

# ACOUSTIC PERFORMANCE AND DESIGN OF WOOD CONSTRUCTIONS

Presented by:

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Acoustic Consulting

Sydney

# BCA History of Sound Insulation

Before we look at lightweight and mass timber constructions it's important to review the history of the BCA sound insulation code and its limitations today



# BCA History of Sound Insulation

The goal of the BCA is to *“enable the achievement of nationally consistent, minimum necessary standards”*



# BCA History of Sound Insulation

*BCA Part F5 Sound insulation:*

*“provide insulation against the transmission of airborne and impact generated sound sufficient to prevent illness or loss of amenity to the occupants”.*



# BCA History of Sound Insulation

Pre 2004:

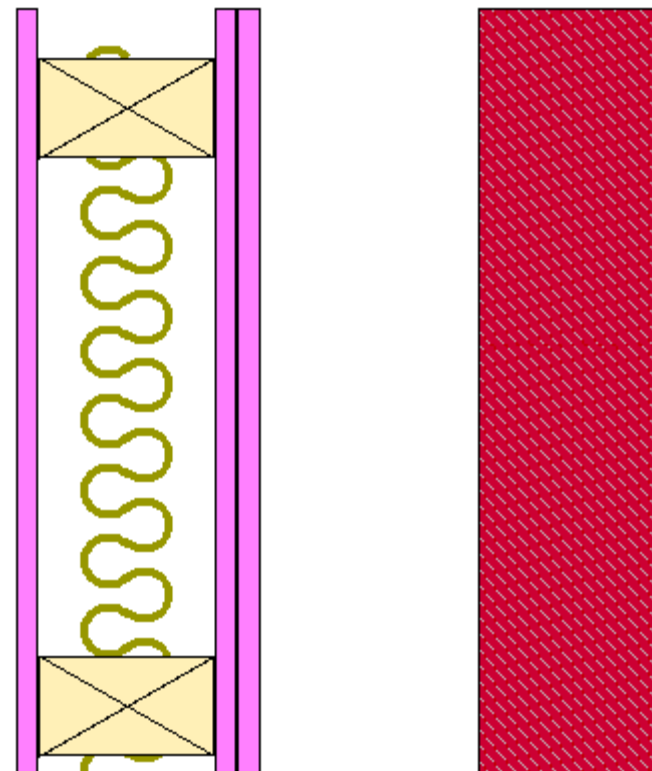
- Airborne:  $STC \geq 45$

Walls:

Single stud

Rendered brickwork

Noise complaints were common



# BCA History of Sound Insulation

Pre 2004:

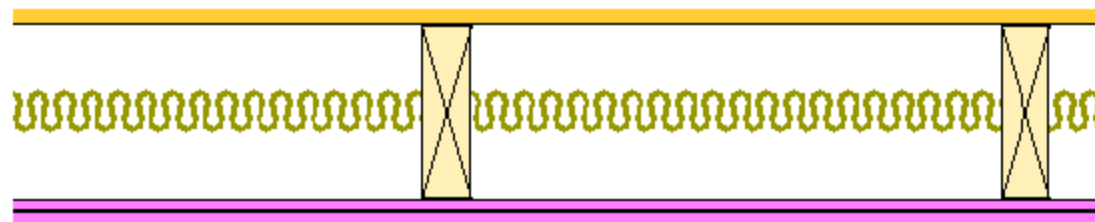
- Airborne:  $STC \geq 45$

Floors:



Thin concrete slab

Joists with direct  
fix ceiling



# BCA History of Sound Insulation

Post 2004:

- Airborne:  $R_w + C_{tr} \geq 50$

Changing to  $\geq 50$  and including  $C_{tr}$  negative correction lifts the  $R_w$  to 60+ which is 15dB of additional performance.



# BCA History of Sound Insulation

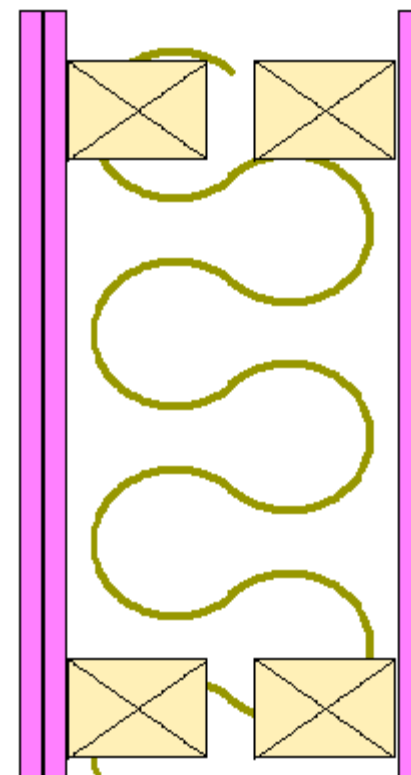
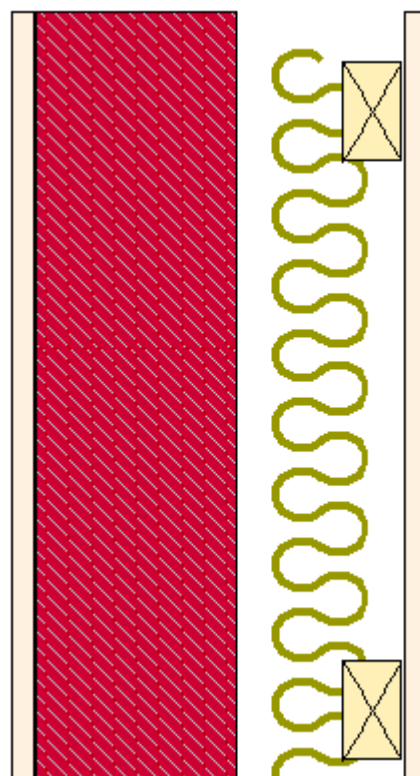
Post 2004:

- Airborne:  $R_w + C_{tr} \geq 50$

Walls:

Separate discontinuous  
studs

Very few noise complaints





# BCA History of Sound Insulation

Post 2004:

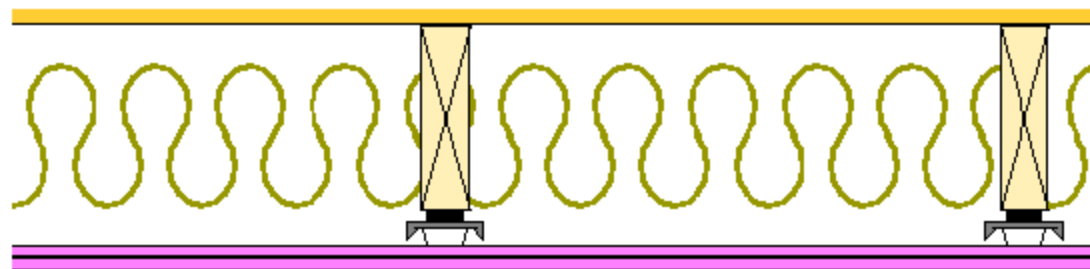
- Airborne:  $R_w + C_{tr} \geq 50$

Floors:

