**TEMPORARY WORKS AND THE STRUCTURAL ENGINEER**

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**Synopsis**

This note provides an overview of temporary works and associated roles and responsibilities. Although the industry has advanced considerably since the major collapses of the 1970s, current issues of concern remain. Whilst, for most projects, contractors and temporary works designers are the lead players, permanent works designers will always play at least two important roles: a technical one (the design of the permanent works determines what temporary works are needed and what the primary loads will be) and a managerial one (ensuring that appropriate contractual provision and arrangements are in place).

**Background**

Our journals and other outlets have no difficulty in finding examples of projects worthy of commentary: exemplary aesthetics, tight cost control, sophisticated design processes, and, more recently, leading sustainability considerations. However, it will be rare for the text of such papers to concentrate on the temporary works which were required to facilitate construction of the permanent structure. They are the unseen and unsung feature of most projects, yet vitally important nonetheless.

It is unfortunate that temporary works are not explicitly billed or otherwise identifiable as, if they were, and it could be seen that they typically represented a significant cost element of the project, and were often an important influence on programme, this might give greater impetus , in the early stages of the project, to considerations of buildability and temporary works requirements. Additionally, temporary works always add safety (and often health) risk.

Whether the project is complex (and at Wembley stadium there the same order of steel used in the temporary works as in the permanent works) or more straightforward, temporary works are important. Their use must be thought about carefully and they must be understood and managed competently. One could say that the most economic temporary works solution is when they have been designed out of the scheme.

Although temporary works are the direct responsibility of one or more contractors, the permanent works design engineer plays an essential role and will carry some associated responsibility stemming from duties under the CDM Regulations. The appropriate structural solution is one which considers the implications stemming from both permanent and temporary works.

**History**

We forget the lessons of history at our peril. The major falsework failures in the 1970s (although there were many before this) were the catalyst which led to the publication of the ‘Bragg’ report [1] in 1975 and subsequently, as a direct result, BS5975 in 1982. This has been updated since to widen the scope of procedural advice from falsework to temporary works [2]. The key Bragg report findings were:

* A lack of clarity in the division of responsibility.
* The need for a ‘falsework co-ordinator’
* A failure to reflect the ‘high risk’ nature of falsework in the design and site controls.
* The essential need to provide robust means of ensuring lateral stability, and specifically so at forkhead level.
* The need to discard damaged or distorted items.
* The need for stiffeners at all substantive load bearing points in steel grillages

And observing that:

* Falsework requires the same skill and attention to detail as the design of permanent structures of like complexity, and indeed falsework should always be regarded as a structure in its own right, the stability of which at all stages of construction is paramount for safety.

Although the Bragg report was limited to falsework, many of the recommendations, and certainly those relating to procedures, are applicable to temporary works generally.

 The industry has come a long way since these recommendations were formulated. However, we would be foolish to conclude that all are now accommodated. These issues remain highly pertinent.

**Industry changes**

There have been a number of major positive changes to the construction industry, and the manner in which it works, which have developed since the Bragg report, viz:

* A positive transformation in safety standards and culture.
* The introduction of legislation which has clarified division of responsibility and the responsibilities themselves.
* Improved specialist plant and equipment
* Availability of specific design guidance
* Clear management advice (including the role of the Temporary Works Co-ordinator)

Against this however, are some examples which are not necessarily beneficial, viz:

* Intense commercial pressure
* Fragmentation of the supply chain and hence a proliferation of interfaces.
* Loss of in-house temporary works departments within many contractor organisations
* Packaged work which is shaped to suit commercial risk, rather than safety risk
* A general reduction in skill base and supervision
* Complex code changes (for example Eurocodes).
* Lack of structured introduction to concepts in Undergraduate courses and to detailed advice through further learning

 **Permanent works designers**

Permanent works designers may be engaged by the client or by contractors and their work may arise at any time within the project timeline. In discharging their obligations it will be necessary to consider buildability and this may necessitate consideration of temporary works issues. There will be many instances when there is no required involvement: an experienced contractor will be able to manage the process without further input. However, even on some common structures e.g. multi-storey in-situ flat slab, thought and guidance may be required on, for example, striking times, early strength requirements, slab capacities for temporary loading during back-propping and the like [3]. A particular concern being lightly loaded thin slabs required to carry the weight of subsequent construction at higher level.

On more complex structures, or refurbishment projects, the stability of the permanent works may be critically related to the temporary works, in terms of sequence, space, movement limits or strength. In these cases, the permanent works designer will have a key role to play in eliminating unnecessary hazards, reducing risk and finally ensuring that key information is conveyed to contractors.

The likely need for lateral restraint of falsework systems, and the ability of the permanent works to provide for this, should always be considered.

The permanent works designer should also act to have included within the construction contract the appropriate requirements regarding temporary works management [4]. The mandatory appointment of a temporary works co-ordinator being a prime, but not exclusive, example.

**Temporary works designers**

In many respects, temporary works design is no different in principle from permanent works design: it needs to be functional, economic and safe. This can only be achieved with appropriate competence. However, there are key differences of which the designer must be aware, viz:

* Re-use of material
* Possibility of abuse on site
* Lesser certainty of vertical accuracy in particular
* Some categories e.g. falsework liable to receive full design load (unlike many permanent works)
* Essential need for robust lateral support to above ground structures.
* Complex dismantling scenarios e.g. lack of space or under load.
* Low dead weight and often little redundancy

The design process itself has become more involved with the introduction of Eurocodes. The choice of design methodology (permissible stress or limit state) and other procedural issues have been commented on by the Temporary Works Forum (TWf) [4] and further work is in hand.

**Site management**

Bragg recognised that the key to the safe use of falsework was effective site management. This theme was adopted by BS5975 (now including procedural advice relating to temporary works) which, unusually for a British Standard, spells out, in some detail, the key elements. These have become established within the industry and include expected practice on appointments, information flow and a single point of defined responsibility via the Temporary Works Co-ordinator (TWC). All contracts should require this guidance to be adopted [2].

**Contemporary issues**

There remain a number of important technical and managerial issues of which designers need to be aware. It is not the intent of this note to provide answers, but instead to draw attention to these issues which if not considered could lead to additional cost and delay or failure.

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| Eurocodes | BS EN12812 [5] and 12811 [6] operate alongside BS5975 in a technical sense (the latter is not withdrawn unlike the established permanent works design standards). The procedural section of BS5975 [2] applies to all temporary works. It is important to recognise the different scope of the Eurocodes and their approach to analysis and application. TWf has a Working Group considering these and other issues.  |
| Information flow | The key to any project from both commercial and safety perspective. |
| Sourcing of materials | It is important that temporary works materials come from a known reliable source. CROSS has also reported on concerns relating to provenance ([www.structural-safety.org](http://www.structural-safety.org) Newsletter No. 27 July 2012)  |

**Summary**

Temporary works are a vital element of most projects. They demand careful attention by all duty-holders if economic loss and accidents are to be avoided. There is now a considerable quantity of advice and guidance available although contemporary issues remain. The conclusions of the Bragg report, despite being some 37 years old, hold good today, and should not be forgotten.

Thinking to the future, it would be nice to think that a new breed of exemplar projects might emerge in which all states of the permanent works throughout construction are self-supporting, such that no temporary works are needed. Designs of this type will need the closest relationship between builder and designer; a type of relationship that should be our model.

**References**

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