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BRE Test Report

Testing of Manthorpe Dry Fix Systems to BS 8612

Prepared for: Ben Hales

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Summary of test report

SUMMARY RESULTS OF TESTING MANTHORPE SMARTVERGE INTERLOCKING PLAIN TILE VERGE SYSTEM TO BS8612:2018		
Product	**Characteristic**	**Result**
Manthorpe SmartVerge Interlocking Plain Tile Verge System	Mechanical resistance	**732.2N**
Manthorpe SmartVerge Interlocking Plain Tile Verge System	Vertical load	**3532.6Pa**
Manthorpe SmartVerge Interlocking Plain Tile Verge System	Rain drainage	**Pass**
Manthorpe SmartVerge Interlocking Plain Tile Verge System	Durability (UV ageing)	**Met the requirement (retained ≥ 60% of its tensile strength after UV ageing)**

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1 Introduction

At the request of Ben Hales, Manthorpe Building Products Ltd, BRE issued proposal P123548 on 15th June 2022. The proposal was accepted by Ben Hales on 16th June 2022.

This report details testing undertaken of the Manthorpe SmartVerge Interlocking Plain Tile Verge System to BS 8612:2018[1]. The testing was carried out at BRE, Bucknalls Lane, Watford, WD25 9XX under the BRE Standard Terms and Conditions of Business for testing as BRE Project number P123548 -1000.

2 Details of the tests carried out

The following tests were carried out to determine the performance of the Manthorpe SmartVerge Interlocking Plain Tile Verge System against the requirements of BS 8612:2018:

2.1 Mechanical resistance tests for verges to Annex E.10

For the tests on verge units, a rig was developed by BRE to comply with Figure E.4 of BS 8612. In this test the verge unit is subjected to horizontal load via a hydraulic ram and the load is measured by a Novatech loadcell. The loadcell has a range of 0.1kg to 500kg and has an accuracy of ±0.1%.

A horizontal load is applied to two verge units and gradually increased until failure occurs. The testing is repeated three times and the average uplift resistance is determined. The purpose of this testing is to establish the resistance of the verge units to horizontal wind action.

2.2 Vertical load tests for wind uplift resistance of verges to Annex F

For these tests a rig was developed by BRE to comply with Figure F.1 of BS 8612. The testing is carried out using both flat and profiled roof tiles. The purpose of this testing is to establish the uplift resistance of the verge units when subjected to simulated wind uplift forces.

A Mecmesin force gauge was used to measure the loads. The gauge measurement range if 1N to 2500N and has an accuracy of ± 0.1% f.s.

The tiles were initially laid without fixings in order to determine the test load F_{VO} required to lift the tail of tile A by 10mm. This test load included the self-weight of the tiles and fixing clamps and loading equipment.

A trial test was then carried out to establish the expected failure load $F_{V,test}$. This value was then used to establish the loading increments which were < $F_{V,\ test}$/5.

The loads were applied as specified in BS 8612 Annex F. Each load increment was applied and then removed, and the residual deflection measured. This was repeated until failure occurred, where failure is defined as one of the following:

a) the verge unit breaks;

b) the verge unit fixing pulls out;

c) either the roof tiles break; or

d) the verge unit disengages from the verge unit below or from the tile.

When event d) occurs before any of a) to c), then if possible, continue to incrementally increase the load until one of events a) to c) does occur.

The testing was repeated a minimum of three times using new verge units for each test.

2.3 Rain drainage from verges test to Annex G

For these tests a rig was developed by BRE to comply with Figure G.1 of BS 8612. The verge units were tested using plain tiles. The purpose of this testing is to establish if the verge units satisfactorily discharge rainwater away from the face of a building.

The tiles and verge units were installed on a test rig complying with the requirements of BS 8612 Annex G. The pitch of the test rig was 22.5°, the water flow rate was set to 2l/min and water outlet at 35°

The testing was repeated three times. A visual assessment of the drainage performance of the verge was made.

The requirement is that the rain shall not discharge in concentrated continuous or intermittent streams on the wall.

2.4 Durability testing

This testing is for load-bearing components designed to be exposed to daylight. The purpose of this testing is to establish the long-term durability of the load-bearing component when subjected to expose to daylight.

