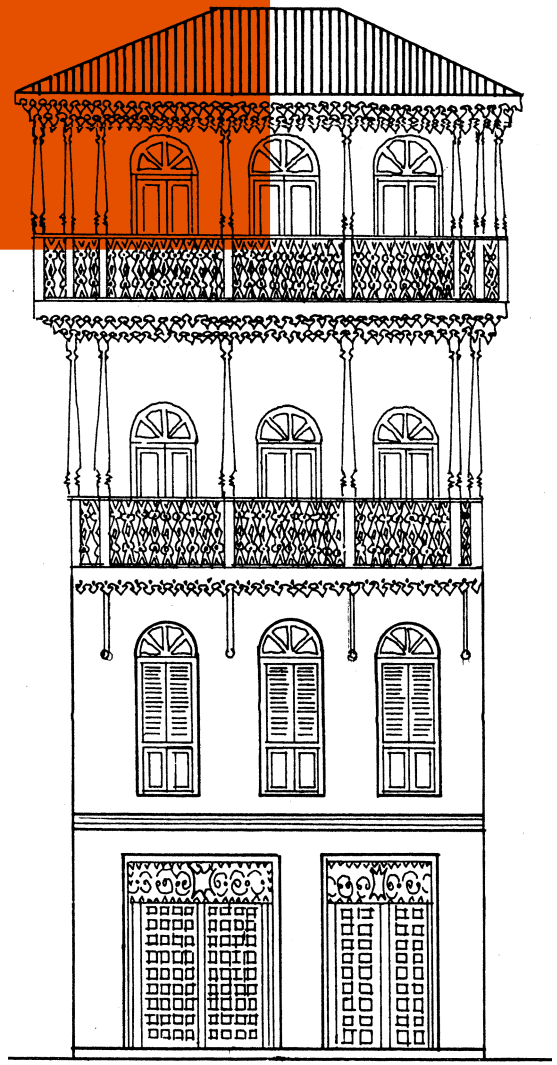
8.

TIMBER CONSERVATION



THE AGA KHAN TRUST FOR CULTURE

INTRODUCTION

This section provides guidelines on recommended procedures of repair and maintenance of both structural and non-structural timber elements.

CAUSES OF DECAY

Diagnosis

IMPORTANT PRINCIPLES OF TIMBER REPAIR

Key Points
Glue

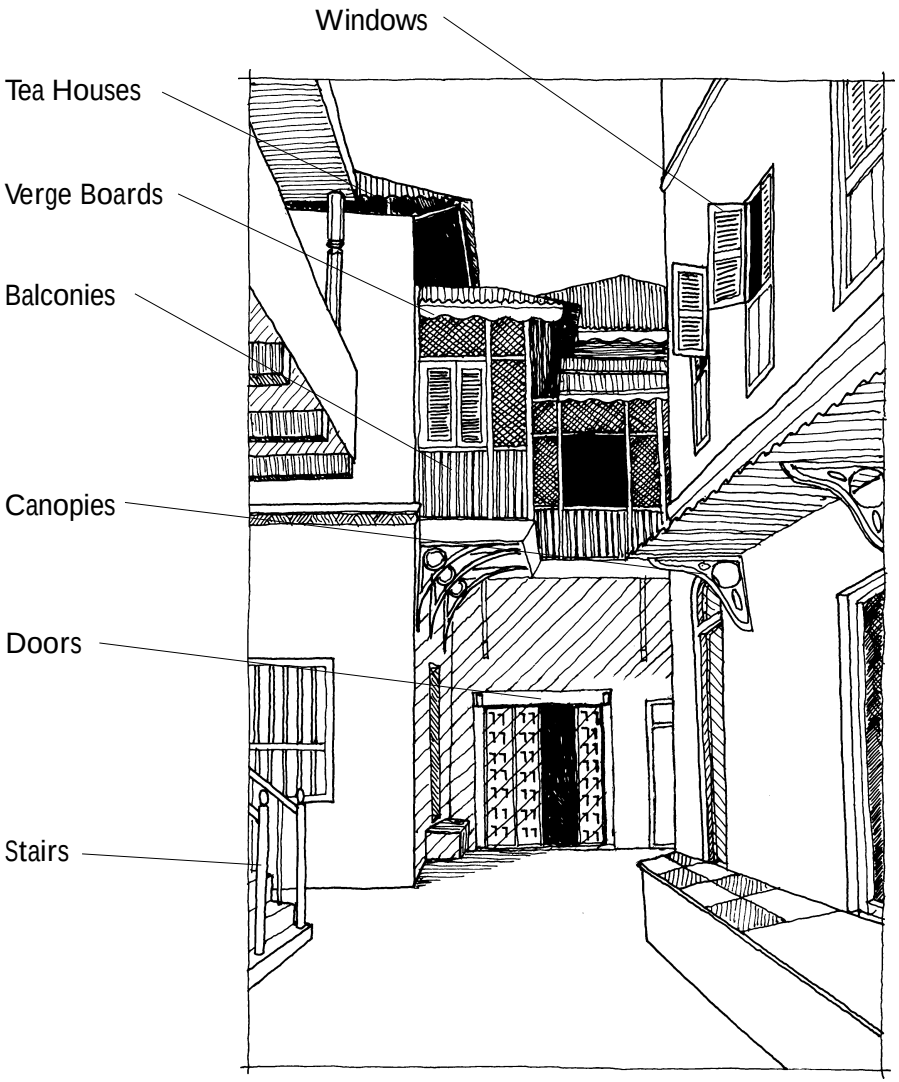
REPAIRS TO JOINERY

Plug Repair
Repair to Mortice and Tenon
Repair Around a Hinge
Replacement of Broken Louver Without Opening the Frame
Repair of Rat Damage

REPAIRS TO STRUCTURAL MEMBERS

Scarf Joints
Halved Scarf
Repair of Carpentry Joints
Beam End Repair – Steel Flitch System
Base of Timber Post

Note: The procedures described in this section are guidelines only. Before undertaking substantial structural repairs or tackling serious structural problems, consult a building professional.



Timber elements of buildings in the Stone Town

All buildings in the Stone Town include elements made from timber. These might be doors, windows, balconies, teahouses, verge boards, roofs, canopies, etc. The timber elements perform important jobs: doors and windows provide security and privacy, roofs keep out the rain, and balconies increase ventilation. In order to continue functioning correctly, it is important that they are maintained and repaired properly.

But, apart from the practical tasks they perform, the timber parts of buildings are an important aspect of the historical character of the Stone Town. Many of the timber elements such as doors and balconies are very old, and are often elaborately carved. These pieces are valuable because they were made by skilled craftsmen and demonstrate the richness of Zanzibar's history. When they are allowed to disintegrate through neglect, or are destroyed or removed by bad repair work, the Stone Town is diminished.

