Translation from Romanian

CERTIFICAT DE PERFORMANŢĂ ENERGETICĂ AL CLĂDIRII

City postal code | Registration no. with the Local Council | Registration date z z l l a a

Energy performance certificate

Building energy performance	Energy rating: 99.45	
Certification system: *Methodology for calculating the Energy Performance of Buildings developed in application of Law 372/2005*	Certified building	Reference building
Eficienţă energetică ridicată A B C D E F G Low energy efficiency	A	A
Annual specific energy consumption[kWh/m²year]	104.26	124.92
Equivalent emissions index CO_2 [kg_{CO_2}/m²year]	24.61	29.16

Annual specific energy consumption [kWh/m²year] for:		Energy class: Certified building	Energy class: Reference building
Heating:	73.21	Class B	Class A
Domestic hot water:	9.85	Class A	Class C
Air conditioning:	-	-	-
Mechanical ventilation:	-	-	-
Artificial lighting:	21.20	Class A	Class A

Specific annual energy consumption from renewable sources [kWh/m²year]: 0

Data on the certified building:

Address of the building: **"LUCIAN BLAGA" THEORETICAL HIGH SCHOOL, BUILDING C1-NORTH, ALEEA BAISOARA NR. 4, LOC. CLUJ-NAPOCA, JUD. CLUJ**

Building category: **CLĂDIRE DE ÎNVĂŢĂMÂNT**

Height regime: **B+GF+3F**

Year of construction: **1973**

Purpose of drawing up the energy certificate: **INFORMATIONAL**

Suprafaţa încălzită: **3207.37 m²**

Volumul încălzit al clădirii: **10696.59m³**

Calculation program used: _____ **, version:** _____

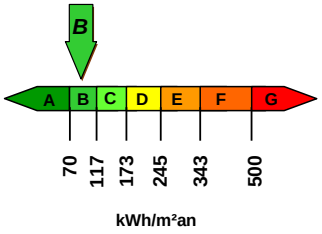
Data regarding the identification of the energy auditor for buildings:

Specialty: (c, i, ci)	Name and surname:	Series and number of attestation certificate:	No. and date of registration of the certificate in the auditor's register:	Auditor's signature and stamp:
C+I	**LAZARESCU GEORGE-ANTON**	**SSA/02356**	**0031/20.06.2022**	

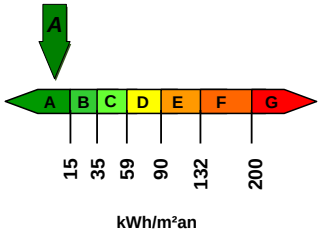
DATA REGARDING THE EVALUATION OF THE ENERGY PERFORMANCE OF THE BUILDING *Translation from Romanian*

- **Energy classification grids of the building according to the specific annual heat consumption:**

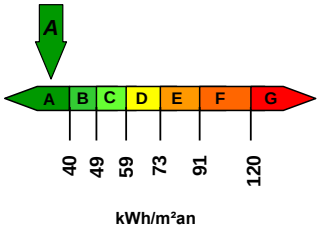
HEATING:



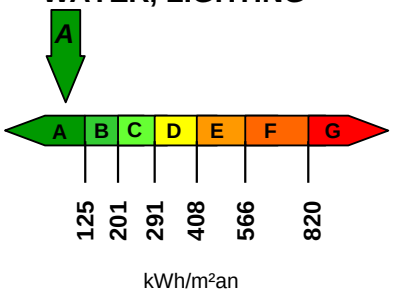
DOMESTIC HOT WATER:



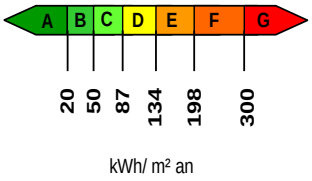
LIGHTING:



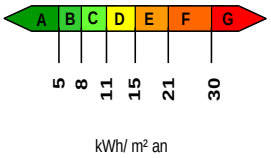
TOTAL: HEATING, HOT DOMESTIC WATER, LIGHTING



AIR CONDITIONING:



