CROSS: Basement excavation under a semi-detached house causes collapse

This month's CROSS Safety Report highlights the importance of the relationship between the permanent works engineer, the temporary works engineer, and the contractor in basement construction, and the need for competent persons to fill these roles regardless of the size of the overall project.

Overview

During construction of a new basement, a semi-detached house suffered a significant collapse due to inadequate temporary works during excavation of the basement. The form of the underpinning may have also contributed to the collapse.

Report

A reporter says that during construction of a new basement, a semi-detached house suffered a significant collapse. The collapse was caused by inadequate temporary works during excavation of the basement. The flank wall, rear wall, internal floors and roof as well as part of the front wall all collapsed. The party wall to the adjacent property was also damaged. Fortunately, the house was not occupied at the time.

The existing walls had been underpinned with reinforced concrete walls to a similar thickness as the masonry walls over. The underpinning concrete did not, however, have any toe or other thickening at its base to spread load. The new basement had been excavated but critically no propping restraints had been put in place to any of the surrounding walls. The basement slab had not been started.

The collapse occurred following a period of heavy rainfall which may well have contributed to the failure. The removal of the overburden soil within the basement will have lessened the soil strength under the foundation, potentially allowing a slip circle to form within the clay below the underpinning. The soil failure caused the underpinned flank wall to drop and rotate significantly.

The reporter considered that the inadequate underpinning and lack of any horizontal restraint to the new basement walls prior to the new slab being constructed caused the collapse.

The party wall to the adjacent property was stabilised by the local authority.

Expert Panel comments

Basement construction is specialist work

The lateral pressure on partly constructed or completed basement walls is very significant. Groundwater and/or adjacent surcharge loadings (e.g. from a highway) can add greatly to the forces exerted on basement walls. It seems many overlook the fact that in basements, the floor(s) have an additional role to provide the horizontal propping between the basement walls. With basements, there is the dilemma of the project being stable when finished, but potentially unstable at intermediate stages. This is why basement construction is specialist high-risk work that can go catastrophically wrong and should only be undertaken by suitably qualified and experienced teams.

Basement design

The permanent works designer for a basement must indicate a viable sequence for the works and detail the basement walls and slab to allow construction in stages. This design and sequencing will be considered by the contracting team.

Basements require considerable temporary works

Temporary propping to resist ground forces is essential during basement construction. *BS 5975:2019 Code of practice for temporary works procedures and the permissible stress design of falsework* gives recommendations for temporary structures, with practical guidelines on design, specification, construction, and the use and dismantling of falsework.

Basement temporary works should be designed by a suitably qualified and experienced engineer – the Temporary Works Engineer (TWE). Furthermore, a named person must be appointed to coordinate temporary works on site

Key learning outcomes

For clients and architects:

- →| Ensure temporary works engineers as well as permanent works engineers are engaged
- →| Party wall surveyors and structural engineers may be required
- →| Basement construction is specialist work for experienced basement contractors only

For structural designers:

- →| Structural designers must consider the construction processes required to build their designs and, as far as reasonably possible, eliminate foreseeable risk
- →| Information about significant residual risks (e.g., the requirement for lateral restraint to basement walls as excavation proceeds) shall be made available to the contractor and other duty holders

For the construction team:

- →| Temporary works required for basement construction must be designed and constructed with the same degree of competence and quality as required for permanent works
- →| Basement construction is specialist work which should only be undertaken by experienced basement contractors
- →| A Temporary Works Coordinator should be appointed

> **BASEMENT CONSTRUCTION IS SPECIALIST HIGH-RISK WORK THAT CAN GO CATASTROPHICALLY WRONG**

– the Temporary Works Coordinator (TWC). This may be a dedicated person on larger sites, or the site manager or another manager on smaller sites. Both the TWE and TWC must be competent in basement construction. Regardless of project size, these roles need fulfilling.

In planning for construction, there should be discussions between the designer of the permanent works, the TWE, the TWC, the Principal Contractor and any specialist contractors to ensure that appropriate designs and sequences are in place before work starts.

The CDM Regulations 2015

It is critically important to understand that temporary works designers have the same designers' duties as permanent works designers as confirmed within the Construction (Design and Management) Regulations 2015 (CDM 2015). The regulations also require the Principal Designer to take reasonable steps to ensure cooperation between all designers, including to confirm that permanent and temporary works designs are compatible. The Principal Designer's role continues into the construction phase when design work is carried out. On a design-and-build (D&B) project it will be common for the D&B contractor to be appointed as both Principal Designer and Principal Contractor.

Basement construction guidance

Significant guidance is available (some of which is aimed at domestic-scale projects) to help all parties, including clients. The Association of Specialist Underpinning Contractors has an excellent guide on *Safe and efficient basement construction* which provides a significant body of practical guidance for clients, designers, engineers and others.

The Institution of Structural Engineers has published concise guidance in its *Temporary Works Toolkit Part 2* covering CDM 2015 and the responsibilities of permanent works designers with regard to temporary works. The Temporary Works forum has guidance including *Information Sheet No 6: The safe management of temporary works: The basics for small and medium-sized enterprises (SMEs)*.

All temporary works should strictly follow BS 5975. The Health and Safety Executive has produced a summary guide for *Domestic basement construction projects* following the principles in BS 5975:

- →| Ensure a suitably competent TWE is in place to confirm safe and secure construction processes taking account of all the forces acting.
- →| Ensure adequate information flow between permanent works designers, the TWE and contractors.
- →| Ensure the permanent works and temporary works designs are checked and complement one another.
- →| Ensure verification of correct erection of the temporary works and a TWC overseeing and monitoring the whole process.

Projects affecting party walls

Where projects impact party walls, party wall surveyors and structural engineers should ensure the design (both permanent and temporary) and construction method statements are properly reviewed.

Get appropriate expertise

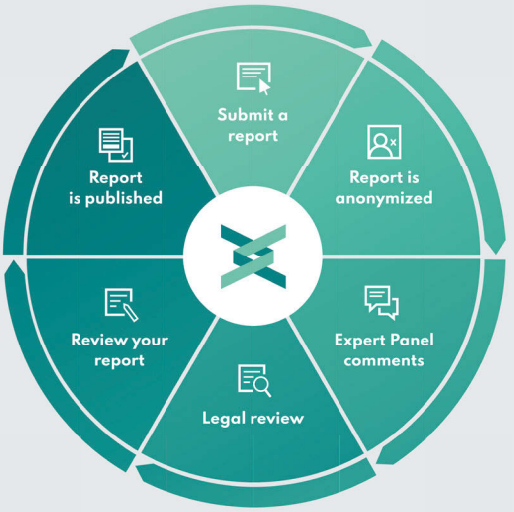
Whichever approach is followed, there should be clear evidence that appropriate temporary works expertise has been engaged and basement failures, such as reported, won't follow.

The full report, including links to guidance mentioned, is available on the CROSS website (report ID: 1063) at **www.cross-safety.org/uk/safety-information/cross-safety-report/basement-excavation-under-semi-detached-house-causes-1063/**.

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.



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