

Structural-Safety Group Review 2015-16

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<http://www.structural-safety.org/publications/biennial-reports/>

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Chairman's foreword

Structural-Safety, the amalgam of SCOSS, the Standing Committee on Structural Safety, and CROSS, Confidential Reporting on Structural Safety, was founded in 2005 and celebrates its 11th year. But its roots go back much further, to 1976, which was the formation of SCOSS.

As the incoming Chair of SCOSS, I look back at this history with gratitude, recognising the energy and commitment of committee members, chairs and staff. Their strict adherence to exemplar quality, professionalism and integrity has made SCOSS, CROSS, and now Structural-Safety, effective. I learn all I can from the 19 previous bi-annual Reports, which chart themes of investigation and development in the structural engineering profession.

The importance of Structural-Safety's work is underlined by who its three sponsors are: the Institution of Structural Engineers, the Institution of Civil Engineers and the Health and Safety Executive. All see Structural-Safety as an essential instrument in the health of the industry, bringing insight and awareness, facilitating learning and the avoidance of future errors. The sponsors, the Director and the Committee and Panel members value the work of Structural Safety so highly that, despite the austerity of our times, it provides a service to the industry which is free at the point of use. There are approaching 9,000 direct subscribers to the Structural-Safety outputs, and several times that number who read these outputs through onward distribution; beyond that perhaps a further factor of 100 or 1,000 should be applied to count the number of people who ultimately benefit.

Having come to Structural-Safety as a SCOSS Committee member some four years ago, I have noted how the organisation has been able to influence change by shaping legislation, codes and guidance documents. Attention has focussed on the organisation's heartland of learning from failure and near misses in components, structural systems, management and workmanship, but it is interesting to see how new avenues of activity are emerging:

- How catastrophic incidents *sub-judice* can be reported, so we can learn from them
- Behavioural best practices at professional level, such as reflective thinking
- International

These are themes I look forward to developing, building on the excellent work already done. I am particularly excited about the international interest: we must be doing something right to have attracted so much attention in Europe, America, the Far East and Australasia. Many are looking to emulate our formula, and an international database of case study material is an exciting prospect indeed: the scope for learning is immense.

In addition to the emerging themes above, I shall be looking to bring more emphasis to

- Structural safety at each stage of the construction process, with a focus on temporary works
- How we communicate the learning that Structural Safety distils in different ways: what new channels can we use and how can we partner with others
- How emerging digital technologies can help us to derive greater value from the database of case study material

In respect of the last of these, I am delighted to have been invited to co-sponsor, with Gordon Masterton my predecessor as Chair, a PhD at The University of Edinburgh, to investigate how this better value can be derived. We have high hopes!

Sharing experiences, particularly of what has not gone entirely to plan, is at the heart of engineering professional practice. It is the idea that launched the Institution of Civil Engineers in 1818 and it remains fully relevant today. It is enabled by the Institutions and HSE through the confidential reporting of CROSS and the dissemination of learning by SCOSS. It is a noble cause in the public interest.

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I hope you enjoy and learn from this report, respecting the openness of those who have made reports, and the dedication and integrity of those that have taken the reports and turned them into learning. Having done that, I hope you will feel encouraged to contribute yourself, a second or third time perhaps, or perhaps for the first; www.structural-safety.org refers.

Bill Hewlett, Chair

1. Overview

This is the third Review from Structural-Safety and covers the period December 2015 to December 2016 for work done by SCOSS (The Standing Committee for Structural Safety) and CROSS (Confidential Reporting on Structural Safety). It is the 20th Review since SCOSS was formed in 1976. The SCOSS Committee seeks to identify trends where industry practice may not provide adequate safeguard against failure and to suggest changes in procedures and arrangements for the future. CROSS handles issues which might not otherwise have had formal recognition, and important safety considerations have been brought to the attention of engineers, both in the UK and overseas. Confidence in the system, independence, and confidentiality have proved to be keys to success.

In May 2016 Gordon Masterton stepped down as chair of SCOSS after six (?) years and the position was taken on by Bill Hewlett, a Director of Costain and Chair of the Temporary Works Forum. Several Committee members retired during the period and their contributions of time and expertise are gratefully acknowledged. New members have taken their places and are warmly welcomed. Indeed, the generous, and voluntary, donation of time by these senior practitioners is the greatest asset of the Group.

