

Calculation example for load transfer requirements at construction joints in industrial floors.

General data:

slab size	10.000 m ²	
Concrete grade	C30/37	(f _{ck} = 30,00 N/mm ²)
material safety	$\gamma_c = 1,5$ [-]	(concrete safety factor acc. TR34 = 1,5)
load transfer expectation	LT = 40,0 %	(load transfer coming from initial floor design)
subgrade reaction	$k_w = 0,05$ N/mm ³	(usual values 0,03 - 0,1 N/mm ³)

load case: two adjacent point loads near the joint

loading	$P_2 = 95$ kN	
loading safety factor	$\gamma_{p2} = 1,2$ [-]	(loading safety for racks acc. TR34 = 1,2)
distance between loads	$a = 300$ mm	
base plate dimension	$x = 120$ mm	$y = 120$ mm
design loading value	$P_{2,d} = 228$ kN	($P_{2,d} = 2 \cdot P_2 \cdot \gamma_{p2}$)

factors for design:

mean compressive strength	$f_{cm} = f_{ck} + 8 =$	38,00 N/mm ²
secant modulus of elasticity	$E_{cm} = 22000 \cdot (f_{cm} / 10)^{0,3} =$	32837 N/mm ²

Cosinus Slide® Joint:

slab thickness	$h = 180$ mm	
concrete volume needed	1.800 m³	
radius of relative stiffness	$l_e = [(E_{cm} \cdot h^3) / (12 \cdot (1 - \nu^2) \cdot k_w)]^{1/4} =$	759,3 mm
distribution length	$l_e' = 0,9 \cdot l_e =$	683,4 mm
affected distribution length	1787 mm	
$V_{Rd,c} = V_{min} = 0,0525 / \gamma_c \cdot k^{3/2} \cdot f_{ck}^{1/2} \cdot 0,80 \cdot h / 1,4 =$	55,8 kN/m	(design value at ULS)
with: $k = 1 + (200 / d)^{0,5} \leq 2, 2,00$		
with: $d = h - 60$ [mm]		
number of activated dowels	-	(continued load transfer system, no single dowel activation)
load transfer capacity	$V_{Rd,c} = 99,65$ kN	
point load	$P_{2,d} = 228$ kN	
percentage of load transfer	43,7 %	> 40,0 % OK

rectangular plate dowels:

slab thickness	$h = 210$ mm	
concrete volume needed	2.100 m³	
radius of relative stiffness	$l_e = [(E_{cm} \cdot h^3) / (12 \cdot (1 - \nu^2) \cdot k_w)]^{1/4} =$	852,4 mm
distribution length	$l_e' = 0,9 \cdot l_e =$	767,2 mm
affected distribution length	1954 mm	
plate length	$d_L = 180$ mm	
plate width	$d_W = 120$ mm	
plate thickness	$d_T = 8$ mm	

distance between plates	$d_d =$	600 mm	(center to center distance)
calculated embeded lenght:	check 1	45 mm	$(d_w / 2 - 15 \text{ mm})$
	check 2	64 mm	$(d_T * 8)$
	$l_{emb} =$	45 mm	
effective depth	$d_{eff} =$	75,75 mm	(75 % of remaing thickness below dowel)
perimeter of bursting area	$u =$	746 mm	
concrete shear capacity at ULS	$V_{Rd,c} =$	0,542 N/mm ²	
	$P_{burst,d} =$	30,6 kN	(in case of single dowel activation)
	$V_{Rd,c} =$	41,1 kN/m	(in case of overlapping of bursting areas)
overlapping of bursting areas?	$d_o =$	303 mm	(overlapping distance = 4 . d_{eff})
	$d_c =$	420 mm	(clear distance between plates)
	$d_o <$	d_c	No overlap of bursting areas → single dowel acitvation
number of activated dowels		3	(no single dowel activation)
load transfer capacity	$V_{Rd,c} =$	91,92 kN	
point load	$P_{2,d} =$	228 kN	
percentage of load transfer		40,3 %	> 40,0 % OK

concrete savings

Cosinus Slide® Joint:	concrete volume needed	1800 m ³
rectangular plate dowels:	concrete volume needed	2100 m ³

savings: 300 m³ = 14,3% savings on concrete volume

explanations / disclaimer:

Only the minimum load transfer requirement of 40 % for 1 load case was verified.
 Other loads, load cases or analyses of the entire structure may deliver different results.
 This example serves to illustrate the differences in the performance of various joint systems.
 Calculations are based on Technical Report 34 (4th edition), published from Concrete Society. Only values of Cosinus Slide® Joints are based on suppliers data.
 No distance is foreseen between loading and joint.
 The load is supposed to be placed directly at (not on) the joint.
 The calculations are for industrial slabs on ground only.
 Only one dirction of load placement is checked, just the smaller base plate size is used.
 All dowels are supposed to be located in the center of the section and to be centered at 0 mm opening.
 The joint opening is set at 15 mm.
 The embedded length is equal to 0,5 . dowel width - 15 mm (or 8 . dowel thickness, whatever governs).
 Only concrete bursting is checked, other possible failure mechanisms are not considered.
 All calculations are based on unreinforced concrete.
 This calculation representes not a full industrial floor design check, nor a full load transfer check. It only provides figures for the specific load case in order to compare the load transfer capacity and its possible impact on the slab thickness.