ATRIA & FARRINO

LOAD & DURABILITY CERTIFICATION

BS EN 1991-1-4:2005+A1:2010

RAAFT

TEST REPORT

Lucideon Reference:	UK234413 (QT-72325/1/MM)/Ref. 2
Project Title:	Load and Durability Testing of Raaft Ltd's Preventa System Incorporating Atria and Farrino Porcelain Tiles
Client:	Raaft Ltd Compass Park Staplecross East Sussex TN32 5BS
For the Attention of:	Mr Stuart Bowie
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CONTENTS

1 INTRODUCTION

Raaft Ltd supply Raised Decking Systems.

They required a programme of testing to establish the resistivity to wind uplift of their Raaft Preventa System, incorporating Atria and Farrino Porcelain Tiles.

Raaft Ltd provided Lucideon Limited with the following materials to construct samples of each of the systems within Lucideon Limited's wind uplift rig:

- Preventa Metal Pedestals.
- Preventa Aluminium Joists.
- Preventa Wind Uplift Clips.
- 4 mm Tile Spacers (4 way).
- Atria 20 mm Porcelain Tiles.
- Farrino 20 mm Porcelain Decking.

Product Data Sheets for each component supplied can be found within Appendix A, along with Installation Instructions.

Testing was completed between 18 January and 24 March 2025 in Lucideon Limited's Structures Laboratory, Queens Road, Stoke-on-Trent, ST4 7LQ.

Installation was completed by Representatives from Lucideon Limited following Raaft Ltd's installation videos and literature.

2 TEST PROGRAMME

The following testing was completed on samples of both the Preventa System incorporating Atria and Farrino Porcelain Tiles.

Table 1 − Test Programme

Test Type	Test	Standard	Clause	Sample Size
Load Testing	Point Load	BS EN 1991-1-1:2002	6.3.1.2	1800 mm x 1800 mm
	Uniformly Distributed Load (UDL)			
	Soft Body Impacts	BS EN 12871:2013	6.2.5	
	Hard Body Impacts	ISO 7892:1998	3.1	
Durability Testing	Hygrothermal Testing	EAD 090062-01-0404:2021	Annex M	1200 mm x 800 mm

3 SAMPLE CONSTRUCTION

Samples were constructed by Representatives from Lucideon Limited following Raaft Ltd's installation videos and literature, which can be seen in Appendix A.

The Raaft Preventa System with Atria 20 mm Porcelain Tiles consisted of the following components:

- 600 mm x 600 mm x 20 mm Atria Porcelain Tiles laid in a half bond pattern.
- Preventa Metal Pedestals spaced along the Preventa Aluminium Joists at 600 mm centres.
- Preventa Aluminium Joists set at 300 mm centres.
- Wind Uplift Clips installed per installation manual of two per tile.
- 4 mm tile spacers installed per installation manual (snapped to suit the tile junction).

The Raaft Preventa System with Farrino 20 mm Porcelain Decking consisted of the following components:

- 1200 mm x 200 mm x 20 mm Farrino Porcelain Decking laid in a third bond pattern.
- Preventa Metal Pedestals spaced along the Preventa Aluminium Joists at 200 mm centres.
- Preventa Aluminium Joists set at 400 mm centres.
- Wind Uplift Clips installed per installation manual of two per tile.
- 4 mm tile spacers installed per installation manual (snapped to suit the tile junction).

Photographs of each test set-up can be seen in the Plates Section of this report.

4 TEST METHODS

4.1 Point Load Testing

Testing was completed in accordance with BS EN 1991-1-1:2002 Eurocode 1: Actions on Structures – Part 1-1:General Actions – Densities, Self-Weight, Imposed Loads for Buildings and NA to BS EN 1991:2002 UK National Annex to Eurocode 1: Actions on Structures – Part 1-1:General Actions – Densities, Self-Weight, Imposed Loads for Buildings.

For each set of point load tests, two portal frames were spanned over the floor system and bolted down to the Structures Laboratory Strong Floor to ensure rigidity.

A crossbeam was clamped to span in between the portal frames. A hydraulic ram was fixed to the crossbeam, with the ability to be moved along the beam, to suit the relevant loading position.

