SCION
Next generation biomaterials

IMPROVING THE SOUND INSULATION AND SUSTAINABILITY OF TIMBER-FRAMED FLOORS

(or)

An LCA Journey by an Ignorant one.

Grant Emms (the ignorant one)

Barbara Nebel (the educated one)

Background

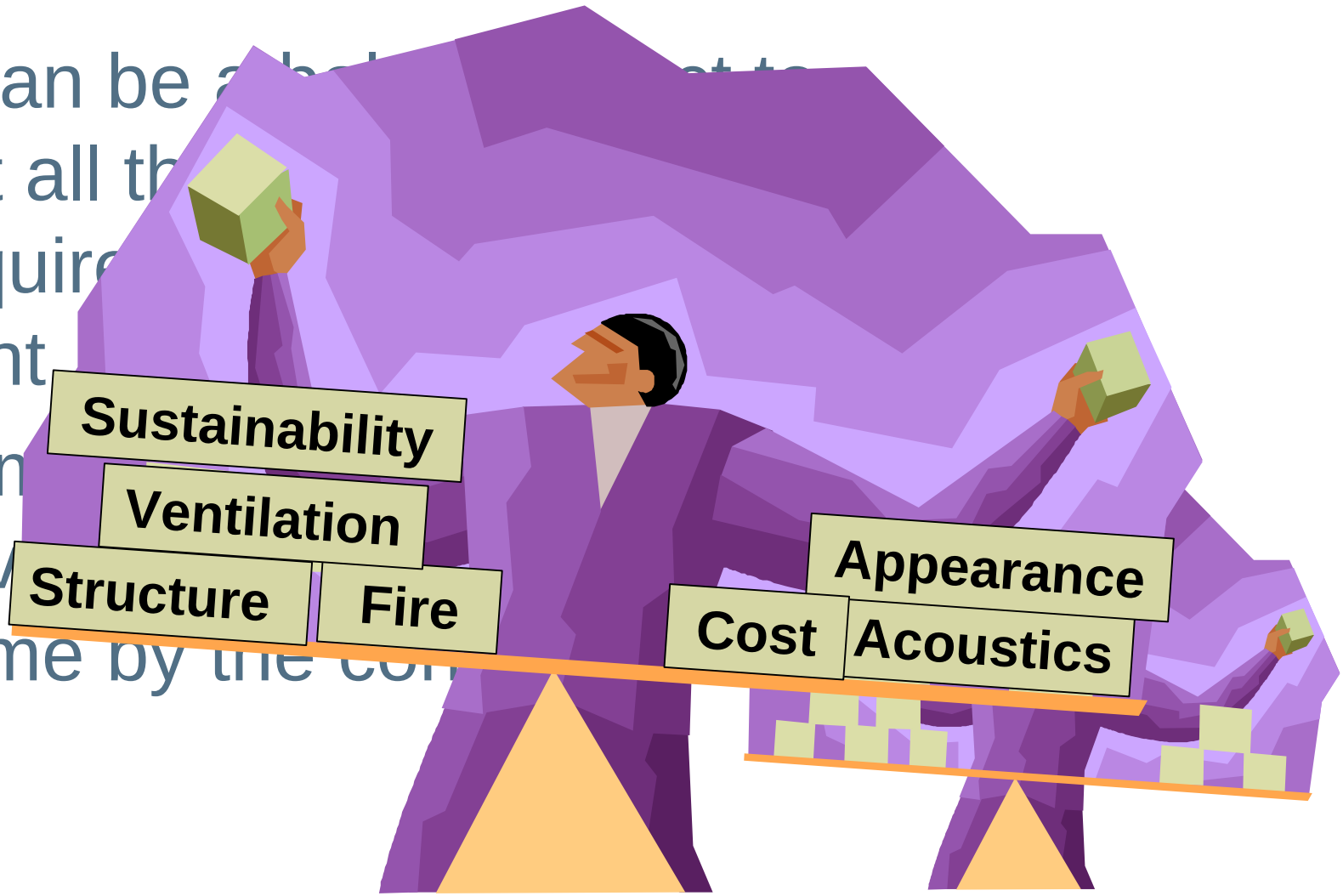
- I’m a building acoustics scientist.
- This paper reports a case study which allowed me to:-
  - Evaluate some floor system designs for environmental impact.

Setting the Scene

- For this study we considered:-
  - **Multi-storey multi-family** residential timber-framed buildings.
  - One building element – an **inter-tenancy floor** design.
  - The interaction between an **acoustic performance metric** and an **environmental life cycle assessment** .

