



2. THE WIND
JAMES COOK CYCLONE STRUCTURAL TESTING STATION

CYCLONE TESTING STATION

c/- Department of Civil and Systems Engineering,
James Cook University, Townsville,
QLD 4811 AUSTRALIA

Telephones: (077) 81 4754 81 4330
Facsimile: (077) 75 1184

Report Number: TS384
Job Number: 92105ST

6th of April, 1992

TEST: Cyclic Loading of Metrotile Metal Roof Tiles

FOR: Metrotile (N.Z.) Ltd

REF: Mr J. Ross

Metrotile Metal Roof Tiles

The Metrotile metal roof tiles are light weight steel panels stamped to have the appearance of a series of tiles. The panels are 1333mm long and are profiled to form eight tile shapes. A small ridge runs between every tile shape. The panels have a scallop shaped front and back edge which interlock when installed on a roof. The panels have a total width of 410mm and provide an approximate cover of 370mm. The base metal thickness was specified as 0.4mm, +/-5%. The top surface of each panel is covered in a coating of stone chips.

The panels are laid onto 50mm x 38mm F5 pine battens spaced 370mm apart. They are fastened horizontally with 50mm x 3.15 galvanized flat head nails through the ridges along the front edge.

Test Parameters

The tests were to determine if the roofing could resist the fatigue loading criteria, as set out in clause 3.6 of the Australian Standard Wind Loading Code AS1170.2-1989. The roof sheeting was considered to be an impermeable membrane having to resist both the external and internal pressures, as well as a local pressure factor on the external uplift pressure.

The design pressure was calculated for a 15m high house in Region C, terrain category 2 as specified in the Wind Loading Code. The criteria used for the calculations follow:



JAMES COOK CYCLONE STRUCTURAL TESTING STATION

CYCLONE TESTING STATION

c/- Department of Civil and Systems Engineering,
James Cook University, Townsville,
QLD 4811 AUSTRALIA

Telephones: (077) 81 4754 81 4330
Facsimile: (077) 75 1184

Region C - terrain category 2	
Basic wind speed (V_u)	70.0m/s
Maximum building height	15.0m
Terrain/Height multiplier	1.07
Shielding multiplier	1.0
Topographic multiplier	1.0
Structure importance multiplier	1.0
Internal pressure coefficient	0.7
External pressure coefficient	-0.9
Local pressure factors:	

Trial 1	4 nails per panel	1.0
Trial 2	8 nails per panel	2.0

The resulting ultimate strength limit state design pressures for the 4 nails per panel, Trial 1, and 8 nails per panel, Trial 2, were 5.39kPa and 8.43kPa respectively.

Test Specimens

The configurations constructed for the tests were two spans wide and 2300mm long, approximately one and three quarter panels. The panels were nailed horizontally through the front edge into the hardwood battens with 50mm x 3.15 flat head galvanized nails. For Trial 1, a nail in the ridge of every second tile shape was used. Trial 2 used a nail in every ridge. One sample was used for Trial 1, and for Trial 2, three samples were used.

Test Procedure

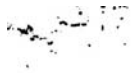
The fatigue loading criteria in the Wind Loading Code require that each of three samples satisfies the following loading sequence.

8000	cycles from	0kPa to $0.40 \times P$
2000	cycles from	0kPa to $0.50 \times P$
200	cycles from	0kPa to $0.65 \times P$
1	cycle from	0kPa to $1.00 \times P$

Where P is the ultimate strength limit state design wind pressure.

Notes: If two samples are tested the last cycle load is increased from $1.0 \times P$ to $1.2 \times P$; and if only one sample is tested the last cycle load is increased to $1.3 \times P$.

The loading sequence is based on the inclusion of a material capacity reduction factor. The load P is therefore increased by dividing by 0.9.



JAMES COOK CYCLONE STRUCTURAL TESTING STATION

CYCLONE TESTING STATION

c/- Department of Civil and Systems Engineering,
James Cook University, Townsville,
QLD 4811 AUSTRALIA

Telephones: (077) 81 4754 81 4330
Facsimile: (077) 75 1184

The cyclic loading was provided by displacing the central batten downwards a small amount and thus pulling the roofing down against inflated airbags. The reaction pressure of the airbags simulated uniform uplift pressure on the roofing.

Test Results

For Trial 1, the sample resisted the fatigue load criteria followed by the prescribed overload of 1.3 times the factored ultimate strength limit state design load, thus satisfying the test criteria.

Trial 2 used three samples to reduce the required overload. The first sample was cycled 10200 times and then subjected to the overload. A tile shape buckled at 9.1 kPa. The panels showed no obvious signs of fatigue, i.e. no elongation or cracking around the nail holes and no cracking or creasing along the ridges and front and back edges of the panels. From these results and previous observations, the two remaining samples were not cycled, only overloaded. A tile shape buckled in the second sample at 8.9 kPa, and in the third sample at 9.0 kPa. Therefore the test criteria were satisfied for Trial 2.

Conclusion

The tested Metrotile metal roof tile samples satisfied the fatigue and overload criteria as specified in clause 3.6 of the Wind Loading Code AS1170.2-1989 for the most severely loaded parts of a roof up to 15 metres high in cyclone Region C, terrain category 2.

Four 50mm x 3.15 nails per panel were used for the 1.0 local pressure factor, the body of the roof, while eight nails per panel were used for the 2.0 local pressure factor.

Tested by

Checked

Professor Ray Volker
Head, Department of Civil &
Systems Engineering

Note: This report may not be published except in full unless permission for publication of an approved abstract has been obtained in writing from the Head, Department of Civil and Systems Engineering.