Sound Insulation of Timber Framed Structures

THE EIGHTH WESTERN PACIFIC ACOUSTICS CONFERENCE

Keith Ballagh

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Timber Framed Buildings

- Advantages
  - Economical
  - Earthquake resistant
  - Quick construction time
  - Light weight
  - Easily modified

- Disadvantages
  - Less durable
  - Limited height
  - Acoustic performance can be poor.

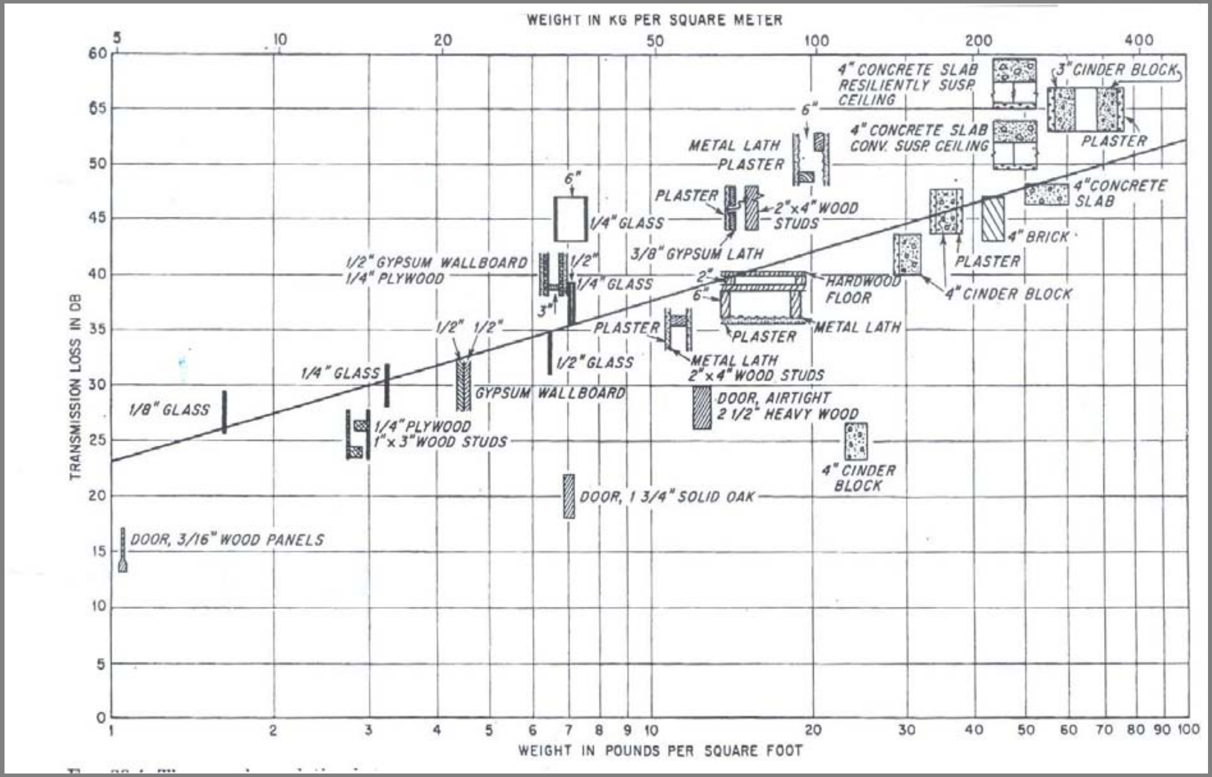
Historical Trends in Sound Insulation

	Rw (dB)
Scrim and sarking	15-20 (est)
Lath and plaster	30
Split stud	43
Staggered stud	45
Resilient rail	48
Isolated Stud/Resilient clip	50

Factors affecting sound insulation

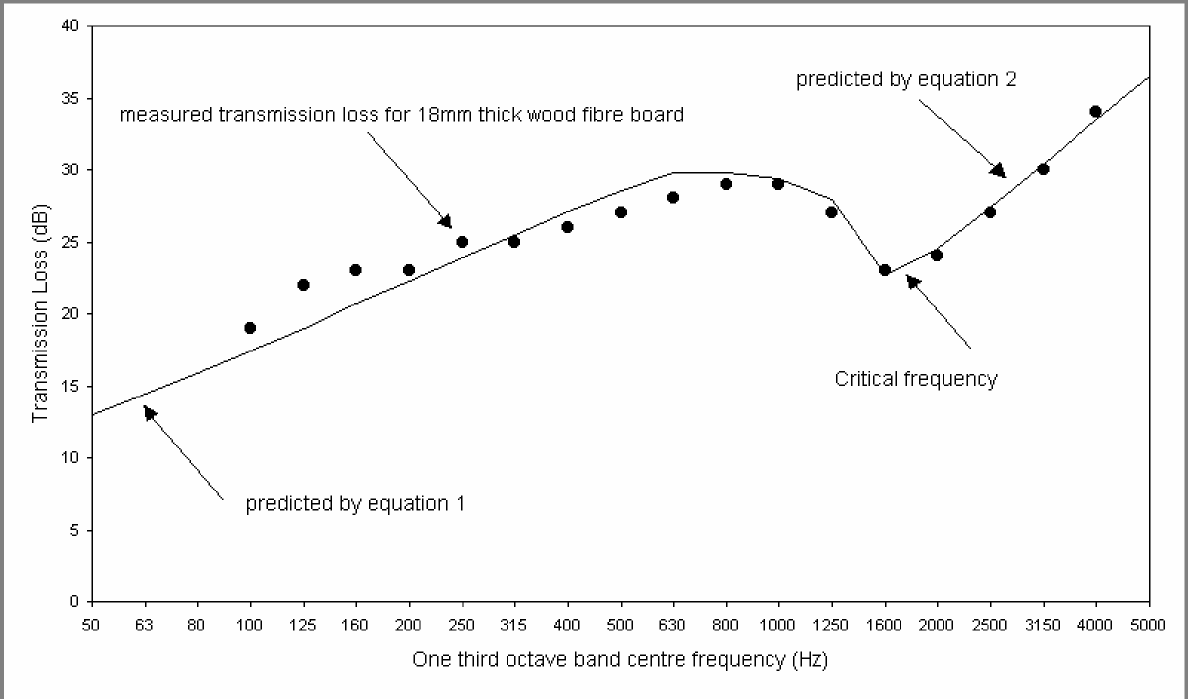
- Mass Law
- Cavity Walls
- Effect of absorptive infill
- Connections between linings
- Methods of isolating linings
- Leakage
- Flanking

The Mass Law



WEIGHT IN KG PER SQUARE METER
TRANSMISSION LOSS IN DB
WEIGHT IN POUNDS PER SQUARE FOOT
4" CONCRETE SLAB RESILIENTLY SUSP. CEILING
3" CINDER BLOCK
4" CONCRETE SLAB CONV. SUSP. CEILING
PLASTER
METAL LATH PLASTER
4" CONCRETE SLAB
1/4" GLASS
2"×4" WOOD STUDS
3/8" GYPSUM LATH
4" BRICK
1/2" GYPSUM WALLBOARD
1/4" PLYWOOD
HARDWOOD FLOOR
METAL LATH
4" CINDER BLOCK
1/2" GLASS
METAL LATH 2"×4" WOOD STUDS
1/4" GLASS
GYPSUM WALLBOARD
1/8" GLASS
DOOR, AIRTIGHT 2 1/2" HEAVY WOOD
1/4" PLYWOOD 1"×3" WOOD STUDS
4" CINDER BLOCK
DOOR, 1 3/4" SOLID OAK
DOOR, 3/16" WOOD PANELS

