Non-conformance Prevalence, Testing Capacity and Nature amongst Specific Building Product Categories

Final Industry Report, Project 3.47

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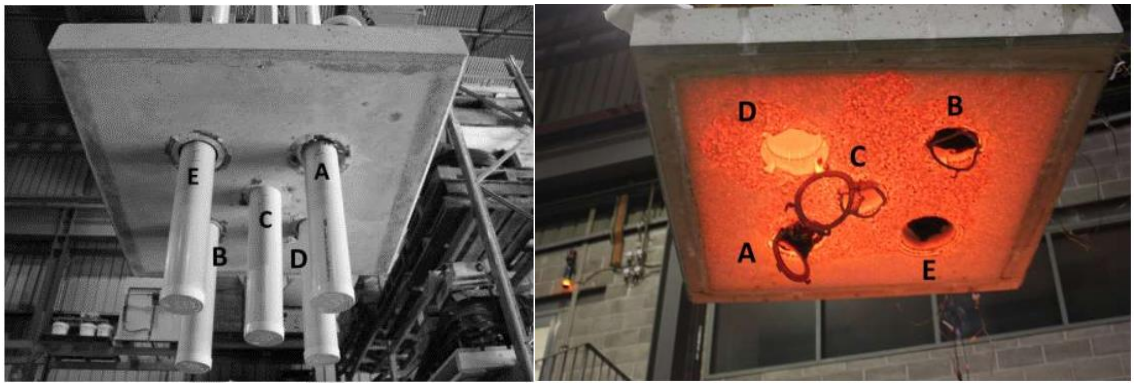

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This Final Industry Report summarises research carried out in SBEnrc Project 3.47 Non-conformance Prevalence, Testing Capacity and Nature amongst Specific Building Product Categories.

Preface

The Sustainable Built Environment National Research Centre (SBEnrc), the successor to Australia's Cooperative Research Centre (CRC) for Construction Innovation, is committed to making a leading contribution to innovation across the Australian built environment industry. We are dedicated to working collaboratively with industry and government to develop and apply practical research outcomes that improve industry practice and enhance our nation's competitiveness.

We encourage you to draw on the results of this applied research to deliver tangible outcomes for your operations. By working together, we can transform our industry and community through enhanced and sustainable business processes, environmental performance and productivity.

John V McCarthy AO
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Executive Summary

Non-conforming building products (NCBPs) have become a prevalent issue in the industry raising concerns amongst government authorities and consumers. The Lacrosse Tower façade fire in Docklands, Victoria, which happened in 2014, is one such case, which resulted in AUD $24 million damages claim. Internationally, one infamous case of NCBPs is the Grenfell Tower fire in London, which occurred in 2017 due to combustible cladding materials. The fire resulted in over 70 deaths and a financial impact as high as £1 billion.

This project examines the capacity and nature of non-conformance testing in Australia by conducting random off-the-shelf independent product testing to improve the evidence base relating to NCBPs. Two products were selected for investigation from the recommendations of the sponsoring agencies. The data generated from these investigations have been kept in-confidence because of their sensitivity. The investigation concluded that each NCBP case should be treated on its own merit as there are many different underlying causes for NCBP problems. The root causes of NCBPs are related to the state of the Australian building regulatory system and the culture of the industry as highlighted in the Shergold and Weir report[1].

The project examined the Australian conformity assessment system and compared it with those of other regions of the world, such as in the European Union and Japan. While conformity evaluation of building products is considered as a government task in most countries, it is left largely for the building industry to handle in Australia.

The project found that test evaluation of NCBPs for performance is difficult for non 'Deemed-to-Satisfy' products. A suitable test method and criteria for evaluation must be devised for each specific aspect of performance of the product. It is useful to distinguish conformance testing from product development testing. For conformance testing, the performance is controlled by its weakest feature and it is adequate to examine only this feature, while for product development, all relevant features must be evaluated to obtain an acceptable solution. Test evaluation for 'Deemed-to-Satisfy' products is much simpler as there are National Construction Code (NCC) referenced standards for guidance. A key NCBP problem in Australia is the lack of independent verifiable information on the performance and use of building products and the accessibility for those who need this information.

[1] Peter Shergold and Bronwyn Weir, February 2018, Building Confidence – Improving the effectiveness of compliance and enforcement systems for the building construction industry across Australia.

