

INSUL Prediction Software

A Short Course for Knauf Insulation

Keith Ballagh

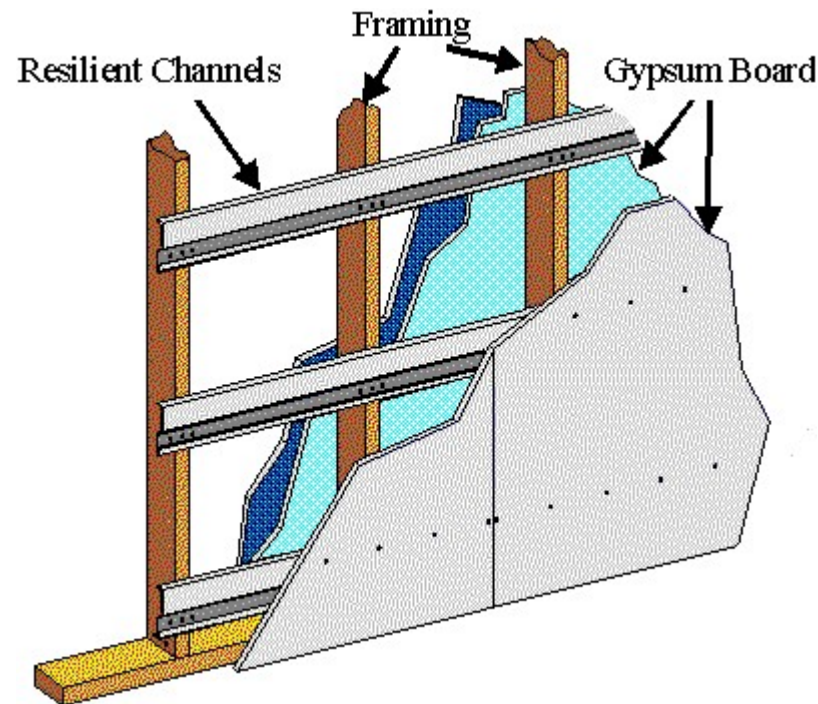
MARSHALL DAY 
Acoustics



A Quick Introduction



- Predicting performance of a stud wall



A Quick Introduction



WALL CEILING FLOOR ROOF GLAZING

Panel 1 Frame 1 Panel 2 Frame 2 Panel 3 Glazing Porous Material

Layer 1 Layer 2 Layer 3 Layer 4 Layer 5 Layer 6

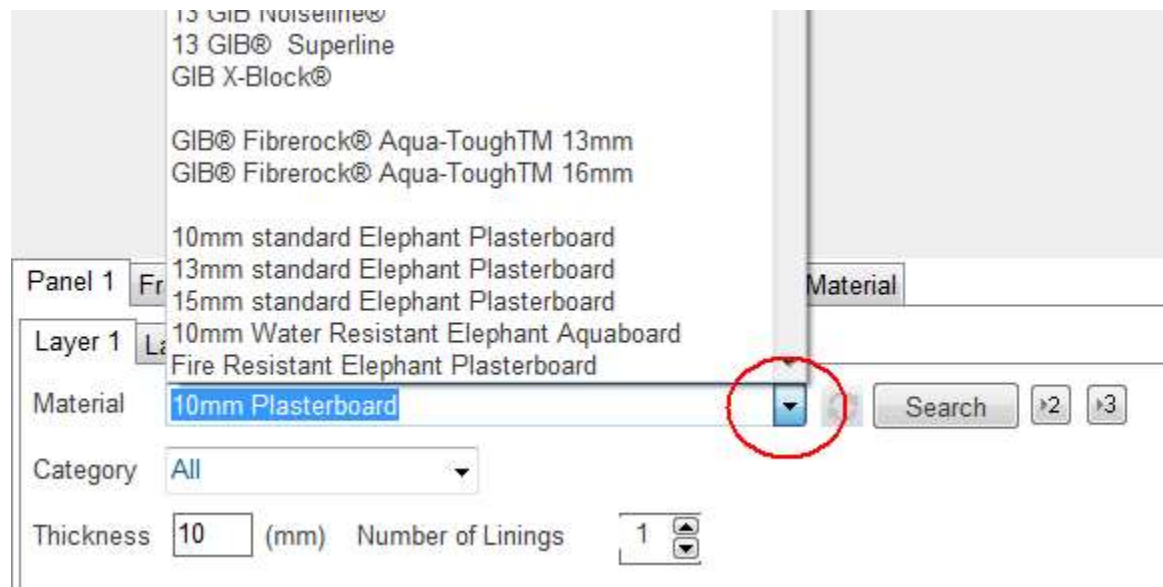
Material: 10mm Plasterboard [Refresh] Search [x2] [x3]

Category: All

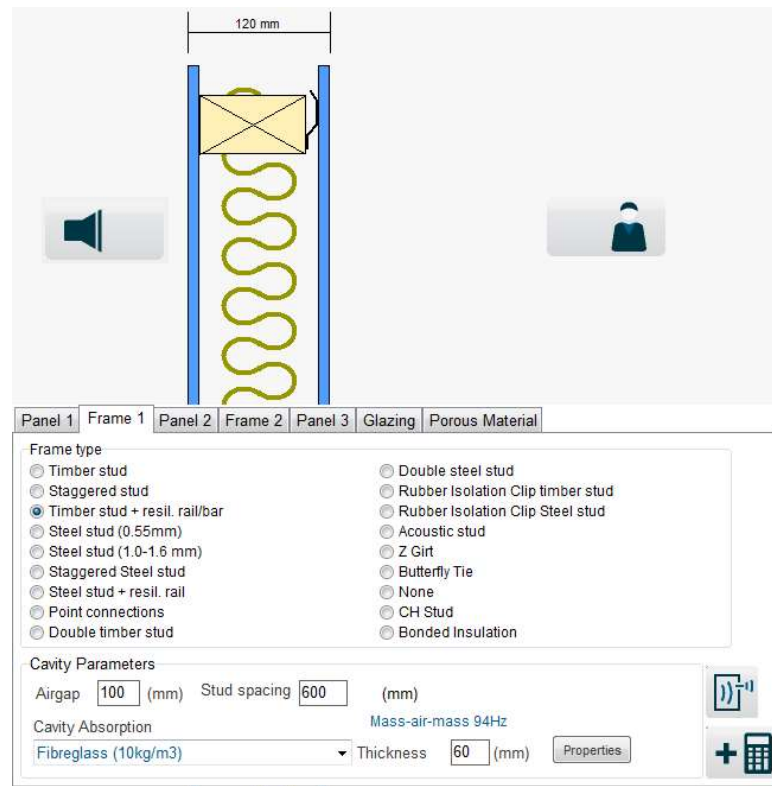
Thickness: 10 (mm) Number of Linings: 1 [Up] [Down]

Material Properties Materials List Editor

Select materials



Select Frame/Connections



Panel 2

WALL CEILING FLOOR ROOF GLAZING

Panel 1 Frame 1 Panel 2 Frame 2 Panel 3 Glazing Porous Material

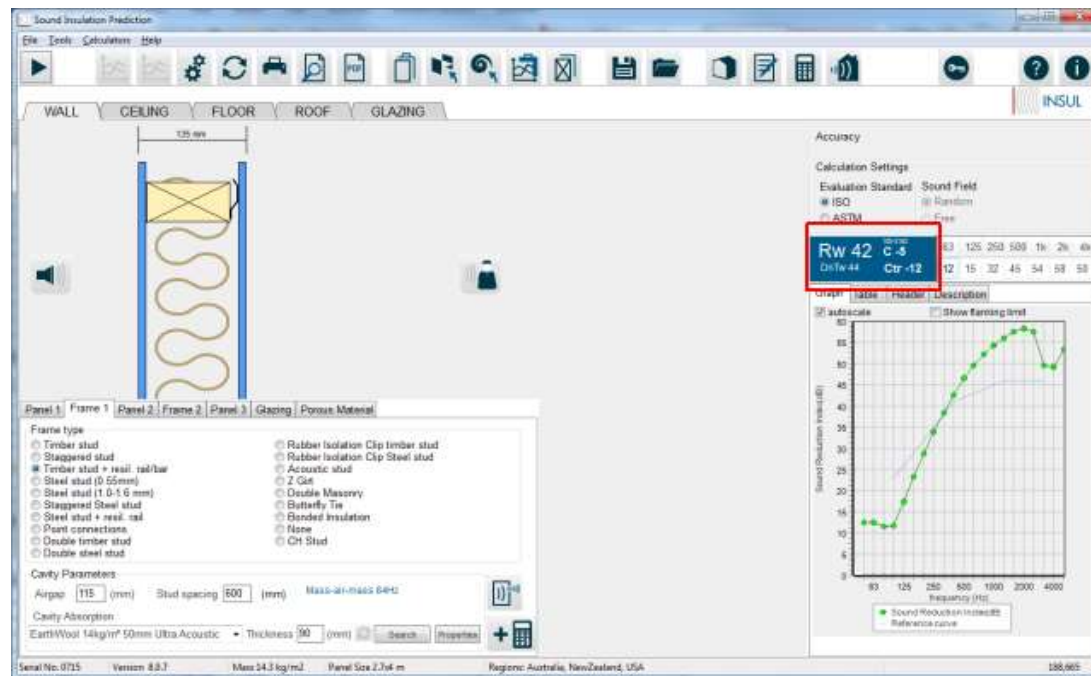
Layer 1 Layer 2 Layer 3 Layer 4 Layer 5 Layer 6

