BUILDING ANALYSIS

TECHNICAL ENVIRONMENTAL SYSTEM

Project submitted by

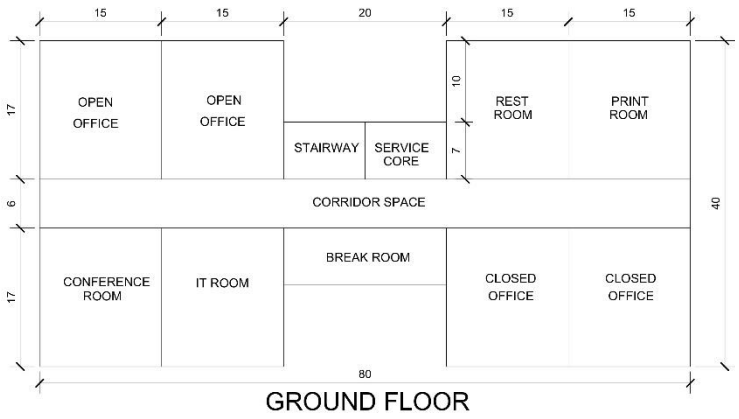
Shpat Ademaj [914120]

Nisha Elizabeth Bedford [914004]

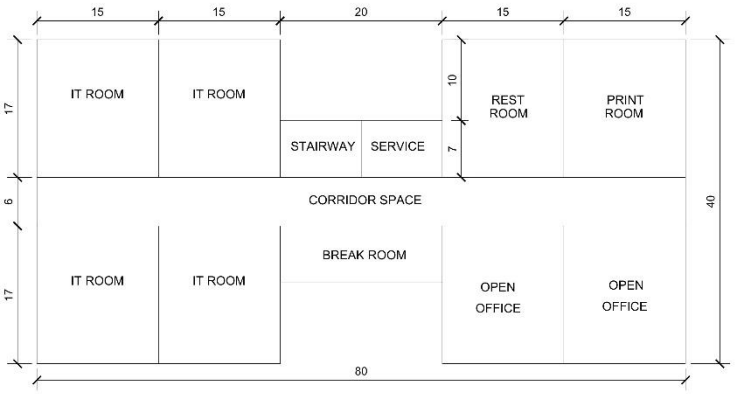
POLITECNICO
MILANO 1863

BUILDING ANALYSIS INTRODUCTION

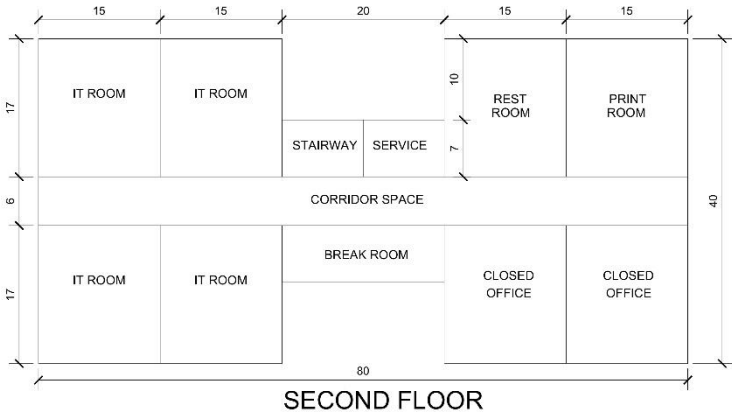
This report focuses on the Building Analysis by calculating the energy performance of a selected built form using 'Open Studio' software. The building chosen is an Office building with a set of rooms like Open Office Rooms, Restrooms, Corridor and staircase, breakrooms etc. The office building has glass windows all along the 4 facades. The 3 sides of the building have an overhang as a shading device. All the floor plans of the Office building as shown below. The total built up area of the building is 8580 Sq.m



