INSUL Prediction Software

A Short Course for Knauf Insulation

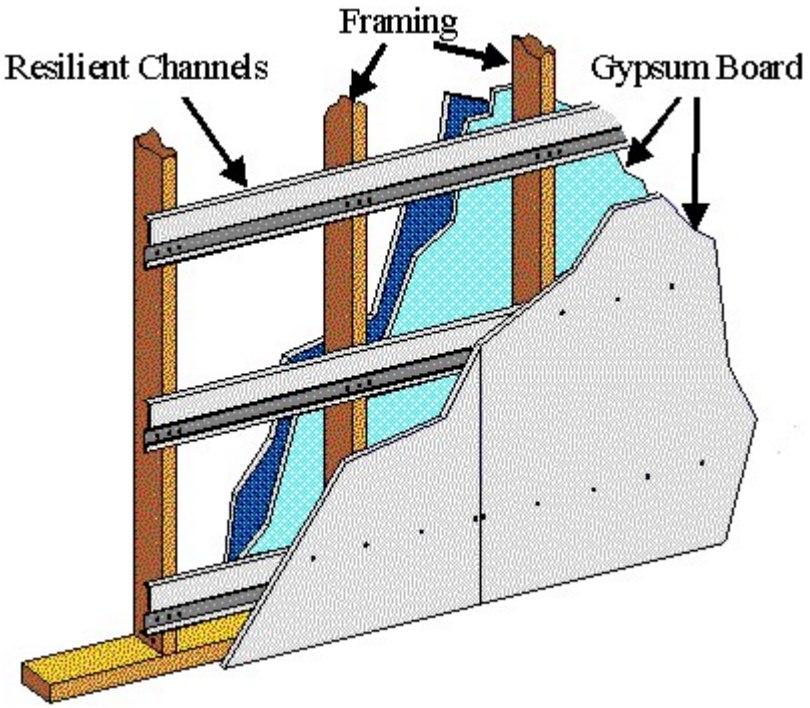
Keith Ballagh

MARSHALL DAY Acoustics

A Quick Introduction

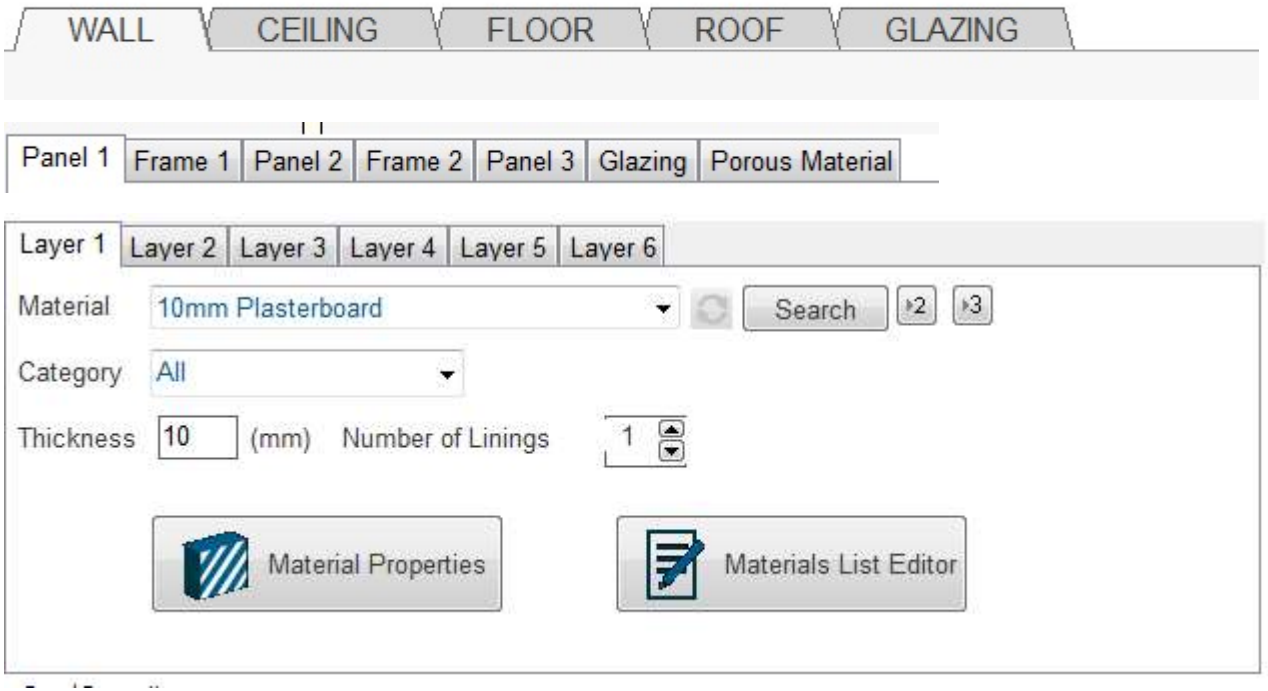
INSUL

- Predicting performance of a stud wall

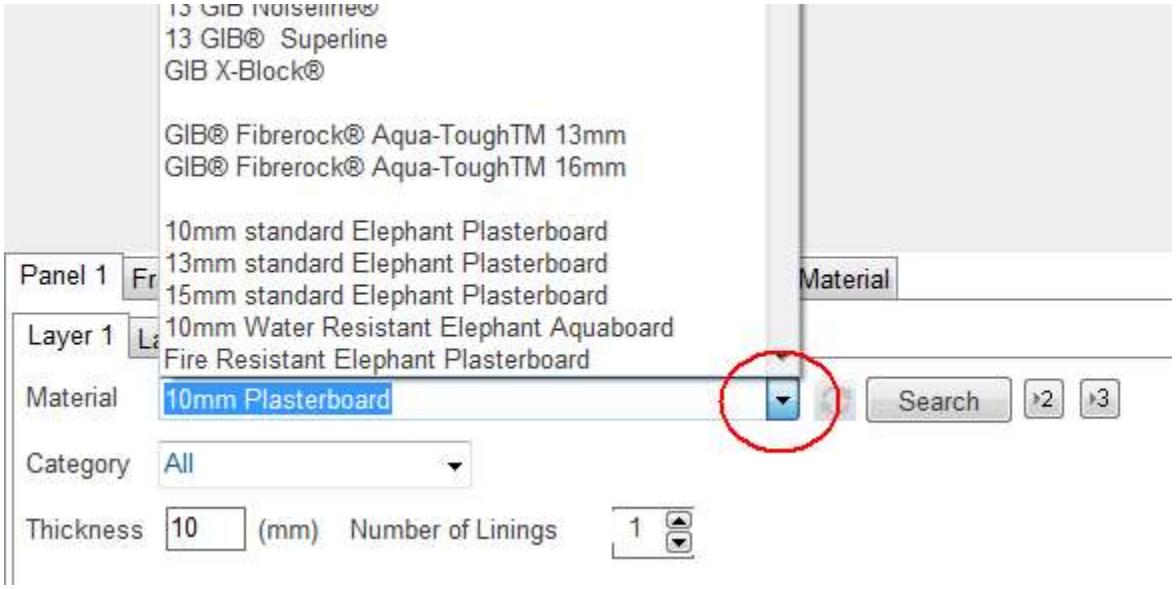


MARSHALL DAY Acoustics

A Quick Introduction

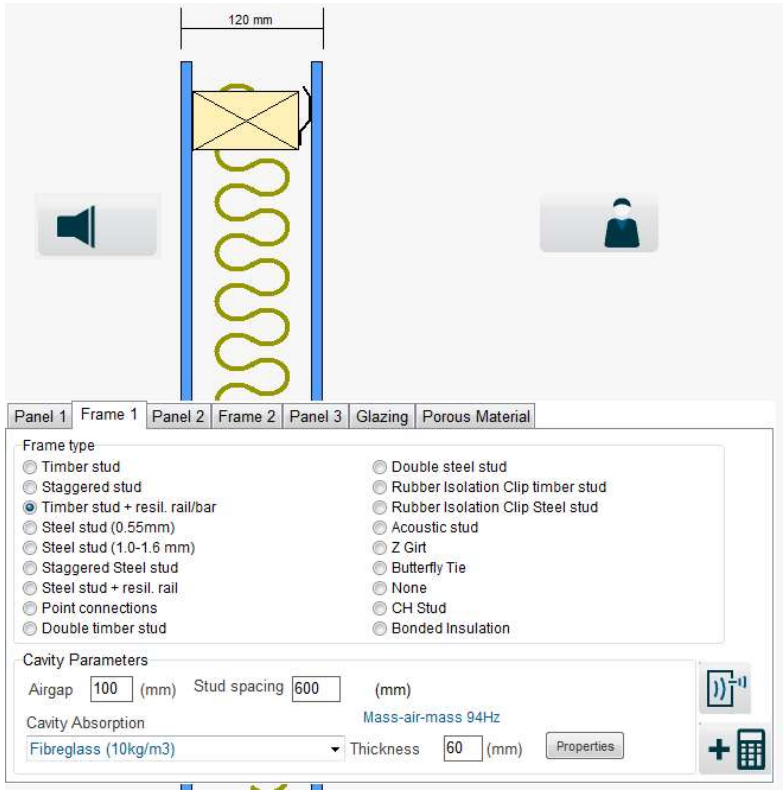


Select materials



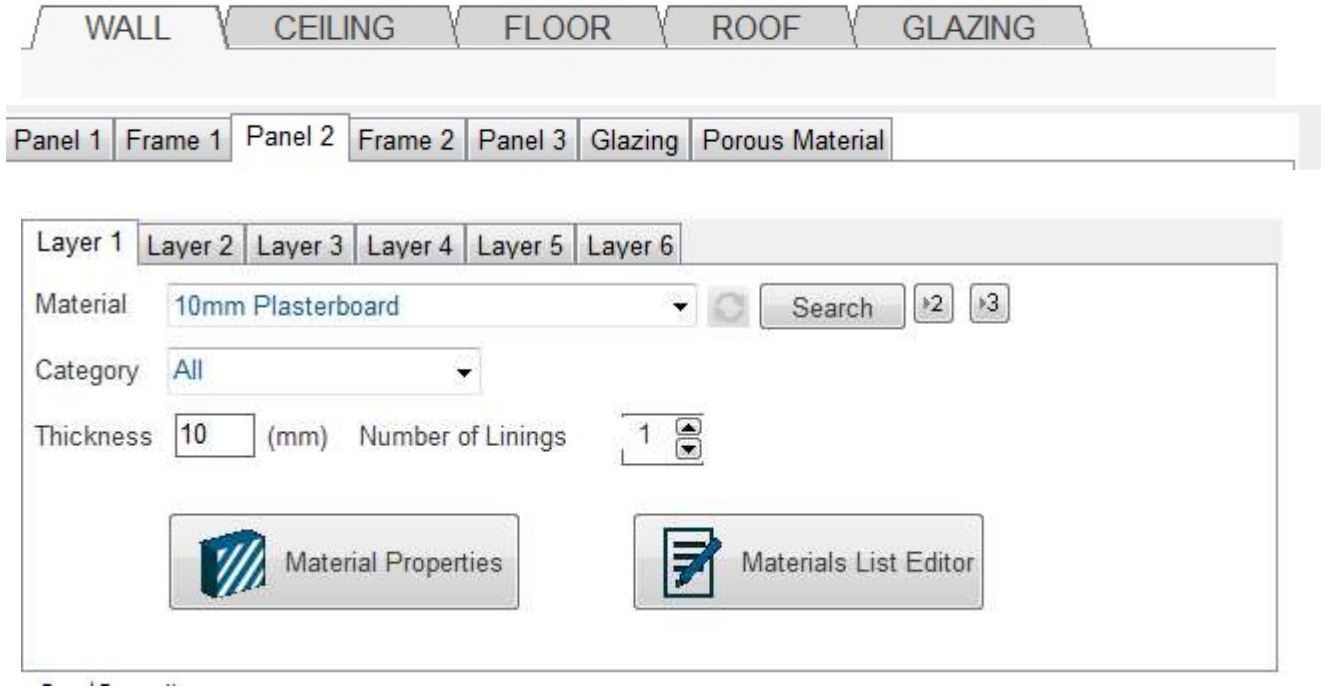
MARSHALL DAY Acoustics

Select Frame/Connections



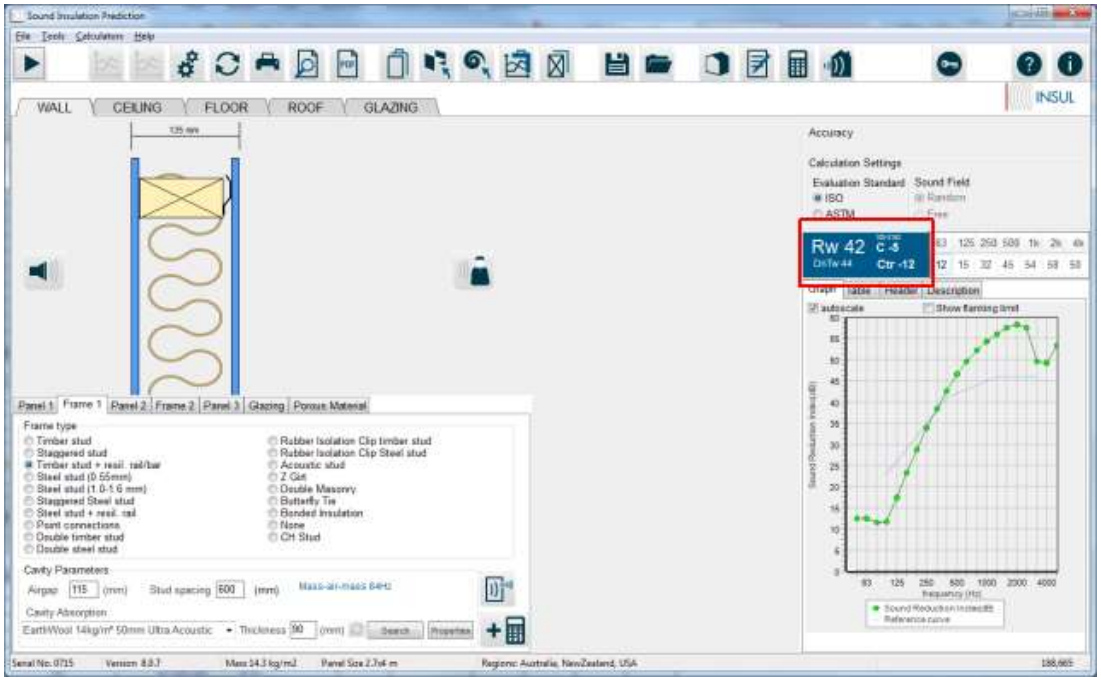
MARSHALL DAY Acoustics

Panel 2



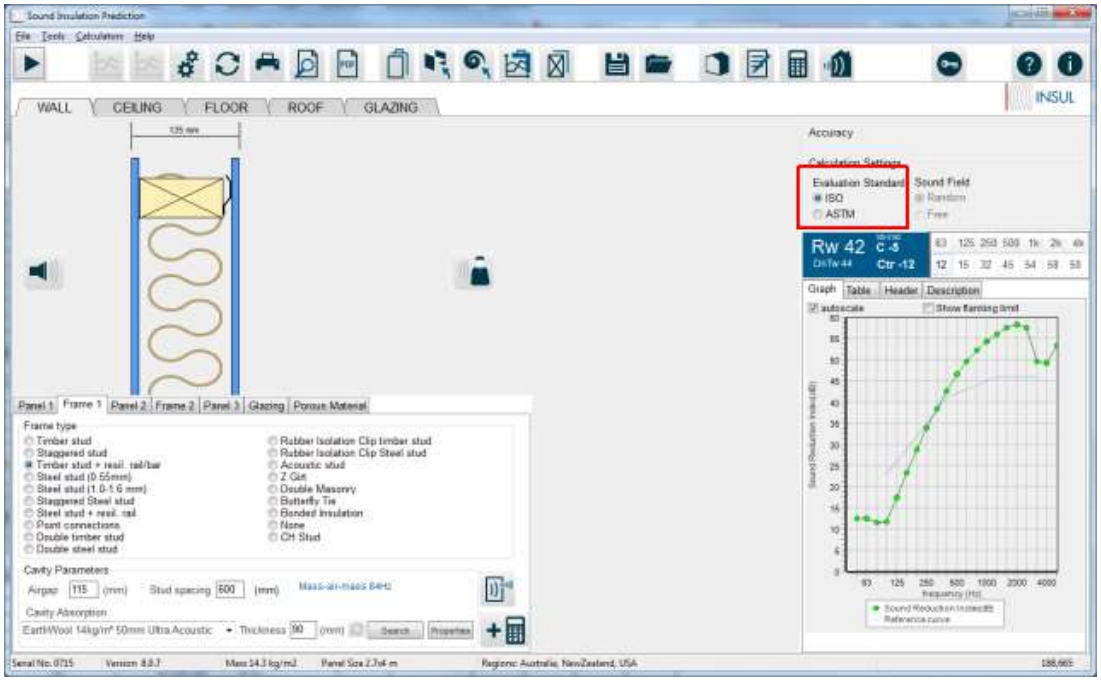
MARSHALL DAY Acoustics

Results



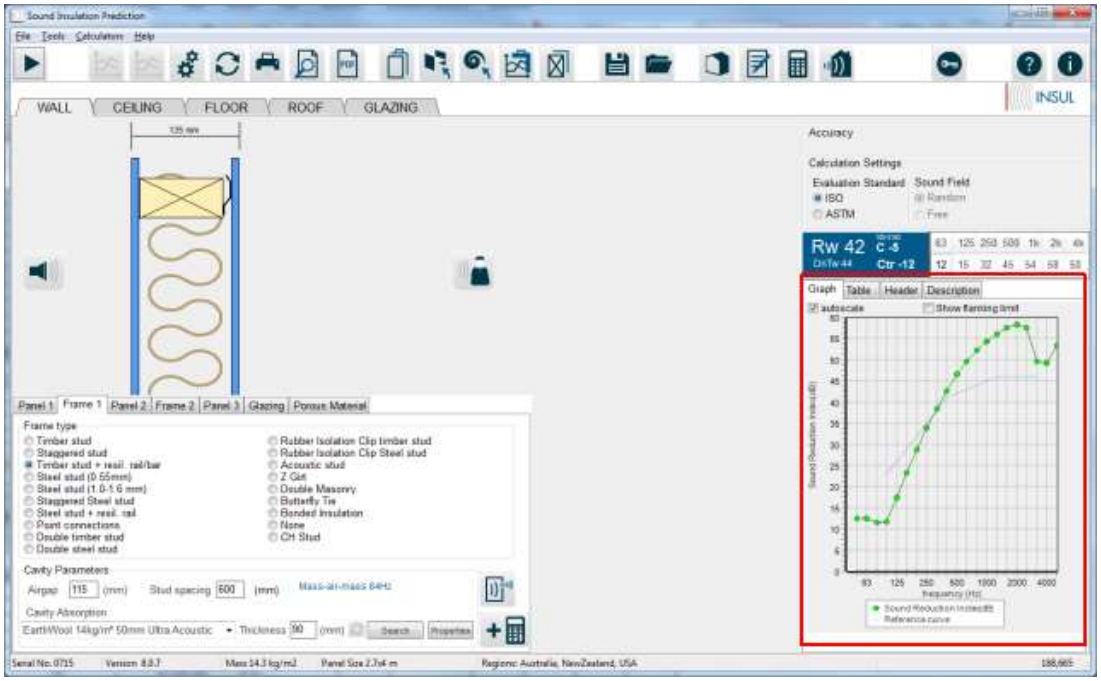
MARSHALL DAY Acoustics

Results



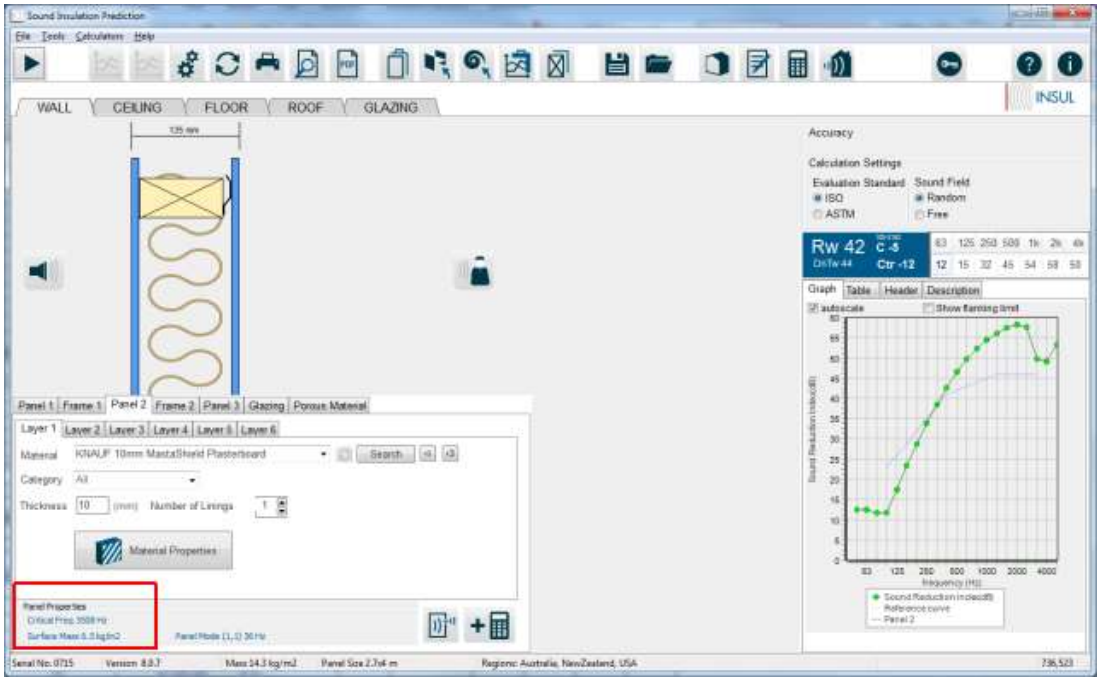
