



# SELP ANCHOR BOLTS

TECHNICAL MANUAL  
EuroCODE DESIGN

## Contents:

1	ANCHOR BOLT PRINCIPLE .....	4
2	ANCHOR BOLTS .....	4
2.1	ANCHOR BOLT MATERIALS.....	4
2.2	ANCHOR BOLTS ORDERING CODE .....	4
2.3	SELP/L ANCHOR BOLT DIMENSIONS .....	5
2.4	SELP/P ANCHOR BOLT DIMENSIONS .....	6
2.5	MANUFACTURING .....	7
2.5.1	Manufacturing method .....	7
2.5.2	Tolerances.....	7
2.5.3	Markings .....	7
3	RESISTANCES .....	8
3.1	DESIGN CONCEPT .....	8
3.2	RESISTANCES FOR AXIAL FORCE .....	8
3.3	RESISTANCES FOR SHEAR FORCE.....	9
4	USE OF ANCHOR BOLTS .....	10
4.1	LIMITATIONS OF USE .....	10
4.2	ANCHOR BOLT EDGE AND CENTER DISTANCES.....	10
5	REINFORCEMENT .....	11
5.1	REINFORCEMENT FOR TENSION.....	11
5.1.1	LAP REINFORCEMENT OF SELP/P ANCHOR BOLTS .....	11
5.1.2	TRANSVERSE REINFORCEMENT OF SELP/P ANCHOR BOLTS .....	12
5.1.3	CONCRETE CONE REINFORCMEENT OF SELP/L ANCHOR BOLTS .....	14
5.1.4	SPLITTING REINFORCEMENT OF SELP/L ANCHOR BOLTS .....	15
5.1.5	BLOW-OUT REINFORCEMENT OF SELP/L ANCHOR BOLTS .....	16
5.2	REINFORCEMENT FOR COMPRESSION FORCE .....	17
5.3	SHEAR REINFORCEMENT .....	18
6	INSTALLATIONS .....	19
6.1	EQUIPMENT.....	19
6.2	INSTALLATION TOLERANCES .....	19
6.3	BENDING OF BOLTS .....	20
6.4	WELDING OF BOLTS.....	20
7	QUALITY CONTROL.....	20
8	SUPERVISION OF ASSEMBLY .....	21
8.1	ASSEMBLY OF COLUMNS.....	21
8.2	SUPERVISION OF BOLT ASSEMBLY .....	21



# 1 ANCHOR BOLT PRINCIPLE

SELP high-strength anchor bolts are steel parts embedded in concrete before casting. They transfer loads from attached structures to base column or footing. Bolts are anchored with rebar anchorage (SELP/P) or with anchor plates (SELP/L).

## 2 ANCHOR BOLTS

### 2.1 ANCHOR BOLT MATERIALS

Table 1. Anchor bolt materials

Part	Material	Standard
Thread	Imacro M $f_{yk} \geq 700 \text{ MPa}$ $f_{uk} \geq 800 \text{ MPa}$	SFS-EN 10027
Rebar	B500B	SFS 1300
Anchor plate	S355J2+N	SFS-EN 10025
Washer	S235JR+AR	SFS-EN 10025
Nut	Grade 10 Dimensions	EN ISO 898-2 DIN 934 / ISO 4032

### 2.2 ANCHOR BOLTS ORDERING CODE

Anchor bolts may be ordered without coating or hot-dip galvanized.