CAUSES OF DECAY

DIAGNOSES

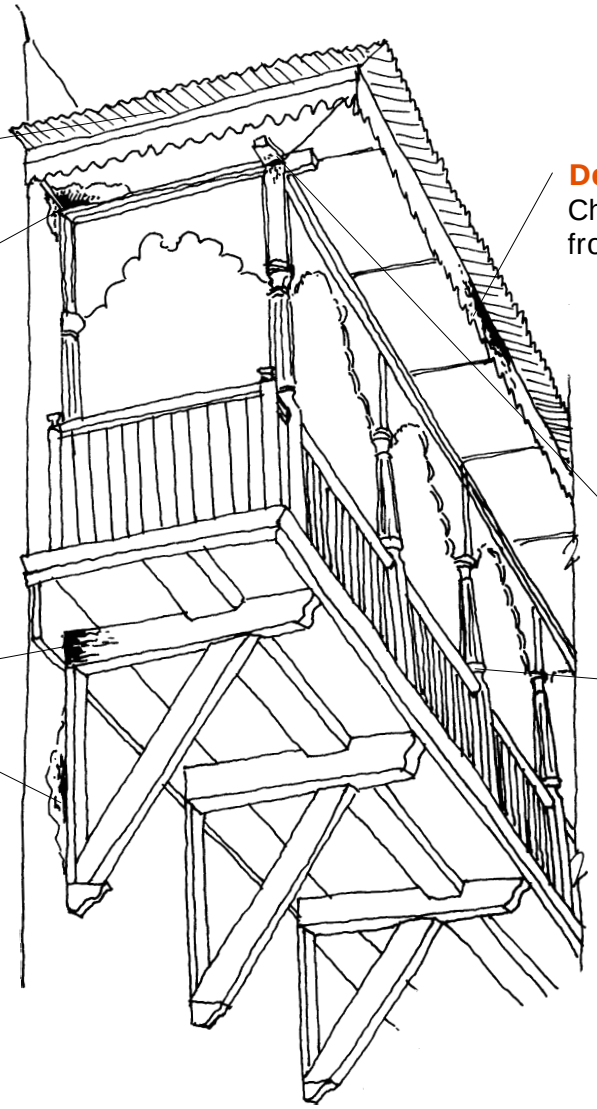
Most problems with timber in the Stone Town can be traced back to the presence of water. Timber elements were originally made from hardwood such as teak, mninga or mvule. As the name implies, hardwoods are far denser and heavier than softwoods such as cypress, and are therefore much more durable and resistant to the harsh environment of the tropics.

But even hardwoods become vulnerable to decay caused by insect attack or mould growth when saturated for long periods. Occasional saturation will not normally cause problems, so long as the timber dries in between, but when moisture remains in the timber for long periods, it breaks down the natural resistance of the hardwoods, quickly leading to decay.

Well-detailed and maintained timber should not become saturated. Water ingress is often caused by the failure of other building parts immediately adjacent to the timber or even some distance from it. For instance, a cracked plaster window sill can allow water to collect around the bottom of a window frame causing it to rot; or, a damaged roof can allow water to collect around the buried ends of timber beams leading to decay.

When considering a repair, it is important that the cause of the damage is diagnosed and dealt with, as well as the actual damage to the timber part. If the causes are ignored, the repaired piece will quickly become like the original damaged section. In most cases, it should be enough to repair the original detail (e.g., re-plaster the sill or repair the roof), but in some cases, the original detail may have been at fault (e.g., the sill may have sloped inwards instead of outwards allowing water to collect under the sill). In these cases, the fault must be corrected or the timber given extra protection to help it cope with the effects.

Common problem areas found in timber elements



Water in the ceiling
Check the roof for leaks and repair the roof.

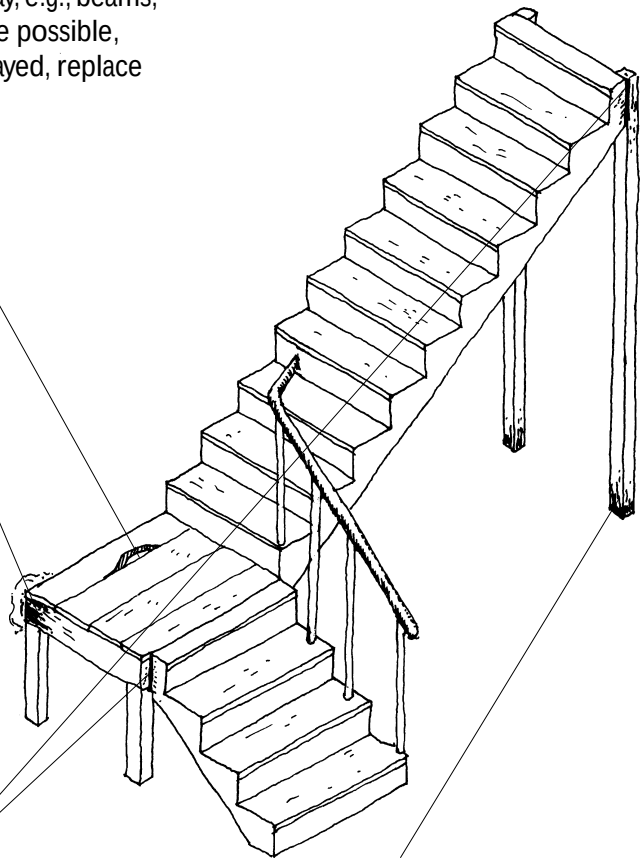
Decay caused by water
First check joint between roof and wall. If this is open, it may be a sign of serious structural subsidence.

Signs of rot in beam set into wall
First check for serious structural subsidence, using a spirit level and plumb bob. Check extent of damage by tapping with a metal object or drill small holes with a hand-held drill. Decaying timber sounds hollow and will be soft.
If deck or balcony are damaged, consider how to prevent water from collecting here. Repair with boards and plugs.

Decorative Verge Board
Check for rot and possible cause from roof damage.

Open joints
Check for structural subsidence. First check if the balcony is leaning with a spirit level and plumb bob. If there is a problem, support the balcony with temporary support, (see Section 3 of Design Guidelines).

Important: Check all structural timber for signs of decay, e.g., beams, posts, joints, etc. Where possible, repair timber, or if decayed, replace with identical piece.



Broken planks
Use a plug to repair.

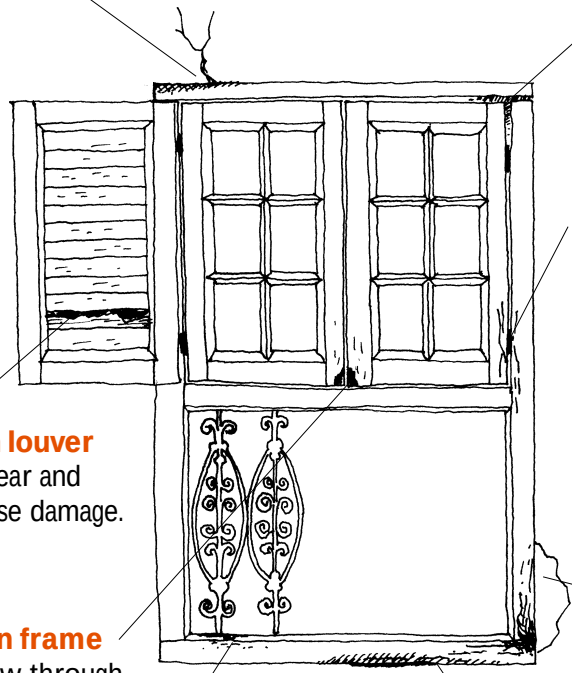
Water collecting around timber
First consider how to prevent water damage and decay caused when timber is set into the wall.