It continues to be clear from the literature and elsewhere that structural failure is a world-wide phenomenon. Structural failure brings economic loss and business disruption but, because of its nature, often results also in human loss. The UK has a safety record amongst the best. However, as our infrastructure is ageing and budgets for maintenance are increasingly limited, we cannot afford to be complacent.

The number of reported concerns or events is but a small fraction of the total, many of which are probably regarded as near hits, and not significant. The data base provides evidence of various types of failure and has been used to provide industry wide advice on several topics. In the public arena, there have been some notable collapses which emphasise the need for continued vigilance. There have also been prosecutions by HSE for breaches of the law including corporate manslaughter convictions.

The work the Group was recognised by the Professional Engineering Committee of the Engineering Council in this recommendation to all engineering institutions: "Developing a reporting and follow up system similar to the Confidential Reporting on Structural Safety system."

This report is a summary and further information can be obtained from the [Structural-Safety](http://www.structural-safety.org) website.

2. Topics discussed

The Structural-Safety Committee comprising CROSS and SCOSS members meets four times a year to consider safety matters arising from publicly available information and from confidential reports. As is standard practice reports are de-identified before being seen by anyone other than the Director. Twice a year there are meetings of the sponsors' representatives (IStructE, ICE and HSE) to consider overall strategy and the business model that needs to be developed to enable the Group to become more self-sustaining in future. There has been discussion by the sponsors about the establishment of a new legal entity to encompass the affairs of the Group.

A Topics list is maintained of events that are of interest and during this period. Amongst these was an initiative to assess whether damage from weather related events was becoming more severe as a result of the apparent increasing number of storms and other extreme events. This has been funded by CLG (Communities and Local Government) who will look at the results to see if any changes need to be considered for future Building Regulations. All local authorities in England have been asked to participate by LABC (Local Authority Building Control) and in Scotland by Building Standards. The web site has been adapted to accommodate weather related reports as well as the normal structural reports. Climate change has been discussed by the committee and it was concluded that flooding poses the greatest current risk. Wind has also been a subject of interest with reports on damage caused to buildings and to temporary works in city centres.

Several problems with high strength steels were noted, including the failure of some large diameter bolts, and an Alert on the subject will be prepared. There has been publicity given to possible problems with basement construction, particularly under large domestic properties in London, and a watching brief is being kept on these. Several cladding fires in tall buildings in the UAE have been noted and although it is not thought that similar events could occur in the UK, again a watching brief is being maintained. In 2014 HSE published an open letter to the structural timber industry about the risks of fires on site and this prompted a revision of the SCOSS Alert "Timber framed buildings in fire situations: the role of the designer - amended March 2015".

There have been instances overseas of large crawler cranes blowing over sometimes with fatal results to the public and an Alert is being prepared in association with Plant Hire Association. The general subject of hazard identification has been raised in various forms and the Committee are active on several fronts. The work of the Hazards Forum in this regard is noted and the IStructE publications on *Managing Health & Safety Risks* are recommended.

Masonry walls, particularly free-standing walls, have been a topic of concern for many years and there have been two notable incidents recently; by coincidence both in Edinburgh and both involving schools. A pupil died after a free-standing wall fell at a school and part of a gable wall at another school collapsed, fortunately without causing injury. The findings of formal investigations into the events were not complete at the time of writing but will be of great interest in due course.

Another perennial topic is that of fixings whether these are large structural bolts or lightweight ceiling components. Fixings make up 16% of the reports to CROSS and is the largest group apart from generic steel of concrete structures. Not enough attention is paid to them either in design offices or on site despite these being amongst the most safety-critical components in any structure. The Management of Safety Critical Fixings is currently being addressed by Highways England and CIRIA have started work on lightweight fixings.

It is felt that more should be done to disseminate Alerts and Newsletters to universities and training colleges and this will be followed through in the next year.

Two high profile collapses of interest are, firstly, Abraham Darby school canopy which failed during construction in August 2011 injuring five workers. The firm involved was fined £100,000 for what was described as: "key sections of the 180ft steel framework supporting the canopy had been insufficiently welded together." A full forensic analysis has yet to be published. Secondly was the total collapse during construction of the City Gates building in Ilford in January 2012 and again no full analysis is in the public domain. Work is in hand to publish some relevant information about lessons that can be learned from this failure in a SCOSS Alert.

