

# STRUCTURAL DESIGN

## An Overview



**Structural design is the methodical investigation of the stability, strength and rigidity of structures. The basic objective in structural analysis and design is to produce a structure capable of resisting all reasonably feasible applied loads without failure during its design life.**

### **Basis of structural design**

Structural analysis and design calculations are carried out in accordance with British and European Standards and Codes of Practice.

Typically these would be:

British Standards

BS6399	Loadings for Buildings
BS5950	Structural use of steelwork in building
BS8110	Structural use of concrete
BS5628	Code of practice for the use of masonry
BS5268	Structural use of timber
BS8002	Earth retaining structures
BS8004	Foundations



#### European Standards

BS EN1991	Actions on structures
BS EN1992	Design of concrete structures
BS EN1993	Design of steel structures
BS EN1994	Design of composite steel and concrete structures
BS EN1995	Design of timber structures
BS EN1996	Design of masonry structures
BS EN1997	Geotechnical design

### **What is generally included in our designs**

Structural calculations for the items agreed in our quotation or confirmation.

A layout drawing showing the general location of any beams, padstones, piers, columns and foundations.

The section size, width and depth of structural members.

Details of beam to beam connections, beam to column connections where required or the loads at steel connections to allow the fabricator to design the connections.

We will consider elements of structure covered by building regulations Approved Document A – Structure which included within the services listed on our quotation.

We produce details on CAD and require a copy of the architectural drawings in dwg or dxf format for us to overlay our information.



## What is generally excluded

Setting out dimensions and lengths of members for fabrication or manufacture.

Dealing with party wall matters or agreeing position of party walls or boundaries.

Design of staircase, handrails and barriers unless specifically included in the scope of work agreed.

Design of precast concrete, roof trusses, glass structures or items of specialist manufacture.

Detailing and design of piled or reinforced foundations. If no site-specific ground investigation is provided then an assumed bearing pressure will be used and will need to be confirmed when construction starts on site.

Dimensional survey of the site or existing building. Where architectural drawings or other information is provided dimensions will be taken from them or scaled from.

Temporary works design. The design of temporary supports to allow the permanent works to be installed is normally carried out by the contractor. We can carry this out if requested and agreed separately to the design of the permanent works.

## Existing Buildings and Structures

Extending or altering existing buildings and structures has unique challenges. The most significant of these challenges is obtaining information on the existing structural elements and working with older materials and construction techniques. For a new structural design to be carried out details of the existing structure need to be obtained or assumptions made.

Any assumptions made need to be confirmed during the construction phase to ensure that the design is valid. The ideal situation would be for all the structure to be exposed for checking and, where appropriate, testing before any design work begins. This is not always practical dependent upon occupation, ownership and timescales. In most instances, full exposure of the structure is not feasible and therefore varying levels of investigation can be carried out to assess the existing structure.

Level 1 – A visual inspection with measurements of elements of structure which are available and a check on span of floors, roof and beams that are exposed. If sufficient information can be obtained a design can be carried out based on the



information obtained from similar buildings or structure types and historical data. This type of assessment will require any assumptions made to be confirmed once the structure is exposed and any adjustments made.

The client should allow for cost variations to the construction work because of anything which is uncovered. There is also the possibility of unexpected elements such as flues or unusual structures which could not have reasonably been foreseen.

Level 2 – Partial removal of finishes to expose the structure. Carried out at critical locations to establish which walls are load bearing or locate columns, beams or check floor spans. This would be directed by the engineer based upon what structural form is expected from an initial visual inspection and any drawings of the existing structure. This may include trail holes to expose existing foundations and check foundation bearing strata dependent upon the extent and nature of proposed works. This type of investigation reduces the number of unknown factors which affect the design but there is still the possibility of unexpected elements being uncovered during the construction phase.

Level 3 – Complete removal of finishes to expose existing structure with testing and investigations as deemed appropriate by the engineer. This type of investigation reduces the number of unknowns to a minimum and therefore provides the greatest cost certainty during construction.

## **Asbestos**

Any building constructed before the year 2000 has the potential to contain asbestos. It is important to assess the risk of asbestos containing material (ACM's) to be identified if it is likely to be disturbed during any building works. The identification and removal of ACM must be carried out by a licensed contractor. If any ACM's are encountered or suspected during the works then work in that area must stop until the material is tested and identified. It is an offence for ACM's to be removed by a non-licensed contractor or to allow people to be exposed to asbestos fibres.

## **Site Visits and Inspections**

If we are requested to make inspections of the work during construction it is important that these are carried out at the correct times. This will allow us to see the structural elements at or close to final stage and before they are covered up. For example, a reinforcement in slabs or walls should be inspected when set up but prior to concreting or when beams are installed in their final position but before covering in finishes. The same would apply to foundations where the bearing strata should be inspected before pouring concrete. We rely on the contractor or client to advise us



of progress on site so that inspections can be made at the correct time. Building Control also need to be advised so that they can make their inspections.

## **CDM Regulations**

Any building works carried out need to comply with health and safety regulations. This is covered by the Health and Safety at Work Act 1974 and CDM Regulations 2015. Certain types and duration of work must be notified to the Health and Safety Executive. For small works compliance can be achieved by appointing a principal contractor who will be responsible for ensuring that the works are carried out safely. It is important that the contractor is aware of and appointed for this role in addition to carrying out the works.

For medium and larger projects, demolition and high-risk activities it is necessary for the client to appoint a principal designer and a principal contractor. Under the legislation it is the client's responsibility to assess that the persons employed are suitable for the project in relation to them being carried out in a safe manner.

## **Building Regulations**

Any structural alteration carried out requires building regulations approval. This includes rebuilding a wall to a building or underpinning works. This approval can be obtained by submitting details of the work to be carried out the local authority or by using approved inspectors. There is a list of inspectors approved by the government who can carry out the function of building control.

For small works e.g., domestic extensions or internal alterations works can be done by submitting a building notice to the local authority. This allows work to proceed in a shorter timescale, albeit at the client's risk. The same information is required by the checking authority for a building notice but they will make the necessary inspections.

Other types of work may require building regulations approval if alterations affect fire regulations, thermal insulation or ventilation. Examples are changes to internal layouts which affect means of escape, replacement of windows (unless using a FENSA contractor), electrical installations or alterations. The advice of an architect, surveyor or enquiry with the local authority is recommended if you are carrying out alterations and wish to check whether building regulations apply.

Alterations externally usually require planning permission, with certain exemptions, and any changes to listed building will require listed building consent. If in doubt check with an architect or with your local authority.