Zidana ispuna a-b zgrada

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Ovo predavanje se temelji na projektu (2019.):

Development of infill masonry solution for Adriatic region

izrađenom od strane

UNIVERSITY OF SPLIT,
FACULTY OF CIVIL ENGINEERING,
ARCHITECTURE AND GEODESY

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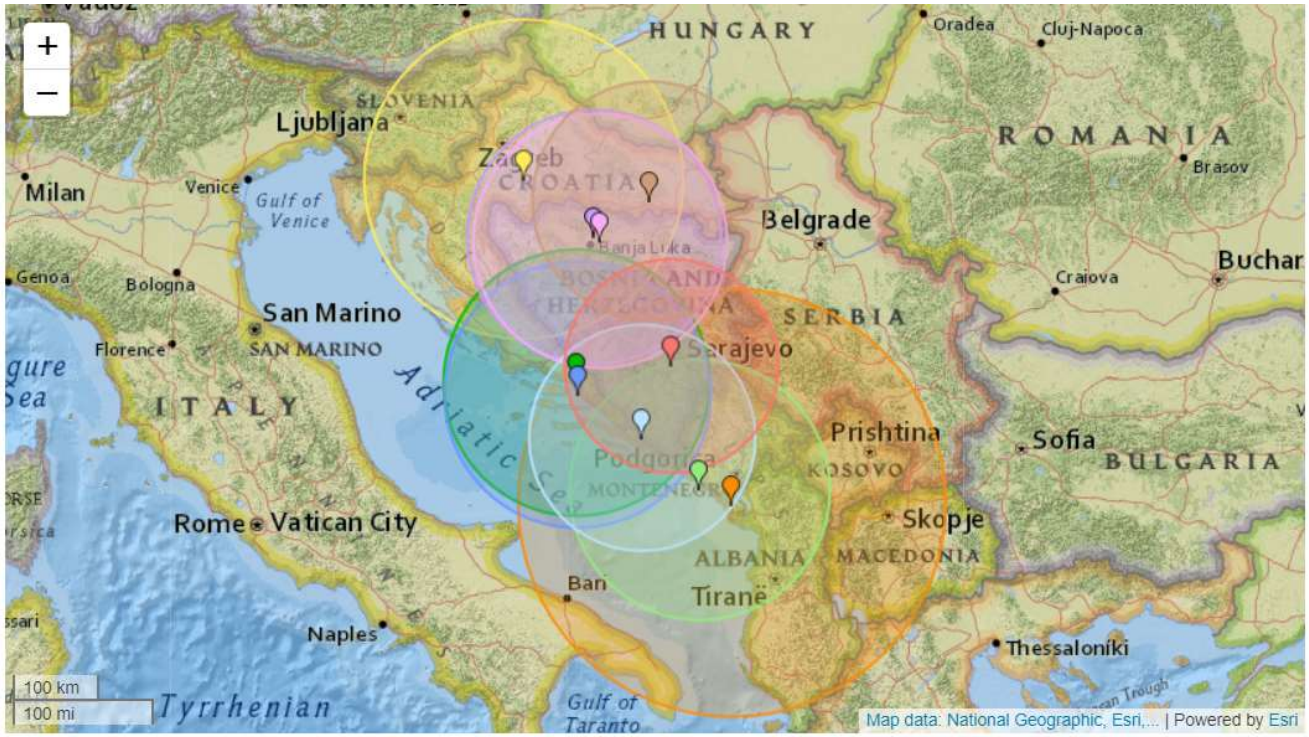
Ispunsko ziđe POROHERM IZO PROFI – Mehanička svojstva

Ispunsko ziđe POROHERM IZO PROFI – Mehanička svojstva

Broj katova:	+	+/-	+
Toplinska svojstva:	-	+	+

Ispunsko ziđe POROHERM IZO PROFI – Mehanička svojstva

Jadranska regija – seizmički aktivno područje



https://https://earthquaketrack.com/p/croatia/biggest

42 years ago 6.9 magnitude, 10 km depth
Stari Bar, Montenegro

5 months ago 6.4 magnitude, 10 km depth
Petrinja, Sisačko-Moslavačka, Croatia

42 years ago 6.2 magnitude, 8 km depth
Budva, Budva, Montenegro

59 years ago 6.2 magnitude, 15 km depth
Baška Voda, Splitsko-Dalmatinska, Croatia

59 years ago 6.2 magnitude, 15 km depth
Tučepi, Splitsko-Dalmatinska, Croatia

51 years ago 6.1 magnitude, 15 km depth
Trn, Republika Srpska, Bosnia and Herzegovina

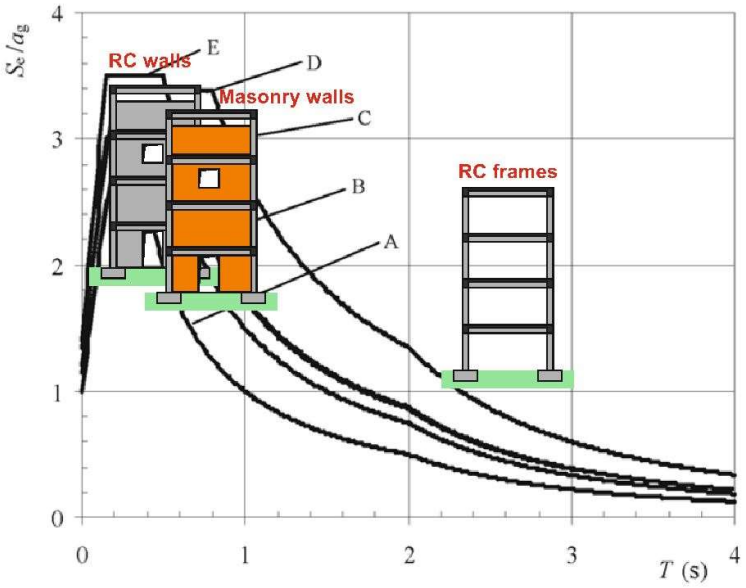
51 years ago 6.1 magnitude, 15 km depth
Trn, Republika Srpska, Bosnia and Herzegovina

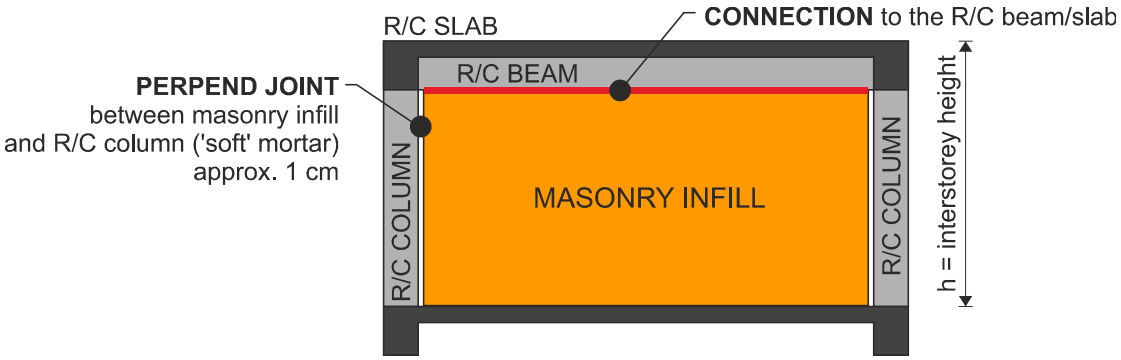
24 years ago 6.0 magnitude, 10 km depth
Podgora, Dubrovačko-Neretvanska, Croatia

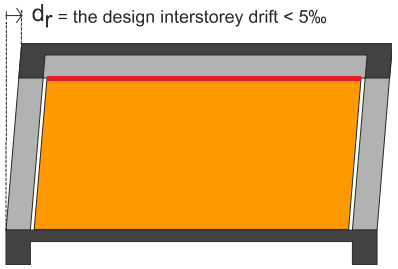
57 years ago 6.0 magnitude, 15 km depth
Podvinje, Brodsko-Posavska, Croatia

