



Architectural Cladding Association

Sustainability and precast concrete cladding



| a guide for clients, contractors and designers

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This publication is dedicated to the memory of Mike Downing, long-standing Chairman of the Architectural Cladding Association and one of very few recipients of the British Precast Lifetime Contribution Award. Mike was much respected for his enthusiasm for architectural cladding, structural precast and good engineering and architecture; he was a keen advocate for sustainable construction.

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Front cover image
1 Coleman Street, London

Introduction

Sustainability is an increasingly important issue in today's construction projects, whatever definition one chooses to use, whether the focus is on the 'triple bottom line' (environmental, social and economic issues) or simply environmental protection. As a result, the UK construction industry and its customers now have higher expectations. For example, specifiers and designers are asking for greater clarity about environmental credentials, clients expect supply chains to be using responsible sourcing standards and others want to know how to achieve 'zero carbon' buildings.

Today's construction product manufacturers are responding to these calls and, in many instances, the precast concrete industry is leading the way by innovating in sustainable design, manufacture and construction. 'More from Less' is an entirely appropriate motto for an industry moving towards more energy efficient, resource efficient, socially responsible and environmentally friendly ways of operating.

Within the £2.3bn UK precast concrete sector, cladding is an excellent example of a building product that is made in a safe manufacturing environment, using predominantly abundant materials and locally available labour, and which contributes to energy efficient, healthy and long-lasting buildings.

The term precast cladding describes a range of concrete products used to enclose a building; it includes loadbearing, structural panels and non-loadbearing elements, such as cills. Cladding elements are made off-site either using a concrete mix that mimics natural stone or concrete that is faced with another material, such as stone, terracotta or bricks. Precast concrete cladding dates back to the early 1900s and is well-established in Europe and elsewhere.

In the UK, the major precast cladding manufacturers are members of The Architectural Cladding Association (ACA), based in Leicester. The ACA has produced this guide to help designers, specifiers, clients and contractors understand the sustainability benefits that can be gained from specifying and using precast cladding.

The following sections of the guide cover all the important stages in the development of a building, from design to performance in use, showing how precast cladding has significant environmental, social, and economic advantages to offer. Examples of good practice are given throughout.

Further questions or feedback on this publication are welcome: ACA contact details are given on the back cover.



Precast cladding panels need no packaging and so reduce transport costs



This reconstructed stone and sandstone façade at Paternoster Square already incorporates glazing, reducing on-site operations

Sustainable performance in use

The most important aspect of any discussion about the sustainability of buildings must be the actual performance of a completed building during its life. This encompasses a broad range of issues such as energy use, water consumption, maintenance cycles, fitness for purpose and even fire safety. It is vitally important to approach the design of sustainable buildings with their whole life performance in mind – a short-term attitude simply will not deliver on long-term sustainability objectives. Buildings should be robust, energy efficient, healthy and comfortable for their occupants, whether for commercial, domestic or industrial uses.

Long life, loose fit

It is critical that buildings are designed with their future in mind so that they can offer outstanding performance standards in use and even outlast their intended service life. They should be long-lasting and adaptable to change, where needed – this is called 'long life, loose fit' and it is a term that is well-matched to precast concrete cladding which provides a long-lasting enclosure to a building without restricting future adaptation inside. In fact, where desirable, concrete cladding panels can be removed safely (deconstructed) and re-installed after works to extend the footprint of a building. This is very resource-efficient and reduces unnecessary waste from refurbishment projects.

Furthermore, the proven durability and low maintenance credentials of this type of construction are evidenced in the number of early 20th Century precast clad buildings in existence today, many of which still look brand new. The high quality surface finishes achieved in the factory will remain an extremely robust face to the weather for many decades, even hundreds of years, and are therefore easy to maintain.