The product is tested as specified in Clause 4.4.3 and is subjected to UV ageing for a period of 1600 hours in accordance with BS EN ISO 4892-3:2016. The tensile strength is then measured in accordance with BS EN ISO 527-2. The product must retain ≥ 60% of its tensile strength after ageing. Note that Clause 4.3.3 specifies ≥ 40% not ≥ 60% - this is an error in the standard.

The Manthorpe SmartVerge Interlocking Plain Tile Verge System was tested to Clause 4.3.3.

3 Test results

3.1 Mechanical resistance tests for verges to Annex E

In these tests the Manthorpe verge units were fixed to battens by 40mm x 3.5 stainless steel pan head screws and tested with plain tiles.

The results from the horizontal load tests on the verge units are given in Table 1. Figure 1 shows the verge unit prior to test. In all cases the results were within 15% of the mean and so the results are valid with three repeats.

Test Number	F_{HT} (N)	Failure mode
Test 1	944.7	Verge unit broke
Test 2	933.9	Verge unit broke
Test 3	977.1	Verge unit broke
Allowable range	809.1	1094.7
Mean	**951.9**	

Table 1. Horizontal pull-off ultimate failure results for the Manthorpe SmartVerge Interlocking Plain Tile Verge System.

The design horizontal resistance is determined by dividing the characteristic (average) value given in Table 1 by the partial factor, γ_M, given in Table C.2 of BS 8612, which are as follows:

γ_M for serviceability failure = 1.0

γ_M for metal failure = 1.1

γ_M for failure of timber, plastics, roof tiles or slates = 1.3

The verge unit broke leaving the fixing in situ, as shown in Figures 2 and 3. This is an ultimate failure, with a partial factor of 1.3.

The design horizontal loads are:

951.9/1.3 = **732.2N**

Figure 1. Manthorpe verge unit prior to test.

Figure 2. Ultimate failure of Manthorpe verge unit.

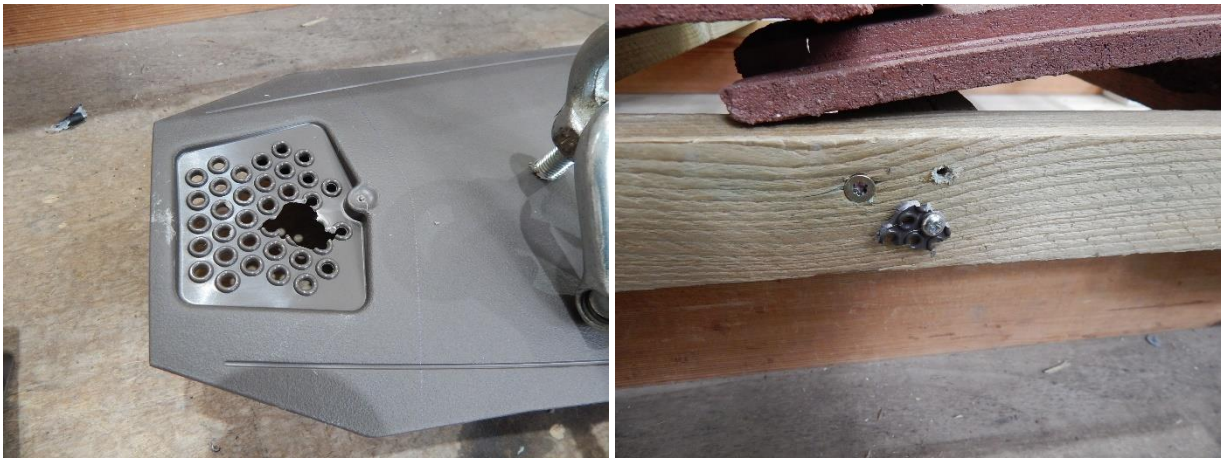

Figure 3. Manthorpe verge at failure.

3.2 Vertical load tests for wind uplift resistance of verges to Annex F

For these tests the Manthorpe verge units were tested with a plain tile and were fixed to the battens by 40mm x 3.5 stainless steel pan head screws.