Contents

Introduction

Non-conforming building products (NCBPs) have become a prevalent issue in the industry, raising concerns amongst government authorities and consumers. The Lacrosse Tower façade fire in Docklands, Victoria, which happened in 2014, is one such case, which resulted in a $24 million (Australian) damages claim. Internationally, the Grenfell Tower fire in London, which occurred in 2017 due to combustible cladding materials, resulted in over 70 deaths and a financial impact as high as £1 billion.

This SBEnrc project was initiated because of the difficulties in obtaining independent, verifiable data on non-conforming building products (NCBPs) despite numerous anecdotal reports. This is quite understandable considering the legal liabilities and other consequences involved in this kind of investigation. The problem has been highlighted in the Government of Australia's Senate Inquiry into NCBPs in May 2016 and the final report tabled in December 2018[2].

Australia's Conformity Assessment System

To understand the nature of NCBPs in Australia, it is necessary to understand the Australian building regulatory system. This is underpinned by the Australian National Construction Code (NCC)[3]. The NCC is a performance-based code. This means that the only mandatory requirements of the NCC are the Performance Requirements. As illustrated in *Figure **1***, compliance with the Performance Requirements can be demonstrated either by following a Performance Solution path, a Deemed-to-Satisfy (DTS) Solution path or a combination of both.

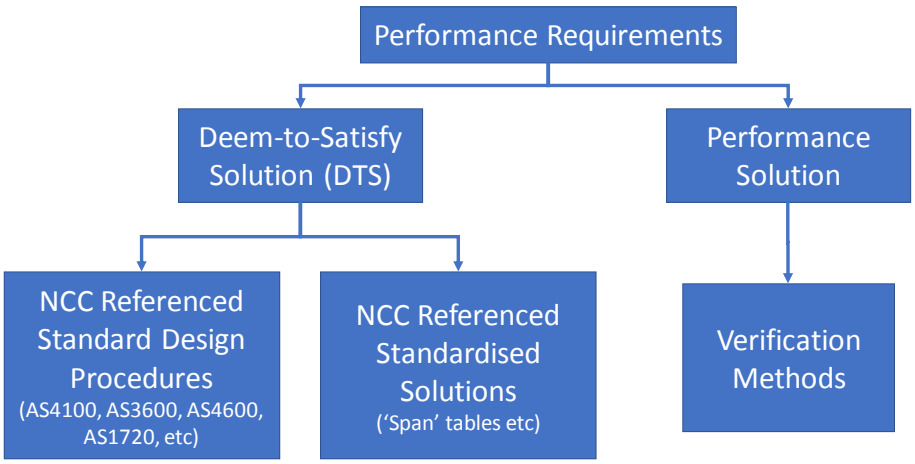


Figure 1: The NCC performance Framework

The DTS Solution path includes a large number of standardised processes and products that are referenced in the NCC. The use of these referenced processes and products is acceptable as satisfying the NCC Performance Requirements.