Material 10mm Plasterboard

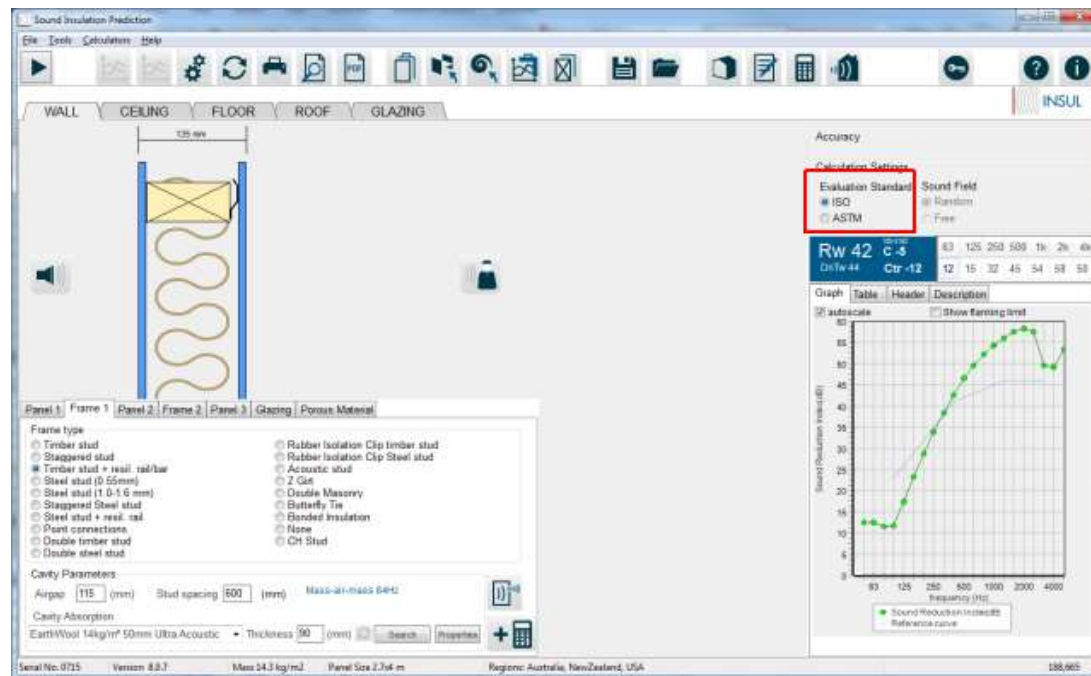
Category All

Thickness 10 (mm) Number of Linings 1

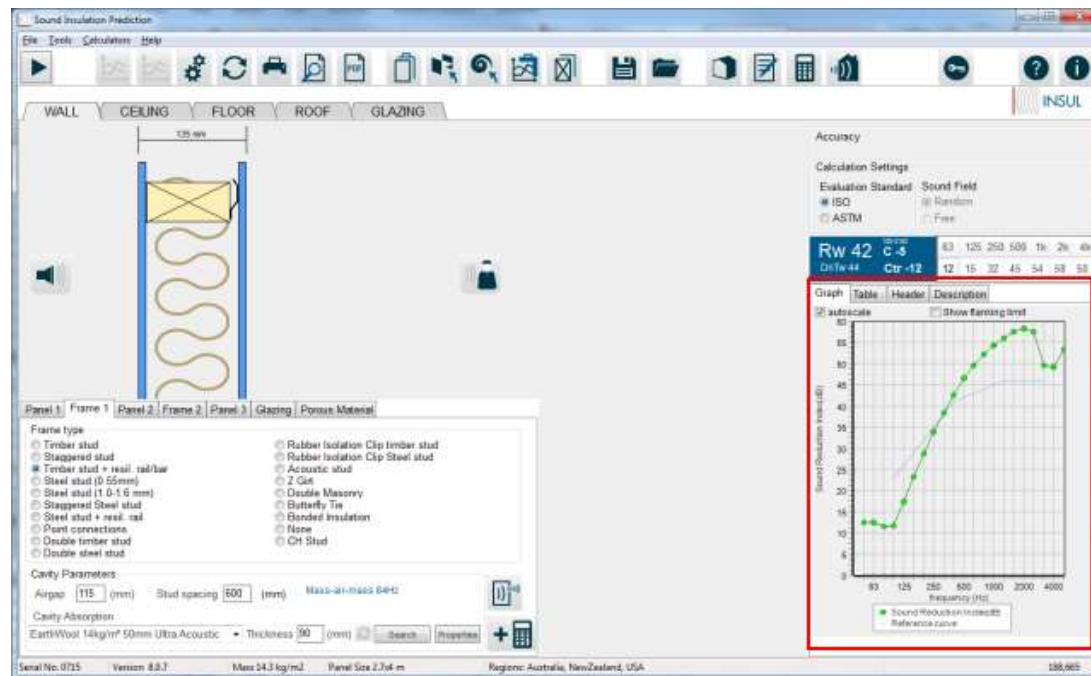
Results



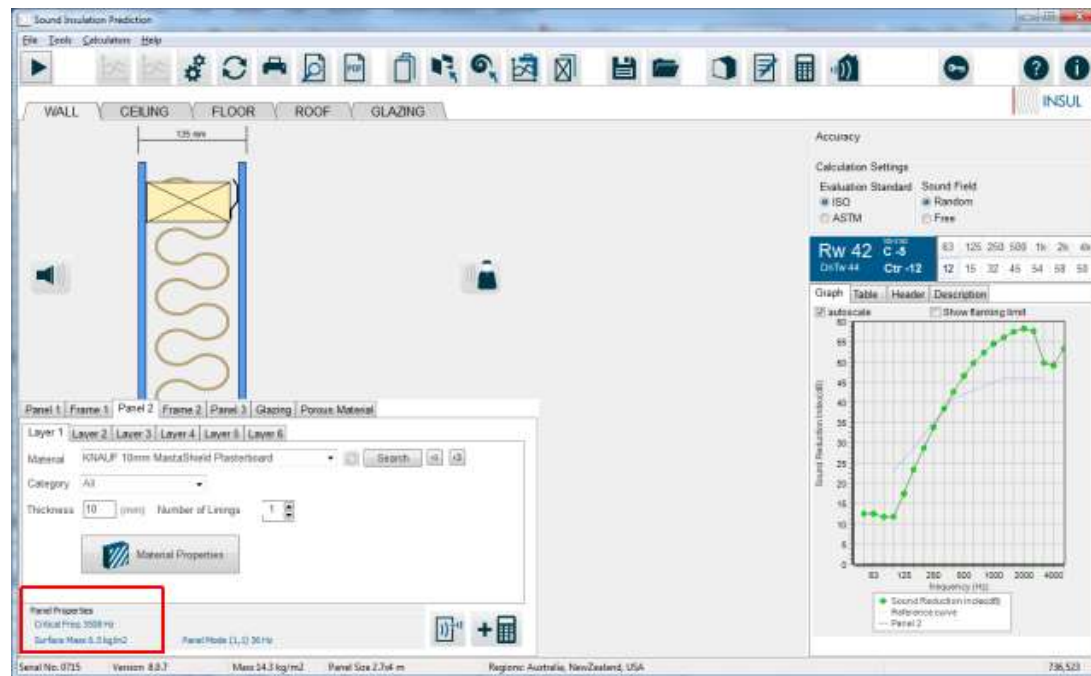
Results



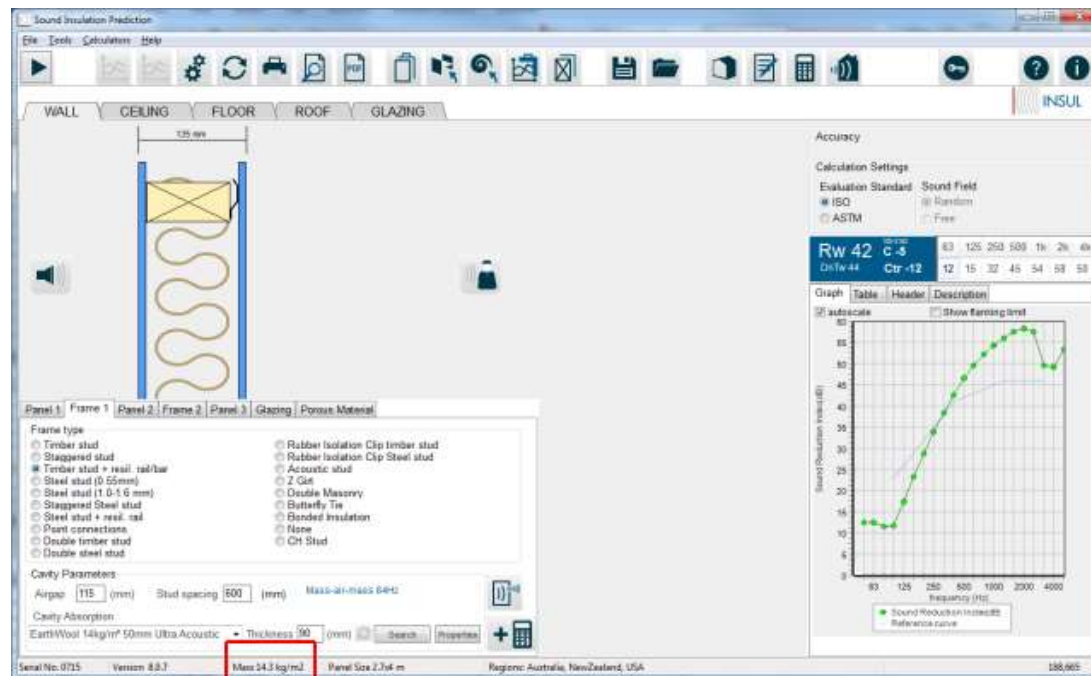
Results



Results



Results



In more detail

- Panels, Layers and Linings
- Frame (connections)
- Cavity Absorption
- Settings, Saving, Printing

Selecting materials

- Choose from drop down box, or

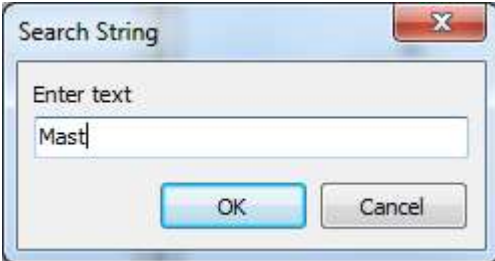
Material

- Type in first letters ('Knau'), or
- Narrow down selection by

- Filter list by Category
- Searching by text string eg




(Reset after Searching )

Category





A dialog box titled "Search String" with a close button (X) in the top right corner. It contains a text input field with the text "Mast" and two buttons at the bottom: "OK" and "Cancel".

Layers

- You can set the number of linings for a given material.  Number of Linings  

(Note 2 layers of 13mm gypsum board is not the same as 1 layer of 26mm gypsum board)

- If you have different materials fixed to a stud you use “layers” [max of 6]

- If your wall is symmetrical you can use the   buttons to transfer your build-up to panel 2 or panel 3.

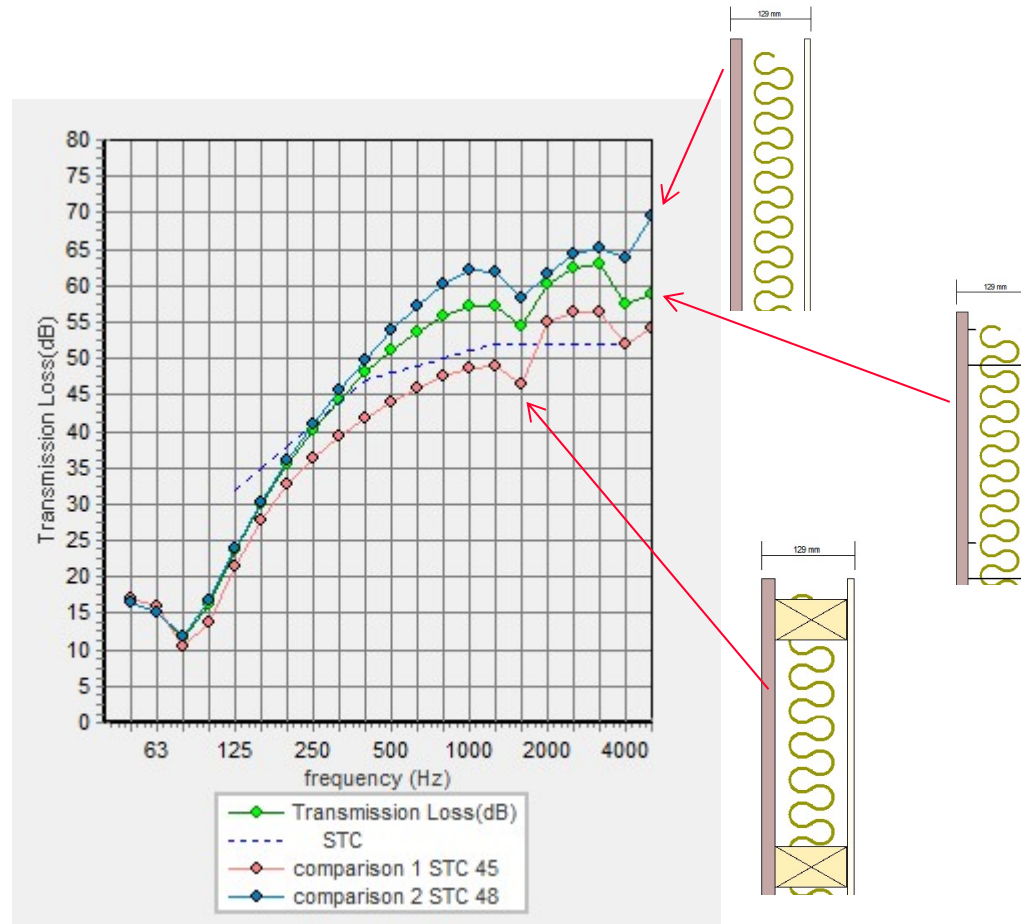
Frame type (connections)

- Most practical double or triple panel walls have a structural or other connection between sides.
- The connection is a very important path at mid and high frequencies
- INSUL has pre-defined connection types and you must choose the closest type to your construction

Connections

- Timber stud = line connection (worst case)
- Double stud (timber or steel) and none = no connection at all (no path except the air cavity) best case
- Other types are intermediate and all have a defined attenuation (not editable at this stage)
- Read help file for guidance

Example



Equivalents

PAC International RSIC / ST001 clip



Pliteq Genie clip



Kinetics IsoMax clip



Frames/Connections

WALL

Frame type

- Timber stud
- Staggered stud
- Timber stud + resil. rail/bar
- Steel stud (0.55mm)
- Steel stud (1.0-1.6 mm)
- Staggered Steel stud
- Steel stud + resil. rail
- Point connections
- Double timber stud
- Double steel stud
- Rubber Isolation Clip timber stud
- Rubber Isolation Clip Steel stud
- Acoustic stud
- Z Girt
- Double Masonry
- Butterfly Tie
- Bonded Insulation
- None
- CH Stud

CEILING

FLOOR

ROOF

Frame type

- Solid joist(timber or Twinaplate)
- Suspended light steel grid
- Resilient clip or channel
- Rubber Isolation Clip
- Separate joists
-  Z Girt
- Mason FSN floating floor mount
- Kinetics RIM System
- Steel Spring Hanger
- Resilient batten and steel rail

Frames/Connections

Cavity Parameters

Airgap (mm) Stud spacing (mm)

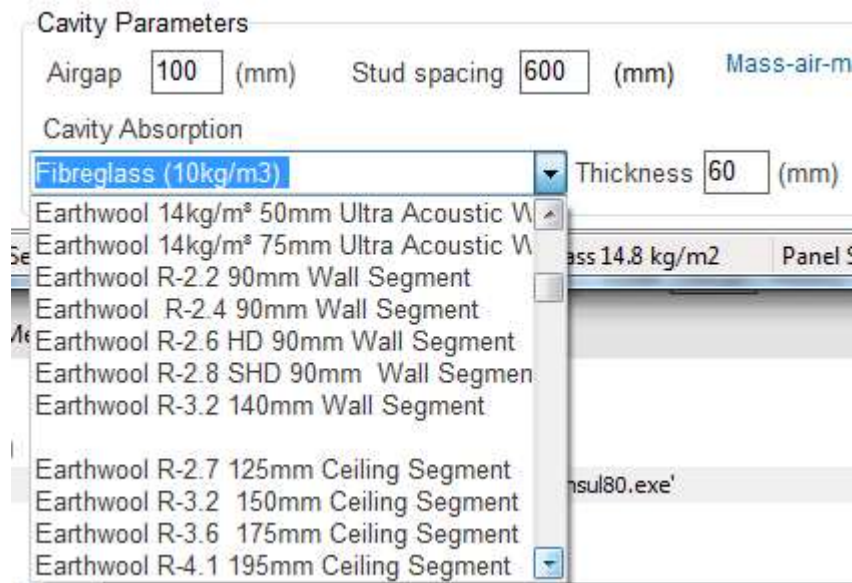
Cavity Absorption

▼ Thickness (mm)

