Disclaimer

The information in this document is for general information purposes. While we aim to keep the information provided in this document complete, accurate and in line with state-of-the-art design methods, we cannot make warranties of any kind.

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Connectors

Our Connectors are engineered to build essential mass timber systems such as diaphragms, composite floors and floor to wall systems.

MTC Solutions

General Notes to The Designer

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General information
Factored Resistances
Geometry Requirements
Detailing Section
MTB Testing

MTS 15 - Mass Timber Strap

General information
Factored Resistances
Geometry Requirements
Building Forests in the City

MEC Head Office
Vancouver, BC

MTC stands for Mass Timber Connections. We are a specialty supplier of connection solutions for modern mass timber applications in commercial, industrial and residential projects. We are proud to be working with the most innovative partners on cutting-edge projects across North America. Our goal is to see the wood construction industry thrive and help to maintain a low carbon footprint through education, research, and cost-effective approaches.

WE SUPPLY
MTC Solutions stocks more than 450 mass timber connection solutions ready for delivery throughout North America.

WE FUND
We do extensive research with leading North American universities to innovate Mass Timber Connection Solutions, reduce costs and extend the reach of mass timber in the market.

WE GUIDE
We offer free educational sessions on mass timber solutions in the form of webinars, technical learning sessions and event participation throughout North America.

WE EDUCATE
We provide the support needed to design efficient connection solutions. Our North American Support team is available to answer any design questions.
General Notes to The Designer

1. Factored resistances presented in this design guide were derived in accordance with the CSA-O86 and the ASTM standard D7147.

2. All suggestions and details shown are to be treated as general and cannot be assumed to be valid for all construction requirements and specific site conditions.

3. Factored resistances presented must be adjusted in accordance with all applicable adjustment factors as detailed in the CSA-O86:19, chapter 12.

4. Listed factored resistances apply to different timber species according to their respective mean relative densities (G) as per CSA-O86:19.

5. Connectors in combination with carbon steel fasteners are to be used in dry service conditions and temperature below 50°C such that $K_{sf}=1.0$ and $K_T=1.0$.

6. If splitting of the wood or wood-based material is observed during installation or prior to installation of the fasteners, a design professional must be contacted immediately, and appropriate measures must be taken. In case of fastener damage or breakage, a design professional must also be notified.

7. The designer must ensure that all possible stress limits in the wood members, such as the shear capacity, the rolling shear capacity of the Cross Laminated Timber (CLT) or other material properties, are not exceeded.

8. Connections must respect the geometry requirements as specified in the connection geometry requirements section of this guide.

9. Installation of the MTB or the MTS fasteners into voids, splits and gaps is to be avoided.
MTB - Mass Timber Bracket

The Mass Timber Brackets are engineered from thin 1.5 mm galvanized steel with a reinforced perimeter and are easily installed with ASSY self-tapping screws. The MTBs can withstand loads similar to thicker 3 mm steel brackets, providing a cost-effective solution.

Associated Hardware
Fasteners and Installation Tools

ASSY Ecofast 4.5 x 50 mm

Countersunk Head

AW 20 Bit

Applications

Wall to Floor
Floor to Wall
Wall to Wall
Table 1.1, F1 - Factored Lateral Resistance in CLT

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Fasteners</th>
<th>Factored Resistance [kN]</th>
<th>Estimated Modulus [kN/mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>F1 - Lateral Resistance</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Standard Loading</td>
<td>Short Term Loading</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[K_D = 1.0]</td>
<td>[K_D = 1.15]</td>
</tr>
<tr>
<td>90</td>
<td>Ecofast 4.5 x 50</td>
<td>6.7</td>
<td>7.7</td>
</tr>
<tr>
<td>105</td>
<td>Ecofast 4.5 x 50</td>
<td>6.8</td>
<td>7.9</td>
</tr>
</tbody>
</table>

Notes:
1. See detailed notes under table 2.2, page 7.

Table 2.2, F1 - Estimated Ultimate Lateral Resistance in CLT

<table>
<thead>
<tr>
<th>Angle Bracket</th>
<th>Fasteners</th>
<th>Ultimate Resistance [kN]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>F1 - Lateral Resistance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Estimated 5th Percentile</td>
</tr>
<tr>
<td>90</td>
<td>Ecofast 4.5 x 50</td>
<td>10.1</td>
</tr>
<tr>
<td>105</td>
<td>Ecofast 4.5 x 50</td>
<td>10.4</td>
</tr>
</tbody>
</table>

