The Little Green Book of Concrete

Sustainable construction with precast concrete

Precast concrete

For the purposes of this Little Book of Concrete, precast includes all factory-made concrete products from smaller modular items such as concrete bricks, paving and roof tiles, through larger standard products such as pipeline systems, piles and precast floor beams, to bespoke units such as cladding panels and structural units designed and manufactured to specific architectural and engineering requirements.

This amazing portfolio of products serves the needs of society every day, and supports economic growth. Together they provide:

- Shelter and protection against the forces of nature
- Drinking water, drainage and sanitation systems
- Communication and transport infrastructures
- Energy supply systems
- Commercial, educational and healthcare facilities

As well as these functions, precast concrete products also have very positive inbuilt sustainability advantages with environmental profiles that are improving month by month. In use they help to combat some of the direct effects of climate change such as hotter summers, high winds, flash flooding and urban heat islands.

Contents

BRITISH PRECAST

Published by
British Precast
60 Charles Street
Leicester LE1 1FB
Tel +44(0)116 253 6161
info@britishprecast.org
www.britishprecast.org

Members of

Ref. LB/02 Published 2008

"It is the most commonly used building material in the world; yet we normally take what it does for granted – too often this means that much of what concrete can offer is overlooked."

So said the first Little Book of Concrete which provided an overview of the 100 advantages that can be gained from using precast concrete.

Introduction

There is increasing demand for construction options that will contribute to achieving sustainable development. This little book provides the architect, the designer, the engineer, the client, the financier, the insurer and the environmentalist with a summary guide to the sustainability credentials of precast concrete. It explains how the precast industry is becoming more resource efficient and environmentally aware and how its products can contribute to achieving greener construction.

We hope you enjoy reading about how sustainable construction can be achieved with precast concrete. If you wish to know more please visit:

www.britishprecast.org
www.sustainableprecast.com
www.sustainableconcrete.org.uk
www.bibm.eu
www.concretecentre.com
www.concretethinker.com
or contact us: **info@britishprecast.org**

BRITISH PRECAST

THE PRECAST SECTOR SUSTAINABILITY CHARTER

BRITISH PRECAST CONCRETE FEDERATION MEMBER DECLARATION ON SUSTAINABILITY

acknowledges the need to go beyond legislation and take voluntary actions to make its products and operations more sustainable, and commits that from this date it will do this by working towards the adoption of the following principles:

- Develop products that improve the quality and sustainability of the built environment
- Liaise effectively with local communities to foster mutual understanding and respect
- Manage all waste streams effectively and minimise waste disposed to landfill
- Measure, report and improve performance on sustainability issues
- Minimise pollution and emissions associated with production and transportation
- Operate in a responsible manner to protect employees, contractors and visitors
- Operate in an efficient and financially sustainable manner without compromising legal, quality or sustainability principles
- Operate to the highest ethical standards necessary to develop a skilled and competent workforce
- Operate to the highest quality standards necessary to satisfy customers and consumers
- Protect and enhance the natural environment adjacent to or affected by precast production
- Recognise that competition encourages the development of more sustainable products and practices
- Use energy more efficiently and reduce carbon footprint
- Use primary materials more efficiently and promote the use of secondary materials
- Use water more efficiently and minimise demand on mains water supplies
- Work constructively with other organisations to deliver sustainable policies and practices

Signatories

Chief Executive, British Precast Concrete Federation

President, British Precast Concrete Federation

British Precast welcomes any developers and work in partnership with the signatories and their representatives to support the delivery of these commitments

Using natural resources effectively

We have a responsibility to use our natural resources wisely by specifying building products carefully and ensuring that these have a high recycled content, where appropriate. The materials that are used to make precast concrete are available locally and are plentiful in the UK, but cannot be taken for granted.

Steps are being taken by the industry to encourage resource efficiency and to design out waste throughout the manufacturing and construction process. Specifiers can be confident that precast concrete products are sourced responsibly.

End-of-life destinies such as recycling for concrete aggregates or deconstruction for re-use in buildings or structures are increasingly being considered.

From December 2007, British Precast member companies have been able to demonstrate their commitment by signing the members Sustainability Charter shown opposite. From mid-2008 the Charter is supported by an audit system. For a full list of signatories check **www.britishprecast.org**

Uses plentiful, natural raw materials

All the materials that go into precast concrete products come from natural and recycled sources, mainly inorganic. This means they are subject to minimal processing or chemical treatments to render them suitable for use, which results in concrete having a relatively low embodied energy value, unlike highly processed materials, such as plastics.

Local sourcing supports regional economies and employment. Indeed, about 85% of UK aggregate travels less than 30 miles to reach its destination. There are over 800 concrete product plants in the UK with most types of product available locally.

www.sustainableconcrete.org.uk

No need to import

Most of the UK needs for precast products can be met locally, so with precast there's simply no need to import materials from thousands of miles away.

As an example, more than 98% of the timber used in UK construction is imported. A recent report shows that timber's predominant impact on the environment comes from transportation of the raw materials. This constituted 99.5% of all impacts, with the largest effect coming from the long distances travelled from Canada, Russia, Finland and Sweden.

It is estimated that shipping can double the carbon footprint of construction materials, so the associated environmental impact from shipping's fuel consumption and pollution is clearly cause for concern. Recent UN reports show that shipping CO_2 and other pollution has been seriously underestimated by around 300% – all environmental profiles of imported materials will therefore need updating.

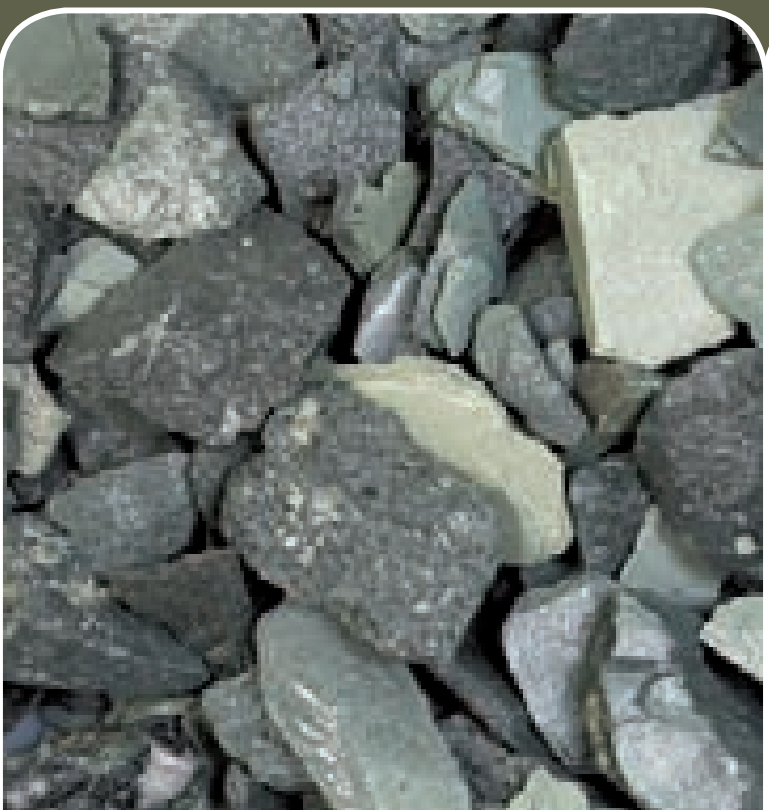
Incorporates an abundant natural resource...

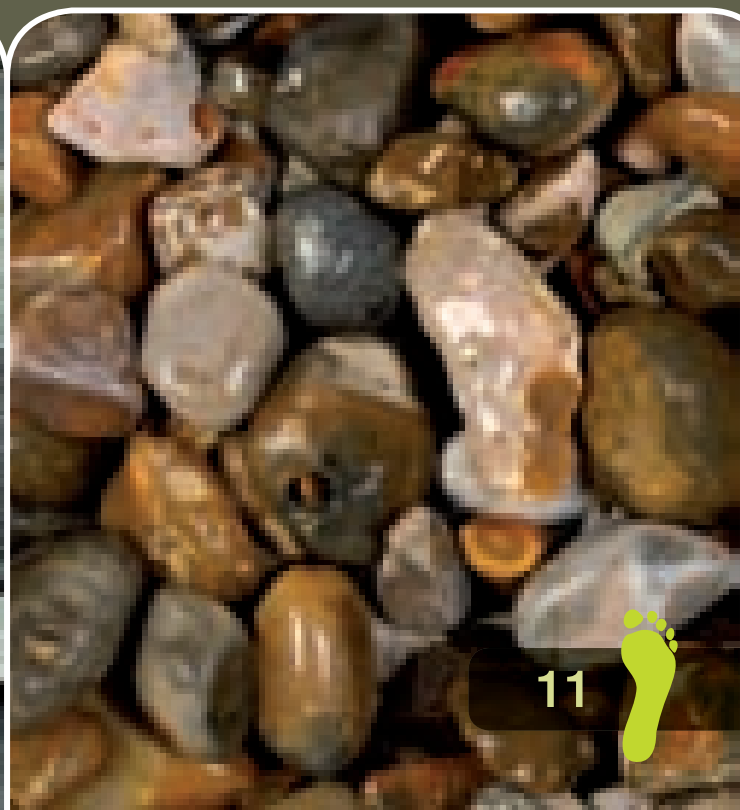
Precast concrete products consist predominantly of natural aggregates – sand, coarse and fine stones from rock quarries or river gravels. The UK has a fantastic range of aggregates to offer and so there is no real need to import these from elsewhere. Advice on the sourcing of both local and recycled aggregates can be obtained from precast producers and organisations like QPA and WRAP.

www.qpa.org
www.wrap.org.uk

..which arrives by sustainable transport

The local availability of aggregates makes for low carbon footprint deliveries to the precast factory. In fact, it is common to see rail and water being used – river and canal barges and dredgers are now used to transport millions of tonnes of aggregate every year in the UK, making excellent use of our industrial heritage waterways.





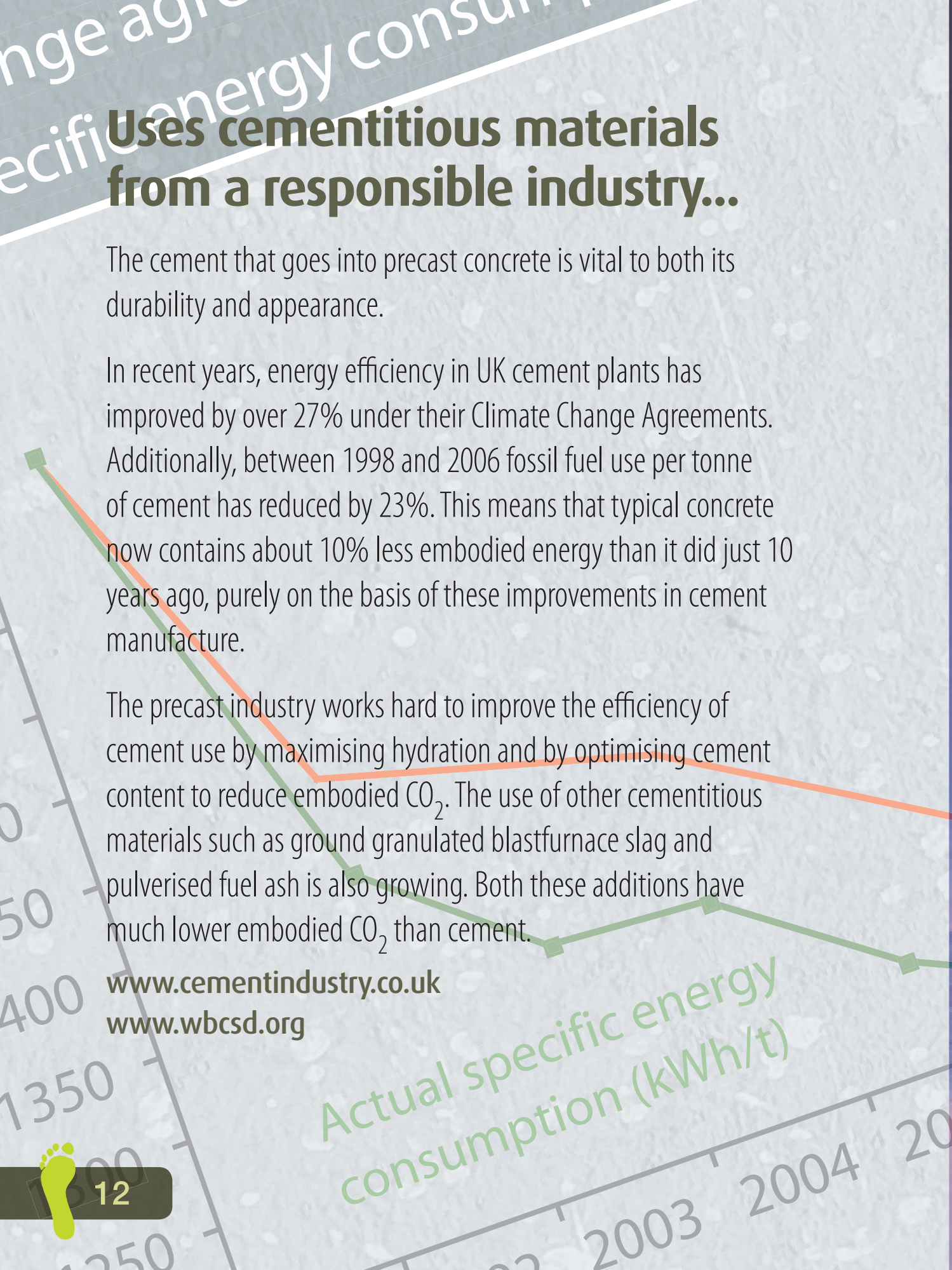
Uses cementitious materials from a responsible industry...

The cement that goes into precast concrete is vital to both its durability and appearance.

In recent years, energy efficiency in UK cement plants has improved by over 27% under their Climate Change Agreements. Additionally, between 1998 and 2006 fossil fuel use per tonne of cement has reduced by 23%. This means that typical concrete now contains about 10% less embodied energy than it did just 10 years ago, purely on the basis of these improvements in cement manufacture.

The precast industry works hard to improve the efficiency of cement use by maximising hydration and by optimising cement content to reduce embodied CO_2. The use of other cementitious materials such as ground granulated blastfurnace slag and pulverised fuel ash is also growing. Both these additions have much lower embodied CO_2 than cement.

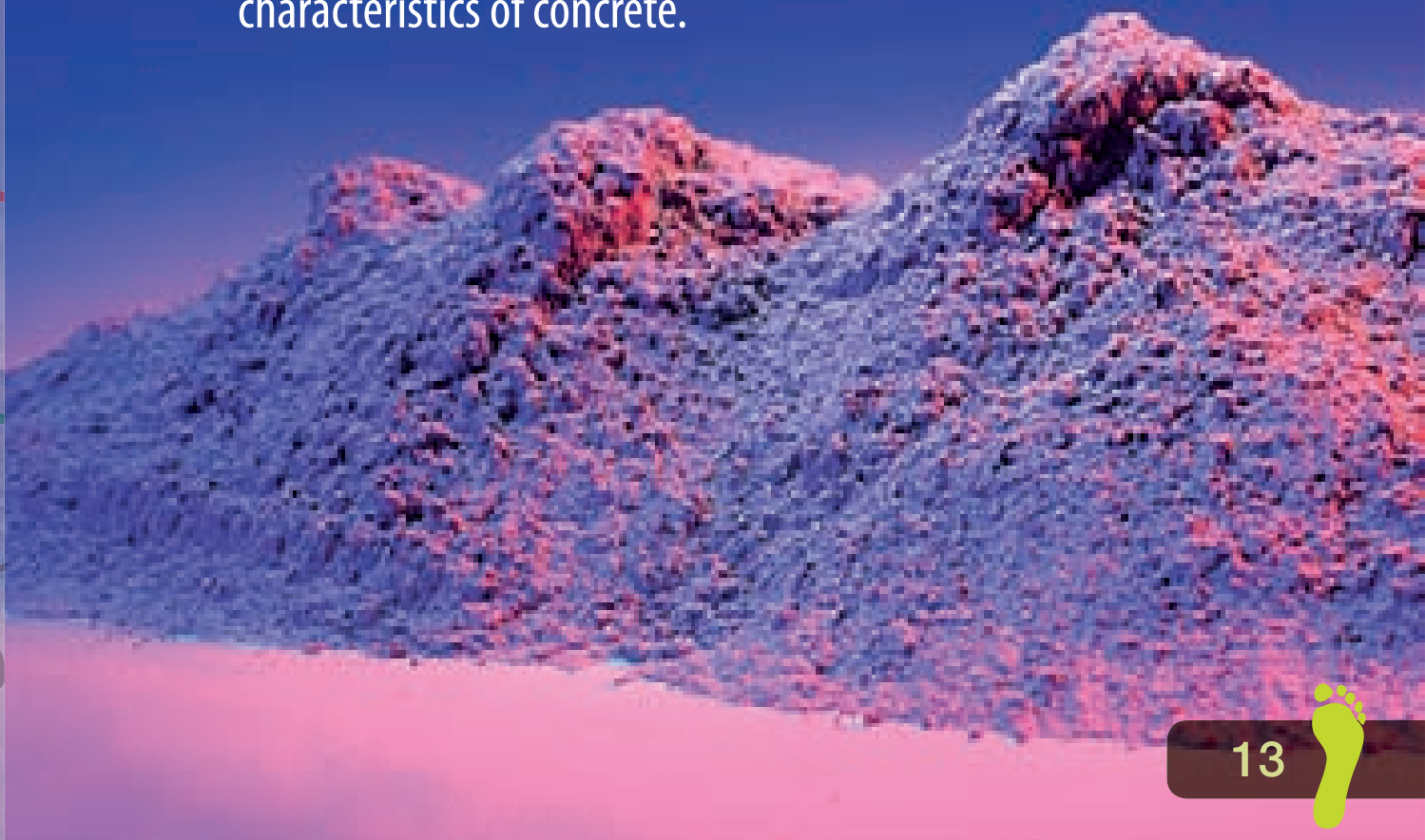
www.cementindustry.co.uk
www.wbcsd.org



...which is reducing its carbon emissions

Making cement in a kiln requires a great deal of heat energy, but the amount of non-renewable fossil fuels used to produce this heat is being reduced.

