BRNO UNIVERSITY OF TECHNOLOGY
VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

FACULTY OF CIVIL ENGINEERING
FAKULTA STAVEBNÍ

INSTITUTE OF BUILDING STRUCTURES
ÚSTAV POZEMNÍHO STAVITELSTVÍ

HOTEL

6.1 – BUILDING PHYSICS

DIPLOMA THESIS
DIPLOMOVÁ PRÁCE

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AUTOR PRÁCE

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VEDOUCÍ PRÁCE

BRNO 2019

CONTENT

2. Identification data of the building

Construction:	Hotel
Location:	Suvorovova 2888/9, 902 01 Pezinok [846163], Slovakia Cadastral area Pezinok [846163], Stará hora Plot number 840/3, 840/24
Builder:	Richard Sasko and collective
Address:	Suvorovova 2888/9, 902 01 Pezinok-Stará hora, Slovakia
Designer:	Richard Sasko
Address:	Suvorovova 2888/9, 902 01 Pezinok-Stará hora, Slovakia

The building is designed as a two floor hotel. Construction is based on Czech brickwork from company Heluz with one main entrance and four side entrances. The main entrance is located in a front /south-western/ side of the building that also faces public communication and the rest is facing surrounding wildlife area and wine yards.

The building is designed with a purpose of usage for temporary or seasonal accommodation with maximal capacities of 42 people. It is placed in a suburban area situated by recently built horse riding facilities without previously available accommodational facilities.
It is founded on a side wall made of concrete blocks standing on a foundation strip. Construction is made of clay bricks from company Heluz, more exactly the vertical load-bearing structure is based on Heluz 50 2in1 with already installed thermal insulation in brick cavities and Heluz AKU 30, while the non load-bearing vertical structure is based on Heluz 11.5. Horizontal load-bearing structure is also a product of company Heluz, more precisely ceramic ceiling Heluz MIAKO formed of ceiling joists and filling brick cartridges.

3. Purpose of assessment

The purpose of assessment is according to Decree n. 269/2009 Coll., about technical requirements on buildings amended by Decree n. 20/2015 to verify whether the construction of building meets the requirements of §16 of the Decree:

-Thermo-technical properties of the hotel

-Calculation of heat transmission of the envelope of the building

-Assessment of given object from the sound reduction point of view

- Evaluation of the lowest surface temperature

-Assessment of temperature factor of surface of internal corner

4. Materials of elaboration

- Drawings and documentations of project
- Technical lists of manufacturers
- Compositions of walls and floors
- Climatic background data of region

5. Used standards an regulations

-ČSN 73 0540 - 1,2,3,4 Thermal protection of buildings

-ČSN 73 0532 - Acoustics- Noise protection in buildings and related acoustic properties of construction products

6. Technical data of construction

6.1 Climatic data of given region, boundary conditions in exterior and interior

Altitude:	162.00 m.a.s.l.
Temperature region:	2

Proposed external temperature:	θ_e = -15°C
Proposed internal temperature:	θ_{ai} = +20°C
Proposed temperature of soil:	θ_{ai} = +5°C
Proposed relative humidity of external air:	φ_e= 80%
Proposed relative humidity of internal air:	φ_i= 50%
Safety humidity overcharge:	$\Delta \varphi_i$ = 5%

6.2 Characteristics of cooled structures of building- description and composition

Composition of all walls and floors can be seen in the folder D.1.1.1 Compositions.

Cooled structures are considered following:

-Peripheral load-bearing walls of the first and the second above ground floor.

-Floor structure and soil

-Construction of roof

-Openings - Windows and doors

6.3 Characteristics of structures with requirement on airborne sound insulation requirements- description and composition

Composition of all walls and floors can be seen in the folder D.1.1.1 Compositions.

7. Standard requirements

7.1 Protection against noise

The detail calculations can be found in the document 6.2- Assessment of airborne sound insulation.