Open joints
Check that the structure is not subsiding or falling apart.

Posts set in the ground
Check for decay. Ensure the base is clear of debris and check timber in the base, frequently very vulnerable, and replace bottom part if required.

Decaying window frame
Check plaster. Cracks may allow water into the frame.

Open joint
Check for signs of movement in the wall above. Subsidence can create structural load on the window frame.



Cracks around hinges
Use hook and eye to fix shutters back in the wind.

Broken louver
Shear wear and tear cause damage.

Holes in frame
Rats gnaw through the timber frame.

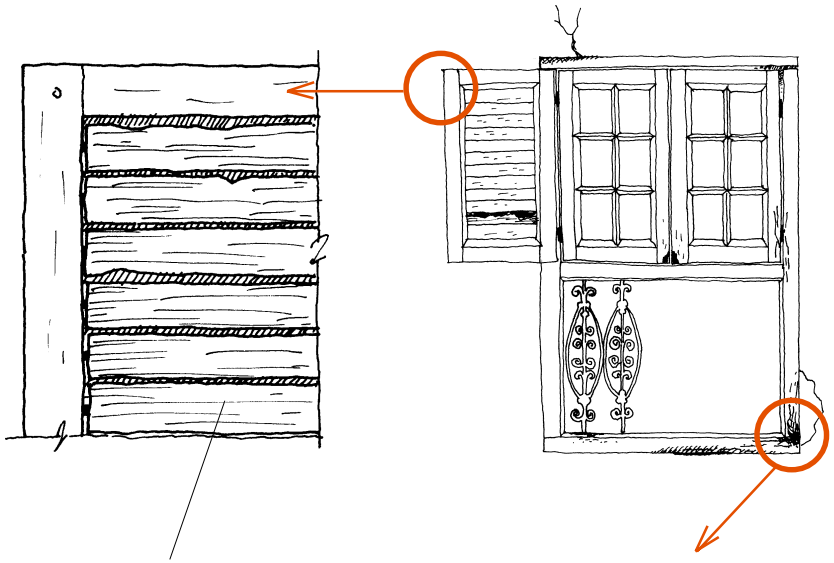
Damaged plaster
Allows water into window frame.

Decayed sill top
Check joint between metal rails and sill. Rust and decay may mean water is collecting in the joint.

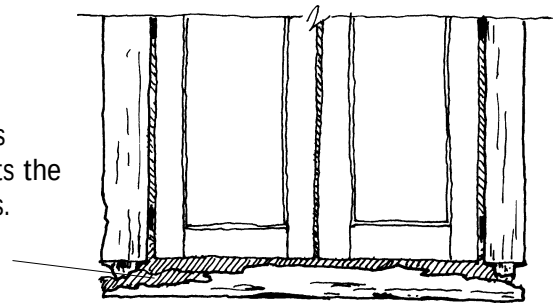
Decayed sill bottom
Check plaster adjacent to sill for damage.

PRINCIPLES OF TIMBER REPAIR

KEY POINTS



Louvers are weathered but do not need to be replaced. Repair where required, treat and finish.



Bottom sill of window frame is decayed and no longer protects the interior from outside elements. Replace with new timber sill.

In historic buildings, it is always better to retain as much of the original historic timber as possible. Where the original is covered in fine carvings, the reason for this is obvious. But even if the timber piece is quite plain, it will have a character that comes from age, which is impossible to reproduce. It is this character that makes the Stone Town unique.

Always try to repair a timber element in a building rather than replace it.

Often decay or structural damage affects only a part of a timber element. For instance, timber beams may only be rotten where the timber is buried in the wall; the rest of the beam may be perfectly sound. In such cases, it is sometimes enough to cut away and repair the section of timber that has failed or is rotten, whilst retaining most of the original piece.

When carrying out repairs to timber elements, always consider these key points:

1. Assess the condition: Fitness for the job

As timber ages, it often becomes rough in texture as the grain is exposed, and wear and tear leaves marks and scars across its surface. But this texture of age is not in itself a reason to replace old timber. In fact, the texture or 'patina' of age is what gives old timber its character.

When considering repairs to timber, it is important to try and keep as much of the original timber as possible. The judgement about whether to retain or replace a timber section should not be made on the basis of appearance alone, but rather on the fitness of the timber piece or element to do the job it was designed for. In other words, a rough grained louver on a window does not need to be replaced if it is strong enough to hinge properly, will continue to stand-up to daily use and keeps the elements out, whereas a badly decayed beam that can no longer support any weight, must be replaced in its entirety.

2. Like with Like

As a living tree, wood is composed of millions of small cells filled with moisture. When a tree is made into timber, it is dried and most of the moisture in the cells evaporates. The timber shrinks, but the cellular structure remains, and because of this, timber will continue to respond to its environment, expanding or shrinking according to the dampness of the air.

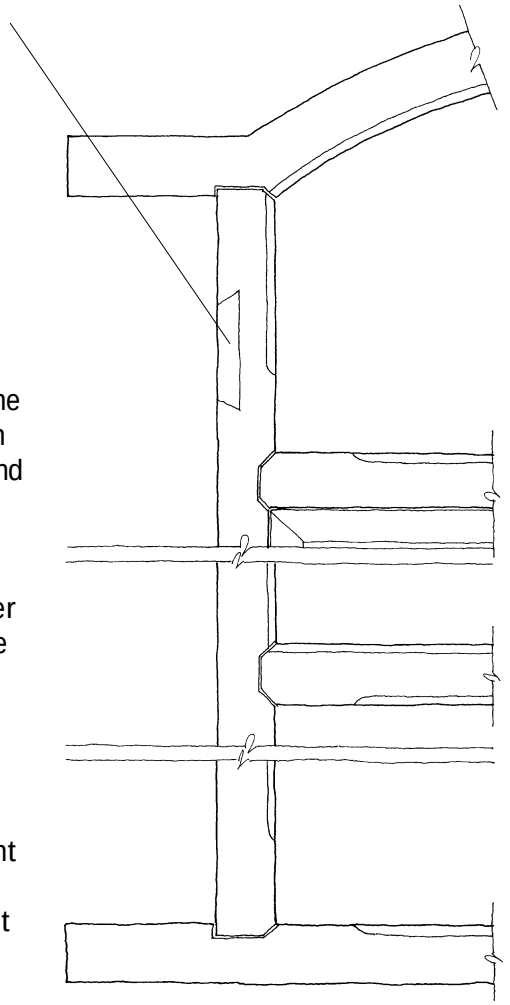
It is important to bear this in mind when carrying out repairs to old timber. For the repair to be effective, the damaged part must be cut out and a new piece of timber fixed in its place with glue or a joint. The new section is fixed tightly against the old, but both the new timber and the old will continue to move according to the environment. If the new timber is very different from the old in density or age, it will move at a different rate. The joint between the two is put under pressure and may eventually fail.

When carrying out repairs, always use timber identical or similar to the original!

