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REPORT 65507/S/1

PORT ARTHUR HOUSE, NAFC SHETLAND

FLOOR LOAD TESTS

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NAFC Marine Centre
Port Arthur
Scalloway
Shetland
ZE1 0UN

This Report comprises
5 pages of text
Figures 1 to 4b
Appendix A of 6 sheets
Appendix B of 6 sheets
Appendix C of 6 sheets
Photographs 1 to 12

For the attention of Mr G Young

23 September 2019

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FLOOR LOAD TESTS

Instruction: Purchase Order Nos. 33031 and 33219 issued by NAFC Marine Centre.

1. INTRODUCTION

Port Arthur House is a two storey accommodation block within the NAFC Marine Centre in Scalloway. The first floor is formed from concrete reinforced by permanent steel shuttering; this floor has sagged at mid-span to an extent sufficient for use of the building to have been suspended pending checks on its ongoing safety. This report describes a programme of load testing that was specified by Mott MacDonald and undertaken by Sandberg over the period 29 August to 13 September 2019.

The accommodation block contains 25 study/bedroom units along with two lounges, two kitchenettes and a games room. The external walls are load bearing as are the walls on both sides of a central corridor. The ground floor walls support the permanent steel shuttering for the first floor slabs that generally span 5.65metres; it is some parts of these slabs that have sagged. While much of the sag could have developed at the time of construction, stiffening and jamming doors have indicated an ongoing effect.

The load testing required follows the guidelines detailed in Clause 9.5 of BS 8110-2:1982 'Structural use of concrete Part 2: Code of practice for special circumstances' (withdrawn). This standard has been used because the later Eurocodes do not incorporate an equivalent section. The essence of the required procedure is that the structural element to be tested should be loaded up to three times while the associated deflections and recoveries are monitored. The third loading is held for 24 hours at full test load. The appropriate test load is the greater of 1.25 x full design live load + any missing dead load and 1.125 x full design live load + 1.125 x dead load less any dead load already present; usually the former condition is the greater.

The design live load was taken to be 4.0kN/m² with an allowance of 0.55kN/m² for missing dead load. With the multiplier of 1.25 on the live load this equates to a test load of 5.55kN/m².

Scaffold catchment and instrument support cages were installed below the test areas so that deflections of the slab could be monitored and the slab supported in the event of excessive deflection developing.

The test load was applied by constructing polythene lined water tanks on the first floor and then filling them in increments until the required load had been reached. An external reservoir and two 50mm pumps facilitated reasonably quick filling and emptying of the tanks.

Three tests were undertaken these being in: rooms 19/20 combined, the first floor lounge and room 18 (Figure 1). In advance of Sandberg attending site the partition walls between rooms 19 and 20 had been removed along with floor finishes and other fittings that would have obstructed assembly of the test setup.

2. TEST METHOD

The three test locations are indicated on Figure 1.

The test entailed formation of polythene lined, timber framed enclosures the sides of which were both anchored to the floor and tied across the tank to resist the hydrostatic pressure from the water. The resulting tanks were filled with water to a target depth of 566mm, equivalent to a load of 5.55kN/m². Filling was always in five equal depth increments with checks being made five minutes after each increment to ensure that no reasonably discoverable sign of distress passed undetected.

A scaffold cage was set up on the ground floor below each area; the cage sizes and numbers of standards differed to suit the differing sizes of the test areas. A clearance of about 20mm was left between the tops of the standards and the slab soffit to allow the slabs unrestrained deflection up to the stop being reached; thereafter the scaffold would have provided support. The standards were all fitted with electric displacement transducers to measure deflection. Gauge positions and numbering are indicated on Figures 2, 3 and 4a and 4b.

Each area was loaded three times. In the first cycle the area was loaded and then unloaded with unloading commencing five minutes after completion of loading. A minimum interval of one hour was then allowed before reloading; on this occasion full load was maintained for one hour before unloading. Another interval of at least one hour was then allowed before the third loading cycle commenced. In the third cycle full load was maintained for 24 hours before unloading commenced. A variable recovery period was allowed after completion of unloading, had recovery been insufficient in the third test this might have extended up to 24 hours. In practice several of the intervals between loadings ran overnight.

The target maximum deflections were span/350. In rooms 19/20 and the lounge this equated to 5650/350 = 16.1mm while in room 18, where a thinner slab spanned in an atypical direction, the limit was 4195/350 = 12.0mm.

On completion of the load testing exercise seven nominal 100mm diameter cores were diamond cut from the floor slabs. These samples were taken to Sandberg's Clapham laboratory for testing under separate instruction. The core positions are indicated on Figures 2, 3, 4a and 4b.

3. RESULTS

Figure 1 shows the positions of the three test areas within the building. Figures 2, 3 and 4a and 4b show the positions of tanks and instruments relative to the internal faces of walls on the first floor. When assessing the exercise it should be noted that the load bearing perimeter walls to the ground floor are thicker than those on the first floor.

Photographs 1 to 12 show the building and much of the sequence through the test exercise.

Test results are fully detailed in the Appendices A to C covering respectively: Rooms19/20, the Lounge and Room 18. The appendices each contain full tabulated results showing deflections at every loading increment and plots showing deflections during progress through the test sequence. The results are summarised in the three tables below.

Rooms 19/20 (Test Area 1)

Figure 2 shows the positions of the tanks and gauges in Rooms 19/20 along with the gauge numbering. Core sample locations and numbers are also shown. The deflections and recoveries at mid-span positions in each of the three loadings were:

	First loading cycle		Second loading cycle		Third loading cycle (24 hour)	
Gauge	Peak deflection mm	Recovery %	Peak deflection mm	Recovery %	Peak deflection mm	Recovery %
3	1.78	56	1.07	92	1.14	90
7	3.84	52	2.09	91	2.22	89
11	4.82	50	2.56	90	2.71	90
15	4.45	54	2.52	91	2.64	91
19	2.16	63	1.41	92	1.44	93

Occasional creaking noises were heard during the first loading cycle.

The recovery periods in the three tests were, in sequence, 1 hour, 14 hours and less than 1 hour.

Lounge (Test Area 2)

Figure 3 shows the positions of the tanks and gauges in the Lounge along with the gauge numbering. Core sample locations and numbers are also shown. The deflections and recoveries at mid-span positions in each of the three loadings were:

	First loading cycle		Second loading cycle		Third loading cycle (24 hour)	
Gauge	Peak deflection mm	Recovery %	Peak deflection mm	Recovery %	Peak deflection mm	Recovery %
3	2.84	47	1.61	85	1.41	>100
8	6.32	54	3.88	90	3.62	98
13	7.65	55	4.74	90	4.42	99
18	5.24	61	3.55	91	3.34	99
23	1.90	72	1.48	93	1.41	100

Many creaking noises were heard during the first loading cycle.

The recovery periods in the three tests were, in sequence, 14 hours, 1 hour and 16 hours.

Rooms 18 (Test Area 3)

Figures 4a and 4b show the positions of the tanks and gauges in Rooms 18 along with the gauge numbering. Core sample locations and numbers are also shown. In this area intense services below the slab restricted the positions at which gauges could be installed. The deflections and recoveries at span positions in each of the three loadings were:

	First loading cycle		Second loading cycle		Third loading cycle (24 hour)	
Gauge	Peak deflection mm	Recovery %	Peak deflection mm	Recovery %	Peak deflection mm	Recovery %
5	3.35	85	2.94	>100	3.00	100
6	1.97	75	1.57	>100	1.61	>100
8	3.11	86	2.79	>100	2.86	>100
9	1.50	80	1.26	>100	1.30	>100

No noises were reported during the loading.

The recovery periods in the three tests were, in sequence, 1 hour, 14 hours and less than 1 hour.

4. REMARKS

The floors in the three test areas behaved in a generally similar manner. In the first cycle of loading the deflections were significantly larger than in the subsequent two cycles and also the recoveries were incomplete. In the subsequent loadings deflections were smaller and recoveries most satisfactory.

No deflection at any stage reached the limit of span/350.

The source of the creaking noises heard in Test Areas 1 and 2 was not positively identified but it is considered likely that it was associated with slight movements between adjacent sections of the permanent metal shuttering.

The performance in all three areas achieved the requirement of a minimum 75% recovery stipulated in BS 8110-2. The lower recovery in the first cycle of loading is not an issue for concern, it seemingly represents some slack in the system being taken up. There are several possibilities for the presence of this slack but this aspect lies outside the scope of this report. Seven core samples have been collected and will be subject to a series of tests.

In our opinion the strength of the floors has been demonstrated as being suitable for ongoing use in an accommodation block.

NAFC Marine Centre
Port Arthur
Scalloway
Shetland
ZE1 0UN

For the attention of Mr G Young

SMP/fe/Inspection

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for Sandberg LLP

S M Pringle

23 September 2019

Materials, samples and test specimens are retained for a period of 2 months from the issue of the final report.

Tests reported on sheets not bearing the UKAS mark in this report/certificate are not included in the UKAS accreditation schedule for this laboratory.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

FIGURES

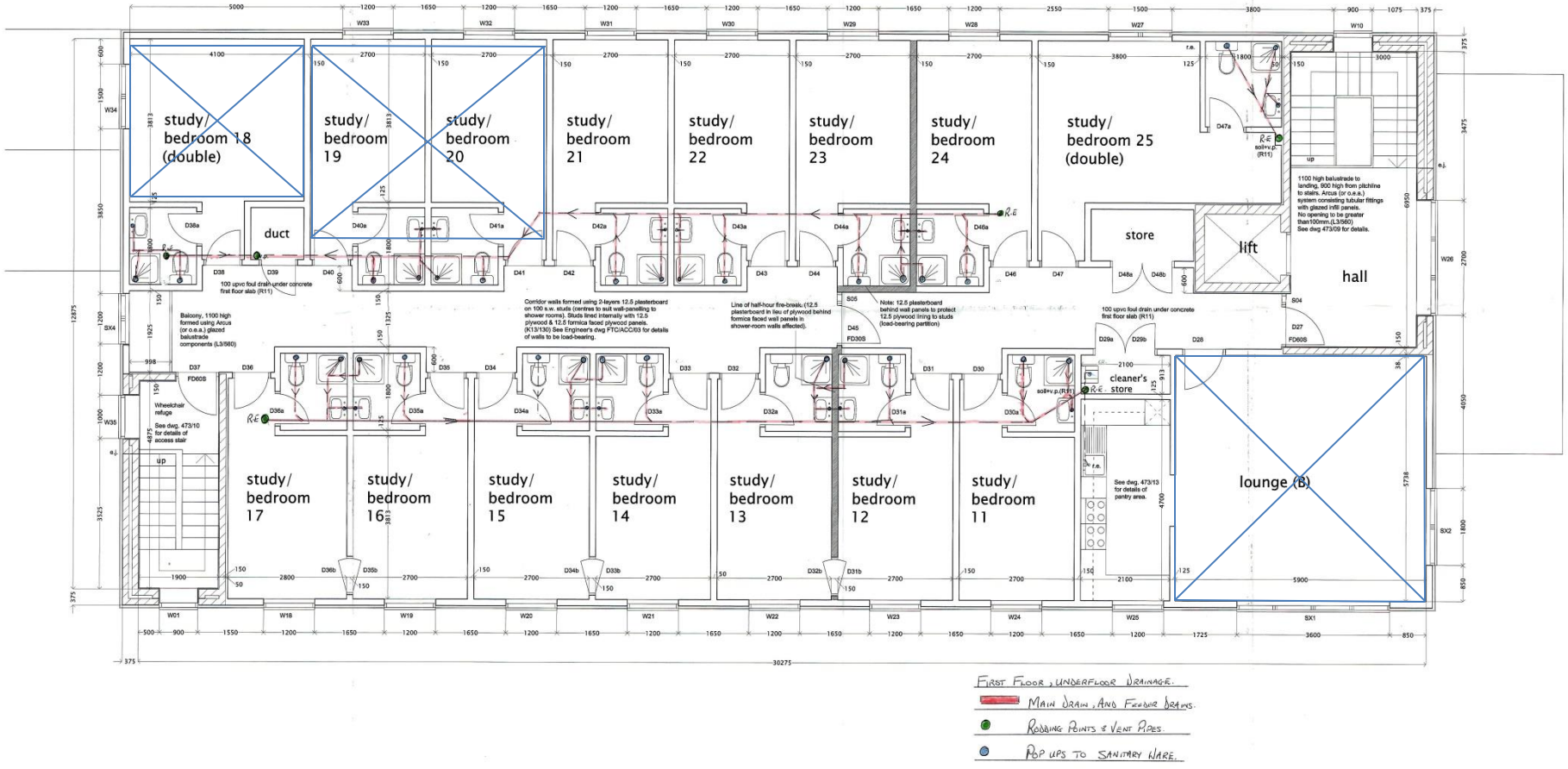

Figure 1 Test areas on first floor (marked with blue lines)