- Air gap = distance between linings
- For single stud walls = stud size
- For double stud walls = 2 x stud size + gap between frames

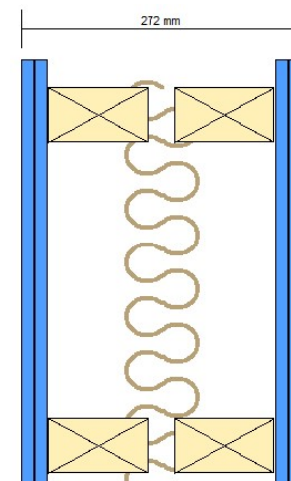
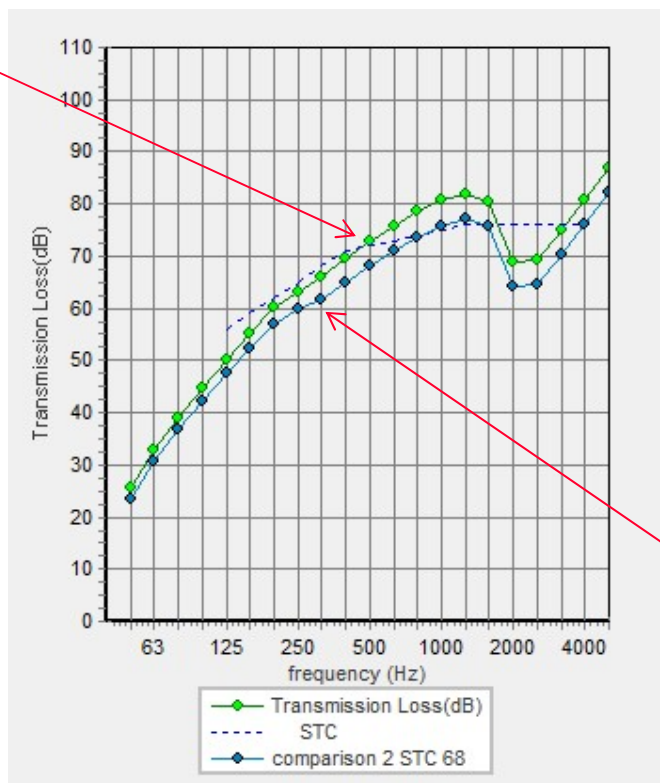
Cavity absorption

- Choose from drop down list
- For 2 layers set thickness = 2 x thickness of single layer
- Cavity absorption can be less than airgap



Effect of Absorption

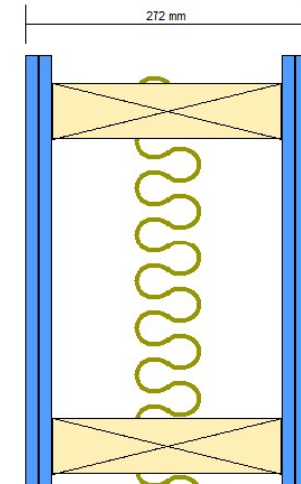
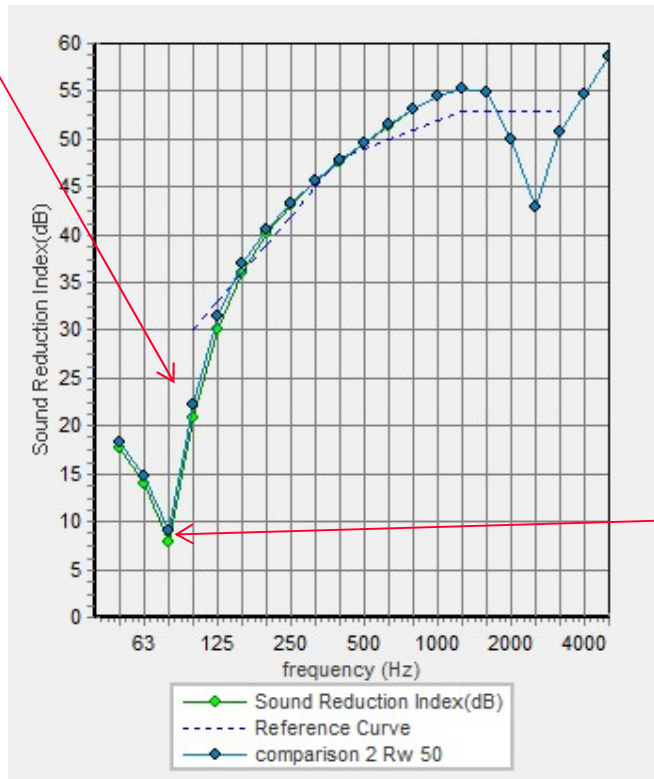
Earthwool UltraAcoustic (14kg/m^3)
 $R_f = 14,000 \text{ Rayl/m}$
 $R_w/\text{STC } 72$



75mm fibreglass (10kg/m^3)
 $R_f = 4,000 \text{ Rayl/m}$
 $R_w/\text{STC } 68$

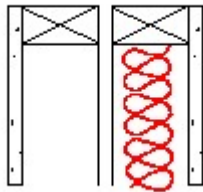
Effect of Absorption

Earthwool UltraAcoustic (14kg/m^3)
 $R_f = 14,000 \text{ Rayl/m}$
 $R_w 50 \text{ STC } 47$

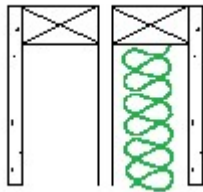


75mm fibreglass (10kg/m^3)
 $R_f = 4,000 \text{ Rayl/m}$
 $R_w 49 \text{ STC } 47$

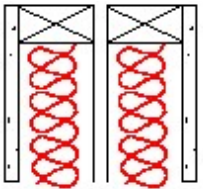
Effect of Flow resistivity



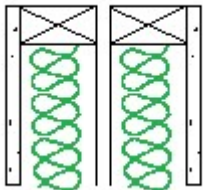
cavity infill 90mm 12kg/m³ (=4000 Rayl/m) **STC 56**



cavity infill 90mm 16kg/m³ (=8000 Rayl/m) **STC 58**



cavity infill 2x90mm 12kg/m³ (=4000 Rayl/m) **STC 59**



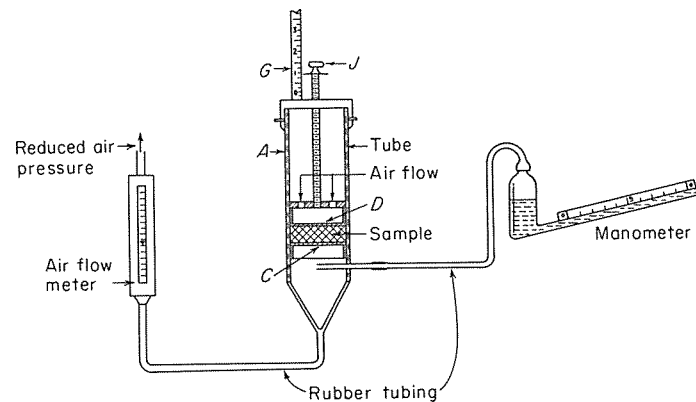
cavity infill 2x90mm 16kg/m³ (=8000 Rayl/m) **STC 61**

Flow Resistivity

Flow Resistivity. For bulk materials the flow resistivity (specific flow resistance per unit thickness of material) is

$$R_1 = \frac{R_f}{l} = \frac{\Delta p}{lu} \quad \text{mks rays/m} \quad (10.2)$$

where l = thickness of the material, m



Settings



- Region (different Countries have different brands, choose Australia to simplify lists)
- Units (inches and lbs for USA)
- Language
- Edge damping (leave on)
- Sewell's correction (leave on)
- Rain Noise (generally set Lab rainfall, Intensity and dBA)

Changing Regional Settings



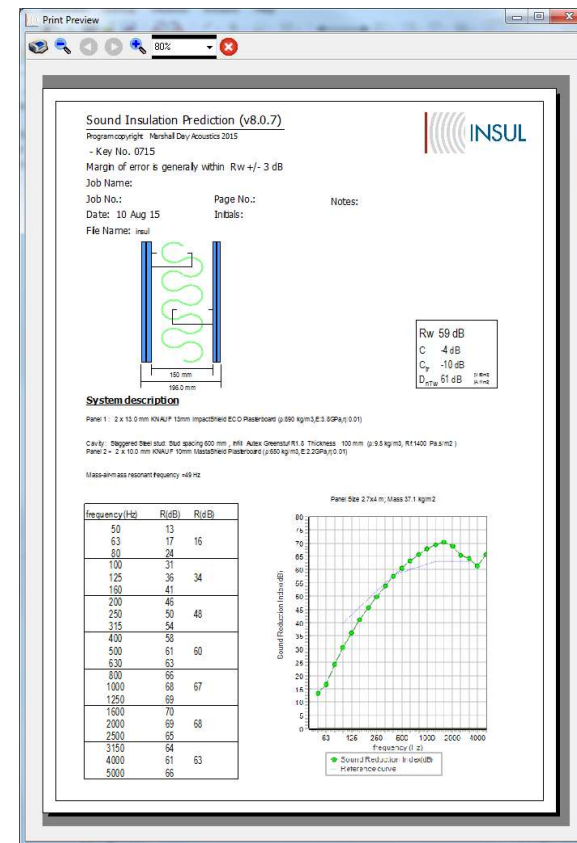
Save/Recall

- You can save a complex construction for QA purposes or for later recall.



Print (or PDF)

- You can preview/print/pdf the main results (Custom logo possible)



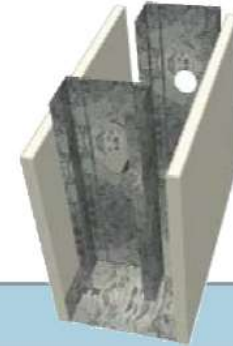
End of part 1

Some Practice

KSW20

WALL LINING: [Side 1] 1 layer of 10mm **MastaShield**
 [Side 2] 1 layer of 10mm **MastaShield**

FRAME: Staggered steel studs at maximum 600mm centres [300mm staggered]
 [10mm **MastaShield** may be substituted with 10mm **WaterShield**]



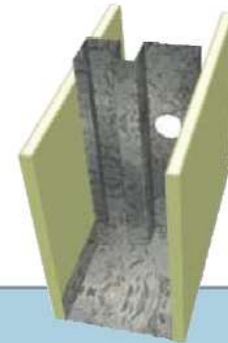
FRL - / - / -	Stud Size (mm)		Max Height UDL 0.25 kPa (m)		Width (mm)	Acoustics Rw (Rw + Ctr)				Acoustic Report Day Design 3094-33 Note: Impact Sound Resistant
	Stud Depth	Stud BMT	Non-Load Bearing Studs at 600mm	Non-Load Bearing Studs at 450mm		No Insulation	50mm EarthWool 11 kg/m ³	65mm Polyester TSB3/ASB3	75mm Polyester 14 kg/m ³	
	64mm stud in 92mm track	0.5	2.375	2.59	112	33 (26)	42 (31)	42 (31)	43 (32)	
		0.75	2.83	3.19						
		1.15	3.51	3.87						
	76mm stud in 92mm track	0.55	2.61	2.80	112	33 (26)	42 (31)	42 (31)	43 (32)	
		0.75	3.00	3.32						
		1.15	3.60	4.00						
92mm stud in 150mm track	0.55	2.74	2.99	170	34 (26)	44 (32)	44 (32)	45 (33)		
	0.75	3.19	3.48							
	1.15	3.75	4.12							

More practice

KSW240

WALL LINING: [Side 1] 1 layer of 10mm **SoundShield**
[Side 2] 1 layer of 10mm **SoundShield**

FRAME: Rondo QUIET STUDS® at maximum 600mm centres



FRL - / - / -	Stud Size (mm)		Max Height UDL 0.25 kPa (m)		Width (mm)	Acoustics Rw (Rw + Ctr)				Acoustic Report Day Design 3094-12
	Stud Depth	Stud BMT	Non-Load Bearing Studs at 600mm	Non-Load Bearing Studs at 450mm		No Insulation	50mm EarthWool 11 kg/m³	65mm Polyester TSB3/ASB3	75mm Polyester 14 kg/m³	
					92		0.55	3.70 No noggings	4.02 No noggings	

More practice

KSW380

WALL LINING: [Side 1] 1 layer of 13mm **FireShield** plus 1 layer of 13mm **MastaShield**

[Side 2] 1 layer of 13mm **FireShield** plus 1 layer of 13mm **MastaShield**

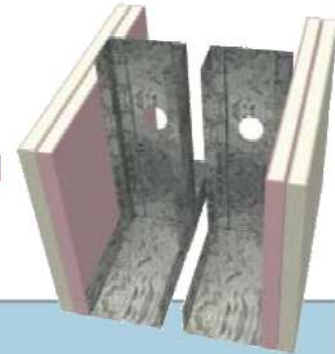
FRAME: Double steel studs at maximum 600mm centres with minimum 20mm air gap

[13mm **FireShield** can be substituted with 13mm **MultiShield** or 13mm **ImpactShield** or 13mm **QuadShield**]

[13mm **MastaShield** can be substituted with 13mm **WaterShield**]

