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TEST REPORT

Ceram Reference:	131169 (QT-26353/3/JB)/Ref.7/Supp.1
Project Title:	Testing of Ron Sammons Ltd Wall Starter
Client:	C4CI 2 Long Barn Tufton Warren Whitchurch Hampshire RG28 7RH
For the Attention of:	Luke Whale
Author(s):	Miss Joanne Booth
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Work Location:	Ceram UK

This report supersedes the report issued 20 August 2013.

Miss Lisa Cobden
Consultancy Team
Reviewer

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1 INTRODUCTION

Ron Sammons Ltd trading as Teco Building Products Ltd manufacture a wall starter system that is designed for tying new masonry walls to existing masonry walls. The wall starter is a two component system which employs starter channels and separate ties with de-bonding sleeves which are positioned within the channel at specified centres to coincide with new masonry construction.

In the absence of any British or European standards, performance testing of the wall starter system was carried out to a standard BBA specification.

The ties within the channels were subjected to horizontal shear forces representing wind suction and pressure and differential displacement representing movement between new and existing masonry.

2 SAMPLE RECEIVED

The wall starter system supplied is a two-part system consisting of a 1.2m long channel with separate slot-in wall ties. The channel is fixed to existing brickwork with 50mm long x 5.5mm diameter coach bolts and plastic rawl plugs with a nominal maximum nominal hole diameter of 8mm. Average dimensions or the channel and ties are given in Table 1. Details of the channel are shown in Figure 1.

3 TEST PROGRAMME

Three walls in the form of 'H' sections were constructed using semi-dried pressed 'Fletton' bricks as the cross walls and AAC (Autoclaved Aerated Concrete) blocks as the head walls. These were tested in shear with and without an applied vertical displacement of the cross wall with respect to the head wall.

4 METHOD OF CONSTRUCTION

Head walls 2½ blocks long by 6 high were constructed from AAC blocks and designation (iii) mortar, 1:1:6 cement: lime: sand by volume. The head walls were allowed to cure for a minimum of 2 days to allow sufficient strength for the wall starter system to be bolted into place. Five holes were drilled down the centreline of the head walls and directly into the head wall blocks using a 8mm drill bit at approximately 300mm centres for the top four fixings and 150mm spacing for the bottom fixing. The fixing positions are shown in Figure 3. A Fischer SX8 plastic plug was fitted into each of the drilled holes and the channels were screwed into place using the screw fixings as supplied by the client and described in 2.0 above.

The cross walls were constructed from Fletton bricks and designation (iii) mortar and were built off a steel beam faced with polythene, allowing easy removal of the beam when the wall was cured. The compressive strength of the mortar used is given in Table 2.

Five wall ties were built into each cross wall to head interface at 225mm centres giving a total of 10 wall ties for each 'H' wall.

The format of the 'H' wall including the wall tie positions is shown in Figure 3.

The properties of the masonry units used are given in Table 3.

At the time of construction of the head walls and cross walls, mortar cubes were taken. These were cured under water and tested for compressive strength to coincide when each 'H' wall was tested.

5 METHOD OF TEST

5.1 Loading Arrangement

The horizontal loading system applied loads representing shear forces due to wind suction and pressure, and consisted of two hydraulic jacks with 900mm x 100mm spreader plates attached fixed at 1/3 point. A load cell was used to measure the applied horizontal force. For simulation of vertical movement a load call was positioned between a loading jack and a steel beam used for the load reaction. A spreader beam spanning the length of the crosswall was used to give a uniform vertical load. A general view of the loading arrangement is shown in Plate 1.

5.2 Instrumentation

Linear displacement transducers were fixed at three positions down each side of the cross wall approximately 50mm from the head wall intersection. Any horizontal movement of the head walls was also monitored using a transducer at the top of each head wall. Two transducers were placed under the cross walls to measure the applied vertical movement of the cross wall. The transducer positions are shown in Figure 2.

The horizontal load was measured using a load cell that was connected via a common manifold from the horizontal jacks into a load cage. The vertical load was measured using a load cell placed between the loading jack and the upper steel beam. All outputs were recorded onto a datalogger. All equipment is calibrated and traceable to national standards.

5.3 Test procedure

For all three walls a horizontal shear load of 3.0kN equivalent to the design load, was applied to the face of the cross wall in one increment and released in one increment. Deflection readings were taken at the maximum load and immediately on recovery.

The shear load was then reapplied to the wall in five equal increments and released in five equal increments. This was then repeated. Deflection readings were taken at each increment and decrement and on recovery.

A vertical load was then applied to the cross wall so as to produce a 5mm vertical movement of the cross wall in relation to the head wall. The load required to produce the deflection was recorded.

Maintaining the 5mm displacement the vertical load was released and the shear load was reapplied in the same way as above.

A vertical load was then applied to the cross wall so as to achieve a maximum displacement of 10mm. The load was recorded.

Maintaining the 10mm displacement but with the vertical load released, the shear load was applied to the wall in the equal increments up to the design load and then loaded to failure.

6 RESULTS

A summary of the failure loads of 'H' walls 1-3 is given in Table 4 along with the maximum load required to achieve the 5mm and 10mm vertical displacement.

The loads and horizontal deflections measured at all positions on 'H' walls 1 to 3 is given in Appendix A in Tables A1 – A3 respectively.

