1. Overview of wood products and Engineered Wood Products (EWP) used for prefabrication [globally]

1.1 1 Dimensional Products

In this category the most common materials for beams, joists and headers are listed. Most of theses products are available in British Columbia but some have to be imported from the US (I-beams, LSL, OSL, PSL, LVL) and some are currently not available (Box-beam, deciduous glulam).

1.2 2 Dimensions

In this category the most common materials for panels and sheets are listed. Most of these products are available and also produced in British Columbia. Some are only produced in small volumes (NLT, CLT, DLT) and also imported from the US or Europe to fulfil market needs. Some are not produced and imported (deciduous plywood, LVL) and 3-ply is currently not available

1.3 Prefabricated Products

These products have to be individually engineered and are commonly classified as the simplest form of prefabrication. Trusses and framing packages are widely available across British Columbia and usually locally produced.

1.4 Wood Fiber Based Materials

These products are based on or are using cellulose and/or wood fibers. MDF is widely available and also produced in British Columbia. None of the different forms of wood fiber insulations is produced in British Columbia but several companies import the material from Europe. Some of the wood fiber composites are available and imported from the US. Gypsum Fiber and Wood Concrete Composite are not available in British Columbia.

Deciduous Trees (Deci.)		**Coniferous Trees**	
Ash	A	Spruce/Pine/Fir	SPF
Aspen	As	Douglas Fir	DF
Beech	B		
Birch	Bi		
Chestnut	C		
Oak	O		
Poplar	Po		

1.1 Logs

DF

Logs are not engineered materials themselves, but because they are usually prepared off-site to achieve a perfect fit, they are seen as the oldest version of prefabrication. Logs can be used vertically for posts and columns and horizontally as beams. Log homes are commonly referred to buildings in which stacked logs comprise the walls. Today, the market share of log-homes is miniscule. Clients choose this method mainly because of emotional reasons, leading to a small but still active log-home builder industry in BC. With the increased code requirements for thermal performance, it will become very challenging to build code-compliant buildings using this method. Additional layers of material will have to be added. The costs are comparably high, not just because of the large amount of wood to be used, but also the size and quality of the logs and the labor-intensive process.

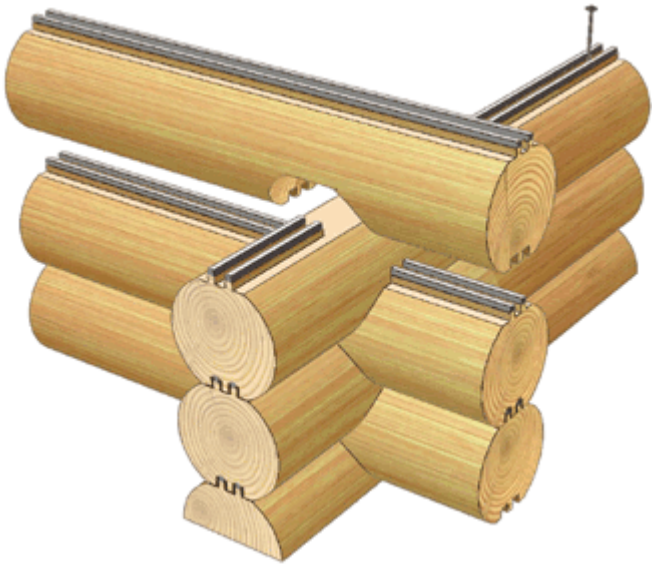

Photo: tltimber

Advantages:

- Historically log homes offered a superior durability and thermal performance because of the relatively low thermal conductivity of wood
- Specific architectural appearance

Disadvantages:

- Limited thermal performance, not sufficient for energy efficient buildings
- High production costs
- Uses very large volume of wood

1.2 Dimensional Lumber (finger jointed)

SPF

This material is the base for several EWP and, with finger-jointed lumber, the first step of refinement is introduced.