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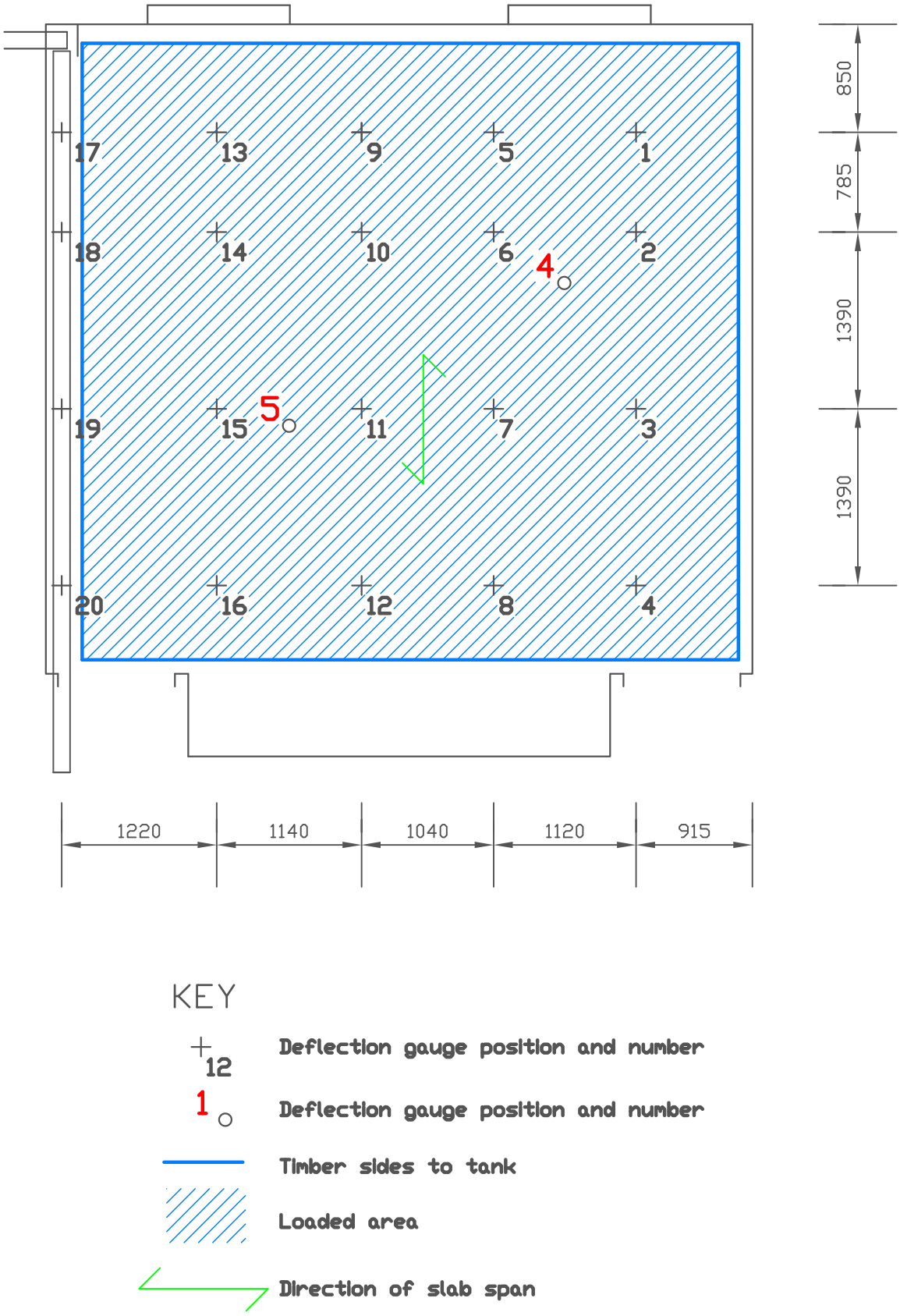

Figure 2 First floor Rooms 19/20 showing layout of tank, positions of gauges and locations of core samples.

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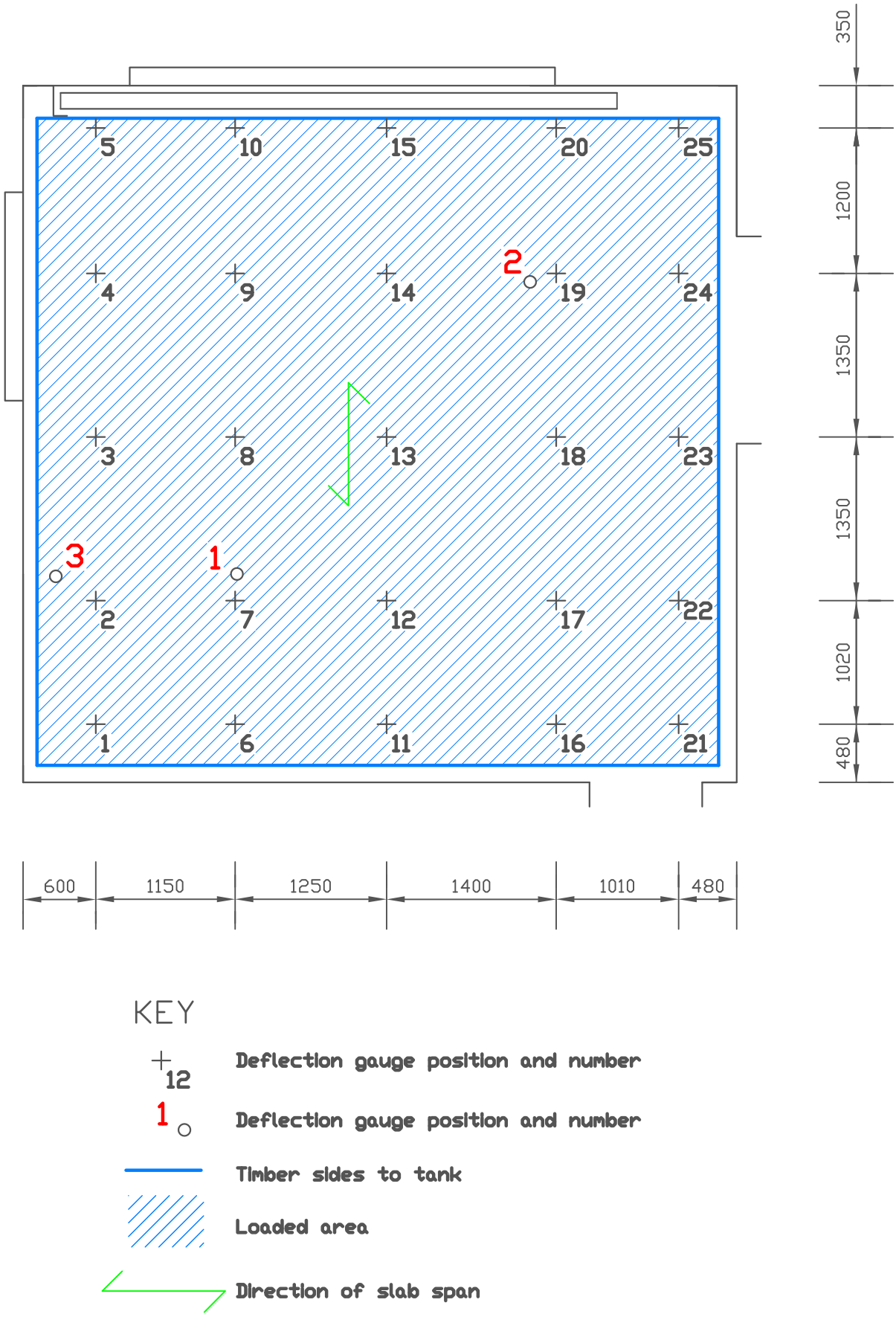

Figure 3 First floor lounge showing layout of tank, positions of gauges and locations of core samples.

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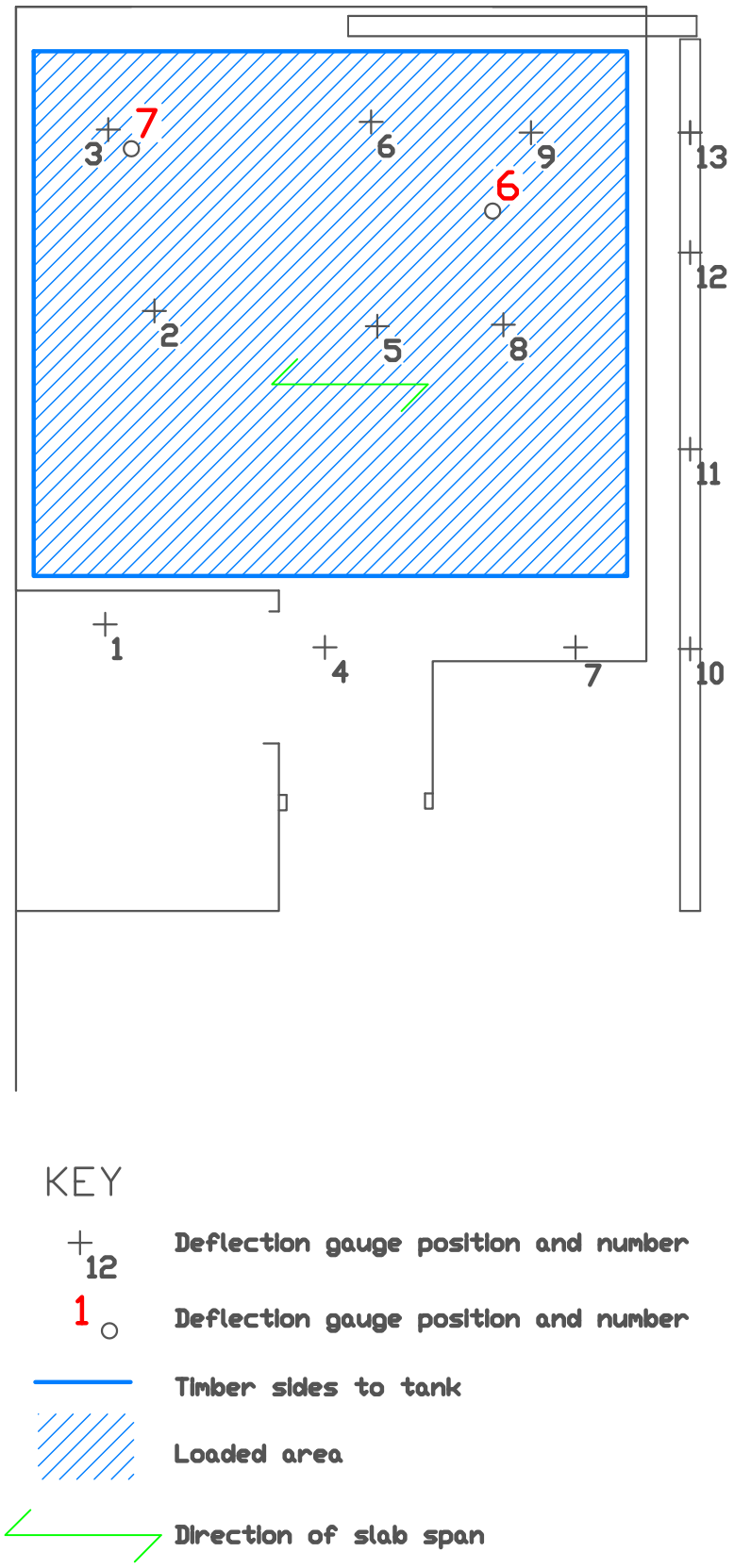

Figure 4a First floor Room 18 showing layout of tank, positions of gauges and locations of core samples.

