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Webinar Q&A

How to Use the Mass Timber Fastening Guide

1. Just to be sure, can you confirm again that all design values are based on modes III & IV?

The American version of the Mass Timber Fastening (MTF) design guide is composed of multiple types of connection. For most common connections utilized in shear walls and floor diaphragm, the design tables are created using fasteners yielding in mode IIIs and IV, when possible. These connections are identifiable by the notes under the table that indicate such yield modes. Here is an example of a common note under the design table: "Reference lateral design values presented in the table above provide failure mode IIIs or IV except if otherwise identified with an asterisk (*) in which case the failure mode is not IIIs or IV."

2. Are the design provisions for screws installed at an angle to grain in your design guide covered at all in the NDS?

For withdrawal application, NDS does not directly cover the self-tapping wood screws installed at an angle to grain. However, the ICC approval ESR-3178 does cover the installation of our fastener at an angle to the grain for withdrawal application.

The NDS does cover the different dowel embedment strength for the calculation of reference lateral design value at different wood grain angles, ex: fasteners installed parallel or perpendicular to the wood grain.

3. Any information regarding connections between mass timber and reinforced concrete?

Our Ricon and Megant hanger can be connected to concrete by expansion bolts or steel embed plate. Our MTBL and BSP-S angles can also be connected to concrete.

Our fasteners may also be utilized to create Timber Concrete Composite, more information may be found in this **white paper.**
For more connection details, the Mass Timber connection indice document by woodworks has typical mass timber connections.

4. For CLT panel to panel connections, what is the best connection to reduce floor vibration or a way to allow adjacent members to transfer vertical loads?

Floor vibration is determined by a series of factors including the mode of excitation, floor composition, floor layout (grid pattern/ span length), primary and secondary beam size and layout, just to name a few. The CLT panel-to-panel connection is just one component but to put simply, the butt joint may be designed to be the most rigid panel to panel connection. More information can be found in the research thesis on panel-to-panel connections with self-tapping screws by Kyle Sullivan (2017) and Afrin Hossain (2019).

WoodWorks recently released the U.S. Mass Timber Floor Vibration Design Guide which can be found on their website. Additionally, the ThinkWood website has a research library with several papers on CLT floor vibration.

5. To take advantage of predrilling, where can we find the required diameter for pre-drilling and the increase in capacity or edge distance?

Pre-drilling recommendations can be found in the **Structural Screw Design Guide** (page 40). Doing a complete pre-drilling allows the designer to utilize the lag screw geometry requirements, which are typically smaller than the requirements for self-tapping wood screws installed without pre-drilling. With or without pre-drilling the design values remain unchanged.

6. Could you go over the difference in spacing requirements of screw thru steel plate and only wood to wood?

There's no difference in spacing requirements as at least one of the members is wood. Spacing and Edge distance requirements can be found in the Structural Screw Design Guide and taken from the ICC-ESR, CCMC & ETA approval of the fasteners for installation without pre-drilling. For installation with pre-drilling of the wood member the lag screw geometry requirements may be utilized as seen in the NDS 2018 Cl. 12.5 and CSA O86:19 Cl. 12.6.2.

Note that in all cases, steel plates must be pre-drilled prior to the installation of our fasteners, as our fasteners are considered as self-tapping only through the timber portion of the connection.

7. If someone wants to see the technical reports, can we share them?

The technical reports (code approvals) can be found on our website under Resources **Code Approvals.**

8. Why is a plywood spline connection for CLT to CLT more common than the interlocked CLT option? Does one have more capacity then the other?

Plywood spline connection is typically the most economical connection as it generally involves less CNC machining hence less material wastage. Also, the interlocking (lap joint) connection involves more coordination in panel installation sequence and hence is more prone to due incorrect installation. The panel with the bottom lap should be installed first and top lap after.

Connection capacity i.e. lateral strength is based on the NDS yield equations (based on the European Yield Model) and is dependent on member species (specific gravity, G), thickness of members, screw diameter, length, and mechanical properties. Another factor is the screw orientation i.e. whether the screw is primarily loaded in shear or axially loaded in the case of inclined screws. More information can be found on our website under Resources > Technical Blogs. Our webinars on Lateral Connection Design and Basic and Advanced Theory & Behavior of Inclined Screws explains this well.

