



Technical Manual

Technical changes and
errors reserved

Version 14.2.2017

RKL, R2KL and R3KL fastening plates

Design according to Eurocodes (Swedish NA)



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R-Group Finland OY


 asiakastieto.fi

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1. DESCRIPTION OF THE SYSTEM

The RKL fastening plates manufactured by R-Group Finland Oy are steel plates equipped with anchors which are mounted to the concrete before hardening of the concrete. The anchors transfer the stresses of the steel plate to the concrete structure. Connections to the fastening plates are done by welding straight to the steel plate.

2. DIMENSIONS AND MATERIAL

2.1 RKL and R2KL fastening plates dimensions

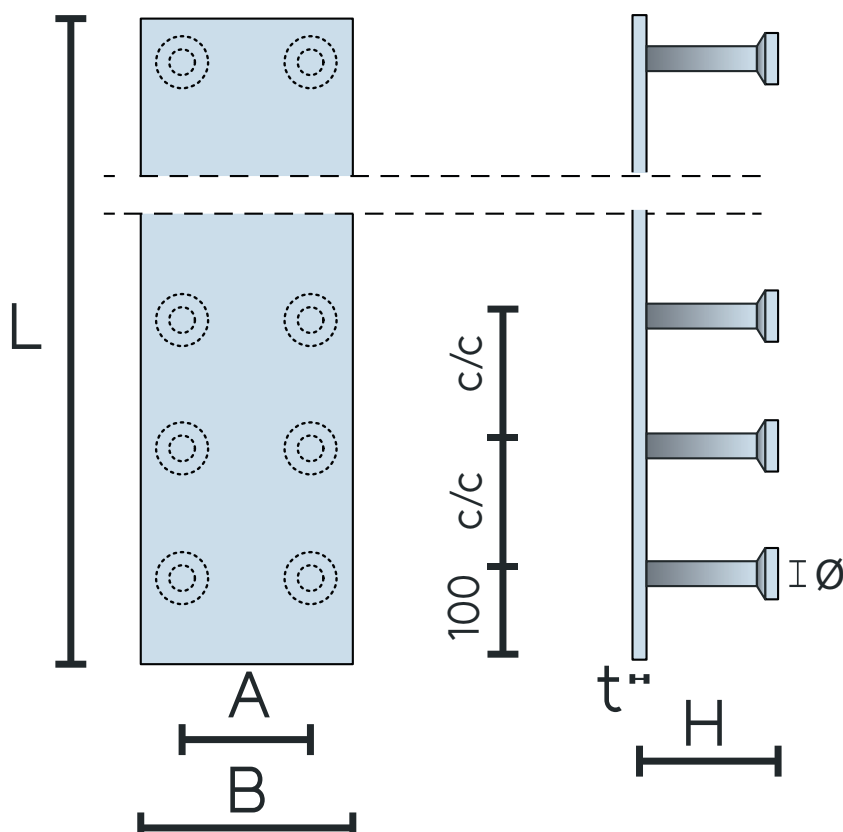


Figure 1. Markings of dimensions for RKL and R2KL fastening plate

Length of the fastening plate L is a multiple of center distance ($L = n \times c/c$, $L_{\max} = 2000$ mm).

Table 1. Dimensions of RKL and R2KL fastening plates

Fastening plate size B x L	H mm	A mm	c/c mm	t mm	Ø mm
RKL 100 x L	70	50	150	10	12
RKL 150 x L	70	90	150	10	12
RKL 200 x L	70	100	150	10	12
R2KL 100 x L	115	50	200	15	16
R2KL 150 x L	115	90	200	15	16
R2KL 200 x L	115	100	200	15	16
R2KL 300 x L	115	200	200	15	16
R2KL 400 x L	115	300	200	20	16