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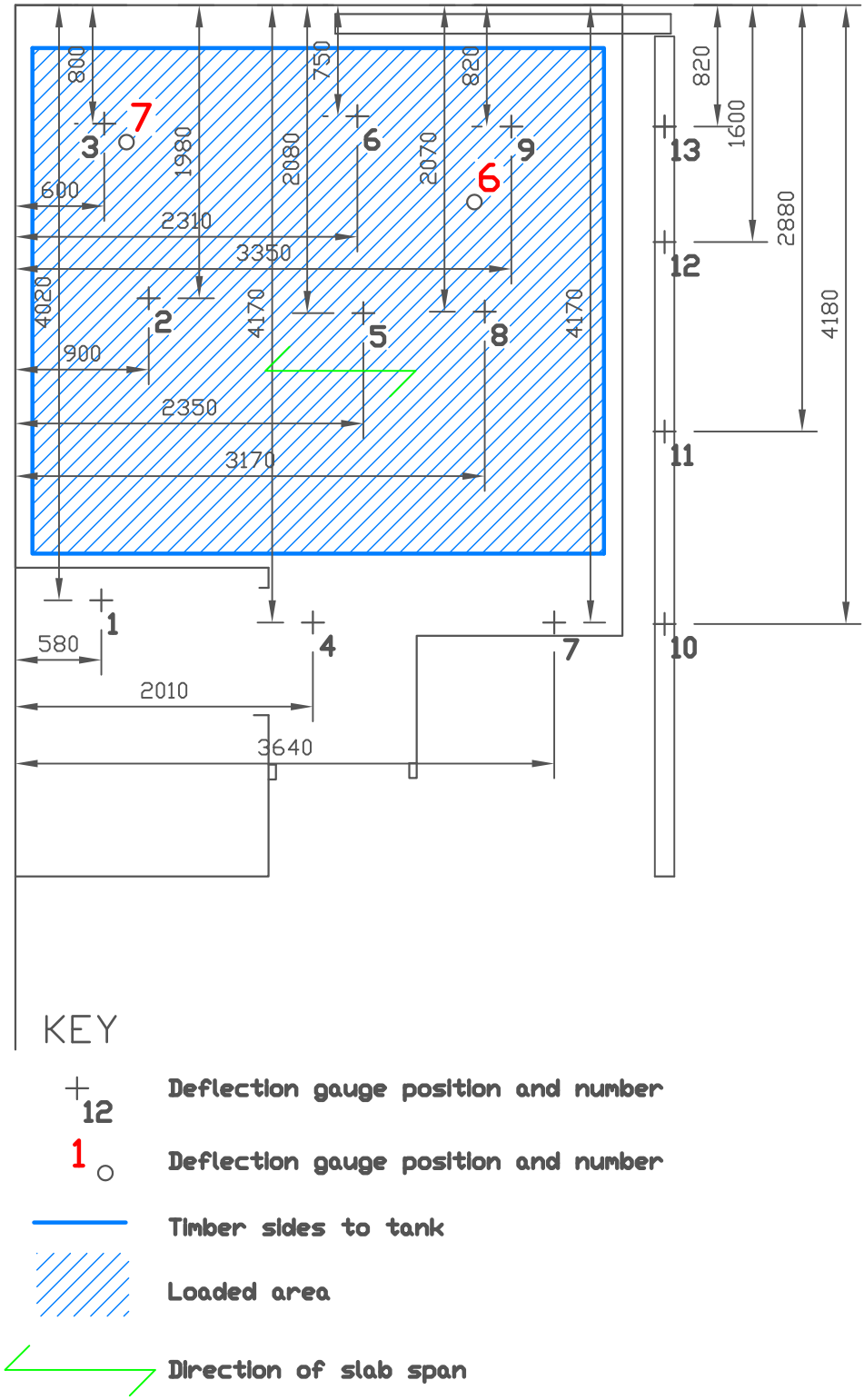

Figure 4b First floor Room 18 showing layout of tank, positions of gauges and locations of core samples.

APPENDIX A

Results for Test Area 1, Rooms 19/20

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Location Test Area 1 (Rooms 19/20), Test 1

		Deflections mm												Recovery %
	Date	04/09/19	04/09/19	04/09/19	04/09/19	04/09/19	04/09/19	04/09/19	04/09/19	04/09/19	04/09/19	04/09/19	04/09/19	
	Time	08:00	08:25	08:45	09:05	09:30	09:50	10:15	10:35	11:00	11:25	11:55	13:00	
	Stage in test	1	2	3	4	5	6	7	8	9	10	11	12	
	Load kN/m²	0.00	1.11	2.22	3.33	4.44	5.55	4.44	3.33	2.22	1.11	0.00	0.00	
	Load	0	20%	40%	60%	80%	100%	80%	60%	40%	20%	0%	0%	
Gauge 1	E62.04	0.00	0.11	0.30	0.49	0.75	1.08	1.01	0.90	0.79	0.62	0.44	0.43	60
Gauge 2	E62.11	0.00	0.17	0.42	0.67	1.03	1.52	1.51	1.25	1.08	0.88	0.64	0.63	59
Gauge 3	E62.18	0.00	0.18	0.47	0.75	1.14	1.78	1.64	1.46	1.27	1.04	0.79	0.78	56
Gauge 4	E62.03	0.00	0.11	0.26	0.42	0.69	1.14	1.06	0.94	0.82	0.68	0.53	0.52	54
Gauge 5	E62.25	0.00	0.22	0.61	1.00	1.53	2.00	1.86	1.68	1.48	1.24	0.95	0.92	54
Gauge 6	E62.26	0.00	0.34	0.94	1.54	2.42	3.27	3.03	2.71	2.40	2.02	1.58	1.54	53
Gauge 7	E62.07	0.00	0.38	1.10	1.82	2.80	3.84	3.56	3.19	2.82	2.39	1.91	1.86	52
Gauge 8	E62.19	0.00	0.23	0.59	0.95	1.57	2.25	2.10	1.88	1.66	1.40	1.11	1.08	52
Gauge 9	E62.22	0.00	0.22	0.58	0.96	1.52	1.99	1.84	1.64	1.45	1.22	0.95	0.93	53
Gauge 10	E62.10	0.00	0.43	1.20	1.99	3.11	4.04	3.74	3.35	2.97	2.54	2.04	1.98	51
Gauge 11	E62.24	0.00	0.49	1.40	2.31	3.69	4.82	4.48	4.02	3.57	3.05	2.47	2.40	50
Gauge 12	E62.16	0.00	0.29	0.78	1.30	2.11	2.80	2.61	2.34	2.08	1.77	1.40	1.37	51
Gauge 13	E62.21	0.00	0.20	0.54	0.93	1.47	1.94	1.78	1.57	1.36	1.13	0.87	0.85	56
Gauge 14	E62.08	0.00	0.43	1.11	1.84	2.90	3.74	3.43	3.05	2.68	2.26	1.78	1.74	54
Gauge 15	E62.12	0.00	0.50	1.30	2.15	3.42	4.45	4.10	3.65	3.20	2.70	2.11	2.06	54
Gauge 16	E62.20	0.00	0.31	0.78	1.28	2.12	2.79	2.59	2.31	2.02	1.70	1.32	1.29	54
Gauge 17	E62.23	0.00	0.13	0.29	0.48	0.76	1.00	0.90	0.78	0.66	0.53	0.38	0.37	63
Gauge 18	E62.05	0.00	0.25	0.59	0.95	1.50	1.93	1.75	1.51	1.28	1.01	0.73	0.71	63
Gauge 19	E62.17	0.00	0.26	0.63	1.04	1.67	2.16	1.96	1.70	1.44	1.15	0.83	0.81	63
Gauge 20	E62.06	0.00	0.09	0.22	0.37	0.65	0.90	0.83	0.74	0.64	0.53	0.41	0.40	56
Temperature °C		16	16	16	16	16	16	16	16	16	16	16	16	

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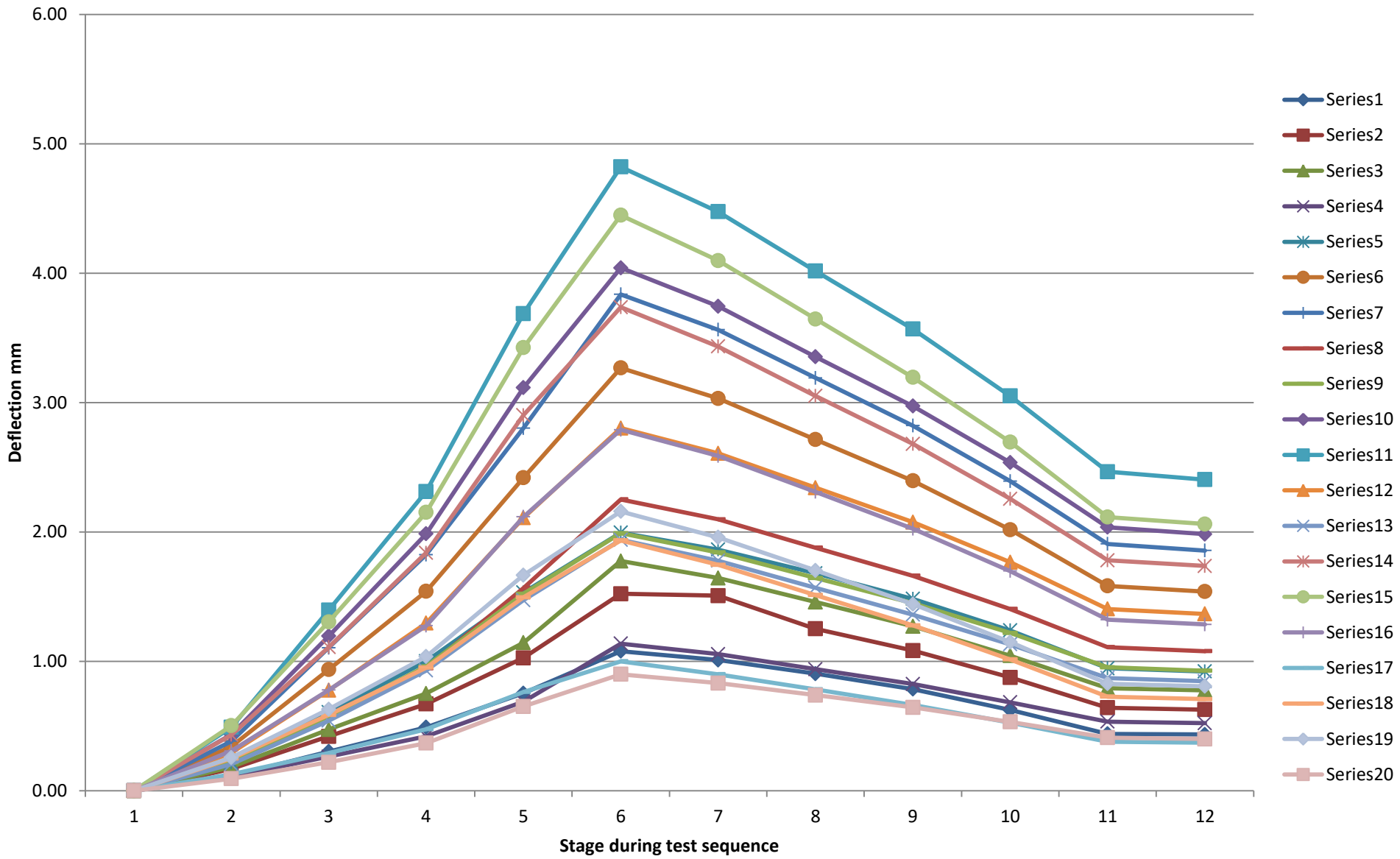
Plot 1 Area 1, Test 1 Deflections during course of test



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Location Test Area 1 (Rooms 19/20), Test 2

		Deflections mm													Recovery %
	Date	04/09/19	04/09/19	04/09/19	04/09/19	04/09/19	04/09/19	04/09/19	04/09/19	04/09/19	04/09/19	04/09/19	04/09/19	05/09/19	
	Time	13:00	13:25	13:45	14:05	14:20	14:45	15:45	16:05	16:20	16:40	17:05	17:30	07:30	
	Stage in test	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Load kN/m²	0.00	1.11	2.22	3.33	4.44	5.55	5.55	4.44	3.33	2.22	1.11	0.00	0.00	
	Load	0	20%	40%	60%	80%	100%	100%	80%	60%	40%	20%	0%	0%	
Gauge 1	E62.04	0.00	0.13	0.31	0.42	0.54	0.69	0.67	0.61	0.52	0.40	0.24	0.05	0.05	93
Gauge 2	E62.11	0.00	0.18	0.40	0.56	0.73	0.95	0.92	0.83	0.70	0.51	0.31	0.07	0.03	93
Gauge 3	E62.18	0.00	0.20	0.44	0.61	0.81	1.07	1.04	0.93	0.77	0.57	0.35	0.09	0.06	92
Gauge 4	E62.03	0.00	0.12	0.27	0.37	0.50	0.67	0.65	0.58	0.49	0.37	0.23	0.07	0.05	90
Gauge 5	E62.25	0.00	0.23	0.50	0.68	0.88	1.13	1.10	0.99	0.83	0.63	0.39	0.10	0.07	91
Gauge 6	E62.26	0.00	0.35	0.76	1.05	1.39	1.82	1.78	1.58	1.31	0.98	0.63	0.17	0.11	91
Gauge 7	E62.07	0.00	0.39	0.86	1.19	1.58	2.09	2.04	1.81	1.49	1.10	0.68	0.19	0.12	91
Gauge 8	E62.19	0.00	0.23	0.51	0.71	0.94	1.25	1.23	1.09	0.91	0.68	0.42	0.13	0.09	90
Gauge 9	E62.22	0.00	0.21	0.47	0.64	0.85	1.11	1.08	0.96	0.79	0.59	0.36	0.10	0.07	91
Gauge 10	E62.10	0.00	0.40	0.89	1.23	1.64	2.17	2.11	1.87	1.53	1.14	0.70	0.20	0.13	91
Gauge 11	E62.24	0.00	0.47	1.04	1.44	1.92	2.56	2.49	2.20	1.81	1.34	0.83	0.25	0.16	90
Gauge 12	E62.16	0.00	0.28	0.62	0.87	1.16	1.53	1.50	1.33	1.10	0.82	0.51	0.15	0.10	90
Gauge 13	E62.21	0.00	0.21	0.46	0.64	0.86	1.14	1.11	0.98	0.80	0.59	0.35	0.10	0.07	91
Gauge 14	E62.08	0.00	0.38	0.84	1.17	1.57	2.10	2.04	1.79	1.47	1.07	0.65	0.19	0.11	91
Gauge 15	E62.12	0.00	0.46	1.02	1.41	1.89	2.52	2.45	2.16	1.78	1.31	0.80	0.24	0.14	91
Gauge 16	E62.20	0.00	0.29	0.66	0.91	1.22	1.61	1.57	1.39	1.15	0.85	0.53	0.16	0.11	90
Gauge 17	E62.23	0.00	0.11	0.26	0.37	0.50	0.66	0.63	0.56	0.46	0.33	0.20	0.05	0.05	92
Gauge 18	E62.05	0.00	0.22	0.50	0.70	0.95	1.27	1.22	1.07	0.88	0.64	0.38	0.10	0.07	92
Gauge 19	E62.17	0.00	0.24	0.55	0.78	1.06	1.41	1.37	1.20	0.98	0.71	0.42	0.11	0.08	92
Gauge 20	E62.06	0.00	0.11	0.21	0.30	0.41	0.55	0.53	0.47	0.39	0.29	0.18	0.06	0.06	89
Temperature °C		16	16	16	16	16	16	16	16	16	16	16	16	15	