The great majority of precast concrete mixes are made up of low carbon footprint sand, gravel or crushed rock meaning that the carbon content of cement is diluted many times over. The confusion between cement and concrete carbon footprints is the major source of misinformation about the real beneficial sustainability characteristics of concrete.



Conserves water resources in the factory....

Although water is a widely available resource and is currently in plentiful supply, it is important to manage its consumption. Water recycling and conservation is a common feature in precast factories. For example, tanks, ponds and lagoons are used to store rainwater, which is used in the factory to minimise mains water consumption saving thousands of cubic metres per annum.

Some precast factories have on-site water treatment plants to recycle their used process water – one precast factory alone has reduced its water use by 2.5 million gallons per annum.

...and on site

Precast concrete arrives on site ready for installation and usually requires no further treatment or additions.

Executing all the necessary finishing tasks in the precast factory allows process water to be more easily controlled, recycled and re-used.

Uses recycled steel reinforcement

All reinforcing steel is made from 100% steel scrap, and is mainly fabricated in UK-based mills. At the end of a precast element's life the reinforcement can be recovered for recycling again. Most of the rebar used in precast concrete products therefore scores highly in terms of recycled content. Stainless steel reinforcement is used mainly in weather-critical precast products - such as cladding - where enhanced durability and long life justifies its selection.

www.uk-bar.org

Uses by-products from other industries

In many cases precast products incorporate materials such as blast furnace slag (GGBS) from the steel industry and fuel ash (PFA) from coal-fired power stations that might otherwise go to waste. As a rule of thumb:

- Substituting 50% of cement with GGBS = 40% less CO_2
- Substituting 30% of cement with PFA = 20% less CO_2

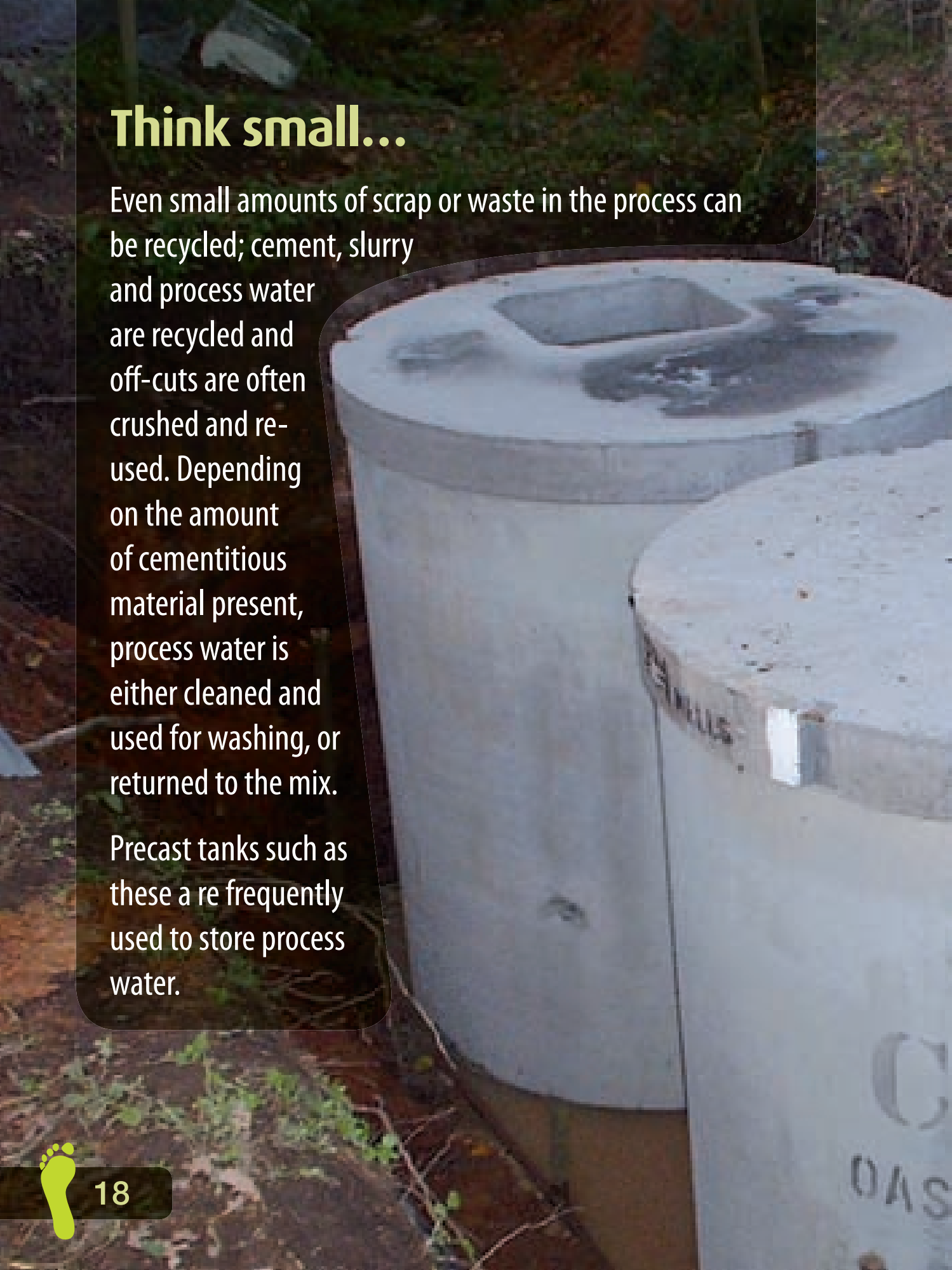
These materials can improve the performance of concrete and it is now possible to specify products with over 70% replacement material. Materials like microsilica, glass, limestone powder and china clay waste can also replace Portland cement or primary aggregates.

www.aggregain.org.uk
www.wrap.org.uk
www.ukqaa.org.uk
www.ukcsma.co.uk

Think small…

Even small amounts of scrap or waste in the process can be recycled; cement, slurry and process water are recycled and off-cuts are often crushed and re-used. Depending on the amount of cementitious material present, process water is either cleaned and used for washing, or returned to the mix.

Precast tanks such as these a re frequently used to store process water.



...then think big!

New precast factories are built with closed-loop recycling systems already installed. Precast manufacturing plants have set a new standard for manufacturing efficiency and in so doing are achieving significant environmental savings.

All wet waste is automatically conveyed back to a central recycling plant where aggregates are cleaned and added to stock or crushed with dry concrete waste. These systems virtually eliminate all waste, which is great news for the environment.

Lean thinking means less waste

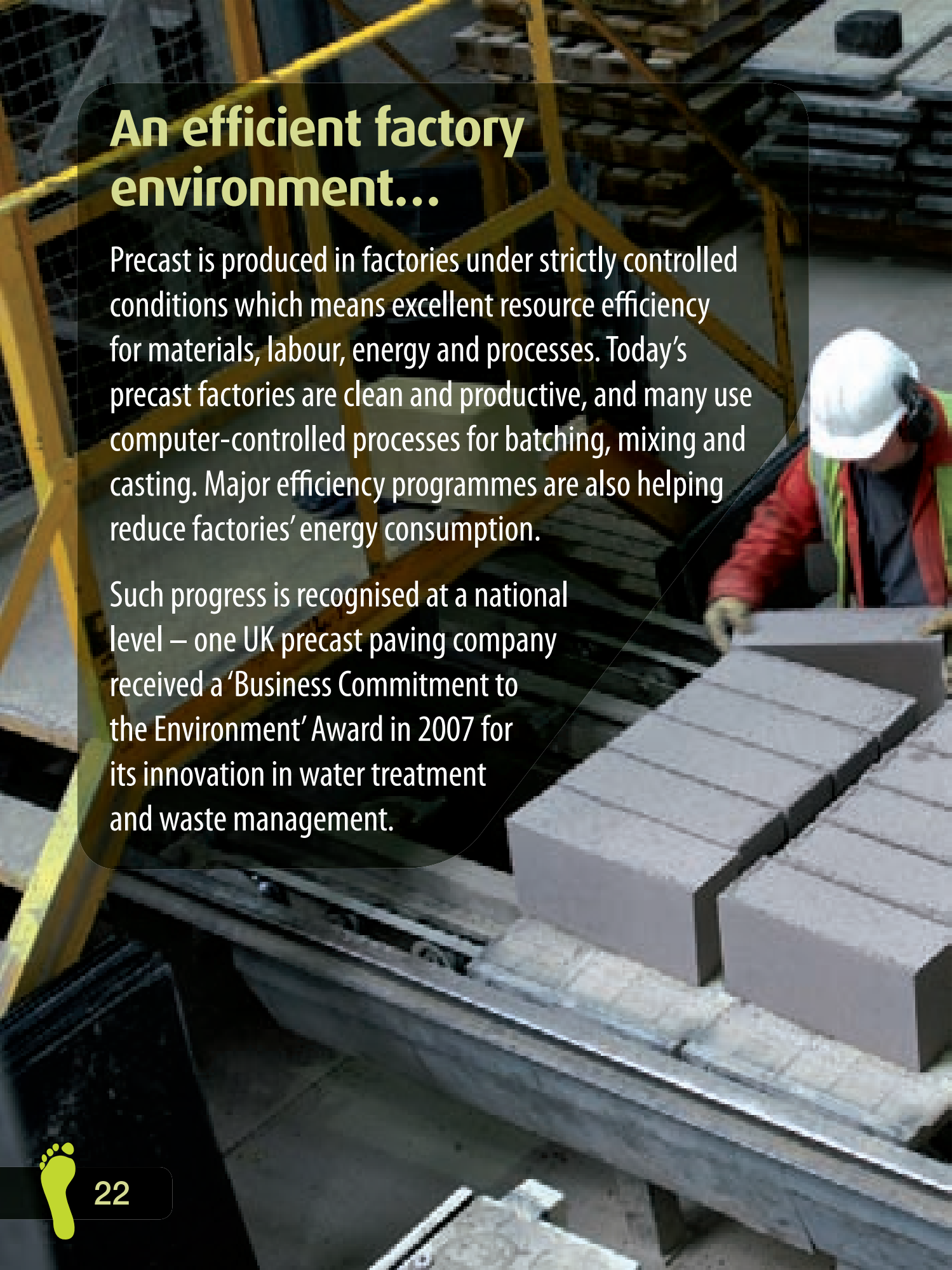
Sustainability in the precast factory is about improving resource efficiency, reducing waste and ensuring that standards such as ISO 14001 and EMAS are maintained. New factories incorporate major recycling systems and act as role models in UK manufacturing.

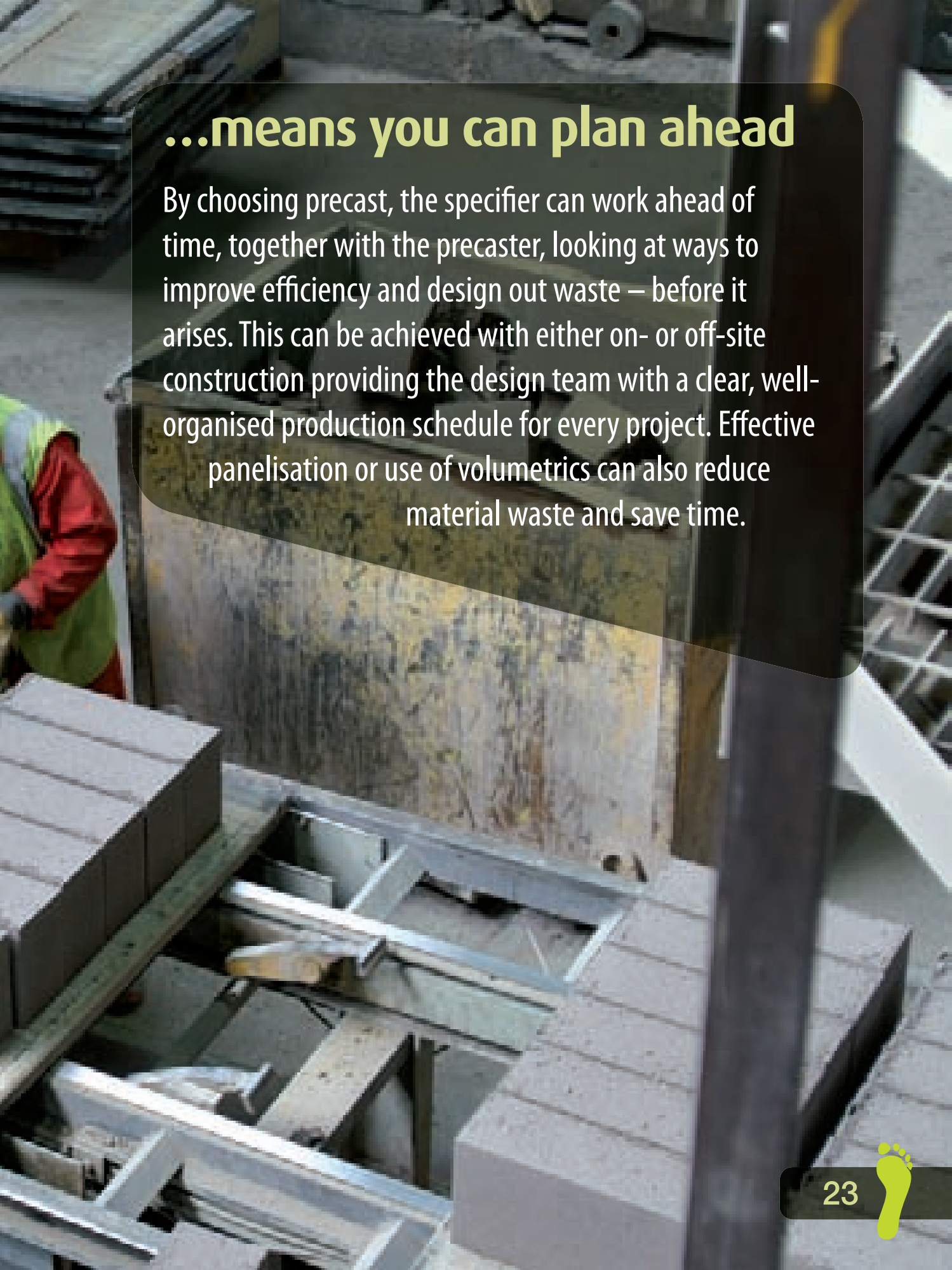
None of this would be possible without the sector's highly skilled and dedicated workforce who are critical to its success and, in many cases, are the driving force behind advances in energy saving techniques, recycling initiatives and local community liaison programmes.

An efficient factory environment…

Precast is produced in factories under strictly controlled conditions which means excellent resource efficiency for materials, labour, energy and processes. Today's precast factories are clean and productive, and many use computer-controlled processes for batching, mixing and casting. Major efficiency programmes are also helping reduce factories' energy consumption.

