CO-CONSTRUCT

Services Co-ordination with Structural Beams

Guidance for a defect-free interface

By Sally Mitchell, Martin Heywood, and Glenn Hawkins

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BSRIA

The Steel Construction Institute

What is Co-Construct?

Co-Construct is a network of five leading construction research and information organisations - Concrete Society, BSRIA, CIRIA, TRADA and SCI - who are working together to produce a single point of communication for construction professionals.

BSRIA covers all aspects of mechanical and electrical services in buildings, including heating, air conditioning, and ventilation. Its services to industry include information, collaborative research, consultancy, testing and certification. It also has a worldwide market research and intelligence group, and offers hire calibration and sale of instruments to the industry.

The **Construction Industry Research and Information Association** (CIRIA) works with the construction industry to develop and implement best practice, leading to better performance. CIRIA's independence and wide membership base makes it uniquely placed to bring together all parties with an interest in improving performance.

The Concrete Society is renowned for providing impartial information and technical reports on concrete specification and best practice. The Society operates an independent advisory service and offers networking through its regions and clubs.

The Steel Construction Institute (SCI) is an independent, international, member-based organisation with a mission to develop and promote the effective use of steel in construction. SCI promotes best practice through a wide range of training courses, publications, a members advisory service and through internet-based information resources.

TRADA provides timber information, research and consultancy for the construction industry. The fully confidential range of expert services extends from strategic planning and market analysis through to product development, technical advice, training and publications.

For more information on Co-Construct visit www.construction.co.uk.

Services Co-ordination with Structural Beams

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Introduction

The office boom of the early 1980s led to many innovations: facade engineering, myriad forms of air conditioning, and many new designs of steel structures. Trendsetting developers discovered that the choice of structural beam had a fundamental effect on the efficiency and speed of construction. By running services through holes in structural beams – and designing those beams with services distribution in mind – developers were able to reduce storey heights, increase lettable area, and save on the cost of the external envelope.

However, real reductions in capital cost only accrue from properly co-ordinated design, where the structure and services are designed in harmony, and where the policy of integration is followed through to installation. For less well co-ordinated projects, the theoretical savings can be more than wiped out by lack of detailed co-ordination. The resulting problems can only be solved through costly improvisation by site contractors.

This guide, the second in a series called Interface Engineering Publications, aims to provide guidance on the best ways to engineer the interface between structural design and services distribution. BSRIA and The Steel Construction Institute (SCI) have pooled their technical knowledge to provide structural and services engineers with consistent, interlocking advice.

The publication largely contains material repackaged from existing BSRIA and SCI guidance. Details of the original publications, relevant European and British Standards and other references for further reading are provided at the end of this publication.

Much of the guidance in this publication concentrates on the technical aspects of a well co-ordinated design. It argues that structural engineers must invite their services colleagues to take part in option analysis, to design the beam openings to cater for the favoured services systems, and to help resolve the inevitable conflicts that occur in ceiling voids. The risk from not doing so will be increased time or cost overruns during installation, largely caused by the need to adapt ductwork and pipework, and to provide additional fittings required to make services go together.

The key message is that structural design must not be carried out in isolation from the design of the building services. All parties to the design process should make it clear to the client – and the client's representatives – that savings will only be achieved if services are installed so they will perform properly, and in a manner that enables them to be maintained.

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Martin Heywood, The Steel Construction Institute

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How to use this guide

Advice about the mechanical engineering requirements of running services through structural beams will be found in blue-tinted boxes. Comments marked by ■ link to structural sections listed under *see also*. Comments marked by ■ denote a link common to both specialisms.

Advice about the structural requirements of running services through structural beams will be found in yellow-tinted boxes. Comments marked by ■ link to mechanical engineering sections listed under *see also*. Comments marked by ■ denote a link common to both specialisms.

Key mechanical watchpoints

☐ Essential mechanical engineering messages from the guide

Key structural watchpoints

☐ Essential structural messages from the guide

See also

1 **Links** to m&e sections
2 **Links** to structural sections
3 **Links** common to both sections

Standards for structural and m&e design

Further reading to support this guide

Glossary for terms and definitions

Early design decisions

Building structure is often designed between the client, the architect and the structural engineer, but the services engineer also has a key role to play. If savings in construction materials and installation cost are to be achieved, along with a well integrated services installation, then the structural engineer must obtain guidance from the building services engineer on the dimensional nature of the proposed services design, and the preferred routes of those services.

