CROSS Safety Report

Unusual steelwork connection discovered during fit-out works

This month's report discusses an unusual steelwork connection found during an inspection of an existing structure.

Report

When involved with a fit-out in a high specification building, a reporter found an unusual steelwork connection during the inspection of the existing structure. The structural form was steel frame supporting composite concrete decks, with reinforced concrete (RC) core walls. When exposing the end of a main 9m long floor beam to check its connection into the RC stair core, the reporter found that an approximately 600mm deep floor beam (plate girder compositely designed with floor slab) was supported off a 203UC trimming beam. This, in turn, was supported off a single M30 bolt, and small fin plate into the RC core (see **Figure 1 and 2**).

The reporter questions how this connection came to be a) constructed, and b) signed-off and accepted?

The reporter believes the connection might be okay under the original design loading, which they assessed to be around 240kN of shear (ULS), as a single M30 bolt could potentially carry 215kN in single shear. Therefore, depending upon original loadings and design, it is not impossible for the design reaction to be within the bolt's capacity.

However, the detail is not shown on the as-built drawings and there are many other checks to consider such as the plate bending and weld capacity. Also, the reporter holds concerns about single bolt fixings in primary structural elements, even if the calculations stack up.

The reporter adds that in the example described in this report, the connection detail was observed on two floors that they were working on and a more robust remediation detail was implemented on site.

Key learning outcomes

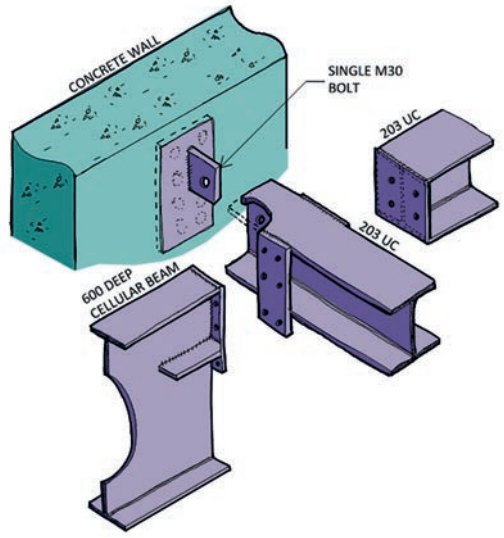
For clients, building owners/managers and the project team:

- →| Where an existing building is subject to change of use or refurbishment, it is good practice to carry out an intrusive structural inspection
- →| Be aware that historic as-built drawings may not reflect what has been built and should be supported with inspections
- →| If there is doubt, arrange for structural inspections and risk assessments to be undertaken by engineers who are suitably qualified and experienced persons – normally chartered structural engineers

For civil and structural design engineers:

- →| Connections can often be the weak link in structures and attention to detail is required, particularly at interfaces between different materials. The role of tolerances should not be overlooked
- →| Connection designs should be carried out by suitably qualified and experienced persons to ensure sufficient redundancy, longevity and compatibility

↗**FIGURE 1:** Single M30 bolt supporting beams to fin plate



↗**FIGURE 2:** 3D sketch of connection detail

> **ALL STEEL STRUCTURES ARE ONLY AS STRONG AND RELIABLE AS THEIR CONNECTIONS**

Expert Panel comments

All steel structures are only as strong and reliable as their connections. CROSS has previously stated that the weak link in any structure can often be the joints or fixings. Yet, in many ways, these are the parts that receive least attention in design.

Industry standard connections are designed in standard formats proven adequate by testing and long experience, therefore special design care is required in unusual connections because load paths and exact performance are very difficult to predict.

Single points of failure are never best practice, and many consulting engineers and steel connection designers often specify a minimum of two No. M20 bolts be adopted for each connection. Two bolts are also often required to aid with, and ensure, the safe installation of steel beams.

The reporter rightly expresses concern over the use of a single bolt, and they should be commended on not relying on as-built drawings and instead carrying out a thorough site inspection of the existing structure. The more we are encouraged to repurpose old buildings, the more we need to be aware of historic practice and the quality of as-built drawings. This report exemplifies the importance of carrying out an intrusive site inspection.

The full CROSS Safety Report, including links to guidance mentioned, is available on the CROSS website (report ID: 1244) at **www.cross-safety.org/uk/safety-information/cross-safety-report/unusual-steelwork-connection-discovered-during-fit-out-1244**.

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.

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