Ordering code SELP/P: long anchor bolt

Ordering code SELP/L: short anchor bolt with anchor plate

Ordering code SELP/P-KZN: long anchor bolt hot-dip galvanized

Ordering code SELP/L-KZN: short anchor bolt with anchor plate hot-dip galvanized

## 2.3 SELP/L ANCHOR BOLT DIMENSIONS

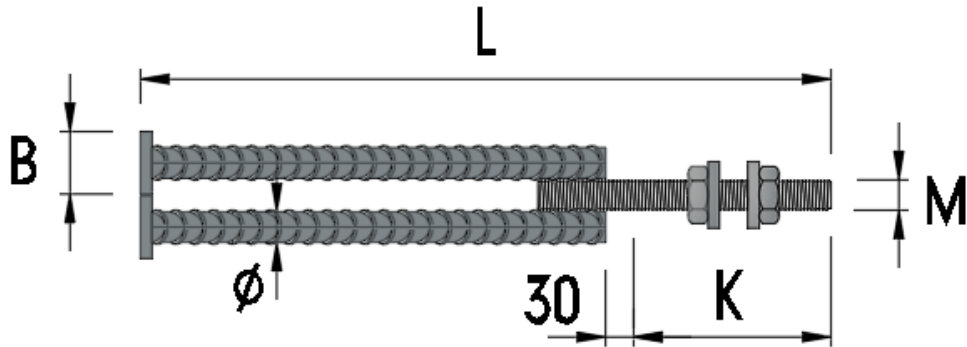


Figure 1. SELP/L anchor bolt dimensions

Table 2. SELP/L anchor bolt dimensions

Anchor bolt	M	$\varnothing$ [mm]	$n_s$ [kpl]	K [mm]	B [mm]	$h_{ef}$ [mm]	L [mm]	Washers	Weight [kg]	Color
SELP 27 L	27	16	3	150	36	442	600	$\varnothing 56 \times 6$	3,0	-
SELP 30 L	30	25	2	190	55	510	670	$\varnothing 65 \times 8$	5,0	Black
SELP 36 L	36	20	4	190	50	562	740	$\varnothing 80 \times 8$	7,2	Red
SELP 39 L	39	25	3	190	55	680	880	$\varnothing 90 \times 10$	10,3	Brown
SELP 45 L	45	25	4	220	55	770	980	$\varnothing 100 \times 10$	15,1	Violet
SELP 52 L	52	32	4	250	70	893	1140	$\varnothing 100 \times 12$	28,0	White

Bolt delivery includes nuts and washers (2 pcs/bolt).

NB! When using SELP anchor bolts with SSK wall shoes, washers for wall shoes must be used.

## 2.4 SELP/P ANCHOR BOLT DIMENSIONS

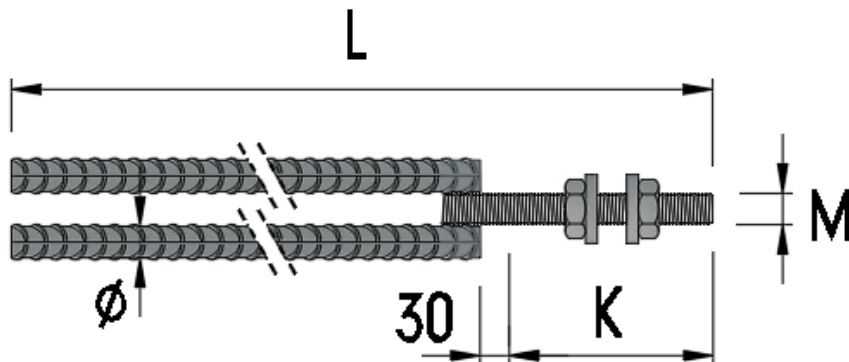


Figure 2. SELP/P anchor bolt dimensions

Table 3. SELP/P anchor bolt dimensions

Anchor bolt	M	Ø [mm]	$n_s$ [kpl]	K [mm]	L [mm]	Washers	Weight [kg]	Color
SELP 27 P	27	16	3	150	1490	Ø56 x 6	7,1	-
SELP 30 P	30	25	2	190	1760	Ø65 x 8	13,1	Black
SELP 36 P	36	20	4	190	1630	Ø80 x 8	15,7	Red
SELP 39 P	39	25	3	190	2010	Ø90 x 10	22,9	Brown
SELP 45 P	45	25	4	220	2040	Ø100 x 10	30,9	Violet
SELP 52 P	52	32	4	250	2160	Ø100 x 12	52,6	White

Bolt delivery includes nuts and washers (2 pcs/bolt).

Length of SELP/P anchor bolts has been determined for rebas lap length in "good" bond conditions with concrete class C25/30. Lap length factor  $\alpha_6 = 2,0$  (according to Finnish NA with this length factor it may assumed that requirement for lap arrangement according to 8.7.2(3) is fulfilled and all tension bars may lapped in same section (percentage in 8.7.2(4) is 100 %)).

NB! When using SELP anchor bolts with SSK wall shoes, washers for wall shoes must be used.

## 2.5 MANUFACTURING

### 2.5.1 Manufacturing method

Rebars are cut to length mechanically. Rebars are welded to the thread part and anchor plates are welded to rebar ends (SELP/L). MIG welding, manual or robotic. Welding class C according to SFS-EN ISO 5817.

### 2.5.2 Tolerances

Total length:	$\pm 10$ mm
Thread length:	+ 5, -0 mm, thread 6g
Washer sides and hole	$\pm 1$ mm

### 2.5.3 Markings

Delivery includes Kiwa Inspecta Oy marking, steel part code and manufacturers name.

