Gábor Becker PhD / Gyula Dési titular Docent

BUILDING CONSTRUCTIONS 1

Stairs 1
basic concepts, design

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Budapest University of Technology and Economics
Faculty of Architecture Department of Building Constructions

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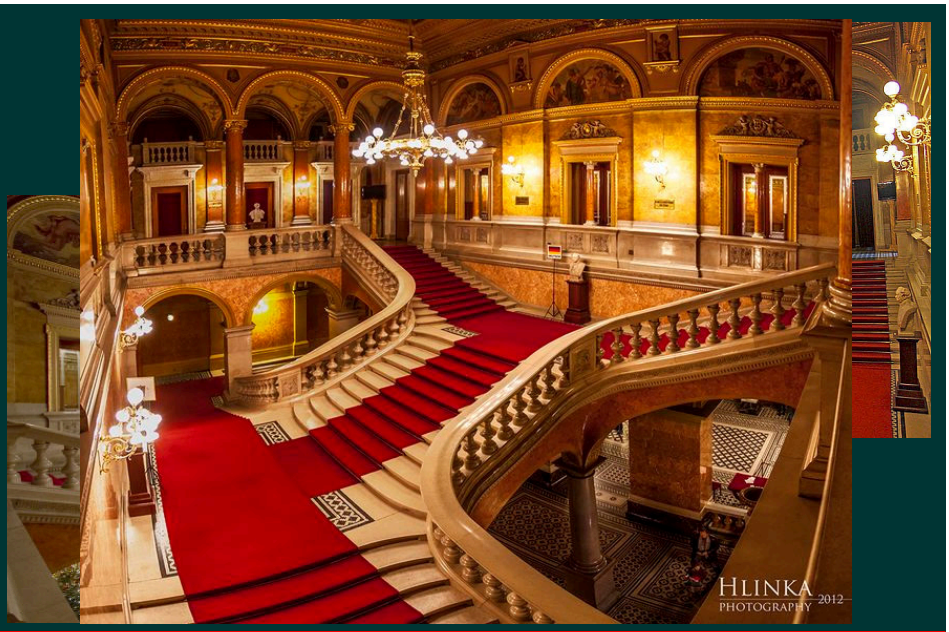
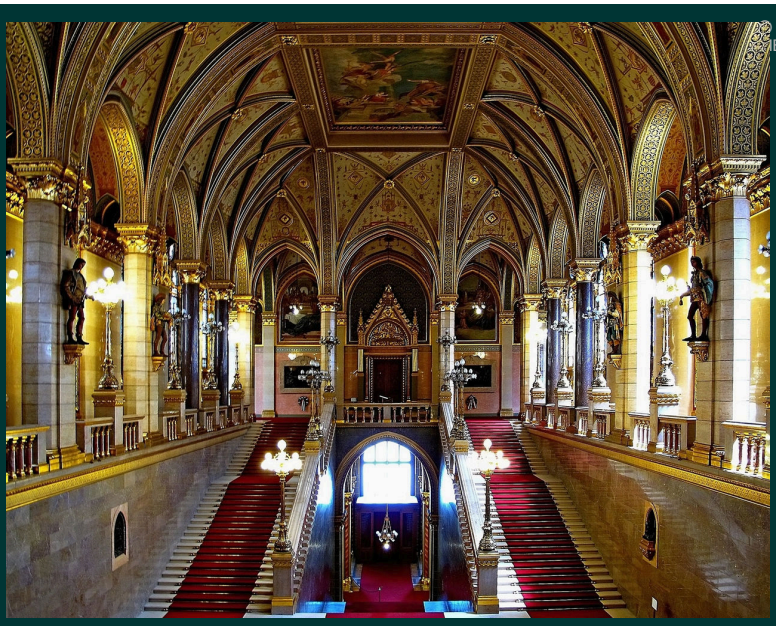
purpose (function): bridging levels, vertical direction
(pedestrian) traffic

architecturally and functionally
accentuated – with specific stylistic features
building constructions and architecture are inseparable



definition of stairs
stairs - basic concepts, groupings



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definition of stairs
stairs - basic concepts, groupings