The Mass Law



f < fc $R = 20Log(mf) - 48$

f > fc $R = 20Log(mf) - 10Log(2\eta\omega / \pi\omega c) - 48$

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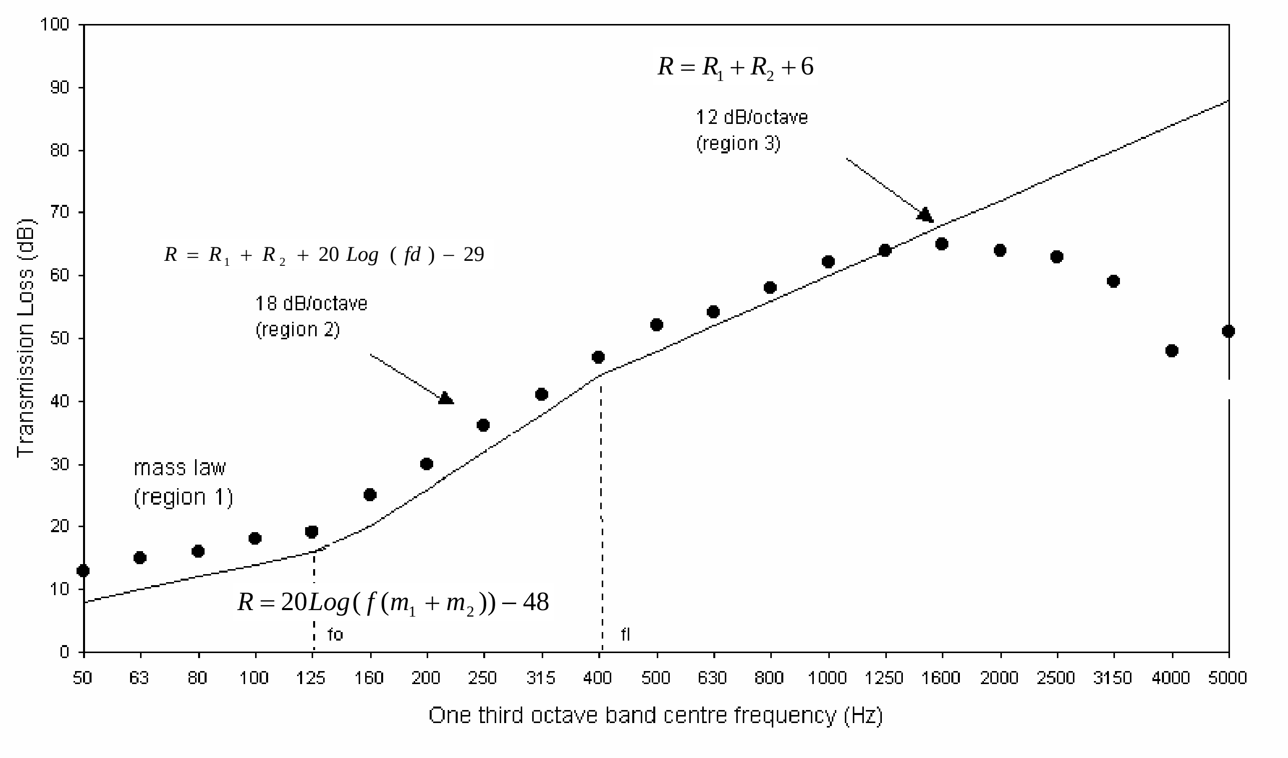
Cavity Wall Performance