The typical 60+ years design life reduces the frequency of maintenance cycles and also lessens costs and inconvenience for the owner. In addition, where pollution is a particular problem, manufacturers can provide surface finishes and coatings that will help prevent the build up of dirt from exhaust fumes. These photocatalytic treatments to cladding panels help keep façades clean; the nano-particles simply do not allow dirt particles to stick to the surface and they are washed away by rain.

Life safety and resilience

Precast concrete increases its strength for many years after it is cast, but even immediately after installation it is durable and robust and resists rain penetration, wind-blown debris and in some cases, blasts and chemical attack. The fire resistance properties of concrete are also important. Precast concrete cladding does not catch fire, burn, melt, or drop molten particles and can prevent the spread of fire – usually only minor repairs are required to make good after a fire.



The precast concrete on the Brighton Aquarium building dates from the 1920s



This innovative office building has self-cleaning precast cladding to prevent dirt build-up on the façade

Moving towards zero carbon

Specifiers are frequently asking about the carbon footprints of building products, but it is definitely more important to remember the life time carbon footprint of a building; that is the more significant sustainability issue, in most cases, by an order of magnitude. About 90% of a building's environmental impacts will arise during its operation or use, much of which is from the energy used for heating, lighting and, in some cases, cooling of the spaces inside.

By contrast, just 10% of impacts arise from the manufacture and construction of the building's structure. This is another very good reason to think long term about buildings and to not simply focus on capital costs. In the precast factory, energy consumption can be as low as 150 – 200 MJ /tonne of product, and normally batching and mixing processes add no more than 3 – 5 kg CO₂e /tonne of finished product. Using fly ash and ggbs will reduce carbon emissions even further.

Research has shown that concrete buildings can pay back their initial carbon 'investment' in just over 10 years, and then continue to provide savings by having an in-built ability to moderate extremes of temperature, particularly during the summer months. Essentially, the use of precast concrete cladding in a building contributes to its thermal mass which helps to even out daily and

seasonal temperature swings, making indoor spaces more comfortable without having to resort to air conditioning. This saves energy and money in the long term and, in the short term, saves on capital investment and maintenance bills for air conditioning plant.

That said, in the UK and any country with a lengthy winter season, certain levels of insulation must also be provided in the building envelope to ensure that heat is not lost through the façade. There is no problem in combining precast concrete cladding with insulation products either in the factory, or on site.

Precast concrete insulated sandwich cladding panels offer a very efficient and practical solution, achieving a U value of 0.25 W/m²K or better. Insulation sits within two precast concrete layers; the external leaf provides protection against the elements and the internal layer provides thermal mass 'in the right place', i.e. facing internal heat sources such as people and computers. The vulnerable insulation layer is thus protected effectively and the building envelope is doing all that can be asked of it by moderating extremes, whether these arise from cold winter temperatures or internal heat gains. The occupants remain comfortable and the building owner saves energy and money. What's more, precast concrete is inert, so it doesn't give off any gases, toxic compounds or volatile organic compounds in use.

Research has shown that concrete buildings can pay back their initial carbon 'investment' in just over 10 years



Installing insulation in a sandwich cladding panel



Incorporating many sustainable features, this precast concrete building is the HQ for Thames Water in Reading

Planning for a sustainable project

The importance of thinking long-term about sustainability in buildings is well-known, but there are, of course, practical challenges in achieving this. For instance, the building project team may be under time and cost pressures or be unsure about a client's needs. Indeed, the early stages of a building project can be particularly fraught or problematic. However, decisions made at that time can affect not only the build programme, but also long-term building performance, so it is important to get them right.

It is for these reasons that teams trying to address sustainability from the outset need help to ensure that their decisions and subsequent actions do produce the intended results in practice. The early appointment of a precast cladding manufacturer can pay dividends because they will bring expertise, experience and insight to the process.