Thicker slabs



Resilient mounted  
ceilings



# BCA History of Sound Insulation

Pre 2004:

- Impact: Not mentioned

More apartments were removing carpet and replacing with hard floors

Noise complaints were very common

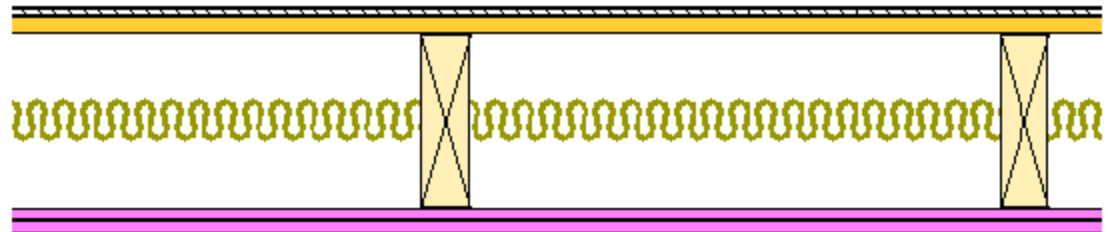


# BCA History of Sound Insulation

Pre 2004:

- Impact: Not mentioned

Lightweight always  
with carpet due to  
By-law regulations



# BCA History of Sound Insulation

Pre 2004:

- Impact: Not mentioned

Concrete with carpet



# BCA History of Sound Insulation

Post 2004:

- Impact:  $L_{n,w} + C_i \leq 62$
- Impact criteria introduced.
- Unfortunately a failure which allowed even a bare concrete slab to comply
- Impact criteria is poor and resulted in known deficient constructions able to achieve compliance.
- Mostly due to the  $C_i$  correction which the acoustic community has been petitioning the BCA to remove.



# BCA History of Sound Insulation

Post 2016:

- Impact:  $L_{n,w} \leq 62$

$C_i$  correction removed which is some progress



# BCA History of Sound Insulation

Post 2016:

- Impact:  $L_{n,w} \leq 62$

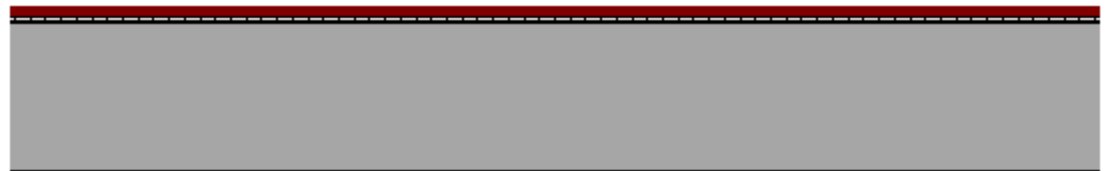
Floor:

Bare slab with

Ceiling



Timber and underlay  
with no ceiling



# BCA History of Sound Insulation

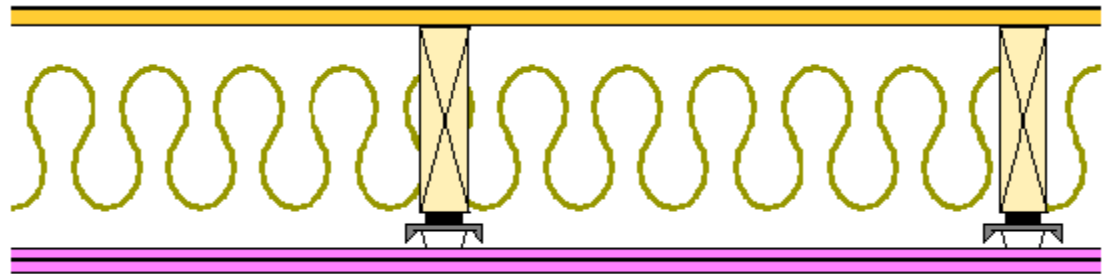
Post 2016:

- Impact:  $L_{n,w} \leq 62$

Floor:

Airborne required

Resilient mount



No carpet can comply



# BCA History of Sound Insulation

Post 2016:

- Impact:  $L_{n,w} \leq 62$

Noise complaints are still common

Therefore the BCA does not *“provide insulation against the transmission of airborne and impact generated sound sufficient to prevent illness or loss of amenity to the occupants”*.



# PKA Impact Criteria

$L_{nT,w}$	Perceived Environment
< 35	Peaceful and generally quiet
40	Can be considered liveable
45	Audible but can be tolerable
50	Audible but can be tolerable
55	Audible
60	Noisy, poor standard of living
65	Basically unliveable
> 70	Unliveable



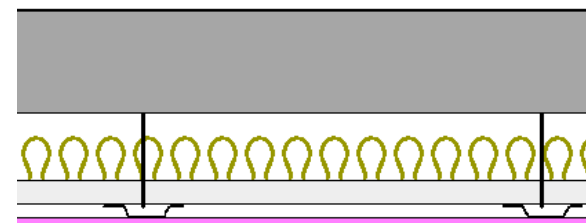
# PKA Impact Criteria

$L_{nT,w}$	Perceived Environment	PKA Hard Floor Criteria	AAAC Star Rating
< 35	Peaceful and generally quiet		
40	Can be considered liveable	PKA practical limit of hard floor performance	6 Star
45	Audible but can be tolerable	PKA recommended for luxury apartments	5 Star
50	Audible but can be tolerable	PKA recommended for apartments	4 Star
55	Audible	PKA minimum for apartments	3 Star
60	Noisy, poor standard of living	BCA	
65	Basically unliveable		2 Star
> 70	Unliveable		



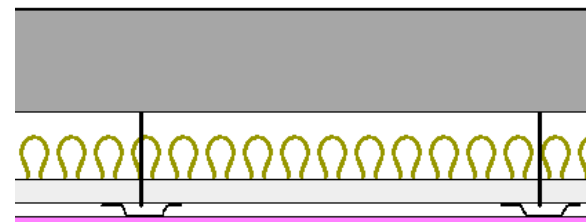
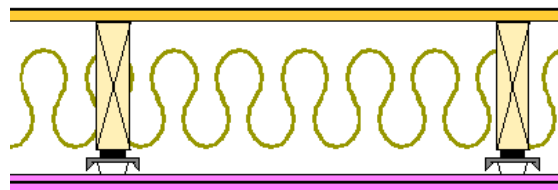
# PKA Impact Criteria

