



SKRUTKOVÉ SPOJE PREFABRIKOVANÝCH ŽELEZOBETÓNOVÝCH KONŠTRUKCÍ

27. 9. 2023

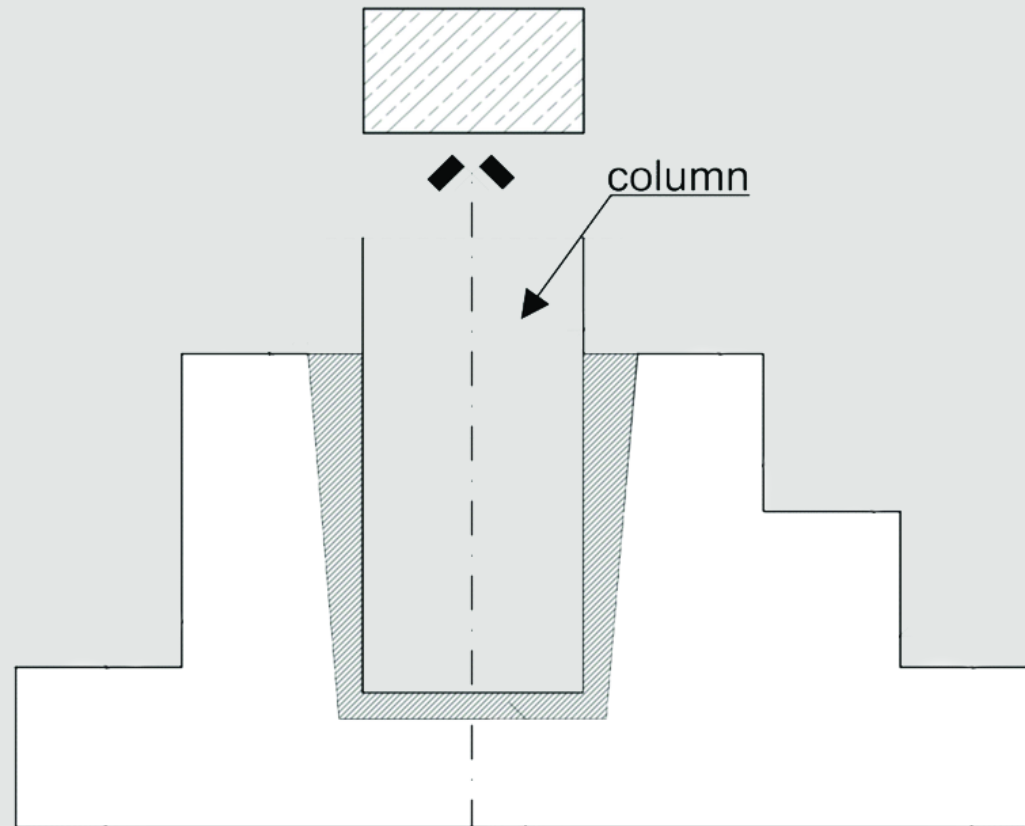
Gabriel Morvay



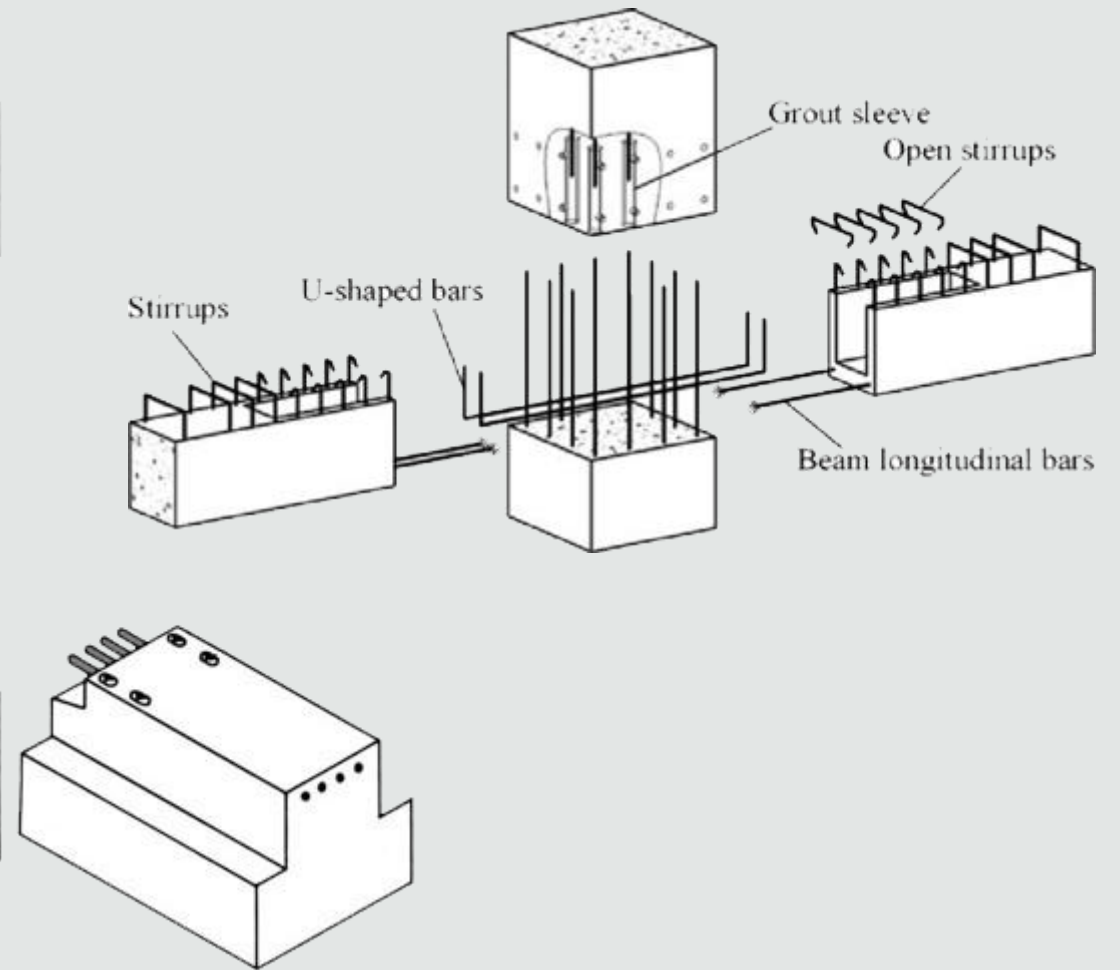
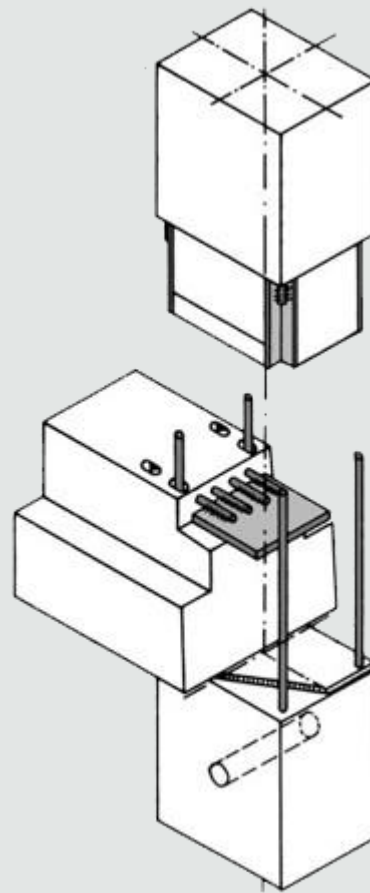
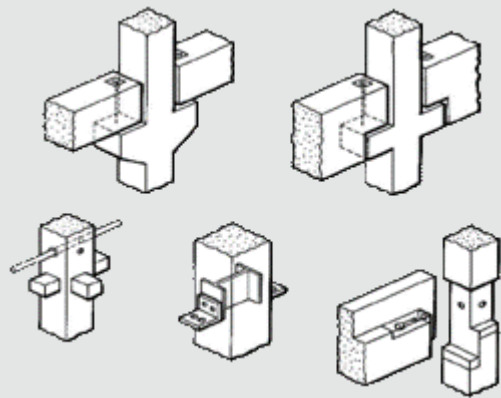
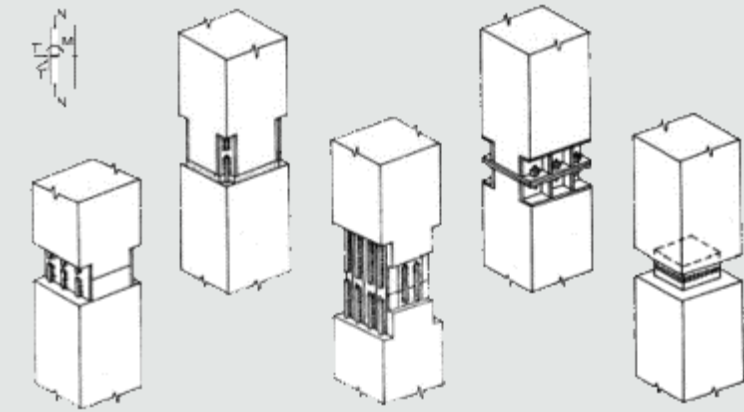


