

FALSEWORK: FULL CIRCLE?

Update Note August 2010

Since this note was originally produced in 2002 a number of key changes have occurred, specifically:

- i) a revised BS 5975: 2008
- ii) introduction of BS EN12812
- iii) introduction of CDM2007;
- iv) withdrawal of Construction Health Safety and Welfare Regulations (subsumed into iii)
- v) introduction of the Work at Height Regulations 2005
- vi) introduction of the CDM Co-ordinator to replace the Planning Supervisor

These changes should be borne in mind when reading the text. However the recommendations and concerns raised in this note remain pertinent.

It is intended that falsework issues be covered by the Temporary Works Forum which is being established in 2010.

Background

The late 1960s and early 1970s was a time of great activity and innovation in the construction industry, following the austerity years of the Second World War and the 1950s. Boundaries were being pushed out in all directions - in respect of design, materials and scale of projects. This brought about some great achievements, but also a number of serious repercussions.

In design, bridge engineers were importing analysis concepts, hitherto used by aircraft engineers to analyse thin walled structures, in areas of design not covered by any British standard. A lack of design thoroughness however led to the collapse of the Milford Haven Bridge⁽¹⁾ - and other bridges abroad. One of the new material concepts was the use of high alumina cement (HAC), a popular choice as it enabled strength to be gained in precast products more quickly than by using OPC, with obvious commercial advantage. Although warnings had been given by academia⁽²⁾, it was not recognised by those designing structures that chemical conversions within the cement matrix, could lead to dramatic loss of strength. Collapses to public buildings resulted⁽³⁾. The use of precast panel products in a manner which extrapolated their use from the original intent, failed to provide adequate redundancy, and created extreme construction difficulties, also led to serious difficulties with wide repercussions, as exemplified by the collapse of Ronan Point flats⁽⁴⁾. The last example has of course become a classic symbol of both engineering failure, and the initiation of a step change in regulation. Examples in other fields might include the Tacoma Narrows Bridge and the Abbeystead Pumping Station.

The scale of project was also increasing at this time, with a need for a complexity of falsework support not experienced before on such a large or regular scale. The 1970s in particular, saw a series of falsework collapses of major significance within both the building and civil engineering sectors of the industry; other collapses had preceded these, for example the falsework collapse on Barton Bridge in Manchester in 1959.

As a consequence of growing concern over an area of work not well regulated at the time, an advisory committee was established under the chairmanship of S L Bragg with a wide remit to investigate the use of falsework⁽⁵⁾. His committee produced the report known by his name - the Bragg Report.

Subsequent to the Bragg Report (and in compliance with one of its recommendations) industry produced the first British Standard BS 5975 in 1982, 'The Code of Practice for Falsework'. Those drafting the code drew on the guidance given in the 'Falsework Report' produced by the Joint Committee of The Institution of Structural Engineers and The Concrete Society.

The consideration given by the Bragg Committee, and the publication of this standard, meant that the UK had become a world leader in many respects in understanding the very special considerations that need to be given to falsework, and the means by which its design, erection and use should be managed.

It is now some 20 years since the BS was published. Much has changed in the intervening years and which has a potential influence on falsework safety.

The Bragg Report Recommendations

Bragg made a number of pointed recommendations. Although some are now incorporated into industrial practice, others remain a concern. These include (paraphrased) recommendations :

- i) To provide a 'full written brief' to be implemented in conjunction with the design procedure outlined in the Report
- ii) For the design to be checked, approved and countersigned by a competent supervisor
- iii) That the permanent works designer should have the opportunity to comment on falsework proposals
- iv) To nominate a single individual (with appropriate responsibility and authority) to act as Temporary Works Co-ordinator (TWC)
- v) For suppliers to provide relevant test data to justify loads used.

We will return to these in due course.

Changes to Construction Methodologies since the 1970s

There have been a number of fundamental changes to the industry since the considerations of the Bragg Committee and the first publication of the British Standard. SCOSS believes these have had a profound effect upon the manner in which falsework is dealt with in its widest sense.

The principal changes are:

- Few 'main contractors' now have their own temporary works departments; the norm is for the temporary works responsibility to fall to a sub contractor or to a specialist contractor/supplier. This can result in a lengthy supply chain. In the 1970s almost all main contractors would design their falsework in-house.
- The concept of the management contractor, a lead role that dispenses with the main contractor, was not known in the 1970s.
- The nature of falsework has changed. Whereas in the 1970s most falsework construction was made using 'tube and coupler', the proprietary system now dominates the market. The design skills, and the knowledge of the abilities of the systems, lie with the specialist organisations.
- The gradual but inexorable loss of traditional skills within the industry has meant that the site foreman, with a lifetime's experience of 'what works,' has been largely lost.
- Procurement routes are usually chosen to maximise commercial benefit and have little regard to information flow considerations. The difficulties experienced with long supply chains are further exacerbated when erection responsibility is split from design responsibility, and design or supply briefs do not include for site inspection.
- The industry exists in a very much harsher commercial climate than 20 years ago.