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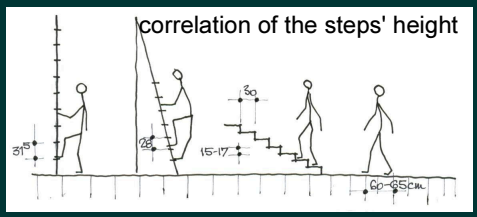
bridging height level differences
- calculation on basis of the step length



vertical ladder ladder stairs step length
the height of risers is decisive

grouping of stairs by
- location
- number of flights
- shape of flights
- material
- construction method
- static scheme

grouping

material	technology
reinforced concrete	monolithic, prefabricated (semi-prefabricated)
steel, steel frame + tread	mounted
wood	mounted

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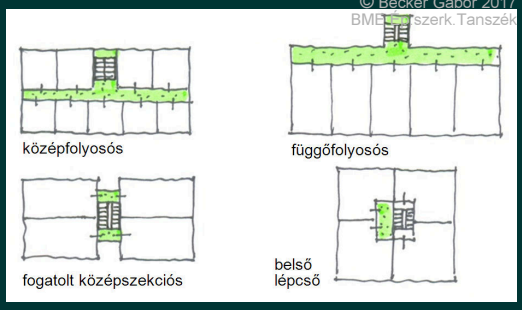
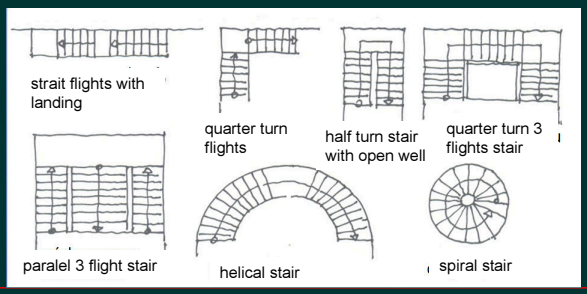
location depends on the:
- purpose of the building,
- type of circulation
- traffic

most common placement schemes of stairs



the floor plan layout is defined by the:
- function
- architectural concept
- floor plan layout
- nature of the use

most common floor plans of stairs



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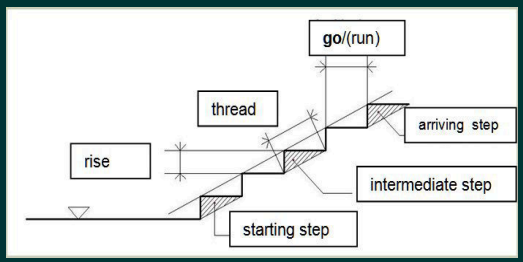
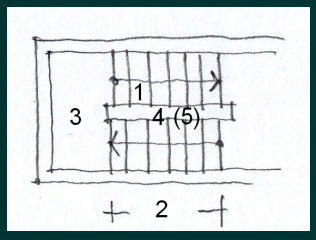
requirements (on basis of function, architectural demand, way and nature of the use)

architectural: location, size, scale, material, form, thoughtfulness, elaboration
traffic: volume and nature of traffic, walking safety
building constructions: harmony of materials and structures
implementation: economical and feasible
structural: clear load and force schemes, clear structure



stairs-related vocabulary

1 step
2 flight of steps
3 landing
4 stairwell
5 stairwell-wall



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most important design specifications:

walking causes fatigue (pitch of flight, number and shape of steps) - therefore it is regulated (average lenght of step 60-65 cm)

flight: (OTÉK 64.§)
- along the walk line: only steps with the same rise
- in one flight max. 20 steps, for handicapped access ≤1,8m
- width min. 80 (60) cm, preferably 1,20 → 1,30, … (escape time calc.)