The combined verge and head fixing uplift resistance is calculated using equations 1 and 2 below for serviceability and ultimate limit states (equations F.1 and F.2 in BS 8612):

$R_{ui} = (F_{v,max} - F_{v0})$ … (1)

$R_{si} = (F_{v,s} - F_{v0})$ … (2)

The characteristic value of the uplift resistance, $R_{kx,max}$ or $R_{kx,s}$ of the verge unit and tile head fixings is taken as the mean value of the test results and is calculated for both ultimate limit state failures, where applicable.

Where $R_{kx,max}$, is the ultimate limit state failure and $R_{kx,s}$ is the serviceability limit state failure.

The design value of the uplift resistance of the verge unit and tile head fixings for the ultimate limit state failure (R_u) and serviceability limit state failure (R_S) are given as the characteristic value divided by the appropriate value of the partial safety factor γ_M for ultimate and serviceability failure as given by equations 3 and 4 below (equations F.3 and F.4 in BS 8612):

$R_u = R_{kx,max} / \gamma_M \times A_t$ … (3)

$R_s = R_{kx,s} / \gamma_M \times A_t$ … (4)

Where γ_M for ultimate failure of metal = 1.1, for timber, plastics, roof tiles and slates = 1.3
γ_M for serviceability failure = 1.0 (from Table C.2)
A_t is the exposed area of the verge tile

Note that the higher γ_M value should be adopted where failure occurs in more than one material.

Figure 4 highlights the verge units prior to test. The results from the tests are given in Table 2.

Figure 4. Manthorpe verge units prior to test.

Test Number	$F_{v,max}$ (N)	Ru_i (N)	F_{v0} (N)	Failure mode
Test 1	206	186	20	Verge unit disengaged
Test 2	244	225	20	Verge unit disengaged
Test 3	218	198	20	Verge unit disengaged
Allowable range	26	189		
$R_{ks,max}$	**202.7**			

Table 2. Test results for the Manthorpe verge unit.

As the verge unit disengaged, Figure 5, this is an servicability failure with a partial safety facor, γ_M for ultimate failure of plastics = 1.0. It was not possible to continue the test to achieve ultimate failure of the verge unis.

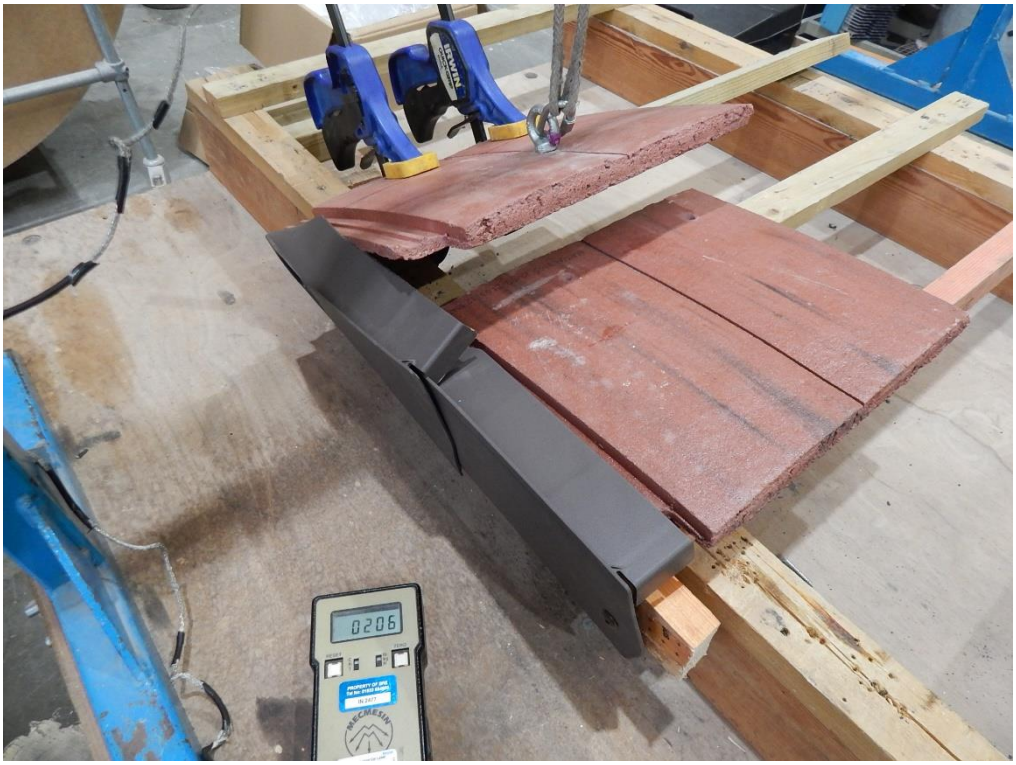

Figure 5. Image to highlight the ultimate failure of the Manthorpe verge.