$L_{nT,w}$	Perceived Environment	Concrete	Concrete
< 35	Peaceful and generally quiet	Thick carpet + underlay	Carpet + underlay
40	Can be considered liveable	Carpet + underlay	Hard floor + screed + thick rubber underlay
45	Audible but can be tolerable		Hard floor + screed + rubber underlay
50	Audible but can be tolerable	Hard floor + screed + thick rubber underlay	Hard floor + rubber underlay
55	Audible	Hard floor + screed + rubber underlay	Hard floor + foam underlay
60	Noisy, poor standard of living	Hard floor + rubber underlay	Bare
65	Basically unliveable	Hard floor + foam underlay	
> 70	Unliveable	Bare	



# PKA Impact Criteria

$L_{nT,w}$	Perceived Environment	Lightweight	Concrete
< 35	Peaceful and generally quiet		Carpet + underlay
40	Can be considered liveable	Thick carpet + underlay	Hard floor + screed + thick rubber underlay
45	Audible but can be tolerable	Carpet + underlay	Hard floor + screed + rubber underlay
50	Audible but can be tolerable		Hard floor + rubber underlay
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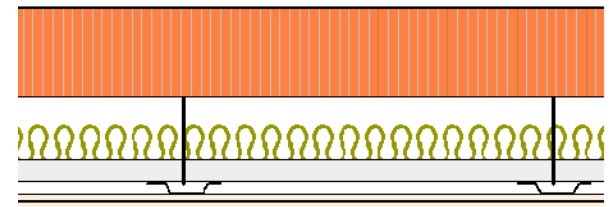
# PKA Impact Criteria

$L_{nT,w}$	Perceived Environment	CLT	Concrete
< 35	Peaceful and generally quiet		Thick carpet + underlay
40	Can be considered liveable		Carpet + underlay
45	Audible but can be tolerable		
50	Audible but can be tolerable		Hard floor + screed + thick rubber underlay
55	Audible	Thick carpet + underlay	Hard floor + screed + rubber underlay
60	Noisy, poor standard of living	Carpet + underlay	Hard floor + rubber underlay
65	Basically unliveable		Hard floor + foam underlay
> 70	Unliveable	Hard floor + screed + thick rubber underlay	Bare



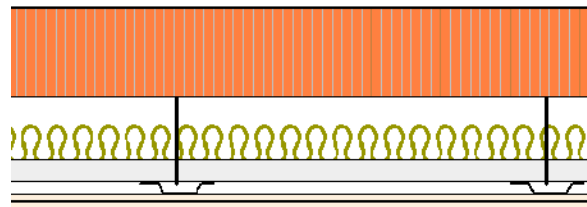
# PKA Impact Criteria

$L_{nT,w}$	Perceived Environment	CLT	CLT
< 35	Peaceful and generally quiet		Thick carpet + underlay
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# PKA Impact Criteria

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< 35	Peaceful and generally quiet	Thick carpet + underlay	Thick carpet + underlay
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65	Basically unliveable	Bare	Hard floor + foam underlay
> 70	Unliveable		Bare





# Complying CLT Systems

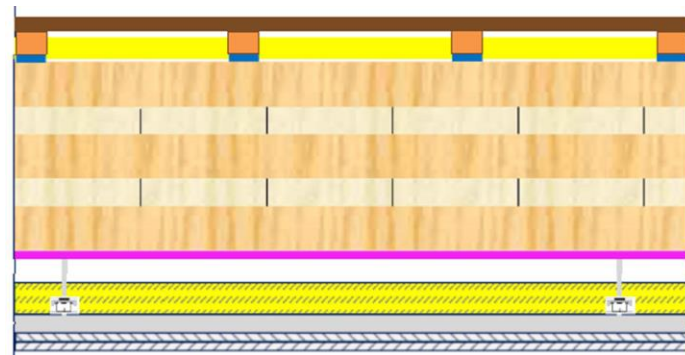
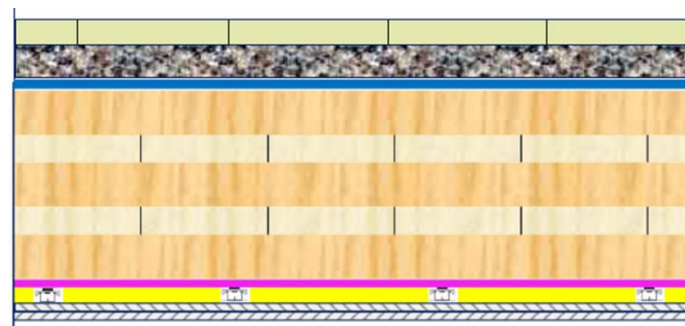
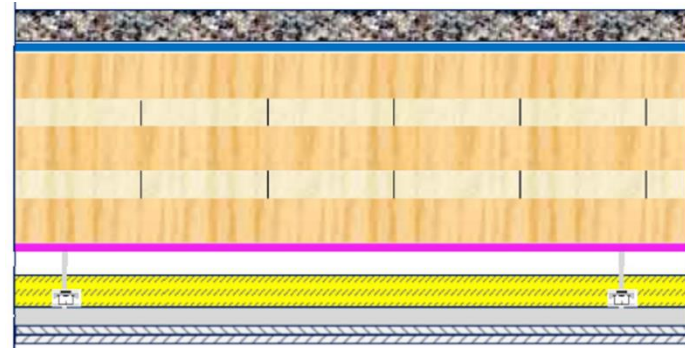
- Achieves  $R_w + C_{tr} \geq 50$
- Achieves  $L_{n,w} \leq 55$