Graphs of load against deflection for H-walls 1-3 are given in Charts 1-3 respectively.

Note that the loads quoted are per starter strip.

7 DISCUSSION

All walls failed due to either channel or tie deformation indicating that the performance of the wall starter system is dependent on the stainless steel material used in its manufacture and not on the performance of either the fixings or masonry units.

8 SUMMARY

To summarise, the Wall Starter System achieved a mean ultimate shear load of 5.1kN per 1.2m channel length when tested with an applied vertical deflection of up to 10mm when mechanically fixed into an AAC block substrate and built into Fletton masonry brickwork.

Table 1
Average Dimensions of the Wall Starter System

Component Type	Length (mm)	Width (mm)	Thickness of Metal (mm)
Wall Tie	95	36	0.6
Channel	1200	41	0.55

- Length of component between slot and fixing end
- Overall length of component

Table 2
Compressive Strength of Mortar

Mortar Designation	Compressive strength(N/mm^2)
(iii), 1:1:6 cement lime sand by volume	4.1

Table 3
Properties of Masonry Units to BS3921

Masonry Unit Type	Mean water Absorption (%)	Mean Compressive Strength (N/mm2)	Density (kg/m3)
Fletton Brick	18.2	30.6	-
Autoclaved Aerated Concrete Block	-	4.1	880

Table 4
Summary of Failure Loads of all 'H' Walls Tested incorporating
Ron Sammons Ltd Wall Starter System.

'H' Wall Number	Load to Cause 5mm Vertical Displacement (kN)	Load to cause 10mm Vertical Displacement (kN)	Shear Load at Failure (kN)	Mode of Failure
1	9.80	9.80	4.8	Flexural failure of fletton cross wall with deformation of tie at channel connection
2	10.10	9.90	5.5	Distortion of channel between fixings
3	9.50	9.40	5.0	Failure of tie at the Channel Connection
Mean	**9.8**	**9.7**	**5.1**	-

Plate 1
Flexural Failure of Wall One

Plate 2
Deformation of Channel –Wall 2

Plate 3
Deformation of Tie to Channel Connection – Wall 3

APPENDIX A - Load Deflection Data
Load Deflection Data for Wall One
(Note: Shear load is represented as Load per starter strip)

Application	Shear Load (kN)	Tr.1 (mm)	Tr.2 (mm)	Tr.3 (mm)	Tr.4 (mm)	Tr.5 (mm)	Tr.6 (mm)	Tr.7 (mm)	Tr.8 (mm)
Apply Design Load and Release	0.18	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.63	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00
	1.23	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	1.94	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
	2.44	0.03	0.05	0.00	0.00	0.00	0.00	0.00	0.00
	3.08	0.08	0.10	0.01	0.02	0.00	0.00	0.00	0.00
	1.71	0.09	0.10	0.02	0.03	0.00	0.00	0.00	0.00
	1.36	0.09	0.10	0.02	0.03	0.00	0.00	0.00	0.00
	0.63	0.06	0.09	0.02	0.02	0.00	0.00	0.00	0.00
	0.17	0.01	0.03	0.00	0.01	0.00	0.00	0.00	0.00
	0.62	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
	1.27	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
	1.86	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00
	2.54	0.06	0.08	0.00	0.01	0.00	0.00	0.00	0.00
	3.11	0.11	0.11	0.02	0.03	0.00	0.00	0.00	0.00
	2.53	0.12	0.11	0.02	0.04	0.00	0.00	0.00	0.00
	1.75	0.12	0.11	0.02	0.03	0.00	0.00	0.00	0.00
	0.95	0.11	0.11	0.02	0.04	0.00	0.00	0.00	0.00
	0.58	0.09	0.10	0.03	0.03	0.00	0.00	0.00	0.00
	0.19	0.04	0.05	0.01	0.01	0.00	0.00	0.00	0.00
Apply 5mm Vertical Deflection									
Apply Design Load And Release	0.01	0.02	0.32	0.16	0.39	0.11	0.32	5.06	5.40
	0.63	0.05	0.32	0.17	0.42	0.11	0.32	5.09	5.40
	1.26	0.08	0.32	0.17	0.42	0.11	0.32	5.09	5.40
	1.87	0.26	0.19	0.10	0.37	0.11	0.32	5.09	5.40
	2.45	0.55	0.13	0.05	0.21	0.11	0.32	5.09	5.39
	3.06	1.12	0.69	0.38	0.09	0.11	0.32	5.09	5.42
	2.06	1.12	0.69	0.38	0.10	0.11	0.32	5.09	5.43
	1.72	1.12	0.69	0.38	0.09	0.11	0.32	5.09	5.42
	1.16	1.08	0.68	0.35	0.08	0.11	0.32	5.09	5.42
	0.72	0.96	0.58	0.32	0.03	0.11	0.32	5.09	5.42
	0.19	0.77	0.39	0.20	0.05	0.11	0.32	5.09	5.42
	0.67	0.77	0.39	0.20	0.05	0.11	0.32	5.09	5.43
	1.25	0.78	0.39	0.20	0.05	0.11	0.32	5.09	5.43
	1.96	0.89	0.48	0.26	0.02	0.11	0.33	5.09	5.42
	2.44	1.00	0.58	0.32	0.03	0.11	0.32	5.09	5.43
	2.97	1.16	0.74	0.41	0.12	0.11	0.32	5.09	5.43
	2.47	1.17	0.73	0.40	0.12	0.11	0.32	5.09	5.43
	1.83	1.17	0.74	0.40	0.13	0.11	0.32	5.09	5.43
	1.13	1.11	0.72	0.37	0.11	0.11	0.32	5.09	5.43
	0.60	0.98	0.59	0.32	0.04	0.11	0.32	5.09	5.44
	0.01	0.82	0.42	0.23	0.02	0.11	0.32	5.09	5.43
Apply 10mm Vertical Deflection									
Load to	0.01	0.34	0.14	0.32	0.60	0.48	0.68	9.75	10.42

