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## Solid Wood & Panel Technology

MARCH 2012

Cutting **Tools**,  
Cutting **Costs**

The  
Perfect **Fit**

Drying For  
**Excellence**

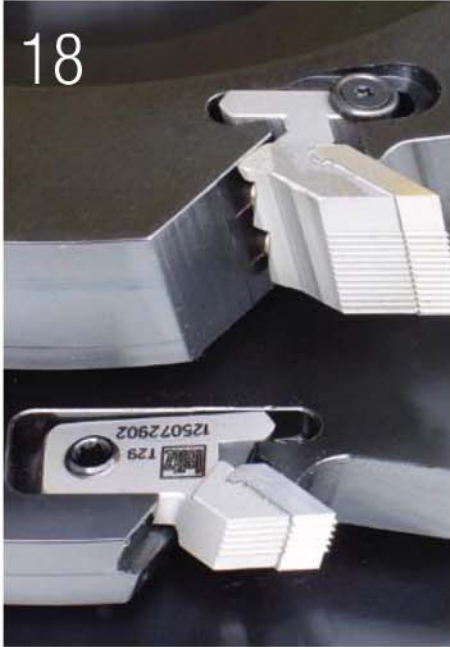
# CUT AND TRIM

## Modular Systems For The Future

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- Interzum Guangzhou (China) March 27 - 30





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**Y**ears ago, as the world began its search for an uncharted market, all eyes were trained on India and China. These two nations, with their huge populations and large masses of undeveloped land, presented enormous potentials. Decades on, the fortunes of the two countries cannot be more different. China has since established a willing domestic market that propelled its woodworking industry forward, becoming a major importer of raw wood materials and exporter of wood products, as well as making in roads to penetrate overseas markets with its machinery and tools.

Although the furniture sector in India is one of the fastest growing industries of the country, with a reported 30 percent compound growth rate per annum, it continues to contribute marginally to the nation's economy. Valued at around US\$8 billion, it constitutes just 0.5 percent of the country's GDP. As of 2010, commodity wood consumption per capita, excluding solid hardwood, is at 0.003 cubic metres, compared to China's 0.08 cubic metres.

The contrast in the fortunes is a result of two factors—infrastructure and spending power. India's furniture industry features both organised and unorganised sectors. It is only until recently that the Indian government paved the way for 100 percent foreign ownership in single-brand retail. The old requirement of 51 percent foreign ownership was one of the reasons that deterred overseas investors, such as IKEA which has been trying to venture into the land since 2010.

The wealth divide in India remains large. The middle-income group, which is essential for market growth, is increasing but still not prominent enough. As of 2011, the country has 31.4 million middle class household, translating to 160 million individuals. This figure is projected to increase 67 percent to 267 million people by 2015. With a population of over 1.2 billion, only 13 percent of its people are currently within the middle-income bracket. The top 10 percent of the income groups earn as much as 33 percent of the nation's income.

As a silver lining to the situation, more large Indian enterprises can be seen at the recently concluded IndiaWood. These include manufacturers of laminates, flooring and machinery, as well as distributors of hardware and tools. Their sustained growth will hinge on the wealth distribution of the nation.

Elsewhere in the world, the US housing market is gradually gaining momentum for its recovery. Indonesia remains a country with huge promise and efforts have been in place to advance the furniture scene there.

Although there are still uncertainties with regard to the global economic climate, the first few months of the year have not been as bad as some have feared. With encouraging signs from the West and Southeast Asia, there are still plenty of cause for optimism.