MECHANICAL VENTILATION:



- **Energy performance of the reference building:**

Annual specific energy consumption [kWh/m²year]			Energy rating
for:			**98.24**
Heating:		45.12	
Domestic hot water:		58.61	
Air conditioning:		-	
Mechanical ventilation:		-	
Lighting:		21.20	

- **Penalties granted to the certified building and their motivation:**

Penalty coefficient	p
p1 - penalty coefficient depending on the condition of the technical basement of the building - for collective buildings	
Individual building - EDUCATION BUILDING	1.00
p2 - penalty coefficient depending on the use of the entrance door to the building - for collective buildings	
Educational building - the access doors are provided with a locking system.	1.00
p3 - penalty coefficient depending on the state of the movable closing elements in the common spaces (stairwell)	
Windows / doors in good condition and provided with sealing gaskets	1.00
p4 - penalty coefficient depending on the condition of the closing and adjusting fittings from the static bodies - for buildings equipped with a central heating installation with static bodies	
The static bodies are equipped with adjustment fittings and they are functional	1.00
p5 - penalty coefficient depending on the washing / cleaning of the indoor heating installation - for buildings connected to a centralized heating point or district heating plant	
The static bodies were completely dismantled and washed more than three years ago	1.05
p6 - penalty coefficient depending on the existence of fittings for separating and emptying the heating columns - for collective buildings equipped with a central heating installation	
The heating columns are provided with separation fittings and are not functional	1.03

p7 - penalty coefficient depending on the existence of measuring equipment for setting heat consumption - for buildings connected to centralized heat supply systems	
There is neither a general heat meter for heating, nor a general heat meter for domestic hot water, heat consumption being determined in a flat rate system	1.00
p8 - penalty coefficient depending on the condition of the external finishes of the external walls - for buildings with brick walls or BCA	
Good condition of the exterior plaster	1.00
p9 - penalty coefficient depending on the state of the external walls in terms of their moisture content	
Dry exterior walls	1.00
p10 - penalty coefficient depending on the state of the roof over the bridge - for buildings with uninhabitable bridge	
Sealed roof	1.00
p11 - penalty coefficient depending on the condition of the smoke exhaust chimney / chimneys - for buildings equipped with local heating systems / preparation of domestic hot water with liquid or solid fuel	
Another type of building	1.00
p12 - penalty coefficient that takes into account the possibility of ensuring the required fresh air at the comfort value	
Building without organized ventilation system	1.10
Total =Π(p1:p12)	**1.25**

- **Recommendations for reducing costs by improving the energy performance of the building:**

• Increasing the corrected thermal resistance of the external walls above the minimum value provided by the technical norms in force, through thermal insulation without changing the external appearance of the building.
• Increasing the corrected thermal resistance of the floor above the last level as well as the screed above the minimum value stipulated by the technical norms in force
• Increasing the corrected thermal resistance of the slab on the ground and the floor above the basement, the minimum value provided by the technical norms in force
• Increasing the thermal resistance of glazed elements above the standard minimum value.

The following related measures are also recommended in order to directly or indirectly increase the energy performance of the educational building:

• Elimination of deposits of organic and inorganic matter from inside the thermal agent pipes and heating bodies by washing and equipping the installation with efficient filters
• The introduction of a surface between the wall and the radiator to reflect the radiant heat to the room
• Thermo-hydraulic balancing of heating bodies, thermal agent columns, distribution network
• Installation of faucets with thermostat on the connection of the heating bodies.
• Restoration of the insulation of the heating agent and domestic hot water distribution pipes.
• Reduction of heat supply during non-occupancy periods of the building
• Ensuring the adjustment of the heating thermal load by room types
• Equipping the domestic hot water installation with fittings provided with water consumption limitation
• Installation of LED bulbs and implementation of a lighting control system.
• Ensuring indoor air quality by implementing ventilation systems with energy recovery simultaneously with reducing cold air infiltration by sealing the joints.
• Ensuring the maintenance of the construction and related installations

It is recommended to carry out a study on the feasibility of using alternative systems of high efficiency from a technical, economic and environmental point of view.

