COMPOSITE FIBRE PLASTIC MATERIAL
Natural wood has certain qualities that predispose its use in buildings, especially in outdoor applications. It is used in decks, docks, railings, porches, garden benches, walkways, stairs, pool surrounds and many other outdoor settings because of its strength, elegance and natural appearance which are aesthetically pleasing.

Unfortunately, due to wide-spread deforestation, there are not many tropical forests left to meet the demand for natural wood. Further, the durability of natural wood, which is defined as resistance to decay and insect attack, is affected by its surrounds e.g. swimming pool decks which are constantly wet. Consequently, they need to be treated and periodically maintained against fading, moulding, cracking, splintering and rotting.

As an alternative to natural wood, composite fibre plastic material offers a practical middle ground and can be used to replace timber in some applications. Due to its inherent characteristics such as resistant to weather, moisture and termites and low maintenance, they are increasingly used widely in many applications as a substitute for natural wood. However, composite materials are not load-bearing or structural members and they are not as strong as traditional hardwood.
11.1 BACKGROUND
After years of continuous research and development, the base polymer from PVC was discovered as a suitable material that shared the same or closely similar physical characteristics, mechanical properties and workability as timber hard wood.

The composite fibre plastic material is made from a combination of organic fibre (e.g. rice husk or other similar materials) and post-consumer recycled plastics, which have different mechanical properties within the finished structure. The benefit of this composite technology is twofold: the polymer shields the organic fibre from moisture and insect damage, so there is no rotting or splintering. And the fibre protects the plastic from UV damage and gives a solid, natural feel.

11.2 HOW ARE THEY MADE?
The first step in composite fibre plastic fabrication is called compounding, where organic fibres are blended with inorganic recycled polymers. The percent of fibre used in this step is very important as it directly affects the tensile strength and Young’s modulus of the end product. Additives are also added in small amounts to enhance its properties. For example, lubricants improve surface appearance and processing, and coupling agents improve adhesion between the fiber and polymer compounds. The powder is blended to dough-like consistency and then extruded to the desired shapes by extrusion and injection moulding.

Fig. 11.3 – A typical production cycle of composite fibre plastic material.
11.3 PHYSICAL AND MECHANICAL PROPERTIES

<table>
<thead>
<tr>
<th>S NO</th>
<th>CHARACTERISTIC</th>
<th>TEST METHOD</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tensile strength</td>
<td>ASTM D638</td>
<td>27 mpa</td>
</tr>
<tr>
<td>2</td>
<td>Elongation</td>
<td>ASTM E638</td>
<td>1.9%</td>
</tr>
<tr>
<td>3</td>
<td>Flexural strength</td>
<td>ASTM D709</td>
<td>13.8 KN</td>
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<tr>
<td>4</td>
<td>Fire resistance</td>
<td>BS 476, part 7</td>
<td>Class 1</td>
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<tr>
<td>5</td>
<td>Water absorption 24 hour</td>
<td>ASTM D1037-93</td>
<td>Change in wt : 1.02 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Change in Dimension: 0.5%</td>
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<tr>
<td>6</td>
<td>UV resistance after 500 hour</td>
<td>ASTM D4329</td>
<td>1.5%</td>
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<td>7</td>
<td>Coefficient of linear thermal expansion</td>
<td>ASTM D696</td>
<td>3.6x10-5 m/m/0C</td>
</tr>
</tbody>
</table>

*The above values are indicative only. The actual values may vary from one manufacturer to another and also depend on the proportion of raw materials used.

11.4 CHARACTERISTICS OF COMPOSITE FIBRE PLASTIC MATERIAL

The primary use of this material is for external works such as decks, trellis, screen walls, garden furniture, etc. The following are the key characteristics of the material.

**Durability**
The life of composite materials is generally longer. Although some variety of composite materials can be costly than solid wood, this is often balanced by reduced costly maintenance and less frequent replacement due to rotting and splintering.

**Appearance**
The material is also popular because of its uniform appearance and consistency in pattern. The synthetic material is manufactured from the “right proportion” of mixed substances, and thus each board has the same appearance as the next.

**Moisture resistance**
The plastic content in composite decking makes it less susceptible to moisture, which would normally cause wood to expand and contract. This characteristic reduces wear and tear and prevents warping. The synthetic material also protects the surface from decay caused by prolonged exposure to weather.

**Resistance to heating and fading**
Typically the material is treated with UV stabilizer and hence has better resistance to heating and fading. The added preservatives and colorant keep the uniform appearance and prevent the deck from fading to some extent.

**Design flexibility**
One of the advantages of composite material over wood is its ability to be moulded to meet special shapes and sizes. It can be extruded to make continuous profiles of desired cross-section with better dimensional consistency and accuracy. It also behaves almost like wood and can be shaped using conventional woodworking tools. Staining is not necessary but colour can be applied, if desired, for aesthetic reasons.

**Environment**
The material can be considered as environmentally friendly because it uses recycled plastics. It can also be recycled completely, and processed without any significant deterioration in performance.

**Low maintenance**
They do not require frequent staining, sealing and other additional treatments. Decks can easily be cleaned by normal sweeping, hose or water jet occasionally.
Fig. 11.4 – Versatile composite material for outdoor applications.

Fig. 11.5 – Use of extruded members leads to consistent profile and dimensions.
11.5 LIMITATIONS AND OTHER CONSIDERATIONS

- Composite materials are not load-bearing or structural members and they are not as strong as traditional hardwood. That is why some brands of composite wood decks are still dependent on using a hardwood base to keep it structurally rigid.

- Adequate support, space between joists, fastening method, gap between boards, length of board and end profile are important parameters to consider when using composite materials. The manufacturer’s recommendations on the method of installation should be followed closely. Any local codes or other requirements should also be complied with.

- For decking, stiffness of the flooring is an important consideration. Joists for solid wood decking are usually spaced at 600 mm intervals. For composite materials, this spacing should be reduced to get better stiffness. This may increase the cost of the flooring.

- Although composite materials are manufactured with UV coatings, adverse effects of UV radiation may still affect the surface. The hardness of the surface is also not as good as hardwood. Thus the surfaces tend to be damaged or scratched under normal wear.

Fig. 11.6 – The soft surface is prone to scratches and wear.

- Not all composite decks are made in the same way. As there are a number of manufacturers worldwide, the quality of the end product and their characteristics may vary from one manufacturer to another. So, it is important to check with the suppliers and verify the test reports before proceeding to use the material.