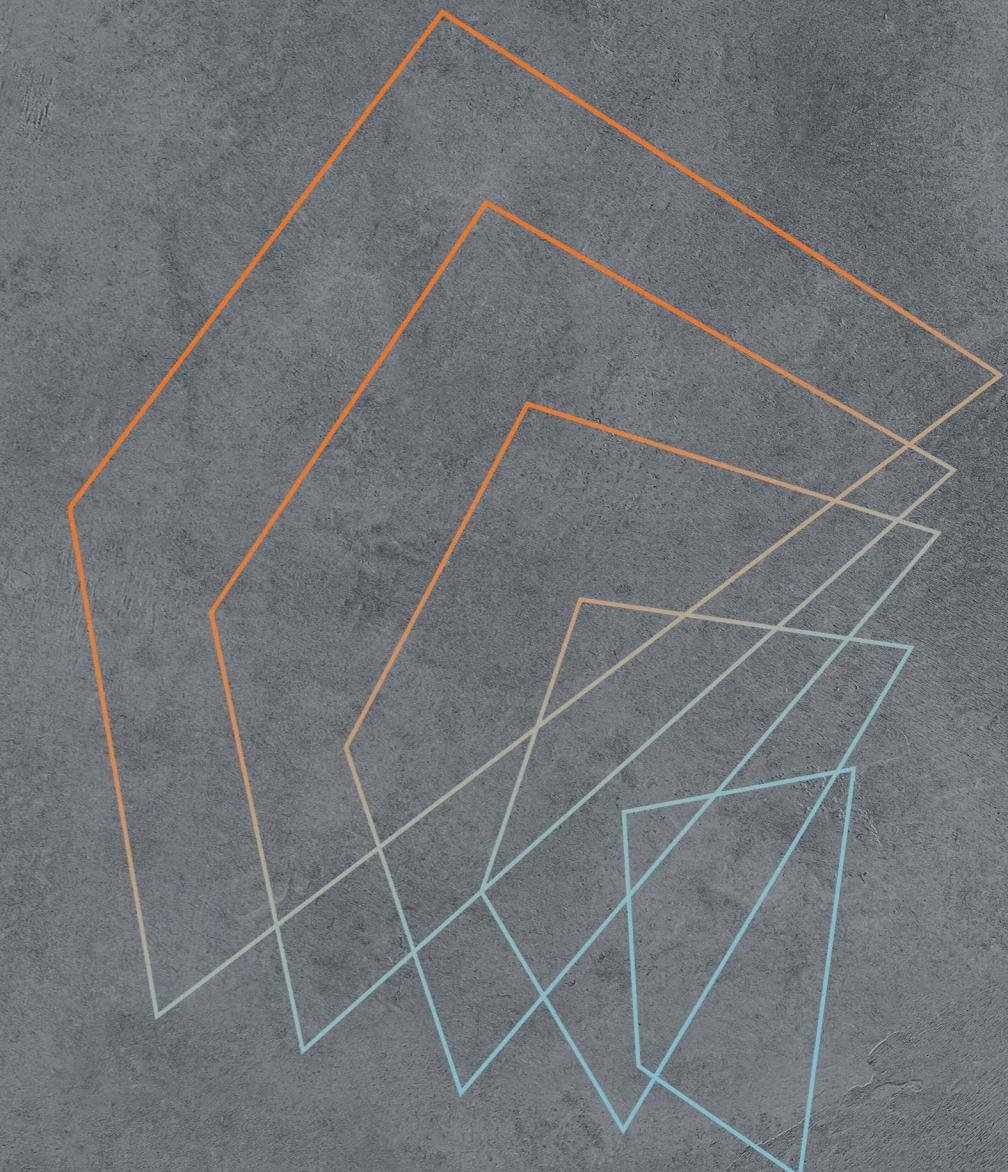




- PREDNAPREGNUTE ŠUPLJE PLOČE
- PRESTRESSED HOLLOW CORE SLABS



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M O B E C O

MONTAŽNE
BETONSKE
KONSTRUKCIJE



SADRŽAJ CONTENT

| | |
|--|--------------|
| Uvod / Introduction | 1-2 |
| Karakteristike montažnih elemenata Opportunities for Prefabrication | 3-4 |
| Šuplje ploče - Opšte karakteristike Hollow core slabs - General characteristics | 5-18 |
| Tipovi šupljih ploča Type of hollow core slabs | 19-20 |
| Echo - tabele nosivosti Echo - tables of capacity | 21-28 |
| Elematic - tabele nosivosti Elematic - tables of capacity | 29-34 |
| Bezbednost i rukovanje Safety and handling | 35-38 |
| Detalji veza Connection details | 39-44 |

■ UVOD / ■ INTRODUCTION

Jedna desetina svetske privrede obuhvata izgradnju i organizaciju stambenih i komercijalnih objekata. Ovaj sektor troši više materijala za izgradnju, minerala, vode i struje nego preostalih 90% privrede. Upravo zbog toga, tokom svih faza izgradnje, neophodan je nov pristup koji će zadovoljiti sve veće ljudske potrebe, a pritom očuvati i zaštititi životnu sredinu i prirodne resurse.

Projektovanje za potrebe održivog razvoja uključuje upotrebu građevinskog materijala koji ispunjavaju nove zahteve fleksibilnosti i prilagodljivosti, štednju energije tokom gradnje i upotrebe objekata, ekološku demontažu i recikliranje umesto rušenja uz prisustvo buke i prašine.



One tenth of the world's economy goes towards building and managing housing and commercial property. This sector accounts for more wood, minerals, water and electricity than the remaining 90 percent of the economy. Therefore new approaches in all life stages of buildings are needed, which will meet the challenges of satisfying the growing human needs while conserving and protecting the environmental quality and natural resources.

Designing for sustainable development involves the use of building materials that meet new requirements of flexibility and adaptability, energy conservation during construction and use of facilities, environmental disassembly and recycling instead of demolition in the presence of noise and dust.



Karakteristike montažnih elemenata / Opportunities for prefabrication

Betonske konstrukcije, posebno montažni elementi, imaju odlične performanse koje mogu da zadovolje sadašnje i buduće zahteve koji se tiču očuvanja životne sredine. Proizvodnja montažnih betonskih elemenata se odvija u kontrolisanim klimatskim uslovima u zatvorenim fabrikama. Na taj način je kontrola otpada, emisije i nivoa buke lako uporediva sa istim procesom koji se odvija na gradilištu. Upravo zbog toga je nelagodnost znatno smanjena u poređenju sa klasičnim graditeljskim metodama.

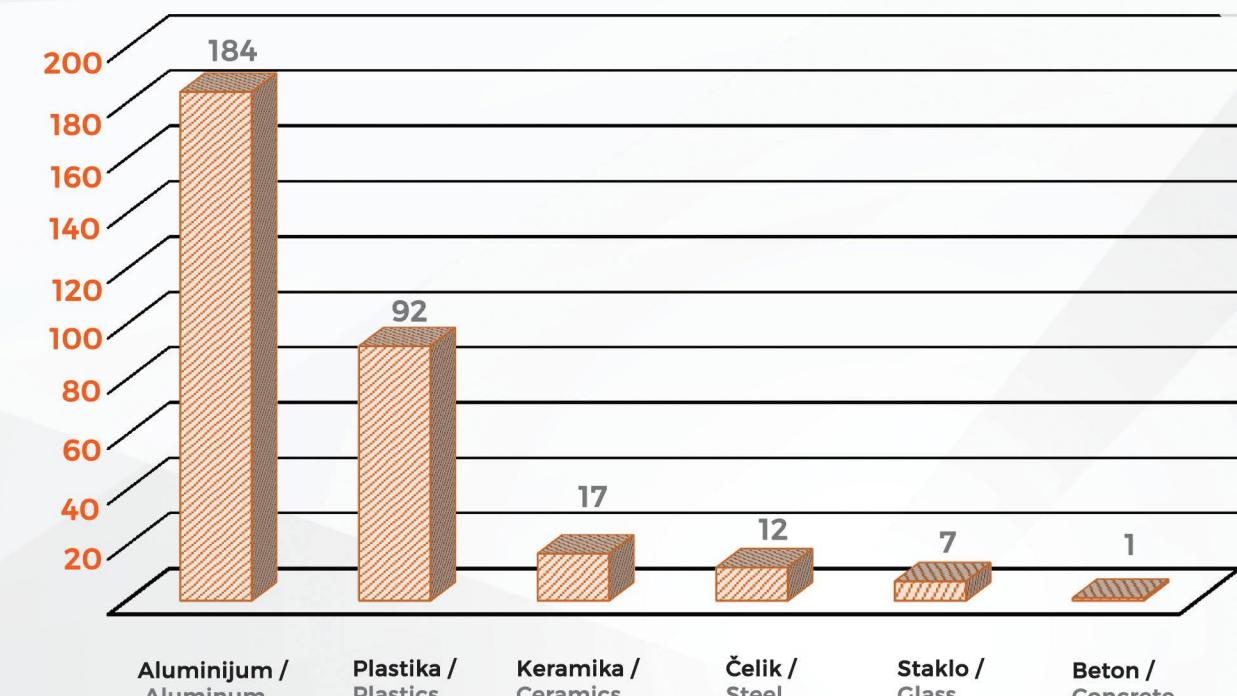
Pri fabričkoj proizvodnji, okruženje u kojima radnici rade se lako kontroliše. Takođe, recikliranje materijala je neuporedivo jednostavnije u fabričkim uslovima.

Concrete structures in general and prefabrication in particular have excellent opportunities to respond to the present and future environmental demands. The production of precast concrete elements takes place under controlled climatic conditions in enclosed factories. This makes control with waste, emissions and noise levels easy compared to the same processes at the building site. Consequently the inconvenience to the public is greatly reduced in comparison with traditional building methods.

With factory production, the environment for the workers is easily controlled. Also recycling of all materials is comparatively simple to achieve in a closed factory environment.



Beton kao materijal poseduje dosta ekoloških prednosti. Izdržljiv je, te ne zahteva toksične prezervative koji sprečavaju njegovo propadanje. U industrijalizovanim zemljama, korozija čelika košta oko 4% bruto nacionalnog proizvoda, a polovina svetske godišnje proizvodnje čelika se koristi da bi se zamenile korodirane konstrukcije. Energija koju troši beton je izuzetno mala u poređenju sa drugim materijalima (Grafikon 1.). Iskorišćenje termalne mase betona će uštedeti do 35% energije koja je neophodna za hlađenje ili grejanje zgrada. Osim toga, betonska masa ima izvanrednu sposobnost zvučne izolacije.



Grafikon 1. - Potrošnja energije za proizvodnju gradevinskih materijala /
Chart 1. - Energy consumption for the production of building materials

Concrete has properties that at the outset are ecologically advantageous. Concrete is durable, and requires no toxic preservatives in order to prevent its deterioration. In industrialized countries corrosion of steel is costing about 4% of the gross national product, and half of the annual steel production in the world is used to replace corroded structures. In addition, the energy consumption of concrete is extremely low, compared to other construction materials (Graphic 1). The utilization of the thermal mass of the concrete will save up to 35% of the energy required to heat or cool buildings. Furthermore, the mass of concrete provides excellent sound insulating properties.

■ ŠUPLJE PLOČE - OPŠTE KARAKTERISTIKE / ■ HOLLOW CORE SLABS - GENERAL CHARACTERISTICS

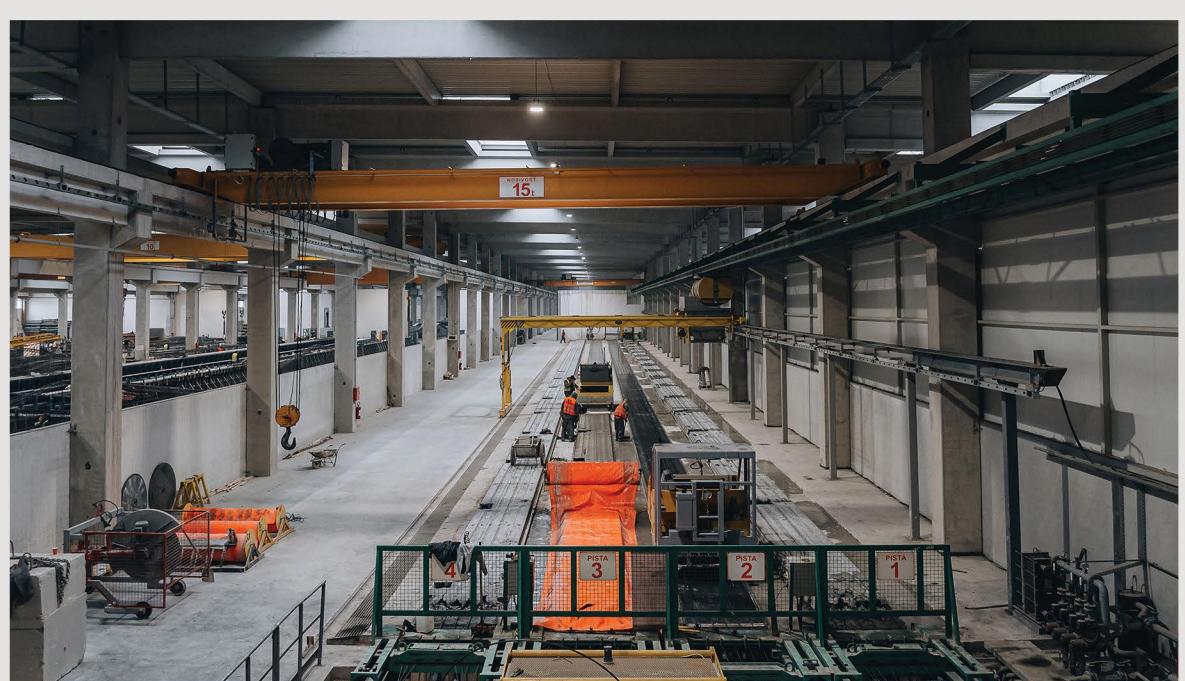
Industrija montažnih betonskih elemenata je stalno u potrazi za novim proizvodima i gradeviškim sistemima koji će zadovoljiti novonastale potrebe i zahteve modernog društva: nedostatak radne snage, konstruktivna efikasnost, otpornost na požar, brzina gradnje, kvalitet izvođenja i održiva gradnja. U tom smislu, jedno od najuspešnijih rešenja su prednapregnute šuplje ploče. One daju odgovor na sadašnje zahteve tržišta i izazove gradevinske industrije. Poseduju konstruktivnu efikasnost, malu potrošnju materijala, visoko automatizovani proces proizvodnje koji je bezbedan po okolini, visoku čvrstoću betona, kao i mogućnost ponovnog korišćenja i recikliranja na kraju upotrebnog veka.



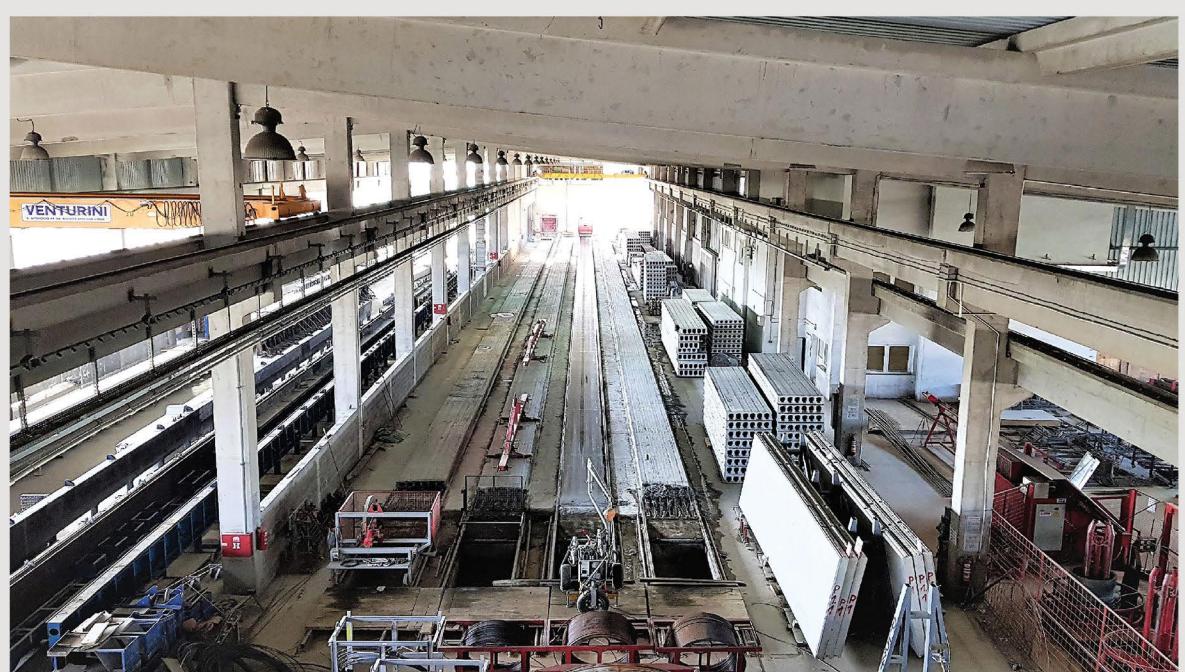
The precast concrete industry is constantly searching for new products and building systems to satisfy the coming needs and demands of our modern society: shortage of labour force, structural efficiency, fire resistance, speed of construction, quality of execution, and last but not least sustainable construction. One of the most remarkable and successfull developments in this context is the prestressed hollow core slab. It provides an answer to most of the present market demands and challenges for the building industry: structural efficiency, low material consumption, highly automated and environmentally friendly production process, high concrete strength, slender floor thickness, and possibilities for reuse and recycling at the end of the life cycle.

Proizvodnja šupljih ploča odvija se na pistama, metodom ekstrudovanja ili vibriranja specijalnog betona uz pomoć kliznih finišera koji formiraju presek ploča sa kontinuiranim unutrašnjim šupljinama. Proizvodna širina ploča je 120cm, dužina je promenljiva, a debljina direktno zavisi od opterećenja i raspona ploča.

The production of hollow core slabs takes place on standard production beds by the method of extrusion or vibrations of special concrete with the help of slipform pavers which form slab section with continual interior holes. The production width of slabs is 120cm, the length is variable, whereby thickness depends on load and the span of slabs.



Slika 1. - Pogon za livenje šupljih ploča - Nova Pazova / Image 1. - Section for casting hollow core slabs - Nova Pazova



Slika 2. - Pogon za livenje šupljih ploča - Niš / Image 2. - Section for casting hollow core slabs - Niš

Za proizvodnju šupljih ploča primenjujemo dve tehnologije:

- 1.ECHO - šuplje ploče se liju SLIP FORMER mašinom
2. ELEMATIC - izlivanje ploča mašinom EXTRUDER.

Prva tehnologija se primenjuje u niškom pogonu, a druga u pogonu u Novoj Pazovi.

We use two technologies for the production of hollow core slabs:

1. ECHO - hollow core slabs are casted with SLIP FORMER machines
2. ELEMATIC - casting of hollow core slabs with machine EXTRUDER.

The first technology is applied in the section in Niš, and the other in the section in Nova Pazova.