MARSHALL DAY Acoustics

Results



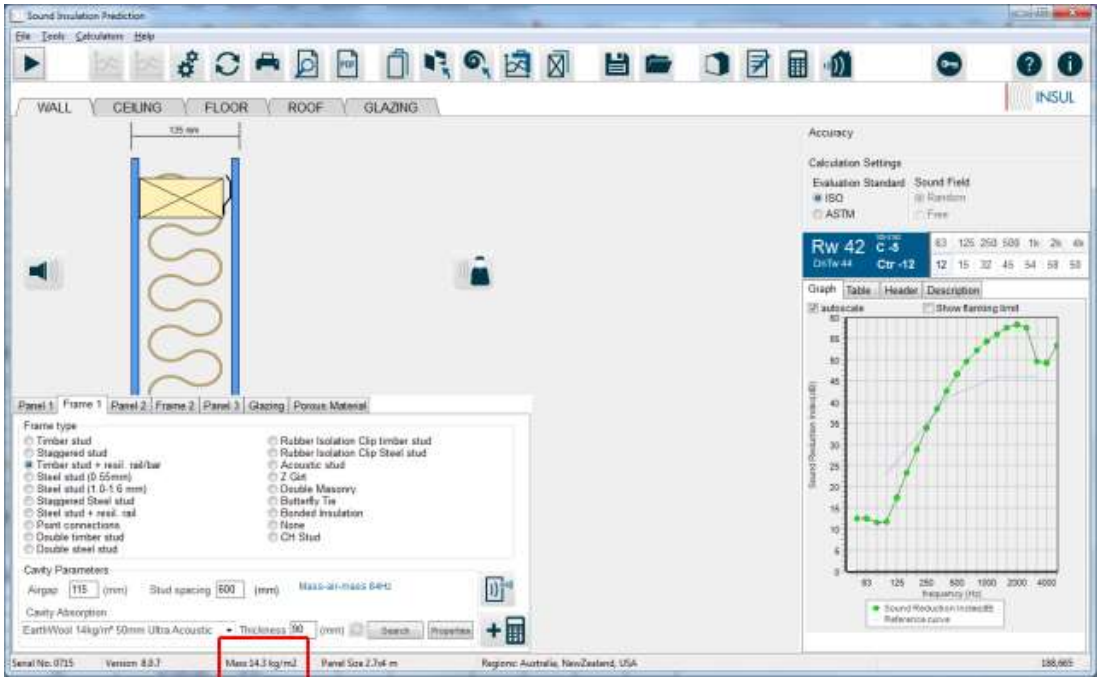
MARSHALL DAY Acoustics

Results



MARSHALL DAY Acoustics

Results



MARSHALL DAY Acoustics

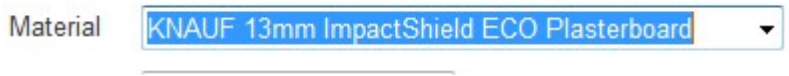
In more detail

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

MARSHALL DAY Acoustics

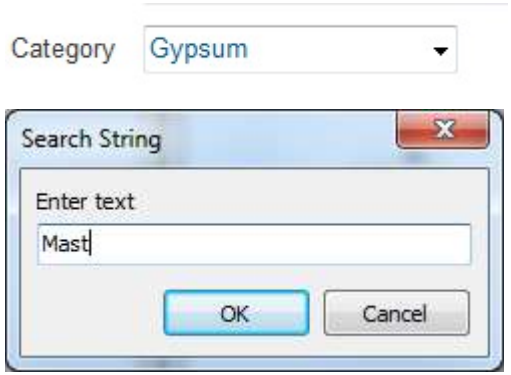
Selecting materials

- Choose from drop down box, or



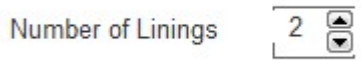
- Type in first letters (‘Knau’), or
- Narrow down selection by
  - Filter list by Category
  - Searching by text string eg

(Reset after Searching)



MARSHALL DAY Acoustics

Layers

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

  (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.