More recent high profile collapses include the new Barton Bridge collapse during construction (May 2016), the Didcot Power Station collapse during demolition (February 2016) with four fatalities, the wall collapse at a recycling centre in Birmingham (July 2016) with five fatalities. In due course it is hoped that the reasons behind these events will be put in the public domain for the benefit of others. However there has been a long-standing issue that forensic information on many failures remains secret due to legal or insurance constraints. To address this an initiative has been launched by ICE Structures Expert panel to examine the measures that might be taken to encourage the early release of safety-critical data.

Emerging risks from wind turbines is a subject that is being examined following the failure of several of these in different countries but it is too early to say whether there are structural implications. Also on the current agenda is the topic of Old plasterwork ceiling fixings following the dramatic collapse of one at the Apollo Theatre in London in 2013 and concerns within the industry. Lightweight steel frames have been the subject of several reported concerns and these will be addressed with a paper to be published on the findings.

3. Publications

A major change during the period has been that joint meetings were held between the SCOSS Committee and the CROSS Expert Panel. This was to improve efficiency and also to broaden the approach so that the widest range of expertise could be brought to bear on subjects under discussion. A list of topics is maintained and updated quarterly with matters that have been brought to the attention of the Group. By its nature some items are ongoing and indeed are similar to those considered over several years. Others are more immediate such as a major collapse. The following is a summary of some key items discussed since the 2012 review.

Alerts

[Wind Adjacent to Tall Buildings - December 2015](#)

Reports to CROSS have raised concerns about the design of temporary works to resist wind loading in urban environments. Temporary works have suffered local wind damage, and it is suspected that is, in part, because wind loads have not been determined correctly. Although reports relate to urban environments, temporary structures adjacent to tall buildings in exposed location may also be adversely affected. The flow around buildings is complex and three-dimensional. However, it is possible to understand some of the underlying principles to assist in deciding when specialist advice is required. A desk study by a specialist can often provide a good indication of the significant issues.

Designers of temporary structures should consider how the environment around a temporary structure will change during the construction process. Different stages in the construction of a tall building may introduce blockage effects that alter or funnel wind flow, and give the critical design case for wind loading (e.g. with the addition of cladding). Advice should be sought in critical and complex situations, where a competent wind engineer may be able to help identify the main wind-related issues or suggest quantitative studies (e.g. wind tunnel or otherwise) where necessary.

[PV installations: structural aspects - November 2016](#)

Structural-Safety has concerns about some structural aspects of roof mounted PV and solar thermal panels. Reports have been received of problems with installations including:

- lack of guidance on structural aspects
- excessive load on existing structure
- number and quality of fixings
- quality of workmanship
- damage to roof trusses and timbers
- damage to waterproofing
- wind damage to completed installations

There have also been concerns expressed in the technical press about compliance, or lack of it, with Part A of the Building Regulations (England), the effectiveness of the claimed 25-year life in some cases, the durability of the fixings, the quality of workmanship, and the possibility of leaking roofs and the potential effects of PV installations on

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fire ignition, growth, development, and firefighting operations. Recommendations are given for existing roofs and for new roofs.

Topic Papers

[Timber framed buildings in fire situations: the role of the designer - amended March 2015](#)

This paper was originally published in November 2010 and has been updated in January 2015 to take account of an *open letter* issued by HSE in October 2014 to all parties involved in the design, specification, procurement and construction of timber framed structures. It states what HSE expects from the timber frame industry and has been produced in association with the Structural Timber Association. A timber frame as discussed in this document has panelised structural walls and floors using small section timber studs and board products for the walls. The term does not refer to timber post and beam structures or timber engineered structural frames.

[Structures at the end of their design life - June 2015](#)

Much of our small scale built environment was developed without a defined service life. The structure, services and finishes are likely to have been upgraded progressively without disproportionate cost and with limited regulation. The paper also briefly considers major public infrastructure and industrial/commercial structures, bridges, industrial structures and commercial structures. The importance of inspection and assessment processes in order to evaluate ongoing serviceability.