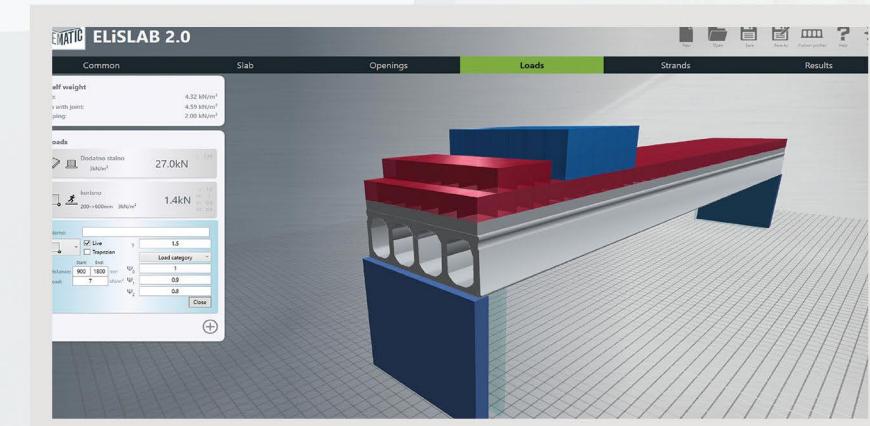
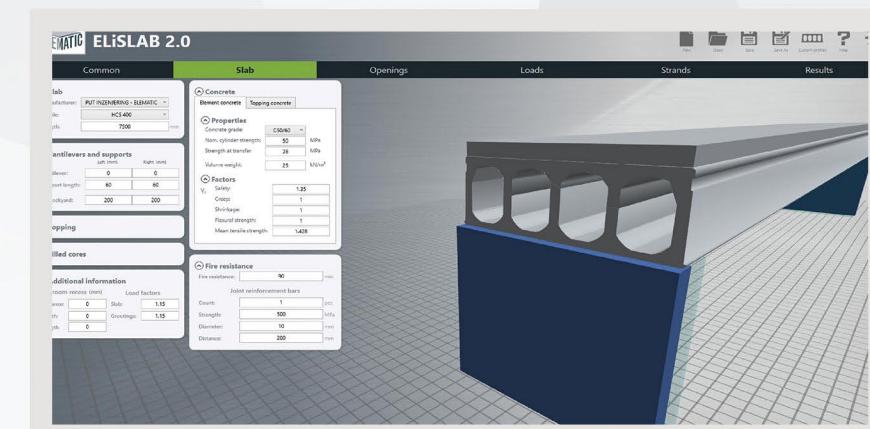
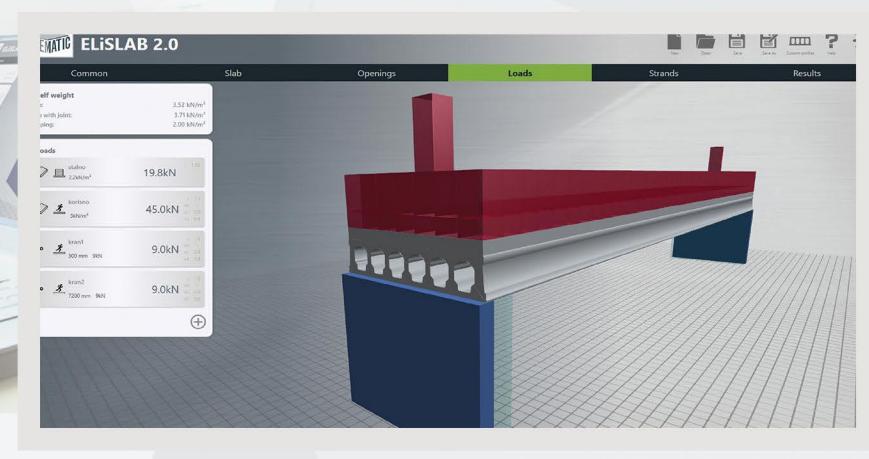
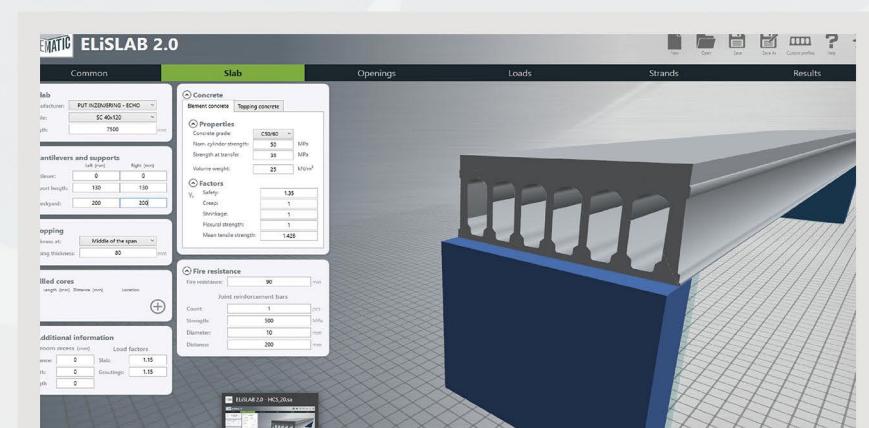
SLIP FORMER - ECHO



EXTRUDER - ELEMATIC EL900E



Kao softversku podršku za statički proračun nosivosti i vatrootpornosti šupljih ploča, koristimo program Elemenatic ELiSLAB 2.0.



As software support for static calculation of load capacity and fire resistance of hollow core slabs, we use the Elemenatic ELiSLAB 2.0 program.

ELEMATIC

Glavne prednosti prednapregnutih šupljih ploča / Main advantages of prestressed hollow core slabs



Smanjena težina

Postiže se unutrašnjim šupljinama koje se pružaju duž cele šuplje ploče. Smanjuje troškove gradnje: za proizvodnju je potrebno 40% do 50% manje sirovina u odnosu na metodu livenja na licu mesta.

Reduced weight

Attained by interior hollow cores along the entire length of hollow core slabs reduces the cost of building: production requires 40% to 50% less raw materials in comparison with the method of casting in situ.



Velika nosivost

Omogućava primenu prednapregnutih šupljih ploča u izgradnji proizvodnih pogona i objekata za skladištenje.

Great bearing capacity

Enables the application of prestressed hollow core slabs in building production plants and storage facilities.



Fleksibilnost

Fleksibilnost postižemo sečenjem šupljih ploča na bilo koju dužinu i pod različitim uglovima.

Flexibility

Is achieved by cutting hollow core slabs to any length and under different angles.



Brza gradnja

Proizvodnja prednapregnutih šupljih ploča je automatizovana i brza. Tokom montaže nije potrebna nosiva skela i najčešće se montaža vrši direktno sa vozila na nosivi zid ili gredu što smanjuje vreme i utrošak energije. Procesi koji slede nakon montaže mogu da otpočnu odmah nakon montaže.

Speedy construction

The production of prestressed hollow core slabs is automated and speedy; mounting does not require scaffolding and often it is performed directly from the vehicle to the retaining wall or beam which reduces time and energy consumption; mounting follow-up processes can start immediately after mounting.

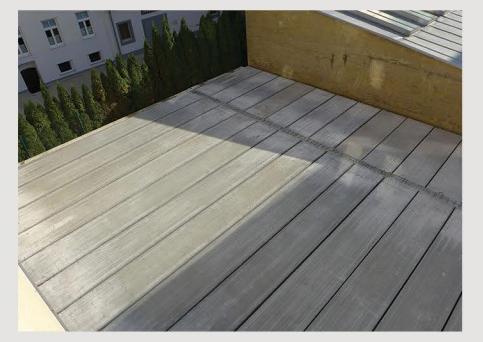


Smanjenje broja radnika

Automatizacija procesa u fabriki smanjuje potreban broj radnika u proizvodnom pogonu i pri montaži na gradilištu.

Number of site personnel reduction

The automation of processes in the factory reduces the required number of members of the site personnel in the production plant and on the construction site in the course of mounting.



Široko polje primene

Prednapregnute šuplje ploče obezbeđuju duge, čiste raspone i veliku nosivost, što je pogodno za izgradnju stambenih objekata, bolnica, škola, sportskih objekata, industrijskih postrojenja, skladišta, komercijalnih objekata, višespratnih garaža.

Wide scope of applications

Prestressed hollow core slabs ensure long clear spans and great bearing capacities, which is good for building residential buildings, hospitals, schools, sports facilities, industrial plants, depots, commercial facilities, multi-floor garages.



Prilagodljivost svakom sistemu gradnje

Prednapregnute šuplje ploče mogu se kombinovati sa montažnom AB konstrukcijom, monolitnom AB konstrukcijom i čeličnom konstrukcijom.

Adaptability to every system of building

Prestressed hollow core slabs can be combined with the precast prefabricated AB construction, monolithic AB construction and steel construction.

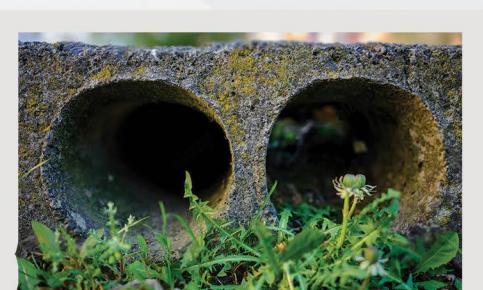


Odlična akustička izolacija i toplotne karakteristike

Njihova masa i stepen amortizacije redukuju vibracije zgrada za koje je to potrebno.

Excellent acoustic insulation and thermal characteristics

Their mass and the level of amortization reduce vibrations of buildings for which this is advisable.





Otpornost na požar

Rezultati ispitivanja pokazuju da međuspratne i krovne konstrukcije od prednapregnutih šupljih ploča mogu biti otporne na požar i preko 120 minuta.



Fire resistance

Testing results show that interfloor and roof constructions from prestressed hollow core slabs can resist fire over 120 minutes.

Ekonomično rešenje

Upotrebom prednapregnutih šupljih ploča smanjuju se troškovi izgradnje, eksploatacije, kao i adaptacije i demontaže (rušenja).

Economical solution

Prestressed hollow core slabs reduce building costs, exploitation costs, as well as costs of renovation and dismantling (demolition).

Ekološki proizvod

Proizvodnja i montaža prednapregnutih šupljih ploča su bezbedni po životnu sredinu iz više razloga: smanjena upotreba sirovina i energije, smanjenje buke, prašine i emisije opasnih materija, olakšan i kontrolisan tretman otpadnih materijala.

Ecological product

The production and mounting of prestressed hollow core slabs are environmentally safe for several reasons: reduced use of raw materials and energy, noise reduction, reduction of dust and hazardous substances emission, facilitated and controlled treatment of waste materials.

Mogućnost ponovnog korišćenja i recikliranja

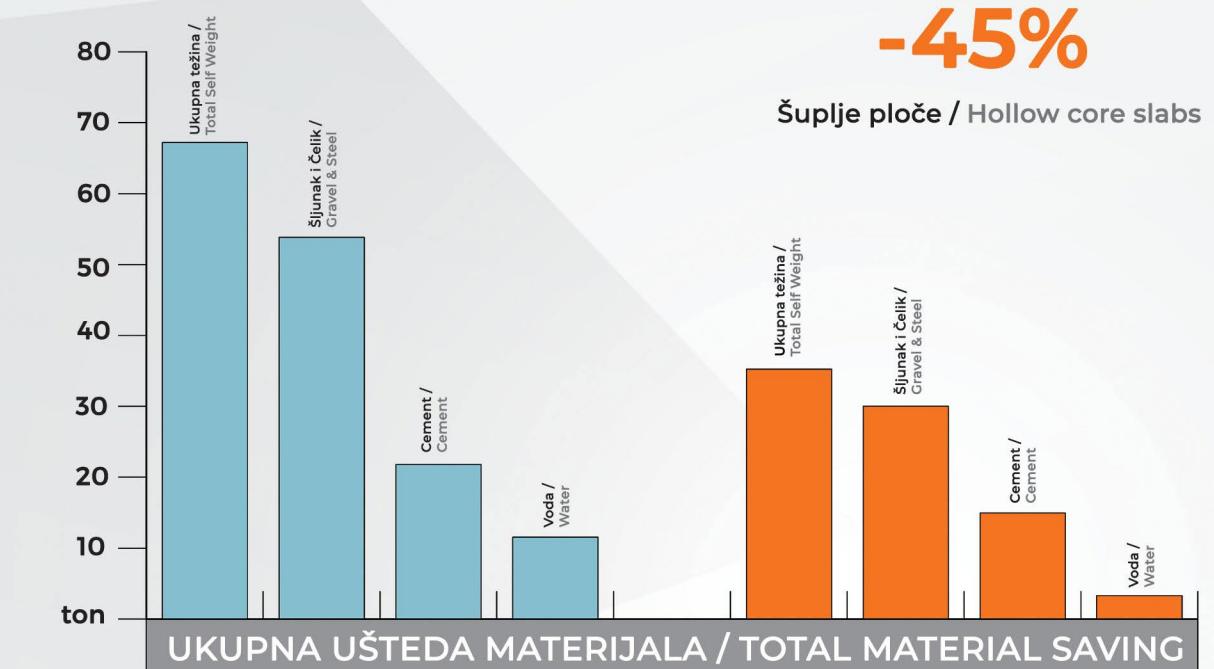
Bitna prednost montažne gradnje je mogućnost demontaže i redizajna postojećih montažnih objekata.

The possibility of recovery and recycling

The essential advantage of the precast prefabricated building is the possibility of dismantling and redesigning existing precast prefabricated facilities.

Montažni prednapregnuti podovi od šupljih ploča i armirani podovi liveni na licu mesta koji se koriste za porodičnu stambenu jedinicu-poređenje uticaja na životnu sredinu /

Comparison of the environmental effects between a precast prestressed hollow core floor and a plain cast in-situ reinforced floor for single family housing.



Grafikon 2. - Ukupno iskorišćenje materijala za šuplje ploče u poređenju sa pločama koje se liju direktno na gradilištu /

Chart 2. - Total material consumption of hollow core slabs compared to cast in-situ floors

Sledeće tabele pokazuju rezultate komparativne LCA studije koja je poredila prednapregnute šuplje ploče i ploče koje su livenе na licu mesta. Cifre se odnose na jedan kvadratni metar betonskog sprata pojedinačne porodične stambene jedinice tokom perioda od 50 godina. Rezultati pokazuju da šuplje ploče imaju mnogo bolje rezultate od onih koje su livenе na licu mesta, i to po skoro svim parametrima koji se odnose na bezbednost životne sredine:

- 28% manje primarnog utroška energije,
- 40% do 50% manje sirovina,
- 37,8% manje stvaranje otpada.

The following tables show the results of a comparative LCA study of a prestressed concrete hollow core slabs compared to a plain cast in-situ slabs. The figures are related to one square meter of concrete storey floor in a single family house, over a period of 50 years. The results show that the hollow core slabs scores much better than the in-situ floor, on most environmental parameters:

- 28% less primary energy consumption,
- 40% to 50% less raw material,
- 37,8% less generation of waste.

| | Šuplje ploče / Hollow core floor slabs | Livene ploče / Cast in-situ floor slabs |
|---|---|--|
| Ukupno čelika (MJ) / Steel total (MJ) | 119 | 183 |
| Procentualno čelika (%) / Steel share (%) | 25,8% | 28,5% |
| meki čelik / mild steel | 67 | 306 |
| prednapregnut čelik / prestressing steel | 117 | - |
| reciklirano / recycling | -65 | -123 |
| Ukupno cementa (MJ) / Cement total (MJ) | 213,3 | 173 |
| Procentualno cementa (%) / Cement share (%) | 46,3% | 26,9% |
| Portland B / Portland B | 32,3 | - |
| Portland C / Portland C | 181 | - |
| Visoka peć / Blast furnace A | | 173 |
| Ukupno vezivo (MJ) / Filler total (MJ) | 39,8 | 20,3 |
| Procentualno vezivo (%) / Filler share (%) | 8,6% | 3,2% |
| pesak / sand | 7,1 | 8,0 |
| šljunak / gravel | | 11,9 |
| krečnjak / lime stone | 32,6 | - |
| voda / water | 0,2 | 0,4 |
| Ukupan transport (MJ) / Transport total (MJ) | 55,1 | 66,3 |
| Procentualno transport (%) / Transport share (%) | 12,0% | 10,3% |
| kamion 40t / truck 40t | 32,6 | - |
| kamion 28t / truck 28t | 10,6 | 11,4 |
| kamion 16t + mixer / truck 16t + truck mixer | 1,0 | 39,7 |
| brod / ship | 11,0 | 15,2 |
| Kraj životnog ciklusa (MJ) / End of life cycle (MJ) | 18,1 | 60,1 |
| Kraj životnog ciklusa (%) / End of life cycle (%) | 3,9% | 9,4% |
| Gubitak (deponija) / Loss (dumping) | 0 | 0 |
| Iskorišćen visokokvalitetni beton / Reuse high quality concrete | -9,5 | 15,5 |
| Iskorišćen niskokvalitetni beton / Reuse low quality concrete | 27,6 | 44,6 |
| Proizvodna energija (MJ) / Production energy (MJ) | 15,8 | 139,9 |
| Proizvodna energija (%) / Production energy (%) | 3,4% | 21,8% |
| Ukupna energija / Total energy | -1,4 | - |
| dizel / diesel | 3,4 | 5,6 |
| gas / gas | 5,3 | 7,6 |
| struja / electricity | 21,1 | 30,9 |
| propan / propane | | 95,8 |
| Ukupno (MJ) / Total (MJ) | 461 | 643 |
| Ukupno (%) / Total (%) | 72% | 100% |

Tabela 1. - Doprinos proizvodnog procesa iskorišćenju primarne energije/
Table 1. - Contribution by the production processes to the useof primary energy



| | Šuplje ploče / Hollow core floor | Livene ploče / Cast in-situ floor |
|--|-------------------------------------|--------------------------------------|
| Eutrofikacija (kg PO43) / Eutrophication (kg PO43- eq.) | 0,035 | 0,0410 |
| Izduvni gasovi (*10-12) / Exhaustion (*10-12) | 0,0468 | 0,0707 |
| Ekotoksicitost (* 10 ³ m ³) / Ecotoxicity (* 10 ³ m ³) | 2,78 | 5,81 |
| Efekat staklene bašte (kg CO ₂ eq) / Greenhouse effect (kg CO ₂ eq) | 55,2 | 53,4 |
| Acidifikacija (kg CO ₂) / Acidification (kg SO ₂ eq.) | 0,252 | 0,0460 |
| Letnji smog (kg CO ₂) / Summer smog (kg SO ₂ eq.) | 0,0297 | 0,0460 |
| Ljudska toksicitet (kg) / Human toxicity (kg) | 0,318 | 0,411 |
| Upotreba primarne energije (MJ) / Use of primary energy (MJ) | 461 | 643 |
| Čvrst otpad (kg) / Solid waste (kg) | 36,3 | 58,8 |

Tabela 2. - Absolutne vrednosti uticaja na životnu sredinu;
Izvor: CREM - Consultancy and Research for Environmental Management - Amsterdam,
Holandija /

Table 2. - Absolute values of the environmental effects;
Source: CREM - Consultancy and Research for Environmental management – Amsterdam,
The Netherlands

Literatura

- Fib bilten 21 "Pitanja zaštite životne sredine pri montažnim radovima" - Mart 2003;
Federation internationale du Beton - Lozana, Švajcarska /

Literature

- Fib bulletin 21 "Environmental issues in prefabrication" - March 2003; Fédération
internationale du Béton – Lausanne, Switzerland



Izdržljivost i dug životni vek / Durability and long lifespan

Osnovni preduslov za dug vek trajanja je izdržljiva noseća konstrukcija, uključujući i spratove. Usled velike izdržljivosti betona, niske poroznosti i dovoljnog pokrivača prednapregnute armature, spratovi od šupljih ploča će zadržati konstruktivni kapacitet 100 godina i duže. Proizvodnja mora biti usklađena sa nacionalnim standardima (na primer - Evropski propis EN 1168) i strogo kontrolisana u skladu sa sistemom samokontrole, a nadgledana od strane ovlašćenog spoljnog organa.