# Complying CLT Systems

## Hard Floor Systems:

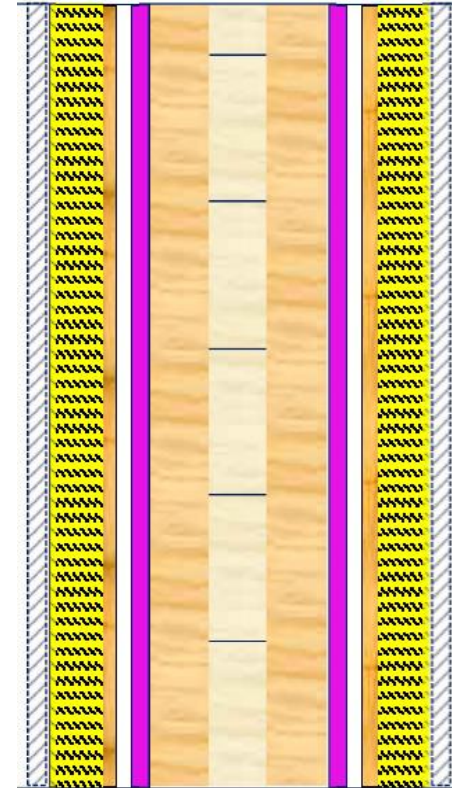
- Screed
- Tiles
- Timber
- Batten



# Complying CLT Systems

## Wall Systems

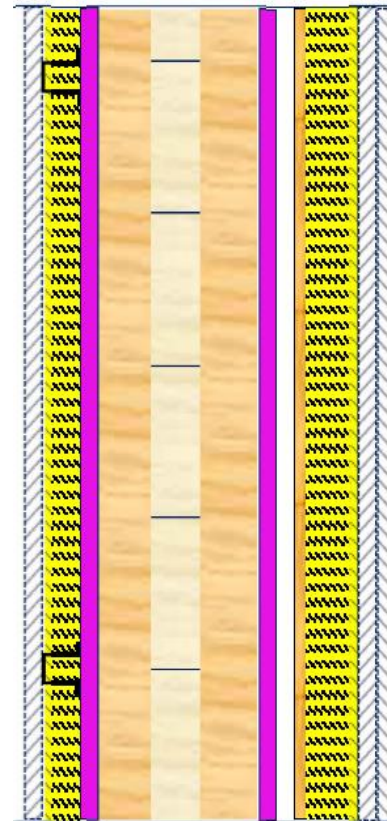
- Separate stud both sides



# Complying CLT Systems

## Wall Systems

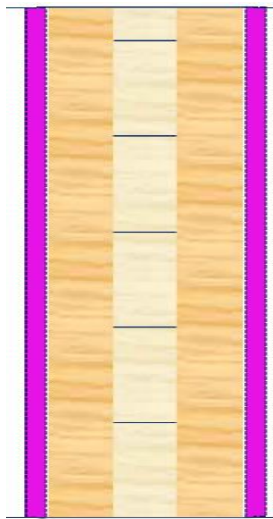
- Separate stud and furring channel





# CLT and Fire

- BCA deemed-to-satisfy fire protected timber Specification A1.1





# CLT and Fire

Other fire-rated options are being explored like charring barrier



# Flanking Issues

- Flanking is sound that transfers between spaces indirectly rather than through the separating element
- BCA does not comment on flanking sound
- BCA does provide in-situ verification testing criteria which indirectly relates to flanking
- BCA sound insulation assumes a concrete floor e.g. discontinuous construction which provides an energy sink





