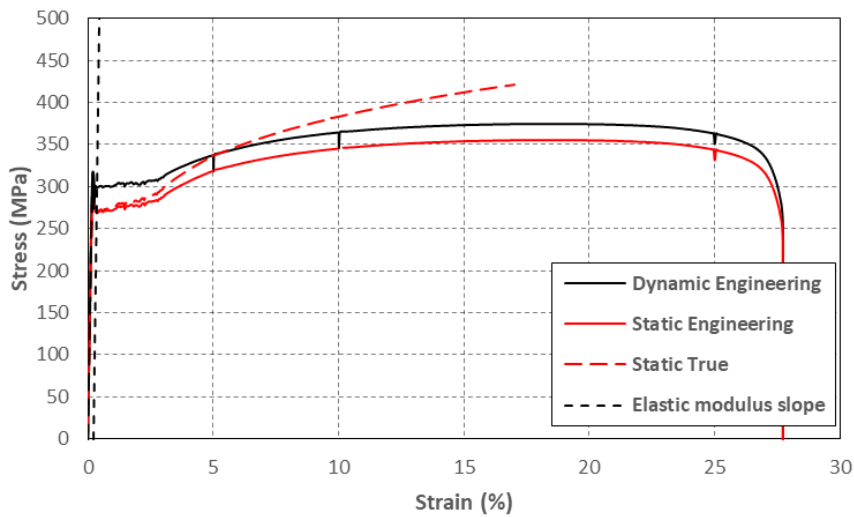


Figure G.18: S11012a Flat coupon test results

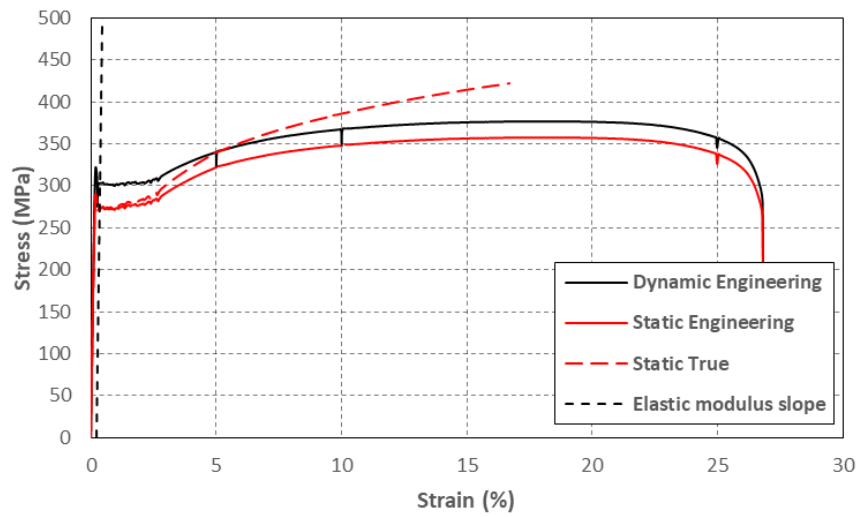


Figure G.19: S11012b Flat coupon test results

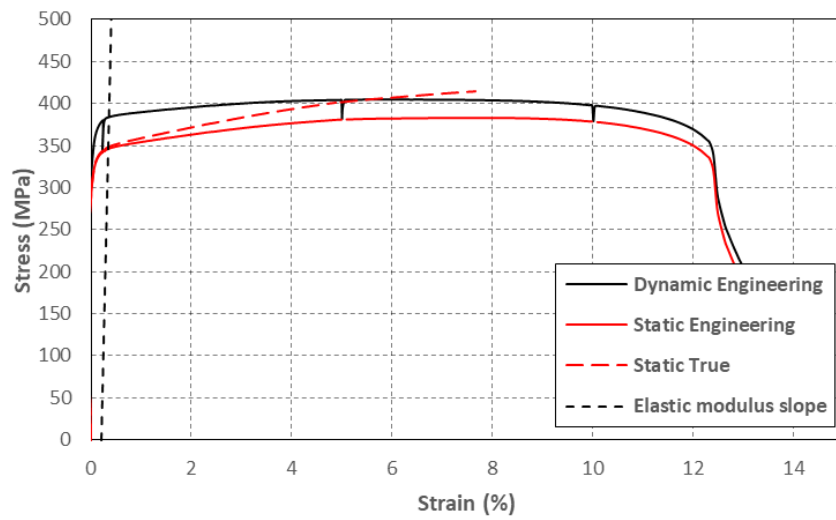
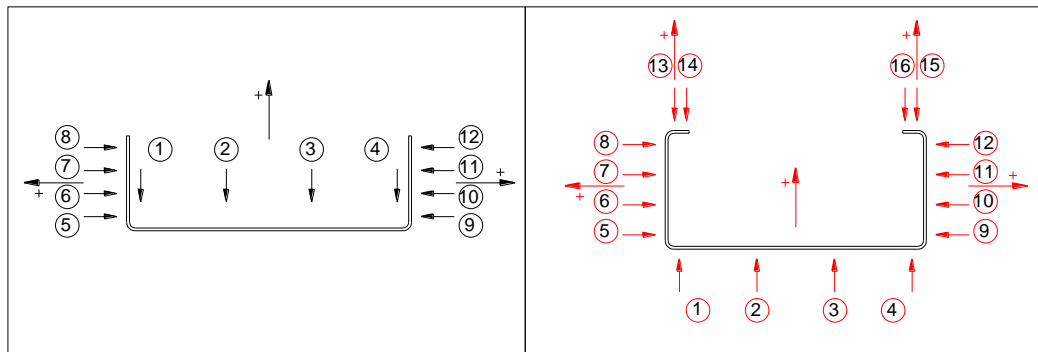


Figure G.20: S11012 Corner coupon test results

Appendix H

Long Columns Geometric Imperfections Before Assembly

Appendix H contains the geometric imperfections recorded on the components of the long columns before they were assembled into their final configurations. In the figures, the coordinate along the length of the column is normalized by dividing it by the measured length. The location of each measuring line is represented in the diagrams included below. The sign convention used for the imperfection measurements is included in the diagram. Further details about the imperfections recorded on the long columns are included in Section 5.6 of the main text.



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H.1. T13014

H.1.1 T13014-1

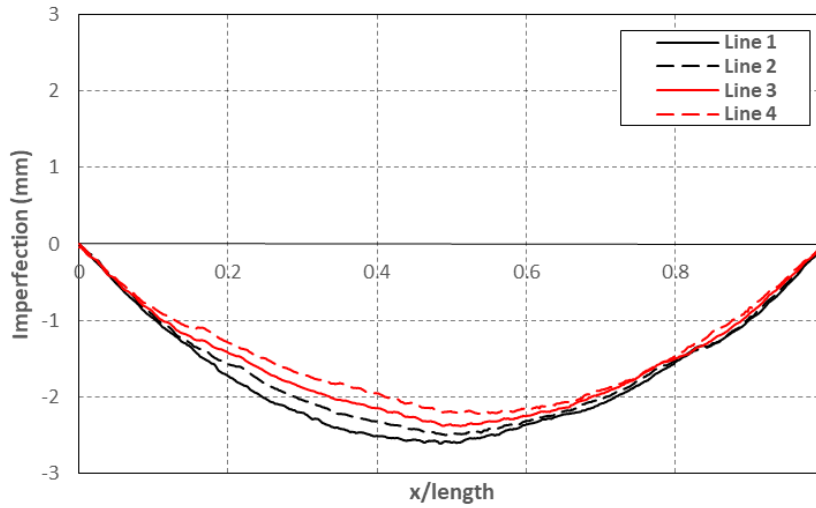


Figure H.1: Imperfections web channel T13014-1 (before assembly)

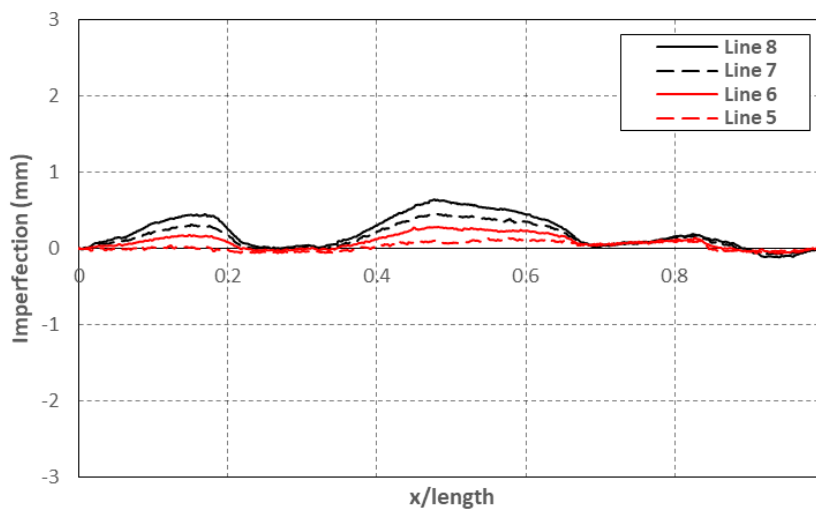


Figure H.2: Imperfections left flange channel T13014-1 (before assembly)

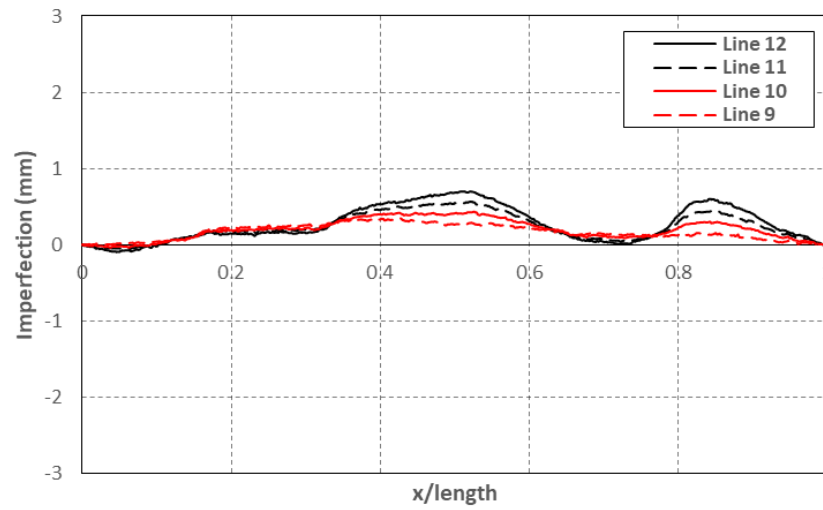


Figure H.3: Imperfections right flange channel T13014-1 (before assembly)

H.1.2 T13014-2

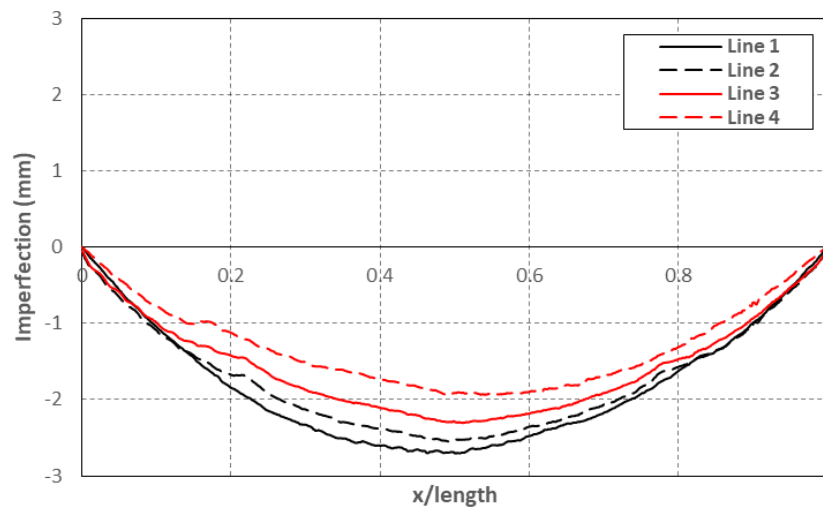


Figure H.4: Imperfections web channel T13014-2 (before assembly)

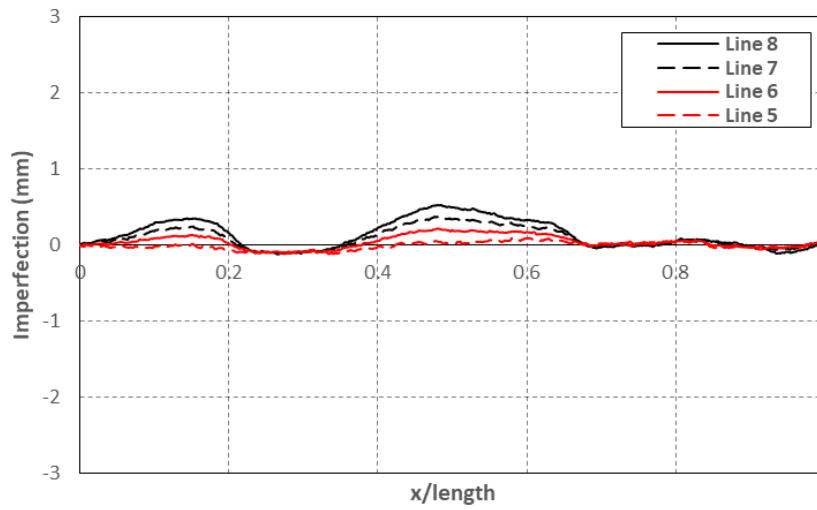


Figure H.5: Imperfections left flange channel T13014-2 (before assembly)

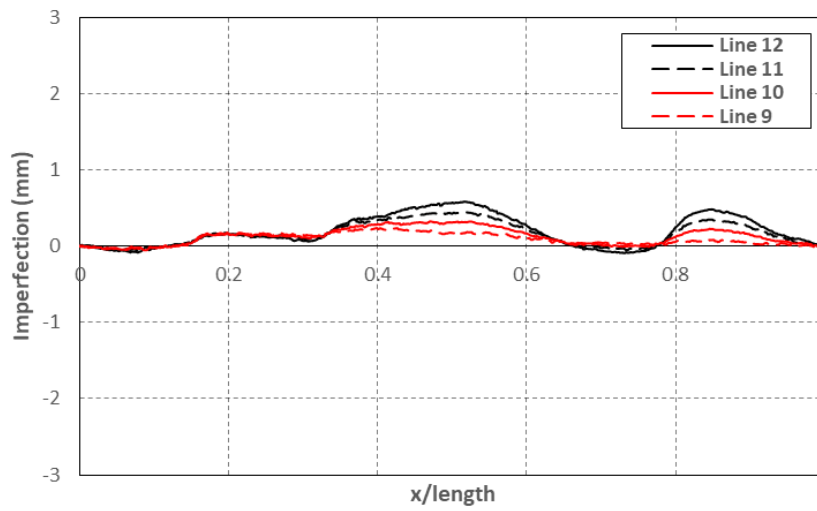
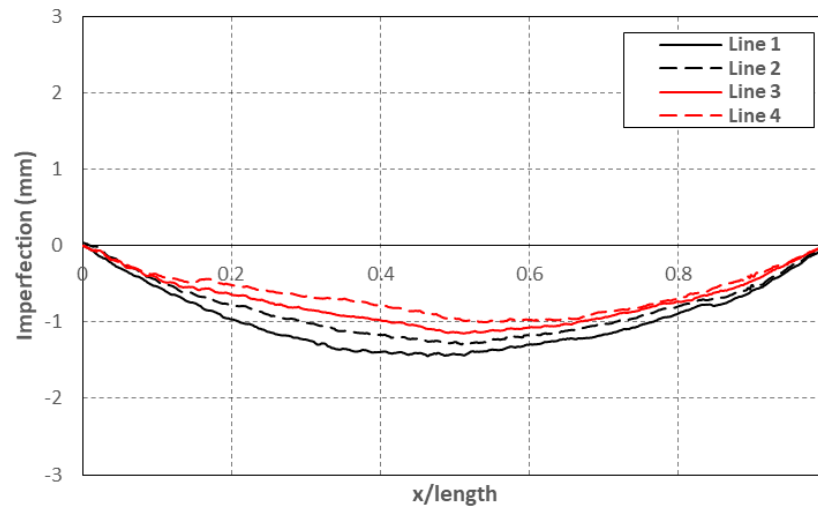
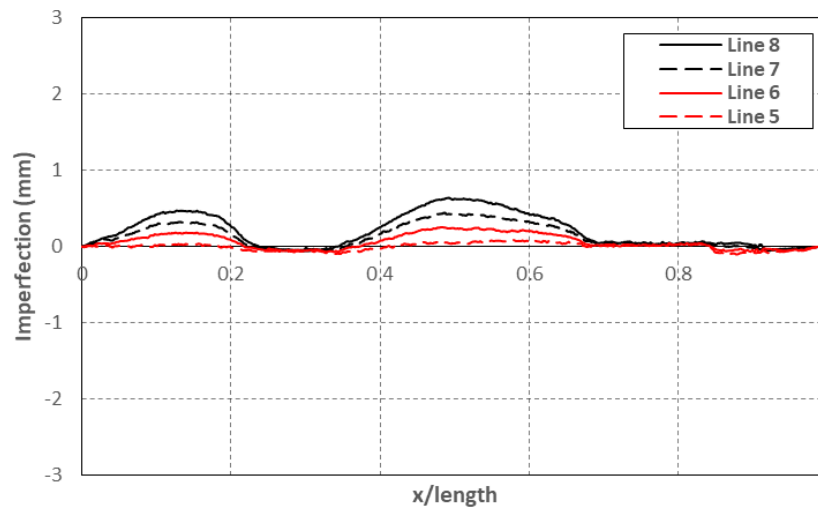
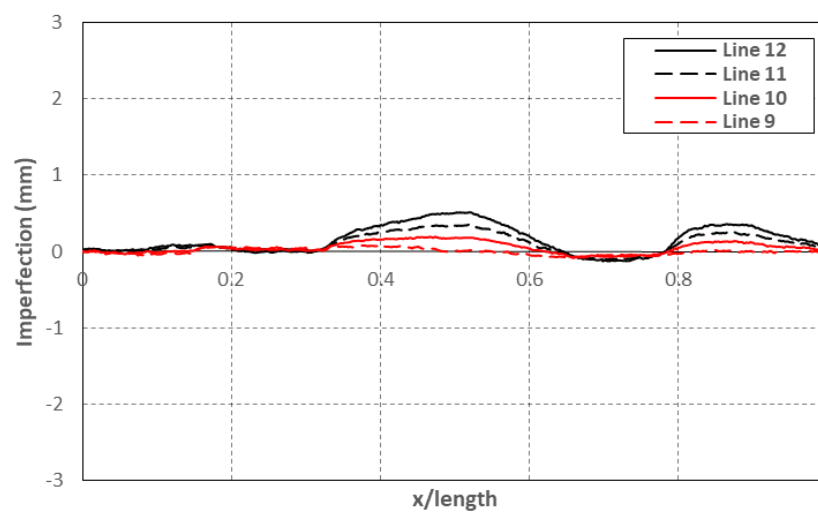


Figure H.6: Imperfections right flange channel T13014-2 (before assembly)

H.1.3 T13014-3**Figure H.7: Imperfections web channel T13014-3 (before assembly)****Figure H.8: Imperfections left flange channel T13014-3 (before assembly)****Figure H.9: Imperfections right flange channel T13014-3 (before assembly)**

H.1.4 T13014-4

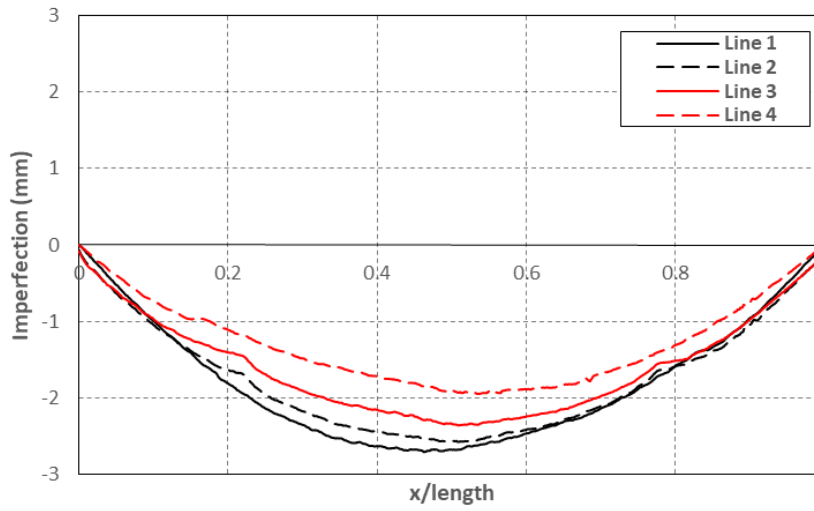


Figure H.10: Imperfections web channel T13014-4 (before assembly)

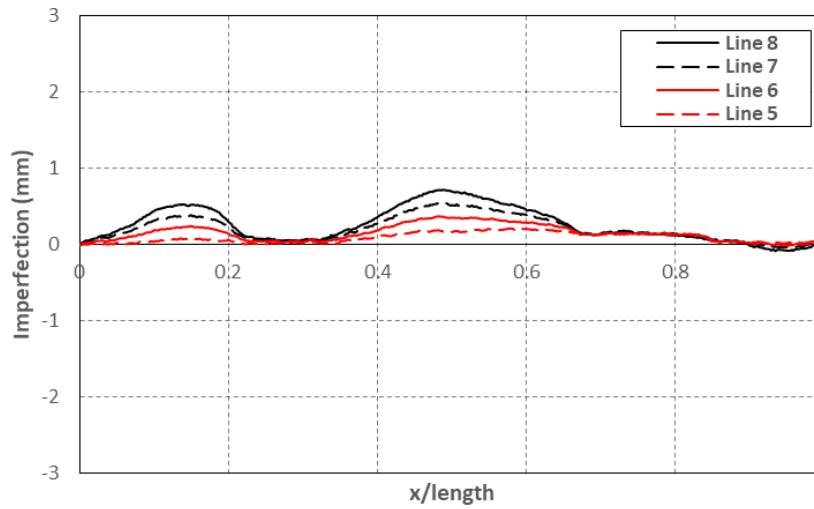


Figure H.11: Imperfections left flange channel T13014-4 (before assembly)

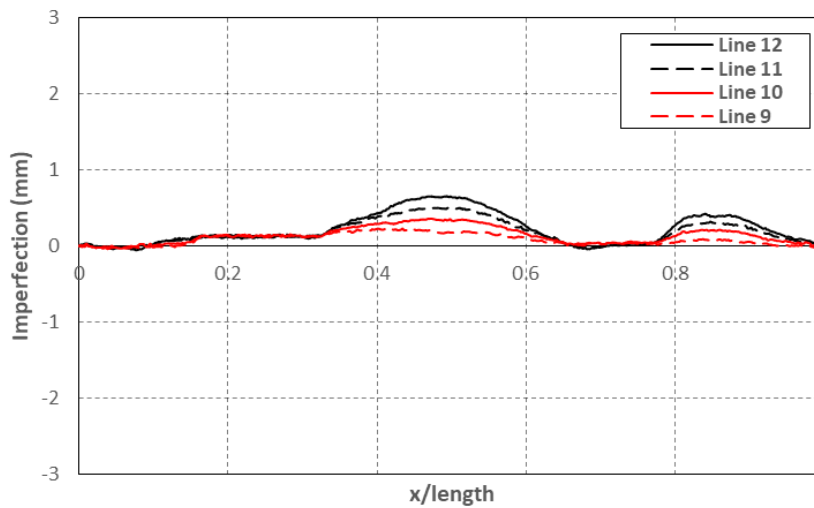
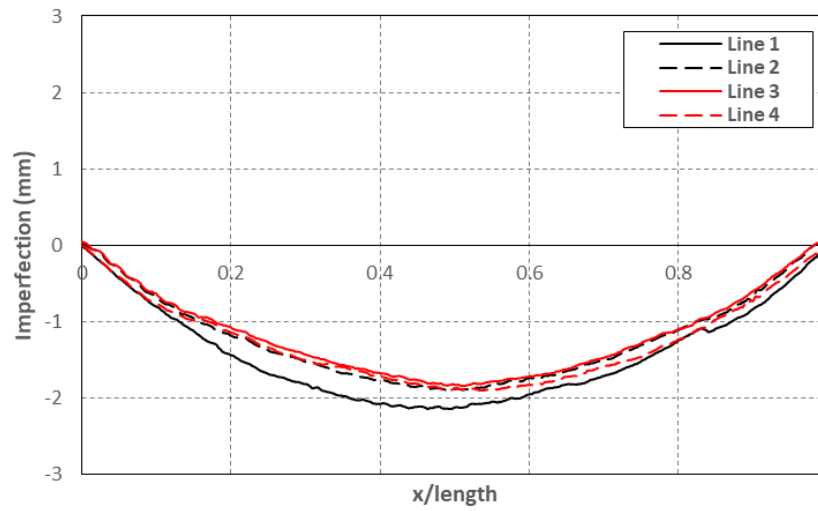
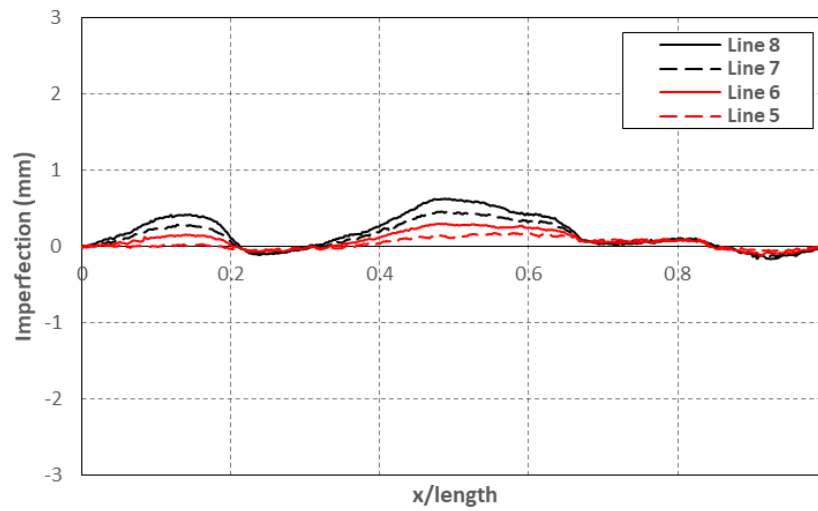
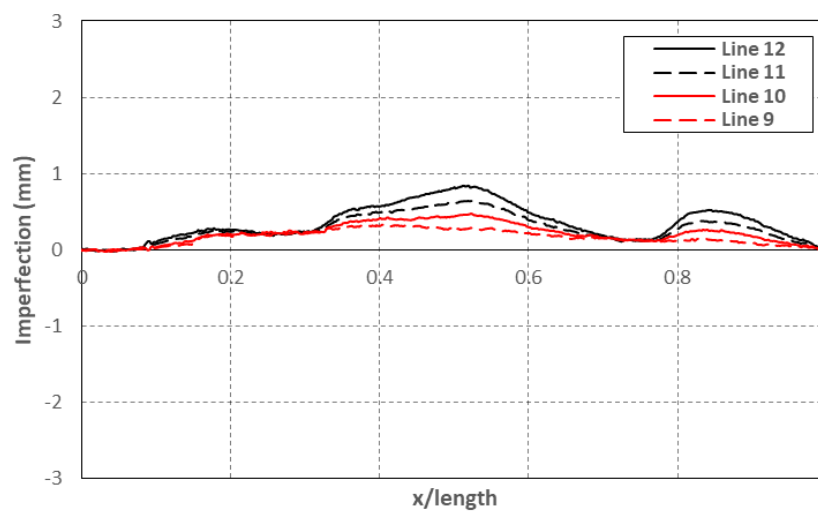


Figure H.12: Imperfections right flange channel T13014-4 (before assembly)

H.1.5 T13014-5**Figure H.13: Imperfections web channel T13014-5 (before assembly)****Figure H.14: Imperfections left flange channel T13014-5 (before assembly)****Figure H.15: Imperfections right flange channel T13014-5 (before assembly)**

H.1.6 T13014-6

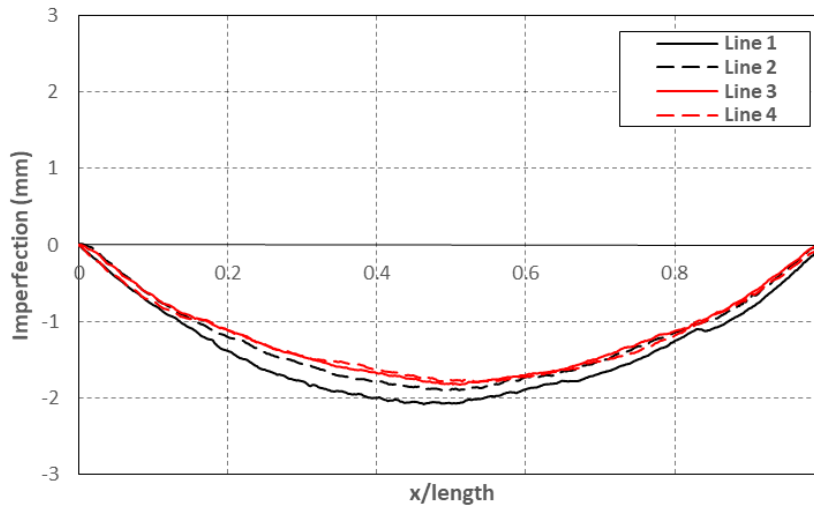


Figure H.16: Imperfections web channel T13014-6 (before assembly)

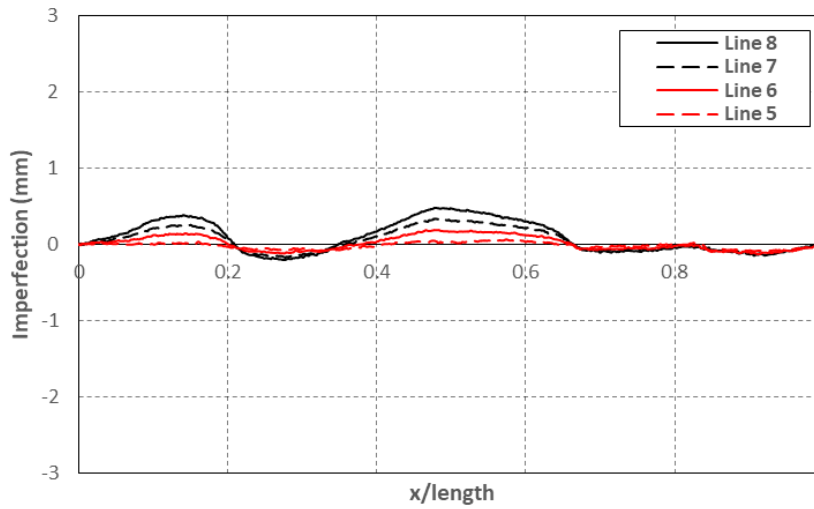


Figure H.17: Imperfections left flange channel T13014-6 (before assembly)

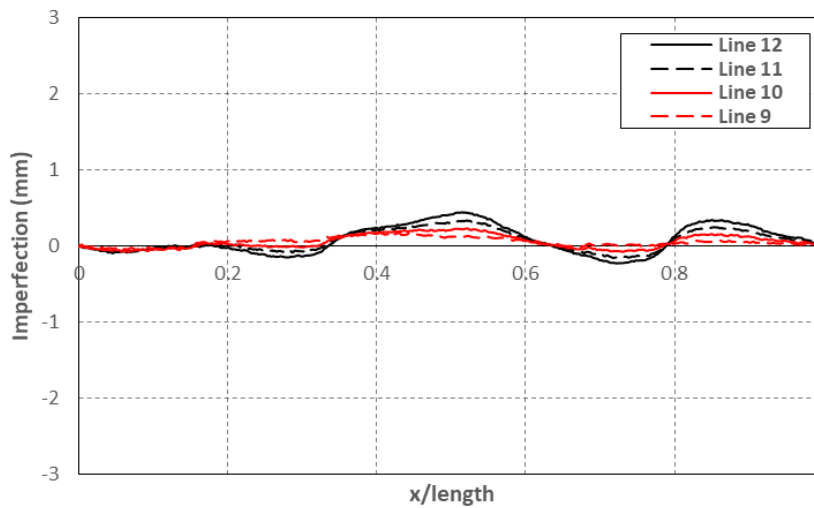
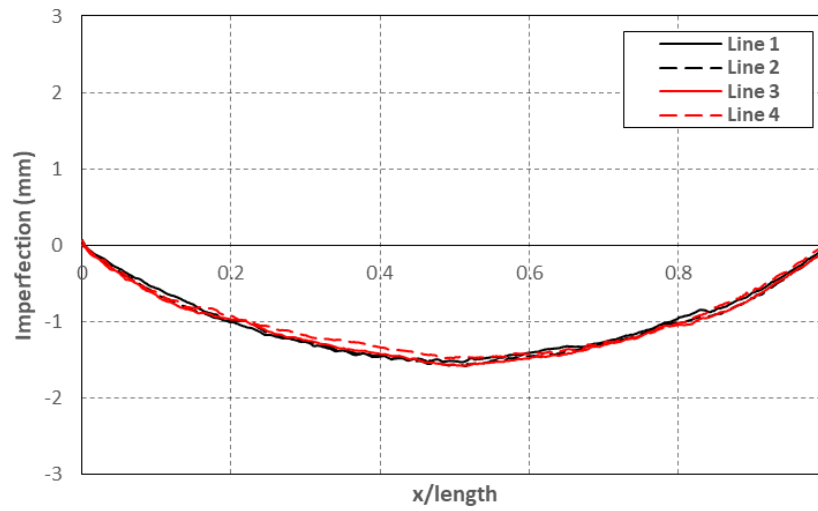
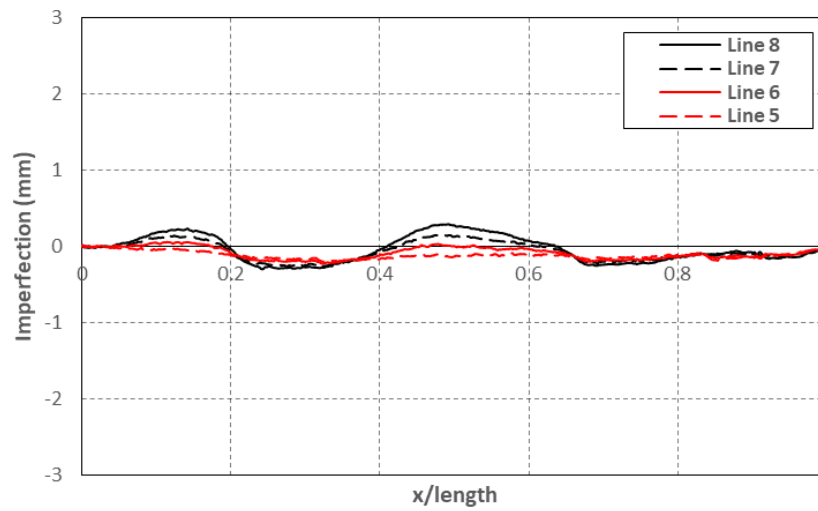
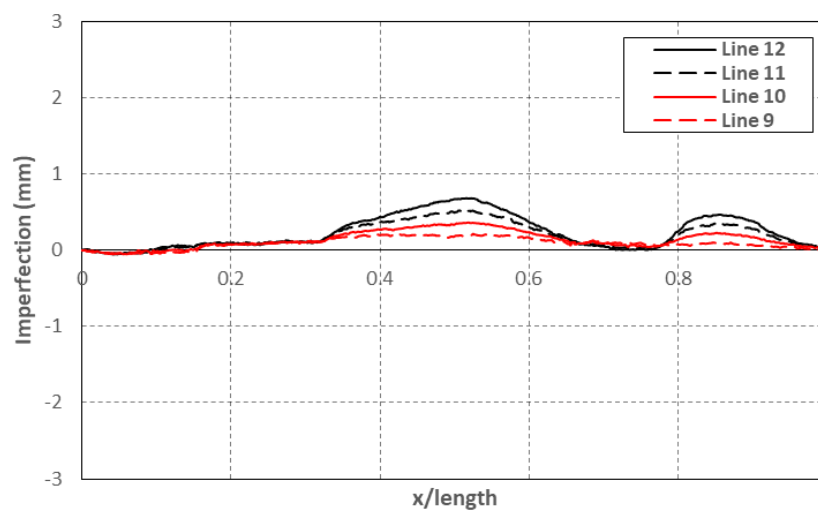


Figure H.18: Imperfections right flange channel T13014-6 (before assembly)

H.1.7 T13014-7**Figure H.19: Imperfections web channel T13014-7 (before assembly)****Figure H.20: Imperfections left flange channel T13014-7 (before assembly)****Figure H.21: Imperfections right flange channel T13014-7 (before assembly)**

H.1.8 T13014-8

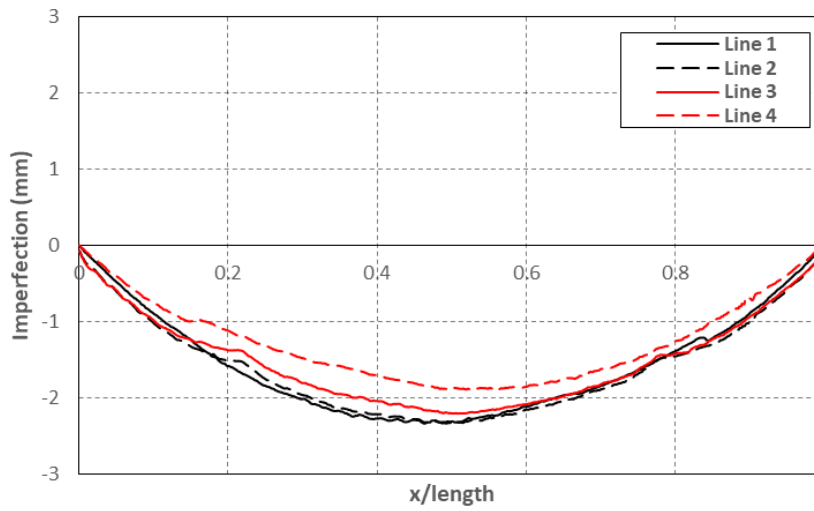


Figure H.22: Imperfections web channel T13014-8 (before assembly)

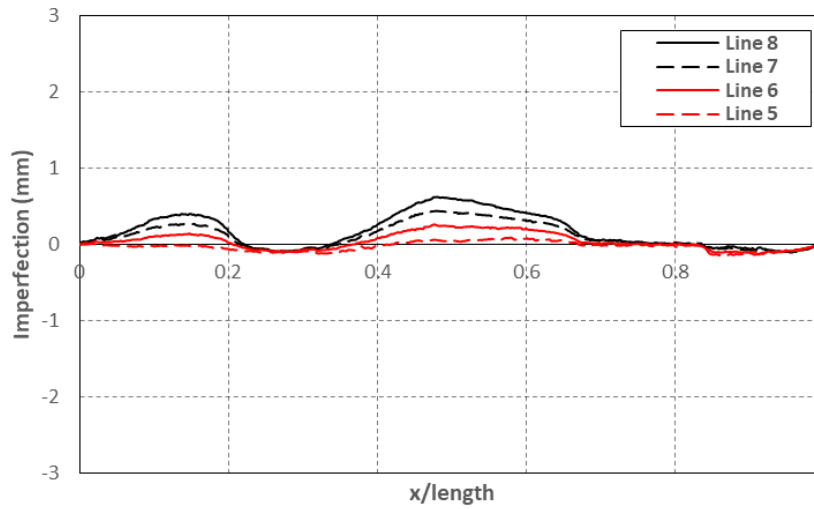


Figure H.23: Imperfections left flange channel T13014-8 (before assembly)

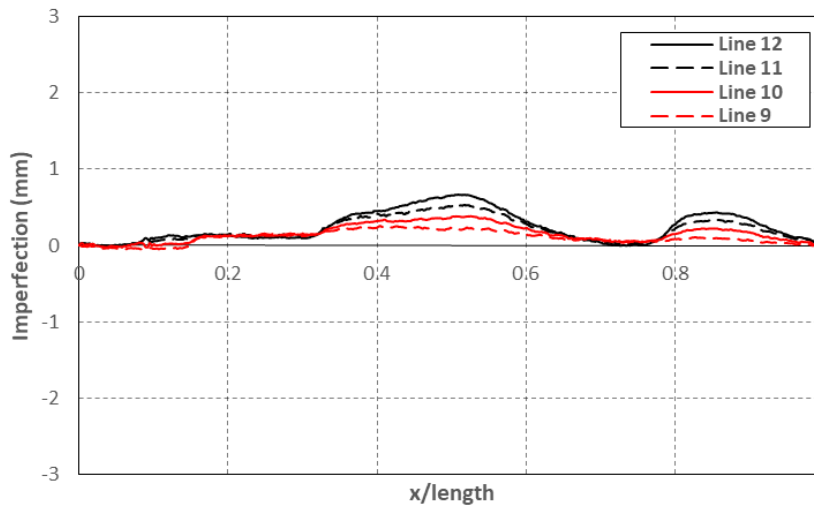
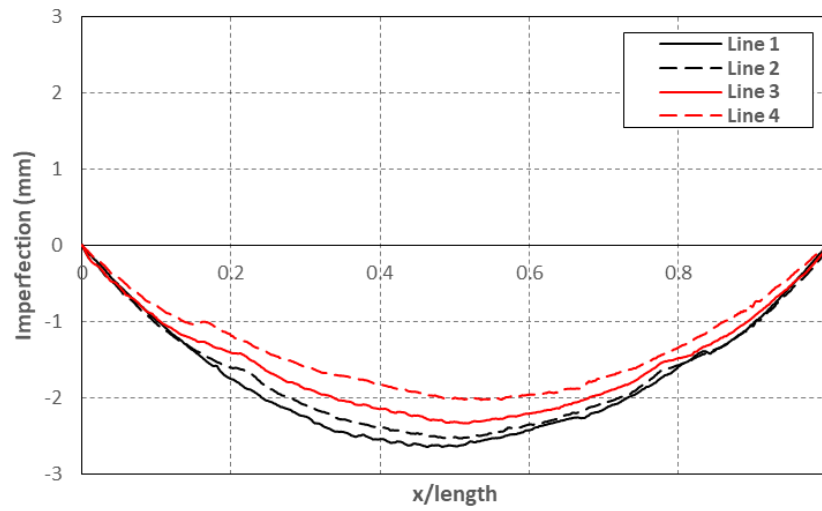
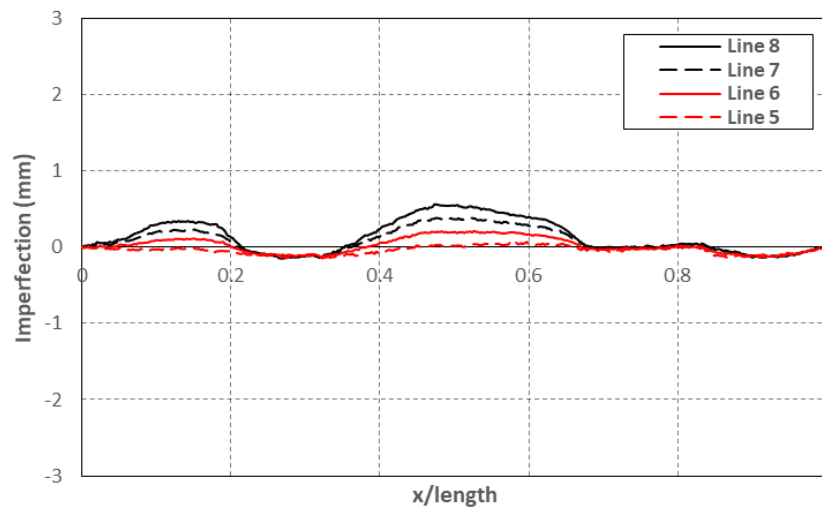
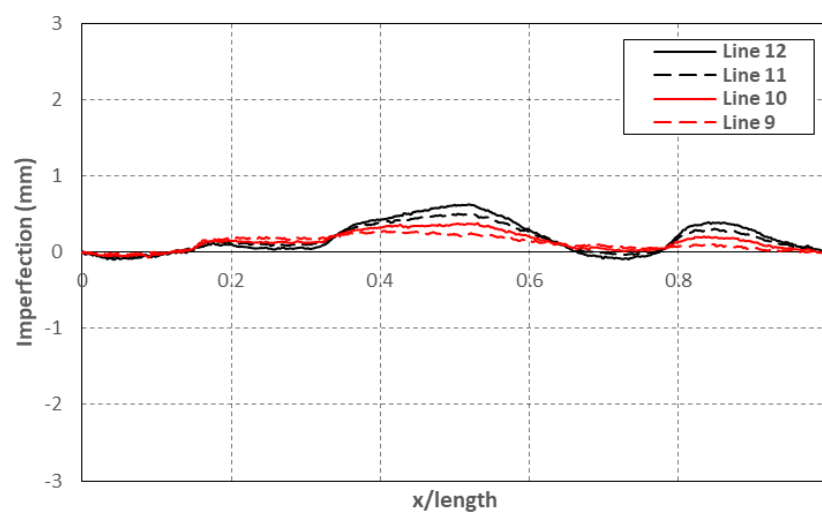


Figure H.24: Imperfections right flange channel T13014-8 (before assembly)

H.1.9 T13014-9**Figure H.25: Imperfections web channel T13014-9 (before assembly)****Figure H.26: Imperfections left flange channel T13014-9 (before assembly)****Figure H.27: Imperfections right flange channel T13014-9 (before assembly)**

H.1.10 T13014-10

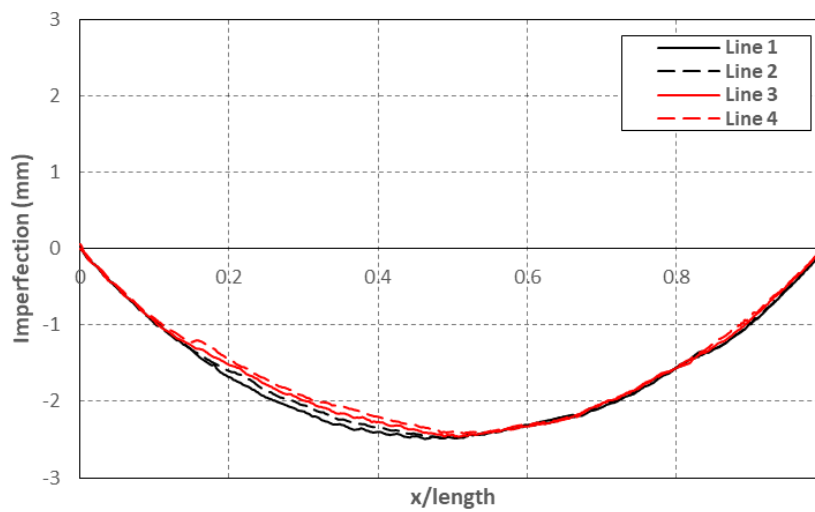


Figure H.28: Imperfections web channel T13014-10 (before assembly)

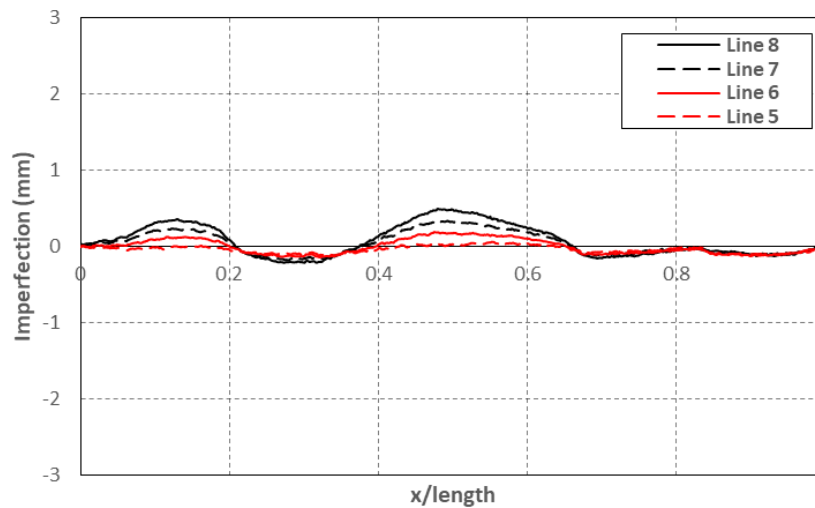


Figure H.29: Imperfections left flange channel T13014-10 (before assembly)

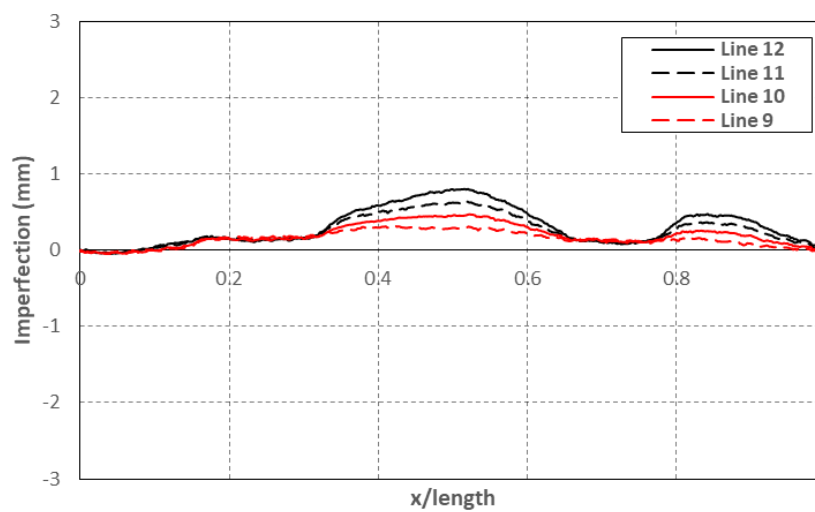
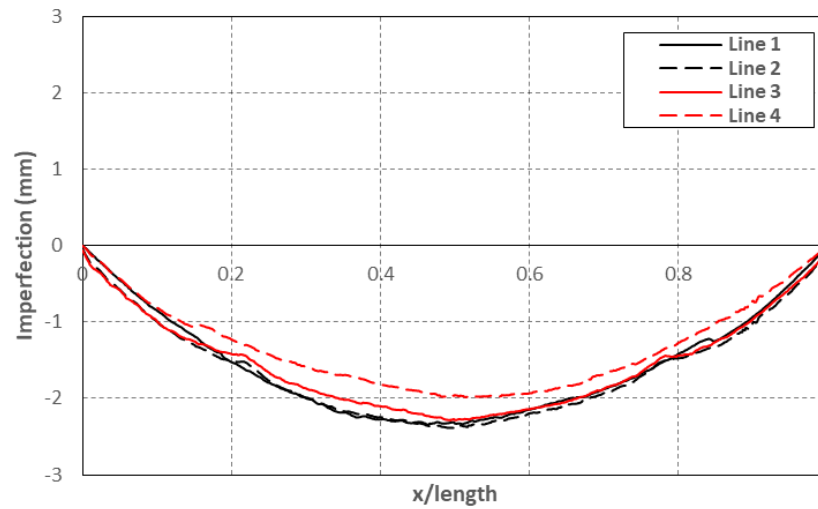
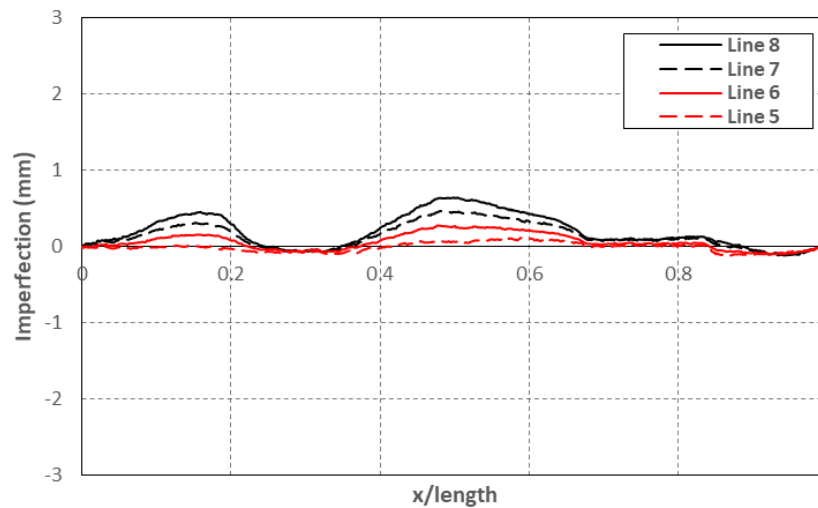
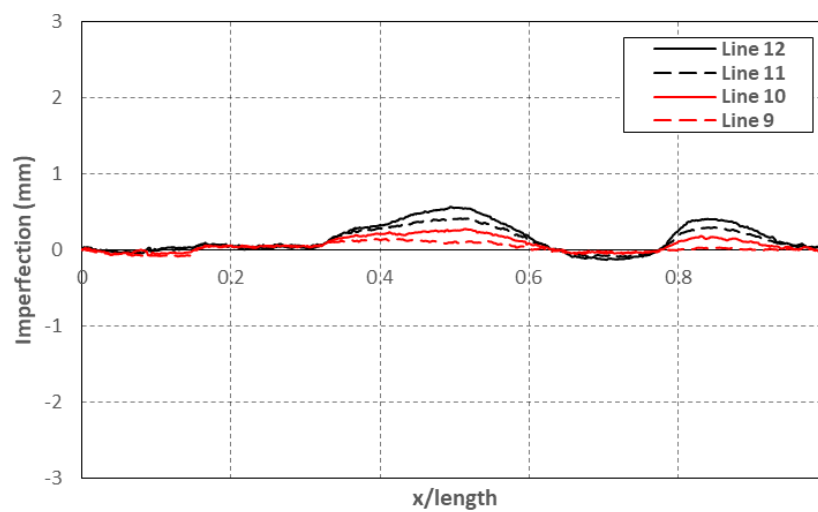


Figure H.30: Imperfections right flange channel T13014-10 (before assembly)

H.1.11 T13014-11**Figure H.31: Imperfections web channel T13014-11 (before assembly)****Figure H.32: Imperfections left flange channel T13014-11 (before assembly)****Figure H.33: Imperfections right flange channel T13014-11 (before assembly)**

H.1.12 T13014-12

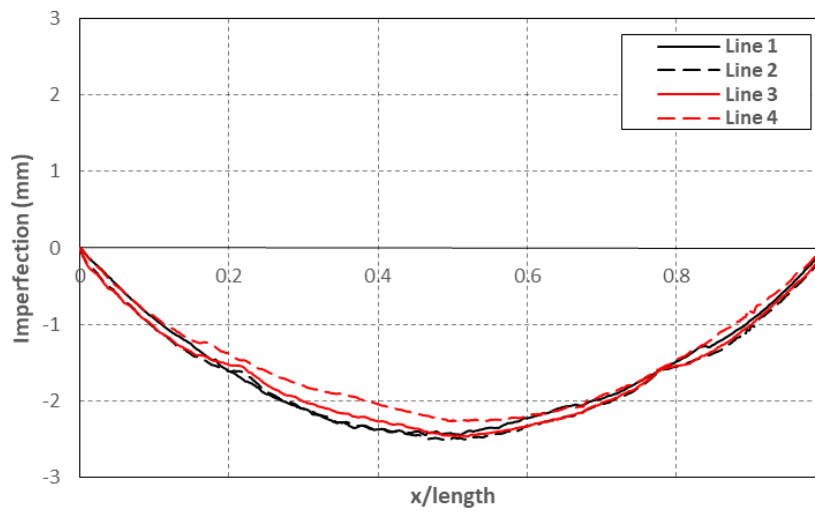


Figure H.34: Imperfections web channel T13014-12 (before assembly)

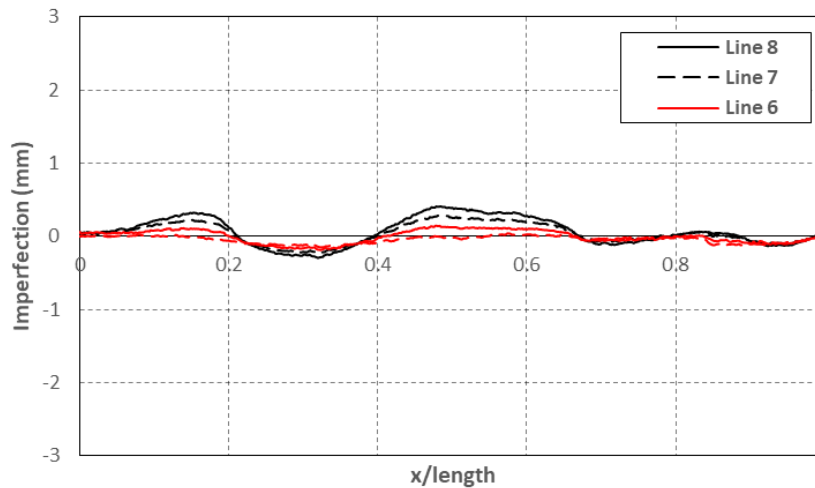


Figure H.35: Imperfections left flange channel T13014-12 (before assembly)

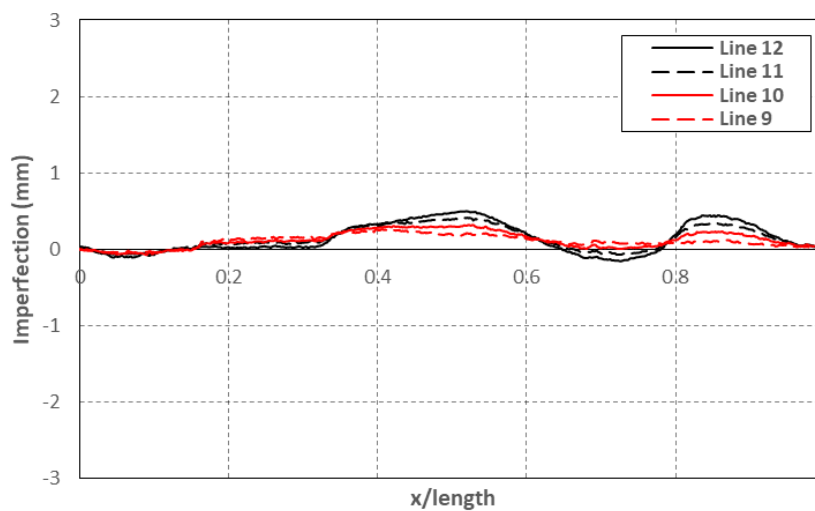


Figure H.36: Imperfections right flange channel T13014-12 (before assembly)

H.2. T7914

H.2.1 T7914-1

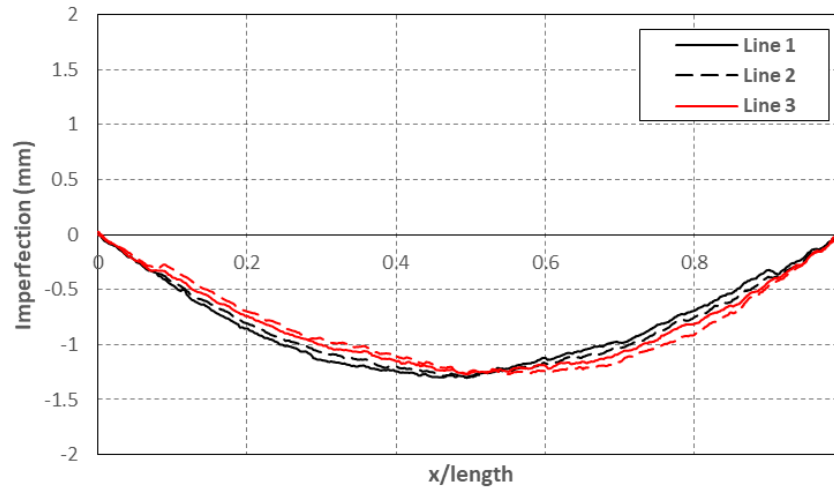


Figure H.37: Imperfections web channel T7914-1 (before assembly)

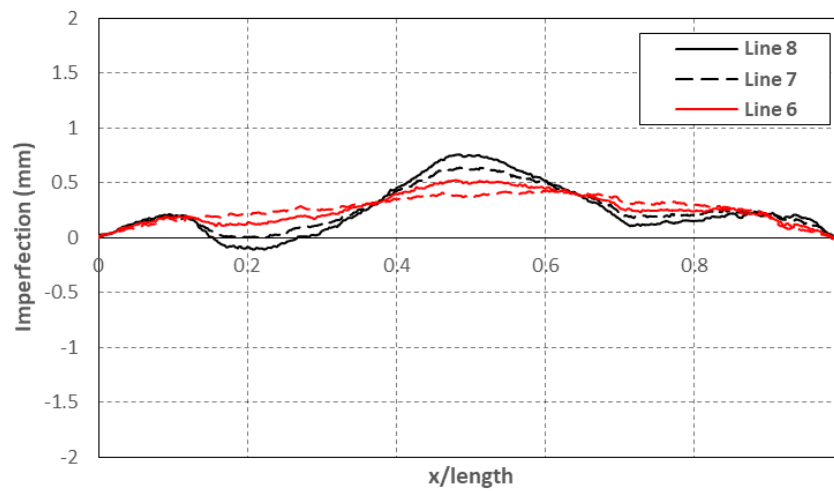


Figure H.38: Imperfections left flange channel T7914-1 (before assembly)

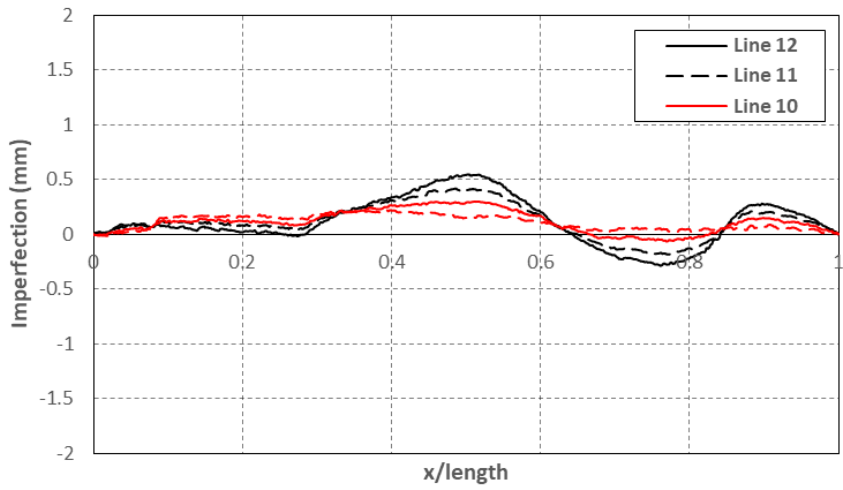


Figure H.39: Imperfections right flange channel T7914-1 (before assembly)

H.2.2 T7914-2

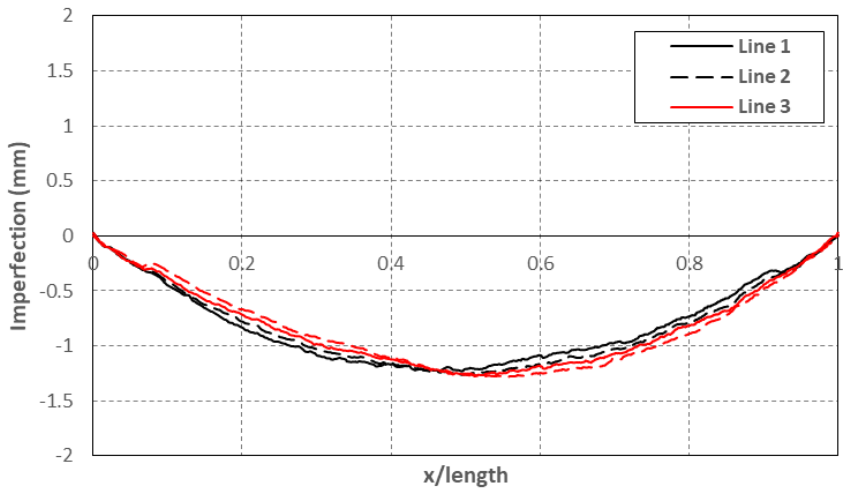


Figure H.40: Imperfections web channel T7914-2 (before assembly)

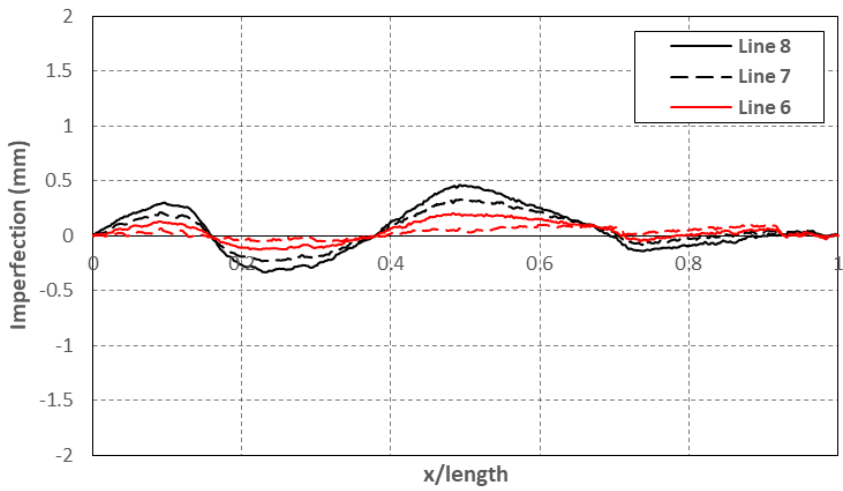


Figure H.41: Imperfections left flange channel T7914-2 (before assembly)

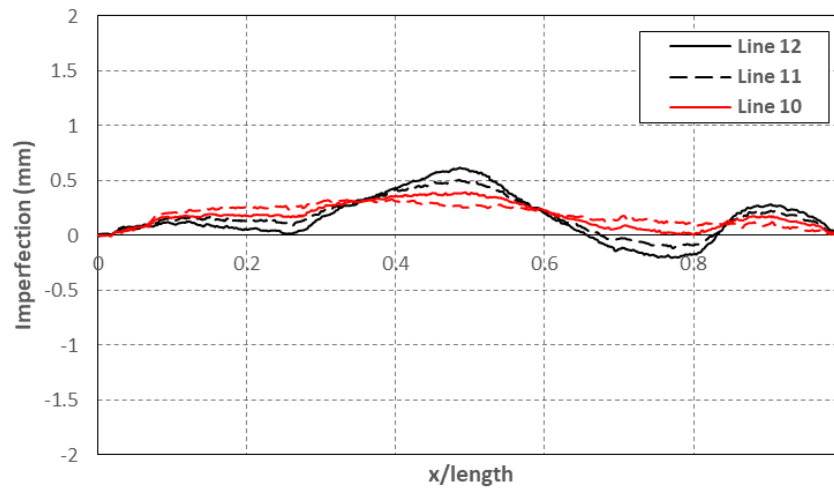


Figure H.42: Imperfections right flange channel T7914-2 (before assembly)

H.2.3 T7914-3

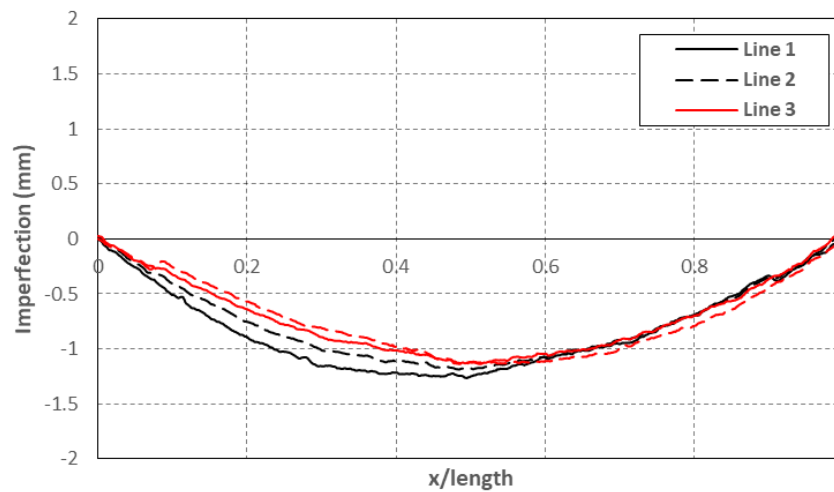


Figure H.43: Imperfections web channel T7914-3 (before assembly)

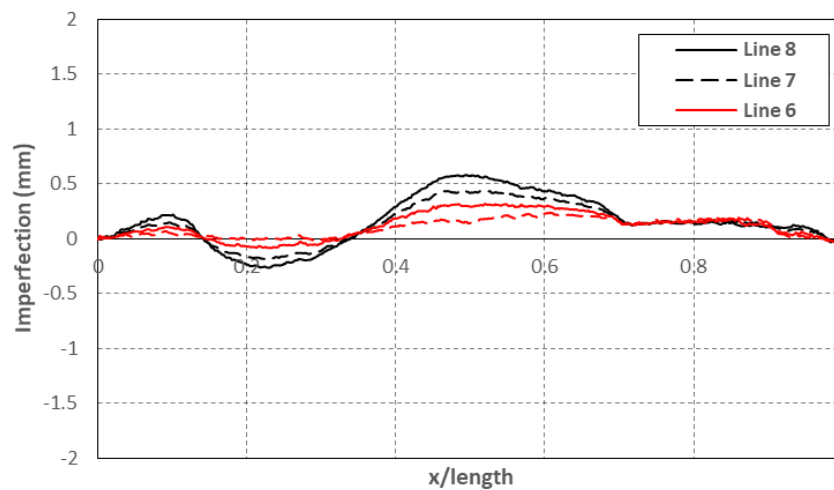


Figure H.44: Imperfections left flange channel T7914-3 (before assembly)

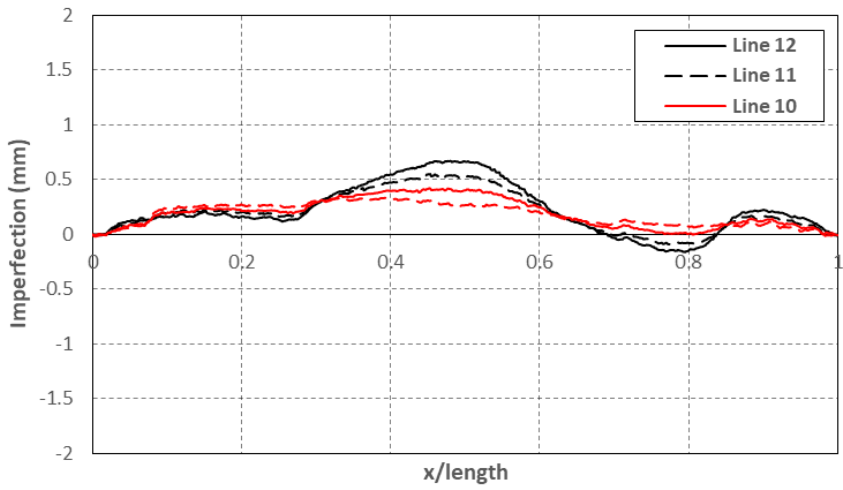


Figure H.45: Imperfections right flange channel T7914-3 (before assembly)

H.2.4 T7914-4

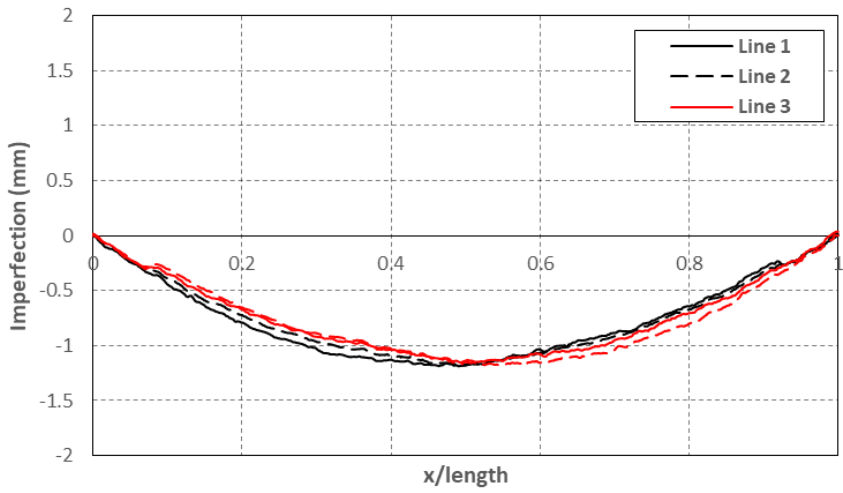


Figure H.46: Imperfections web channel T7914-4 (before assembly)

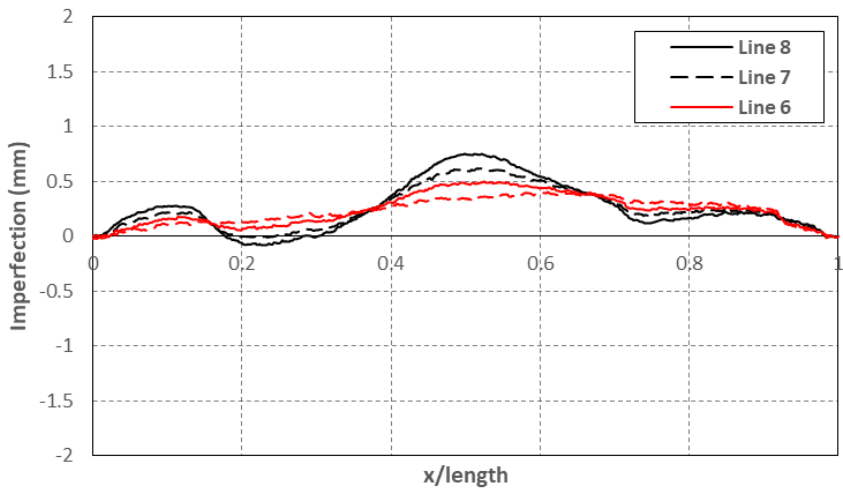


Figure H.47: Imperfections left flange channel T7914-4 (before assembly)

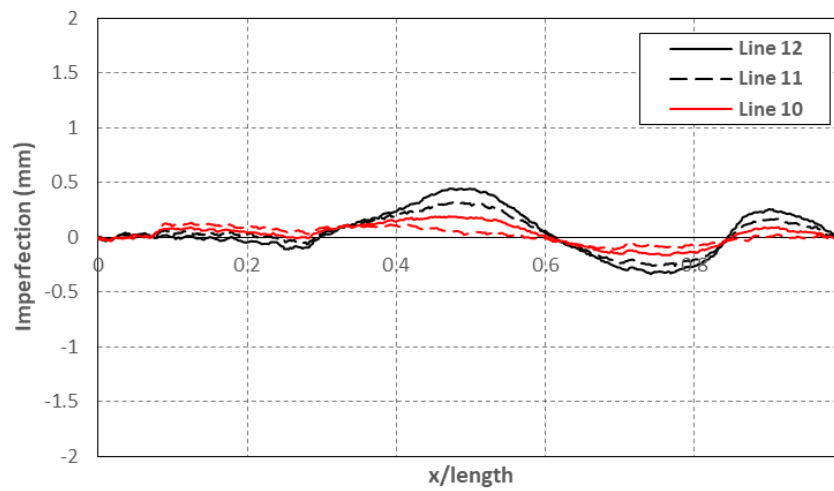


Figure H.48: Imperfections right flange channel T7914-4 (before assembly)

H.2.5 T7914-5

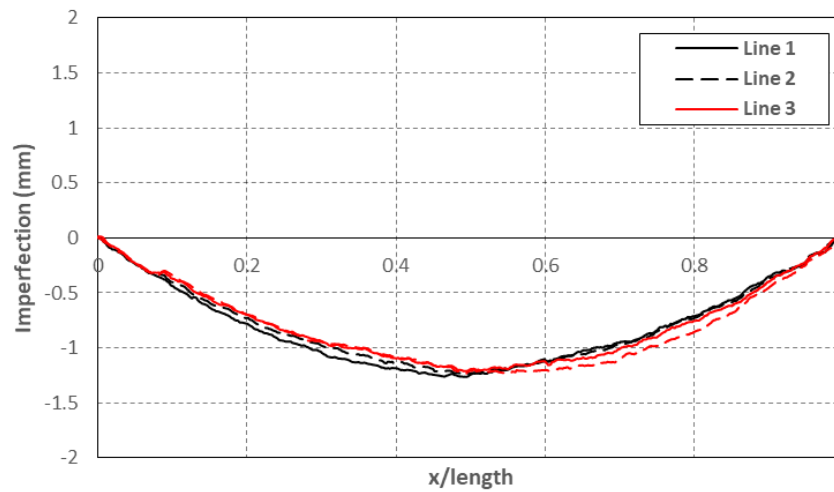


Figure H.49: Imperfections web channel T7914-5 (before assembly)

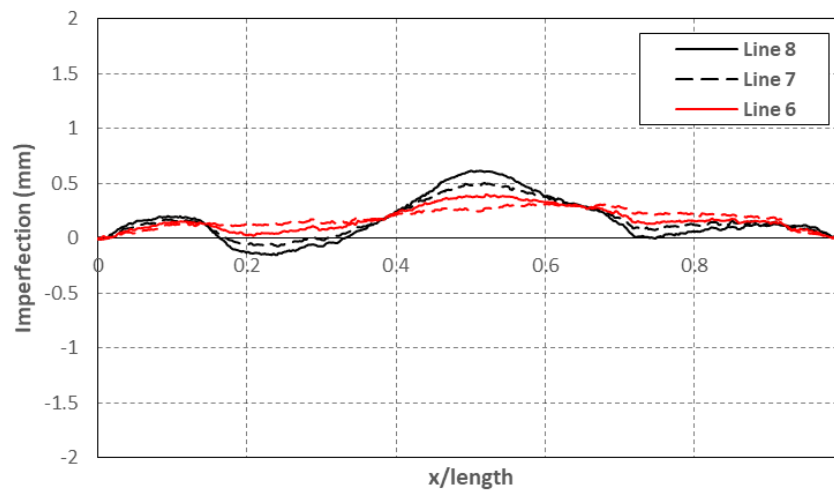


Figure H.50: Imperfections left flange channel T7914-5 (before assembly)

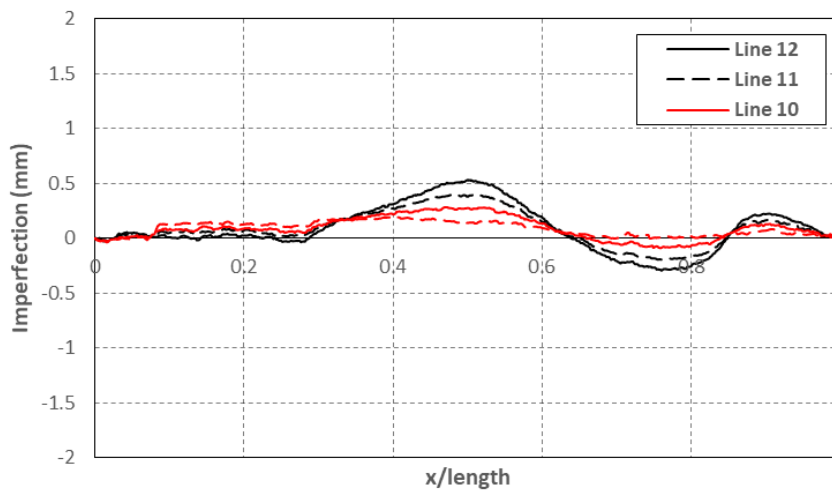


Figure H.51: Imperfections right flange channel T7914-5 (before assembly)

H.2.6 T7914-6

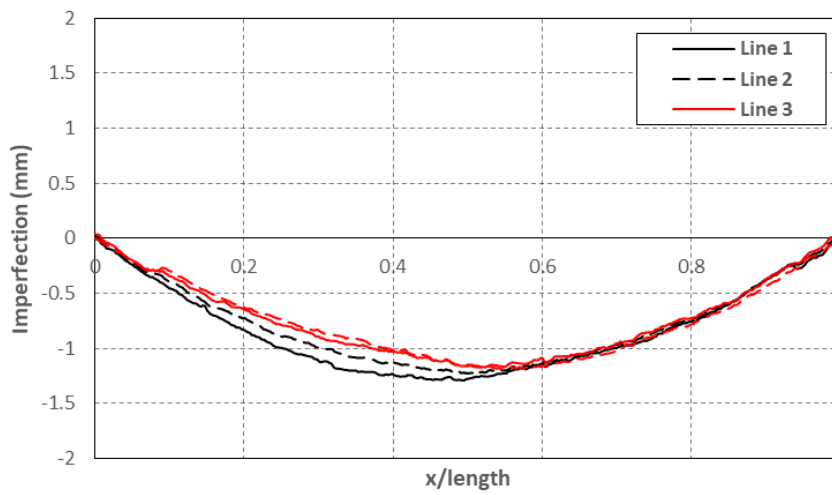


Figure H.52: Imperfections web channel T7914-6 (before assembly)

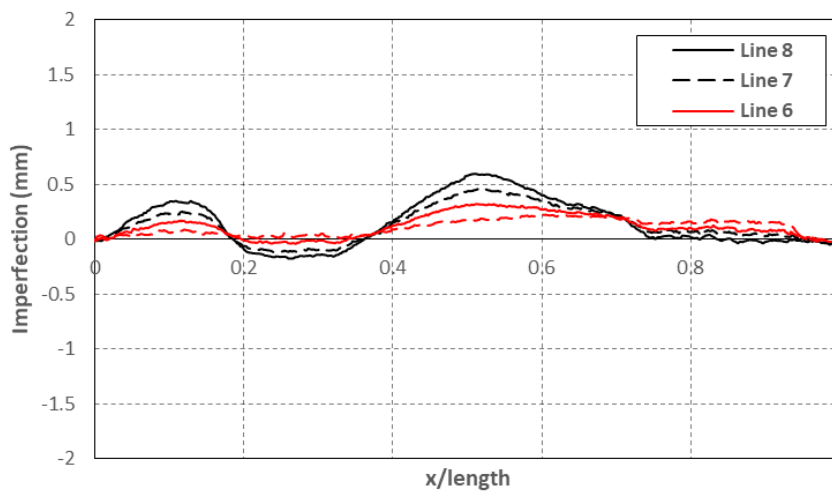


Figure H.53: Imperfections left flange channel T7914-6 (before assembly)

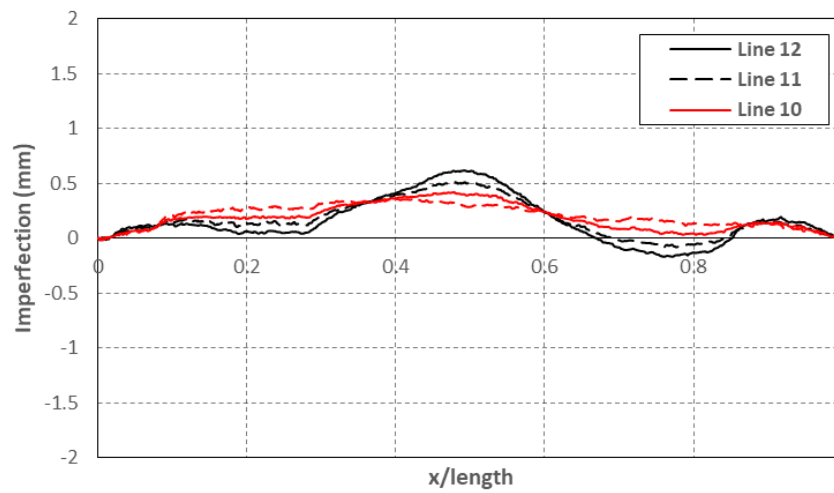


Figure H.54: Imperfections right flange channel T7914-6 (before assembly)

H.2.7 T7914-7

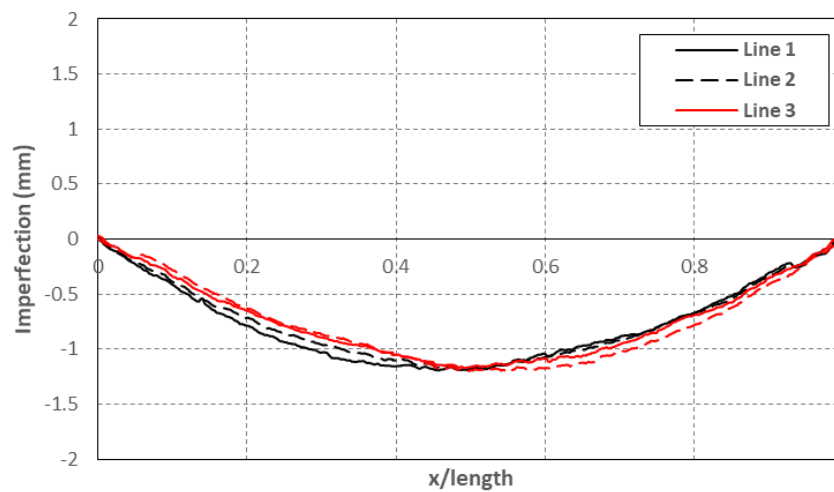


Figure H.55: Imperfections web channel T7914-7 (before assembly)

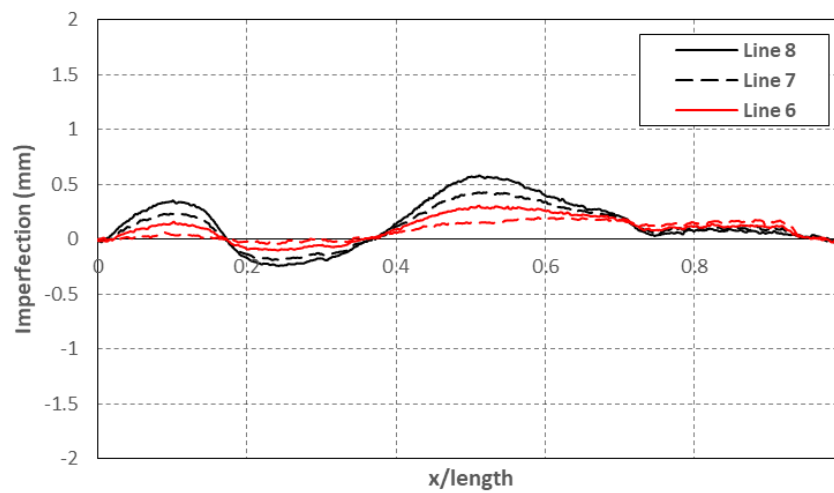


Figure H.56: Imperfections left flange channel T7914-7 (before assembly)

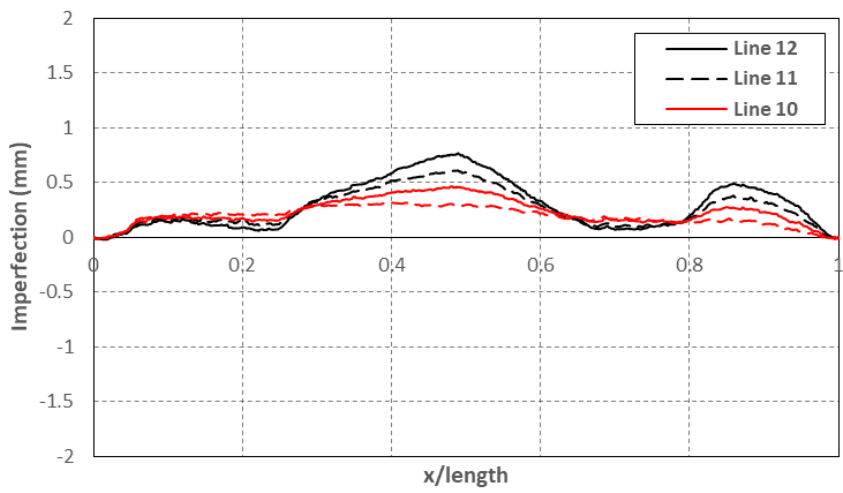


Figure H.57: Imperfections right flange channel T7914-7 (before assembly)

H.2.8 T7914-8

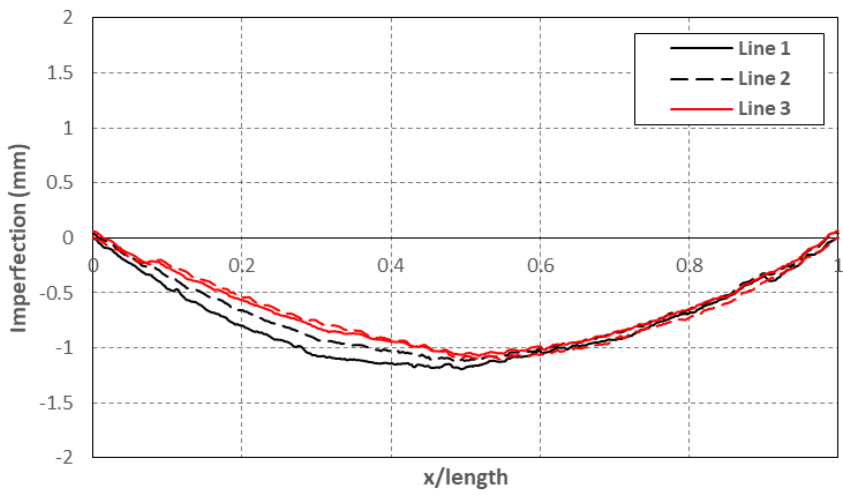


Figure H.58: Imperfections web channel T7914-8 (before assembly)

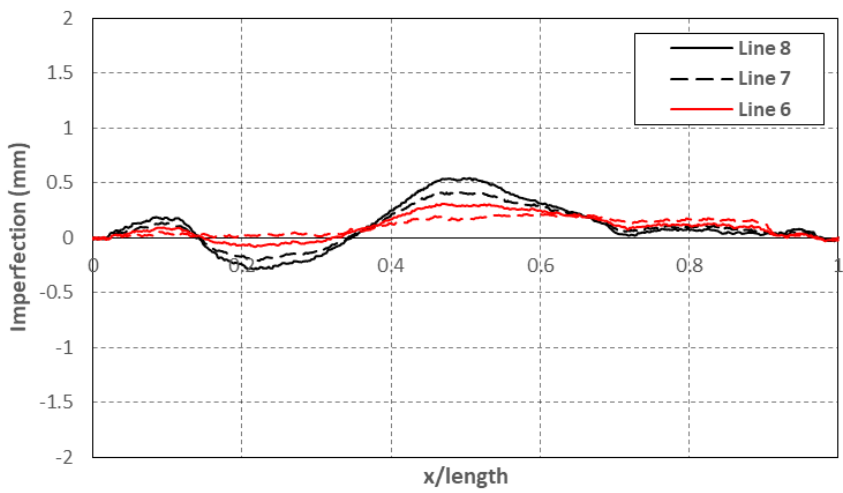


Figure H.59: Imperfections left flange channel T7914-8 (before assembly)

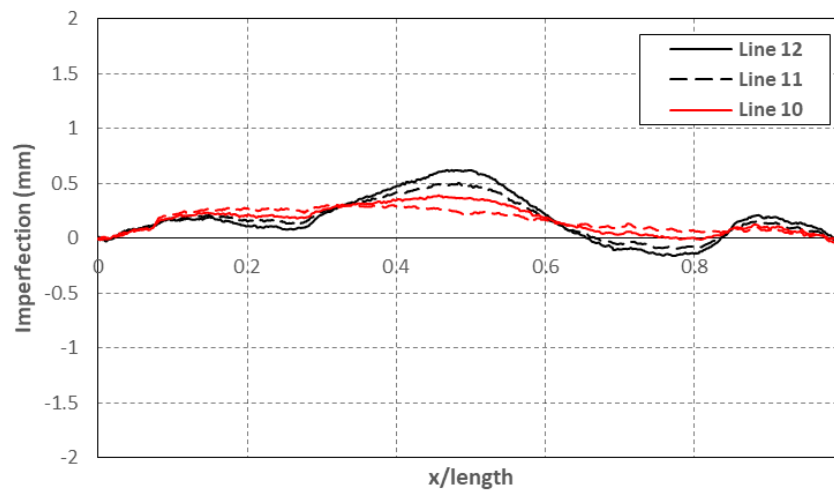


Figure H.60: Imperfections right flange channel T7914-8 (before assembly)

H.2.9 T7914-9

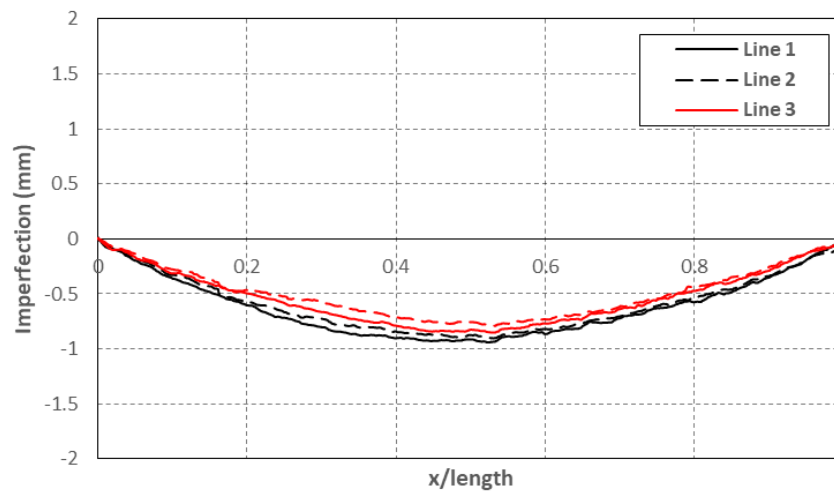


Figure H.61: Imperfections web channel T7914-9 (before assembly)

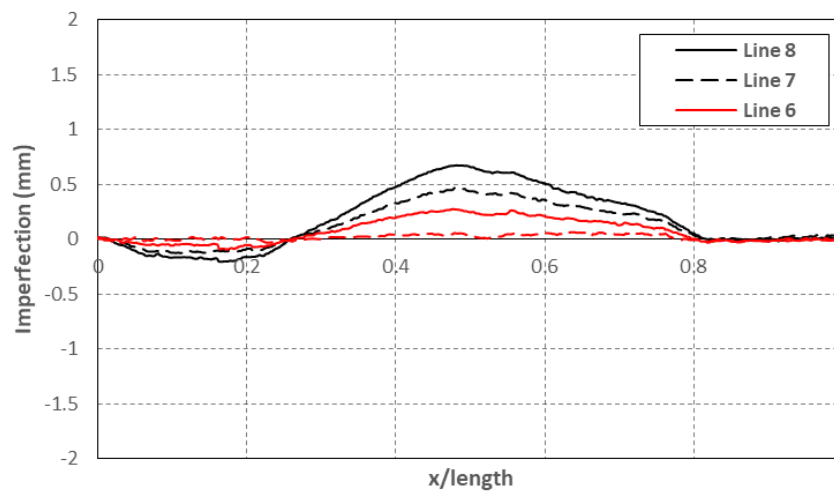


Figure H.62: Imperfections left flange channel T7914-9 (before assembly)

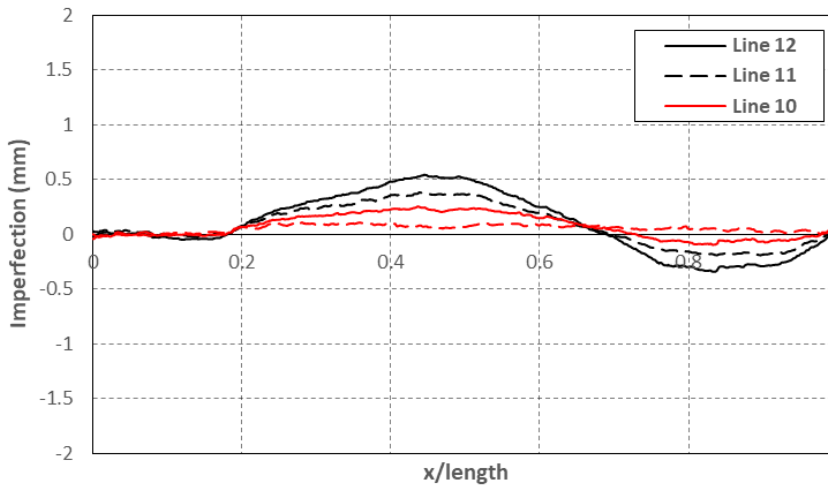


Figure H.63: Imperfections right flange channel T7914-9 (before assembly)

H.2.10 T7914-10

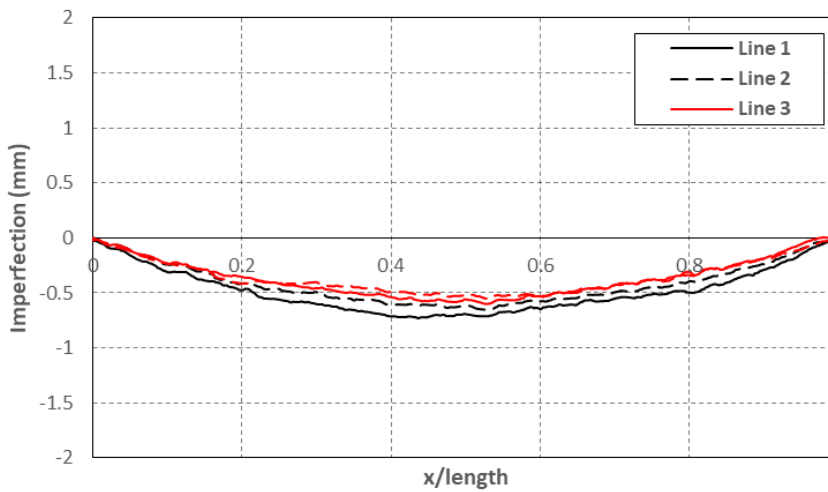


Figure H.64: Imperfections web channel T7914-10 (before assembly)

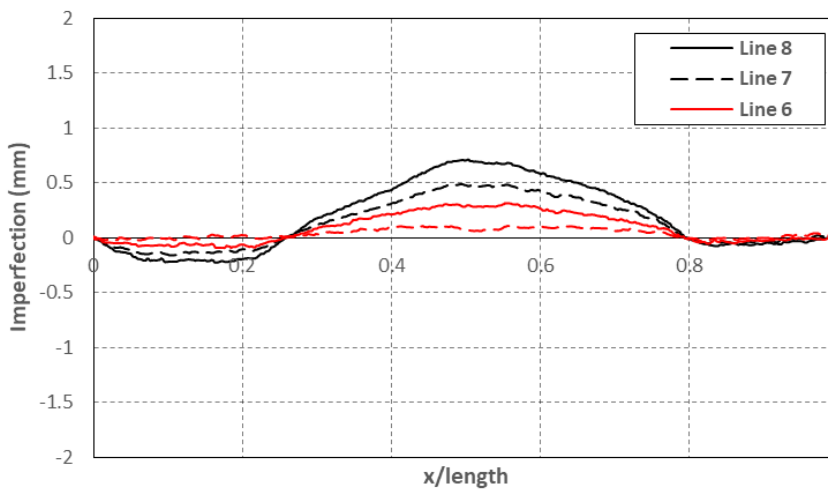


Figure H.65: Imperfections left flange channel T7914-10 (before assembly)

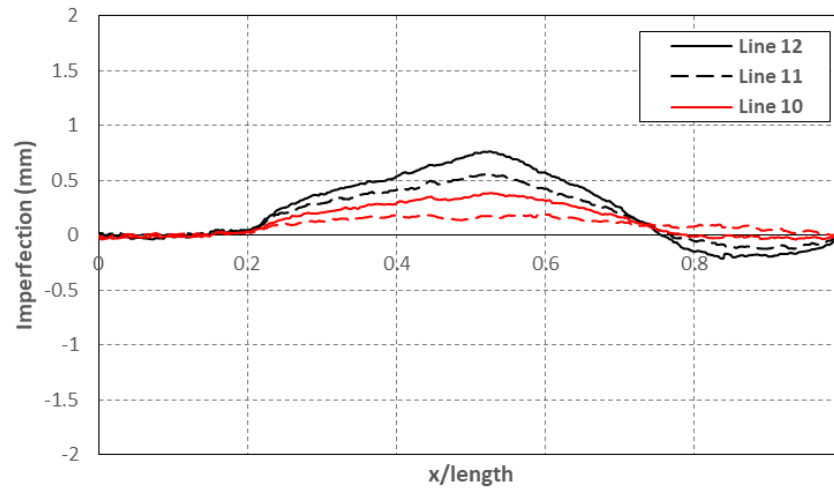


Figure H.66: Imperfections right flange channel T7914-10 (before assembly)

H.2.11 T7914-11

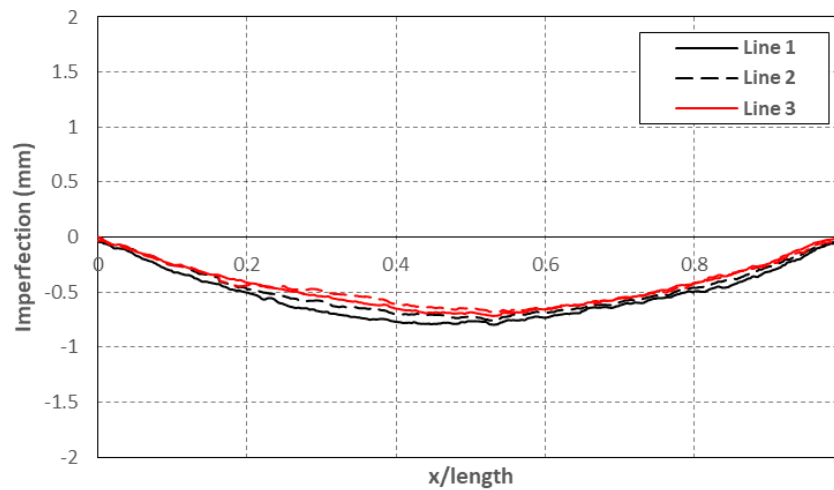


Figure H.67: Imperfections web channel T7914-11 (before assembly)

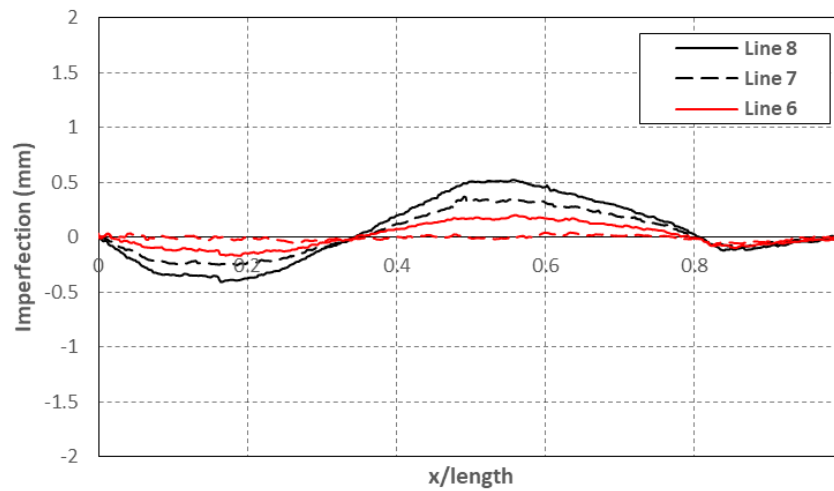


Figure H.68: Imperfections left flange channel T7914-11 (before assembly)

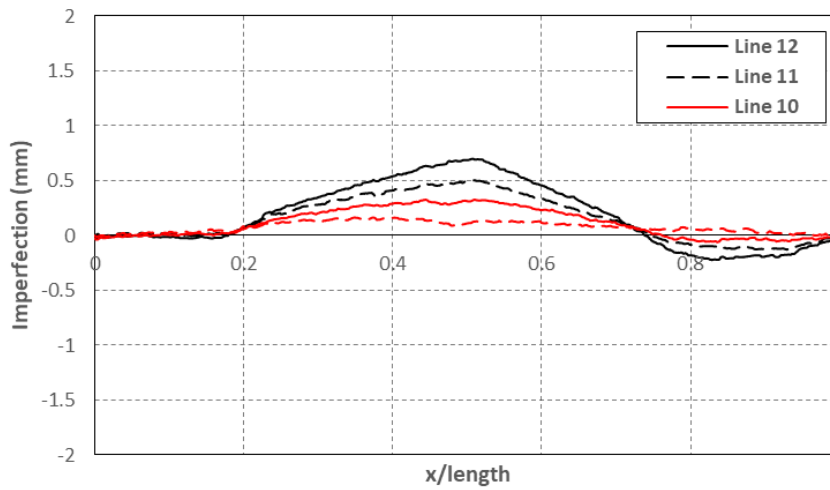


Figure H.69: Imperfections right flange channel T7914-11 (before assembly)

H.2.12 T7914-12

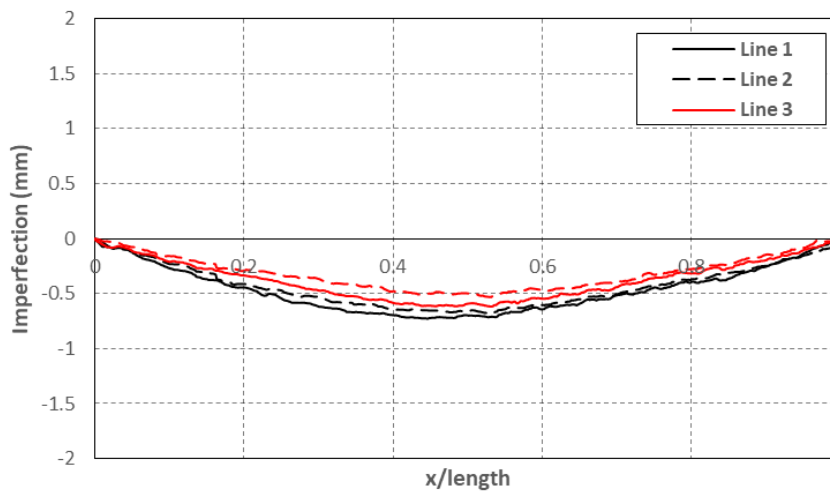


Figure H.70: Imperfections web channel T7914-12 (before assembly)

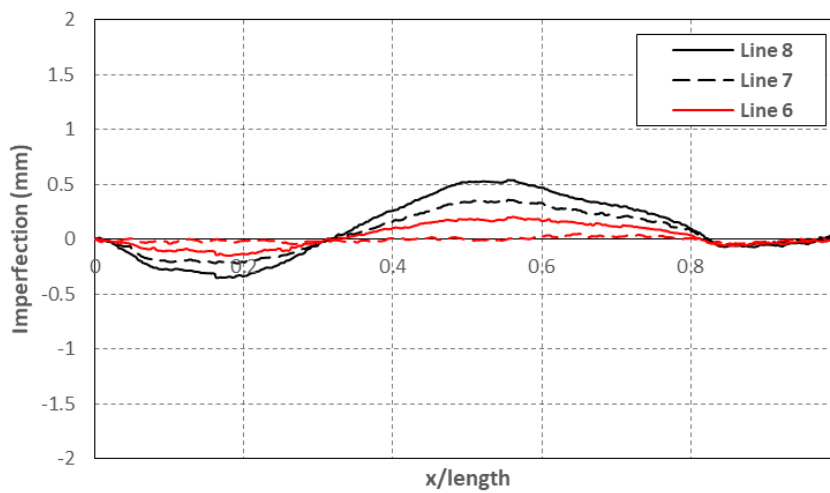


Figure H.71: Imperfections left flange channel T7914-12 (before assembly)

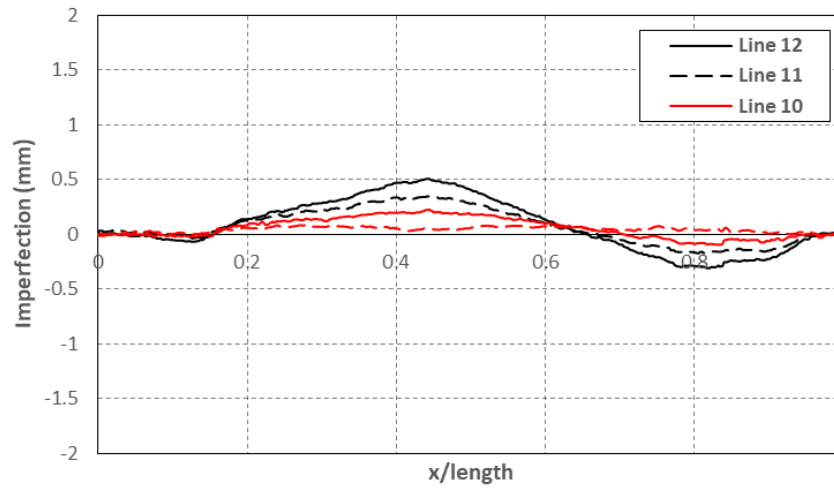


Figure H.72: Imperfections right flange channel T7914-12 (before assembly)

H.3. T15414

H.3.1 T15414-1

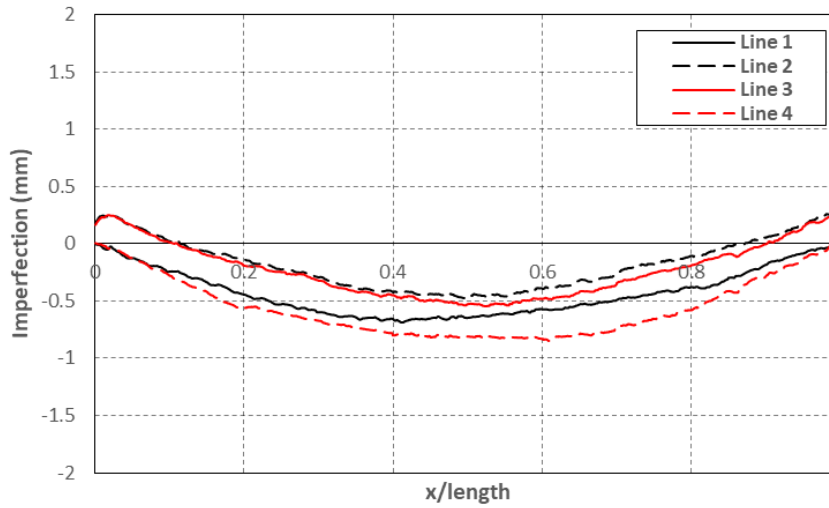


Figure H.73: Imperfections web channel T15414-1 (before assembly)

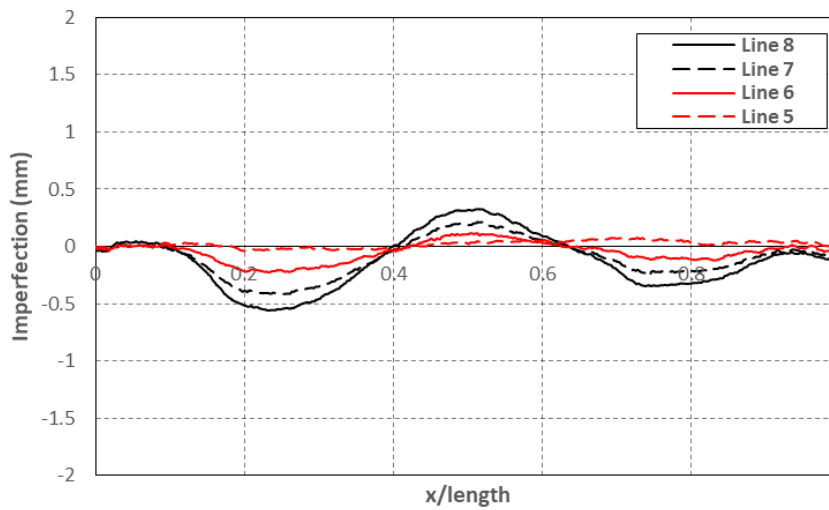


Figure H.74: Imperfections left flange channel T15414-1 (before assembly)

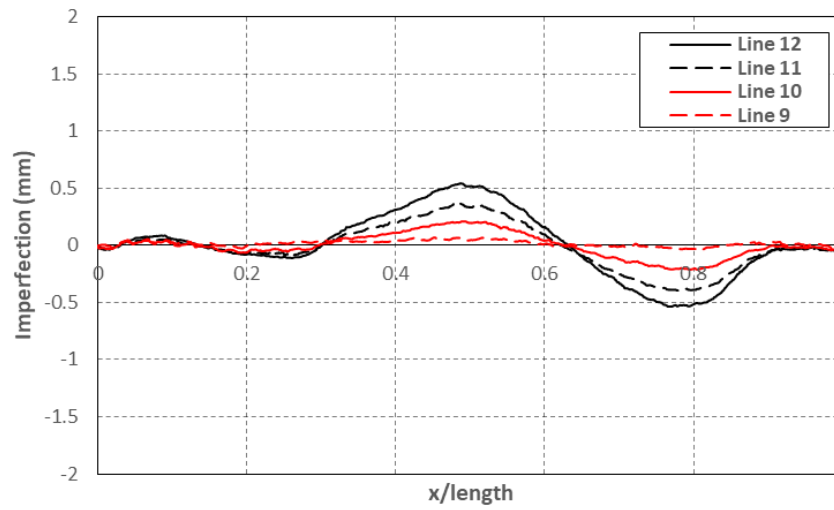


Figure H.75: Imperfections right flange channel T15414-1 (before assembly)

H.3.2 T15414-2

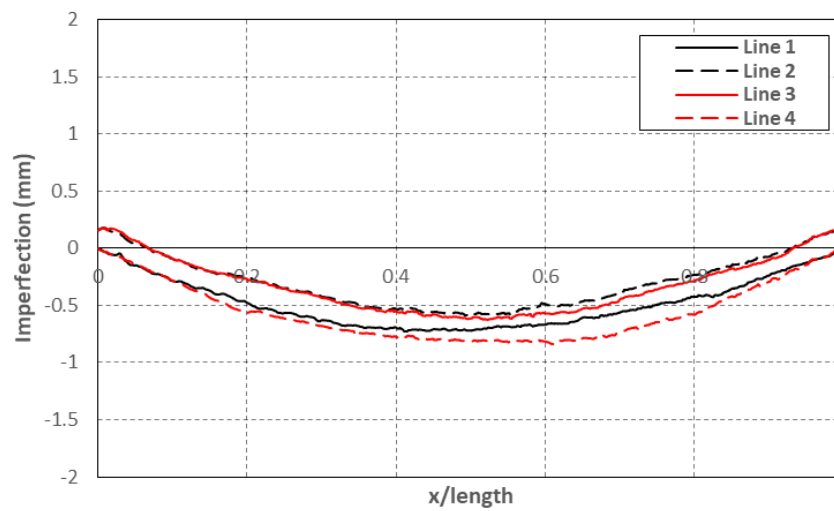


Figure H.76: Imperfections web channel T15414-2 (before assembly)

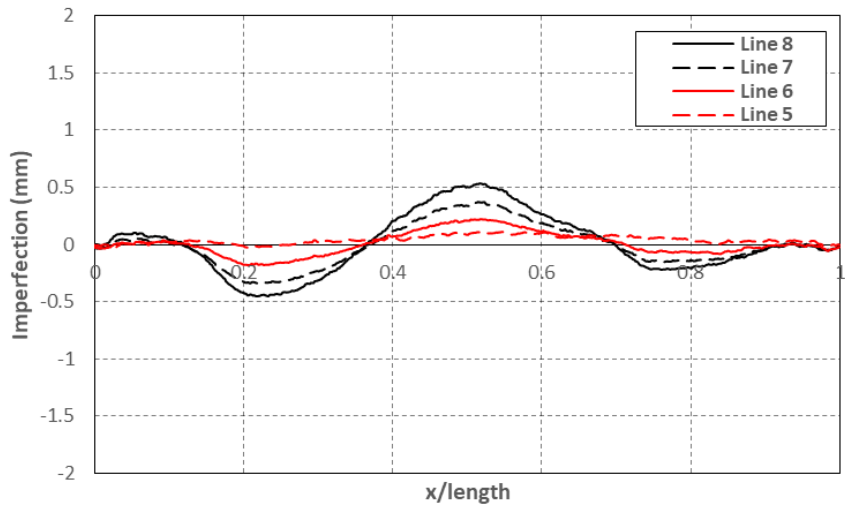


Figure H.77: Imperfections left flange channel T15414-2 (before assembly)

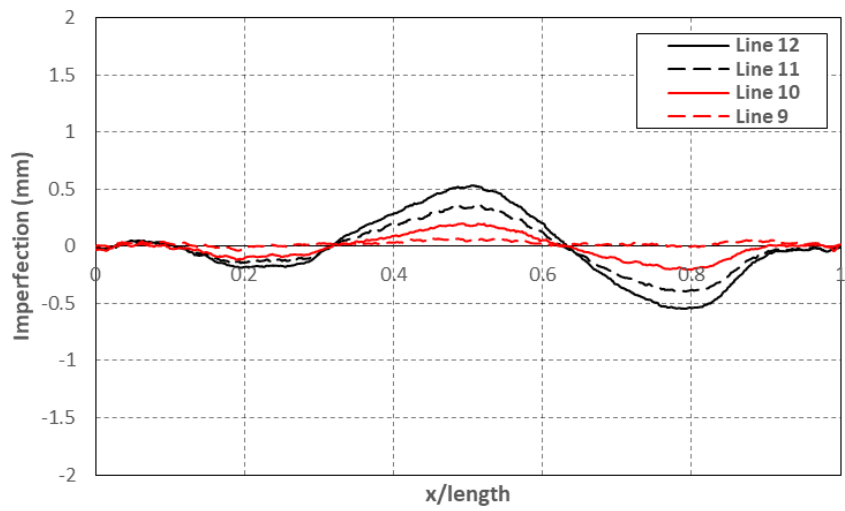
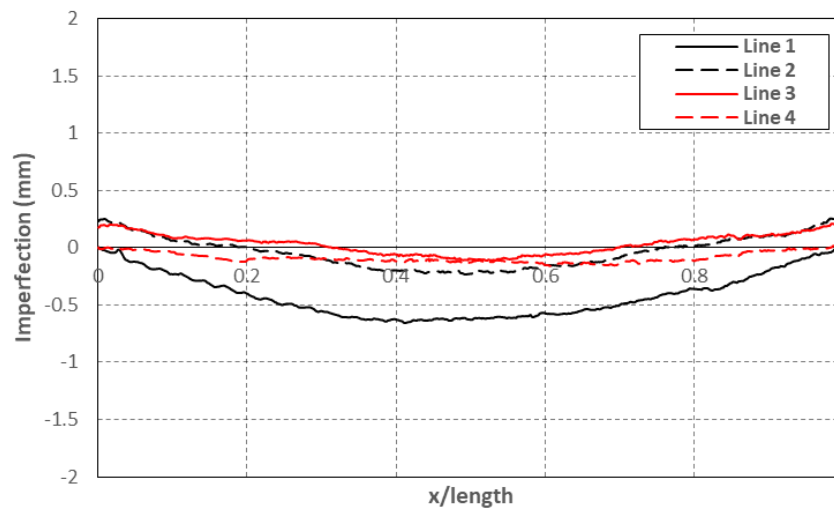
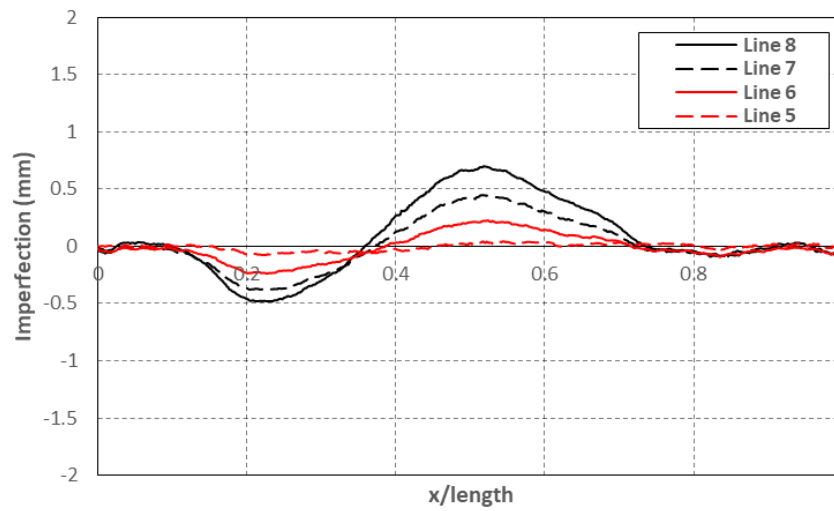
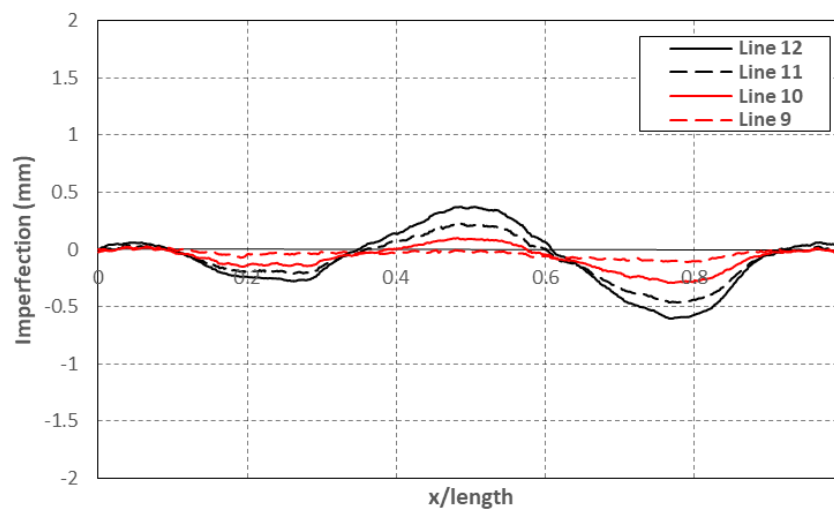


Figure H.78: Imperfections right flange channel T15414-2 (before assembly)

H.3.3 T15414-3**Figure H.79: Imperfections web channel T15414-3 (before assembly)****Figure H.80: Imperfections left flange channel T15414-3 (before assembly)****Figure H.81: Imperfections right flange channel T15414-3 (before assembly)**

H.3.4 T15414-4

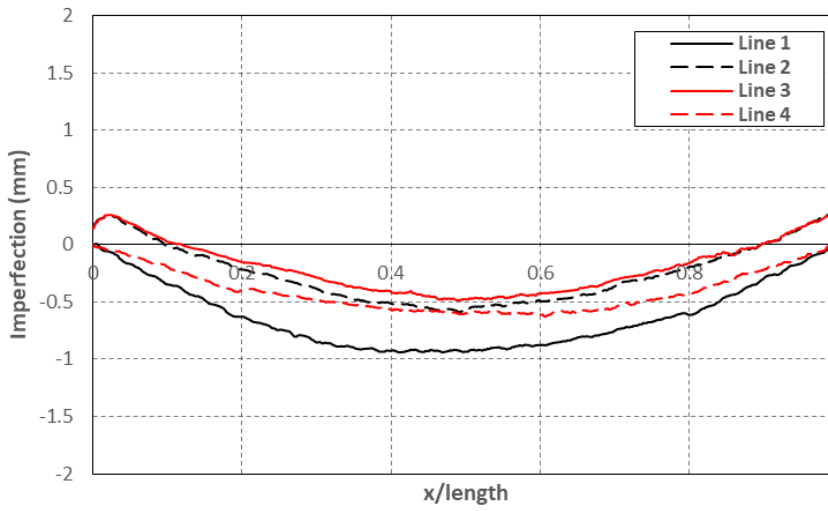


Figure H.82: Imperfections web channel T15414-4 (before assembly)

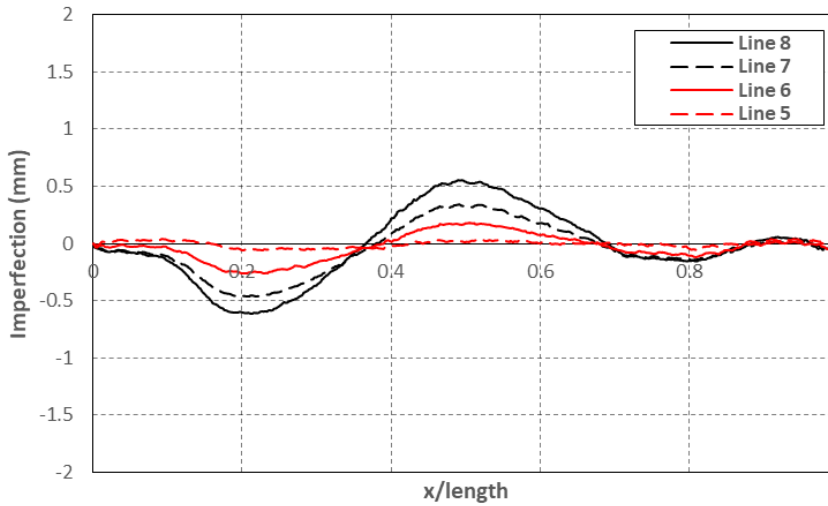


Figure H.83: Imperfections left flange channel T15414-4 (before assembly)

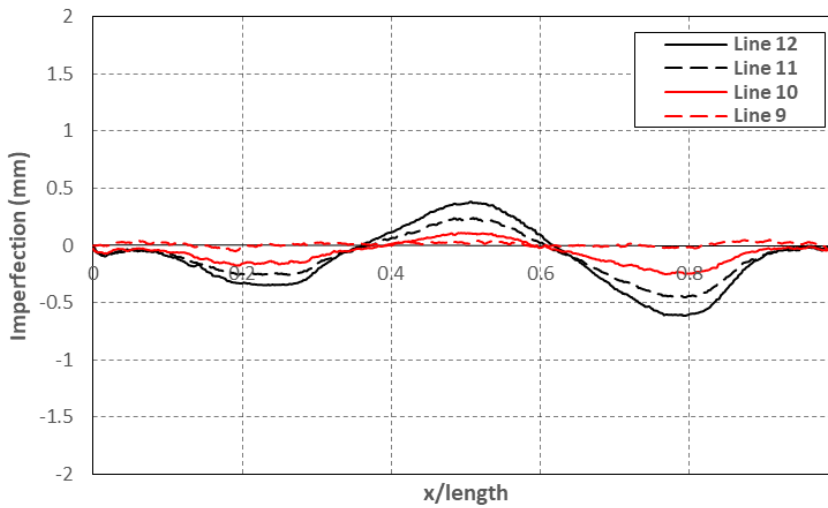
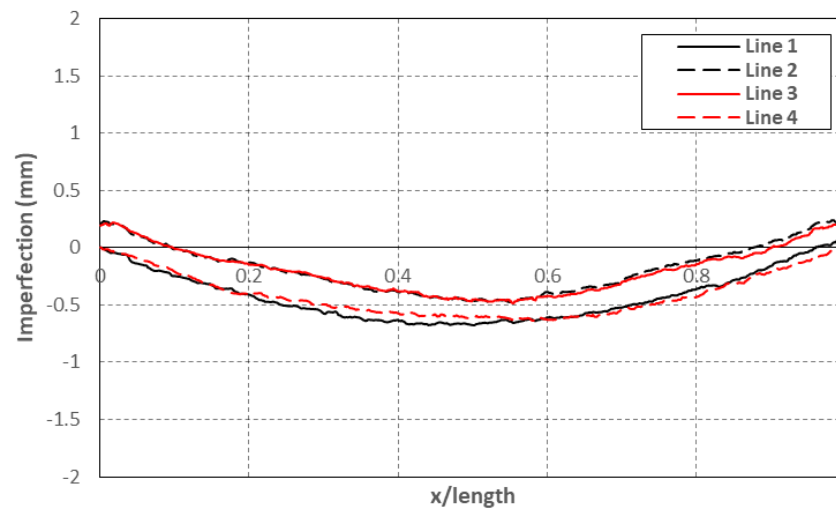
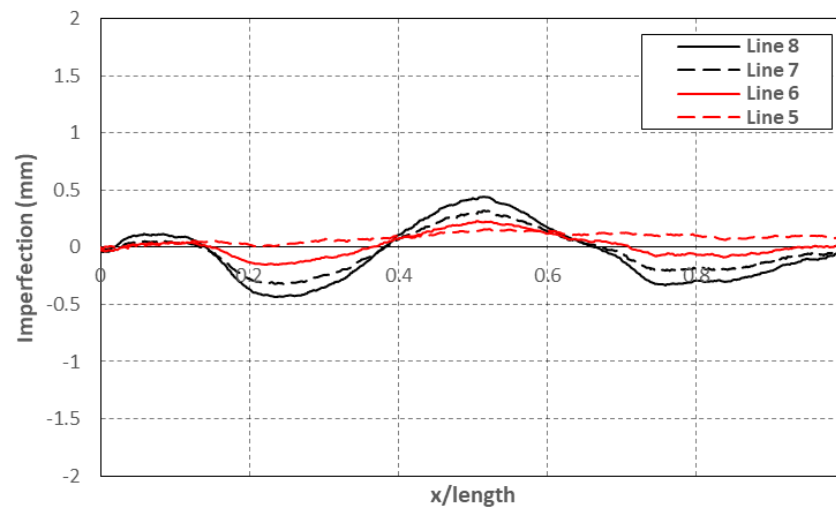
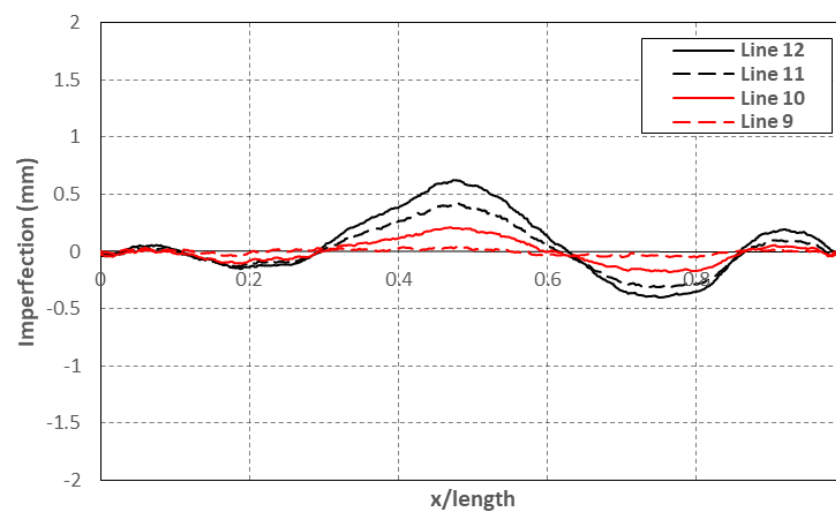