## 3 RESISTANCES

### 3.1 DESIGN CONCEPT

Resistances of SELP anchor bolts are designed according to

EN 1992-1-1: Eurocode 2: Design of concrete structures

EN 1992-4: Eurocode 2: Design of concrete structures

EN 1993-1-1: Eurocode 3: Design of steel structures

EN 1993-1-8: Eurocode 3: Design of steel structures

Resistances are calculated in concrete class C25/30.

Resistances are calculated for static loads in ULS in "good" bond conditions. Design for dynamic loads must be done separately.

### 3.2 RESISTANCES FOR AXIAL FORCE

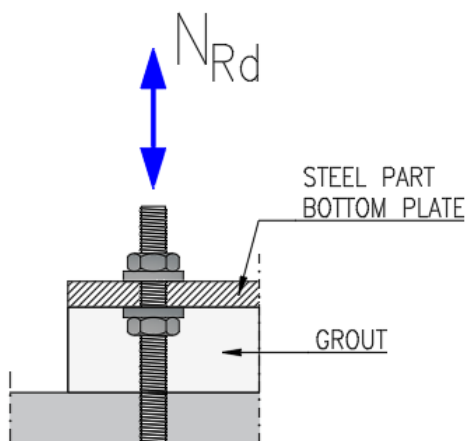


Figure 3. Resistance for axial force

Table 4. Design values of resistance for axial forces (concrete class C25/30)

Anchor bolt	Design value of resistance for axial force $N_{Rd}$ [kN]
SELP 27	262
SELP 30	322
SELP 36	470
SELP 39	562
SELP 45	752
SELP 52	1012

Design value of resistance for axial force in assembly stage is the same as in final situation with grout thicknesses in table 5.

### 3.3 RESISTANCES FOR SHEAR FORCE

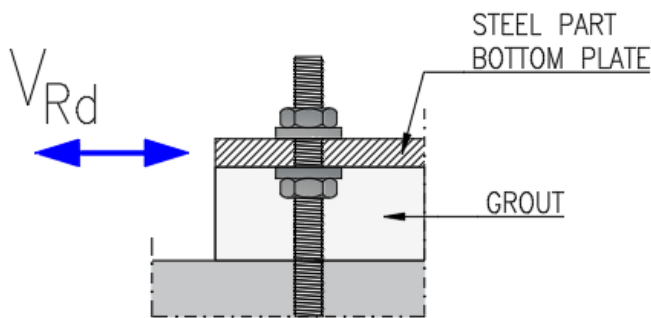


Figure 4. Resistance for shear force

Table 5. Design values of resistance for shear force (concrete class C25/30)

Anchor bolt	Design value of resistance for shear force $V_{Rd}$ [kN]		Grout thickness [mm]
	Final situation	Assembly situation	
SELP 27	73	39	50
SELP 30	89	53	50
SELP 36	130	87	55
SELP 39	155	104	60
SELP 45	207	144	65
SELP 52	219	215	70

In final situation after grout concrete has hardened, shear force may also be transferred with friction between column and foundation. Friction coefficient must be selected according to applicable design standards. Use of friction requires concrete structure to be reinforced accordingly.

## 4 USE OF ANCHOR BOLTS

### 4.1 LIMITATIONS OF USE

Resistances of SELP anchor bolts are designed for static loads. Resistances for dynamic and fatigue loads must be designed separately for each use case.

### 4.2 ANCHOR BOLT EDGE AND CENTER DISTANCES

Edge and center distances of SELP anchor bolts must always be designed according to exposure class and anchoring of ribbed steel bars.

For SELP/P anchor bolts edge and center distances are defined by exposure class and center distances between ribbed steel bars (anchoring according to Eurocodes).

For SELP/L anchor bolts reinforced according to section 5 minimum edge and center distances are given in figure 5 and table 6.

