Armatherm™

Minimise building energy loss and improve building envelope performance

ARMATHERM™

THERMAL BRIDGING SOLUTIONS

THERMAL BRIDGING SOLUTIONS FOR COMMERCIAL BUILDINGS

A more accurate way to identify and prevent heat losses due to **thermal bridging**

Thermal bridging through steel and concrete structures can have significant impact on a building's energy performance. Reducing heat flow through a building's thermal envelope reduces energy consumption as well as potential condensation issues.

Thermal bridging has been recognised as a significant factor in building envelope heat loss. As early as 2006, many European countries had already instituted improved energy rating systems for new buildings to better control and reduce domestic energy consumption. Nearly 10 years ago, in response to an EU initiative to improve the energy performance of buildings even further, Armadillo Ltd. developed its first thermal break material, "Armatherm™" to prevent heat loss due to thermal bridging.

Since 2011, drawing on Armadillo Ltd.'s experience, Armadillo Inc. has been working with architects and structural engineers in North America to improve building design details and reduce heat loss due to thermal bridging within the building thermal envelope.

Armatherm™ thermal break materials provide a combination of low thermal conductivity and high compressive strength and have been designed and tested to prevent thermal bridging. Armatherm™ has been proven through three dimensional modelling to reduce heat loss in wall assemblies, transitions and structural connections throughout the building envelope.

Armatherm™ solutions can be used anywhere a penetration or transition exists in the building envelope creating a thermal bridge. Solutions to minimise heat loss include balcony, canopy, parapet, masonry shelf angle, cladding/Z-girt connections and wall-to-foundation transitions. Improvements in the effective U value of wall assemblies can be as much as 70%.

We are a collaborative, design-build partner who can assist in determining the extent of thermal bridging heat loss on building envelope performance including thermal modelling and connection design calculations. We look forward to working with you.

CONTENTS

THERMAL BRIDGING AND THE BUILDING ENVELOPE

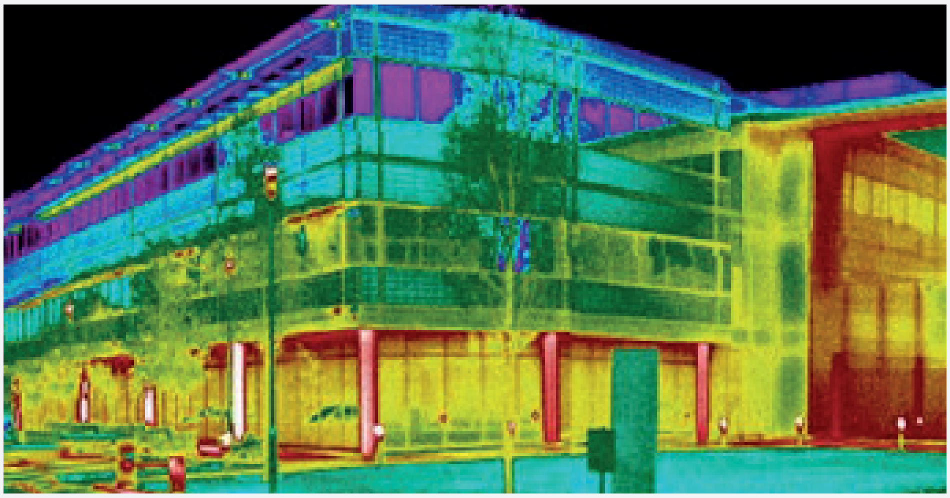
Conductive heat transfer through the building thermal envelope creates significant energy losses. Think canopies, balconies and cladding attachments.

- Thermal bridging can reduce the R value of a wall assembly by as much as 50%
- Thermal bridging can be responsible for up to 30% of a dwelling's heat loss

What are thermal bridges?

To achieve higher R and U values, thermal bridging and air leakage must be minimised to reduce building energy consumption. Thermal bridges are highly conductive structural elements that create heat transfer between the exterior and interior of the building thermal envelope. Heat moves from warm to cold and is transferred via conduction, convection or radiation. All building materials conduct heat and each has a thermal conductivity value (k). The U-Value, also known as thermal transmittance, is the rate of transfer of heat through a structure divided by the difference in temperature across that structure. The units of measurement are W/m^2K. The R value or thermal resistance to heat flow of a material is equal to the material thickness divided by its k value. Thermal bridging occurs through any material that is more conductive than the insulation it bridges.

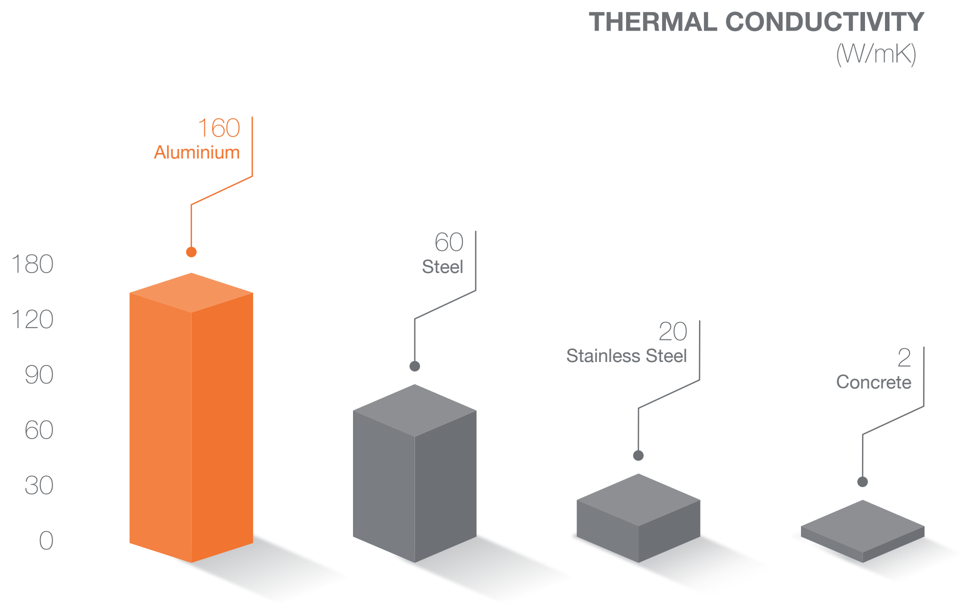
Thermal image showing areas in a building envelope where thermal bridging is creating heat losses.



