Introducing DLT
Dowel Laminated Timber (DLT) is a mass timber product that can be used for floor, wall, and roof structures. It is known as dübelholz in Europe. These solid wood panels use hardwood dowels to friction fit pre-milled boards together on edge, creating a panel which is particularly efficient for horizontal spans and is architectural versatile.

DLT panels are the only all wood mass timber product – in concept, they involve no glue or nails. With no metal fasteners, DLT panels can be easily processed using CNC machinery, creating a high tolerance panel which can also contain pre-integrated acoustic materials, electrical conduit, and other service interfaces.

Unique to DLT as a mass timber product, a wide variety of profiles can be integrated inexpensively into the bottom surface of the panel. Each finger-jointed board goes through a molder, allowing a limitless range of different profiles to be explored and exposed in the bottom of a panel, this includes high-performing acoustic profiles using wood fiber insulation to absorb sound.

HISTORY OF DLT

The concept of using hardwood dowels to connect softwood boards together was conceived in Switzerland in the 1990s. Julius Natterer spearheaded the resurgence of NLT / brettstapel to Europe in the 1970’s and 1980’s, as he believed that this efficient method of construction could be used to make beautiful, low carbon, healthy buildings that are quick and easy to build.

In the early 1990s, DLT / dübelholz was developed by a Swiss company. They saw this product as a superior product to NLT / brettstapel in every way – it used only wood, it was CNC machinable, and production of the panel was possible with automated machinery. They proceeded to create the first automated machinery line for DLT. Several companies in Germany, Austria, and Switzerland adopted this idea and started manufacturing DLT commercially, using automated systems for drilling and inserting the dowels.

StructureCraft is the first to bring DLT to the North American Market with the world’s largest automated DLT manufacturing line now housed in our new state of the art 50,000sqft facility in Abbotsford, BC.
**Profile Moulding**
Each of the boards in a DLT panel are run through our profile moulder, allowing custom profiles to be integrated into the bottom of the panel.

**Profile Options**
Some examples of aesthetic and acoustic profiles we offer are shown below. Each of the profiles are parametric - for example chamfers, roundovers, or kerfs are available in any size, radius, or depth. The acoustic profiles are able to develop Noise Reduction Coefficients of up to 0.80.

**New Profiles**
Developing a new profile is a simple process and can be done a project basis. Profiles are fully customizable to suit the particular performance and aesthetic requirements of each project.
Timber-concrete composite (TCC) is a technology which connects the mass timber floor slab with a concrete topping to create a structural element which is stronger and stiffer than either material separately. Typically TCC floors are used when there are longer floor panel spans (>20ft), when floor buildup height is to be minimised, or when there are stringent requirements for floor stiffness or vibration performance.

There are many options for creating structural composite action between a DLT panel and the concrete topping. The principles behind three common methods have been illustrated here. Robust design methodologies for each of these methods have been developed in Europe, and have been put into use in many buildings over the past 10-15 years.

StructureCraft has conducted full-scale stiffness and vibration testing of several different composite systems and can provide timber engineering services to design these systems.
VISUAL QUALITY COATINGS and FINISHES

A variety of coatings are possible to the exposed face of DLT panels.

We have worked extensively with coating manufacturers to develop a standard sealer and range of finish options which are durable for exterior exposure, and show well on the interior.
There are many visual grade options for DLT panels available, depending on the wood species selected.

Visual grading of the lumber is purely an aesthetic choice for designers and has no affect on the structural performance of the panel.

**Board Widths**
Unique to DLT, any board width can be used - not just nominal 2x material. Thicker boards using 3x, 4x, or even 6x material can be processed through our finger-jointer, moulder, and DLT machine (up to a maximum of 6” thick boards). This gives a range of aesthetic options for the visible side of the panels.

**Custom Finishes**
Custom finishes like band sawn, rough sawn, are possible on a project specific basis.
Versatility of DLT

Any wood species recognised in North American grading rules can be used in DLT. Some examples of species are shown below - but many more options are possible.

Because each of the boards in a DLT panel spans itself between supports, the structural performance of a DLT panel is very simple - like a group of floor joists placed side-by-side. This means the structural values recognised for wood species in CSA O86 or NDS 2015 can be used to design DLT panels, and there is no need for product-specific testing.

**Treated Lumber**
FRT treated lumber can be used in DLT panels.

**External Use**
Unlike glued mass timber products, DLT is recognised as a mass timber product which can be used in exterior exposure. Finger joints in the boards are certified exterior finger-joints. This means DLT can be used for decks, balconies, and canopies.