59 years ago 5.9 magnitude, 15 km depth
Pazarić, Federation of Bosnia and Herzegovina, Bosnia and Herzegovina

Ispunsko ziđe: Ponašanje u ravnini zida







EUROCODES BUILDING THE FUTURE

EN 1998-1:2004

4 PRORAČUN ZGRADA

4.3 Proračun konstrukcije

4.3.6 Dodatne mjere za okvire s ispunskim ziđem

4.3.6.1 Općenito

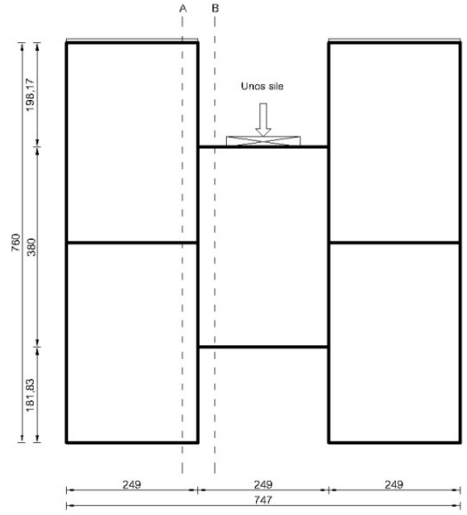
(4) U betonskim zidnim sustavima ili dvojnim sustavima istovrijednim zidnim kao i u ukrućenim čeličnim ili spregnutim čelično-betonskim sustavima međudjelovanje s ispunskim ziđem smije se zanemariti.

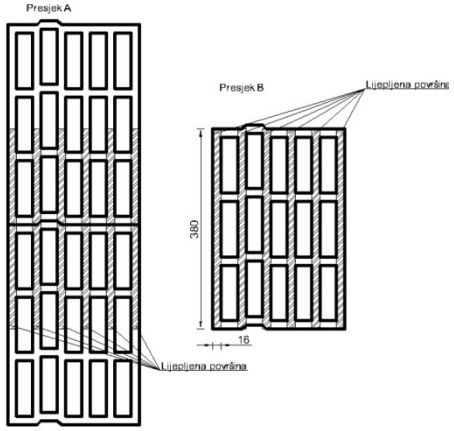
S ograničenjem međukatnog pomaka na 5 ‰ [prema EN 1998-1:2004, 4.4.3.2 (1)]:

- ispunsko ziđe nema značajan doprinos u ukupnoj krutosti na horizontalna djelovanja
- oštećenja zgrada uslijed potresa su minimalna jer ziđe može podnijeti takve međukatne pomake bez značajnih oštećenja

Ispunsko ziđe: Ponašanje u ravnini zida

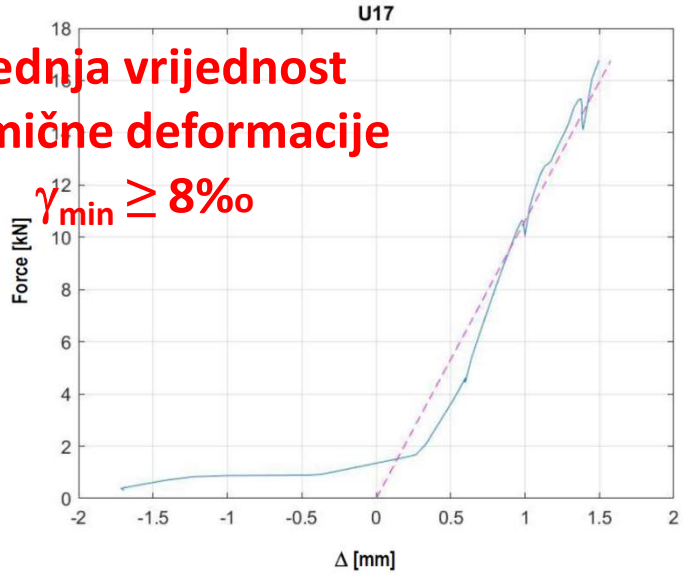
Određivanje posmične čvrstoće na kontaktu između blokova lijepljenih ljepilo Dryfix.Extra (poliuretanski adheziv)





Srednja vrijednost posmične deformacije

$\gamma_{min} \geq 8‰$



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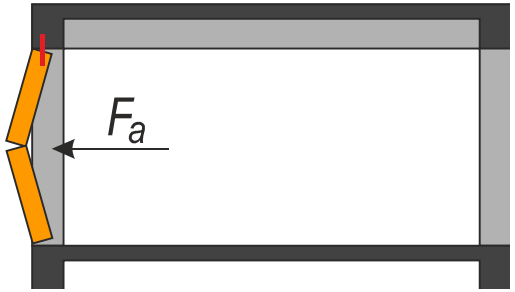
Ispunsko ziđe: Ponašanje okomito na ravninu zida



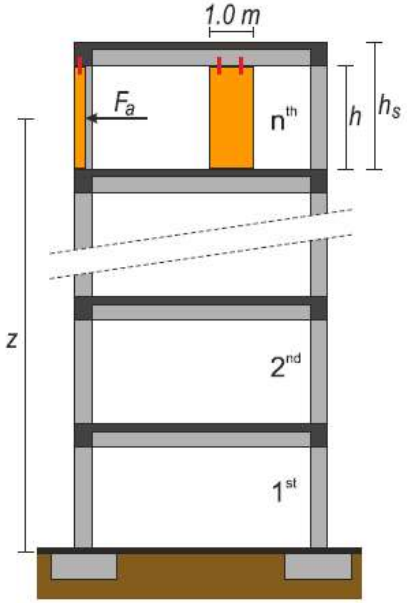


Fig 2.4 Masonry infill wall – non-structural elements

According to EN 1998-1, non-structural elements may be verified on seismic load as shown below.

The effects of the seismic action may be determined by applying to the non-structural element a horizontal force F_a which is defined as follows

$$F_a = (S_a * W_a * \gamma_a) / q_a \qquad \text{[EN 1998-1:2004; (4.24)]}$$

MASONRY INFILL WALL - Porotherm IZO Profi with Porotherm Dryfix.extra adhesive bonding system
Verification according to EN 1998-1 (4.3.5 Non-structural elements) and EN 1996-1

Wienerberger

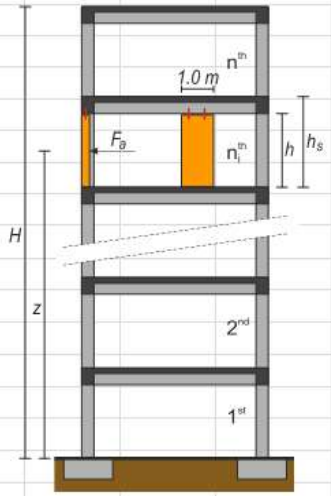
Use this table "as is" - without warranty. Use it at your own risk.

