PRORAČUNAJTE ANKERE UZIMAJUĆI U OBZIR UTICAJ DODATNE ARMATURE U BET. ELEMENTU

VEBINAR ĆE POČETI ZA NEKOLIKO MINUTA

Hilti Srbija

PRORAČUNAJTE ANKERE UZIMAJUĆI U OBZIR UTICAJ DODATNE ARMATURE U BET. ELEMENTU

VEBINAR ĆE POČETI ZA 5 MINUTA

Hilti Srbija

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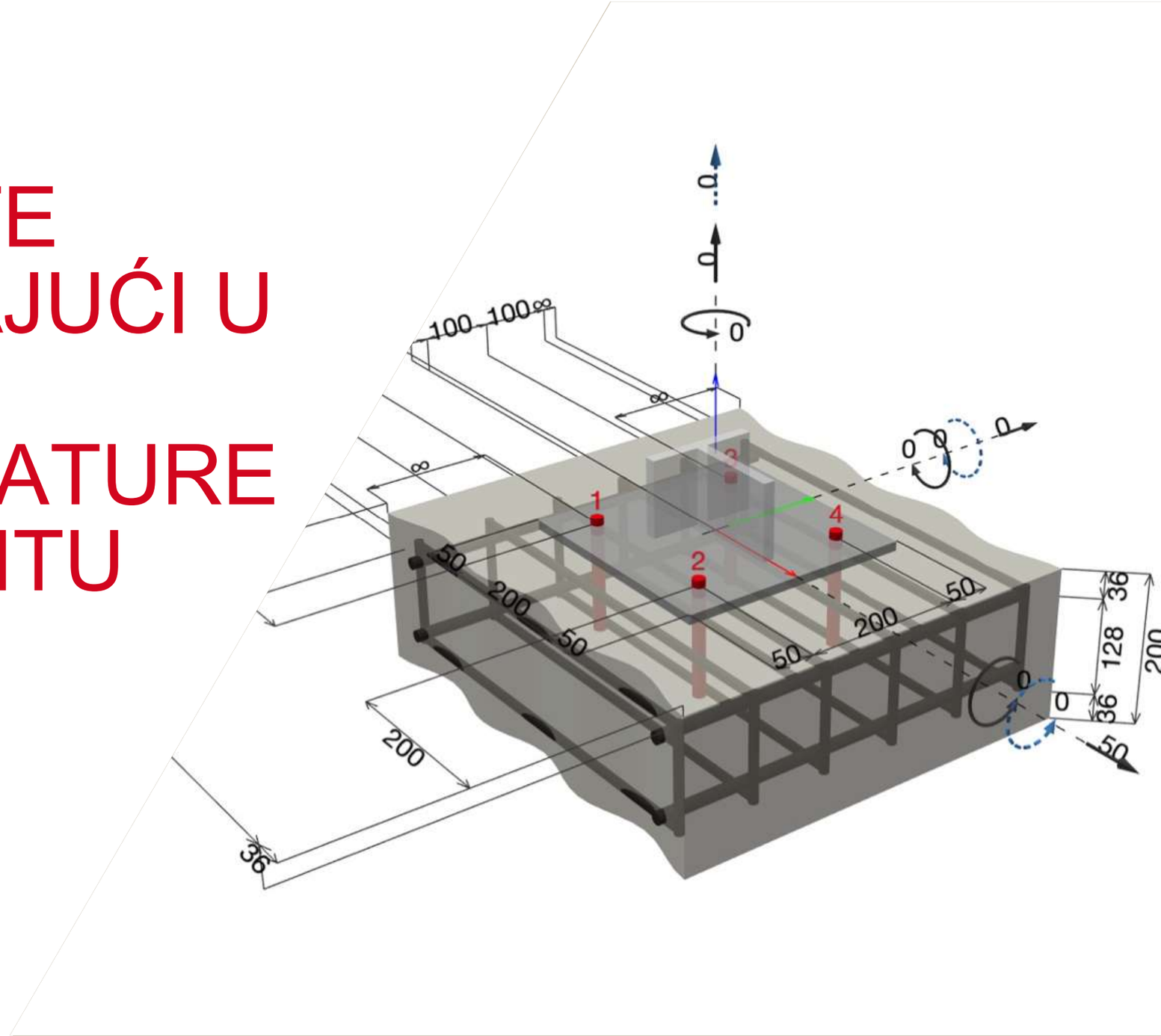
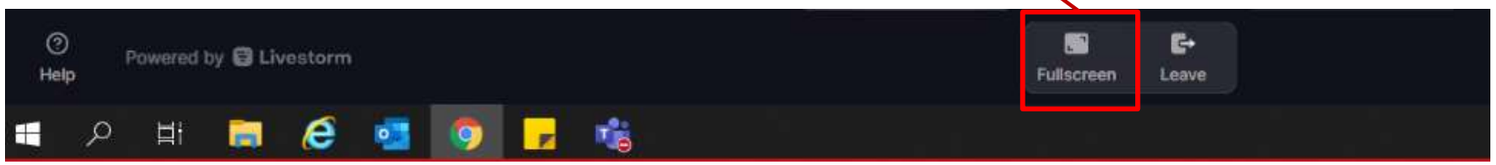


Hilti Srbija

LIVESTORM PLATFORMA

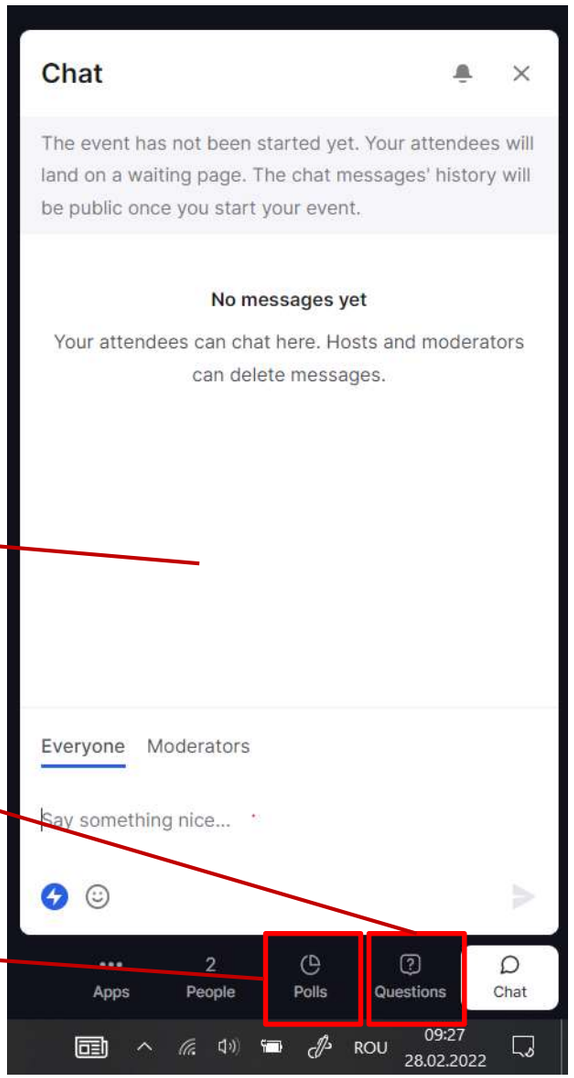
Podešavanja ekrana



Čet i pitanja

Pitanja

Ankete



DANAŠNJI PREZENTERI

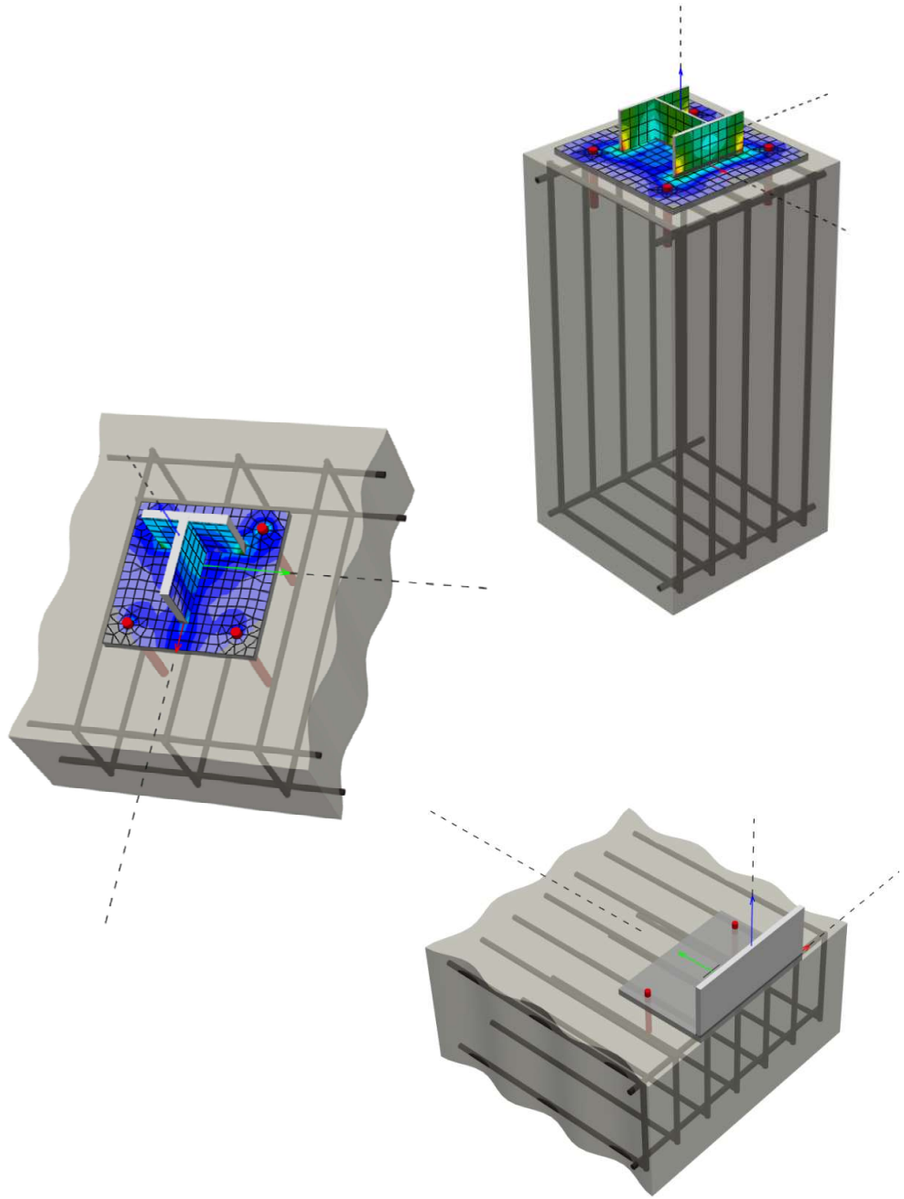
Marija Radosavljević
Field Engineer

Bojan Ristanović
Field Engineer

Luka Bogdanović
Product Manager

AGENDA

- Uvod
- Eurocode 2-4/2019 regulativa
- Osnovni principi proračuna
- Koraci proračuna
- Primeri
- Vaša pitanja



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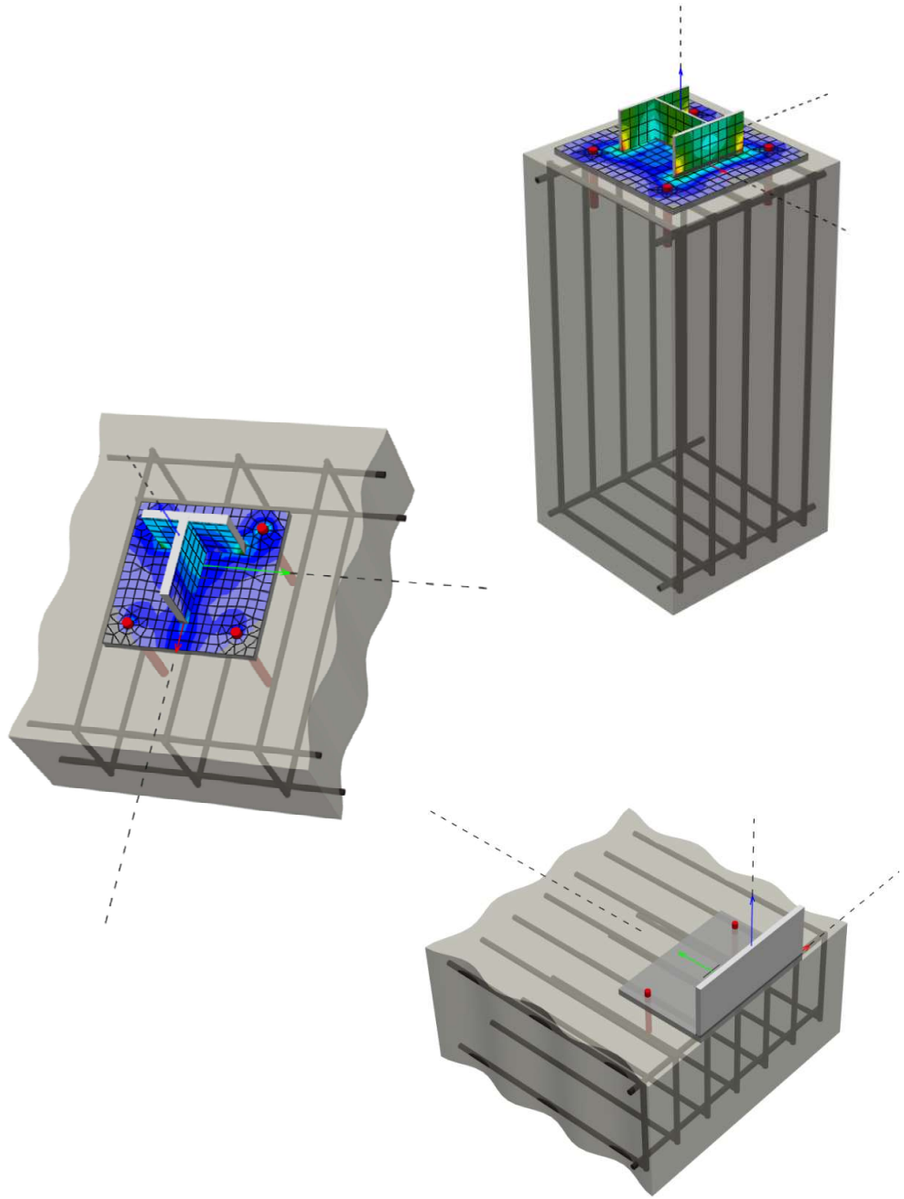
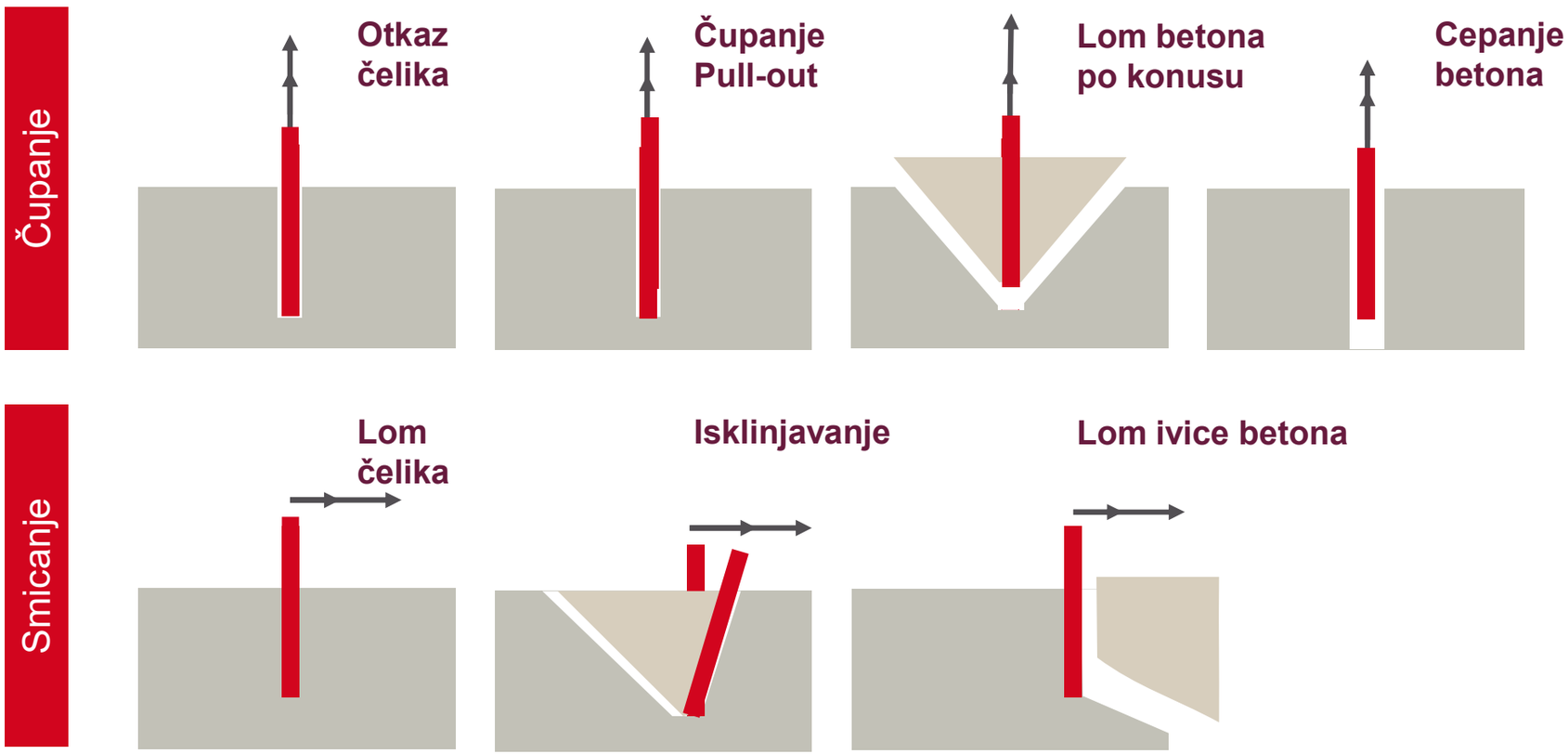
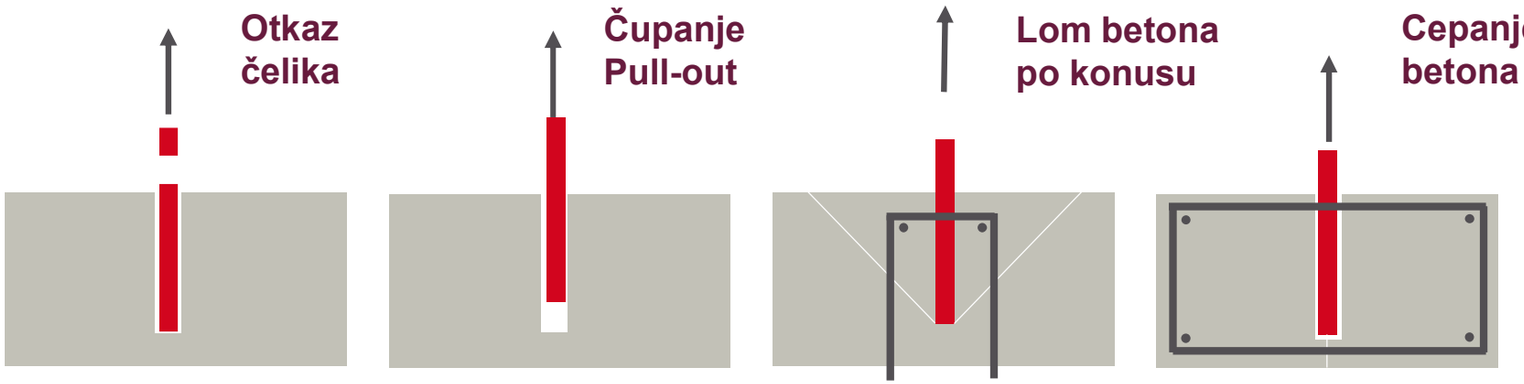


