SE Laboratory
Structural Engineering Laboratory

AIT
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Report on Testing and Evaluation of Strength and Robustness Performance of "SPEEDWALL FAIRFACE" Partition System

Client:
FIN MANUFAC CO., LTD.

Doc. No. S0369-21

CONTENT

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June 21, 2021

SUMMARY OF TEST PROGRAM

1. CLIENT: COMPOUND CLAY COMPANY LIMITED

2. TEST SPECIMEN

The specimen of the expanded polystyrene concrete panels named as "Speedwall Fairface" having size of 5,000 x 3,000 x 100 mm., each panel having dimension 600 x 2,800 mm., reinforced with formed steel. Adhesive mortar and accessories were used to fix the joints between the concrete panels and the perimeter frame along all edges. Both exposed surface were plastered with concrete plaster.

Figure 2.1 Wall during construction

Figure 2.2 Completed wall configuration

CHAPTER III
SUMMARY OF TEST RESULTS

3.1 PERFORMANCE REQUIREMENT

For a partition to conform to an individual performance requirement, a specimen partition shall be tested by the method given in the relevant test and shall satisfy criteria for test performance that falls within the criteria given in the Tables 3.1 and 3.2.

Table 3.1 Summary of grade requirements and performance levels

Requirement	Units	Grade				Criteria
		LD	MD	HD	SD	
Stiffness	mm.	25	20	15	10	Maximum deflection
	mm.	5	3	2	1	Maximum residual deformation
Small hard body impact:						
- Surface damage	N.m	3	3	6	10	Judgment of indent
- Perforation	N.m	-[1)]	5	15	30	No perforation of facing
Large soft body impact:						
- Damage	N.m	20	20	40	100	2 mm. maximum deformation
- Structural damage	N.m	60	60	120	120	No collapse or dislocation
Door slam	No.	20	20	100	100	No damage and 1 mm Maximum displacement
1) No requirement for this grade						

Table 3.2 Summary of tests for crowd pressure, lightweight anchorages and heavyweight anchorages

Requirement	Units	Performance Level	Criteria
Crowd pressure	kN/m.	0.75, 1.5 or 3.0	No collapse or dangerous damage
Lightweight anchorages:			
Pull-out	N	100 minimum	Shim retained
Pull-down	N	250 minimum	Shim retained and 2 mm maximum displacement
Heavyweight anchorages:			
Wash basin	N	500 minimum	5 mm maximum deflection 1 mm max residual deformation
	N	1,000 to 1,500 range	20 mm maximum deflection 1 mm max residual deformation
Wall cupboard	N	2,000 to 4,000 range	5 mm. maximum deflection 1 mm max residual deformation

Table 3.2.2 Summary of test for crowd pressure, light weight anchorages and heavyweight anchorage

Requirement	Performance Level	Principal Criteria	Test Level	Test Result	Remark
Resistance to Crowd Pressure (G)	0.75, 1.50, or 3.00 kN./m.	No Collapse or Damage	0.75, 1.50 and 3.02 kN./m.	No Damage	Pass

Light Weight Anchorages	Performance Level	Principal Criteria	Test Level	Test Result	Remark
Pull – Out (H)	100 N	Shim Retained	100 N	Shim Retained	Pass
			1,079 N	Shim Released	
Pull – Down (J)	250 N	Shim Retained	250 N	Shim Retained	Pass
	< 2.00 mm	Max. Displacement	0.03 mm		
			2,942 N	Shim Released	

Heavy Weight Anchorage	Performance Level	Principal Criteria	Test Level	Test Result	Remark
Wash Basin (K)	500 N	Shim Retained	539 N	Shim Released	Pass
	< 5.00 mm	Max. Deflection	0.02 mm		
Wall Cupboard (L)	2,000 N – 4,000 N	Shim Retained	4,021 N	Shim Retained	Pass
	< 5.00 mm	Max. Deflection	0.05 mm		

3.2 SUMMARY OF TEST RESULTS

The test results on strength and robustness performance of partition system is summarized and shown in Table 3.2.1. The detail of testing results is also presented in Appendix A.

Table 3.2.1 Summary of grade requirements and principal test performance levels

Grade Requirement	BS 5234 Requirements						Remark
	Test Results	LD	MD	HD	SD	Units.	
Stiffness (A)							
Maximum Deflection	0.04	25.00	20.00	15.00	10.00	mm.	SD
Residual Deformation	0.05	5.00	3.00	2.00	1.00	mm.	SD
Small Hard Body Impact							
Surface Damage (B)	10	3	3	6	10	N.m.	SD
Perforation (D)	30	-[1)]	5	15	30	N.m.	SD
Large Soft Body Impact							
Damage (C)	100	20	20	40	100	N.m.	SD
Maximum Deformation	0.04	< 2.00				mm.	
Structural Damage (E)	120	60	60	120	120	N.m.	SD
Door Slam (F)	100	20	20	100	100	Slams	SD
Maximum Displacement	0.07	< 1.00				mm.	

