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1707

MULTISTOREY FRAME SYSTEM FOR ENERGY EFFICIENT BUILDINGS



*concept of precast RC
frame for energy efficient
buildings*



Basic idea

Nowadays increasing tendency

wooden based buildings from CLT (cross laminated timber)

Limitations: space rigidity of multistory structure

acoustic performance

fire safety

The combination of light concrete frame and wooden based other parts of structure (envelope, partitions, roof structure) could solve some of these problems.

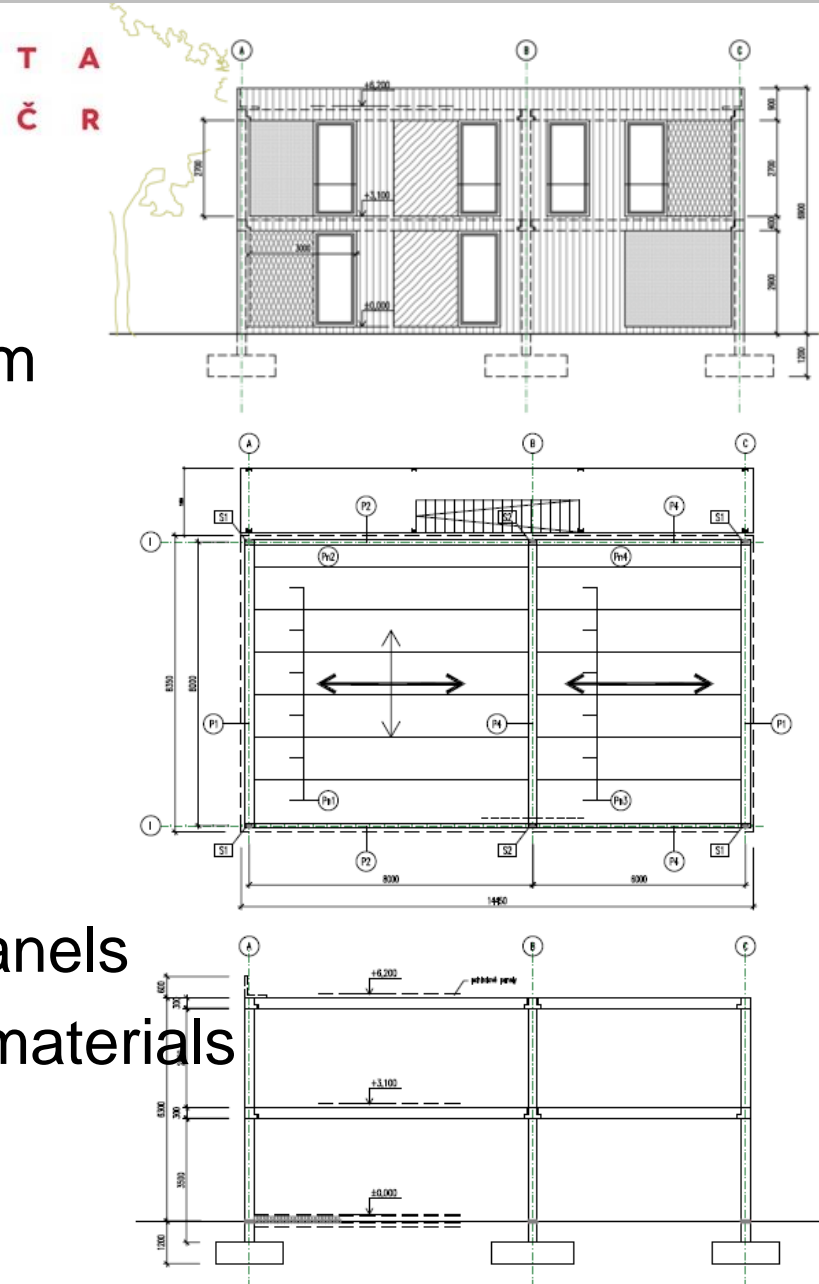


concept of load bearing frame OSEEB

- subtle precast elements
- lightened floor panels
- flat ceiling
- flexibility – large spans up to 9 x 9 m
- fast construction
- design for dismounting

Conceptual solution:

- use of FC 70/85
- use of Peikko corbels joints
- prestressed flat girders and floor panels
- lightening elements from recycled materials
- transverse post tensioning