MARSHALL DAY Acoustics

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

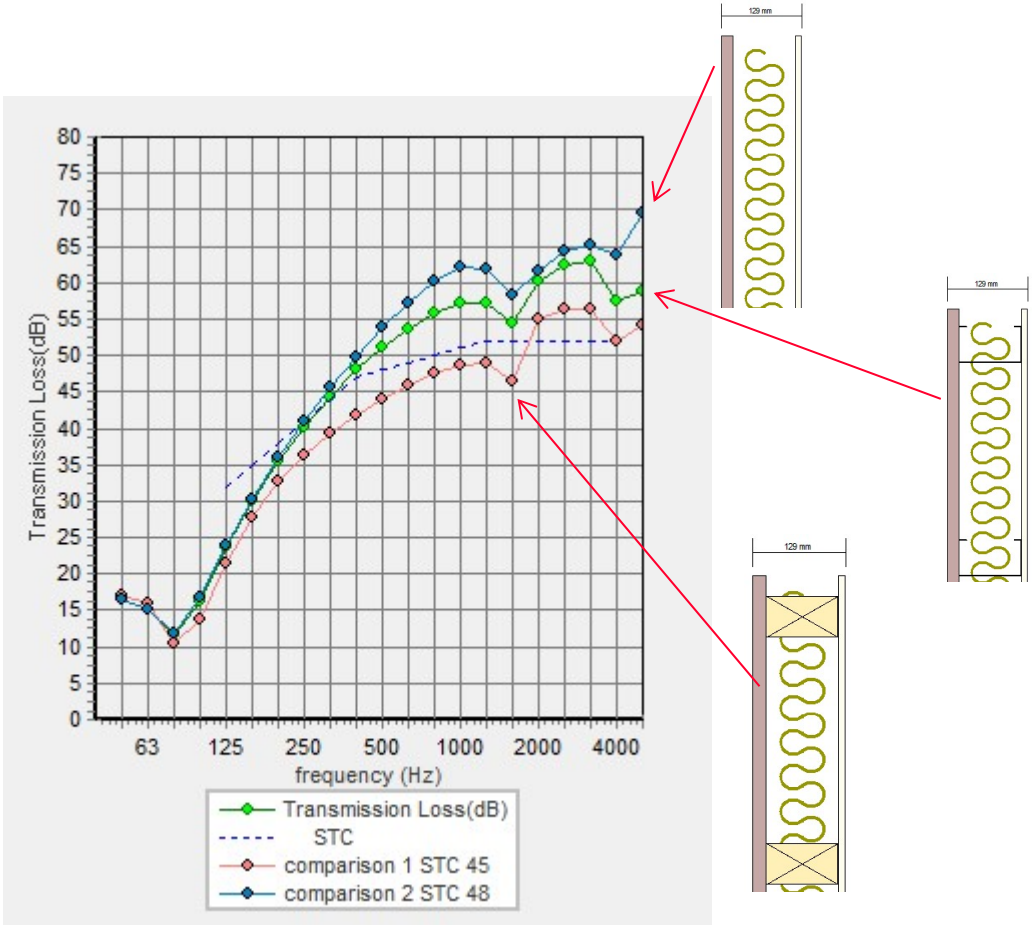
MARSHALL DAY Acoustics

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

MARSHALL DAY Acoustics

Example



MARSHALL DAY Acoustics

Equivalents

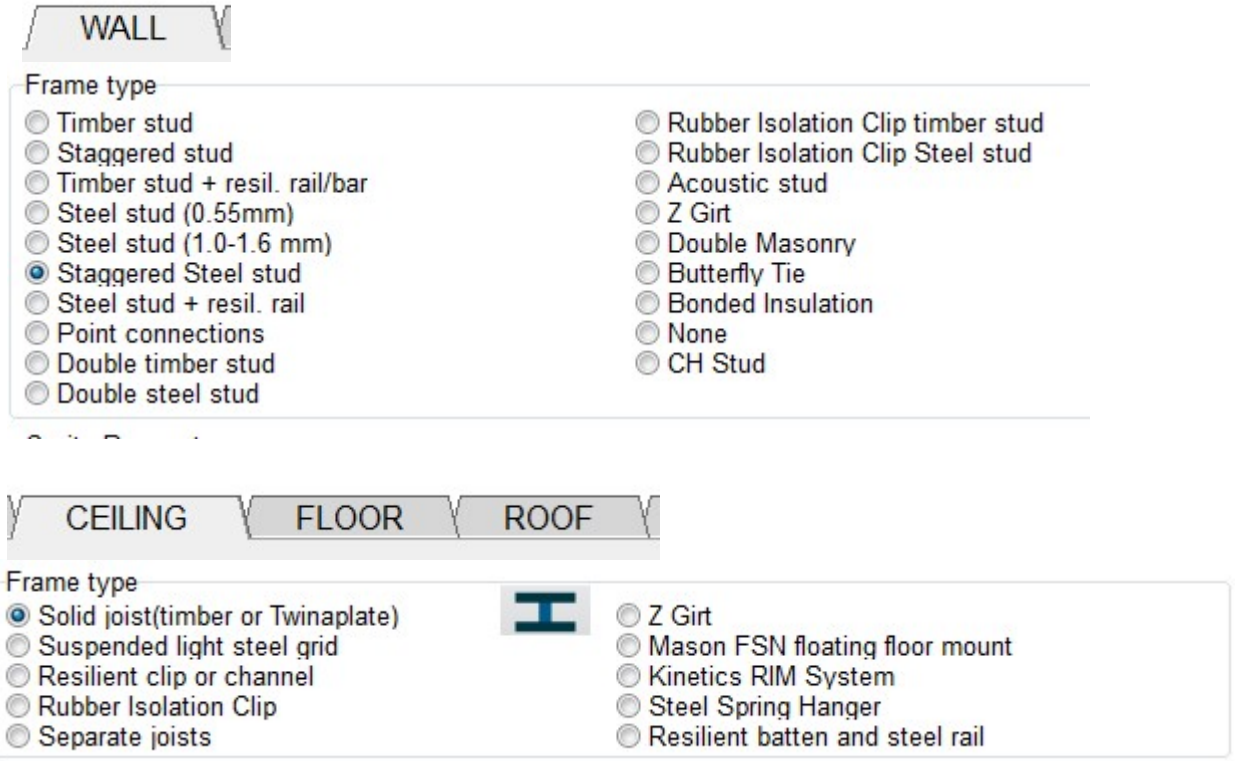
PAC International RSIC / ST001 clip

Pliteq Genie clip

Kinetics IsoMax clip

MARSHALL DAY Acoustics

Frames/Connections



MARSHALL DAY Acoustics

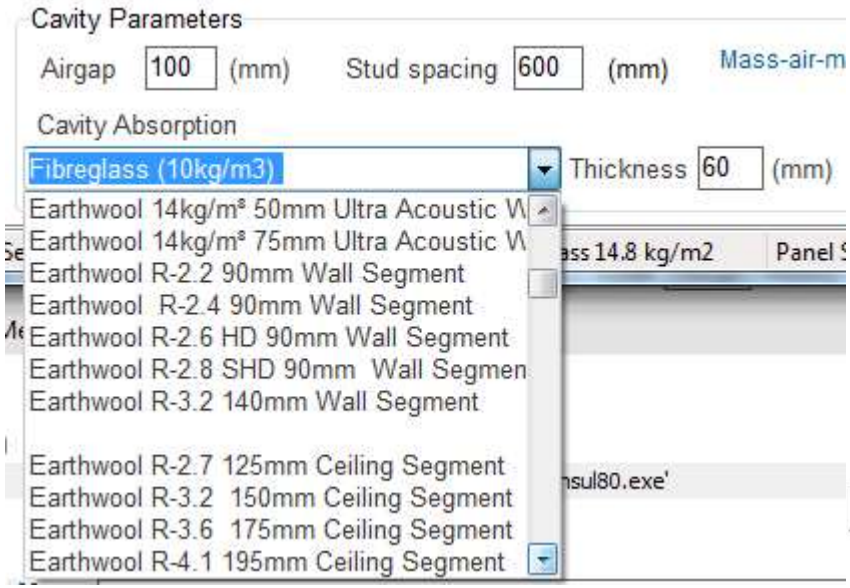
Frames/Connections

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

MARSHALL DAY Acoustics

Cavity absorption

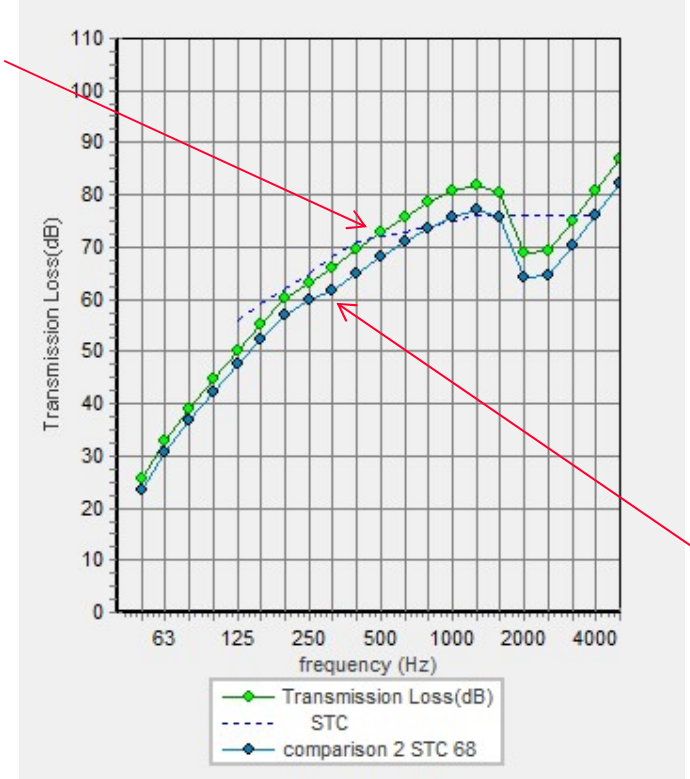
- Choose from drop down list
- For 2 layers set thickness = 2 x thickness of single layer
- Cavity absorption can be less than airgap

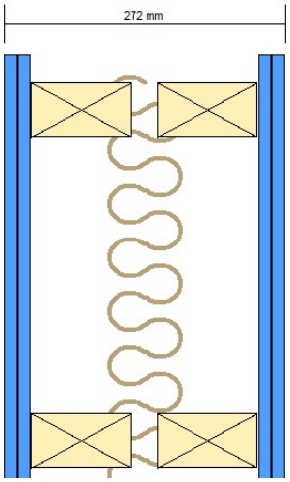


ARSHALL DAY Acoustics

Effect of Absorption

Earthwool UltraAcoustic (14kg/m^3)
Rf = 14,000 Rayl/m
Rw/STC 72



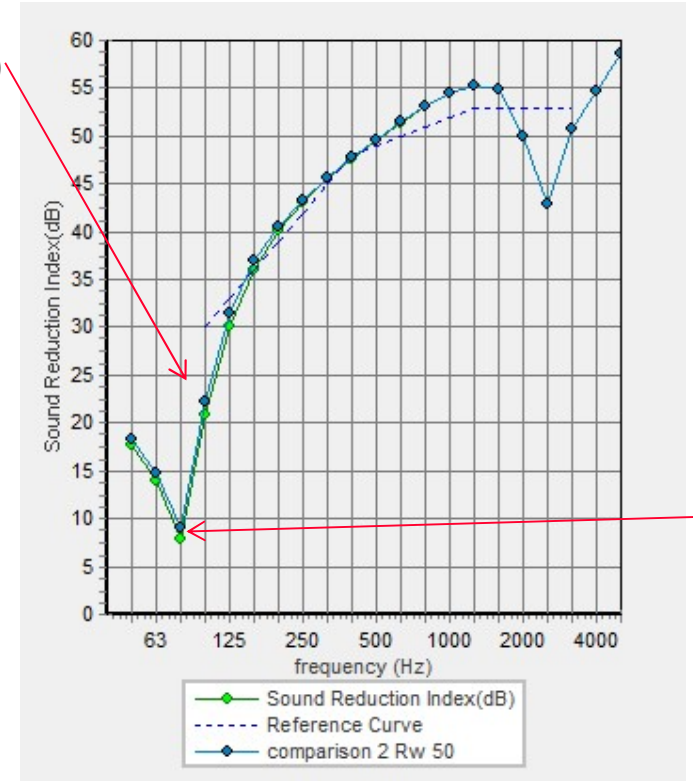


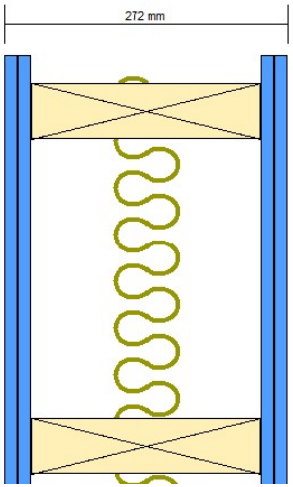
75mm fibreglass (10kg/m^3)
Rf = 4,000 Rayl/m
Rw/STC 68

MARSHALL DAY Acoustics

Effect of Absorption

Earthwool UltraAcoustic (14kg/m^3)
Rf = 14,000 Rayl/m
Rw 50 STC 47

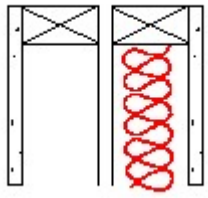




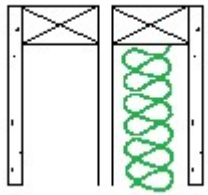
75mm fibreglass (10kg/m^3)
Rf = 4,000 Rayl/m
Rw 49 STC 47

MARSHALL DAY Acoustics

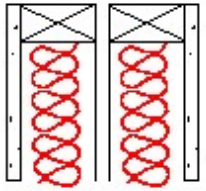
Effect of Flow resistivity



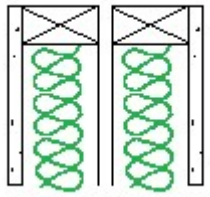
cavity infill 90mm 12kg/m3 (=4000 Rayl/m) **STC 56**



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**

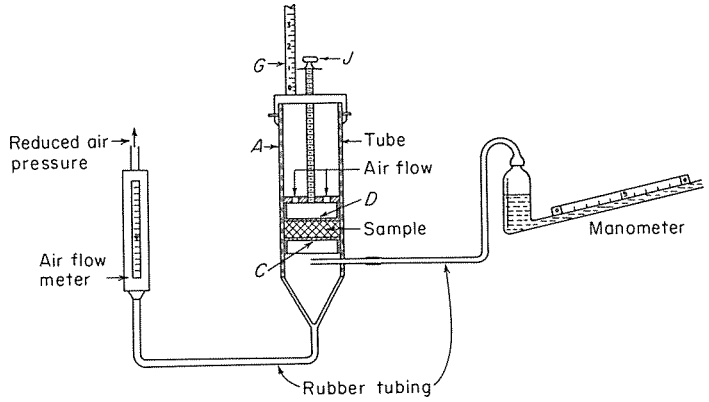
MARSHALL DAY Acoustics

Flow Resistivity

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

$$R_1 = \frac{R_f}{l} = \frac{\Delta p}{lu} \qquad \text{mks rayls/m} \tag{10.2}$$

where l = thickness of the material, m



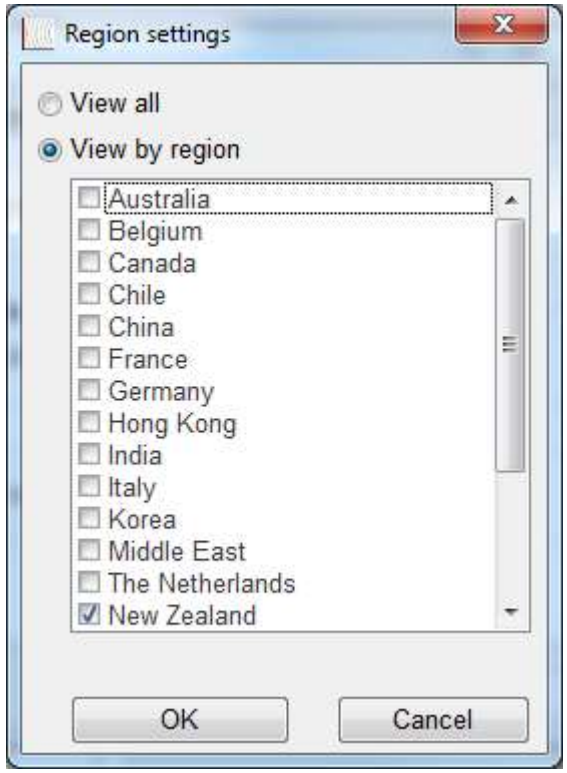
MARSHALL DAY Acoustics

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)

MARSHALL DAY Acoustics

Changing Regional Settings



MARSHALL DAY Acoustics

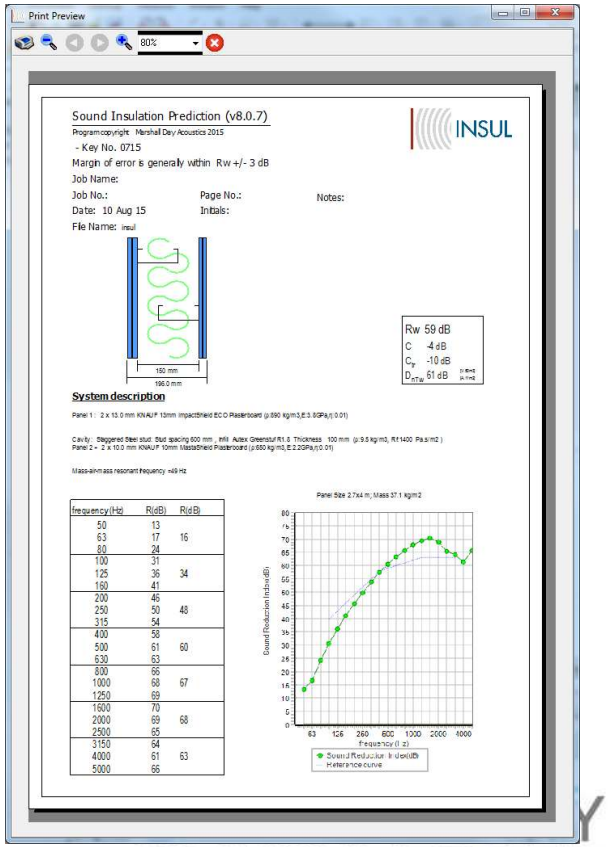
Save/Recall

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

MARSHALL DAY Acoustics

Print (or PDF)

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



Acoustics

End of part 1

MARSHALL DAY Acoustics

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)				
	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	
– / – / –	64mm stud in 92mm track	0.5 0.75 1.15	2.375 2.83 3.51	2.59 3.19 3.87	112	33 (26)	42 (31)	42 (31)	43 (32)	Acoustic Report Day Design 3094-33
	76mm stud in 92mm track	0.55 0.75 1.15	2.61 3.00 3.60	2.80 3.32 4.00	112	33 (26)	42 (31)	42 (31)	43 (32)	Note: Impact Sound Resistant
	92mm stud in 150mm track	0.55 0.75 1.15	2.74 3.19 3.75	2.99 3.48 4.12	170	34 (26)	44 (32)	44 (32)	45 (33)	

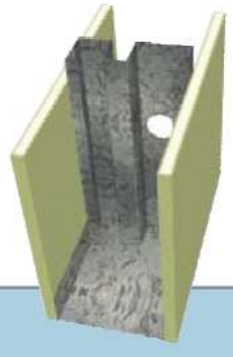
MARSHALL DAY Acoustics

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)				
	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	112	36 (30)	45 (35)	45 (35)	46 (36)	Acoustic Report Day Design 3094-12

