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BUILDING CONSTRUCTIONS 1

Floors: requirements, groupings

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floors - purpose, flat floors and vaults

classification by ● material, ● technology, ● structural design, ● statical scheme, ● rebars, ● position within the building

grouping of floors based on their structural design

parts of the floor (broader sense): load-bearing + floor structure

requirements for floors

- strength
- durability
- waterproofing
- thermal insulation
- acoustic insulation
- fire resistance requirements
- special requirements: vibration resistance, electrostatic charge protection, transparency
- possibility of wire installation

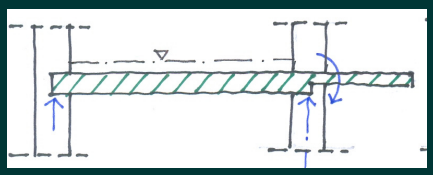
floor: space separating (covering) structure supported by walls or pillars; typically horizontal and flat, less often curved, occasionally inclined

purpose (function): space separation → load-bearing

secondary function: stiffening, optional: acoustic insulation, thermal insulation, waterproofing (precipitation or sanitary water)

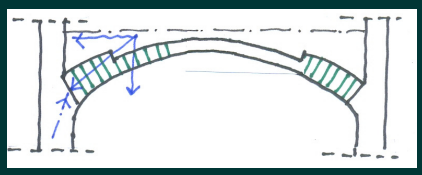
according to the shape of the enclosure slabs (their load-bearing structures) can be

flat floors



supported along one or more lines or point by point
transfers loads (shear forces, moments) to the walls/pillars

vaults



curved surface
transfers loads with vault-pressure to the retaining walls/pillars

groupings of floors (their load-bearing structures) by

- material
- technology
- structural design
- static scheme
- reinforcement
- position within the building

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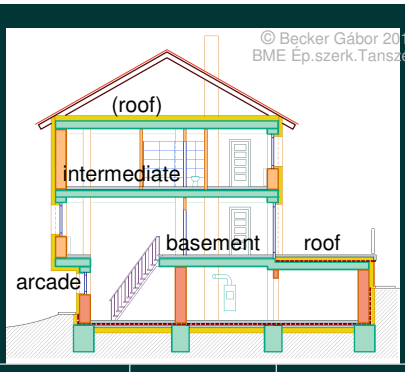
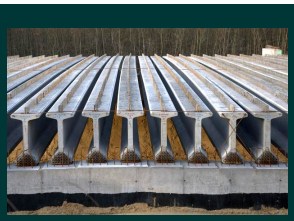
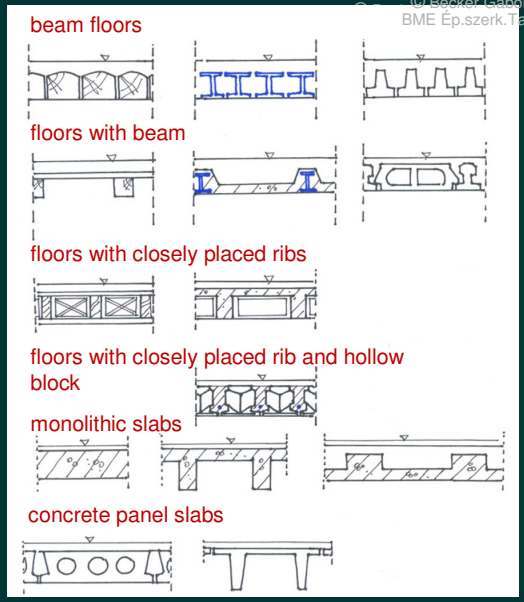


material	technology	structure
RC concrete	monolith, semi-monolith prefab.	slab, row of beams, beam
steel	mounted	beam
timber	mounted	row of beams, beam
brick, stone	masonry	vault

statical scheme	reinforcement	position
one-way load-bearing	mild steel bars	roof
two-way load-bearing	pre-stressed	basement
dual supported	post-stressed	intermediate
Multiple support		arcade