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Type of Test: Determination of partition stiffness (BS 5234: Part2:1992 Annex A)

Date of Test: March 31, 2021

Test Result:

Deflection of partition subjected to the applied load

Load (N)	Deflection of Partition		
	Point 1 (mm.)	Point 2 (mm.)	Average (mm.)
0	0.00	0.00	0.00
108	0.00	0.00	0.00
196	0.00	0.00	0.00
294	0.01	0.00	0.01
392	0.03	0.00	0.02
490	0.06	0.02	0.04
Residual Deformation	0.05	0.05	0.05

Summary of tested results for determining partition stiffness

Description	Maximum Deflection (mm.)	Residual Deformation (mm.)	Condition of Surface Partition
Tested specimen	0.04	0.05	No surface damage occurred.
Acceptance criteria for partition grade "Severe Duty (SD)"	10.00	1.00	The partition shall be no damage or detachment, loosening or dislodgment of a partition's parts or fixings, other than superficial cracking of the surface.

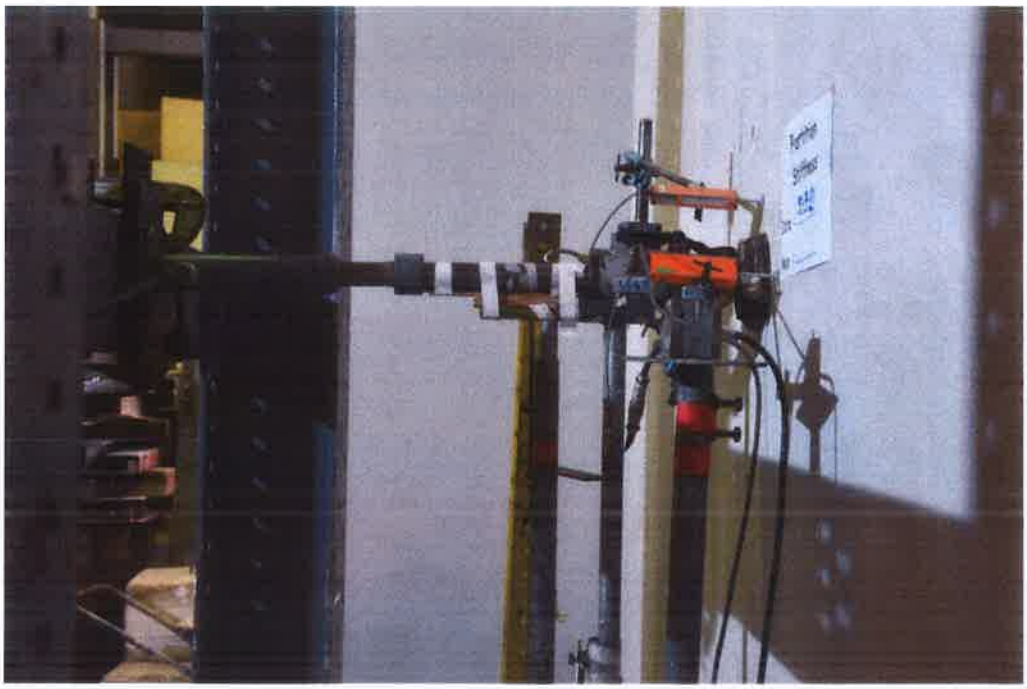

Figure 1 Equipment set up for testing of partition stiffness

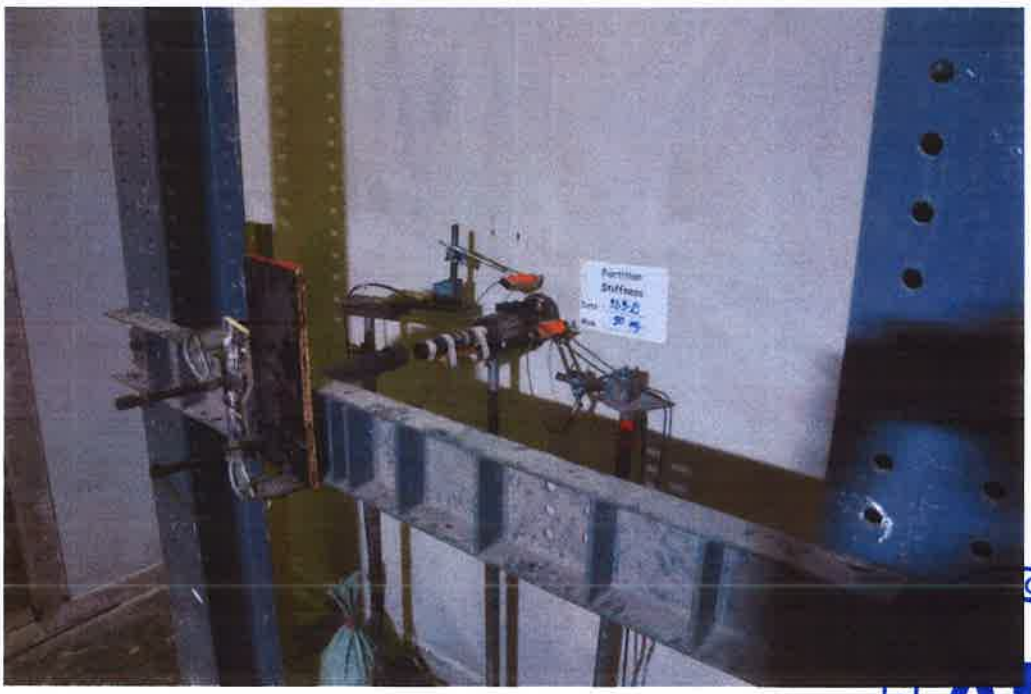

Figure 2 No damage after partition stiffness test

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Type of Test: Determination of surface damage by small hard body impact
(BS 5234 Part2:1992 - Annex B)