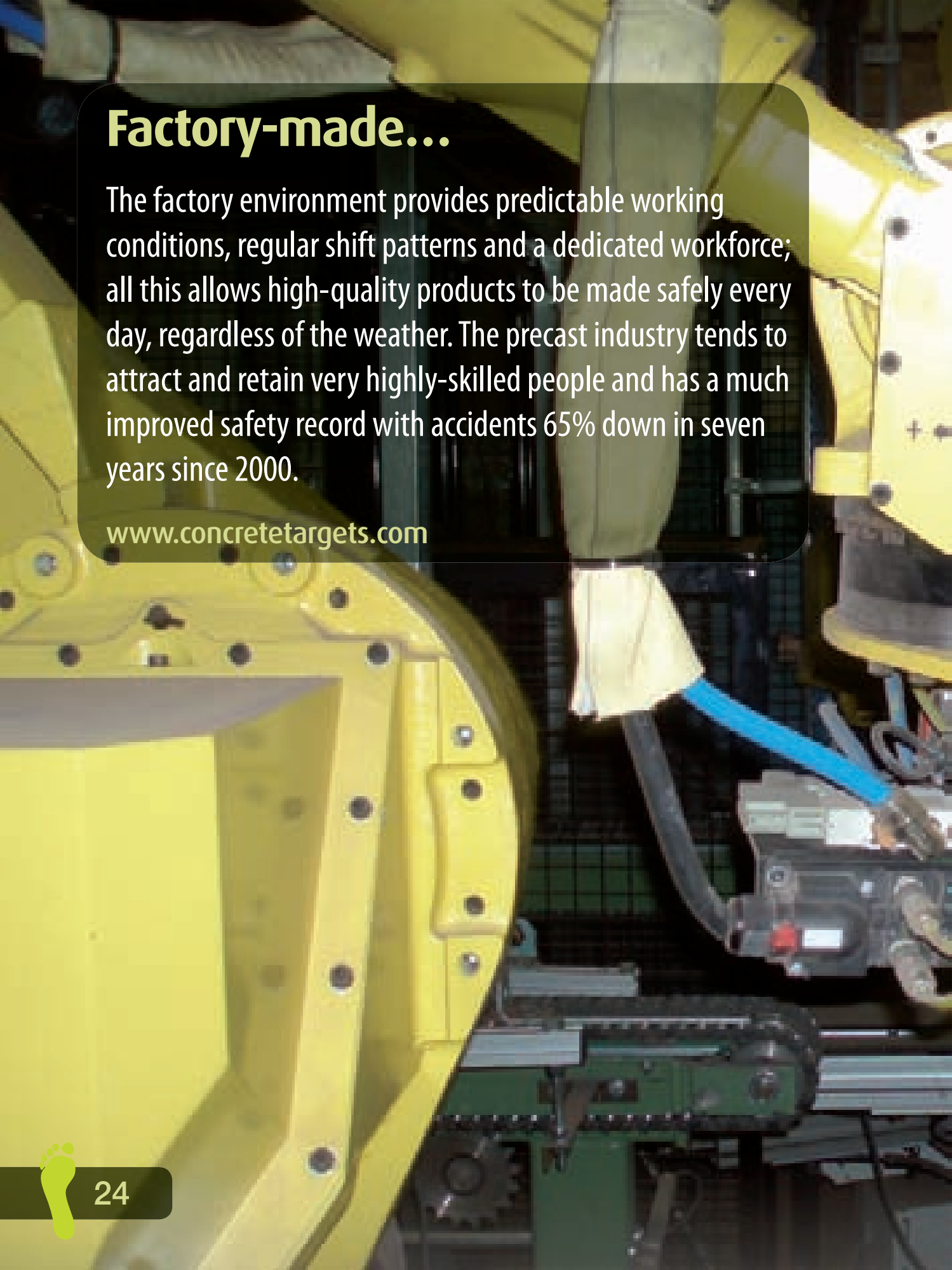
Such progress is recognised at a national level – one UK precast paving company received a 'Business Commitment to the Environment' Award in 2007 for its innovation in water treatment and waste management.





...means you can plan ahead

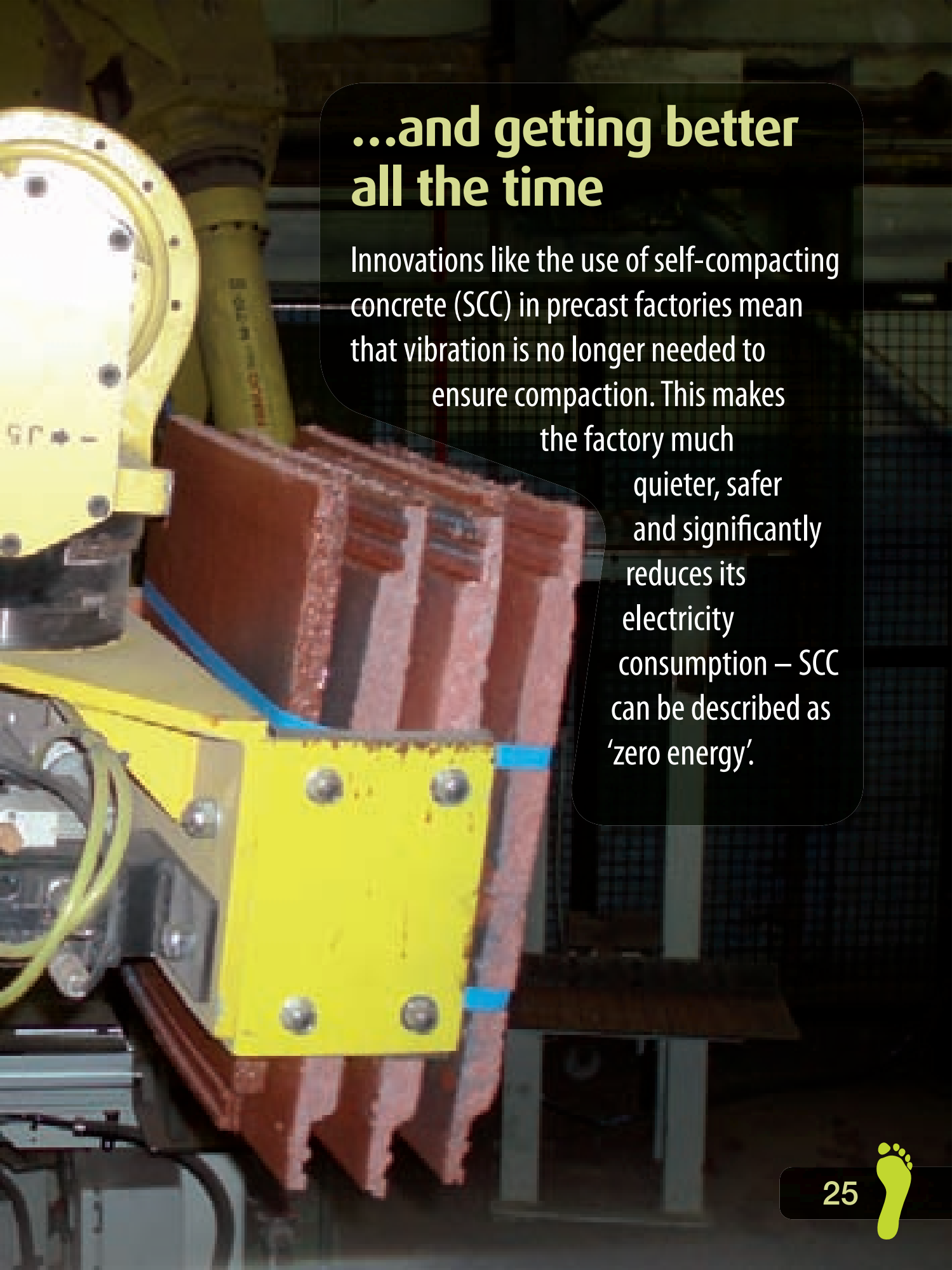
By choosing precast, the specifier can work ahead of time, together with the precaster, looking at ways to improve efficiency and design out waste – before it arises. This can be achieved with either on- or off-site construction providing the design team with a clear, well-organised production schedule for every project. Effective panelisation or use of volumetrics can also reduce material waste and save time.



Factory-made…

The factory environment provides predictable working conditions, regular shift patterns and a dedicated workforce; all this allows high-quality products to be made safely every day, regardless of the weather. The precast industry tends to attract and retain very highly-skilled people and has a much improved safety record with accidents 65% down in seven years since 2000.

www.concretetargets.com



...and getting better all the time

Innovations like the use of self-compacting concrete (SCC) in precast factories mean that vibration is no longer needed to ensure compaction. This makes the factory much quieter, safer and significantly reduces its electricity consumption – SCC can be described as 'zero energy'.

Great results, over and over again…

Having decided to specify precast, it's important to have confidence in the solution and this is where factory-controlled procedures are critical. Repetition of individual units can be achieved with confidence whether 1, 10 or 100 are required. Re-using a mould makes both environmental and economic sense – every additional cast saves materials, energy and time, and prevents moulds going to recycling or to disposal prematurely.

…with long-lasting moulds

Moulds for precast concrete can be stored to allow later replication, whether additional units are required one day, one week or one year later.

Even at the end of this extended life, a timber mould can be useful – it can be made into wood chips or pellets and burned to generate heat for the factory and offices. Moulds embedded with nails and screws can also now be dealt with and recycled. This means much less waste goes to landfill.

These are locally available products

Precast concrete products are predominantly sourced from within the UK. Distribution of products tends to be well-coordinated: wherever possible, return load planning by hauliers ensures that delivery vehicles are never empty – this prevents wasted fuel and reduces road congestion. Driver training aimed at improving fuel efficiency is now commonplace

Research conducted by BRE in 2007 showed that British-made precast concrete paving has half the environmental impact of imported Indian sandstone. As with other imported construction products there are also ethical issues to consider, including child exploitation and environmental degradation.

Being closer means using less carbon

The local supply network for precast means travel distances are shorter and so the fuel used during haulage is minimised. With calls for travel distances from supplier to site to be reduced, precast is a viable and sensible option to reduce the carbon footprint of a project.

For example, the use of precast hollowcore flooring from within a 35 mile radius of the BedZED development saved 120 tonnes of CO_2, equal to 2% of the embodied energy for the whole project.

The majority of factory waste is recycled

The highly effective recycling systems used in precast factories enable virtually all process water, slurry, aggregates or cement to be safely re-captured and put back into production. This means that a closed-loop system is in operation – one which minimises any outgoing waste materials.

Even broken pallets are not wasted, but recycled. By careful management to segregate, reuse and recycle, one precast paving factory showed its commitment by reducing its packaging waste from 1,200 tonnes to just 40 tonnes in the space of a few years.

Avoids expensive environmental disposal costs

Making better use of natural resources makes good business and environmental sense; the Landfill Tax penalises poor use of materials, so contractors who waste more, will pay more. Using ready-made precast products prevents waste disposal costs being incurred on site, so extra costs do not have to be passed on to the customer and resource efficiency is maximised.

A visionary workforce…

Some 22,000 people are employed in the UK precast industry with an equivalent number indirectly employed. Forward-thinking employers now share their sustainability vision with employees, and some of the best ideas and programmes for enhanced safety, energy and waste savings have come from the shopfloor.

Their efforts in raising awareness of energy efficiency and taking the initiative to improve working conditions for their colleagues are to be applauded. In one precast concrete company, an energy-efficiency awareness scheme is aiming to reduce energy consumption by 15% – saving carbon of course, plus about £1.5 million each year.

…has close links with the community

Many companies invest heavily in time and effort to create a positive relationship with local communities, often donating materials and their time for the benefit of good causes.

By helping to lay paths, repair walls, build community centres or by liaising with schools, these employees show their respect for people – the precast industry prides itself on good citizenship.

Improving construction

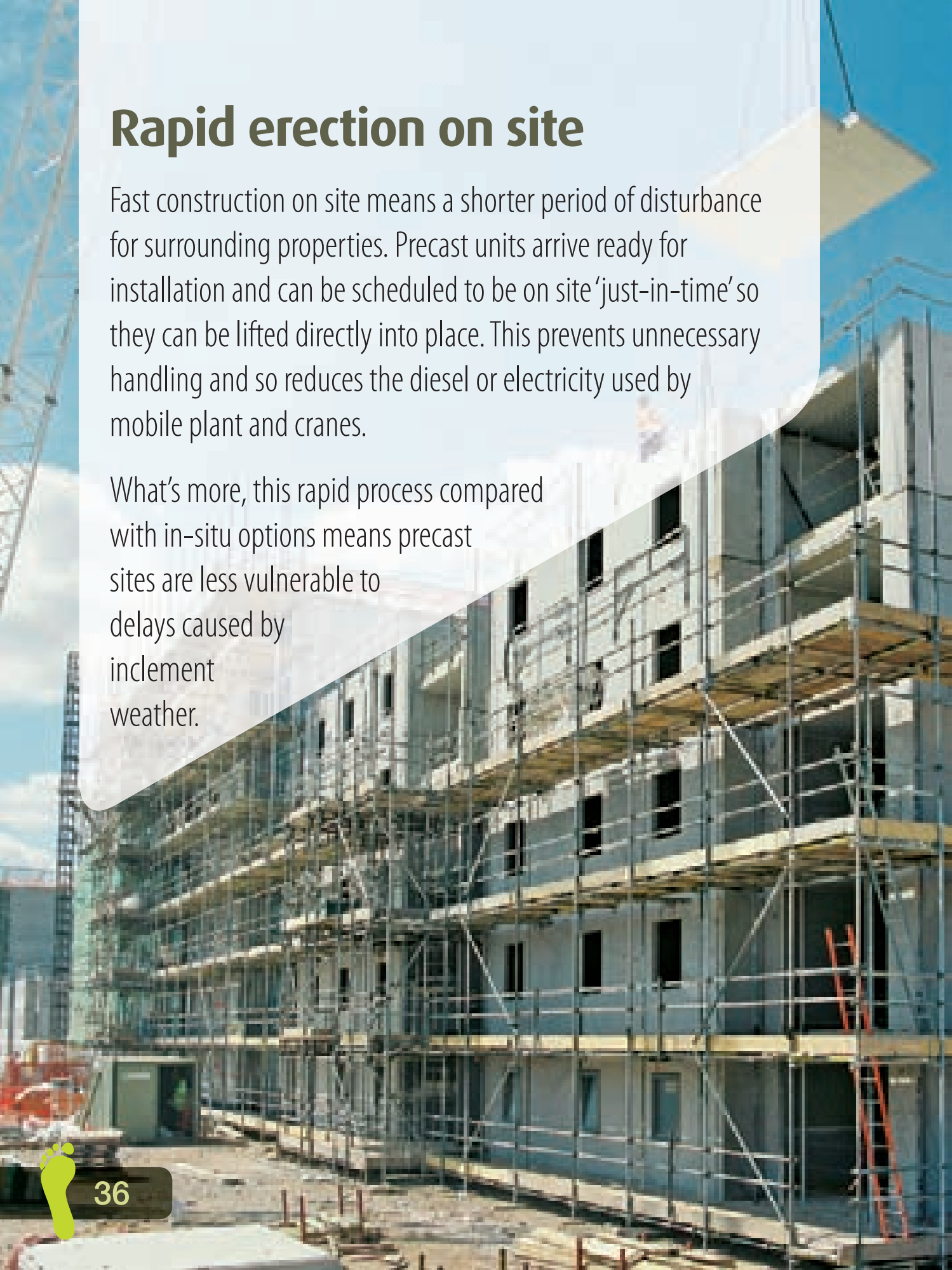
The production of precast concrete off-site, in a factory, means that construction sites are cleaner, quieter and safer. The installation of precast units is usually fast and efficient.

Such efficiency helps to reduce the impact that construction has on surrounding areas. This social aspect of precast's sustainability is therefore a major benefit – helping to improve construction's reputation with the public.

Rapid erection on site

Fast construction on site means a shorter period of disturbance for surrounding properties. Precast units arrive ready for installation and can be scheduled to be on site 'just-in-time' so they can be lifted directly into place. This prevents unnecessary handling and so reduces the diesel or electricity used by mobile plant and cranes.

What's more, this rapid process compared with in-situ options means precast sites are less vulnerable to delays caused by inclement weather.



Bar-codes or e-tags speed up construction and facilitate re-use

The addition of bar coding strips or embedded micro chips to precast products can help distribution managers identify individual elements, making sure each one reaches its planned destination at the correct time. This technology can also help managers on site speed up the construction process while at the same time ensuring each element is accurately positioned.

E-tags can contain technical data, plus additional information on recycled material content, which ensures effective re-use or recycling at a later date.

Waste on site is not lost…

With over 100 million tonnes of waste emanating from UK construction sites every year, using precast is a highly effective strategy to reduce waste from wet concrete, formwork and other sources. Even if all does not go to plan on site due to changing designs, precast products can always be used elsewhere.

Scrap created at the building site can be segregated, collected and broken up to create aggregate. The BRE estimates that 50% of recovered concrete on site is crushed and recycled, and a further 40% is 'downcycled' for use as hardcore or in road construction.

…it often never even appears

Some precast companies now operate a deliver, unwrap and tidy up service. All unwanted packaging material is removed from site by the delivery vehicle. This keeps the site tidy, ensures that any waste is recycled and helps site managers to meet their environmental commitments, for example, to ISO 14001.

Improves safety on site

As well as having established codes of practice for safe delivery and erection, innovations have made the use of precast concrete even safer; these include air-inflated crash bags, nets and mats.

