

Contents

1. Introduction	1
2. Design	2
2.1. Types of Timber Doors	2
2.2. Types of Door Panel	5
2.3. Ironmongery	7
2.4. Standardisation	9
2.5. Structural Support	10
2.6. Planning for Sequence of Installation	11
3. Material Selection	13
3.1. Door Panel and Frame	13
3.2. Door Finishes	15
3.3. Ironmongery	16
4. Fabrication	18
4.1. Planning for Fabrication	18
4.2. Fabrication Process	19
5. Handling, Delivery and Storage	23
5.1. Handling	23
5.2. Delivery	23
5.3. Storage	24
6. Preparatory Works	26
7. Installation	29
7.1. Installing Swing Door	29
7.2. Installing Sliding Door	37
7.3. Inspection	39
8. Protection	46
9. Common Complaints	50
Appendix A-B	54
References	60



1. Introduction

The door is a major component of buildings. In selecting the door design, designers should take into consideration the performance characteristics of the various door systems. In addition, the choice of ironmongeries, especially the hinges and securing devices, is important to ensure that the selected door system meets the specified performance requirements.

The timber door is one of the most common and more problematic areas in building works. Defect complaint on timber door is one of the main complaints especially during handing over. Some of the common complaints from owners are mentioned in Chapter 9.

This guide is to share with the industry the good practices to achieve quality timber doors through proper door design, handling & storage, preparatory works, installation and protection works. It adopts the quality standards set out in CONQUAS 21 and includes the CONQUAS quality assessment criteria in the recommended inspection checklists.

Due to volume constraint, this guide focuses on the installation of swing doors for residential projects. Fire-rated doors are not covered.


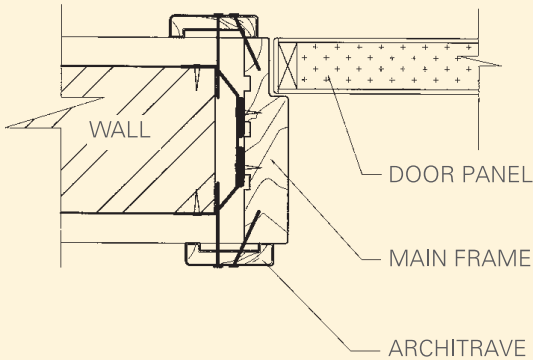
2. Design


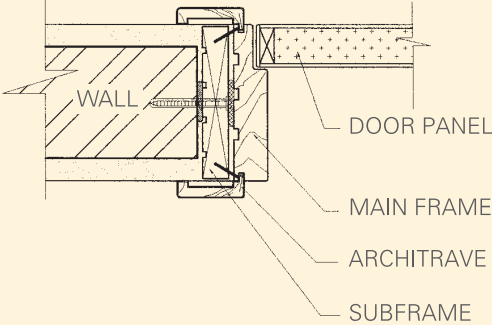

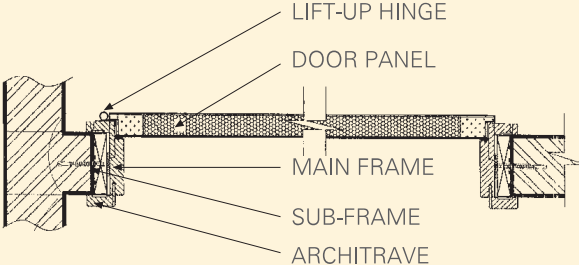
There is a wide range of timber doors and ironmongeries available in the market. This guide focuses only on the commonly used products.

2.1. TYPES OF TIMBER DOORS

Table 2.1 shows the types of timber doors commonly used in local residential projects.

Table 2.1 Types of timber doors

Types of timber doors	Description and uses
1. Swing door	
1.1. Traditional system	  <ul style="list-style-type: none"> • Installation of door frame is carried out as the wall is being erected. • This system is fast being replaced by the sub-frame system as installing the door frame at early stage of construction faces the following problems: <ul style="list-style-type: none"> ◦ Door frame may warp or shrink due to movement, tension, as well as change in moisture content and temperature during plastering or grouting work ◦ Door frame may be damaged/ dented by impact of heavy objects ◦ Door frame may be stained by cement mortar or paint • Proper protection of the door frame is needed while other trades are in progress.

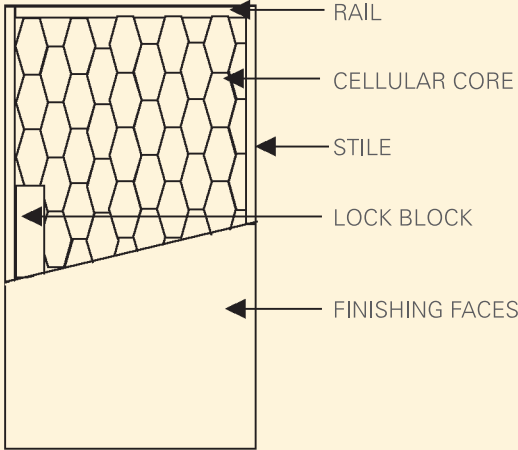
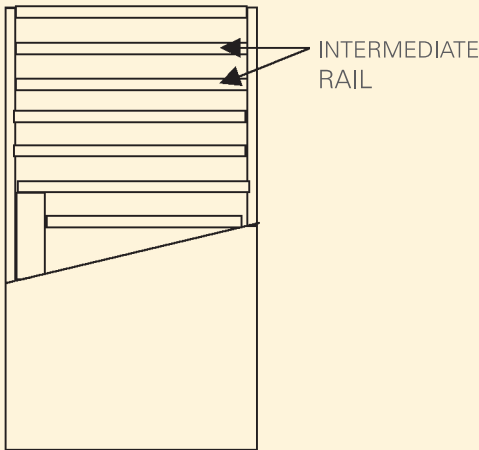
Types of timber doors	Description and uses
<div>1.2. Sub-frame system</div> <div></div>	<div></div> <ul style="list-style-type: none">• Consists of a sub-frame and a main frame.• The sub-frame is installed at the early stage of construction. The installation of the main frame will only commence after the completion of other internal trades.• Sub-frame is usually fabricated with a smaller width (about 10mm) than the main frame to allow adjustment for any misalignment.• There are two methods of installing the sub-frame:<ul style="list-style-type: none">◦ before wall erection; and◦ after wall erectionInstalling the sub-frame after wall erection is preferred as no studding of door sub-frame is needed.• The advantages of sub-frame system are:<ul style="list-style-type: none">◦ Prevent damages to the main frame and save cost and time from undesirable abortive works◦ No staining of door frame by cement mortar and paint◦ The main frame is less likely to be subjected to warpage or shrinkage due to differential movement, tension or change in moisture content and temperature during plastering or grouting work
<div>1.3. Rebated and lift-up door system</div> <div></div>	<div></div> <ul style="list-style-type: none">• This is a modified sub-frame system with the following difference:<ul style="list-style-type: none">◦ Concealed gap between door and frame◦ Better acoustic effect◦ More convenient and easier to uplift the door panel with the use of lift up hinges◦ Lift-up hinges required

