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SCI Assessed Report – Farrat Thermal Break Materials – TBK, TBL and TBF

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EXECUTIVE SUMMARY

The first two versions of this report v01 and v02 in 2013 only included Farrat thermal break materials TBK and TBL. In 2022, the report scope was extended to include Farrat thermal break materials TBK, TBL and TBF.

This report describes the structural properties of Farrat thermal break materials TBK, TBL and TBF. The properties are supported by test data and have been confirmed by independent review carried out by SCI.

Farrat thermal break materials TBK, TBL and TBF can be used in structural applications. Thermal break plates are used between flanged connections of internal and external steelwork or internal concrete and external steelwork to reduce thermal transmittance through the connection to reduce cold bridging.

SCI has examined the test data for TBK, TBL and TBF 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 result of SCI's independent review, Farrat thermal break materials TBK, TBL and TBF and the associated technical data presented in this report has been granted "SCI Assessed" status.

SCI Assessed
A list of SCI Assessed products and their associated certificates are given on the SCI Assessed website – www.sci-assessed.com. Please visit the SCI website to conform validity of certificates.

Contents

1 INTRODUCTION

This report describes the findings of the SCI assessment of the Farrat thermal break materials TBK, TBL and TBF.

1.1 Thermal performance

Energy efficiency is an increasingly important parameter in the design of buildings. The thermal insulation provided by the building envelope is key to energy efficiency but thermal bridges - weak spots in the insulation - lead to local heat losses that reduce the efficiency.

The thermal efficiency of a building envelope is a function of the thermal performance of the planar elements (e.g. wall, roofs, windows) and the local heat losses that can occur around the planar elements and where the planar elements are penetrated by building components. These local heat losses are the result of areas of the envelope where the thermal insulation is impaired. These areas of impaired thermal insulation are known as ‘thermal bridges’ or ‘cold bridges’.

The ongoing process of revisions to Building Regulations requirements have emphasised the importance of the thermal efficiency of building envelopes, including limiting heat losses through thermal bridges. As part of a thermal assessment of the building envelope, it is recognised that local heat losses due to penetrations or similar local effects have to be calculated and where necessary minimised, so that the thermal efficiency of the building envelope is within acceptable limits.

1.2 Thermal bridging

Thermal bridges occur where the insulation layer is penetrated by a material with a relatively high thermal conductivity and at interfaces between building elements where there is a discontinuity in the insulation. Thermal bridges result in local heat losses, which mean more energy is required to maintain the internal temperature of the building and lower internal surface temperatures around the thermal bridge.

Local heat losses caused by thermal bridges become relatively more important, as the thermal performance (i.e. U-values) of the planar elements of the building envelope are improved.

Steel has a high thermal conductivity compared with many other construction materials. The high thermal conductivity means that steel construction systems, both the structural frame and cladding, must be carefully designed to minimise unwanted heat flows.

There are three ways of reducing thermal bridging in steel construction:

- Eliminate the thermal bridge by keeping the steelwork within the insulated envelope
- Locally insulate any steelwork that penetrates the envelope
- Reduce the thermal transmittance of the thermal bridge by using thermal breaks, changing the detailing or by including alternative materials.

1.3 Reducing thermal transmittance

The thermal transmittance of a thermal bridge can be reduced by using thermal breaks, changing the detailing or by including alternative materials.

Thermal breaks may be provided by inserting a material with a low thermal conductivity (e.g. Farrat TBK, TBL or TBF) between elements with higher thermal conductivities, as illustrated in Figure 1.1. Reducing the cross-sectional area of an element can also be used to reduce its thermal transmittance where it bridges an insulated building envelope.

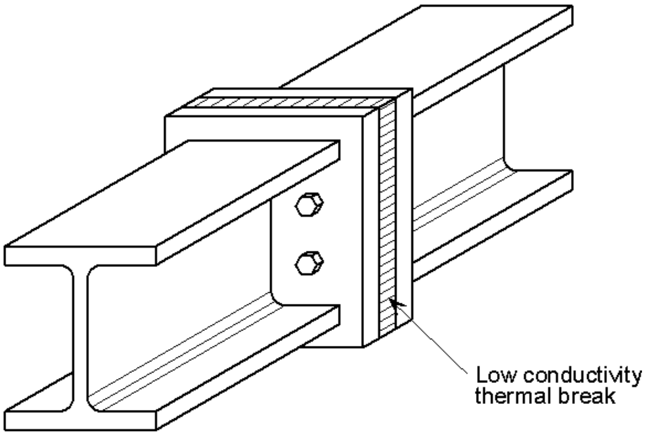


Figure 1.1 Thermal break between steel beams

Thermal breaks are provided in certain manufactured elements, such as metal window frames and composite steel cladding panels, where the steel skins are separated at junctions by a layer of insulation. Similarly, thermal break pads can be provided behind the brackets of brickwork support systems.

Where structural forces are transferred through steel elements that pass through the insulated envelope of a building, such as in balcony connections, brickwork support systems and roof structures, the form of break must be considered carefully. It is vital to ensure that the structural performance remains acceptable. Materials used for thermal breaks may be more compressible than steel. Therefore, deflections, as well as strength, should be checked when thermal breaks are used (see Section 4).

2 PRODUCTS AND APPLICATIONS

2.1 Applications

Thermal break plates are used between flanged connections of internal and external steelwork or concrete and external steelwork to reduce thermal transmittance through the connection to reduce cold bridging. They provide a simple, economical and effective solution to meeting Part L of the Building Requirements by way of reducing heat loss and the risk of internal condensation.

The thermal conductivity value of steel is approximately 57 W/mK. Farrat thermal breaks have a thermal conductivity value between 0.187 and 0.292 W/mK (see Table 3.1). Further improvements in thermal performance of the connection itself can be achieved by using stainless steel bolts and thermal break washers.

Thermal breaks are typically used in new-build and refurbishment projects in the following building elements:

- Balconies
- Brise-soleil (see Figure 2.3)
- Entrance structures / canopies
- Roof plant enclosures
- Façade systems
- Internal / external primary structure junctions
- External staircases
- Balustrading
- Man-safe systems.

The drawings in Figure 2.1 and Figure 2.2 show typical applications of Farrat thermal break plates. The thermal break plates should be the same size (height and width) as the steelwork end plates. Additional applications drawings are provided in Appendix B.

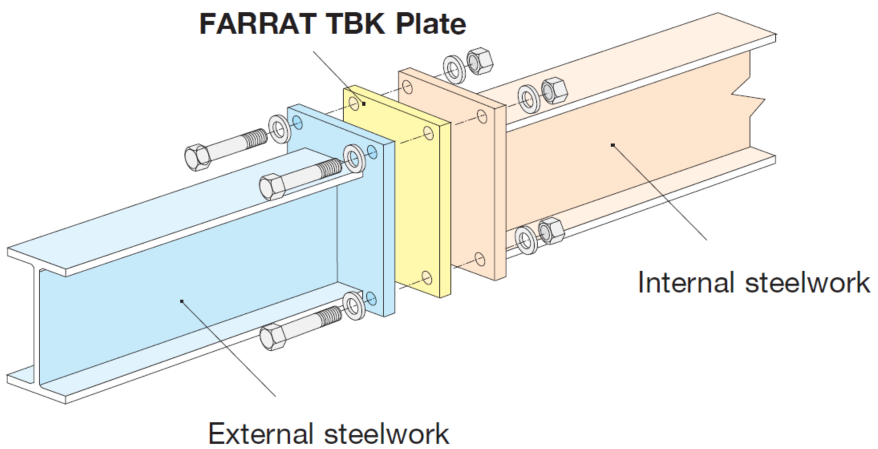


Figure 2.1 Farrat thermal break plate between internal and external steelwork

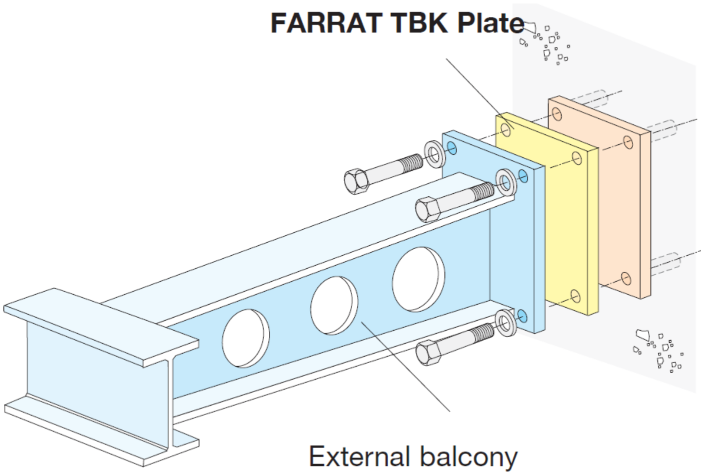


Figure 2.2 Farrat thermal break plate between concrete and external steelwork

Figure 2.3 Brise soleil and balcony structures

2.2 Farrat products

There are two types of Farrat thermal break plates that are included in this report:

- Farrat TBK
- Farrat TBL
- Farrat TBF.