**AKÉ SPOJE NAVRHUJETE PRI
ŽELEZOBETÓNOVÝCH
PREFABRIKÁTOCH?**

TRADIČNÝ SPOJ PREFABRIKOVANÝCH PRVKOV



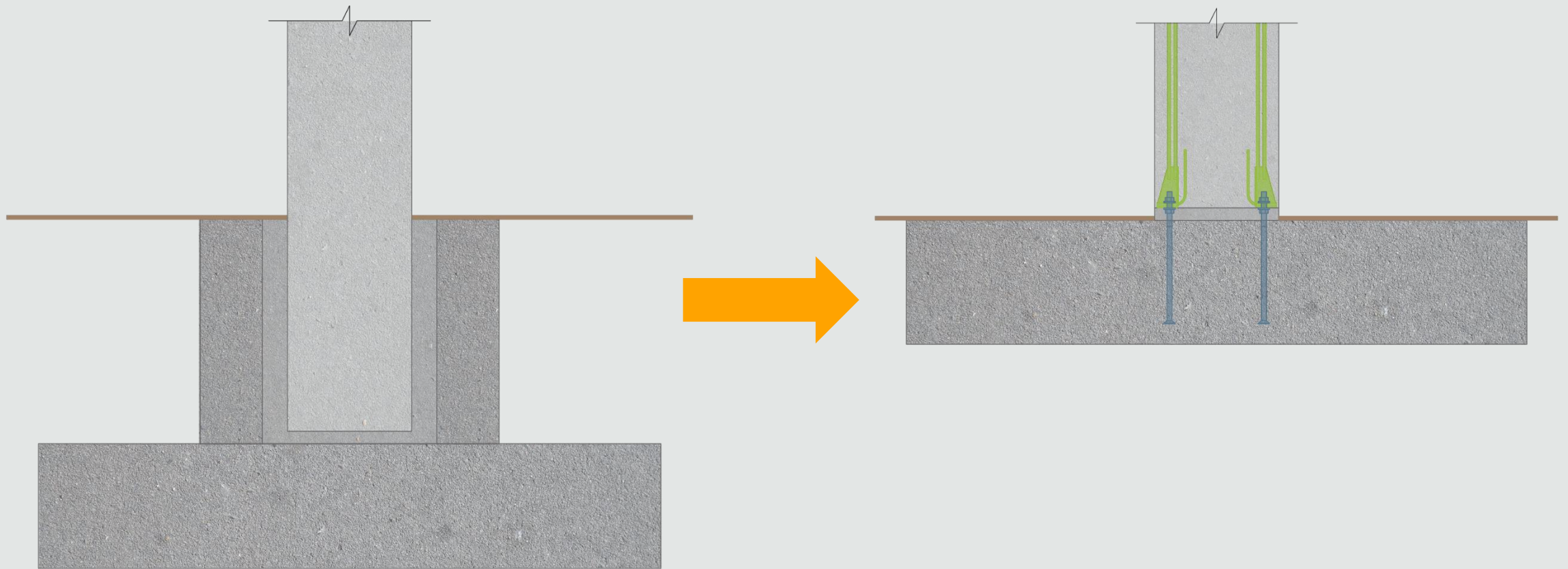
TRADIČNÉ SPOJE PREFABRIKOVANÝCH PRVKOV



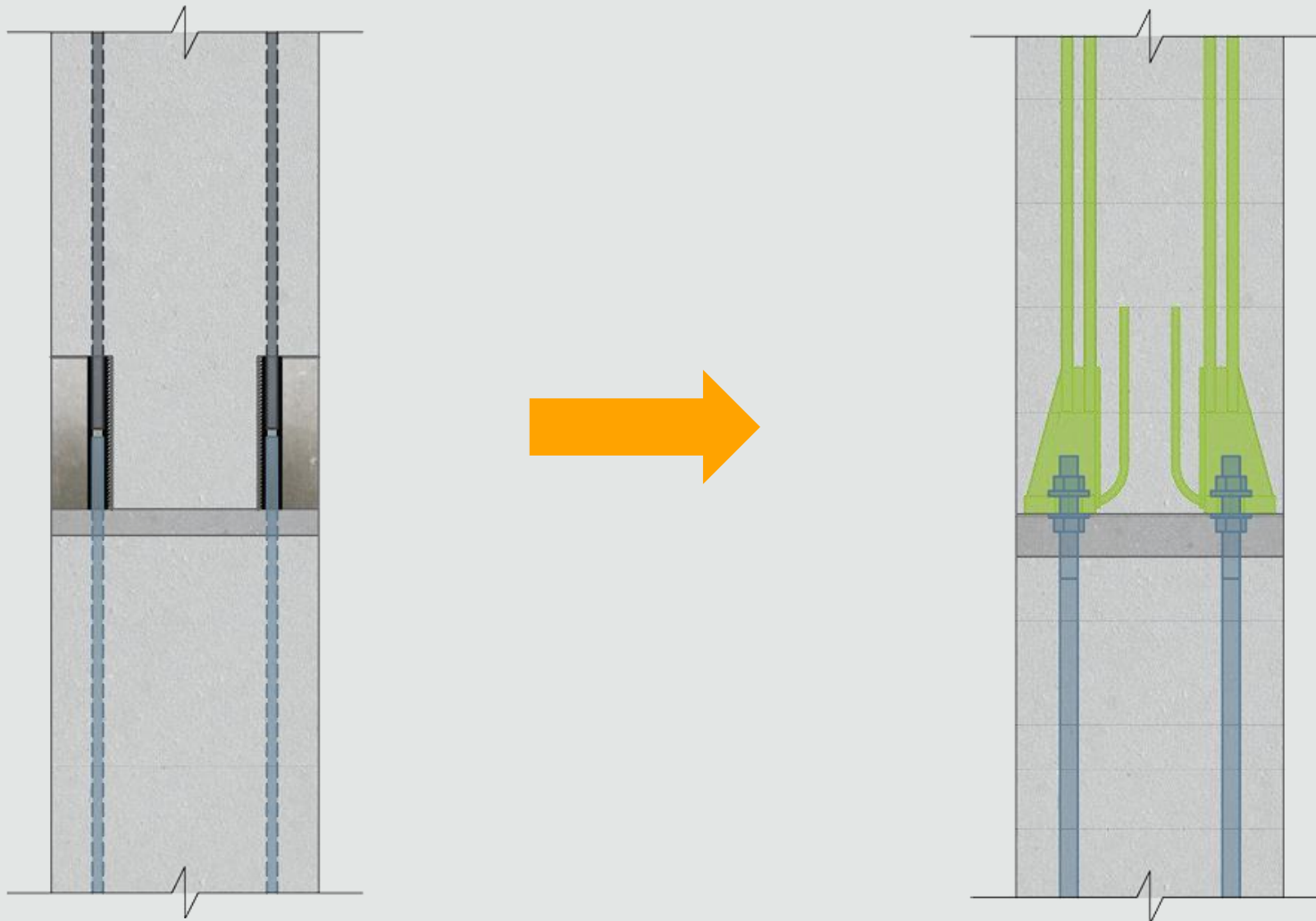


**KDE SA DAJÚ NAHRADIŤ TRADIČNÉ
SPOJE ZA SKRUTKOVÉ SPOJE?**

POROVNANIE SKRUTKOVÝCH SPOJOV



POROVNANIE SKRUTKOVÝCH SPOJOV



STĚPOVÁ PÄTKA A KOTEVNÄ SKRUTKA

KOTVENIE PRE STREDNE VEL'KÉ ZAŽÄENIA

HPKM® STĚPOVÄ PÄTKA



HPM® KOTEVNÄ SKRUTKA

HPM® L Rebar Anchor Bolt

HPM® P Rebar Anchor Bolt



STĹPOVÁ PÄTKA A KOTEVNÄ SKRUTKA

KOTVENIE PRE VEĹKÉ ZAŹAŹENIA

BOLDA® STĹPOVÄ PÄTKA



PPM® KOTEVNÄ SKRUTKA

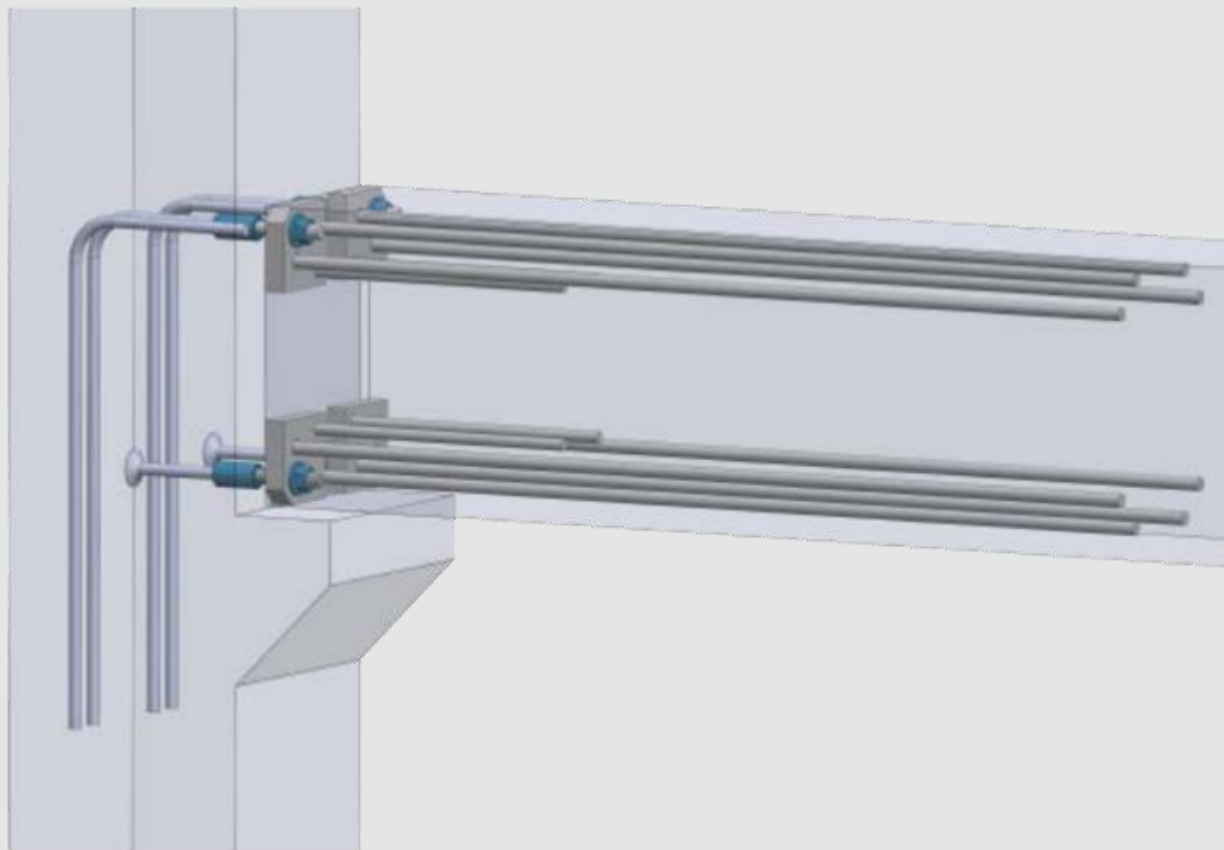
PPM® L Anchor Bolt



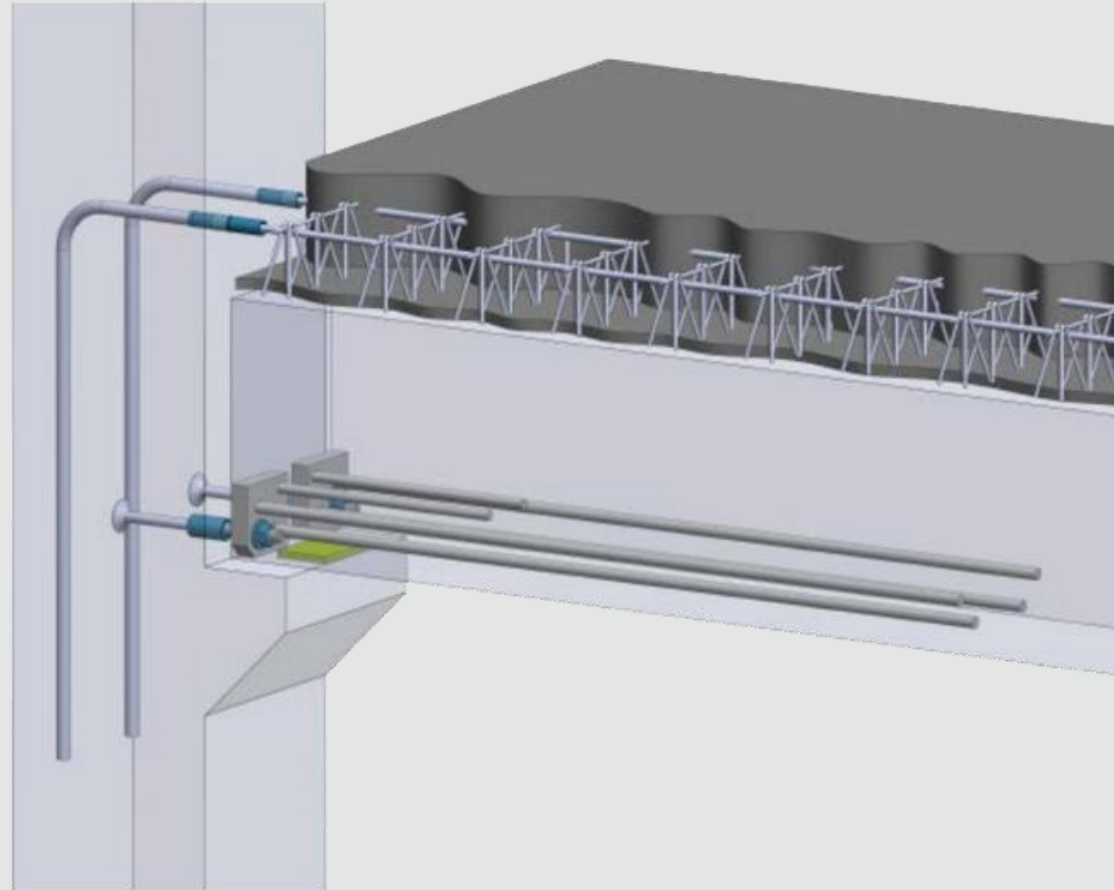
PPM® P Anchor Bolt



PRIEVLAKOVÁ PÄTKA A KOTEVNÁ SKRUTKA

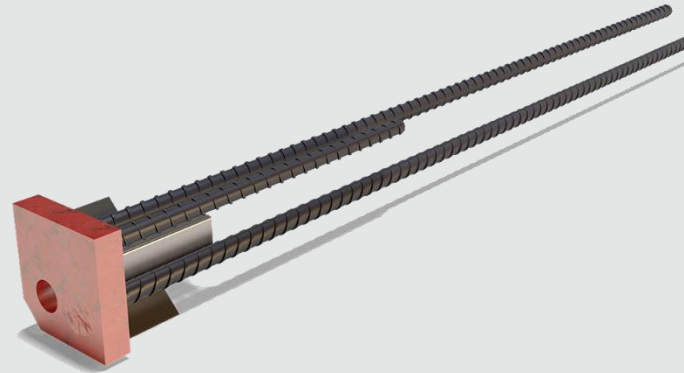


PRIEVLAKOVÁ PÄTKA A KOTEVNÁ SKRUTKA



PRIEVLAKOVÁ PÄTKA A KOTEVNÁ SKRUTKA

BECO® PRIEVLAKOVÁ PÄTKA

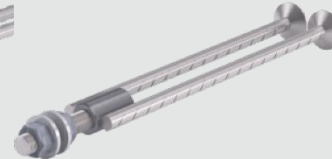


COPRA® KOTEVNÁ SKRUTKA

a)



b)



c)



SKRUTKOVÝ SPOJ STIEN



STENOVÁ PÄTKA A KOTEVNÁ SKRUTKA

SUMO[®] STENOVÁ PÄTKA



HPM[®]/PPM[®] + AL PODLOŽKA





INŠTALÁCIA

POSTUP KOTVENIA STĽPOV DO ZÁKLADOVEJ KONŠTRUKCIE



MONOLITICKÁ PILÓTA



VÝKOP PRE PILÓTOVÚ HLAVICU



ODŠRAMOVANIE VRCHNEJ ČASTI PILÓTY



PODKLADNÝ BETÓN NA PRESNÚ VÝŠKU



OSADENIE VÝSTUŽE (ARMOKOŠA) DO HLAVICE



OSADENIE DEBNENIA HLAVICE





**PRESNÉ OSADENIE SKRUTIEK S
MONTÁŽNOU ŠABLÓNOU**

ZABETÓNOVANÁ HLAVICA



**OSADENIE STĽPA, REKTIFIKÁCIA A
UTIAHNUTIE MATÍC**



ZMONOLITNENIE NEZMRAŠŤUJÚCOU ZÁLIEVKOU





