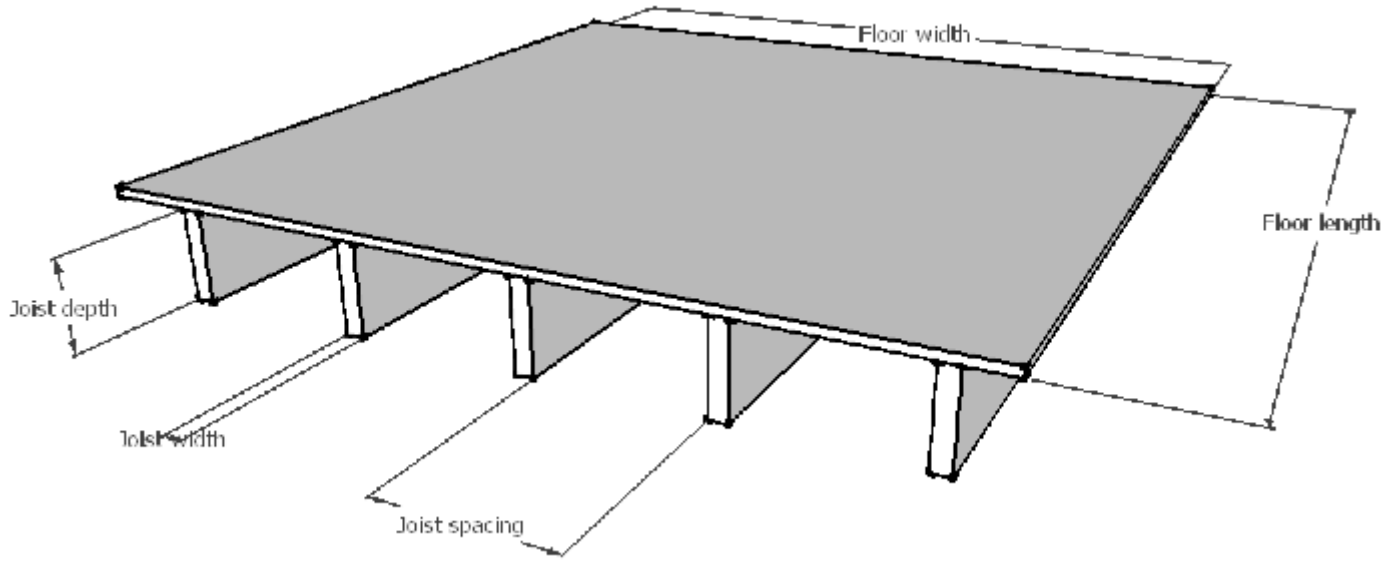

Impact sound insulation predictions for light weight floors.

An idea:

Potential modal response of the floor and its effect on impedance

INSUL

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Context

Light weight floors are commonly used in many countries.

There is a design and compliance demand for accurate prediction of IICs.

Wanted:

a *quick* prediction method to *engineering* accuracy

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Existing theory

Cremers theory for massive floors:

$$ISPL = F_{rms}^2 \left[Re[Y] \left(\frac{1}{\omega \eta \rho_s S} \right) \right] \rho c S \sigma$$

- Force: F, hammer of a tapping machine
- Floor : Re[Y], η, ρ_s, S
  Infinite plate model for Re[Y]
- SPL: σ, S, ρc