OTKAZ ANKERA SE MOŽE DESITI USLED UTICAJA SILA ČUPANJA I SILA SMICANJA

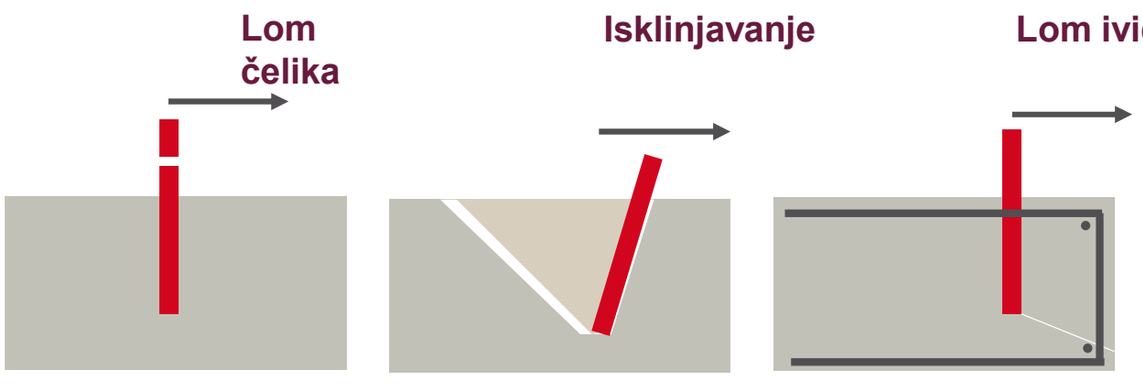


OTKAZ ANKERA SE MOŽE DESITI USLED UTICAJA SILA ČUPANJA I SILA SMICANJA

Čupanje



Smicanje



✓ Armatura može biti efikasno rešenje u slučaju kada do otkaza dolazi usled popuštanja betonskog elementa, **lom betona** ili **cepanje.**

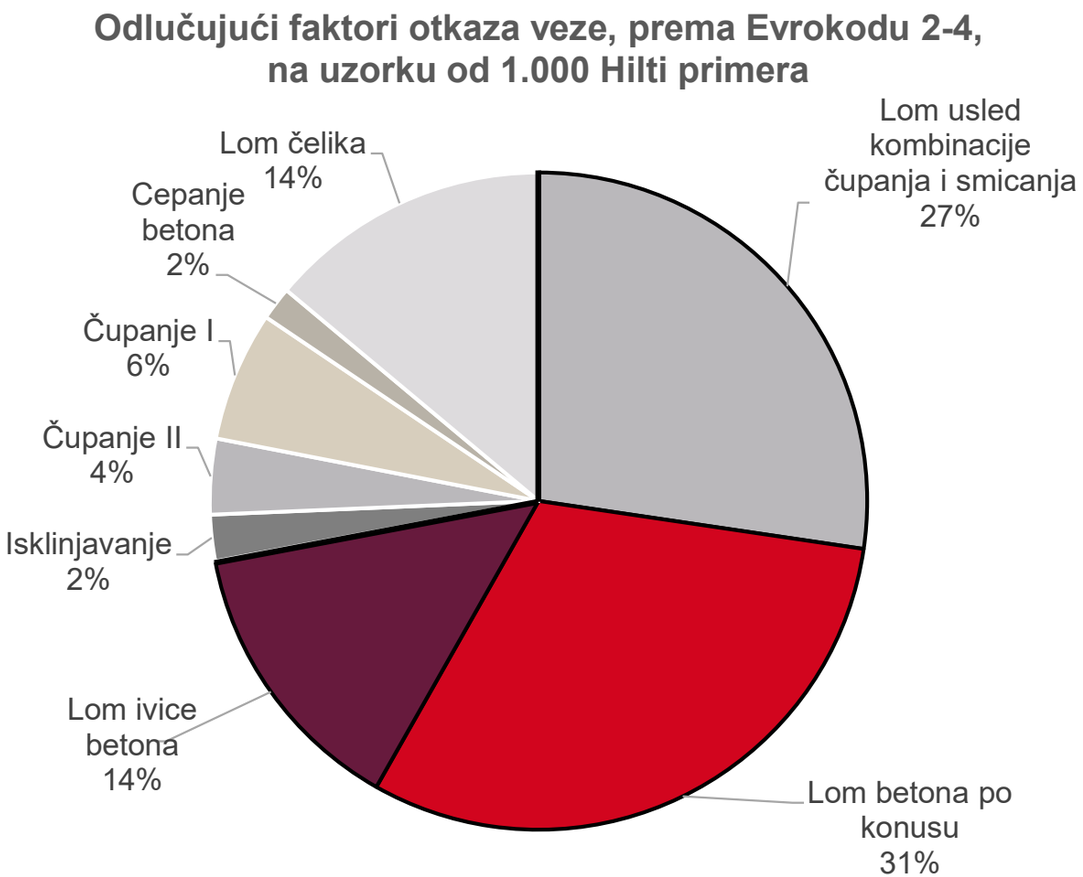
✗ Armatura ne pomaže u slučaju čupanja ili otkaza čelika.

ANKETA 1:

NA KOJE SLUČAJEVE NAJČEŠĆE NAILAZITE U PRAKSI?

Lom betona po konusu
Lom ivice betona
Lom čelika

U VELIKOM BROJU SLUČAJEVA PRORAČUNA ANKERA UTICAJ DODATNE ARMATURE BI MOGAO DA BUDE OD KORISTI



U oko 70% slučajeva do otkaza veze dolazi usled loma betona (provera prema EN 1992-4):

- Lom ivice betona (smicanje)
- Lom betona po konusu (čupanje)
- Lom betona usled kombinovanog delovanja sila čupanja i smicanja

OTKAZ BETONA KADA SE DODATNA ARMATURA NE UZIMA U OBZIR

Otkaz betona – zatezanje / čupanja

$$N_{Rk,c} = N^0_{Rk,c} \cdot \frac{A_{c,N}}{A^0_{c,N}} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec,N} \cdot \psi_{M,N}$$

$$N^0_{Rk,c} = k_1 \cdot \sqrt{f_{ck}} \cdot h_{ef}^{1,5}$$

Glavni faktori: površina pod uticajem, dubina ankerisanja, međusobni razmak ankera, kvalitet betona

Otkaz betona - smicanja

$$V_{Rk,c} = V^0_{Rk,c} \cdot \frac{A_{c,V}}{A^0_{c,V}} \cdot \psi_{s,V} \cdot \psi_{h,V} \cdot \psi_{ec,V} \cdot \psi_{\alpha,V} \cdot \psi_{re,V}$$

$$V^0_{Rk,c} = k_9 \cdot d_{nom}^{\alpha} \cdot l_f^{\beta} \cdot \sqrt{f_{ck}} \cdot c_1^{1,5}$$

Glavni faktori: površina pod uticajem, razmak od ivice, međusobni razmak ankera, kvalitet betona

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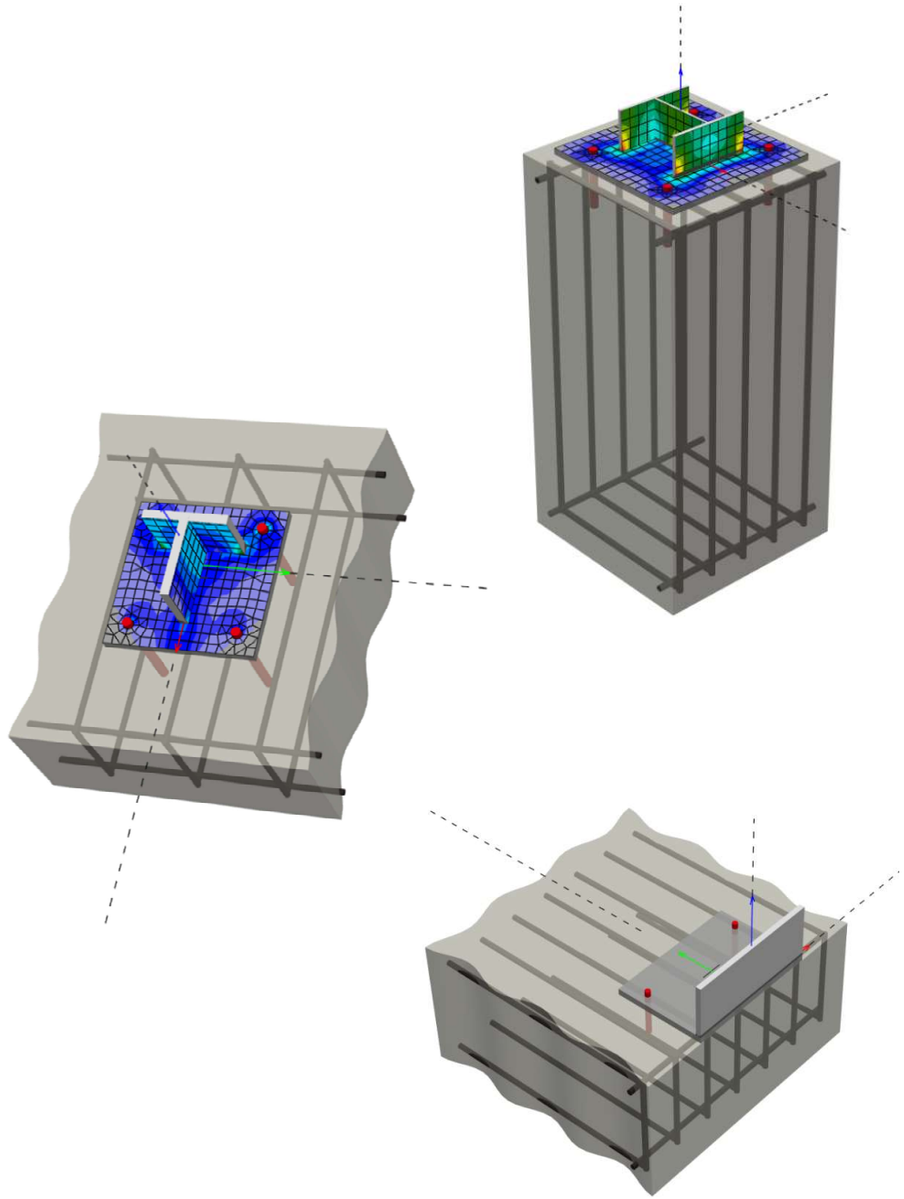
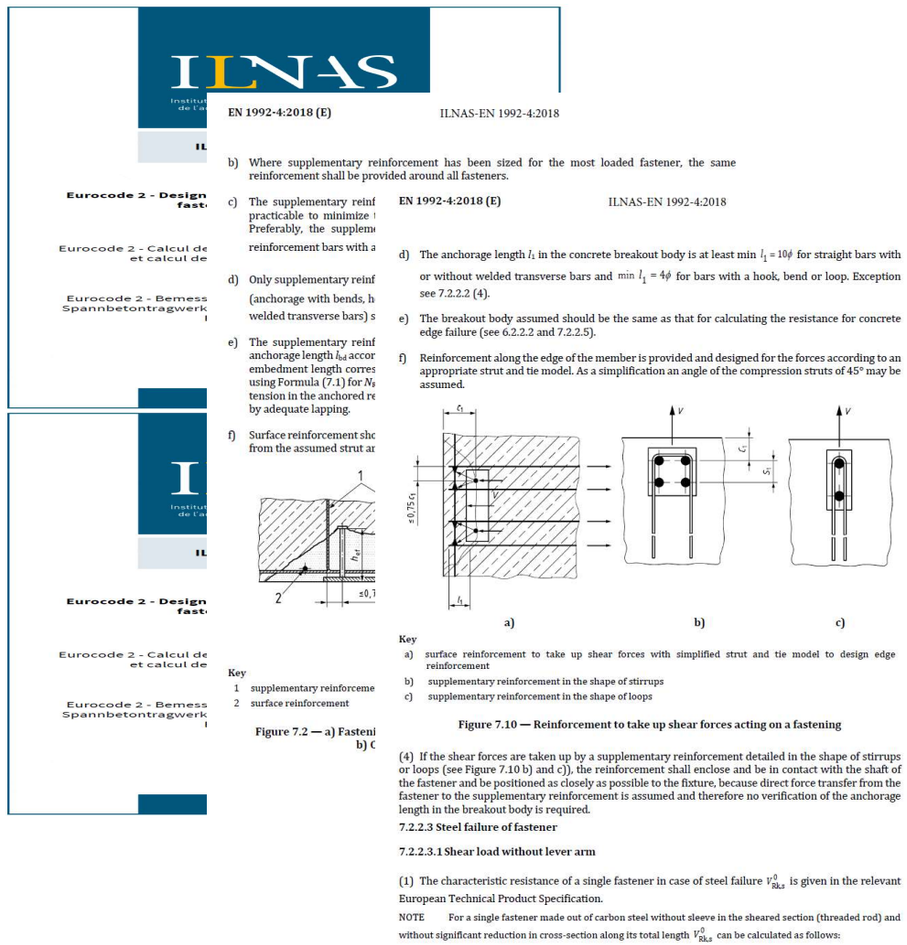


NOVI EVROKOD 2-4 DOZVOLJAVA UZIMANJE U OBZIR UTICAJA DODATNE ARMATURE NA NOSIVOST NAKNADNO UGRAĐENIH ANKERA

- Armatura ima uticaja na otkaze ankera koji su povezani sa nosivošću betona.
- Evrokod 2-4 daje upute kako dizajnirati dodatnu armaturu u cilju sprečavanja pucanje/otkaz betona (usled dejstva sila čupanja i sila smicanja).
- Proračun ankera uz uticaj dodatne armature zahteva poznavanje **položaja armature unutar betonskog elementa**.
- Evrokodom 2-4 je obuhvaćena dodatna armatura za **statička** i za **seizmička** dejstva.



