Thomas Ashton Institute

SAFER STRUCTURES WORKSHOP SUMMARY REPORT

12th June 2018

University of Manchester

The Safer Structures Workshop brought together industry, HSE and University of Manchester experts and practitioners to identify and discuss some of the current and future challenges around the theme of Safer Structures. The attendees explored some broad themes relevant to that group's areas of interest and generated many specific and detailed ideas that provide excellent material for forming future research proposals and activities that will have impact, because industry needs the answers. The themes focused around:

- Advanced Materials
- Asset Integrity and Structural Integrity
- Infrastructure Life Extension
- Skills

NEXT STEPS

The Safer Structures Workshop provided a snapshot of some of the issues facing the attendees. The data and opinions collected form part of a wider discussion around what the Thomas Ashton Institute will focus its efforts on. Expect to see research proposals and ideas generated from the valuable information gained on the 12th June.
A brief summary of the main themes follows.

ADVANCED MATERIALS

The **Advanced Materials** theme considered the areas of composites and additive manufacturing as a means of developing safer structures.

Additive Manufacturing shows great potential for deployment beyond the manufacture of components to industries which encompass "structures" in their broadest terms. The major question raised was whether the knowledge and expertise in production, integrity, quality assurance and regulations that has been gained in the additive manufacturing of components is transferable to additive manufacturing of *structures*. This question in turn generated a detailed list of areas requiring study that will greatly help to answer that question.

Composites already have known applications in structures, but a better evidence base regarding their performance is essential. The confidence and predictability we have with

traditional structural materials is not yet matched with composites. Some composites have advantages over traditional materials – but their performance over long periods of time and under load is not well understood but is critical to develop before they are widely taken up in building structures. Other composites themselves may offer novel solutions to addressing safety issues, for example in ageing infrastructure. The discussion of required research included detailed materials performance data, new assurance methods, codes and standards, scale-up of production methods to enable economic production at high volumes, and the integration of composites with other technologies to produce smart, multifunctional materials for use in structures. It was noted that all require a reskilling to produce a workforce that has the appropriate new skills and competencies.

ASSET INTEGRITY AND STRUCTURAL INTEGRITY

The **Asset Integrity and Structural Integrity** groups discussed making structures safer through the process of delivering safer designs, effective sharing of knowledge, and the use of Building Information Modelling (BIM).

Databases for Sharing of Knowledge around structural performance and failures were highlighted as being highly desirable but difficult to implement effectively because of the confidential nature of much of the useful data, which can be subject to litigation and commercially sensitive considerations. However, when structured and managed appropriately, they can be used to not only provide learning about failures, but also to help predict remaining life and to analyse such effects as the impact of behaviour and culture on structural performance. The Rail Accident Investigation Branch reports were highlighted as a good example of a database that effects change well. A proposal was made to develop an infrastructure database, with the Thomas Ashton Institute playing a role in its formation and management.

The Process of Delivering Safer Designs discussions considered the evolution of design standards, codes and regulations and the impact of new materials on these mechanisms for ensuring safe designs. Points raised included, relating the conditions applied to newer materials during their testing and performance evaluation to the conditions experienced by real structures; inclusion of knowledge and data on the deterioration of newer material within design methods; and understanding of safety margins where we cannot rely on a known history of materials performance. In addition, there were concerns raised on contractual risk where long established contracts and subcontract agreements based on existing materials, can be affected by the need to adopt newer materials. These areas are not the exclusive preserve of newer materials, with similar shortfalls existing with older, more established, materials as well. There is a task to ensure that standards, codes of practice and regulations include our best knowledge of materials performance data, new or old.

BIM is already widely adopted as a means of managing all data on construction projects. The group first discussed some of the current limitations. This included the lack of a common BIM platform, the feeling that the BIM BEP requirement is too labour intensive, and the data itself: What level of detail is appropriate, how do you assure the reliability of

the data, who owns it, how can it be shared, and the functionality of interfaces with personnel using the data that encourages its use?

One major issue was highlighted – that BIM is not maximising its potential and adding as much value as it could across many areas. The group focused on "how can we capitalise on the use of BIM to improve safety, reliability and project performance?". Suggestions included: improvements to the communication process; developing more collaborative delivery models; extending the models to incorporate human behavioural influence; identifying and communicating risks; incorporating lessons learned from previous projects; and the opportunity to help guide design decisions by incorporating the perspectives of a wide range of specialists such as, for instance, medical professionals. In this way BIM can become not just a data storage medium but a design tool, producing safer structures and giving improved economic outcomes. This provides many actions and opportunities for the Thomas Ashton Institute to pursue.

INFRASTRUCTURE LIFE EXTENSION

The **Infrastructure Groups** focused their discussions on life extension, specifically around data acquisition using sensors, and improved intervention methods. Infrastructure life extension presents an unusual set of challenges. These are ageing facilities, often non-traditional in design, at a variety of different stages in their lifecycle, possibly having old and new facilities integrated, and having a complex interface between operators, suppliers and the public, which may include a financial settlement if the business is regulated. In some cases, infrastructure can be centuries old.

Condition Monitoring and Data Acquisition, whilst highly desirable, requires an assurance that enough data is being collected, of good quality, measuring the right things, and using sensors that have the right capability and reliability to deliver quality data, and that the data is correctly interpreted – especially where data is limited. The advance of sensor systems presents a huge opportunity to produce and operate structures safely, on a real time basis, with huge economic advantage. Research is needed that to show that sensors can provide the required information; that they can perform effectively in the real world and under real conditions; and whether they can really deliver reduced maintenance and increased structural availability without reducing structural safety.

Maintenance Interventions on more complex assets in shorter time frames, whilst still ensuring quality and safety, is a key challenge for industry. Good project management plays its part, particularly in ensuring good interfaces between adjacent contractors or effective scheduling of tasks, but there are opportunities with the adoption of technologies that move towards preventative maintenance; increasing the speed with which interventions can be undertaken, or reducing their frequency, have major economic and safety benefits. Reducing the number of people placed in hazardous environments during interventions will have a major benefit in reducing the potential for harm.
Technologies discussed included new materials and repair methods, data collection on condition and interpretation for infrastructure management, and improved life prediction methods. New materials are being increasingly adopted for new build and repairs of existing infrastructure with concerns around an adequate demonstration of their

performance, human health effects, and the competency for those who are using them. Adoption of these technologies and approaches requires the underpinning research to ensure safe deployment. (The direct link to the discussions under 'advanced materials' is noted.)

The group also sought evidence on interactions between old and new infrastructure and research into whether our experience shows it is more cost and time effective to repair or replace when considering a future lifecycle.

SKILLS

A common theme from all discussion groups was around skills, with two main themes emerging:

- How do we provide skills for enough people to have the specialist knowledge needed to design, construct, operate and maintain our structures when new technologies and techniques are developing and being deployed continually?
- How do we increase the effectiveness of training of people to work safely on sites, and in what areas?

Through understanding new technologies and their deployment, the necessary skills to ensure competency of those working with the technologies can be identified and suitable training developed. These areas will emerge as the Thomas Ashton Institute work gets underway.

The work of the Thomas Ashton Institute will also explore one of the basic questions that was asked regarding training: What works? There is already evidence that some training, considered as a core requirement, doesn't actually generate any health and safety benefits. Research based on statistical analysis, behavioural science and learning techniques will help in ensuring that training has positive outcomes in terms of safety improvements, rather than just training for trainings sake.