steps: (65.§)
- 2 rise + going = 60 – 64 cm
- rise max. usually 17 cm, for handicapped access 15 cm, for secondary functions or inside a flat 20 cm
- in public buildings handicapped access means steps without nosing!
- first and last steps: marking (risk of accidents)

landing: (67.§)
- its size: between flights in straight stair min. 60 cm, otherwise min. the width of flights (+10 cm on intermediate landing, +20 cm on floor landing)

slopes - ramp: (66.§)
- up to 17 cm level difference max. 8%, over 17 cm 5 %

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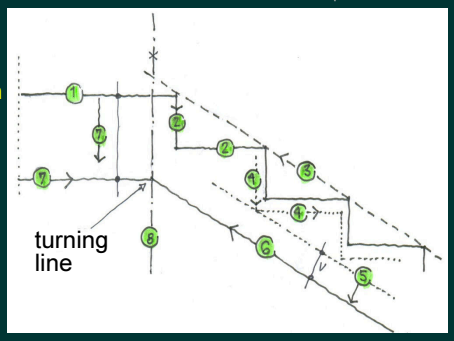
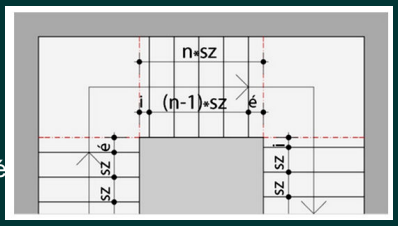
calculation of stairs

basic data:
floor height (floor thickness + head room) = h
arrangement and number of flights: 1, 2...
flight width, landing sizes
rise height, m (OTÉK)



data to be planned:
- number of rises: n = h/m (pcs)
- height of risers, r = h/n (cm)
- depth of tread (going), g = (60-64)-2r
- rises by flights = (n/number of flights)
- number of going by flights: n-1
- length of flight = g x rises by flights
- length of stairwell: length of flight + g (é
- width of staircase: landings+ stairwell



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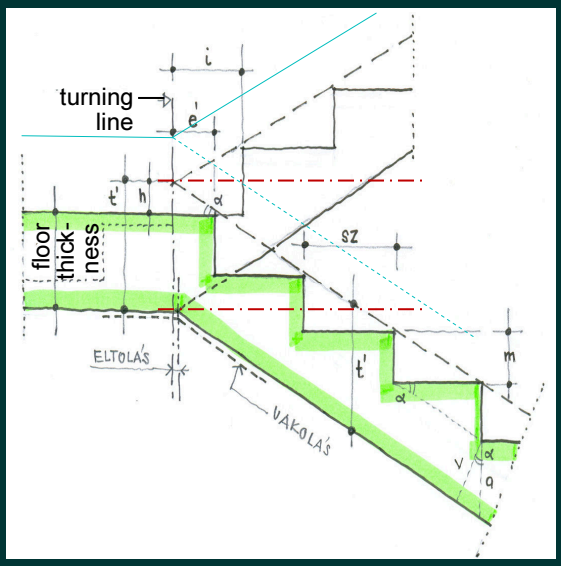
key element: joining of inclined and horizontal planes

1 drawing the floor line of the landing
2 constructing sz (going) and m (rise) of the step
3 walk line (pitch line)
4 decision of paving thickness
5 calculation of slab thickness
6 definition of flight's bottom plane
7 definition of landing's bottom plane
8 drawing the turning edge line
9 mirroring the pitch line along the horizontal axis
10 drawing é and i
11 adjusting the footing and handrail to the turning line



design of turning line
stairs – design

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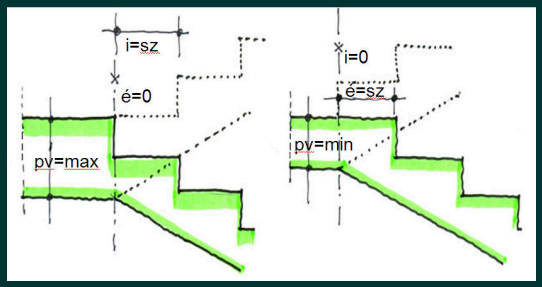
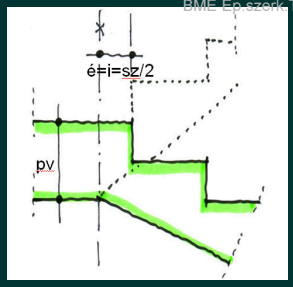


