

Test Preface

Test Report No. N950-24-18683

Long Term Durability

The following preface is intended to provide (in readily understood terms) some 'background' to this particular test, its purpose, relevance to 'real world' façade performance and an accurate interpretation of the results.

The most important testing that a façade product should undergo (but rarely does) is; 'durability testing'.

The independent testing of facades is now commonplace. The construction industry is familiar with the process. A façade material/product gets specified and a large scale test panel is constructed. A few days later, it's subjected to the standard suite of CWCT tests. It performs (on the day), hopefully adequately and interested parties 'ride off into the sunset' clutching their 'positive' test reports, assuming that they're secure in the knowledge that the material/product is suitable for use as a building façade.

The missing vital component is of course 'time'. The façade may well be required to perform in the manner that it did on day one, on day twenty two thousand and one! (Assuming a not uncommon 60 year design life). The effects of continuous daily 'weathering' and 'building movements' are rarely given any concerted thought and even more rarely actually 'tested'.

This might not be a catastrophic omission with some façade types that are comprised of individual, entirely open jointed façade elements, but this is certainly not the case with a brick slip façade.

During recent years we've seen a number of products that marry typical rainscreen fixing/sub-structure technologies with a veneer of mortared brick slips. The substructures are usually predominantly aluminium, with all of its propensity for significant thermal movements and the brick slips usually have not much more than a cursory (inherently) shallow depth of relatively inflexible mortar injected between them.

Should the potential degradation caused by weathering and building movements cause the mortar to 'break down', or cause the security of the brick slip's retention to become compromised, the cost to the building owner to effect repairs, particularly to a 'high rise' development does not bare thinking about!

The small amount of durability testing that we've seen undertaken by some brick slip system suppliers is, more often than not, inadequate. Durability tests are carried out on artificially very small panels which minimise thermal movements.

Important factors that contribute to durability (such as cyclic wind loading) are omitted from the testing regime. Deflections exhibited by the 'backing wall' to which brick slip systems are attached are unrealistic and the full range of potential individual brick slip heights that might conceivably be encountered is conveniently ignored.

Because of this, we wanted to prove, through a programme of thorough 'long term durability testing' that the Barracuda system could be durable for periods of at least 60 years.

Facades get very hot during the summer and then they're rapidly cooled when it rains on them. In the winter they get rained on even more (especially in the UK!) and then they freeze. All the time they're subjected to positive and negative wind pressure pulses and are required to continually perform their function as safe, attractive, protective screens ('rainscreens', as they've become known).

When they get hot, metal components, in particular aluminium components, such as sub-structure rails will increase in length, and when they get cold, they'll shorten. Brickwork and mortar will exhibit far less 'thermal movement' and it's this 'difference' in the amount that these materials move, combined with the façade being continually pushed and pulled by the wind that will potentially result in the brick slip façade's mortar joints deteriorating. If the mortar joints deteriorate to any significant extent, water can become trapped, that water can freeze and the joints will deteriorate even further and faster. Once there's significant mortar loss, eventually the brick slips themselves will deteriorate, potentially 'spalling' or fracturing in such a way that will compromise their security.

Our durability testing of the Barracuda system was carried out in general accordance with European Assessment Document EAD 090062-00-0404, Technical Specification DD CEN/TS 772-22: 2006, CWCT Standard Test Methods for Building Envelopes and CWCT Technical Notes TN75 and TN76

The basics of our test process would be;

We'd construct our test panel during January when the ambient temperatures were just above the point where the use of mortar is viable (approx. 5°C). This way we'd construct with cold sub-structure and induce the maximum dimensional change (lengthening of the sub-structure) during Heat/Rain cycling.

We'd ensure that our test panel was large enough so that sub-structure lengths were representative of typical 'real' constructions. Again, to ensure that they underwent the maximum/representative dimensional change during Heat/Rain and Freeze/Thaw cycling.

We'd attach our Barracuda system to a lightweight metal stud backing wall construction that had been engineered to represent the sort of fully economised backing wall construction that would be found on a typical 'actual' large scale construction project. So, nothing too 'artificially' stiff!

This way we'd really get the system moving 'back and forth' with the positive and negative wind pressure pulses during the cyclic wind load testing phase. Our backing wall construction was the same as that used for wind resistance testing (Test Report No. N950-22-18408) so we knew that the 2400 pascal serviceability test pressure produced total mid-span deflection ranges of about 15mm in the backing wall and about 12mm in the brick slips themselves.