These are used in an area under construction until such time as the precast units are securely installed. In the rare event of an accident, these will break the fall of a worker or even a whole precast unit.

Provides an instant work platform

Precast structures and in particular floors and staircases provide an early, secure and broad platform from which subsequent site activities can be undertaken.

This solid footing helps speed up construction and gives managers confidence that operatives can go about their work safely – allowing safe access and egress, even in an emergency.

Reduces noise levels on the building site…

No vibration, no sawing and no other noise-generating processes are needed to install most precast concrete products, whatever their size. This results in substantially quieter construction sites, which are:

- Safer – because workers can easily hear any warning alarms.
- More pleasant – because they can speak to one another without having to shout.

There are obvious long-term benefits to workers' health and wellbeing by improving working conditions in this way.

… and for neighbouring properties

The easy installation of precast products makes for much less noise from the construction site and this is of great benefit to those inhabiting or working in adjoining properties. Life is quieter and therefore much more tolerable during the construction period.

In addition, a precast site will emit virtually no dust – lessening the likelihood of problems with dirt and poor air quality, the most common causes for complaint amongst construction's neighbours.

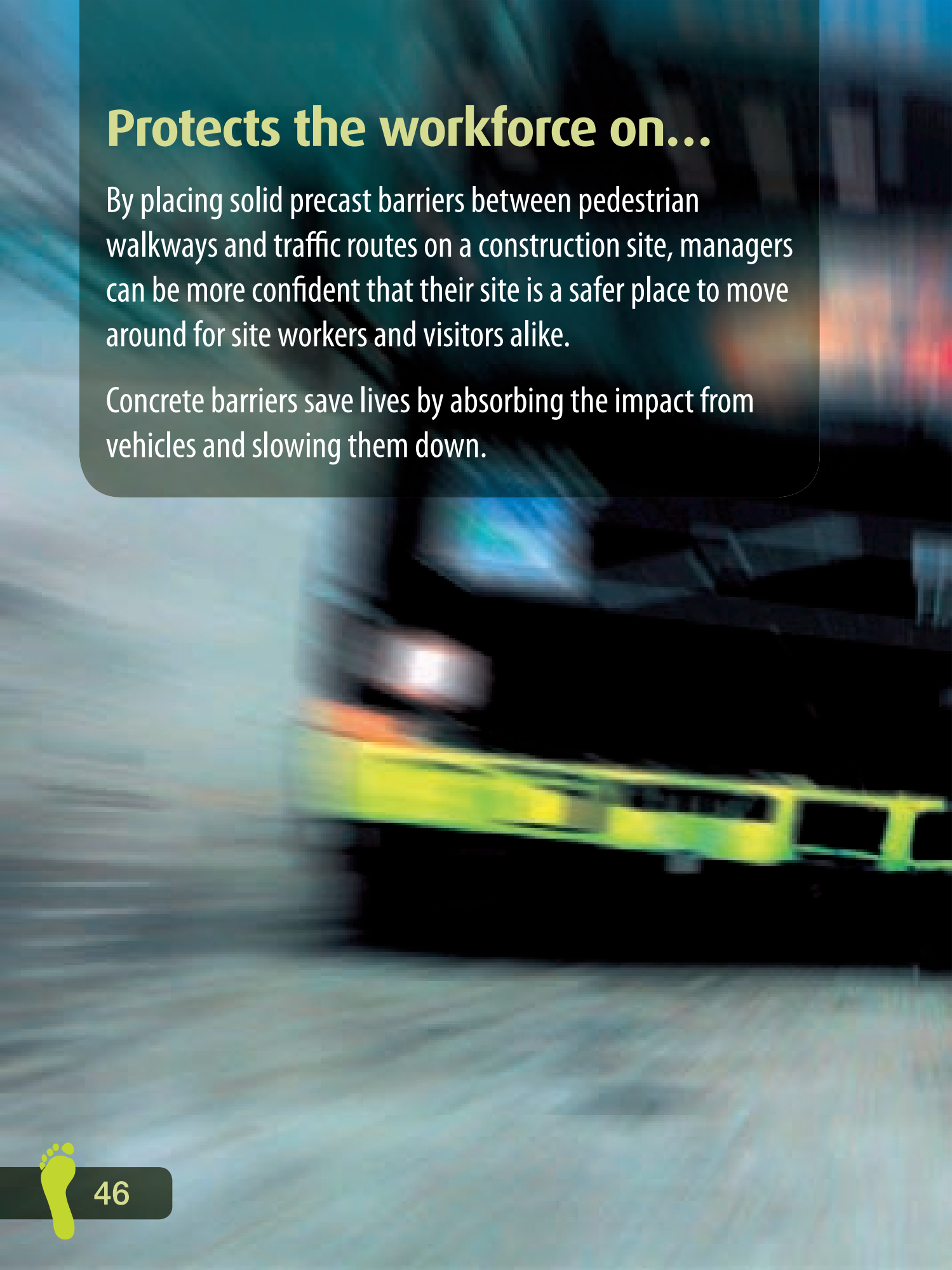
Built to a precise specification

Cover to rebar is consistent and correct, as are strength and concrete quality. Hence the inherent durability of the delivered product is assured. In addition, precast companies work with specialist fixing teams to install their products. This guarantees precise, reliable workmanship ensuring that the quality of service from precast is maintained long after the products leave the factory.

Easy to clean and repair

Despite all the best intentions on a construction site, sometimes minor dents, damage or dirtying can occur, which can compromise the appearance of neatly installed concrete units.

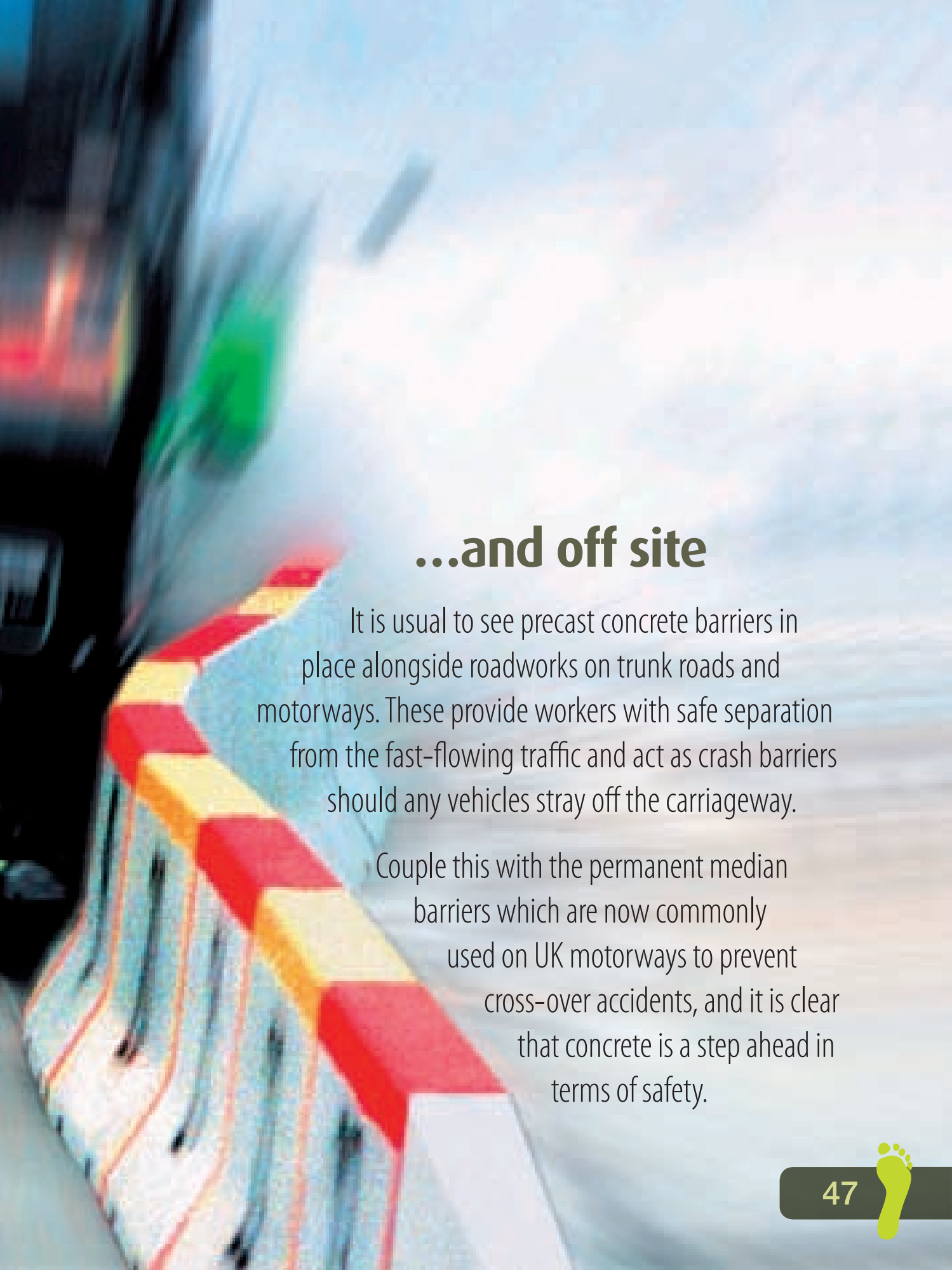
The excellent surface finish of precast makes cleaning and repairs easy – most manufacturers offer extensive guidance on how best to undertake these tasks.



Protects the workforce on…

By placing solid precast barriers between pedestrian walkways and traffic routes on a construction site, managers can be more confident that their site is a safer place to move around for site workers and visitors alike.

Concrete barriers save lives by absorbing the impact from vehicles and slowing them down.



...and off site

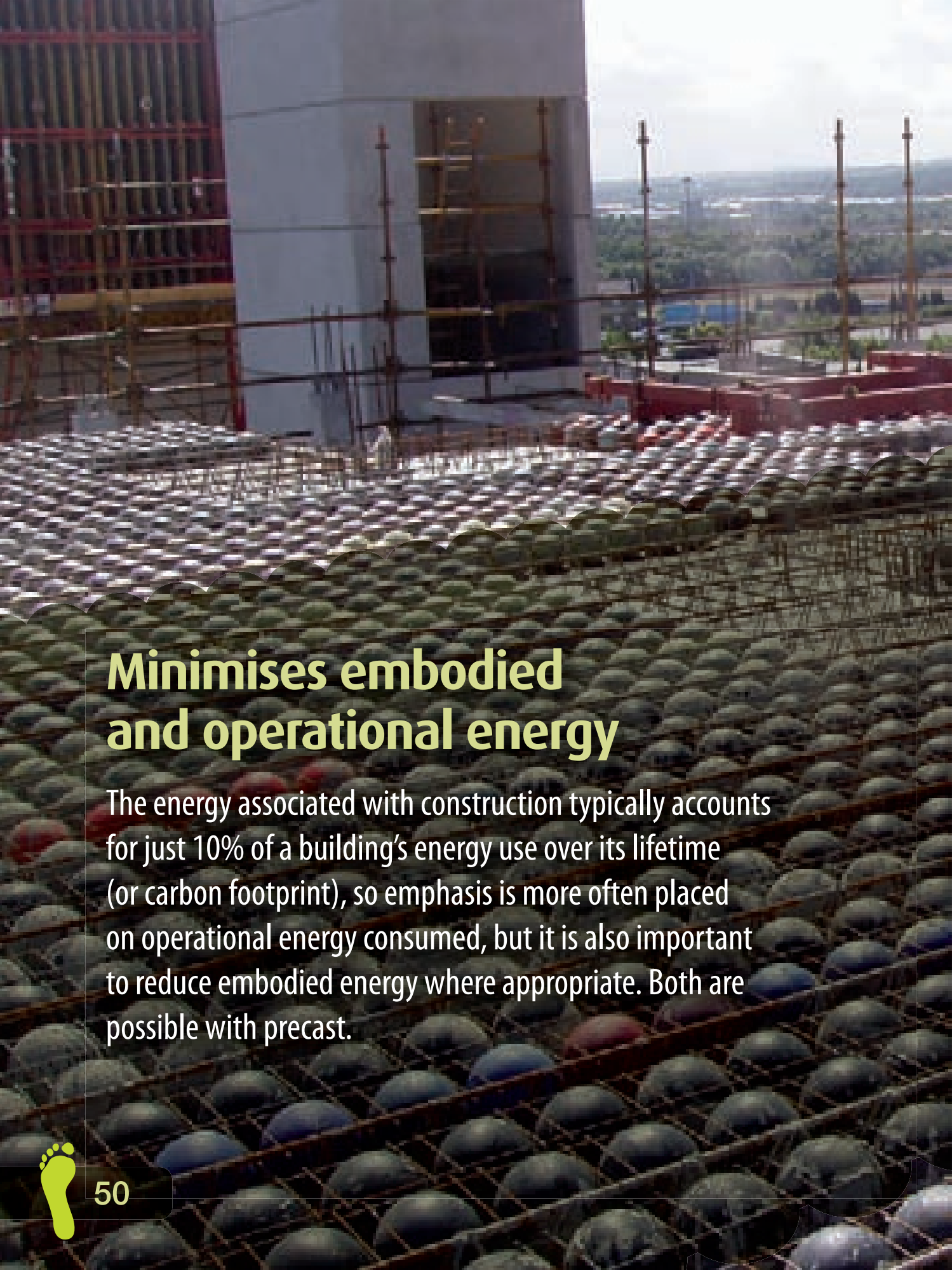
It is usual to see precast concrete barriers in place alongside roadworks on trunk roads and motorways. These provide workers with safe separation from the fast-flowing traffic and act as crash barriers should any vehicles stray off the carriageway.

Couple this with the permanent median barriers which are now commonly used on UK motorways to prevent cross-over accidents, and it is clear that concrete is a step ahead in terms of safety.

Achieving zero carbon

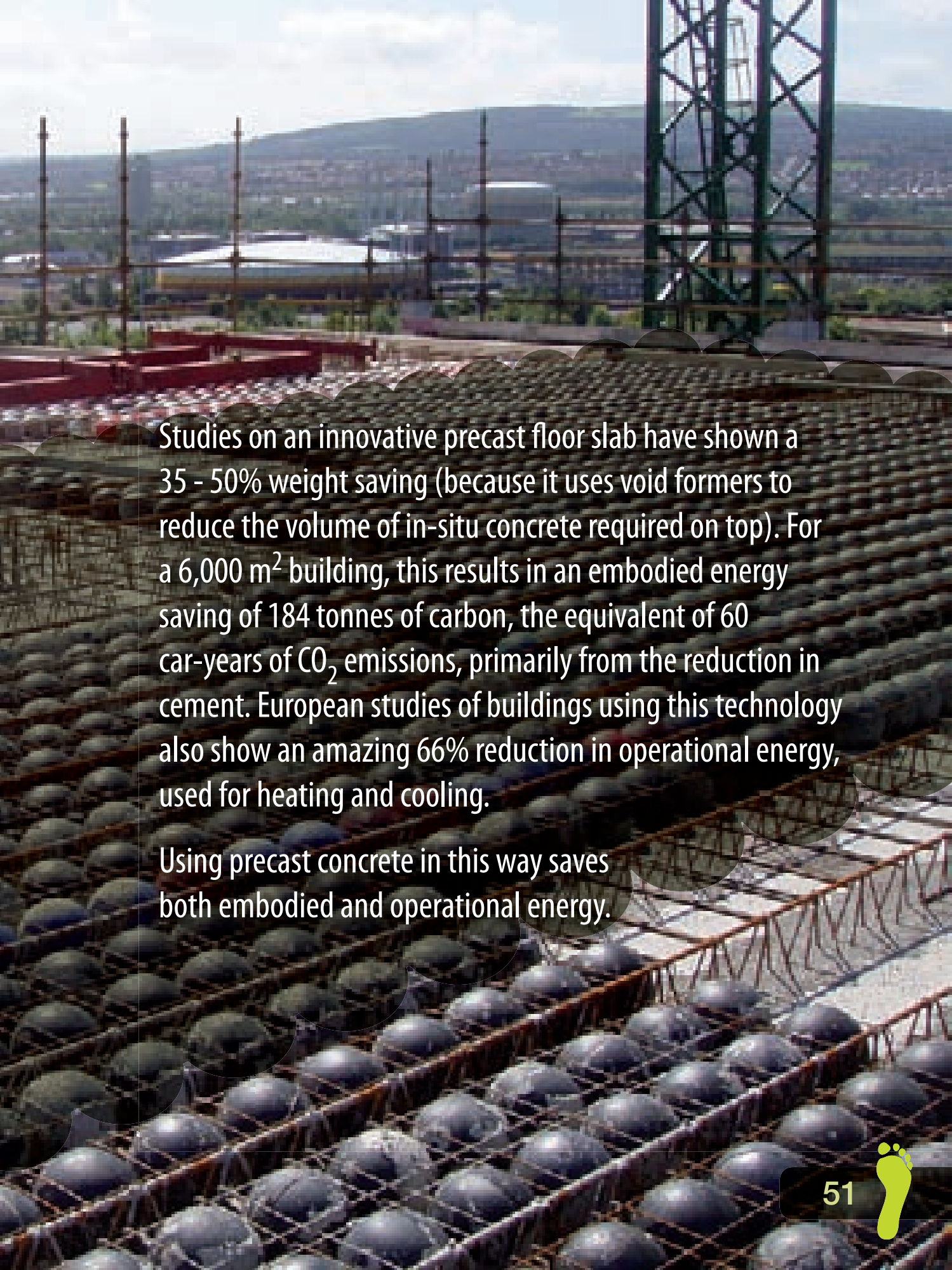
There is increasing pressure on the construction industry to build sustainably. For example, the target of 'zero carbon' homes is now well established in the UK. The precast and masonry sectors have signed a Government pledge supporting a target date of 2016. Local material sourcing, resource efficiency and waste reduction in the factory all mean that precast and masonry can help specifiers go for low carbon footprint buildings.