Energija / Energy



Otpadni materijal /
Waste materials

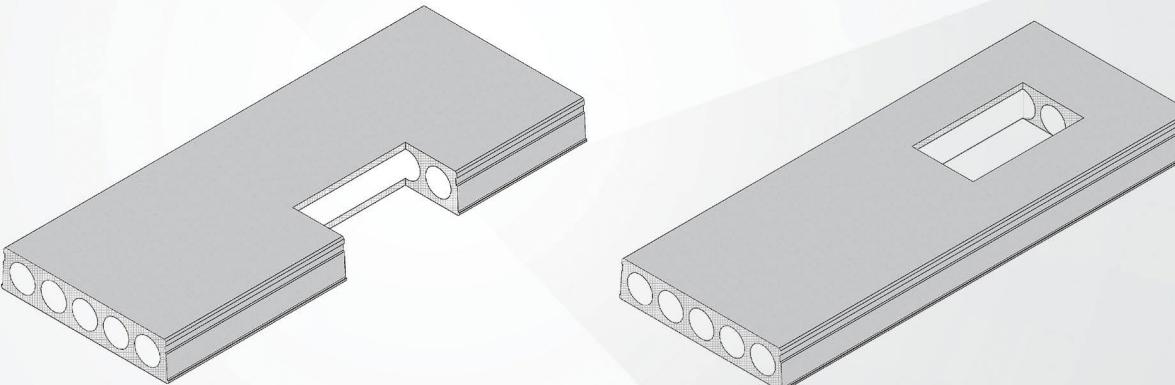
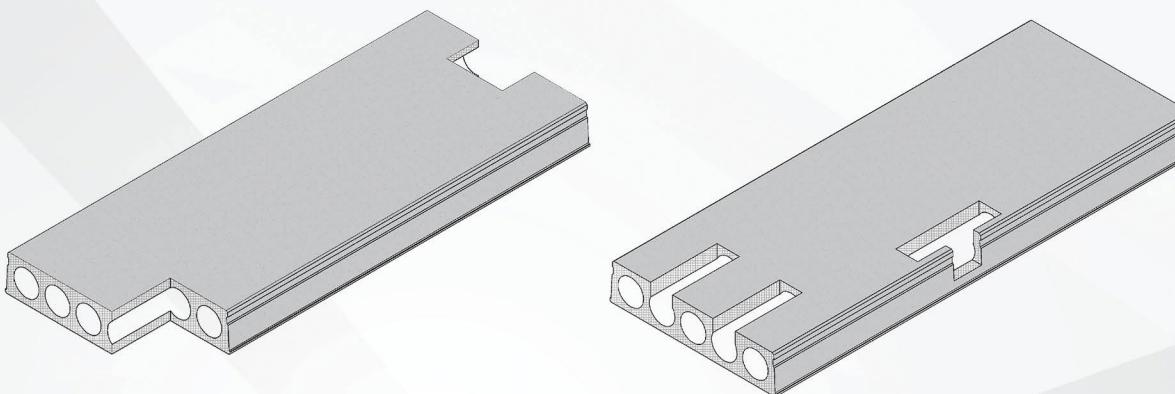


The prerequisite for a long life span is durable load bearing structures, including the floors. Hollow core slabs will retain their structural capacity for 100 years and more because of their high concrete strength, low porosity and sufficient cover to the prestressing reinforcement. The manufacture has to respond to the national product standard (e.g. European Product Code EN 1168), and is strictly controlled according to a system of self-control, supervised by an accredited external body.

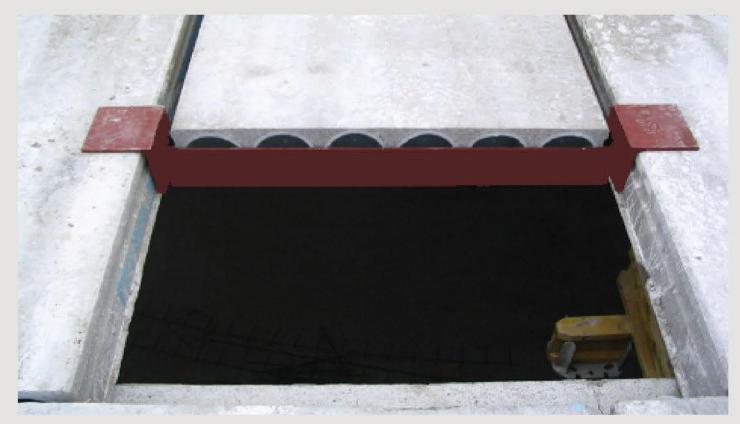
Otvori i zaseci u šupljim pločama / Opens and cuts in hollow core slabs

Otvori i zaseci u prednapregnutim betonskim šupljim pločama se mogu proizvesti u pogonu prema statičkim proračunima. Rubovi zaseka su grubi zbog načina proizvodnje. Zaseci se mogu pojaviti duž čitave širine elementa, dok se veći otvori mogu realizovati i pomoću čeličnih potkonstrukcija. Na crtežima se mogu videti primeri zaseka i otvora.

In the prestressed concrete hollow core slabs, openings and cuts can be produced according to the static calculations. The edges of the cuts are rough due to the production method. Cuts can appear over the entire width of the element, while larger openings can also be realized using steel substructures. The drawings show examples of cuts and openings.

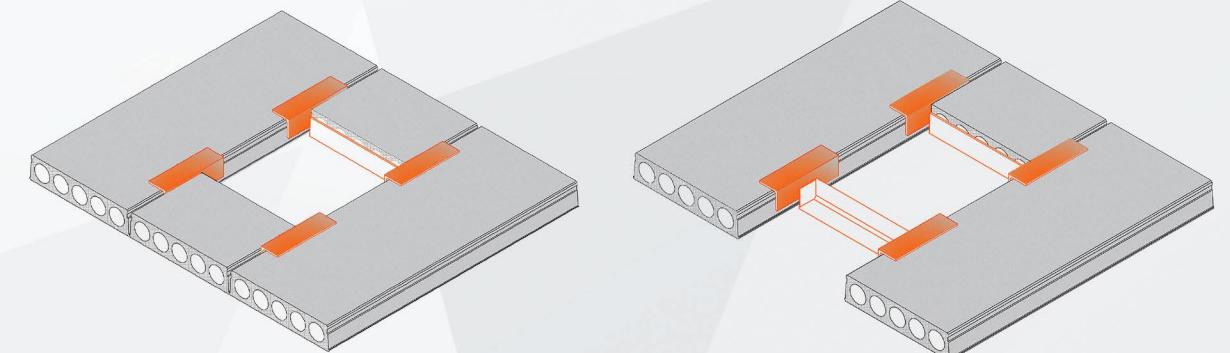


Otvori i zaseci u šupljim pločama - primeri / Opens and cuts in hollow core slabs - examples



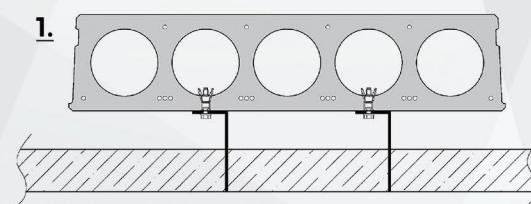
Ako nema druge potpore, otvor za stepenice, kamine, krovne prozore, kao i otvor za različite vrste instalacija mogu se napraviti konstrukcijom zamenskih nosača (vekslom).

Openings for stairs, fireplaces roof windows, and opens for different types of instalation. If there is no other support, can be made by the construction of replacement girders.

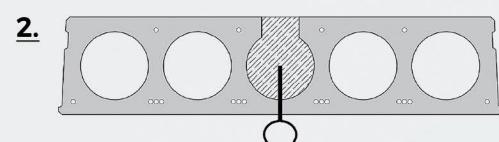


Upotreba zamenskih nosača - vekslji / Use of replacement girders

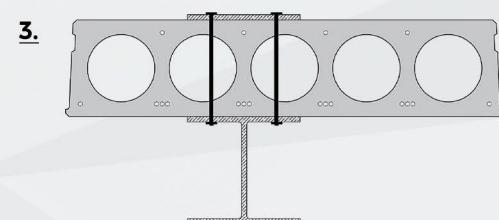
Načini kačenja visećih tereta / Ways of hanging loads



1.



2.

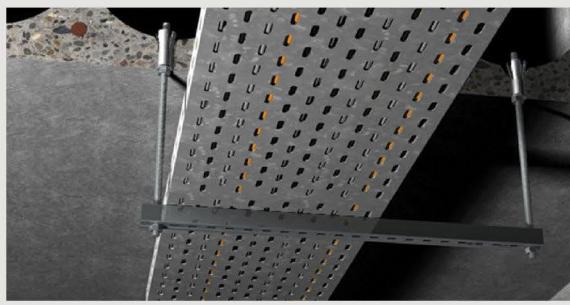
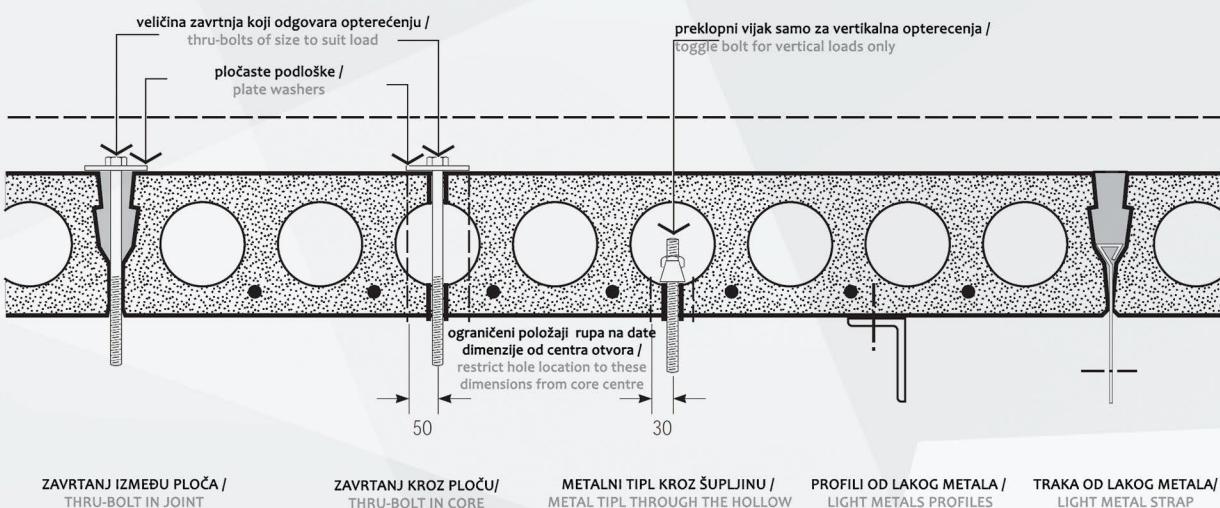


3.

U zavisnosti od težine tereta postoji više načina kačenja tereta (1.-3. crteži od najlakšeg do najtežeg tereta). Jako je bitno voditi računa o mestu bušenja i striktno je zabranjeno bušiti na mestima užadi. Koriste se za kačenje cevovoda, nosača kablova, ventilacionih sistema, sprinkler sistema, spuštenih plafona, raznoraznih konzola, čeličnih i drvenih konstrukcija.

Depending on the weight of cargo, there are three ways to load loads (1.-3. drawings from the easiest to the most difficult load). It is very important to take care of the drilling site and it is strictly forbidden to drill at the rope sites. They are used for pipelines, cable trays, ventilation systems, sprinkler systems, suspended ceilings, consoles, steel constructions, timber constructions.

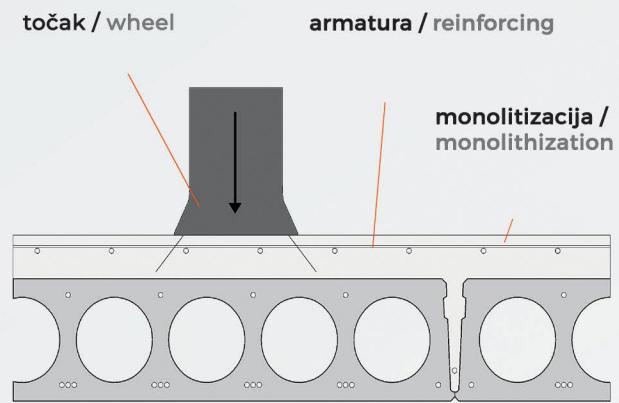
Načini kačenja tereta / Methods of loading cargo



Završna obrada šupljih ploča i zalivanje betonom / Finishing of hollow core slabs and concrete sealing

U zavisnosti od tipa i namene prostorije, vrste opterećenja i drugih uticaja vrši se proračun potrebne debljine sloja monolitizacije. Najčešće usvajamo debljinu 5-6cm, dok po potrebi može biti i veća. U posebnim slučajevima šuplje ploče nije potrebno zalivati betonom. Kod tačkastog i neravnomernog opterećenja sloj monolitizacije se dodatno ojačava ugrađivanjem mrežaste armature.

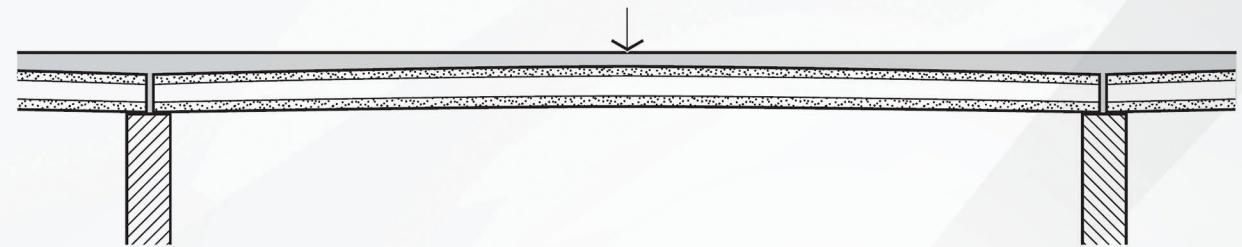
Depending on the type and purpose of the room, types of loads and other influences, the calculation of the required thickness of the monolithic layer is carried out. Usually we adopt a thickness of 5-6cm, while if necessary it can be even larger. In special cases, hollow core slabs need not be flooded with concrete. In the case of point and uneven loading, the monolithic layer is additionally reinforced by the installation of reticulate reinforcement.



Završna obrada gornje strane ploče takođe zavisi od vrste i namene prostorije. Može biti glatka, ukoliko ne postoji monolitni sloj, odnosno hrapava, radi boljeg vezivanja sa monolitnim slojem betona.

Final treatment at the top layer of the slab also depends on the type and purpose of the room. It can be smooth, if there is no monolithic layer, that is, rough, for better bonding with the monolithic layer of concrete.

Debljina topinga varira u zavisnosti od kontra ugiba ploče / Topping thickness varies with hollow core slab deflection



■ TIPOVI ŠUPLJIH PLOČA / ■ TYPE OF HOLLOW CORE SLABS

U našoj ponudi postoje dva tipa šupljih ploča, ECHO i ELEMATIC, koje se međusobno razlikuju po obliku poprečnog preseka, tj. po različitoj tehnologiji izrade. ECHO ploče se izrađuju slipformerom i proizvodimo ih u pogonu u Nišu, dok se ELEMATIC ploče izrađuju uz pomoć extrudera u Novoj Pazovi.

In our offer there are two types of hollow core slabs, ECHO and ELEMATIC, which differ from one another in the form of a cross-section, i.e. the molds in which they come out. ECHO slabs are made with slipformer and we manufacture them in the factory in Niš, while the ELEMATIC slabs are made with the help of extruders in Nova Pazova.

| ECHO | | ELEMATIC | |
|--|--|--|--|
| HCS 15x120 dužina do 7m/ length up to 7m | | HCS 20x120 dužina do 11m/ length up to 11m | |
| HCS 20x120 dužina do 11m/ length up to 11m | | HCS 26.5x120 dužina do 12m/ length up to 12m | |
| HCS 25x120 dužina do 12m/ length up to 12m | | HCS 32x120 dužina do 14m/ length up to 14m | |
| HCS 30x120 dužina do 14m/ length up to 14m | | HCS 40x120 dužina do 17m/ length up to 17m | |
| HCS 35x120 dužina do 15m/ length up to 15m | | HCS 50x120 dužina do 20m/ length up to 20m | |
| HCS 40x120 dužina do 17m/ length up to 17m | | | |

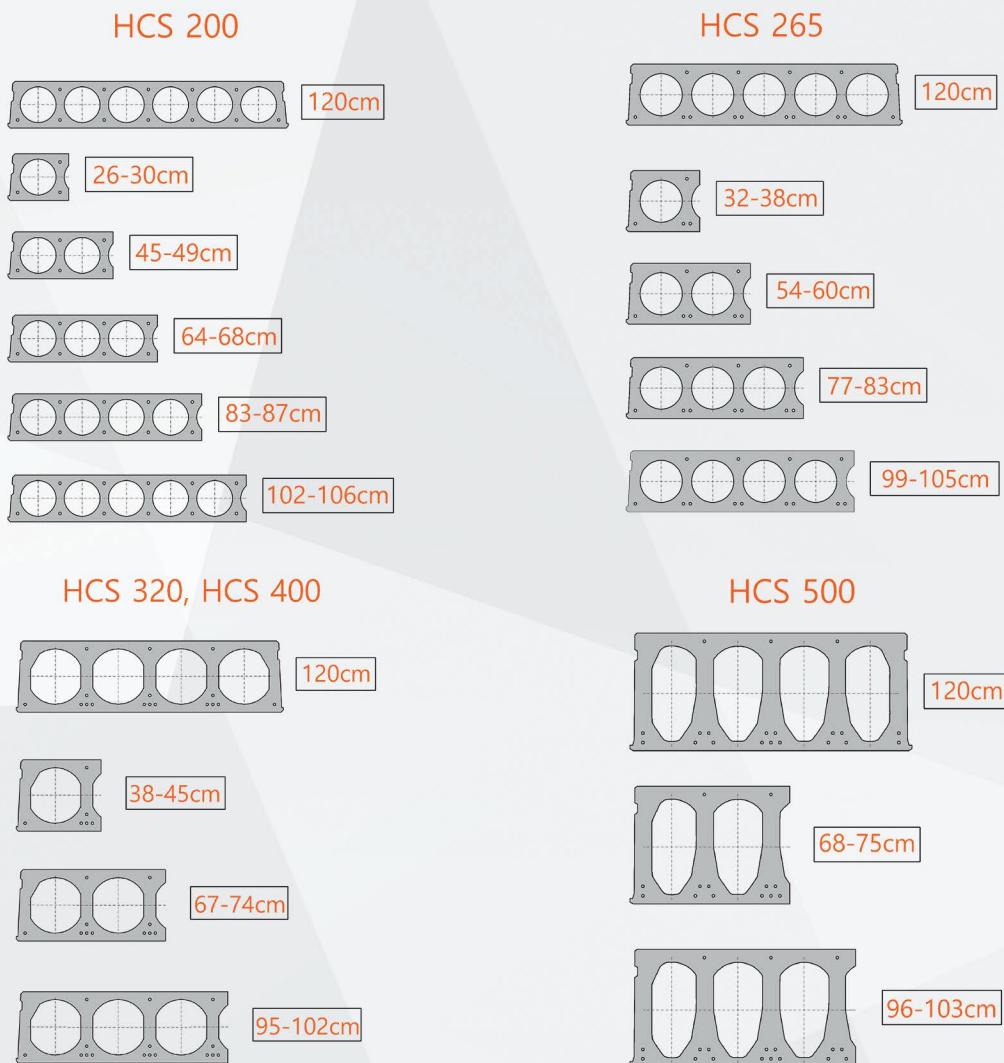
Radi lakšeg uklapanja, tj. ređanja šupljih ploča prilikom formiranja međuspratne konstrukcije, ploče je moguće seći po dužini. Širine sečenja su odredene statičkim proračunom i prikazane su u sledećim crtežima.

In order to facilitate the fitting of the hollow core slabs when forming the intermediate structure, the hollow core slabs can be cut lengthwise. The cutting widths are determined by the static calculation, and are shown in the following drawings.