MARSHALL DAY Acoustics

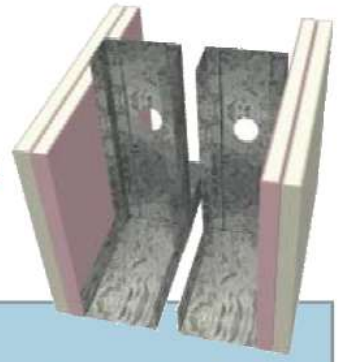
More practice

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	Stud Size (mm)		Max Height UDL 0.25 kPa (m)		Width (mm)	Acoustics Rw (Rw + Ctr)						
	Stud Depth	Stud BMT	Non-Load Bearing Studs at 600mm	Non-Load Bearing Studs at 450mm		No Insulation	1 x 50mm EarthWool 11 kg/m³	2 x 50mm EarthWool 11 kg/m³	1 x 65mm Polyester TSB3/ASB3	2 x 65mm Polyester TSB3/ASB3	1 x 75mm EarthWool 11 kg/m³	Acoustic Report Day Design 3094-48
– /90/90 60/60/60 rated from both sides Fire Report FAR3210 FAR3230	64 148mm cavity	0.5	2.72	2.93	200	51 (42)	61 (48)	64 (**51**)	58 (48)	61 (**51**)	62 (**50**)	Note: Impact Sound Resistant – Discontinuous Construction
		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								

MARSHALL DAY Acoustics

Staggered Stud timber

KTW21

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

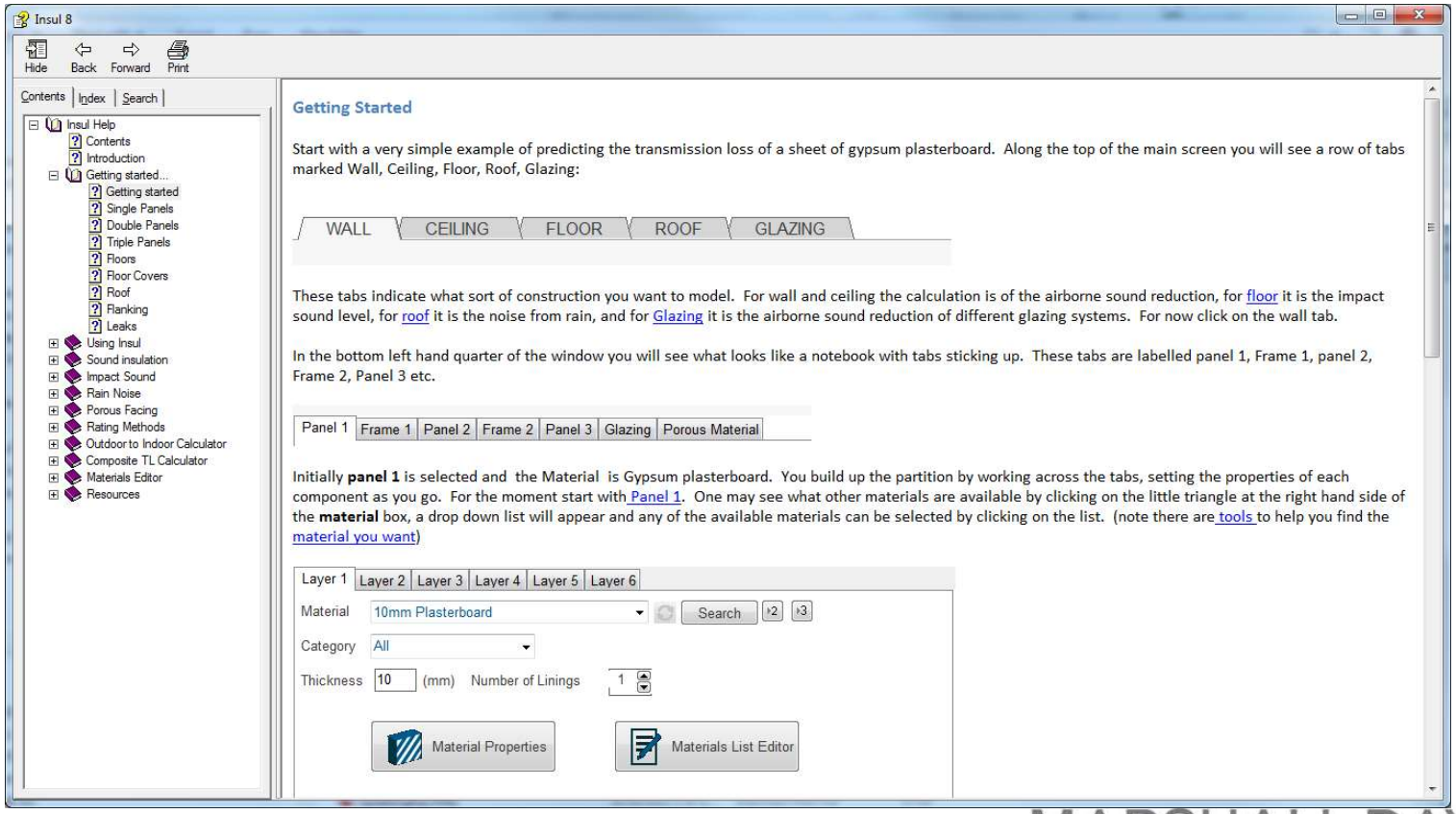
FRAME: Staggered timber studs at maximum 600mm centres [300mm staggered]

[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	Acoustic Report Day Design 3094-45 Note: Impact Sound Resistant
– / – / –	70mm on 90mm plate	35	3.33	3.53	120	38 (33)	45 (36)	47 (37)	45 (36)	
		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						

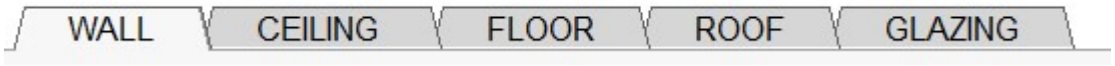
MARSHALL DAY Acoustics

Help



MARSHALL DAY Acoustics

Wall/Ceiling/Floor/Roof



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

MARSHALL DAY Acoustics

Impact Sound

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

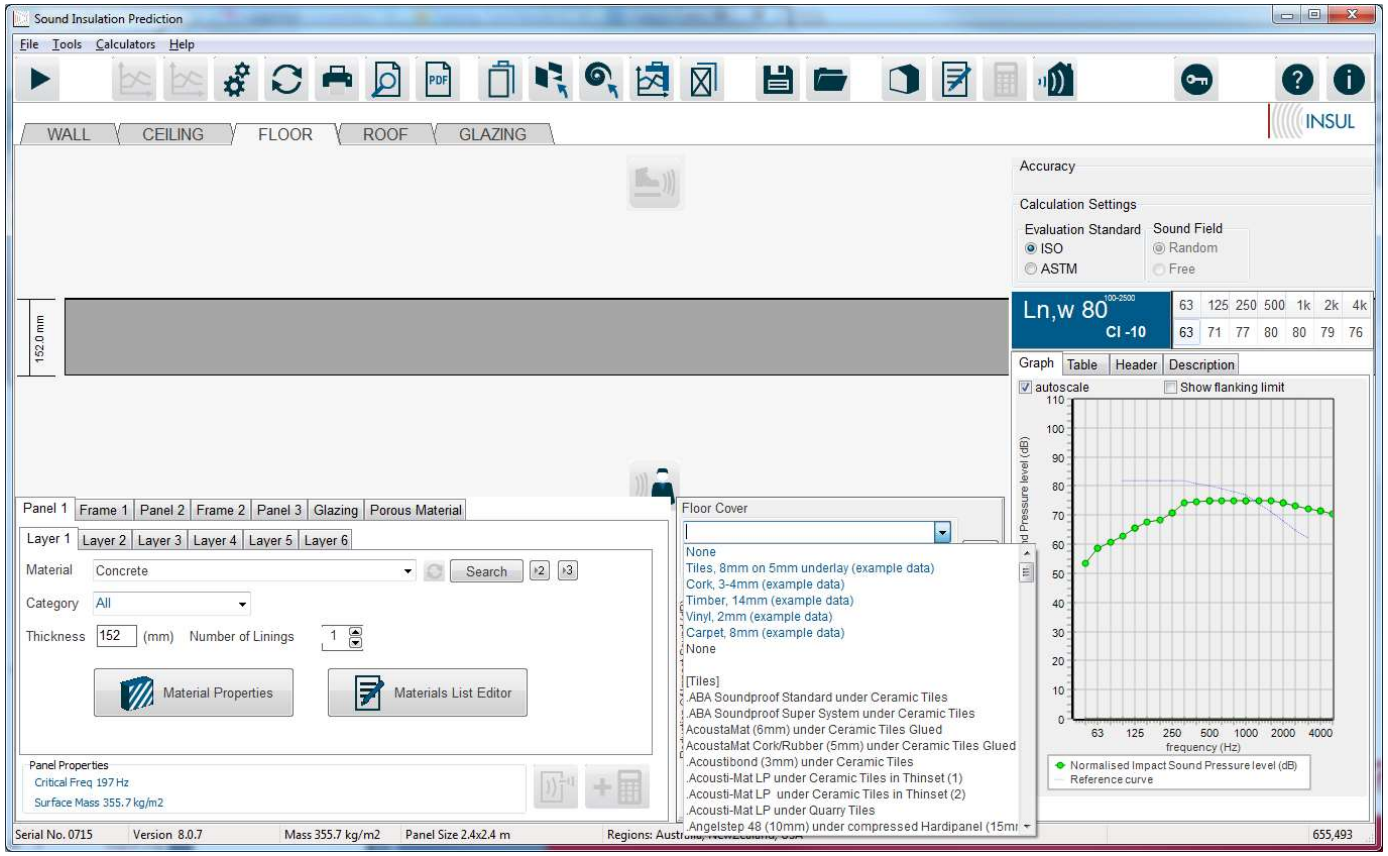
MARSHALL DAY Acoustics

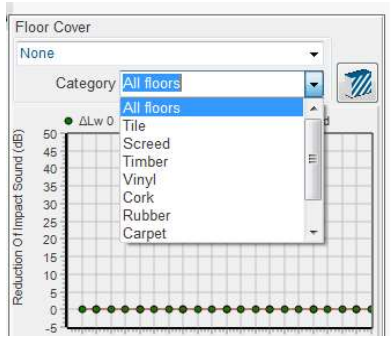
Floor Covering

- 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.

MARSHALL DAY Acoustics

Floor Coverings





MARSHALL DAY Acoustics

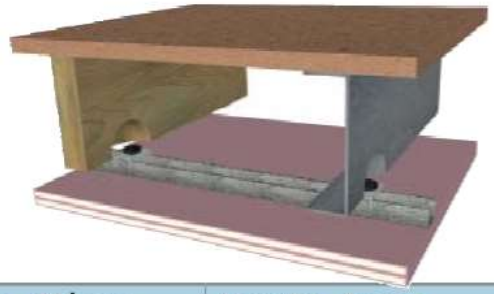
More Practice

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 Rated from below only	RISF	Plasterboard Ceiling Lining	Max Framing Centres (mm)	Acoustics – Airborne Rw (Rw + Ctr)			Acoustics – Impact Ln,w (Ln,w + Ci)		
	Fire Report FAR 2879				No Insulation	50mm EarthWool 11 kg/m³	65mm Polyester ASB3/TSB3	Carpet and Underlay	Tiled or Left Bare	
KF230	**30/30/30**	–	1 layer of 13mm FireShield	600	47 (42)	51 (45)	51 (44)	27 (**31**)	65 (64)	Acoustic Report Day Design 3094-26 3094-50
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**)	

MARSHALL DAY Acoustics

A breather

MARSHALL DAY Acoustics

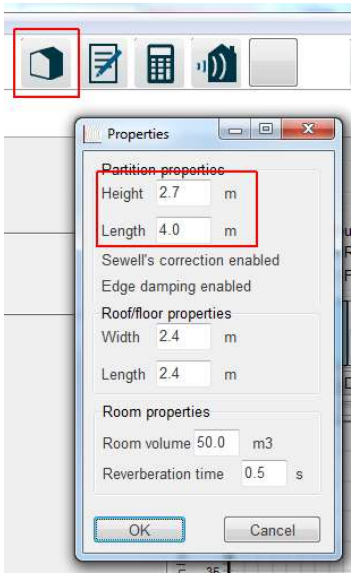
Low Frequency
factors to be aware of

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

MARSHALL DAY Acoustics

Panel Size

- Standard test area is 10 m^2
- For small panels (e.g. windows) the apparent sound insulation is better at low frequencies.

