LIGHTWEIGHT COMPOSITE STONE PANELS
Composite stone panel consists of a thin natural stone veneer (3 mm - 5 mm) bonded to a backing panel. The backing panel can be of aluminum (honeycombed or ply), fiberglass, ceramic or other material, depending on the type of use. The two parts are tightly bonded together with high strength glue under high temperature and pressure. The resultant composite panel not only preserves the natural beauty of the granite or marble, it also overcomes inherent properties and characteristics like fragility and heaviness present in natural stones. Composite panels can be produced virtually in any natural stone material including granite, marble, limestone, slate and sandstone. They are used in a wide range of applications like exterior and interior wall claddings, elevators, over-lays, counter-tops and other special applications.

4.1 CHARACTERISTICS OF COMPOSITE STONE PANELS

a. Light weight

The standard composite panel comprising stone veneer with plastic laminated panels reinforced with honeycomb aluminium is 1/2 or 1/3 lighter than solid stone panel. This reduces the dead load of the building. As it is lighter, the erection speed is also improved, especially in high-rise building claddings. There is therefore savings in structural requirements, labour and time. Besides providing stability to the thin layer stone, the fabrication technique eliminates warpage – a natural characteristic often seen in long stone panels. The composite stone panel can be installed on most substrates using a variety of installation methods including adhesion or mechanical fastenings like concealed screws or interlocking channels.
b. Better impact resistance, flexural strength and water resistant

Composite stone panel has better impact resistance and flexural strength due to their backing support. The backing support panels can be flexed, making them ideal for a variety of architectural applications. They reduce the fragile and brittle properties of natural stones and can be used in place of natural stones for their aesthetic beauty. In addition, the epoxy skinned composite panel is impervious to water penetration, even with open structured stones such as travertine or limestone.

![Fig. 3.3 - The backing technology yields better flexural strength.](image)

![Fig. 4.3 - Thin cuts from same block increases utilization ratio.](image)


c. Increase stone utilization ratio

The use of thin stone veneer in composite panels maximizes the usage of natural stone. The utilization ratio is generally about 3 times higher than if the material comprise wholly of natural stone. For example, 1 m$^3$ of raw stone can be used to fabricate up to 135 m$^2$ of composite stone panels compared to about 45 m$^2$ of natural stone panels. This is a more efficient use of limited resources, reduces the exploitation of natural resources and promotes environmental conservation. Furthermore, getting a larger quantity of stone veneer from a single block allows the manufacturer to achieve a more consistent tone and texture in the end-product.
4.2 TYPES OF COMPOSITE BACKINGS

a. Aluminum honeycomb backing
The honeycomb backing is suitable for both marble and granite finish. The thickness of the stone can be as thin as 3 mm and the backing can be in the range of 10 to 25 mm. This backing is not only lightweight, it also has high strength, better resistance to moisture, corrosion and fire. Furthermore, the aluminum alloy plates between the honeycombs provide good impact resistance and flexural strength. The panel’s properties permit its use in internal or external wall claddings and counter tops.

Fig. 4.5 – Aluminum honeycomb backing with thin marble.

b. Aluminum polymer backing
The thin polyester aluminum backing panel is about 2.5 to 4 mm thick and such composite panels are suitable for applications requiring light weight and thinness. It can be used for internal wall claddings, lift interiors and decorative ceilings. Apart from being light weight, the polyester aluminum panels are more even and resistant to corrosion and chemical attack.

Fig. 4.6 – Thin aluminum polymer backing with marble.

c. Fiberglass net backing
This method is more suitable for granite and less common for marble finish as marble is softer and more fragile than granite. The advantages of using fibreglass net backing are its strength, stiffness and lightness. The panels can be installed using either adhesive or mechanical fastening.

Fig. 4.7 – Layer of fiberglass net backing with granite.

d. Glass backing
The composite panel is formed by glass, stone and epoxy. The glass can be either tempered or laminated and bonded to the stone using a translucent epoxy that does not affect the natural colour of the stone. This method works well with stones of translucent onyx, alabaster or white marble as the pattern of natural veins of the stone will glitter and be transparent under lighting. Such composite panels are used in hotel proscenium, feature walls, elevators and ornamental ceilings.

Fig. 4.8 – Glass backing with marble is bonded by translucent epoxy.

e. Ceramic backing
This method is often used with marble finish as marble is softer and have the characteristic of open veins. The marble needs a stronger backing particularly for flooring applications. The composite tiles can be installed by cementing for flooring or mechanically anchored for wall claddings. The marble can be cut to ultra-thin veneer of 3 mm thickness and adhered to ceramic backing of 8 mm thickness. Although the ceramic backing gives a strong base, these panels are heavier than the other methods.

Fig. 4.9 – Ceramic backing with marble: Primarily for flooring.
4.3 An overview of fabrication of composite stone panels

The natural stone from the quarry in the form of blocks are cut into thin slabs. They are bonded to backing panels by special resin followed by application of uniform heat and pressure to ensure proper bonding throughout the whole slab. Once the glue has set, the slab is sawn into half and the pieces are polished or honed. Finally, the pieces are cut to size mechanically according to customer’s requirements.

Fig. 4.10 - Composite panel fabrication process.

1. Apply resin on stone to bond with backing material.
2. Double sided bonded backing.
3. Apply pressure & heat.
4. Sawn into half.
5. Polish.
6. Mechanical cutting.
7. QC Check.
8. Packing.
4.4 LIMITATIONS AND CONSIDERATIONS IN COMPOSITE STONE PANELS

Although the technology economizes the use of natural stone, speeds up installation and improves the performance and range of applications, it may not be cost effective in applications involving natural stones with low and medium cost range. However for applications that use high-end luxurious stones like onyx marble or sky blue granite, there are potential benefits and savings as the usage of the more costly raw material is greatly reduced.

The strength and performance of the composite stone panel are very much dependant on the manufacturing technology and the quality of resin used. Hence it is important to ensure the right materials and suppliers are chosen to supply the product.

The choice of installation methods e.g. mechanical fastening or by adhesive glue, requires appropriate skilled labour to ensure the effectiveness of the installation. Hence it may be necessary to ensure there are adequately trained workers to carry out the installation works before considering light weight composite stone panels.