The available product thicknesses are given in Table 2.1.

Table 2.1 Farrat Thermal Break Plates Product Range

Product	Available thicknesses (mm)	Colour
Farrat TBK	5, 10, 15, 20, 25	Amber
Farrat TBL	5, 10, 15, 20, 25	Black
Farrat TBF	5, 10, 15, 20, 25	Grey

3 MATERIAL PROPERTIES

3.1 Test data

Laboratory testing of the Farrat products TBK, TBL and TBK has been carried out by a company based in Germany called MPA TU Braunschweig (Institute for Building Materials, Concrete construction and Fire Protection). The company website address is http://www.mpa.tu-bs.de/mpacms/. The testing was carried out to DAkks Accreditation standards.

Laboratory testing of the Farrat product TBF has also been carried out by a company based in the UK called Element Materials Technology Hitchin Ltd. The company website address is www.element.com. The testing was carried out to ISO 604:2002.

Farrat has provided a test report for the following tests carried out on their thermal break materials TBK, TBL and TBF:

- Compressive strength
- Elastic modulus
- Thermal conductivity
- Density
- Water absorption
- Long term creep.

SCI has examined the test reports provided by Farrat and has independently verified the material properties listed in Table 3.1. The values given in Table 3.1 are mean values from several tests. Data relating to individual test results are given in Appendix A.

Table 3.1 Material Properties Testing

Property	Farrat TBK	Farrat TBL	Farrat TBF	Units	Test Standard
Compressive strength (at 20°C)	321.8	97.4	398	N/mm^2	EN 826, ISO 604
Compressive strength (at 700°C)	---	---	269	N/mm^2	ISO 604
Elastic modulus (at 20°C)	5178	2586	7757	N/mm^2	EN 826, ISO 604
Thermal conductivity (at 20°C)	0.187	0.292	0.200	W/mK	EN 12667
Density (at 20°C)	1465	1137	2160	kg/m^3	EN 12087
Water absorption (at 20°C)	0.14	0.48	0.40	%	EN 12087
Long term creep (at 20°C)	17.7	27.1	---	%	EN 1606

Note: Long term creep value is the additional compression after 1000 hours, expressed as a percentage of the compression after 6 minutes.

- EN 12667: Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Products of high and medium thermal resistance.
- EN 12087: Thermal insulating products for building applications - Determination of long term water absorption by immersion.

- EN 826: Thermal insulating products for building applications - Determination of compression behaviour.
- EN 1606: Thermal insulating products for building applications - Determination of compressive creep.
- ISO 604:2002. Plastics — Determination of compressive properties.

3.2 Compressive strength characteristic values

For use in structural design calculations, the compressive strength of the thermal break materials which have been obtained from testing must be converted in to characteristic compressive strength values. The characteristic values are used in conjunction with a partial safety factor to obtain a design value of compressive strength. Details of the design process are presented in Section 4.

The characteristic compressive strength values of Farrat TBK and Farrat TBL have been calculated in accordance with BS EN 1990, Annex D. The design resistance is calculated using Equation 1, which is based on BS EN 1990, Equation (D.1).

$$X_{\mathrm{d}} = \frac{X_{\mathrm{k}}}{\gamma_{\mathrm{m}}} = \frac{X_{\mathrm{b=1}}\left(m_{\mathrm{b}} - k_{\mathrm{n}} s_{\mathrm{b}}\right)}{\gamma_{\mathrm{m}}} \quad (1)$$

where:

X_{d}	is the design resistance of property X
$X_{\mathrm{k(n)}}$	is the characteristic resistance of property X, derived from n tests
γ_{m}	is the relevant partial safety factor, in this case γ_{M2}
$X_{\mathrm{b=1}}$	is the resistance of property X corresponding to a correction factor of b = 1
m_{b}	is the mean correction factor
k_{n}	is an adjustment coefficient that depends on the number of tests that have been undertaken, taken from BS EN 1990, Table D1
s_{b}	is the standard deviation of the correction factor

Six compressive strength tests were carried out on Farrat TBK and Farrat TBL (see Table 3.2).

Table 3.2 Compressive strength test results

Test	Compressive strength [N/mm^2]		
	Farrat TBL	Farrat TBK	Farrat TBF
1	89.1	318.3	367.7
2	97.4	323.7	401.0
3	99.0	320.8	411.5
4	98.6	330.7	380.3
5	100.2	320.7	415.0
6	99.8	316.9	414.0
Mean	97.4	321.8	398.3
Standard deviation	3.80	4.50	18.10

For a set of six tests, k_n = 2.18, from Table D1 of BS EN 1990 (V_x unknown has been used, as there is no prior knowledge of the variation of the tests). Applying this to the values given in Table 3.2 gives the following characteristic values.

For Farrat TBL,

Characteristic compressive strength, f_{ck} $= 97.4 - 2.18 \times 3.80$

$= 89.1$ N/mm^2

For Farrat TBK,

Characteristic compressive strength, f_{ck} $= 321.8 - 2.18 \times 4.50$

$= 312$ N/mm^2

For Farrat TBF,

Characteristic compressive strength, f_{ck} $= 398.3 - 2.18 \times 18.10$

$= 359$ N/mm^2

The characteristic values for design to BS EN 1993-1-8 should be converted to design values by using the partial safety factor γ_{M2}, which is defined as 1.25 in the UK National Annex. This value is considered appropriate to Farrat TBL and Farrat TBK due to the mode of failure and the consistency of the test results. The design values for compressive strength are given in Table 3.3.

Table 3.3 Compressive strength values

Property	Farrat TBL [N/mm^2]	Farrat TBK [N/mm^2]	Farrat TBF [N/mm^2]
Characteristic compressive strength, f_{ck}	89.1	312	359
Design value for compressive strength, f_{cd}	71.3	250	287

3.3 Long term creep

The long term creep test was conducted over a period of 1000 hours (41.7 days). The results show that the Farrat thermal break materials FBL and TBK exhibit low levels of creep behaviour.

Three creep tests were carried out on each material type; graphs showing compression against time are provided in Appendix A.6. For both material types the vast majority of the creep is experienced over the first 500 hours with limited creep occurring in the period from 500 to 1000 hours (see Table 3.4).

Table 3.4 Long term creep performance

Property	Farrat TBK [%]	Farrat TBL [%]	Farrat TBF [%]
Creep (from 0 to 500 hrs)	16.3	24.2	---
Creep (from 500 to 1000 hrs)	1.4	2.9	---
Creep (from 0 to 1000 hrs)	**17.7**	**27.1**	**---**

Note: Creep is expressed as the additional compression as a percentage of the compression after 6 minutes.

At the time of producing this report (October 2022), specific long term creep performance data for Farrat TBF is not available. However, based on the composition and density of TBF and TBK, the long term creep performance of TBF is expected to be no worse than that of TBK.

4 STRUCTURAL DESIGN GUIDANCE

4.1 General

In general, steelwork connections should be designed in accordance with the latest SCI guidance publications as listed below:

Simple Connections –

- SCI-P212: Joints in steel construction. Simple connections (BS 5950-1).
- SCI-P358: Joints in steel construction. Simple joints to Eurocode 3.

Moment Connections –

- SCI-P207: Joints in steel construction. Moment connections (BS 5950-1).
- SCI-P398: Joints in steel construction. Moment joints to Eurocode 3.

However, additional design checks should be carried out for connections that include Farrat thermal break plates between the steel elements. These additional checks are explained in the following Sections 4.2, 4.3, 4.4 and 4.5 (of this report).

4.2 Compression resistance of thermal break

4.2.1 Nominally pinned connections

Nominally pinned connections (also referred to as simple connections) are generally designed to only transmit shear forces and tying forces, as shown in Figure 4.1. Therefore, the thermal break plate is not required to resist compression forces. Hence, for nominally pinned connections there is generally no requirement for the designer to check the compression resistance of the thermal break plate within the connection.