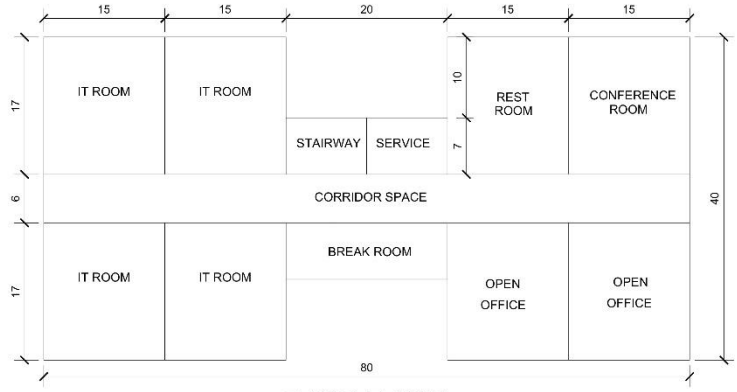
GROUND FLOOR



FIRST FLOOR



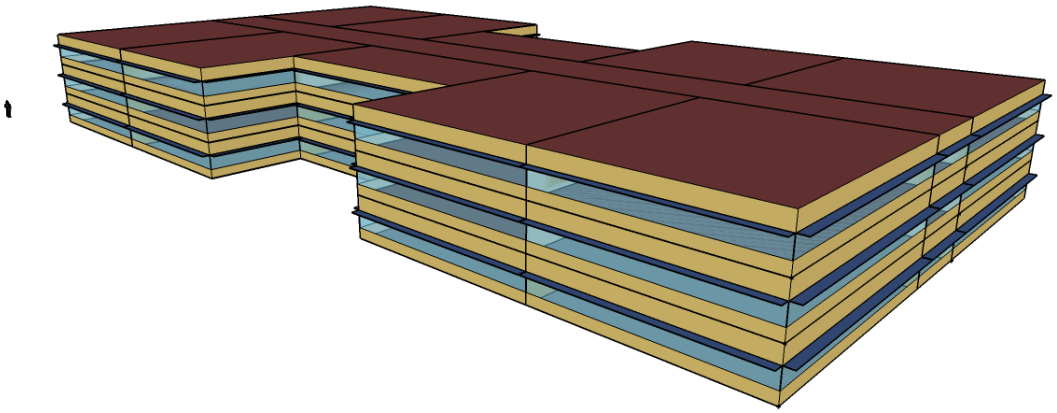
SECOND FLOOR



THIRD FLOOR

This building has been placed in 3 different cities of the world – Milan, Italy; Ankara, Turkey; and Chennai, India. This model is then analysed using the software to calculate different parameters such as Cooling and Heating Loads, Energy Use and Site and source Energy.

Once the recalculations of the Energy performance were done, it was compared to the parameters that were Cooling and Heating Loads, Energy Use and Site and Source Energy. The results were examined, and conclusion was made.



CLIMATIC ZONES ANALYSIS

MILAN, Italy:

Milan has a humid subtropical climate. Winter (December to February) is cold, wet and gray. Temperatures often remain around freezing (0 °C) also in the daytime. There is a moderate amount of rainy days, even though the winter is relatively dry when compared with the other seasons. Snow usually falls at least once every year and the temperature rarely drops below -10 °C. Typically, from the second half of February, the temperature tends to increase, and highs exceed quite often 10 °C. Spring in Milan is initially unstable, and gradually becomes a pleasant season, especially from mid-April to late May, when there are many sunny days, with mild or pleasantly warm temperatures during the day. Summer, from June to August, is hot

and muggy, and generally sunny. Autumn offers several nice days in September, and sometimes in early October, then quickly becomes cloudy and rainy. The first cold days typically occur in November. Overall, autumn is the rainiest season of the year. Although the number of rainy days is not too high, when it rains, the rain tends to last several hours, even the whole day.

ANKARA, Turkey:

Ankara has a hot-summer Mediterranean climate which closely borders a hot summer Mediterranean continental climate. Under the Trewartha climate classification, Ankara has a middle latitude steppe climate (*BSk*). Due to its elevation and inland location, Ankara has cold, somewhat snowy winters and hot, dry summers. Rainfall occurs mostly during the spring and autumn. Ankara lies in USDA Hardiness zone 7b, and its annual average precipitation is fairly low at 400 millimeters (16 in), nevertheless precipitation can be observed throughout the year. Monthly mean temperatures range from 0.3 °C (32.5 °F) in January to 23.5 °C (74.3 °F) in July, with an annual mean of 12.02 °C (53.6 °F).

