Energy consumption

INDEX

Energy consumption

1.- ENERGY CONSUMPTION CALCULATION RESULTS

1.1.- Monthly results.

1.1.1.- Annual energy consumption of the building.

		Jan (kWh)	Feb (kWh)	Mar (kWh)	Apr (kWh)	May (kWh)	Jun (kWh)	Jul (kWh)	Aug (kWh)	Sep (kWh)	Oct (kWh)	Nov (kWh)	Dec (kWh)	Year (kWh·year)	Year (kWh/m²·year)
BUILDING (S_u = 441.10 m²; V = 1546.78 m³)															
Energy demand	Heating	652.2	371.6	3.2	0.1	--	--	--	--	--	2.0	16.9	218.5	1264.4	2.9
	Cooling	19.3	302.9	889.3	1551.4	2382.6	3002.5	3396.1	3493.4	2380.8	1403.0	550.0	171.1	19542.4	44.3
	TOTAL	671.5	674.4	892.5	1551.5	2382.6	3002.5	3396.1	3493.4	2380.8	1404.9	566.8	389.6	20806.7	47.2
Electricity (f_{cep} = 1.954)	EF_{heat}	0.1	0.1	--	--	--	--	--	--	--	--	--	0.0	0.1	
	EP_{heat}	0.1	0.2	--	--	--	--	--	--	--	--	--	0.0	0.3	
	$EP_{nr,heat}$	0.1	0.1	--	--	--	--	--	--	--	--	--	0.0	0.3	
	EF_{cool}	4.7	86.4	275.8	523.8	854.3	1193.0	1382.5	1469.6	908.4	505.0	157.8	46.3	7407.5	16.8
	EP_{cool}	11.2	204.7	653.1	1240.3	2023.0	2825.1	3273.8	3479.9	2151.0	1195.8	373.6	109.5	17541.0	39.8
	$EP_{nr,cool}$	9.2	168.9	538.9	1023.5	1669.3	2331.3	2701.6	2871.6	1775.0	986.8	308.3	90.4	14474.8	32.8
	EF_{dhw}	--	--	--	--	--	--	--	--	--	--	--	--	--	
	EP_{dhw}	--	--	--	--	--	--	--	--	--	--	--	--	--	
	$EP_{nr,dhw}$	--	--	--	--	--	--	--	--	--	--	--	--	--	
Natural gas (f_{cep} = 1.189)	EF_{heat}	787.6	443.1	4.6	0.1	--	--	--	--	--	3.6	21.1	278.6	1538.7	3.5
	EP_{heat}	941.2	529.5	5.5	0.1	--	--	--	--	--	4.3	25.2	332.9	1838.8	4.2
	$EP_{nr,heat}$	936.5	526.8	5.5	0.1	--	--	--	--	--	4.3	25.0	331.3	1829.6	4.1
	EF_{cool}	--	--	--	--	--	--	--	--	--	--	--	--	--	
	EP_{cool}	--	--	--	--	--	--	--	--	--	--	--	--	--	
	$EP_{nr,cool}$	--	--	--	--	--	--	--	--	--	--	--	--	--	
	EF_{dhw}	--	--	--	--	--	--	--	--	--	--	--	--	--	
	EP_{dhw}	--	--	--	--	--	--	--	--	--	--	--	--	--	
	$EP_{nr,dhw}$	--	--	--	--	--	--	--	--	--	--	--	--	--	
Auto-consumed electricity (f_{cep} = 1.954)	EF	--	--	--	--	--	--	--	--	--	--	--	--	--	
	EP	--	--	--	--	--	--	--	--	--	--	--	--	--	
	EP_{nr}	--	--	--	--	--	--	--	--	--	--	--	--	--	
	$C_{ef,total}$	792.4	529.6	280.4	523.9	854.3	1193.0	1382.5	1469.6	908.4	508.6	178.8	324.9	8946.3	20.3
	C_{ep}	952.5	734.3	658.6	1240.4	2023.0	2825.1	3273.8	3479.9	2151.0	1200.1	398.8	442.5	19380.0	43.9
	$C_{ep,nr}$	945.9	695.9	544.4	1023.6	1669.3	2331.3	2701.6	2871.6	1775.0	991.1	333.3	421.7	16304.6	37.0

where:

- S_u: Residential area of the building, m².
- V: Net residential area of the building, m³.
- f_{cep}: Conversion factor for final energy to primary energy obtained from non-renewable sources.
- EF: Final energy consumed by the system at consumption point, kWh.
- EP: Primary energy consumption, kWh.
- EP_{nr}: Non-renewable primary energy consumption, kWh.
- $C_{ef,total}$: Total energy consumption at consumption point, kWh/m²·year.
- C_{ep}: Total primary energy consumption, kWh/m²·year.
- $C_{ep,nr}$: Total non-renewable primary energy consumption, kWh/m²·year.