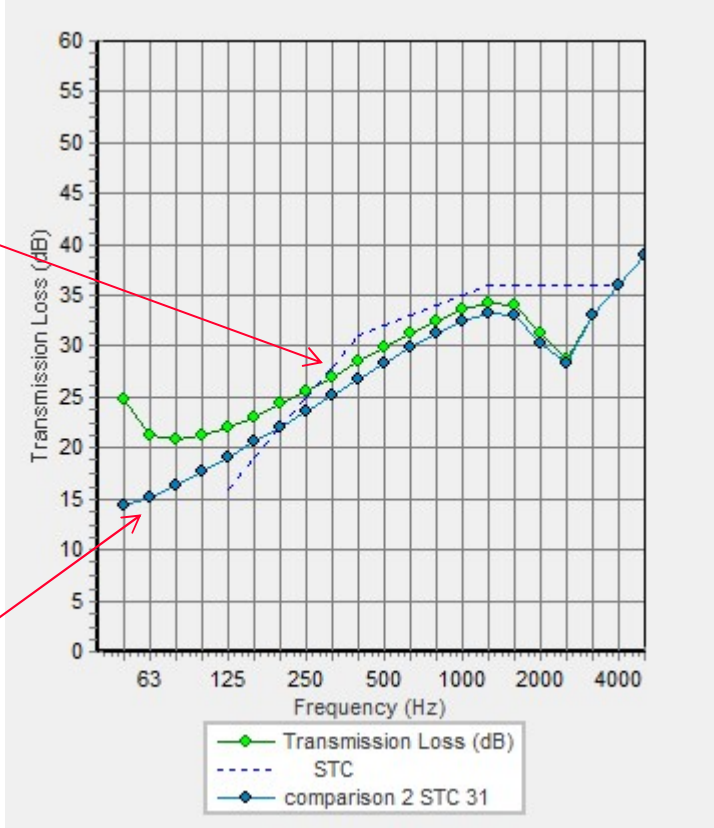


MARSHALL DAY Acoustics

Window (6mm) – effect of size

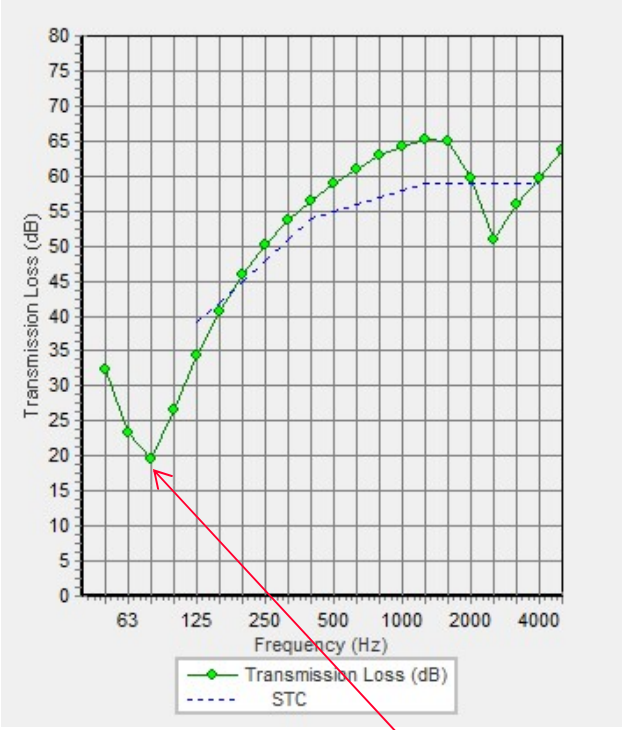
1.5 m^2

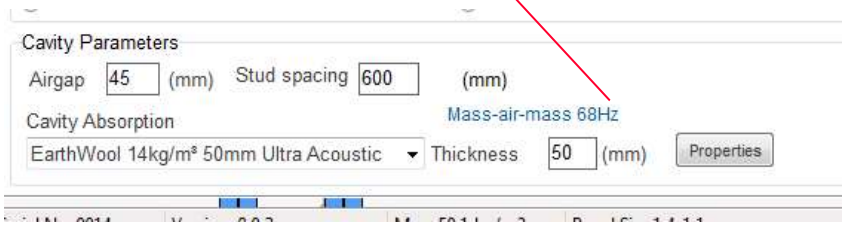
10 m^2

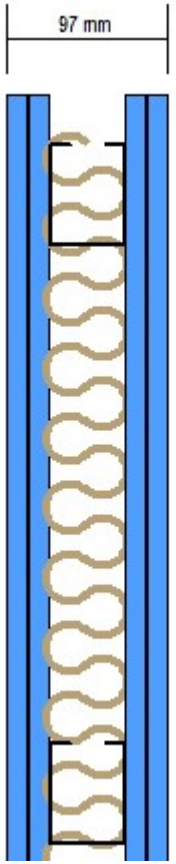


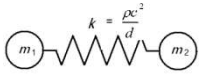
MARSHALL DAY Acoustics

Mass-air-mass Resonance





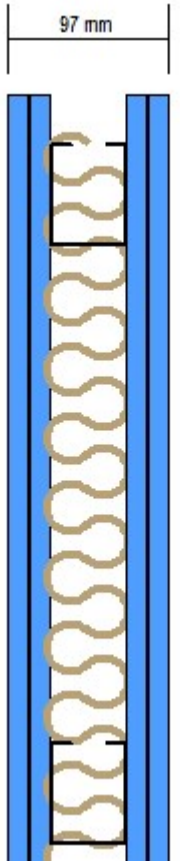




MARSHALL DAY Acoustics

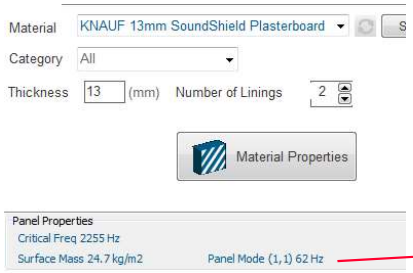
Mass-air-mass Resonance

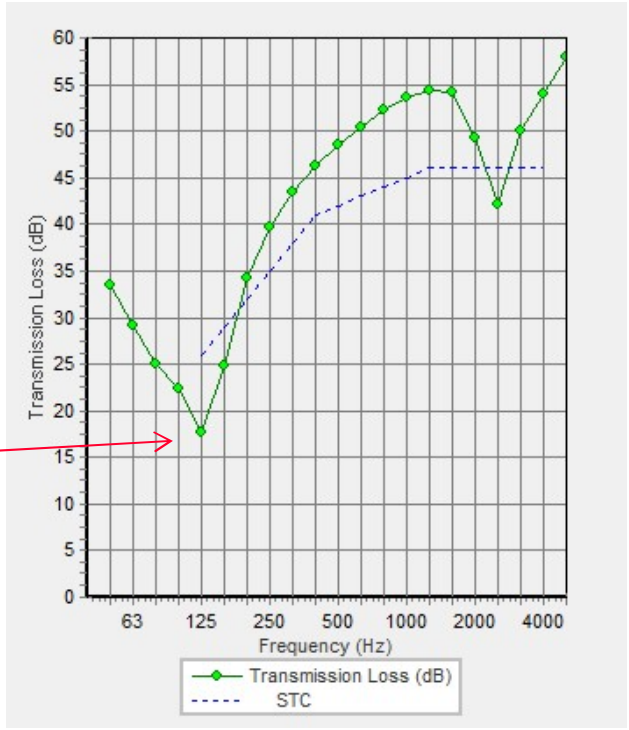
- Avoid light weight panels
- Avoid small cavity widths
- Avoid empty cavities

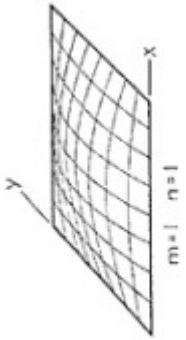


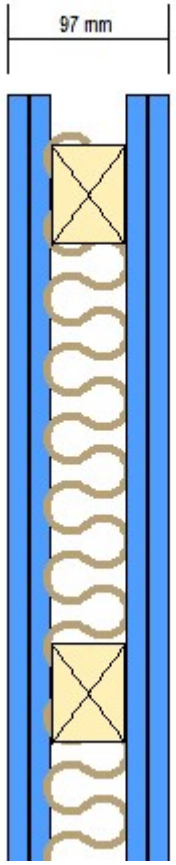
MARSHALL DAY Acoustics

Panel Mode







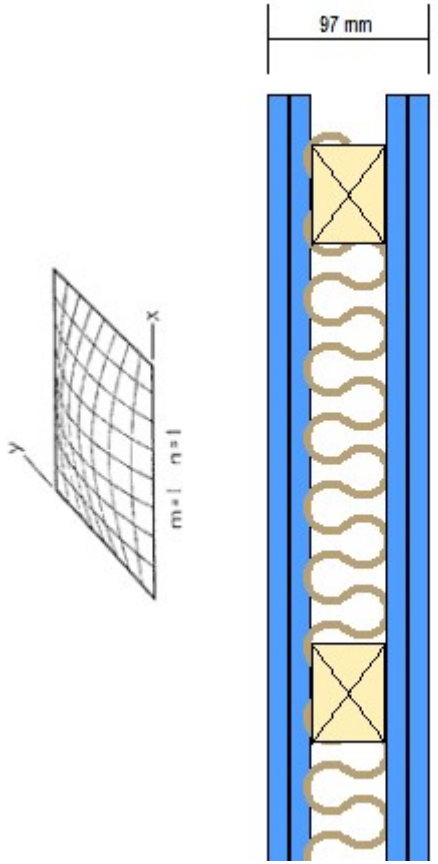


MARSHALL DAY Acoustics

Panel Mode

•Avoid close stud spacings (less than 600mm)

•Avoid stiff panels (thick panels)

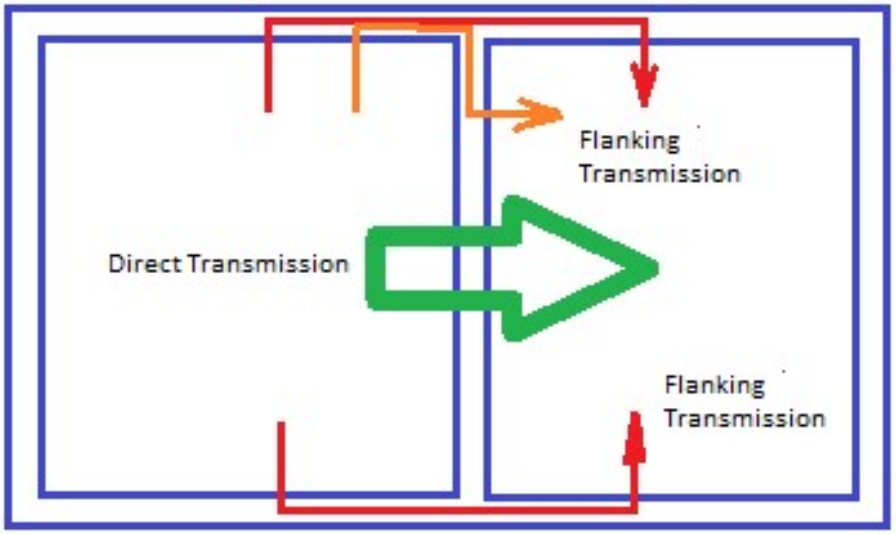


MARSHALL DAY Acoustics

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

MARSHALL DAY Acoustics



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

MARSHALL DAY Acoustics

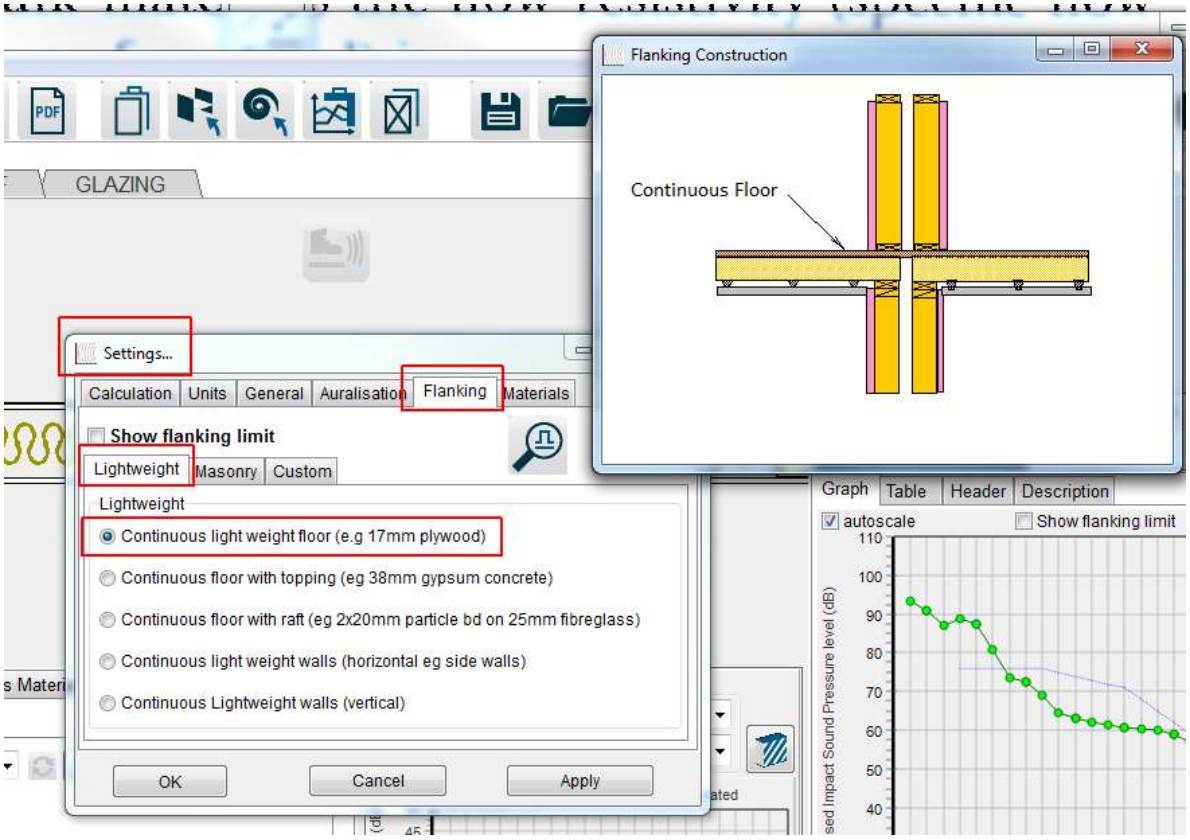
INSUL Flanking

- Select the approximate surrounding construction and indicate the likely magnitude of flanking transmission

- Especially important when high performance partitions (≥STC/Rw 55) are to be used

MARSHALL DAY Acoustics

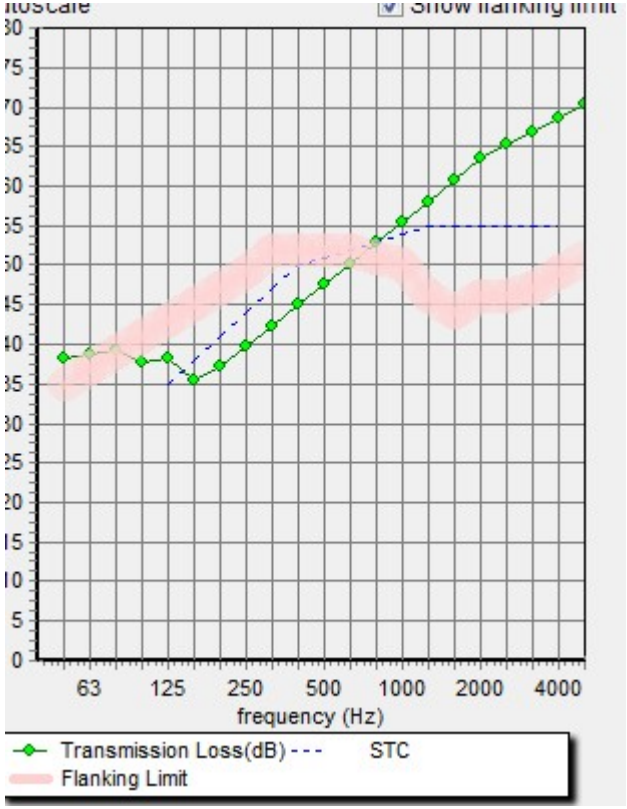
Flanking limit

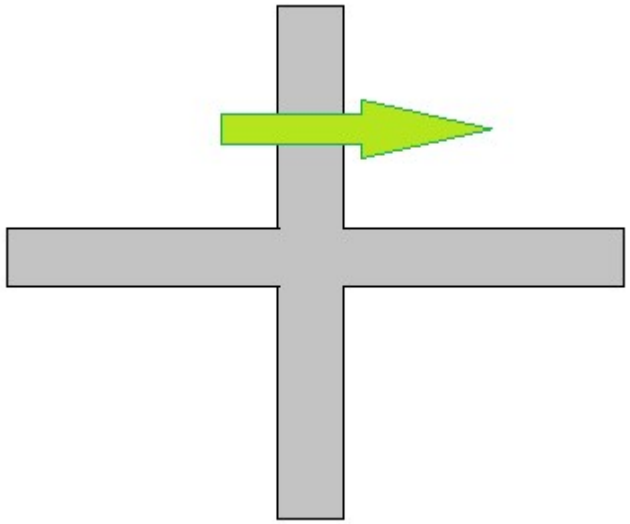


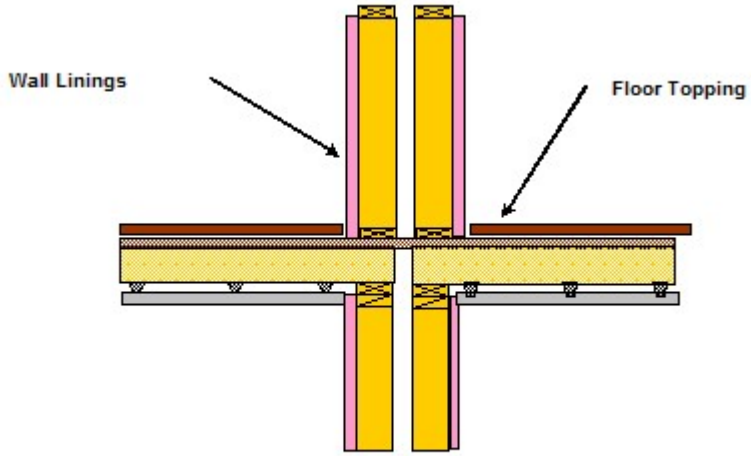
MARSHALL DAY Acoustics

- 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.

MARSHALL DAY Acoustics


63
125
250
500
1000
2000
4000
frequency (Hz)
Transmission Loss(dB)
STC
Flanking Limit




Wall Linings
Floor Topping

- 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.

