Strands On Board

Augustine Quek takes a look at the OSB manufacturing process and recent developments in production technology.

Oriented strand board (OSB) was first described in 1949 by Armin Elmendorf, who later patented it in 1965. It is an engineered mat-formed composite panel made from wood strands, flakes or wafers, oriented in a controlled manner, and bonded with wax and exterior-grade adhesives such as phenol-formaldehyde or isocyanate, under intense heat and pressure. Developed in the early 1980s from wafer boards, OSB competed with plywood as a structural material that uses a low quality resource.

OSB's cross-oriented layers are created by shredding lumber wood into strips, sifted and then oriented on a belt. The mat is made in a forming bed, where the layers are built up with the external layers aligned in the panel direction and internal layers randomly positioned. The number of layers placed is proportional to the required thickness of the finished panel; a typical 15 cm layer will produce a panel about 15 mm thick. The mat is then placed in a thermal press, after which individual panels are cut.

Different qualities in terms of thickness, panel size, strength, and rigidity, can be given to the OSB by changes in the manufacturing process. OSB panels have no internal gaps or voids, and are water-resistant. The finished product has similar properties to plywood, but is uniform and cheaper. It has begun to replace natural plywood in many environments. The most common uses are as sheathing in walls, sub flooring, underlayment, roof sheathing, and exterior siding.

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Making Strands

While there may be variations in the manufacturing process from one supplier to another, the process flow of OSB manufacturing essentially consists of the log conditioning, stranding, drying, blending, forming, pressing, final processing and quality control production sequences.

Logs are conditioned by soaking freshly cut logs in hot water ponds. The soaking softens the wood to facilitate debarking and making of strands or wafers, thereby reducing the amount of fines and slivers generated. Pond temperatures are increased during cold weather conditions to maintain effectiveness. After conditioning, the logs are debarked and fed into a strander or waferiser. The sharp knives cut the log pieces into strands or wafers along the grain. Most mills separate core and surface strands and wafers, and are brought together only at the mat-forming stage.

The strands or wafers are conveyed to wet storage bins and are screened to remove fine particles. They are then placed in large cylindrical dryers, which rotate slowly to minimise breakage of the strands while ensuring consistent drying. A final moisture content of three to seven percent by volume is usually achieved.

The Right Blend

After drying, the strands or wafers are mixed with resin and wax in a blender. The small quantity of hot wax (about 1.0 to 1.5 percent of the weight of wafers) sprayed on the wafers helps to distribute the powdered or liquid phenol-formaldehyde resin or polyurethane binder (2.0 percent to 3.5 percent by weight or more) evenly. The strands or wafers are continuously weight metered to ensure the proper quantities enter the blenders so that the correct resin coverage is achieved.

Forming Mats

Next, the core and surface strands are brought together to the mat former, where the forming machine arranges the strands or wafers in several layers to form a mat on stainless steel press sheets or on a continuous belt. For OSB, the strands for the faces are usually oriented parallel with the longitudinal direction of the panel (machine direction) and the core layers are either cross-oriented or laid random. Disk type orienters are the most common devices to align strands along the length of the mat, and star-type orienters are typically used to align strands perpendicular to the length of the mat.

Formers provide a high level of flexibility in tailoring plant operations to the material being furnished for the mat. The introduction of the 3.65-m (12-foot) wide forming line allows the line to operate more slowly for a given capacity. This allows for easier quality inspections, better forming control and less product variation. Mat uniformity is the key to consistent panel properties. Density variations increase production costs by forcing the mills to run to higher average targets.

Density Variations

A low-cost, yet efficient and innovative method of checking density variations is the belt scale. Thayer's Model FP-M low-density belt scale is an example. Like the belt feeder, it also utilises FMSS, interposed between a live, multi-idler weigh bridge and a single weight transducer. Each Model FP is custom made to fit existing continuous, pre-pressed OSB mat stream conveying lines. It also provides intuitive operator interface displays and can be equipped with a variety of serial and/or device level interfaces for seamless integration with mill host supervisory control systems

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After mat formation, the mats are pressed under high pressure and temperature to produce finished panels. Typical temperatures in excess of 120°C are common, where the heat and pressure polymerise the thermosetting resin or binder, bonding the strands or wafers together strongly into a rigid panel.

Multi-Opening Presses

Multi-opening presses are the most commonly used in OSB production because of their high capacity and the limited concern over thickness variation in OSB panels. In multi-opening presses, the mats are placed in the press accommodating from 10 up to 24 sheets at a time. Each mat sits between a pair of heated platens. When all the mats have been inserted, the press is closed under heavy pressure. The introduction of 3.65-m (12-foot) wide presses has resulted in higher capacities, less trim waste and panels in 91 or 122-cm (3or4-foot) wide increments.

Continuous Presses

However, continuous presses are rapidly being adopted by the OSB industry. Their capacity has traditionally been lower than that of multi-opening presses. But the development of the 3.05 m (10 foot) wide continuous press and increases in press length permitting faster line speeds have made press capacity less important. In addition, the continuous board lends itself well to custom cut-to-size applications, where the demand exists.

Panel trimming and cutting is normally done immediately after pressing, since cooling is not necessary. A grader checks the panel surfaces visually for imperfections using an oblique light and a reflecting mirror. The panels are then sorted by grades, and stacked with an automatic system. Sanding is only performed on some of the production, (eg: subfloor panels) to reduce thickness variations, and it takes place off-line.

Online Quality

Rejecting boards with defects and delamination can be done automatically with in-line detectors. Totally automated saw positioning systems, with servomotors controlling the blade position, can change the saw position often, to produce a variety of panel sizes. Camera systems are available to view the top, bottom and edge surfaces for conditions such as surface blisters, edge and trimming defects.

A combination of technologies (ultrasound, RF, microwave, camera, X-ray) can be fully automated to detect internal and surface defects. For example, BMS-1000 Bond Measurement System from Ultrasonic Arrays comprises up to 48 pairs of ultrasonic transmitter/receivers for detecting internal defects (blows, blisters, delaminations) and measuring the quality of internal bond. Calibration of transducers is completely automatic, with the electronics self-calibrating at every gap between panels. The BMS-1000 also removes ambiguity in the ultrasonic signal that is transmitted through the wood panel, like acoustic and electromagnetic noise, panel temperature, product thickness and density. The BMS controller automatically synthesizes and drives each sensor pair at its resonant frequency to maximise the signal to noise ratio of each sensor. These aides in reducing the noise floor permitting increased sensitivity, accuracy and repeatability in the defect detection/bond measurement without degrading system performance.

Making The Grade

New stress-grading equipment is being commercially developed, which can measure the mechanical properties (parallel and perpendicular) of the panels on-line. A common standard for wood is its modulus of elasticity (E) through mechanical stress grading (MSG). An example is Tadpole (Technically Advanced Production Monitoring of Local-E) MSG monitor, a self-contained, computer based, real-time stress grading machine and product monitoring tool. It reads the E values measured by the grading machine and process the readings continuously during the production process. It can also analyse and display results from product monitoring tests and provide a comprehensive report. It can be a stand alone, turnkey solution, but is also compatible with current control systems for mechanically stress-graded timber used in various parts of the world. Tadpole software interfaces with the CLT, HCLT, Computermatic and Dart grading machines for reading the E values generated by the grading machine during the grading process.

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On the quality assurance side, online equipment is currently available to measure continuously mat thickness and density, strand orientation, and moisture content, finished board thickness and internal bond; to detect delamination; and to monitor edge and surface quality of each board. There is a growing acceptance of online devices to continuously monitor board quality as opposed to random board analysis. FDM