


Gábor Becker PhD / Gyula Dési titular Docent

BUILDING CONSTRUCTIONS 1
Stairs 2: acoustics and mounted stairs

www.epszerk.bme.hu



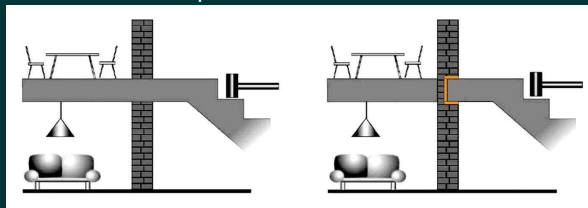
Budapest University of Technology and Economics
 Faculty of Architecture  Department of Building Constructions

acoustics of stairs

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walking hits the slab → generates vibration → transmits vibration laterally

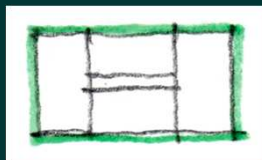
its unit is the weighted structure-borne sound pressure level



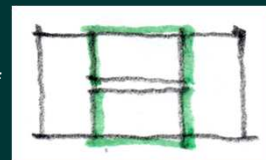
structural connection between the walking surface and the interior must be interrupted

two ways of separation:

acoustic
separation of
the entire
staircase



separation of
flights from
floated
landings



need for separation
 acoustics of stairs

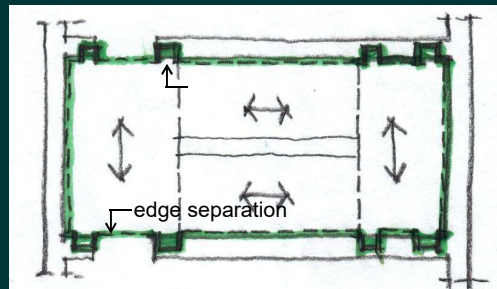


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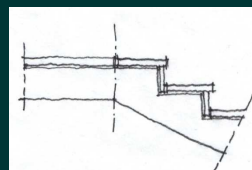
separating stairs from surrounding structures 1

the entire staircase is separated from the walls and ring beams, sits in recessed soundproof boxes, supported point-wise

there is a separation plate between all contacting surfaces



floor plan scheme – supported in soundproofed recesses



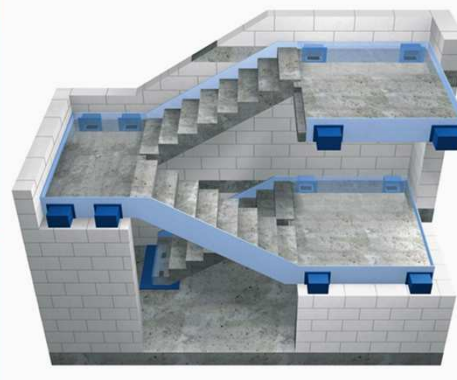
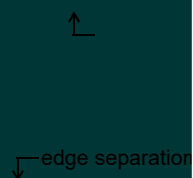
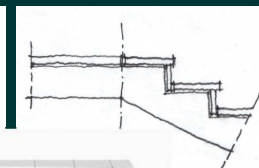
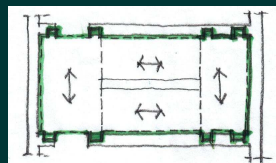
sketch of the turning line – the structure is continuous



separation of the entire stair structure
acoustics of stairs – acoustic bridge breaks

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separating stairs from surrounding structures 1



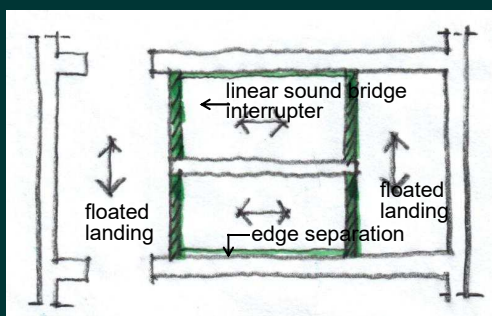
separation of the entire stair structure
acoustics of stairs – acoustic bridge breaks