1.1.2.- Results by occupied zone and month

Offices - South (S_u = 189.33 m²; V = 643.14 m³)

		Jan (kWh)	Feb (kWh)	Mar (kWh)	Apr (kWh)	May (kWh)	Jun (kWh)	Jul (kWh)	Aug (kWh)	Sep (kWh)	Oct (kWh)	Nov (kWh)	Dec (kWh)	Year (kWh·year)	Year (kWh/m²·year)
Energy demand	Heating	249.9	142.7	0.7	--	--	--	--	--	--	0.4	2.2	66.9	462.8	2.4
	Cooling	14.2	197.8	504.0	758.1	1108.2	1404.8	1610.1	1688.3	1202.6	795.5	393.0	132.9	9809.4	51.8
	TOTAL	264.1	340.5	504.7	758.1	1108.2	1404.8	1610.1	1688.3	1202.6	796.0	395.1	199.8	10272.2	54.3

		Jan (h)	Feb (h)	Mar (h)	Apr (h)	May (h)	Jun (h)	Jul (h)	Aug (h)	Sep (h)	Oct (h)	Nov (h)	Dec (h)	Year (h)
Unmet load hours[*]	Heating	4.00	3.00	--	--	--	--	--	--	--	--	--	--	7.00
	Cooling	--	--	--	--	2.00	23.00	49.00	44.00	7.00	--	--	--	125.00

*Number of hours in which the air temperature of the spaces of the zone lies outside the range of the setpoint heating or cooling temperatures, with a margin greater than 0.2 °C for heating and 0.2 °C for cooling.

where:

Energy consumption

S_u: Useful surface area of the habitable zone, m².

V: Net volume of the occupied zone, m³.

DHW_{sol}: Solar net energy provided, kWh.

DHW_{sis}: Net energy provided by the system, kWh.

Offices - North (S_u = 143.72 m²; V = 485.51 m³)

		Jan (kWh)	Feb (kWh)	Mar (kWh)	Apr (kWh)	May (kWh)	Jun (kWh)	Jul (kWh)	Aug (kWh)	Sep (kWh)	Oct (kWh)	Nov (kWh)	Dec (kWh)	Year (kWh·year)	Year (kWh/m²·year)
	Heating	363.4	206.5	1.2	--	--	--	--	--	0.7	11.4	137.3	720.5	5.0
Energy demand	Cooling	--	70.8	292.6	628.1	1024.4	1292.2	1453.0	1461.2	942.8	462.7	100.2	20.5	7748.7	53.9
	TOTAL	363.4	277.3	293.8	628.1	1024.4	1292.2	1453.0	1461.2	942.8	463.4	111.5	157.8	8469.2	58.9

		Jan (h)	Feb (h)	Mar (h)	Apr (h)	May (h)	Jun (h)	Jul (h)	Aug (h)	Sep (h)	Oct (h)	Nov (h)	Dec (h)	Year (h)
Unmet load hours*	Heating	7.00	3.00	--	--	--	--	--	--	--	--	--	1.00	11.00
	Cooling	--	--	--	--	2.00	23.00	46.00	37.00	4.00	--	--	--	112.00

*Number of hours in which the air temperature of the spaces of the zone lies outside the range of the setpoint heating or cooling temperatures, with a margin greater than 0.2 °C for heating and 0.2 °C for cooling.

where:

S_u: Useful surface area of the habitable zone, m².

V: Net volume of the occupied zone, m³.

DHW_{sol}: Solar net energy provided, kWh.

DHW_{sis}: Net energy provided by the system, kWh.