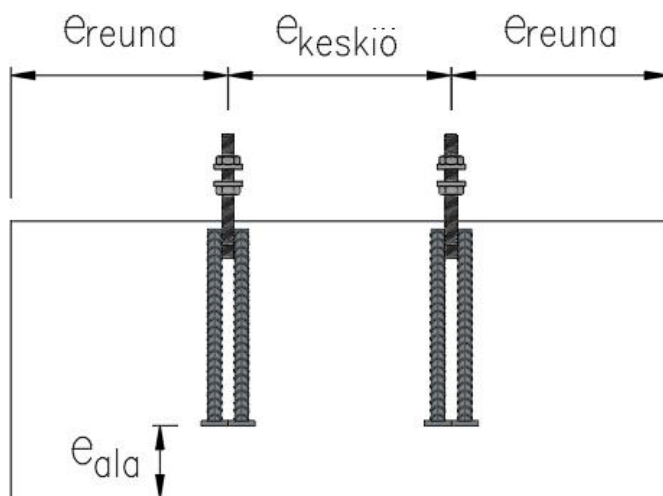


Figure 5. Minimum distances of SELP/L anchor bolts

Table 6. Minimum distances of SELP/L anchor bolts

Anchor bolt	edge distance $e_{reuna}$ [mm]	center distance $e_{keskiö}$ [mm]	distance to bottom $e_{ala}$ [mm]
SELP 27 L	100	100	According to exposure class.
SELP 30 L	110	140	
SELP 36 L	120	160	
SELP 39 L	130	170	

SELP 45 L	160	190	For compressed bolts according to section 5.2.
SELP 52 L	170	220	

## 5 REINFORCEMENT

### 5.1 REINFORCEMENT FOR TENSION

#### 5.1.1 LAP REINFORCEMENT OF SELP/P ANCHOR BOLTS

Tension force in long SELP/P anchor bolts is transmitted by lapping of bars. Surface area of lap bars according to surface area for bars in anchor bolt.

Surface area of lap bars is given in figure 6 and table 7.

$A_{sj}$  = minimum surface area for full tension resistance of anchor bolt.

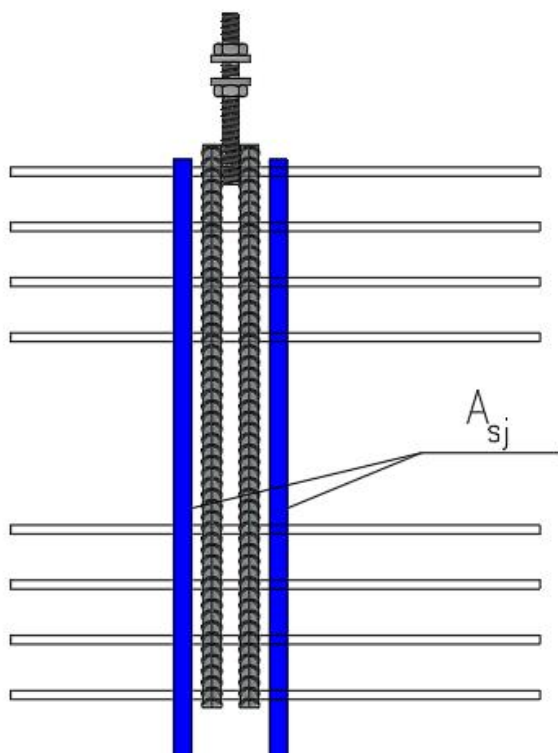


Figure 6. Lap reinforcement of SELP/P anchor bolts

Table 7. Lap reinforcement of SELP/P anchor bolts

Anchor bolt	Lap length $l_0$ [mm]	$A_{sj}$ [mm <sup>2</sup> ]
SELP 27 P	970	603

SELP 30 P	1145	982
SELP 36 P	1115	1256
SELP 39 P	1330	1473
SELP 45 P	1335	1964
SELP 52 P	1405	3216

### 5.1.2 TRANSVERSE REINFORCEMENT OF SELP/P ANCHOR BOLTS

For long SELP/P anchor bolts transverse reinforcement is required in the lap zone to resist transverse tension forces. Reinforcement areas and placement in tension zone according to EN 1992-1-1 paragraph 8.7.4.

Transverse reinforcement in the lap zone for SELP/P anchor bolts is given in figure 7 and table 8.