All structures meet the necessary requirements.

7.2 Heat distribution in construction and envelope of the building

Requirements of standard ČSN 73 0540-2 on the lowest surface temperature has to be fulfilled:

-$f_{Rsi,N}$= 0.789 – for interior structures

- $f_{Rsi} > f_{Rsi,N}$

Requirements of standard ČSN 73 0540-2 on the heat transfer coefficient has to be fulfilled:

- $U \leq U_{N,20}$

- $U_{N,20}$ is taken from table of required and recommended values of heat transfer coefficient for buildings with interior temperature θ_{im} = 18 - 22°C

8. Data about fulfilment of standard requirements

8.1 From thermo-technical point of view

- according to ČSN 73 05401- 1,2,3,4

Construction	θai	U	Rsi	θe	θsi,min [°C]	fRsi [-]	fRsi,N [-]	Result
	[°C]	[W/m2*K]	[m2*K/W]	°C]				
External wall	21	0,115	0,25	-15	19,965	0,971	0,789	**Complies**
Roof	21	0,131	0,25	-15	19,820	0,967	0,789	**Complies**
Terrace	21	0,135	0,25	-15	19,783	0,966	0,789	**Complies**
Floor	21	0,212	0,25	-15	19,092	0,947	0,789	**Complies**
Windows	21	0,800	0,25	-15	13,800	0,800	0,656	**Complies**
Doors	21	0,680	0,25	-15	14,880	0,830	0,656	**Complies**

8.1.1 The lowest interior surface temperature θsi,min [°C]

- according to ČSN 73 05401- 1,2,3,4

$$\theta si,min = \theta ai - U*R_{si}*(\theta ai - \theta e)$$

-where: θai - proposed internal temperature [°C]

U - heat transfer coefficient, [W/m^2*K]

R_{si} - internal surface resistance of given structure, [m^2*K/W]

θe - proposed external temperature [°C]

8.1.2 Temperature factor of interior surface fRsi

- according to ČSN 73 05401- 1,2,3,4

$$f_{Rsi}=(\theta si,min-\theta e)/(\theta ai-\theta e)$$

-where: θsi,min - the lowest interior surface temperature [°C]

θe - proposed external temperature [°C]

θai - proposed internal temperature [°C]

8.1.3 Heat transfer coefficient U [W/m^2*K]

- according to ČSN 73 05401- 1,2,3,4

$$U= 1/R_T\ [W/m^2*K]$$

-where: U - heat transfer coefficient, [W/m^2*K]

R_T - thermal resistance of given structure, [m^2*K/W]

Construction	Calculated coefficient U[W/m2*K]	Required coefficient UN,20[W/m2*K]	Result
External wall	0,115	0.3	**Complies**
Roof	0,131	0.24	**Complies**
Terrace	0,135	0.75	**Complies**
Floor	0,212	0.45	**Complies**
Windows	0,610	1.5	**Complies**
Doors	0,680	1.7	**Complies**

8.1.4 Thermal resistance R

$$R= \Sigma\ R_j\ [m^2*K/W]$$

$$R_j = d_j/\lambda_j$$

-where: R_j - thermal resistance of given layer, [m^2*K/W]

d_j - thickness of given layer, [m]

λ_j - proposed coefficient of thermal resistance of given material, [W/ m*K]

External wall:

N. of layer	Material	d [m]	λj [W/ m*K]	Rj[m2*K/W]
1	Mortar exterior	0,01	0,74	0,014
2	Heluz 2in1	0,5	0,058	8,621
3	Mortar interior	0,001	0,54	0,002
4	Dropped ceiling	0,013	0,22	0,059

Σ **R = 8.695** m^2*K/W

Roof:

N. of layer	Material	d [m]	λj [W/ m*K]	Rj[m2*K/W]
1	Vegetation substrate	0,07	0,65	0,108
2	Geotextile	0,002		0,000
3	Drainage	0,02	0,16	0,125
4	Geotextile	0,002		0,000
5	SBS bitumen felt	0,004	0,2	0,020
6	SBS bitumen felt	0,004	0,2	0,020
7	Thermal insulation EPS 200	0,14	0,034	4,118
8	Thermal insulation EPS 200	0,1	0,034	2,941
9	Vapour barrier SBS bitumen felt	0,004	0,2	0,020
10	Concrete grouting	0,06	1,4	0,043
11	Concrete slab	0,19	1,58	0,120
12	Dropped ceiling	0,025	0,22	0,114

Σ **R = 7.628** m^2*K/W

Terrace:

N. of layer	Material	d [m]	λj [W/ m*K]	Rj[m2*K/W]
1	SBS bitumen felt	0,004	0,2	0,020
2	SBS bitumen felt	0,004	0,2	0,020
3	Thermal insulation EPS 200	0,14	0,034	4,118
4	Thermal insulation EPS 200	0,1	0,034	2,941
5	Vapour barrier SBS bitumen felt	0,004	0,2	0,020
6	Concrete grouting	0,06	1,4	0,043
7	Concrete slab	0,19	1,58	0,120
8	Dropped ceiling	0,025	0,22	0,114

Σ **R = 7.396** m^2*K/W

Floor:

N. of layer	Material	d [m]	λj [W/ m*K]	Rj[m2*K/W]
1	Tiles	0,01	1,01	0,010
2	Adhesive	0,004	0,004	1,000
3	Waterproofing	0,001	0,04	0,025
4	Concrete grouting	0,07	1,4	0,050
5	Thermal insulation EPS 200	0,04	0,034	1,176
6	Thermal insulation EPS 200	0,08	0,034	2,353
7	SBS bitumen felt	0,004	0,2	0,020
8	SBS bitumen felt	0,004	0,2	0,020
9	Concrete slab with kari net	0,1	1,58	0,063

Σ **R = 4.718** m^2*K/W

Thermal resistance of give structure R_T

$$R_T = R_{si} + \Sigma R + R_{se}$$

-where: R_T - thermal resistance of given structure, [m^2*K/W]

R_{si} - internal surface resistance of given structure, [m^2*K/W]

ΣR - sum of thermal resistance of individual layers, [m^2*K/W]

R_{se} - external surface resistance of given structure, [m^2*K/W]

R_{si} = 0.13 m^2*K/W - for walls – horizontally

= 0.17 m^2*K/W - for floors – from up to down

= 0.10 m^2*K/W - for ceilings – from down to up

R_{se} = 0.04 m^2*K/W - for winter period

Construction	**R_{si}**	**ΣR**	**R_{se}**	**R_T**
External wall	0.13	8.695	0.04	8.865
Roof	0.10	7.628	0.04	7.768
Terrace	0.10	7.396	0.04	7.536
Floor	0.17	4.718	0.04	4.928

8.2 From the airborne and impact sound insulation R'$_w$ point of view

$$R'_w = R_w - k$$

-where: R'_w - weighted sound insulation [dB]

R_w – weighted laboratory value of sound insulation [dB]

k – correction, k= 2 dB

$$R'_w \geq R'_{w,N}$$

The detail calculations can be found in the document 6.2- Assessment of airborne sound insulation. All structures meet the necessary requirements.

8.3 Protocol of energy label of building envelope

The detail calculations can be found in the document 6.6 Protocol of Energy Label of Building Envelope. All structures meet the necessary requirements.

9. Conclusion

Building fulfils all set requirements given by standards and is classified as Building class A.

10. Annexes

6.1 - Thermal building assessment of structures

6.2 - Assessment of airborne sound insulation

6.3 - Heat transfer of windows and doors

6.4 - Calculation of thermal bridges

6.5 -Daylighting of accommodation room

6.6 Protocol of Energy Label of Building Envelope

Date: Name:

26.5.2016

Richard Sasko