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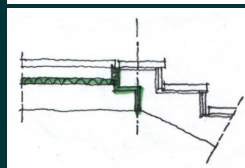
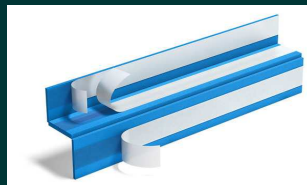
separating stairs from surrounding structures 2

separation of flights from floated landings

there is a separating plate between the flight and the load-bearing landing



floor plan scheme – flight is supported along a soundproofed line



sketch of the turning line – the two structures are separated + floated landings

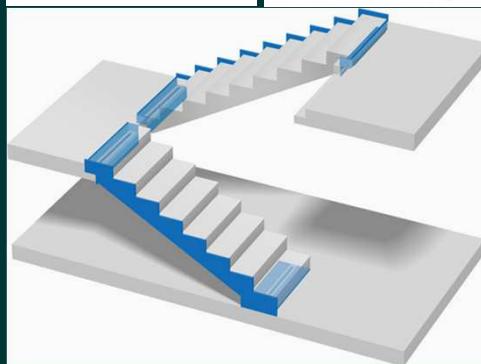
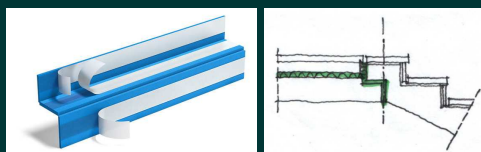
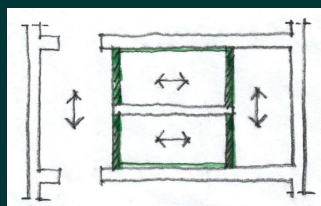


separation of landings

acoustics of stairs – acoustic bridge breaks 2

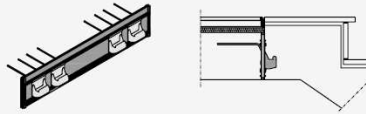
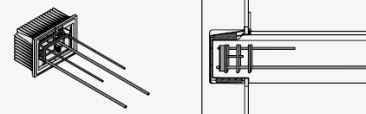
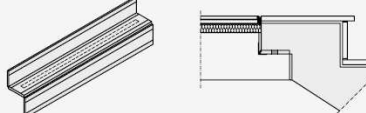
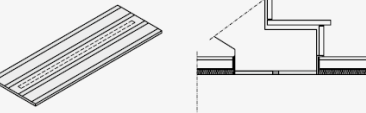
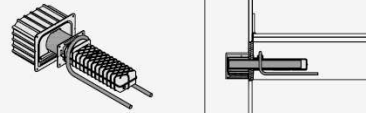
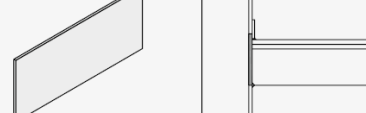
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separating stairs from surrounding structures 2



separation of landings

acoustics of stairs – acoustic bridge breaks 2

<p>Schöck Tronsole® Typ T</p>  <p>monolithic/prefabricated $DL_w \geq 36/42$ dB</p>	<p>Schöck Tronsole® Typ Z</p>  <p>monolithic $L_w \geq 36$ dB</p>
<p>Schöck Tronsole® Typ F</p>  <p>prefabricated $DL_w \geq 40$ dB</p>	<p>Schöck Tronsole® Typ B</p>  <p>starting: monolithic/prefabricated $L_w \geq 40$ dB</p>
<p>Schöck Tronsole® Typ Q</p>  <p>monolithic small cross section $DL_w \geq 38$ dB</p>	<p>Schöck Tronsole® Typ L</p>  <p>edge separation monolithic/prefabricated</p>

data is for information only, later we will learn more about them

acoustic bridge break types
acoustics of stairs – acoustic bridge breaks 3

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"Italian" stairs

the width of the going is complemented by an integer multiple of one step length i.e. $2h+w = 60 \dots 64$ cm + $n \times 60 \dots 64$ cm (OTEK 64.§)

- slope of walkline can be max. 8%, no landing is needed

can be constructed in- and outdoor

"Italian" stairs
stairs – atypical stairs

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ramps

barrier-free ramp (OTÉK 66. § (2))

- for max. 17 cm level difference, max. 8% slope(one step)
- usually max. 5% (1:20),
- one flight of ramp can bridge max. 0.45 m level difference,
- horizontal free area of min. 1.50 m diameter is required at starting and arriving ends
- multi-flight ramp with transparent parapet
- two handrails are required: at the height of 0.70 and 0.95 m if flight is wider than 1.50 m: on both sides and running continuously
- inside the building a multi-flight ramp can bridge max. 1.8 m level difference



barrier-free ramp
ramps – basic information

ramps

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Is this the best solutions / idea?



barrier-free ramp
ramps – basic information

balustrade of stairs

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compulsory, if (OTÉK 68.§)

- the horizontal projection of the stairs/ramp is longer than 1 m
- the level difference between the walking surface and the joining terrain is min. 60 cm

the balustrade is usually 1 m high, no object with 12 cm diameter should get through its openings, and it should contain no elements that help climbing

by their design can be:

- solid
- perforated

solid balustrades can be:

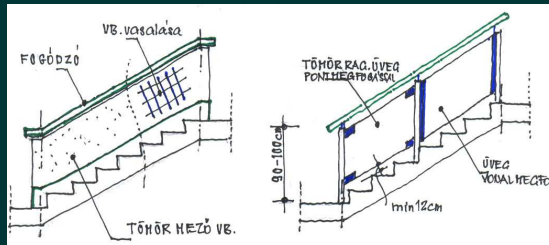
- parapet made from silicate materials

concrete, cement with steel mesh, stone plate, brick infill

- parapet made from glass

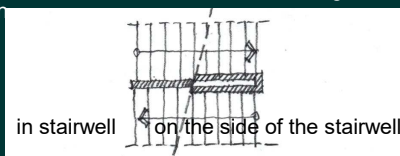
and steel:

laminated safety glass (in steel frame)



solid parapet balustrade made of concrete, or cement with steel mesh

solid parapet balustrade made of laminated glass



placement options of solid balustrades

solid balustrades
stairs – balustrades

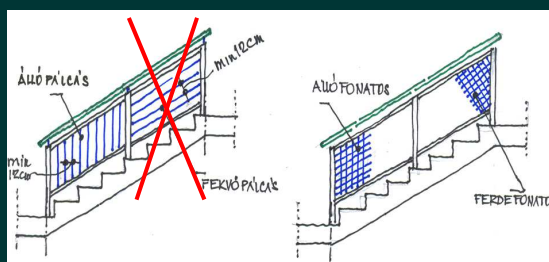
perforated balustrades

may be: in frame

- fields with metal banisters vertical or horizontal

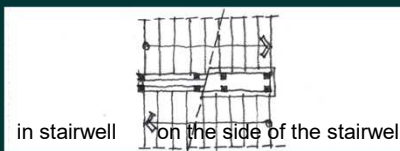
banisters

- metal mesh fields, welded mesh
 - perforated-expanded metal fields with sheet
- balustrades with banisters tensioned wires



perforated balustrades with banisters

perforated balustrades with mesh



placement options of perforated balustrades

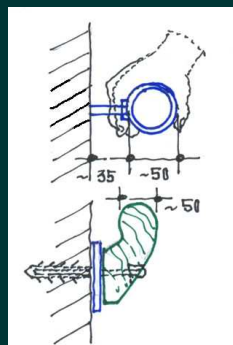
perforated balustrades
stairs – balustrades 2

handrails

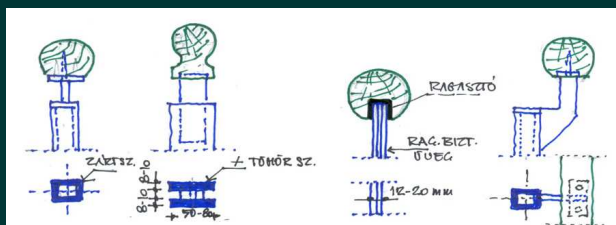
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balustrade and handrail is always required on one side of the stairs, but for flights wider than 2 m balustrade has to be placed on both sides - they can be:

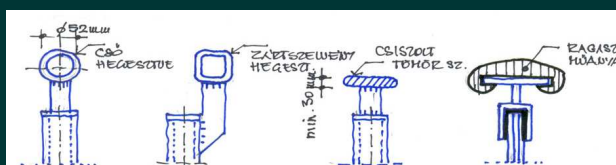
- by their design - wall-mounted or mounted on post
- by material: wood, metal, plastic



wall-mounted
handrails and their
dimensions



wood handrails



steel handrails

handrails of stairs stairs – balustrades 3

wood and steel stairs

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mounted stairs

- wood stairs
- steel stairs
- combined stairs (steel+wood, steel+glass, ...)

can be:

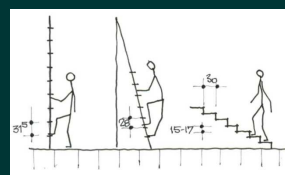
- „ship stair”(60-70°), service function (e.g.attic) stairs
- within one functional unit: usually 30-45° interior stairs

wood stairs

material: well-formable, cutable, good flexural strength, solid texture wood

- **softwood**: larch, pine, spruce
- **hardwood**: oak, robinia, beech

frame may be made of softwood, but the **steps** should be **hardwood** for stairs with higher standard



wood stairs stairs – mounted stairs

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wood as building material: timber

	thickness	width
batten	18-38 mm (22, 24)	18-48 mm
board	18-38 mm (22, 24)	80-320 mm
slave		
(stave)	48-100 mm	48-100 mm
plank	45-100 mm	120-320 mm
beam	100-250 mm	



the cross-section and structure of the tree

organic, "living" material, responds to changes in air conditions

- wet → swelling
 - dry → shrinking
- warps and its shape and dimensions are changing