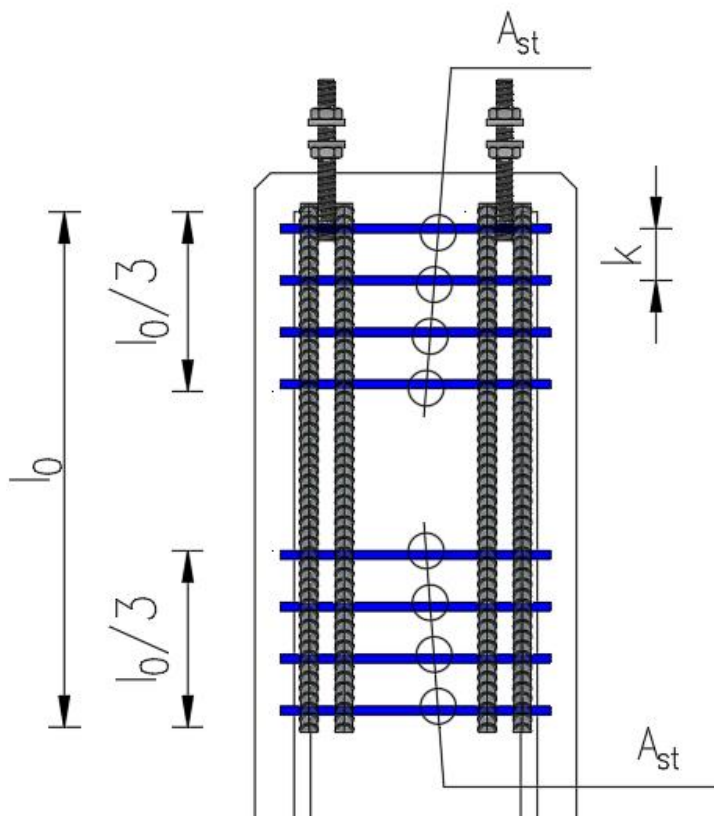


Figure 7. Transverse reinforcement in the lap zone for SELP/P

Table 8. Transverse reinforcement in the lap zone for SELP/P

Anchor bolt	Lap length $l_0$ [mm]	$l_0 / 3$ [mm]	$A_{st}$ [mm <sup>2</sup> ]	$n_s$ [kpl]	$d_s$ [mm]
SELP 27 P	970	323	150	3	8
SELP 30 P	1145	382	186	4	8
SELP 36 P	1115	372	271	4	10

SELP 39 P	1330	443	323	4	10
SELP 45 P	1335	445	432	4	12
SELP 52 P	1405	468	582	5	12

### 5.1.3 CONCRETE CONE REINFORCEMENT OF SELP/L ANCHOR BOLTS

Tension reinforcement of short SELP/L anchor bolts is given in figure 8 and table 9. Reinforcement is made of loops or stirrups, and it is anchored outside the concrete cone.