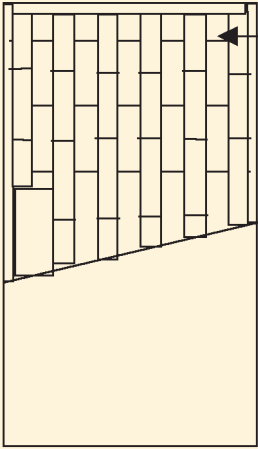
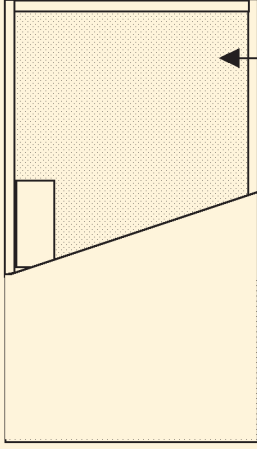
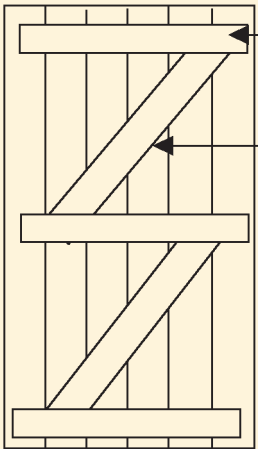
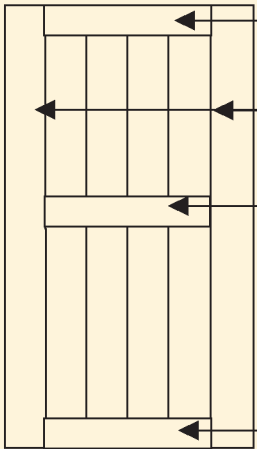
Types of timber doors	Description and uses
<p data-bbox="183 284 347 315">2. Sliding door</p> 	<ul style="list-style-type: none"> <li data-bbox="639 353 1294 385">• Door panel slides to the left or to the right of the doorway.  <ul style="list-style-type: none"> <li data-bbox="639 1227 1406 1290">• It is generally used in a narrow space where the use of swing door is not feasible. <li data-bbox="639 1308 1406 1460">• Recently, pocket wall framing system that hides a sliding door panel inside a wall is used in some residential projects. This system gives better aesthetics as the track and door panel are hidden inside the wall. However, repair of any damaged sliding track may require one side of the wall to be removed. <div data-bbox="683 1534 1007 2027">  </div> <div data-bbox="1045 1534 1369 2027">  </div>

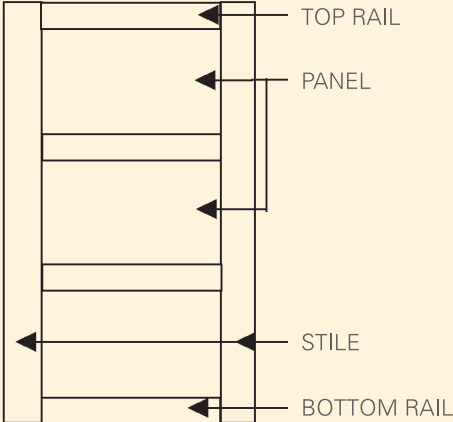
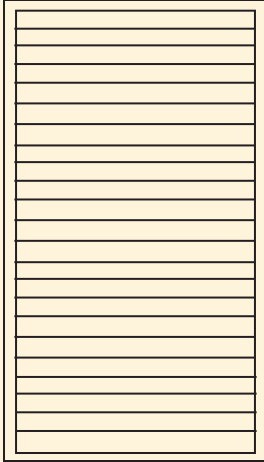
2.2. TYPES OF DOOR PANEL

There are a number of different door panel designs. While the door design is chosen by the designers, the contractors should also ensure the selected door meets its performance requirements. The types of door panel, material and other related requirements are stated in SS 347:1990 Specification for Timber Door. Table 2.2 provides a summary of the types of door panel stated in SS 347.

Table 2.2 Types of door panel

Types of door panel	Description
1. Flush door	
<ul style="list-style-type: none">• Flush door is a door having two plane faces which entirely cover and conceal its structure.• It includes doors with cellular, intermediate rail, block board or particle board cores.	
1.1 With cellular core	1.2 With intermediate rail core
	
<ul style="list-style-type: none">• The door panel comes with cellular type core infill, to which the finishing faces are bonded.	<ul style="list-style-type: none">• The door panel comprises intermediate rails evenly distributed at a spacing of not exceeding 200mm centre-to-centre, to which the finishing faces are bonded.


Types of door panel	Description
<p>1.3. With block board core</p>  <p>BLOCK BOARD CORE</p> <ul style="list-style-type: none"> The door panel is made of block board cores glued edge-to-edge to form a solid door. A finishing face is then bonded over the block board core. 	<p>1.4. With particle board core</p>  <p>PARTICLE BOARD CORE</p> <ul style="list-style-type: none"> The door panel is made of particle board cores to form a solid door. A finishing face is then bonded over the particle board core.
2. Joinery door	
<ul style="list-style-type: none"> Joinery door has solid vertical members, rails and panels. 	
<p>2.1. With ledges and braces</p>  <p>LEDGE</p> <p>BRACE</p> <ul style="list-style-type: none"> Each door should have no less than three ledges. Braces should be neatly scribed to the ledges. 	<p>2.2. With frames and ledges</p>  <p>TOP RAIL</p> <p>STILE</p> <p>INTERMEDIATE RAIL</p> <p>BOTTOM RAIL</p> <ul style="list-style-type: none"> The framing members should be joined by means of mortises and tenons, or dowels, to produce a rigid framing.

Types of door panel	Description
<p>2.3. With panels</p>  <ul style="list-style-type: none">The panels can be made of plywood, hardwood, glass or particleboard.	<p>2.4. With louvres</p>  <ul style="list-style-type: none">The louver blades should not be less than 6mm thick.


2.3. IRONMONGERY

The selection of quality ironmongeries, especially the hinges and securing devices (i.e. latches or locks), is critical to ensure the performance of door. Table 2.3 describes the types of ironmongery commonly used in the local industry.

Table 2.3 Types of ironmongery

Types of ironmongery	Description and uses
<p>1. Door handle, latch & lock</p> 	<ul style="list-style-type: none">In most cases, door handle, latch & lock work as a set and operate in conjunction with one another.Door handles can be classified in the following two categories:<ul style="list-style-type: none">Those that have a basic knob design; andThose that operate in a lever fashion.The type of latch & lock used for a door depends mainly on the degree of security required. Internal door normally require only a latch fitted with suitable handle. Exterior door may require a lock and a latch, which are often incorporated in a single piece.The quality and security level of lock vary considerably. Careful selection of lock for exterior door is, hence, critical in ensure adequate security.

