

**15<sup>TH</sup> BIENNIAL REPORT FROM SCOSS**  
**The Standing Committee on Structural**  
**Safety**

**June 2005**

**SCOSS**  
**11 Upper Belgrave Street**  
**London SW1X 8BH**

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## **FOREWORD**

I am very pleased to be able to present the 15<sup>th</sup> Biennial Report from the Standing Committee on Structural Safety (SCOSS).

SCOSS was founded in 1976 and has acted as an influential voice on matters relating to structural safety since that time. Unfortunately, the need for such a Committee has not diminished as can be seen by studying the content that follows.

This year I am particularly pleased to announce that a pilot scheme to allow the confidential reporting of matters of structural concern will be launched in June and will run for 12 months. This is a major step and one that brings the construction industry in line with a number of other industries. It is up to those working in the industry however to make use of it and contribute to it where possible; the output will only ever be as good as the input allows.

The Committee continues to receive information which raises safety concerns about issues associated with people, processes and products. A well informed industry is essential to maintaining adequate levels of structural safety in its widest sense. The pressure for transparency and assurance, specifically in respect of competency, is growing.

I hope that this report will be widely read and disseminated. The recommendations apply to practitioners as well as those in positions of influence.

**Kate Priestley**  
**Chairman**

## SUMMARY

In this report, presented in electronic format as was its predecessor<sup>1</sup>, SCOSS outlines the issues considered over the two year intervening period and the concerns arising from them as they relate to structural safety.

The report begins in Chapter 2 with an update on the Confidential Reporting on Structural Safety (CROSS) scheme which is now moving towards a launch on 10 June 2005. This is considered to be a major milestone. It is down to the industry to make it a success such that wide benefit is obtained.

A feature which emerges strongly from the Committee's deliberations is that concern relating to structural safety risk is not limited to construction products e.g. the strength of steel, or of connections, important though they are. The possibility of an unacceptable reduction in the safeguards against failure may be found at all points in the engineering process and hence this report is structured around the three key components i.e. **people, process and product**.

Structural engineering requires **people** with appropriate skills, knowledge and abilities and aspects of competency are reviewed in Chapter 3. The **process** of engineering involves many activities and in Chapter 4 consideration is given to risk management, designer responsibilities, certification of products, Eurocodes, the workings of BSI committees, and impounding structures. Chapter 5 considers some specific aspects of **products** i.e. liquid metal assisted cracking, large panel structures and some general issues including deterioration of our building stock.

Chapter 6 reflects upon the fact that there continue to be failures around the world all of which have lessons for us in our day to day design and construction activities. Finally, the actions taken on the recommendations of the 14<sup>th</sup> Report are outlined in Chapter 7.

It is the case that items identified in the 14<sup>th</sup> Report, i.e. Risk Management and Eurocodes remain as central threads to current concerns, and hence feature again in this Report.

The period since the 14<sup>th</sup> Report has illustrated once again that at its best the industry continues to hold its world ranking. It also illustrates however that, as noted in the Summary to the previous Report, we cannot afford to take our eye off the ball; this is amply demonstrated by the examples quoted in Chapter 6.

The Committee is able to report in particular that it has played a part in:

- initiating a survey on the efficacy of the BSI committee system
- encouraging the provision of practical information on risk management
- the establishment of a standing committee to monitor issues associated with the introduction of Eurocodes
- the establishment of CROSS

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<sup>1</sup> but accompanied by a hard copy Executive Summary Report. A hard copy of the full report has been placed in the principal libraries.

## Report recommendations

The purpose of SCOSS is to collate and consider issues which may have a medium or long term bearing on structural safety, and to suggest actions to be taken by those most able to influence the practices adopted within the construction industry.

In order to assist in the assimilation of the report recommendations, they are directed at *Influencers*, and at *Practitioners*.

*Influencers* are individuals or organisations able to influence or directly bring about change. These will include for example Government Departments and Agencies, Institutions, BSI and Higher Education centres. *Practitioners* are all those who practise structural engineering or who manage the process. In some instances however, the recommendations will also be relevant to Owners and Facility Managers. The recommendations for *Influencers* are in many cases different to the recommendations for *Practitioners*.

## Chapter 2: Confidential Reporting on Structural Safety (CROSS)

### Influencers

2/I1	All those of influence are requested to encourage use of CROSS in order to allow a meaningful quantum of data to be collated, and for the culture of the industry to change such that reporting matters of concern becomes the norm.
2/I2	Institutions are encouraged to open a debate to identify how contemporary information on specific items of concern may be discussed and made known, even though the issue may be subject to legal action. The text quotes the initial reports on two foreign structural collapses as examples.

### Practitioners

2/P1	All those practising structural engineering- as designers, specifiers, academics, and others, are asked to contribute to CROSS should they have a valid point of concern. It is only by having contributions from those at the coal face will the industry be able to improve and avoid unnecessary pitfalls.
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## Chapter 3: People

### Influencers

3/I1	(3.1 Competency) Institutions are encouraged to review their validation procedures to ensure members maintain an adequate level of competency over their working life.
3/I2	(3.1 Competency) Institutions are encouraged to ensure that the education and initial professional development phases place sufficient emphasis on the issues highlighted within this Chapter. Employers are encouraged to ensure that in-career development of their employees covers these issues.

3/I3	(3.1 Competency) Design organisations are encouraged to review their internal procedures to ensure risk is identified and managed in accordance with best practice.
3/I4	(3.1 Competency) Suppliers of software and design aids should ensure that their products provide adequate guidance on aspects which might influence the appreciation or analysis of risk elements.

### Practitioners

3/P1	(3.1 Competency) Individuals involved in structural engineering should consider the specific issues identified in this Chapter and how they may impinge on individual competency.
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## Chapter 4: Process

### Influencers

4/I1	(4.1 Risk Management) ODPM are encouraged to promote guidance on appropriate risk management measures that would satisfy the disproportionate collapse requirements for buildings in class 3.
4/I2	(4.1 Risk Management) Institutions are encouraged to consider how IPD courses based round the syllabus given, may be introduced.
4/I3	(4.1 Risk Management) Academia and Industry are encouraged to consider the issues arising from paras 4.1.10-4.1.17 in connection with model validation.
4/I4	(4.1 Risk Management) Institutions should consider whether the interview process for membership should include reference to this topic.
4/I5	(4.2 Designer Responsibilities) Institutions are encouraged to raise a debate on the issues identified in this section, as they have the potential to impinge directly upon the maintenance of adequate levels of safety. (Note ICE and IStructE have already agreed to review this topic area.)
4/I6	(4.2 Designer Responsibilities) Design organisations should consider the points discussed when entering into commercial arrangements and to bring pressure to bear where possible in order to minimise the identified shortfalls.
4/I7	(4.3 Certification, use of products and other associated matters) Industry should consider producing a clear definitive guide to this subject area (perhaps through the Construction Products Association or as an extension to the existing ODPM guide to CE marking) written in a manner which will assist those specifying or using products.
4/I8	(4.6 Impounding Structures) The ICE, and the British Dam Society (BDS) in particular, should consider how it may assist DEFRA in making a case for changing the assessment of reservoirs to a risk based approach, regardless of size.
4/I9	(4.6 Impounding Structures) The ICE, and the British Dam Society (BDS) in particular, should obtain further data on the concerns outlined in respect of PII, and if appropriate make a case to DEFRA. This should be undertaken expeditiously.

### **Practitioners**

4/P1	(4.1 Risk Management) Practitioners are encouraged to ensure that they have an understanding of the elements of the 'risk management' course.
4/P2	(4.1 Risk Management) Practitioners should consider the points made in respect of model analysis, and to apply these to their own projects.
4/P3	(4.3 Certification, use of products and other associated matters) Practitioners should be alert to the issues associated with certification and use of products as there are real safety issues involved, specifically during the period of familiarisation with EU standards and procedures.
4/P4	(4.6 Impounding Structures) Panel Engineers should assist the British Dam Society (BDS) in respect of Recommendation 4/I7 and 8.

## **Chapter 5: Product issues**

### **Influencers**

5/I1	(5.2 Large Panel Structures) ODPM are encouraged to ensure that local authorities are aware of the issues associated with Large Panel Structures generally, and specifically on the use of LPG in and around multi-storey structures, and its relationship to 'fuel poverty'.
5/I2	(5.4 Miscellaneous ) The House Builders Federation is encouraged to expedite a means of providing adequate warning of unintended collapse due to inappropriate use of timber joist hangers.

### **Practitioners**

5/P1	(5.1 Liquid Metal Assisted cracking) Practitioners in steelwork design or fabrication should make themselves aware of the issues associated with liquid metal assisted cracking.
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# 1 INTRODUCTION

## Aims of SCOSS

- 1.1 The formal aims and objectives of SCOSS are set out on the *website*. In brief terms however, the Committee is charged by its sponsors<sup>2</sup> with investigating, and then, if appropriate, disseminating advice to the industry on matters concerning structural safety that are considered of sufficient importance to warrant action. The Committee is concerned with trends and practices rather than one-off events. A list of topics considered over the last two years is to be found in *Appendix B*, and the *website* contains downloadable files of all previous reports and other documents issued by the Committee.
- 1.2 A survey conducted in January 2005, through the ICE ‘Infoshare’ facility, indicated that all survey participants were supportive of the concept of SCOSS. To make it fully effective, however, it requires input from the industry to identify matters for review. This will be assisted, commencing in June 2005, by a pilot ‘confidential reporting scheme’ described in more detail in Chapter 2.

## Introduction

- 1.3 This is the 15<sup>th</sup> Biennial Report produced by the Committee, since it was formed in 1976. As was the case for the *14th Report*, published in 2003, it has been produced in electronic format and placed on the SCOSS website thus allowing immediate and easy access for practitioners, those able to influence the manner of structural engineering, researchers and industry historians.
- 1.4 An Executive Summary has also been produced, in hard copy, and issued to those who are in a position to influence others and bring about change.
- 1.5 The general aim of this report is to summarise subjects discussed by the Committee over the last two years, to draw them together into logical groups where appropriate and to indicate how, in the Committee’s view, matters may be improved. Further detail on some of these topics may be found in specific papers on the website. The subjects raised in the report have been grouped under the three generic heads of **people**, **process** and **product**, thus emphasising the wide sources and influences of structural risk.
- 1.6 The Committee has retained the innovation introduced in the 14<sup>th</sup> Report, which is to direct the recommendations specifically at either ‘practitioners’, anticipated to be the majority readership, or ‘influencers’ i.e. those who are able to influence the manner in which the industry works. This influence might be by contribution to Institution or Government deliberations, or by bringing influence to bear in a more general way via experience or standing.
- 1.7 The Committee has, over the years, been effective in raising awareness of issues, resulting in the establishment of guidance and best practice methodologies, changes to standards, and other benefits to the industry. The

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<sup>2</sup> Institution of Civil Engineers, Institution of Structural Engineers and the Health and Safety Executive.



Committee is pleased to note that action has been taken on a number of the recommendations from the 14<sup>th</sup> Report, as noted below under ‘Successes and Advances’ and also in Appendix C.

- 1.8 However, those who take some time to review past concerns and matters of discussion will soon identify that there is much yet to be done. Many of the points raised by the Committee over the years recur; either in a slightly different format, or because no action has been taken.

