

# ventilated systems

In the last few years there is obvious „invasion“ of various facade covers. Their variety contributes to creating new looks of cities, it influences the overall urban infrastructure and eventually the quality of our lives. To quote a Spanish architect: „Exchange in architectural styles is always a part of cultural pattern change. Nowadays, this is happening due to existence of different materials. Possibilities given by different materials in creating new architecture are unique!“ Aside from spectacular visual effect, it is good to state all the benefits of ventilated facades.

## ENERGY SAVING AND EFFICIENCY

Climate changes are becoming more and more obvious, and are caused by heavy exploitation of natural resources. Allegedly insufficient sources of conventional energy are imposing re-evaluation of energy strategies, which are breaking through traditional boundaries and becoming a part of a joint European energy policy. Serbia has developed a „National Short-Term and Long-Term Energy Efficiency Program“. The main aim of ventilated facades is to provide adequate micro-climate in objects, with maximum energy saving and prevention of environmental pollution. „Energetic management“ is a discipline that defines controlling principles of heating expenses. Basic advantage of ventilated facades – energy saving – is fully in line with European and national programs. Insufficiently efficient thermo insulation can lead to significant losses in temperature and raise the overall heating expenses for nearly 15-20%, through so called „thermo bridges“.

„Thermo bridges“ are spots of increased heating transfer, which are formed on steel metal surfaces: bearers, beams, columns, back-planes. Low temperatures are formed around these spots, therefore at the temperature around 10° C degrees, formation of dew is possible, which usually happens in the interior; consequences are strong condensation and formation of mold, i.e. worsening of the rooms` micro-climate.

By laying efficient thermo insulation on outer building walls, more energy is saved, interior atmosphere is more comfortable, healthy life conditions are provided and the overall environment gets protected.

Ventilated facades are the softer version of hanged glass facades, and the same principles applied in those cases are applicable here – supporting systems in simple and continuous beams, movable and immovable supporters, oval spaces for temperature expansion, while mounting is done externally and it requires a scaffold, fasteners, basic angle bars, thermo insulators, accessory and a façade cover.

Variety in production of façade covers created a need for supporting construction, which eventually led to the system of ventilated facades.

Openings in the base of the fasteners enable the use of one or two fastening

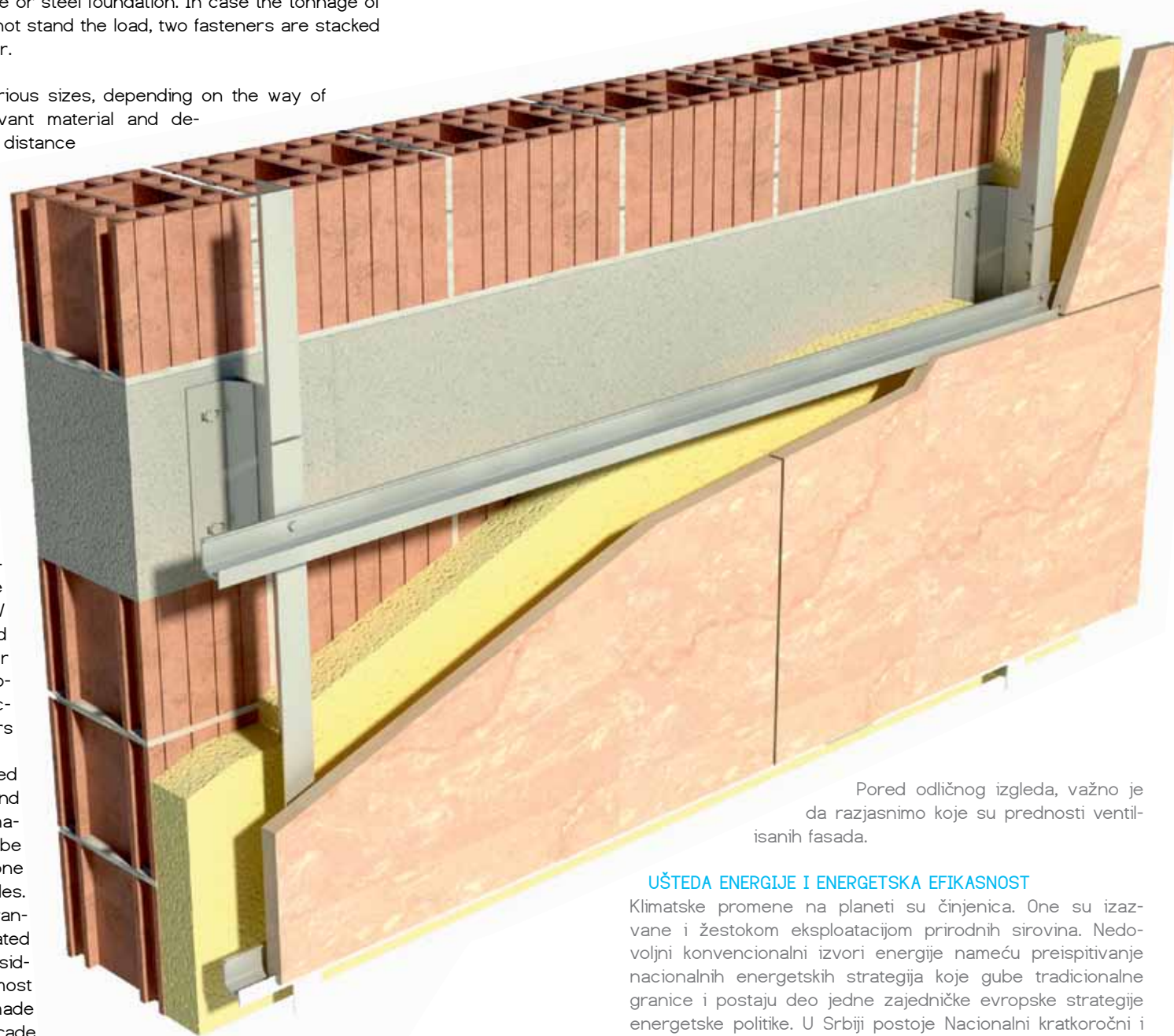
elements, if the load is heavy. The openings are also used for tightening of basic carrying angle bar, a rounded one for immovable supporter, and an oval one for the movable supporter.

