Timber Repair Review

ISSUE 1

Review of Timber Repair & Preservation Techniques

There is no 'timber repair industry' as such - we really need one

An example of Tie Beam Repair using a Timber Resin Splice, Macintosh Mill. © George Hockey 2007

In the UK we have a small range of historical repair methods in use today by the building contractors, who largely prefer to rip out the entire original timber and replace it with steel.

Why? Because it makes for a bigger repair project and it is easy to cost when you have familiarity with standard building materials. The builders operate on the basis that the Client is not interested in saving non-renewable materials, but times are certainly changing.

Most decayed structural timbers are irreplaceable. You simply cannot buy 'dry' 12 inch x 12 inch (300mm x 300mm) solid timber for installation indoors in a centrally heated building. Certainly 'green', wet (freshly felled) timber is available in some species, but it is definitely going to crack and split ('shake') when exposed to the high temperature, low humidity environments in which we live today. This shrinkage is inevitable and natural and explains why Architects have to build-in big movement tolerances when constructing new building in 'green' Oak.

The nearest total replacement that is in manufacture today is the 'Glulam' beam: a nice, striped looking softwood component mainly found in large span situations (schools, churches, gymnasia), made of many thin strips of softwood glued together. It does not offer a substitute for the look or shape, let alone species of original structural timbers and is usually incorporated in new build projects, or occasionally as complete spans in refurbishments or major extensions.

So, the Timber Repair Review will investigate current best practice in repair techniques and provide detailed Case Studies of projects carried out by the UK's specialists, in the hope that the information provided will encourage Architects, Engineers and other Specifiers' to insist on methods that reduce waste, restore existing timbers and avoid non-sustainable replacement in steel.

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Case Study:

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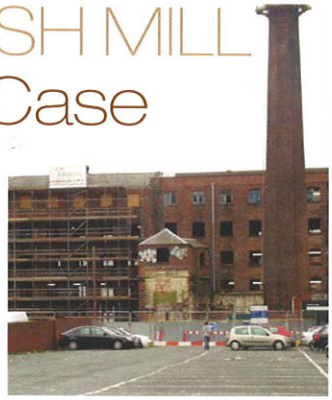
MACINTOSH MILL Tie Beam Case Study



Macintosh Mill before renovation

About the Macintosh Mill Project:

Taylor Woodrow has developed Manchester's Macintosh Village, which combines a significant 2-hectare master plan for 1.7 hectares of refurbished historic warehouses and new buildings. The £130 million scheme centres around the campus of land formerly owned and operated by the Charles Macintosh & Co Ltd Rubber Works. This unique urban district, just a short walk from the city centre, will be at the hub of Manchester's exciting new Southern Gateway, which is undergoing full-scale regeneration.

George Hockey, Managing Director of Trace Remedial Building Services, has been instrumental in surveying the extensive rot problems in the bearing ends of the Mill's carrier beams, tie beams and rafters and chose to specify the Timber-Resin Splice technique. Over 35 of these repair end units were manufactured in matching Pitch Pine and fitted on site by Trace Remedial's technicians.

Timber-Resin splice in place

Slots cut, ready to fit Timber Resin Splice

Introduction

An example of rot in a Tie Beam Bearing End

Conventionally Tie Beams have been replaced completely, or 'plated' with large steel plates, fixed through with bolts or 'scarfed'. These repairs have a few disadvantages:

a) complete replacement

costly, disruptive to the whole frame, involves a lot of ancillary building works, massive support scaffolding, new timber hard to find in original size and appearance, possible loss of 'heritage', difficulty of moving a large component into an existing building, almost certainly will result in the installation of a rigid steel joist (RSJ), which is made of an increasingly expensive and non-sustainable material.

b) plated repairs

ugly, large bolt holes prone to wear and decay, difficult to install into the wall alongside the original stump, limited repair length, cannot be nailed or screwed into for attached timbers, prone to condensation and rusting.

c) scarfed repairs

require carpentry skills, have limited strength, repair length restricted to the bearing, difficult to assess structurally.