# Flanking Issues

- Multistorey lightweight and mass timber construction is prone to flanking





# **STUDY REPORT**

**SR 208 (2013)**

**Optimised Wall-to-Floor  
Junctions in Multi-Storey,  
Multi-Residential  
Light Timber-Framed Buildings**

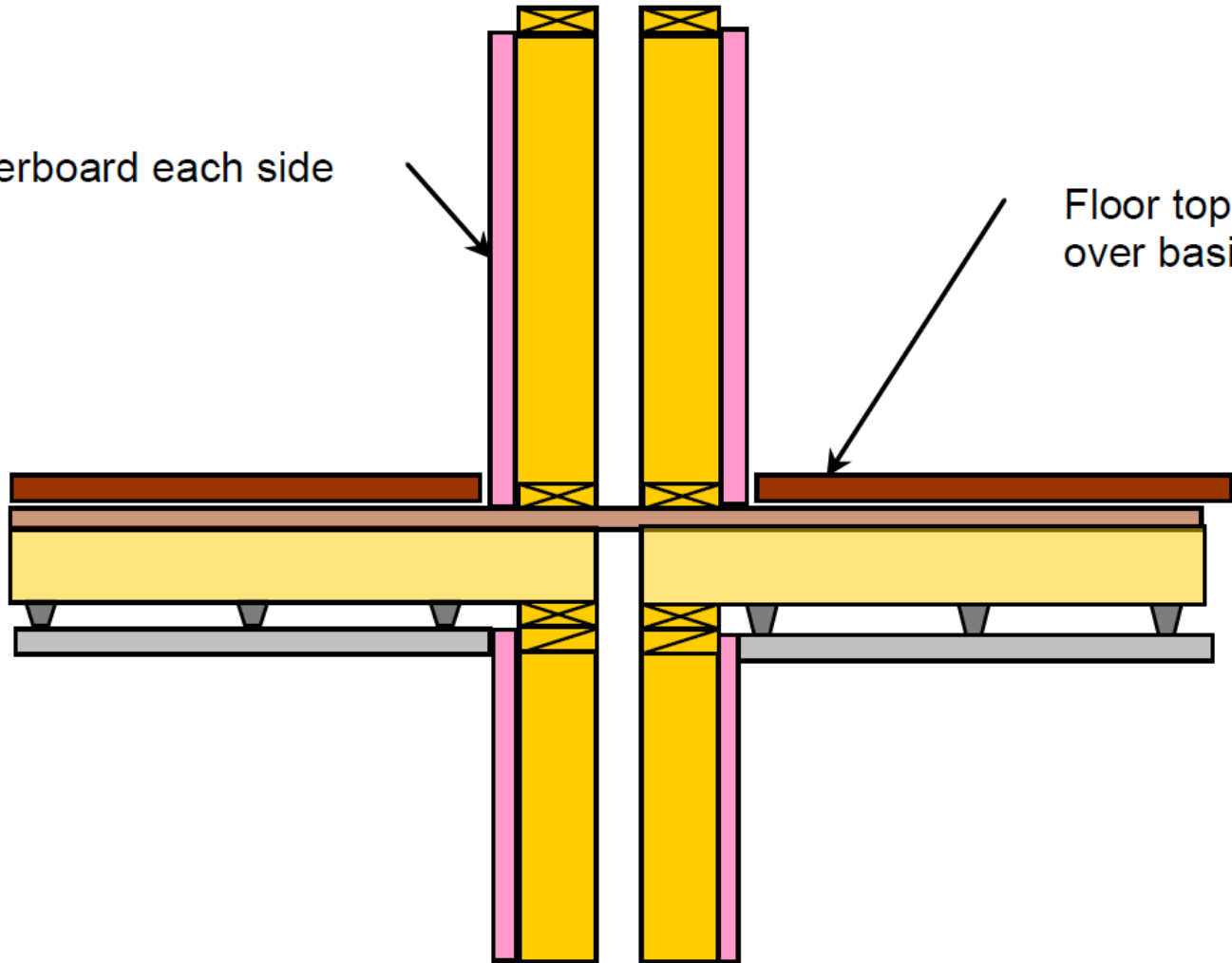


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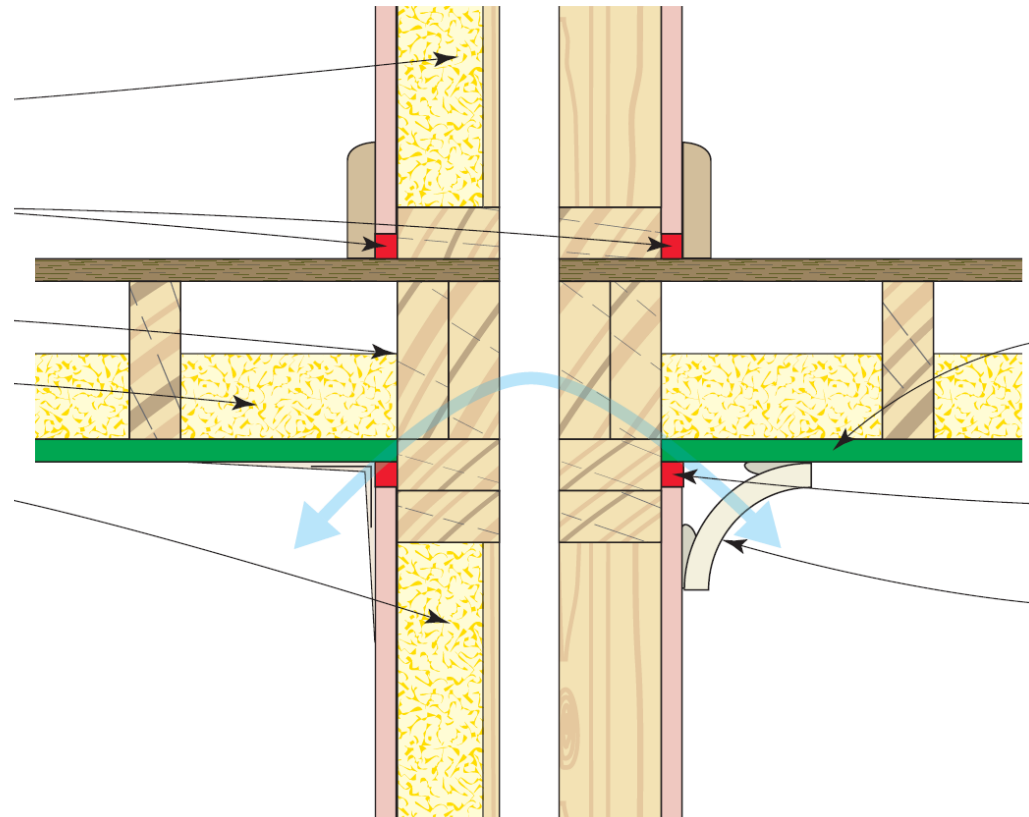
Two layers of plasterboard each side

Floor topping  
over basic floor



# Flanking Issues

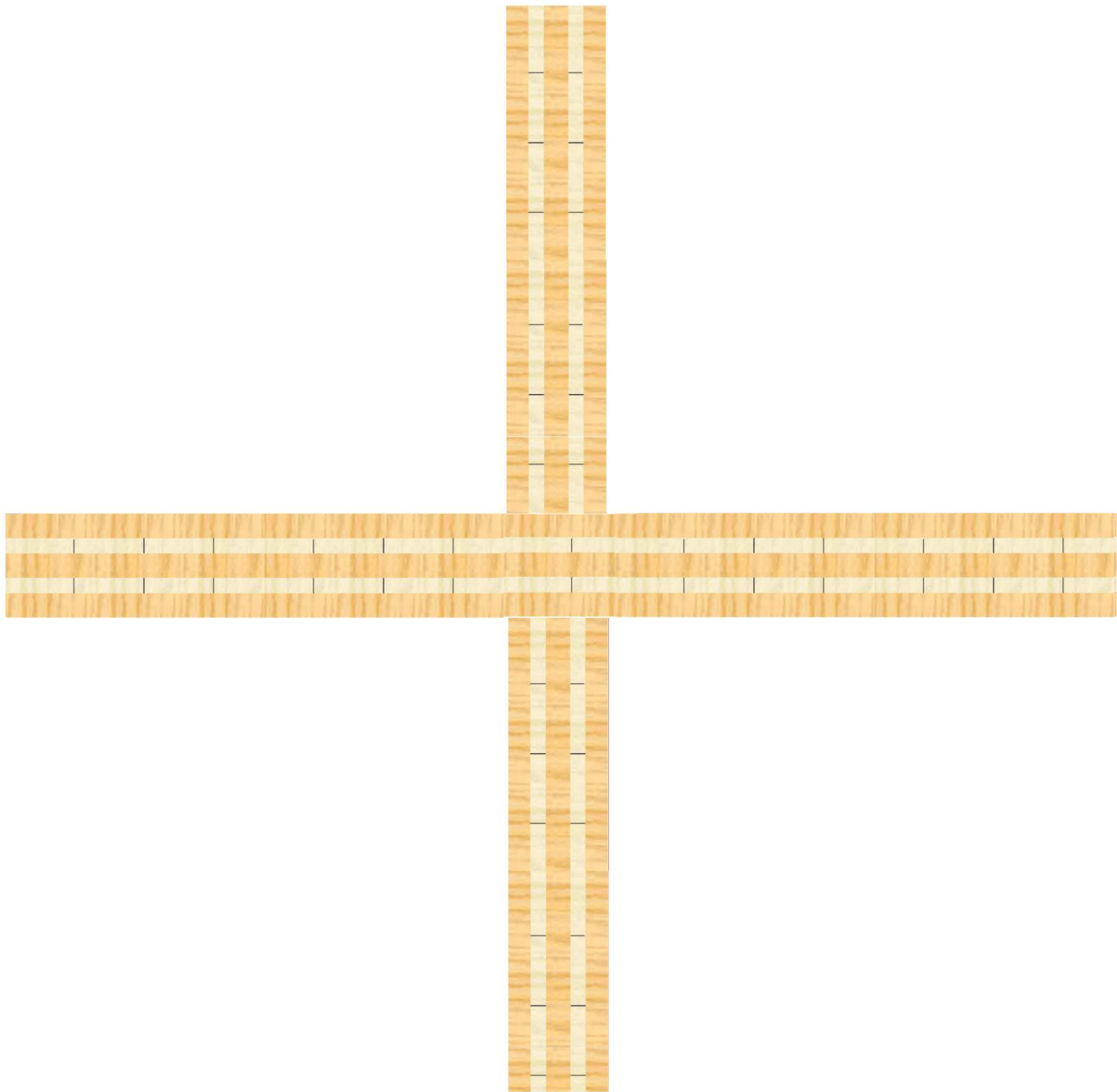
- Acoustically solve lightweight flanking with complete isolation between apartments