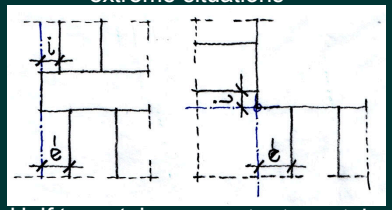
max. thickness of landing é(a) = 0

min. thickness of landing é(a) = sz(g)

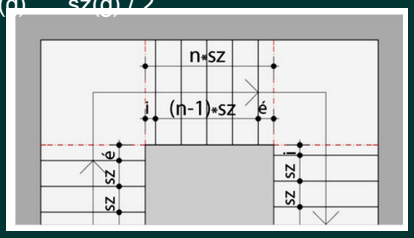


unique situation: é(a) = i(s) = sz(g) / 2

extreme situations



Half turn stairs quarter turn stairs



floor plan detail of quarter turn stairs

situations, quarter landing stairs
stairs – design – turning line design

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calculation sample

- (Arrangement – where to situate the room for the stair within the building?)
- Floor height? (3,05 m)
- Function of the building? → Rise → Go (Residential, 17 cm, 30 cm)
- Step dimensions → No. of steps (18×17= 306 cm, to modify floor height)
- Function → Length / height of one flight (as you wish – architectural tool, what is the shape of the room?)
- No. of flights (as you wish – architectural tool, what is the shape of the room?)
- Landing dimensions (+10, +20, +40 cm: doors, measures)
- Material of the stair? (Monolithic RC)
- Method of load-bearing? (Between landings)
- Finishing? Thickness of the finishing? (Stone) (linoleum, PVC, rubber, cork, carpet, tile, steel artificial stone)
- Load-bearing cross-section (span /20, but minimum 12 cm)
- Special requirements? (Thermal ins., airtight, …)

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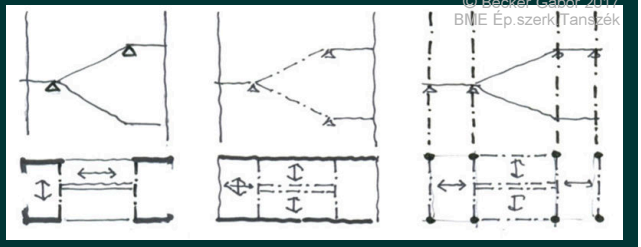
floating stairs – slab stairs cross-section involved in load-bearing

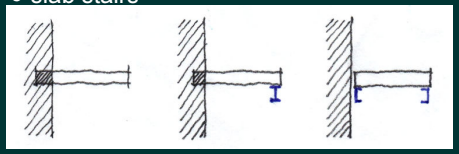
most common static schemes for slab stairs



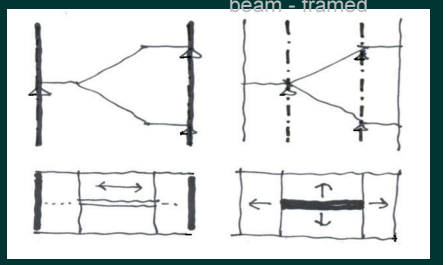
landing supported by beam and wall | supported by well-beam and wall | supported by well-beam and edge beam - framed