Elaborated,

S.C. ZAL INVESTMENTS COMPANY S.A

Energy auditor for buildings,

Eng. GEORGE-ANTON LAZARESCU

Translation from Romanian

INFORMATION REGARDING THE CERTIFIED BUILDING
Annex to the Energy Performance Certificate no. *0031/20.06.2022*

1. Construction data:

- Building category (apartment building): ☐ residential, individual ☐ residential with several apartments ☐ dormitories, boarding schools ☐ hospitals, polyclinics ☐ hotels and restaurants ☐ sports buildings ☐ social-cultural buildings ☒ educational buildings ☐ other types of energy-consuming buildings
- No. of floors: ☒ Basement ☐ Semi-basement ☒ Ground floor ☒ 3 Floors
- ☐ The heated volume of the building: 10696.59 m³
- ☐ Situation plan / sketch of the apartment indicating the orientation to the cardinal points, the distances to the nearby buildings and their height and the positioning of the heat source or the connection point to the external heat source.

N

❑ Geometrical and thermo technical characteristics of the envelopment:

Corrected thermal resistances					
Building element		A	R	R'	r
		[m^2]	[m^2K/W]	[m^2K/W]	
EXTERIOR WALL		1650.89	1.70	1.48	0.87
NON-CIRCULABLE TERRACE		802.55	2.82	2.56	0.91
FLOOR OVER UNHEATED BASEMENT		207.7	0.45	0.44	0.98
FLLOR OVER THE GROUND		592.02	3.03	2.49	0.82
CARPENTRY	PVC	817.31	0.55	0.55	1

2. Date privind instalaţia de încălzire interioară:

❑ Sursa de energie pentru încălzirea spaţiilor:

☒ Own source: **Own thermal power plant**
☐ District heating plant
☐ Heating - central thermal point
☐ 0 Heating – local thermal point
☐ Other or mixed source:

❑ Type of heating system:

☐ Local heating with stoves,
☒ Central heating with static fixtures,
☐ Hot air central heating,
☐ Central heating with underfloor heating,
☐ Other heating system:

- Calculation heat requirement: **256 000 W**

- Connection to the centralized heat source ☒ single connection,
  ☐ multiple: ..... points,
  ☐ not applicable

- Heat meter: - meter type No
  - year of installation .....
  - the existence of the metrological visa .....

- Thermal and hydraulic adjustment elements:
  - at connection level No
  - at the level of static bodies No

3. Energy source for the preparation of domestic hot water:

❑ Energy source for the preparation of domestic hot water:

☒ Own source: ***Local electric boilers/instants***
☐ District heating plant
☐ Heating - central thermal point
☐ Heating – local thermal point
☐ Other or mixed source: .....

❑ Type of domestic hot water preparation system:

☐ From centralized source,
☐ Own source: own thermal plant
☐ Boiler with bivalent storage,
☒ Local preparation with instant DHW appliances,
☐ Local preparation on the stove,
☐ Other DHW preparation system: .....

- ❑ Connection to the centralized heat source: ☒ single connection,
  ☐ multiple: ..... points,
  ☐ not applicable
- ❑ DHW water recirculation pipe: ☐ functional,
  ☐ not working
  ☒ does not exist
- ❑ General heat meter: - meter type ..... NO .....
  - year of installation .....
  - the existence of the metrological visa .....
- ❑ Flow meters at consumption points: ☒ does not exist
  ☐ partially
  ☐ everywhere

3. Data regarding the lighting installation:

The calculation was carried out applying the simplified method, with the specification that the interior lighting installation is not provided with a safety lighting system nor with a lighting control system.