#### **Successes and Advances: 2003-2005**

- 1.9 The Committee is pleased to note that a number of the issues raised in the 14<sup>th</sup> Report have been considered and actioned by others, albeit to varying degrees, viz:

*Membership of BSI Committees:* (Recommendation 6/I2). The Report expressed concern over the increasing difficulty of obtaining adequate representation on BSI technical committees. This concern had also been raised in 2000 [1] but no action had been taken. The Committee is pleased to note that ICE has taken action on this matter by instigating a joint survey with BSI to determine the current situation on this, and other aspects of BSI Committee functioning. BSI’s involvement is particularly welcome. The survey results should be available in July 2005.

*Risk Management:* (Recommendations 2/I1-I3). These three recommendations were closely linked and related to the need for designers to take a broad and whole-life structured approach, taking account of failures generally, and including the lessons from the 9/11 collapses in New York as they might apply to buildings generally. IStructE has agreed to produce a booklet on risk management as it relates to structural engineers. It will cover structural safety in conjunction with occupational safety and health. Notwithstanding, this subject is likely to continue to be a ‘standing item’ of discussion as it is central to engineering activity.

*Eurocodes:* (Recommendations 4/I1-3). The Committee expressed concern that the proposal to create a ‘Standing Committee on Structural Eurocodes’- first recommended in 2000 [1] had not been actioned by ODPM. Since the publication of the last report however:

- The IStructE has led a committee which produced a report entitled ‘National Strategy for Implementation of the Structural Eurocodes: Design Guidance’, which again recommended the formation of such a group, and recently,
- ODPM has supported the formation of a ‘Standing Committee’, which commenced work in February 2005. (See Section 4.4)

*Benchmarking of Skills:* (Recommendation 2/I5). Although no specific action has been taken, this subject was discussed as part of a wider ‘competency’

debate (see Section 3.1). The ICE and IStructE have agreed to consider the points raised in a Viewpoint article on this subject. [2]

*Gathering of Information on Matters of Structural Safety:* (Recommendation 3/I1). The Committee is pleased to report that this proposal for a confidential reporting scheme is now moving ahead as described in Chapter 2. This is considered to be a major milestone.

1.10 In addition to action being taken on the 14<sup>th</sup> Report recommendations, the Committee has also raised issues of concern over the past two years in respect of:

- *Falsework*
- *Light metal structures*
- *Timber Joist Hangers*

These subjects are discussed in Section 5.4.

1.11 The subject matter chosen for the 14<sup>th</sup> Report, i.e. Risk Management, Education, and Eurocodes, has remained central to current concerns. The items discussed in that report remain germane to practising engineers, academics, and those responsible for influencing the manner in which the industry moves forward; it is for this reason that they recur again throughout this report.

### **On-going concerns**

1.12 It is worth reflecting that in the period since the Committee published its last report, failures have continued to occur, across a wide range of countries and structural types, and for a variety of reasons. Whatever the causes, and some are not yet formally declared, they all have a human and financial cost. Some examples and the issues arising are discussed in Chapter 6

### **This Report**

1.13 This report discusses a number of matters considered by the Committee to be central to the continued maintenance of adequate levels of structural safety, some of which overlap with the above. In this respect:

**Chapter 2** provides an update on the scheme for confidential reporting on structural safety (CROSS),

**Chapter 3** relates to **people** issues and discusses the topic of competency,

**Chapter 4** is concerned with a number of **process** matters: risk management, designer responsibilities, certification, Eurocodes, BSI committee work and impounding structures,

**Chapter 5** deals with some concerns relating to **product**: liquid metal assisted cracking, large panel structures, deterioration of structures and finally some miscellaneous matters reviewed by the Committee,

**Chapter 6** summarises some recent failures, and

**Chapter 7** reviews the actions taken on the recommendations from the *14th Report*.

The Report recommendations are contained in the **Summary Appendices A-C** contain details of the Committee, topics discussed since the last Report, and actions taken on its recommendations.

## REFERENCES

1	<i>Review of Structural Design Codes in Construction</i> Study Group led by Prof Les Clarke prepared for the Office of Deputy Prime Minister et al, June 2000
2	<i>Competency in structural engineering design</i> The Structural Engineer Vol:82 No:15, 3 August 2004, p16-p18

## 2 CONFIDENTIAL REPORTING ON STRUCTURAL SAFETY (CROSS)

- 2.1 The 14<sup>th</sup> Report devoted *Chapter 3* to this topic and outlined the desire to move forward with a pilot scheme to test the industry's response. It set out the case for such a scheme in an industry with no systematic means of effective feedback and dissemination of matters relating to structural safety.
- 2.2 The Committee is pleased to report that the scheme preparatory period commenced in March 2005, and the 12 month pilot period is due to commence in June 2005. Details may be found on the SCOSS *website*.
- 2.3 The scheme is designed to allow those with a concern relating to '**people, process or product**', in connection with structural engineering, to discuss this in confidence with the scheme Director. A key element of the scheme is that this feedback should be disseminated to the wider industry expeditiously and the pilot period will be used to examine how this might be best achieved.
- 2.4 As noted previously the scheme is constructed to achieve confidentiality. It is not a 'whistle-blowing' scheme as the parties involved are never divulged, nor is it designed to replace any internal management or contractual pathways.
- 2.5 This proposal has the wide support of the industry, including:

### **Government**

Constructing Excellence  
Department of Trade and Industry\*  
Health and Safety Executive\*  
Office of the Deputy Prime Minister  
Office for Government Commerce  
Scottish Building Standards Agency\*

### **Industry**

Association for Consultancy and Engineering  
Construction Industry Council  
Institution of Civil Engineers\*  
Institution of Structural Engineers\*

Those supporters marked with an asterisk are contributing towards the funding of the pilot.

- 2.6 The Committee believes that this support demonstrates the belief in such a system for the construction industry. Reporting of this type has been the norm in a number of other industries for some time. The off-shore industry reports in an open manner without recourse to confidentiality reflecting a forward thinking culture.
- 2.7 The success of the scheme depends upon industry support. The Committee is aware of issues that ought to receive wider publicity and attention; it needs specific examples however in order to demonstrate the validity of these concerns.

2.8 In this respect the Committee was pleased to read of one example where the principles of the airline reporting scheme (CHIRP) were being applied internally within a contracting organisation as a means of enhancing safety culture and learning from experience<sup>3</sup>. CROSS has been designed around the CHIRP model.

2.9 The Committee hope that by the time the next biennial report is published CROSS will have become a permanent and accepted feature of the industry.

**Enabling the learning process from specific problems**

2.10 The scheme described above is designed so as not to divulge the author, the organisations involved or the project. Nonetheless, the Committee believes there has been a long standing need to develop a system which will allow critical information to be made available from specific projects, processes or products where a situation has occurred which ought to receive wide and expeditious dissemination.

2.11 The difficulty in this situation is that the parties concerned are often not keen to divulge the details (and indeed others may not even be aware of there being any issue) for want of protecting their reputation, image, liability or commercial position. Confidentiality is often an integral part of any civil settlement, and very few criminal cases work their way through the legal system to allow a full analysis<sup>4</sup>.

2.12 As has been pointed out again recently<sup>5</sup> there is a need for a process which allows the rapid dissemination of critical data; the recent events in Singapore (Nicoll Highway collapse)<sup>6</sup> and Charles de Gaulle airport (Terminal building collapse)<sup>7</sup> illustrate that this can be done; in both cases preliminary reports were available within a relatively short timeframe.

2.13 The Committee do not underestimate the challenge in this respect; nonetheless they would like to see some debate on this issue as a means of exploring how it might be achieved in the UK.

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<sup>3</sup> 'Firm pilots air safety rules': Construction News 2 September 04

<sup>4</sup> The Port of Ramsgate walkway collapse was an exception and provides an example of the educative insight desired.

<sup>5</sup> NCE Comment p17 17 February 2005

<sup>6</sup> [www.mom.gov.sg/MOM/CDA](http://www.mom.gov.sg/MOM/CDA)

<sup>7</sup> [www.equipement.gouv.fr](http://www.equipement.gouv.fr)

### 3.1 COMPETENCY

3.1.1 The Committee has continued to take an interest in this subject since the last report was published, which itself had a section devoted to the matter (paragraphs 2.17-2.20).

3.1.2 In the intervening period:

- The Scottish Building Standards Agency has introduced a register of competent structural engineers licensed to certify compliance with the structural requirements of the Building Regulations under the Building (Scotland) Act 2003. This register is jointly administered by the ICE and IStructE through ‘Structural Engineers Registration Ltd’.
- Self-certification is now permitted in respect of other parts of the Building Regulations (e.g. Part P) by those assessed as ‘competent’. This is part of a wider aim to allow controlled self-certification by competent operators.
- A debate has taken place in the technical press and elsewhere over the role of designers in connection with the CDM Regulations<sup>8</sup>,
- The Health and Safety Executive have been reviewing the CDM Regulations<sup>9</sup>, and specifically the requirements for ‘competency’.
- Issues regarding competency have arisen in other professions, but specifically the medical profession.
- A ‘Viewpoint’ article [1], originating from the Committee, reviewed the subject from a general perspective and made some specific recommendations.

3.1.3 Although some of the above may at first sight appear to be more concerned with occupational safety, than the safety of structures, they are included to demonstrate the emphasis that is now being placed on this issue. It is the Committee’s belief however that competence has to be considered as a whole, and that the requirements of competence brought about via regulations such as CDM, lead to overall benefit.

3.1.4 In the last report the Committee stated:

*It appears to the Committee that the pressure is growing for transparent accountability in respect of competence. In the short term, structural engineers need to ensure that they comply with their institution code of conduct in respect of CPD and scope of work undertaken. In the longer term it is likely that some form of licensing may apply as a means of demonstrating to others that minimum standards are met and maintained.*

3.1.5 The Committee continues to hear of anecdotal evidence of ‘near misses’ and other concerns in respect of competency matters<sup>10</sup>. A commentary was

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<sup>8</sup> See Section 4.2

<sup>9</sup> A Consultation Document was published in June 2005

<sup>10</sup> there is now an avenue for informing SCOSS in a confidential manner –see Chapter 2.

provided in the Viewpoint article mentioned in reference 1. The key messages arising from this were:

*Competency – Influences on the Individual*

- 3.1.6 The need to celebrate the advances made in methods of analysis, and our ability to promote structural form that would have been out of the question a generation ago is acknowledged. In conjunction with this however is the constant requirement for vigilance in respect of ensuring that the outputs- specifically from software analysis and complex contemporary design codes- are acceptable, remains. This is not a theoretical position, and is borne out by real example, as the interim reports in connection with Charles de Gaulle airport terminal collapse confirm (Chapter 6).

*Competency – Influences on the Organisation*

- 3.1.7 The nature of the organisation has also changed significantly. Paradoxically, commercial constraints often mean that there is not time to consider things that do make good commercial sense e.g. the quality of information contained within various forms of communications, and the standards of checking being undertaken.

The individual is heavily influenced by company ethos and practice in these respects.