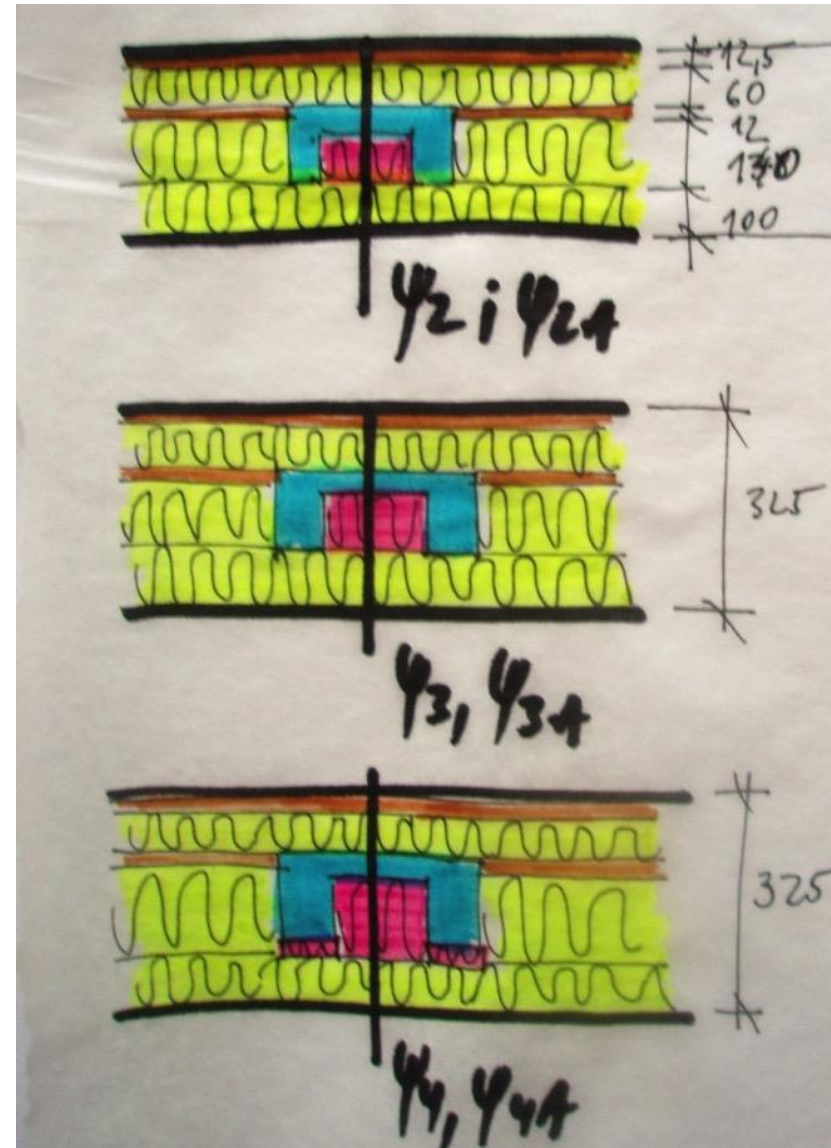
concept of building envelope for OSEEB

Load bearing structure

- subtle RC precast frame

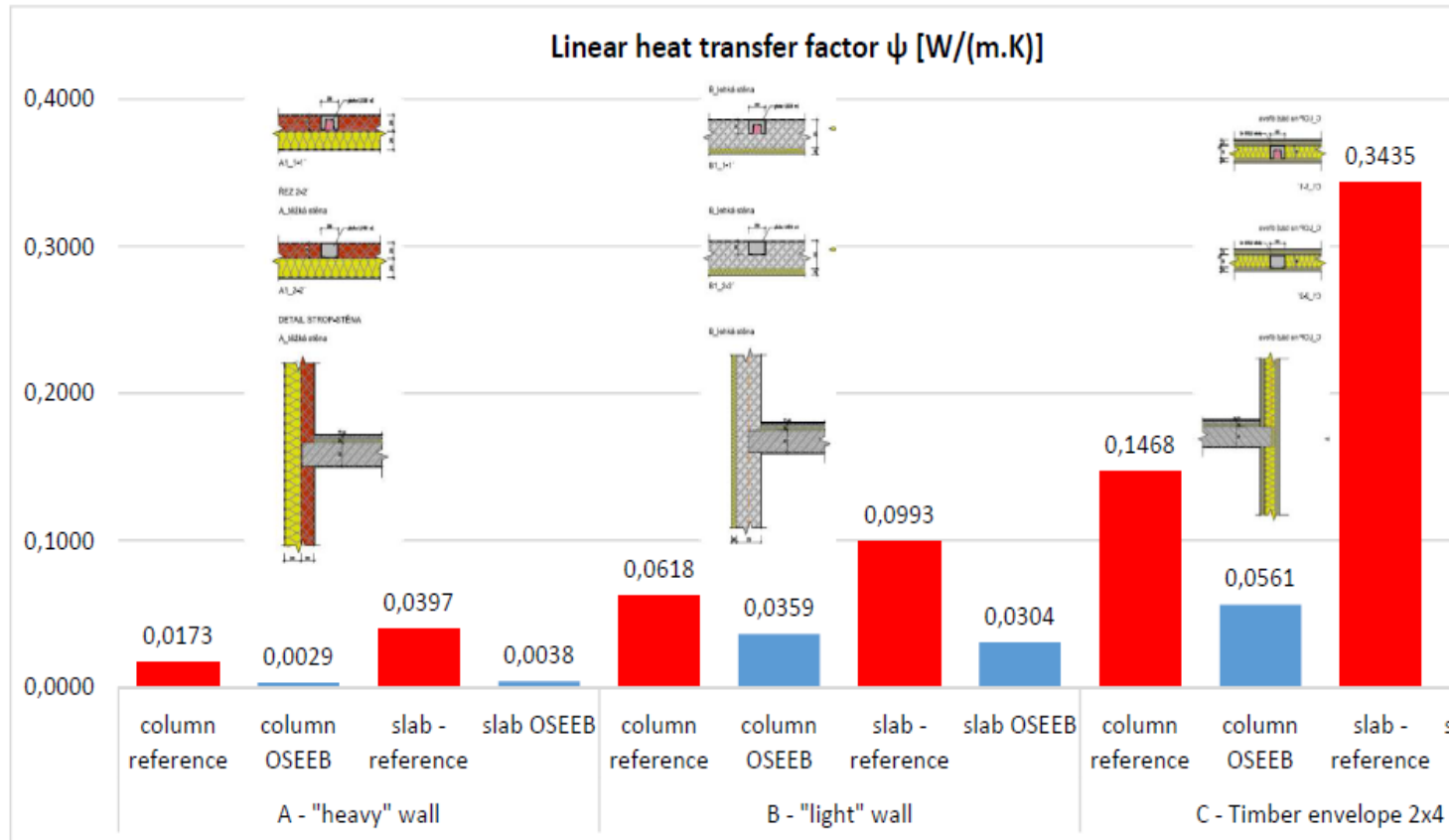
Building envelope

- light timber frame structure
- heavily insulated by thermal insulation
- subtle columns integrated in building envelope
- C-shape of columns enable integration of thermal insulation



concept of building envelope for OSEEB

Comparison of linear heat transfer factor ψ for assessed variants of building envelope