Failure	0.59	0.34	0.14	0.34	0.62	0.47	0.69	9.74	10.41
	1.22	0.35	0.14	0.34	0.62	0.48	0.69	9.74	10.42
	1.87	0.53	0.00	0.27	0.57	0.48	0.69	9.74	10.41
	2.56	0.83	0.30	0.10	0.38	0.48	0.69	9.74	10.41
	3.03	1.11	0.60	0.05	0.21	0.48	0.69	9.74	10.42
	3.08	1.17	0.67	0.10	0.18	0.48	0.69	9.74	10.41
	3.43	1.46	0.95	0.29	0.01	0.47	0.69	9.74	10.41
	3.68	1.62	1.11	0.39	0.09	0.46	0.69	9.74	10.41
	3.98	2.10	1.50	0.81	0.42	0.37	0.66	9.73	10.41
	4.24	2.37	2.61	2.84	2.34	0.22	0.67	9.87	10.57

Load Deflection Data for Wall Two
(Note: Shear load is represented as Load per starter strip

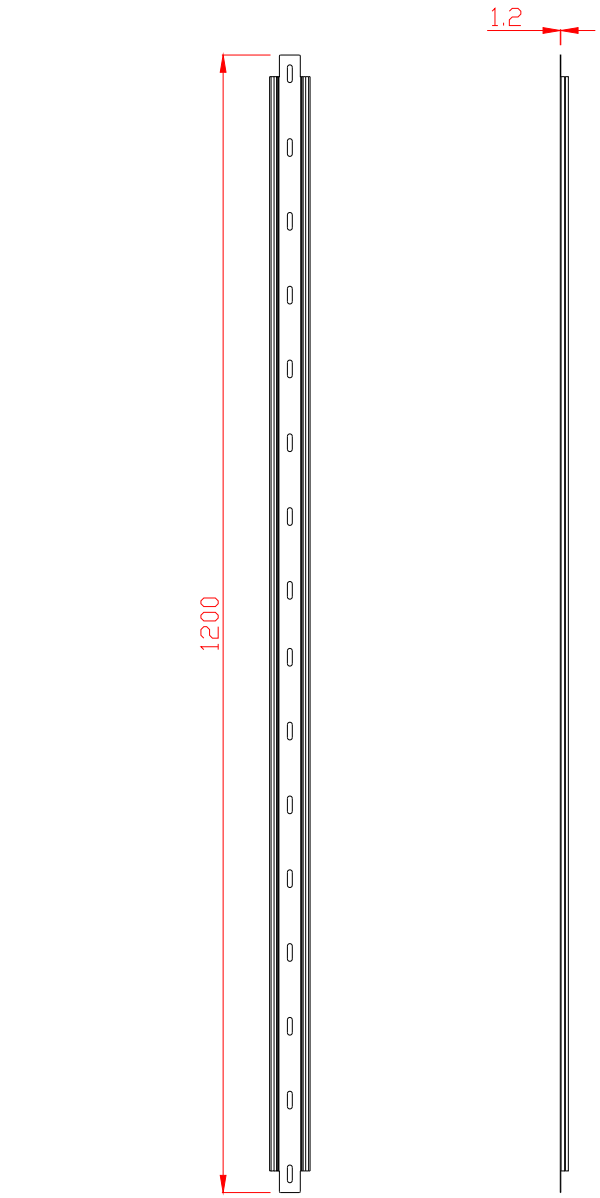
Application	Shear Load (kN)	Tr.1 (mm)	Tr.2 (mm)	Tr.3 (mm)	Tr.4 (mm)	Tr.5 (mm)	Tr.6 (mm)	Tr.7 (mm)	Tr.8 (mm)
Apply Design Load And Release	0.05	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	0.60	0.02	0.00	0.01	0.01	0.00	0.01	0.00	0.00
	1.32	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.01
	1.86	0.04	0.08	0.02	0.01	0.00	0.01	0.00	0.01
	2.50	0.15	0.19	0.06	0.06	0.01	0.00	0.00	0.00
	3.01	0.27	0.31	0.15	0.13	0.04	0.02	0.00	0.01
	1.98	0.27	0.31	0.15	0.13	0.03	0.02	0.00	0.01
	1.71	0.27	0.31	0.15	0.13	0.03	0.02	0.00	0.01
	1.19	0.27	0.29	0.14	0.12	0.03	0.02	0.00	0.00
	0.61	0.19	0.21	0.10	0.08	0.02	0.02	0.00	0.01
	0.10	0.00	0.02	0.01	0.01	0.00	0.00	0.00	0.01
	0.74	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.10
	1.24	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.01
	1.86	0.08	0.11	0.03	0.02	0.00	0.00	0.00	0.01
	2.42	0.16	0.19	0.07	0.06	0.01	0.00	0.00	0.01
	3.00	0.29	0.34	0.16	0.14	0.04	0.03	0.00	0.01
	2.46	0.29	0.34	0.16	0.14	0.04	0.03	0.00	0.01
	1.86	0.28	0.34	0.16	0.14	0.04	0.02	0.00	0.01
	1.23	0.27	0.33	0.16	0.14	0.04	0.02	0.00	0.01
	0.59	0.20	0.22	0.11	0.08	0.02	0.02	0.00	0.01
Apply 5mm Vertical Deflection									
Apply Design Load and Release									
	0.14	0.27	0.33	0.38	0.20	0.14	0.29	4.84	5.51
	0.65	0.28	0.34	0.37	0.21	0.14	0.30	4.82	5.50
	1.20	0.21	0.29	0.37	0.20	0.15	0.30	4.81	5.48
	1.81	0.15	0.10	0.19	0.01	0.14	0.30	4.79	5.46
	2.41	0.78	0.65	0.14	0.29	0.14	0.30	4.79	5.43
	3.04	1.40	1.39	0.69	0.87	0.12	0.29	4.75	5.38
	2.51	1.40	1.39	0.72	0.89	0.12	0.29	4.76	5.38
	1.25	1.29	1.22	0.65	0.79	0.12	0.30	4.78	5.38
	0.66	1.15	1.07	0.52	0.65	0.14	0.30	4.78	5.38
	0.09	0.86	0.78	0.28	0.44	0.15	0.31	4.78	5.38
	0.63	0.86	0.78	0.28	0.44	0.15	0.32	4.78	5.38
	1.23	0.89	0.78	0.29	0.45	0.16	0.32	4.78	5.39
	1.84	1.04	0.94	0.43	0.57	0.17	0.32	4.78	5.39
	2.41	1.20	1.15	0.58	0.74	0.16	0.31	4.78	5.39
	3.03	1.44	1.45	0.88	1.08	0.14	0.30	4.78	5.39
	2.36	1.44	1.45	0.89	1.09	0.14	0.30	4.78	5.39
	1.78	1.43	1.42	0.87	1.06	0.13	0.30	4.79	5.39
	1.28	1.37	1.32	0.81	0.98	0.14	0.30	4.79	5.39
	0.54	1.19	1.14	0.65	0.80	0.15	0.31	4.79	5.40
	0.09	0.92	0.87	0.40	0.56	0.16	0.31	4.79	5.40
Apply 10mm Vertical Deflection									
Load to	0.04	0.05	0.05	0.47	0.06	0.35	0.69	9.80	10.85