(Source: www.inspectionfacades.com)

THERMAL CONDUCTIVITY

It has been estimated that the total heat flow through typical wall assemblies is underestimated by as much as 20%-70% due to thermal bridging. Simply adding insulation to walls has been proven to not necessarily decrease the energy use of a building. Heat flow paths (thermal bridges) allow heat to by-pass the insulation, negating any benefit of having more insulation in the wall. By ignoring thermal bridging, the unaccounted for heat flow creates higher heating and cooling costs, oversizing of the HVAC equipment, operational inefficiencies and higher energy consumption.



CALCULATING HEAT FLOW

The latest version of the Building Regulation Part L (2013) as well as the Approved Document L 1A indicate the requirement of thermal bridging to be included in the fabric heat loss calculations. This is a must when trying to pass building control requirements in England and Wales. The implemented guidelines are also there to be beaten rather than matched.

The Government Standard Assessment Procedure (SAP 2012) provides a framework for calculating the energy performance and carbon emissions targets that need to be achieved for the particular build. The thermal bridging calculations within SAP 2012 can be found at detail 5.06 of the document as well as being listed on this page.

The methods when calculating the heat loss due to thermal bridging (H_{TB}) are:

a) The sum of all linear transmittances (Ψ) x length of detail (L)

$$H_{TB} = \Sigma (L \times \Psi)$$

Alternatively:

b) If details of the thermal bridges are not known use factor y = 0.15 in the following equation:

$$H_{TB} = y\Sigma A_{exp}$$

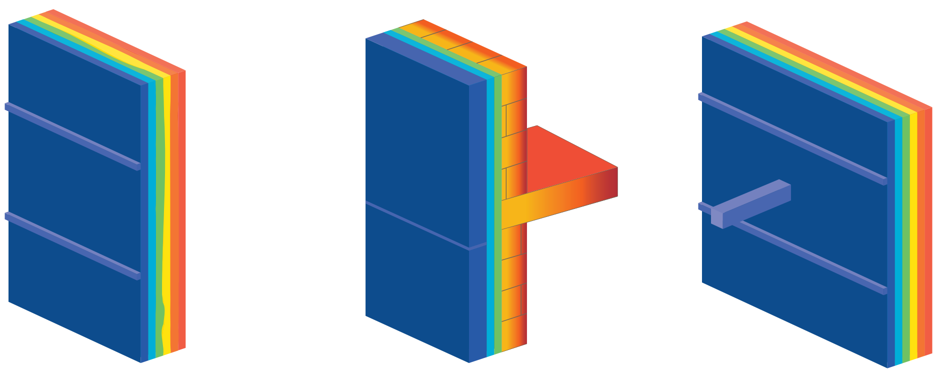
Where A_{exp} = total exposed fabric area

The relevant information for the thermal transmittance Ψ values used in $H_{TB}=\Sigma(L \times \Psi)$ can be comprised from three methods:

- Use values from the ‘accredited” column of SAP Appendix Table K1
- Uncalculated details from the ‘default’ column of SAP Appendix Table K1
- Calculations by a person with suitable expertise and experience in accordance to BRE 1/06

CALCULATING HEAT FLOW THROUGH 3D MODELLING

A more accurate way to calculate the total heat flow through a building envelope is to use 3D thermal modelling. The reason being that the different transmittances can be included into the sum of the planar building assembly.



CLEAR FIELD U_O

LINEAR Ψ psi

POINT X chi

Examples of thermal transmittance and heat flow through the building envelope. Steel girts can be seen in the clear field wall assembly, a steel shelf angle bolted to a slab edge as an example of a linear detail and a single beam penetrating the envelope as a point detail. (Source: Morrison Hershfield)

Linear and point transmittances along with clear field transmittances can be used to determine the overall heat flow for any size wall or roof by calculating effective R and U values that include the effects of thermal bridging. For whole building load calculations, the linear and point transmittances are simply added to the clear field U value of a given assembly area to calculate the overall thermal transmittance. The overall heat flow can be found by adding all of the components together as shown below.

$$Q = \sum Q \text{ thermal bridges} + QO = \sum (\Psi * L) + \sum (X) + QO$$

Or, as heat flow per area:

$$U = \frac{\sum (\Psi * L) + \sum (X)}{A} + U_O$$

Where A, is the total opaque wall area.

WHAT IS THE IMPACT OF THERMAL BRIDGING ON OVERALL BUILDING PERFORMANCE?

Using the methodology described here, allows details to be characterised by the amount of extra heat flow they add to a wall assembly. The additional heat flow due to thermal bridging is now included in the calculation of the U value of an assembly and thermal break solutions can be evaluated to improve heat loss. By characterising the heat flow in details in this manner, the design team can more accurately make decisions as they relate to the energy efficiency of their building design.

Thermal transmittance values are more accurately found by simulation using three dimensional heat transfer software. The consulting firm, Morrison Hershfield has conducted extensive research evaluating hundreds of typical construction details, wall assemblies, intersections and transitions using the principles of thermal transmittance. They have demonstrated that two dimensional models cannot capture the actual heat flow path through three dimensional intersections and cannot accurately estimate thermal transmittance (U value) and surface temperatures that are of interest in preventing condensation.

Example Calculation

Consider a wall assembly that is 3m high and 1.5m wide which has an effective clear field U value {U_o) of 0.29 W/m²K (R_o= 3.46}. The wall has one interface detail due to a shelf angle {0.15m deep) where the linear transmittance (Ψ) is 0.544 W/mK. The total heat loss of the wall assembly is given by:

$$Q = \sum (\Psi^{*} L) + Q_o$$

= (0.544 x 1.5) + (0.29 x 4.5)

= (0.816) + (1.305)

= 2.121 W/K

$$U = \frac{Q}{A} \qquad U = \frac{2.121}{4.5}$$

$$U_{eff} = 0.471 \qquad RSI_{eff} = \frac{1}{0.471} = 2.12$$

In this example, the thermal bridging due to the shelf angle is responsible for 38% (0.816/2.121) of the heat loss while the shelf angle itself (0.15m x 1.5m) represents only 5% of the area of the wall assembly.

