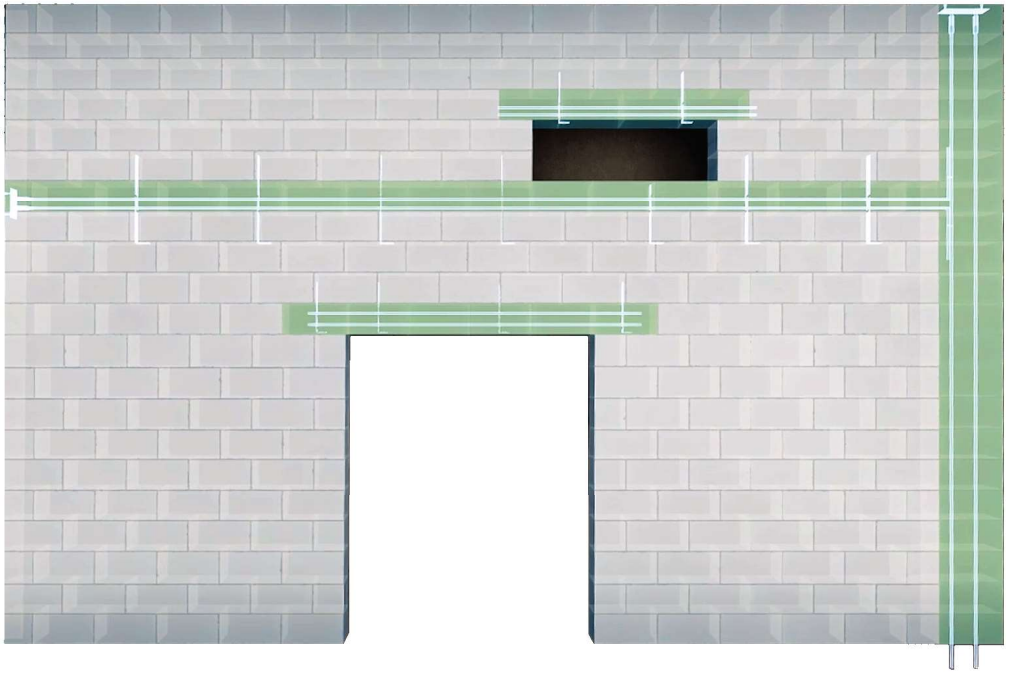
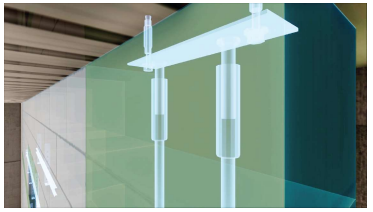
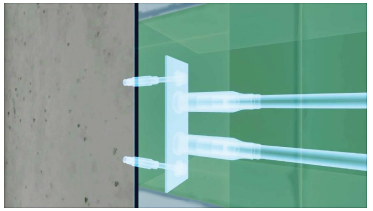
WEMBLEY INNOVATION™

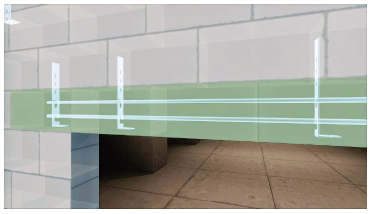
Sustainability Performance of the

# WI System™









# Contents



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# A Sustainable Construction Solution

Most construction projects now have to meet exacting standards of sustainability performance. This may include the environmental impact assessment of the building itself, as well as procurement of the materials and the working practices of all those who contribute to the fulfilment of the project.

Sustainability is integral to the Wi System, from its value engineered design, to procurement of the components, installation and operational performance. Presented here is an overview of the sustainability criteria which demonstrates the ways in which the Wi System can contribute to meeting project requirements for cost-efficient construction and sustainability performance.