[Reflective thinking - December 2016](#)

Reflective thinking is a constant drive to ask questions and to make appropriate responses to them. It is characterised by a healthy scepticism about all inputs to processes, about the processes themselves and about the outcomes from processes. It is a pervasive activity in all risk reduction strategies such as: using the design process, using predictive models, using codes of practice, adopting an ethical approach. In structural analysis the validation question: "Is the model capable of satisfying the requirements?" tends not to be used explicitly by engineers. Likewise, the validation question for use of a code of practice: "Is the design context within the scope of the code of practice?", also tends not to be used in a formal way. But this type of reflective question is critical in reducing risk in structural design. The root causes of major structural failures tend to be more a result of decisions about what calculations should be done (validation) rather than due to errors in carrying out the calculations (verification). Viewed as a main strategy for reducing risk, reflective thinking needs to be much more explicit and more dominant in professional engineering practice.

[CROSS Newsletters](#)

Newsletters are issued in January, April, July and October, and in 2015 and 2016 details concerning sixty-three reports were published from a total of 138 received. Some of the others have been added directly to the web site data base, some of the remainder are awaiting further information or have not yet been processed. The reports are de-identified (anonymised) and comments are provided by the CROSS Expert Panel to give general advice so that lessons can be learned by readers.

Newsletters are circulated by email and are distributed further by some groups and internally by some organisations so the number who has access to them is greater than the 8,000 subscribers. There is the highest potential for reducing risk of structural failure through the Newsletter reports because of the number and range of issues that have been highlighted.

Published subjects this year have included failures and near misses on sites, fixings issues (which remain one of the most significant source of problems), stability and lack of bracing in frames, wind damage, building control issues, fabrication details that differ from the design intent, and temporary works failures.

External publications

Technical papers and articles have been published and there has been attendance at conferences, such as IABSE, to promote the Group.

4. Key topics

As before a list of topics is maintained and updated quarterly with matters that have been brought to the attention of the Group. By its nature some items are ongoing and indeed are similar to those considered over several years. Others are more immediate such as a major collapse. The following is a summary of some key items discussed since the 2014 review.

Weather damage reporting

Climate change has been a subject of interest to the Committee and presentations were made which underlined the significance of global warming. The more difficult impacts to assess are drought, flood either from rivers or failed coastal defences, and subsequent public health issues. To obtain evidence on damage to buildings in the UK a weather damage reporting system has been developed with funding from the Department of Communities and Local Government (CLG). This is in parallel with the usual structural safety system and local authorities will be encouraged by Local Authority Building Control (LABC) to submit reports of damage caused by weather.

In due course the results will be used to help determine whether changes need to be made to the Building Regulations.

Communications strategy

A review of communications was conducted by a working group from the Committee during the previous period. The initial driver was "to recognise the different perspectives and different communication modes commonly used by younger practitioners". Recommendations were accepted by the Committee but budget limitations have restricted their implementation. Instead, for reasons outside the control of the Group, a new web site provider had to be found and the consequent hand-over required some un-planned costs.

CROSS International

There have been expressions of interest in the CROSS scheme from bodies in Europe, the USA, Australia, and South Africa so it is proposed that there should be an initiative for international co-operation. CROSS International would promote confidential reporting as an effective method of enhancing structural safety for the benefit of those involved in the construction industry and the public. This would be done through web sites with an international UK hub linked to national schemes. Principal objectives would be:

- To provide guidance on establishing confidential reporting systems
- To provide advice and assistance in the operation of such systems
- To facilitate the exchange of information between national reporting systems by setting a common style for reporting
- Set quality standards for the material presented and the standard of reviews
- To establish an international data base of reports and expert comment
- To provide a platform for global discussion, identification of trends, and using influence to improve of public safety.

National bodies would form groups in their own countries to establish reporting schemes that are confidential and independent of commercial or regulatory interests so far as operation is concerned.

