Technical Environmental System

Group:

Jui Halvadia

Marwa Ichibane

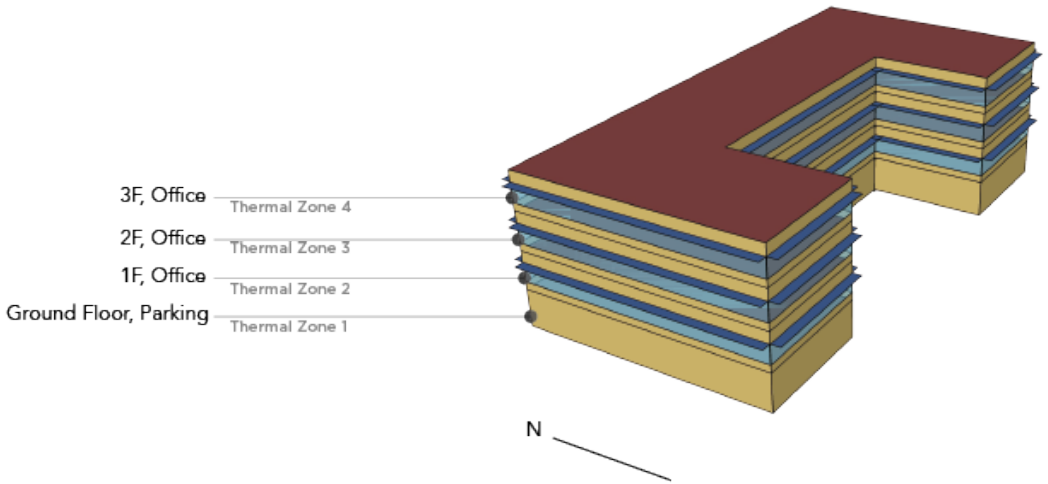
Salwa Abdalla Alhejazi

I-Chen Hung

Politecnico di Milano | Piacenza
Professor | Behzad Najafi
Dec | 2019

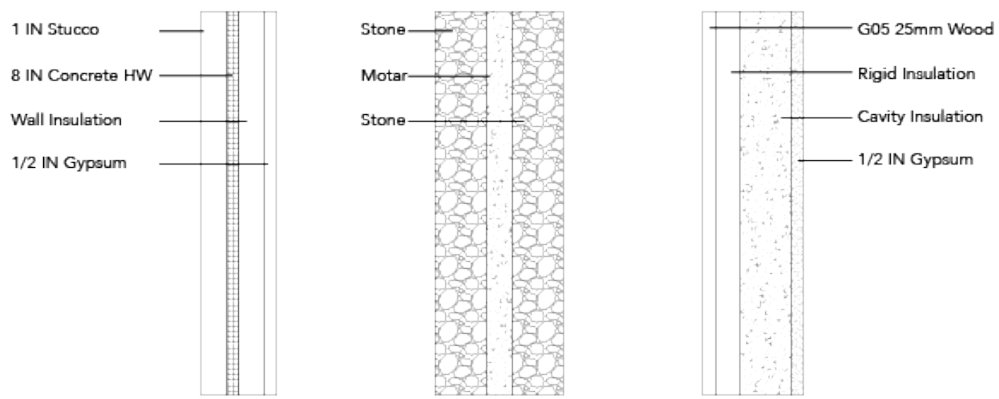
Location and Information

Building Characteristic



Building Area

	Area(m2)
Total Building Area	2496.62
Net Conditioned Building Area	2496.62
Unconditioned Building Area	0.00



Walls

Wall 1

	Roughness	Thickness (m)	Conductivity W/m K	Density kg/m3	Specipic Heat J/kg K	Thermal Absorptance	Solar Absorptance	Visible Absorptance
1IN Stucco	Smooth	0.025300	0.691	1858	837	0.9	0.92	0.92
8IN Concrete HW	Medium Rough	0.203300	1.7296	2243	837	0.9	0.65	0.65
Wall Insulation (31)	Medium Rough	0.033700	0.0432	91	837	0.9	0.5	0.5
1/2IN Gypsum	Smooth	0.012700	0.16	784.9	830	0.9	0.4	0.4

