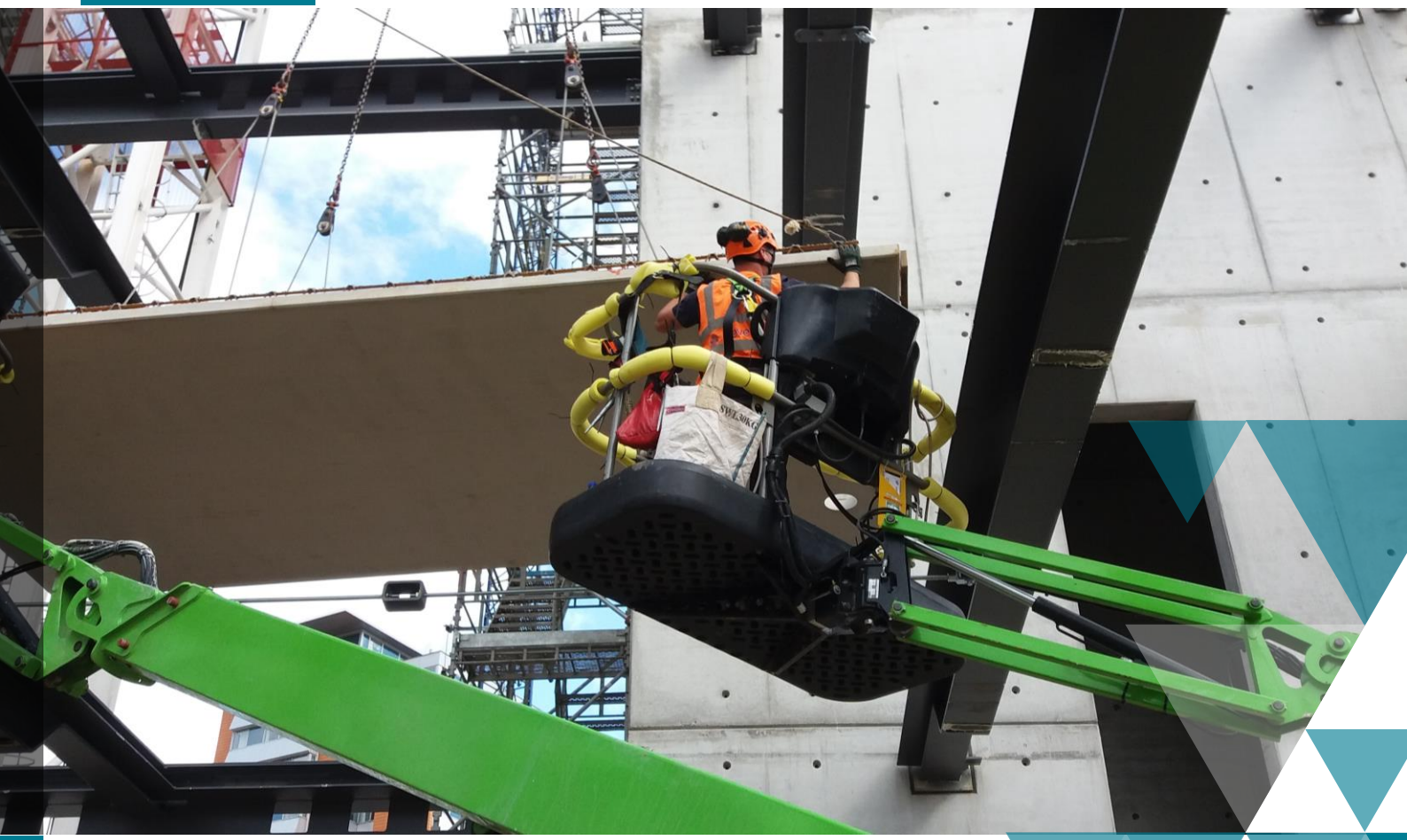

Design Risk Management

Steelwork Temporary Conditions

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Design Risk Management: Steelwork Temporary Conditions

Permanent Works Designers: Responsibilities

This briefing note acts as an extension to the ICE Design Risk Management publication. It provides guidance for designers and their responsibilities for Steelwork Temporary Conditions.