Cafeteria (S_u = 50.51 m²; V = 171.90 m³)

		Jan (kWh)	Feb (kWh)	Mar (kWh)	Apr (kWh)	May (kWh)	Jun (kWh)	Jul (kWh)	Aug (kWh)	Sep (kWh)	Oct (kWh)	Nov (kWh)	Dec (kWh)	Year (kWh·year)	Year (kWh/m²·year)
	Heating	38.9	22.4	1.3	0.1	--	--	--	--	--	0.9	3.3	14.3	81.1	1.6
Energy demand	Cooling	5.0	34.3	92.8	165.2	250.0	305.5	333.1	343.8	235.5	144.7	56.8	17.7	1984.3	39.3
	TOTAL	43.9	56.6	94.0	165.3	250.0	305.5	333.1	343.8	235.5	145.6	60.2	32.0	2065.4	40.9

		Jan (h)	Feb (h)	Mar (h)	Apr (h)	May (h)	Jun (h)	Jul (h)	Aug (h)	Sep (h)	Oct (h)	Nov (h)	Dec (h)	Year (h)
Unmet load hours*	Heating	4.00	2.00	--	--	--	--	--	--	--	--	--	--	6.00
	Cooling	--	--	--	--	1.00	29.00	39.00	49.00	2.00	--	--	--	120.00

*Number of hours in which the air temperature of the spaces of the zone lies outside the range of the setpoint heating or cooling temperatures, with a margin greater than 0.2 °C for heating and 0.2 °C for cooling.

where:

S_u: Useful surface area of the habitable zone, m².

V: Net volume of the occupied zone, m³.

DHW_{sol}: Solar net energy provided, kWh.

DHW_{sis}: Net energy provided by the system, kWh.

Unconditioned (S_u = 57.53 m²; V = 246.23 m³)

		Jan (kWh)	Feb (kWh)	Mar (kWh)	Apr (kWh)	May (kWh)	Jun (kWh)	Jul (kWh)	Aug (kWh)	Sep (kWh)	Oct (kWh)	Nov (kWh)	Dec (kWh)	Year (kWh·year)
Energy demand	TOTAL	--	--	--	--	--	--	--	--	--	--	--	--	--

		Jan (h)	Feb (h)	Mar (h)	Apr (h)	May (h)	Jun (h)	Jul (h)	Aug (h)	Sep (h)	Oct (h)	Nov (h)	Dec (h)	Year (h)
Unmet load hours*	Heating	--	--	--	--	--	--	--	--	--	--	--	--	--
	Cooling	--	--	--	--	--	--	--	--	--	--	--	--	--

Energy consumption

*Number of hours in which the air temperature of the spaces of the zone lies outside the range of the setpoint heating or cooling temperatures, with a margin greater than 0.2 °C for heating and 0.2 °C for cooling.

where:

S_u: Useful surface area of the habitable zone, m².

V: Net volume of the occupied zone, m³.

DHW_{sol}:   Solar net energy provided, kWh.

DHW_{sls}:   Net energy provided by the system, kWh.

2.- DESIGN MODEL OF THE BUILDING.

2.1.- Energy demand of the building.

2.1.1.- Heating and cooling energy demand.

Habitable zones	S_u (m²)	D_{heat} (kWh·year)	(kWh/m²·year)	D_{cool} (kWh·year)	(kWh/m²·year)
Offices - South	189.33	462.8	2.4	9809.4	51.8
Offices - North	143.72	720.5	5.0	7748.7	53.9
Cafeteria	50.51	81.1	1.6	1984.3	39.3
Unconditioned	57.53	--	--	--	--
	441.10	1264.4	2.9	19542.4	44.3

where:

S_u: Useful surface area of the habitable zone, m².

D_{heat}:   Calculated value of the heating energy demand, kWh·year.

D_{cool}:   Calculated value of the cooling energy demand, kWh/m²·year.

2.1.2.- Domestic hot water energy demand.

The planned building does not have any domestic hot water demand.

2.2.- Used final energy to primary energy conversion factors.

Energy vector	$C_{ef,total}$ (kWh·year)	(kWh/m²·year)	f_{cep}	$C_{ep,nr}$ (kWh·year)	(kWh/m²·year)
Electricity	7407.6	16.8	1.954	14475.1	32.8
Natural gas	1538.7	3.5	1.189	1829.6	4.1

where:

$C_{ef,total}$:   Total energy consumption at consumption point, kWh/m²·year.

f_{cep}:   Conversion factor for final energy to primary energy obtained from non-renewable sources.

$C_{ep,nr}$:   Total non-renewable primary energy consumption, kWh/m²·year.