$$W_{ilum}=6 \times A + (t_u \times \Sigma P_n)/1000= 67996.244 \text{ [kWh/year]}$$

$$t_u=(t_D \times F_D \times F_O) + (t_N \times F_O)= 2000 \text{ [h]}$$

T_D – daylight usage time depending on the type of building
F_D – daylight dependence factor
F_O – the dependence factor on the duration of use
T_N – the time when natural light is not used
P_N – installed power
A – total floor area in the building

w_{il}= 21,20 kWh/m^{2}year

Elaborated,

S.C. ZAL INVESTMENTS COMPANY S.A

Energy auditor for buildings,

Eng. GEORGE-ANTON LAZARESCU

Round stamp

Illegible signature

Translation from Romanian

ENERGY PERFORMANCE OF THE BUILDING
– ENERGY CERTIFICATE –
FOR THE EDUCATIONAL BUILDING "LUCIAN BLAGA" THEORETICAL HIGH SCHOOL, BUILDING C1-NORTH LOCATED IN ALEEA BAISOARA NR. 4, LOC. CLUJ-NAPOCA, CLUJ COUNTY

CONTENTS

Bucuresti, Calea Vacaresti Nr 312 , Sect. 4
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E-MAIL: contact@zal.ro

Translation from Romanian

1. Introduction

This document presents the assessment of the energy performance of the "LUCIAN BLAGA" THEORETICAL HIGH SCHOOL objective, BUILDING C1-SOUTH LOCATED IN BAISOARA ALLEY NO. 2, LOC. CLUJ-NAPOCA, JUD. CLUJ, carried out on the basis of data and observations according to the data provided by the beneficiary.

After the general presentation of the evaluated building, the thermal and energy evaluation sheet related to the construction and the heating installation and preparation of domestic hot water was completed.

Finally, the results obtained on the basis of the thermo-energetic assessment of the building and the related heating and hot water preparation installations serve for the energy certification of the building.

The preparation of the building's energy performance certificate was carried out in accordance with the provisions of Methodology Mc 001/2006, regarding the calculation of energy consumption of buildings,

Other related documents are:

• Order no. 2641/2017 regarding the modification and completion of the technical regulation "Methodology for calculating the energy performance of buildings" MC 001-2006

• Law no. 10/1995 regarding quality in construction, with subsequent amendments and additions

• Law no. 372/2005 regarding the energy performance of buildings, with subsequent amendments and additions

• NP 008-97 - Regulations regarding the hygiene of air composition in spaces with various destinations, depending on the activities carried out in the winter-summer regime.

• GT 032-2001 - Guide regarding the procedures for carrying out the measurements necessary for the thermal energy expertise of constructions and related installations.

• C 107/1-2005 - Regulations regarding the calculation of global thermal insulation coefficients for residential buildings.

• C 107/3-2005 - Normative regarding thermotechnical calculation of construction elements of buildings.

• C 107/5-2005 - Regulations regarding the thermotechnical calculation of construction elements in contact with the ground.

• SR 1907/1-2014 - Heating installations. Calculation of heat requirement. Calculation method.

• SR 1907/2-2014 - Heating installations. Calculation of heat requirement. Conventional indoor temperatures for calculation.

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2. General presentation of the energy assessed building

2.1 Elements of architectural composition

The evaluated building is an educational building with a height regime B+GF+3F, located in ALEEA BAISOARA NR. 2, LOC. CLUJ-NAPOCA, CLUJ COUNTY with the ground floor built area of 913 m^2, , and the development area of 3638.37 m^2.

The building has a rectangular plan, the orientation of the main facade of the building is WEST, with the overall maximum dimensions of 67.75 m x 24.90 m.

The existing architectural solution for the building groups the following functions per level:

- Partial basement: technical space
- Ground floor and floors: classrooms, laboratories, administrative offices, sanitary groups and other technical spaces.

The average level heights are:

- basement: 1.69 m
- ground floor: 3.33 m
- 1st floor: 3.32 m
- 2nd floor: 3.30 m
- 3rd floor: 3.37 m

The roof is a wooden roof covered with tin, thermally insulated with 10 cm mineral wool.

The exterior and interior joinery is comprised of white double-glazed PVC windows and doors.

Building finishes:

• Exterior wall finishes are plaster and structured decorative painting.

• Interior wall finishes are simple, with washable paint and chipboard paneling, mosaic plasters, and tiled tiling in the bathrooms.