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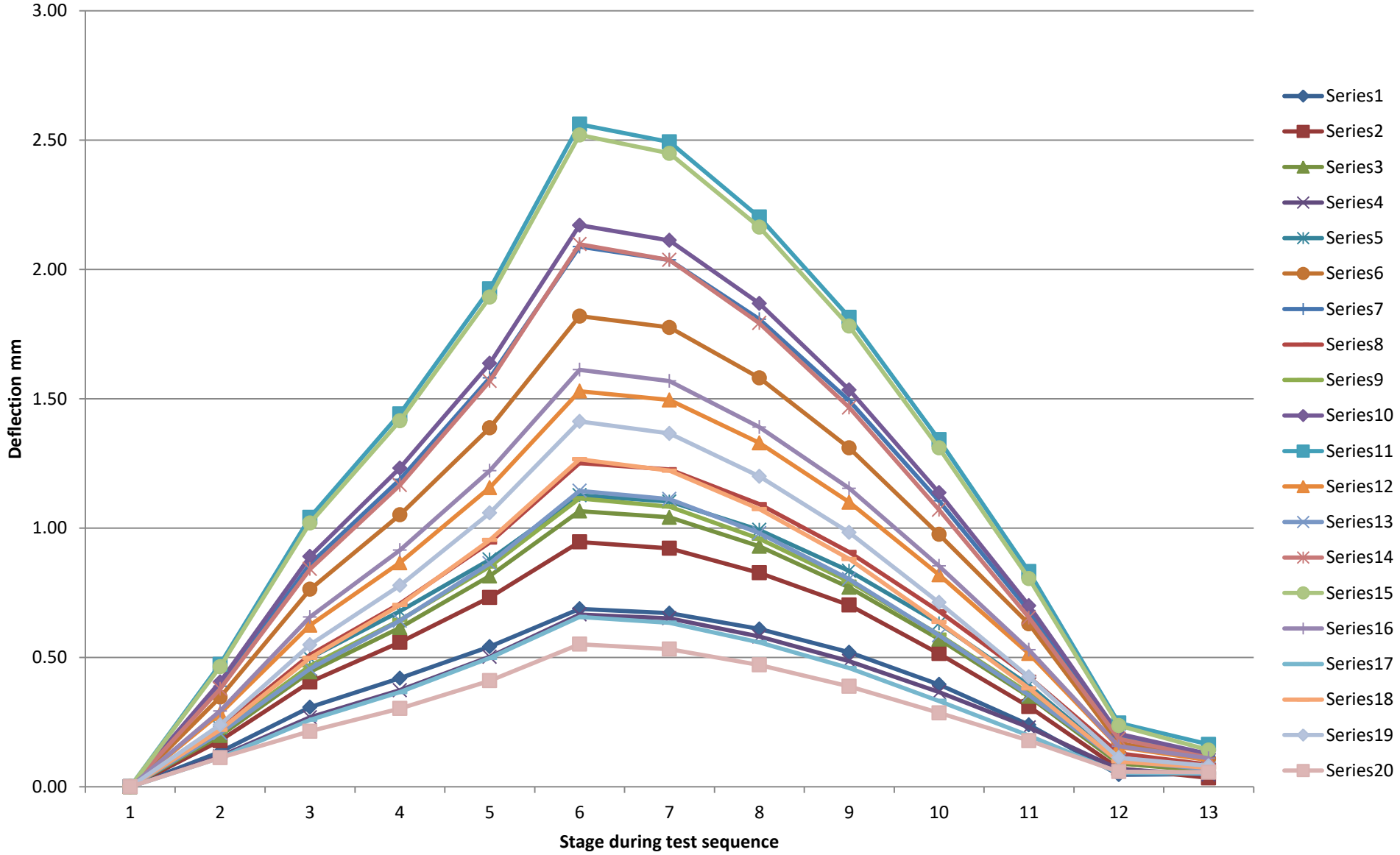
Plot 2 Area 1, Test 2 Deflections during course of test



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Location Test Area 1 (Rooms 19/20), Test 3

		Deflections mm													Recovery %
Date		05/09/19	05/09/19	05/09/19	05/09/19	05/09/19	05/09/19	06/09/19	06/09/19	06/09/19	06/09/19	06/09/19	06/09/19	06/09/19	
Time		07:30	07:55	08:15	08:35	08:55	09:20	09:20	09:40	09:55	10:20	10:45	11:20	12:00	
Stage in test		1	2	3	4	5	6	7	8	9	10	11	12	13	
Load kN/m²		0.00	1.11	2.22	3.33	4.44	5.55	5.55	4.44	3.33	2.22	1.11	0.00	0.00	
	Load	0	20%	40%	60%	80%	100%	100%	80%	60%	40%	20%	0%	0%	
Gauge 1	E62.04	0.00	0.14	0.28	0.43	0.55	0.68	0.70	0.62	0.51	0.40	0.22	0.04	0.03	95
Gauge 2	E62.11	0.00	0.20	0.39	0.59	0.76	0.96	1.00	0.88	0.73	0.57	0.35	0.10	0.09	90
Gauge 3	E62.18	0.00	0.20	0.41	0.62	0.83	1.06	1.14	0.99	0.80	0.63	0.39	0.12	0.11	90
Gauge 4	E62.03	0.00	0.13	0.25	0.38	0.51	0.66	0.72	0.63	0.51	0.40	0.24	0.08	0.08	89
Gauge 5	E62.25	0.00	0.24	0.47	0.71	0.91	1.14	1.15	1.01	0.83	0.65	0.40	0.09	0.07	92
Gauge 6	E62.26	0.00	0.35	0.71	1.09	1.43	1.83	1.91	1.64	1.34	1.05	0.64	0.19	0.16	90
Gauge 7	E62.07	0.00	0.40	0.80	1.23	1.63	2.10	2.22	1.90	1.54	1.21	0.74	0.24	0.20	89
Gauge 8	E62.19	0.00	0.23	0.47	0.73	0.97	1.25	1.34	1.15	0.94	0.74	0.46	0.15	0.13	89
Gauge 9	E62.22	0.00	0.21	0.43	0.66	0.87	1.11	1.15	0.98	0.79	0.61	0.36	0.09	0.07	93
Gauge 10	E62.10	0.00	0.41	0.83	1.27	1.68	2.17	2.28	1.94	1.58	1.22	0.75	0.23	0.19	90
Gauge 11	E62.24	0.00	0.47	0.95	1.47	1.96	2.54	2.71	2.31	1.87	1.46	0.89	0.28	0.23	90
Gauge 12	E62.16	0.00	0.28	0.57	0.88	1.17	1.52	1.64	1.40	1.15	0.90	0.56	0.19	0.16	89
Gauge 13	E62.21	0.00	0.21	0.42	0.65	0.88	1.13	1.16	0.98	0.78	0.59	0.34	0.08	0.06	93
Gauge 14	E62.08	0.00	0.39	0.78	1.20	1.61	2.10	2.17	1.84	1.48	1.12	0.67	0.18	0.15	92
Gauge 15	E62.12	0.00	0.46	0.93	1.44	1.93	2.50	2.64	2.24	1.81	1.39	0.84	0.24	0.20	91
Gauge 16	E62.20	0.00	0.29	0.58	0.90	1.21	1.57	1.68	1.44	1.16	0.90	0.54	0.14	0.11	91
Gauge 17	E62.23	0.00	0.11	0.23	0.37	0.50	0.64	0.65	0.54	0.41	0.32	0.17	0.01	0.01	98
Gauge 18	E62.05	0.00	0.20	0.44	0.70	0.95	1.24	1.28	1.07	0.83	0.63	0.35	0.06	0.05	95
Gauge 19	E62.17	0.00	0.22	0.48	0.77	1.03	1.38	1.44	1.22	0.96	0.73	0.42	0.10	0.09	93
Gauge 20	E62.06	0.00	0.07	0.16	0.27	0.38	0.50	0.53	0.45	0.37	0.28	0.15	0.05	0.04	91
Temperature °C		15	15	15	15	15	15	16	16	16	16	16	16	16	

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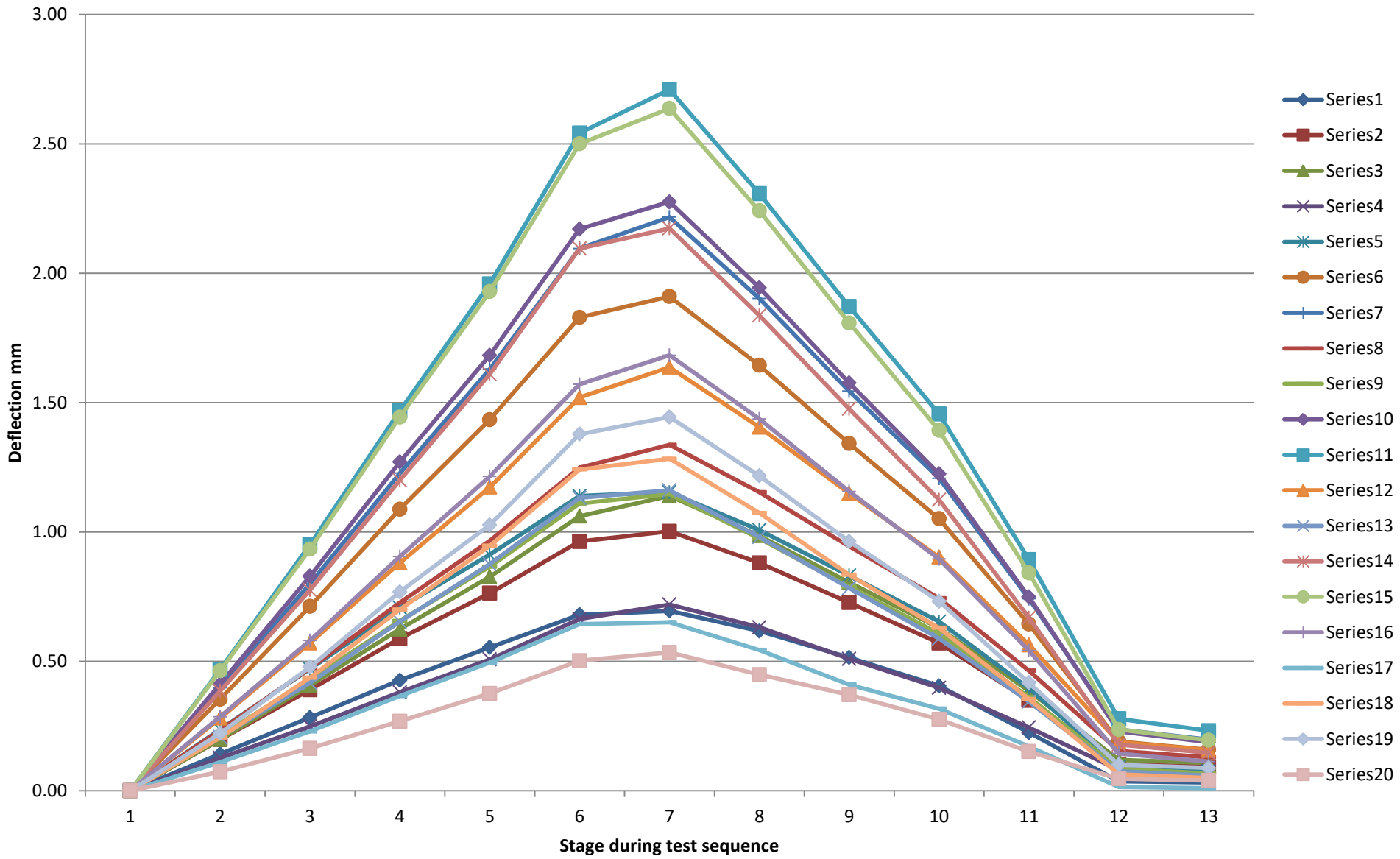
Plot 3 Area 1, Test 3 Deflections during course of test