static schemes for stairs

- hanging stairs (cantilevered)
- supported stairs
- slab stairs



hanging (cantilevered) | supported by beam and wall | supported by beam



(double) turned RC slab supported by wall | supported by well-wall

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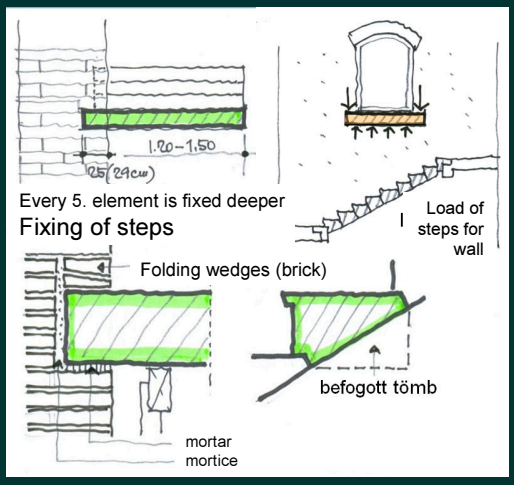
hanging steps – fixed into wall

material of steps: stone, concrete, concrete-artificial stone (steel, wood)

- block-section steps
- weight reduction → wedge-section steps
- steps working together through supporting grooves
- the wall and the landing beam are involved in the load-bearing

landing: slab-like or floor-like



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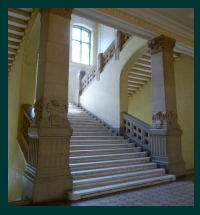
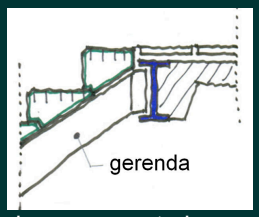
supported stairs

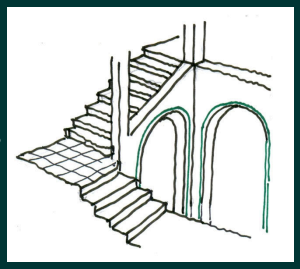
supported steps and landings

- method of support:
  - wall,
  - beam,
  - vault,
  - slab-like
- by construction method:
  - prefabricated elements
  - monolithic RC
- by material:
  - stone, monolithic RC, prefab RC

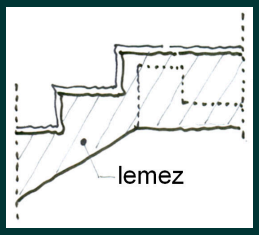




beam supported



vault supported



slab/floor-like

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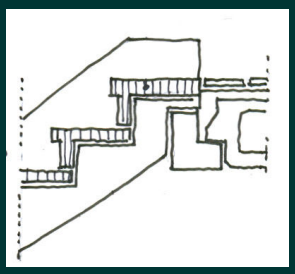
prefabricated stairs

can be: small, medium and large element stairs

small element stairs
- small steps with support beams,
- slab-like small element stairs

medium element stairs
- plank-like, narrow, toothed stringers with traversely placed steps
- plank-like landings



small element stairs

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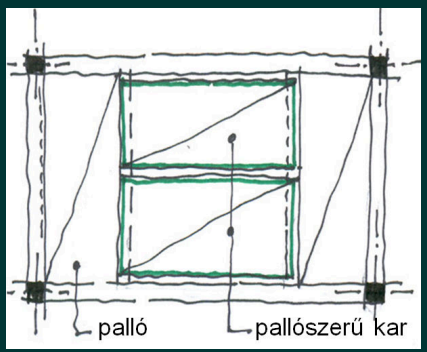
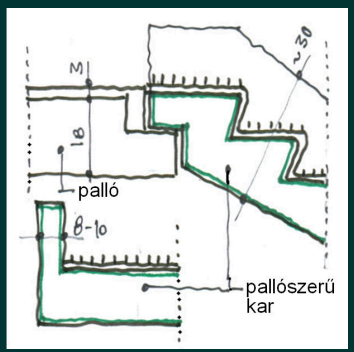
large element stairs