This section describes the benefits of planning for a sustainable building by working with a manufacturer as early as possible to best deliver specific project sustainability objectives, such as:

- Low energy consumption in use
- Minimal transport emissions
- Minimal water use on site
- Delivering ongoing training for workers
- Use of environmental management standards
- Use of responsible sourcing standards

Confidence built-in

Selecting precast cladding early in a project's development provides a much better chance of achieving key sustainability objectives (such as those for energy use, resource efficiency, waste management and transport emissions). Early discussions between the project team and the manufacturer enable good practice to be designed in; this builds confidence, is much more cost effective than trying to do so later and ensures that opportunities are not missed as the project progresses.

Manufacturing members of the Architectural Cladding Association regularly get involved in project discussions (typically from RIBA Stage B onwards). They are accustomed to explaining to designers and clients how they can get the best out of precast cladding products, for example, by utilising the benefits of an efficient factory environment and the performance attributes of the material. This might include presentations or a factory visit, for example to see environmental management systems at work, and perhaps a visit to a completed cladding project, to hear about the precast advantage first-hand. In any case, the approachability of the precast cladding manufacturers will make this a helpful and constructive dialogue.



Early appointment of a precast cladding manufacturer can pay dividends



A site visit helps clients and architects see what can be achieved with precast

Sustainability management

Many of the good practices that precast cladding manufacturers put into place every day can be seen on pages 8 - 11 of this guide, ranging from efficient use of raw materials to water conservation strategies.

That said, overarching these practical aspects are the management systems and procedures that are used to ensure that precast factories are exemplars of good practice in the way that sustainability is managed, for example, through good environmental and health and safety practices. ACA member companies are easily able to demonstrate their achievements in these areas via quality and environmental procedures, such as BS EN ISO 9001 and BS EN ISO 14001. The formation of third-party accredited systems like these enable manufacturers to provide robust evidence of their procedures, both in the factory and administratively. Clients can thus be clear that precast cladding companies go 'beyond compliance' and are demonstrating effective product stewardship.

For example, working with The Carbon Trust, one company has put into place several new energy reduction initiatives including additional insulation to the factory envelope, new heating controls and better use of daylighting to save lighting energy. Ongoing monitoring systems are now in place and lessons learned have been applied in a new manufacturing facility.

In addition, manufacturers have sustainability policies in place and are contributing to the development of sector sustainability initiatives in the broader concrete industry. An effective exchange of ideas and knowledge transfer is well-established in the precast industry, principally via British Precast – this allows best practices to be shared between companies, regardless of the product being manufactured. An example of this is the annual collection of industry sustainability statistics, using Key Performance Indicators (KPIs), to which ACA cladding manufacturers submit data on critical environmental, social and economic issues. This is an important way in which progress is measured and communicated (more information can be found at www.britishprecast.org).

All ACA member companies are signatories to a successful BPCF Health & Safety scheme known as Concrete Targets 2010. The H&S performance of the precast concrete sector has improved considerably with the numbers of accidents reported in the sector falling by 65% in the period between 2000 and 2007.

ACA members also contribute to the work of national trade bodies such as British Precast, The Concrete Society and the Glass Reinforced Concrete Association. Some are signatories to the British Precast Sustainability Charter, which engenders commitment from companies to a set of sustainability principles against which they will be audited. They are also members of specialist training and advice organisations, such as the Confederation of Construction Specialists, Proskills and the Engineering Employers Federation.

Precast cladding companies go 'beyond compliance' and are demonstrating effective product stewardship



The British Precast Sustainability Charter



Members of the ACA take part in industry initiatives, such as the British Precast Sustainability Charter

Designing responsibly

In practical terms, project teams will often need to liaise closely with precast cladding manufacturers to ensure that sustainability objectives are met in the long term. It is important to understand that this involvement starts early in the design process, but to be truly effective, it must continue throughout the detailed design, production information and construction processes. Cladding manufacturers are accustomed to providing this type of guidance – in many instances, the success of such ongoing, trust-based relationships is a major reason for repeat work.

This section explains how benefits are accrued all the way through a precast cladding project, but also notes how an over-reliance on the results from project/environmental rating systems can limit potential long-term benefits.