The ram had a calibrated load cell connected in a series within a cage, to measure the load applied to the board, and a hand pumping unit was used to apply said load.

A 50 mm square loading plate was placed onto the relevant loading position, to enable application of the load.

On top of this loading plate was an additional, wider steel plate to allow for two deflection readings to be taken, either side of the hydraulic ram.

Two calibrated Linear Voltage Displacement Transducers (LVDT's) were positioned via scaffolding and connected to the steel plate described.

The LVDT's and the load cell were connected to a calibrated Data Logger and laptop to record data at a frequency of 1 Hz.

Refer to Plate 1 for the general test arrangement.

Load was applied to the loading plate until such time as the sample failed.

4.2 Uniformly Distributed Load (UDL) Testing

Testing was completed in accordance with BS EN 1991-1-1:2002 and NA to BS EN 1991−1−1:2002 and In-House Methodology BM56 – Test Methodology (UDL Airbag).

There is no test method for this test stated within the aforementioned Standard, there are however, based upon the classification of the floor under test, values at which the floor should not fail. These are detailed within Table 6.2 of BS EN 1991-1-1:2002 and further defined within Table NA.3 within NA to BS EN 1991-1-1:2002.

There is also no serviceability limit state noted within BS EN 1991-1-1:2002 or NA to BS EN 1991-1-1:2002. Therefore, the limit state defined within Table NA.5 for limiting factors for deflections of individual beams within NA to BS EN 1995-1-1:2004 +A2:2014 UK National Annex to Eurocode 5: Design of Timber Structures – Part 1-1: General – Common Rules and Rules for Buildings was Adopted.

This serviceability limit state of L/250 where L is the clear span between bearers was set as detailed below:

- Atria Tiles System serviceability limit state was 1.2 mm.
- Farrino Tiles System serviceability limit state was 1.6 mm.

Two No. large steel stanchions, each comprising a 500 mm x 500 mm x 10 mm baseplate with a 152 x 152 x 37 Universal Column (UC) welded at right angles to one face of the baseplate, were bolted to the laboratory strong floor at 2000 mm centres along one widths edge.

Two No. large steel stanchions, each comprising a 500 mm x 500 mm x 10 mm baseplate with a 152 x 152 x 37 UC welded at right angles to one face of the baseplate, were bolted to the laboratory strong floor at 2000 mm centres along the opposing floor widths edge.

Two No. 406 x 178 x 60 Universal Beams (UB's) were clamped across each opposing pair of stanchions.

Air bags were laid across the entirety of the sample face ensuring a 100 mm overlap of each airbag to ensure the whole area was loaded.

The air bags were connected to a common supply manifold which was connected to an air regulator and an air compressor.

A manometer was connected to the same common supply manifold to measure the pressure within the airbags.

A large reaction frame, constructed from 18 mm plywood sheets, 50 mm x 50 mm x 5 mm internal strengthening bars within a 35 mm x 50 mm x 5 mm Parallel Flange Channel (PFC) perimeter frame was placed approximately 50 mm above the uppermost surface of the air bags and clamped to the underside of the UB's described previously.

Linear Voltage Displacement Transducers (LVDT's) were positioned at the centre span of two tiles, one on an edge tile and the other at on a centra tile to the floor.

The manometer and transducers were connected to a Data Logger, which in turn was connected to a laptop to record data during testing at a rate of 1 Hz.

Air was used to fill the air-bags quasi-statically so as to allow the manometer to measure the static pressure within the air system only.

The airbags were inflated to such a time as the serviceability deflection limit was reached. The air was then released.

Photographs of the test set-up can be seen in the Plates Section of this report.

4.3 Soft Body Impacts

Impact testing was completed in accordance with BS EN 12871:2019 Wood-Based Panels − Determination of Performance Characteristics for Load Bearing Panels for Use in Floors, Roofs and Walls.

Five No. impact positions were selected, the centre span between joists, centrally between tile edges as this was identified as the most onerous position.

Each impact area was marked out, and the impact bag was weighed.

The impact bag, as defined within BS EN 1995:1998, under Clause 6.2.5.1 of BS EN 12871:2019 weighed 30.2 kg.

The impact bag was lifted by way of an overhead crane and positioned over each test point, in turn.