9. Are there any pre-engineered connections for facade attachment?

We have been involved in multiple projects where we assisted the design team with the creation of the facade attachment. We typically see our ASSY fasteners used in the façade connection to connect steel angles or plates to the wood members. For technical assistance, please reach out to support@mtcsolutions.com.

10. Is there any safety factor in Canada like the USA?

Canada uses Limit States Design (LSD) as specified in the CSA O68. This design methodology relies on a reliability analysis of the material and hardware utilized, which is then factored down to a factored design value. This value is then compared to the loads applied at the element, which are factored up based on the governing load combination.

The United States, on the other hand utilizes Allowable Stress Design (ASD), where minimum safety factors are built in the allowable design value of different building elements. The safety factor of these elements varies depending on the elements, for self-tapping wood screws, the NDS requires a minimum safety factor of 5. The allowable design value of the element is then compared to the design load applied.

11. Are the load directions defined relative to the panel face in the tables?

Yes, both our Structural Screw Design Guide and Structural Mass Timber Fastening Design Guide have tables with design values relative to the panel face i.e. parallel or perpendicular to wood grain. For laterally loaded connections, the grain direction is typically taken as the grain direction at the shear plane.

12. Do you have guides to make sure the diagonal screws are installed in the correct angles? Do the full thread screws require pre-drilling?

Yes, we do sell a 45deg Pre-drilling jig that may be utilised for steel to wood connection utilizing our wedge washers. See the following **blog post for more information.**

For wood-to-wood connection, installers typically fabricate a jig on-site made out of plywood. Suitable pilot holes are only required to set the angle and initiate installation, and so are only a few inches deep, even for long screws.

Our fully threaded screws have a self-drilling tip hence pre-drilling is not required. For very long fasteners installed into dense wood, pre-drilling or a pilot hole does help to reduce the drive-in torque on the fastener and helps eliminate screw damage or breakage. The installation of our fasteners at an angle without pre-drilling may be done by initiating short holes using the screws at 90°. Once the threads engage the wood enough to hold the screws in place, the angle of the screws is manually adjusted, usually by referencing a triangular framing square.

13) Have any of your screw connections been tested under fast impulsive dynamic loading other than seismic, such as for blast or progressive collapse? Do you recommend using the seismic dynamic testing values for this type of loading?

Our fasteners were utilized in the blast testing performed on CLT in 2016. More information on these tests may be found on the **Woodworks website.**

With that said, the fasteners do exhibit great ductile behavior and this has been proven from seismic testing. Connection resistance is affected by load duration and both NDS and CSA O86 addresses this with modification factors that may be found in the respective connection design chapters.

14. Do you have regional distributors?

We are the only North American distributor of ICC-ESR-approved ASSY structural fasteners and extensively tested pre-engineered KNAPP beam hanger systems for mass timber post-to-beam and girder-to-beam connections.

We ship and supply projects directly from our warehouse located in the pacific northwest for more than 10 years and have provided hardware for thousands of timber frame and mass timber buildings from Alaska to Florida.

For product availability, please reach out to our **sales team**.

15. How is MTC addressing the low R (3 or 3.5) value given to CLT shear walls in the latest ASCE 7-22 draft?

The R values affect the ASD design loads. The new proposed duration factor (Cd), listed in Table 12.2-1 of the SDPWS, changes the design values of the fastener connection. The time duration modification factor may be applied to the ASSY screws as outlined in the “Notes To The Designer” in our brochures.

16. For connections that are capacity protected, is it necessary to follow the minimum main member thickness of 50mm for screws d<10 and 100 for screws d>10?

The minimum member thicknesses should be respected in order to follow the requirements presented in our CCMC & ICC-ESR approvals. Requirements are not the same for laterally loaded screws and screws acting in withdrawal.

17. For deflection calculations, under SLS and ULS (seismic in particular), do you provide stiffness, along with capacities?

The stiffness of a connection is impacted by multiple parameters such as type of connection, wood density, diameter of the fastener, spacing and geometry between the fasteners in the connection. For this reason, it is not possible to provide this information for generic connections as the stiffness would be only valid between specific boundary conditions.

Some of our connectors in our connector design guide are presented with stiffness information.