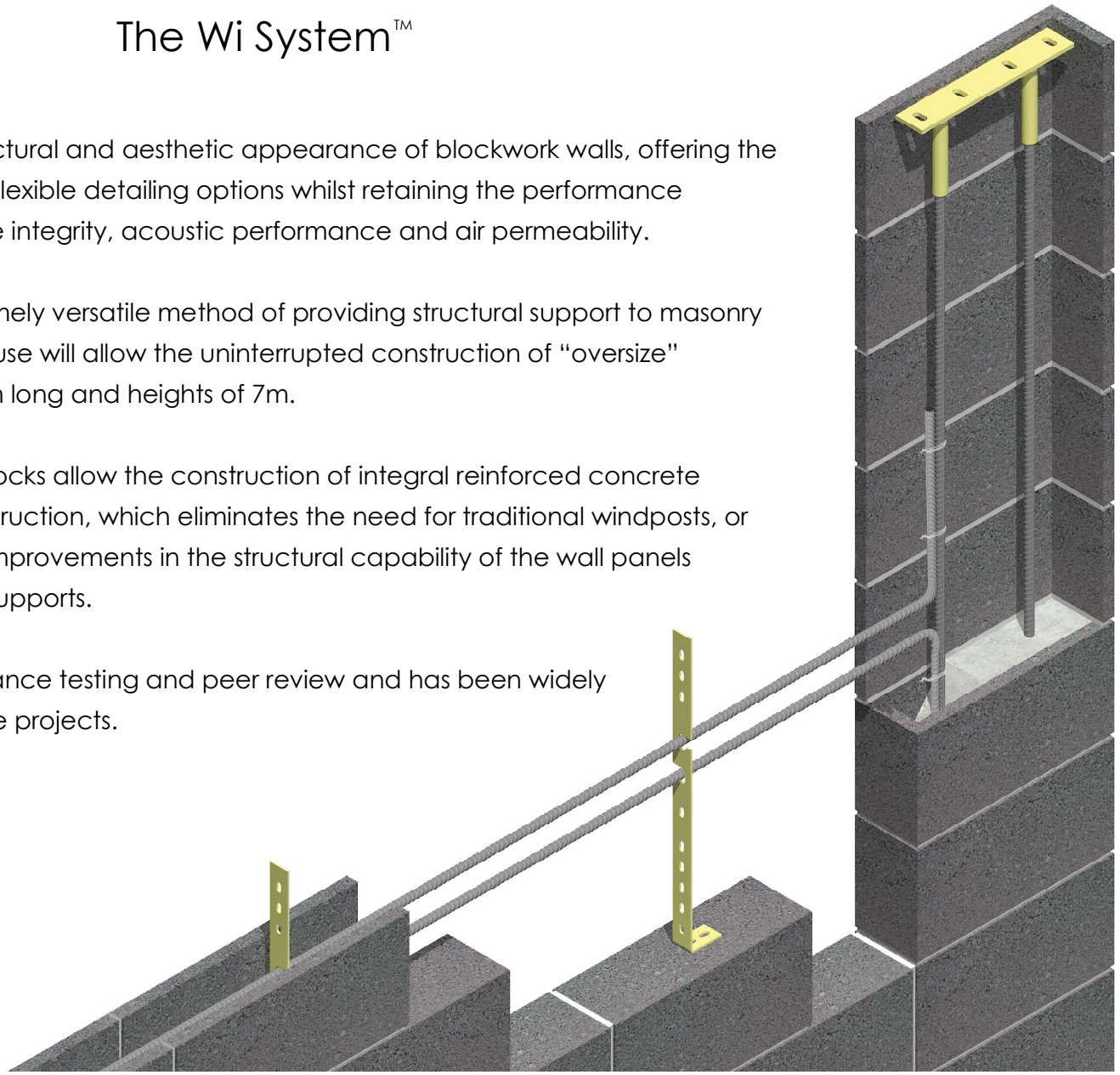
# The Wi System™

The Wi System significantly improves the architectural and aesthetic appearance of blockwork walls, offering the possibility of creating uninterrupted panels with flexible detailing options whilst retaining the performance characteristics of traditional masonry such as fire integrity, acoustic performance and air permeability.

The Wi System is a deceptively simple, yet extremely versatile method of providing structural support to masonry panels subject to wind or other lateral loads. Its use will allow the uninterrupted construction of "oversize" blockwork walls with unrestrained lengths of 11m long and heights of 7m.