Benefits all the way

Effective early decision-making can help improve sustainability, but time is of the essence if a team is to ensure that all possibilities to reduce impacts and maximise value are utilised. For example, early planning with the precast manufacturer means that:

1. Materials can be sourced locally, so reducing transport emissions and supporting regional economies.
2. Panels can be designed to be manufactured efficiently and installed easily.
3. Production in the factory can be made more efficient in terms of raw material use, mould reuse and finishing.
4. Automation of production is more likely to be feasible.
5. Energy use can be reduced by using self-compacting concrete and natural curing.
6. Deliveries to site can be coordinated to make best use of truck journeys.

7. Waste and other impacts can be reduced by coordinating with other trades to eliminate unnecessary waste in site
8. Thermal mass benefits can be utilised in the building.

Responsible sourcing

A recent development is the use of responsible sourcing standards within construction as a means of assessing the sustainability credentials of the parties within the supply chain. This is pertinent because it offers clients greater confidence in the provenance of the products and services being specified and is also a project-long activity. Although individual companies are taking action (for example by insisting their suppliers have ISO 14001), a pan-industry framework standard (known as BES 6001) for this now exists, and the concrete industry launched a certification scheme in December 2008 that allows concrete products to be recognised as 'responsibly sourced'. ACA members support the ethos of this initiative and are keen to ensure that the environmental, economic, social and ethical credentials of the cladding industry are made clear to clients.

See www.britishprecast.org for details

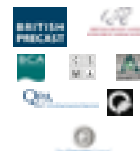


Sustainability involves the whole workforce and supply chain in good management practices

Concrete Industry Guidance Document

to support
breglobal

BES 6001
Framework Standard for the
Responsible Sourcing of
Construction Products



Issue 1: December 2008

Guidance is available to help manufacturers comply with BES 6001, the responsible sourcing standard

*Effective early
decision-making
can help improve
sustainability*

Precast cladding and the Green Guide

In the UK, the Building Research Establishment's Green Guide to Building Specification contains environmental ratings for about 1,200 building elements, including precast concrete cladding. The aim is to provide a simple-to-use rating system so that specifiers can easily compare alternatives for a particular element, such as roofing or flooring. Indeed, it has proved popular and has recently been updated and extended.

The ratings are categorised from A+ to E (with A+ being the best over a range of indicators), based on a 60-year design life and can be selected according to building type. Importantly, the rating is for all of the products which make up an element (i.e. cladding, insulation, facings etc). Both the BREEAM suite of environmental assessment methods for buildings and the Code for Sustainable Homes include 'points' for Green Guide rated solutions, but these account for no more than 15% of the total points available.

The few precast cladding solutions included in the Green Guide are rated between B and D, but specifiers should note that the Green Guide ratings are for guidance only; they are generic, do not assess products against all sustainability objectives and do not reflect project-specific circumstances. The ratings do not take account of fire resistance or thermal mass.

Unlike other types of production, concrete cladding produces very little or no waste on

site, but this is not accounted for. Indeed, the constraints of the methodology currently adopted by BRE disadvantage all methods of off-site construction. Moreover, the series of weightings used within the calculation method may be disadvantageous to any concrete product (because it is comprised of virgin materials, cement and water). In fact, mineral extraction is given a higher weighting than lifetime carbon emissions. The precast concrete industry is working closely with BRE to ensure that future ratings are as accurate as possible. Further information can be found at:

www.thegreenguide.org.uk

Looking at it holistically

While the Green Guide does offer a helpful yardstick to compare building elements, concern about the breadth of issues addressed is important – an environmental focus is important, but not sufficiently holistic to represent a true sustainability assessment. After all, “a good building is more than the sum of its parts”, according to the Construction Products Association.

The ACA is keen to help specifiers understand the full spectrum of sustainability issues associated with building construction. For instance, the benefits of thermal mass are not reflected in the Green Guide ratings, which is unfortunate; please see pages 2 – 3 of this guide to find out how choosing precast cladding is critically important to improving the operational performance of a building over its lifetime by utilising thermal mass.