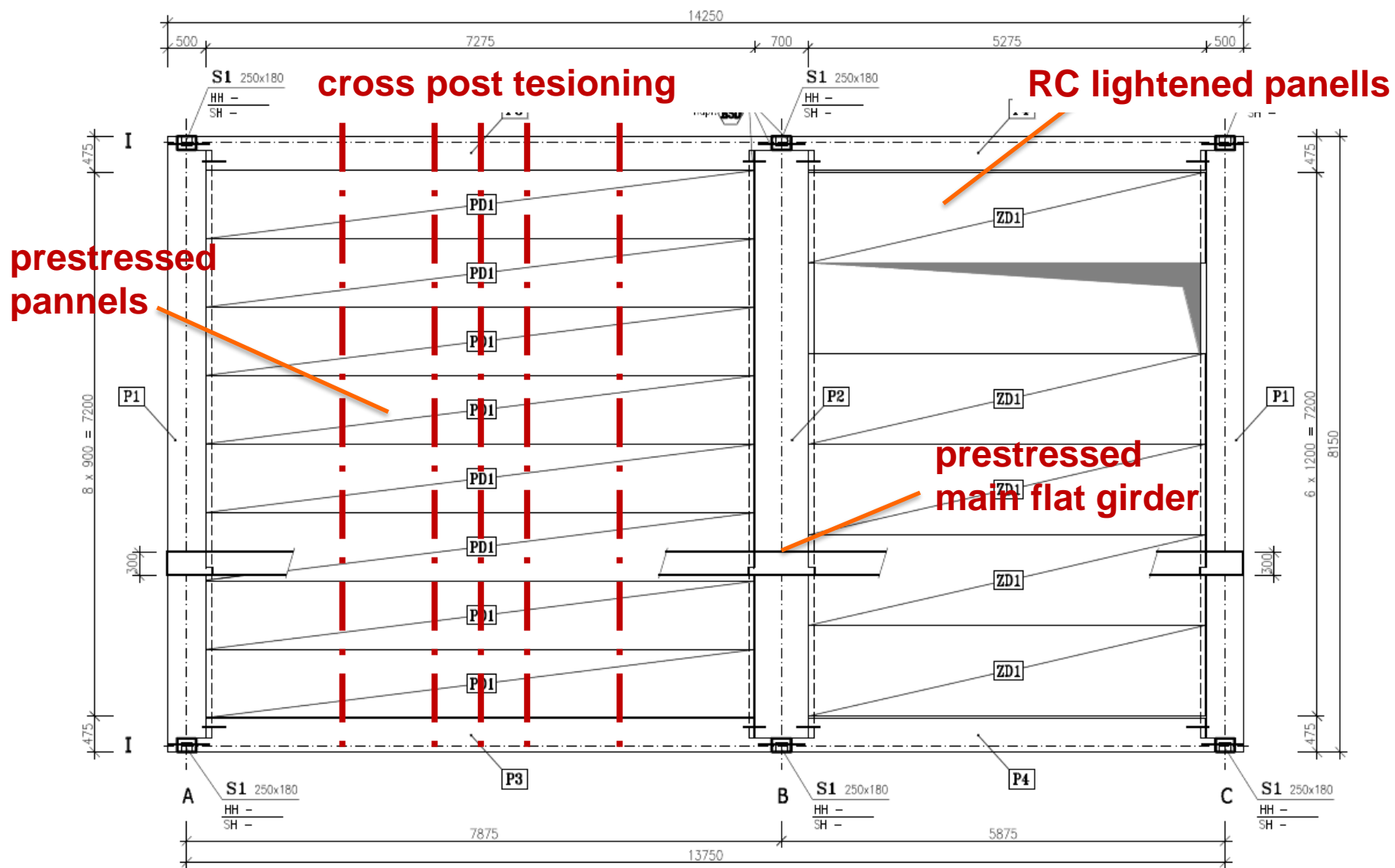


Ceramic blocks or foamed concrete blocks or timber building envelope (OSEEB)

