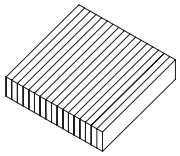
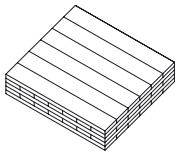
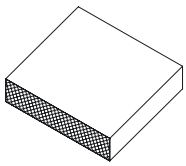


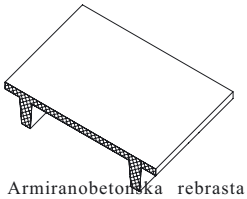
Slika 1: Lesena lepljena plošča.
Wooden glued slab.



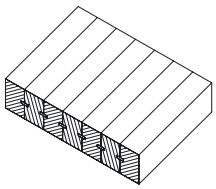
Slika 2: Lesena lepljena plošča iz križno ležečih desk.
Wooden glued slab with planks lying cross-wise.



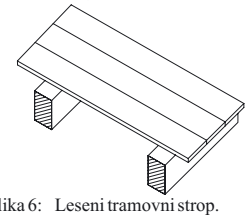
Slika 3: Armiranobetonska plošča.
Reinforced concrete slab.



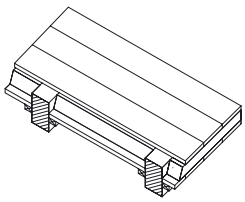
Slika 4: Armiranobetonska rebrasta in rebričasta plošča.
Reinforced ribbed slab.



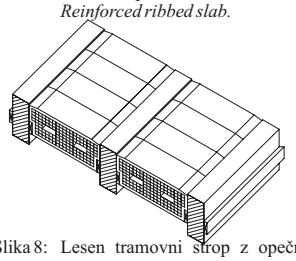
Slika 5: Lesen zmozničeni tramovni strop.
Wooden tree nailed beam slab.



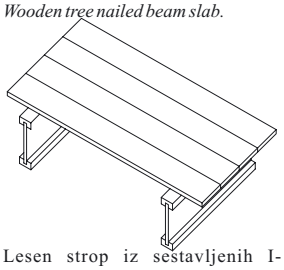
Slika 6: Leseni tramovni strop.
Wooden beam slab.



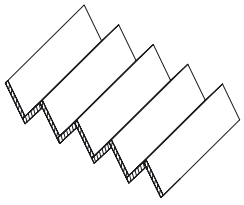
Slika 7: Lesen tramovni strop z vmesnim nasutjem.
Wooden beam slab with intermediate filling.



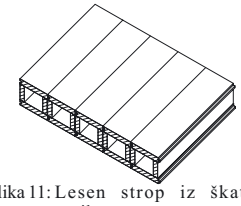
Slika 8: Lesen tramovni strop z opečnimi polnili.
Wooden beam slab with brick filling.



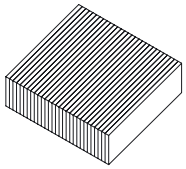
Slika 9: Lesen strop iz sestavljenih I-nosilcev.
Wooden slab from composite I-beams.



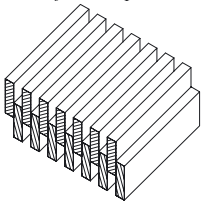
Slika 10: Lesen strop iz diagonalnih stojin.
Wooden slab with diagonal column.



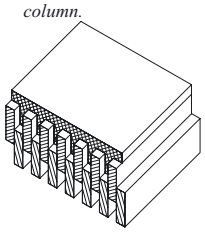
Slika 11: Lesen strop iz škatlastih nosilcev.
Wooden slab from box-beams.



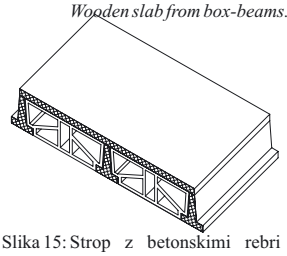
Slika 12: Lesena žebljana plošča.
Nailed wooden slab.



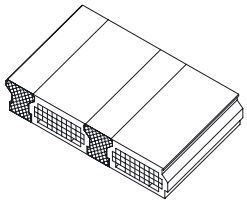
Slika 13: Lesen strop iz povezanih zamaknjenih desk.
Wooden slab from joined shifted planks.



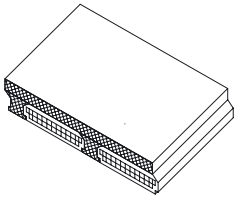
Slika 14: Lesen strop iz povezanih zamaknjenih desk in betona.
Wooden slab from joined shifted planks and concrete.



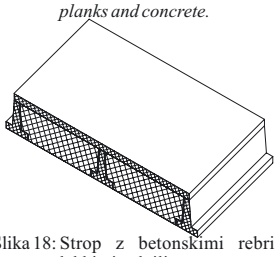
Slika 15: Strop z betonskimi rebri in betonskimi polnili.
Slab from concrete ribs and concrete filling.



