

CONSERVATION GUIDELINES
TECHNICAL SUPPLEMENT



UNDERSTANDING
THE TIMBER FLOORS &
STAIRCASES

July 1997

SINGAPORE

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TOWARDS A TROPICAL CITY OF EXCELLENCE

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INTRODUCTION

The upper floors of conservation buildings are usually constructed in timber. The structure consists of the timber joists which span between the party walls. (See Fig 1) The timber floor boards are then laid horizontally on the joists and are usually joined by the tongue and groove method. Being one of the key architectural elements which contributes to the internal spatial quality and original character of the shophouse, it is important that the timber floor should be retained.

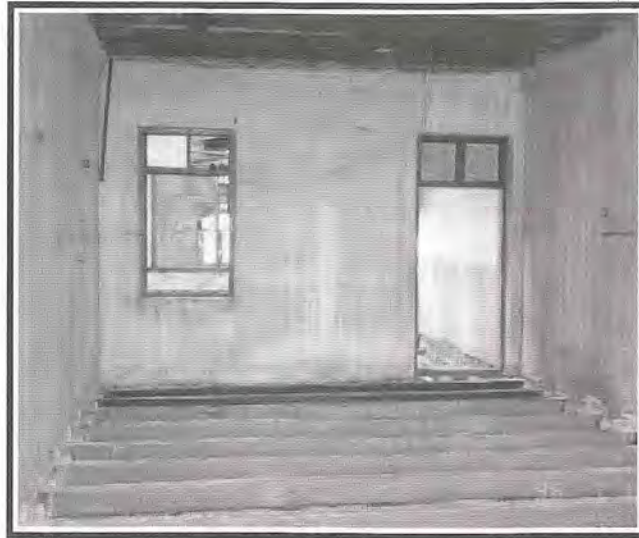


Fig 1: Timber floor joists spanning between the partywalls.

Ideally, the original internal layout of the conservation building should not be altered i.e. the staircase should be retained and restored in its original position. This is because any relocation of the staircase would mean a change in the structural layout and is tantamount to a reconstruction as the timber floor joists and floor boards would be affected. The original spatial quality of the building will also be altered. (See Fig 2 - 4)



Fig 2: Location of existing staircase is tied in with the existing timber floor structure.



Fig 3: Timber floor and staircase in the process of being restored.



Fig 4: Existing location of staircase retained after restoration. Original spatial quality of shophouse is retained.


**TIMBER FLOOR JOISTS
AND BOARDS**

Assessment

Before restoring the timber floor, a visual inspection should be carried out to detect decayed and termite infested joists and floor boards. The existing floor boards are usually removed so that the timber joists can be inspected. Such an inspection would determine the extent of retention, repair and replacement that is required. (See Fig 5 - 7)



Fig 5: Visual inspection of the timber floor joists and boards should be carried out to determine the extent of decay and structural damage.

Fig 6: Badly deteriorated timber floor joists due to termite infestation, water penetration and fungal attack.



Fig 7: Areas of rot usually occur at the ends of the timber floor structural members.



Fig 8: Timber splinters lifted up in short irregular pieces as a result of breakdown of the fibre strength due to timber decay.

Severe deterioration is usually apparent on visual inspection and by knocking. Other less severely deteriorated timber areas may be detected by jabbing a small screw driver into a wetted timber surface at an angle and prying up a small section of the timber. Sound wood will separate in long fibrous splinters, but decayed timber will lift up in short irregular pieces as a result of the breakdown of the fibre strength. (See Fig 8) Another method is to push the screw driver into the timber, perpendicular to the surface. If the core is badly decayed, pressure on the probe will force it through the apparently sound skin.

In addition, the species of the hardwood has to be determined. Some commonly used species are chengal, balau and kapur. A test sample of the section should also be taken to assess the inherent strength of the timber. The test sample should not however be taken at the critical mid-span area.

The issue of building use has implications on the existing structure as conversion from part residential to commercial and other uses will potentially increase the loading. The structural engineer has to ensure that the existing timber structure can take the new loading.

Retention and Restoration

In cases where the intended use is similar to the original use, the existing timber structure is usually adequate to take the new loading. However, the existing floor boards are usually replaced with new fire-retarded timber floor boards as these existing floor boards are often beyond the point of repair. Before the original joists are treated with termite resistant paint, the timber members have to be cleaned by sanding the surfaces. After treatment, the timber members are left to dry in a clean and dry environment, and are subsequently placed back into the original positions.