Figure H.84: Imperfections right flange channel T15414-4 (before assembly)

H.3.5 T15414-5**Figure H.85: Imperfections web channel T15414-5 (before assembly)****Figure H.86: Imperfections left flange channel T15414-5 (before assembly)****Figure H.87: Imperfections right flange channel T15414-5 (before assembly)**

H.3.6 T15414-6

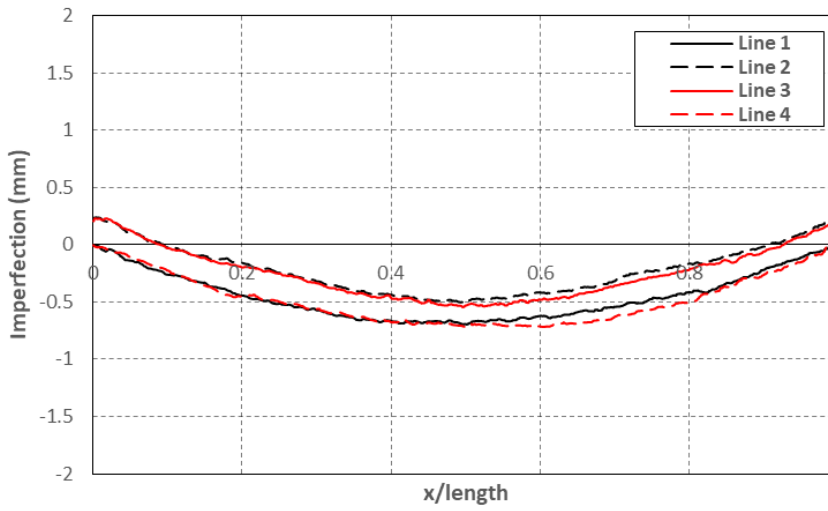


Figure H.88: Imperfections web channel T15414-6 (before assembly)

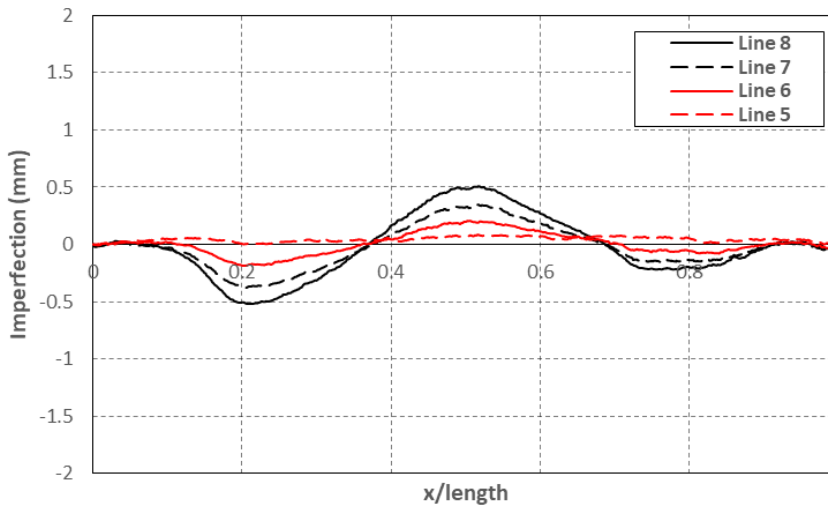


Figure H.89: Imperfections left flange channel T15414-6 (before assembly)

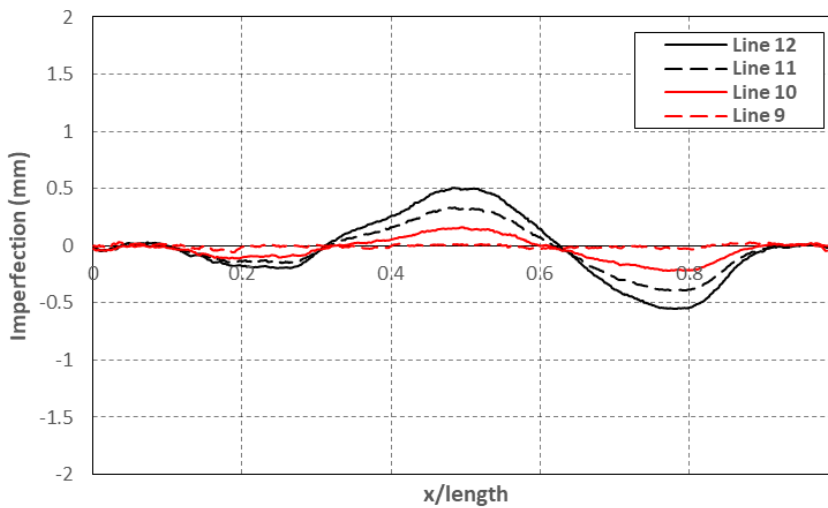
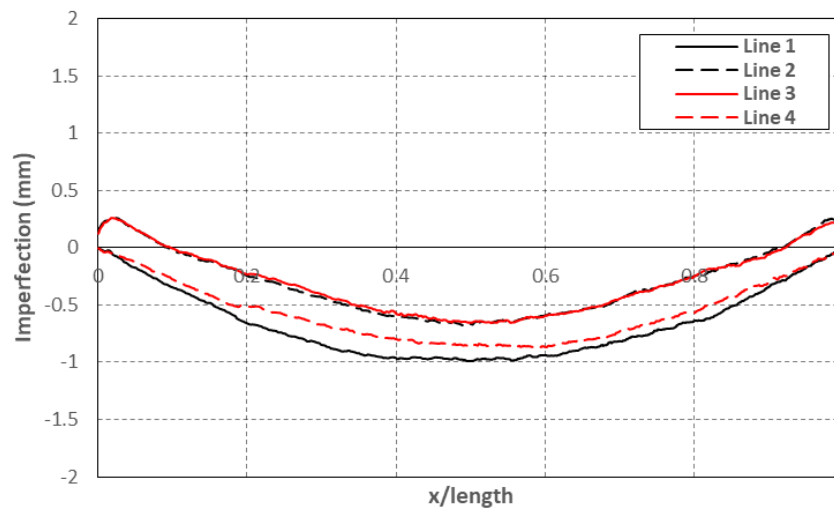
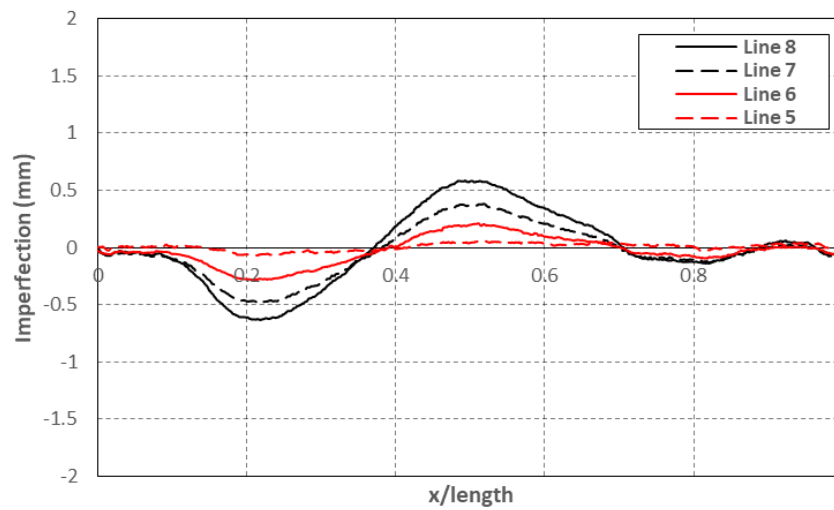
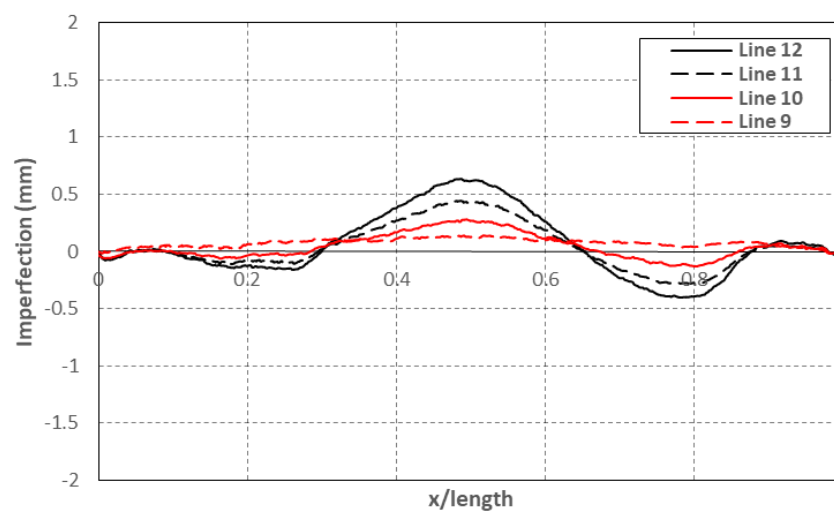


Figure H.90: Imperfections right flange channel T15414-6 (before assembly)

H.3.7 T15414-7**Figure H.91: Imperfections web channel T15414-7 (before assembly)****Figure H.92: Imperfections left flange channel T15414-7 (before assembly)****Figure H.93: Imperfections right flange channel T15414-7 (before assembly)**

H.3.8 T15414-8

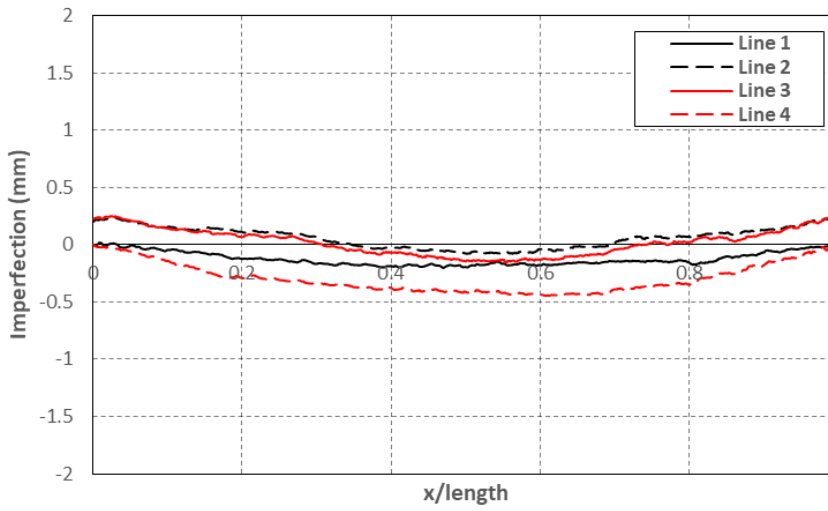


Figure H.94: Imperfections web channel T15414-8 (before assembly)

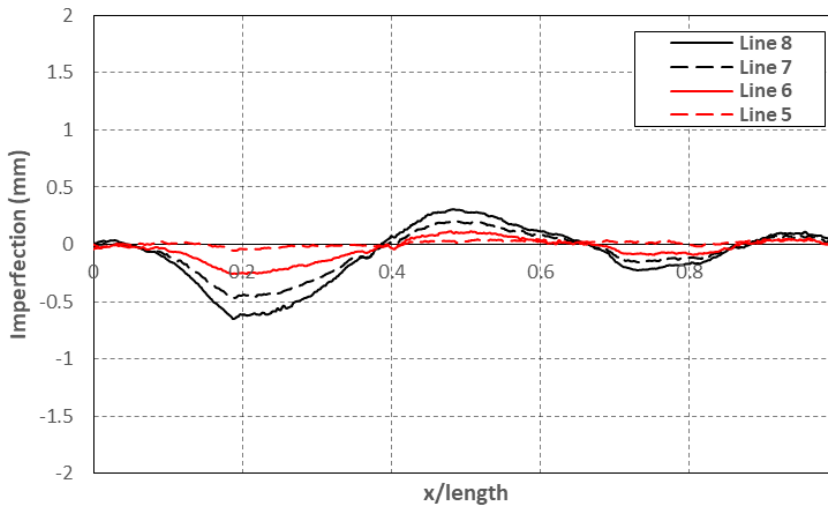


Figure H.95: Imperfections left flange channel T15414-8 (before assembly)

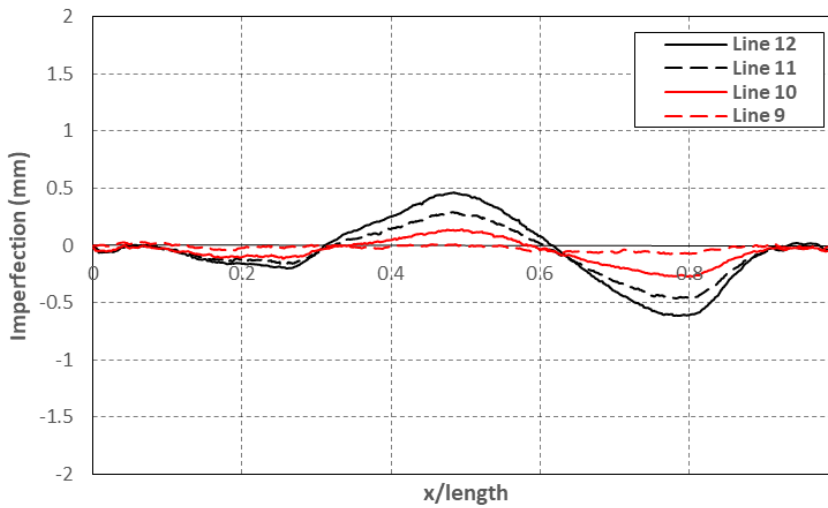
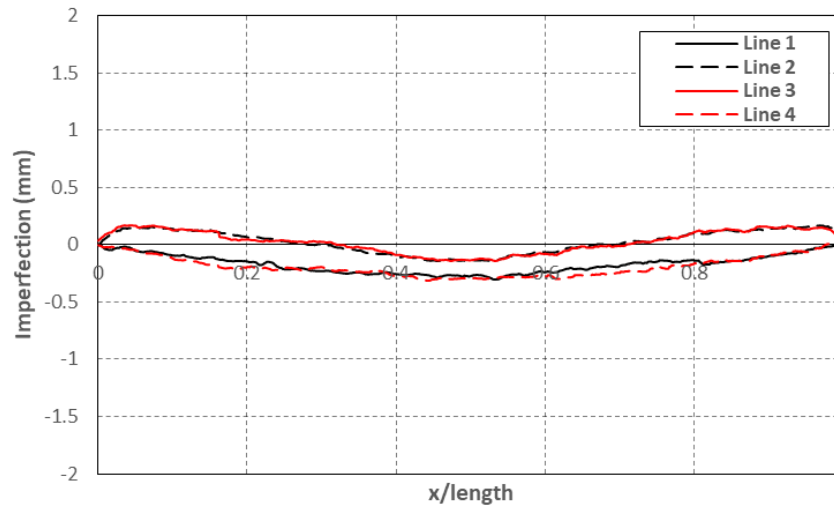
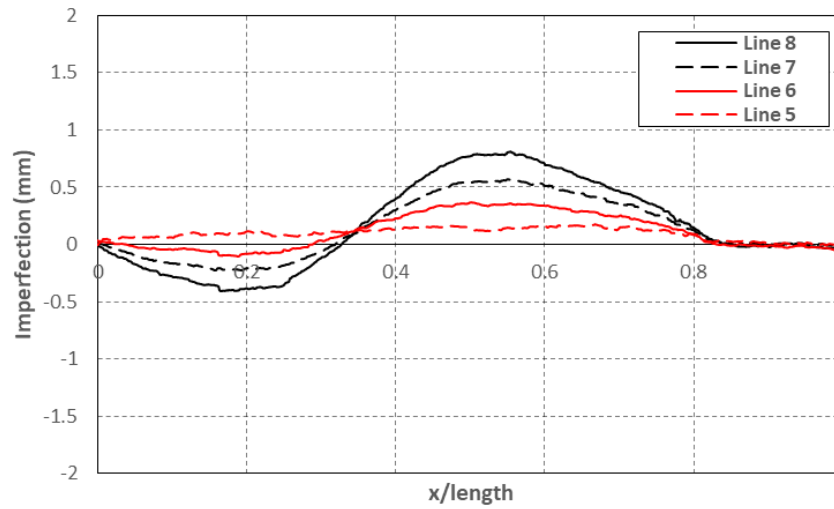
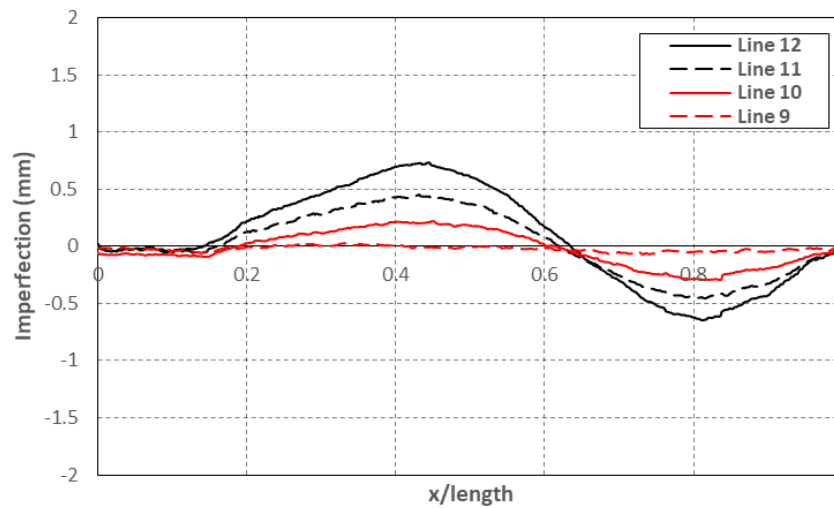


Figure H.96: Imperfections right flange channel T15414-8 (before assembly)

H.3.9 T15414-9**Figure H.97: Imperfections web channel T15414-9 (before assembly)****Figure H.98: Imperfections left flange channel T15414-9 (before assembly)****Figure H.99: Imperfections right flange channel T15414-9 (before assembly)**

H.3.10 T15414-10

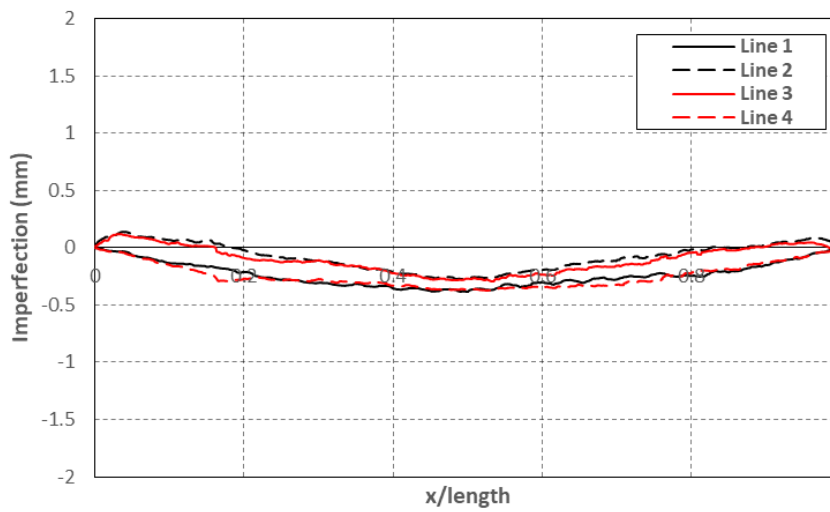


Figure H.100: Imperfections web channel T15414-10 (before assembly)

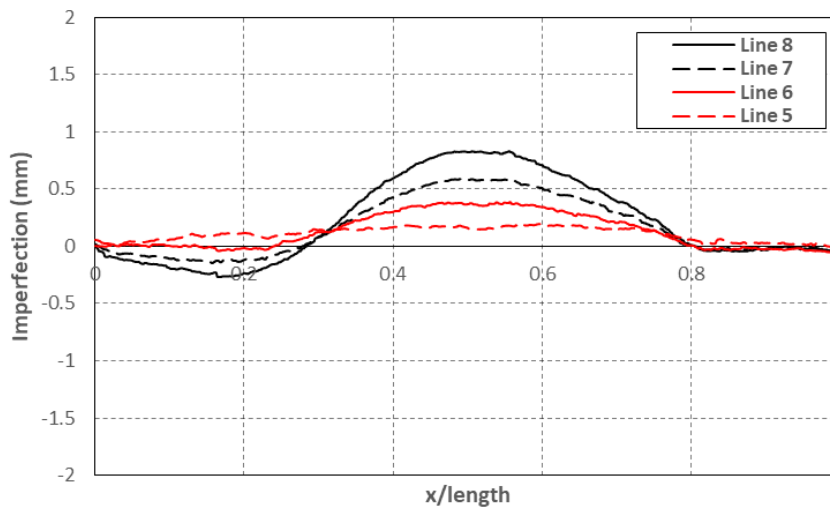


Figure H.101: Imperfections left flange channel T15414-10 (before assembly)

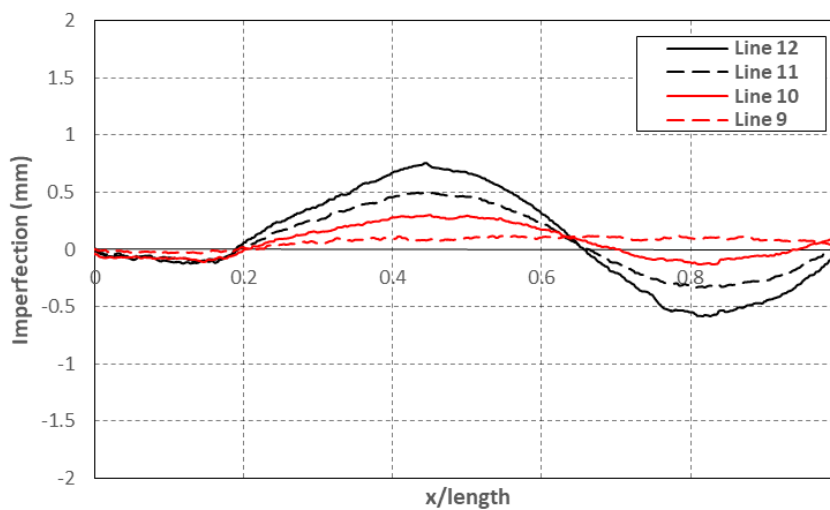
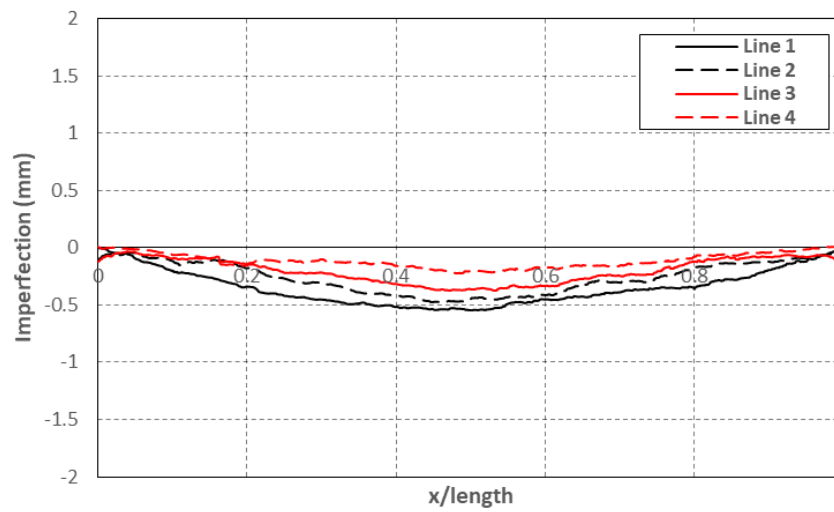
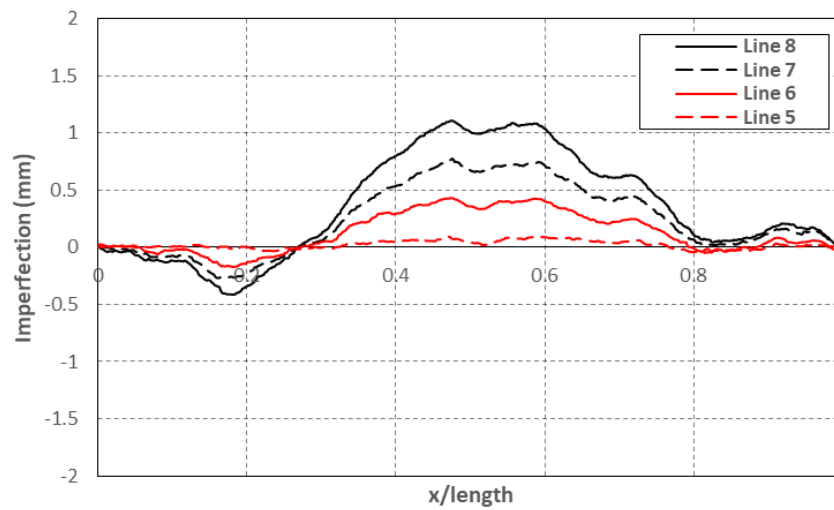
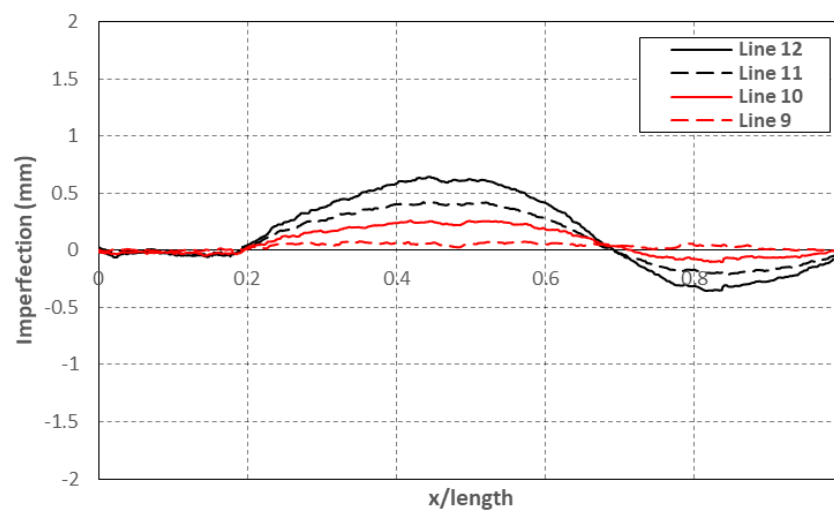


Figure H.102: Imperfections right flange channel T15414-10 (before assembly)

H.3.11 T15414-11**Figure H.103: Imperfections web channel T15414-11 (before assembly)****Figure H.104: Imperfections left flange channel T15414-11 (before assembly)****Figure H.105: Imperfections right flange channel T15414-11 (before assembly)**

H.3.12 T15414-12

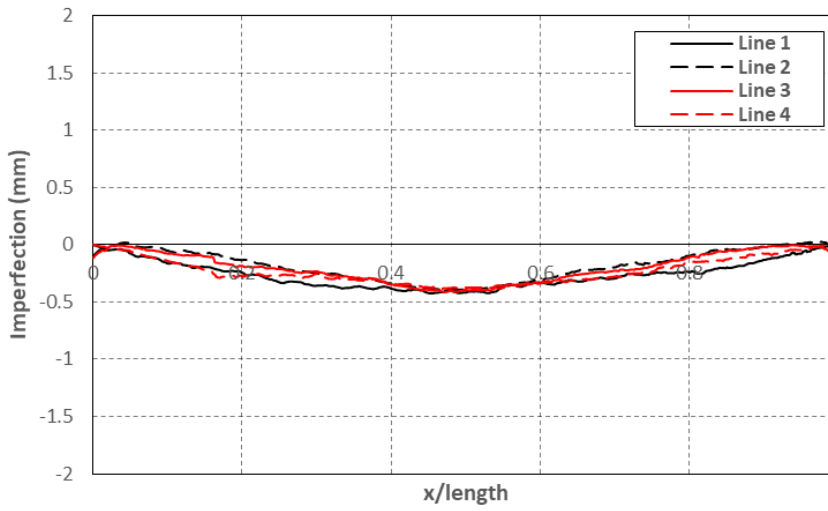


Figure H.106: Imperfections web channel T15414-12 (before assembly)

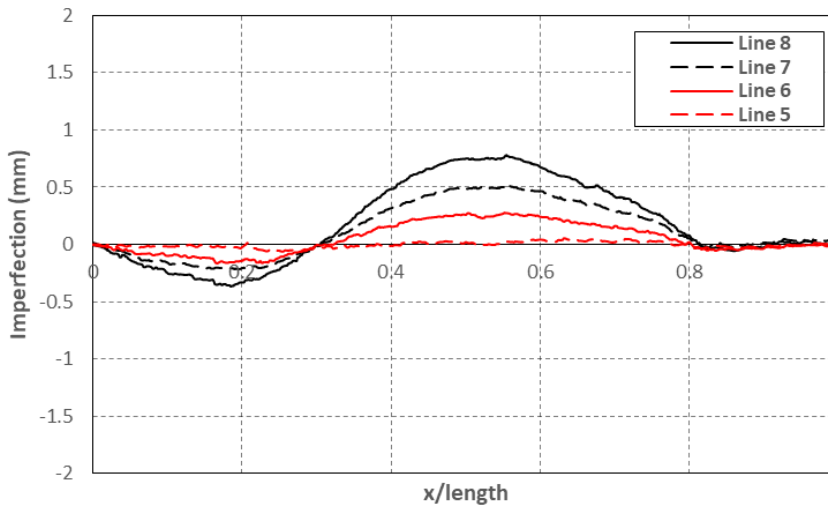


Figure H.107: Imperfections left flange channel T15414-12 (before assembly)

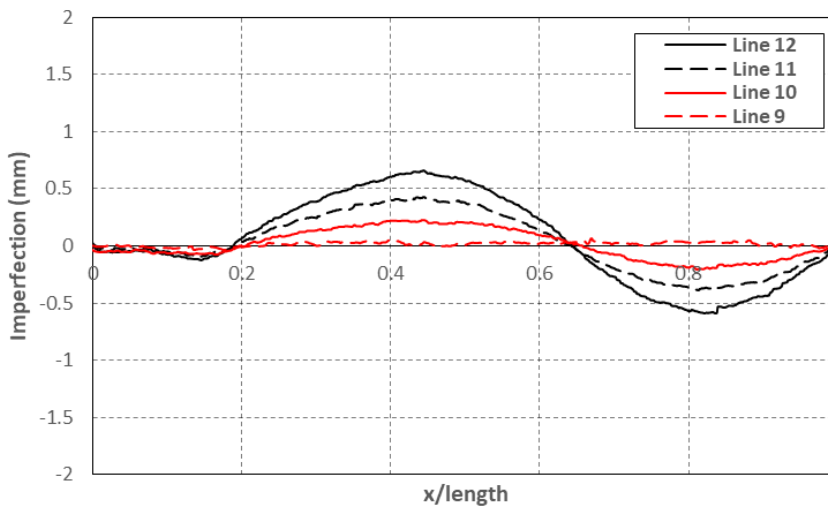


Figure H.108: Imperfections right flange channel T15414-12 (before assembly)

H.4. T12012

H.4.1 T12012-1

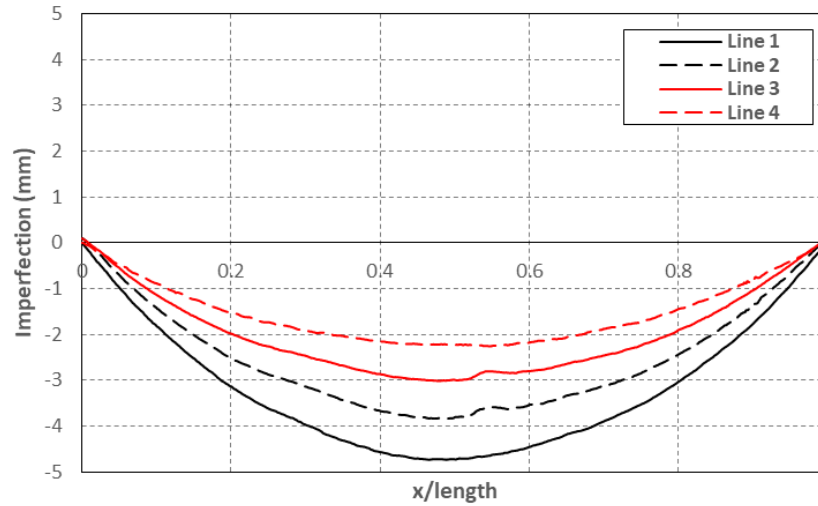


Figure H.109: Imperfections web channel T12012-1 (before assembly)

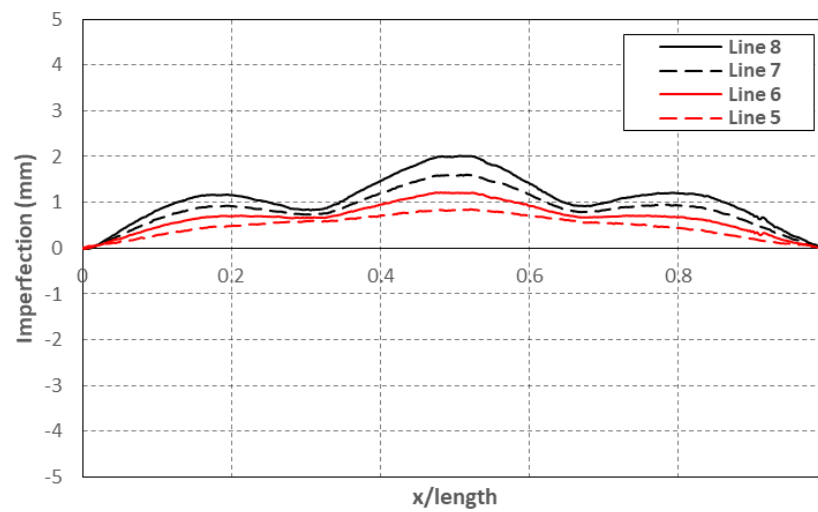


Figure H.110: Imperfections left flange channel T12012-1 (before assembly)

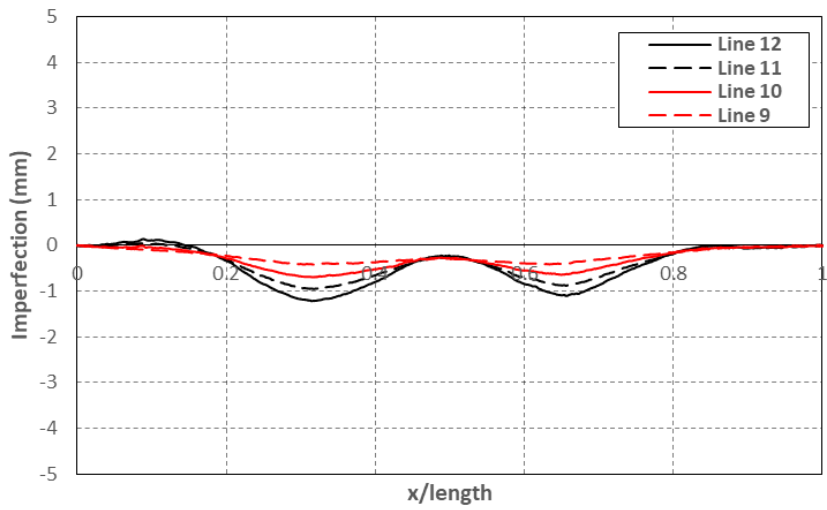


Figure H.111: Imperfections right flange channel T12012-1 (before assembly)

H.4.2 T12012-2

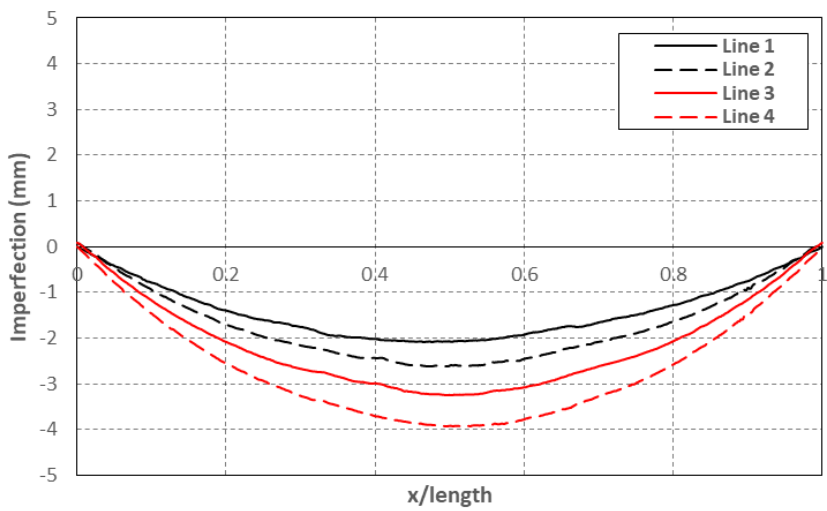


Figure H.112: Imperfections web channel T12012-2 (before assembly)

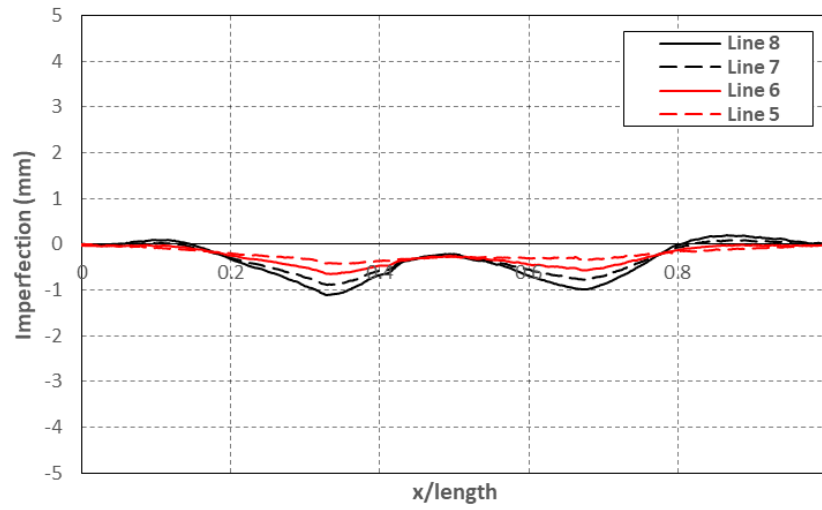


Figure H.113: Imperfections left flange channel T12012-2 (before assembly)

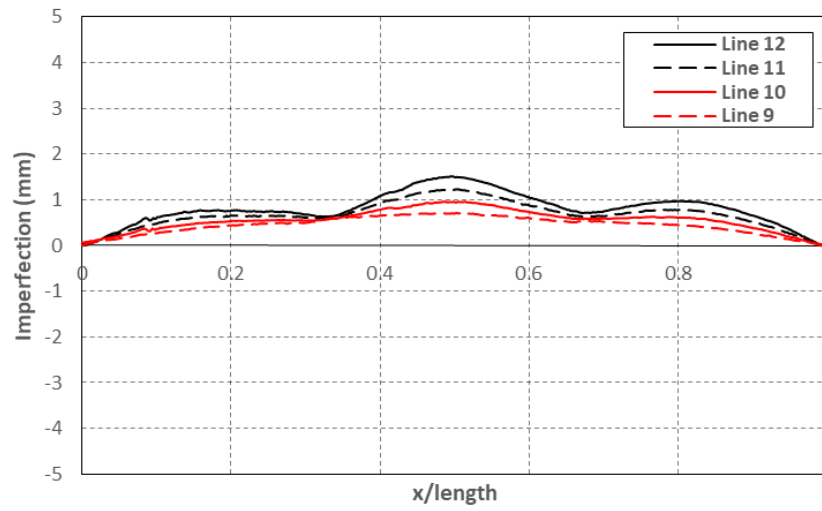


Figure H.114: Imperfections right flange channel T12012-2 (before assembly)

H.4.3 T12012-3

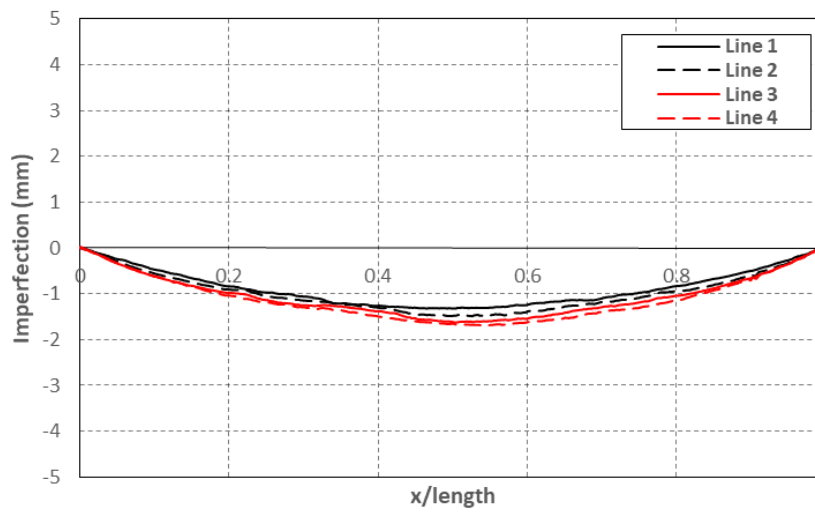


Figure H.115: Imperfections web channel T12012-3 (before assembly)

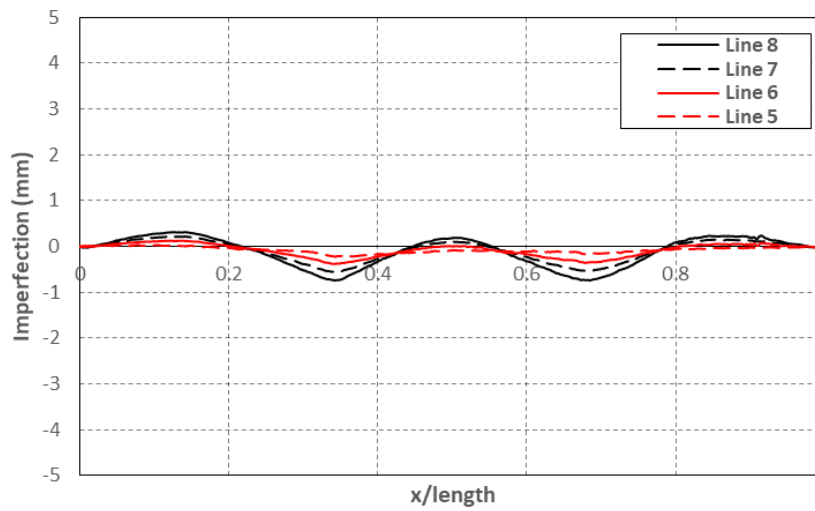


Figure H.116: Imperfections left flange channel T12012-3 (before assembly)

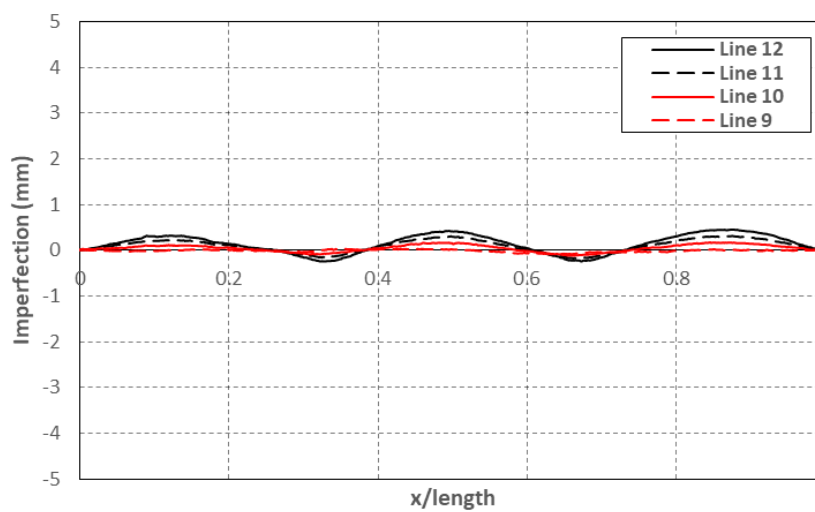
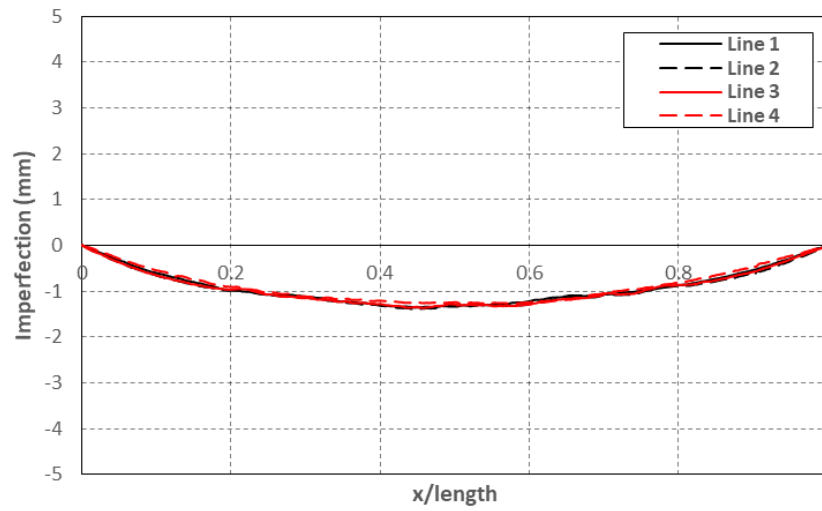
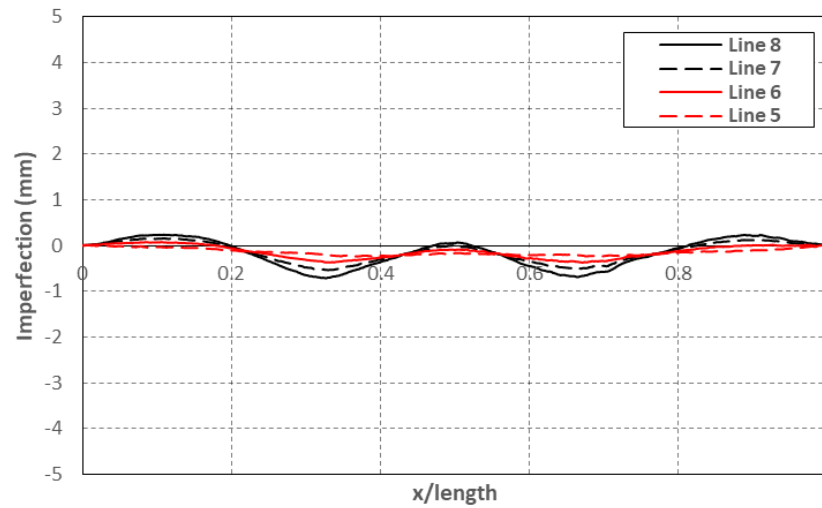
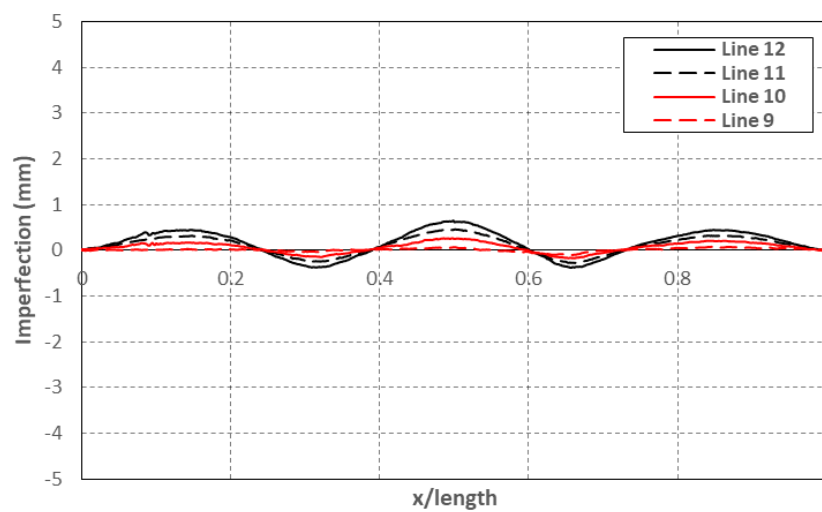
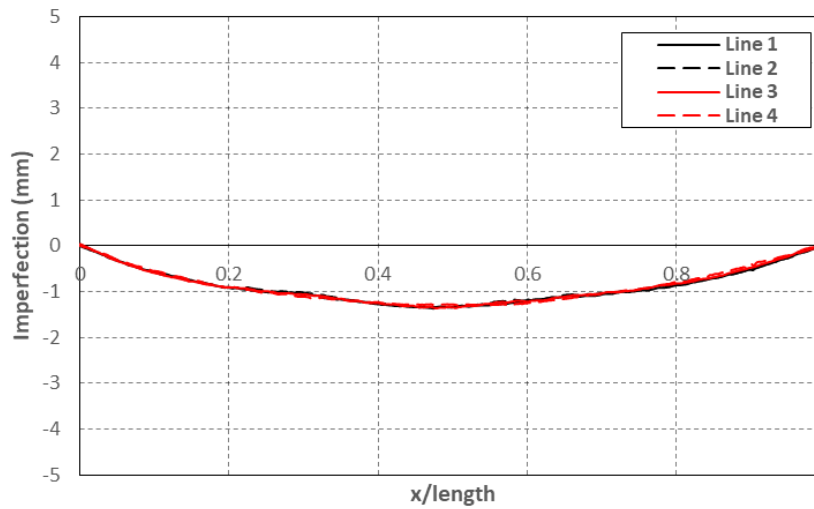
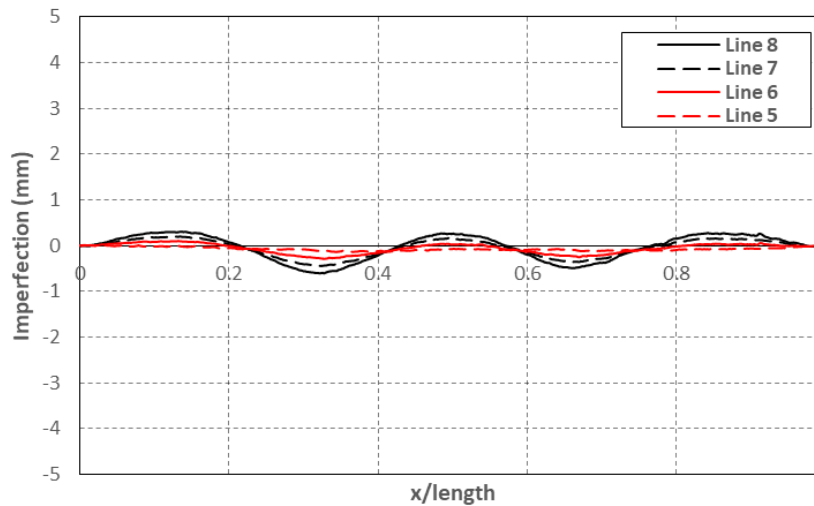
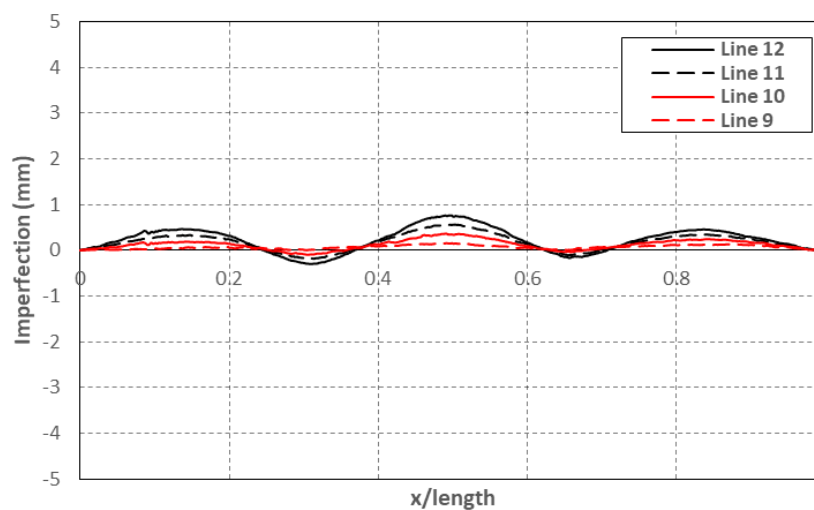
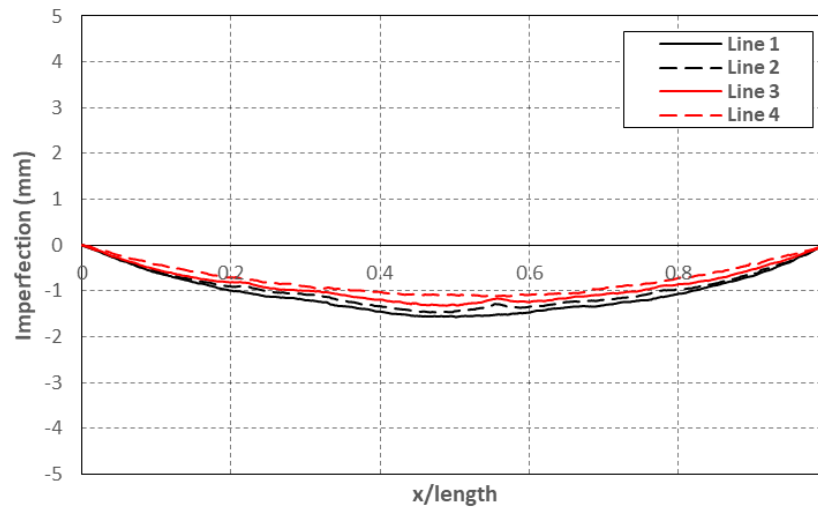
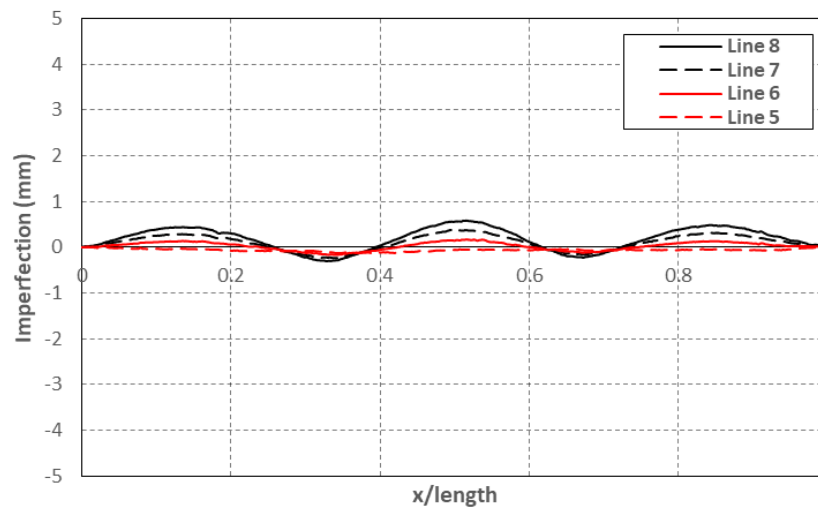
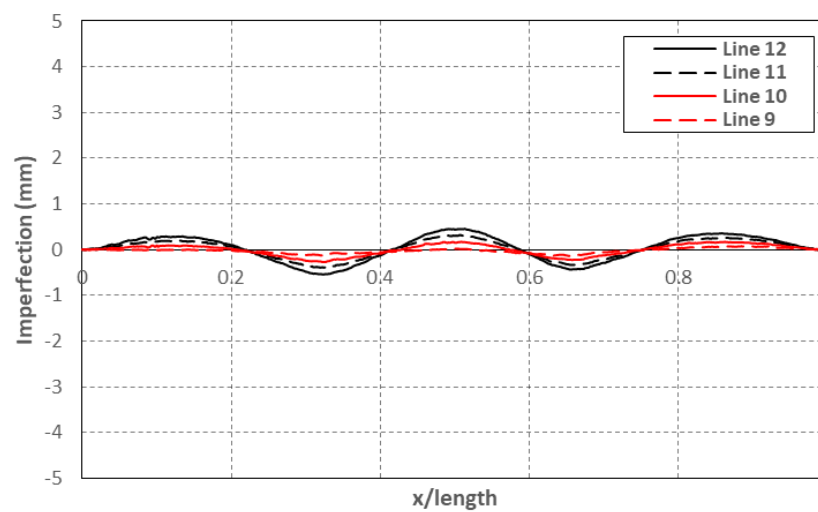


Figure H.117: Imperfections right flange channel T12012-3 (before assembly)

H.4.4 T12012-4**Figure H.118: Imperfections web channel T12012-4 (before assembly)****Figure H.119: Imperfections left flange channel T12012-4 (before assembly)****Figure H.120: Imperfections right flange channel T12012-4 (before assembly)**

H.4.5 T12012-5**Figure H.121: Imperfections web channel T12012-5 (before assembly)****Figure H.122: Imperfections left flange channel T12012-5 (before assembly)****Figure H.123: Imperfections right flange channel T12012-5 (before assembly)**

H.4.6 T12012-6**Figure H.124: Imperfections web channel T12012-6 (before assembly)****Figure H.125: Imperfections left flange channel T12012-6 (before assembly)****Figure H.126: Imperfections right flange channel T12012-6 (before assembly)**

H.4.7 T12012-7

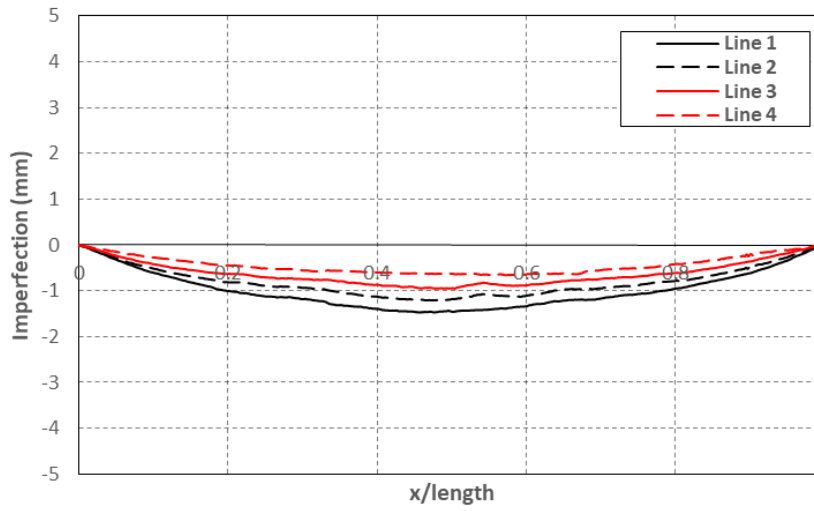


Figure H.127: Imperfections web channel T12012-7 (before assembly)

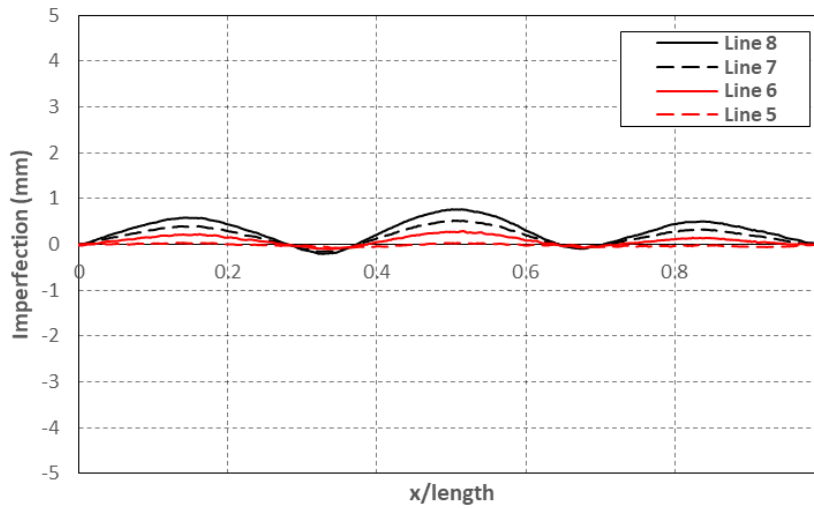


Figure H.128: Imperfections left flange channel T12012-7 (before assembly)

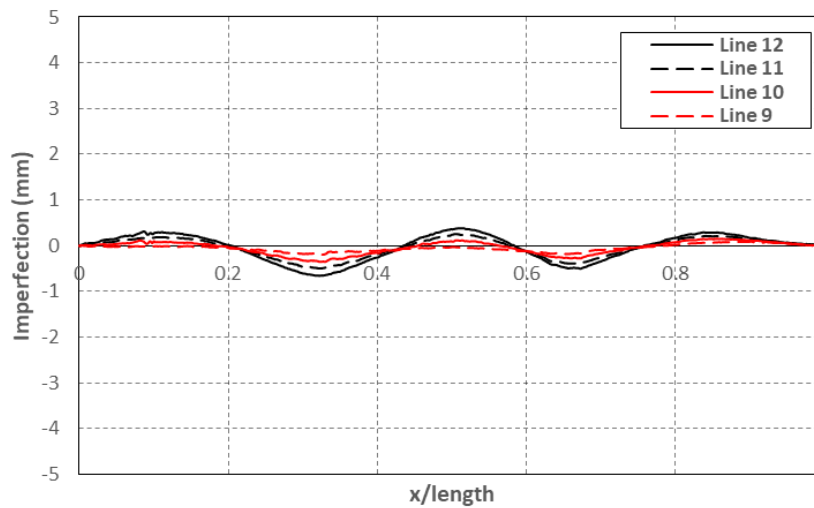
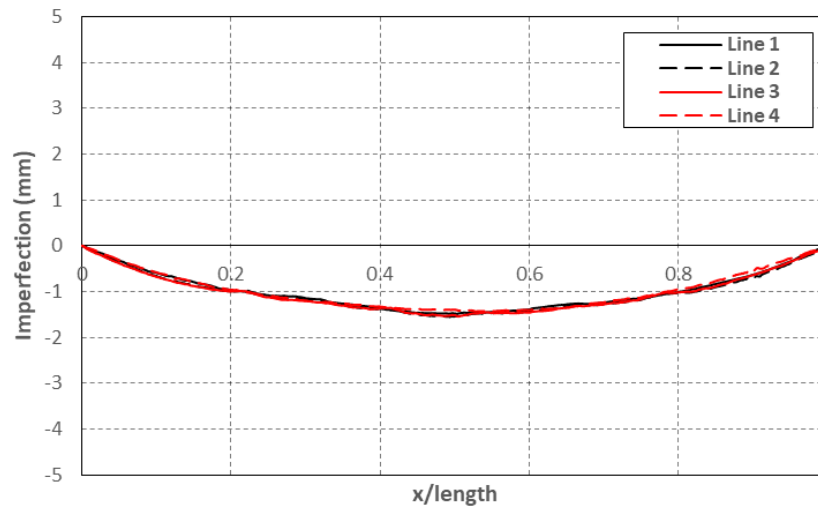
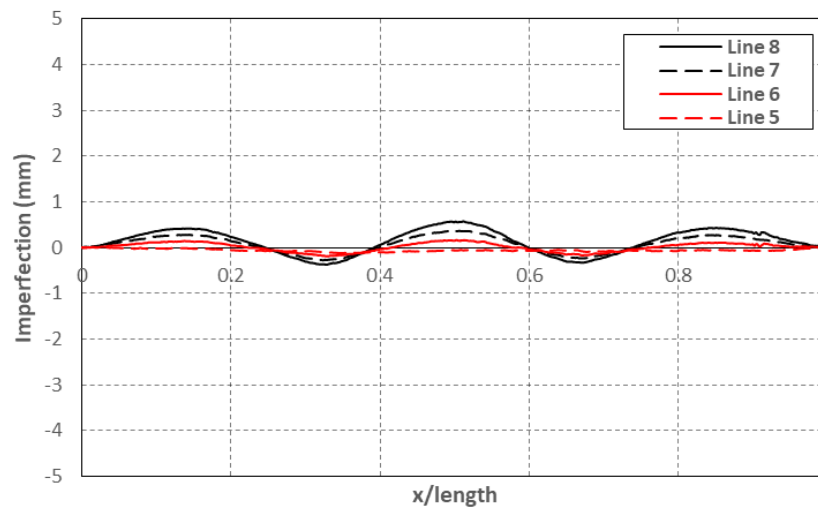
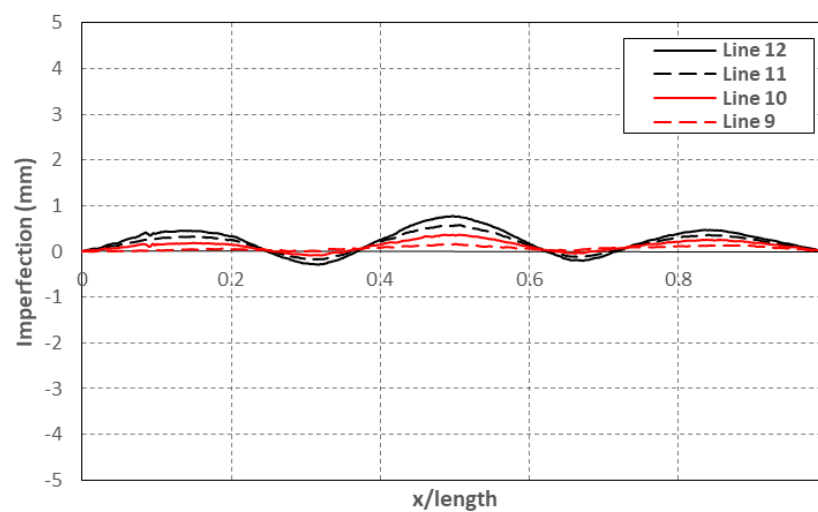


Figure H.129: Imperfections right flange channel T12012-7 (before assembly)

H.4.8 T12012-8**Figure H.130: Imperfections web channel T12012-8 (before assembly)****Figure H.131: Imperfections left flange channel T12012-8 (before assembly)****Figure H.132: Imperfections right flange channel T12012-8 (before assembly)**

H.4.9 T12012-9

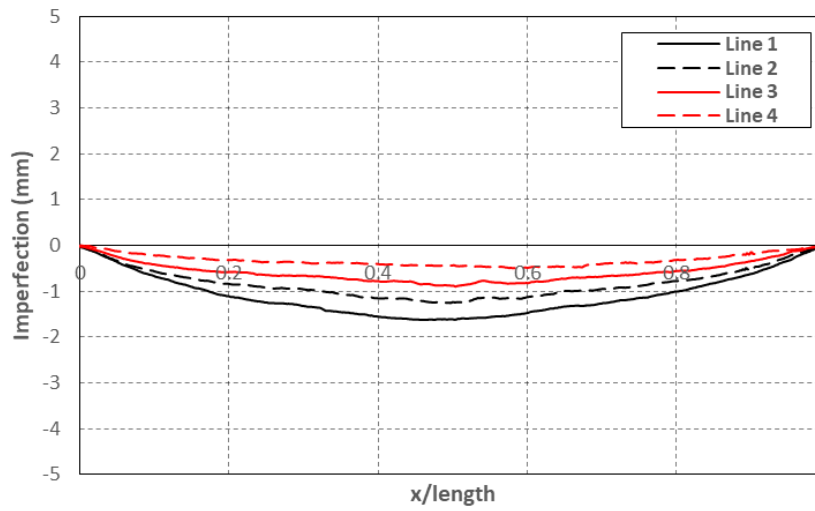


Figure H.133: Imperfections web channel T12012-9 (before assembly)

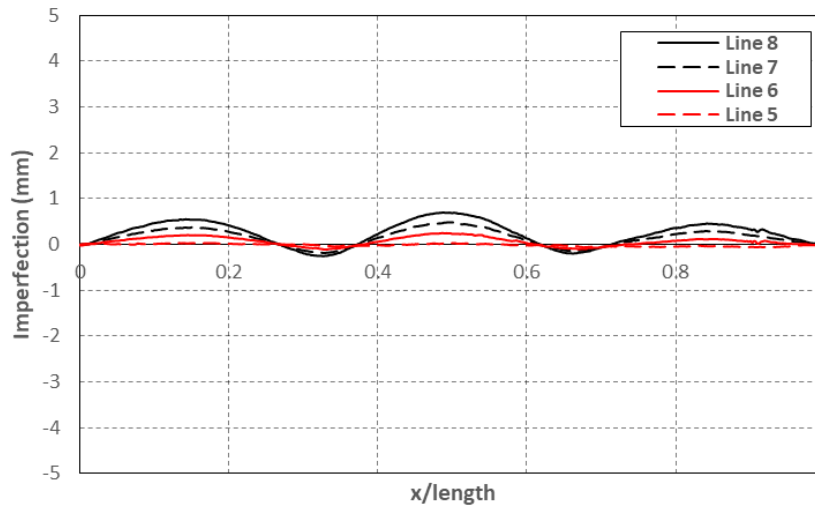


Figure H.134: Imperfections left flange channel T12012-9 (before assembly)

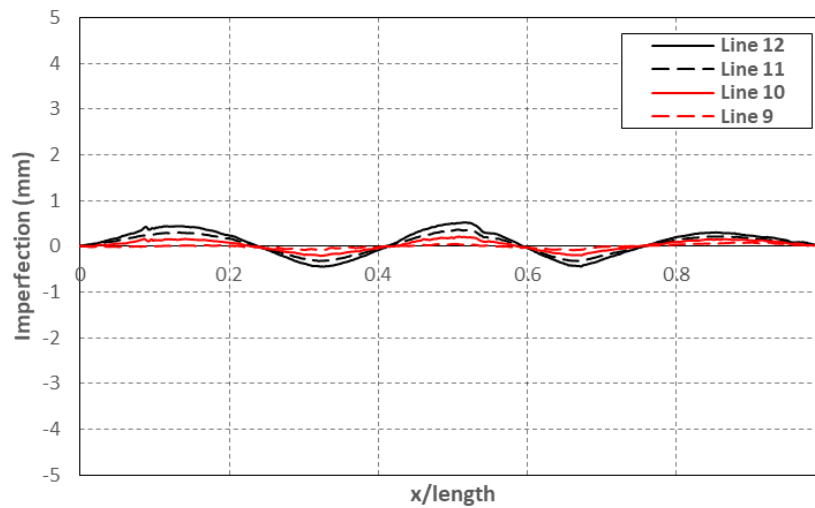
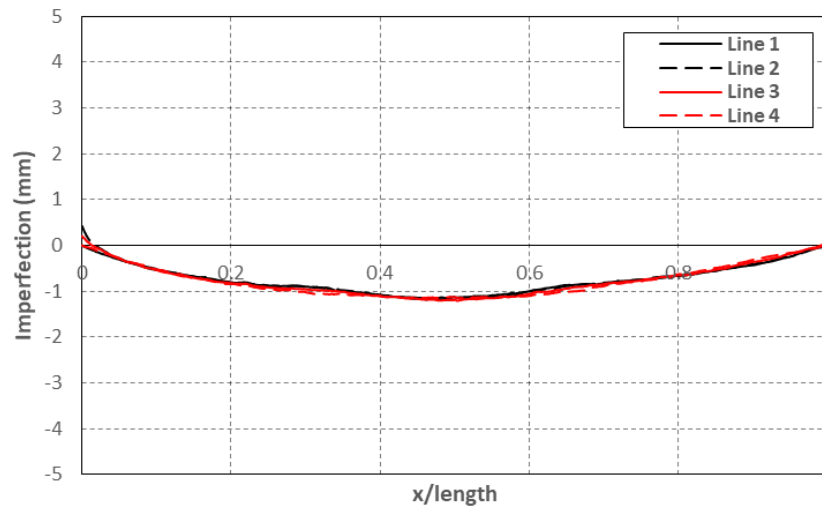
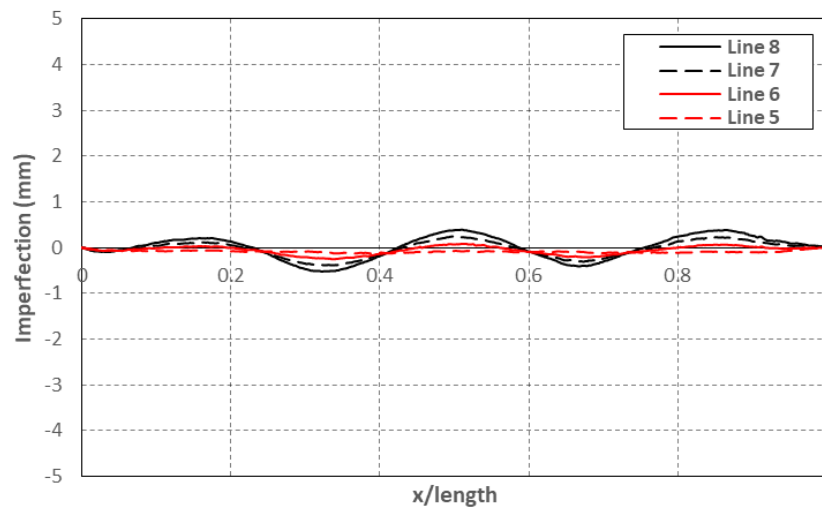
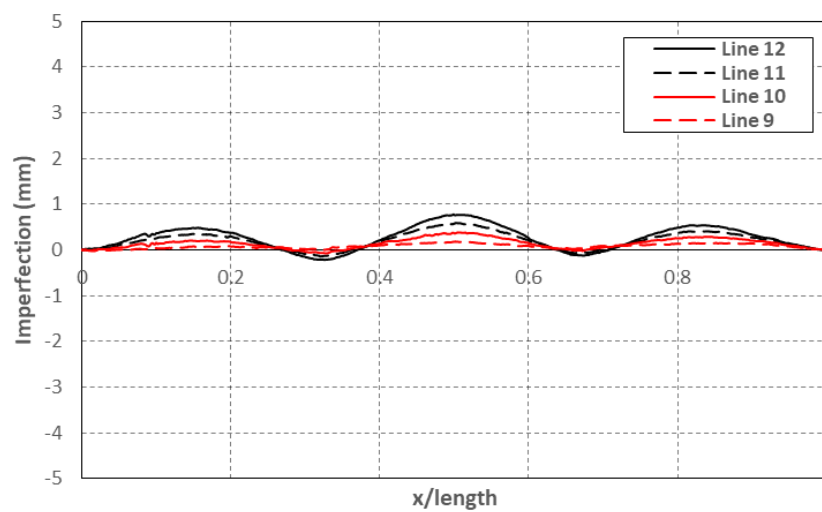


Figure H.135: Imperfections right flange channel T12012-9 (before assembly)

H.4.10 T12012-10**Figure H.136: Imperfections web channel T12012-10 (before assembly)****Figure H.137: Imperfections left flange channel T12012-10 (before assembly)****Figure H.138: Imperfections right flange channel T12012-10 (before assembly)**

H.4.11 T12012-11

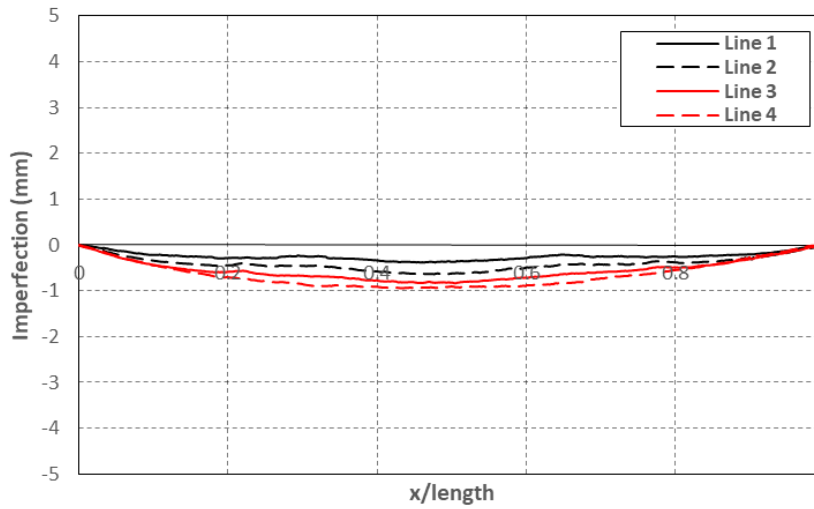


Figure H.139: Imperfections web channel T12012-11 (before assembly)

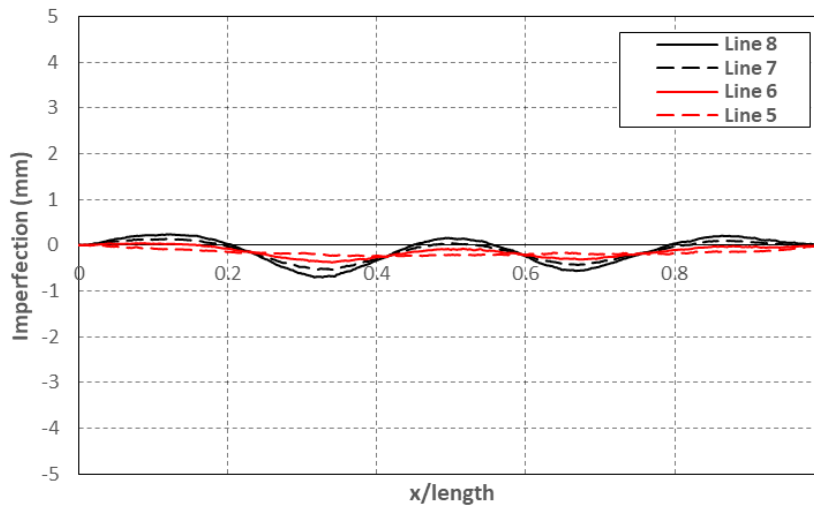


Figure H.140: Imperfections left flange channel T12012-11 (before assembly)

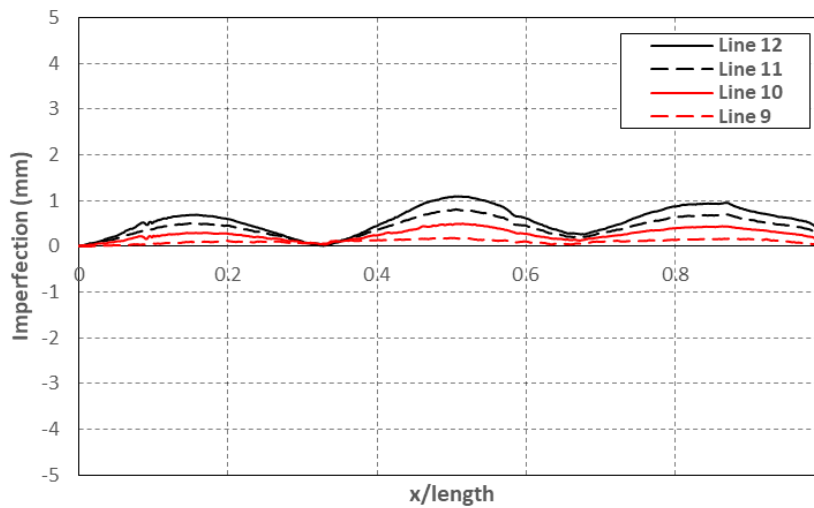
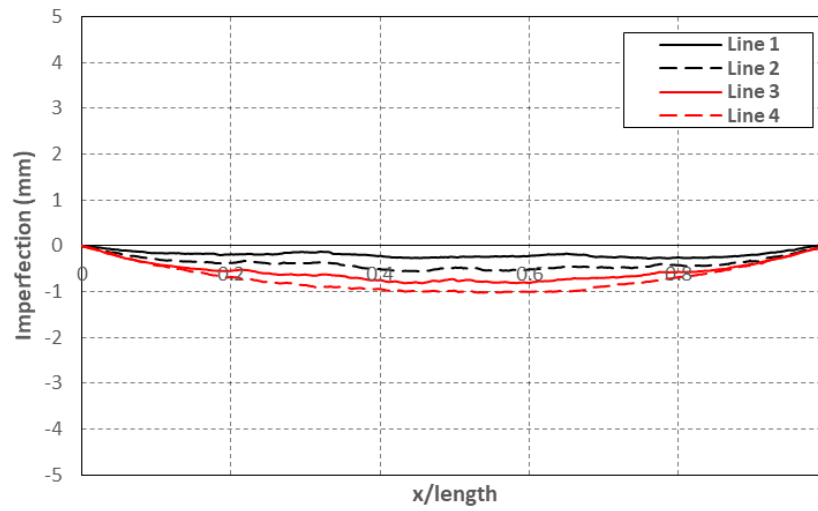
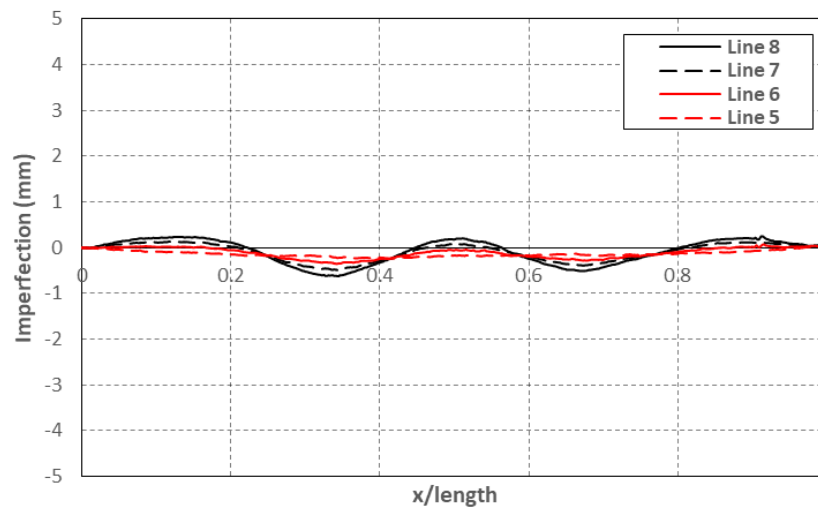
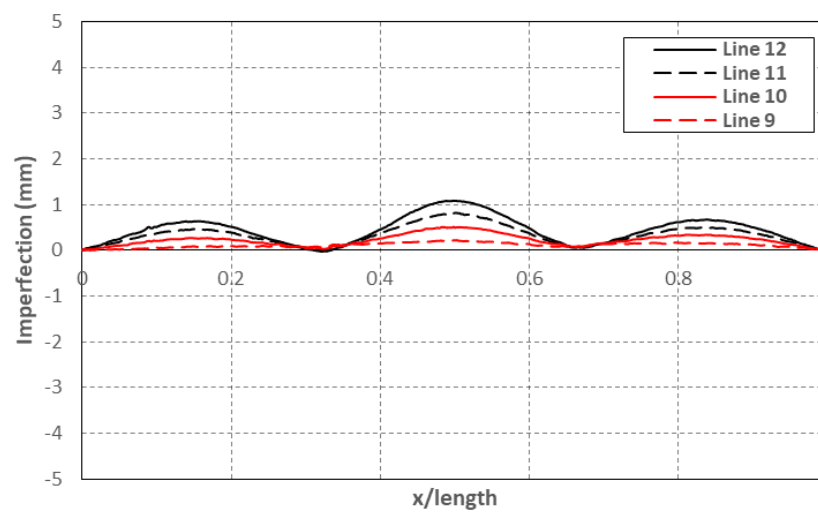


Figure H.141: Imperfections right flange channel T12012-11 (before assembly)

H.4.12 T12012-12**Figure H.142: Imperfections web channel T12012-12 (before assembly)****Figure H.143: Imperfections left flange channel T12012-12 (before assembly)****Figure H.144: Imperfections right flange channel T12012-12 (before assembly)**

H.4.13 T12012-13

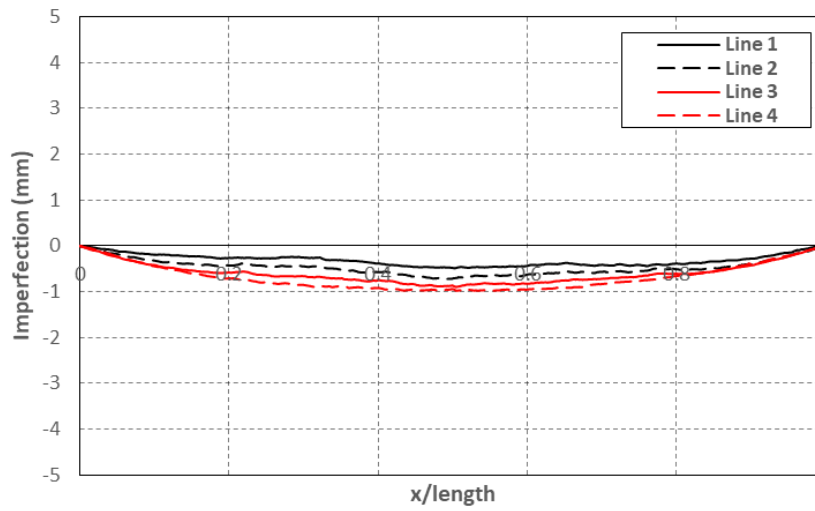


Figure H.145: Imperfections web channel T12012-13 (before assembly)

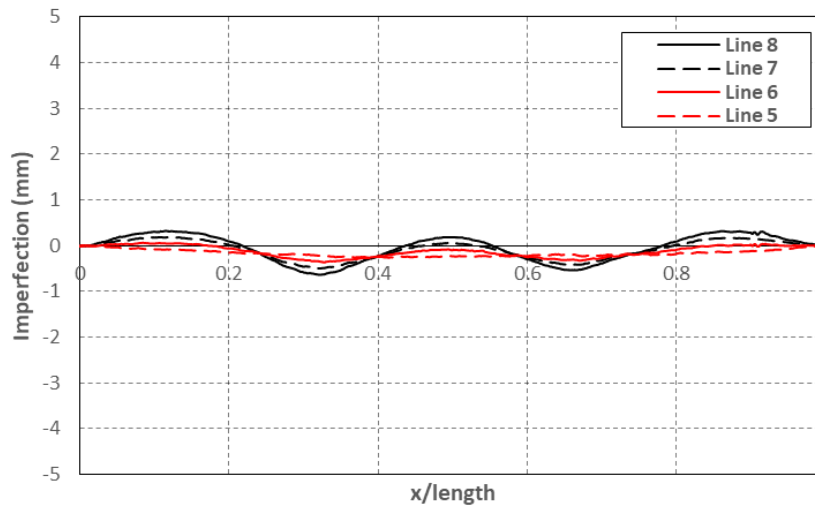


Figure H.146: Imperfections left flange channel T12012-13 (before assembly)

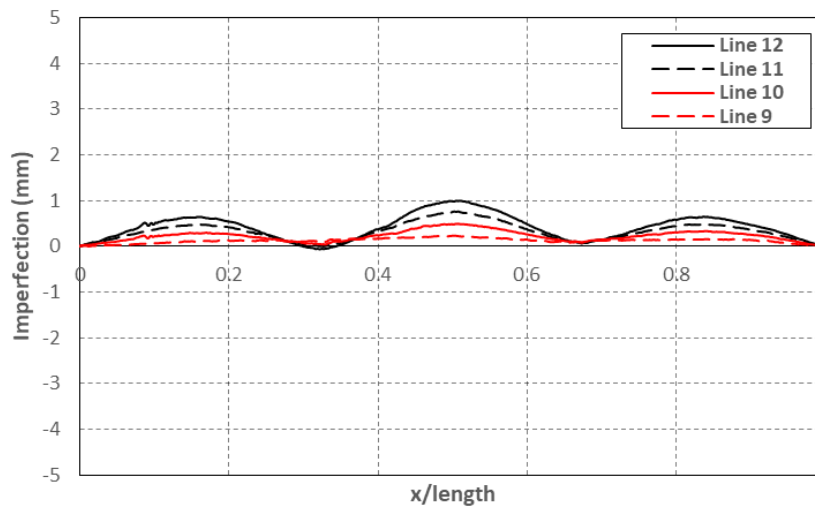
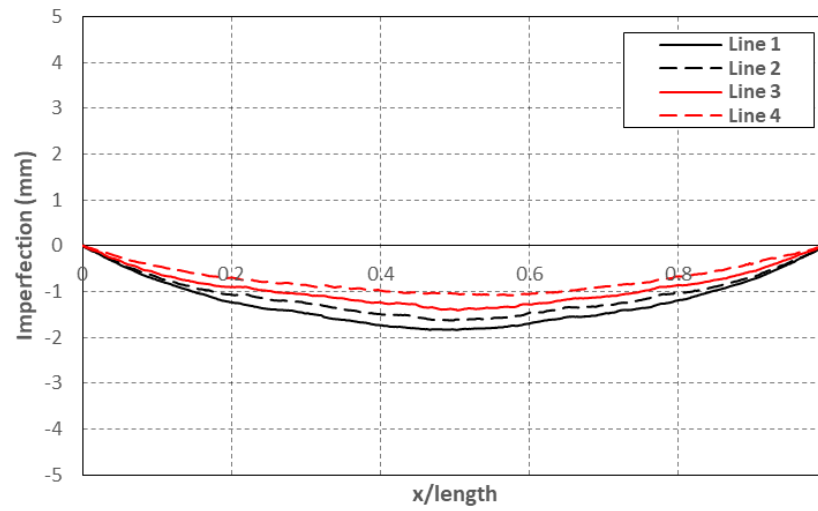
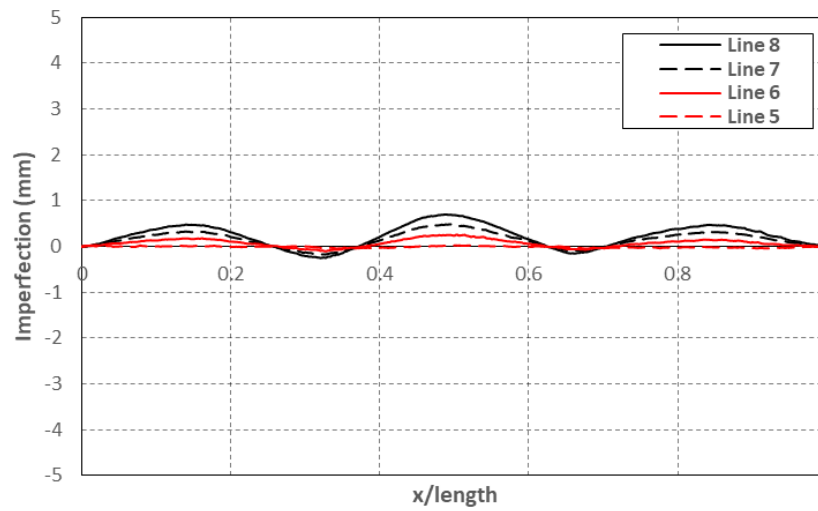
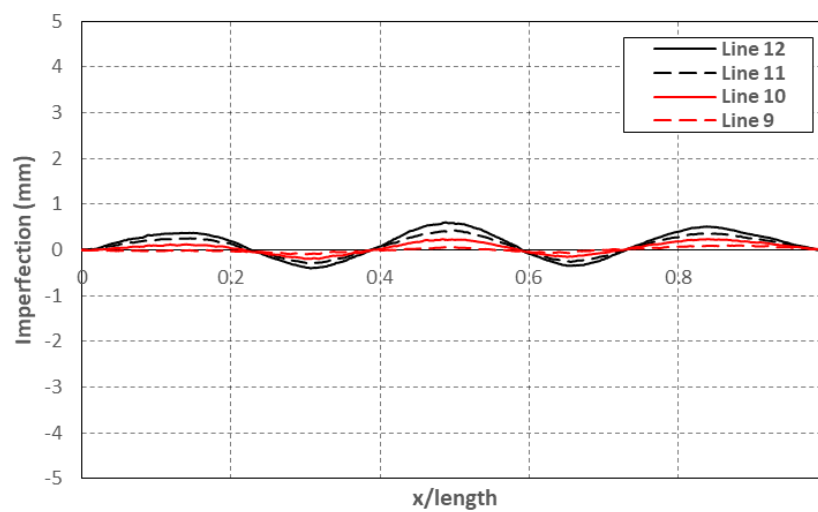


Figure H.147: Imperfections right flange channel T12012-13 (before assembly)

H.4.14 T12012-14**Figure H.148: Imperfections web channel T12012-14 (before assembly)****Figure H.149: Imperfections left flange channel T12012-14 (before assembly)****Figure H.150: Imperfections right flange channel T12012-14 (before assembly)**

H.4.15 T12012-15

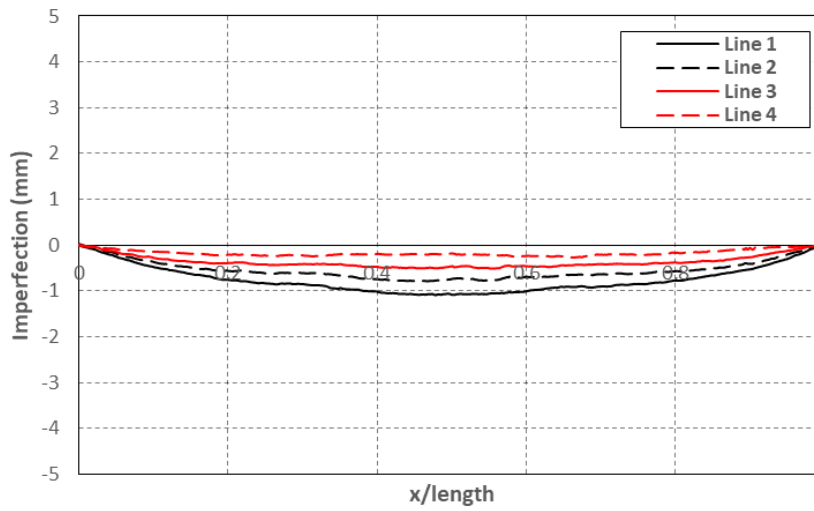


Figure H.151: Imperfections web channel T12012-15 (before assembly)

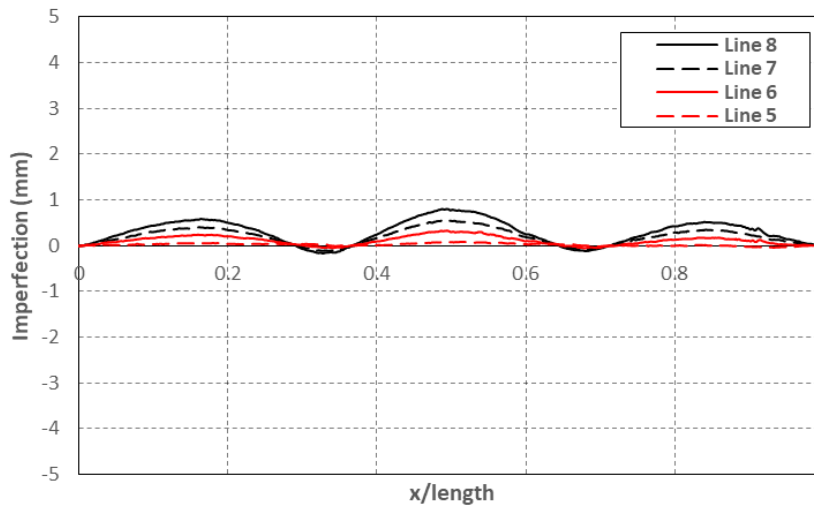


Figure H.152: Imperfections left flange channel T12012-15 (before assembly)

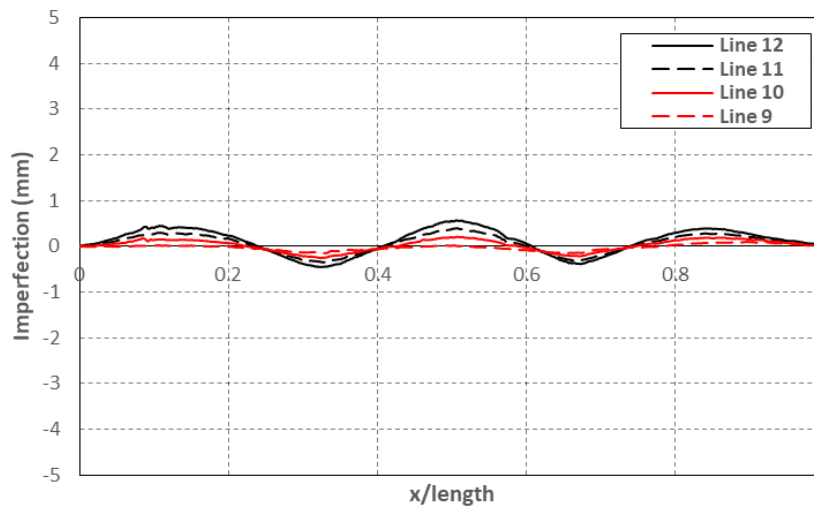
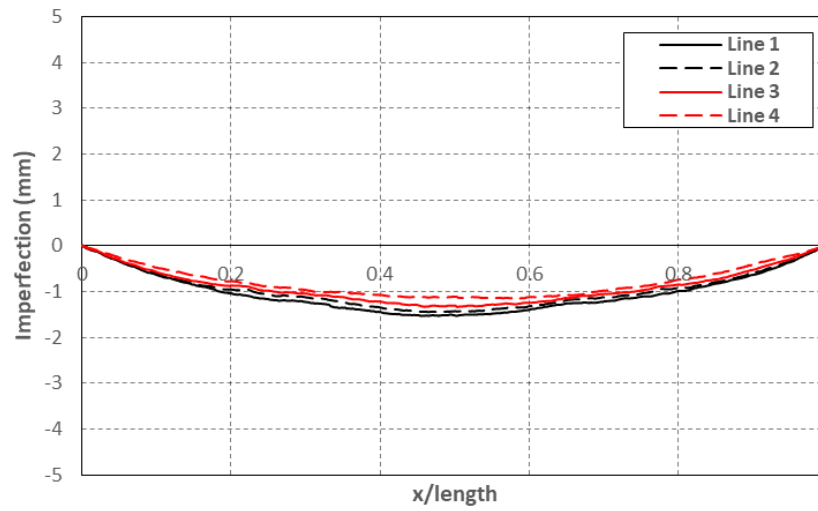
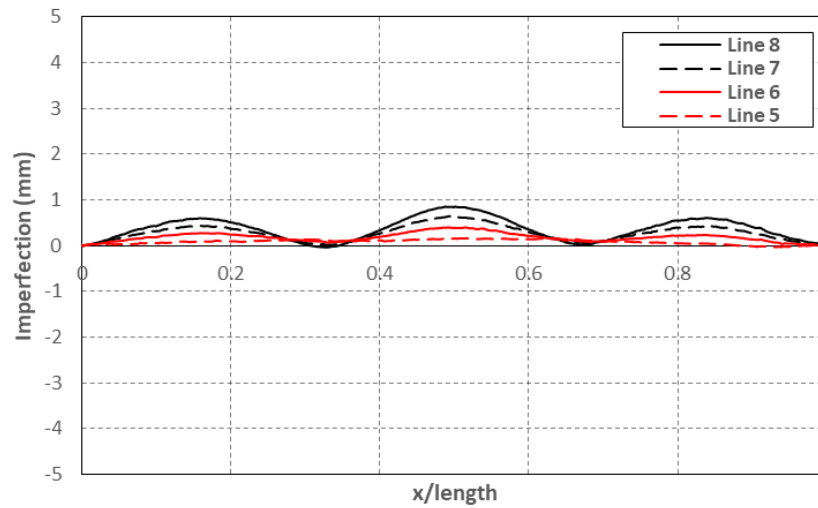
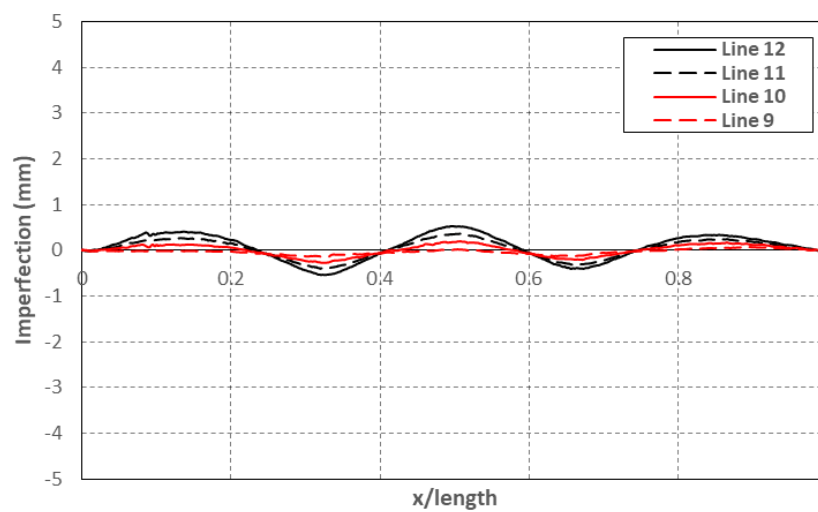


Figure H.153: Imperfections right flange channel T12012-15 (before assembly)

H.4.16 T12012-16**Figure H.154: Imperfections web channel T12012-16 (before assembly)****Figure H.155: Imperfections left flange channel T12012-16 (before assembly)****Figure H.156: Imperfections right flange channel T12012-16 (before assembly)**

H.4.17 T12012-17

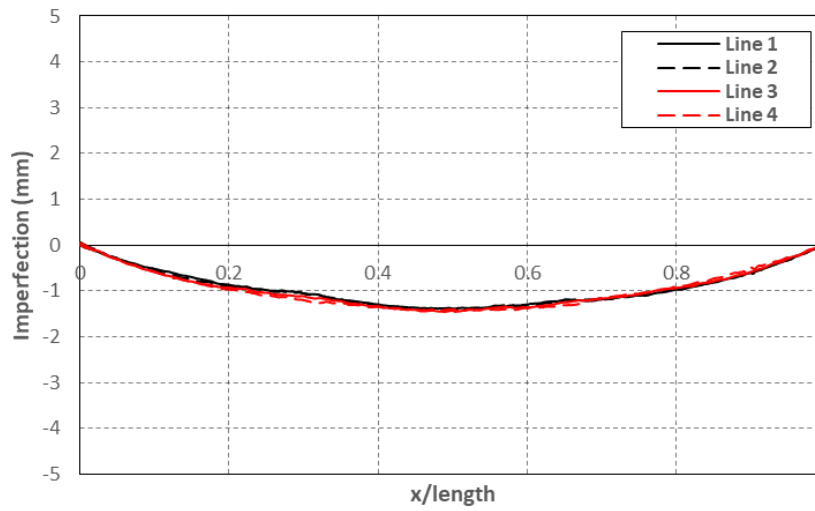


Figure H.157: Imperfections web channel T12012-17 (before assembly)

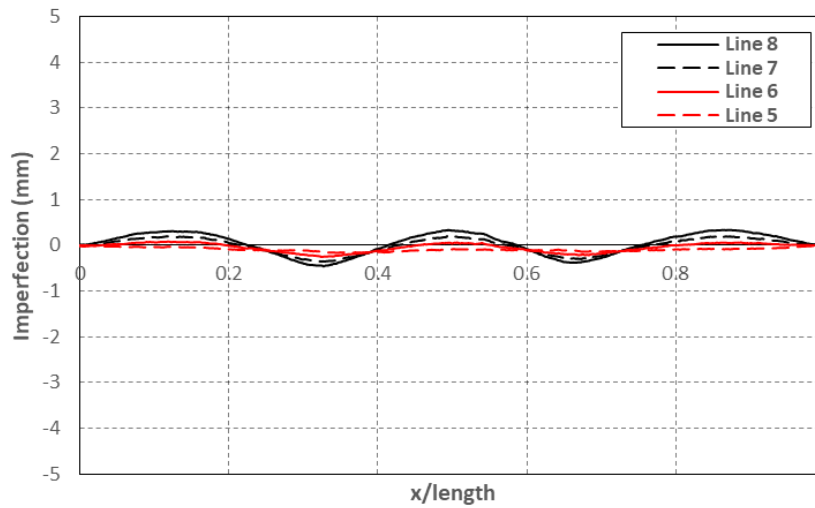


Figure H.158: Imperfections left flange channel T12012-17 (before assembly)

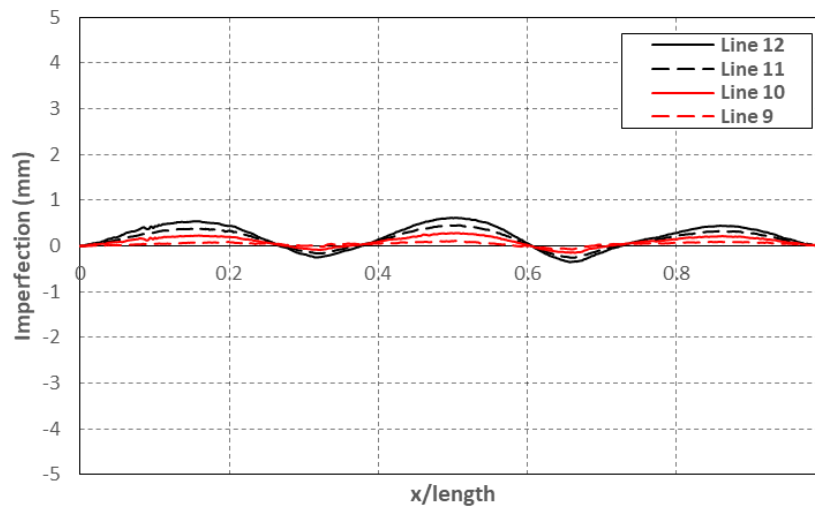
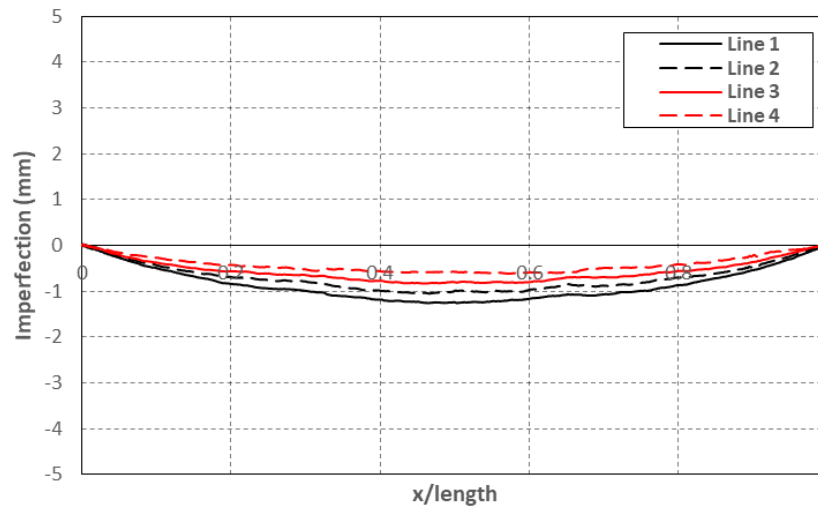
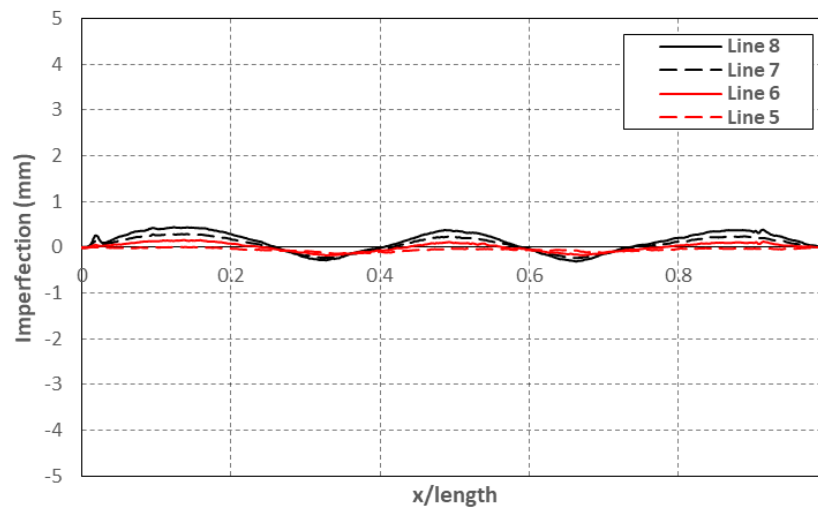
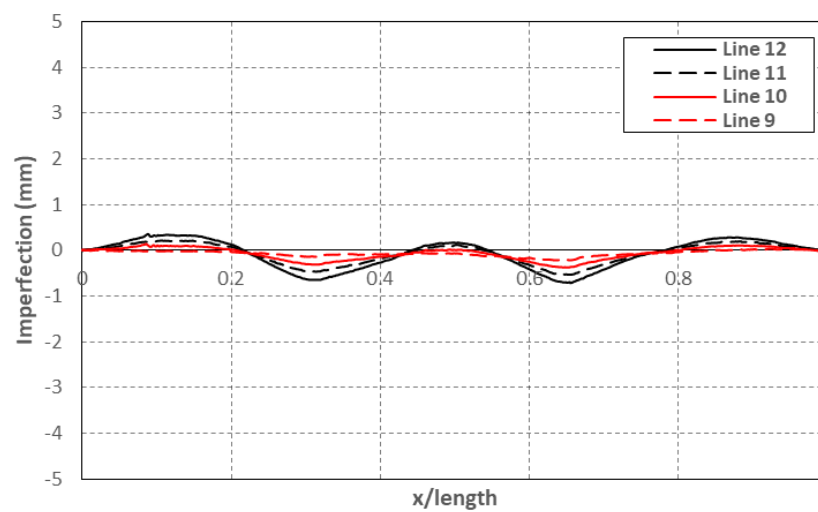


Figure H.159: Imperfections right flange channel T12012-17 (before assembly)

H.4.18 T12012-18**Figure H.160: Imperfections web channel T12012-18 (before assembly)****Figure H.161: Imperfections left flange channel T12012-18 (before assembly)****Figure H.162: Imperfections right flange channel T12012-18 (before assembly)**

H.4.19 T12012-19

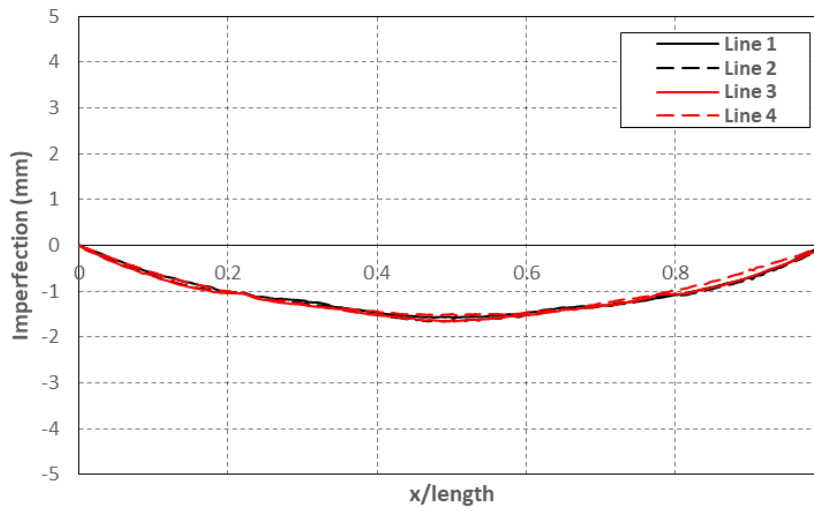


Figure H.163: Imperfections web channel T12012-19 (before assembly)

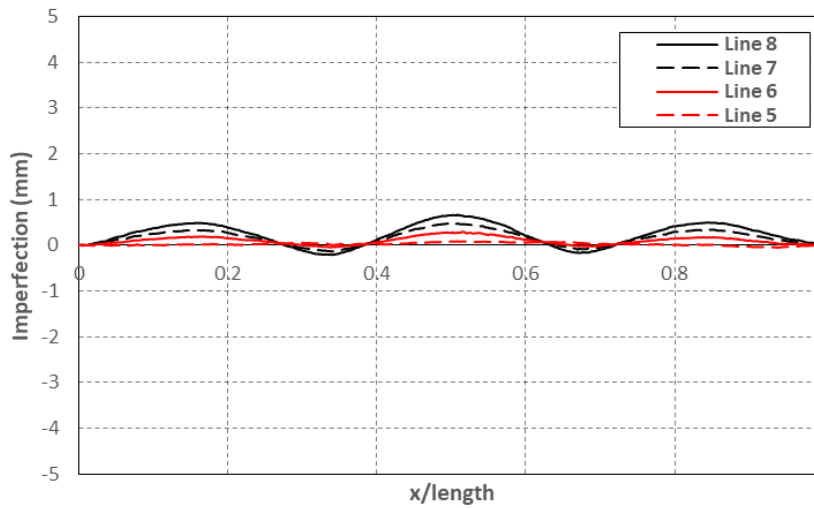


Figure H.164: Imperfections left flange channel T12012-19 (before assembly)

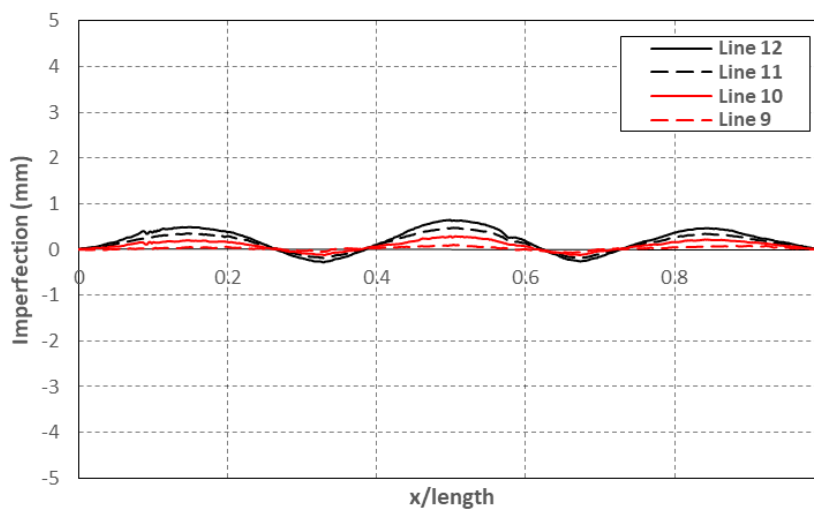
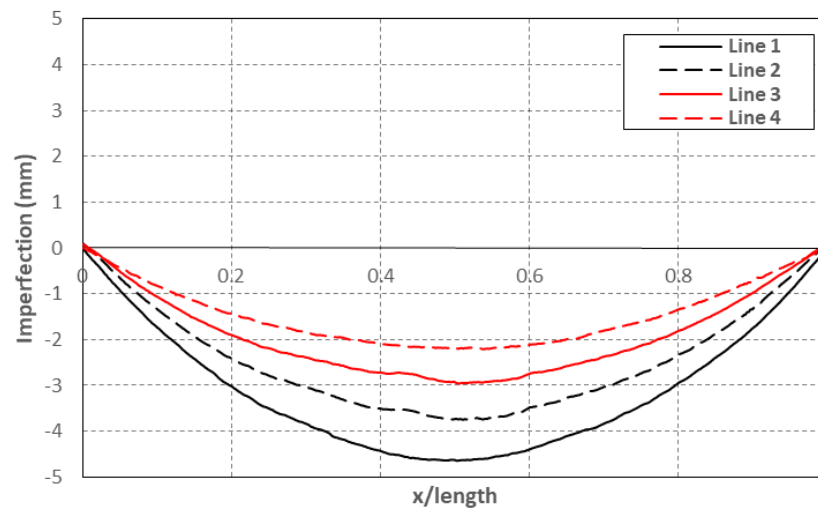
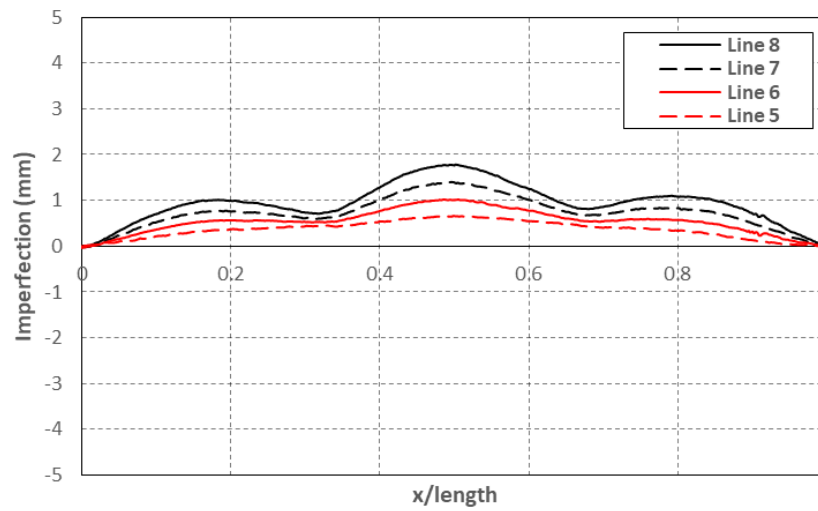
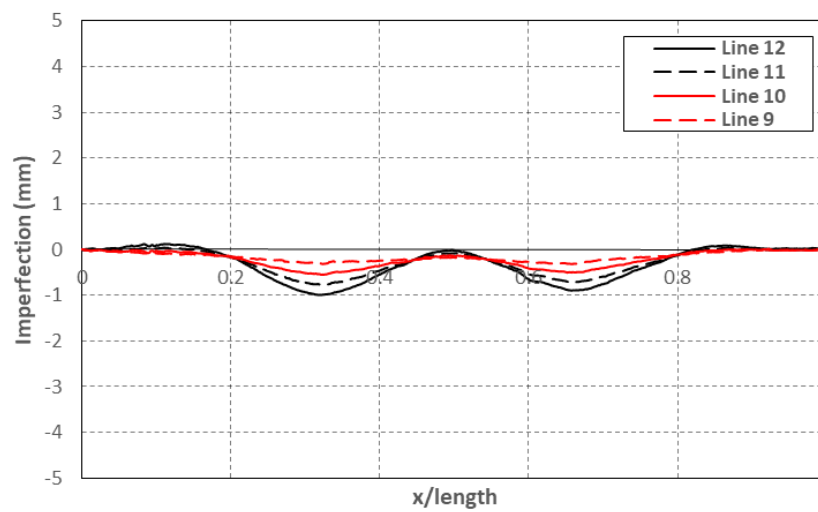


Figure H.165: Imperfections right flange channel T12012-19 (before assembly)

H.4.20 T12012-20**Figure H.166: Imperfections web channel T12012-20 (before assembly)****Figure H.167: Imperfections left flange channel T12012-20 (before assembly)****Figure H.168: Imperfections right flange channel T12012-20 (before assembly)**

H.4.21 T12012-21

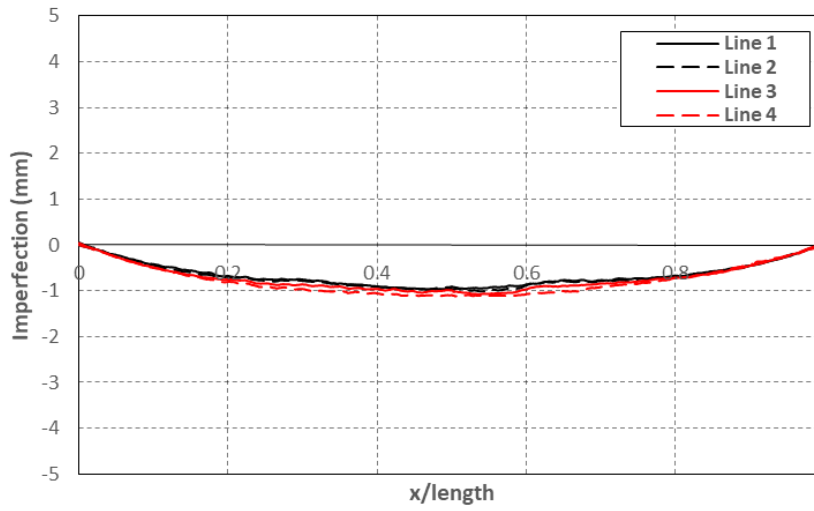


Figure H.169: Imperfections web channel T12012-21 (before assembly)

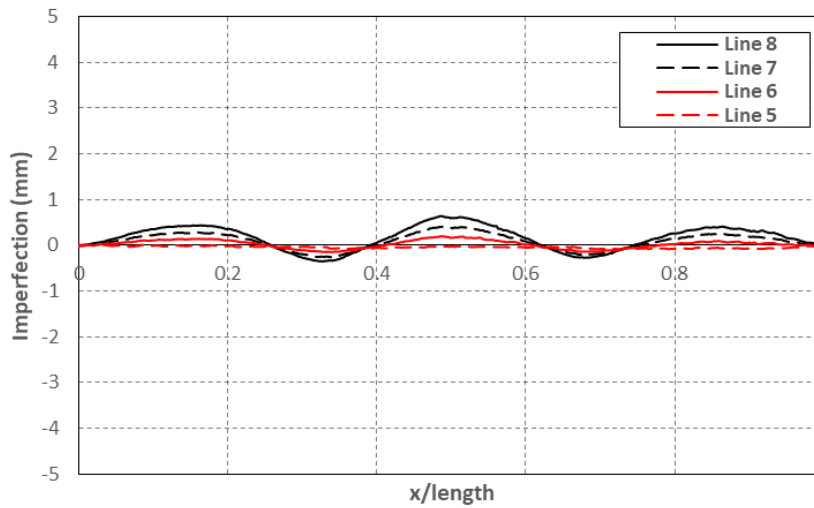


Figure H.170: Imperfections left flange channel T12012-21 (before assembly)

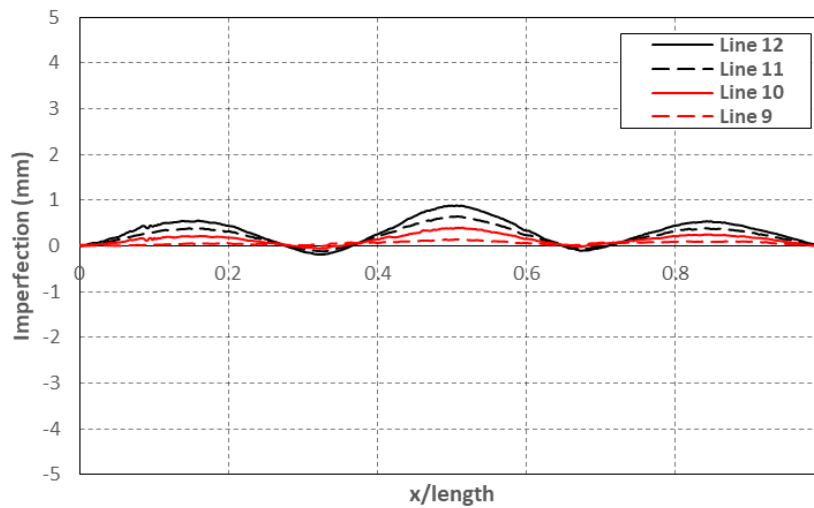


Figure H.171: Imperfections right flange channel T12012-21 (before assembly)

H.4.22 T12012-22

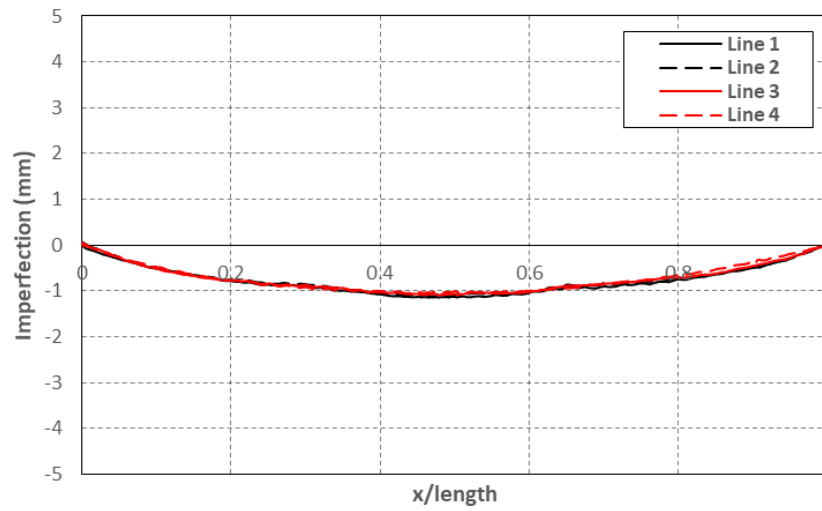


Figure H.172: Imperfections web channel T12012-22 (before assembly)

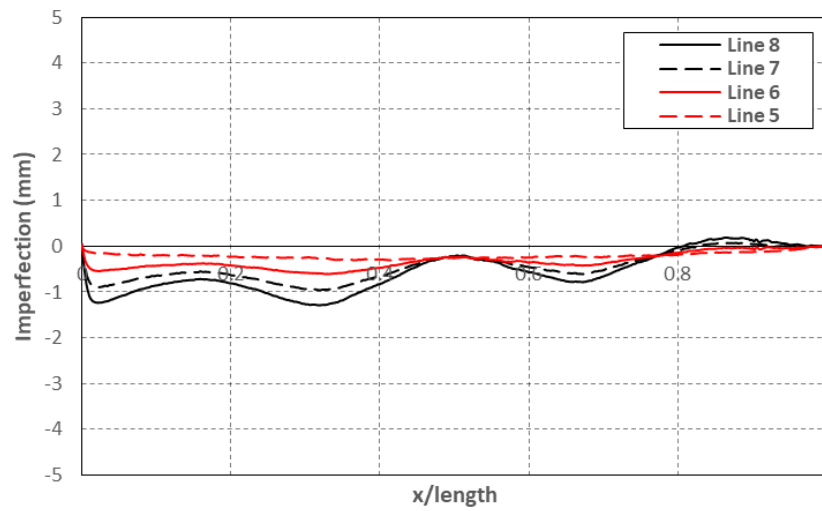


Figure H.173: Imperfections left flange channel T12012-22 (before assembly)

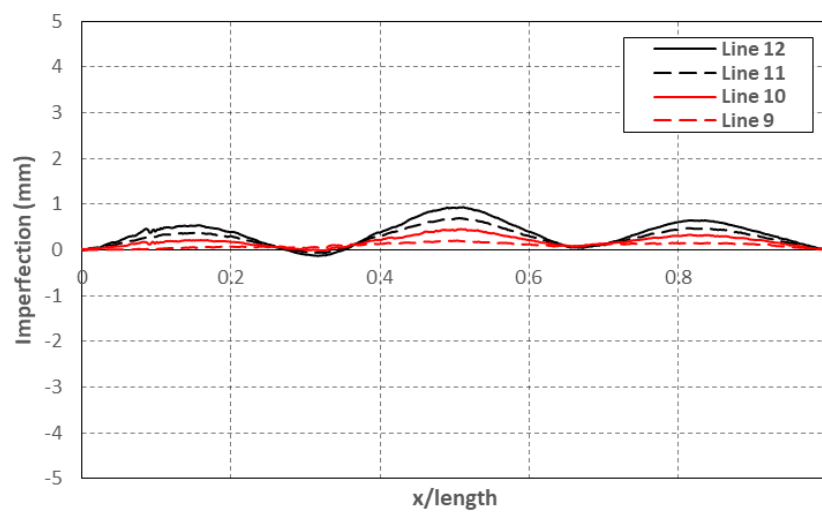


Figure H.174: Imperfections right flange channel T12012-22 (before assembly)

H.4.23 T12012-23

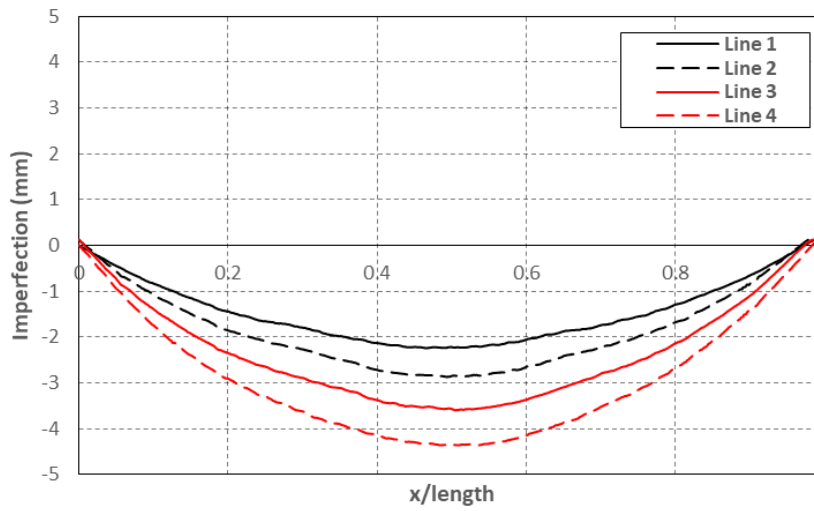


Figure H.175: Imperfections web channel T12012-23 (before assembly)

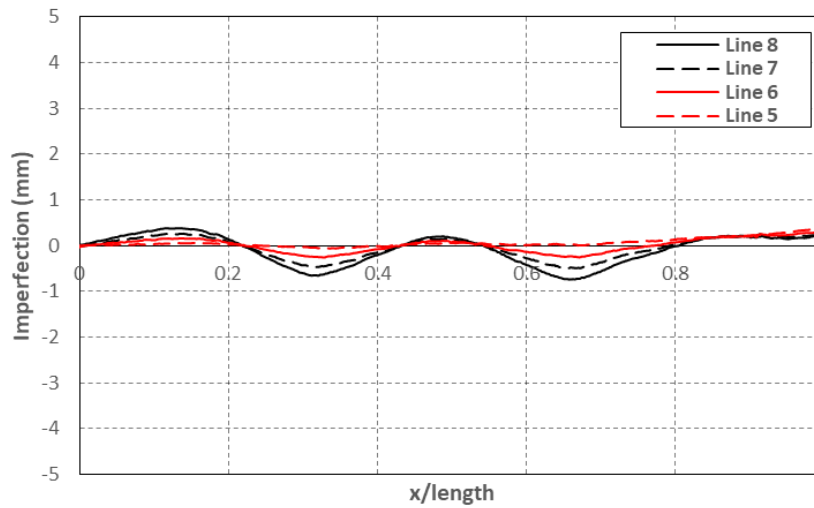


Figure H.176: Imperfections left flange channel T12012-23 (before assembly)

