Timber Resin Splice (TRS® Patented)

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Timber Resin Splice

Introduction

A Timber Resin Splice (**TRS**®) is a Rotafix patented solution for repairing damaged and/or under-specification timber members. New sections of replacement timber can be species and moisture matched and joined using our innovative design approach and specially designed materials.

Timber resin splice repairs have been used in many UK and International historic buildings where there is a requirement to retain as much of the original material and features of the building as possible. Our low disturbance technique is a cost effective way of breathing new life into original features.

Advantages

- Maintains the maximum amount of the original timber
- Flexible repair options in accordance with access
- Our adhesive materials are designed specifically to behave like wood
- Low disturbance to building fabric
- Cost effective solution compared to complete removal and replacement
- Upgrades the strength and performance of the original timber

The diagrams below show typical examples of Timber Resin Splice units.

TG6 restored end

Moment Resistant Joint RSA and GFRP

Rods and top slot with TG6 Structural Grout

Side slot and rod ready for RSA thixotropic adhesive

Applications

Timber Resin Splice repairs can be used in the following applications:

- Structural joints
- Lintels
- Tie beams
- Bressumers
- Wall plates
- Posts
- Glulam beams and columns

Preparation

Rotafix has the capability to provide machined and fully prepared **TRS®** units that have the bonded in rods in place ready to be fitted. To meet your design we can machine slot and drill the holes into any material that you may require.

We manufacture and supply the Rotafix adhesives, Rotaflex rods and plates, as required, to complete your own design or manufacture.

It is imperative that all damaged and decayed wood is removed from the parent timber. The cause of the damage, be that of infestation, moisture ingress or inadequate design, needs to be established and rectified prior to the installation of the replacement **TRS®** to ensure that the repair will last.

Rotafix recommend boron based products for both eradicative and on-going preservation treatments to timber.

Rotafix **TRS®** units are all tailor made to suit your design.

Standard sections of timber are shown below. For softwood we recommend C24 Planed All Round Timber. Other section sizes are available by bonding sections of standard sized timber together with Rotafix Lamset.

Width (mm)	Height (mm)
47	100
47	150
47	200
47	250
47	300
75	225
75	250
75	300
100	150
100	200
100	300
150	300

Structural Adhesives and Grouts

Rotafix have developed a specific range of structural adhesives, grouts and ancillary products designed for repairing and/or restoring timber. The choice of adhesive and methodology is determined by the access available for the repair. The following adhesives are suitable:

TG6

TG6 is a pourable 3 part structural grout designed specifically for timber repairs. By using a header it is possible to pour up to 50 litres of adhesive that will flow up to 6 metres. The unique formulation of TG6 ensures that it de-gases, forming a void free solid timber substitute. The mixed and cured TG6 system has a fire rating of 1 hour.

Rotafix Structural Adhesive (RSA)

RSA is pumpable 2 part thixotropic epoxy system that forms a high strength adhesive. This slow setting system is ideal for injecting and pumping into blind holes, side slots, cracks and fissures. The gap filling adhesive has been designed to be used as a thick film. The cured low modulus system has a degree of movement which allows it to flex with the wood.

Engineering Adhesive (EA)

EA is a pumpable 2 part thixotropic epoxy resin similar to RSA in consistency but modified to further increase the modulus of the cured adhesive. This slow setting, gap filling adhesive, which is designed to be used as a film up to 12 mm thick, gives the operator the opportunity to position and move the repair components for precise location.

CB10T

CB10T a faster setting 2 part thixotropic epoxy adhesive used for bonding in Rotaflex rods or plates where speed is of the essence.

Timberset

Timberset is a 2 part thixotropic adhesive used where the moisture content of the timber is up to 20% and where the timber is expected to remain in moist condition as a result of exposure to the elements.

Performance Table

ADHESIVE	Compressive Strength	Tensile Strength	Tensile Modulus	Flexural Strength	Bond Strength	Workable Time @ 20°C
TG6	>50N/mm^2	17 N/mm^2	9GPa	32N/mm^2	3N/mm^2	50 Mins
RSA	>60N/mm^2	38 N/mm^2	2GPa	70N/mm^2	6-10N/mm^2	6 Hrs
EA	>60N/mm^2	40 N/mm^2	3GPa	70N/mm^2	6N/mm^2	6 Hrs
CB10T	>50N/mm^2	17 N/mm^2	7GPa	34N/mm^2	4N/mm^2	30 Mins
Timberset	>50N/mm^2	18 N/mm^2	2.4GPa	70N/mm^2	6-10N/mm^2	30 Mins

TRS® Materials

Rotafix have developed, tested and implemented solutions with a broad range of construction materials. Architects, structural engineers and contractors need to determine the most suitable of the Rotafix range of materials available.