A WORD ABOUT CONDENSATION

In addition to creating a breach in heat flow, thermal bridges reduce the surface temperature on internal surfaces as they penetrate the thermal envelope. This can result in potential moisture problems. Moisture within the building structure can corrode metal and deteriorate concrete over time.

In cold climates, moisture can collect on the internal surfaces of exterior walls. When these surfaces become too cold due to a thermal bridge, the relative humidity of the air in the area of the thermal bridge could exceed 65%. The higher the relative humidity, the greater the water vapour content. Condensation will occur on cold surface areas when the temperature at the internal surface of an external wall is at or below the dew point temperature of the air.

Building Regulations Part L includes the requirement that condensation should be minimised in accordance to BS 5250 by reducing the internal surface temperature therefore reducing the risk of mould.

Using a temperature factor (f_{rsi}) is the best way to assess condensation risk. The frs; can be used to predict whether condensation will occur by comparing the coldest interior surface temperature to the dew point temperature. Condensation will occur if the interior surface temperature is less than the dew point temperature.

A measure of condensation risk is the temperature factor f_{rsi}:

$$f_{rsi} = \frac{\text{Lowest surface temperature at junction - outside air temperature}}{\text{Inside air temperature - outside air temperature}}$$

More thermally efficient building envelope details using thermal break materials and vapour barriers will reduce the risk of condensation by forcing the dew point outwards of the thermal envelope. Thermally broken structural connections prevent excessive heat flow and potential condensation problems associated with thermal bridging.

STRATEGIES TO PREVENT THERMAL BRIDGING

Thermal transmittances due to thermal bridging can be reduced or prevented by using materials with low thermal conductivities or creating a thermal break in the interface detail connection. This is accomplished by introducing a material or component which has a much lower thermal conductivity in the connection where it penetrates the thermal envelope.

Materials with low thermal conductivities can be manufactured/engineered from a wide array of plastic composites and elastomeric or foam based compounds. In thermally broken, structural connections such as cladding attachments, canopies and balconies, materials used as thermal breaks must have high strength, stiffness and creep resistance.

High strength materials however tend to have high thermal conductivity values whereas low strength materials tend to have low thermal conductivity values. The most effective thermal break solutions will therefore have sufficient strength for structural support and a low thermal conductivity capable of reducing heat flow and preventing a thermal bridge.

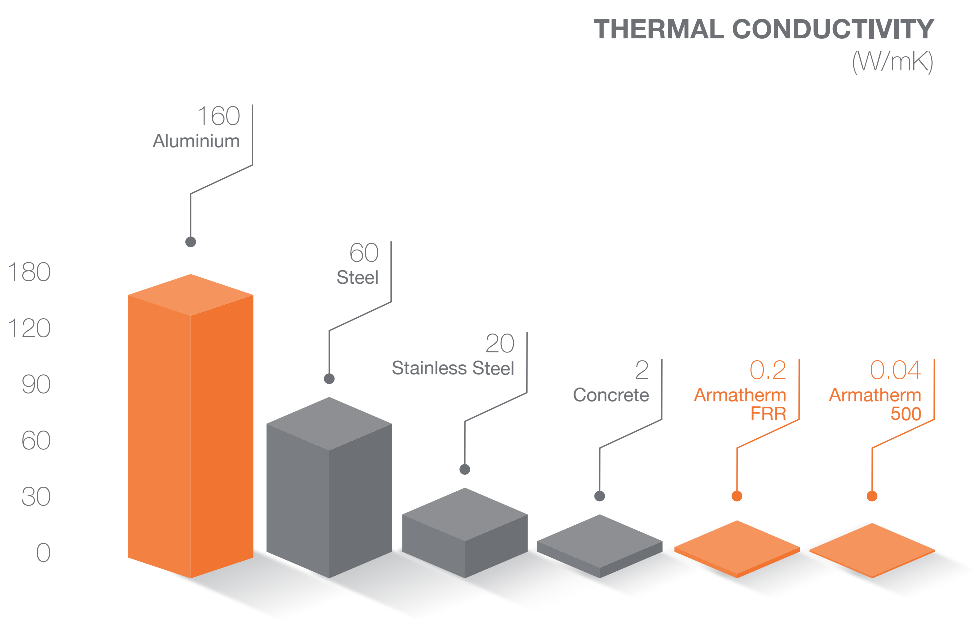
Thermoplastics (nylon, PVC, Teflon) and rubber materials (neoprene, nitrile) can have low thermal conductivities, however they deflect, creep and take a permanent set under load. Long-term plastic deformation may not be desirable in a structural connection.

Thermoset materials on the other hand, such as polyurethanes and epoxy resins are ideal for use as thermal breaks because they are much more resistant to creep and deformation under load while also having low thermal conductivities.

REDUCING THERMAL TRANSMITTANCE

It has been stated that thermal bridges in conventional construction may reduce insulation effectiveness by as much as 50%, resulting in wall assemblies and interface details that do not meet current energy code requirements for minimum U value.

Examples of typical assemblies, transitions and structural connections where Armatherm™ thermal break materials can be used to reduce thermal transmittance and improve U values follow.



Thermal conductivity values of Armatherm™ structural thermal break materials as compared to standard building materials.

Armatherm™ STRUCTURAL THERMAL BREAKS - MATERIAL PROPERTIES

Armatherm™ provides two grades of structural thermal breaks, Armatherm™ FRR and the Armatherm™ 500 series. All materials can be cut, drilled and bonded to our customers specification. Armatherm™ products have also been independently assessed by the Steel Construction Institute (SCI) and can be designed in accordance with the latest SCI guidance publications.