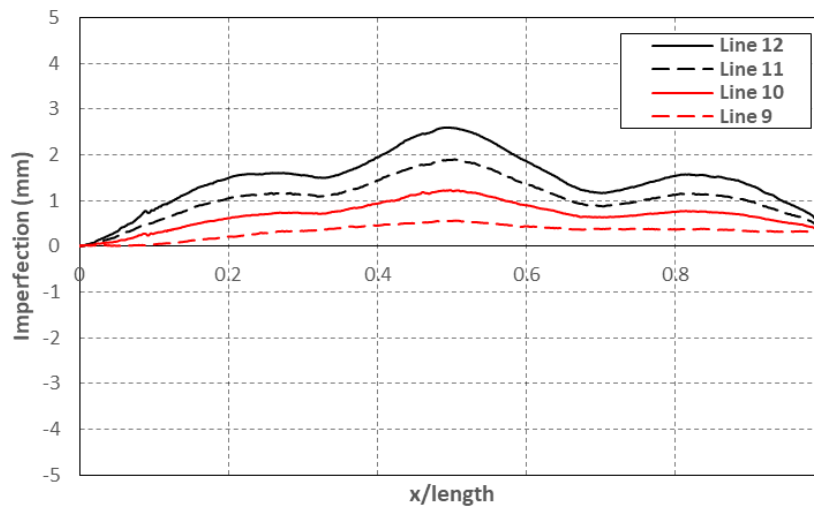
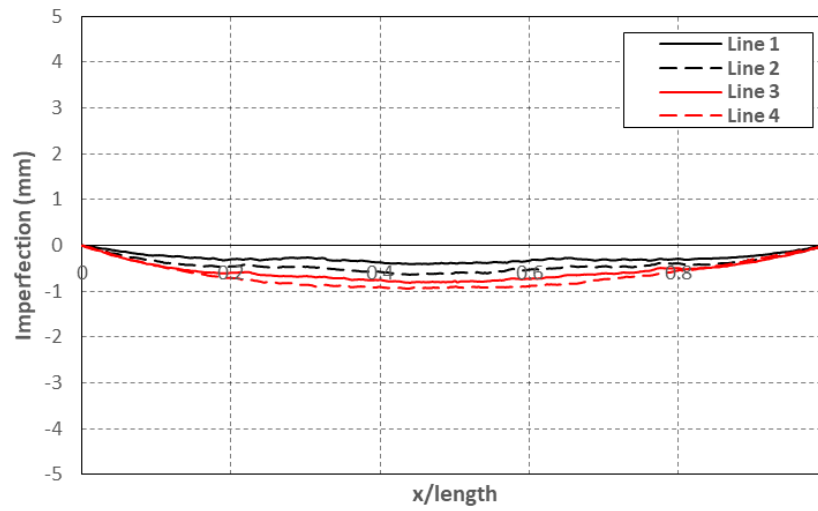
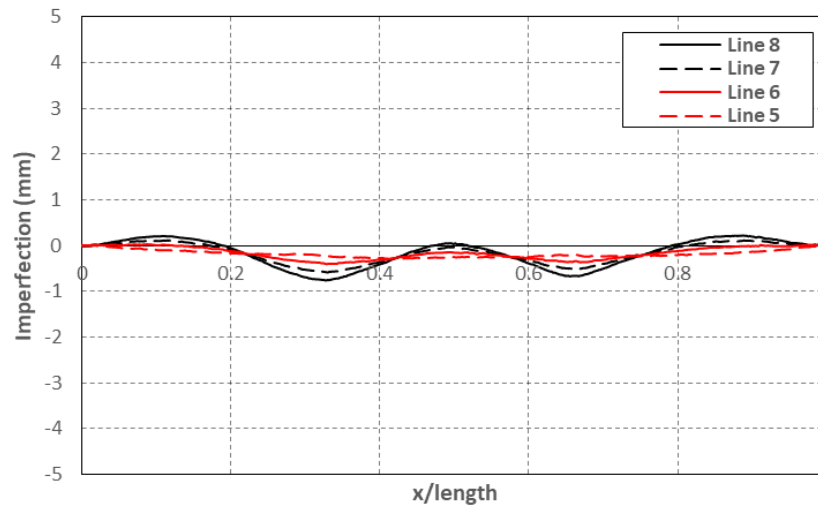
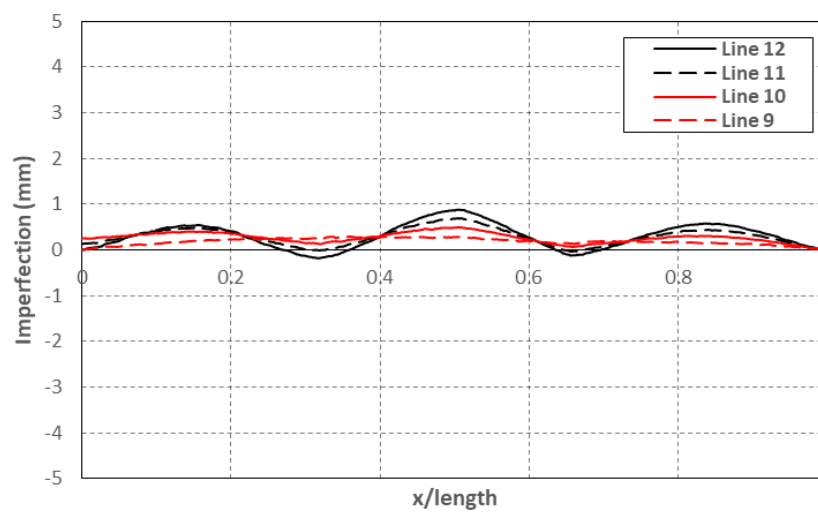


Figure H.177: Imperfections right flange channel T12012-23 (before assembly)

H.4.24 T12012-24**Figure H.178: Imperfections web channel T12012-24 (before assembly)****Figure H.179: Imperfections left flange channel T12012-24 (before assembly)****Figure H.180: Imperfections right flange channel T12012-24 (before assembly)**

H.5. S11012

H.5.1 S11012-1

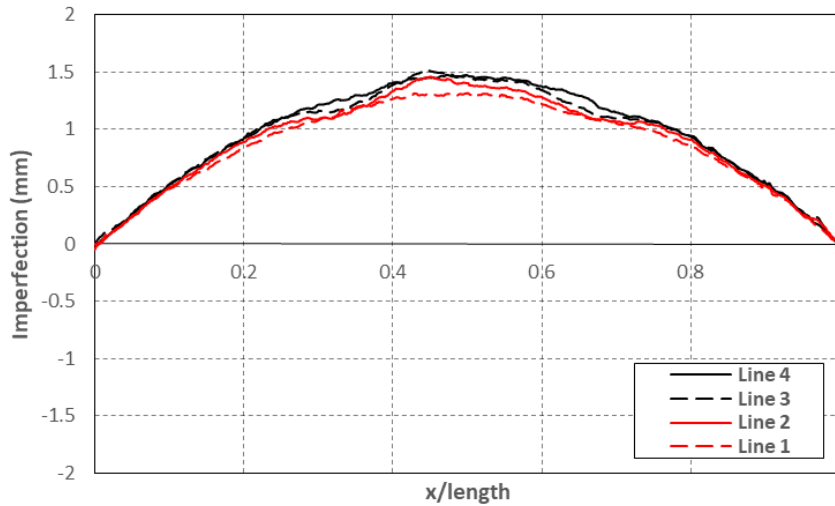


Figure H.181: Imperfections web channel S11012-1 (before assembly)

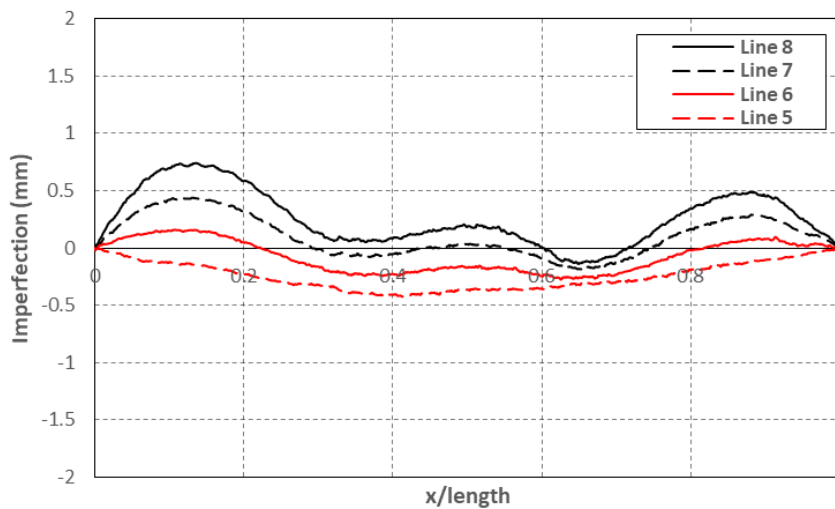


Figure H.182: Imperfections left flange channel S11012-1 (before assembly)

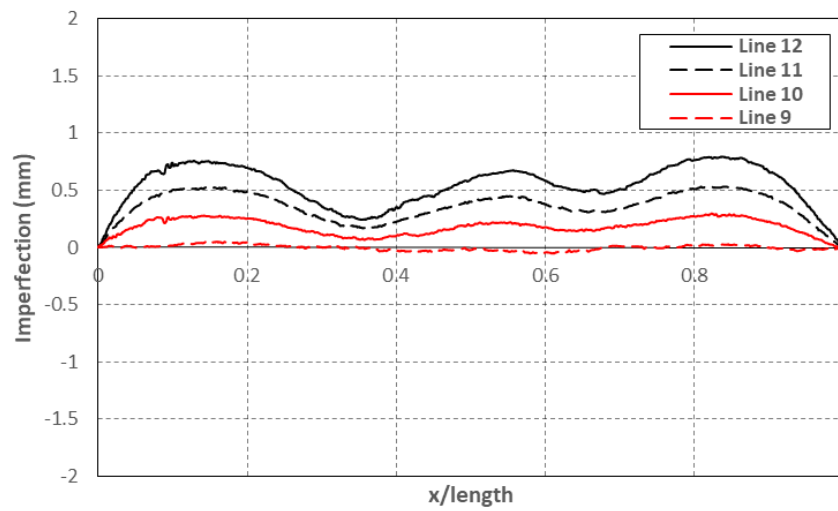


Figure H.183: Imperfections right flange channel S11012-1 (before assembly)

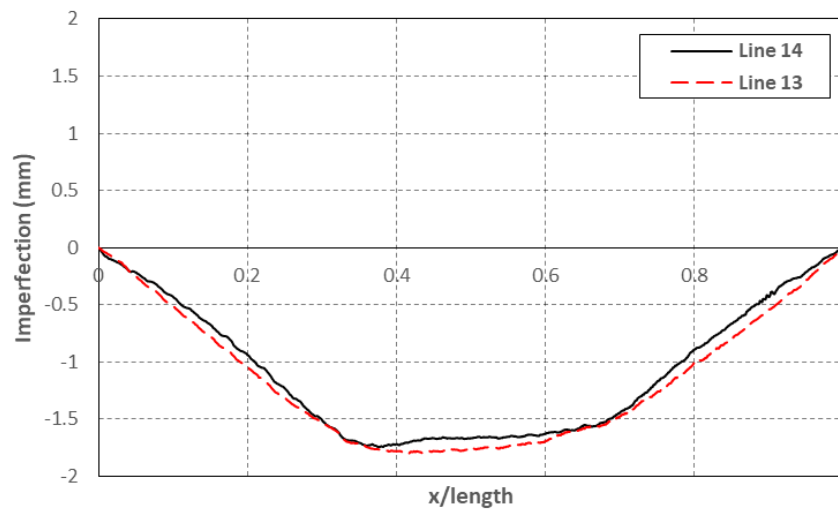


Figure H.184: Imperfections left lip channel S11012-1 (before assembly)

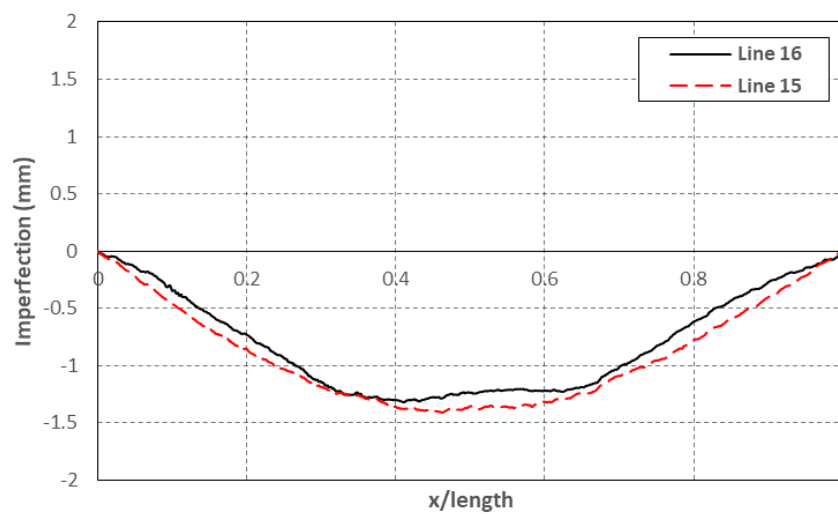


Figure H.185: Imperfections right lip channel S11012-1 (before assembly)

H.5.2 S11012-2

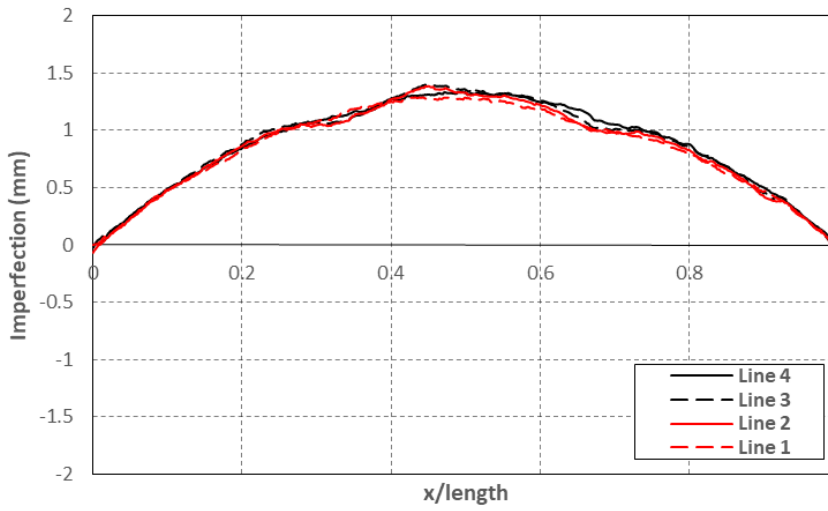


Figure H.186: Imperfections web channel S11012-2 (before assembly)

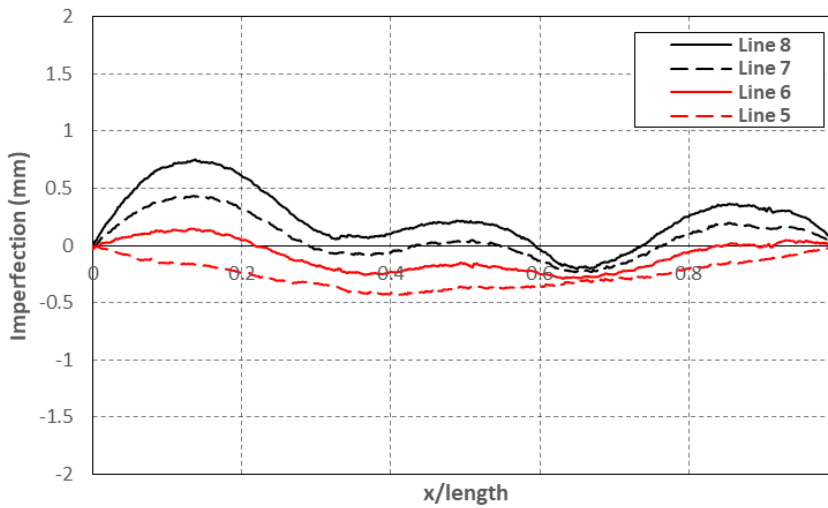


Figure H.187: Imperfections left flange channel S11012-2 (before assembly)

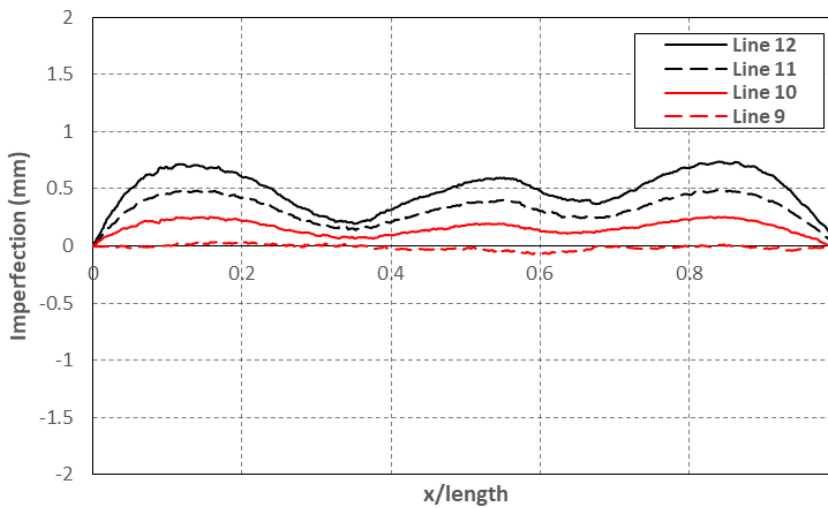


Figure H.188: Imperfections right flange channel S11012-2 (before assembly)

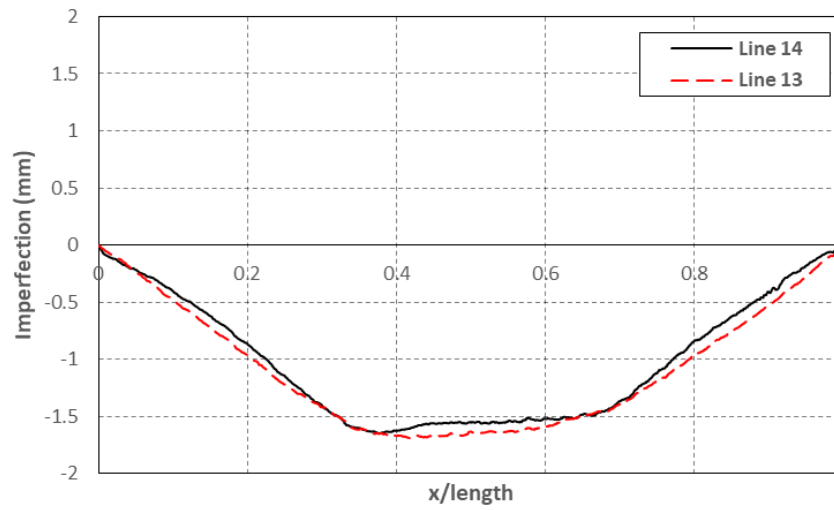


Figure H.189: Imperfections left lip channel S11012-2 (before assembly)

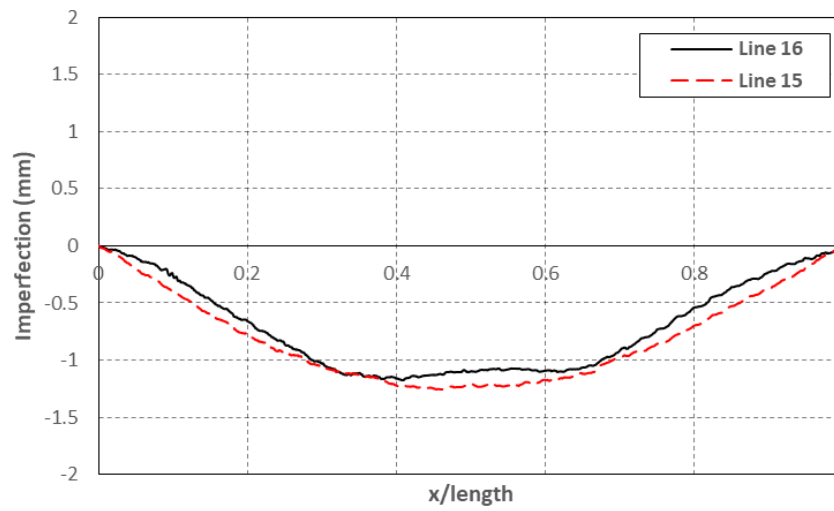


Figure H.190: Imperfections right lip channel S11012-2 (before assembly)

H.5.3 S11012-3

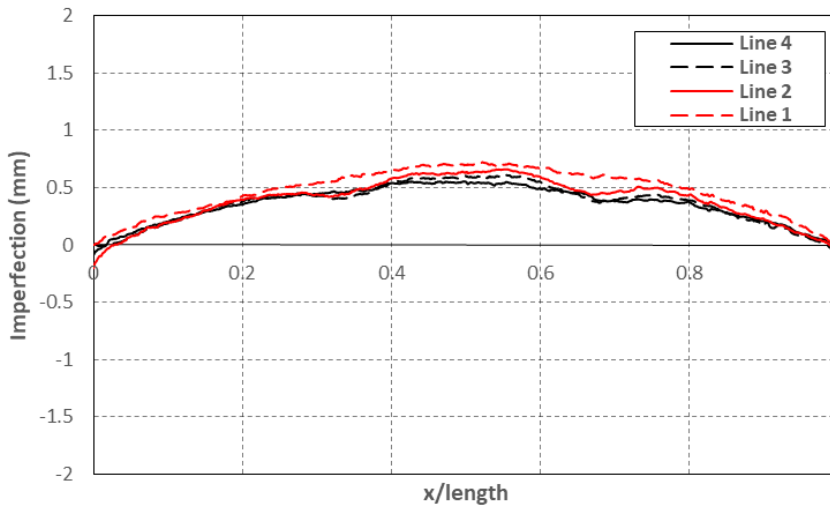


Figure H.191: Imperfections web channel S11012-3 (before assembly)

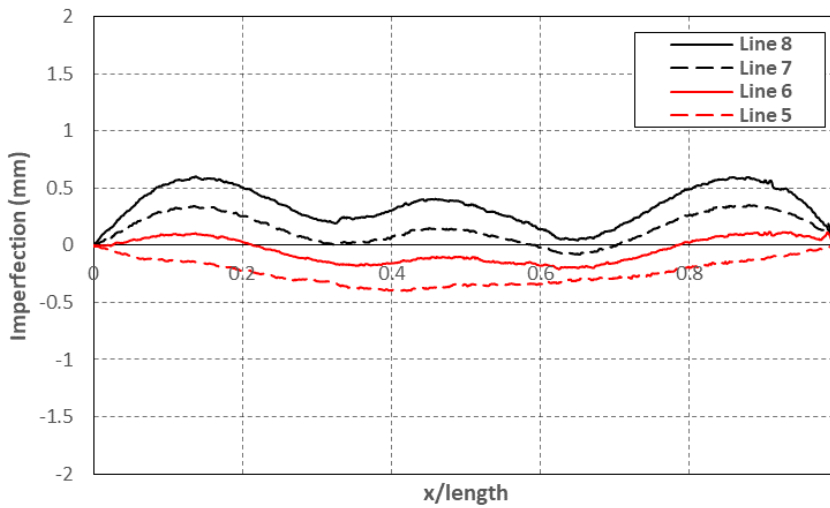


Figure H.192: Imperfections left flange channel S11012-3 (before assembly)

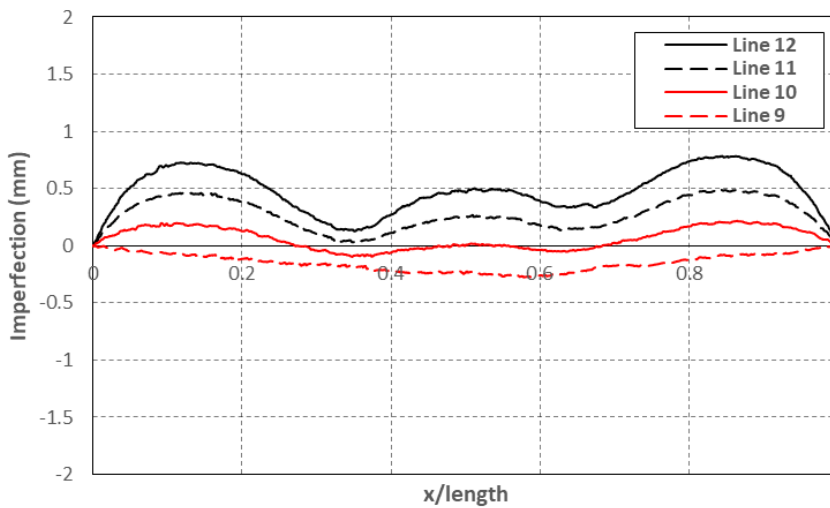


Figure H.193: Imperfections right flange channel S11012-3 (before assembly)

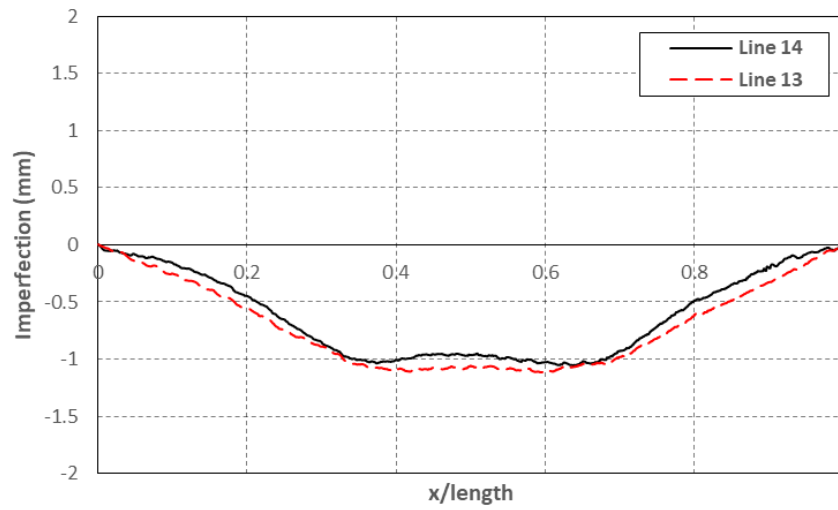


Figure H.194: Imperfections left lip channel S11012-3 (before assembly)

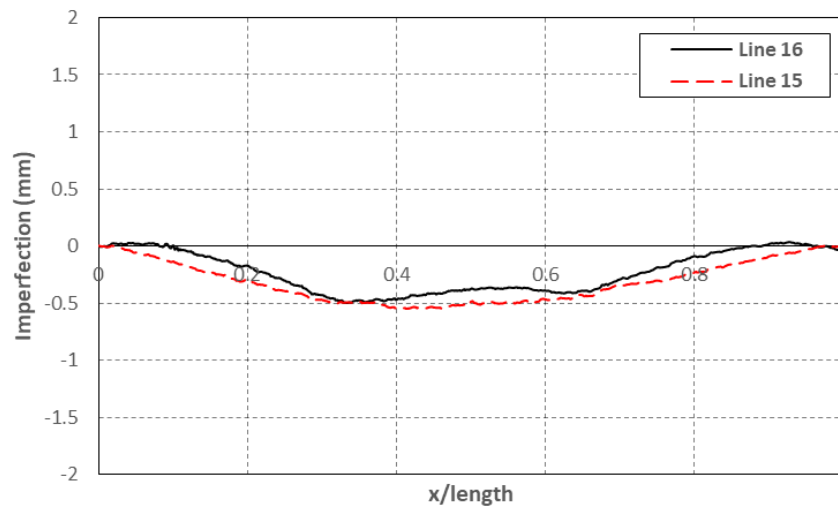


Figure H.195: Imperfections right lip channel S11012-3 (before assembly)

H.5.4 S11012-4

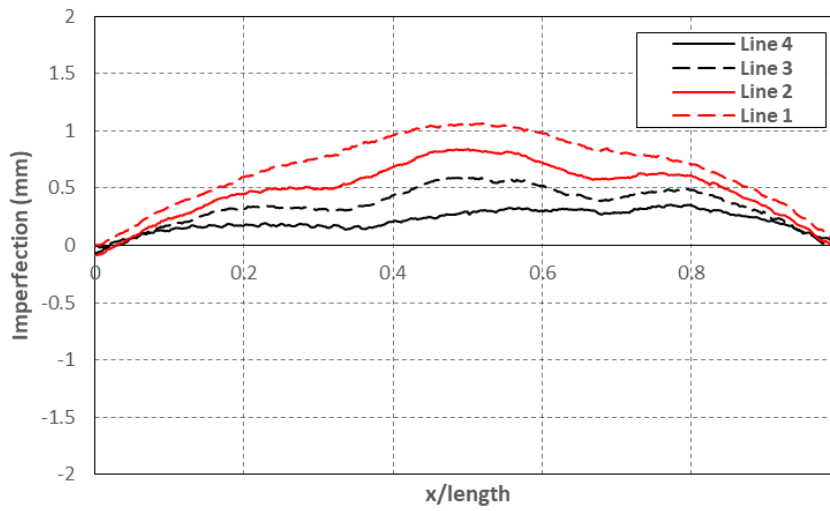


Figure H.196: Imperfections web channel S11012-4 (before assembly)

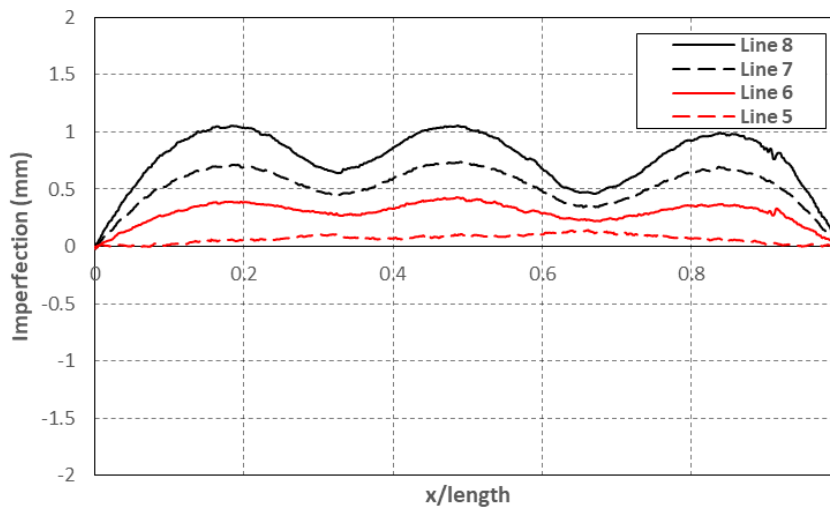


Figure H.197: Imperfections left flange channel S11012-4 (before assembly)

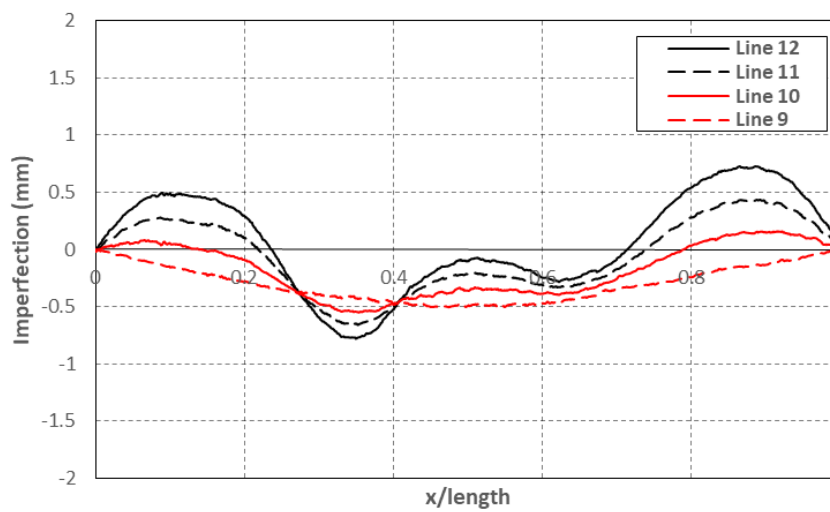


Figure H.198: Imperfections right flange channel S11012-4 (before assembly)

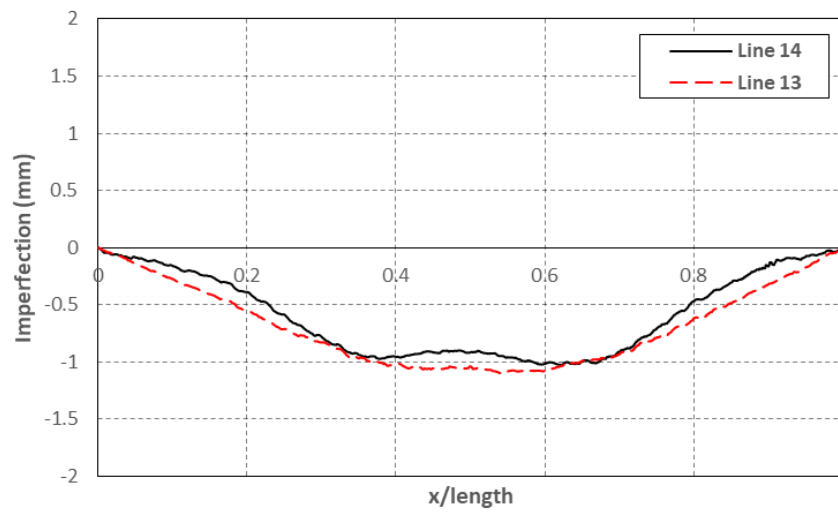


Figure H.199: Imperfections left lip channel S11012-4 (before assembly)

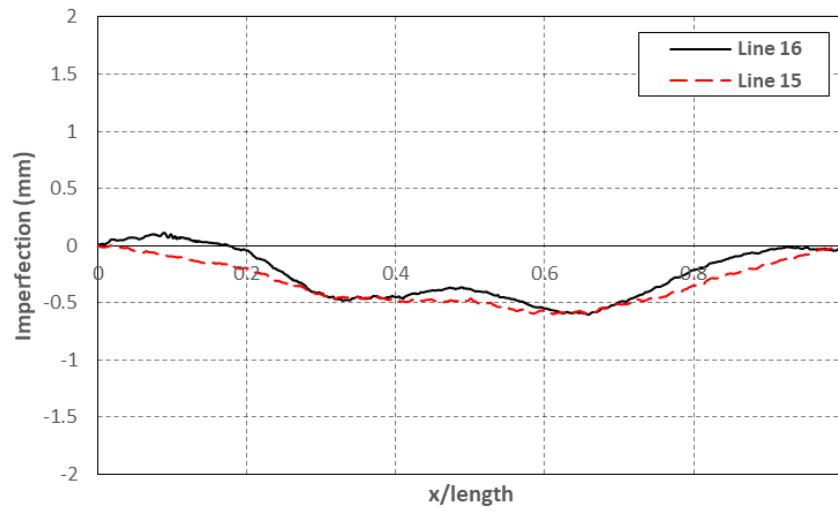


Figure H.200: Imperfections right lip channel S11012-4 (before assembly)

H.5.5 S11012-5

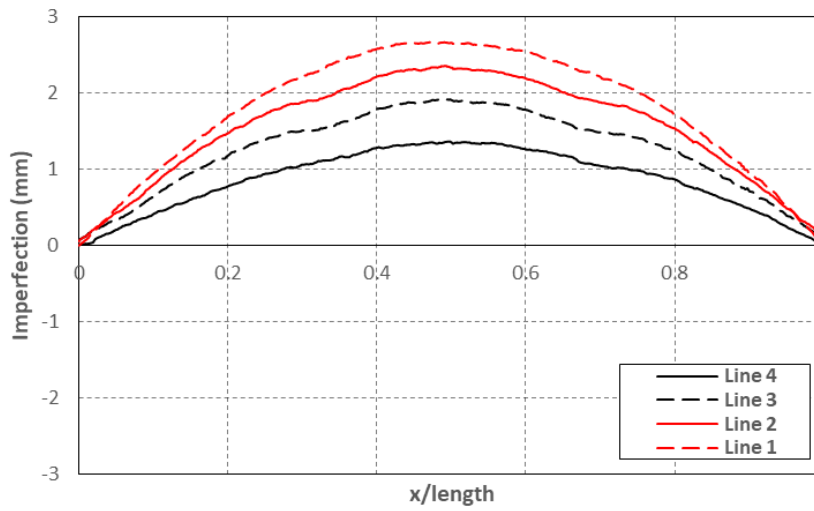


Figure H.201: Imperfections web channel S11012-5 (before assembly)

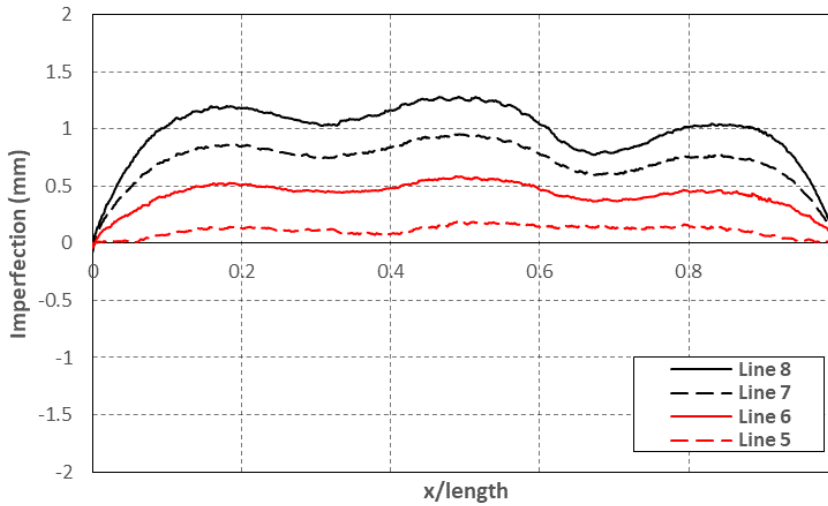


Figure H.202: Imperfections left flange channel S11012-5 (before assembly)

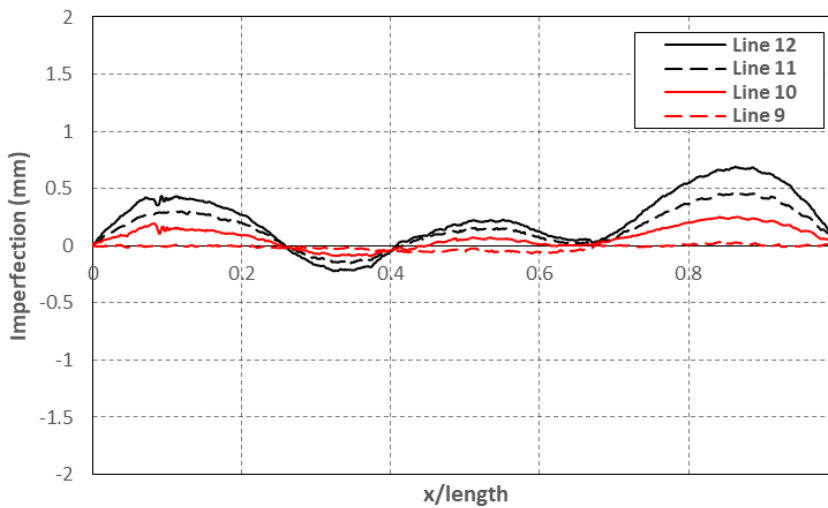


Figure H.203: Imperfections right flange channel S11012-5 (before assembly)

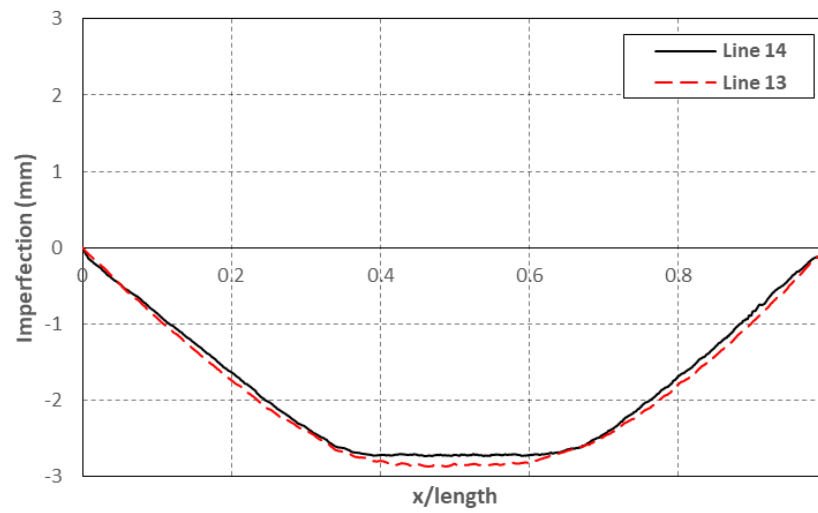


Figure H.204: Imperfections left lip channel S11012-5 (before assembly)

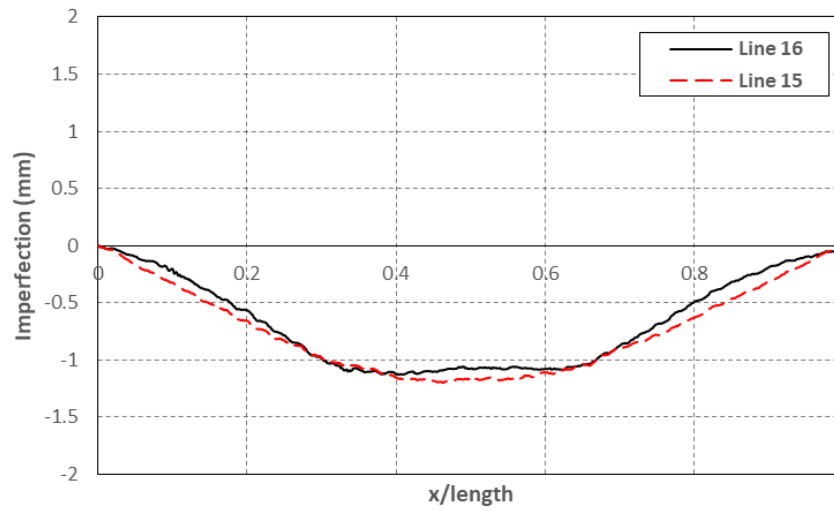


Figure H.205: Imperfections right lip channel S11012-5 (before assembly)

H.5.6 S11012-6

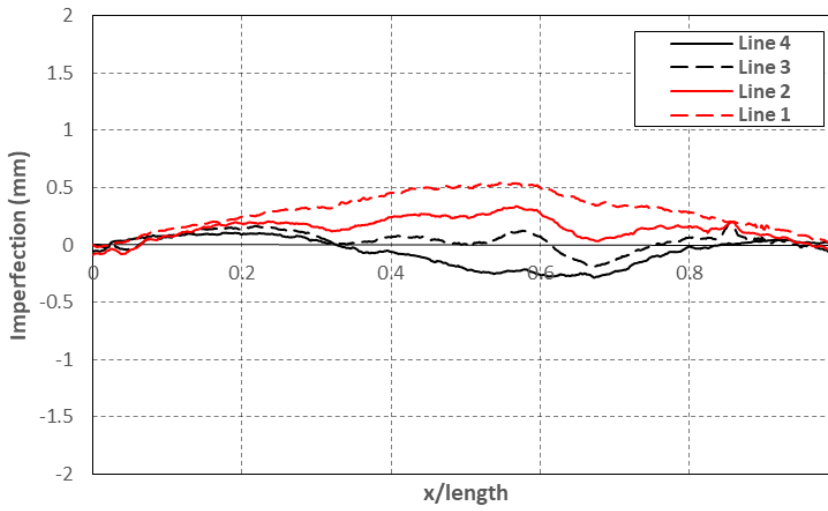


Figure H.206: Imperfections web channel S11012-6 (before assembly)

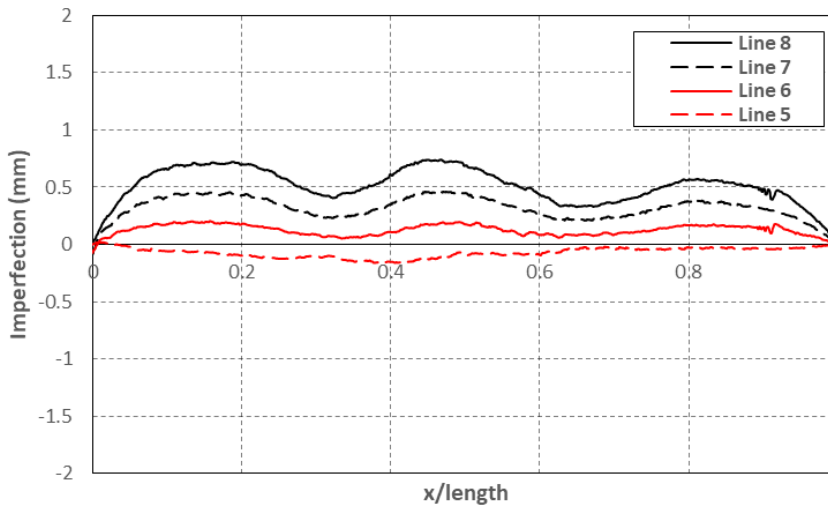


Figure H.207: Imperfections left flange channel S11012-6 (before assembly)

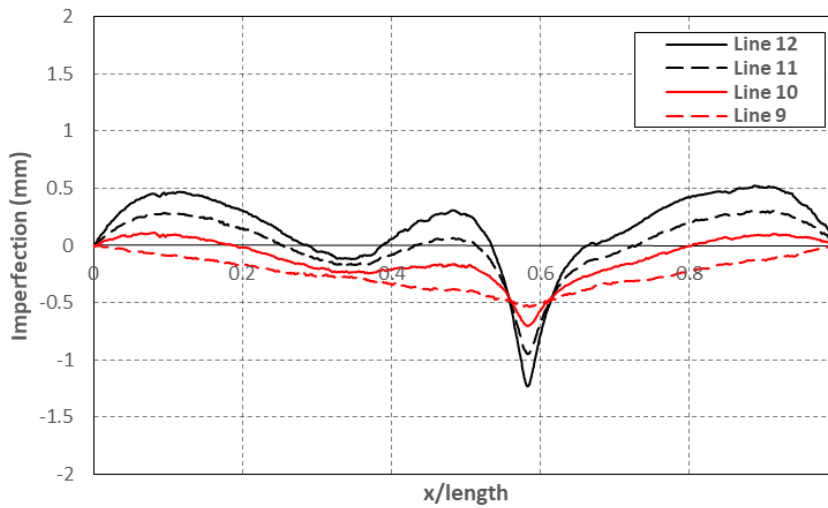


Figure H.208: Imperfections right flange channel S11012-6 (before assembly)

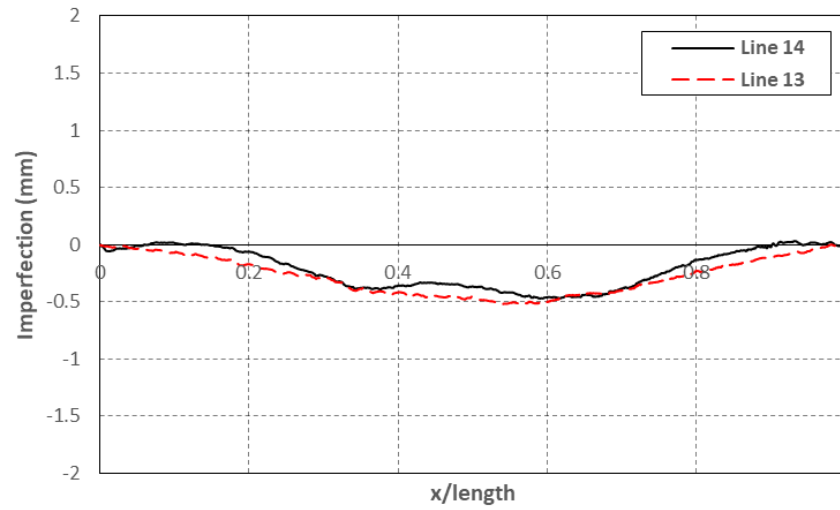


Figure H.209: Imperfections left lip channel S11012-6 (before assembly)

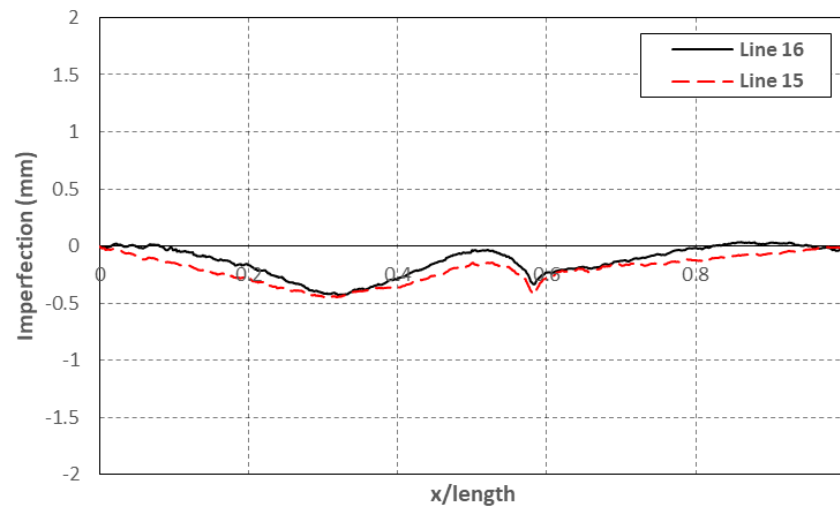


Figure H.210: Imperfections right lip channel S11012-6 (before assembly)

H.5.7 S11012-7

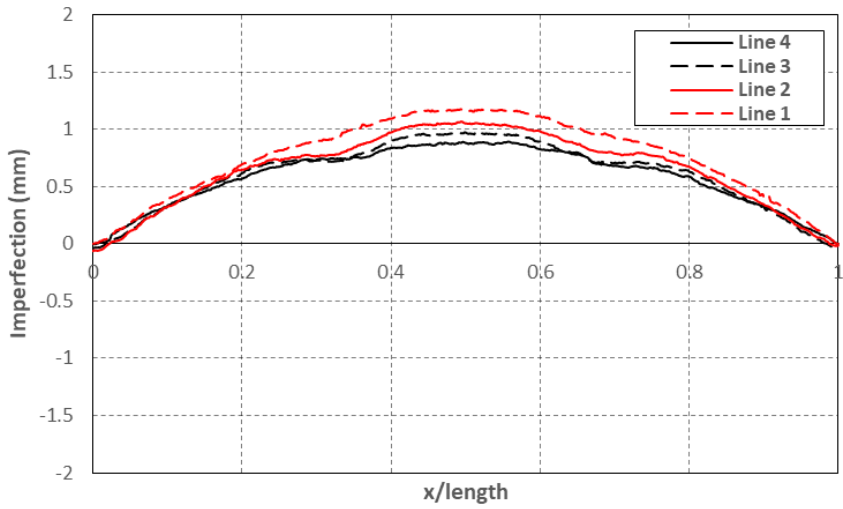


Figure H.211: Imperfections web channel S11012-7 (before assembly)

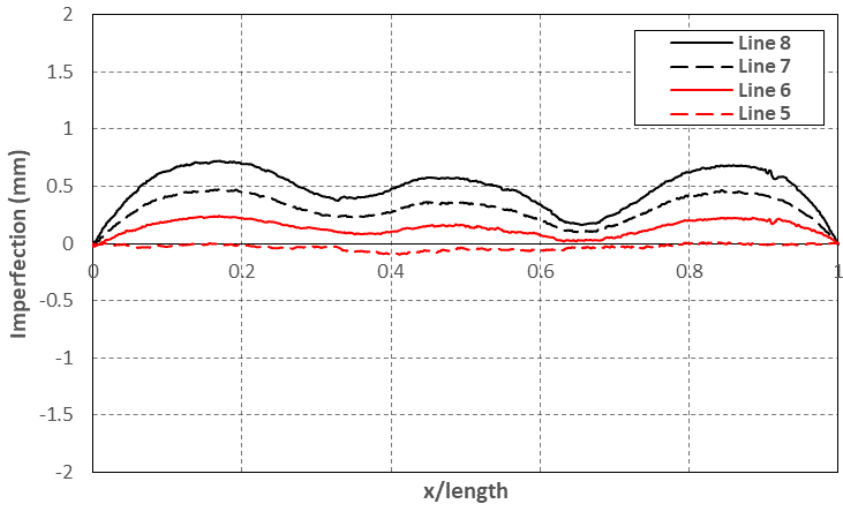


Figure H.212: Imperfections left flange channel S11012-7 (before assembly)

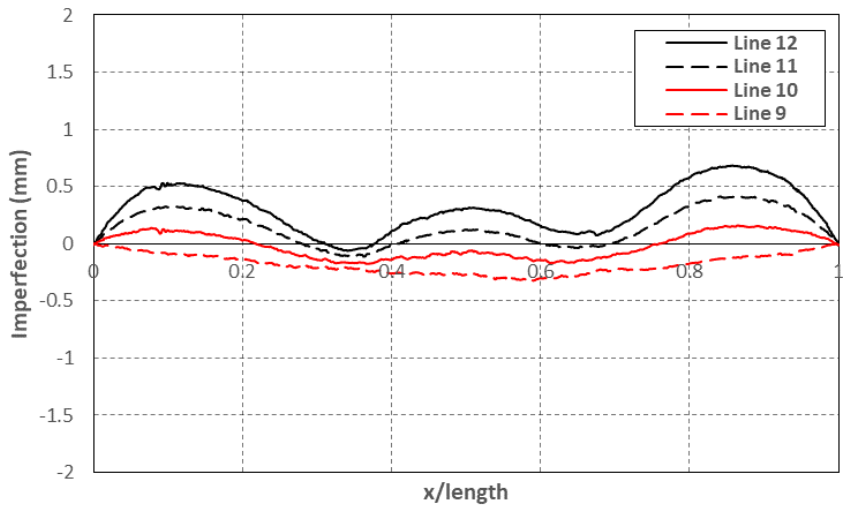


Figure H.213: Imperfections right flange channel S11012-7 (before assembly)

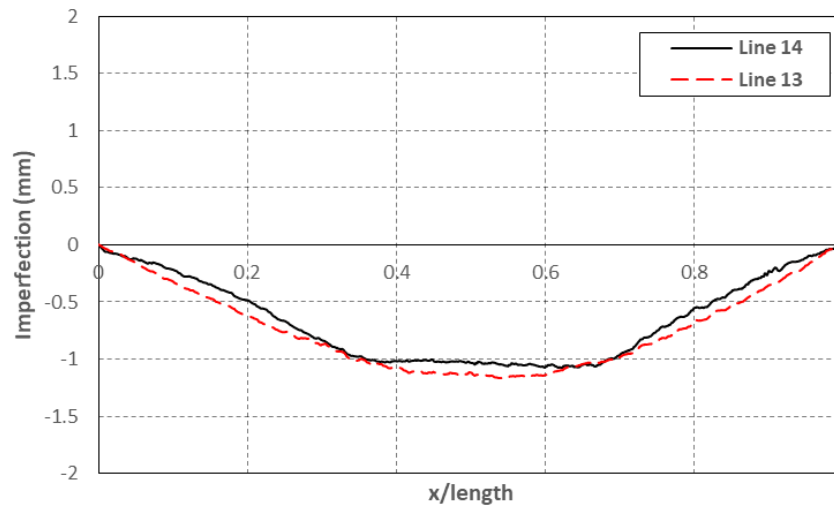


Figure H.214: Imperfections left lip channel S11012-7 (before assembly)

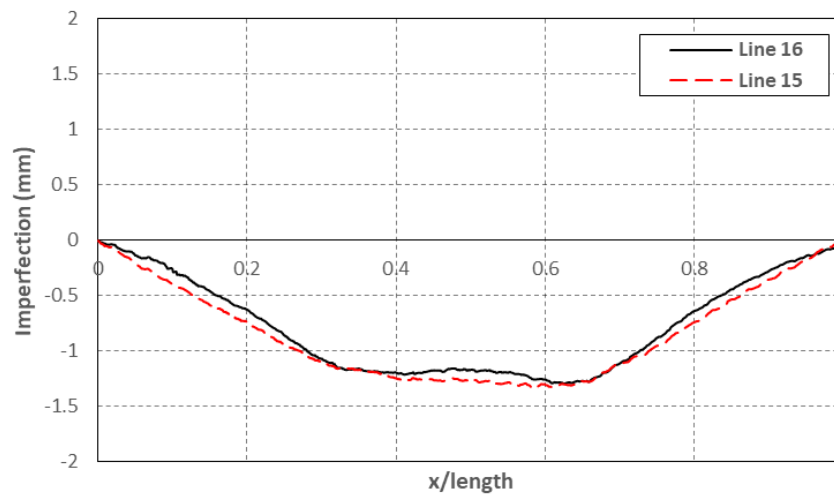


Figure H.215: Imperfections right lip channel S11012-7 (before assembly)

H.5.8 S11012-8

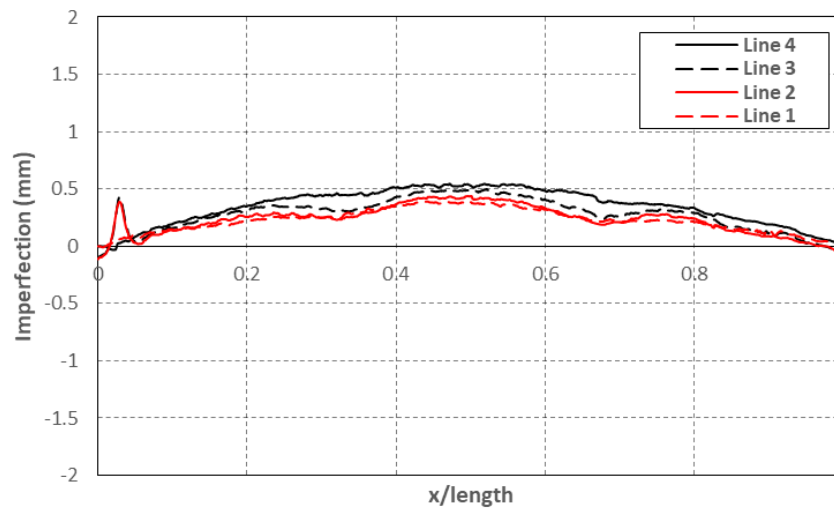


Figure H.216: Imperfections web channel S11012-8 (before assembly)

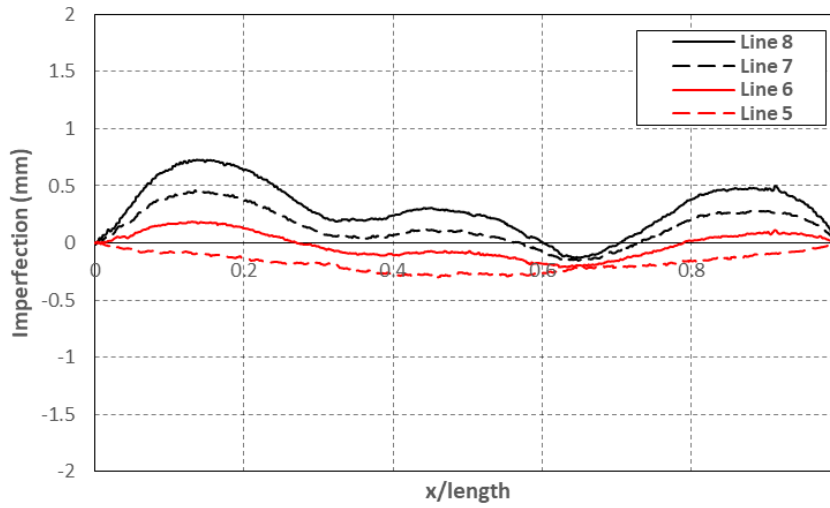


Figure H.217: Imperfections left flange channel S11012-8 (before assembly)

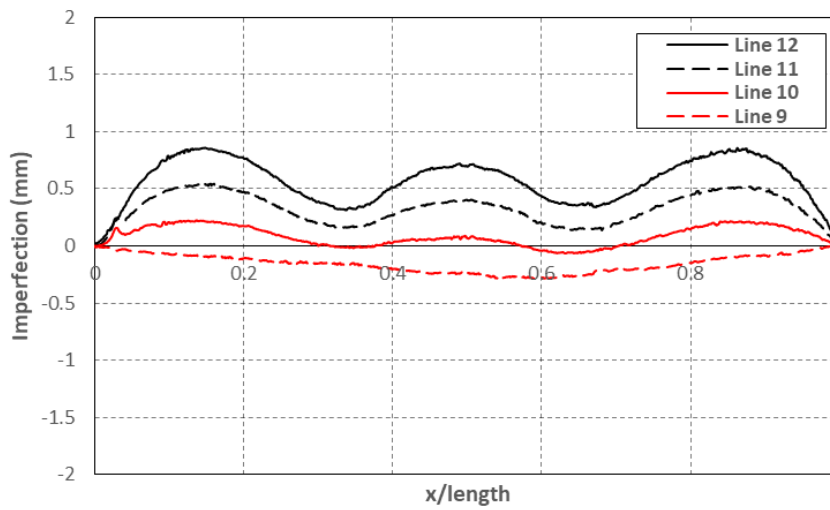


Figure H.218: Imperfections right flange channel S11012-8 (before assembly)

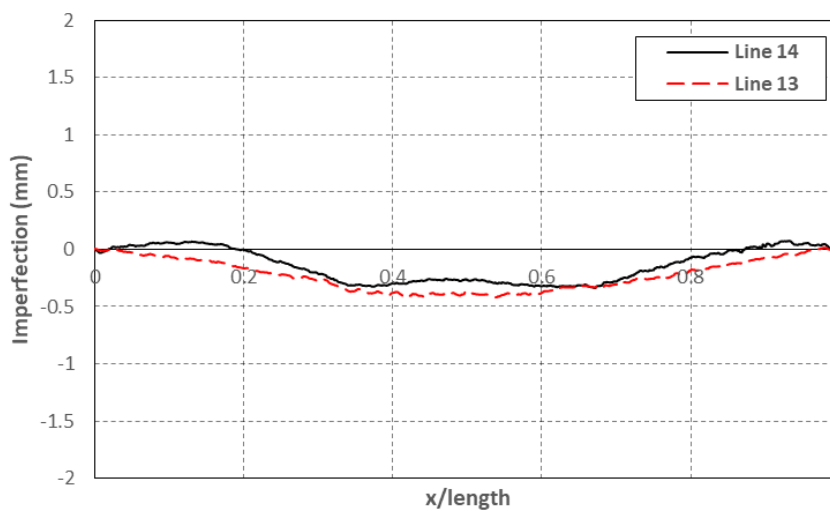


Figure H.219: Imperfections left lip channel S11012-8 (before assembly)

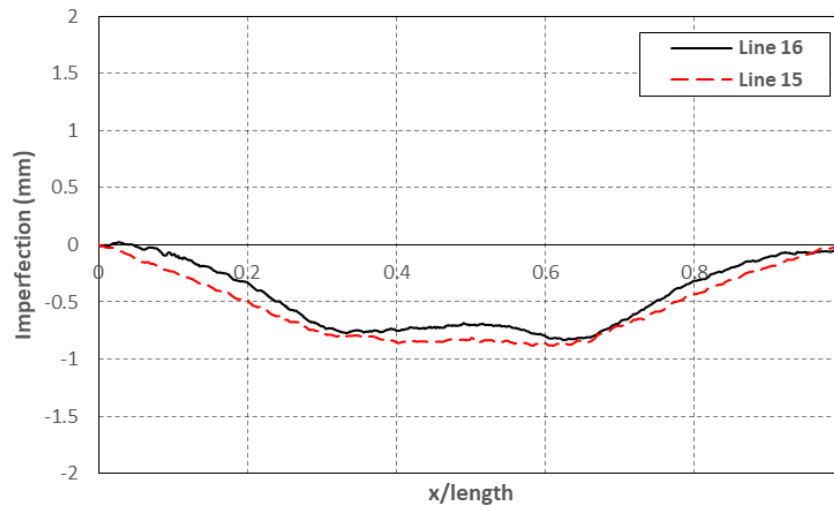


Figure H.220: Imperfections right lip channel S11012-8 (before assembly)

H.5.9 S11012-9

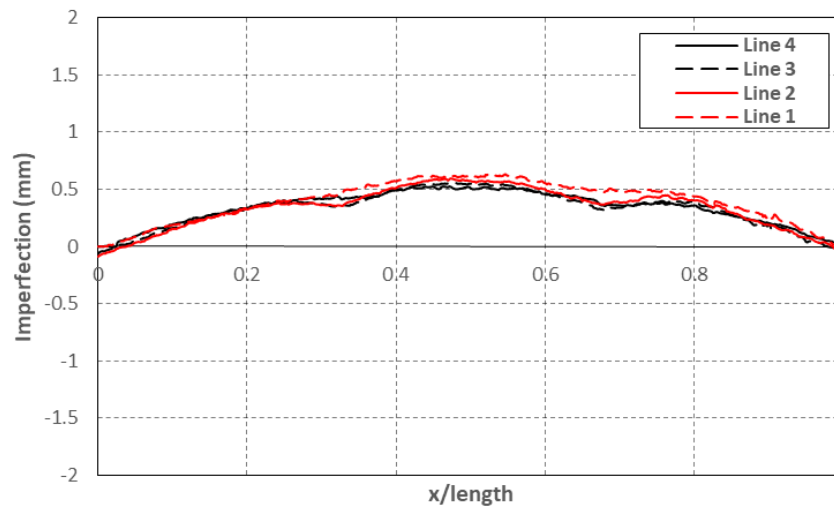


Figure H.221: Imperfections web channel S11012-9 (before assembly)

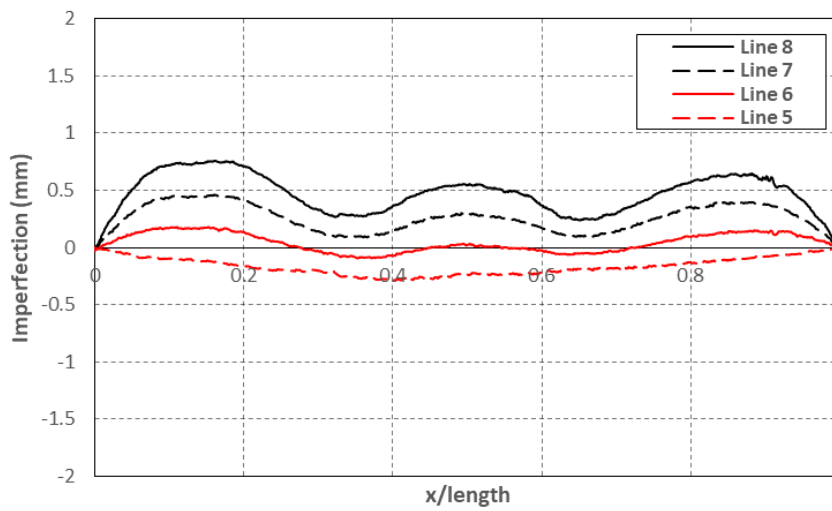


Figure H.222: Imperfections left flange channel S11012-9 (before assembly)

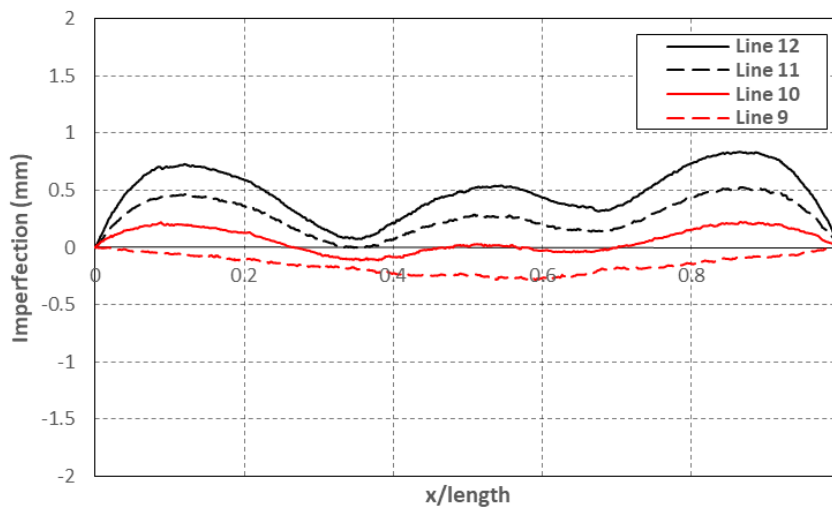


Figure H.223: Imperfections right flange channel S11012-9 (before assembly)

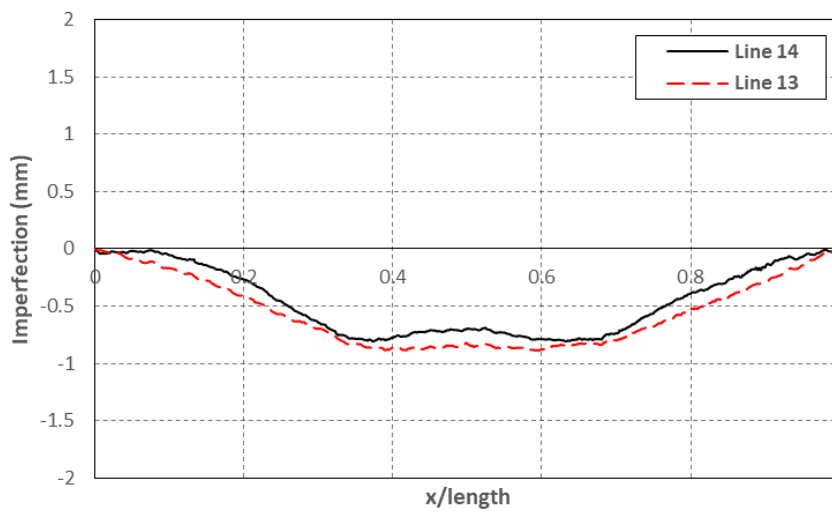


Figure H.224: Imperfections left lip channel S11012-9 (before assembly)

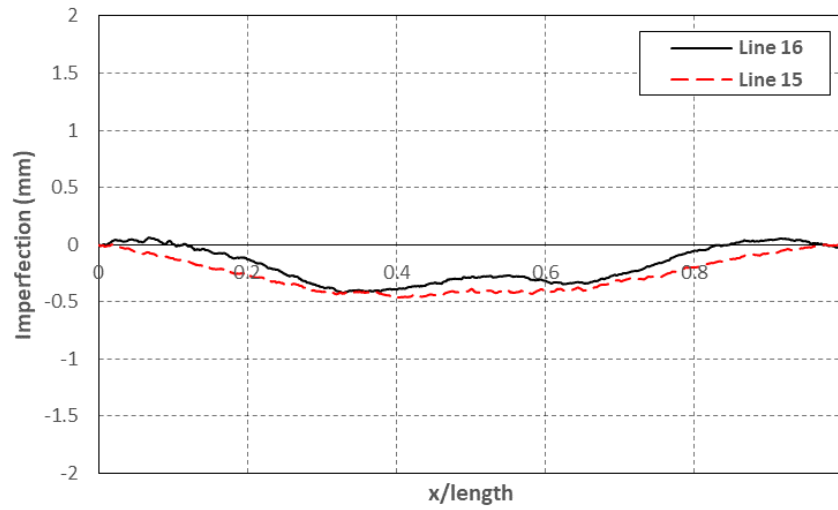


Figure H.225: Imperfections right lip channel S11012-9 (before assembly)

H.5.10 S11012-10

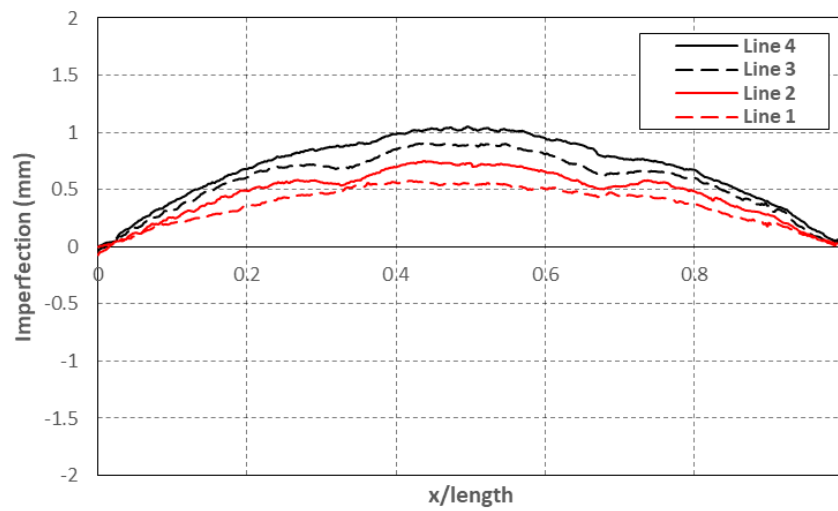


Figure H.226: Imperfections web channel S11012-10 (before assembly)

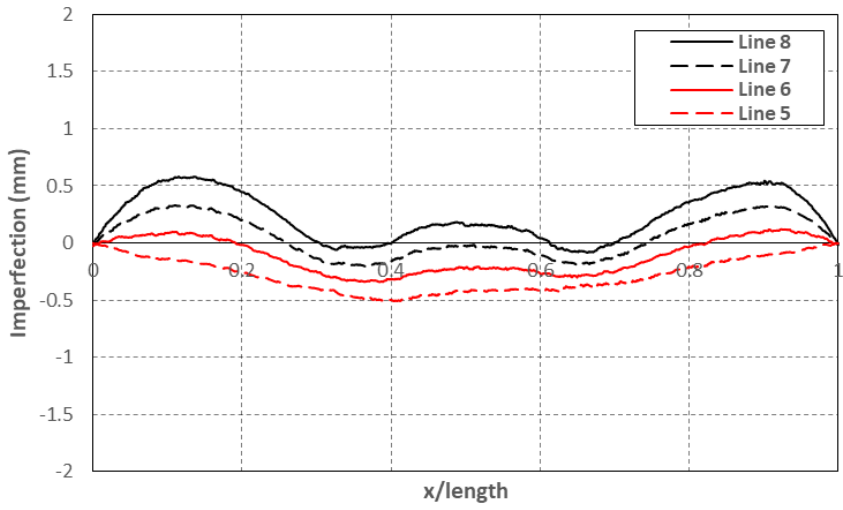


Figure H.227: Imperfections left flange channel S11012-10 (before assembly)

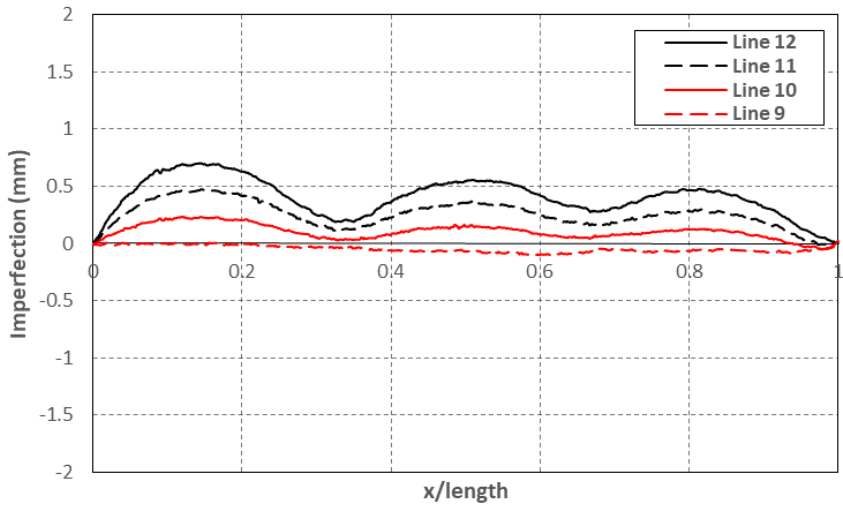


Figure H.228: Imperfections right flange channel S11012-10 (before assembly)

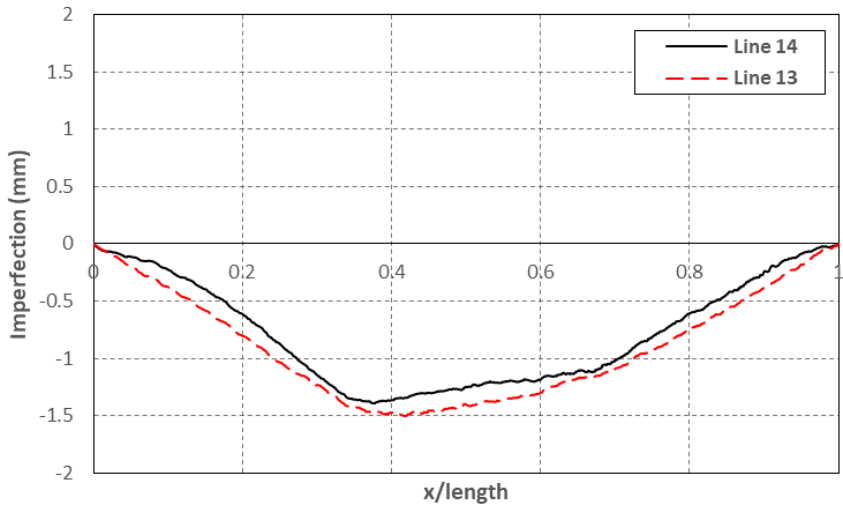


Figure H.229: Imperfections left lip channel S11012-10 (before assembly)

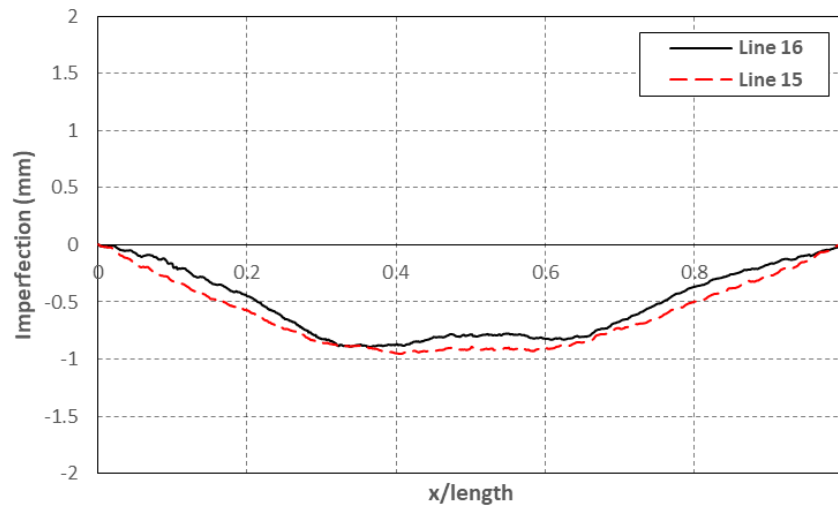


Figure H.230: Imperfections right lip channel S11012-10 (before assembly)

H.5.11 S11012-11

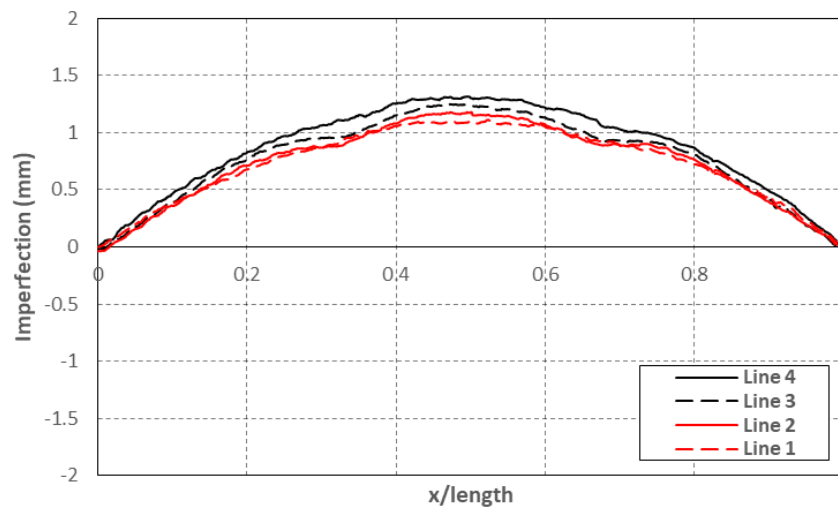


Figure H.231: Imperfections web channel S11012-11 (before assembly)

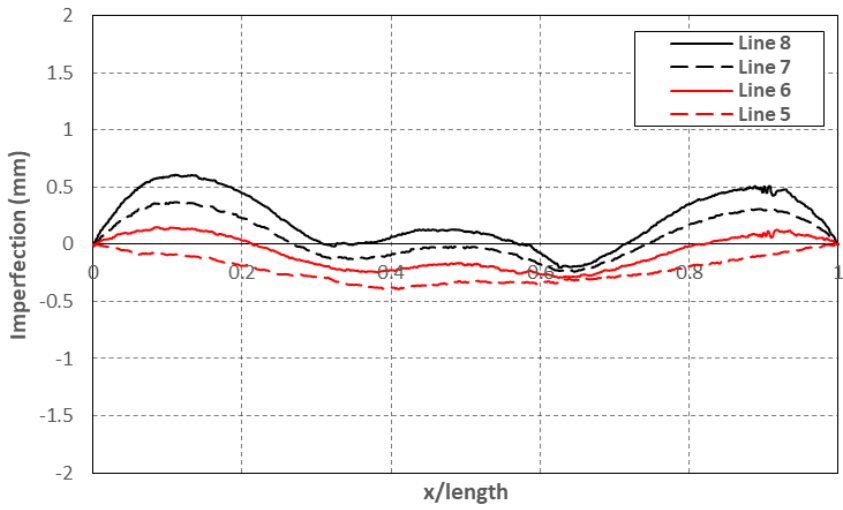


Figure H.232: Imperfections left flange channel S11012-11 (before assembly)

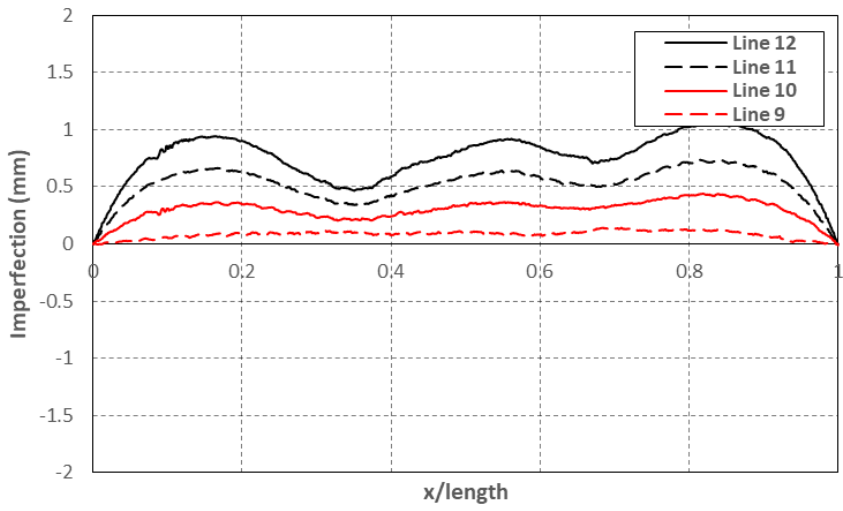


Figure H.233: Imperfections right flange channel S11012-11 (before assembly)

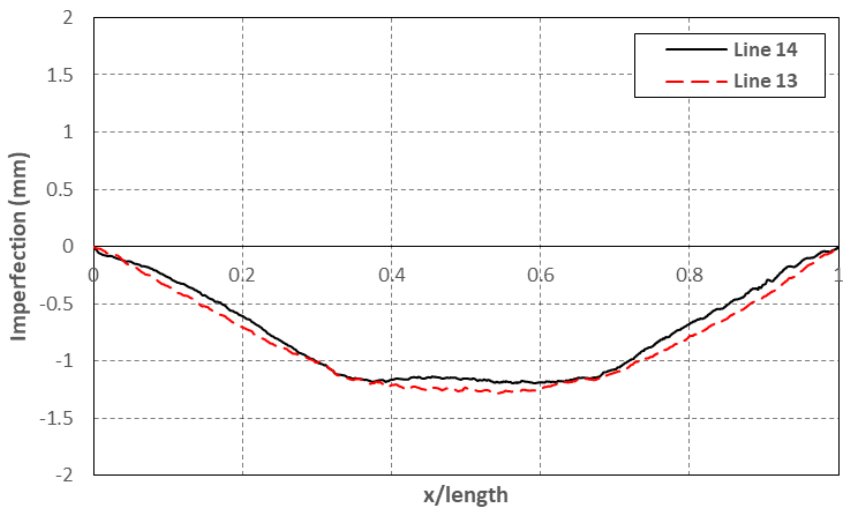


Figure H.234: Imperfections left lip channel S11012-11 (before assembly)

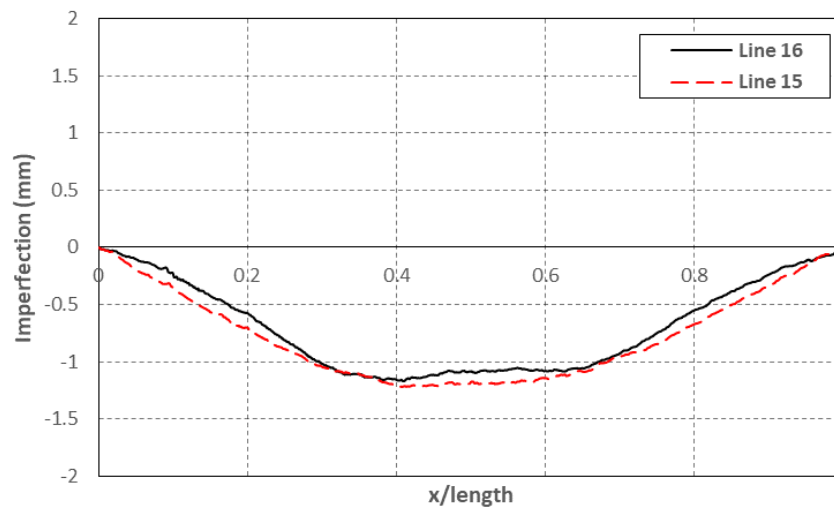


Figure H.235: Imperfections right lip channel S11012-11 (before assembly)

H.5.12 S11012-12

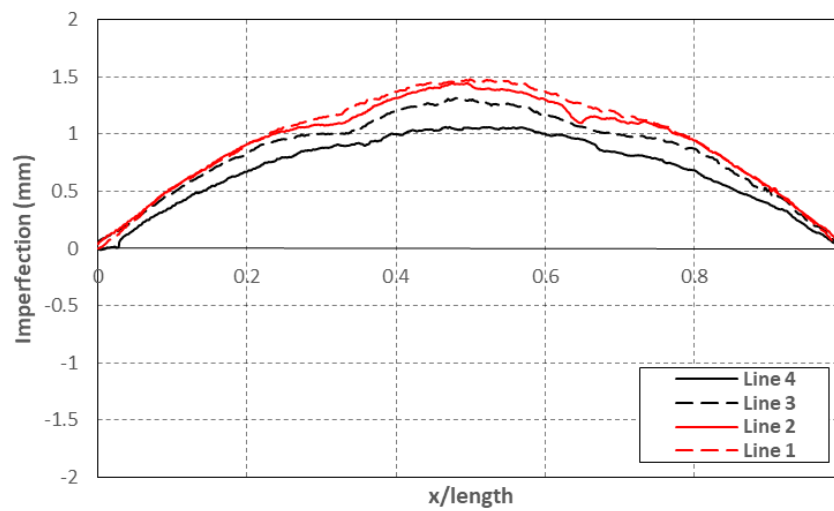


Figure H.236: Imperfections web channel S11012-12 (before assembly)

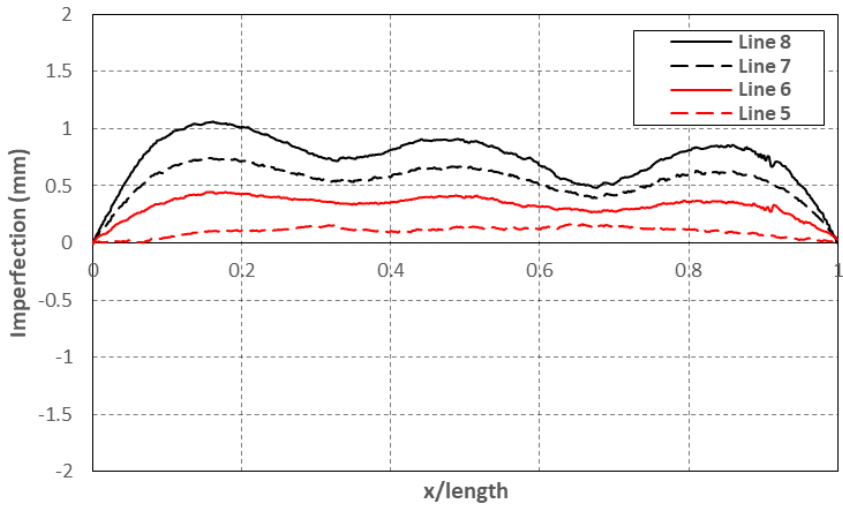


Figure H.237: Imperfections left flange channel S11012-12 (before assembly)

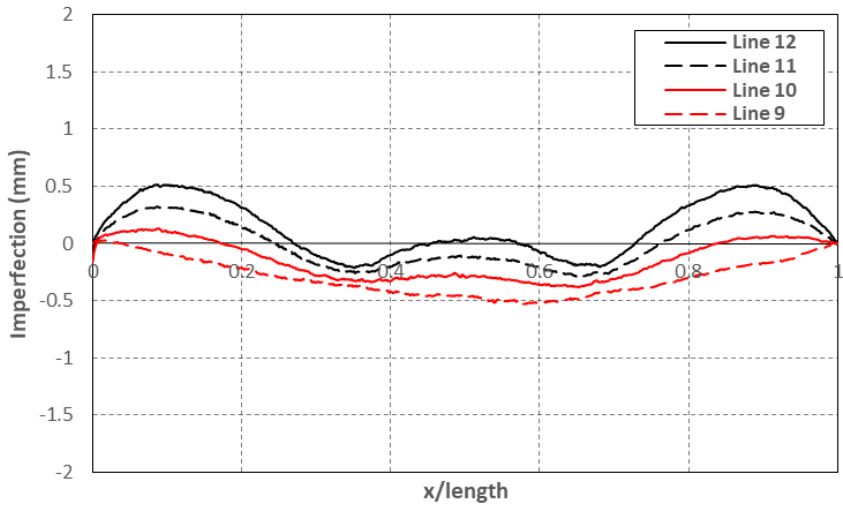


Figure H.238: Imperfections right flange channel S11012-12 (before assembly)

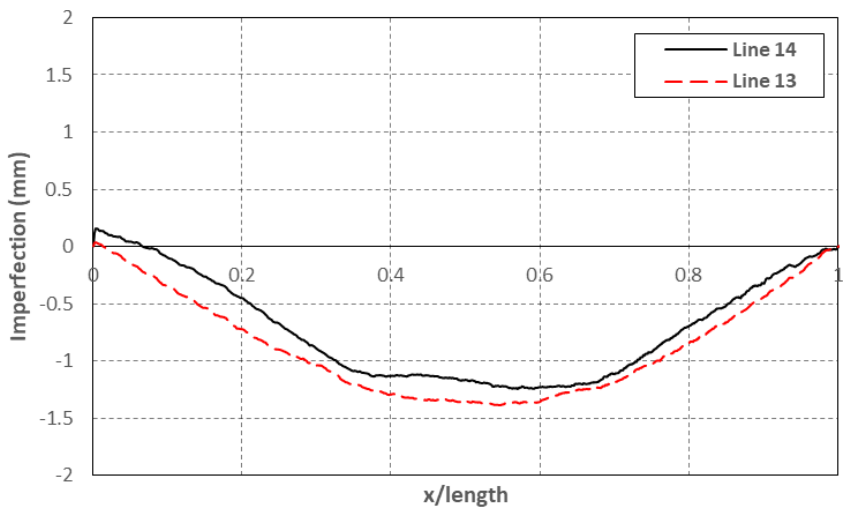


Figure H.239: Imperfections left lip channel S11012-12 (before assembly)

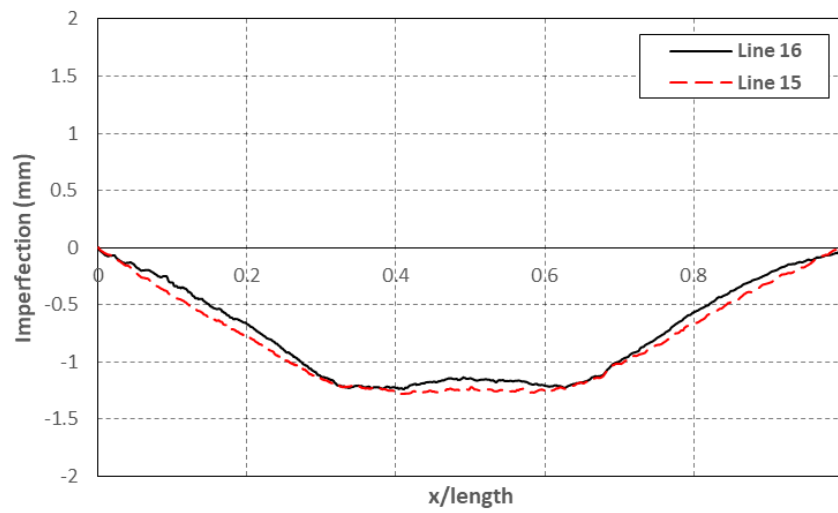


Figure H.240: Imperfections right lip channel S11012-12 (before assembly)

H.5.13 S11012-13

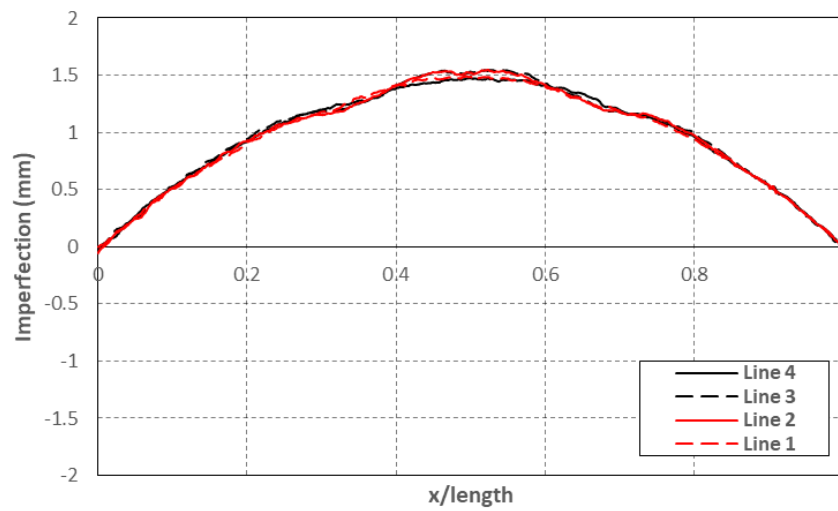


Figure H.241: Imperfections web channel S11012-13 (before assembly)

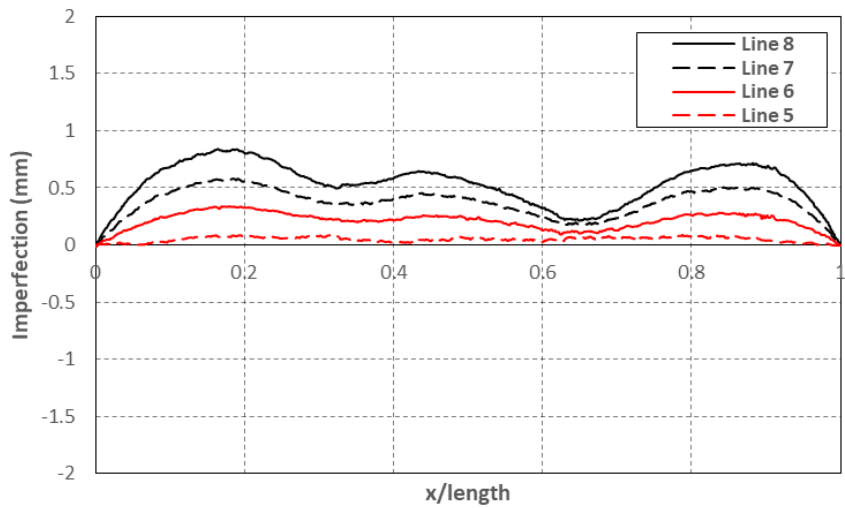


Figure H.242: Imperfections left flange channel S11012-13 (before assembly)

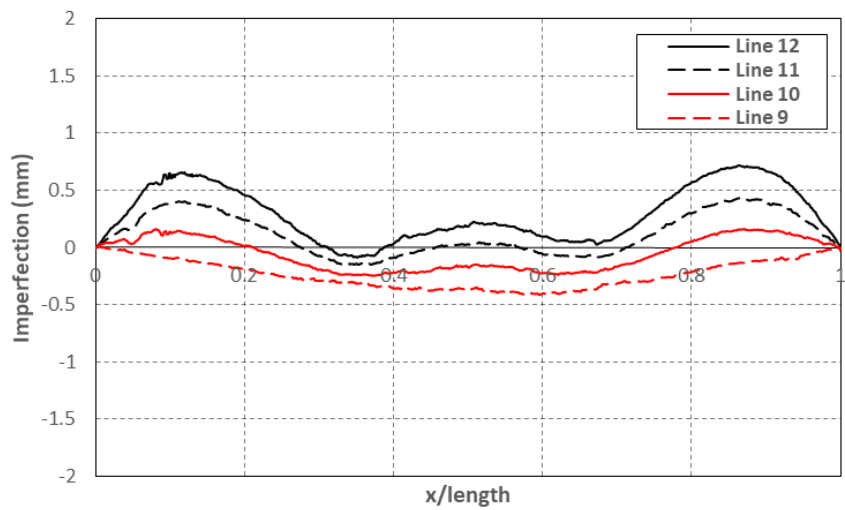


Figure H.243: Imperfections right flange channel S11012-13 (before assembly)

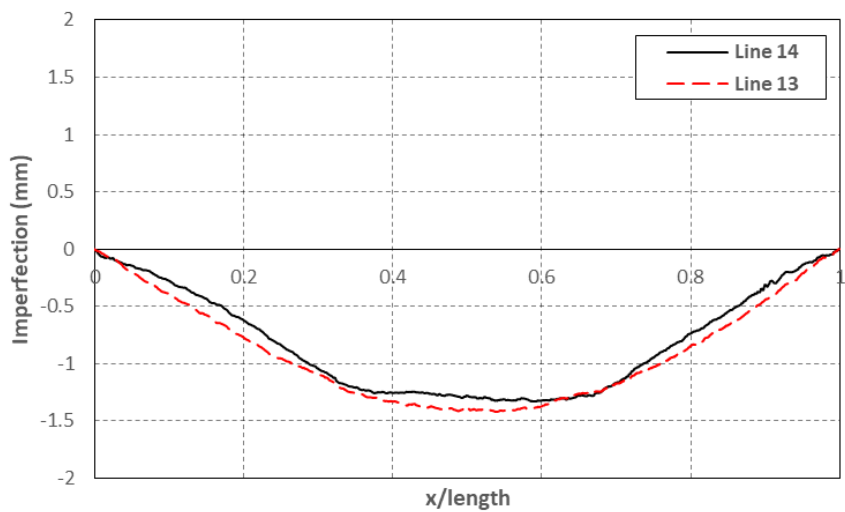


Figure H.244: Imperfections left lip channel S11012-13 (before assembly)

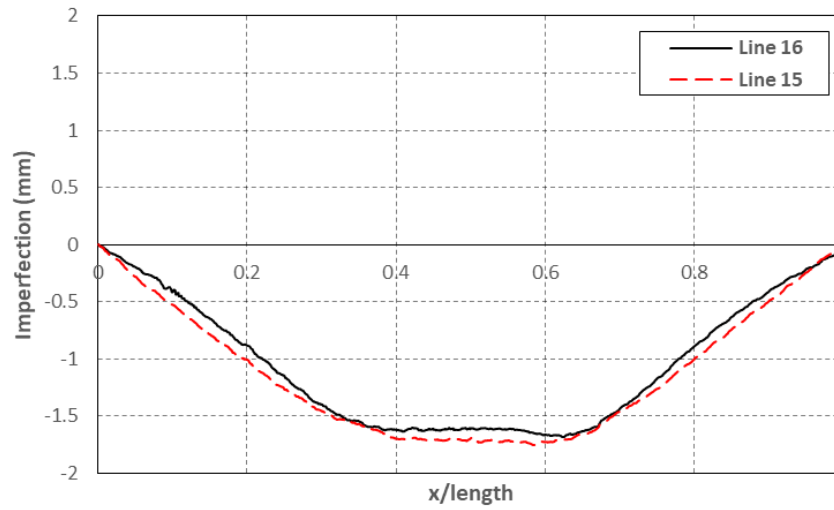


Figure H.245: Imperfections right lip channel S11012-13 (before assembly)

H.5.14 S11012-14

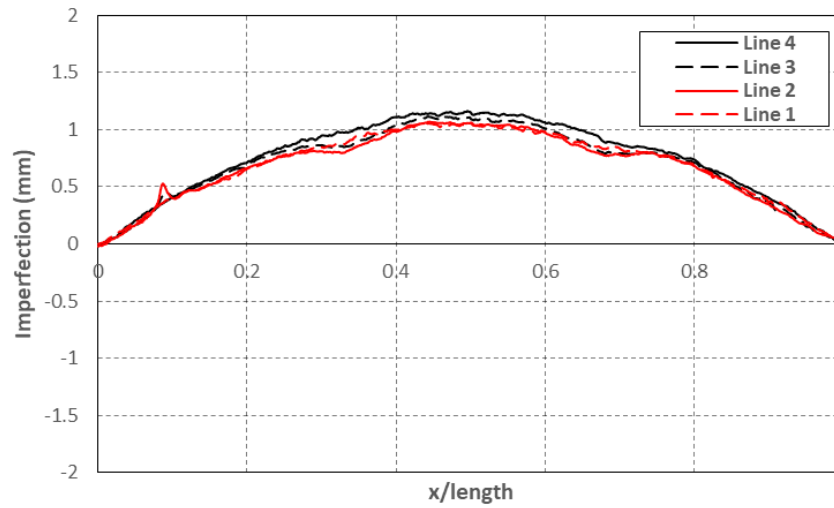


Figure H.246: Imperfections web channel S11012-14 (before assembly)

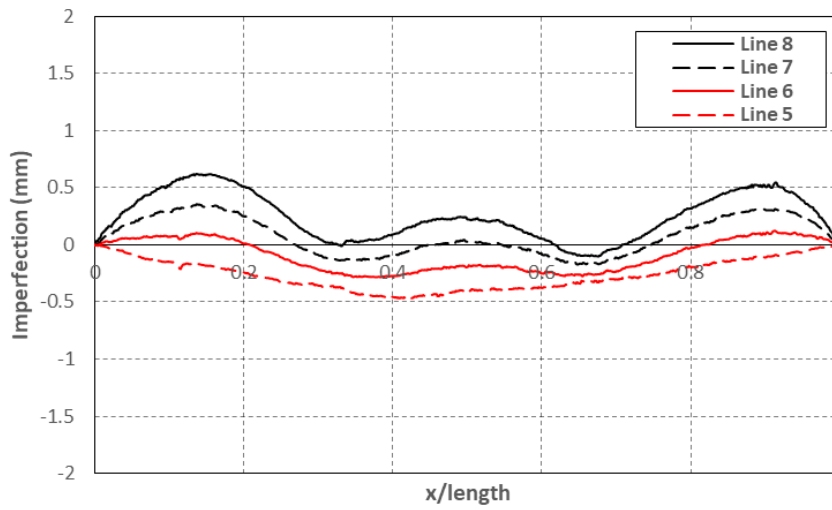


Figure H.247: Imperfections left flange channel S11012-14 (before assembly)

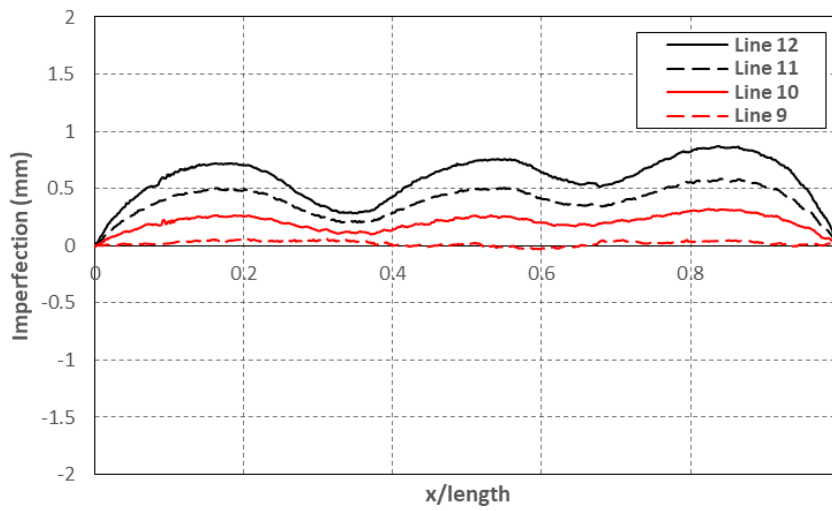


Figure H.248: Imperfections right flange channel S11012-14 (before assembly)

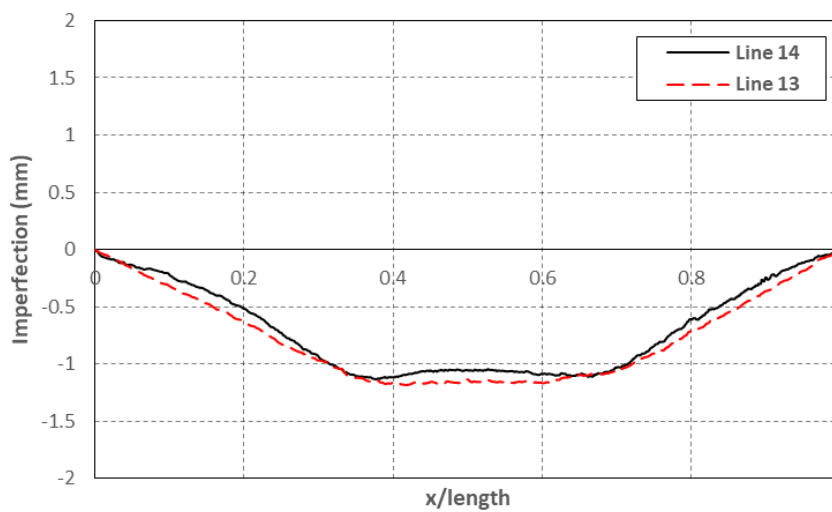


Figure H.249: Imperfections left lip channel S11012-14 (before assembly)

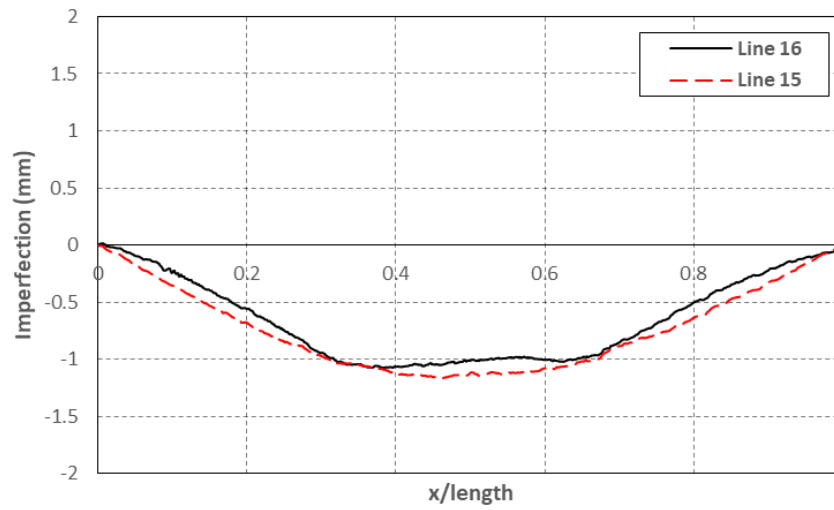


Figure H.250: Imperfections right lip channel S11012-14 (before assembly)

H.5.15 S11012-15

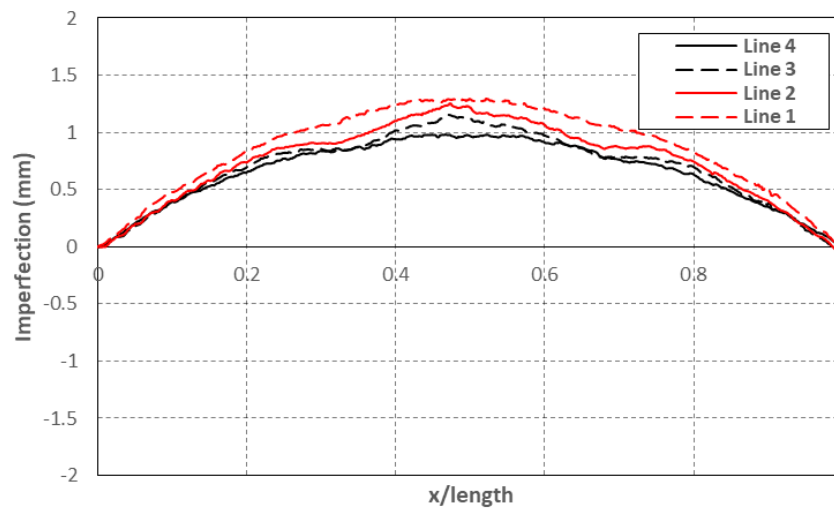


Figure H.251: Imperfections web channel S11012-15 (before assembly)

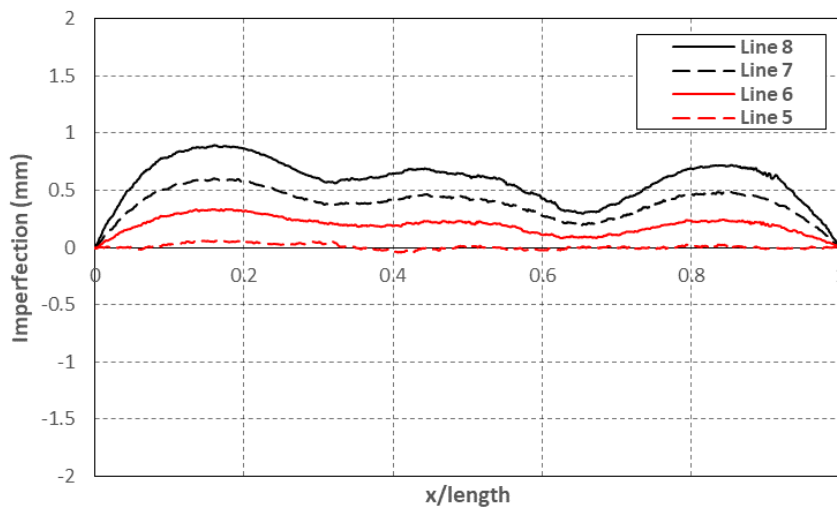


Figure H.252: Imperfections left flange channel S11012-15 (before assembly)

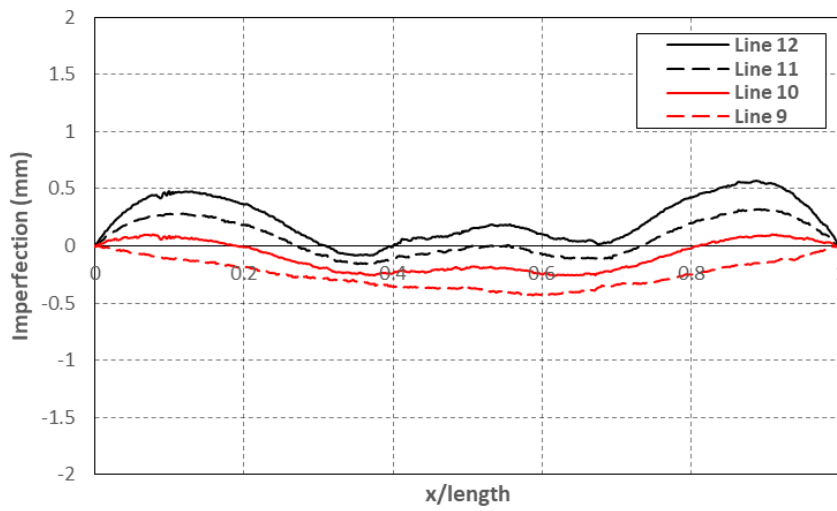


Figure H.253: Imperfections right flange channel S11012-15 (before assembly)

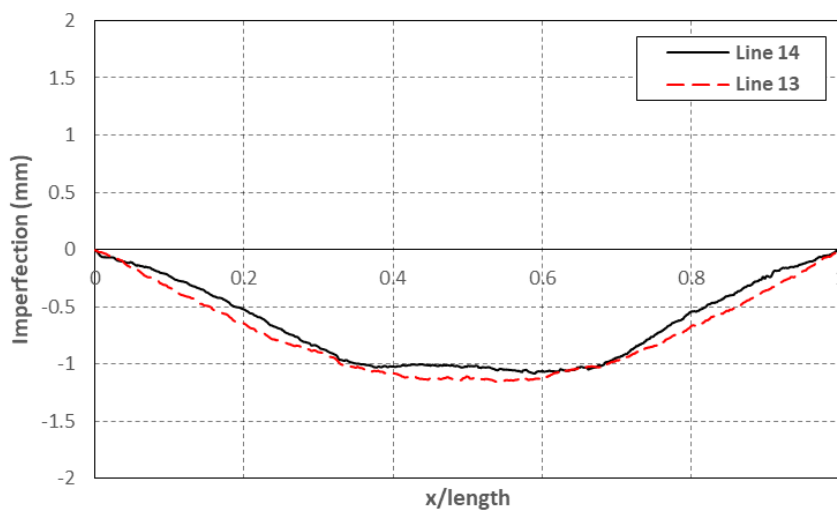


Figure H.254: Imperfections left lip channel S11012-15 (before assembly)

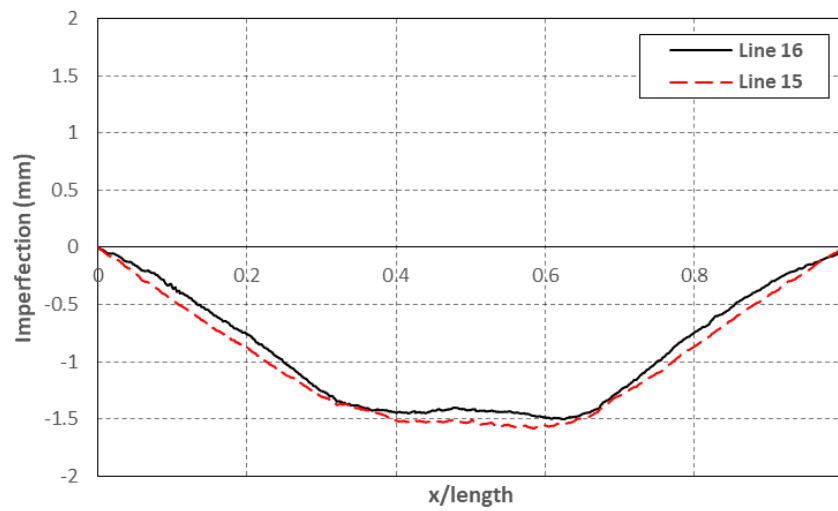


Figure H.255: Imperfections right lip channel S11012-15 (before assembly)

H.5.16 S11012-16

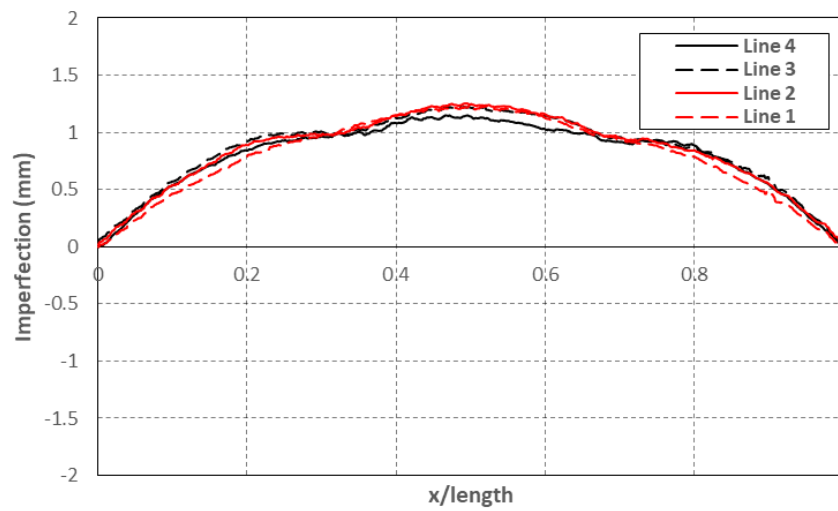


Figure H.256: Imperfections web channel S11012-16 (before assembly)

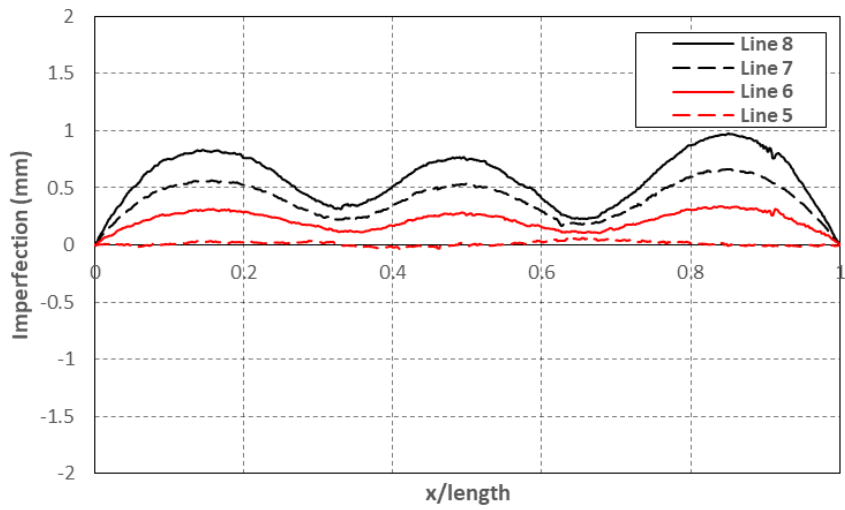


Figure H.257: Imperfections left flange channel S11012-16 (before assembly)

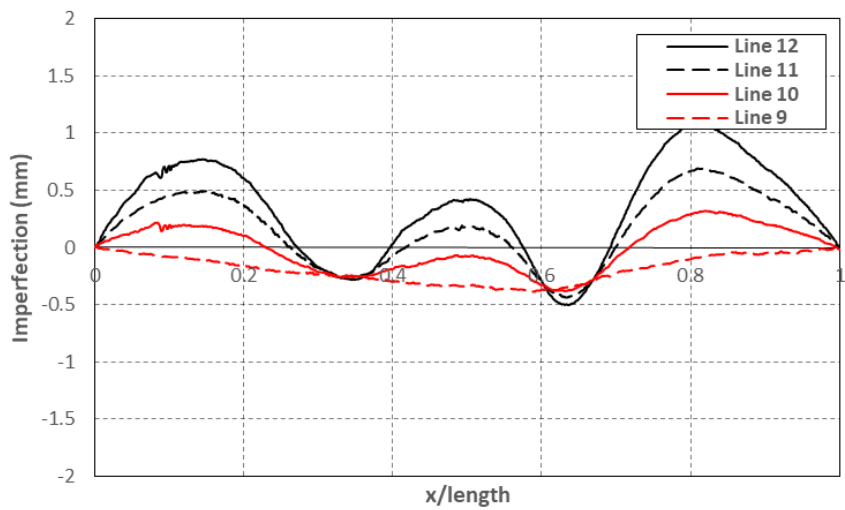


Figure H.258: Imperfections right flange channel S11012-16 (before assembly)

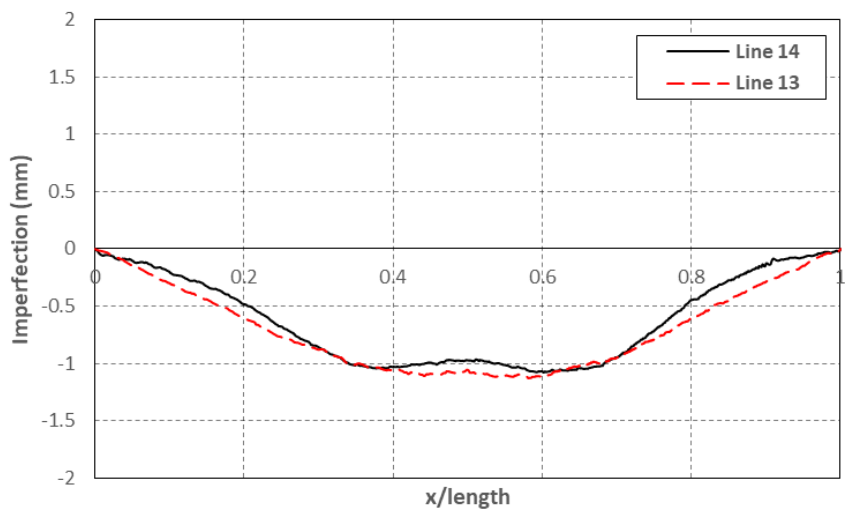


Figure H.259: Imperfections left lip channel S11012-16 (before assembly)

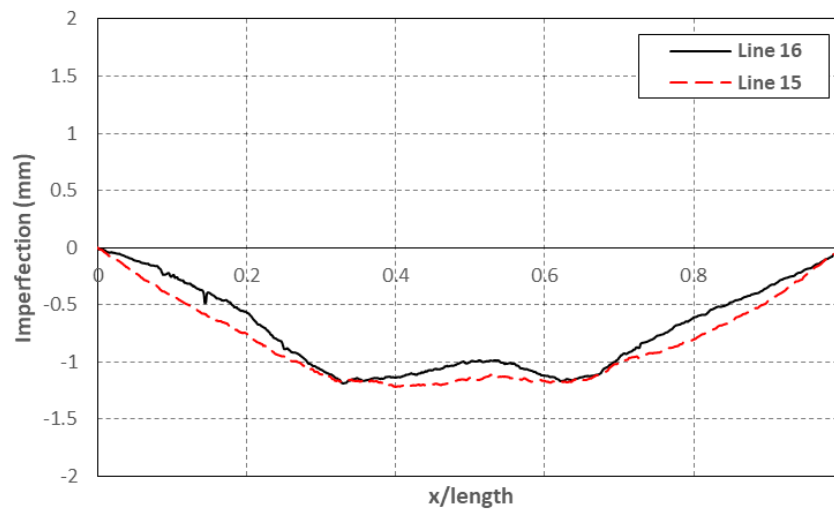


Figure H.260: Imperfections right lip channel S11012-16 (before assembly)

H.5.17 S11012-17

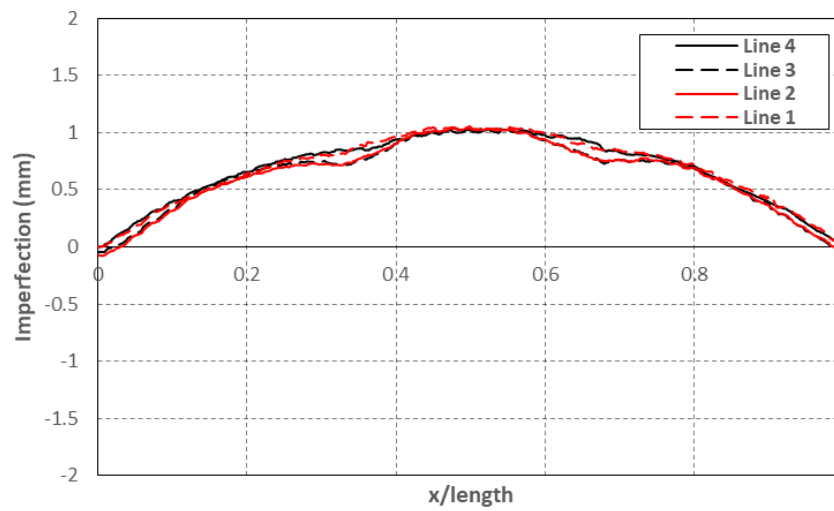


Figure H.261: Imperfections web channel S11012-17 (before assembly)

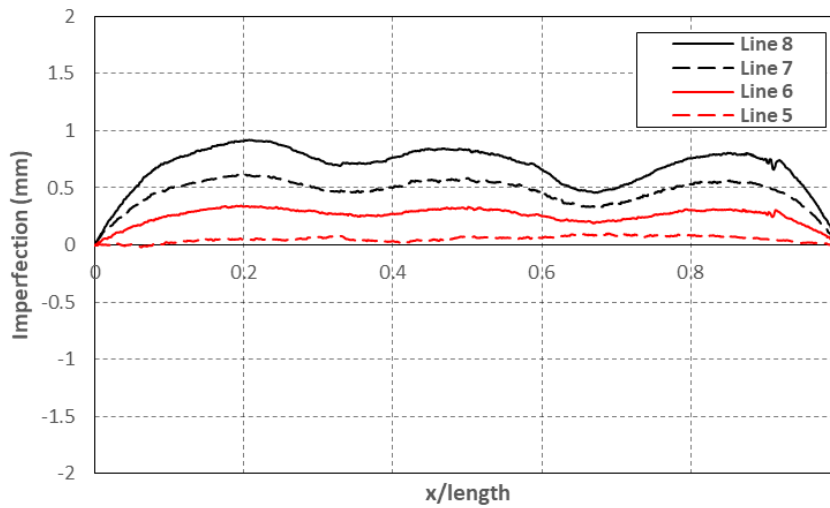


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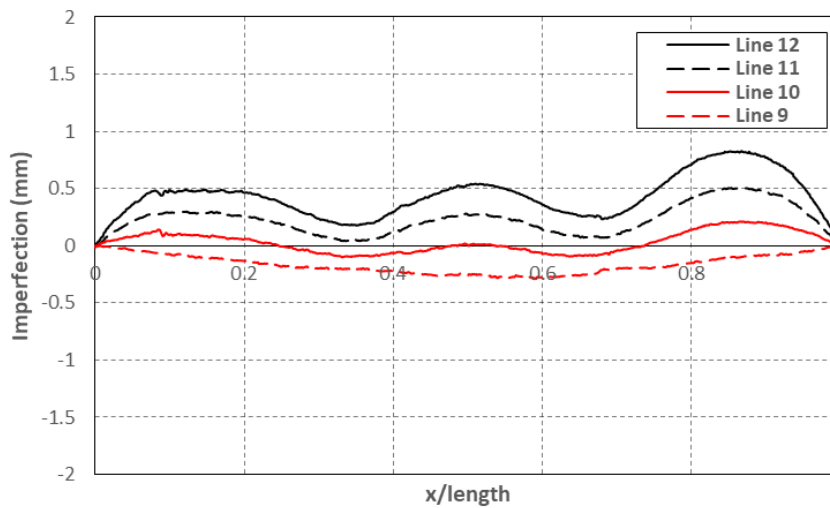


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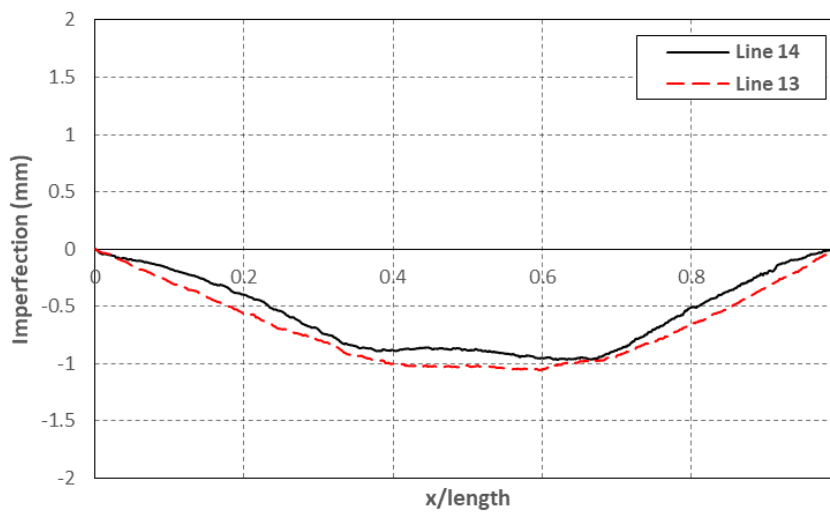


Figure H.264: Imperfections left lip channel S11012-17 (before assembly)

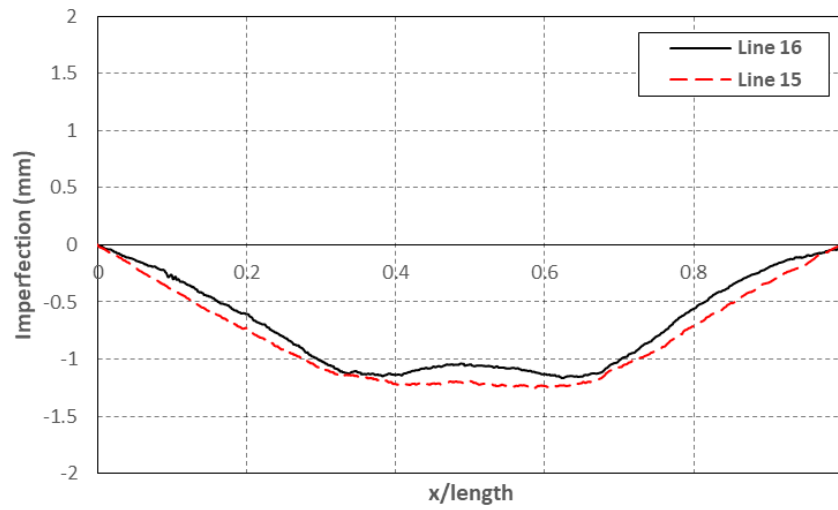


Figure H.265: Imperfections right lip channel S11012-17 (before assembly)