• The floors are made of PVC carpet or mosaic in the area of the corridor and the staircase, parquet in the classrooms and tiles in the bathrooms.

2.2 Components of the resistance structure:

The resistance structure of the building is made up as follows:

• Reinforced concrete elevations;

• Vertical structure with exterior brick walls reinforced with cores and reinforced concrete belt. The external walls are insulated with 5 cm expanded polystyrene, having a total thickness of 40 cm.

• horizontal elements – reinforced concrete floors

The infrastructure is made as follows:

• plain concrete structural walls

• slab on the ground made of reinforced concrete

• continuous plain concrete foundations with flares next to certain pillars

The partition walls are mainly made of BCA/brick masonry.

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2.3 General presentation of the installation systems related to the building:

The heating is provided by the heating agent supply from an own thermal plant located in a body attached to the school building formed by a battery of two De Dietrich boilers, model GT 336, year of manufacture 2018, with a total installed power of 320 kW, operating with natural gas.

The conventional calculation conditions are fixed by the values: Ti=20°C, Te=-18°C.

The distribution of the thermal agent is achieved through a bi-tubular system with lower distribution and vertical columns that cross the floors. The heating bodies are made of cast iron and are not equipped with shut-off and adjustment valves.

The building is supplied with cold water from the city network and is provided at the level of the branch with flow meters for recording consumption.

Hot water is prepared locally with the help of electric instants.

The lighting of the interior spaces is mostly provided with fluorescent lighting fixtures. The building is not equipped with presence sensors to operate the lighting fixtures or twilight sensors in order to adjust the luminous flux according to the light input.

3. Building's expertise sheet

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4. Building's expertise sheet

The building: "LUCIAN BLAGA" THEORETICAL HIGH SCHOOL, BUILDING C1-SOUTH
Address: ALEEA BAISOARA NR. 2, LOC. CLUJ-NAPOCA, CLUJ COUNTY

☐ Main destination of the building:

☐ houses	☐ offices	☐ hospital
☐ trade	☐ hotel	☐ local authorities
☐ school	☐ culture	☒ education

☐ Type of building:

☒ individual	☐ Inline
☐ apartment building	☐ apartment building section

☐ Climatic zone where the building is located: III
☐ Height regime of the building: B+GF+3F
☐ Year of construction: 1974
☐ Constructive structure:

☒ bearing masonry	☐ reinforced concrete frames
☐ reinforced concrete structural walls	☒ columns and beams
☐ reinforced concrete diaphragms	☐ metal skeleton

☐ Existence of construction documentation and related installation:

☒ piece of architecture for each type of representative level
☒ representative sections of the construction
☐ construction details,
☐ plans for the indoor heating system,
☐ column diagram for the indoor heating system,
☐ plans for the sanitary installation,

☐ Degree of exposure to wind:

☒ sheltered	☐ moderately sheltered	☐ freely exposed (unsheltered)

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- ☐ Situation plan / sketch of the building with the indication of the orientation to the cardinal points, the distances to the nearby buildings and their height and the positioning of the heat source or the connection point to the external heat source.

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Translation from Romanian

☐ Identification of the constructive structure of the building in order to appreciate the main thermotechnical characteristics of the construction elements of the building envelope:

☑ Opaque exterior walls:

✓ Composition:

	Description	Surface [m^2]	Component layers (i -> e)		Reduction coefficient
			Material	Thickness [m]	
PE	Brickwork (R=1,48 m^2K/W)	1650.89	-Lime mortar plaster - Brick masonry -Expanded polystyrene -Structured decorative plaster	0,025 0,30 0,05 0,015	0,87

The total area of the opaque external walls [m^2]: 1650.89

SOUTH	NORTH	EAST	WEST	TOTAL
225.67	188.5	483.2	753.53	1650.89

✓ Condition: ☐ good ☒ condensation spots ☐ moisture

✓ State of the finishes: ☐ good ☒ partially / totally fallen plaster

✓ Type and color of finishing materials: on the outside – yellow & red painting

✓ Shading elements of the facades: shading due to the horizon as well as fins and protrusions