2.2 R3KL fastening plates dimensions

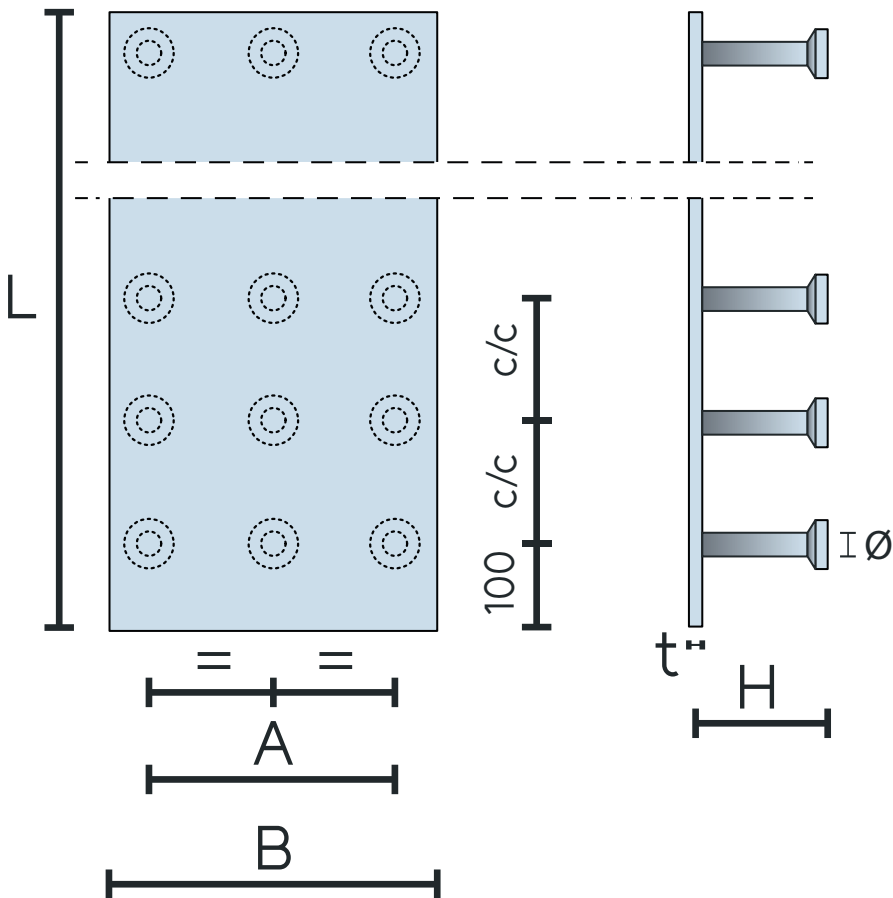


Figure 2. Markings of dimensions for R3KL fastening plate

Length of the fastening plate L is a multiple of center distance
($L = n \times c/c$, $L_{\max} = 2000 \text{ mm}$).

Table 2. Dimensions of R3KL fastening plates

Fastening plate size R3KL B x L	H mm	A mm	c/c mm	t mm	Ø mm
R3KL 300 x L	220	200	200	25	20
R3KL 400 x L	220	300	200	25	20
R3KL 500 x L	220	400	200	25	20
R3KL 600 x L	220	500	200	25	20

2.3 RKL fastening plates ordering codes

Table 3. RKL, R2KL and R3KL fastening plates ordering codes

Ordering code	Steel plate	Anchors	Type
RKL	S355J2+N	S235JR+AR	Plain steel
R2KL			
R3KL			
RKLR	1.4301	S235JR+AR	Stainless
R2KLR			
R3KLR			
RKLH	1.4401	S235JR+AR	Acid resistant
R2KLH			
R3KLH			

2.4 Materials and standards of RKL fastening plates

Table 4. Materials and standards of RKL fastening plates

Part	Fastening plate	Material	Standard
Anchors	RKL, RKL, RKLH, R2KL, R2KLR, R2KLH, R3KL, R3KLR, R3KLH	S235JR+AR	EN 10025
Steel plate	RKL, R2KL, R3KL	S355J2+N	EN 10025
Steel plate	RKLR, R2KLR, R3KLR	1.4301	EN 10088
Steel plate	RKLH, R2KLH, R3KLH	1.4401	EN 10088

3. MANUFACTURING

3.1 Manufacturing method

Plates	Flame or mechanical cutting
Anchor bars	Mechanical cutting
Welding	MAG or arc stud welding (EN 14555) by hand or by robot
Welding class	C (EN ISO 5817), EXC2 (EN 1090-2)
Execution class	EXC2 (EN 1090-2) [more demanding classes according to separate instructions]