Date of Test: April 1, 2021

Test Result:

Indentation due to small hard body impact by using a drop height of 330 mm. to produce an impact energy of 10 N-m.

No. of Impact	Diameter of Indentation (mm.)	Depth of Indentation (mm.)	Surface Condition
1	17.76	1.36	Indentation marks with shallow depth.
2	18.80	1.66	
3	17.63	1.17	
4	18.06	0.29	
5	18.39	1.33	
6	15.34	0.88	
7	17.42	1.12	
8	16.93	1.19	
9	17.13	1.12	
10	17.72	1.24	

Acceptance criteria for testing of surface damage by small hard body impact

Description	Impact Energy (N.m)	Surface Condition
Tested specimen	10	No surface damage occurred.
Acceptance criteria for partition grade "Severe Duty (SD)"	10	No specific criterion for acceptance.

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Indentation due to small hard body impact at particle junction by using a drop height of 330 mm. to produce an impact energy of 10 N-m.

No. of Impact	Diameter of Indentation (mm.)	Depth of Indentation (mm.)	Surface Condition
1	20.02	1.44	No damage penetrated through partition panel.

Acceptance criteria for testing of surface damage at particle junction by small hard body impact

Description	Impact Energy (N.m)	Surface Condition
Tested specimen	1	No surface damage occurred.
Acceptance criteria for partition grade "Severe Duty (SD)"	1	No specific criterion for acceptance.

Figure 3 Drop height set up for testing of surface damage by small hard body impact

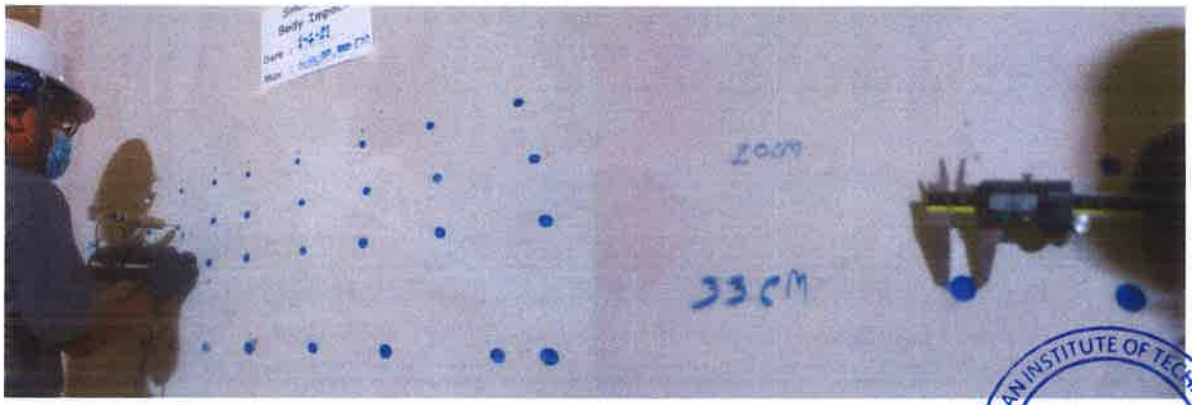

Figure 4 Measurement of diameter and depth of indentation

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Type of Test: Determination of resistance to damage by impact from a large soft body (BS 5234 Part2:1992 - Annex C)

Date of Test: April 1, 2021

Test Result:

Deformation due to large soft body impact by using a drop height of 204 mm. to produce an impact energy of 100 N-m.

No. of Impact	Permanent Deformation (mm.)		Surface Condition
	Point 1	Point 2	
1	0.04	0.00	No surface damage occurred.

Comparison the tested results with acceptance criteria

Description	Permanent Deformation (mm).	Surface Condition
Tested specimen	0.04	No Surface damage occurred.
Acceptance criteria for partition grade "Severe Duty (SD)"	2.00	The partition and a right-angle junction shall be capable of withstanding the impact energies for the grade being tested without sustaining either permanent deformation in excess of 2 mm. or any damage.