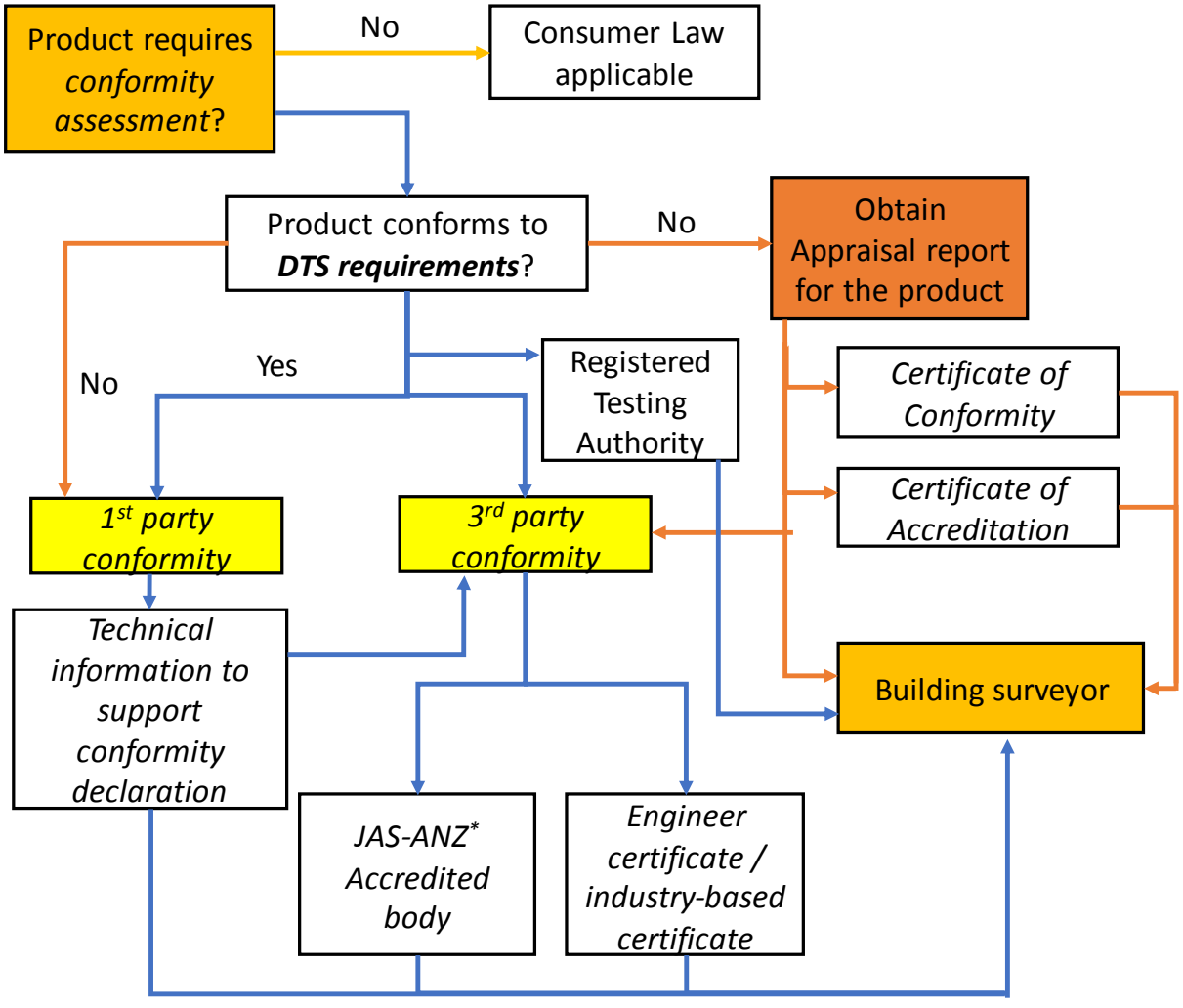
[2] The Senate Economics Reference Committee, December 2018, Non-conforming building products: the need for a coherent and robust regulatory regime.
[3] National Construction Code (NCC) 2016, Australian Government and States and Territories of Australia.

For the Performance Solution path, the NCC requires that the solution is assessed by a number of methods:

- Documentary evidence as described in NCC Volume 1 Clause A2.2
- Verification methods
- Expert judgements
- Comparison to Deemed-to-Satisfy Provisions

It should be noted that the system was set up before the introduction of the performance-based code, consequently the system seems to work better for the DTS path than the Performance path. The use of performance, however, is essential for future development.

In Australia, the enforcement of building regulations is considered as a States and Territories responsibility. As a result, Australia has eight slightly different versions of building regulations. The only common features with regard to the acceptance of design and construction can be found in NCC Part A2 'Acceptance of Design and Construction' Clauses A2.1 and A2.2 (illustrated in Figure 2).



**JAS-ANZ = Joint Accreditation System of Australia and New Zealand*

Figure 2: Flowchart for Australian NCC acceptance options

Conformity Assessment Systems in Other Countries

European Conformity Assessment System

The European conformity assessment system is controlled by the Construction Products Directive (CPD). The Construction Products Directive 89/106/EEC is part of the European Community Laws containing a number of key elements including:

- Essential Requirements (equivalent to our NCC Performance Requirements)
- Harmonised Technical Specifications (equivalent to our NCC Referenced Documents)
- Attestation of conformity (equivalent to NCC A2.2)
- CE Marking (for declaration of conformity)

Six Essential Requirements for construction works are:

- Mechanical resistance and stability
- Safety in case of fire
- Hygiene, health and the environment
- Safety in use
- Protection against noise
- Energy economy and heat retention

It is interesting to note that durability is not covered in the CPD, but it is covered in other documents such as European Standards and Guidelines for Technical Approval.

To assess the suitability of a product *to be placed in the market*, the EU has set up a system with the following 3 components:

1. Harmonised Technical Specifications

The purpose of Harmonised Technical Specifications is to ensure that the test methods and methods for declaration of results will be the same for any member State; although their values may be different between States.

