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BUILDING CONSTRUCTIONS 1

Repetition: Floor structures 1: timber, steel and reinforced concrete floors

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flat floors

traditional floors: timber floors, steel beam floors

timber floors

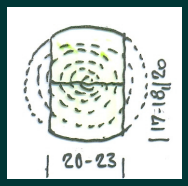
today it is the structure of timbered buildings, typically weekend houses and cottages, but also used in residential buildings (until 1920, the majority of the closing floors was timber)

material: ● larch (resin content),
● oak (> bending strength), 600-800 kg/m^3

strength: parallel to the fibers, the compressive and bending strength is greater, 130 kp/cm^2

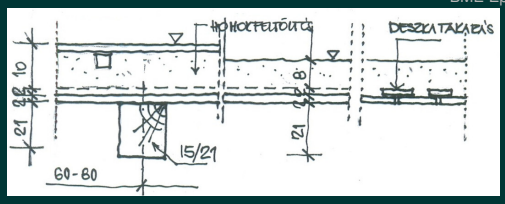
timber deformation: shrinkage (drying), swelling (moisture absorption)

design and reconstruction issues: sitting, rotting, fungus

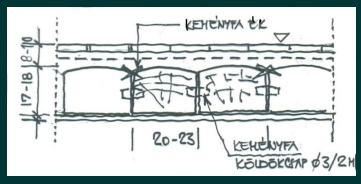


cut from logs

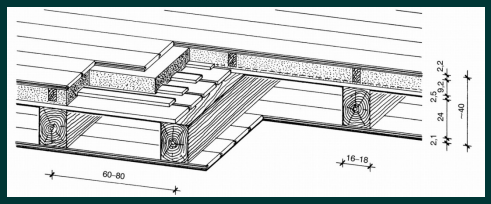
"cheap" floor



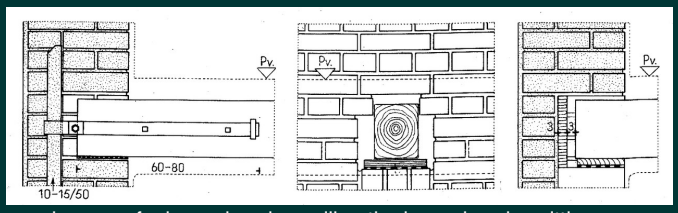
dowelled beam floor



covered beam floor



timber floor details



anchorage of a beam head to walled iron plate | walling the beam head (underlaying, ventilation) | sitting, walling

evaluation

- holding the walls together is ensured by tie rods
- co-working of timber floors (except dowelled floor) and their multi-support is difficult to be solved
- they are vibration-sensitive
- with a min. 8 cm thick filling of incombustible material they are moderately fire-resistant
- despite their small self-weight (due to the layered construction), their airborne sound insulation is favorable,
- hard floors of sanitary rooms (e.g. bathrooms) must be insulated!

steel beam floors

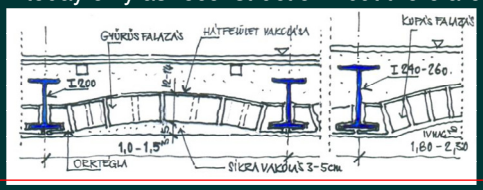
- rarely in residential buildings, more often in public, mostly in industrial buildings,
  typically used in steel-framed construction systems (halls)
- approx. until 1920, used as an intermediate floor of residential buildings (Prussian vault)
- material: hot rolled steel beams, I and U profile

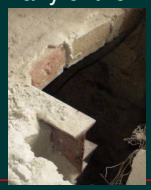
design issues:

- fire and corrosion protection of the beams must be provided,
- joints - welded: rigid, moment-resistant, screwed: dismantlable

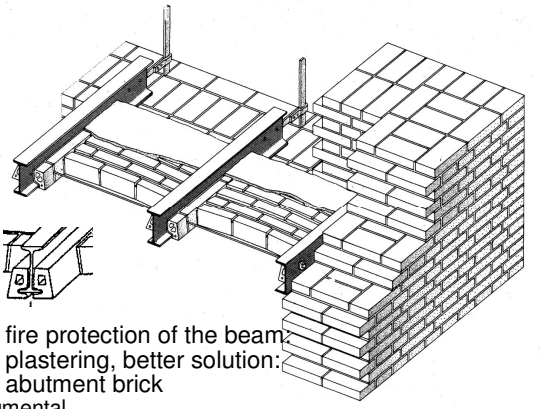
Cambered vault floor - floor with steel beams and brick vaults