First steps in design

Early on in the design of a building, the structural engineer and architect have to make important decisions regarding the layout of the structural frame. Although the total cost of the structural steelwork in a typical commercial building is less than 10% of the total capital cost, these decisions can have a significant effect on building whole-life cost.

The design of the steel frame should be considered as part of the overall building design. When selecting a beam and column layout, the structural engineer needs to take account of the present and future requirements for unobstructed floor space, the type of floor system to be used, the effect of the structural layout on the overall building height, the proposed layout of the building services, and the level of flexibility required, such as cutting additional services risers.

Beam span and layout

The structural engineer should aim for long span solutions in order to minimise the number of columns and maximise the unobstructed floor space. This provides flexibility for the design of the internal layout and allows for future changes of use.

The exact span between the columns should be selected to suit the architectural grid, so that the locations of the structural members coincide with the spacing of the partitions, ceilings and, in some cases, fixed items of furniture. The architectural grid typically has intervals of 0·6 m, in which case suitable beam spans would be 3·6 m, 6·0 m, 7·2 m, 9·0 m etc.

Having decided on the column locations, the structural engineer must then decide on the arrangement of primary and secondary beams to transfer the loads from the floor to the columns (figure 1).

The use of secondary beams is often necessary because the spacing of the columns usually exceeds the maximum span of the floor decking units.

	Mechanical engineering issues
	Structural issues

Storey height

It is often advantageous to reduce storey height in order to minimise the cost of the cladding, or to comply with planning restrictions on the overall height of the building. This requires the careful selection of beam members and consideration of services integration into the structure.

2 If the beams are arranged such that the secondary beams span further than the primary beams (figure 1), it is sometimes possible to use primary and secondary beams of a similar depth. This approach minimises the depth of the steelwork, but might prevent the services from being passed through the beam webs, resulting in a need for a separate services zone beneath the beams.

If a beam layout is chosen that requires deep primary beams and shallow secondary beams, the depth of the steelwork will be greater, but it should be possible to pass services through the webs of the primary beams and under the secondary beams. The minimum storey height does not therefore always correspond to the minimum beam depth.

Integrating the building services

The services engineer has the choice of passing the services beneath the beams in a separate services zone, or locating them within the depth of the beams. It is essential that the building services engineer and structural engineer discuss the options early on in the design process and work closely to arrive at the best integrated solution.

3 If it is decided to pass the services through the beam webs, the services engineer must provide data on the number, size and spacing of the required holes so that the beams can be fabricated accordingly. Failure to do so could lead to expensive alterations on site.

Key structural watchpoints

- ☐ Although the total cost of the structural steelwork in a typical commercial building is less than 10% of the total capital cost of the building. The structural engineer can have a significant effect on the whole-life cost of the building
- ☐ Explain to the client that savings in installation time and cost will accrue from the structural and services engineers working together in an integrated approach
- ☐ Savings will accrue from matching the size and shape of the beam openings to the dimensional and performance requirements of the building services; standardisation should be a priority

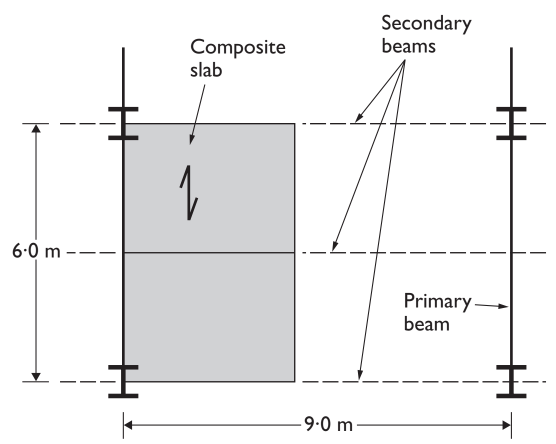

Figure 1: A typical layout for primary and secondary beams. ©The Steel Construction Institute (SCI). See also Figure 11, page 16.

See also

1 Services Detailed Design, page 16
2 Table 1, page 11
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