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Ideal Double Wall Behaviour

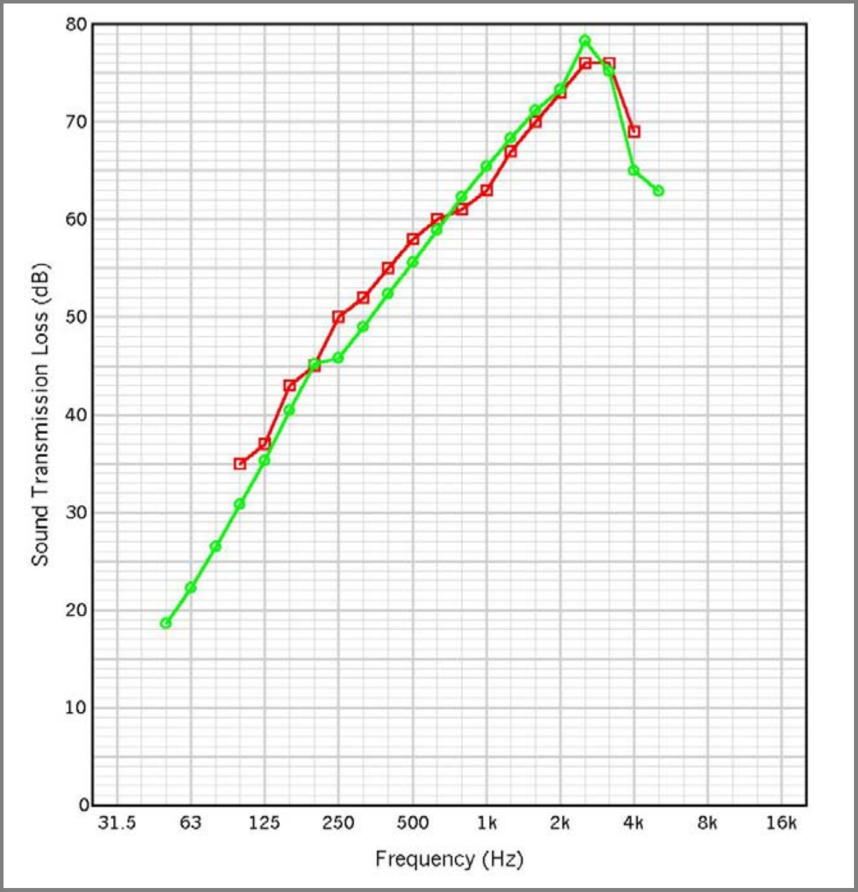

Fig 2 Double frame wall with 2x10mm gypsum board on each side

- measured
- predicted for ideal double wall

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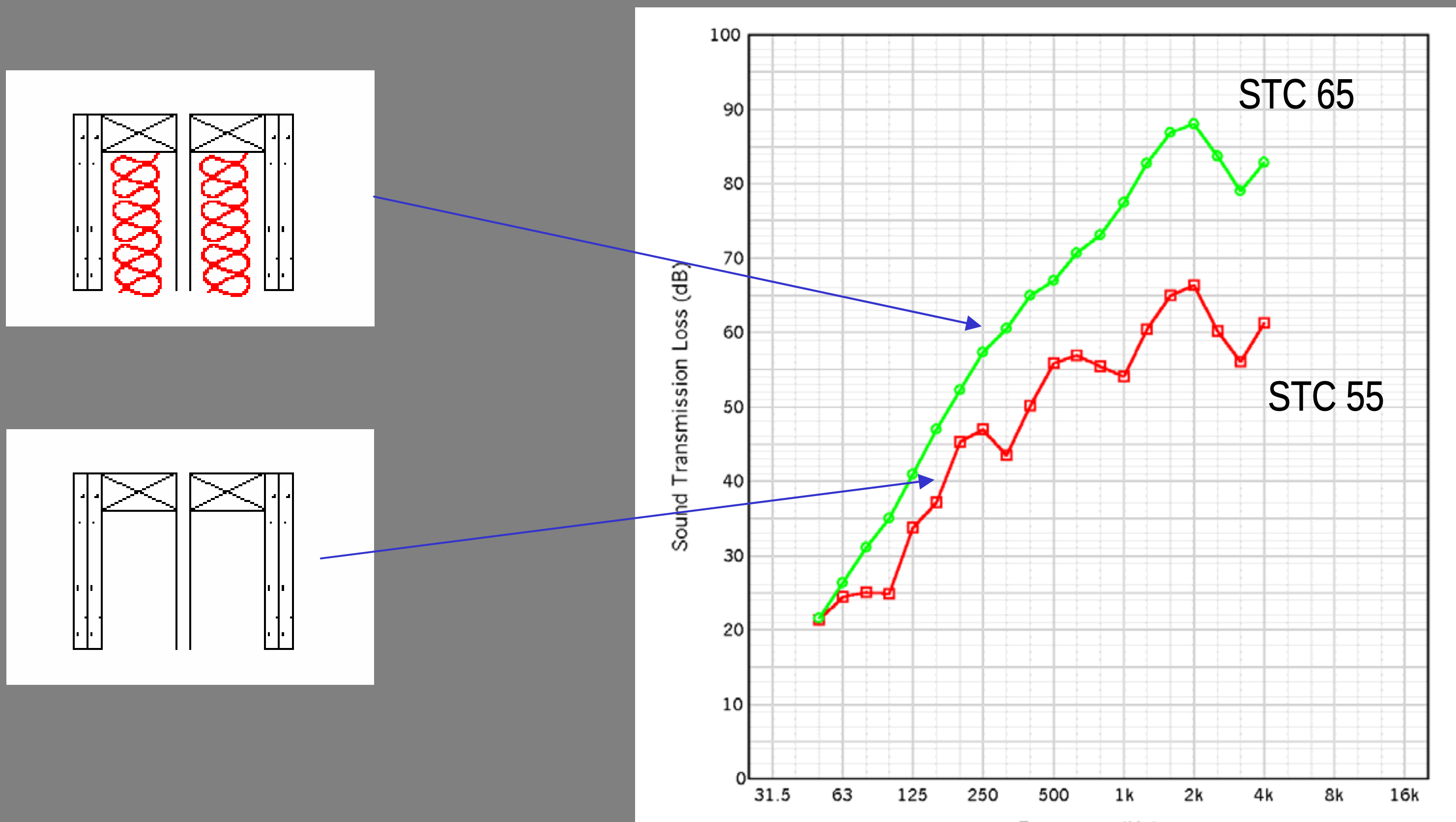
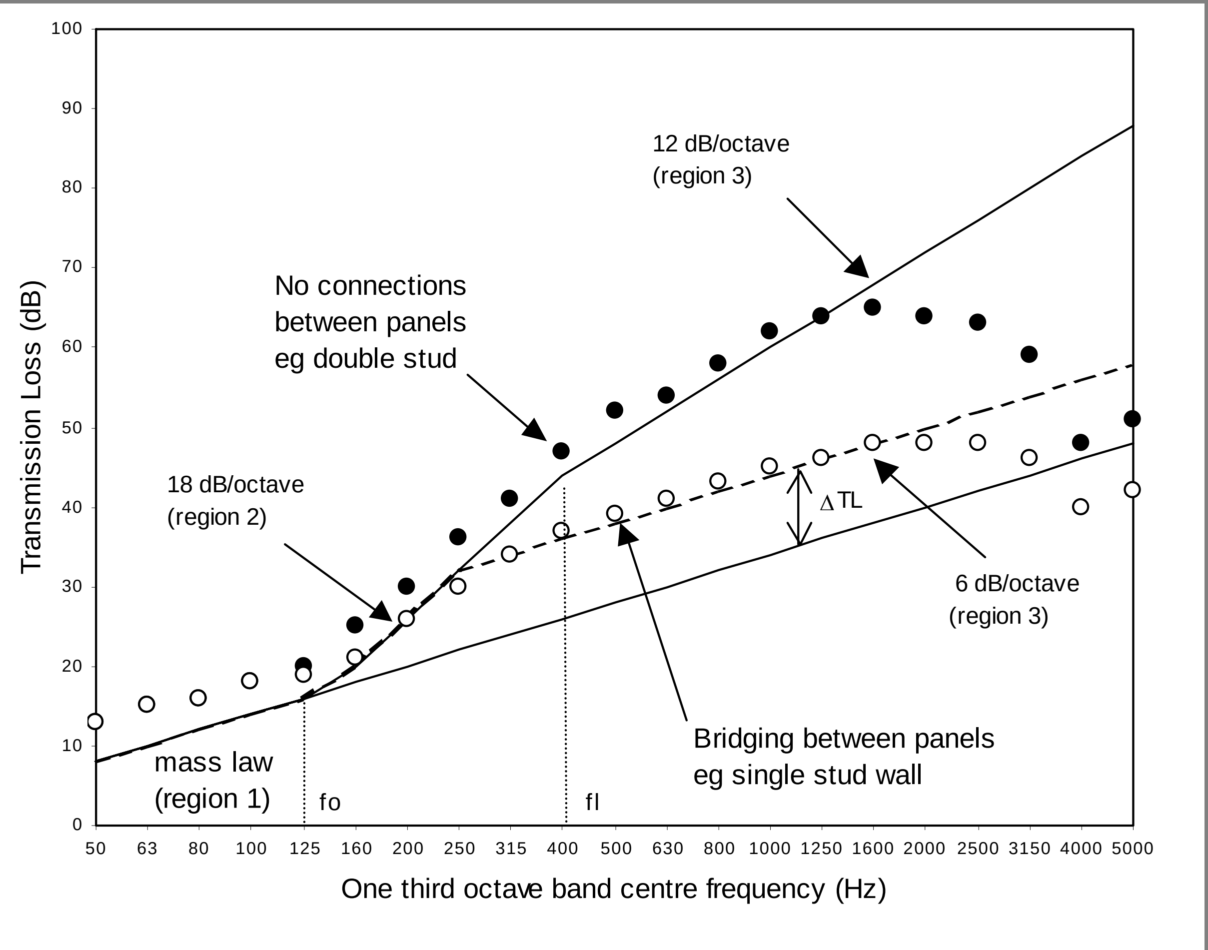
Effect of Cavity Absorption



Effect of Connections to Frame



$$R = R_{1+2} + 10 Log(b.f_c)$$
$$+ 20 Log[m_1 / (m_1 + m_2)] - 18$$

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Effect of Connections to Frame

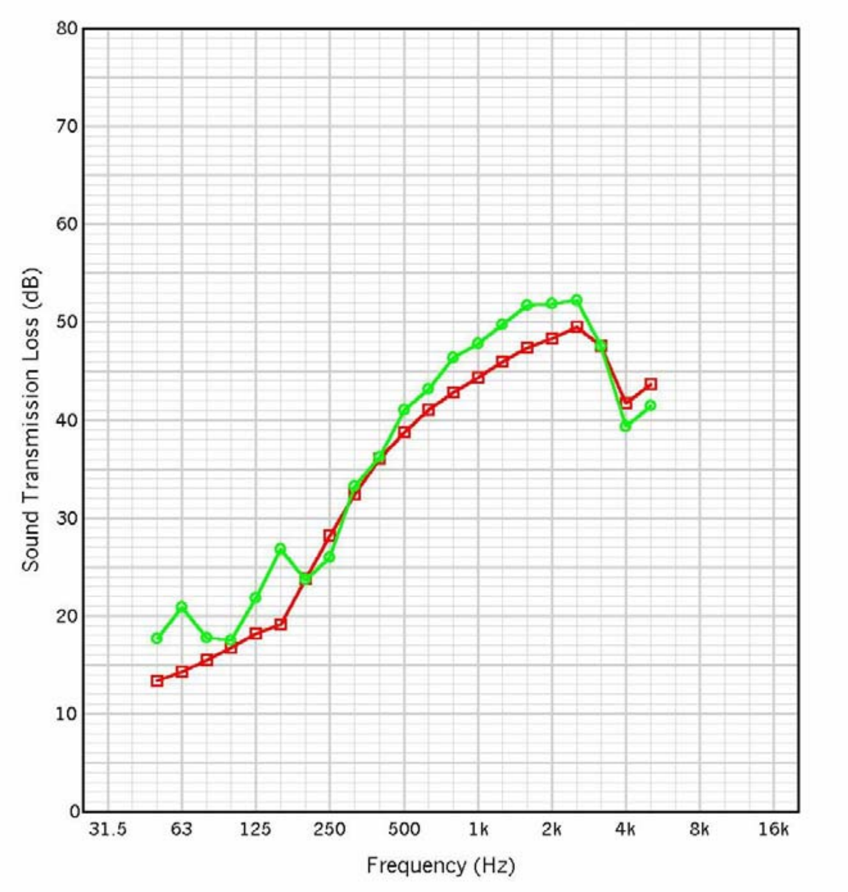

Fig. 3 Single frame wall width 10mm gypsum board on 90 x 35 mm frame with studs at 600mm centres

