

# Cast ahead

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## Concrete manufactured off-site can be a reliable means of ensuring the strength and resilience of construction projects, argues Elaine Toogood

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The versatility of form and resilience of concrete means that its potential applications in the built environment are virtually unlimited, ranging from pipes and tunnels, bridges and roads, building structures and cladding to street paving and furniture.

The use of concrete in off-site manufacture is similarly wide-ranging and well established as a form of construction in the UK. It ranges from factories with considerable capacity for reproduction at scale to smaller workshops, using processes as different as highly automated digital production and very skilled manual work.

### Precast products

Precast concrete products can be categorised as being from one of the 3 following sources:

- off-the-shelf components with predetermined dimensions and performance qualities;
- standard, repeatable elements whose dimensions and composition can be customised to meet project requirements, within given design parameters;
- completely bespoke elements with unique shapes, dimensions and qualities to suit specific project requirements.

The majority of concrete that is used in the UK has also been manufactured in the UK using locally sourced materials. The traceability of materials and stewardship of manufacture underpins a robust and responsible local supply chain. Around 90% of all concrete in the UK has been certified to the highest standard of responsible sourcing certification [BES 6001](#), according to the [Summary of Concrete Performance Indicators](#) produced by [MPA The Concrete Centre](#).

### Hidden strengths

The use of prefabricated concrete is not always obvious in a completed building, as structural walls and floors are often hidden behind plasterboard wall linings or suspended ceilings. The growing understanding of concrete's thermal mass as part of a low-energy servicing strategy has, however, led to a resurgence in exposed structural and precast concrete on the inside of buildings, though the outside of buildings with concrete cladding may still go unrecognised as concrete at all.

Architectural precast concrete is more readily perceived to be made of stone than concrete by most people. Commonly referred to as 'reconstituted stone' or 'recon', it can be created in a range of colours, textures and forms, with the concrete itself often hidden behind an embedded surface layer of brick or stone.

Prefabricated external wall panels of concrete can also be supplied with rigid insulation fixed to the rear, or placed between 2 layers of concrete to create a sandwich panel. The 2 concrete layers making up the panel are secured together mechanically with low-conductivity wall ties. The panels can be designed to be load-bearing, with the inner layer taking the loadings from the floor and structure, or non-load-bearing.

The external layer of a concrete cladding panel can act as a weather barrier and architectural finish but also contributes to airtightness. Non-load-bearing cladding panels, which usually have a single skin, can either be stacked to a height of around 8 storeys or else supported by the main frame of the structure.

## **Cross to bear**

The location and design of the fixings for elements is key in any form of off-site construction. Using concrete offers the benefits of knowledge and experience built up over decades of use, compared to more recently developed alternatives. The standards and codes governing its manufacture and assembly are similarly well established, having evolved through real-time trials and testing.

Crosswall construction, for example, is a well-established off-site construction product that can be manufactured to project requirements. It involves a series of solid, reinforced-concrete load-bearing walls to create the cellular structural frame, which has been effectively used for residential buildings such as hotels, student accommodation and prisons.

Units are connected by a series of hidden joints and ties in each panel that are grouted in place as the work progresses. All units have built-in inspection points for the ties and grouting, thereby embedding quality control into the assembly of the system.

Some of the other advantages of using concrete manufactured off site relate to the performance characteristics of the material itself, such as its fire resistance, sound insulation, thermal mass, durability and water resilience; all of these offer benefits during construction, and beyond it, throughout the life of a structure.

## **Resistance is useful**

Take concrete's resistance to water as an example. Precast concrete is robust enough to be supplied to a construction site according to the principles of just-in-time delivery, without the need for extensive packaging to protect it from the weather or accidents during transit.

The risk of damage from rain or standing water is also avoided throughout the build process, reducing the need for temporary weather protection while providing opportunities for robust, safe working platforms and stairs early on in construction. Since concrete retains its structural integrity in waterlogged conditions, the risk of damage from slow leaking taps or flooding during occupation is also removed.

Fire resistance is another major benefit. Fire safety during construction is not covered by [the Building Regulations](#) ; however, [the Health and Safety Executive \(HSE\) advises](#) that designers have a duty of care to reduce risk through design. Choosing a non-combustible structure avoids the need for additional work and materials to reduce fire risk on site.

The detailing to meet the fire performance requirements of the finished building is also arguably far simpler than it is for other combustible materials, not just in terms of design but

also installation and maintenance. Concrete construction often exceeds minimum performance requirements as well.

A concrete load-bearing wall in a building up to 10 storeys high, for example, may have to fulfil the requirements for structural fire resistance class REI 90; that is, ensure its integrity and load-bearing and insulation capacities for 90 minutes in the event of fire. Given that this entails 140mm-thick concrete walls, a typical 150mm-thick precast wall for cross-wall construction meets this need even before any internal linings are added.

Not having to rely on such additional linings to fulfil minimum fire performance standards has clear benefits, both immediately and in the long term. Any breaches of the lining to recess services are risk-free, then, while the chance of compromising designed fire performance in future with alterations to the building fabric during occupation is significantly reduced. For example, recessing a TV screen into the plasterboard lining of a concrete wall has far fewer potential consequences than if the wall itself is made of combustible material.

## **The Landsdowne**

The structure of the Landsdowne, a new 17-storey residential building in Birmingham, was assembled using a precast concrete frame and floor planks (see Figure 1). The external walls are insulated concrete sandwich panels, with an outer layer of concrete cast to embed a layer of facing brick slips. Several full-size mock-up panels were constructed in the factory ahead of manufacture to help with the design development and approvals. The prefabricated panels removed the need for scaffolding and minimised the health and safety risk for people working at height.



**Figure 1: Construction of the Landsdowne, Birmingham**

Prefabricated architectural balconies are a good example of the simplicity and performance of concrete that is precast off site. They can be manufactured with a good surface finish to all exposed sides, of a bespoke colour, texture and form to suit the specific aesthetic requirements for a building and its location.

Inherent robustness, fire and weather resistance and a thermal break at the point of connection to the main structure together enable the balconies to be installed without additional insulation and linings, saving time and money on this process as well as on long-term maintenance. The use of fewer materials simplifies the details, improving the speed of construction and reducing the risk of mistakes at interfaces and junctions.

## Full factory service

The coordination and assembly of materials in the factory rather than on site is often heralded as one of the major benefits of any off-site method of construction, especially in relation to services installation. Concrete is no different in this regard, offering the opportunity for cast-in conduits, fully glazed windows and so on. The flat soffits, a characteristic of many precast flooring systems, also offer robust and simple installation of services.

It is essential to seek the expertise of a precast concrete manufacturer or supplier early in the design process in order to optimise the design for off-site manufacture. Many offer a full design service as well as providing technical support; likewise, many also use building information modelling as part of the design and manufacturing process, which enables early detection of clashes.

There are clear benefits to embedding manufacturing and construction efficiencies in design development, particularly in terms of element size, opportunities for repetition, and standardising components and details.

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## Further information

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