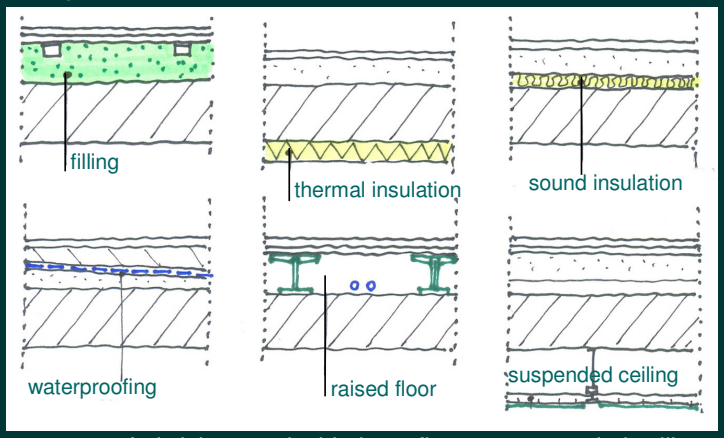
grouping of floors based on their structural design



parts of the floor (broader sense): load-bearing + floor structure

the complete floor structure can include:

filling thermal insulation sound insulation



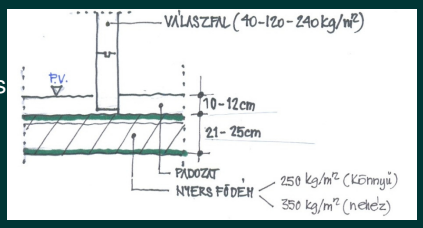
waterproofed slab double-layer floor suspended ceiling

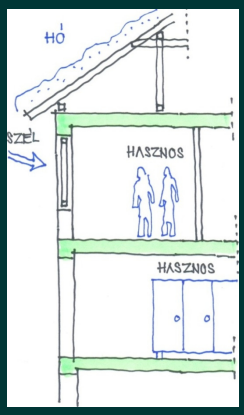
requirements for floors : strength, sound insulation, thermal insulation, waterproofing (precipitation or sanitary water), fire resistance, special requirements, possibility of wire installation

strength: floors must always be dimensioned!

loads:

- permanent loads (self-weight + weight of partitions)





- additional (first three: live) loads:
  - apartment - 1.5 kN/m²
  - office - 2 kN/m²
  - classroom - 3 kN/m²
  - snow load: $p = h \times \gamma$ (air density)
  - wind load: $p = c \times p_t = c \times \gamma/2 \times \omega^2$ (speed)

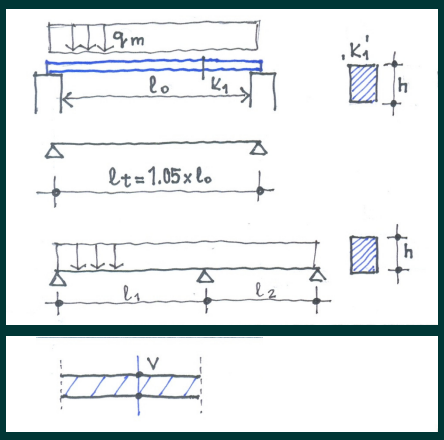
determining cross section dimensions, size estimation

for prefabricated structures: $M_M < M_H$ (kNm), $q_M < q_H$ (kN/m)

monolithic structures - based on rules of thumb, with estimated dimensions *

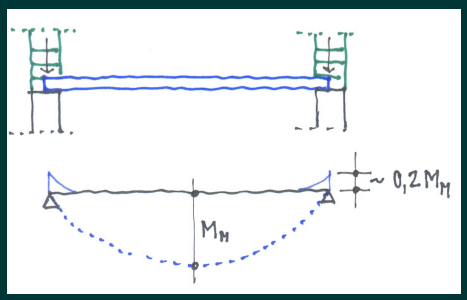
beam:
- dual supported $h = \frac{l_0}{20}$
- multiple-supported $h = \frac{l_0}{25}$

slab:
- dual supported $v = \frac{l_0}{30}$
- multiple-supported $v = \frac{l_0}{35\text{-}40}$



strength - dimension estimation
requirements for floors 2

interpretation of partial fixing:



deflection - requirement: maximum allowed deflection

affected by: load, span, the inertia of the support, the elasticity of its material

monolithic and prefabricated slabs behave differently for deformations

deflection limits for HQ buildings l /400 - l /600
for other structures l /300 *

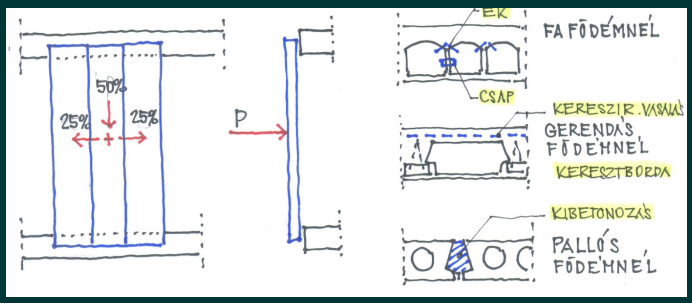
strength - fixed end, deflection
requirements for floors 3

working together: distribution of the concentrated load on the slab to the adjacent elements (beams)