The bag was allowed to drop from the designated drop height as defined within Clause 6.2.5.2 of BS EN 12871:2019, which can be seen below.

Table 2 – Impact Sequence and Requirement Table

Drop height mm	Impact Energy J	Requirement
150 [a]	45	No visible damage or crack on any of the 5 set-ups
300 [a]	90	No visible damage or crack on any of the 5 set-ups
450	135	Visible cracks permitted on 1 set-up in the sample
600	180	Impact body not allowed through the damage
750	225	Impact body not allowed through the damage
900	270	Impact body allowed through 1 set-up in the sample [b]
Each set-up shall go through all the above energy levels.		
Energy levels are service class independent.		
[a] Serviceability limit is exceeded if set is above 1 mm.		
[b] The impact body damages the set-up so that it is no longer still supported by the panel(s).		

The set, defined as the irreversible deformation of the test floor, wall or roof after the removal of the applied load was measured, by way of a calibrated dial gauge attached to an adjustable (height) straight bar.

The set was measured after each of the first 2 drop heights in the sequence.

After each impact, the sample was visually inspected and any deterioration, cracks or stress marks were highlighted and documented.

4.4 Hard Body Impacts

Impact testing was completed in accordance with ISO 7892:1998 Vertical Building Elements – Impact Resistance Tests – Impact Bodies and General Test Procedures.

A 0.5 kg steel ball of diameter 50 mm was dropped down a guide tube from a height of 610 mm to impart a hard body impact of 3 Joules (J) in three areas.

A 1 kg steel ball of diameter 62.5 mm was dropped down a guide tube from a height of 1020 mm to impart a hard body impact of 10 Joules (J) in three areas.

Observations were made following each impact and any deterioration of the system, was noted.

Samples of both the Raaft Preventa System with Atria 20 mm Porcelain Tiles and the Raaft Preventa System with Farrino 20 mm Porcelain Decking were tested.

4.5 Hygrothermal Testing

Testing was completed in accordance with EAD 090062-00-0404:2021 Kits for External Wall Claddings Mechanically Fixed, Annex M.

Samples, of nominal dimensions 800 mm x 2400 mm of each of the Raaft Preventa Systems (Atria and Farrino Tiles) were constructed within a hygrothermal chamber within Lucideon Limited's Construction Laboratory and subjected to the following cycles: -

4.5.1 Heat/Rain Cycles

The sample was subjected to a series of 80 cycles, comprising the following phases: -

1. Heating to 70°C (rise for 1 hour) and maintaining at (70 ± 5)°C and 10-30% Relative Humidity (RH) for 2 hours (total of 3 hours).
2. Spraying for 1 hour (water temperature (+15 ± 5)°C, amount of water 1 l/m².min).
3. Leave for 2 hours (drainage).

4.5.2 Heat/Cold Cycles

After at least 48 hours of subsequent conditioning at temperatures between 10 and 25°C and a minimum RH of 50%, the sample was subjected to a series of five heat/cold cycles of 24 hours comprising of the following phases: -

1. Exposure to (50 ± 5)°C (rise for 1 hour) and maximum 30% RH for 7 hours (total of 8 hours).

2. Exposure to (-20 ± 5)°C (fall for 2 hours) for 14 hours (total of 16 hours).

At periods of every four cycles during the heat/rain cycles and at every cycle during the heat/cold cycles, observations relating to change in characteristics or performance (blistering, detachment, crazing, loss of adhesion, formation of cracks, etc.) were recorded as follows:-

- The surface finish of the samples was examined to establish whether any cracking has occurred. The dimensions and position of any cracks were measured and recorded.
- The surface was checked for any blistering or peeling, and the location and extent were again recorded.
- All profiles were checked for any damage/degradation together with any associated cracking of the any element. Again, the location and extent were recorded.

5 RESULTS

5.1 Point Load Tests

BS EN 1991-1-1:2002 and NA to BS EN 1991−1−1:2002 Table 6.2 gives details of minimum values for concentrated loads (point loads) based upon the intended use.

For use on balconies the minimum load to be achieved before failure is stated as 2-3 kN.

Raaft Preventa System incorporating Atria Porcelain Tiles achieved a mean load value of 7.02 kN prior to failure by way of the tile cracking.

