CLT Buildings Sound Insulation

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Introduction

Airborne Sound and Impact Sound

- Airborne Sound:
  Examples: - Talking
            - Music

- Impact Sound (Structure-borne Sound):
  Examples: - Foot-steps impact of walking, jumping on a floor
            - Hammer impact on a floor or a wall

Scope

- The assemblies separating adjacent spaces:
  - Common interior walls
  - Partitions
  - Floor/ceiling assemblies

Flanking Transmission

- Direct sound transmission paths:
  - Walls
  - Partitions
  - Floor/ceiling assemblies

- Flanking transmission: Not through the direct paths such as
  - Leaks
  - Junctions of wall/floor or ceiling/wall
  - More to learn
Introduction

Classify Sound Insulation of Building Assembly without Flanking

- STC (Sound Transmission Class)
  - Airborne sound insulation of walls or floor/ceiling assemblies

- IIC (Impact Insulation Class)
  - Impact sound insulation of floor/ceiling assemblies

Classify Sound Insulation of Building Assembly in Field with Flanking

- FSTC (Field Sound Transmission Class)
  - Airborne sound insulation of walls or floor/ceiling assemblies in real buildings with flanking

- FIIC (Field Impact Insulation Class)
  - Impact sound insulation of floor/ceiling assemblies in real buildings with flanking

FSTC < STC, FIIC < IIC

Introduction

Code Requirements – e.g. IBC

<table>
<thead>
<tr>
<th>Number of layers</th>
<th>Thickness (in.)</th>
<th>Assembly type</th>
<th>STC</th>
<th>IIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3-3/4 to 4-1/2</td>
<td>Wall</td>
<td>32-34</td>
<td>N.A.</td>
</tr>
<tr>
<td>5</td>
<td>5-1/3</td>
<td>Floor</td>
<td>39</td>
<td>23</td>
</tr>
<tr>
<td>5</td>
<td>5-3/4</td>
<td>Floor</td>
<td>39</td>
<td>24</td>
</tr>
</tbody>
</table>

Measured on field bare CLT wall and floor

<table>
<thead>
<tr>
<th>Number of layers</th>
<th>Thickness (in.)</th>
<th>Assembly type</th>
<th>STC</th>
<th>FIIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>4-1/8</td>
<td>Wall</td>
<td>28</td>
<td>N.A.</td>
</tr>
<tr>
<td>7</td>
<td>8-1/5</td>
<td>Floor</td>
<td>N.A.</td>
<td>25-30</td>
</tr>
</tbody>
</table>
CLT Wall and Floor Sound Insulation Design

Essential Knowledge – Principle for Good Sound Insulation Design

- Sufficient mass
- Soft surface of floor finishing
- Floating topping and finishing
- Suspended drywall ceiling
- Decouple
- Discontinue

Essential Knowledge – Human Perception to Sound Pressure Level Change

3dB change in sound pressure level is just perceivable

Important rule for the development of cost-effective solutions!

Design Examples for >50 STC Walls

- STC 50:
  1 and 3 = 4-1/2 in. CLT; 2 = 1-1/8 in. Mineral wool in the gap
- STC 55:
  Adding 5/8 in. gypsum board directly to both sides
- STC 60:
  with the gypsum boards and double the thickness of the gap and mineral wool

Design Examples for >50 STC and IIC Floors

<table>
<thead>
<tr>
<th>End view of cross-section</th>
<th>Floor detail</th>
<th>STC</th>
<th>IIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 5-layer CLT panel of 5-3/4”</td>
<td>64</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>2. Sound isolation clips of 4” high</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Metal hat channel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Sound absorption material (such as glass fibre) of 4”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Gypsum board of 1/2”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Gypsum board of 1/2”</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Increase the thickness of the gypsum board to 5/8”

63 | 62
### Design Examples for >45 FSTC Walls

<table>
<thead>
<tr>
<th>Top view of cross-section</th>
<th>Wall detail</th>
<th>FSTC</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Top view of cross-section" /></td>
<td>1 &amp; 5 = 5/8” Gypsum board 2 &amp; 4 = Resilient channels at 24” o.c. 3. 5-layer CLT of 7-1/4”</td>
<td>46</td>
</tr>
<tr>
<td><img src="image2" alt="Top view of cross-section" /></td>
<td>1 &amp; 7 = 5/8” Gypsum board 2 &amp; 6 = Resilient channels at 24” o.c. 3 &amp; 5 = 3-layer CLT of 3.07” 4 = 1” air gap filled with mineral wool</td>
<td>47</td>
</tr>
</tbody>
</table>

### Design Examples for >45 FSTC and FIIC Floors

<table>
<thead>
<tr>
<th>End view of cross-section</th>
<th>Floor detail</th>
<th>FSTC</th>
<th>FIIC</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="End view of cross-section" /></td>
<td>1 = Carpet, or floating flooring about 2/5” on 1/8” resilient underlayment of 0.16 to 0.37 lb./ft.$^2$ 2 = At least 5.12 lb./ft.$^2$ dry topping, e.g. 0.8-1” gypsum board, cement fibreboard 3 = Resilient underlayment, e.g. 2/5” rubber mat of 0.84 lb./ft.$^2$, 1/6” texture felt of 0.27 lb./ft.$^2$, 1/2” low density wood fibreboard of 0.73 lb./ft.$^2$ 4 = 5-layer CLT of 6-7/8”</td>
<td>~45</td>
<td>~45</td>
</tr>
<tr>
<td><img src="image4" alt="End view of cross-section" /></td>
<td>Replace the dry topping by wet topping, e.g. 1 5/8” concrete of at least 15.6 lb./ft.$^2$</td>
<td>~50</td>
<td>~50</td>
</tr>
</tbody>
</table>

- Replace 1) by hardwood flooring nailed to 3/4” plywood  
- Replace 2) by thick resilient underlayment, e.g. 2/5” rubber mat of 0.84 lb./ft.$^2$, 1/6” texture felt of 0.27 lb./ft.$^2$, 1/2” low density wood fibreboard of 0.73 lb./ft.$^2$  
- Replace 1) by ceramic tile glued to 1/2” and 1/4” plywood  
- Replace 2) by thick resilient underlayment, e.g. 2/5” rubber mat of 0.84 lb./ft.$^2$, 1/6” texture felt of 0.27 lb./ft.$^2$, 1/2” low density wood fibreboard of 0.73 lb./ft.$^2$
**Best Practice**

Minimizing Flanking – Pay Attention to Details otherwise the Sound Insulation Performance of the Design Examples Will No Be Achieved!

- Seal the leakages and gaps
- Decouple
- Discontinue

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**Best Practice**

For Occupants’ Satisfaction

- FSTC >50
- FIIC >50

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**Best Practice**

Conduct Field Inspection on Completed Building

- Measure the FSTC and FIIC
- Conduct your own subjective evaluation of the sound insulation performance if you are the builder, or the design engineer, or the architect

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**Conclusion**

With proper design and installation, CLT buildings can achieve satisfactory sound insulation and be cost-effective
Recommendation

Journey began,
Continue the journey with us

Questions & Answers

Thank you!

Contact

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