Harmonised Technical Specifications are either

- Harmonised European product standards (hEN): Standards prepared by the European Committee for Standardisation or Comité Européen de Normalisation (CEN)
- European Technical Approvals (ETA) by European Organisations for Technical Approvals (EOTA), when there is no appropriate hEN for the product

Chapter 5 of the CPD allows different degrees of third party assessment of conformity. Six levels of attestation are used:

1^+ Product conformity certification with audit
1 Product conformity certification without audit
2^+ Factory control certification with continuous surveillance
2 Factory control certification without continuous surveillance
3 Initial type testing
4 Manufacturer's declaration

2. Notified Bodies

These are bodies that can do the assessment of conformity:

- Attestation Bodies: bodies approved by member states to do the attestation tasks against CEN product standards that have the benefit from a 'presumption of conformity' (similar to Australia's NCC Deemed-To-Satisfy products)
- European Technical Approvals (ETA) Approval Bodies: bodies designated by member states to issue European Technical Approval for products for which no CEN standard is available

3. European Union CE Marking System

The European Union CE marking system is illustrated in *Figure 3*.

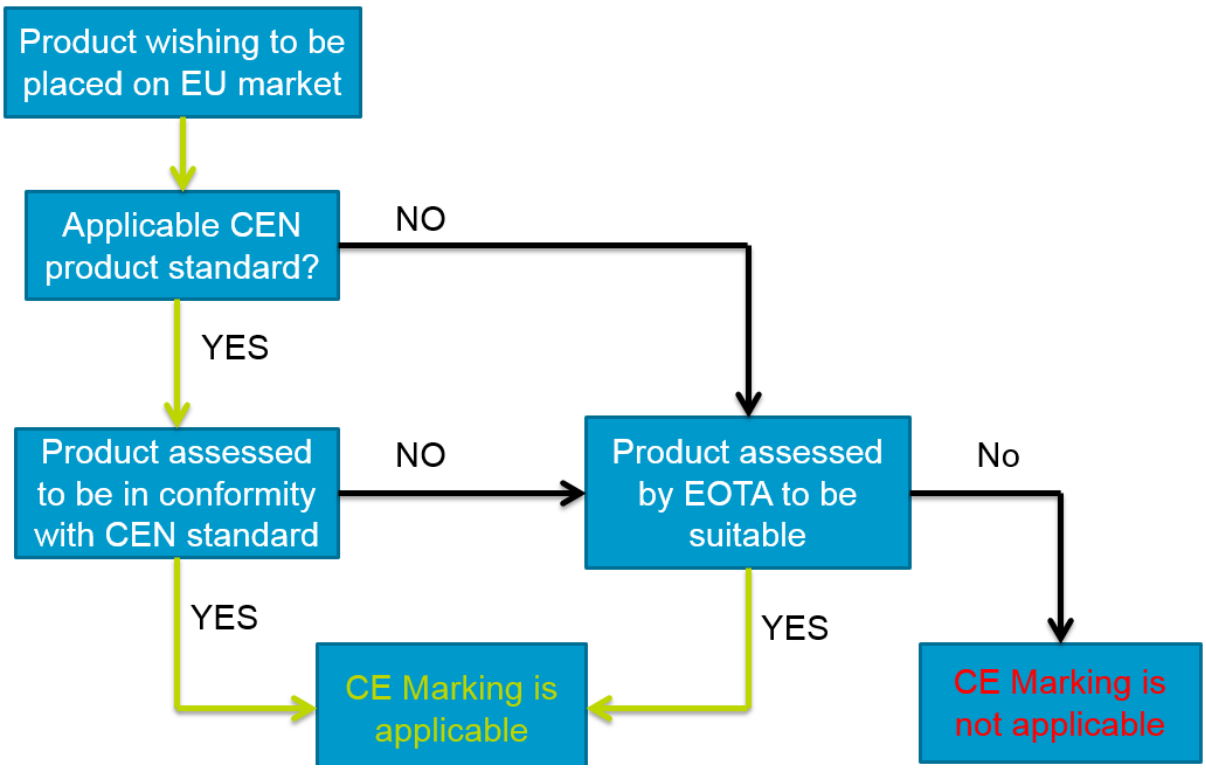


Figure 3: Flowchart illustrating European Union CE Marking System

Japanese Conformity Assessment System

The Japanese Building Standard Law (BSL) has a performance hierarchy which stipulates several compliance paths including a 'deemed-to-comply' prescriptive solution similar to that used in Australia. Where regulated building products do not comply with the BSL prescriptive provisions, they can still be used if they are evaluated against the performance criteria and approved by the Ministry of Land, Infrastructure and Transport (MLIT). Under BSL, this evaluation work can only be undertaken by an 'Evaluation Body' which is recognised by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT).