Types of ironmongery	Description and uses
    	<ul style="list-style-type: none"> • The common types of lock & latch used are as follows: <ul style="list-style-type: none"> ◦ Mortice lock This is operated by a latch and a lock. The latch is operated by a handle while the lock is operated by a key. ◦ Security cylinder This is used when a degree of security is required. ◦ Cylindrical lock This is mostly used for internal doors. It is relatively cheaper and easy to install. ◦ Latch This is normally used for added security for external doors. ◦ Door guard This is normally used for added security for external doors. It allows the occupier to open the door slightly to see who is outside the door, and yet remain secured.
<p>2. Hinges</p> 	<ul style="list-style-type: none"> • The most commonly used hinges for internal and external doors are butt hinges. For large doors such as width of door more than 1.2m, pivoted hinges are quite commonly used. • The number and type of hinges used depends on the door design (i.e. types and dimensions). Manufacturer's recommendations and instructions should be followed.

Types of ironmongery	Description and uses
<p>3. Other accessories</p> 	<ul style="list-style-type: none">• A door closer automatically closes the door in a controlled and smooth manner. The closer can be either surface mounted or concealed.• The selection of concealed closer is mainly due to aesthetic consideration. However, if the door is heavy, closer with compatible strength should be chosen.

2.4. STANDARDISATION

It is recommended to standardize the door size and door structural opening wherever possible. Table 2.4 shows examples of ideal structural opening sizes recommended by manufacturer. The advantages of standardizing the door size and opening are as follows:

- Simplify design details and less change of misunderstanding
- Less co-ordination on site

Table 2.4 Ideal structural opening sizes

Location of door	Structural opening sizes (mm)
1. Main entrance	900
	950
	1,000
2. Bedroom	800
	850
	900
3. Bathroom	700
	750
4. Kitchen	850
	900

2.5. STRUCTURAL SUPPORT

Inadequate design may transfer the vertical load of the wall to the door frame. This affects the ease of operation of the door. Vertical load above the door must be designed to be transferred to a lintel or other structural systems to minimize deflection in the door (Figure 2.1).


Figure 2.1 Types of lintel used for door opening




2.6. PLANNING FOR SEQUENCE OF INSTALLATION

Installation of door involves the fixing of the door frame/ sub-frame at an earlier construction stage and subsequent installation of door panel, main frame (for sub-frame system), architrave and ironmongery at the later stage of construction. To ensure quality, it is important to plan and follow the proper sequence of installation. Table 2.5 summaries the recommended sequence of installation to achieve a quality timber door.

Table 2.5 Sequence of installation for different types of doors



Installing timber door	Sequence of installation
1. Swing door	
1.1. Installing door frame	<ul style="list-style-type: none">For traditional system, installation of door frame is carried out as wall is being erected (before plastering or installing wall tiles).  <ul style="list-style-type: none">For sub-frame and rebated systems, there are two methods of installing the sub-frame:<ul style="list-style-type: none">Before wall erection orAfter wall erectionThe installation of main frame is carried out only after completion of all the following trades:<ul style="list-style-type: none">Plastering and painting of wall or wall tilingFlooringOther internal trades, such as installation of built-in cabinet, etc.
1.2. Installing architrave, door panel and ironmongery	<ul style="list-style-type: none">Installation of architrave, door panel and ironmongery should only commence after completion of all the following trades:<ul style="list-style-type: none">Plastering and painting of wall or wall tilingFlooringOther internal trades, such as installation of built-in cabinet, etc.For wall with skirting, the interface between architrave and skirting should be well coordinated.




Installing timber door	Sequence of installation
2. Sliding door	
<p>2.1. Installing sliding track/ cavity wall frame</p>	<ul style="list-style-type: none"> For sliding door, installation of the sliding track is carried out after the completion the following trades: <ul style="list-style-type: none"> Plastering and painting of wall Flooring For pocket wall framing system, the installation of cavity wall frame commences as wall is being erected (before plastering or installing wall tiles) 
<p>2.2. Installing architrave, door panel and ironmongery</p>	<ul style="list-style-type: none"> Installation of architrave, door panel and ironmongery should only commence after completion of all the following trades: <ul style="list-style-type: none"> Plastering and painting of wall or wall tiling Flooring Other internal trades, such as installation of built-in cabinet, etc.

3. Material Selection

3.1. DOOR PANEL AND FRAME


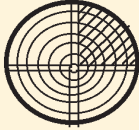
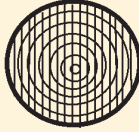


The following are the types of materials commonly used for door panel and frame.

Types of materials	Description and uses
<p>1. Timber</p> 	<ul style="list-style-type: none">• Timber used should comply with the requirements specified in SS 347. It may be in a single length or finger-jointed.• For finger-joint timber, the ends of the timber interlock with one another and are glued together using special resins under pressure to produce long length of timber.• It is important to treat the timber to prevent deformation in long term.• Features:<ul style="list-style-type: none">◦ More cost effective with reduced wastage◦ Free of unsightly knots◦ Less prone to bowing or warping◦ Flexibility to join the sections to achieve the required length
<p>2. Plywood</p> 	<ul style="list-style-type: none">• All plywood used should comply with the requirements specified in SS 347.• Plywood is formed by gluing layers of sliced timber together, e.g. veneers or plies of softwood or hardwood. The type of glue and veneer used will determine the application of the plywood.• Features:<ul style="list-style-type: none">◦ Available in different thickness and sizes◦ Different strengths of the plywood can be achieved through the use of different types of glues

Types of materials	Description and uses
<p>3. Particle board</p> 	<ul style="list-style-type: none"> Particle board is manufactured from small timber particles blended with a synthetic resin adhesive and compressed under heat and pressure. Quality of adhesive/resin plays a vital role to withstand weather condition. The particles are either chips, flakes, shaving or splinters produced through cutting or breaking process. Features: <ul style="list-style-type: none"> Available in different thickness and sizes Lower tolerances in thickness Stable, tough and hardy surface. It is harder than solid timber Smooth surface that does not twist and turn Eco-friendly as it is made from the waste from producing other wood products
<p>4. Medium density fibre (MDF) board</p> 	<ul style="list-style-type: none"> MDF board is manufactured from powder of timber materials blended with a synthetic resin adhesive and compressed under heat and pressure. Quality of adhesive/resin plays a vital role to withstand weather condition. Features: <ul style="list-style-type: none"> Available in different thickness and sizes Lower tolerances in thickness Stable, tough and hardy surface. It is harder than solid timber Smooth surface that does not twist and turn Eco-friendly as it is made from the waste from producing other wood products Good for profile cutting
<p>5. Honeycomb</p> 	<ul style="list-style-type: none"> Honeycomb is made of recycled craft papers formed in hexagonal cells and sandwiched between plywoods or melamine boards. It produces a strong and light weight structure. It is important to ensure good adhesion of each honeycomb cell to enhance uniform resistance to perpendicular crushing forces. Features: <ul style="list-style-type: none"> Relatively light in weight but rigid in structure Minimum warping and twisting Relatively cheaper

3.2. DOOR FINISHES



The following are types of door finishes commonly used in the market.


