

SCOSS TOPIC PAPER

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FC Twente stadium roof collapse – learning from the fatal consequences

The following link is to the report, in English, on the collapse at the FC Twente Stadium in Holland in 2011, and the Dutch authorities are to be complimented on their rapid publication of the facts. There are many lessons to be learned from this event and industry must ensure that there are no repeats.

<http://www.onderzoeksraad.nl/en/onderzoek/1824/collapsed-roof-grolsch-veste-7-july-2011>

The main aspects which flow out of the report are:

The main contractor must coordinate the activity of all subcontractors.

There must be coordination of the design process and integration of the various interfaces to ensure there is good fit within the respective tolerances of the connecting components.

Temporary conditions are often more onerous than permanent ones.

Temporary works must be designed to accommodate temporary loads and any change to those loads should be advised to the temporary works designer to ensure those changes do not impact on his design.

Sufficient time must be allocated to work activities.

All activities should follow a defined method statement and sequence of work activities when critical to temporary stability. Any changes to that method statement and/or sequence should be referred to the originator/designer prior to any deviation.

Operations should be signed off prior to follow-on trades starting.

What went wrong? Well, simply, the planned sequence of operations necessary to build such a structure was not followed. It would appear that there were a number of reasons.

1. The erector's programme of works was severely condensed.
2. Concurrent activities took place which should have been sequential to ensure stability at all times.
3. Respective tolerances were not allowed for in the design.
4. Overly tight programme period allowed no float to rectify the lack of fit.
5. Members were installed in a manner that induced stresses above working stresses.
6. Members critical for temporary and permanent stability were not installed in sequence.
7. The structure was loaded in its temporary condition prior to completion of necessary stability members. Materials were loaded on the structure in a way that produced a temporary condition more onerous than the permanent condition.

It appears that overly-tight completion dates were allowed to drive the programme in an unsafe manner. The programme, whilst important, must never over-rule safety. The CDM regulations in the UK place a number of responsibilities onto the client, not least the need to ensure sufficient resources and time are allocated to all steps in the design and construction sequence.

It may seem obvious but a structure made up from a number of components needs to be erected in a logical sequence to ensure there is stability at all times. That is an overriding factor. Stability issues can change as other members get added but there must be a clear understanding of loads, their load paths and stability throughout. Until a portion of structural works is handed over there should be no additional load, apart from its self-weight, applied to it unless agreed in writing with the author of the erection method statement. Loading-out of follow-on trades' material is often a critical load case so one must carefully plan the timing of that load application and its position within the structure. Not only can incorrectly placed material cause local failure, it can also cause structure instability and collapse: in particular, the absence of sufficient counterbalance material will cause a cantilever to overturn.

The appointment of a competent Temporary Works Coordinator and the proper implementation of BS5975:2008 + A1:2011, *Code of practice for temporary works procedures and the permissible stress design of falsework*, should help lead to an avoidance of such events. One weapon in the temporary works designer's armoury should be the precedence diagram. This defines activities (and part activities) which cannot start until another is complete. This is more than a mere statement of the construction sequence. It specifies the unique, essential, basis for the temporary works stages and should be put on a drawing and issued to the contractor. An example for such a chart for a semi-top down excavation sequence is given in "Design and construction of deep basements including cut and cover structures" [1].

In conclusion:

- Appoint a Temporary Works Coordinator and assign responsibilities
- Leave responsibility and control of risks and hazards with those who are competent and best placed to control them
- Do not blur those lines
- If B must follow A then ensure that happens and do not deviate unless advised by the originator that it is safe to do so
- Do not work to impossible programmes, no matter what the client wants
- Better to be alive and a few days late
- One would hope that following the UK CDM regulations would prevent such an occurrence
- However hope should not be part of a safety regime.

Reference: The Institution of Structural Engineers, London, March 2004 (ISBN 0 901297 32 1); Figure 14.1

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