Purpose designed hollow column and trough blocks allow the construction of integral reinforced concrete columns and beams within the blockwork construction, which eliminates the need for traditional windposts, or lintels. This novel approach leads to significant improvements in the structural capability of the wall panels compared with the use of traditional windpost supports.

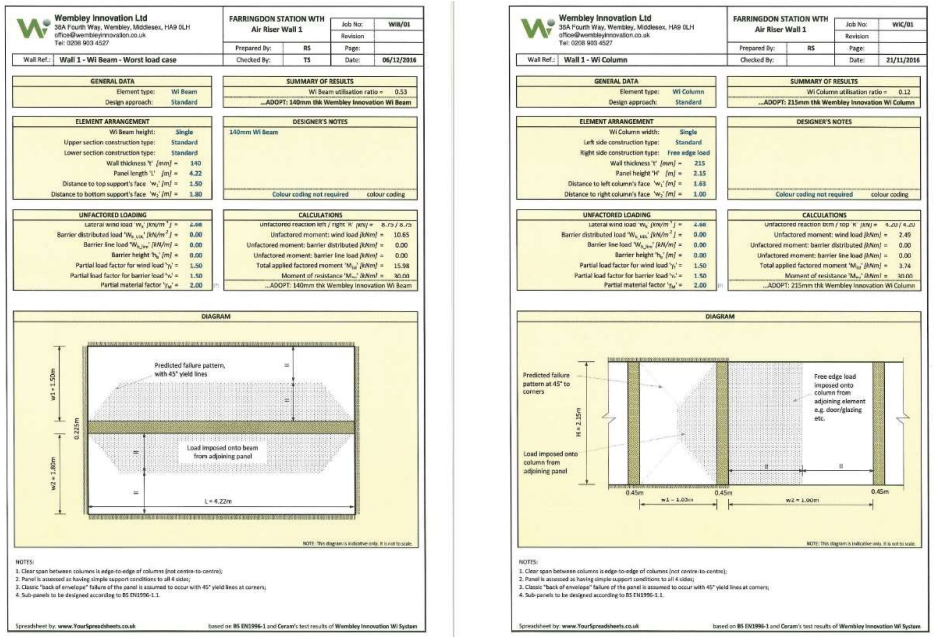
The concept has undergone extensive performance testing and peer review and has been widely used in commercial, leisure and rail infrastructure projects.



# The Design

*An engineered design allows efficient sizing of masonry panels, avoiding waste and optimising economy*

The research and development that underpins the Wi System represents the most extensive evaluation of a masonry system undertaken in recent times. The result is a value engineered solution which optimises the structural capabilities of the individual components which make up the Wi System and produces a versatile walling system that can be easily adapted to suit the loading and panel size requirements for any project. The economic design of walls incorporating the Wi System is supported by simple-to-use Design Guides, Standard Details and the Wi System Design Program.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FARRINGDON STATION WTH
Air Riser Wall 1

Job No: Wi8/01
Revision:
Prepared By: RS
Page:
Checked By: TS
Date: 06/12/2016

Wall Ref.: Wall 1 - Wi Beam - Worst load case

GENERAL DATA
Element type: Wi Beam
Design approach: Standard

SUMMARY OF RESULTS
Wi Beam utilisation ratio = 0.53
...ADOPT: 140mm thk Wembley Innovation Wi Beam

ELEMENT ARRANGEMENT
Wi Beam height: Single
Upper section construction type: Standard
Lower section construction type: Standard
Wall thickness 't' (mm) = 140
Panel length 'L' (m) = 4.22
Distance to top support's face 'w1' (m) = 1.50
Distance to bottom support's face 'w2' (m) = 1.80

DESIGNER'S NOTES
140mm Wi Beam
Colour coding not required — colour coding

UNFACTORED LOADING
Lateral wind load 'Wk' (kN/m²) = 2.66
Barrier distributed load 'Wk,dist' (kN/m²) = 0.00
Barrier line load 'Wk,lin' (kN/m) = 0.00
Barrier height 'hb' (m) = 0.00
Partial load factor for wind load 'γf' = 1.50
Partial load factor for barrier load 'γf' = 1.50
Partial material factor 'γM' = 2.00