In North America Lumber is cut and milled to standard dimensions, called dimensional lumber. This construction material is by far the most commonly used in North America. The nominal values are expressed in inch, for example 2x4, 2x6 up to 2x12. The actual values are 0.5 inch smaller in both dimensions, when below 6 inch, and 0.75 inch smaller when above. Lumber qualities are graded as #3, #2 and #1. The difference between #2 grade and #1 is only visual, strength is the same. Lumber grade #1 is occasionally referred to as J-grade and is mainly for export. Countries, such as Japan are not willing to accept low lumber quality, hence J-grade. Dimensional lumber is mainly used for stick frame walls and trusses, but when further processed can be also used for CLT, DLT and NLT.

The National Lumber Grades Authority: grade stamps the lumber, names the grading agency, identifies the mill, and identifies the wood species, the grade name, the method of conditioning and the NLGA grade rule.

Other measurements, such as 4x4, also exist, with dimensions between 4x6 up to 4x12 while wider dimensions are commonly referred to as heavy timber. Standard dimensions in other regions of the world differ from the inch based system (1.5inch = 38mm). Common lumber size in Scandinavia is 45mm wide and in central Europe 60mm wide. The 60mm in central Europe are often already glued and laminated into posts and beams, commonly referred to as glulam.

Photo: Home Depot

Advantages:

- Availability of lower grades
- Very cost efficient, minimal knowledge and skill level necessary

Disadvantages:

- Small width of 38 mm results in small distances between studs and only very small screw sizes can be used
- Low dimensional stability (grade #2,) warping and bending
- Low accuracy, therefore limited use for automation
- Inconsistent or relatively high humidity levels

1.3 Glulam

A | C | O | B | As | DF | SPF

Glulam is a linear material for posts or beams, consisting of several finger jointed smaller boards (lamellae), glued and laminated into one larger and thicker element. This can be done with a variety of wood species, such as Spruce, Pine and Fir, Douglas Fir and Aspen. The grain of the lamellae run parallel to the length of the beam. Glulam has excellent strength to weight ratios. Any deficiencies of an individual layer are compensated for by the other layers. Besides this, one of the biggest advantages, compared to sawn timber, is the dimensional stability and prospective accuracy of the end product.
The smallest form, in Europe, is the commonly used 60mm stud, consisting of two or three layer of upright lamination. Currently, this version of glulam does not play a significant role in the North American market. North American producers commonly use lamella sizes based on dimensional lumber sizes. While European producers commonly use 20mm increments making a large variety is possible, depending on the costumer's specifications. Currently, only three glulam manufacturers operate in Western Canada with a low total production capacity. The 10 largest glulam manufacturers in Austria and Germany produce between 100,000 to 400,000m³ per plant per year.

Glulam is manufactured using a wide variety of wood species, including deciduous species. The use of Beech, Oak and Chestnut, for glulam is approved across Europe and in Switzerland, and the use of Ash is approved for construction purposes. The approval of other species is currently in process.

Similarly, to deciduous based LVL, deciduous glulam uses the advantages of faster growing species combined with their higher load bearing capacity, resulting into very environmentally friendly and structurally very capable products.

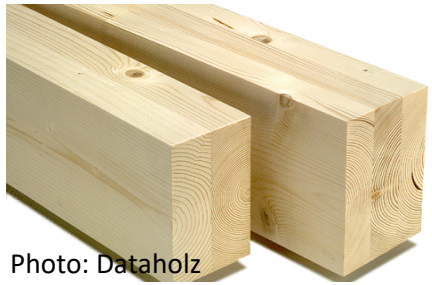

Photo: Dataholz

Photo: Deutsche Bauzeitung

Advantages:

- High structural strength and dimensional very stability,
- Product can be mass produced,
- Many wood species can be used,
- Various structural and architectural qualities can be produced,
- Suitable for automation.