This is an approximate calculation with the following assumptions:

- infill wall is fixed at the bottom (mortar) and at the top (by PU or by two stell 2 dowels/m+mortar)
- plane of failure is parallel to the bed joints
- calculation is carried out on a wall L=1 m long
- specific weight of masonry: γ = 7.5 kN/m3
- additional permanent load on infill wall (blaster, insulation, other permanent load): W_{add} = 0.10 kN/m2
- characteristic compressive strength of masonry: f_k = 6.35 MPa [experimental testing, ZAG Ljubljana/Slovenia, št. P 0550/08-650-3]
- modulus of elasticity: E = 7.48 GPa [experimental testing, ZAG Ljubljana/Slovenia, št. P 0550/08-650-3]
- importance factor of the element: γ_a = 1.0 [EC8; 4.3.5.3 (2)]
- behaviour factor of the element: q=2.0 [EC8; Table 4.4.]
- flexural strength of masonry with the plane of failure parallel to the bed joints: f_{xk1} = 0.15 MPa [EC6; 3.6.3]

Note: Fullfill only yellow cells

Input data:			
thickness of infill wall	t =	*0.25*	*m*
number of storeys of RC building	n =	*8*	*storeys*
storey on which the infill wall is located	n_i =	*7*	
height of infill wall (clear storey height)	h =	*2.7*	*m*
storey height	h_s =	*2.9*	*m*
the ratio of the design ground acceleration on type A ground	α =	*0.22*	*g*
ground type [EC8; Table 3.1]		A	
partial factor for material [HRN EN 1996-1-1:2011/NA]	γ_M =	2	
Results:			
the weight of the infill wall (L=1.0 m)	W_a =	5.3	kN
fundamental vibration period of the infill wall in the relevant direction	T_a =	0.0209	s
fundamental vibration period of the building in the relevant direction [EC8; Eq. 4.6]	T_1 =	0.53	s
soil factor	S =	1.00	
seismic coefficient applicable to non-structural elements	S_a =	0.51	
horizontal seismic force, acting at the centre of mass of the non-structural element	F_a =	1.36	kN
design bending moment due to horizontal seismic force F_a: $M_{Ed,fxk1}=F_a*h/8$	$M_{Ed,fxk1}$ =	0.46	kNm/m
design load-bearing moment with the plane of failure parallel to the bed joints	$M_{Rd,fxk1}$ =	**0.78**	**kNm/m** > $M_{Ed,fxk1}$



Tema: POTRESNO INŽENJERSTVO
Theme: EARTHQUAKE ENGINEERING

Predavanje: PRORAČUN ZIDOVA NA OTKAZIVANJE IZVAN RAVNINE
Lecture: CALCULATION PROCEDURE OF OUT-OF-PLANE WALL FAILURE

Predavač, tvrtka, adresa/Lecture, firm, adress:
Doc.dr.sc. Marija Demšić, dipl.ing.građ./Assist.Prof., PhD. CE, (marija.demsic@grad.unizg.hr), Sveučilište u Zagrebu, Građevinski fakultet/University of Zagreb, Faculty of Civil Engineering, Zagreb, Hrvatska/Croatia, Matea Sruk, mag.ing.aedif. (matea.sruk@toding.hr), Toding d.o.o. Zagreb, Hrvatska/Croatia

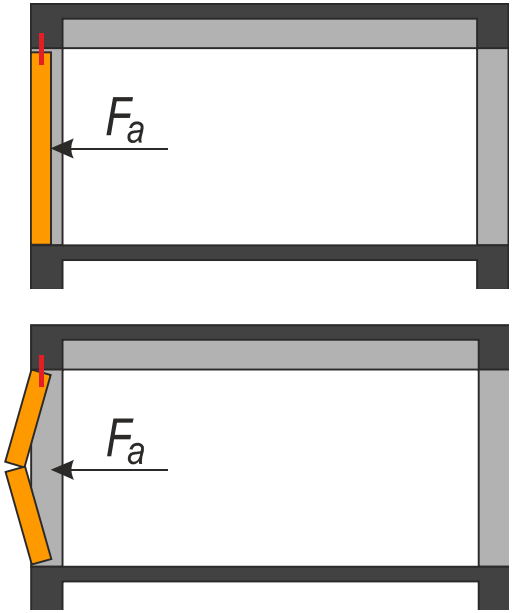
ELSEVIER

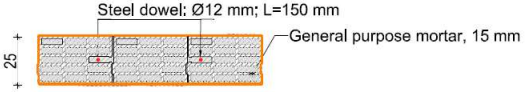
Engineering Structures
Volume 242, 1 September 2021, 112525

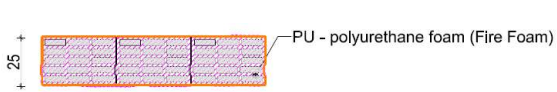
Experiment-based out-of-plane resistance of strong masonry infills for codified applications

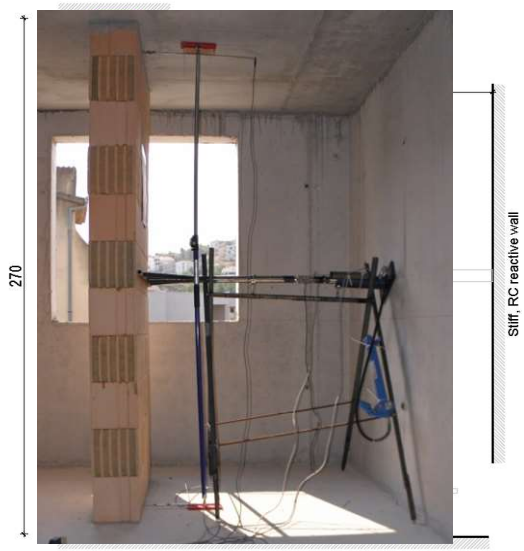
Riccardo R. Milanesi [a], Paolo Morandi [b], Sanja Hak [c], Guido Magenes [a, b]

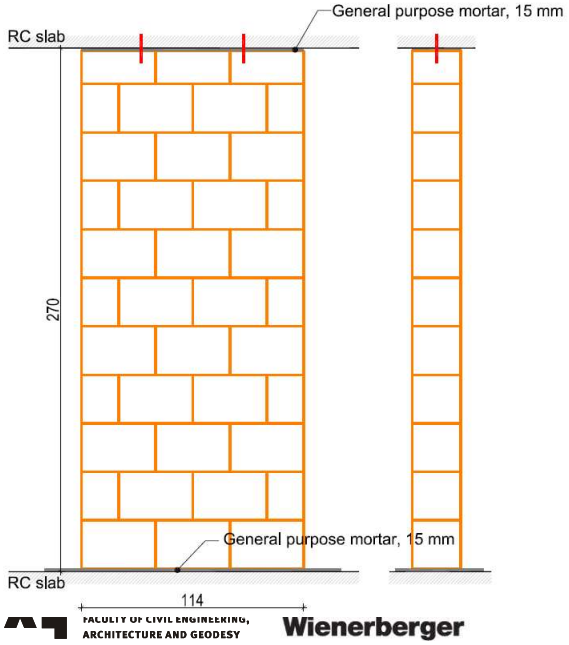
Ispunsko ziđe: Ponašanje okomito na ravninu zida