Wall 2

	Roughness	Thickness (m)	Conductivity W/m K	Density kg/m3	Specipic Heat J/kg K	Thermal Absorptance	Solar Absorptance	Visible Absorptance
Stone	Rough	0.101600	2	2100	1000	0.9	0.85	0.85
Motar 1	Medium Rough	0.012700	0.16	1648	830	0.9	0.4	0.4
Stone	Rough	0.101600	2	2100	1000	0.9	0.85	0.85

Wall 3

	Roughness	Thickness (m)	Conductivity W/m K	Density kg/m3	Specipic Heat J/kg K	Thermal Absorptance	Solar Absorptance	Visible Absorptance
G05 25mm Wood	Medium Smooth	0.025400	0.15	608	1630	0.9	0.5	0.5
Rigid Insulation	Medium Rough	0.025400	2	100	1630	0.9	0.5	0.5
Cavity Insulation	Medium Smooth	0.033700	0.043	40	1300	0.9	0.5	0.5
1/2IN Gypsum	Smooth	0.012700	0.16	784.9	830	0.9	0.4	0.4

Walls- U value

Wall-1

R-stucco= 0.037 m2 °C/ W
R-concrete= 0.12 m2 °C/ W
R-wall-insulation= 0.16 m2 °C/ W (Air Space)
R-gypsum= 0.077 m2 °C/ W

R-total
= R-stucco + R-concrete
+ R-wall-insulation + R-gypsum

= 0.037 + 0.12 + 0.16 + 0.079

= 0.396 m2 °C/ W

U-total

= 1 / R-total

= 1/0.396

= 2.52 W/ m2 °C

Wall-2

R-stone= 0.13 m2 °C/ W
R-motar= 0.018 m2 °C/ W
R-stone= 0.13 m2 °C/ W

R-total
= R-stone + R-motar + R-stone

= 0.13 + 0.018 + 0.13

= 0.278 m2 °C/ W

U-total

= 1 / R-total

= 1/0.278

= 3.59 W/ m2 °C

Wall-3

R-wood= 0.22 m2 °C/ W
R-rigid-insulation= 0.98 m2 °C/ W
R-cavity-insulation= 0.16 m2 °C/ W
R-gypsum= 0.079m2 °C/ W