Moisture content: Typically, new hardwoods will have a moisture content of between 15% and 18%, whereas old hardwood may have a moisture content as low as 7%. For this reason, whenever possible, patching repairs to old joinery items should be made using old timber of approximately the same age, taken from another old timber piece that has been discarded. Where, for instance, an entire member of a frame is to be replaced, new hardwood can be used, but the joint between old and new must allow for movement.

Similar timbers: It is best to determine the species of the timber to be repaired and to use the same species for the replacement piece. Never use softwoods such as cypress to repair hardwoods. The repair will always fail.

Appearance: If the timber element is to be finished with a clear finish such as teak or linseed oil, an effort should be made to match the appearance of the new timber piece (e.g. colour, grain pattern, etc.) with the original.



3. Grain

When carrying out repairs by plugging, or repairs that in any other way involve letting-in and mating pieces of new timber to original joinery items, it is essential that the direction of the grain of the repair is the same as the direction of the grain of the surrounding original timber. When making new members for joinery items, the grain direction of the new member must be the same as the original member.

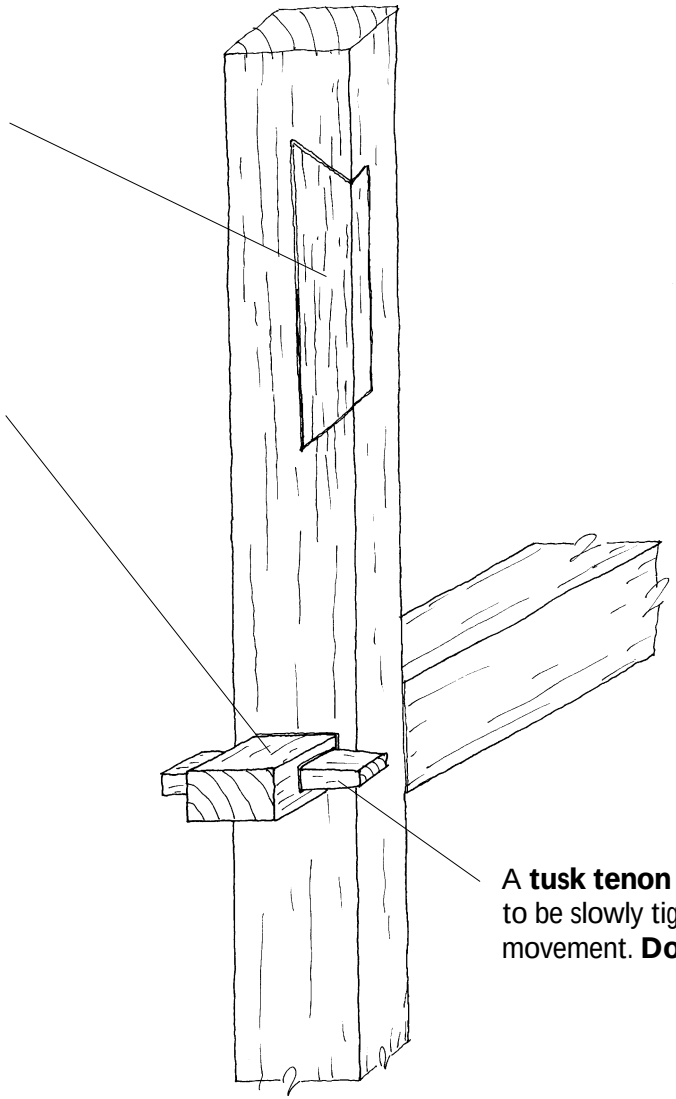
4. Strength

The strength or rigidity of a joint must not be altered in any way as a result of a repair. Where joints have originally been left open to allow for movement, or fixed without glue or mechanical fastening, these must not be 'strengthened' during the course of the repair by the addition of glue, mechanical fixings such as screws, or by any other method. Generally, care should be taken to make joints that are not too rigid or strong, as movement is inevitable, and if a joint is inflexible, the stresses will be transferred to the timber, which, if old and brittle, may crack.

5. Repair in-situ

It is generally better to carry out repairs to timber in situ, or in other words, whilst the timber element remains in its original position. This is because removal usually results in more unnecessary damage both to the timber and to the buildings around, and if an element is disassembled for repair, reassembly once the repair is complete is very difficult and usually shows.

When carrying out structural repairs, the same principle applies, although great care must be taken to ensure that the structure is properly supported and prevented from collapse before repairs begin (see Guidelines, Section 3, Shoring and Temporary Support).



A **tusk tenon** joint allows the frame to be slowly tightened in response to movement. **Do not** repair with glue.

GLUES

During the course of the restoration project on the Old Dispensary, several different glues or adhesives were tested. Whilst the results of this research is presented below, it should be noted that the manufacturer's instructions on use should be followed at all times.

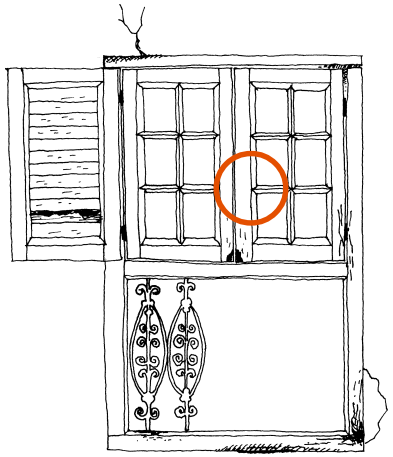
The choice of adhesives will be determined by the expected structural performance of the glue joint, the location of the piece to be glued (e.g., whether or not it is exposed to rain and moisture), and cost.

Urea-formaldehyde glues are both strong and highly resistant to moisture, but they are also expensive, and so it is recommended that they be only used where a joint is load bearing or is likely to be in contact with moisture, and lower specification glue used elsewhere.

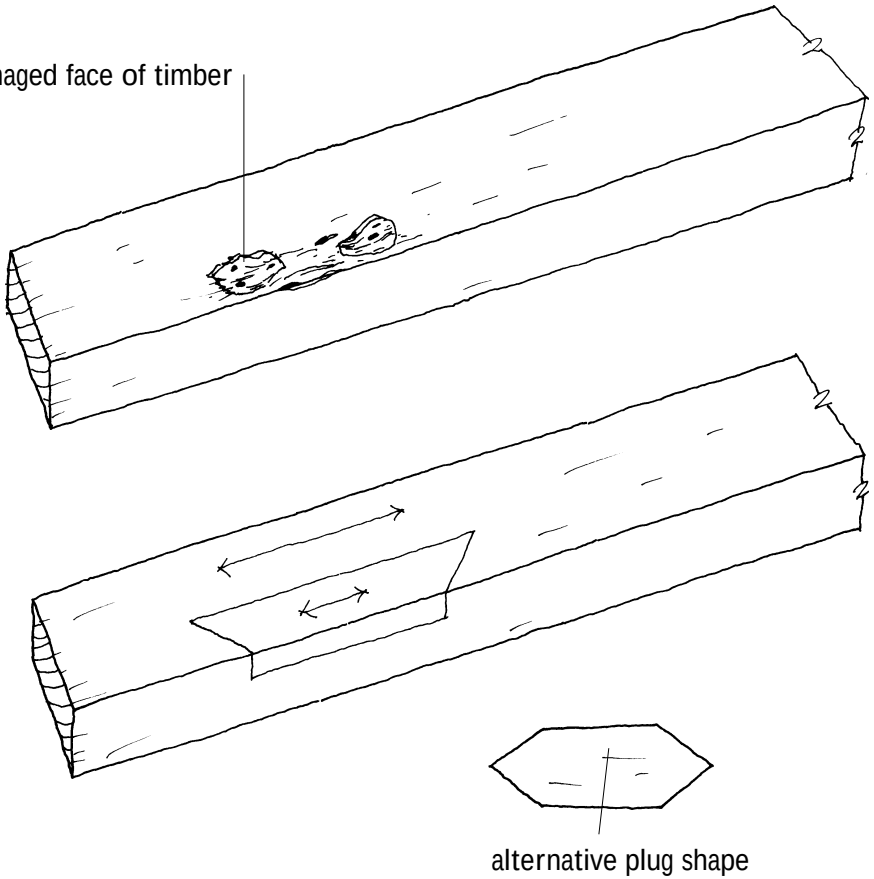
- It should be noted that Urea-formaldehyde glues are usually two-pack, which means that the two ingredients must be mixed up on site in order to make the adhesive. Once mixed, two-pack adhesives must be used immediately, and cannot be stored in its mixed state.