CALCULATIONS
Unfactored reaction left / right 'R' (kN) = 8.73 / 8.73
Unfactored moment: wind load (kNm) = 10.65
Unfactored moment: barrier distributed (kNm) = 0.00
Unfactored moment: barrier line load (kNm) = 0.00
Total applied factored moment 'Msd' (kNm) = 15.98
Moment of resistance 'Mrd' (kNm) = 30.00
...ADOPT: 140mm thk Wembley Innovation Wi Beam

DIAGRAM
Predicted failure pattern, with 45° yield lines
Load imposed onto beam from adjoining panel
w1 = 1.50m
0.225m
w2 = 1.80m
L = 4.22m

NOTES:
1. Clear span between columns is edge-to-edge of columns (not centre-to-centre);
2. Panel is assessed as having simple support conditions to all 4 sides;
3. Classic "back of envelope" failure of the panel is assumed to occur with 45° yield lines at corners;
4. Sub-panels to be designed according to BS EN1996-1.1.

Spreadsheet by: www.YourSpreadsheets.co.uk — based on BS EN1996-1 and Ceram's test results of Wembley Innovation Wi System


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FARRINGDON STATION WTH
Air Riser Wall 1

Job No: WiC/01
Revision:
Prepared By: RS
Page:
Checked By:
Date: 21/11/2016

Wall Ref.: Wall 1 - Wi Column

GENERAL DATA
Element type: Wi Column
Design approach: Standard

SUMMARY OF RESULTS
Wi Column utilisation ratio = 0.12
...ADOPT: 215mm thk Wembley Innovation Wi Column

ELEMENT ARRANGEMENT
Wi Column width: Single
Left side construction type: Standard
Right side construction type: Free edge load
Wall thickness 't' (mm) = 215
Panel height 'H' (m) = 2.15
Distance to left column's face 'w1' (m) = 1.63
Distance to right column's face 'w2' (m) = 1.00

DESIGNER'S NOTES
Colour coding not required — colour coding

UNFACTORED LOADING
Lateral wind load 'Wk' (kN/m²) = 2.66
Barrier distributed load 'Wk,dist' (kN/m²) = 0.00
Barrier line load 'Wk,lin' (kN/m) = 0.00
Barrier height 'hb' (m) = 0.00
Partial load factor for wind load 'γf' = 1.50
Partial load factor for barrier load 'γf' = 1.50
Partial material factor 'γM' = 2.00

CALCULATIONS
Unfactored reaction btm / top 'R' (kN) = 4.20 / 4.20
Unfactored moment: wind load (kNm) = 2.40
Unfactored moment: barrier distributed (kNm) = 0.00
Unfactored moment: barrier line load (kNm) = 0.00
Total applied factored moment 'Msd' (kNm) = 3.74
Moment of resistance 'Mrd' (kNm) = 30.00
...ADOPT: 215mm thk Wembley Innovation Wi Column

DIAGRAM
Predicted failure pattern at 45° to corners
Load imposed onto column from adjoining panel
Free edge load imposed onto column from adjoining element e.g. door/glazing etc.
H = 2.15m
0.45m
0.45m
0.45m
w1 = 1.63m
w2 = 1.00m

NOTES:
1. Clear span between columns is edge-to-edge of columns (not centre-to-centre);
2. Panel is assessed as having simple support conditions to all 4 sides;
3. Classic "back of envelope" failure of the panel is assumed to occur with 45° yield lines at corners;
4. Sub-panels to be designed according to BS EN1996-1.1.