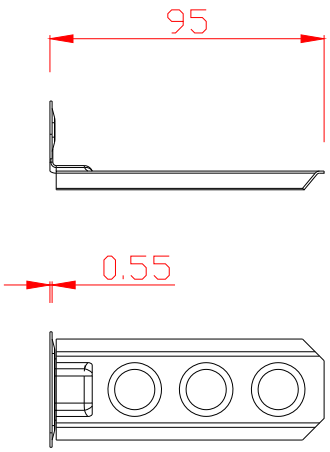
Failure	0.68	0.06	0.05	0.47	0.06	0.35	0.70	9.79	10.85
	1.21	0.16	0.00	0.41	0.01	0.35	0.70	9.77	10.84
	1.83	0.41	0.26	0.16	0.20	0.35	0.70	9.76	10.83
	2.45	0.88	0.77	0.26	0.65	0.35	0.70	9.75	10.82
	2.96	1.27	1.24	0.73	1.14	0.33	0.70	9.75	10.81
	3.52	2.13	2.13	1.53	1.97	0.27	0.61	9.71	10.75
	4.01	3.17	3.05	2.71	3.09	0.21	0.56	9.70	10.77
	4.52	4.50	4.24	4.18	4.39	0.09	0.56	9.78	10.90
	5.06	6.18	5.77	6.05	6.08	0.06	0.44	9.97	11.21
	5.35	7.62	6.90	7.62	7.31	0.28	0.35	10.13	11.54

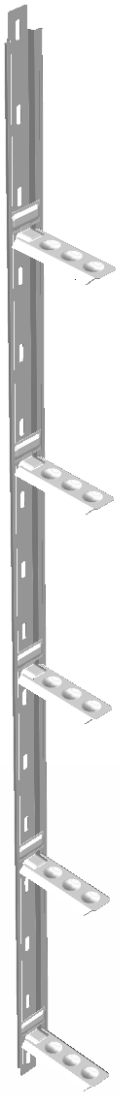
Load Deflection Data for Wall Three
(Note: Shear load is represented as Load per starter strip

