"WEATHERING TESTS ON MANTHORPE LEAD ABUTMENT VENTILATION SYSTEM, JUNE 2002"

Summary

The Marley Building Materials Wind Tunnel Testing Facility was used to simulate extreme severity wind driven and deluge rain conditions on a model of an abutment section fitted with lead flashing both with and without the ventilation strip. These tests were run at two roof pitches with both profile tiles and flat tiles.

Comparisons were made between the performance of the abutment with just the lead flashing and the performance of the abutment with the ventilation strip to ascertain whether any difference in weather tightness could be observed.

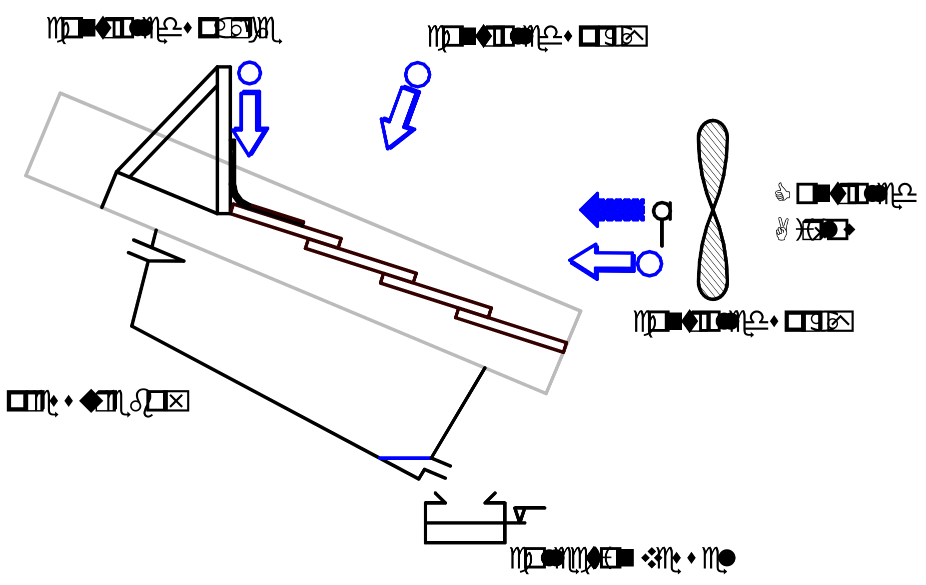
While fully quantitative analysis was not possible due to the nature of the construction used, close observation of leakage behaviour during test showed no evidence that the ventilation strip significantly influenced the amount of leakage compared with standard lead flashing.

Description of Apparatus

The test apparatus consisted of a combination of the Marley Building Materials Wind Tunnel Testing Rig ("the rig") and a purpose made attachment designed to simulate a wall of 2m in height ("the wall"). The wall was attached to the rig in such a way that it could be adjusted to suit the two different pitches under test and still be vertical, and positioned so that the abutment was directly above the under-roof water collection vessel of the rig. A full description of the rig may be found in Appendix I.

Rain was applied to the rig and wall in two ways: for the wind driven simulation, rain was introduced into an air stream striking the wall horizontally; for the deluge test, rain was added from a spray nozzle perpendicular to the tiled rig. For both tests, a simulated runoff was added via a sparge pipe at the top of the wall. The sparge delivered water equivalent to that from a wall height of 2m above the abutment.

Figure 1. Schematic of Test Apparatus



Test Program

	Deluge Rainfall	Wind Driven Rainfall
At 30°		
Sparge water flow l/min:	9.66	5.17
Spray water flow l/min:	6.30	3.37
Differential pressure range Pa:	+40 to -50	+40 to -40
Wind speed m/s:	0	13
Rainfall mm/hour:	194.86	104.28
At 15°		
Sparge water flow l/min:	9.37	3.67
Spray water flow l/min:	7.03	2.75
Differential pressure range Pa:	+40 to -50	+40 to -40
Wind speed m/s:	0	13
Rainfall mm/hour:	217.33	85.04

The test conditions chosen reflect extreme weather conditions likely to be achieved in the British Isles only once in a 50 year period.