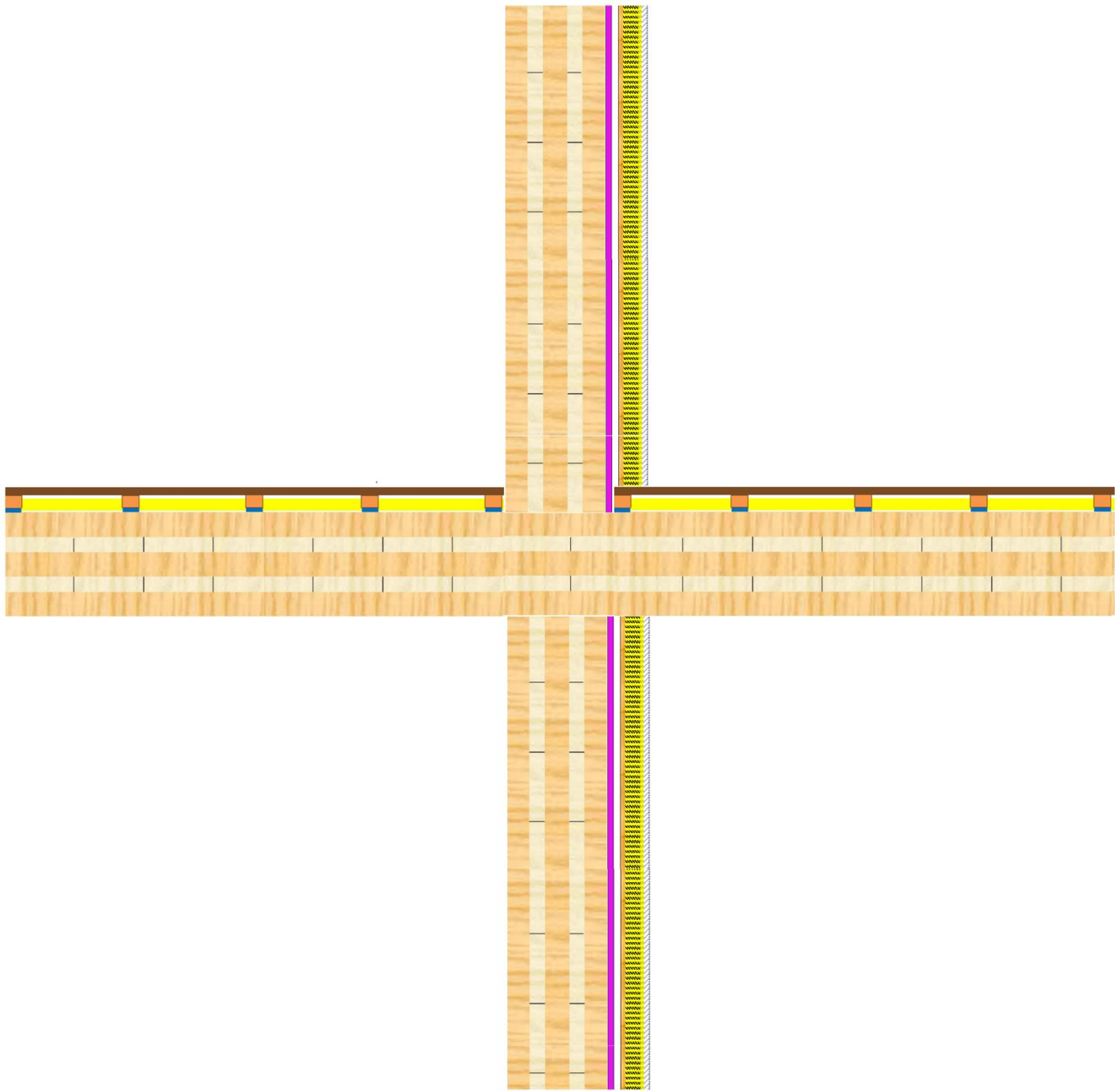


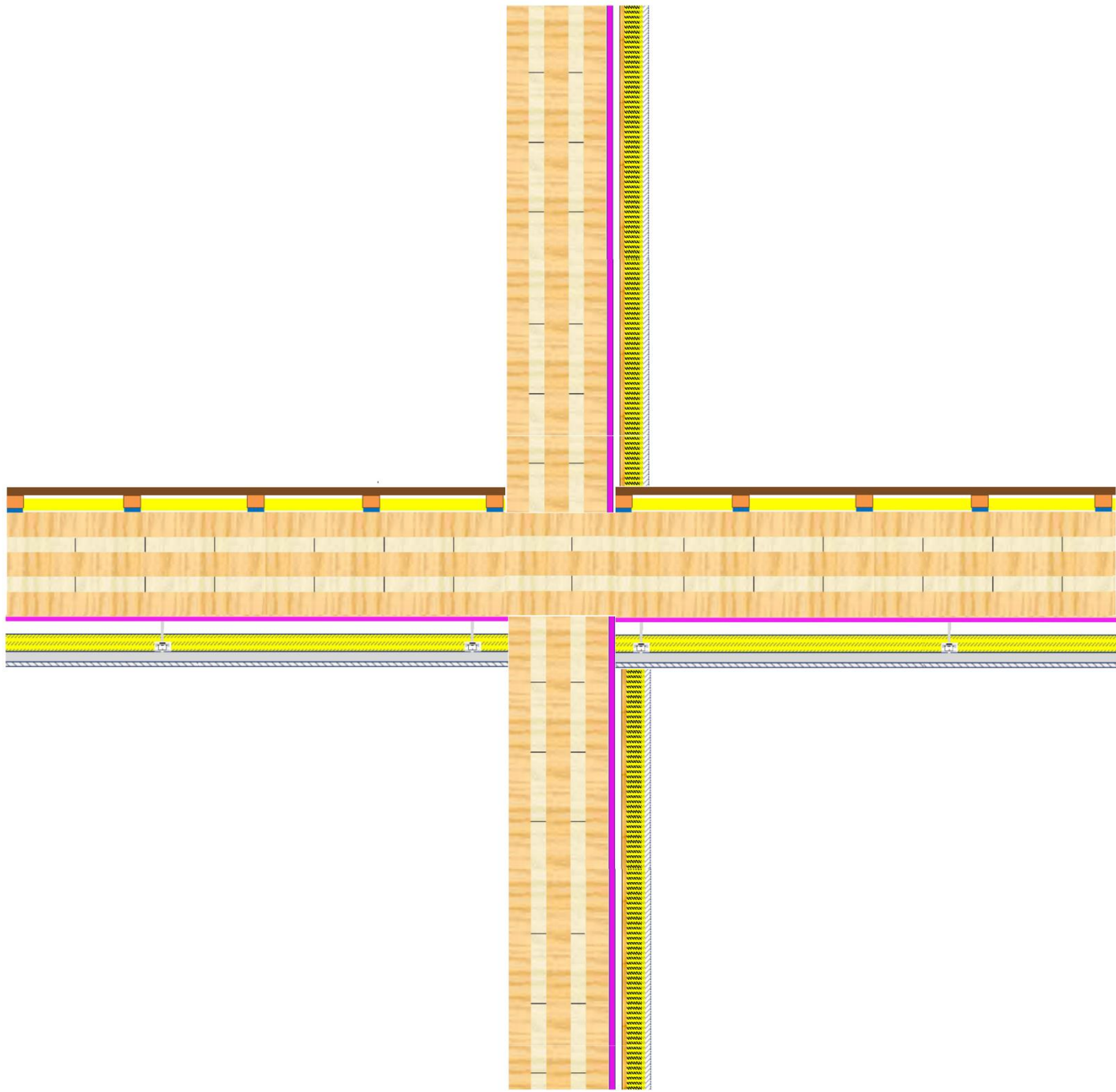
# Flanking Issues

- Mass timber is proving to be more difficult

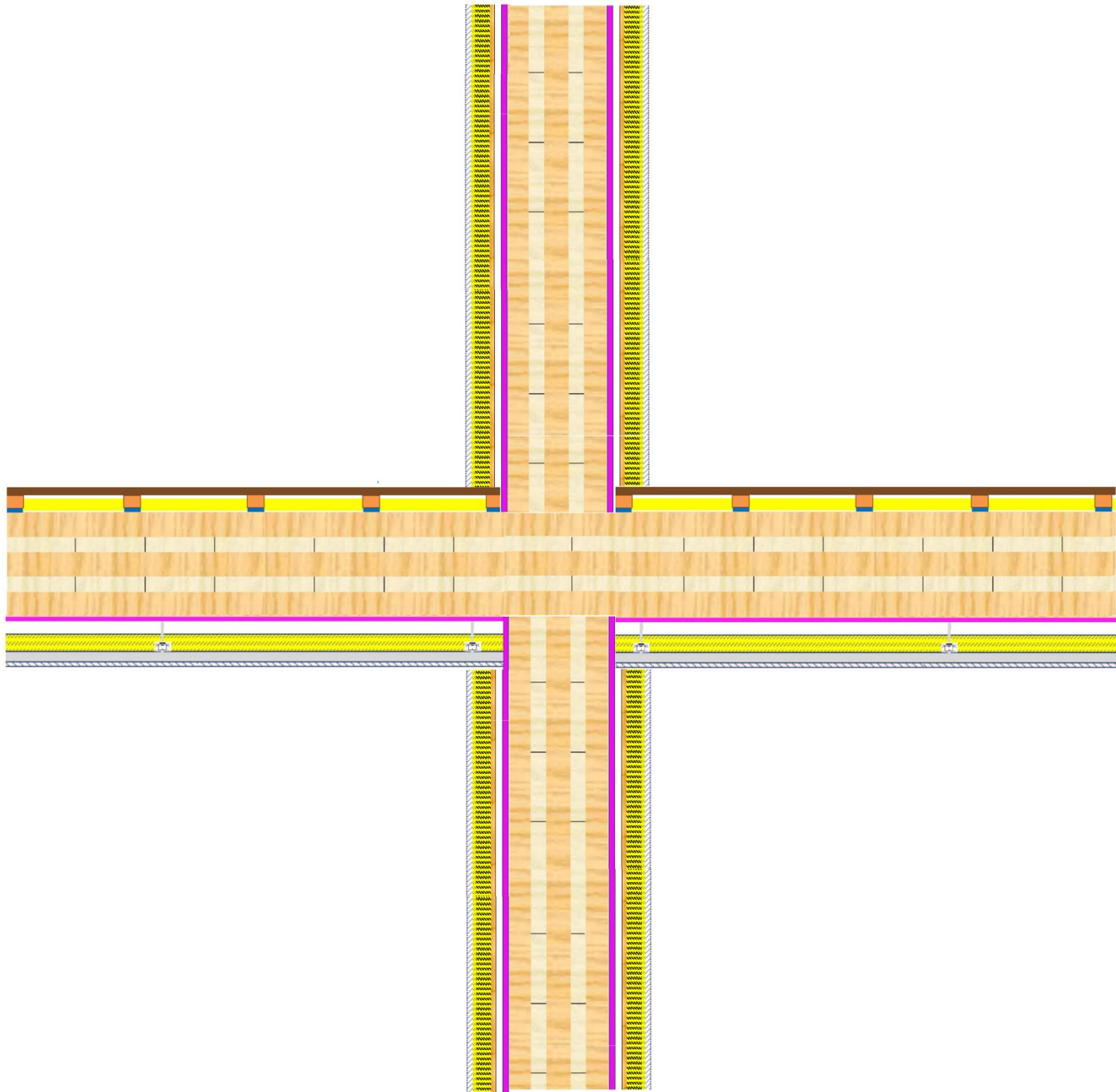












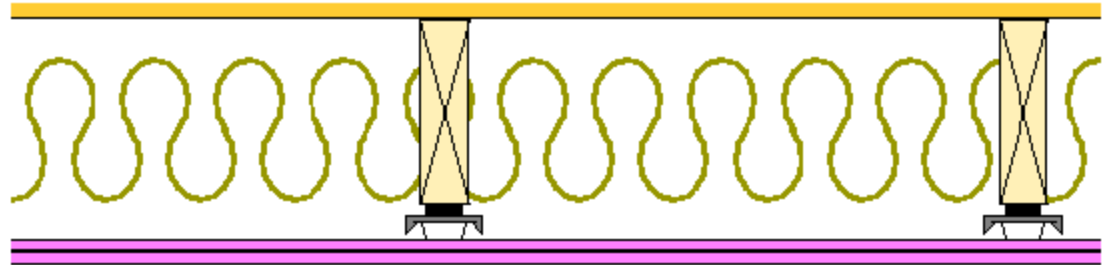
# Flanking Issues

- Isolating products such as Rothoblass / Plax are potential solutions



# Fire Considerations for Lightweight Floors

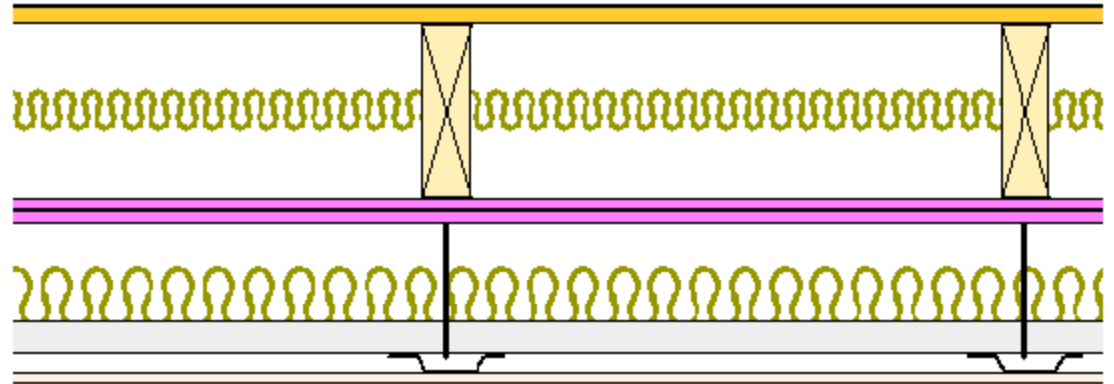