☑ ☐ Floor board:

✓ Composition:

	Description	Surface [m^2]	Component layers (i -> e)		Reduction coefficient
			Material	Thickness [m]	
P_{sol}	Plate on the ground (R=3,03 m^2K/W)	592.02	PVC carpet Support screed / Concrete Gravel fill	0,01 Covor pvc 0,10 Șapă suport / Beton 0,10 Umplutură pietriș	0,82

✓ The total area of the slab on the ground [m^2]: 592.02

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☑ Floor over the basement:

✓ Composition:

	Description	Surface [m^2]	Component layers (i -> e)		Reduction coefficient
			Material	Thickness [m]	
PL_{subsol}	BA plate (R=0,45 m^{2}K/W)	207.70	PVC carpet / Parquet Support screed / Concrete Reinforced concrete	0,01 0,05 0,10	0,98

✓ ☐ The total area of the plate on the ground [m^2]: 207.70

☑ Roof:

✓ Type: ☒ Terrace ☐ Framing

✓ State: ☐ Good ☒ Damaged

☐ Dry ☒ Wet

✓ Last repair: ☐ < 1 year ☐ 1-2 years

☐ 2-5 years ☒ > 5 years

Roof	Description	Surface [m^2]	Component layers (i -> e)		Reduction coefficient r
			Material	Thickness [m]	
PL_{POD}	Unheated bridge floor (R=2,82 m^{2}K/W)	802.55	Bituminous membrane Digging equalization Thermal insulation - Mineral wool Layer of sand Slope concrete Reinforced concrete Plaster	0,02 0,01 0,1 0,01 Lime 0-0,1 0,11 0,02	0,91

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☑ Exterior windows / doors:

Orientation	Type	Length [m]	Height [m]	Material	Piece no.	A [m^2]
S	1	2.65	2.00	PVC carpentry	20	106.00
Subtotal SOUTH						**106.00**
N	1	2.64	2.00	PVC carpentry	23	121.44
N	2	2.63	3.00	PVC carpentry	1	7.89
N	3	2.60	0.85	PVC carpentry	3	6.63
N	7	2.67	0.90	PVC carpentry	3	7.21
Subtotal NORTH						**143.17**
E	1	2.64	2.00	PVC carpentry	77	406.56
E	4	1.76	1.80	PVC carpentry	4	12.67
Subtotal EAST						**419.23**
W	1	2.65	2.00	PVC carpentry	23	121.90
W	5	2.68	2.80	PVC carpentry	1	7.50
W	6	2.10	0.65	PVC carpentry	4	5.46
W	7	2.70	0.65	PVC carpentry	8	14.04
Subtotal WEST						**148.90**

✓ Carpentry condition:
- ☒ good
- ☐ without sealing measures (wooden carpentry)
- ☒ with sealing gaskets (PVC carpentry)
- ☐ with special sealing measures

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☑ Mobile construction elements in the common spaces:

✓ Entrance doors to the building:

☒ door is equipped with an automatic closing system

☐ the door is not equipped with an automatic closing system and remains closed when not in use

✓ Windows related to unheated spaces - the condition of the windows, the carpentry and the degree of sealing:

☒ windows / doors in good condition and fitted with seals

☐ windows / doors in good condition but leaky

☐ windows / doors in poor condition, missing or broken

☑ Characteristics of the living / heated space:

Construction element	Type	R_j	S
		[m^2K/W]	[m^2]
Carpentry	PVC	0,55	817.31

✓ Floor area of the heated space: 3207.37 m^2

✓ The volume of the heated space: 10696.59 m^3

☐ Degree of occupancy of the heated space / no. of operating hours of the heating installation:

- 12 hours/day during the week at calculation temperature: 20°C
- Weekends and the holiday period at low temperature: 12°C

☐ Indoor heating system:

✓ Energy source for space heating:

☐ own source, with gaseous fuel: THERMAL PLANT

☐ district heating plant

☒ heating - central thermal point

☐ heating – local thermal point

☐ other source or mixed source

✓ Type of heating system:

☐ local heating with stoves

☒ central heating with static fixtures

☐ hot air central heating

☐ central heating with underfloor heating

☐ other heating system

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Translation from Romanian

☐ Data regarding the indoor heating installation with static bodies (evaluation):

✓ Type of distribution of the thermal heating agent:

☐ lower ☐ upper ☒ mixed ☐ not applicable

✓ Calculation heat requirement: 256 000 W

✓ Heat meter: NU

✓ Thermal and hydraulic adjustment elements (at the column level): NO

✓ Thermal and hydraulic adjustment elements (at the level of static bodies): NO

☐ The static bodies are equipped with adjustment fittings and they are functional

☐ Static bodies are equipped with adjustment fittings, but at least a quarter of them are not functional

☒ Static bodies are not equipped with adjustment fittings or at least half of the existing adjustment fittings are not functional

☐ Data regarding the domestic hot water installation:

✓ Energy source for preparing domestic hot water:

☒ Own source: ***Local electric boilers/instants***

☐ District heating plant

☐ Heating - central thermal point

☐ Heating – local thermal point

☐ Other or mixed source:

✓ Type of domestic hot water preparation system:

☐ From centralized source

☐ Own thermal plant

☐ Storage boiler

☒ Local preparation with instant DHW.

☐ Local cooking on the stove

☐ Other DHW preparation system

✓ DHW recirculation pipe:

☐ functional in the basement ☐ does not work ☒ does not exist

✓ Heat meter: Not applicable

✓ Flow meters at consumption points: not the case

✓ Other information:

- accessibility to the hot water connection: YES
- invoices for natural gas consumption for buildings with their own hot water production installation. operating on natural gas: Not applicable
- cold water temperature 10°C
- average number of people: 545

☐ **Data regarding the lighting installation:**

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Translation from Romanian

The calculation was carried out applying the simplified method, with the specification that the interior lighting installation is not provided with a safety lighting system nor with a lighting control system.

$$W_{ilum}=6 \times A + (t_u \times \Sigma P_n)/1000= 67996.244 \text{ [kWh/year]}$$

$$t_u=(t_D \times F_D \times F_O) + (t_N \times F_O)= 2000 \text{ [h]}$$

T_D daylight usage time depending on the type of building

F_D – daylight dependence factor

F_O – the dependence factor on the duration of use

T_N – the time when natural light is not used

P_N – installed power

A – total floor area in the building

w_{il}= 21,20 kWh/m^{2}an

Elaborated,

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Energy auditor for buildings,

Eng. GEORGE-ANTON LAZARESCU

Round stamp

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Translation from Romanian

4. Evaluation of the energy performance of the building

4.1 Expert report

4.1.1 General information

Building	LUCIAN BLAGA" THEORETICAL HIGH SCHOOL, BUILDING C1-SOUTH
Address	ALEEA BAISOARA NR. 2, LOC. CLUJ-NAPOCA, CLUJ COUNTY
The main destination of the building	Education
Building type	Individual
Year of construction	1973
Constructive structure	BA pillars and beams + Brick masonry walls

Geometric characteristics of the envelopment:

Exterior carpentry: **Opaque exterior walls:**

Construction element	Orientation	Surface	Construction element	Orientation	Surface
	-	m^2		-	m^2
0	*1*	*2*	*0*	*1*	*2*
Exterior carpentry	SOUTH	106.00	Exterior wall	SOUTH	225.67
	NORTH	143.17		NORTH	188.50
	EAST	419.23		EAST	483.20
	WEST	148.90		WEST	753.53

4.1.2 Information regarding the heating installation

Energy source for space heating	The city heating network
Type of heating system	Heating installation with static bodies
Distribution of the heating agent	Mixed
Calculation heat requirement (W)	256 000
Connection to centralized heat source	Da
Heat meter for heating	Nu
Thermal and hydraulic adjustment elements	Nu

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4.2 4.2 Energy calculations - Real Building