Types of doors finishes	Description and uses
<p>1. Veneer</p> 	<ul style="list-style-type: none"> Veneers are manufactured by slicing or peeling slices of wood skin from tree logs. The main methods of veneer cutting are as follows: <ul style="list-style-type: none">  <ul style="list-style-type: none"> Quarter cut The log is sliced at 90° to the growth rings  <ul style="list-style-type: none"> Crown cut The log is sliced along its length  <ul style="list-style-type: none"> Peeling The log is peeled to give a continuous veneer. It is generally used for construction plywood as the veneer sheets cannot be matched and its appearance is less attractive As veneer is a natural material, variations in shade and colour will occur. Depending on the species of timber used, natural features such as sound knots, drops or buttons are commonly found in the veneer. Designer should be aware of the possible natural features of the species selected. Features: <ul style="list-style-type: none"> Easily sourced and available in various designs and patterns
<p>2. Laminate</p> 	<ul style="list-style-type: none"> Laminate is made of multiple layers of paper saturated with resin and pressed together under high heat and pressure and then finished with a printed surface. Features: <ul style="list-style-type: none"> Can feature a variety of wood prints More consistent in colour and grain pattern compared to veneer Durable and has higher resistance against dents than the timber finishes Easy to maintain

Types of doors finishes	Description and uses
3. Hardboard	<ul style="list-style-type: none"> This is a low cost material which is produced from timber pulp blended with adhesive and pressed to the required thickness. Paint finishes is normally applied over the hardboard for better appearance.

3.3. IRONMONGERY

There is a wide array of materials for ironmongery available in the market. The ironmongery used should conform to the requirements of endurance test as specified by products' manufacturer. The following should also be considered:

Types of ironmongery	Description
1. Hinges 	<ul style="list-style-type: none"> Hinges used should comply with BS EN 1935. Coating should be able to withstand the ambient weather conditions to prevent deterioration. For example, correct type of finishes should be specified if project is near seaside.
2. Door closer 	<ul style="list-style-type: none"> Door closer used should comply with BS EN 1154.


Types of ironmongery	Description
<div>3. Lock</div> <div></div>	<ul style="list-style-type: none">• It is recommended to specify the lock is tested to meet the standard required to ensure the quality and security level. For example, Mortice lock is tested to meet the BS EN 12209.• Quality of materials such as coatings, stainless steel should be able to resist the ambient weather conditions. For example, correct type of finishes should be specified if project is near seaside.

4. Fabrication

Assurance of the quality and performance of doors starts in the factory where the door components are fabricated and assembled.

4.1. PLANNING FOR FABRICATION

For effective planning of the fabrication schedule, it is important that the following information is provided in time.

Planning for fabrication	Information to note
1. Delivery time	<ul style="list-style-type: none">Suppliers should plan the delivery of materials to site in accordance with the installation schedule to minimize storage and handling on site.
2. Types of materials & finishes	<ul style="list-style-type: none">The types and finishes of the door frame, door panel and architrave should be pre-determined so that supplier has sufficient information to ensure that the physical quality of the timber and its finishes is as per the approved samples.  <ul style="list-style-type: none">According to SS 347:1990, moisture content of timber door should be within 10-15%. Where this moisture content range is unsuitable for a particular location or purpose, the moisture content of the component should be within 2% of an agreed value.



4.2. FABRICATION PROCESS

High quality doors can be effectively achieved by fabricating and assembling as many components as possible in the factory. This helps to minimize site assembly where quality control is relatively more difficult. The use of automated machinery will help to improve production efficiency and deliver more consistent quality products.

Fabrication process	Good practices
1. Cutting	<div><ul style="list-style-type: none">Door frames & panels are cut to the specified sizes based on project information. Where applicable, site measurement on door openings should be obtained before proceeding with the cutting of sub-frames, main frames and door panels.</div> <div></div> <div><ul style="list-style-type: none">After cutting, physical measurement should be carried out to ensure there is no inconsistency in size and alignment. Also, visual inspection should be carried out to ensure no physical defect in finishes.</div>
2. Wrapping	<div><ul style="list-style-type: none">Hot press machine should be used to laminate veneer on flat panel surfaces. Edge banding machines should be used to ensure short edges is banded to match the curve.</div> <div></div>

Fabrication process	Good practices
<p>3. Cutting for installation of ironmongery</p>	<ul style="list-style-type: none">Materials are then cut to provide for the installation of ironmongeries, such as hinges and handles. Wherever possible, openings for ironmongeries, such as hinges and locksets, should be pre-cut in factory to minimize site cutting. 
<p>4. Surface preparation & finishing</p>	<ul style="list-style-type: none">Door components are smoothened via the sanding process. To achieve better quality, the use of sensor sanding machine is recommended.For better finishes, Ultraviolet (UV) light machine can be used for the application of door panel from the base coat to finishing coat in a single cycle. 

Fabrication process	Good practices
5. Quality control	<ul style="list-style-type: none"> • Carry out visual inspection for proper finishes and colour tonality. • Measurement should be taken to ensure the door is fabricated in accordance with the specified dimensions and design. • For door panels (<i>source SS347:1990</i>), the following tolerances should be achieved during fabrication: <ul style="list-style-type: none"> ◦ Height : $\pm 2\text{mm}$ ◦ Width : $+2\text{mm}$ and -0mm ◦ Thickness : <ul style="list-style-type: none"> • for joinery doors <ul style="list-style-type: none"> ◆ ledged & braced $+1\text{mm}$ and -2mm ◆ interior & exterior $\pm 1\text{mm}$ • for other doors <ul style="list-style-type: none"> ◆ interior & exterior $+1\text{mm}$ and -2mm ◦ Squareness : The difference between the lengths of the diagonals of a door panel should not exceed 3mm. ◦ Flatness : When a door is measured in accordance with Appendix A of SS 347, twist should not exceed 5mm and bending should not exceed the following : <ul style="list-style-type: none"> • Door height $\leq 2150\text{mm}$: 4mm • Door height $> 2150\text{mm}$ and $\leq 2400\text{mm}$: 6mm • Door width $\leq 1020\text{mm}$: 2mm
6. Assembly of finishing parts	<ul style="list-style-type: none"> • Power & holdfast straps should be used to assemble and secure the sub-frame. After checking the squareness of sub-frame, length of batten should be fit across the angle of the head to maintain the squareness of the frame during delivery, storage and installation. <div data-bbox="772 1373 1275 1664" data-label="Image"> </div> <ul style="list-style-type: none"> • Wherever possible, mainframe, architrave and door panel should be assembled in the factory for better quality control. <div data-bbox="659 1783 995 2087" data-label="Image"> </div> <div data-bbox="1011 1783 1394 2087" data-label="Image"> </div>

Fabrication process	Good practices
7. Packing	<ul style="list-style-type: none">Check the finished products to ensure the door components are in accordance with the project specifications.Pack the product using “shrink-wrapping” or “strap wrapping” method. Corrugated cardboard may be used to give additional protection to the door panels. <div></div> <ul style="list-style-type: none">All fabricated sub-frame, mainframe, architrave and door panel should be organised in batches and properly labelled for ease of identification. <div></div>

5. Delivery, Handling and Storage

5.1. HANDLING

Care should be exercised during loading, unloading and handling of the door frames and panels to prevent chipping, dent, staining or other physical damages to these components. The materials should be protected with polythene sheets via 'shrink-wrapping' or 'strap wrapping' methods (Figure 5.1).