Building Performance

- It can be a
  get all th
  require
  right
- Son
  driv
  some by the co



SCION
Next generation biomaterials

Building Performance

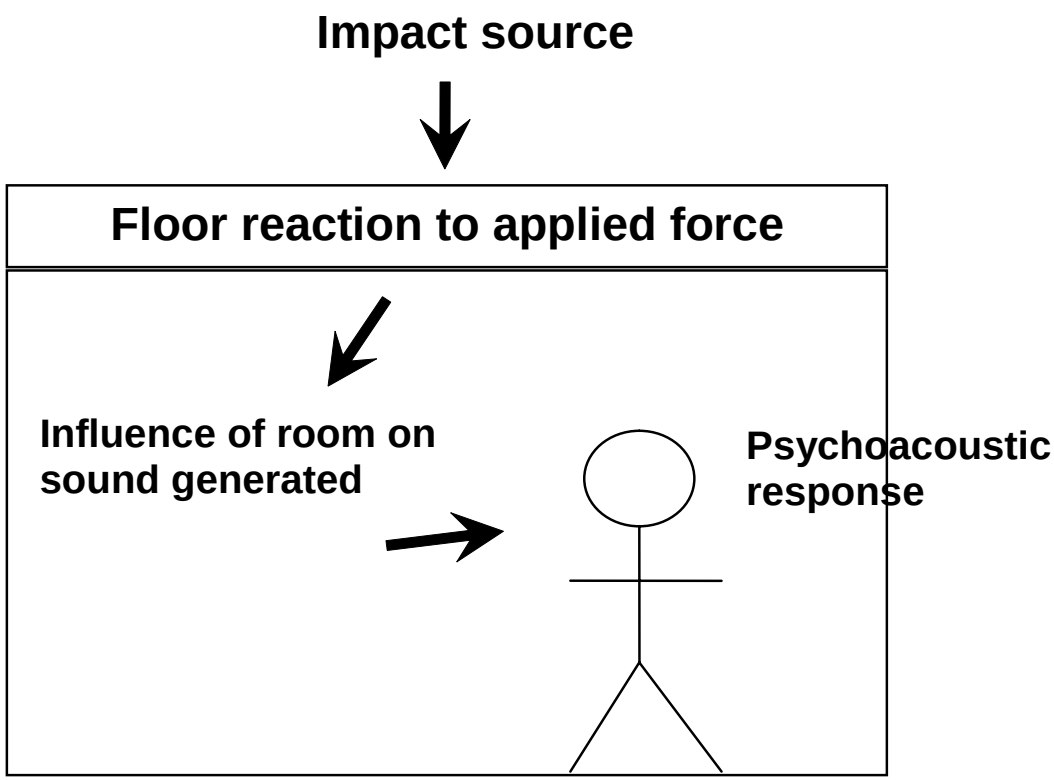
- Considering all the necessary factors early on enables a better outcome in the end.
- Let’s see what can happen when we balance acoustic requirements against environmental impact ….

Acoustic Performance

- For timber-framed, inter-tenancy floors the main problem people notice is the poor low-frequency impact sound insulation.
- This is a technical way of saying that people can hear the neighbours walking about above them.

Acoustic Performance

- In a previous project we looked at how to improve the situation.