MARSHALL DAY Acoustics

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

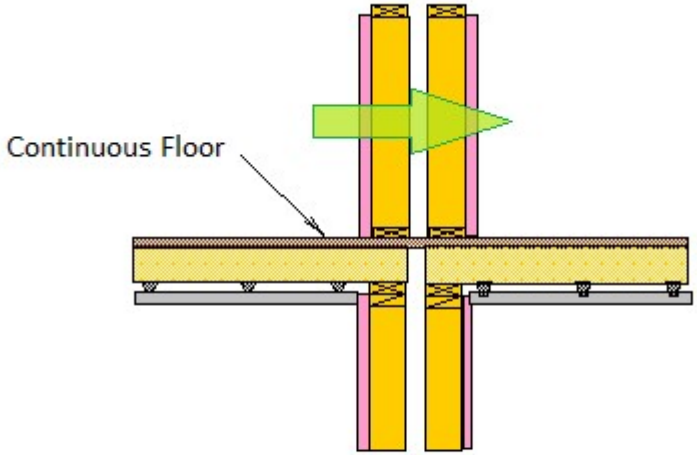
MARSHALL DAY Acoustics

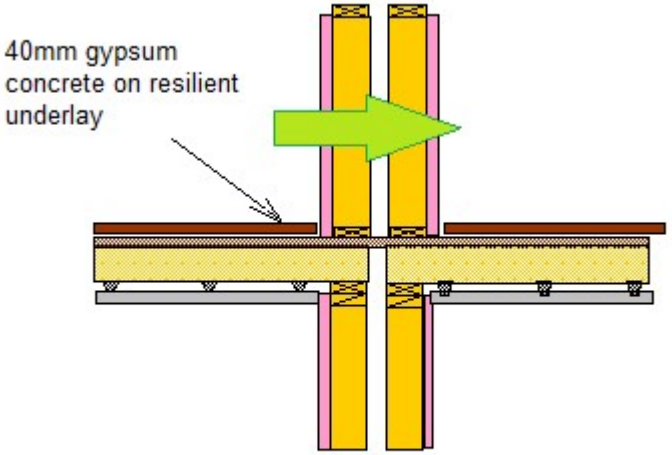
Lightweight flanking structures

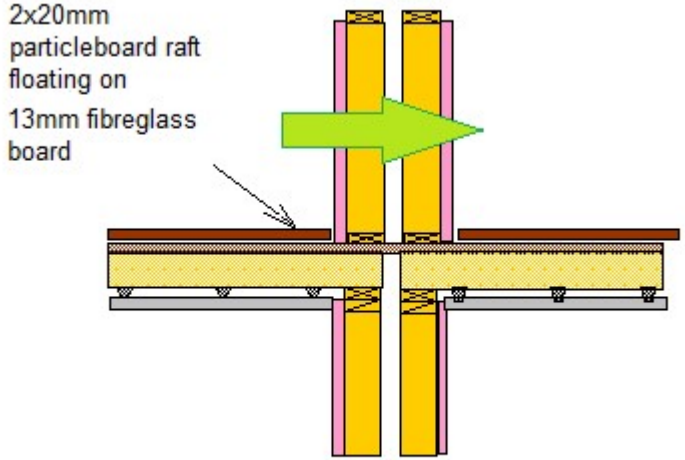
- For lightweight construction it is not practical at this time to calculate the flanking transmission, and

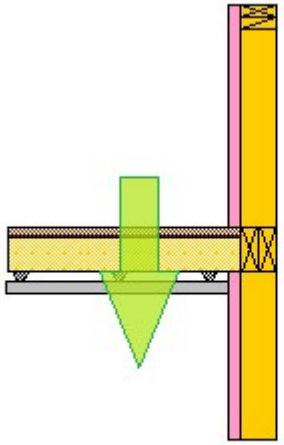
- So experimental results have been used to predict the flanking for some common constructions.

MARSHALL DAY Acoustics









MARSHALL DAY Acoustics

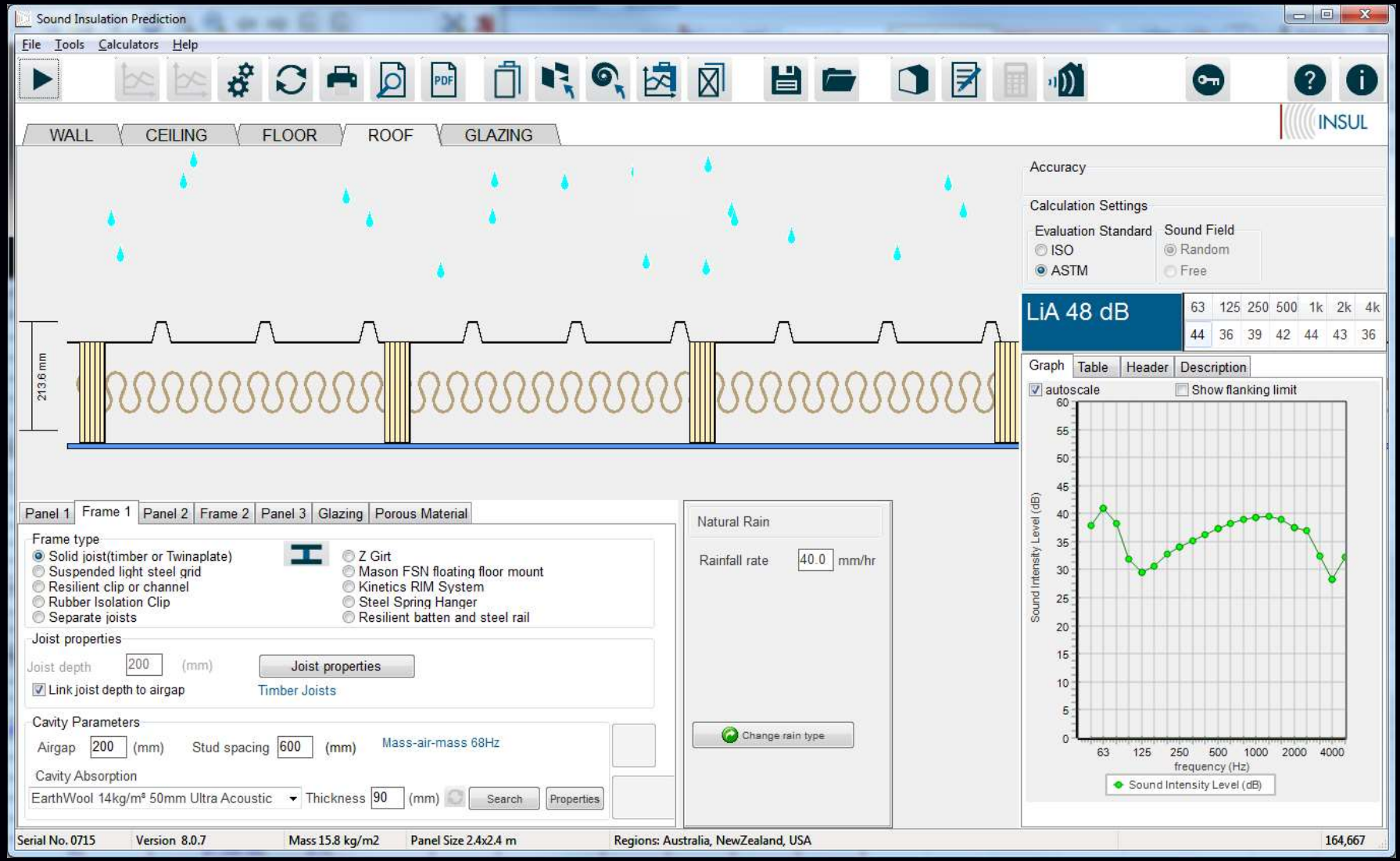
End of Part 2

MARSHALL DAY Acoustics

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 Lp, Li and Lw, with results given in third octave bands, octave bands, dBA, NC and PNC

MARSHALL DAY Acoustics



MARSHALL DAY Acoustics

- 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

MARSHALL DAY Acoustics

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

MARSHALL DAY Acoustics

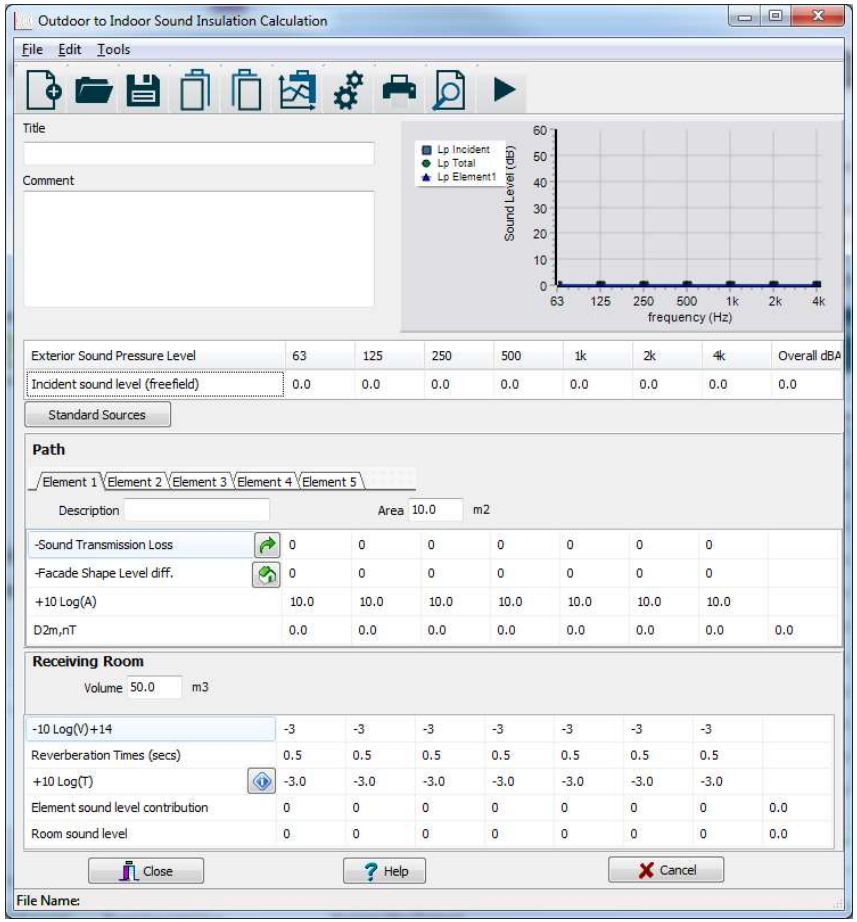
- Calculations are based on EN 12354/3: *Estimation of acoustic performance in buildings from the performance of elements. Airborne sound insulation against outdoor sound*.
- Input/Output
  - Several standard outdoor noise spectra are available (e.g. traffic noise, aircraft noise, entertainment noise, 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,

MARSHALL DAY Acoustics

- 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

MARSHALL DAY Acoustics

- Input/Output (cont)



MARSHALL DAY Acoustics

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

MARSHALL DAY Acoustics

- 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

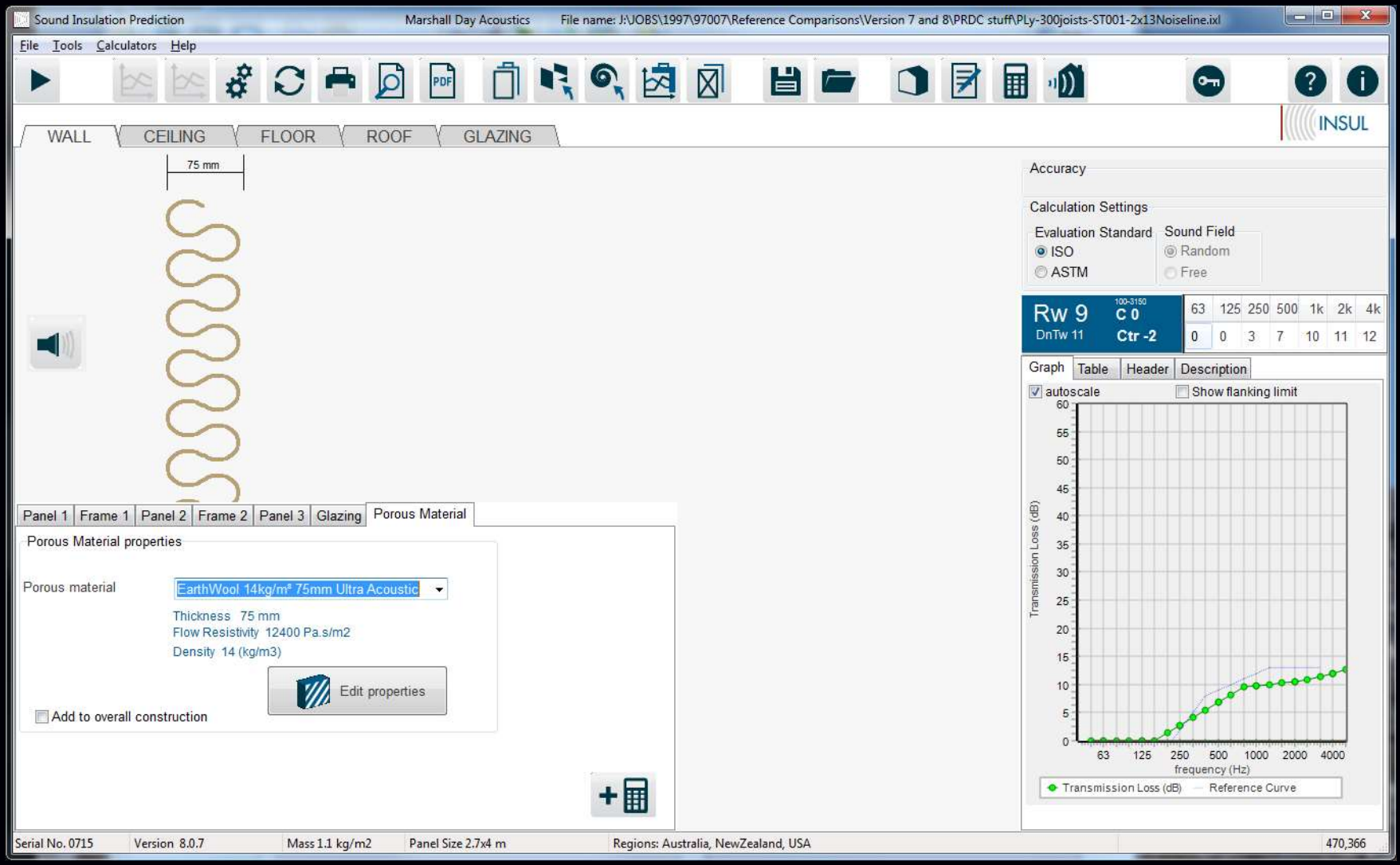
- This can be extended by adding an airgap and a second lining, with or without an acoustic blanket in the cavity