# A Tale Of 2 Giants

*T.H. Wong*  
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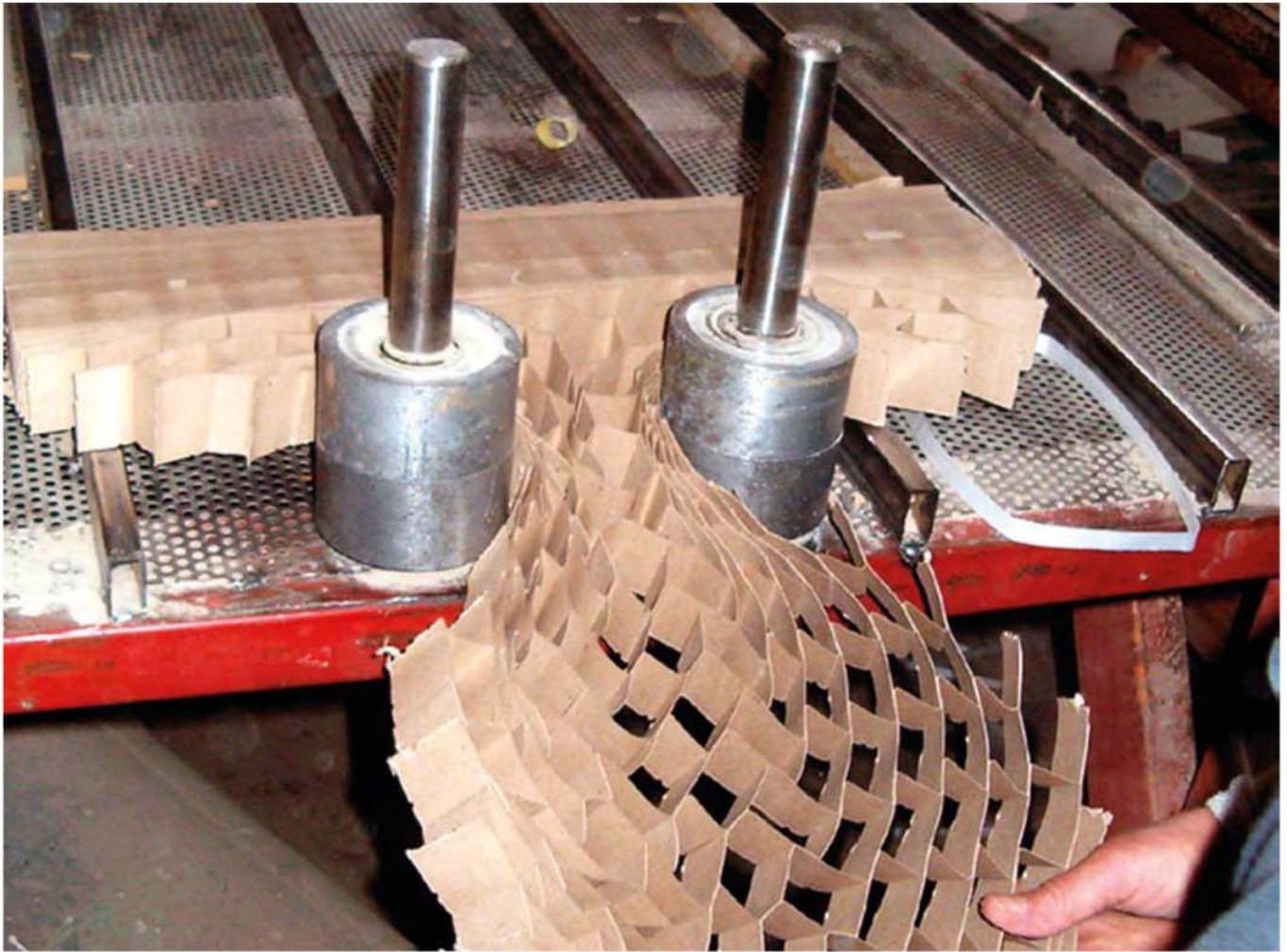
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# The **Golden Glow** of **Honeycomb**

The growing prices of raw materials, energy and transport have made the use of honeycomb panels an attractive proposition. The outstanding strength to weight ratio of these panels makes them possible solution for the future. By **Assoc Professor Ioannis Barboutis and MSc Vasiliki Kamperidou, Aristotle University of Thessaloniki**

An increasing interest in lightweight panels has developed in the last few years for the furniture industry worldwide, mainly due to the fact that this kind of products have the potential to replace conventional wood-based panels that are currently in use for relevant furniture and joinery applications.

The unceasing search for weight reduction and structural improvements has made sandwich composite constructions popular. Lightweight sandwich technology has been in existence for centuries and has been employed in several industries, such as aerospace, transportation, furniture, doors, sports equipment, etc. They can also be found

in many other fields, like packaging materials, in a great variety of cabinets and wooden structures.