The characteristic values of the uplift resistance of the Manthorpe SmartVerge Interlocking Plain Tile Verge System and fixings are:

Plan tile: $R_{kx,T}$ = **202.7N**

The design value of the uplift resistance of the Manthorpe SmartVerge Interlocking Plain Tile Verge System and fixings are given by equations 3) and 4) taking the exposed area (A_t) of 302mm x 190mm for the plain tiles. The design value of the uplift resistance when used with tiles of any other exposed area can be determined by substituting the actual tile size into equations 3) and 4).

The design values of the uplift resistance of the Manthorpe SmartVerge Interlocking Plain Tile Verge System and tile fixings are:

Plain tile: R_s = 202.7 / (1.0 x 0.302 x 0.190) = **3532.6Pa**

3.3 Rain drainage from verges test to Annex G

The Manthorpe verge units were tested with a plain tile and were fixed to the battens by 40mm x 3.5 stainless steel pan head screws. An eaves closure unit was fixed using 35mm x 4.5mm pan head torque screws, Figure 6.

During the test, Figure 7, a stream of water was seen to flow down the verge unit. However, none of the verge units allowed water to discharge in concentrated continuous or intermittent streams on to the fascia board.

The Manthorpe SmartVerge Interlocking Plain Tile Verge System units meet the rain drainage performance requirements of Annex G.

Figure 6. Manthorpe SmartVerge Interlocking Plain Tile Verge System prior to the rain drainage test.

Figure 7. Stream of water on verge unit during rain drainage test.

3.4 Durability testing to Clause 4.4.3

Table 3 shows the results of the sample before and after aging.

BS 8612:2018 Annex B (UV Ageing Test	
Test Date	12/12/2022
Temperature (°C)	20
Humidtiy (rh%)	28.6
Tested by	I Rance

Sample	Width (mm)	Failure Load before ageing (N)	Failure Load after ageing (N)
P117272-01	10.0	452.5	425.5
P117272-02	10.0	497.5	475.5
P117272-03	10.0	484	469.5
P117272-04	10.0	478	486
P117272-05	10.0	477.5	475
P117272-06	10.0	469.5	429.5
	Average failure load (N)	476.5	460

Table 3. Results of testing to Clause 4.4.3

The average tensile failure before UV aging was 476.5N

The average tensile failure load after aging was 460.0N

The requirement is that the product must not lose more than 40% of its tensile strength after UV ageing. The Manthorpe SmartVerge Interlocking Plain Tile Verge System material lost 3.5% in tensile strength after UV ageing and therefore meets the requirements of BS 8612.

4 Conclusion

This report describes tests carried out to assess the performance of the Manthorpe SmartVerge Interlocking Plain Tile Verge System to BS 8612. The testing was carried out to the procedures given in BS 6812 Annexes E, F, G and Clause 4.3.3.

The conclusions from the testing are as follows:

- When tested to Annex E, the design horizontal wind uplift of the Manthorpe SmartVerge Interlocking Plain Tile Verge System when tested with plain tiles is **732.2N**
- When tested to Annex F, the vertical wind uplift resistance of the Manthorpe SmartVerge Interlocking Plain Tile Verge System when tested with plain tiles is **3532.6Pa**
- When tested to Annex G, the Manthorpe SmartVerge Interlocking Plain Tile Verge System when tested with plain tiles met the rain runoff requirements and do not allow water to discharge on to the adjacent wall.
- When tested to clause 4.3.3, the Manthorpe SmartVerge Interlocking Plain Tile Verge System material retained ≥ 60% of its tensile strength after ageing after UV ageing and therefore meets the requirements of BS 8612

5 References

1, BS 8612:2018, Dry Fixed ridge, hip and verge systems for tiling - specification

Report Ends