The material should be transported in covered vehicles and unloaded under good weather conditions (Figure 5.2). Never transport or unload timber doors and frames in the rain.



Figure 5.1 Door panels protected with polythene sheets



Figure 5.2 Materials transported in covered vehicle and under good weather conditions

5.2. DELIVERY

Upon receiving, the materials should be checked to ensure their type, finishes and dimensions are in accordance with the approved samples (Figure 5.3). The delivered materials should also be inspected to be in good physical condition.

Where applicable, it is advisable to send the materials directly to the units where they are to be installed (Figure 5.4). It is important to note that delivery to site at an unnecessary early stage may result in damages to the products during storage and unnecessary handling.



Figure 5.3 Approved samples of door frames



Figure 5.4 Door panels and frames should be sent directly to the units where they are to be installed

5.3. STORAGE

Proper storage of the door panels and frames are important to ensure these components maintain their desired performance and appearance. The storage space should be sheltered, well ventilated, clear from debris and kept dry at all times. Door frames and panels should be stacked horizontally on raised ground (such as on wooden blocks) to prevent warpage and other possible damages caused by the surface water/moisture (Figure 5.5).

The appearance of some timbers and veneers, such as cherry, can be affected by sunlight. These materials should not be left unprotected in direct sunlight. It is advisable to protect them with opaque covers to avoid direct sunlight that may cause discolouration of these materials.

Ironmongery should be stored in such a manner to prevent contact with water, staining by foreign materials or other damages.

Figure 5.5 Storage of timber doors





6. Preparatory Works

To achieve quality door installation, the following preparatory works should be carried out before installing the door frames and panels. Supervisory personnel must ensure that these steps are properly carried out.

Preparatory works	Good practices
<p>1. Set out reference line in relation to wall alignment</p>  	<ul style="list-style-type: none"> Check that 1m datum level, setting-out reference line and level pegs are clearly marked.   

Preparatory works	Good practices
<p>2. Check that the wall opening provided is as per the approved shop drawing.</p> 	<ul style="list-style-type: none">The wall opening should be as per approved dimensions, e.g. not more than 5mm (without grouting) or 25mm (with grouting) away from sub frame.  <ul style="list-style-type: none">Wall openings that are too large should be reinstated by suitable filling materials such as chipping concrete or brick in-fill to within the specified tolerances. On the other hand, undersized openings should be chipped off and made good to the specified sizes.
<p>3. Check condition of flooring</p> 	<ul style="list-style-type: none">Flooring around the door location should be kept dry and free from debris.If there is ponding of water, installation should not proceed as the timber frame may warp due to excessive dampness.

Preparatory works	Good practices
<p data-bbox="181 297 494 324">4. Treat surface of sub-frame</p> 	<ul data-bbox="624 297 1406 360" style="list-style-type: none">• The surface of sub-frame should be properly treated. For example, apply aluminium primer to the surface of sub-frame.  <ul data-bbox="624 969 1406 1032" style="list-style-type: none">• The primer will help to reduce contact with moisture from the concrete and plaster.

7. Installation

7.1. INSTALLING SWING DOOR

The following tables summarise the good practices to be adopted when installing swing doors:

- Table 7.1.1 on installing door frame
- Table 7.1.2 on installing door panel & ironmongery
- Table 7.1.3 on installing architrave

Table 7.1.1 Installing door frame

Installing door frame	Good practices
<p>1. Installing door frame / sub-frame (for traditional system, sub-frame system & rebated door system)</p> <p>1.1. Confirm the door location against the approved shop drawing. Verify that the dimensions of the opening are as specified in the drawing.</p> 	<ul style="list-style-type: none">• It is a good practice to also measure the dimension of the door frame or sub-frame to verify that the frame is of the correct size. 

Installing door frame

- 1.2. Align the door frame or sub-frame against the setting out lines, 1m datum line and level pegs.

**Good practices**

- This is important in ensuring proper alignment of the frame/sub-frame.



- 1.3. Secure the frame temporarily using timber wedges. Adjust the position of the wedges to obtain the required vertical and horizontal alignment.



- There should be sufficient gaps between the wall and door frame to receive the wall finishes.



Installing door frame

1.4. After verifying the alignment of the frame, fasten the frame in position using approved wall plugs or galvanised straps.



Good practices

- Timber bracing can be used to support and maintain the squareness of the frame.





1.5. Grout the gap between the wall and door frame.



- Timber strip should be used to provide a firm backing during grouting to enhance the compactness of the grout.



Installing door frame	Good practices
	<ul style="list-style-type: none"> • Do not remove any props/ bracing and wedges until grouting and plastering are fully cured. • Door frame of traditional system should be protected to minimize physical damages. • If the frame is accidentally knocked out of alignment or squareness by other trades, door installer should be informed before grouting or plastering works is carried out. Rectification works should be completed before grouting or plastering can proceed.
<p>2. Installing main frame (for sub-frame system & rebated door system)</p>	
<p>2.1. Verify the dimensions of the sub-frame opening.</p> 	<ul style="list-style-type: none"> • It is a good practice to carry out site measurement to confirm the required dimensions of the door frame before proceeding to actual fabrication of the frame.

Installing door frame	Good practices
<p>2.2. Where possible, the completed set of main frame, architrave and door panel should be delivered directly to the unit where the door is to be installed.</p> 	<ul style="list-style-type: none">• Check to ensure that the frame, panel and architrave are of the correct type, size and quality.• Provision of openings for the installation of ironmongery such as hinges and lockset should be pre-cut in the factory to minimize site cutting.
<p>2.3. Assemble the pre-cut main frame using finishes nails or screws if the frame is not pre-assembled in the factory.</p> 	<ul style="list-style-type: none">• It is recommended that the main frame be assembled in the factory for better quality assurance. 
<p>2.4. Apply approved bonding agent evenly over the sub-frame and main frame.</p>  	<ul style="list-style-type: none">• It is recommended that silicon be applied on the bottom edges of the frame for better water resistance. 

Installing door frame

2.5. Install the main frame onto the sub-frame.

**Good practices**

- Timber wedges could be used to temporarily secure the main frame.
- Check that the main frame is properly aligned horizontally and vertically.
- If necessary, door panel template could be used to check the squareness and size of opening.