["1 x" indicates insulation required in one frame only]

["2 x" indicates insulation required in both frames]



FRL – /90/90 60/60/60 rated from both sides Fire Report FAR3210 FAR3230	Stud Size (mm)		Max Height UDL 0.25 kPa (m)		Width (mm)	Acoustics Rw (Rw + Ctr)						Acoustic Report Day Design 3094-48 Note: Impact Sound Resistant – Discontinuous Construction
	Stud Depth	Stud BMT	Non-Load Bearing Studs at 600mm	Non-Load Bearing Studs at 450mm		No Insulation	1 x 50mm EarthWool 11 kg/m ³	2 x 50mm EarthWool 11 kg/m ³	1 x 65mm Polyester TSB3/ASB3	2 x 65mm Polyester TSB3/ASB3	1 x 75mm EarthWool 11 kg/m ³	
	64 148mm cavity	0.5	2.72	2.93	200	51 (42)	61 (48)	64 (51)	58 (48)	61 (51)	62 (50)	
		0.75	3.25	3.53								
		1.15	3.58	3.93								
	64 200mm cavity	0.5	2.72	2.93	252	52 (44)	62 (50)	65 (53)	59 (50)	62 (53)	63 (52)	
		0.75	3.25	3.53								
		1.15	3.58	3.93								

Staggered Stud timber

KTW21

WALL LINING: [Side 1] 1 layer of 10mm **MastaShield**
 [Side 2] 2 layers of 10mm **MastaShield**

FRAME: Staggered timber studs at maximum 600mm centres [300mm staggered]
 [10mm **MastaShield** can be substituted with 10mm **WaterShield**]



FRL - / - / -	Stud Size (mm)		Max Height UDL 0.25 kPa (m)		Width (mm)	Acoustics Rw (Rw + Ctr)				
	Stud Depth	Stud Width	Non-Load Bearing MGP10 Timber Studs at 600mm	Non-Load Bearing MGP10 Timber Studs at 450mm		No Insulation	R1.5 EarthWool	R2.0 EarthWool	R1.5 Polyester	
- / - / -	70mm on 90mm plate	35	3.33	3.53	120	38 (33)	45 (36)	47 (37)	45 (36)	Acoustic Report Day Design 3094-45 Note: Impact Sound Resistant
		45	3.50	3.73						
	90mm on 120mm plate	35	4.11	4.39	150	38 (33)	47 (38)	48 (39)	47 (38)	
		45	4.35	4.67						

Help



Insul 8

Hide Back Forward Print

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 - Getting started
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 - Sound insulation
 - Impact Sound
 - Rain Noise
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 - Rating Methods
 - Outdoor to Indoor Calculator
 - Composite TL Calculator
 - Materials Editor
 - Resources

Getting Started

Start with a very simple example of predicting the transmission loss of a sheet of gypsum plasterboard. Along the top of the main screen you will see a row of tabs marked Wall, Ceiling, Floor, Roof, Glazing:

WALL CEILING FLOOR ROOF GLAZING

These tabs indicate what sort of construction you want to model. For wall and ceiling the calculation is of the airborne sound reduction, for [floor](#) it is the impact sound level, for [roof](#) it is the noise from rain, and for [Glazing](#) it is the airborne sound reduction of different glazing systems. For now click on the wall tab.

In the bottom left hand quarter of the window you will see what looks like a notebook with tabs sticking up. These tabs are labelled panel 1, Frame 1, panel 2, Frame 2, Panel 3 etc.

Panel 1 Frame 1 Panel 2 Frame 2 Panel 3 Glazing Porous Material

Initially **panel 1** is selected and the Material is Gypsum plasterboard. You build up the partition by working across the tabs, setting the properties of each component as you go. For the moment start with [Panel 1](#). One may see what other materials are available by clicking on the little triangle at the right hand side of the **material** box, a drop down list will appear and any of the available materials can be selected by clicking on the list. (note there are [tools](#) to help you find the [material you want](#))

Layer 1 Layer 2 Layer 3 Layer 4 Layer 5 Layer 6

Material 10mm Plasterboard Search +2 +3

Category All

Thickness 10 (mm) Number of Linings 1

Material Properties Materials List Editor

Wall/Ceiling/Floor/Roof



- Wall and Ceiling Tabs = airborne
- Floor tab = impact sound
- Roof tab = rain noise

Impact Sound

- Much the same as for airborne sound
- Can choose a floor covering from standard list

Floor Covering

- Floor coverings have a big effect on impact noise (but insignificant effect on airborne noise).
- INSUL has a database of floor coverings
- Organised into different types
- When you select the “Floor” tab the list of floor covers is available.
- The database is different for heavy or masonry floors to timber or light weight floors.

Floor Coverings

Sound Insulation Prediction

File Tools Calculators Help

WALL CEILING FLOOR ROOF GLAZING

INSUL

Accuracy

Calculation Settings

Evaluation Standard: ISO ASTM

Sound Field: Random Free

$L_{n,w} 80$
CI -10

63	125	250	500	1k	2k	4k
63	71	77	80	80	79	76

Graph Table Header Description

autoscale Show flanking limit

Panel 1 Frame 1 Panel 2 Frame 2 Panel 3 Glazing Porous Material

Layer 1 Layer 2 Layer 3 Layer 4 Layer 5 Layer 6

Material: Concrete

Category: All

Thickness: 152 (mm) Number of Linings: 1

Material Properties Materials List Editor

Panel Properties

Critical Freq 197 Hz

Surface Mass 355.7 kg/m²

Serial No. 0715 Version 8.0.7 Mass 355.7 kg/m² Panel Size 2.4x2.4 m Regions: Austr... 655,493

Floor Cover

None

Category: All floors

- All floors
- Tile
- Screed
- Timber
- Vinyl
- Cork
- Rubber
- Carpet

More Practice

KF230-KF238

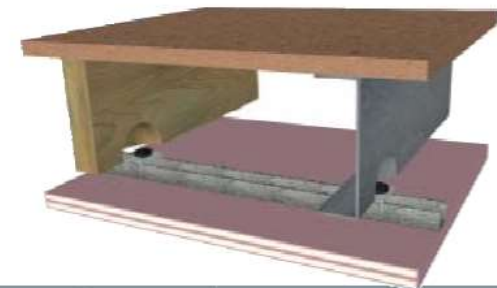
FLOORING: 19mm min particleboard flooring or timber flooring with either carpet, tiles or left bare

FRAME: 140mm min deep timber or steel joists or concrete slab, with resilient mounts and furring channel

[Use **MultiShield** in place of **FireShield** for external fire rated ceilings]

[Carpet requires an underlay and tiles require a fibre cement underlay]

[Impact acoustic values determined using insulation]



System	FRL <small>Rated from below only</small>	RISF	Plasterboard Ceiling Lining	Max Framing Centres (mm)	Acoustics – Airborne Rw (Rw + Ctr)			Acoustics – Impact Ln,w (Ln,w + Ci)	
					No Insulation	50mm EarthWool 11 kg/m ³	65mm Polyester ASB3/TSB3	Carpet and Underlay	Tiled or Left Bare
KF230	30/30/30 <small>Fire Report FAR 2879</small>	–	1 layer of 13mm FireShield	600	47 (42)	51 (45)	51 (44)	27 (31)	65 (64)
KF231	60/60/60	30	2 layers of 13mm FireShield	450	51 (46)	56 (50)	55 (49)	26 (30)	63 (62)
KF232	60/60/60	–	1 layer of 16mm FireShield	450	48 (43)	53 (47)	52 (47)	27 (31)	65 (64)
KF233	60/60/60	60	1 layer of 13mm FireShield (applied first) plus 1 layer of 16mm FireShield	600	53 (48)	56 (51)	56 (50)	26 (30)	62 (61)
KF234	60/60/60	60	2 layers of 16mm FireShield	600	54 (48)	56 (51)	56 (51)	26 (30)	62 (61)
KF235	90/90/90	60	2 layers of 16mm FireShield	450	54 (48)	56 (51)	56 (51)	26 (30)	62 (61)
KF236	90/90/90	60	3 layers of 13mm FireShield	450	55 (50)	59 (53)	58 (53)	26 (30)	61 (60)

Acoustic Report
Day Design
3094-26
3094-50

MARSHALL DAY
Acoustics 

A breather

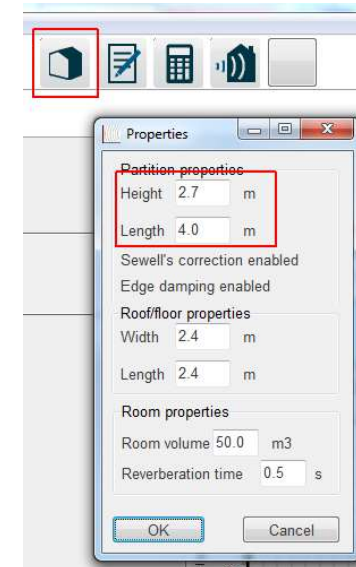
Low Frequency

factors to be aware of

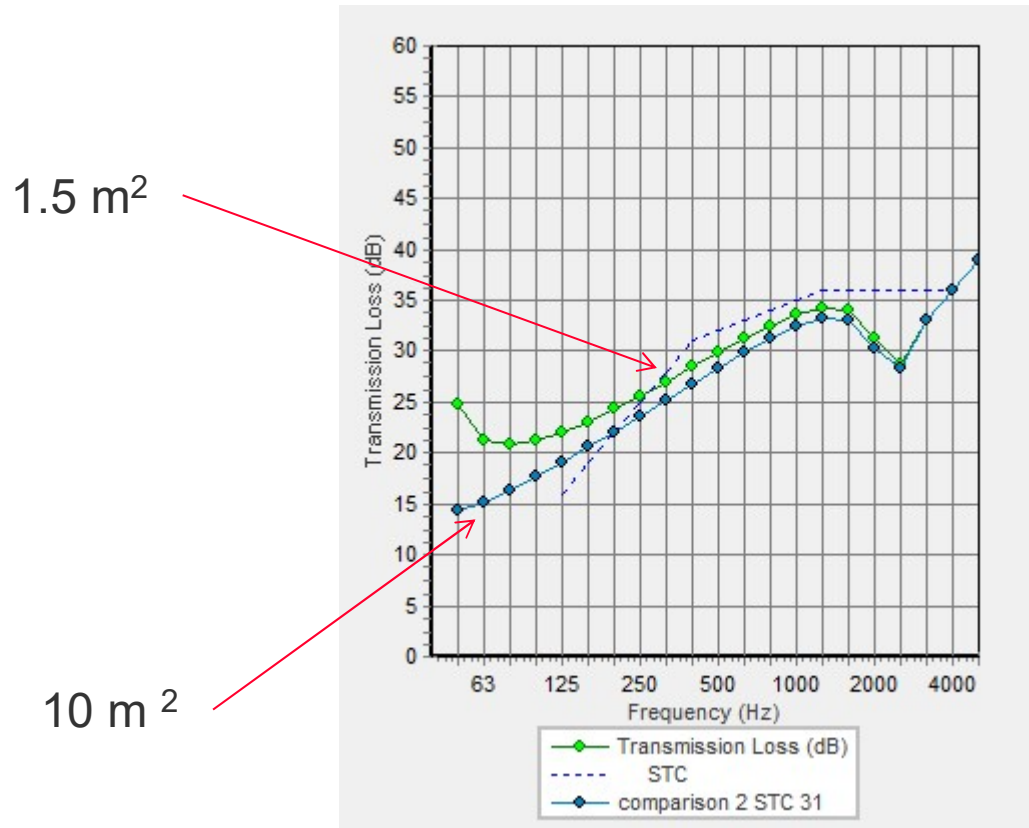
- Partition size (Sewell's correction)
 - Due to poor radiation efficiency (size versus wavelength)
- Mass-air-mass resonance
- Panel Modes

Panel Size

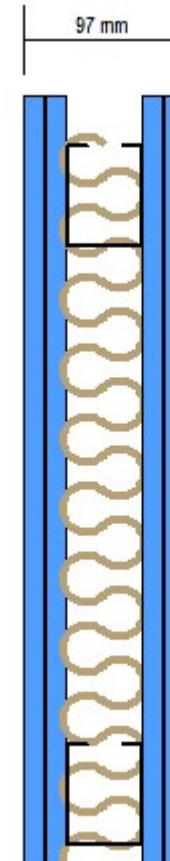
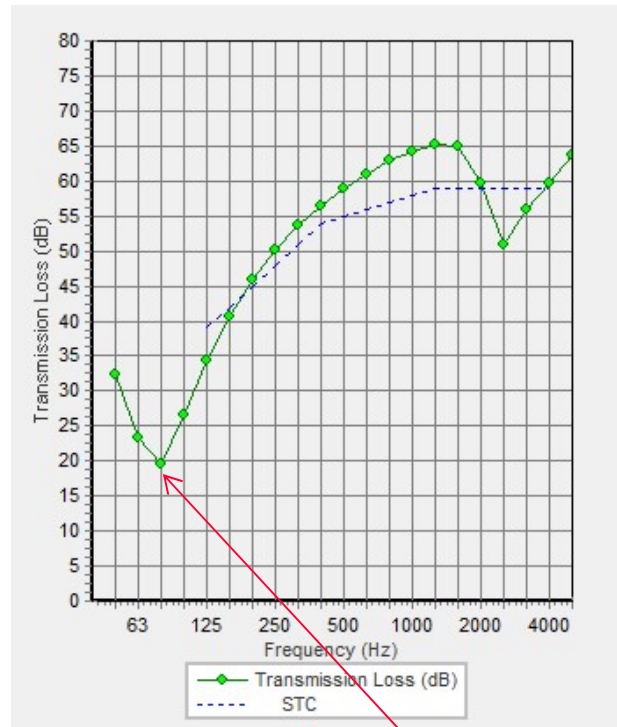
- Standard test area is 10 m²
- For small panels (e.g. windows) the apparent sound insulation is better at low frequencies.