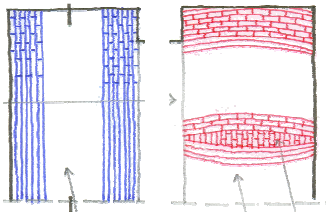
- historical floor, the sections between the beams are bricked as barrel vaults
- today only as reconstruction - but there are many of them





- 1,00-1,30 m axis distance → from below, the slab can be plastered to flat plane; larger span is plastered in curve
- vault between beams
- taking the lateral pressure of
- equalization of lateral pressu
  during construction: all fiel
  constructed at the same ti
- co-working: thin cement mortar top-filling





fire protection of the beam: plastering, better solution: abutment brick

anchorage of a beam head to walled iron plate, side fields with tie rod

evaluation

steel beam floors:

- holding the walls together is ensured by tie rods
- are solid, medium durable, vibration-sensitive structures,
- co-working of structural elements should be ensured (e.g. with top-filling mortar),
- multiple-support scheme → beams running over two tracts
- with a min. 8 cm thick filling of incombustible material they are moderately fire-resistant,
- moisture and corrosion sensitive – their protection must be ensured

monolithic reinforced concrete floors

history: - with the introduction of concrete technology, since the early 1900s
- initially between steel beams, constructed as bottom or top ribbed slabs

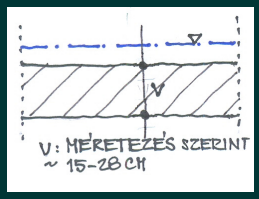
- constructed on site, concrete pouring after formwork preparation and reinforcement laying
- material: concrete (due to the curved structure with C16, C20….C30 class, where "C" means the 28-day strength of the concrete, 16, 20…30 N/mm2
- advantage: homogeneous material, robust co-working structure, good soundproofing, ensuring multiple-support, favourable cross-sectional ratios
- disadvantage: high self-weight, expensive formwork, relatively long

reinforcement during placement

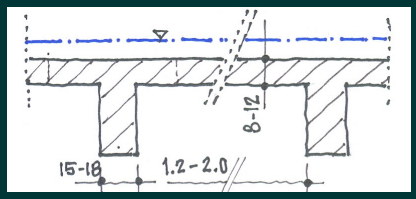
formwork during installation

type of monolithic reinforced concrete floors

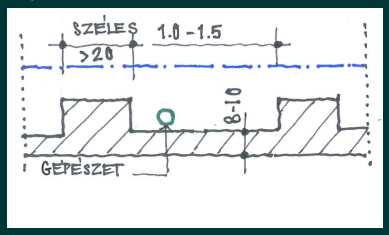
flat floor



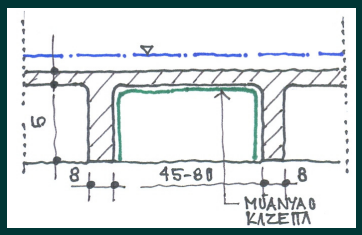
bottom-ribbed floor



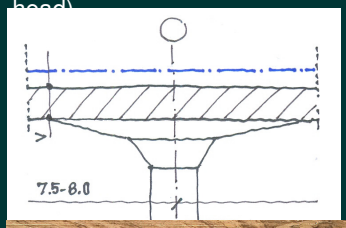
top-ribbed floor



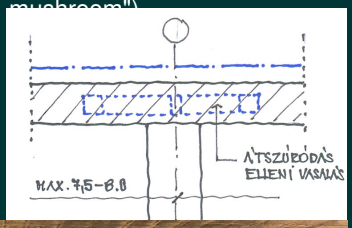
waffle slab

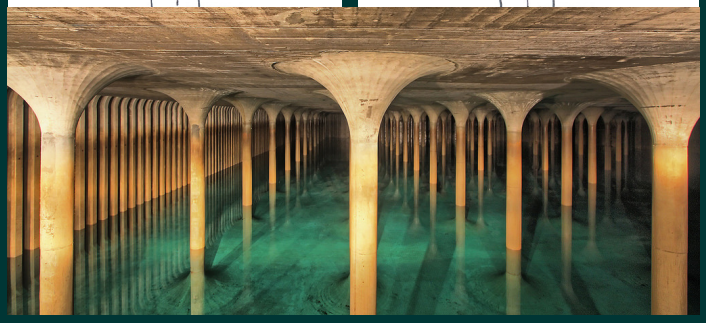


mushroom slab (with mushroom head)



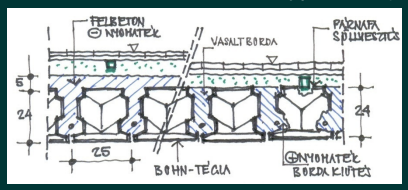
mushroom floor with top-to-bottom flat surface ("hidden mushroom")