H.5.18 S11012-18

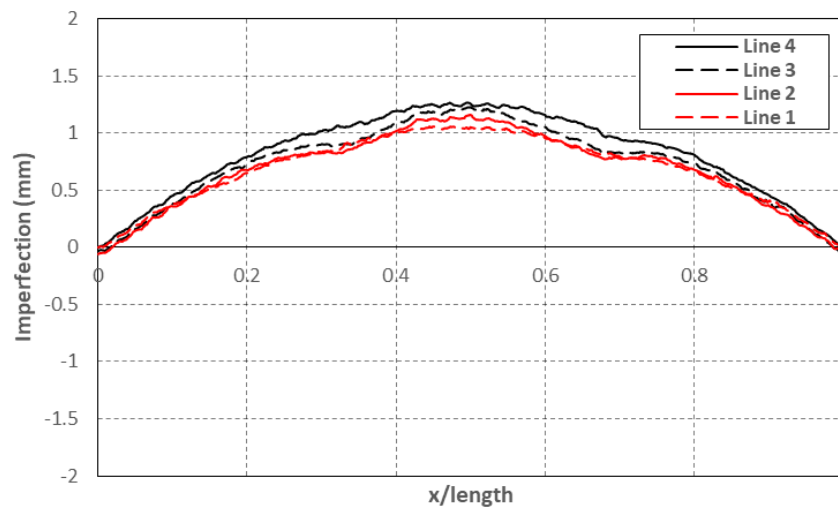


Figure H.266: Imperfections web channel S11012-18 (before assembly)

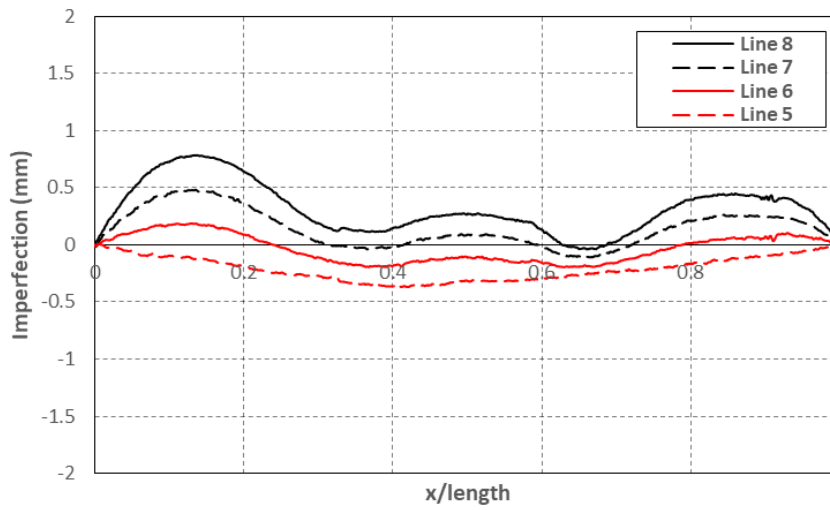


Figure H.267: Imperfections left flange channel S11012-18 (before assembly)

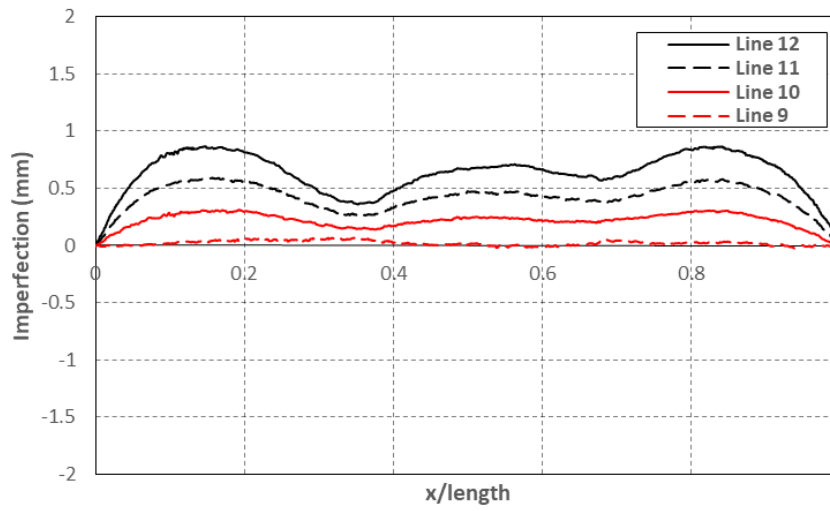


Figure H.268: Imperfections right flange channel S11012-18 (before assembly)

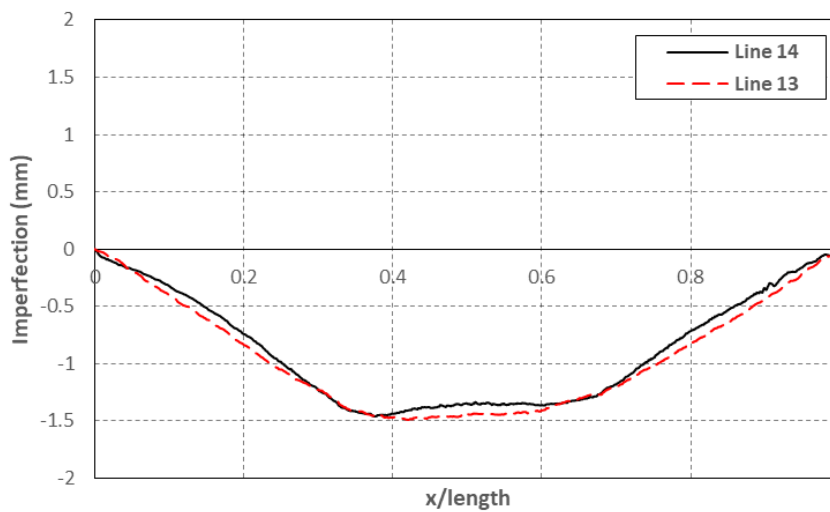


Figure H.269: Imperfections left lip channel S11012-18 (before assembly)

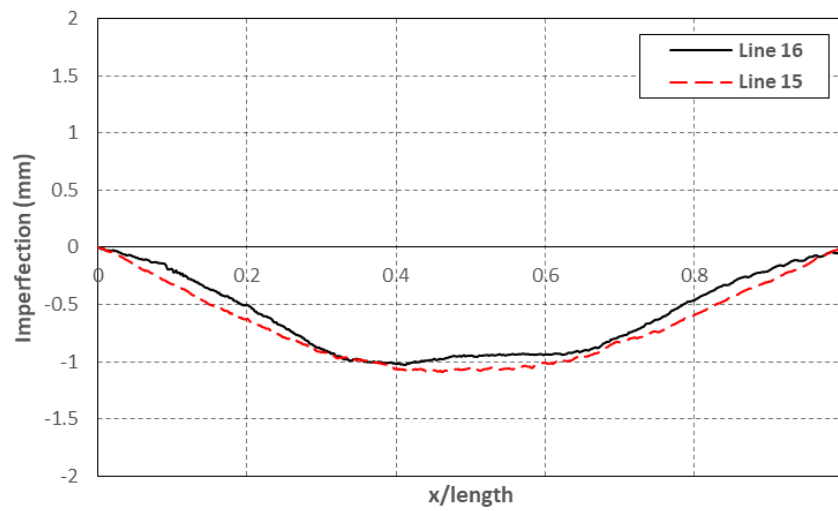


Figure H.270: Imperfections right lip channel S11012-18 (before assembly)

H.5.19 S11012-19

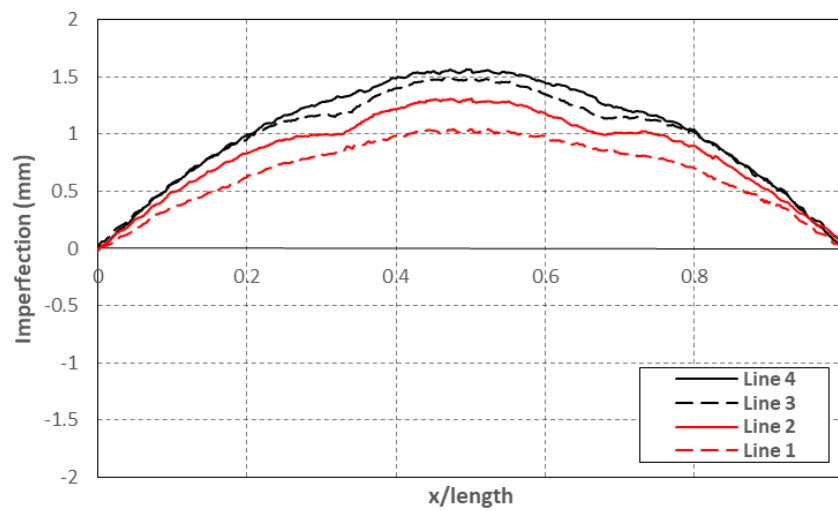


Figure H.271: Imperfections web channel S11012-19 (before assembly)

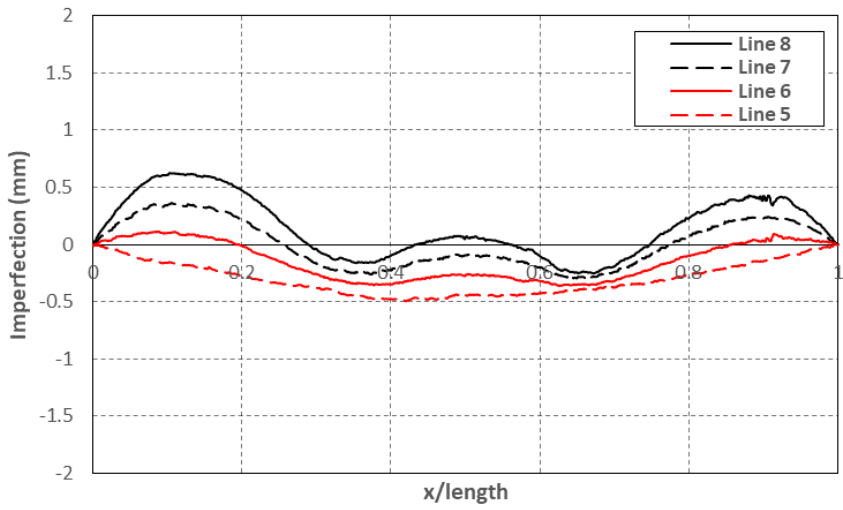


Figure H.272: Imperfections left flange channel S11012-19 (before assembly)

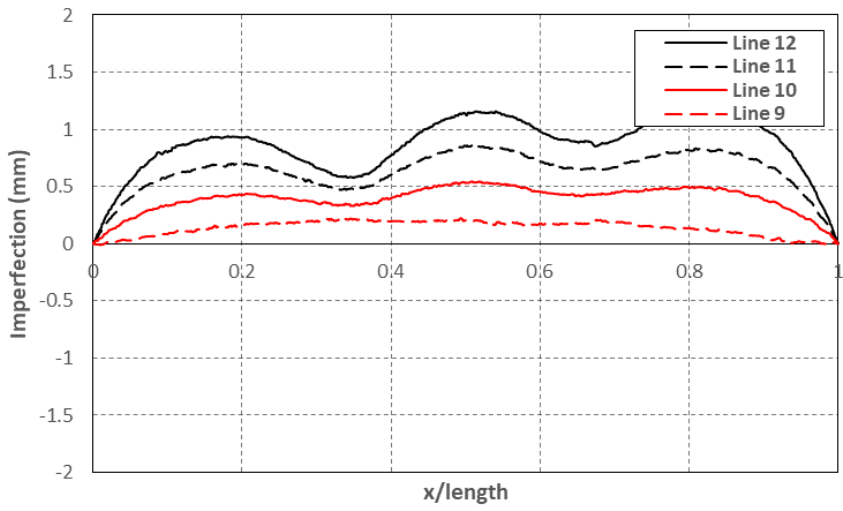


Figure H.273: Imperfections right flange channel S11012-19 (before assembly)

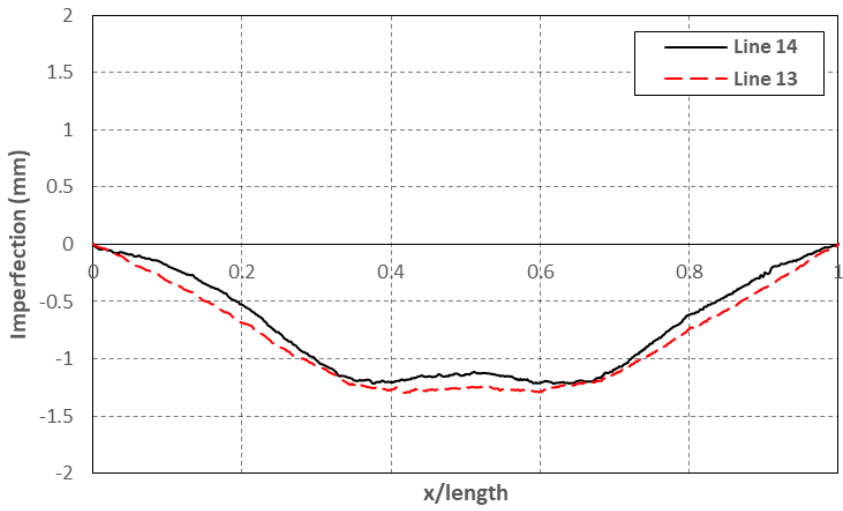


Figure H.274: Imperfections left lip channel S11012-19 (before assembly)

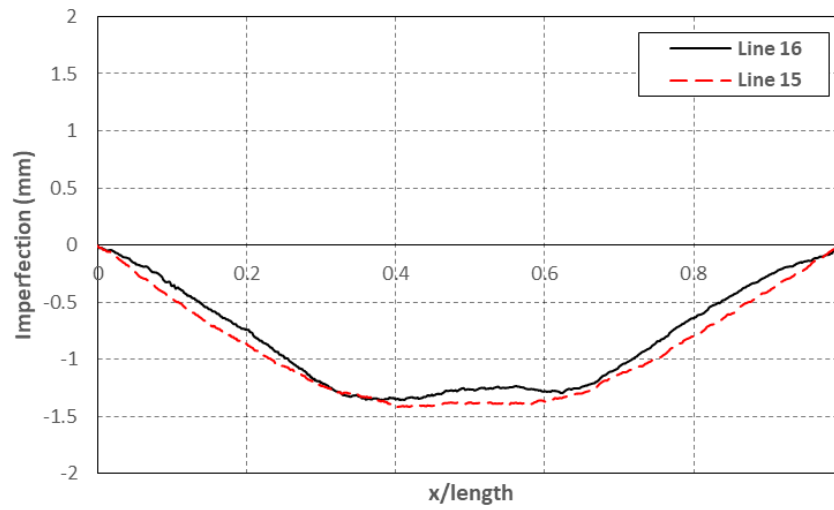


Figure H.275: Imperfections right lip channel S11012-19 (before assembly)

H.5.20 S11012-20

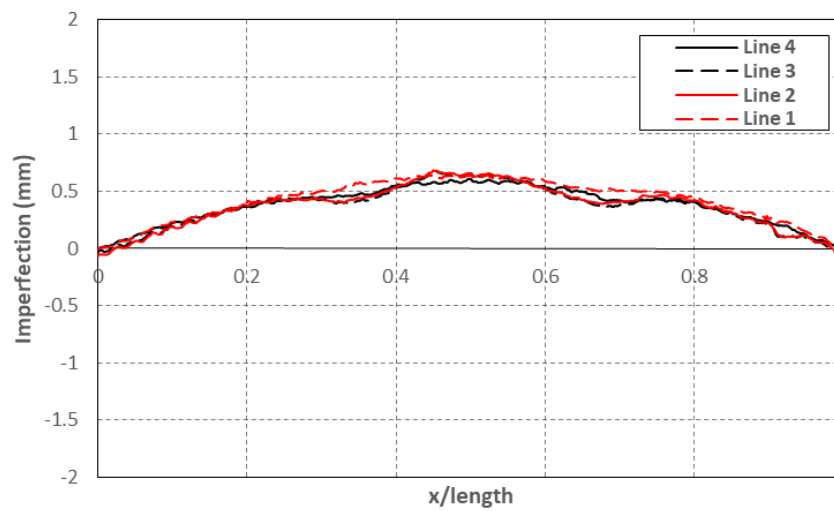


Figure H.276: Imperfections web channel S11012-20 (before assembly)

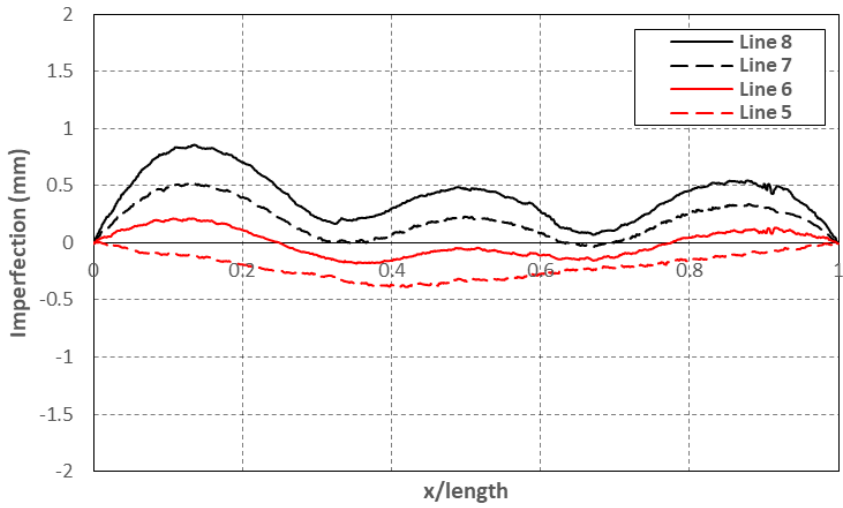


Figure H.277: Imperfections left flange channel S11012-20 (before assembly)

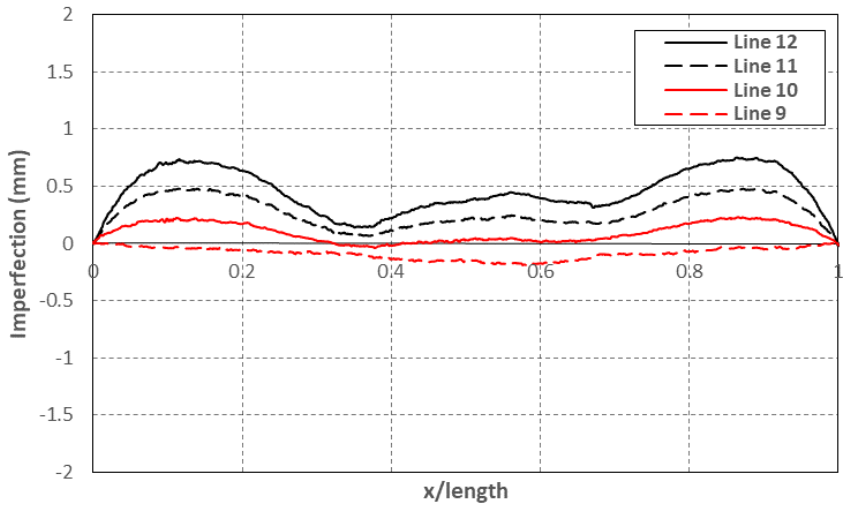


Figure H.278: Imperfections right flange channel S11012-20 (before assembly)

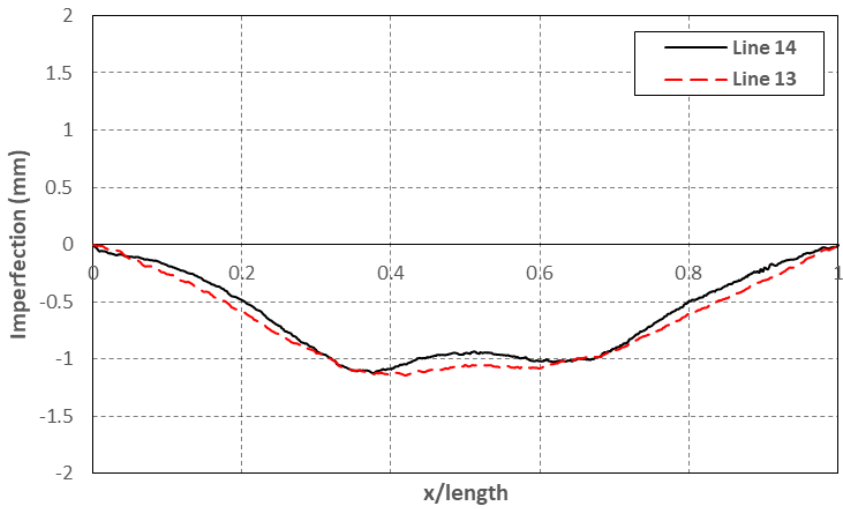


Figure H.279: Imperfections left lip channel S11012-20 (before assembly)

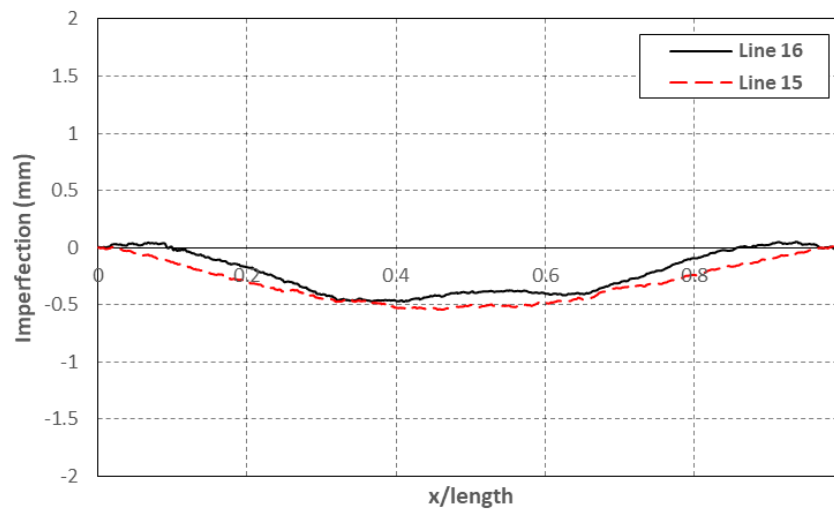


Figure H.280: Imperfections right lip channel S11012-20 (before assembly)

H.5.21 S11012-21

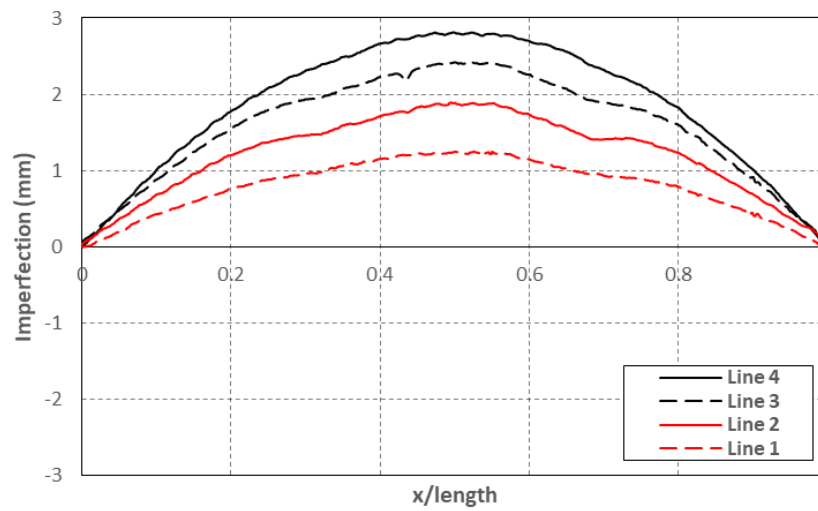


Figure H.281: Imperfections web channel S11012-21 (before assembly)

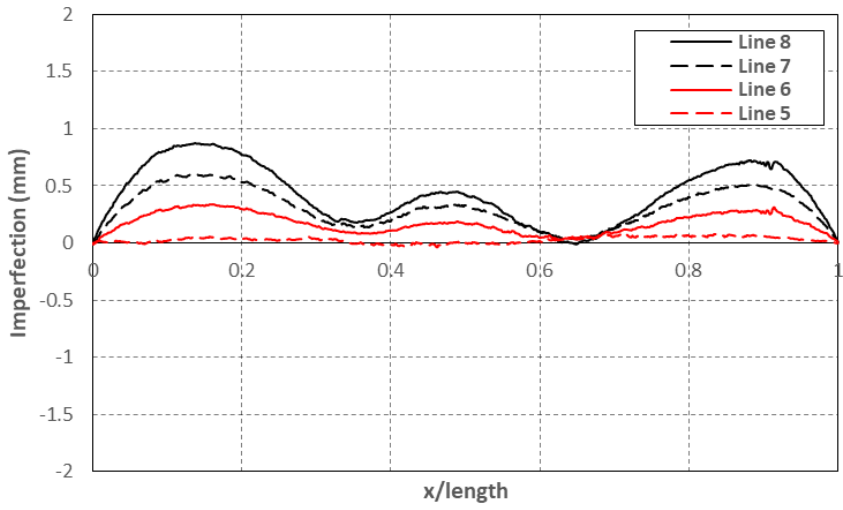


Figure H.282: Imperfections left flange channel S11012-21 (before assembly)

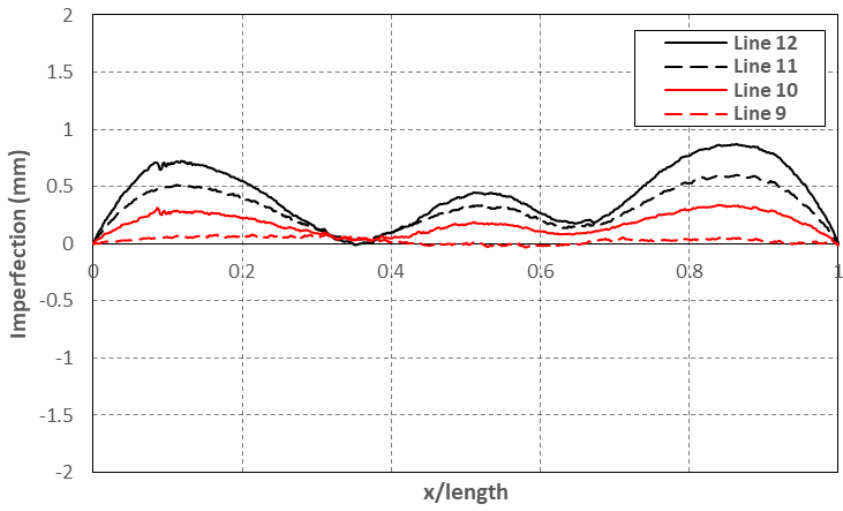


Figure H.283: Imperfections right flange channel S11012-21 (before assembly)

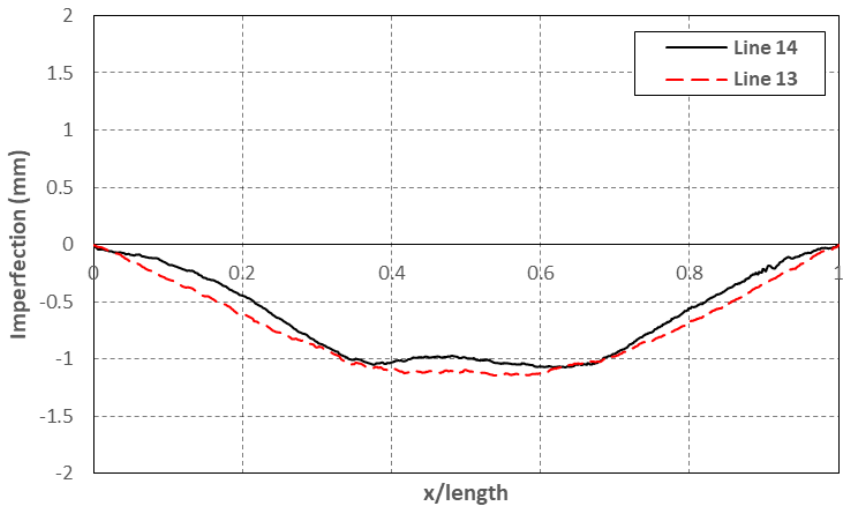


Figure H.284: Imperfections left lip channel S11012-21 (before assembly)

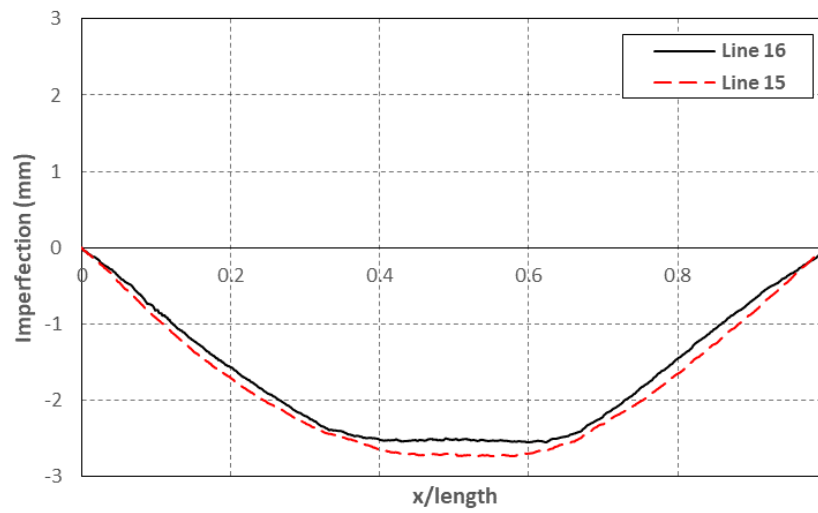


Figure H.285: Imperfections right lip channel S11012-21 (before assembly)

H.5.22 S11012-22

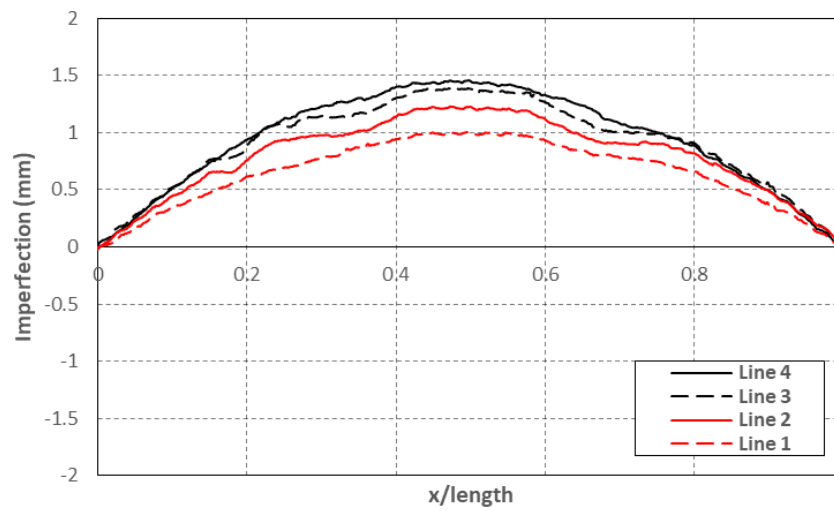


Figure H.286: Imperfections web channel S11012-22 (before assembly)

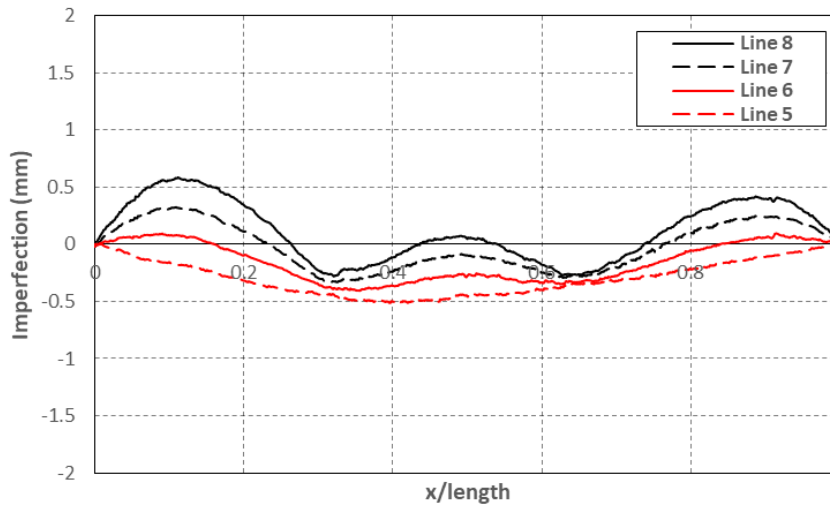


Figure H.287: Imperfections left flange channel S11012-22 (before assembly)

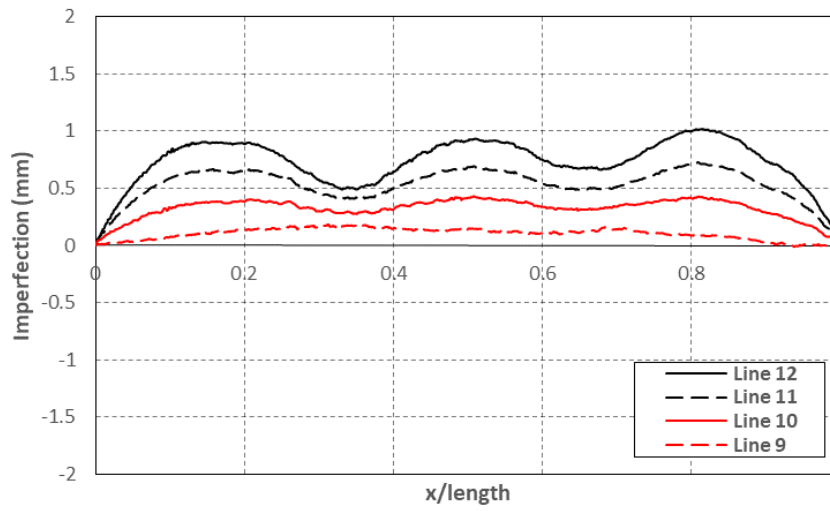


Figure H.288: Imperfections right flange channel S11012-22 (before assembly)

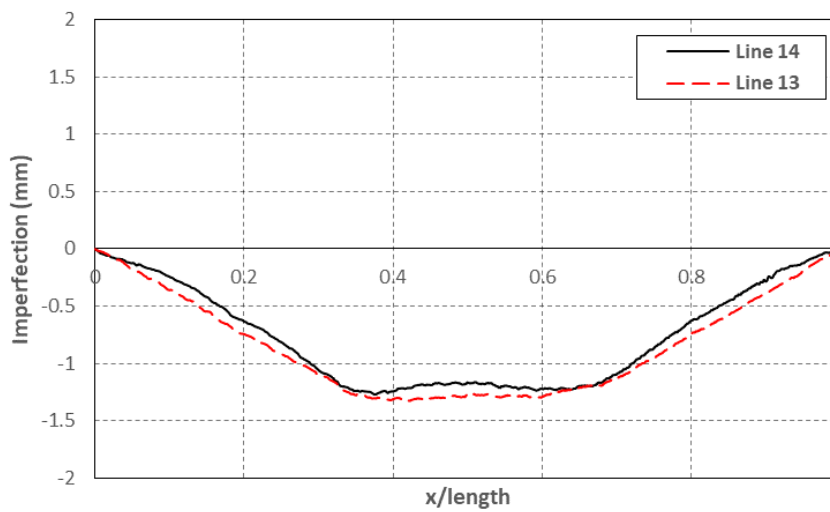


Figure H.289: Imperfections left lip channel S11012-22 (before assembly)

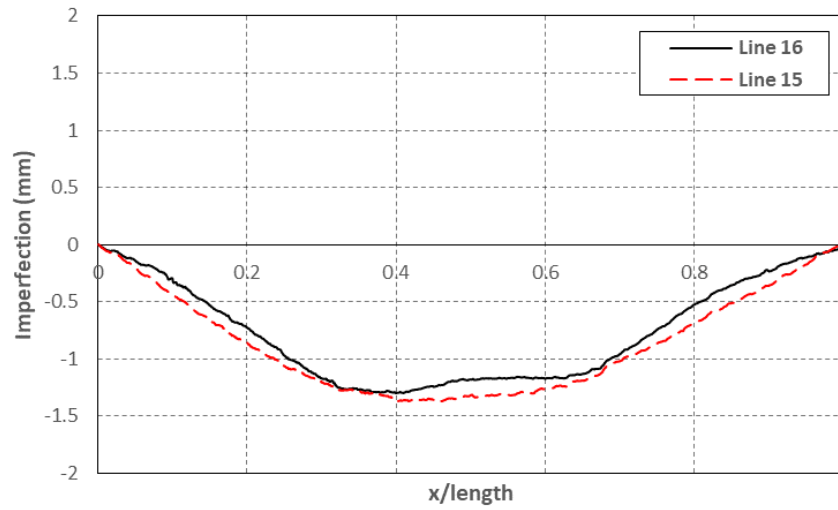


Figure H.290: Imperfections right lip channel S11012-22 (before assembly)

H.5.23 S11012-23

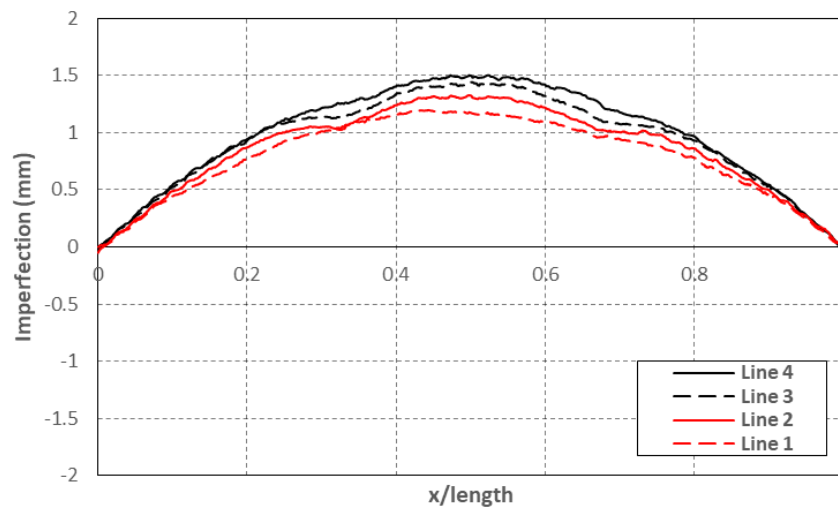


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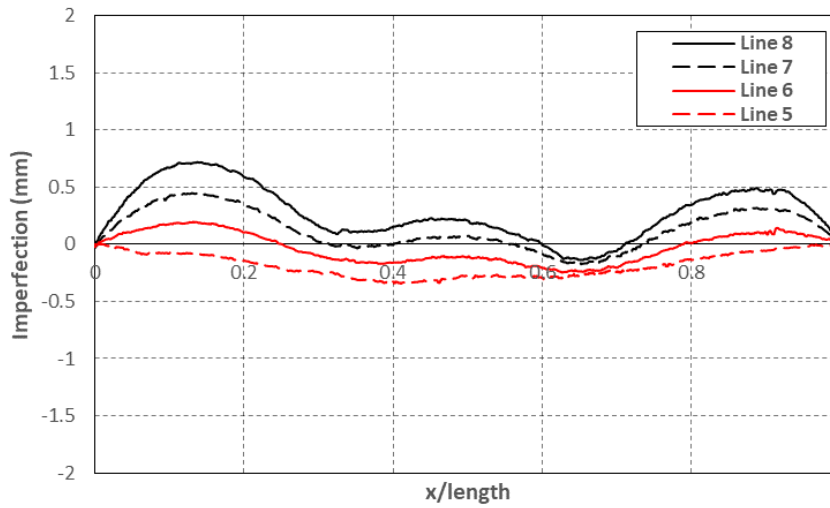


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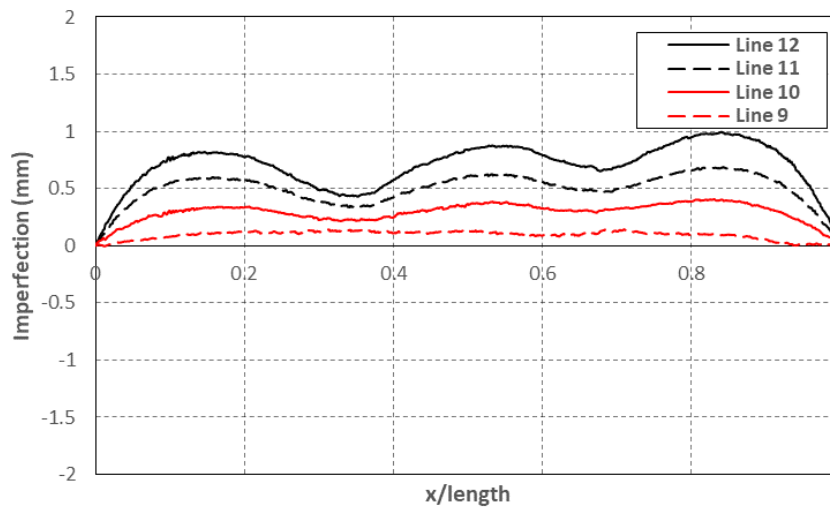


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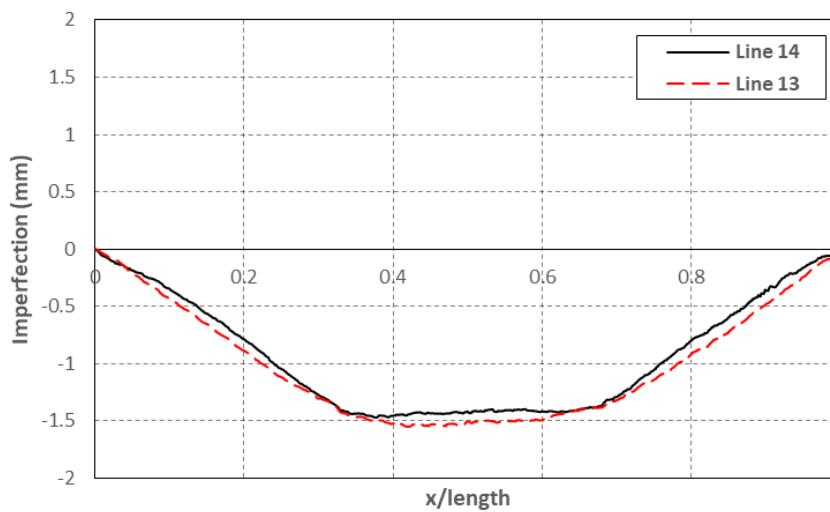


Figure H.294: Imperfections left lip channel S11012-23 (before assembly)

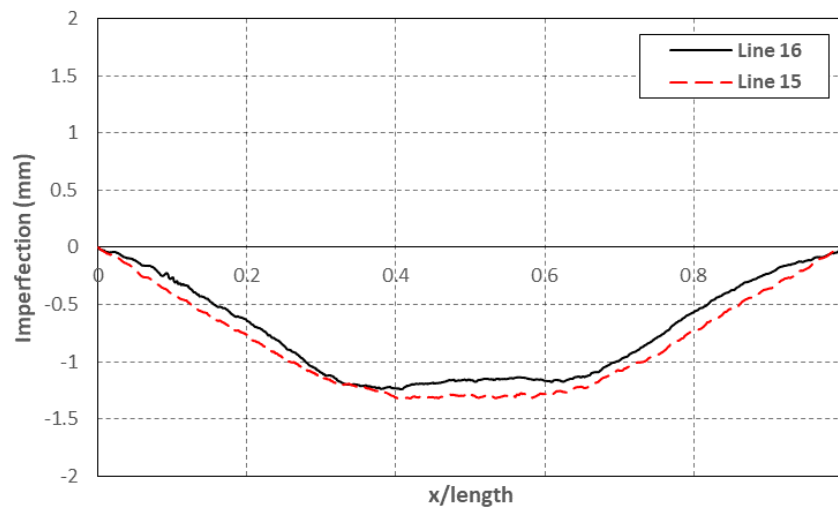


Figure H.295: Imperfections right lip channel S11012-23 (before assembly)

H.5.24 S11012-24

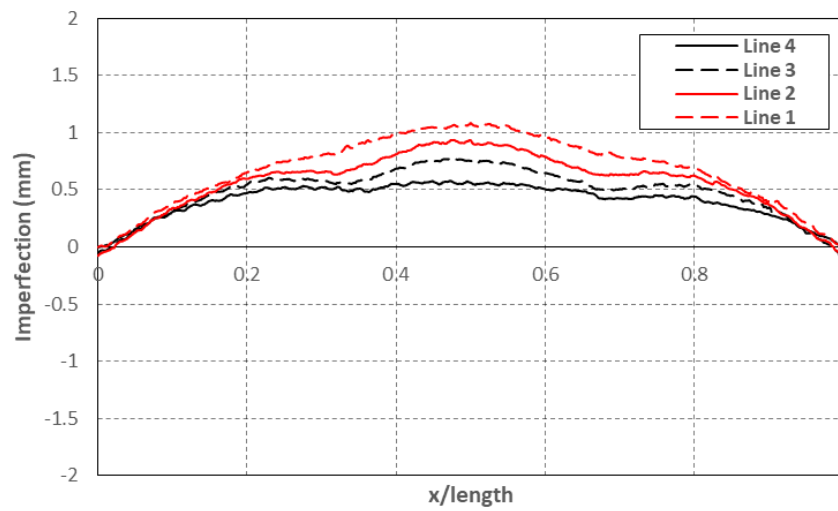


Figure H.296: Imperfections web channel S11012-24 (before assembly)

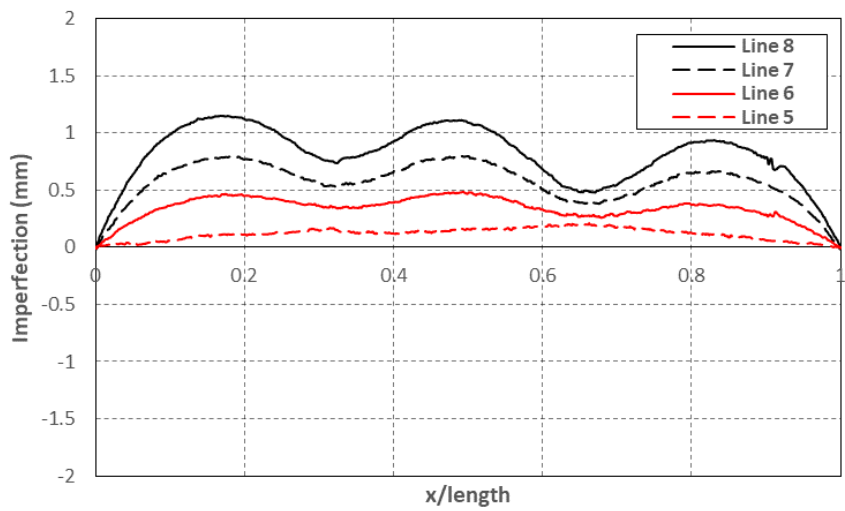


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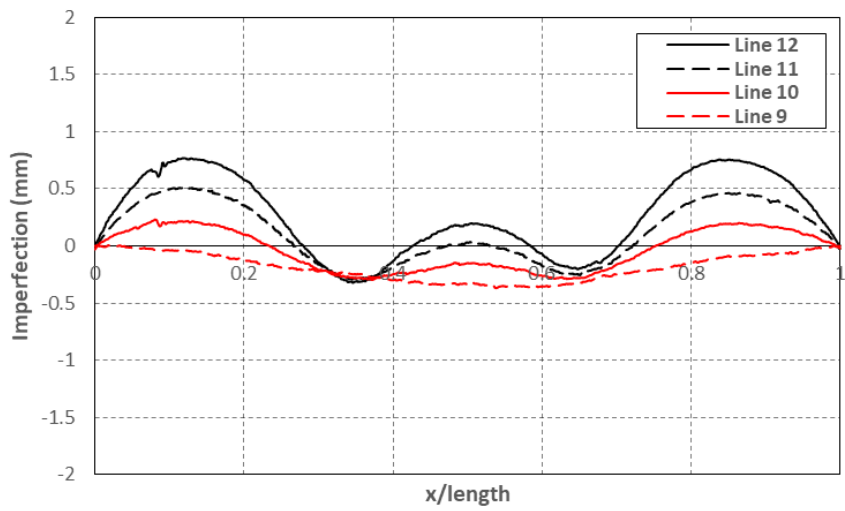


Figure H.298: Imperfections right flange channel S11012-24 (before assembly)

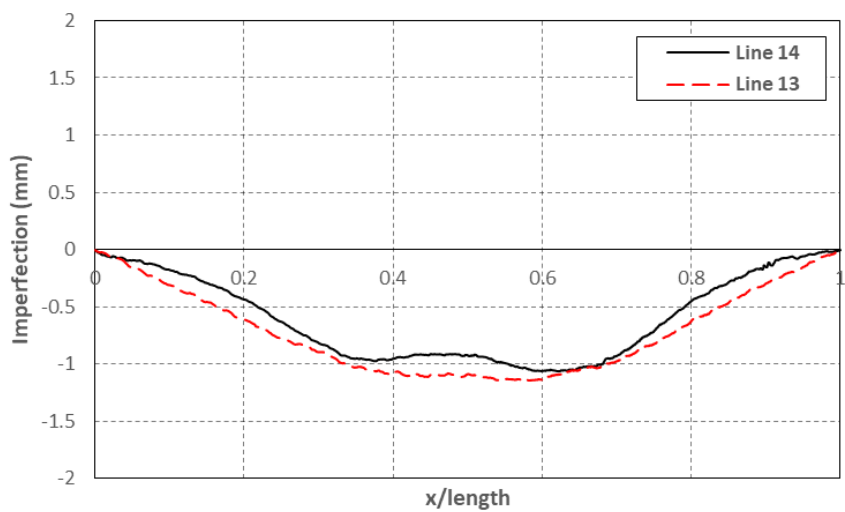


Figure H.299: Imperfections left lip channel S11012-24 (before assembly)

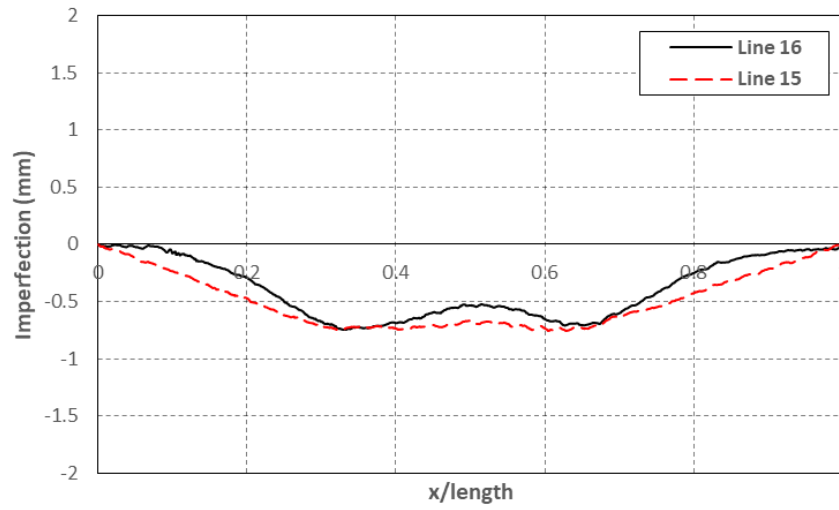
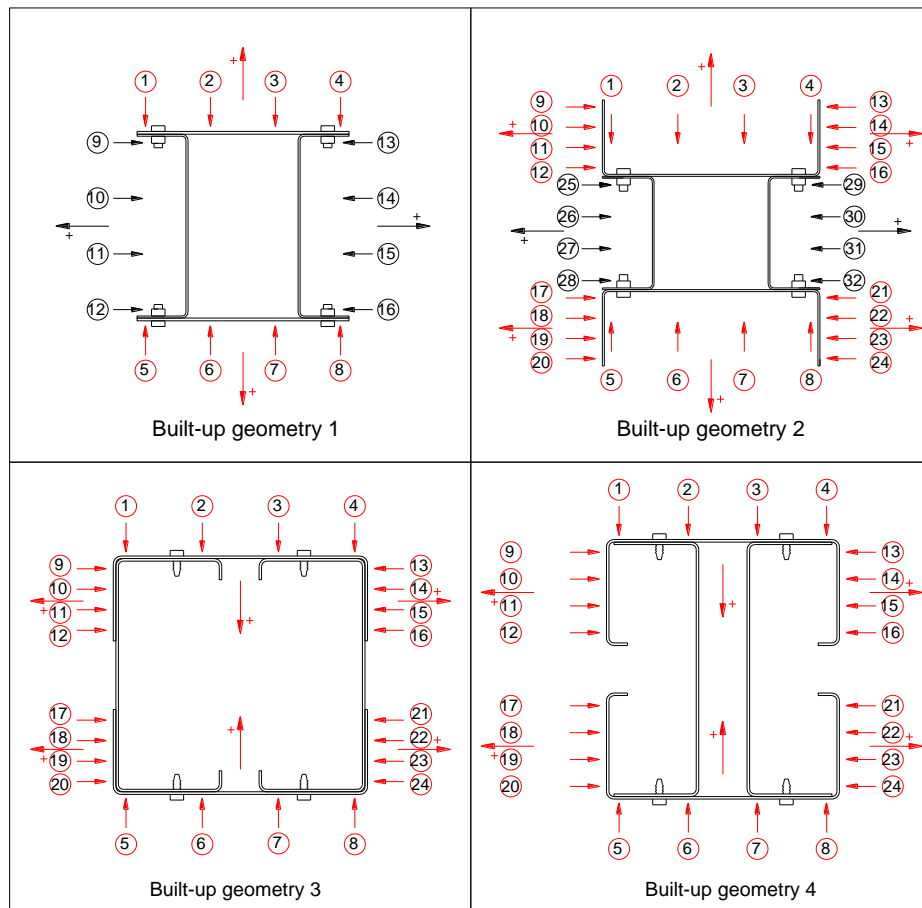


Figure H.300: Imperfections right lip channel S11012-24 (before assembly)

Appendix I

Long Columns Geometric Imperfections After Assembly

Appendix I contains the geometric imperfections recorded on the components of the long columns after they were assembled into their final configurations. In the figures, the coordinate along the length of the column is normalized by dividing it by the measured length. The location of each measuring line is represented in the diagram included below for each built-up geometry. The sign convention used for the imperfection measurements is included in the diagram. Further details about the imperfections recorded on the long columns are included in Section 5.6 of the main text.



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I.1. Built-up geometry 1 (LC1)

I.1.1 LC1-2a

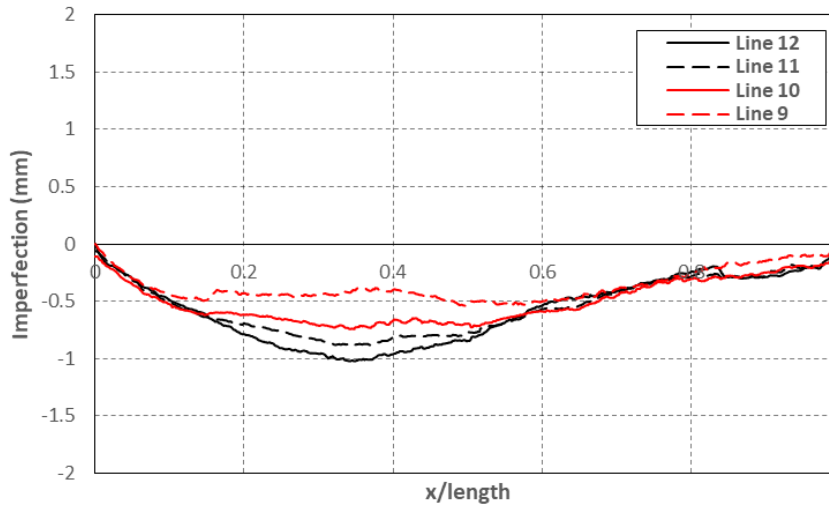


Figure I.1: Imperfections web channel T13014-1 (after assembly)

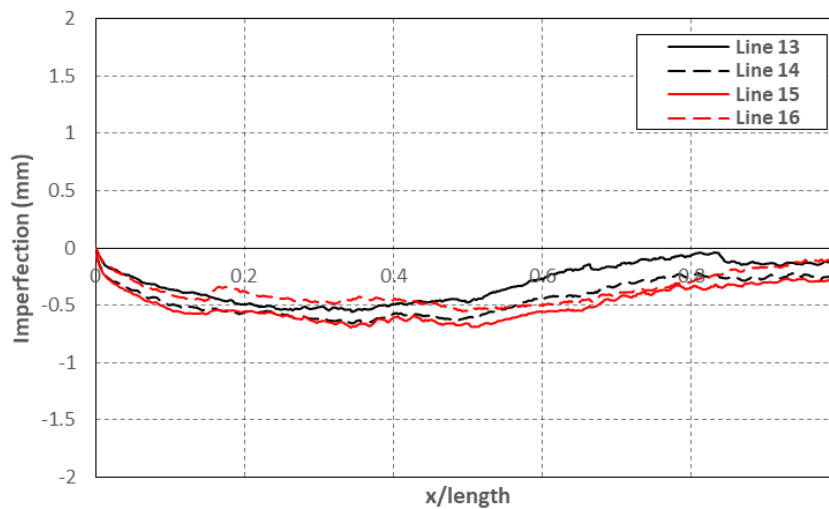


Figure I.2: Imperfections web channel T13014-2 (after assembly)

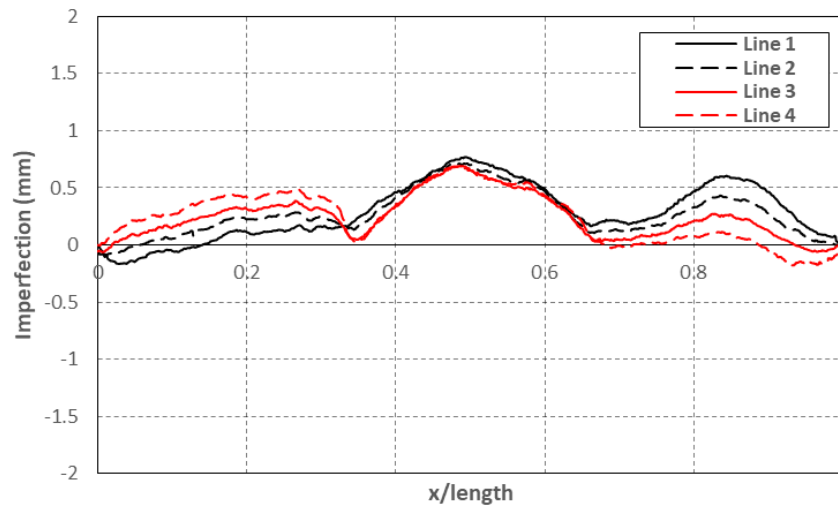


Figure I.3: Imperfections plate P15020-1 (after assembly)

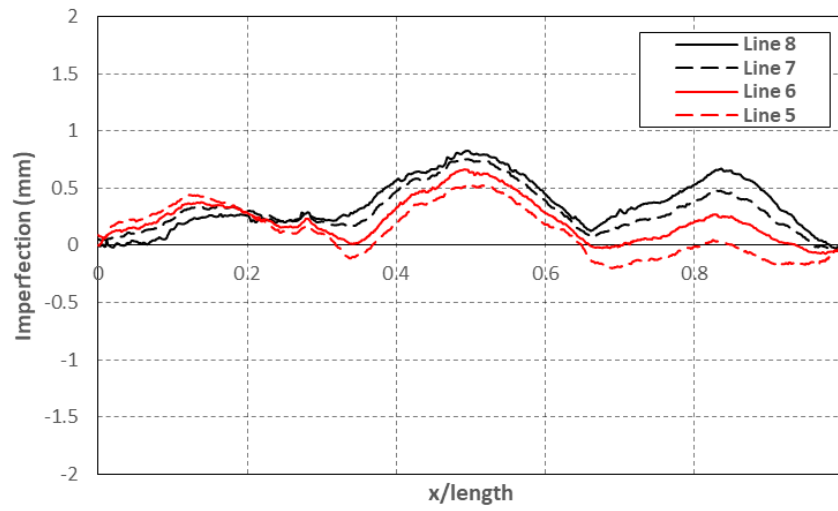


Figure I.4: Imperfections plate P15020-2 (after assembly)

I.1.2 LC1-2b

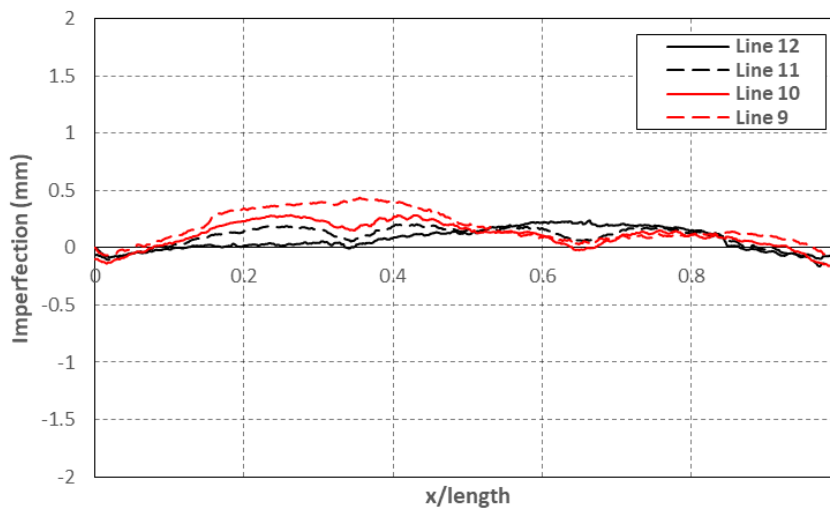


Figure I.5: Imperfections web channel T13014-3 (after assembly)

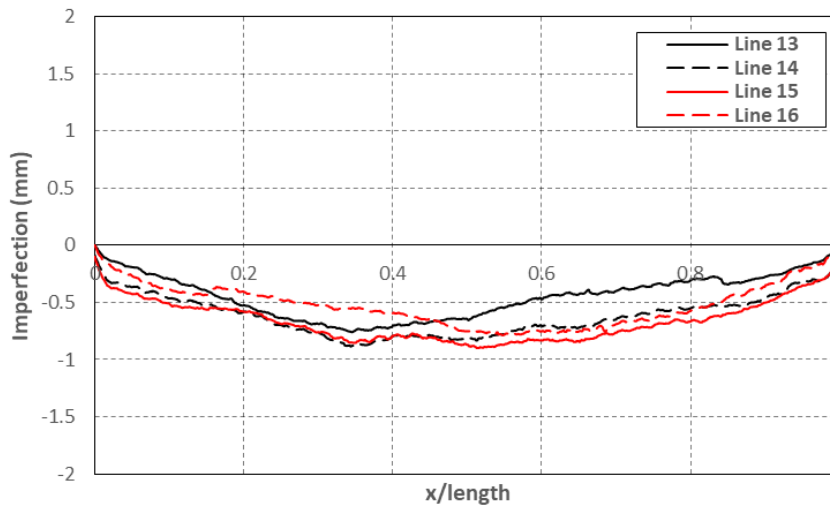


Figure I.6: Imperfections web channel T13014-4 (after assembly)

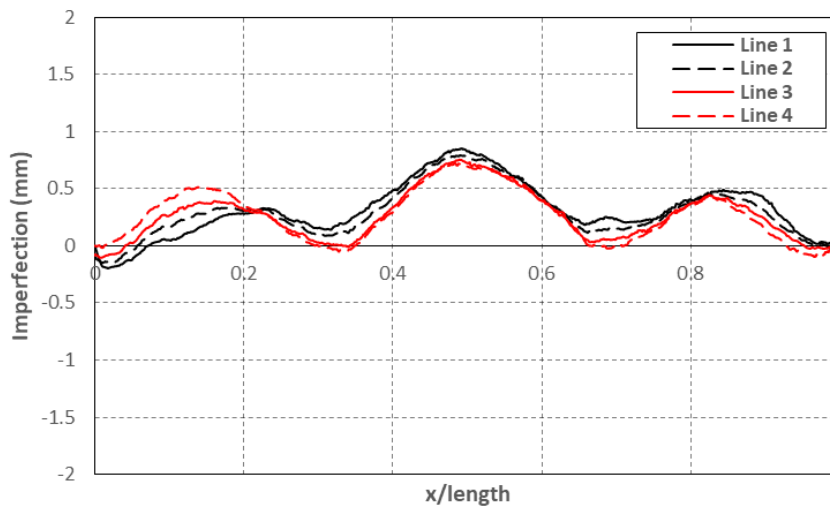


Figure I.7: Imperfections plate P15020-3 (after assembly)

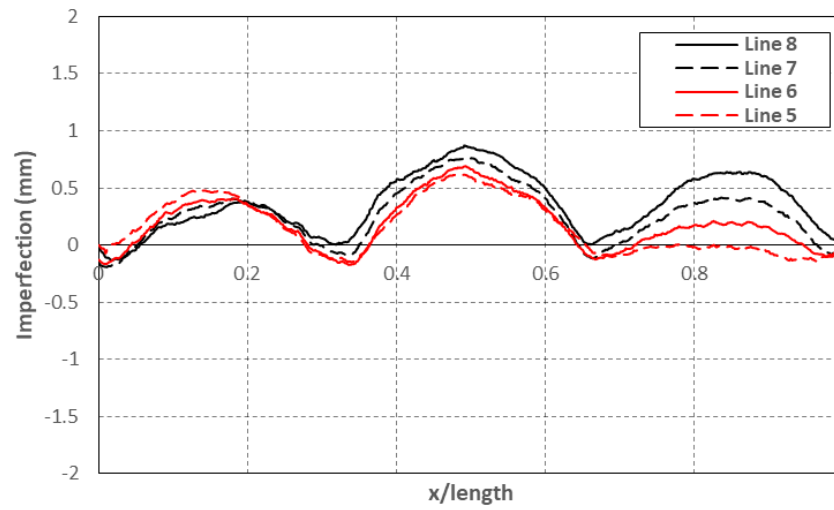


Figure I.8: Imperfections plate P15020-4 (after assembly)

I.1.3 LC1-3a

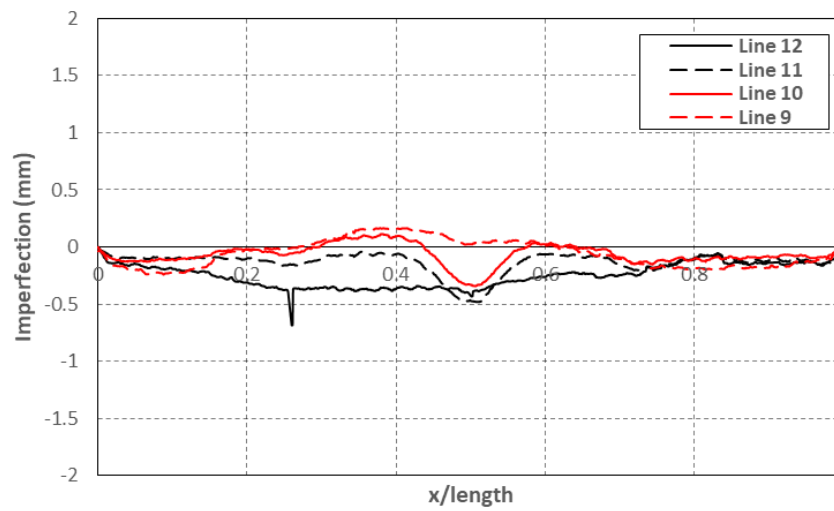


Figure I.9: Imperfections web channel T13014-5 (after assembly)

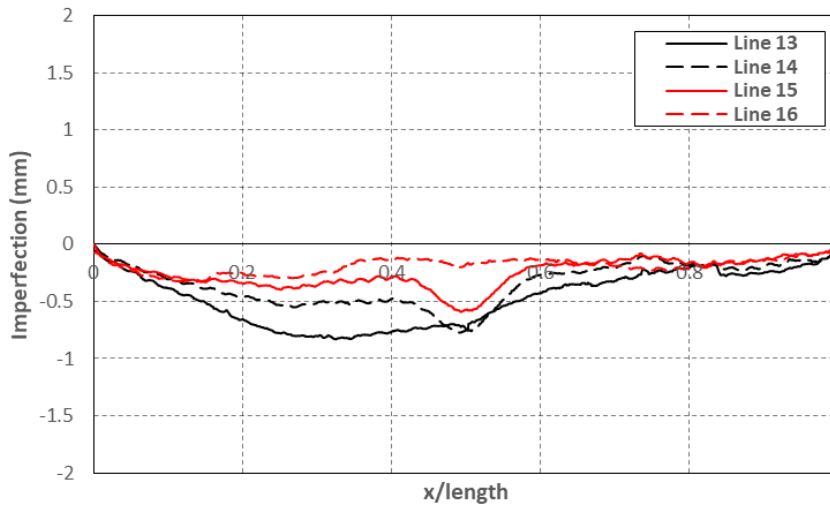


Figure I.10: Imperfections web channel T13014-6 (after assembly)

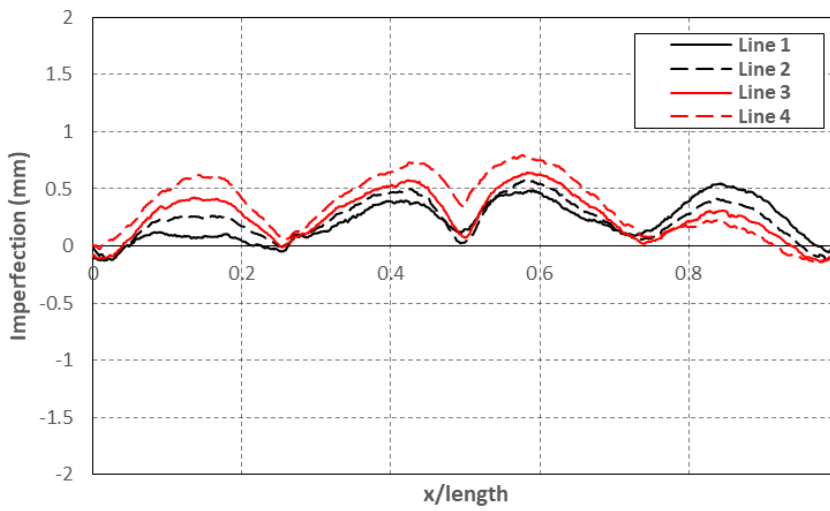


Figure I.11: Imperfections plate P15020-5 (after assembly)

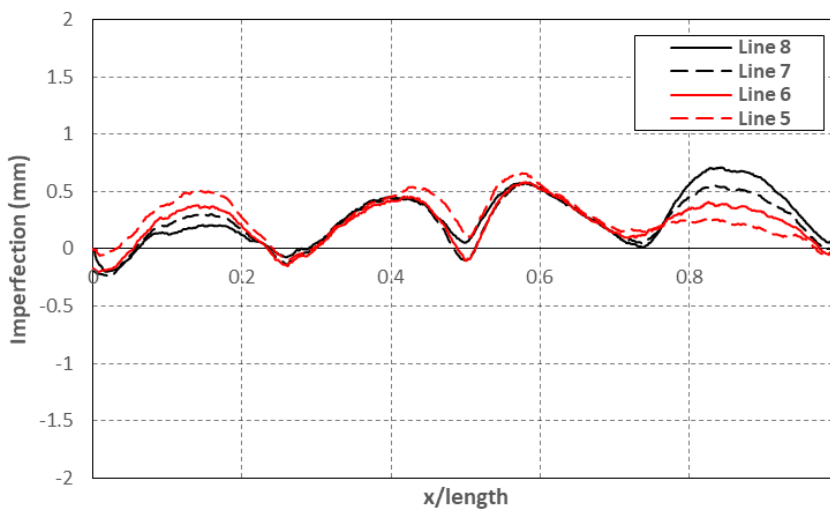


Figure I.12: Imperfections plate P15020-6 (after assembly)

I.1.4 LC1-3b

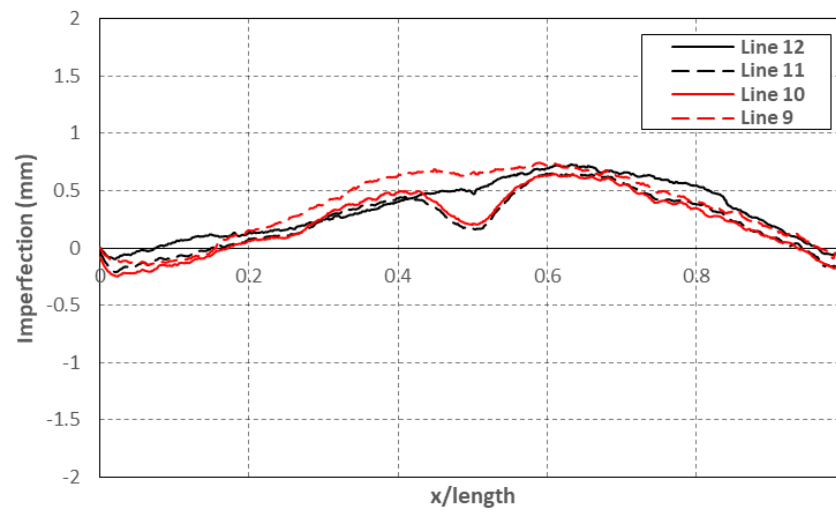


Figure I.13: Imperfections web channel T13014-7 (after assembly)

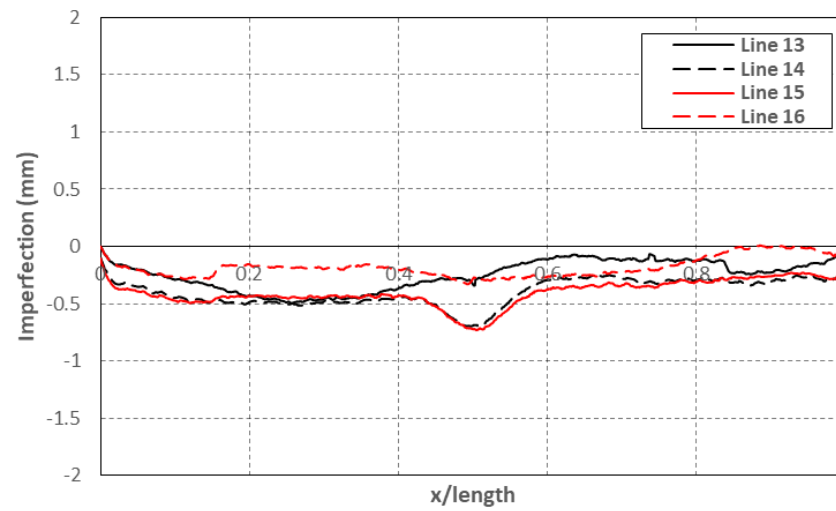


Figure I.14: Imperfections web channel T13014-8 (after assembly)

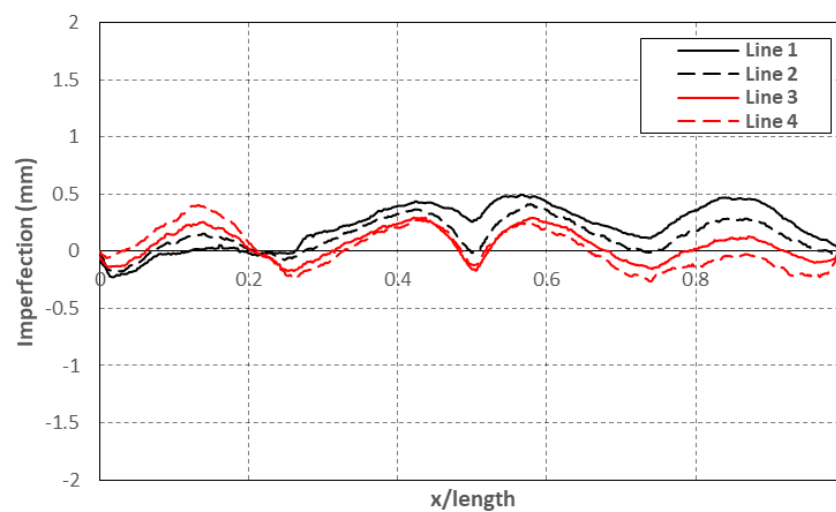


Figure I.15: Imperfections plate P15020-7 (after assembly)

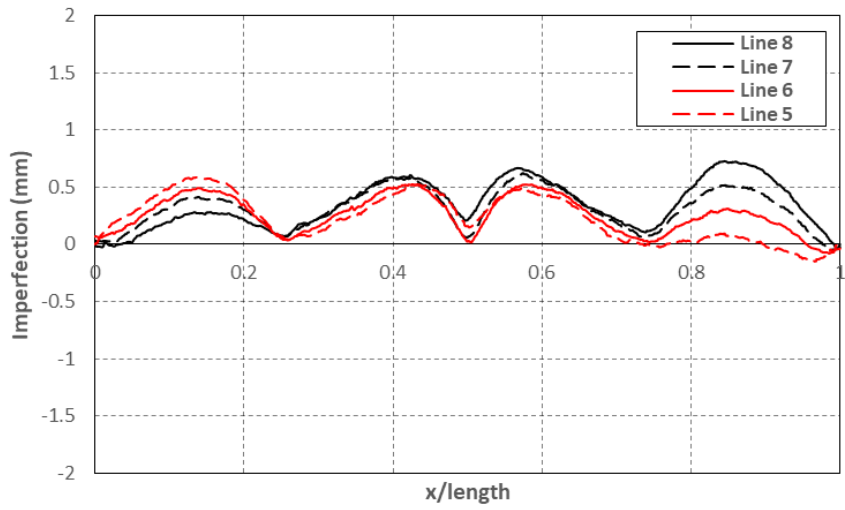


Figure I.16: Imperfections plate P15020-8 (after assembly)

I.1.5 LC1-8a

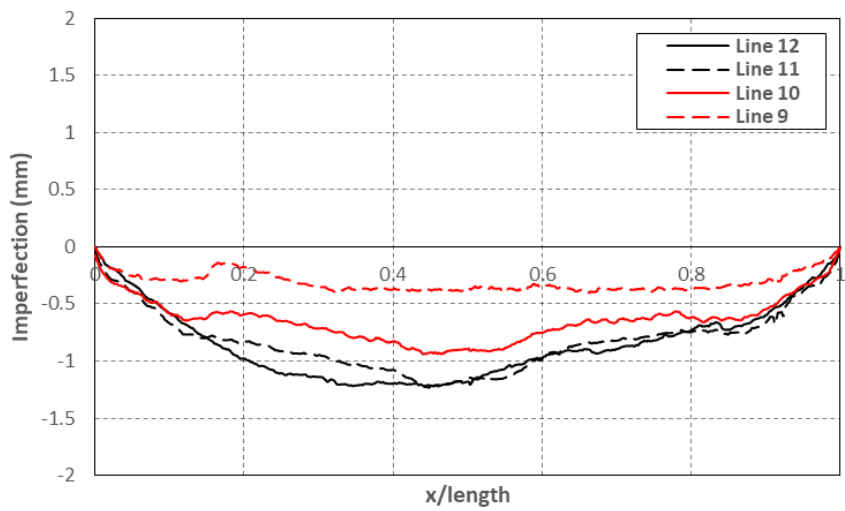


Figure I.17: Imperfections web channel T13014-9 (after assembly)

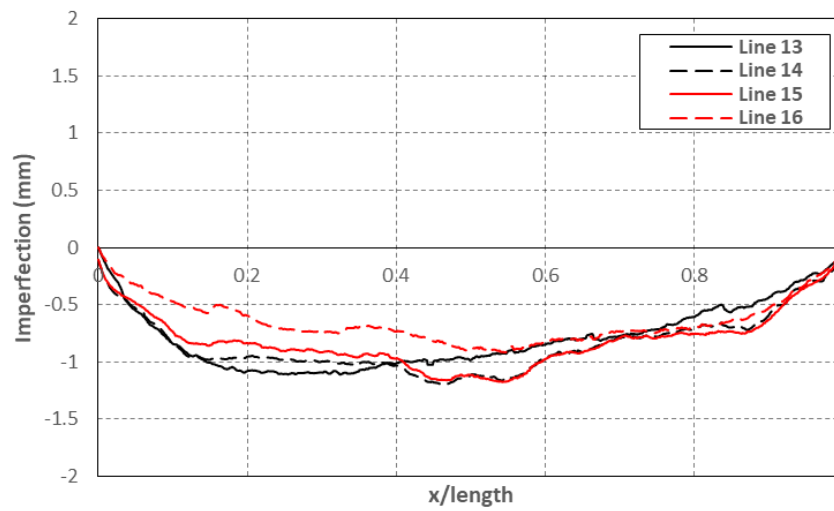


Figure I.18: Imperfections web channel T13014-10 (after assembly)

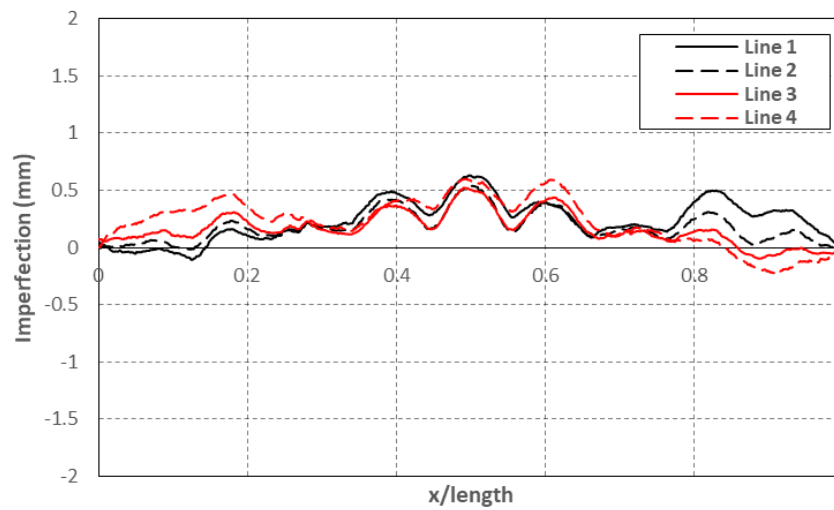


Figure I.19: Imperfections plate P15020-9 (after assembly)

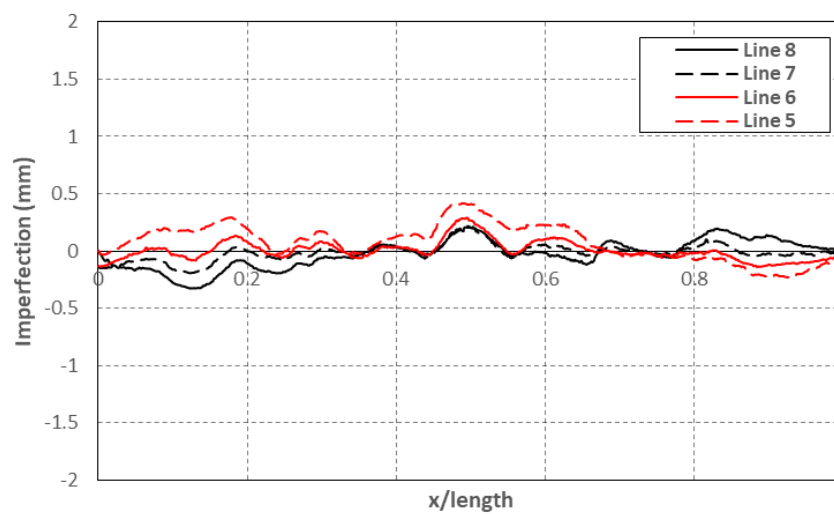


Figure I.20: Imperfections plate P15020-10 (after assembly)

I.1.6 LC1-8b

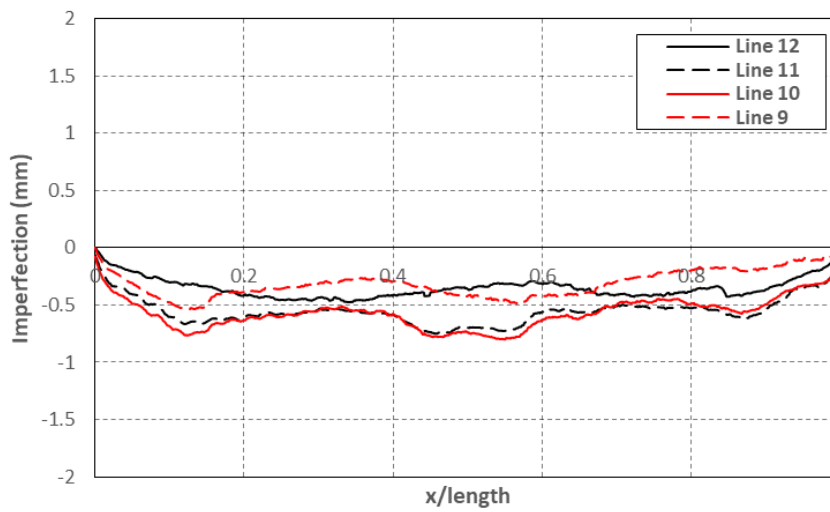


Figure I.21: Imperfections web channel T13014-11 (after assembly)

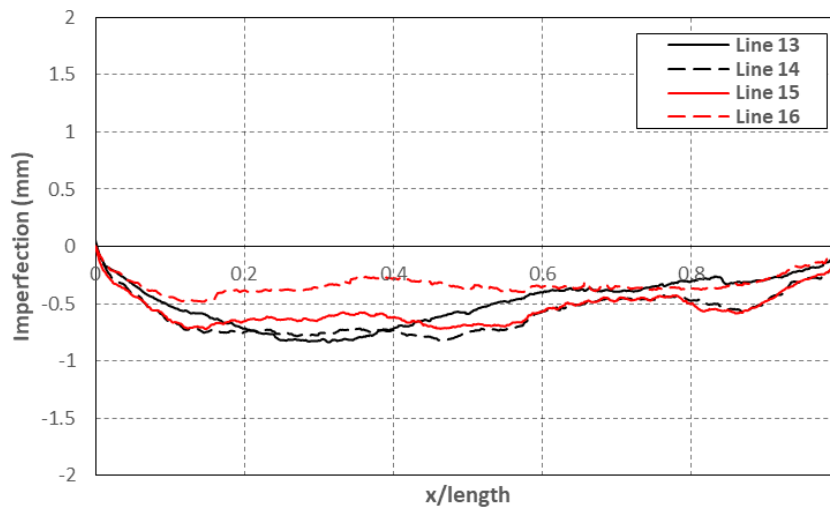


Figure I.22: Imperfections web channel T13014-12 (after assembly)

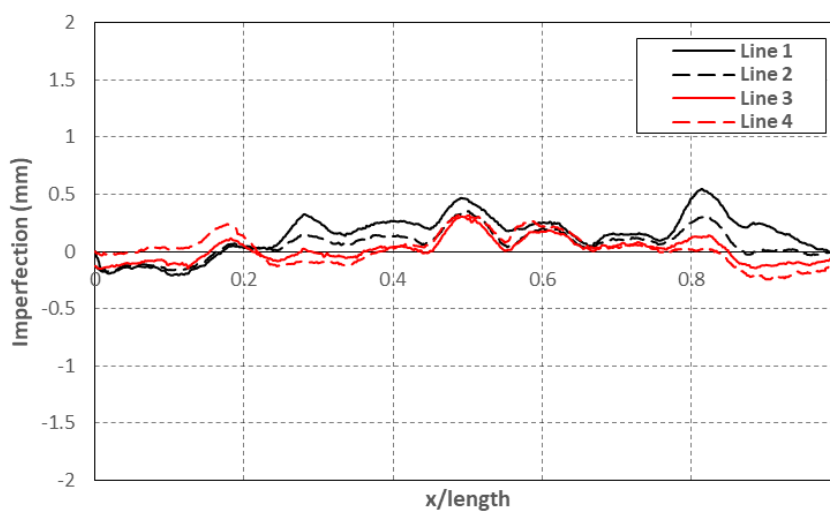


Figure I.23: Imperfections plate P15020-11 (after assembly)

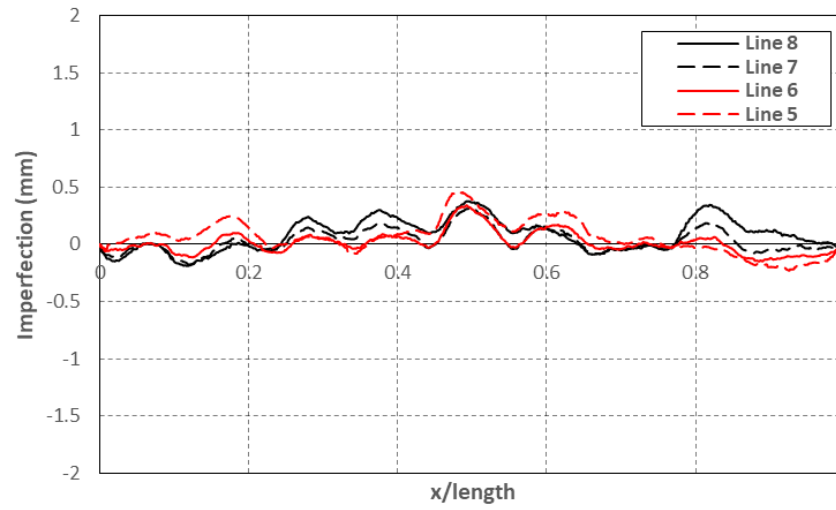


Figure I.24: Imperfections plate P15020-12 (after assembly)

I.2. Built-up geometry 2 (LC2)

I.2.1 LC2-2a

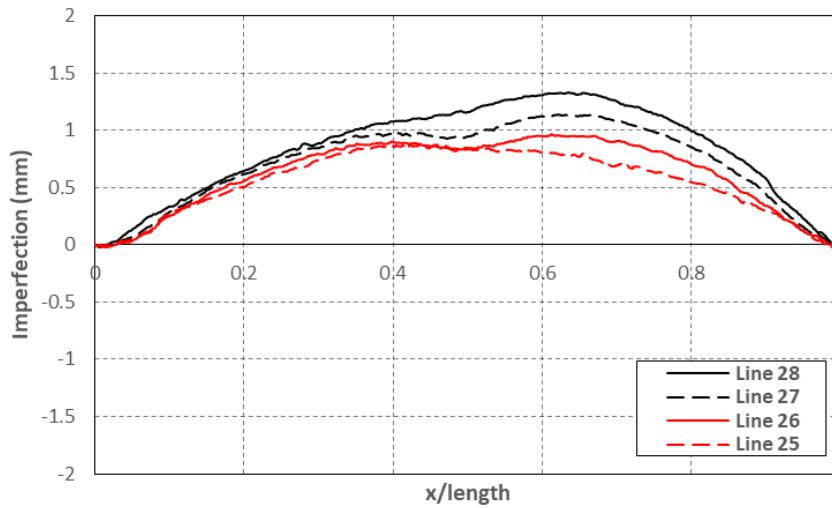


Figure I.25: Imperfections web channel T7914-1 (after assembly)

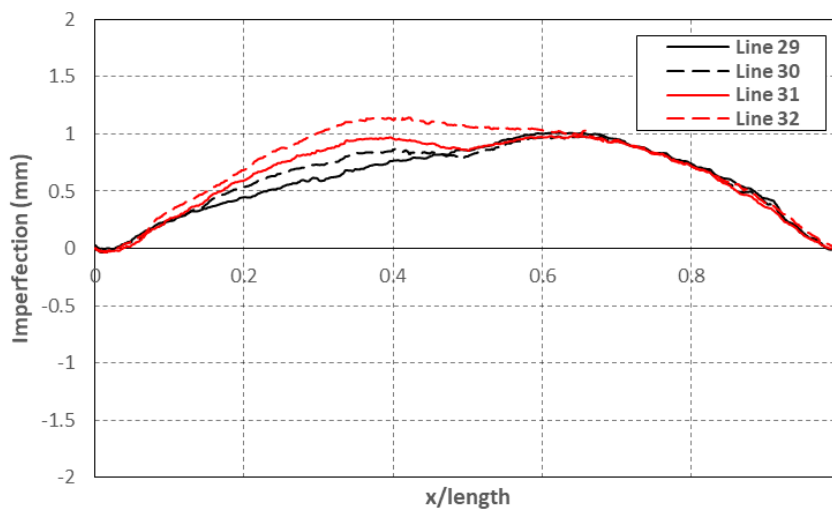


Figure I.26: Imperfections web channel T7914-2 (after assembly)

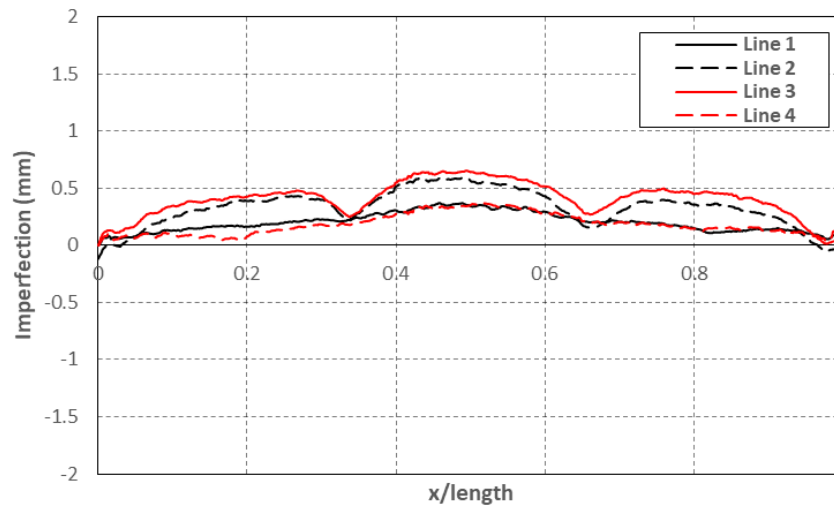


Figure I.27: Imperfections web channel T15414-1 (after assembly)

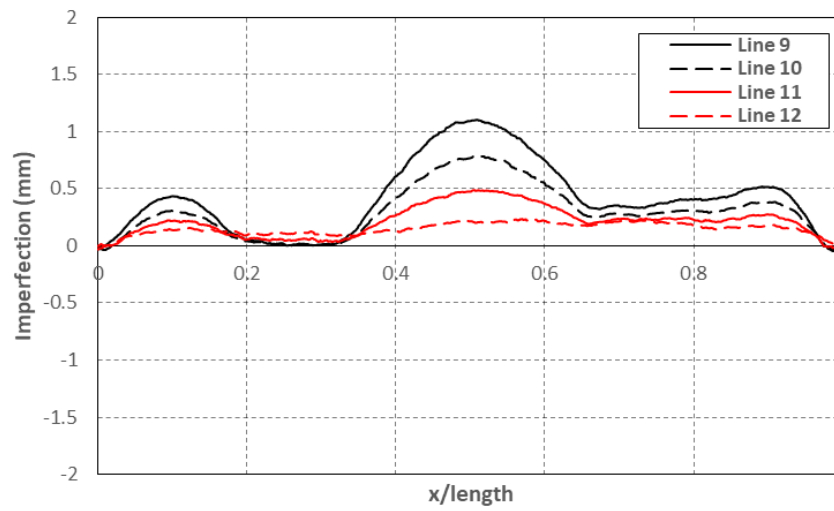


Figure I.28: Imperfections left flange channel T15414-1 (after assembly)

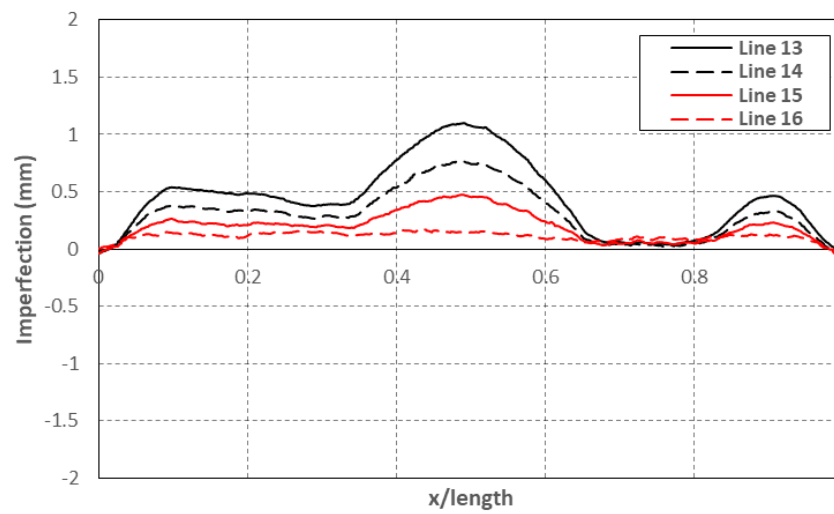


Figure I.29: Imperfections right flange channel T15414-1 (after assembly)

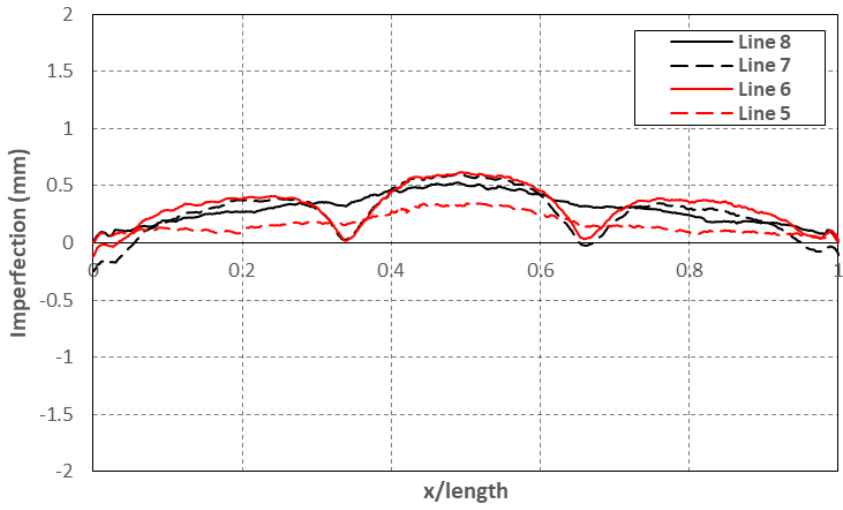


Figure I.30: Imperfections web channel T15414-2 (after assembly)

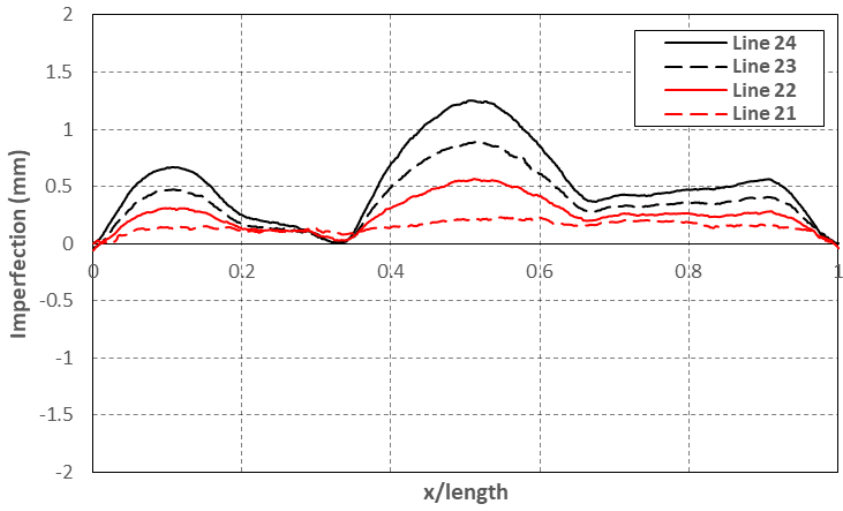


Figure I.31: Imperfections left flange channel T15414-2 (after assembly)

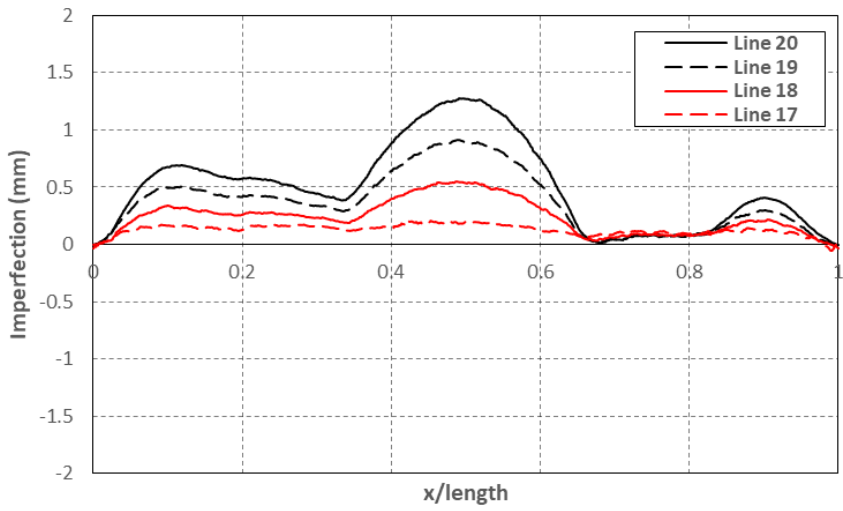


Figure I.32: Imperfections right flange channel T15414-2 (after assembly)

I.2.2 LC2-2b

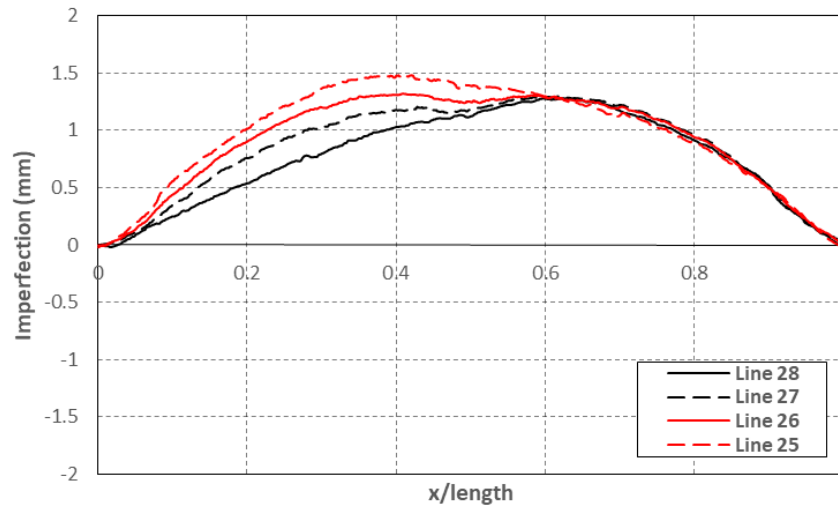


Figure I.33: Imperfections web channel T7914-3 (after assembly)

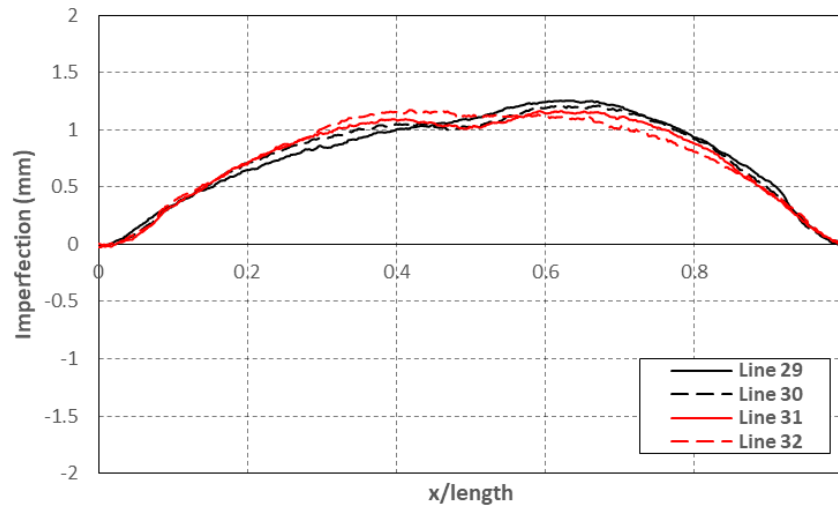


Figure I.34: Imperfections web channel T7914-4 (after assembly)

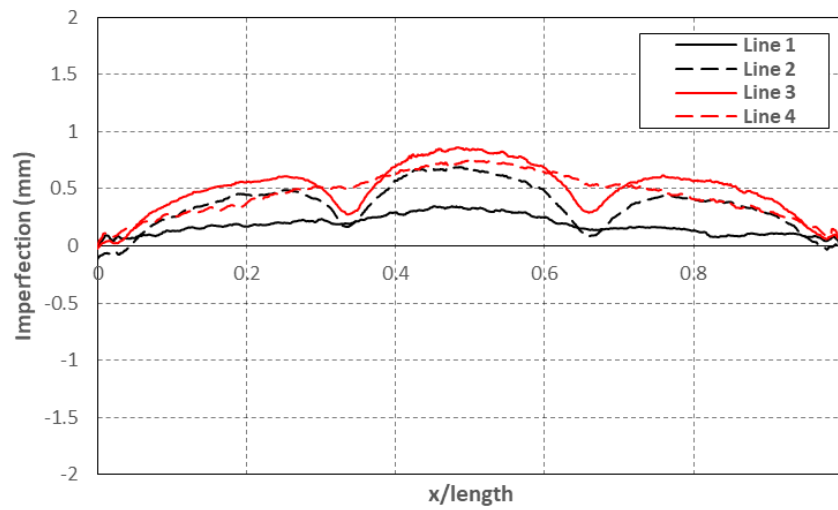


Figure I.35: Imperfections web channel T15414-3 (after assembly)

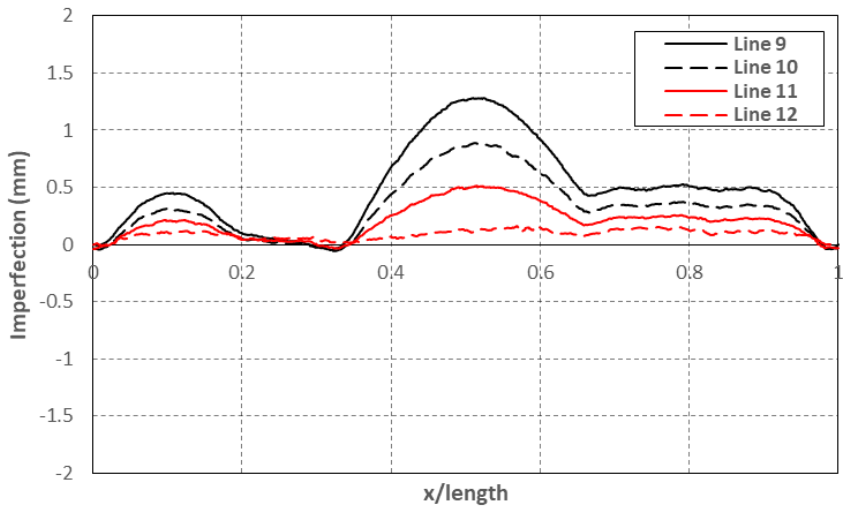


Figure I.36: Imperfections left flange channel T15414-3 (after assembly)

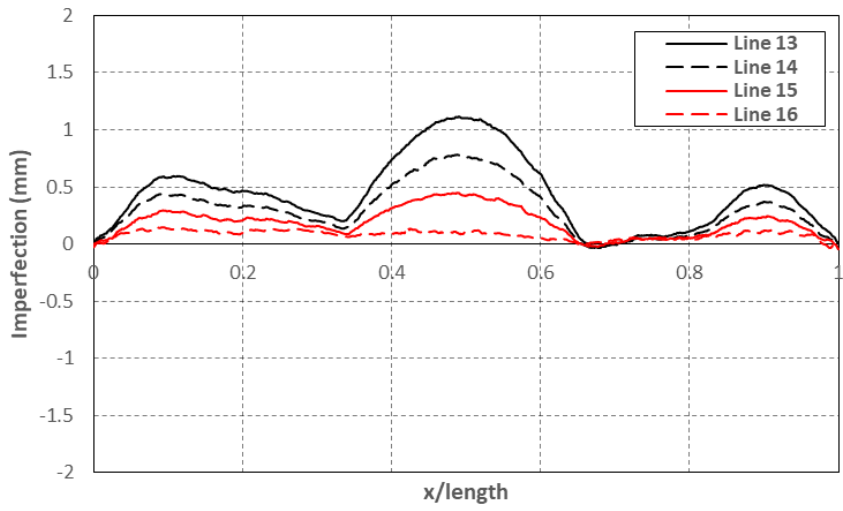


Figure I.37: Imperfections right flange channel T15414-3 (after assembly)

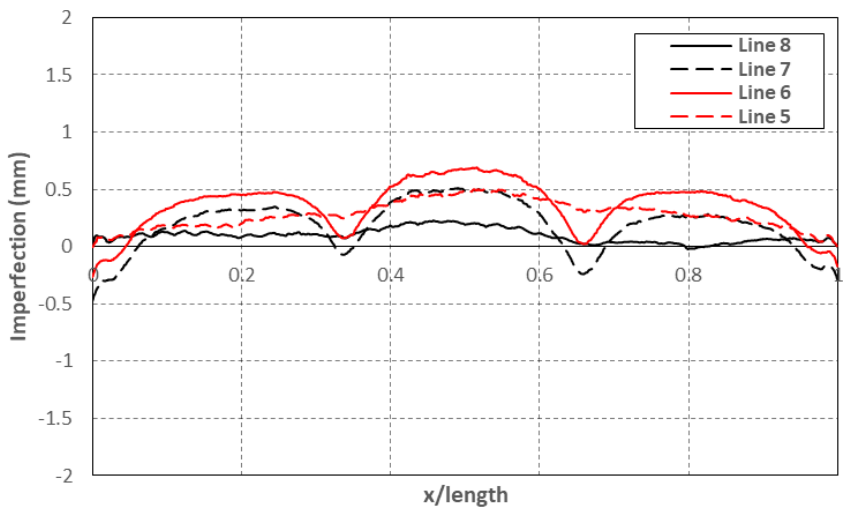


Figure I.38: Imperfections web channel T15414-4 (after assembly)

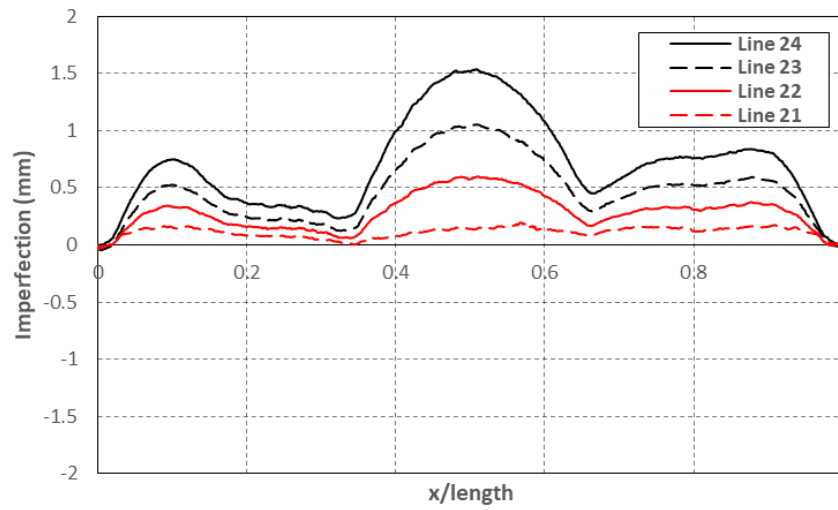


Figure I.39: Imperfections left flange channel T15414-4 (after assembly)

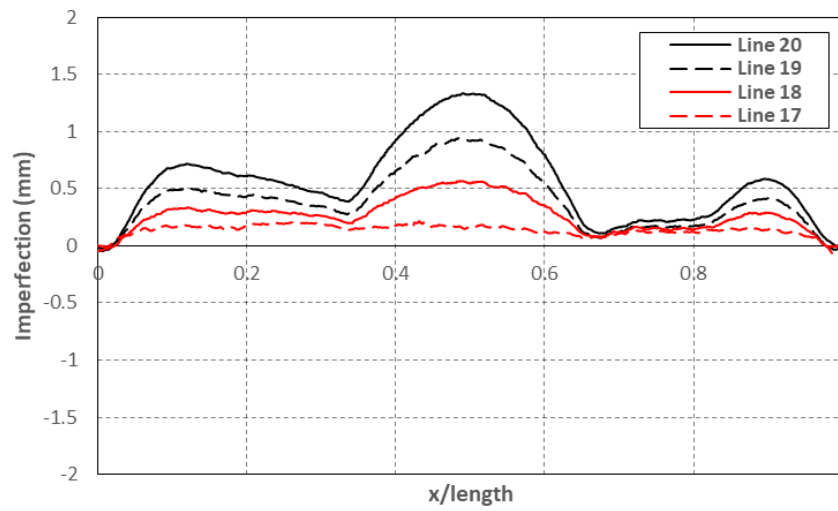


Figure I.40: Imperfections right flange channel T15414-4 (after assembly)

I.2.3 LC2-6a

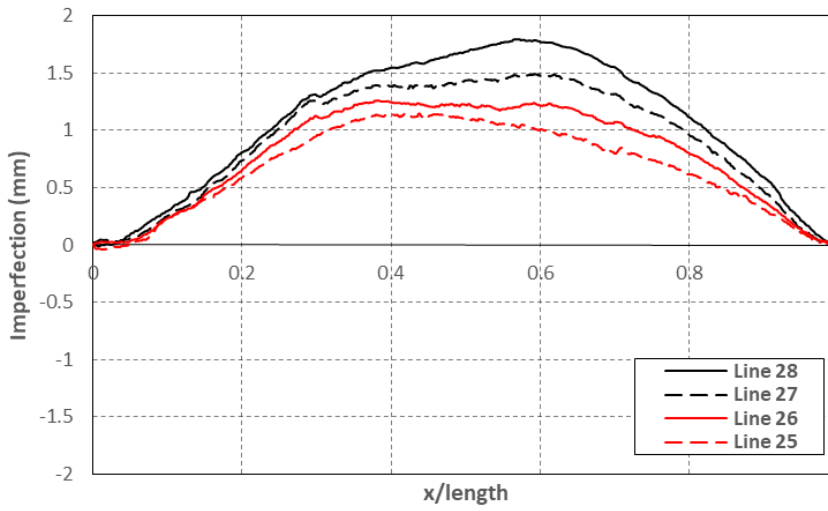


Figure I.41: Imperfections web channel T7914-5 (after assembly)

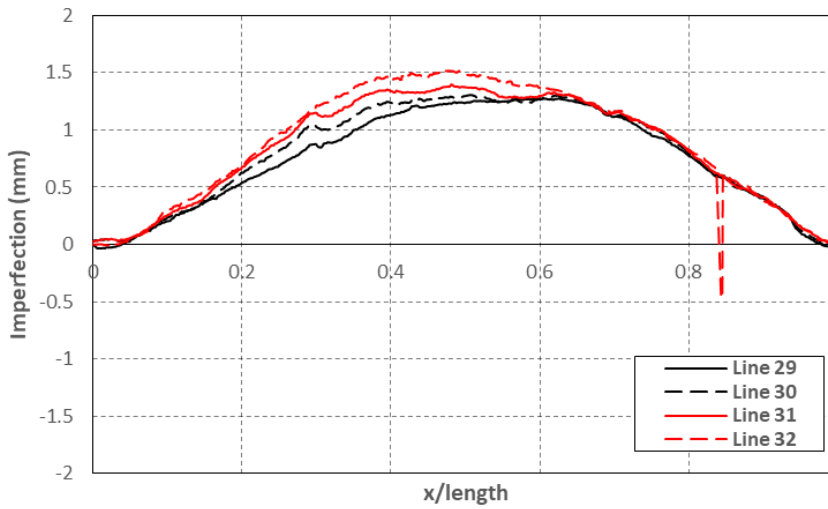


Figure I.42: Imperfections web channel T7914-6 (after assembly)

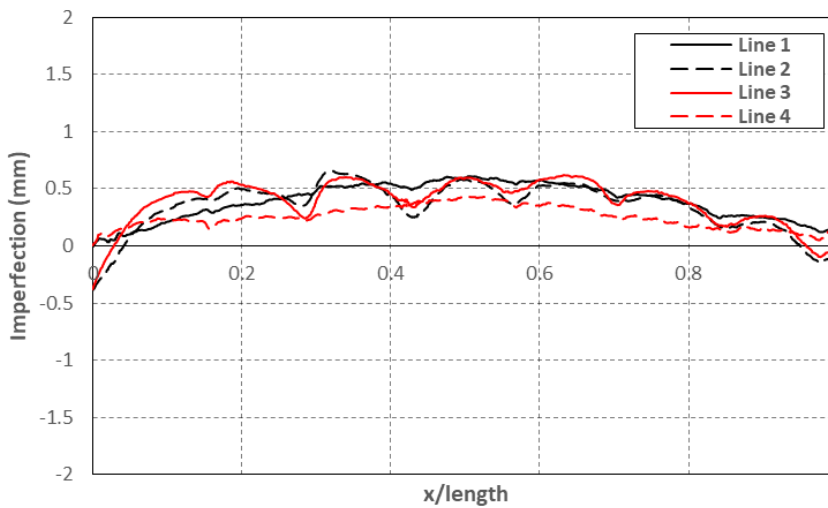


Figure I.43: Imperfections web channel T15414-5 (after assembly)

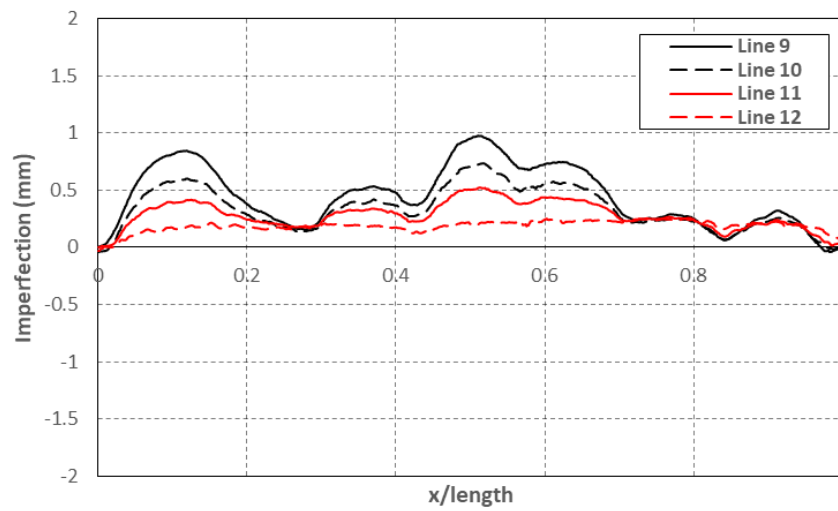


Figure I.44: Imperfections left flange channel T15414-5 (after assembly)

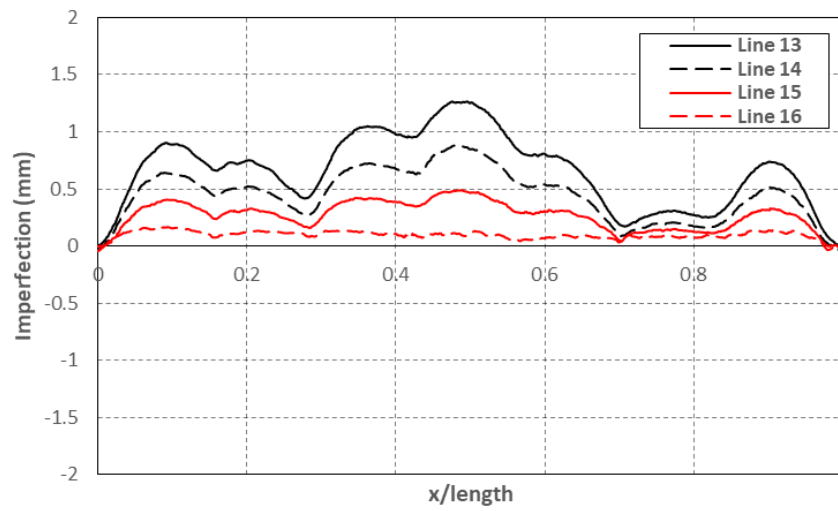


Figure I.45: Imperfections right flange channel T15414-5 (after assembly)

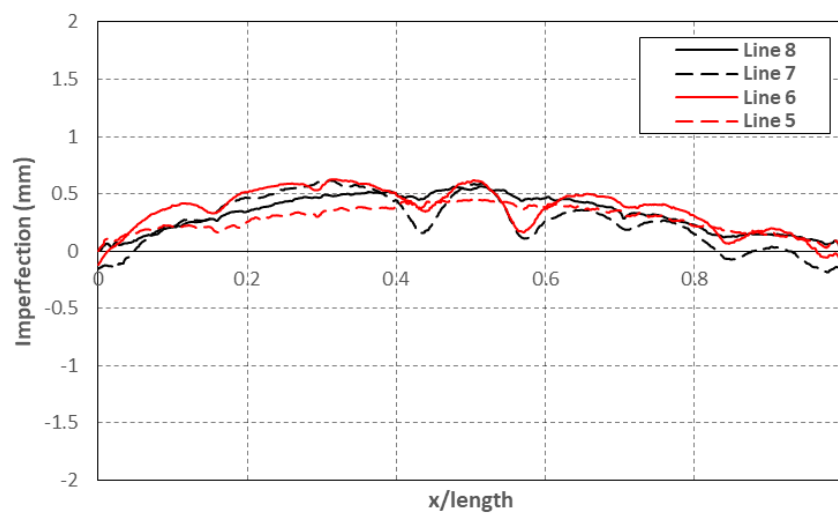


Figure I.46: Imperfections web channel T15414-6 (after assembly)

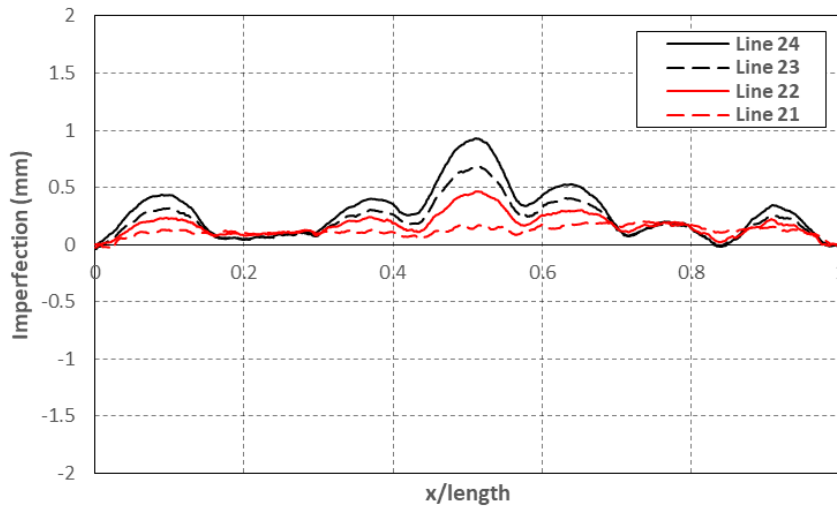


Figure I.47: Imperfections left flange channel T15414-6 (after assembly)

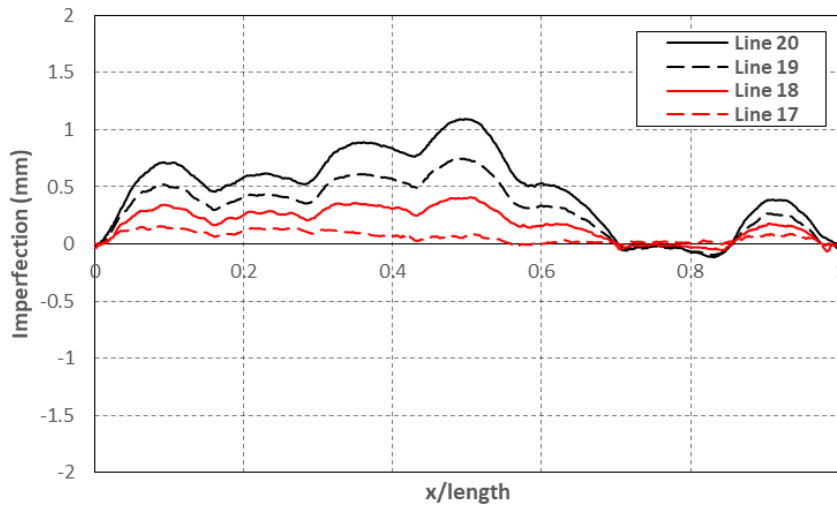


Figure I.48: Imperfections right flange channel T15414-6 (after assembly)

I.2.4 LC2-6b

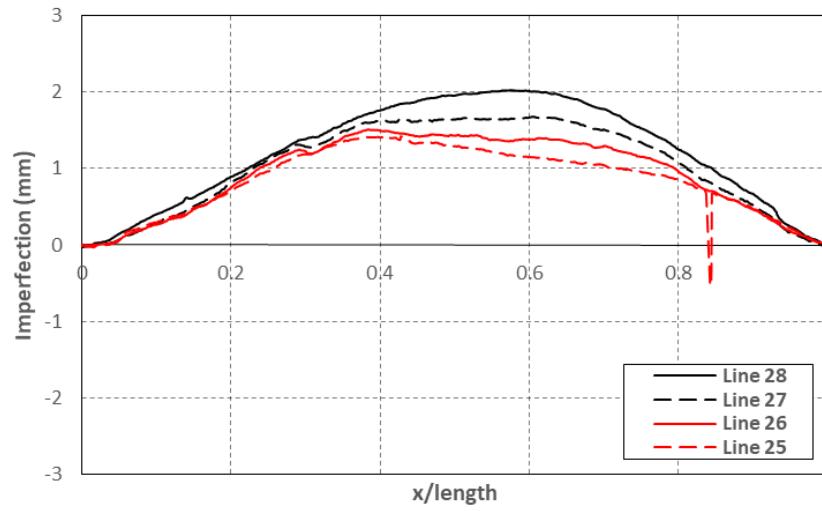


Figure I.49: Imperfections web channel T7914-7 (after assembly)

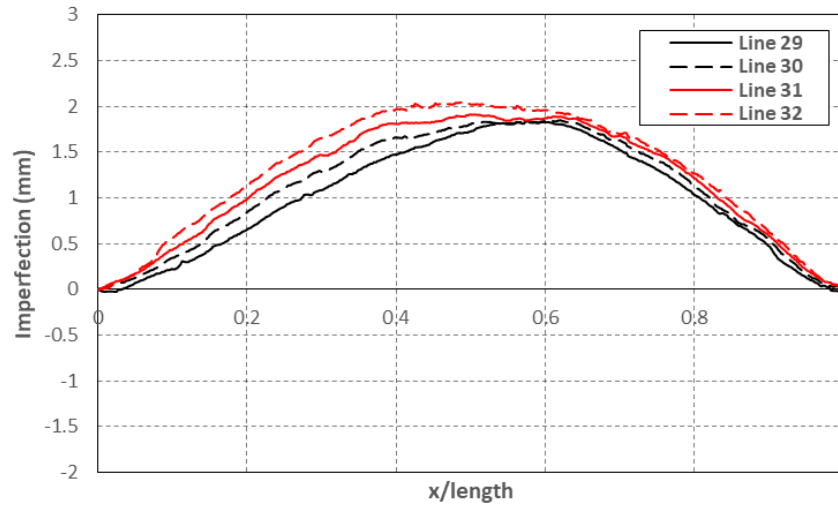


Figure I.50: Imperfections web channel T7914-8 (after assembly)

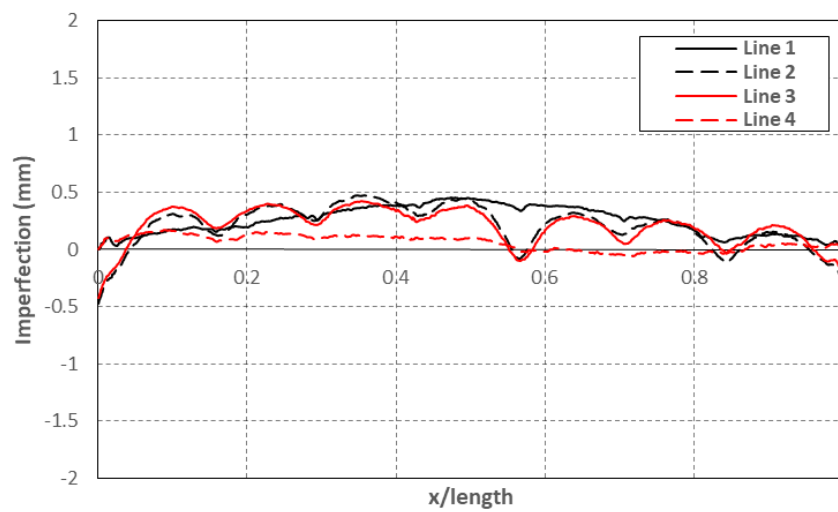


Figure I.51: Imperfections web channel T15414-7 (after assembly)

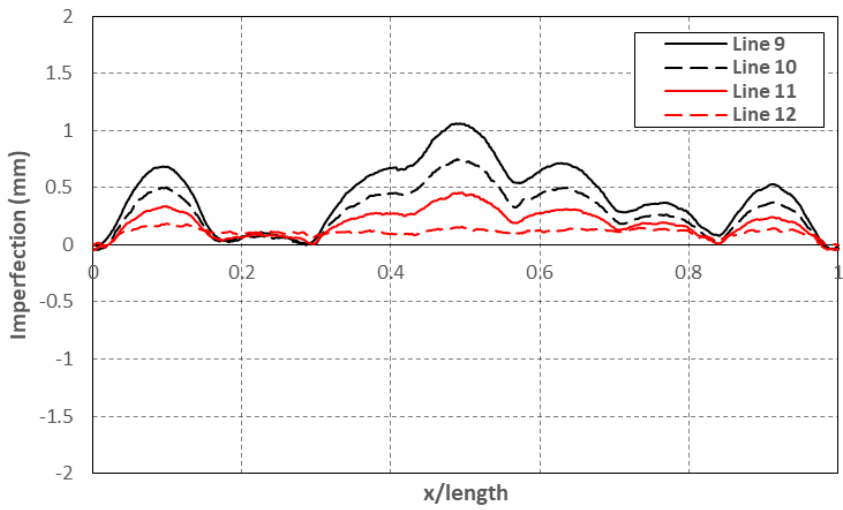


Figure I.52: Imperfections left flange channel T15414-7 (after assembly)