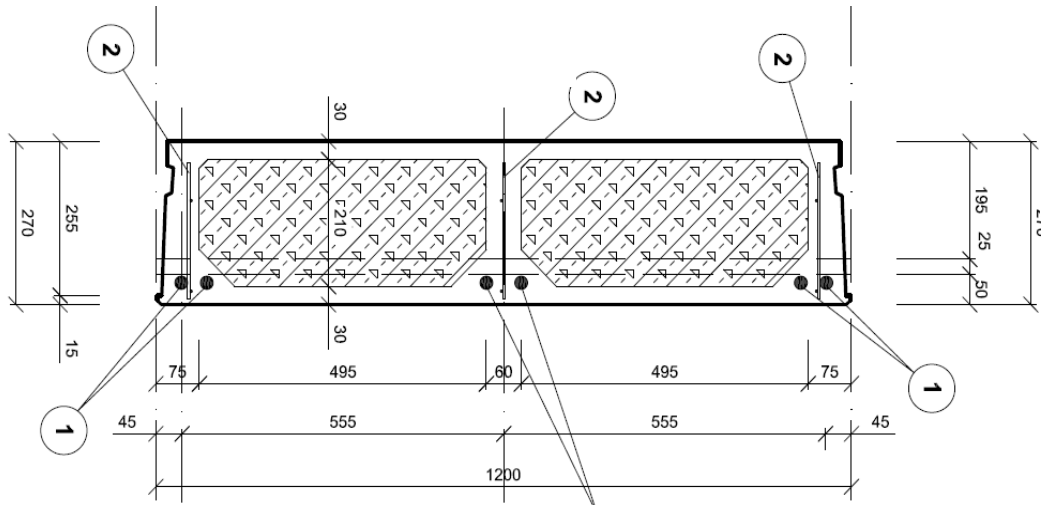


floor structure – flat RC slab

STRUCTURAL SCHEME



floor panels – optimization of lightening



Wood shavings concrete



Stered /Stered concrete



Liapor concrete

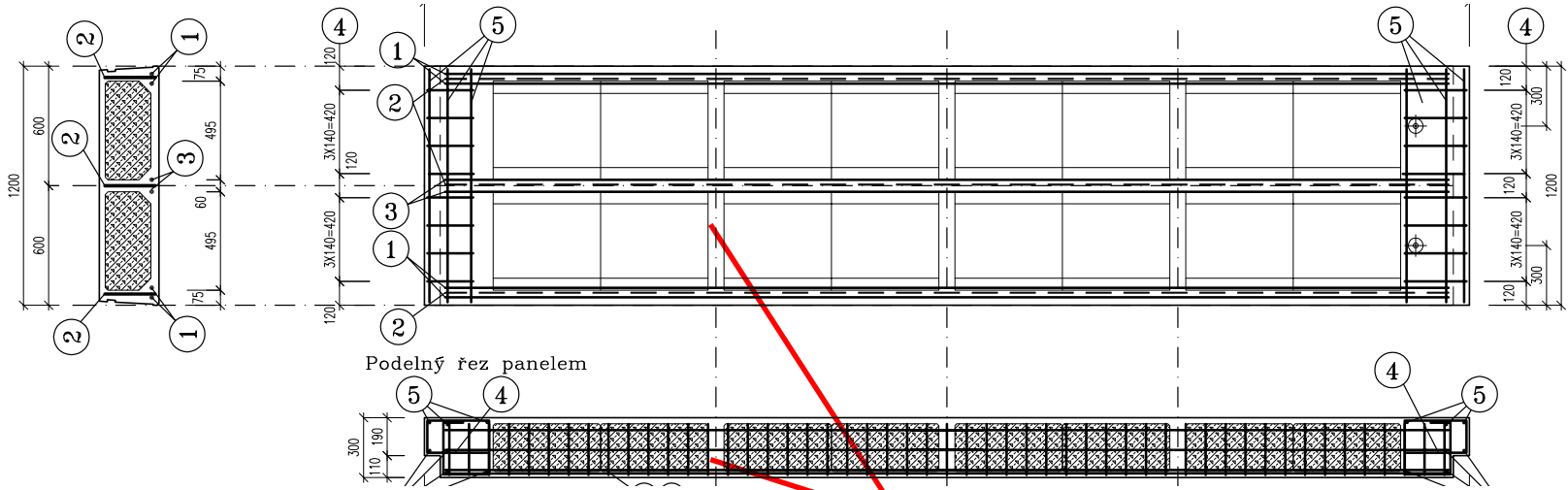


- Weight
- Acoustic – airborne sound
- Fire safety
- Environmental impact

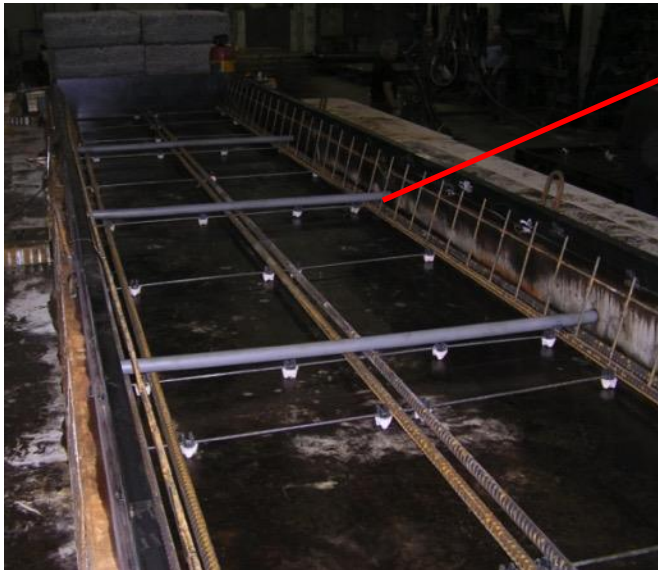
Expanded clays with hybrid cements based binder