Note:
We do not recommend the use of organic wood glues (e.g., casein glue which is milky-white in colour), as these tend to quickly deteriorate when exposed to moisture. A wood glue called 'Woodfix' is commonly used in Zanzibar; however, our tests showed that this glue failed when saturated. In particular, NEVER use casein glues such as Woodfix for structural repairs.

1. ADHESIVES FOR JOINERY WORK	
External (Joinery exposed to moisture)	**Aerolite 306**, manufactured by The Kenya Swiss Chemical Company, E.Africa (Nairobi).
Internal	**Ponal-3**, manufactured by Heinkel, E.Africa (Nairobi).
2. ADHESIVES FOR STRUCTURAL TIMBER	
External & Internal	All adhesives used for load-bearing structural timber work, to be Urea-formaldehyde type, to BS 1204 PART 1; **Aerolite 306**, manufactured by The Kenya Swiss Chemical Company, E.Africa (Nairobi) **Resorcincol**, available in Nairobi **Aerodux 185** by Ciba-Geigy (Novartis)



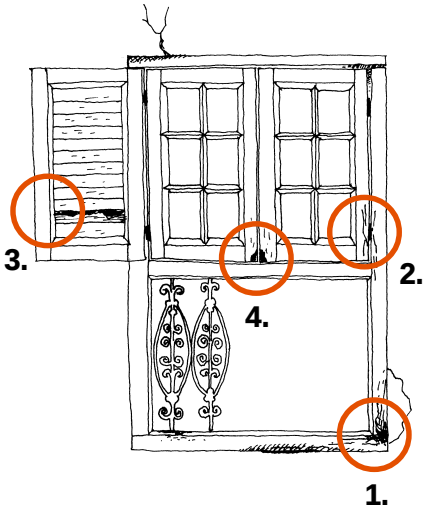
PLUG REPAIR



Note: the grain of the timber of the plug must run in the same direction as the surrounding timber, and the moisture content and species must be the same as the piece being repaired.

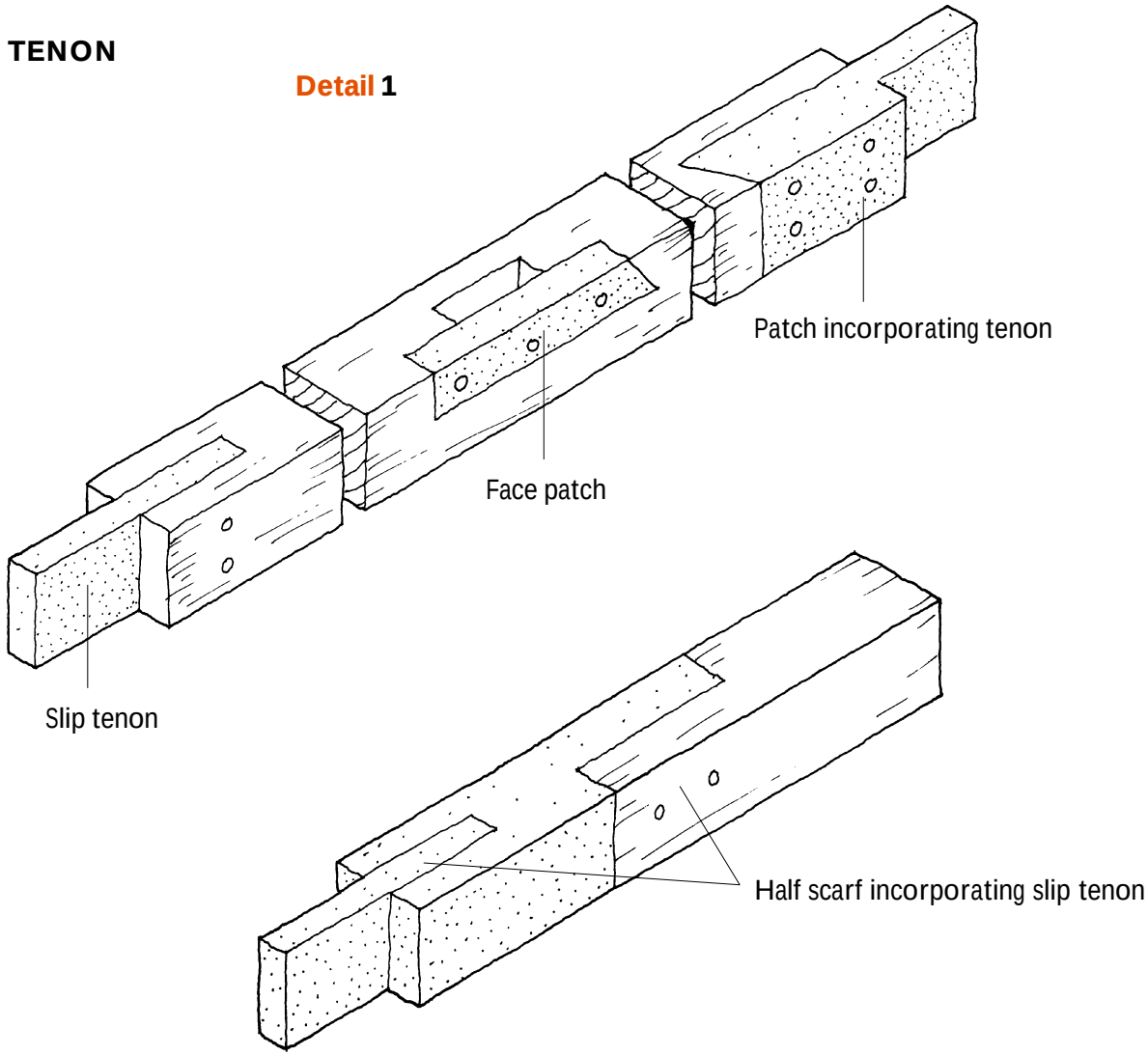
1. Cut rebate with a chisel. The plug should be proud of the surrounding timber.