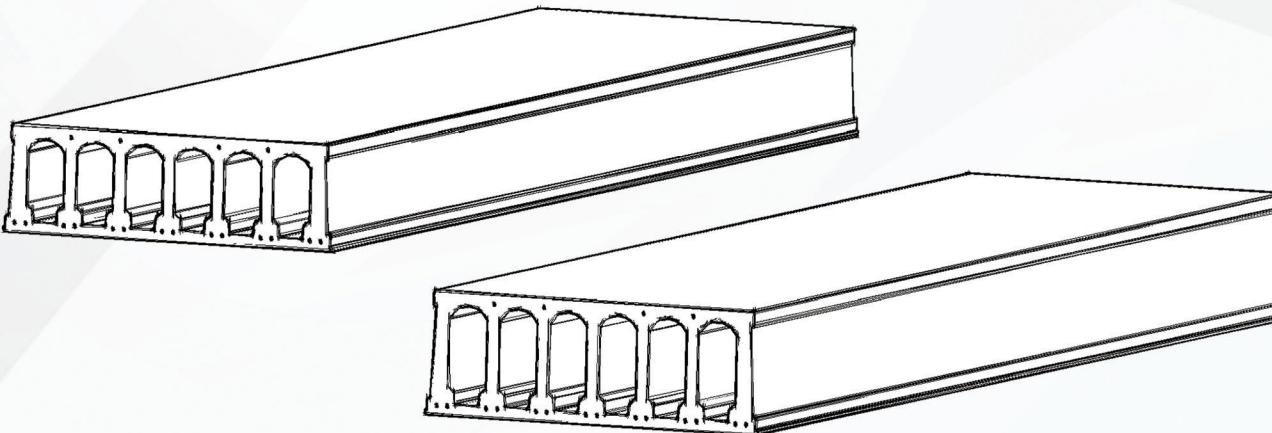
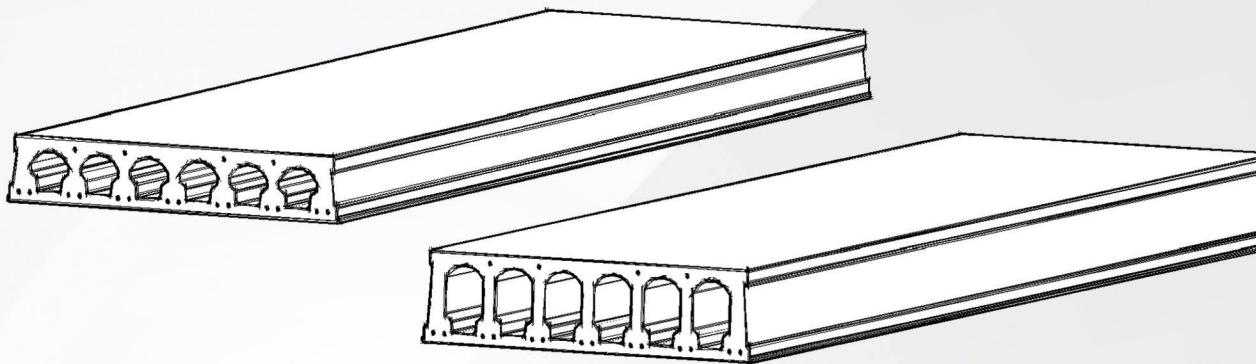
ECHO



ELEMATIC



TABELE NOSIVOSTI PLOČA ECHO TEHNOLOGIJE / TABLES CAPACITY SLABS ECHO TECHNOLOGY



* Korisno opterećenje prema
SRPS EN 1991-1-1:

Za opterećenja manja od 5 kN/m² - Tip C
Za opterećenja veća od 5 kN/m² - Tip E

* Live load according
SRPS EN 1991-1-1:

Loads less than 5 kN/m² - Type C
Loads greater than 5 kN/m² - Type E

* Važi za sve Echo tabele / Applies to all Echo tables

HCS 150

Toping = 5cm

| Tip prednaprezanja / Prestressing type | CT | DT | FT | KT | LT | PT | | |
|---|--|--------------------------------|-----------------------|----------------|----------------|--------|------|------|
| Gornja zona / Upper strands | 4Ø5 | 4Ø5 | 4Ø5 | 4Ø5 | 4Ø5 | 4Ø5 | | |
| Donja zona / Lower strands | 7Ø7 | 7Ø9.3 | 5Ø9.3 + 2Ø12.5 | 3Ø9.3 + 4Ø12.5 | 2Ø9.3 + 5Ø12.5 | 7Ø12.5 | | |
| Stalno opterećenje [kN/m ²] | Korisno opterećenje [kN/m ²] | Tip korisnog opterećenja po EC | RASPON PO EC [M] | | | | | |
| 1.5 | 1 | C | 5.80 | 7.40 | 7.95 | 8.35 | | |
| 1.5 | 1.5 | C | 5.68 | 7.25 | 7.80 | 8.23 | | |
| 1.5 | 2 | C | 5.55 | 7.10 | 7.65 | 8.10 | | |
| 1.5 | 2.5 | C | 5.45 | 6.98 | 7.50 | 7.95 | | |
| 1.5 | 3 | C | 5.35 | 6.85 | 7.35 | 7.80 | | |
| 1.5 | 3.5 | C | 5.25 | 6.73 | 7.20 | 7.65 | | |
| 1.5 | 4 | C | 5.15 | 6.60 | 7.05 | 7.50 | | |
| 1.5 | 4.5 | C | 5.10 | 6.50 | 6.90 | 7.35 | | |
| 1.5 | 5 | E | 4.80 | 6.10 | 6.50 | 6.90 | | |
| 1.5 | 5.5 | E | 4.70 | 5.95 | 6.38 | 6.78 | | |
| 1.5 | 6 | E | 4.60 | 5.80 | 6.25 | 6.65 | | |
| 1.5 | 6.5 | E | 4.53 | 5.70 | 6.13 | 6.50 | | |
| 1.5 | 7 | E | 4.45 | 5.60 | 6.00 | 6.35 | | |
| 1.5 | 7.5 | E | 4.38 | 5.50 | 5.90 | 6.28 | | |
| 1.5 | 8 | E | 4.30 | 5.40 | 5.80 | 6.20 | | |
| 1.5 | 8.5 | E | 4.25 | 5.30 | 5.70 | 6.10 | | |
| 1.5 | 9 | E | 4.20 | 5.20 | 5.60 | 6.00 | | |
| 1.5 | 9.5 | E | 4.15 | 5.10 | 5.53 | 5.90 | | |
| 1.5 | 10 | E | 4.10 | 5.00 | 5.45 | 5.80 | | |
| Dead load [kN/m ²] | Live load [kN/m ²] | Type of live load acc. EC | Span according EC [m] | | | | | |
| | | | 4.10 | 5.00 | 5.45 | 5.80 | 5.95 | 6.25 |

Napomena: Tabela je informativnog karaktera i ne zamenjuje statički proračun.

Note: Put inženjering is not responsible for direct or indirect damage as a result of imperfections in these data.

Sopstvena težina šuplje ploče + težina zalivenih spojnica + toping:

$$2,5 + 0,13 + 1,25 = 3,88 \text{ kN/m}^2$$

Zapreminska težina betona: 2500 kg/m³

Vatrootpornost: 60 min

Klasa betona: C40/50

Zaštitni sloj betona donje užadi: 35mm

Self weight of hollow core slab + jointfilling + toping:

$$2,5 + 0,13 + 1,25 = 3,88 \text{ kN/m}^2$$

Density of concrete: 2500 kg/m³

Fire resistance: 60 min

Concrete quality: C40/50

Concrete cover on lower strands: 35mm

Težina ploče po m²: 2.50 kN/m²

Težina ploče po m': 3.00 kN/m'

Površina poprečnog preseka: 0.12m²

Površina zalivenih spojnica: 0.005 m²

Broj šupljina: 6

Slab weight per m²: 2.50 kN/m²

Slab weight per m': 3.00 kN/m'

Slab cross section area: 0.12m²

Joint filling crosssection area: 0.005 m²

Number of holes: 6

HCS 200

Toping = 6cm

| Tip prednaprezanja / Prestressing type | CFB | EFB | GFB | LFB | NFB | PFB | SFB | UFB | | |
|---|--|--------------------------------|-----------------------|-------------------|--------|-------------------|-------------------|-------------------|-------|-------|
| Gornja zona / Upper strands | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | | |
| Donja zona / Lower strands | 7Ø7 | 7Ø9.3 | 5Ø9.3 + 2Ø12.5 | 2Ø9.3 + 5Ø12.5 | 7Ø12.5 | 2Ø9.3 + 7Ø12.5 | 5Ø9.3 + 7Ø12.5 | 7Ø9.3 + 7Ø12.5 | | |
| RASPON PO EC [M] | | | | | | | | | | |
| Stalno opterećenje [kN/m ²] | Korisno opterećenje [kN/m ²] | Tip korisnog opterećenja po EC | 6.75 | 8.50 | 9.10 | 9.90 | 10.30 | 10.75 | 11.20 | 11.80 |
| 1.5 | 1 | C | 6.63 | 8.35 | 8.93 | 9.70 | 10.15 | 10.65 | 11.08 | 11.70 |
| 1.5 | 1.5 | C | 6.50 | 8.20 | 8.75 | 9.50 | 10.00 | 10.55 | 10.95 | 11.60 |
| 1.5 | 2 | C | 6.38 | 8.05 | 8.60 | 9.33 | 9.83 | 10.38 | 10.83 | 11.50 |
| 1.5 | 2.5 | C | 6.25 | 7.90 | 8.45 | 9.15 | 9.65 | 10.20 | 10.70 | 11.40 |
| 1.5 | 3 | C | 6.15 | 7.75 | 8.30 | 9.00 | 9.48 | 10.03 | 10.53 | 11.23 |
| 1.5 | 3.5 | C | 6.05 | 7.60 | 8.15 | 8.85 | 9.30 | 9.85 | 10.35 | 11.05 |
| 1.5 | 4 | C | 5.95 | 7.50 | 8.00 | 8.70 | 9.15 | 9.70 | 10.15 | 10.85 |
| 1.5 | 4.5 | C | 5.85 | 7.40 | 7.95 | 8.60 | 9.05 | 9.60 | 10.05 | 10.75 |
| 1.5 | 5 | E | 5.65 | 7.10 | 7.55 | 8.25 | 8.65 | 9.15 | 9.55 | 10.00 |
| 1.5 | 5.5 | E | 5.55 | 6.93 | 7.43 | 8.10 | 8.50 | 8.98 | 9.38 | 9.85 |
| 1.5 | 6 | E | 5.45 | 6.75 | 7.30 | 7.95 | 8.35 | 8.80 | 9.20 | 9.70 |
| 1.5 | 6.5 | E | 5.35 | 6.63 | 7.15 | 7.83 | 8.20 | 8.63 | 9.03 | 9.50 |
| 1.5 | 7 | E | 5.25 | 6.50 | 7.00 | 7.70 | 8.05 | 8.45 | 8.85 | 9.30 |
| 1.5 | 7.5 | E | 5.18 | 6.38 | 6.88 | 7.55 | 7.93 | 8.33 | 8.70 | 9.13 |
| 1.5 | 8 | E | 5.10 | 6.25 | 6.75 | 7.40 | 7.80 | 8.20 | 8.55 | 8.95 |
| 1.5 | 8.5 | E | 5.03 | 6.13 | 6.63 | 7.28 | 7.68 | 8.05 | 8.40 | 8.83 |
| 1.5 | 9 | E | 4.95 | 6.00 | 6.50 | 7.15 | 7.55 | 7.90 | 8.25 | 8.70 |
| 1.5 | 9.5 | E | 4.90 | 5.90 | 6.40 | 7.03 | 7.43 | 7.80 | 8.13 | 8.58 |
| 1.5 | 10 | E | 4.85 | 5.80 | 6.30 | 6.90 | 7.30 | 7.70 | 8.00 | 8.45 |
| Dead load [kN/m ²] | Live load [kN/m ²] | Type of live load acc. EC | Span according EC [m] | | | | | | | |

Napomena: Tabela je informativnog karaktera i ne zamenjuje statički proračun.

Note: Put inženjeriјe is not responsible for direct or indirect damage as a result of imperfections in these data.

Sopstvena težina šuplje ploče + težina zalivenih spojnika + toping:
 $3,19 + 0,15 + 1,5 = 4,84 \text{ kN/m}^2$
Zapreminska težina betona: 2500 kg/m³
Vatrootpornost: 60 min
Klasa betona: C40/50
Zaštitni sloj betona donje užadi: 35mm

Težina ploče po m²: 3.19 kN/m²
Težina ploče po m': 3.82 kN/m'
Površina poprečnog preseka: 0.1529m²
Površina zalivenih spojnika: 0.007 m²
Broj šupljina: 6

Self weight of hollow core slab + jointfilling + toping:
 $3,19 + 0,15 + 1,5 = 4,84 \text{ kN/m}^2$
Density of concrete: 2500 kg/m³
Fire resistance: 60 min
Concrete quality: C40/50
Concrete cover on lower strands: 35mm

Slab weight per m²: 3.19 kN/m²
Slab weight per m': 3.82 kN/m'
Slab cross section area: 0.12m²
Joint filling crosssection area: 0.005 m²
Number of holes: 6

HCS 250

Toping = 6cm

| Tip prednaprezanja / Prestressing type | CT | DT | FT | KT | LT | PT | PT | | |
|---|--|--------------------------------|-----------------------|--------|-------------------|-------------------|-------------------|-------|-------|
| Gornja zona / Upper strands | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | | |
| Donja zona / Lower strands | 7Ø9.3 | 5Ø9.3 + 2Ø12.5 | 2Ø9.3 + 5Ø12.5 | 7Ø12.5 | 2Ø9.3 + 7Ø12.5 | 5Ø9.3 + 7Ø12.5 | 7Ø9.3 + 7Ø12.5 | | |
| RASPON PO EC [M] | | | | | | | | | |
| Stalno opterećenje [kN/m ²] | Korisno opterećenje [kN/m ²] | Tip korisnog opterećenja po EC | 9.60 | 10.25 | 11.15 | 11.70 | 12.15 | 12.65 | 13.35 |
| 1.5 | 1 | C | 9.40 | 10.05 | 10.93 | 11.48 | 12.00 | 12.53 | 13.23 |
| 1.5 | 1.5 | C | 9.20 | 9.85 | 10.70 | 11.25 | 11.85 | 12.40 | 13.10 |
| 1.5 | 2 | C | 9.05 | 9.68 | 10.50 | 11.03 | 11.65 | 12.20 | 12.95 |
| 1.5 | 2.5 | C | 8.90 | 9.50 | 10.30 | 10.80 | 11.45 | 12.00 | 12.80 |
| 1.5 | 3 | C | 8.75 | 9.33 | 10.13 | 10.63 | 11.25 | 11.80 | 12.58 |
| 1.5 | 3.5 | C | 8.60 | 9.15 | 9.95 | 10.45 | 11.05 | 11.60 | 12.35 |
| 1.5 | 4 | C | 8.45 | 9.00 | 9.80 | 10.30 | 10.85 | 11.40 | 12.10 |
| 1.5 | 4.5 | C | 8.30 | 8.85 | 9.65 | 10.15 | 10.70 | 11.30 | 12.00 |
| 1.5 | 5 | E | 7.75 | 8.40 | 9.25 | 9.70 | 10.25 | 10.70 | 11.35 |
| 1.5 | 5.5 | E | 7.58 | 8.23 | 9.08 | 9.53 | 10.05 | 10.50 | 11.13 |
| 1.5 | 6 | E | 7.40 | 8.05 | 8.90 | 9.35 | 9.85 | 10.30 | 10.90 |
| 1.5 | 6.5 | E | 7.25 | 7.88 | 8.73 | 9.18 | 9.68 | 10.13 | 10.70 |
| 1.5 | 7 | E | 7.10 | 7.70 | 8.55 | 9.00 | 9.50 | 9.95 | 10.50 |
| 1.5 | 7.5 | E | 6.95 | 7.55 | 8.38 | 8.83 | 9.35 | 9.78 | 10.33 |
| 1.5 | 8 | E | 6.80 | 7.40 | 8.20 | 8.65 | 9.20 | 9.60 | 10.15 |
| 1.5 | 8.5 | E | 6.68 | 7.28 | 8.05 | 8.50 | 9.03 | 9.45 | 9.98 |
| 1.5 | 9 | E | 6.55 | 7.15 | 7.90 | 8.35 | 8.85 | 9.30 | 9.80 |
| 1.5 | 9.5 | E | 6.45 | 7.03 | 7.78 | 8.20 | 8.70 | 9.15 | 9.65 |
| 1.5 | 10 | E | 6.35 | 6.90 | 7.65 | 8.05 | 8.55 | 9.00 | 9.50 |
| Dead load [kN/m ²] | Live load [kN/m ²] | Type of live load acc. EC | Span according EC [m] | | | | | | |

Napomena: Tabela je informativnog karaktera i ne zamenjuje statički proračun.

Note: Put inženjeriјe is not responsible for direct or indirect damage as a result of imperfections in these data.

Sopstvena težina šuplje ploče + težina zalivenih spojnika + toping:
 $3,52 + 0,19 + 1,5 = 5,21 \text{ kN/m}^2$
Zapreminska težina betona: 2500 kg/m³
Vatrootpornost: 60 min
Klasa betona: C40/50
Zaštitni sloj betona donje užadi: 35mm

Težina ploče po m²: 2.52 kN/m²
Težina ploče po m': 4.22 kN/m'
Površina poprečnog preseka: 0.1688m²
Površina zalivenih spojnika: 0.009 m²
Broj šupljina: 6

Self weight of hollow core slab + jointfilling + toping:
 $3,52 + 0,19 + 1,5 = 5,21 \text{ kN/m}^2$
Density of concrete: 2500 kg/m³
Fire resistance: 60 min
Concrete quality: C40/50
Concrete cover on lower strands: 35mm

Slab weight per m²: 2.52 kN/m²
Slab weight per m': 4.22 kN/m'
Slab cross section area: 0.1688m²
Joint filling crosssection area: 0.009 m²
Number of holes: 6

HCS 300

Toping = 6cm

| Tip prednaprezanja / Prestressing type | | | GF4B | LF4B | PF4B | RF4B | WF4B | UF4B | ZF4B | | | |
|---|--|--------------------------------|-----------------------|----------------|----------------|----------------|-------|----------------|-------|-------|-------|-------|
| Gornja zona / Upper strands | | | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | | | |
| Donja zona / Lower strands | | | 5Ø9,3 + 2Ø12,5 | 2Ø9,3 + 5Ø12,5 | 2Ø9,3 + 7Ø12,5 | 4Ø9,3 + 7Ø12,5 | 12Ø12 | 7Ø9,3 + 7Ø12,5 | 14Ø12 | | | |
| RASPON PO EC [M] | | | | | | | | | | | | |
| Stalno opterećenje [kN/m ²] | Korisno opterećenje [kN/m ²] | Tip korisnog opterećenja po EC | 1.5 | 1 | C | 11.20 | 12.10 | 13.45 | 14.00 | 15.15 | 14.70 | 15.90 |
| 1.5 | 1.5 | C | 10.98 | 11.90 | 13.20 | 13.80 | 15.03 | 14.58 | 15.75 | | | |
| 1.5 | 2 | C | 10.75 | 11.70 | 12.95 | 13.60 | 14.90 | 14.45 | 15.60 | | | |
| 1.5 | 2,5 | C | 10.58 | 11.48 | 12.70 | 13.35 | 14.70 | 14.20 | 15.48 | | | |
| 1.5 | 3 | C | 10.40 | 11.25 | 12.45 | 13.10 | 14.50 | 13.95 | 15.35 | | | |
| 1.5 | 3,5 | C | 10.23 | 11.08 | 12.25 | 12.88 | 14.23 | 13.70 | 15.05 | | | |
| 1.5 | 4 | C | 10.05 | 10.90 | 12.05 | 12.65 | 13.95 | 13.45 | 14.75 | | | |
| 1.5 | 4,5 | C | 9.90 | 10.70 | 11.85 | 12.40 | 13.70 | 13.20 | 14.35 | | | |
| 1.5 | 5 | E | 9.00 | 10.00 | 11.20 | 11.75 | 12.85 | 12.45 | 13.35 | | | |
| 1.5 | 5,5 | E | 8.80 | 9.78 | 11.00 | 11.53 | 12.60 | 12.23 | 13.18 | | | |
| 1.5 | 6 | E | 8.60 | 9.55 | 10.80 | 11.30 | 12.35 | 12.00 | 13.00 | | | |
| 1.5 | 6,5 | E | 8.43 | 9.15 | 10.58 | 11.10 | 12.13 | 11.78 | 12.75 | | | |
| 1.5 | 7 | E | 8.25 | #REF! | 10.35 | 10.90 | 11.90 | 11.55 | 12.50 | | | |
| 1.5 | 7,5 | E | 8.10 | 8.80 | 10.15 | 10.68 | 11.70 | 11.35 | 12.28 | | | |
| 1.5 | 8 | E | 7.95 | #REF! | 9.95 | 10.45 | 11.50 | 11.15 | 12.05 | | | |
| 1.5 | 8,5 | E | 7.80 | 8.65 | 9.78 | 10.28 | 11.30 | 10.98 | 11.88 | | | |
| 1.5 | 9 | E | 7.65 | 8.50 | 9.60 | 10.10 | 11.10 | 10.80 | 11.70 | | | |
| 1.5 | 9,5 | E | 7.53 | 8.35 | 9.43 | 9.93 | 10.95 | 10.63 | 11.50 | | | |
| 1.5 | 10 | E | 7.40 | 8.20 | 9.25 | 9.75 | 10.80 | 10.45 | 11.30 | | | |
| Dead load [kN/m ²] | Live load [kN/m ²] | Type of live load acc. EC | Span according EC [m] | | | | | | | | | |

Napomena: Tabela je informativnog karaktera i ne zamenjuje statički proračun.