Figure 5 Drop height set up for testing of resistance to damage by impact from a large soft body impact

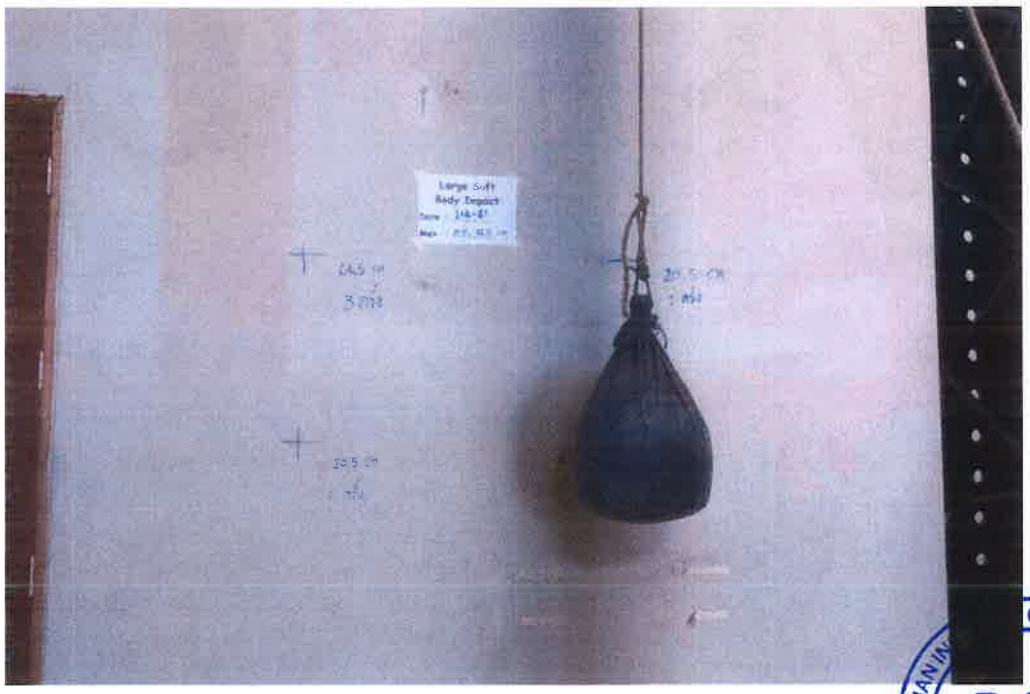

Figure 6 No damage on partition after large soft body impact test

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Type of Test: Determination of perforation by small hard body impact (BS 5234 Part2:1992 - Annex D)

Date of Test: April 1, 2021

Test Result:

Indentation due to small hard body impact by using impact a drop height of 1,000 mm. to produce an impact energy of 30 N-m.

No. of Impact	Diameter of Indentation (mm.)	Depth of Indentation (mm.)	Surface Condition
1	28.73	3.77	Major indentation marks with NO perforation.
2	27.12	3.15	
3	26.76	3.00	
4	26.47	3.14	
5	27.04	3.06	
6	23.08	2.25	
7	24.42	2.78	
8	23.58	2.62	
9	25.48	2.93	
10	24.43	2.69	

Acceptance criteria for testing of perforation by small hard impact

Description	Impact Energy (N.m)	Surface Condition
Tested specimen	10	No perforation occurred.
Acceptance criteria for partition grade "Severe Duty (SD)"	10	The partition shall be capable of withstanding the impact energies.

Figure 7 Drop height set up for testing of perforation by small hard body impact

Figure 8 Measurement of diameter and depth of indentation

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Type of Test: Determination of resistance to structural damage by multiple impacts from a large soft body (BS 5234 Part2:1992 - Annex E)

Date of Test: April 1, 2021

Test Result:

Condition of the tested specimen after three impacts by using a drop height of 245 mm. to produce an impact energy of 120 N-m.

No. of Impact	Surface Condition
3	No surface damage occurred.

Comparison the tested results with acceptance criteria

Description	No. of Impact	Surface Condition
Tested specimen	3	No surface damage occurred.
Acceptance criteria for partition grade "Severe Duty (SD)"	3	The partition shall be capable of withstanding the impact energies, for the grade being tested without collapsing or dislocating the partition.

Figure 9 Drop height set up for testing of resistance to structural damage by multiple impacts from a large soft body