Immovable supporter can stand its own weight as well as the wind force from the surface called „load plane“. Considering that it is the most burdened supporter, it has to be tightened to a steel/concrete or steel foundation. In case the tonnage of one fastener cannot stand the load, two fasteners are stacked next to each other.

They come in various sizes, depending on the way of fastening of relevant material and demands of minimal distance

between fastening elements and the material. It is recommendable to have the angle bar length equal to the floor height. Oval openings of mounted fasteners come in dimensions that can stand angle bar expansion up to 3 meters. The angle bar is fastened by an inert support in the head of the steel/concrete plan, and through 1,5 meter gaps movable supporters, i.e. secondary supporters are installed.

As it is, ventilated facades can stand different cover materials. We will be presenting stone ventilated facades. Stone rocks (granite, marble) ventilated facades are considered „heavy“. In most cases, they are made by fixing the façade panels onto carriers, in this particular case, onto aluminium sub-construction.



Pored odličnog izgleda, važno je da razjasnimo koje su prednosti ventilisanih fasada.

## UŠTEDA ENERGIJE I ENERGETSKA EFIKASNOST

Klimatske promene na planeti su činjenica. One su izazvane i žestokom eksploatacijom prirodnih sirovina. Nedovoljni konvencionalni izvori energije nameću preispitivanje nacionalnih energetske strategije koje gube tradicionalne granice i postaju deo jedne zajedničke evropske strategije energetske politike. U Srbiji postoje Nacionalni kratkoročni i dugoročni programi Energetske efikasnosti. Njihov je osnovni cilj obezbeđenje dobre mikroklimu u zgradama uz minimalnu potrošnju energije i sprečavanje zagađenja životne sredine. „energetski menadžment“ definiše principe kontrole i up-

# ventilisani sistemi

ravljanja troškovima grejanja. Osnovna prednost ventilisanih fasada – ušteda energije – u skladu je sa evropskim i nacionalnim programima. Nedovoljno efikasna termoizolacija može da izazove znatne gubitke toplote i povećanje troškova za oko 15-20% preko takozvanih „thermo mostova“.

„Thermo mostovi“ su mesta povećanog prenosa toplote. Nastaju kod površina od armiranog betona: nosača, greda, serklaža, stubova, čela ploča. Oko ovih mesta nastaju zone niske temperature. Područje u kojem dolazi do rošenja oko +10°C – premešta se unutar prostorije, dolazi do stvaranja jakog kondenzata, a kasnije i do nastanka plesni, odnosno do pogoršanja mikroklimu u prostoriji.