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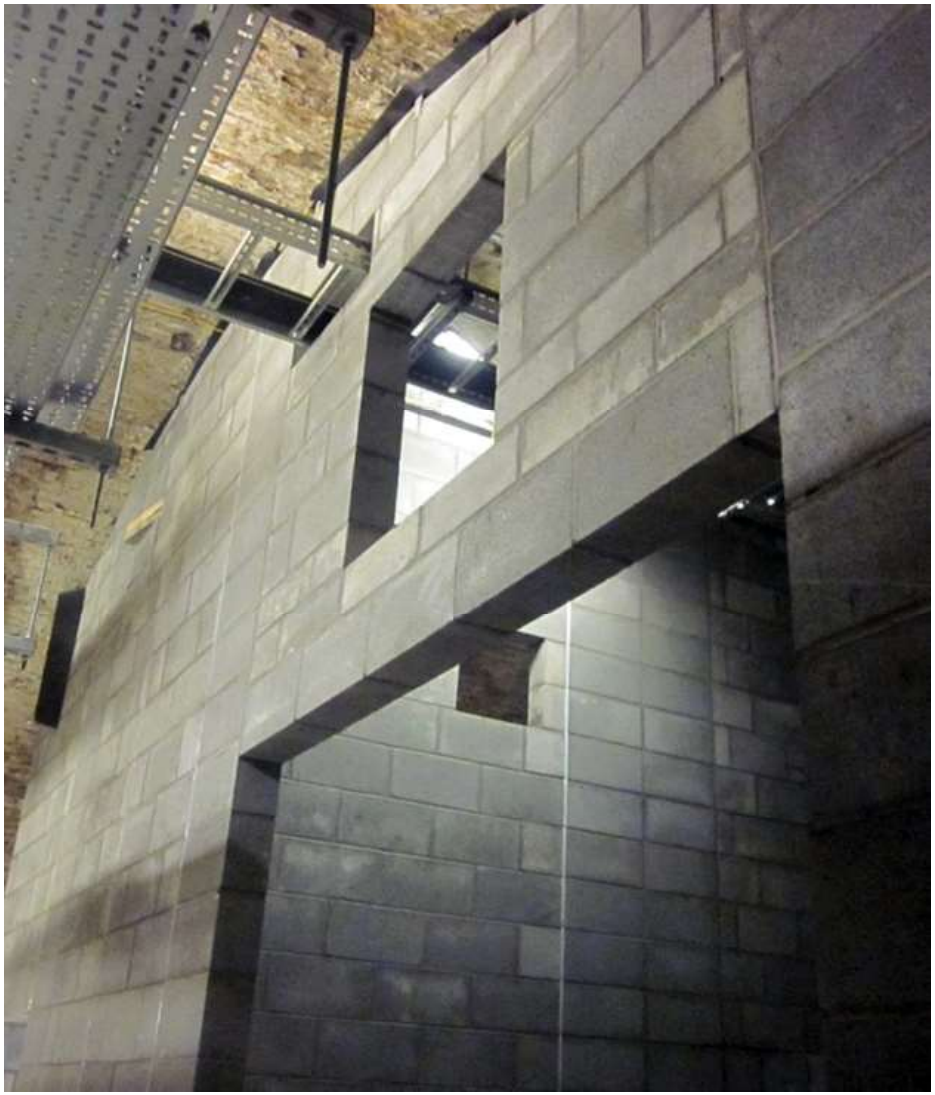
Wi System Design Program outputs



# Resources Use

*The Wi System seeks to exploit our resources carefully*

The Wi System is based on a principle of using resources in the most appropriate and sustainable manner. This is achieved in a number ways, and illustrated by the following examples;

**ECONOMY IN DESIGN**

The Wi System is an engineered solution allowing blockwork panels to be designed to suit project specific loading requirements, ensuring the optimum size wall panels and the minimum numbers of supports.

**ECONOMY IN MATERIALS**

The engineered design allows material usage (blocks, mortar, steel components) to be accurately predicted thereby significantly reducing site wastage. The Wi Slot block units have narrow slots which, as well as reducing the unit weight and saving about 15% of material compared to solid units, facilitate the cutting of blocks thereby reducing wastage as well as reducing the labour content of this task.

**ECONOMY IN THE PROCESS**

The Wi System is effectively a single process in bringing the construction of masonry walls to completion. Unlike conventional masonry in framed construction, the Wi System eliminates the need for steel windposts, separate lintels and any associated fire protection. This has significant benefits for the principal contractor as there are less trades to administer and the risk to health and safety is appreciably reduced. Having a single process also means less plant and equipment is required on site and less vehicle movements as fewer types of materials are required.