CHENNAI, India:

Chennai has a tropical wet and dry climate. The city lies on the thermal equator and is also on the coast, which prevents extreme variation in seasonal temperature. The hottest part of the year is late May to early June, with maximum temperatures around 35–40 °C (95–104 °F). The coolest part of the year is January, with minimum temperatures around 19–25 °C (66–77 °F). The lowest recorded temperature was 13.9 °C (57.0 °F) on 11 December 1895 and 29 January 1905. The highest recorded temperature was 45 °C (113 °F) on 31 May 2003. The average annual rainfall is about 140 cm (55 in).

The city gets most of its seasonal rainfall from the north–east monsoon winds, from mid–October to mid–December. Cyclones in the Bay of Bengal sometimes hit the city. The highest annual rainfall recorded is 257 cm (101 in) in 2005. Prevailing winds in Chennai are usually south-westerly between April and October and north-easterly during the rest of the year. Historically, Chennai has relied on the annual rains of the monsoon season to replenish water reservoirs, as no major rivers flow through the area. Chennai has a water table at 2 metres for 60 percent of the year.

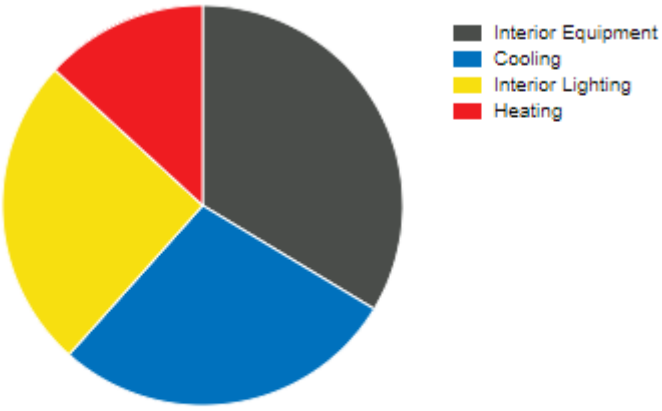
BUILDING SUMMARY:

The Office Building is a 3-storey building comprising of office spaces and conference spaces. Percentages of the walls are covered in windows and the windows are shaded by overhangs on the sides of the buildings.
Using Open Studio and Energy plus, the location on of the project, construction materials, opening ratio, thermal zones and space attributes are set to enable us to run a simulation and evaluate the energy performance of the building.

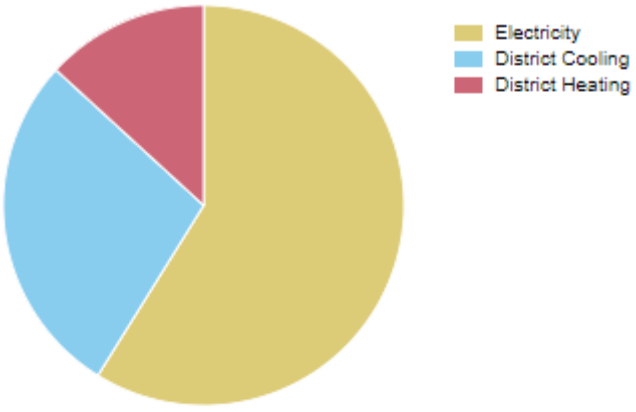
The images below depict the project in terms of the various attributes set.

Office Building, Milan:

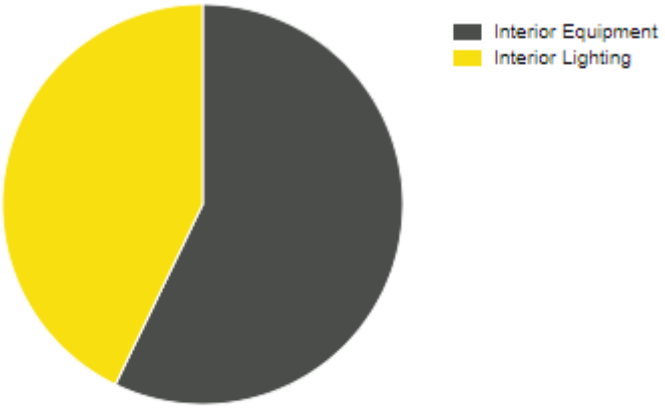
Data	Value
Building Name	Building 1
Total Site Energy	3,541,016 kBtu
Total Building Area	92,354 ft^2
Total Site EUI	38.34 kBtu/ft^2