1.0 Background

The This note is based around the statutory provisions of CDM2015 (Regulation 9 – Designer duties) and authoritative associated industry guidance:

- AD 435: Beams supporting precast planks: checks in the temporary condition (1)
- SCI publication P401: Design of composite beams using precast concrete slabs in accordance with Eurocode 4 (2)

And also:

- BS5975:2019+A1:2020 Code of practice for temporary works procedures and the permissible stress design of falsework
- BS EN 1090-2:2018 Structural Steel and Aluminium

These are of direct relevance to Permanent Works and Temporary Works Designers.

- Clause 8 of BS5975 sets out requirements for Permanent Works Designers
- Clause 9.3.1 of BSEN1090 sets out requirements for Permanent Works Designers regarding the design basis for the erection method.

Further advice is also given in References 3 & 4

2.0 Introduction

It is nearly always the case when designing steelwork that more than one 'Designer' is involved.

In this situation it is imperative (and usually a statutory obligation) for clarity with regards to residual risk and further design needs.

3.0 The Designers Role

Typically, there are at least two designers:

a) Client appointed permanent works designer

b) (Steelwork) Contractor designer

The requirements set out below hold good no matter how many Designers.

a Client-Appointed Permanent Works Designer

This Designer is obligated to inform subsequent Designers[1] and/or Contractors by:

Table 1: Client appointed designers: information to subsequent Designers

	Requirement	Deliverable	Regulation
1	Providing details of significant residual risks (remembering the obligation to avoid or reduce these SFARP[2])	This would include (consistent with the developed stage of the design) information on: • members of the structure likely to be unstable in the temporary condition or • where the forces/stresses in the temporary condition are likely to be greater than in the permanent condition.	CDM Reg 9 (3)
2	Setting out a construction sequence unless it is obvious to a competent contractor	The Designer should: • provide information on the sequence of construction assumed within the design (and request information on any contractor alternative, if permitted under the contract). • highlight any key stages, or critical loadings. • consider the accommodation of likely additional loadings on the permanent works arising from the temporary works sequence assumed.	CDM Reg 9 (4) and section 8.3 of BS 5975
3	Providing clarity as to what additional permanent works design is required to complete the design, and the assumptions made, codes used and the like, on the design being	It is essential that: ▪ clarity is provided; and ▪ the assumptions stated e.g. loading, restrictions, ground conditions, movement limitations, ▪ design codes used,	CDM Reg 9 (4) and section 8.3 of BS 5975

[1] These may be permanent works or temporary works Designers.
[2] So Far As Is Reasonably Practicable. See reference 3 for the practical application of this.

	handed over.	and the like, ▪ details of temporary bracing, or other stability measures, for the assumed construction sequence, are all provided.	
4	Considering the design programme	If the likely temporary works will impact upon the permanent works, then the timeline of the entire design of the permanent and temporary works needs to have regard to likely enhancements of the permanent works to accommodate the temporary works	CDM reg 9(4)

b (Steelwork) Contractor Designer

Frequently, this will be the same company that erects the steelwork.

[*If design is involved then this Contractor must be appointed on a 'design and construct' basis].*

Although this Designer is likely to be part of the same organisation as the 'construct' arm, it is essential that Items 1 and 2, and 3 as applicable, of Table 1, are dealt with and passed on to the Contractor and relevant others in the Construction Team. This should be done in a formal manner, even though they may be colleagues from the same company. It would be expected, given the proximity (contractual and physical) of any Contractor appointed Designer and the Contractor itself, that this information transfer, and the design co-ordination generally, would occur as a matter of course. However, when this contractual proximity does not occur, clear communication lines with all the separate parties are essential.

4.0 Specific examples of where Table 1 can apply, and measures should be taken by the Permanent Works Designer.

These examples not only illustrate 'good integrated design' but also illustrate how residual risk may be eliminated or reduced.

4.1 Steel beams supporting pre-cast planks with in-situ topping to provide stability.

The beams must be designed for the temporary conditions of pre-cast and wet concrete during which restraint to lateral torsional buckling may not be provided. The Designer should either design this out, or clearly indicate the necessary temporary support needed until the topping is integrated.