ILNAS

EN 1992-4:2018 (E) ILNAS-EN 1992-4:2018

b) Where supplementary reinforcement has been sized for the most loaded fastener, the same reinforcement shall be provided around all fasteners.

c) The supplementary reinf
practicable to minimize
Preferably, the supplem
reinforcement bars with a

d) Only supplementary reinf
(anchorage with bends, h
welded transverse bars) s

e) The supplementary reinf
anchorage length l_{bd} accor
embedment length corres
using Formula (7.1) for N_s
tension in the anchored re
by adequate lapping.

f) Surface reinforcement sho
from the assumed strut a

Key
1 supplementary reinforceme
2 surface reinforcement

Figure 7.2 — a) Fasteni
b) C

EN 1992-4:2018 (E) ILNAS-EN 1992-4:2018

d) The anchorage length l_1 in the concrete breakout body is at least min $l_1 = 10\phi$ for straight bars with or without welded transverse bars and $\min l_1 = 4\phi$ for bars with a hook, bend or loop. Exception see 7.2.2.2 (4).

e) The breakout body assumed should be the same as that for calculating the resistance for concrete edge failure (see 6.2.2.2 and 7.2.2.5).

f) Reinforcement along the edge of the member is provided and designed for the forces according to an appropriate strut and tie model. As a simplification an angle of the compression struts of 45° may be assumed.

a) b) c)

Key
a) surface reinforcement to take up shear forces with simplified strut and tie model to design edge reinforcement
b) supplementary reinforcement in the shape of stirrups
c) supplementary reinforcement in the shape of loops

Figure 7.10 — Reinforcement to take up shear forces acting on a fastening

(4) If the shear forces are taken up by a supplementary reinforcement detailed in the shape of stirrups or loops (see Figure 7.10 b) and c)), the reinforcement shall enclose and be in contact with the shaft of the fastener and be positioned as closely as possible to the fixture, because direct force transfer from the fastener to the supplementary reinforcement is assumed and therefore no verification of the anchorage length in the breakout body is required.

7.2.2.3 Steel failure of fastener

7.2.2.3.1 Shear load without lever arm

(1) The characteristic resistance of a single fastener in case of steel failure $V^0_{Rk,s}$ is given in the relevant European Technical Product Specification.

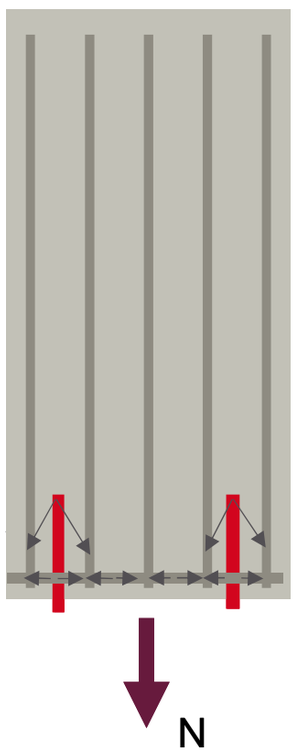
NOTE For a single fastener made out of carbon steel without sleeve in the sheared section (threaded rod) and without significant reduction in cross-section along its total length $V^0_{Rk,s}$ can be calculated as follows:

ŠTA JE DODATNA ARMATURA?

Sila čupanja

Lom po konusu

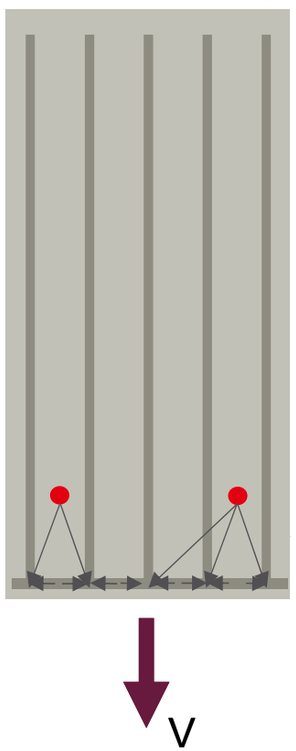
Greda – poprečni presek



Sila smicanja

Lom ivice

Ploča - pogled odozgo



1 Lom betona

Bez pomoći dodatne armature, nosivost je određena nosivošću samog betona, kada dolazi do loma betona po konusu ili loma ivice.

2 Dodatna armatura

Dodatna armatura je armatura unutar betonskog elementa, koja preuzima sile nakon pucanja betona.
Ova armatura se mora proračunati prema EN1992-4.

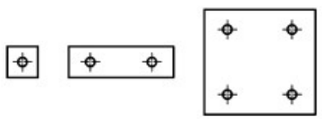
3 Postojeća armatura

Postojeća armatura, učestvuje u distribuciji napona. Nije neophodno znati tačan položaj šipki.

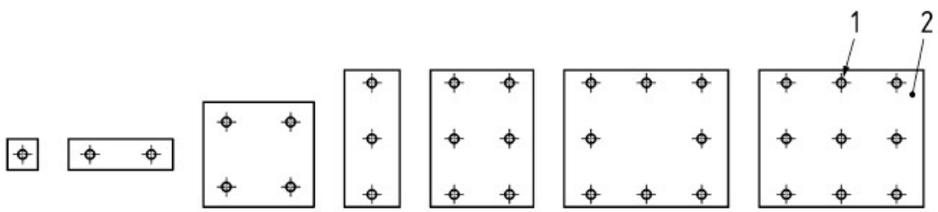
EVROKOD – VERIFIKACIJA ANKERA UZ UTICAJ DODATNE ARMATURE (STATIČKI I SEIZMIČKI UTICAJI)

Konfiguracije ankera za koje Evrokod 2-4 dozvoljava uzimanje uticaja dodatne armature na nosivost ankera

U blizini ivice



U blizini ivice uz popunjeni zazor između ankera i ank. ploče

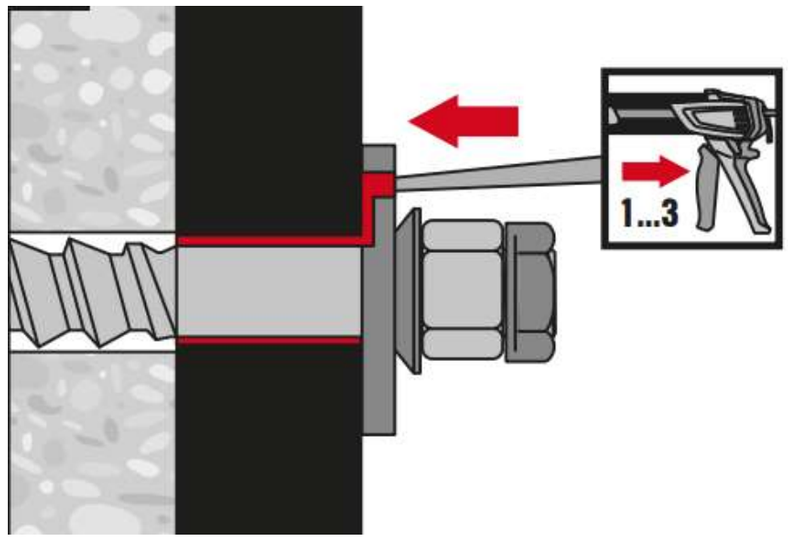


Ostalo – SOFA

Nije dozvoljeno uzimanje u obzir uticaja dodatne armature na nosivost.

POPUNJAVANJE ZAZORA IZMEĐU ANKERA I ANKERNE PLOČE

+



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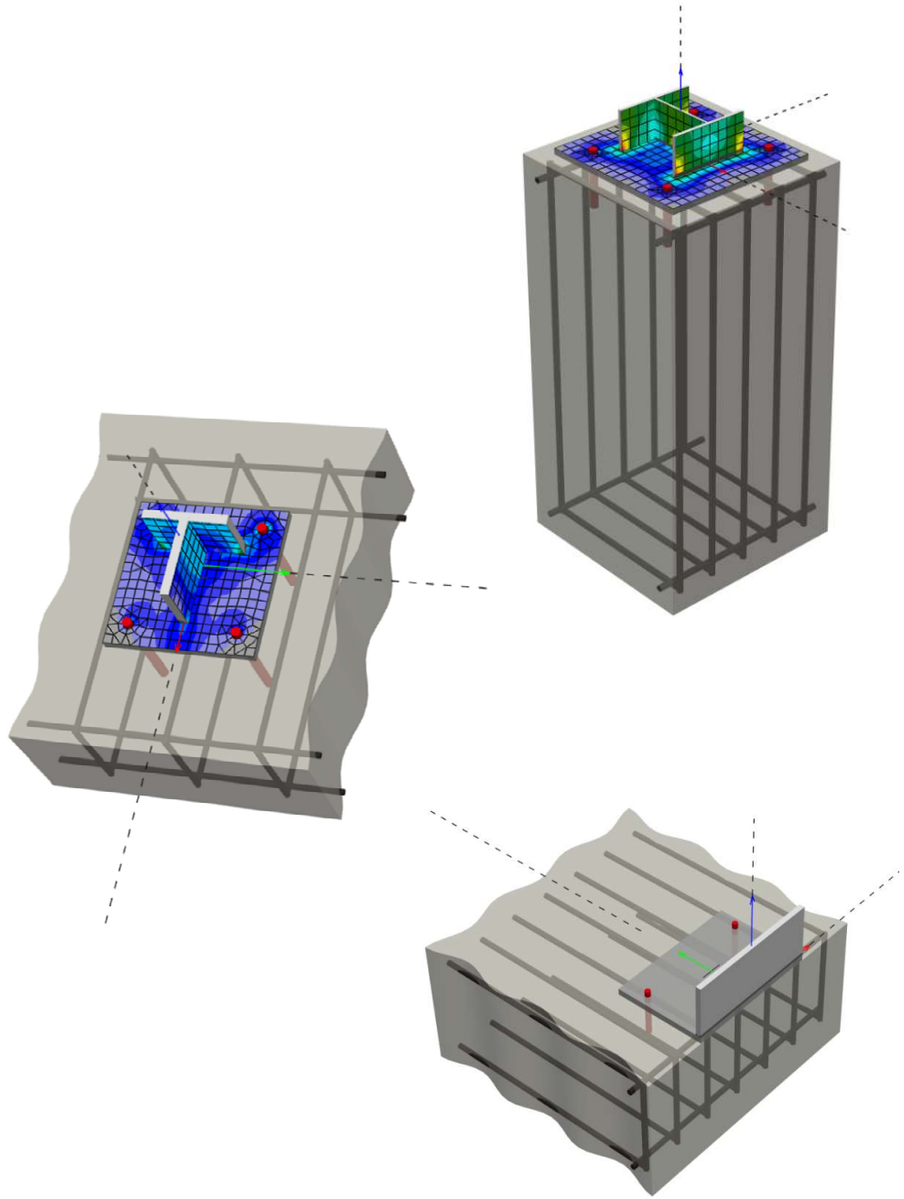
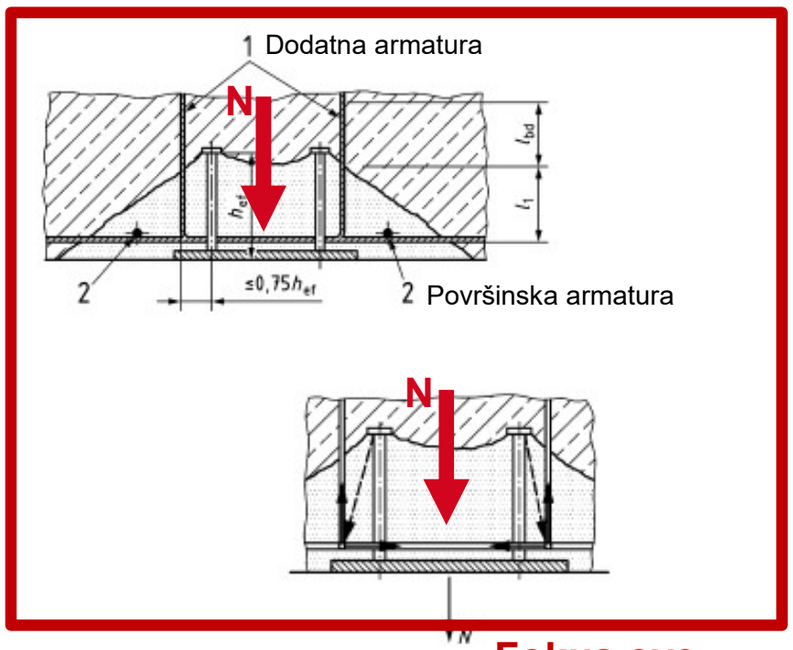


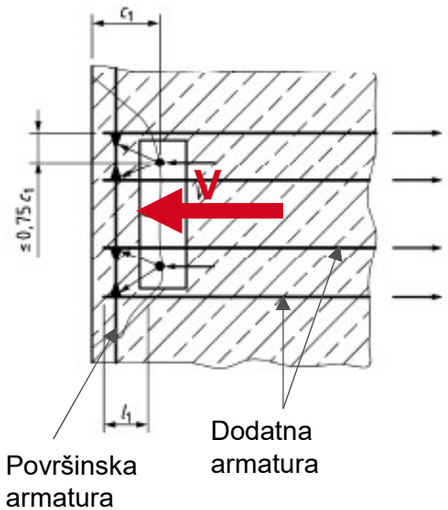
EVROKOD 2-4 DAJE NEKOLIKO OPCIJA ZA UZIMANJE DODATNE ARMATURE U OBZIR

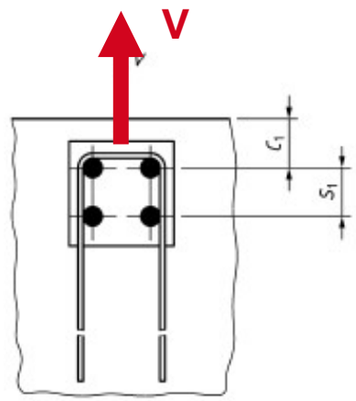
Dodatna armatura za čupanje

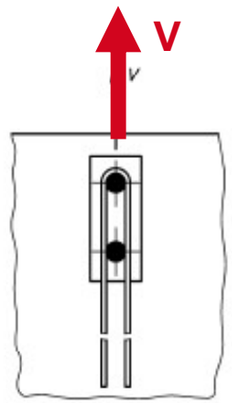


Fokus ove prezentacije

Dodatna armatura za smicanje





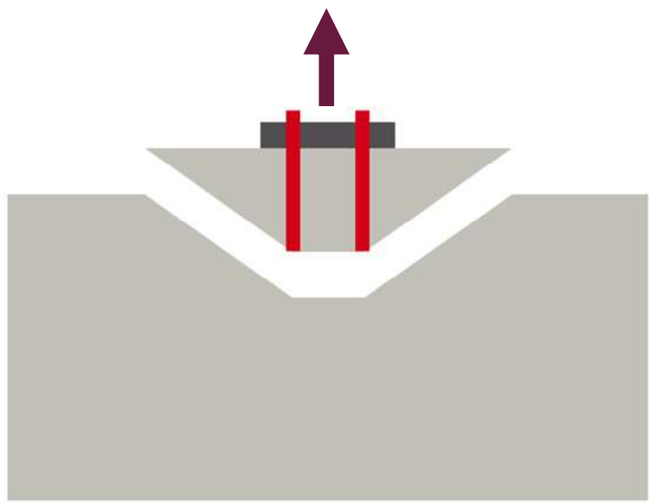


Takođe dostupno u Profis Engineering-u

EN1992-4: dodatna armatura koja se razmatra je prečnika od **6mm** do **16mm**, $f_{yk} \leq 600N/mm^2$.