# Recycled Materials

*The Wi System utilises recycled or secondary materials, reducing the demand for primary materials*

Using recycled and secondary aggregates can be very positive, as this reduces the demand for virgin material and optimises material efficiency in construction. The concrete blocks procured for the Wi System have a declared recycled content of over 30%. This can be used to gain credits for recycled material contents in environmental assessment schemes, such as BREEAM and LEED (Leadership in Energy and Environmental Design).

The carbon steel components used in the Wi System would be expected to have a minimum of 70% recycled content.

# Carbon Footprinting

*Independent assessment confirms Wi System superior carbon footprint benefits over other methods.*

The carbon footprint of the Wi System has been assessed in accordance with PAS 2050: 2011. The assessment carried out examined the cradle-to-gate life phases, encompassing the following elements:

Raw materials used

Transport of materials to site

Personnel required for construction

Plant required for construction

The assessment was undertaken by the Faculty of Engineering & Science, University of Greenwich and extended to include a comparison of the Wi System with conventional masonry strengthened using steel windposts. A model was developed whereby the carbon footprint was determined for each construction approach based on designs that provided equivalent structural performance. Compared to traditional windposts, the Wi Beam System offers a 13.6% saving in carbon, whilst the Wi Column System exhibits a 23.6% saving in carbon. The use of the Wi System delivers carbon savings through the use of less steel and the benefits of purpose-designed slotted masonry blocks.
Additionally there are savings from the use of less plant and equipment and reduced construction times.

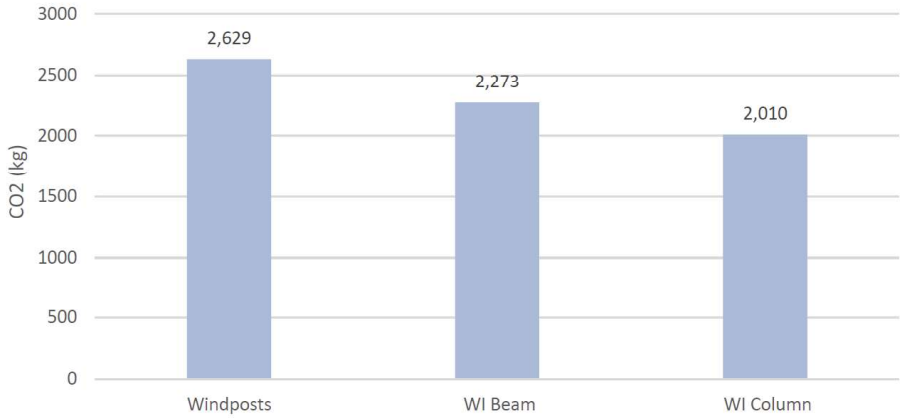



Figure 1: Comparison of total carbon footprints (The Wi System vs. masonry with steel windposts

The Report of the Wi System Carbon Footprint Assessment produced by the University of Greenwich is available on request.

# Operational Performance

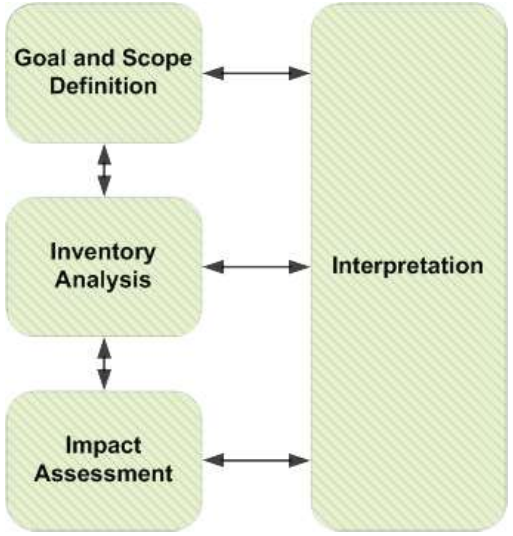
*The Wi System performance is based on recognised environmental data*