Material Properties	Armatherm™ FRR	Armatherm™ 500-160	Armatherm™ 500-250	Armatherm™ 500-320	Armatherm™ 500-490
Compressive Strength (N/mm^2)	301.5	2	4.3	6.8	18.5
Density (Kg/m^3)	1331	160	250	320	490
Thermal Conductivity (W/mK)	0.2	0.031	0.042	0.054	0.078
Colour	Brown	Green	Peach	Brown	Grey
Thicknesses Available (mm)	6, 10, 12, 15, 20, 25, 50	12, 20, 25, 30 50, 100	5, 10, 12, 15, 20, 25, 50, 100	5, 10, 12, 15, 20, 25, 50, 100	5, 10, 12, 15, 20, 25, 50, 100

Please note: *Non standard grades and dimensions are available upon request.*

ACCREDITATIONS

The Royal Institute of British Architects (RIBA)

RIBA has a strategy and purpose to provide a professional body driving excellence of architecture. One of RIBA's several 2016-2020 strategies is to provide access to education, knowledge and skills. Armatherm™ thermal breaks have been incorporated in more than 6000 applications across the globe, working with RIBA enables our vast expertise and knowledge within the thermal bridging industry to be broadcasted within this body.

Armatherm™ also provides a RIBA CPD accredited webinar called "Thermal Bridging Solutions: Improving Building Envelope Performance" which is a 'crash course' on the effects of thermal bridging, how it can be prevented, the appropriate calculations to be made when calculating thermal performances of a building, as well as a comparison in reduction of heat loss when using an Armatherm™ thermal break in certain applications.

National Building Specification (NBS)

The Armatherm™ product range can be found within the NBS Plus library which easily lets the user see our product specifications and import our product information into their specifications. All our products are also available on the RIBA product selector website, as well as documents showing where Armatherm™ thermal breaks would be used within certain connections, such as balconies, roof penetrations and Z-Girts.

The Steel Construction Institute (SCI)

SCI has examined the test data for Armatherm™ FRR and has derived resistance values suitable for use in structural design. Recommended design methods are presented which should be used when thermal break materials are used in structural connections.

As a results of SCI's independent review, Armadillo thermal break materials Armatherm™ FRR and the associated technical data presented in this report has been granted "SCI Assessed" status.

The British Board of Agrément (BBA)

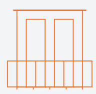
The BBA Agrément Certificate is a mark of excellence based on rigorous national standards that validate a construction product's specialist formulation, capability and uniqueness.

OUR PRODUCTS

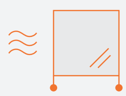
Armatherm™ FRR

Armatherm™ FRR structural thermal break material provides a combination of low thermal conductivity and high compressive strength and has been used in hundreds of structural steel framing connections transferring load in moment and shear conditions. Armatherm™ FRR can support up to 301.5N/mm^2. The material is made of a reinforced, thermoset resin which is fire resistant and has very limited creep under load, making it the ideal material for use in structural and façade thermal break connections.

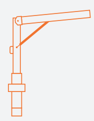
Applications using Armatherm™ FRR to reduce heat flow include:



Balcony / canopy

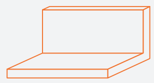


Equipment screen / wind screen

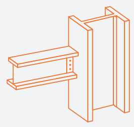


Roof davits and anchors

Mullion connections



Shelf angles

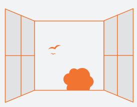


Steel framing connections

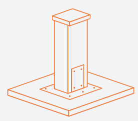
Armatherm™ 500

Armatherm™ 500 is a high strength, thermoset polyurethane manufactured in several densities which can support loads up to 27.5 N/mm^2 with R values as high as 3.8 per 25mm which is superior to the properties of aerated concrete and wood blocking.

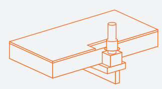
Applications using Armatherm™ 500 to reduce heat flow include:



Fenestration

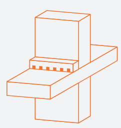


Column bases

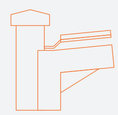


Roof penetrations

Wall-to-foundation transitions



Slab edges



Parapet to roof intersections

MASONRY SHELF ANGLE

Masonry veneer walls require tiebacks and shelf angles which form significant thermal bridges and can reduce a walls' R value by as much as 50% making it difficult to meet energy codes. Shelf angles transfer the masonry load back to the buildings' structural steel or concrete slab edge interrupting the continuous insulating layer of the wall assembly creating a continuous thermal bridge.

To improve the U value of a masonry wall assembly, the shelf angle can be connected to the structure at discreet, evenly spaced points such as plate "blades" allowing the insulation to pass behind the steel angle, reducing the effects of a continuous thermal bridge. However, building the shelf angle outwards requires larger geometries and additional material to support the cantilevered load.

Alternatively, Armatherm™ FRR material can be used directly behind the shelf angle as a thermal break within the insulating layer significantly reducing the linear transmittance of the shelf angle. Rigid, metal flashing used as waterproofing can then be replaced with a non-conductive, self-adhered membrane.

Scenario	**Exterior + Cavity Insulation 1D R-Value** ft²hr°F/BTU (W/m² K)	**Clear Wall R-Value (R_O)** ft²hr°F/BTU (m² K/W)	**U_O** BTU/ft²hr°F (W/m² K)	**R *effective* with shelf angle** ft²hr°F/BTU (m² K/W)	**U *effective*** BTU/ft²hr°F (W/m² K)	**Linear Transmittance of Shelf Angle** BTU/hrft°F (W/mK)	**% Reduction in Heat Loss**
Continuous Steel Shelf Angle	R-15 + R-12 (2.64) + (2.11)	R-19.8 (3.48)	0.051 (0.29)	R-9.9 (1.74)	0.101 (0.58)	0.314 (0.544)	-
Steel Shelf Angle with 1" Armatherm™ FRR with washer, bushing and S.A.M.	R-15 + R-12 (2.64) + (2.11)	R-19.8 (3.48)	0.051 (0.29)	R-13.8 (2.43)	0.072 (0.41)	0.135 (0.234)	57%