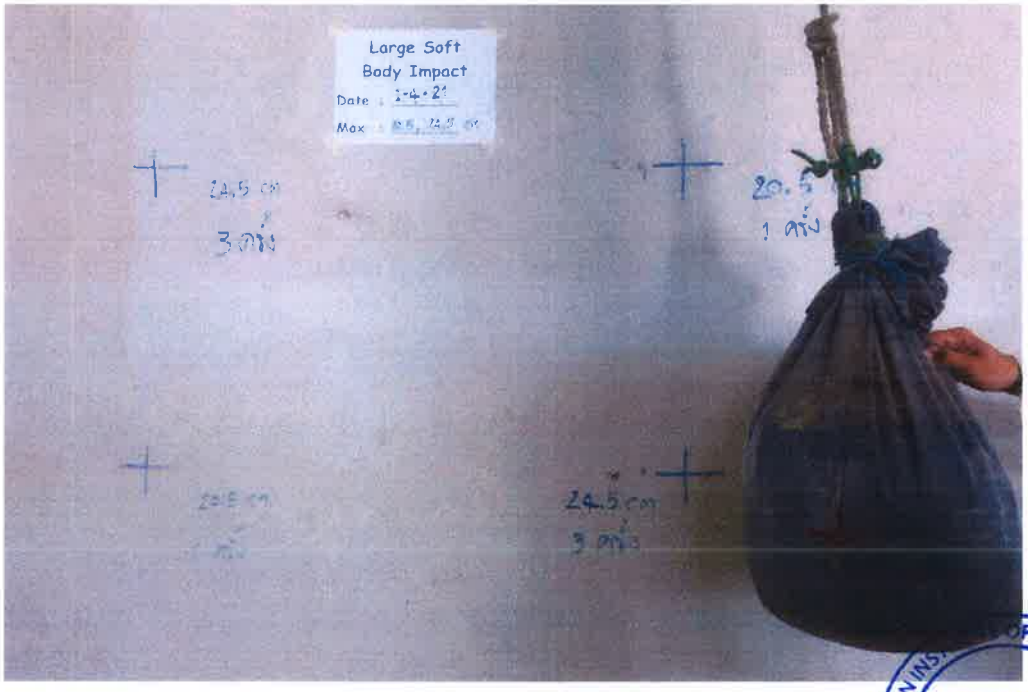

Figure 10 No damage on partition after large soft multiple impact test

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Type of Test: Determination of the effects of door slamming
(BS 5234 Part2:1992 - Annex F)

Date of Test: April 1, 2021

Test Result:

Residual displacement of the door leaf

Type of Test	No. of Impact	Residual Displacement (mm.)
Pre-Slam Test	3	0.06
Main Test	100	0.07

Acceptance criteria for testing of door slamming

Description	Acceptance Criteria	Test Result
No of Slams	100	No damage occurred.
Residual Deformation	< 1.0 mm	0.07 mm.

Figure 11 Equipment setup for testing of effects of door slamming

Figure 12 No partition damage after door slamming test

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Type of Test: Determination of resistance to crowd pressure
(BS 5234 Part2:1992 - Annex G)

Date of Test: April 1, 2021

Test Result:

Deformation due to crowd pressure

Load applied to Beam (kN/m.)	Deflection of Partition (mm.)			Surface Condition
	Point 1	Point 2	Average	
0.00	0.00	0.00	0.00	
0.75	0.19	0.15	0.17	No damage of partition occurred.
1.50	0.47	0.54	0.51	No damage of partition occurred.
2.00	0.68	0.83	0.76	No damage of partition occurred.
2.50	0.89	1.12	1.01	No damage of partition occurred.
3.02	1.15	1.50	1.33	No damage of partition occurred.
Released Load	0.22	0.38	0.30	No damage of partition occurred.

Acceptance criteria for testing of crowd pressure

Description	Acceptance Criteria
Tested specimen	No damage of partition occurred.
All	When tested as described, there shall be no collapse or damage that would render the partition dangerous, due to any of its parts becoming dislodged or shattered in a manner that could cause injury.

Figure 13 Equipment setup for resistance to crowd pressure test

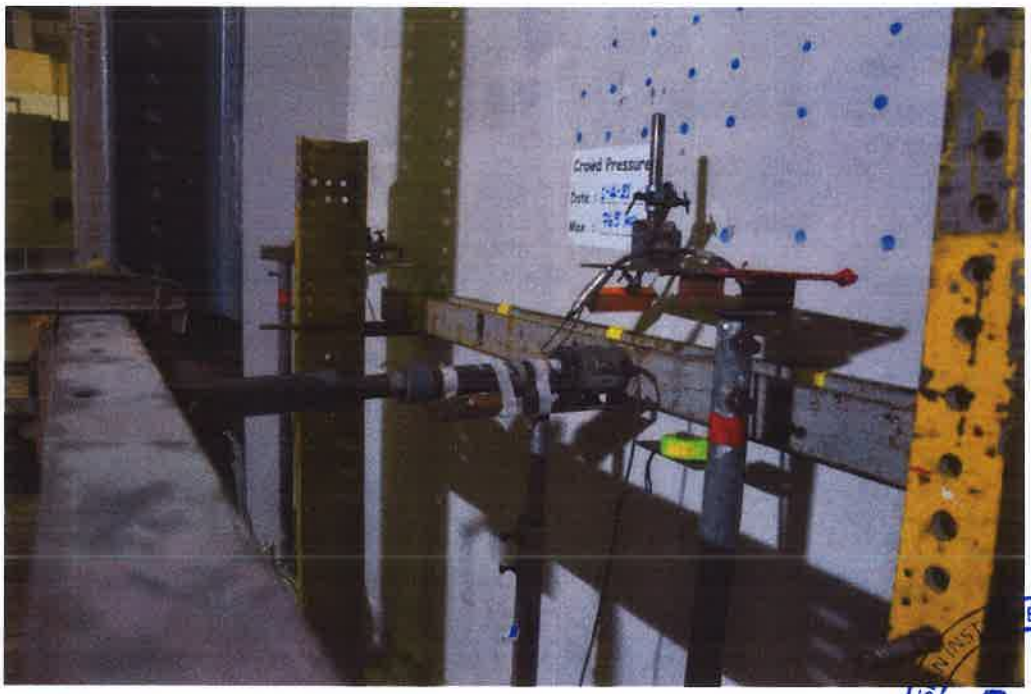

Figure 14 No damage after crowd pressure test

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Type of Test: Determination of lightweight anchorage pull-out (BS 5234 Part2:1992 - Annex H)

Date of Test: March 30, 2021

Test Result:

Condition of partition as applied pull-out load

Applied Load (N)	Bracket and Partition Condition
100	The shim plate did not release from the interface between bracket and partition.
1,079	The pull-up shim plate released from the interface between bracket partition and the maximum tested load.