*Ensuring Competency*

- 3.1.8 Although the competency of the engineer is well regulated up to the point where he/she becomes a chartered or incorporated engineer, thereafter it is generally less well regulated although there is a personal obligation on the individual.
- 3.1.9 There are a number of existing ‘competence’ registers administered by the ICE and IStructE viz:

<b>Register</b>	<b>ICE/IStructE</b>
Adjudicators	ICE
Arbitrators	ICE
Conciliators	ICE
Conservation (CARE)	ICE/IStructE
Expert Witness	ICE
Health and Safety	ICE
Reservoir Safety (Panel Engineer)*	ICE
Certifiers under the Scottish Building Regulations	IStructE/ICE

\* a statutory register under the Reservoirs Act 1975

- 3.1.10 A feature of all these registers is that the registrants are obliged to demonstrate their on-going competence, in part through CPD. In terms of structural engineering however, these registers do not yet make an impact as they have limited membership, and they do not cover all work activities.

*Achieving Competency at the workplace*

3.1.11 The Committee considered that the necessary action could be attributed to several bodies, viz:

**Institutions/Academia**

**A Education Phase**

- by ensuring an *awareness* of the challenges associated with the use of software is recognised within courses.
- by ensuring a *knowledge* relating to the use of mental and approximate checking methods, and 3D sketching.

**B IPD Phase assessment**

- by ensuring the candidate has *experience* to identify measures to counter the problems associated with use of software encountered in their field of work.
- by making reference to the specific issue of software within relevant institution literature.
- by testing the candidate's knowledge of risk management
- by ensuring that candidates have adequate *knowledge* of construction techniques

**C Thereafter, in practice**

- by ensuring CPD for all members includes an ongoing 'risk management' element. (See Section 4.1 as to how this might be assisted).
- by requiring all corporate members to submit an annual return of CPD, a sample of which would be audited.

**Organisations: Designers**

**A Corporate Level**

- by having a clear policy, driven by the Board and senior management which recognises these issues [2].
- by use of corporate procedures designed to minimize risk.<sup>11</sup>

**B Project Level**

- by adoption of the advice given in the references, in particular the concept of a project risk register, and a team holistic approach to risk management.

**Organisations: Suppliers of software or design aids**

- by recognising the essential need to identify the assumptions, limitations and other key elements of their products.
- by providing information in a format and terminology that can be readily understood by competent users.

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<sup>11</sup> through communication strategies, hazard identification and the like.



### Corporate Members of Institutions (acting as Individuals)

- by having an *ability* to recognise these issues, and to deal with them
- by having an active policy of making those engineering designers, for whom a member is responsible, aware of the issues, and passing on personal experiences.
- by undertaking and recording appropriate CPD.

3.1.12 Other examples lend weight to the concept of a formalised approach to the assessment of competence viz:

*UKIPG*<sup>12</sup> 'Guide to the re-validation of professional competence' [3]. This guide published in 2002 sets out very clearly the argument for an auditable re-validation policy. It recommends that this be accredited to UKAS to give it the appropriate standing.

*IOSH*<sup>13</sup> This institution now requires all its corporate members to file an annual CPD return, constructed around a standard model which allocates a score to individual components. The score has to reach a minimum figure over a two year rolling programme. All members are obliged to return a summary indicating their score, and 10% of returns are audited in detail.

### Summary

3.1.13 Most of the suggestions made above can be simply achieved, at little cost, and with significant potential saving in terms of exposure to risk of failure. Others are considered a necessity in order that we may as a profession be seen to be doing, what others are likely to interpret as reasonable, to ensure that safety is maintained.

### REFERENCES

1	<i>Competency in Structural Engineering Design</i> The Structural Engineer Vol:82 No:15, 3 August 2004, p16-p18
2	<i>Implementing Turnbull</i> A Boardroom Briefing: September 1999 The Institute of Chartered Accountants (ICA) 1999
3	Available on <a href="http://www.ukipg.org.uk/publications.htm">http://www.ukipg.org.uk/publications.htm</a>

<sup>12</sup> UK Inter Professional Group ([www.ukipg.org.uk](http://www.ukipg.org.uk))

<sup>13</sup> Institution of Occupational Safety and Health

## 4.1 RISK MANAGEMENT

4.1.1 The management of risk is central to the work of a structural engineer and its importance is reflected in the fact that it has featured in a number of SCOSS reports over the years, including the 14<sup>th</sup> Report (Chapter 2). The key role it plays in the engineer's world was described in a recent paper sponsored by HSE [1] and relating to undergraduate construction courses, thus:

*Architecture, Building, Engineering and Surveying<sup>14</sup> are fundamentally about creativity and innovation, adding to the wealth of the nation and the wider world. They are professions involved with the derivation of solutions to our built environment, often utilising imperfect and incomplete data, and frequently within tight constraints of time, space and finance. Consequently, their activities are concerned with the management of risk, without which they cannot achieve their intended objectives.*

4.1.2 Chapter 2 of the last report was wide ranging in its consideration of risk, and covered items and made recommendations which remain valid today (progress with the recommendations is detailed in Appendix C). The discussions in most other sections of this report also interact with this section.

### **Risk in Engineering**

4.1.3 The Committee has compiled a bibliography of reference sources in this topic area (placed at the end of this section). Some are not widely known, but all are very relevant. The references have been chosen to reflect a practical holistic approach of use to practising engineers. It is intended to build on this list and to place it on the SCOSS website.

4.1.4 The Committee has involved itself in this topic area by taking action and involving itself in a number of specific areas.

- A risk management syllabus for a CPD course
- Disproportionate collapse
- Introducing concepts of risk in analysis to undergraduates

#### *Risk management syllabus for a CPD course*

4.1.5 A syllabus has been developed as a means of encouraging engineers to develop an understanding and ability in risk management. Its structure is designed to provide a rounded appreciation of the subject, from which a more detailed analysis may be undertaken. The majority of engineers do not need more than this introduction.

4.1.6 The course covers:

#### **The Relevance of Safety Risk Management**

- Defining risk pragmatically

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<sup>14</sup> Covering CIBSE, CIOB, ICE, IStructE, , RIBA, RICS

- The Business case
- Human loss and cost
- Corporate Social Governance
- Dealing with adverse reaction

#### **Responsibilities of the Professional**

- Duty of Care
- Institution Code of Conduct
- Contractual and civil obligation
- Statutory obligation

#### **Where risk occurs within the Industry**

People:

- Skill and competency

Process:

- Procurement
- Design
- Construction

Product:

- Materials

#### **Learning from past disasters**

- Case studies and timeless lessons

#### **Assessment techniques for safety risk**

- Essential elements
- Formalised techniques by type e.g. HAZOP, RAMP, or in other industries
- Qualitative approaches and risk register
- Structural adequacy
- Human safety (including health)

The Committee hope that this will feature as an offered course within the initial professional development (IPD) phase in particular.<sup>15</sup>

#### *Disproportionate Collapse*

- 4.1.7 The Committee has argued for some time that the requirements of Regulation A3 of the Building Regulations (relating to disproportionate collapse) should apply to buildings of 4 storeys or less. The Committee is pleased to note that this now applies, with some limited, but reasonable exceptions, and came into force in December 2004. The background to this change is well set out in Reference 3. The actions required to satisfy the requirements of A3 are set out in Table 11 of the Regulations and are described in familiar terms in relation to horizontal and vertical ties, for buildings in classes 1&2.

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<sup>15</sup> SCOSS is content for others to use this structure, but requests that the origin is acknowledged.

4.1.8 For class 3 buildings however (buildings exceeding the limits of Class 2A, 2B, grandstands holding more than 5000 people, and buildings containing hazardous substances or processes) the requirement is for the designer to ‘undertake a systematic risk assessment to take account of all normal hazards which may reasonably be foreseen, together with any abnormal hazard’. No guidance is provided as to how this should be achieved to obtain both acceptance and consistency. ODPM has acknowledged [3] that there is a ‘paucity of guidance at the present time’ and confirms that it intends to provide further guidance on the measures to be adopted for class 3 buildings in due course. Independently of this position however a recent paper set out some ideas as to how designers might approach this issue [4].

4.1.9 This appears to be an opportunity for an industry approach to robustness to be developed and for previous recommendations, such as those that came from the IStructE ‘*Safety in Tall Buildings*’ report, to be taken on board. The risk managed approach adopted by the regulations however does mean that as knowledge develops in this field the measures considered necessary to satisfy Regulation A3 may be changed and adapted whilst still remaining compliant. This is the essence of the goal setting approach that has now been introduced.

*Introducing concepts of risk in structural analysis to undergraduates*

4.1.10 The Committee recently had presented to it a plea for analysis model<sup>16</sup> validation and verification to be taught during the education phase [2]. This was related to a belief that undergraduates needed to understand the risks involved in modelling structures as an inherent part of their education, alongside classical analysis methodologies. It was noted that in civil engineering (unlike for example Naval Architecture) undergraduate courses do not normally include any material on this topic. Instead students are usually taught that there is an absolute correct answer e.g. to a moment distribution problem, whereas in reality it is affected by other issues such as stiffness assumptions and secondary distribution i.e. the real answer is uncertain and approximate.

4.1.11 The two processes emphasised were:

Model Validation: the process of establishing whether or not the model is capable of meeting the objectives on which it is based,

Results Verification: the process of assessing whether the model has been correctly implemented.<sup>17</sup>

This suggestion encapsulates the key issues connected with risk management i.e. are our assumptions satisfactory, how robust is our analysis, what else might crop up, and are our conclusions valid?

4.1.12 The following strategies have been suggested, in no specific order:

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<sup>16</sup> Usually, but not always, a software model.

<sup>17</sup> See also IStructE report on ‘Guidelines for the use of computers for engineering calculations’

- observe real structures (often difficult to do in practice)
- derive specification for model
- validate models
- verify results
- implement sensitivity analysis
- understand mathematical model
- do simple calculations

4.1.13 The importance of validation and verification of the analysis is amply demonstrated through the examples of the off-shore platform (Sleipner 1991) and the Hartford Civic Centre roof (1986). In the former case, and despite many £m being spent on computer analysis and design, a simple hand calculation, after the event, had revealed the significant shear deficiency that resulted in failure. In the case of Hartford Civic Centre, the failure to allow for strut eccentricities in the analysis and design led to the collapse. These examples emphasise the importance generally of ensuring an understanding of site tolerances, interim stages of construction, and matters which might invalidate results. It is imperative also for a clear distinction between analysts (who may know little of engineering) and designers. It was noted also that an analysis of failures will show that major companies are often involved.

4.1.14 SCOSS is aware that design practice does not have a standard process for assessing validity or verification although a recent Viewpoint on behalf of SCOSS<sup>18</sup> has suggested this.

4.1.15 Although it might be thought that innovative structures receive more attention in this field, SCOSS is not sure that this is always the case, and is aware also that many common structures may be saved from distress by virtue of cladding and other non structural attachments.

4.1.16 SCOSS has noted that on many simple frames, which used to be designed as pinned members, designers were now taking account of moment, and shear (presumably because the software programme allowed this, and they sought the lightest and notionally cheapest option). This can create a problem for fabricators and leave less margin for error. There is a general associated concern that as a result of the reliance on computer analysis, hand-based calculations are considered by some as ‘inferior’ and less suitable whereas they remain an essential tool.

4.1.17 Although this subject was raised in connection with the education phase, it appears to the Committee that it is equally applicable to those in practice [5], and is an issue that does not receive sufficient attention.

#### **An overview**

4.1.18 An excellent overview of risk in structural engineering is given in reference 6 which is also included in the bibliography.