Window (6mm) – effect of size



Mass-air-mass Resonance



$$m_1 \text{---} \text{Spring} \text{---} m_2$$

$$k = \frac{\rho c^2}{d}$$

Cavity Parameters

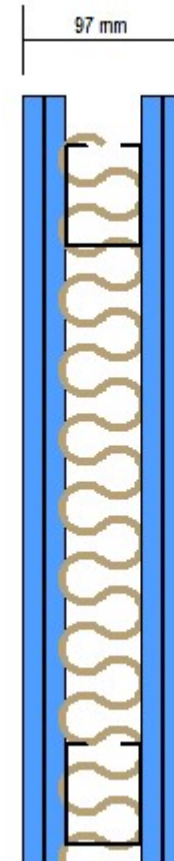
Airgap (mm) Stud spacing (mm)

Cavity Absorption Mass-air-mass 68Hz

EarthWool 14kg/m³ 50mm Ultra Acoustic Thickness (mm)

Mass-air-mass Resonance

- Avoid light weight panels
- Avoid small cavity widths
- Avoid empty cavities

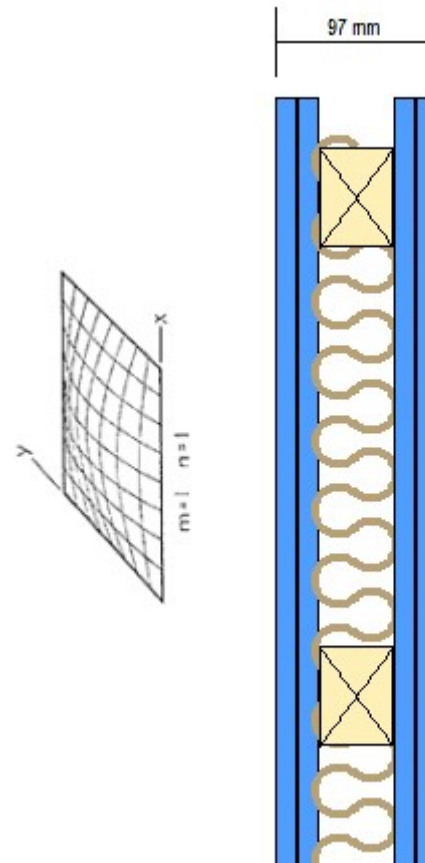
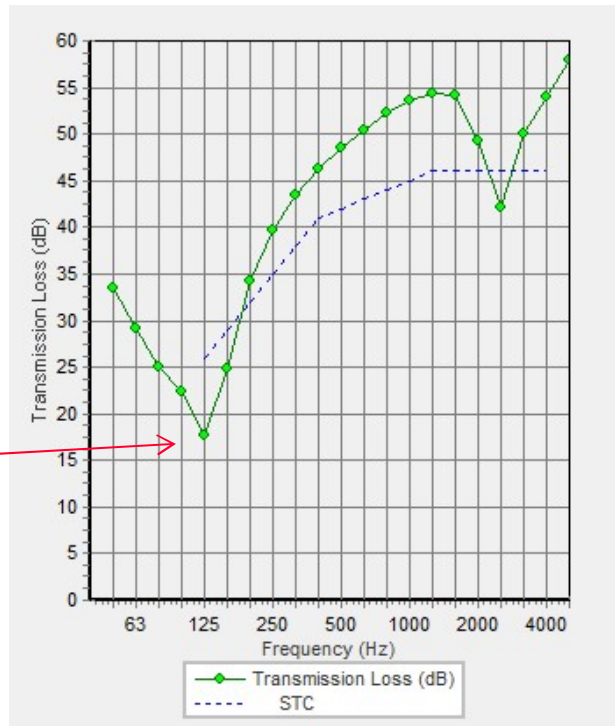


Panel Mode

Material: KNAUF 13mm SoundShield Plasterboard
Category: All
Thickness: 13 (mm) Number of Linings: 2

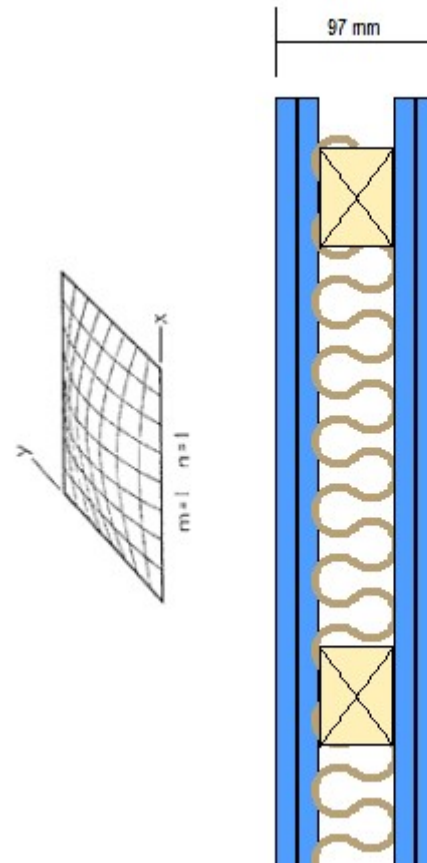
Material Properties

Panel Properties
Critical Freq 2255 Hz
Surface Mass 24.7 kg/m² Panel Mode (1, 1) 62 Hz



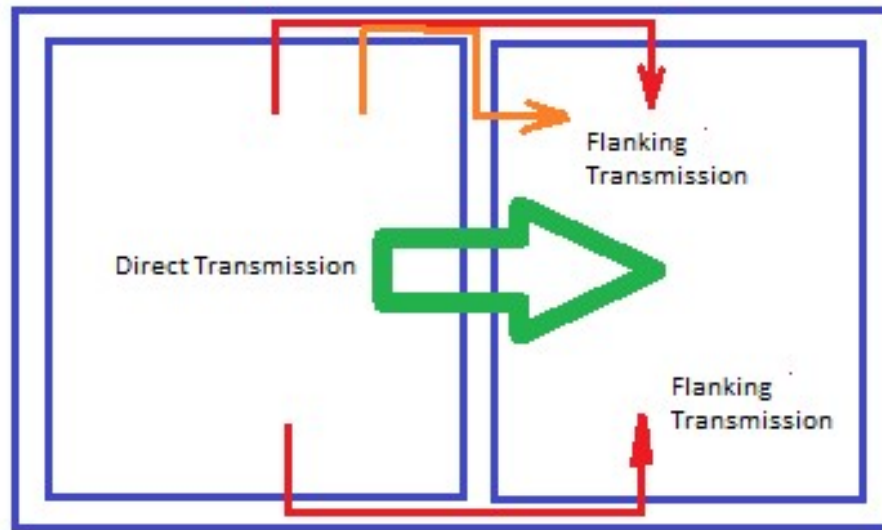
Panel Mode

- Avoid close stud spacings (less than 600mm)
- Avoid stiff panels (thick panels)



Flanking Transmission

- INSUL can predict very high performance (estimated Lab performance)
- which will not be achieved on site,
- sound will be transmitted around the partition by various flanking paths



The picture above shows a few of the possible flanking paths (in red). With 2 rectangular boxes joined together on one face there are 12 possible flanking paths that will contribute

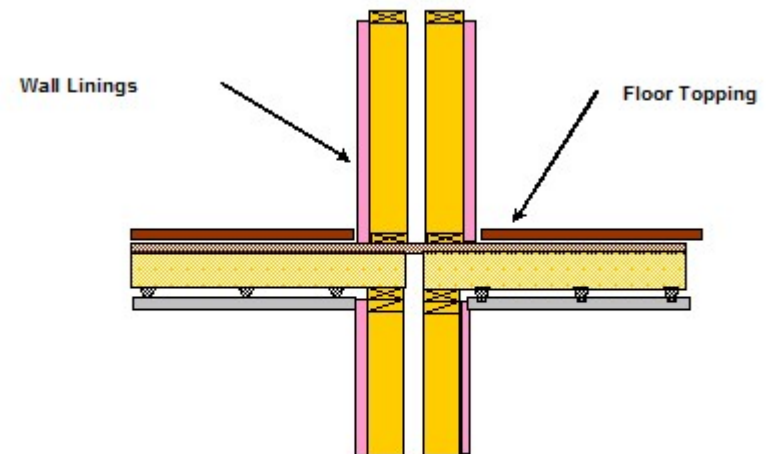
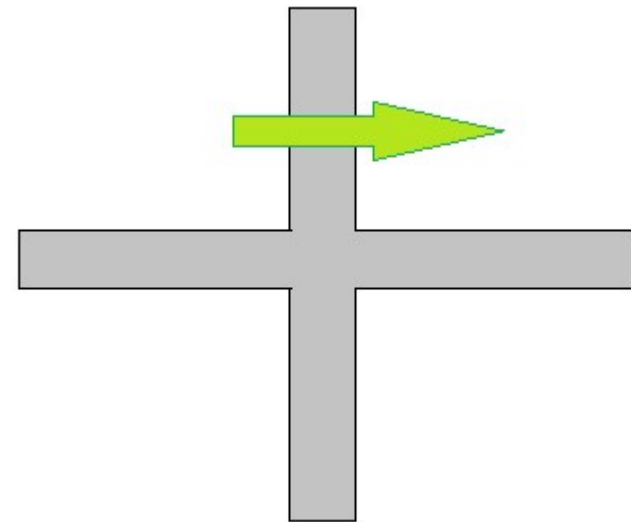
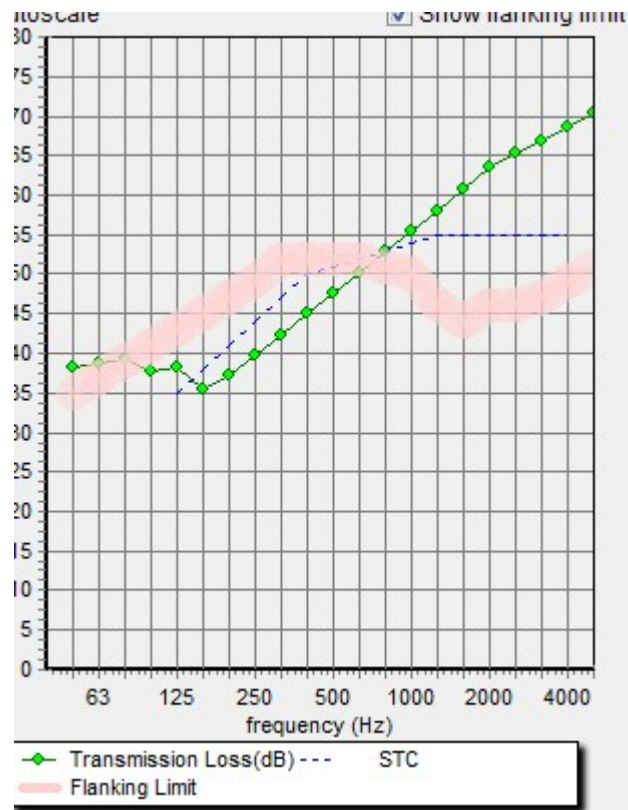
INSUL Flanking

- Select the approximate surrounding construction and indicate the likely magnitude of flanking transmission
- Especially important when high performance partitions (\geq STC/Rw 55) are to be used

Flanking limit

The screenshot displays a software interface for acoustic calculations. A 'Flanking Construction' dialog box is open, showing a cross-section diagram of a wall and floor assembly. The diagram is labeled 'Continuous Floor' and shows a horizontal yellow layer (floor) and vertical yellow layers (walls) meeting at a corner. The 'Settings...' dialog box is also open, with the 'Flanking' tab selected. Under 'Show flanking limit', the 'Lightweight' category is chosen, and the 'Continuous light weight floor (e.g 17mm plywood)' option is selected. A graph in the bottom right corner shows the 'Weighted Impact Sound Pressure level (dB)' on the y-axis (ranging from 40 to 110) against frequency on the x-axis. The graph features a green line with circular markers representing the calculated flanking limit, which starts at approximately 95 dB at 125 Hz and decreases to about 60 dB at 5000 Hz. A blue horizontal line is also visible at approximately 75 dB. The graph has checkboxes for 'autoscale' (checked) and 'Show flanking limit' (unchecked).

- INSUL does not directly calculate the flanking transmission within a building.
- Visual reminder of the level of flanking transmission to alert the user to flanking transmission
- A fuzzy pink line is shown on the graph, to indicate approximately the likely flanking transmission.