- plank-like flight and landing, or
- broken-line slab flight and landing in one element,
- with or without edge beams



large element stairs in a framed building - floor plan



large element stairs with edge beam - details

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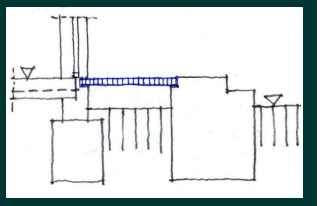
exterior stairs

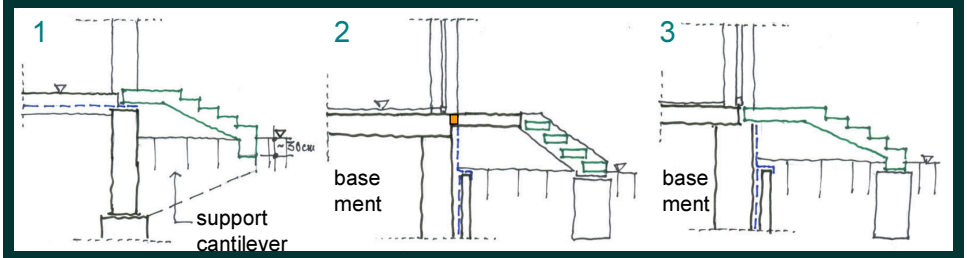
- garden and terrain stairs independent from the building
- entrance stairs and shaft stairs integrated in the building

entrance stairs

- sit on support cantilever (1)
- sit on fixed, cantilevered slab, with foundation at the end (2)
- sit on wall, with foundation at the end (3)



"bridge-like" entrance stairs



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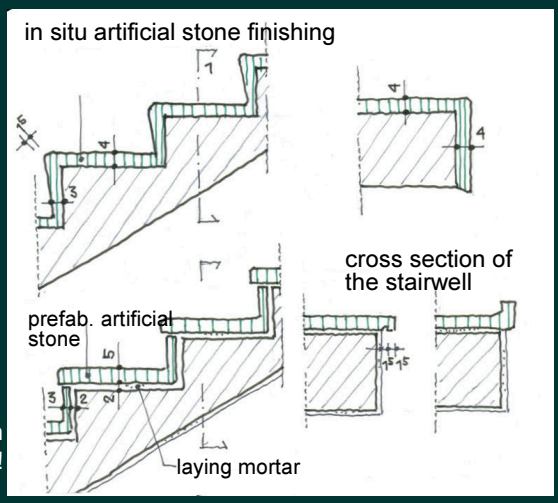
finishing of steps

- in situ artificial stone
- prefabricated artificial stone
- natural stone
- ceramics
- rubber, PVC, wall-to-wall carpet
- wood

design considerations

- connection of the horizontal and vertical paving
- anti-slip design
- fixing, joint design and edge protection of the finishing
- possibility of cleaning
- in case of barrier-free design keeping the plane is important!
- marking first and last steps



prefabricated artificial stone paving

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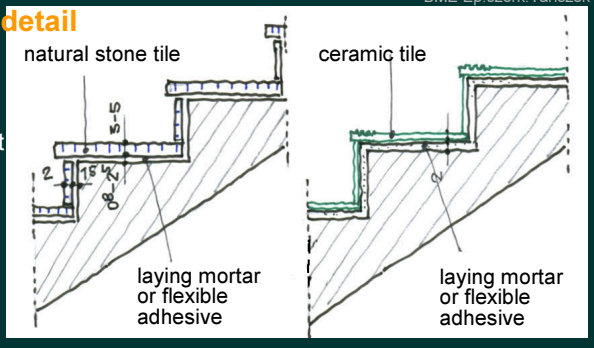
anti-slip design, edge detail

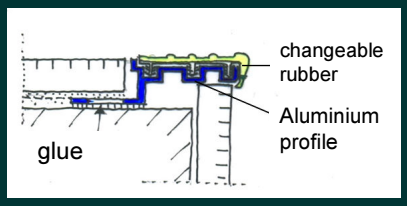
- stone, artificial stone: grooving, in grooves anti-slip metal, rubber, plastic, corundum insert
- ceramics: ribbing of the surface
- metal or plastic (rubber) edge protection profiles