measured

predicted for line connections at 600mm

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Behaviour of panel fixings

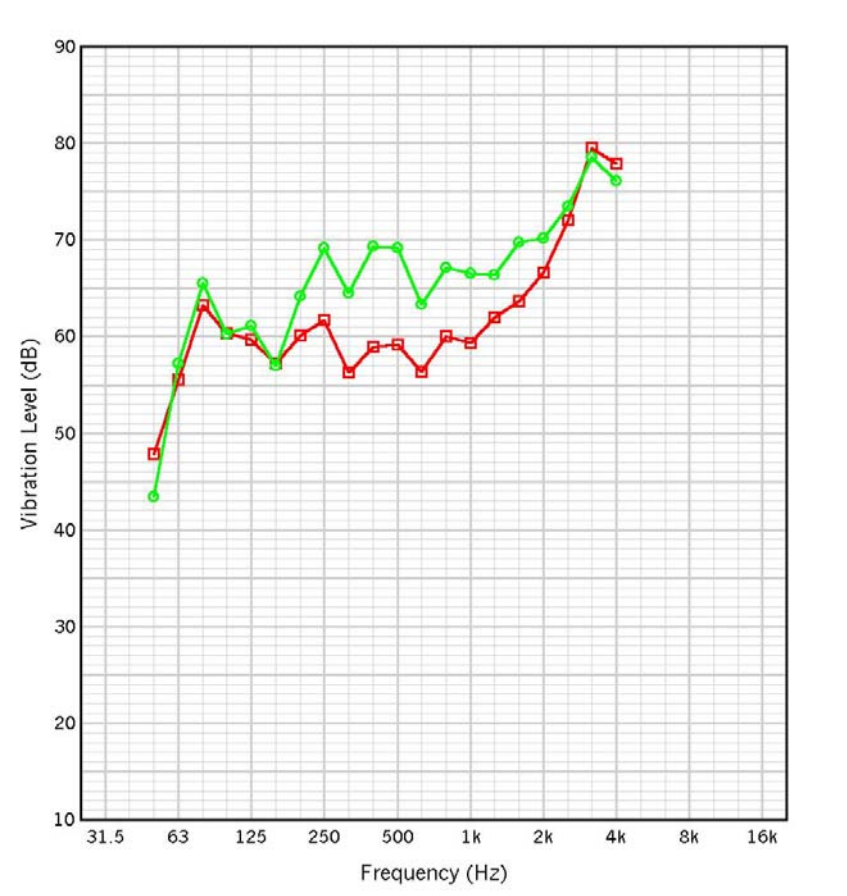
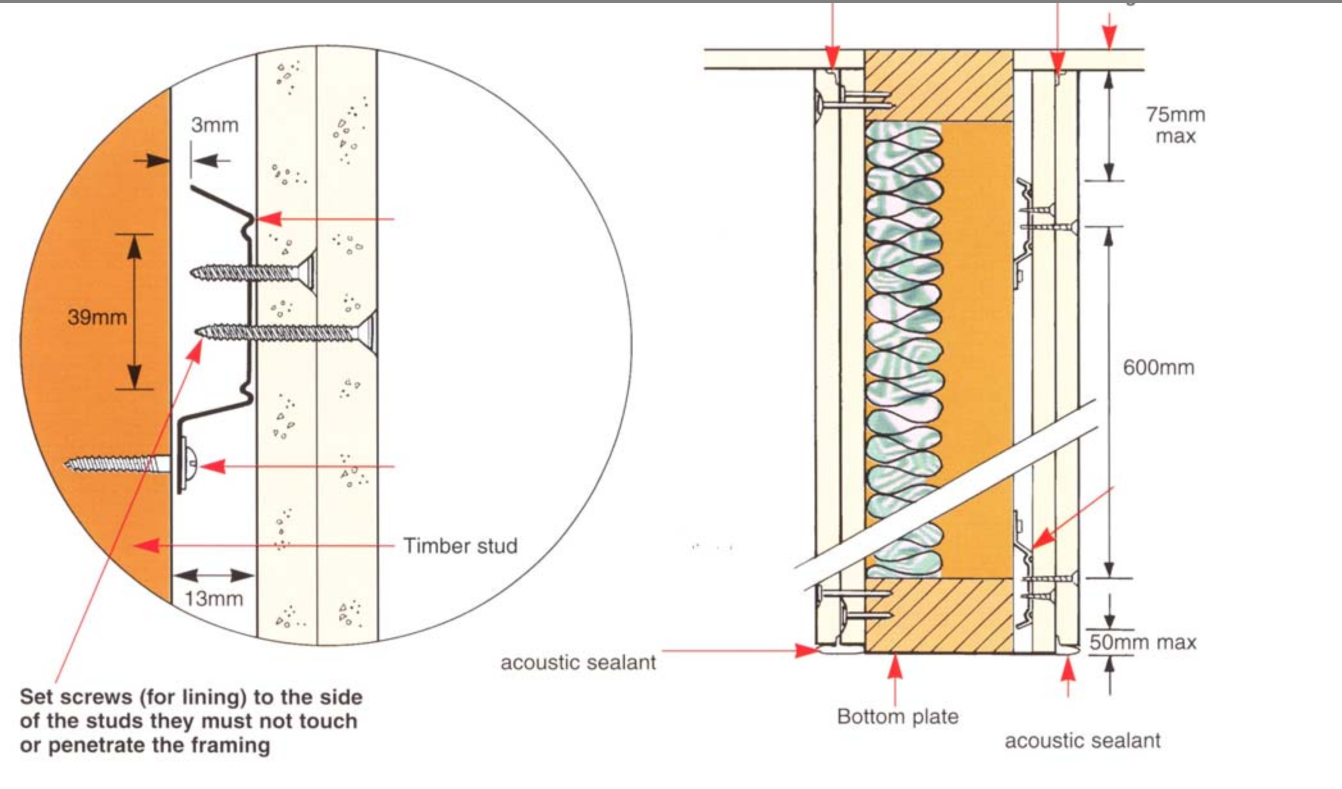


Fig. 4 Vibration measured on gypsum board on stud line for single stud wall

measured on screw
measured between screws

Methods of isolating wall linings



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Methods of isolating wall linings

