Servicing Occupant Needs: MEP Integration & Acoustics

Presented by
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 MEP Layout & Integration
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Set Realistic Owner Expectations About Aesthetics
• MEP fully exposed with MT structure, or limited exposure?
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Key considerations:
• Level of exposure desired
• Floor to floor, structure depth & desired head height
• Building occupancy and configuration (i.e. central core vs. double loaded corridor)
• Grid layout and beam orientations
• Need for future tenant reconfiguration
• Impact on fire & structural design: concealed spaces, penetrations

Credit: WoodWorks
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Smaller grid bays at central core (more head height)
- Main MEP trunk lines around core, smaller branches in exterior bays

Credit: Blaine Brownell
Credit: WoodWorks
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- Smaller grid bays at central core
- Main MEP trunk lines around core
- Smaller branches in exterior bays

Credit: ARUP
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Grid impact: Relies on one-way beam layout. Columns/beams spaced at panel span limits in one direction.

Beam penetrations are minimized/eliminated

Recall typical panel span limits:

<table>
<thead>
<tr>
<th>Panel</th>
<th>Example Floor Span Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-ply CLT (4-1/8&quot; thick)</td>
<td>Up to 12 ft</td>
</tr>
<tr>
<td>5-ply CLT (6-7/8&quot; thick)</td>
<td>14 to 17 ft</td>
</tr>
<tr>
<td>7-ply CLT (9-5/8&quot;)</td>
<td>17 to 21 ft</td>
</tr>
<tr>
<td>2x4 NLT</td>
<td>Up to 12 ft</td>
</tr>
<tr>
<td>2x6 NLT</td>
<td>10 to 17 ft</td>
</tr>
<tr>
<td>2x8 NLT</td>
<td>14 to 21 ft</td>
</tr>
<tr>
<td>5&quot; MPP</td>
<td>10 to 15 ft</td>
</tr>
</tbody>
</table>

Credit: Hacker Architects
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Dropped below MT framing
• Can simplify coordination (fewer penetrations)
• Bigger impact on head height
Grid impact: Usually more efficient when using a square-ish grid with beams in two directions

Credit: SOM Timber Tower Report
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In penetrations through MT framing
- Requires more coordination (penetrations)
- Bigger impact on structural capacity of penetrated members
- Minimal impact on head height
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In chases above beams and below panels
- Fewer penetrations
- Bigger impact on head height (overall structure depth is greater)
- FRR impacts: top of beam exposure
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In chases above beams and below panels at Platte 15
- 30x30 grid, purlins at 10 ft, 3-ply CLT

Credit: KL&A Engineers & Builders

Credit: JC Buck
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In chases above beams and below panels at Catalyst
- 30x30 grid, 5-ply CLT ribbed beam system
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In gaps between MT panels
• Fewer penetrations, can allow for easier modifications later
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In gaps between MT panels

• FRR impacts: generally topping slab relied on for FRR
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In gaps between MT panels

- Impact on assembly acoustics performance
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In gaps between MT panels
• Greater flexibility in MEP layout
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In gaps between MT panels
• Aesthetics: often uses ceiling panels to cover gaps
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In raised access floor (RAF) above MT
- Aesthetics (minimal exposed MEP)
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In raised access floor (RAF) above MT
- Impact on head height
- Concealed space code provisions
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In topping slab above MT
• Greater need for coordination prior to slab pour
• Limitations on what can be placed (thickness of topping slab)
• No opportunity for renovations later
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Consider Impacts of:
• Timber & Topping Thickness
• Panel Layout
• Gapped Panels
• Connections & Penetrations
• MEP Layout & Type
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Acoustics & Sound Control

**Air-Borne Sound:**

**Sound Transmission Class (STC)**
- Measures how effectively an assembly isolates air-borne sound and reduces the level that passes from one side to the other
- Applies to walls and floor/ceiling assemblies
Structure-Borne sound: Impact Insulation Class (IIC)

- Evaluates how effectively an assembly blocks impact sound from passing through it
- Only applies to floor/ceiling assemblies
Code requirements only address residential occupancies:

For unit to unit or unit to public or service areas:

Min. STC of 50 (45 if field tested):
• Walls, Partitions, and Floor/Ceiling Assemblies

Min. IIC of 50 (45 if field tested) for:
• Floor/Ceiling Assemblies
# Acoustics & Sound Control

<table>
<thead>
<tr>
<th>STC</th>
<th>What can be heard</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>Normal speech can be understood quite easily and distinctly through wall</td>
</tr>
<tr>
<td>30</td>
<td>Loud speech can be understood fairly well, normal speech heard but not understood</td>
</tr>
<tr>
<td>35</td>
<td>Loud speech audible but not intelligible</td>
</tr>
<tr>
<td>40</td>
<td>Onset of &quot;privacy&quot;</td>
</tr>
<tr>
<td>42</td>
<td>Loud speech audible as a murmur</td>
</tr>
<tr>
<td>45</td>
<td>Loud speech not audible; 90% of statistical population not annoyed</td>
</tr>
<tr>
<td>50</td>
<td>Very loud sounds such as musical instruments or a stereo can be faintly heard; 99% of population not annoyed.</td>
</tr>
<tr>
<td>60+</td>
<td>Superior soundproofing; most sounds inaudible</td>
</tr>
</tbody>
</table>
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MT: Structure Often is Finish

Photos: Baumberger Studio/PATH Architecture/Marcus Kauffman | Architect: Kaiser + PATH
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But by Itself, Not Adequate for Acoustics
### TABLE 1:
Examples of Acoustically-Tested Mass Timber Panels