Energy Use - view table

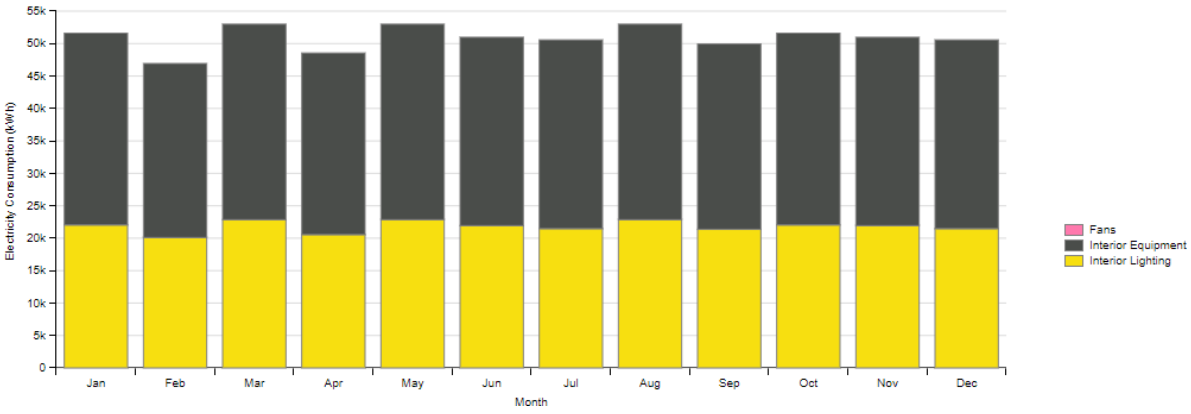


EUI - Electricity - view table

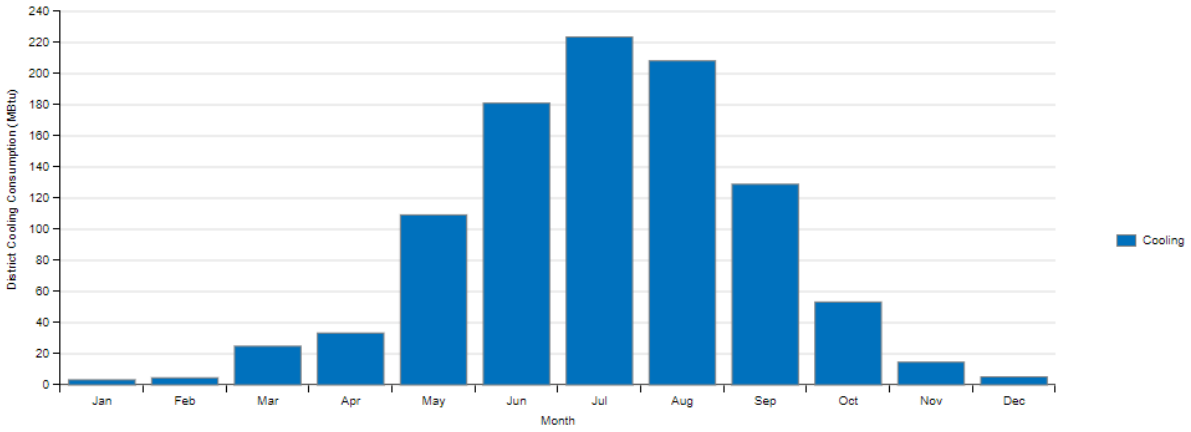


EUI - Gas - view table

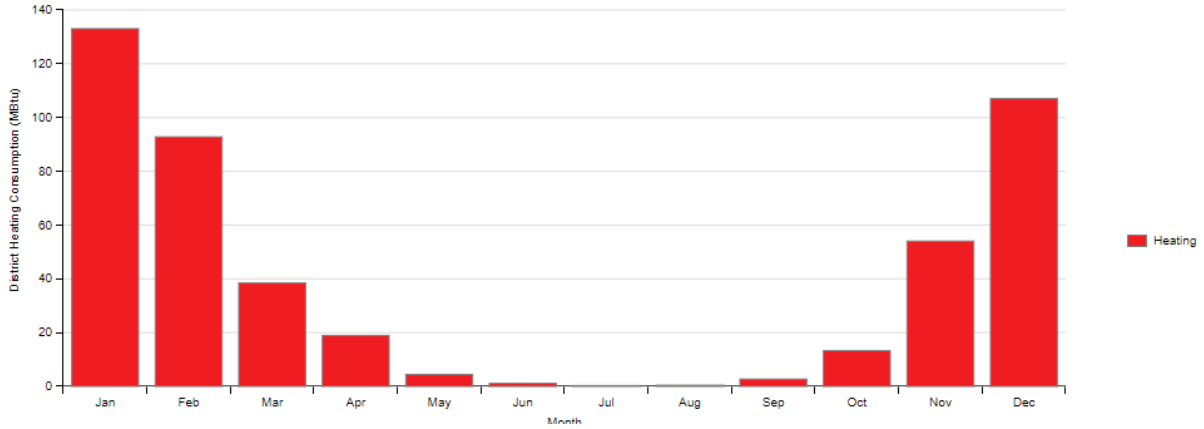
Electricity Consumption (kWh) - view table



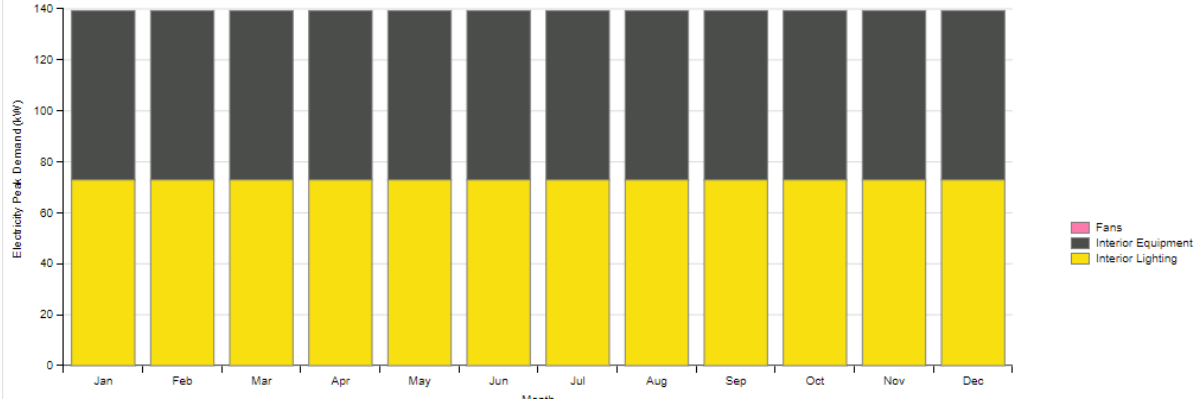
District Cooling Consumption (MBtu) - view table