Note: Put inženjering is not responsible for direct or indirect damage as a result of imperfections in these data.

Sopstvena težina šuplje ploče + težina zalivenih spojnica + toping:
 $3,84 + 0,25 + 1,5 = 5,59 \text{ kN/m}^2$
Zapreminska težina betona: 2500 kg/m³
Vatrootpornost: 60 min
Klasa betona: C40/50
Zaštitni sloj betona donje užadi: 35mm

Težina ploče po m²: 3.84 kN/m²
Težina ploče po m³: 4.61 kN/m³
Površina poprečnog preseka: 0.1843m²
Površina zalivenih spojnica: 0.012 m²
Broj šupljina: 6

Self weight of hollow core slab + jointfilling + toping:
 $3,84 + 0,25 + 1,5 = 5,59 \text{ kN/m}^2$
Density of concrete: 2500 kg/m³
Fire resistance: 60 min
Concrete quality: C40/50
Concrete cover on lower strands: 35mm

Slab weight per m²: 3.84 kN/m²
Slab weight per m³: 4.61 kN/m³
Slab cross section area: 0.1843m²
Joint filling crossection area: 0.012 m²
Number of holes: 6

HCS 350

Toping = 6cm

| Tip prednaprezanja / Prestressing type | | | GF4B | LF4B | PF4B | RF4B | WF4B | UF4B | | | | |
|---|--|--------------------------------|-----------------------|----------------|----------------|----------------|-------|----------------|-------|-------|-------|--|
| Gornja zona / Upper strands | | | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | | | | |
| Donja zona / Lower strands | | | 5Ø9,3 + 2Ø12,5 | 2Ø9,3 + 5Ø12,5 | 2Ø9,3 + 7Ø12,5 | 4Ø9,3 + 7Ø12,5 | 12Ø12 | 7Ø9,3 + 7Ø12,5 | | | | |
| RASPON PO EC [M] | | | | | | | | | | | | |
| Stalno opterećenje [kN/m ²] | Korisno opterećenje [kN/m ²] | Tip korisnog opterećenja po EC | 1.5 | 1 | C | 12.00 | 13.00 | 14.40 | 15.10 | 16.35 | 15.90 | |
| 1.5 | 1.5 | C | 11.78 | 12.78 | 14.13 | 14.83 | 16.20 | 15.70 | | | | |
| 1.5 | 2 | C | 11.55 | 12.55 | 13.85 | 14.55 | 16.05 | 15.50 | | | | |
| 1.5 | 2,5 | C | 11.33 | 12.33 | 13.63 | 14.30 | 15.78 | 15.23 | | | | |
| 1.5 | 3 | C | 11.10 | 12.10 | 13.40 | 14.05 | 15.50 | 14.95 | | | | |
| 1.5 | 3,5 | C | 10.88 | 11.90 | 13.18 | 13.80 | 15.25 | 14.68 | | | | |
| 1.5 | 4 | C | 10.65 | 11.70 | 12.95 | 13.55 | 15.00 | 14.40 | | | | |
| 1.5 | 4,5 | C | 10.40 | 11.50 | 12.70 | 13.35 | 14.70 | 14.20 | | | | |
| 1.5 | 5 | E | 9.50 | 10.60 | 12.00 | 12.65 | 13.85 | 13.40 | | | | |
| 1.5 | 5,5 | E | 9.30 | 10.38 | 11.75 | 12.40 | 13.60 | 13.15 | | | | |
| 1.5 | 6 | E | 9.10 | 10.15 | 11.50 | 12.15 | 13.35 | 12.90 | | | | |
| 1.5 | 6,5 | E | 8.93 | 9.95 | 11.25 | 11.90 | 13.10 | 12.68 | | | | |
| 1.5 | 7 | E | 8.75 | 9.75 | 11.00 | 11.65 | 12.85 | 12.45 | | | | |
| 1.5 | 7,5 | E | 8.58 | 9.55 | 10.80 | 11.43 | 12.65 | 12.23 | | | | |
| 1.5 | 8 | E | 8.40 | 9.35 | 10.60 | 11.20 | 12.45 | 12.00 | | | | |
| 1.5 | 8,5 | E | 8.25 | 9.20 | 10.43 | 11.00 | 12.25 | 11.80 | | | | |
| 1.5 | 9 | E | 8.10 | 9.05 | 10.25 | 10.80 | 12.05 | 11.60 | | | | |
| 1.5 | 9,5 | E | 7.98 | 8.90 | 10.08 | 10.63 | 11.85 | 11.40 | | | | |
| 1.5 | 10 | E | 7.85 | 8.75 | 9.90 | 10.45 | 11.65 | 11.20 | | | | |
| Dead load [kN/m ²] | Live load [kN/m ²] | Type of live load acc. EC | Span according EC [m] | | | | | | | | | |

Napomena: Tabela je informativnog karaktera i ne zamenjuje statički proračun.

Note: Put inženjering is not responsible for direct or indirect damage as a result of imperfections in these data.

Sopstvena težina šuplje ploče + težina zalivenih spojnica + toping:
 $4,17 + 0,30 + 1,5 = 5,97 \text{ kN/m}^2$
Zapreminska težina betona: 2500 kg/m³
Vatrootpornost: 60 min
Klasa betona: C40/50
Zaštitni sloj betona donje užadi: 35mm

Težina ploče po m²: 4.17 kN/m²
Težina ploče po m³: 5.00 kN/m³
Površina poprečnog preseka: 0.2m²
Površina zalivenih spojnica: 0.014m²
Broj šupljina: 6

Self weight of hollow core slab + jointfilling + toping:
 $4,17 + 0,30 + 1,5 = 5,97 \text{ kN/m}^2$
Density of concrete: 2500 kg/m³
Fire resistance: 60 min
Concrete quality: C40/50
Concrete cover on lower strands: 35mm

Slab weight per m²: 4.17 kN/m²
Slab weight per m³: 5.00 kN/m³
Slab cross section area: 0.2m²
Joint filling crossection area: 0.014m²
Number of holes: 6

HCS 400

Toping = 6cm

| Tip prednaprezanja / Prestressing type | GF4B | LF4B | PF4B | RF4B | WF4B | UF4B | ZF4B | | | | | |
|---|--|--------------------------------|-----------------------|-------------------|-------|-------------------|-------|-------|-------|-------|-------|-------|
| Gornja zona / Upper strands | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | | | | | |
| Donja zona / Lower strands | 5Ø9.3 + 2Ø12.5 | 2Ø9.3 + 5Ø12.5 | 2Ø9.3 + 7Ø12.5 | 4Ø9.3 + 7Ø12.5 | 12Ø12 | 7Ø9.3 + 7Ø12.5 | 14Ø12 | | | | | |
| RASPON PO EC [M] | | | | | | | | | | | | |
| Stalno opterećenje [kN/m ²] | Korisno opterećenje [kN/m ²] | Tip korisnog opterećenja po EC | 1.5 | 1 | C | 12.70 | 13.80 | 15.20 | 16.00 | 17.50 | 17.00 | 18.20 |
| 1.5 | 1.5 | C | 12.40 | 13.55 | 14.93 | 15.70 | 17.25 | 16.70 | 18.05 | | | |
| 1.5 | 2 | C | 12.10 | 13.30 | 14.65 | 15.40 | 17.00 | 16.40 | 17.90 | | | |
| 1.5 | 2.5 | C | 11.85 | 13.08 | 14.43 | 15.13 | 16.70 | 16.10 | 17.58 | | | |
| 1.5 | 3 | C | 11.60 | 12.85 | 14.20 | 14.85 | 16.40 | 15.80 | 17.25 | | | |
| 1.5 | 3.5 | C | 11.35 | 12.65 | 13.98 | 14.63 | 16.15 | 15.55 | 17.00 | | | |
| 1.5 | 4 | C | 11.10 | 12.45 | 13.75 | 14.40 | 15.90 | 15.30 | 16.75 | | | |
| 1.5 | 4.5 | C | 10.90 | 12.20 | 13.50 | 14.15 | 15.60 | 15.05 | 16.40 | | | |
| 1.5 | 5 | E | 9.95 | 11.15 | 12.70 | 13.45 | 14.70 | 14.25 | 15.60 | | | |
| 1.5 | 5.5 | E | 9.75 | 10.90 | 12.43 | 13.15 | 14.45 | 14.00 | 15.35 | | | |
| 1.5 | 6 | E | 9.55 | 10.65 | 12.15 | 12.85 | 14.20 | 13.75 | 15.10 | | | |
| 1.5 | 6.5 | E | 9.38 | 10.45 | 11.90 | 12.58 | 13.95 | 13.50 | 14.85 | | | |
| 1.5 | 7 | E | 9.20 | 10.25 | 11.65 | 12.30 | 13.70 | 13.25 | 14.60 | | | |
| 1.5 | 7.5 | E | 9.03 | 10.08 | 11.43 | 12.08 | 13.48 | 13.00 | 14.38 | | | |
| 1.5 | 8 | E | 8.85 | 9.90 | 11.20 | 11.85 | 13.25 | 12.75 | 14.15 | | | |
| 1.5 | 8.5 | E | 8.70 | 9.73 | 11.03 | 11.65 | 13.05 | 12.53 | 13.95 | | | |
| 1.5 | 9 | E | 8.55 | 9.55 | 10.85 | 11.45 | 12.85 | 12.30 | 13.75 | | | |
| 1.5 | 9.5 | E | 8.43 | 9.40 | 10.68 | 11.28 | 12.63 | 12.10 | 13.55 | | | |
| 1.5 | 10 | E | 8.30 | 9.25 | 10.50 | 11.10 | 12.40 | 11.90 | 13.35 | | | |
| 1.5 | 12.5 | E | 7.70 | 8.60 | 9.75 | 10.30 | 11.55 | 11.10 | 12.55 | | | |
| 1.5 | 15 | E | 7.25 | 8.10 | 9.15 | 9.70 | 10.85 | 10.40 | 11.80 | | | |
| 1.5 | 20 | E | 6.50 | 7.25 | 8.25 | 8.75 | 9.75 | 9.40 | 10.60 | | | |
| Dead load [kN/m ²] | Live load [kN/m ²] | Type of live load acc. EC | Span according EC [m] | | | | | | | | | |

Napomena: Tabela je informativnog karaktera i ne zamenjuje statički proračun.

Note: Put inženjeriјe is not responsible for direct or indirect damage as a result of imperfections in these data.

Sopstvena težina šuplje ploče + težina zalivenih spojnika + toping:

$$4,5 + 0,35 + 1,5 = 6,35 \text{ kN/m}^2$$

Zapreminska težina betona: 2500 kg/m³

Vatrootpornost: 60 min

Klasa betona: C40/50

Zaštitni sloj betona donje užadi: 35mm

Težina ploče po m²: 4.50 kN/m²

Težina ploče po m¹: 5.40 kN/m¹

Površina poprečnog preseka: 0.216m²

Površina zalivenih spojnika: 0.016m²

Broj šupljina: 6

Self weight of hollow core slab + jointfilling + toping:

$$4,5 + 0,35 + 1,5 = 6,35 \text{ kN/m}^2$$

Density of concrete: 2500 kg/m³

Fire resistance: 60 min

Concrete quality: C40/50

Concrete cover on lower strands: 35mm

Slab weight per m²: 4.50 kN/m²

Slab weight per m¹: 5.40 kN/m¹

Slab cross section area: 0.216m²

Joint filling crosssection area: 0.016m²

Number of holes: 6

HCS 450

Toping = 6cm

| Tip prednaprezanja / Prestressing type | GF4B | LF4B | PF4B | RF4B | WF4B | UF4B | ZF4B | | | | | |
|---|--|--------------------------------|-----------------------|-------------------|-------|-------------------|-------|-------|-------|-------|-------|-------|
| Gornja zona / Upper strands | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | 4Ø7 | | | | | |
| Donja zona / Lower strands | 5Ø9.3 + 2Ø12.5 | 2Ø9.3 + 5Ø12.5 | 2Ø9.3 + 7Ø12.5 | 4Ø9.3 + 7Ø12.5 | 12Ø12 | 7Ø9.3 + 7Ø12.5 | 14Ø12 | | | | | |
| RASPON PO EC [M] | | | | | | | | | | | | |
| Stalno opterećenje [kN/m ²] | Korisno opterećenje [kN/m ²] | Tip korisnog opterećenja po EC | 1.5 | 1 | C | 13.15 | 14.45 | 15.95 | 16.70 | 18.35 | 17.80 | 19.10 |
| 1.5 | 1.5 | C | 12.85 | 14.20 | 15.65 | 16.40 | 18.08 | 17.48 | 18.90 | | | |
| 1.5 | 2 | C | 12.55 | 13.95 | 15.35 | 16.10 | 17.80 | 17.15 | 18.70 | | | |
| 1.5 | 2.5 | C | 12.28 | 13.70 | 15.10 | 15.85 | 17.50 | 16.88 | 18.35 | | | |
| 1.5 | 3 | C | 12.00 | 13.45 | 14.85 | 15.60 | 17.20 | 16.60 | 18.00 | | | |
| 1.5 | 3.5 | C | 11.78 | 13.20 | 14.63 | 15.35 | 16.93 | 16.33 | 17.70 | | | |
| 1.5 | 4 | C | 11.55 | 12.95 | 14.40 | 15.10 | 16.65 | 16.05 | 17.40 | | | |
| 1.5 | 4.5 | C | 11.35 | 12.70 | 14.20 | 14.85 | 16.35 | 15.80 | 17.20 | | | |
| 1.5 | 5 | E | 10.40 | 11.65 | 13.25 | 14.05 | 15.55 | 15.00 | 16.30 | | | |
| 1.5 | 5.5 | E | 10.18 | 11.40 | 12.98 | 13.78 | 15.30 | 14.78 | 16.05 | | | |
| 1.5 | 6 | E | 9.95 | 11.15 | 12.70 | 13.50 | 15.05 | 14.55 | 15.80 | | | |
| 1.5 | 6.5 | E | 9.78 | 10.95 | 12.48 | 13.25 | 14.83 | 14.28 | 15.55 | | | |
| 1.5 | 7 | E | 9.60 | 10.75 | 12.25 | 13.00 | 14.60 | 14.00 | 15.30 | | | |
| 1.5 | 7.5 | E | 9.43 | 10.55 | 12.03 | 12.75 | 14.38 | 13.78 | 15.05 | | | |
| 1.5 | 8 | E | 9.25 | 10.35 | 11.80 | 12.50 | 14.15 | 13.55 | 14.80 | | | |
| 1.5 | 8.5 | E | 9.10 | 10.18 | 11.60 | 12.30 | 13.90 | 13.30 | 14.60 | | | |
| 1.5 | 9 | E | 8.95 | 10.00 | 11.40 | 12.10 | 13.65 | 13.05 | 14.40 | | | |
| 1.5 | 9.5 | E | 8.83 | 9.85 | 11.23 | 11.93 | 13.45 | 12.85 | 14.20 | | | |
| 1.5 | 10 | E | 8.70 | 9.70 | 11.05 | 11.75 | 13.25 | 12.65 | 14.00 | | | |
| 1.5 | 12.5 | E | 8.10 | 9.05 | 10.30 | 10.95 | 12.30 | 11.80 | 13.00 | | | |
| 1.5 | 15 | E | 7.60 | 8.50 | 9.70 | 10.25 | 11.55 | 11.10 | 12.20 | | | |
| 1.5 | 20 | E | 6.85 | 7.65 | 8.75 | 9.25 | 10.40 | 10.00 | 11.00 | | | |
| Dead load [kN/m ²] | Live load [kN/m ²] | Type of live load acc. EC | Span according EC [m] | | | | | | | | | |

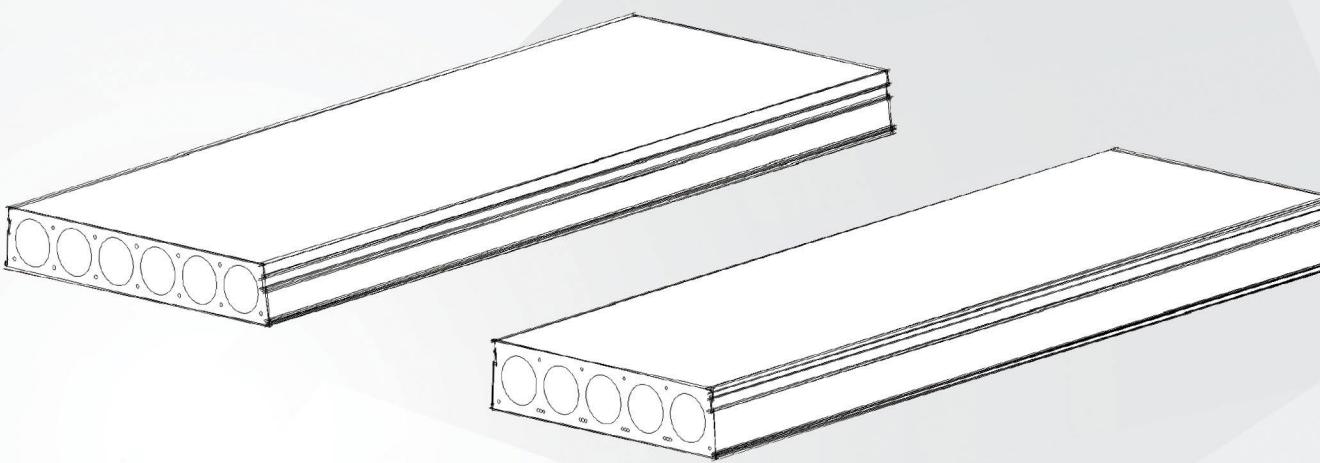
Napomena: Tabela je informativnog karaktera i ne zamenjuje statički proračun.

Note: Put inženjeriјe is not responsible for direct or indirect damage as a result of imperfections in these data.