Table 3 − Raaft Preventa System Incorporating Atria Porcelain Tiles
Point Load Results

Test No.	Maximum Load (kN)	Maximum Deflection (mm)
1	7.04	3.15
2	8.67	3.64
3	6.28	3.29
4	6.09	2.62
Mean	**7.02**	**3.18**

Raaft Preventa System incorporating Farrino Porcelain Tiles achieved a mean load value of 6.32 kN prior to failure by way of the tile cracking.

Table 4 − Raaft Preventa System Incorporating Farrino Porcelain Tiles
Point Load Results

Test No.	Maximum Load (kN)	Maximum Deflection (mm)
1	6.07	3.44
2	7.54	3.16

Test No.	Maximum Load (kN)	Maximum Deflection (mm)
3	7.67	6.55
4	3.99	5.54
Mean	**6.32**	**4.67**

Charts 1 and 2 give the load against deflection curves for each test.

5.2 Uniformly Distributed Load (UDL) Testing

BS EN 1991-1-1:2002 and NA to BS EN 1991−1−1:2002 Table 6.2 gives details of minimum values for Uniformly Distributed Loads (UDL's) based upon the intended use.

For use on balconies the minimum load to be achieved before failure is stated as 2.5-4 kN/m^2 (kPa).

In Section 4.2 it was stated that the serviceability limit state for deflection was to be set at L/250 where L is the clear span between bearers:

- Atria Tiles System serviceability limit state was 1.2 mm.
- Farrino Tiles System serviceability limit state was 1.6 mm.

Raaft Preventa System incorporating Atria Porcelain Tiles achieved a load value of 30.36 kN/m^2 (kPa) with no failure at a deflection of 0.75 mm prior to the air bags being punctured by the tile edges.

Raaft Preventa System incorporating Farrino Porcelain Tiles achieved a load value of 30.03 kN/m^2 (kPa) with no failure at a deflection of 1.2 mm prior to the air bags being punctured by the tile edges.

Chart 3 gives pressure against deflection curves for both samples tested.

5.3 Soft Body Impact Testing

Within BS EN 12871:2019 Clause B 3.2 it states that floors used for load Category A, B, C, and D within BS EN 1991-1-1:2002 should conform with Impact Class I.

Both the Raaft Preventa System incorporating Atria Porcelain Tiles and the Raaft Preventa System incorporating Farrino Porcelain Tiles conformed to Impact Class I for soft body impacts.

Table 5 − Soft Body Impact Test Results for Raaft Preventa System Incorporating Atria and Farrino Tiles

Impact Point	Impact Energy (J)	Drop Height (mm)	Comment	Classification
1	45	150	No Deterioration	Impact Class I
	90	300		
	135	450		
	180	600		
	225	750		
	270	900		
2	45	150	No Deterioration	
	90	300		
	135	450		
	180	600		
	225	750		
	270	900		
3	45	150	No Deterioration	
	90	300		
	135	450		
	180	600		
	225	750		
	270	900		
4	45	150	No Deterioration	
	90	300		
	135	450		
	180	600		
	225	750		
	270	900		
5	45	150	No Deterioration	
	90	300		
	135	450		
	180	600		
	225	750		
	270	900		

5.4 Hard Body Impact Tests

There is no classification for hard body impact tests.

Both the Raaft Preventa System incorporating Atria Porcelain Tiles and the Raaft Preventa System incorporating Farrino Porcelain Tiles showed no signs of failure for hard body impacts.

Table 6 − Hard Body Impact Test Results for Raaft Preventa System Incorporating Atria and Farrino Tiles

Test Energy (J)	Test No.	Comment
3	1	No deterioration
	2	
	3	
10	1	
	2	
	3	

5.5 Hygrothermal Testing

As previously stated within Section 4.5 there are observations to be noted should any of the aforementioned defects occur during any stage of testing.

- The surface finish of the samples was examined to establish whether any cracking has occurred. The dimensions and position of any cracks were measured and recorded.
- The surface was checked for any blistering or peeling, and the location and extent were again recorded.
- All profiles were checked for any damage/degradation together with any associated cracking of the any element. Again, the location and extent were recorded.

For Raaft Preventa Systems incorporating Atria and Farrino Porcelain Tiles none of the aforementioned defects were noted prior to, during, or after testing was complete.