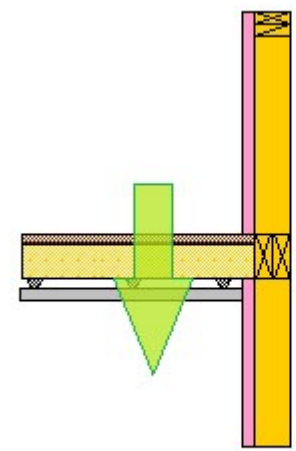
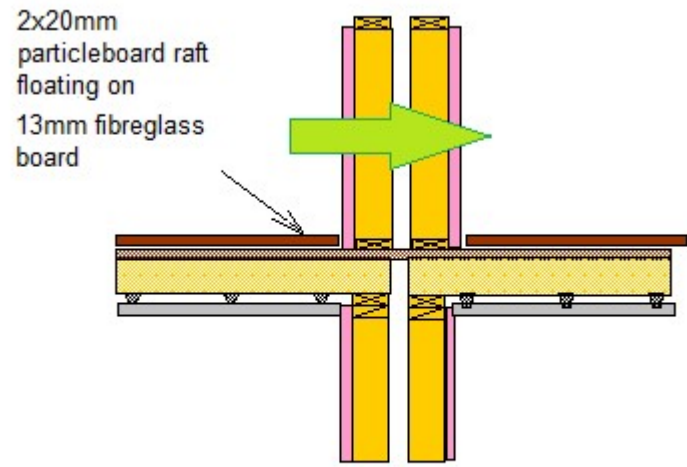
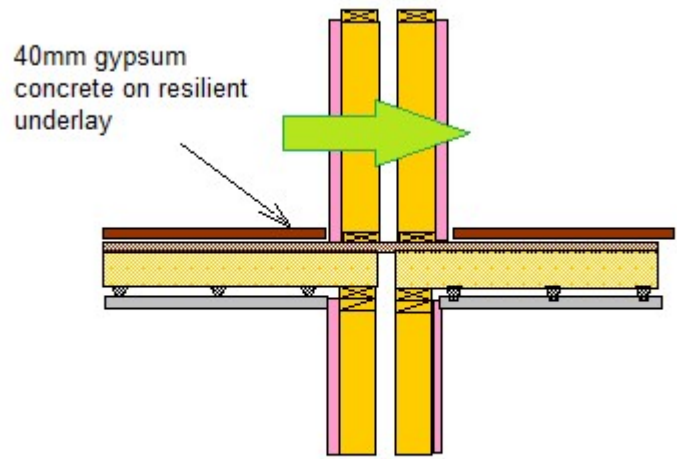
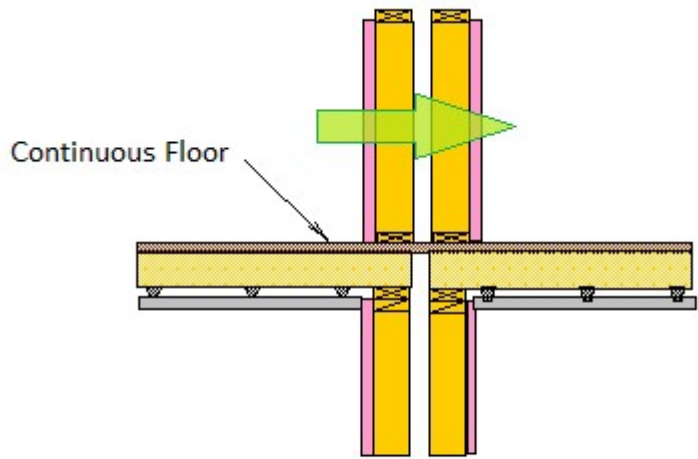
- Note that the degree of flanking transmission is dependent on the type of building elements surrounding the partition.
- The user can select a flanking construction in the settings form.
- The flanking will be different depending on the weight of the construction and any vibration isolation in the structure.

Masonry flanking structure

- The European Standard EN 12354-1:2000 provides a simple method for estimating flanking transmission in masonry or heavy construction.
- INSUL incorporates a few simple results based on masonry construction of various thickness and junction details

Lightweight flanking structures

- For lightweight construction it is not practical at this time to calculate the flanking transmission, and
- So experimental results have been used to predict the flanking for some common constructions.



End of Part 2

Prediction of Rain Noise

- Predictions for ISO 140-18 simulated rain or natural rainfall
- Predictions for single roof panels or roof panels with a ceiling beneath
- Predictions of L_p , L_i and L_w , with results given in third octave bands, octave bands, dBA, NC and PNC

Sound Insulation Prediction

File Tools Calculators Help

WALL CEILING FLOOR ROOF GLAZING

INSUL

Accuracy

Calculation Settings

Evaluation Standard Sound Field

ISO Random Free

ASTM Free

LiA 48 dB

63	125	250	500	1k	2k	4k
44	36	39	42	44	43	36

Graph Table Header Description

autoscale Show flanking limit

Panel 1 Frame 1 Panel 2 Frame 2 Panel 3 Glazing Porous Material

Frame type

- Solid joist (timber or Twinaplate)
- Suspended light steel grid
- Resilient clip or channel
- Rubber Isolation Clip
- Separate joists
- Z Girt
- Mason FSN floating floor mount
- Kinetics RIM System
- Steel Spring Hanger
- Resilient batten and steel rail

Joist properties

Joist depth (mm)

Link joist depth to airgap

Cavity Parameters

Airgap (mm) Stud spacing (mm) Mass-air-mass 68Hz

Cavity Absorption

EarthWool 14kg/m³ 50mm Ultra Acoustic Thickness (mm)

Natural Rain

Rainfall rate mm/hr

Serial No. 0715 Version 8.0.7 Mass 15.8 kg/m2 Panel Size 2.4x2.4 m Regions: Australia, NewZealand, USA 164,667

○ Method:

- ISO1 40-18:*Laboratory measurement of sound generated by rainfall on building elements* (Caution)
- Model for natural rainfall to simulate levels of rain noise under real conditions:
 - Based on original research carried out by MDA
 - It is very useful for countries where rain fall is high and buildings are often constructed from light weight materials
 - Original research was prompted by problems in NZ classrooms where it was impossible to hear a teacher's voice at times of high rainfall

Calculation of Outdoor to Indoor Transmission

- The Outdoor to Indoor calculator is a simple tool for estimating the internal noise levels for a given external noise level at the building façade
- Takes into account:
 - STL of the building facade elements
 - Size of room
 - Room acoustical characteristics

- Calculations are based on EN 12354/3:
Estimation of acoustic performance in buildings from the performance of elements. Airborne sound insulation against outdoor sound.
- Input/Output
 - Several standard outdoor noise spectra are available (e.g. traffic noise, aircraft noise, entertainment noise, voice) ,Or
 - User can enter the frequency spectrum of the sound level
 - STL data can come from INSUL or be manually entered from other data
 - User enter area building element, room volume,

○ Input/Output (cont)

- User enters:
 - area building element,
 - room volume,
 - reverberation time
- Up to 5 elements can be combined in one calculation
- The calculation can be made in octave or 1/3 octave bands
- Contribution of each path is shown numerically and graphically for easy visual ranking of element performance

○ Input/Output (cont)



Outdoor to Indoor Sound Insulation Calculation

File Edit Tools

Title

Comment

Sound Level (dB)

frequency (Hz)

Exterior Sound Pressure Level	63	125	250	500	1k	2k	4k	Overall dBA
Incident sound level (freefield)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Standard Sources

Path

Element 1 | Element 2 | Element 3 | Element 4 | Element 5

Description Area 10.0 m2

-Sound Transmission Loss	0	0	0	0	0	0	0	
-Facade Shape Level diff.	0	0	0	0	0	0	0	
+10 Log(A)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
D2m,nT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Receiving Room

Volume 50.0 m3

-10 Log(V)+14	-3	-3	-3	-3	-3	-3	-3	
Reverberation Times (secs)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
+10 Log(T)	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	
Element sound level contribution	0	0	0	0	0	0	0	0.0
Room sound level	0	0	0	0	0	0	0	0.0

Close Help Cancel

File Name:

Trapezoidal Profiled Metal Panels

- INSUL has improved the prediction of profiled metal panels
- Complex constructions using corrugated or profiled panels
- Typically used for commercial and industrial buildings
- New routines based on the work of Lam and Windle in England allow more accurate prediction of particular profiles

- Drop down menu of standard ‘proprietary’ profiles or user generated profile
- Constructions using profiled panels in conjunction with flat sheets and in cavity constructions can be predicted
- This can be extended by adding an airgap and a second lining, with or without an acoustic blanket in the cavity

Porous Blankets And Facings

- INSUL can now predict the sound transmission loss of porous blankets either alone or as a facing for a construction
- Porous blankets such as fibreglass, mineral wool or polyester
- A porous facing can be added to a construction.
 - Typical of an acoustic panel system for machine enclosures, or metal roofs incorporating a perforated pan

Sound Insulation Prediction
Marshall Day Acoustics File name: J:\JOBS\1997\97007\Reference Comparisons\Version 7 and 8\PRDC stuff\Ply-300joists-ST001-2x13Noiseline.ixl

File Tools Calculators Help

WALL CEILING FLOOR ROOF GLAZING

75 mm

INSUL

Accuracy

Calculation Settings

Evaluation Standard: ISO ASTM
Sound Field: Random Free

Rw 9	100-3150 C 0	63	125	250	500	1k	2k	4k
DnTw 11	Ctr -2	0	0	3	7	10	11	12

Graph Table Header Description

autoscale Show flanking limit

Transmission Loss (dB)

frequency (Hz)

◆ Transmission Loss (dB) — Reference Curve

Panel 1 Frame 1 Panel 2 Frame 2 Panel 3 Glazing Porous Material

Porous Material properties

Porous material: **EarthWool 14kg/m² 75mm Ultra Acoustic**

Thickness 75 mm
Flow Resistivity 12400 Pa.s/m²
Density 14 (kg/m³)

Add to overall construction

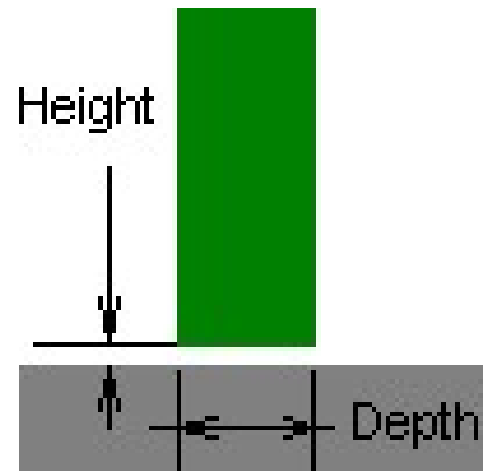
Edit properties

Serial No. 0715 Version 8.07 Mass 1.1 kg/m² Panel Size 2.7x4 m Regions: Australia, NewZealand, USA 470,366

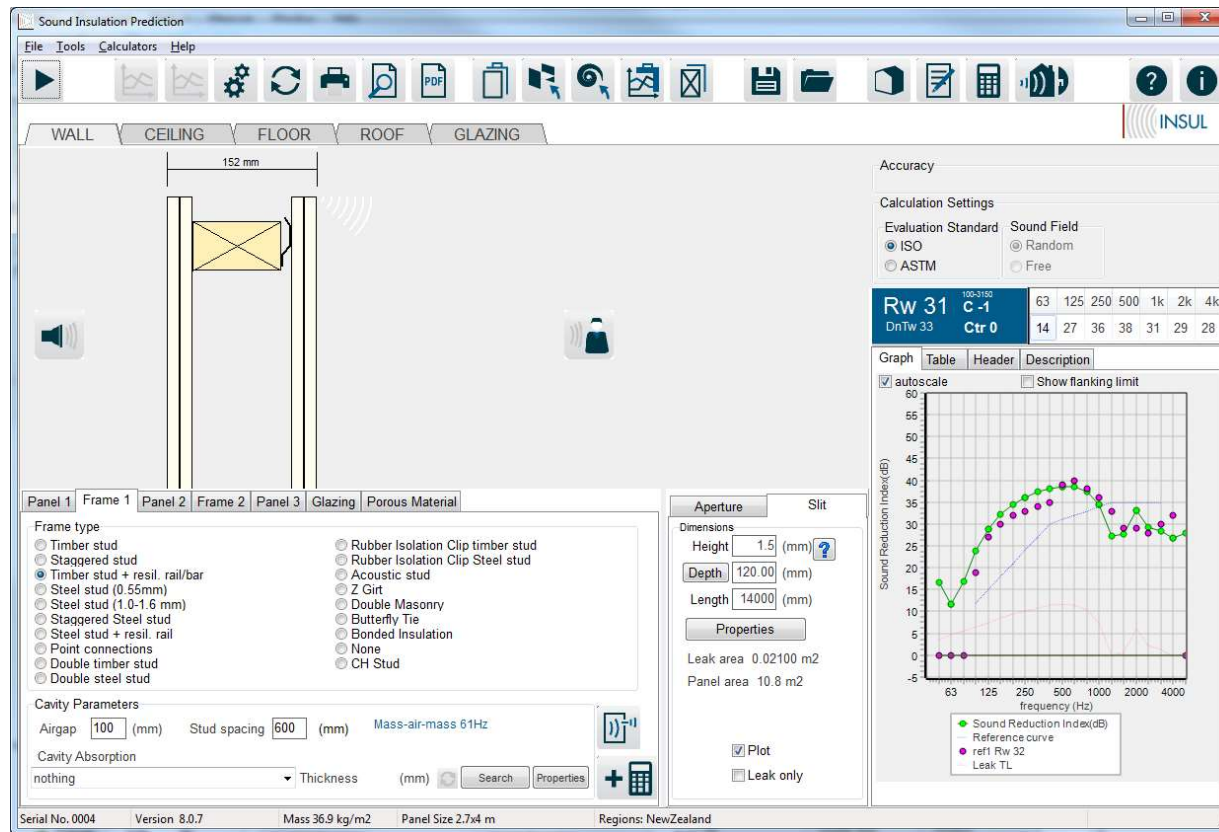
Prediction Of Leak Effects

- Leaks – panels, walls, ceilings, double glazing
 - Aperture leak models circular hole in a building element (middle, edge, corner)
 - Slit leak models long narrow leak through building element e.g. gap under door, gap along side of partition (middle or edge)
 - Gomperts or Mechel calculation routines