Requires penetrations  
to be fire-rated



# Fire Considerations for Lightweight Floors

Place fire-rated  
plasterboard  
against joists

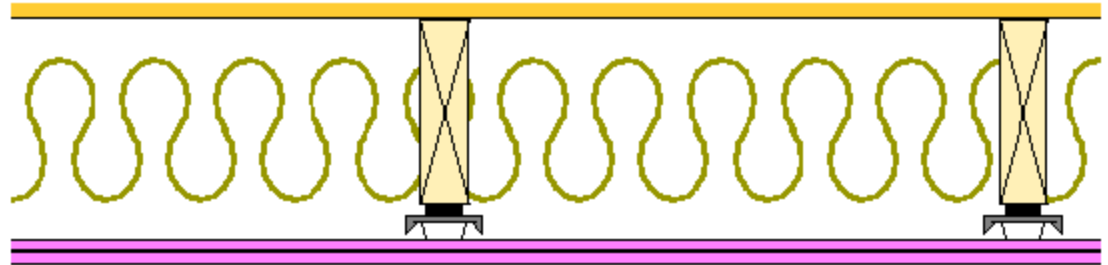
Add false ceiling  
for penetrations



# Fire Considerations for Lightweight Floors

Airborne:  $R_w + C_{tr} = 50$

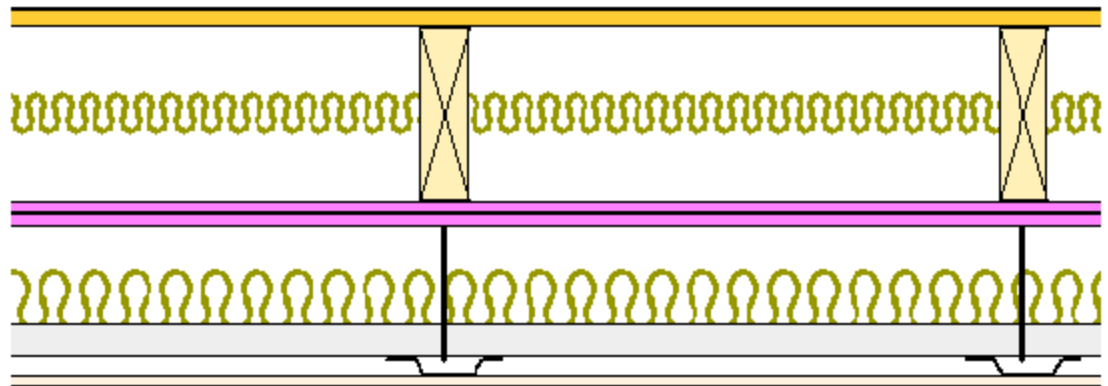