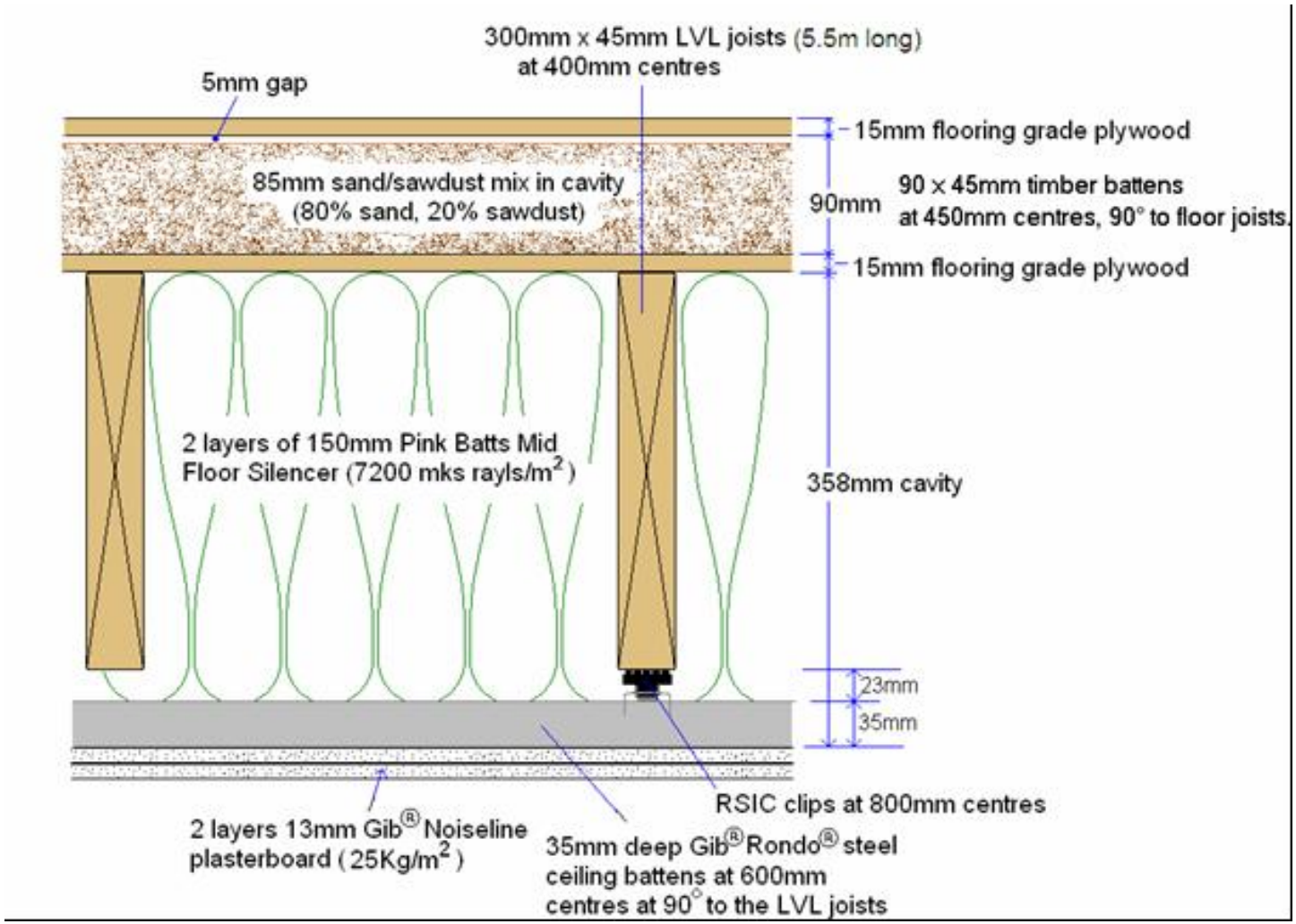


Acoustic Performance

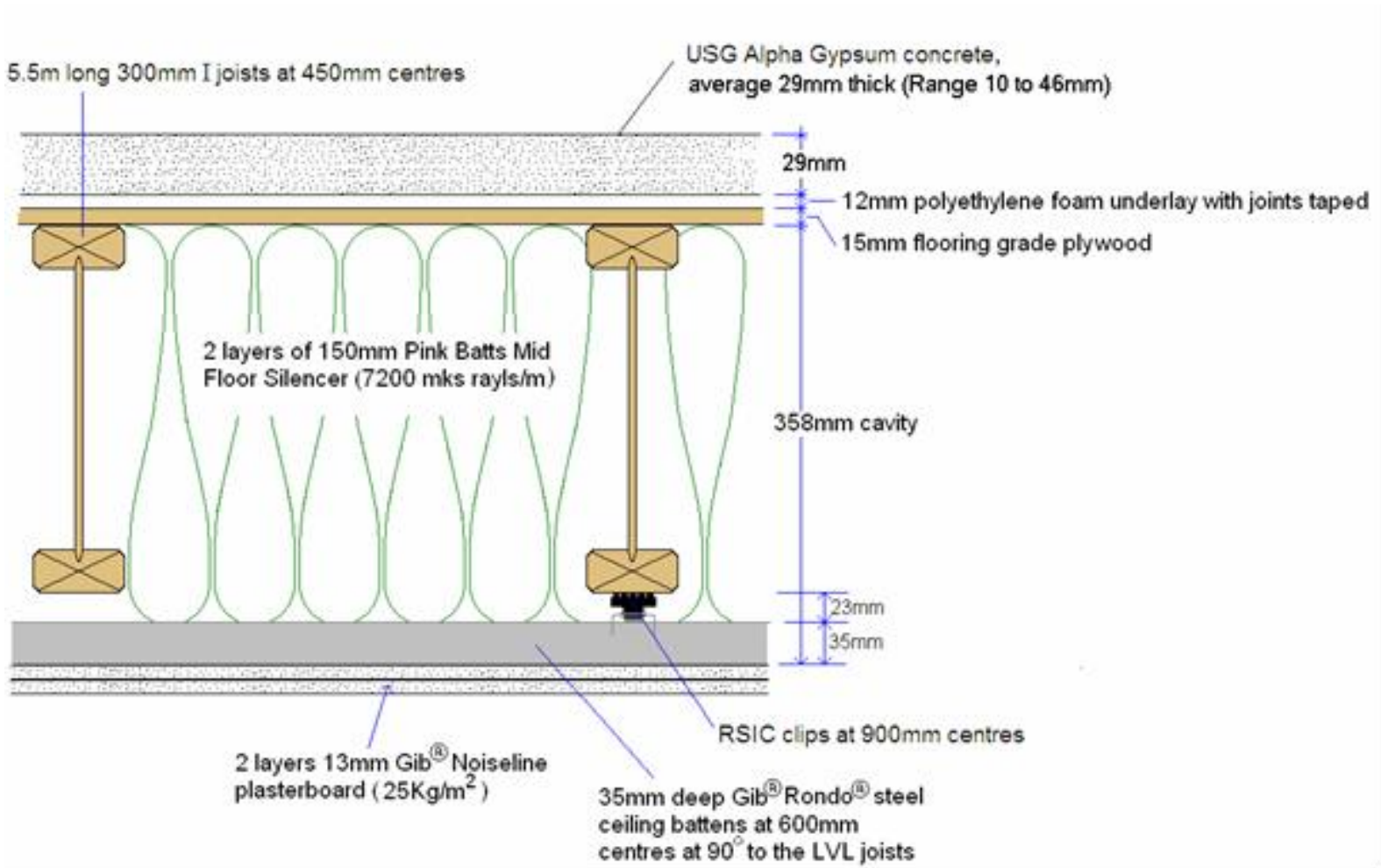
- The result was a number of timber floor system designs with much improved low-frequency impact sound insulation performance.
- We now consider two floor systems which were assessed to have a high level of such performance.