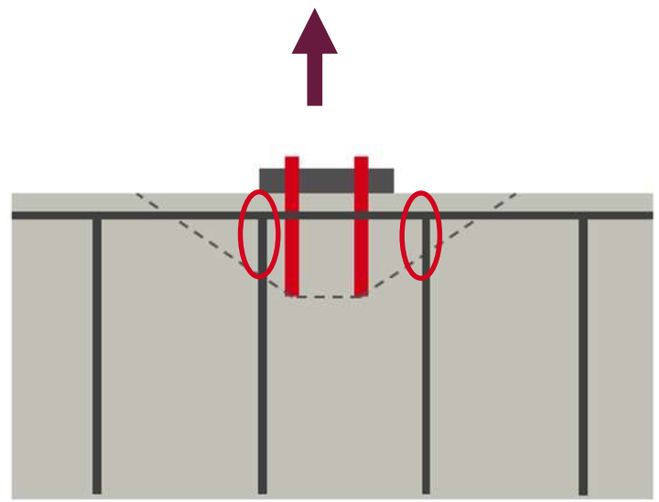
NEOPHODNE PROVERE ZA DODATNU ARMATURU – SLUČAJ ČUPANJA

Bez armature



- Provera loma betona je neophodna ✓

Dodatna armatura za čupanje



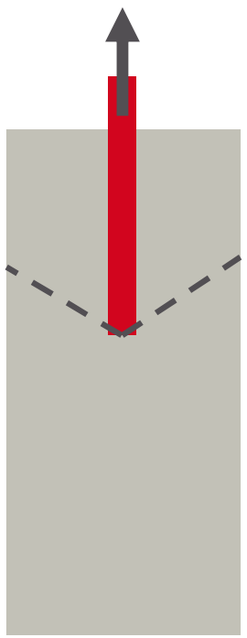
- Provera betona nije neophonda ✗
- **Provera nosivosti armature** je neophodna ✓
- **Provera ankerisanja** dodatne armature je neophodna ✓

Mora se obezbediti prenos sila iz dodatne armature na betonski element, prema EN 1992-1.

DODATNA ARMATURA ZA ČUPANJE JE NAROČITO ZNAČAJNA U TANKIM BETONSKIM ELEMENTIMA (MALO RASTOJANJE IVICA)

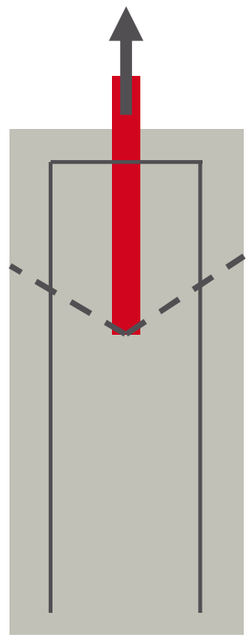
Rastojanje ivica << 1.5 h_{ef}

Bez armature



- **Tipičan lom betonskog elementa**

Dodatna armatura za čupanje

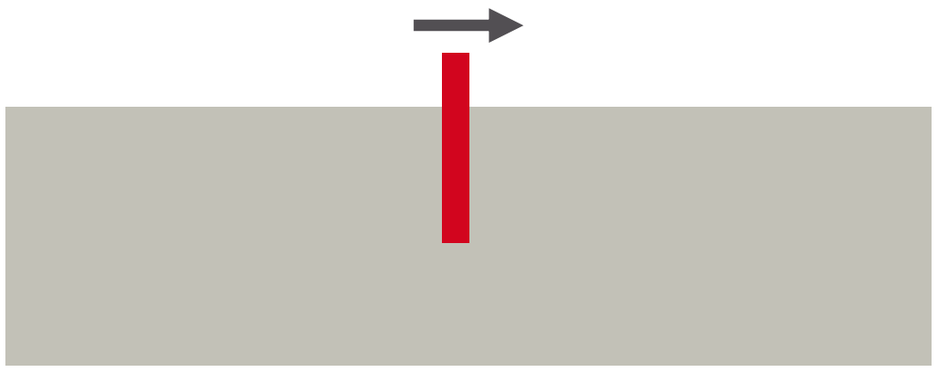


- **Provera betonskog elementa nije izvršena**
- Nosivost dodatne armature je ograničena nosivošću na **čupanje** i nosivošću **veze** armatura-beton

Dodatna armatura može povećati ukupnu nosivost.

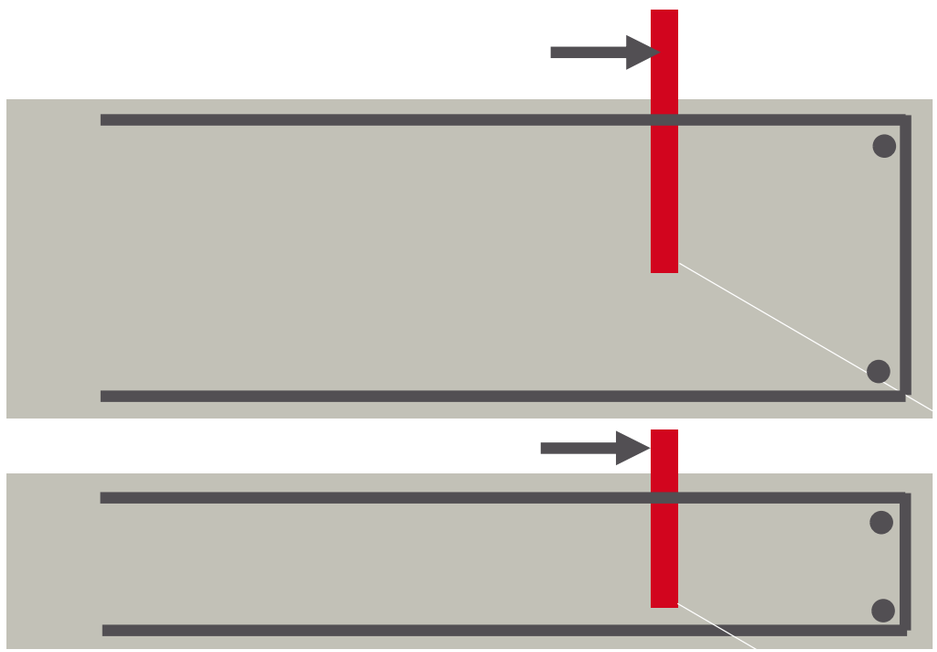
SMICANJE – DODATNA ARMATURA ZNAČAJNA KOD ANKERISANJA U BLIZINI IVICE

Udaljen od ivice



- Ne postoji rizik od loma ivice betona

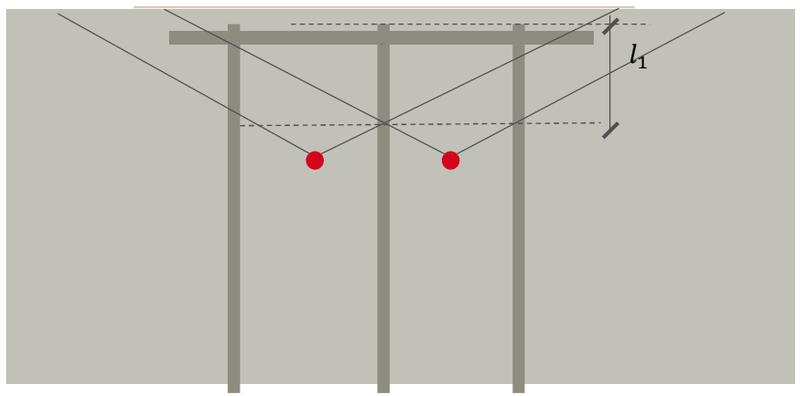
Blizu ivice i blizu ivice + tanak element



- Uglavnom postoji rizik od loma ivice betona
- Površina koja se odupire lomu je takođe manja kada je element tanji

ANKERI VRLO BLIZU IVICE – NEDOVOLJNA DUŽINA ANKERISANJA ARMATURE (L1)

Blizu ivice



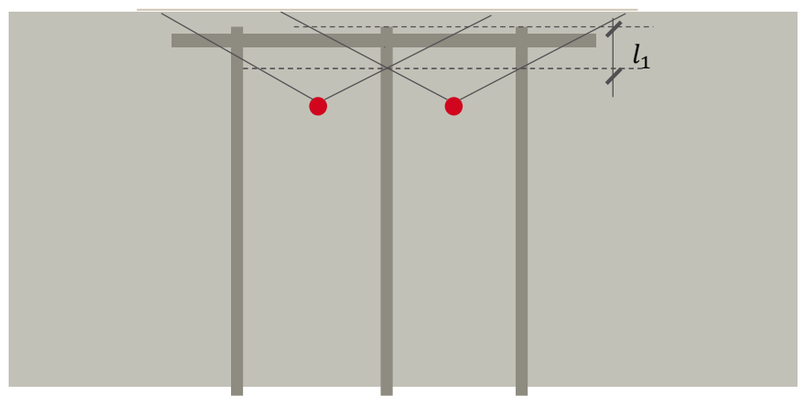
- Dužina armature u konusu po kom dolazi do loma betona, mora biti:

  $l_1 \geq 4\emptyset$ Uzengije

  $l_1 \geq 10\emptyset$ Prave šipke

Prema EC2-4 & EC2-1-1, 7.2.2.2 (2) d.

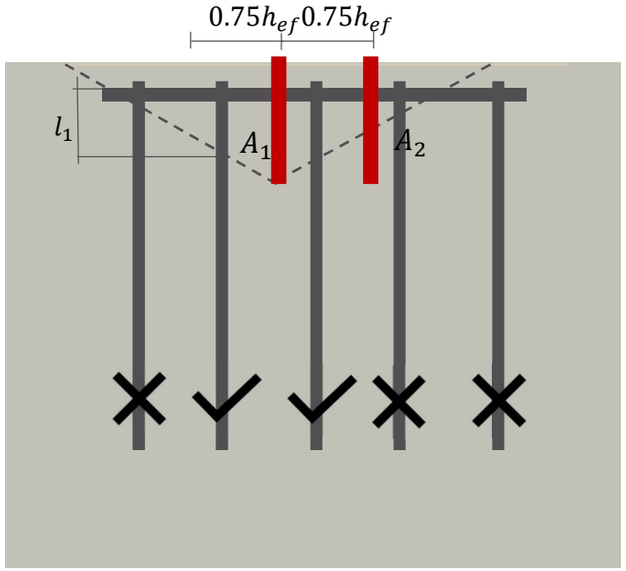
Vrlo blizu ivice



- Kod ankerisanja vrlo blizu ivice betona do otkaza uglavnom dolazi zbog loma betona jer kod armature ne postoji potrebna dužina l_1

VAŽNO: ŠIPKE ARMATURE MORAJU BITI U BLIZINI ANKERA

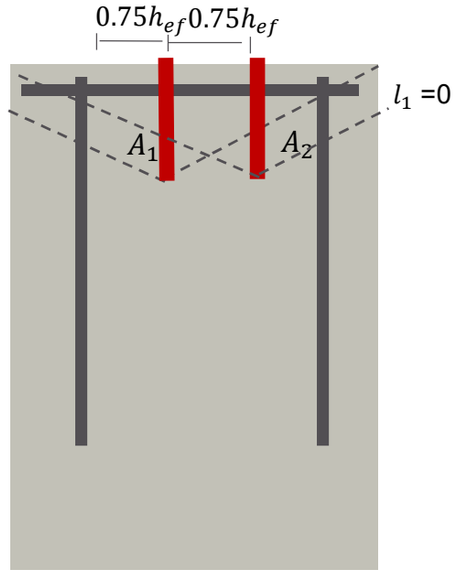
Armaturne šipke udaljene više od 0.75hef ne mogu se smatrati dodatnom armaturom

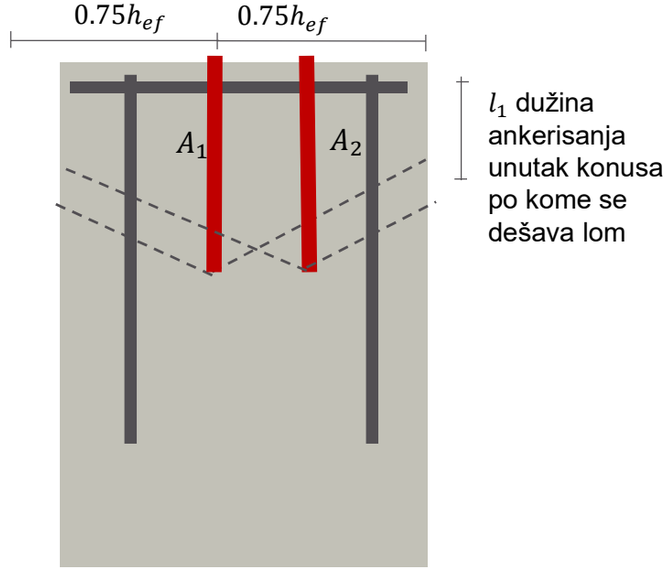


Zašto?

Armatura mora biti unutar konusa po kome se dešava lom.