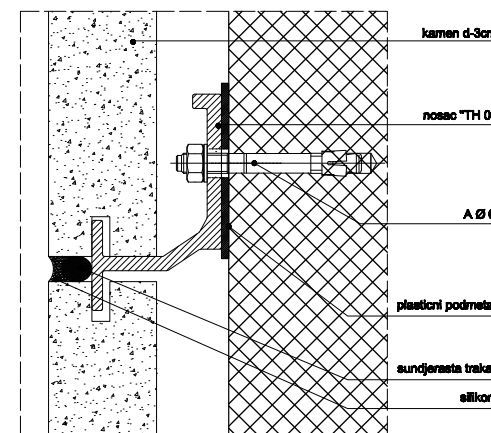
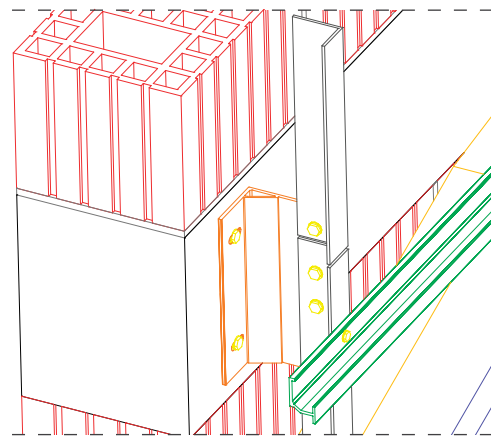
Postavljanjem efikasne termoizolacije na spoljašnje zidove zgrade smanjuju se gubici i troškovi energije, povećava se komfor u prostoriji, obezbeđuju se zdravi uslovi života i čuva životna sredina.

Ventilisane fasade su lakša verzija okačenih staklenih fasada. Isti principi važe i ovde – podupiranje: jednostavne i neprekidne grede, pokretni i nepokretni oslonci, ovalni otvori za temperaturno širenje. Montaža se ostvaruje spolja. Za montažu su potrebni skela, sidra-ankeri, osnovni noseći profili, termoizolacija, aksesoari i fasadna obloga.

Raznolikost fasadnih obloga stvorila je potrebu, za konstrukcijom za njihovo pričvršćivanje. Ova potreba za nosećom konstrukcijom stvorila je sistem za ventilisane fasade. Otvori u osnovi u nosačima omogućuju da se koriste jedan ili dva pričvršna elementa, ukoliko opterećenje to nalaže. Otvori na nosačima služe za pričvršćivanje osnovnog nosećeg profila: okrugli za nepokretni oslonac i ovalni za pokretni oslonac. Nepokretni oslonac podnosi opterećenje sopstvene težine fasadne obloge i opterećenja. S obzirom na to da je najopterećeniji oslonac, on mora da bude pričvršćen za armirano-betonsku ili čeličnu podlogu.

Ukoliko nosivost jednog sidra nije dovoljna da podnese opterećenje, postavljaju se dva sidra jedno iznad drugog. Dimenzionisani su i projektovani u različitim veličinama zavisno od načina pričvršćivanja odgovarajućeg materijala i zahteva u pogledu minimalnih rastojanja pričvršnih elemenata od njega. Preporučljivo je da dužine profila budu jednake visini etaže. Ovalni otvori montažnog sidra dimenzionisani su tako da podnose temperaturno širenje profila dužine oko 3 m i više. Profil se pričvršćuje jednim nepokretnim osloncem u čelu armirano betonske ploče –pozicije, a na razmaku od ~1,5 m ugrađuju se pokretni oslonci, odnosno sekundarni nosači. Kao što je poznato i kod ventilisanih fasada, obloga može biti od različitih materijala. Ovde ćemo predstaviti kamene ventilisane fasade. Kamene (granit, mermer, itd) ventilisane fasade su „teške fasade“. One se najčešće realizuju fiksiranjem fasadnih kamenih ploča na odgovarajuće nosače, odnosno u ovom slučaju na aluminijumsku podkonstrukciju.





**Tabaš**

**ESTETIKA I ARHITEKTONSKA SLOBODA**

Sa aluminijumskom potkonstrukcijom za ventilisane kamene fasade, projektantu se omogućava veća sloboda u izboru dimenzija kamena. Dobra kamena ventilisana fasada vizuelno ističe objekat, koji na sebi ima prirodni i dugotrajni materijal.