Disadvantages:

- Relatively expensive manufacturing process, even if highly automated
- Significant financial investments needed to produce in large volumes including automated sorting machine, finger jointer, glue applicator, high frequency kiln, press and planer

1.4 Box Beam

SPF

Box beams, are beams consisting of four parts, two vertical and two horizontal boards glued and potentially mechanically fastened to form a long rectangular beam. Usually, dimensional lumber is used to glued together these beams. They are dimensionally very stable. Their structural performance, compared to the amount of wood used, is optimized and each element is still relatively light. The cavity can be used as a service cavity or partially filled with other materials to increase e.g. the acoustic performance. By adding several beams horizontally, a floor can be built. This can be done in a factory or on-site.

Photo: Lignatur

Advantages:

- Relative simple and cost efficient manufacturing process
- Flexible system with multiuse of cavity, small and light segments possible
- Predictable in case of fire, thickness of boards can be increased to increase fire safety by adding additional charring layer

Disadvantages:

- Limited level of prefabrication possible, still several labor steps on site are necessary
- Width of beams is limited by maximum width of boards available, hence relatively small size and large number necessary to build floor

1.5 I-Beam (I-Joist)

As Bi SPF

I-beams, occasionally also referred to as I-joists, consist of two pieces of solid lumber or Laminated Veneer Lumber (LVL), where the upper cord functions, in most cases, as the compression cord and the lower as the tension cord. The upper and lower cords are held together by either plywood or Oriented Strand Boards (OSB). There are many different dimensions for the total height of the beam as well as the size of the cords are available. I-beams can carry very high loads compared to their own weight.

I-beams are available in up to 610mm height and up to 20m length. The cords can be up to 89 mm wide.

I-beams may be used as studs, but this would require a more complex approach by the structural engineer as the product is not accredited for this use. If used vertically, it allows for deep cavities for insulation and reduces the thermal bridge to a minimum.

Photo: Dataholz

Advantages:

- Very cost efficient product,
- Structurally extremely efficient,
- Light and easy to handle on site.
- Dimensionally stable

Disadvantages:

- Very low fire resistance
- Sensitive to moisture damage.
- High glue content

1.6 Laminated Strand Lumber (LSL)

Po As

Laminated Strand Lumber is a wood-based composite manufactured from a water-resistant adhesive and poplar wood strands, measuring 0.8 mm in thickness, 25 mm width and 300 mm in length. The wood strands are encapsulated in adhesive and due to the homogenous structure of the composite, LSL is partly weather-resistant (exposure to direct weathering should be avoided). Two types of LSL can be distinguished: Boards where the strands are all aligned in the direction of the major axis of the product, and boards where a portion of the strands are aligned on the minor axis of the product. The former is suitable for use as beams, rafters, sills, columns, and the latter for use as walls, floors, and ceilings.

LSL is made by aligning thin chips or strands of Aspen and Poplar wood and then gluing them under pressure. The wood grain of the strands is oriented parallel to the length of the member and then machined to consistent, finished sizes. It is strong when either face- or edge-loaded, but typically has lower strength and stiffness properties than LVL. LSL is used in a variety of applications, such as beams, headers, studs, rim boards, and millwork components.

Photo: LP

Advantages:

- Very cost efficient product
- Dimensionally stable
- Uniform material
- Only small diameter trees needed
- Uses several different species

Disadvantages:

- Lower structural strength than LVL
- High glue content,
- Very sensitive to moisture

1.7 Oriented Strand Lumber (OSL)

Po As

Oriented Strand Lumber is made from flaked wood strands. The length to thickness ration is not around 300 as it is for LSL but around 75. Panels are made from narrow strands of fiber oriented length-wise and then arranged into layers at right angles to one another, laid into mats and bonded together with waterproof, heat-cured adhesives. OSL's appearance is very similar to OSB but within OSL all strands and flakes throughout the material are oriented in one direction and not only the outer layers as in OSB. Commonly used species are Aspen and other Poplar.