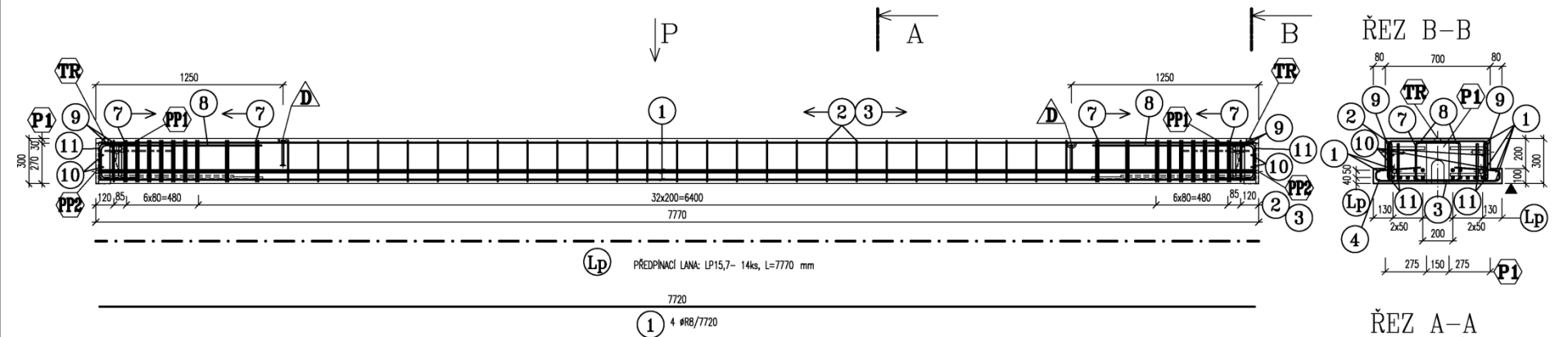
prestressed floor panels | RC floor panels



tubes for transverse post tensioning

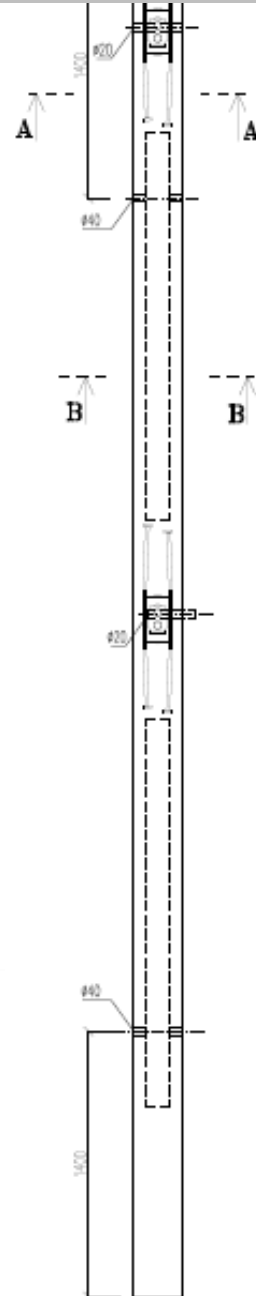
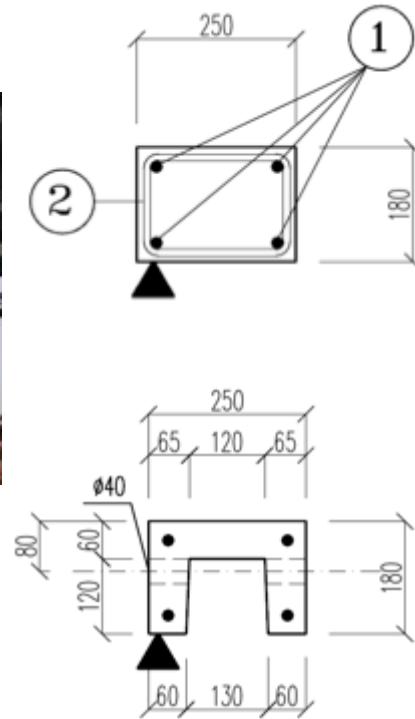
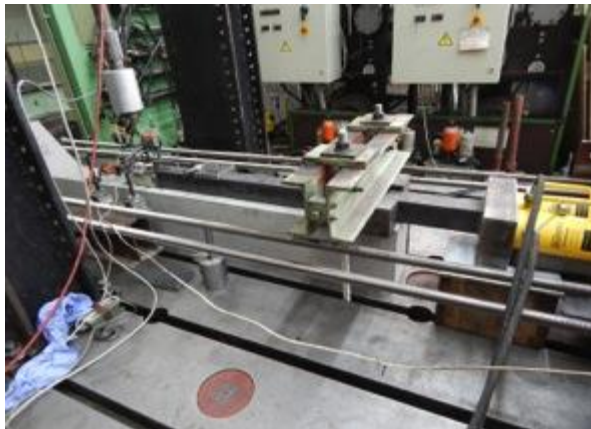