Table 2.1, F4 - Factored Uplift Resistance in CLT

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Fasteners</th>
<th>Factored Resistance [kN]</th>
<th>Estimated Modulus [kN/mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>F4 - Uplift Resistance</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Standard Loading</td>
<td>Short Term Loading</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[K_D = 1.0]</td>
<td>[K_D = 1.15]</td>
</tr>
<tr>
<td>90</td>
<td>Ecofast 4.5 x 50</td>
<td>6.3</td>
<td>7.2</td>
</tr>
<tr>
<td>105</td>
<td>Ecofast 4.5 x 50</td>
<td>6.0</td>
<td>6.9</td>
</tr>
</tbody>
</table>

Table 2.2, F4 - Estimated Ultimate Uplift Resistance in CLT

<table>
<thead>
<tr>
<th>Angle Bracket</th>
<th>Fasteners</th>
<th>Ultimate Resistance [kN]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>F4 - Uplift Resistance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Estimated 5th Percentile</td>
</tr>
<tr>
<td>90</td>
<td>Ecofast 4.5 x 50</td>
<td>10.5</td>
</tr>
<tr>
<td>105</td>
<td>Ecofast 4.5 x 50</td>
<td>10.2</td>
</tr>
</tbody>
</table>

Notes:
1. Factored resistances listed are only valid for Limit State Design in the Canada.
2. Factored resistances listed are only valid for listed ASSY screws.
3. The estimated slip modulus were derived from cyclic loading, in accordance with the EEEP method as detailed in ASTM E216-11.
4. The ultimate resistance values at 5th and 95th percentile were derived based on at least 12 brackets tested in each loading orientation, in accordance with the EN 14358 standard and CSA-O86:14, chapter 11.
5. The maximum installation torque for the 4.5 mm diameter ASSY Ecofast screws is 3.4 N.m.
### Table 3.2, F2 - Factored Withdrawal Resistance in CLT

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Fasteners</th>
<th>F2 - Withdrawal Resistance [kN]</th>
<th>Estimated Slip Modulus [kN / mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Standard Loading ( K_D = 1.0 )</td>
<td>Short Term Loading ( K_D = 1.15 )</td>
</tr>
<tr>
<td>Angle Bracket</td>
<td>Relative Density</td>
<td>Type</td>
<td>Quantity</td>
</tr>
<tr>
<td>90</td>
<td>0.42 (SPF)</td>
<td>Ecofast</td>
<td>20</td>
</tr>
<tr>
<td>105</td>
<td></td>
<td>4.5 x 50</td>
<td>26</td>
</tr>
</tbody>
</table>

### Table 3.2, F2 - Estimated Ultimate Withdrawal Resistance in CLT

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Fasteners</th>
<th>F2 - Estimated Withdrawal Resistance [kN]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Estimated 5(^\text{th}) Percentile</td>
</tr>
<tr>
<td>Angle Bracket</td>
<td>Relative Density</td>
<td>Type</td>
</tr>
<tr>
<td>90</td>
<td>0.42 (SPF)</td>
<td>Ecofast</td>
</tr>
<tr>
<td>105</td>
<td></td>
<td>4.5 x 50</td>
</tr>
</tbody>
</table>

Notes:
1. See detailed notes under table 4.2, page 8.

### Table 4.1, F3 - Factored Compression Resistance in CLT

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Fasteners</th>
<th>F3 - Compression Resistance [kN]</th>
<th>Estimated Slip Modulus [kN / mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Standard Loading ( K_D = 1.0 )</td>
<td>Short Term Loading ( K_D = 1.15 )</td>
</tr>
<tr>
<td>Angle Bracket</td>
<td>Relative Density</td>
<td>Type</td>
<td>Quantity</td>
</tr>
<tr>
<td>90</td>
<td>0.42 (SPF)</td>
<td>Ecofast</td>
<td>20</td>
</tr>
<tr>
<td>105</td>
<td></td>
<td>4.5 x 50</td>
<td>26</td>
</tr>
</tbody>
</table>

### Table 4.2, F3 - Estimated Ultimate Compression Resistance in CLT

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Fasteners</th>
<th>F3 - Estimated Compression Resistance [kN]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Estimated 5(^\text{th}) Percentile</td>
</tr>
<tr>
<td>Angle Bracket</td>
<td>Relative Density</td>
<td>Type</td>
</tr>
<tr>
<td>90</td>
<td>0.42 (SPF)</td>
<td>Ecofast</td>
</tr>
<tr>
<td>105</td>
<td></td>
<td>4.5 x 50</td>
</tr>
</tbody>
</table>