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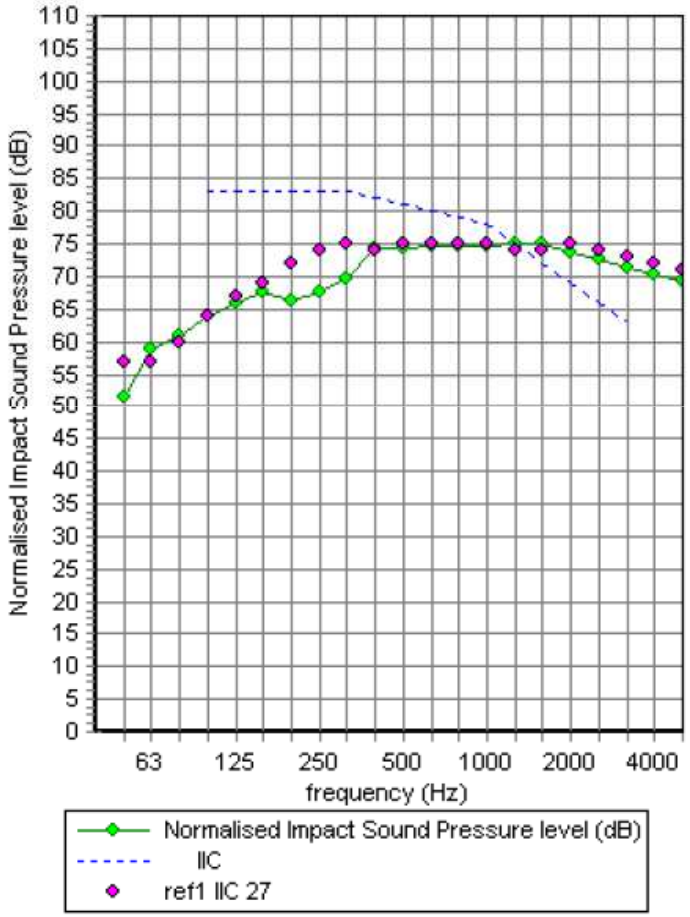
Existing theory



- INSUL

  Sound insulation prediction software

- **Comparison**:

  150mm Concrete slab (NRC)

  Insul prediction (based on Cremer)

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Existing theory

For light weight floors, Rabold et al (2010) provides a nice summary

- As before:

$$ISPL = F_{rms}^2 \left[Re[Y] \left(\frac{1}{\omega \eta \rho_s S} \right) \right] \rho c S \sigma$$

- Force can be adjusted to account for:
  Contact stiffness (Ver, 1971)
  Floors with higher admittance (Brunskog & Hammer, 2003)
  Relative velocity of the floor and hammer (Rabold et al, 2010)

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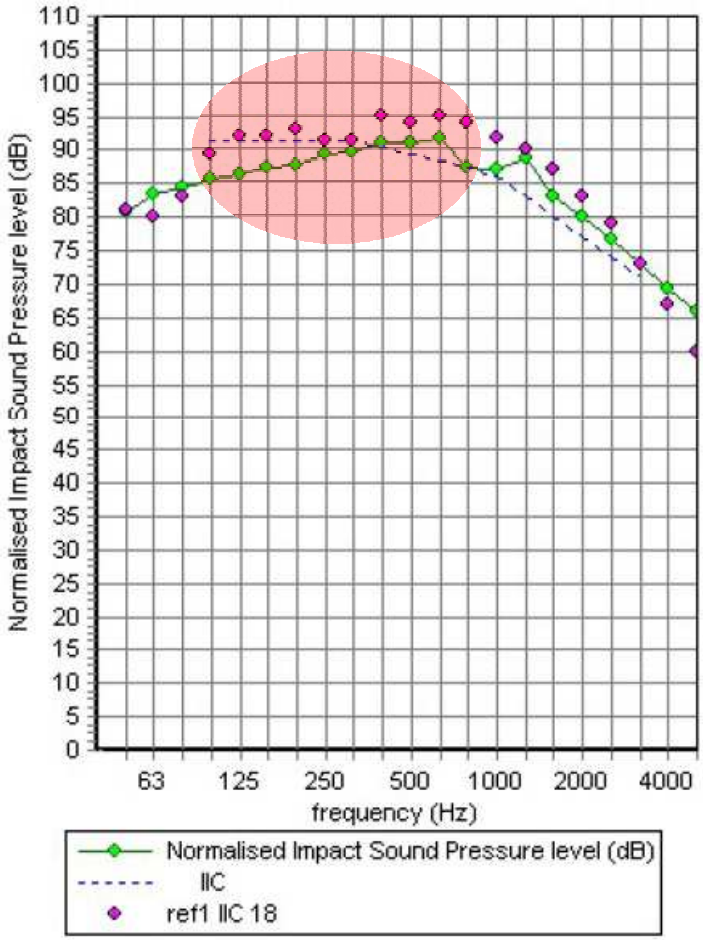
Existing theory