R-total
= R-wood + R-rigid-insulation
+ R-cavity-insulation + R-gypsum

= 0.22 + 0.98 + 0.16 + 0.079

= 1.439 m2 °C/ W

U-total

= 1 / R-total

= 1/1.439

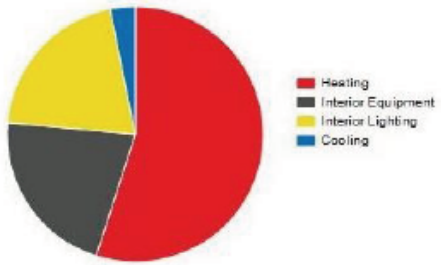
= 0.7 W/ m2 °C

Eaxmple Wall- Wall 1

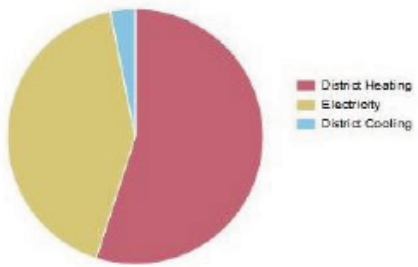
Wall 1- Copenhagen

Annual Overview

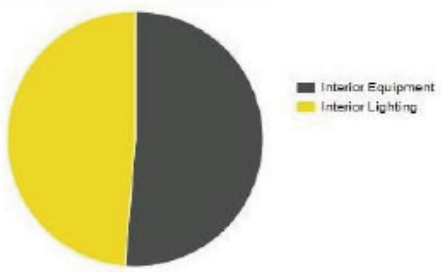
End Use - view table



Energy Use - view table



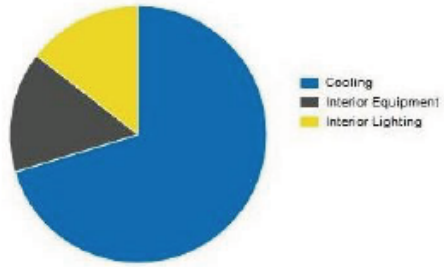
EUI - Electricity - view table



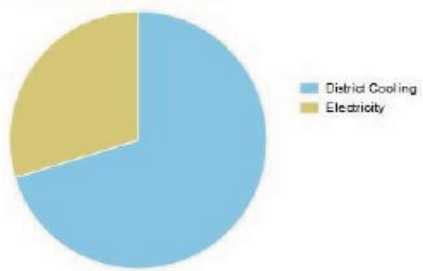
Wall 1- Mumbai

Annual Overview

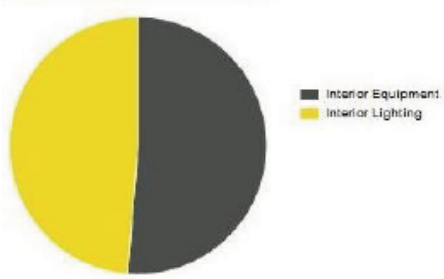
End Use - view table



Energy Use - view table



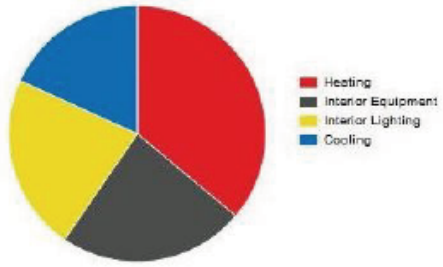
EUI - Electricity - view table



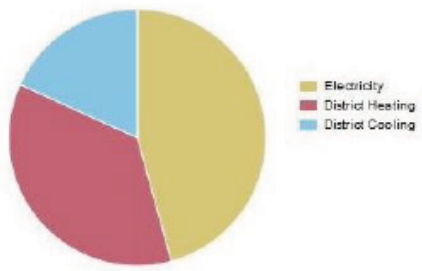
Wall 1- Piacenza

Annual Overview

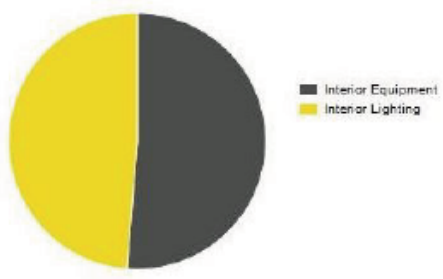
End Use - view table



Energy Use - view table



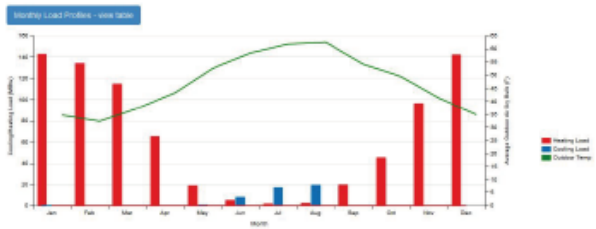
EUI - Electricity - view table



Eaxmple Wall- Wall 1

Wall 1- Copenhagen

HVAC Load Profiles

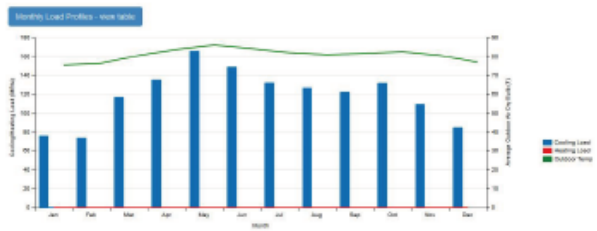


End Uses

	Electricity [W]	Natural Gas [W]	Propane [W]	District Cooling [W]	District Heating [W]	Water [m3/s]
Time of Peak	02-JAN-08:09	-	-	03-AUG-14:50	11-DEC-06:10	-
Heating	0.00	0.00	0.00	0.00	251679.75	0.00
Cooling	0.00	0.00	0.00	62507.32	0.00	0.00
Interior Lighting	23944.16	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	17172.07	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	41116.23	0.00	0.00	62507.32	251679.75	0.00