Repair

Any repair should be carried out using traditional jointing methods, such as scarfing, halving, mortice and tenon. Where this is not possible, modern jointing methods may be considered. Minor repairs can be done by epoxy-injection at the connection area between the timber joists and the partywall or by splicing. (See Fig 9, next page)

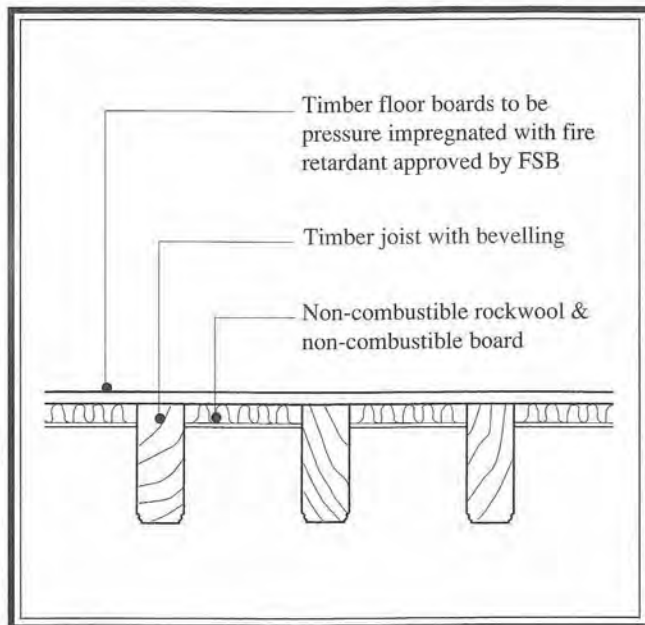


Fig 9: Repairs at the connections between timber joists and the partywall.

In the case of the epoxy resin, small holes are drilled at close intervals and the resin mixture is injected until the timber can absorb no more. The section is thus transformed into a resin composite.

A bevelled edge can be introduced to the original floor joists by using a specific mould cutter on the underside of the joists, provided the structural strength of the timber members is not compromised. Alternatively, bevelled sections of timber could be added to the original floor joists to achieve the same ornamental effect. (See Fig 10)

Fig 10: Use of bevelled timber floor joists as a form of architectural expression within the shophouse.



Strengthening

There are 2 methods of strengthening the timber floor joists to meet the current building codes:

- a To increase the depth of the timber joists by adding timber sections to the bottom of the joists.
- b To insert additional joists between the existing joists to reduce the loading on the original members. (See Fig 11)



Fig 11: Insertion of additional timber floor joists between the existing joists to reduce the loading on the original members.

Alternatively, the ends of weakened timber beams can be replaced with reinforced epoxy mortar. Where necessary steel reinforcement could be incorporated to achieve the necessary load bearing requirement. (See Fig 12 - 13)