2.6. Secure the main frame onto the sub-frame using wave nails.









- Wave nails are preferred as they provide better securing of the main frame onto the sub-frame.



Table 7.1.2 Installing door panel & ironmongery

Installing door panel & ironmongery	Good practices
<p>1. Select the correct door panel as per approved shop drawing.</p> 	<ul style="list-style-type: none">• Check the dimensions of the door panel against the opening.  <ul style="list-style-type: none">• Where applicable (i.e. without removing the protection), check visually for any surface damage before installation.
<p>2. Install the door panel.</p>  	<ul style="list-style-type: none">• Recess or opening for the installation of hinges should be pre-cut in the factory prior to delivery to project site.• Ensure proper alignment and verify the under-cut dimensions before fastening the hinges.• It is recommended to use electrical screw driver to secure the hinges.• Ensure a consistent gap and not more than 5mm between the door panel and frame. Gap may vary depending on type of hinges, lockset used and thickness of door panel.
<p>3. Install the lockset.</p>  	<ul style="list-style-type: none">• Check and ensure the correct type of lockset is used.• After fixing the ironmongeries, a simple functional test should be conducted by closing and opening the door. The ironmongery should operate smoothly.



Table 7.1.3 Installing architrave

Installing architrave	Good practices
<p>1. Check and ensure the right type of architrave is used.</p> 	<ul style="list-style-type: none">• Check for any blemishes or cracks on the architraves.• Remove any unwanted material or stains around the architrave area. 
<p>2. Apply bonding agent to the under-side of the architrave according to manufacturer's recommendation.</p>  	<ul style="list-style-type: none">• Ensure that the gap between the wall finishes and frame is concealed before slotting the architrave on the mainframe.
<p>3. Install the architrave.</p>  	<ul style="list-style-type: none">• Ensure the mitre-joints are flat and square.• Nails used to secure the architrave should be fastened at inconspicuous locations.• The nail holes should be patched up with matching wood filler. The patched areas should then be sanded down after the curing of the wood filler.


7.2. INSTALLING SLIDING DOOR

Tables 7.2 summarises the good practices recommended for the installation of sliding door.

Table 7.2 Installing sliding door

Installing sliding door	Good practices
<p>1. Installing sliding track/ pocket wall</p> <p>1.1. As the wall is been erected (before plastering or installing wall tiles), install the sub-frame (for normal sliding door) or pocket wall frame (for pocket wall framing system). Refer to procedure on Section 1 of Table 7.1.1 for the details.</p> <p>The pocket wall frame normally comprises a pre-assembled steel casing, aluminium track and sub-frame. Supplier's installation instructions should be followed.</p> 	<ul style="list-style-type: none">For pocket wall framing system, wiremesh should be used to reinforce the cement-sand plaster. 
<p>2. Installing door panel & ironmongery</p> <p>2.1. Check and ensure the door panel is as per the approved shop drawing.</p> 	<ul style="list-style-type: none">Check visually for any surface damage before installation.Check the dimensions of the door panel against the opening.Install the door panel before installing the main frame. 

Installing sliding door	Good practices
<p data-bbox="181 297 667 324">2.2. Fix the ironmongery onto the door panel.</p> 	<ul style="list-style-type: none">• Check and ensure the correct types of ironmongeries are used.• The recesses or openings for the fixing of ironmongeries should be pre-cut in the factory.• The use of electrical screw driver is recommended.• After fixing the ironmongeries, a simple functional test should be conducted by closing and opening the door. The ironmongery should operate smoothly
3. Installing main frame & architrave	
<p data-bbox="181 1308 973 1464">3.1. Install the main frame according to Section 2 of Table 7.1.1, except that the pre-cut main frame would be assembled on site. Secure the vertical parts of the door frame using approved bonding agent. Install the horizontal part of the frame the following day or after the vertical frames are firmly secured.</p> 	<ul style="list-style-type: none">• It is important to ensure the vertical parts of the frames are firmly secured before installing the horizontal part of the frame as the horizontal part of the frame may push the vertical parts out of the alignment.• Ensure a consistent gap between the panel and frame to ensure smooth operation of the door. 

Installing sliding door	Good practices
<p>3.2. Install the architrave.</p> 	<ul style="list-style-type: none">• Refer to Table 7.1.3.

7.3. INSPECTION

In order to achieve high workmanship quality, it is important that quality control be driven by the site management.

Site supervisors and installers should be adequately trained and competent in their works. Quality control starts with good planning. It is a good practice to prepare an Inspection and Test Plan, ITP (see Appendix A) which summaries the project’s inspection, acceptance criteria and frequency of inspection. Appendix B shows a sample of inspection checklist for installation of timber door. In-process inspections should be carried out to ensure the installation procedures are properly executed. Holding points should be set at critical stages where unsatisfactory work can be rectified before proceeding to the next stage of work.

The finished works should be inspected to ensure they meet the client’s requirements and standards. Table 7.3 shows a recommended checklist for final inspection of timber door. The inspection criteria in the checklist are in accordance with the CONQUAS 21 quality assessment standards.

Table 7.3 Checklist for final inspection of timber door

Inspection checklist	
1. CONQUAS 21 Assessment - Joints & Gap	
1.1. Consistent and neat joints.	
	
1.2. No visible gaps between door frame and wall.	
	
1.3. Consistent gap between door panel and frame. Gap should not be more than 5mm.	
	

Inspection checklist	
2. CONQUAS 21 Assessment - Alignment & Evenness	
2.1. Alignment/ level with walls.	
	
2.2. Door frame and panel to flush.	
	


Inspection checklist**2. CONQUAS 21 Assessment - Alignment & Evenness**

2.3. Door and frame corners maintained at right angles.

**3. CONQUAS 21 Assessment - Material & Damages**

3.1. No stain marks and any visible damage.



Inspection checklist	
3. CONQUAS 21 Assessment - Material & Damages	
3.2. No sags and warps on door panel.	
	
3.3. Door joints and nail holes filled up, properly sanded down and with good paint finish (including on top and bottom of door panel and consistent in colour).	
	

Inspection checklist**3. CONQUAS 21 Assessment - Material & Damages**

3.4. Glazing clean and evenly sealed with gasket.

**4. CONQUAS 21 Assessment - Functionality**

4.1. Ease in opening and closing. No squeaky sound during swinging the door panel.



Inspection checklist	
5. CONQUAS 21 Assessment - Accessories Defects	
5.1. No sign of corrosion in ironmongery.	
	 <p>Rusty hinge</p>
5.2. No missing or defective accessories.	
	 <p>Missing screws</p>
5.3. Lock sets with good fit and no stains.	
	

8. Protection

Protection should be provided to all exposed surfaces such as the door frame, main frame, architrave, door panel and ironmongery. Protection should start in the factory and should remain throughout the construction process until the doors are scheduled for handing over (Table 8.1).





Proper co-ordination among various construction trades is critical in preventing damages to the timber door. Time windows should be well planned for various trade contractors and works should be executed according to proper work sequence to prevent work conflicts.