Dodatna amratura je naročito pogodna kod hemijskih ankera sa velikom dubinom ankerisanja





$$N_{Rd,a} = \frac{l_1 \pi \emptyset f_{bd}}{\alpha_1 \alpha_2}$$

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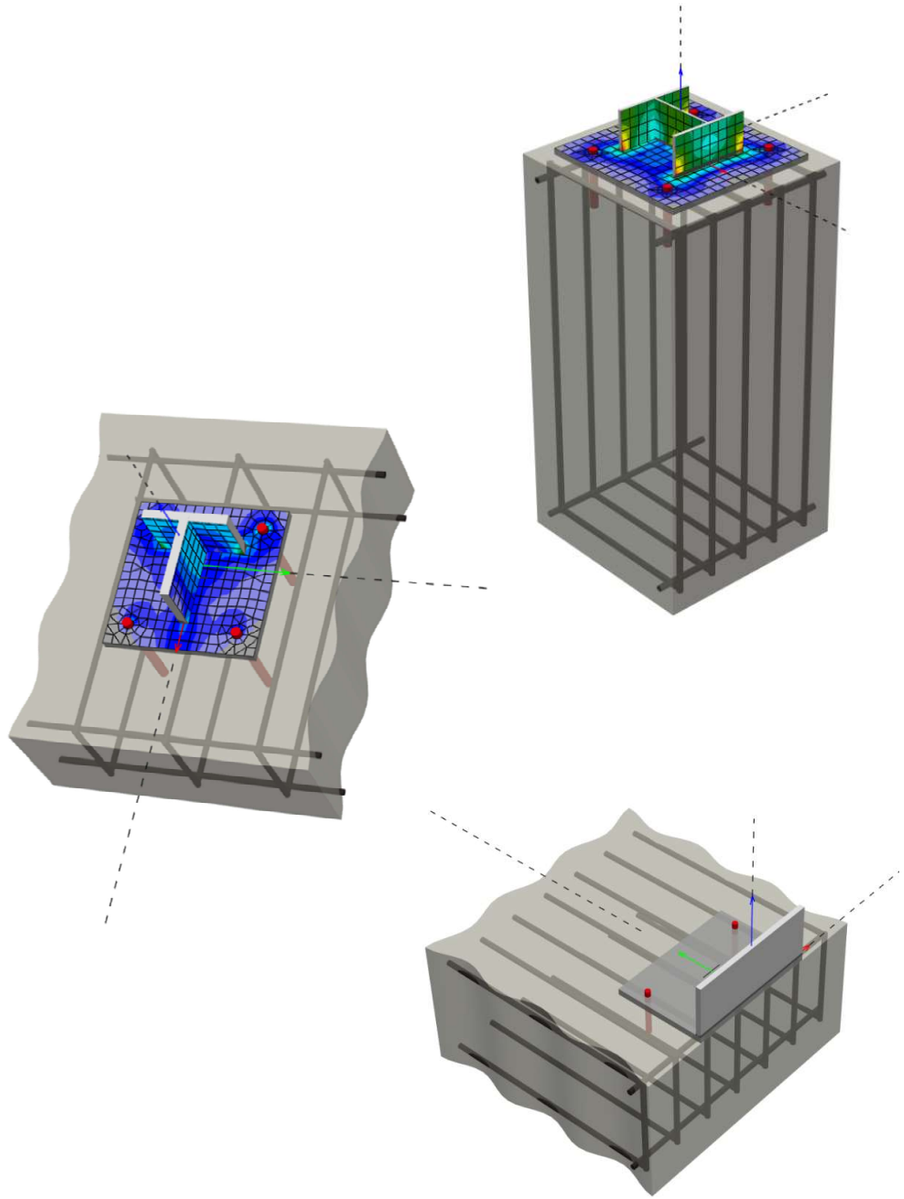


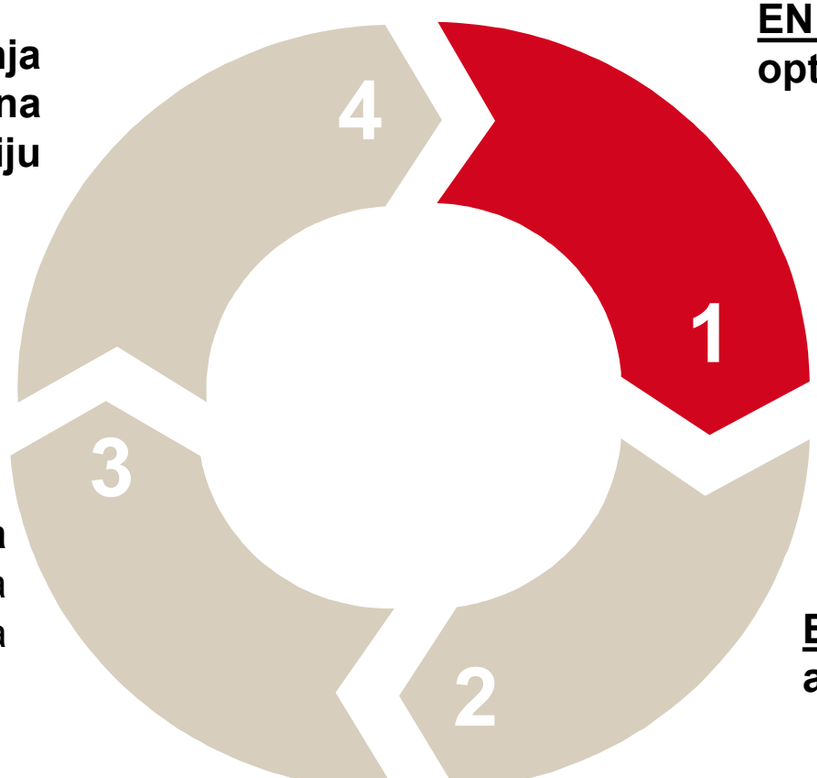
ANKETA 2:

KOJI METOD PRORAČUNA KORISTITE ZA ANKERE KOJI SE NAKNADNO UGRAĐUJU?

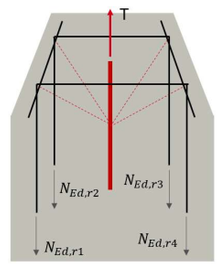
Ručni proračun
Excel fajl
Odgovarajući softver
Profis engineering

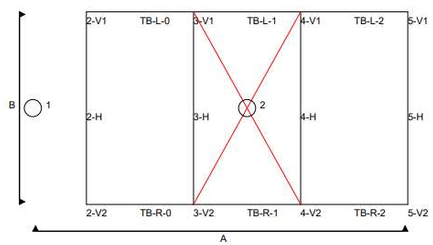
PRORAČUN DODATNE ARMATURE – ZATEZANJE

<u>EN1992-1-1</u> prenos opterećenja sa dodatne armature na konstrukciju

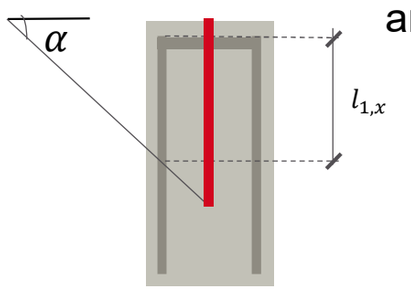


<u>EN1992-4</u> prenos opterećenja na armaturu:





<u>EN1992-4</u> provera armature: dužina ankerisanja

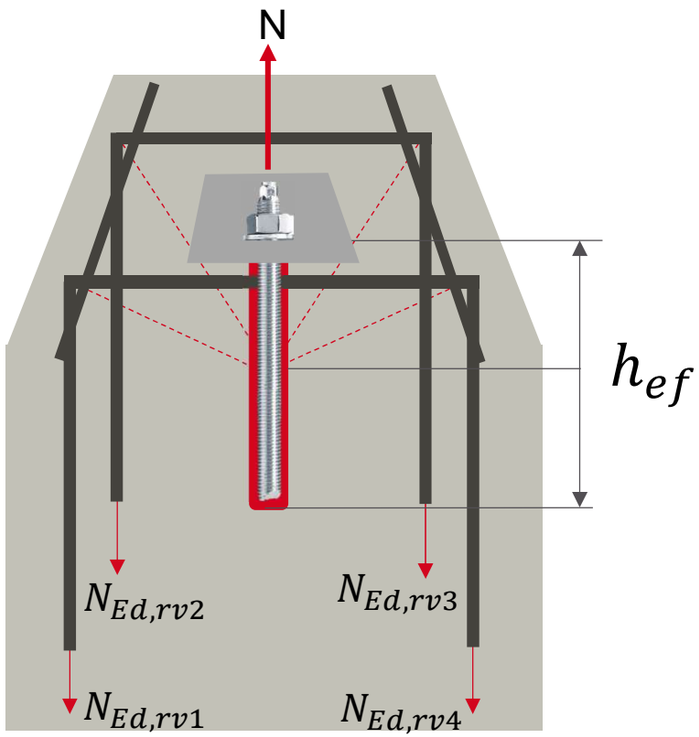


<u>EN1992-4</u> provera armature: presek

$$N_{\mathrm{Rk,re}} = \sum_{i=1}^{n_{\mathrm{re}}} A_{\mathrm{s,re,i}} \cdot f_{\mathrm{yk,re}}$$

1) UTICAJI KOJI SE PRENOSE NA ARMATURU

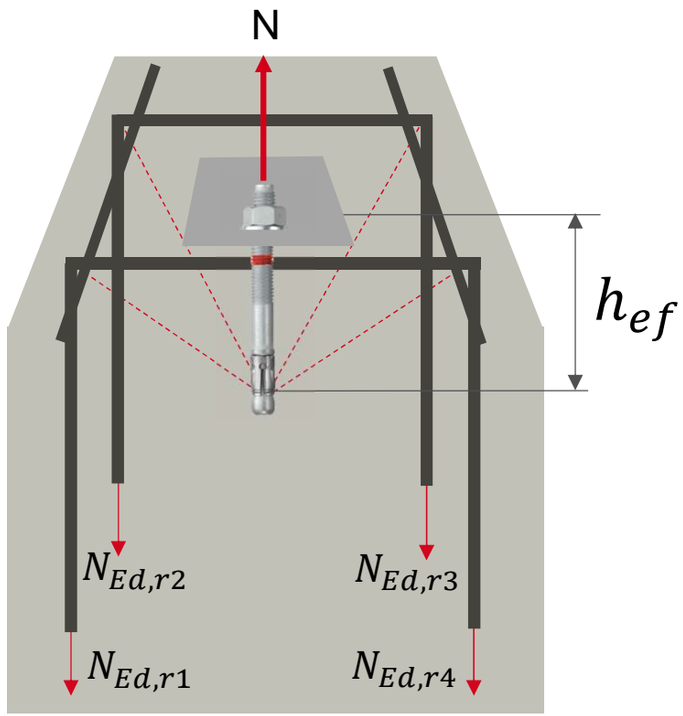
Hemijsi ankeri



Pritisak - beton

Zatezanje - armatura

Mehanički ankeri



Pritisak - beton

Zatezanje - armatura

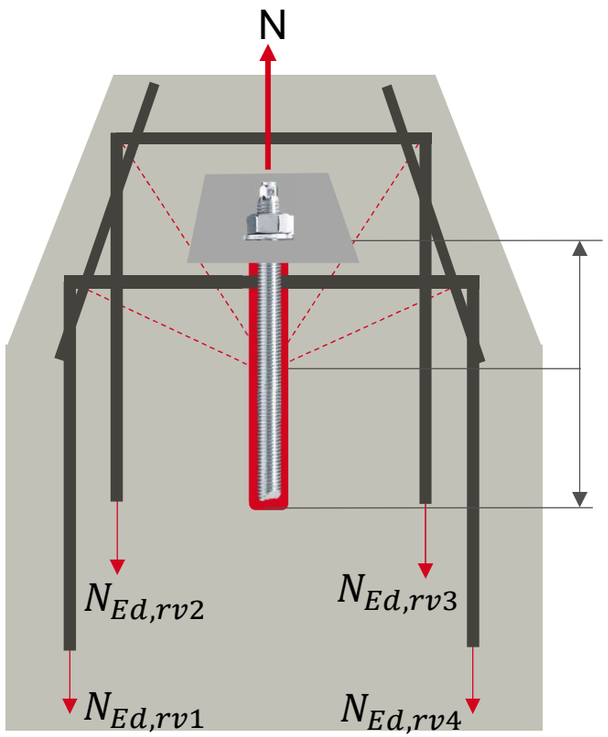
Korisno:

Hemijski ankeri: distribucija napona od $h_{ef}/2$

Mehanički ankeri: distribucija napona od h_{ef}

1) UTICAJI KOJI SE PRENOSE NA ARMATURU

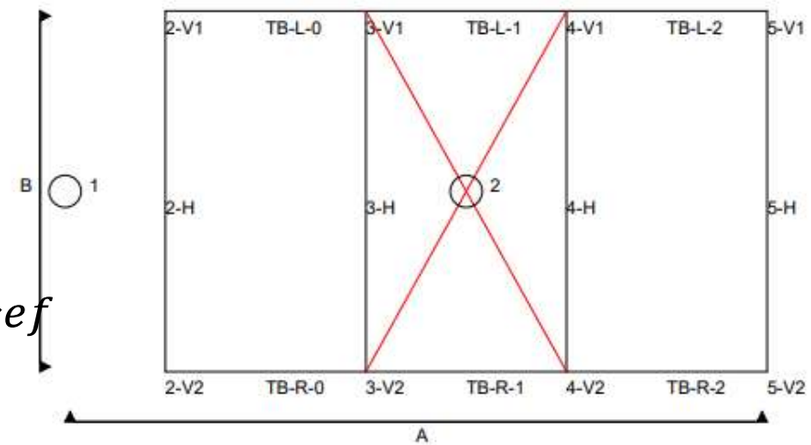
Model



Pritisak - beton

Zatezanje - armatura

Pogled odozgo



$N_{Ed,r1} = 10.7kN$

$N_{Ed,r2} = 10.7kN$

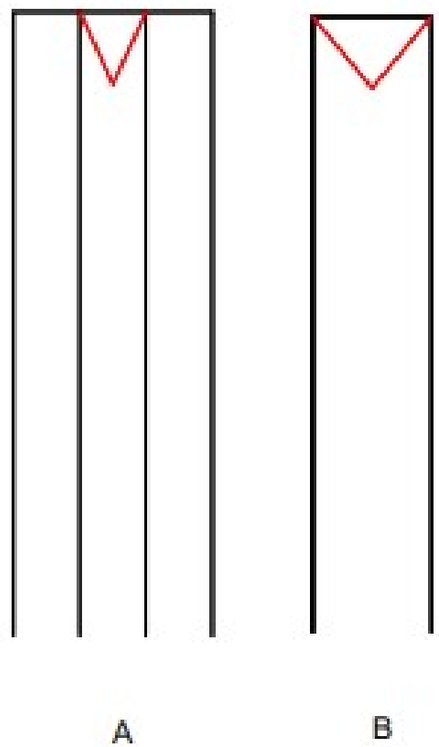
$N_{Ed,r3} = 10.7kN$

$N_{Ed,r4} = 10.7kN$

$N_{Ed,rh1} = 4.4kN$

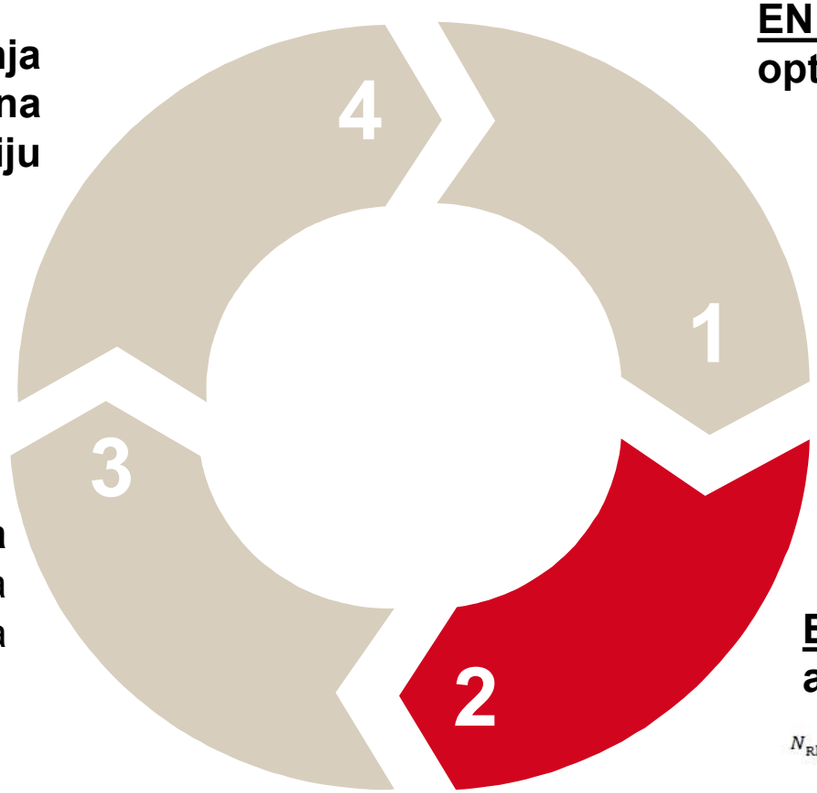
$N_{Ed,h2} = 7.9kN$

Pogled sa strane

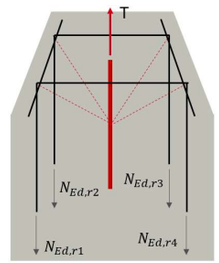


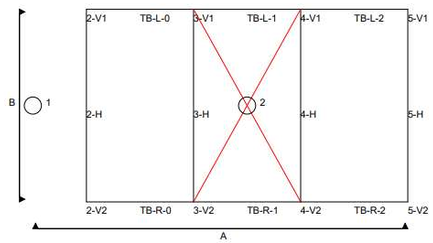
PRORAČUN DODATNE ARMATURE – ZATEZANJE

<u>EN1992-1-1</u> prenos opterećenja sa dodatne armature na konstrukciju

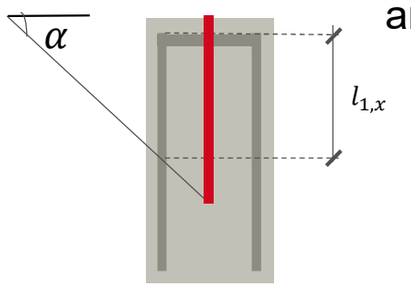


<u>EN1992-4</u> prenos opterećenja na armaturu:





<u>EN1992-4</u> provera armature: dužina ankerisanja



<u>EN1992-4</u> provera armature: presek

$$N_{\mathrm{Rk,re}} = \sum_{i=1}^{n_{\mathrm{re}}} A_{\mathrm{s,re,i}} \cdot f_{\mathrm{yk,re}}$$

2) NOSIVOST ARMATURE

Čvrstoća čelika dodatne armature

Armatura ø10 $f_{yk} = 500N/mm^2$

Uzengije ø10 $f_{yk} = 500N/mm^2$

$$N_{Rd,re} = 1 \cdot 79 \cdot 500/1.15 = 49.2kN > N_{Rd,a,1} = 30.03kN$$

$N_{Ed,r1} = 10.7kN \leq 30.03kN$

$N_{Ed,r2} = 10.7kN \leq 30.03kN$

$N_{Ed,r3} = 10.7kN \leq 30.03kN$

$N_{Ed,r4} = 10.7kN \leq 30.03kN$

$N_{Ed,rh1} = 4.4kN \leq 30.03kN$

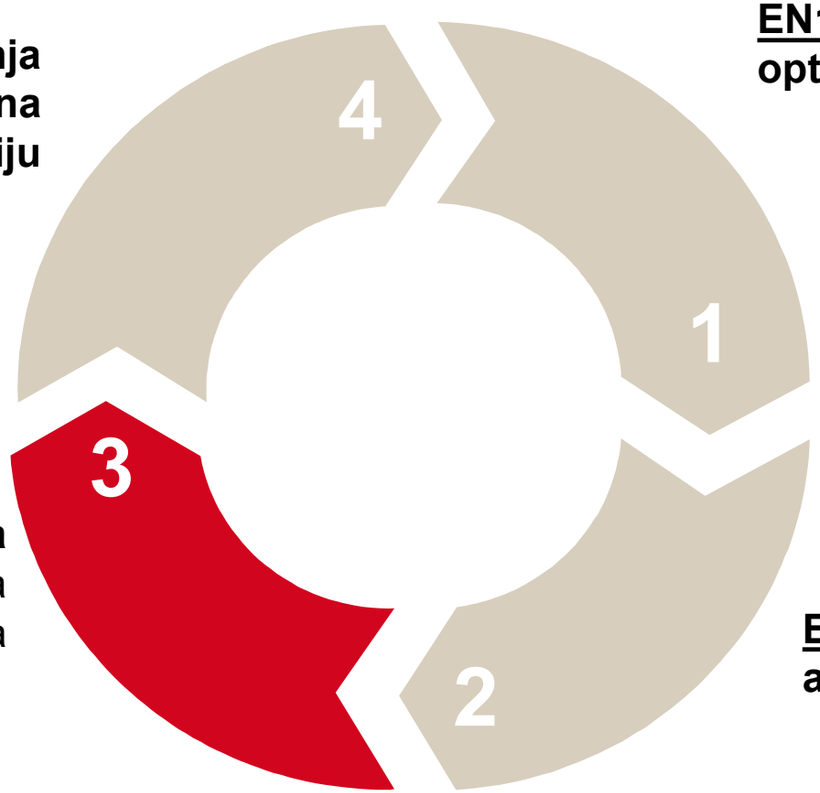
$N_{Ed,h2} = 7.9kN \leq 30.03kN$

OK!

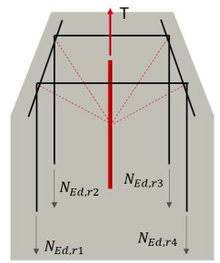
U PROFIS ENGINEERING-u se proverava svaka šipka armature i prikazuje max iskorišćena

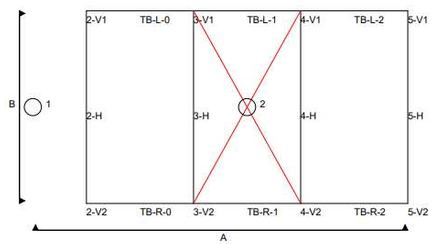
PRORAČUN DODATNE ARMATURE – ZATEZANJE

<u>EN1992-1-1</u> prenos opterećenja sa dodatne armature na konstrukciju

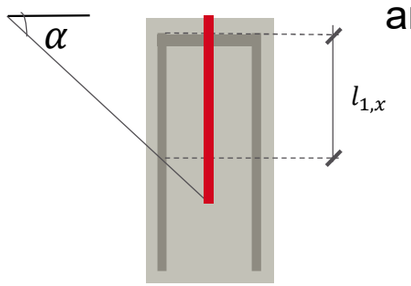


<u>EN1992-4</u> prenos opterećenja na armaturu:





<u>EN1992-4</u> provera armature: dužina ankerisanja

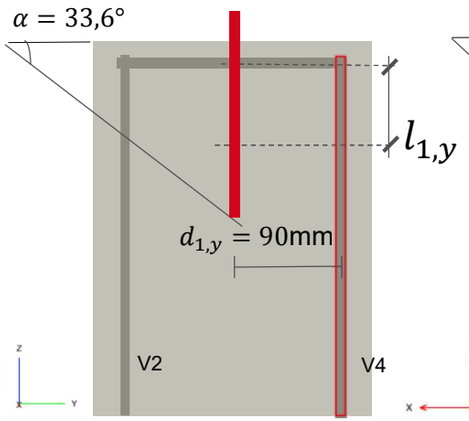


<u>EN1992-4</u> provera armature: presek

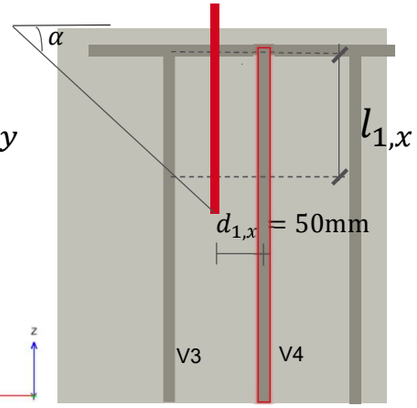
$$N_{Rk,re} = \sum_{i=1}^{n} A_{s,re,i} \cdot f_{yk,re}$$

3) NOSIVOST ARMATURE – DUŽINA ANKERISANJA

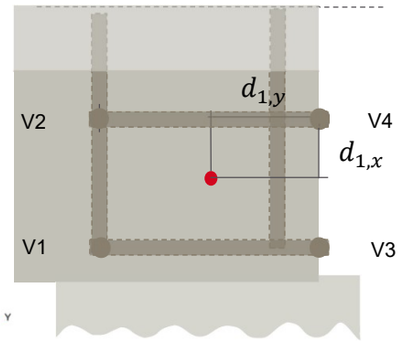
Pogled spreda



Pogled sa strane



Pogled odozgo



$$N_{Rd,a} = \sum_{i=1}^{n_{re}} N^0_{Rd,a}$$

where

$$N^0_{Rd,a} = \frac{l_1 \cdot \pi \cdot \phi \cdot f_{bd}}{\alpha_1 \cdot \alpha_2} \le A_{s,re} \cdot f_{yk,re} \cdot \frac{1}{\gamma_{Ms,re}}$$

Iz tabele 8.2 $\alpha_1 = 1$ $\alpha_2 = 0{,}7$

Table 8.2: Values of α_1, α_2, α_3, α_4 and α_5 coefficients

Influencing factor	Type of anchorage	Reinforcement ba
		In tension
Shape of bars	Straight	$\alpha_1 = 1{,}0$
	Other than straight (see Figure 8.1 (b), (c) and (d)	$\alpha_1 = 0{,}7$ if $c_d > 3\phi$ otherwise $\alpha_1 = 1{,}0$ (see Figure 8.3 for values of c_d)
Concrete cover	Straight	$\alpha_2 = 1 - 0{,}15\,(c_d - \phi)/\phi$ $\ge 0{,}7$ $\le 1{,}0$
	Other than straight (see Figure 8.1 (b), (c) and (d))	$\alpha_2 = 1 - 0{,}15\,(c_d - 3\phi)/\phi$ $\ge 0{,}7$ $\le 1{,}0$ (see Figure 8.3 for values of c_d)
Confinement by		

l_1 se može odrediti preko trigonometrije :

$\alpha = \tan^{-1}(1/1.5) = 33.6^{\circ}$ (uvek)

$$l_{1,x} = h_{ef} - c_{top} - d_1 \tan\alpha = 248mm \ge 4\emptyset$$

$$l_{1,y} = h_{ef} - c_{top} - d_1 \tan\alpha = 222\ mm \ge 4\emptyset$$

$$N_{Rd,a,x} = \frac{l_1 \pi \emptyset f_{bd}}{\alpha_1 \alpha_2} = \frac{248 \cdot \pi \cdot 10 \cdot 3.04}{1 \cdot 0.7} = 43.9kN$$

$$N_{Rd,a,y} = \frac{l_1 \pi \emptyset f_{bd}}{\alpha_1 \alpha_2} = \frac{222 \cdot \pi \cdot 10 \cdot 3.04}{1 \cdot 0.7} = 30.3kN$$

$$N_{Rd,a} = min\left(N_{Rd,a,x}, N_{Rd,a,y}\right)$$

$N_{Rd,a,1} = 30.3kN > N_{Ed,a,1} = 10.7kN$ **OK!**

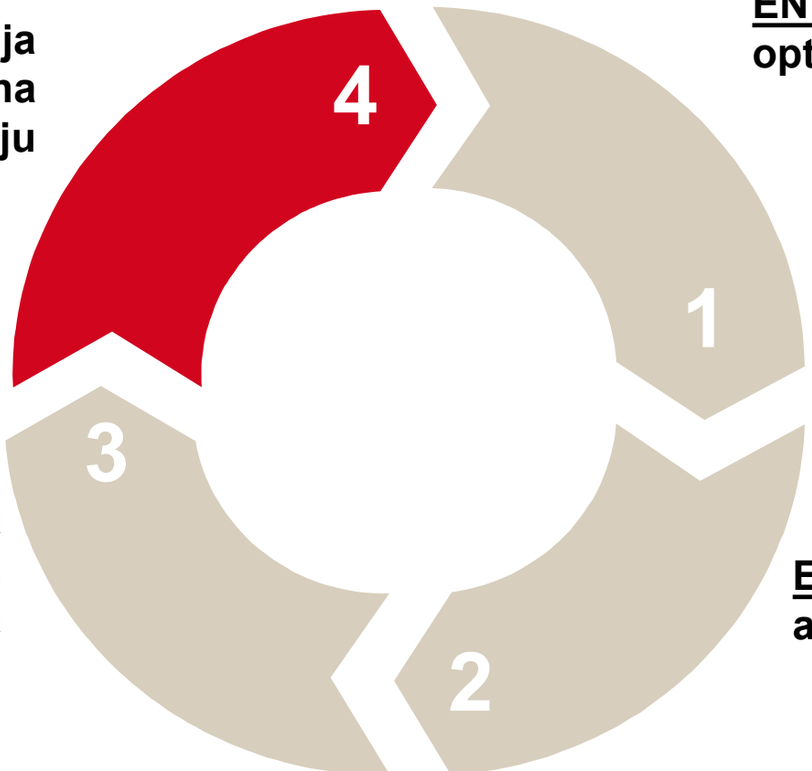
$N_{Rd,a,2} = 30.3kN > N_{Ed,a,2} = 10.7kN$ **OK!**

U PROFIS Engineering-u je svaka armatura proverena, i prikazana je najveća iskorišćenost .

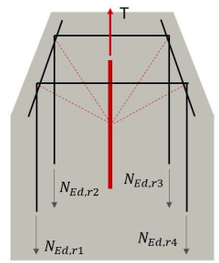
Note: Što je armatura udaljenija od ankera: manje je l_1, manja je i nosivost ankera !

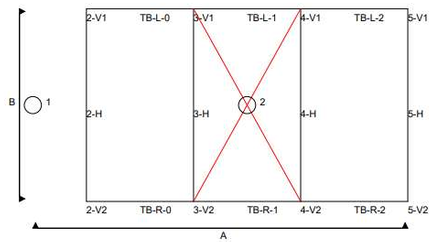
PRORAČUN DODATNE ARMATURE – ZATEZANJE

<u>EN1992-1-1</u> prenos opterećenja sa dodatne armature na konstrukciju

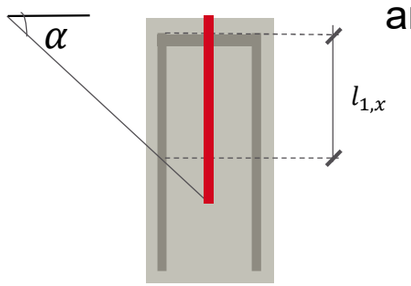


<u>EN1992-4</u> prenos opterećenja na armaturu:





<u>EN1992-4</u> provera armature: dužina ankerisanja



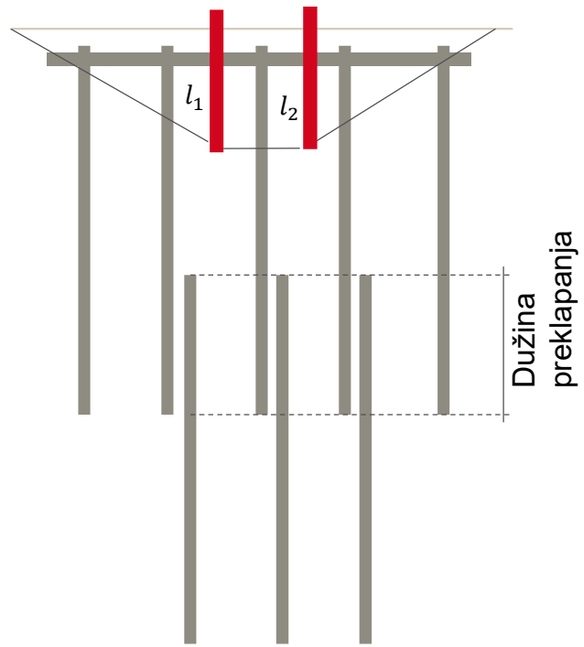
<u>EN1992-4</u> provera armature: presek

$$N_{\mathrm{Rk,re}} = \sum_{i=1}^{n_{\mathrm{re}}} A_{\mathrm{s,re,i}} \cdot f_{\mathrm{yk,re}}$$

4) PRENOS OPTEREĆENJA SA DODATNE ARMATURE NA KONSTRUKCIJU

Evrokod 2-4 proračunava dodatnu armaturu koja sprečava lom betona. **Prenošenjem opterećenja na armaturu stvaraju se dodatni naponi koji se moraju rasporediti.**

Evrokod 2-1-1 definiše prenos uticaja iz armature na beton.