S

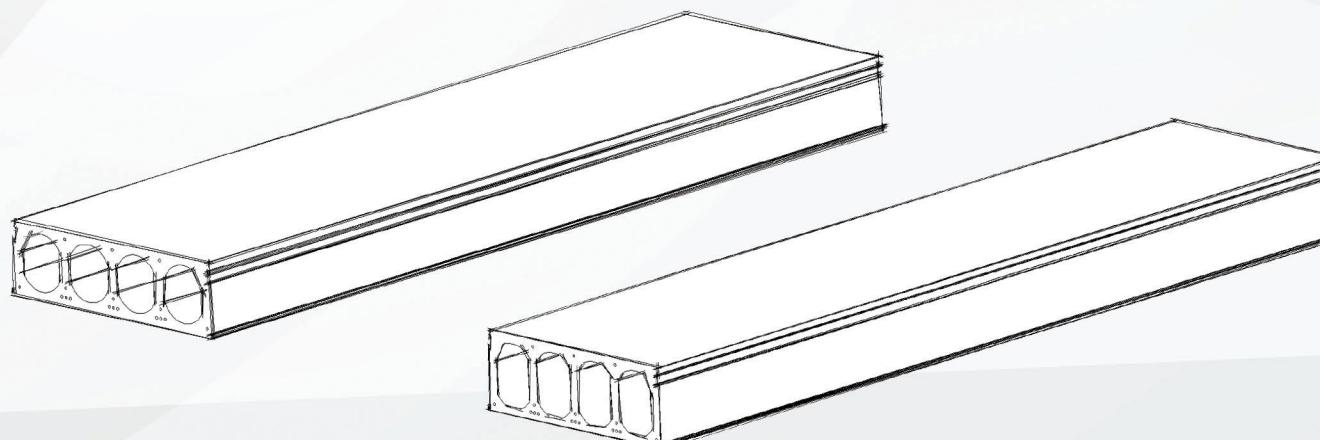
TABELE NOSIVOSTI PLOČA ELEMENTIC TEHNOLOGIJE /

TABLES CAPACITY SLABS ELEMENTIC TECHNOLOGY



ELEMATIC

SMART EVOLUTION



* Korisno opterećenje prema
SRPS EN 1991-1-1:

Za opterećenja manja od 5 kN/m² - Tip C
Za opterećenja veća od 5 kN/m² - Tip E

* Live load according
SRPS EN 1991-1-1:

Loads less than 5 kN/m² - Type C
Loads greater than 5 kN/m² - Type E

* Važi za sve Elematic tabele / Applies to all Elematic tables

HCS 200

Toping = 6cm

| Tip prednaprezanja / Prestressing type | 4X/7X | 7X | 4X/3X+4 | 3X+4 | 4X/7 | 7 | | |
|---|--|--------------------------------|-----------------------|-------------------|--------|--------|-------|-------|
| Gornja zona / Upper strands | 4Ø9.3 | / | 4Ø9.3 | / | 4Ø9.3 | / | | |
| Donja zona / Lower strands | 7Ø9.3 | 7Ø9.3 | 3Ø9.3 + 4Ø12.5 | 3Ø9.3 + 4Ø12.5 | 7Ø12.5 | 7Ø12.5 | | |
| Stalno opterećenje [kN/m ²] | Korisno opterećenje [kN/m ²] | Tip korisnog opterećenja po EC | RASPON PO EC [M] | | | | | |
| 1.5 | 1 | C | 8.70 | 8.90 | 9.48 | 10.03 | 10.33 | 10.63 |
| 1.5 | 1.5 | C | 8.55 | 8.70 | 9.40 | 9.83 | 10.23 | 10.50 |
| 1.5 | 2 | C | 8.40 | 8.50 | 9.30 | 9.60 | 10.13 | 10.33 |
| 1.5 | 2.5 | C | 8.23 | 8.33 | 9.23 | 9.40 | 10.03 | 10.10 |
| 1.5 | 3 | C | 8.05 | 8.15 | 9.10 | 9.20 | 9.85 | 9.90 |
| 1.5 | 3.5 | C | 7.90 | 8.00 | 8.93 | 9.03 | 9.65 | 9.70 |
| 1.5 | 4 | C | 7.75 | 7.85 | 8.78 | 8.88 | 9.45 | 9.53 |
| 1.5 | 4.5 | C | 7.63 | 7.73 | 8.60 | 8.70 | 9.28 | 9.35 |
| 1.5 | 5 | E | 7.18 | 6.95 | 8.08 | 8.18 | 8.75 | 8.75 |
| 1.5 | 5.5 | E | 7.03 | 6.78 | 7.93 | 8.00 | 8.55 | 8.60 |
| 1.5 | 6 | E | 6.90 | 6.63 | 7.78 | 7.85 | 8.40 | 8.40 |
| 1.5 | 6.5 | E | 6.78 | 6.48 | 7.65 | 7.68 | 8.25 | 8.25 |
| 1.5 | 7 | E | 6.65 | 6.33 | 7.50 | 7.48 | 8.10 | 8.10 |
| 1.5 | 7.5 | E | 6.55 | 6.20 | 7.38 | 7.33 | 7.95 | 7.95 |
| 1.5 | 8 | E | 6.45 | 6.05 | 7.25 | 7.18 | 7.80 | 7.80 |
| 1.5 | 8.5 | E | 6.35 | 5.95 | 7.15 | 7.03 | 7.68 | 7.68 |
| 1.5 | 9 | E | 6.25 | 5.85 | 7.05 | 6.90 | 7.55 | 7.53 |
| 1.5 | 9.5 | E | 6.15 | 5.73 | 6.95 | 6.78 | 7.40 | 7.35 |
| 1.5 | 10 | E | 6.08 | 5.65 | 6.85 | 6.65 | 7.18 | 7.13 |
| Dead load [kN/m ²] | Live load [kN/m ²] | Type of live load acc. EC | Span according EC [m] | | | | | |

Napomena: Tabela je informativnog karaktera i ne zamenjuje statički proračun.

Note: Put inženjerstvo is not responsible for direct or indirect damage as a result of imperfections in these data.

Sopstvena težina šuplje ploče + težina zalivenih spojница + toping:
2,51 + 0,13 + 1,5 = 4,14 kN/m²
Zapreminska težina betona: 2500 kg/m³
Vatrootpornost: 60 min
Klasa betona: C50/60
Zaštitni sloj betona donje užadi: 35mm

Težina ploče po m²: 2.51 kN/m²
Težina ploče po m¹: 3.02 kN/m¹
Površina poprečnog preseka: 0.1207 m²
Površina zalivenih spojница: 0.006 m²
Broj šupljina: 6

Self weight of hollow core slab + jointfilling + toping:
2,51 + 0,13 + 1,5 = 4,14 kN/m²
Density of concrete: 2500 kg/m³
Fire resistance: 60 min
Concrete quality: C50/60
Concrete cover on lower strands: 35mm

Slab weight per m²: 2.51 kN/m²
Slab weight per m¹: 3.02 kN/m¹
Slab cross section area: 0.1207 m²
Joint filling crosssection area: 0.006 m²
Number of holes: 6

HCS 265

Toping = 6cm

| Tip prednaprezanja / Prestressing type | 6X | 2X/6X | 2X/6 | 2+4X | 8 | 2X/10 |
|---|--|--------------------------------|-----------------------|----------------|--------|---------|
| Gornja zona / Upper strands | / | 2Ø9.3 | 2Ø9.3 | / | / | 2Ø9.3 |
| Donja zona / Lower strands | 6Ø9.3 | 6Ø9.3 | 6Ø12.5 | 4Ø9.3 + 2Ø12.5 | 8Ø12.5 | 10Ø12.5 |
| RASPON PO EC [M] | | | | | | |
| Stalno opterećenje [kN/m ²] | Korisno opterećenje [kN/m ²] | Tip korisnog opterećenja po EC | 9.25 | 9.48 | 11.25 | 10.20 |
| 1.5 | 1 | C | 9.25 | 9.48 | 11.25 | 10.20 |
| 1.5 | 1.5 | C | 9.03 | 9.28 | 11.00 | 9.90 |
| 1.5 | 2 | C | 8.75 | 9.13 | 10.80 | 9.65 |
| 1.5 | 2.5 | C | 8.55 | 8.90 | 10.60 | 9.40 |
| 1.5 | 3 | C | 8.35 | 8.70 | 10.40 | 9.20 |
| 1.5 | 3.5 | C | 8.15 | 8.50 | 10.23 | 9.00 |
| 1.5 | 4 | C | 7.98 | 8.33 | 10.10 | 8.80 |
| 1.5 | 4.5 | C | 7.83 | 8.15 | 9.90 | 8.65 |
| 1.5 | 5 | E | 7.10 | 7.38 | 9.40 | 7.85 |
| 1.5 | 5.5 | E | 6.93 | 7.20 | 9.23 | 7.65 |
| 1.5 | 6 | E | 6.78 | 7.05 | 9.08 | 7.48 |
| 1.5 | 6.5 | E | 6.63 | 6.90 | 8.88 | 7.33 |
| 1.5 | 7 | E | 6.50 | 6.75 | 8.70 | 7.18 |
| 1.5 | 7.5 | E | 6.38 | 6.63 | 8.53 | 7.05 |
| 1.5 | 8 | E | 6.25 | 6.50 | 8.38 | 6.93 |
| 1.5 | 8.5 | E | 6.13 | 6.40 | 8.20 | 6.80 |
| 1.5 | 9 | E | 6.03 | 6.28 | 8.05 | 6.68 |
| 1.5 | 9.5 | E | 5.93 | 6.18 | 7.95 | 6.55 |
| 1.5 | 10 | E | 5.83 | 6.08 | 7.80 | 6.45 |
| Dead load [kN/m ²] | Live load [kN/m ²] | Type of live load acc. EC | Span according EC [m] | | | |

Napomena: Tabela je informativnog karaktera i ne zamenjuje statički proračun.

Note: Put inženjerište je neodgovorno za direktni ili ne-direktni oštetu u posledicu nesavršenosti ovih podataka.

Sopstvena težina šuplje ploče + težina zalivenih spojnika + toping:

$$3,65 + 0,17 + 1,5 = 5,32 \text{ kN/m}^2$$

Zapreminska težina betona: 2500 kg/m³**Vatrootpornost:** 60 min**Klasa betona:** C50/60**Zaštitni sloj betona donje užadi:** 35mm**Self weight of hollow core slab + jointfilling + toping:**

$$3,65 + 0,17 + 1,5 = 5,32 \text{ kN/m}^2$$

Density of concrete: 2500 kg/m³**Fire resistance:** 60 min**Concrete quality:** C50/60**Concrete cover on lower strands:** 35mm**Težina ploče po m²:** 3.65 kN/m²**Težina ploče po m'**: 4.38 kN/m'**Površina poprečnog preseka:** 0.1751 m²**Površina zalivenih spojnika:** 0.008 m²**Broj šupljina:** 5**Slab weight per m²:** 3.65 kN/m²**Slab weight per m'**: 4.38 kN/m'**Slab cross section area:** 0.1751 m²**Joint filling crosssection area:** 0.008 m²**Number of holes:** 5

HCS 320

Toping = 6cm

| Tip prednaprezanja / Prestressing type | 5X | 3X/5 | 3X/7 | 3X/9 | 3X/11 | 3X/14 !* |
|---|--|--------------------------------|-----------------------|--------|---------|----------|
| Gornja zona / Upper strands | / | 3Ø9.3 | 3Ø9.3 | 3Ø9.3 | 3Ø9.3 | 3Ø9.3 |
| Donja zona / Lower strands | 5Ø9.3 | 5Ø12.5 | 7Ø12.5 | 9Ø12.5 | 11Ø12.5 | 14Ø12.5 |
| RASPON PO EC [M] | | | | | | |
| Stalno opterećenje [kN/m ²] | Korisno opterećenje [kN/m ²] | Tip korisnog opterećenja po EC | 9.13 | 11.65 | 12.95 | 13.88 |
| 1.5 | 1 | C | 9.13 | 11.65 | 12.95 | 13.88 |
| 1.5 | 1.5 | C | 8.88 | 11.40 | 12.70 | 13.75 |
| 1.5 | 2 | C | 8.65 | 11.18 | 12.48 | 13.63 |
| 1.5 | 2.5 | C | 8.43 | 11.00 | 12.25 | 13.38 |
| 1.5 | 3 | C | 8.23 | 10.83 | 12.00 | 13.13 |
| 1.5 | 3.5 | C | 8.05 | 10.63 | 11.80 | 12.85 |
| 1.5 | 4 | C | 7.90 | 10.43 | 11.65 | 12.65 |
| 1.5 | 4.5 | C | 7.73 | 10.28 | 11.45 | 12.45 |
| 1.5 | 5 | E | 7.00 | 9.45 | 10.85 | 11.80 |
| 1.5 | 5.5 | E | 6.88 | 9.25 | 10.65 | 11.60 |
| 1.5 | 6 | E | 6.70 | 9.05 | 10.45 | 11.40 |
| 1.5 | 6.5 | E | 6.58 | 8.88 | 10.25 | 11.20 |
| 1.5 | 7 | E | 6.45 | 8.68 | 10.05 | 11.00 |
| 1.5 | 7.5 | E | 6.33 | 8.50 | 9.85 | 10.85 |
| 1.5 | 8 | E | 6.20 | 8.35 | 9.68 | 10.65 |
| 1.5 | 8.5 | E | 6.08 | 8.20 | 9.50 | 10.50 |
| 1.5 | 9 | E | 5.98 | 8.08 | 9.35 | 10.35 |
| 1.5 | 9.5 | E | 5.88 | 7.95 | 9.20 | 10.20 |
| 1.5 | 10 | E | 5.78 | 7.83 | 9.05 | 10.05 |
| Dead load [kN/m ²] | Live load [kN/m ²] | Type of live load acc. EC | Span according EC [m] | | | |

Napomena: Tabela je informativnog karaktera i ne zamenjuje statički proračun.

* obavezna ispluna betonom dve šupljine na oba kraja ploče u dužini od po 50cm

Note: Put inženjerište je neodgovorno za direktni ili ne-direktni oštetu u posledicu nesavršenosti ovih podataka.

Sopstvena težina šuplje ploče + težina zalivenih spojnika + toping:

$$3,86 + 0,19 + 1,5 = 5,55 \text{ kN/m}^2$$

Zapreminska težina betona: 2500 kg/m³**Vatrootpornost:** 60 min**Klasa betona:** C50/60**Zaštitni sloj betona donje užadi:** 35mm**Self weight of hollow core slab + jointfilling + toping:**

$$3,86 + 0,19 + 1,5 = 5,55 \text{ kN/m}^2$$

Density of concrete: 2500 kg/m³**Fire resistance:** 60 min**Concrete quality:** C50/60**Concrete cover on lower strands:** 35mm**Težina ploče po m²:** 3.86 kN/m²**Težina ploče po m'**: 4.63 kN/m'**Površina poprečnog preseka:** 0.1852 m²**Površina zalivenih spojnika:** 0.009 m²**Broj šupljina:** 4**Slab weight per m²:****Slab weight per m'**:**Slab cross section area:****Joint filling crosssection area:****Number of holes:**

HCS 400

Toping = 6cm

| Tip prednaprezanja / Prestressing type | 5X | 3X/5 | 3X/7 | 3X/9 | 3X/11 | 3X/14 !* | | |
|---|--|--------------------------------|-----------------------|--------|---------|----------|-------|-------|
| Gornja zona / Upper strands | / | 3Ø9.3 | 3Ø9.3 | 3Ø9.3 | 3Ø9.3 | 3Ø9.3 | | |
| Donja zona / Lower strands | 5Ø9.3 | 5Ø12.5 | 7Ø12.5 | 9Ø12.5 | 11Ø12.5 | 14Ø12.5 | | |
| RASPON PO EC [M] | | | | | | | | |
| Stalno opterećenje [kN/m ²] | Korisno opterećenje [kN/m ²] | Tip korisnog opterećenja po EC | 9.70 | 12.85 | 14.33 | 15.60 | 16.68 | 17.50 |
| 1.5 | 1 | C | 9.45 | 12.63 | 14.05 | 15.30 | 16.45 | 17.35 |
| 1.5 | 2 | C | 9.20 | 12.40 | 13.80 | 15.05 | 16.18 | 17.20 |
| 1.5 | 2.5 | C | 9.03 | 12.18 | 13.55 | 14.75 | 15.90 | 17.00 |
| 1.5 | 3 | C | 8.80 | 11.98 | 13.30 | 14.50 | 15.60 | 16.75 |
| 1.5 | 3.5 | C | 8.63 | 11.73 | 13.10 | 14.25 | 15.35 | 16.45 |
| 1.5 | 4 | C | 8.45 | 11.50 | 12.90 | 14.00 | 15.10 | 16.20 |
| 1.5 | 4.5 | C | 8.30 | 11.25 | 12.70 | 13.80 | 14.85 | 15.90 |
| 1.5 | 5 | E | 7.60 | 10.28 | 11.85 | 13.10 | 14.05 | 15.00 |
| 1.5 | 5.5 | E | 7.43 | 10.05 | 11.58 | 12.80 | 13.80 | 14.80 |
| 1.5 | 6 | E | 7.25 | 9.85 | 11.35 | 12.50 | 13.45 | 14.50 |
| 1.5 | 6.5 | E | 7.13 | 9.65 | 11.10 | 12.25 | 13.15 | 14.20 |
| 1.5 | 7 | E | 7.00 | 9.45 | 10.90 | 12.00 | 12.90 | 14.00 |
| 1.5 | 7.5 | E | 6.88 | 9.28 | 10.70 | 11.75 | 12.60 | 13.75 |
| 1.5 | 8 | E | 6.73 | 9.15 | 10.50 | 11.55 | 12.35 | 13.50 |
| 1.5 | 8.5 | E | 6.63 | 8.98 | 10.30 | 11.35 | 12.15 | 13.30 |
| 1.5 | 9 | E | 6.53 | 8.83 | 10.10 | 11.15 | 11.95 | 13.10 |
| 1.5 | 9.5 | E | 6.43 | 8.70 | 9.95 | 10.95 | 11.75 | 12.90 |
| 1.5 | 10 | E | 6.33 | 8.55 | 9.80 | 10.75 | 11.45 | 12.75 |
| Dead load [kN/m ²] | Live load [kN/m ²] | Type of live load acc. EC | Span according EC [m] | | | | | |

Napomena: Tabela je informativnog karaktera i ne zamenjuje statički proračun.

* obavezna ispluna betonom dve šupljine na oba kraja ploče u dužini od po 50cm

Note: Put inženjer je ne odgovoran za direktni ili ne direktni oštetu posledica imperfekcija u ovim podacima.

Sopstvena težina šuplje ploče + težina zalivenih spojnika + toping:

$$4,32 + 0,27 + 1,5 = 6,09 \text{ kN/m}^2$$

Zapreminska težina betona: 2500 kg/m³

Vatrootpornost: 60 min

Klasa betona: C50/60

Zaštitni sloj betona donje užadi: 35mm

Težina ploče po m²: 4.32 kN/m²

Težina ploče po m¹: 5.18 kN/m¹

Površina poprečnog preseka: 0.2072m²

Površina zalivenih spojnika: 0.013m²

Broj šupljina: 4

Self weight of hollow core slab + jointfilling + toping:

$$4,32 + 0,27 + 1,5 = 6,09 \text{ kN/m}^2$$

Density of concrete: 2500 kg/m³

Fire resistance: 60 min

Concrete quality: C50/60

Concrete cover on lower strands: 35mm

Slab weight per m²: 4.32 kN/m²

Slab weight per m¹: 5.18 kN/m¹

Slab cross section area: 0.2072m²

Joint filling crosssection area: 0.013m²

Number of holes: 4

HCS 500

Toping = 6cm

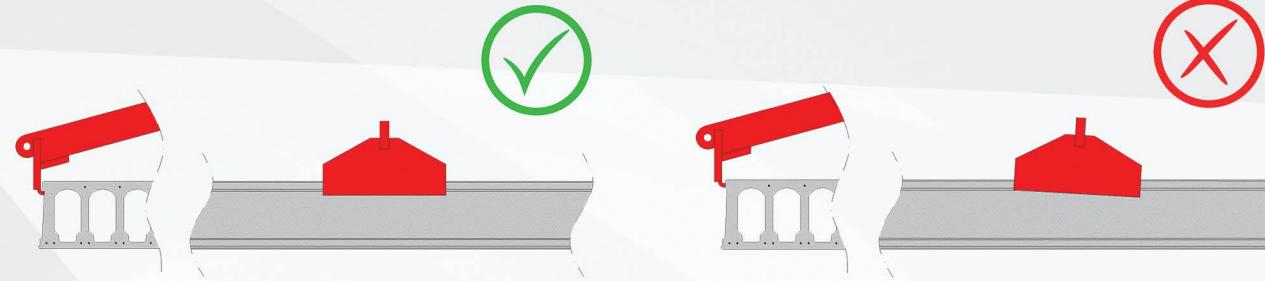
| Tip prednaprezanja / Prestressing type | 2X/5 | 3X/7 | 3X/9 | 3X/12 | 4X/15 | 18 | | | | | | | | |
|---|--|--------------------------------|-----------------------|---------|---------|---------|-------|-------|-------|-------|-------|-------|-------|-------|
| Gornja zona / Upper strands | 2Ø9.3 | 3Ø9.3 | 3Ø9.3 | 3Ø9.3 | 4Ø9.3 | / | | | | | | | | |
| Donja zona / Lower strands | 5Ø12.5 | 7Ø12.5 | 9Ø12.5 | 12Ø12.5 | 15Ø12.5 | 18Ø12.5 | | | | | | | | |
| RASPON PO EC [M] | | | | | | | | | | | | | | |
| Stalno opterećenje [kN/m ²] | Korisno opterećenje [kN/m ²] | Tip korisnog opterećenja po EC | 1.5 | 1 | C | 13.15 | 15.10 | 16.35 | 18.00 | 18.95 | 20.60 | | | |
| 1.5 | 1.5 | C | 9.45 | 12.63 | 14.05 | 15.30 | 16.45 | 17.35 | 12.85 | 14.85 | 16.05 | 17.75 | 18.80 | 20.40 |
| 1.5 | 2 | C | 9.20 | 12.40 | 13.80 | 15.05 | 16.18 | 17.20 | 12.60 | 14.65 | 15.85 | 17.50 | 18.55 | 20.15 |
| 1.5 | 2.5 | C | 9.03 | 12.18 | 13.55 | 14.75 | 15.90 | 17.00 | 12.35 | 14.40 | 15.60 | 17.20 | 18.25 | 19.85 |
| 1.5 | 3 | C | 8.80 | 11.98 | 13.30 | 14.50 | 15.60 | 16.75 | 12.15 | 14.20 | 15.40 | 16.95 | 18.00 | 19.55 |
| 1.5 | 3.5 | C | 8.63 | 11.73 | 13.10 | 14.25 | 15.35 | 16.45 | 11.95 | 14.00 | 15.15 | 16.70 | 17.75 | 19.20 |
| 1.5 | 4 | C | 8.45 | 11.50 | 12.90 | 14.00 | 15.10 | 16.20 | 11.70 | 13.80 | 14.95 | 16.50 | 17.50 | 18.95 |
| 1.5 | 4.5 | C | 8.30 | 11.25 | 12.70 | 13.80 | 14.85 | 15.90 | 11.50 | 13.55 | 14.75 | 16.25 | 17.25 | 18.70 |
| 1.5 | 5 | E | 7.60 | 10.28 | 11.85 | 13.10 | 14.05 | 15.00 | 10.65 | 12.50 | 14.00 | 15.55 | 16.50 | 17.80 |
| 1.5 | 5.5 | E | 7.43 | 10.05 | 11.58 | 12.80 | 13.80 | 14.80 | 10.45 | 12.25 | 13.80 | 15.30 | 16.25 | 17.55 |
| 1.5 | 6 | E | 7.25 | 9.85 | 11.35 | 12.50 | 13.45 | 14.50 | 10.25 | 12.00 | 13.50 | 15.10 | 16.00 | 17.25 |
| 1.5 | 6.5 | E | 7.13 | 9.65 | 11.10 | 12.25 | 13.15 | 14.20 | 10.05 | 11.80 | 13.25 | 14.85 | 15.75 | 17.00 |
| 1.5 | 7 | E | 7.00 | 9.45 | 10.90 | 12.00 | 12.90 | 14.00 | 9.90 | 11.60 | 13.05 | 14.65 | 15.50 | 16.75 |
| 1.5 | 7.5 | E | 6.88 | 9.28 | 10.70 | 11.75 | 12.60 | 13.75 | 9.70 | 11.40 | 12.85 | 14.45 | 15.25 | 16.50 |
| 1.5 | 8 | E | 6.73 | 9.15 | 10.50 | 11.55 | 12.35 | 13.50 | 9.55 | 11.20 | 12.60 | 14.25 | 15.05 | 16.25 |
| 1.5 | 8.5 | E | 6.63 | 8.98 | 10.30 | 11.35 | 12.15 | 13.30 | 9.40 | 11.05 | 12.40 | 14.05 | 14.90 | 16.00 |
| 1.5 | 9 | E | 6.53 | 8.83 | 10.10 | 11.15 | 11.95 | 13.10 | 9.25 | 10.90 | 12.20 | 13.85 | 14.65 | 15.75 |
| 1.5 | 9.5 | E | 6.43 | 8.70 | 9.95 | 10.95 | 11.75 | 12.90 | 9.00 | 10.55 | 11.85 | 13.45 | 14.30 | 15.30 |
| 1.5 | 10 | E | 6.33 | 8.55 | 9.80 | 10.75 | 11.45 | 12.75 | 8.43 | 9.90 | 11.10 | 12.60 | 13.50 | 14.30 |
| Dead load [kN/m ²] | Live load [kN/m ²] | Type of live load acc. EC | Span according EC [m] | | | | | | 7.95 | 9.30 | 10.45 | 11.85 | 12.75 | 13.45 |

Napomena

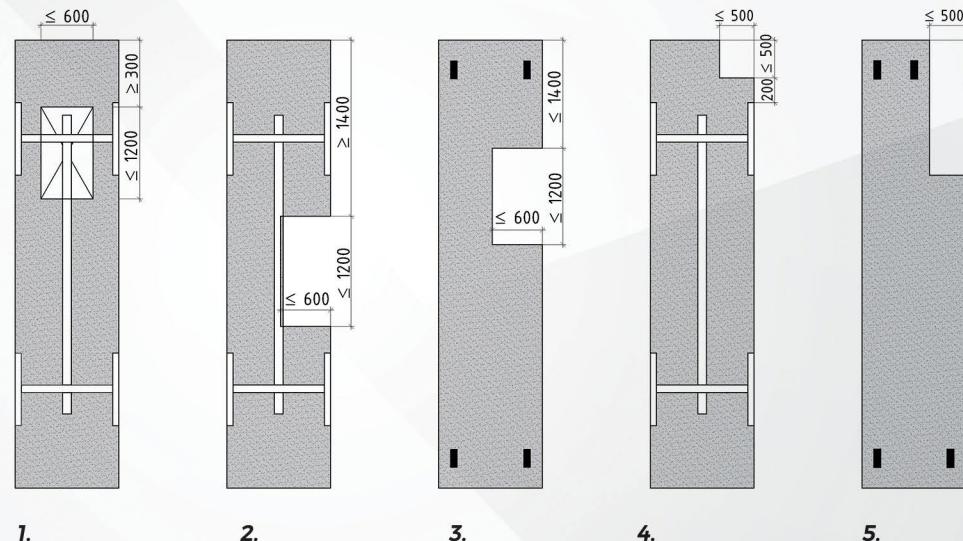
■ BEZBEDNOST I RUKOVANJE / ■ SAFETY AND OPERATING

Kačenje šupljih ploča mora biti prema uputstvima prikazanim ispod.

The mounting of the hollow core slabs must be according to the instructions shown below.

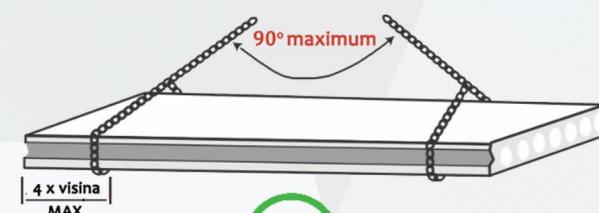
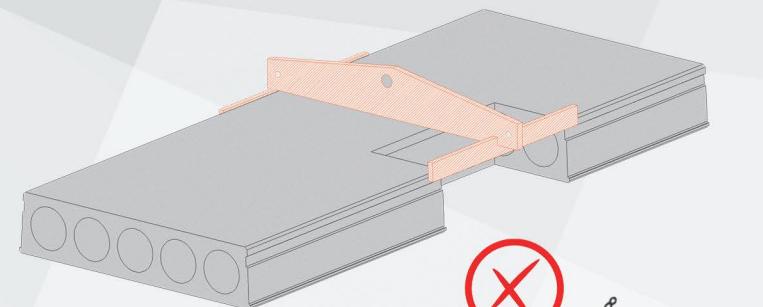


U prilogu je raspored hvatanja ploča sa otvorima i zasecima prilikom podizanja
Attached is a schedule for capturing hollow core slabs with holes and notches when lifting

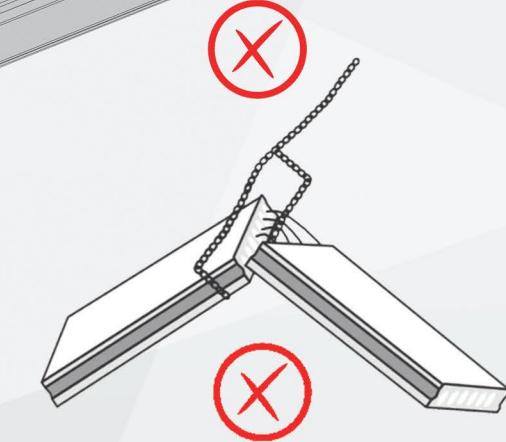


1. Podizanje ploče sa otvorom u ploči pomoću hvataljke
Lifting the hollow core slabs with the hole in the slab using a gripper
2. Podizanje ploče sa bočnim zasekom pomoću hvataljke
Lifting hollow core slab with a side cut-out using a gripper
3. Podizanje ploče sa bočnim zasekom pomoću lanaca
Lifting hollow core slab with a side cut-out using a chains
4. Podizanje ploče sa zasekom na kraju ploče pomoću hvataljke
Lifting hollow core slab with a cut-out at the end of the slab using a gripper
5. Podizanje ploče sa velikim zasekom na kraju ploče pomoću lanaca
Lifting hollow core slab with a cut-out at the end of the slab using a gripper

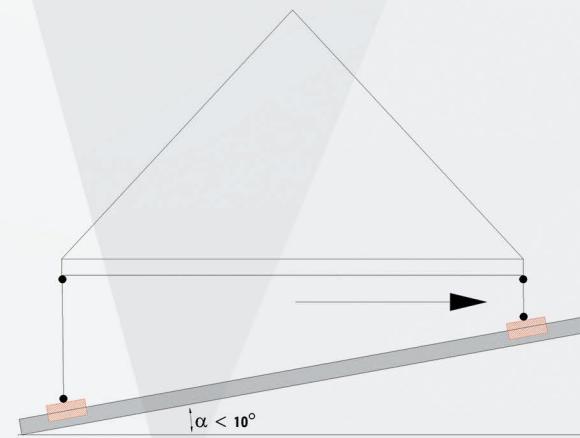
**Nepравилно каћење плоче /
Erroneous way for hanging
hollow core slab**



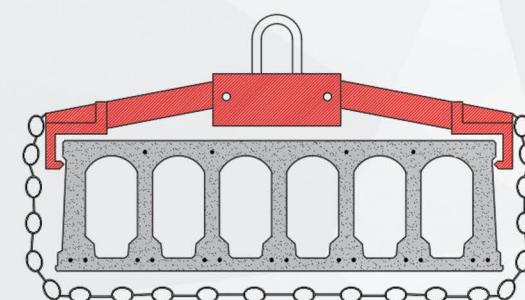
Ispравно подизање ланцима
Properly lifting by chains



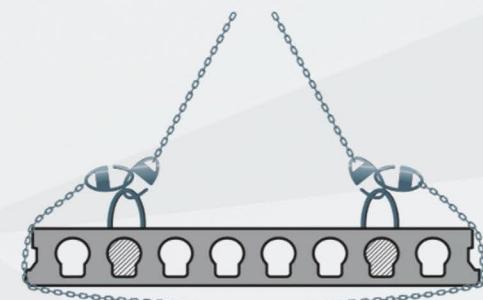
Неисправно подизање ланцима
Improperly lifting by chains



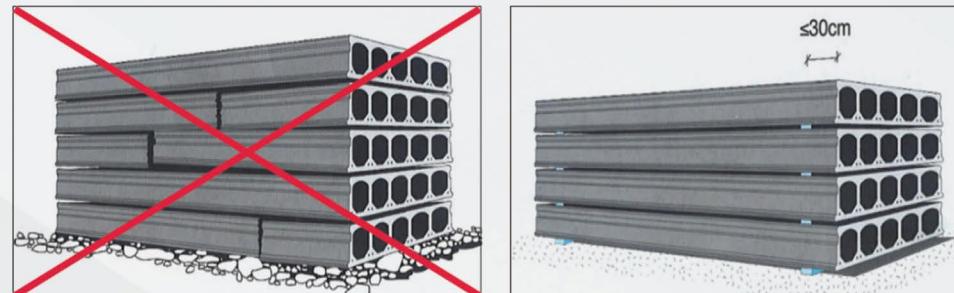
Dozvoljeni ugao nagiba ploče prilikom manipulacije pločama je max 10°
The permissible angle of inclination of the hollow core slabs during manipulation is maximum 10°.



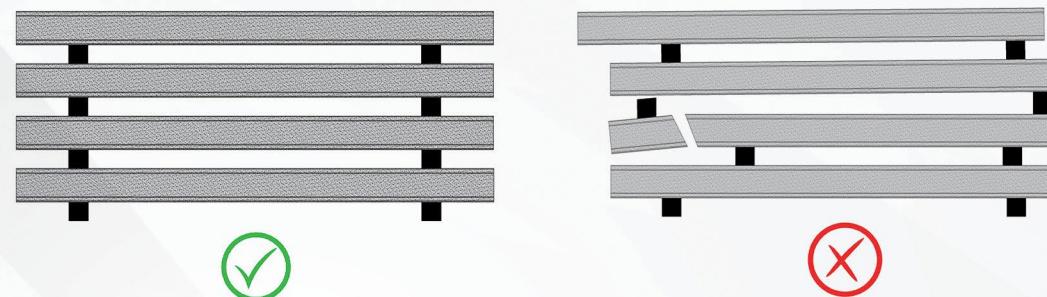
Sigurnosni lanci prilikom podizanja hvataljkama
Safety chains for lifting with a gripper



Sigurnosni lanci prilikom podizanja lancima
Safety chains for lifting with a chain

Skladštenje šupljih ploča / Hollow core slabs storage

Šuplje ploče ne mogu da se skladište na neravnom terenu.
Hollow core slabs cannot be stored on uneven ground.



Drvene letvice moraju biti u liniji, jedna ispod druge na maksimalnom rastojanju od 30cm od same ivice šuplje ploče.

The wooden slats must be in line, one below the other at a maximum distance of 30cm from the edge of the hollow core slabs.



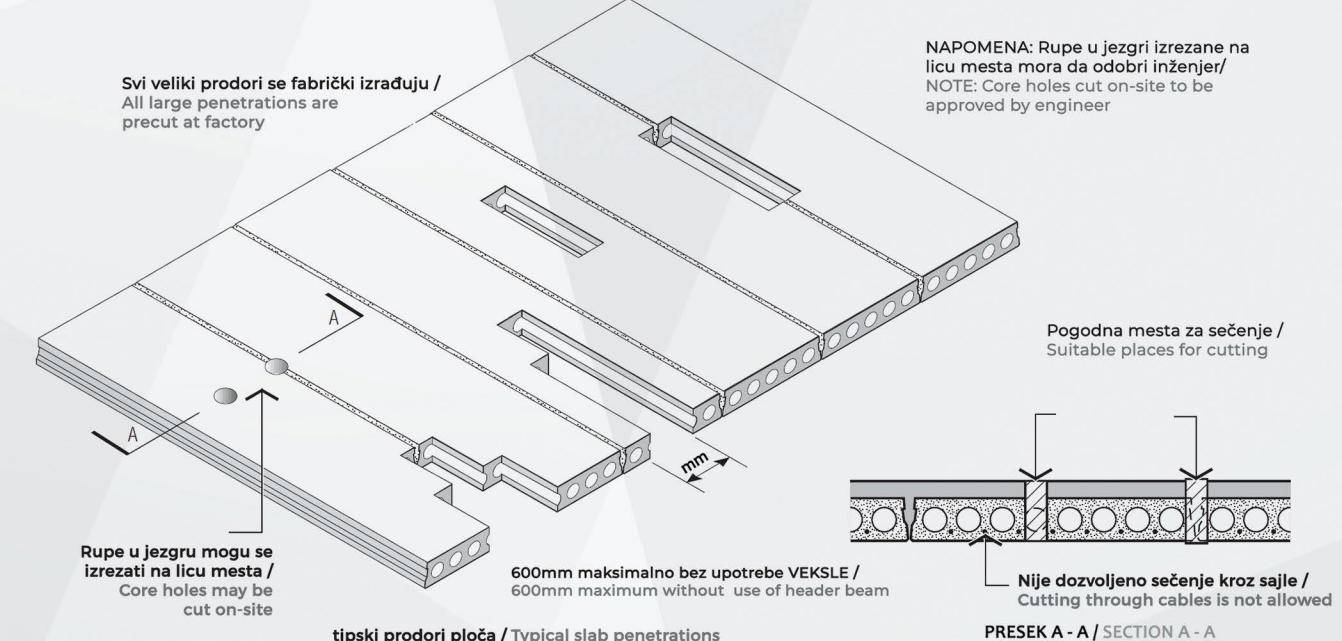
Ploče se odlazu jedna preko druge, precizno, ravnajući se po širini i dužini.
Hollow core slabs are stored one on top of the other, precisely, aligning to width and length.

Dozvoljeni broj ploča koje mogu da se lageruju jedna na drugu:
Permissible number of hollow core slabs that can be stored on top of each other:

HCS150; HCS200 - 10kom / pcs
HCS250; HCS265 - 8kom / pcs
HCS300; HCS320; HCS350 - 7kom / pcs
HCS400; HCS500 - 6kom / pcs

Tabela prečnika mogućih prodora kroz šupljinu ploče bez presecanja užadi za prednaprezanje.
Za ove prodore nije potreban statički proračun jer oko užadi ostaje zaštitni sloj betona od 35mm.
Ukoliko je neophodan veći prođor, može se napraviti uz prethodnu statičku proveru nosivosti ploče bez jednog užeta.

Table of possible diameters penetrations through the hollow core slab without cutting the prestressing ropes.
For these penetrations, static calculation is not required, because of protective concrete layer of 35 mm remains around the ropes.
If a larger penetration is required, it can be done with a previous static check of the bearing capacity of the hollow core slab without one rope.