There are several categories of assessment and recognition for undertaking evaluation works stipulated in the BSL. Typical categories are material quality, fire resistance and non-combustibility. An example of the typical documentation required by BSL for evaluation is given below:

(1) Performance Evaluation Work Application Form (English)
(2) Description of product/material (English and Japanese translation*)
(3) Product/material characteristics explanation (English and Japanese translation*)
(4) Quality data (English and Japanese translation*)
    (a) When the product/material has been produced by different methods from the prescribed test/examination methods in the Minister Notification No.1446 (2000) (hereinafter referred to as MN1446), the applicant shall submit the comparative data where the product has been tested/examined by the said prescribed methods. In that case, the test, etc., following the prescribed methods for comparison, shall be conducted an appropriate number of times.
(5) Testing methods (English and Japanese translation*)
    (a) When the product/material has been produced by different methods from the prescribed test/examination methods in MN1446, the applicant shall submit documents that compare the applied method with the prescribed method.
(6) Quality control methods (English and Japanese translation*)
    (a) Information of manufacturer's factory, etc.
        (i) Manufacturer's management policy, including quality control policy (unless the evaluation work is based on MN1446 III (2))
        (ii) Organisation chart (including company-wide chart and placement of quality manager)
        (iii) Outline of education and training to the employees (unless the evaluation work is based on MN1446 III (2))
    (b) Information on production process
        (i) Manufacturer's written internal process/manual
        (ii) Product qualities and quality control methods (including storekeeping methods)
        (iii) Name of product and manufacturer
        (iv) Manufacturing process
        (v) Management methods
        (vi) Manufacturing facilities and those management methods
        (vii) Testing facilities and those management methods
        (viii) Outsourcing work and those management methods
        (ix) Complaint procedure
    (c) Quality manager
        (i) Name and job title
        (ii) CV
        (iii) Education on quality control
    (d) Manufacturer's written process/manual and quality control record
        (i) Internal process of inspection stipulated in MN1446, Table3 (b), manufacturing, transportation and storekeeping, etc.

(ii) Quality control, organisation management, nomination and role of quality manager, etc.
(iii) Inspection record and data.
(iv) Record of (i) to (iii)

(e) Certification of ISO9000.2: 2000 (in the case that the evaluation work is based on MN1446 III (2) only)

It is also interesting to note that there is a fixed fee schedule for the evaluation work determined by the Ministry of Construction.

Conformity Assessment Methodology

Causes of Non-conformity

A product may be not fit for the intended purpose because of one or a combination of the following causes:

a) The product is not in accordance with its specification. For example, there are faults in its production line. This is a Quality Assurance issue.
b) The wrong product is used. For example, when non-fire rated products are used where fire rated products are specified. This is a non-compliance issue.
c) The product is not correctly installed. For example, when anchors are not installed in accordance with instructions. This happens more often than any other causes and usually can be attributed to lack of supervision or training.
d) The specification itself is not correct for the intended use. For example, in the traditional tie-down of roof trusses to unreinforced double brick walls to prevent uplift.
e) The product does not last as long as the users expect. For example, when metal roof cladding is rusted out after one year.

Examples d) and e) are particularly difficult to assess in the Australian regulatory system. Example d) requires extensive research and testing and example e) is not covered in the NCC.

Conformity Assessment

Conformity assessment is a performance-based assessment of whether a product is fit for its intended purpose. It is essential therefore to have the 'intended use' properly established. Products can be a material, a component or an assembly of components. Each of these categories requires different performance criteria.

Conformity assessment may consist of one or all of the following activities: sample testing, inspection, process evaluation, supplier's declaration, certification, registration, peers' assessment, etc.

Within Australian system, it is useful to distinguish between established products that are specified under Deemed-to-Satisfy (DTS) provisions and new/innovative products that have to be assessed under performance provisions.

Deemed-to-Satisfy Products

DTS products are products that are considered as acceptable by the NCC. For these products, there are usually a number of standard specifications for their manufacture and use. Assessment can therefore be made in terms of a), b) and c) above (Causes of Non-conformity).