Wall 1- Mumbai

HVAC Load Profiles

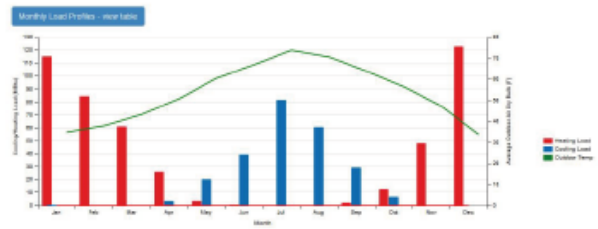


End Uses

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	0.00	0.00
Cooling	0.00	0.00	0.00	1499.83	0.00	0.00
Interior Lighting	308.90	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	325.35	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	634.25	0.00	0.00	1499.83	0.00	0.00

Wall 1- Piacenza

HVAC Load Profiles



End Uses

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	500.42	0.00
Cooling	0.00	0.00	0.00	252.39	0.00	0.00
Interior Lighting	308.90	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	325.35	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	634.25	0.00	0.00	252.39	500.42	0.00

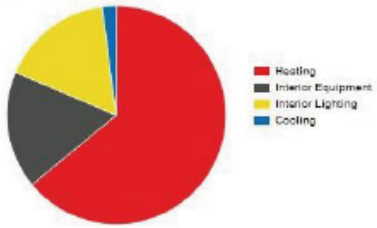
Note: District heat appears to be the principal heating source based on energy usage.

Example City- Copenhagen

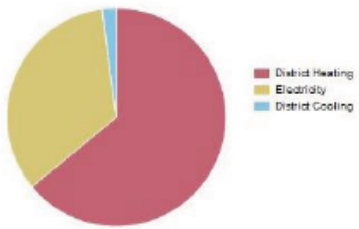
Wall 2- Copenhagen

Annual Overview

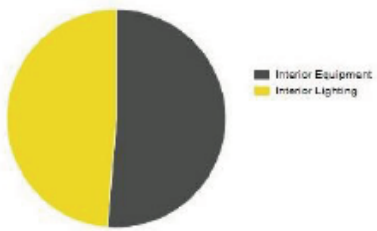
End Use - view table



Energy Use - view table

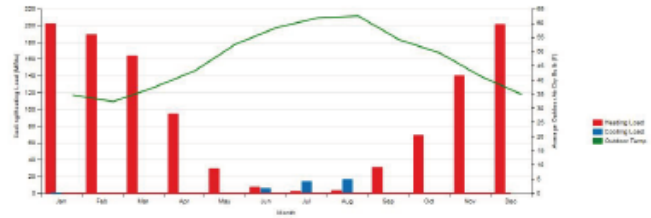


EUI - Electricity - view table

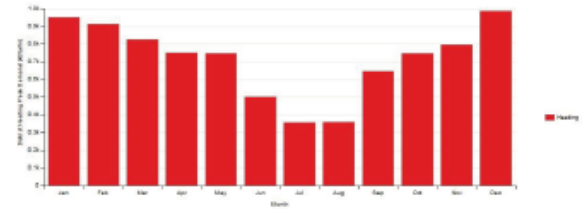


HVAC Load Profiles

Monthly Load Profiles - view table

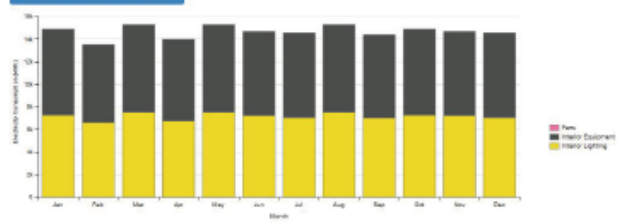


District Heating Peak Demand (kBtu/hr) - view table

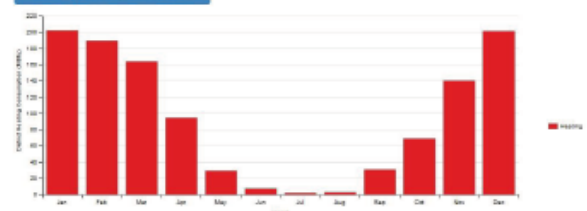


Monthly Overview

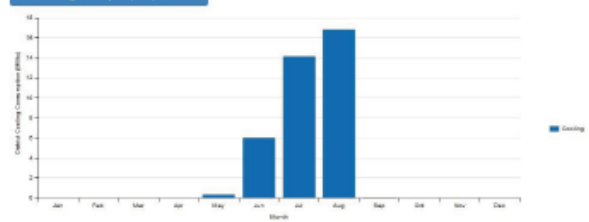
Electricity Consumption (kWh) - view table