District Heating Consumption (MBtu) - view table



Electricity Peak Demand (kW) - view table



Envelope Summary

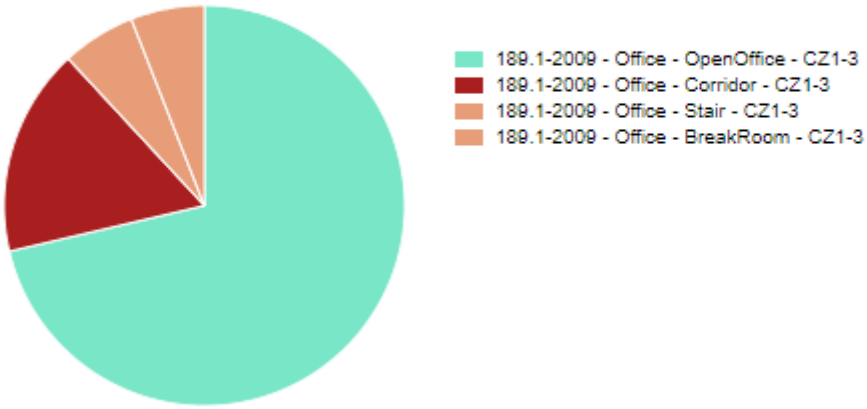
Base Surface Constructions

Construction	Net Area (ft^2)	Surface Count	R Value (ft^2*h*R/Btu)
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 2-5	30,785	11	24.73
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 3	16,181	60	8.77

