

CROSS Safety Report

Accidental partial demolition of a beam

This month we present a report about a permanent works design engineer who noticed that hydro-demolition of the end of a floor supporting beam had taken place out of sequence. This introduced a pattern of bending moments and shear forces that were not considered in the original design.

Report

An existing concrete building constructed in the early 1990s is being redeveloped. This involves substantial demolition works, some of which use a hydro-demolition method to retain and reuse existing reinforcement.

Change in demolition sequence

During a site visit, the permanent works design engineer noticed that hydro-demolition of the end of a floor supporting beam had taken place out of sequence. Removing this portion breaks the beam continuity and leads to a pattern of bending moments and shear forces not considered in the original design. Fortunately, there was minimal construction loading on the floor slab at this time. No damage occurred and nobody was injured.

The project had good relationships between parties and an effective escalation procedure, so when the issue was identified an exclusion zone was set up immediately and a propping scheme was installed within 24 hours. The demolition sequence had been changed in order to group this hydro-demolition work with other areas, and therefore undertake all in a single visit by the sub-contractor.

The reporter believes the biggest lesson learnt is effective communication between parties. Within construction there is always an important interface between the permanent works designers, temporary works designers and contractor. This can be even more important when working with existing buildings where the original

design is complex, and possibly not understood fully by all parties. The permanent works designers will generally have the greatest understanding of the original structural arrangement, and the effects which alterations could have.

Effective communication and collaboration

Communication and collaboration are industry-wide issues. However, some of the steps identified which could have improved collaboration in this specific situation were:

- | focus on transfer of information between parties to ensure important information is clear
- | more frequent site visits by the permanent works designers
- | promoting open and trusting relationships throughout the supply chain.

Expert Panel comments

The reporter is to be congratulated on bringing together an important story about communication, or the lack thereof. Members of the CROSS panel all have recollections of problems from this cause and stress the need for good communication when sequential demolition is planned. Structural stability has to be maintained at all times.

The extent of the deconstruction, the location of cuts and the sequencing of cuts should be prescribed on the designer's drawings and designers need to ensure that their intentions are clear and unambiguous. Indeed, partial demolition of a structure

can be more dangerous than construction, as previous changes and underlying defects may be buried in finishes and only come to light when exposed by demolition.

In this case the desire for a single visit for the hydro-demolition subcontractor is an obvious course of action that the contractor would want to follow. The designer should have given some thought to the

Key learning outcomes

For the client and construction team:

- | Be aware that structures may have been susceptible to poor detailing and construction, as well as degradation over time which may need to be accounted for prior to demolition
- | It is good practice to discuss any changes to the construction sequence with the permanent works designer to ensure the design intent is not affected
- | Be aware that partial demolition of a structure can be more dangerous than construction, as previous changes and underlying defects may be buried in finishes and only come to light when exposed by demolition
- | It may be argued that due to the unknowns there is even more reason for the permanent works designer to be on site during this type of demolition works than for new construction

For civil and structural design engineers:

- | Consider how the design intent and construction methodology can be effectively communicated to contractors on site, particularly on high-risk complex projects
- | On projects where there is a high level of uncertainty over the design approach, consider attending site to oversee the works



IN EVERY CASE LIKE THIS THERE HAS TO BE A DESIGNER WHO WILL PLAN THE DEMOLITION SCHEME AND VERIFY THAT THE STRUCTURE IS STABLE AT EACH STAGE OF THE 'REVERSE CONSTRUCTION PROCESS'

methodology in their guidance as to the sequence of demolition. Equally the demolition contractor should have discussed this with the designer.

In general terms structural demolition is like a structural erection in reverse – with some of the following differences:

- | there will be structural loading to some extent – but maybe not precisely defined
- | there will be a degree of uncertainty about the condition of the elements
- | as with erection there will be issues of strength and stability (local and global) for each stage corresponding to the plan for the works.

In every case like this there has to be a designer who will plan the demolition scheme and verify that the structure is stable at each stage of the 'reverse construction process'. It will be essential to

convey the staged process to the site staff with clear, unambiguous information. Assuring temporary stability may require the addition of temporary works.

A difference to erection is that with erection there is reasonable certainty of material quality before the start, whereas with demolition the material quality may be questionable. Therefore, alertness and staged verification of design assumptions is prudent.

Finally, it may be argued that due to the unknowns there is even more reason for the designer to be on site during this type of demolition than for new construction.

The full report, including links to guidance mentioned, is available on the CROSS website (report ID: 855) at www.cross-safety.org/uk/safety-information/cross-safety-report/accidental-partial-demolition-beam-855.

What is CROSS?

Collaborative Reporting for Safer Structures (CROSS) helps professionals to make structures safer by publishing safety information based on the reports it receives and information in the public domain.

CROSS operates internationally in the UK, US, and Australasia. All regions cover structural safety, while CROSS-UK also covers fire safety.



How reporting to CROSS works

The secure and confidential safety reporting system allows professionals to share their experiences to help others.

Professionals can submit reports on safety issues related to buildings and other structures in the built environment. Reports typically relate to concerns, near misses or incidents. Find out more, including how to submit a safety report, at <https://bit.ly/cross-safety>. Your report will make a difference.



The Drawing Board

TheStructuralEngineer

Enter a sketch in the next competition – deadline 5 April 2024

The Drawing Board is *The Structural Engineer's* quarterly sketching competition, judged by Ron Slade FStructE of WSP.

Sketches must be:

- hand drawn (no CAD, except for 'guided free-hand')
- from a real project or assignment
- at a suitable scale for publication (i.e. not too intricate/detailed).

Please also submit a short description (150 words) to put the sketch into context.

To take part, submit your entries to: tse@istructe.org

Each published entry will receive a free single e-book from the Institution's current list of titles.

Background sketch by Kevin Lyons (Lyons O'Neill)