REFERENCIE

IKEA COMPONENTS
MALACKY, SLOVAKIA



**IKEA COMPONENTS
MALACKY, SLOVAKIA**



LIDL
GALANTA, SLOVAKIA



LIDL
GALANTA, SLOVAKIA



FUTBALL STADIUM
BRATISLAVA, SLOVAKIA



FUTBALL STADIUM BRATISLAVA, SLOVAKIA



**WAREHOUSE MARLENKA
FRÝDEK MÍSTEK, CZECHIA**



**WAREHOUSE MARLENKA
FRÝDEK MÍSTEK, CZECHIA**



**WAREHOUSE MARLENKA
FRÝDEK MÍSTEK, CZECHIA**





**FERENC PUSKÁS STADIUM,
BUDAPEST, HUNGARY**





**FERENC PUSKÁS STADIUM,
BUDAPEST, HUNGARY**



**FERENC PUSKÁS STADIUM,
BUDAPEST, HUNGARY**





NAVRHOVANIE SKRUTKOVÝCH SPOJOV

NAVRHOVANIE SKRUTKOVÝCH SPOJOV

European Technical Assessment

ETA-02/0006
of 25 July 2022

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:

Deutsches Institut für Bautechnik

Trade name of the construction product

PEIKKO HPM L Anchor Bolts

European Technical Assessment

ETA-19/0814
of 17 August 2022

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:

Deutsches Institut für Bautechnik

Trade name of the construction product

Peikko PPM L Anchor Bolts

European Technical Assessment

ETA 18/0037
of 15/11/2018

I General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011:

Eurofins Expert Services Oy

Trade name of the construction product

HPKM 16, HPKM 20, HPKM 24, HPKM 30 and HPKM 39 column shoes

European Technical Assessment

ETA-20/0529
of 16 July 2021

English translation prepared by DIBt - Original version in German language

General Part

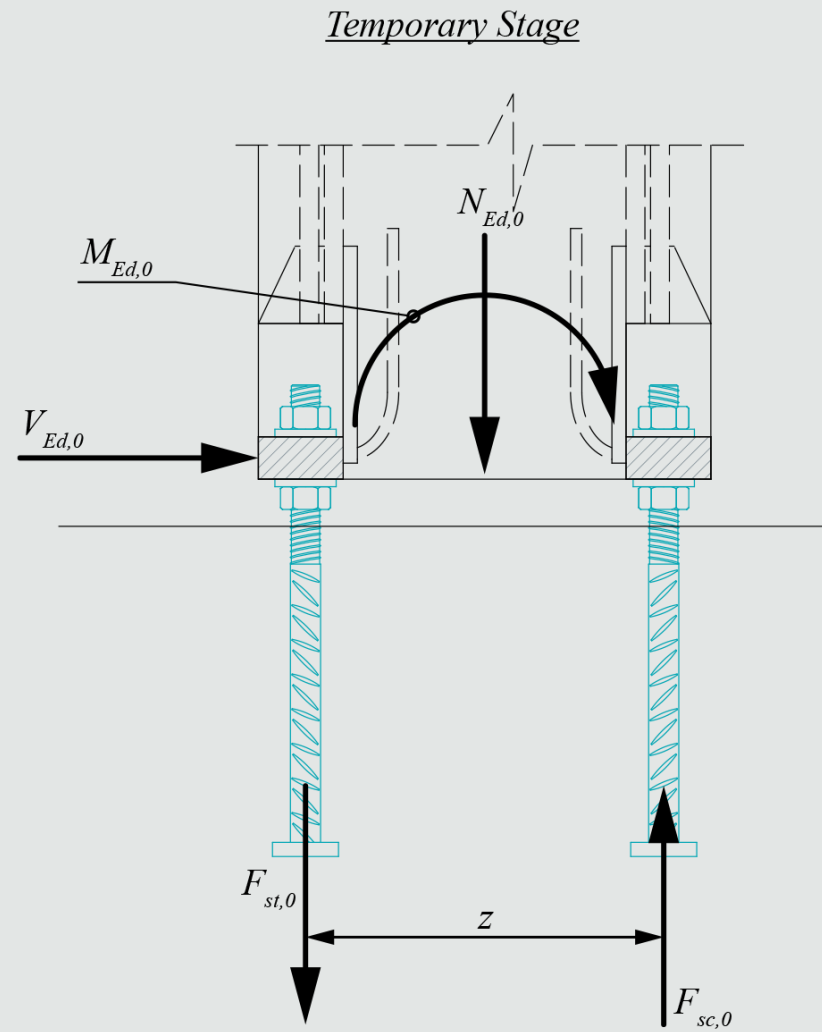
Technical Assessment Body issuing the European Technical Assessment:

Deutsches Institut für Bautechnik

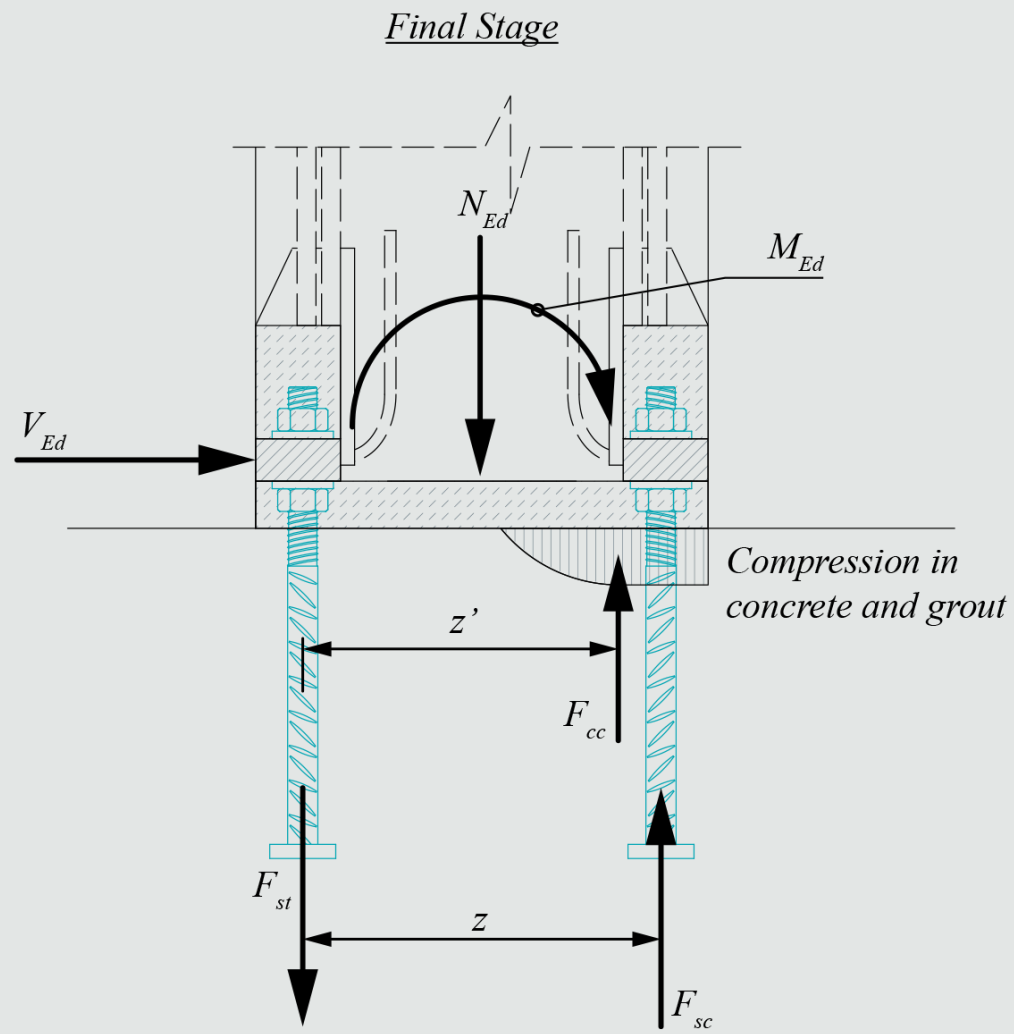
Trade name of the construction product

Peikko Bolda® Column Shoe

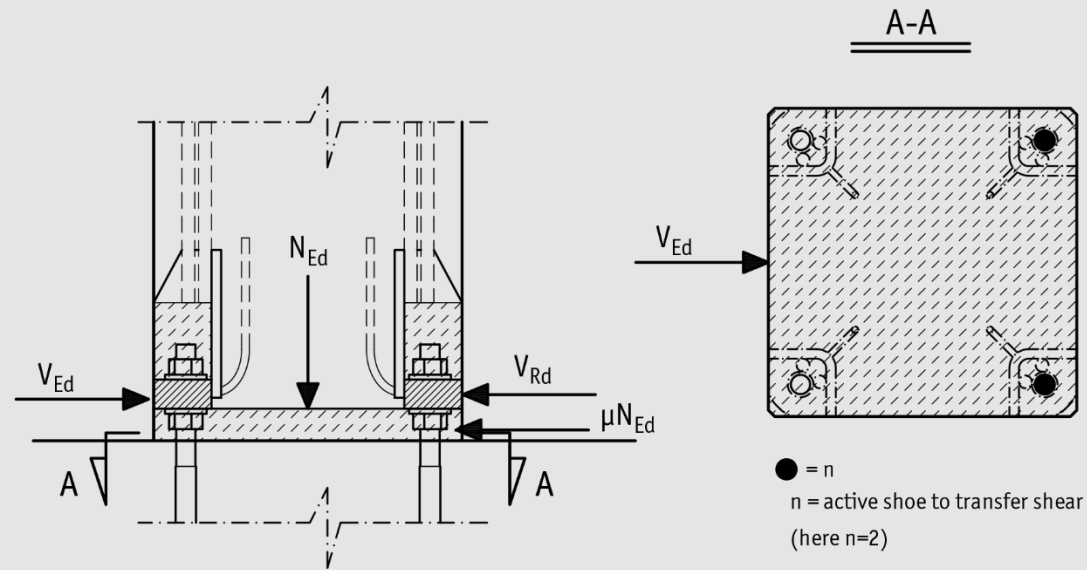
MONTÁŽNE ŠTÁDIUM



FINÁLNE ŠTÁDIUM

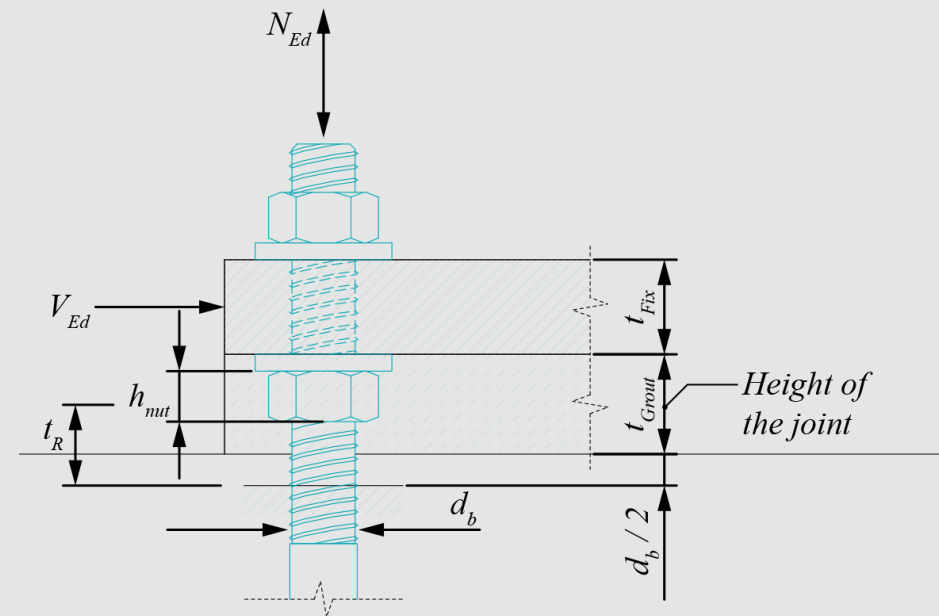


FINÁLNE ŠTÁDIUM



ODOLNOST

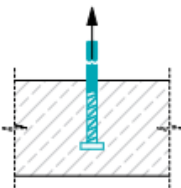
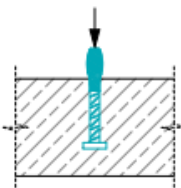
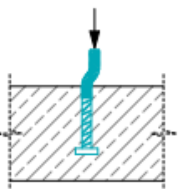
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- EN 1992-1-2:2004
- EN 1992-4:2018
- EN 1993-1-1:2005/AC:2009
- EN 1993-1-8:2005/AC:2005
- ETA



d_b = Diameter of stress area in thread
 h_{nut} = Thickness of nut
 t_R = Equivalent span of anchor bolt
 $= t_{Grout} - h_{nut} + d_b/2$

Figure 7. Loads and parameters characterizing the joint.

POSÚDENIA – OSOVÁ SILA – PORUŠENIE OCELE

Failure mode	Example	HPM® L Rebar Anchor Bolts	HPM® P Rebar Anchor Bolts
Steel strength		Required (for most loaded bolt)	Required (for most loaded bolt)
Failure mode	Example	HPM® L Rebar Anchor Bolts	HPM® P Rebar Anchor Bolts
Steel strength		Required (for most loaded bolt)	Required (for most loaded bolt)
Buckling strength ¹⁾		Required (for most loaded bolt)	Required (for most loaded bolt)

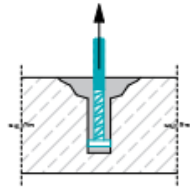
POSÚDENIA – OSOVÁ SILA – PORUŠENIE OCELE

HPM® ...			16 L	20 L	24 L	30 L	39 L
Steel failure							
Characteristic resistance	$N_{Rk,s}$	[kN]	86,2	134,6	193,9	308,3	536,7
Partial factor	$\gamma_{Ms}^{1)}$	[-]	1,4				

PPM® ...			30 L	36 L	39 L	45 L	52 L	60 L
Steel failure								
Characteristic resistance	$N_{Rk,s}$	[kN]	448,8	653,6	780,8	1044,8	1406,4	1769,3
Partial factor	$\gamma_{Ms}^{1)}$	[-]	1,5					1,4

POSÚDENIA – OSOVÁ SILA – PORUŠENIE VYTIAHNUTÍM

Pull-out strength



Required
(for most loaded bolt)

Not applicable

POSÚDENIA – OSOVÁ SILA – PORUŠENIE VYTIAHNUTÍM

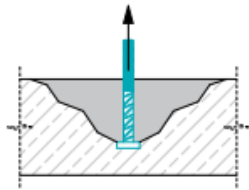
Concrete pull-out failure							
Characteristic resistance In uncracked concrete C20/25	$N_{Rk,p}$	[kN]	195,9	283,0	395,8	639,3	1072,1
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p}$	[kN]	140,0	202,2	282,7	456,6	765,8
Increase factor for higher concrete grades for $N_{Rk,p}$ $N_{Rk,p} = N_{Rk,p (C20/25)} \cdot \psi_c$	ψ_c	C25/30	1,25				
		C30/37	1,50				
		C35/45	1,75				
		C40/50	2,00				
		C45/55	2,25				
		C50/60	2,50				
Partial factor	$\gamma_{Mp}^{1)}$	[-]	1,5				

POSÚDENIA – OSOVÁ SILA – PORUŠENIE VYTIAHNUTÍM

Concrete pull-out failure								
Characteristic resistance in uncracked concrete C20/25	$N_{Rk,p}$	[kN]	792	1132	1188	1583	2557	2557
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p}$	[kN]	566	809	848	1131	1827	1827
Increase factor for higher concrete grades for $N_{Rk,p}$ $N_{Rk,p} = N_{Rk,p (C20/25)} \cdot \psi_c$	ψ_c	C25/30	1,25					
		C30/37	1,50					
		C35/45	1,75					
		C40/50	2,00					
		C45/55	2,25					
		C50/60	2,50					
Partial factor	$\gamma_{Mp}^{1)}$	[-]	1,5					

POSÚDENIA – OSOVÁ SILA – PORUŠENIE BETÓNOVÉHO KUŽELA

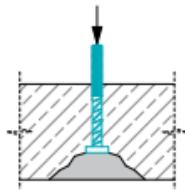
Concrete cone strength ¹⁾



Required
(for anchor group)

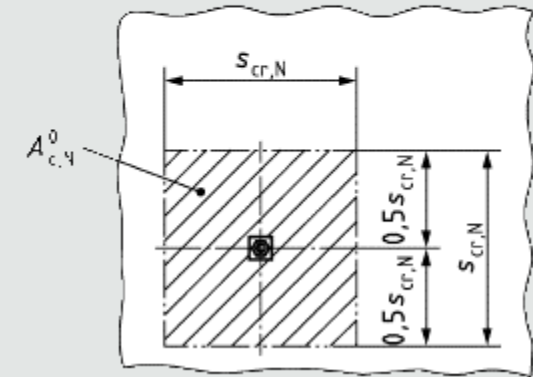
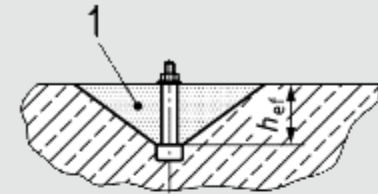
Not applicable

Punching strength under the anchor head ²⁾



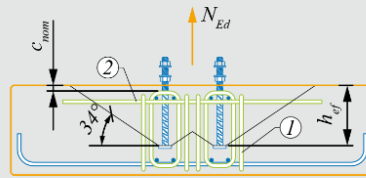
Required
(for anchor group)