Photo: Weyerhauser

Advantages:

- Very cost efficient product
- Only small diameter trees needed
- Uses several different species

Disadvantages:

- Lower structural strength than LSL
- Very sensitive to moisture,
- High glue content

1.8 Parallel Strand Lumber (PSL)

DF

Parallel Strand Lumber is manufactured from veneers clipped to long flaked wood strands (longer than OSL) laid in parallel formation and bonded together with an adhesive to form the finished structural section. It is well suited for beams and columns in post-and-beam construction, beams, headers and lintels in light framing. PSL is dimensionally stable, offers high strength and stiffness. Visually attractive, PSL is also suited to applications where finished appearance is important. Commonly used Species is Douglas Fir.

Photo: Canadian Wood Council

Advantages:

- High structural strength, material with
- Homogenous performance
- Visually appealing
- Only small diameter trees needed

Disadvantages:

- Relatively high glue content,
- Sensitive to moisture

2.1 3-Ply

SPF

3-Ply solid wood panels are individual softwood lamellae sorted, planed, and assembled into multi-layered boards (always odd numbers) consisting of parallel outer layers and at least one core layer perpendicular to the orientation of the outer layers. Adhesive is used to bond the lamellae. Swelling and shrinkage due to climatic changes is minimal because of the cross pattern. Solid wood panels have a symmetrical lay-up, and the thickness of the outer layers is recommended to be a minimum of 5mm, fulfilling the requirements for loadbearing structural timber components. No open joints are allowed in the core layer.

For many decades this has been commonly used in central Europe with similar applications as plywood for construction, sheer walls and furniture. In a research project, in Austria, in the early 1990's the thickness of the layers of 3-Ply was significantly increased. The innovative description for this new product was coined: Cross Laminated Timber.

Photo: Dataholz

Advantages:

- Dimensional stable, shrinkage is effectively eliminated
- Structurally strong,
- Number (always odd) and thickness of layers is flexible
- Low glue content and excellent air tightness if joints are properly sealed

Disadvantages:

- Manufacturing less efficient than plywood as lamellae are sawn and not peeled.
- Currently not available in BC

2.2 Plywood

B | As | Bi | DF | SPF

Plywood consists of at least three veneer layers glued together crosswise. Therefore, the layers are placed adjacent to each other at right angles. The lay-up of boards has to be symmetrical throughout the entire thickness. The single veneer layers are manufactured by peeling steamed, round wood. The thickness of individual veneers must not exceed 7 mm (preferably <5mm). Boards for applications in dry, humid, or exterior conditions are available. Plywood uses typically softwoods but deciduous plywood is available as well.

Plywood is commonly used to add lateral stiffness to framed walls, floors and several types of EWP such as DLT or NLT. Plywood >12.7mm thickness generally qualifies as vapour retarder, according to BCBC. If all joints are properly sealed with appropriate tapes, plywood is also a good air barrier. Because of this and its high sensitivity to moisture, in central Europe, it is most commonly used for sheathing on the inside (prefabrication is precondition).

Deciduous based plywood is most commonly utilizing Birch or Aspen. These boards either contain only Birch, only Aspen, or a certain percentage of each mixed with Spruce, Pine, or Fir (SPF). Using veneers from other species such as Beech or Aspen and Beech is possible too.

Although structurally strong, deciduous based plywood is most commonly used in interior finishes and furniture due to its beautiful architectural finish.

Photo: Home Depot

Photo: Rona

Advantages:

- Dimensionally stable, shrinkage effectively eliminated,
- Structurally strong,
- Number of layers (always odd) and thickness of layers (<7mm) is flexible.
- Medium glue content and good air tightness if joints are properly sealed.
- Can be used as airtight layer and vapour retarder

Disadvantages:

- Relatively high price
- Deciduous boards even higher price

2.3 Oriented Strand Board (OSB)

B | As | Bi | SPF

Oriented Strand Boards are multi-layered, wood-based composites. The individual layers consist of long slender wood strands bonded by a polymeric adhesive. The strands on the surface layers are oriented on the major axis of the board. The high aspect ratio of the strands (length to width 10:1) increases the board's bending strength in the direction of the strand. Strands in the core layer can be distributed randomly, but generally, they are aligned perpendicular to the grain of the surface layer (minor axis).

