SID

The bigger they are, the harder they fall

Contractors have a legal duty to protect workers from the hazards of erecting steel. Designers can aid them in this, by incorporating features that minimise exposure to risk.

By increasing your awareness of the hazards associated with erecting steelwork, you can design in measures that minimise them. The hazards to consider are:

- **Temporary instability**
- **Falls from height**
- **Lifting components**
- **Handling loads**
- **Collapse of temporary works and other equipment**

This guide considers each hazard in turn.

Life outside the tick box.

Temporary instability

Steelwork is usually erected piece by piece. So at any time, there is the potential for the frame to be unstable. You can help to reduce the risk of instability by:

- **Specifying bracing between the first two bays that are erected, to form the basis of a braced erection**
- **Providing symmetrical bracing**
- **Ensuring that plan bracing connects into vertically-braced bays**
- **Paying close attention to loads on steel members during erection. Members that are especially vulnerable to temporary instability include:**
  – Long-span (slender) members
  – Floor beams, especially when they are part of a composite system. This is because flooring materials like PC panels, profiled steel forms and concrete are stored in piles, and put extra weight on a particular area of the beams
  – Roof beams, especially portal rafters, where profiled roofing assembly materials are likely to be stacked
- **Designing columns as free-standing cantilevers that are capable of withstanding short-term loads – like wind or ladder lateral forces – during erection**
- **Ensuring that the lengths of steel members needed for your design are practicable from a construction point of view**
- **Ensuring that slender members can resist the compression imposed by lifting slings**
- **Considering the loads that are likely to be generated by fall-protection equipment**
- **Designing portal and arch-type structures that can resist the lateral thrusts developed at their bases**

It is essential that you communicate the assumptions you make in your design about load allowances, and the tolerances on your structure, to the contractor. That way, they can make decisions on the basis of your calculations.

Where Mobile Elevating Work Platforms (MEWPs) are to be used in the construction phase, you should take account of their load on the partially erected structure, and specify materials that are able to withstand it. You should also ensure there is enough space around the building perimeter to accommodate them.

Falls from height

Any unprotected edge poses a fall-risk. There are two ways for a designer to help mitigate this risk:

- **By reducing the amount of time workers have to spend at height**
- **By designing in provisions for worker protection**

Reducing the amount of work completed at height
This option is the ideal for designers. Strategies that help achieve it include:

- **Taking full advantage of the opportunities posed by prefabrication**
- **Limiting the number of bolts in connections**
- **Minimising the number of components, such as purlins, in a steelwork structure**
- **Designing buildings with fewer steel members**
- **Using PC floor construction as opposed to profiled steel, which needs bolting down**
- **Providing seating cleats, pre-attached to columns, that assist erectors in making connections at height**
- **Incorporating brackets to connect steelwork to other materials, such as concrete, in the construction of those other materials. For example, brackets could be cast into the concrete, to reduce the amount of time needed to make the connection at height. This might not be an option when working on existing buildings**

Protecting workers at height
Construction workers are at greatest risk of falling from height when steel structures are ready to receive follow-on components like PC floor units, profiled steel formwork and roof assemblies. This is because the installation of such materials creates an advancing unprotected leading edge.

You should consider specifying design features that will protect workers from falling. Such features might include:

- **Parapets at the eaves that act as temporary guard rails**
- **Holes in column flanges at 2.1m above floor steel level that are capable of resisting 15kN. These provide anchorage for lanyards**
- **Anchorage points in follow-on components such as PC units and profiled steel forms**
- **Non-fragile roof assemblies, as defined by the Advisory Committee for Roof Safety (ACR) in ACR[M]001: 2000**

You should also make sure that steel members can resist the loads from the safety net anchorages and lifelines that you specify in your design. Any members that cannot bear such loads should be highlighted unambiguously in your drawings.

Wherever possible, access to the place of work at height should be by permanent staircases, which are capable of withstanding construction loads.

Lifting components

Designers can make it easier for construction workers to lift steel members, and reduce the hazards associated with this. For example, you should only specify materials that can be lifted by the size of crane that can be used on a site, given the space available.

On your drawings, state the maximum piece-weight to be lifted, as well as its location. This will enable the contractor to source an appropriate crane.

You should incorporate lifting points into steel members, and ensure that they can withstand the loads under which they will be put while being moved.

Where purlins feature in your design, you should ensure there is sufficient space for the largest component in the remaining structure to be lowered between them.

Handling loads

This hazard is especially likely to arise on a refurbishment project, where the constraints of the existing structure limit the options for use of cranes and mechanical handlers. That means workers have to manhandle steel members into place, which puts them at risk of musculoskeletal injury.

Easing handling
Design beams with splices. This enables piecemeal installation, and makes it easier to handle them in confined spaces. You should also consider replacing single-length sections with two – for example, you could specify two rolled-steel channel sections rather than a single universal beam.

Additionally, you should bear the constraints of the site in mind when specifying steelwork. If members are to be carried through corridors, for example, make sure they can be manoeuvred around corners.

When steel is to be connected to other materials, fin-type connections are likely to be easier to handle than end-plate type connections.

Erection tolerances
Bear erection tolerances in mind when detailing members for fabrication, especially when they are to be installed in an existing building. In such circumstances, a detailed survey of the building will provide the necessary accuracy for your plans.

You also need to be aware of the erection tolerances of other materials than steel, and factor these into your design.

Collapse of temporary works and other equipment

Temporary works equipment (TWE) needs to be stabilised. Designers should provide members to which TWE can be attached. For example:

- **Cladding side rails can be designed to bear the lateral loads applied when scaffold ties are attached (10kN)**
- **Eaves beams can be designed to carry the lateral loads applied when mobile towers are attached (3kN)**
- **Profiled steel forms and supporting steel beams should be designed to support the concentrated leg loads applied by a mobile tower (6kN)**
- **Ladders can apply lateral loads of up to 1kN when they are tied at the top – steel members should be designed to bear these loads**

In every case, designers should provide contractors with sufficient information to design temporary supports. This involves giving contractors a clear understanding of the assumptions made in your design about tolerances, loads and stability concepts.

Further guidance about temporary works is available in CON306 **Temporary Works**.

Plan for the future

The concern for health and safety should not end once a structure is erected. You should also design to minimise the exposure of workers to hazards while maintaining the building – perhaps by specifying low-maintenance components.

This will ensure that you continue to contribute to the minimisation of on-site risk, well into the future.

Useful resources

Safety in Erecting Structural Frames (British Standard 5531: 1988)
Health and Safety Executive Guidance Note GS 28, parts 1 – 4
Design for Construction (Steel Construction Institute Publication 178)
Erectors' Manual: A Guide to Health and Safety in Steel Erection
(BCSA publication no 16/93)
National Structural Steelwork Specification for Building Construction
(BCSA Publication no 1/89)
The BCSA is the national association for the steel construction industry.

See elsewhere on SID:

MTN501 Refurbishment
CON301 Manual handling and vibration
CON306 Temporary works
CON307 Fall prevention by design
CON302.1 Crane information