07 February 2019

THE BENEFIT OF PRODUCT TESTING ON THE SUPPLY CHAIN AND PREDICTABILITY OF OFFSITE HOUSING SUPPLY

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LUCIDEON

Lucideon background

- The British Ceramic Research Association (BCRA) was established in 1948 to better serve the ceramics industry through a single research organization (later renamed Ceram)
- The construction technologies laboratory was established in the 1970's
- In 2006, Ceram acquired further materials analysis capabilities in the US
- Rebranded to Lucideon in 2014 - a greater focus on sector specific offerings

Aerospace

Ceramics

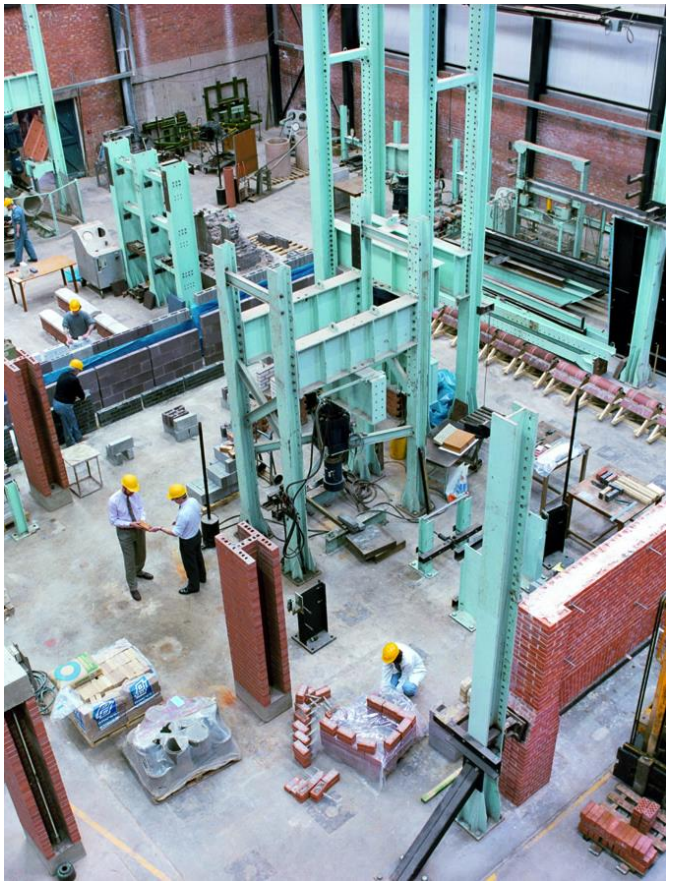
Construction

Energy

Healthcare

Versatile purpose-built facilities

- Large-scale construction laboratory
- Lifting capability with 11m clearance
- Loading rigs with 1,000 tonne capacity
- 5 large-capacity hygrothermal testing chambers
- Indoor dynamic wind loading and wind uplifting rig with a 6.2 X 3.6m wide chamber



Methods of testing for modular housing

- Structural verification of panels
- Environmental performance
- Testing of modules and full assemblies
- Ongoing factory production control

Why does modular housing require testing?

- Testing is required for:
  - Confirmation of design
  - Value engineering
  - Quality control
  - Proof of constructed performance
  - End user confidence; insurance bodies, LABC, mortgage providers and homeowners

Location of testing within the supply chain

- Testing fits within a number of parts of the supply chain:
  - Research and development
  - Design
  - Manufacturing
  - Construction, including delivery to site

Research and development

- Component testing to establish the design:
  - Types of fixings
  - Fixing centres
  - Frame material gauge and section size
  - Connections
  - Lifting and installation requirements