Armatherm™ FRR
Thermal Break
1
Armatherm™
FRR Washer
Armatherm™
FRR Bushing
3
2

Rear View

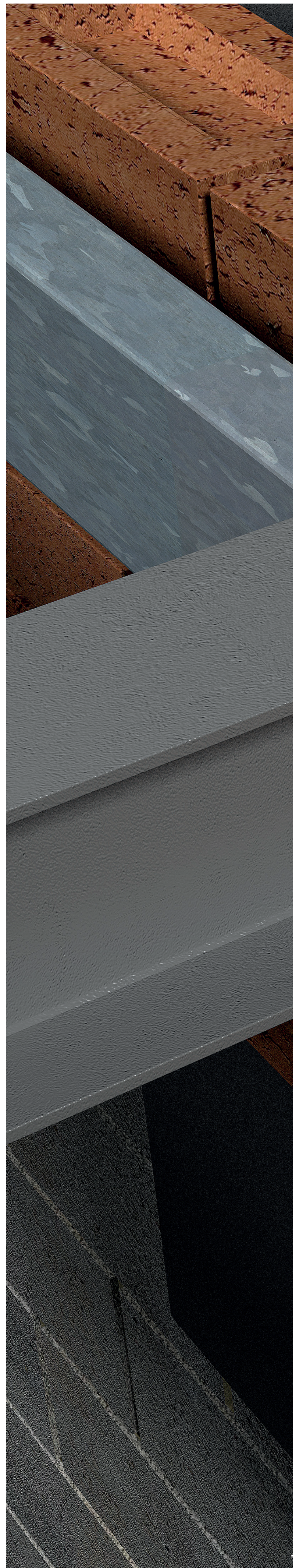
STEEL CANOPY/BALCONY

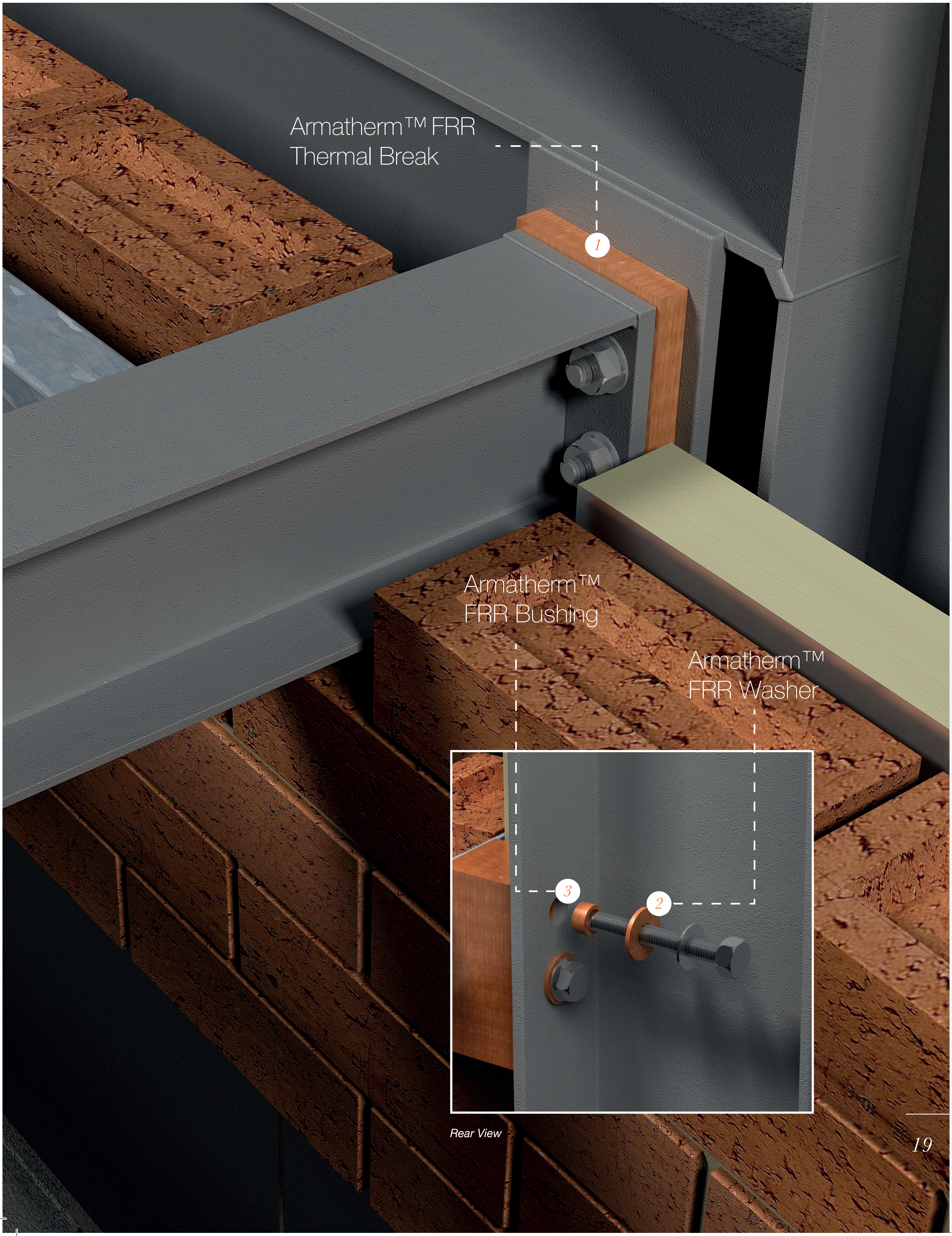
(Steel to Steel)

The most common interface details for structural framing are canopies and balconies that use cantilevered steel or aluminium elements. These elements are typically connected to slab edges or spandrel beams on the interior side of the thermal envelope passing through insulation and air barrier layers. The R value of a wall assembly can be reduced by as much as 60%.

Using a thermal break at these connections will improve the U value of a wall assembly which includes this type of point transmittance. Armatherm™ FRR structural thermal break material is capable of transferring the loading in moment and shear connections without creating significant rotation. In fact, in structural testing, Armatherm™ FRR has been evaluated in moment and shear connections for creep, rotation and any impact on bolt force. While minimising heat flow, the structural performance of these connections must remain acceptable.