APPENDIX B

Results for Test Area 2, Lounge

SANDBERG

Location Test Area 2 (Lounge), Test 1

		Deflections mm												Recovery %
	Date	06/09/19	06/09/19	06/09/19	06/09/19	06/09/19	06/09/19	06/09/19	06/09/19	06/09/19	06/09/19	06/09/19	07/09/19	
	Time	14:00	14:20	14:40	15:00	15:25	15:50	16:10	16:30	16:50	17:10	17:35	08:20	
	Stage in test	1	2	3	4	5	6	7	8	9	10	11	12	
	Load kN/m²	0.00	1.11	2.22	3.33	4.44	5.55	4.44	3.33	2.22	1.11	0.00	0.00	
	Load	0	20%	40%	60%	80%	100%	80%	60%	40%	20%	0%	0%	
Gauge 1	E62.04	0.00	0.05	0.11	0.20	0.32	0.46	0.44	0.39	0.34	0.29	0.23	0.19	58
Gauge 2	E62.11	0.00	0.21	0.52	1.00	1.66	2.49	2.36	2.14	1.93	1.69	1.41	1.32	47
Gauge 3	E62.18	0.00	0.26	0.65	1.12	1.89	2.84	2.69	2.44	2.20	1.91	1.59	1.50	47
Gauge 4	E62.24	0.00	0.21	0.48	0.80	1.30	1.96	1.83	1.62	1.43	1.19	0.93	0.87	55
Gauge 5	E62.25	0.00	0.08	0.14	0.17	0.29	0.46	0.43	0.38	0.32	0.25	0.16	0.16	65
Gauge 6	E62.26	0.00	0.14	0.33	0.60	0.96	1.39	1.30	1.17	1.04	0.88	0.71	0.64	54
Gauge 7	E62.07	0.00	0.48	1.13	2.12	3.34	4.76	4.45	3.98	3.53	3.00	2.40	2.26	53
Gauge 8	E62.19	0.00	0.67	1.62	2.88	4.48	6.32	5.90	5.26	4.65	3.91	3.10	2.93	54
Gauge 9	E62.22	0.00	0.61	1.24	2.42	3.75	5.30	4.92	4.35	3.79	3.12	2.38	2.24	58
Gauge 10	E62.10	0.00	0.34	0.71	1.16	1.75	2.39	2.20	1.92	1.64	1.29	0.89	0.81	66
Gauge 11	E62.13	0.00	0.19	0.39	0.73	1.12	1.59	1.48	1.30	1.14	0.95	0.73	0.63	61
Gauge 12	E62.16	0.00	0.57	1.25	2.49	3.90	5.46	5.06	4.50	3.96	3.32	2.62	2.46	55
Gauge 13	E62.21	0.00	0.81	1.84	3.60	5.51	7.65	7.03	6.24	5.50	4.60	3.61	3.40	55
Gauge 14	E62.08	0.00	0.70	1.55	3.06	4.61	6.31	5.82	5.14	4.49	3.72	2.87	2.70	57
Gauge 15	E62.12	0.00	0.39	0.79	1.52	2.25	3.00	2.78	2.44	2.12	1.71	1.26	1.18	61
Gauge 16	E62.20	0.00	0.16	0.35	0.63	0.97	1.37	1.26	1.10	0.96	0.78	0.59	0.50	64
Gauge 17	E62.23	0.00	0.47	1.03	1.97	2.99	4.19	3.84	3.37	2.92	2.40	1.82	1.69	60
Gauge 18	E62.05	0.00	0.62	1.36	2.53	3.77	5.24	4.78	4.17	3.60	2.92	2.18	2.03	61
Gauge 19	E62.17	0.00	0.47	0.99	1.77	2.63	3.64	3.31	2.86	2.44	1.95	1.40	1.28	65
Gauge 20	E62.06	0.00	0.12	0.23	0.38	0.54	0.74	0.68	0.59	0.50	0.39	0.27	0.24	67
Gauge 21	E62.14	0.00	0.02	0.02	-0.01	-0.03	-0.05	-0.07	-0.08	-0.10	-0.11	-0.12	-0.13	>100
Gauge 22	E62.02	0.00	0.19	0.41	0.59	0.88	1.20	1.08	0.90	0.73	0.56	0.35	0.30	75
Gauge 23	E62.29	0.00	0.27	0.55	0.93	1.38	1.90	1.70	1.44	1.19	0.90	0.59	0.53	72
Gauge 24	E62.27	0.00	0.35	0.59	0.93	1.25	1.64	1.52	1.29	1.11	0.89	0.62	0.27	83
Gauge 25	E62.28	0.00	0.06	0.12	0.20	0.29	0.41	0.37	0.31	0.26	0.20	0.13	0.10	76
Temperature °C		17	17	17	17	17	17	17	17	17	17	17	17	

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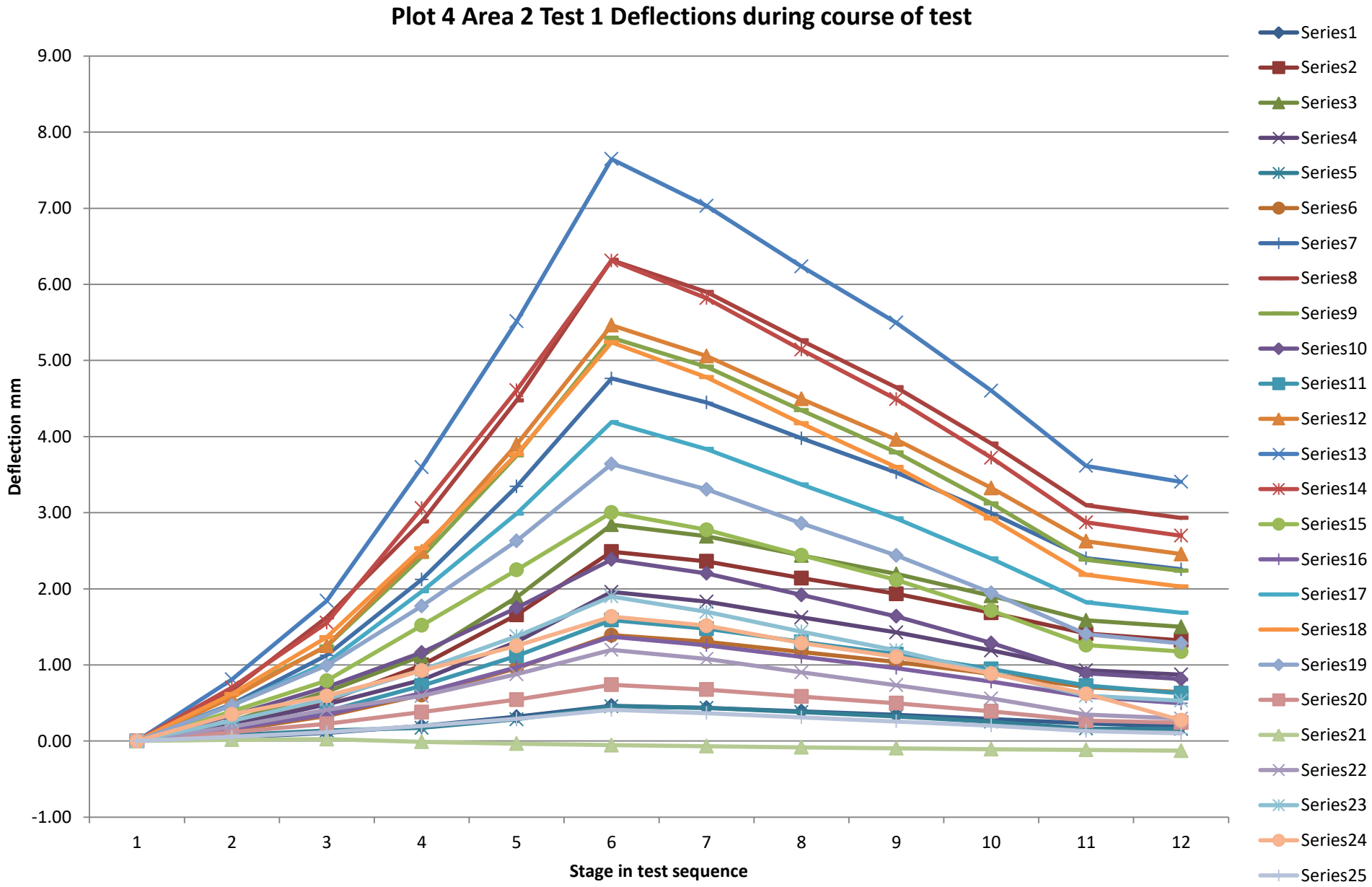
65507/S/1



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Location Test Area 2 (Lounge), Test 2

		Deflections mm													Recovery %
	Date	07/09/19	07/09/19	07/09/19	07/09/19	07/09/19	07/09/19	07/09/19	07/09/19	07/09/19	07/09/19	07/09/19	07/09/19	07/09/19	
	Time	08:20	08:45	09:05	09:30	09:55	10:20	11:25	11:50	12:05	12:25	12:45	13:15	14:20	
	Stage in test	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Load kN/m²	0.00	1.11	2.22	3.33	4.44	5.55	5.55	4.44	3.33	2.22	1.11	0.00	0.00	
	Load	0	20%	40%	60%	80%	100%	100%	80%	60%	40%	20%	0%	0%	
Gauge 1	E62.04	0.00	0.06	0.11	0.17	0.22	0.29	0.32	0.29	0.25	0.20	0.15	0.09	0.08	75
Gauge 2	E62.11	0.00	0.23	0.48	0.73	0.98	1.31	1.39	1.21	1.00	0.79	0.56	0.25	0.21	85
Gauge 3	E62.18	0.00	0.27	0.56	0.85	1.13	1.51	1.61	1.41	1.17	0.92	0.64	0.29	0.24	85
Gauge 4	E62.24	0.00	0.23	0.46	0.69	0.91	1.22	1.29	1.13	0.94	0.73	0.51	0.22	0.19	85
Gauge 5	E62.25	0.00	0.10	0.19	0.25	0.30	0.40	0.45	0.40	0.35	0.29	0.22	0.11	0.14	69
Gauge 6	E62.26	0.00	0.15	0.30	0.46	0.61	0.81	0.87	0.76	0.64	0.50	0.36	0.17	0.14	84
Gauge 7	E62.07	0.00	0.49	1.00	1.54	2.08	2.75	2.87	2.48	2.03	1.56	1.06	0.41	0.32	89
Gauge 8	E62.19	0.00	0.64	1.33	2.06	2.77	3.71	3.88	3.36	2.74	2.09	1.40	0.51	0.40	90
Gauge 9	E62.22	0.00	0.58	1.21	1.86	2.50	3.35	3.50	3.03	2.49	1.91	1.28	0.46	0.36	90
Gauge 10	E62.10	0.00	0.32	0.69	1.00	1.32	1.79	1.88	1.63	1.36	1.06	0.72	0.28	0.28	85
Gauge 11	E62.13	0.00	0.20	0.40	0.59	0.78	1.02	1.08	0.93	0.77	0.60	0.42	0.18	0.15	86
Gauge 12	E62.16	0.00	0.57	1.19	1.82	2.43	3.25	3.37	2.90	2.36	1.80	1.20	0.43	0.33	90
Gauge 13	E62.21	0.00	0.77	1.63	2.53	3.40	4.57	4.74	4.05	3.30	2.53	1.68	0.60	0.46	90
Gauge 14	E62.08	0.00	0.69	1.43	2.18	2.93	3.94	4.08	3.51	2.87	2.18	1.45	0.51	0.39	91
Gauge 15	E62.12	0.00	0.34	0.71	1.10	1.49	2.04	2.15	1.89	1.57	1.21	0.82	0.31	0.28	87
Gauge 16	E62.20	0.00	0.17	0.35	0.52	0.69	0.90	0.95	0.83	0.67	0.51	0.35	0.13	0.11	88
Gauge 17	E62.23	0.00	0.47	0.99	1.51	2.01	2.68	2.77	2.37	1.93	1.48	0.98	0.35	0.27	90
Gauge 18	E62.05	0.00	0.61	1.28	1.94	2.59	3.44	3.55	3.04	2.47	1.88	1.24	0.43	0.32	91
Gauge 19	E62.17	0.00	0.46	0.98	1.45	1.91	2.56	2.62	2.25	1.83	1.40	0.92	0.32	0.24	91
Gauge 20	E62.06	0.00	0.10	0.21	0.31	0.41	0.54	0.57	0.50	0.42	0.33	0.23	0.10	0.08	86
Gauge 21	E62.14	0.00	0.01	0.03	0.04	0.05	0.06	0.07	0.06	0.05	0.04	0.03	0.02	0.01	82
Gauge 22	E62.02	0.00	0.17	0.34	0.56	0.75	0.96	1.00	0.86	0.69	0.51	0.33	0.10	0.07	93
Gauge 23	E62.29	0.00	0.25	0.55	0.82	1.09	1.44	1.48	1.26	1.01	0.76	0.49	0.15	0.10	93
Gauge 24	E62.27	0.00	0.44	0.66	0.93	1.14	1.38	1.45	1.26	1.09	0.90	0.69	0.37	0.33	77
Gauge 25	E62.28	0.00	0.06	0.12	0.18	0.24	0.31	0.33	0.28	0.23	0.16	0.12	0.04	0.04	88
Temperature °C		17	17	17	17	17	17	17	17	18	18	18	18	17	