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<sup>18</sup> The Structural Engineer, 16 April 2002, p11

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1	<i>Guidelines on Risk Issues</i> The Engineering Council 1993
2	<i>An introduction to three reports on Risk and Engineering</i> Royal Academy of Engineering
3	<i>2-Common Methodologies for Risk Assessment &amp; Management</i> Royal Academy of Engineering
4	<i>3-Risk Posed by Humans in the control Loop</i> Royal Academy of Engineering
5	<i>Biennial Risk Management and Risk Financing Survey</i> Griffiths & Armour
6	<i>Risky Business</i> Adam Smith Institute 1999
7	<i>Risk Analysis of Major Projects(RAMP)</i> Thomas Telford 1998
8	<i>Reducing Risk; Protecting People.</i> HSE Books
9	<i>Risk in Structural Engineering</i> A Mann The Structural Engineer. Vol:81 No:10, 20 May 2003, p12-17
10	<i>Reflections on Structural Safety</i> J Carpenter The Structural Engineer. Vol:80 No:8, 16 April 2002

## REFERENCES

1	<i>Health and safety Risk Management: The Case for inclusion within undergraduate construction courses.</i> HSE Statement November 2004
2	<i>Risk in modelling: the importance of model validation and results verification.</i> Emeritus Professor Iain MacLeod University of Strathclyde. (Paper to SCOSS Committee) See also ' <i>Lessons from Failure</i> ' to be published by Thomas Telford.
3	<i>Revised Part A of the Building regulations: Technical Update</i> G Harding (ODPM) The Structural Engineer Vol:83 No:2, 18 January 2005 p18-19
4	<i>New approach to disproportionate collapse</i> S Alexander The Structural Engineer. Vol: 82 No 23, 7 December 2004 p14-16
5	<i>Reflections on Structural Safety: Viewpoint</i> J Carpenter The Structural Engineer Vol:80 No:8, 16 April 2002
6	<i>Risk in Structural Engineering: Viewpoint</i> A Mann The Structural Engineer. Vol:81 No:10, 20 May 2003, p12-17

## 4.2 DESIGNERS' RESPONSIBILITIES

### Introduction

- 4.2.1 The Committee has noted the uncertainty and concern expressed in various technical articles in respect of designer responsibilities under the CDM Regulations. These articles have appeared in NCE<sup>19</sup>, Viewpoint<sup>20</sup> and Verulam<sup>21</sup>. The Committee considers that uncertainty as to what is required of designers is a serious impediment to progressing productive dialogue between all parties involved in construction. The Committee sees an opportunity, if not an obligation, in the fact that ISE, ICE and HSE are the sponsors of SCOSS, to bring greater clarity to the issues generally, and specifically to bring clarity to the issue of designer duties.
- 4.2.2 The Committee is mindful of its remit to focus on trends and developments, and is therefore particularly keen to understand root causes, or primary reasons behind the issues. SCOSS also has to focus effort, since its own resources are limited, on disseminating information for others to act upon. The issues for the Committee therefore were considered to be:
- How can the discussion be moved forward, and clarity improved?
  - How can the Committee work with the Institutions and HSE to help this?
- 4.2.3 With this in mind, a meeting was held between SCOSS and HSE in December 2004 at which these issues and others were explored and discussed. Those who attended considered this exchange of views to be positive and helpful to the debate. The following paragraphs review these issues, and the actions required to move forward in an inclusive manner to the benefit of all.

### The CDM Regulations

- 4.2.4 For much of the period during which the CDM Regulations have been in place, and for the whole of the preceding period, the regulatory spotlight has been on the contractor. In the period since 1999<sup>22</sup> there have been 122 successful prosecutions for failing to comply with CDM, of which 10 have been under regulation 13, against designers. Hence despite the impression given by recent press coverage, and the concern by some that 'designers are being targeted' the number of successful cases brought against designers is very few.
- 4.2.5 In this debate HSE are keen for the origin of the CDM Regulations not to be forgotten. The EU Directive, from which the Regulations originated, had identified:

*'.. unsatisfactory architectural and /or organisational options or poor planning of the works at the project preparation stage have played a*

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<sup>19</sup> NCE 17 June 2004 p17

<sup>20</sup> The Structural Engineer Vol:82 No:15, 3 August 2004 p16-18

<sup>21</sup> The Structural Engineer Vol:82 No:13, 6 July 2004, p26

<sup>22</sup> the date from which the prosecutions database has operated.

*role in more than half of the occupational accidents occurring on construction sites in the Community’.*

4.2.6 The discussion identified a number of organisational shortcomings in the manner in which many projects were organised, viz:

- lack of clear leadership on safety issues
- leadership lacking competency (specifically experience); those with the competence often lacking authority
- contractual responsibilities often not in support of, or in conflict with statutory obligations
- a need for closer links between design and implementation phases to minimise fragmentation
- the diminishing role of supervision in the implementation phase, by those involved in the pre-construction phase
- low fee (and no-fee) culture adversely affecting ‘safety culture’.

4.2.7 In respect of designers specifically, the meeting identified the following issues:

- a need to move away from a ‘formula approach’ and to see a wider vision of design
- the importance of the quality and the nature of communication<sup>23</sup>
- the importance of ensuring there is clarity of responsibility in respect of ‘design’ and ‘construction’
- a need for greater examples of best practice through institution papers and similar sources
- a need to build on our successes.

4.2.8 In terms of further debate on more general issues, in order that greater clarity could be brought to bear, the items identified included:

- The conflict between contractual and statutory obligations,
- Communications - concentrating on essential issues rather than the demand for more,
- Competency in all roles,
- Control of project implementation,
- Involvement of pre-construction people in project implementation,
- The need to build on good practice,
- The need for British Standards to give safety issues and associated duties due attention.

4.2.9 The points made above were tabled at the annual meeting held with the sponsors of SCOSS, i.e. the Presidents of the ICE and IStructE, and the HSE

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<sup>23</sup> this concern was succinctly put in an American Council of Engineering Companies (ACEC) paper entitled ‘A guideline addressing coordination and completeness of structural construction documents’ 2003. Case Document 962 D. This report is commended to practitioners and influencers.



Chief Scientist. It was agreed by the institutions to discuss these within their respective committee structures<sup>24</sup>.

### **Responsibility for structural design within projects**

4.2.10 All projects will involve a number of suppliers, some of whom will also be designers; these include the scheme consultant, steelwork fabricator, precast concrete manufacturers, proprietary component suppliers, other specialist contractors. The attention of the Committee has been drawn to the manner in which these responsibilities are sometimes allocated across a project, which can often lead to a quantifiable risk to structural safety, and can be illustrated through the following examples:

4.2.11 *Interfaces*: ensuring that interfaces are appropriately considered is a key element in the design process. Not all designers will be aware of the overall requirements; some will be tempted to sit within their contractual envelope without taking a wider view on the impact of their input on the overall design.

4.2.12 The scheme designer, traditionally the guardian of the overall design, may not be appointed to undertake this role although BS8110 and BS5950 are clear that, in respect of overall structural stability, there should be a designer with this responsibility.<sup>25</sup> The Committee are aware of examples where, but for the fortuitous involvement of the scheme designer (outwith their limited contractual duties) a serious structural shortcoming would have arisen although this might not be classified as ‘overall structural stability’.

#### *Proprietary product data*

4.2.13 The Committee is aware of instances where proprietary product literature is insufficiently clear:

- In base data provision. Data and diagrams originating in other languages is an example of this.
- In respect of specific site situations that might give rise to a reduction in margin against failure because the standard solution will not function as intended or is being used outside its original validated purpose.

4.2.14 These examples need vigilance on the part of those specifying or selecting these products, particularly so if this represents a change to the original specification. This latter situation presents a potential problem if it occurs during the construction phase and the scheme designer is not involved.

### **Summary**

4.2.15 The debate and discussions reported on in this Section illustrate that there are a number of potential concerns in respect of ensuring overall adequacy of design input. Some of these concerns relate to the competency of designers

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<sup>24</sup> there was no progress to report at the time of writing.

<sup>25</sup> BS8110 Clause 2.2.2.1 ‘The engineer responsible for the overall stability of the structure should ensure compatibility of the design and detail of parts and components even when some or all of the design and detail of those parts and components are not made by this engineer’

themselves, but most are in fact to do with the management and organisation of a project and the frequently met barriers which prevent a holistic approach being taken. These barriers, such as limitations on contractual duty, sub-contracting policies, time constraints, are often outside the control of the key designers and are imposed as a consequence of commercial drivers.

## **4.3 CERTIFICATION, USE OF PRODUCTS AND OTHER ASSOCIATED MATTERS**

### **Certification**

- 4.3.1 In recent years ‘certification’ has taken on a greater prominence and importance. CE marking is now appearing on many products, ‘self certified’ work under the Building Regulations is permitted, subject to certain constraints, and there is an expectation in many fields that products and services should in some way be assured.
- 4.3.2 Whilst overall this is to be encouraged, this move has identified a number of uncertainties. The Committee would be concerned if ‘certification’ was to be utilised in circumstances where risk to structural safety could result from inappropriate application or mistaken reliance.

### **UK Certification**

- 4.3.3 This subject was also examined in the *13<sup>th</sup> Report* (Section 2.6: Checking and Certification). It was pointed out that ‘certification’ may have several meanings. Although many organisations claim to operate certification schemes these may have limited value because of their lack of independence. For example:
- 1<sup>st</sup> party certification    self-certification of products, systems or services
  - 2<sup>nd</sup> party certification    peer certification through, say, a trade organization
  - 3<sup>rd</sup> party certification    certification through independent assessment
- 4.3.4 1st and 2nd party schemes suffer from the accusation that they are not transparently independent, and are open to charges of conflict of interest. 3rd party certification operated under a regime such as UKAS is fully independent confirmation that products, systems and services meet and continue to meet appropriate standards. There is a concern that those involved in construction (including many professionals) are not always able to differentiate between these types of scheme.
- 4.3.5 With the advent of EU driven ‘certification’, and its increasing use, there may be a disparity between this, and the unregulated UK ‘certification’ that is not appreciated by specifiers or users.
- 4.3.6 Certification differs from testing, which is basically a snapshot at a point in time showing that a specific sample of the product passed a certain test on a given day. Certification comprises testing and regular audits, thus helping ensure that products, systems and services comply with prevailing standards, which are themselves subject to revision and re-issue.