2. Glue and plain to finish.



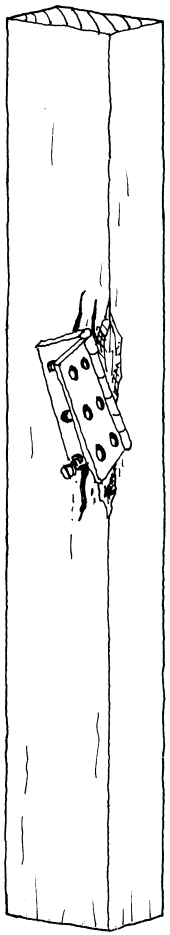
REPAIR OF MORTICE & TENON

Detail 1

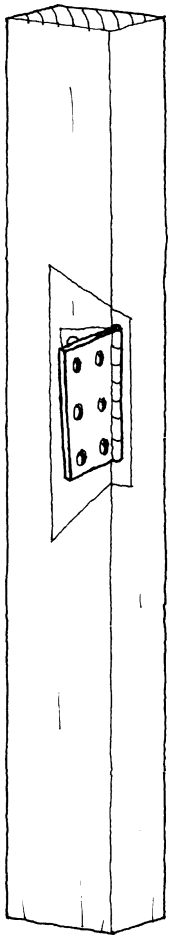


REPAIR AROUND A HINGE

Detail 2



Damage around hinge



Dovetailed plug repair

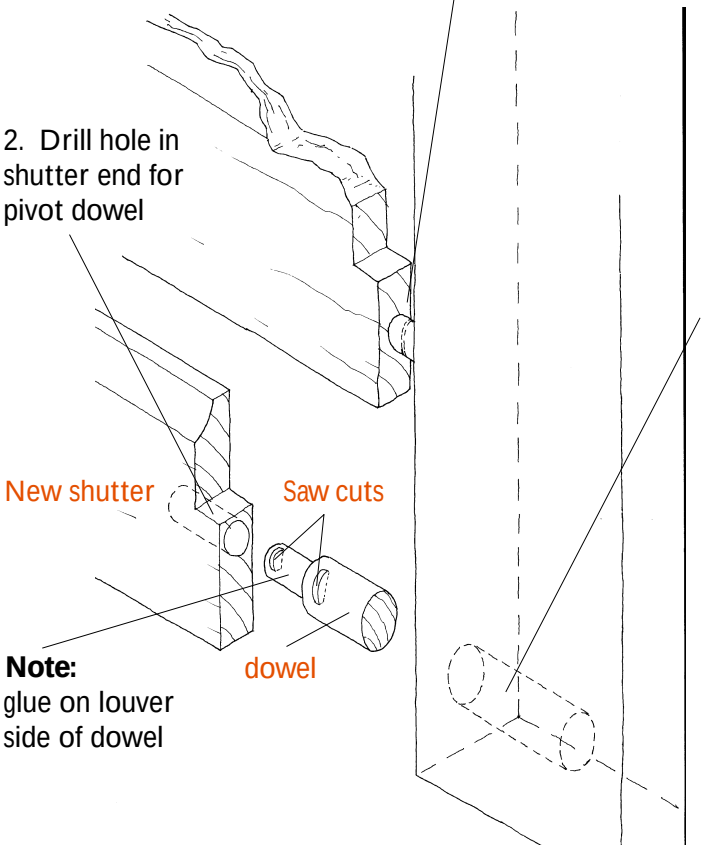
Note:
ensure grain direction is the same

REPLACEMENT OF BROKEN LOUVERS WITHOUT OPENING THE FRAME

Detail 3

1. Cut off old pivot to remove louver

2. Drill hole in shutter end for pivot dowel



3. Deepen pivot hole

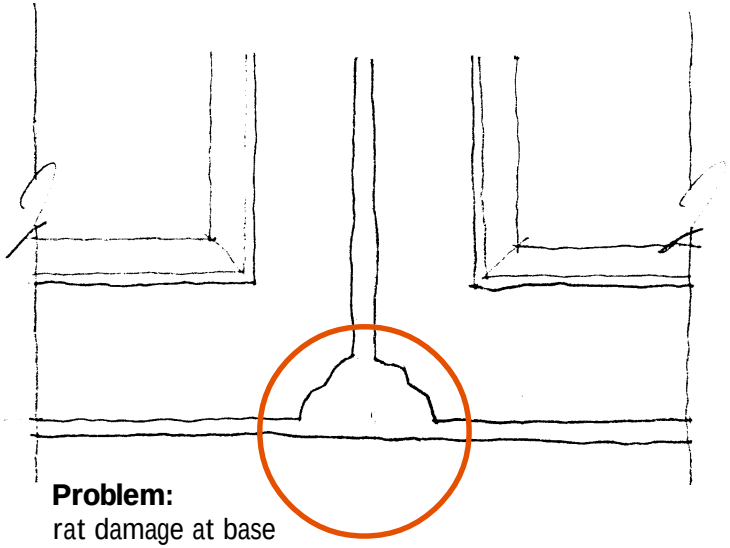
4. Push the loose pivot in the deep hole until it is flush then position louver