Scenario	Exterior Insulation 1D R-Value ft²hr°F/BTU (m² K/W)	Clear Wall R-Value (R_o) ft²hr°F/BTU (m² K/W)	U_o BTU/ft²hr°F (W/m² K)	R *effective* with Beam ft²hr°F/BTU (m² K/W)	U *effective* with Beam BTU/ft²hr°F (W/m² K)	Point Transmittance of Beam BTU/hr°F (W/K)	% Reduction in Heat Loss
Continuous Beam	R-15 (2.64)	R-18.5 (3.25)	0.054 (0.31)	R-6.9 (1.21)	0.145 (0.83)	1.73 (0.92)	-
25mm Armatherm™ FRR using steel bolts	R-15 (2.64)	R-18.5 (3.25)	0.054 (0.31)	R-7.3 (1.28)	0.138 (0.78)	1.56 (0.83)	10%
25mm Armatherm™ FRR using stainless steel bolts	R-15 (2.64)	R-18.5 (3.25)	0.054 (0.31)	R-8.4 (1.48)	0.119 (0.68)	1.16 (0.62)	33%
25mm Armatherm™ FRR using stainless steel bolts & FRR washers & bushings	R-15 (2.64)	R-18.5 (3.25)	0.054 (0.31)	R-9.2 (1.61)	0.109 (0.62)	0.95 (0.50)	45%
50mm Armatherm™ FRR using stainless steel bolts & FRR washers & bushings	R-15 (2.64)	R-18.5 (3.25)	0.054 (0.31)	R-10.2 (1.79)	0.098 (0.56)	0.72 (0.38)	58%




Armatherm™ FRR
Thermal Break
1
Armatherm™
FRR Bushing
Armatherm™
FRR Washer
3
2

Rear View

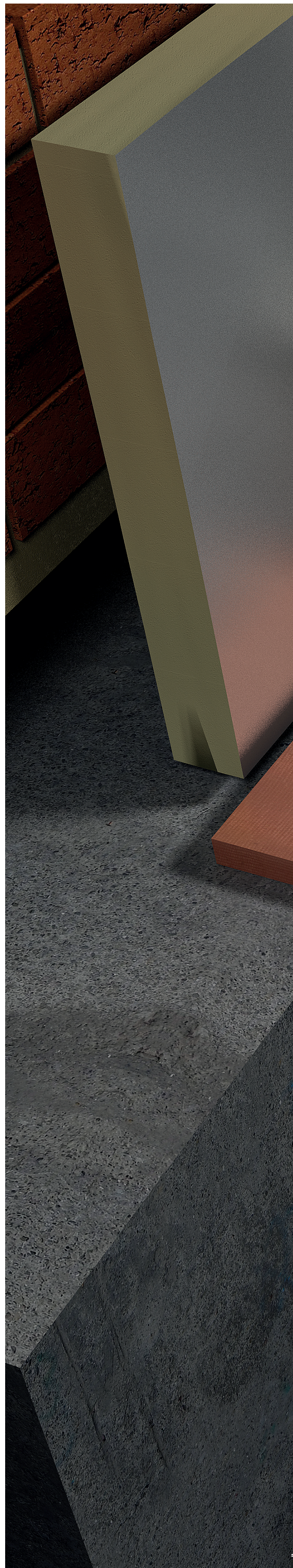
FOUNDATION TO WALL TRANSITION

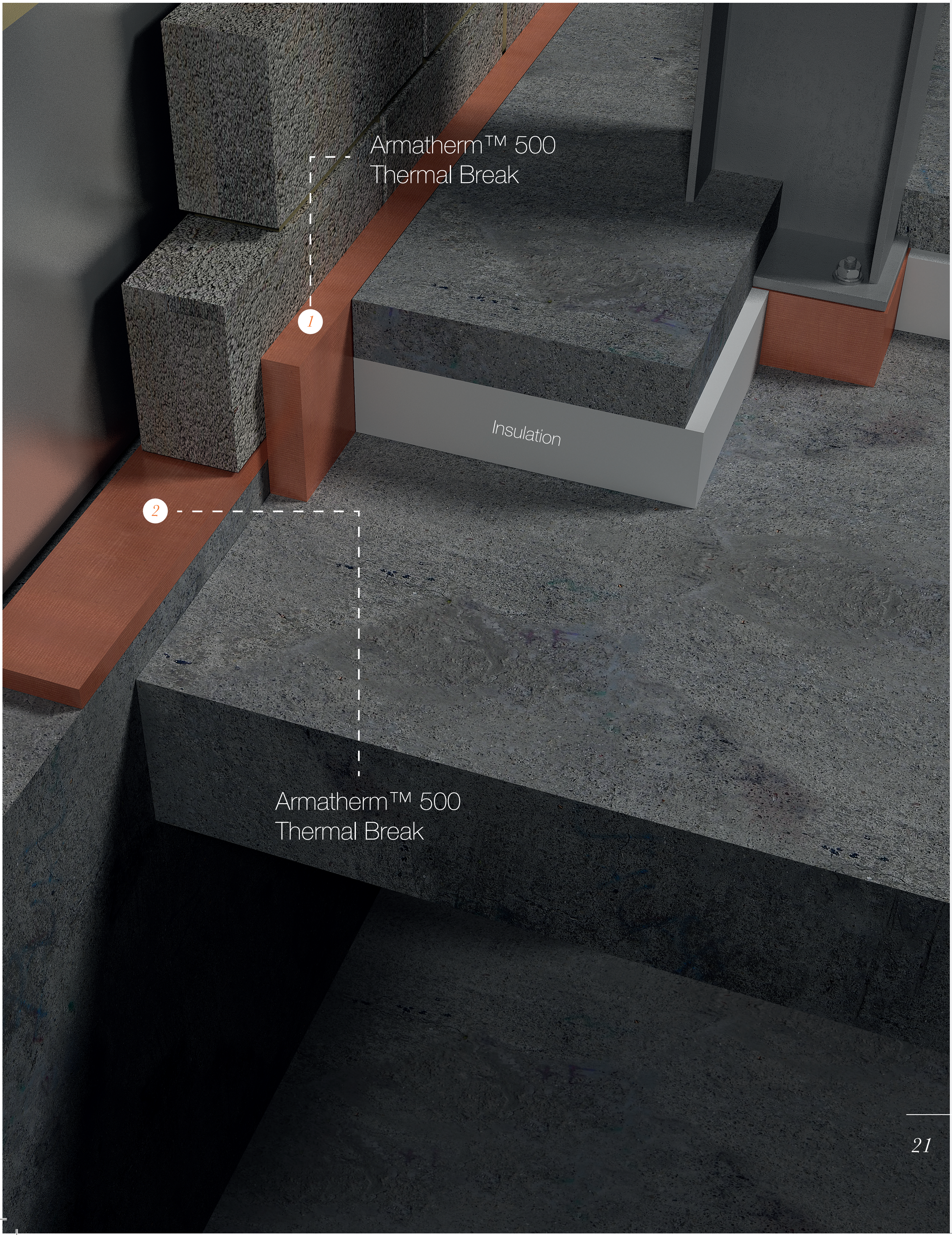
Foundations are part of a buildings' thermal envelope. The intersection at a slab on grade to foundation wall and the exterior wall to foundation transition are both areas where heat flows out of a building due primarily to non-continuous insulation details.