- 4.3.7 Validated 3<sup>rd</sup> party certification has the potential of providing benefit to everyone in the supply chain, from the manufacturer to the end client, because it gives peace of mind that the product actually meets the requisite standards. The need for this is illustrated by one testing house's experience of testing products, which identified that over 75% of those submitted failed to pass tests when first presented.
- 4.3.8 Certification is generally voluntary in the UK - most other European countries require 3rd party certification of products and installations. Examples where UK practice demands certification include domestic electrical work under Part P of the Building Regulations, installation of replacement double glazing under Part L and gas installations under the CORGI scheme. However, these are all self-certification in respect of the work itself.
- 4.3.9 The 13<sup>th</sup> Report made reference to the practice adopted by the Highways Agency in respect of the certification of bridges where they utilize all three levels of certification depending upon the complexity and cost of the highway structure. This procedure has served them well, and therefore it appears to the Committee that there continues to be a strong case to be made for this arrangement to apply to buildings, specifically those which are innovative (such as the Charles de Gaulle Airport Terminal building). The 13<sup>th</sup> report recommended that:

*For safety-critical aspects of design and construction of structures whose failure would have high consequences, third party certification is needed to give adequate assurance of structural safety.*

The Committee was concerned to note that a recent survey found that only 13% of work was independently checked in this manner, and that only 36% was peer checked. [1]

### **Conflict of Interest, Misuse of Standards and Enforcement**

- 4.3.10 Unfortunately there are claims made within the marketplace that can mislead specifiers and others into believing a product, system or service has 3<sup>rd</sup> party certification when in fact it does not. It is reported as common to find phrases printed on products, packaging or marketing material such as “designed to....”, “complies with....”, “tested to....”, “meets BS...” or even just “BS...”. Most people assume that this means the product meets this standard but this may not be the case and none of these claims are readily verifiable. Products may be tested and fail those tests and still be sold as “tested to....”. By the use of 3rd party certified products, the user can seek independent confirmation that the product did actually pass all the required tests.

### **Enforcement**

- 4.3.11 The UK is reliant on an under-resourced Trading Standards system for checking the validity of claims and enforcing compliance. Trading Standards Officers often have more pressing business in other consumer protection

fields. The better approach is to provide for improved awareness amongst specifiers and users, and to encourage appropriate certification procedures.

### **EU Certification**

4.3.12 EU certification stems from the 'New Approach Directives' (primarily, but not exclusively in the construction industry, this relates to the Construction Products Directive) and is designed to remove barriers to trade across the EU and give assurances in respect of certain aspects of the product. 'Certification' or 'Attestation of Conformity' as it is referred to, is available at one of 6 levels (denoted 1, 1+, 2 etc) set down in the associated harmonised European Norms (Standard) or, if none is available, the European Technical Approval (ETA) awarded to the manufacturer for a specific product. The applicable level is set by the Commission for each product family or group.

### **CE Marking**

4.3.13 CE marking is a trading requirement established by numerous EU Directives for those products to be sold on the internal EU market. It is neither a 'quality mark' nor a mark of origin. CE marking only shows that a product meets "*Essential Requirements*" set out in one or more Directives and the applicable harmonised European Norms (hEN). If no hEN is available it will be the subject of an ETA<sup>26</sup> and an Attestation of Conformity. However the public, and sometimes the industry itself, is generally unaware of this limitation. There are six essential requirements<sup>27</sup> of which three relate to structural safety viz:

- Mechanical resistance and stability
- Safety in case of fire
- Safety in use

Not all of these will apply to all products. As the CE mark is not a quality mark, performance functions such as durability, reliability, maintenance, traceability, etc, that are not part of the Essential Requirements, will not be reviewed. [28]

4.3.14 It is not easy to check if the CE marking is valid as identification does not necessarily appear with this mark on the product and no lists are compiled. It is frequently not immediately clear to what the CE marking refers; for many products multiple Directives might apply. At its worst, CE marking is affixed by suppliers with no checks or monitoring. The detail behind the CE mark on any product may be ascertained from the EOTA website on <http://www.eota.be/> although it is a somewhat lengthy process.

4.3.15 Currently the UK does not require the use of products CE marked under the Construction Products Directive within the Building Regulations system.

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<sup>26</sup> Which will have a guidance note known as an ETAG e.g. ETAG001 relates to concrete anchors, compliance with which will have allowed issue of the ETA.

<sup>27</sup> <http://europa.eu.int/comm/enterprise/construction/internal/essreq.htm>

<sup>28</sup> A recent case in point is the discovery of incorrect alkali levels in cement produced by Lafarge (NCE 27 January 2005). Although cement is covered by a CE mark, alkali levels are not included as one of the essential requirements of the harmonised standard and hence was not checked by the external audit.

Hence it is possible for imported products which do not meet the minimum Essential Requirements to be used in the UK market.

### **Adequacy of Data**

4.3.16 Notwithstanding the use of CE marking, the appropriate use of products, specifically proprietary products, relies on the manufacturer providing adequate data which can then be used by the designer or contractor to ascertain the suitability of the use of the product or its means of installation. Recent enquiries by the Committee have revealed that this is not always achieved and this is discussed in Section 4.2.

### **Development of Standards and their Appropriateness**

4.3.17 We have reached a situation where there is little investment being made in independent research and expertise in support of the development of standards. Standards committees are nowadays often dominated by manufacturers, trade and other interests; they can have an excessive influence on the process and so the "consensus" they reach often fails to recognise broader societal needs and does not always follow a scientific approach. In some fields the true meaning of the performance criteria established in the standard has been lost. For example, a fire door rated at 30 minutes means that it passed a test lasting 30 minutes, not that this performance is guaranteed in every possible fire scenario. As engineers make greater use of performance-based approaches in design they will become more reliant on an understanding of the underpinning science rather than taking standards at face value.

The wider issues in respect of British Standards are addressed in Section 4.5.

### **Maintenance of Performance**

4.3.18 It is not sufficient for products to be tested and certified on initial installation. Ongoing checks are needed to ensure that products work properly - for example, fire detectors need cleaning and functionality testing, and sprinkler systems need water pressure testing. Even fire doors can warp or drop and may not provide the expected level of protection. Many high-tech products require regular and skilled inspection and maintenance in order to give ongoing assurance of effectiveness. It is vital that professionals:

- instigate comprehensive hand-over checks,
- recommend proper maintenance to reassure and inform the end user to ensure that their overall investment will operate as intended over its lifespan.

There is already a statutory requirement and a suitable vehicle for achieving this transfer of information in the form of the health and safety file.

## **Inappropriate Use**

4.3.19 The Committee has become aware of two examples of inappropriate use of construction products and is concerned that this might indicate a wider problem. The examples are:

- The use of Corus ‘Strongbox’ sections as structural members, despite not being intended to meet structural grade requirements. (New Steel Construction Magazine issued a warning in respect of this issue in March 2004 p41).
- Changes on site to the specification of fixing bolts in concrete, without seeking authority from the designer. This had been drawn to the attention of the Committee and is also highlighted in a survey by the Construction Fixings Association (CFA).

4.3.20 The survey mentioned under the second bullet point found that 43% of designers believed that their specification for anchors was ignored on site. The CFA Chairman is reported as saying<sup>29</sup> that changes on site often ignore the complex matrix of factors that determine a fixing’s adequacy. The CFA has published guidance as a means of avoiding such incidents (<http://www.fixingscfa.co.uk/guidancenotes.asp>). CFA has also found from recent research that some 13% of fixings failed to attain the requisite load capacity as a consequence of inadequate installation.

4.3.21 The prevention of failures through misuse of proprietary products, such as fixings, will be achieved through the use of competent persons, and an appropriate assurance regime that does not allow changes to be made without due authority.

4.3.22 The reasons for these occurrences will vary but likely contributing factors are:

Designer	Insufficient investigation of appropriate products Too little key data provided to the Contractor Insufficient investigation of the ‘constructability’ of the designed solution No involvement on site
Contractor	Acting on insufficient data, Taking ‘design’ decisions when not engaged or authorised to do so Insufficient consultation with designers Failing to brief/supervise a sub-contractor Allowing unsuitable alternatives to be used

It will be seen that these concerns overlap with those expressed in Section 4.2

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<sup>29</sup> Construction News 2 December 04, p18

## REFERENCES

1	<i>Bouncing the checks</i> Pelle Chiari The Structural Engineer, Vol:82 No:13, 6 July 2004, p17-18
2	<i>CE marking under the Construction Products Directive</i> Office of the Deputy Prime Minister 2002 (updated 2004)



## 4.4 EUROCODES

- 4.4.1 In the 14<sup>th</sup> Report the Committee expressed a number of concerns in respect of the impending introduction of structural Eurocodes (Chapter 4). One of the key recommendations of the 14<sup>th</sup> Report was to reiterate the recommendation previously made that a standing advisory committee be established to set a strategy, monitor the implementation and provide advice.
- 4.4.2 In the intervening period there has been a significant growth of awareness of the changes that will come about, and the actions required, as a consequence of the Eurocodes. This has arisen in particular from the various conferences that have been held, the report by IStructE for ODPM on the implementation strategy for Eurocodes [1], and the significant publicity through the industry organisations representing material sectors. Many of the new design codes have now been published although their use is limited as not all National Annexes are available and the overall code package necessary for a complete design exercise is incomplete. These design codes have been matched by a similar influx of new EN material and product codes.
- 4.4.3 The IStructE report recommended that a standing committee on the implementation of the Eurocodes be established to:

*‘monitor the process of implementation of the structural Eurocodes in the UK and advise on changes to the strategy that become necessary as the process progresses.’*

The Committee is pleased to note that this is now in place and that its remit will be to:

*‘oversee, update, and modify the implementation of the strategy for implementation of the structural Eurocodes in the UK’.*

- 4.4.4 Although this venture remains a significant undertaking, the Committee considers that a framework is now in place, via this committee, within which a detailed plan of action by government, BSI, institutions, software houses, and design organisations can be developed in greater detail. There are however some significant hurdles to overcome including:
- Adequacy of funding to ensure that the programme is effectively implemented
  - Establishing an authoritative feedback and advice centre
  - Bringing some certainty to key milestone dates
  - Establishing and implementing an appropriate calibration regime
- 4.4.5 The question of the pricing of Eurocodes (a concern raised in the 14<sup>th</sup> Report-Recommendation 4/I3) is expected to be considered by the standing committee.

This is very much an on-going matter in which the Committee will maintain a keen interest.

## REFERENCES

1	<i>National Strategy for Implementation of the Structural Eurocodes in the UK: Design Guidance</i> Prepared for the Office of the Deputy Prime Minister by the Institution of Structural Engineers 2004
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## 4.5 BSI CODE COMMITTEES

- 4.5.1 The *14<sup>th</sup> Report* expressed concern, previously expressed by others [1], in respect of the declining representation from practising engineers, government departments and their agencies on code committees. It was emphasised that positive action was required to rectify this situation.
- 4.5.2 As a consequence of the SCOSS recommendation that arose from this concern (Recommendation 6/I2), ICE decided to instigate a survey of stakeholders to determine the current situation on this and a wider set of issues related to code production. The Committee is pleased to note that, as a result of ICE's contact with BSI, the latter agreed to join with them in this survey, the results of which are anticipated in July 2005.
- 4.5.3 The pricing policy adopted by BSI for Eurocodes was also a concern raised by the Committee in the *14<sup>th</sup> Report*. In view of the large number of parts required to undertake a design in each of the major materials, this represents a considerable financial burden, particularly for smaller companies. The Committee is pleased to note that this is a matter which is being addressed by the recently formed Standing Committee.
- 4.5.4 Some progress has been made by BSI in the development of a student guide for application of the Eurocodes, which is to be welcomed<sup>30</sup>.
- 4.5.5 The Committee would be pleased to hear of any concerns from those with direct experience of the BSI committee workings.

## REFERENCES

1	<i>Review of Structural Design Codes in Construction.</i> Study Group led by Prof Les Clarke prepared for the Office of the Deputy Prime Minister et al. June 2000
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<sup>30</sup> However, this does not as yet reflect the final version of the Eurocodes, or the National Annexes. The cost (£60) may also be a barrier to many.