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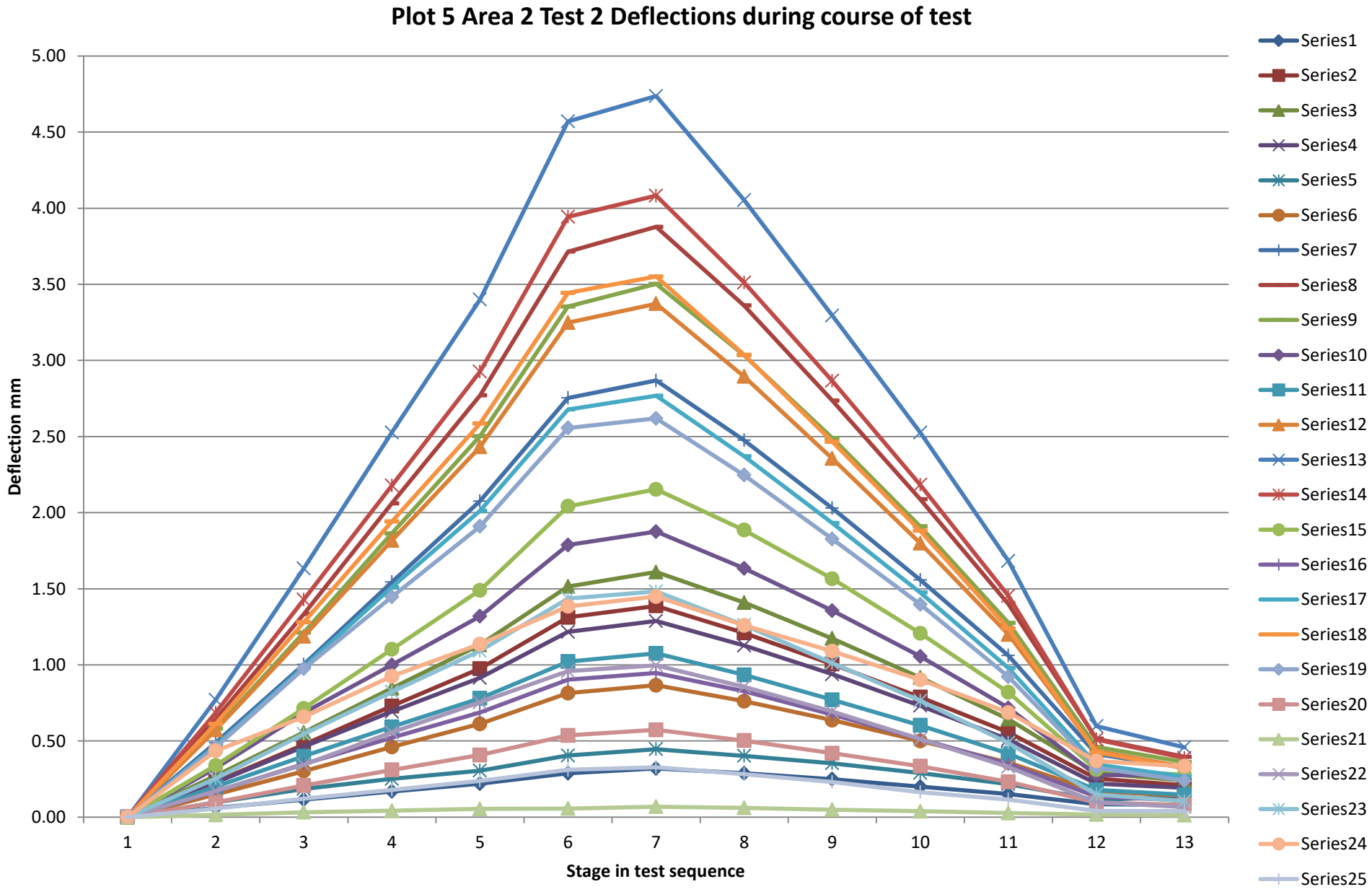
65507/S/1



SANDBERG

Location Test Area 2 (Lounge), Test 3

		Deflections mm													Recovery %
	Date	07/09/19	07/09/19	07/09/19	07/09/19	07/09/19	07/09/19	08/09/19	08/09/19	08/09/19	08/09/19	08/09/19	08/09/19	09/09/19	
	Time	14:20	14:45	15:05	15:25	15:50	16:10	16:10	16:25	16:45	17:25	17:45	18:15	10:00	
	Stage in test	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Load kN/m²	0.00	1.11	2.22	3.33	4.44	5.55	5.55	4.44	3.33	2.22	1.11	0.00	0.00	
	Load	0	20%	40%	60%	80%	100%	100%	80%	60%	40%	20%	0%	0%	
Gauge 1	E62.04	0.00	0.04	0.08	0.13	0.17	0.22	0.23	0.20	0.15	0.11	0.06	-0.01	-0.06	>100
Gauge 2	E62.11	0.00	0.20	0.43	0.67	0.90	1.13	1.22	1.05	0.84	0.63	0.41	0.08	-0.02	>100
Gauge 3	E62.18	0.00	0.23	0.49	0.77	1.03	1.29	1.41	1.20	0.96	0.71	0.46	0.31	-0.02	>100
Gauge 4	E62.24	0.00	0.17	0.37	0.58	0.78	0.98	1.07	0.90	0.70	0.51	0.30	-0.02	-0.06	>100
Gauge 5	E62.25	0.00	0.04	0.09	0.14	0.18	0.21	0.26	0.22	0.17	0.11	0.05	-0.06	-0.07	>100
Gauge 6	E62.26	0.00	0.12	0.26	0.41	0.55	0.69	0.74	0.64	0.51	0.39	0.25	0.04	-0.04	>100
Gauge 7	E62.07	0.00	0.45	0.94	1.46	1.95	2.45	2.64	2.25	1.80	1.35	0.89	0.17	0.03	99
Gauge 8	E62.19	0.00	0.60	1.26	1.98	2.66	3.34	3.62	3.09	2.46	1.84	1.21	0.22	0.07	98
Gauge 9	E62.22	0.00	0.67	1.11	1.76	2.37	2.97	3.23	2.78	2.19	1.63	1.05	0.15	0.01	100
Gauge 10	E62.10	0.00	0.23	0.52	0.84	1.14	1.43	1.58	1.38	1.09	0.80	0.49	0.00	-0.10	>100
Gauge 11	E62.13	0.00	0.16	0.33	0.52	0.70	0.87	0.92	0.80	0.63	0.47	0.30	0.04	-0.06	>100
Gauge 12	E62.16	0.00	0.53	1.11	1.73	2.32	2.91	3.14	2.69	2.12	1.59	1.04	0.19	0.03	99
Gauge 13	E62.21	0.00	0.72	1.53	2.42	3.26	4.10	4.42	3.78	2.97	2.23	1.46	0.24	0.05	99
Gauge 14	E62.08	0.00	0.63	1.32	2.07	2.78	3.50	3.78	3.24	2.62	1.90	1.23	0.19	0.02	99
Gauge 15	E62.12	0.00	0.28	0.61	0.99	1.35	1.70	1.90	1.65	1.30	0.97	0.61	0.05	-0.06	>100
Gauge 16	E62.20	0.00	0.15	0.30	0.47	0.63	0.79	0.83	0.70	0.56	0.42	0.26	0.03	-0.06	>100
Gauge 17	E62.23	0.00	0.44	0.92	1.43	1.92	2.40	2.58	2.20	1.74	1.30	0.85	0.15	0.02	99
Gauge 18	E62.05	0.00	0.57	1.18	1.84	2.47	3.09	3.34	2.82	2.22	1.66	1.08	0.18	0.04	99
Gauge 19	E62.17	0.00	0.41	0.86	1.33	1.79	2.23	2.40	2.05	1.60	1.19	0.76	0.10	0.00	100
Gauge 20	E62.06	0.00	0.09	0.18	0.27	0.36	0.45	0.51	0.44	0.35	0.26	0.17	0.02	0.00	100
Gauge 21	E62.14	0.00	0.00	0.01	0.02	0.03	0.03	0.06	0.04	0.04	0.03	0.02	0.01	0.00	>100
Gauge 22	E62.02	0.00	0.16	0.35	0.52	0.70	0.86	0.95	0.80	0.62	0.47	0.30	0.01	0.00	99
Gauge 23	E62.29	0.00	0.23	0.49	0.77	1.04	1.30	1.41	1.20	0.93	0.69	0.44	0.06	0.00	100
Gauge 24	E62.27	0.00	0.21	0.44	0.59	0.83	1.06	1.14	0.98	0.80	0.66	0.46	0.19	-0.09	>100
Gauge 25	E62.28	0.00	0.04	0.11	0.17	0.23	0.28	0.31	0.26	0.22	0.17	0.11	0.03	-0.02	>100
Temperature °C		17	17	17	17	17	17	17	17	17	17	17	17	17	

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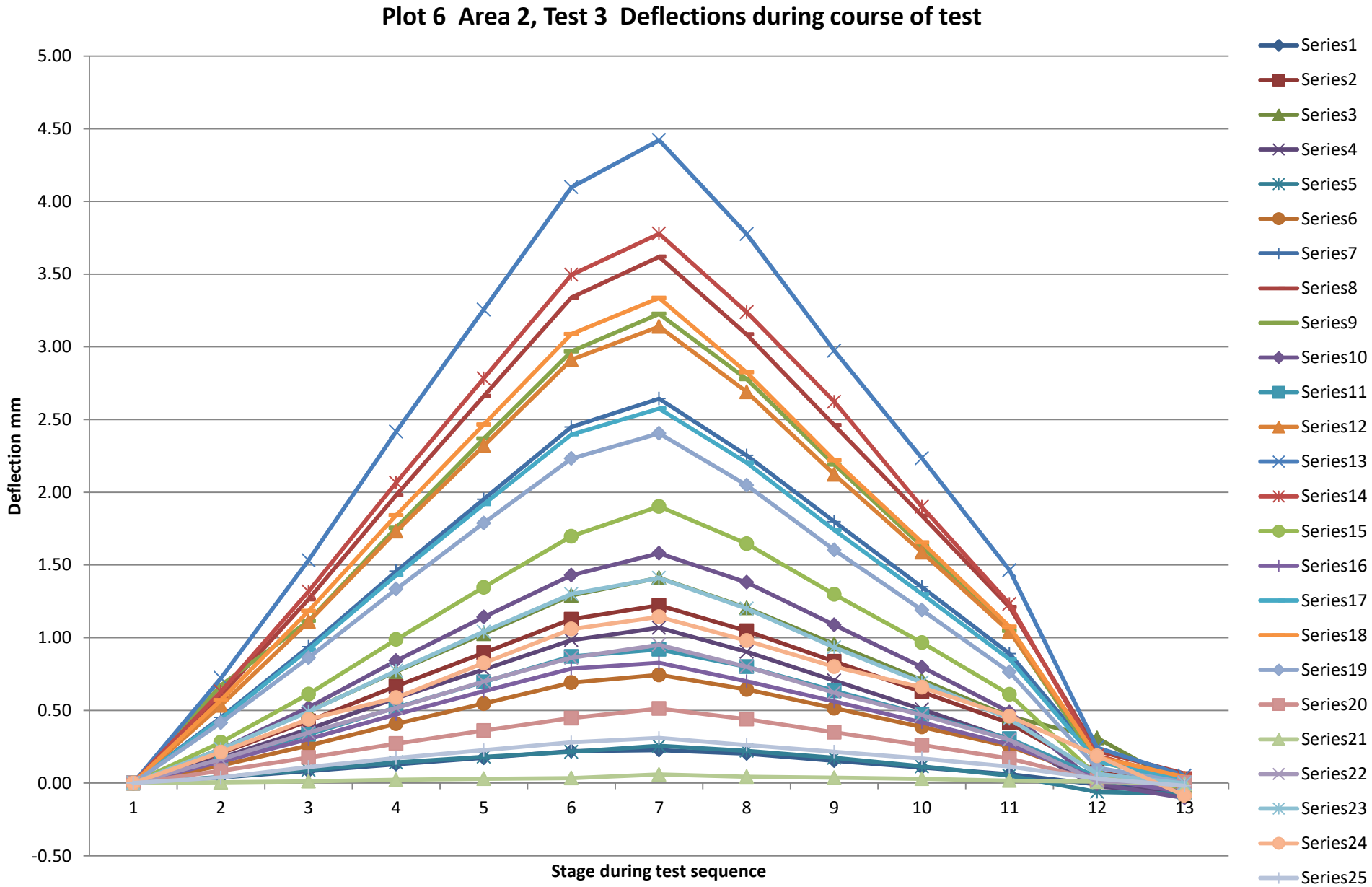