The linear transmittance at these locations can be reduced by as much as 60% by using an efficient, structural thermal break. Armatherm™ 500 is a load bearing, thermal break material manufactured in several densities to provide a range of load capacities with R values as high as 3.8 per 25mm.

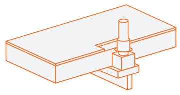
Note: Foundation insulation length under floor slab was 305mm for these scenarios. The linear transmittance can be reduced further by increasing the length of the slab insulation. L values are similar to F factors and are the heat flow of the slab on grade per unit length of the slab perimeter.

Scenario	Clear Wall R-Value (R_o) ft^{2}hr°F/BTU (W/m^2 K)	Slab 1D R-Value ft^{2}hr°F/BTU (W/m^2 K)	Slab Heat Loss L2DF BTU/ft^{2}hr°F (W/m^2 K)	Assembly Heat Loss L2DT BTU/ft^{2}hr°F (W/m^2 K)	Linear Transmittance of Wall to Slab BTU/ft^{2}hr°F (W/m^2 K)	% Reduction in Heat Loss
Exterior Wall directly on footing. 25mm fiberboard floor to foundation	R-10.2 (1.79)	R-5 (0.88)	1.18 (2.04)	1.88 (3.25)	0.309 (0.534)	-
50mm Armatherm™ 500 under exterior wall and interior wall. 25mm fiberboard floor to foundation	R-10.2 (1.79)	R-5 (0.88)	1.18 (2.04)	1.74 (3.01)	0.170 (0.294)	45%
50mm Armatherm™ 500 under exterior wall and interior wall. 50mm Armatherm™ 500 floor to foundation	R-10.2 (1.79)	R-5 (0.88)	1.18 (2.04)	1.71 (2.96)	0.139 (0.241)	55%




Armatherm™ 500
Thermal Break
1
Insulation
2
Armatherm™ 500
Thermal Break

ROOF PENETRATION

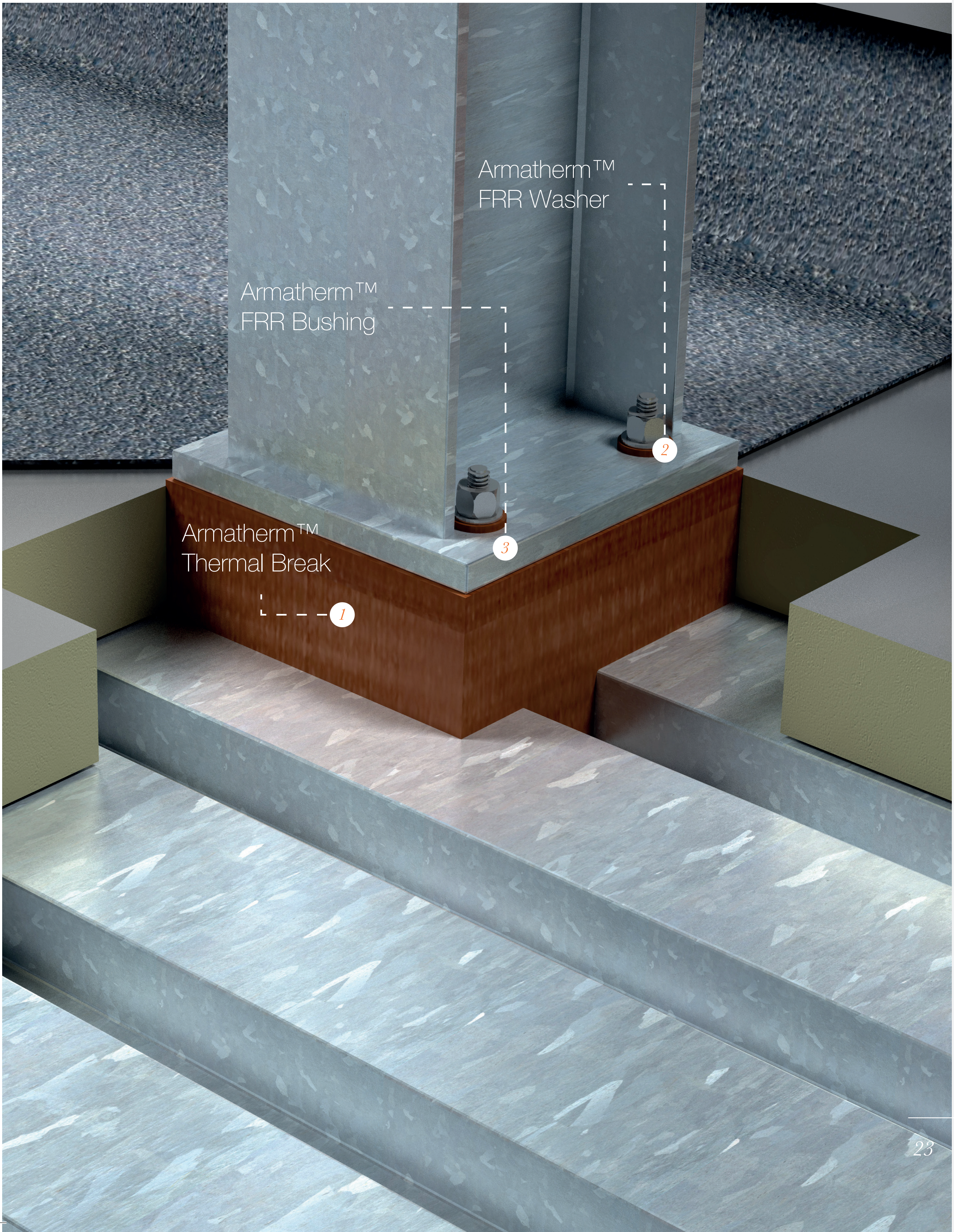


The roof is part of the building envelope where penetrations such as davits, anchors and supports for dunnage extend through the thermal envelope and roof insulation creating non-continuous insulation. These interface details are typically connected to interior trusses or structural elements creating a thermal bridge and point transmittance. The R value of the roof can be reduced by up to 40% in these areas.