Resilient Sound Isolation Clip

Quietzone Acoustic Framing

Resilient fastenings of Linings

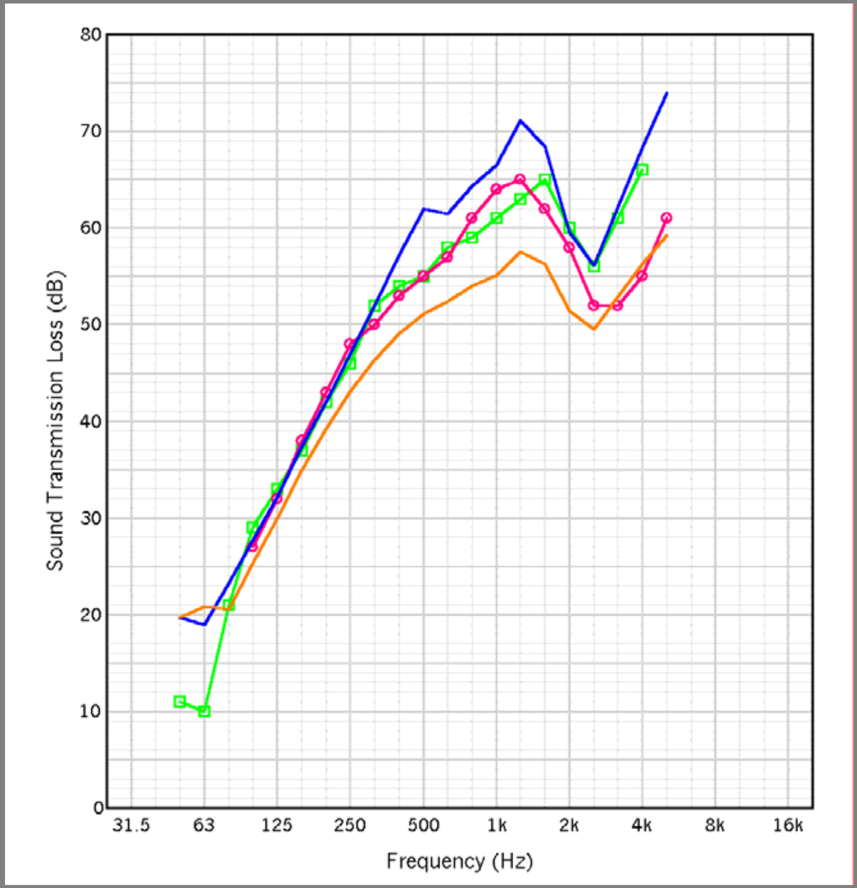
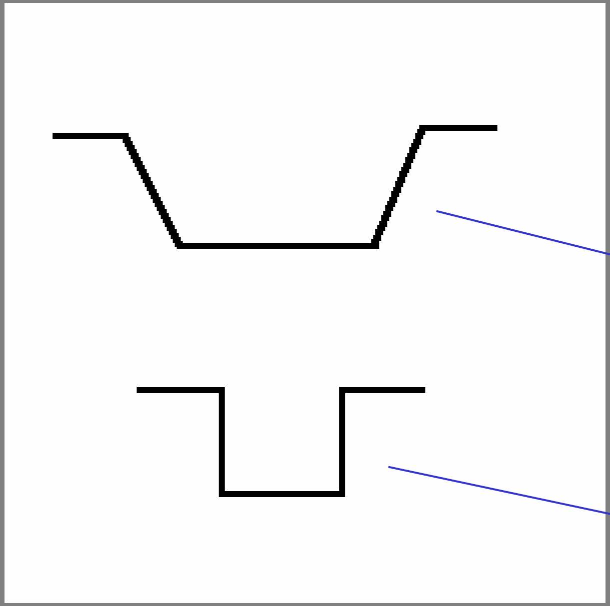
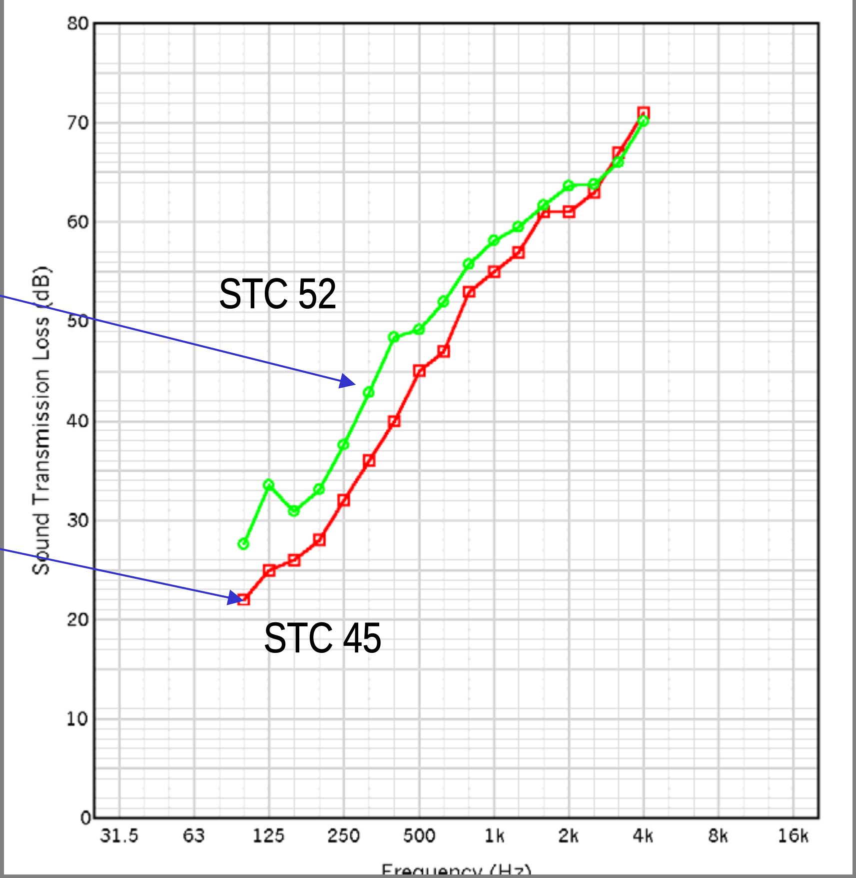


Fig. 5 Performance of resilient fastenings
16mm plaster board on 100x50 studs

- Rubber Isolation Clip
- Quietzone studs
- ideal double wall
- resilient rail

Substitution of Generic Components





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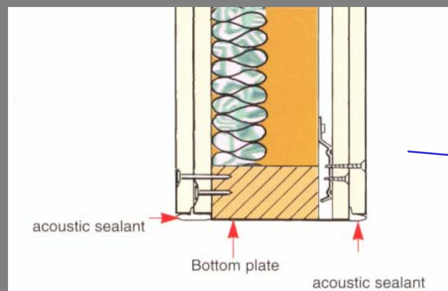
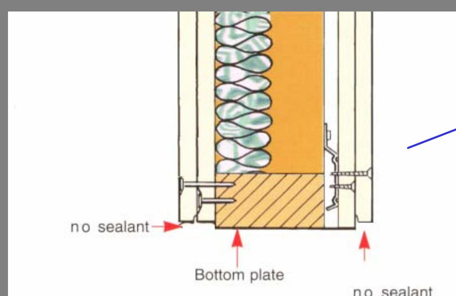
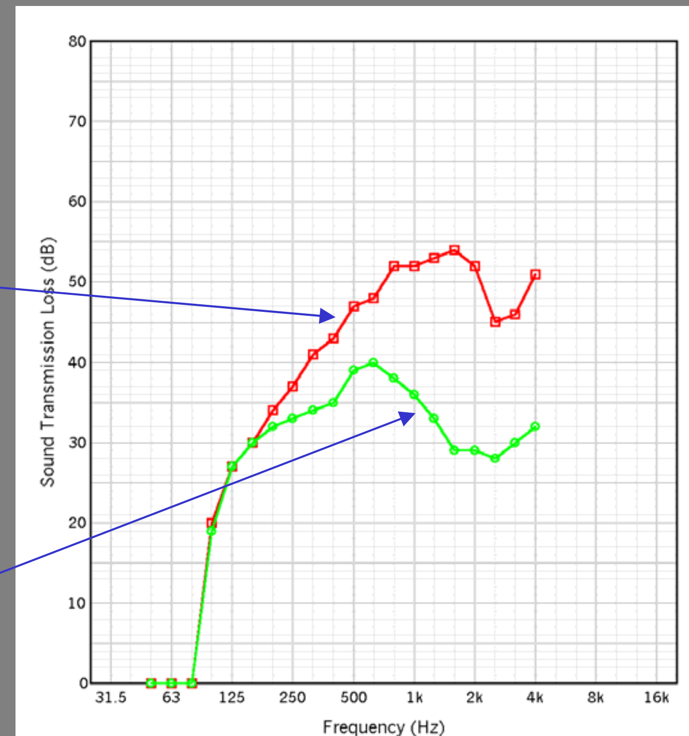
Effect of Leakage