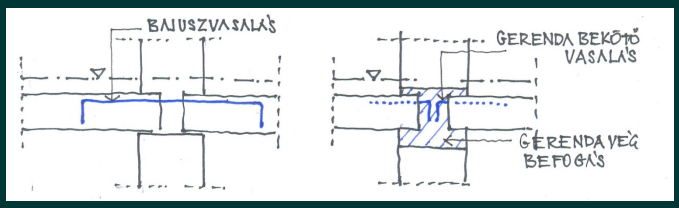
advantage: smaller load on one support, smaller cracks, provides reserve, e.g. no reinforcement is needed at reconstructions
measurement: ratio - it is good if V > 50 % (transmitted load)

for monolithic floors easy to solve, for prefabricated slabs can be solved only with additional structures (cross rib)

interpretation of together working and its additional structures



multiple-support - for multi-span roofs → smaller moment, deflection and crack
for monolithic floors easy to solve, for prefabricated slabs can be solved only with additional structures

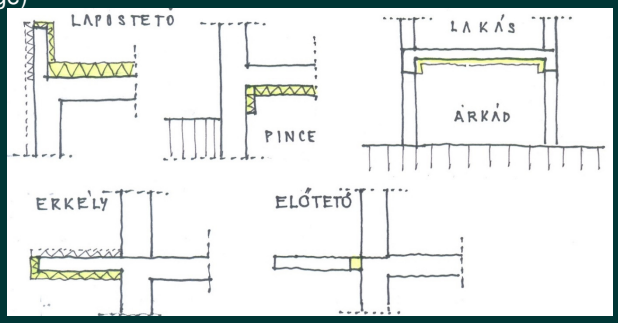


durability requirements:
- physical wear (should be a durable structure)
- moral wear (consistency of structure, function and modernity, obsolescence)

waterproofing requirements:
- always needed for roof floors (precipitation effect)
- for intermediate floors: in case of group shower, or special technology
- for balconies: protection of built-in layers (frost damages) and bottom surface (plastering)

thermal insulation requirements:

- always needed for floors separating spaces with different temperatures
- for structures joining the slab, being in contact with outdoor space (to prevent thermal bridge)



slabs
thermal transmittance requirements:

flat roof U=0,17 W/m2K
arcade U=0,25 W/m2K
attic floor U=0,17 W/m2K
basement floor U=0,26 W/m2K

floors by their acoustic (structure-borne sound insulation) operation

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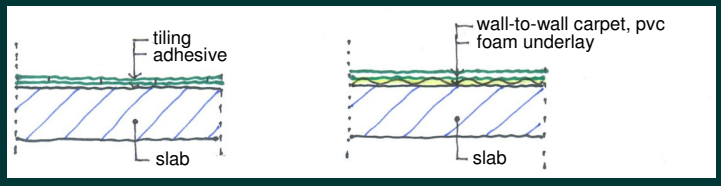
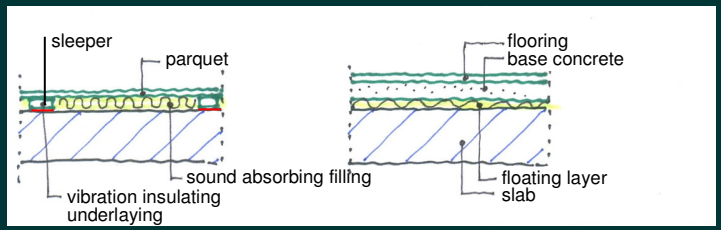
contact floors



hard floor — soft floor

composite (multilayer) flooring



flexible floor — floating floor

fire protection features of construction products

goal: maintaining the building's stability for a specified period of time, limiting the spread of fire, serving the safety of escape and rescue

classification methods:

- fire class (reaction-to-fire) – description of the fire behavior of a building material or a construction product (flammability - how difficult it is to ignite, rate of smoke development, burning dripping)

  A1, A2 B, C, D, E (F) s1, s2, s3 d0, d1, d2

- fire resistance limit – duration for which a building structure withstands the fire impact (R, E, I performance features + duration in minute – 15…240 minutes)

load-bearing capacity in case of fire

preservation of integrity (burning through)

thermal insulation capacity in case of fire

fire protection requirements for floors

classification:

- intermediate floor (general)
- basement floor (increased requirement)
- fire-retardant slab (around fire compartment)
- roof support structure (bar-like elements (beam) - not space separation)
- space separating structure of roof slab (structures of surface weight below 60 kg/m2 - sandwich panels, layers constructed on corrugated steel sheet)

examples of requirements:

	building risk level and number of floors		
floor type	Very Low, B+GF+R	Low, B+GF+2	Middle, B+GF+4
basement floor	A2, REI 30	A2, REI 45	A2, REI 60
intermediate floor	D, REI 15	C, REI 30	A2, REI 45
fire-retardant slab	A2, REI 30	A2, REI 30	A2, REI 60

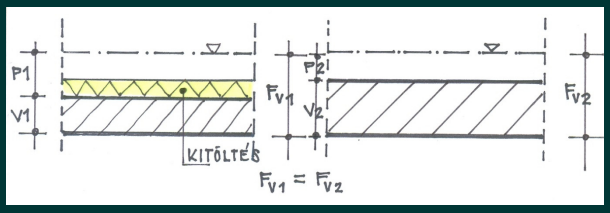
fire protection features of slabs

examples:

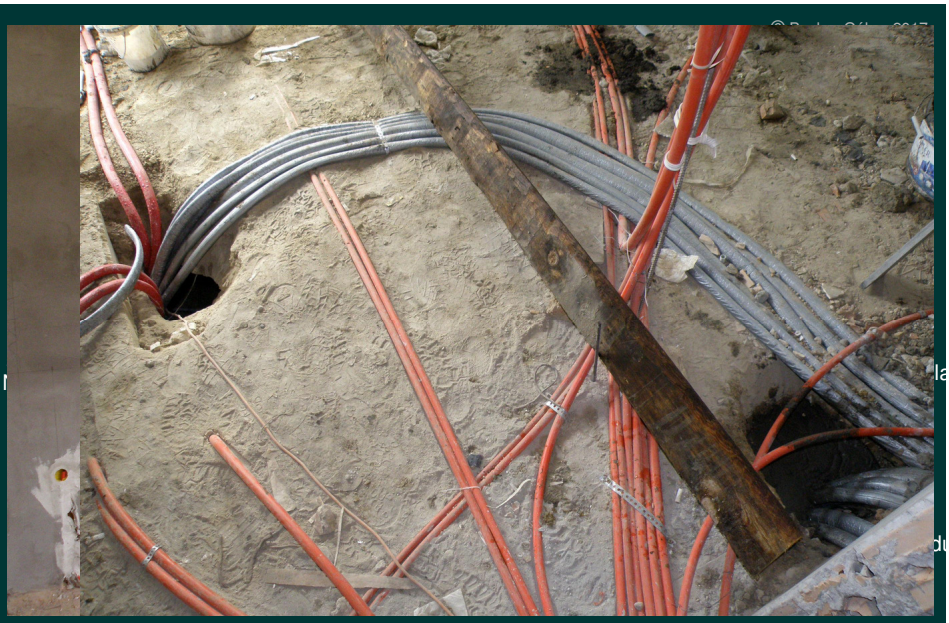
- covered beam timber floor: D, REI 45
- dowelled beam timber floor: D, REI 60
- Cambered arch vault (HR steel beam + brick vault): A1, REI 15 – REI 30
- E beam floor with concrete filler block, plastered: A1, REI 45
- monolithic RC slabs (depending on dimensioning): A1, REI 30- REI 120

additional - special - requirements:

- harmonization of different floor structures and coverings



- floor slabs for dynamic loads (large-section garage slabs with bottom ribs, coffered ceiling)
- floors against electrostatic charge (conductive floor coverings connected to grounding grid)
- transparency-opaque requirements (glued safety glass slabs)



floors - purpose, flat floors and vaults

classification by ● material, ● technology, ● structural design, ● statical scheme, ● rebars, ● position within the building

grouping of floors based on their structural design

parts of the floor (broader sense): load-bearing + floor structure

requirements for floors

- strength ● loads - floors must always be dimensioned!
  - ● cross section dimensions, size estimation
    - ● deflection - requirement: maximum allowed deflection
    - ● together working
    - ● multi-support (economical!)
- durability
- waterproofing
- thermal insulation: thermal transmittance regulation: flat roof U=0,17 W/m2K

- sound insulation requirements: airborne and structure-borne sounds
  - their operation by structure-borne (immpact) sound insulation: contact floors, composite floors
  - sound insulation features of unpaved floors
  - impact sound insulation improving effect of floorings
  - sound insulation improving effect of floorings
- fire resistance requirements
- special requirements: vibration resistance, electrostatic charge protection, transparency etc.
- possibility of wire installation