Improving energy efficiency in operational areas and logistics, in addition to choosing products with a minimal embodied energy burden, is absolutely critical. With the potential to contain recycled materials and some impressive credentials in terms of operational energy savings, precast concrete and masonry have much to offer.



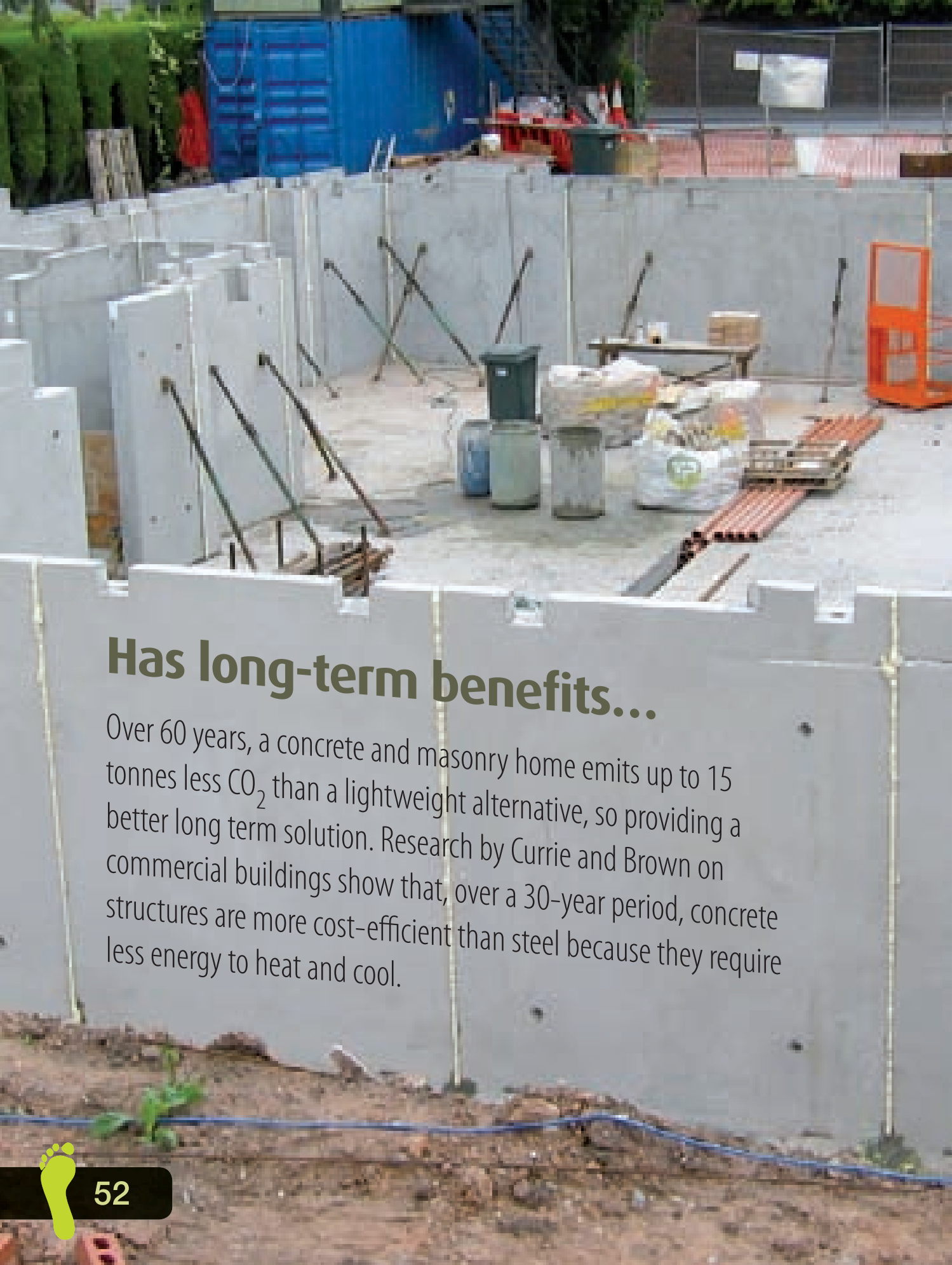
Minimises embodied and operational energy

The energy associated with construction typically accounts for just 10% of a building's energy use over its lifetime (or carbon footprint), so emphasis is more often placed on operational energy consumed, but it is also important to reduce embodied energy where appropriate. Both are possible with precast.



Studies on an innovative precast floor slab have shown a 35 - 50% weight saving (because it uses void formers to reduce the volume of in-situ concrete required on top). For a 6,000 m^2 building, this results in an embodied energy saving of 184 tonnes of carbon, the equivalent of 60 car-years of CO_2 emissions, primarily from the reduction in cement. European studies of buildings using this technology also show an amazing 66% reduction in operational energy, used for heating and cooling.

Using precast concrete in this way saves both embodied and operational energy.

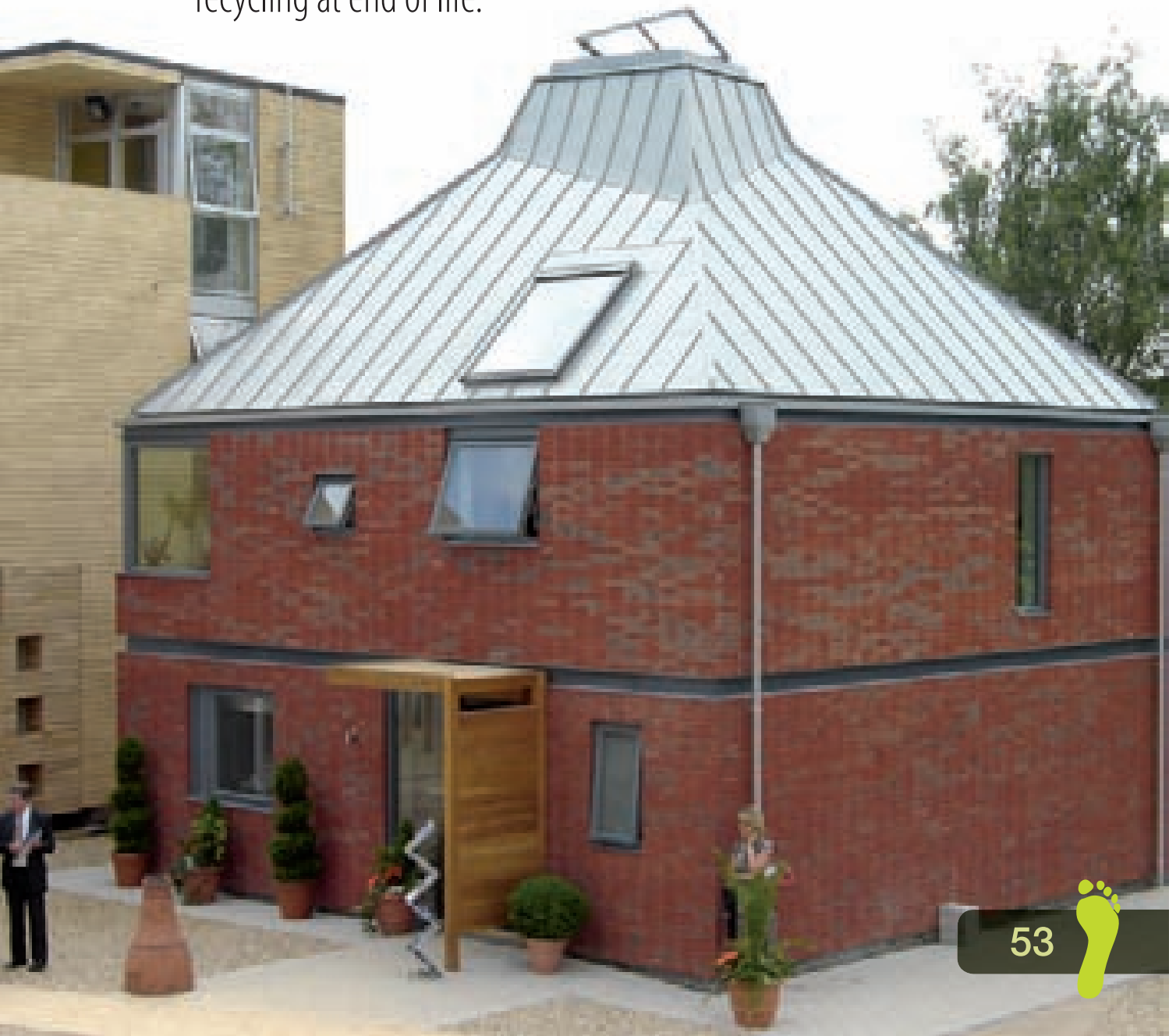


Has long-term benefits…

Over 60 years, a concrete and masonry home emits up to 15 tonnes less CO_2 than a lightweight alternative, so providing a better long term solution. Research by Currie and Brown on commercial buildings show that, over a 30-year period, concrete structures are more cost-efficient than steel because they require less energy to heat and cool.

...and

During its lifetime precast concrete will effectively re-absorb much of the carbon dioxide that was used to create it in the first place. Precast units, aggregate blocks and aircrete will ultimately re-absorb the CO_2 used to create them, a process called carbonation that accelerates when products are crushed for recycling at end of life.



Ratings now available…

More and more homes and business premises in the UK are being built to exacting environmental standards, such as BREEAM, and so specifiers need to be confident about the products they select. Many UK precast and masonry manufacturers have had their product ranges checked by independent assessors to certify environmental performance – many achieve the highest rating of A+ or A.

…but

For a full sustainability profile many other factors must be added in such as length of life, reusability and recyclability, thermal mass properties, solar gain minimisation, higher security, and resistance to insect attack, mould growth, fire and wind.

We strongly recommend that product ratings be taken as part of a holistic approach to sustainable design.

Can have a high recycled content…

Many precast products now contain by-products or recycled waste materials, such as pulverised fuel ash from coal-fired power stations and granulated slag from blastfurnaces. The demand from specifiers for products with a higher recycled content is growing steadily.

Precast concrete products such as blocks have some of the lowest (and best) embodied energy values of all commonly used construction products.

…and can be relocated

Most standard aggregate and aircrete concrete blocks are 100% recyclable and some use up to 97% reclaimed material in their manufacture.

The large precast retaining wall units shown here are made mainly from recycled materials and are relocatable.

Minimises reliance on fossil fuels…

On a large scale, precast concrete is used to construct the towers for wind turbines, but even on a domestic scale precast products support the drive to use renewable technologies. An innovative roof tile has been developed that incorporates photovoltaic cells – these harness the energy from daylight to create electricity, every day, even if the sun is not shining.

… and oil-based products

A good quality finish relies on achieving a clean break between precast concrete and its casting mould or bed; vegetable-based release agents can be used as a substitute for oil-based chemicals, thereby reducing the overall environmental impact.

In addition, concrete is not as vulnerable as plastics and asphalt to increases in oil and gas prices and is well-positioned for the post-oil age, especially considering the growing diversion of wood as biofuel for heating and power systems, a trend that will significantly raise global timber prices.

Can be re-used…

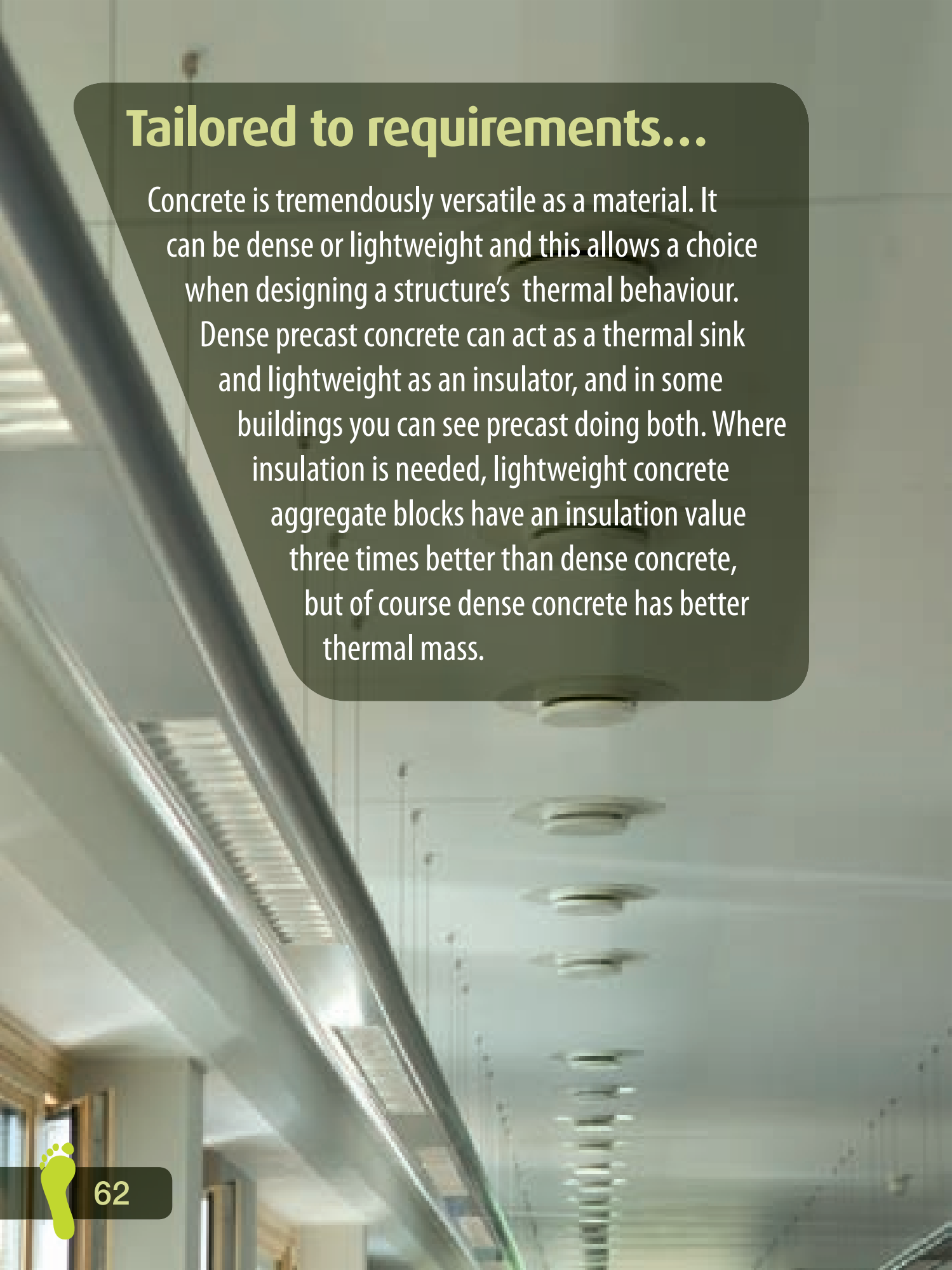
At the end of a structure's life, precast units can be re-used in their entirety, for example floor slabs can be reclaimed as whole elements These could be re-installed in the same building or even transported a short distance and used in a comparable structure elsewhere. Now, with a greater number of products incorporating technical information on a bar code or microchip, designers can be more confident about re-using precast products, such as piles and frame elements.

…or recycled

As with many concrete products, precast is easy to crush and recycle as aggregate – almost 100% of a concrete building can be recycled, no matter how heavily reinforced. Demand for recycled materials has more than doubled in the last decade and is growing every year in the UK. The government is encouraging the use of secondary or recycled aggregates through networks for suppliers and customers.

In an excellent example of closed-loop recycling, damaged or unwanted concrete roof tiles can be used as 'recyclates' – these are an alternative feedstock in cement kilns.

www.aggregain.org.uk
www.wrap.org.uk
www.qpa.org



Tailored to requirements...