The first paper honeycomb structures might have been constructed by the Chinese 2,000 years ago for ornaments, while the expansion production process has been invented in Germany in 1901 for decorative applications as well.



The new and ingenious materials developed rapidly.

In the US, an office furniture company collaborated with a forest laboratory to construct a three-layer honeycomb panel, made of recyclable paper in the medium layer, which resulted in quite satisfying properties. In Germany, in 2003, close cooperation among equipment, panel and furniture manufacturers and other sector partners resulted in the introduction of equipment specifically designed for manufacturing lightweight panels based on an expanded paper honeycomb core. This equipment enables fully automated production of the material.

### Main Applications

With the prices of raw materials, energy and transport in the woodworking industry constantly rising, composite sandwich constructions are beginning to find increased acceptance, mainly because they can offer the huge advantages of low material weight, reduced shipping costs, easier assembly and disassembly, as well as ease of handling, especially when it comes to mobile furniture.

Honeycomb panels are suitable for a wide variety of applications in home furniture (ie: kitchen, living room, bedroom) and other applications, such as office furniture, conference tables, shelving, desks, floors, cabinets, shop fitting, counters and other work surfaces, components and fixtures for exhibition stands, and space dividers.

Uses for honeycomb panels also include doors and other constructions in houses, trailers, shelter buildings, warehouses, farm buildings, lightweight shipping containers, miscellaneous office furnishings, thick contemporary design pieces, displays for department stores and other retail establishments.

### Composition

Generally, the core materials are in the form of a lattice to ensure lightweight,

which is an idea, inspired by the interior structure of a beehive honeycomb structure.

The lightweight honeycomb panels consist of three basic elements, surface layers (top side and bottom side), the core (hexagonal honeycomb, corrugated honeycomb or compartments) and frame (optional with or without frame). The facing sheets can be made of thin wood (hardwood or softwood), plywood, particleboard, high-density fibreboard or medium density fibreboard (MDF), asbestos, ABS, acrylic, PVC, veneer, aluminium or even plastic laminate.

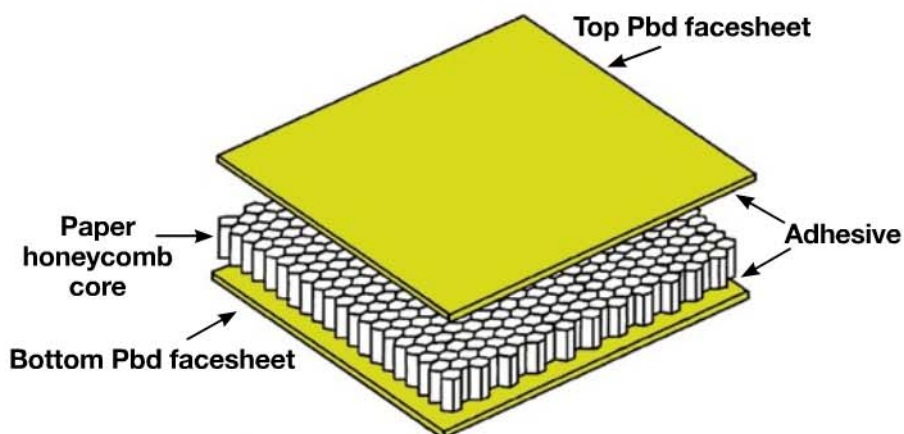
Other types of lightweight core material, except for paper honeycomb structure, could be balsa wood, hard foamed rubber, plastic foams, and sheets of cloth or metal.

of high strength honeycomb panels at low cost. The core can be a hexagonal structural type that is strong and safe, compared to other structures, with a panel density of about 0.65-0.75 g/m<sup>3</sup>. Furthermore, the core can be constructed in different dimensions and thicknesses, which makes the supply of honeycomb panels vast and diversified.

### Production Process

The three commonly used basic honeycomb production techniques are expansion, corrugation and moulding, initially developed in 1901 for non-sandwich applications.