**TIP PLOČE / HOLLOW CORE SLAB TYPE**

| | |
|---------------------------------|-------|
| ECHO - SVE VISINE / ALL HEIGHTS | 80mm |
| ELEMATIC 200 | 125mm |
| ELEMATIC 265 | 150mm |
| ELEMATIC 320; 400; 500 | 175mm |

PREČNIK PRODORA / DIAMETER PENETRATION

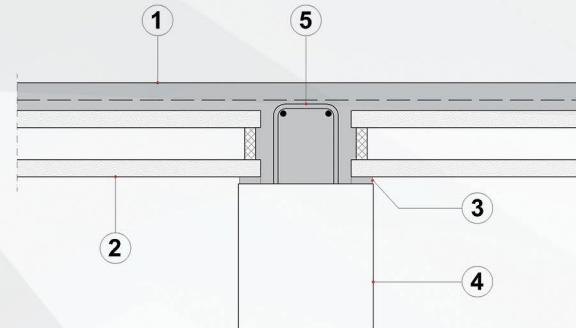
TEHNIČKI DEO

TECHNICAL PART

Tipske veze šuplje ploče sa:

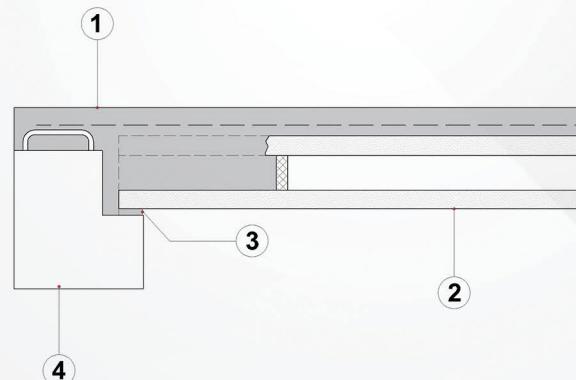
Standard connections of hollow core slabs with:

1a Unutrašnjom betonskom gredom
Inward concrete beam



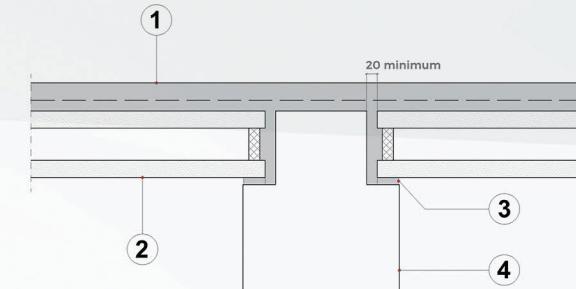
1. Toping prema zahtevu (po potrebi)
Topping as required
2. Šuplja ploča sa zatvaračima u šupljinama
Hollow core slab with dam in cores
3. 3mm neoprenska podloška, standardna
3mm neoprene bearing pads, typical
4. Montažna betonska greda ili greda koja se lije od betona na licu mesta
Precast or IN SITU concrete beam
5. Armatura grede / Beam reinforcement

2 Spoljašnjom betonskom gredom
External concrete beam



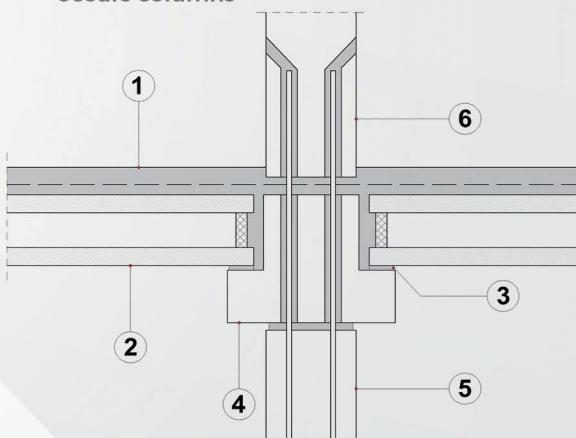
1. Toping prema zahtevu (po potrebi)
Topping as required
2. Šuplja ploča sa zatvaračima u šupljinama
Hollow core slab with dam in cores
3. 3mm neoprenska podloška, standardna
3mm neoprene bearing pads, typical
4. Ivična, montažna betonska greda ili greda koja se lije od betona na licu mesta
Precast or IN SITU concrete edge beam

1b Unutrašnjom betonskom gredom
Inward concrete beam



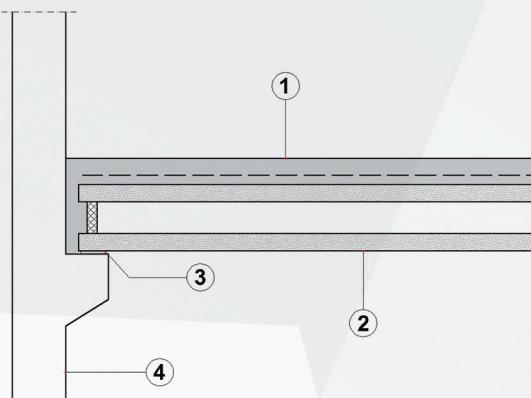
1. Toping prema zahtevu (po potrebi)
Topping as required
2. Šuplja ploča sa zatvaračima u šupljinama
Hollow core slab with dam in cores
3. 3mm neoprenska podloška, standardna
3mm neoprene bearing pads, typical
4. Ivična, montažna betonska greda ili greda koja se lije od betona na licu mesta
Precast or IN SITU concrete edge beam

**3 Unutrašnjom betonskom gredom,
kada se javi prekid stuba**
Inward concrete beam, when the interruption occurs columns



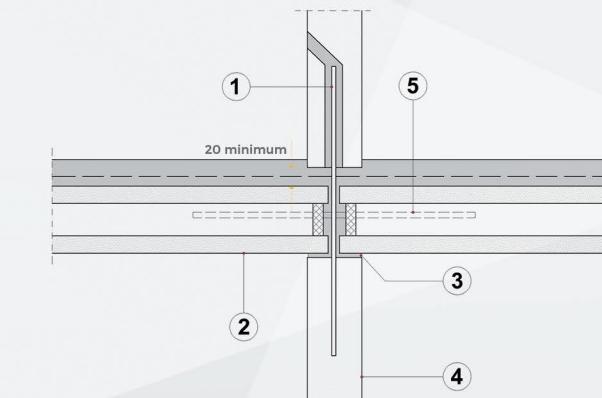
1. Toping prema zahtevu (po potrebi)
Topping as required
2. Šuplja ploča sa zatvaračima u šupljinama
Hollow core slab with dam in cores
3. 3mm neoprenska podloška, standardna
3mm neoprene bearing pads, typical
4. Ivična, montažna betonska greda ili greda koja se lije od betona na licu mesta
Precast or IN SITU concrete edge beam

4 Spoljašnjim nosećim betonskim zidom
External load-bearing concrete wall



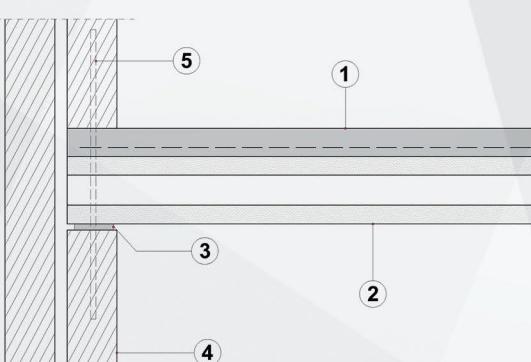
1. Toping prema zahtevu (po potrebi)
Topping as required
2. Šuplja ploča sa zatvaračima u šupljinama
Hollow core slab with dam in cores
3. 3mm neoprenska podloška, standardna
3mm neoprene bearing pads, typical
4. Montažni betonski zid ili zid koja se lije od betona na licu mesta
Precast or IN SITU concrete wall

5 Unutrašnji nosećim betonskim zidom
Inward load-bearing concrete wall



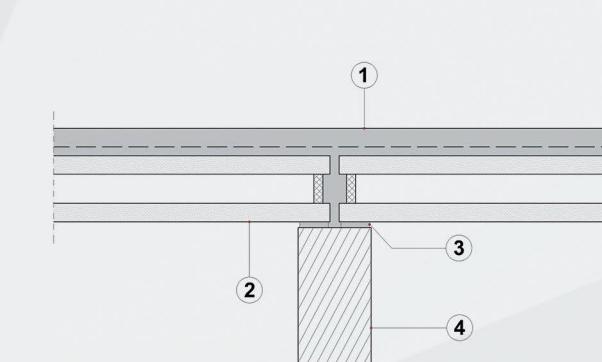
1. Ispunjeno malterom tiplo prema zahtevu
Grouted dowel as required
2. Šuplja ploča sa zatvaračima u šupljinama
Hollow core slab with dam in cores
3. 3mm neoprenska podloška, standardna
3mm neoprene bearing pads, typical
4. Montažni betonski zid ili zid koja se lije od betona na licu mesta
Precast or IN SITU concrete wall
5. Vezna armatura zalivena betonom po potrebi
Tie grouted into keyway as required

6 Spoljašnjim zidanim zidom
External masonry wall

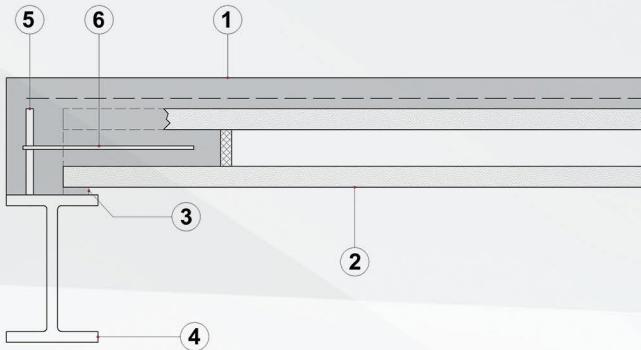


1. Toping prema zahtevu (po potrebi)
Topping as required
2. Šuplja ploča
Hollow core slab
3. 3mm neoprenska podloška, standardna
3mm neoprene bearing pads, typical
4. Noseći zidani zid
Masonry load-bearing wall
5. Veza po potrebi
Tie as required

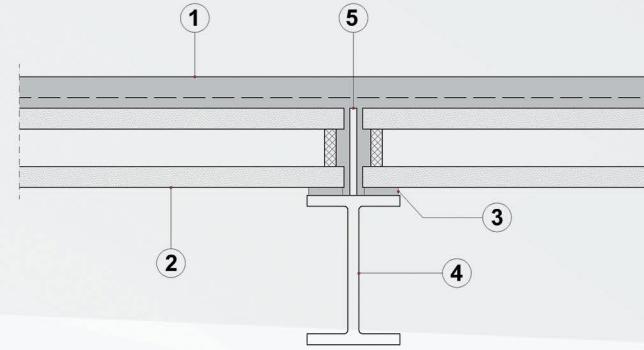
**7 Unutrašnjim zidanim nosećim zidom /
Unutrašnjim zidanim nosećim zidom**



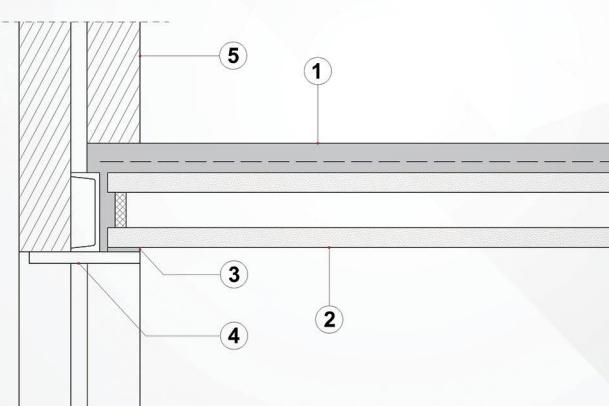
1. Toping prema zahtevu (po potrebi)
Topping as required
2. Šuplja ploča
Hollow core slab
3. 3mm neoprenska podloška, standardna
3mm neoprene bearing pads, typical
4. Noseći zidani zid
Masonry load-bearing wall
5. Veza po potrebi
Tie as required

8 Spoljašnjom čeličnom gredom
External steel beam

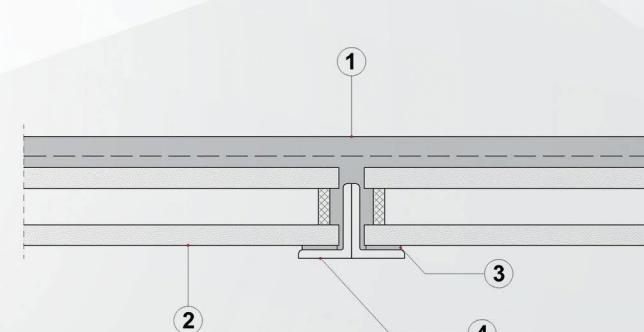
1. Toping sa ojačanjem (armaturom) po potrebi
Topping with reinforcement as required
2. Šuplja ploča sa zatvaračima u šupljinama
Hollow core slab with dam in cores
3. 3mm neoprenska podloška, standardna
3mm neoprene bearing pads, typical
4. Čelična ivična greda
Steel edge beam
5. Anker za vezu, tipski
Anchor for connection, typical
6. Otvorena uzengija, tipska
Hairpin, typical

9 Unutrašnjom čeličnom gredom
Inward steel beam

1. Toping sa ojačanjem (armaturom) po potrebi
Topping with reinforcement as required
2. Šuplja ploča sa zatvaračima u šupljinama
Hollow core slab with dam in cores
3. 3mm neoprenska podloška, standardna
3mm neoprene bearing pads, typical
4. Čelična noseća greda
Steel support beam
5. Anker za vezu, tipski
Anchor for connection, typical

10 Spoljašnjom čeličnim linijskim osloncem
External steel line support

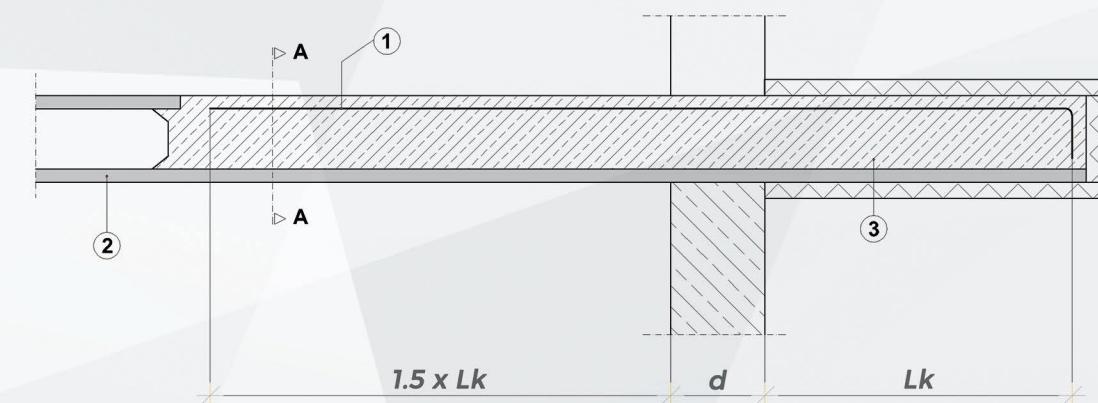
1. Toping sa ojačanjem (armaturom) po potrebi
Topping with reinforcement as required
2. Šuplja ploča sa zatvaračima u šupljinama
Hollow core slab with dam in cores
3. 3mm neoprenska podloška, standardna
3mm neoprene bearing pads, typical
4. Kanal i ploča nadvratnika iznad otvora
Channel and slab lintel over opening
5. Anker za vezu, tipski
Anchor for connection, typical

11 Unutrašnjom čeličnim linijskim osloncem
Inward steel line support

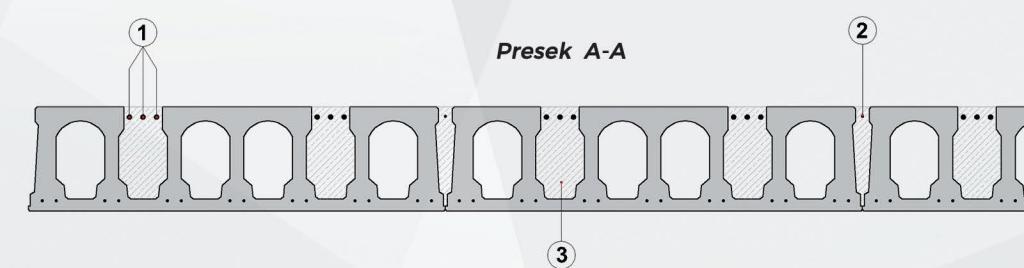
1. Toping sa ojačanjem (armaturom) po potrebi
Topping with reinforcement as required
2. Šuplja ploča sa zatvaračima u šupljinama
Hollow core slab with dam in cores
3. 3mm neoprenska podloška, standardna
3mm neoprene bearing pads, typical
4. Čelični „L“ profili leđa o leđa
Steel "L" profiles back to back

■ Šuplje ploče sa konzolom ■ Console hollow core slabs

Sve šuplje ploče do 40cm visine se mogu prepustiti preko međuspratne grede i formirati konzolu.
All hollow core slabs up to 40 cm high can be passed over the floors beam and form a console.



1. Dodatna armatura na konzolnom delu
Additional reinforcement on the console
2. Šuplja ploča
Hollow core slab
3. Dodatna betonska ispuna
Additional concrete infill



Presek A-A

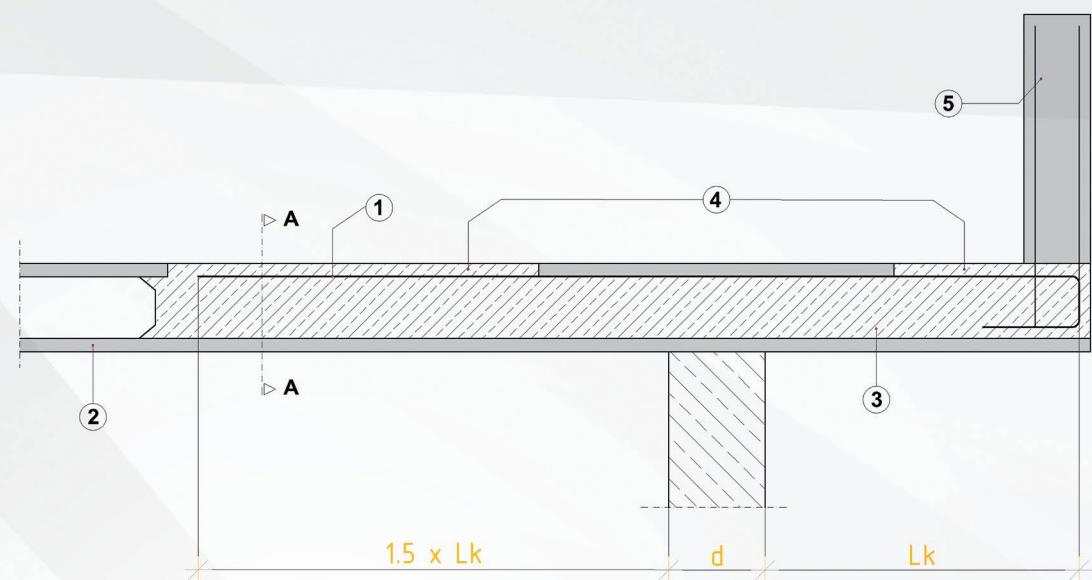
1. Dodatna armatura na konzolnom delu
Additional reinforcement on the console
2. Dodatna armatura na spoju
Additional reinforcement at the junction
3. Dodatna betonska ispuna
Additional concrete infill

Parapetna greda na prepustu šupljih ploča

Zaseci iznad šupljina na ploči se prave u proizvodnom pogonu. Aramatura za vezu ploče i parapeta se postavlja na licu mesta i betonira se prvo šupljina, pa zatim parapetna greda. Treba voditi računa da na kraju ploče užad za prednaprezanje budu zaštićena od korozije.

Parapet beam on the overhang of hollow core slabs

The notches above the cavities on the hollow core slabs are made in the production plant. The reinforcement for the connection of the slab and the parapet is placed on the spot and the cavity is concreted first and then the parapet. Care should be taken to protect the prestressing ropes at the end of the plate from corrosion.



- 1. Dodatna armatura na konzolnom delu
Additional reinforcement on the console
- 2. Dodatna armatura na spoju
Additional reinforcement at the junction
- 3. Dodatna betonska ispuna
Additional concrete infill
- 4. Otvori u šupljoj ploči
Open in a hollow core slab
- 5. Atika / Attica

Vrednosti maksimalne dužine konzole (prepusta) i potrebna armatura konzola u smeru raspona sa opterećenjem $q_k = 5 \text{ kN/m}^2$

Values of the maximum length of the console (overhang) and the required reinforcement of the console in the direction of the range with load $q_k = 5 \text{ kN/m}^2$

| Tip šuplje ploče / Hollow core slab type | max. L _k | Dodata armatura u ploči / Added reinforcement in the slab |
|---|---------------------|--|
| ECHO: HCS150; HCS200 | 1,2 m | 3 šupljine (3 hollow) / 3x3φ14 |
| EL: HCS200 | 1,2 m | 2 šupljine (2 hollow) / 2x4φ14 ili / or 2x2φ20 |
| ECHO/EL: HCS250; HCS265 | 1,5 m | 2 šupljine (2 hollow) / 2x5φ14 ili / or 2x3φ20 |
| ECHO/EL: HCS300; HCS320; HCS400 | 1,5 m | 2 šupljine (2 hollow) / 2x3φ20 |

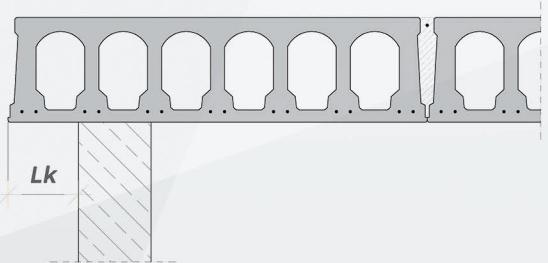
Upravne konzole na pravac prostiranja užadi za prednaprezanje.

Zbog nedostatka poprečne armature, konzole se mogu napraviti samo do druge šupljine. Ove konzole mogu biti malo opterećene poput oluka za kišu i slično...

Perpendicular consoles to the direction of the prestressing ropes.

Due to the lack of the transverse reinforcement, the console can only be made up to the second cavity. These consoles can be lightly loaded like rain gutters and etc..

| Tip šuplje ploče / Hollow core slab type | max. L _k |
|---|---------------------|
| ECHO: HCS150; HCS200 | 16 cm |
| EL: HCS200 | 20 cm |
| ECHO/EL: HCS250; HCS265 | 25 cm |
| ECHO/EL: HCS300; HCS320; HCS400 | 30 cm |



Prostor za beleške / Notes space