Application	Shear Load (kN)	Tr.1 (mm)	Tr.2 (mm)	Tr.3 (mm)	Tr.4 (mm)	Tr.5 (mm)	Tr.6 (mm)	Tr.7 (mm)	Tr.8 (mm)
Apply Design Load and Release	0.07	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	0.76	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.01
	1.22	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.01
	1.86	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
	2.39	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.01
	2.98	0.07	0.07	0.04	0.01	0.00	0.01	0.00	0.01
	2.33	0.08	0.07	0.04	0.01	0.00	0.00	0.00	0.00
	1.74	0.07	0.07	0.04	0.01	0.00	0.01	0.01	0.01
	1.20	0.07	0.07	0.04	0.01	0.00	0.00	0.00	0.01
	0.72	0.07	0.07	0.04	0.01	0.00	0.00	0.00	0.01
	0.08	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01
	0.67	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	1.24	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	1.83	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.01
	2.40	0.04	0.02	0.01	0.00	0.00	0.01	0.00	0.01
	3.02	0.08	0.08	0.04	0.01	0.00	0.01	0.00	0.01
	2.43	0.09	0.08	0.05	0.01	0.00	0.01	0.01	0.01
	1.82	0.09	0.08	0.05	0.02	0.00	0.00	0.01	0.00
	1.20	0.09	0.07	0.05	0.01	0.00	0.00	0.00	0.01
	0.66	0.08	0.08	0.04	0.01	0.00	0.01	0.00	0.01
Apply 5mm Vertical Deflection									
Apply Design Load and Release									
	0.14	0.09	0.41	0.02	0.59	0.12	0.38	4.82	5.56
	0.58	0.07	0.41	0.02	0.60	0.12	0.38	4.80	5.56
	1.17	0.02	0.39	0.01	0.59	0.11	0.40	4.74	5.56
	1.85	0.34	0.18	0.21	0.53	0.11	0.41	4.68	5.56
	2.40	1.02	0.35	0.66	0.22	0.25	0.43	4.60	5.56
	2.93	1.40	0.75	1.11	0.23	0.28	0.43	4.59	5.55
	2.43	1.40	0.75	1.11	0.24	0.27	0.43	4.59	5.55
	1.84	1.40	0.75	1.12	0.24	0.27	0.43	4.59	5.55
	1.34	1.40	0.75	1.11	0.24	0.27	0.43	4.59	5.55
	0.37	1.20	0.65	0.91	0.09	0.27	0.43	4.59	5.55
	0.09	0.89	0.42	0.68	0.05	0.25	0.43	4.59	5.55
	0.58	0.89	0.43	0.67	0.06	0.24	0.44	4.59	5.55
	1.25	0.99	0.43	0.71	0.07	0.23	0.44	4.59	5.55
	1.88	1.13	0.47	0.86	0.01	0.23	0.45	4.58	5.55
	2.45	1.28	0.64	1.02	0.12	0.24	0.44	4.58	5.55
	2.97	1.50	0.85	1.22	0.32	0.28	0.44	4.56	5.54
	2.35	1.49	0.85	1.22	0.32	0.27	0.45	4.56	5.54
	1.81	1.50	0.85	1.22	0.33	0.27	0.44	4.55	5.54
	1.13	1.49	0.85	1.19	0.32	0.28	0.45	4.56	5.54
	0.58	1.37	0.78	1.08	0.24	0.27	0.44	4.56	5.54
Apply 10mm Vertical Deflection									
Load to	0.14	0.66	0.11	0.39	0.78	0.18	0.97	9.39	10.58

Failure	0.71	0.67	0.11	0.39	0.79	0.18	0.97	9.34	10.58
	1.21	0.74	0.10	0.45	0.79	0.18	0.98	9.27	10.58
	1.87	0.99	0.06	0.70	0.66	0.18	1.02	9.20	10.58
	2.39	1.28	0.30	1.00	0.44	0.22	1.03	9.17	10.56
	2.97	1.65	0.60	1.35	0.16	0.33	1.03	9.14	10.54
	3.51	2.23	1.08	1.95	0.31	0.51	1.01	9.09	10.48
	3.93	2.73	1.60	2.76	0.97	0.69	0.99	9.09	10.45
	4.53	4.19	2.55	4.53	2.07	1.48	0.87	9.08	10.39
	5.10	5.90	3.71	7.11	3.97	1.80	1.00	9.18	10.65