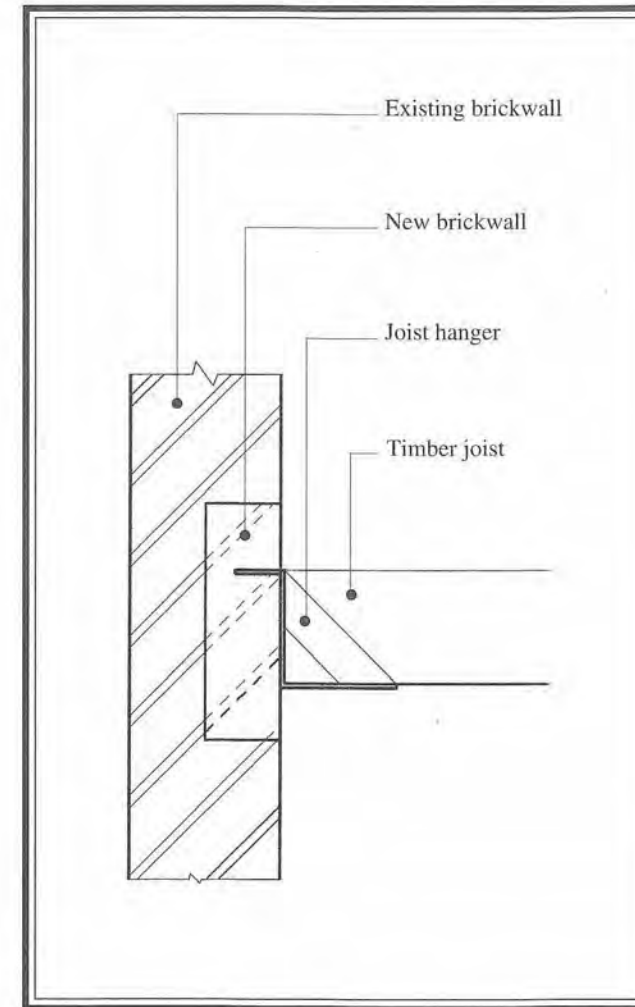


Fig 12: Use of repair joints at the areas of decay of the timber members.

Fig 13: Use of galvanised steel brackets at the repair joints.



Replacement

Although the retention of the original timber members is always desirable and encouraged, there comes a point when the condition of the element may indicate the need for replacement.


When replacing these old timber elements, the original materials are preferred. The traditional types of timber used are balau, chengal and kapur. New timber has to be properly treated before use. The recommended method of treating timber in Singapore's hot and humid weather is pressure impregnation with preservatives. This is now done in the factory before the timber is delivered to site. The new detailing should always follow the original ones.

Any repair or replacement of the timber joists should be carried out on an elemental basis i.e. replacing only one or two members at a time so as not to affect the lateral structural support stability of the building. Alternate beams are dislodged from the party walls and replaced immediately.

(See Fig 14)

Fig 14: The replacement of the decayed timber floor joists.





TIMBER STAIRCASES

Assessment

In addition to passing the visual inspection for timber rot, retention of the original timber staircase is also subject to compliance with the current building codes in terms of the riser and tread dimensions, and the clear width of the staircase. (See Fig 15)