5. CROSS Reports

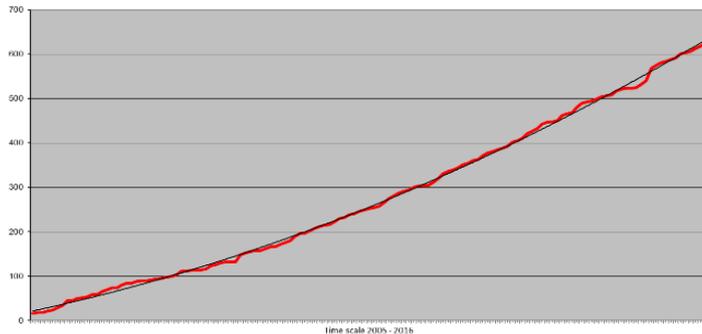


Figure 1 Reports received

The number of reports received increases year on year as shown in Figure 1 where the red line indicates actual numbers and black is the trend over the past eleven years. By no means are all of the reports confidential although everyone is treated as such. Some cases come from HSE and some from press reports where a relevant event has been identified. Most originate in the UK but a few have come in the last two years from Australia and Southern Africa, and the occasional report from elsewhere. They are all however relevant to structural safety.

Subjects include quality of design, checking and construction, failures of structures and components, fixing problems (again), unsafe practices, falls of material from old structures, and wind damage. More reports are always needed and there are continuous efforts to encourage individuals and organisations to submit their concerns.

6. Summary of past reviews

Following the last Review for the years 2012-14 the outcomes from all SCOSS biennial reviews from 1977 – 2014 were re-visited and a summary of the most important outcomes was made. This is given in the Table below and whilst the data is historic the lessons are all relevant and valid in today's industry.

Topic	Recommendations made	Outcome
Building Regulations in the UK	<ol style="list-style-type: none">1. Building regulations should be updated particularly on disproportionate collapse.2. Concerns expressed over standards of submissions.	<ol style="list-style-type: none">1. Improvements made over the years including changes on robustness and disproportionate collapse.2. ICE is working with LABC in this respect. IStructE taking action too.
Duty to warn	In some situations, it might be appropriate or essential to give a warning.	SCOSS Alerts and CROSS Newsletters give guidance. IStructE Ethics Panel formed.
Fixings and fasteners	The safety critical nature of the selection and installation of fixings must be recognised.	SCOSS Alerts, new British Standard, authoritative industry guidance.
Inspection, maintenance and deterioration	Owners and operators to arrange for periodic inspections and structural appraisals since structures deteriorate over time.	IStructE guidance publications issued.
Multi-storey car parks	Lack of maintenance and deterioration should be more widely known in the car parking industry.	Recommendations given in publications by ICE, IStructE, CLG, and the British Parking Association.

Risk appreciation and assessments	Advice on procedures for assessment of hazards and risks to be improved.	Guidance published by IStructE. SCOSS raised the profile of risk management approaches generally and the need to consider the 'soft hazards' i.e the '3Ps'
Temporary structures	Local authorities, and others, should ensure that temporary structures for public events are structurally safe.	AGOTS publication on TDS Guidance now the de facto standard. SCOSS Alert used for London Olympics temporary stands.
Temporary Works	Concerns about the implementation of the Bragg Report on Temporary Works	Temporary Works Forum established
Timber	Concerns about design, fire risks, and fixings.	Number of failures greatly reduced

7. Achievements and looking ahead

The Newsletters and other publications continue to be well received by industry. The documents are circulated amongst staff by some firms and on the list of subscribers are names from many companies in the UK and a good few overseas. The CEO of one construction firm calls a meeting of his managers when a Newsletter is published and uses the contents as the agenda for a meeting. Are any of the issues reported similar to activities on their sites?

A new activity, proposed by Chair Bill Hewlett, is to have Forum meetings at which young engineers will introduce recent CROSS reports and there will be open discussion. Initially there be one at IStructE and one at ICE.

A significant move has been to reach agreement with Network Rail for reports on some of their experiences with structural and civil engineering problems to be shared with CROSS. Hitherto these would have had restricted circulation but are now being included with other confidential reports.

There are two UK research projects being undertaken in the UK with connections to Structural-Safety. One is at Edinburgh University where a PhD student, sponsored by Costain, is investigating construction failures. The other is at the University of Liverpool where a PhD student is completing a PhD on the potential of Natural Language Processing (NLP), Big Data and Artificial Intelligence (AI) for the retrieval and re-use of risk knowledge and data using CROSS a prototype model.