Precast reconstructed Portland stone louvres provide solar shading at the Sainsbury HQ in Holborn, London



Sustainable buildings make best use of concrete's thermal mass and other long-term benefits

Sustainable manufacture

The manufacture of precast concrete cladding takes place in safe, efficient and well-managed factories – the protected environment in these facilities ensures high quality products, but it also makes environmental protection and sustainable manufacture easier to achieve. The extensive use of quality management standards and procedures ensures that this happens day in, day out. In this respect, customers can feel confident that manufacturers are acting responsibly within and outside the factory gate. This section outlines a range of innovative approaches that are commonly used in precast cladding factories to conserve resources, prevent pollution and enhance safety, and also describes ways in which companies liaise with local communities.

Materials and waste management

The way in which precast cladding is produced is inherently resource efficient. Furthermore, the process relies on mainly local supply chains, is well-established and understood. Factory scheduling is highly efficient, with repetition being key to achieving the greatest economy. This description is common for most precast concrete products, but is worth emphasising here. Cladding manufacturers are experts in managing and conserving natural resources, taking great care to design concrete mixes so that cements, aggregates and other materials are combined to produce high quality products. In addition, companies are taking further steps to reduce primary resource extraction, minimise waste or reduce production energy, by using:

- Cement replacement materials – such as ground granulated blast furnace slag, fly ash and silica, which are by-products from other industries and would otherwise go to waste.
- Self-compacting concrete – this removes the need for vibration (saving energy, reducing noise and preventing HAVS and hearing loss in workers) and uses less primary aggregates.
- Locally quarried stone – this saves transport emissions and fuel.
- Reconstructed stone – this uses small pieces of aggregate and stone which may otherwise be classified as waste and so saves tonnes of natural stone from being quarried.
- Computer-controlled batching and mixing of raw materials to avoid waste.
- Up to 100% recycled steel reinforcement – in fact, all UK-produced steel rebar is composed of recycled steel, saving significant amounts of energy and reducing waste. It can be cut and bent to shape on demand in the factory and is all purchased from CARES-approved suppliers (or similar approved standards).
- Recycled water from finishing processes – this reduces the burden on boreholes and mains water supplies; some factories also capture rainwater from their roofs.
- Timber sourced from Forestry Stewardship Council (FSC) approved suppliers for moulds and forms and minimal use of hardwoods.
- Reusing moulds and tables – steel moulds can be re-used many times and, if well-designed, timber moulds can be reused successfully.
- Recycling and waste minimisation initiatives – segregation of waste happens at source.
- Zero packaging – precast products require no packaging for transport.
- Closed curing chambers and energy-efficient curing techniques.
- Sealed chambers for grit-blasting, producing virtually no waste as grit is recaptured and reused.



A clean modern factory provides a protected environment



Wherever possible, wooden moulds are carefully constructed for reuse

The trained and skilled workforce is an important part of the life of a cladding factory

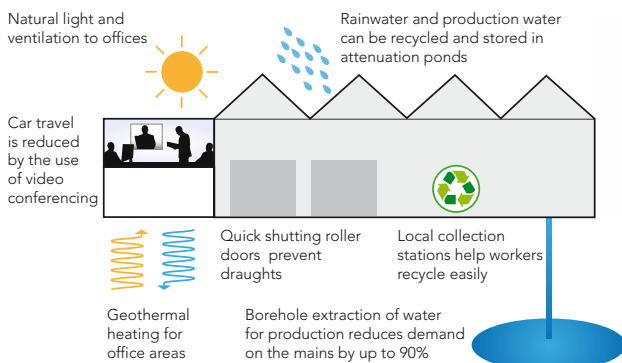
Socially responsible employers and neighbours

Precast factories provide 22,000 much-needed jobs in many regions of the UK; many workers are local, some from families with long histories of working in concrete manufacture. Indeed, the trained and skilled workforce is an important part of the life of a cladding factory – especially where highly-bespoke specialist cladding panels are made. Experienced stone masons, skilled joiners and pattern-makers are all part of the team; job satisfaction is high and employees buy-in to the concept of sustainability. Labour efficiency is correspondingly very high, close to 100%, and staff turnover is low. Above all, the small size of most precast cladding factories makes for a close-knit team that takes health and safety very seriously. Most factories will also extend a hand of friendship to local community groups, schools and charities and are keen to welcome visitors.