Rotafix are able to supply **TRS®** units in the following materials to suit your needs.

- Graded softwood
- Hardwood
- KERTO, VERSA-LAM (Paralam)
- Laminar Veneered Lumber (LVL)
- Cross Laminated Timber (CLT)
- Accoya
- Glue laminated graded softwood
- Glue laminated graded hardwood

Softwood

Graded softwood such as C24 is commonly used for **TRS®** units. Graded timbers are selected purely to ensure that the quality and strength of the timber are not compromised by knots or grain patterns.

Hardwood

Rotafix adhesives perform excellently in hardwood. The small particle size of the adhesives gives excellent penetration of the 2 part thixotropic unfilled adhesives such as Rotafix Structural Adhesive (RSA).

KERTO/VERSA-LAM

KERTO/ VERSA-LAM is a laminated timber made up of 3mm rotary sliced sheets bonded together to give a dimensionally stable and predictable engineered product designed specifically for structural members. It can be laminated to provide section sizes as required. Rotafix have the in-house capability to laminate the KERTO / VERSA-LAM to meet your requirements.

Accoya

Accoya is an Engineered Wood Product (EWP). Accoya is dimensionally stable, machines well and is extremely durable for outside applications. Accoya takes paint and stains well. It is guaranteed for 50 years above the ground and 25 years in the ground.

Glulam

Glulam, or Glue Laminated Timber, can be used for the manufacture of Rotafix **TRS®** units. Depending on the size of the layers in the glulam it is sometimes possible to omit a section to accommodate a rod side slot. GLULAM is becoming increasingly popular for large architectural spans.

ROTAFIX TRS® REINFORCING MATERIALS

The following materials can be used to bond the principal and secondary adherends. All of the following components are available from Rotafix:

- Rotaflex CFRP Plate. 50mm wide x 2mm thick x 5 metres long
- Rotaflex GFRP Plate. 100mm wide x 4mm thick x 5 metre long
- Rotaflex GFRP Rods. 5, 6, 8, 10, 12, 16, 20mm diameter x 2.5 metres long

Also available:

- Stainless Steel Reinforcing Rods to BS6744/BS86666
- Stainless Steel Threaded Rods to BS3643, CARE Certificated
- BS4449 Carbon Steel High Yield Reinforcing Rods
- Small diameter (5mm) pultruded GFRP Rod available for easy insertion and bending into restricted end beam situation.

Material choice depends on engineering requirements. All the Rotafix grouts and adhesives are compatible with the above material specifications with regard to quoted bond stress value.

Rod Diameters for Drilled or Formed Hole and Slot Diameters

The Rotafix system is based on thick film adhesives (2-12mm). As a guide the following table will give an indication as to the diameter of the holes to be used for a specific threaded rod diameter or a BS4449 rebar diameter.

Threaded Rod or Pultruded Rod Diameter	Preferred Drilled Hole Diameter
5	10
6	10
8	12
10	14
12	16
16	20
18	22
20	24
24	28
-	-

BS4449 Reinforcing Rod Nominal Diameter	Preferred Hole Diameter
-	-
6	10
-	-
10	16
12	16
16	20
-	-
20	26
24	30
32	36

Calculating Strength Requirements

The number of rods and the pattern of the location of the rods/plates varies according to the performance you are looking to achieve and the loads that you are expecting to experience. Rotafix recommends using the services of a structural engineer to calculate the appropriate design.

As well as increasing the number of rods to strengthen a design if space is a constraint then it is possible to laminate the carbon fibre strips to increase the strength value of the reinforcement.

TRAINING

Rotafix strongly suggest using a trained and approved contractor to carry out this work.

Rotafix have approved contractors throughout the UK and Europe. We would be happy to recommend one of these to you.

If you are interested in becoming a trained and approved contractor please call our Head Office to make the arrangements. We can be contacted on +44(0)1639 730481.

If you are an architect, structural engineer, or are involved in the design of timber repairs, we run a series of Continuous Professional Development (CPD) training sessions that will ensure that you are up to speed with the latest methods and techniques that will allow you to specify these methods with confidence.

If you are interested in CPD training then please give our Head Office a call and we will make the necessary arrangements to meet your needs.

Our head office can be contacted by telephone on +44(0)1639 730481 or by fax on +44(0)1639 730858. Alternatively, you can send an email to sales@rotafix.co.uk

A training session provided by Rotafix for European engineering graduates at Mons University, Belgium.