Acceptance criteria for testing of pull-out of a lightweight anchorage

Description	Acceptance Criteria
Tested specimen	The partition can withstand the axial load of 100 N without releasing the pull-up shim plate or damage the partition other than superficial cracking.
All	The partition shall withstand the axial load of 100 N without releasing the pull-up shim plate or damage the partition other than superficial cracking.

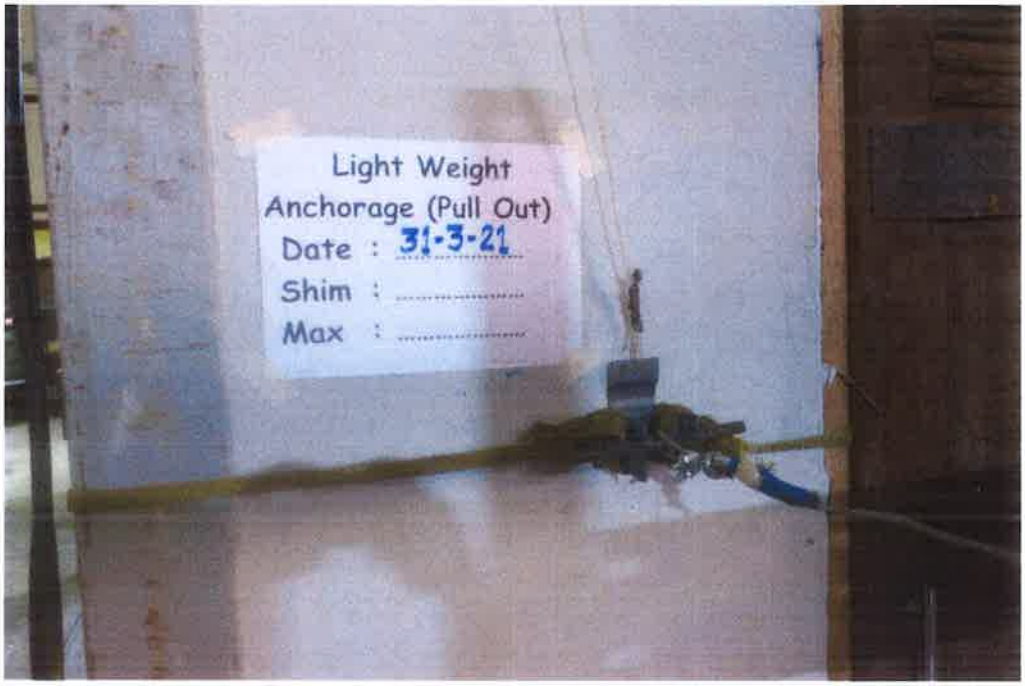

Figure 15 Lightweight anchorage pull-out test

Figure 16 Release of shim plate at 1,079 N pull-out load

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Type of Test: Determination of lightweight anchorage pull-down
(BS 5234 Part2:1992 - Annex J)

Date of Test: March 30, 2021

Test Result:

Condition of partition as applied pull-down load

Applied Load (N)	Movement of Bracket (mm.)	Bracket and Partition Condition
250	0.03	The pull-up shim plate did not release from the interface between bracket and partition.
2,942	1.87	The pull-up shim plate release from the interface between bracket and maximum tested load.

Acceptance criteria for testing of pull-down of a lightweight anchorage

Description	Acceptance Criteria
Tested Specimen	The partition can withstand the transverse load of 250 N without releasing the pull-up shim plate or damage the partition other than superficial cracking. The movement of the pull-down bracket is 0.03 mm.
All	The partition shall withstand the transverse load of 250 N without releasing the pull-up shim plate or damage the partition other than superficial cracking and the maximum movement of the pull-down bracket shall not exceed 2 mm.

Figure 17 Lightweight anchorage pull-down test

Figure 18 Release of shim plate at 2,942 N pull-down load

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Type of Test: Determination of eccentric downward loading of heavyweight anchorage – wash basin (BS 5234 Part2:1992 - Annex K)

Date of Test: March 31, 2021

Test Result:

Condition of partition as applied downward load

Applied Load (N)	Movement of Partition (mm.)				Bracket and Partition Condition
	1*	2**	3***	4****	
0	0.00	0.00	0.00	0.00	No damage of partition occurred.
265	0.00	0.00	0.00	0.00	No damage of partition occurred.
490	0.00	-0.01	0.00	0.01	No damage of partition occurred.
539	0.02	0.01	0.00	-0.01	Shim released and partition damage.
Released Load	0.01	0.01	0.00	-0.01	Partition damage.