However, more modern techniques do exist and have considerable advantages;

(i) solid poured resin repairs

an extension of concrete engineering – build a 'shutter' box, add steel reinforcement and pour in an epoxy grout. Very strong, durable and easy to calculate structurally. Downsides – expensive, non-sustainable epoxy resin used in bulk, 'shuttering' requires some carpentry skills, ugly if visible, restricted opportunities due to the access needed to fit the steel reinforcement.

to Tie Beam Repairs

This edition of Timber Repair Review features the repair of decayed Tie Beams, a common structural component part of a rafter 'A' frame combination – so, in other words, we are going to look at how to repair the horizontal timber that holds the frame together, without replacing the whole piece of wood.

(ii) resin & rebar strength upgrades

known as a 'modified flitch', this technique uses a slot cut into a timber over its whole span, filled with high tensile rebar, set in an epoxy pouring grout. This 'composite' fill strengthens the timber, reduces deflection and can be used to carry greater loads (for example: change of use, from domestic to commercial loading). A useful way of avoiding timber replacement, much easier than fitting a 'flitch' plate, which involves a precision slot and a very heavy awkward steel plate, which is usually drilled and bolted.

(iii) 'dugout' repairs with resin

used where an 'historic' or decoratively important timber is largely decayed in the centre, but a skin can be preserved to act as a 'shutter'.

Rebar and resins are used to fill the 'dugout' and extend into slots or holes cut into the sound part. An excellent way of invisibily strengthening a beam where appearances are crucial.

(iv) reinforcement with bars in resin

also known as 'stitching', this technique uses bars (epoxy glass, zinc plated steel or stainless steel) bonded into holes filled with a thixotropic epoxy resin. The resulting internal connection of the upper and lower parts of a structural timber can stiffen the structure and is also used to make good cracks, splits and 'shakes', which are natural, along the grain shrinkage defects.

(v) timber-resin splice

replacement of a rotted bearing end or mid-span section of a timber beam with a new, purpose made timber component, secured with structural epoxy pouring grout. The new beam part is laminated from kiln dried, maximum section structural timber and fitted with high tensile, zinc plated steel bars, or supplied with built in slots, as a complete ready to fit kit. The new part can be made in a matching timber (e.g. oak, elm, Douglas fir, pitch pine etc) and the final repair is stronger than the parent timber.

(vi) joist repair plates

for domestic loaded joists these pairs of plates, fitted using Coach Screws, are available to replace the bearing ends and offer a quicker alternative to bolted splices.

For excellent Site photographs go to www.iscapreservation.co.uk

Diagnosing the Rot

No matter which repair technique we use correct diagnosis is essential. Timber rots for only one reason – it has become damp. At sustained moisture contents above 18% most timbers will decay and the insects like to join in.

Measuring dampness in Timber

Typically, in the UK, the common furniture beetle (Anobium punctatum) prefers damp softwoods, but is slow acting and has a 3-5 year life cycle. The Death Watch Beetle prefers rotting Hardwoods, is also slow acting, but has a longer life cycle (8-10 years) and bores much bigger tunnels, usually up the centre of beam bearing ends sitting in damp walls. Wood boring weevil is mainly found in very wet softwood and is not considered to be a pest as such – as soon as the wood dries out the insect disappears.
Rots can be divided into two groups – wet rots and Dry rot.
The distinction is only important because Dry rot can spread beyond the area of dampness into relatively dry wood – wet rots cannot.
There is only one Dry Rot fungus, Serpula lacrymans, but there are many wet rots and some of their forms look very like Dry rot. Care is therefore needed to identify these correctly – the BRE (Building Research Establishment) publishes an excellent book on this subject (including insect identification), available from their on-line bookshop www.brebookshop.com

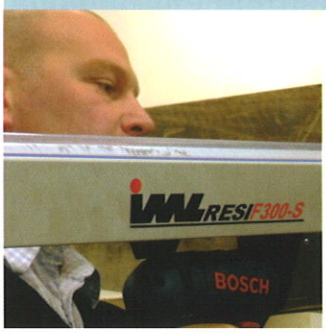
In order to select a repair technique we need to firstly identify the rot type, the insect type (usually by hole size) and the extent of the decay. The extent can be difficult to establish, but it is crucial to the dimensions of the repair component, so we have to:

1. Open up the surrounding areas as much as possible
2. Establish the source of the dampness
3. Probe with a screwdriver and 'sound' with a hammer
4. Take moisture readings to establish the edges of the dampness problem, including some internal readings using insulated probes
5. Drill small holes with an Auger, to see if the centre of the timber is sound
6. Look at the access – can we reach the timber from above, beneath or from the sides
7. Decide if the repair is 'cosmetic' – do we need to match the timber species or even the grain and colour?

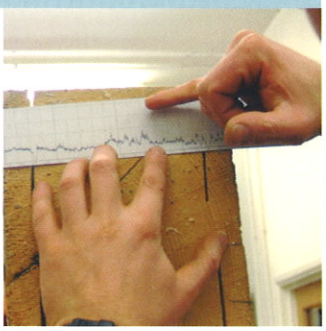
We can now set about choosing a repair technique and costing the alternatives.

Advanced Diagnosis

The Scientific Approach



Resistograph drilling in progress



Graph shows density variations

We can Ultrasound a baby in the womb, so why not timber?

Yes, used in exactly the same way, Ultrasound does indeed give us an instant reading of the density of timber and this enables us to locate areas of reduced density, most likely to be caused by decay.
This preliminary test takes little time and is invaluable because it allows us to focus our main test, the Resistograph, on small areas, saving time and money.

Ultrasound in use

The Resistograph machine is basically a high speed electric drill attached to a very fine stainless steel needle. As the drill drives the needle into the wood the resistance is measured and marked onto a paper tape graph. The needle is then withdrawn and the fine hole, about 3mm in diameter, is barely visible.

By charting the results we can accurately show where decay has occurred. This gives a Surveyor or Contractor enough information to decide a cut off point and to specify dimensions for a timber repair, for example the Timber-Resin Splice system.

As an alternative to 'sounding' with a hammer and drilling with an Auger these techniques have many advantages: accuracy, minimal hole size, graphing record production and repeat-ability – operator opinion of the tapping sound or the visual state of the borings does not enter the equation.

If Dry rot has been diagnosed, or is a possibility, we could also specify the installation of some Dry Rot Sensor sticks – these blue treated sticks will change colour, from blue to yellow, if Dry rot is active – always a worthwhile additional check at the perimeter of a damp area.

To be featured in Review No. 2 : Treating the Rot - a preview

Because dampness is the underlying cause of all decay we have to consider treatments appropriate to the level of dampness inside the timber – surface treatments alone cannot do the job.

Installing a Boron rod
Borate based preservatives provide the best long term protection against rots and insect attack because they remain inside the timber long term – they have no vapour, do not evaporate and love moisture, thus spreading themselves readily through the damp, most vulnerable areas.

In hardwoods, like Oak and Elm we may also need to treat Death Watch Beetle, which because of its long life cycle also needs internal, drilled injection treatment and annual re-inspection.

Timber which has lost its grain structure is scrap – it must be cut back or dug out to reach sound wood. We need to reach sound wood in order to connect our chosen repair to something solid and durable.

The remaining timber will be damp – conductivity meter testing should be used to see how far along the timber readings above 18% can be found. This will determine the treatment zone. Timber below 18% is not vulnerable, but care must be taken to allow for the possibility of seasonal re-wetting – for example, in mid Summer an exposed timber frame may be down to 10% moisture content, but we can safely predict that it will become vulnerable to decay during the next Winter.

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References :

T.R.A.D.A. Eurocode 5
Resin Repair Systems
www.trada.co.uk

B.R.E.
The identification of Insects and Rots

Suggestions :

Would you like to see an article on a specific subject?
Would you like to make a contribution?
Contact David Moore, the Editor (details below).

About the Timber Repair Review:

An independent technical publication aimed at presenting topical analysis of all timber repair and treatment techniques for the use of Architects, Structural Engineers and other interested professionals in the building refurbishment industry.

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