DIMENSIONS NOMINAL

DWG. N°.	SCALE:	DATE:	DRAWN BY:
Figure 1	NOT TO SCALE	12/08/2013	A. BELLAMY

TITLE: Detail and dimensions for WST wall-starter

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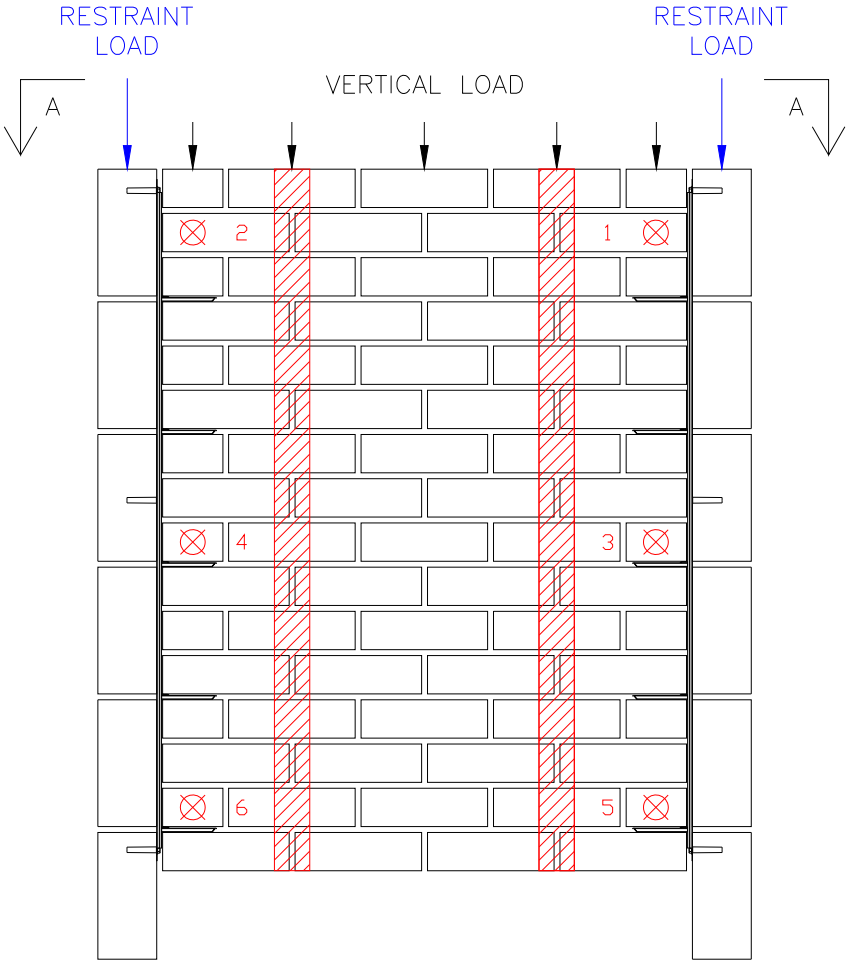