Remarks: 1* : The movement was measured from the displacement transducer which attached with the same side of applied load and 1.20 m. height from base.
2** : The movement was measured from the displacement transducer which attached with the same side of applied load and 1.75 m. height from base.
3*** : The movement was measured from the displacement transducer which attached with the other side of applied load and 1.20 m. height from base.
4**** : The movement was measured from the displacement transducer which attached with the other side of applied load and 1.75 m. height from base.

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Acceptance criteria for testing of heavyweight anchorage – wash basin

Description	Acceptance Criteria
Tested specimen	The maximum deflection at the maximum applied load is 0.02 mm. and maximum residual deformation is 0.01 mm.
All	The anchorage shall be capable of withstanding the load selected applied to the two linked brackets without releasing either pull-up shim plate, exceeding the deflection or residual deformation limits given in Table 10 Page 7 in BS 5234:Part 2:1992 and without loosening, detaching or damaging the partition.

Figure 19 Heavyweight anchorage by eccentric downward loading (wash basin)

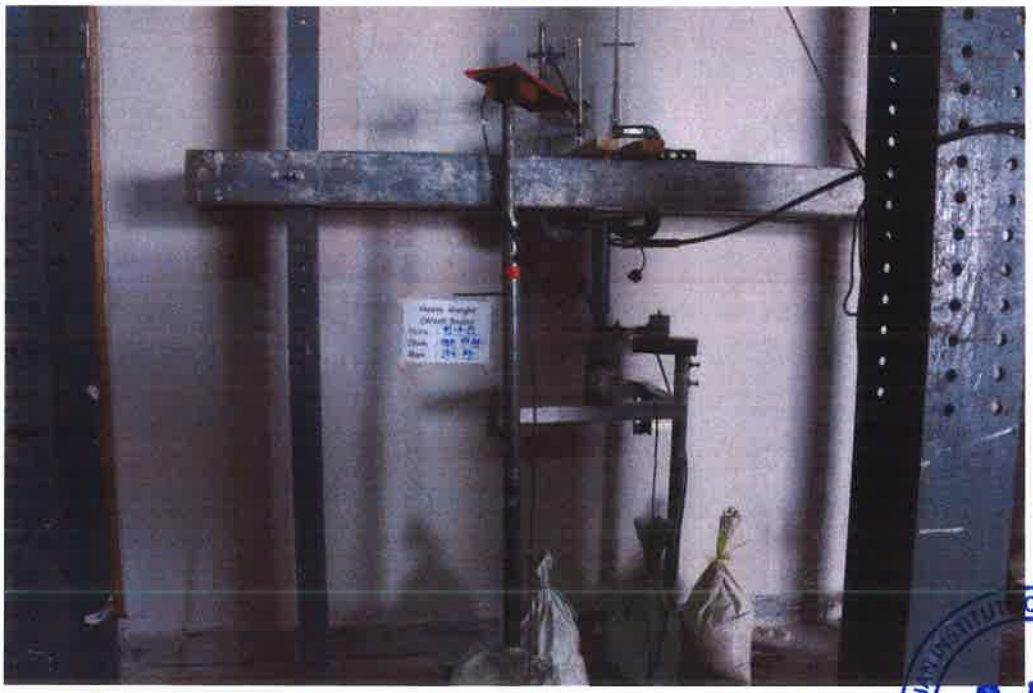

Figure 20 Release of shim plate at 539 N wash basin load

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Type of Test: Determination of eccentric downward loading of heavyweight anchorage - high level wall cupboard (BS 5234 Part2:1992 - Annex L)

Date of Test: March 31, 2021

Test Result:

Condition of partition as applied downward load

Applied Load (N)	Movement of Partition (mm.)				Bracket and Partition Condition
	1*	2**	3***	4****	
0	0.00	0.00	0.00	0.00	No partition damage occurred.
490	0.00	0.00	0.01	0.00	No partition damage occurred.
991	0.00	0.00	0.01	0.00	No partition damage occurred.
1,520	0.00	0.00	0.01	0.00	No partition damage occurred.
2,001	0.00	-0.01	0.01	0.01	No partition damage occurred.
2,501	0.00	-0.02	0.00	0.02	No partition damage occurred.
3,011	-0.01	-0.02	0.00	0.03	No partition damage occurred.
3,511	0.00	-0.03	0.00	0.04	No partition damage occurred.
4,021	0.00	-0.04	0.00	0.05	No partition damage occurred and Maximum tested load.
Released Load	-0.01	-0.02	0.00	0.00	No partition damage occurred.

Remarks: 1* : The movement was measured from the displacement transducer which attached with the same side of applied load and 1.20 m. height from base.
2** : The movement was measured from the displacement transducer which attached with the same side of applied load and 1.75 m. height from base.
3*** : The movement was measured from the displacement transducer which attached with the other side of applied load and 1.20 m. height from base.
4**** : The movement was measured from the displacement transducer which attached with the other side of applied load and 1.75 m. height from base.