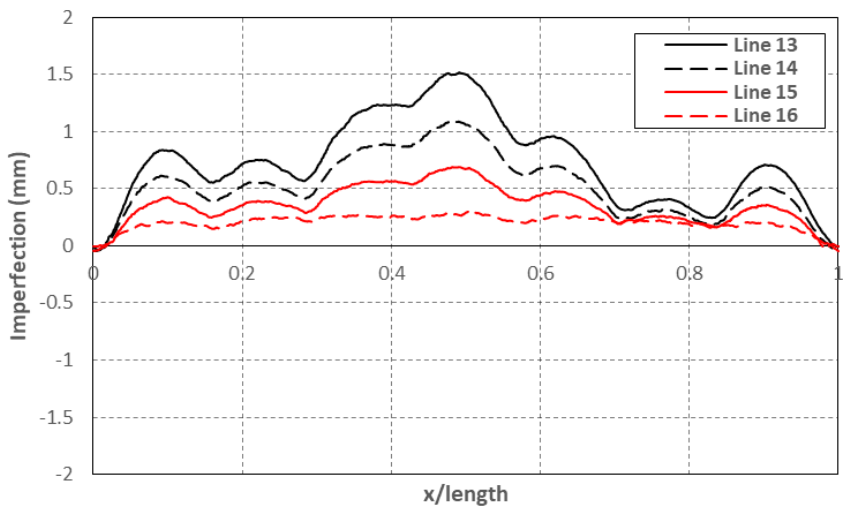


Figure I.53: Imperfections right flange channel T15414-7 (after assembly)

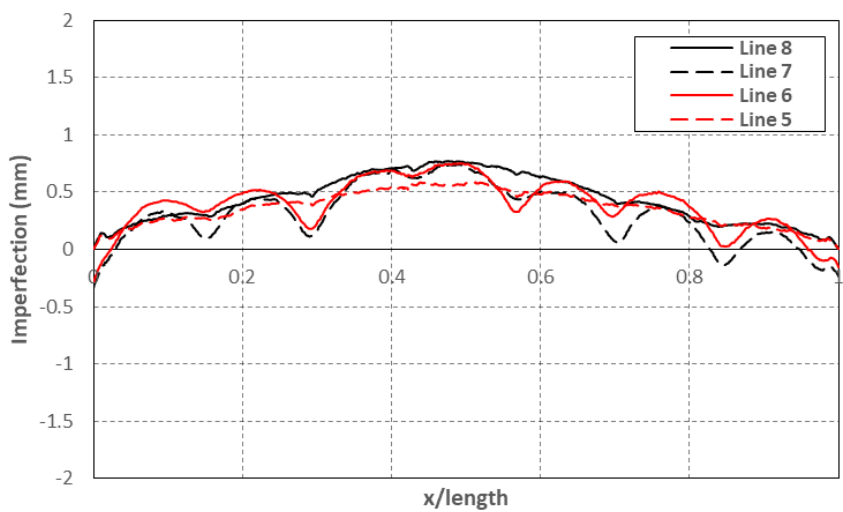


Figure I.54: Imperfections web channel T15414-8 (after assembly)

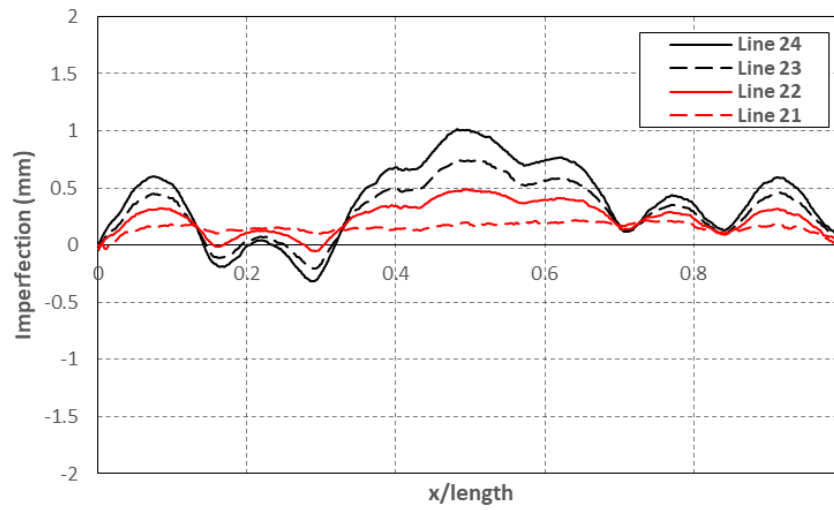


Figure I.55: Imperfections left flange channel T15414-8 (after assembly)

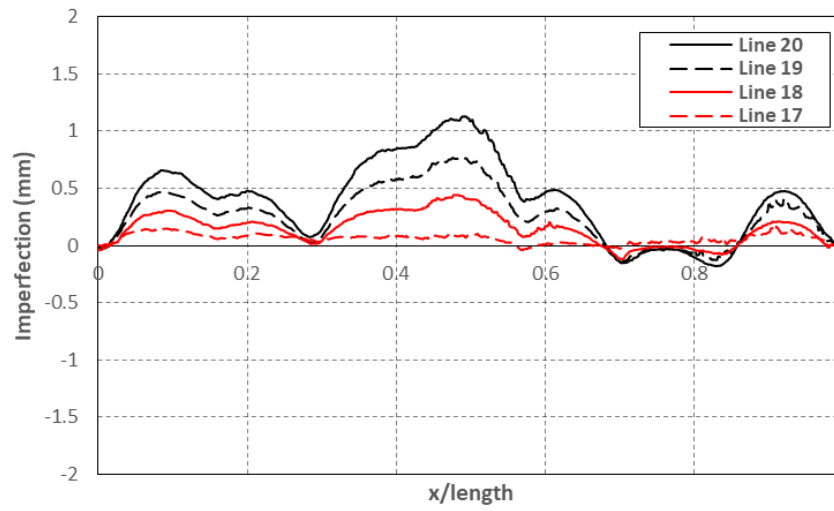


Figure I.56: Imperfections right flange channel T15414-8 (after assembly)

I.2.5 LC2-4a

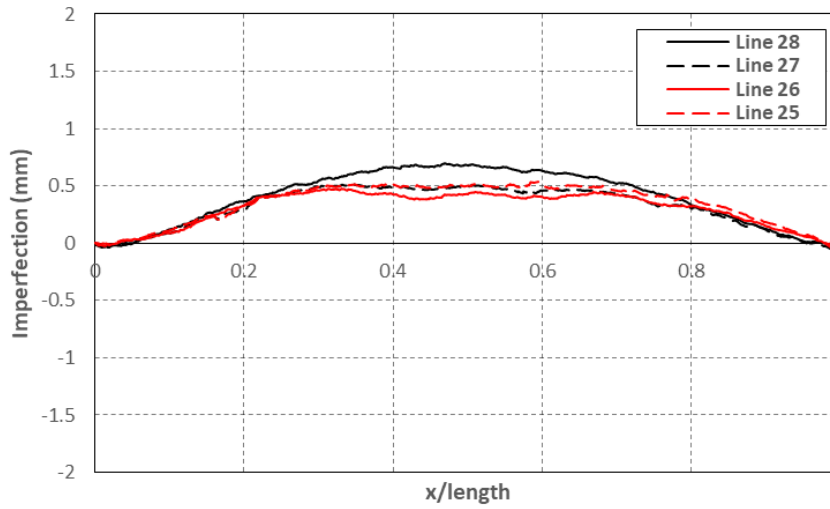


Figure I.57: Imperfections web channel T7914-9 (after assembly)

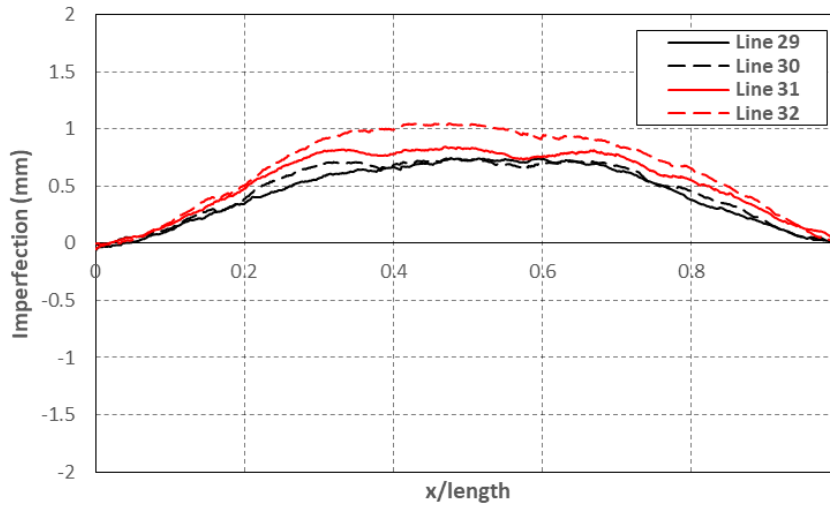


Figure I.58: Imperfections web channel T7914-10 (after assembly)

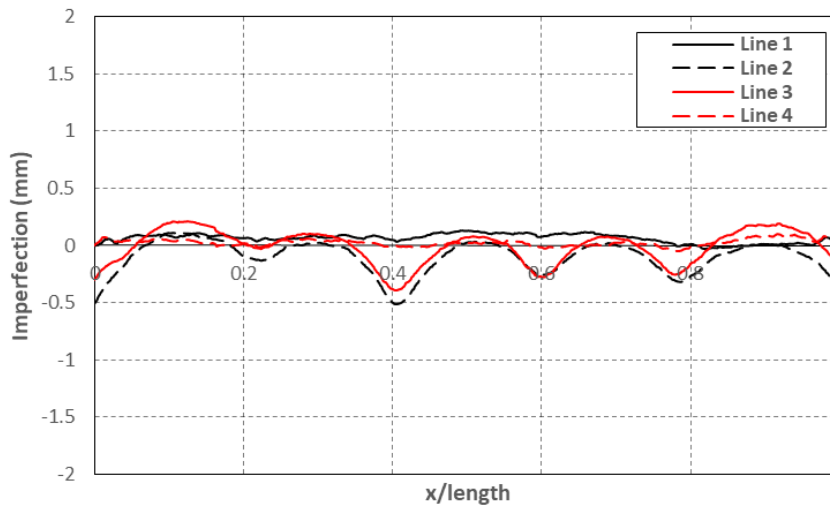


Figure I.59: Imperfections web channel T15414-9 (after assembly)

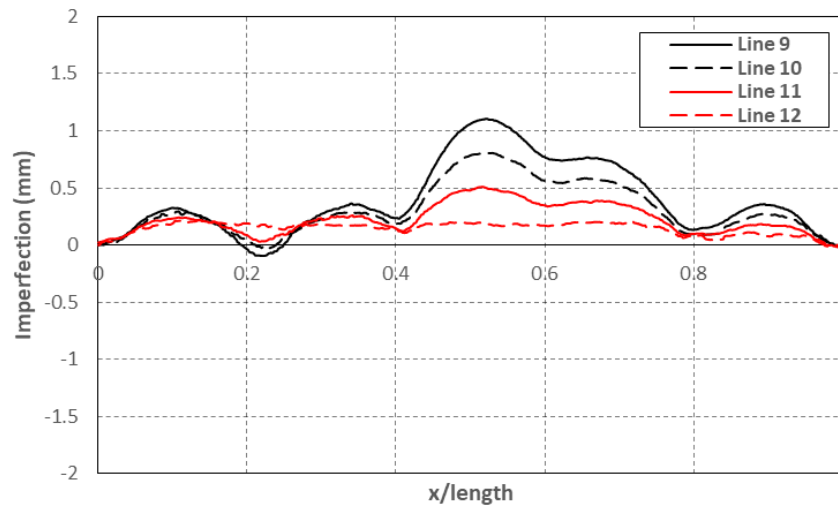


Figure I.60: Imperfections left flange channel T15414-9 (after assembly)

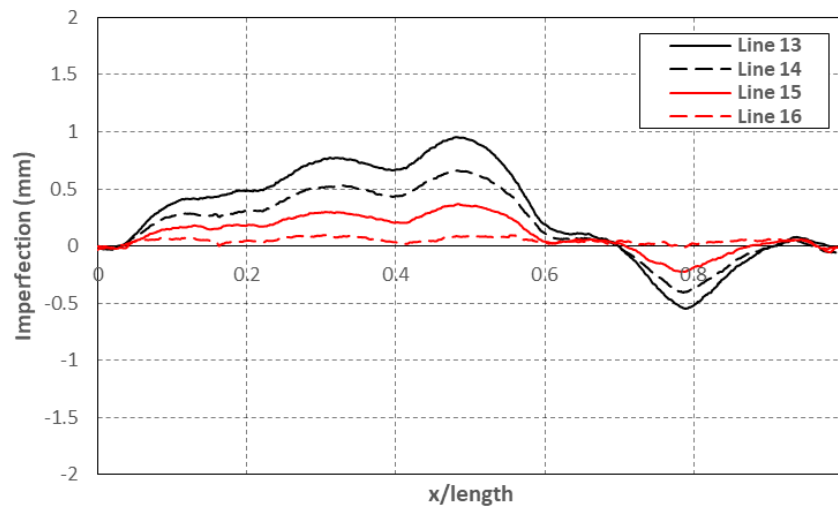


Figure I.61: Imperfections right flange channel T15414-9 (after assembly)

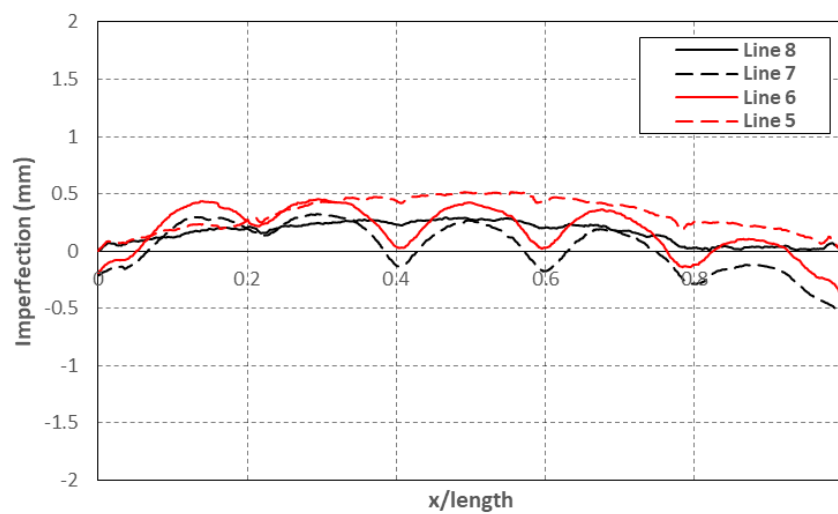


Figure I.62: Imperfections web channel T15414-10 (after assembly)

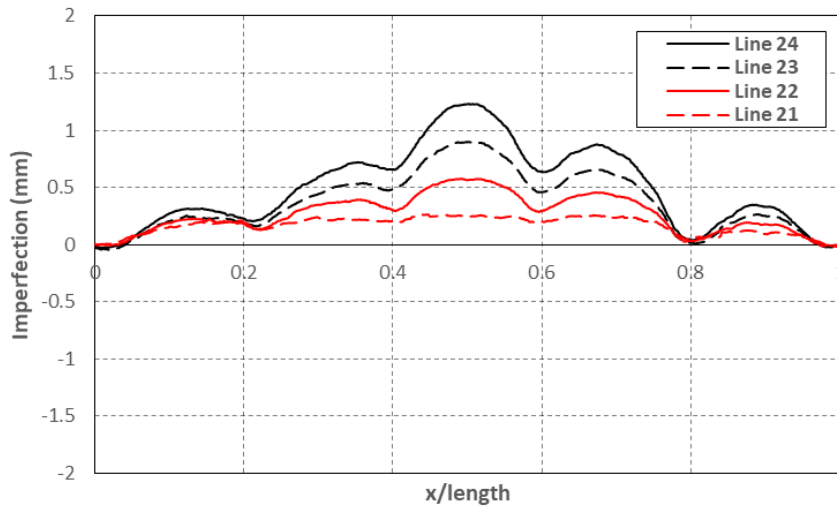


Figure I.63: Imperfections left flange channel T15414-10 (after assembly)

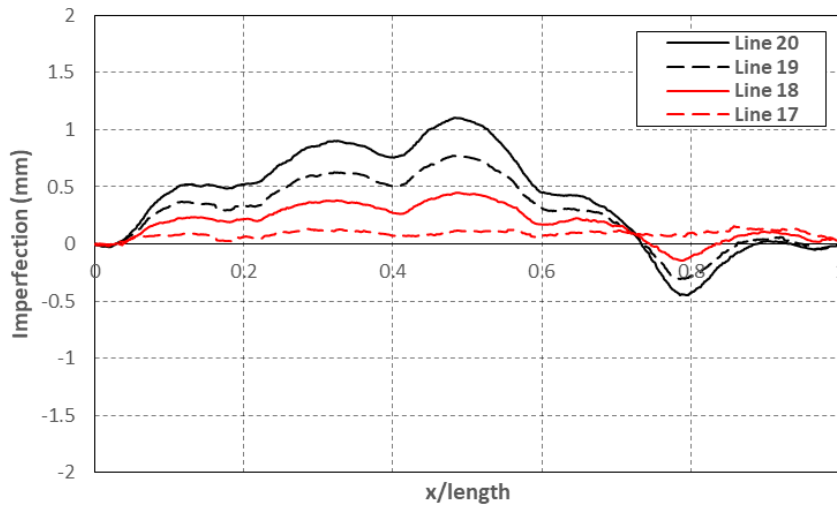


Figure I.64: Imperfections right flange channel T15414-10 (after assembly)

I.2.6 LC2-4b

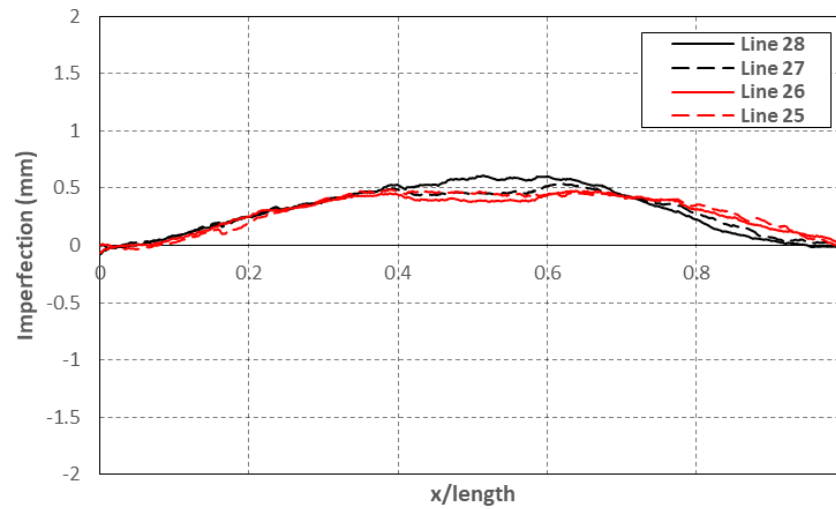


Figure I.65: Imperfections web channel T7914-11 (after assembly)

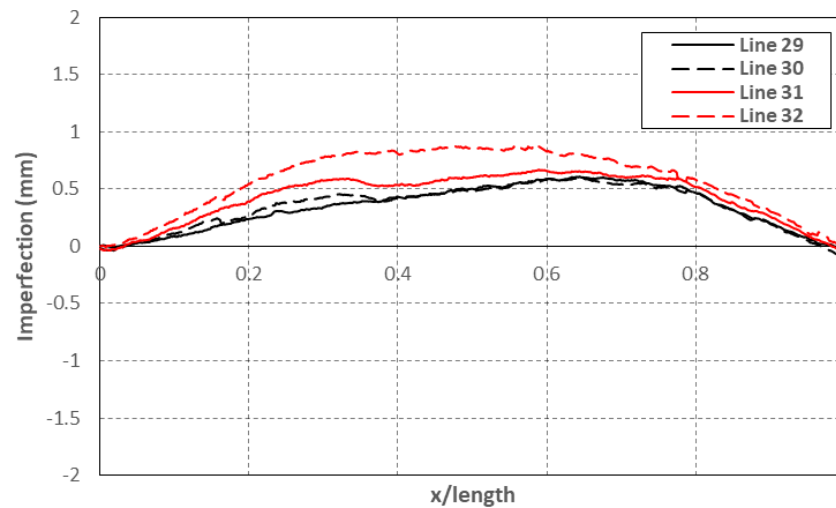


Figure I.66: Imperfections web channel T7914-12 (after assembly)

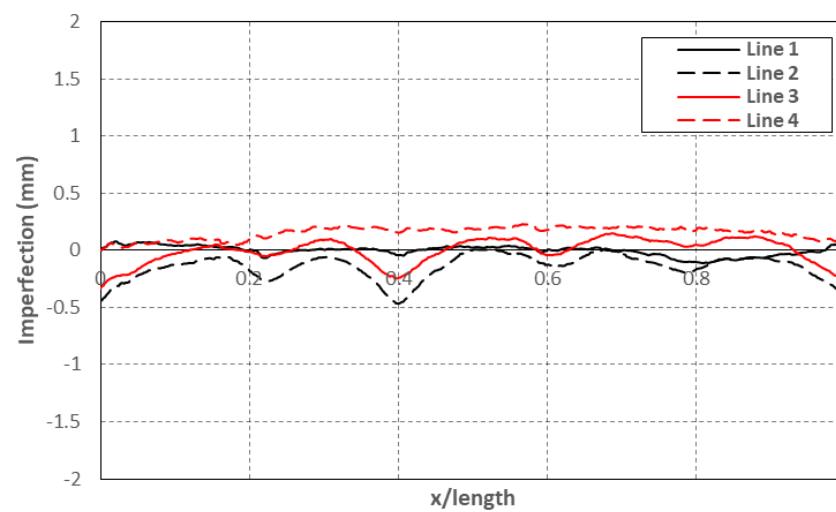


Figure I.67: Imperfections web channel T15414-11 (after assembly)

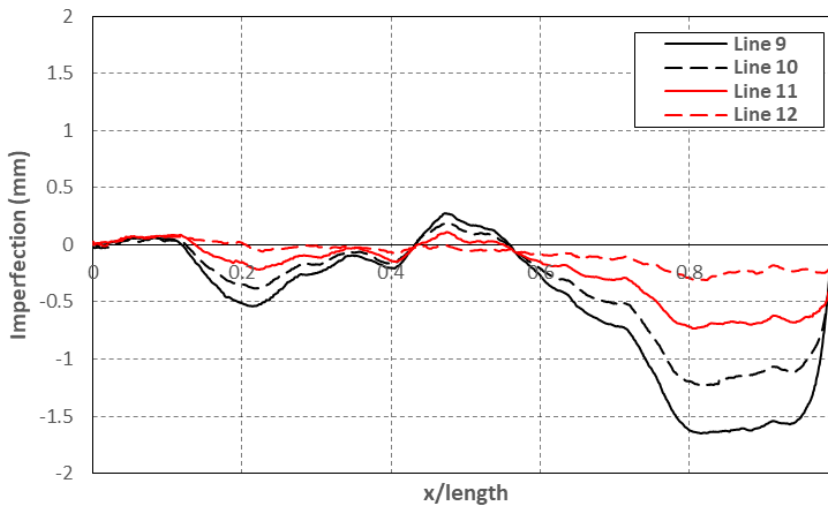


Figure I.68: Imperfections left flange channel T15414-11 (after assembly)

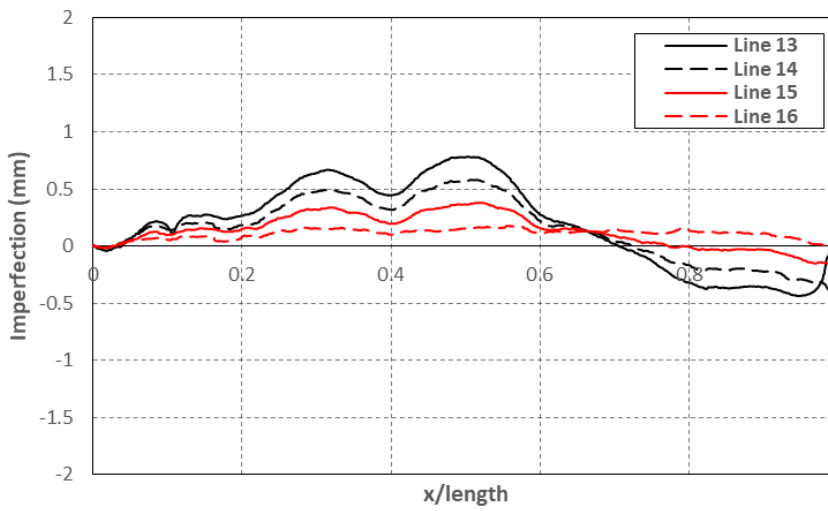


Figure I.69: Imperfections right flange channel T15414-11 (after assembly)

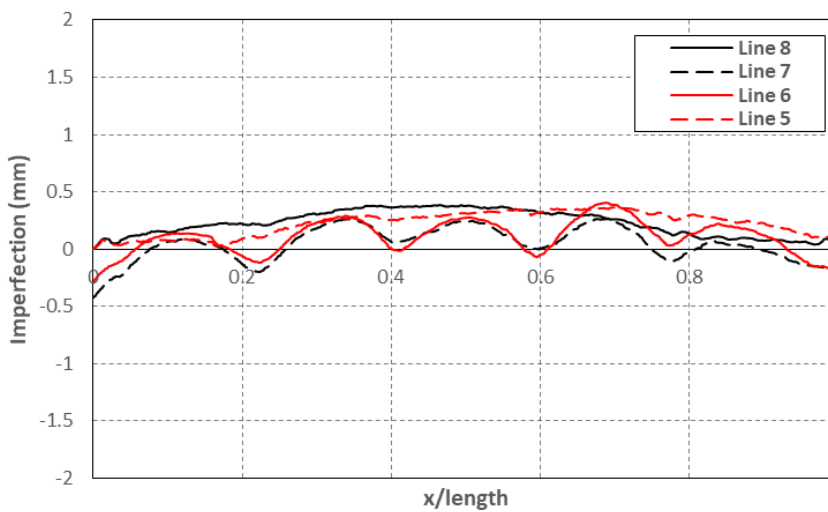


Figure I.70: Imperfections web channel T15414-12 (after assembly)

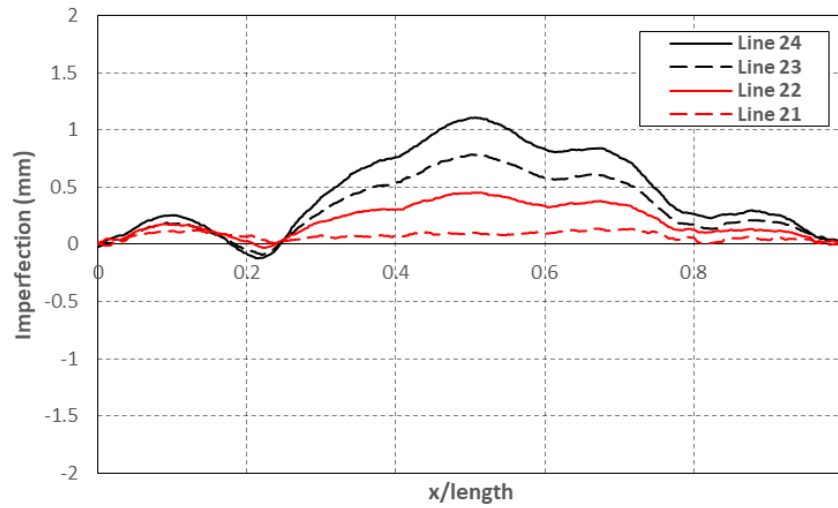


Figure I.71: Imperfections left flange channel T15414-12 (after assembly)

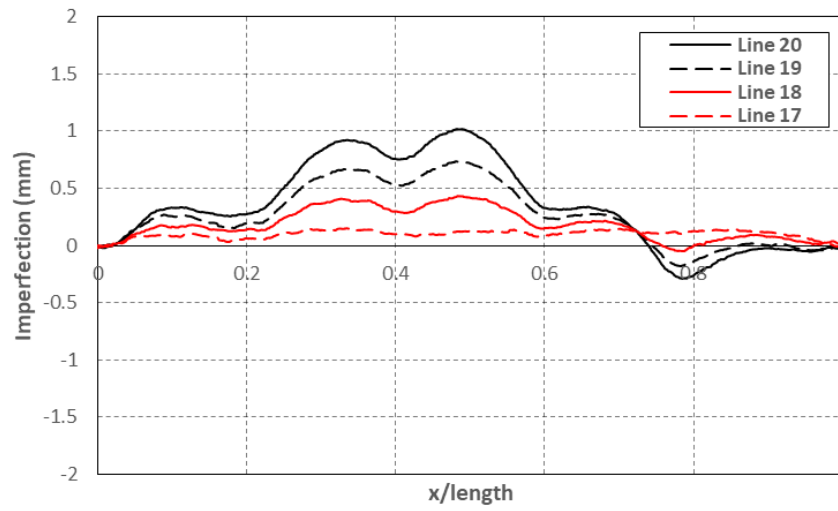


Figure I.72: Imperfections right flange channel T15414-12 (after assembly)

I.3. Built-up geometry 3 (LC3)

I.3.1 LC3-2a

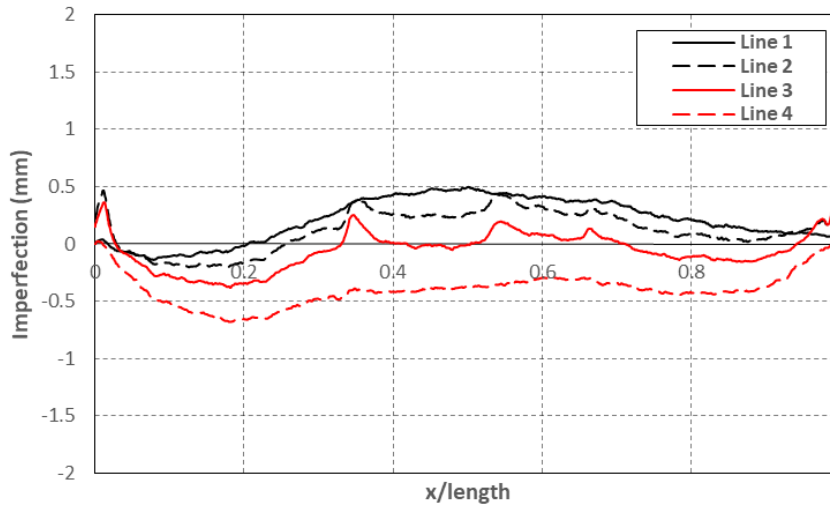


Figure I.73: Imperfections web channel T12012-1 (after assembly)

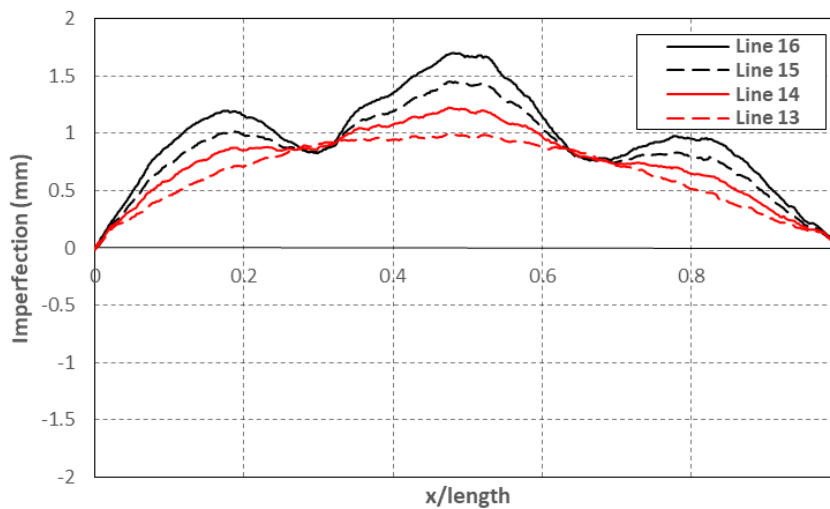


Figure I.74: Imperfections left flange channel T12012-1 (after assembly)

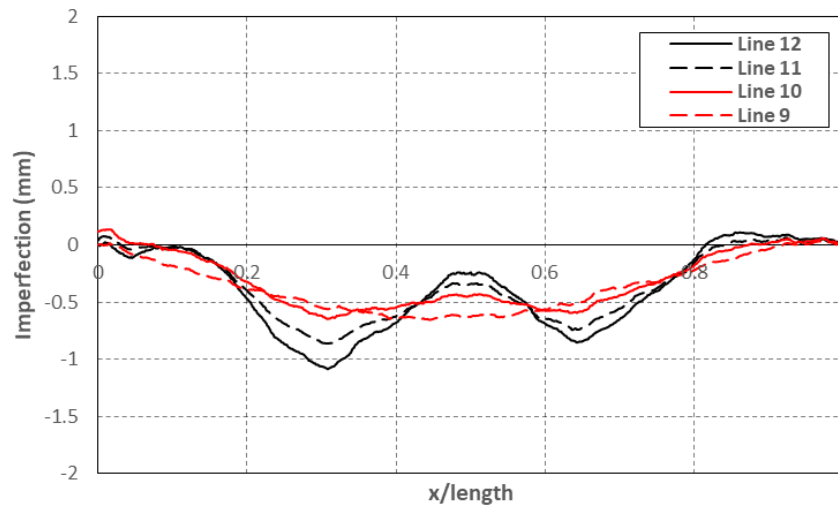


Figure I.75: Imperfections right flange channel T12012-1 (after assembly)

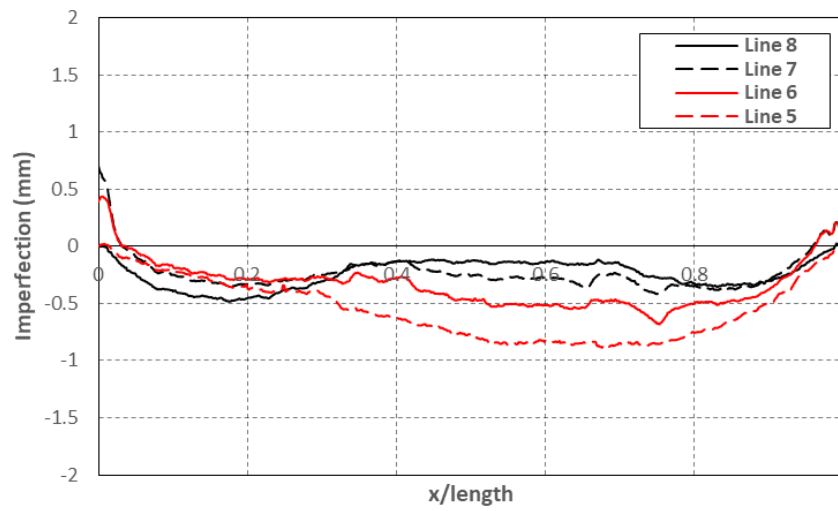


Figure I.76: Imperfections web channel T12012-2 (after assembly)

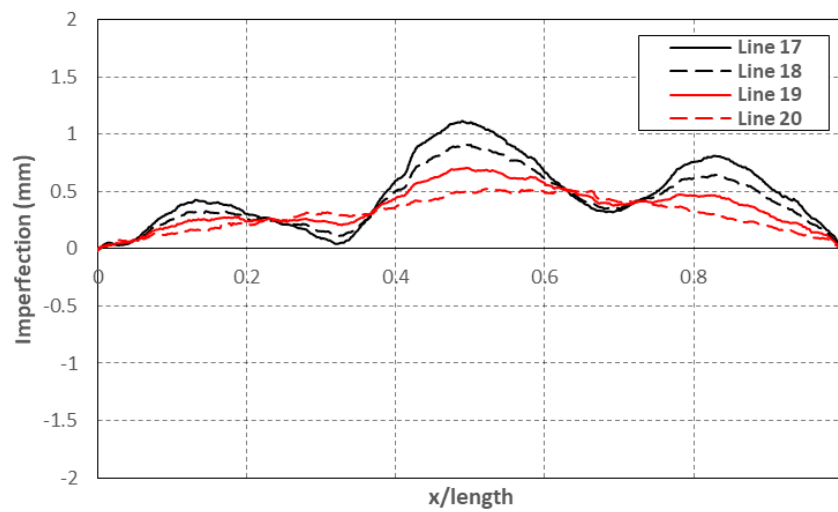


Figure I.77: Imperfections left flange channel T12012-2 (after assembly)

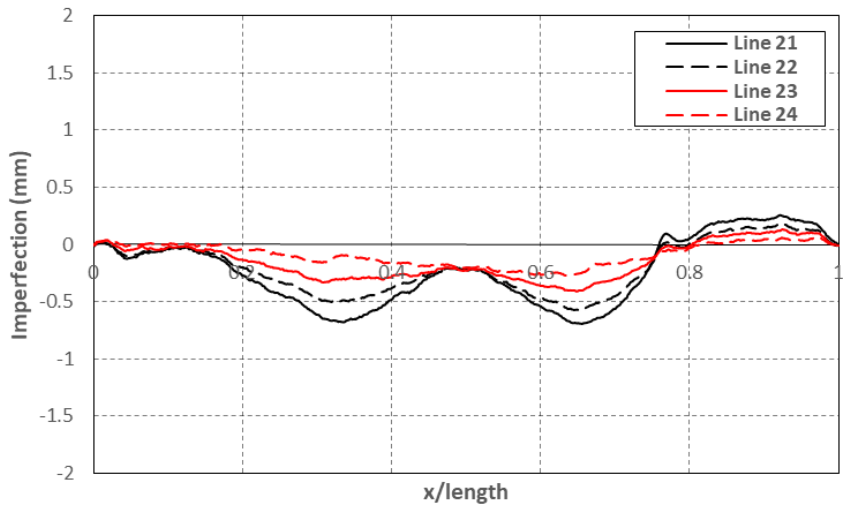


Figure I.78: Imperfections right flange channel T12012-2 (after assembly)

I.3.2 LC3-2b

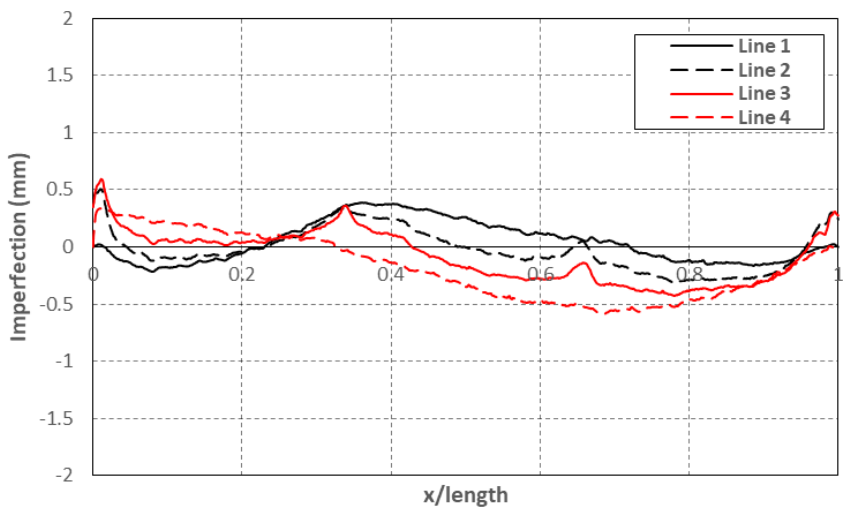


Figure I.79: Imperfections web channel T12012-3 (after assembly)

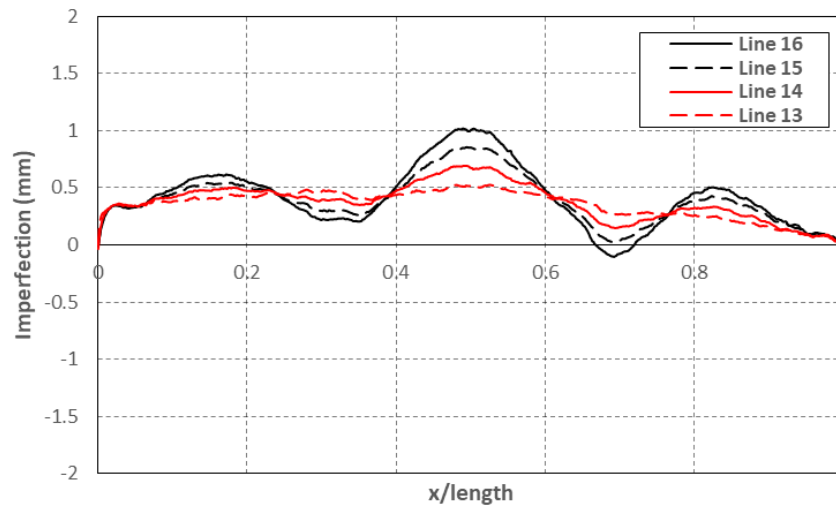


Figure I.80: Imperfections left flange channel T12012-3 (after assembly)

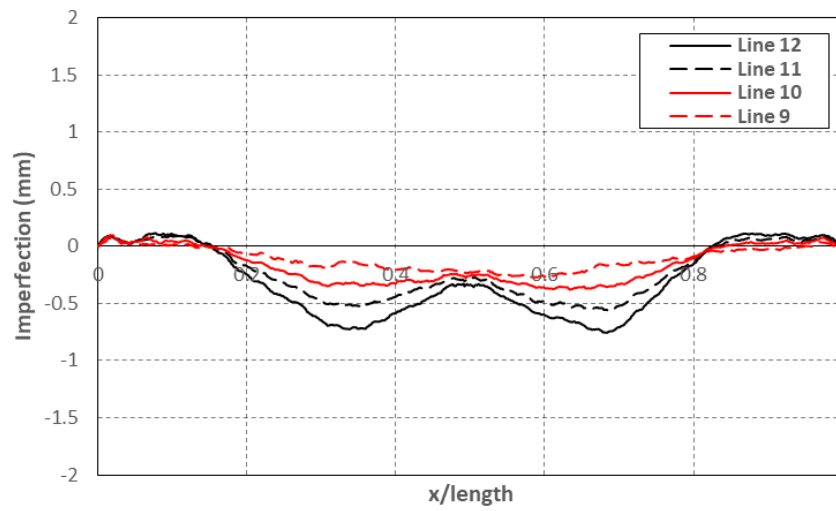


Figure I.81: Imperfections right flange channel T12012-3 (after assembly)

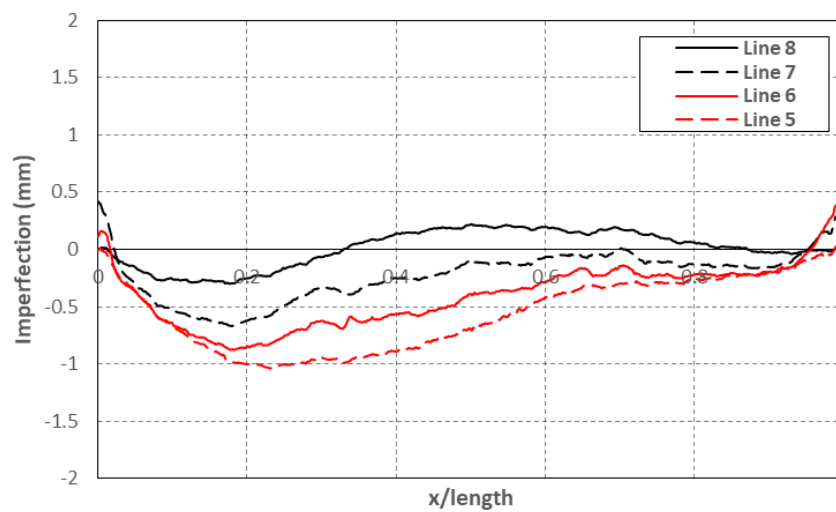


Figure I.82: Imperfections web channel T12012-4 (after assembly)

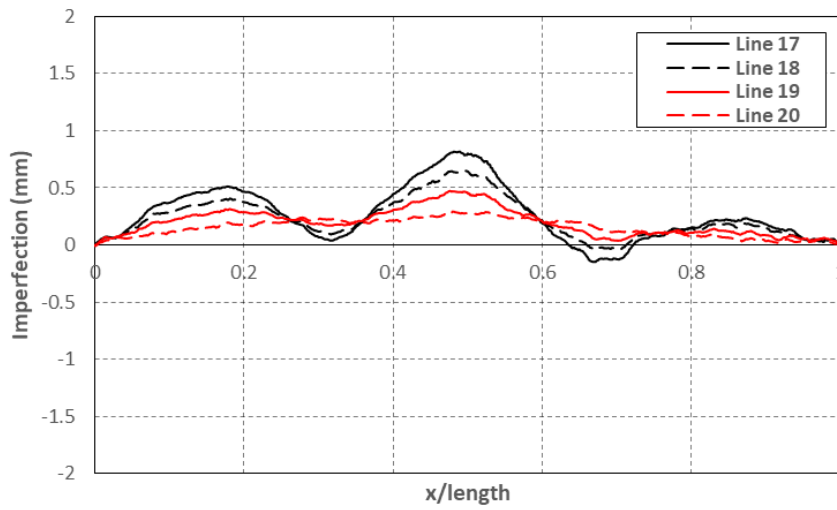


Figure I.83: Imperfections left flange channel T12012-4 (after assembly)

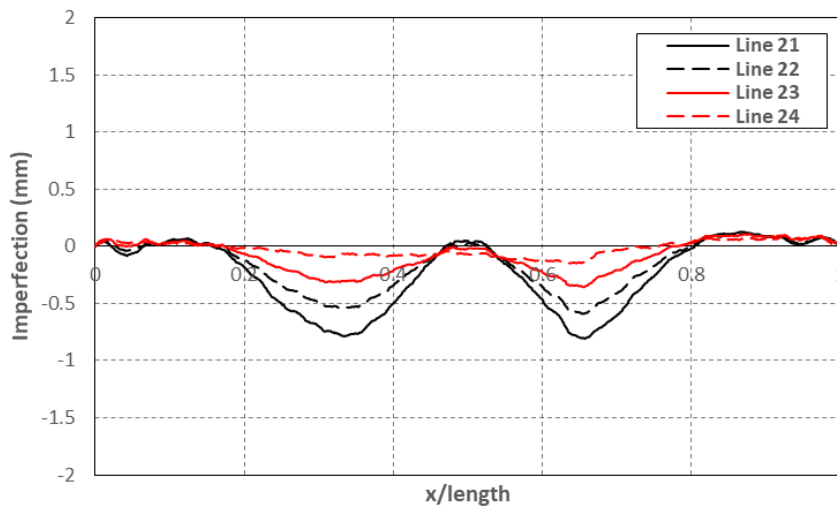


Figure I.84: Imperfections right flange channel T12012-4 (after assembly)

I.3.3 LC3-3a

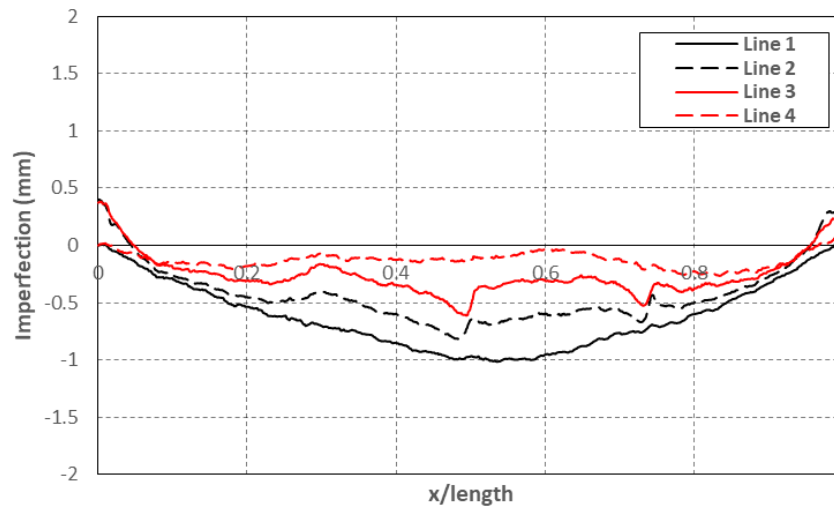


Figure I.85: Imperfections web channel T12012-5 (after assembly)

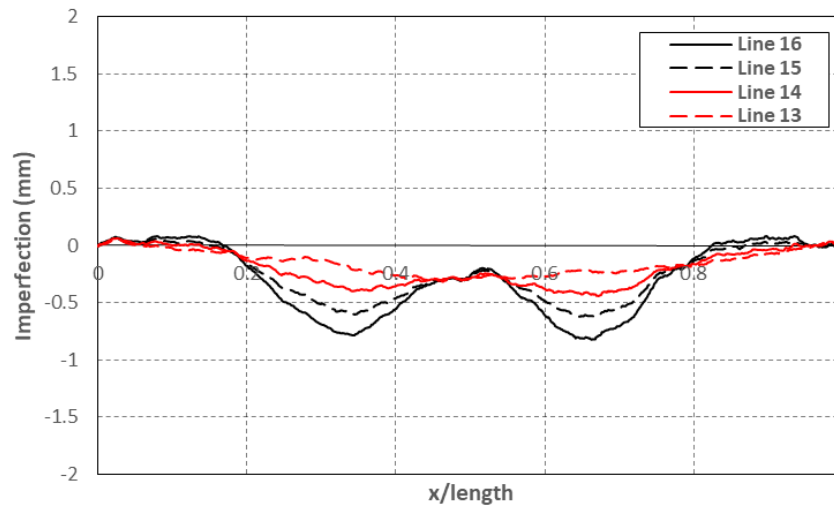


Figure I.86: Imperfections left flange channel T12012-5 (after assembly)

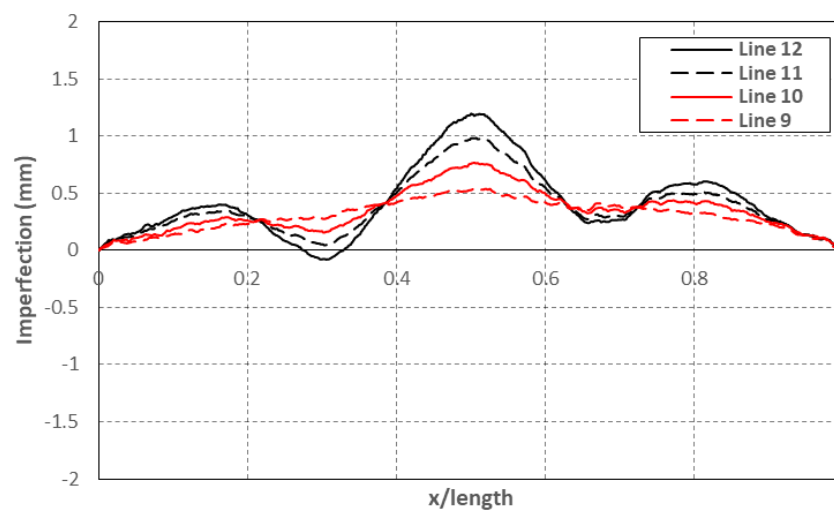


Figure I.87: Imperfections right flange channel T12012-5 (after assembly)

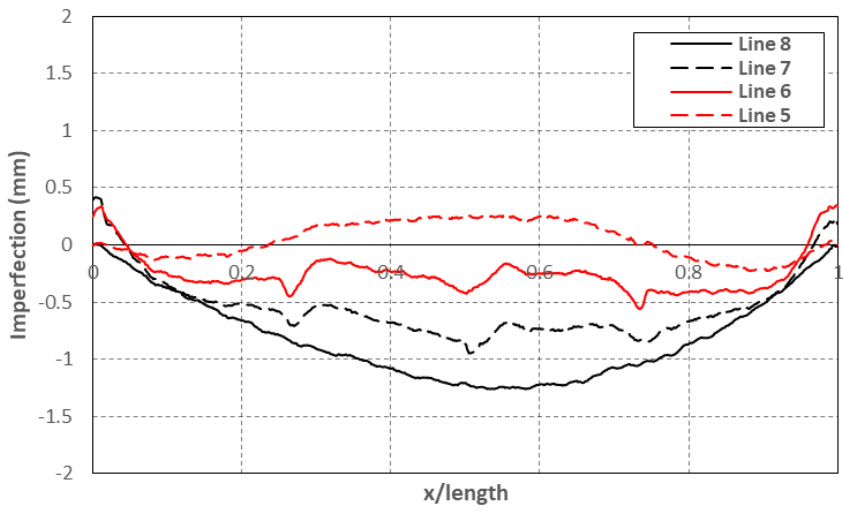


Figure I.88: Imperfections web channel T12012-6 (after assembly)

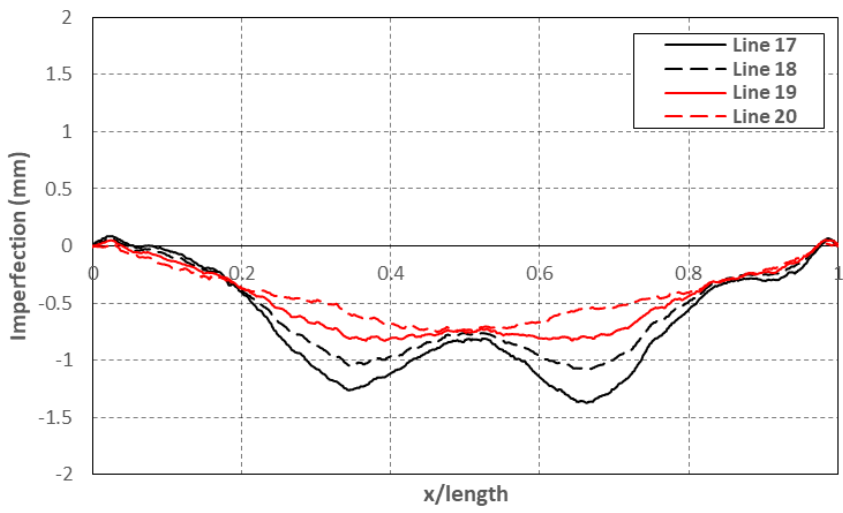


Figure I.89: Imperfections left flange channel T12012-6 (after assembly)

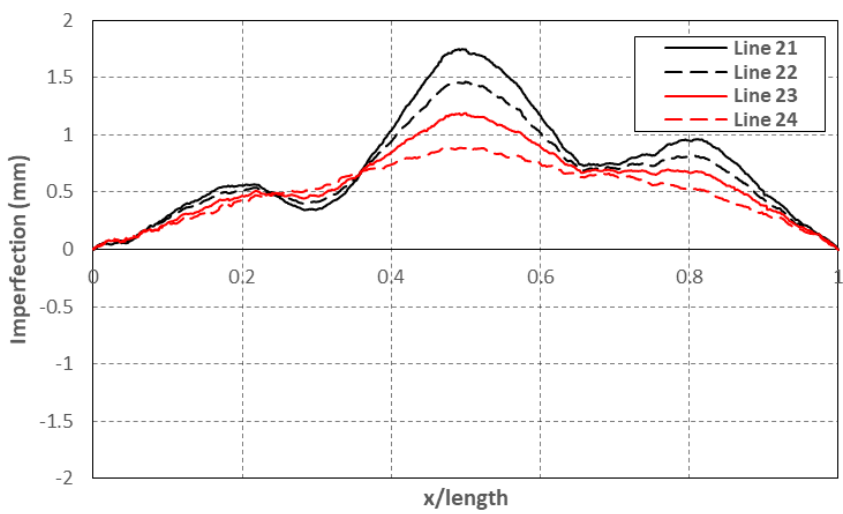


Figure I.90: Imperfections right flange channel T12012-6 (after assembly)

I.3.4 LC3-3b

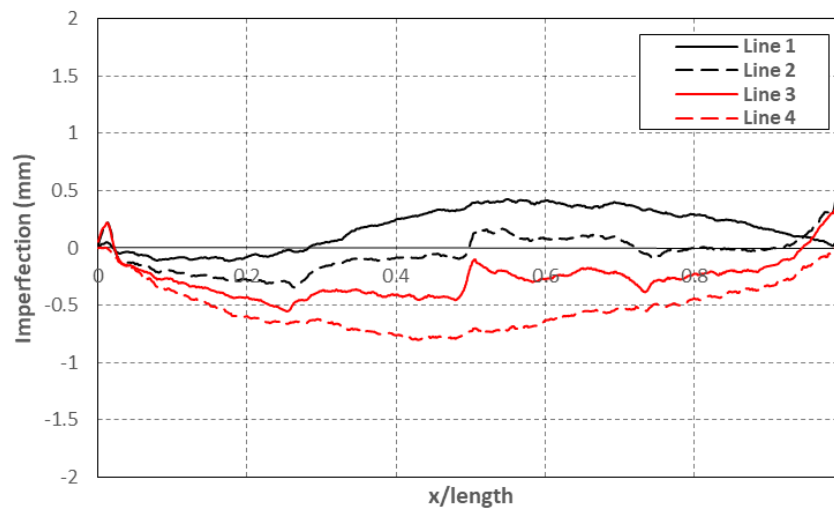


Figure I.91: Imperfections web channel T12012-7 (after assembly)

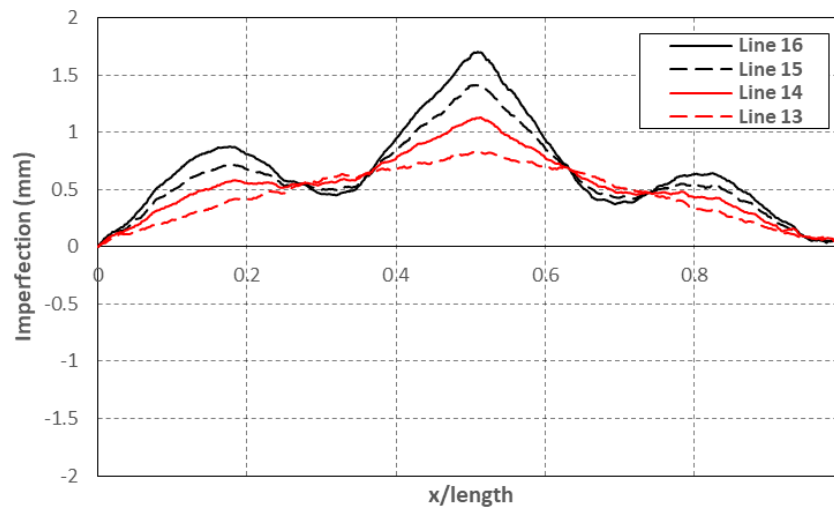


Figure I.92: Imperfections left flange channel T12012-7 (after assembly)

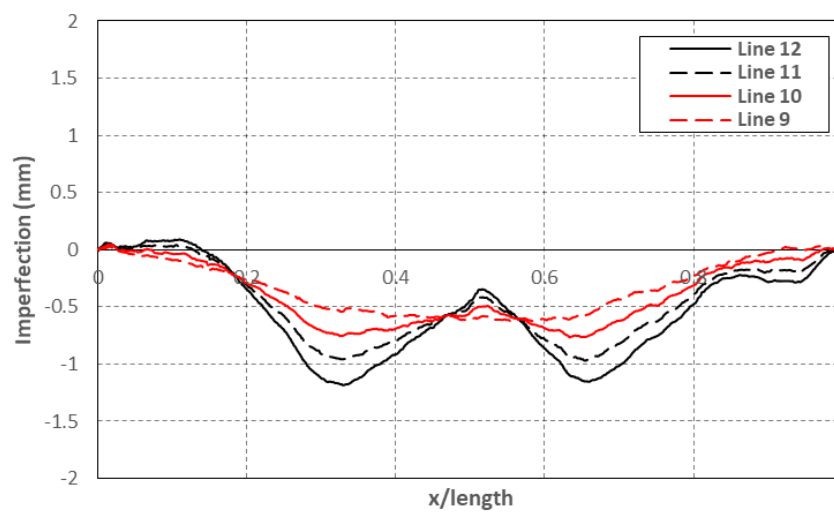


Figure I.93: Imperfections right flange channel T12012-7 (after assembly)

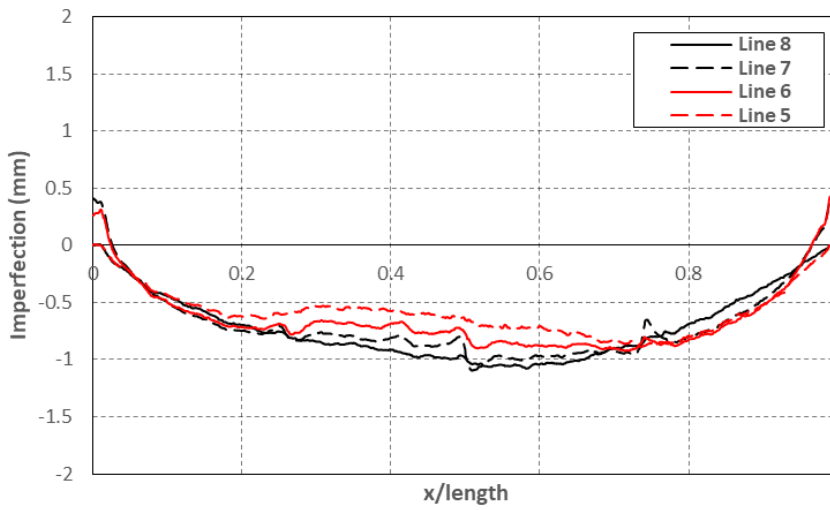


Figure I.94: Imperfections web channel T12012-8 (after assembly)

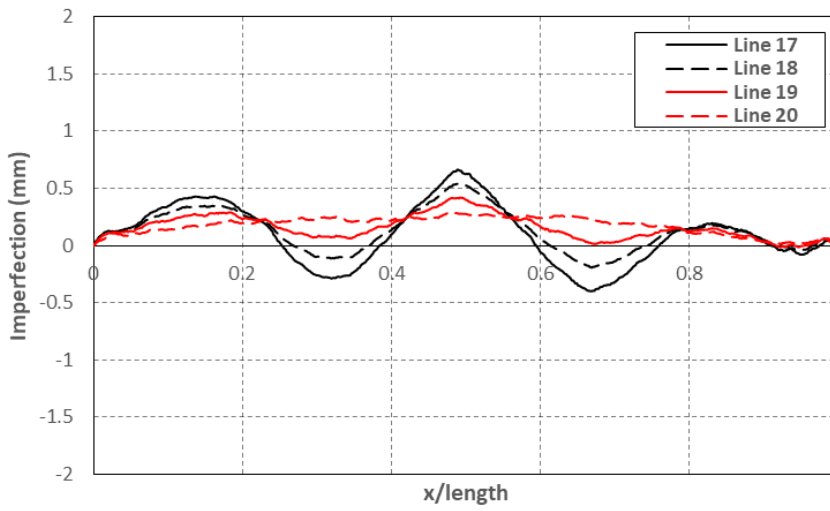


Figure I.95: Imperfections left flange channel T12012-8 (after assembly)

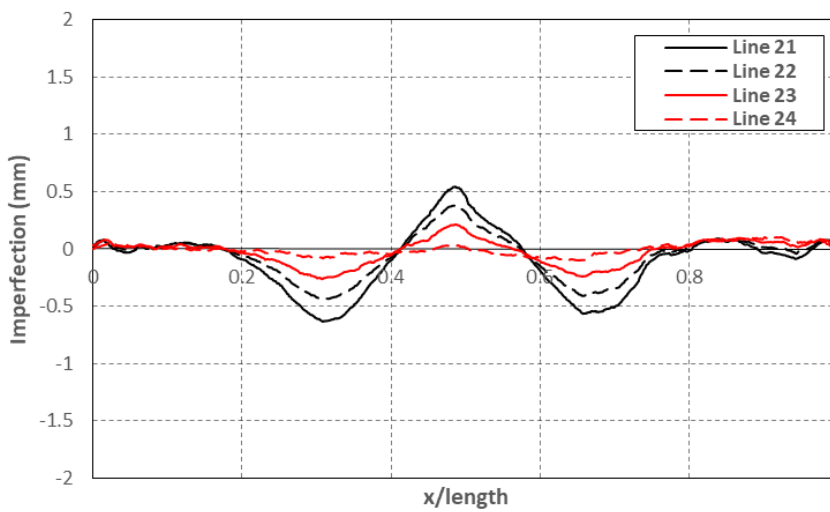


Figure I.96: Imperfections right flange channel T12012-8 (after assembly)

I.3.5 LC3-8a

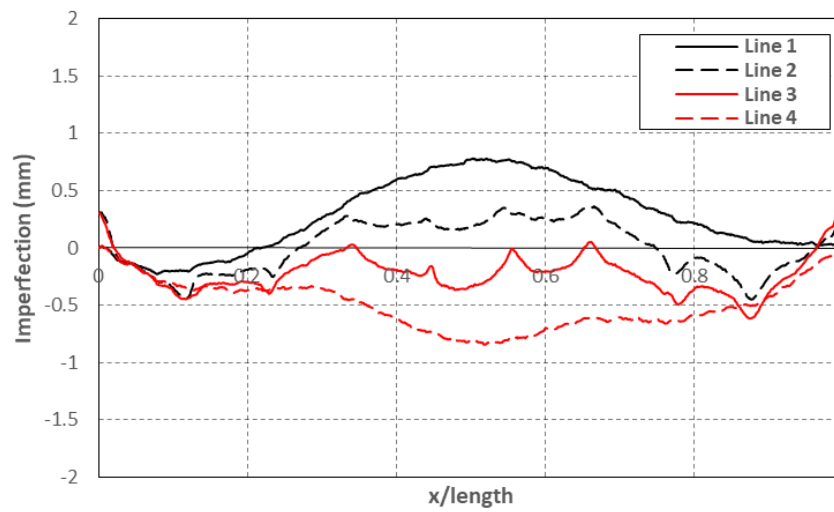


Figure I.97: Imperfections web channel T12012-9 (after assembly)

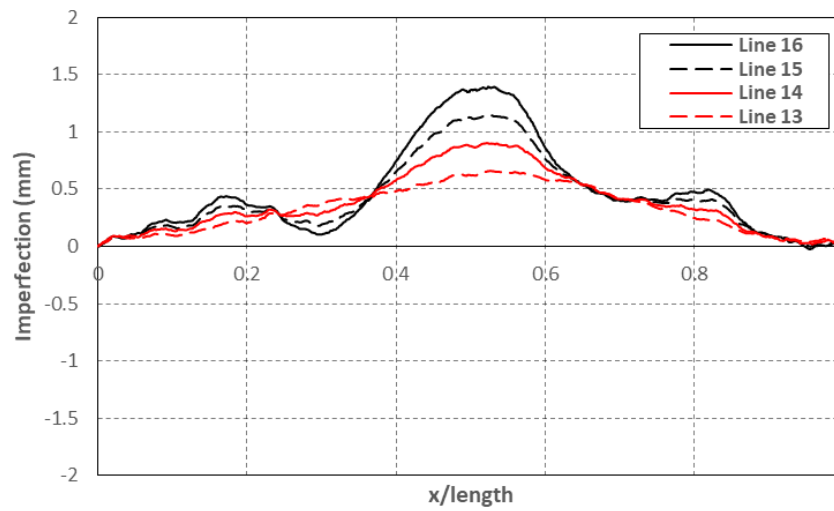


Figure I.98: Imperfections left flange channel T12012-9 (after assembly)

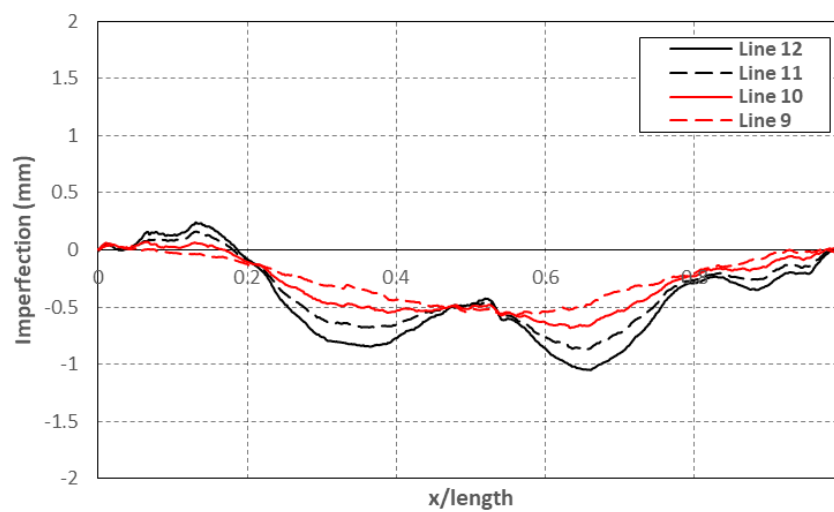


Figure I.99: Imperfections right flange channel T12012-9 (after assembly)

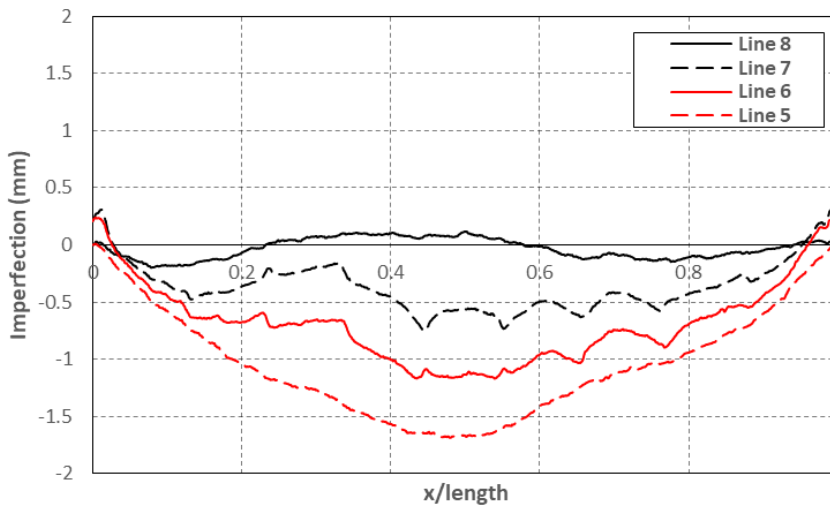


Figure I.100: Imperfections web channel T12012-10 (after assembly)

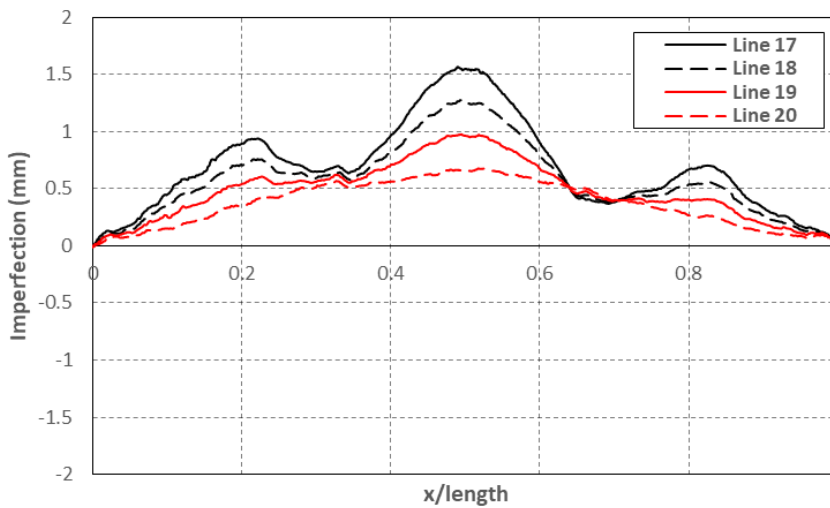


Figure I.101: Imperfections left flange channel T12012-10 (after assembly)

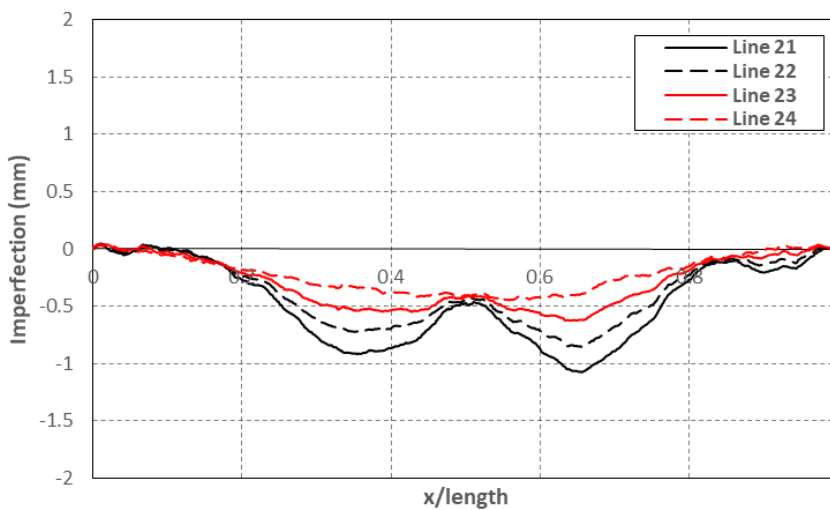


Figure I.102: Imperfections right flange channel T12012-10 (after assembly)

I.3.6 LC3-8b

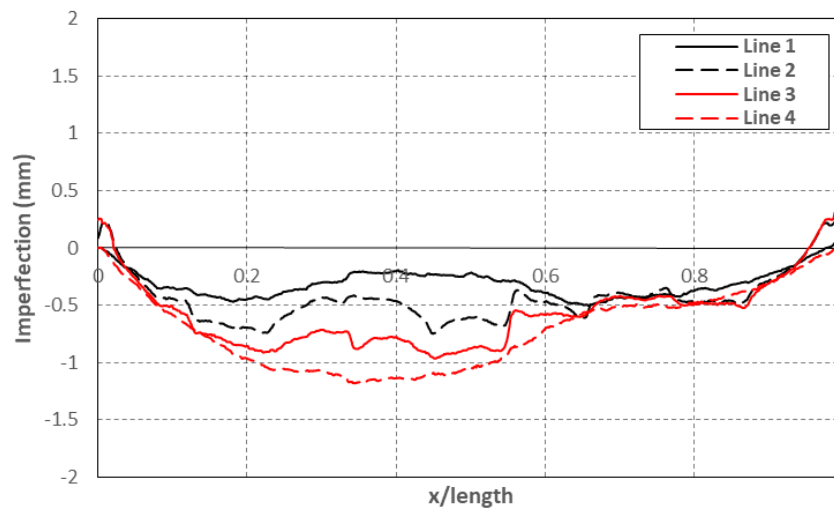


Figure I.103: Imperfections web channel T12012-11 (after assembly)

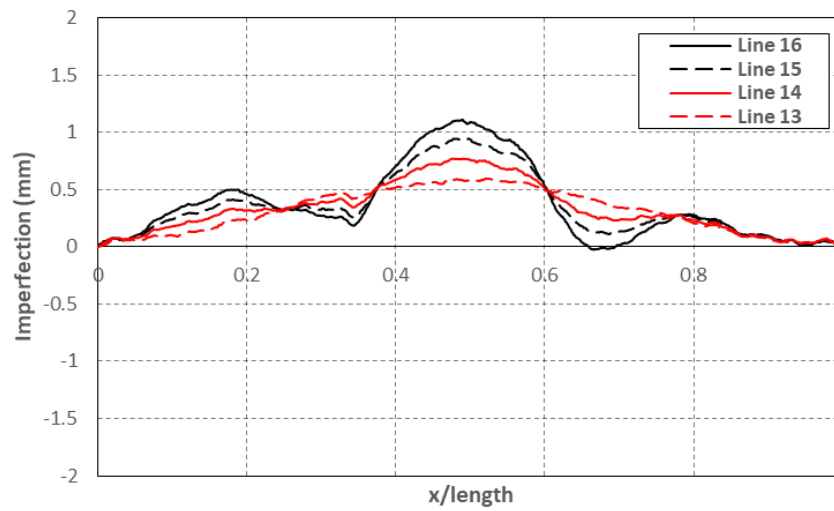


Figure I.104: Imperfections left flange channel T12012-11 (after assembly)

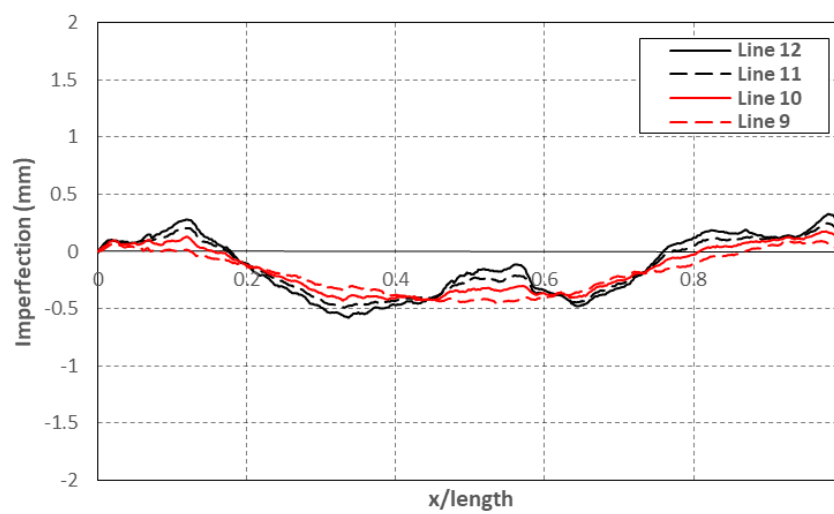


Figure I.105: Imperfections right flange channel T12012-11 (after assembly)

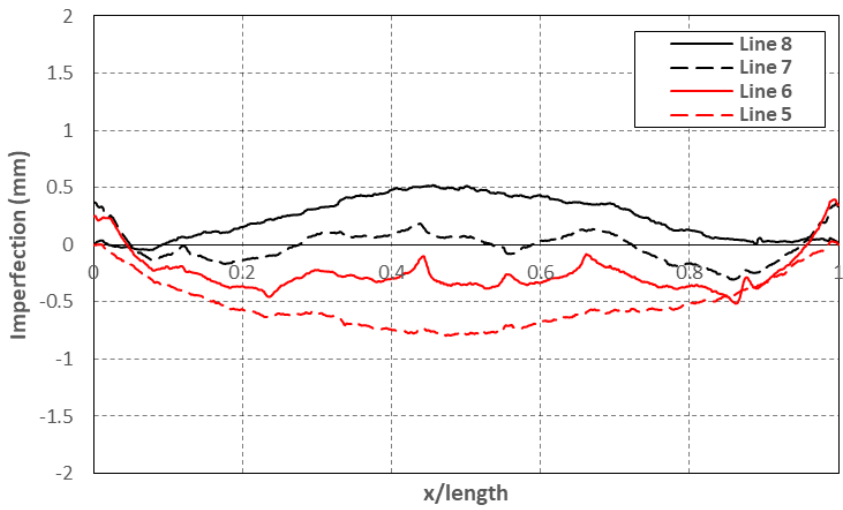


Figure I.106: Imperfections web channel T12012-12 (after assembly)

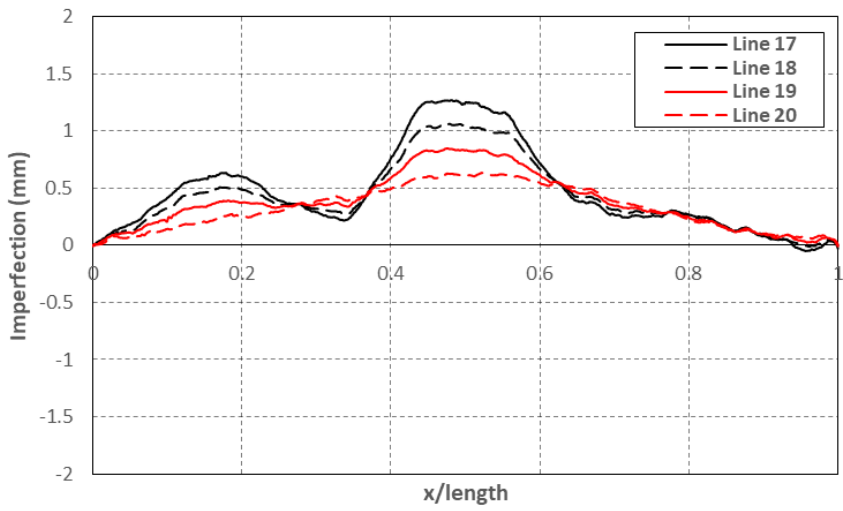


Figure I.107: Imperfections left flange channel T12012-12 (after assembly)

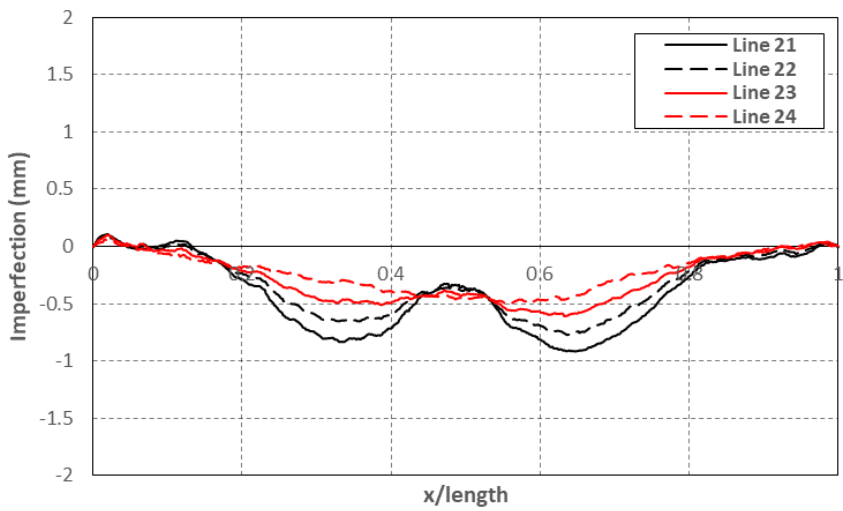


Figure I.108: Imperfections right flange channel T12012-12 (after assembly)

I.4. Built-up geometry 4 (LC4)

I.4.1 LC4-2a

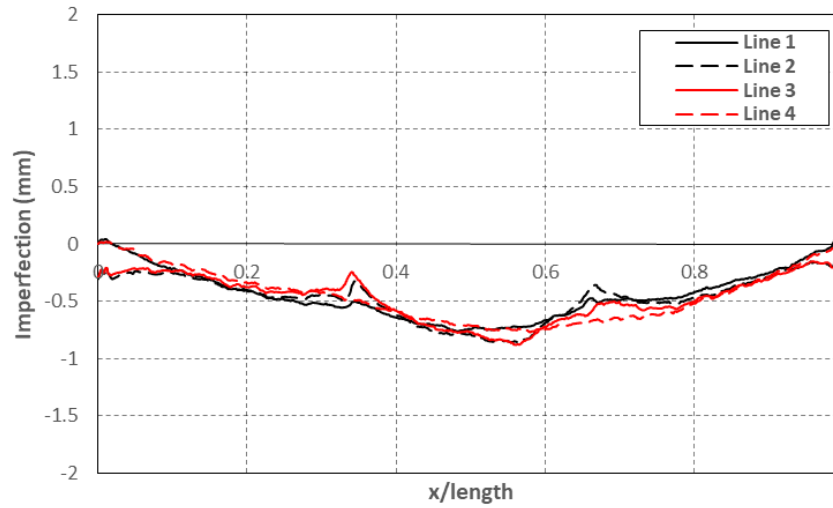


Figure I.109: Imperfections web channel S11012-1 (after assembly)

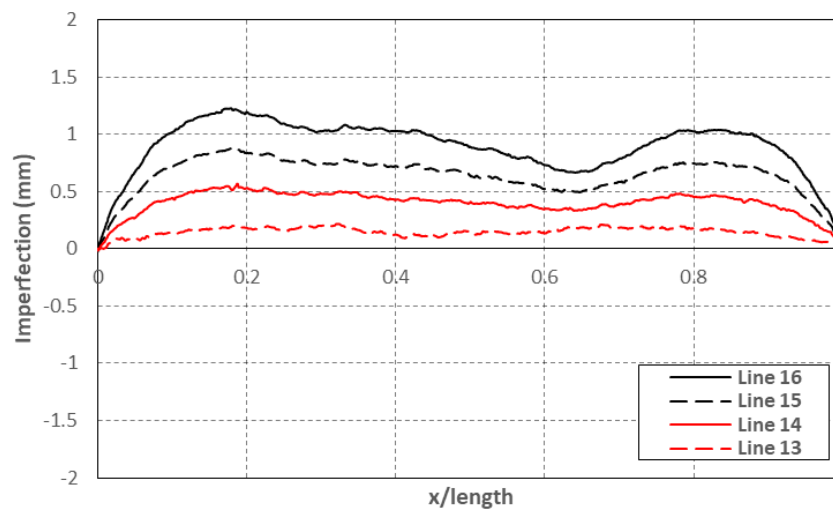


Figure I.110: Imperfections left flange channel S11012-1 (after assembly)

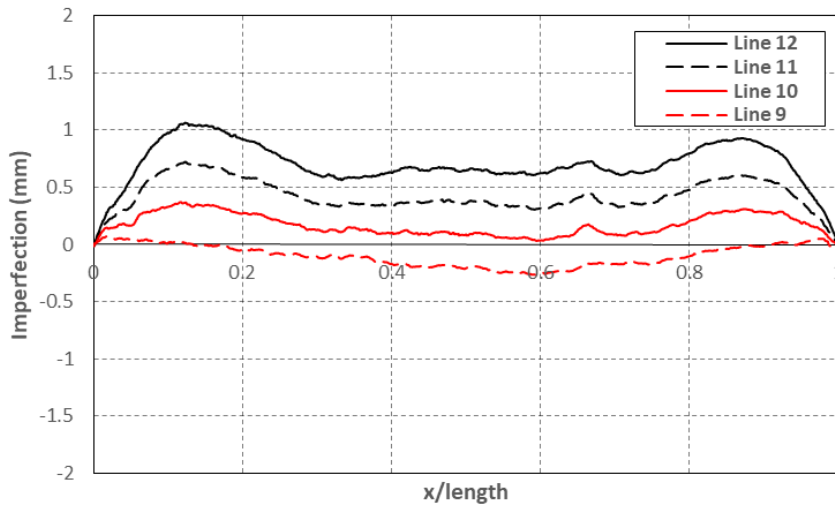


Figure I.111: Imperfections right flange channel S11012-1 (after assembly)

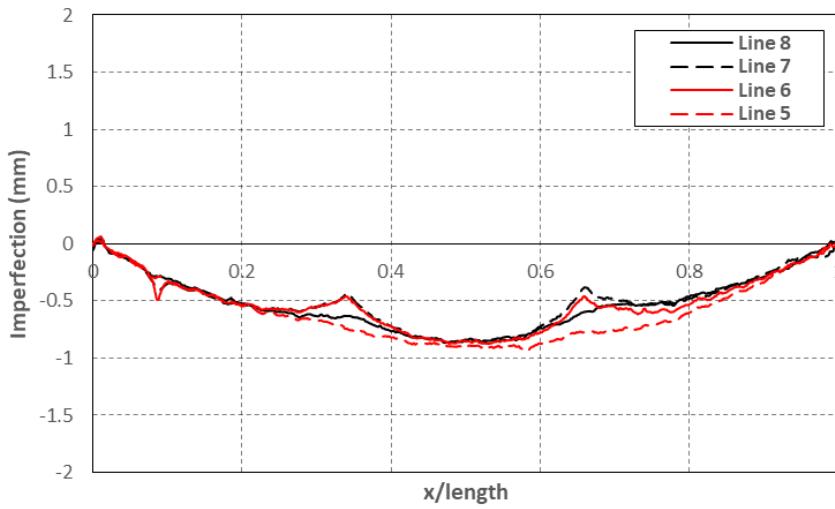


Figure I.112: Imperfections web channel S11012-2 (after assembly)

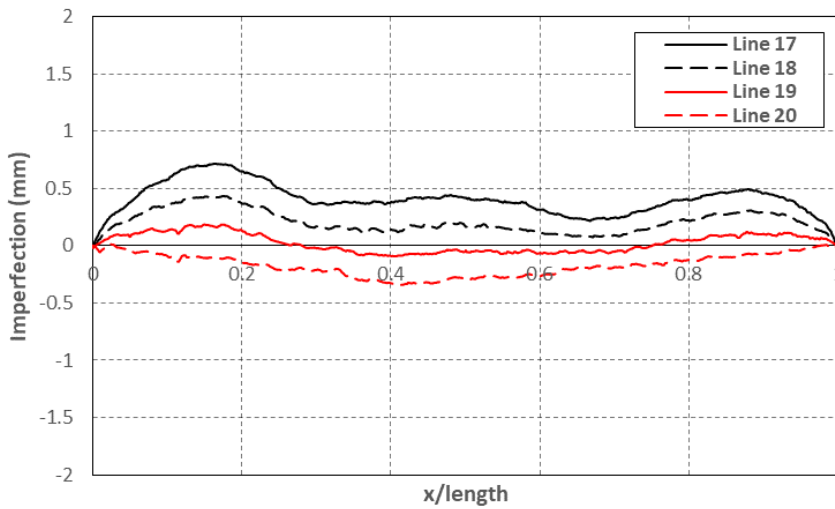


Figure I.113: Imperfections left flange channel S11012-2 (after assembly)

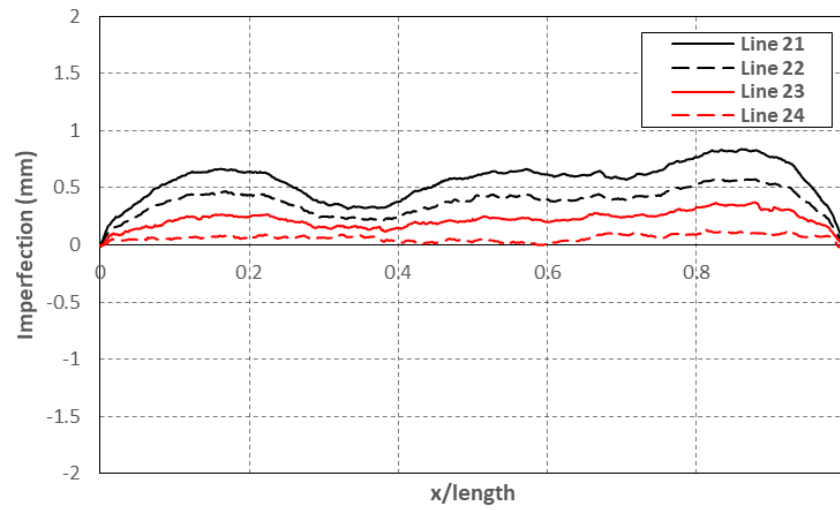


Figure I.114: Imperfections right flange channel S11012-2 (after assembly)

I.4.2 LC4-2b

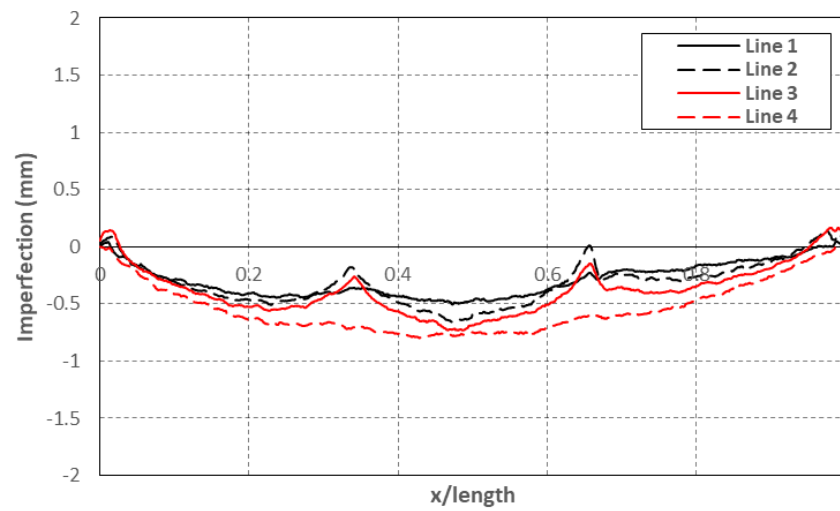


Figure I.115: Imperfections web channel S11012-3 (after assembly)

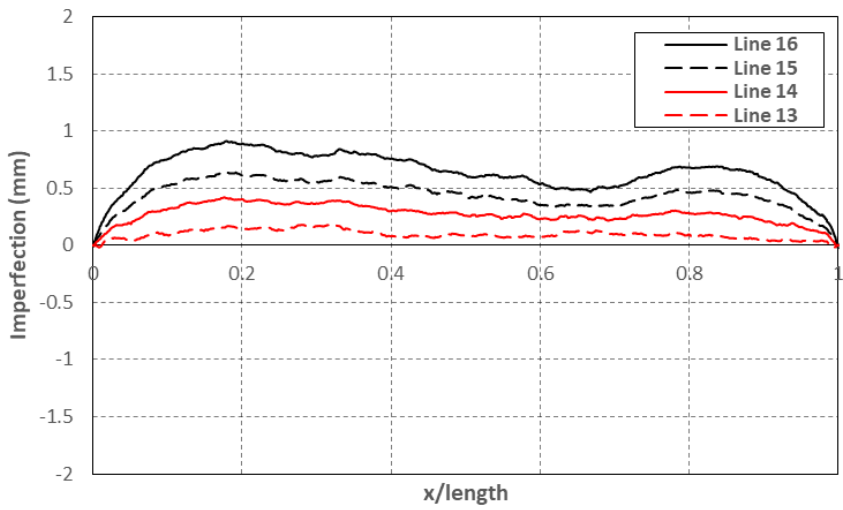


Figure I.116: Imperfections left flange channel S11012-3 (after assembly)

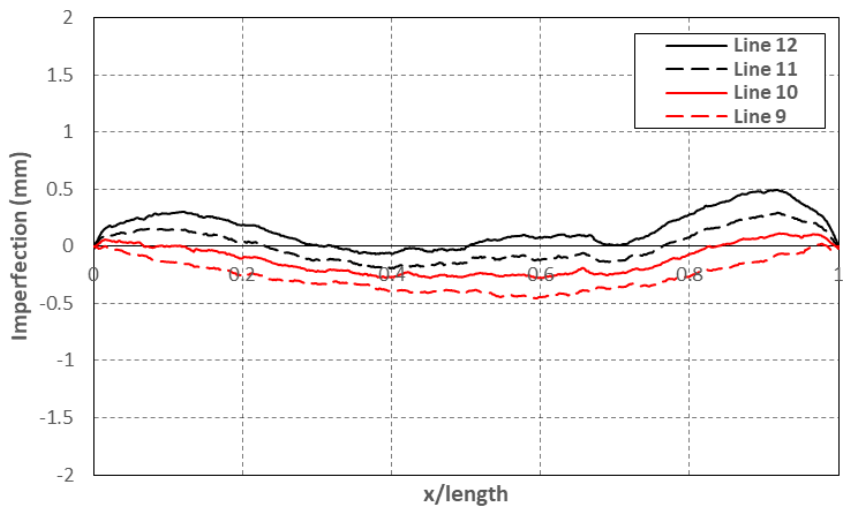


Figure I.117: Imperfections right flange channel S11012-3 (after assembly)

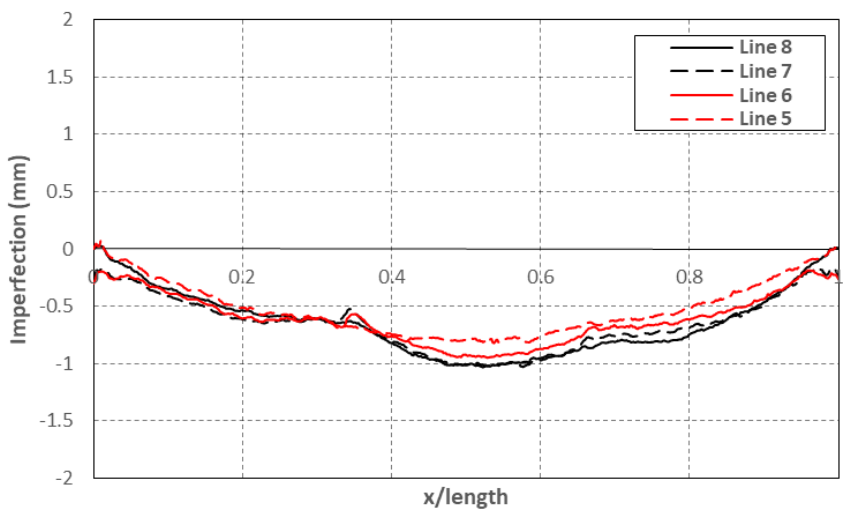


Figure I.118: Imperfections web channel S11012-4 (after assembly)

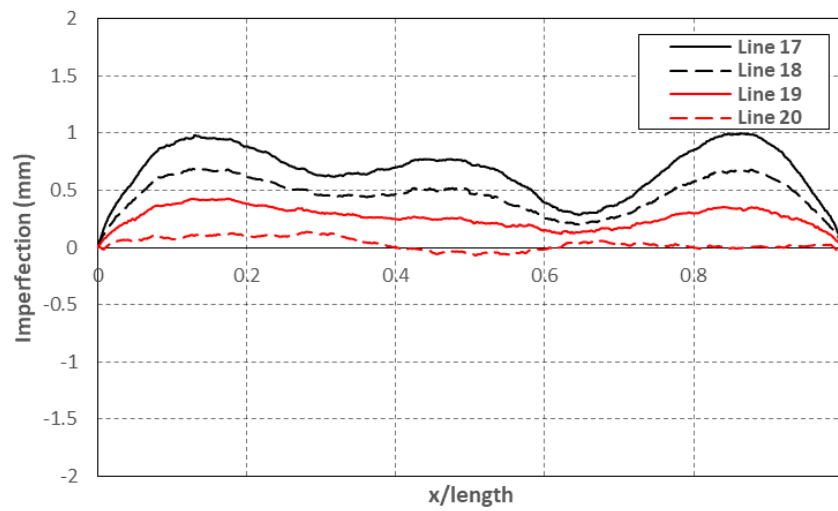


Figure I.119: Imperfections left flange channel S11012-4 (after assembly)

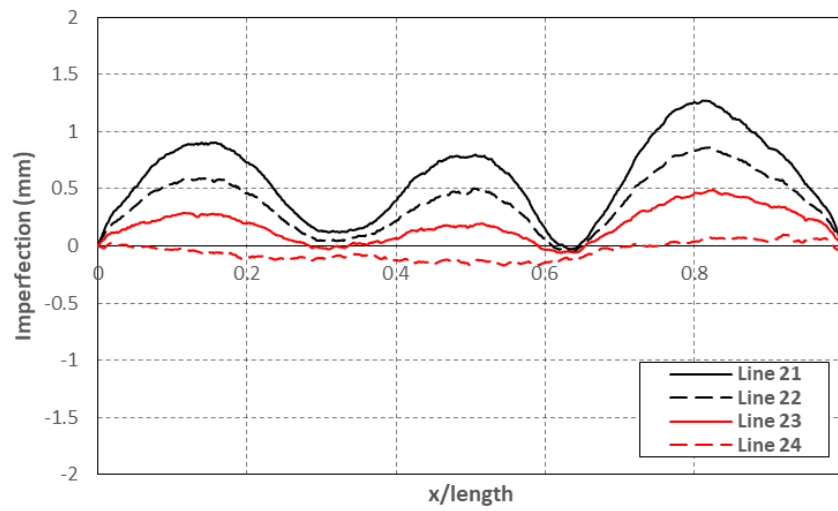


Figure I.120: Imperfections right flange channel S11012-4 (after assembly)

I.4.3 LC4-3a

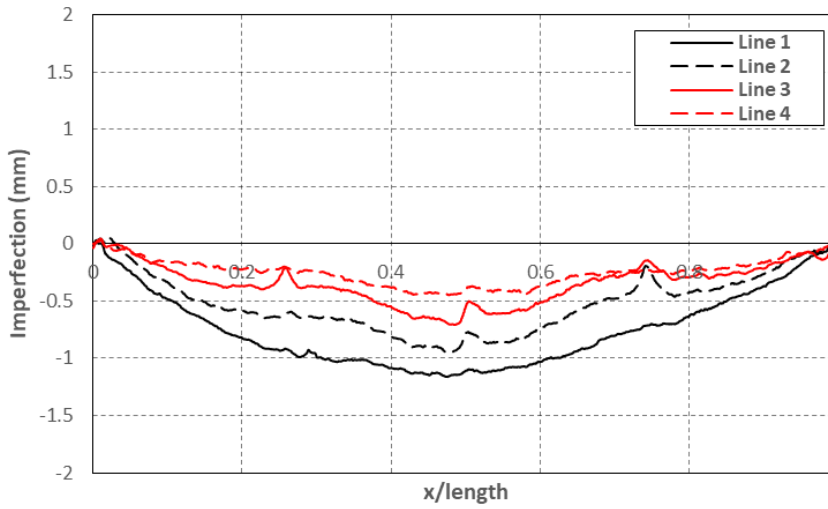


Figure I.121: Imperfections web channel S11012-5 (after assembly)

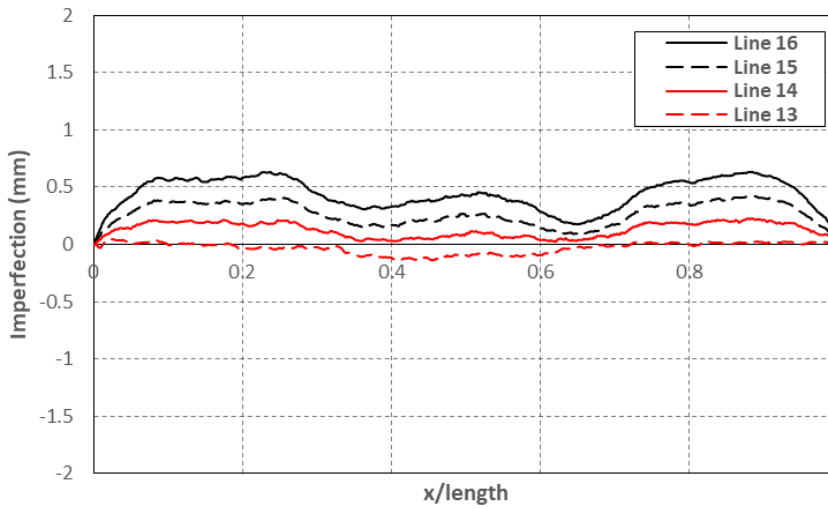


Figure I.122: Imperfections left flange channel S11012-5 (after assembly)

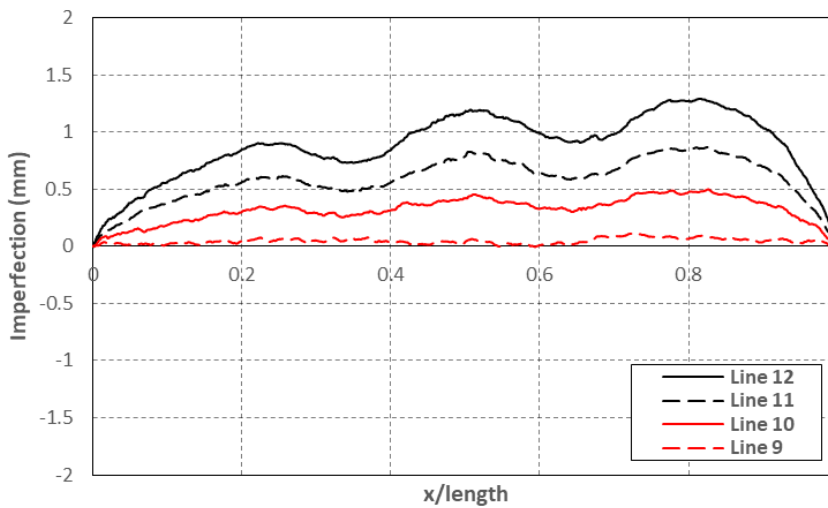


Figure I.123: Imperfections right flange channel S11012-5 (after assembly)

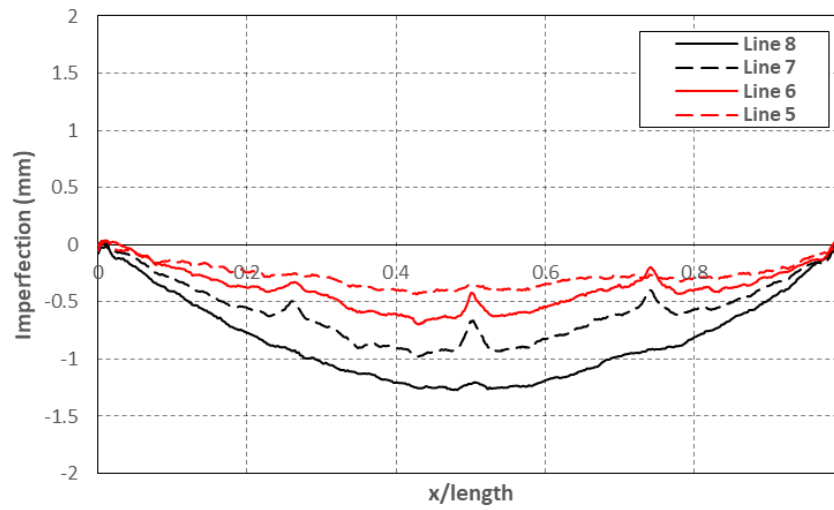


Figure I.124: Imperfections web channel S11012-6 (after assembly)

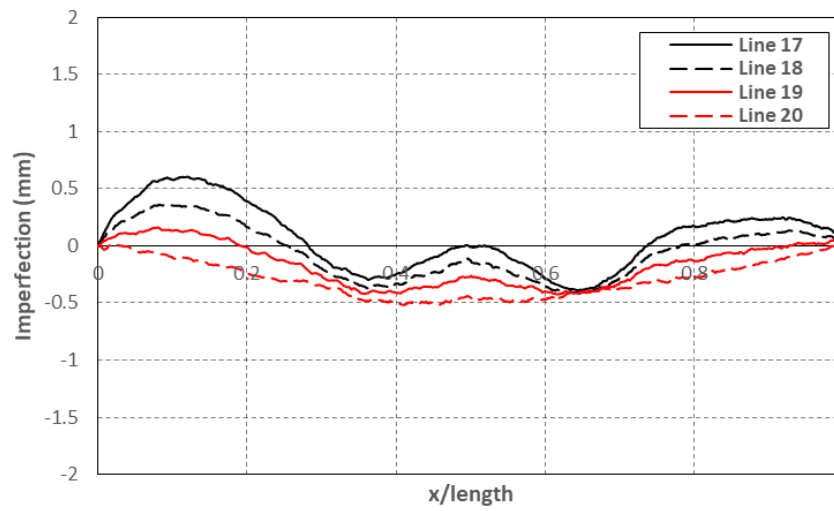


Figure I.125: Imperfections left flange channel S11012-6 (after assembly)

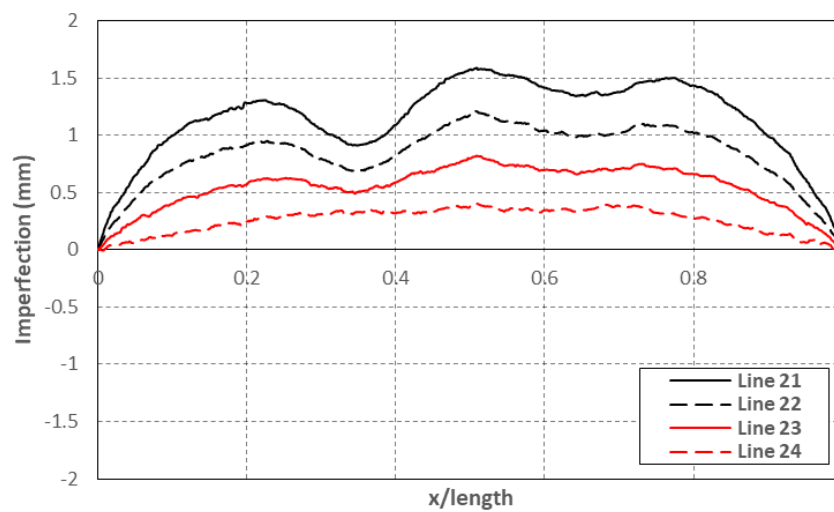


Figure I.126: Imperfections right flange channel S11012-6 (after assembly)

I.4.4 LC4-3b

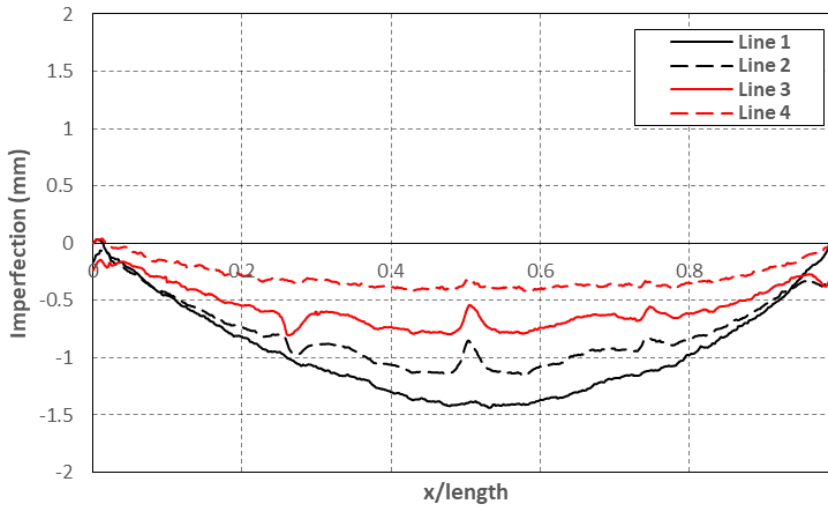


Figure I.127: Imperfections web channel S11012-7 (after assembly)

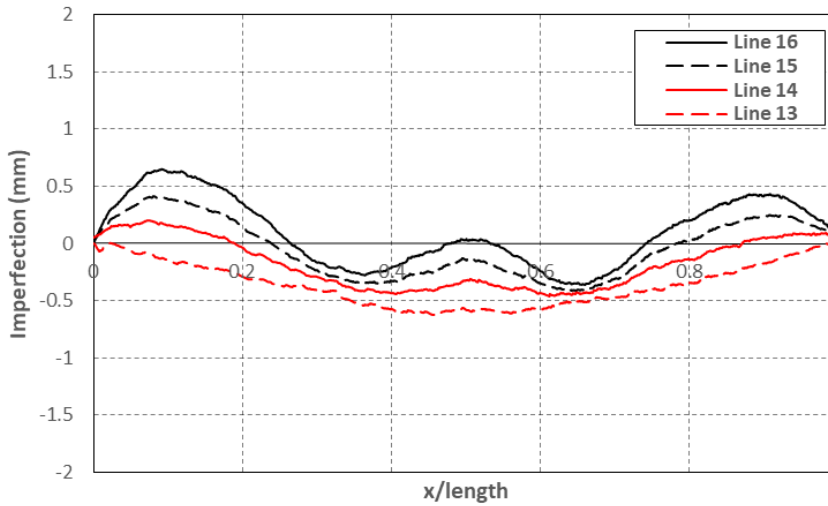


Figure I.128: Imperfections left flange channel S11012-7 (after assembly)

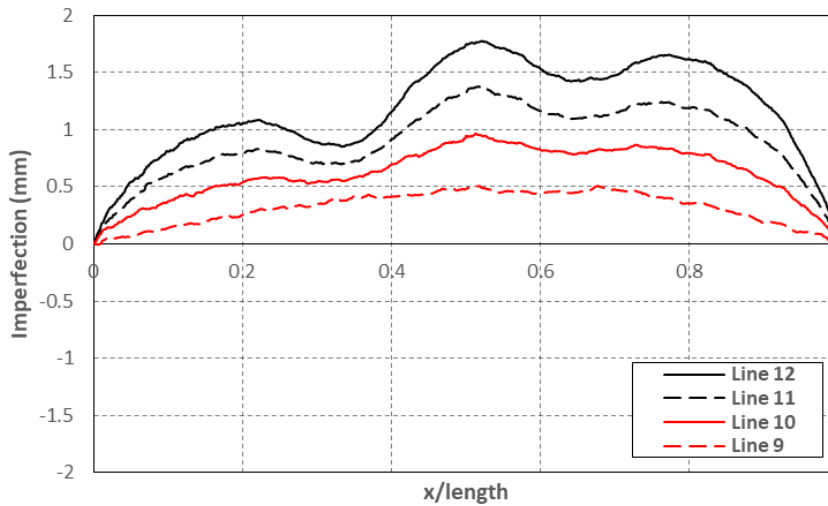


Figure I.129: Imperfections right flange channel S11012-7 (after assembly)

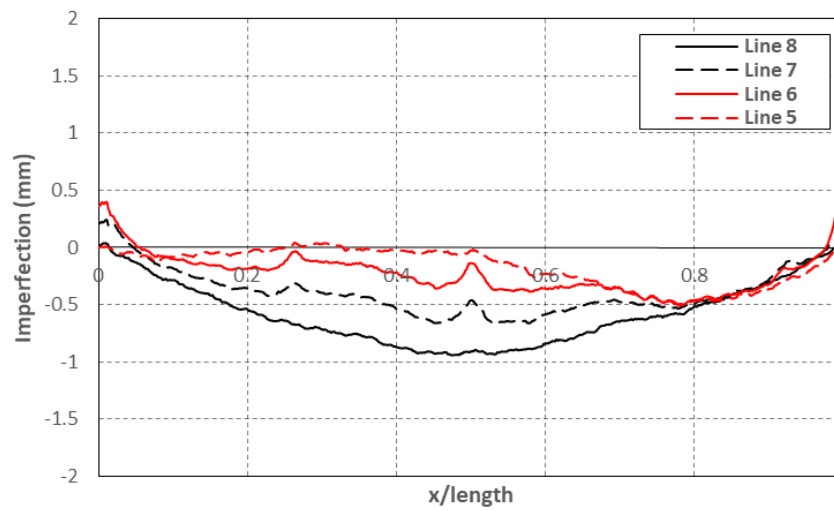


Figure I.130: Imperfections web channel S11012-8 (after assembly)

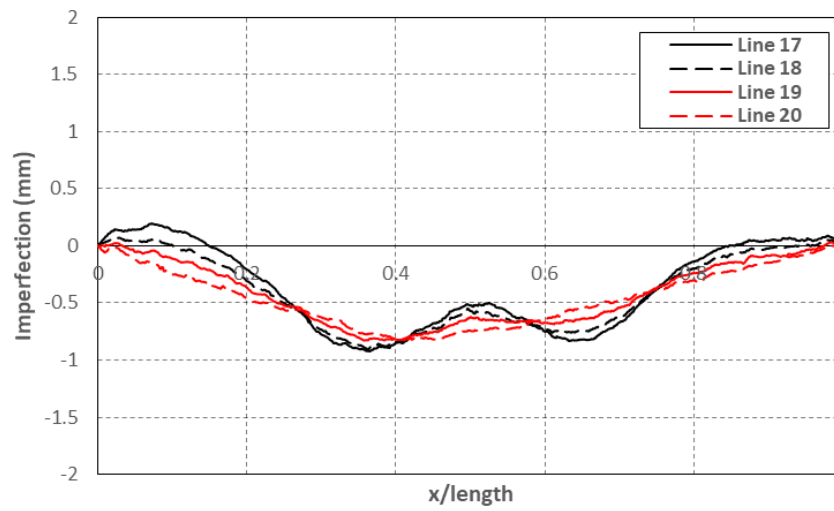


Figure I.131: Imperfections left flange channel S11012-8 (after assembly)

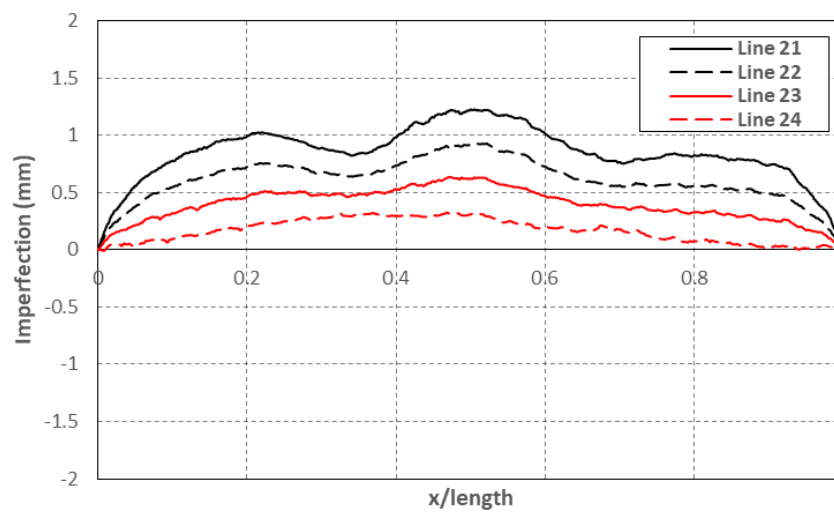


Figure I.132: Imperfections right flange channel S11012-8 (after assembly)

I.4.5 LC4-8a

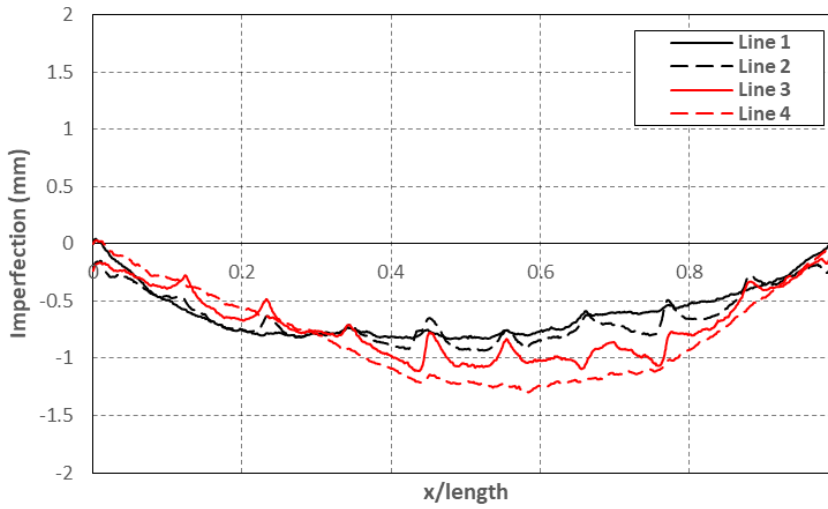


Figure I.133: Imperfections web channel S11012-9 (after assembly)

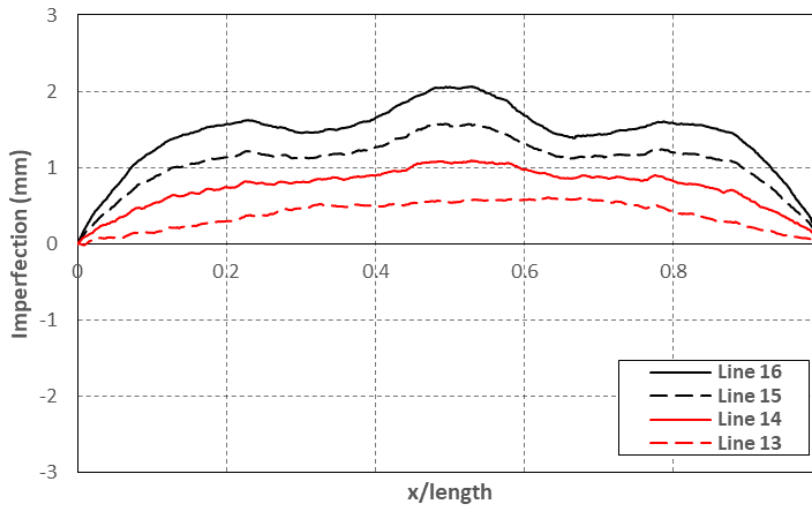


Figure I.134: Imperfections left flange channel S11012-9 (after assembly)

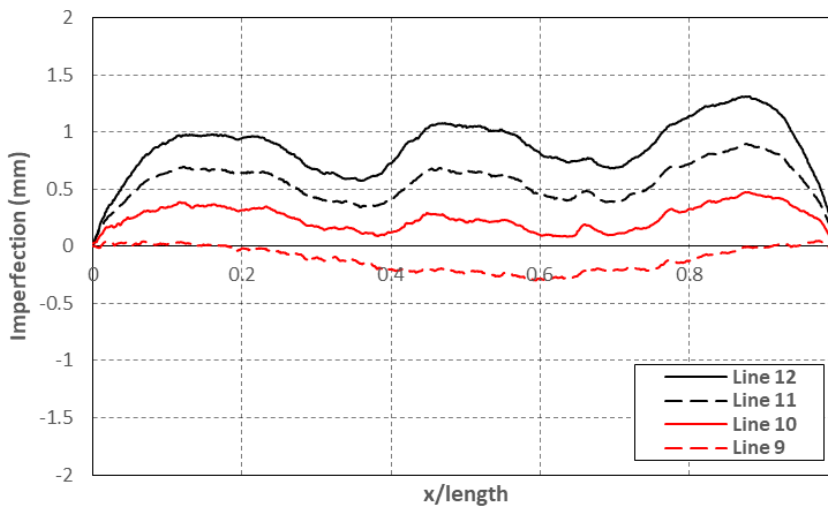


Figure I.135: Imperfections right flange channel S11012-9 (after assembly)

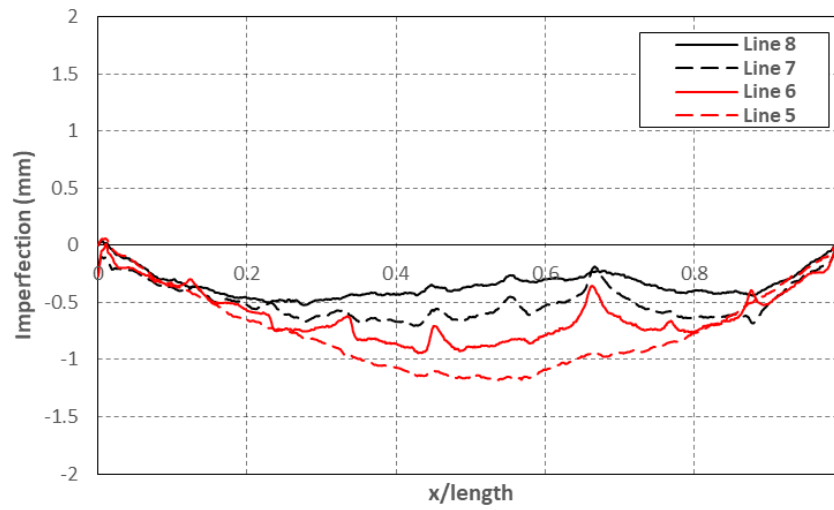


Figure I.136: Imperfections web channel S11012-10 (after assembly)

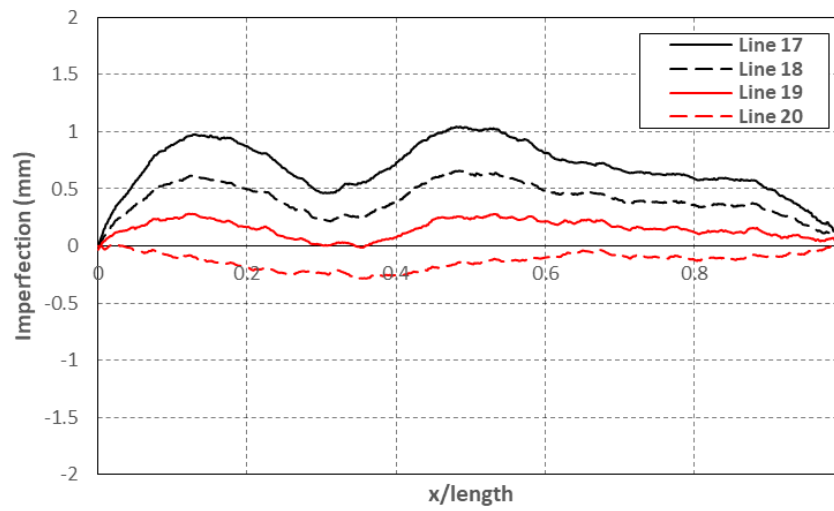


Figure I.137: Imperfections left flange channel S11012-10 (after assembly)

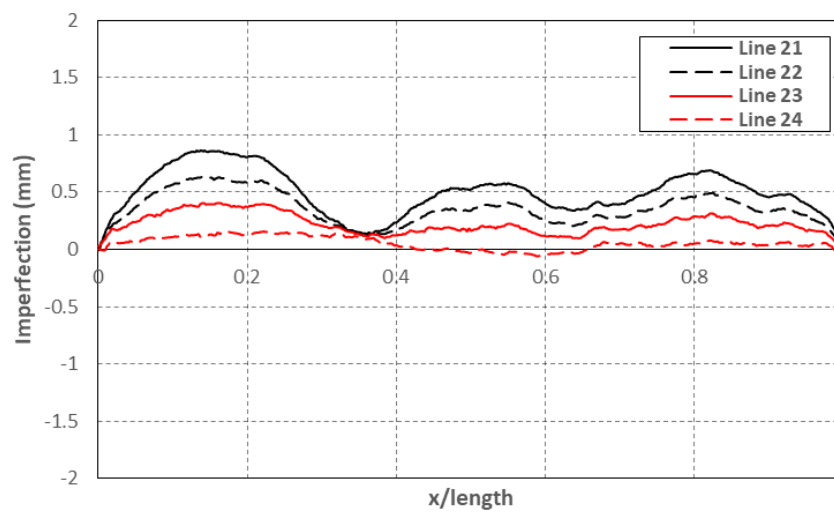


Figure I.138: Imperfections right flange channel S11012-10 (after assembly)

I.4.6 LC4-8b

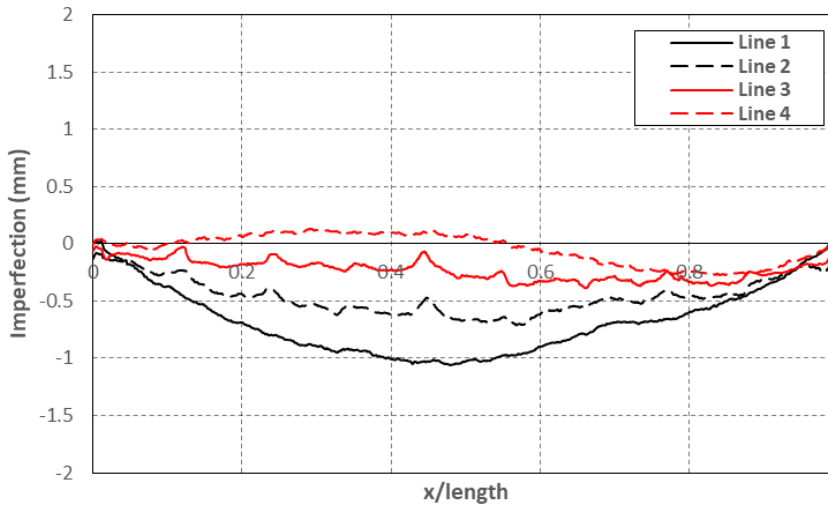


Figure I.139: Imperfections web channel S11012-11 (after assembly)

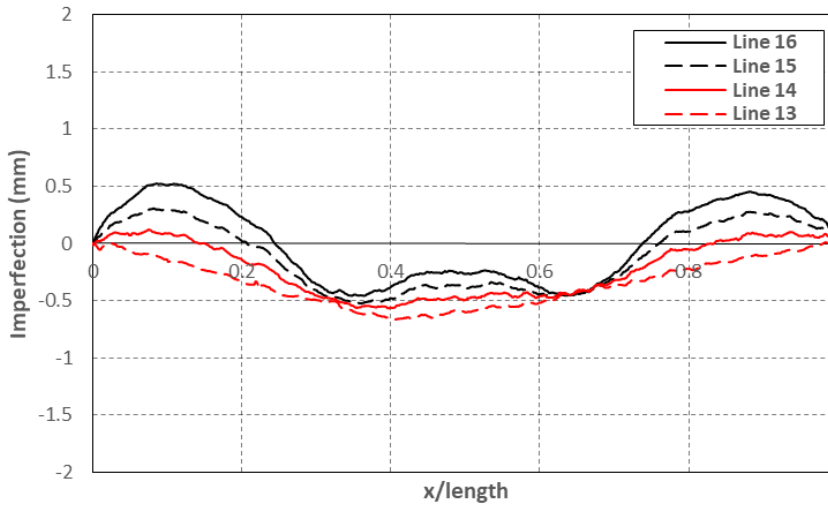


Figure I.140: Imperfections left flange channel S11012-11 (after assembly)

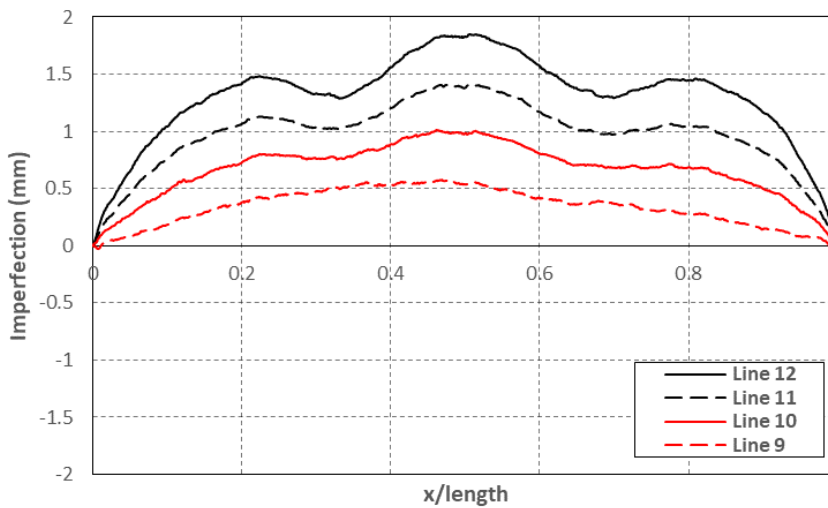


Figure I.141: Imperfections right flange channel S11012-11 (after assembly)

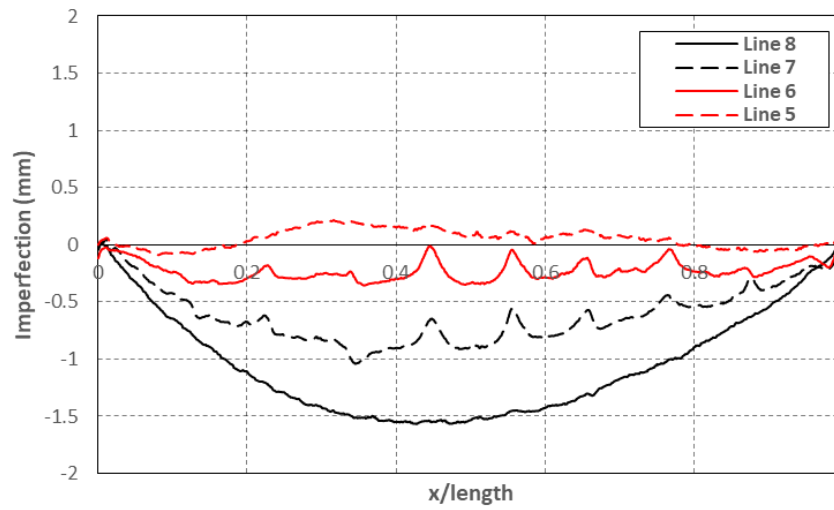


Figure I.142: Imperfections web channel S11012-12 (after assembly)

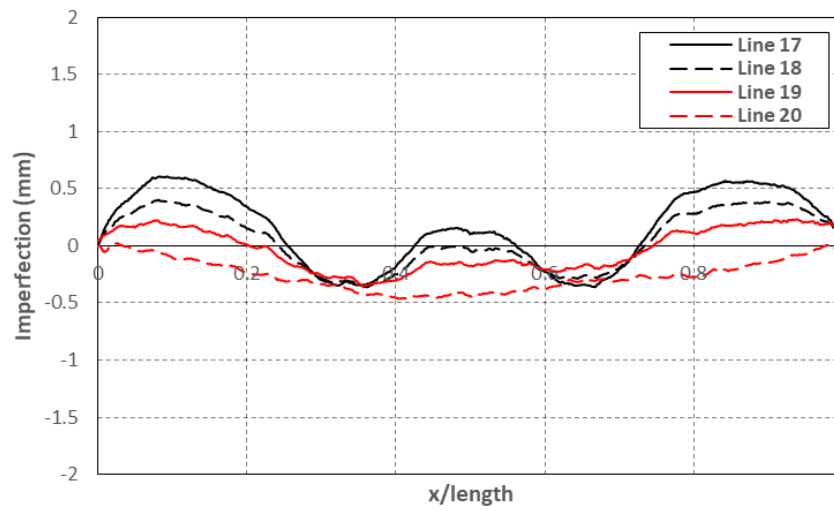


Figure I.143: Imperfections left flange channel S11012-12 (after assembly)

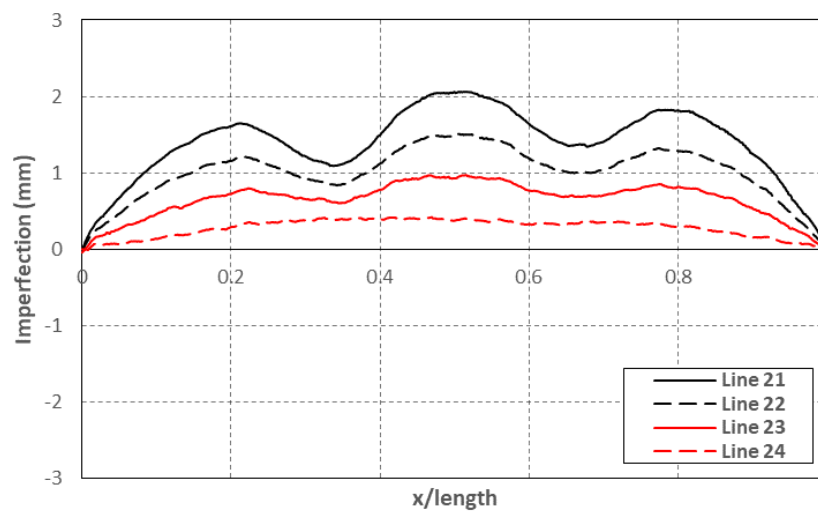


Figure I.144: Imperfections right flange channel S11012-12 (after assembly)

Appendix J

Long Columns Cross-Sectional Imperfections Comparison Before and After Assemblage

Appendix J contains a comparison of the cross-sectional imperfections of the channels used to assemble the long columns computed before and after they were assembled into their final configuration. In the figures, the coordinate along the length of the column is normalized by dividing it by the measured length, while the vertical dashed black lines indicate the location of the connectors along the column. Further details about the imperfections recorded on the long columns are included in Section 5.6 of the main text.