Notes:
1. Factored resistances listed are only valid for Limit State Design in the Canada.
2. Factored resistances listed are only valid for listed ASSY screws.
3. The estimated slip modulus were derived from cyclic loading, in accordance with the EEEP method as detailed in ASTM E216-11.
4. The ultimate resistance values at 5th and 95th percentile were derived based on at least 12 brackets tested in each loading orientation, in accordance with the EN 14358 standard and CSA-O86:14, chapter 11.
5. The maximum installation torque for the 4.5 mm diameter ASSY Ecofast screws is 3.4 N\(\cdot\)m.
6. All connection design must meet all relevant requirements of the Notes to the Designer section, page 5.
7. Connector placement must respect the requirements presented in the MTB Geometry Requirements Section, page 9.
8. The MTB were tested in monotonic and reverse cyclic loading configurations.
9. For the MTB 105, the reference design values presented in this guide assume side B is always perpendicular to the load direction F4 and parallel to the load directions F2 and F3. The load direction F1 is independent of install direction. See page 9.
MTB - Geometry Requirements

Notes:
1. All dimensions provided in this section are in mm.
2. Distances \( a \) are minimum end distances.
3. Distances \( e \) are minimum edge distances.

MTB 90
Front View

MTB 105
Front View

MTB - Detailing Section

MTB 90

MTB 105

Side A

Bracket Thickness = 1.5
Perimeter Thickness = 3

Side B

\( \varnothing = 5 \)

\( \varnothing = 13 \)

Notes:
1. All 5 mm holes are to be filled.
2. All dimensions provided in this section are in mm.
3. For the MTB 105, the reference design values presented in this guide assume side B is always perpendicular to the load direction F4 and parallel to the load directions F2 and F3. The load direction F1 is independent of install direction.
MTB Testing

MTB - Data Analysis

The load-displacement graphs presented in this section show hysteresis loops and envelope curves. They have been recorded during our research project and have been selected to show an average result from a set of tests. The envelope curves were obtained from the hysteresis loop created by the reverse cyclic tests.

For the reverse cyclic test, ASTM E2126 was followed to analyze the results. Analysis has shown that the MTB angle brackets have an average ductility ratio of 3 or more in all loading directions following the Equivalent Energy Elastic-Plastic (EEEP) method in both monotonic and cyclic loading conditions.

F1 - Lateral Load / Displacement Curves in CLT

Notes:
1. The MTBs were tested in monotonic and reverse cyclic loading configurations.
2. Graphs shown represent an average result recorded in the tests.
MTB - Data Analysis

The witnessed failure modes varied depending on loading direction, however, ductile steel failure and ductile screw yielding were the prevalent failure modes observed. In load directions F1 Lateral and F3 Compression, steel yielding was recorded. In load directions F2 Withdrawal and F4 Uplift, both screw withdrawal and steel yielding was observed.

Throughout the testing, it was observed that the MTB 90 and the MTB 105 performed similarly in a variety of selected test setups. This result is due to similarities in the design of each MTB with respect to hole patterns and the amount and location of fasteners on each leg.

1. The MTBs were tested in monotonic and reverse cyclic loading configurations.
2. Graphs shown represent an average result recorded in the tests.
MTS 15 - Mass Timber Strap

The brand-new Mass Timber Strap 15 is a tested high capacity connector, designed for mass timber elements. MTC’s new solution for tension applications uses strong code approved ASSY self-tapping screws for fast and easy installation.

Associated Hardware
Fasteners and Installation Tools

ASSY Kombi Fully Threaded 12 x 160 mm
Hexagonal Head

17 mm Magnetic Socket
Specified Magnetic Socket Bit for Installation

Applications

Opening Reinforcing Strap
Wall Strap
Diaphragm Strap
### Table 1, Tested Factored Lateral Resistance in CLT

<table>
<thead>
<tr>
<th>CLT Panel &amp; Plate Configuration</th>
<th>Fasteners</th>
<th>Factored Resistance [kN]</th>
<th>Estimated Slip Modulus [kN / mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 PLY + Z</td>
<td>SPF (0.42)</td>
<td>≥ 175 ASSY Kombi Fully Threaded 12 x 160 24</td>
<td>100</td>
</tr>
</tbody>
</table>

**Notes:**
1. Listed factored lateral resistances are derived in accordance with the CSA-086, 2019 edition.
2. Factored resistances listed are only valid for listed ASSY screws.
3. All connection design must meet all relevant requirements of the Notes to the Designer section, page 5.
5. Shall pre-drilling be required, a 1/4" diameter drill bit may be used for pre-drilling.
6. The maximum installation torque for the 12 mm diameter ASSY Kombi screws is 47 N.m.

### MTS 15 - Geometry Requirements

**Diaphragm Strap Installation**
**Top View**

**Wall Strap Installation**
**Front View**

**Notes:**
1. All geometry requirements are in accordance with the testing performed.
2. All dimensions provided in this section are in mm.
3. Distances "a" are minimum end distances.
4. Distances "e" are minimum edge distances.
MTC Solutions provides sustainable, high quality mass timber connection solutions to a rapidly evolving and thriving industry. We drive innovation through certified research and development and contribute our part to the education of young talent and experienced professionals in the technology used in sustainable design.