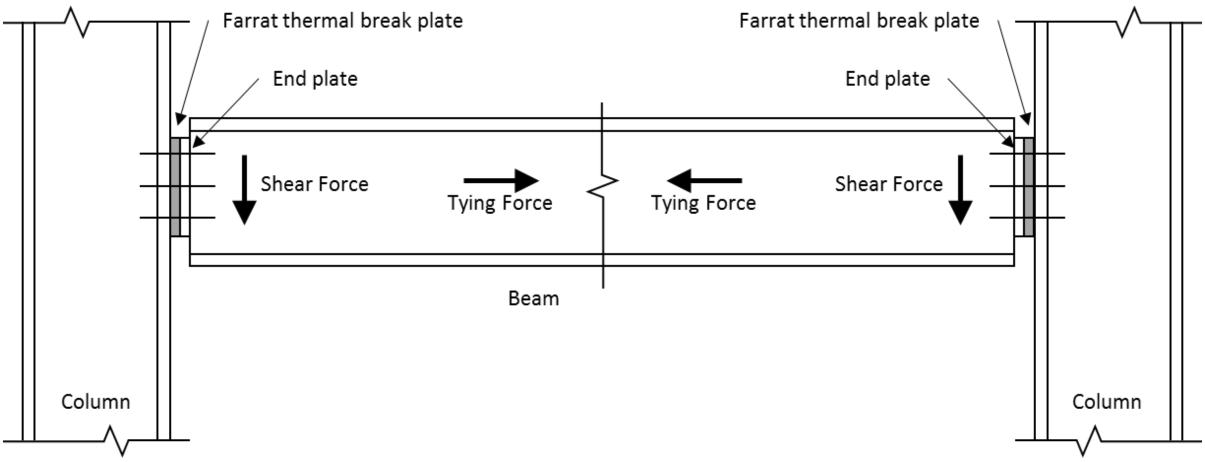


Figure 4.1 Nominally pinned connection with Farrat thermal break plate

However, there may be situations where beams are also subject to axial load, in these situations the thermal break plate is required to resist compression forces and should be designed accordingly. The design procedure presented in Section 4.2.2 can be adapted to suit thermal break plates subject to compression. Alternatively, the thermal break plate can be treated in a similar way to the concrete under a column base plate (see Section 7 of SCI publication P358).

4.2.2 Moment connections

Applications where Farrat thermal break plates are required in connections will generally be moment resisting connections e.g. steel beams supporting balconies or canopies.

In moment resisting connections one part of the connection is in tension and the other part of the connection is in compression, as shown in Figure 4.2. Therefore, a thermal break plate within the connection is required to resist compression forces. Hence, for moment connections there is a requirement for the designer to check the compression resistance of the thermal break plate within the connection.

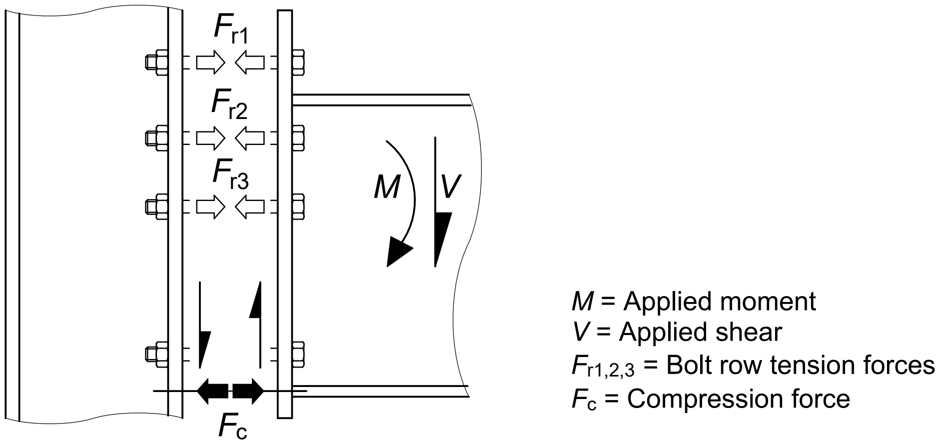


Figure 4.2 Forces in a typical moment connection

The designer must check that the compressive stress applied to the thermal break plate is less than the design compression strength of the thermal break material. This is achieved by satisfying the Expression (2), given below.

$$F_c \leq \frac{B \times L \times f_{ck}}{\gamma_{M2}} \qquad (2)$$

where:

F_c is applied design compression force

B is the depth of the compression zone on the thermal break plate

L is the width of the compression zone on the thermal break plate

f_{ck} is the characteristic compression strength of the thermal break plate

γ_{M2} is a partial safety factor, which is defined as 1.25 in the UK National Annex. This value is considered appropriate to Farrat TBL and Farrat TBK due to the mode of failure and the consistency of the test results.

The compression force F_c can be obtained from published data for standard moment connections (see SCI-P207 and SCI-P398). Alternatively, F_c is calculated as part of the normal connection design process if standard moment connections are not used.

The dimensions B and L are calculated based on a dispersal of the compression force from the beam flange as shown in Figure 4.3 and Figure 4.4. Dimensions B and L are defined in expressions (3) and (4). However, it should be noted that B and L must be reduced if the beam end plate projection is insufficient for full dispersal of the force or if the column flange width is insufficient for full dispersal of the force.

$$B = t_{f,b} + 2(s + t_p) \tag{3}$$

where:

$t_{f,b}$ is the beam flange thickness

s is the weld leg length

t_p is the end plate thickness.

$$L = b_b + 2 \times t_p \tag{4}$$

where:

b_b is the beam flange width

t_p is the end plate thickness.

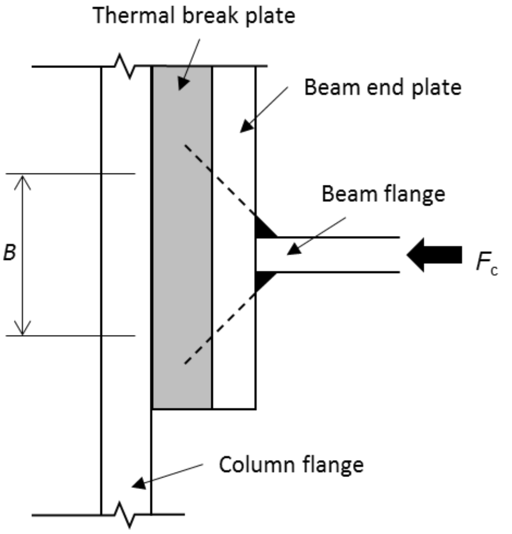


Figure 4.3 Dispersion of force through connection compression zone

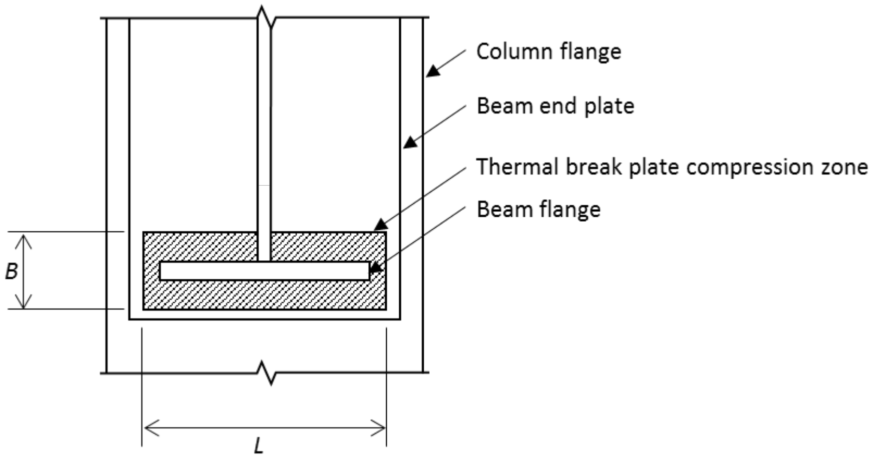


Figure 4.4 Thermal break plate compression zone

4.3 Additional rotation due to compression of thermal break

4.3.1 Nominally pinned connections

Nominally pinned connections are designed to rotate and therefore any additional rotation due to the presence of a thermal break plate within the connection can generally be neglected in the design process.

4.3.2 Moment connections

For moment connections, such as those supporting balconies, the rotation of the connection under load is an important design consideration, typically for aesthetic and serviceability requirements.

The amount of compression of the thermal break plate ΔT is calculated as given in expression (5).

$$\Delta T = \frac{t_{\text{tb}} \times \sigma_{\text{tb}}}{E_{\text{tb}}} \qquad (5)$$

where:

t_{tb} is the thickness of the thermal break plate

σ_{tb} is the stress in the compression zone of the thermal break plate

E_{tb} is the elastic modulus of the thermal break plate.

The additional rotation of the connection (θ) due to the presence of a thermal break plate within the connection can be calculated using the expression (6).

$$\theta = \text{Arcsin}\left(\frac{\Delta T}{h_{\text{b}}}\right) \qquad (6)$$

where:

h_{b} is the depth of the beam.