- **Comparison**:

  19mm OSB (NRC) IIC 18

  Available theory IIC 21

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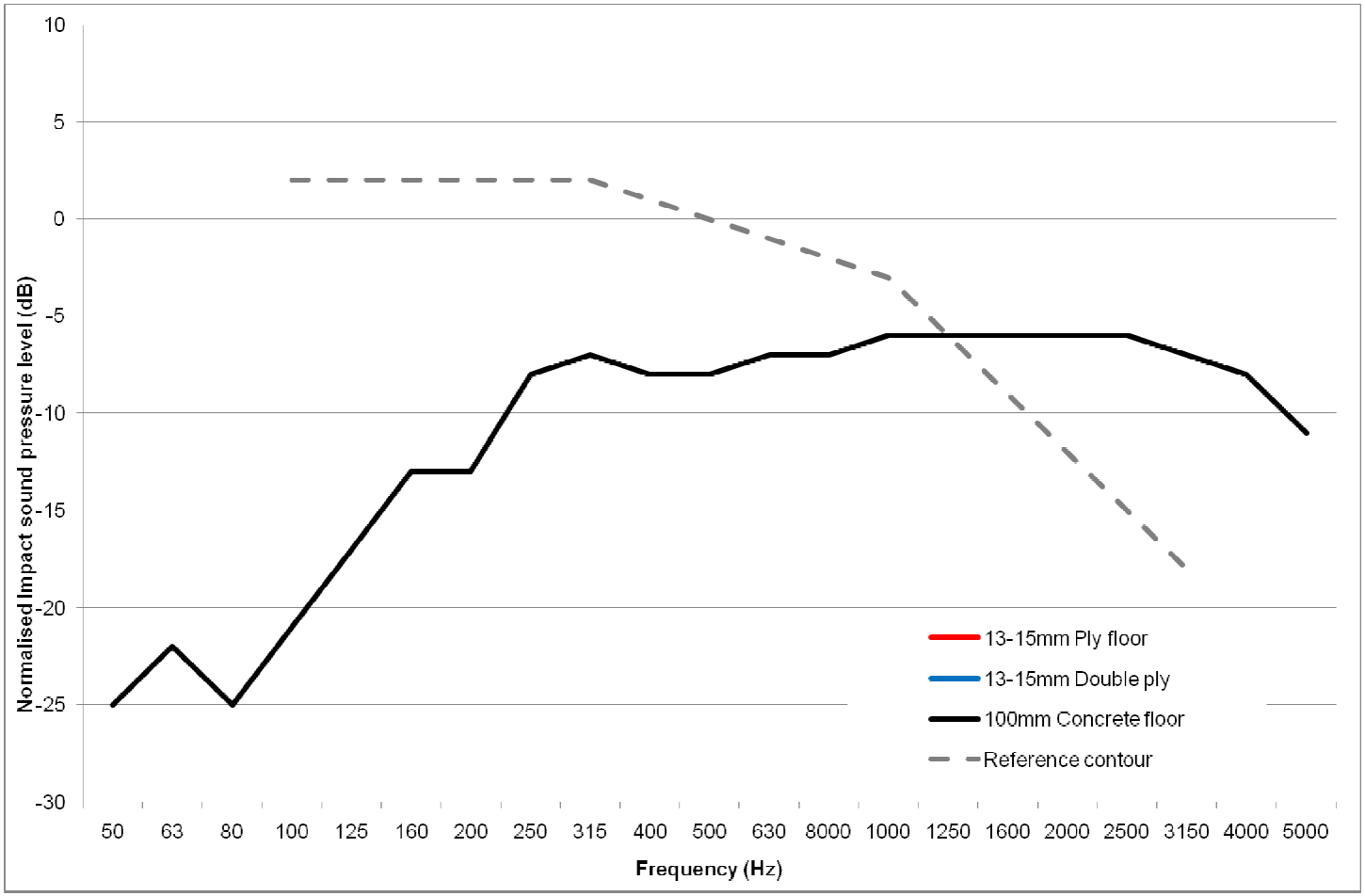
NRC Measured data