CASE STUDY 1

George Street, St Albans

The floor joists in this timber framed jettied property dated back to 1600AD. As can be seen in the picture opposite *Fig 1*, the floor joists have become detached from the main frame of the building. To make the upper floor of the building usable again it was necessary to re-establish the integrity of the floor.

Given the historical importance of the building and the Grade 2 listing it was necessary to effect a repair that retained as much of the original timber as possible.

Fig. 1 Detached floor joists

Fig. 2 Propped floor joists with decay removed

In this project we used the Rotafix patented Timber Resin Splice (**TRS**®) repair incorporating carbon fibre plate and Rotafix Structural Adhesive (RSA).

The first step in the repair was to prop up the beams from the underside *Fig. 2*

We then removed the damaged wood until we arrived at 'good' wood.

Slots were cut into the timber using a specially modified Rotafix chainsaw and a jig to ensure that the slots were straight and of consistent depth *Fig. 3*

Fig. 3 Slots being cut with a jig and modified chainsaw

The next step was to replace the damaged ends with new ends that had been fabricated off site. Each new end was made to measure. It was important to species and moisture match the timber where possible to ensure that any expansion or contraction was consistent in both the new and existing timbers.

Fig. 4 RSA being injected

Fig. 5 Carbon Fibre Reinforced Plate being inserted to check length

Fig. 4 above shows the slots being carefully injected with RSA. The Carbon Fibre Reinforced Plate (CFRP) was then inserted centrally into the RSA as in *Fig. 5*

After approximately 24 hours the props were removed. The new timbers were then contoured, shaped, coloured and made to be visually compatible with the original beams.

Fig. 6 Underside of the repaired beam prior to being contoured

CASE STUDY 2

Aydon Castle, Northumberland

Aydon Castle was originally a wooden baronial hall built by Hugh de Reymes in the thirteenth century. It overlooks the valley of the Cor Burn in Aydon, near Corbridge, Northumberland, North East England.

As can be seen in *Fig. 1*, the floor joists had decayed in the wall pocket, more than likely as a result of damp ingress in the stone walls. The joists had an internal span of approximately 5 metres. The species of the wood is thought to be Baltic pine softwood (*pinus sylvestris*).

Fig. 1 Decayed floor joint in wall pocket

Fig. 2 Sufficient floor boards removed for access

By using the Timber Resin Splice (**TRS®**) it was possible to replace the ends of these beams without disturbing the majority of the floor as would be necessary if we were to completely replace the joists. This is one of the biggest advantages of the **TRS®** method.

In this example we used a Rotafix **TRS®** with metallic rods bonded to the original timber with TG6 Structural Grout. A drill and appropriate diameter bit was used to form the continuous vertical slot in the timber.

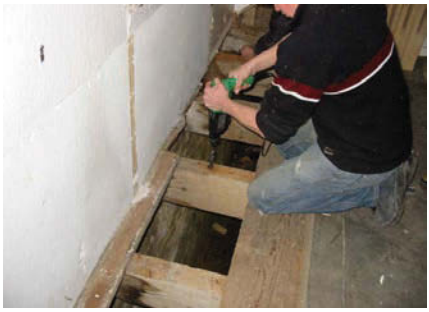

Fig. 3 Slots being drilled into the original floor joists

New joist ends were manufactured off-site at the Rotafix workshop. In this case we used five 12mm stainless steel rebar rods. A top slot was created to allow the TG6 to pour around the rods in the new timber end. See *Fig. 4*

The **TRS®** used was butted up to the existing timber and a timber slip used to hold it in place as shown in *Fig. 5*

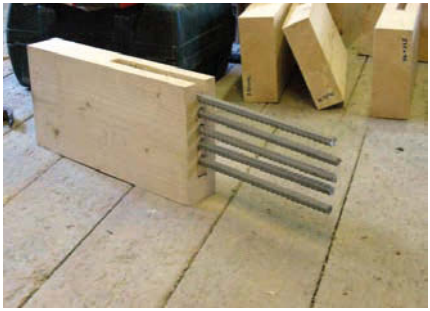

Fig. 4 New TRS® with Stainless Rebar Rods

Fig. 5 TRS® unit fitted in place

Fig. 6 Header box to assist pouring of TG6

P8 Bonding Paste was used to seal the joint between the new and the existing timbers as a temporary measure to prevent the TG6 leaking between the joint.

The TG6 was poured in to the header box as shown in *Fig. 6*. This helped ensure that we achieved a complete fill in the void and that there were no pockets left unfilled.

It was important to ensure that the pocket was completely filled with the TG6 as can be seen in *Fig. 7*

Fig. 7 TG6 Filled TRS Unit

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