Non-Deemed-to-satisfy Products

Non-DTS products will have to be assessed under performance. A performance evaluation usually involves the following steps:

a) Identify the relevant performance requirements in accordance with the intended purpose.
b) For each performance aspect, consider whether the conformity can be established by following the DTS path.
c) For the performance aspect(s) that the DTS path cannot be follow, consideration must be given to how to assess its performance by testing. The test might already have been established or may need to be designed. The test data is to be included in an appraisal report.
d) The performance criteria for appraisal is 'fit for the intended purpose'.

When evaluating a component, it is important to be aware of its roles in relation to other components. Its failure, for example, may have far reaching consequences well beyond its role in the system.

Roles of Testing

Testing is used in many areas of engineering and it is important to ascertain the purpose of the test in order to select the appropriate test and its role in the evaluation of a product.

Types of Tests

Standard Testing

The engineering properties of a product can be obtained from standard testing; i.e. the testing specification has been standardised (in many cases internationally) for all relevant aspects; for example, the sample size and shape, test procedure, etc. The test can therefore be registered with a central recognised body who can check the testing body's work and equipment. It is to be noted that there is no general 'Registered Testing Authority', only specific test procedures can be registered. This kind of routine testing is essential for quality assurance purpose and the only test results considered to be 'acceptable' to the NCC.

Performance Testing

To evaluate the properties of a new/innovative product, it is necessary to carry out performance testing. The testing procedure may or may not be standardised. Many test laboratories at universities and research institutions are of this type. The test specimen, test procedure and test equipment have to be designed to achieve the specific purpose of the test. The test report therefore cannot be considered as being from a 'Registered Testing Authority'.

Use of Tests

Different types of test are used for different purposes including the following:

- Quality Assurance: This kind of test is usually based on standard testing. The main problems are to decide on the number of samples and method of sampling to ensure the consistency of the manufactured product.
- Initial type testing: This type of testing is used to evaluate the performance of a product from a typical sample. The test may involve both standard and performance tests.
- Product development testing: There is no limit to what types of test that could or should be carried out in product development but it is important to distinguish it from conformance testing.
- Conformance testing: the purpose of conformance testing is to check whether a product conforms to specified requirements. It is useful to distinguish DTS products from Non-DTS products for this purpose. Conformance testing may involve both standard and performance tests.

  All conformance activities may involve testing, these include:

  - Initial type testing (see above) at the early stage of conformity evaluation
  - Market surveillance as a means to monitor the product performance in practice. This may include site testing or point-of-sale testing. This is important to ensure that the products in use are the same as the products submitted for initial type of testing.

Checklist for Non-conformance Investigation

The following checklist has been developed as part of this project.

1. Identify type of product to be investigated – component or assembly?
    1.1. For a component, what is the role of the component in relation to other components and/or assembly?
    1.2. For an assembly, what is its intended use?

2. Marketing/Labelling
    2.1. How is the product sold in the markets: separately or in combination with other products?
    2.2. How is it documented?
        2.2.1. Does it indicate intended uses?
        2.2.2. Does it have a manufacturing specification?
        2.2.3. Does it have a Quality Assurance Scheme?
        2.2.4. Does it have instructions for installation?
        2.2.5. What (if any) does it claim conformity to?

3. How far can it be traced back in the supply chain?

4. Potential non-conforming issues:
    4.1. Identify the non-conforming issues that need to be investigated
    4.2. Consequences of non-conforming? – safety related?
    4.3. Are the issues durability related?

5. Relevant codes and standards?

6. Relevant established test procedures?

7. Availability of existing data?

8. Feasibility of testing for the determination of non-conformance?
    8.1. Can existing test procedures be used or must new ones be established?
    8.2. Sampling issues?

Conclusions

The following are lessons learned from the current investigation:

- Specific non-conforming building product (NCBP) problems should be handled with care because of public confidence, financial and legal consequences.
- Each NCBP problem should be treated on its own merit since there are many causes and no universal solution.
- Our current system can cope with products with Australian National Construction Code-referenced documentation but becomes very vague when dealing with performance solutions. Certain provisions need to be revised, such as NCC Volume 1 Clause A2.2 on the acceptance of products and systems.
- Given the complexity of the Australian compliance regimes, a simple definition of conformity as 'fit for purpose' can be helpful.
- There is a lack of independent, verifiable technical information on new products and systems in Australia.

This research would not have been possible without the ongoing support of our core industry, government and research partners:

Find out more
Project webpage: https://sbenrc.com.au/research-programs/3-47/

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