PROFIS Engineering daje potrebnu dužinu preklapanja samo kao predlog, odluku donosi inženjer:

Splice length outside of the assumed failure cone

$$l_0 = \alpha_1 \cdot \alpha_6 \cdot l_b \cdot = \alpha_1 \cdot \alpha_6 \cdot \frac{d_{s,re}}{4} \cdot \frac{f_{yk,re}}{\gamma_{Ms,re} \cdot f_{bd}} \cdot \frac{\sigma_{s,re}}{f_{yk,re}} \geq l_{0,min} \quad \textit{(Eurocode 2-1-1)}$$

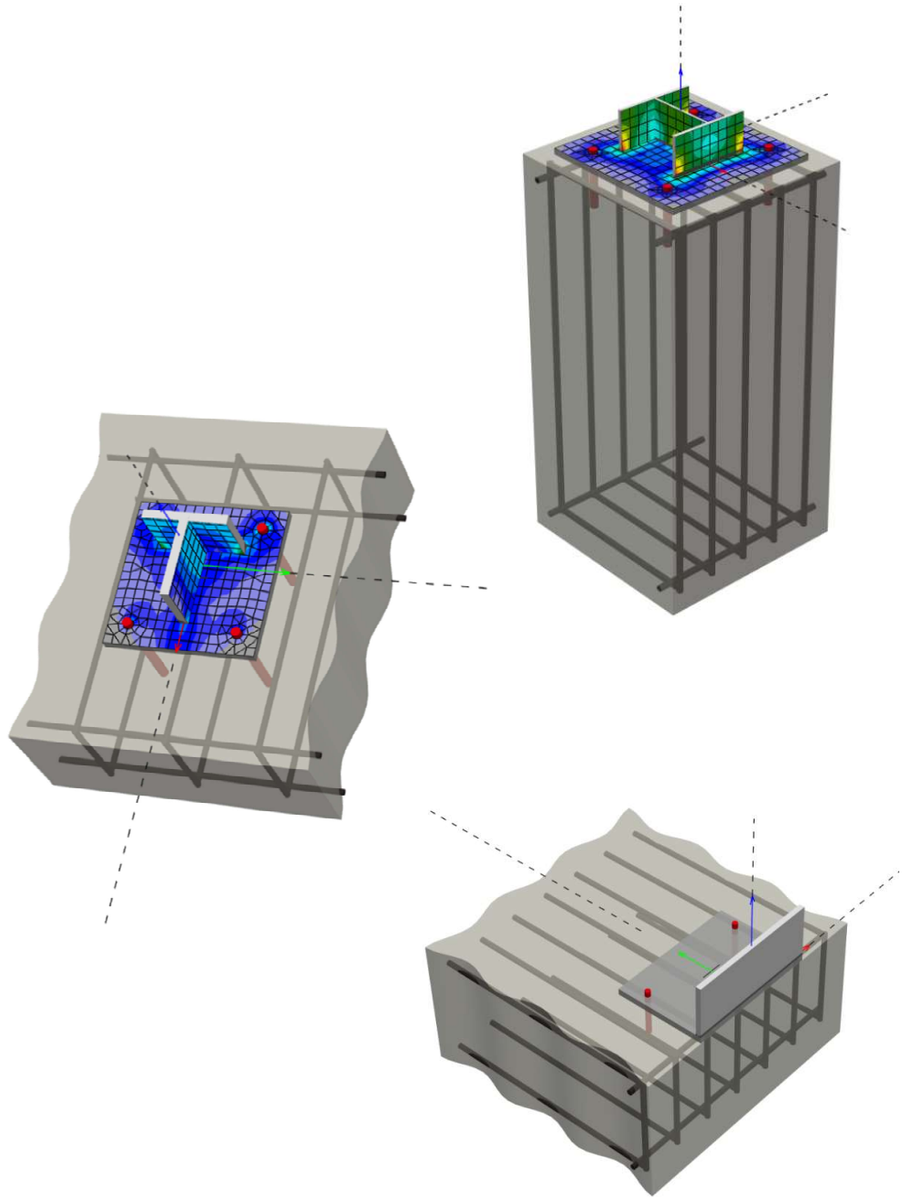
$$l_{0,min} = \max(0.3 \cdot \alpha_6 \cdot l_{b,rqd} , 15 \cdot d_{s,re} , 200.0 \text{ mm})$$

$$l_{b,rqd} = \frac{d_{s,re}}{4} \cdot \frac{f_{yk,re}}{\gamma_{Ms,re} \cdot f_{bd}}$$

VAŽNO:
Ako ne postoji dužina armature za prenos opterećenja, na kraju armature bi došlo do loma po betonu. PROFIS to ne može da proveri , jer bi u tom slučaju bilo potrebno modelovati celu konstrukciju.

AGENDA

- Uvod
- Eurocode 2-4/2019 regulativa
- Osnovni principi proračuna
- Koraci proračuna
- **Primeri**
- Vaša pitanja



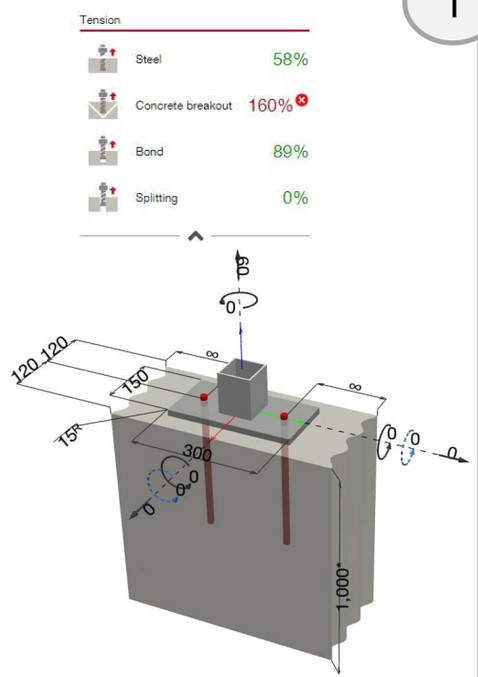
PRIMER 1 – ZATEZANJE / ČUPANJE

Karakteristike:

- Klasa betona: C30/37
- Beton širina: 240 mm
- Ankerna ploča: 300x150mm
- N = 60kN

- Rastojanje od ivice y: ∞
- Rastojanje u y pravcu : 200mm
- Rastojanje od ivice x: 120mm

1



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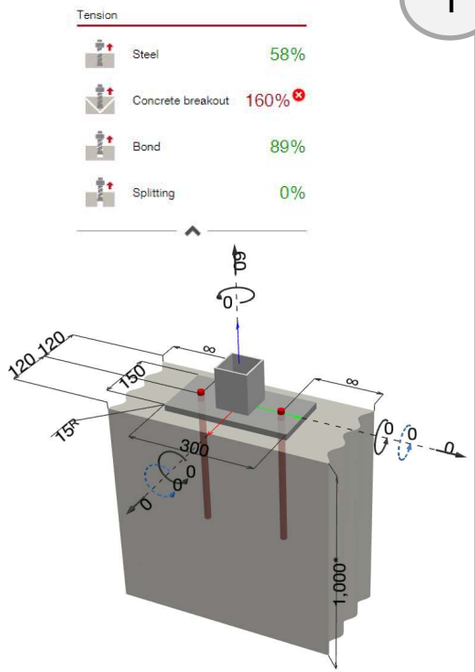
1



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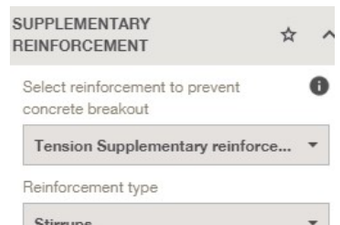
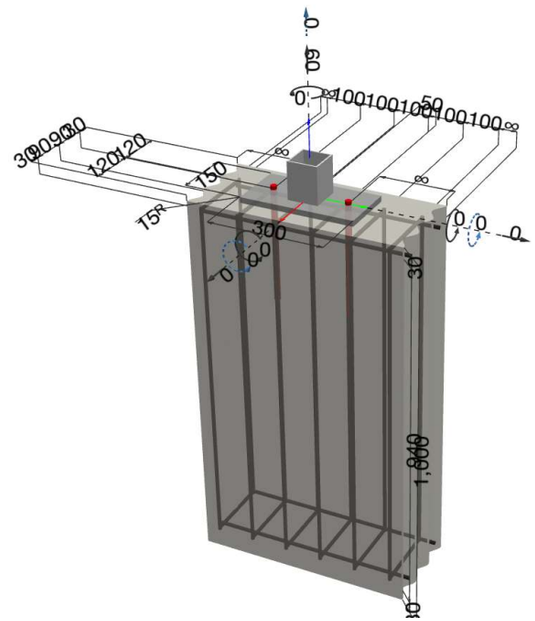
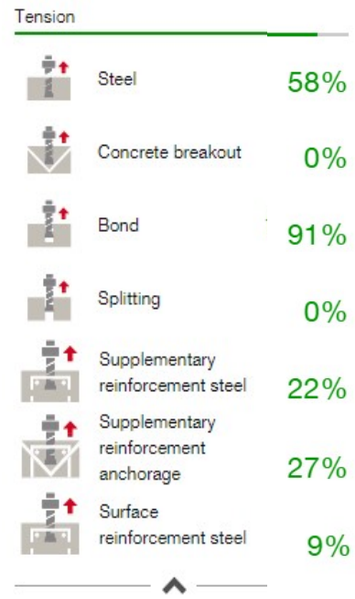
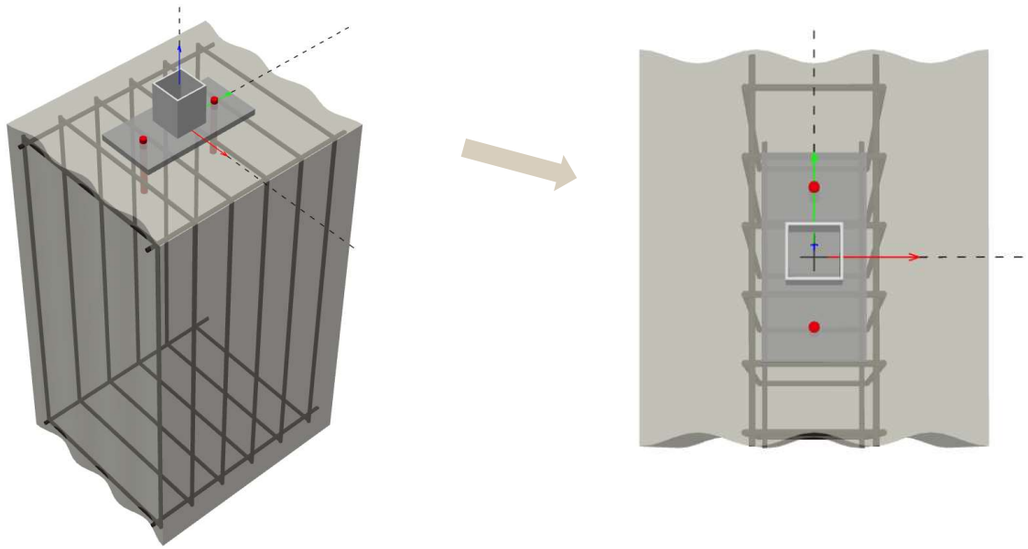






DODATNA ARMATURA NEĆE BITI UZETA U OBZIR UKOLIKO:

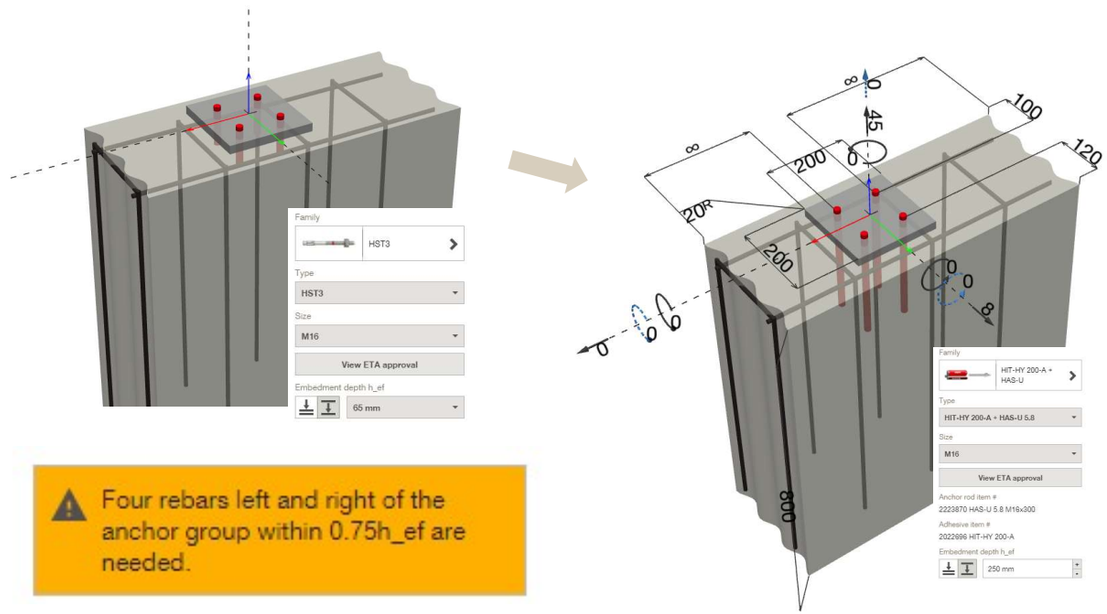
Armatura udaljena više od $0.75h_{ef}$



The anchorage length inside the concrete cone breakout body is insufficient. A minimum length of 40 mm is required.