Sound Transmission Loss of Cinema Wall

- 2x16mm plasterboard each side of 225mm airgap
- 400mm Concrete

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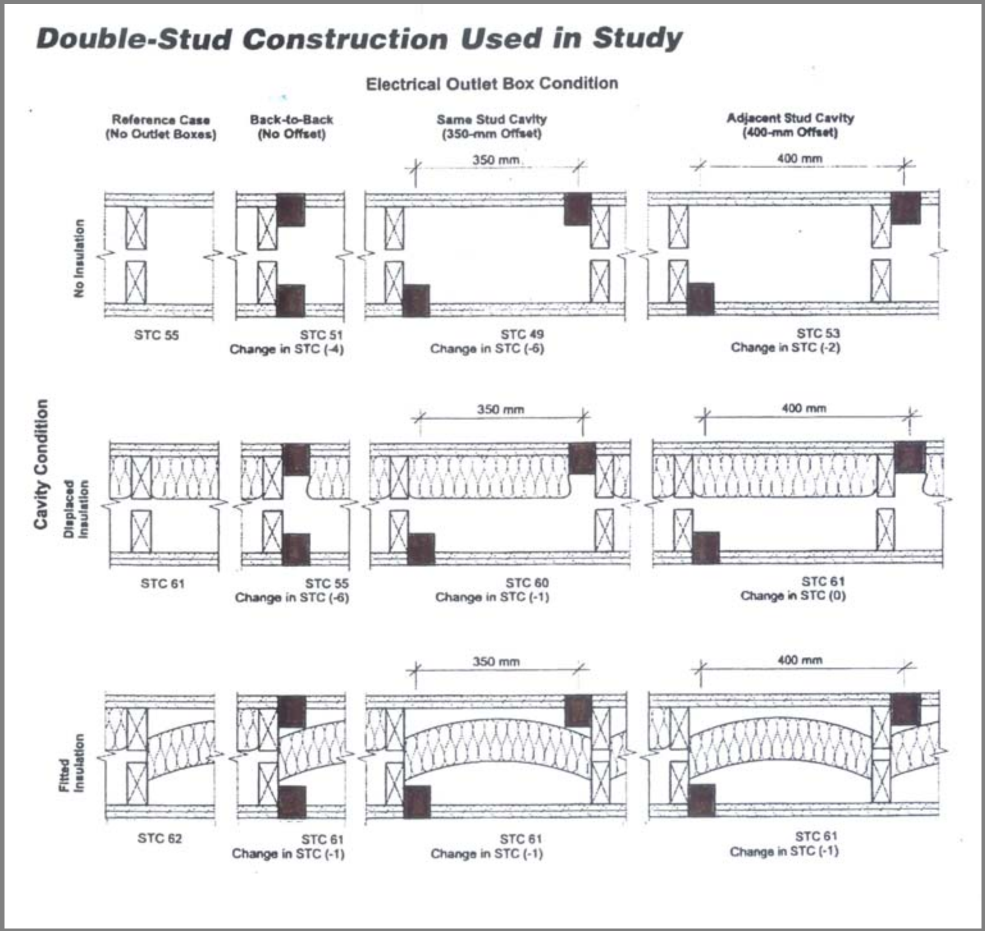
Effect of Leakage



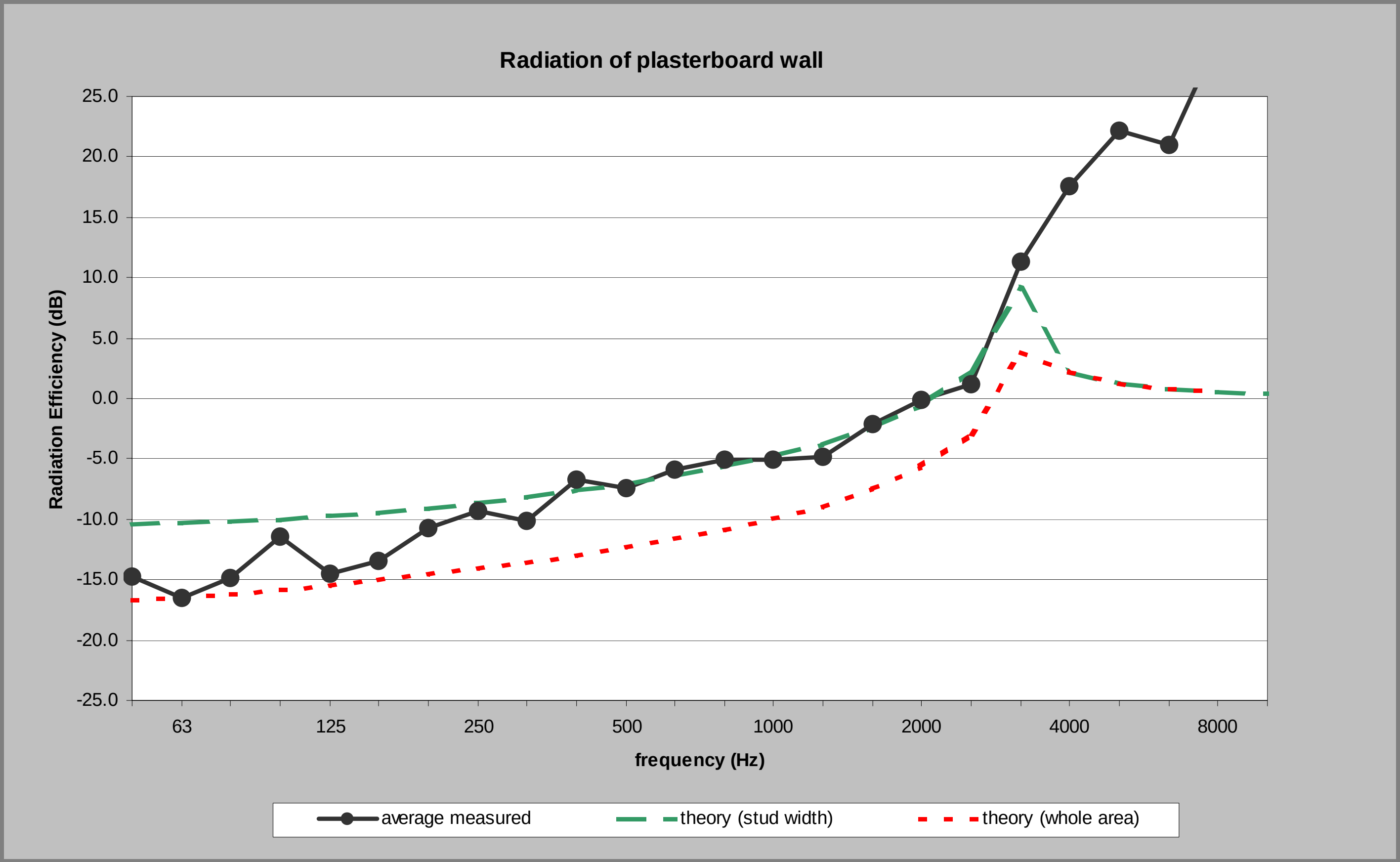
Prediction of Flanking Transmission

A simple expression for flanking transmission R_f

$$R_f = R_i - 10\log\sigma + Joint\ loss + 10\,Log\left(\frac{A}{A_f}\right)$$

Where
Rf is the flanking transmission
Ri is the transmission of the flanking element
A is the area of the main partition
Af is the area of the flanking element which radiates into the receive room