Pull-through testing

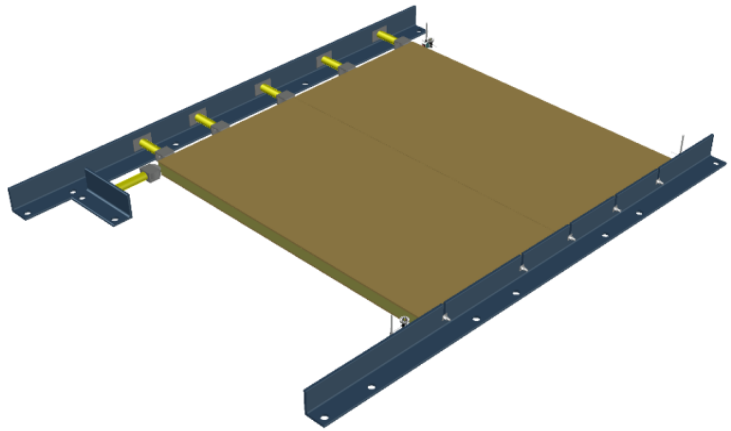
- Pull-out testing is conducted to demonstrate the performance of fixings used to connect the exterior cladding to the external wall panels under wind loading
- Testing is carried out to ETAG 034
- The pull-out test result gives a value for fixing strength based on the type of fixing and the thickness of the board

Testing as part of design

- Panel testing to prove; design calculations, proposed loadings, ability to withstand environmental conditions or to change design accordingly
- Numerous tests are available at the design stage. Typical tests carried out to aid a manufacturer with their design include:
  - Simulated wind load
  - Racking tests
  - Hygrothermal tests
  - Vertical loading tests

Racking testing

- Racking resistance testing is one of the tests used to measure the structural capacity of panel systems
- Racking tests are carried out to BS EN 594:2011
- Results from racking tests give an indication of the adequacy of the sheathing board and are then used to provide values for design calculations



Hygrothermal testing

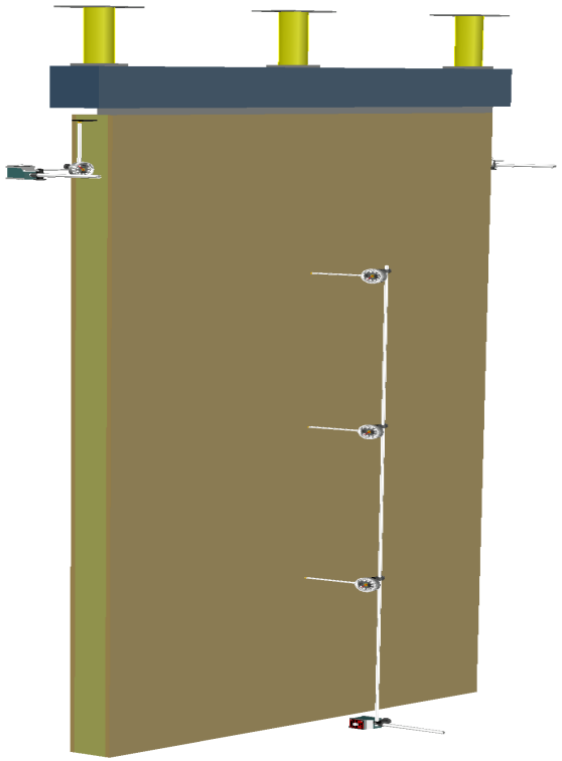
- Hygrothermal testing is the accelerated weathering of an external façade system
- Range of European Technical Approvals which define accelerated weathering cycles, incorporating:
  - Heat-rain cycles (heating to + 70^{O}C and wetting at 10^{O}C)
  - Heat-cold cycles (heating to + 50^{O}C and freezing to -20^{O}C)
  - Freeze-thaw (heating to + 50^{O}C and wetting at 10^{O}C and freezing to -20^{O}C)
- Important that the system is tested and not individual components
- Gives a working life of +25 years

Testing as part of manufacturing

- Test regimes are used to provide 3rd party certification that systems are valid. Types of tests include:
  - Structural load
  - Rain penetration
  - Wind loading
  - Bond strength
  - Impact tests