MARSHALL DAY Acoustics

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

MARSHALL DAY Acoustics



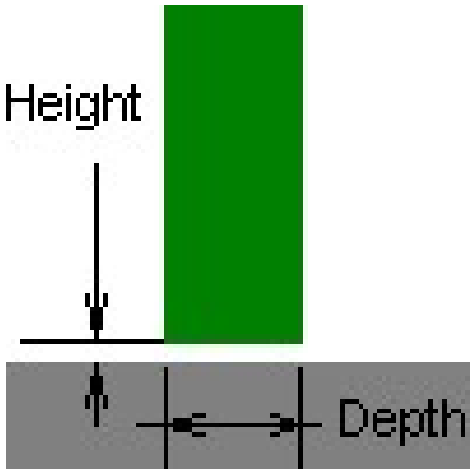
MARSHALL DAY Acoustics

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

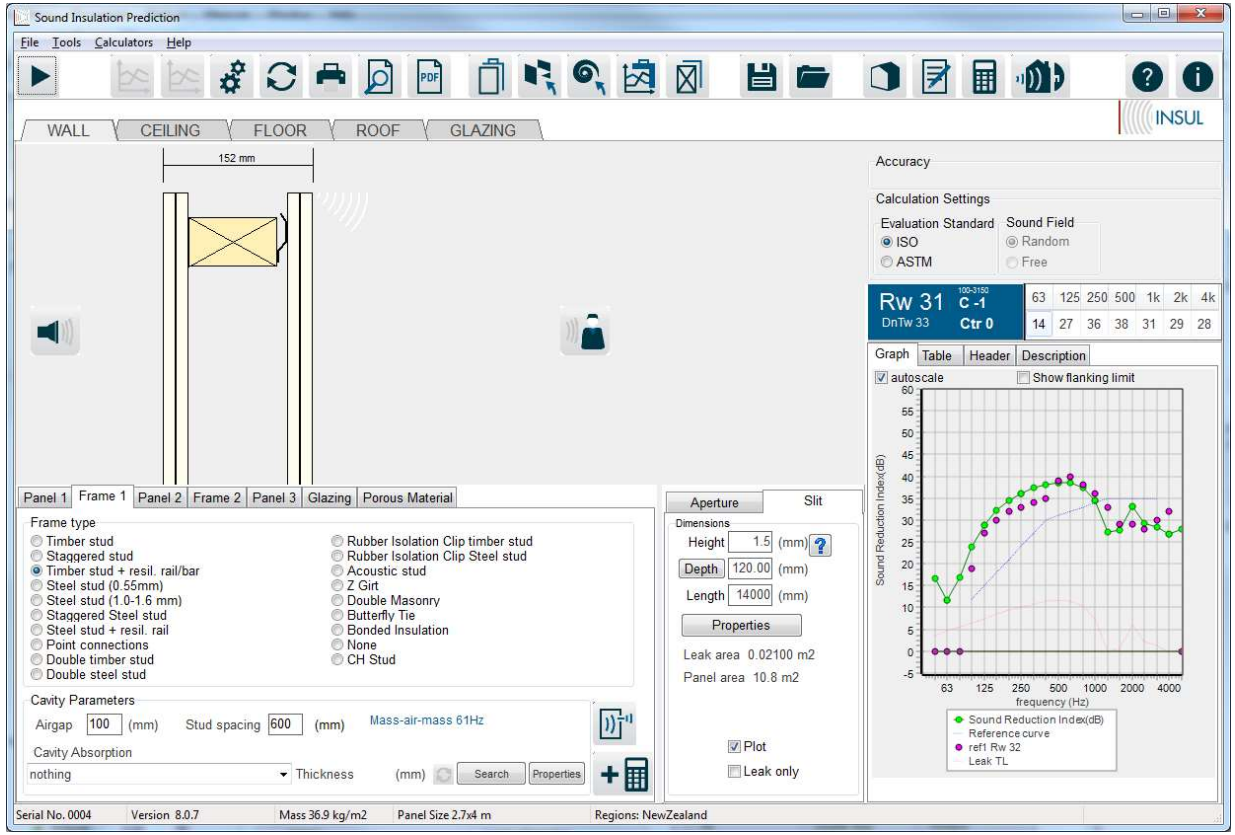
MARSHALL DAY Acoustics

Leak Effect Prediction



MARSHALL DAY Acoustics

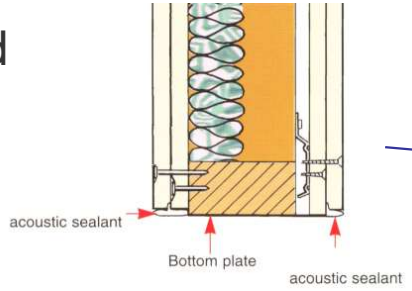
Effect of leakage



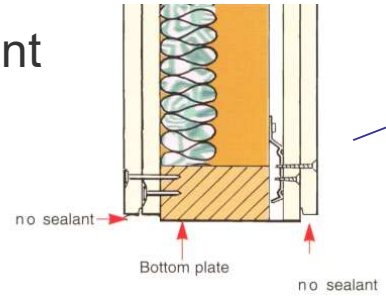
MARSHALL DAY Acoustics

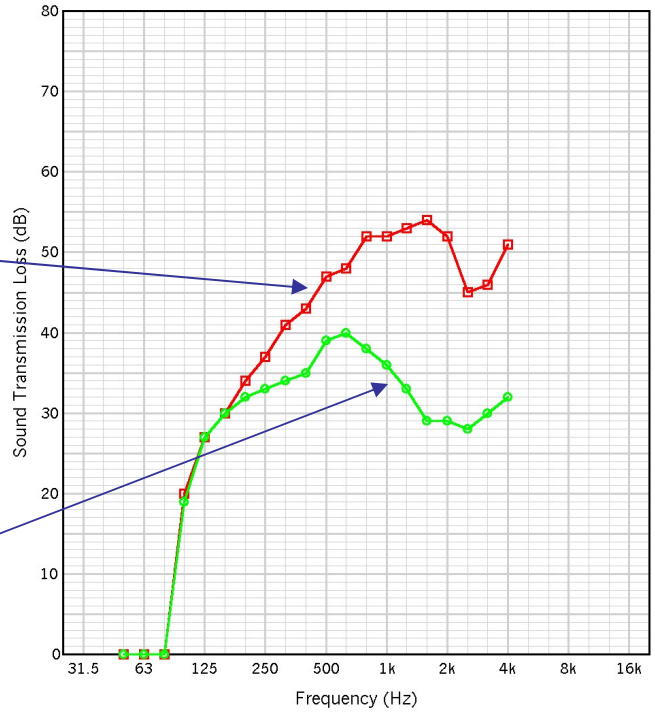
Effect of Leakage

Sealed
Rw 47



No sealant
Rw 32





MARSHALL DAY Acoustics

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.

MARSHALL DAY Acoustics

- 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:

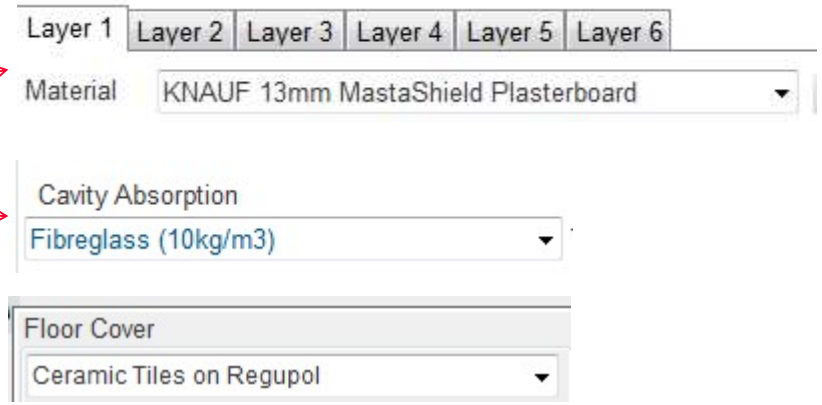
  - So demonstrating differences in low frequency performance with headphones may be quite ineffective

  - Likewise, trying to listen to the effect of very high performance walls may be impossible if the background noise is not very low

MARSHALL DAY Acoustics

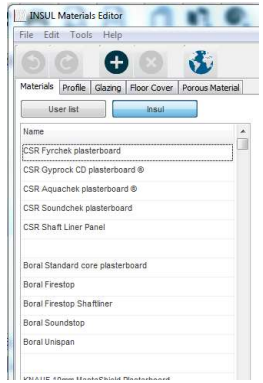
The Databases

- Three key databases
  - Materials
  - Absorbers
  - Floor covers
- Three other databases
  - Glazing materials
  - Profile
  - Core materials (for elastic core materials)



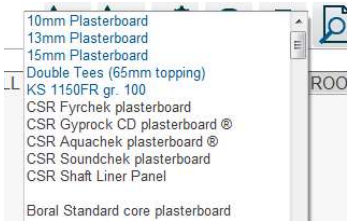
MARSHALL DAY Acoustics

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



MARSHALL DAY Acoustics

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)

MARSHALL DAY Acoustics

Absorber database

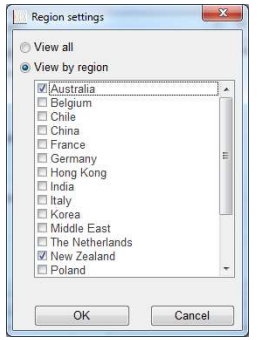
- Two key parameters
  - Density (kg/m^3)
  - Flow resistivity (Pas/m^2 = Rayl/m) see ISO

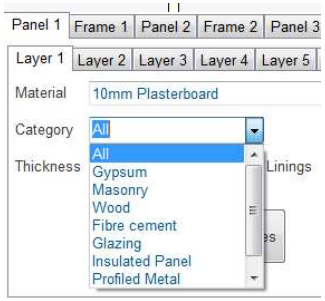
- Secondary parameters (name, region, category, type, colour)

MARSHALL DAY Acoustics

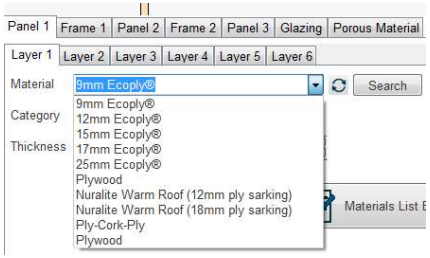
Database Features

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



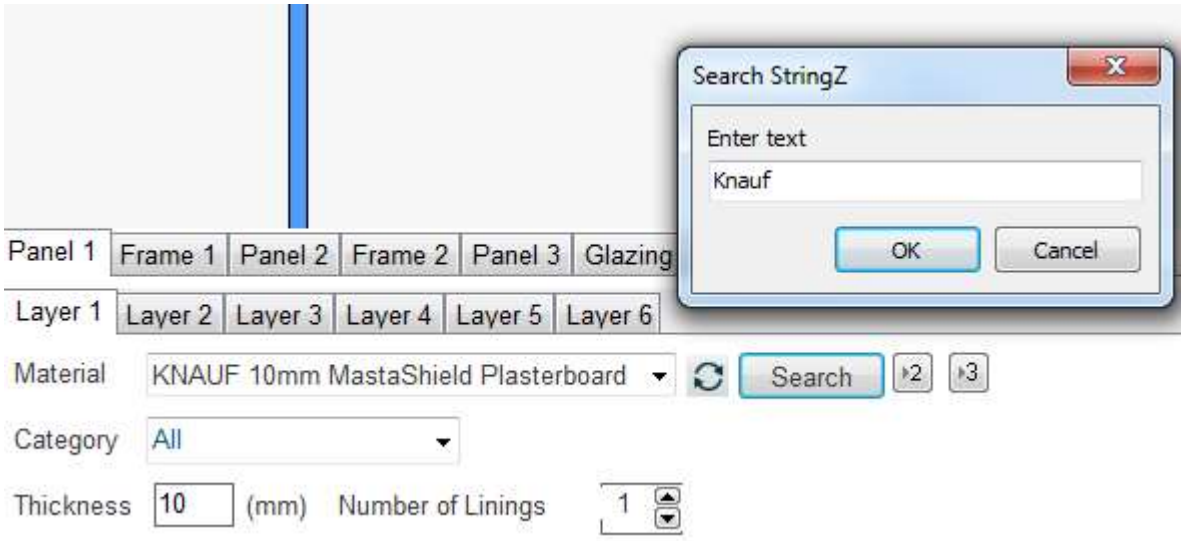


- User can search by text string on Description (in example below we have searched on “ply”)



MARSHALL DAY Acoustics

Database selection



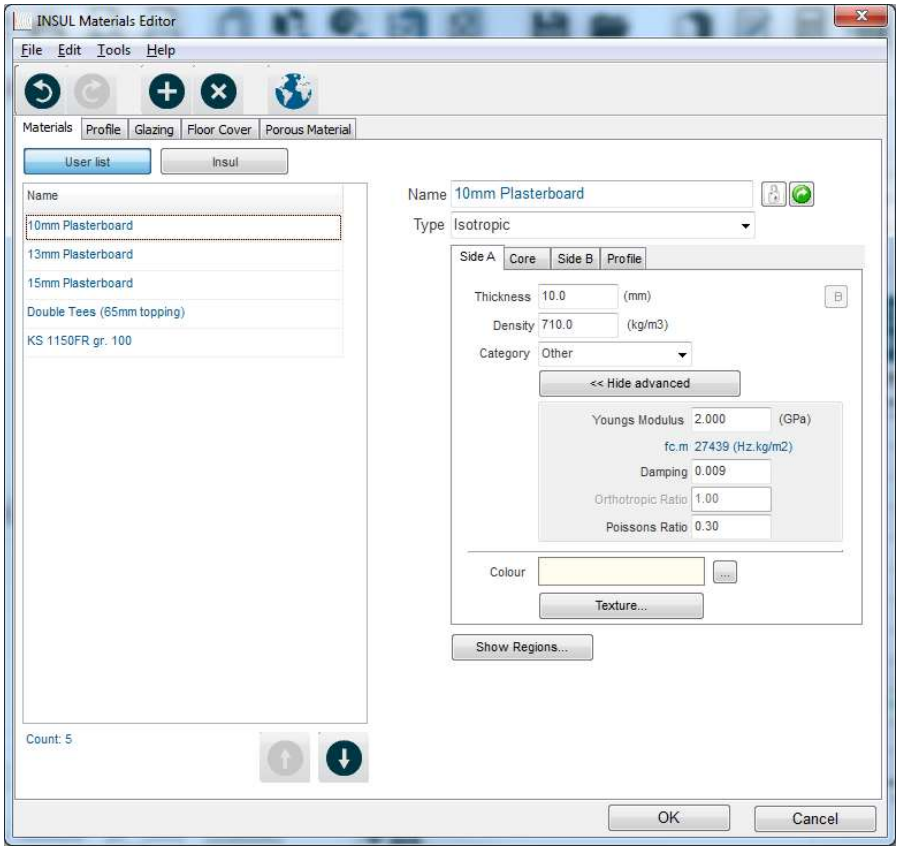
MARSHALL DAY Acoustics

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

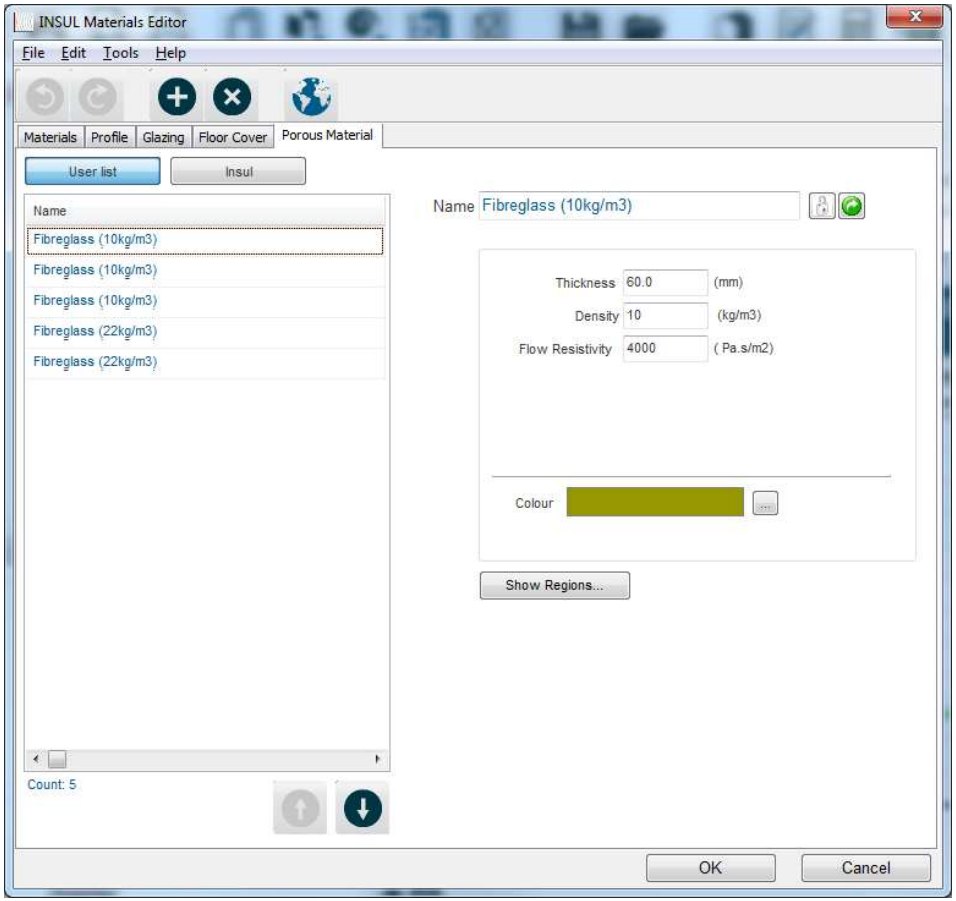
MARSHALL DAY Acoustics

Entering material parameters



MARSHALL DAY Acoustics

Entering material parameters



MARSHALL DAY Acoustics

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 categroy 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)