prestressed floor girders



RC columns with Peikko corbels

Verification of cohesion of HPC and corbel of Peikko system



construction of experimental frame OSEEB



Construction of experimental OSEEB frame

■ Basic data of structure



- **location:** Bustehrad, Kladno, CTU in Prague, UCEEB
- **realization:** February – April 2016
- **load tests:** 30.06.16 and 07.07.16

Precast pocket footings from recycled c.



Construction of experimental OSEEB frame



Construction of experimental OSEEB frame



Construction of experimetal OSEEB frame



Life Cycle Assessment of subtle frame



Life Cycle Assessment of OSEEB frame

- balance of input data of assessment variants
 - two-storey experimental OSEEB frame

■ **V1** – reference precast RC frame C30/37 and C40/50, columns 400x400 mm, girders 550x650 mm, hollow core prestressed panels 265 mm

■ **V2** – experimental frame **OSEEB**, HPC 70/85, columns „C“ 180x250 mm, girders 500x300 mm and 700x300 mm, lightened floor panels 300 mm

CONSTRUCTION				
Balance of input data of assessment variants		unit	V2 TYPE_1_P OC	V3 TYP_2_P HPC
concretes	concrete C30/37	m ³	20.6	16.7
	concrete C40/50	m ³	57	0
	concrete HPC70/85	m ³	0	40.6
	cement CEM I 42.5 R	t	27.8	22.1

END OF LIFE PHASE calculates with the amount of waste from demolition, amount of demountable components that can be reused and related transport.

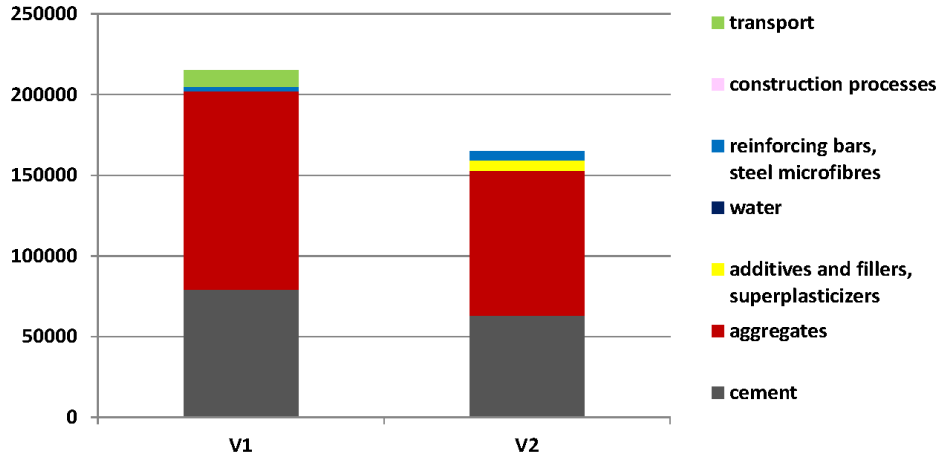
cor	steel fibres/steel microfibres	t	0	1.5
	superplasticizers	t	0.325	0.330
	water	t	14.94	11.18
other	reinforcing bars (steel)	t	5.7	4.6
	prestressing steel	t	0.8	0.8
	Stered	t	0	11.8
transport	-			
	freight traffic - long-distance	tkm	17,430	21,065
	freight traffic - local	tkm	1,731	1,539