NOTE: The results given in this report apply only to the samples that have been tested.

END OF REPORT

PLATES

Plate 1 − Point Load Test Set-Up Atria Tiles

Plate 2 − Point Load Test Set-Up Farrino Tiles

Plate 3 − Typical Failure for Atria Tile Point Load

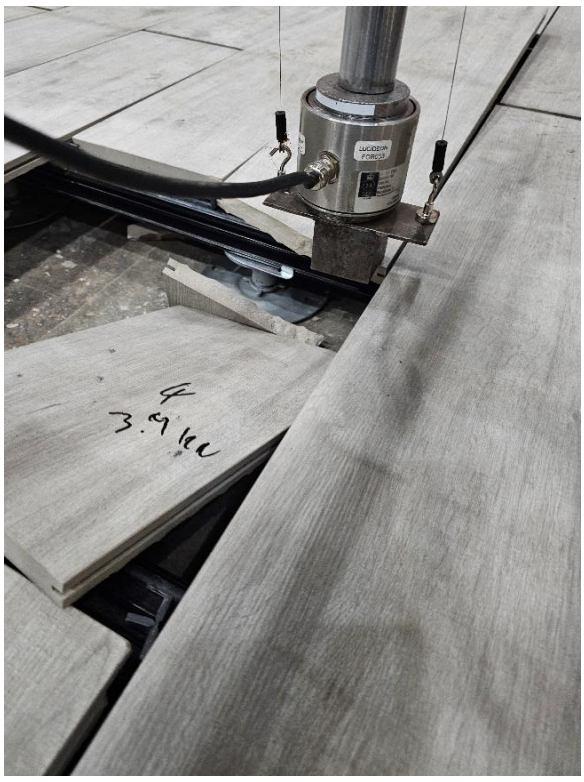


Plate 4 −Typical Failure for Farrino Tile Point Load

Plate 5 − Atria UDL Test Sample

Plate 6 − Farrino UDL Test Sample

Plate 7 − Sample with Airbags Installed

Plate 8 − Reaction Frames Installed

Plate 9 − Sample Under Test

Plate 10 − Samples Installed into Hygrothermal Chamber

Chart 1 - Load Deflection Curves for Point Load Testing of Raaft Ltd's Preventa System Incorporating Atria Porcelain Tiles