5. Use saw cuts in dowel to assist positioning of dowel

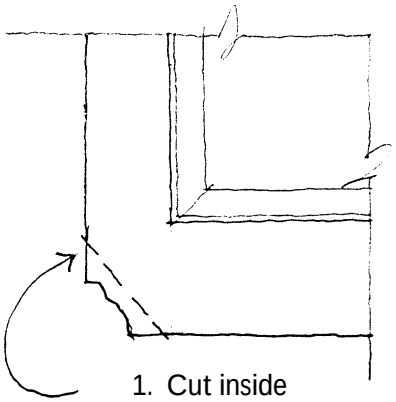
Note:
glue on louver side of dowel

REPAIR OF RAT DAMAGE

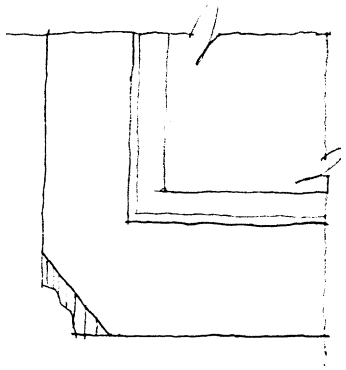
Detail 4



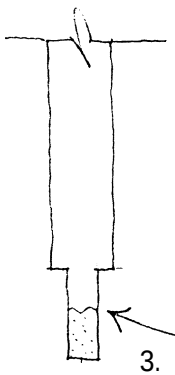
Problem:
rat damage at base of doors



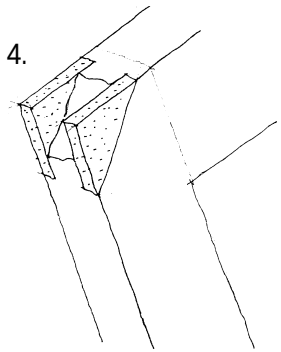
1. Cut inside damage to depth of 10mm



2. Original timber under-neath



3. Original timber may be tenon



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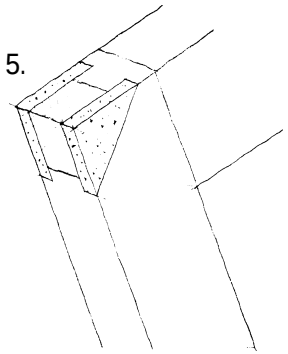
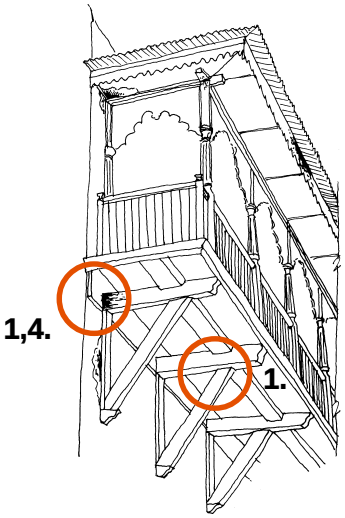
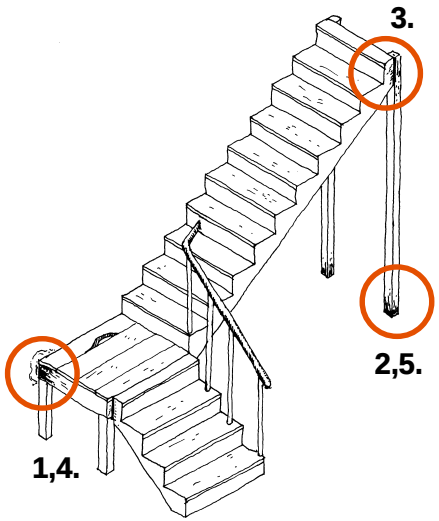


5.

