Performance and performance-based requirements

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The simple part:

Performance > Requirement

Not always simple:

Define *all relevant* performances and requirements

Definitions

- *Performance:* The properties of a building component with respect to various *exposures* (exposures are e.g. a load, a sound level, a standard fire)
- *Performance-based requirement:* The performance needed, given in general terms (non-material specific)
- *Deem-to-satisfy requirement:* Material specific requirement, e.g. a table giving allowable spans for timber beams

Performance

- Properties of a building component or assembly.
- Ideally determined from standards, by tests or calculations. The result can be a number (like sound insulation), or a class (like reaction to fire). The performance is often included in the CE-marking.
- Free movement of goods presupposes that performance is determined by the same methods in all countries.
- Fair competition requires that the performance is determined in the same way for different materials and components.

Requirement - principles

- Requirements ought to be *performance-based*, so each requirement is given with reference to a *performance* determined by a prescribed method.
- Both requirements and performance should be independent of materials.

Requirements – from where

- Prime source is national Building Regulations (BR)
- Requirement can also be in other documents, invoked by BR, e.g. for structural safety in Eurocodes and National Annexes.
- Some types of exposures are only covered by common practice, and become *de facto* requirements.
- The building owner might require higher performance than minimum requirements, in order to increase the quality.

Deem-to-satisfy requirements

- However, *deem-to-satisfy* requirements still exists:
  - Deflection of floors
  - Standard fire
- Simplifications of performance-based requirements in e.g. guidelines should not be confused with deem-to-satisfy requirements

Example 1 – Structural safety

Eurocodes aim at a common reliability index β

- Performance: Load-carrying capacity from material Eurocodes, EC 5 for timber, EC 2 for concrete, etc.
- Requirements: Loads and load-combinations as defined in Eurocode 1 and Eurocode 0

\+ Material independent (aim to be, difficult)

\+ Performance can be calculated (no daily need for tests)

− Material Eurocodes might cheat in design equations

− Choice of e.g. statistical distributions and service life influence ratio between materials

Example 2 – Sound transmission

Considered properties:

1 Air borne sound transmission R_w

2 Impact sound transmission $L_{n,w}$

- Performance: 2 numbers, determined by well-defined testing and procedure for weighing of frequencies
- Requirements: Classes defined based on weighted parameters determined by testing

\+ Simple principle, independent of material (almost!)

− Difficult to calculate performance (requires individual tests)

− User perception might deviate from the numbers, e.g. due to weighing of frequencies

Example 3 – Vibration of floors

Aim is to ensure comfort

- Performance: Stiffness, Eigen-frequency etc. Not similar for e.g. wood and concrete
- Requirements: Varies between material and countries, some given in material Eurocodes (should be EC 0 or 1)
- National rules-of-thumb based on deflection for static load is close to deem-to-satisfy requirement

Other serviceability properties have similar problems with strict definition of performance and requirements

Example 4 – Fire

Aim at ensuring fire safety

- Performance for Standard fire: Rxx and EIxx
- Requirements for Standard fire: Same

\+ Simple principle, independent of material

\+ Possibility to calculate performance is improving

− Standard fire is not a good measure for real fires, because 'load' is not considered => Deem-to-satisfy

− Natural fire is difficult to handle, and many national deviations from European standards

(Lots of other national requirements, not dealt with here)

Summary

- Thinking in requirement and performance both when giving general rules or specifying a building is an effective communication tool
- Any requirement must be accompanied by a method to determine the performance of a material or component
- Requirements should be general (not material specific)
- Methods to determine performance ought to be general (perhaps not always possible)