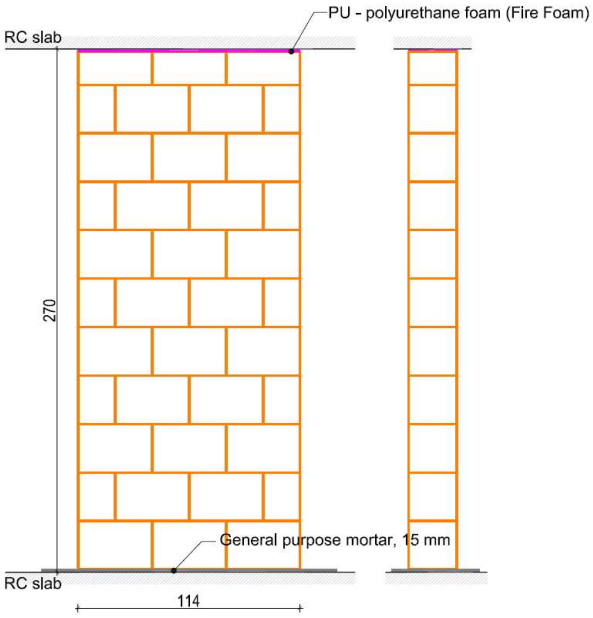




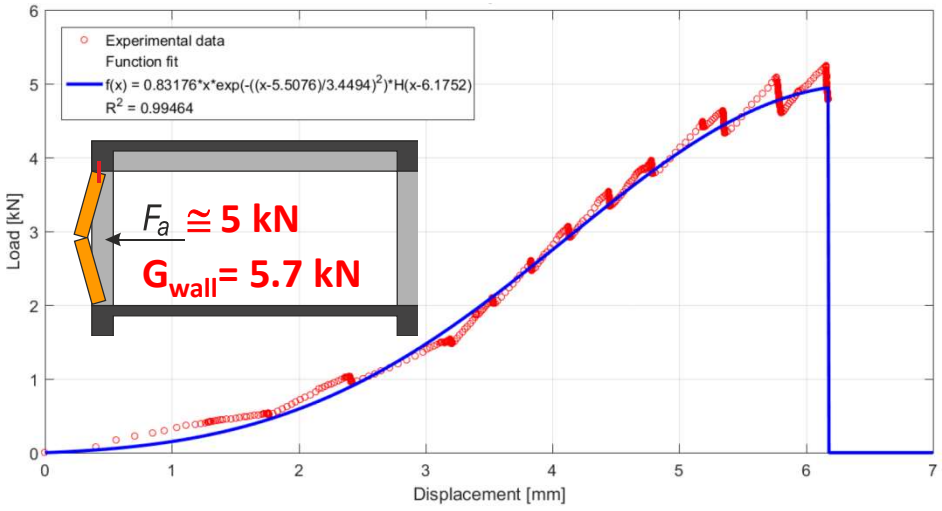


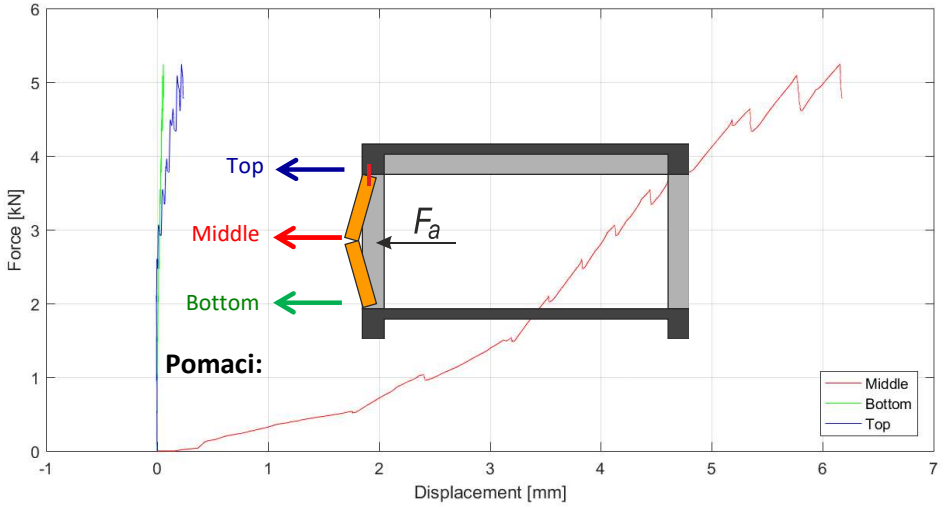






Ispunsko ziđe: Ponašanje okomito na ravninu zida



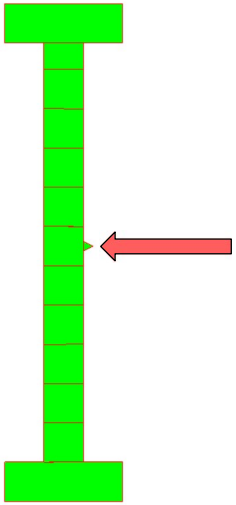


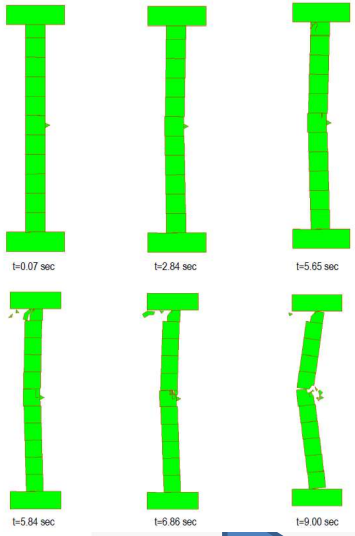
Ispunsko ziđe: Ponašanje okomito na ravninu zida

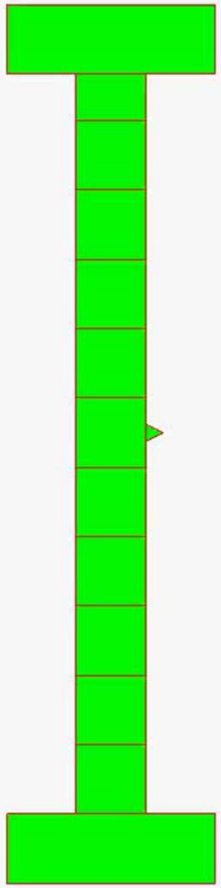
Overall results for experimental tests of masonry infill

Sample - Connector on the top	Intensity of force in midspan [kN]	Horizontal deflection in midspan [mm]	Horizontal deflection at the bottom [mm]	Horizontal deflection at the top [mm]
SD: steel dowels + general purpose mortar	$F_{SD,\,mean} = 5.0$	$\delta_m = 3.7$	$\delta_b = 0.0$	$\delta_t = 0.36$
PU: polyurethane foam (Fire Foam)	$F_{PU,mean} = 4.9$	$\delta_m = 5.2$	$\delta_b = 0.03$	$\delta_t = 0.20$
PU-o: polyurethane ordinary foam	$F_{PU\text{-}o,\,mean} = 3.6$	$\delta_m = 3.1$	$\delta_b = 0.06$	$\delta_t = 0.50$
	$F_{mean} = 4.5$	$\delta_{m,mean} = 4.0$	$\delta_{b,mean} = 0.03$	$\delta_{t,mean} = 0.39$

Ispunsko ziđe: Ponašanje okomito na ravninu zida

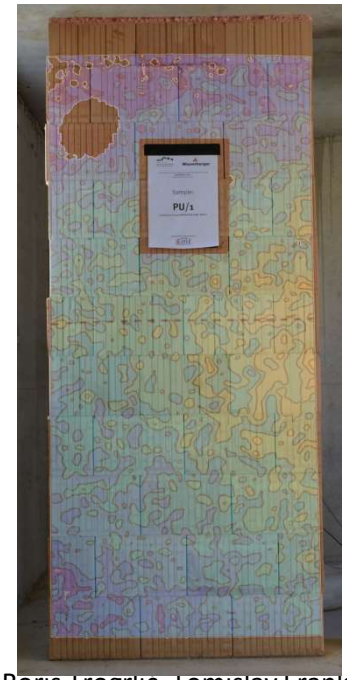




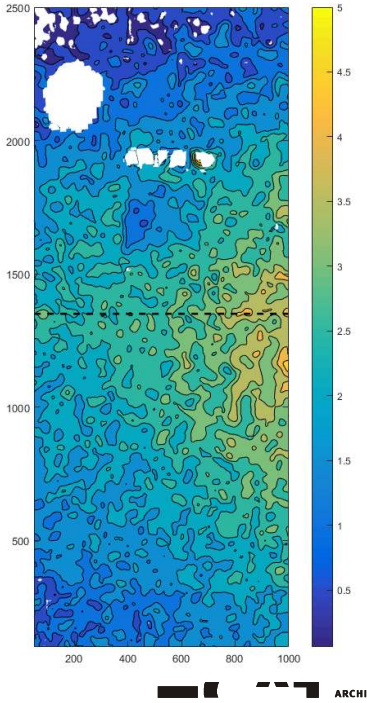


video

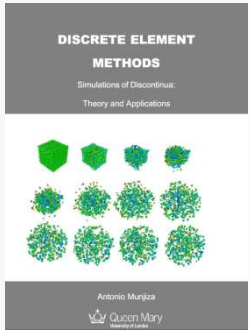
Displacement field overlay on the photo of wall