All connections (with or without a thermal break plate) will rotate when loaded. In most typical cases the additional connection rotation due to the presence of a thermal break plate will be small. A typical example is presented in Table 4.1, as can be seen the additional rotation for Farrat TBL is 0.175° and for Farrat TBK is 0.307°.

Table 4.1 Example rotation

Connection property	Farrat TBL	Farrat TBK
Depth of beam (mm)	150	150
Thickness of thermal break plate (mm)	25	25
Stress in compression zone of thermal break plate at serviceability limit state (N/mm^2)	47.52	166.4
Elastic modulus of thermal break plate (N/mm^2)	2586	5178
Compression of thermal break plate (mm)	0.459	0.803
Additional rotation of connection (Degrees)	**0.175**	**0.307**

4.3.3 Long term creep

The Farrat thermal break materials exhibit low levels of creep behaviour (see Section 3.3). Therefore, in the consideration of additional rotation due to compression of the thermal break plates the designer should include an allowance for long term creep.

Based on the test results provided by Farrat it is recommended that additional rotation calculated using the data and methodology given in Section 4.3.2 should be increased as follows:

- For TBK, increase deformation by 20% to allow for long term creep.
- For TBL, increase deformation by 30% to allow for long term creep.

4.4 Bolt shear resistance

4.4.1 Packs

A thermal break plate in a connection must be considered as a pack in terms of connection design. Where packs are used in connections there are detailing rules that should be followed and depending on the thickness of packs it may be necessary to reduce the shear resistance of the bolts within the connection. Design rules for bolts through packing are given in clause 6.3.2.2 of BS 5950-1 and clause 3.6.1(12) of BS EN 1993-1-8.

The number of packs should be kept to a minimum (less than 4).

The total thickness of packs t_{pa} should not exceed $4d/3$, where d is the nominal diameter of the bolt.

If t_{pa} exceeds $d/3$ then, the shear resistance of the bolts should be reduced by the factor β_p given in expression (7).

$$\beta_{p} = \frac{9d}{8d + 3t_{pa}} \qquad (7)$$

where:

d is nominal bolt diameter

t_{pa} is the total thickness of packs.

4.4.2 Large grip lengths

A thermal break plate in a connection will increase the total grip length (T_g) of the bolts. The total grip length is the combined thickness of all the elements that the bolt is connecting together (e.g. end plate, thermal break plate, column flange, additional packs etc.) Depending on the size of the grip length it may be necessary to reduce the shear resistance of the bolts within the connection. Design rules for bolts with large grip lengths are given in clause 6.3.2.3 of BS 5950-1. BS EN 1993-1-8 does not include design rules for bolts with large grip lengths, however, it is recommended that the following design guidance is followed.

If T_g exceeds $5d$ then, the shear resistance of bolts with large grip lengths should be reduced by the factor β_g give the expression given in expression (7).

$$\beta_g = \frac{8d}{3d + T_g} \tag{8}$$

where:

d is nominal bolt diameter

T_g is the total grip length of the bolt.

4.5 Frictional resistance

4.5.1 Non-preloaded bolts

The coefficient of friction of the thermal break plate is not a relevant property for the structural design of connections with non-preloaded bolts.

4.5.2 Preloaded bolts

For the structural design of connections with preloaded bolts the coefficient of friction of the thermal break plate will be required. The slip resistance of the bolted connection is calculated in accordance with Section 3.9 of BS EN 1993-1-8. The number of friction surfaces is required for this calculation.

The SCI has not been provided with data for the coefficient of friction of Farrat TBK or TBL. The manufacturer should be consulted for the necessary data.

In addition, the local compression force around the bolt holes on the thermal break plate must be checked to ensure the compressive strength of the thermal break plate is not exceed.

Preloaded bolts are also known as HSFG bolts.

4.6 Structural design summary

Connections that include thermal break plates should be designed in accordance with the relevant design standards (e.g. BS EN 1993-1-8) or industry guidance (e.g. SCI publications). The following additional checks should also be undertaken:

1. Check that the thermal break plate can resist the applied compression forces (see Section 4.2).
2. Check that any additional rotation due to the compression of the thermal break plate (including allowance for long term creep) is acceptable (see Section 4.3).
3. Check that the shear resistance of the bolts is acceptable given that there may be a reduction in resistance due to:
    a. Packs (see Section 4.4.1).
    b. Large grip lengths (see Section 4.4.2).
4. For connections using preloaded bolts:
    a. Check the slip resistance of the connection taking into account the coefficient of friction and number of friction surfaces (see Section 4.5.2).

b. Check that the thermal break plate can resist the local compression forces around bolts (see Section 4.5.2).

5 OTHER DESIGN ISSUES

Other design issues that are not directly addressed with structural test data are discussed below. In the majority of situations Farrat thermal break plates will be used in a protected environment within the façade of a building. Therefore, the thermal break materials are not exposed to the full extent of the environment.

5.1 Moisture & UV

Thermal breaks are typically used in protected cavities or within protected roof envelopes and both Farrat materials have very low water absorption rates which limits their vulnerability to moisture and humidity.

Within the protected environment the materials are protected from UV degradation. However, where an application poses a greater risk (e.g. a fully exposed external location) then additional protection can be provided. In these situations it is recommended that only Farrat TBK is used with a suitable additional epoxy coating. It is also possible to use cladding flashing details to protect thermal breaks.

5.2 Frost

Thermal breaks are not normally exposed to extremes of temperatures because they are located in the protected environments in the insulation layer of a façade.

In the event that the Farrat thermal break materials are exposed to frost, TBL, TBK and TBF have very low water absorption rates which limits their vulnerability to any damage caused by frost action.

5.3 Fire

Generally, the thermal breaks supplied by Farrat are used in locations that do not require fire protection. Where the connection requires a fire rating then the following options are available;

- A board fire protection system can be applied.
- Sprayed fire protection can be applied. The compatibility of the applied fire protection material should be checked with the thermal break material. Advice from the manufacturer should be obtained.
- The connection may be designed on the assumption of complete loss of thermal break material in the accidental condition. For accidental conditions excessive deformations are acceptable provided that the stability of the structure is maintained.

Farrat TBF has been tested for reaction to fire performance in accordance with EN 1350101: 2018. The full details of the testing is presented in WarringtonFire test report WF424837, dated 5th March 2020.

Farrat TBF is classified as Class A2-s1,d0 in accordance with BS EN 13501-1 : 2018.

5.4 Certified Thermal Details

Several details which use Farrat TBF and TBK in structural balcony support details have been certified by BRE. The Certified Thermal Details and Products Scheme (www.bregroup.com/certifiedthermalproducts) and database allows users to search a range of accurate and independently assessed thermal junction details, products and elements, ensuring accuracy, consistency, credibility and quality throughout the design and specification process.

Farrat Isolevel Ltd have submitted a range of junction details to BRE. These were assessed against the requirements of the Certified Thermal Details and Products Scheme, as set out in BRE SD227: Rev 0.4.

Full details are provided on the BRE website. A summary of the details with Farrat TBF are provided in Table 5.1.

Table 5.1 Farrat TBF Certified BRE Details

Scheme detail reference	SAP Ref	Description	Calculated Ψ-value (W/m·K)	Temperature Factor
600376	E23	Farrat TBF (15mm) Balcony: Steel to steel connection (‘small’ beam)	0.347	0.91
600377	E23	Farrat TBF (25mm) Balcony: Steel to steel connection (‘large’ beam)	0.426	0.90
600378	E23	Farrat TBF (15mm) Balcony: Steel to concrete connection (‘small’ beam)	0.308	0.82
600379	E23	Farrat TBF (25mm) Balcony: Steel to concrete connection (‘small’ beam)	0.300	0.82
600380	E23	Farrat TBF (15mm) Balcony: Steel to concrete connection (‘large’ beam)	0.424	0.83
600381	E23	Farrat TBF (25mm) Balcony: Steel to concrete connection (‘large’ beam)	0.404	0.84

6 UK PROCUREMENT ROUTE AND RESPONSIBILITIES

The flowchart in Figure 6.1 shows the typical UK procurement route for Farrat thermal break materials and the associated responsibilities.

The Architect is normally responsible for ensuring that the connection meets the requirements of the Building Regulations Part L (SAP). For the thermal break this would normally relate to the specified thermal performance.

The Structural Engineer is normally responsible for designing the connection or providing a performance specification for the steelwork fabricator. For the connection designer the strength of the thermal break would normally be the primary consideration.