The arrangement of pre-cast planks, e.g., relative spanning direction, the length of precast beam span on either side of the steel beam, the pre-cast beam installation sequence, the support arrangement for precast beams and in-situ concrete pouring sequence, may also result in torsions and torsional displacements that are unacceptable in the temporary condition but may also be 'locked-in' to the beam in the permanent condition. Edge beams in particular are vulnerable. All these detrimental aspects should be considered by the permanent works Designer and either designed out (the first option) or flagged up to alert the Contractor and any other relevant parties.

4.2 Temporary loads on foundations

The temporary loads on foundations can often be problematic. The uplifts generated in braced bays are often beyond the pile / foundation capacity, if designed only for the final condition. The Permanent Works Designer should consider if this is likely to be an issue for the suggested erection sequence and if so, identify the solution assumed in the design.

4.3 Ground floor slabs

The suggested or likely construction sequence will often require ground floor slabs to resist significant and predictable temporary shear loads from bracing systems. If this is the case, then the Permanent Works Designer should either:

- Clarify their assumption that the ground floor needs to be cast early enough to allow it to be used to transfer the horizontal loads from bracing systems, or
- Confirm that the design the pile caps and foundations have an allowable shear resistance to accommodate temporary lateral loads of xxkN, such that use of the slab is not necessary.

4.4 Free-standing Columns (flag poling)

Permanent Works Designers often complete the design of fixings into concrete, this includes the design and specification of HD bolts and base plates.

As part of this design, the Permanent Works Designer should clarify the design assumption with regard to the temporary stability of the column (when released from the crane and prior to it being tied-in to stiff structure in orthogonal directions) as described in BCSA publication 39-05 (4). The overturning BMs generated can compromise the foundations, the HD bolts and the base plates.

At the time of design, the Permanent Works Designer may not know all of the detail, e.g., column splice positions, time exposed in the temporary condition (working wind or transient), connection details adding to out of plumb BMs, base packing/wedging details etc. However a quick assessment can be carried out and or a minimum 'robustness' BM employed in their design and capacities indicated on the drawings.

This is particularly important for nominally pinned column bases that are not part of a bracing system and hence the HD bolts are not loaded in the permanent condition and serve only for location and temporary stability purposes in the temporary condition.

4.5 Edge beams supporting temporary edge protection.

During construction the Contractor is required to provide edge protection to prevent operatives and debris falling from the structure. The edge protection is normally bolted to the perimeter beam which requires adequate torsional stiffness, and sufficient strength to resist the accidental loads / wind load.

Where this situation is predicable, the Permanent Works Designer should anticipate these temporary loads and design edge beams accordingly.

Where floor slabs extend beyond the column line and small edge-trimmers are employed, the beams are often not capable of supporting the edge protection. The Permanent Works Designer should consider this scenario and either design for a bespoke edge protection scheme (providing details) or flag up the situation to the Contractor.

4.6 Long-span slender beams in temporary conditions.

The Permanent Works Designer should check slender beams in the temporary condition when they are not fully restrained by other members or by metal deck and concrete diaphragms (during lifting or in partial erection conditions). In these temporary conditions, checks must be carried out to ensure that they are capable of supporting their own weight whilst spanning without lateral restraint and that they are not at risk of significant deflections. If there is an issue, then the residual risk (of lateral buckling or deflection) should be flagged up on the drawings if it cannot reasonably be eliminated.

This is also important with long span trusses where the top (compression) chord relies on intermediate lateral restraint.

4.7 Temporary props for composite decking

Both slabs and beams within composite constructions may require propping to support the load of 'wet' concrete. The permanent works designer should clarify the assumption made with regard to temporary propping within the design and consider the potential effect of loads from propping on lower floors.

4.8 Rotation of curved floor beams?

Curved floor beams may require temporary propping until rotational loads are accommodated by the permanent slab/upstand. The permanent works designer should clarify how they have assumed the temporary instability will be accommodated.

5.0 References

1. AD 435: Beams supporting precast planks: checks in the temporary condition at AD 435: Beams supporting precast planks: checks in the temporary condition – newsteelconstruction.com (accessed 7th February 2022)
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4. ICE publication Guidance for design risk management – improving design risk management (DRM) in the construction industry. https://www.ice.org.uk/media/usuhymf3/drm-guidance-version-2-march-2020.pdf

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5. BCSA guide to steel erection in windy conditions at lo-rise book (steelconstruction.info) (accessed on 7th February 2022)
6. HSE publication L153: Managing H&S in construction

Contributors

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