Sub Surface Constructions

Construction	Net Area (ft^2)	Surface Count	U-factor (Btu/ft^2*h*R)	SHGC	VLT
ASHRAE 189.1-2009 ExtWindow ClimateZone 3	10,787	60	0.55	0.25	0.32

Space Type Breakdown - view table

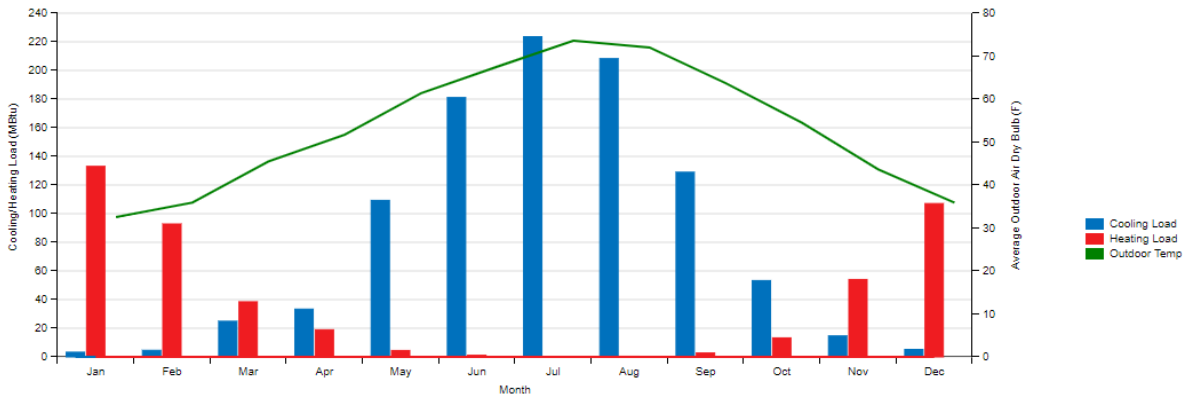


189.1-2009 - Office - BreakRoom - CZ1-3
(3 spaces and 3 thermal zones)

Definition	Value	Unit	Inst. Multiplier
189.1-2009 - Office - BreakRoom - CZ1-3 People Definition	0.0500	people/ft^2	1.0
189.1-2009 - Office - BreakRoom - CZ1-3 Electric Equipment Definition	4.4600	W/ft^2	1.0
189.1-2009 - Office - BreakRoom - CZ1-3 Lights Definition	1.0800	W/ft^2	1.0
189.1-2009 - Office - BreakRoom - CZ1-3 Infiltration	0.0595	cfm/ext surf area ft^2	
189.1-2009 - Office - BreakRoom - CZ1-3 Ventilation (outdoor air method Sum)	15.0000	cfm/person	

HVAC Load Profiles

Monthly Load Profiles - view table



Site and Source Energy

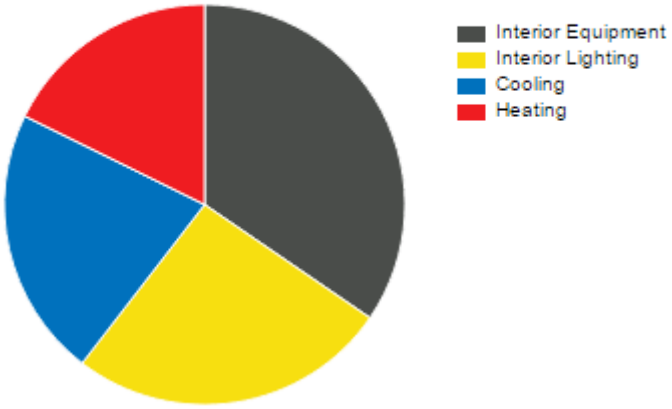
	Total Energy (kBtu)	Energy Per Total Building Area (kBtu/ft^2)	Energy Per Conditioned Building Area (kBtu/ft^2)
Total Site Energy	3541016.3	38.3	38.3
Net Site Energy	3541016.3	38.3	38.3
Total Source Energy	9331677.0	101.0	101.0
Net Source Energy	9331677.0	101.0	101.0