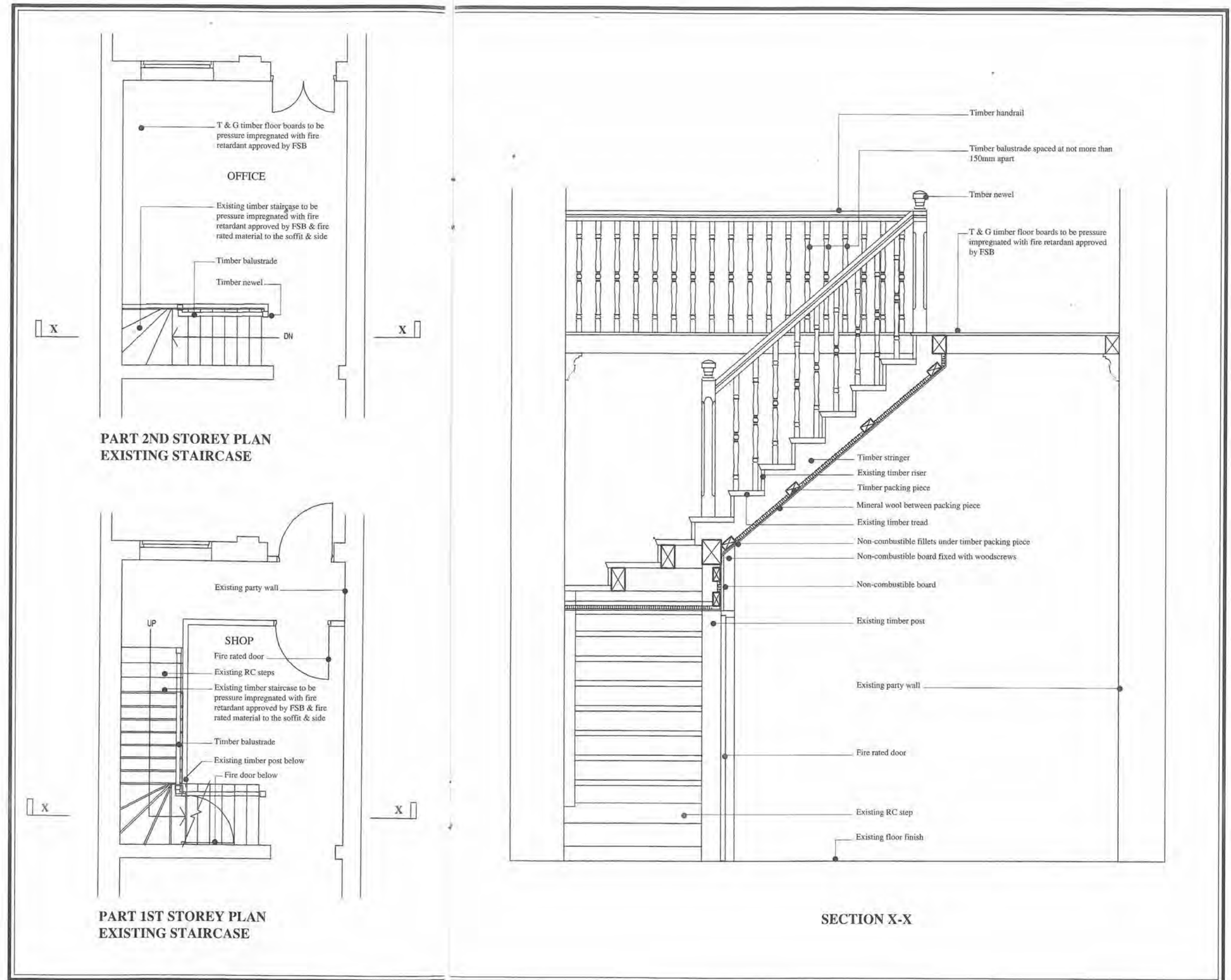


Fig 15: Plan and Section of an existing staircase which has been retained in its original position, and complies with current building codes.

Retention and Repair

Usually, the timber staircase elements are in acceptable condition and thus only minimal repair work needs to be done. Any minor replacement of the parts should match the original. For some staircases, the existing timber balustrades may have been replaced with mismatched designs. It is important to establish the original design of the timber balustrades to ensure that exact replicas of the ornately carved newels and handrails can be produced. In this way, the authenticity of the original material and

Fig 16: Mismatched balustrades before restoration.



design can be reflected in the restored staircase. (See Fig 16 - 17)

Reconstruction

Where the original staircase cannot comply with the current building codes or when there is a necessity to change the internal layout, the reconstructed staircase should try to reuse all the existing timber elements which are still in good condition. (See Fig 18 - 19)

Fig 17: Restored staircase, using matching balustrades.



Fig 18: Timber staircase reconstructed to comply with current building codes.

Fig 19: Reconstruction and reconfiguration due to changes in the internal layout of the shophouse.





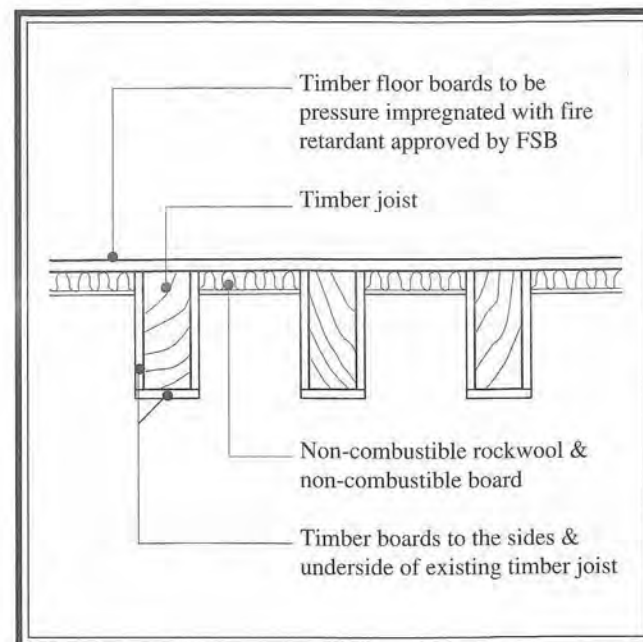
FIRE SAFETY REQUIREMENTS

Fire safety in shophouses is an important consideration during restoration. Timber, being a combustible material, fails when subjected to extreme heat during a fire. As such, it is important that the timber floors and staircases are adequately fire-rated to ensure fire-safety within the shophouse.

