2.1 Common Types of Engineered Wood System

Engineered wood flooring can be laid directly onto the subfloor or an underlay based on the following systems:

Direct Lay to Subfloor
For direct laying of engineered wood, the flooring strips are glued to the subfloor using compatible adhesive. This is effective for subfloor that meets evenness tolerance. This method of laying provides a solid feel for the user.

With Underlay and Fixed
The engineered wood flooring strips are glued to an underlay (plywood, rubber or felt) which is fixed to the subfloor using suitable adhesive and/or nailing. If plywood is used, it is recommended to use Water Boil Proof (WBP) plywood.

With Underlay and Floating
The underlay is not fixed to the subfloor and the engineered wood flooring strips are installed without fixing to the underlay. This method provides a floating feel.
2.2 Subfloor

The condition of subfloor greatly affects the performance of the engineered wood flooring. The following are key factors that need to be taken into consideration.

**Moisture**

There are various methods, be it non-destructive or destructive, to test the moisture in the concrete / floor screed.

One of the methods is to check the Relative Humidity (RH) of concrete. This is done by drilling a small hole in the subfloor based on tester’s specification 24hrs before the testing and sealing it up. A reading within the hole 24hrs later will indicate the RH of the concrete. The optimum is to have the RH below 80%.

The common method used in Singapore is measuring the moisture content of the subfloor. This is by placing the measuring device on the subfloor surface. The surface moisture content should be less than 6% or as specified by the flooring manufacturer.

If RH or moisture content exceeds the requirement, moisture barrier is to be applied on the subfloor surface.

Each engineered wood floor manufacturer provides recommendations for installation of its product. These should be adhered to.
The subfloor surface should not be brittle or chip off or crack when tested for hardness. This is to ensure that the subfloor has the capacity to receive the nailing of underlay or the engineered wood flooring. The rigidity and hardness of the subfloor can be tested by tapping a hammer on the surface or using the grid-scratching method.

Excessive unevenness of the subfloor may lead to air pockets between the engineered wood flooring and the subfloor and thus cause noise and excessive deflection of the floor under foot traffic. Excessive unevenness would also result in over-usage or wastage of adhesive.

If the evenness of the floor screed is not within the required tolerance, proper rectification or self-levelling compound could be considered to be applied to the surface to achieve the required levelness.

The subfloor surface needs to be clean and free from debris, paint and dust before the underlay or wood flooring is installed as impurities will affect the bonding.

The subfloor surface can be grinded and vacuumed to prepare it for the next process.
2.3 Timber Planks

There are wide selections of timber species in engineered wood flooring. Timber being a natural product will have natural attributes e.g. knots, grains and various colours and tone. There can be big contrast of tone and colour even within a single species. In the production process, manufacturers would sort them in categories and collection. Some collections have minimum colour variation and a knot free look, while some would have contrasting tone with prominent knots. The photographs below show some of the collections available.

![Clear and well balanced](image1)

End users should be informed of the features and characteristic of the floor that they have selected. While attempts are made to sort to the control sample, it would be difficult to produce identical and consistent look as timber is a natural product.

Engineered wood flooring can be produced with a single plank lamella or 2-3 strips lamella. Single plank generally cost more and would have lesser colour variation and tonality within the board. Functionally, single plank and 2-3 strips plank are similar.

![Rustic with natural attributes](image2)

![Full plank top](image3)

![Multi strip top](image4)
2.3.1 Structure of Engineered Wood Plank

1. Finishing Layer
   - UV-cured solvent free lacquer or oil, wax.

2. Hardwood Wear Layer (commonly known as Lamella)
   - Solid wood layer, most commonly 2-4mm thick.

3. Core Layer
   - Usually made of hardwood, spruce or compressed plywood with thickness based on manufacturer’s specification.
   - Absorbs stress and strain and keeps the floor stable.

4. Back Layer
   - Usually plywood or medium soft wood.
   - Combines with other layers to prevent the floor from cupping and warping.
Engineered wood plank provides increased stability with each layer running at a 90 degree angle to the layer above. This restricts the widthwise movement of adjacent layers and helps to reduce warping within each strip.

Some of the popular solid wood species used in flooring and their respective hardness rating are shown below. This chart is not to be considered as an absolute indication of the hardness or performance of the flooring according to the type of wood used. For engineered wood flooring, other factors that affect the performance of the flooring include the type of core layer, thickness of lamella and finishing layer.
2.3.2 Engineered Wood Floor Manufacturing Process

- **PURCHASE**
  (Selection of required wood species - Critical)

- **KILN DRY PROCESS**
  (Control moisture content)

- **ROUGH MILLING**
  (Plane / mould raw wood)

- **CONDITIONING**

- **SPLITTING**
  (Splitting face layers into lamellas)

- **GRADING**
  (Selecting & sorting face lamellas)

- **PRESS PROCESS**
  (Pressing the face lamellas on the core & back layer)

- **SANDING PROCESS**
  (Sanding and calibrating planks)

- **FINISHING PROCESS**
  (Different surface finishes)

- **PROFILING PROCESS**
  (Locking system profiling)

- **TESTING & QA / QC CHECKS**

- **PACKING PROCESS**
  (Protect and final check before transport)

- **COMPOSING MULTI STRIP SURFACE PATTERN**

- **CORE PROCESS**
  (Composing core mat)

- **FULL PLANK**

- **MULTI STRIP**

- **DELIVERY**
2.3.3 QA/QC Checks and Good Practices in Manufacturing Process

High quality engineered wood planks can be achieved as the full manufacturing process and the finishing coats are done in factory. Automated process and well planned quality checks at necessary stages deliver consistent quality planks.