OSB is commonly used to add lateral stiffness to framed walls, floors and several types of EWP such as DLT or NLT. OSB has already some vapour diffusion resistance and can be used for airtightness if all joints are sealed. Because of this and its high sensitivity to moisture, in central Europe, it is most commonly used for sheathing on the inside (prefabrication is precondition).

OSB comes in panels, commonly starting at around 9 mm and is available up to 30mm. When several panels are glued together, OSB can be used as mass timber.

Photo: Dataholz

Advantages:

- Very low price,
- Lightweight
- Fasteners holding strength high close to edge
- Excellent air tightness if joints are properly sealed
- Only small diameter trees needed
- Uses several different species

Disadvantages:

- Slightly less strong than plywood
- Sensitive to moisture,
- High glue content

2.4 Laminated Veneer Lumber (LVL)

B | As | Bi | SPF

LVL is mainly used as a panel or beam product. It consists of peeled spruce or pine layers up to 6 mm thick. These wood veneers are bonded with their individual ends offset and with fibers oriented primarily in the same direction. LVL is manufactured in a continuous process in large boards, using a phenolic resin. LVL contains veneers with fibers aligned primarily in the major axis, but sometimes veneers align on the minor axis. LVL is then commonly cut into beams.

LVL can be used as a bracing element in load-bearing floors and ceilings. LVL containing veneers with fibers aligned exclusively in the major axis is used in load-bearing structures, trusses, beams and rafters. LVL can be used for the same applications as glued laminated timber. LVL is suited for pressure treatments and thus can be designed for special applications, such as in areas with high risk to biological attack (e.g. by fungi or insects) or where special climatic conditions prevail.

LVL is most commonly used as lumber 45mm wide and 241mm to 606mm depth. Other sizes are possible.

LVL is commonly produced with coniferous species but can also be made with Beech and potentially other deciduous species.

LVL can be produced with deciduous species such as Birch, Aspen or Beech. For example, in Germany, structural beams and panels, using Beech are available.

In LVL the direction of the fiber usually runs parallel to the plane of the panel but by cutting and re-gluing, the direction of the fiber can also run perpendicular to the plane of the panel.

LVL products are structurally very capable and are usually left visible due to their beautiful architectural appearance.

Photo: Canadian Wood Council

Photo: Pollmeier

Advantages:

- Cost efficient,
- High structural strength,
- Can be visually very appealing,
- Less sensitive to moisture
- Versatile application
- Can be used as board or as beam
- **Disadvantages:**
- Slightly more difficult to cut, hard on blades

2.5 Nail Laminated Timber (NLT)

SPF

Nail Laminated Timber is the oldest of the mass timber panels with the earliest application more than 100 years ago. NLT is typically created by fastening individual dimensional lumber (2x4, 2x6, 2x8, 2x10, or 2x12), stacked on edge, into one structural element with nails. But some manufacturers position the boards in a crossing pattern, similar to CLT, and nail one layer after another together. One proprietary system (Hundegger) uses aluminum nails which allows any CNC mill to cut the panel. The nailing process is completed by manual labor or fully automated with so-called nailing bridges. NLT panels are utilized for load bearing walls, but without additional materials very limited lateral stiffness is offered. Spanning in one direction the only typical applications are floors, decks, and roofs. NLT offers a consistent and attractive appearance for decorative and exposed applications. In addition, sheathing added to one topside provides a structural diaphragm allowing its use as a wall panel element. Another proprietary option (Beck) is the use of wooden nails, compressed and with epoxy treated beech wood, applied with nailing gun.