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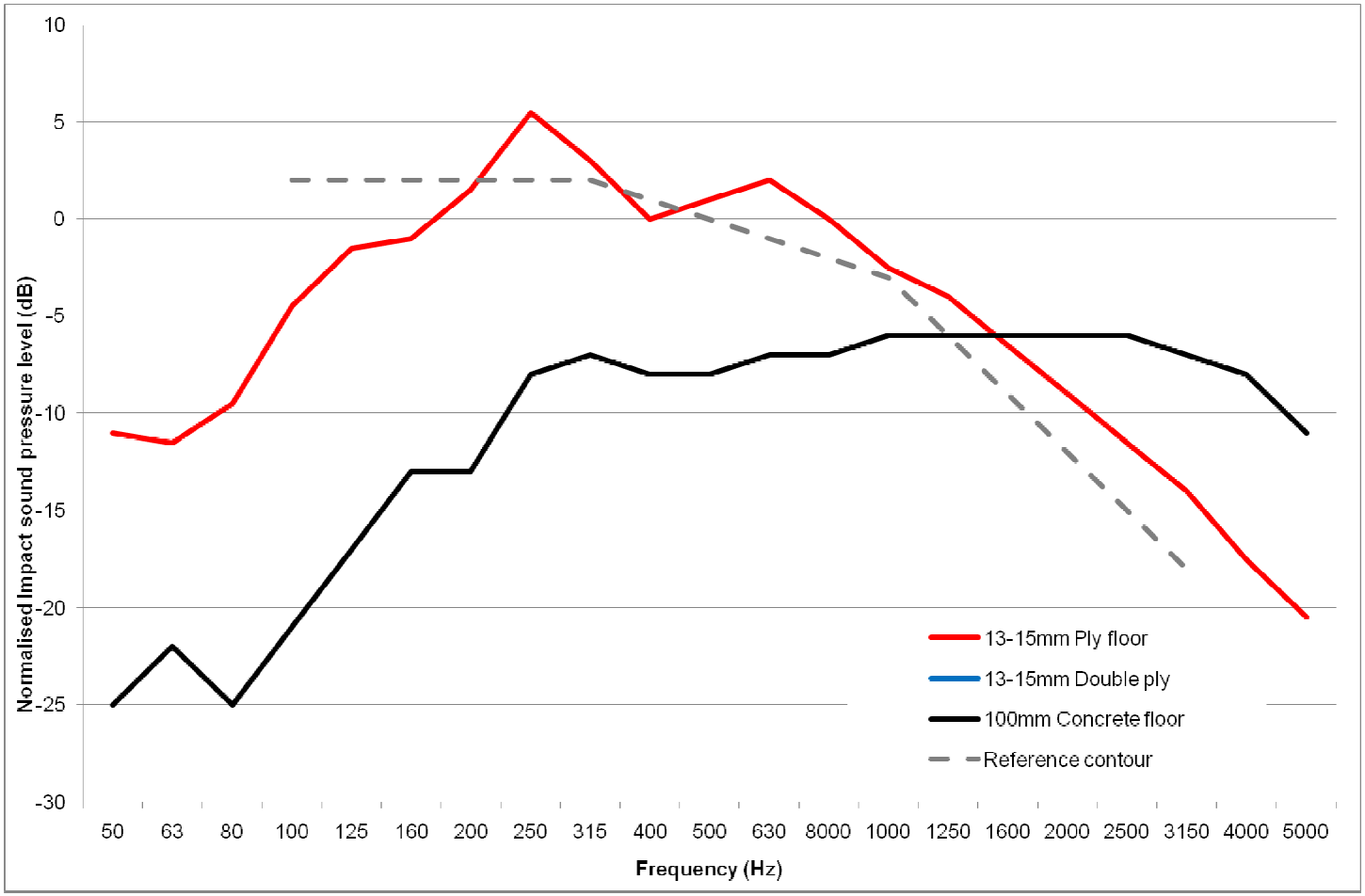
NRC Measured data