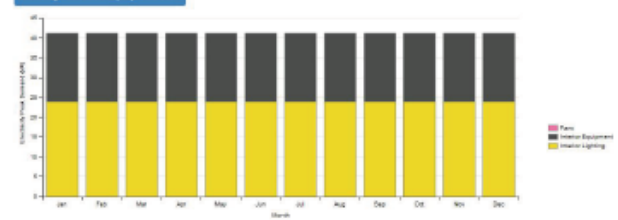
District Heating Consumption (kBtu) - view table



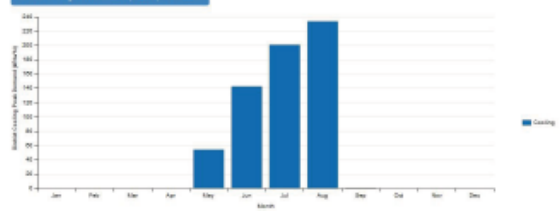
District Cooling Consumption (kBtu) - view table



Electricity Peak Demand (kW) - view table

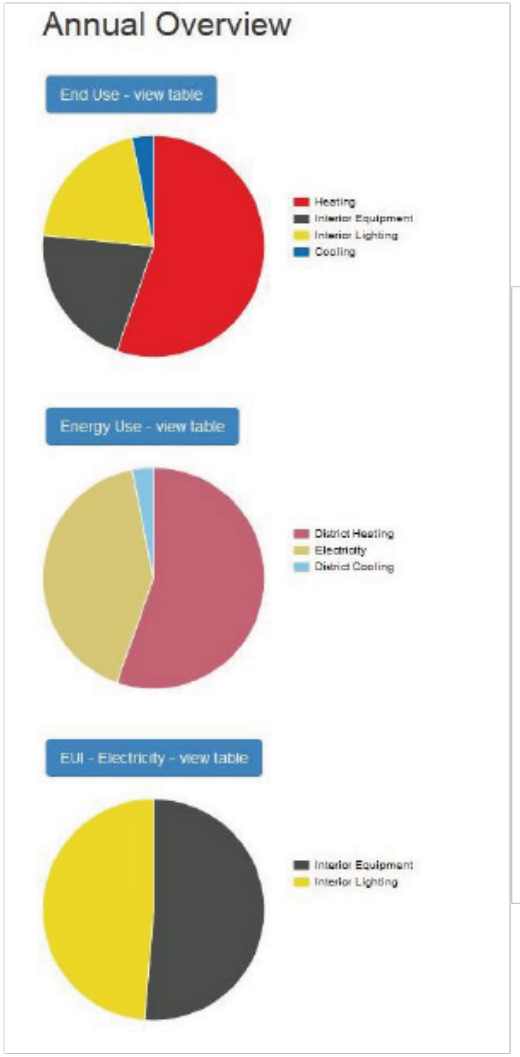


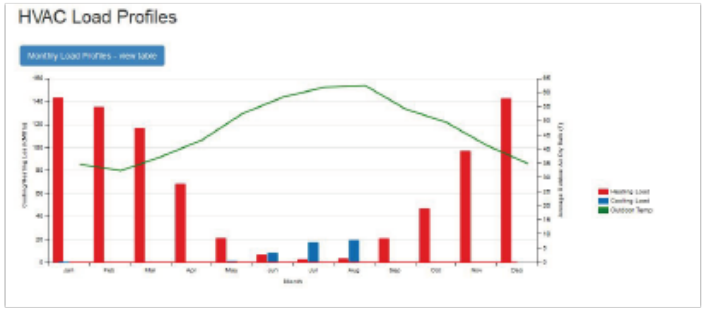
District Cooling Peak Demand (kBtu/hr) - view table