The best protection is to install the main frame, door panel, architrave and ironmongery after the completion of all wet trades, flooring works and other internal trades such as built-in cabinet. If applicable, the following protection should also be provided to ensure good timber door finishes.

Table 8.1 Protection of door components

Components	Protection
1. Protection after fabrication	
1.1. Door panel & frame	<ul style="list-style-type: none">Door panel should be protected by suitable means such as corrugated cardboard, bubble pack etc in the factory before packing. Corrugated cardboard may be used to protect the edges of door panel. After that, door panel and frame should be packed using "shrink-wrapping" or "strap wrapping" method.  

Components	Protection
2. Protection throughout construction process	
2.1. Door frame (for traditional system) or Sub-frame	<div><ul style="list-style-type: none">Timber bracing can be used to maintain the squareness of the door frame or sub-frame.<ul style="list-style-type: none">Door frame should be protected with either plywood or metal sheet.</div>
2.2. Main frame (for sub-frame system) and architrave	<div><ul style="list-style-type: none">Varnished surface should be protected with PVC tape, polyethylene sheet, etc.<div></div></div>

Components	Protection
<p>2.3. Door panel</p>	<ul style="list-style-type: none">• Door panel should be protected with either bubble pack, cardboard, canvas sheet, polyethylene sheet, etc <div data-bbox="643 396 1007 878"></div> <div data-bbox="1042 396 1409 878"></div>
<p>2.4. Ironmongery</p>	<ul style="list-style-type: none">• Door knobs/handles should be wrapped with either bubble pack, polyethylene sheet, paper, etc and secured with adhesive tape. <div data-bbox="624 1041 1054 1615"></div> <div data-bbox="1067 1041 1431 1615"></div>




Components	Protection
3. Protection after completion of door installation	
3.1. Completed door	<div><ul style="list-style-type: none">• Proper site control of environmental condition should be maintained. The area should be well ventilated to maintain regular air flow.• The completed door should be free from any direct contact with water and/or chemical.• Where necessary, the door should be protected from the sun's intense UV light by covering the external windows. Direct sunlight may also have adverse effect, such as discolouring, on the door surface.</div> <div></div>

9. Common Complaints

To achieve quality timber door, contractors must understand the common complaints and how to prevent them. The following are common complaints from owners and the associated measures to prevent them.

Common Complaints	Possible Causes	Recommendations
1. Joints & Gap		
1.1. Visible gap between wall and door frame 	a) Poor alignment/levelness of wall b) Door frame is out of alignment c) Frame of wrong size is used	<ul style="list-style-type: none"> • Ensure proper wall alignment/levelness • Ensure proper setting up & installation • Ensure frame of the correct size is used
1.2. Inconsistent gap between door panel and frame 	a) Poor workmanship b) Door frame is out of alignment c) Inconsistent width of door panel	<ul style="list-style-type: none"> • Engage skilled worker & ensure proper supervision • Ensure proper setting up & installation • Select proper cutting tool
1.3. Visible carpentry joints 	a) Poor workmanship b) Dimensional defects of timber	<ul style="list-style-type: none"> • Engage skilled worker & ensure proper supervision • Use timber with suitable dimensional stability • Better dimensional control by machine cutting • Check dimensional defects when receiving the door components

Common Complaints	Possible Causes	Recommendations
2. Alignment & Evenness		
<p>2.1. Door frame not parallel to edge of ceiling</p> 	<p>a) Ceiling is out of alignment</p> <p>b) Door frame is out of alignment</p>	<ul style="list-style-type: none"> • Ensure proper alignment of ceiling • Ensure proper setting up & installation of door frame
<p>2.2. Door panel warped, resulting in visible gap and inability to close the door properly</p> 	<p>a) Improper storage before installation</p> <p>b) Excessive temperature variation</p>	<ul style="list-style-type: none"> • Ensure proper storage and stacking before installation • Ensure adequate ventilation after installation
3. Material & Damages		
<p>3.1. Visible crack line on door panel</p> 	<p>a) Shrinkage of door panel</p> <p>b) Knock or heavy impact on door panel</p>	<ul style="list-style-type: none"> • Select door panel with acceptable moisture content • Proper protection

Common Complaints	Possible Causes	Recommendations
3.2. Dents & scratches 	a) Inadequate protection during fabrication, delivery, storage and installation b) Improper handling by workers at factory or site	<ul style="list-style-type: none"> • Proper protection • To inspect the door frame & panel after delivery and prior to installation • Ensure proper handling
3.3. Visible nail holes 	a) Poor workmanship – nail holes are not properly patched up b) Nails are fixed at prominent locations	<ul style="list-style-type: none"> • Engage skilled worker and ensure proper patching up • Nails to be fixed at inconspicuous locations and properly patched up
4. Functionality		
4.1. Insufficient clearance between door and floor	a) Uneven floor finish level b) Door panel is out of alignment c) Door panel warp due to exposure to moisture or improper storage d) Improper or insufficient number of hinges used.	<ul style="list-style-type: none"> • Ensure proper flooring installation • Ensure proper setting out and installation • Proper storage • Ensure correct type and number of hinges
5. Accessories Defects		
5.1. Staining 	a) Stained by other trades after installation	<ul style="list-style-type: none"> • Proper protection after installation

Sample of Inspection and Test Plan (ITP)

Project: _____

Scope of Work: Timber door

Appendix A

S/No	Activity	Responsibility	Inspection Method	Requirement Reference	Acceptance Criteria	Frequency	Records
1 SUBMISSION							
1.1	Shop drawings	MC/ADO	Review	-	Approved	Initial stage	Approved submissions
1.2	Door samples	MC/ADO	Review	Section 2.1/2.2	Approved	Initial stage	Approved submissions
1.3	Test reports	MC/ADO	Review	-	Approved	Initial stage	Approved submissions
1.4	Technical data	MC/ADO	Review	-	Approved	Initial stage	Approved submissions
2 INCOMING MATERIALS INSPECTION							
2.1	Door frame	MC/ADO	Visual/ Measurement	Section 5.2	As per approved samples & conform to specifications	Each delivery	Delivery document
2.2	Door panel	MC/ADO	Visual/ Measurement	Section 5.2	As per approved samples & conform to specifications	Each delivery	Delivery document
2.3	Ironmongeries	MC/ADO	Visual	Section 5.2	Conform to specifications	Each delivery	Delivery document
2.4	Cement grout & adhesives	MC/ADO	Visual	-	Conform to specifications	Each delivery	Delivery document
Prepared by _____		Verified by _____		Approved by _____			
Date _____		Date _____		Date _____			
LEGEND		MC – Main contractor/ Installer		ADO – Architect/ Designer/ Owner			

Sample of Inspection and Test Plan (cont'd)