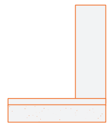
A thermal break at these locations will improve the U value of the roof assembly and prevent potential condensation problems at the structural connection. Armatherm™ FRR and 500 series thermal break materials can transfer the loading conditions at these locations while significantly reducing heat flow. The transmittance can be improved by as much as 80%.

Material data information for the thermal modelling examples shown is available upon request. Please contact us to obtain these or the thermal performance and condensation indices results of other modelled areas in the building envelope from our thermal modelling library.

Scenario	**Roof Insulation 1D R-Value** ft²hr°F/BTU (W/m² K)	**Clear Field R-Value (R_o)** ft²hr°F/BTU (m² K/W)	**U_o** BTU/ft²hr°F (W/m² K)	**R *effective*** ft²hr°F/BTU (m² K/W)	**U *effective*** BTU/ft²hr°F (W/m² K)	**Point Transmittance of Anchor** BTU/hrft°F (W/mK)	**% Reduction in Heat Loss**
Roof Anchor without Thermal Break	R-40 (7.04)	R-42.3 (7.44)	0.024 (0.134)	R-25.5 (4.49)	0.04 (0.223)	0.204 (0.35)	-
Roof Anchor with 12.5mm" Armatherm™ FRR	R-40 (7.04)	R-42.3 (7.44)	0.024 (0.134)	R-27.2 (4.79)	0.036 (0.209)	0.175 (0.30)	14%
Roof Anchor with 152mm Armatherm™ 500	R-40 (7.04)	R-42.3 (7.44)	0.024 (0.134)	R-37.2 (6.55)	0.027 (0.153)	0.041 (0.07)	80%


Armatherm™
FRR Washer
2
Armatherm™
FRR Bushing
3
Armatherm™
Thermal Break
1

COLUMN BASE



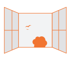
Steel columns traditionally extend through the building envelope (floor slab) and insulation at their base. In low temperature buildings such as freezer rooms and cold storage facilities, this creates a thermal bridge and point transmittance between the steel column and the foundation. This is also the case for columns which bear on exposed foundation walls. Armatherm™ 500, high strength material can support and transfer column loads while providing an effective thermal break between the column base and concrete foundation. With R values as high as R 3.8 per 25mm, Armatherm™ can help to meet the baseline insulation requirements for floors in refrigerated storage facilities more efficiently than timber or aerated concrete.

Note This scenario is of a single column in a 3.05m x 3.05m floor space, so the impact of one column on the floor slab R value is not tremendous but the reduction in heat loss at that singular point is large. More columns in a given area will increase the effective R values.

Scenario	Slab Insulation 1D R-Value ft²hr°F/BTU (W/m² K)	Clear Field R-Value (R_o) ft²hr°F/BTU (m² K/W)	U_o BTU/ft²hr°F (W/m² K)	R *effective* ft²hr°F/BTU (m² K/W)	U *effective* BTU/ft²hr°F (W/m² K)	Point Transmittance of Anchor BTU/hrft°F (W/mK)	% Reduction in Heat Loss
Steel Column without Thermal Break	R-30 (5.26)	R-31.7 (5.57)	0.03 (0.179)	R-29.9 (5.26)	0.03 (0.190)	0.504 (0.864)	-
Steel Column with 152mm Armatherm™ 500	R-30 (5.26)	R-31.7 (5.57)	0.03 (0.179)	R-31.5 (5.55)	0.03 (0.180)	0.046 (0.079)	91%

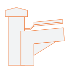

1
Insulation
Armatherm™ 500
Thermal Break

ADDITIONAL ENVELOPE LOCATIONS TO CONSIDER



Fenestration

Windows and doors can severely degrade a whole wall thermal performance. Window R values have the largest impact on a walls' overall R value. Transition and framing details can have a major impact because these connections create conductive heat losses (thermal bridges) that pass through the thermal envelope. Armatherm™ 500 series thermal break material has an R value as high as 3.8 per 25mm and can be used between framing connections and profiled/machined for use as window sill components.



Parapet/Roof Edge

Roof to wall intersections and parapet locations require structural framing for support, which prevents continuous insulation from roof to wall. The designs of these intersections often create thermal bridges. Armatherm™ structural thermal break materials can be used at these locations to create continuous insulation and improve heat loss at these interface details by as much as 30%.

Curtain wall Mullion Connections

Like shelf angles, curtain wall mullions have an impact on the thermal performance of a building's envelope. Small in area, but required in many locations, the total heat loss due to these highly conductive elements can be substantial. Armatherm™ FRR thermal break material transfers the structural loads of curtain wall frames and spandrel panel connections while reducing heat loss.

Cast in situ Concrete Balcony

Uninsulated concrete balconies are a classic example of a highly conductive, structural thermal bridge. The steel reinforcing bars that transfer shear and moment load in a cantilevered concrete slab, greatly increase heat flow resulting in poor linear transmittance values at the connection point to the main floor slab. Conditioning the floor area on the internal side of these connections in cold climates is an enormous waste of energy. To reduce heat loss and prevent the thermal bridge created by steel reinforced concrete, Armatherm™ 500 material and GRP reinforcing bars can be used at this structural connection. Heat loss can be improved by 50% using this approach.

Cladding / Façade Connections

Continuous exterior insulation is almost always compromised by metallic structural connections such as clips and girts which create a thermal bridge when connected to steel stud framing. These connections in conjunction with the steel studs have a significant impact on the U value of wall assemblies. Insulation effectiveness can be reduced by as much as 50% due to these heat flow paths. Armatherm™ Z GIRTs improve the U value of cladding and wall panel assemblies by eliminating the use of highly conductive metal girts and aluminum brackets creating wall assemblies that are up to 98% efficient.

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