<table>
<thead>
<tr>
<th>Mass Timber Panel</th>
<th>Thickness</th>
<th>STC Rating</th>
<th>IIC Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-ply CLT wall</td>
<td>3.07&quot;</td>
<td>33</td>
<td>N/A</td>
</tr>
<tr>
<td>5-ply CLT wall</td>
<td>6.875&quot;</td>
<td>38</td>
<td>N/A</td>
</tr>
<tr>
<td>5-ply CLT floor</td>
<td>5.1875&quot;</td>
<td>39</td>
<td>22</td>
</tr>
<tr>
<td>5-ply CLT floor</td>
<td>6.875&quot;</td>
<td>41</td>
<td>25</td>
</tr>
<tr>
<td>7-ply CLT floor</td>
<td>9.65&quot;</td>
<td>44</td>
<td>30</td>
</tr>
<tr>
<td>2x4 NLT wall</td>
<td>3-1/2&quot; bare NLT 4-1/4&quot; with 3/4&quot; plywood</td>
<td>24 bare NLT 29 with 3/4&quot; plywood</td>
<td>N/A</td>
</tr>
<tr>
<td>2x6 NLT wall</td>
<td>5-1/2&quot; bare NLT 6-1/2&quot; with 3/4&quot; plywood</td>
<td>22 bare NLT 31 with 3/4&quot; plywood</td>
<td>N/A</td>
</tr>
<tr>
<td>2x6 NLT floor + 1/2&quot; plywood</td>
<td>6&quot; with 1/2&quot; plywood</td>
<td>34</td>
<td>33</td>
</tr>
</tbody>
</table>

*Source: Inventory of Acoustically-Tested Mass Timber Assemblies, WoodWorks"
Regardless of the structural materials used in a wall or floor ceiling assembly, there are 3 effective methods of improving acoustical performance:

1. Add mass
2. Add noise barriers
3. Add decouplers
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What does this look like in typical wood-frame construction:

1. Add mass
2. Add noise barriers
3. Add decouplers
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Mass timber has relatively low “mass”
Recall the three ways to increase acoustical performance:

1. Add mass
2. Add noise barriers
3. Add decouplers
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Concrete Slab:
- 6” Thick
- 80 PSF
- STC 53

CLT Slab:
- 6-7/8” Thick
- 18 PSF
- STC 41
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There are three main ways to improve an assembly’s acoustical performance:

1. Add mass
2. Add noise barriers
3. Add decouplers
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There are three main ways to improve an assembly’s acoustical performance:

1. Add mass
2. Add noise barriers
3. Add decouplers

**Acoustical Mat:**
- Typically roll out or board products
- Thicknesses vary: Usually $\frac{1}{4}”$ to $1”+$

Credit: Maxxon
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Acoustical floor underlayments

Photo: AcoustiTECH

Photo: Kinetics Noise Control, Inc.

Photo: Maxxon Corporation

Photo: Piteq Inc.
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Common mass timber floor assembly:
- Finish floor (if applicable)
- Underlayment (if finish floor)
- 1.5” to 4” thick concrete/gypcrete topping
- Acoustical mat
- WSP (if applicable)
- Mass timber floor panels

Credit: AcoustiTECH
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Solutions Paper

Acoustics and Mass Timber: Room-to-Room Noise Control

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Inventory of Acoustically Tested Mass Timber Assemblies

Following is a list of mass timber assemblies that have been acoustically tested as of March 16, 2022. Sources are noted at the end of this document. For free technical assistance on any questions related to the acoustical design of mass timber assemblies, or free technical assistance related to any aspect of the design, engineering or construction of a commercial or multi-family wood building in the U.S., email help@woodworks.org or contact the WoodWorks Regional Director nearest you: http://www.woodworks.org/project-assistance

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https://www.woodworks.org/resources/inventory-of-acoustically-tested-mass-timber-assemblies/
# Inventory of Tested Assemblies

**Table 1: CLT Floor Assemblies with Concrete/Gypsum Topping, Ceiling Side Exposed**

<table>
<thead>
<tr>
<th>CLT Panel</th>
<th>Concrete/Gypsum Topping</th>
<th>Acoustical Mat Product Between CLT and Topping</th>
<th>Finish Floor</th>
<th>STC</th>
<th>IIC</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLT 3-ply (3.5&quot;)</td>
<td>3&quot; concrete</td>
<td>Maxxion Acousti-Mat® 3/4</td>
<td>None</td>
<td>53</td>
<td>45</td>
<td>72</td>
</tr>
<tr>
<td>2&quot; concrete</td>
<td>Plytec GenieMat™ FF25</td>
<td></td>
<td>None</td>
<td>54</td>
<td>44</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LVT on GenieMat RST05</td>
<td>53</td>
<td>48</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Eng Wood on GenieMat RST05</td>
<td>53</td>
<td>46</td>
<td>91</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Carpet Tile</td>
<td>52</td>
<td>50</td>
<td>92</td>
</tr>
<tr>
<td>CLT 3-ply (4.125&quot;)</td>
<td>3&quot; concrete</td>
<td>Kinetics® R/I-M-33L-2-24 System with ¾&quot; Plywood</td>
<td>None</td>
<td>57</td>
<td>45</td>
<td>103</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LVT</td>
<td>-</td>
<td>58</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 layers of ¾&quot; USG Fiberock® on Kinetics® Soundmatt</td>
<td>55</td>
<td>55</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LVT on 2 layers of ¾&quot; USG Fiberock® on Kinetics® Soundmatt</td>
<td>-</td>
<td>59</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>None</td>
<td>57</td>
<td>46</td>
<td>107</td>
</tr>
</tbody>
</table>
Questions? Ask us anything