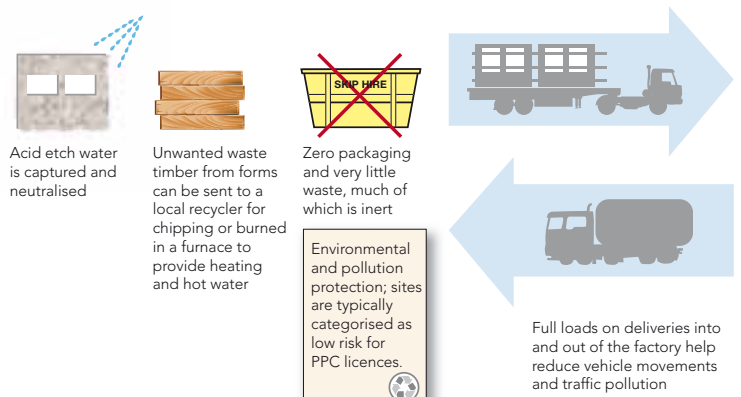
Good practice in precast cladding factories

There are many specific sustainability and environmental improvement initiatives that can be seen in precast cladding manufacturing, but not all are readily visible to the naked eye. Sustainability within the factory means implementing an effective combination of both physical features (such as rainwater harvesting and storage ponds) and work practices (e.g. ensuring full delivery loads and using energy management systems). All factories will implement a range of these initiatives, but in reality the choice will depend on factory size, nature of production techniques and the cladding products being manufactured. The diagram below shows examples of typical sustainability characteristics that can be found in precast concrete cladding factories.

Good practice in the factory...



...and around the yard



Safe, sustainable construction on-site

The sustainability advantages of precast cladding are accrued not only during production, but continue to emerge after products leave the factory. Significant attention to detail regarding delivery arrangements and on-site construction operations means that there are further benefits to be gained through the just-in-time, zero waste approach which characterises precast cladding projects.

Many clients and contractors are now asking material suppliers for clear statements on responsible sourcing, sustainable practices and environmental credentials, both on and off site. Precast cladding manufacturers are accustomed to these requests and will work closely with the contractor to substantiate this by delivering safe, just-in-time and zero waste construction.

Using precast cladding from ACA member companies gives project teams confidence that deliveries, on-site handling and erection processes will go smoothly. This section explains how manufacturers and specialist erectors work together, offering additional benefits such as fully-glazed, insulated and finished panels – a completed wall installed in a matter of minutes, saving energy, time, labour and materials.

Delivering the goods

Although about a quarter of the UK's energy use (and carbon emissions) are associated with transport, only a small proportion of this is related to the transportation of construction products, but it is still important to try to reduce this as far as possible. Precast manufacturers invest great effort in devising efficient delivery patterns and load planning with their hauliers.

Essentially, this means making each load count – ensuring that trucks are full (not transporting 'air' around the country) and that return journeys are stocked with deliveries of other products wherever possible. Loads are maximised on fuel-efficient trucks, deliveries are arranged for off-peak hours and all this from local factories – most UK construction sites are within 200 miles of ACA members' factories. In addition, with most cladding products destined for the external façades of buildings, they are extremely robust and can travel safely with little or no packaging which means zero waste burden and Landfill Tax for the receiving site.