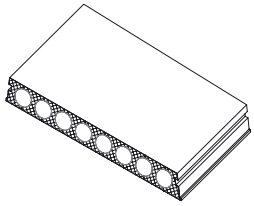
Slika 16: Strop z betonskimi rebri in opečnimi polnili.
Slab from concrete ribs and brick filling.



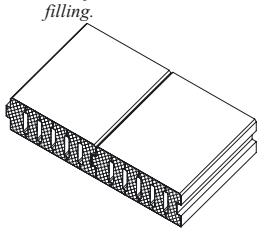
Slika 17: Strop z betonskimi rebri, opečnimi polnili in tlačno ploščo.
Slab from concrete ribs, brick filling



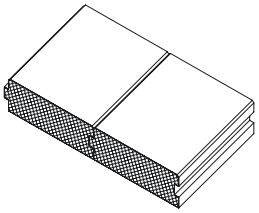
Slika 18: Strop z betonskimi rebri in lahkimi polnili.
Slab with concrete ribs and light filling.



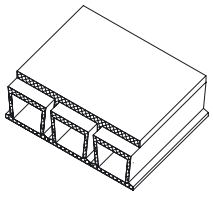
Slika 19: Prednapeta votla betonska plošča iz lamel.
Pre-stressed laminated hollow concrete slab.



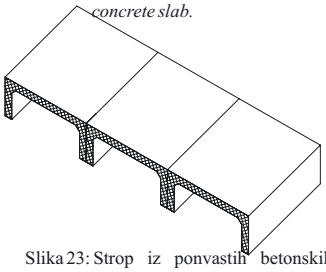
Slika 20: Votla plošča iz lahkega armiranega betona iz lamel.
Hollow plate of laminated light reinforced concrete.



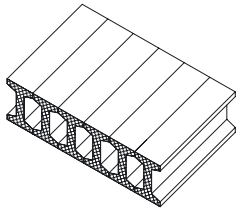
Slika 21: Plošča iz lahkega armiranega betona iz lamel.
Plate from laminated light reinforced concrete.



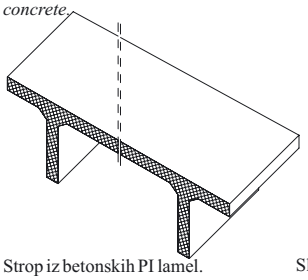
Slika 22: Strop iz škatlastih betonskih nosilcev.
Slab from concrete box-beams.



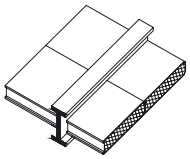
Slika 23: Strop iz ponvastih betonskih nosilcev.
Slab from concrete pan-beams.



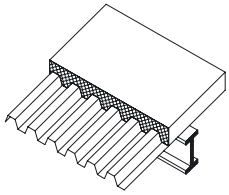
Slika 24: Strop iz betonskih I-nosilcev.
Slab from concrete I-beams.



Slika 25: Strop iz betonskih PI lamel.
Slab from concrete PI lamellas.



Slika 26: Strop iz kovinskih nosilcev in polnil.
Slab from metal beams and filling.



Slika 27: Strop iz kovinskih nosilcev, trapezne pločevine in betona.
Slab from metal beams, trapeze sheet metal and concrete.

Martina Zbašnik-Senegačnik, Janez Kresal

STROPI
CEILINGS

raziskava, *research*

povzetek

Stropi (mednadstropne ali medetažne konstrukcije) v zgradbah omejujejo prostor navzgor, njihove ostale funkcije pa so še nosilnost, zvočna, požarna in toplotna zaščita. Hkrati morajo zagotavljati tesnost prostorov in nuditi psihološko ugodje. V zgodovini so se najprej uporabljale lesene izvedbe stropov, saj je ta edini od takrat poznanih gradiv, ki je odporen na upogib. Zaradi slabše požarne varnosti lesa so kasneje lesene strope zamenjali stropi iz kamna in opeke, vendar le v pomembnejših zgradbah. S pojavom betona in kovin (armiranega betona) so se v začetku 20 stol. stropne konstrukcije iz lesa, kamna in opeke počasi začele umikati. Ponovno jih je pred dobrim desetletjem oživila ekološko osveščena miselnost, ki je v armiranem betonu našla negativne vplive na okolje in človeka v celotnem življenjskem ciklusu. V nalogi smo poskušali dokazati, da obstaja širok spekter stropov, ki dosegajo ali celo presegajo danes še vedno najbolj razširjeno armiranobetonsko ploščo.