Principle:
maximise surface area for gluing

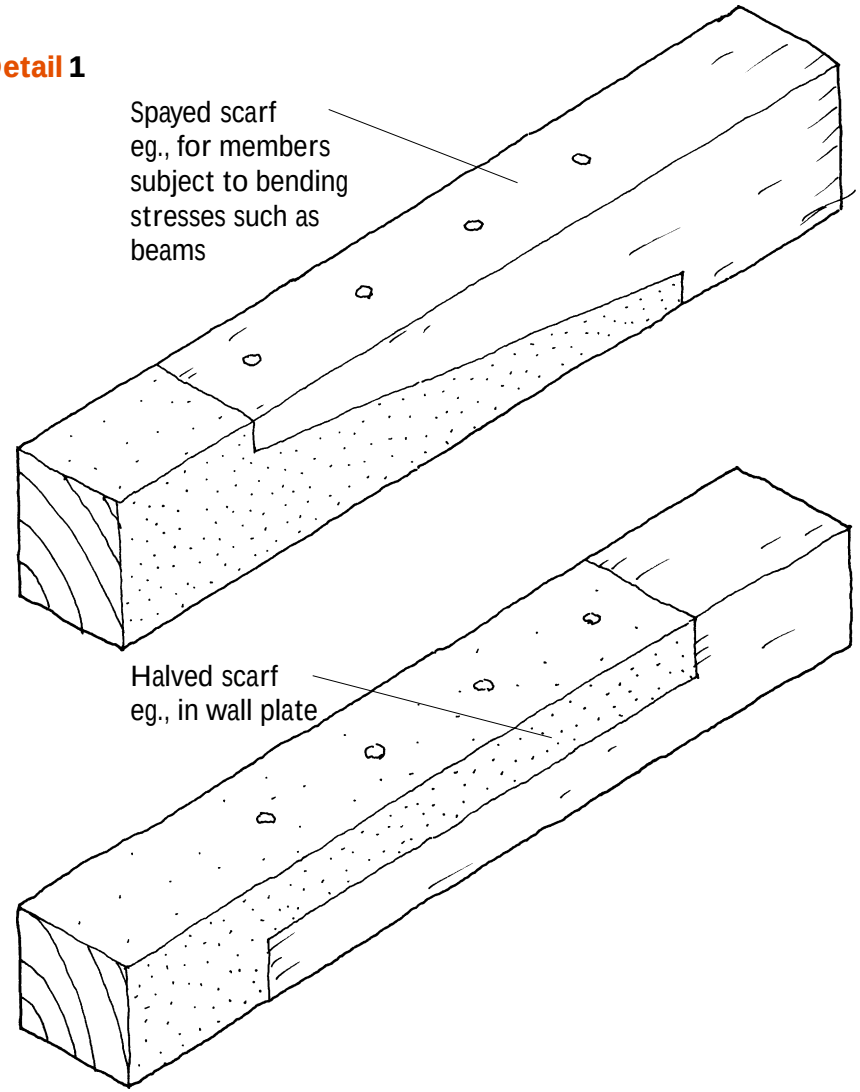
STRUCTURAL REPAIRS





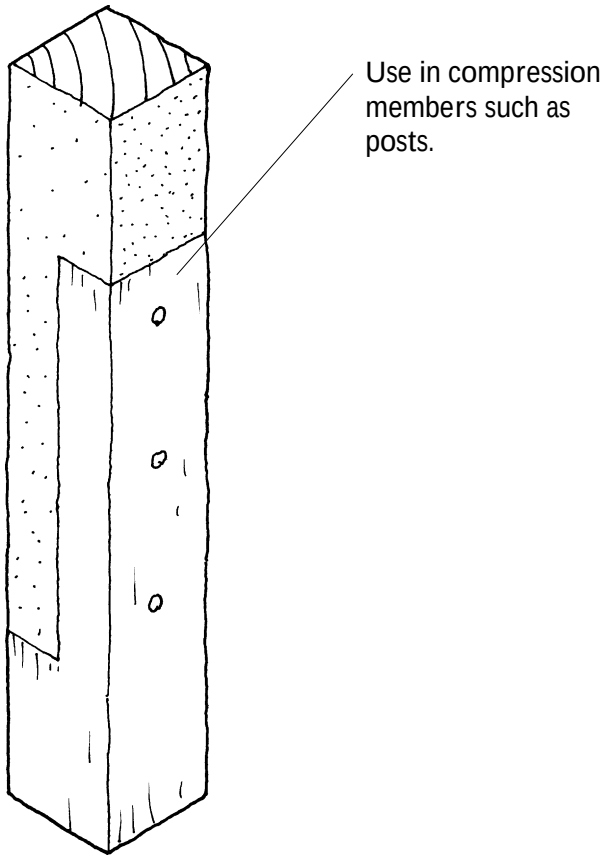
SCARF JOINTS

Detail 1



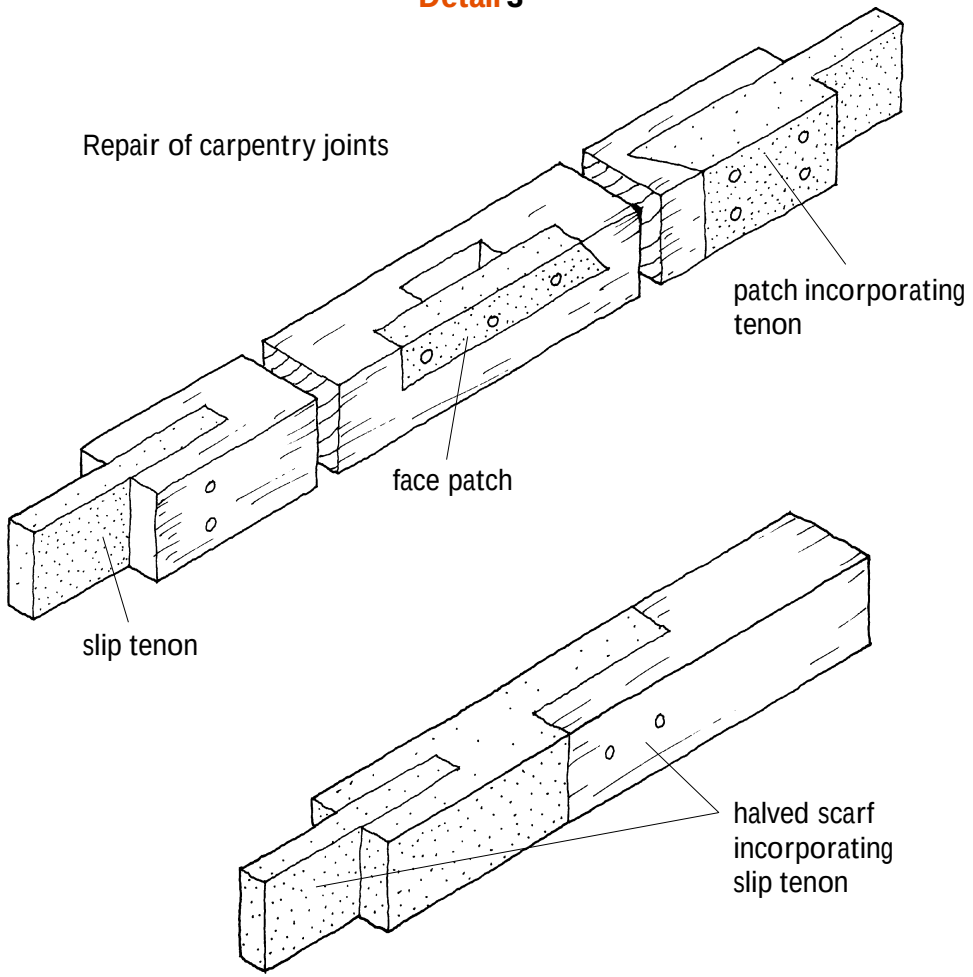
HALVED SCARF

Detail 2



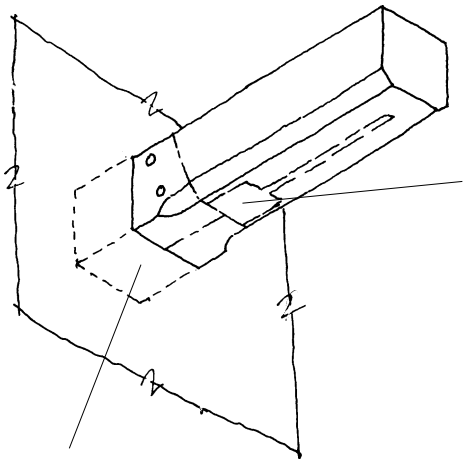
REPAIRS OF CARPENTRY JOINTS

Detail 3

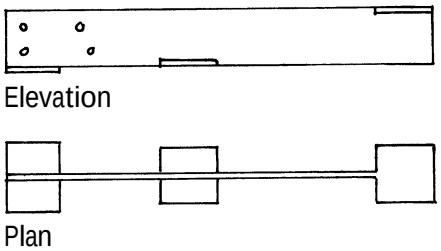


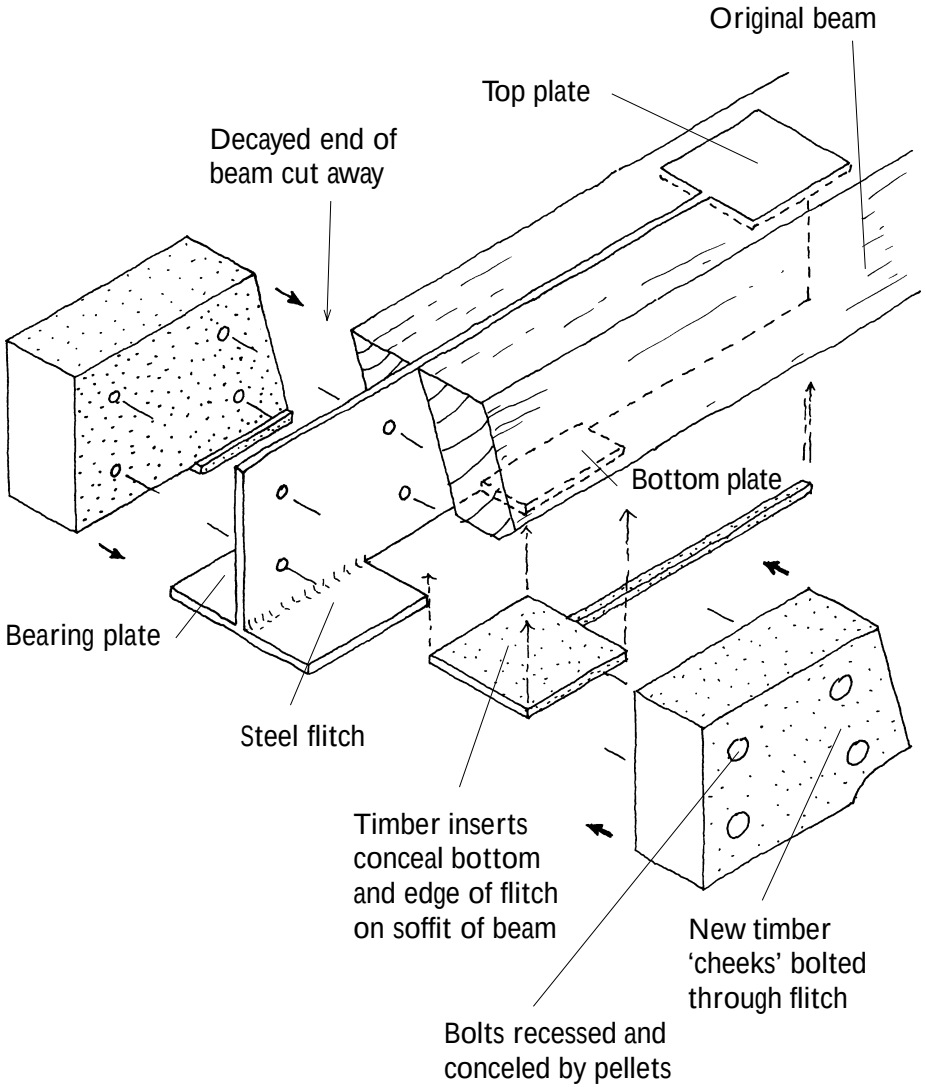
BEAM END REPAIR WITH STEEL FLITCH SYSTEM

Detail 4



Steel Flitch detail





BASE OF TIMBER POST

Detail 5