3.2 Manufacturing tolerances

Dimensions of the plate	± 3 mm	$L \leq 120$ mm
	± 4 mm	$120 \text{ mm} < L \leq 315$ mm
	± 6 mm	$315 \text{ mm} < L \leq 1000$ mm
	± 8 mm	$L > 1000$ mm
Straightness of the plate	L/150	
Roughness of cut plate	EN 1090-2	
Angularity of cut plate	EN 1090-2	
Height of the fastening plate	± 5 mm	
Location of the anchors	± 5 mm	
Mutual location of the anchors	± 5 mm	
Pitch of the anchors	± 5°	

3.3 Manufacturing markings

Fastening plates are marked with Inspecta Sertifiointi Oy control mark, the emblem of R-Group Finland Oy, the type of the fastening plate and production date.

3.4 Coatings

The fastening plates are coated with water-borne primer. It can be overcoated both with water and solvent-borne topcoats. Fastening plates S355J2+N have a 40 µm protective painting on top surface and on sides. Plates 1.4301 and 1.4401 have no surface coating. Fastening plates may also be ordered galvanized or epoxy painted.

3.5 Quality control

Quality control of the fastening plates is done according to the requirements of EN 1090-2 and the instructions according to quality and environment system of the R-Group Finland Oy (ISO9001 and ISO14001). R-Group Finland Oy has a quality control contract with Inspecta Sertifiointi Oy.

4. RESISTANCES

4.1 Design principles

Resistances of fastening plates are calculated for static loads according to limit state dimensioning method according to

EN 1992: Eurocode 2
EN 1993: Eurocode 3
CEN/TS 1992-4

with Swedish National Annexes.

Resistances are calculated for concrete C25/30.

Resistances take into account the manufacturing tolerances and an assembly tolerance of ± 15 mm.

Dimensioning for dynamic and fatigue loads must be done separately.

4.2 Resistances of RKL, R2KL and R3KL fastening plates

Resistances in table are design resistances in the ultimate limit state for RKL fastening plates with additional reinforcement (additional reinforcement see chapter 4.3). Edge distances apply to longer sides of the RKL, R2KL and R3KL fastening plates, short sides may be level with concrete edge.