Timber Joists

In order to improve the fire resistance of timber floors, thereby minimising the possibility of a fire spreading from one floor to another, the principal approach is to use sacrificial timber. The cross section of existing timber joists is increased by covering with timber sections to achieve the required fire-rating while retaining the appearance of the exposed timber members. The existing timber joists, when retained, have to be pressure impregnated with fire-retardants upon reuse. The impregnation process is carried out in an off-site factory. However, if the existing timber floor joists can fulfill the fire-rating requirements, they need not be pressure impregnated. (See Fig 20)

Fig 20: Timber floor joists covered with additional timber sections to achieve the required fire-rating.



Timber Floor Boards

To meet the current fire safety requirements, the original floor board joinery must be tongue and groove or of the butt-edged type. The timber boards must also be fire protected. There are two ways of achieving the necessary fire rating:

Treating the timber floor boards with fire retardants.

Impregnation of the timber floor boards with fire retardants are normally carried out in the factory by pressure treatment. The impregnated original tongue and groove floor boards would usually require sanding-down to ensure that the joints fit properly. For residential use, pressure impregnation of the timber floor boards does not apply provided there is no increase in floor area or addition of a new roof mezzanine. (See Fig 21 - 23)

Fig 21: The use of tongue and groove joinery during restoration as a fire-safety measure.



Fig 22: The laying of the new fire-retardant timber boards.



Fig 23: The timber floor being polished after laying and fastening to the timber joists.

Installing fire rated ceiling boards and insulation between the floor joists.

This is not recommended as it will not be possible to expose the timber floor joists and boards to retain the existing character of the building. However, for buildings with new roof mezzanines, the timber floor boards have to be lined on the underside between floor joists with non-combustible boards to achieve the required fire-rating as the pressure impregnation method is not acceptable. (See Fig 24)



Fig 24: Use of non-combustible boards between timber floor joists to achieve the required fire-rating.

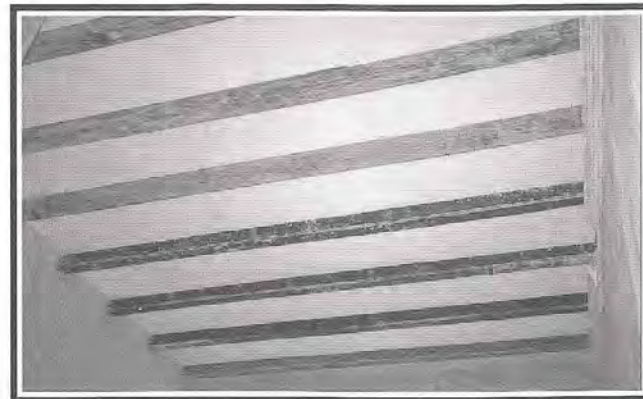


Fig 25: New metal spiral staircase at the rear court.



Timber Staircases

Protection of staircases is an important fire safety precaution as they serve as means of escape. For non-residential uses, staircases have to be compartmentalised and pressure impregnated with flame retardant chemicals to meet the relevant fire escape requirements. Fire-rated boards or brickwall partitions are used to compartmentalise the staircase in compliance with fire-safety requirements. Distance runs, manual call points and exit sign provisions, will have to comply with the current codes. (See Fig 26 - 28, opposite page)

For buildings with new rear extension, it is sometimes necessary to erect a new spiral staircase at the rear court to meet the fire regulations. (See Fig 25)