prevention and mitigation of warping

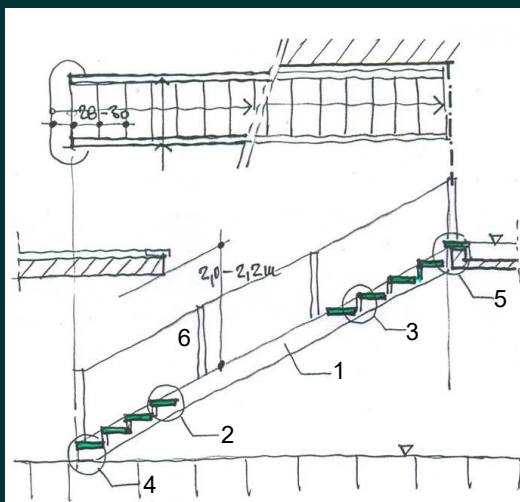
- glued-laminated - blocked timber
- longitudinal cuts
- wood substitutes - e.g. plywood



wood as material
stairs – wood stairs

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calculation of mounted stairs



design phases, determinative elements of the stairs

- 1 - stringer
- 2 - design of steps
- 3 - stringer-step connection
- 4 - stringer-lower slab connection
- 5 - stringer-upper slab connection
- 6 - design of balustrade

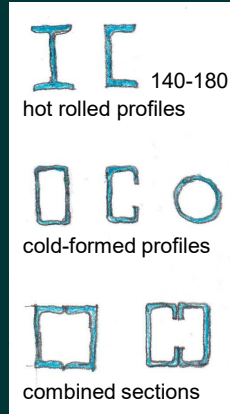


design
stairs – design of mounted stairs

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stringers

steel beams



measured!

steps of steel stairs

flat v. ribbed sheet 2.5-4 mm

sheet reinforced with bending

sheet reinforced with profiles

concrete-filled tray

(galvanized or stainless) steel grating



elements

stairs – design of mounted stairs 2

stringers



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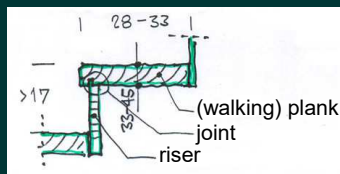


sample

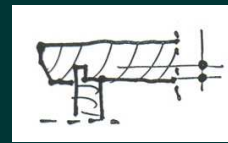
stairs – design of mounted stairs 2

design of steps

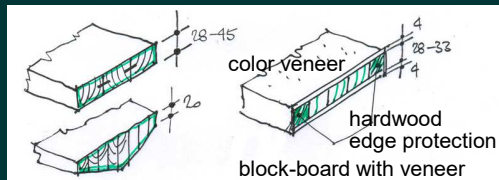
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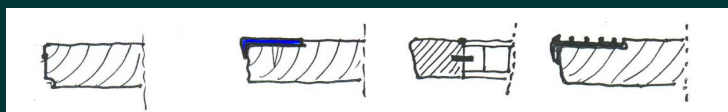
step with (closed)
riser



riser and tread joint:
tongue&groove



steps made of
guelam sections
and block-boards



edge
protection
options

profile milling

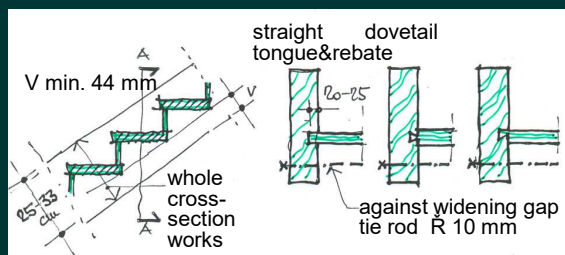
steel edge
protection

hardwood
edge
protection

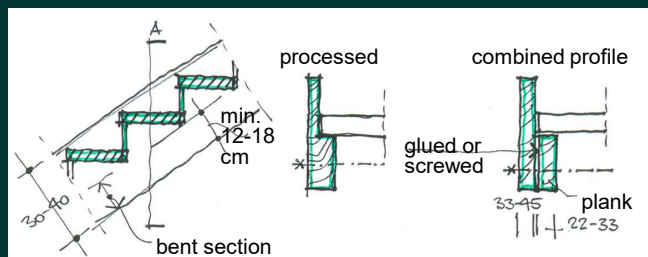
rubber/plastic
edge protection

wood steps

stairs – design of mounted stairs 3



treads **grooved in the
stringer** – the whole cross-
section works



treads **sit on stringers** –
only the cross-section
under the tread works

joint of treads and stringer
stairs – design of mounted stairs 4