As has been said before it is all too frequently a building or engineered structure will collapse somewhere in the world. Over the past two years hundreds of people have been killed and many more injured. Examples include multi-storey building collapses in India, collapses in Nigeria and other parts of Africa, collapses in parts of Asia and in many other places. The human toll is shocking to those of us in a country where we have few major failures. It is however most important to be able to know what has gone wrong and in due course it is hoped that forensic details of these tragedies will become available so that lessons can be learned by engineers, and others, everywhere.

The need to understand failures is an essential part of the learning process to develop better safety cultures, particularly where saving lives is concerned. Many checks and balances exist in any regime where there are responsible designers and constructors working in accordance with sound regulations which are responsibly enforced. But there are always cases where something goes wrong and the difference between a near miss and a catastrophe can be very thin. In a learning culture such events are recorded, acknowledged, analysed, and the findings disseminated to make a difference in future.

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Cognisance of pre-cursors in any environment is a proven way of helping to reduce the consequences of more extreme events. It is recommended that the Institutions should provide members with incentives to encourage them to provide Structural-Safety with reports, and that HSE should consider further ways of providing Structural-Safety with reports.

SCOSS maintains a watch on events globally but remains the only body of its type anywhere so its influence is restricted. Governments and relevant organisations in other countries are encouraged to adopt similar processes so that greater structural safety in their countries can be developed.

Appendix A – People

SCOSS Chair

Bill Hewlett MA FICE FIET, Director Costain, [From May 2016]

Structural-Safety Director

Alastair Soane BSc PhD CEng FICE FStructE, [from 2005]

SCOSS Members

Brian Bell MA MSc DIC CEng FICE FStructE, Director, Bell Johnson Ltd [from October 2008]

Prof Luke Bisby BEng MSc(Eng) PhD, Professor of Fire and Structures at University of Edinburgh [from July 2015]

Steve Brunswick BSc CEng FICE FCIQB Technical Services Director, Carillion Group Technical Services [from January 2017]

David Cormie MEng(Hons) CEng CEnv FStructE FICE MASCE, Associate Director, Arup [from July 2012]

Ala Hammad BEng MSc MIEI Site Engineer, Kilnbridge Construction Services Limited [From February 2016]

Christopher Leadbetter Associate, Clyde & Co LLP [from October 2016]

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Steve Parncutt, BEng (Hons) CEng MICE, HM Principal Specialist Inspector (Construction), Health and Safety Executive [from July 2014]

John Rees BEng ACGI MSc DIC CEng MICE, Flint & Neill [from January 2011]

Alastair Soane BSc PhD CEng FICE FStructE, Director Structural-Safety [from 2005]

Richard Snell BSc (Hons) FICE FRAE FStructE, Consultant, formerly BP Exploration [From October 2008]

Christopher Yapp MEng, Consultant at BRE (Building Research Establishment) [From October 2016]

CROSS Expert Panel Members

Sally Boorer BEng CEng MStructE, Engineering Policy Manager, NHBC [from January 2015]

Tony Jones BEng PhD CEng FICE Associate Director, Arup [from 2005]

David MacKenzie MS BE FStructE MASCE MHKIE, Chief Executive Officer at Flint & Neill Limited [from 2005]

Allan Mann BSc, PhD, CEng, FEng, FStructE, MICE, Consultant, Jacobs [from 2005]

Vladislava Palan MEng, Principal Structures Advisor, Highways England [from 2016]

Steve Parncutt BEng (Hons) CEng MICE, HM Principal Specialist Inspector (Construction), Health and Safety Executive [from July 2014]

Nick Price BSc MSc CEng DMS MICE FCIWEM Principal Engineer, Department of Communities and Local Government [from July 2013]

Mark Pundsack CEng MStructE MRICS, Principal Building Control Officer, City of London [from 2008]

John Rushton BEng MSc CEng MICE MStructE, Peter Brett Associates [from 2005]

Steve Williams BEng (Hons) CEng MICE MStructE AMAPM Programme Engineering Manager, Network Rail [from July 2016]

Secretary

Daniel Antwi BA (Hons), The Institution of Structural Engineers [from August 2016]

Ala Hammad BEng MSc MIEI, The Institution of Structural Engineers [to August 2015]

Babasola Thomas MEng, The Institution of Structural Engineers [to August 2016]