A negative differential pressure implies suction from the top to the underside of the roof structure – e.g. as can be generated by batten space airflow during wind loading. A positive value is generated by the ram pressure of the wind.

The tile profiles used were Double Roman and Modern; the Double Roman being a profiled tile and the Modern a flat tile. During the 15° testing of the vent, the tiles were sealed as the minimum specified pitch for these profiles is greater than 15°. While this did reduce leakage through the tiles, not all leakage was stopped.

Results and Observations

During each test, the differential pressure across the simulated roof section was gradually increased until visible leakage occurred. Under many test conditions the tiling array and the wall construction gave rise to leakage before the abutment section itself. The only instance of leakage occurring through the abutment ventilator was when the rig was at an angle of 15° and at a high negative pressure.

The underside of the abutment where the tiles and wall met was observed, however, and the leakage collected in the rig was seen to come solely from the back of the wall and its fixings. No leakage was seen from the junction between the lead, or vent, and the tiles until the differential pressure was very great and beyond that which would be seen in real life applications.

Conclusions

The weathering performance of the abutment ventilator was observed to be comparable with standard unventilated lead flashing at both 30° and 15° when fitted with both profiled and flat interlocking concrete tiles.

Acquiring fully quantitative data on leakage performance requires a more sophisticated mounting frame and model than the one available for these tests.

Appendix I.

Test Equipment

The Marley Building Materials wind tunnel consists of the following elements:

A large, high speed fan fitted with a frequency inverter speed control unit and baffled ducting feeding a laminar air flow into the test room.

A variable pitch monopitch roof rig of approximately $2m^2$ area positioned within the air stream from the fan. This is fitted with support battens and is tiled with the profile under test. No roofing felt or membrane is fitted under the tiles; instead the bottom side of the rig is fitted with a perspex box which incorporates the following:

1) A drainage pipe linked to a collection vessel mounted on a continuous weighing device.
2) An internal pressure monitor
3) A duct system which is connected to two air pumps via a control valve system. This can be used to pressurise or depressurise the box as required.

Simulated rainfall is supplied by a series of spray jets fed via control valves from a pumped water system. These are arranged as follows:

1) Three water jets directing water into the air stream directed onto the rig.

2) A square nozzle water jet directing water onto the rig from an elevated position above the air stream for simulating deluge rainfall.

In addition, simulated runoff (to mimic rainfall running down from an area of roof above the portion under test) is supplied by a sparge pipe running across the top of the roof rig feeding water onto the tiles via a series of apertures.

All environmental variables are controlled via a PLC unit linked to a computer. All water and air handling systems are fitted with proportional valves linked to the PLC and through the use of PID loop control a high degree of reproducibility is achieved in terms of the test conditions.

An extensive range of data, covering both the operational status, measured environmental conditions and the amount of water passing through the test roof is logged automatically and processed via dedicated software.

General Test Method

The test method employed follows that outlined in a report titled “UK Feasibility Study To Develop Rain Resistance Test For Tiles And Slates” originating from BSI committee B542/1/WG2; reference 97/107892 September 1997; CEN document number N26E

After fitting each array of tiles to be tested to the rig, the edges are sealed using a non setting waterproof putty. A thin line of putty may also be applied to the underside of the tiles behind any weathercheck bar features. This has the function of ensuring that any water that penetrates the tie and runs down the underside of the tile is deflected and drips into the collecting vessel. Without taking this step, it has been found that reproducibility of the tests is not as good due to the variation of the amount of water leaving the undersides of the tiles.

Following preparation of the roof rig, and adjusting the rig to the desired pitch, testing is carried out as follows:

The wind fan, pressure fans, water spray jets and sparge feed are switched on and the system left to run for a set time. During this time, the water leakage is measured and recorded automatically. After this time has elapsed the system moves on to the next pressure increment that was programmed into the control system.

Throughout the test the following parameters are constantly measured:

1) Amount of water leaking through the array
2) Differential pressure between the underside of the tiles (perspex box) and the exterior
3) Wind speed
4) Water feed via each set of spray jets and sparge pipe
5) Evacuated air volume needed to create the desired suction pressure