Photo: Structurecraft

Advantages:

- Very simple production process,
- Relatively high fire rating possible, charring used as protective layer
- One of the most cost efficient option of mass timber panels
- Suitable for automation
- Boards can be profiled before nailing to create acoustic ceiling

Disadvantages:

- Spans only in one direction and potentially needs additional sheathing for lateral loads
- Very moisture sensitive, panel can swell perpendicular to the span

2.7 Cross Laminate Timber (CLT)

DF SPF

In the early 1990s, Cross Laminated Timber was developed in Austria and pioneered by KLH (Kreuz Lagen Holz, German for Cross Laminated Timber). In Europe, it is seen as an evolution of the extremely popular 3-Ply. The concept of cross lamination is identical to the popular 3 ply, but increasing the dimensions of the lumber and the, always odd, number of layers.

CLT consists of at least three layers of layer-glued softwood timber planks where the direction of the grain in adjacent layers is perpendicular to each other. Individual planks are either visually or machine graded. CLT has to be symmetrical in cross section of the product. Planks may be joined by edge-gluing or be finger-jointed in the longitudinal direction.

CLT is an engineered wood panel typically consisting of boards in three, five, or seven layers, oriented at right angles to one another and then glued to form structural panels able to span to some degree in both dimensions, with exceptional strength, dimensional stability, and rigidity. Commonly used increments are 20mm in Europe and 35mm in North America.

Photo: Dataholz

Advantages:

- Low quality lumber can be used in the mid layers
- Spanning, to some degree, in two directions
- Offers significant lateral stiffness
- Can carry very high loads
- Dimensionally exceptionally stable,
- Relative resistant to moisture,
- Can be machined with CNC.
- Performs well and predictable in case of fire due to charring layer

Disadvantages:

- Higher production costs compared to NLT and DLT.
- Less strong in main axis compared to NLT, DLT or glulam on flat

2.8 Dowel Laminated Timber (DLT)

SPF

Doweled Laminated Timber is the only all-wood mass timber product with the exemption of NLT with wooden nails. It can be used for floor, wall, and roof structures. Hardwood dowels are dried to very low humidity and then pushed in pre-milled and pre-drilled boards together on edge. Swelling of hardwood dowel due to the adjusting to humidity of the boards around 12%, creates a friction fit. The dowels are driven in either perpendicular to the grain into the panel or diagonally.

Another option is the orientation of boards in a crossing pattern, similar to CLT, and using dowels perpendicular to the panels plane. The diagonal doweling system is less moisture sensitive as swelling will be minimized due to the forces taken by the dowels. To gain increased lateral stiffness in the DLT, additional sheathing can be applied. With no metal fasteners, panels can be easily processed using CNC machinery, creating a high tolerance panel that may contain pre-integrated acoustic materials, electrical conduit, and other service interfaces.

Photo: Sohm, Holz100

Advantages:

- Very simple production process,
- Relatively high fire rating possible, charring used as protective layer
- One of the most cost efficient option of mass timber panels
- Suitable for automation, can be fully CNC machined
- Boards can be profiled before dowelling to create acoustic ceiling
- Best environmental performance as no glue or metal is required

Disadvantages:

- Spans only in one direction and potentially needs additional sheathing for lateral loads
- Panel width limited by dowelling technology (currently up to 1.2m)
- Very moisture sensitive due to swelling perpendicular to span, better if diagonally doweled

3.1 Wood Trusses, Nailing Trusses

SPF

Trusses are built with all different kinds of timber dimensions, the most common type in North America, is dimensional lumber, typically utilizing 2x3 up to 2x8. Individual members are connected to a larger two-dimensional structure, serving either as a beam, column or in a more complex structure, a triangular shape, to build a sloped roof. Light frame trusses can span up to 20m and beyond. Nailing plates are most commonly used for connections but can be done via finger jointing (better fire performance). In timber framing, other connections are occasionally used as well.

Trusses are an Engineered Wood Product but are occasionally also categorized as a prefabricated product. During transportation, storage and installation lateral bending has to be prevented, resulting typically in temporary bracing during lifting and permanent bracing after installation.