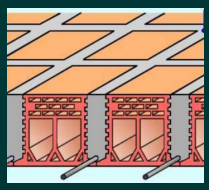




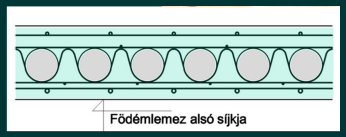
floors with closely placed ribs and clay elements

- dense, reinforced concrete ribs between the co-working loadable blocks (notched, ribbed side surface)
- increasing the compressed zone with concrete overlay
- increasing the positive moment with breaking out the rib of the block
- best known is the Bohn type slab (burnt brick clay)





lightened monolithic RC slabs



hollow block monolithic RC slab

recirk plastic

bubble deck slab

beam prefabricated in full cross-section

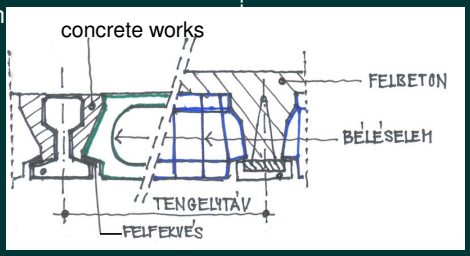
partially prefabricated

by the extent of prefabrication they can be:

- prefabricated in full cross-section (RC beam) and
- partially prefabricated (with ceramic shell)

by their rebars

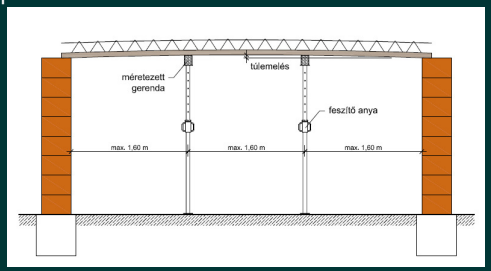
- mild and
- tensioned rebars



design and installation (floors with beams and hollow blocks

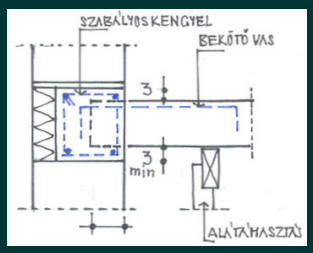
supporting and over lifting during construction

- during construction, the semi-precast beams (in ceramic shell) should be
  - supported – carrying a temporary load
  - over lifted - reducing deflection (usually l /300)
- support
  - up to 2.50-3.20 m span one,
  - over 3.20 m two,
  - over 4.80-5.0 m three supports (product-specific, see application manuals!)