## 4.6 IMPOUNDING STRUCTURES

### Background

4.6.1 There are estimated to be some 2,100 reservoirs, over 25,000 cubic metres capacity, in England and Wales. Of these it is considered that around 70% pose a potential risk to life.[1]

4.6.2 The safety of our reservoirs is ensured through the requirements of two acts of parliament, viz:

#### *The Reservoirs Act 1975.*

4.6.3 This superseded and updated the thinking behind its predecessor, the 1930 Act, and was introduced to provide, in part, for the appropriate involvement of competent independent engineers (Panel Engineers) in the construction, operation and maintenance of all impounding reservoirs over 25,000 cubic metres capacity above natural ground level. Reservoir undertakers (who have ultimate responsibility for reservoirs) are obliged to appoint Supervising Engineers to undertake regular safety checks, and Inspecting Engineers to implement commissioning and other inspections. These acts have together led to a commendable level of safety over the last 70 years.

4.6.4 From the 1st October 2004, responsibility for the enforcement of the Act transferred from local authorities to the Environment Agency (EA). The new role of the EA is well set out in a recent publication [1].

4.6.5 However, this act does not legislate in respect of those reservoirs with a capacity of less than 25,000 cubic metres of which there are many, although the exact number is unknown. Although most reservoirs over the capacity limit are well defined in terms of ownership, and hence responsibilities under the Act, there are some, particularly those outwith the Act, where ownership is uncertain or where many parties are involved. In this latter category there is often reluctance, and no obligation, to employ a Panel Engineer.

#### *The Health and Safety at Work etc Act 1974*

4.6.6 This places a duty on 'employers' and 'those in charge of premises' to have regard to the safety of others that may be affected by their undertaking. Where a reservoir is, for example, a key part of a farm, an industrial process, or a utility, there is clearly an 'undertaking' and the act applies (regardless of the size of the reservoir). However, if there is no undertaking or no work, as might apply to a private reservoir, the act will not apply. Enforcement of this act, in respect of reservoirs of all sizes, falls to the Health and Safety Executive (HSE).

4.6.7 HSE and EA are liaising on this issue to ensure that there is a joined-up regulatory approach.

## Concerns

- 4.6.8 The Committee became involved in this topic as it was concerned at two aspects of reservoir safety, viz:

### *Size of reservoir*

- 4.6.9 The Reservoirs Act 1975 was formulated prior to the introduction of risk-based approaches to the analysis of potential hazards and to the prioritisation of remedial work. Shortly after the Act came into force, however, the concept of dam categories<sup>31</sup> (A-D) was introduced to give guidance to the requisite flood return periods when related to the risk to life or damage to property. However, this did not extend to the provision of risk based guidance on the question of maintenance priorities.
- 4.6.10 The Act provides a cut-off size, below which the reservoir ceases to be governed by the legislation; this is set at 25,000 cubic metres capacity. Hence a reservoir of 24,500 cubic metres capacity does not fall under the Act (and hence does not require the use of Panel, Supervisory or Inspection Engineers) even though the risk of failure, and the consequences of such a failure, may be greater than for one of nominally larger capacity bringing it within the compass of the Act. For many of these older reservoirs there are no records of construction and it has to be assumed that some were not formally designed.
- 4.6.11 Current thinking on the management of risk would suggest that all impounding reservoirs should be assessed on a risk managed basis, and that subsequent actions be related to this analysis. Guidance could be given to relate necessary action to consequence, e.g. loss of life, property damage, or strategic importance, and to the structure's condition, e.g. age, maintenance history, construction detail. This approach might result in a Panel Engineer (or equivalent) being brought in on a relatively small reservoir because a loss of life was identified as a possible consequence of failure. Table 1 of footnote 1, would be a start in this respect.
- 4.6.12 EA has confirmed that they also recognise this issue and that they are in the process of collecting data, with a view to determining if there is a case for amending the current legislation [2]. However, they point out that in view of the recent parliamentary time expended on the Water Act, it is unlikely that time will be found for 4-5 years.
- 4.6.13 Although it is not possible to impose the requirements of the Reservoirs Act on those facilities below the cut-off capacity, it is possible and desirable to remind owners that the obligations of the Health and Safety at Work Act do apply, i.e. there is a duty to prevent risk<sup>32</sup> to others, so far as reasonably practicable, subject to the limitations set out in paragraph 4.6.6. One reasonable way of discharging that obligation would be to use the offices of a Panel Engineer to undertake a survey of the structure in question. Such an

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<sup>31</sup> See Table 1 of 'Floods & reservoirs safety' ICE 1996

<sup>32</sup> It is sufficient in law that a potential risk exists; it does not have to manifest itself in a failure, accident or ill health for the Act to apply.

approach would at least partly bridge the gap before parliamentary time was available.

*Professional Indemnity Insurance (PII)*

4.6.14 The British Dam Society<sup>33</sup> (BDS) has expressed concern that the financial risk to Panel Engineers in carrying out inspections was disproportionate to the fee received. Concern is at two levels; the effect of claims on future premiums and the fact that insurance excesses are now very substantial.

4.6.15 BDS believes that unless some remedy can be found the number of Panel Engineers will decline, and some of those that remain may be inadequately insured, and may not be the most experienced. If sufficient Panel Engineers were to withdraw, the inspection regime envisaged by the Reservoirs Act would be in jeopardy<sup>34</sup>. The suggestion has been put forward that Panel Engineers' liability should be limited to a stated multiple of the fee received, or capped in some other way as has been done on consultancy commissions in other fields, specifically in relation to contaminated land.

**REFERENCES**

1	<i>Reservoir Safety - the Environment Agency's new enforcement role</i> Environment Agency. June 2004.
2	Letter from the Environment Agency to SCOSS dated 17 December 2004.

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<sup>33</sup> An associated society of the ICE

<sup>34</sup> SCOSS is aware of one major consultant that has decided to withdraw.

## 5.1 LIQUID METAL ASSISTED CRACKING

- 5.1.1 The Committee Topic Paper<sup>35</sup> on this subject, published in June 2004, describes this phenomenon as a “rare but serious event”. To repeat the introduction:

*Liquid Metal Assisted Cracking (LMAC) or Liquid Metal Embrittlement (LME), as it is known in the USA, is a phenomenon that can occur when a susceptible steel is hot dip-galvanized (HDG). Unlike some other forms of cracking that may occur during the fabrication or galvanizing process, LMAC is relatively rare but also, at this time, less well understood than other cracking mechanisms. When it does occur, LMAC manifests itself as gross cracks that are most often visible but can also be present as cracks that are neither visible, nor simple to detect with non-destructive testing.*

- 5.1.2 The Topic Paper went on to emphasise the role that other factors might play in the cracking process. Since publication of the Topic Paper more information has come to light in this respect. The Committee has also received comments from individuals with experience of this phenomenon, hence the revised guidance being developed will be a welcome addition to designers’ knowledge base.
- 5.1.3 The Topic Paper was intended as an interim means of informing the industry of an important problem, in the knowledge that more detailed advice was forthcoming in the form of design guidance, authored jointly by the British Constructional Steelwork Association (BCSA) and the Galvanisers’ Association (GA). The BCSA are due to publish this updated guidance document (*Galvanising structural steelwork: an approach to the management of liquid metal assisted cracking*) by June 2005.

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<sup>35</sup> *Liquid metal assisted cracking of galvanised steelwork: A very rare but important issue* can be found on the SCOSS website at [www.scoss.org.uk/publications.asp](http://www.scoss.org.uk/publications.asp)

## 5.2 LARGE PANEL STRUCTURES

5.2.1 Large panel structures first came to the attention of the wider structural engineering community (and the general public) in 1968, following the partial collapse of the Ronan Point flats in London. This type of construction exhibited fundamental flaws, both in its design and in its construction. The design relied on gravity forces and friction to hold all the panels together and this could lead to progressive collapse, as evidenced by Ronan Point, if one part failed.

This occurrence was a seminal event, and led to a major re-think of high density housing construction and a change to the building regulations in 1970 to regulate against disproportionate collapse.

5.2.2 These specific regulations (Regulation A3) have applied since that time, but only to buildings over 4 storeys. As noted in Section 4.1 the Committee has argued for some years that they should be applied to all buildings, with limited exceptions (e.g. single storey, domestic housing)<sup>36</sup> and is pleased to note the change to the regulation to bring more buildings within its remit. This new regulation does not apply retrospectively however, which is relevant to the following paragraphs.

5.2.3 Following the Ronan Point collapse, directions were issued through the then Minister for Housing and Local Government for all buildings of this type of construction, and over 6 storeys in height, to be checked for structural adequacy (robustness). The equivalent static loads to be used in this exercise were related to whether gas supplies were present or not. The specified imposed loads were 34 kN/m<sup>2</sup> if gas supplies remained, and 17 kN/m<sup>2</sup> if they had been removed. These checks were implemented to MHLG Circular 62/68 and BRE guidance published in 1987 [2]. After 1987 all blocks over 4 storeys should have received a check for structural adequacy.

5.2.4 As a consequence of this directive and guidance, many blocks of flats had their gas supplies removed by the responsible local authority, to be replaced with electrical supplies. This then allowed the structural check to proceed under the lower imposed load.

5.2.5 In the interim period, many of these blocks, or individual flats, have been sold. The structures themselves are now 40 years older than when this concern first arose. In addition, it is reported that economic pressures on some tenants has led to the use of liquid petroleum gas (LPG) bottles being taken into the flats for cooking and heating purposes. Specific cases have been reported of these bottles also being stored under the flats by those engaged in mobile catering activities.<sup>37</sup>

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<sup>36</sup> SCOSS Reports 10 and 11.