Calculated displacement field

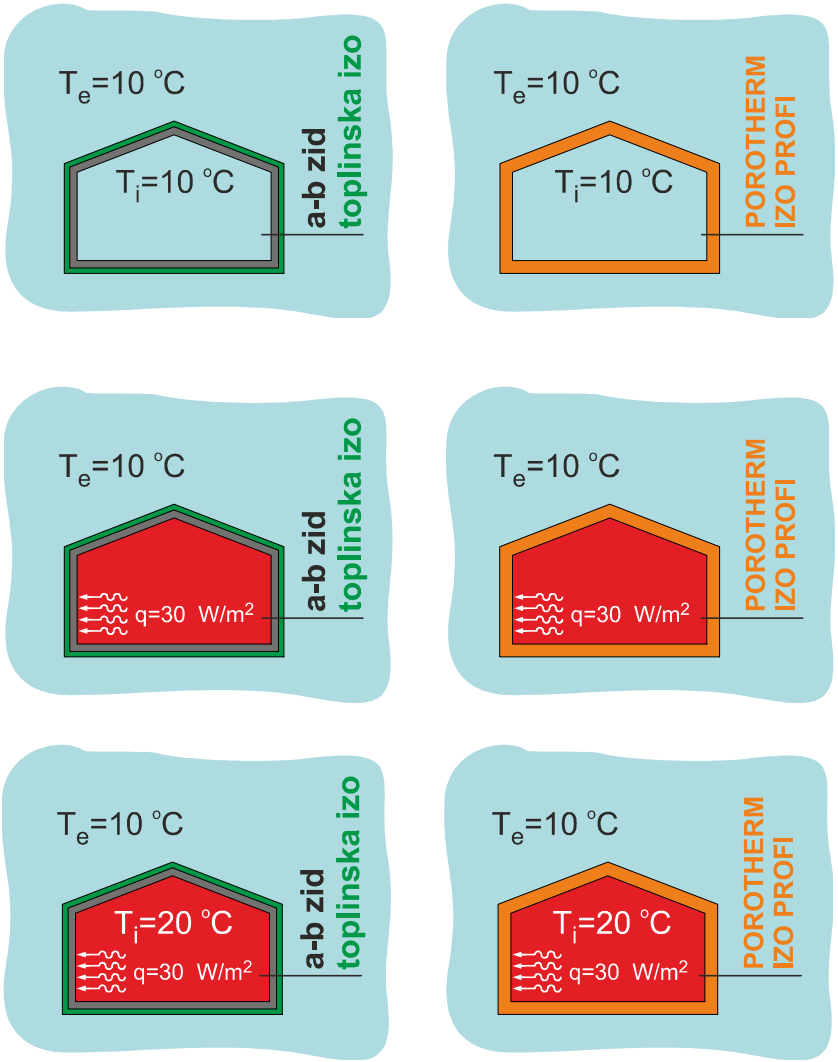


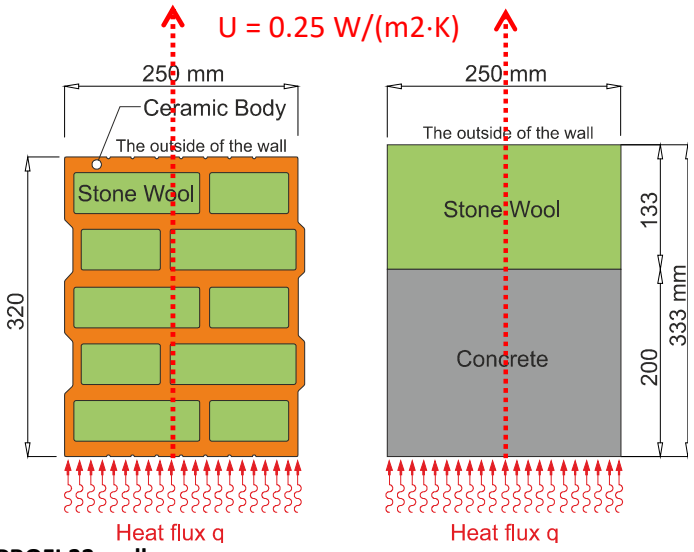
Prof.
Antonio Munjiza



Ispunsko ziđe POROHERM IZO PROFI – Toplinska svojstva

Ispunsko zide POROHERM IZO PROFI – Toplinska svojstva





POROTHERM IZO PROFI 32 wall:

Ceramic body:

Thermal conductivities in the direction of X, Y KXX=KYY= 0.18 W/(m·K)

Densityr = 1450 kg/m3; Specific heat c = 900 J/(kg·K)

Thermal isolation (stone wool):

Thermal conductivities in the direction of X, Y KXX=KYY=0.034 W/(m·K)

Density r = 50 kg/m3; Specific heat c = 1030 J/(kg·K)

Convective heat transfer coefficient: **U = 0.25 W/(m2·K)**

R/C wall with thermal insulation (+ stone wool outside):

Concrete:

Thickness of concrete wall: t = 0.20 m

Thermal conductivities in the direction of X, Y: KXX=KYY= 2.6 W/(m·K)

Density ρ = 2400 kg/m3; Specific heat c = 1000 J/(kg·K)

Thermal isolation (mineral wool) - ETICS:

Thickness of mineral wool: t = 0.133 m*

(*thickness chosen to obtain equal value of U for both walls)

Thermal conductivities in the direction of X, Y KXX=KYY=0.034 W/(m·K)

Density ρ = 50 kg/m3; Specific heatc = 1030 J/(kg·K)

Convective heat transfer coefficient (R/C wall with thermal insulation):

U = 1/ (Σ t_i/KXX_i) = 1/(0.20/2.6+0.133/0.034) **U = 0.25 W/(m2·K)**

Ispunsko ziđe: Toplinska svojstva

Transientna analiza provođenja topline – ravninski problem:

3. Governing equation

The material obeys Fourier's law of heat conduction:

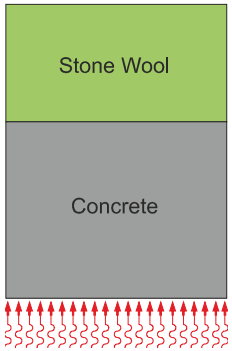
$$\boldsymbol{q} = -\boldsymbol{K}\frac{\partial \boldsymbol{T}}{\partial \boldsymbol{x}}$$

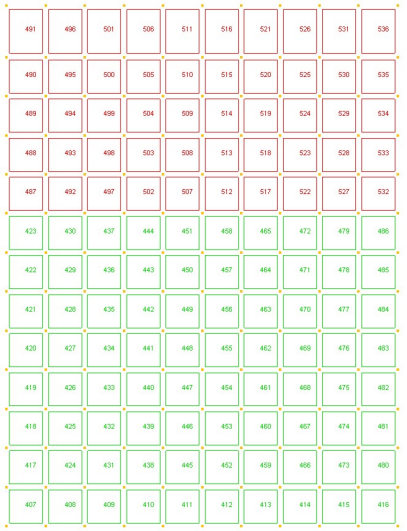
where:

$\boldsymbol{q}$ ..... the rate of heat flow conducted per unit area

$\boldsymbol{K}$ ..... the thermal conductivity tensor for the material

$\frac{\partial \boldsymbol{T}}{\partial \boldsymbol{x}}$ ..... the temperature gradient vector in Cartesian coordinates.