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J.1. Built-up geometry 1 (LC1)

J.1.1 LC1-2a

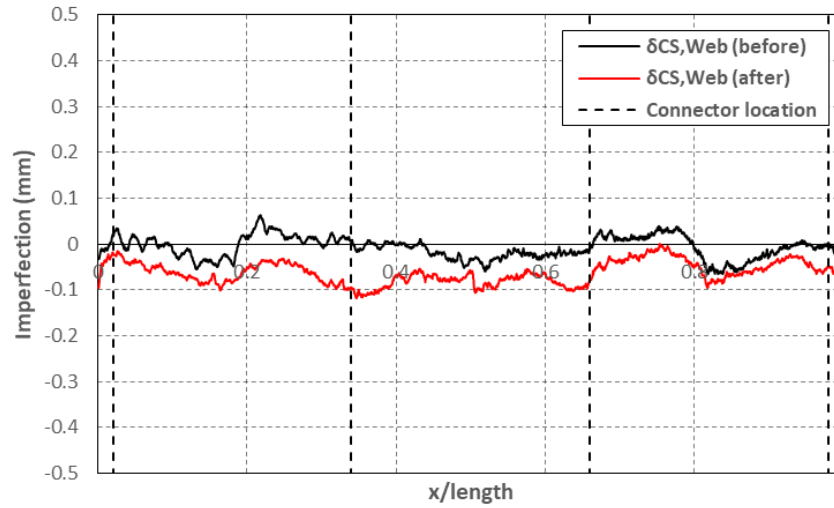


Figure J.1: Cross-sectional imperfections web channel T13014-1 before and after assembly

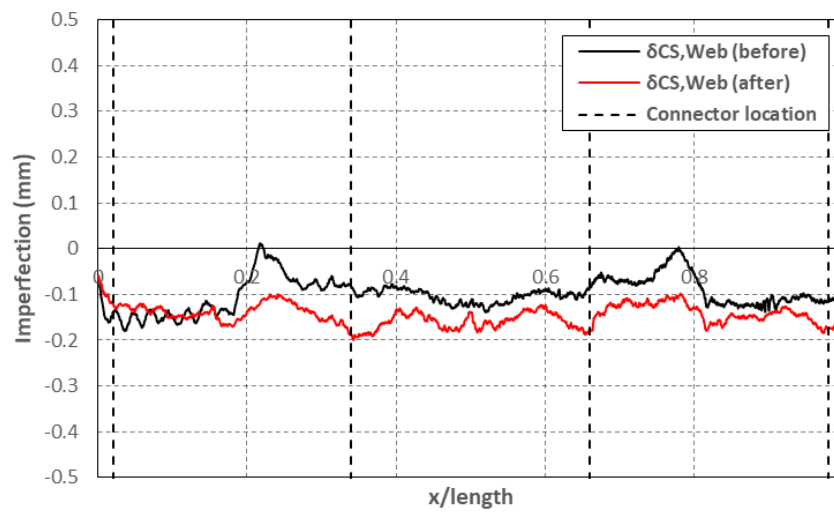


Figure J.2: Cross-sectional imperfections web channel T13014-2 before and after assembly

J.1.2 LC1-2b

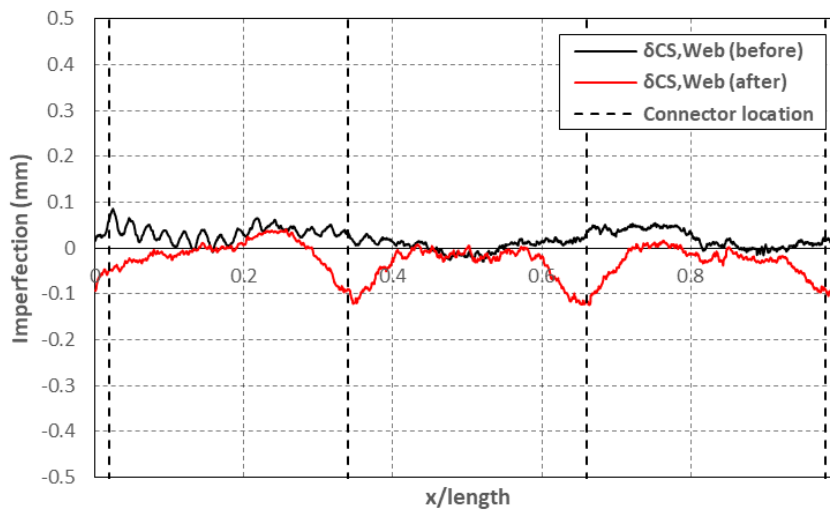


Figure J.3: Cross-sectional imperfections web channel T13014-3 before and after assembly

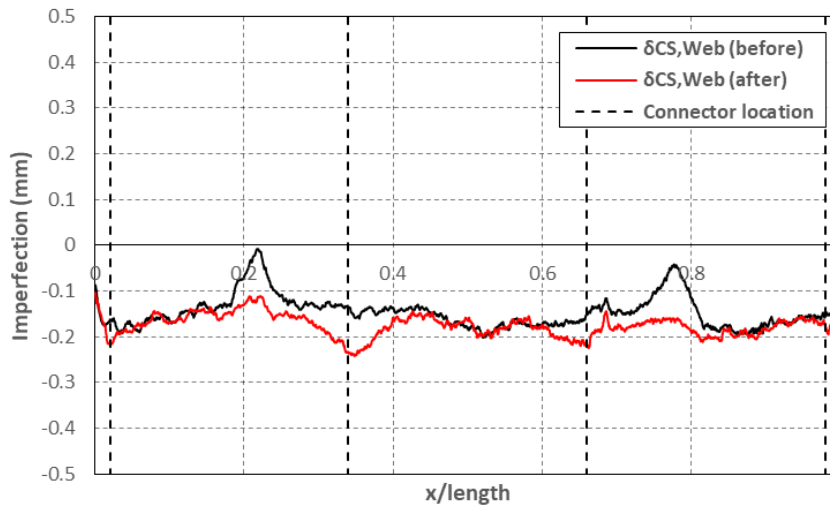


Figure J.4: Cross-sectional imperfections web channel T13014-4 before and after assembly

J.1.3 LC1-3a

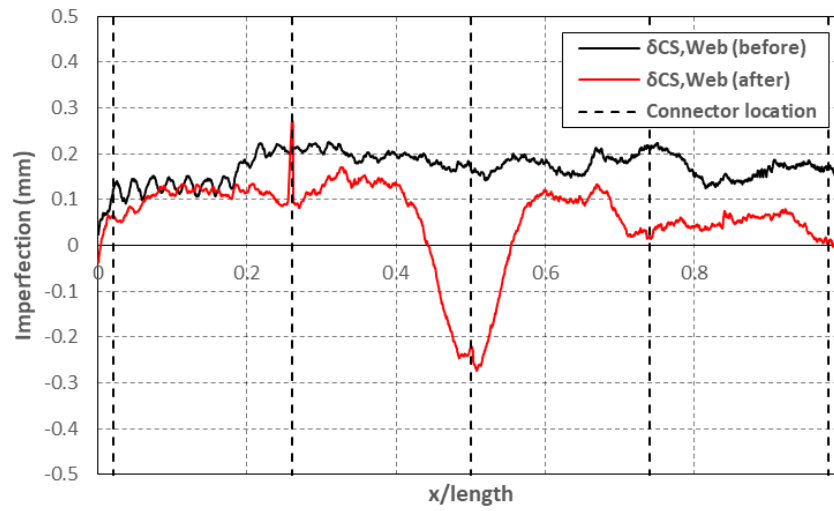


Figure J.5: Cross-sectional imperfections web channel T13014-5 before and after assembly

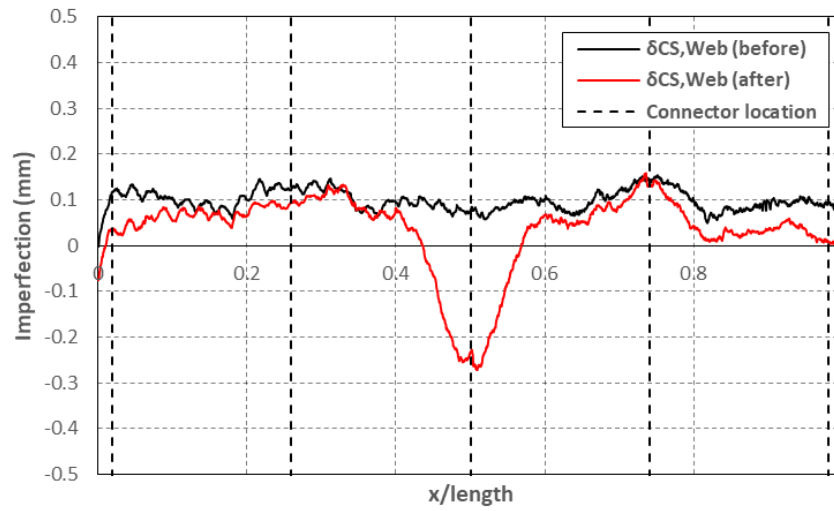


Figure J.6: Cross-sectional imperfections web channel T13014-6 before and after assembly

J.1.4 LC1-3b

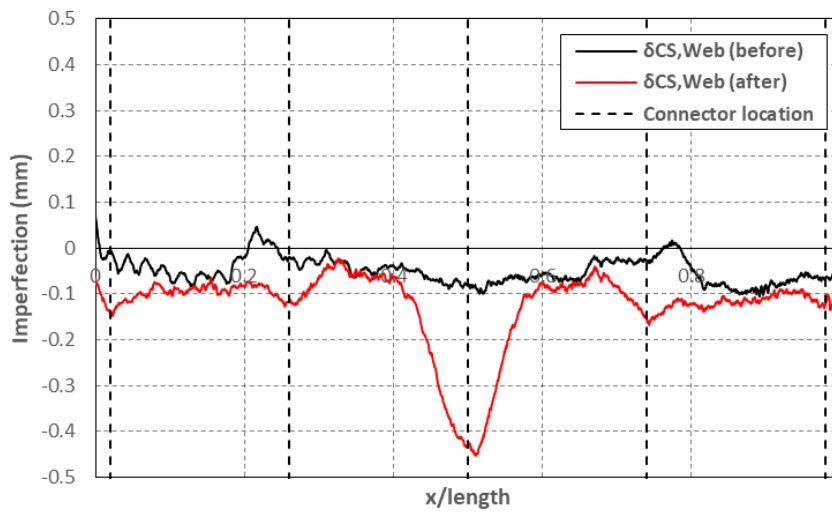


Figure J.7: Cross-sectional imperfections web channel T13014-7 before and after assembly

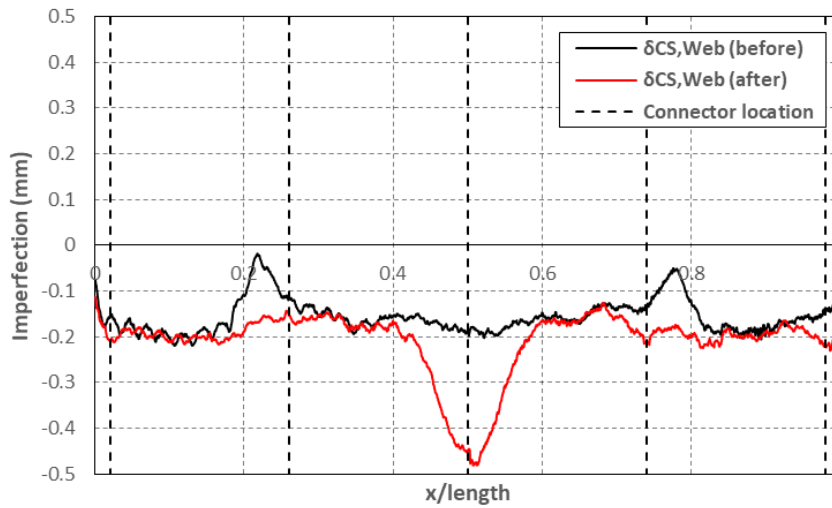


Figure J.8: Cross-sectional imperfections web channel T13014-8 before and after assembly

J.1.5 LC1-8a

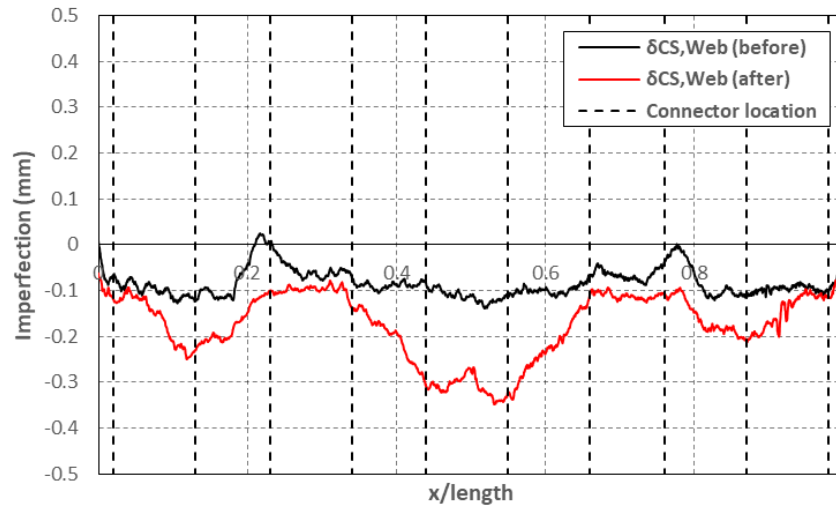


Figure J.9: Cross-sectional imperfections web channel T13014-9 before and after assembly

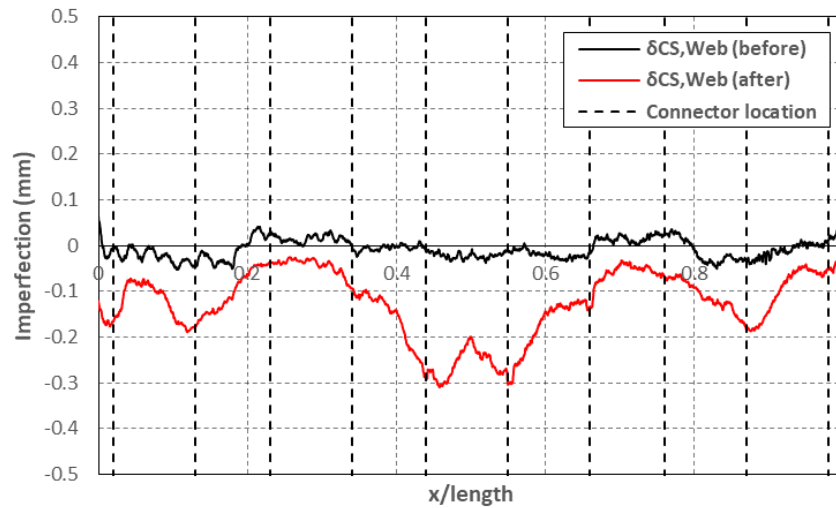


Figure J.10: Cross-sectional imperfections web channel T13014-10 before and after assembly

J.1.6 LC1-8b

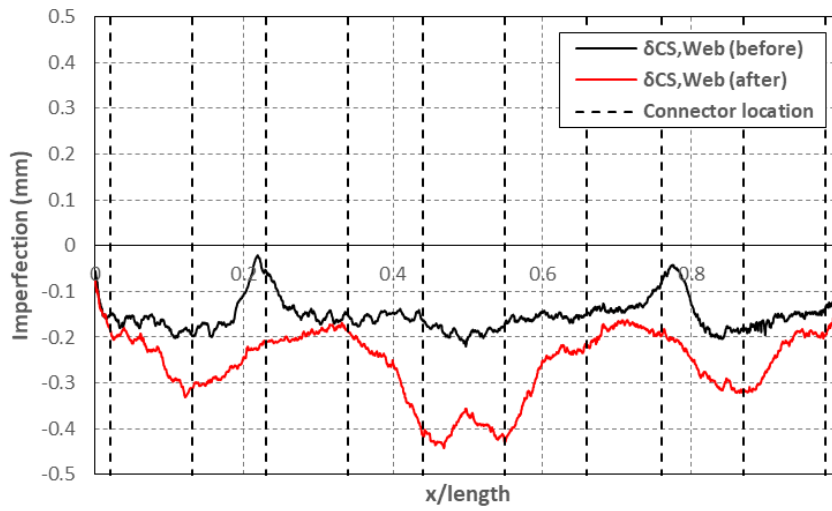


Figure J.11: Cross-sectional imperfections web channel T13014-11 before and after assembly

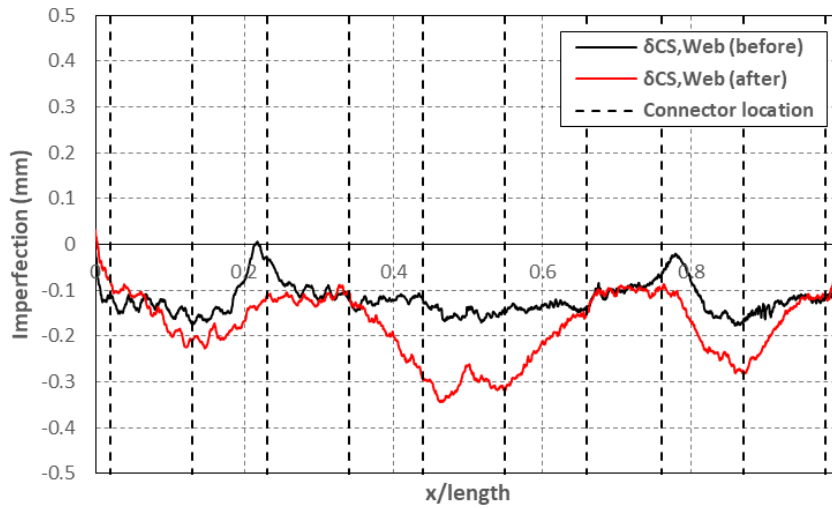


Figure J.12: Cross-sectional imperfections web channel T13014-12 before and after assembly

J.2. Built-up geometry 2 (LC2)

J.2.1 LC2-2a

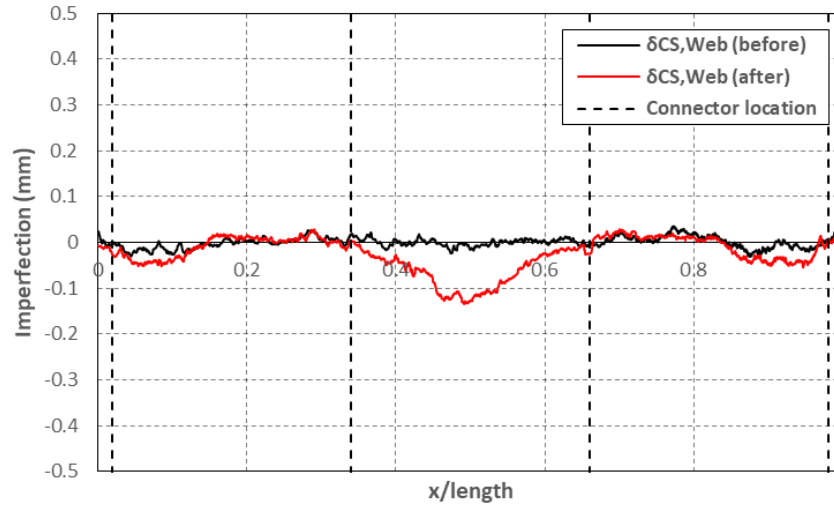


Figure J.13: Cross-sectional imperfections web channel T7914-1 before and after assembly

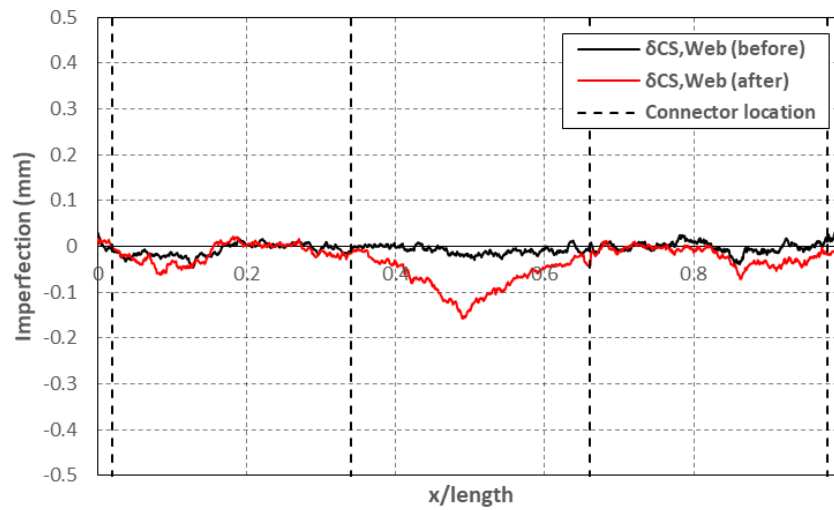


Figure J.14: Cross-sectional imperfections web channel T7914-2 before and after assembly

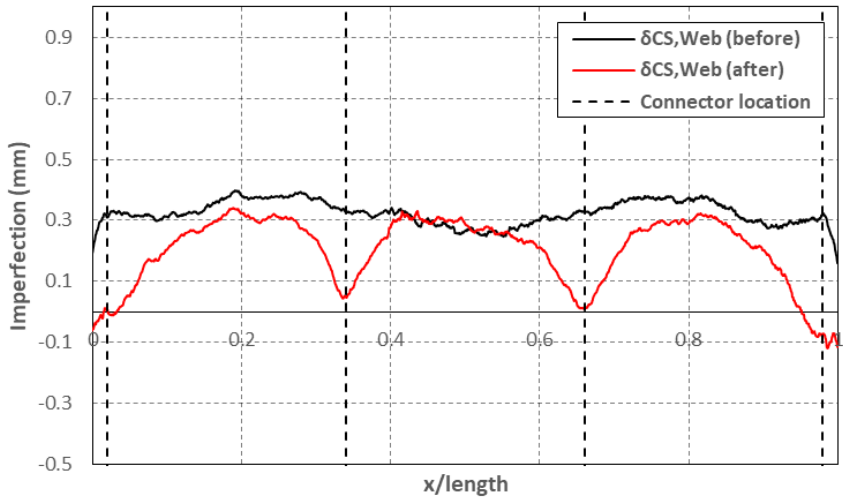


Figure J.15: Cross-sectional imperfections web channel T15414-1 before and after assembly

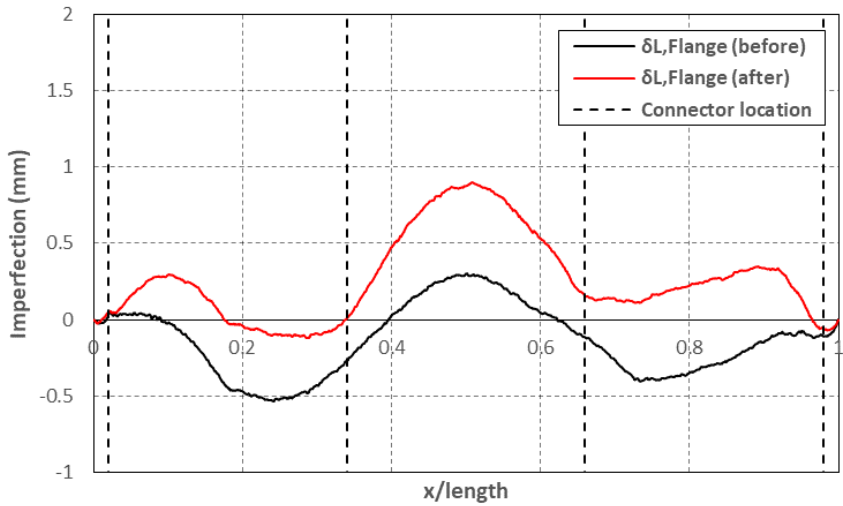


Figure J.16: Cross-sectional imperfections left flange channel T15414-1 before and after assembly

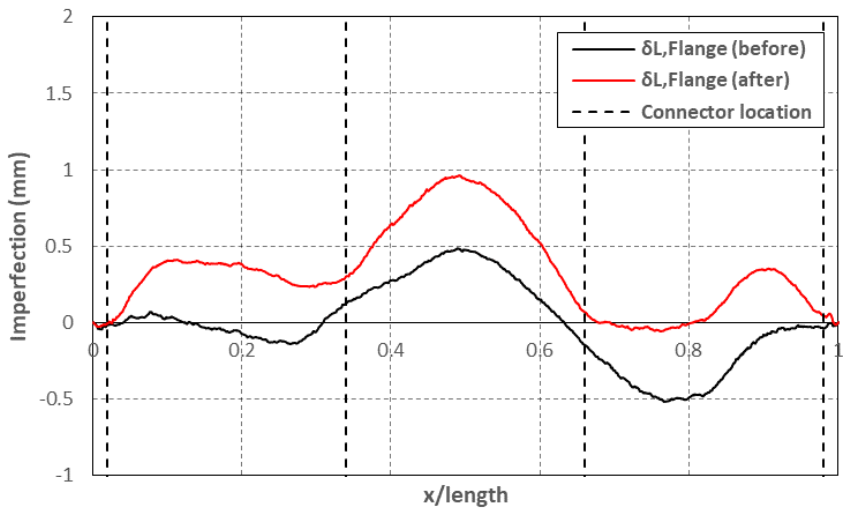


Figure J.17: Cross-sectional imperfections right flange channel T15414-1 before and after assembly

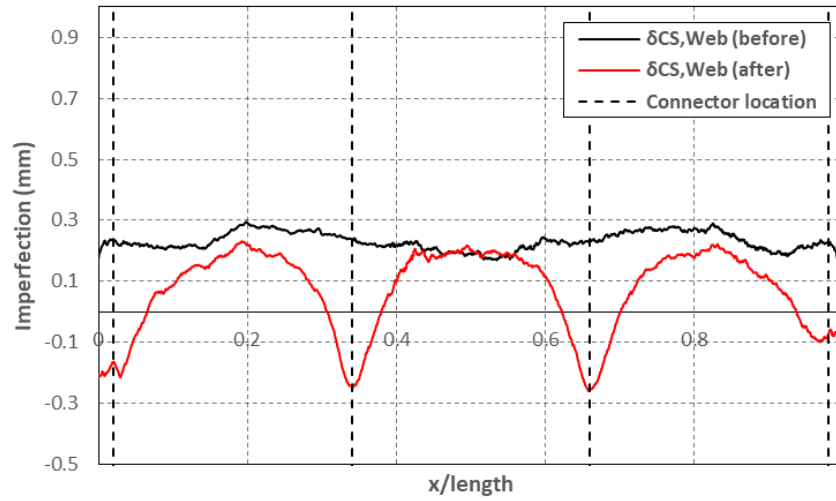


Figure J.18: Cross-sectional imperfections web channel T15414-2 before and after assembly

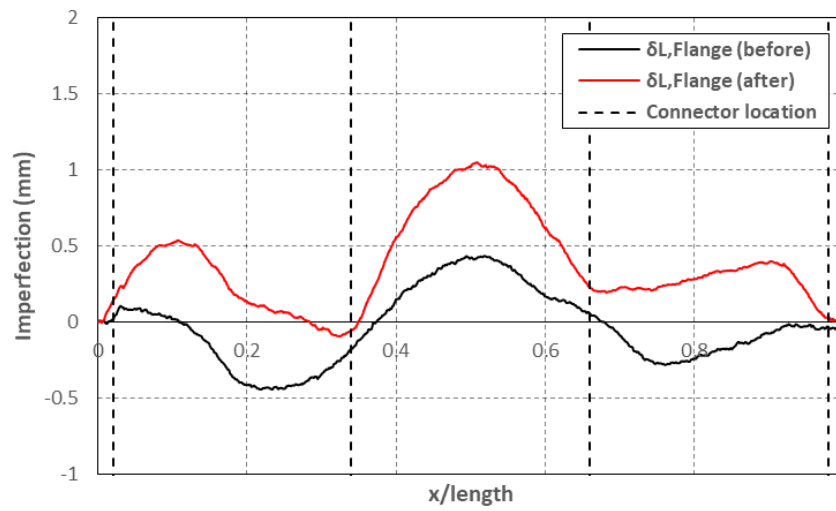


Figure J.19: Cross-sectional imperfections left flange channel T15414-2 before and after assembly

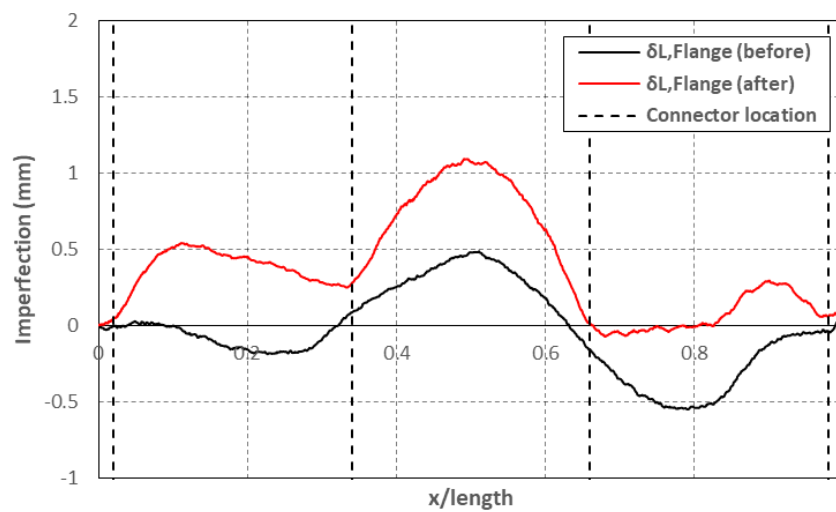


Figure J.20: Cross-sectional imperfections right flange channel T15414-2 before and after assembly

J.2.2 LC2-2b

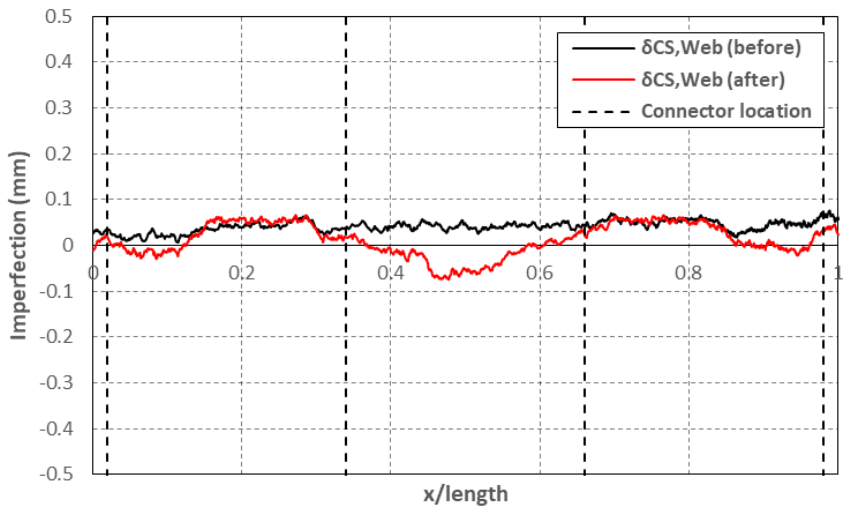


Figure J.21: Cross-sectional imperfections web channel T7914-3 before and after assembly

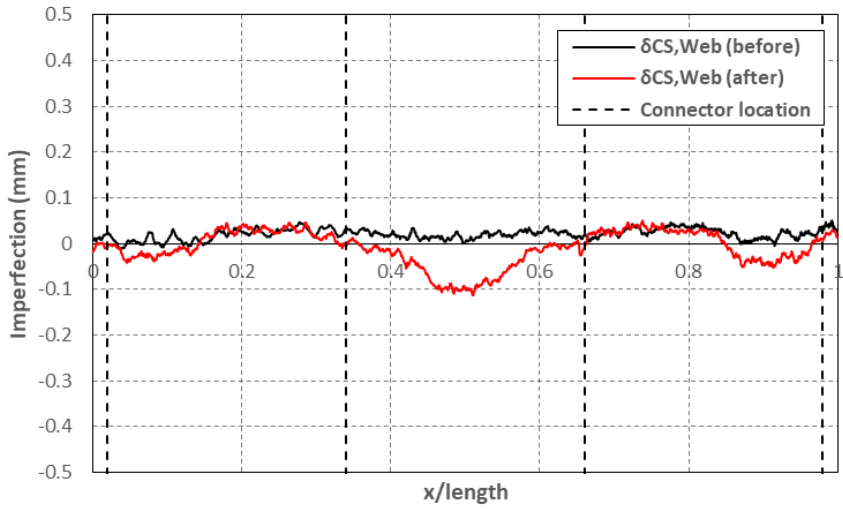


Figure J.22: Cross-sectional imperfections web channel T7914-4 before and after assembly

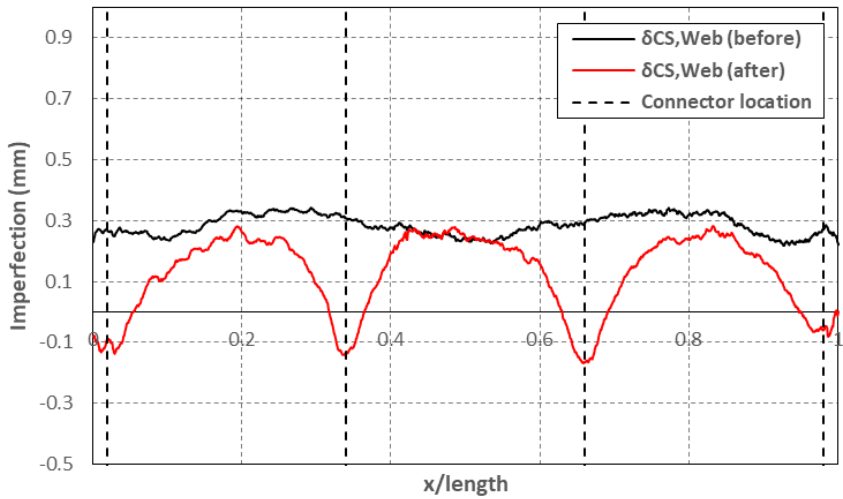


Figure J.23: Cross-sectional imperfections web channel T15414-3 before and after assembly

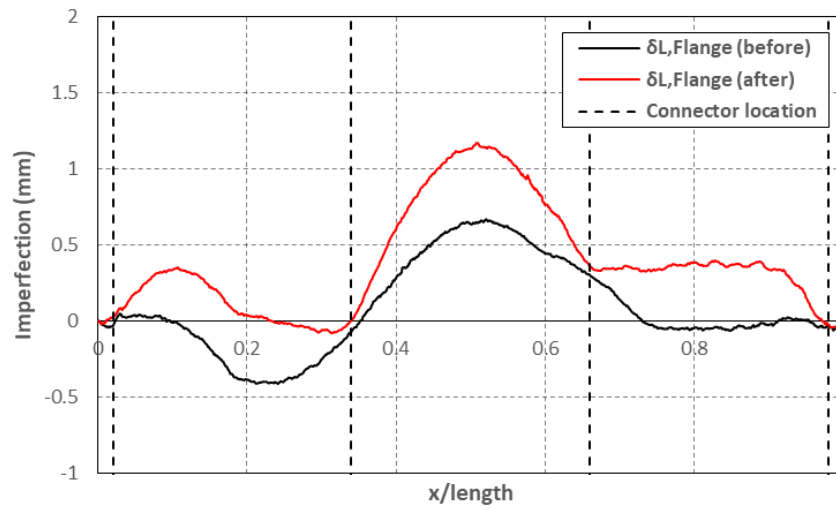


Figure J.24: Cross-sectional imperfections left flange channel T15414-3 before and after assembly

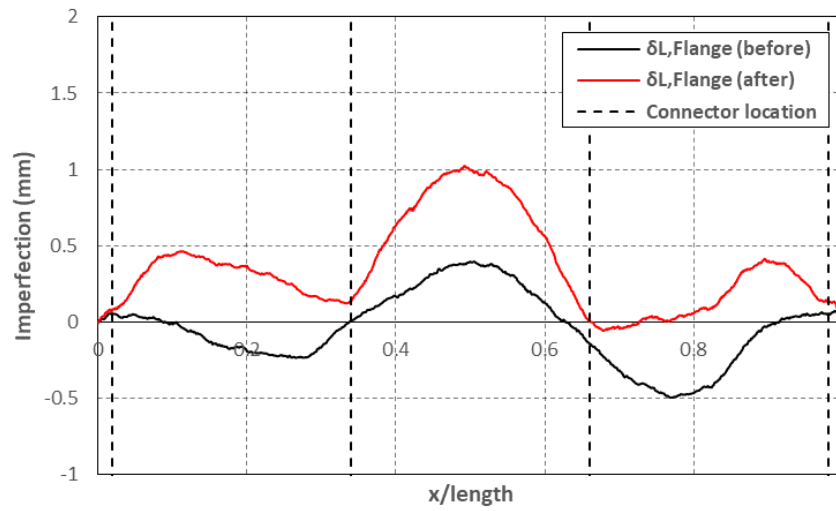


Figure J.25: Cross-sectional imperfections right flange channel T15414-3 before and after assembly

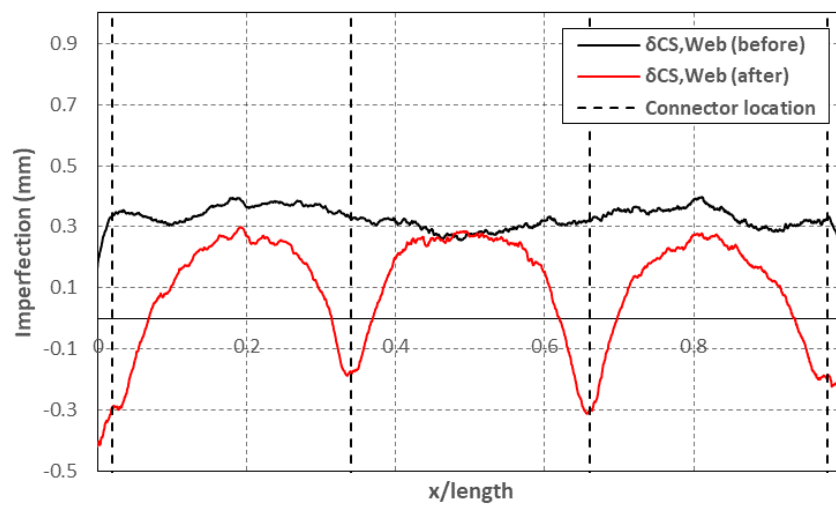


Figure J.26: Cross-sectional imperfections web channel T15414-4 before and after assembly

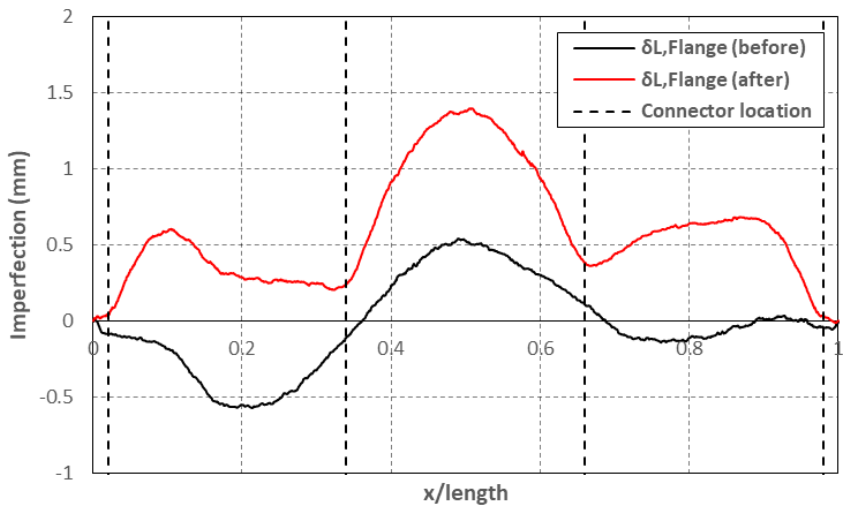


Figure J.27: Cross-sectional imperfections left flange channel T15414-4 before and after assembly

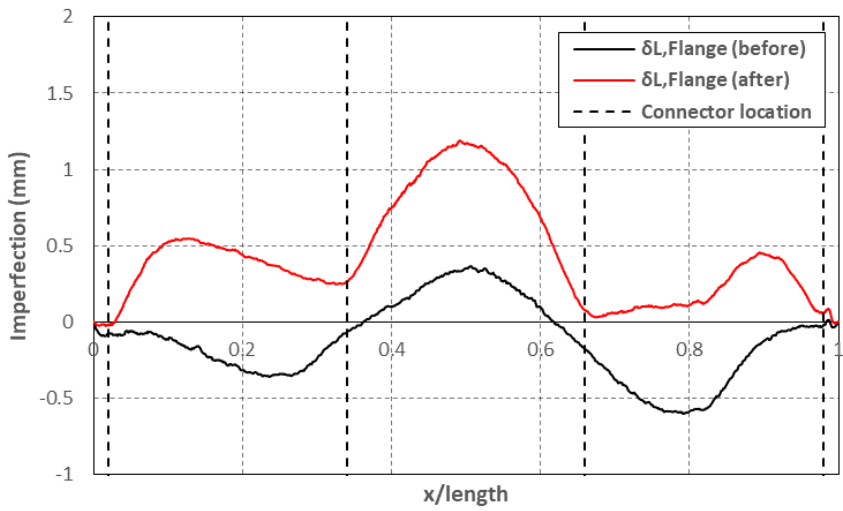


Figure J.28: Cross-sectional imperfections right flange channel T15414-4 before and after assembly

J.2.3 LC2-6a

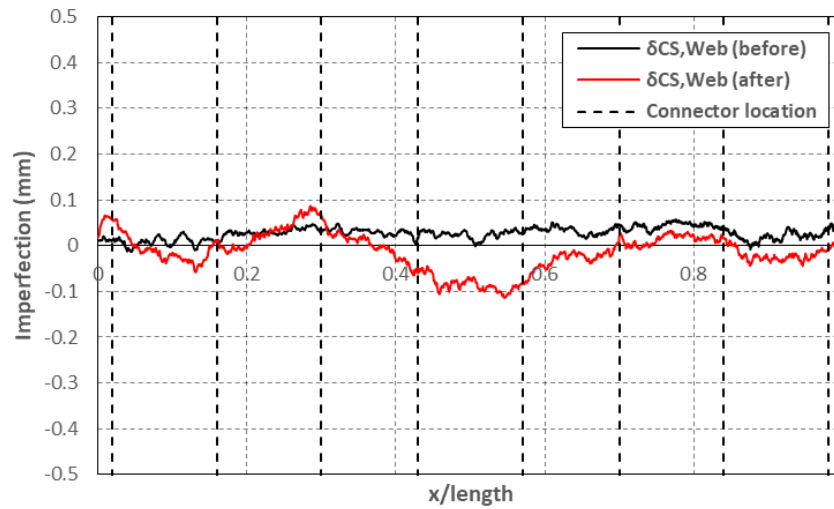


Figure J.29: Cross-sectional imperfections web channel T7914-5 before and after assembly

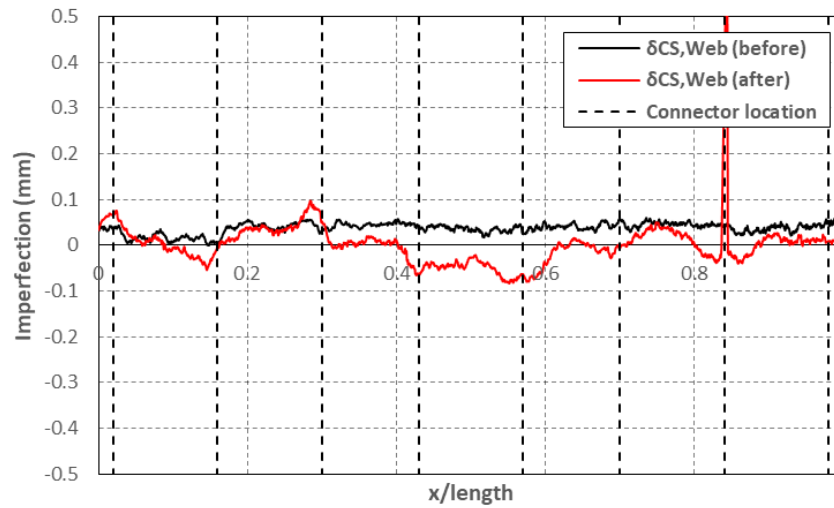


Figure J.30: Cross-sectional imperfections web channel T7914-6 before and after assembly

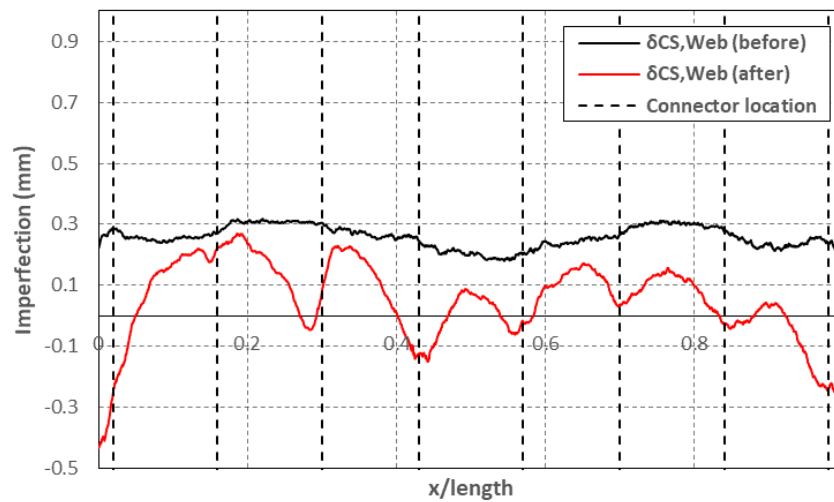


Figure J.31: Cross-sectional imperfections web channel T15414-5 before and after assembly

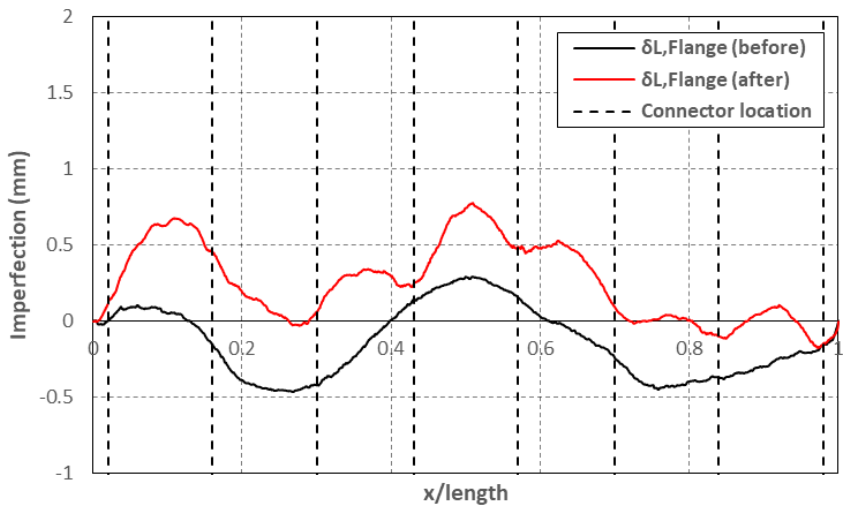


Figure J.32: Cross-sectional imperfections left flange channel T15414-5 before and after assembly

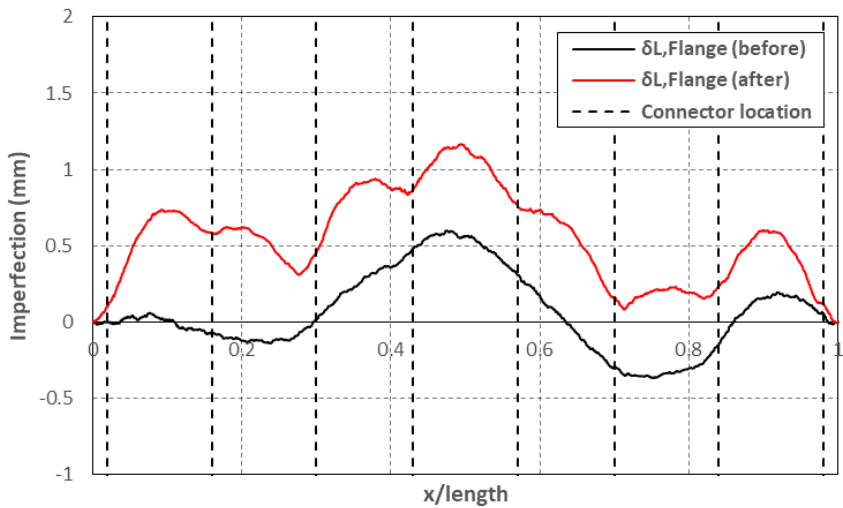


Figure J.33: Cross-sectional imperfections right flange channel T15414-5 before and after assembly

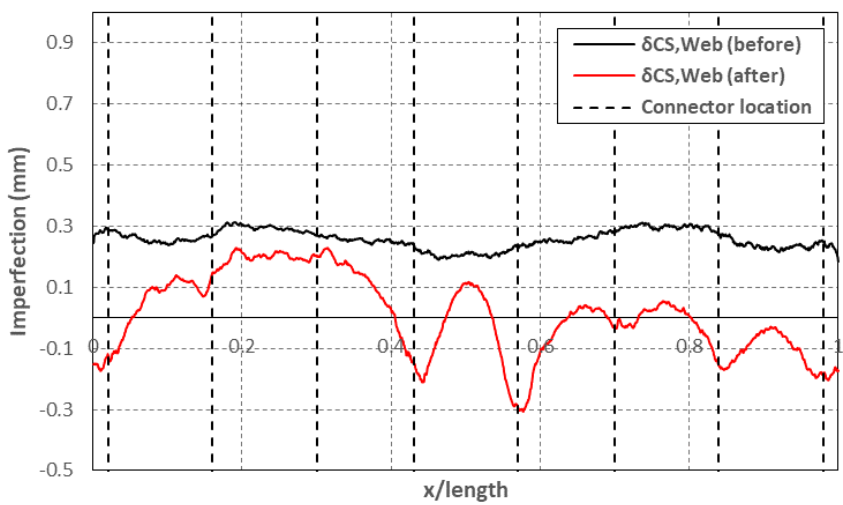


Figure J.34: Cross-sectional imperfections web channel T15414-6 before and after assembly

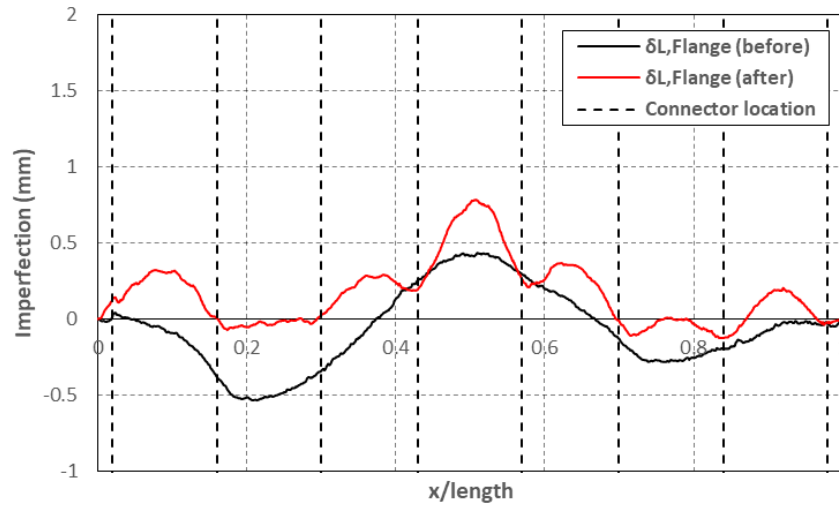


Figure J.35: Cross-sectional imperfections left flange channel T15414-6 before and after assembly

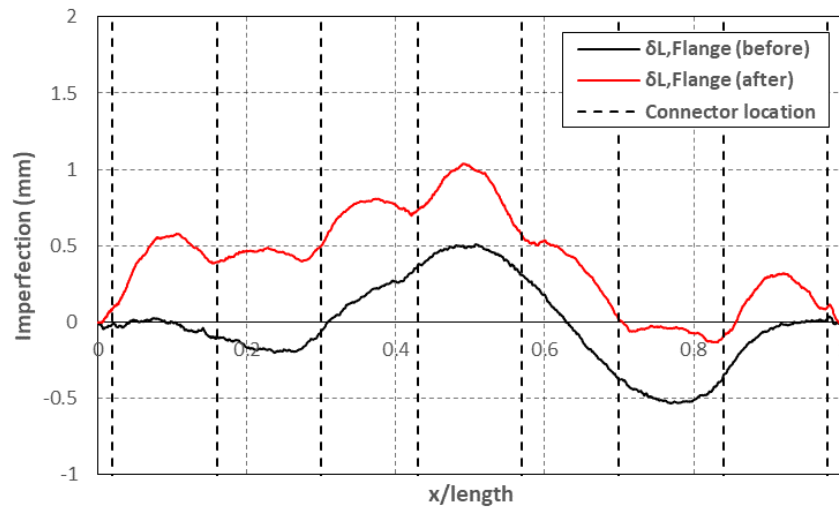


Figure J.36: Cross-sectional imperfections right flange channel T15414-6 before and after assembly

J.2.4 LC2-6b

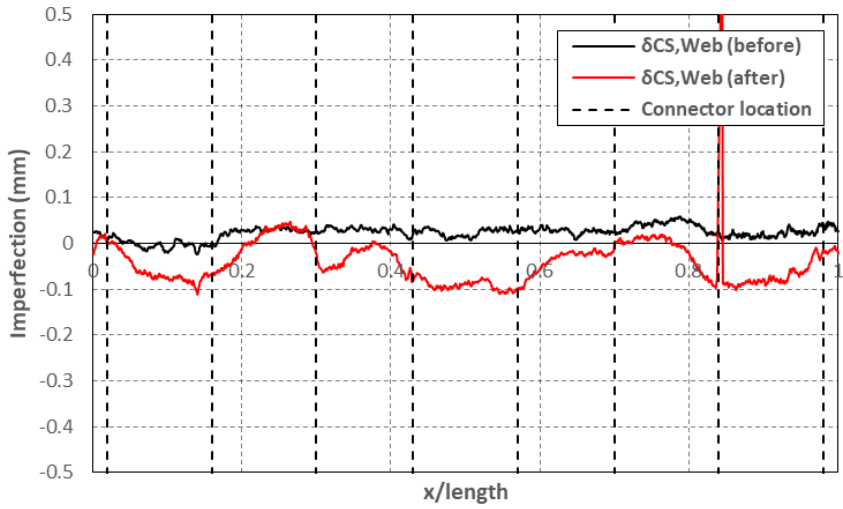


Figure J.37: Cross-sectional imperfections web channel T7914-7 before and after assembly

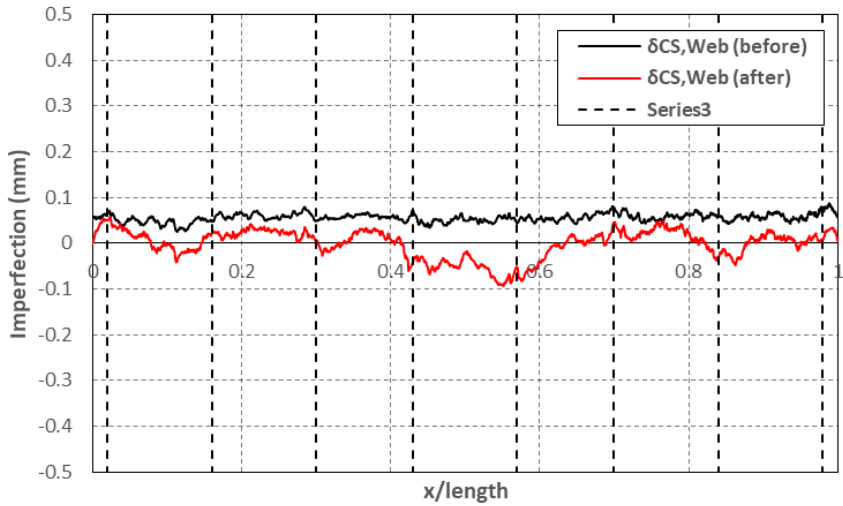


Figure J.38: Cross-sectional imperfections web channel T7914-8 before and after assembly

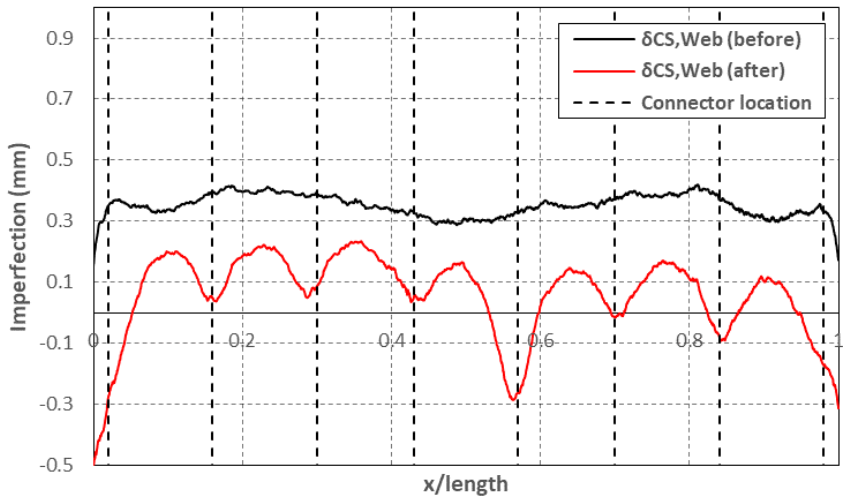


Figure J.39: Cross-sectional imperfections web channel T15414-7 before and after assembly

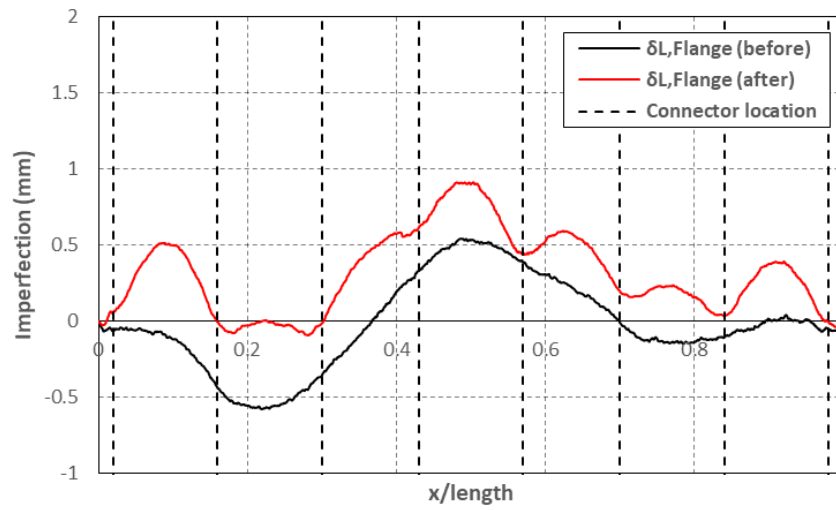


Figure J.40: Cross-sectional imperfections left flange channel T15414-7 before and after assembly

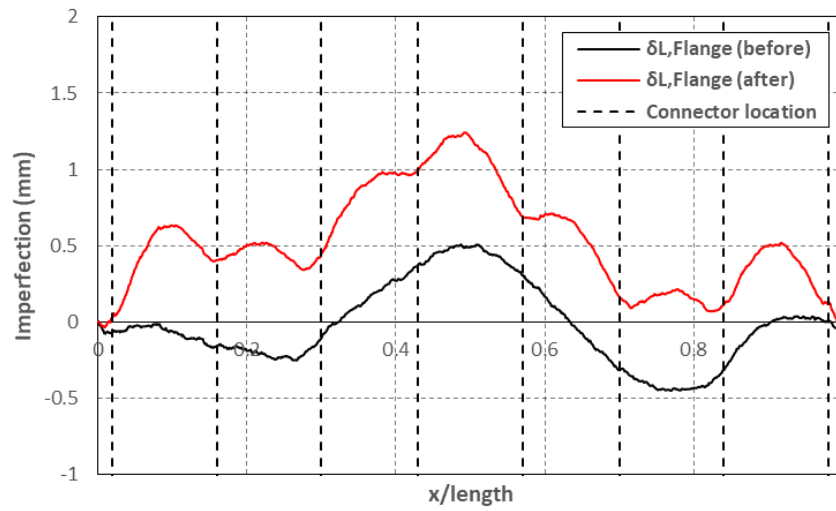


Figure J.41: Cross-sectional imperfections right flange channel T15414-7 before and after assembly

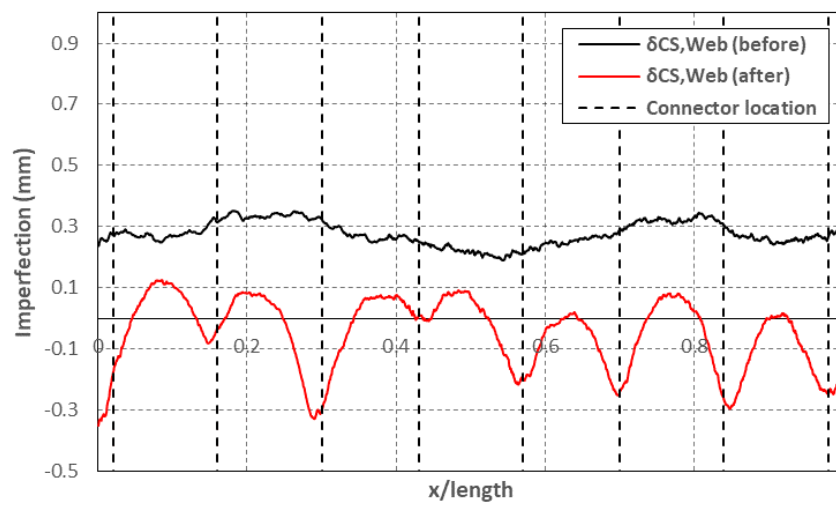


Figure J.42: Cross-sectional imperfections web channel T15414-8 before and after assembly

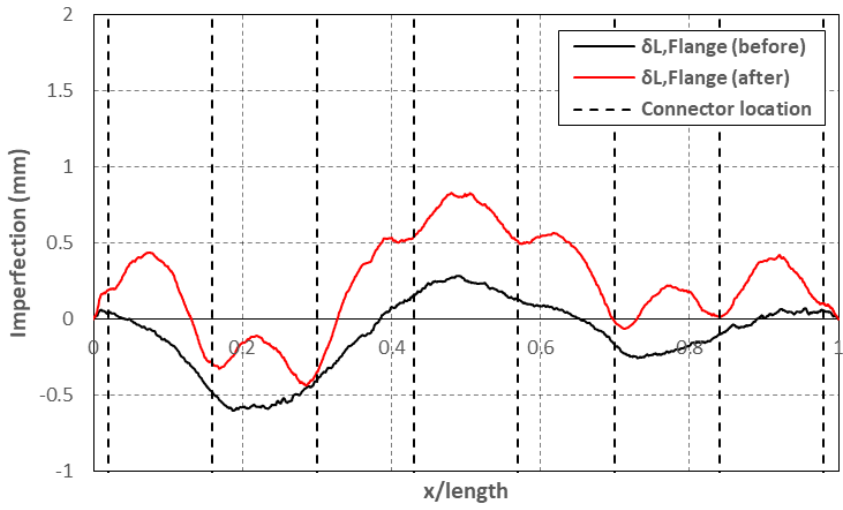


Figure J.43: Cross-sectional imperfections left flange channel T15414-8 before and after assembly

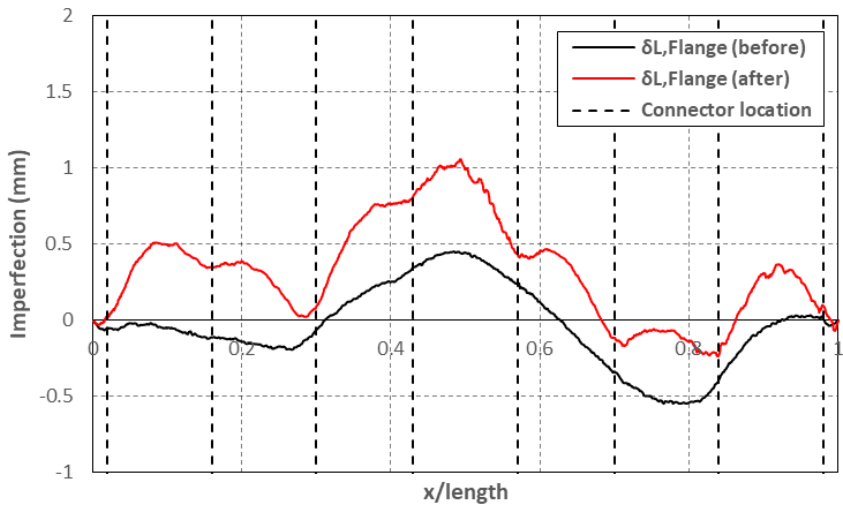


Figure J.44: Cross-sectional imperfections right flange channel T15414-8 before and after assembly

J.2.5 LC2-4a

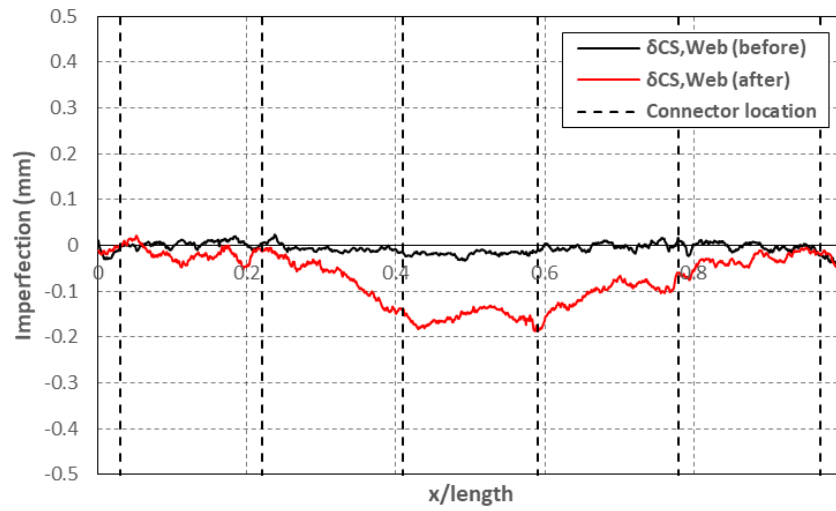


Figure J.45: Cross-sectional imperfections web channel T7914-9 before and after assembly

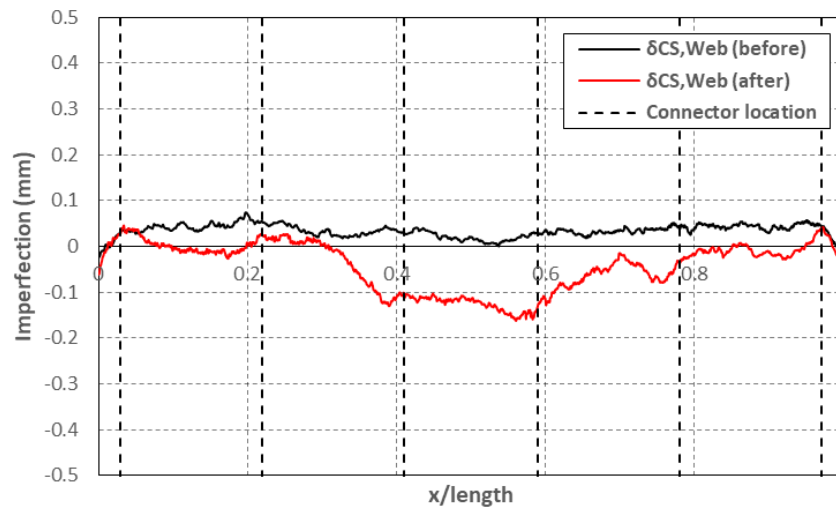


Figure J.46: Cross-sectional imperfections web channel T7914-10 before and after assembly

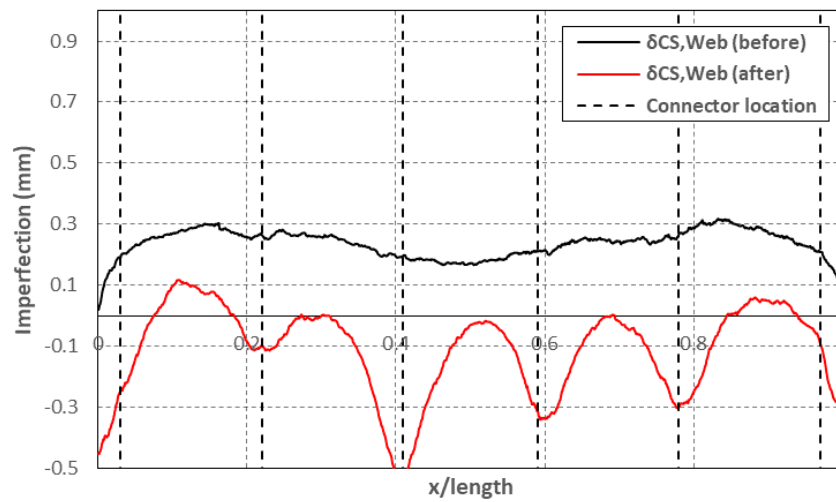


Figure J.47: Cross-sectional imperfections web channel T15414-9 before and after assembly

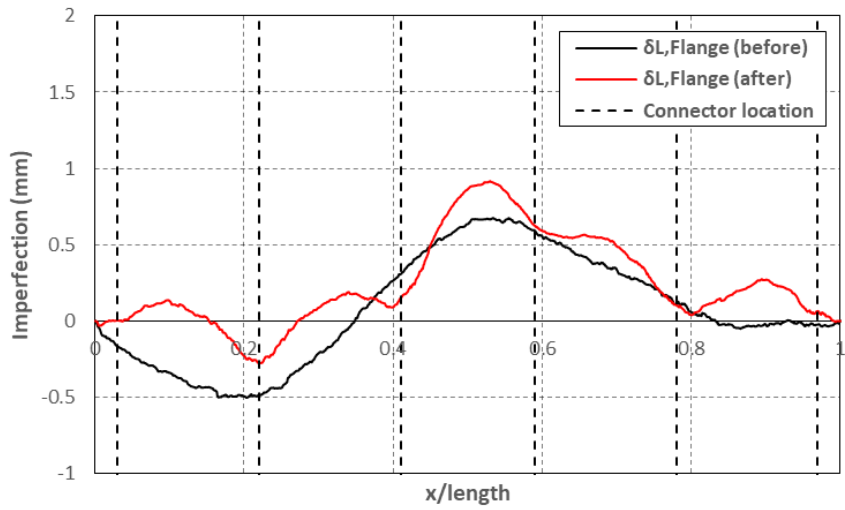


Figure J.48: Cross-sectional imperfections left flange channel T15414-9 before and after assembly

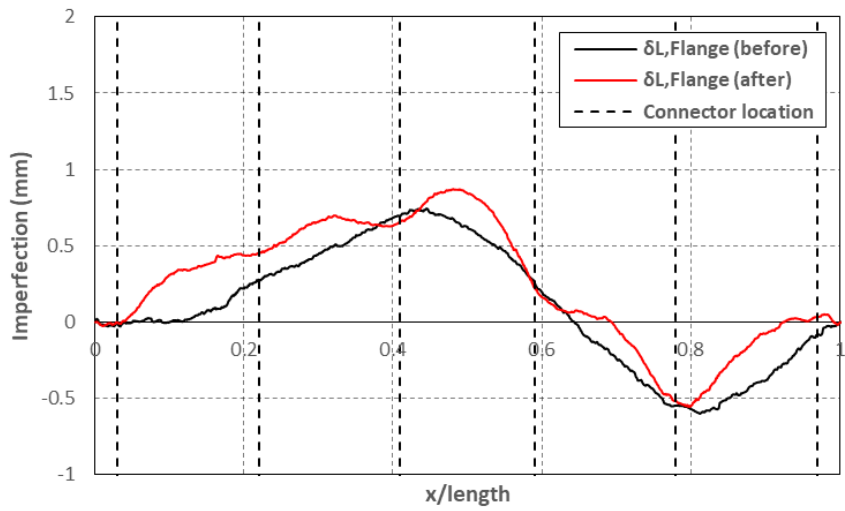


Figure J.49: Cross-sectional imperfections right flange channel T15414-9 before and after assembly

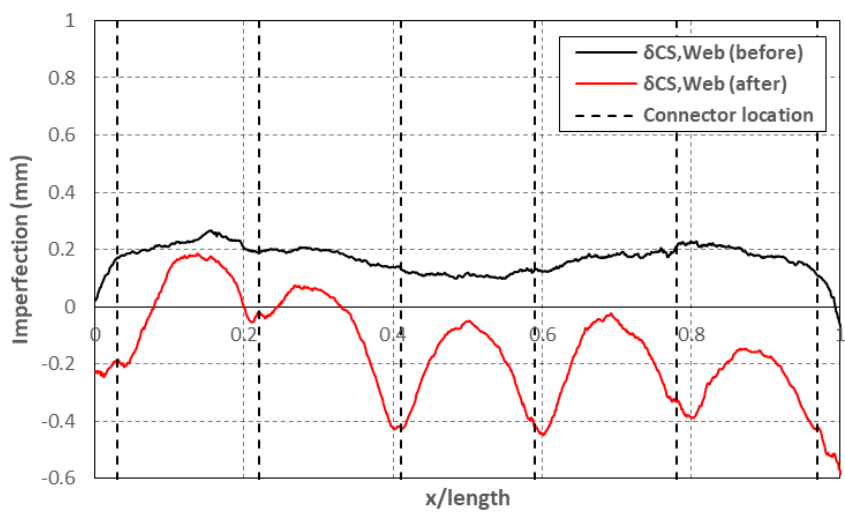


Figure J.50: Cross-sectional imperfections web channel T15414-10 before and after assembly

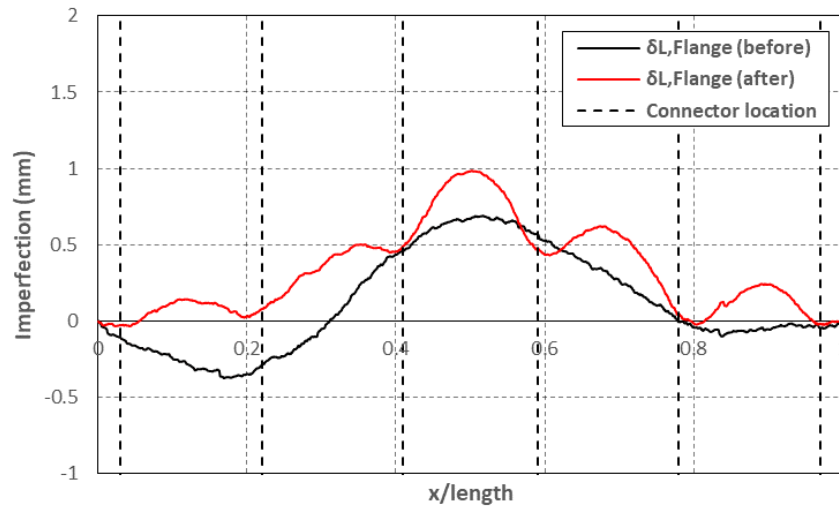


Figure J.51: Cross-sectional imperfections left flange channel T15414-10 before and after assembly

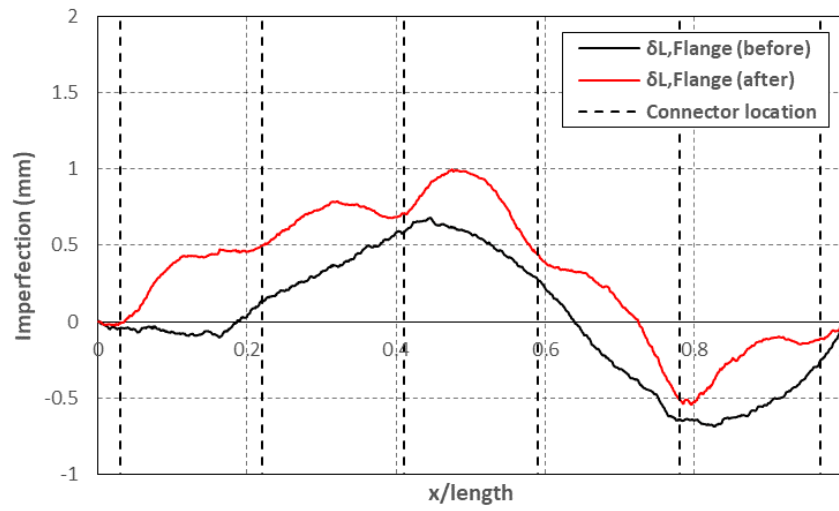


Figure J.52: Cross-sectional imperfections right flange channel T15414-10 before and after assembly

J.2.6 LC2-4b

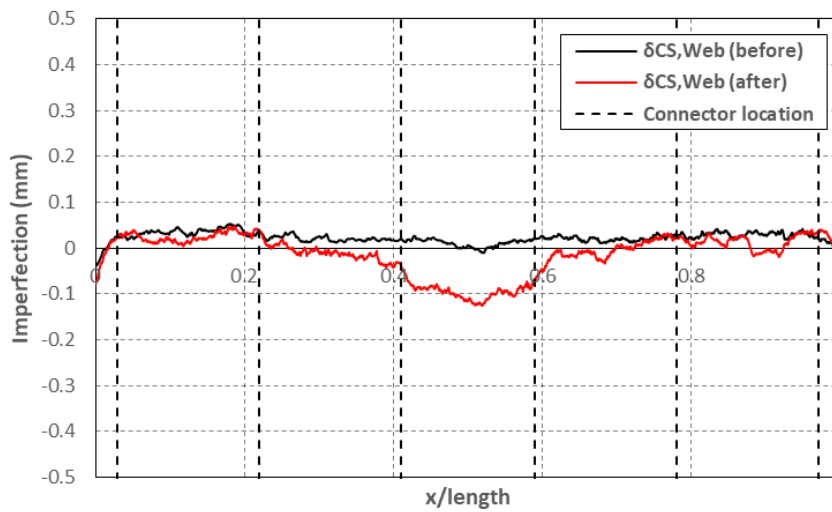


Figure J.53: Cross-sectional imperfections web channel T7914-11 before and after assembly

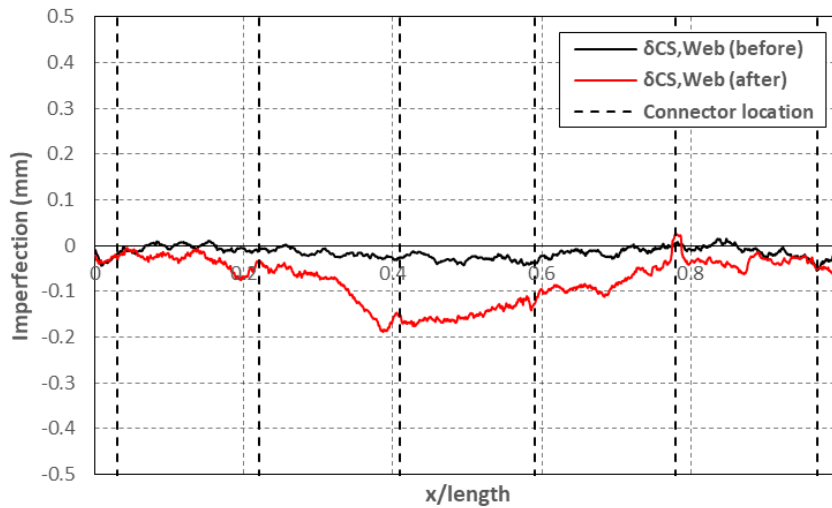


Figure J.54: Cross-sectional imperfections web channel T7914-12 before and after assembly

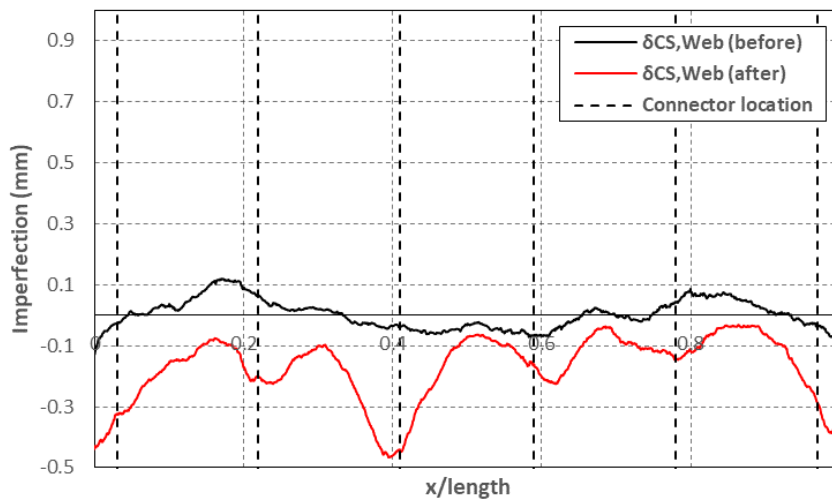


Figure J.55: Cross-sectional imperfections web channel T15414-11 before and after assembly

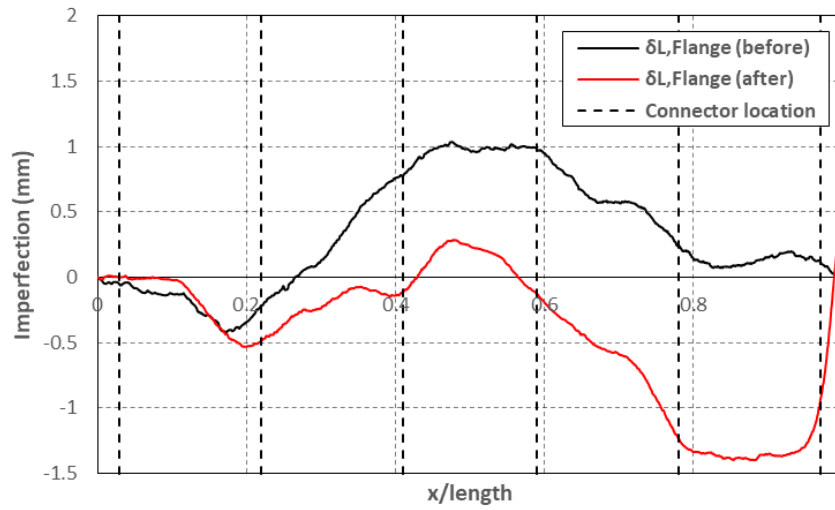


Figure J.56: Cross-sectional imperfections left flange channel T15414-11 before and after assembly

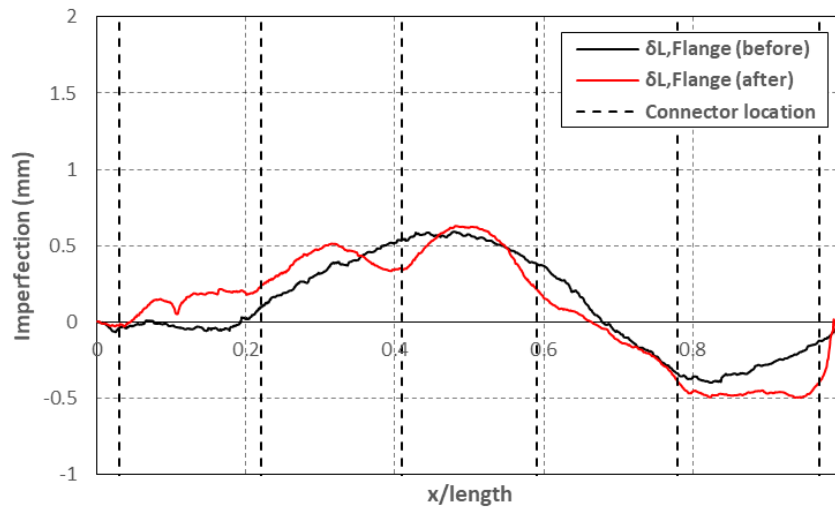


Figure J.57: Cross-sectional imperfections right flange channel T15414-11 before and after assembly

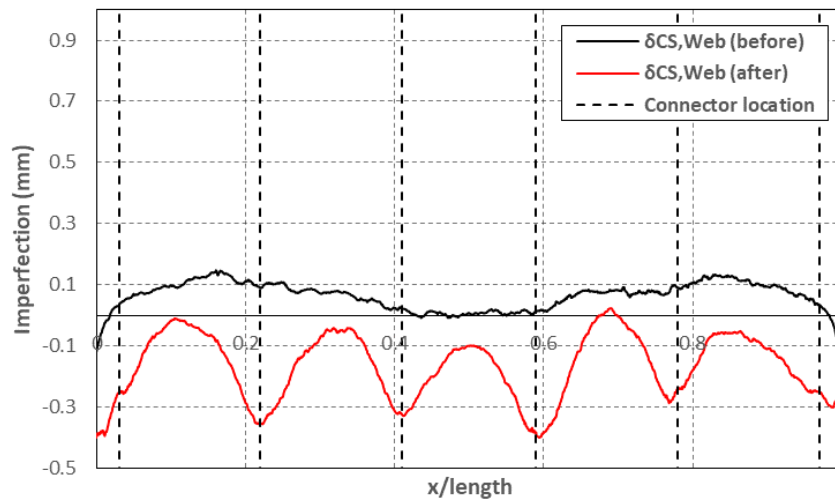


Figure J.58: Cross-sectional imperfections web channel T15414-12 before and after assembly

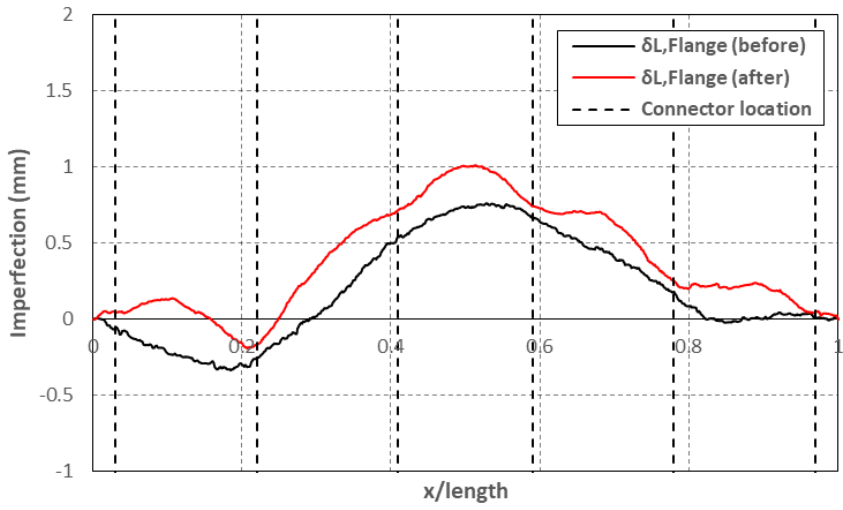


Figure J.59: Cross-sectional imperfections left flange channel T15414-12 before and after assembly

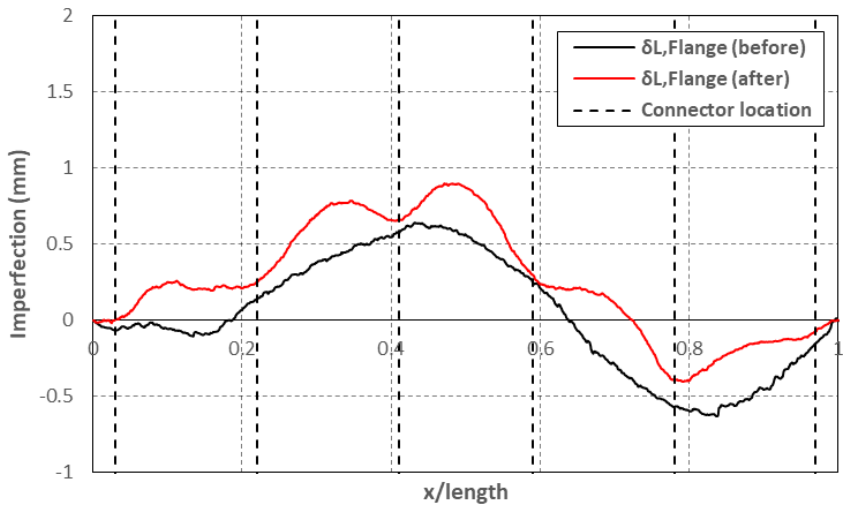


Figure J.60: Cross-sectional imperfections right flange channel T15414-12 before and after assembly

J.3. Built-up geometry 3 (LC3)

J.3.1 LC3-2a

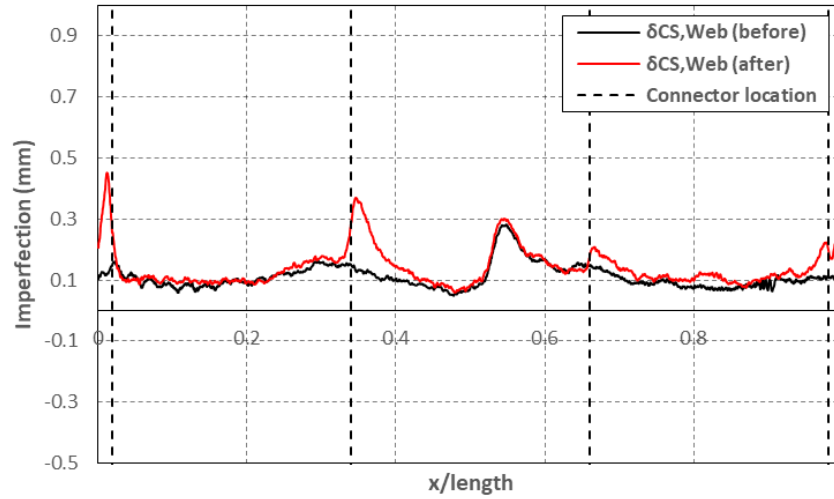


Figure J.61: Cross-sectional imperfections web channel T12012-1 before and after assembly

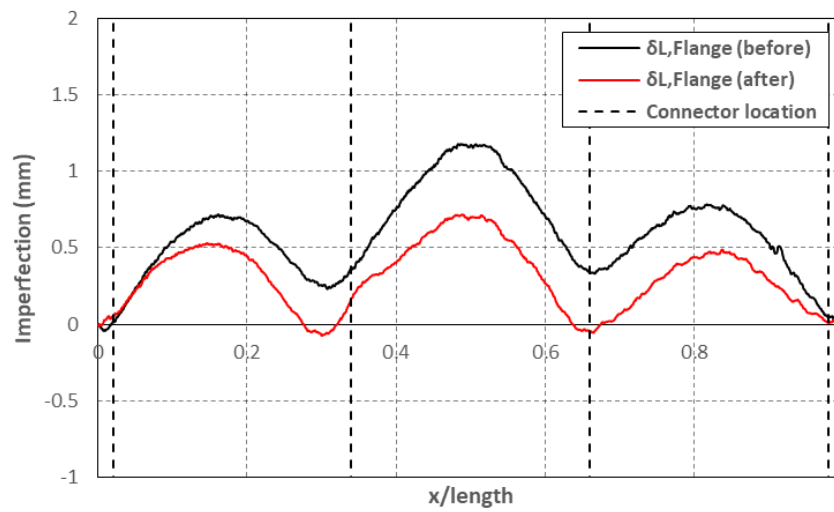


Figure J.62: Cross-sectional imperfections left flange channel T12012-1 before and after assembly

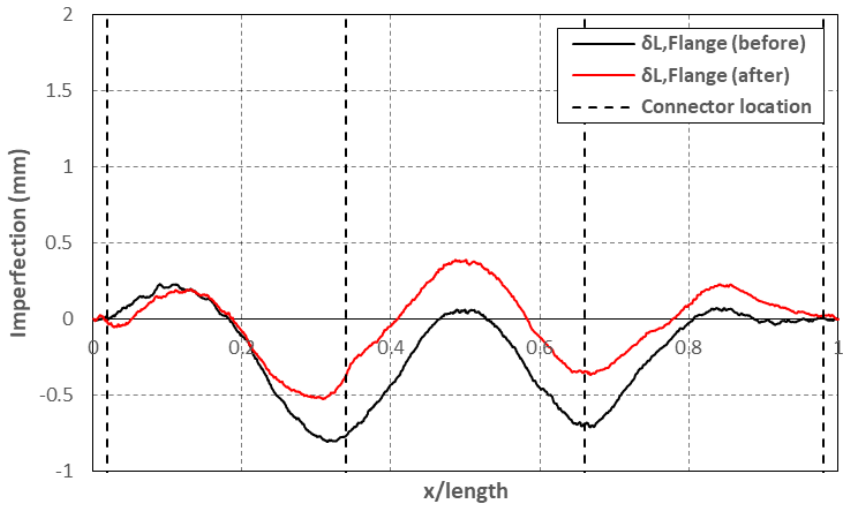


Figure J.63: Cross-sectional imperfections right flange channel T12012-1 before and after assembly

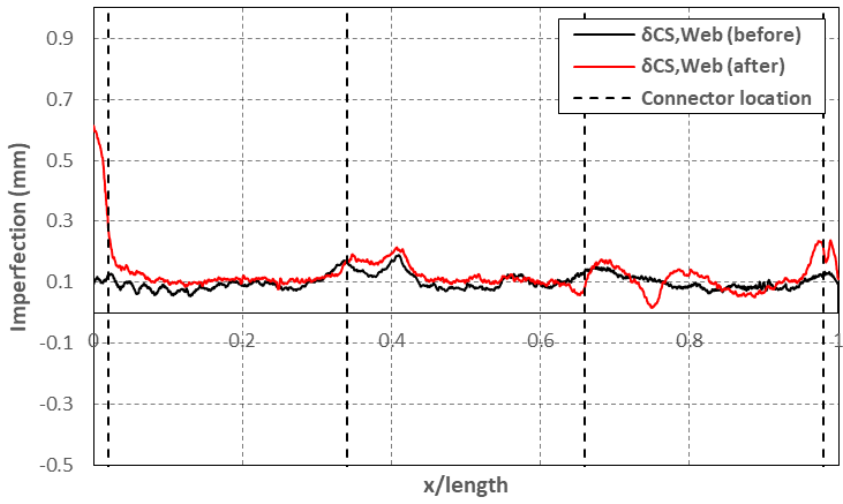


Figure J.64: Cross-sectional imperfections web channel T12012-2 before and after assembly

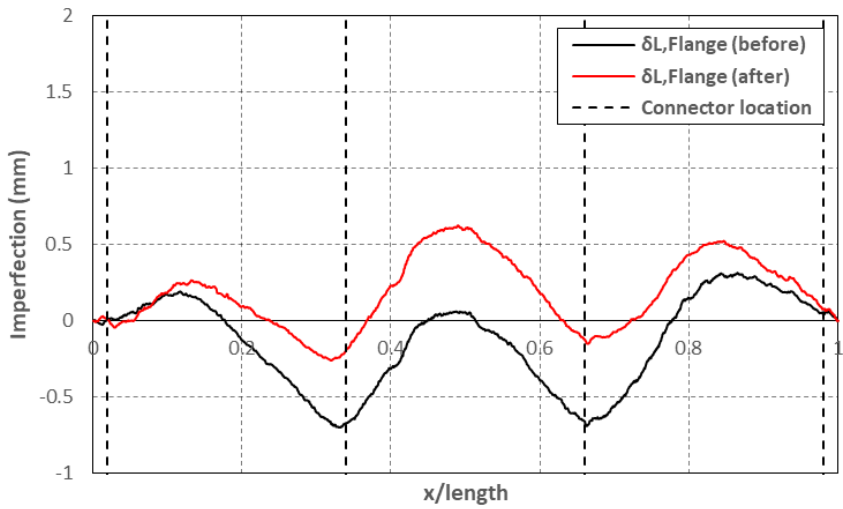


Figure J.65: Cross-sectional imperfections left flange channel T12012-2 before and after assembly

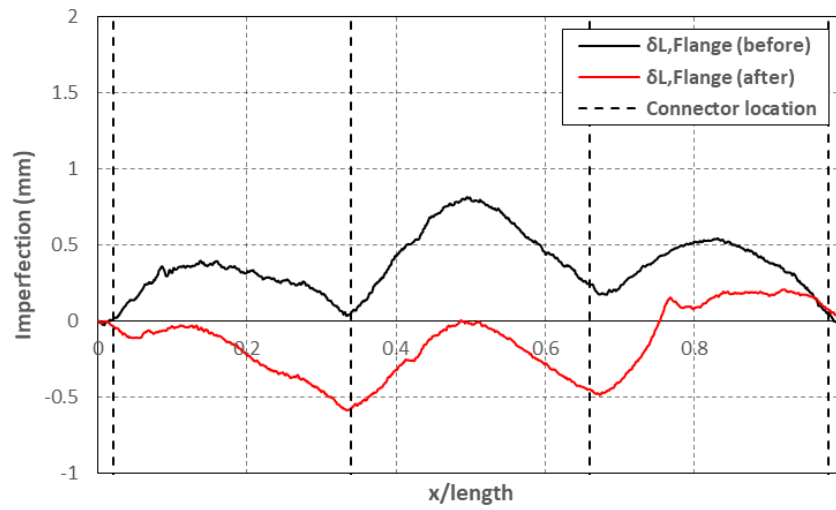


Figure J.66: Cross-sectional imperfections right flange channel T12012-2 before and after assembly

J.3.2 LC3-2b

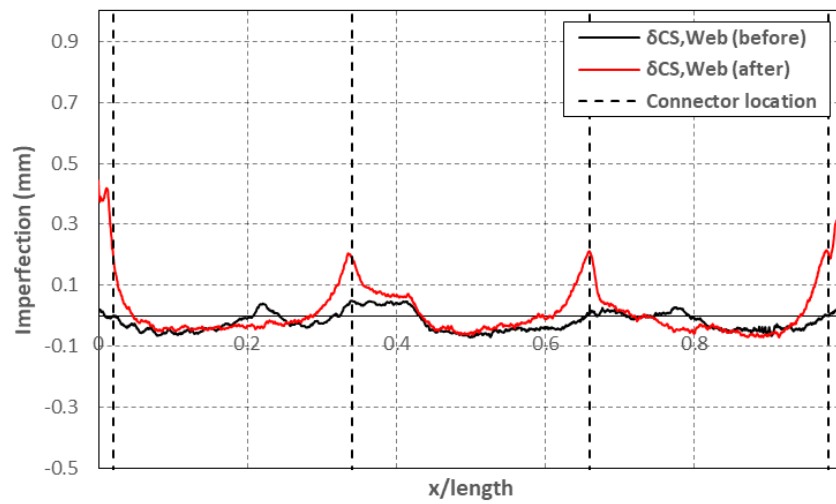


Figure J.67: Cross-sectional imperfections web channel T12012-3 before and after assembly

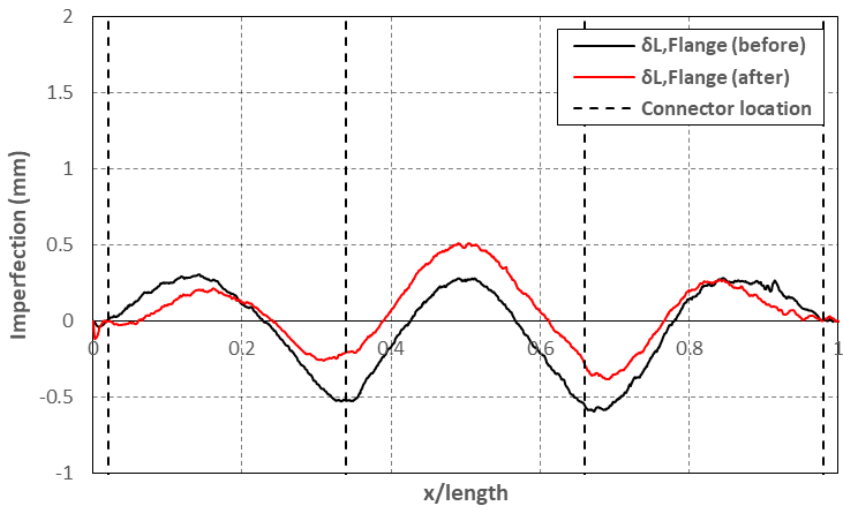


Figure J.68: Cross-sectional imperfections left flange channel T12012-3 before and after assembly

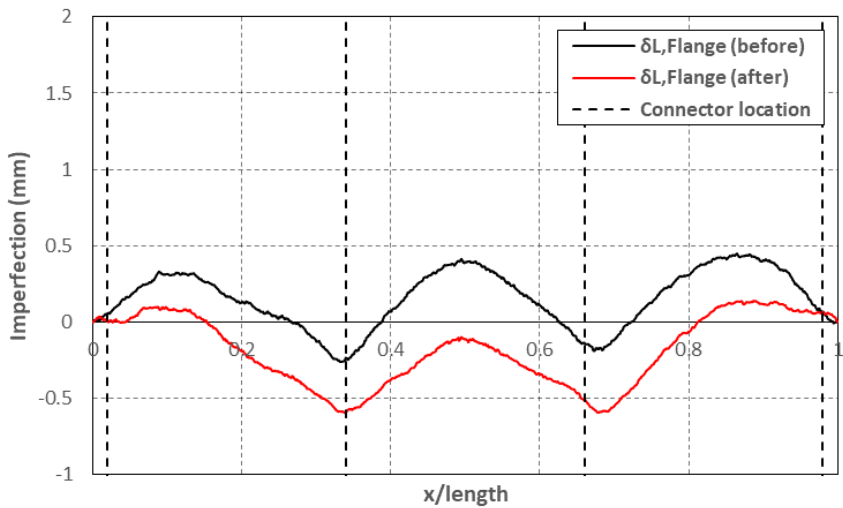


Figure J.69: Cross-sectional imperfections right flange channel T12012-3 before and after assembly

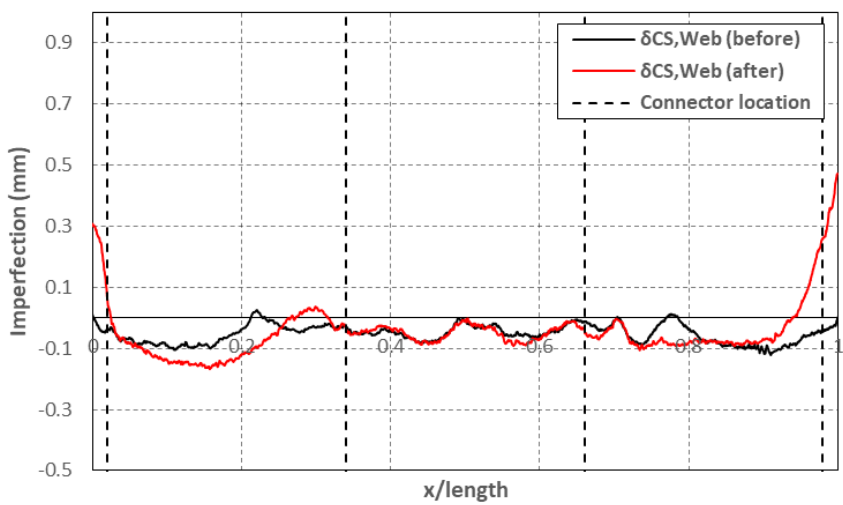


Figure J.70: Cross-sectional imperfections web channel T12012-4 before and after assembly

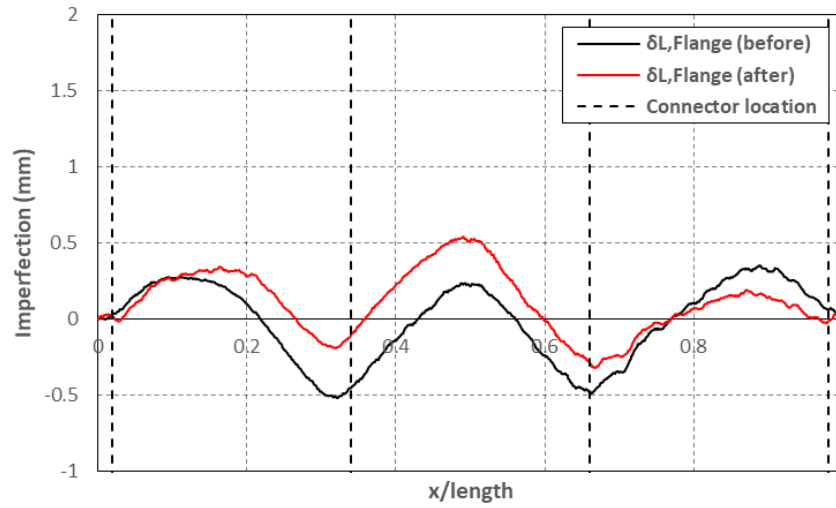


Figure J.71: Cross-sectional imperfections left flange channel T12012-4 before and after assembly

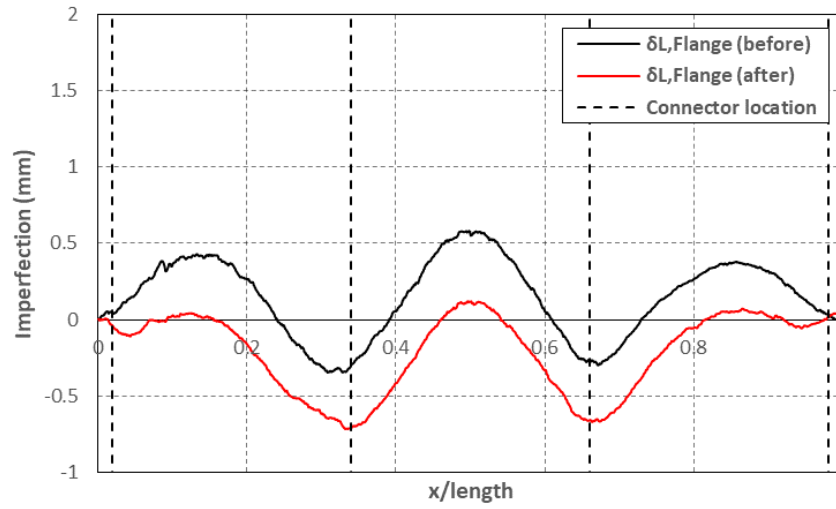


Figure J.72: Cross-sectional imperfections right flange channel T12012-4 before and after assembly

J.3.3 LC3-3a

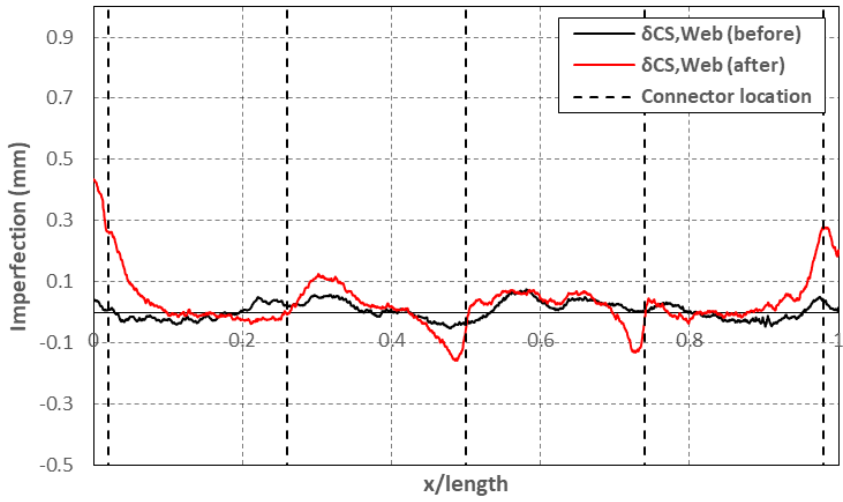


Figure J.73: Cross-sectional imperfections web channel T12012-5 before and after assembly

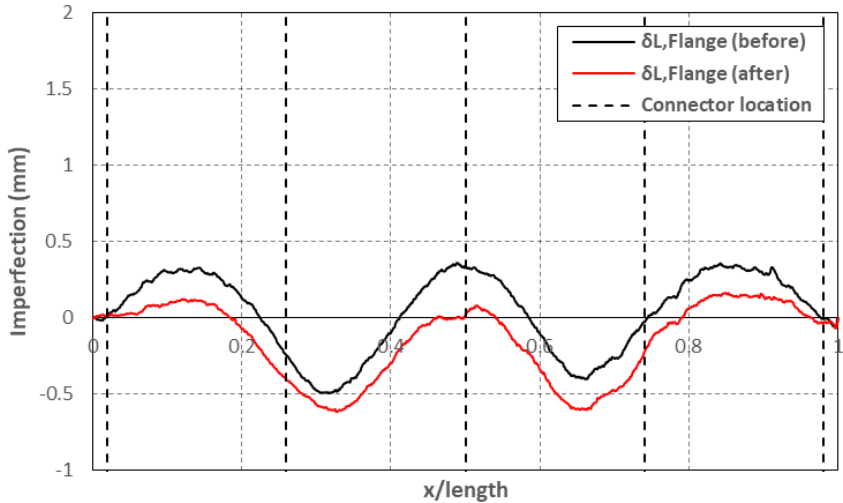


Figure J.74: Cross-sectional imperfections left flange channel T12012-5 before and after assembly

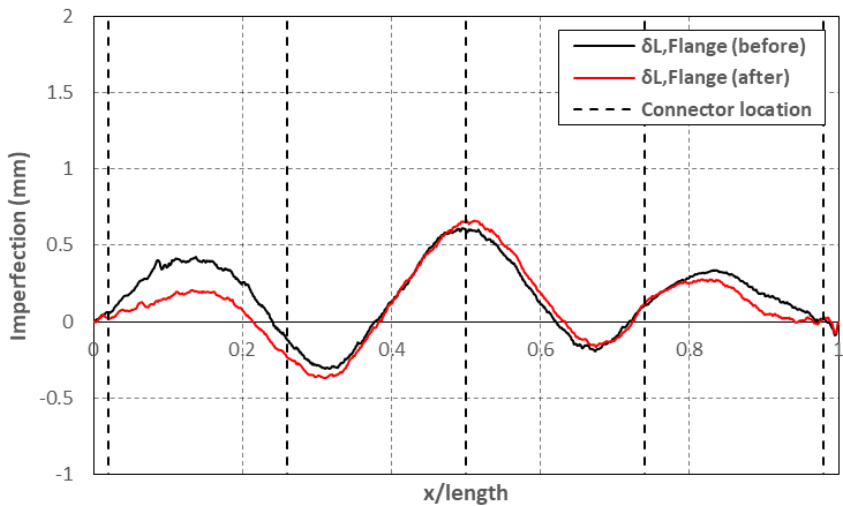


Figure J.75: Cross-sectional imperfections right flange channel T12012-5 before and after assembly

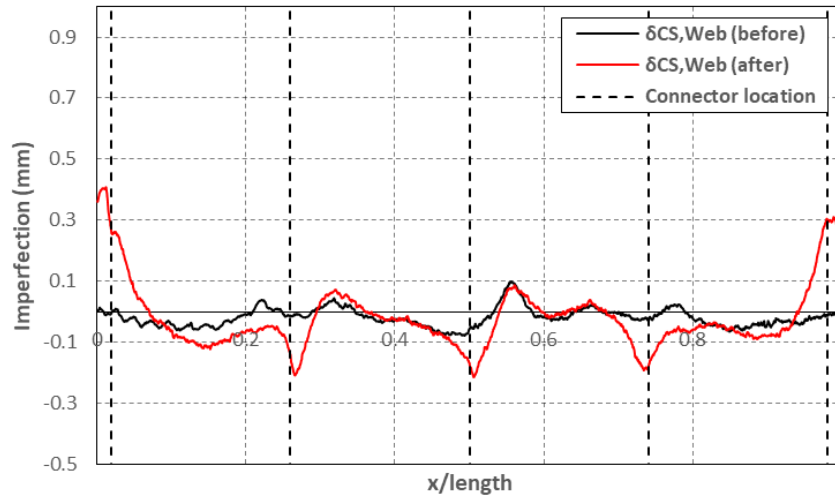


Figure J.76: Cross-sectional imperfections web channel T12012-6 before and after assembly

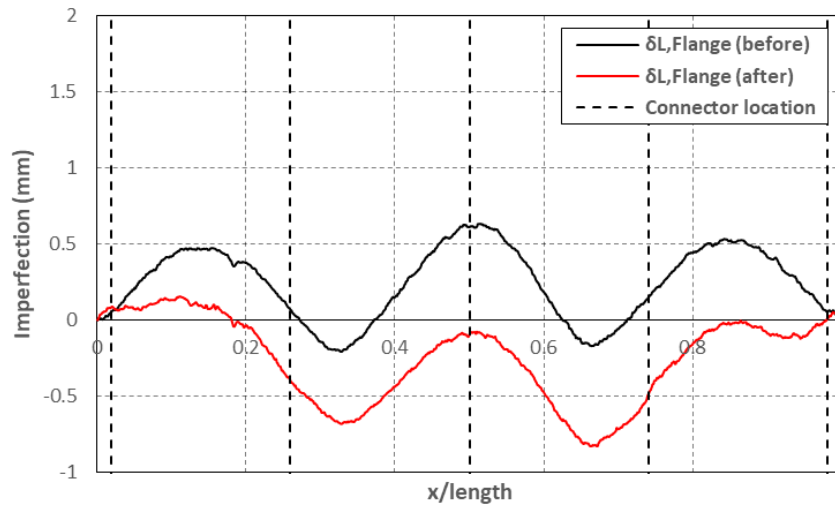


Figure J.77: Cross-sectional imperfections left flange channel T12012-6 before and after assembly

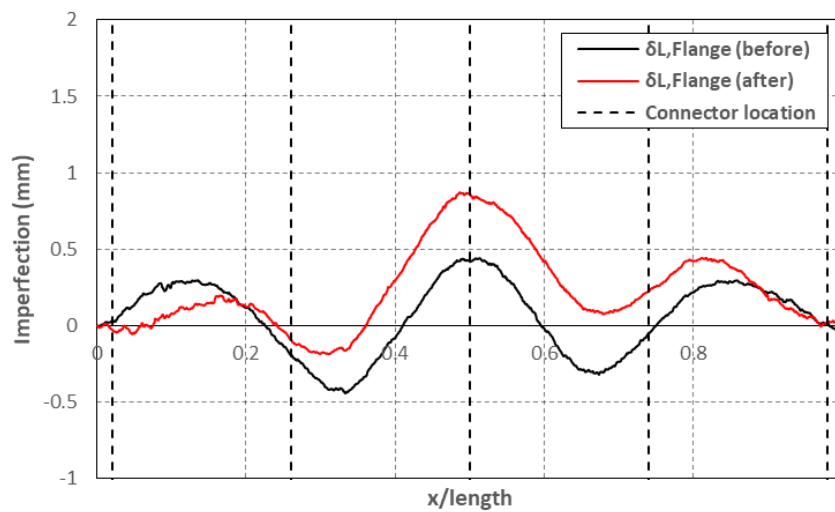


Figure J.78: Cross-sectional imperfections right flange channel T12012-6 before and after assembly

J.3.4 LC3-3b

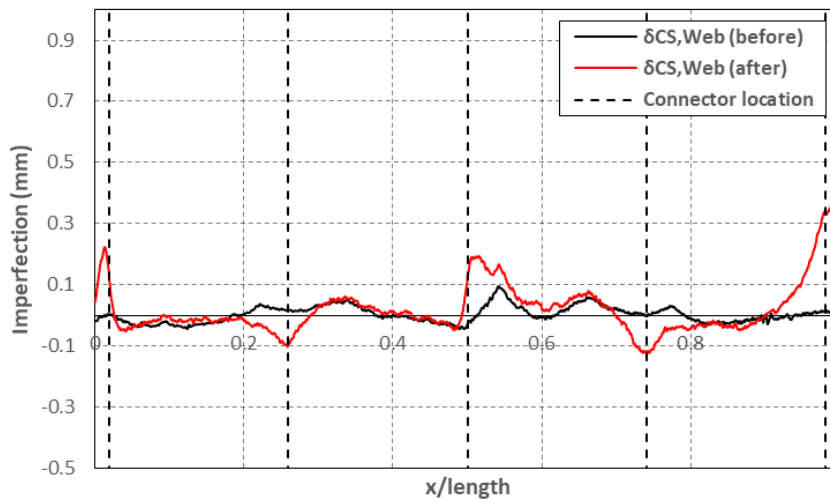


Figure J.79: Cross-sectional imperfections web channel T12012-7 before and after assembly

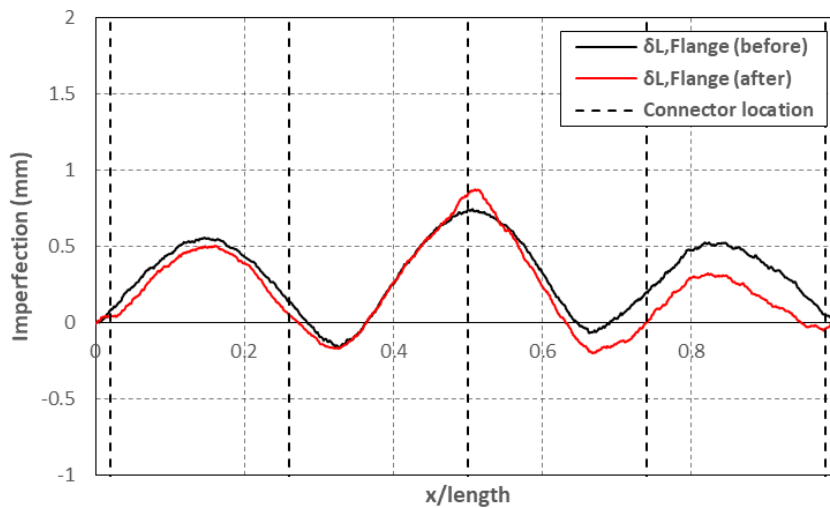


Figure J.80: Cross-sectional imperfections left flange channel T12012-7 before and after assembly

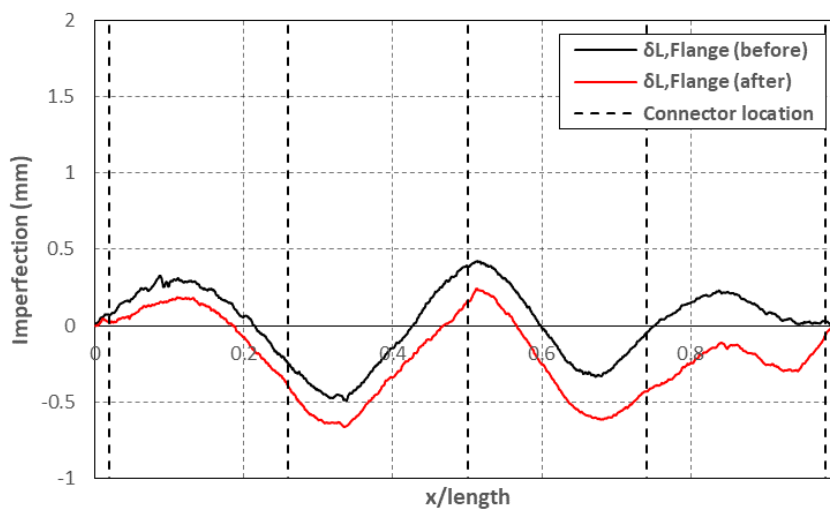


Figure J.81: Cross-sectional imperfections right flange channel T12012-7 before and after assembly

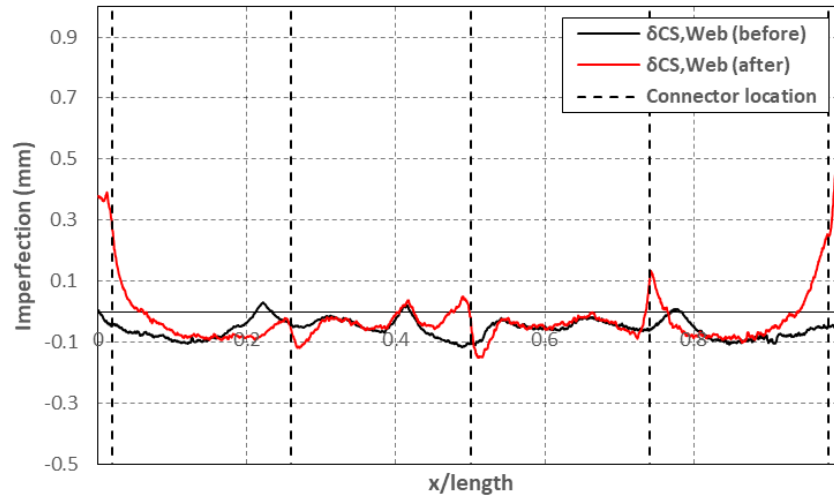


Figure J.82: Cross-sectional imperfections web channel T12012-8 before and after assembly

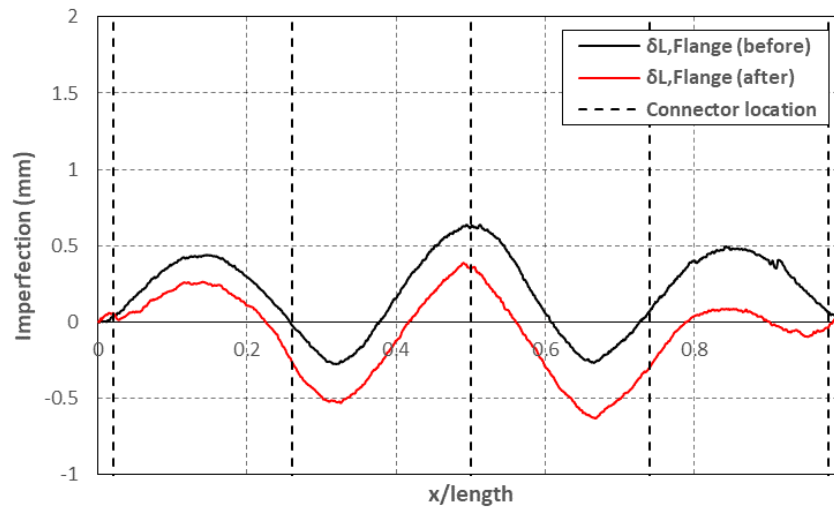


Figure J.83: Cross-sectional imperfections left flange channel T12012-8 before and after assembly

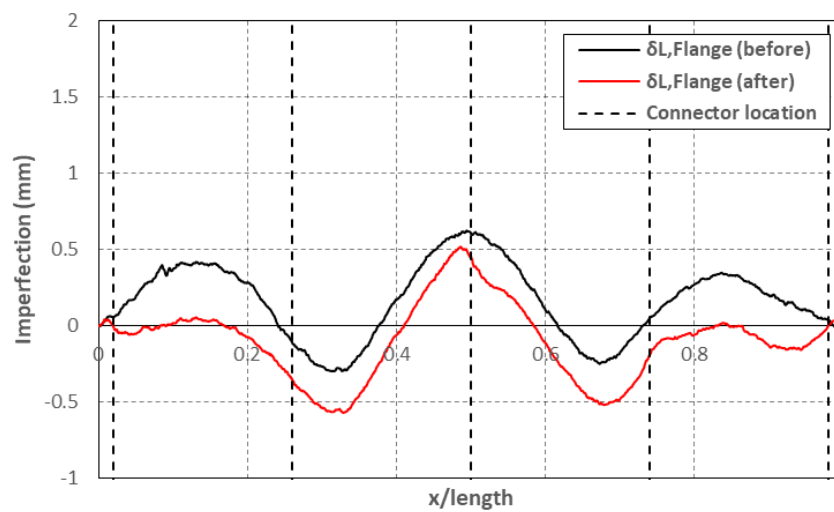


Figure J.84: Cross-sectional imperfections right flange channel T12012-8 before and after assembly

J.3.5 LC3-8a

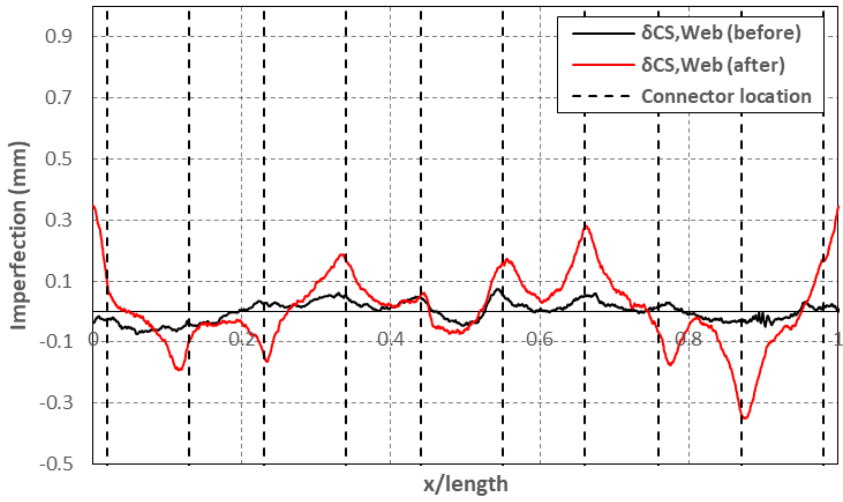


Figure J.85: Cross-sectional imperfections web channel T12012-9 before and after assembly