- first and last steps: marking (risk of accidents)



natural stone paving ceramic paving

bonded aluminum edge protection profile with replaceable rubber profile



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purpose (function) bridging different levels, vertical direction
(pedestrian) traffic
- architecturally and functionally accentuated

grouping of stairs
location, floor plan layout

requirements: architectural, circulation, building constructions, implementation, load-bearing
most important design specifications for flights, steps, landings, slopes

calculation of stairs:
- basic data (from the building)
- data to be calculated – defining the stairs
- turning line design – extreme and unique situations, quarter landing stairs

static schemes for stairs
- most common static schemes for slab stairs
- floating stairs – fixed into wall, working together
- supported stairs

prefabricated stairs: small, medium and large element
entrance stairs, their force models and design
paving of stairs: stone, artificial stone, ceramics, rubber etc.
anti-slip design and edge protection for different pavings

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Complex arrangement:
everything in one

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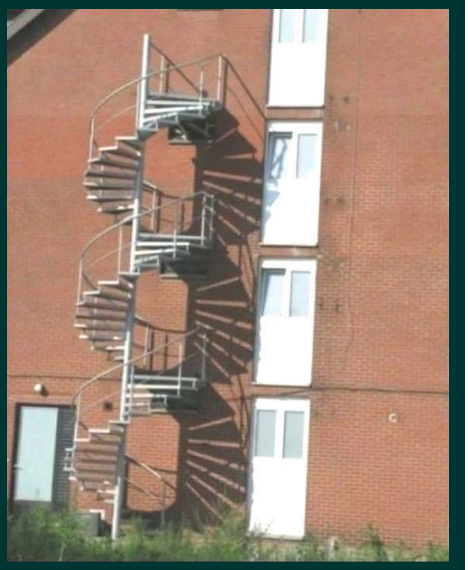
Complex arrangement:
everything separately



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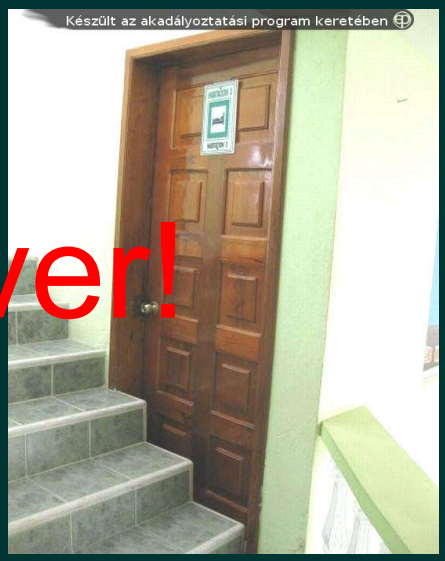
Complex arrangement:
the staircase is larger than the room

Never!



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Complex arrangement:
the minimal headroom is 2,2 m above the stair

Don’t even think about it!

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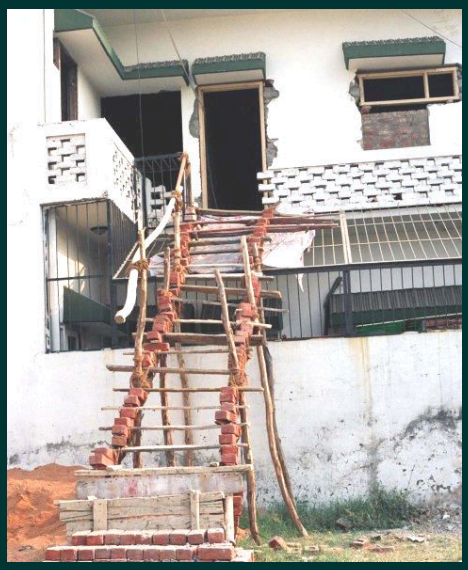
Better than that,
please!



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for your attention!

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