<table>
<thead>
<tr>
<th>Process</th>
<th>Good Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Splitting of lamellas</td>
<td>• Thickness checks on the lamellas after the splitting process help to achieve consistency in size.</td>
</tr>
<tr>
<td>Grading of lamellas</td>
<td>• The lamellas are sorted according to shades and natural attributes. This allows better control of samples which can be more easily matched and used as per project requirements.</td>
</tr>
</tbody>
</table>
Engineered wood planks go through a finishing process where multiple layers of protective coats are applied on the planks.

- Abrasion test checks the toughness of the coated surface.
- Random checks on the sheen/gloss level are done to ensure consistent coated surface.
- Random scratch tests are conducted to determine the resistance level of coating surface.
Profiling of the joint

Manufacturers adopt various methods of joining engineered wood planks to ensure edges of the planks are aligned during installation.

A) Conventional ‘tongue and groove’ method

B) Proprietary locking systems

C) Proprietary clicking system

*Courtesy of Unilin – patented Uniclic Multifit System
### Profiling of the joint

- A profile accuracy check ensures consistency in the joint profile dimensions and proper interlocking of engineered wood planks.

- A tensile stress test can also ensure the tightness of the engineered wood floor when the planks are installed on site.
Types of Edge Finishes

There are various types of edge finishes, namely:

- Square/flat (Section View)

- Top & Bottom Bevel / Micro-bevel (Section View)

- Top Bevel / Microbevel & Square Underside (Section View)

Cupping and bowing check

- This ensures compatibility of the different layers of wood and absence of cupping or bowing due to adverse reaction of wood at the end of manufacturing process.
2.4 Selection of Adhesive

There are various adhesives for engineered wood flooring. It is critical to understand the behaviour and use of the respective adhesives. These include polyurethane and silane based adhesives. The surface where the adhesives are to be used on and the time available for curing also need to be considered. Table 2.4 below shows the conditions that need to be considered for the selection of adhesives.

Table 2.4 Selection of Adhesive Considerations

<table>
<thead>
<tr>
<th>Type of subfloor &amp; underlay</th>
<th>The adhesive between the subfloor and underlay needs to be compatible with both surfaces.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Enough curing time should be considered.</td>
</tr>
<tr>
<td>Type of Engineered Wood</td>
<td>Compatibility study needs to be carried out between the adhesive and wood.</td>
</tr>
<tr>
<td></td>
<td>To avoid water based adhesive on wood as wood would react with moisture.</td>
</tr>
<tr>
<td>Properties of Adhesives</td>
<td>Shelf life: the length of time from the manufactured date that an un-opened container of adhesive can be stored without becoming unfit for use. Adhesive should be used within the shelf life to ensure that its properties are as specified.</td>
</tr>
<tr>
<td></td>
<td>Pot Life: this is usually for two components adhesive. It is the length of time the adhesive remains suitable for use after mixing the two components.</td>
</tr>
<tr>
<td></td>
<td>Open Time: the length of time the adhesive remains suitable for use after getting exposed to the atmosphere. Each application area and speed of flooring installer need to be considered to ensure optimum use of the adhesive.</td>
</tr>
<tr>
<td></td>
<td>Elasticity and adhesive strength of the adhesives should be considered to allow the flooring to resist moisture movement of timber and thermal expansion of substrates.</td>
</tr>
</tbody>
</table>
2.5 Provision for Movement

The lamination of wood layers laid 90 degrees to each other makes engineered wood planks more stable against width wise movement due to changes in relative humidity in comparison to solid wood timber. Nevertheless, it is important to introduce expansion gaps of 5 to 8mm or in accordance to manufacturer’s recommendation for all the 4 sides of a location.

2.6 Joint Interface with Other Material

One of the design considerations is the interface joint of engineered wood floor with other materials such as ceramic tile, natural stone or aluminium door/window, etc. Planning for a smooth interface joint involves the understanding of sequence of works, matching the finished level of the adjoining flooring and selecting the appropriate interface material. Some designers may select wood filler to seal such joint whereas others may introduce metallic strip, capping or sealant, etc as an alternative to achieve a neat joint. Examples of metallic strip and capping are shown below.

*Metallic Strip Joint*

*Joint with Capping*
2.7 Other Considerations

It is important to identify the heavy traffic area where wear and tear is higher. The design should consider appropriate material for the flooring and if engineered wood is used, identify preventive measures to reduce wear and tear of the engineered wood surface.

Besides identifying heavy traffic flow e.g. at the entrance, dust and sand particles may be brought into the interior by shoes. It is important to introduce mitigating measures such as dust trapping carpet at the entrance to reduce the amount of damage. However, the size of the carpet determines the effectiveness in trapping of dust.