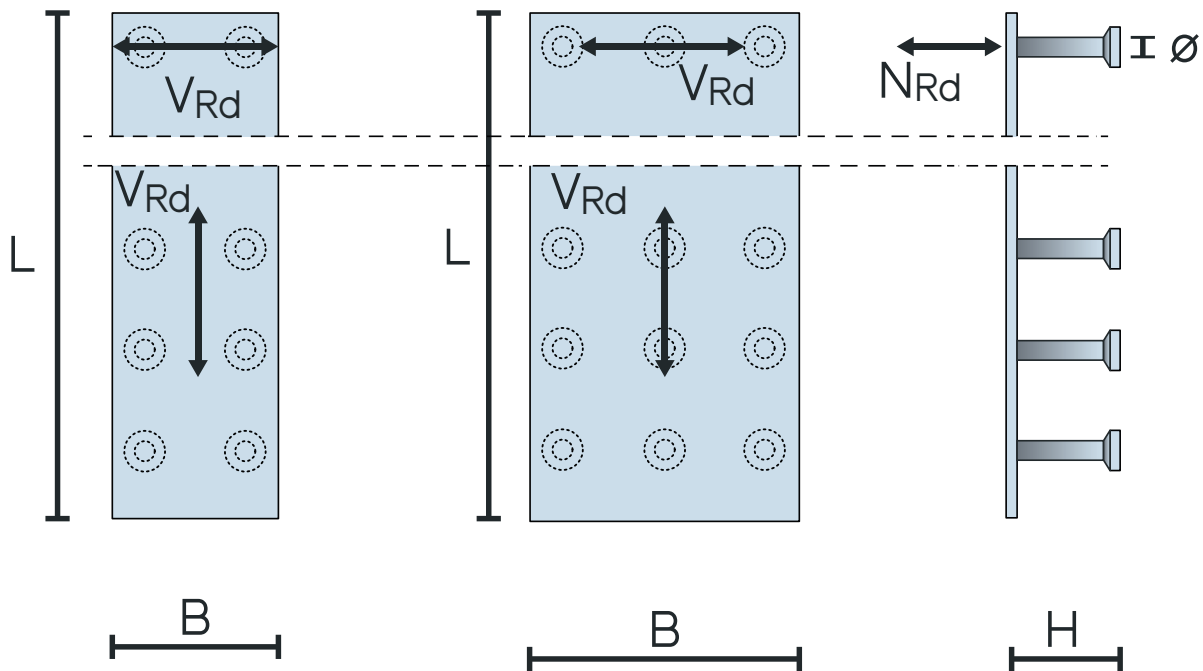


Figure 3. Marking of resistances for RKL, R2KL and R3KL fastening plates

Table 5. Resistances of RKL, R2KL and R3KL fastening plates, concrete C25/30, edge distance 11Ø on one side

Fastening plate size B x L	H mm	N _{Rd} kN	V _{Rd} kN	Minimum fastening area	
				RKL, R2KL, R3KL mm x mm	RKLR, RKLH R2KLR, R2KLH R3KLR, R3KLH mm x mm
RKL 100 x L	70	8.5	12.8	23 x 80	23 x 92
RKL 150 x L	70	10.0	15.0	43 x 80	43 x 92
RKL 200 x L	70	10.4	15.6	48 x 80	48 x 92
R2KL 100 x L	115	19.5	29.3	23 x 131	23 x 144
R2KL 150 x L	115	21.7	32.6	43 x 109	43 x 125
R2KL 200 x L	115	22.3	33.5	48 x 83	48 x 104
R2KL 300 x L	115	27.8	41.7	107 x 60	124 x 86
R2KL 400 x L	115	33.3	49.1	222 x 44	236 x 73
R3KL 300 x L	220	28.1	42.2	50 x 163	50 x 169
R3KL 400 x L	220	32.0	48.0	74 x 152	74 x 160
R3KL 500 x L	220	35.9	49.1	99 x 141	99 x 152
R3KL 600 x L	220	39.8	49.1	124 x 131	132 x 143

Resistances N_{Rd} and V_{Rd} given in table 5 apply for one pair or row of anchors.

Resistances given in table 5 are applicable only with reinforcement according to chapter 4.3 and with distance from middle of the anchor to the concrete edge $\geq 11 \times \varnothing$ (\varnothing = anchor diameter, see tables 1 and 2) on one side. In this case the edge distance on other long side must be $\geq c_{cr}$. $c_{cr} = 1.5 \times$ height of the fastening plate (H in table 4). With smaller edge distances or if the edge distance on two sides is less than c_{cr} , resistances for RKL, R2KL and R3KL fastening plates must be reduced with reduction factors given in table 6. Reduction factors must also be used if distance between anchors of adjacent RKL, R2KL and R3KL fastening plates is $< 2 \times c_{cr}$.

Table 6. Reduction factors

Edge distance	on one side	on two sides
$11 \times \varnothing$	1.00	0.87
$8 \times \varnothing$	0.85	0.66
$5 \times \varnothing$	0.66	0.47

Values in between may be linearly interpolated for table 6.

4.3 Additional reinforcement

When using resistances according to chapter 4.2, additional reinforcement according to figure 4 and table 7 must always be installed. Additional reinforcement is installed for every pair or row of anchors and in the direction of the shear load.