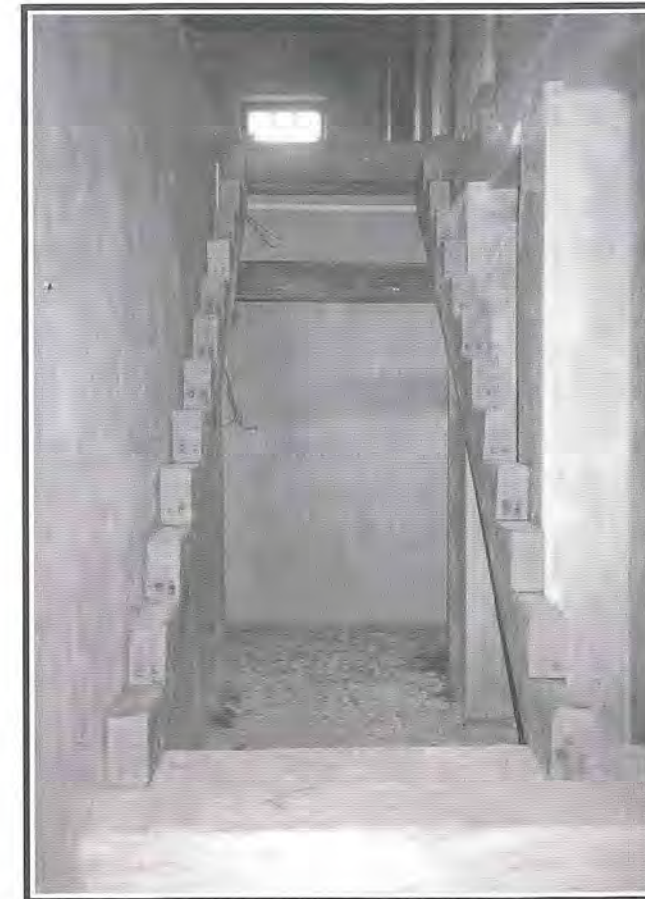


Fig 26: A compartmentalised staircase being constructed.



Fig 28: A completed compartmentalised staircase.

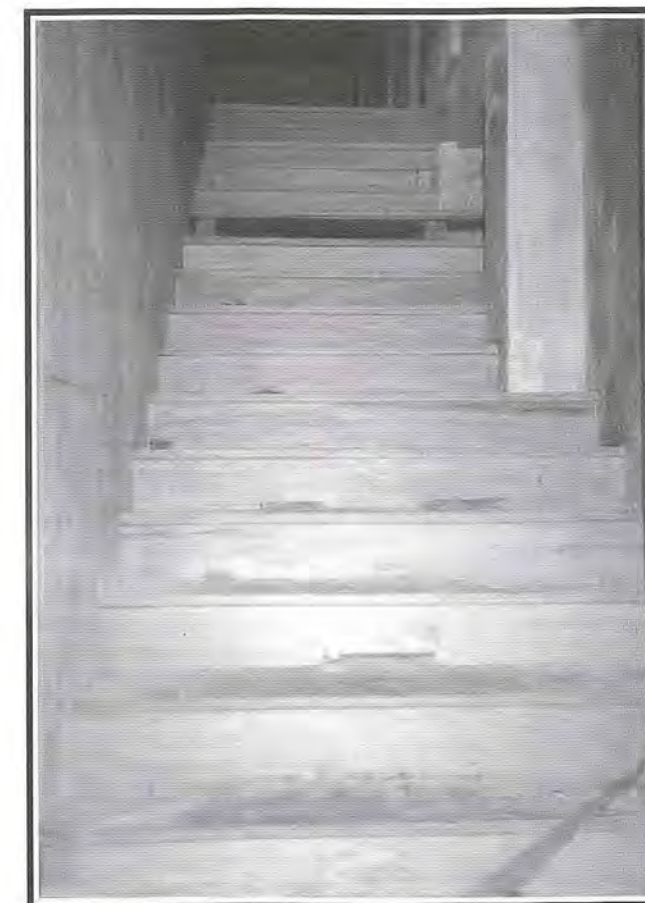
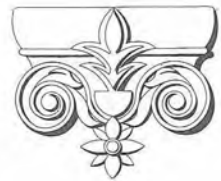


Fig 27: Laying of timber treads and risers.

The restored timber floor joists and boards and staircases should be periodically examined to ensure that there is no water accumulation (particularly at the junctions between the partywall and the timber floor joists) which will cause timber deterioration. The termite resistant coating added to the timber members also has to be checked frequently to determine whether repainting is necessary, or if there is already an infestation, to localise the problem and repair the affected members. Early treatment would reduce costs. (See Fig 29 - 30)



MAINTENANCE



Fig 29: Restored timber staircase to be properly maintained to prevent deterioration due to water accumulation and termite infestation.

Fig 30: Timber floors after restoration.