Test Report: UK234413/Ref. 2

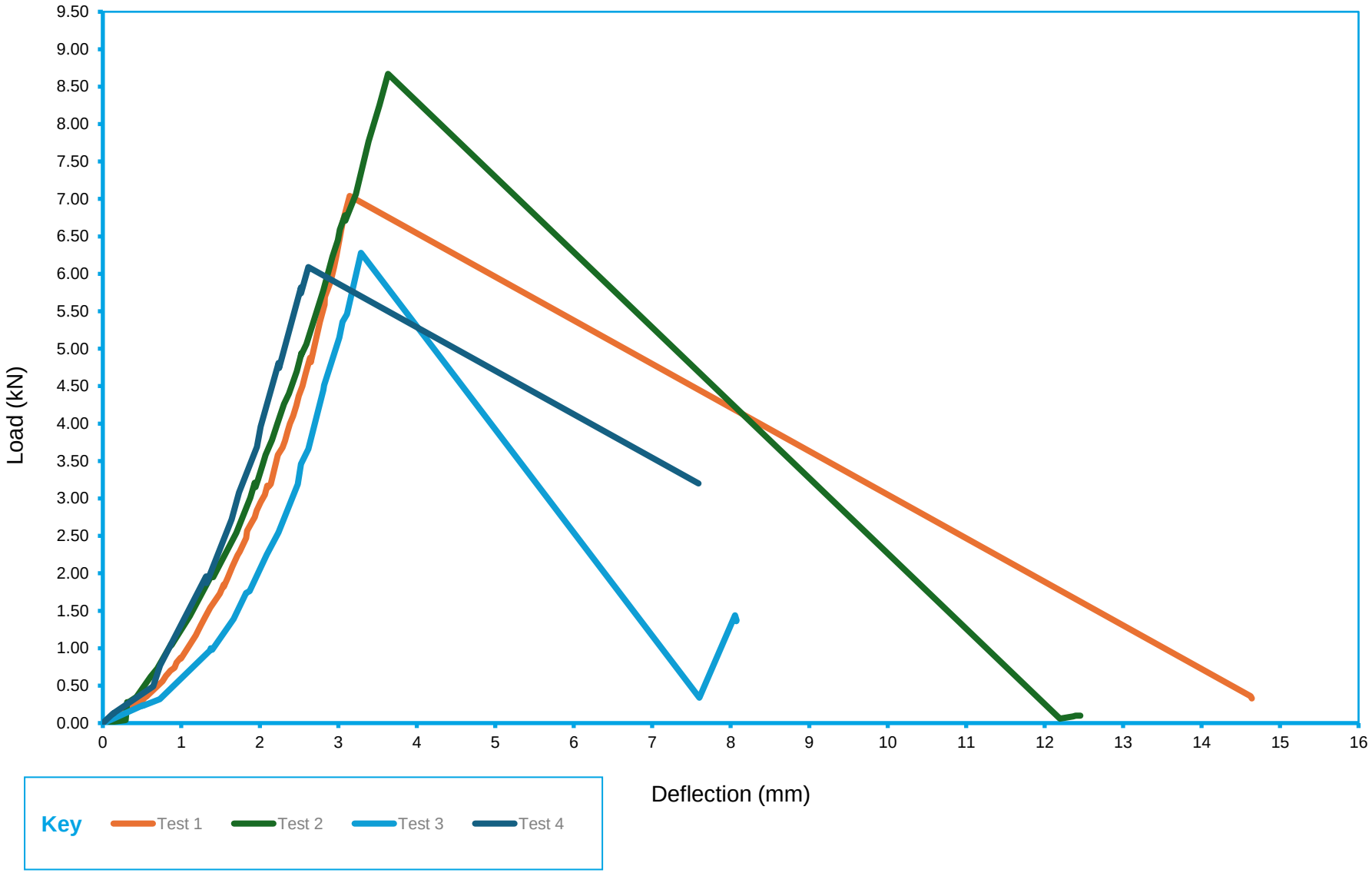


Chart 2 - Load Deflection Curves for Point Load Testing of Raaft Ltd's Preventa System Incorporating Farrino Porcelain Tiles