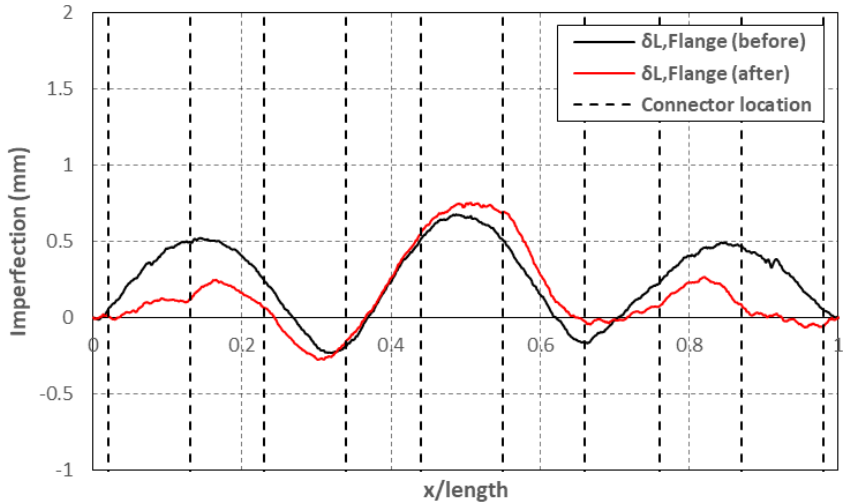


Figure J.86: Cross-sectional imperfections left flange channel T12012-9 before and after assembly

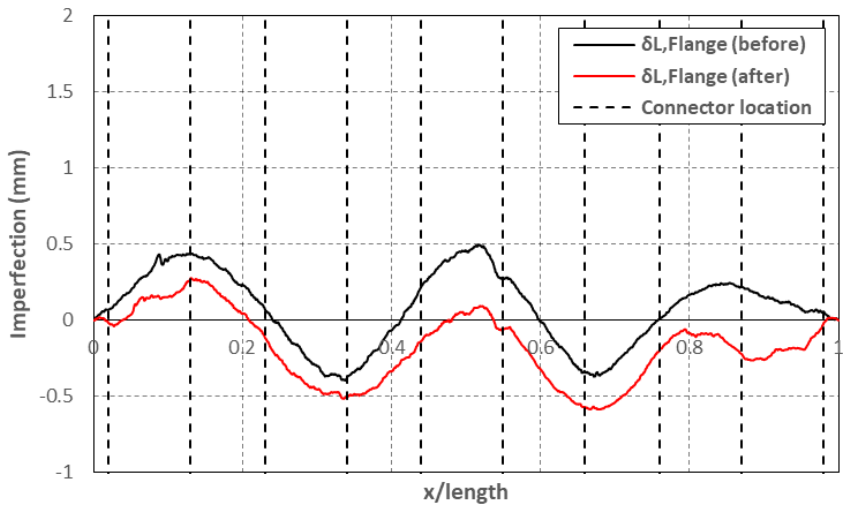


Figure J.87: Cross-sectional imperfections right flange channel T12012-9 before and after assembly

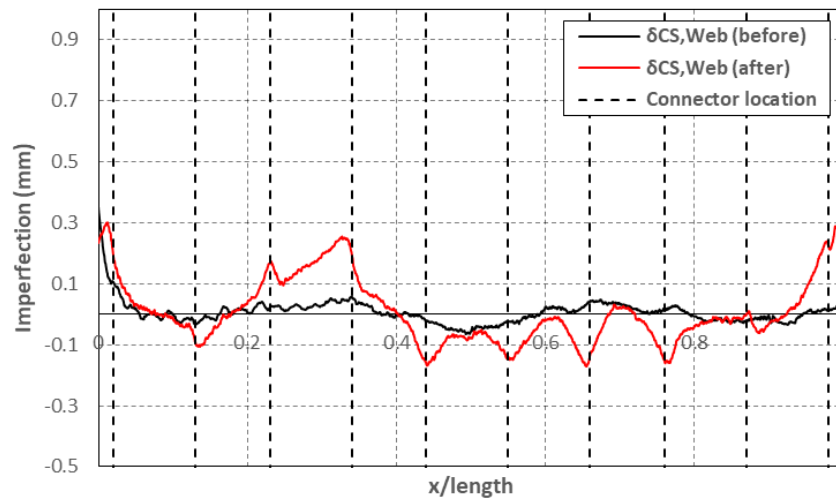


Figure J.88: Cross-sectional imperfections web channel T12012-10 before and after assembly

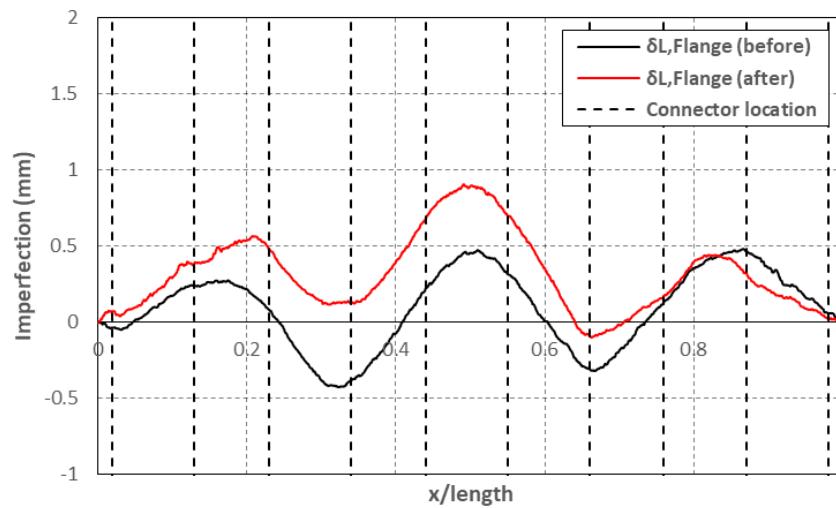


Figure J.89: Cross-sectional imperfections left flange channel T12012-10 before and after assembly

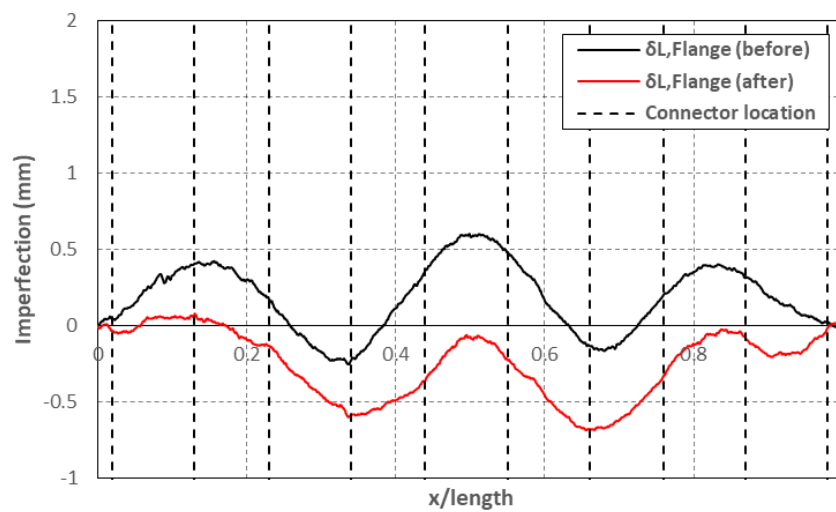


Figure J.90: Cross-sectional imperfections right flange channel T12012-10 before and after assembly

J.3.6 LC3-8b

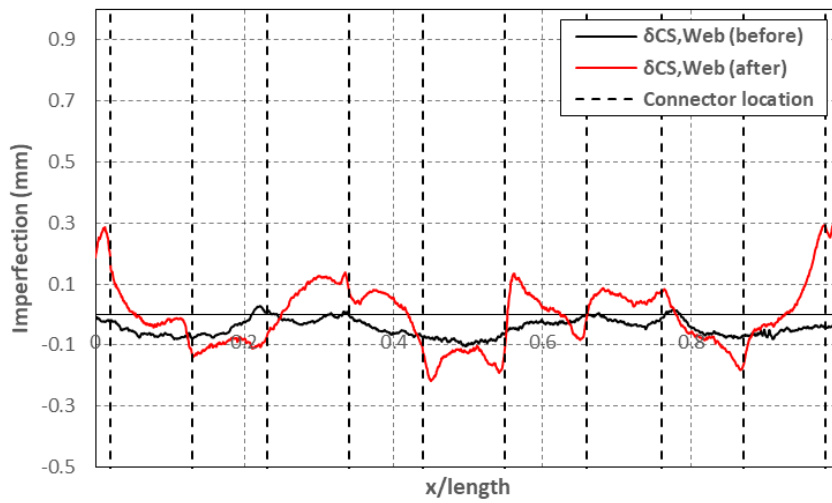


Figure J.91: Cross-sectional imperfections web channel T12012-11 before and after assembly

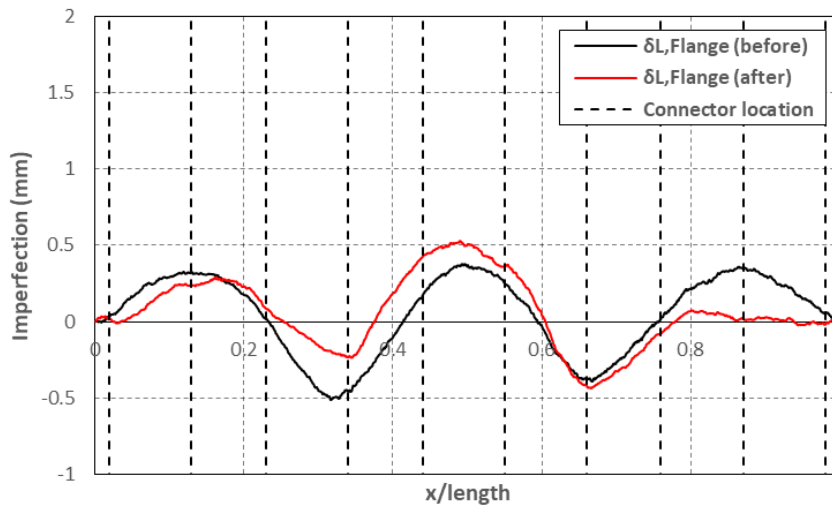


Figure J.92: Cross-sectional imperfections left flange channel T12012-11 before and after assembly

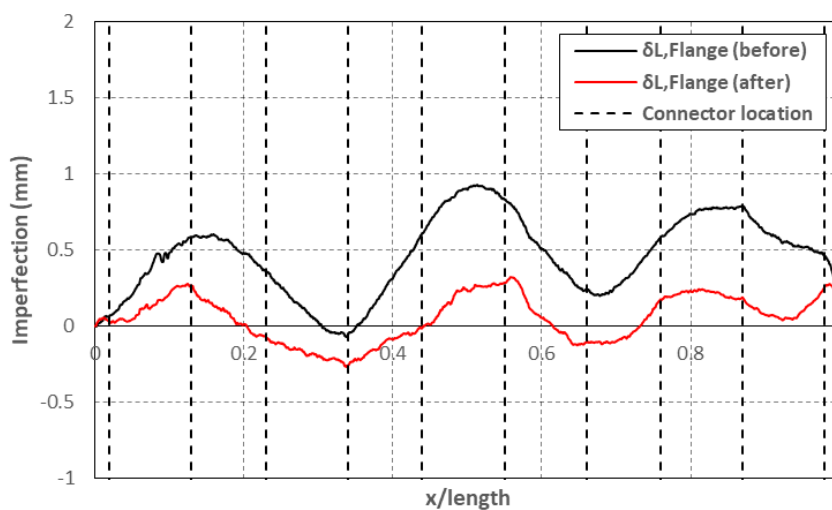


Figure J.93: Cross-sectional imperfections right flange channel T12012-11 before and after assembly

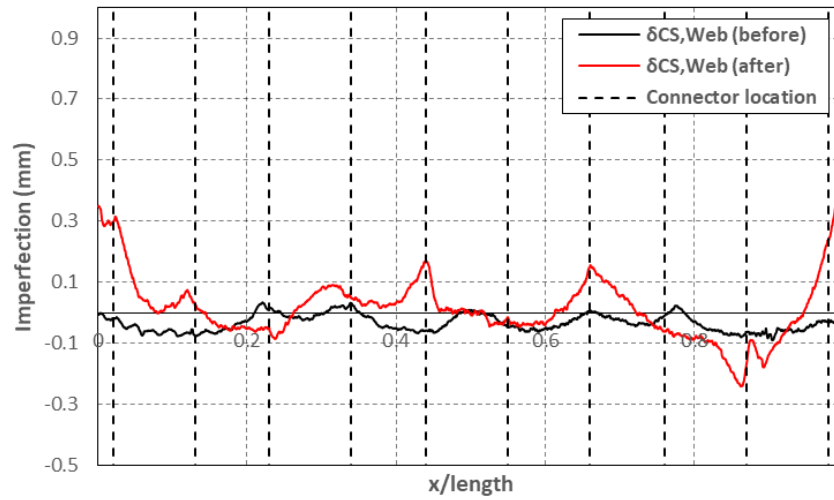


Figure J.94: Cross-sectional imperfections web channel T12012-12 before and after assembly

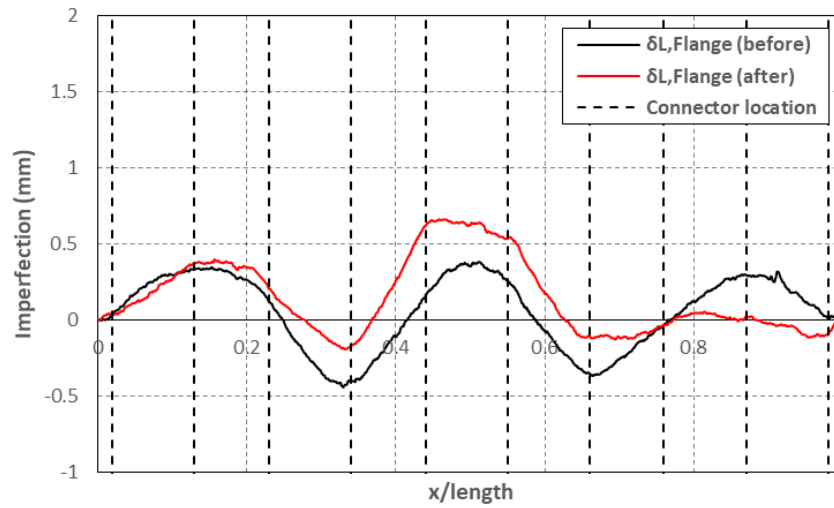


Figure J.95: Cross-sectional imperfections left flange channel T12012-12 before and after assembly

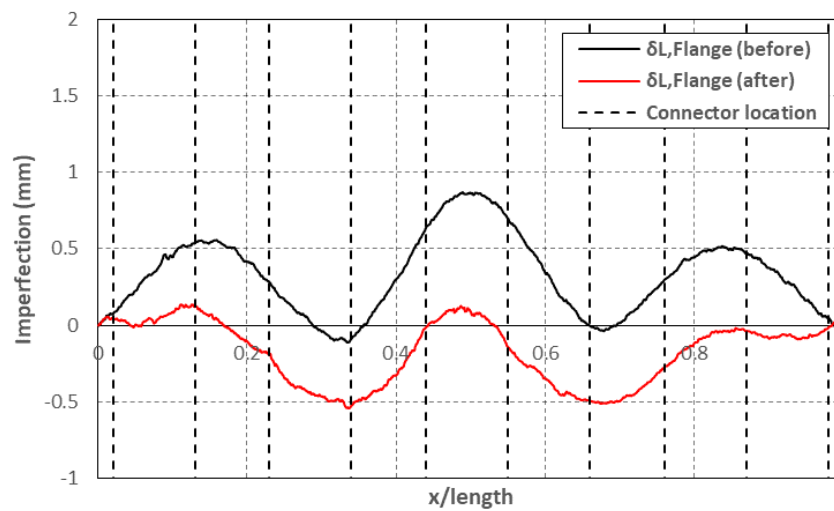


Figure J.96: Cross-sectional imperfections right flange channel T12012-12 before and after assembly

J.4. Built-up geometry 4 (LC4)

J.4.1 LC4-2a

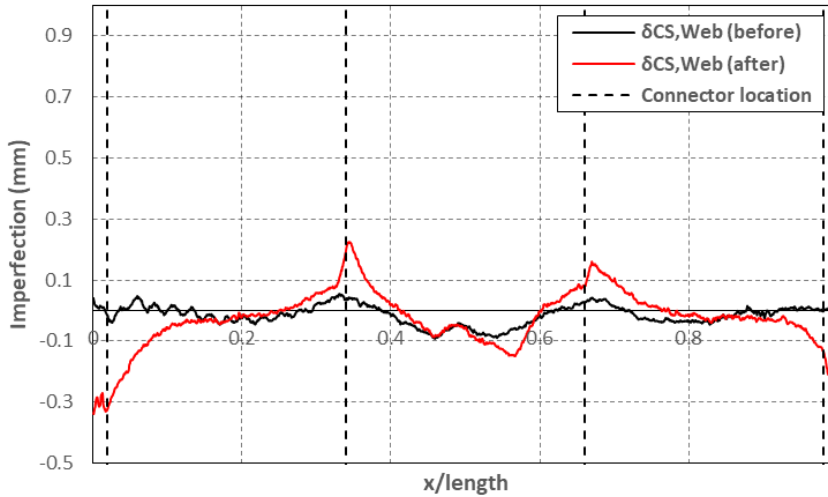


Figure J.97: Cross-sectional imperfections web channel S11012-13 before and after assembly

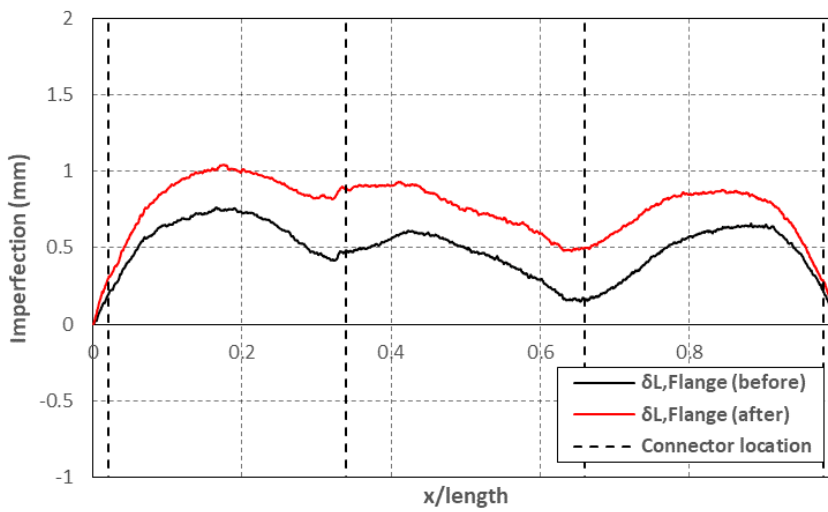


Figure J.98: Cross-sectional imperfections left flange channel S11012-13 before and after assembly

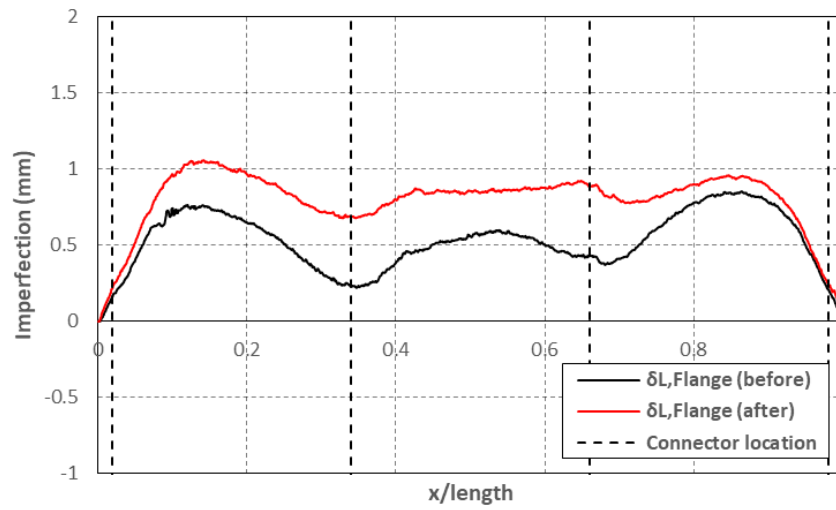


Figure J.99: Cross-sectional imperfections right flange channel S11012-13 before and after assembly

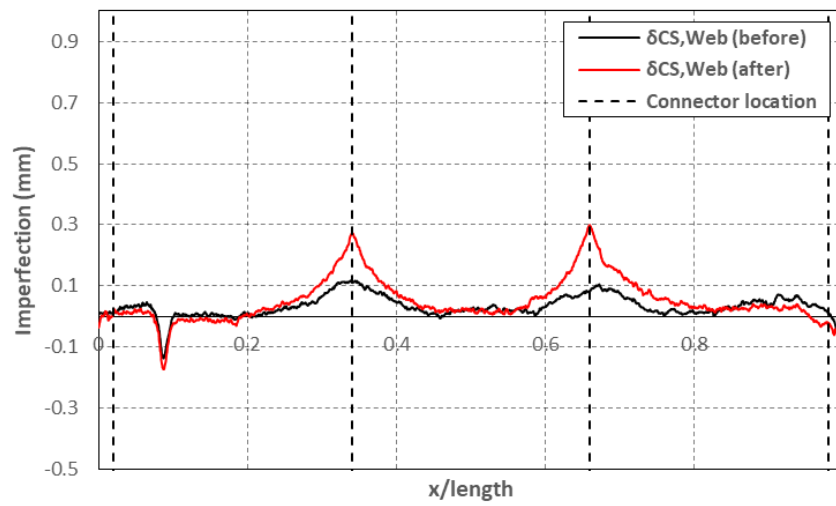


Figure J.100: Cross-sectional imperfections web channel S11012-14 before and after assembly

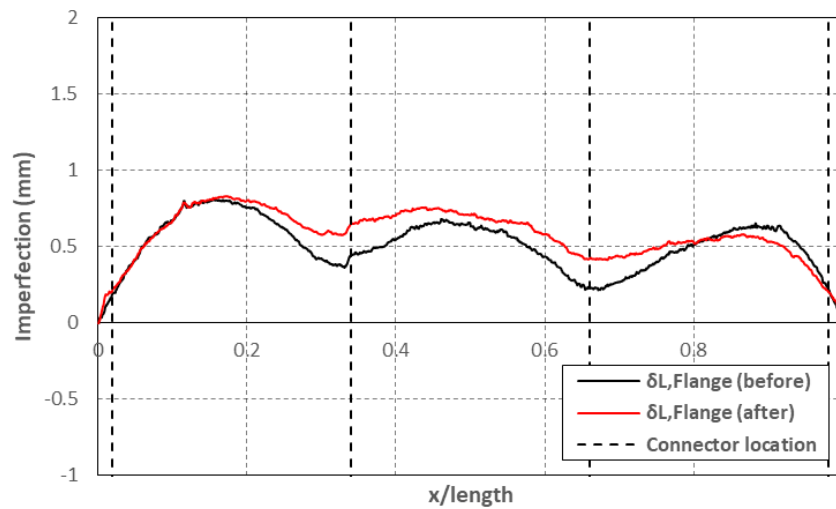


Figure J.101: Cross-sectional imperfections left flange channel S11012-14 before and after assembly

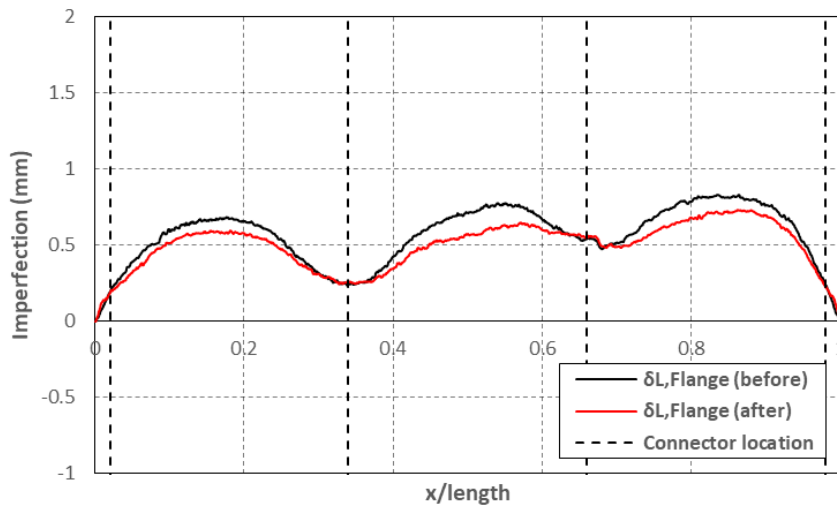


Figure J.102: Cross-sectional imperfections right flange channel S11012-14 before and after assembly

J.4.2 LC4-2b

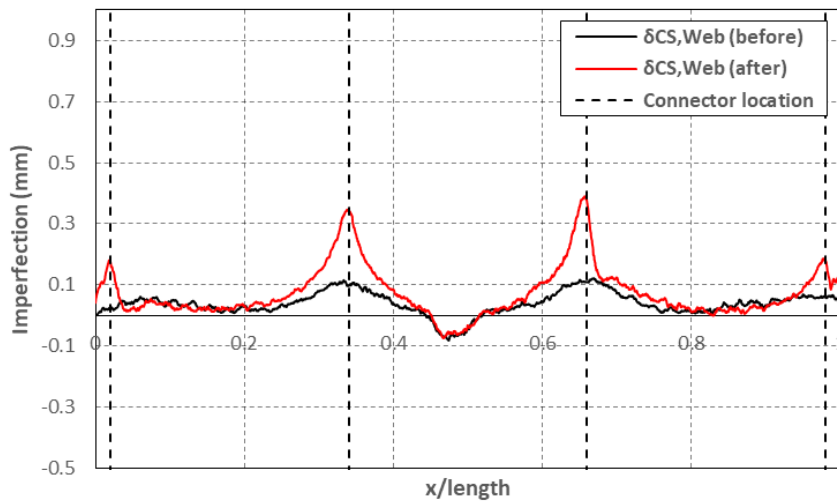


Figure J.103: Cross-sectional imperfections web channel S11012-15 before and after assembly

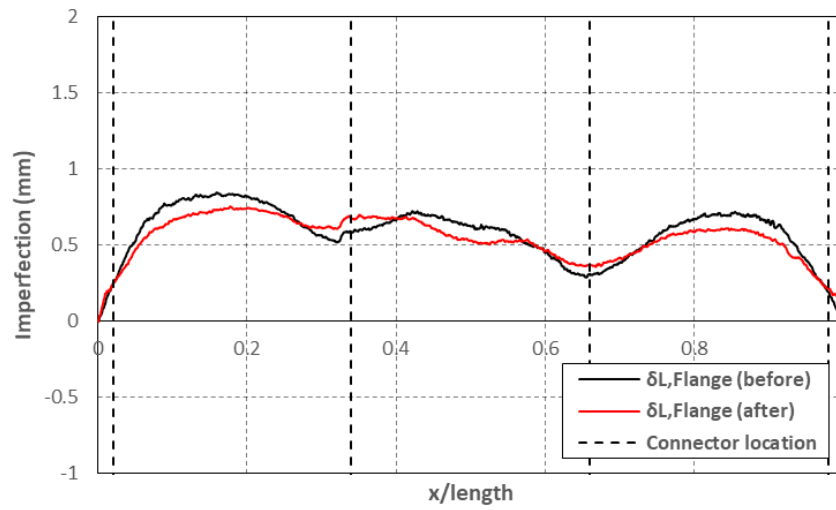


Figure J.104: Cross-sectional imperfections left flange channel S11012-15 before and after assembly

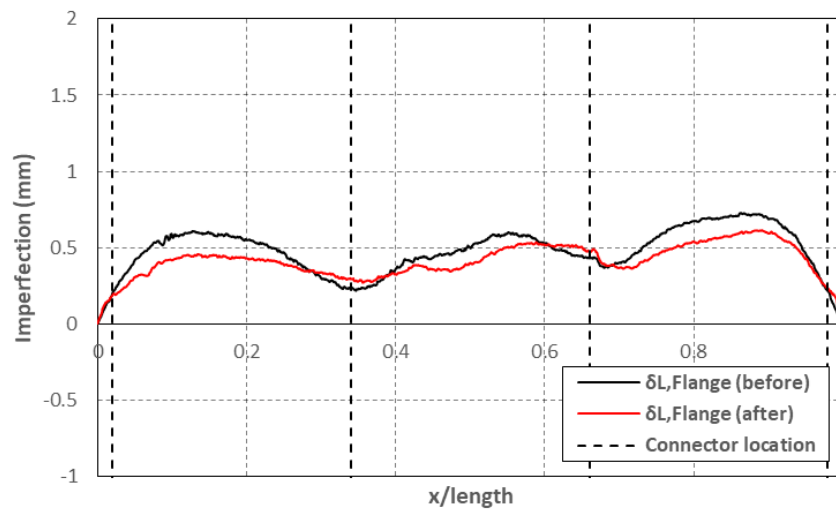


Figure J.105: Cross-sectional imperfections right flange channel S11012-15 before and after assembly

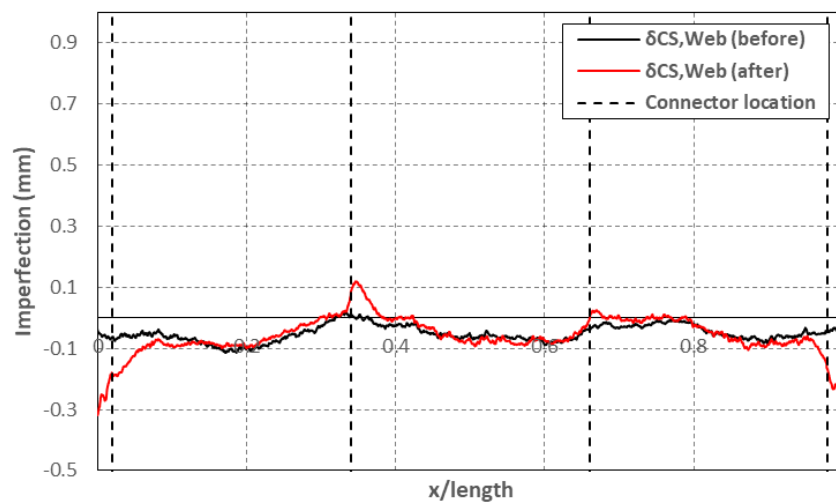


Figure J.106: Cross-sectional imperfections web channel S11012-16 before and after assembly

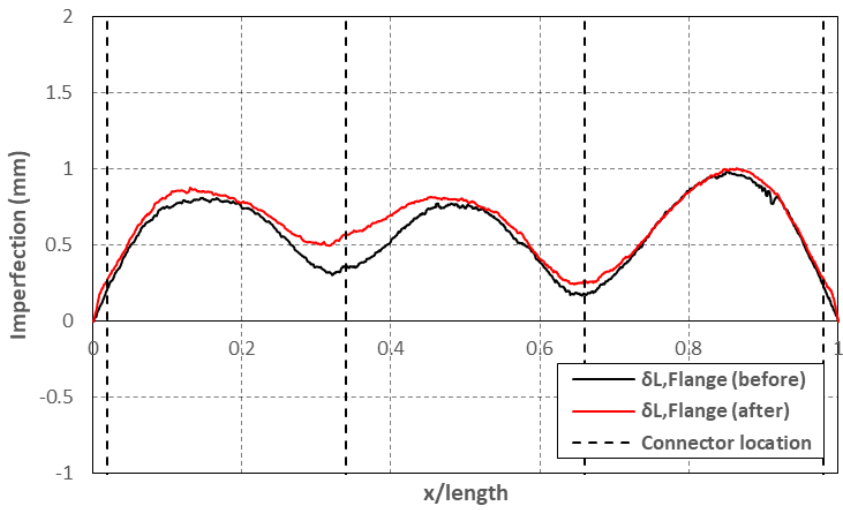


Figure J.107: Cross-sectional imperfections left flange channel S11012-16 before and after assembly

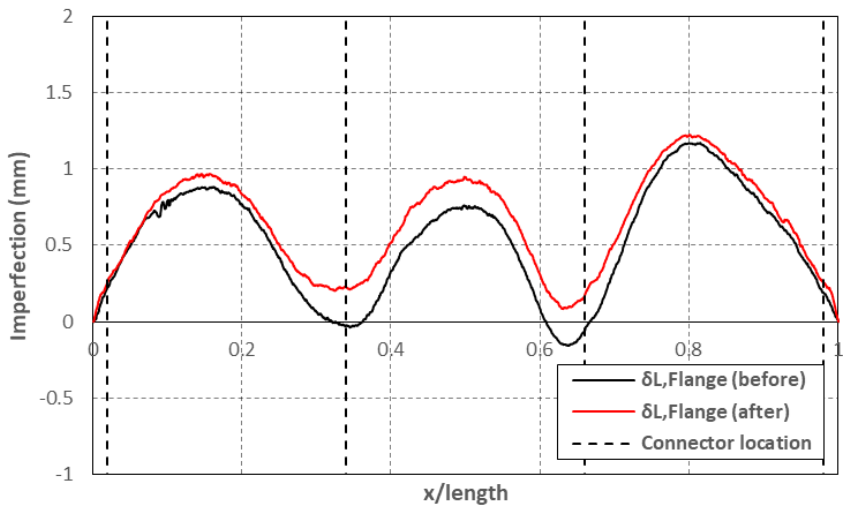


Figure J.108: Cross-sectional imperfections right flange channel S11012-16 before and after assembly

J.4.3 LC4-3a

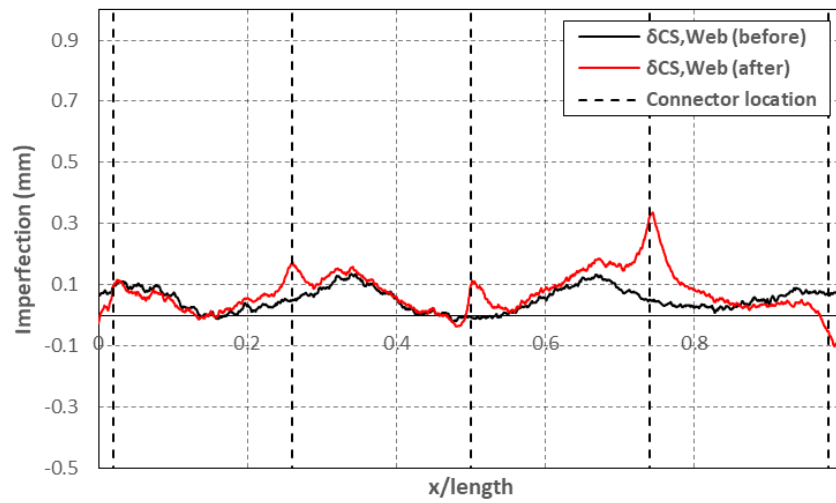


Figure J.109: Cross-sectional imperfections web channel S11012-17 before and after assembly

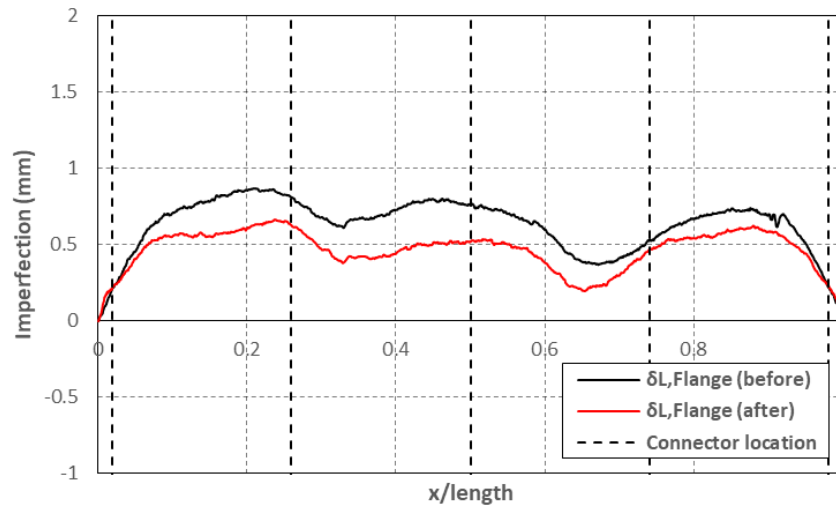


Figure J.110: Cross-sectional imperfections left flange channel S11012-17 before and after assembly

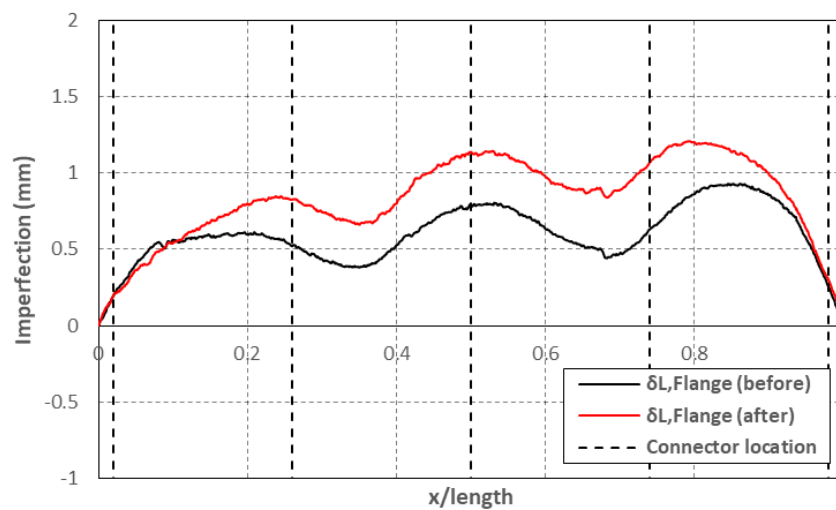


Figure J.111: Cross-sectional imperfections right flange channel S11012-17 before and after assembly

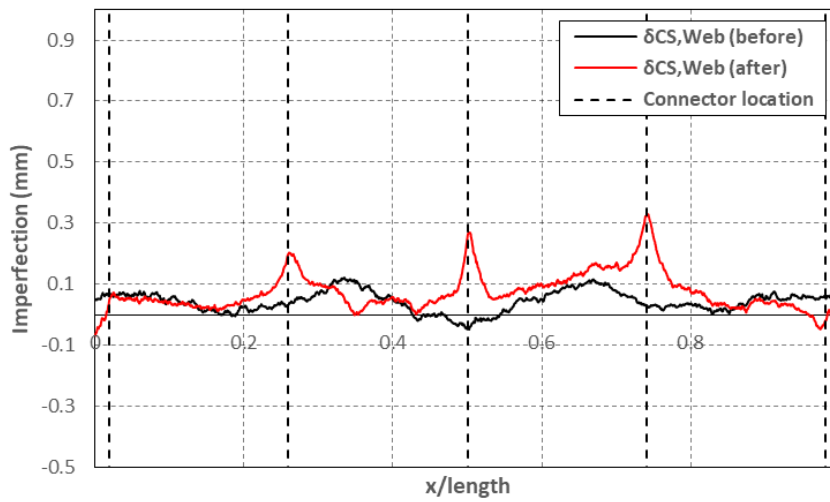


Figure J.112: Cross-sectional imperfections web channel S11012-18 before and after assembly

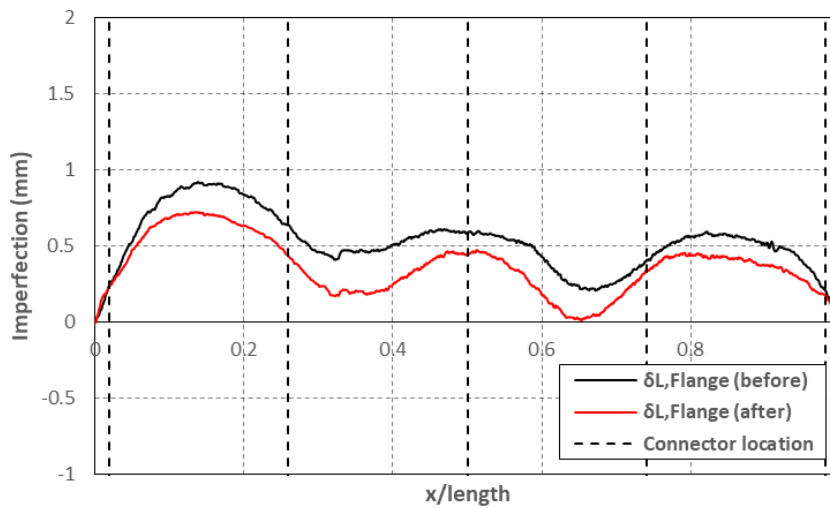


Figure J.113: Cross-sectional imperfections left flange channel S11012-18 before and after assembly

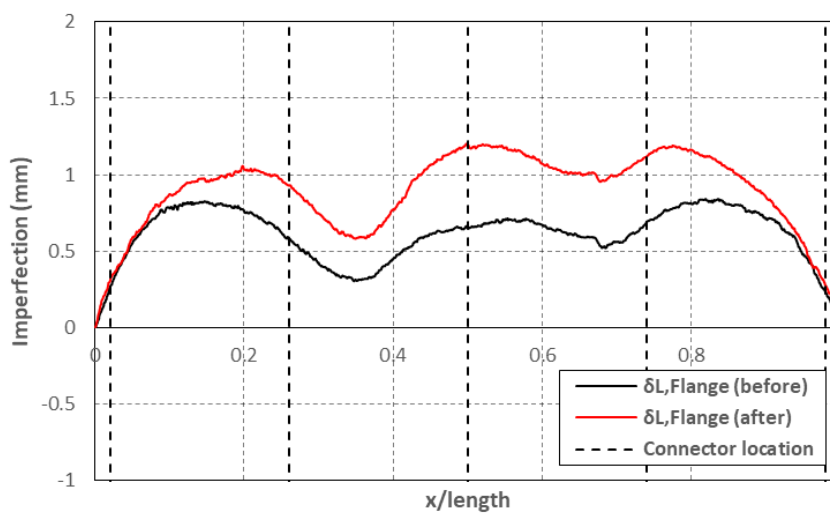


Figure J.114: Cross-sectional imperfections right flange channel S11012-18 before and after assembly

J.4.4 LC4-3b

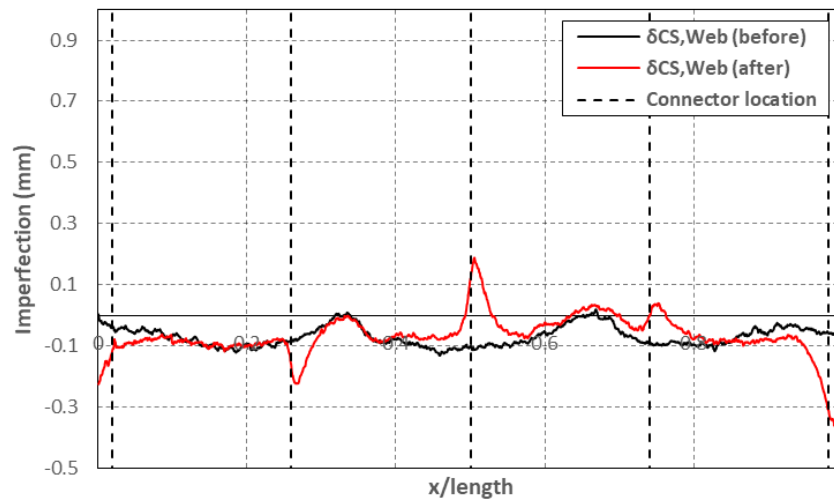


Figure J.115: Cross-sectional imperfections web channel S11012-19 before and after assembly

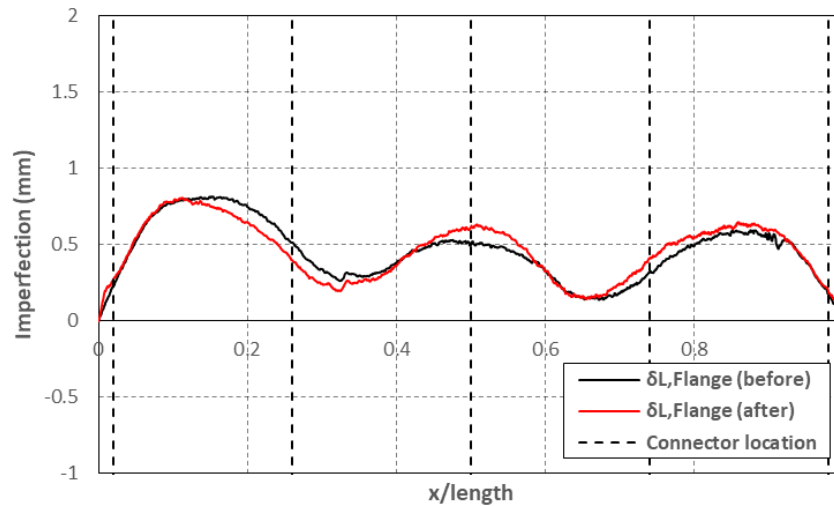


Figure J.116: Cross-sectional imperfections left flange channel S11012-19 before and after assembly

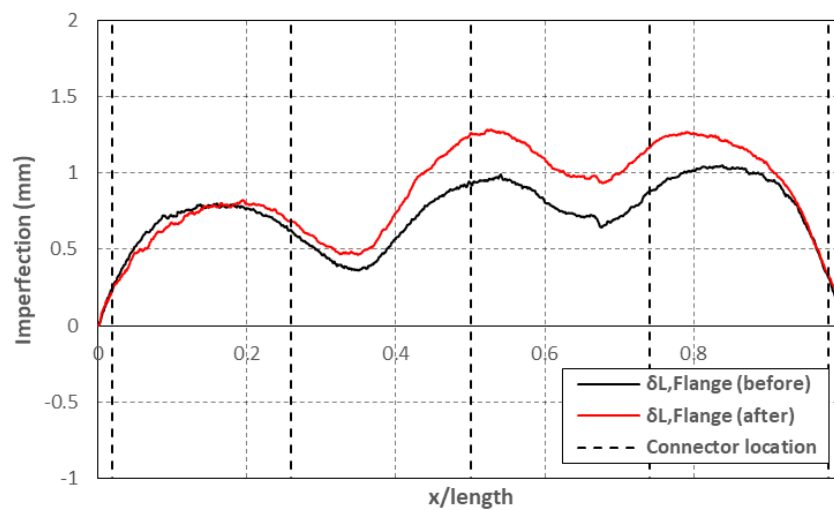


Figure J.117: Cross-sectional imperfections right flange channel S11012-19 before and after assembly

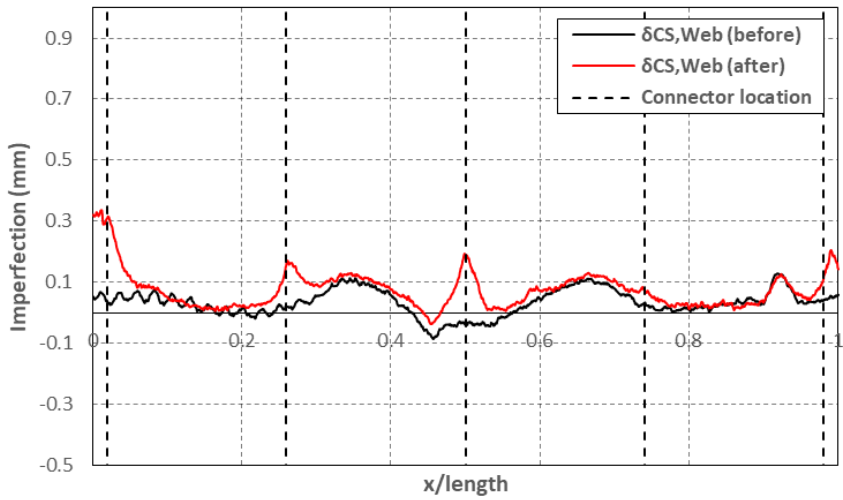


Figure J.118: Cross-sectional imperfections web channel S11012-20 before and after assembly

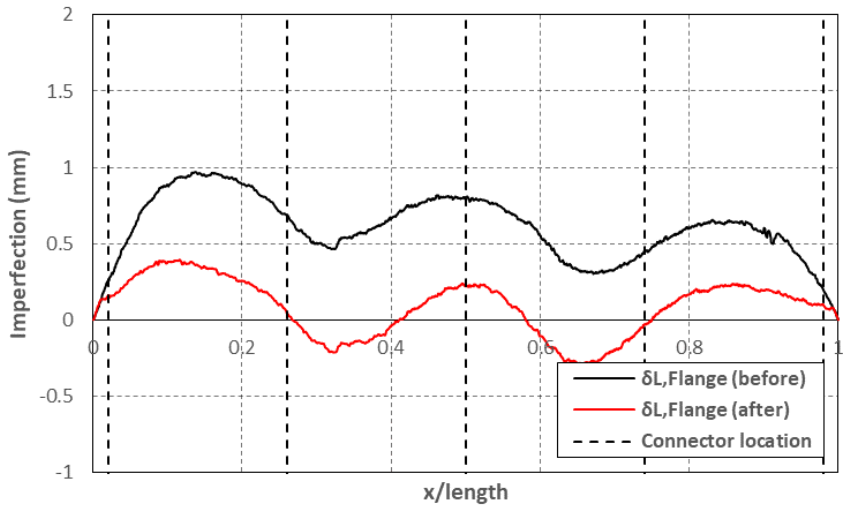


Figure J.119: Cross-sectional imperfections left flange channel S11012-20 before and after assembly

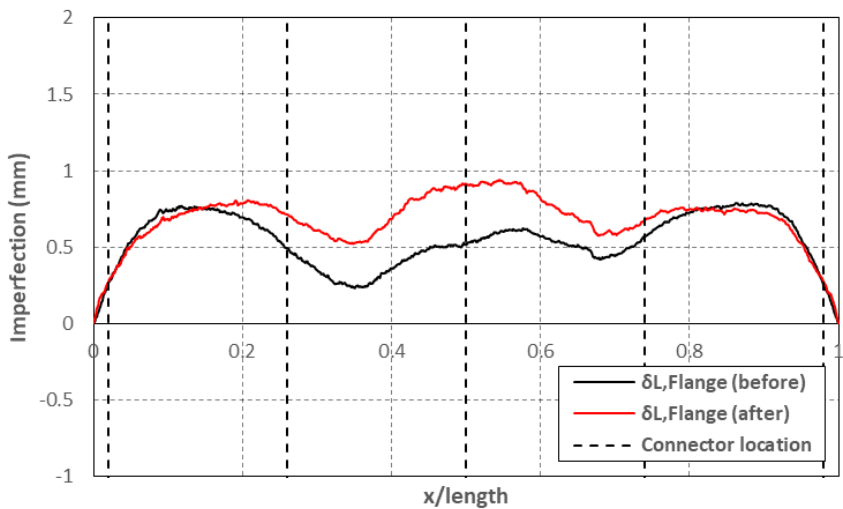


Figure J.120: Cross-sectional imperfections right flange channel S11012-20 before and after assembly

J.4.5 LC4-8a

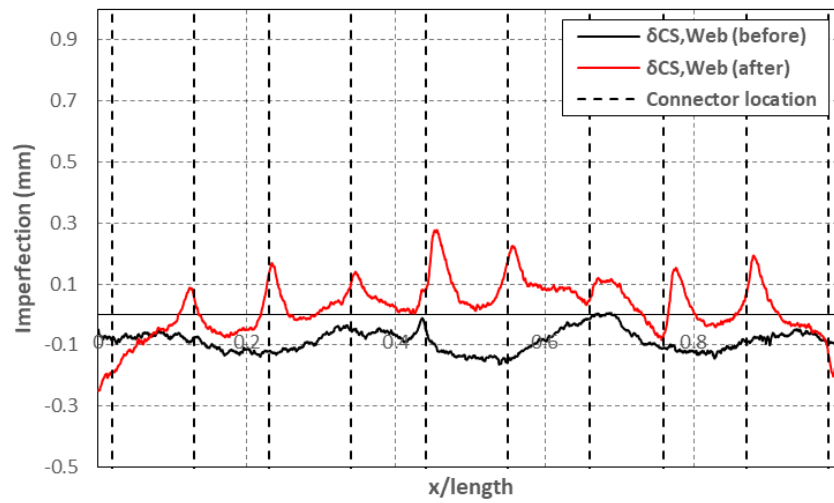


Figure J.121: Cross-sectional imperfections web channel S11012-21 before and after assembly

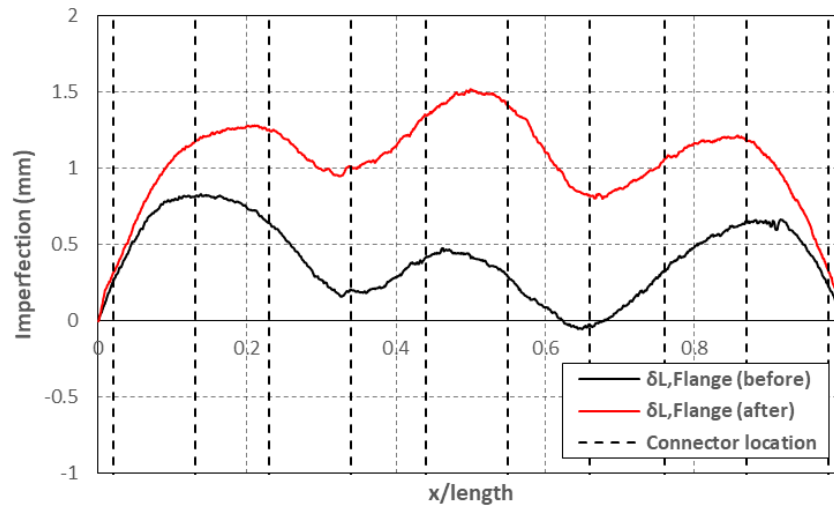


Figure J.122: Cross-sectional imperfections left flange channel S11012-21 before and after assembly

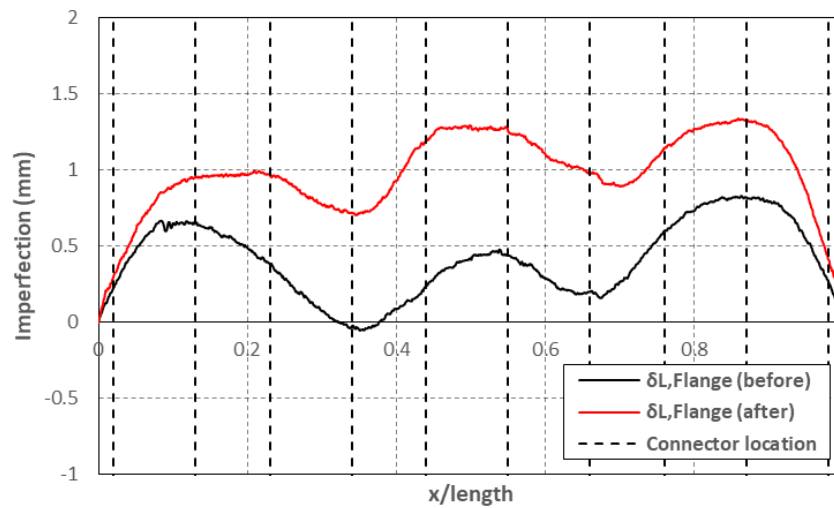


Figure J.123: Cross-sectional imperfections right flange channel S11012-21 before and after assembly

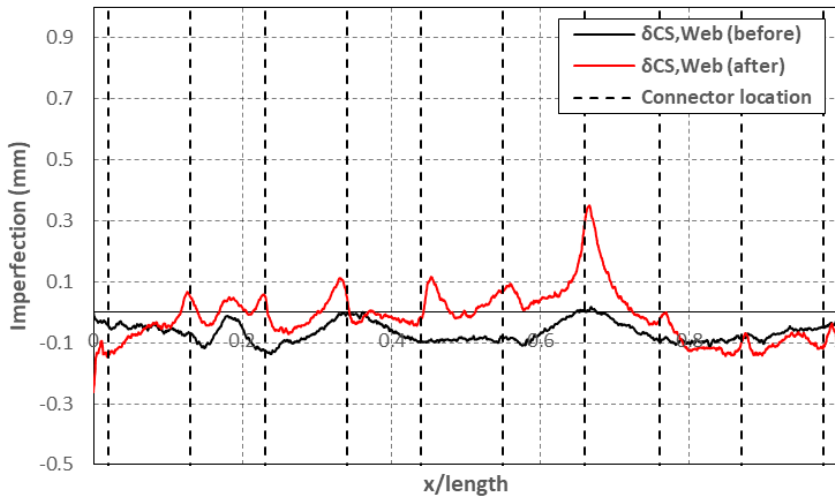


Figure J.124: Cross-sectional imperfections web channel S11012-22 before and after assembly

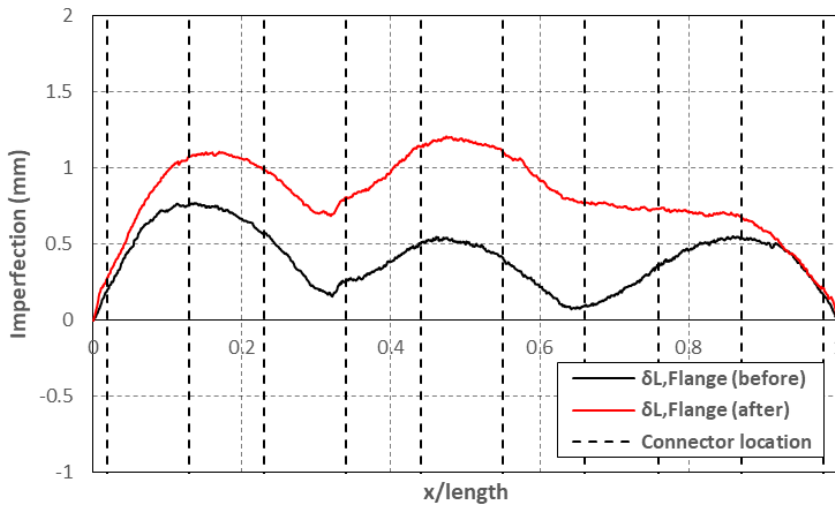


Figure J.125: Cross-sectional imperfections left flange channel S11012-22 before and after assembly

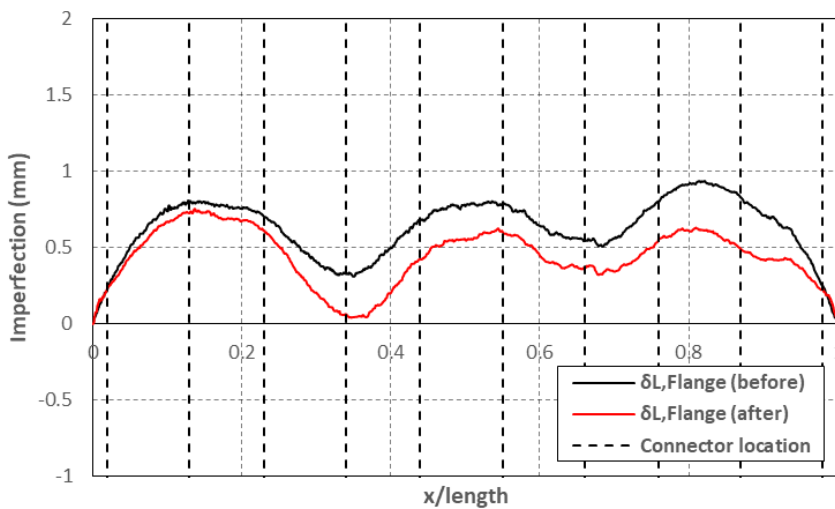


Figure J.126: Cross-sectional imperfections right flange channel S11012-22 before and after assembly

J.4.6 LC4-8b

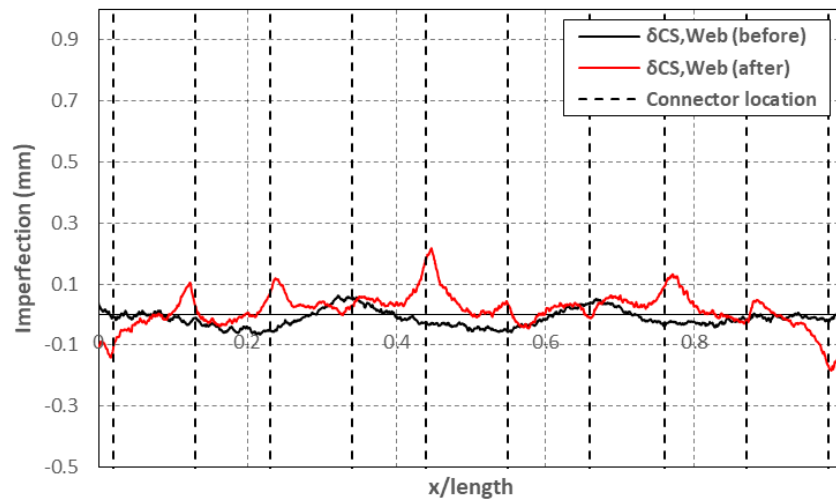


Figure J.127: Cross-sectional imperfections web channel S11012-23 before and after assembly

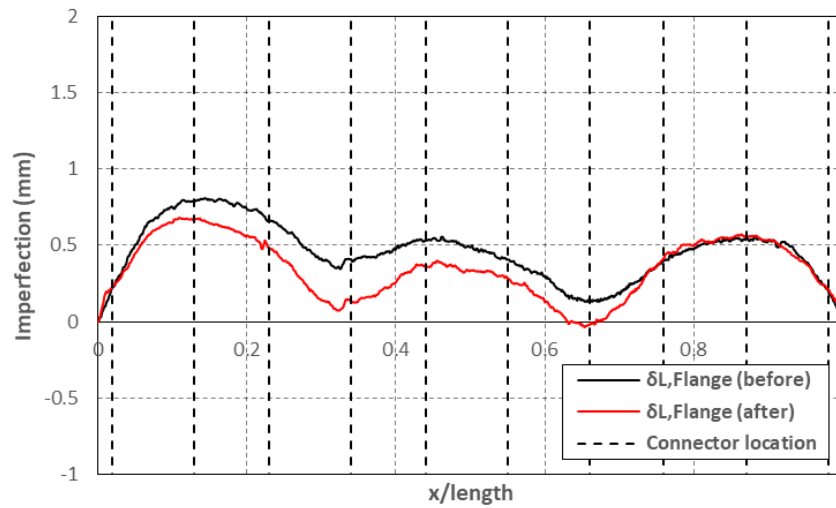


Figure J.128: Cross-sectional imperfections left flange channel S11012-23 before and after assembly

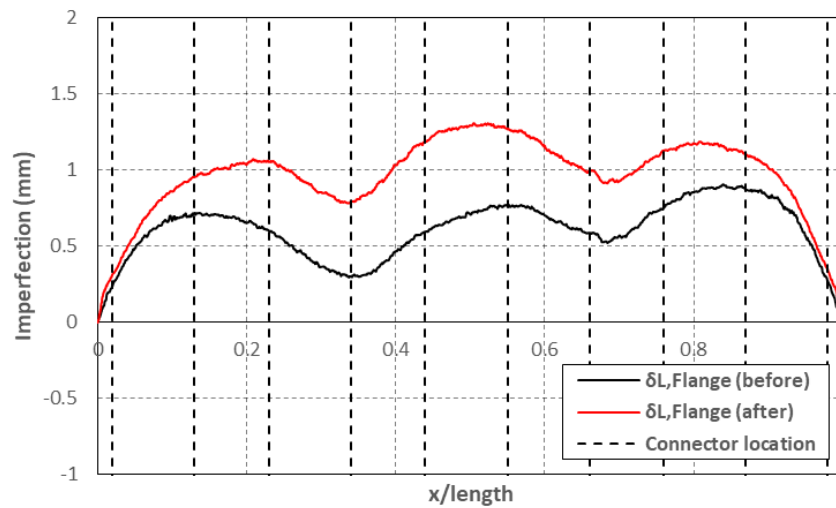


Figure J.129: Cross-sectional imperfections right flange channel S11012-23 before and after assembly

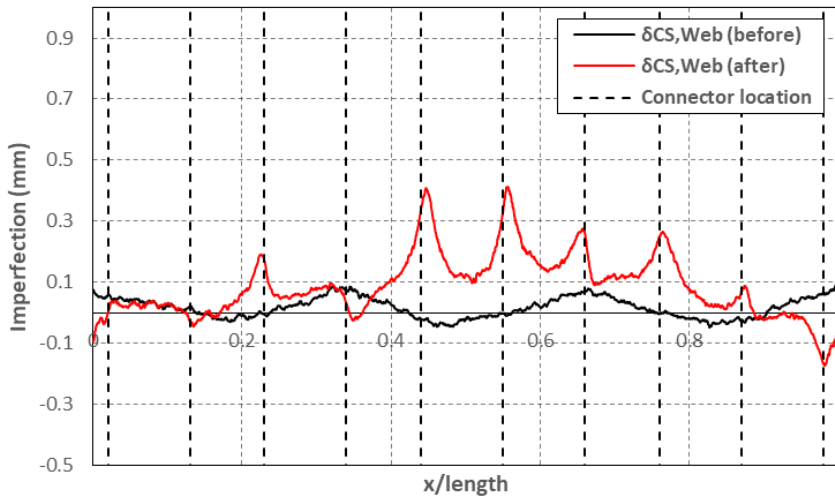


Figure J.130: Cross-sectional imperfections web channel S11012-24 before and after assembly

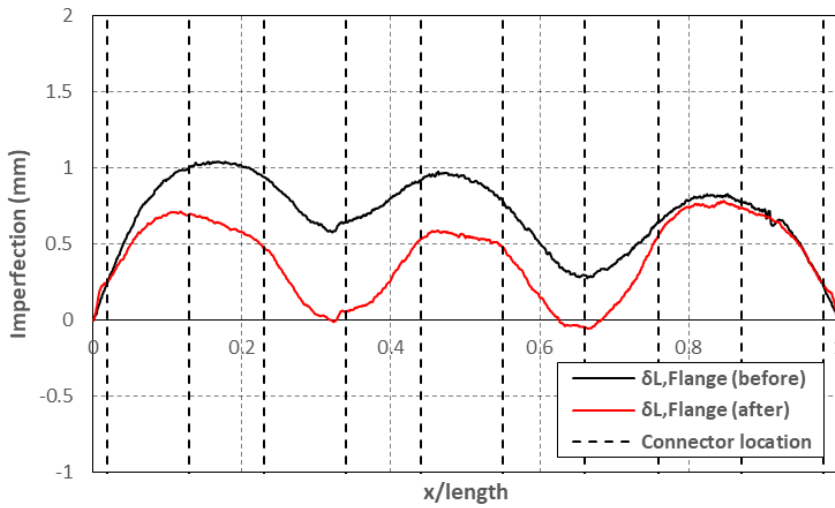


Figure J.131: Cross-sectional imperfections left flange channel S11012-24 before and after assembly

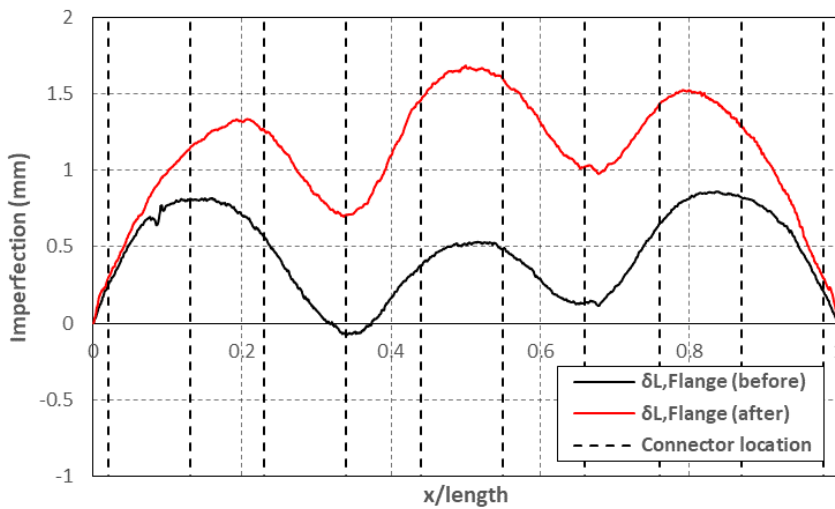


Figure J.132: Cross-sectional imperfections right flange channel S11012-24 before and after assembly

Appendix K

Long Columns Test Results

Appendix K contains the results obtained from the long column tests. The results are presented in the form of load vs. axial shortening curves, including the dynamic and static load, and load vs. lateral deformation curves obtained for each test specimen. In addition, axial load vs. compressive strain curves are also included for those specimens instrumented with strain gauges. Further details about the long columns test results are included in Section 5.8 of the main text.

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K.1. Built-up geometry 1 (LC1)

K.1.1 LC1-2a

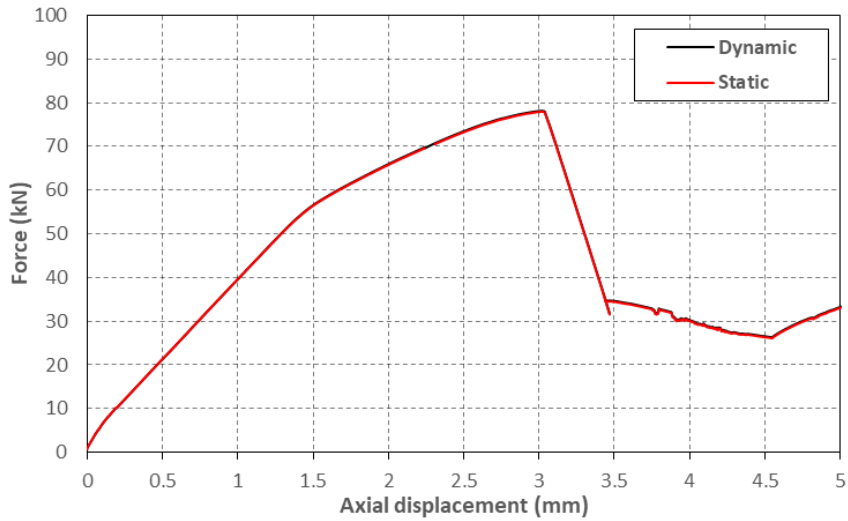


Figure K.1: Axial load vs axial displacement LC1-2a

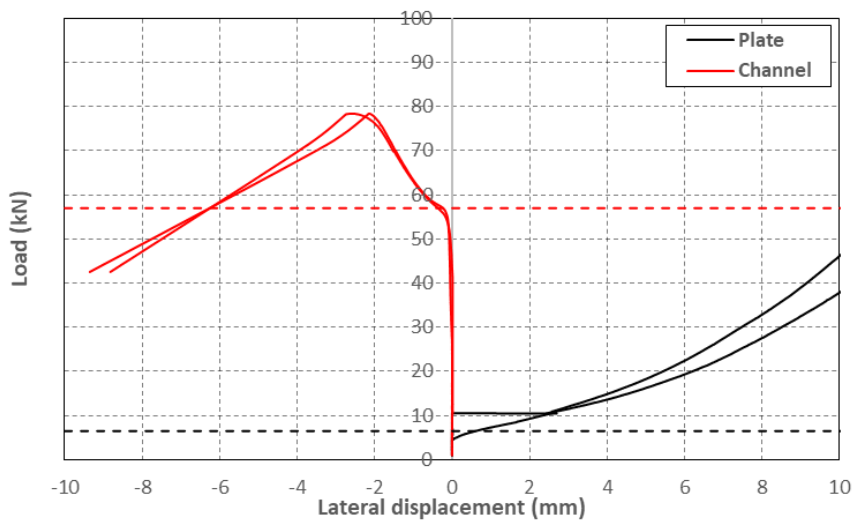


Figure K.2: Axial load vs lateral displacement LC1-2a

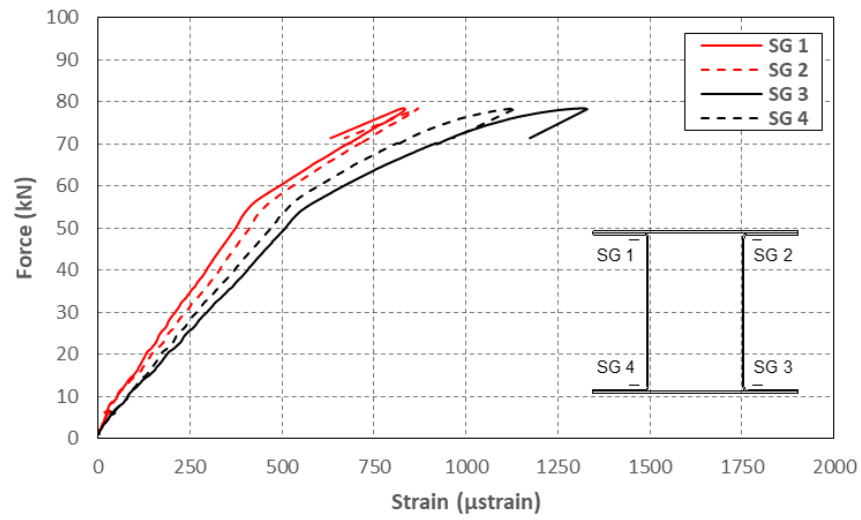


Figure K.3: Axial load vs compressive strain LC1-2a

K.1.2 LC1-2b

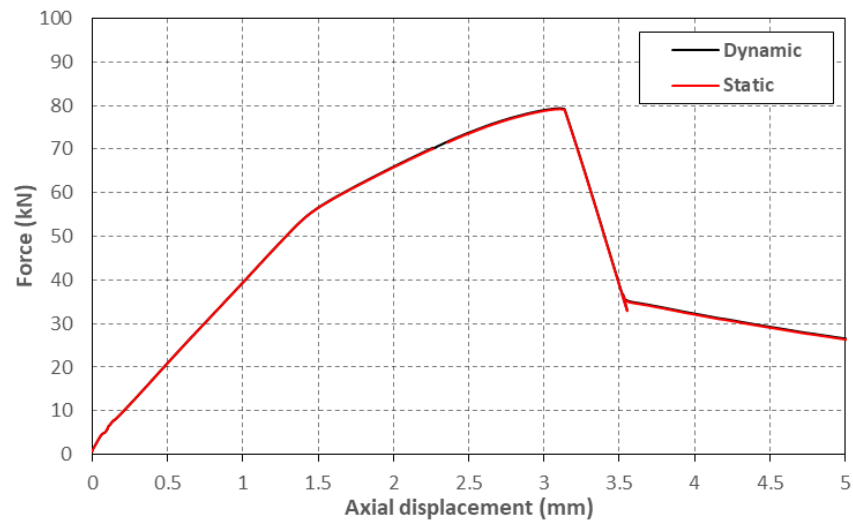


Figure K.4: Axial load vs axial displacement LC1-2b

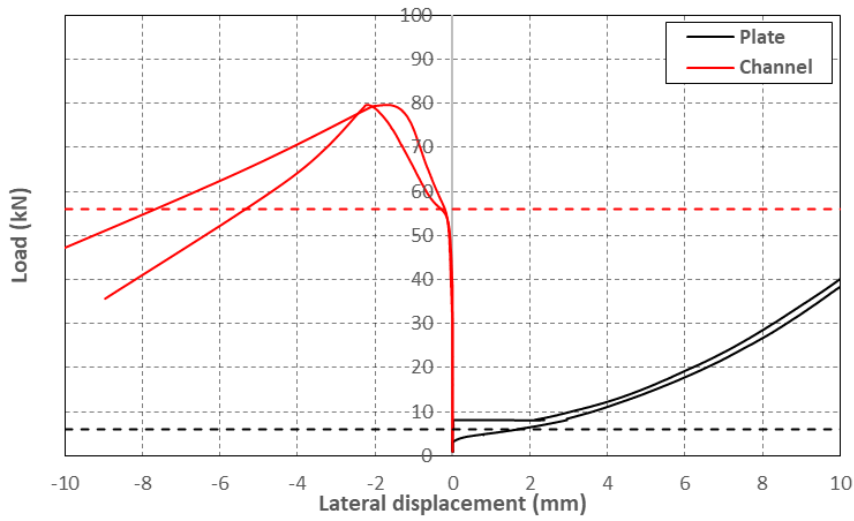


Figure K.5: Axial load vs lateral displacement LC1-2b

K.1.3 LC1-3a

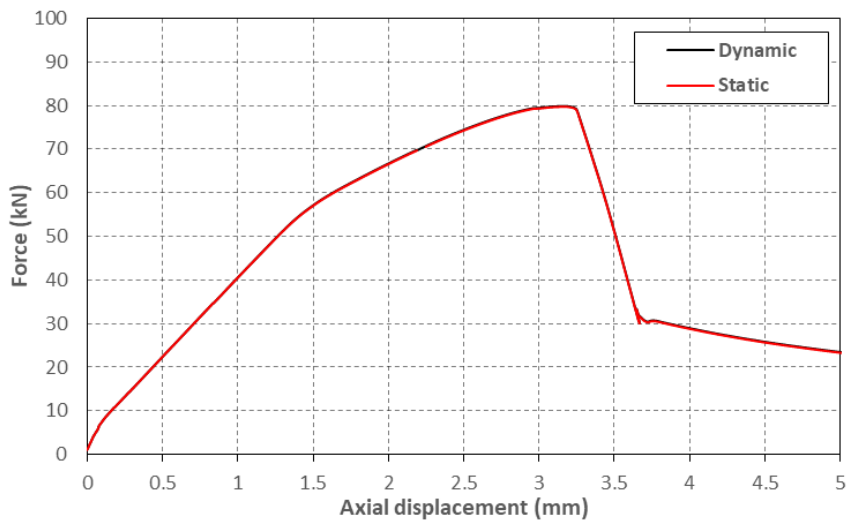


Figure K.6: Axial load vs axial displacement LC1-3a

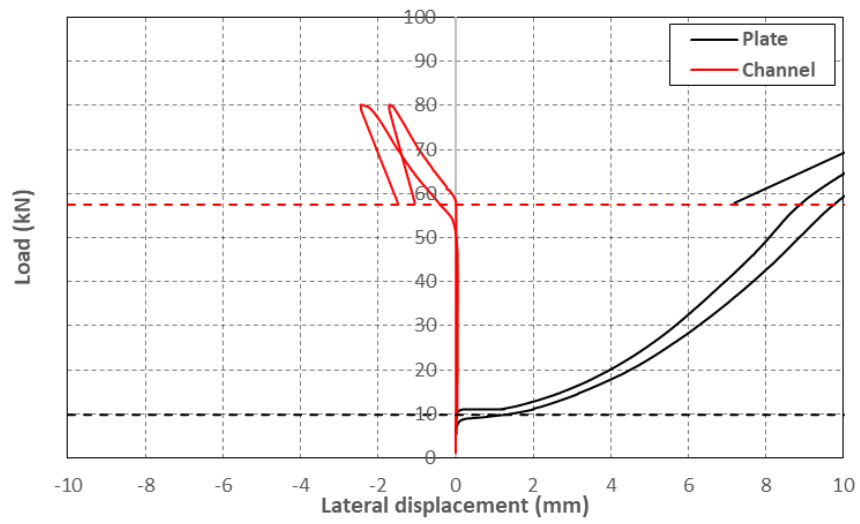


Figure K.7: Axial load vs lateral displacement LC1-3a

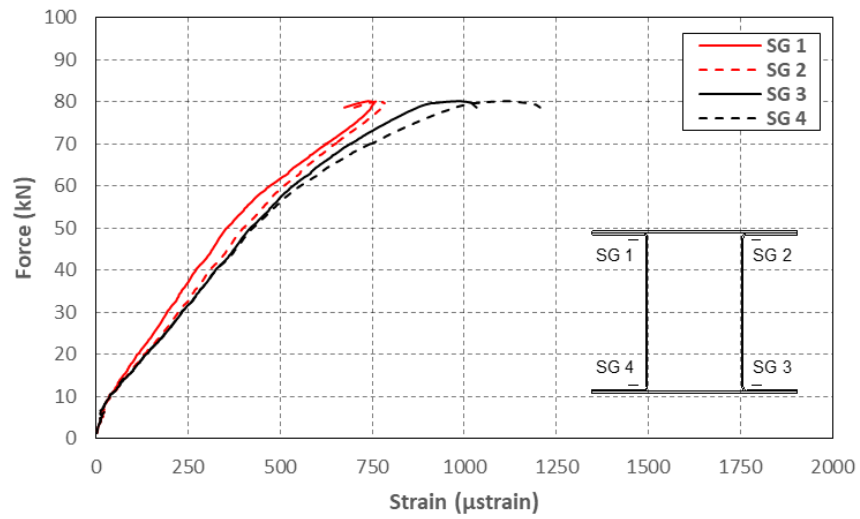


Figure K.8: Axial load vs compressive strain LC1-3a

K.1.4 LC1-3b

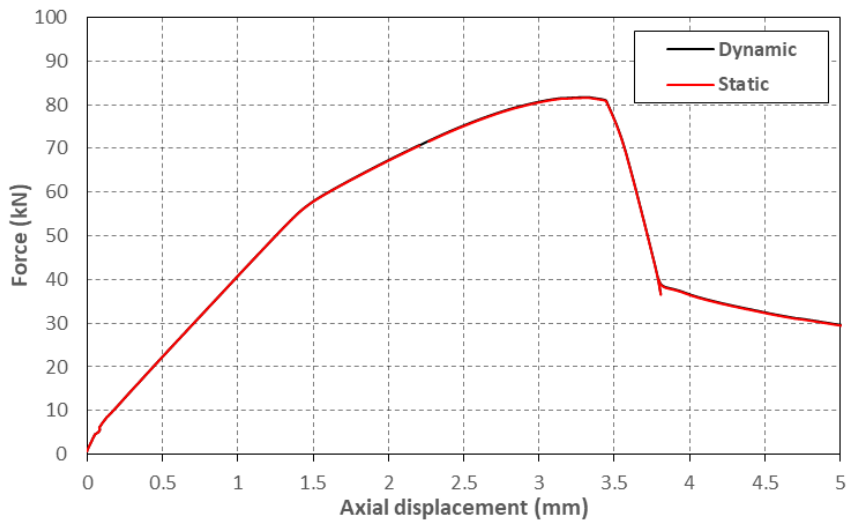


Figure K.9: Axial load vs axial displacement LC1-3b

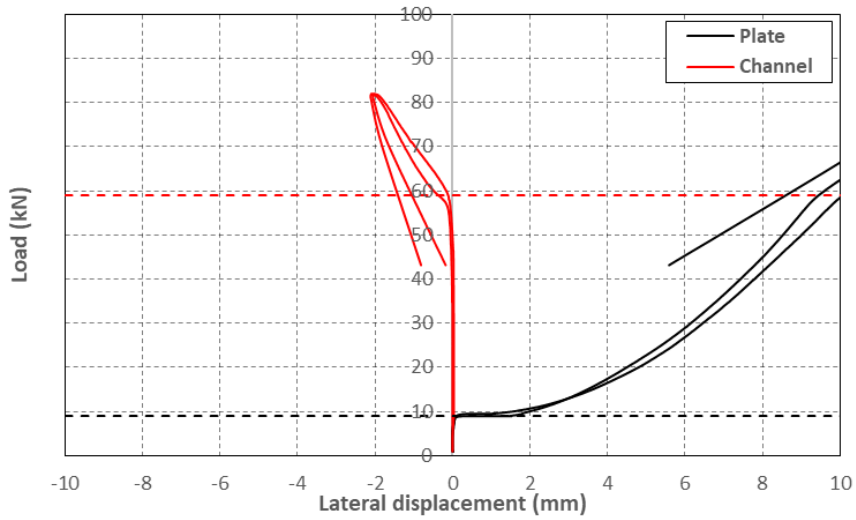


Figure K.10: Axial load vs lateral displacement LC1-3b

K.1.5 LC1-8a

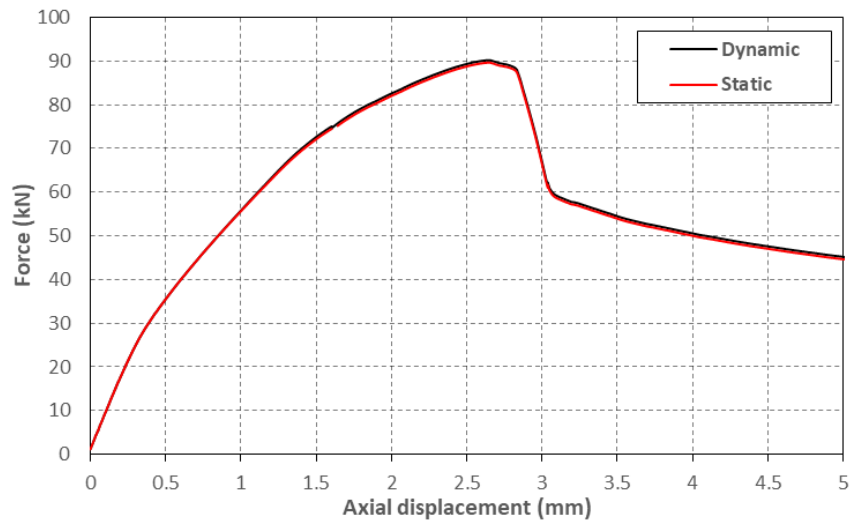


Figure K.11: Axial load vs axial displacement LC1-8a

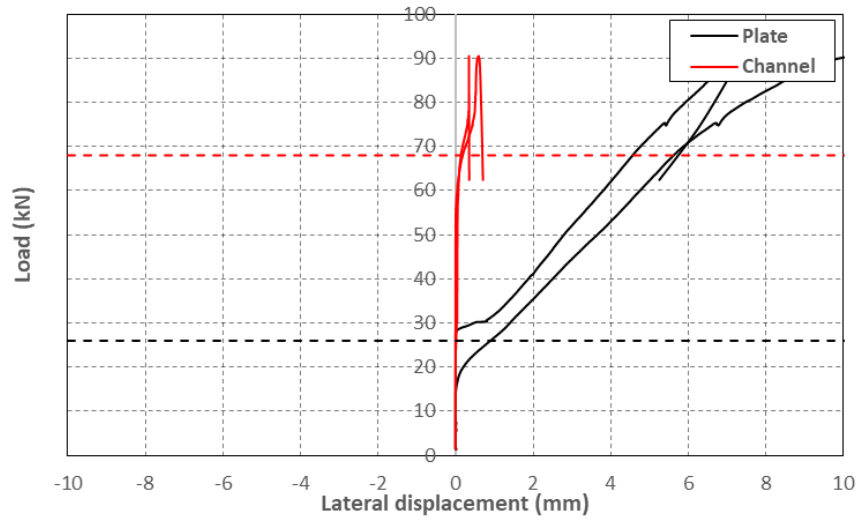


Figure K.12: Axial load vs lateral displacement LC1-8a

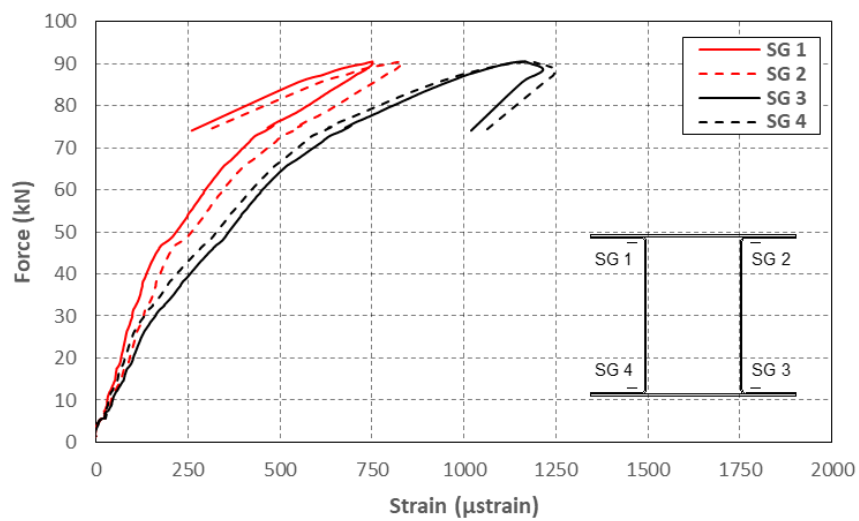


Figure K.13: Axial load vs compressive strain LC1-8a

K.1.6 LC1-8b

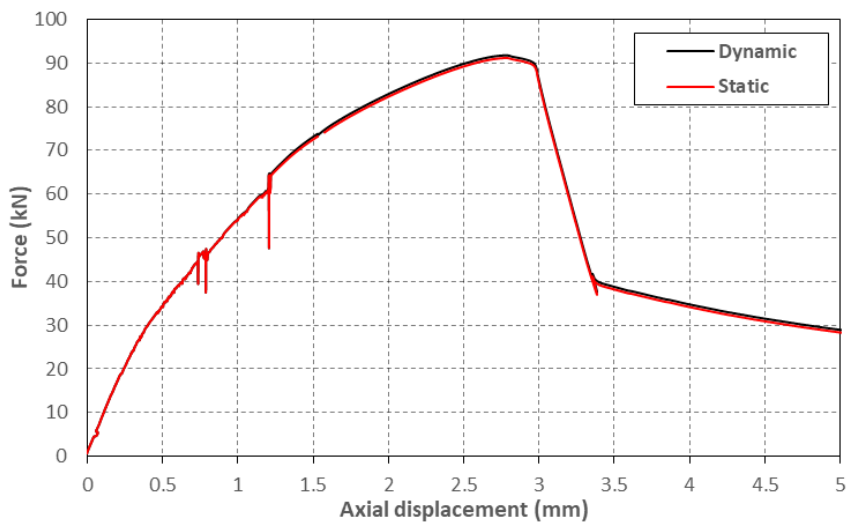


Figure K.14: Axial load vs axial displacement LC1-8b

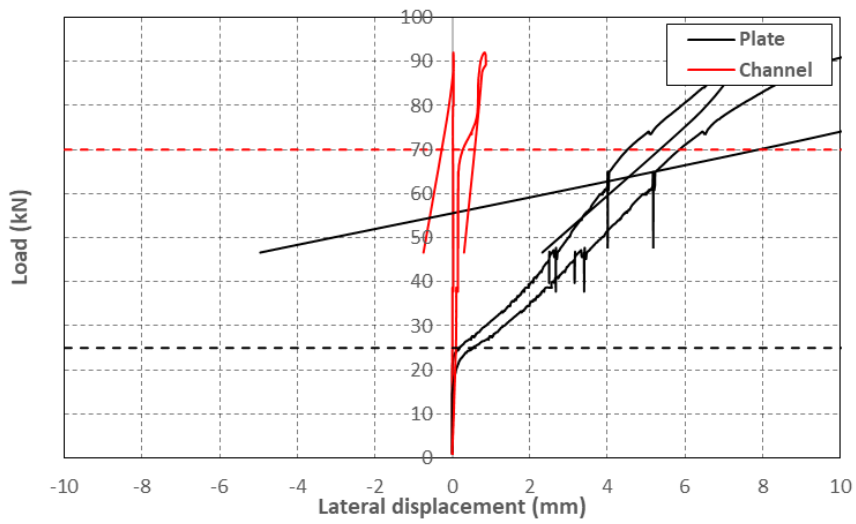


Figure K.15: Axial load vs lateral displacement LC1-8b

K.2. Built-up geometry 2 (LC2)

K.2.1 LC2-2a

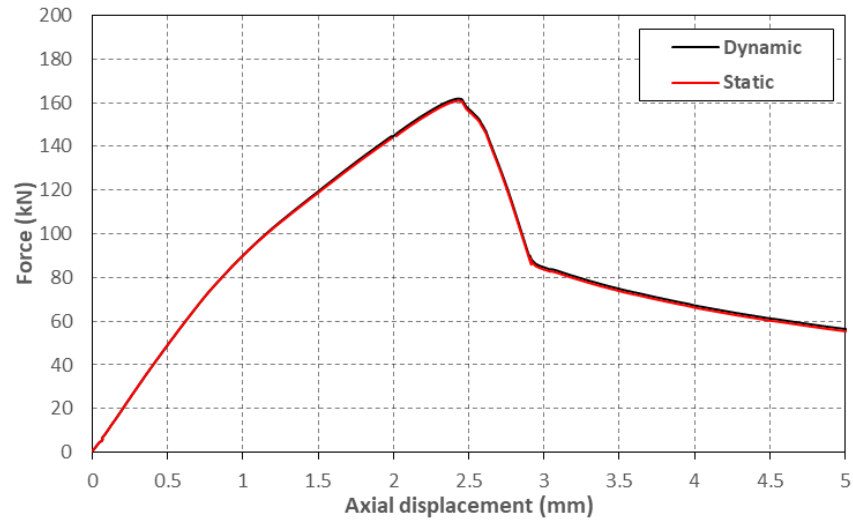


Figure K.16: Axial load vs axial displacement LC2-2a

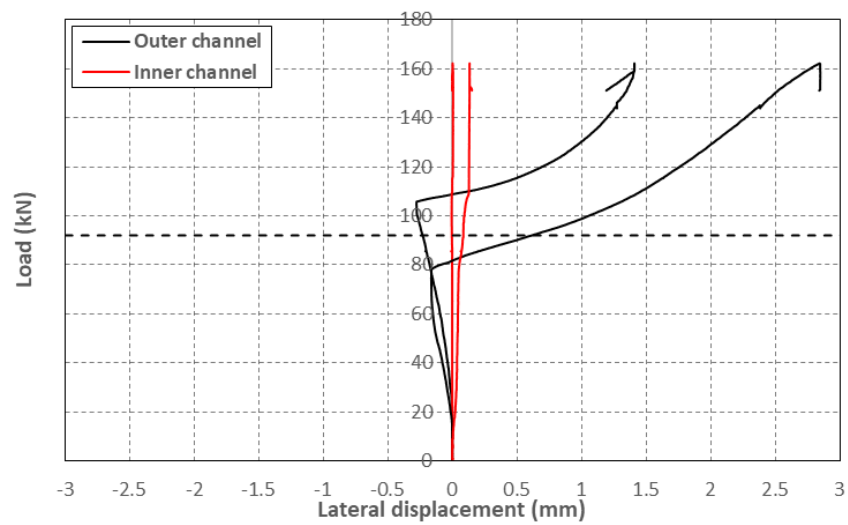


Figure K.17: Axial load vs lateral displacement LC2-2a

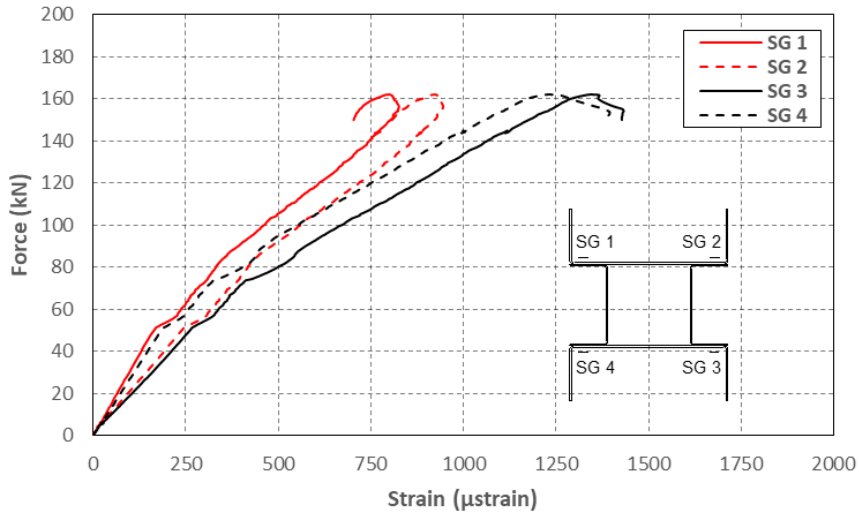


Figure K.18: Axial load vs compressive strain LC2-2a

K.2.2 LC2-2b

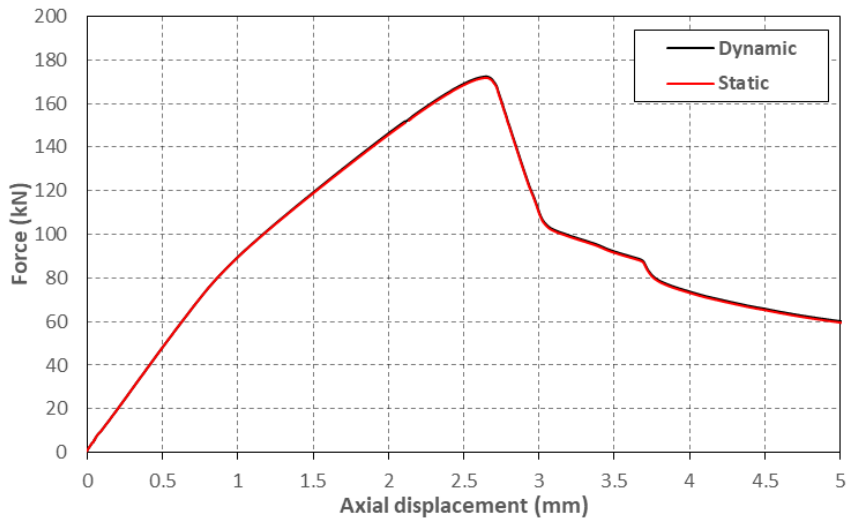


Figure K.19: Axial load vs axial displacement LC2-2b

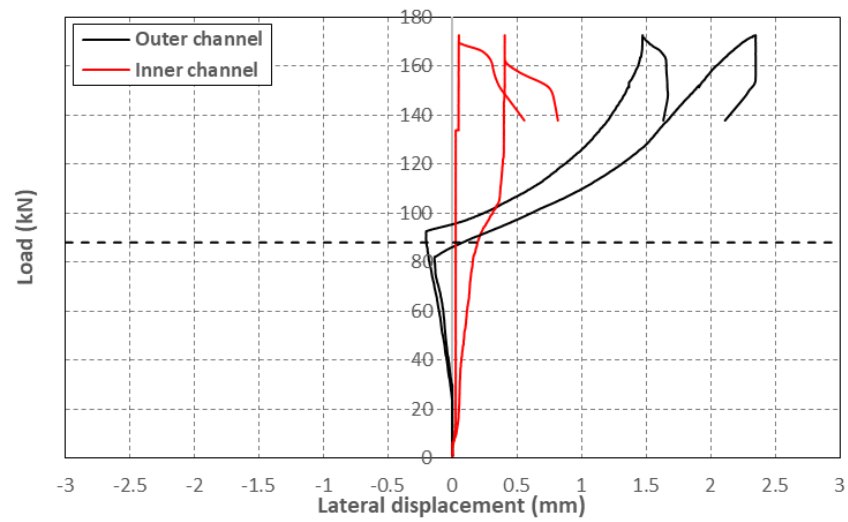


Figure K.20: Axial load vs lateral displacement LC2-2b

K.2.3 LC2-6a

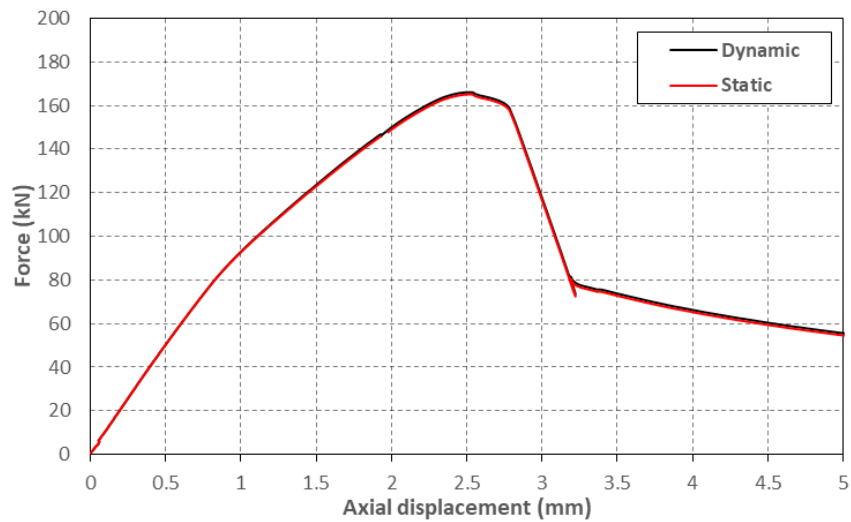


Figure K.21: Axial load vs axial displacement LC2-6a

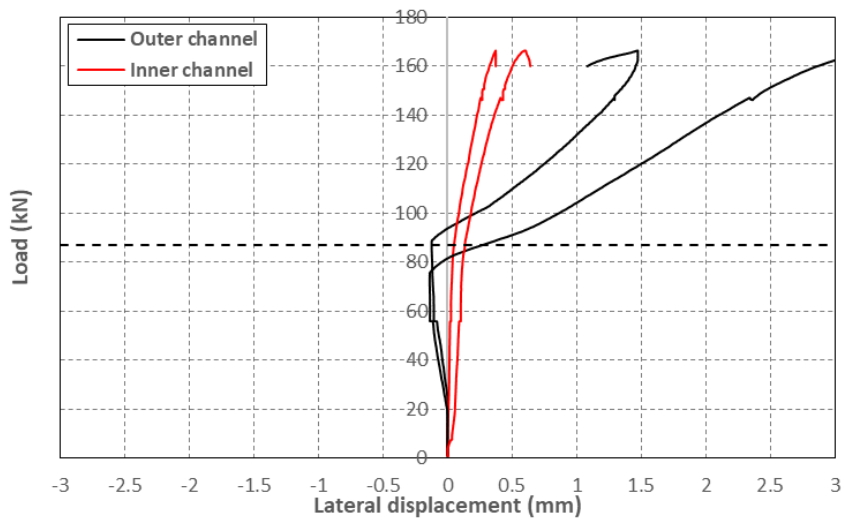


Figure K.22: Axial load vs lateral displacement LC2-6a

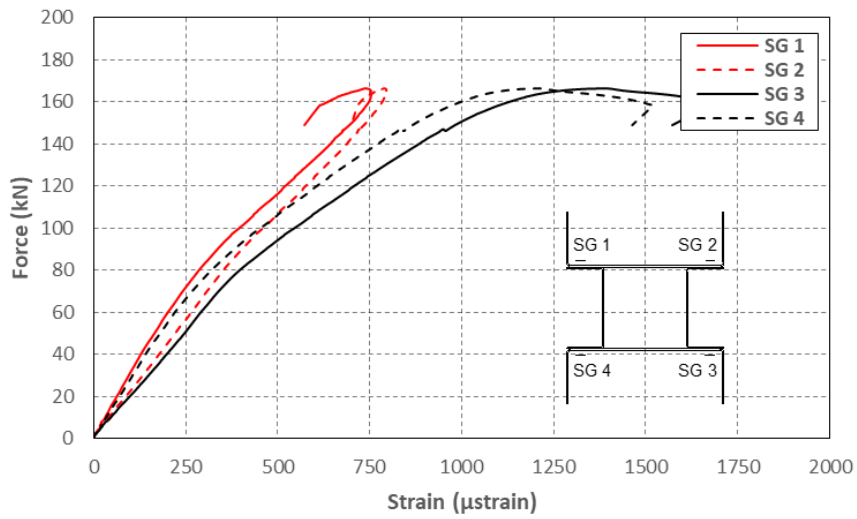
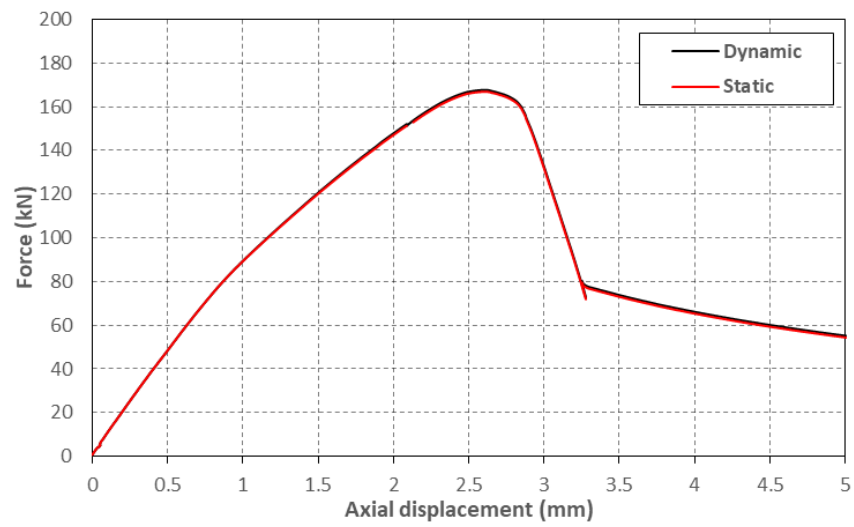
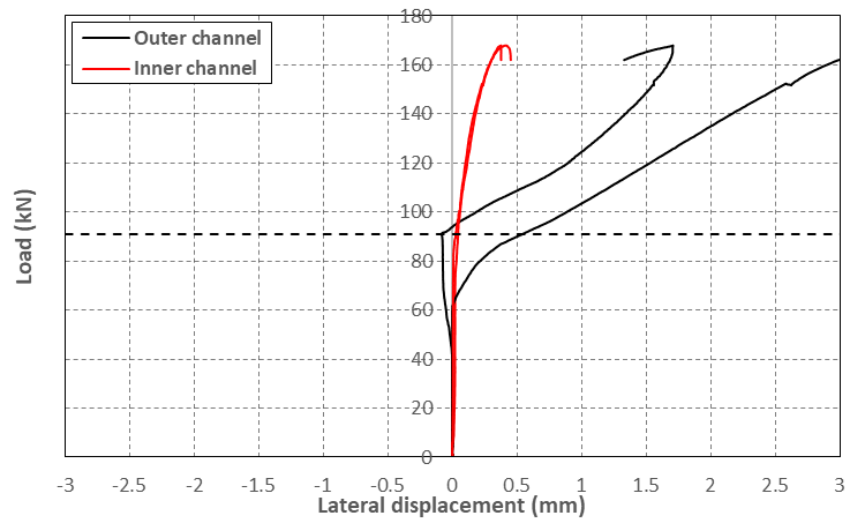


Figure K.23: Axial load vs compressive strain LC2-6a

K.2.4 LC2-6b**Figure K.24: Axial load vs axial displacement LC2-6b****Figure K.25: Axial load vs lateral displacement LC2-6b**

K.2.5 LC2-4a

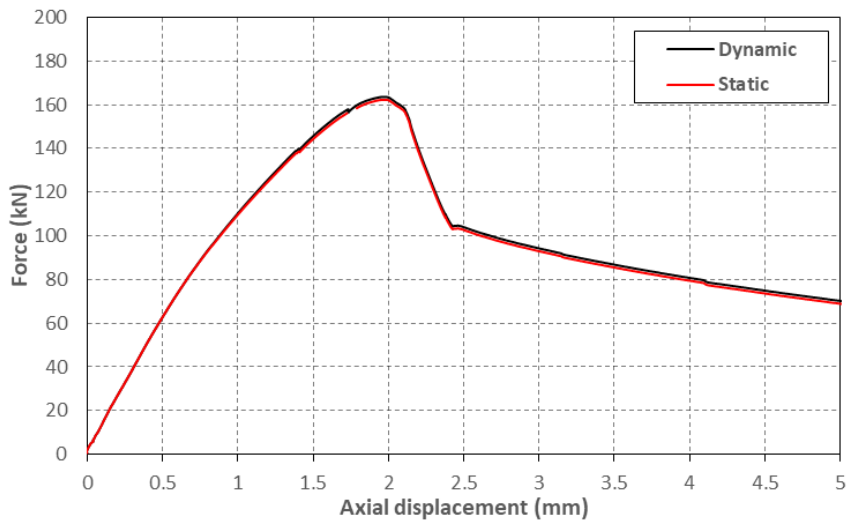


Figure K.26: Axial load vs axial displacement LC2-4a

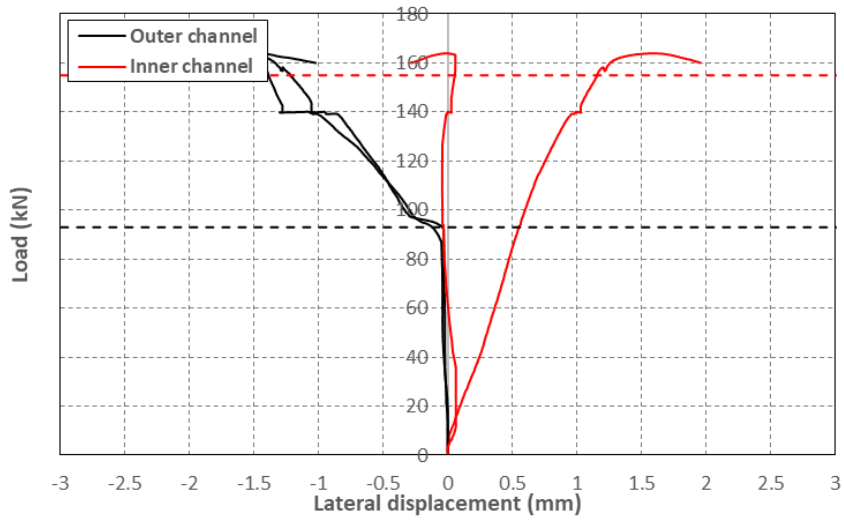


Figure K.27: Axial load vs lateral displacement LC2-4a

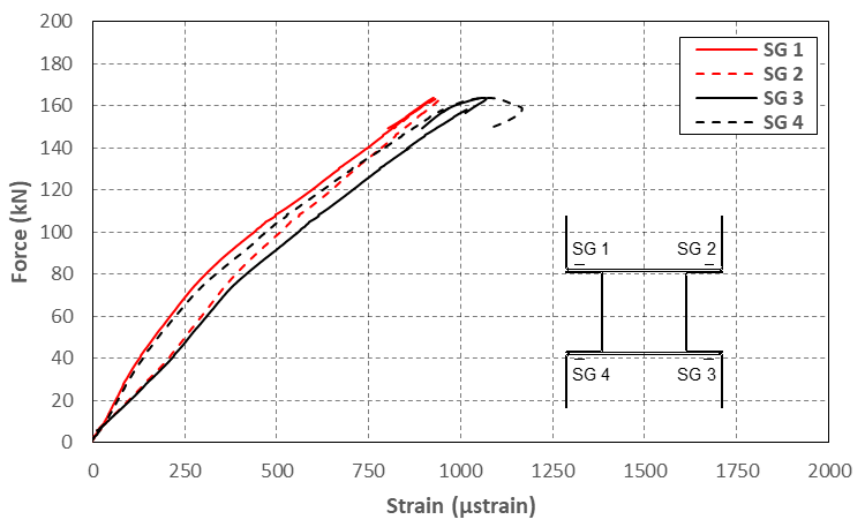
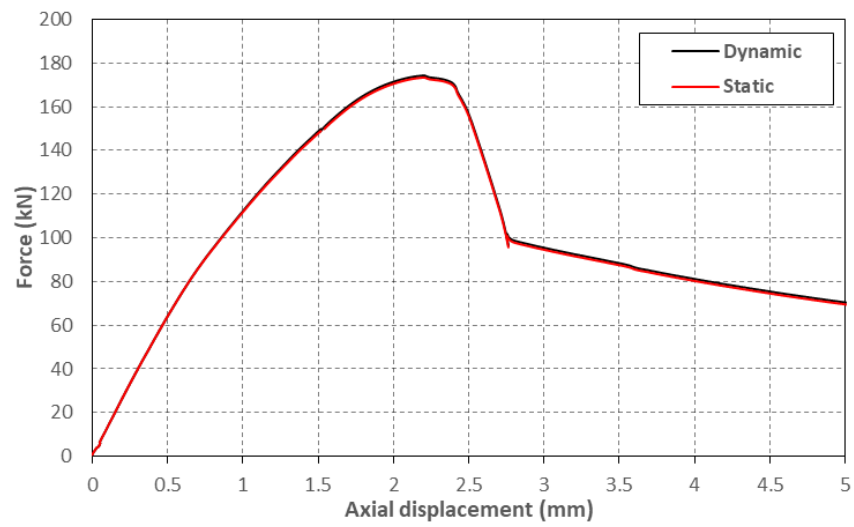
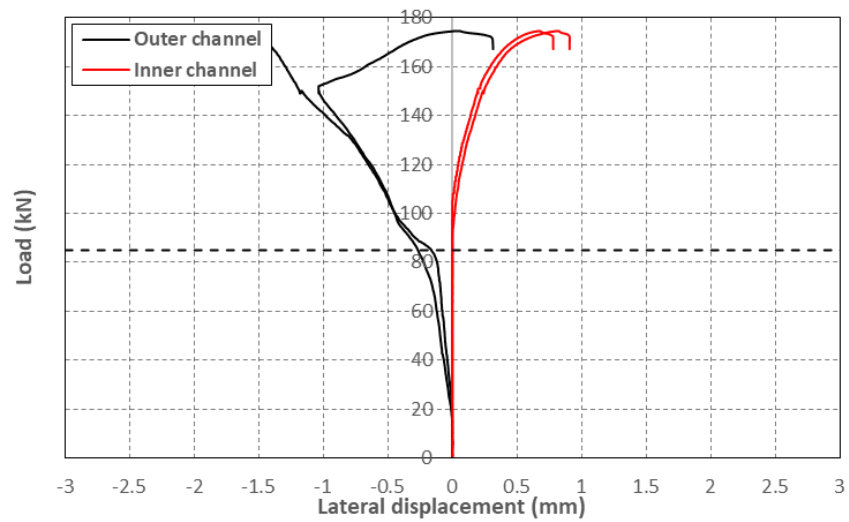


Figure K.28: Axial load vs compressive strain LC2-4a

K.2.6 LC2-4b**Figure K.29: Axial load vs axial displacement LC2-4b****Figure K.30: Axial load vs lateral displacement LC2-4b**

K.3. Built-up geometry 3 (LC3)

K.3.1 LC3-2a

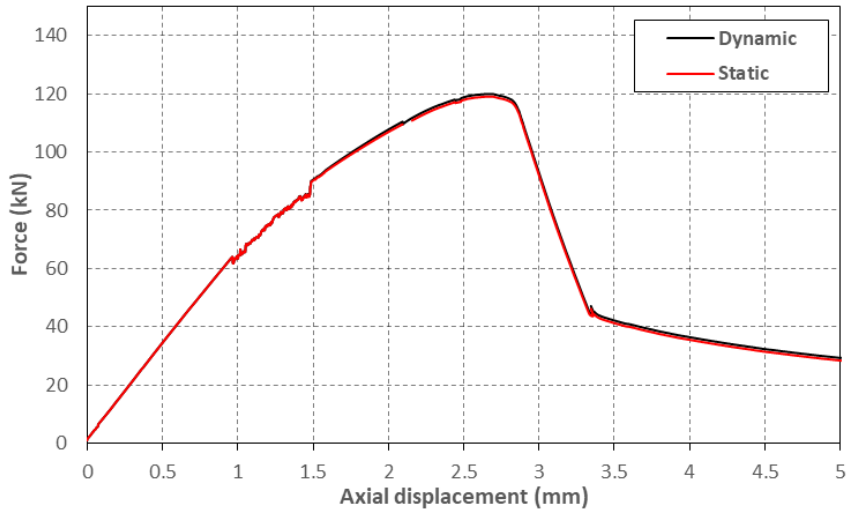


Figure K.31: Axial load vs axial displacement LC3-2a

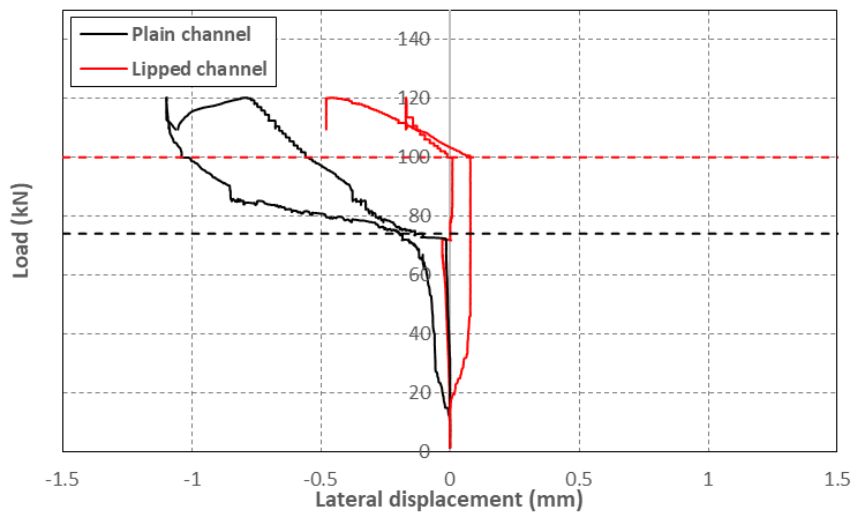


Figure K.32: Axial load vs lateral displacement LC3-2a

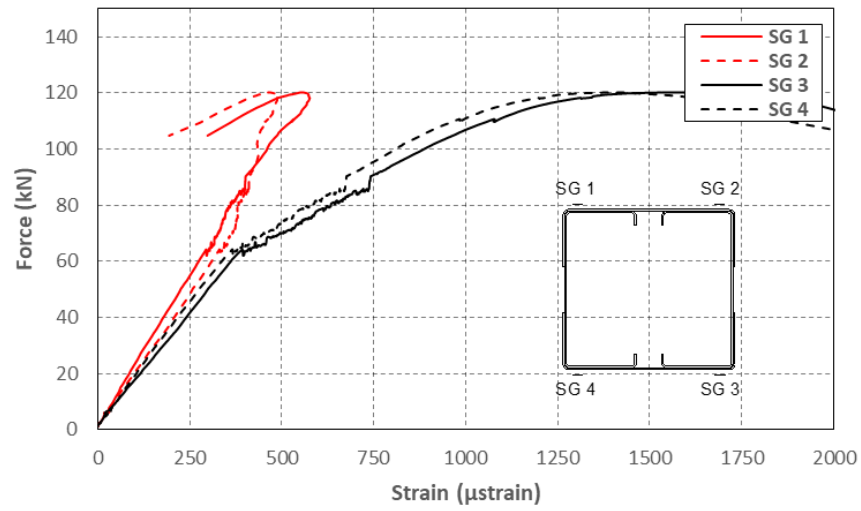


Figure K.33: Axial load vs compressive strain LC3-2a

K.3.2 LC3-2b

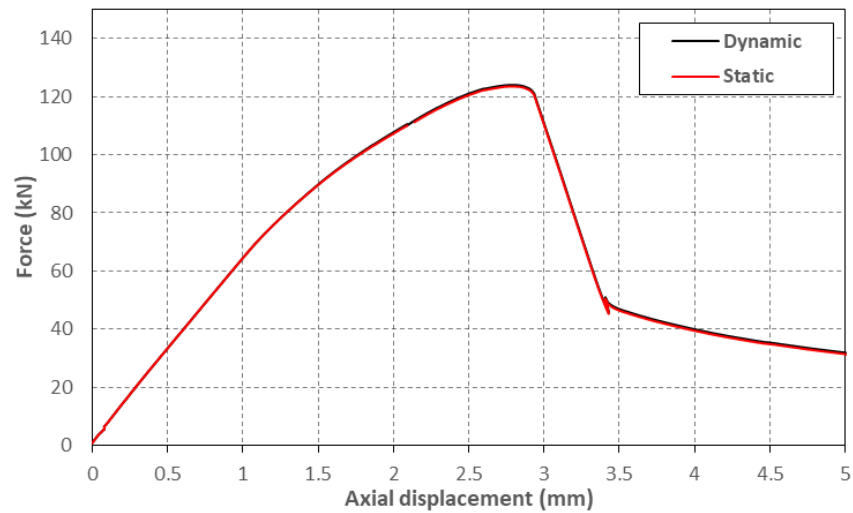


Figure K.34: Axial load vs axial displacement LC3-2b

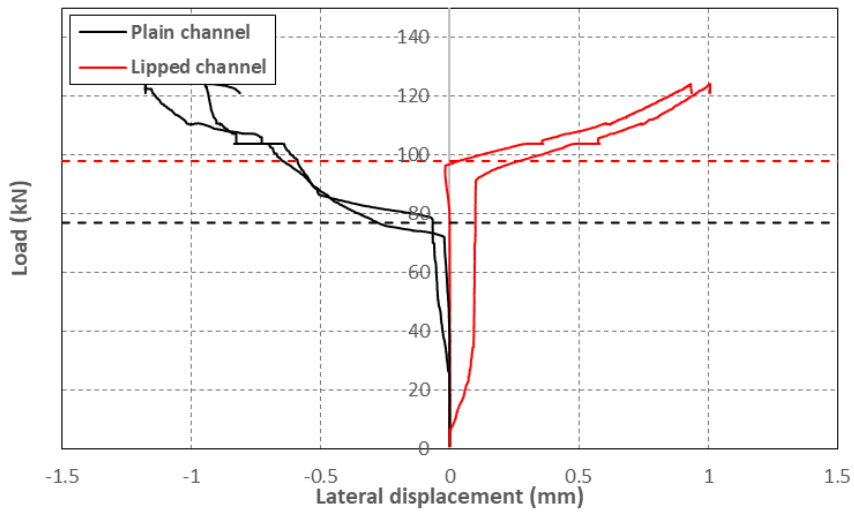


Figure K.35: Axial load vs lateral displacement LC3-2b

K.3.3 LC3-3a

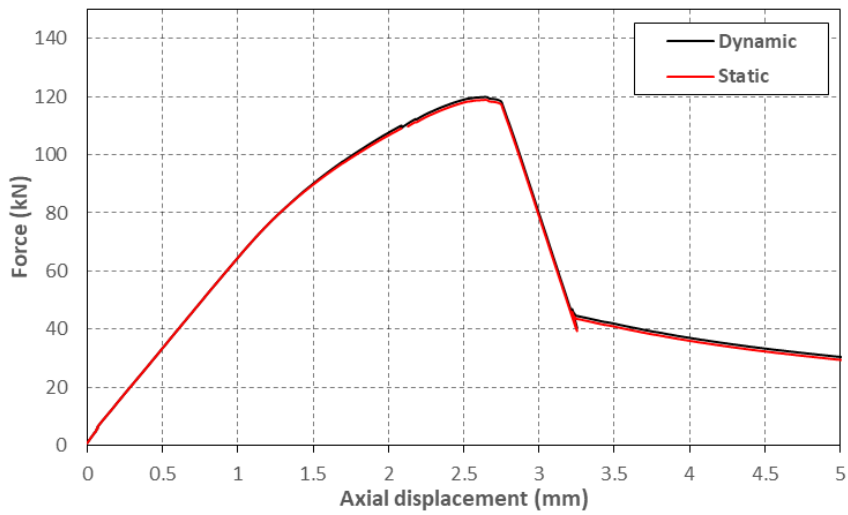


Figure K.36: Axial load vs axial displacement LC3-3a

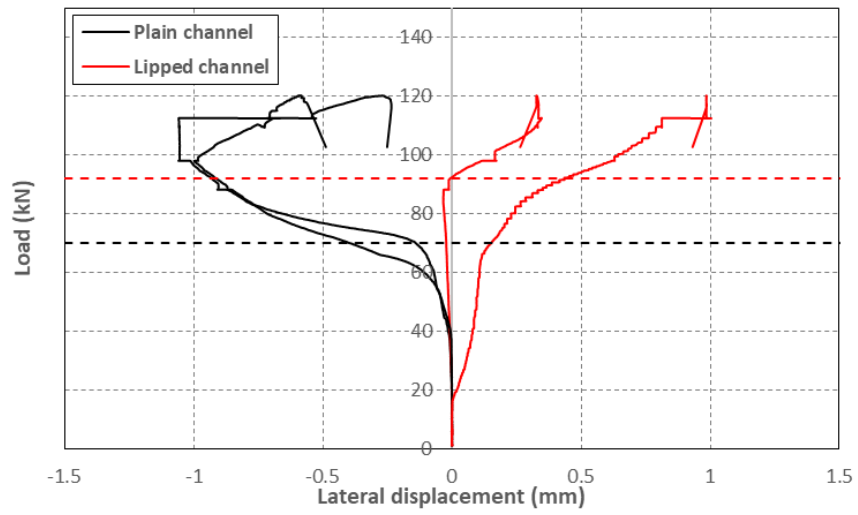


Figure K.37: Axial load vs lateral displacement LC3-3a

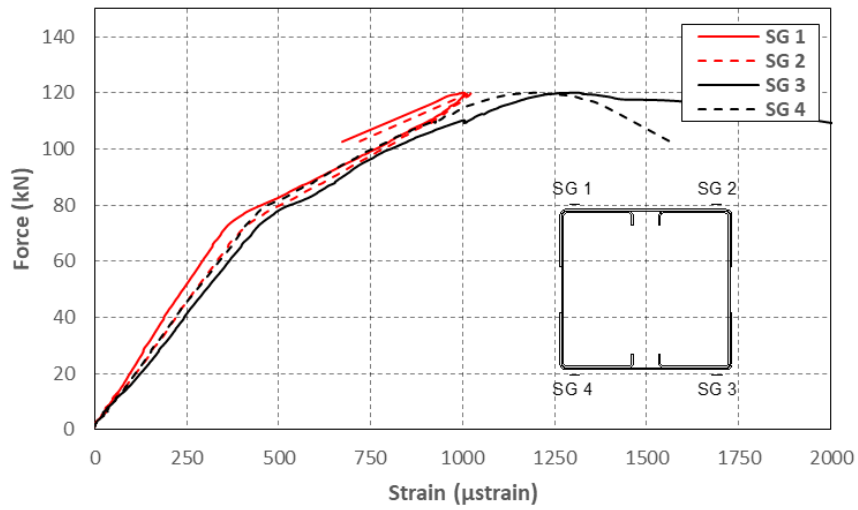


Figure K.38: Axial load vs compressive strain LC3-3a

K.3.4 LC3-3b

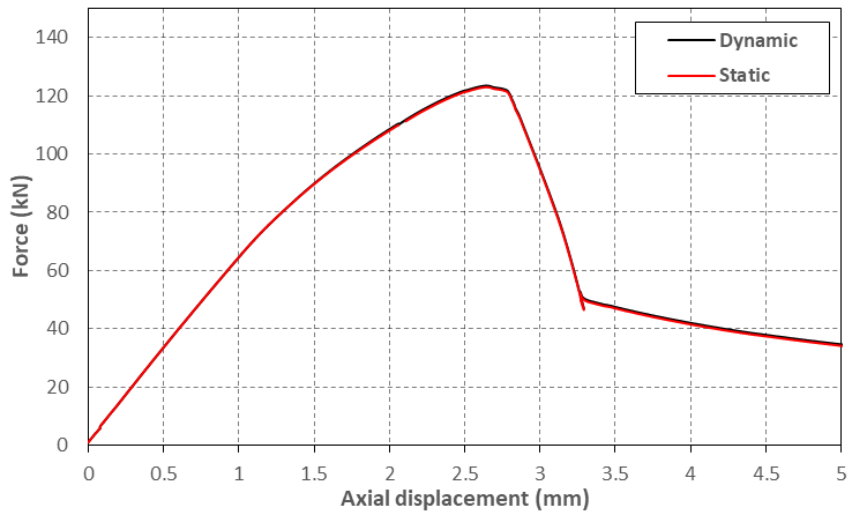


Figure K.39: Axial load vs axial displacement LC3-3b

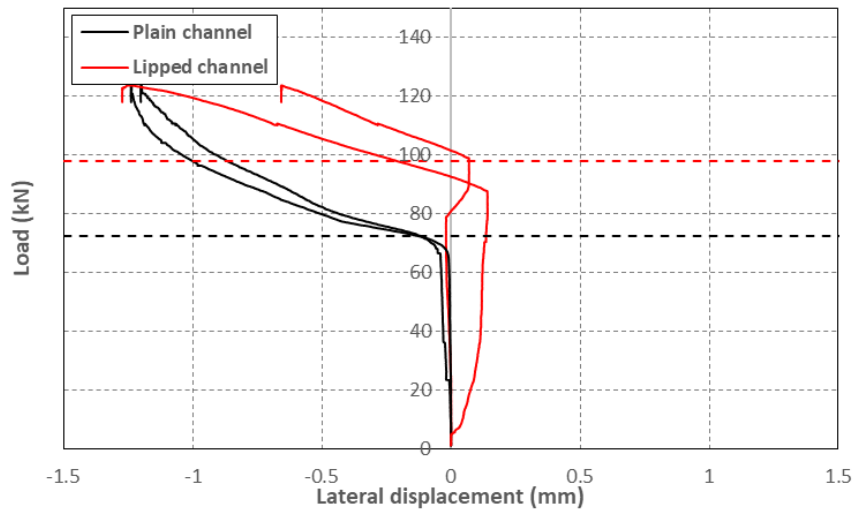


Figure K.40: Axial load vs lateral displacement LC3-3b

K.3.5 LC3-8a

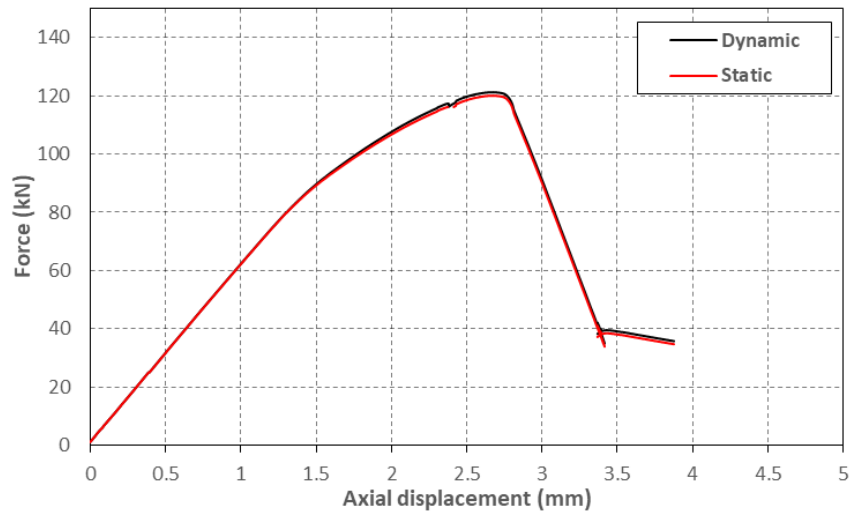


Figure K.41: Axial load vs axial displacement LC3-8a

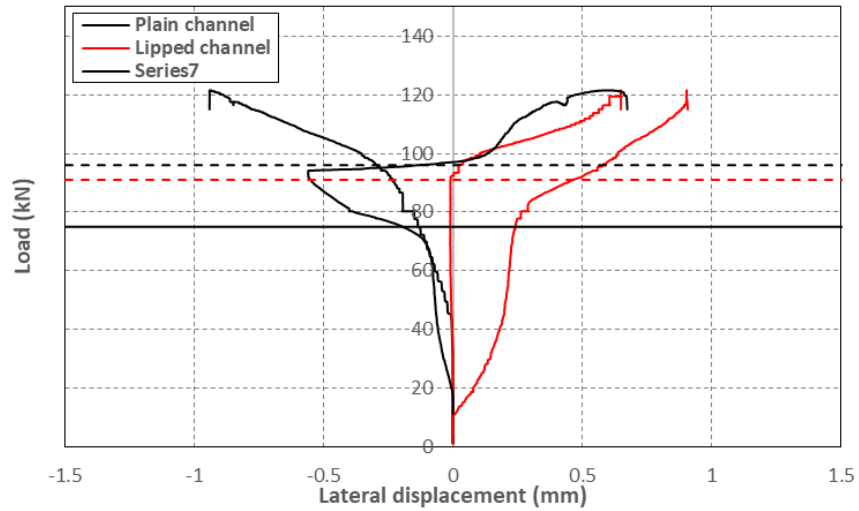


Figure K.42: Axial load vs lateral displacement LC3-8a

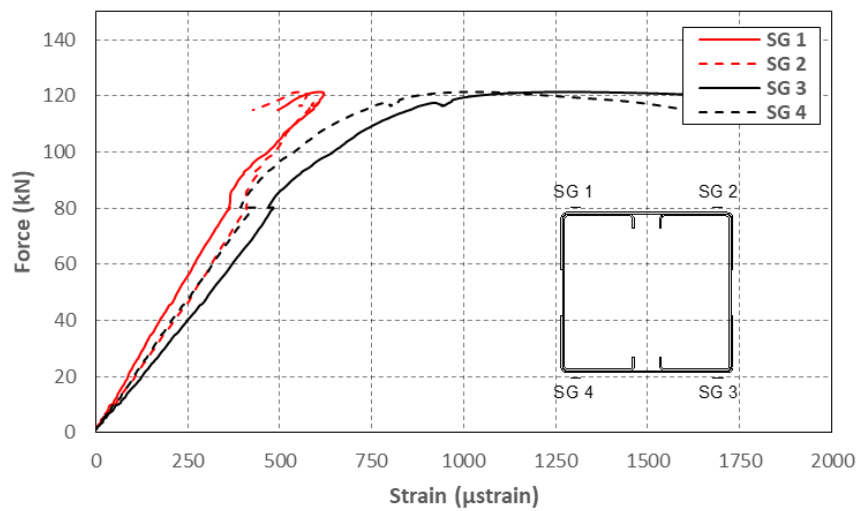


Figure K.43: Axial load vs compressive strain LC3-8a

K.3.6 LC3-8b

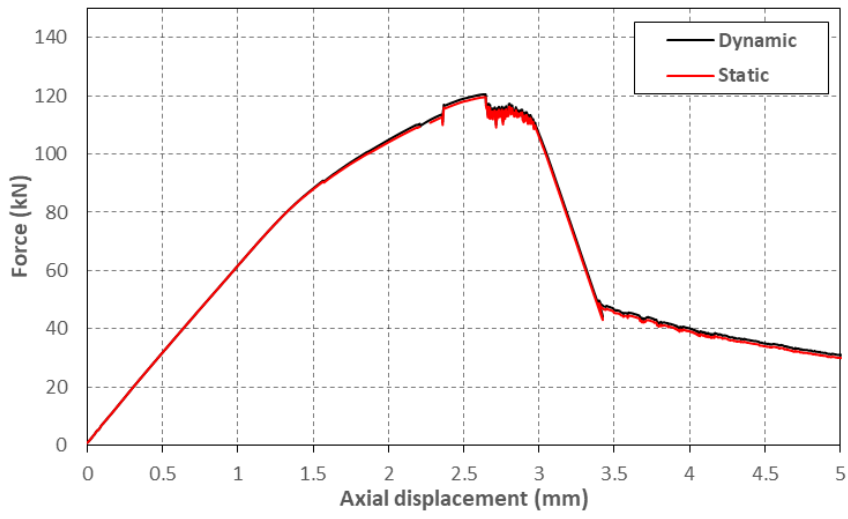


Figure K.44: Axial load vs axial displacement LC3-8b

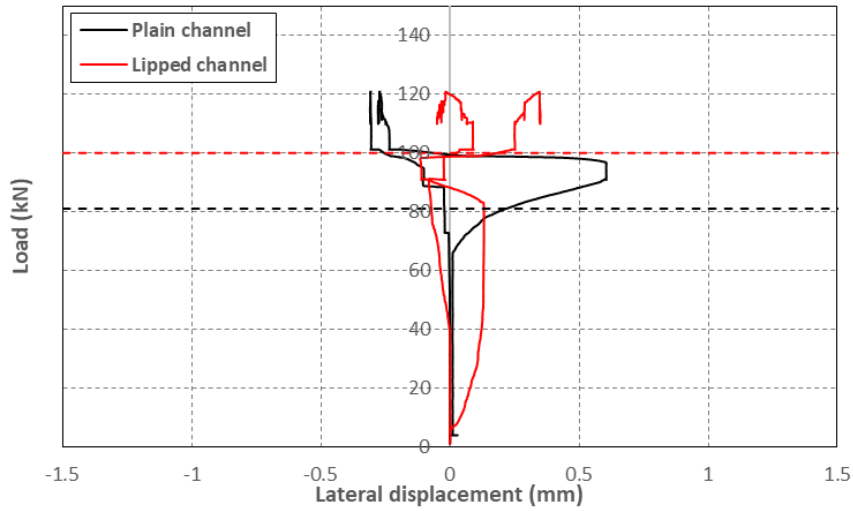


Figure K.45: Axial load vs lateral displacement LC3-8b

K.3.7 Built-up geometry 4 (LC4)