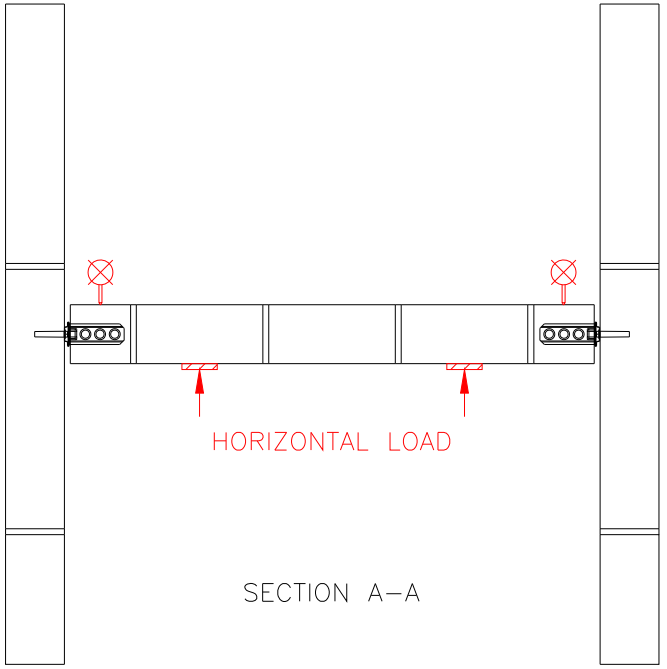

TRANSDUCERS

DWG. N°.	SCALE:	DATE:	DRAWN BY:
Figure 2	NOT TO SCALE	12/08/2013	A. BELLAMY

TITLE: Test setup for WST wall-starters

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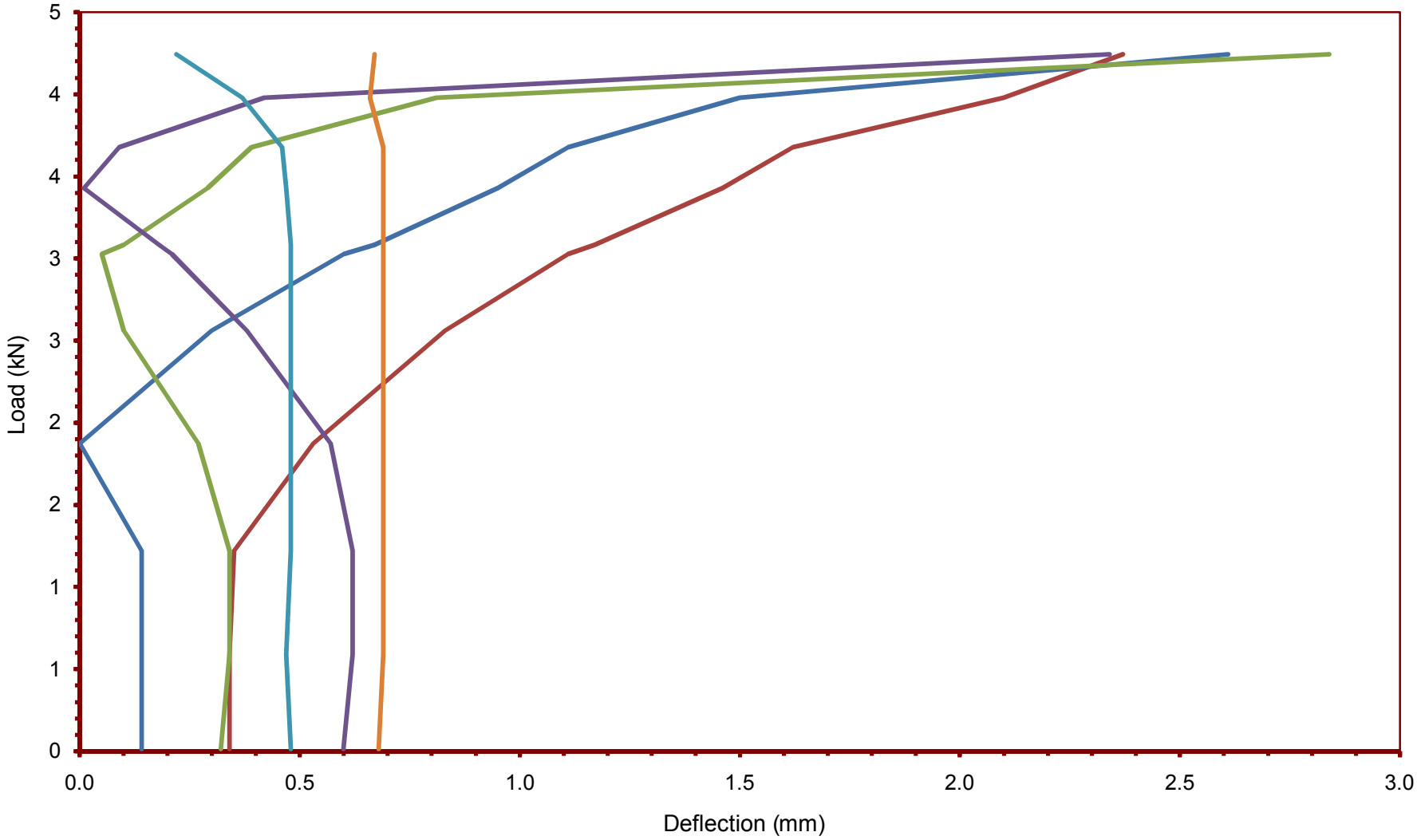
Chart 1

Load v Horizontal Deflection for Ron Sammons Wall StarterTested in Shear with 10mm applied vertical Movement

Wall One - Failure Cycle



Key — Tr.1 Tr.2 Tr.3 Tr.4 Tr.5 Tr.6

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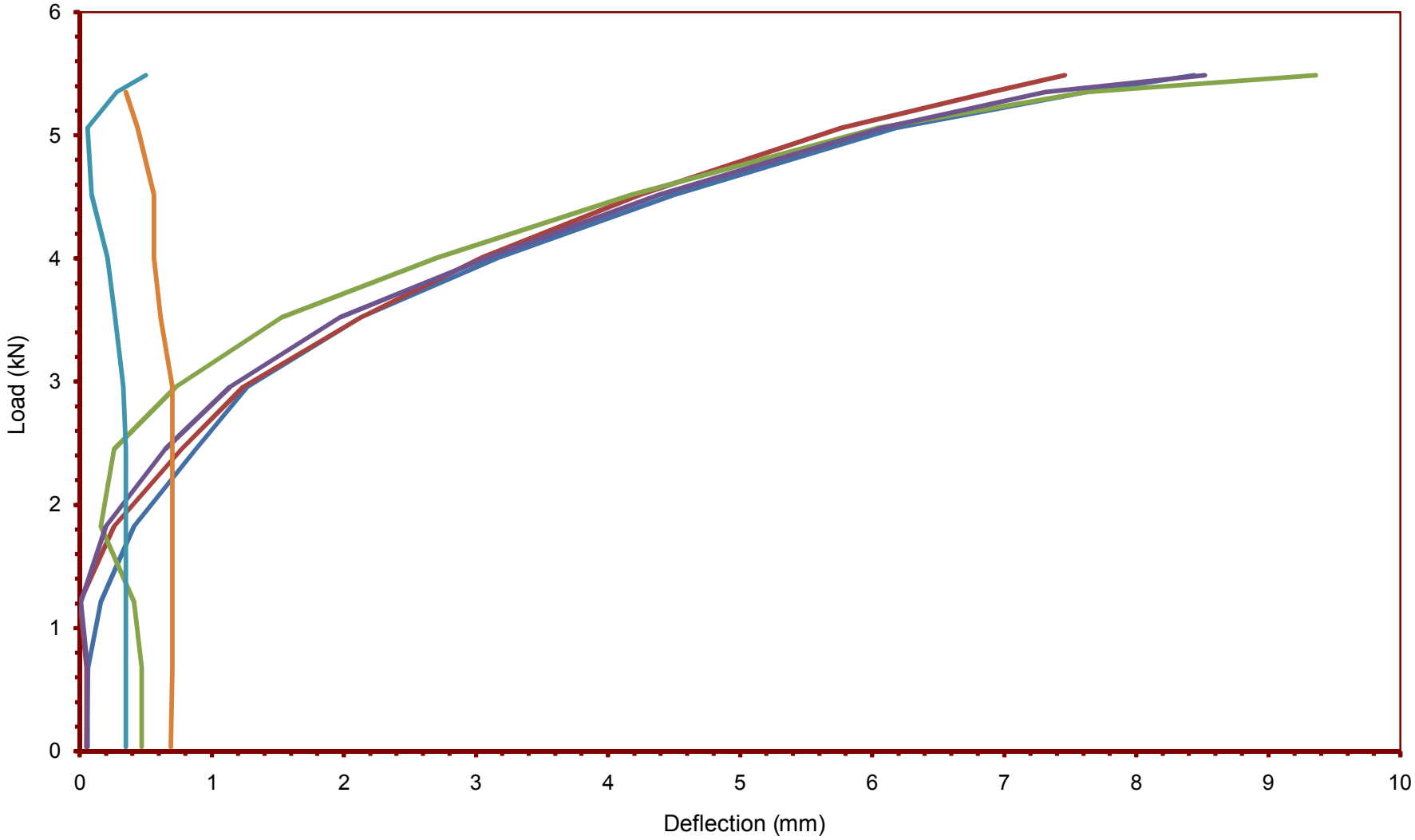
Chart 2