Test Report: UK234413/Ref. 2

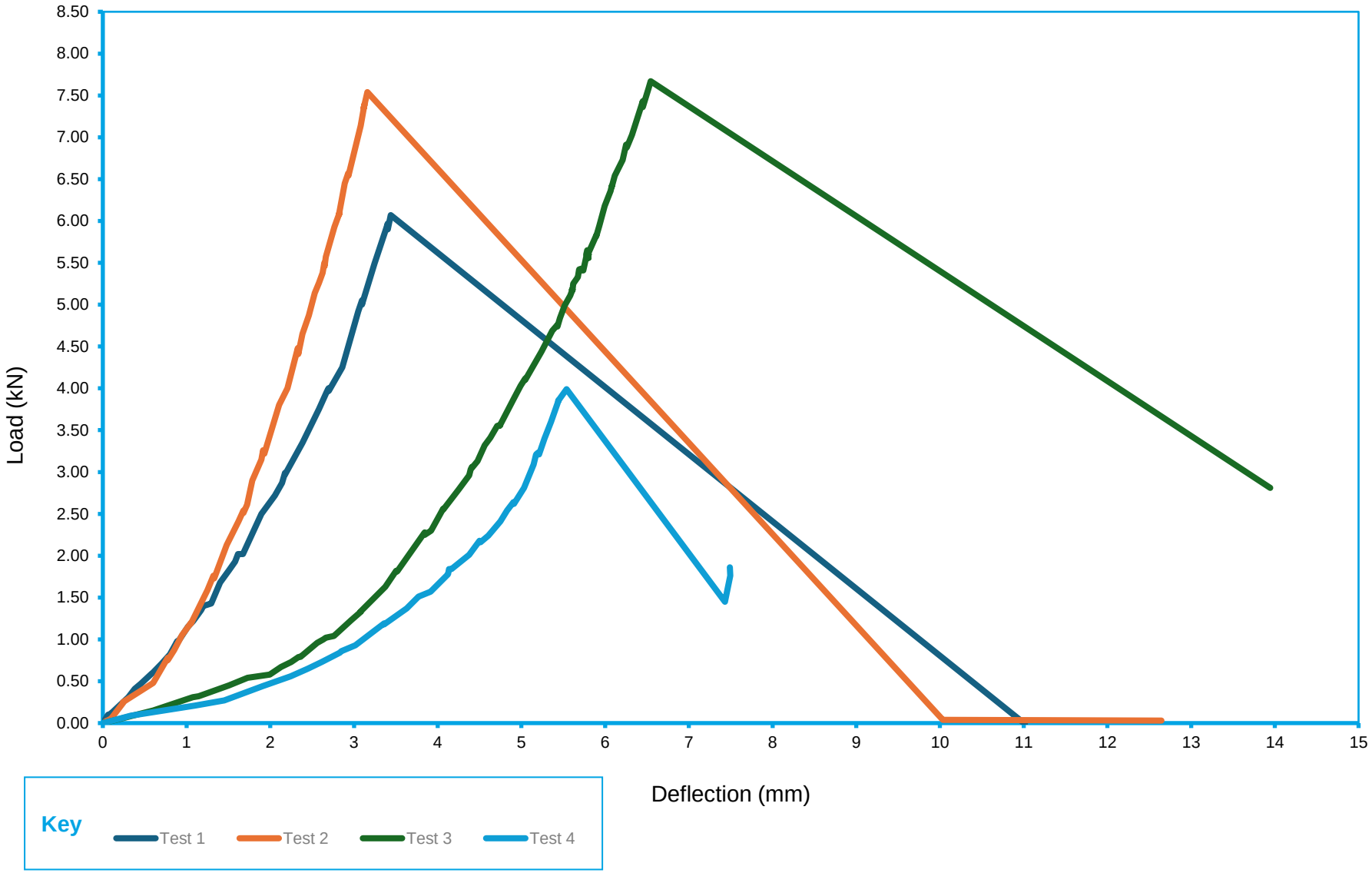
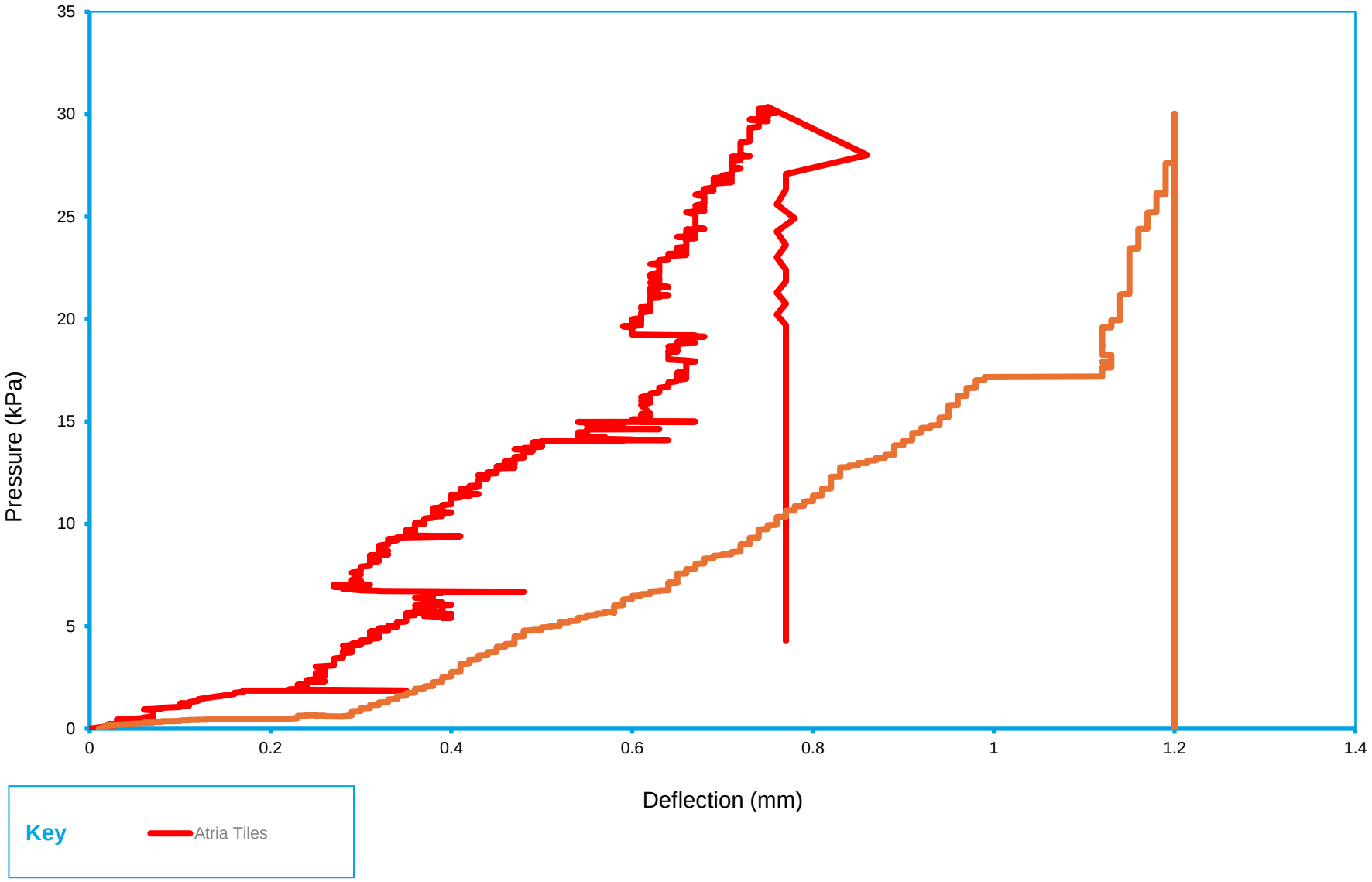