Concrete is tremendously versatile as a material. It can be dense or lightweight and this allows a choice when designing a structure's thermal behaviour. Dense precast concrete can act as a thermal sink and lightweight as an insulator, and in some buildings you can see precast doing both. Where insulation is needed, lightweight concrete aggregate blocks have an insulation value three times better than dense concrete, but of course dense concrete has better thermal mass.

…and thermally versatile

This important characteristic of precast concrete can be seen in its application as a medium for heating or cooling, whether this is via air or fluids.

The hollow cores in precast floors can be used or pipes can be cast into slabs, to form cooling systems that use up to 50% less energy than air conditioning. The concrete surface radiates very effectively, protects the heating or cooling system within and allows room space to be used without the cost and hindrance of radiators or ducting.

Concrete pipe systems and precast and masonry labyrinths can be used to cool buildings and so reduce energy costs. Precast piles are also available with built-in ground source heat exchange systems.

Comfortable now...

The thermal mass properties of concrete help even out daily and seasonal temperature swings, making indoor spaces more comfortable without having to resort to air conditioning. With operational energy accounting for about 90% of the energy consumption of a building, this ability to moderate extremes in temperature is important.

Recent European research on energy efficiency shows that making the best use of thermal mass in homes saves 15 – 20% in heating costs and decreases energy needed for cooling by up to 50%. It also saves on capital investment and maintenance bills compared with air-conditioned homes.

...and in the future thermal mass will ease summer overheating

The future effects of climate change are now dominating the way we build. Recent studies show that lightweight homes in the UK will suffer significant overheating if summer temperatures rise as predicted. By contrast, masonry and concrete houses with solar shading will be more comfortable to live in and less likely to become reliant on air conditioning systems to maintain habitable temperatures inside because they make best use of concrete's thermal mass properties.

According to research by Arup, compared with an equivalent lightweight house, a masonry or concrete house will pay back its CO_2 'investment' within 11 years, and then continue to provide savings over its life.

www.sustainableconcrete.org.uk

Good for life...

The choice of precast concrete in a building or structure means that you are building-in resilience. The inherent properties of the material help it to withstand all manner of weather conditions, infestations and other less common threats such as explosions.

Quality of life is a clear priority in sustainability as is ensuring that we are constructing a built environment that will last for successive generations, not just for today. Precast concrete offers significant sustainable benefits in these areas.

Durable...

Concrete buildings and structures from hundreds of years ago are still in use today. Some say concrete can last up to 2000 years. At least two recent European precast projects were built to a 1000-year minmum design life.

Effective design detailing helps to lengthen the life of a concrete building; precast manufacturers can offer guidance on designing for durability.

…and it gets stronger every day

Precast concrete goes on increasing its strength for hundreds of years after it is cast.

What's more, during that time it won't shrink, warp, move or creep excessively, so can be relied upon to perform consistently year after year.

Weather-proof

Precast concrete is resistant to rain penetration and wind-blown debris – only concrete and masonry walls can provide this protection. In a study of exterior wall systems, Texas Tech. University's Wind Engineering Research Center found that only concrete wall systems were proven to withstand 100% of all known hurricane-force winds, and over 99% of tornado-force winds.

Concrete can also withstand many winters of freeze-thaw cycles, unlike other materials that can deteriorate quickly with such regular exposure to climatic changes. In damp, exposed or harsh environments, other materials struggle to match the performance of concrete.

Resistant to the effects of climate change

Predictions of higher winds, more driving rain, tropical-style deluges and flash floods, and more incidences of localised windstorms in the UK are of concern for homeowners and businesses.

Precast concrete and masonry products offer better protection against these possible effects of climate change because they are robust, durable and have structural integrity.

Does not rust

Precast concrete is corrosion-resistant and can therefore be used with confidence, even in very aggressive environments. For example, precast concrete piers are resistant to the inter-tidal anaerobic attack experienced in some marine environments.

Furthermore, tight quality controls in factory production mean that cover levels for rebar are guaranteed in any application, and in most cases this prevents even minor unsightly rust patches developing.

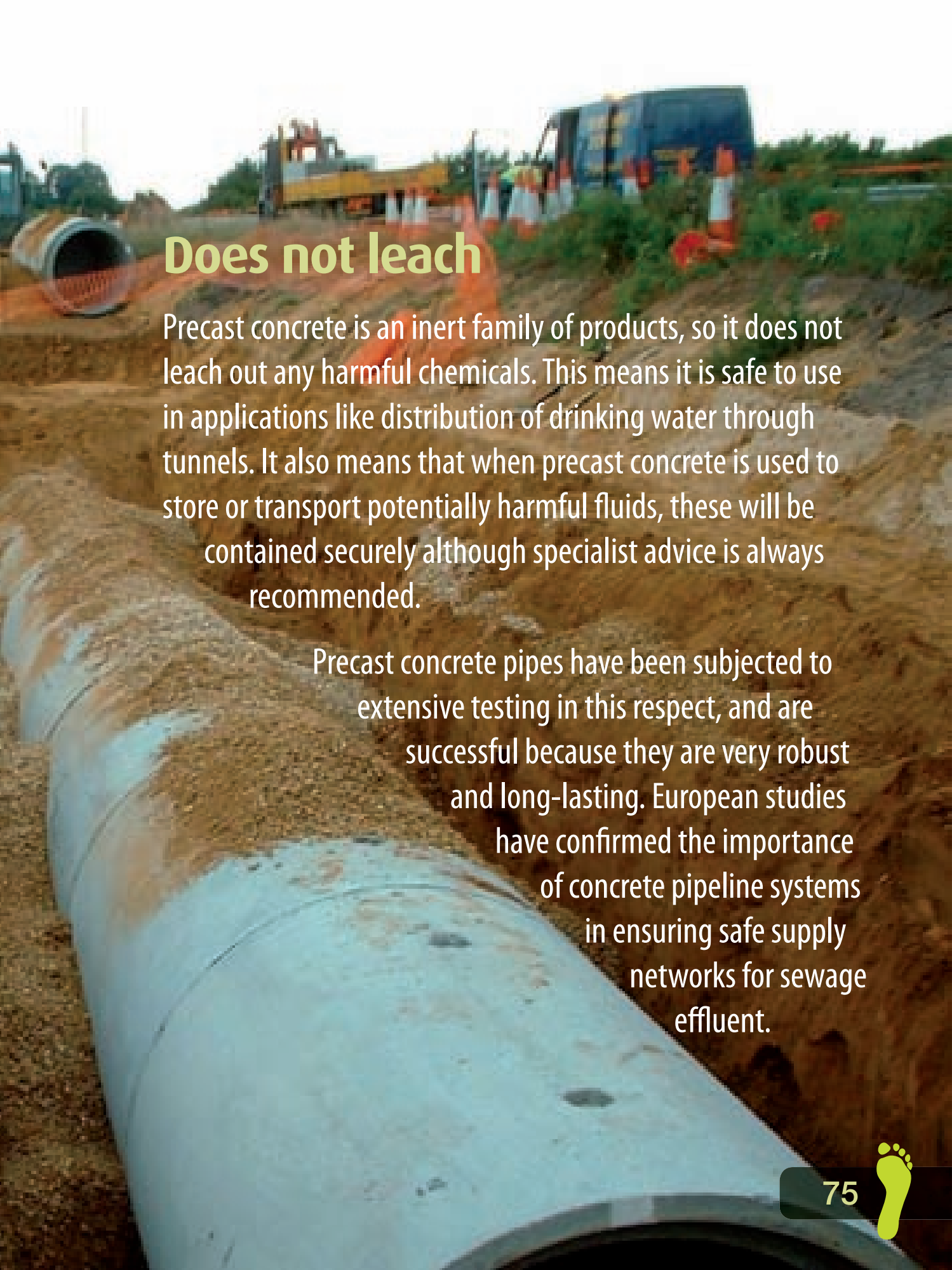
Resists chemical attack

For vehicle hard-standing, aircraft standing aprons and other paved areas, concrete paving blocks are an ideal choice because they are resistant to fuel and oil spills. Their use makes sense economically and environmentally because pavement repairs are localised, using less materials and causing less disruption.

Everyday resilience

On a domestic scale, precast and masonry are also used for basements where below ground living needs robust and waterproof construction.

Precast concrete is tough and durable and can withstand everyday maintenance, but it is also resilient in the face of intense pressure. For example, used for underground pipes, precast is resistant to jetting (to clean out the system).



Does not leach

Precast concrete is an inert family of products, so it does not leach out any harmful chemicals. This means it is safe to use in applications like distribution of drinking water through tunnels. It also means that when precast concrete is used to store or transport potentially harmful fluids, these will be contained securely although specialist advice is always recommended.

Precast concrete pipes have been subjected to extensive testing in this respect, and are successful because they are very robust and long-lasting. European studies have confirmed the importance of concrete pipeline systems in ensuring safe supply networks for sewage effluent.

Rot proof, fungus proof and mildew resistant

Precast is dense, tough and does not shrink or warp. It simply will not fall prey to these common enemies of organic materials. Specifying precast means having confidence that a structure won't rot away – seen or unseen.

Damage is often done within or behind walls and on discovery, it is often too late to resolve easily; such repairs cost millions of pounds every year in the UK alone.

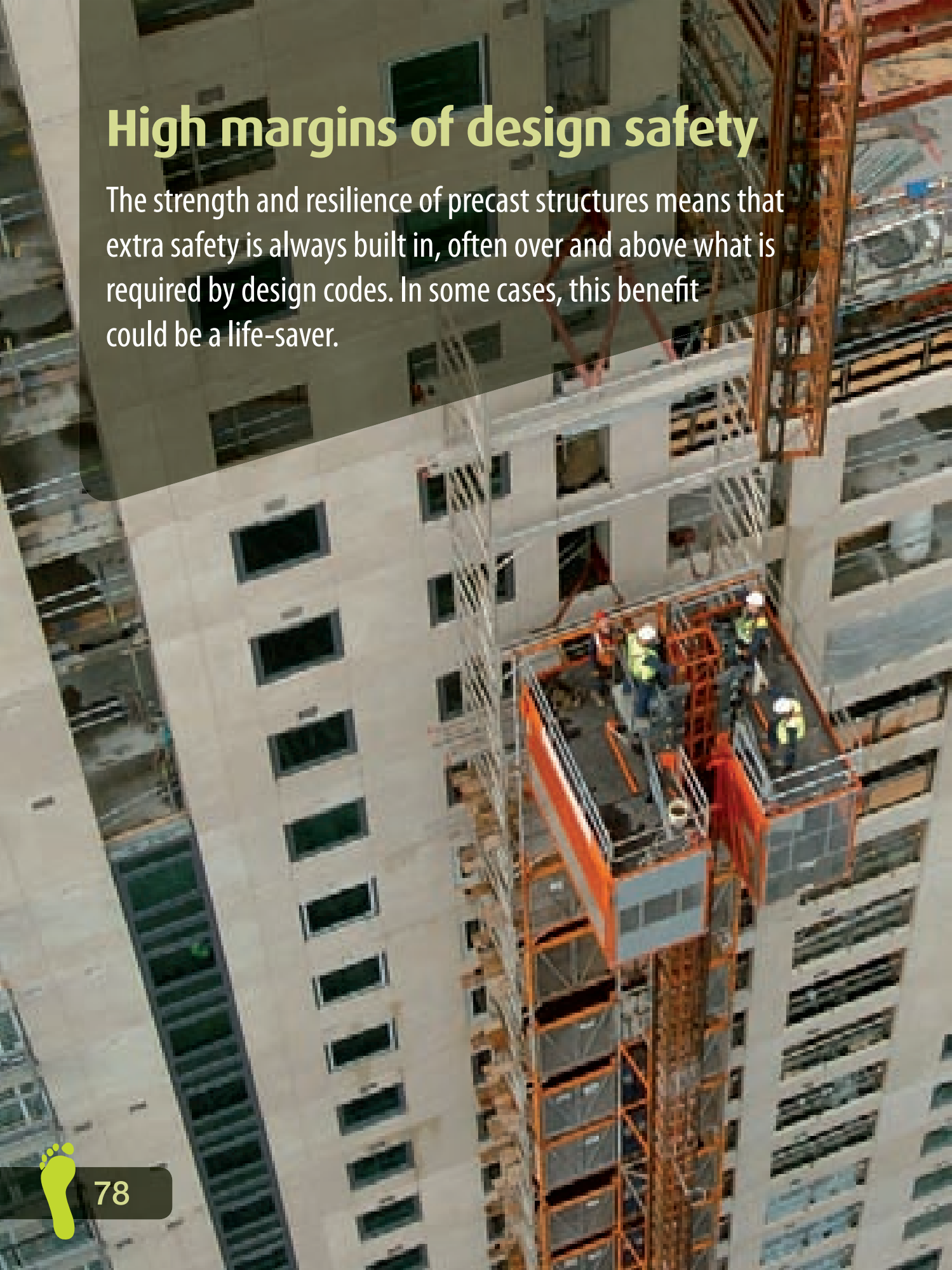
Inedible to termites and rodents

Organic building materials make the best food for these pests and with climate change having a profound effect on the flora and fauna in Europe, termites are now threatening the UK.

Precast concrete is resistant to attack from termites and other infestations such as rats and mice, so buildings made with concrete and masonry will be less susceptible to such damage.

High margins of design safety

The strength and resilience of precast structures means that extra safety is always built in, often over and above what is required by design codes. In some cases, this benefit could be a life-saver.



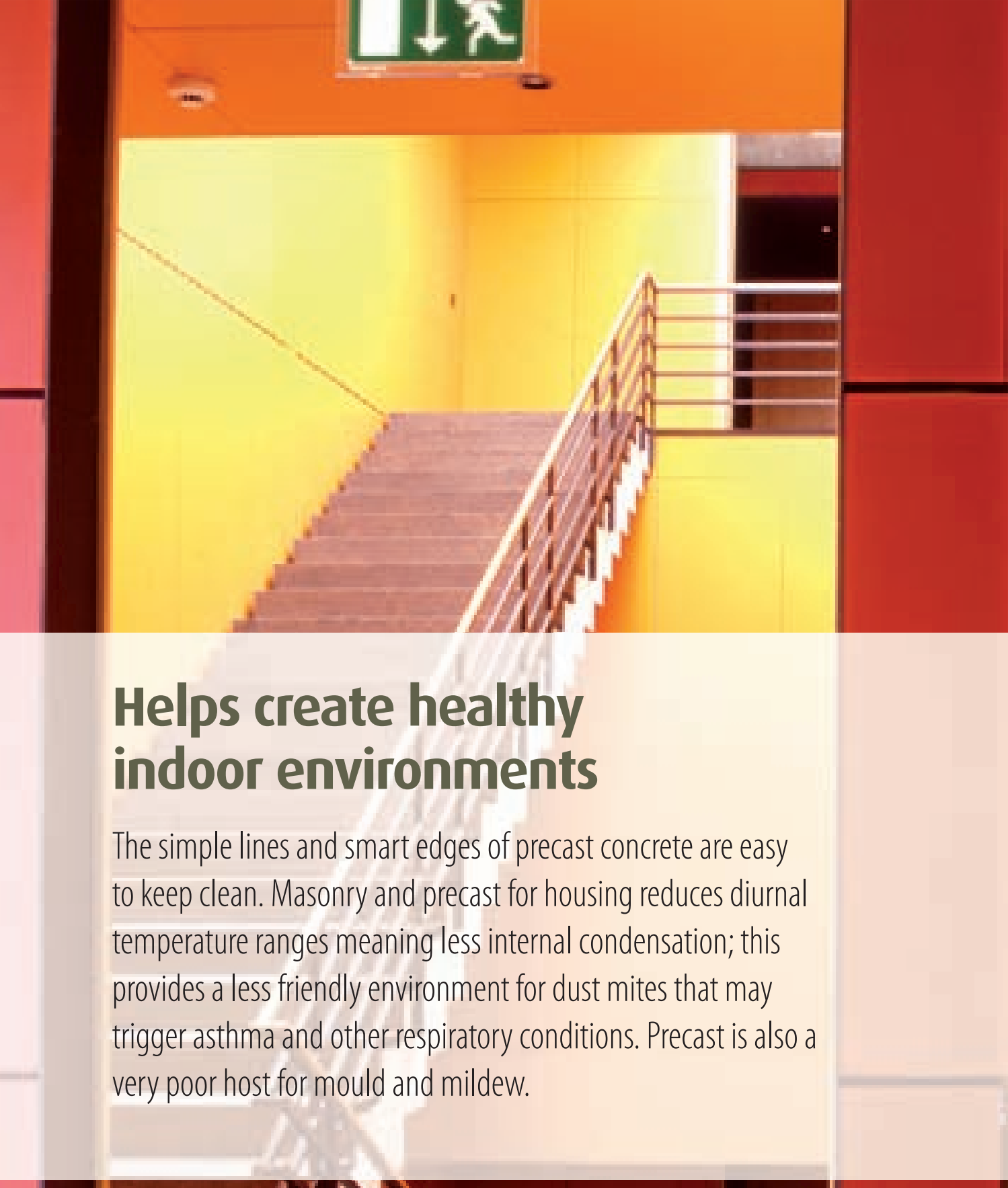
Absorbs impacts and offers blast protection

Precast concrete can resist massive impacts. There is a growing need for built structures to be more resilient to threats from flood and fire. In extreme applications, blast protection from explosions may be a necessary design criteria. Sufficiently reinforced and thickened precast units can perform a critical role here.