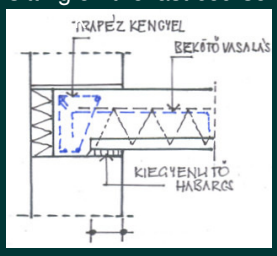


ring beam - beam head joint

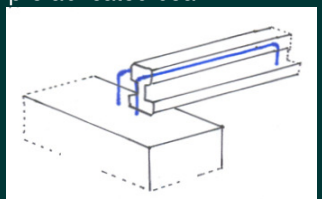
restrained beam end



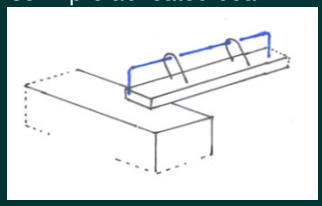
sitting on the last course



prefabricated beam



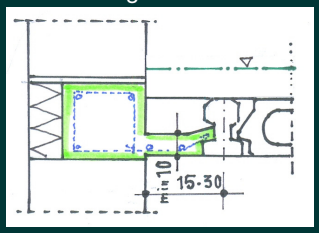
semi-prefabricated beam



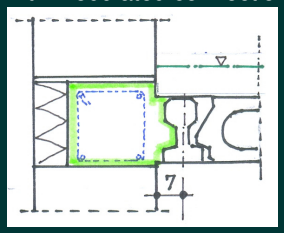
ring beam tie reinforcement

beam position, ring beam connection parallel to the beams

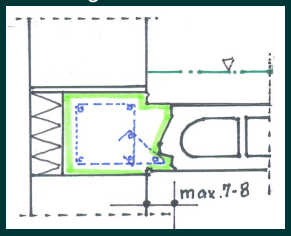
with leveling slab



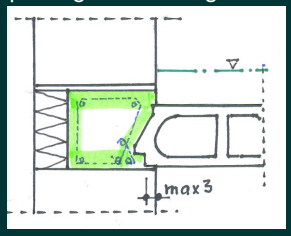
with modulated connection



with ring beam extension

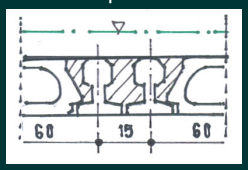


placing into the ring beam

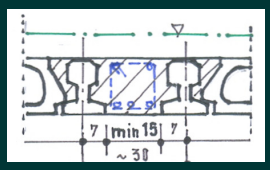


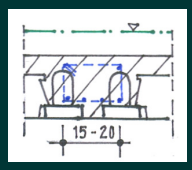
increasing options of load bearing capacity

beam duplication

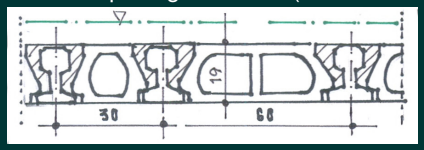


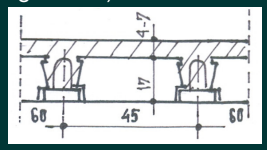
monolithic rib



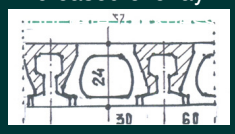


denser spacing of beams (narrower filling blocks)

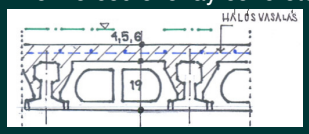




increased overlay



reinforced overlay concrete

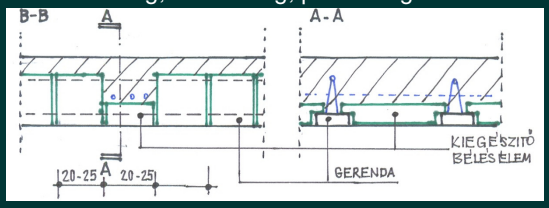


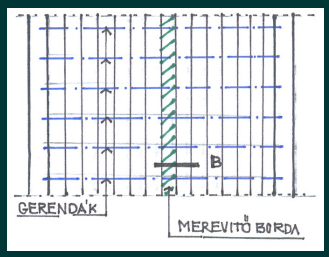
stronger versions of floors

prefabricated floors - beams and filler blocks

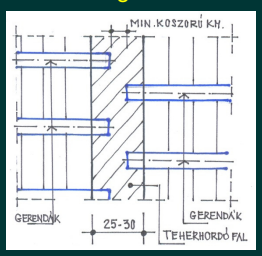
cross rib - stiffening rib

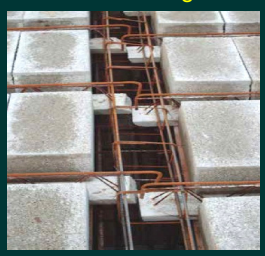
task: stiffening, co-working, preventing cracks





minimal ring beam on internal load bearing wall !!





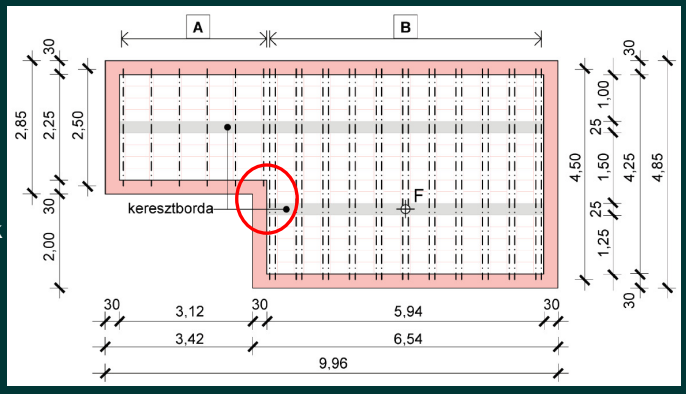
number of stiffening ribs:
2.00-3.75 m span - 1
3.75-5.75 m span - 2
5.75-7.00 m span - 3
(product-specific, see application manuals!)

stiffening (cross) rib, ring beam on internal load bearing wall

prefabricated floors - beams and filler blocks

floor design

- load-bearing walls
- stiffening walls
- load-bearing direction
- span
- choice of structure
- (span check)
- load capacity check determining the structure
- critical places: openings, penetrations, partitions
- balcony, loggia
- beam spacing
- detail plans



2.50 m span: single beam, 60 cm spacing

4.25 m span: double beam, 45 cm hollow block

the plan serves only as an illustration, the right-hand floor is actually over-reinforced by approx.double than needed