Measured Radiation Efficiency



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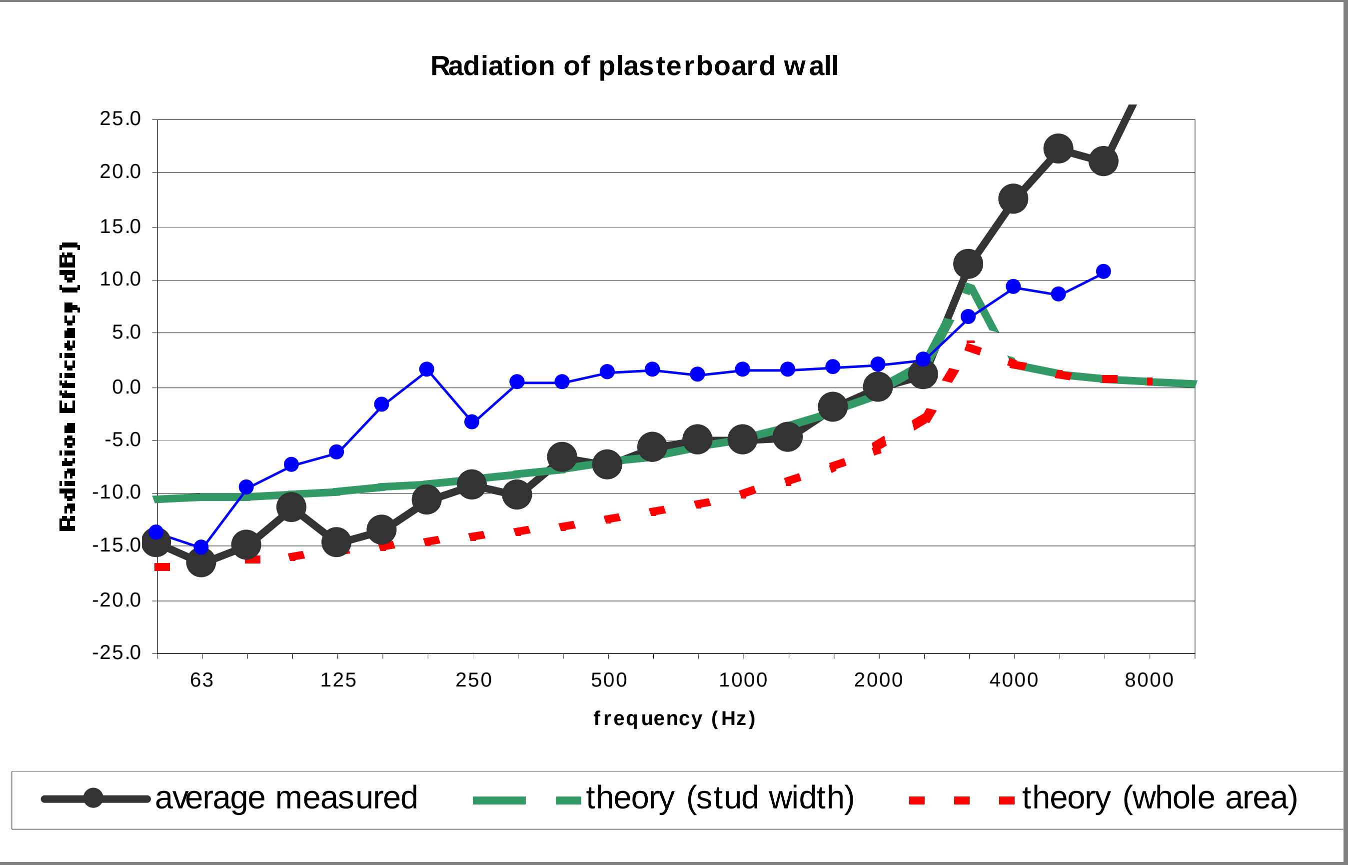
Measured Radiation Efficiency



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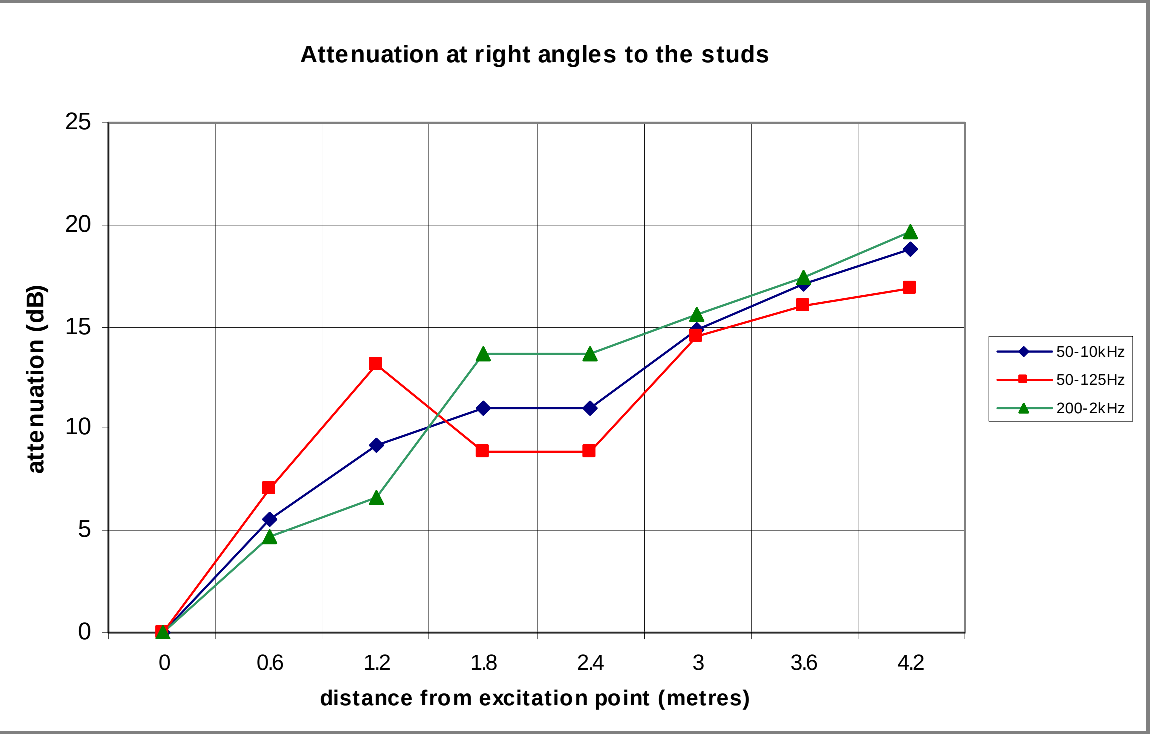
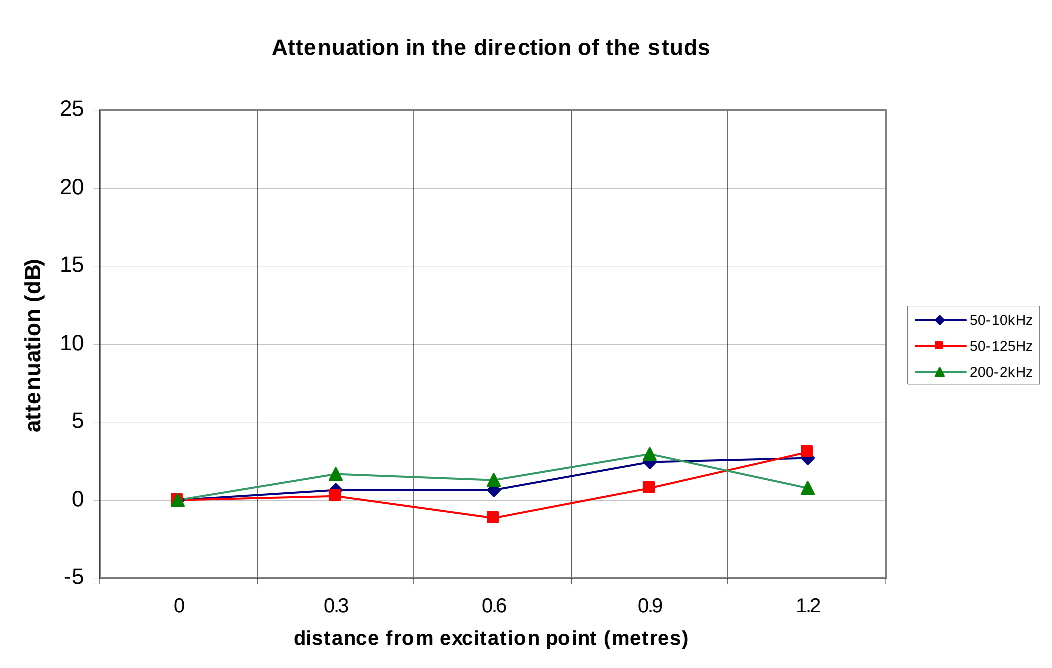
Attenuation of structure-borne sound