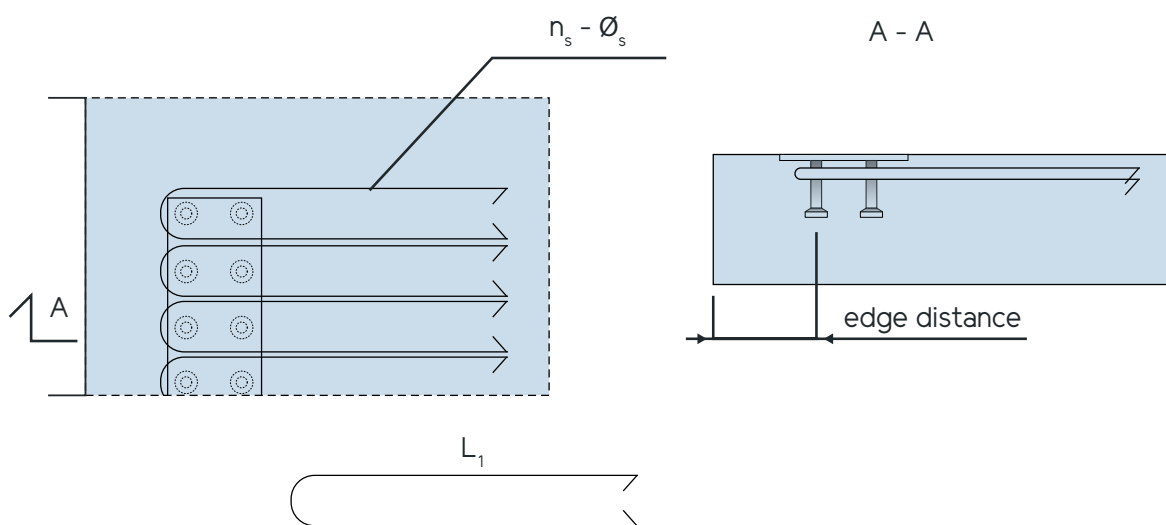


Figure 4. Placement of additional reinforcement

Additional reinforcement steel material B500B (K500C-T).

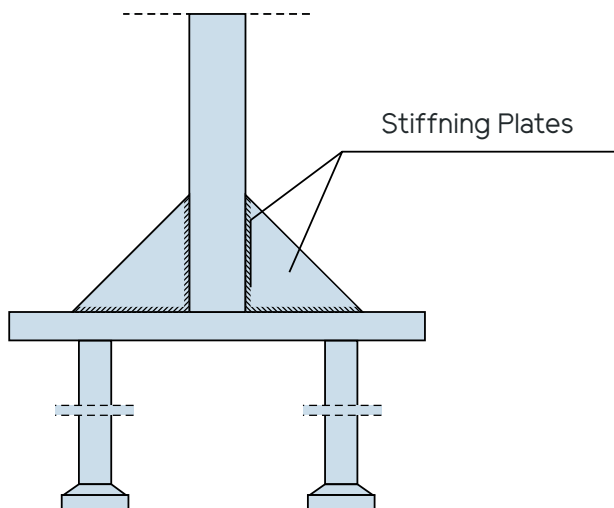
Table 7. Additional reinforcement for resistances according to chapter 4.2

Fastening plate size B x L	n_s [kpl]	\varnothing_s [mm]	L_1 [mm]
RKL 100 x L	2	8	450
RKL 150 x L	2	8	450
RKL 200 x L	2	8	500
R2KL 100 x L	2	10	500
R2KL 150 x L	2	10	550
R2KL 200 x L	2	10	550
R2KL 300 x L	2	12	750
R2KL 400 x L	2	12	850
R3KL 300 x L	2	12	750
R3KL 400 x L	2	12	850
R3KL 500 x L	2	12	950
R3KL 600 x L	2	12	1050

4.4 Fastening area

Minimum fastening areas which correspond with resistances are given in table 5. The requirement for the minimum fastening area applies to stresses which bend the steel plate. These stresses are the tension stress.

If the dimensions of the structural part which is attached to the fastening plate are smaller than the minimum fastening area in table 5, the steel plate of the fastening plate must be stiffened e.g. according to figure 5. If the attached structural part is welded with a continuous weld around, the weld may be included in the fastening area.


Figure 5. Stiffening of the fastening plate

If the fastening area is smaller than the minimum fastening area and no stiffening is made, the resistances must be reduced. The reduction of resistances is proportional to the fastening area. The reduction of resistance must be done for tension forces. For shear forces the reduction is not necessary.