Superimposed on this backcloth is the phenomenon known as 'collective amnesia' whereby one generation often forgets, or is unaware, of the lessons learnt by the preceding generation.

Current Concerns

The Health and Safety Executive recently commissioned research into aspects of falsework; this was published as a research report entitled *Investigation into aspects of falsework*, report 394/2001.

The researchers interviewed a sample of those involved in falsework design and procurement in order to ascertain the level of appreciation of the structural behaviour of falsework; the researchers also undertook site

measurements of the verticality of falsework support members in order to determine compliance with the BS and also the proposed Eurocode requirements.

The findings should be of great concern to the industry. They show that there is:

- A lack of understanding of the fundamentals of stability of falsework and the basic principles involved. This shortfall occurs at all levels.
- Wind load is rarely considered, and, if included, it tends not to be to BS6399.
- There is a lack of clarity in terms of design brief and coverage of key aspects such as ground conditions.
- The lateral restraint assumptions made by designers were often ignored/misunderstood by those on site.
- There is a lack of adequate checking and a worrying lack of design expertise.
- Erection accuracy leaves much to be desired.

The key concerns stemming from the research are:

- Competency of the designer
- Sufficiency of data
- Adequacy of supervision
- The Role of the Temporary Works Co-ordinator
- Competency of those erecting falsework

The necessary actions are straightforward and no more than the implementation of good practice and adherence to the BS. They also fit well with the aspirations of Rethinking Construction in respect of integrating the team and the provision of co-ordinated information. Some suggestions are given below under 'Recommendations'.

In addition to contractual obligations however, it should be noted that those involved in falsework (throughout the supply chain) have a number of statutory duties; these cannot be delegated or 'written out'. They include the need to be satisfied as to the competency of those appointed to undertake design or construction, the obligation to co-operate with other designers, to avoid and control risk as far as reasonably practicable, and for the appropriate transfer of information. The two sets of regulations most applicable are the Construction (Health, Safety and Welfare) Regulations 1996, [CHSW] and the Construction (Design and Management Regulations 1994.(CDM)

On all schemes the Planning Supervisor will have a role to play. This aspect was not within the remit of the research, but one wonders what input the Planning Supervisor had on those projects reviewed by the research team.

The development of proprietary falsework systems has, notwithstanding the comments made, made a valuable contribution to the greater efficiency of the construction industry.

Recommendations

SCOSS believes that a number of parties need to take action in order to ensure that an adequate margin of safety is maintained when using falsework systems.

Manufacturers of Proprietary Systems

Manufacturers should review their literature with a view to ensuring the information is clear and verifiable, particularly to designers. Serviceability or 'safe' capacities should be accompanied by the associated collapse load so that the margin is apparent. Manufacturers have legal responsibilities to ensure their products are safe and to provide sufficient data to allow them to be used safely. BS5975 sets out a range of data that should be provided (due to be superseded by BS EN 12812 which is likely to increase design complexity).

Designers

Designers of falsework systems (i.e. the assembly of components) should ensure that their staff are competent. This is a statutory obligation as well as good business sense.

Particular attention should be paid to:

- Requisite knowledge of structural mechanics, and, in particular, the special behavioural aspects of falsework.

- Use of software to ensure, inter alia, that the means of analysis is understood and that the assumptions are clearly stated and known.
- An understanding of the importance of the adequacy, and design responsibility of interfaces e.g. ground conditions, adjacent permanent structure.
- Experience of falsework systems on site.
- CPD as a means of attaining contemporary knowledge.

Designers should also ensure that an appropriate design review procedure is in place, executed by a chartered engineer with the requisite experience. The ICE 'Clause 8A' procedure is well established in the civil engineering field.

Although not emanating from research brief, it should be noted that:

- BS EN 12812, in line with other Eurocodes, will operate using limit state principles, and will in some circumstances involve consideration of second order effects. The current BS is written in 'permissible stress' format. This may warrant training provision for temporary works designers.
- Designers need to pay particular regard to the interim conditions of temporary works, such as those affecting stability.
- Some formwork is also critical, involving possibly steel grillages.

Sufficiency of Data

This impinges on a number of parties.

No design should be undertaken without sufficient information. The tender or appointment should make it clear as to which party is responsible for provision or determination of data needed for design. Issues such as ground conditions, availability of the permanent works for lateral restraint and early striking criteria are key.

It would no doubt assist if the designer set out, in a standard format, the information required from their Client. This also links formally with the CDM Regulations (Regulation 11), and the emphasis placed on this topic by the ACOP⁽⁸⁾, where there is a statutory obligation on the Client to provide data. This might well require the commissioning of surveys and other exploration.