Attenuation of structure-borne sound



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Flanking Transmission

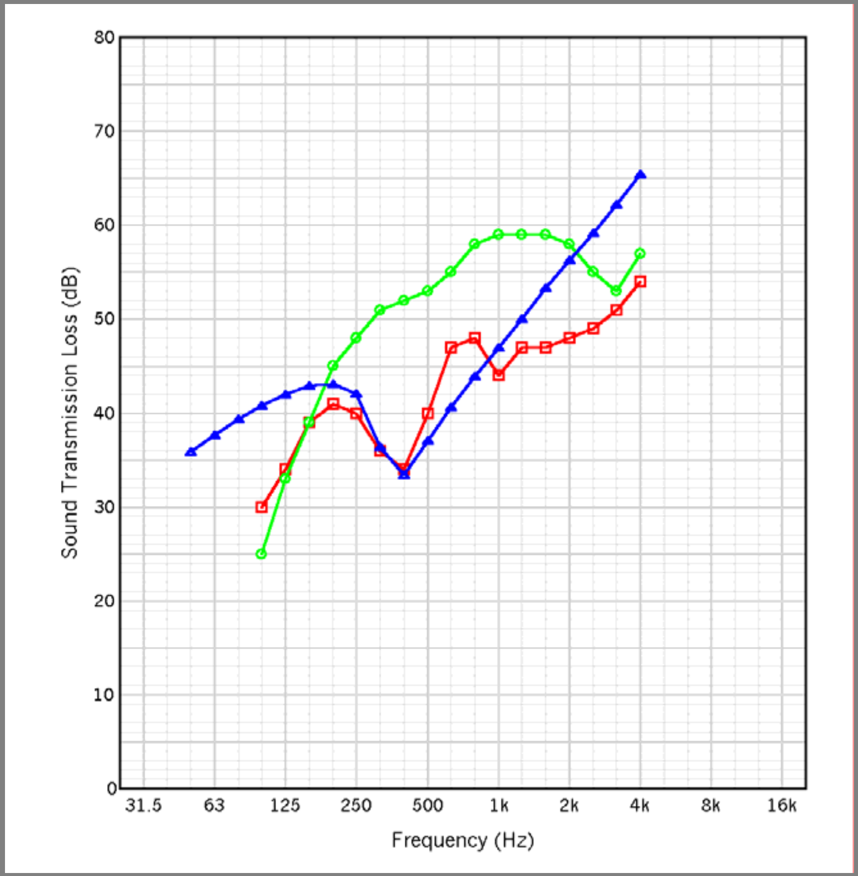

Fig 7 Predicted flanking transmission for 32mm thick timber floor

- measured transmission with flanking
- Transmission loss of wall
- predicted flanking transmission

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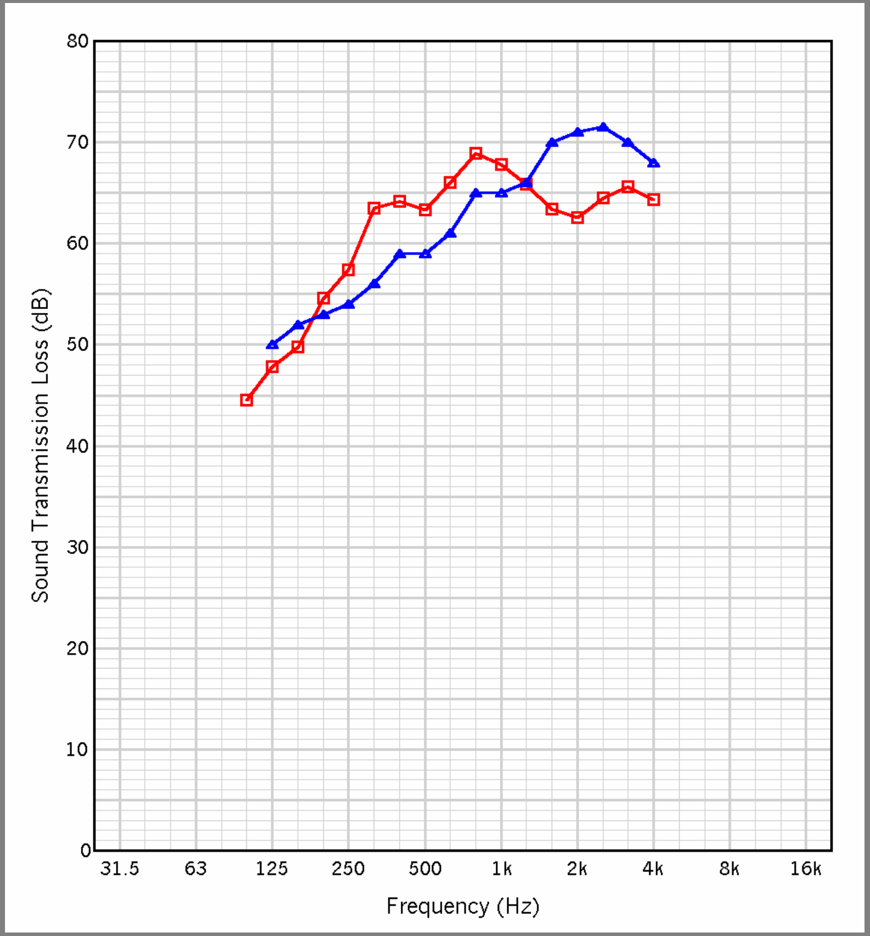
High performance walls

Sound Transmission Loss of Cinema Wall

- 2x16mm plasterboard each side of 225mm airgap
- 400mm Concrete

	Thickness (mm)	Mass (kg)
2x16mm plasterboard on 2x100x50 studs	290	68 kg/m2
400mm Solid concrete blocks	400	900kg/m2



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Conclusions

- Timber framed construction has significant practical advantages
- Sound Insulation has traditionally been perceived as a disadvantage
- Techniques are available to achieve high sound insulation
- High performance designs are vulnerable to poor construction

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