Many high-profile infrastructure projects and government buildings in the UK and elsewhere feature precast concrete products because of their robustness and resilience. Some have even been put to the test and proved impenetrable under attack.

…and good for living

Precast concrete has a range of structural properties and functional benefits, which ensure that buildings are fit for purpose, secure and sound. Not only is this reassuring for occupants, but it also means that precast concrete buildings tend to attract lower insurance premiums than those built from other construction materials. This can become particularly evident in high risk areas such as those at threat from floods, arson, accidental fire and burglary.



Helps create healthy indoor environments

The simple lines and smart edges of precast concrete are easy to keep clean. Masonry and precast for housing reduces diurnal temperature ranges meaning less internal condensation; this provides a less friendly environment for dust mites that may trigger asthma and other respiratory conditions. Precast is also a very poor host for mould and mildew.

Precast is emission free

In its daily use, precast concrete is an inert substance, so it doesn't emit or give off any gases, toxic compounds or volatile organic compounds.

This all means allergy sufferers can breathe easy because precast does not contribute to the symptoms of 'sick building syndrome' – some estimate that SBS costs UK businesses over £600 million every year in lost productivity.

Withstands everyday use

All structures and buildings are subject to everyday wear and tear and this is where the use of precast concrete really makes sense. Its hard, tough surface is extremely resistant to everyday dents and punctures.

This might sound like a minor consideration, but its an inherent benefit of concrete structures that they are resilient and long-lasting from top to toe, offering an absolute minimum of 60 years service life.

Built for generations

By adhering to the principles of 'lifetime homes', successive generations of people can be accommodated in the same properties without recourse to major changes or even relocation.

Precast concrete responds well to this important aspect of social sustainability in its use for basements, which provide easily adaptable extra space for playrooms, utility rooms or even home offices – removing the need for commuting. Basements can save up to 27% of land required to build the same volume of living space in a house with two storeys above ground. That same house is automatically up to 10% more energy efficient as 1/3 of its volume is below ground.

Precast lift shafts are now available as are precast bathroom pods.

www.basements.org.uk

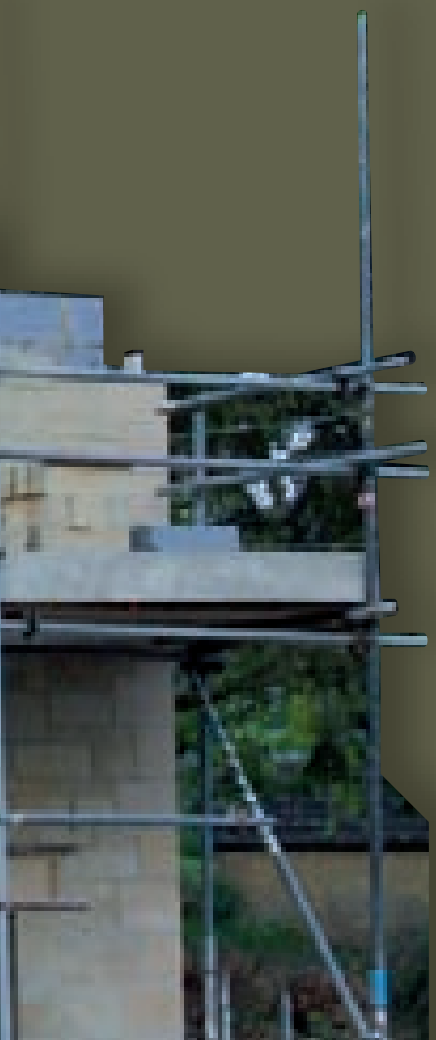
Flexibility for life

Considerable flexibility can be built into precast concrete. Not only can window and door shapes be created, but there is scope to design elements so that they are more lightly reinforced in some areas – these can then be cut through at a later date, should perhaps the client wish to add a door between two rooms. Aircrete and aggregate concrete blockwork is easy to handle, cut and replace.

Easy to extend

The fact that precast elements can be dismantled (or deconstructed) means that it is easy to add extensions or new wings to precast structures. Where precast panels were used it is simple to remove them and continue building – they can be re-installed on completion.

In addition, precast concrete structures can be designed for future generations by specifying them to withstand greater loads than are needed today.



Quiet…

As a dense material, precast elements in a building make for a peaceful lifestyle. It is the mass of concrete which helps to deaden noise, whether this arises from people talking, playing music or doing DIY.

Privacy and effective sound reduction are thus ensured, and with UK planning policy requiring better acoustic separation between residential buildings, masonry and precast walls and floors are the ideal choice.

…yet acoustically versatile

Because precast can be moulded to any shape, size and texture it can be used to deflect or absorb noise. This makes it a good acoustic host for music but also an effective sound barrier alongside busy roads.

Road noise and vibration from traffic are a common cause for complaints, so any measures that can be taken to improve this aspect of people's quality of life should be welcomed.

Protects against fire

Precast is fireproof. It does not catch fire or burn. It protects against the spread of fire between rooms or properties – fewer fire-related deaths are recorded proportionately in concrete buildings. In fire tests, concrete performs consistently well, typically needing very little remedial treatment following exposure to the high temperatures of a fire. In most cases, some minor patching and a new coat of paint may be all that is required to make good.

Studies in Sweden have indicated that a major fire is more than 10 times less likely to develop in houses built from concrete or masonry. Furthermore, Professor Ulrich Schneider of Vienna University of Technology has also found a clear link between construction materials and fire safety – there are about three times fewer fire victims in countries which build mainly in concrete, masonry and stone.

Does not melt

Just like many other concrete and masonry materials, precast concrete does not melt in high temperatures. This means that there is no need for protective paints or special insulation – and finishes can be viewed just as the designer intended. Concrete will not drip molten particles in a fire, and this helps protect human life by providing safe escape routes and preventing fire spread.

Offers a safe haven…

the structural strength and dense nature of precast concrete makes it an ideal choice for safe or panic rooms in houses.

In a large building, concrete structures are often used for escape stair cores and can form a protective area around designated places of safety, for example, for wheelchairs in evacuation or escape routes.

…and keeps buildings secure

The prevention of fear of crime and disorder is a major issue within social sustainability, but security also has a massive impact on people's livelihoods.

Whether for homes, businesses or increasingly for prisons, precast is secure against break-ins and break-outs; it can't easily be cut open and is extremely resistant to impact.

Making better places

It is vital that we invest in infrastructure which is long-lasting and robust – but we must also consider the overall quality of the environment so that it is a healthy world for people to enjoy.

The onset of the effects of climate change, including flooding and sea level rise, mean that the future pressure on civil engineering structures could be much greater than today. Precast concrete allows us to build sustainably and with confidence in the face of such adversity.

Essential for sustainable transport systems

Clean, greener options for travelling to work, school or home are being built throughout the UK, and precast concrete is at the heart of many schemes.

Guided bus lanes and track beds, and bridges for light rail or tram systems commonly include precast elements because they are long-lasting, durable, robust and can also have a very attractive surface finish.

Can reduce traffic fumes

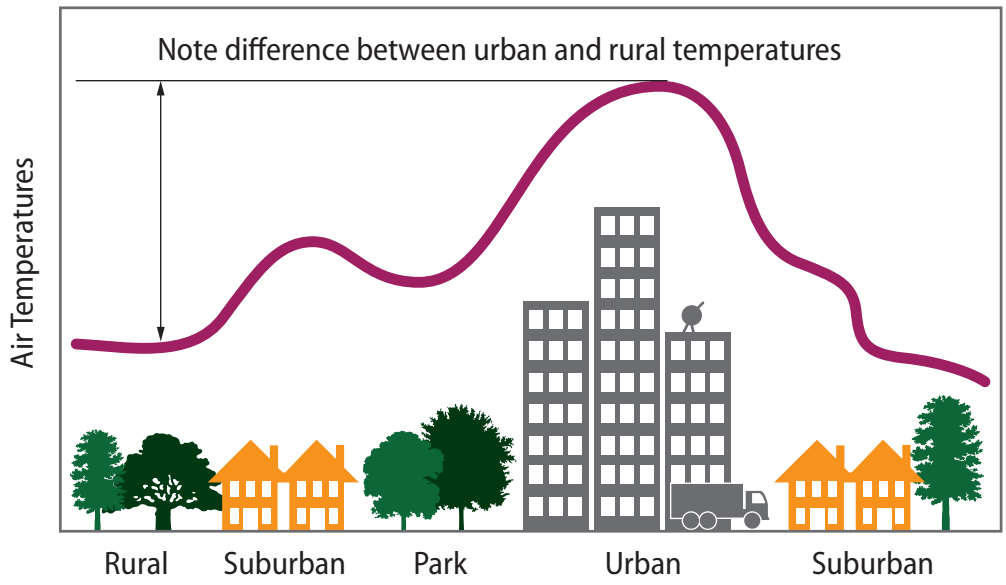
Using an ingenious materials innovation, precast concrete incorporating titanium modified cement can reduce emissions from traffic fumes. These fumes are harmful to health and can trigger respiratory problems such as asthma. A process called photocatalysis occurs which entraps the SOx and NOx particles from vehicle exhausts. These, are then dispersed harmlessly when rain falls on the road surface.

Tests in Europe show that treated concrete block pavers can reduce typical urban pollutants by about 50%.

Clean energy from wind turbines

Precast concrete is often used for wind turbines – its high levels of weather resistance and inherent stiffness help provide a stable and resilient structure.

Precast concrete rings create wind turbine towers that generate electricity which is a renewable resource. However, the best locations to place wind turbines are also often the harshest environments, so it is important to use a structural material that does not rust or decay.



Cross-section of a typical urban heat island

Saves energy in the city

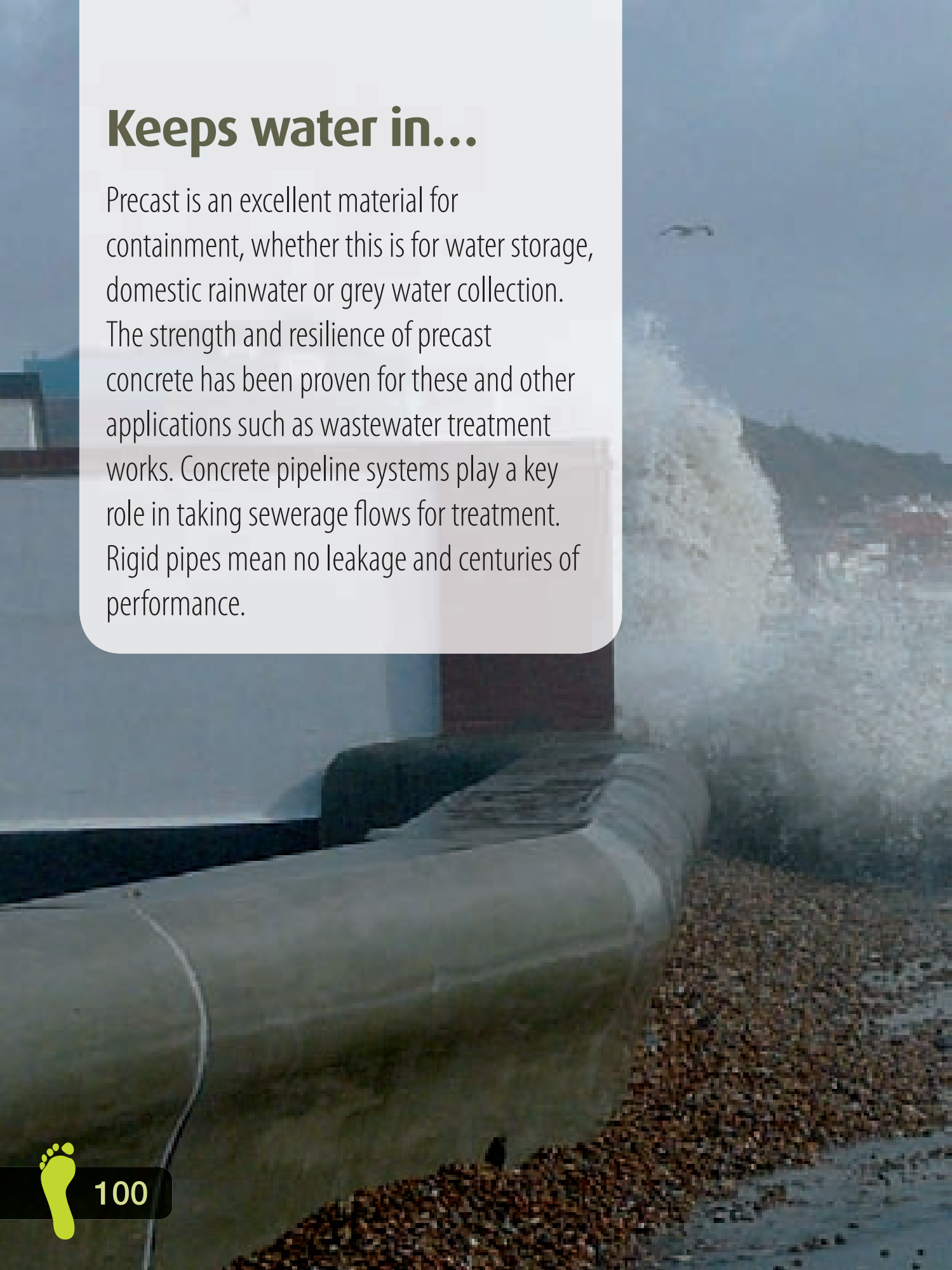
On a hot day, pale coloured concrete finishes, including paving and roofs, reflect more sunlight and heat than dark surfaces, so keeping buildings cooler and mitigating the 'urban heat island' effect.

This reduces urban energy use because people are less likely to use air conditioning, potentially saving many tonnes of carbon and millions of pounds every year.

The pale colours that can be achieved with precast concrete finishes really help to reflect light – reducing heat gain in buildings, but also making the streets brighter and safer at night allowing lower street lighting energy use where appropriate.

Keeps water in...

Precast is an excellent material for containment, whether this is for water storage, domestic rainwater or grey water collection. The strength and resilience of precast concrete has been proven for these and other applications such as wastewater treatment works. Concrete pipeline systems play a key role in taking sewerage flows for treatment. Rigid pipes mean no leakage and centuries of performance.



...and out!

In other situations where we need to keep water out, precast can be used for flood protection, and river and coastal barriers to protect against inundation from high tides and storms. It is estimated that flooding costs the UK about £1bn per annum at present, so there is a financial imperative to act.

Precast concrete flood mats and barriers can protect river banks and livelihoods – and with the onset of climate change, such flooding could become more frequent and widespread. The use of similar precast elements can also be used to create breakwaters and artificial reefs out to sea.

Reduces the risk of flooding...

Permeable paving systems, soakaways and attenuation tanks are used in sustainable urban drainage systems (SUDS). These systems help prevent rapid run-off of rainwater from roads and pavements in urban areas by allowing water to permeate quickly and naturally. All precast paving allows some permeability; in contrast hard surfaces with no joints are a problem because rainfall cannot drain sufficiently quickly and the water builds up, causing localised flooding – which is inconvenient, damaging and potentially dangerous.

…and eases the clear-up

The high quality surface of precast and masonry and the fact that it does not erode or rot make the task of clearing up after a flood a little more straightforward. This can be a difficult time for people struggling to come to terms with the devastation that floods can bring, so precast brings a welcome respite whether the flooding is localised or more widespread, a frequent or an occasional event.

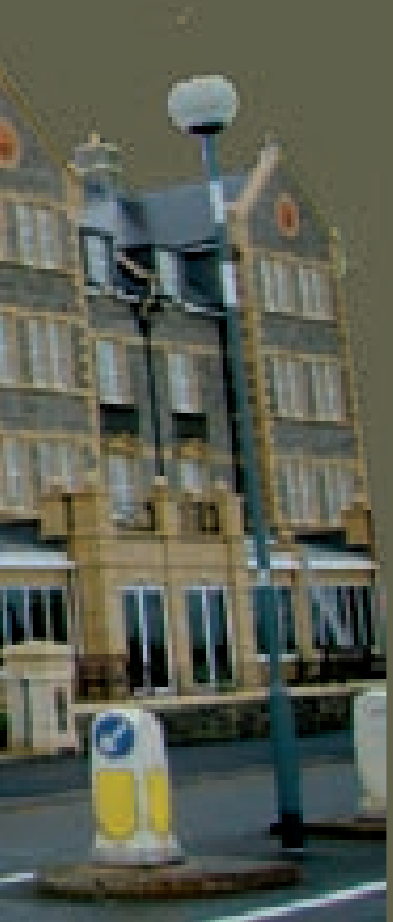
Blends in with existing structures

In areas of historic or architectural importance, it may be important to ensure that any new buildings match or are sympathetic to their older counterparts. Careful mix design in the precast factory and use of mock-ups can ensure that the match is satisfactory for all those involved. Aesthetics and long life are important but overlooked aspects of sustainable design.