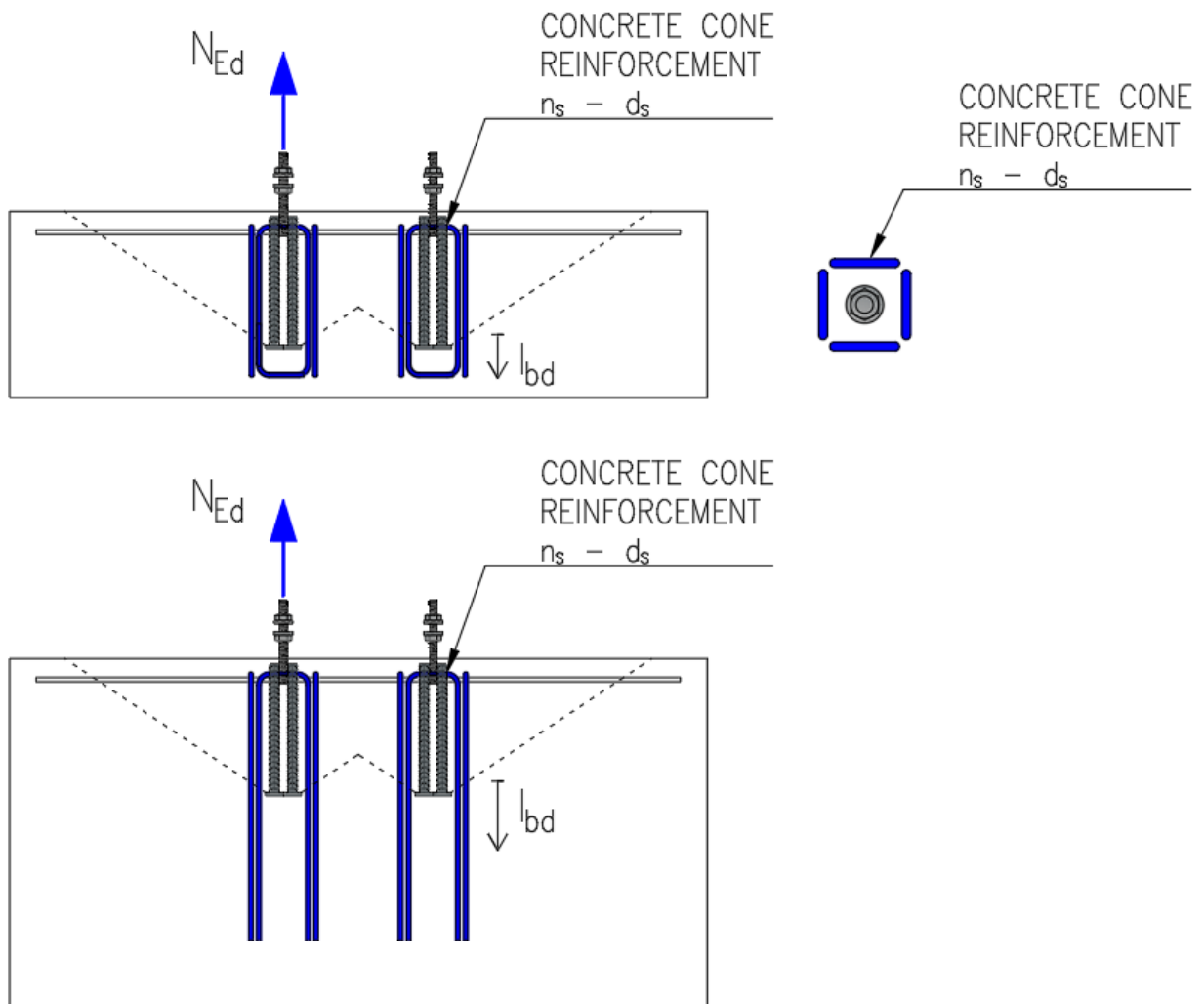


Figure 8. Concrete cone reinforcement of SELP/L

Table 9. Concrete cone reinforcement of SELP/L

Anchor bolt	$n_s$ [kpl]	$d_s$ [mm]
SELP 27 L	4	10
SELP 30 L	4	12
SELP 36 L	5	12
SELP 39 L	4	16
SELP 45 L	5	16
SELP 52 L	6	16

### 5.1.4 SPLITTING REINFORCEMENT OF SELP/L ANCHOR BOLTS

Splitting reinforcement to the top of the concrete structure given in figure 9 and table 10 is required for SELP/L anchor bolts. Splitting reinforcement is required also for sides of the concrete structure if bolt edge distance is less than  $1,8h_{ef}$ .

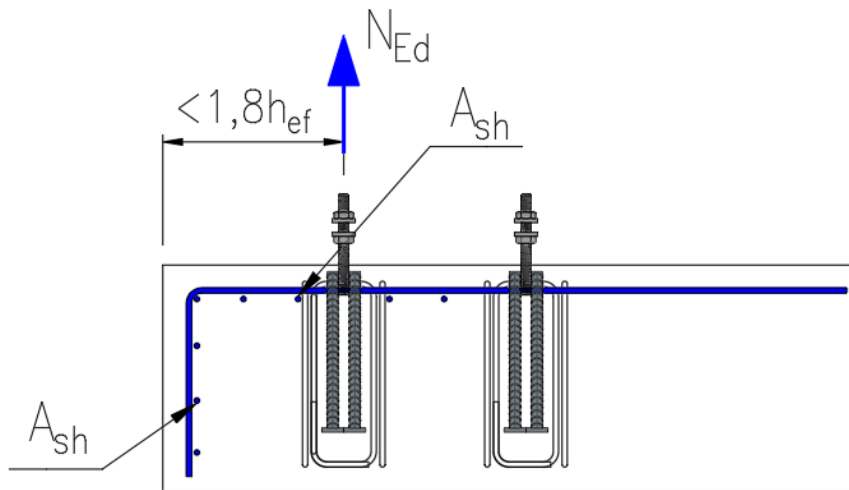


Figure 9. SELP/L splitting reinforcement

Table 10. SELP/L splitting reinforcement

Anchor bolt	$A_{sh}$ [mm <sup>2</sup> ]	$n_s$ [kpl]	$d_s$ [mm]
SELP 27 L	302	4	10
SELP 30 L	371	5	10
SELP 36 L	541	5	12
SELP 39 L	646	6	12
SELP 45 L	865	8	12
SELP 52 L	1164	10	12

### 5.1.5 BLOW-OUT REINFORCEMENT OF SELP/L ANCHOR BOLTS

If edge distance of SELP/L anchor bolt is less than  $0,5h_{ef}$ , reinforcement for blow-out failure is required. Minimum edge distance for reinforced SELP/L anchor bolt is given in figure 10 and table 11.