Impact:  $L_{n,w}$  60



Airborne:  $R_w + C_{tr} = 45$

Impact:  $L_{n,w}$  65

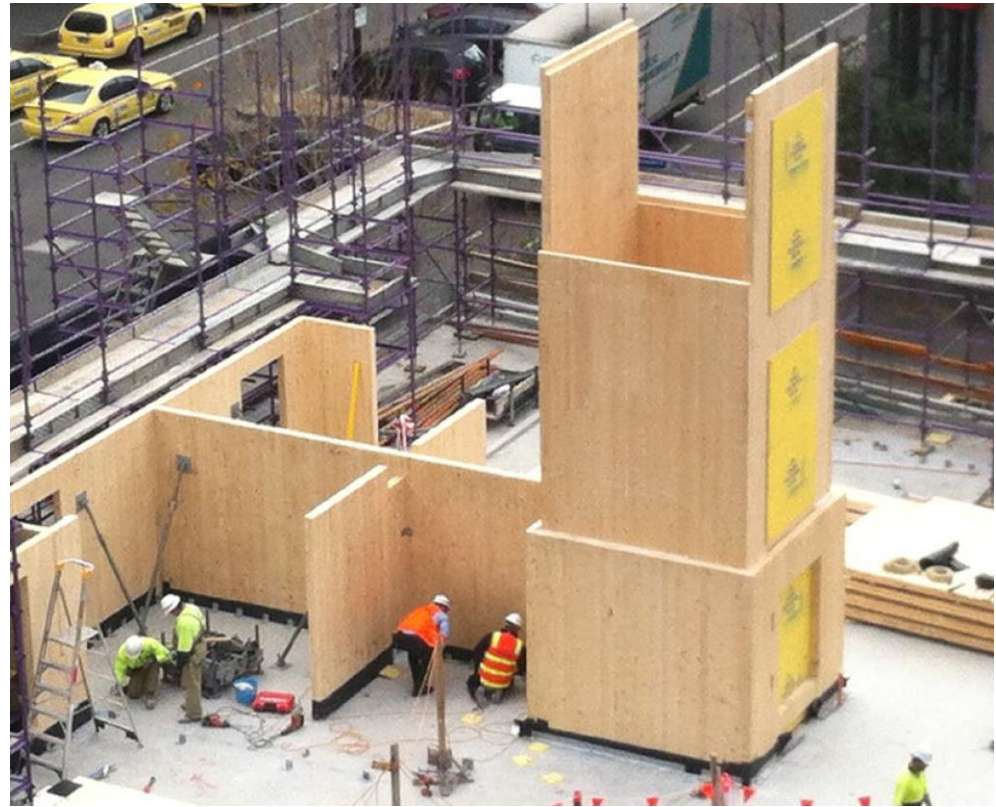
Fails BCA





# Additional Research

## Lift Isolation



# Additional Research

In-situ verification testing

External walls

Roof

Hybrid



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INDUSTRIAL ACOUSTICS

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