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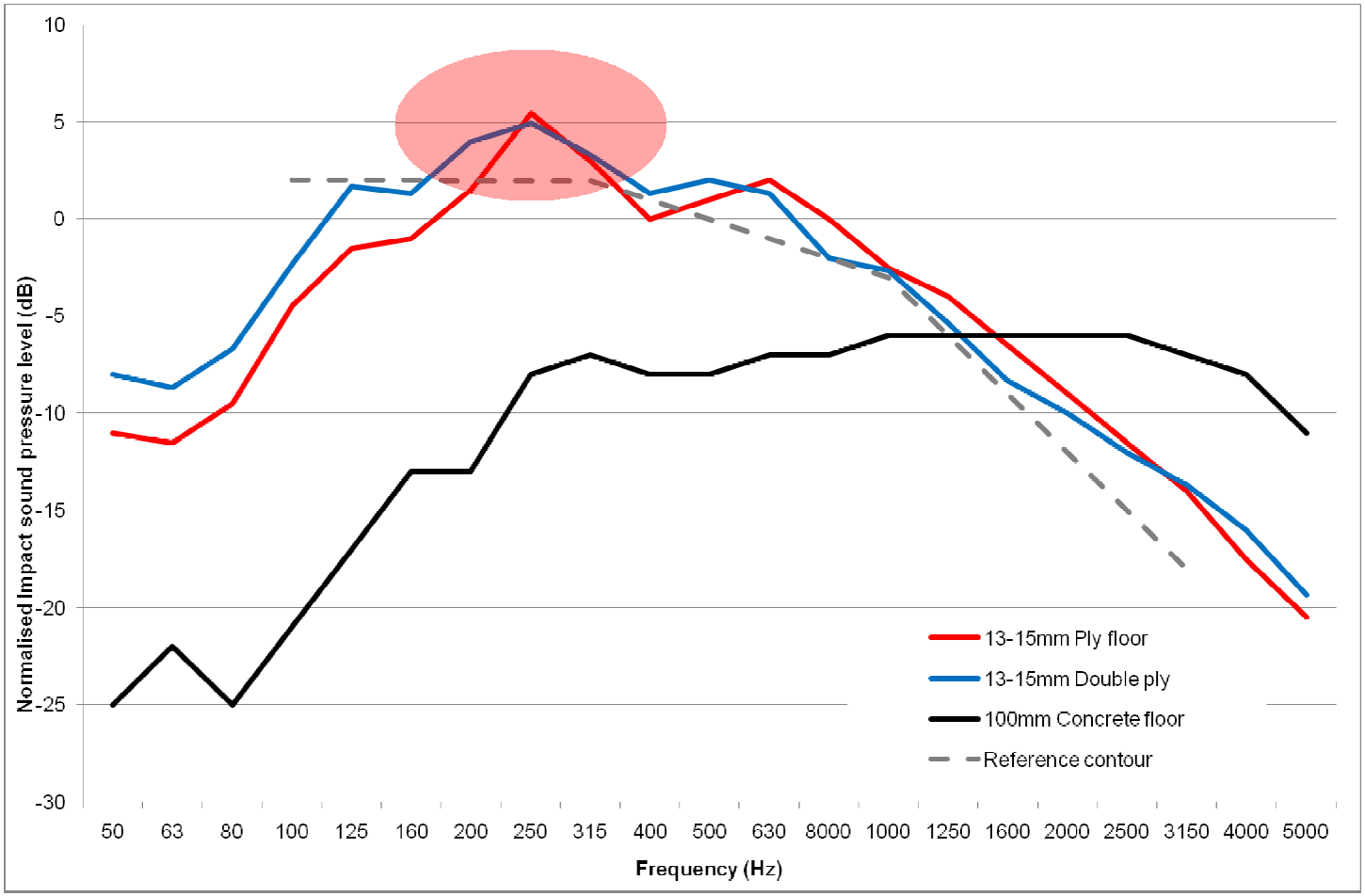
NRC Measured data