U prostor od fasadne obloge do konstrukcije objekta moguće je provući i određene instalacije, a olučne vertikale mogu da budu potpuno skrivene.

**TEHNIČKE KARAKTERISTIKE**

Zaštita objekta od atmosferskih uticaja kao što su kiša, sneg, vetar i sunčevo zračenje, ventilisanom kamenom fasadom je u potpunosti efikasna. Unutrašnji sloj vazdušnog prostora od termike do kamena, omogućava strujanje vazduha koje određenim radnjama može i da se koriguje povećanjem efekta dimnjaka, tako da se pospešuje mogućnost ventiliranja, što doprinosi eliminisanju vlage i pojavu kondenzacije na spoljašnjem delu fasade. Ovakve fasade omogućavaju i eventualne lakše popravke na spoljnjem delu objekta jer se kamene ploče mogu skinuti i iste vratiti.

**IZOLACIJA**

Kombinacija od odgovarajuće termičke izolacije spoljne strane fasadnog zida objekta, vazdušnog prostora i vidna kamena obloga, mogu osetno da doprinesu uštedi energije za grejanje ili hlađenje objekta. Takođe ova kombinacija slojeva dodatno povećava i zvučnu izolovanost objekta.

**"TABAŠ" POTKONSTRUKCIJA**

Potkonstrukcija "TABAŠ" za ventilisanu kamenu fasadu sastoji se od nekoliko posebnih aluminijumskih profila, koji su namenski projektovani i napravljeni za ovaj tip potkonstrukcije. Profili su testirani kako pojedinačno tako i u sklopu, kao sistem. Zbog malog broja elemenata koji se koriste u ovom sistemu, u izvođenju je postignuta preciznost i brzina ugradnje.

Takođe, ovaj sistem omogućava jednostavnu upotrebu različitih dimenzija i debljina kamenih ploča.

Potkonstrukcija «TABAŠ» se sastoji od originalnog primarnog i sekundarnog nosača ("TAp"; "TAs"):

Primarni nosač "TAp", izrađen je sa kosnikom što mu povećava nosivost i krutost. Položaj primarnog nosača "TAp" zavisi od položaja AB serklaža ili grede na objektu.

Sekundarni nosač "TAs" je istog poprečnog preseka kao i primarni, 2,5 puta je manje dužine. Vertikalni nosač "TV", je robusni "L" nosač i poseb-

no je projektovan za ovaj sistem. Dimenzije "TV" nosača u sklopu sa primarnim i sekundarnim nosačem omogućavaju idealnu vertikalnost koja se postiže dozvoljenom tolerancijom od gotovo +/- 3cm u odnosu na vertikalnu ravan, što omogućava pokrivanje većih grešaka od +/-1cm u vertikalnosti izvedenog zida objekta. Standardna dužina TV nosača je 6m, što praktično znači da pokriva gotovo sve spratne visine. Vertikalni L nosači se uglavnom postavljaju na 100cm međusobnog odstojanja, za debljinu kamenih ploča od d=3cm. Horizontalni nosači omogućavaju veliki broj kombinacija fiksiranja - direktnog prihvatanja kamenih ploča.

Osnovna prednost ovog sistema u odnosu na druge, je ta što se kombinacijom profila postiže da svaka pozicija kamena bude samostalno fiksirana ako ima odgovarajuće dimenzije (klupice, plafoni, špaletne ...). Ovim profilima je postignuto kontinuirano oslanjanje kamena, što je povoljnije za kamene ploče u odnosu na tačkasto prihvatanje. Sa aluminijumskom potkonstrukcijom se postiže na fasadi istovetan rad profila kao i kod aluminijumskih fasadnih površina - prozora, a koje su nekad i zastupljenije na fasadnim površinama.

Poslednjih godina se sve više koristi i način ispunje vertikalnih i horizontalnih fuga sa specijalnom elastičnom masom za zaptivanje i sa sunđerastom trakom, kako je prikazano na detalju (tu je i bez termike na spoljnoj strani zida). Ovakvo rešenje još više pospešuje ventilaciju u vazdušnom prostoru iza kamena, stvara se efekat dimnjaka, smanjuje se prodor kiše ka zidu na gotovo 0% i vrši se brža izmena vazduha. Sa ovim sistemom potkonstrukcije, ako vertikalne fuge budu "slepe" zbog specifičnog horizontalnog profila kojim je ispunjena fuga (horizontalna fuga u kamenu mora da postoji min. 3mm širine odnosno visine) nije potrebno nikakvo pupunjavanje fuga, a efekat je vrlo sličan.