Bricks, and the brick slips which are cut from them come in numerous shape types, bricks with large frogs, large core holes, numerous smaller core holes and of course 'solid' bricks etc. The bricks can be any clay material type, extruded, pressed or handmade.

In order to represent this range of brick shape types and brick manufacturing techniques, nine different brick types were selected and incorporated into the durability test panel.

These were;

- Brick Type 1. – Wienerberger Sandalwood Yellow Multi
- Brick Type 2. – Michelmersh Charnwood Light Victorian Red
- Brick Type 3. – Ibstock Leicester Red Stock
- Brick Type 4. – Ibstock Chesterton Multi Red Smooth
- Brick Type 5. – Blockley Windermere Grey Solid
- Brick Type 6. – Wienerberger Olde Ivory Stock
- Brick Type 7. – Wienerberger Smeed Dean London Stock
- Brick Type 8. – Ibstock Aldridge Anglian Red Multi Rustic
- Brick Type 9. – Michelmersh Haddley Brindle Wirecut

Please see test panel drawings appended to the test report for locations/distribution of the different brick types.

The following test cycling was carried out.

Heat/Rain

The test panel was subjected to 100 No. Heat/Rain cycles.

Heating to 70°C rising for 1 hour, maintain for 2 hours at 10% to 30% RH.

Water Spray at 1 Litre per M² per minute for 1 hour with water temperature 15°C.

Drain for 2 hours.

Total single cycle time 6 hours.

Freeze/Thaw

The same test panel was then subjected to 100 No. Freeze/Thaw cycles.

Temperature to fall from 20°C to -15°C in more than 20 but less than 30 minutes.

Temperature maintained at -15°C for more than 90 but less than 100 minutes.

Temperature to rise from -15°C to 20°C in more than 15 but less than 20 minutes.

Water Spray at 6 Litre per LM of sample panel per minute for 120 seconds.

Total single cycle time 150 minutes.

Cyclic Wind Load

The same test panel was then subjected to 7681 No. Wind Load cycles. Wind load cycling was in accordance with BRE Digest 346 Part 7 Table 1. The following sequence was repeated six times followed by single pulse at design wind pressure, representing 60 years of natural wind exposure.

W_p = design wind pressure

Design wind pressure = ± 2400 pascals

- 1 No. cycle at $0.9 \times W_p = \pm 2160$ pascals
- 960 No. cycles at $0.4 \times W_p = \pm 960$ pascals
- 60 No. cycles at $0.6 \times W_p = \pm 1440$ pascals
- 240 No. cycles at $0.5 \times W_p = \pm 1200$ pascals
- 5 No. cycles at $0.8 \times W_p = \pm 1920$ pascals
- 14 No. cycles at $0.7 \times W_p = \pm 1680$ pascals

Impact Testing

The same sample was then subjected to the following impact tests. Testing carried out in accordance with the CWCT Standard Test Methods for Building Envelopes: 2005, Technical Notes TN75 and TN76

To subject our Barracuda system to the toughest test possible, and provide a genuine comparison with the performance of the system prior to long term durability testing, we subjected the test panel to exactly the same (huge) number of closely spaced impacts carried out on the newly constructed impact resistance panel. The long term durability test panel was subjected to an identical, 144 No. impacts across 108 No. different impact locations. Please refer to Fig 1 on page 19 of the test report for soft body impact locations and Fig 2 for hard body impact locations.

Impact Resistance – Soft Body Serviceability:

Impact energy 120J

Impact Resistance – Soft Body Safety:

Impact energies 350J and 500J

Impact Resistance – Hard Body Serviceability:

Impact energies 3J, 6J and 10J

Impact Resistance – Hard Body Safety:

Impact energies 3J and 10J

After all of the preceding testing was carried out; the test panel was both serviceable and safe with no damage to the panel evident.

No damage at all was evident to any of the brick slips or mortar joints after impact testing regardless of impact energy or impact type!

All of the results achieve the very highest **Class 1/Negligible Risk** classification.

These results demonstrate an exceptionally high level of durability.

Because it is always difficult to convey the appearance of brickwork with words (or what would be inevitably relatively small images), this test panel has been retained at the independent test facility by James & Taylor and is available to be viewed upon request. Please contact James & Taylor should you wish to do so.