K.3.8 LC4-2a

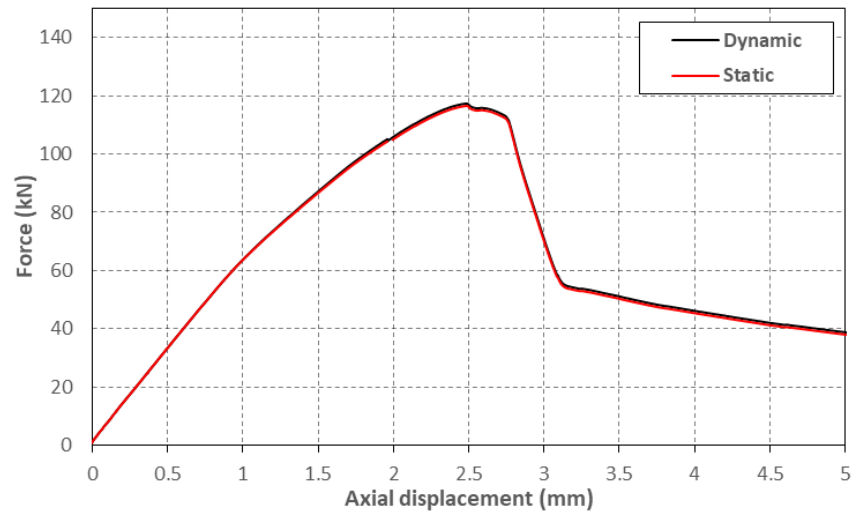


Figure K.46: Axial load vs axial displacement LC4-2a

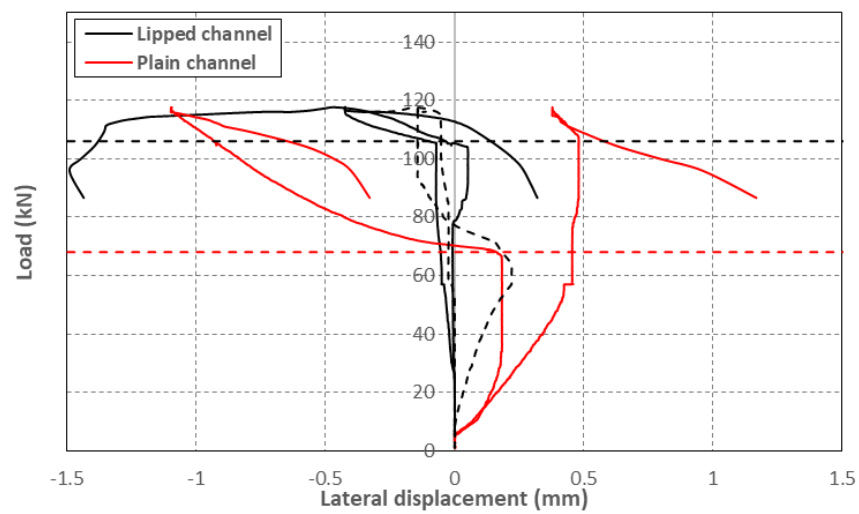


Figure K.47: Axial load vs lateral displacement LC4-2a

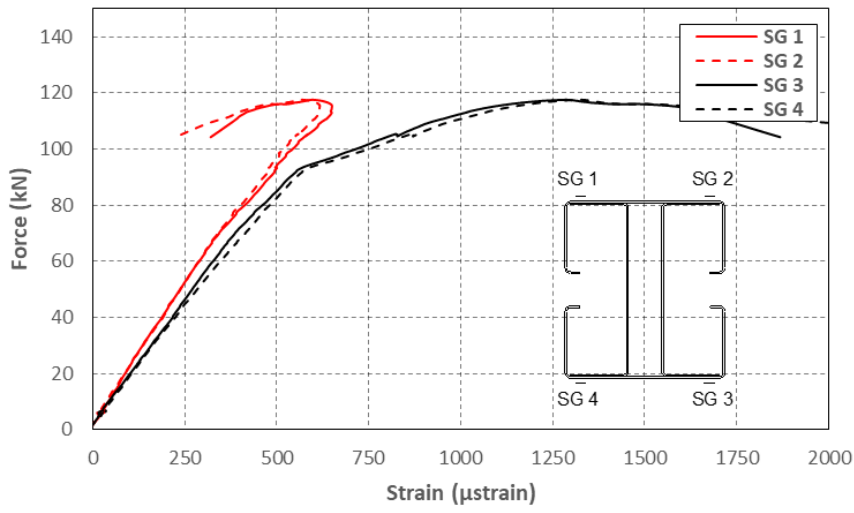


Figure K.48: Axial load vs compressive strain LC4-2a

K.3.9 LC4-2b

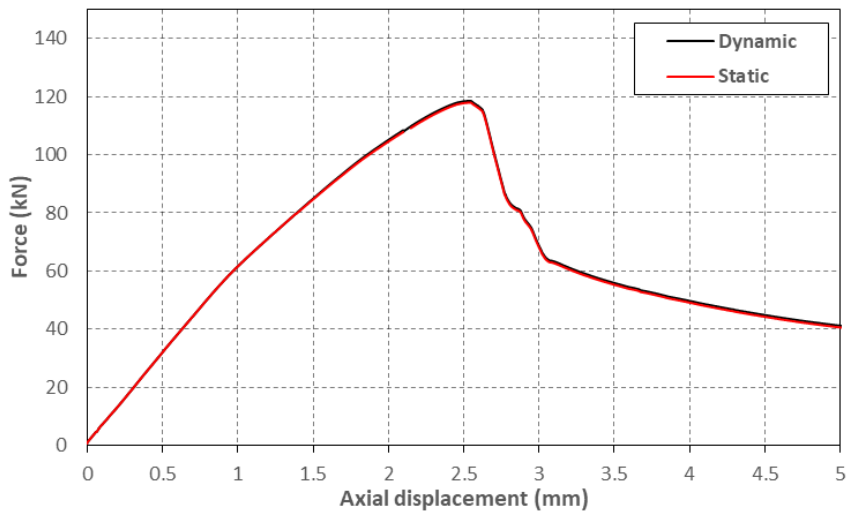


Figure K.49: Axial load vs axial displacement LC4-2b

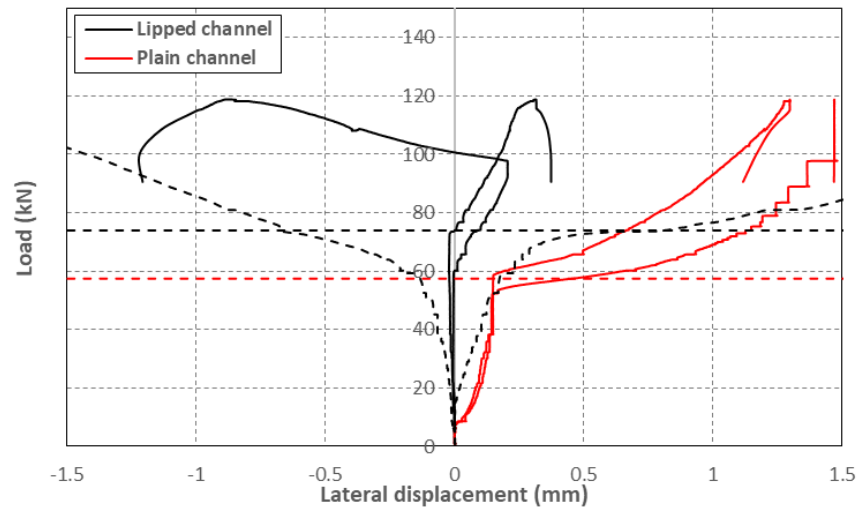


Figure K.50: Axial load vs lateral displacement LC4-2b

K.3.10 LC4-3a

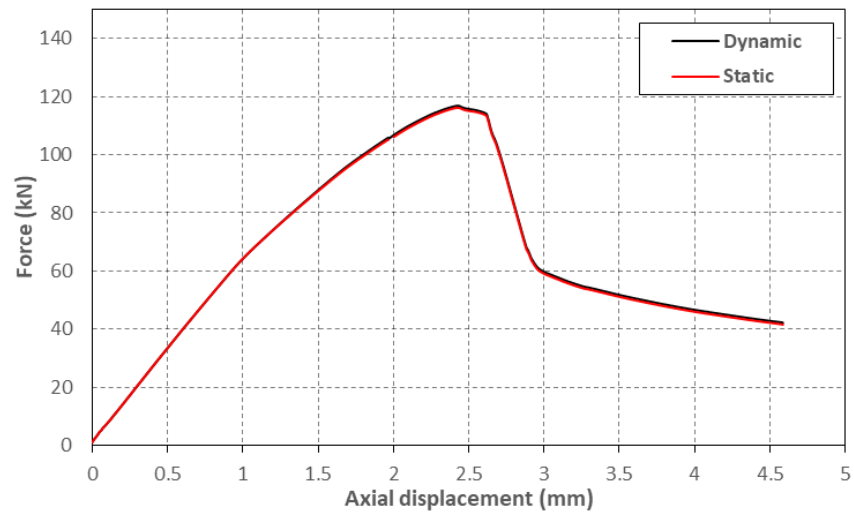


Figure K.51: Axial load vs axial displacement LC4-3a

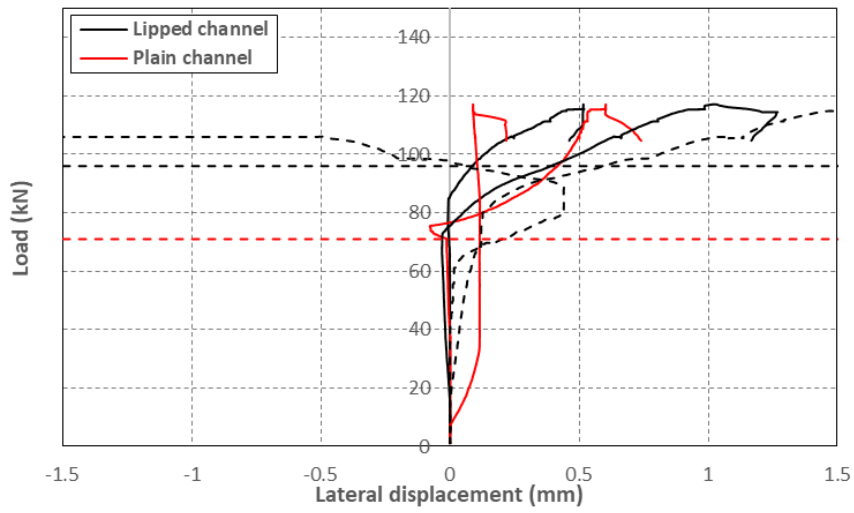


Figure K.52: Axial load vs lateral displacement LC4-3a

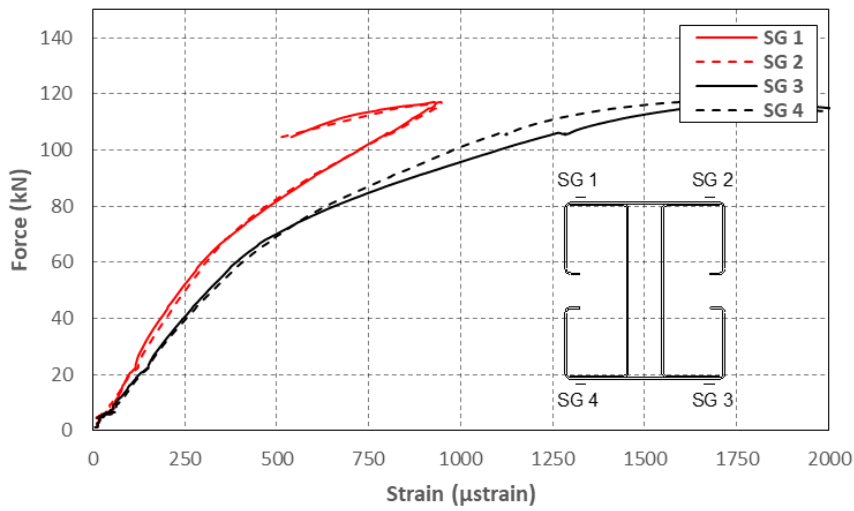
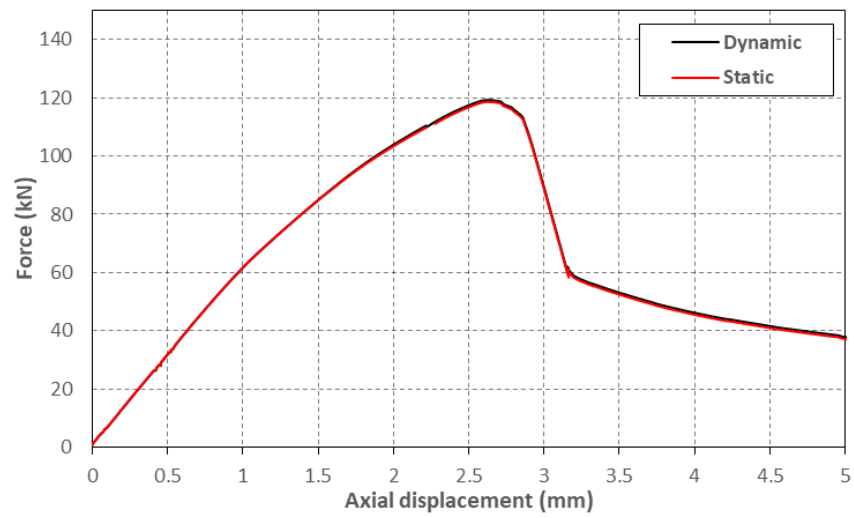
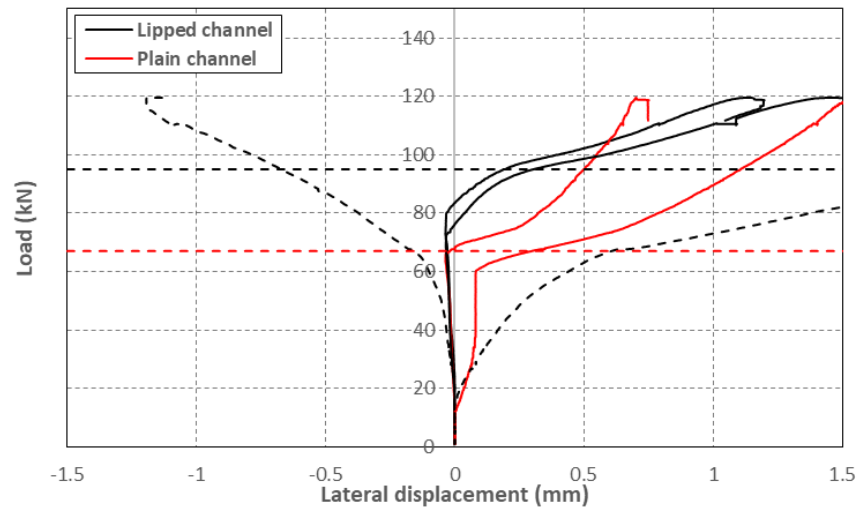


Figure K.53: Axial load vs compressive strain LC4-3a

K.3.11 LC4-3b**Figure K.54: Axial load vs axial displacement LC4-3b****Figure K.55: Axial load vs lateral displacement LC4-3b**

K.3.12 LC4-8a

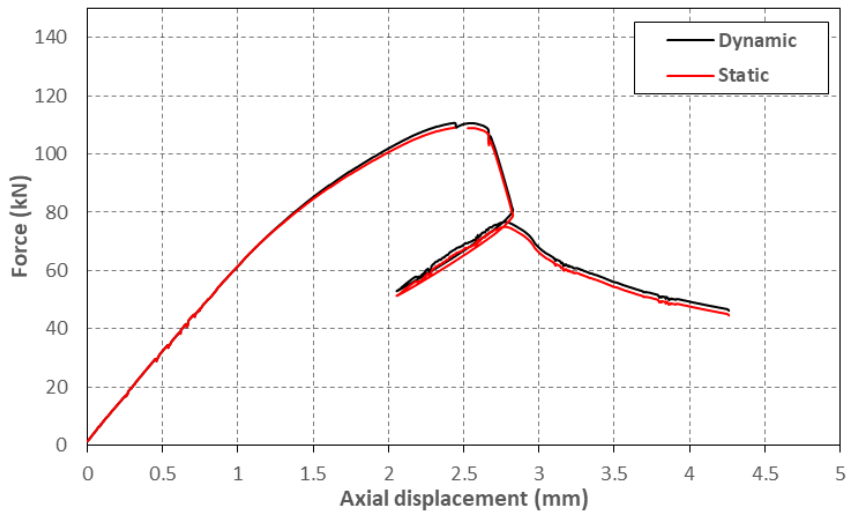


Figure K.56: Axial load vs axial displacement LC4-8a

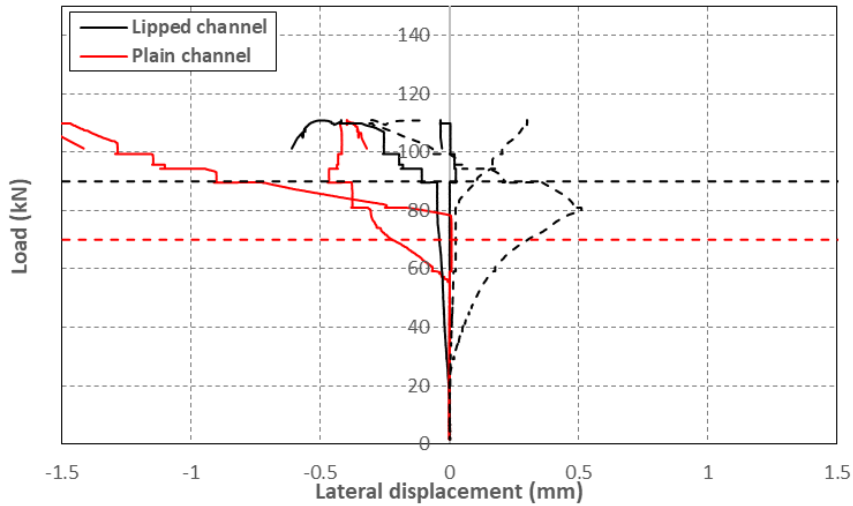


Figure K.57: Axial load vs lateral displacement LC4-8a

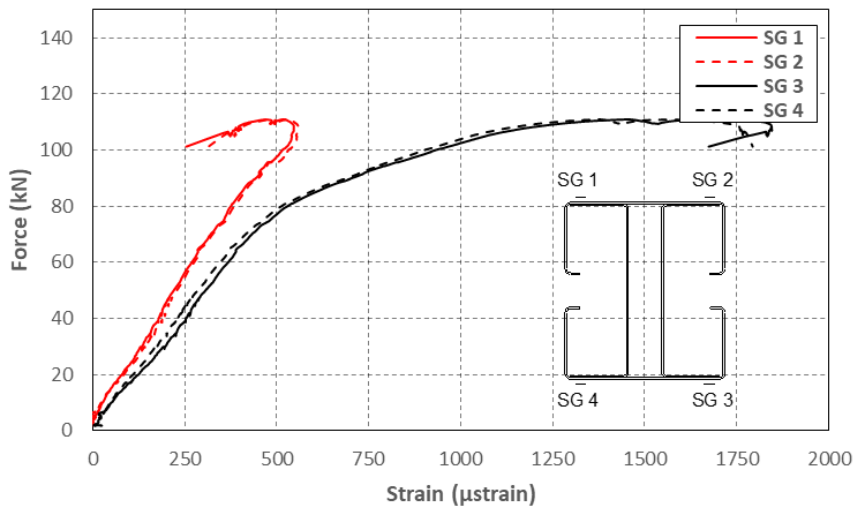
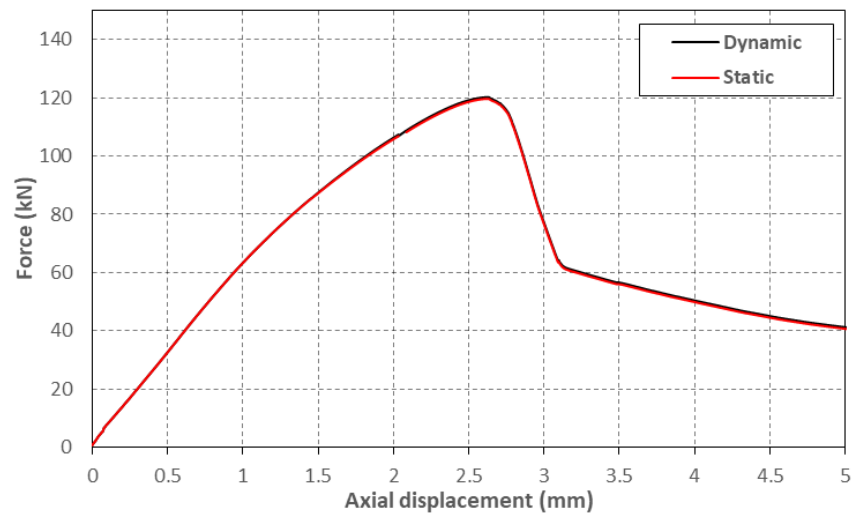
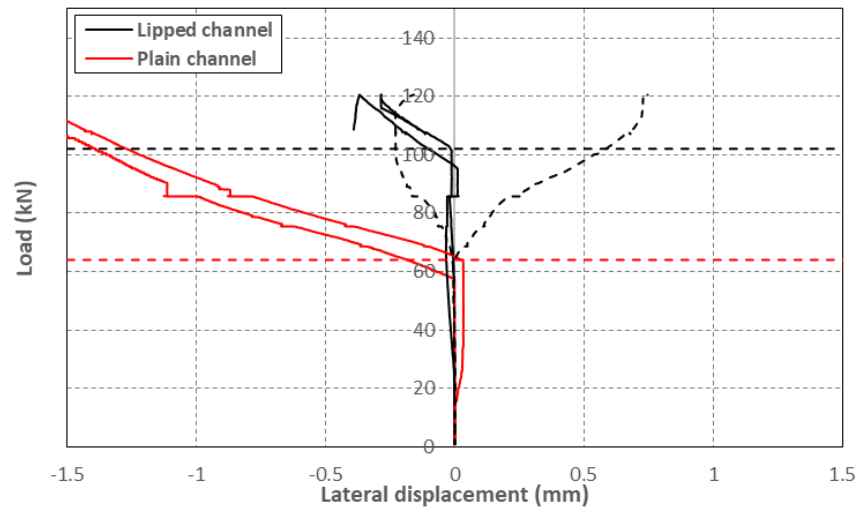


Figure K.58: Axial load vs compressive strain LC4-8a

K.3.13 LC4-8b**Figure K.59: Axial load vs axial displacement LC4-8b****Figure K.60: Axial load vs lateral displacement LC4-8b**

Appendix L

Stub Columns Comparison Experimental and Numerical Results

Appendix L contains graphs comparing the load vs. lateral deformation curves obtained from the FE models of the stub columns with those obtained from the experiments. Further details about these comparisons are included in Sections 7.3.2 and 7.3.3 of the main text.

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L.1. Built-up geometry 1 (SC1)

L.1.1 SC1-2a

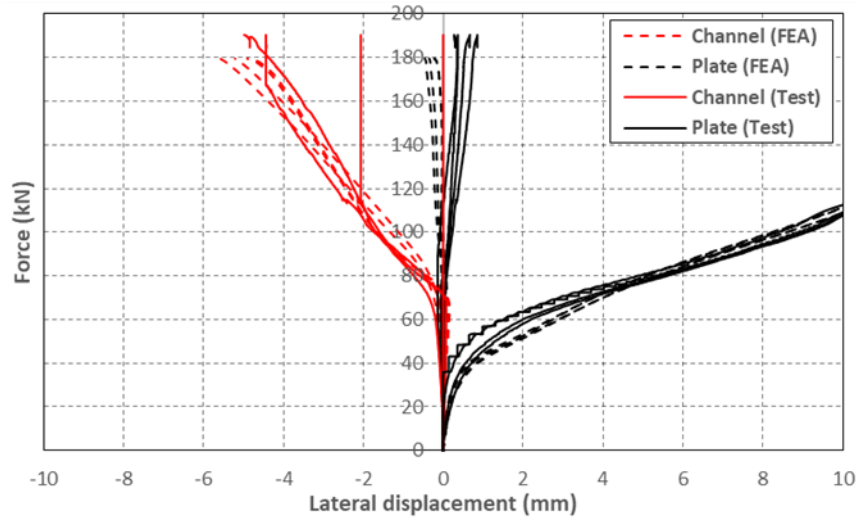


Figure L.1: Experimental and numerical axial load vs lateral displacements SC1-2a

L.1.2 SC1-2b

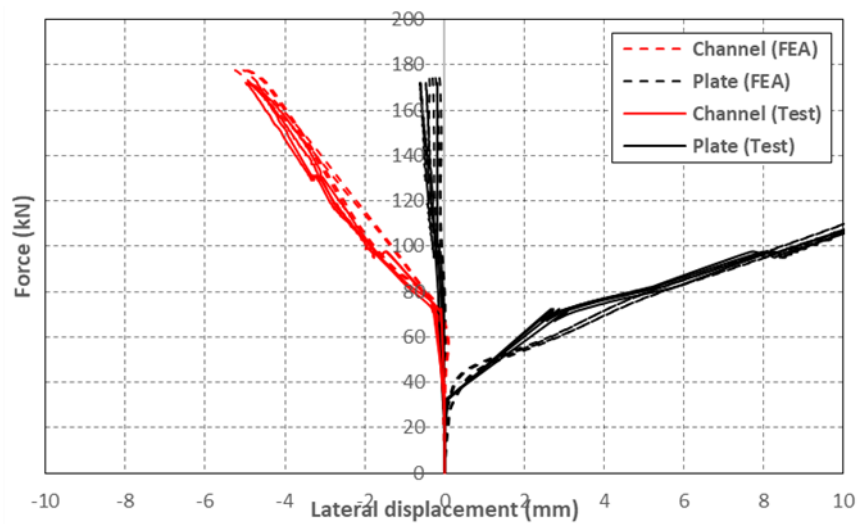


Figure L.2: Experimental and numerical axial load vs lateral displacements SC1-2b

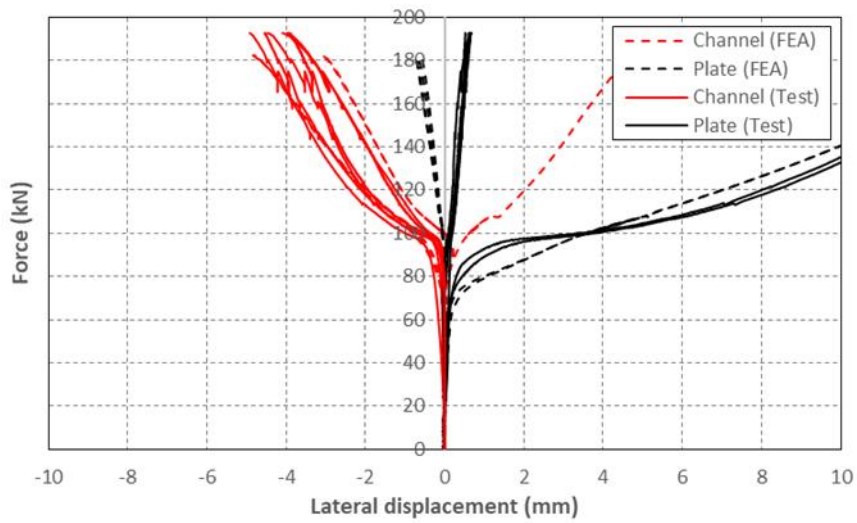
L.1.3 SC1-3a

Figure L.3: Experimental and numerical axial load vs lateral displacements SC1-3a

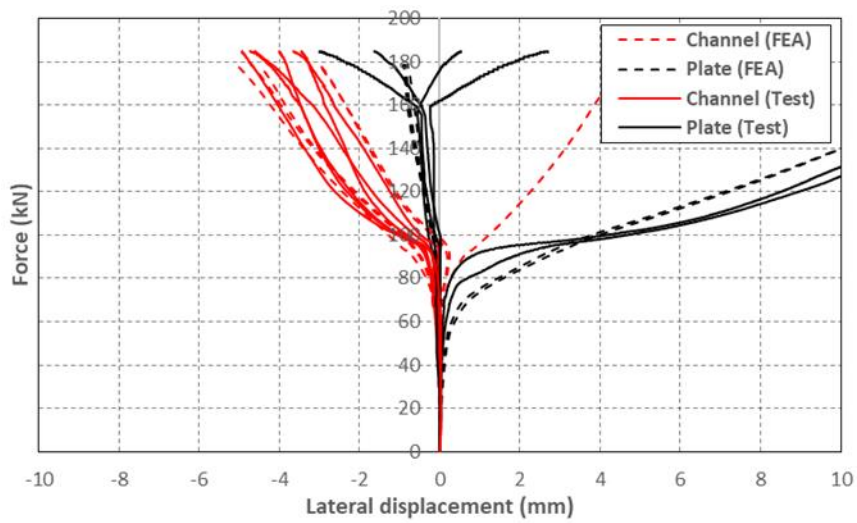
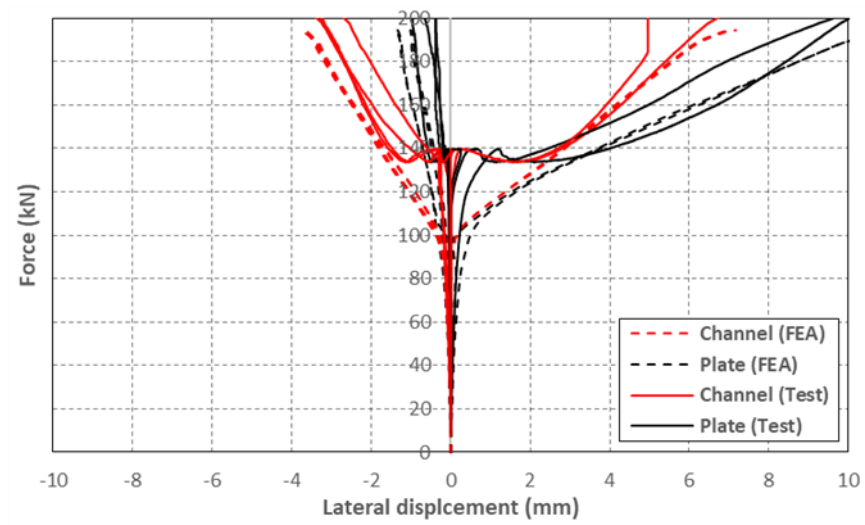
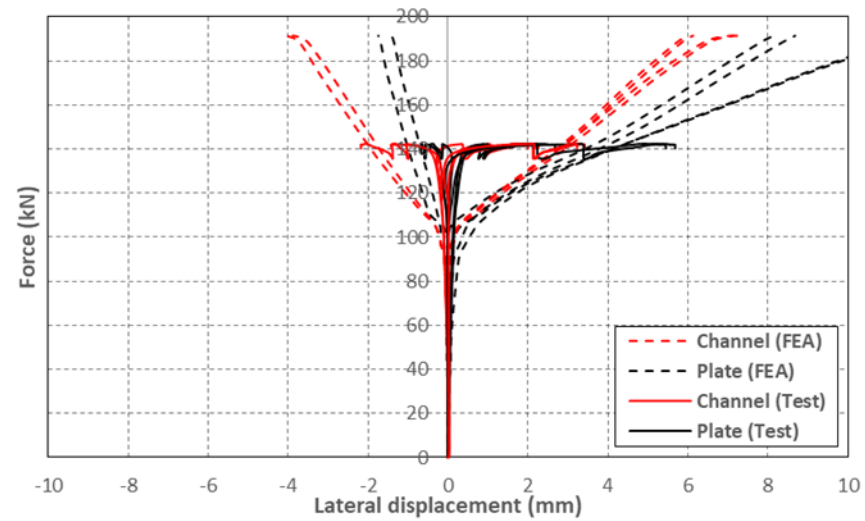
L.1.4 SC1-3b

Figure L.4: Experimental and numerical axial load vs lateral displacements SC1-3b

L.1.5 SC1-5a**Figure L.5: Experimental and numerical axial load vs lateral displacements SC1-5a****L.1.6 SC1-5b****Figure L.6: Experimental and numerical axial load vs lateral displacements SC1-5b**

L.2. Built-up geometry 2 (SC2)

L.2.1 SC2-2a

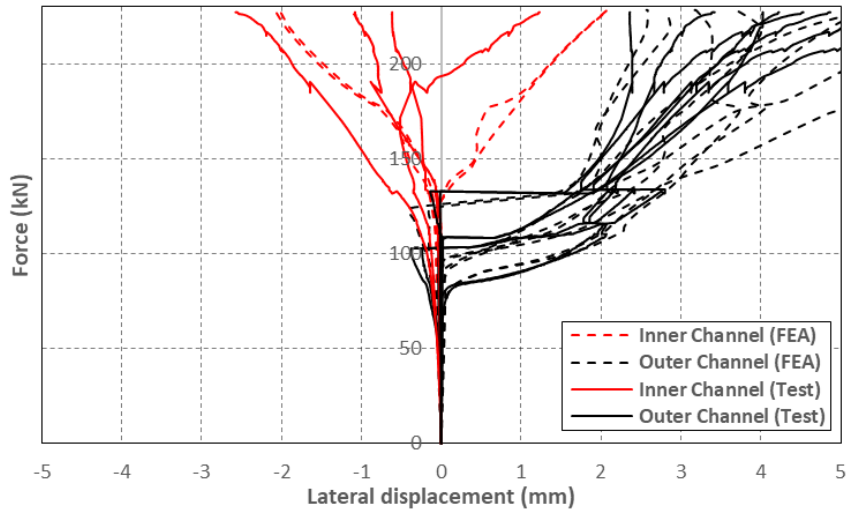


Figure L.7: Experimental and numerical axial load vs lateral displacements SC2-2a

L.2.2 SC2-2b

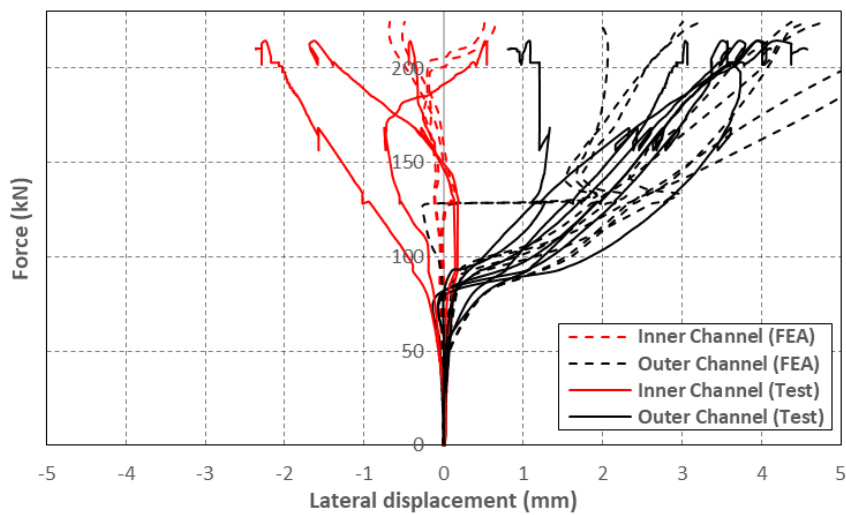


Figure L.8: Experimental and numerical axial load vs lateral displacements SC2-2b

L.2.3 SC2-4a

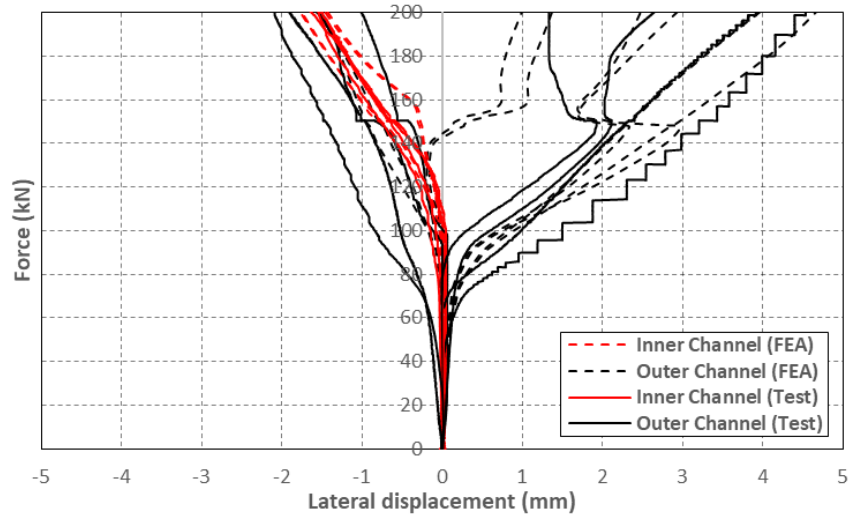


Figure L.9: Experimental and numerical axial load vs lateral displacements SC2-4a

L.2.4 SC2-4b

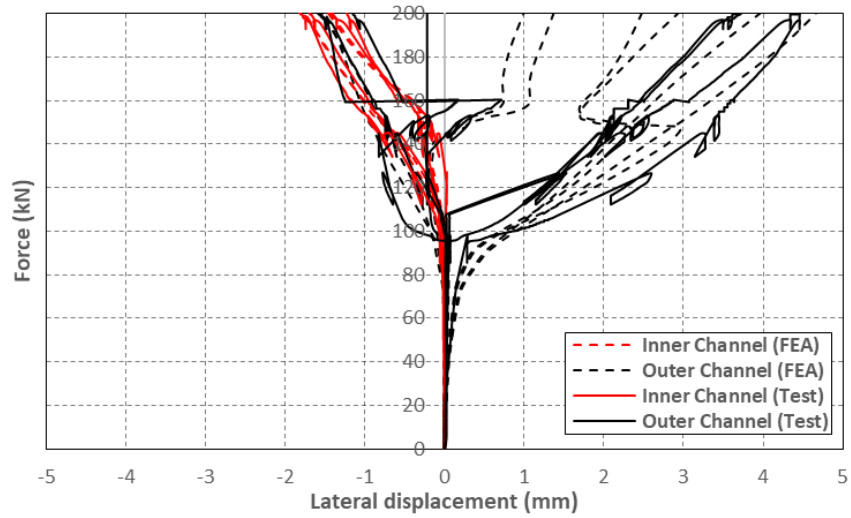


Figure L.10: Experimental and numerical axial load vs lateral displacements SC2-4b

L.2.5 SC2-6a

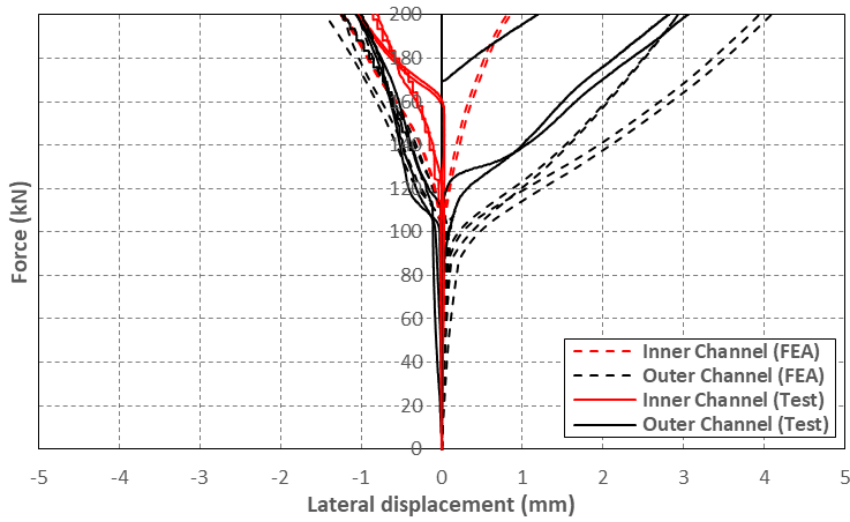


Figure L.11: Experimental and numerical axial load vs lateral displacements SC2-6a

L.2.6 SC2-6b

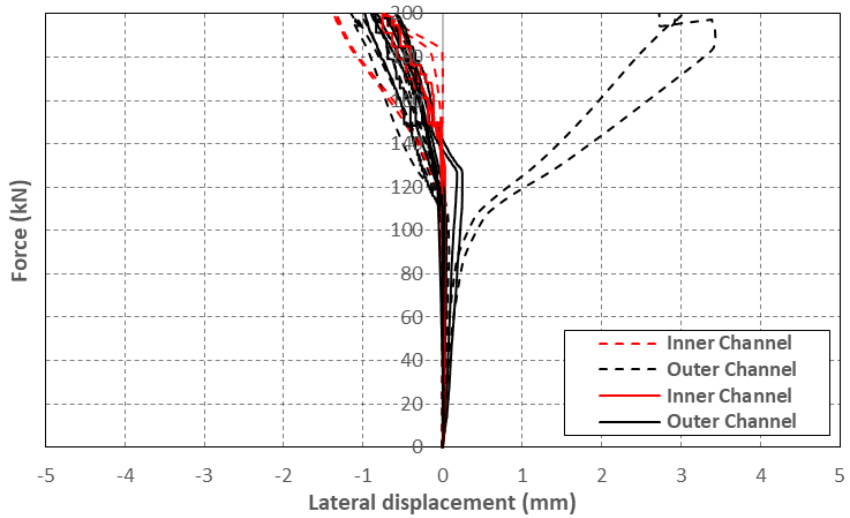


Figure L.12: Experimental and numerical axial load vs lateral displacements SC2-6b

L.3. Built-up geometry 3 (SC3)

L.3.1 SC3-2a

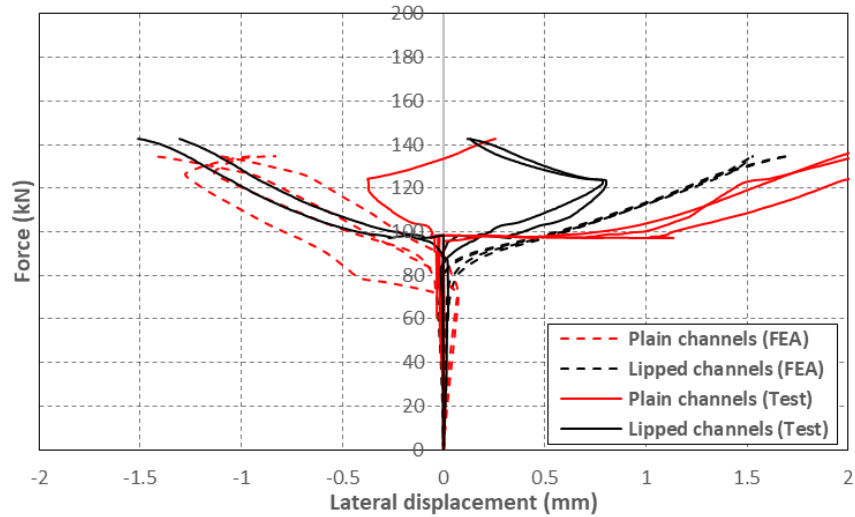


Figure L.13: Experimental and numerical axial load vs lateral displacements SC3-2a

L.3.2 SC3-2b

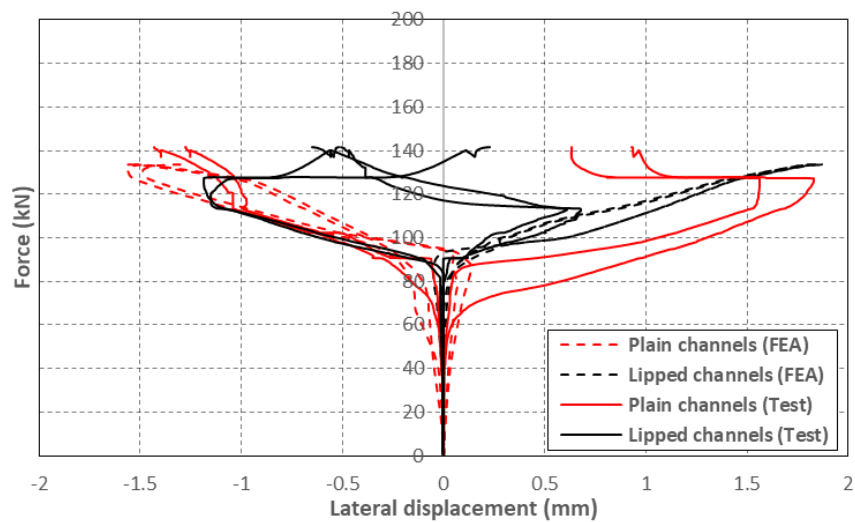


Figure L.14: Experimental and numerical axial load vs lateral displacements SC3-2b

L.3.3 SC3-5a

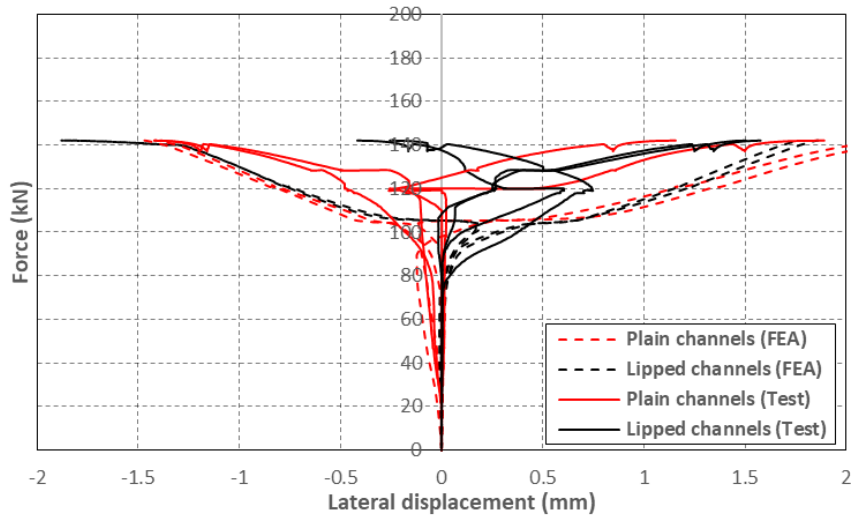


Figure L.15: Experimental and numerical axial load vs lateral displacements SC3-5a

L.3.4 SC3-5b

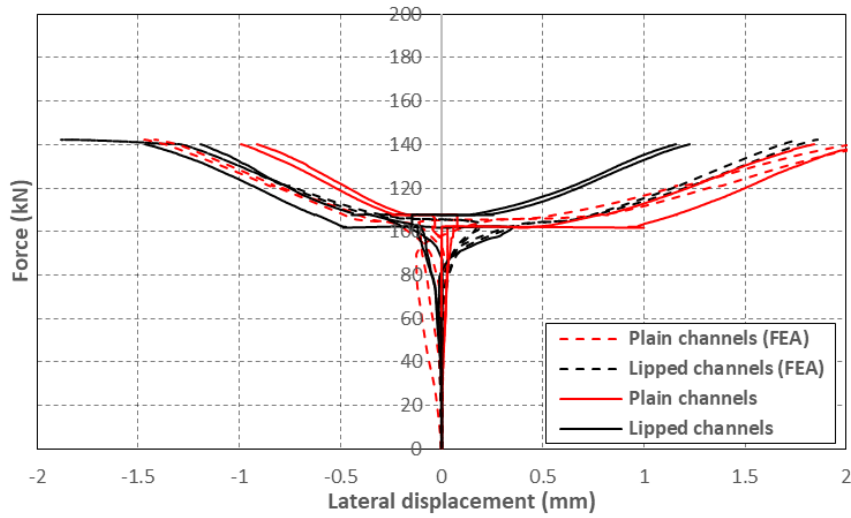


Figure L.16: Experimental and numerical axial load vs lateral displacements SC3-5b

L.4. Built-up geometry 4 (SC4)

L.4.1 SC4-2a

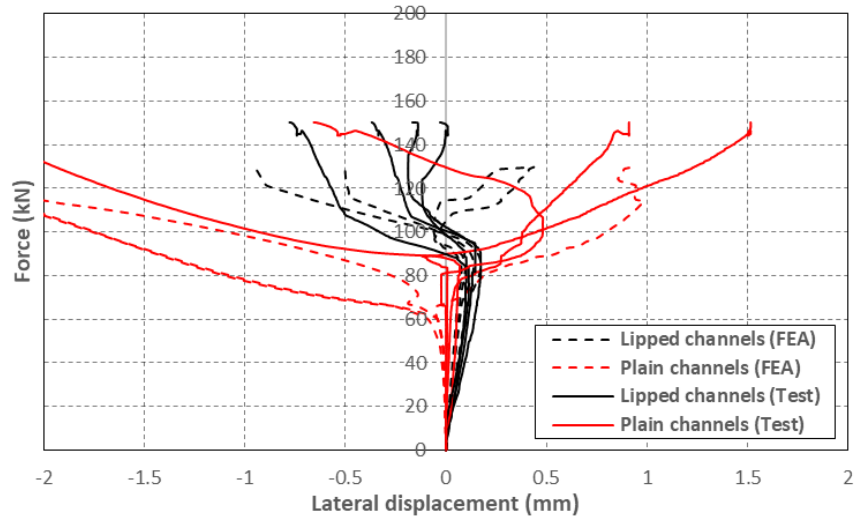


Figure L.17: Experimental and numerical axial load vs lateral displacements SC4-2a

L.4.2 SC4-2b

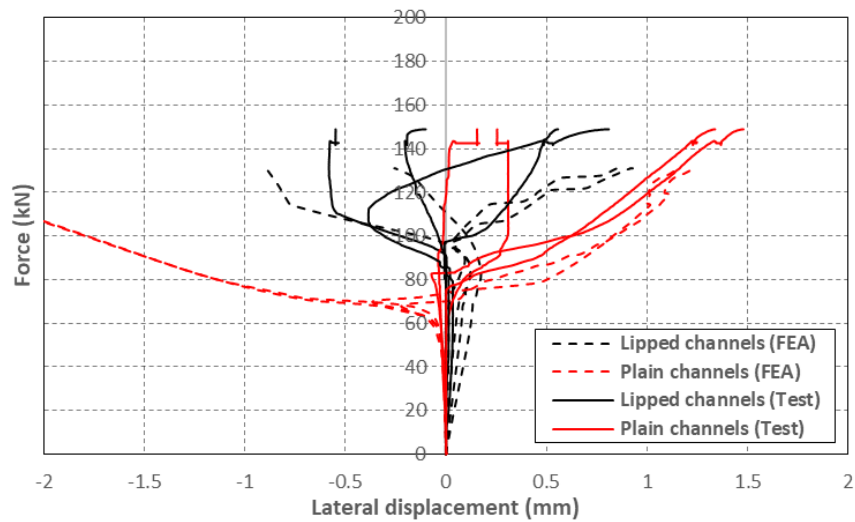


Figure L.18: Experimental and numerical axial load vs lateral displacements SC4-2b

L.4.3 SC4-5a

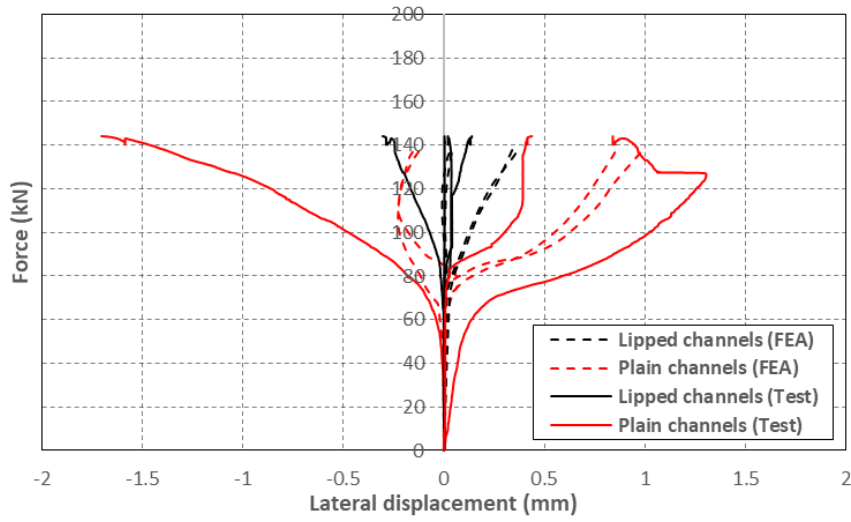


Figure L.19: Experimental and numerical axial load vs lateral displacements SC4-5a

L.4.4 SC4-5b

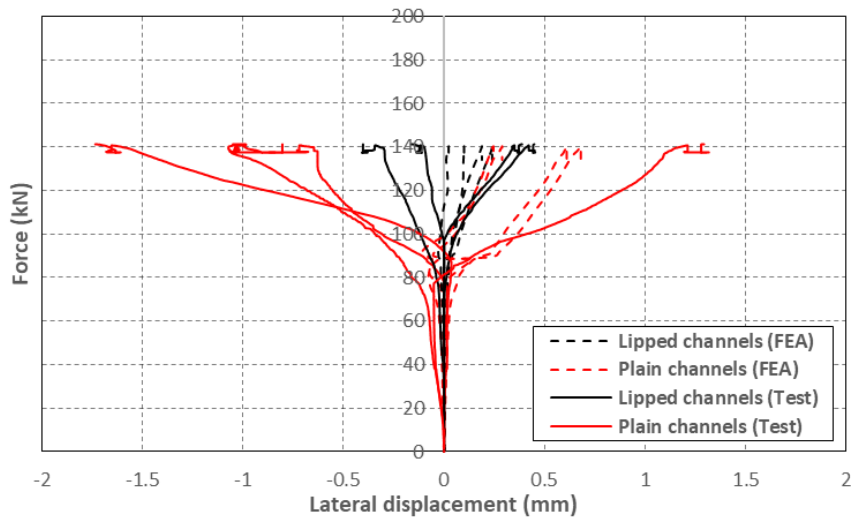


Figure L.20: Experimental and numerical axial load vs lateral displacements SC4-5b

Appendix M

Beams Comparison Experimental and Numerical Results

Appendix M contains graphs comparing the load vs. lateral deformation curves obtained from the detailed and simplified FE models of the beams with those obtained from the experiments. Further details about these comparisons are included in Sections 8.3.3 and 8.4.2 of the main text.

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M.1. Built-up geometry 1 (B1)

M.1.1 B1-0b

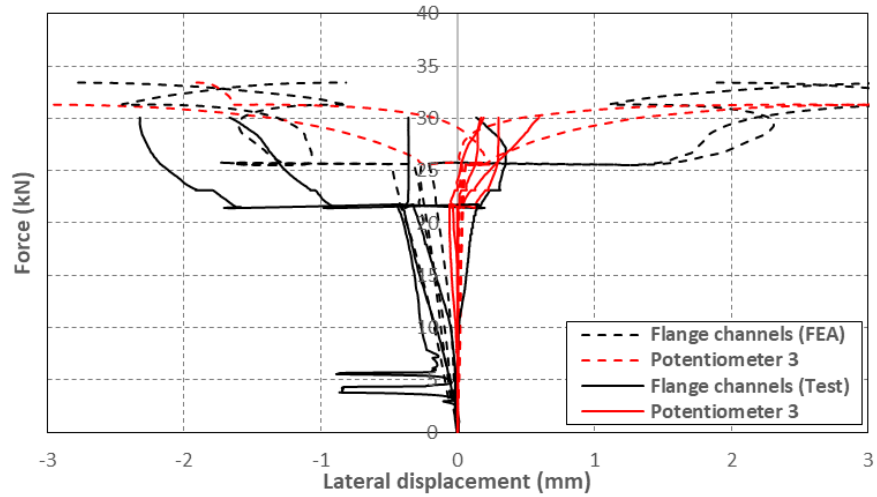


Figure M.1: Experimental and (detailed) numerical load vs lateral displacements B1-0b

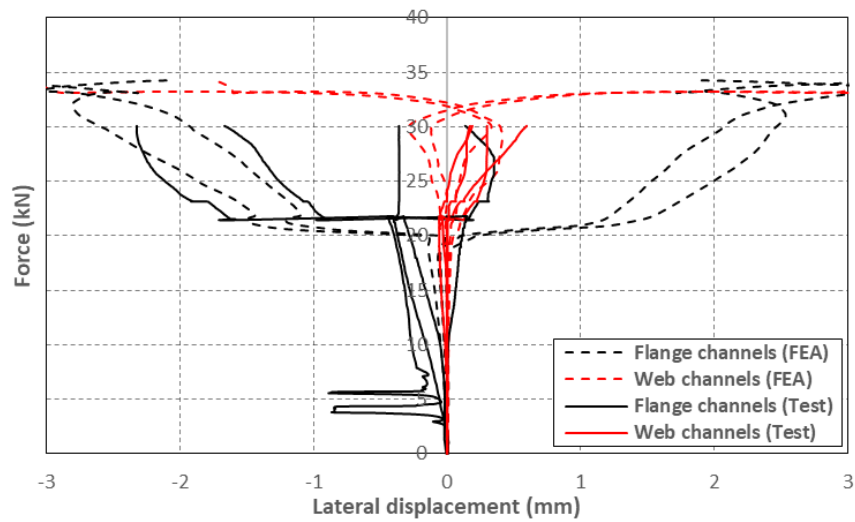


Figure M.2: Experimental and (simplified) numerical load vs lateral displacements B1-0b

M.1.2 B1-2a

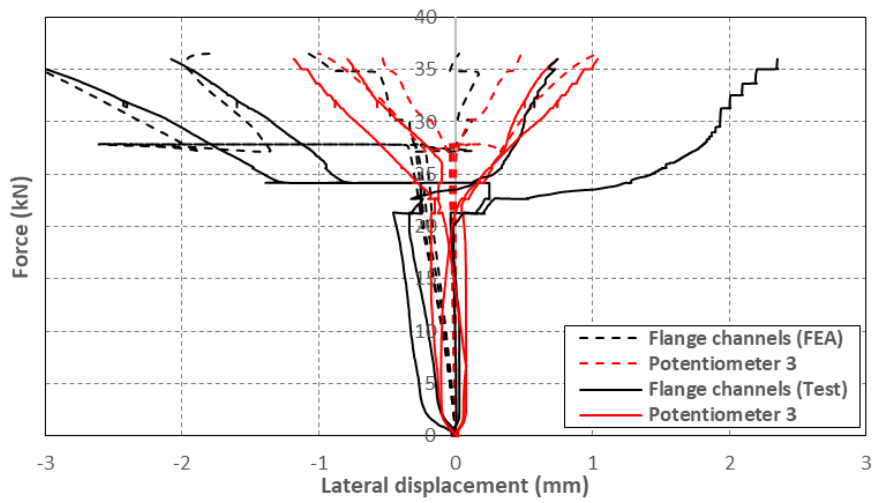


Figure M.3: Experimental and (detailed) numerical load vs lateral displacements B1-2a

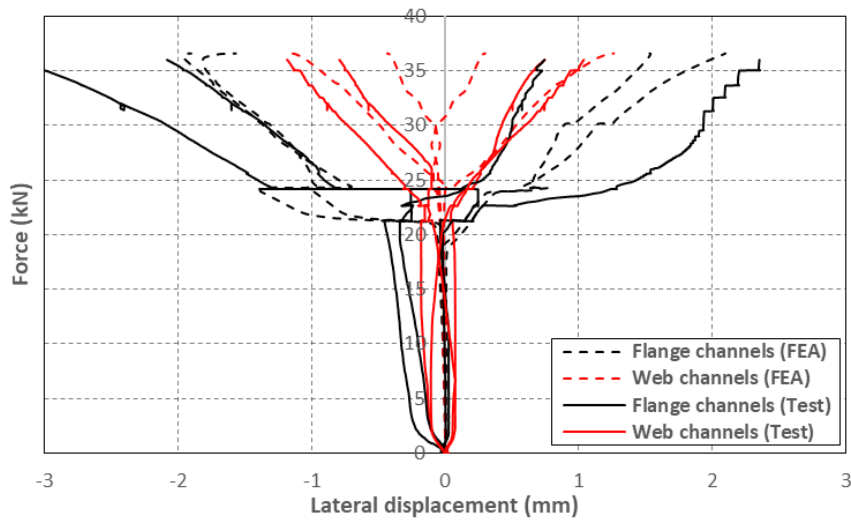


Figure M.4: Experimental and (simplified) numerical load vs lateral displacements B1-2a

M.1.3 B1-2b

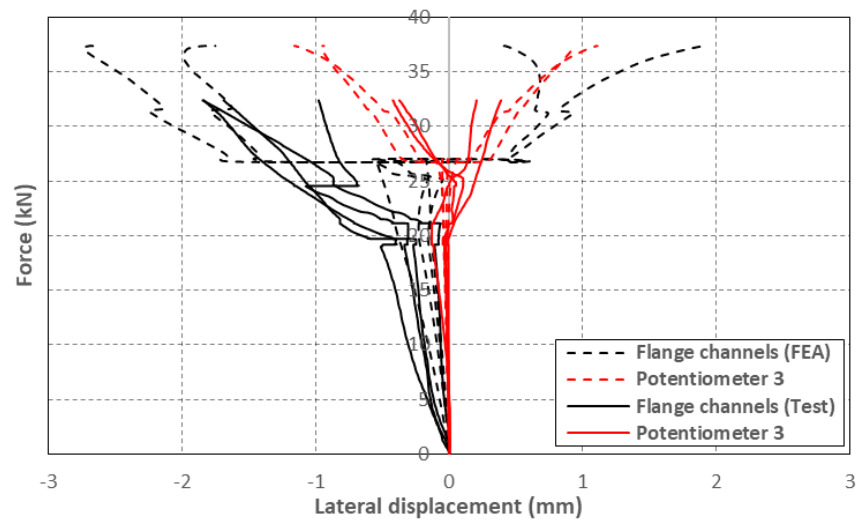


Figure M.5: Experimental and (detailed) numerical load vs lateral displacements B1-2b

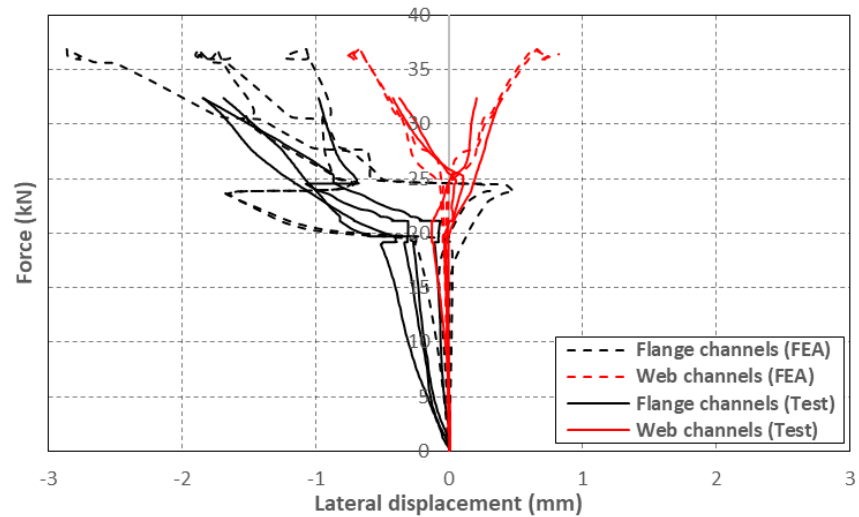


Figure M.6: Experimental and (simplified) numerical load vs lateral displacements B1-2b

M.1.4 B1-3a

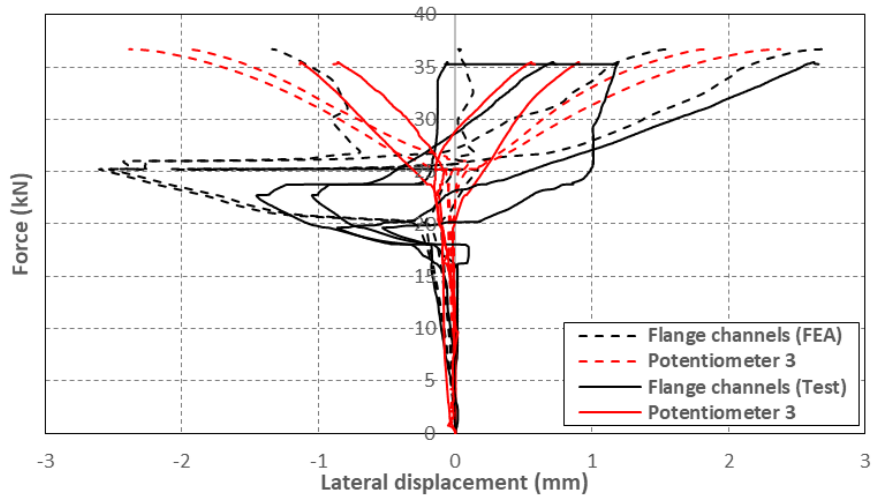


Figure M.7: Experimental and (detailed) numerical load vs lateral displacements B1-3a

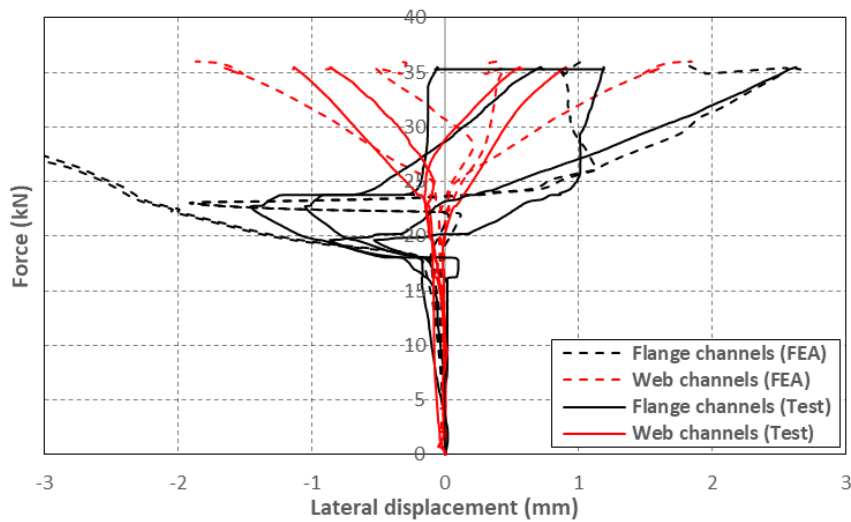


Figure M.8: Experimental and (simplified) numerical load vs lateral displacements B1-3a

M.1.5 B1-3b

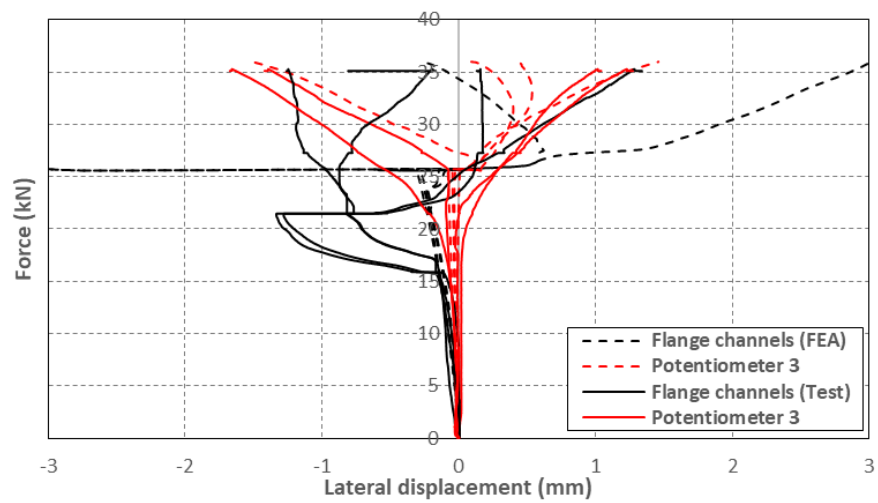


Figure M.9: Experimental and (detailed) numerical load vs lateral displacements B1-3b

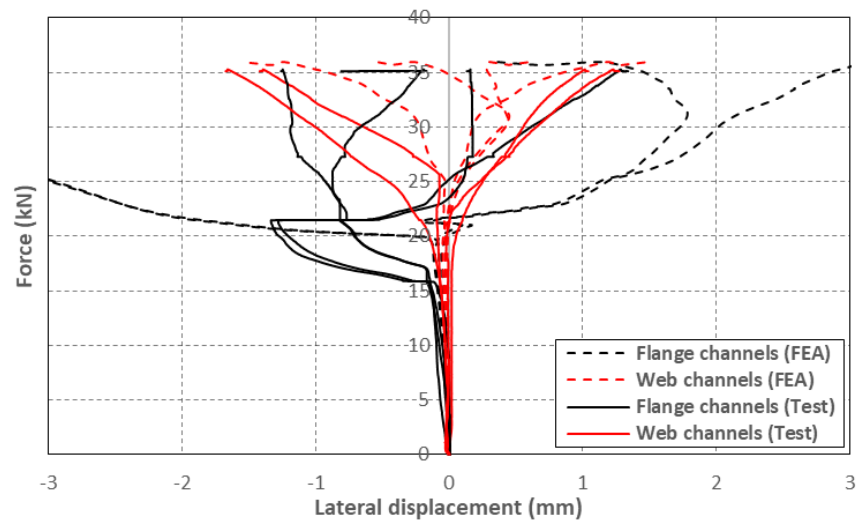


Figure M.10: Experimental and (simplified) numerical load vs lateral displacements B1-3b

M.2. Built-up geometry 2 (B2)

M.2.1 B2-0a

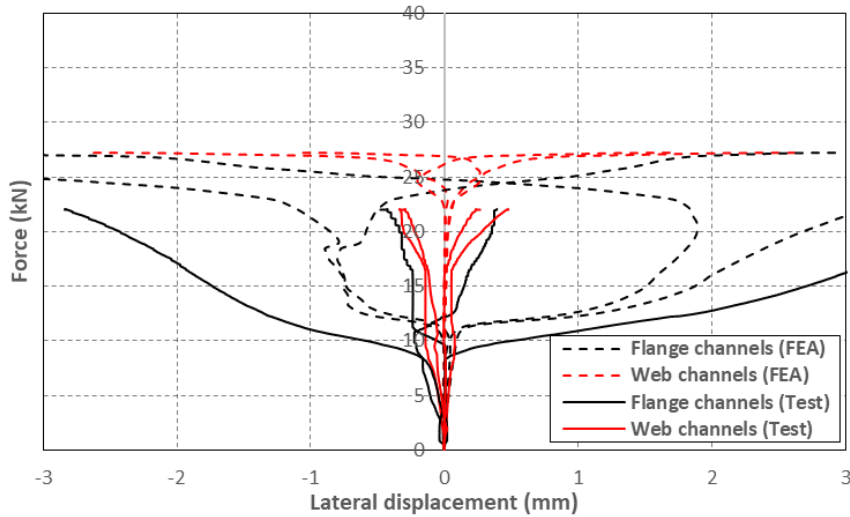


Figure M.11: Experimental and (detailed) numerical load vs lateral displacements B2-0a

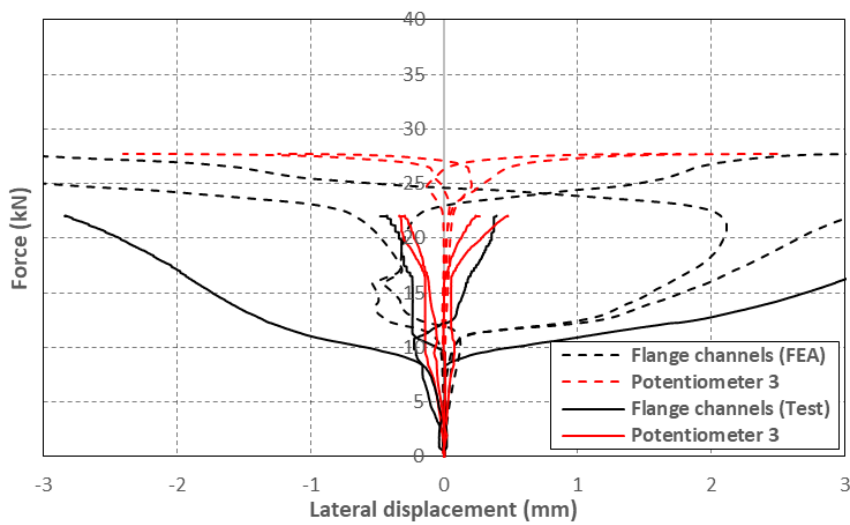


Figure M.12: Experimental and (simplified) numerical load vs lateral displacements B2-0a

M.2.2 B2-0b

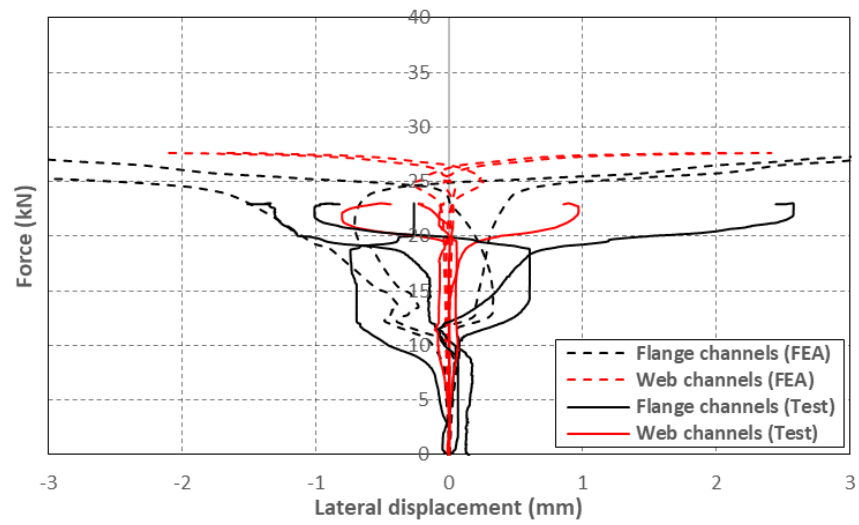


Figure M.13: Experimental and (detailed) numerical load vs lateral displacements B2-0b

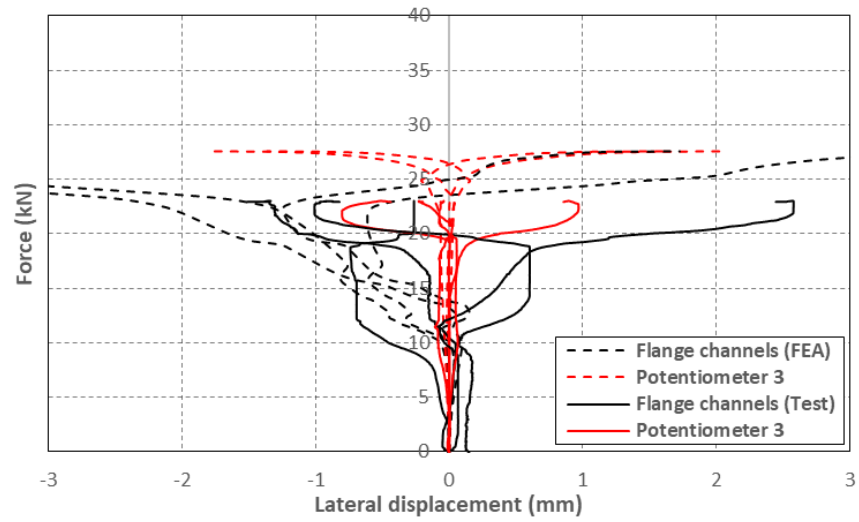


Figure M.14: Experimental and (simplified) numerical load vs lateral displacements B2-0b

M.2.3 B2-2a

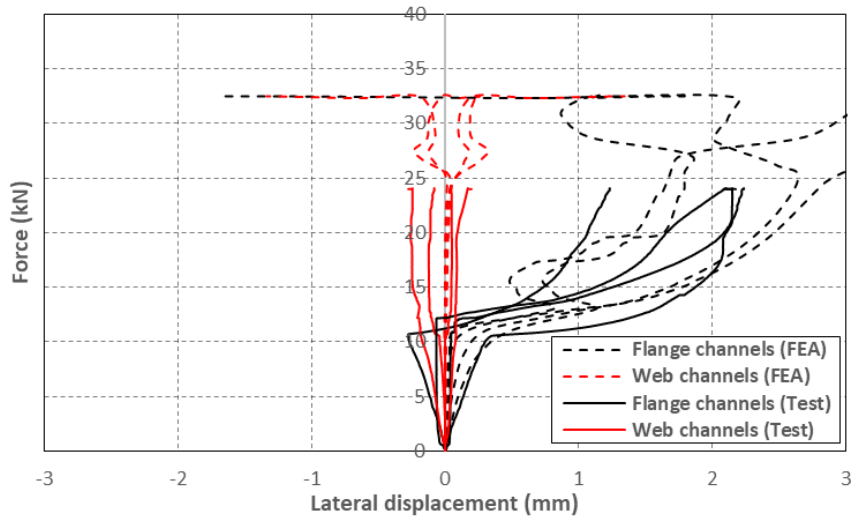


Figure M.15: Experimental and (detailed) numerical load vs lateral displacements B2-2a

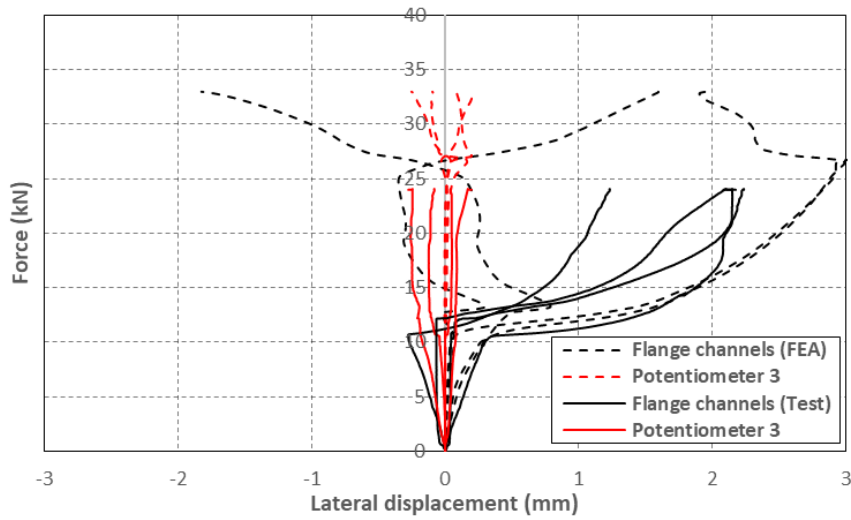


Figure M.16: Experimental and (simplified) numerical load vs lateral displacements B2-2a

M.2.4 B2-2b

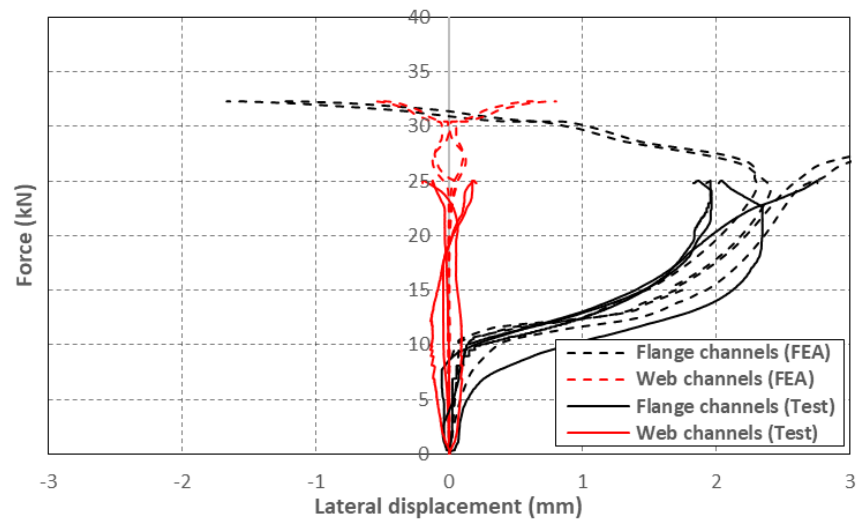


Figure M.17: Experimental and (detailed) numerical load vs lateral displacements B2-2b

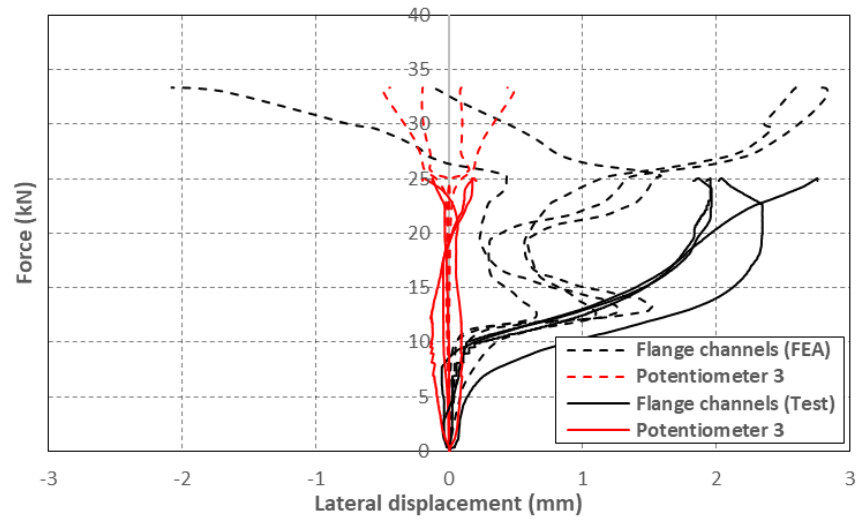


Figure M.18: Experimental and (simplified) numerical load vs lateral displacements B2-2b

M.2.5 B2-3a

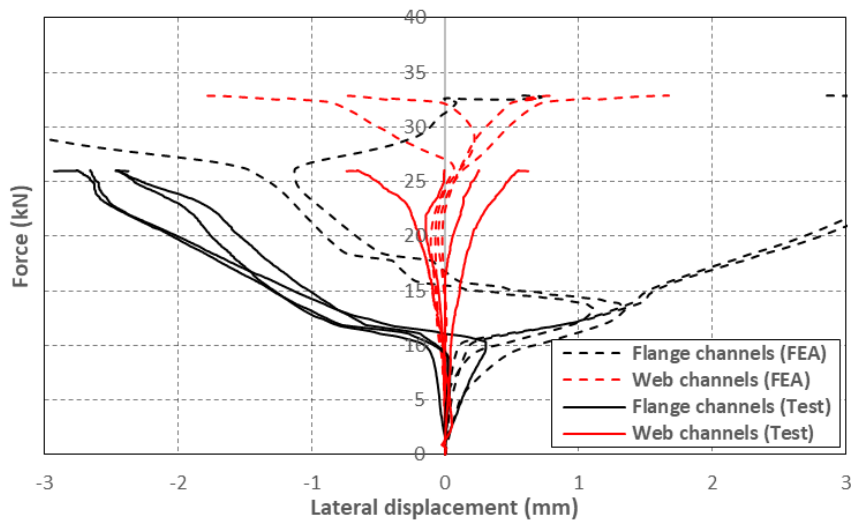


Figure M.19: Experimental and (detailed) numerical load vs lateral displacements B2-3a

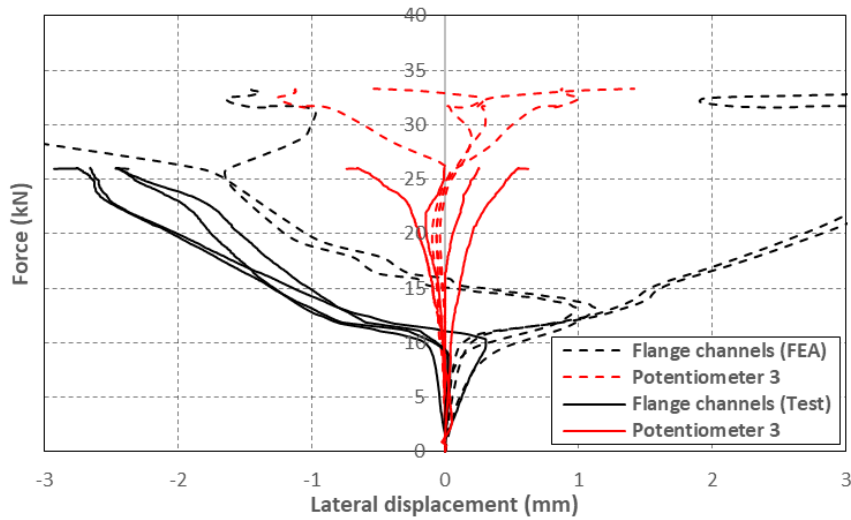


Figure M.20: Experimental and (simplified) numerical load vs lateral displacements B2-3a

M.2.6 B2-3b

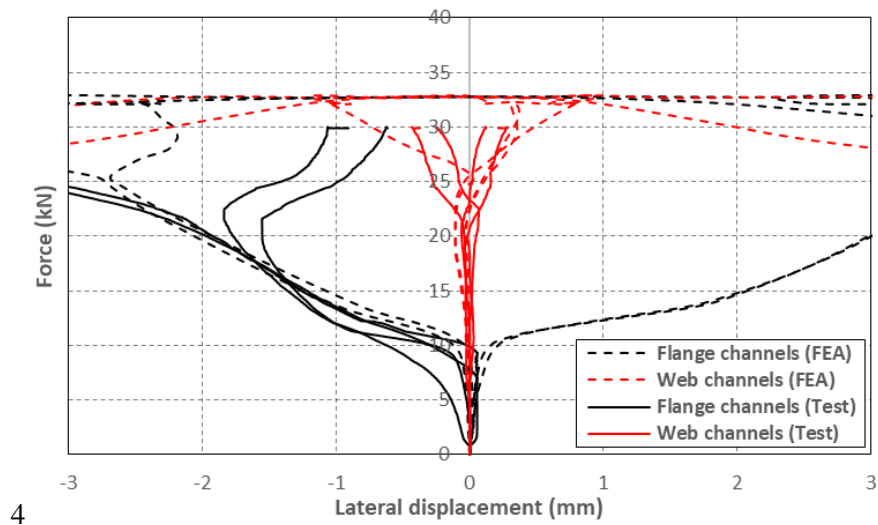
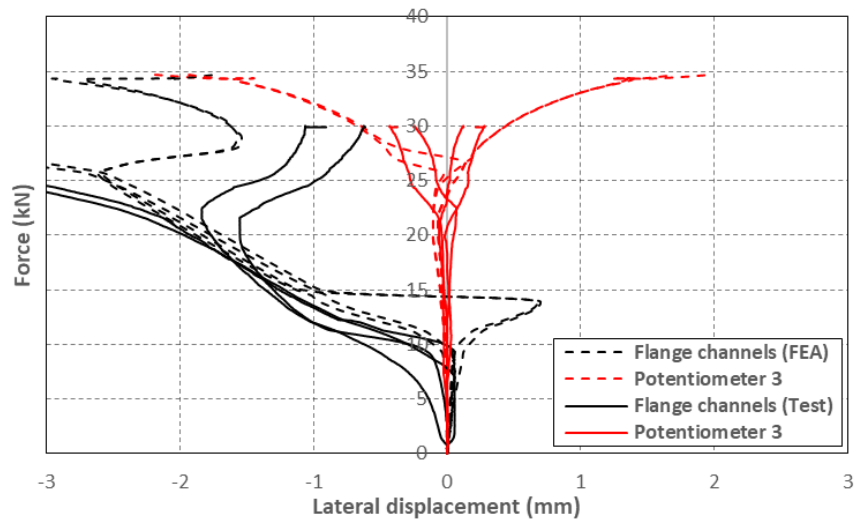
4
Figure M.21: Experimental and (detailed) numerical load vs lateral displacements B2-3b

Figure M.22: Experimental and (simplified) numerical load vs lateral displacements B2-3b

Appendix N

Long Columns Comparison Experimental and Numerical Results

Appendix N contains graphs comparing the load vs. lateral deformation curves obtained from the FE models of the long columns with those obtained from the experiments. Further details about these comparisons are included in Section 9.3.3 of the main text.

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N.1. Built-up geometry 1 (LC1)

N.1.1 LC1-2a

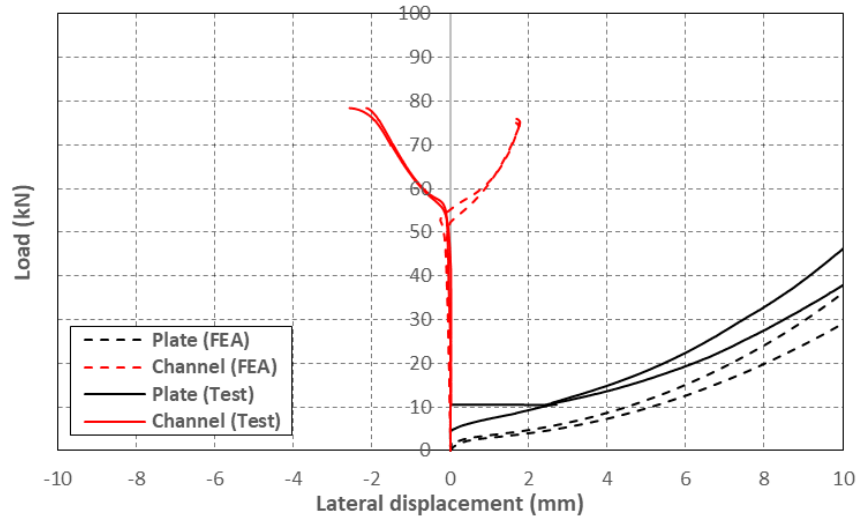


Figure N.1: Experimental and numerical axial load vs lateral displacements LC1-2a

N.1.2 LC1-2b

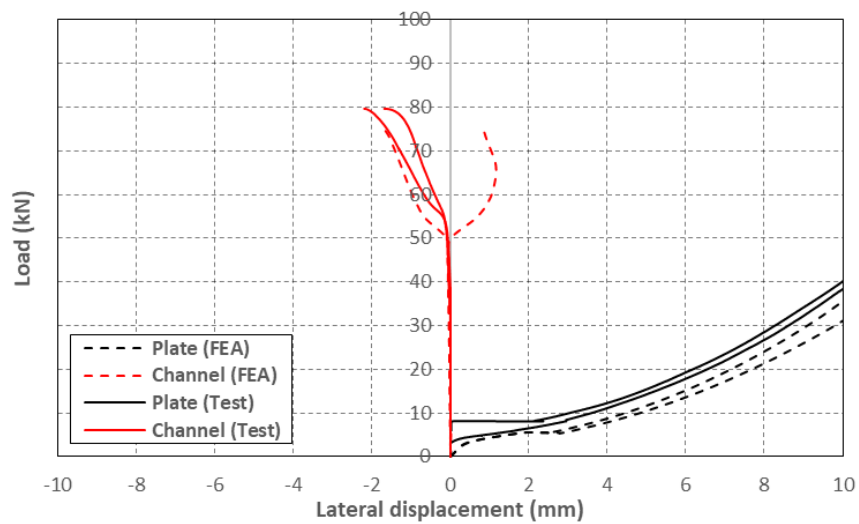


Figure N.2: Experimental and numerical axial load vs lateral displacements LC1-2b

N.1.3 LC1-3a

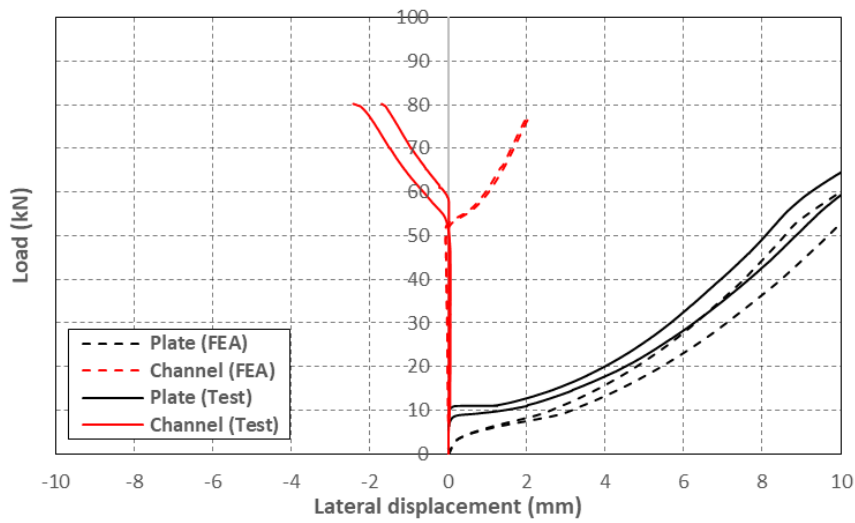


Figure N.3: Experimental and numerical axial load vs lateral displacements LC1-3a

N.1.4 LC1-3b

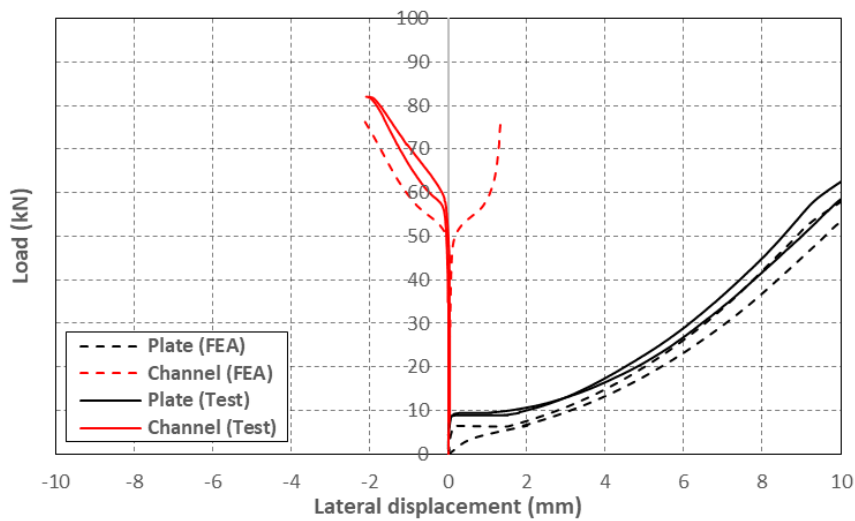
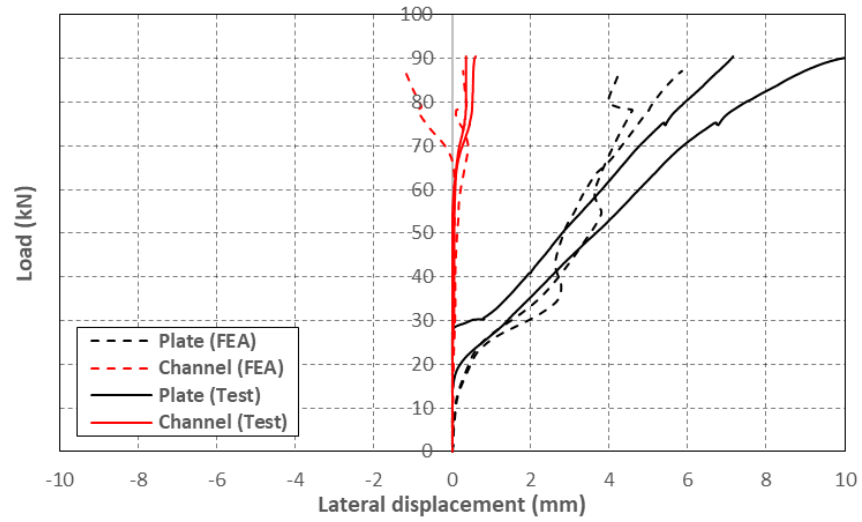
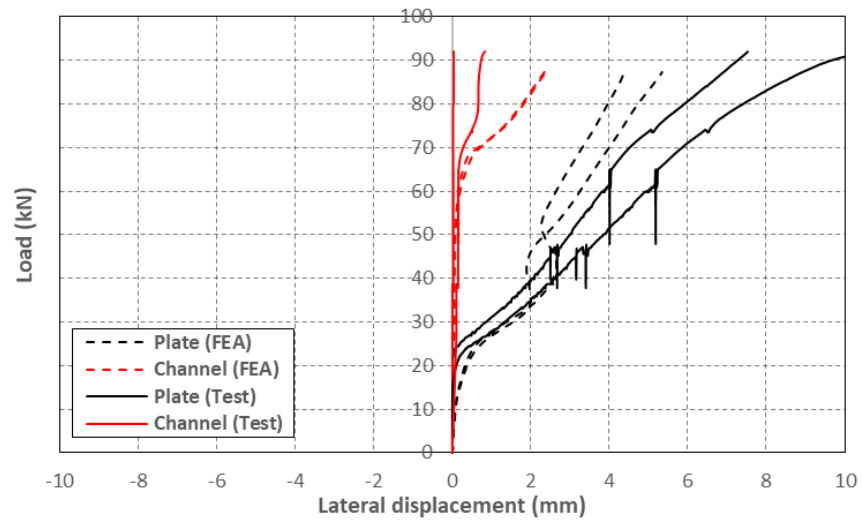


Figure N.4: Experimental and numerical axial load vs lateral displacements LC1-3b

N.1.5 LC1-8a**Figure N.5: Experimental and numerical axial load vs lateral displacements LC1-8a****N.1.6 LC1-8b****Figure N.6: Experimental and numerical axial load vs lateral displacements LC1-8b**

N.2. Built-up geometry 2 (LC2)

N.2.1 LC2-2a

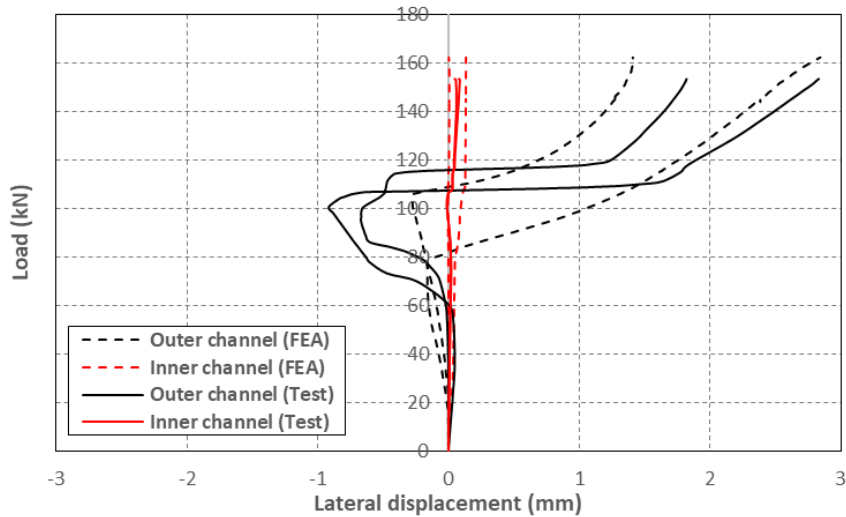


Figure N.7: Experimental and numerical axial load vs lateral displacements LC2-2a

N.2.2 LC2-2b

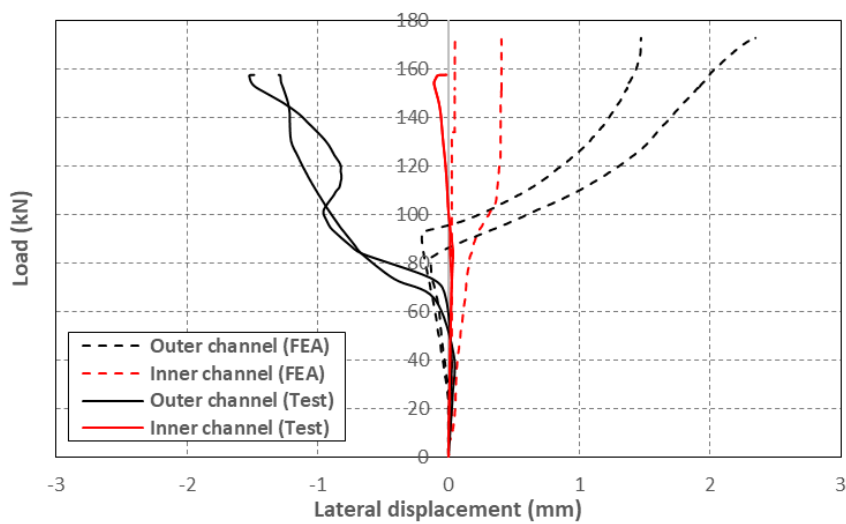


Figure N.8: Experimental and numerical axial load vs lateral displacements LC2-2b

N.2.3 LC2-6a

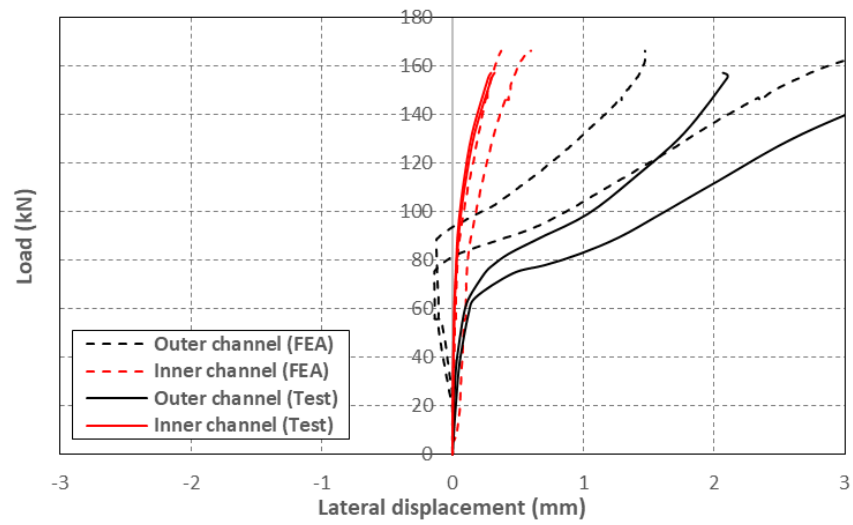


Figure N.9: Experimental and numerical axial load vs lateral displacements LC2-6a

N.2.4 LC2-6b

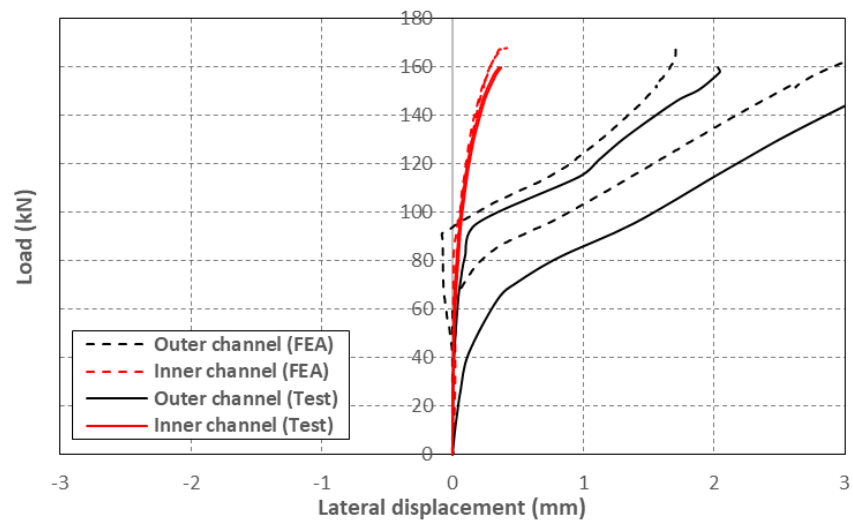


Figure N.10: Experimental and numerical axial load vs lateral displacements LC2-6b

N.2.5 LC2-4a

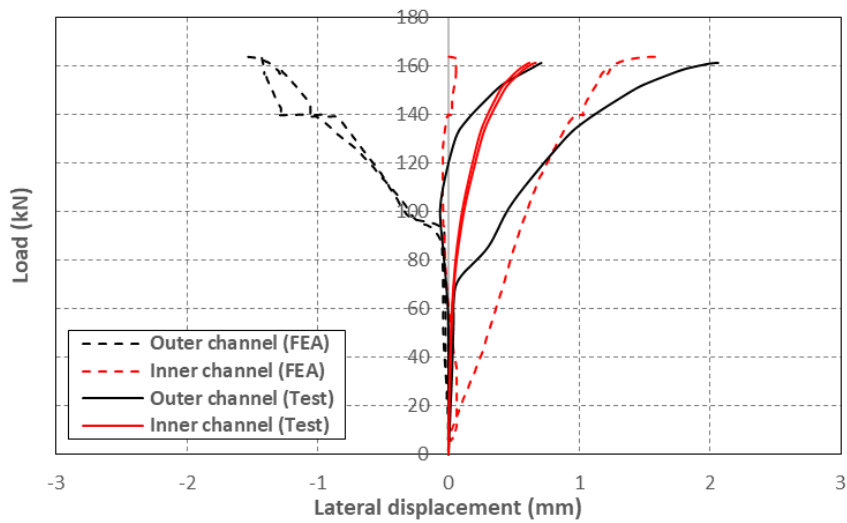


Figure N.11: Experimental and numerical axial load vs lateral displacements LC2-4a

N.2.6 LC2-4b

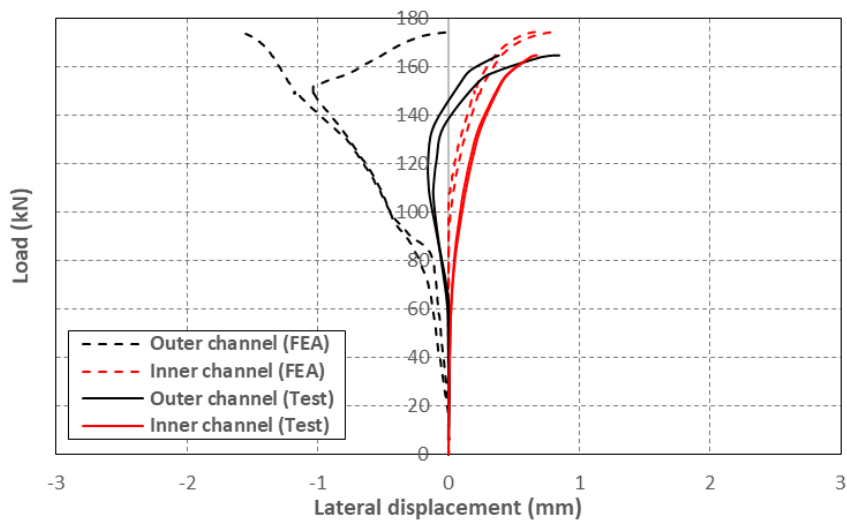


Figure N.12: Experimental and numerical axial load vs lateral displacements LC2-4b

N.3. Built-up geometry 3 (LC3)

N.3.1 LC3-2a

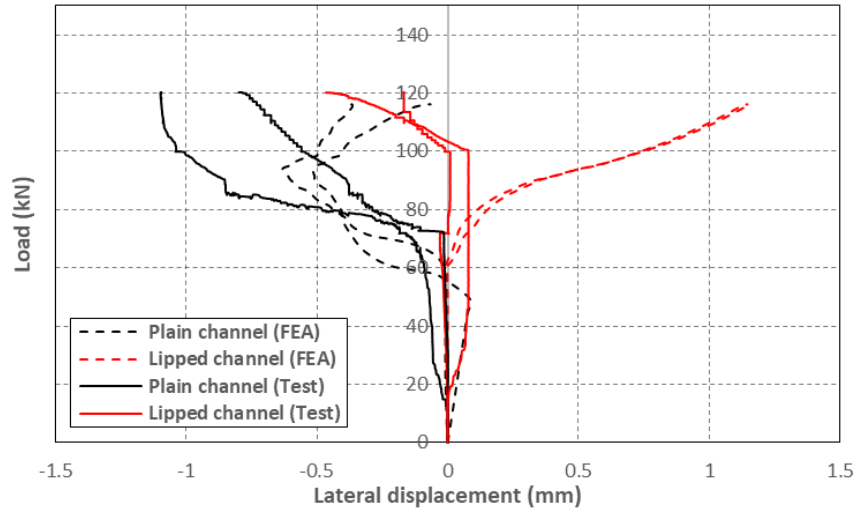


Figure N.13: Experimental and numerical axial load vs lateral displacements LC3-2a

N.3.2 LC3-2b

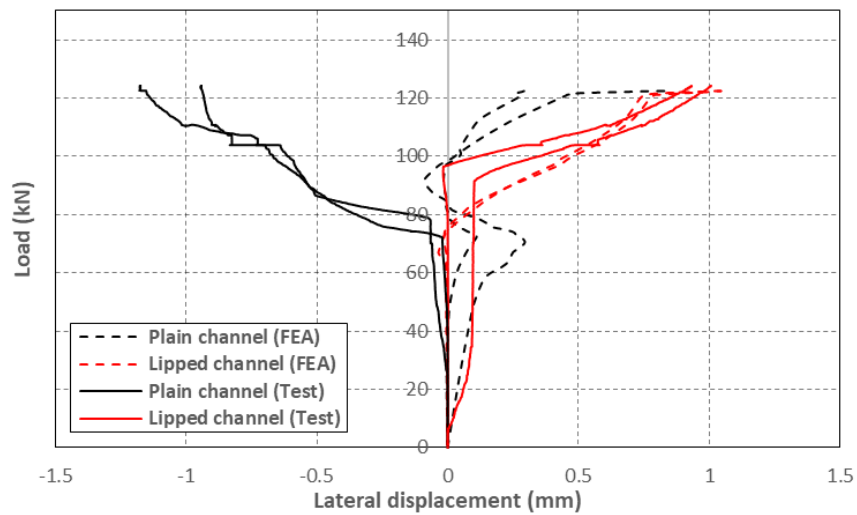


Figure N.14: Experimental and numerical axial load vs lateral displacements LC3-2b

N.3.3 LC3-3a

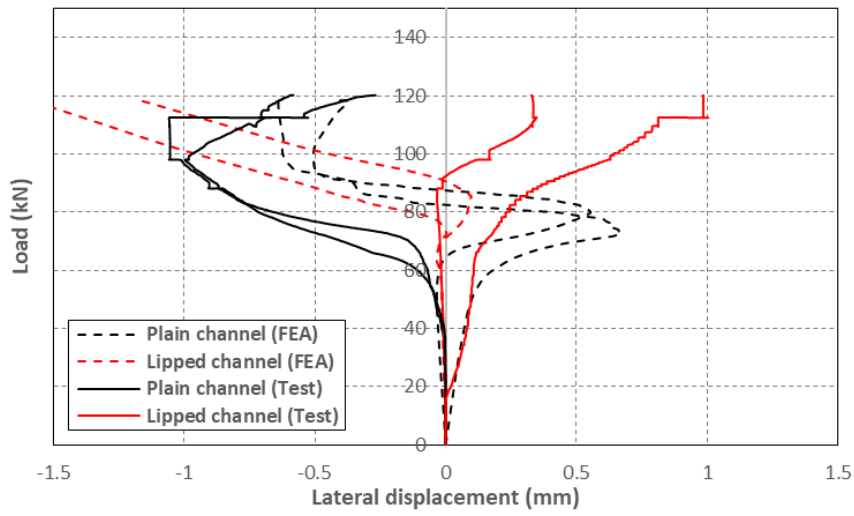


Figure N.15: Experimental and numerical axial load vs lateral displacements LC3-3a

N.3.4 LC3-3b

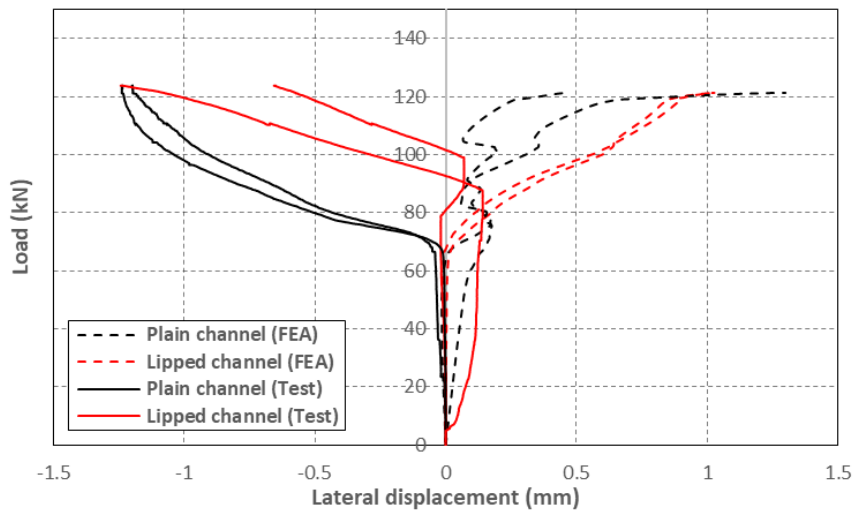


Figure N.16: Experimental and numerical axial load vs lateral displacements LC3-3b

N.3.5 LC3-8a

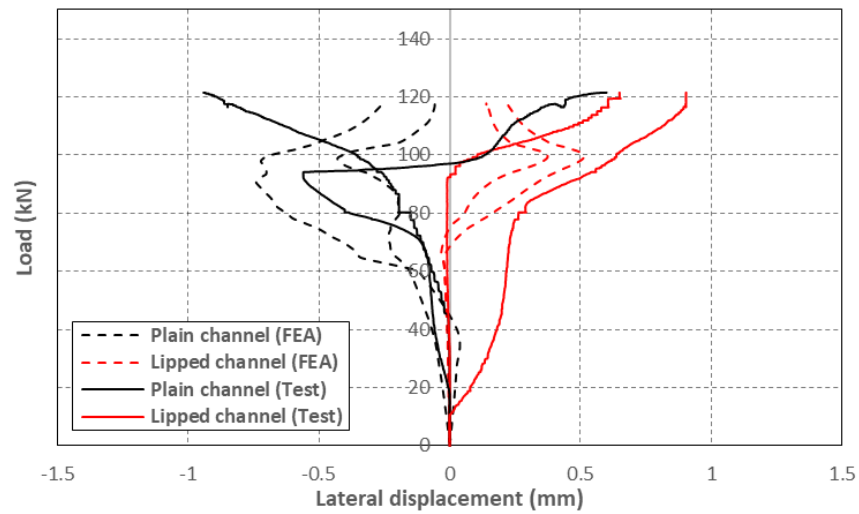


Figure N.17: Experimental and numerical axial load vs lateral displacements LC3-8a

N.3.6 LC3-8b

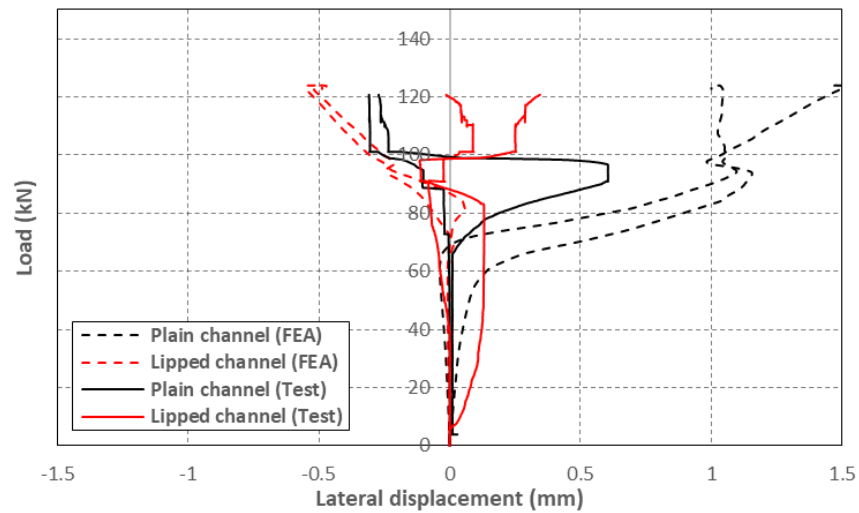


Figure N.18: Experimental and numerical axial load vs lateral displacements LC3-8b

N.4. Built-up geometry 4 (LC4)

N.4.1 LC4-2a

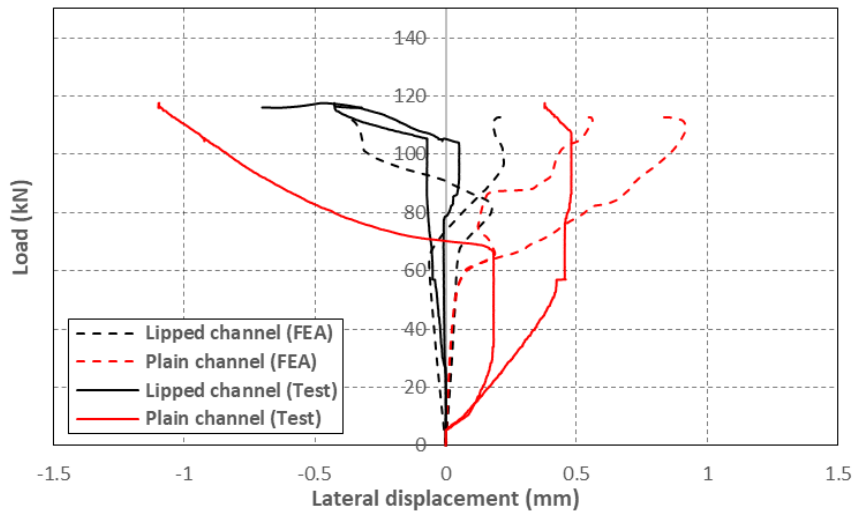


Figure N.19: Experimental and numerical axial load vs lateral displacements LC4-2a

N.4.2 LC4-2b

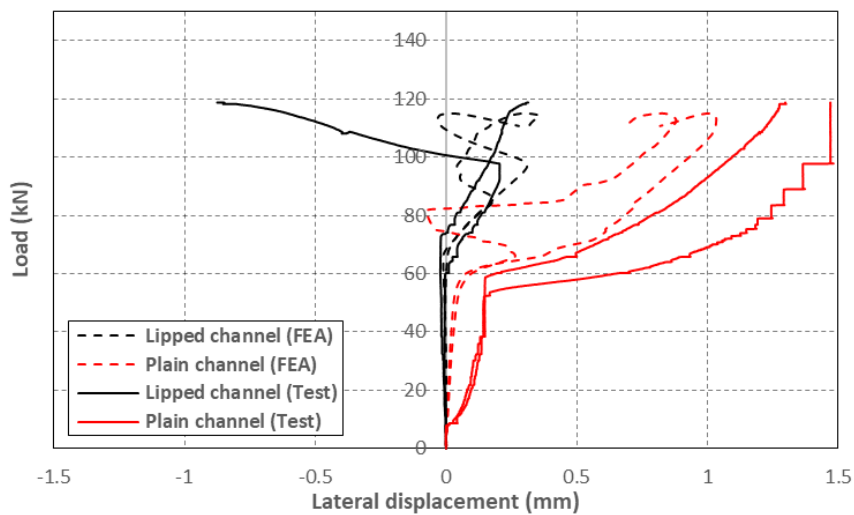


Figure N.20: Experimental and numerical axial load vs lateral displacements LC4-2b

N.4.3 LC4-3a

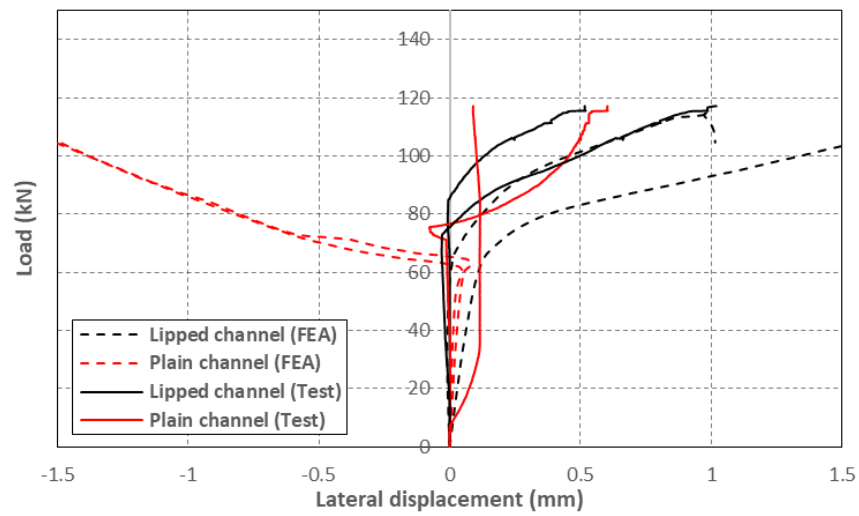


Figure N.21: Experimental and numerical axial load vs lateral displacements LC4-3a

N.4.4 LC4-3b

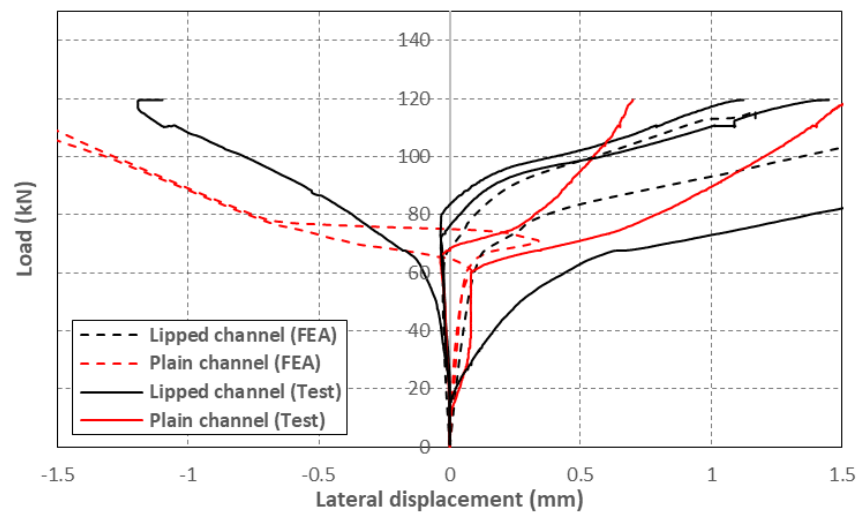


Figure N.22: Experimental and numerical axial load vs lateral displacements LC4-3b

N.4.5 LC4-8a

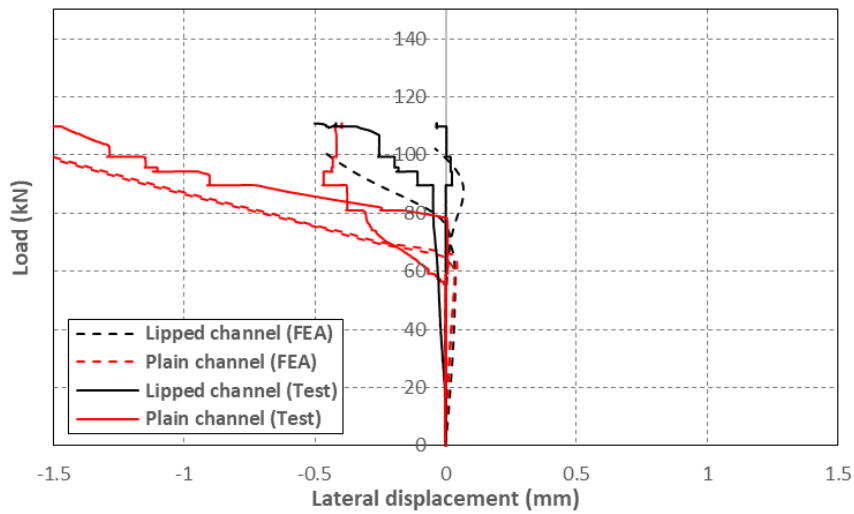


Figure N.23: Experimental and numerical axial load vs lateral displacements LC4-8a

N.4.6 LC4-8b

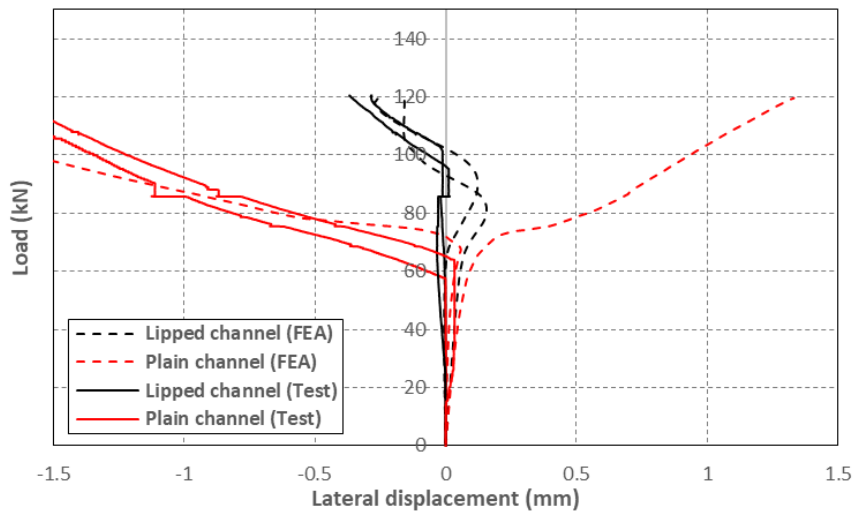


Figure N.24: Experimental and numerical axial load vs lateral displacements LC4-8b