**Reclaimed Wood**
Other wood sources, including project-specific wood sourcing is possible.

Sustainability and Certification
StructureCraft is FSC certified, and can provide FSC or SFI certified DLT panels. As DLT is 100% wood, there are no VOC’s and the sequestered carbon is highest of any mass timber product.
MANUFACTURING

The StructureCraft DLT manufacturing line is fully automated and high capacity, using the latest European technology and machinery for optimising, finger-jointing, and moulding.

The manufacturing process of doweling involves no glue or press curing time, and as a result panel production is faster than similar glued products such as CLT or GLT. The StructureCraft DLT line has a throughput capacity greater than most North American CLT manufacturers.
A year in research and development, StructureCraft’s custom-designed DLT machine is the largest and fastest in the world.

The fully automated loading and pressing process means a panel can be manufactured as quickly as every 5-10 minutes.
Stage 1: Optimising Saw
Visual defects are marked and automatically cut out as necessary in the Optisaw.

Stage 2: Finger-jointer
Boards up to 6” x 12” in cross section are structurally finger-jointed, creating continuous lamella up to 60ft long.

Stage 3: Profile Moulder
Each lamella is run through a moulder, ensuring exact board thickness and applying the many different profile options to the bottom of the board.

Stage 4: DLT Press
Lamella are automatically fed into the DLT press, where 10 tons of pressure are applied both vertically and horizontally on the panel. Hardwood dowels are hydraulically pressed into tight-fit holes drilled sideways through the panel.

Stage 5: Panel Planer
Each panel is run through a planer which ensures exact width and thickness of the panel and creates a smooth finish if required.

Stage 6: CNC Machine
Openings, notches, and drillings are milled into the panel based on project-specific requirements using a gantry-style CNC machine.
DLT MANUFACTURING DOWELING PROCESS

**Step 1: Boards Pressed**
The first package of lamellas is automatically fed into the DLT machine and then hydraulically pressed vertically and horizontally to ensure a flat panel, and remove any gaps between boards.

**Step 2: Holes Drilled**
A drilling aggregate drills 3/4” diameter holes into the wide face of the lamellas with a custom-designed drill bit.

**Step 3: Dowels Inserted**
The 3/4” diameter hardwood dowels are hydraulically pressed into the holes.

**Step 4: Process Repeat**
Additional packages of lamellas are pushed into the DLT press and doweled into the previous packages until a full width panel is created.

**Step 5: Moisture Equilibrium**
As the drier dowel comes into moisture equilibrium with the surrounding lumber, it expands, creating a tight friction fit between the two materials.
DLT PROFILES
The standard profiles: Factory Edge, Square Edge and Chamfered are available in nominal 4” to 14” panel depths, and a variety of wood species and grades. For the laminations nominal 2x, 3x, and 4x and thicker material can be used.

**Profiles**

**Dimensions**

- Length: up to 60.5ft (18.5m)
- Width: up to 12 ft (3.75m) or wider, governed by shipping
- Depth: up to 14in (0.35m)

**Species**

Made with a variety of wood species, including SPF, Douglas Fir, Hem-fir, Sitka Spruce, and Western Red or Yellow Cedar

**Finishes**

Planed, Band Sawn, Factory Sealed, or Stained

Custom finishes are available

**Structural**

Single spans up to 60ft for roofs, 35ft for floors

Transverse (weak axis) spans up to 4ft are achievable with screw reinforcement

**Chamfered**

**Square Edge**

**Factory Round**

**Thicker boards than 1.5” are possible** (3” shown)
**Profiles**

Many different visual profiles are achievable with DLT. A few options are indicated here, but variations and new ideas are easily incorporated. These profiles are available in nominal 4” to 12” panel depths, and a variety of wood species and grades. For the laminations nominal 2x, 3x, and 4x and thicker material can be used.

**Dimensions**

Length: up to 60.5ft (18.5m)  
Width: up to 12 ft (3.75m) or wider, governed by shipping  
Depth: up to 12in (0.3m)

**Species**

Made with a variety of wood species, including SPF, Douglas Fir, Hem-fir, Sitka Spruce, and Western Red or Yellow Cedar

**Finishes**

Planed, Band Sawn, Factory Sealed, or Stained
Custom finishes are available

**Structural**

Single spans up to 60ft for roofs, 35ft for floors  
Transverse (weak axis) spans up to 4ft are achievable with screw reinforcement

**Kerf**

**Sawtooth**

**Bullnose**

**Fillet Edge**
Profiles

Panel layups using boards of different depths or thicknesses is possible with DLT. Fluted patterns create an interesting aesthetic if exposed, as well as having a structural performance which is between that of the two lamination depths. Random patterns are more labor intensive to create but are possible.