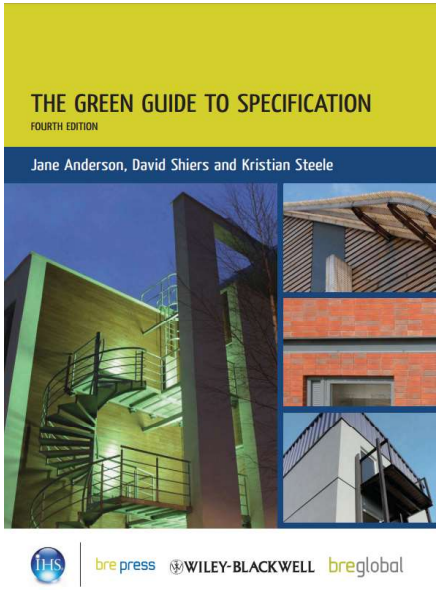
**Environmental Product Declarations and Lifecycle Assessment**

An EPD (Environmental Product Declaration) is an independently verified and registered document that communicates transparent and comparable information about the life-cycle environmental impact of products. These are increasingly acknowledged as an acceptable way to summarise the environmental performance of components. The masonry units which form part of the Wi System account for about 94% of the constructed wall area. EPDs for the Wi System blocks are based on the generic EPDs that have been produced for aggregate concrete blocks by The Concrete Block Association.

An assessment of the lifecycle performance of the Wi System can be made by comparing it with similar constructions, such as those contained in The Green Guide to Specification. These are derived using life cycle assessment (LCA) and are commonly described as Green Guide ratings. These have a practical use in BREEAM and other building environmental assessment methods in that they recognise and encourage the use of construction materials with a low environmental impact (including embodied carbon) over the full life cycle of the building.

Green Guide ratings have been established for commonly used constructions based on a scale of A to E.



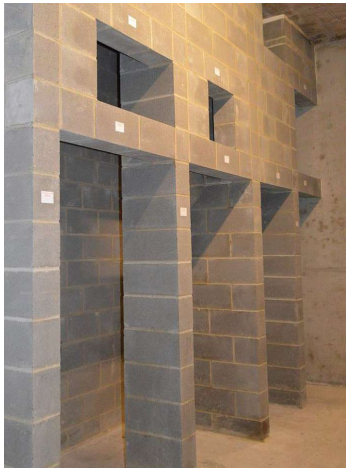
# Operational Performance (continued)

**Thermal Mass**

The thermal mass of a building can be used to positively combat the effects of summertime overheating and retain heat in the winter.
Reducing heat loss through buildings as a result of Part L thermal Standards, also allows the ability of thermal mass to further lower the space heating load as well as improving the comfort of the building for its occupants. Heavy and medium construction such as concrete and masonry are ideal materials to use as they have the ability to absorb and release heat in a way that enables buildings to respond naturally to changes in climatic conditions, helping to stabilise the internal temperature and reducing the risk of summertime overtime heating.

The Wi System installed to the inner leaves of external walls and to internal walls can provide a significant contribution to an effective passive design due to the following attributes:

- A high specific heat capacity to maximise the heat that can be stored per kg of material
- Relatively high density to maximise the overall weight of the Wi System
- Moderate thermal conductivity so that heat transfer is in synchronisation with the diurnal heat flow in and out of the structure



**Durability and Maintenance**

The inherent durability of the Wi System will ensure that the service life requirements for any type of building can be met. The environmental ratings for masonry construction considered in The Green Guide to Specification are based on a 60 year study period and factor-in maintenance work during this period. However, properly designed and executed masonry is expected to last considerably longer.

Moreover, a key advantage of using the Wi System is that little or no maintenance will be required throughout the service life of the construction, resulting in minimal maintenance costs.

# End of Life - Demolition and Recovery

*Wi System components can be reclaimed or recycled for further construction use*

The Wi System components can be readily recycled.

A market exists for these materials to be used as a feedstock for making new construction products, or crushed and used as aggregate for construction fill and for certain grades of site concrete.

The steel components are suitable for recycling.

End of Life →

Deconstruct →

Processed to produce crushed aggregate →

Use as feedstock for new construction products or construction fill