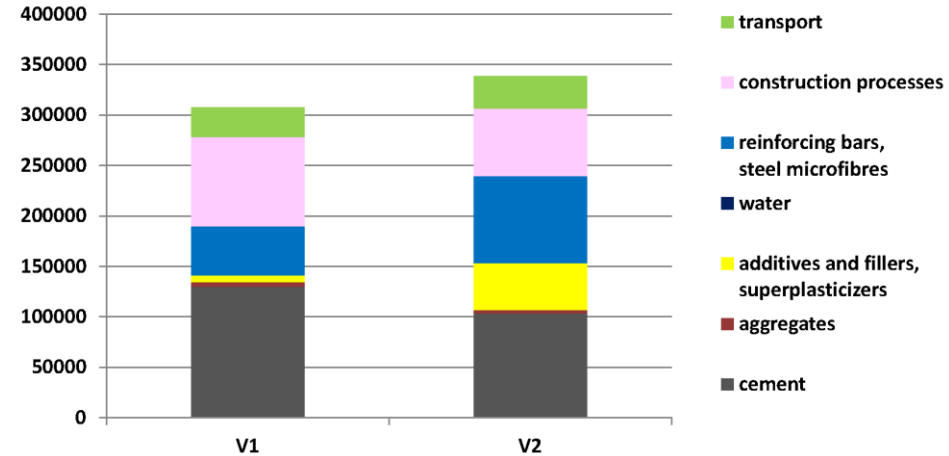
Life Cycle Assessment of OSEEB frame

■ aggregated LCA results

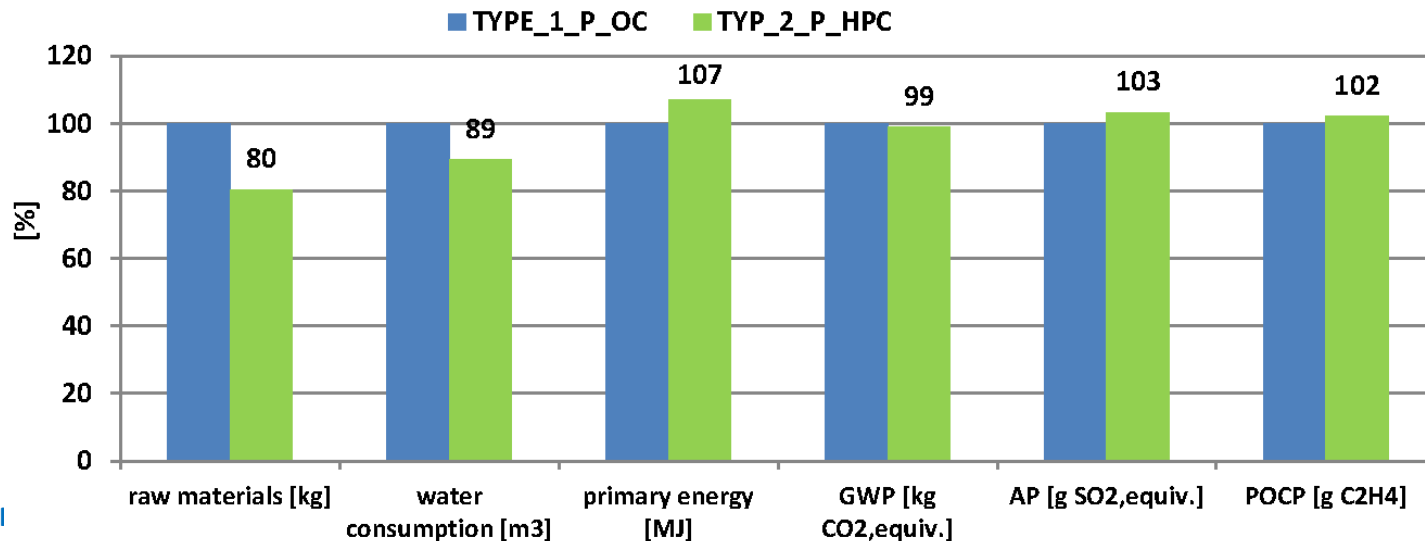
Primary raw materials consumption [kg]



Primary energy consumption [MJ]



Results of Life Cycle Assessment



conclusions



conclusion

- HPC – potential for the reduction of environmental impacts when used in **subtle thin shell structures**
- Environmental assessment should be based on **detailed LCA** of the entire structure (using specific **regional data**)
- **Optimal combination of materials** can result in more sustainable structures

Thank you for attention





Dear friends,

I am so sorry not to be with you in HongKong.

Petr Hajek