<sup>37</sup> SCOSS first raised concerns over bottled gas in its 6<sup>th</sup> report in 1985



- 5.2.6 The Committee has recently become specifically aware of one block of flats that does not appear to have had this check for structural robustness; consultants retained by the tenants have reported that the gas supply has not been removed, and that a structural analysis indicates insufficient strength to withstand a gas explosion. It also identified other shortcomings in respect of general reinforcement provision.
- 5.2.7 The ODPM has indicated its concern over the apparent conservative nature of conventional structural analyses in respect of accidental loading. It is suggested that these do not take account of inherent additional strengths arising from friction and bonding at the panel joints. In order to investigate this hypothesis, it has engaged BRE to carry out a study, with the aim of developing some design rules for future adequacy checks. This study is due for completion in 2005.
- 5.2.8 The Committee has corresponded with the Housing Minister on this topic in view of its potential seriousness. The concern stems from the fact that some:
- blocks may not have received a check on their structural adequacy,
  - local authorities may not now have records of these checks to determine whether checks were implemented,
  - local authorities may not be aware of the situation regarding the possible use of LPG, or that main gas supplies may still be present.
- 5.2.9 The Minister stated that he was minded to await the outcome of the BRE study before recommending structural checks in view of the opportunity for a more accurate method of analysis being available. The Committee's view is that providing the level of risk does not increase, this appears a reasonable approach given the timescales involved.
- 5.2.10 On the question of gas supplies however, the Committee believes that appropriate action should be taken by local authorities and others where it is the case that LPG is being used. To this end the Committee recommended to the Minister that he inform local authorities of this practice amongst some tenants, so that enquiries might be made and action could be put in hand. Gas explosions remain a credible concern. Although they may be of low probability they are high risk<sup>38</sup>. In December 2004 an explosion at a block of flats in Mulhouse, France, caused partial collapse and killed 17 people.
- 5.2.11 The risk from gas explosions was first raised by the Committee in its *2nd Report* in 1978, and again in its *6th Report* in 1985. The concern expressed then is the same as now. In the former case however, it was reported that discussions were held with suppliers of LPG which agreed to re-emphasise to their agents that:

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<sup>38</sup> unfortunately HSE statistics do not allow a detailed analysis

*High rise blocks*

*LPG should not be used in high-rise flats, either in cylinders or piped from the outside if, on safety grounds, the piped mains gas has been disconnected or a supply refused.*

*Flats and Maisonettes of traditional construction over 2 storeys*

*LPG can be piped in from the outside but LPG cylinders should not be allowed inside unless the block has alternative means of escape and has balcony or deck access which can be used for cylinder changing. Irrespective of the above, cylinders should not be used above the fourth storey and lifts must not be used for the transportation of cylinders.*

The report then went on to say ‘*However SCOSS is concerned that many local authorities are still unaware of the risk.*’

5.2.12 The Committee were able to report in their *3rd Report* in 1979, that as a consequence of discussions held with the then DoE and ‘local authority associations’, that local authorities had been advised in 1978 that, as a first step, warning leaflets should be distributed to each tenant within LPS accommodation, which had not been strengthened following the Ronan Point collapse. In the longer term it was recommended that local authorities consider:

- The prohibition of LPG cylinders to buildings particularly at risk through clauses in tenancy agreements,
- The need to warn social service departments of the dangers of supplying LPG appliances as emergency measures to assist tenants.

5.2.13 The Committee is concerned that with the passage of time, and regardless of what is included in tenancy agreements, the risks associated with LPG may have been put to the back of people’s minds.

5.2.14 The Minister has however indicated that local authorities are to be informed<sup>39</sup>. They will be advised to await the outcome of the BRE research<sup>40</sup> unless the risks associated with a particular building are unacceptably high, in which case an immediate appraisal is recommended. It has recently been confirmed to SCOSS however (March 2005) that this communication will itself be delayed until the BRE advice is available as, for some systems, early indications are that significantly less remedial work might be required than hitherto thought. On this basis it is concluded by ODPM that there is no need for an immediate advisory note.

5.2.15 Whilst the Committee understands the need for a measured approach, there does seem to be a case for early advice to local authorities, at least so that action may be taken in respect of gross abuse of LPG. It does however reinforce the concerns generally held over the management of the UK’s

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<sup>39</sup> letter to SCOSS Chairman dated 8 December 2004

<sup>40</sup> see also an article on this research in the *Structural Engineer* Vol 83 No 8 19 April 2005 p13.

building stock, which are discussed in Section 5.3, and the need to remember the lessons of the past.

## REFERENCES

1	<i>Revised Part A of the Building regulations: Technical Update</i> G Harding (ODPM) The Structural Engineer Vol:83 No:2, 18 January 2005 p18-19
2	<i>The structural adequacy and durability of large panel system dwellings</i> BRE 1987

### 5.3 DETERIORATION OF BUILDING STOCK

5.3.1 The Committee has reviewed this subject on a number of occasions over several years; it is an on going matter and one with the potential for becoming a significant issue if not handled appropriately.

5.3.2 It is axiomatic that the nation has an ageing building stock. In particular however, the proportion of the nation's building stock that was part of the very significant growth experienced in the 1960s is now some 40 years old. In fact, the post-war growth in general has not just been in volume terms, but also in terms of technological advance. As is well known, not all of this advance was without its problems, e.g. large panel structures (Ronan Point), high alumina cement (Camden School). In the field of bridge engineering box girder construction also led to difficulties (Milford Haven).

5.3.3 The *13th Report* pointed out, under the heading of *The risk of lack of adequate maintenance and/or inspection* that:

*A lack of adequate maintenance and/or inspection was a major factor in the collapse of Pipers Row multi-storey car park. Codes generally presume that adequate maintenance and inspection will be carried out, but as noted in the Twelfth SCOSS Report, the legislation does not create clear, appropriate duties in this area for all potentially vulnerable structures. There is also confusion over statutory enforcement.*

5.4.4 In the last three years the Committee has issued commentaries on:

The need for a rationalisation of legislation and ownership of 'building maintenance'.	Topic Paper <i>Assessment and inspection of buildings and other facilities</i>
Whole life approach to projects	<i>14<sup>th</sup> Report</i>
Eurocodes emphasis on design assumptions regarding durability and maintenance issues	<i>14<sup>th</sup> Report</i>

5.3.5 As can be seen from Section 5.2, the issue surrounding large panel structures continues to be of concern, and reflects very much the key generic principles:

- Identifying the hazards
- Eliminating or reducing these where possible
- Passing on information to those who need to know
- Implementing a maintenance strategy.

5.3.6 Unfortunately, many of our existing buildings were not designed with a specific maintenance strategy in mind. For some, this has not significantly affected their performance nor has it created an unnecessary cost to the owner. In other cases however, significant costs have arisen as a consequence of poor design, construction or maintenance. In the extreme, it has led to premature

and uncontrolled collapse (e.g. Pipers Row car park), or danger to others (e.g. the stonework failure in Edinburgh in 2000).

- 5.3.7 This range of situations emphasises that the attention given to our existing building stock needs to be tailored to risk such that scarce resource may be effectively targeted. The last example given above led to the Scottish CIC report for the Scottish Executive [1]. It made a number of recommendations to improve and regulate the condition of the building stock in Scotland although the principles are generally applicable.<sup>41</sup> The House Condition Surveys also provide a source of data.
- 5.3.8 In the *14th Report* the Committee pointed out that the incentive for many building owners to consider the safety of the structure is lacking. It appears that efforts by CIC to suggest a simplification of building legislation has not progressed.

*Identifying the hazards*

- 5.3.9 The identification of the hazards and subsequent assessment of the resultant risks is a skilled task, but by approaching it using risk management principles the high risk items may be identified and reviewed without spending time and expense on a whole structure inspection or refurbishment. Budgets may be prioritised and a work plan established. This is a structured safety management approach.
- 5.3.10 There is substantial evidence available to indicate the significant issues on typical building types [2] although this may nonetheless be an area of further fruitful research. It is well established also that ‘new build codes’ are not necessarily the tools for the assessment of structural adequacy on existing building stock.

*Eliminating or reducing these where possible*

- 5.3.11 There is an obligation on duty holders<sup>42</sup> to eliminate or reduce these hazards so far as reasonably practicable. The application of the philosophies outlined in the ICE report on car park maintenance [3] is commended as setting an exemplar of good practice in a manner that may be applied to all structures.

*Passing on information to those who need to know*

- 5.3.12 On many buildings progress is hindered by a lack of information, not just on the physical characteristics of the facility, but also on the assumptions regarding lifespan of components and the maintenance requirements to ensure adequate serviceability and robustness.

Hence, on both existing and new structures a management plan is essential to a properly risk managed approach. This is recommended and outlined in reference 4.

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<sup>41</sup> The CROSS pilot (Chapter 2) is charged with pursuing recommendation 11 from this report which is concerned with the collection and adequacy of data.

<sup>42</sup> Unfortunately the identity of the duty holder is not always clear cut as outlined in the Topic Paper.

*Future Building Stock*

5.3.13 The Committee has already drawn attention<sup>43</sup> to the requirement of EN 1990 *The Basis of Structural Design* (now published) which clearly requires designers to spell out to the client the assumptions regarding lifespan, durability and maintenance (Clause 1.3.2). Other guidance is available to assist designers in this process [4]. This is an action that should be occurring now so as to forestall problems in the future.

**REFERENCES**

1	<i>Risks to Public Safety from Falling Masonry and Other Materials</i> CIC Scotland 2003
2	<i>Appraisal of existing structures</i> (2nd edition) (1996) Institution of Structural Engineers
3	<i>Recommendations for the Inspection, Maintenance and Management of Car Park Structures</i> , 2002 Thomas Telford Ltd
4	<i>Safe access for maintenance and repair C611</i> CIRIA 2004

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<sup>43</sup> 14<sup>th</sup> Report para 2.23 and 2.24

## 5.4 MISCELLANEOUS

- 5.4.1 The Committee reviewed a number of other ‘product related’ items during the period and these are briefly summarised below.

### *Temporary Works (Falsework)*

- 5.4.2 The Committee has kept a watching brief on this subject since the publication of its Topic Paper<sup>44</sup>. More recently, concern has been expressed to the Committee in respect of the robustness of some proprietary aluminium frame systems, mostly manufactured outside the UK. Concern over increased loads being applied to these systems, should they be used for civil engineering works, was noted in a recent paper alongside other issues [1]. The Committee is pleased to note that BS 5975 Falsework is due to be updated, but in the meantime would wish to draw the industry’s attention to the issues highlighted in the quoted documents.

### *Light Metal Structures*

- 5.4.3 The use of light metal structures is growing. These cold formed section structures have a number of advantages over conventional construction viz: they are factory formed, quick to erect and are manufactured to tight tolerances. Concern has been expressed however that the component connections are not supplied with the members, and are left for the contractor to obtain. Although the type and size of fixing is specified there is a risk that their structural role may not be appreciated, and substandard alternatives might be used in lieu. An example of this occurring has been drawn to the attention of the Committee; this was noted by chance by the visiting structural engineer.

It appears that there is a case here for a more co-ordinated approach helping to lessen the risk of an error at a contract interface.

### *Timber Joist Hangers*

- 5.4.4 The use of steel brackets to support floor joists in housing construction has increased in recent times, partly as a consequence of the introduction of Part E of the Building Regulations (this part is concerned with the resistance to the passage of sound). Compliance is assisted if penetrations into walls are minimised.
- 5.4.5 These brackets rely on the structural action with the wall on which they are supported, in order to achieve their load bearing capacity. They also rely on accurate placing, and positioning of timber within the bracket, in order to limit any unintentional eccentric loading. These constraints are not always appreciated by those on site.
- 5.4.6 HSE has expressed concern that a number of accidents have occurred as a consequence of the floor being loaded before the blockwork mortar has cured sufficiently to enable the wall to act as a monolithic unit. These structural collapses have the potential for serious injury or fatality.

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<sup>44</sup> Falsework: Full Circle [www.scoss.org.uk/publications.asp](http://www.scoss.org.uk/publications.asp)

5.4.7 The Committee has been in discussion with the House Builders Federation (HBF) in order to encourage wider publicity and action from their members' designers. It is the designers' responsibility under the CDM regulations to be alert to these issues in the first instance. The hazard should be eliminated or reduced, if reasonably practicable. If a risk remains, any significant information needs to be passed to the contractor. It appears that at present this is not always occurring.

5.4.8 The Committee has suggested that a 'warning box' be placed on the drawing as one simple measure that would go some way to alleviating this problem. Notwithstanding, those engaging and monitoring contractors to do this work are obliged to ensure that there is an appropriate training regime in place.

#### *Structural Fasteners*

5.4.9 The Committee is aware of examples where fasteners acting as structural components have failed. In one case the failure was related to an inadequacy in the installation combined with an optimistic capacity assumption, and in another case the fastener failed below the design load precipitating a serious collapse. Paragraph 4.3.19 also outlines an established concern in respect of the safety of fasteners.