MARSHALL DAY Acoustics

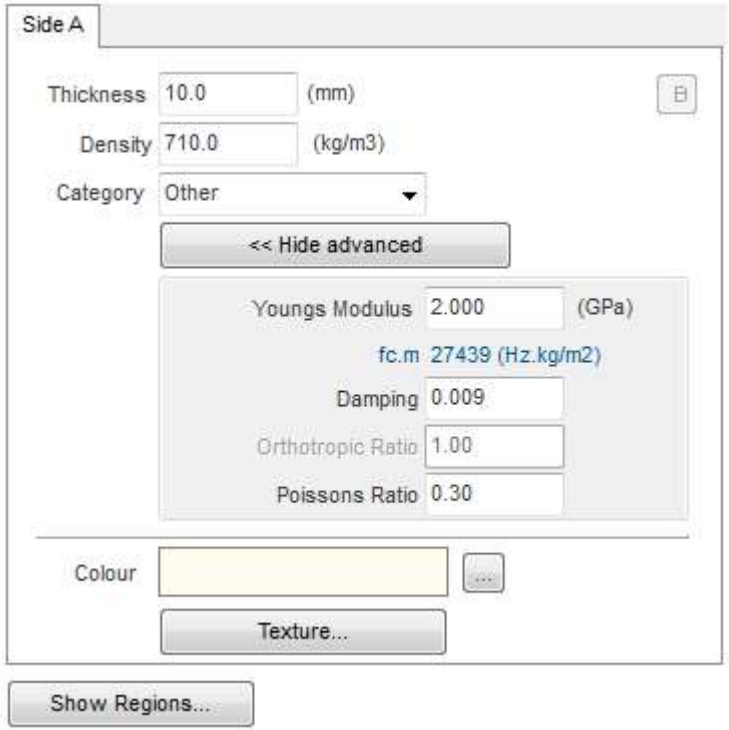
Entering a new material

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 η= 0.01 if no other info)

MARSHALL DAY Acoustics

Entering parameters



MARSHALL DAY Acoustics

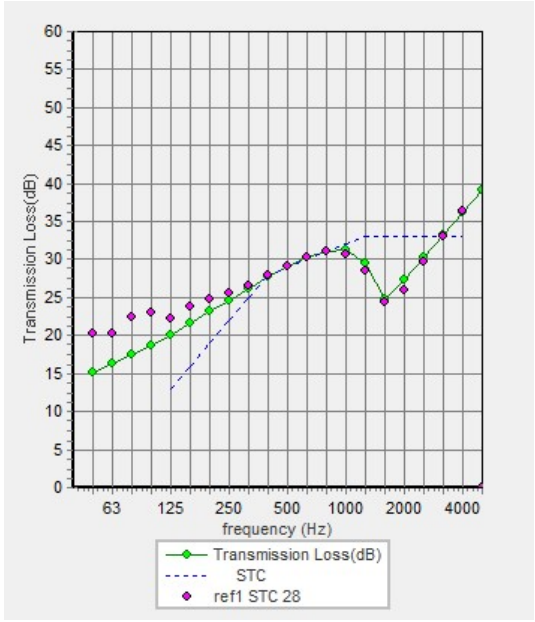
Modulus and damping from acoustic test

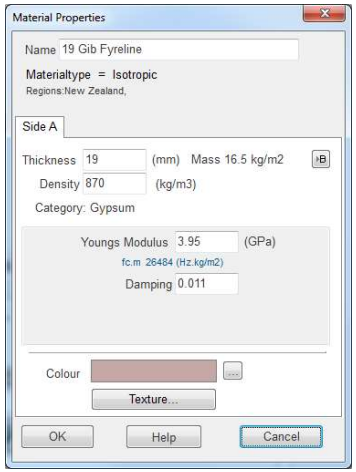
19mm gypsum plasterboard

Best fit :

E = 3.95 GPa (adjust to get frequency right)

η = 0.011 (adjust to get depth of dip right)





MARSHALL DAY Acoustics

End of Part 3

MARSHALL DAY Acoustics

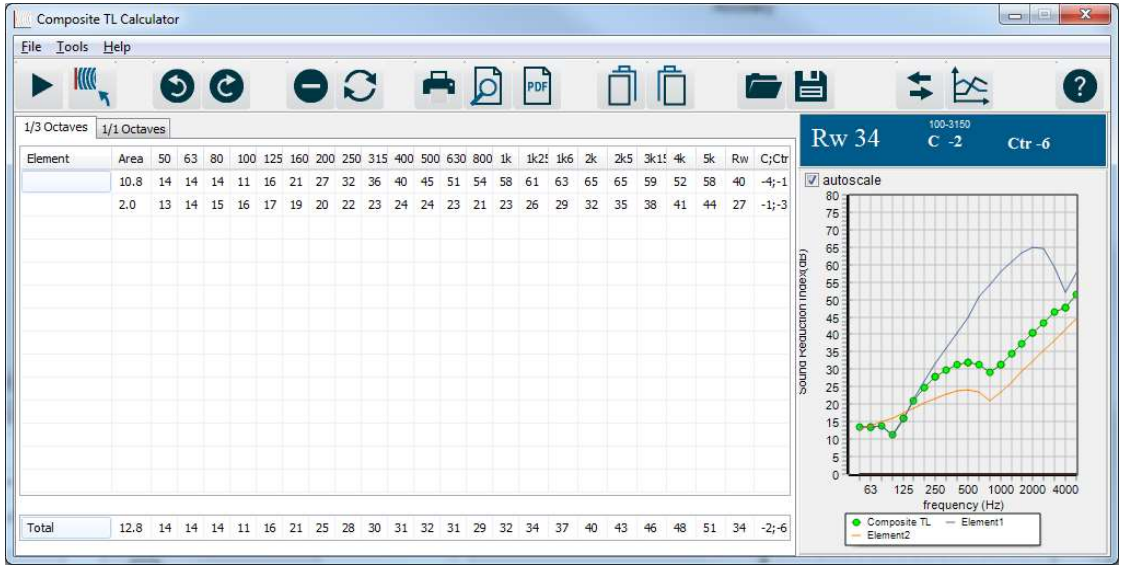
Some Utilities

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

MARSHALL DAY Acoustics

Composite Transmission Loss

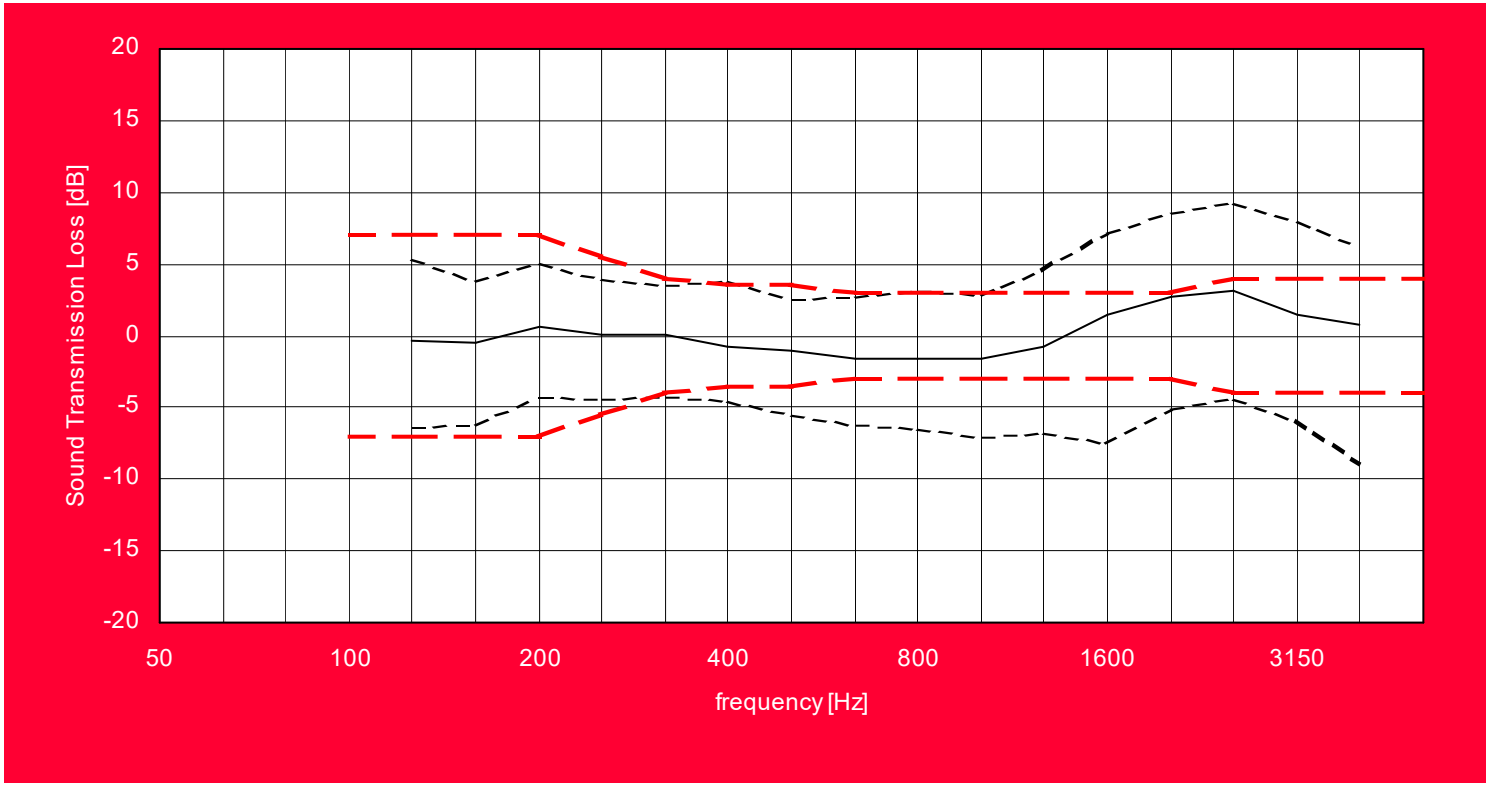
- Single Stud partition (Rw 40)
- Single door (Rw 27)
- Composite Rw 34



MARSHALL DAY Acoustics

Accuracy

(No substitute for Lab data)



Rw/STC
Mean difference
-0.3dB
10% -2dB
90% +3dB

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

MARSHALL DAY Acoustics

Keeping Up to date

- Check for new releases (irregular but free). Bug fixes, small improvements, more materials
- Download and install to be current

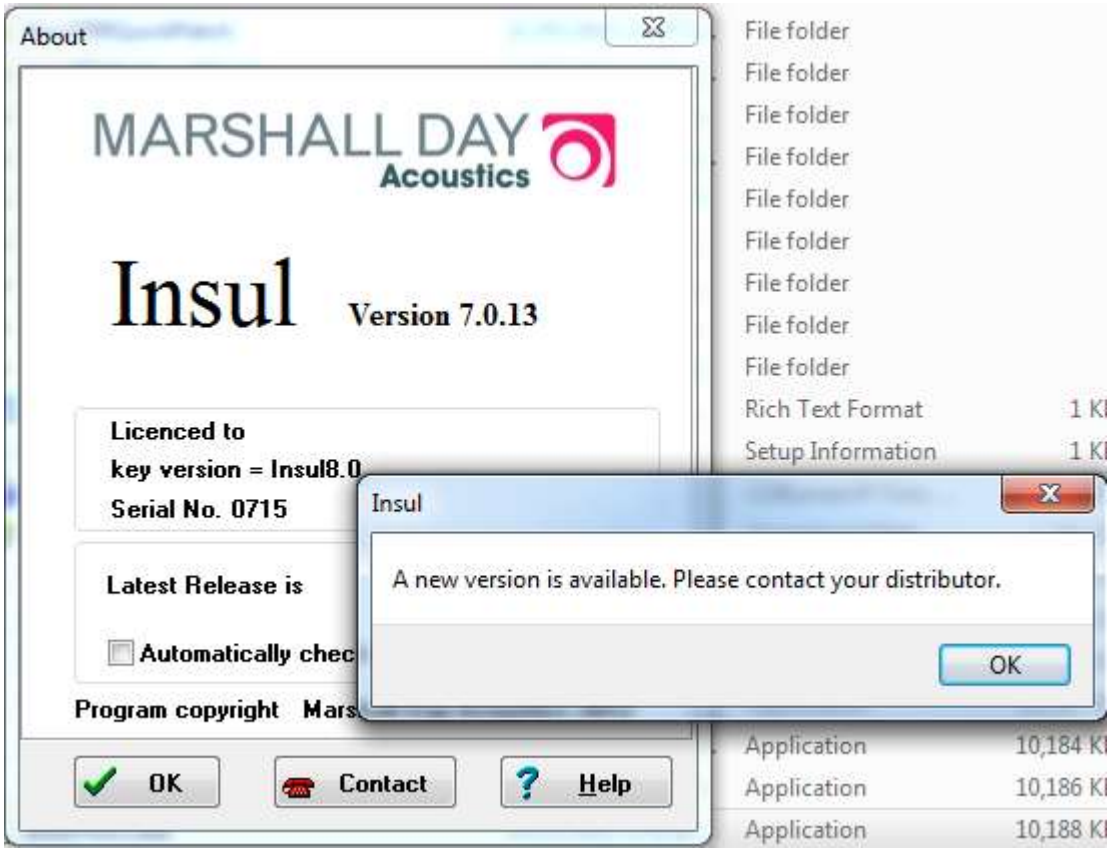
- New Versions come out every 18 months to 2 years (paid for). Recommended

MARSHALL DAY Acoustics

Updating

MARSHALL DAY
Acoustics

New version



MARSHALL DAY
Acoustics

Updating the key

MARSHALL DAY Acoustics

THE END

MARSHALL DAY Acoustics