Leak Effect Prediction

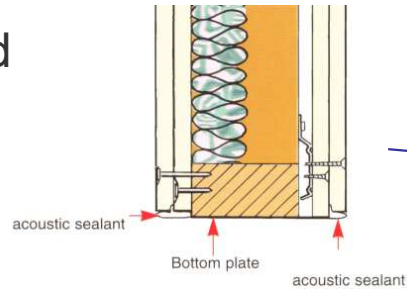


Effect of leakage

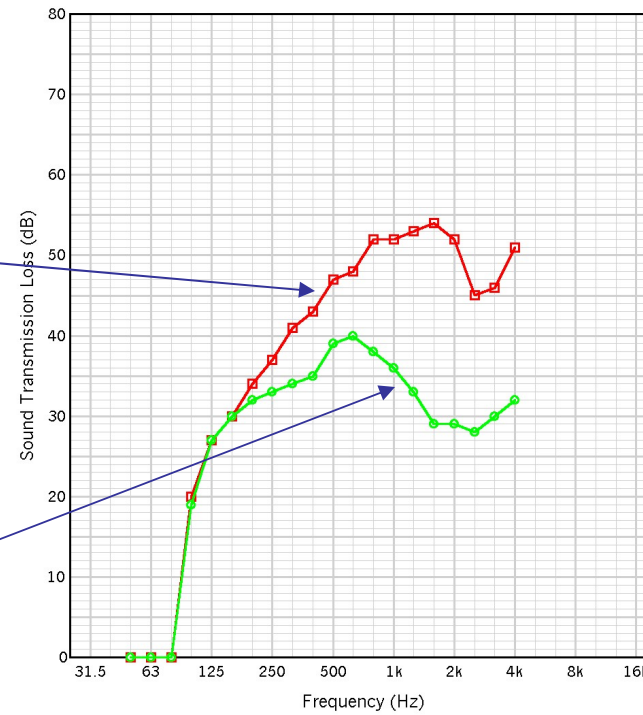
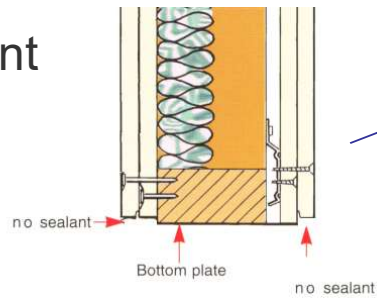


Effect of Leakage

Sealed
Rw 47



No sealant
Rw 32



Auralisation

- The user can now listen to the predicted sound reduction.



- Using, for instance, headphones plugged into the computer sound output, the user can click on a simulation of sound on the source side of the wall, then on the receiver side of the wall.

- Note: the user should be careful that the accuracy of the simulation will depend on the frequency response of the reproduction system and the background noise level:
 - So demonstrating differences in low frequency performance with headphones may be quite ineffective
 - Likewise, trying to listen to the effect of very high performance walls may be impossible if the background noise is not very low

The Databases

- Three key databases

- Materials
- Absorbers
- Floor covers

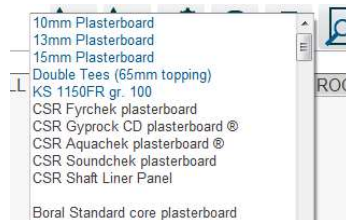
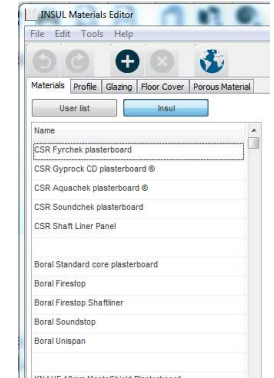
- Three other databases

- Glazing materials
- Profile
- Core materials (for elastic core materials)

The screenshot shows a software interface for selecting materials in a multi-layered system. At the top, there are six tabs labeled 'Layer 1' through 'Layer 6'. Below the tabs, there are three dropdown menus. The first dropdown is labeled 'Material' and has 'KNAUF 13mm MastaShield Plasterboard' selected. The second dropdown is labeled 'Cavity Absorption' and has 'Fibreglass (10kg/m3)' selected. The third dropdown is labeled 'Floor Cover' and has 'Ceramic Tiles on Regupol' selected. Red arrows from the text on the left point to these three dropdown menus.

Database maintenance

- Each database has two parts
- Customers database (unique to user, not updated by new releases)
- INSUL database (not to be edited by user)
- Custom database materials show as blue text
- INSUL database materials (> 1000) show as black



Materials database

- Three key parameters
 - Density (kg/m^3)
 - Stiffness (Modulus of Elasticity = Young's Modulus GPa)
 - Damping (dimensionless)
- Secondary parameters (name, region, category, type, colour, texture)

Absorber database

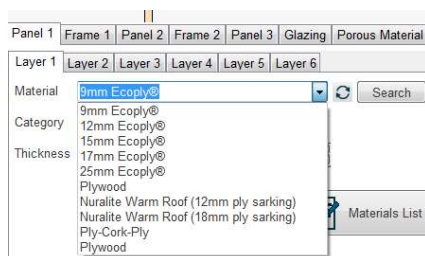
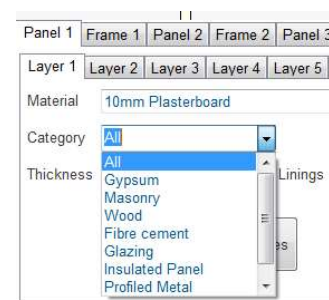
- Two key parameters
 - Density (kg/m^3)
 - Flow resistivity ($\text{Pas/m}^2 = \text{Rayl/m}$) see ISO
- Secondary parameters (name, region, category, type, colour)

Database Features

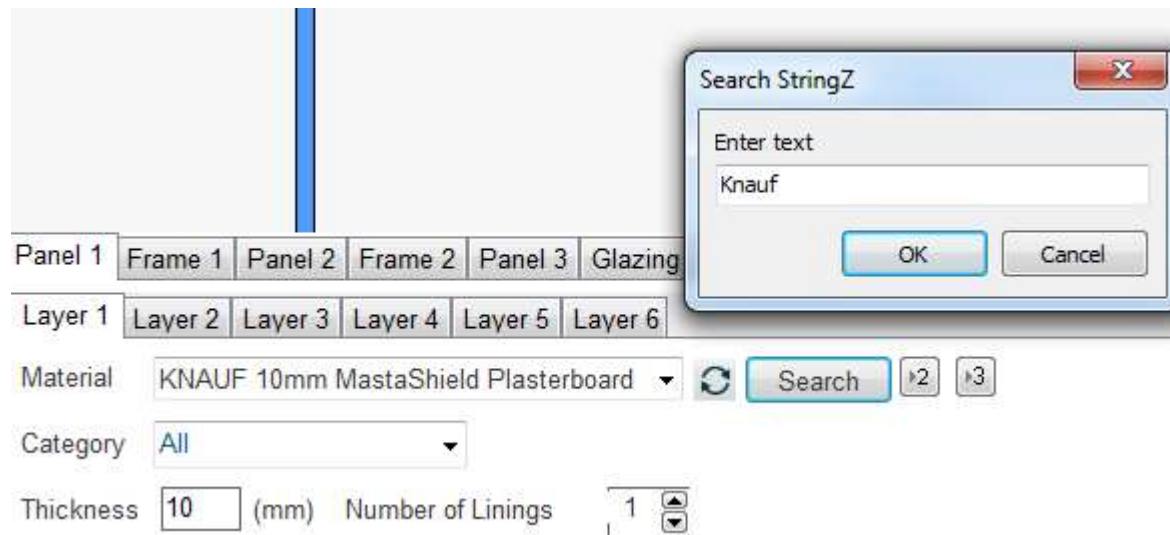
- User can filter the databases by
 - Region
 - Category (plasterboard, masonry, wood, fibre cement etc etc)



- User can search by text string on **Description** (in example below we have searched on “ply”)



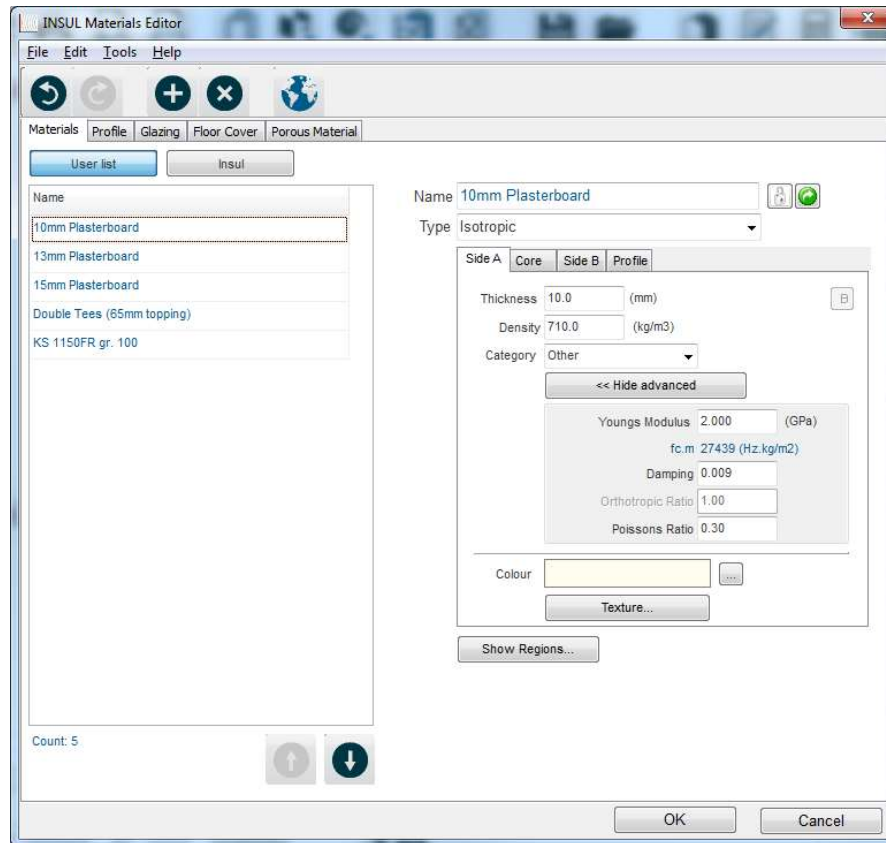
Database selection



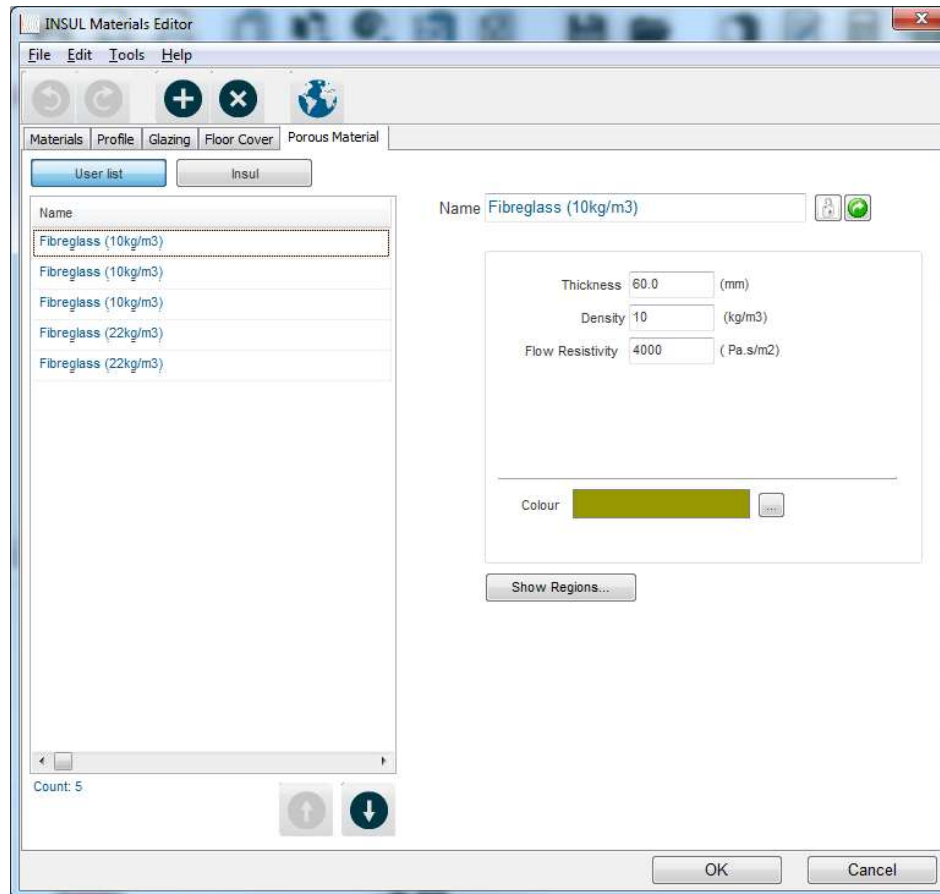
Editing the Custom Databases

- User can enter new materials
- Must know density, Modulus and damping
- Must enter a thickness
- Can choose a material type (usually isotropic)
- Can enter description, colour, texture