SCION
Next generation biomaterials

Sand-filled Floor



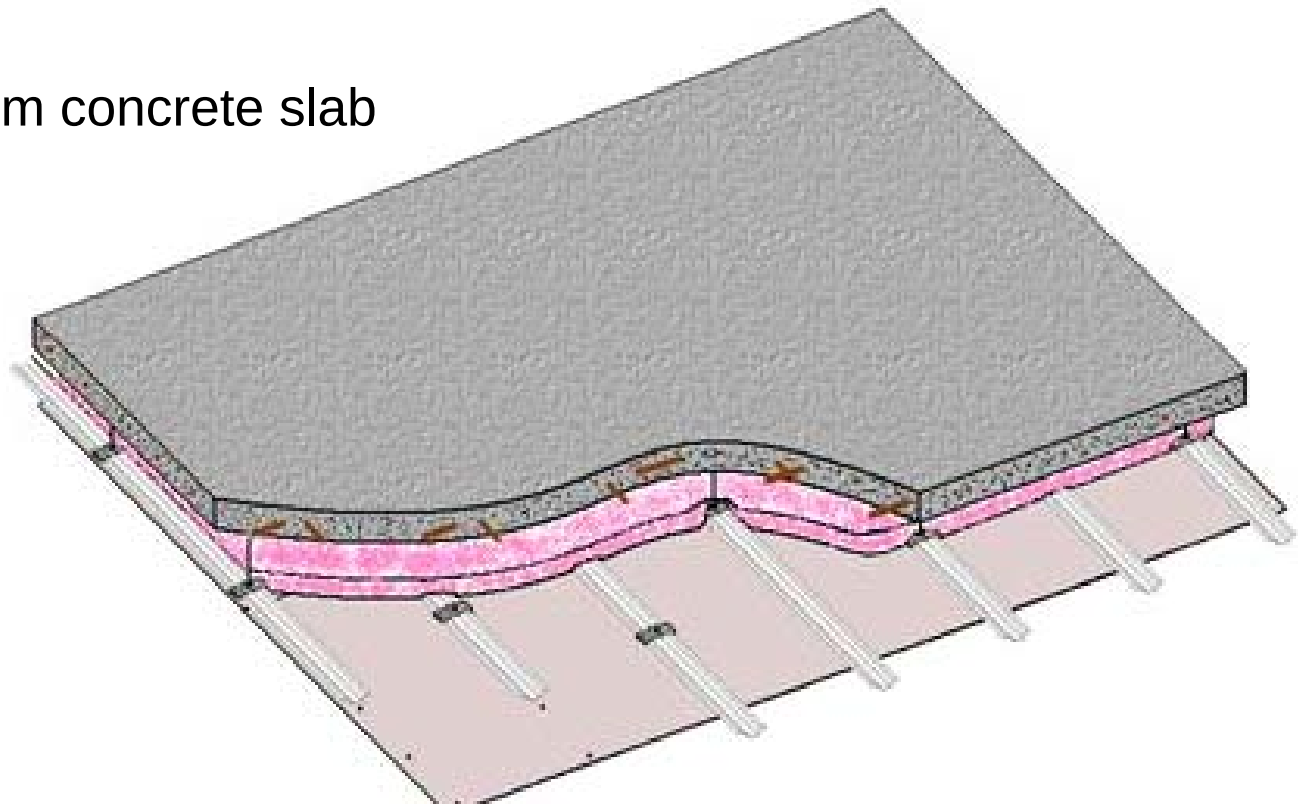
Gypsum concrete topped



Concrete slab floor

For comparison….

150mm concrete slab



Suspended plasterboard ceiling.

An Uneducated Guess

- As a non-LCA person, I (and others) would guess at this point that the sand-filled floor has got to be ‘sustainable’.

- Well, let’s see if we were correct…

Environmental Impact

- Two metrics considered:-
  - Primary energy use: the ‘embodied energy’ or ‘cumulative energy demand’ of non-renewable energy sources.
  - Green house gas emission (CO_2 equivalent). Timber assumed to be carbon neutral (not a carbon store).

(Modelled in GaBi 4.2 LCA software)

SCION
Next generation biomaterials

Environmental Impact

Description	Global Warming Potential (kg CO_2 equivalent) per m^2 of floor	Embodied Energy (MJ per m^2 of floor)
Sand-filled floor	61	566
Floating Gypsum concrete topped floor	41	471
150mm Concrete Floor with suspended ceiling	53	423

A Realisation!

- We were quite wrong.
- Why?
  - Engineered wood products aren't great (mostly thanks to the glue).
  - Anything allowed to dry or set without additional heat is often good.

Optimising

- Let’s pick the ‘best’ timber floor,
- Break down the environmental life cycle assessment into components,
- Find the E-LCA hotspots,
- And see what we can do to make things better.

Gypsum screed floor

Floating Gypsum Concrete Floor Components	MJ (% of total)	kg CO_2-Equiv. (% of total)
Transport	1.8	1.5
Fibreglass	38.6	30.7
Glued laminated timber	16.2	25.7
Gypsum board	16.8	13.2
Gypsum plaster	3.9	3.0
Plywood board (5% humidity)	12.5	21.5
Polyethylene low density	8.3	2.8
Sand (grain size 0/2)	0.3	0.3
Steel sheet galvanized	1.5	1.3

LCA component breakdown of the floor with floating gypsum concrete (Cumulative energy demand and CO2 equivalent emissions).

The LCA ‘Hotspot’

- One LCA ‘hotspot’ is the fibreglass infill.
- This is something we can change without changing the acoustic (and structural) performance.
- Let’s look at some options….

Changing the Infill

	Total floor LCA results	
Acoustic Infill Options for Gypsum Concrete Floor	MJ	kg CO2-Equiv.
300mm (4.5 kg/m^2) of acoustic type fibreglass	471	41
100mm (1.5 kg/m^2) of acoustic type fibreglass	350	33
4.5 kg/m^2 of rock wool	352	34
4.5 kg/m^2 of macerated paper infill	351	30

Cumulative energy demand and CO_2 equiv. emissions for the floating gypsum concrete floor with various infill options.

The different options should not significantly affect the acoustic performance.

To Conclude

- The ill-informed can make some inaccurate assumptions about environmental impacts.
- By including an environmental life cycle assessment at an early design stage, it is possible to improve the environmental impact of a building system without compromising other performance aims.

Basic Timber Floor