18. What does NLT and DLT stand for?

Nail-laminated timber and Dowel-Laminated Timber.

19. Would one do anything different with LVL/MPP (Mass-plywood) than with CLT?

Depending on the orientation of the fasteners installed, LVL and MPP will be more prone to splitting between the glued veneers when larger diameter fasteners are installed into the grain i.e. end-grain or narrow edge installation. Pre-drilling is recommended to prevent splitting. For more information please contact support@mtcsolutions.com.

20. Any design aids for bracing or moment connections?

We do not have any aids specifically for brace or moment connections, but our screws have been specified many times for connections such as these. Inclined screws provided more fixity and axial resistance primarily due to the withdrawal strength of the screw. Our screws are also used to reinforce the knife or kerf connection to prevent perpendicular-to-grain splitting at the bolt connections. For more information please contact support@mtcsolutions.com.

21. Are the MT guides applicable to CLT only or do they include other panel types like NLT/DLT/GLT?

Our guides include other types of mass timber panels. CLT, though, is the most popular and researched mass timber panel material at the moment. For more information please contact support@mtcsolutions.com.

22. For PT screws can you speak a bit about the importance of getting the correct thread length relative to the joint interface? Do we spec a custom thread length as needed?

For the Partially threaded screws, it is good practice to design complete thread penetration into the main member. This provides the tightening effect on the side and main members from the screw threads and screw head. Additionally, the shank diameter may be used to calculate the lateral design/resistance values using the various Yield Equations found in the relevant code.

23. Can you clarify what coating(s) your fasteners use?

Surface coating of our ASSY carbon steel screws are either yellow chromate or zinc plated blue passivated coatings. ASSY stainless steel A2 screws have no additional surface coating.

24. Why do you use a partially threaded screw to position panels instead of a fully threaded one?

The partially threaded screws, with its smooth shank, enables the wood members to be pulled together due to the withdrawal strength of the screw threads and the screw head pull-through strength. Whereas fully threaded screws keep members tightly together. In other words, if there is a gap, or softer material such as non-rigid insulation, the gap will be maintained since the wood members are not pulled together but held in place.

See our Technical Blog on "**Partially Threaded VS Fully Threaded Screws**".

25. What is your preferred way of modelling CLT structures? stick frame model with reduced spring stiffness or plate models - and what software?

Woodworks and FPInnovations websites contain webinars and papers on CLT modeling. Additionally, there are a number of finite element analysis (FEA) software programs that can be used such as S-Timber by S-Frame.

26. For reduced spacing, do you need to predrill the entire length of the screw?

Correct, full penetration length pre-drilling is required for reduced spacing. See the Timber and CLT connection geometry requirements with pre-drilling holes tables found in the Structural Screw Design Guide.

27. Can you use OSB for the spline?

OSB may be used, however it might not be ideal. One of the extra factors to consider is that OSB is less permeable than plywood, hence it takes longer to dry out when wet. It also tends to swell more. Proper construction water-management measures should be in-place to ensure both the mass-timber panels and spline are kept relatively dry. Such measures include ensuring water is not allowed to pond and application of a surface coating to reduce water absorption. A building science engineer would be able to provide recommendations.

Additionally, OSB may be more prone to splitting than plywood depending on the strands orientation. In view of these reasons, plywood is typically utilized for spline connections.

28. I would like to see some seismic CLT and Glulam frame full scale testing references to give some confidence on the mode of collapse. I am very sensitive in the same way for precast concrete frames in seismic regions! Hope that is understandable.

Mass timber panels, such as CLT, is a relatively new product and a lot of research is currently being conducted. As for Progressive Collapse Analysis, this is a specialized field and deals with modeling and simulation by analysis software. More information about this can be found in the GSA Progressive Collapse Guidelines.

Additionally, in 2017 the National Hazards Engineering Research Infrastructure (NHERI) at University of California San Diego (UCSD) conducted a full-scale seismic shake table testing on a 2 storey structure. A 3 storey CLT building has been tested at NIED Tsukuba, Japan. A 7 storey CLT building has been tested at E-Defense, Japan. And a 10 storey mass timber building is scheduled to be tested by NHERI@UCSD in 2021. More information can be found by researching the aforementioned.

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