The general equation for heat conduction in solids is

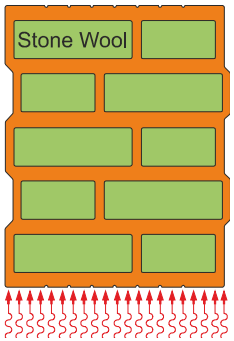
$$\left[\frac{\partial}{\partial x}\left(\boldsymbol{k}_x\frac{\partial \boldsymbol{T}}{\partial x}\right)+\frac{\partial}{\partial x}\left(k_y\frac{\partial \boldsymbol{T}}{\partial y}\right)\right]+\boldsymbol{q}=\rho c\frac{\partial \boldsymbol{T}}{\partial t}$$

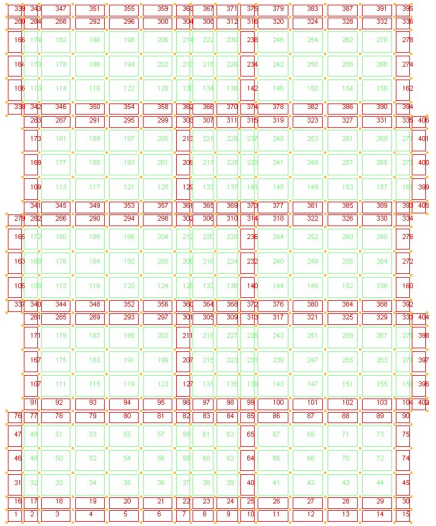
where:

ρ ..... the mass density of the material

c ..... the specific heat

t ..... the time

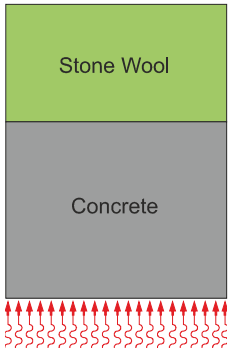


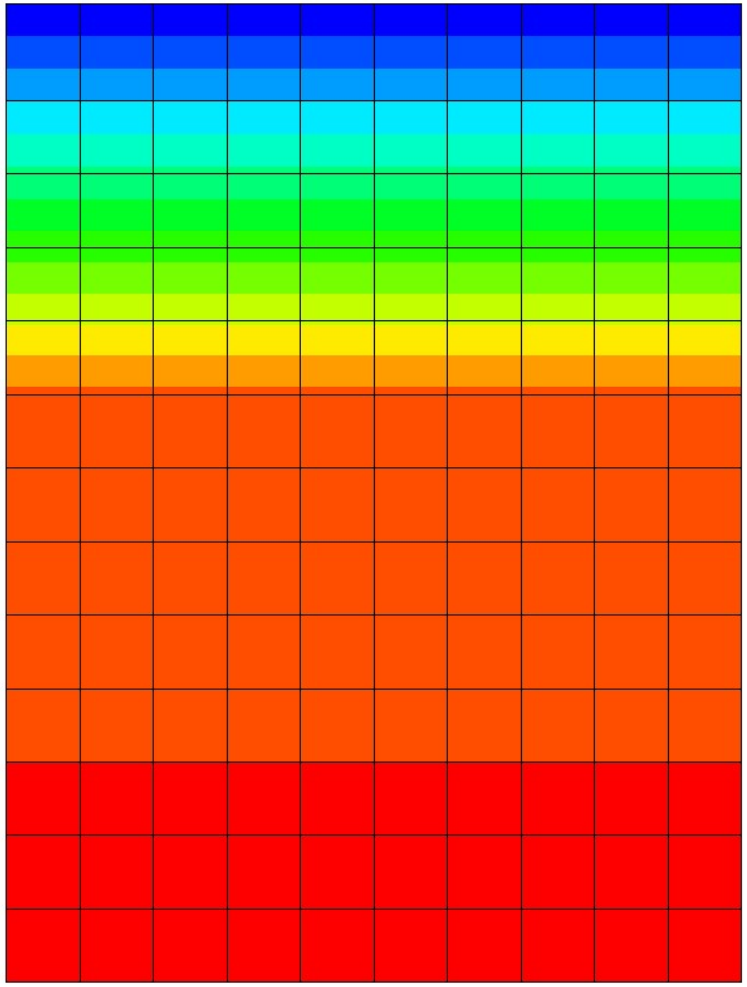


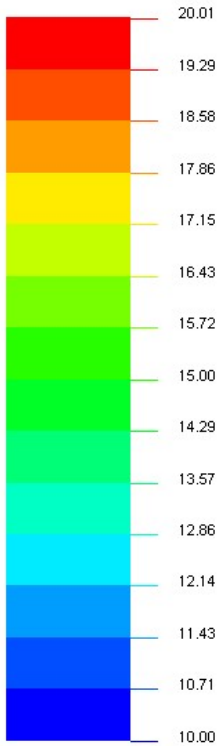
and may be generally subjected to one or more of the following boundary conditions.

Equation is solved by Finite Element Method (2D problem).