Appendix A

Project: _____

Scope of Work: Timber door

S/No	Activity	Responsibility	Inspection Method	Requirement Reference	Acceptance Criteria	Frequency	Records
3 INSTALLING SUB-FRAME							
3.1	Check dimensions of wall opening	MC/ADO	Measurement	-	Conform to approved shop drawing	100% work done	Checklist
3.2	Install sub-frame	MC/ADO	Visual	Table 7.1.1	-	100% work done	Checklist
3.3	Check alignment and plumb of sub-frame	MC/ADO	Visual/ Measurement	Table 7.1.1	Sub-frame is horizontally and vertically aligned	100% work done	Checklist
3.4	Check cement grout used	MC/ADO	Visual	Table 7.1.1	Conform to specifications	100% work done	Checklist
3.5	Check grouting	MC/ADO	Visual	Table 7.1.1	No gap or void in the grouting	100% work done	Checklist
3.6	Remove surplus grout	MC/ADO	Visual	Table 7.1.1	Surface is clean	100% work done	Checklist
4 INSTALLING MAIN FRAME							
4.1	Check dimensions of sub-frame opening	MC/ADO	Visual	-	Conform to approved shop drawing	100% work done	Checklist
4.2	Install main frame	MC/ADO	Visual	Table 7.1.1	-	100% work done	Checklist
4.3	Check alignment and plumb of main frame	MC/ADO	Visual/ Measurement	Table 7.1.1	Main frame is horizontally and vertically aligned	100% work done	Checklist
Prepared by _____		Verified by _____		Approved by _____			
Date _____		Date _____					
LEGEND		MC – Main contractor/ Installer		ADO – Architect/ Designer/ Owner			

Sample of Inspection and Test Plan (cont'd)

Appendix A

Project: _____

Scope of Work: Timber door

S/No	Activity	Responsibility	Inspection Method	Requirement Reference	Acceptance Criteria	Frequency	Records
5 INSTALLING DOOR PANEL & IRONMONGERY							
5.1	Check dimensions of door panel	MC/ADO	Measurement	-	Conform to approved shop drawing	100% work done	Checklist
5.2	Install door panel	MC/ADO	Visual/ Measurement	Table 7.1.2	Door panel is horizontally and vertically aligned. Consistent gap between panel and frame	100% work done	Checklist
5.3	Check correct type of ironmongeries	MC/ADO	Visual	Table 7.1.2	Conform to specifications	100% work done	Checklist
5.4	Install ironmongeries	MC/ADO	Visual	Table 7.1.2	Smooth operation	100% work done	Checklist
6 INSTALLING ARCHITRAVE							
6.1	Check conditions of architrave	MC/ADO	Visual	Table 7.1.3	No damage	100% work done	Checklist
6.2	Install architrave	MC/ADO	Visual	Table 7.1.3	Mitre-joints are flat and square	100% work done	Checklist
6.3	Patch nail holes	MC/ADO	Visual	Table 7.1.3	All nail holes are properly patched	100% work done	Checklist
Prepared by _____		Verified by _____		Approved by _____			
Date _____		Date _____		Date _____			
LEGEND		MC – Main contractor/ Installer		ADO – Architect/ Designer/ Owner			

Sample of Inspection and Test Plan (cont'd)

Appendix A

Project: _____

Scope of Work: Timber door

S/No	Activity	Responsibility	Inspection Method	Requirement Reference	Acceptance Criteria	Frequency	Records
7 FINAL INSPECTION							
7.1	Cleaning	MC/ADO	Visual	-	Surface is clean	At completion	-
7.2	Protection	MC/ADO	Visual	Section 8	Protect finished work	At completion	-
7.3	Work acceptance	MC/ADO	Visual	Section 7.3	As per specifications	At completion	Inspection records
8 WORK HAND-OVER							
8.1	Rectification works	MC/ADO	Visual	-	-	At hand-over	-
8.2	Inspection by owner	MC/ADO	-	-	As per specifications	At hand-over	-
Prepared by _____		Verified by _____		Approved by _____			
Date _____		Date _____		Date _____			
LEGEND		MC – Main contractor/ Installer		ADO – Architect/ Designer/ Owner			

Sample Checklist for In-Process Inspection of Timber door (Sub-frame System)**Project:** _____**Location:** _____

Checklist	Acceptance criteria/ Requirement reference	Date of Inspection	Remarks
PREPARATORY WORKS			
1. Set out 1m datum level, reference line at floor and level pegs on wall	Refer to Section 6		
2. Check dimensions of wall opening	Conform to approved shop drawing		
3. Check condition of floor	Dry and free from debris		
4. Treat surface of sub-frame	Refer to Section 6		
INSTALLING SUB-FRAME			
5. Check dimensions of sub-frame	Conform to approved shop drawing		
6. Install sub-frame	Refer to Table 7.1.1		
7. Check alignment and plumb of sub-frame	Sub-frame is horizontally and vertically aligned		
8. Check cement grout used	Conform to specifications.		
9. Check grouting	No gap or void in the grouting		
10. Remove surplus grout	Surface is clean		
INSTALLING MAIN FRAME			
11. Check dimensions of sub-frame opening	Conform to approved shop drawing		
12. Install main frame	Refer to Table 7.1.1		
13. Check alignment and plumb of main frame	Main frame is horizontally and vertically aligned		
14. Protect completed main frame	Varnished surface should be protected with PVC tape, polyethylene sheet, etc		
INSTALLING DOOR PANEL & IRONMONGERY			
15. Check dimensions of door panel	Conform to approved shop drawing		
16. Install door panel	Refer to Table 7.1.2		
17. Check alignment and plumb of door panel and consistent gap between door and frame	Door panel is horizontally and vertically aligned. Consistent gap between door and frame		
18. Check correct type of ironmongeries	Conform to specifications		
19. Install ironmongeries	Smooth operation		
20. Protect completed door panel & ironmongery	Protective materials to remain intact after installation		

Sample Checklist for In-Process Inspection of Timber door (Sub-frame System)

Project: _____

Location: _____

Checklist	Acceptance criteria/ Requirement reference	Date of Inspection	Remarks
INSTALLING ARCHITRAVE			
21. Check conditions of architrave	No damages		
22. Install architrave	Refer to Table 7.1.3		
23. Patch nail holes	All nail holes are properly patched		
24. Protect completed architrave	Varnished surface should be protected with PVC tape, polyethylene sheet, etc		

References

1. BRE Building Elements
Walls, windows and doors. HW Harrison and RC de Vekey
2. BS EN 1154: 1997
Controlled door closing devices
3. BS EN 1529:2000
Door leaves. Height, width, thickness and squareness. Tolerance classes.
4. BS EN 1530:2000
Door leaves. General and local flatness. Tolerance classes
5. BS EN 1935:2002
Single axis hinges, requirements and test methods
6. BS EN 12209:2003
Locks and latches
7. SS 347:1990
Specification for Timber Doors
8. SS CP 1:2001
Code of practice for the use of timber in buildings
9. Singapore NPQS A6-10
Specification for Internal Doors
10. Singapore NPQS A6-20
Specification for External Doors