Load v Horizontal Deflection for Ron Sammons Wall StarterTested in Shear with 10mm applied vertical Movement
Wall Two -Failure Cycle



Key — Tr.1 Tr.2 Tr.3 Tr.4 Tr.5 Tr.6

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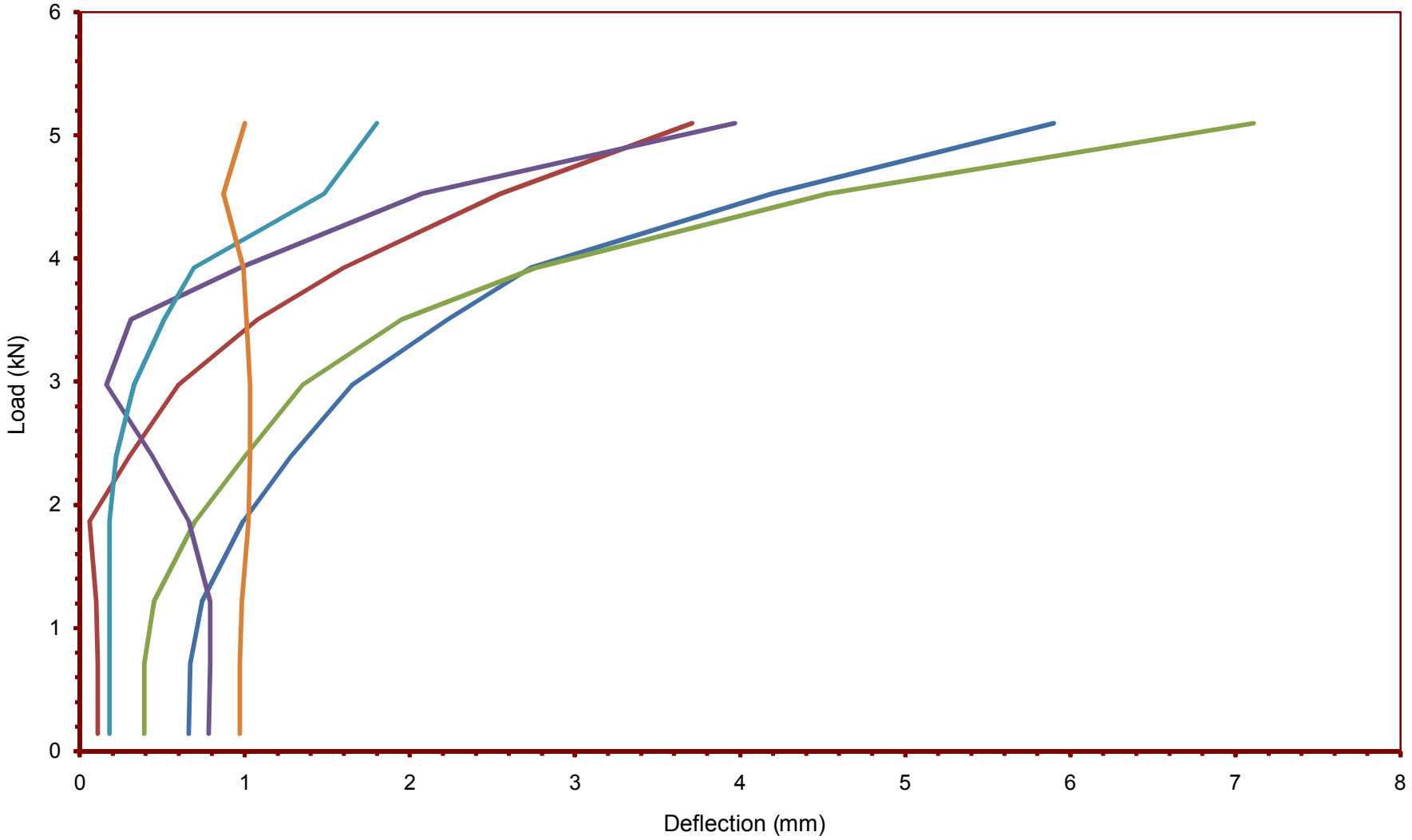
Chart 3

Load v Horizontal Deflection for Ron Sammons Wall StarterTested in Shear with 10mm applied vertical Movement
Wall Three -Failure Cycle



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