Reduction equation for tension and moment forces:

$$F_{\text{red}} = \frac{(e-s_0)}{(e-s_{\text{tod}})} \cdot F_{\text{ud}}$$

e = distance between anchors in the direction of the calculation (A or c/c, figures 1 and 2 and tables 1 and 2)

s_0 = the side measurement of the fastening area according to table 5

s_{tod} = actual side measurement of the fastening area

F_{ud} = resistance value of the force (N_{Rd}) with the minimum fastening area

F_{red} = resistance value with the actual fastening area

4.5 Combined forces

If the fastening plate is simultaneously loaded by several stresses, the combined action of forces must be checked. The combined actions may be checked with the following equation:

RKL, R2KL and R3KL fastening plates:

$$\left(\frac{N_{\text{Ed}}}{N_{\text{Rd}}}\right)^2 + \left(\frac{V_{\text{Ed}}}{V_{\text{Rd}}}\right)^2 \leq 1$$

N_{Ed} = design value of the tension force

N_{Rd} = resistance of the tension force

V_{Ed} = design value of the shear force

V_{Rd} = resistance of the shear force

4.6 RKL fastening plate dimensioning example

Dimensioning example for RKL150x600 fastening plate which is situated in concrete according to figure 6. Forces acting on the fastening plate:

$V_{\text{Ed}} = 11$ kN and $N_{\text{Ed}} = 5$ kN. Forces act on different pairs of anchors.

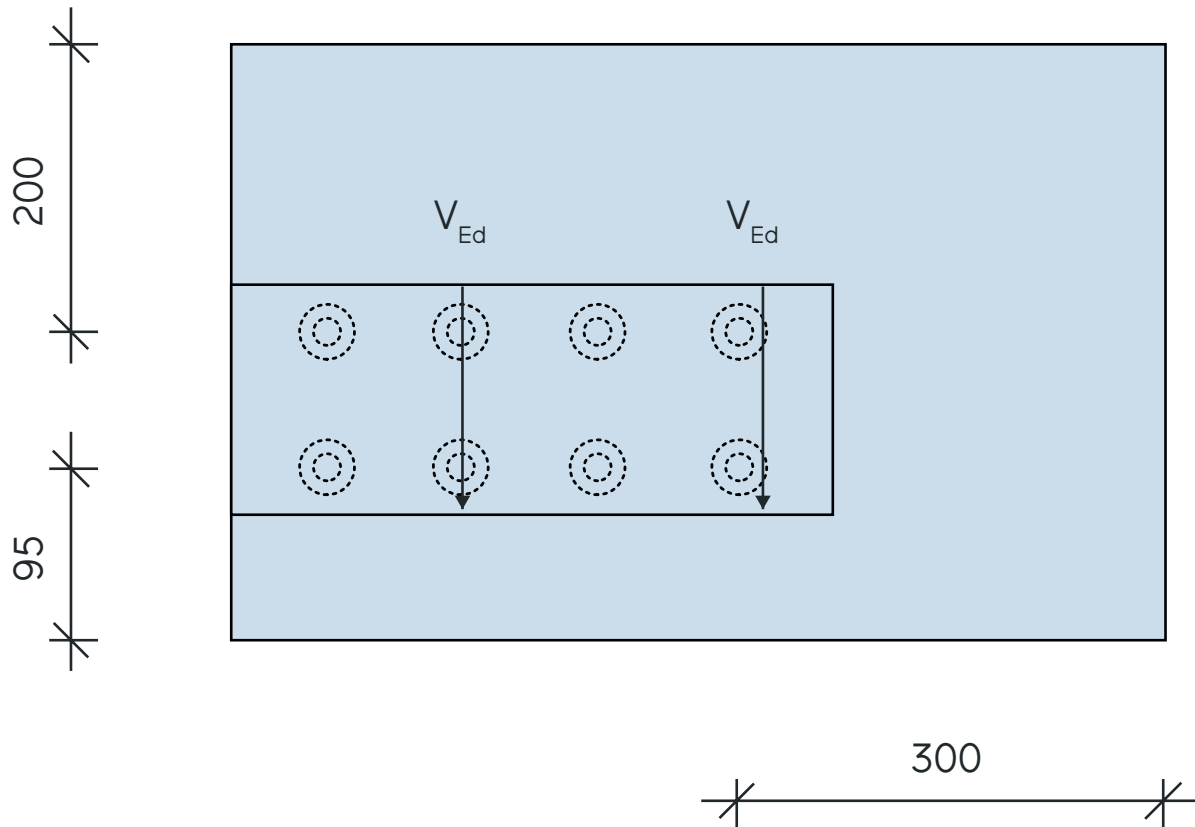


Figure 6. RKL150x600 dimensioning example, edge distances from the centre of the anchors