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NRC Measured data

- Possible causes:

$$ISPL = F_{rms}^2 \left[Re[Y] \left(\frac{1}{\omega \eta \rho_s S} \right) \right] \rho c S \sigma$$

F, Re[Y] , η, σ

- Mayr, Gibbs et al (2008) have shown Re[Y] depends on beam admittance in the low frequency region

- The most plausible cause is Re[Y]

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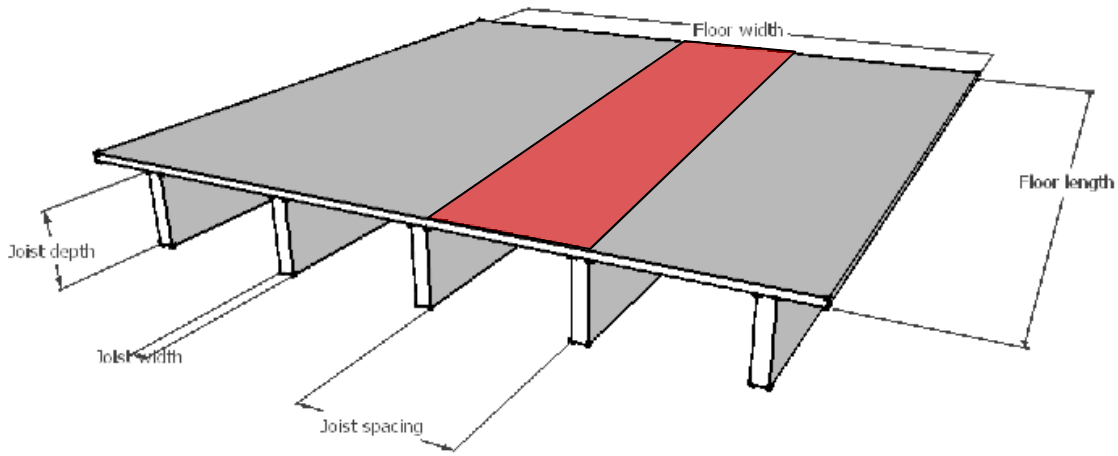
Conjecture

- That the observed mid-frequency trend is due to the modal response of the floor panel and its effect on admittance.

- Specifically,
  the modes associated with the length of the floor and the width between adjacent joists.



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Modes

- Modes: Formulae from Warburton (1954)
- Edge conditions: Floors screw fixed at regular intervals along joists

  More than simply supported, less than clamped
- Admittance: Formula from Hopkins (2007) for admittance envelope

$$\frac{4}{2\pi f \rho_S \eta}$$

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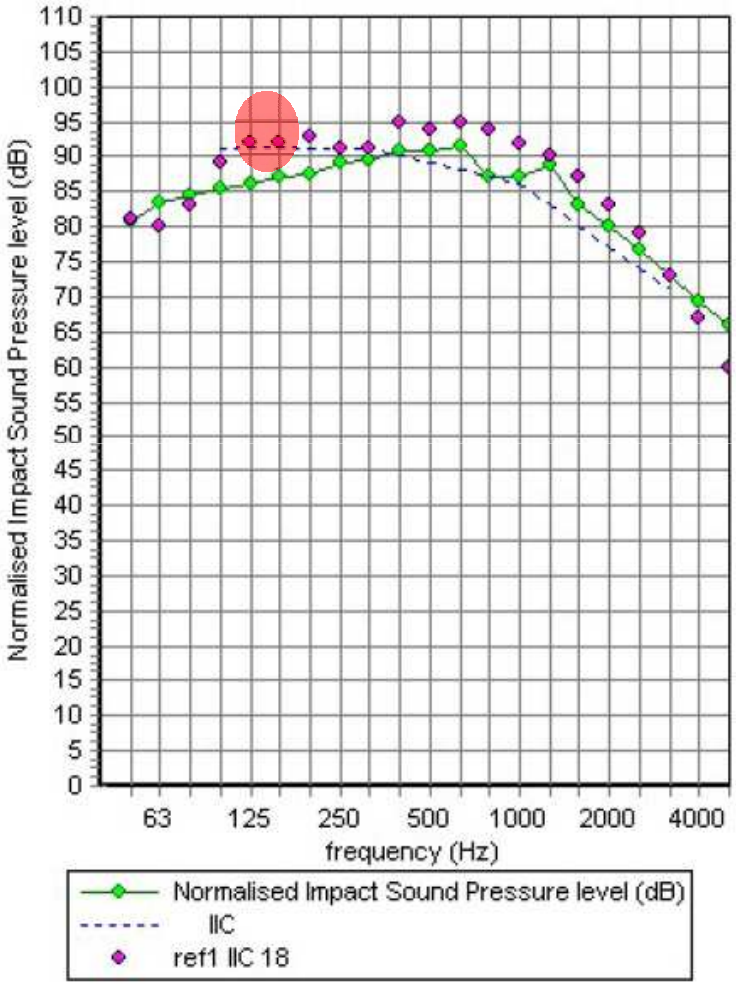
A worked example