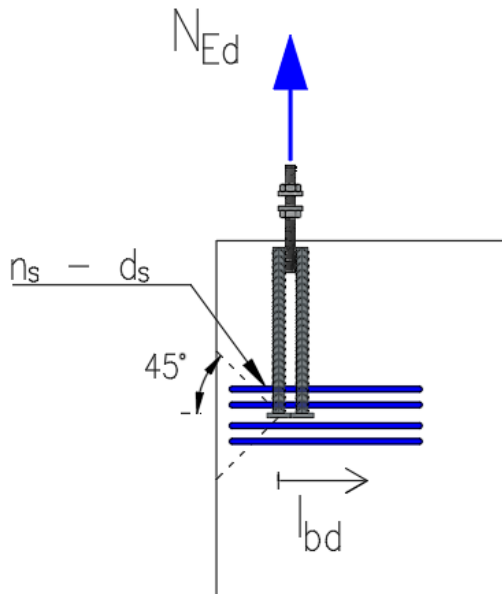


Figure 10. Blow-out reinforcement of SELP/L

Table 11. Blow-out reinforcement of SELP/L

Anchor bolt	$n_s$ [kpl]	$d_s$ [mm]
SELP 27 L	4	10
SELP 30 L	5	10
SELP 36 L	5	12
SELP 39 L	4	16
SELP 45 L	5	16
SELP 52 L	6	16

## 5.2 REINFORCEMENT FOR COMPRESSION FORCE

Concrete cone below anchor plate of compressed SELP/L bolts must be reinforced as instructed in figure 11 and table 12. Minimum distance from the bottom surface of concrete with reinforcement is given in table 12.

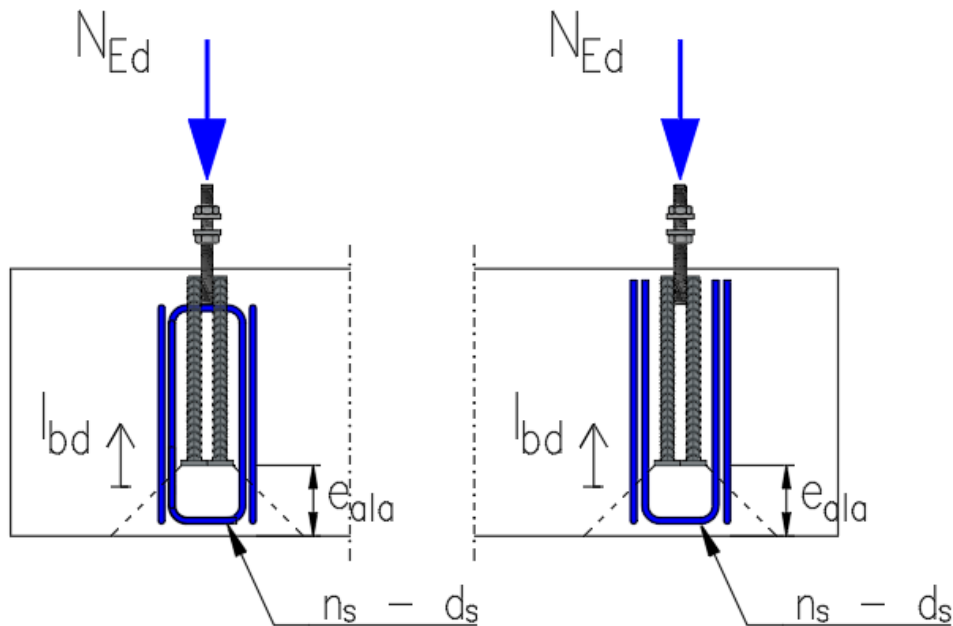


Figure 11. Reinforcement and distance from bottom for compressed SELP/L bolts

Table 12. Reinforcement and distance from bottom for compressed SELP/L bolts

Anchor bolt	$e_{ala}$ [mm]	$n_s$ [kpl]	$d_s$ [mm]
SELP 27 L	120	4	10
SELP 30 L	125	4	12
SELP 36 L	130	5	12
SELP 39 L	130	4	16
SELP 45 L	130	5	16
SELP 52 L	150	6	16

### 5.3 SHEAR REINFORCEMENT

Shear reinforcement of SELP anchor bolts (both P and L) is done according to figure 12 and table 13. Shear reinforcement is installed to tight contact with the anchor bolt. Reinforcement in table 13 is calculated with concrete cover of 35 mm.

When installing shear reinforcement bundling of bars according to EN 1992-1-1 paragraph 8.9 must be accounted for (SELP 45 ja 52).