Ispunsko ziđe: Toplinska svojstva



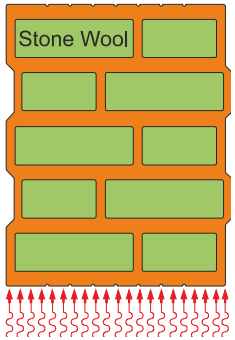


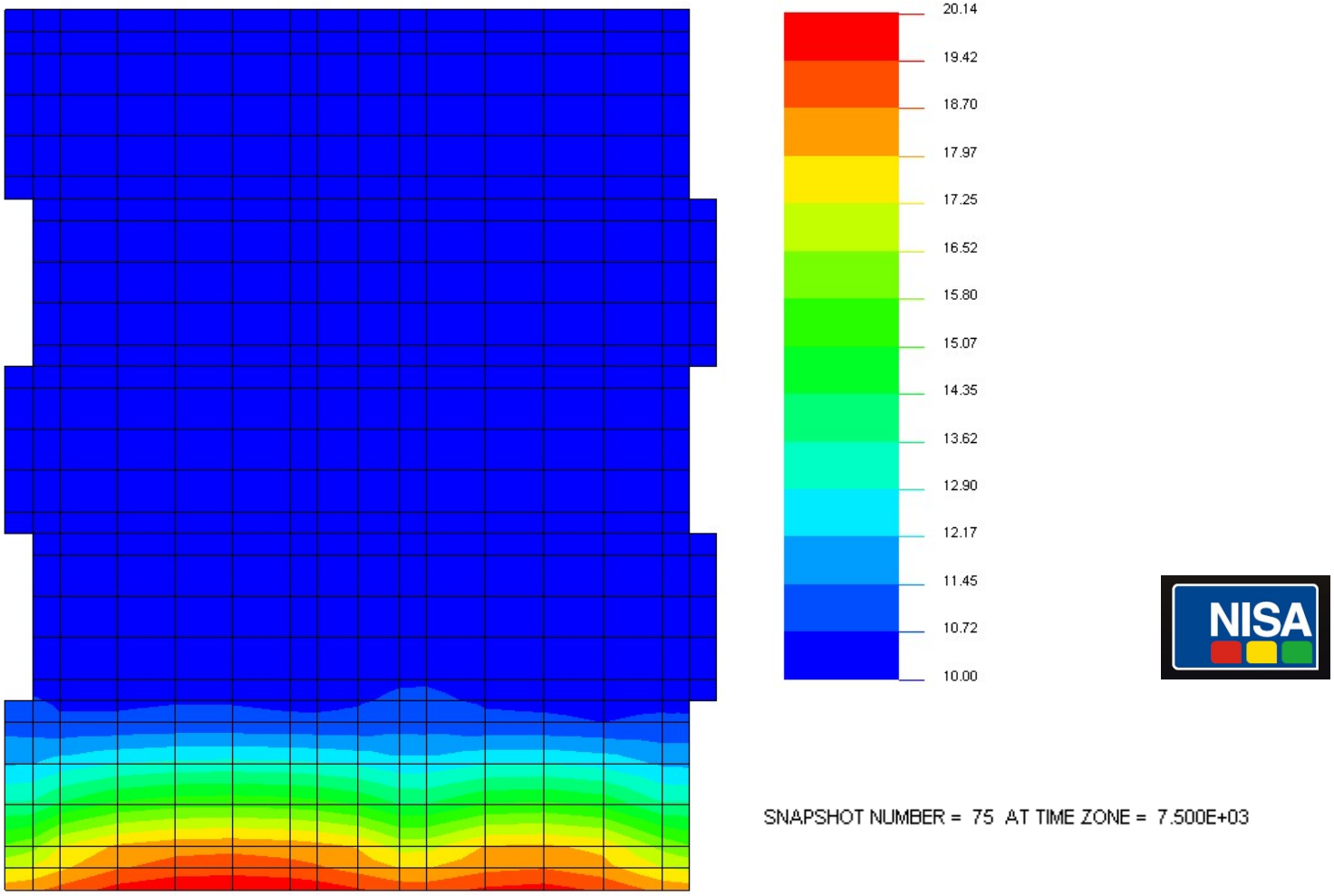


SNAPSHOT NUMBER = 256 AT TIME ZONE = 1.536E+05

Temperature field after t = 153600 sec = 2560 min = 42 hours 40 min

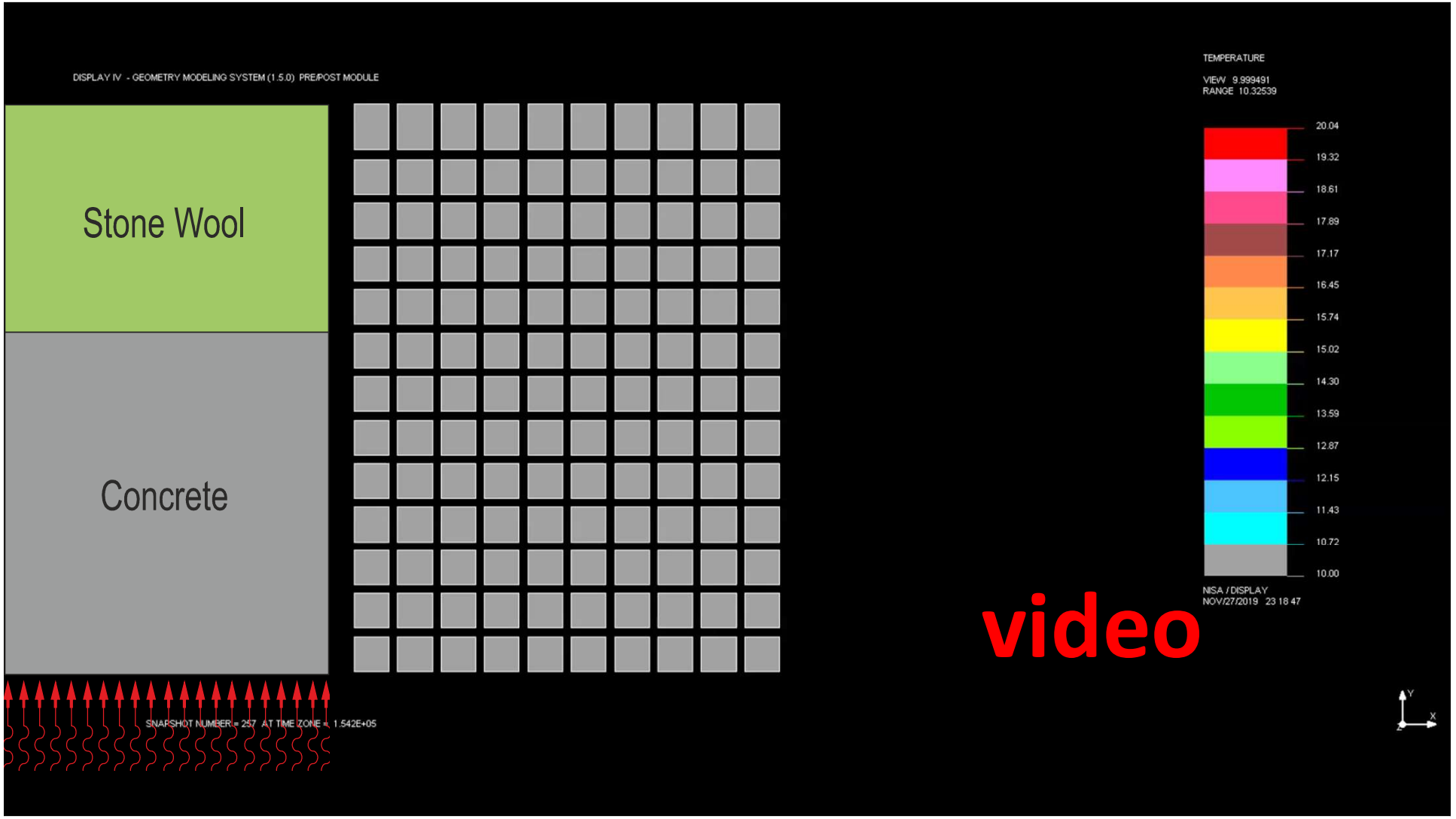
Ispunsko ziđe: Toplinska svojstva



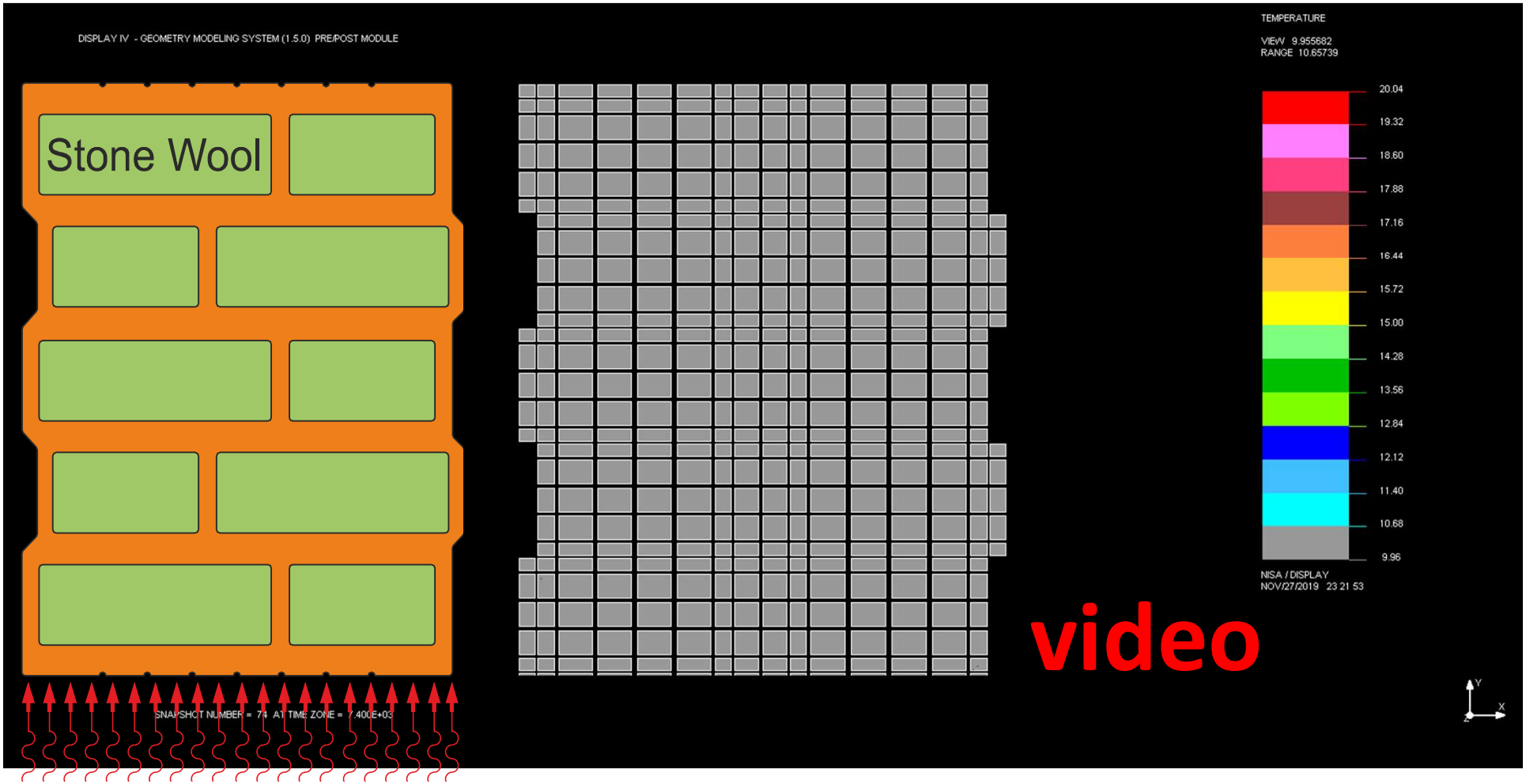


Temperature field after t = 7500 sec = 125 min = 2 hours 5 min

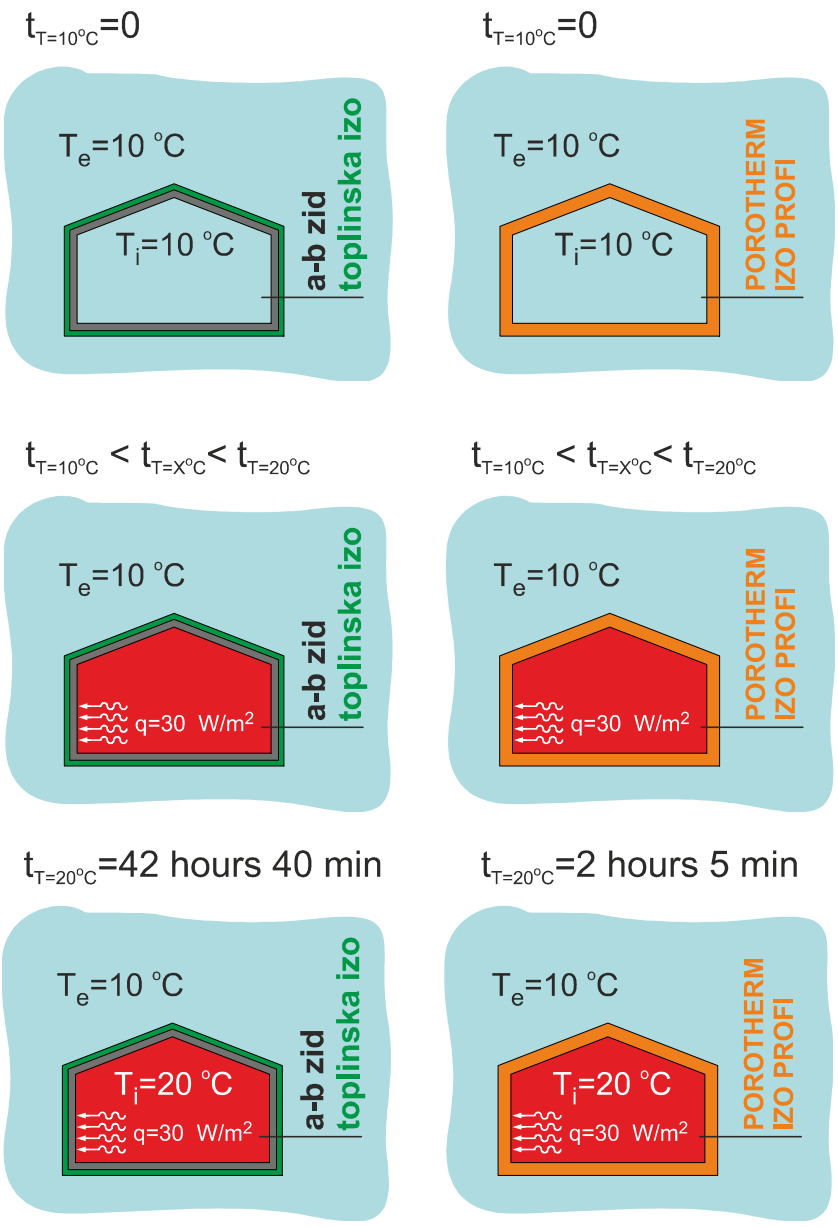
Ispunsko zid: Toplinska svojstva



Ispunsko ziđe: Toplinska svojstva



Ispunsko ziđe: Toplinska svojstva

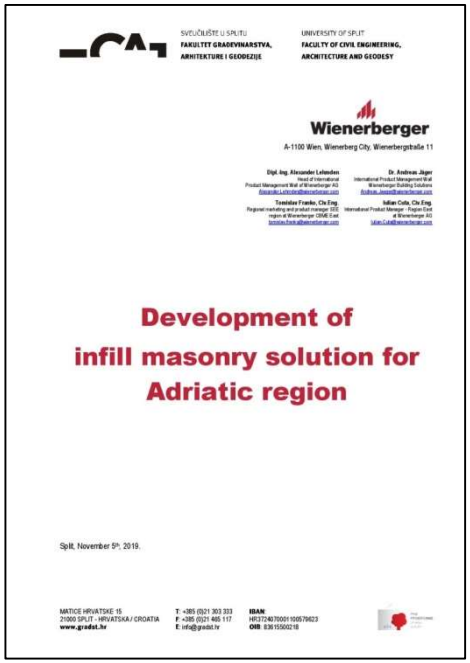


Ciljanu temperaturu na unutarnjoj strani zida od T_i = 20.0 ^{O}C konstrukcija postiže za:

- **2 sata 5 min - POROTHERM IZO PROFI 32 zid**
- **42 sata 40 min – a/b zid s toplinskom izolacijom izvana (kamena vuna)**

U zgradi od POROTHERM IZO PROFI 32 blokova potrebno je 40 sati i 35 minuta manje (uz toplinski tok q=30 W/m2), za postizanje temperature na unutarnjoj strani zida T_i = 20.0 ^{O}C, te je ušteda energije:

Q_{save} = 40.59 sata * 30 W/m2 = 1.217 kWh/m2



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Development of infill masonry solution for Adriatic region

Split, November 5th, 2019.

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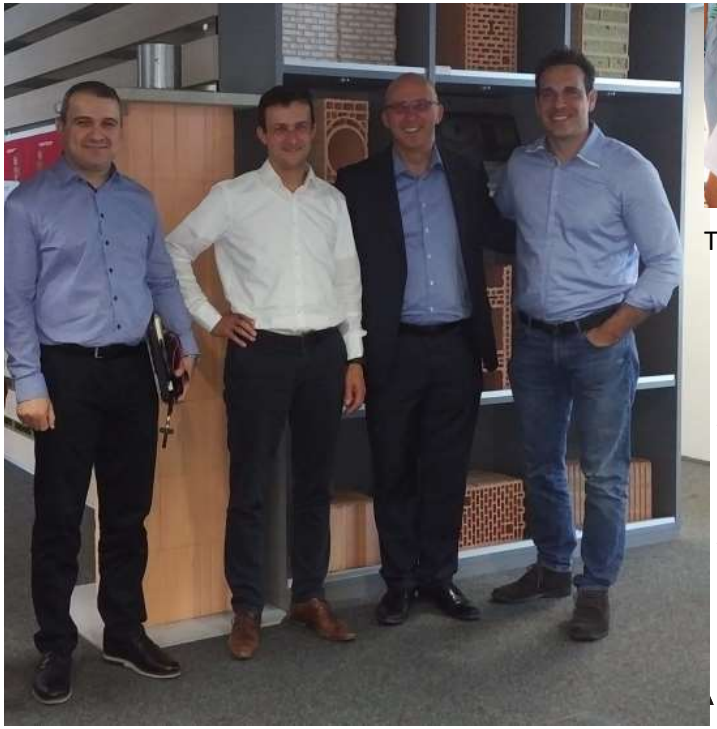

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Ispunsko ziđe POROHERM IZO PROFI – mehanička i toplinska svojstva

HVALA NA PAŽNJI