Can replicate patterns, shapes or other materials

The 'mouldability' of precast means that it is an excellent mimic, whether this entails copying classical details like keystones and capitals or matching the finish of materials like weathered stone. Alternatively, designers can choose dramatic or contrasting colour treatments.

The UK precast industry can source a wide range of aggregates locally – in fact, a tremendous variety of colours and visual effects is possible.



Acts as an aid to visually impaired people…

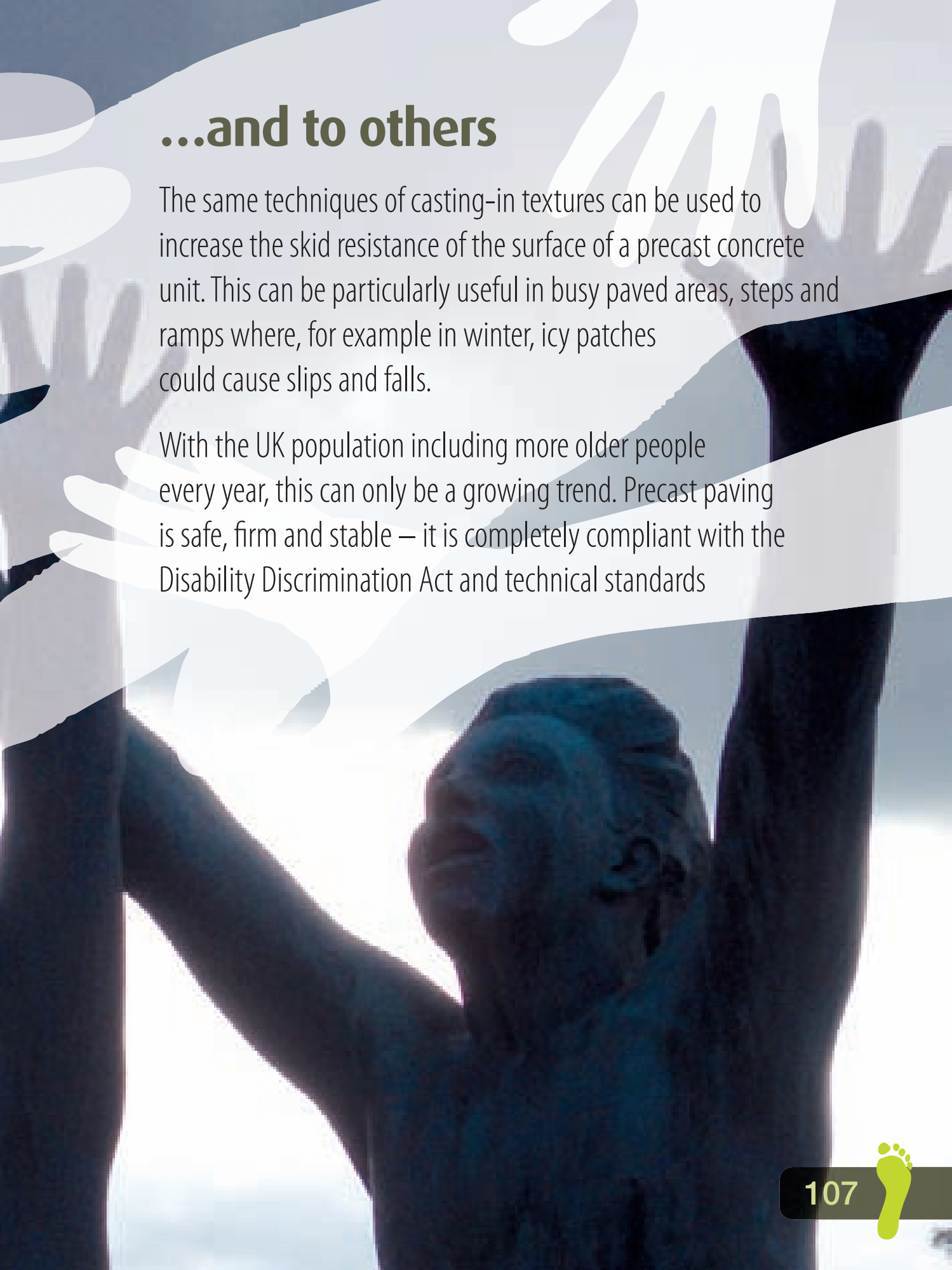
It is common to see textured or profiled paving slabs near pedestrian crossings. Tactile paving helps visually impaired people to recognise changes in level and and direction, and dangers from passing traffic or other hazards.

By making our towns and cities more useable and attractive to all, we can better facilitate social inclusion and accessibility.

…and to others

The same techniques of casting-in textures can be used to increase the skid resistance of the surface of a precast concrete unit. This can be particularly useful in busy paved areas, steps and ramps where, for example in winter, icy patches could cause slips and falls.

With the UK population including more older people every year, this can only be a growing trend. Precast paving is safe, firm and stable – it is completely compliant with the Disability Discrimination Act and technical standards



Appearance matters...

Everywhere you look you will see innovations in precast concrete hard landscaping and street furniture. For example, large planters, planted bridge abutments and living walls help to make places greener and more pleasant.

This also has the effect of increasing biodiversity – the plants support insect life and wild birds too.

...and precast can be self-cleaning

The optional inclusion of titanium dioxide in cement does not only produce white precast concrete but also helps to keep the finished product clean. It does this by capturing dirt particles which are then washed away by rainfall.

Clean buildings look more attractive and are less likely to be subjected to vandalism, damage and graffiti.

Moving the industry forward

The UK precast concrete market is worth approximately £2.6bn a year and employs over 22,000 people directly, plus related upstream and downstream employment. Companies within the industry are making significant progress towards sustainability, by improving supply chain and factory performance, introducing new materials and products, by sharing best practice and by contributing to research and innovation.

Provides leadership in sustainability at home...

Since 2004, the precast concrete industry has established a 'Sector Sustainability Strategy' programme for the UK. Working with Loughborough University, British Precast is engaging with and encouraging action on sustainability across the broad industry.

www.sustainableprecast.com

...and away

Extensive and regular contact between companies and members of British Precast at European and international level enable the UK-based sustainability strategy project to align well with comparable projects underway within BIBM member countries. This ensures that companies learn from others' sustainability success stories.

www.bibm.eu

Recognises progress in sustainability…

The British Precast Sustainability Award is very competitive and attracts high standards of entry from the leaders in sustainable precast in the UK. Entries include major energy awareness campaigns, water conservation projects, community improvement schemes and recycling projects. Some of the supporting evidence provided by companies demonstrates truly outstanding progress.

A precast factory in Yorkshire has become the first active manufacturing site to attain The Wildlife Trust's 'Biodiversity Benchmark', which is a rigorously-audited assessment for quality in land and habitat management.

…and innovation

The British Precast Innovation Award recognises high levels of achievement in its member companies each year. The efforts of companies and their staff to improve innovative performance do not go unnoticed, with many entries having an environmental or sustainability theme running through them.

Is actively involved in research...

Through individual companies and British Precast, the UK precast industry is well-represented on a number of high-profile, UK sustainability research programmes. These include projects examining waste and resource efficiency in construction, and developing a systematic approach to life-cycle carbon inventories.

…and dissemination

British Precast organises large-scale sustainability conferences. All member companies have been presented with copies of the seminal Al Gore DVD, 'An inconvenient truth'.

By ensuring that the best quality information on sustainability reaches a broad audience, the industry is able to demonstrate its progress and share best practice.

The UK Concrete Platform has initiated a website to include case studies and information from all corners of the cement and concrete industry: www.sustainableconcrete.org.uk

The USA website www.concretethinker.com is especially recommended for its case studies on sustainable design.

Promotes health and safety...

While there is no doubt that the controlled and well-managed environment of the precast factory is a very safe place to work, the industry is determined to improve even further.

The 'Concrete Targets 2010' scheme was set up to encourage and reward companies who improve their health and safety track records – it targets zero accidents, injuries and lost time.

...and recognition for skills

The precast industry needs new staff each year as it develops and grows.

With the Proskills initiative, training programmes and input from experts in the UK and Europe, the industry is investing in new educational resources and better recognition for precast's vocational skills.

Leads the way in new factories

The most modern precast factories in the UK are quite simply high-tech!

Recent investments in fully-automated carousel-style production systems have made for speedy, efficient and safe production. Closed-loop recycling systems ensure that virtually nothing goes to waste. Such examples demonstrate precast manufacturers' commitment to the principles of sustainable production.

Is working on responsible sourcing

With pressure from clients, specifiers and environmentalists to account for all stages in the life-cycle of construction products, the precast industry is moving forward on responsible sourcing and addressing the issue of sustainable procurement. The concrete industry is working to develop a certified chain of custody scheme. This will mean that sustainably-produced products can gain 'responsibly sourced material credits', which are set to become commonly used in the construction industry.

For the latest news go to:
www.britishprecast.org
www.sustainableprecast.com

Provides up to date information...

It is important to be able to specify precast concrete and masonry with the confidence that it meets or exceeds environmental performance standards, such as BREEAM and the Code for Sustainable Homes. By providing extensive and robust information on their products and factories, precast manufacturers ensure that their environmental profiles are kept up to date.

...from a cohesive industry

As a part of a wider industry platform, which encompasses all other concrete and cementitous materials products, the precast industry participates actively in several pan-industry task groups and initiatives.

This ensures collaboration and effective cross-fertilisation of ideas and initiatives on sustainability – these groups ensure that effective learning takes place throughout the entire sector.

Has its own Sustainability Charter

As part of the 'Sector Sustainability Strategy' programme, the precast sector has outlined its own Sustainability Charter. This encompasses a set of sustainability principles that are appropriate to precast concrete covering resource efficiency, waste management, community relations, ethical standards and statistical reporting. The charter and an updated list of signatories is on the website

www.sustainableprecast.com

Looks to the future

This Little Book shows that sustainability is part of everyday business for the precast concrete industry, but we think there's still more to come. For example, British Precast has acknowledged its role in promoting action on climate change by signing up to a CBI national programme for trade associations.

We're keen to hear of new possibilities for precast – please send in your sustainability ideas and success stories to: info@britishprecast.org

Information sources

This Little Book is intended to stimulate interest in the sustainability credentials of concrete products. For detailed information in this fast-moving area we suggest that you visit some key websites on a regular basis.

www.britishprecast.org
www.sustainableprecast.com
www.sustainableconcrete.org.uk

We also recommend these industry sites:
The Concrete Centre – **www.concretecentre.com**
The Concrete Society – **www.concrete.org.uk**
British Cement Association – **www.cementindustry.co.uk**
Quarry Products Association – **www.qpa.org**
United Kingdom Quality Ash Association – **www.ukqaa.org.uk**
Cementitous Slag Makers Association – **www.ukcsma.co.uk**
Steel Reinforcement – **www.uk-bar.org**
Cement Admixtures Association – **www.admixtures.org.uk**
Building Research Establishment – **www.bre.co.uk**
Concrete Thinker – **www.concretethinker.com**

We will be pleased to organize speakers at events and meetings. We invite case studies and will publish them. Enquiries and suggestions are very welcome to **info@britishprecast.org**

Precast sustainability

Each of our product groups brings a focus on sustainability to particular construction applications. Websites are as follows:

Aggregate blocks – **www.cba-blocks.org.uk**

Aircrete products – **www.aircrete.co.uk**

Architectural cladding – **www.architectural-cladding-association.org.uk**

Box culverts – **www.boxculvert.org.uk**

Masonry housing – **www.modernmasonry.co.uk**

Paving and kerb – **www.paving.org.uk**

Pipeline systems – **www.concretepipes.co.uk**

Precast floors – **www.precastfloors.info**

Rail sleepers – **www.britishprecast.org/csma**

Roof tiles – **www.britishprecast.org/ctma**

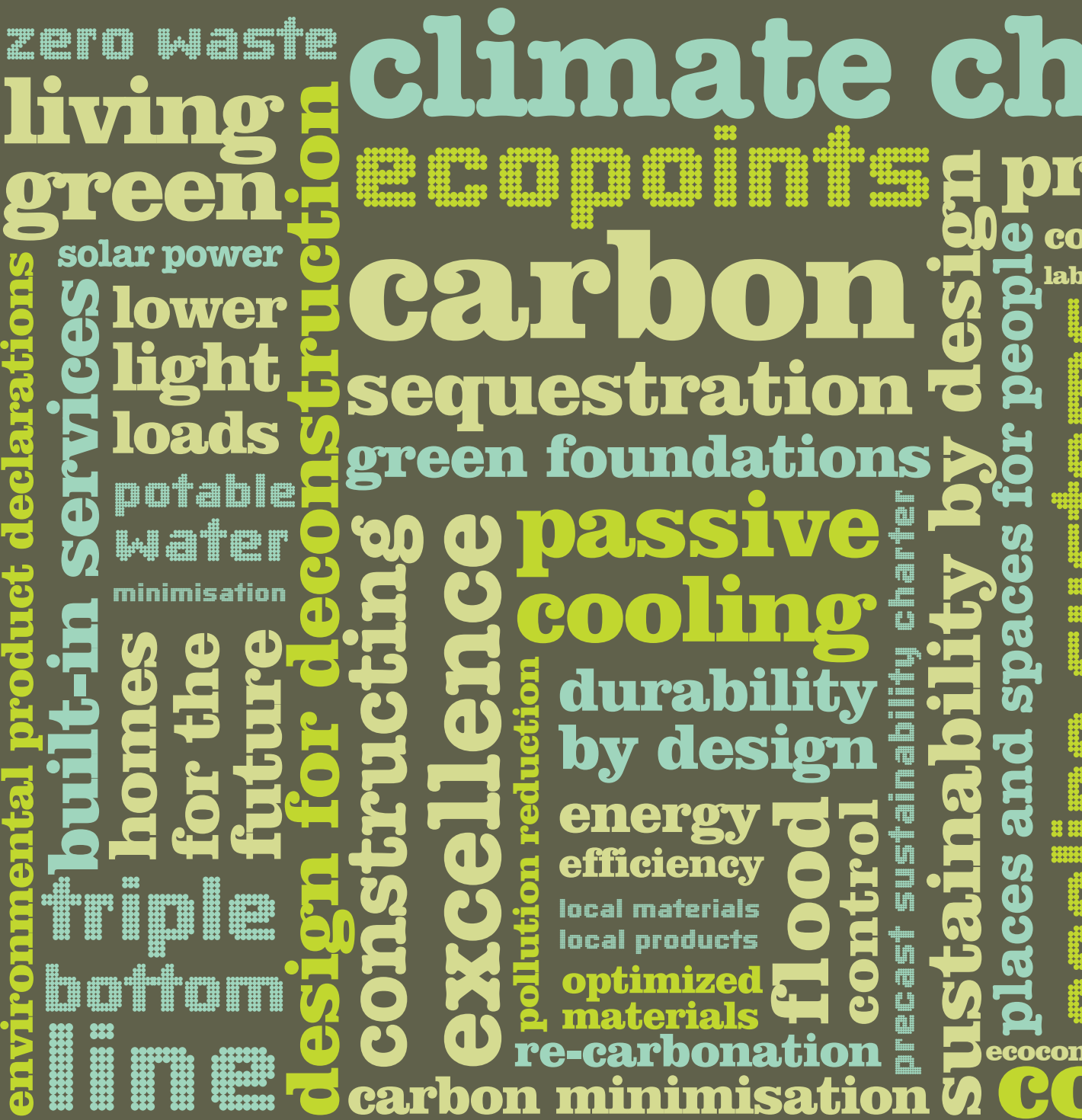
Structural precast – **www.structural-precast-association.org.uk**

Images

Our thanks are due to the many organisations and companies that have provided photographs for use in this publication. Among them are Aggregate Industries, BASF, Bell & Webster, Bison Concrete Products, Buchan Concrete Solutions, Cemex UK, CPM, FeBe, Forticrete, Friends of the Earth Europe, Hanson Building Products, Italcimenti, Lafarge, Marley Eternit, Marshalls, Milbank Floors, Milton Precast, Monier, PCA, Quarry Products Association, Roger Bullivant, SLP Precast, Stanton Bonna, Tarmac, Techrete, Thermonex and The Concrete Centre.

To join **British Precast** email **info@britishprecast.org**
To purchase copies of this publication visit
www.britishprecast.org or **www.concretebookshop.com**

“Sustainability is a journey,
not an end point”



Printed on paper certified by
the Forest Stewardship Council

BRITISH
PRECAST

www.britishprecast.org
www.sustainableprecast.com
www.sustainableconcrete.org.uk