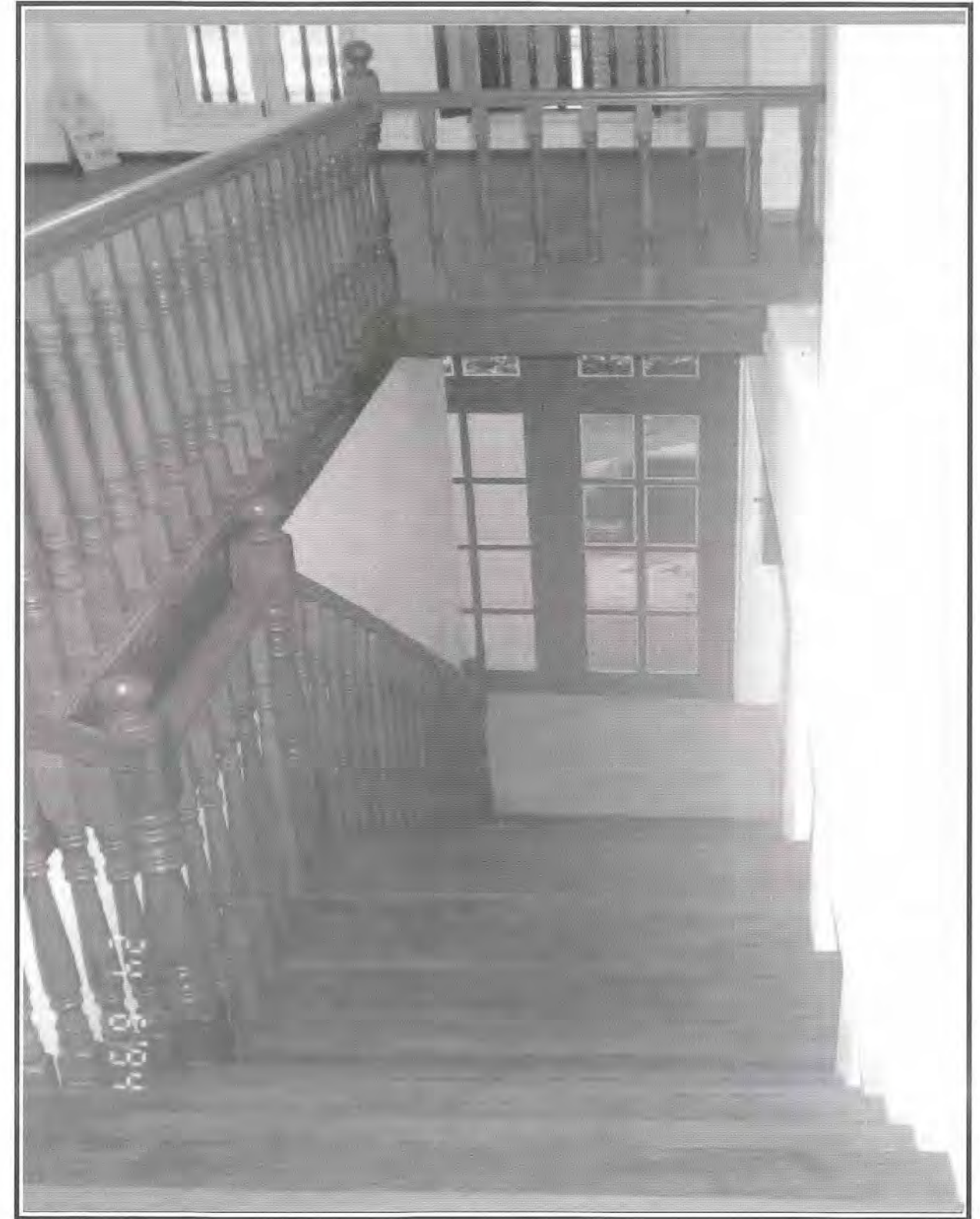
As key elements of the shophouse, restoration of the upper storey timber floor and staircases have to be carefully considered. It is recommended that the essential form and integrity of the original structure be retained. This means supplementing damaged or inadequate structural members and replacing original structural elements only when it is absolutely essential. Where possible, repair of the existing timber floor and staircase should be all that is required. This will retain the original internal quality and appearance of the building.

(See Fig 31- 32)

Fig 31: A restored ornate timber staircase.



Fig 32: Timber floor and existing timber staircase retained and restored, thereby retaining the internal spatial quality and character of the shophouse.



CONCLUSION