Tender Documentation

The design team would normally produce construction drawings showing a fully detailed connection or one communicating the design intent with a supporting specification; e.g. National Building Specification (NBS) or similar. The co-ordination of the connection specification for a steel framed structure would normally be undertaken by the structural engineer.

Manufacturing

Farrat Isolevel Limited operates an ISO 9001:2008 quality assurance system. All thermal breaks are manufactured under this system and fabricated using water jet technology to tolerances well within those set out by the National Structural Steelwork Specification for Building Construction (NSSS): Section 7 – Workmanship – Accuracy of Fabrication.

Thermal break plates are supplied according to the customer’s drawings, cut to size with all holes or slots etc. drilled and clearly labelled for easy identification on site. A typical fabrication drawing for a Farrat thermal break plate is shown in Figure 6.2.

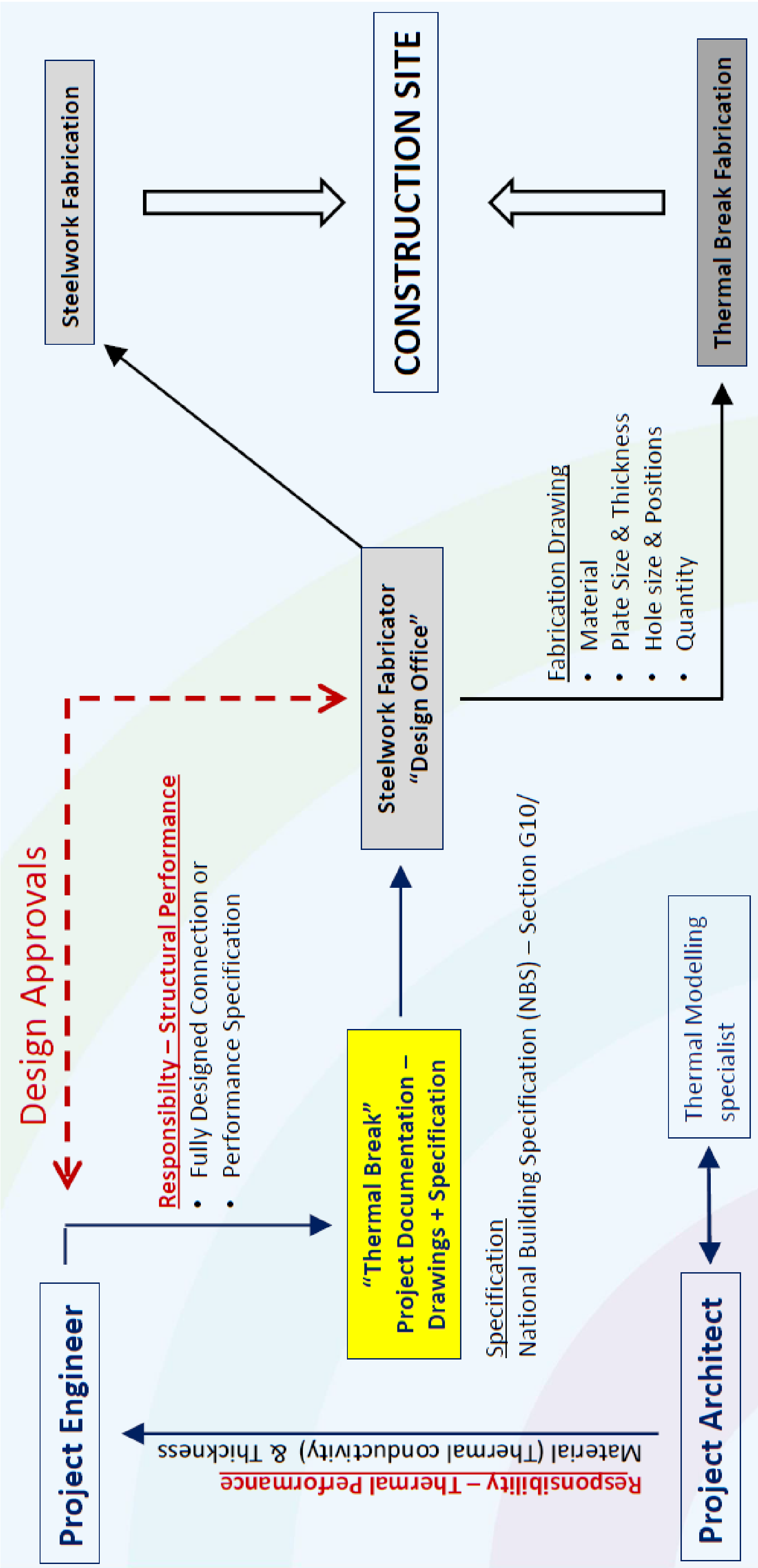


Figure 6.1 Typical procurement route

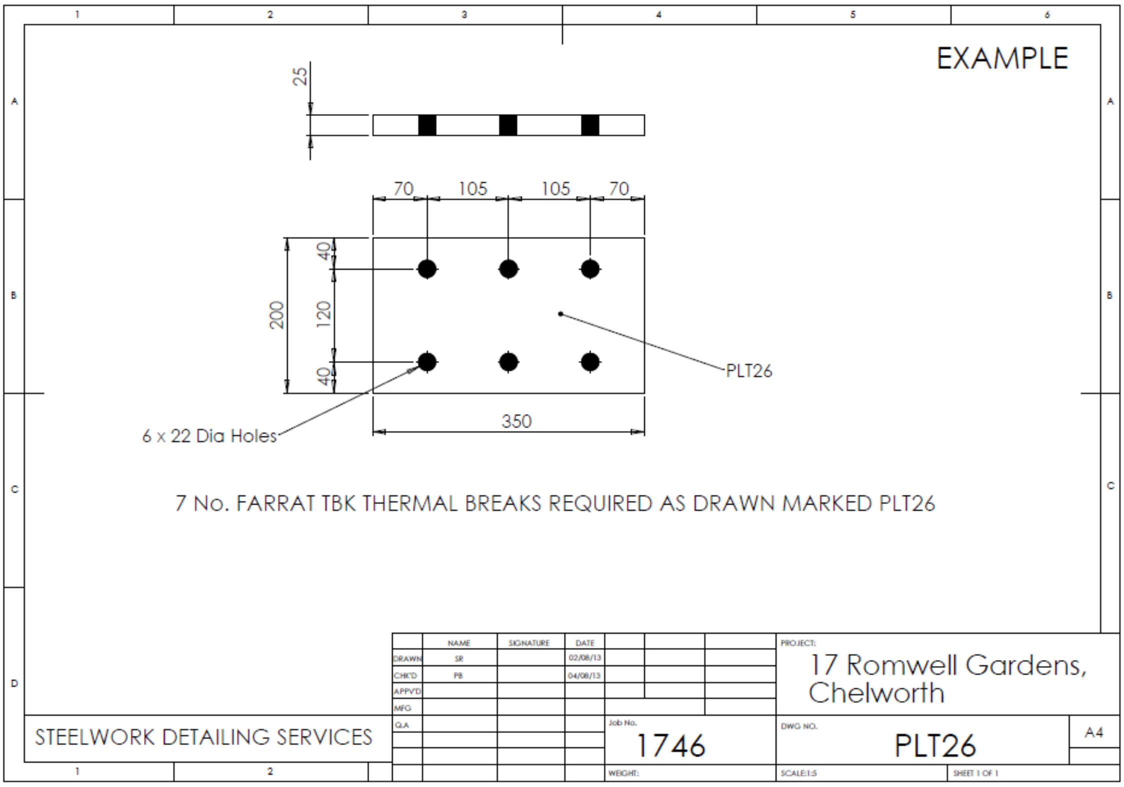


Figure 6.2 Typical fabrication drawing

Handling on site

Thermal breaks are normally procured by the steel fabricator as part of the steel frame package on a project. The delivery from Farrat is normally co-ordinated with the steelwork contractor erection schedule. They are delivered to site with each one labelled with a unique reference linked to the steelwork contractors drawings (e.g. PLT26) as shown in Figure 6.3.

For identification purposes Farrat TBK, TBL and TBF are different in colour. If it is essential to the project that both materials are used on the same project Farrat normally advise that the connection arrangement (e.g. bolt positions) is unique to ensure that no errors are made during installation. This is in addition to Farrat’s normal labelling protocol.

Safety data sheets (COSHH) are made available and all operatives handling the thermal breaks on UK construction sites should use appropriate PPE in line with the requirements of the safety data sheets (primarily gloves & safety glasses). Farrat thermal breaks are bespoke products and no alterations are expected to be undertaken on site.

