Lifting and Handling CLT Elements

FPInnovations
Advanced Building Systems

Sylvain Gagnon, Eng.
Associate Research Leader
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Seattle

Outline

• Transportation of CLT Elements
• Slinging and Fastening Systems
• Lifting Station and Devices
• General Principles for Lifting and Handling
• Accessories and Materials

Please refer to the applicable U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) for more information

Wood-Based Building Solutions

Wood Building Systems

Light Frame  Post & Beam  Massive/CLT  Hybrid

U.S. CLT Handbook
Transportation

Transporting CLT panels can:

- be costly
- require specialized transportation services
- involve the design professional, the contractor/erector and the CLT manufacturer

The emerging CLT construction industry offers various techniques for lifting and handling CLT panels so that they can be used in the erection of buildings and other structures.
Transportation

Designers and contractors must ensure that the route from the plant to the construction site will allow movement of the truck, including its load, without any obstacles being in place that would interfere with the transport of the CLT panels…

- working in conjunction with the CLT manufacturer and their selected transport company

Slinging and Fastening Systems

Parallel with Precast Concrete Industry
Contact Lifting Systems

Steel Rod

Screw Hoist Lifting Systems

Lag Screws or Self Tapping Screws

Anchor and Self Tapping Screws
Screw Hoist Lifting Systems

Lifting loop with threaded sleeve or Threaded eyelet bolt (with base) used with double-threaded socket

Wood Screw System With or Without Recess

Lifting Station and Devices

• Be able to lift all required loads for the duration of construction:
  ✓ Types of loads may vary on the same construction site;
  ✓ If possible, the lifting device should not be moved. However, the lifting device should be capable of being moved as jobsite and erection conditions require;
• Reach appropriate height and distance with required maximum load:
  ✓ Appropriate range must be attained for all required distances, from point A to point B;
  ✓ The travel path of the element to be lifted to reach the desired location must be clear of any obstacles;
• Be efficient, be able to maintain the needed working pace and be flexible, while keeping safety first.
General Principles

Coefficient of Lifting Angle ($\beta$)

<table>
<thead>
<tr>
<th>Cable Angle $\beta$ $^{(1)}$</th>
<th>Angle $\alpha$ $^{(2)}$</th>
<th>Angle Coefficient $z$ $^{(3)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°</td>
<td>0°</td>
<td>1.000</td>
</tr>
<tr>
<td>7.5°</td>
<td>15°</td>
<td>1.069</td>
</tr>
<tr>
<td>15°</td>
<td>30°</td>
<td>1.035</td>
</tr>
<tr>
<td>22.5°</td>
<td>45°</td>
<td>1.082</td>
</tr>
<tr>
<td>30°</td>
<td>60°</td>
<td>1.155</td>
</tr>
<tr>
<td>37.5°</td>
<td>75°</td>
<td>1.260</td>
</tr>
<tr>
<td>45°</td>
<td>90°</td>
<td>1.414</td>
</tr>
<tr>
<td>52.5°</td>
<td>105°</td>
<td>1.643</td>
</tr>
<tr>
<td>60°</td>
<td>120°</td>
<td>2.000</td>
</tr>
</tbody>
</table>

(1) It is strongly recommended to limit $\beta$ to 30°
(2) $\alpha = 2 \times \beta$
(3) $z = 1 / \cos \beta$

It is recommended to limit the angle $\beta$ to 30°.

General Principles

$$F_i = \frac{F_{tot} \times f \times z}{N}$$

where:

$F_i =$ Resultant anchor force (lb.)
$F_{tot} =$ Total weight of assembly to be lifted (lb.)
$f =$ Dynamic acceleration factor (Table 1)
$z =$ Angle coefficient (Table 2)
$N =$ Number of effective anchors (see Figures)
Dynamic Acceleration Factor (f)

Please refer to the applicable U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) for more information

<table>
<thead>
<tr>
<th>Lifting Device</th>
<th>Dynamic Coefficient of Acceleration (f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed crane</td>
<td>1.1 ~ 1.3</td>
</tr>
<tr>
<td>Mobile crane</td>
<td>1.3 ~ 1.4</td>
</tr>
<tr>
<td>Bridge crane</td>
<td>1.2 ~ 1.6</td>
</tr>
<tr>
<td>Lifting and moving on flat terrain</td>
<td>2.0 ~ 2.5</td>
</tr>
<tr>
<td>Lifting and moving on rough terrain</td>
<td>3.0 ~ 4.0 and +</td>
</tr>
</tbody>
</table>

General Principles

- It is recommended not to use excessively long slings so as to avoid instability or to create high angles when lifting.
- If assemblies that require lifting and handling are too long, the use of a spreader system might be a better option, as it will limit the length of the slings.
- If anchors are not symmetrical to the center of gravity, the resultant forces must be adjusted by using the appropriate static equations.
- Other effects such as wind may significantly influence load movement on lifting systems.
- If the same lifting system if used more than once during the same handling/lifting operation, it may be necessary to adjust the allowable anchor capacity to account for previous stressing of the system.

Number of Effective Anchors (N)

- Compensation System

<table>
<thead>
<tr>
<th>Number of effective anchors = 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of effective anchors = 4</td>
</tr>
</tbody>
</table>

Accessories and Materials

Sealing joint between floors, walls, and connectors:
- reduce sound transmission;
- protection against fire and hot combustion gasses;
- Improve energy efficiency by reducing heat loss and by limiting air flow.
Accessories and Materials

Adjustable steel shoring

Beam grip with ratchet and hooks

Manual winch with cables or slings

• Used to bring the CLT panels together once they are supported and juxtaposed.

Lifting and Handling
CLT Elements

Thank You