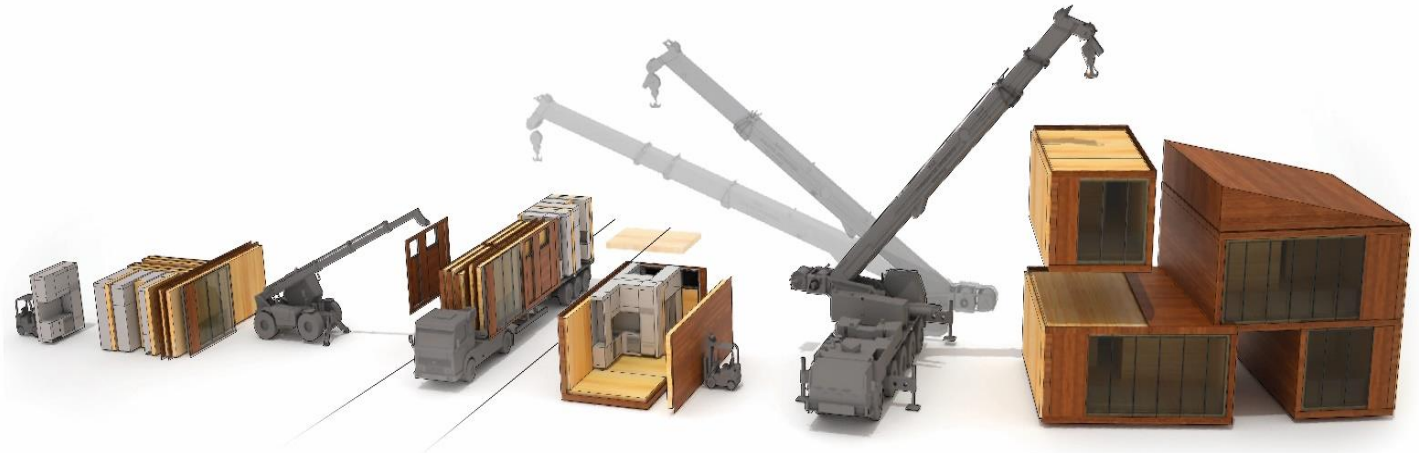
Examples of structural tests

- Structural performance
- Uniformly distributed loading of the floor and roof panels
- Compressive loading of the frame
- Impact testing
- Wind loading of cladding
- Performance of connections



Testing as part of construction

- When modular housing is being built on site, testing is required to ensure that the components delivered have not been damaged in transit (transportability). Transportability stages include:
  - Loading
  - Transport
  - Unloading



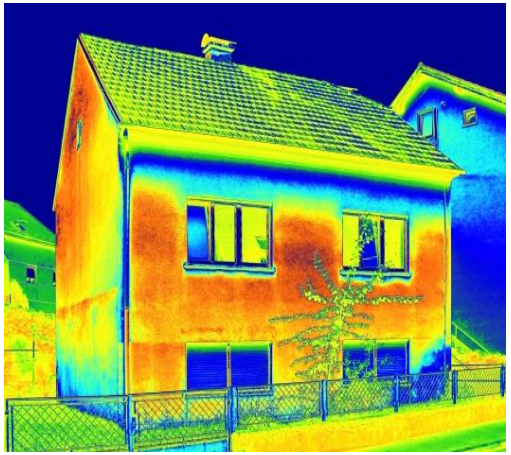
Testing as part of construction

- When delivered to site, the modular components can be tested by means of:
  - Ultrasonic scans of wall panels to check for impact damage
  - Close visual inspection of brick facings - looking for cracks in bricks or mortar

Testing as part of construction

When built, structures can be tested by means of:

- Environmental testing
- Water penetration testing
- Air leakage testing
- Thermal imaging
- Acoustic testing
- Structural testing



Summary

Building control, insurers and mortgage providers need to be satisfied that products will meet the relevant regulations and that they have sufficient longevity.

This is achieved through testing at the four supply chain stages:

- Development
- Design
- Manufacturing
- Construction

Thank you

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