APPENDIX C

Results for Test Area 3, Room 18

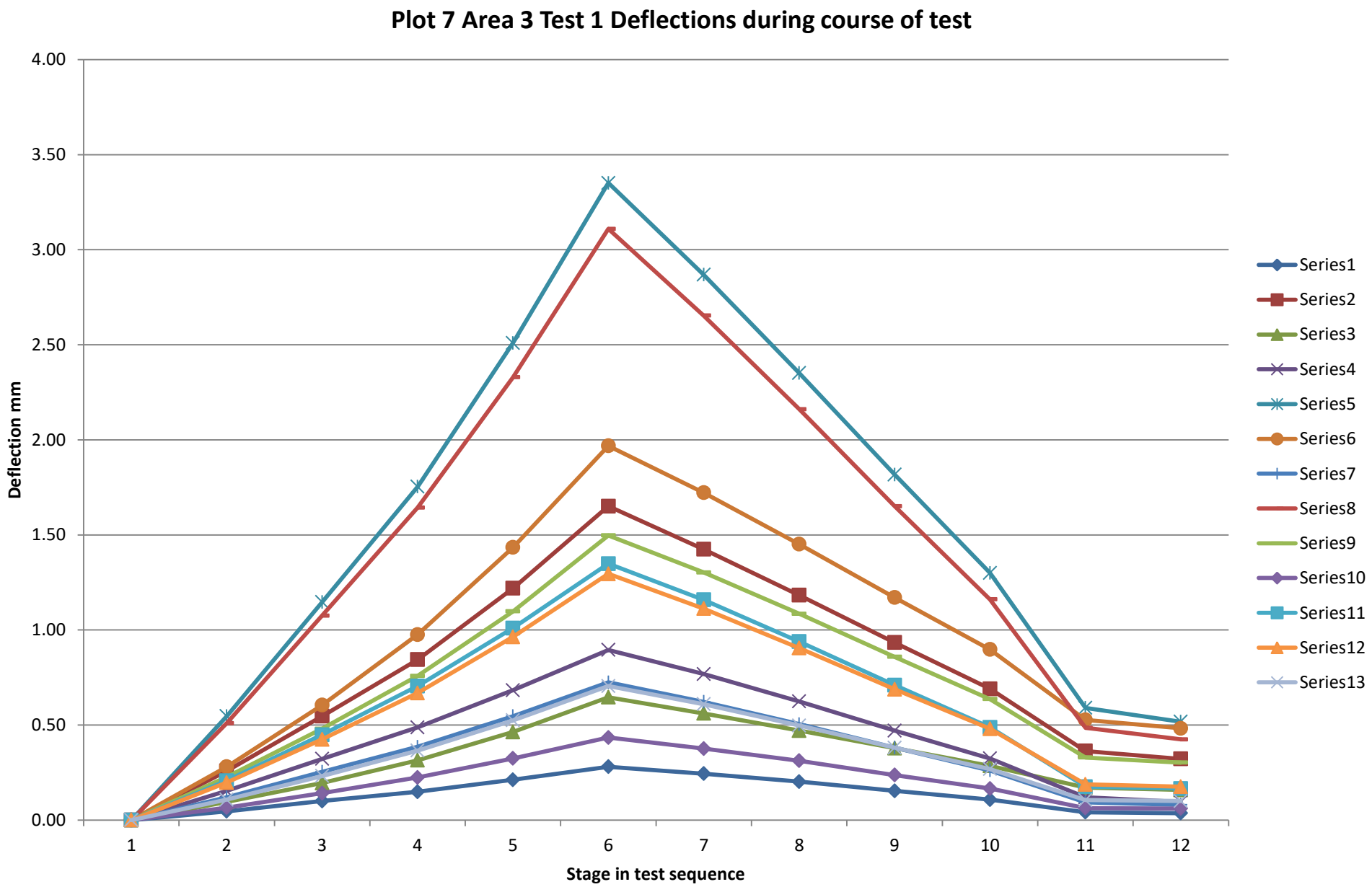
SANDBERG

Location Test Area 3 (Room 18), Test 1

		Deflections mm												Recovery %
	Date	09/09/19	09/09/19	09/09/19	09/09/19	09/09/19	09/09/19	09/09/19	09/09/19	09/09/19	09/09/19	09/09/19	09/09/19	
	Time	10:00	10:15	10:25	10:35	10:50	11:00	11:15	11:25	11:35	11:50	12:05	13:05	
	Stage in test	1	2	3	4	5	6	7	8	9	10	11	12	
	Load kN/m²	0.00	1.11	2.22	3.33	4.44	5.55	4.44	3.33	2.22	1.11	0.00	0.00	
	Load	0	20%	40%	60%	80%	100%	80%	60%	40%	20%	0%	0%	
Gauge 1	E62.04	0.00	0.05	0.10	0.15	0.21	0.28	0.24	0.20	0.15	0.11	0.04	0.04	87
Gauge 2	E62.11	0.00	0.26	0.55	0.84	1.22	1.65	1.42	1.18	0.93	0.69	0.36	0.32	81
Gauge 3	E62.18	0.00	0.10	0.20	0.31	0.46	0.65	0.56	0.47	0.38	0.29	0.17	0.16	75
Gauge 4	E62.24	0.00	0.15	0.32	0.49	0.68	0.90	0.77	0.62	0.47	0.32	0.12	0.10	89
Gauge 5	E62.25	0.00	0.55	1.15	1.75	2.51	3.35	2.87	2.35	1.82	1.30	0.59	0.52	85
Gauge 6	E62.26	0.00	0.28	0.60	0.98	1.43	1.97	1.72	1.45	1.17	0.90	0.53	0.48	75
Gauge 7	E62.02	0.00	0.12	0.25	0.39	0.55	0.72	0.62	0.50	0.38	0.26	0.09	0.08	89
Gauge 8	E62.19	0.00	0.51	1.08	1.64	2.33	3.11	2.65	2.16	1.65	1.16	0.49	0.42	86
Gauge 9	E62.22	0.00	0.23	0.48	0.76	1.10	1.50	1.30	1.09	0.86	0.64	0.33	0.30	80
Gauge 10	E62.10	0.00	0.07	0.14	0.22	0.32	0.43	0.38	0.31	0.24	0.17	0.06	0.06	86
Gauge 11	E62.13	0.00	0.21	0.45	0.70	1.01	1.35	1.16	0.94	0.71	0.49	0.18	0.17	88
Gauge 12	E62.16	0.00	0.20	0.42	0.67	0.96	1.30	1.11	0.90	0.69	0.48	0.19	0.18	86
Gauge 13	E62.21	0.00	0.11	0.23	0.37	0.52	0.70	0.61	0.50	0.38	0.27	0.10	0.10	86
Temperature °C		17	17	17	17	17	17	18	18	18	18	18	18	

SANDBERG

65507/S/1



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Location Test Area 3 (Room 18), Test 2

		Deflections mm													Recovery %
	Date	09/09/19	09/09/19	09/09/19	09/09/19	09/09/19	09/09/19	09/09/19	09/09/19	09/09/19	09/09/19	09/09/19	09/09/19	10/09/19	
	Time	13:05	13:20	13:35	13:45	13:55	14:10	15:15	15:25	15:35	15:50	16:00	16:15	08:00	
	Stage in test	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Load kN/m²	0.00	1.11	2.22	3.33	4.44	5.55	5.55	4.44	3.33	2.22	1.11	0.00	0.00	
	Load	0	20%	40%	60%	80%	100%	100%	80%	60%	40%	20%	0%	0%	
Gauge 1	E62.04	0.00	0.05	0.10	0.15	0.20	0.25	0.26	0.22	0.18	0.13	0.08	0.01	-0.02	>100
Gauge 2	E62.11	0.00	0.27	0.54	0.79	1.08	1.36	1.40	1.17	0.93	0.67	0.40	0.07	-0.02	>100
Gauge 3	E62.18	0.00	0.10	0.20	0.29	0.40	0.50	0.52	0.43	0.34	0.25	0.14	0.03	-0.02	>100
Gauge 4	E62.24	0.00	0.15	0.31	0.46	0.64	0.80	0.81	0.68	0.54	0.38	0.21	0.00	-0.12	>100
Gauge 5	E62.25	0.00	0.57	1.12	1.66	2.27	2.88	2.94	2.43	1.93	1.38	0.80	0.10	-0.04	>100
Gauge 6	E62.26	0.00	0.30	0.59	0.88	1.20	1.53	1.57	1.31	1.04	0.76	0.45	0.08	-0.01	>100
Gauge 7	E62.02	0.00	0.11	0.24	0.36	0.50	0.64	0.65	0.55	0.43	0.30	0.17	-0.01	-0.11	>100
Gauge 8	E62.19	0.00	0.53	1.06	1.57	2.16	2.73	2.79	2.31	1.83	1.31	0.75	0.09	-0.05	>100
Gauge 9	E62.22	0.00	0.24	0.47	0.70	0.97	1.23	1.26	1.06	0.84	0.61	0.36	0.05	-0.03	>100
Gauge 10	E62.10	0.00	0.07	0.14	0.22	0.31	0.40	0.41	0.34	0.28	0.20	0.12	0.03	-0.06	>100
Gauge 11	E62.13	0.00	0.22	0.45	0.69	0.96	1.23	1.26	1.06	0.84	0.61	0.36	0.05	-0.05	>100
Gauge 12	E62.16	0.00	0.21	0.42	0.65	0.90	1.16	1.19	1.00	0.79	0.57	0.33	0.05	-0.05	>100
Gauge 13	E62.21	0.00	0.12	0.24	0.36	0.49	0.63	0.65	0.54	0.43	0.32	0.19	0.03	-0.04	>100
Temperature °C		18	18	18	18	18	18	18	18	18	18	18	18	17	