Paper honeycomb is traditionally produced using the conventional expansion process. It is remarkable



Because of the relatively high density of most woods, only a few types are used for sandwich constructions. End-grain Balsa, to the contrary, is the oldest and still one of the more popular core materials. Presently, of all the materials being utilised in the production of honeycomb core materials, the Kraft paper honeycombs are the cheapest and most obtainable.

These cores exhibit lightweight advantages and good damage resistance. So, it can be claimed that paper is almost the only material apparent at present for the large-scale development

that in the rapidly growing Asian furniture industry, a majority of furniture panels used are paper honeycomb core panels.

However, cell size and core height of these paper honeycombs are usually above 10 mm, because the cutting and bonding production steps are much more time consuming at lower cell sizes. In the 'expanded' type of sandwich panel, sheets of treated paper are laid out and interspaced with parallel and uniformly spaced strips of adhesive. The blanks after bonding are expanded to form hexagonal cell sections.



A second traditional process for honeycombs is the corrugation process. With standard corrugated cardboard sheets, a small cell size of 5 mm can be realised, bearing to a larger density compared to expanded honeycomb cores.

This type of core consists of corrugated sheets of paper assembled parallel to each other and separated by a single treated and uncorrugated sheet or corrugated sheets assembled with principal flute directions of adjacent sheets at right angles or finally, corrugated sheets assembled parallel to each other and bonded at the crests.



Two or more honeycomb boards can be fastened with dowels or screws.

Honeycomb structures come in many different shapes and sizes, such as triangles, squares, hexagons, reinforced hexagons, spirally wrapped, cross-core, circular, etc. Cell width range between 10-40 mm, while cell wall height between 10-90 mm.

As it is evident, a decrease in the modulus of rupture has been recorded by increasing the cell wall height of the honeycomb structure. Honeycomb cores with hexagonal cell, commonly used in furniture structures, are characterised by a considerable rigidity in shear, high crushing stress, almost constant crushing force, long stroke, low weight and relative insensitivity to the overall loss of stability.

The feasibility of ThermHex thermoplastic honeycomb core and

the TorHex paper honeycomb core versions has been proven. These two cost efficient, folded honeycomb cores are suitable for a variety of applications and are produced from one thermoplastic sheet or one corrugated cardboard sheet respectively, by successive in-line operations.

With a low density and open pore structure, a solid can be used to design light, stiff components such as honeycomb panels and large portable structures. The mechanical properties of the cellular solids such as stiffness, compression/tensile strength, shear strength, lateral expansion

is critical to the performance of the sandwich, as the core properties control energy absorption and force transfer through the structure.

Any honeycomb core is satisfactory only in relation to the facings it supports and, conversely, the suitability of any facing may depend on the core. Satisfactory performance of the honeycomb panel depends to a great extent on the bond between the core and facings and the characteristics of the facings and the core, as well.

The critical modes in the core sandwich structures that may cause failure are core buckling, delamination in the impacted facing sheet, core cracking, matrix cracking and fiber breakage in the facings. The performance of the honeycomb sandwich panels can further be improved through the application of edge rail reinforcements and edge band application.

### Honeycomb Panel Connections

Several ways of fastening have been used in order to join two or more honeycomb boards, such as dowels and screws. Connectors that allow load-bearing structures to be created using this innovative material have been developed.

Some of these connectors, suitable also for ready-to-assemble furniture, brought into the market are: Aerofix 100 and Hettinject (mechanical dowel solutions), Tab 20 HC (corner joints, in panels without cross-grain), Rafix 20 HC (corner and middle joints, in panels without cross-grain), Minifix 15 and Maxifix 35 HC (horizontal joints), M20 Connecting bolt, RTA connector, rear panel connectors, carcass connectors, hinges and their suitable fittings.

As it has been proven, the mechanical properties of the sandwich panel can be increased using plastic connecting dowels, which are inserted between the top and bottom surface sheet, using



adhesive. The development of sandwich panels was made possible, in fact, by the introduction of high-quality adhesives. For the agglutination of the core to the two facing sheets, urea-formaldehyde or thermoplastic adhesive of polyurethane is used.

### Advantages Of Honeycomb Panels

It is perfectly clear that the honeycomb panel is facing a bright future and there is a noticeable growing trend in the use of lightweight honeycomb materials in the wood products industry and especially in the furniture manufacturing sector. This product comprises the best combination of natural materials and human ingenuity in the last century of structural and non-structural material invention.