Photo: Homeadvisor, Triforce

Advantages:

- Very simple production
- Structurally efficient, light
- Can be assembled manually or with a high level of automation in a truss plant

Disadvantages:

- Very poor performance in case of fire if not further protected as under the influence of heat the nailing plates become soft very quickly
- For larger panels additional bracing necessary when lifting and throughout installation

3.2 Framing Packages (panelized)

SPF

Panelized framing packages are simple wall panels where the framing typically consists of dimensional lumber in the sizes of 2x4 to 2x8 and plywood or OSB which is already nailed on the panel for lateral stiffness. Similar to truss manufacturing, those panels are produced on a large table to either optimize ergonomics or to utilize automation in form of nailing bridges. Openings for doors and windows are prepared and surrounding reinforcement engineered and installed.

Manufacturing process can be done fully manually or a high level of automation can be implemented. Panels are shipped to site, reducing waste on site and accelerating construction on-site. Panels are still relatively light keeping crane costs low.

Similar to trusses, framed wall panels can be seen as an EWP or as the first and simplest step towards prefabrication.

Photo: doityourself.com

Advantages:

- Very simple production
- Structurally efficient, light
- Can be assembled manually or with a high level of automation in plant

Disadvantages:

- Limited dimensional stability under load compared to mass timber panels
- Moisture sensitive
- For larger panels additional bracing necessary when lifting

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3.3 Kielsteg

SPF

Kielsteg, is a proprietary system, developed in Austria, therefore no generic name for this type of product has been coined yet. The unique design can be seen as an evolution or derivation of the I-Beam. This product is currently only used in horizontal applications for floors and roofs. The upper and lower cords are designed to take the compression or tension forces. The web uses plywood stapled and glued parallel to the span and with an slight offset, resulting in a curved position. The diagonally bend plywood adds additional strength for lateral stiffness.

The height of the panel varies from 228mm to 800mm and depending on this dimension and on the dimension of the lumber used in the upper and lower cords, very large spans (up to 27m) are possible. Panels are produced with limited width to allow for easier trucking and lifting.

Photos: Kielsteg

Advantages:

- Excellent strength to weight ratio,
- Very large spans possible, up to 27m
- Very light and efficient system,
- Relatively simple production process

Disadvantages:

- Medium fire performance without further protection.
- When used as floor, vibrations might become a concern due to very light weight
- Proprietary system

4.1 Medium Density Fiber Boards (MDF) incl. acetylated MDF

SPF

Medium Density Fiber Board's main usage is as the outer layer of a stud wall. Sometimes it is used as the structural layer of the wall (some boards are tested for lateral load). The primary strength of these medium density fiberboards is the exceedingly low vapour diffusion resistance, allowing a very high vapour diffusion rate, which helps to keep the building dry in heating dominated climates. This performance is beneficial for durable buildings as dry plywood is ranked as a vapour retarder and increases the risk of humidity accumulation if used on the outside of the studs. Vapour diffusion open MDF boards such as the 16mm thick Agepan DWD eliminates that risk. The boards are usually produced with a tongue and groove detail to be connected to the next board and allow for sufficient wind-tightness. Paraffin coated boards exist to achieve a certain level of water repellent. These boards must either be wrapped with an external membrane or need a sufficient ventilation layer before the final cladding is installed. Currently, these boards are only available through import from Europe.

Acetylated Medium Density Fiber Boards deliver outstanding durability and dimensional stability, which allows them to be used in applications once limited to products such as concrete, plastics, or metals. With the added benefits of being lightweight, a sustainable raw material and a guaranteed life of up to 50 years above ground and 25 years in-ground, these products have attained a new level of competition.