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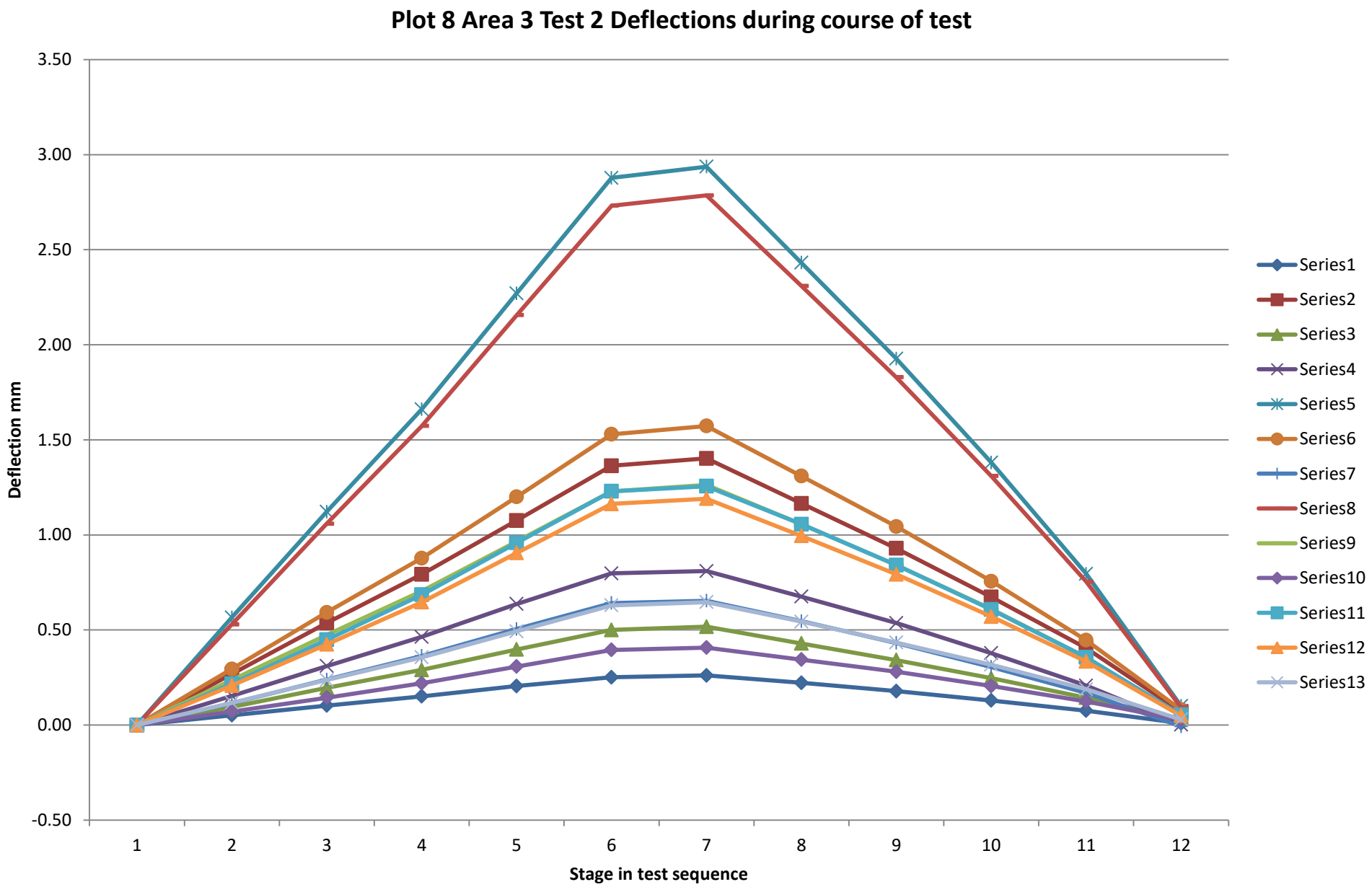
65507/S/1



SANDBERG

Location Test Area 3 (Room 18), Test 3

		Deflections mm													Recovery %
	Date	10/09/19	10/09/19	10/09/19	10/09/19	10/09/19	10/09/19	10/09/19	11/09/19	11/09/19	11/09/19	11/09/19	11/09/19	11/09/19	
	Time	08:00	08:15	08:25	08:35	08:45	09:00	13:45	09:00	09:15	09:25	09:40	09:50	10:05	
	Stage in test	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Load kN/m²	0.00	1.11	2.22	3.33	4.44	5.55	5.55	5.55	4.44	3.33	2.22	1.11	0.00	
	Load	0	20%	40%	60%	80%	100%	100%	100%	80%	60%	40%	20%	0%	
Gauge 1	E62.04	0.00	0.07	0.13	0.18	0.22	0.27	0.27	0.23	0.19	0.13	0.08	0.02	-0.05	>100
Gauge 2	E62.11	0.00	0.28	0.59	0.85	1.11	1.41	1.44	1.33	1.10	0.86	0.60	0.31	-0.02	>100
Gauge 3	E62.18	0.00	0.10	0.21	0.31	0.41	0.51	0.53	0.44	0.35	0.26	0.17	0.06	-0.05	>100
Gauge 4	E62.24	0.00	0.19	0.39	0.55	0.70	0.87	0.87	0.80	0.66	0.51	0.34	0.17	-0.04	>100
Gauge 5	E62.25	0.00	0.55	1.19	1.75	2.31	2.94	3.00	2.88	2.39	1.86	1.31	0.71	0.00	100
Gauge 6	E62.26	0.00	0.29	0.62	0.93	1.22	1.56	1.61	1.50	1.24	0.96	0.68	0.36	-0.01	>100
Gauge 7	E62.02	0.00	0.10	0.25	0.38	0.51	0.66	0.69	0.63	0.51	0.39	0.26	0.12	-0.06	>100
Gauge 8	E62.19	0.00	0.51	1.11	1.66	2.19	2.79	2.86	2.73	2.27	1.77	1.25	0.69	0.00	>100
Gauge 9	E62.22	0.00	0.22	0.49	0.73	0.98	1.25	1.30	1.20	0.99	0.77	0.53	0.28	-0.03	>100
Gauge 10	E62.10	0.00	0.08	0.16	0.24	0.32	0.42	0.46	0.34	0.30	0.24	0.16	0.08	-0.03	>100
Gauge 11	E62.13	0.00	0.20	0.45	0.70	0.95	1.24	1.32	1.20	1.00	0.79	0.55	0.29	-0.03	>100
Gauge 12	E62.16	0.00	0.19	0.44	0.68	0.91	1.18	1.25	1.11	0.93	0.73	0.50	0.26	-0.04	>100
Gauge 13	E62.21	0.00	0.10	0.24	0.37	0.50	0.64	0.68	0.58	0.48	0.38	0.25	0.12	-0.04	>100
Temperature °C		17	17	17	17	17	17	17	14	14	14	14	14	15	

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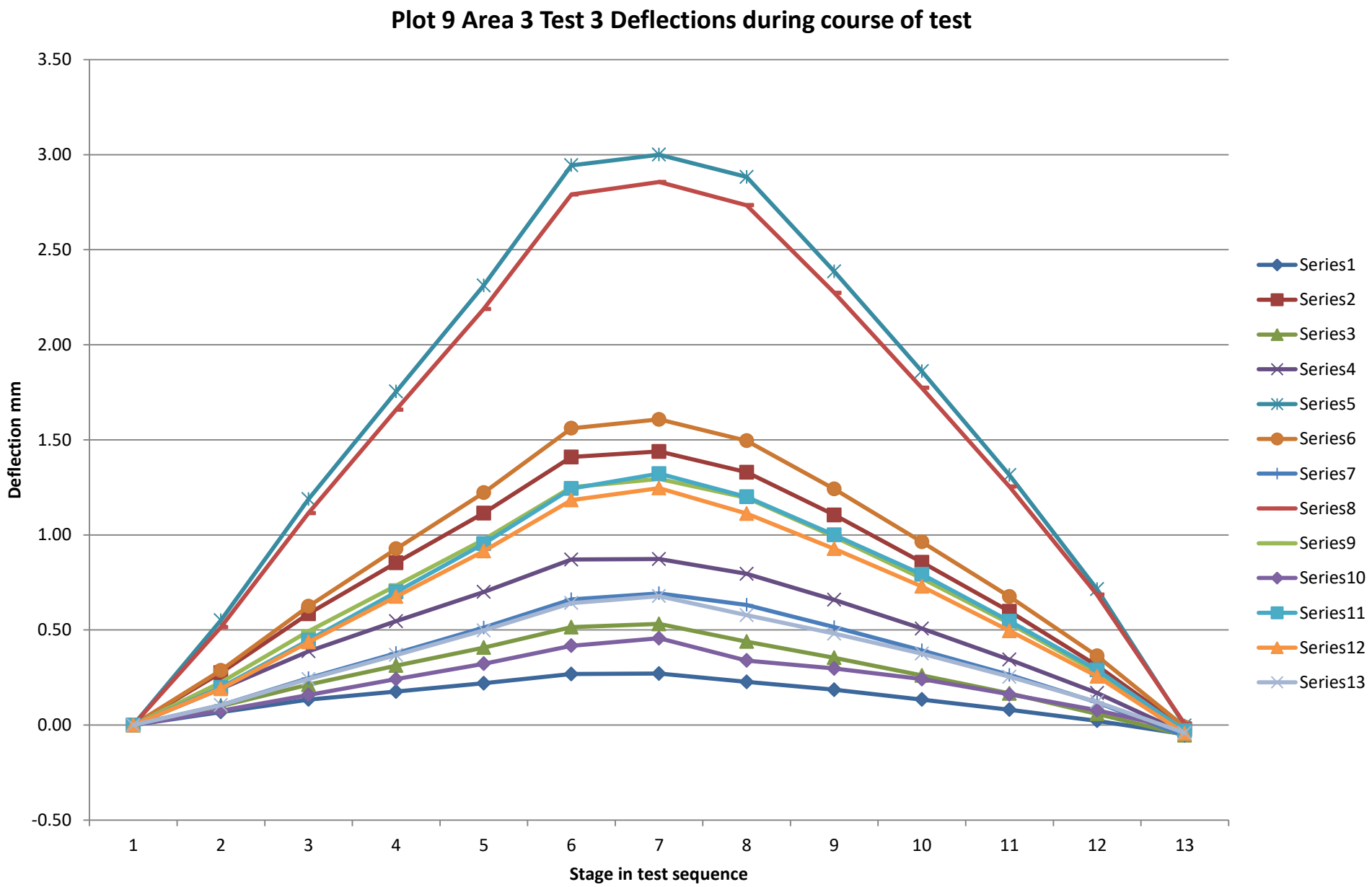

Plot 9 Area 3 Test 3 Deflections during course of test
Deflection mm
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
1
2
3
4
5
6
7
8
9
10
11
12
13
Stage in test sequence
Series1
Series2
Series3
Series4
Series5
Series6
Series7
Series8
Series9
Series10
Series11
Series12
Series13

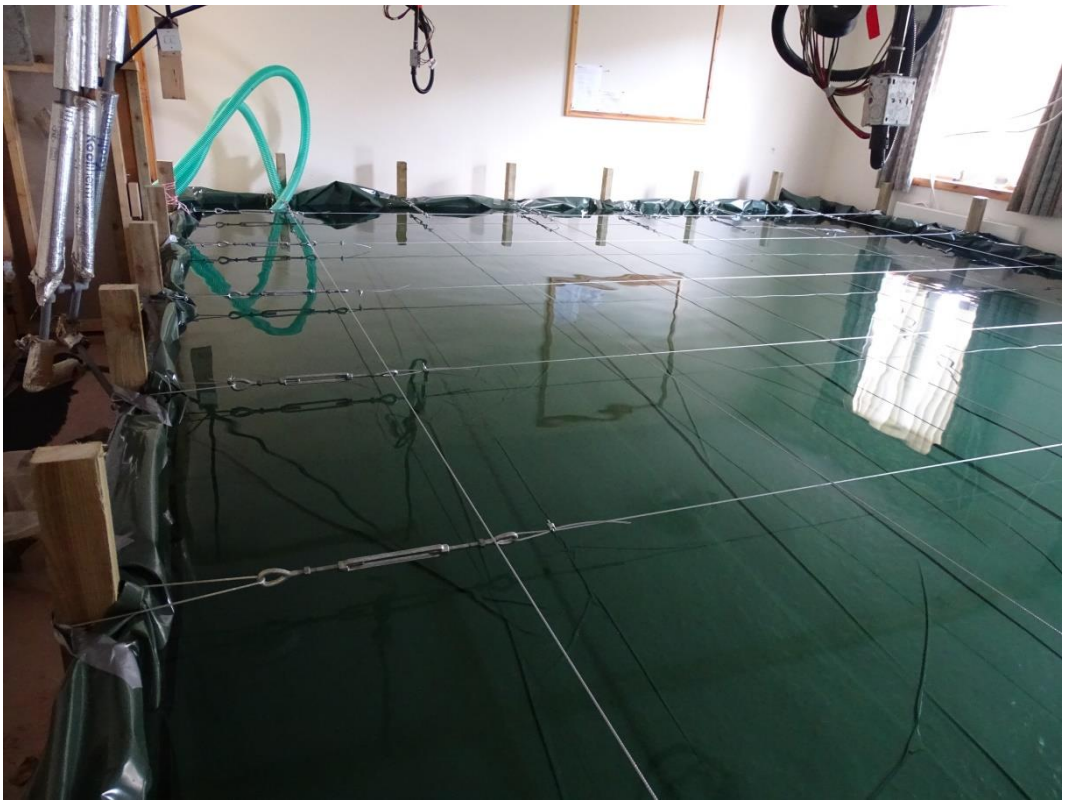
PHOTOGRAPHS

Photograph 1 View of Port Arthur House

Photograph 2 View across Rooms 19/20

Photograph 3 Scaffold below Rooms 19/20

Photograph 4 A typical LVDT displacement sensor mounted below a soffit



Photograph 5 Rooms 19/20 with the water tank filled

Photograph 6 View across the first floor lounge

Photograph 7 The tank under construction in the first floor lounge

Photograph 8 Scaffold and instruments below the lounge

Photograph 9 The lounge with the water tank filled

Photograph 10 Room 18 empty (showing the two core holes that were cut after the load test)

Photograph 11 The tank under construction in Room 18

Photograph 12 Room 18 with the tank filled