Chart 3 - Pressure Deflection Curve for UDL Testing of Raaft Ltd's Preventa System Incorporating Atria and Farrino Porcelain Tiles

Test Report: UK234413/Ref. 2



Atria & Farrino

Load & Durability Certification – Summary

POINT LOAD TEST RESULTS

Atria

Test No.	Maximum Load (kN)	Maximum Deflection (mm)
1	7.04	3.15
2	8.67	3.64
3	6.28	3.29
4	6.09	2.62
Mean	7.02	3.18

Farrino

Test No.	Maximum Load (kN)	Maximum Deflection (mm)
1	6.07	3.44
2	7.54	3.16
3	7.67	6.55
4	3.99	5.54
Mean	6.32	4.67

Refer to Sections 4.1 and 5.1 for more information

UDL TEST RESULTS

Raaft Preventa System incorporating Atria Porcelain Tiles achieved a load value of 30.36 kN/m² (kPa) with no failure at a deflection of 0.75 mm prior to the air bags being punctured by the tile edges.

Raaft Preventa System incorporating Farrino Porcelain Tiles achieved a load value of 30.03 kN/m² (kPa) with no failure at a deflection of 1.2 mm prior to the air bags being punctured by the tile edges.

Refer to Chart 3, Sections 4.2 and 5. 2 for more information

HYGROTHERMAL TESTING

For Raaft Preventa Systems incorporating Atria and Farrino Porcelain Tiles none of the aforementioned defects were noted prior to, during, or after testing was complete.

Refer to Sections 4.5 and 5.5 for more information

SOFT BODY TEST RESULTS

Impact Point	Impact Energy (J)	Drop Height (mm)	Comment	Classification
1	45	150	No Deterioration	Impact Class I
	90	300		
	135	450		
	180	600		
	225	750		
	270	900		
2	45	150	No Deterioration	
	90	300		
	135	450		
	180	600		
	225	750		
	270	900		
3	45	150	No Deterioration	
	90	300		
	135	450		
	180	600		
	225	750		
	270	900		
4	45	150	No Deterioration	
	90	300		
	135	450		
	180	600		
	225	750		
	270	900		
5	45	150	No Deterioration	
	90	300		
	135	450		
	180	600		
	225	750		
	270	900		

Refer to Sections 4.3 and 5.3 for more information

HARD BODY TEST RESULTS

Test Energy (J)	Test No.	Comment
3	1	No Deterioration
	2	
	3	
10	1	
	2	
	3	

Refer to Sections 4.4 and 5.4 for more information