The designer should indicate the key design assumptions on the drawings, ensuring that these are project specific and that non-applicable generic notes are removed.

Adequacy of Supervision

It is a requirement in law (Construction (Health, Safety and Welfare)-CHSW- Regulations) that the erection and dismantling of the falsework is adequately supervised i.e. it is overseen by competent persons. This principle should be extended to the planning and design stages. The CDM Regulations also impose duties on those involved in the process.

Where the designer is not responsible under the contract for signing off the erected falsework structure, it is clearly necessary that the task is undertaken by those who have knowledge of falsework systems, the permanent works, and the BS. It is recommended that the 'Permit to Load' procedure outlined in Clause 13 of the BS is adopted in all cases.

The Role of the Temporary Works Co-ordinator

The role of the Temporary Works Co-ordinator (or 'Falsework Co-ordinator' as used in BS5975) is a very important one and needs to be re-affirmed. Changes to working practice over the years have led to a general diminution of the function and its status; anecdotal evidence suggests that it is often given to site staff more from a point of convenience rather than from an analysis of competence.

The advice given in the BS is based on sound judgement and experience. It is only advisory, but there is a strong case for making it a contractual requirement, and this would be the recommendation of SCOSS.

Those chosen to carry out the role must be competent. There is a statutory duty on those making this appointment to ensure that this is the case. (CHSW Regulations).

Those who erect and dismantle falsework

Erectors, who may or may not be the same company that designed the falsework, should consider deriving a good practice guide for employers covering the basic standards they wish to see on site. This is analogous to the BCSA Site Safe Handover Certificate from which much may be learnt.

Employees should receive appropriate training.

Those who procure falsework

Raising standards is a two way process. Those who procure falsework systems also have a role to play in ensuring that the task is executed safely, using competent persons. This can be achieved by:

- Ensuring adequate site specific data is provided to those tendering.
- Following the requirements of BS 5975 (including the appointment of a competent Falsework Co-ordinator).
- Signing up to good practice principles such as those outlined in BCSA's 'Site Safe' Handover Certificate. Many of the items identified in this document are equally applicable to those erecting falsework.
- Ensuring a competent Planning Supervisor is appointed.(if the Client)
- Ensuring all those appointed have sufficient resource for the project.

Although falsework is usually procured by contractors, the Client is able to exert significant influence on the resulting standards through contractual application of the points made above.

Provision of Training and Learning Routes

Over recent years there has been a fall off in traditional courses in falsework, partly owing to poor take up.

It is recommended that:

- Those compiling courses have regard to the issues raised above so as to make courses as relevant as possible to industry. Courses should include elements on procurement, statutory responsibility, and managing the supply chain as well as the technical issues associated with design.
- The CITB consider their training provision in this area, in the light of comments made.
- HSE review the current provision of information relating to falsework, and whether and consider producing an Information Sheet (in hand).
- Those involved in falsework read the Bragg Report⁽⁵⁾ and the IStructE/Concrete Society Report⁽⁷⁾.

Regulatory Bodies

HSE should consider, in the light of the technical advice available, and the perceived risks associated with falsework, whether more formal 'Guidance' is desirable.

Discussion Seminar

It is also recommended that a specific seminar be held on the subject of Falsework to consider current issues, the Eurocode, procurement, and similar matters. (SCOSS has approached IStructE in this respect who have agreed to promote a seminar in Spring 03)

SCOSS Conclusions

SCOSS believes that there is a need to carefully consider the means by which falsework is currently procured, designed, constructed and supervised. Judging from the evidence mentioned above it is only a matter of time before a serious event occurs.

REFERENCES

- (1) Inquiry into the basis of design and method of erection of steel box girder bridges. HMSO 1973
- (2) Professor Adam Neville
- (3) Report on the collapse of the assembly hall of the Camden School for Girls BRE 1973
- (4) Enquiry into the collapse of flats at Ronan Point. HMSO 1968
- (5) Falsework: Interim report of the Advisory Committee on Falsework HMSO 1974
- (6) Investigation into certain aspects of falsework. Contract Research Report 394/2001 HSE Books
- (7) Falsework Report. Joint Committee of The Institution of Structural Engineers and The Concrete Society
- (8) Managing Health and Safety in Construction HSG224 HSE Books

BIBLIOGRAPHY

- 1 Guide for flat slab formwork and falsework. Due Sept 02, The Concrete Society
- 2 Checklist for erecting and dismantling falsework CS123, The Concrete Society. (An additional checklist is being produced for formwork)
- 3 Safety in falsework for in situ beams and slabs HS(G) 32, Health and Safety Executive*
- 4 Checklists for supervisors and chargehands erecting falsework, Health and Safety Executive* (covered by 2)

*withdrawn.

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