Not applicable

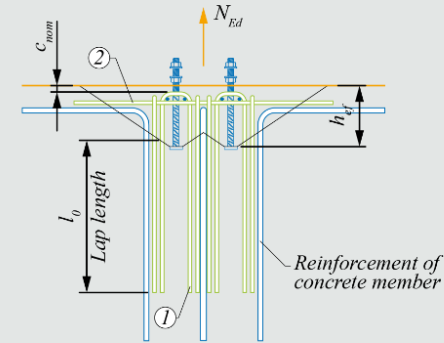


PRÍDAVNÁ VÝSTUŽ – ZÁKLAD

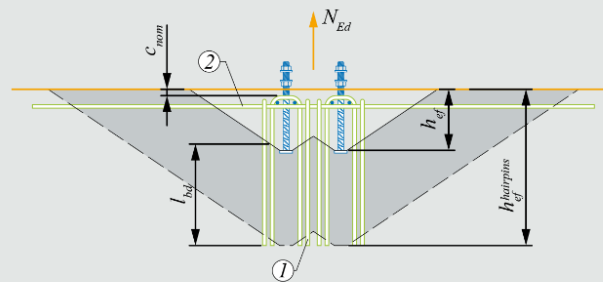
Alternative 1. Closed Stirrups



Alternative 2. Hairpins (U-bars)
Creating lap-splice



Alternative 3. Hairpins (U-bars)
Providing design anchorage length



Top-view

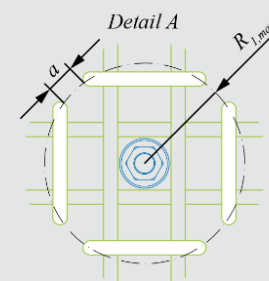
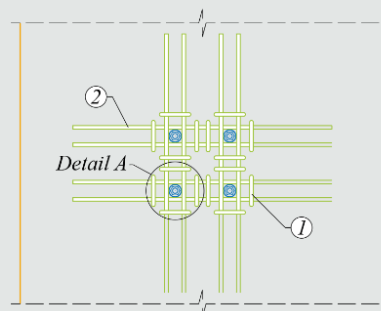


Figure 9. Illustration of detailing of the supplementary reinforcement in the form of stirrups and hairpins.

PRÍDAVNÁ VÝSTUŽ – ZÁKLAD

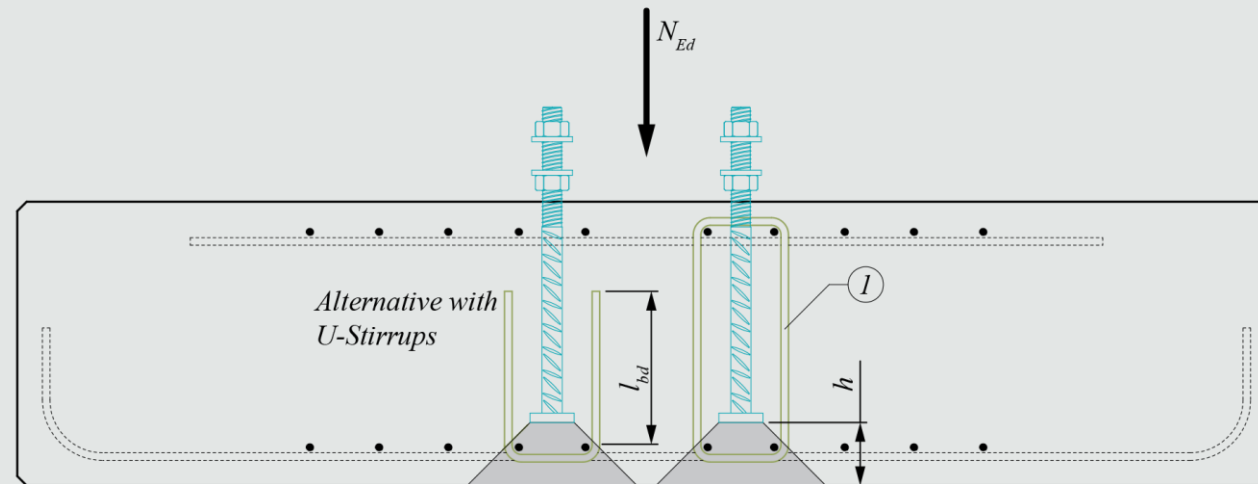
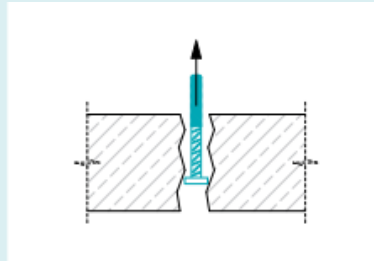


Figure 12. Reinforcing the conical fracture under the bolt.

POSÚDENIA – OSOVÁ SILA – PORUŠENIE ROZLOMENÍM BETÓNU

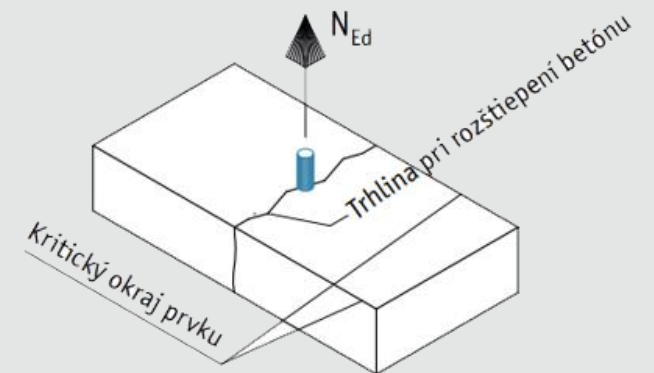
Splitting strength ²⁾



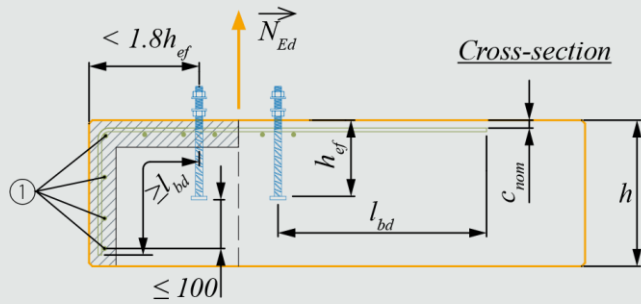
Required
(for anchor group)

Not applicable

Nevyžaduje sa, ak je vzdialenosť od okraja vo všetkých smeroch $c \geq 1,5h_{ef}$ pre jednu skrutku a $c \geq 1,8h_{ef}$ pre spoje s viac ako jednou kotevnou skrutkou alebo ak je zabezpečená prídavná výstuž.



PRÍDAVNÁ VÝSTUŽ – ZÁKLAD



Hatched area – effective reinforcement zone



Top view

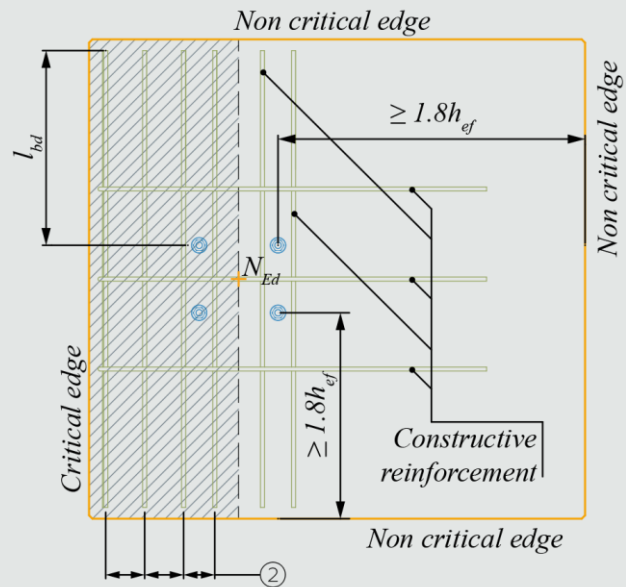


Figure 10. Detail for splitting reinforcement. Example case with one critical edge.

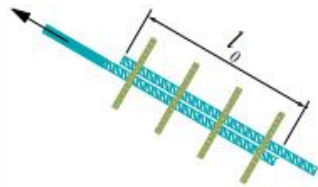
POSÚDENIA – OSOVÁ SILA – PORUŠENIE BOČNÝM VYLOMENÍM OKRAJA

Blow-out strength ³⁾		Required (for anchor group)	Not applicable
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Nevyžaduje sa, ak je vzdialenosť od okraja $c \geq 0,5h_{ef}$ vo všetkých smeroch.

POSÚDENIA – OSOVÁ SILA – STYKOVACIA DĹŽKA

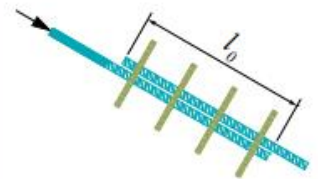
Splicing length ⁴⁾



Not applicable

Required
(for most loaded bolt)