Dimensions

Length: up to 60.5ft (18.5m)
Width: up to 12 ft (3.75m) or wider, governed by shipping
Depth: up to 14in (0.35m)

Species

Made with a variety of wood species, including SPF, Douglas Fir, Hem-fir, Sitka Spruce, and Western Red or Yellow Cedar

Finishes

Planed, Band Sawn, Factory Sealed, or Stained
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Structural

Single spans up to 60ft for roofs, 35ft for floors
Transverse (weak axis) spans up to 4ft are achievable with screw reinforcement
Special Profiles

Profiles

DLT panels with gaps between the individual boards can be used to create exterior decks, balconies, or stairs. Incorporating wood fibre between the boards creates an insulated panel which is high performing thermally and can be used in roof or wall applications.

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Length: up to 60.5ft (18.5m)
Width: up to 12 ft (3.75m) or wider, governed by shipping
Depth: up to 14in (0.35m)

Species

Made with a variety of wood species, including SPF, Douglas Fir, Hem-fir, Sitka Spruce, and Western Red or Yellow Cedar

Finishes

Planed, Band Sawn, Factory Sealed, or Stained
Custom finishes are available

Acoustics

If the DLT panel will be left exposed, the large surface area of the wood fibre is covered with an insert plate, and acts as sound absorption to reduce reverberation times.
DLT PROFILES
Acoustic Profiles

The acoustic profiles are available in nominal 6” to 12” panel depths, and a variety of wood species and grades. For the laminations nominal 2x, 3x, and 4x and thicker material can be used. The aperture of the gap between boards is adjusted to achieve varying levels of noise reduction coefficients (NRC).

**Profiles**

Length: up to 60.5ft (18.5m)
Width: up to 12 ft (3.75m) or wider, governed by shipping
Depth: up to 12in (0.3m)

**Species**

Made with a variety of wood species, including SPF, Douglas Fir, Hem-fir, Sitka Spruce, and Western Red or Yellow Cedar

**Finishes**

Planed, Band Sawn, Factory Sealed, or Stained
Custom finishes are available

**Acoustics**

The Acoustic Round profile incorporates a curved dap into the sides of each board which is acoustically engineered to trap sound waves. This dap can be filled with material to improve the acoustic performance. The other two acoustic profiles integrate wood fiber and felt, which acts as an absorbing material to shorten the reverberation time and create a higher acoustic performance inside rooms.
Service integration inside DLT panels is possible through several different methods:

**CNC’d routing for service runs**
The DLT panel is created flat and then milled to suit the service runs. Services can be left exposed, or smaller infill boards can be added after the services have been run to cover them up. Services can be run perpendicular to panel within the gaps between panel ends.

**Fluted service runs**
If service routs are pre-planned, flutes can be left in certain locations to provide routing for wiring and piping. These can be left exposed, or covered with acoustic treatment or boards after service installation.

**Service channels**
DLT panels can be placed with gaps between them to allow the creation of larger service channels. These channels can be left accessible from above, and can be covered from below with permanent infill panels. Alternatively the channels can be made accessible from below with removable infill panels, and permanently closed in from above.
DLT PROFILES
DLT panels which are singly curved perpendicular to the primary span direction are possible by using a unique moulded profile which allows the panel to curve into shape when set in place. Dowels are placed centrally in the panel, limiting the thickness of panels with which this technique works to between 4” and 10” panels. Radii should be kept above 10ft. More dramatically curved and warped panels are also possible using NLT, which we have done for several projects.

**Profiles**

- Dimensions
  - Length: up to 60.5ft (18.5m)
  - Width: up to 12 ft (3.75m) or wider, governed by shipping
  - Depth: up to 10in (0.25m)

- Species
  - Made with a variety of wood species, including SPF, Douglas Fir, Hem-fir, Sitka Spruce, and Western Red or Yellow Cedar

- Finishes
  - Planed, Band Sawn, Factory Sealed, or Stained
  - Custom finishes are available

- Structural
  - Single spans up to 60ft for roofs
DLT EXTERIOR DECKS and BALCONIES

As DLT panels perform well in exterior conditions, they can be used in exposed elements such as decks, balconies, bridge decks, canopies, or screens.

Incorporating a gap between boards prevents standing water and allows integration of runoff channels if required.

Treated lumber can be used as necessary for long-term performance, and wood species like AYC can be used in termite regions.
DLT WALLS

DLT panels can be used in exposed or hidden wall applications as both structural bearing and shear walls.

**Bearing Walls**
If DLT panels are used for bearing only, they do not require sheathing to either side and can be left exposed. They can be used as fire rated shaft walls, or simply as exposed architectural elements.

**Shear Walls**
DLT panels can be used as shear walls by sheathing one side with plywood or OSB. Design of these shear walls is simple using the standard shear wall design formulations in CSA O86 or AWC SDPWS 2015.