Handling safely

During production precast manufacturers achieve exceptional safety targets and have reduced accidents by 65% over seven years. This record for safety continues on site, where, once panels have arrived, they are scheduled for lifting and installation as soon as possible, if not immediately (i.e. just-in-time). This is organised and undertaken by specialist teams of precast concrete erectors, who are dedicated to the safe and accurate installation of precast cladding panels – safety is paramount.



Installation is a safe, quick and controlled process



After installation, all that remains is to seal the joints

Precast concrete cladding is an efficient, clean and modern method of construction

Installation – energy-efficient, simple and safe

The energy used during the construction of a building can easily be overlooked. To some extent, this is sensible because most of a building's energy is consumed during its operation, but with energy prices rising steadily, there is growing pressure to account for the sustainability of on-site operations.

Precast cladding panels can be produced with all the necessary elements of wall construction included. An example is shown in the diagram in which internal and external finishes, insulation and fully-glazed windows have all been fitted in the precast factory, with no need for anything else to happen on site but jointing and sealing operations. This is a highly cost-efficient way of facing a building because it is fast, uses virtually no labour, minimal equipment and produces no waste - all of which is beneficial to the contractor in developing and implementing a Site Waste Management Plan.

The installation process is also energy efficient, because with precast cladding:

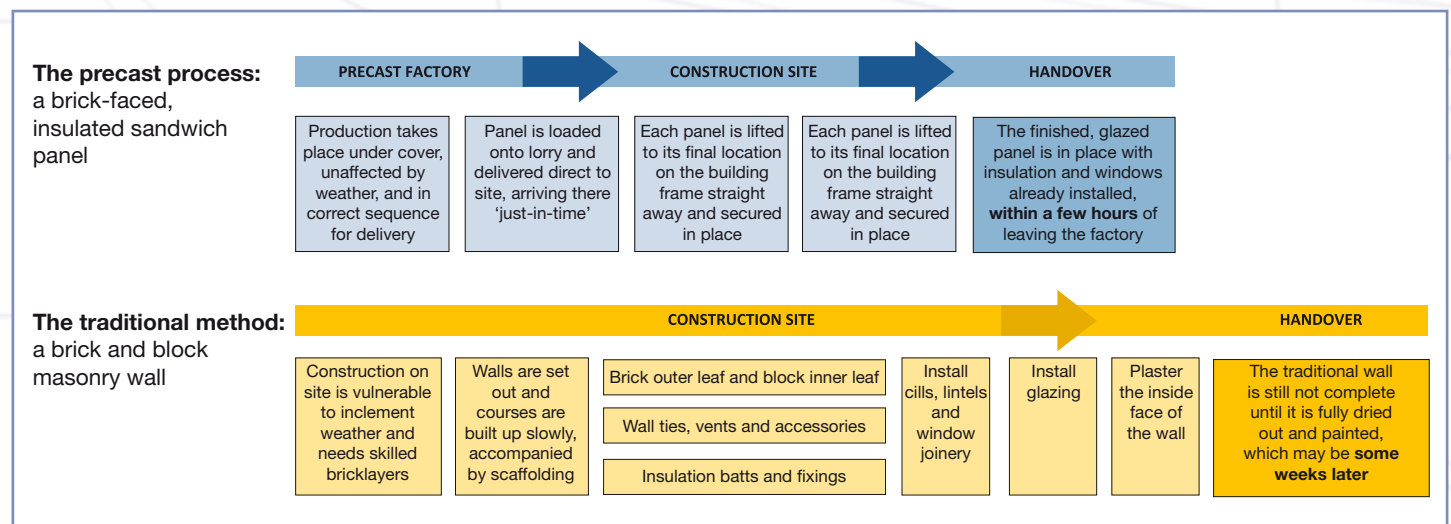
- Crane time and number of lifts are optimised and so electrical energy is reduced
- Site cranes are used, without the need to bring in additional specialist equipment
- There is no need to double handle the panels

- There are no wet trades
- Little energy is needed and power tools are not required
- Small teams of specialist erection workers travel to site together, saving on fuel emissions

Aftercare

Precast concrete cladding is an efficient, clean and modern method of construction, which means that contractors achieve a tidy, safe site that remains clean and dry. Moreover, the early and fast enclosure of a building that uses precast cladding gives workers safe edge protection and a sheltered working environment, ready for fit-out. There is no waste produced in the installation, no packaging to recycle or dispose of. Lifters are cast in to panels, thus further avoiding waste. Finally, a simple wash-down of the panels is all that is required, which uses only water and no harmful chemicals.