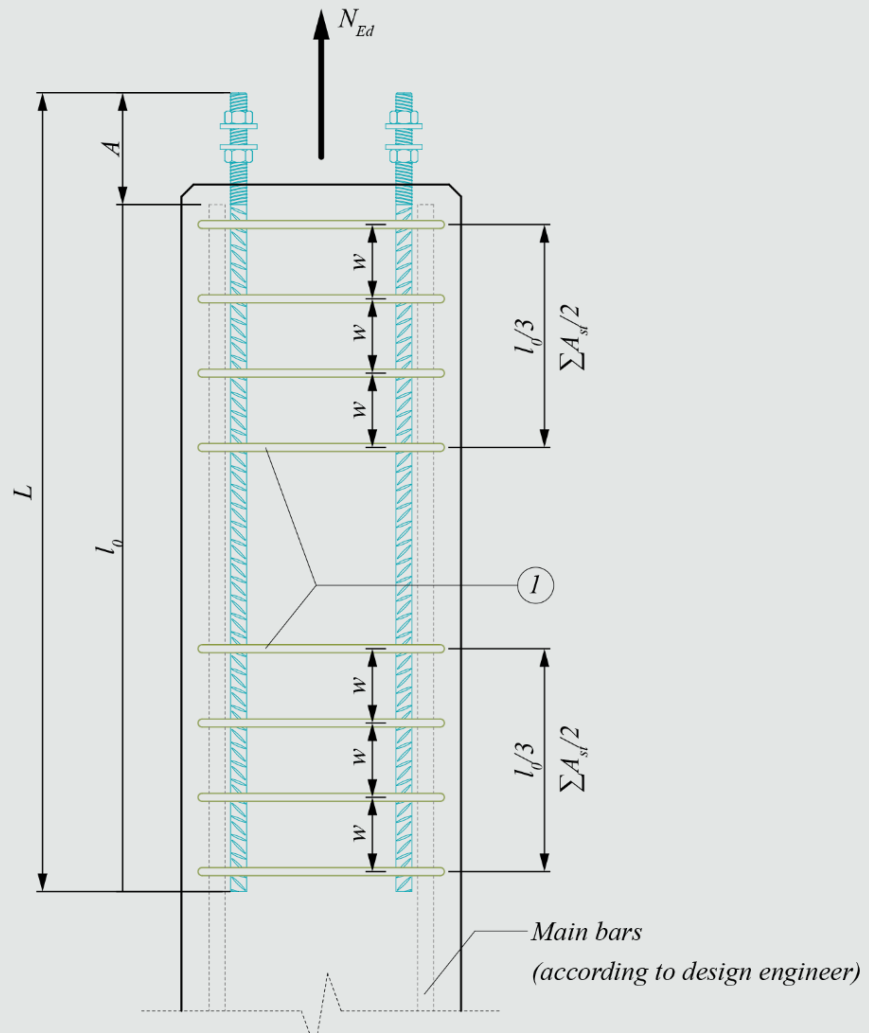
Splicing length ³⁾



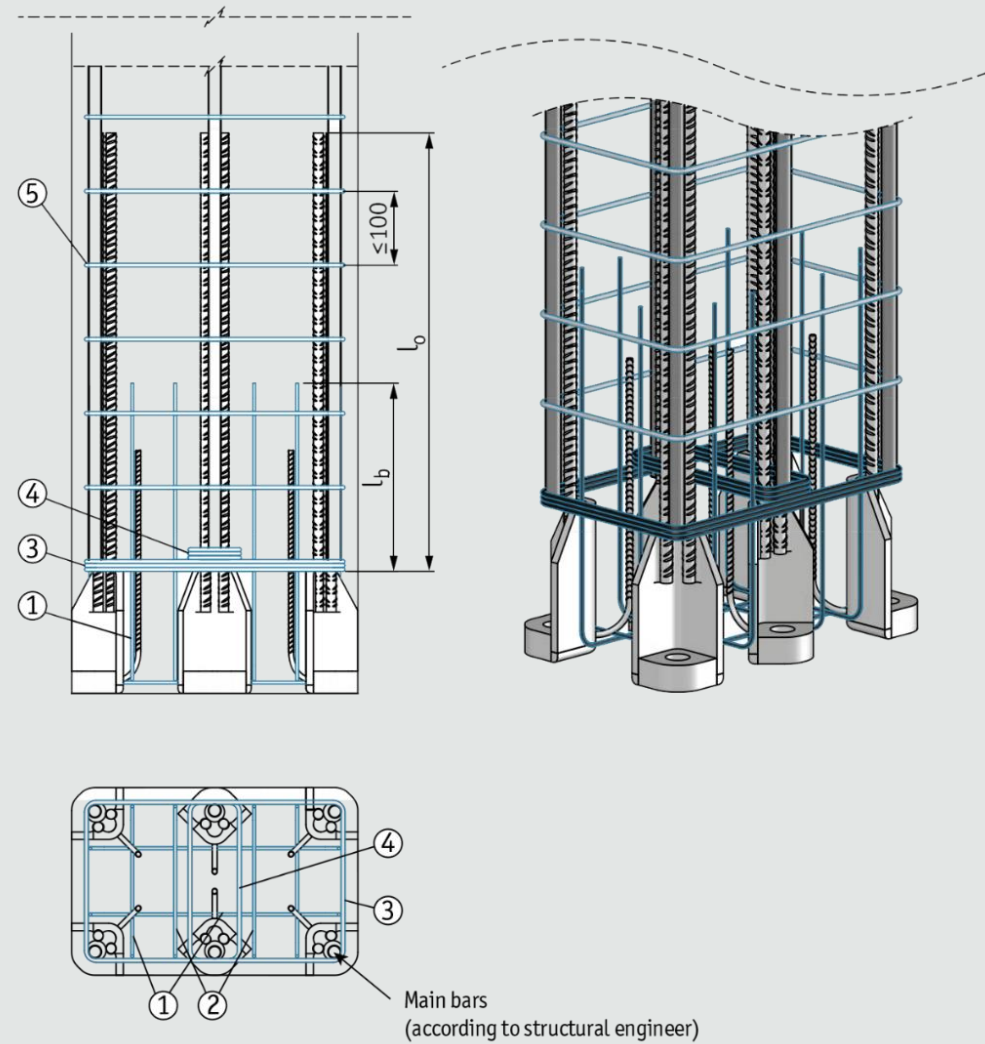
Not applicable

Required
(for most loaded bolt)

PRÍDAVNÁ VÝSTUŽ – STĽP



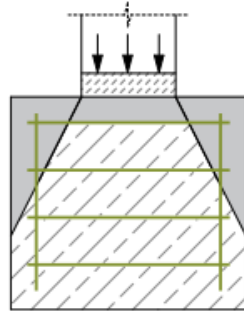
PRÍDAVNÁ VÝSTUŽ - STĽP



POSÚDENIA – OSOVÁ SILA – LOKÁLNE ZATAŽENÉ OBLASTI

Partially loaded areas ⁴⁾

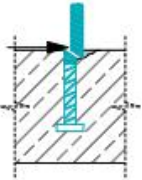
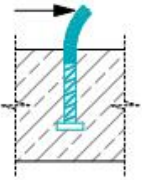
- Local crushing
- Transverse tension forces



Required
only in the final stage
(for the base structure)

Required
only in the final stage
(for the base structure)

POSÚDENIA – ŠMYKOVÁ SILA – PORUŠENIE OCELE SILOU BEZ RAMENA / S RAMENOM

Failure mode	Example	HPM® L Rebar Anchor Bolts	HPM® P Rebar Anchor Bolts
Steel strength		Required (for most loaded bolt)	Required (for most loaded bolt)
Steel strength with lever arm ¹⁾		Required (for most loaded bolt)	Required (for most loaded bolt)

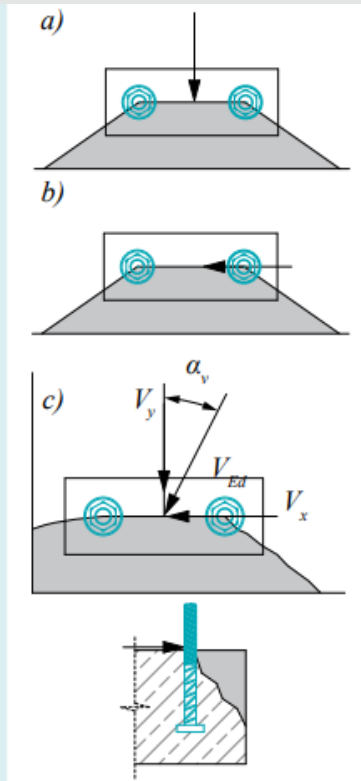
Nevyžaduje sa (podľa ETA-13/0603) v štádiu užívania ak výška spoja nepresiahne hrúbku zálievky uvedenú v pokynboch tohto manuálu.

Overenie sa vykonáva vždy v montážnom štádiu

POSÚDENIA – ŠMYKOVÁ SILA – PORUŠENIE OKRAJA BETÓNU

Concrete edge strength

- a) Shear perpendicular to the edge
- b) Shear parallel to the edge
- c) Inclined shear

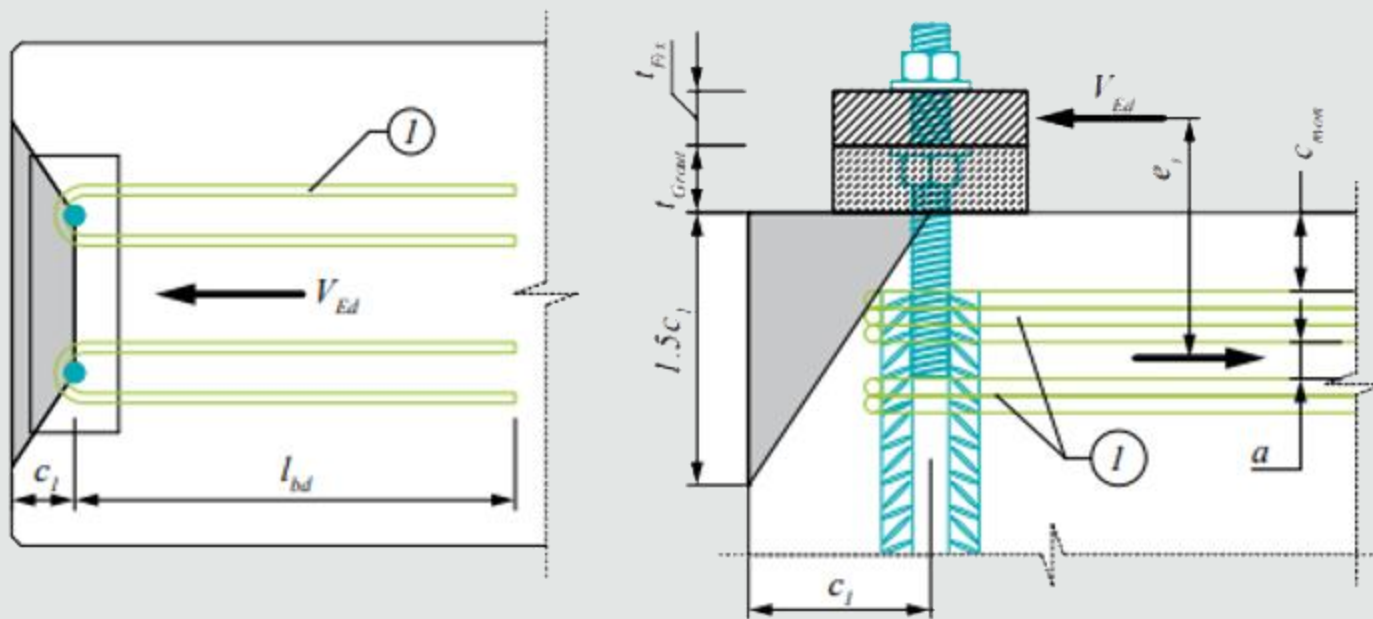


Required
(for anchor group)

Required
(for anchor group)

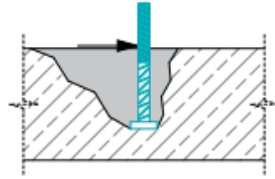
Nevyžaduje sa, ak je vzdialenosť od okraja vo všetkých smeroch $c \geq \min(10h_{ef}; 60\emptyset)$ alebo ak je zabezpečená prídavná výstuž.