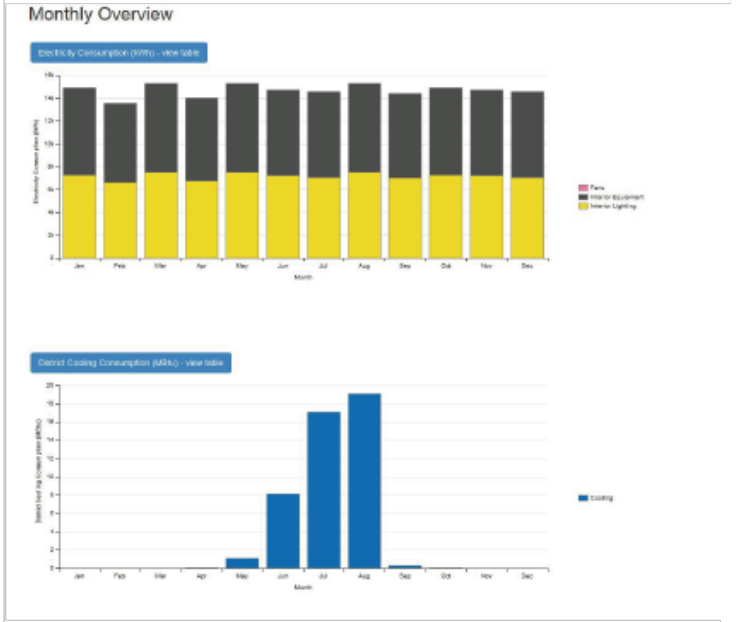


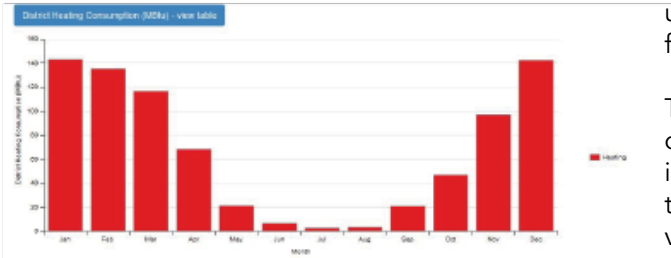
Example City- Copenhagen

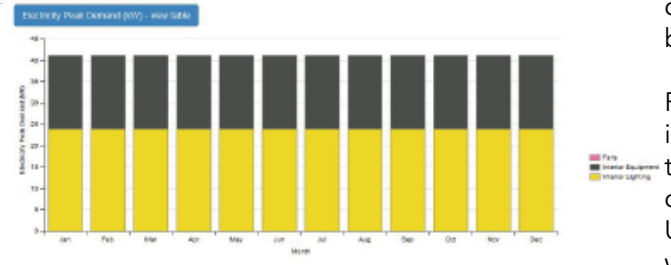
Wall 3- Copenhagen

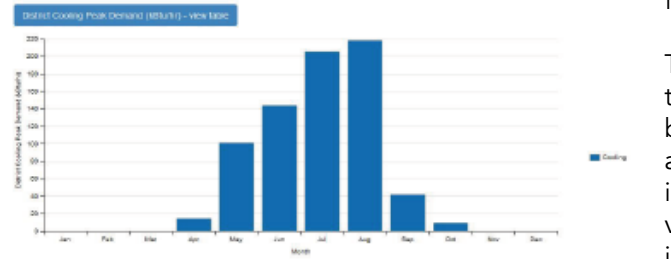












Conclusion

The consumption of energy is varying by using different materials for exterior wall.

Thermal storage capacity of any particular material is depending on the thermal admittance (Y) value, so the higher the thermal admittance, the higher thermal storage capacity of a material will be.

Furthermore, U-factor is inversely propositional to the R-value of a construction material. U=1/R, according to which the more the R-value, the less the U-factor will be.

The higher the U-factor, the more effective building material will be at transferring heat from inside to outside (vice-versa).Therefore, Wall 3 in our base case study will be a good example for exterior wall design in the colder region like Copenhagen.