The general handling requirements for thermal breaks should be in line with other component accessories expected to be handled with the primary steelwork. This is covered in the NSSS: Section 8 Workmanship – Erection. The NSSS also sets out the requirements of the Quality Management System expected to be adopted by all competent steelwork contractors working on UK construction projects.

Figure 6.3 Typical product label

7 CERTIFICATION FOR MANUFACTURING PROCEDURES

SCI do not carry out factory inspections or assessments of manufacturing quality control procedures. However, the Farrat products are manufactured in the UK and the factory has BS EN ISO 9001: 2008 certification.

The Farrat ISO 9001 certificate is issued by TUV UK Ltd and the scope of said certificate includes the design, development manufacture and supply of thermal break materials. The certificate viewed by SCI is valid until 14/11/2014.

SCI has reviewed the Farrat ISO 9001 certificate and conclude that the Farrat manufacturing procedures are suitably accredited.

Appendix A TEST DATA

A.1 Elastic Modulus

TBL								
Sample	**Length**	**Width**	**Height**	**Stress at 5%**	**Stress at 30%**	**Strain at 5%**	**Strain at 30%**	**Elastic Modulus**
	mm	mm	mm	N/mm²	N/mm²	mm/m	mm/m	N/mm²
TBL1	49.8	49.8	26.1	10.19	60.40	7.12	26.81	2551.03
TBL2	50.0	50.0	26.0	10.41	60.22	13.40	33.19	2515.99
TBL3	49.9	50.0	26.1	10.45	60.34	8.61	29.03	2442.48
TBL4	50.1	50.2	26.0	10.30	60.27	7.94	26.60	2679.09
TBL5	50.1	50.1	26.0	10.25	60.33	7.95	26.69	2672.63
TBL6	50.0	49.9	26.1	10.28	60.18	7.95	26.75	2654.55
							Mean	**2586**

TBK								
Sample	**Length**	**Width**	**Height**	**Stress at 5%**	**Stress at 30%**	**Strain at 5%**	**Strain at 30%**	**Elastic Modulus**
	kN	**mm**	**mm**	**N/mm²**	**N/mm²**	**mm/m**	**mm/m**	**N/mm²**
TBK1	50.0	49.9	25.0	50.66	175.41	14.99	39.46	5097.63
TBK2	50.0	50.0	25.0	50.52	175.04	17.51	41.88	5109.98
TBK3	50.0	50.0	25.0	50.50	175.02	16.67	40.77	5165.74
TBK4	50.0	50.0	25.0	50.74	175.26	16.29	39.90	5273.77
TBK5	50.0	50.0	25.0	50.48	174.99	22.58	46.50	5205.43
TBK6	50.0	50.0	25.0	50.53	175.04	20.12	43.99	5216.42
							Mean	**5178**

TBF				
Sample	**Length**	**Width**	**Height**	**Elastic Modulus**
	kN	**mm**	**mm**	**N/mm²**
TBK1	50.08	50.00	29.95	7369
TBK2	50.01	50.03	29.97	7802
TBK3	49.97	50.07	29.95	7913
TBK4	50.01	50.01	29.97	7472
TBK5	50.05	50.01	29.95	7800
TBK6	50.04	50.07	29.94	8183
			Mean	**7757**

A.2 Thermal Conductivity

TBL						
Sample	**Heat flux density [W/m²]**	**Temperature difference [°C]**	**Mean temp. [°C]**	**Lambda [W/mK]**	**r [m²K/W]**	**Calculated Lambda at 10°C [W/mK]**
TBL 1&2	116.68	9.9	14.1	0.2949	0.1703	
TBL 1&2	119.86	9.9	23.7	0.3039	0.1653	0.294
TBL 1&2	120.42	9.9	33.4	0.3055	0.1644	
TBL 3&4	113.38	9.7	13.9	0.2920	0.1720	
TBL 3&4	116.02	9.7	23.5	0.2997	0.1675	0.290
TBL 3&4	117.20	9.7	33.1	0.3032	0.1656	
					Mean	**0.292**

TBK						
Sample	**Heat flux density [W/m²]**	**Temperature difference [°C]**	**Mean temp. [°C]**	**Lambda [W/mK]**	**r [m²K/W]**	**Calculated Lambda at 10°C [W/mK]**
TBK 1&2	150.99	103	15.3	0.1849	0.1365	
TBK 1&2	153.82	103	24.9	0.1886	0.1339	0.184
TBK 1&2	155.42	103	34.6	0.1907	0.1324	
TBK 3&4	148.40	9.9	14.9	0.1895	0.1334	
TBK 3&4	150.12	9.9	24.5	0.1920	0.1317	0.189
TBK 3&4	150.83	9.9	34.2	0.3032	0.1311	
					Mean	**0.187**

TBF					
Sample	**Heat flux density [W/m^2]**	**Temperature difference [°C]**	**Mean temp. [°C]**	**Lambda [W/mK]**	**r [m^{2}K/W]**
1.1	65.2	10	10	0.1968	0.1535
1.1	67.4	10	20	0.2034	0.1485
1.1	68.3	10	30	0.2062	0.1465
1.2	67	10	10	0.2024	0.1487
1.2	69	10	20	0.2083	0.1445
1.2	69.4	10	30	0.2096	0.1436
			Mean	**0.204**	

A.3 Density

TBL					
Sample	**Length [mm]**	**Width [mm]**	**Height [mm]**	**weight [g]**	**density [kg/m^3]**
1	201	200	26.2	1185.9	1126
2	200	199.5	25.9	1178.9	1141
3	200	200	26.0	1185.4	1140
4	200	200	26.0	1183.2	1138
5	200	200	25.9	1180.0	1139
				Mean	**1137**

TBK					
Sample	**Length [mm]**	**Width [mm]**	**Height [mm]**	**weight [g]**	**density [kg/m^3]**
1	200.3	200.4	25.1	1490.8	1478
2	200.3	200.2	25.1	1478.6	1467
3	200.2	200.2	25.1	1474.4	1464
4	200.3	200.2	25.2	1468.3	1456
5	200.2	200.3	25.2	1470.1	1458
				Mean	**1465**

TBF					
Sample	**Length [mm]**	**Width [mm]**	**Height [mm]**	**weight [g]**	**density [kg/m³]**
1	200.1	200.1	30	2.57	2140
2	200.1	200.1	30.1	2.6	2150
3	200.1	200.1	30.1	2.61	2170
4	200.1	200.1	30.1	2.6	2160
5	200.1	200.1	30	2.57	2140
				Mean	**2160**

A.4 Water Absorption

TBL						
Sample	**Length [mm]**	**Width [mm]**	**Height [mm]**	**Weight before [kg]**	**Weight after [kg]**	**Water absorption [%]**
1	200.0	200.0	26.3	1.1858	1.1915	0.54
2	200.0	199.5	25.9	1.1789	1.1839	0.48
3	200.0	200.0	26.0	1.1854	1.1902	0.46
4	200.0	200.5	26.0	1.1832	1.1879	0.45
5	200.0	200.0	25.9	1.1800	1.1847	0.45
					Mean	**0.48**

TBK						
Sample	**Length [mm]**	**Width [mm]**	**Height [mm]**	**Weight before [g]**	**Weight after [g]**	**Water absorption [%]**
1	200.3	200.4	25.1	1490.8	1492.2	0.14
2	200.3	200.2	25.1	1478.6	1479.9	0.13
3	200.2	200.2	25.1	1474.4	1475.8	0.14
4	200.3	200.2	25.2	1468.3	1469.6	0.14
5	200.2	200.3	25.2	1470.1	1471.5	0.14
					Mean	**0.14**

TBF						
Sample	**Length [mm]**	**Width [mm]**	**Height [mm]**	**Weight before [g]**	**Weight after [g]**	**Water absorption [%]**
1	200.1	200.1	30.0	2567.5	2572.6	0.4
2	200.1	200.1	30.1	2595.1	2599.6	0.4
3	200.1	200.1	30.1	2610.5	2613.8	0.3
4	200.1	200.1	30.1	2603.7	2607.3	0.3
					Mean	**0.4**

A.5 Compressive strength

TBL					
Sample	**Length [mm]**	**Width [mm]**	**Height [mm]**	**Load [kN]**	**Compressive strength [N/mm^2]**
1	49.0	49.8	26.1	221.0	89.1
2	50.0	50.0	26.0	243.5	97.4
3	49.9	50.0	26.1	247.1	99.0
4	50.1	50.2	26.0	248.1	98.6
5	50.1	50.1	26.0	251.6	100.2
6	50.0	49.9	26.1	249.1	99.8
				Mean	**97.4**