Pomeriti ojačanje bliže ankeru

Armatura udaljena više od $0.75h_{ef}$



Izabrati anker sa većom h_{ef}

PRIMER 2 – SMICANJE

DESIGN PARAMETER:

- Klasa betona: C25/30
- Greda: 200x600mm
- Ankerna ploča: 300x300mm
- Ved=55kN

- Udaljenje od ivice x: ∞
- Rastojanje x: 200mm
- Udaljenje od ivice y: 200mm
- Rastojanje y: 200mm

Type

HIT-HY 200-A + HAS-U 8.8

Size

M16

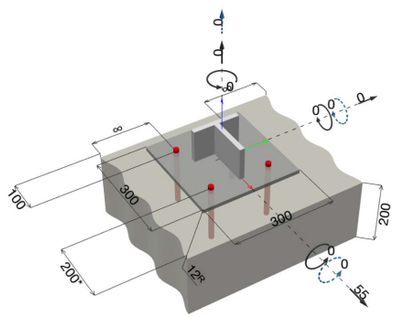
Embedment depth h_ef

164 mm

1

Shear

Steel	28%
Concrete edge breakout	133%
Pryout	50%



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- Ved=55kN

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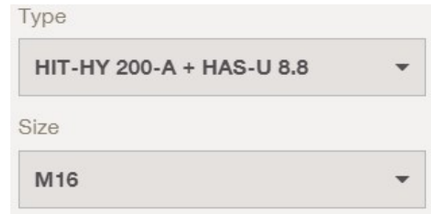
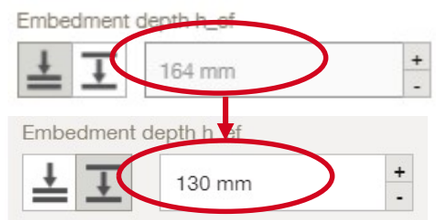
- Rastojanje x: 200mm
- Udaljenje od ivice y: 200mm
- Rastojanje y: 200mm





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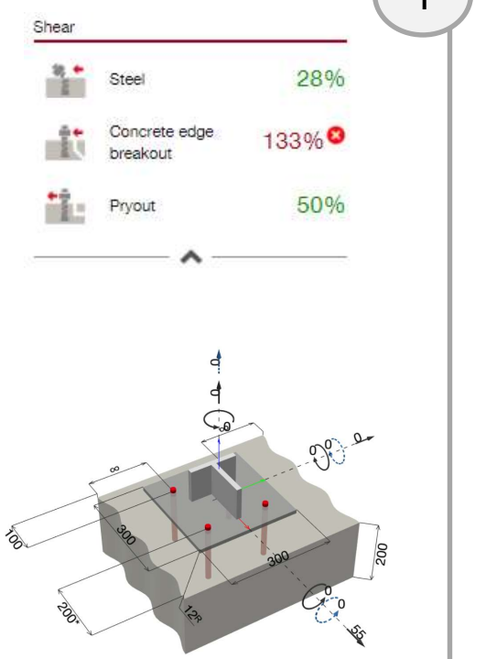
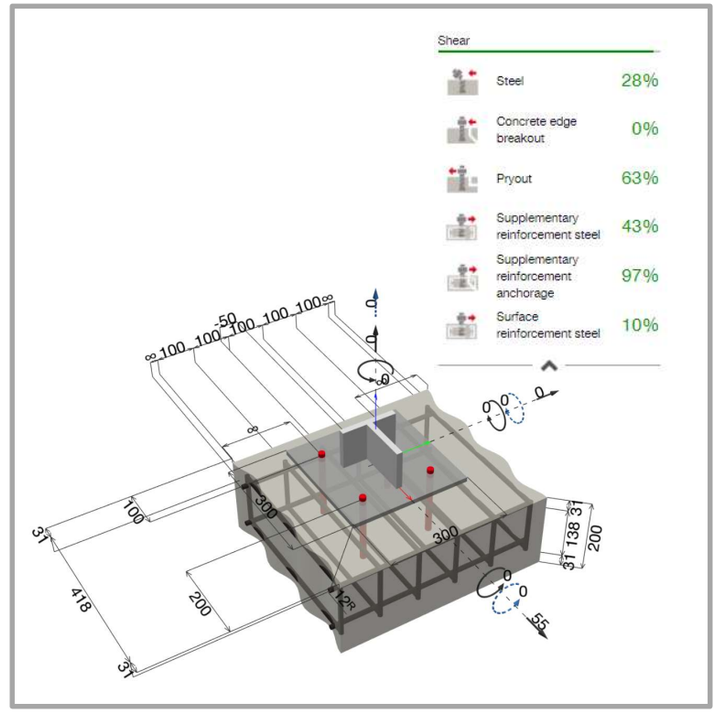


3

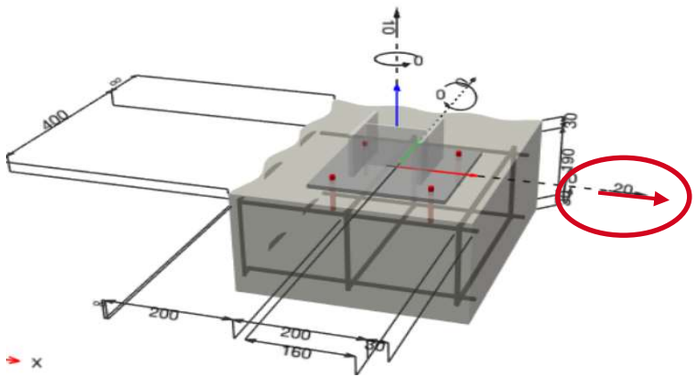
DODATNA ARMATURA.

- Tip: Uzengije
- Prečnik: 12mm
- Razmak: 100mm
- Iskorišćenost armature: 0%
- Tolerancija: 0mm
- Smer betoniranja: Z+
- Ofset: 50mm
- C-ivica: 25mm
- C-gornja pov.: 25mm



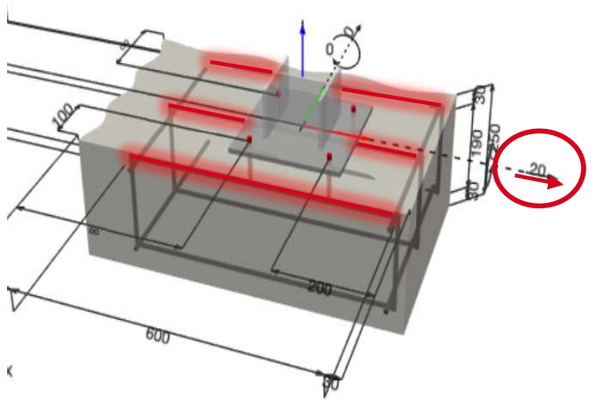
SLUČAJEVI KADA PROFIS NE RADI PRORAČUN ZA DODATNU ARMATURU

Primer:



Shear

Steel	28%
Concrete edge breakout	174%
Pryout	20%
Supplementary reinforcement steel	0%
Supplementary reinforcement anchorage	0%
Surface reinforcement steel	0%



Shear

Steel	28%
Concrete edge breakout	36%
Pryout	27%
Supplementary reinforcement steel	43%
Supplementary reinforcement anchorage	84%
Surface reinforcement steel	11%

Rotation

270 °

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Armatura nije postavljena u pravcu delovanja sile smicanja.

Rešenje: postaviti armaturu u pravcu delovanja sile.

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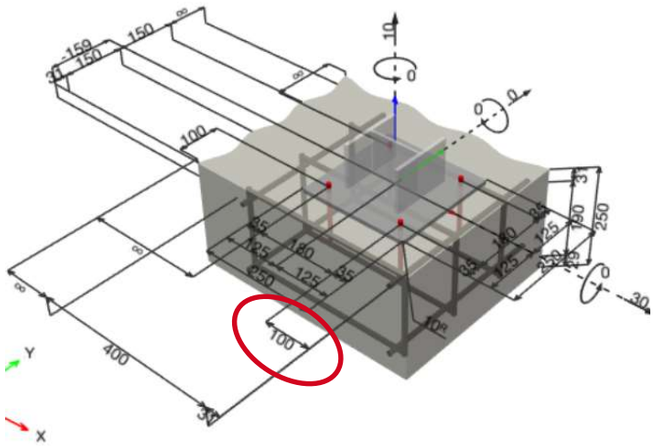
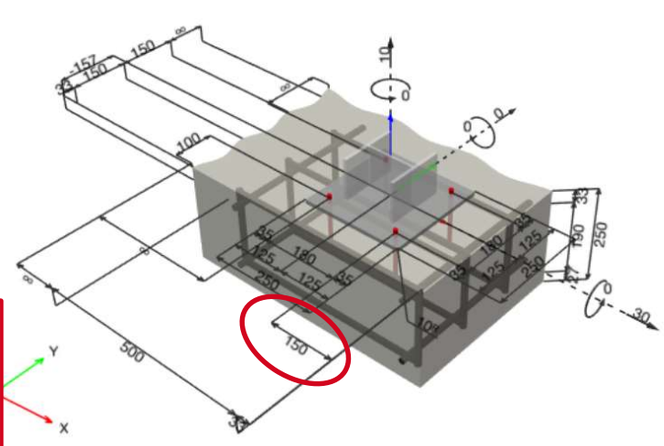


$$l_1 = c_1 - c_{edge} - d_1 \tan\alpha \geq 4\emptyset$$

Shear

Steel	50%
Concrete edge breakout	236%
Pryout	26%
Supplementary reinforcement steel	0%
Supplementary reinforcement anchorage	0%
Surface reinforcement steel	0%



Shear

Steel	50%
Concrete edge breakout	44%
Pryout	28%
Supplementary reinforcement steel	17%
Supplementary reinforcement anchorage	96%
Surface reinforcement steel	7%

Prevelik razmak između ankera i armature ili premali razmak između ankera i ivice

Min. Prava šipka $l_1 \leq 10\emptyset$

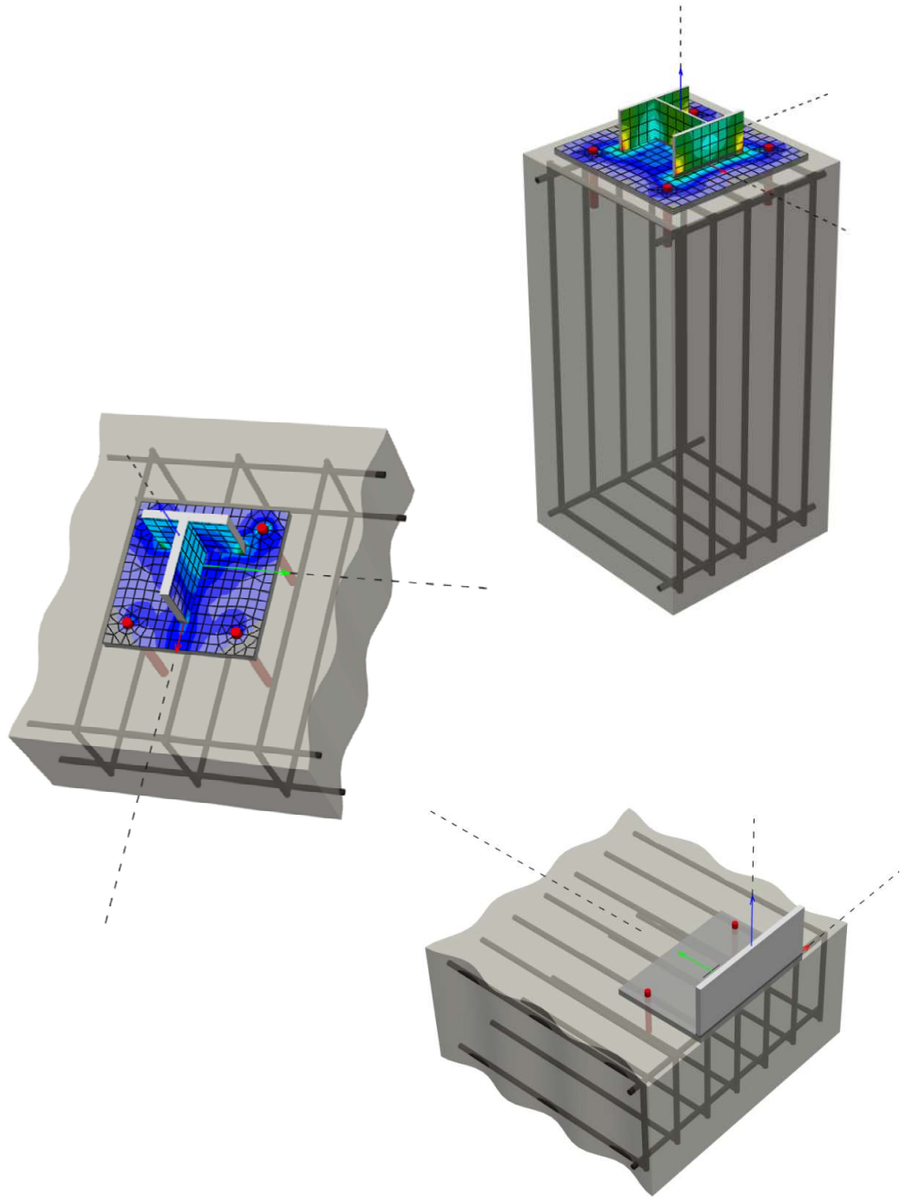
Min Uzengija $l_1 \leq 4\emptyset$

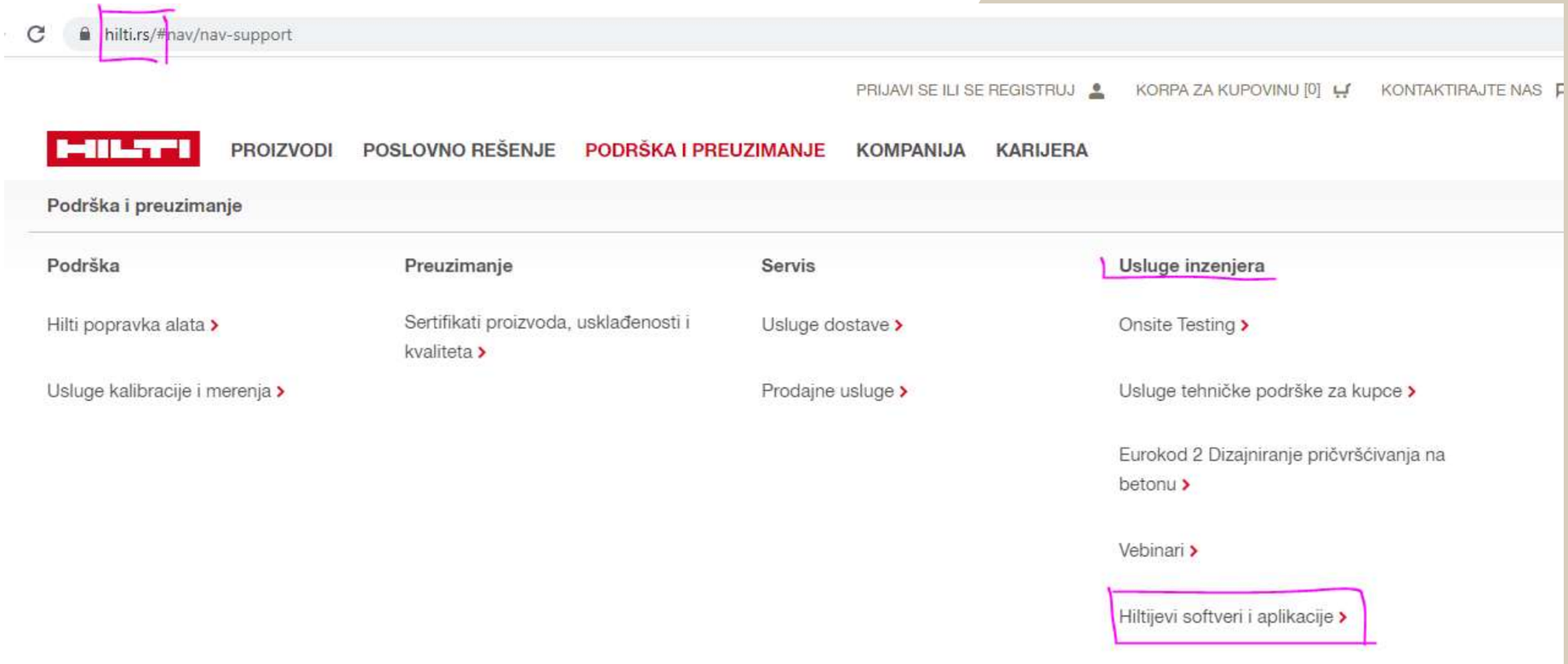
Rešenje 1: Povećati dubinu ankerisanja i/ili smanjiti rastojanje između ankera i armature

Rešenje 2: Udaljiti ankere od ivice

AGENDA

- Introduction
- Eurocode 2-4/2019 regulatory
- Calculation principles
- Design examples
- Software demo
- Vaša pitanja





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Q&A

HVALA