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Acceptance criteria for testing of heavyweight anchorage – high level wall cupboard

Description	Acceptance Criteria
Tested specimen	The maximum deflection at the maximum applied load is 0.05 mm. and maximum residual deformation is 0.00 mm.
All	The anchorages shall be capable of withstanding the load selected applied to the two linked brackets without releasing either pull-up shim plate, exceeding the deflection or residual deformation limits given in Table 11 Page 7 in BS 5234:Part 2:1992 and without loosening, detaching or damaging the partition.

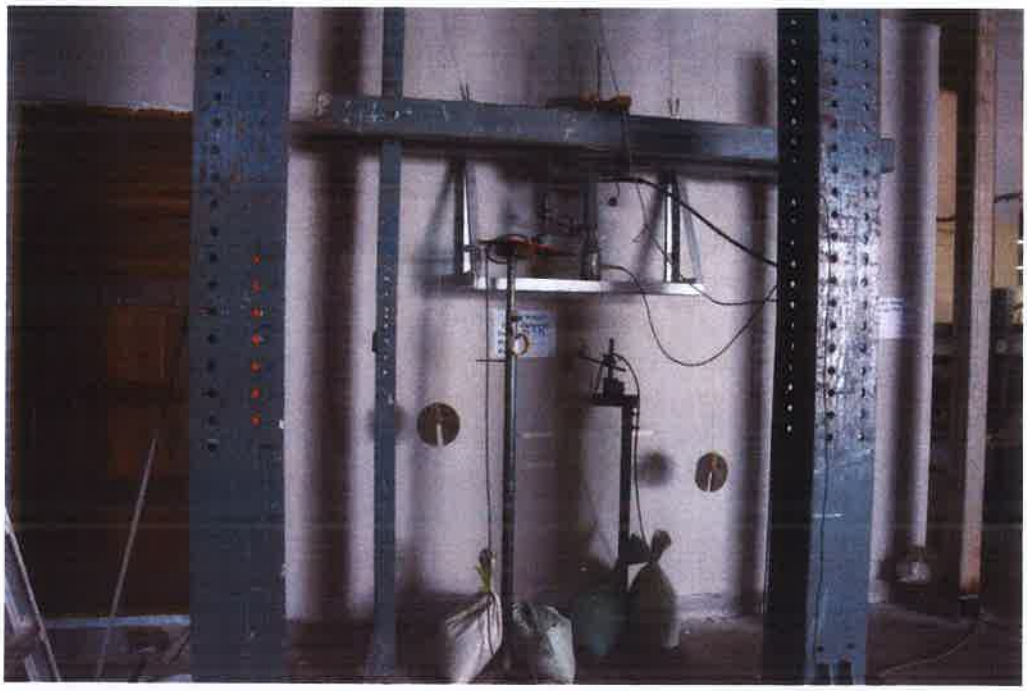

Figure 21 Heavyweight anchorage by eccentric downward loading (wall cupboard)

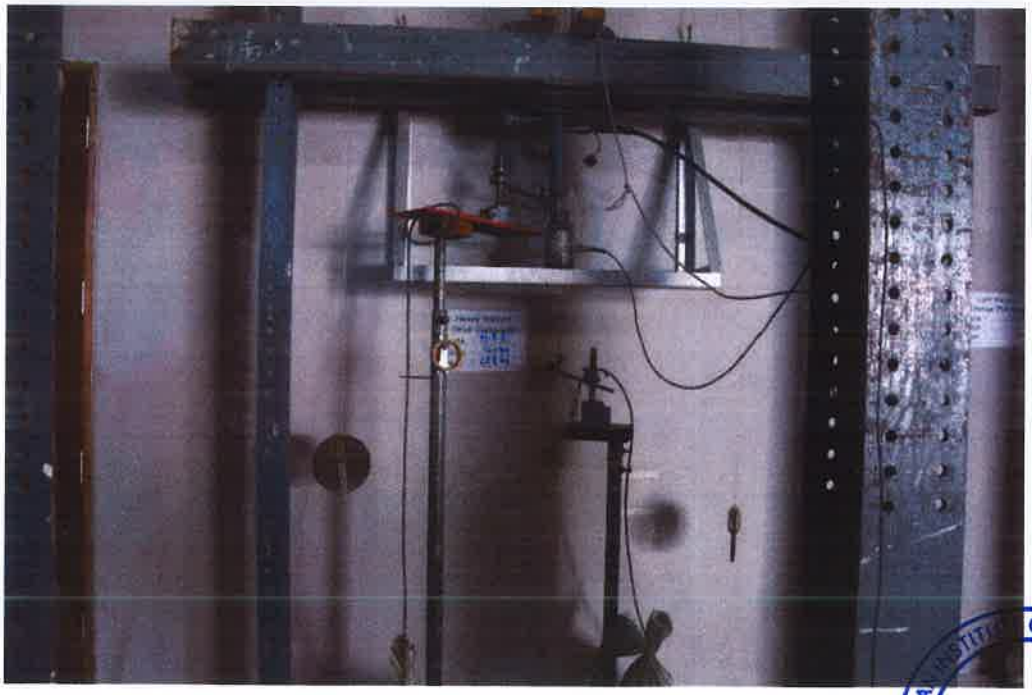

Figure 22 Maximum tested load at 4,021 N wall cupboard load