Honeycomb panels provide excellent characteristics for furniture construction, such as high stability, optimum bending strength, high strength-to-weight ratio, the fact that it can be produced in large spans, long service life, almost no sagging, optimised transport and easy assembly.

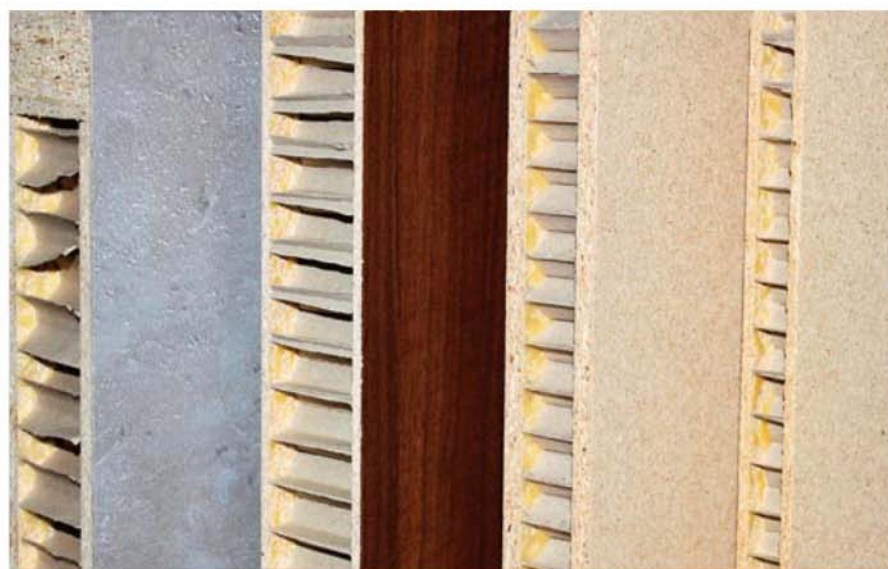
Lightweight honeycomb panels can be as resistant and durable as solid wood panels, while they may weigh up to 70 percent less and this high-performance material could replace solid wood, MDF and plywood as substrate in many applications.

They also offer a response to international product and design trends, an opportunity for market diversification and improved product environmental friendliness by lightening the environmental burden (reducing the pressure on timber resources, reducing energy consumption and reducing or eliminating formaldehyde emissions).

They can be made by processes that lend themselves to mass production from materials that are produced in large volume. The possibility to produce honeycombs in different designs, widths and thicknesses in a

continuous process opens a host of highly interesting prospects in furniture construction, offering a larger range of possibilities in term of formability, with no necessity to stop and reset the production line.

Honeycomb boards fulfil all these requirements and the technological advances have recently made it possible to improve the performance of this new generation of panels. For example, thermofusible polyurethane adhesives have improved product flatness and moisture resistance as well as product mechanical performance and heat resistance.



There is a growing trend in the use of light weight honeycomb materials in wood products and furniture.

In recent years the introduction of automated panel assembly systems and the development of appropriate fitting solutions for light weight panel production have made it far easier and more economical to adopt this concept than a decade ago.

### Bright Future

This product has been a topic of ongoing research for many years, with many experimental investigations and theoretical analyses being performed. As the development of the sandwich structural panel grows, the need for more data on the behaviour of such panels

under ordinary exposure condition will undoubtedly increase.

There are also constantly growing requirements of the manufacturers and the consumers for a reduction of the raw materials cost, weight reduction, easier handling, reduction in transfer cost, and improvement of the properties, in other words the optimisation of the construction technique.

The factors that influence the properties of the product, such as the thickness of the core, the cell diameter and the geometry of the cell, the weight and the type of the paper used in the

honeycomb, the type of the surface layers, the whole panel weight, the adhesive type and the production technology should be further investigated.

Fundamental for the durability of the furniture is the strength and the durability of its joints. Therefore, additional research on the behaviour of the connectors and the development of new connector types is constantly conducted, in order to increase the applications that the honeycomb sandwich panel can be used for and to improve the quality of the material even more. **FDM**

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