V raziskovalni nalogi so stropi sistematično razdeljeni v pregledno shemo po kriteriju konstrukcijske in funkcionalne tipologije. Predstavljeni so aktualni stropi iz različnih gradiv – na osnovi lesa, opeke, armiranega betona in kovin in so uvrščeni v skupino masivnih ali sestavljenih stropov. V nadaljevanju je obdelana problematika zvoka v zgradbah. Pri stropih je še posebej pomemben udarni zvok, ki zahteva posebne ukrepe. Stropi so obdelani tudi s požarnovarnostnega vidika.

doseženi cilji, namen in rezultati

V raziskovalni nalogi so obravnavani stropi, katerih primarna funkcija je nosilnost, druge funkcije pa so še protihrupna, protipožarna in toplotna zaščita. Stropi so uvodoma sistemsko razdeljeni po kriteriju konstrukcijske in funkcionalne tipologije. Po konstrukcijski tipologiji se stropi dodatno delijo na masivne in sestavljene. Vsak pojem je podrobneje obdelan in prikazan v sliki. V nadaljevanju sta podrobneje predstavljeni področji zvočne in požarne zaščite stropov. Namen naloge je bil sistemizirati strope po različnih kriterijih in poiskati relevantne primere iz prakse. Rezultat raziskave bo služil kot pomožno gradivo pri predmetu Tehnologija gradnje.

problematika v arhitekturi, umestitev obravnavane teme v te tokove in njen pomen

Od vseh začetkov je bilo idealno gradivo za strope les, edini od naravnih gradiv, ki je odporen na upogib. Les je gorljiv in manj obstojen od kamna, zato so se zgodaj razvili tudi težki stropi iz kamna (opeke) kot npr. lažna kupola, obok, kupola – vendar so jih praviloma uporabljali le v pomembnejših zgradbah. Z manjšimi izjemami je v preteklosti torej prevladujoče gradivo za izvedbo stropov les (tramovi, gredice, deske). S pojavom modernih gradiv (armirani beton, jeklo) in visokih zgradb so lesene strope povečini zamenjale armiranobetonske plošče ali kombinacije armiranobetonskih nosilcev z vmesnimi lažjimi polnili. Aktualne so tudi kombinacije s kovinskimi nosilci in kovinskimi rebrastimi ploščami. Z naraščanjem ekološke zavesti in z boljšim razumevanjem nezdravih pojavov v modernem graditeljstvu pa se je zanimanje za lesene strope spet povečalo. Izumljajo vedno nove tehnologije uporabe lesa za strope – saj je les najbolj ekološko in zdravo gradivo. V okviru naloge smo poiskali relevantne primere stropov iz prakse in opredelili glavne pojme, ki so potrebni za razumevanje.

ključne besede

strop, medetažna konstrukcija, tla, udarni zvok

summary

Ceilings (the structures between floors) in buildings limit spaces upwards; their other functions are load-bearing, noise reduction, fire protection and heat insulation. They must also ensure airtight spaces and offer psychological comfort. Historically speaking wooden ceiling solutions were the first to emerge, since wood was the only known material at the time that could endure bending. Because of bad fire insulation properties wooden ceilings were later replaced with stone or brick ceilings, but only in the more important buildings. The introduction of concrete and metals (reinforced concrete) at the beginning of the 20th century implied the slow demise of wooden, stone and brick ceilings. They were nevertheless revitalised in the last decade with ecologically conditioned consciousness, when it was discovered that that reinforced concrete had many negative influences on the environment and humanity during the whole lifecycle. In the research we tried to prove that there is a wide range of other ceilings that meet or exceed the performances of the today most widespread type of ceiling, the reinforced concrete slab. In the research ceilings are systematically divided into a simple scheme according to criteria of structural and functional typology. Various present ceilings from various materials are shown, i.e. timber, brick, reinforced concrete and metal, which are further grouped into massive or composite ceilings. In continuation the issue of noise in buildings is dealt with. For ceilings the impact noise is especially important and needs special measures. Ceilings are dealt with also from the aspect of fire safety.

intentions, goals and results

The research deals with ceilings, whose primary function is load-bearing, while the other functions are noise reduction, fire protection and heat insulation. In the introduction ceilings are divided according to criteria of structural and functional typology. According to structural typology they are further divided into massive and composite. All the concepts are dealt with in detail and illustrated. In continuation the fields of noise reduction and fire protection are elaborated. The purpose of the research was to systemise ceilings by various criterions and to find relevant practical examples. The results of the research will be used as supplementary material for the course Building technology.

architectural issues, positioning the topic in ongoing debate and its' significance

From the earliest beginnings the ideal material for ceilings was wood, the only natural material resilient to bending. Wood burns and is less endurable than stone, thus heavy stone (brick) slabs emerged quite soon, such as fake domes, arches, cupolas – but they were generally used only on the most important buildings. In the past the most commonly used material for ceilings, with some exceptions, was wood (beams, girders, planks). With the emergence of modern materials (reinforced concrete, steel) and high buildings wooden ceilings were mostly replaced with reinforced concrete slabs or combinations of reinforced concrete beams with lighter intermediate fillers. Even combinations of metal beams and ribbed metal sheets are quite present. The increasing ecological consciousness and better understanding of unhealthy phenomena in modern construction has triggered significant interest for wooden ceilings. New technologies for using wood are being invented – after all, wood is the most ecological and healthy material. Within the framework of the research we chose the most relevant examples of ceilings built in practise and defined the main concepts needed for understanding.

key words

ceiling, floor structure, ground, sound