4.2.1 Thermal resistances, reduction coefficients, corrected thermal resistances

Corrected thermal resistances					
Building element		A	R	R'	r
		[m²]	[m²K/W]	[m²K/W]	
EXTERIOR WALL		1650.89	1.70	1.48	0.87
NON-CIRCULABLE TERRACE		802.55	2.82	2.56	0.91
FLOOR OVER UNHEATED BASEMENT		207.7	0.45	0.44	0.98
FLOOR PLATE		592.02	3.03	2.49	0.82
CARPENTRY	PVC	817.31	0.55	0.55	1

4.2.2 Surface and average corrected thermal resistance of the building envelope

- Total area of the building envelope: 4070.47 (m^2)
- Corrected average thermal resistance of the building envelope: 1.12 (m^2°K/W)

4.2.3 Calculation data

a) conventional temperatures

- thermal zone: III
- wind zone: IV
- temperature indoor: 20 °C
- temperature outside: -18 °C

b) reference temperatures necessary for the calculation of energy consumption

- calculation temperature: 20 °C – 12 h/day during the week
  12 °C – at night, on weekends and during vacation periods
  - average temperature of the heating period: t_{em}= 0.91 °C

c) The duration of the heating period of the actual building

The duration of the heating period represents the number of days in which the heating installation must operate to maintain the internal temperature at a constant value, taking into account energy inputs and free heat sources inside and outside the building.

Heating duration: Dz = 165 (days)

4.2.4 Annual heat consumption for heating

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- $Q_{f,h}$ annual energy consumption for heating the building: 234804.92 (kWh/year)

To calculate the value of the annual heat consumption at the level of energy supply to the building, the following values were used:

- H_T transmission heat loss coefficient: 3867.73 (W/K)
- H_v heat loss coefficient through ventilation: 4888.64 (W/K)
- Q_L heat losses of the building: 345552.96 (kWh)
- Q_g total heat input: 267715.78 (kWh)
- D_{zreal} actual duration of heating period: 165 (days)
- Q_h heat requirement for heating a building: 174624.91 (W)

4.2.5 Specific annual heat consumption for heating

- at the level of energy supply: 73.21 (kWh/m^{2}year)

4.2.6 The specific annual heat consumption for the preparation of domestic hot water

- at the level of energy supply: 9.85 (kWh/m^{2}year)

It was considered a number of 545 people and a consumption of 5 [l/day] of water at a temperature of 60 ºC, during the period of occupation of the building.

4.2.7 Specific annual energy consumption for lighting

- at the level of energy supply: 21.20 (kWh/m^{2}year)

4.2.8 Total specific annual heat consumption

- at the level of energy supply: 104.26(kWh/m^{2}year)

4.2.9 CO2 emissions: 24.61(kg$_{CO2}$/m^{2}year)

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4.3 Energy calculations - The reference building

In the case of the reference building, the surface of the windows and exterior walls is identical to that of the real building. The thermal resistances of the envelope elements take the minimum recommended values from the point of view of thermal protection of the building. These changes lead to new values for the length of the heating season and the corrected number of degree-days.

The total penalty coefficient given to the reference building is 1.

4.3.1 Surface and average corrected thermal resistance of the building envelope

- Total envelopment surface: 4070.47 (m2)
- Corrected average thermal resistance of the building envelope: 2.00 (m^2K/W)

4.4.2 Heating duration and corrected number of degree days

- Heating duration: 155 (days);

4.4.3 Annual heat consumption for heating

- at the level of energy supply: 144715.45 (kWh/year)

4.4.4 Specific annual heat consumption for heating

- at the level of energy supply: 45.12 (kWh/m^2year)

4.4.5 Specific annual heat consumption for hot water preparation

- at the level of energy supply: 58.61 (kWh/m^2year)

4.4.6 Specific energy consumption for lighting: 21.20 ($kWh/m^2.year$)

4.4.7 Total specific annual heat consumption

- at the level of energy supply: 124.92(KWh/m^2year)

4.4.8 CO2 emissions: 29.19(kg_{CO2}/m^2year)

Elaborated,

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