Entering material parameters



Entering material parameters



Material Types

- **Isotropic** (simple, same properties in each direction) **Most materials = isotropic**
- **Orthotropic** (stiffer in one direction than another, eg corrugated steel roofing)
 - Sub category Trapezoidal
 - Sub category Corrugated
- **Elastic Core** (soft core between dense sheets, eg insulated panels (PIR etc))
- **Composite Steel Floor** (concrete floor cast onto steel decking)
- **Inelastic core** (e.g. light weight concrete cast into steel formwork)

Entering a new material

Required parameters

- **Density** (easy to obtain)
- **Stiffness** (best to obtain from acoustic test by locating critical frequency dip)
- **Damping** (best to estimate from acoustic test by locating critical frequency dip but choose $\eta = 0.01$ if no other info)

Entering parameters

Side A

Thickness (mm)

Density (kg/m3)

Category

Youngs Modulus (GPa)

fc.m (Hz.kg/m2)

Damping

Orthotropic Ratio

Poissons Ratio

Colour

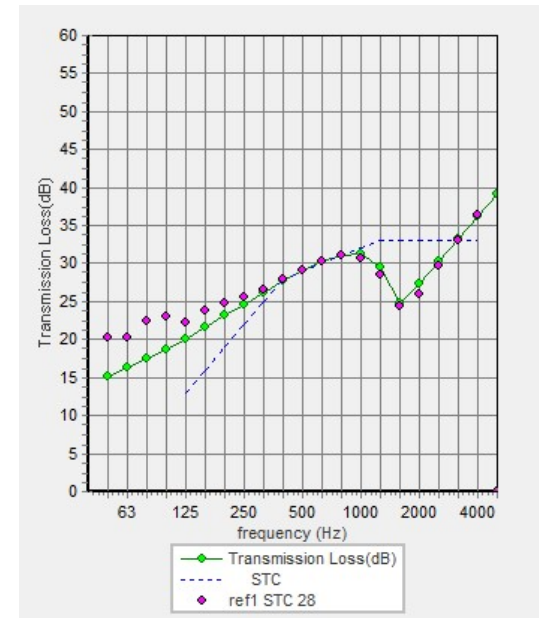
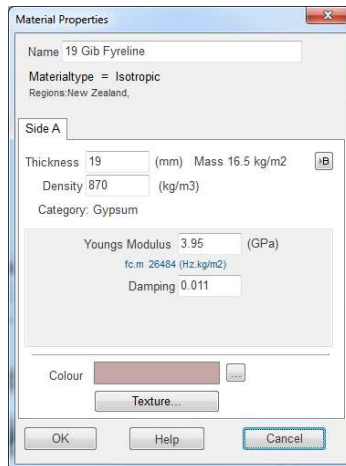
Modulus and damping from acoustic test

19mm gypsum plasterboard

Best fit :

$E = 3.95 \text{ GPa}$ (adjust to get frequency right)

$\eta = 0.011$ (adjust to get depth of dip right)



End of Part 3

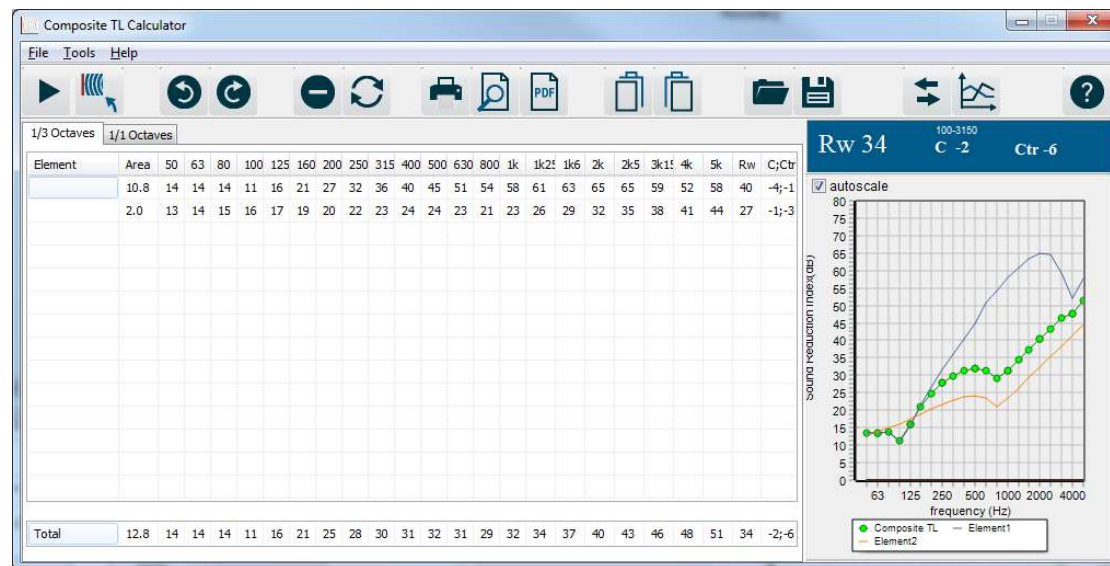
Some Utilities

- Composite calculation
- Comparison between constructions
- Copying and Pasting
 - Results
 - Graph
 - Construction drawing

Composite Transmission Loss

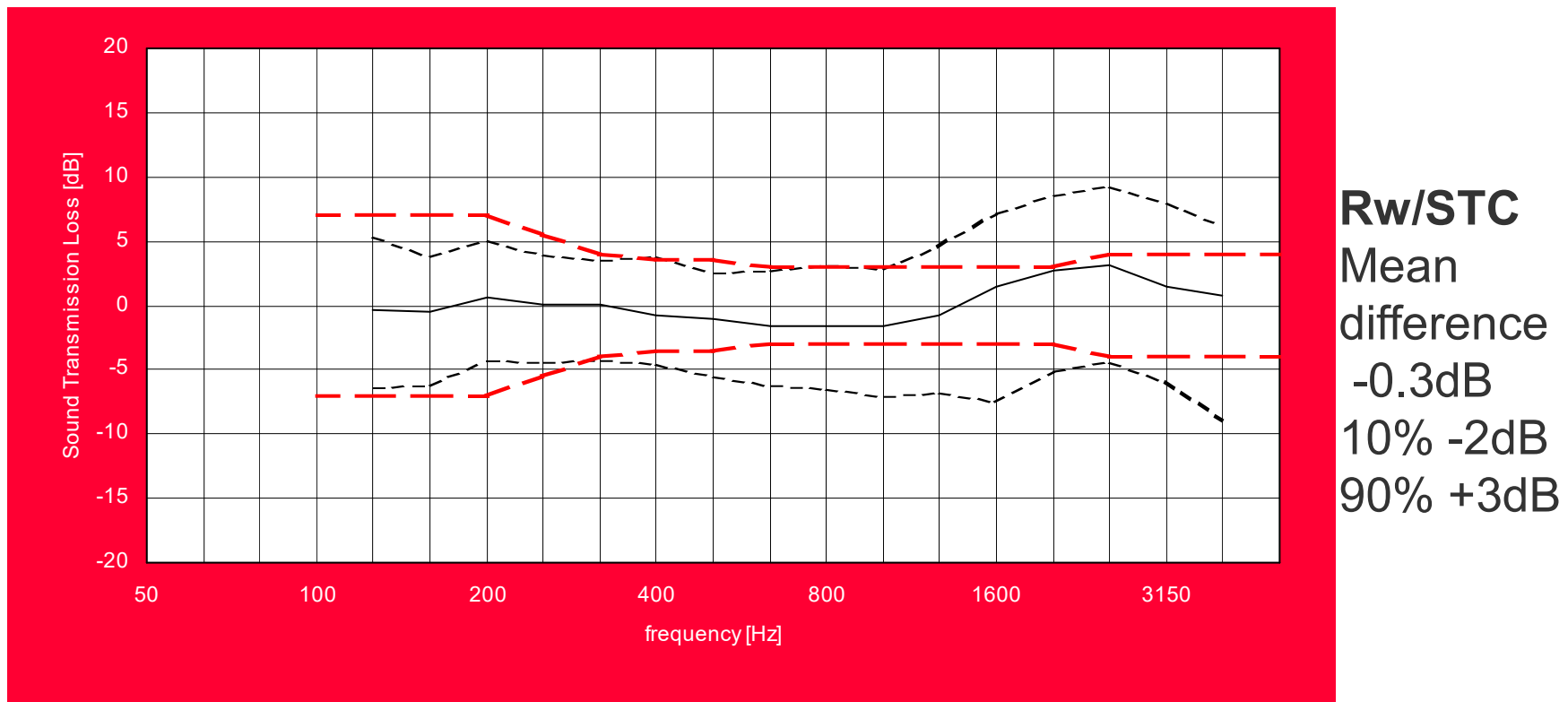


- Single Stud partition (Rw 40)
- Single door (Rw 27)
- Composite Rw 34



Accuracy

(No substitute for Lab data)



Measured less predicted for Californian data for stud walls (--- 10% and 90% limits, —median error, - - - estimated reproducibility between labs ISO 140)

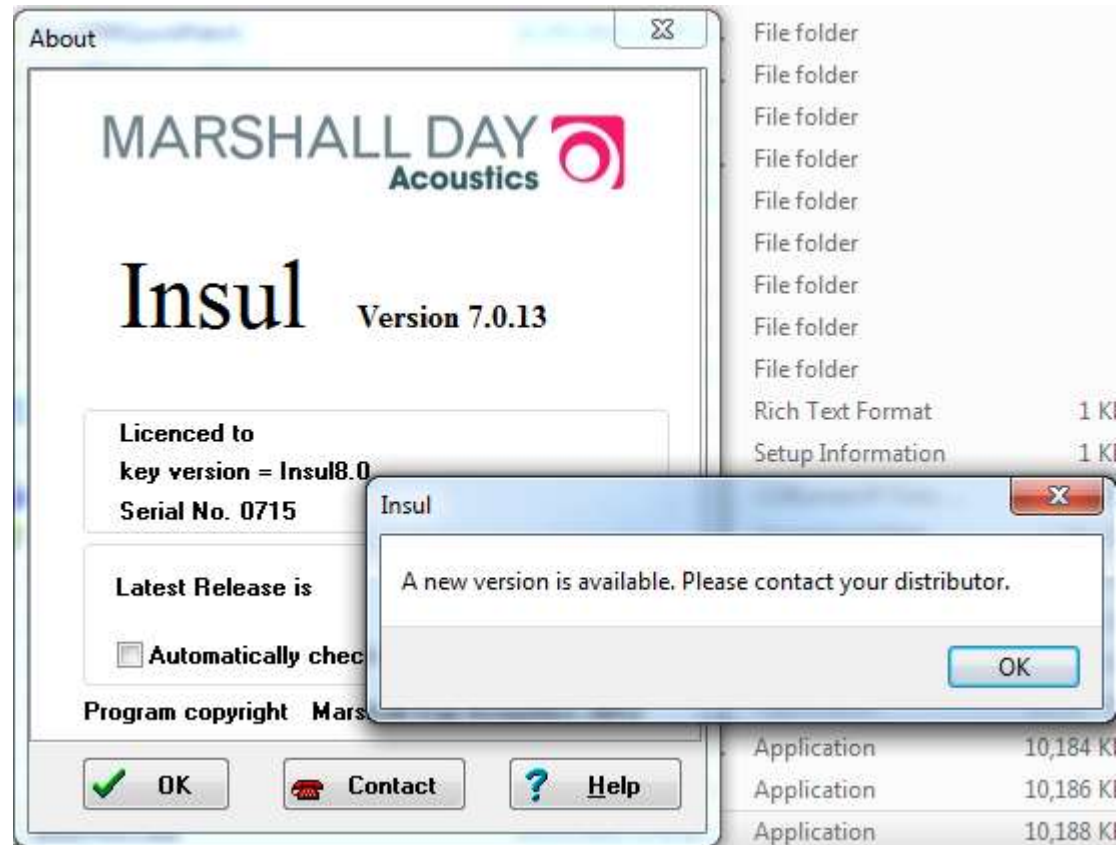
Keeping Up to date

- Check for new releases (irregular but free). Bug fixes, small improvements, more materials
- Download and install to be current
- New Versions come out every 18 months to 2 years (paid for). Recommended

Updating



New version



Updating the key



THE END



MARSHALL DAY
Acoustics 