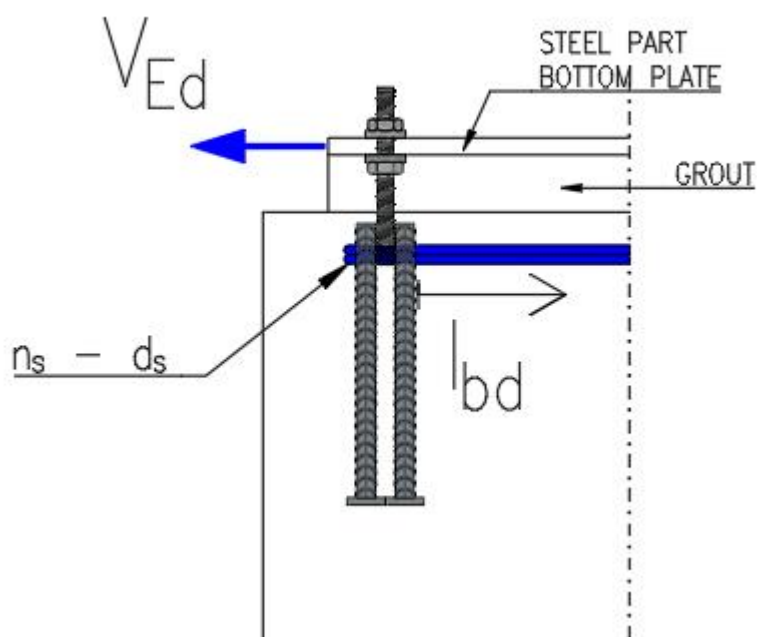


Figure 12. Shear reinforcement of SELP anchor bolts

Table 13. Shear reinforcement of SELP anchor bolts

Anchor bolt	$n_s$ [kpl]	$d_s$ [mm]
SELP 27	2	12
SELP 30	2	16
SELP 36	3	16
SELP 39	3	16
SELP 45	4	16
SELP 52	5	16

## 6 INSTALLATION

### 6.1 EQUIPMENT

Assembling of bolts may be done with an assembly frame or bolts may be assembled as a group by the manufacturer. Assembly frame facilitates use of bolts on work site and transport.

Assembly frames are manufactured for standard column dimensions or by order. Assembly frames ensure the right c/c-dimensions and plumbness of bolts. Assembly frame is attached to the concrete cast mould.

### 6.2 INSTALLATION TOLERANCES

Bolts are installed with following grout thicknesses.

Anchor bolt	Grout thickness [mm]
SELP 27	50
SELP 30	50
SELP 36	55
SELP 39	60
SELP 45	65
SELP 52	70

Height from concrete surface with Semko column and wall shoes are given in technical manuals of column and wall shoes.

With Semko Oy assembly frames c/c-dimension tolerance is  $\pm 3$  mm.

### 6.3 BENDING OF BOLTS

SELP bolts are manufactured with B500B rebars anchors. Normal rules and principles for rebar bending according to *EN1992-1-1* may be used. Lowest allowed bending temperature is -5 °C. If bending must be done in lower temperatures, rebars must be pre-heated to +50 °C.

### 6.4 WELDING OF BOLTS

SELP bolt rebars may be welded with normal fusion welding. Instructions given in applicable parts of Eurocode must be accounted for. In all welding following points must be observed:

- under -5°C or in generally moist environment steel must be pre-heated to at least +50°C
- welding area must be thoroughly cleaned before welding
- welding must be done by qualified professional with adequate welding current and suitable additives.

## 7 QUALITY CONTROL

Quality control of steel parts manufactured by Semko Oy in Seinäjoki factory is supervised by Inspecta Sertifiointi Oy.

Semko steel products have BY (Concrete Society of Finland) approval.

## 8 SUPERVISION OF ASSEMBLY

### 8.1 ASSEMBLY OF COLUMNS

SELP anchor bolts are primarily intended for attaching columns to foundations. Before column installation lower nuts and washers are adjusted to right height. Columns are lifted over washers and upper washers and nuts are installed. Final tightening is done after verification of column plumbness. If needed additional supports under column may be used.

After column installation gap between column and foundation is grouted.

Columns may not be burdened before grouting is hardened.

### 8.2 SUPERVISION OF BOLT ASSEMBLY

Before casting of bolt group following points must be observed:

- bolt and frame size are correct
- positioning of bolt group is correct
- bolt thread is not damaged during casting, if necessary, thread must be protected with tape or other protective measures

After casting positioning of bolt group must be checked. Deviations from plans must be informed to the designer.