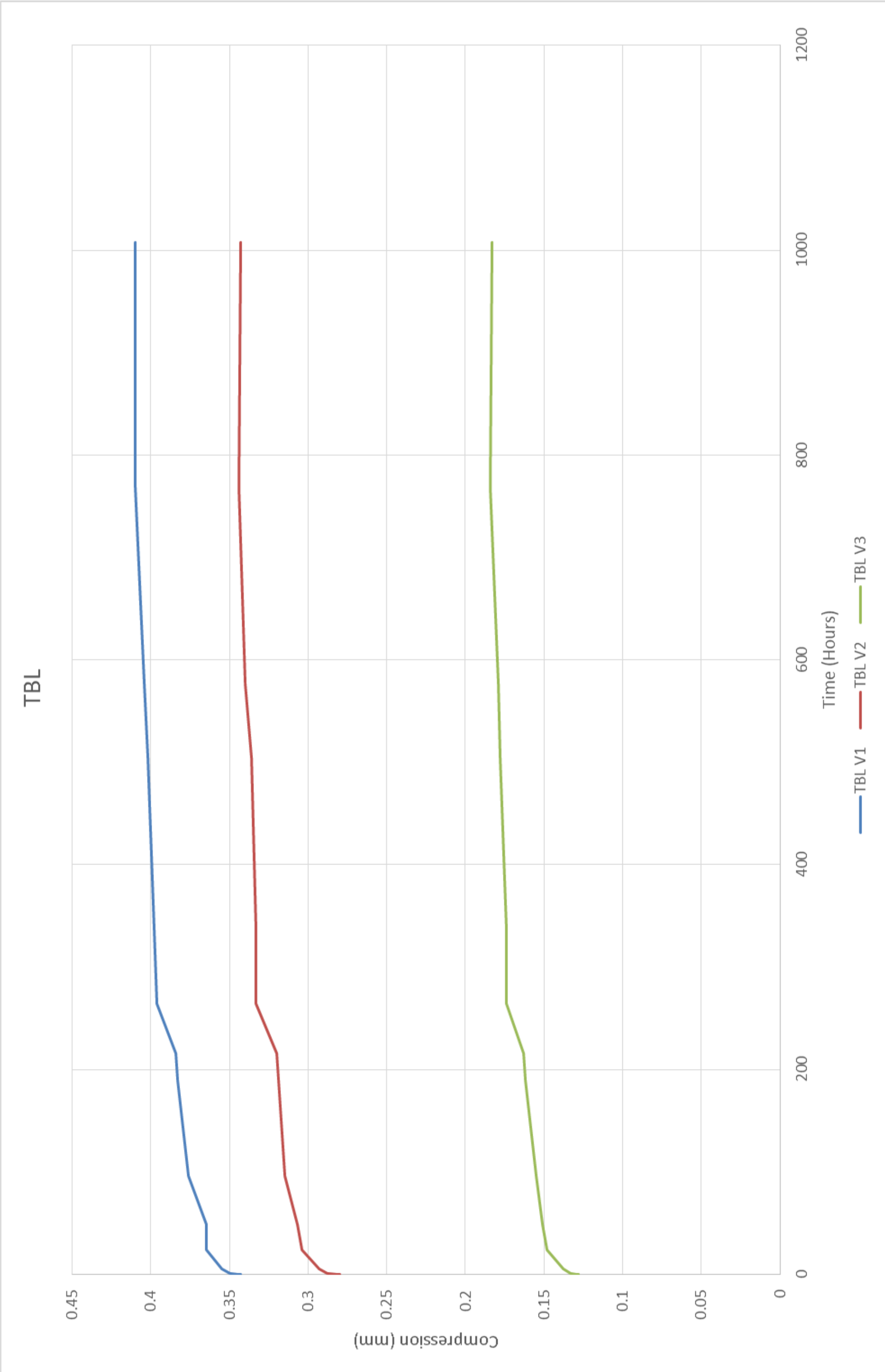
TBK					
Sample	**Length [mm]**	**Width [mm]**	**Height [mm]**	**Load [kN]**	**Compressive strength [N/mm^2]**
1	50.0	49.9	25.0	794.1	318.3
2	50.0	50.0	25.0	809.2	323.7
3	50.0	50.0	25.0	801.9	320.8
4	50.0	50.0	25.0	826.7	330.7
5	50.0	50.0	25.0	801.8	320.7
6	50.0	50.0	25.0	792.2	316.9
				Mean	**321.8**

TBK					
Sample	**Length [mm]**	**Width [mm]**	**Height [mm]**	**Load [kN]**	**Compressive strength [N/mm^2]**
1	50.08	50.00	29.95	920.80	367.7
2	50.01	50.03	29.97	1003.40	401.0
3	49.97	50.07	29.95	1029.50	411.5
4	50.01	50.01	29.97	951.20	380.3
5	50.05	50.01	29.95	1038.70	415.0
6	50.04	50.07	29.94	1037.40	414.0
				Mean	**398.3**

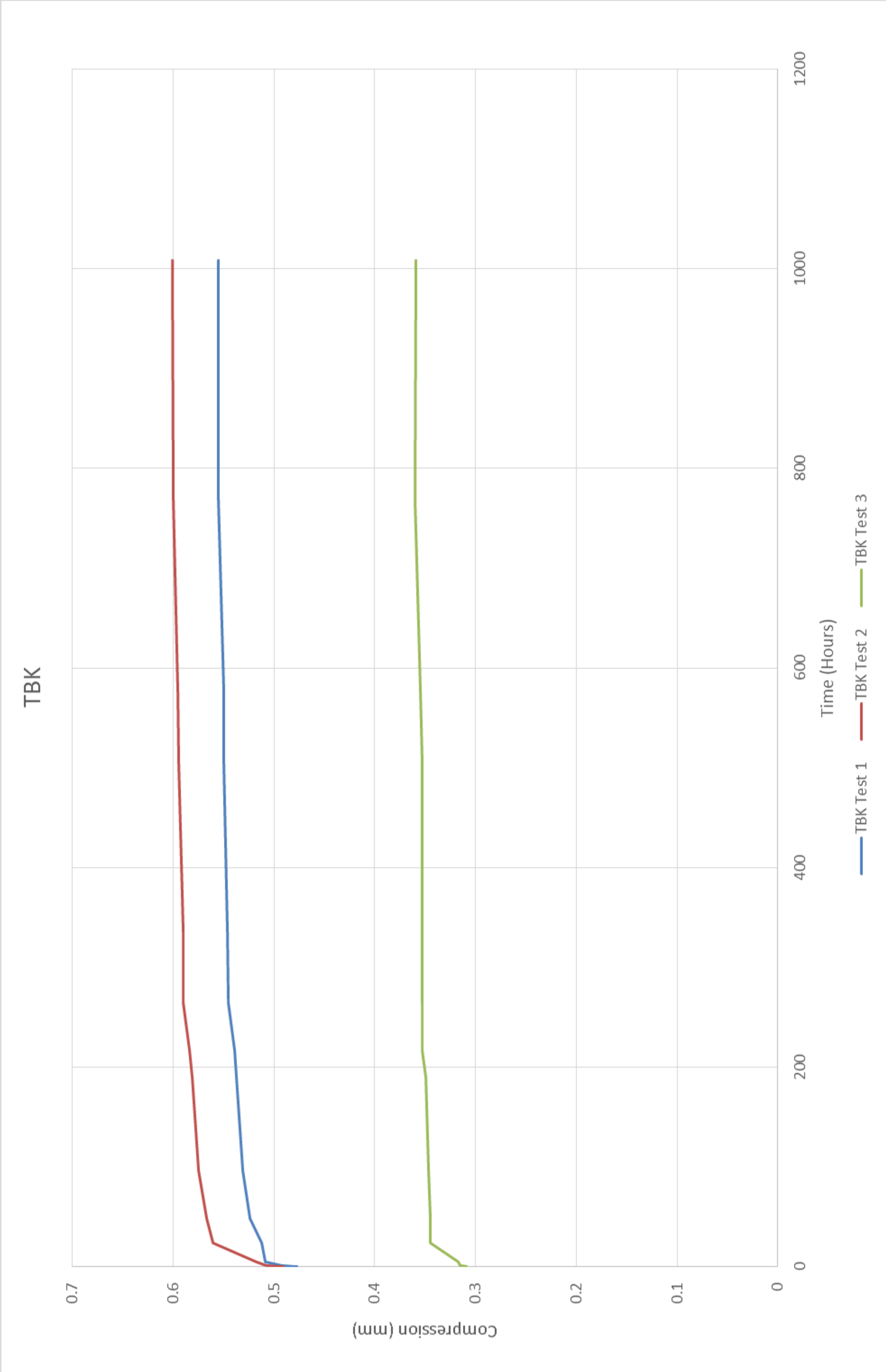
Property	Farrat TBL [N/mm^2]	Farrat TBK [N/mm^2]	Farrat TBF [N/mm^2]
Characteristic compressive strength	89.1	312	358.8
Design value for compressive strength	71.3	250	287.1