PRÍDAVNÁ VÝSTUŽ – ZÁKLAD



POSÚDENIA – ŠMYKOVÁ SILA – PORUŠENIE VYLOMENÍM BETÓNU

Concrete pry-out strength



Required
(for anchor group)

Not applicable

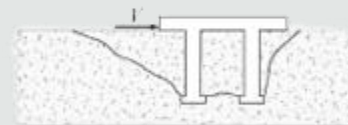
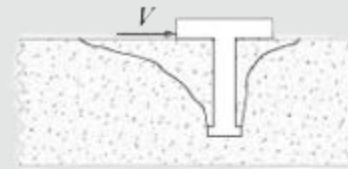
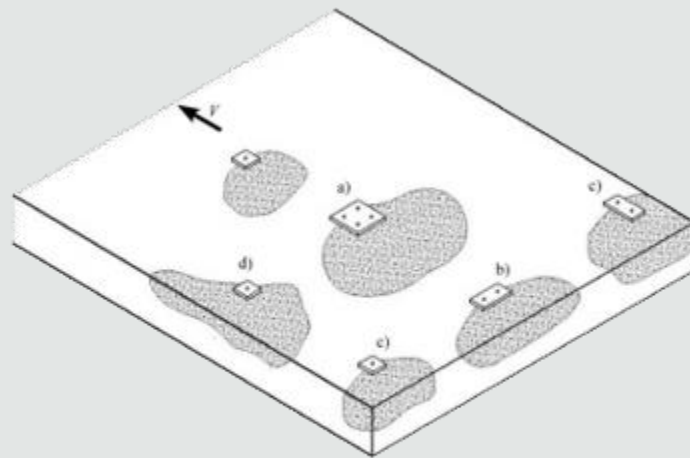
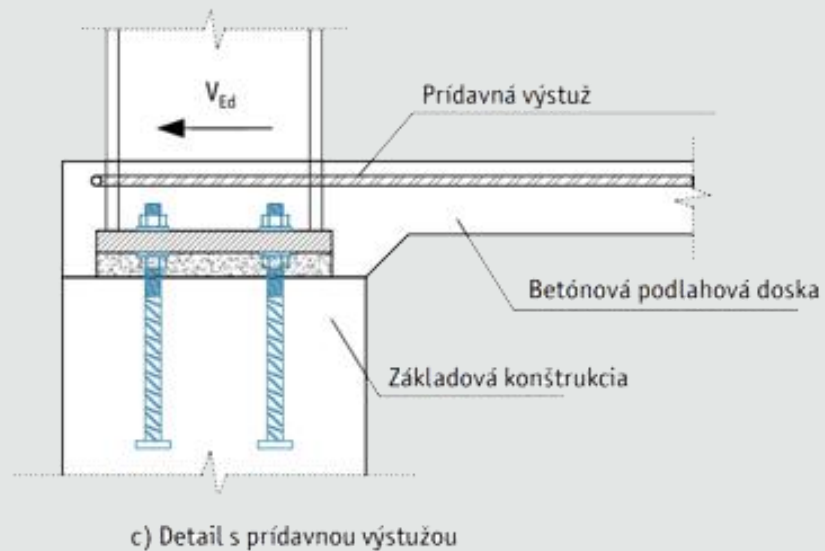
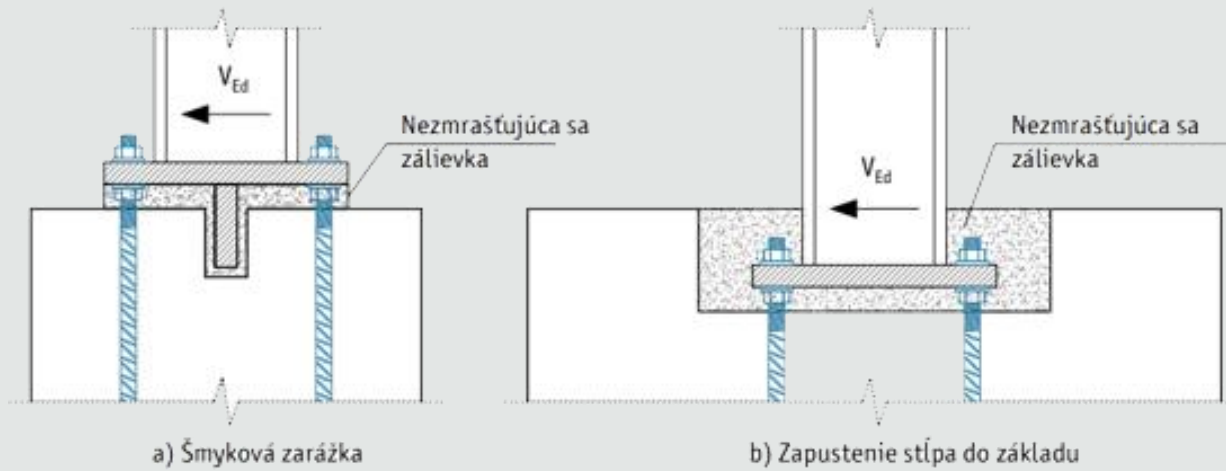


Figure 1.2: Concrete Pryout failure mode a) in-the-filed b) edge influence c) corner influence and d) side influence

VEĽKÁ ŠMYKOVÁ SILA



KOMBINÁCIA N+V – POSÚDENIE OCELE

WITH RESPECT TO STEEL VERIFICATIONS

Bolts in Erection Stage

The simultaneous axial force and shear force in each bolt shall satisfy the condition:

$$\frac{|N_{Ed,\theta}^I|}{N_{Rd,\theta}} + \frac{|V_{Ed,\theta}^I|}{V_{Rd,\theta}} \leq 1$$

Based on ETA-13/0603, Eq. (1)

Bolts in Final Stage

The simultaneous tensile force and shear force in each bolt shall satisfy the condition:

$$\frac{|N_{Ed}^I|}{1.4N_{Rd}} + \frac{|V_{Ed}^I|}{V_{Rd}} \leq 1$$

EN 1993-1-8, Table 3.4

$$\frac{|N_{Ed}^I|}{N_{Rd}} \leq 1$$

EN 1993-1-8, Table 3.4

KOMBINÁCIA N+V – POSÚDENIE BETÓNU

WITH RESPECT TO CONCRETE VERIFICATIONS (applies only for HPM® L Rebar Anchor Bolts)

Bolts without reinforcement or with supplementary reinforcement for both tension and shear:

The simultaneous tensile force and shear force shall satisfy the condition:

$$\left(\frac{N_{Ed}}{N_{Rd,i}}\right)^{1.5} + \left(\frac{V_{Ed}}{V_{Rd,i}}\right)^{1.5} \leq 1 \quad \text{EN 1992-4, Eq. (7.55)}$$

or

$$\left(\frac{N_{Ed}}{N_{Rd,i}}\right) + \left(\frac{V_{Ed}}{V_{Rd,i}}\right) \leq 1.2 \quad \text{EN 1992-4, Eq. (7.56)}$$

with $N_{Ed}/N_{Rd,i} \leq 1$ and $V_{Ed}/V_{Rd,i} \leq 1$.

The largest value of $N_{Ed}/N_{Rd,i}$ and $V_{Ed}/V_{Rd,i}$ for different failure modes shall be taken.

Bolts with supplementary reinforcement for tension or shear only:

The simultaneous tensile force and shear force shall satisfy the condition:

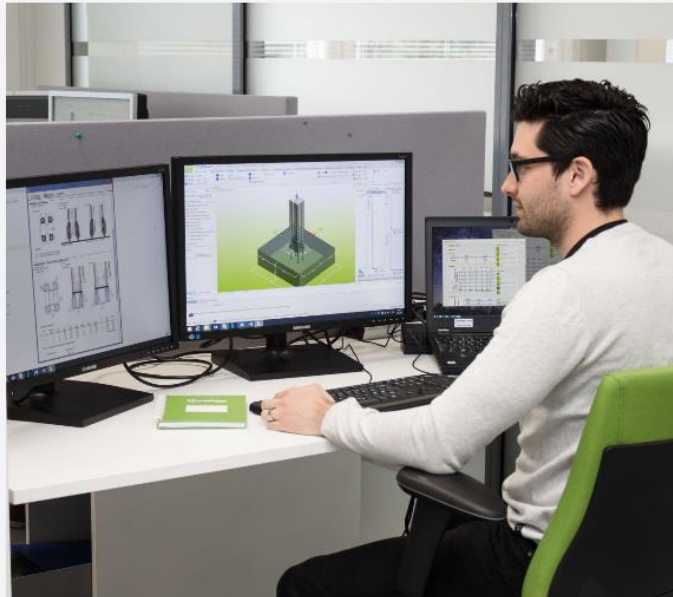
$$\left(\frac{N_{Ed}}{N_{Rd,i}}\right)^{2/3} + \left(\frac{V_{Ed}}{V_{Rd,i}}\right)^{2/3} \leq 1 \quad \text{EN 1992-4, Eq. (7.57)}$$

where N_{Ed} and V_{Ed} are resultant design tension and shear force of the fastener, and $N_{Rd,i}$ and $V_{Rd,i}$ represent the design resistances for the different applicable failure modes.

PEIKKO DESIGNER®

For Designers > Peikko Designer® > Column Connection

Column Connection



Select and calculate Peikko Column Shoes and Anchor Bolts combination for a precast column joint or Peikko Anchor Bolts for a steel column to foundation joint.

Column Connection module resolves the capacities and resistance of bolted Column shoe connection in multiple loading situations. The target is to resolve the complicated loading and stress situations in bolted and grouted connections between columns, beams, and footings. Prepare as many load cases as you need, import them from Excel and create a 2D AutoCAD drawing.

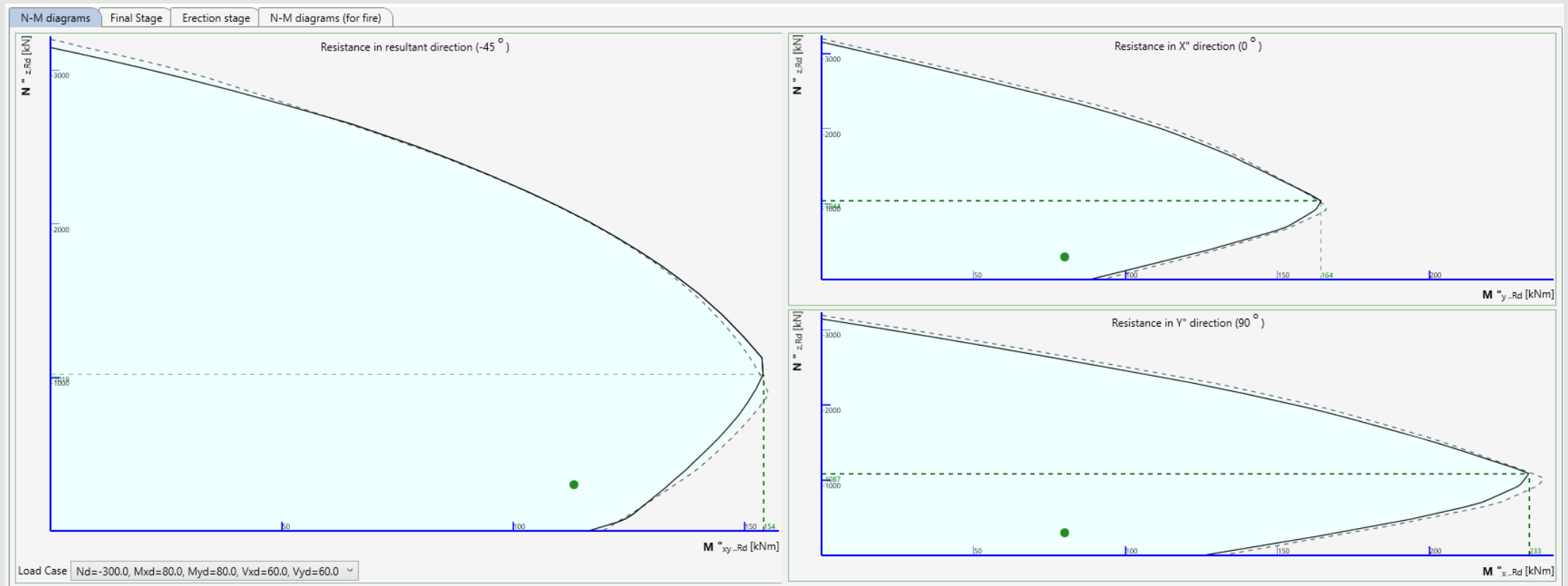
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Peikko Designer 2.5.0