Takođe preporučujemo da spoljni vertikalni uglovi fasada, ako se oblažu kamenom, da strane budu "ravnopravne".

Inače se već pokazalo, montažom na nekoliko objekata, da je ovde puno rešenja sa najmanjim brojem elemenata - profila, a sve to uz korišćenje standardnih alata.

U svakom slučaju ni jednom objektu se ne prilazi šablonski, jer svaki ima specifične zahteve i traži ponekad i takva rešenja.



**AESTHETICS & ARCHITECTURAL FREEDOM**

Aluminium sub-construction for ventilated stone facades provides more freedom to an architect when it comes to choosing the stone panel dimensions. A well done ventilated façade visually accentuates the object, with natural and long-term durable material. The space between the façade cover and construction can be used for storing installations, while vertical gutter cantilevers can remain hidden.

**TECHNICAL FEATURES**

Ventilated stone facade gives fully efficient protection in rain, snow, wind and sun beams. Interior layer of air space, made of thermo insulation and stone, enables air flow which is subject to adjustment, by raising the chimney effect. In that way ventilation is enhanced, humidity is almost completely reduced, as well as condensed water on the outer walls. Stone facades leave room for minor adaptations, since stone panels can easily be removed.

**INSULATION**

When combined, thermo insulation of the outer facade wall, air space and visible stone panels can significantly contribute to energy saving. This combination also raises the object's sound proof feature.

**"TABAŠ" SUB-CONSTRUCTION**

Sub-construction "TABAŠ" for ventilated stone facade is comprised of a few separate aluminium angle bars, custom made for this type of sub-construction. Angle bars have been tested, individually and in composition, so as to get fast and precise performance in instalment. This system also enables simple use of different dimensions and thickness of stone panels.

"TABAŠ" sub-construction is composed of original primary and secondary carriers ("TAp"; "TAs"). Primary carrier "TAp" is constructed with a angle of the beam, extending its tonnage and austerity. The positioning of the primary carrier "TAp" is conditioned by the position of the AB horizontal concrete element or the object cantilever.

Secondary carrier "TAs" has the same diameter as the primary one and is 2,5 times shorter in length. Vertical carrier "TV" is a robust "L" carrier and is specifically designed for this system. Dimension of the

"TV" carrier in combination with the primary and secondary carriers provide ideal vertical positioning, which is achieved by a permitted tolerance of nearly +/- 3cm in relation to the vertical plane. That, in continuation, enables a cover up of more major mistakes of +/- 1cm in the object's vertical part of the wall. Standard length of the "TV" carrier is 6m, what practically means that it covers all possible heights and floors. Vertical "L" carriers are usually installed with 100cm distance, for stone planes of width d=3cm. Horizontal carriers enable great variety of fixing combinations - direct fitting of stone planes. Main advantage of this system when compared to the others is that the combination of angle bars it can be achieved that every plane can be independently fixed, if it is of adequate dimensions. The angle bars provide continuous stone leaning, which is much better for stone panels than random instalment. The aluminium sub-construction on the façade can achieve the same settings of the angle bars as with aluminium façade surfaces - windows, which are sometimes seen on façade surfaces.

Lately it is becoming more popular to fill in vertical and horizontal joint with special elastic filling batter, with spongy band, as shown in the picture (as shown, without the thermo insulation on the outer side of the wall). This solution enhances the ventilation in the air space behind the stone, the chimney effect is achieved, the space towards the wall is reduced to almost 0% and the air flow is faster. This system of sub-construction, if vertical joint get "blinded" because of the specific horizontal angle bar which is inside the joint (there has to be a horizontal joint in the stone, of at least 3mm width/height), no additional filling is required, and the effect is almost identical.

If the outer vertical façade angles are covered in stone, it is recommendable that sides are equal. The experience so far has proved that this approach gives many solutions with the smallest number of elements - angle bars, with the use of standard equipment. In any case, every object is taken into a special consideration, since every object is specific and calls for unique solutions.



**Tabaš**