A.6 Long term creep

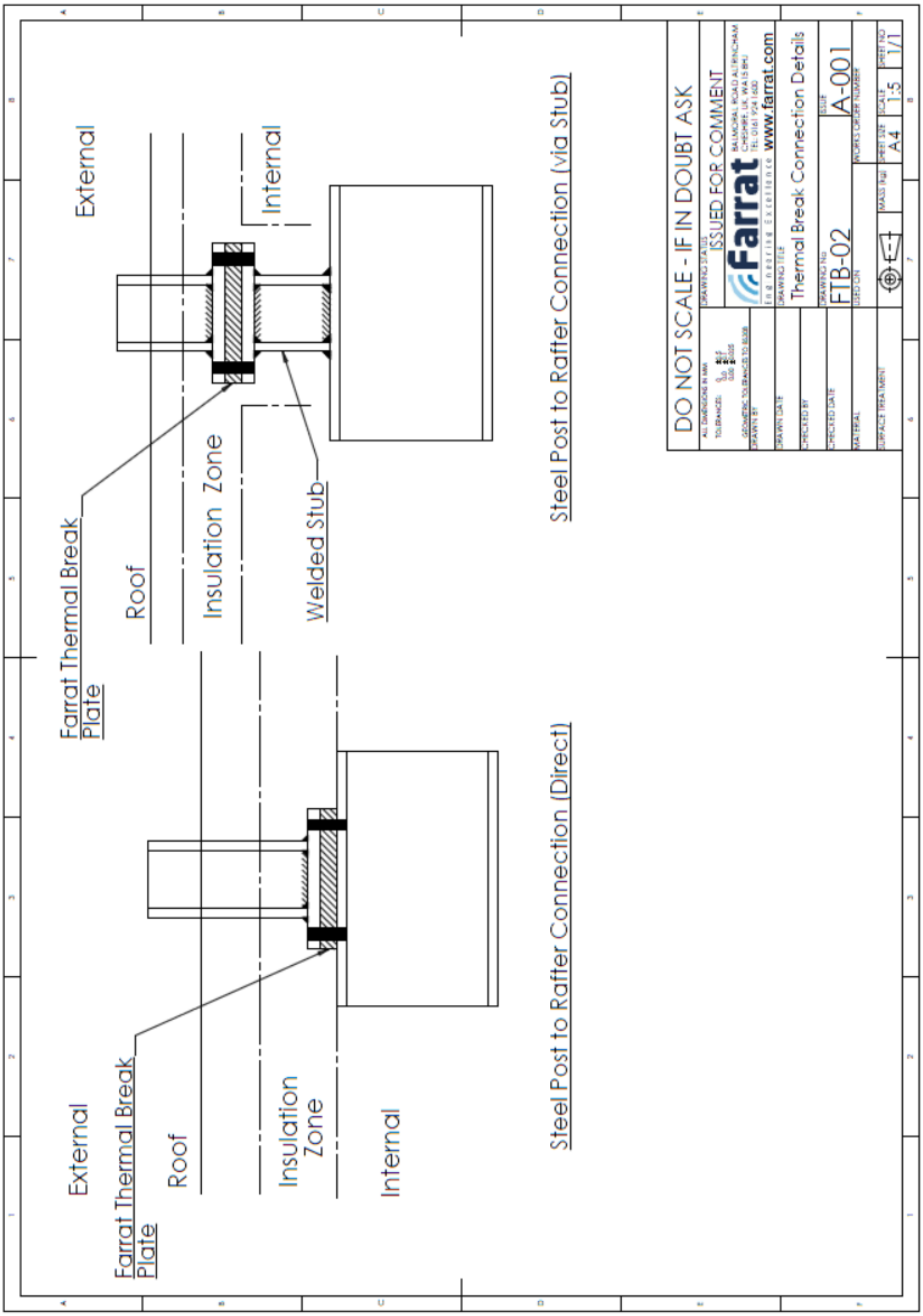
TBL

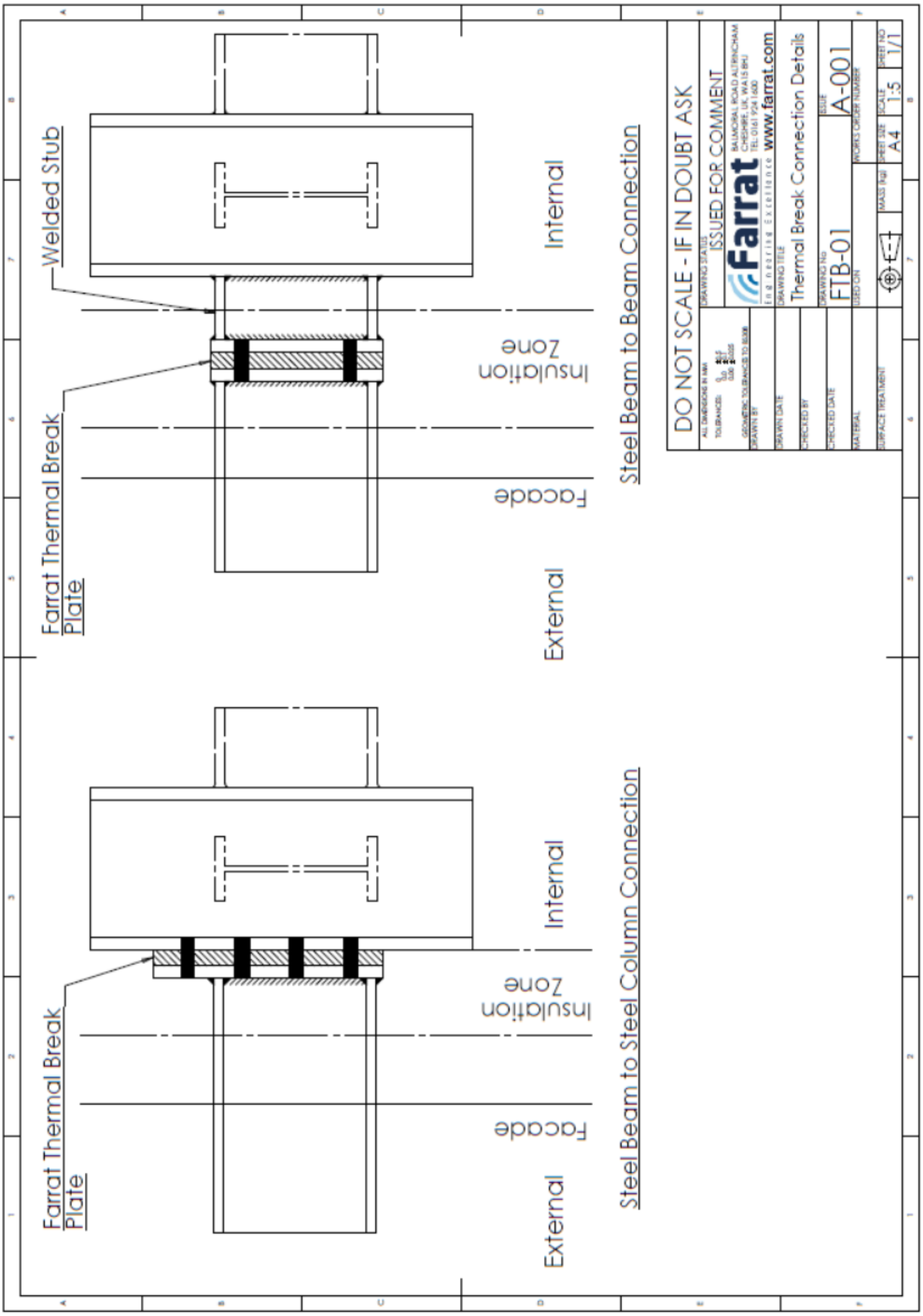


TBK


TBK
Compression (mm)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Time (Hours)
0
200
400
600
800
1000
1200
TBK Test 1
TBK Test 2
TBK Test 3

Appendix B APPLICATION DRAWINGS




Welded Stub
Farrat Thermal Break Plate
Internal
Insulation Zone
Facade
External
Steel Beam to Beam Connection
Farrat Thermal Break Plate
Internal
Insulation Zone
Facade
External
Steel Beam to Steel Column Connection
DO NOT SCALE - IF IN DOUBT ASK
ISSUED FOR COMMENT
Farrat
www.farrat.com
Thermal Break Connection Details
FTB-01
A-001
A4
1:5
1/1