Design of geometry of the staircase – example

Assignment (!!! This is just an example – use your values in the homework !!!)

- Height of the floor $h_k = 3600 \text{ mm}$
- Depth of the main slab $h_s = 230 \text{ mm}$
- Depth of floor structure $h_{\rm f} = 150 \text{ mm}$
- Thickness of cladding of the stairs $h_c = 30 \text{ mm}$

Dimensions of the staircase

- Ideal height of one step is 170 mm
- 3600 / 170 = 21,17 => 22 steps (2 flights with 11 steps)
- Height of one step h = 3600 / 22 = 164 mm
- Width of one step b = 630 2h = 302 mm
- DESIGN: Staircase with 164/300 mm steps, 2 flights, 11 steps in each flight
- Width of the flight 1100 mm (in general, 1100 mm is the minimum width of the flight)
- Width of the gap between the flights 200 mm (common value)
- Width of the landing 1200 mm (should be at least "width of the flight + 100 mm)
- Width of the staircase is 1100*2+200 = 2400 mm
- Slope of the staircase is $\alpha = \arctan(164/300) = 28,66^{\circ}$

Scheme of the staircase



Preliminary check of the depth of the slab

- The staircase is considered as one-way slab with the span of 4500 mm. The slab will be simply supported => the depth should be at least 4500/25 = 180 mm.
- The depth of landings is the same as the depth of the main slab -230 mm.
- The depth of flights can be obtained from the details of flight-landing connections (see the picture, see <u>special file</u> describing the construction of the detail). In our case, the depth is 220 mm.
- 230 mm > 180 mm and 220 mm > 180 mm => **OK**



- 1 Edges of the 1st and last concrete step should be in the same position (because of formwork)
- 2 Both flights should start in the same position (because of formwork and esthetic reasons)
- 3 Claddings in both flights should be in the same position (esthetic reasons) therefore the concrete edges are not in the same position

Perpendicular and head clearance of the staircase

- Head clearance of the staircase should be more than $1500+750/\cos\alpha = 1500+750/\cos(28,66^\circ) = 2355$ mm and more than 2100 mm.
- Head clearance of our staircase is $h_1 = h_k h_s h_f h = 3600 230 150 164 = 3057 \text{ mm} => \mathbf{OK}.$
- Perpendicular clearance of the staircase should be more than $750+1500*\cos\alpha = 750+1500*\cos(28,66^\circ) = 2066$ mm and more than 1900 mm.
- Perpendicular clearance of our staircase is $h_2 = h_1 \cos \alpha = 3057 \cos(28,66^\circ) = 2682 \text{ mm},$ => **OK**.