Peikko Designer®
About Peikko Designer

- Start a new project using
Column Connection
Code: EN Eurocodes (without NA)
- Start a new project using
Punching Reinforcement
Code: ETA 13/0151 - Recommended Values
- Start a new project using
Anchor Plate
Code: ETA-16/0430 + EN Eurocodes + CEN/TS 1992-4:2009
- Start a preselection tool
DELTABEAM SELECT
- Find suitable EBEA® Connectors
EBEA SELECT
- Design a balcony connection
EBEA Balcony Designer
- Start calculation application
FLOOR JOINT

VÝSTUP Z PEIKKO DESIGNER®



VÝSTUP Z PEIKKO DESIGNER®

Steel failure check

Concrete failure check

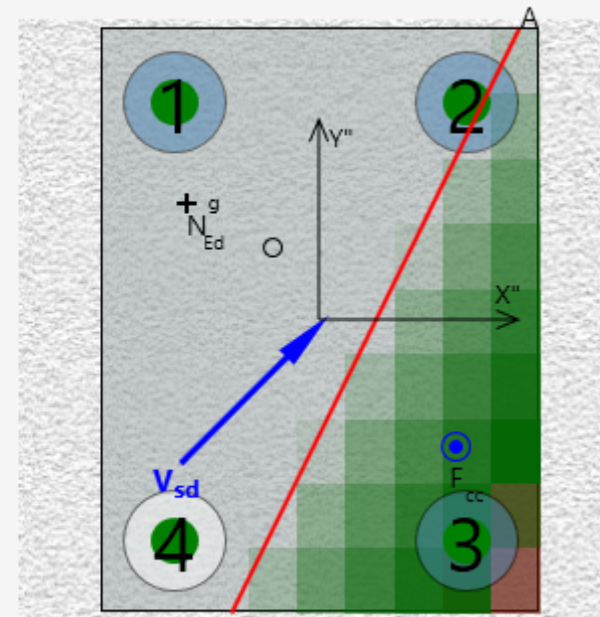
Load Case #1: (Nd=-300.0, Mxd=80.0, Myd=80.0, Vxd=60.0, Vyd=60.0)

Determination of shear load

Design value of normal compressive force in the column	$N_{c,Ed}$	-300	kN
Friction coefficient (between base plate and grout layer)	C_{fd}	0,2	
Joint friction resistance	$F_{t,Rd}$	60	kN
Resultant shear force	V_{sd}	84,85	kN
Resultant shear force taking account friction contribution	$V_{sd,f}$	24,85	kN

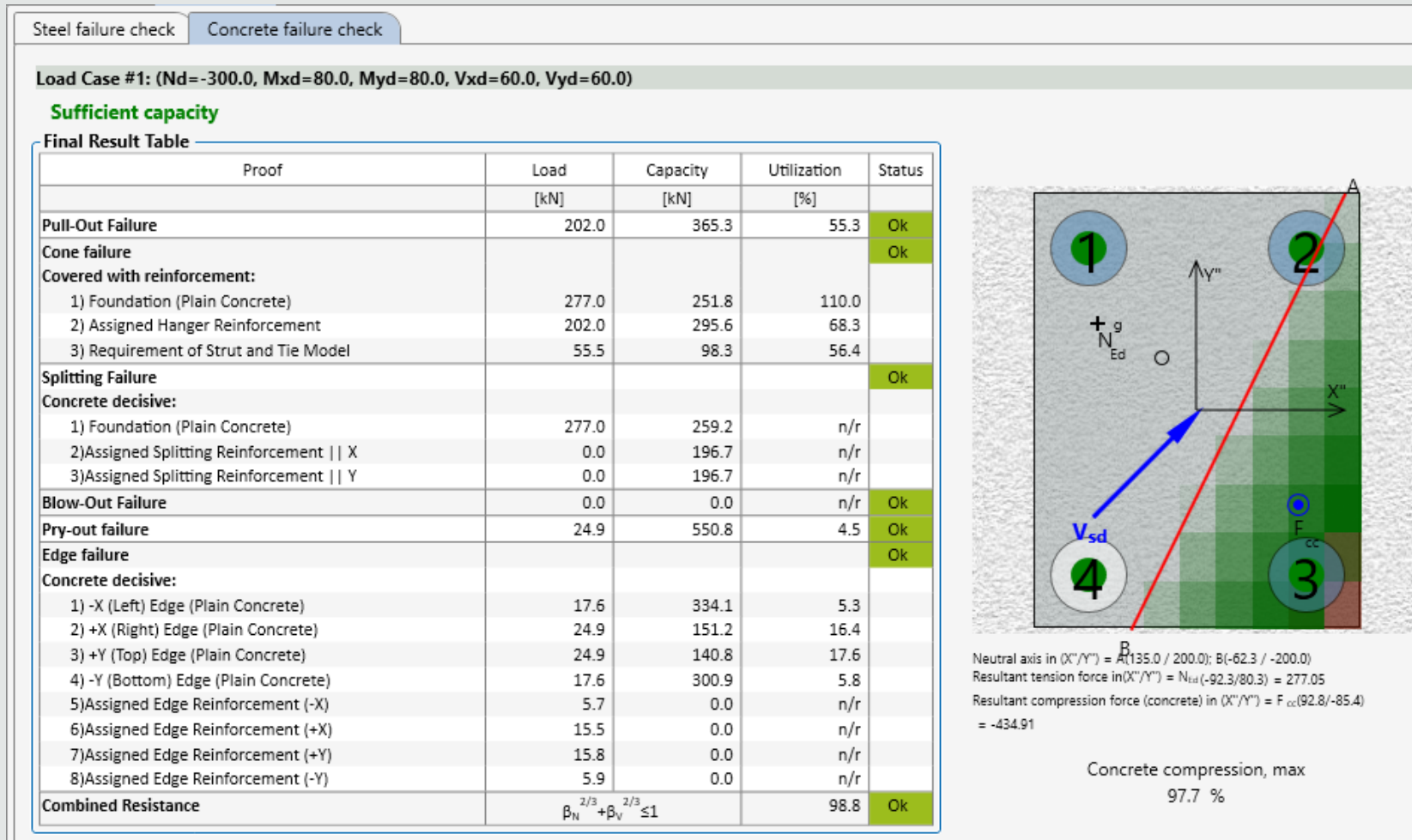
Steel Failure of bolt in joint calculation

Bolt Pos.	Acting axial force [kN]	Design tension resistance [kN]	Axial capacity usage [%]	Acting shear force [kN]	Design shear resistance [kN]	Shear capacity usage [%]	Interaction [%]
1	202.0	202.0	100.0	8.28	71.6	11.6	83.0
2	10.7	202.0	5.3	8.28	71.6	11.6	15.4
3	-142.1	202.0	70.4	8.28	71.6	11.6	n/r
4	64.4	202.0	31.9	0.0	71.6	0.0	n/r

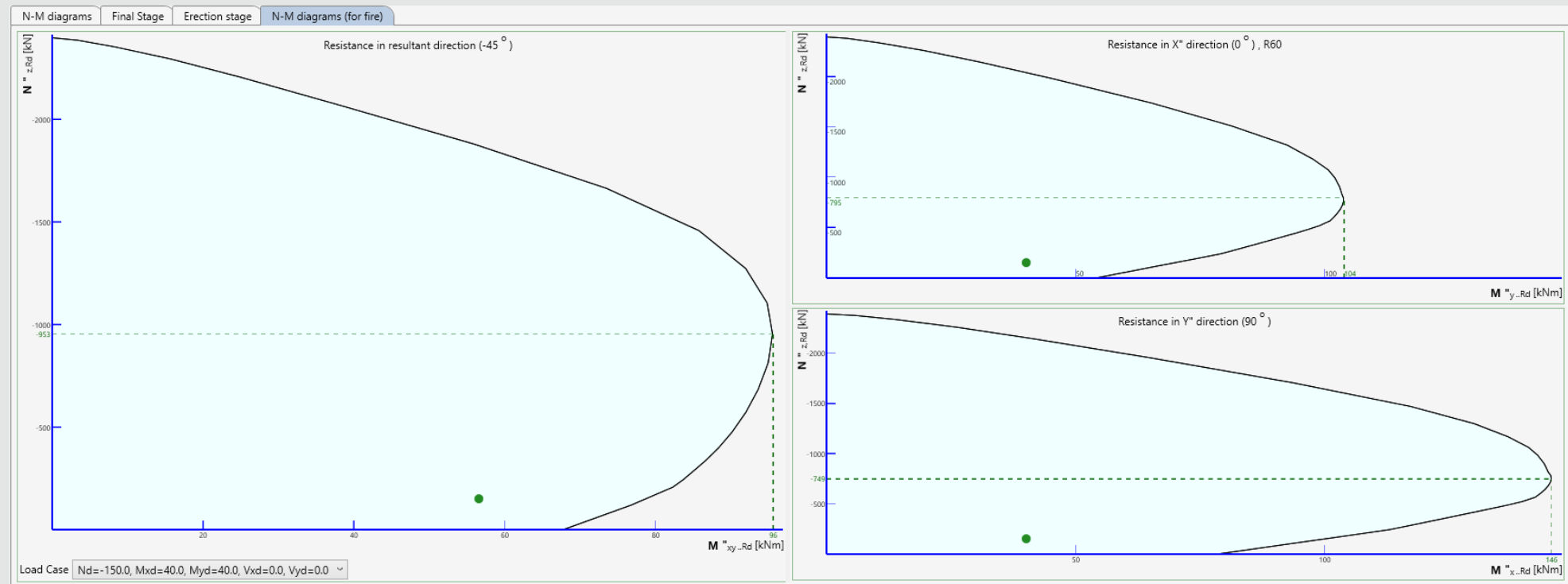


Neutral axis in (X''/Y'') = A(135.0 / 200.0); B(-62.3 / -200.0)
 Resultant tension force in (X''/Y'') = $N_{Ed}(-92.3/80.3) = 277.05$
 Resultant compression force (concrete) in (X''/Y'') = $F_{cc}(92.8/-85.4) = -434.91$

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PRÍKLAD



ĎAKUJEM ZA POZORNOST