Gap between research and design practice to be fulfilled by the design guideline based on the research

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Why CO$_2$ emission/energy consumption is still increasing in building sector?

- Some excuses (true to some extent)
  - Increasing number of households
  - Increasing use of elect. appliances
  - Higher expectation for comfortableness and convenience

- Lack of written design way for energy conservation in buildings
  - No possible education due to that
  - Hopefully secret techniques, but possibly non-existing
Two different engineering field, envelope engineering and building services engineering

- Research in **envelope engineering**
  - Insulation
  - Passive heating (solar gain, heat storage, etc.)
  - Passive cooling, Day-lighting, etc.
  - Advanced façade systems

- Research in **building services engineering**
  - HVAC and other mechanical systems
  - Building automation
Traditional hierarchy of experts in building society

Architects and builders having governed "building concept"

Building envelope industry and engineers
Building services industry and engineers
Two different integrations, "horizontal" and "vertical"

Architects and builders

**Horizontal integration**
- Building envelope
- Industry and engineers

**Building services**
- Industry and engineers
Horizontal integration

- “engineering to engineering” integration
- Including: Material engineering (steel, wood, glass, chemical, etc.), Mechanical engineering (HVAC, boiler, refrigeration, fluid dynamics, energy, etc.), Electric engineering (control, electricity, lighting, etc.)
- The above areas are still divided to some extent, but are being integrated as “Architectural environmental engineering”, many of us are belonging to.
Two different integrations, “horizontal” and “vertical”

Architects and builders, doing architectural design

Building envelope industry and engineers

Building services industry and engineers
Vertical integration

- More difficult integration, between architects/builders and engineering
- Global warming issue is pushing the architects/builders to approach the engineering for energy conservation
- Engineers may stay in lower hierarchy doing satisfactory business, if they can neglect the global warming issue
- Necessity to develop understandable language (design guideline) mainly for the architects and builders
New Role of research for vertical integration

- Architectural design
- Interpretative research
- Research inside engineering
  - Building envelope / building services engineering
Interpretative engineering and research

- Bridging architectural design and engineering
- Understanding knowledge needs of architects and builders
- Obtaining such knowledge through simulations, experiment, monitoring, etc.
- Developing design guidelines for architects and builders
- Further analysis on design methods and theories of buildings is essential and a challenging theme
To realize energy saving in buildings, both of horizontal and vertical integrations are necessary.

The horizontal integration is an issue inside different engineering fields.

The vertical integration needs the interpretative research and engineering to develop design guidelines consisted of common language among architectural design and engineering.