The case for steel

The advantages of choosing steel-framed construction are appreciated by clients, contractors and designers. This advice note sets out the key benefits of steelwork which will be important when choosing the structural solution.

Sustainability credentials

Sustainability is a large topic and includes consideration of stable, factory-based production, social issues, transport and deliveries to site, waste and noise. These are important benefits when choosing steel framed construction.

Steel may be continually recycled without loss of properties. It is not simply downgraded and used as fill, for example, but has a value at the end of the life of a structure. In the UK 94% of steel construction products are reused or re-cycled.

Some steel frames are already re-used, adding little or nothing to the carbon footprint. Re-use of steel structures is simplified and facilitated by the component nature of steel frames.

Fewer site deliveries, the option of timing those deliveries and a shorter construction programme for the frame are significant environmental benefits. Furthermore, construction is dry, dust free and relatively quiet further reducing the impact of construction on the environment and local communities.

Studies show that only a modest thermal mass need be exposed to cater for daily temperature cycles. Around 100mm of composite slab is sufficient for this purpose, without considering the contribution from other elements such as infill walls.

The steel sector has a sustainability charter which sets down a coherent strategy of prioritised sustainability development objectives. To be awarded the charter companies must demonstrate their commitment to a wide range of sustainability practices and submit to an annual independent review of their commitment to the charter.

Floor vibrations

Vibrations need checking for all forms of construction – and can be an important design issue in any floor. Steelwork solutions have been tested, calibrated against predictive methods, and can be designed with confidence. Orthodox floors for normal usages do not need modification, but floors in particularly sensitive environments such as hospital operating theatres will usually need attention.

Research studies have showed that the steel solution for sensitive environments was lighter than the concrete equivalent – with the further implication that concrete solutions for ordinary offices can be conservative. The weight advantage that favours steel can be particularly important, leading to smaller and less involved foundations.

Fire resistance

Steel's behaviour in fire has been thoroughly researched, with a range of unprotected solutions, and well-developed protection systems available.

Other materials often rely on site quality control to ensure the resistance is as expected. This has obvious risks compared to the assurance of off-site, factory controlled systems such as intumescent coatings, or simple to verify site-applied protection.

Quality

Steel from Corus (such as Advance sections) is already CE marked, giving reassurance that the steel is in accordance with the appropriate standard. Following the publication of the harmonised standard, EN 1090-1, it is anticipated that CE marking of fabricated steelwork will commence in 2008. The off-site, factory production conditions and the largely numerically controlled fabrication systems ensures that steel is accurately fabricated and can be safely erected without modification on site. The completed structure is full strength, precise, and independent of the vagaries of site practice.

Tolerances of fabricated and erected steelwork are given in the National Specification for Structural Steelwork (NSSS). This helpful guide (all offices should have a copy) sets out what can be reasonably expected. More onerous limits may be specified if required, and these may be achieved by building in provision for adjustment. The NSSS is recommended reading, not only for tolerance limits.

Health and safety

Designers are obliged to consider health and safety in construction, maintenance and demolition. The discharging of these responsibilities is made easier knowing that steelwork contractors are experienced and competent specialists. The constructional steelwork sector operates a registration scheme for steelwork contractors – the Register of Qualified Steelwork Contractors (RQSC). All steelwork contractors within this scheme are classified according to the type of work they are competent to undertake, and the size of contract that can be safely resourced and managed. Registered companies are regularly audited against a range of criteria covering all aspects of their operations. The RQSC ensures that steelwork contractors may be selected who have the skills to suit a particular project.

Steelwork contractors are specialists in a single discipline, highly experienced in the design, fabrication and erection of steel framed structures. Site erection teams are specialists, and obliged to hold recognised qualifications.

Structural solutions

Shallow floor beams can be rolled or fabricated, which when used with composite decking or precast planks can offer a solution as shallow as 200mm.

Often, floors are serviced, and the services can be conveniently integrated with the structure, offering a slim construction depth overall. A significant advantage of an integrated steel solution is the opportunity to provide long spans without penalty in the construction depth. Long spans and column-free floors are a considerable benefit, allowing for the future flexibility which is certain to be required within the life of the structure.

More significant changes to the structure can be readily accommodated. It is not unusual to extend steel structures, horizontally or vertically, add additional storeys or change the building envelope. The light weight of a steel structure and the ease with which modifications can be made increase the future-proofing of the design.

The additional sections introduced to the Advance range in 2007 extend the opportunity to use shallow beams and small columns within structures, increasing spans yet maintaining only modest structural profiles. Small column profiles can be particularly beneficial, increasing the usable (and lettable) area of the floors. Small column profiles may be hidden in internal walls.

Economics

Independent studies, undertaken by impartial designers, contractors and cost consultants continue to demonstrate that overall, steel solutions make economic sense. Comparisons should be carefully studied, as a steel solution would not necessarily mirror the scheme in an alternative material. Longer spans and smaller foundations would be typical features of a steel solution to be contrasted with any alternative.

Acoustics

A whole range of steel details have been tested, and demonstrated to perform in accordance with the Building Regulations. Whatever material is chosen for the structure, careful detailing is required at junctions of walls and floors

Some traditional solutions, such as blockwork infill walls, are now less appropriate. Steel infill walls are narrower than the equivalent (if acoustic insulation is required) and are significantly lighter.

Key Points

1. Steelwork has excellent environmental credentials – with almost all steel construction products reused or re-cycled.
2. Long span lightweight solutions offer internal flexibility, smaller foundations and the opportunity for future adaption.
3. Use the NSSS, which provides a testing regime and acceptance criteria
4. RQSC registered companies are classified for the type and size of work they are competent to undertake
5. Shallow floor solutions can be achieved with steelwork, and integration of services leads to low overall construction depths
6. Floor vibrations should not be an issue for orthodox floors. Sensitive floors such as hospital operating theatres will need attention, but comprehensive guidance is available.

1. National Structural Steelwork Specification, Available from BCSA and SCI

2. 'The Merits of Structural Steelwork' http://www.steelconstruct.com/publications/Merits_Booklet_2002.pdf

3. Design for construction Available from SCI

4. Comparative structure cost of modern commercial buildings. Available from SCI