Subsequent maintenance of precast cladding is infrequent and minor, with most manufacturers espousing a sensible principle of 'repair, not replace'. The existence of so many precast buildings that remain in excellent condition is good evidence of the robustness, durability and longevity of the product. Although 100% recycling of concrete products is possible at end of life, the added value that cladding panels bring means that most remain in service.



Overview

Making the right choice

There is no doubt that the early decision to use precast concrete cladding can have design and construction benefits, but it is also clear that many sustainability advantages can also be gained by using precast cladding. Member companies of the Architectural Cladding Association have a lengthy track record of successful liaison with customers to ensure that environmental, economic and social objectives can be best met in the long term. Approachable manufacturers make it easy to discuss and decide an appropriate strategy for the building's design and construction.

Confidence in the long-term

Safe, low energy and responsible manufacturing processes produce impressive results – savings in energy and materials, and reductions in waste are all possible in well-managed precast factories which use state-of-the-art sustainable technologies such as ground-source heat pumps, self-compacting concrete and water recycling. Importantly, precast manufacture produces very little waste and is classified as low risk in terms of environmental hazards.

Construction with precast cladding is safe, well-planned and efficient. Contractors can be confident that their project schedule will benefit from just-in-time deliveries and a specialist team to ensure fast and accurate installation. Energy, materials and labour on site are all reduced by specifying precast cladding, which means valuable cost savings for the contractor and the client. But the benefits do not stop accruing after construction – using concrete cladding products ensures that clients gain long-term advantages throughout the life of a building.

The results speak for themselves – precast cladding products already adorn many of the country's best building projects, but, increasingly, specifiers are selecting cladding because of its sustainability and performance attributes as well as its attractive appearance. The judicious selection of high quality, robust and durable construction products like precast cladding results in added value for clients, such as lifetime carbon savings via the energy efficiency achieved through the use of thermal mass.

The main sustainability advantages from using precast concrete cladding are:

- Precast concrete cladding is resilient, energy efficient, low maintenance, attractive and durable.
- Manufacture takes place in low energy, resource efficient and low waste production facilities, managed and staffed by a trained and innovative workforce.
- Precast concrete cladding has significant sustainability benefits to offer.



Precast panels clearly communicate the ethos of the Hadley Centre



Precast panels are stored safely in the factory yard, awaiting 'just-in-time' delivery

Further information

If this publication has been of interest, a wide range of information is available on precast concrete cladding and the sustainability of concrete products. Other publications can be obtained from the Architectural Cladding Association at the address overleaf or go to:

www.architectural-cladding-association.org.uk/

You can also visit the British Precast website to view and download, or order, documents about precast concrete products for free, such as:

- **The little green book of concrete** – sustainable construction with precast concrete. British Precast, Leicester.
- **A little book of concrete** – a guide to 100 advantages. British Precast, Leicester.
- **Cast in concrete** – a guide to the design of precast concrete and reconstructed stone. Sue Dawson, 2003, ACA, Leicester.

In addition, manufacturing member companies that belong to the Architectural Cladding Association are able to answer questions and provide specific details and technical information relating to the issues raised in this publication.

Photography credits

All images have been provided courtesy of ACA member companies.

Precast cladding products already adorn many of the country's best building projects



Using precast cladding at St George Wharf contributed to a quick and easy envelope construction



Crisp, elegant detailing gives precast concrete a distinctive look



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