- 19mm OSB (NRC)
- **Edge conditions**:

  Simply supported ≈ 65Hz

  Clamped ≈ 145Hz

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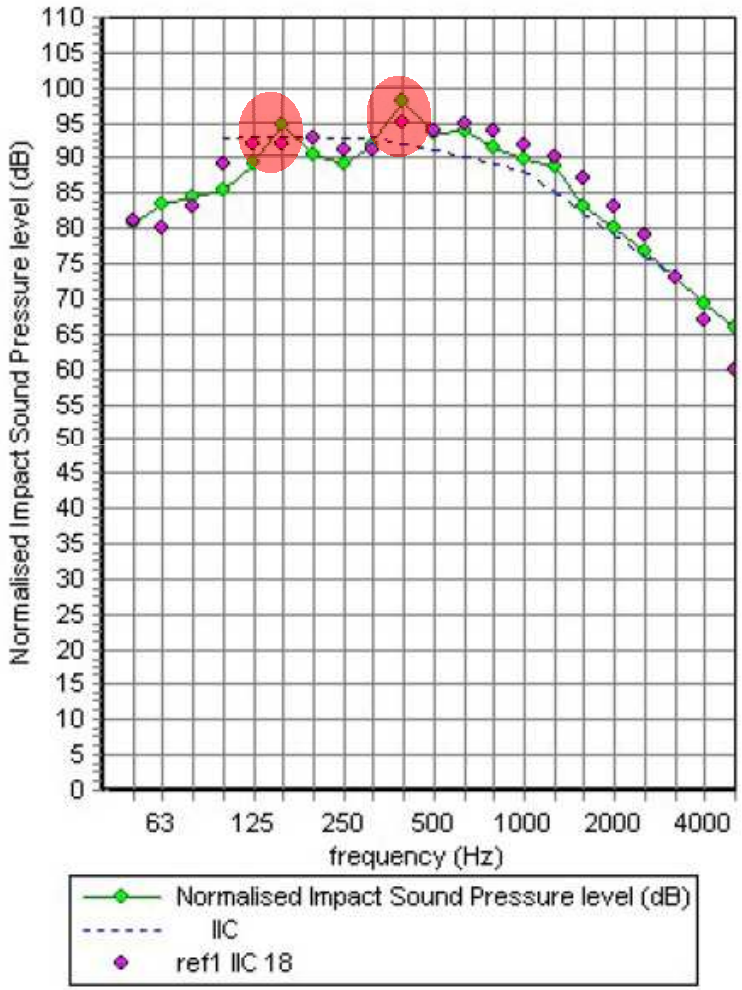
A worked example



- 19mm OSB (NRC)
- **Edge conditions**:

  Simply supported ≈ 65Hz

  Clamped ≈ 145Hz

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Further work

- Measurements and validity testing required
- Limitation: Conjecture based on NRC data only
- Modes to coincide with those over the entire floor plate

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