5.4.10 These instances emphasise the need for caution when specifying structural fasteners, for this to be a risk based approach, and for appropriate quality control and testing on site.

5.4.11 Many of the items covered in Section 4.3 relate to the provision of appropriate safeguards as a means of lessening the chance of failure.

## **REFERENCES**

1	<i>Falsework verticality: leaning towards danger?</i> M Burrow, L Clark, P Pallett, R Ward, D Thomas Civil Engineering 158 February 2005
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## 6 RECENT FAILURES

6.1 As noted in the Introduction, structural failure continues to occur. Some random examples are illustrated below:

Ref	Country	Structure	Cause (if known)
1	France [1]	Charles de Gaulle Terminal 2E Building	Design fault
2	Singapore [2]	Nicoll Highway	Variety of basic shortcomings
3	UK	Lincoln Grandstand	Still under investigation.
4	Spain	Madrid Fire (Torre Windsor tower block)	Failure of fire barrier
5	UK	Collapse of two tower cranes; West Sussex	Still under investigation.
6	Atlantic City car park	Collapse during construction in 2003	Lack of connection between slab and column

Unfortunately, information on the above examples remains limited. A reference has been given where substantive data is available. Reference 1 provides further source information.

6.2 It is interesting to note that behind the apparent immediate cause of failure, there are some root causes which will be familiar to structural engineers. Actions to counter these are suggested below, viz:

Ref	Aspect	Action to counter root causes
1,2	Advanced structures	The desirability of an independent design check (mandatory in the UK for public highway structures, but not for buildings).
4	Design Co-ordination	Ensuring a holistic approach to specialist areas to ensure that extreme event action is understood and appreciated.
2,5,6	Temporary works	The need to recognise the special nature of temporary works and for design co-ordination.
2	Contractual arrangements	The need to integrate design and construction, and to avoid blurring of responsibilities if using complex contractual arrangements.
2,6	Constructability	The need for designers to understand the temporary stability situations that may arise during construction.

6.3 All the above aspects have been mentioned in previous SCOSS publications and have been associated with other collapses. The Committee believes that the risk of such occurrences could be significantly reduced by the implementation of the

actions recommended in this report. It is the Committee's hope that CROSS will also contribute to lessening the risk of failure.

## REFERENCES

1	<i>Paris airport terminal collapse: lessons for the future</i> J G M Wood The Structural Engineer Vol 83 No 5 1 March 2005 p13
2	Interim Report of the Committee of Inquiry into the incident at the MRT Circle Line Worksite (C824 Of The Circle Line Project) that led to the collapse of Nicoll Highway on 20 April 2004 <a href="http://www.mom.gov.sg/MOM/CDA">http://www.mom.gov.sg/MOM/CDA</a>

## **7 ACTIONS TAKEN ON PREVIOUS REPORT RECOMMENDATIONS**

- 7.1 The Committee has tracked the progress of the recommendations made in the last report, and the outcome is summarised in tabular form in Appendix C. Although only a few are 'closed out', it is encouraging that most are being actioned. Some of these subject areas have been discussed again since the publication of the report- demonstrating their on going importance, which has led to separate action in this report, e.g. competency issues (item 2/I5), risk management (2/I1-3).

## **Appendix A – Membership of the Committee**

### *Chairman*

**Kate Priestley** MBA CQSW HFIHEEM FRSA, previously Chief Executive of Inventures; Chairman since October 2002.

### *Members*

**John Collins** MSc CEng MIStructE MICE. Head of Bridges for the Transport Directorate at the Welsh Assembly Government. [until September 2004]

**David Cornes** BSc(Eng) AKC CEng FICE FCI Arb. Founding Partner of Winward Fearon Solicitors specialising in construction. [until September 2004]

**Professor Marios Chryssanthopoulos** BSc MS PhD DIC CEng FICE FIStructE, Professor of Structural Systems at the School of Engineering, University of Surrey. (From October 2003)

**Adrian Judge** BA CEng MICE MIHT, Consultant, formerly Director at Jacksons Civil Engineering. (From October 2004)

**John Lane** BSc CEng MICE, Technical Services Department at Rail Safety & Standards Board. (From October 2002)

**Joe Locke** MBE FEng MSc CEng FIStructE Fweldl, formerly Director at William Hare & Co. (From October 2002)

**David Mackenzie** BEng MS CEng MASCE FIStructE MHKIE, Partner at Flint & Neill Partnership. (From October 2001)

**Dr Allan Mann** FEng, PhD BSc(Eng) CEng FIStructE MICE, Senior Consultant at Jacobs Babbie. (From October 2003)

**Trevor Nicholls** CEng MICE, Kirkpatrick & Lockhart Nicholson Graham LLP. (From October 2004)

**Nigel Rickets** BSc MSc CEng MICE, Regional Structural Engineer at Network Rail (Southern). (From October 2003)

**Professor Brian Rofe** MA (Cantab) FEng FICE FCIWEM, Consultant. (From October 2002)

**John Rushton** BEng (Hons) MSc CEng MIStructE MICE, Partner at Peter Brett Associates. (From October 2001)

**Anthony Umney** BSc CEng FICE, Consultant, previously Group Director Tunnels at FaberMaunsell. (From October 2002)

**Faith Wainwright** FEng BA(Hons) FIStructE, FICE, Director at Arup. (From February 2001)

**Dr Martin Wyatt** BSc PhD CEng MIStructE , Chief Executive at BRE. (From October 2003)

**Phil Wright** BEng MSc CEng MICE DipH&S, HM Principal Specialist Inspector (Construction Engineering) Health and Safety Executive. (From October 2003)

*Secretary*

**John Carpenter** BSc CEng FIStructE FICE FIOSH, Consultant, formerly Director of Health and Safety at Symonds Group.

## **Appendix B – List of Topics considered by the Committee in the period 2003-2005**

BSI committee workings  
Certification issues  
Charles de Gaulle airport terminal building collapse  
Competency  
Confidential reporting on structural safety  
Dams  
Designer responsibilities  
Erection of steelwork  
Eurocodes  
Falsework  
Large panel structures  
Light metal structures  
Liquid metal assisted cracking  
Tack welds  
Timber joist hangers  
Use of software: educational approach

## Appendix C – Progress on actions from the recommendations of the 14th Report

	ITEM	ACTION/PROGRESSION
	<b>Risk management of structures</b>	
2/I1	Institutions and others are encouraged to emphasise the benefit to most structures of application by designers of the broad lessons learnt from the various investigations following the World Trade Center collapse, and specifically as set out in the IStructE Report 'Safety in Tall Buildings'. Guidance should be given to this approach by way of practical advice and examples, related to common structural form.	Items 2/I2, 2/I3, could be included within this recommendation.  ISE are to produce a 'risk management' booklet for structural engineers. Not yet clear as to whether it will encompass all the points made these three items.
2/I2	Institutions are urged to emphasise to their members the benefits of a whole life risk management approach to facility design and to provide appropriate guidance in this respect. A joint initiative with the Construction Best Practice Programme is suggested as a way forward.	See above
2/I3	The Institutions should determine whether there are lessons to be learnt from other industries in respect of whole life risk management, and which are applicable to the day to day project. A conference might provide a suitable vehicle for this as a starting point.	See above
2/I4	Institutions should actively support the Construction Industry Council (CIC) in their endeavour for a comprehensive review and harmonisation of building legislation, in order that it might be better understood, enforced and add value to the process.	Although little progress has been made persuading government to take on board the report recommendations in respect of existing legislation, there is now a group (CIPER- Construction Industry Policy & European Regulations), which arose as a consequence of the report, and which considers intended legislation.
2/I5	Institutions should give continuing thought to the benchmarking of skills in order that third parties are able to make appropriate judgements in respect of competencies, and so that standards are maintained.	ISE has a voluntary CPD register. (to which approximately 40% of the membership subscribes) ICE has referred this recommendation to their Membership Committee. SCOSS has continued this theme (see Structural Engineer 3 August 2004) and both Institutions have now agreed (January 05) to consider the issues arising from the paper.

	<b>ITEM</b>	<b>ACTION/PROGRESSION</b>
<b>2/I6</b>	Government (currently via ODPM) is asked to support initiatives aimed at simplifying building legislation, and provide funding to allow this to progress as a means of achieving a greater degree of 'joined up' construction.	There has been no progress in respect of existing legislation.
<b>2/I7</b>	The Joint Board of Moderators (JBM) should consider the implications of this Chapter on accredited courses.	Chairman wrote to JBM Chairman following release of the report. The Committee is not aware of any action arising from this.
	<b>Gathering of information on matters of structural safety</b>	
<b>3/I1</b>	The Institutions are urged to actively seek ways of establishing a pilot scheme for the gathering of information on matters of structural concern, in order that this may progress without undue delay.	This is now in hand (see Chapter 2) and represents a major milestone.
	<b>Eurocodes</b>	
<b>4/I1</b>	The scale of the structural Eurocode implementation programme makes it essential that a co-ordinated plan of action is compiled between all the major interested parties, in order to ensure a smooth introduction. The Institutions should take a lead in this respect reflecting the outcome of recommendation 4/I2.	This is now in hand (see Section 4.4)  The 'Eurocodes Expert' group also has commenced work.
<b>4/I2</b>	The ODPM is urged to support the concept and funding of the Standing Advisory Committee, recommended by the Review Body which reported in June 2000. It is considered that this body will provide the essential leadership needed. (See also recommendation 6I/2)	See above.
<b>4/I3</b>	BSI is urged to consider the pricing policy for Eurocodes, having particular regard to the smaller practitioner, the availability of English language versions of Annexes relating to other European countries, and the cost of revisions generally.	No specific progress although the matter has been raised with BSI. See also Section 4.5
	<b>Education</b>	
<b>5/I1</b>	The Institutions should convene a forum or working group to review the strategic issues on Education raised in the text, with the specific aspiration of taking the outcome of their deliberations to Government, in conjunction with those sponsoring the Rethinking	No specific action has been taken on this point.



ITEM	ACTION/PROGRESSION
5/I2	The JBM should consider the issues raised in respect to the University curriculum.
	Chairman wrote to JBM Chairman following release of the report. The Committee is not aware of any action arising from this.
<b>Reverse Bidding</b>	
6/I1	Institutions are urged to take a lead in the debate on potential risk to safety if using internet reverse bidding by seeking feedback, providing clear guidance to members, and by entering into a dialogue with Government, industry organisations, and major clients.
	ICE has issued a statement on this subject. IStructE has also undertaken to pursue the matter. (Note: The matter has recently come to the fore again (April 2005) in respect of its use by Transport for London).
<b>British Standards</b>	
6/I2	Institutions and BSI are urged to review the current method of developing British Standards (or their Eurocode equivalents) given the warnings made by a number of commentators on the issues relating to committee membership.
	A joint BSI/ICE survey to determine the issues associated with the BSI committee process is being undertaken See Section 4.5 and also 4/I3.
<b>Review of actions arising from recommendations in Reports 11-13</b>	
7/I1	The Committee urges Influencers and Practitioners alike to review the recommendations made in previous reports, and commented upon in Appendix A.(of Report 14)
	SCOSS does not have any information on this.