Photos: Agepan, Tricoya

Advantages:

- Excellent vapour diffusion open
- Can be treated for moisture resistance

Disadvantages:

- Moisture sensitive depending on treatment,
- Relatively high costs
- Relatively low structural strength

4.2 Wood Fiber Insulation (LDF)

SPF

Wood Fiber Insulation, occasionally also referred to as Low Density Fiber (LDF) Board, is commonly used for thermal insulation and excellent sound absorption. Currently, produced by various manufacturers mainly located in Germany, France, and Austria, Wood Fiber Insulation comes in boards of varying thicknesses (up to 240mm), densities and sizes. It also comes as batt insulation (up to 240mm) or as blown-in fiber insulation. The manufacturing process is quite similar to the above MDF boards; the density at around 150kg/m³ is about four times lower. Thermal conductivity is usually around 0.038 W/mK, which is comparable to EPS. In addition to the excellent insulation and vapor diffusion performance, Wood Fiber Insulation boards are excellent for sound absorption, helping light frame wood structures to overcome one of their inherent disadvantages. Wood Fiber can be treated to achieve a good fire resistance.

Photos: Gutex

Advantages:

- Very environmentally friendly,
- Good insulation performance,
- Excellent sound absorption,
- Relative good fire performance and
- Very vapour diffusion open, therefore simple to use
- Sufficient wind barrier (boards)

Disadvantages:

- High production costs,
- Sensitive to moisture depending on treatment

4.3 Cement Fiber Boards

SPF

Cement Fiberboards increase their tensile strength and add some elasticity by using cellulose or wood fiber. Cement fiberboards are most commonly used for sub-floors, interior, and exterior wall sheathing. Those boards are very resistant to moisture, UV light, physical impact and fire.
Another application is the use of a high percentage of larger wood fibers, mixed with a relatively small amount of cement, to produce acoustic absorption boards which, also offer a high level of fire resistance.
Very similar boards can also use Magnesite to bind the wood fibers.

Photos: Hocre-Board, Hardie, Knauf

Advantages:

- Very durable
- Relatively cost efficient
- High fire resistant

Disadvantages:

- Cutting and drilling challenging (PPE absolutely required)
- Bridle
- High embodied energy

4.4 Wood Concrete Composite

SPF

Mixing wood fiber into concrete is a relatively old method of increasing the tensile strength of concrete and/or to make the material lighter and reduce the thermal conductivity of concrete blocks. In central Europe from the 1940s on, this method was used on a large scale to produce Wood-Concrete Composite bricks and is still popular in some countries, e.g. Austria and Germany.

Materials for different purposes can be produced depending on the ratio of wood fiber to concrete. Beside using them for residential construction, one common application is for example to build large sound absorbing wall alongside freeways in densely populated areas. If used for constructing buildings, layers of insulation material are already inserted to increase their thermal performance further.

The environmental impact is still fairly large as only a relatively small portion of aggregate and cement gets replaced.

Photos: Holzbeton.at, Arbeitskreis Holzbeton

Advantages:

- Very durable
- Fire resistant
- Sound absorbing

Disadvantages:

- High embodied energy
- Heavy material

4.5 Gypsum Fiber Boards

SPF

Contrasting with ordinary drywall, where the cellulose fiber is wrapped around the Gypsum layer, in Gypsum Fiberboards the cellulose, and sometimes wood fiber, is homogeneously mixed into the panel, increasing the structural integrity significantly. Fermacell in Germany, which was recently acquired by James Hardie (US Cement Fiberboard manufacturer), is the global market leader. This product may potentially become available in North America.

Photo: Fermacell

Advantages:

- Durable, much more resilient than drywall
- Some structural performance
- Less sensitive to moisture than drywall
- Fire resistant

Disadvantages:

- Higher price than drywall
- Has to be cut with saw

4.6 Wood Plastic Composites

SPF

Wood fibres are mixed with plastics to create a product which looks somewhat like wood but has the durability of plastic. Its main application is exterior decking.

Photos: Trex

Advantages:

- Very environmentally friendly,
- Good insulation performance,
- Excellent sound absorption,
- Relative good fire performance and vapour diffusion,
- Easy to work with.

Disadvantages:

- High production costs,
- Sensitive to moisture depending on treatment