RKL150x600 anchor diameter according to table 1 is 12 mm and the minimum edge distance is $11\varnothing = 132$ mm for resistances in table 5. RKL150x600 placed as in figure 6 does not fulfill this edge distance on both long sides and reduction factors from table 6 must be applied. Edge distance 95 mm is $8\varnothing$ which makes the reduction factor 0,85. Applicable resistances are thus

$$N_{Rd,red} = 0,85 \times 11,3 \text{ kN} = 9,6 \text{ kN} \text{ and}$$

$$V_{Rd,red} = 0,85 \times 17,0 \text{ kN} = 14,4 \text{ kN}.$$

Checking for combined forces:

$$\left(\frac{5N}{9,6kN} \right)^2 + \left(\frac{11N}{14,4kN} \right)^2 = 0,85 \leq 1 \quad \text{OK!}$$

5. APPLICATION

5.1 Limitations for application

The capacities of the RKL, R2KL and R3KL fastening plates have been calculated for static loads. For dynamic and fatigue loads, greater safety factors have to be used and the parts of the joint must be checked individually for each case.

RKL, R2KL and R3KL fastening plates have been calculated for concrete C25/30.

6. INSTALLATION

6.1 Attachment to formwork

The fastening plate may be attached to formwork or reinforcement by nailing, gluing, double-sided tape or by pressing apparatus. Nail holes to the fastening plates are made by special order. The fastening plate must be attached securely so it cannot move during casting.

During the casting the free drop height of the concrete must be kept as low as possible to avoid separation of the concrete and dynamic loads to the fastening plate.

At the fastening plate the concrete must be compressed carefully and special care must be taken to ensure that there are no holes or empty space under the fastening plate. The fastening plate cannot be vibrated.

6.2 Welding of attached structure parts

Welding of attached structure parts must be done according to designs. For demanding welding it is recommended that the designer provides a welding design which shows e.g. welding order and the additives used. Before the welding process the welding area must be cleaned from all substances which may be detrimental to the weld. After the welding the weld joint and the steel parts are protected according to designs.

If the temperature is below -5°C , preheating of the welded parts is recommended.

6.3 Welding and bending of the anchors

The anchors of the fastening plates may be welded by all commonly used fullfusion welding methods.

The anchors of the fastening plates may not be bended without the permission of the designer. If the anchors are bended the resistances must be individually re-calculated for each case, the resistances in resistance tables can no longer be used.

7. SUPERVISION OF ASSEMBLY

7.1 Assembling the fastening plates

Check list before casting:

- the fastening plate is in good condition
- the fastening plate is according to designs and in the right place
- the fastening plate is attached firmly
- the required additional reinforcement is assembled

During the casting:

- the fastening plate stays in the right place
- the concrete is thoroughly vibrated around the fastening plate

After the casting:

- the situation of the fastening plate is according to designs.

7.2 Assembly of connected structural parts

Check list for the assembly of connected structural parts:

- the fastening plate is according to designs
- the welding is done according to designs using professional welders
- the size and quality of the welds is checked according to designs
- the fire and corrosion treatment and other possible surface treatments of the steel parts are done according to designs

Notes

CREATE A NOTE

About R-Group

R-Group is a leading provider of steel connections for precast and cast-in- situ construction around the globe.

With over three decades of our participation in huge projects, we don't compromise on quality or customer satisfaction and we create connections for a lifetime.




Our customer-oriented service, excellent and reliable network of suppliers plus our extensive product portfolio ensure that we are able to offer professional and flexible solutions for any kind of projects.

In our operations we comply with the ISO 9001 and 14001 standards

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