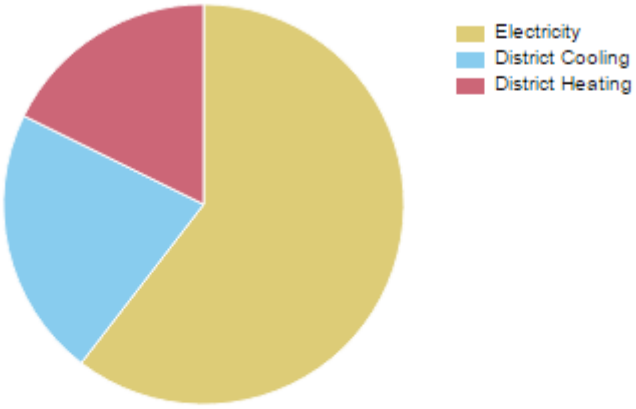
Office Building, Ankara:

Building Summary

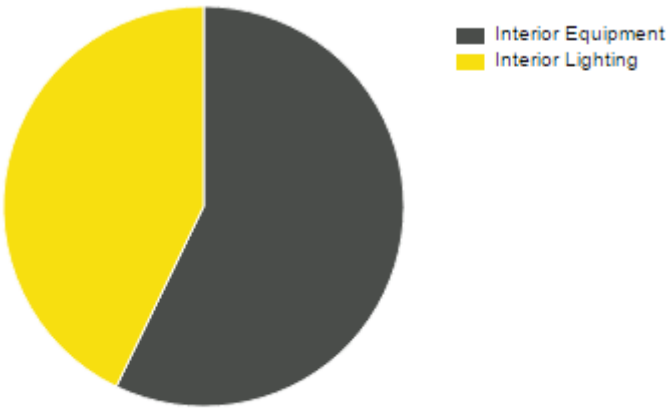
Data	Value
Building Name	Building 1
Total Site Energy	3,447,277 kBtu
Total Building Area	92,354 ft^2
Total Site EUI	37.33 kBtu/ft^2

End Use - view table



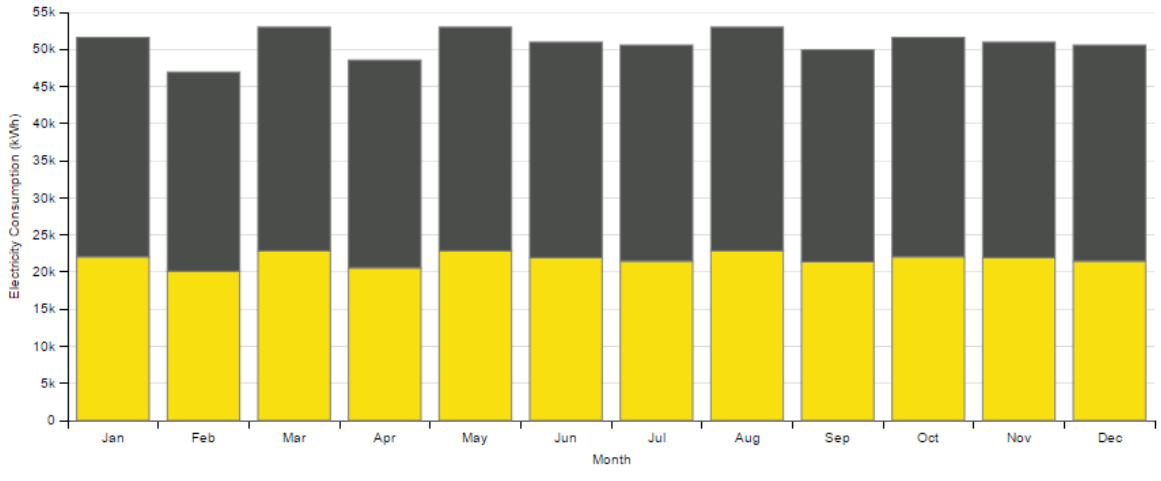


EUI - Electricity - view table

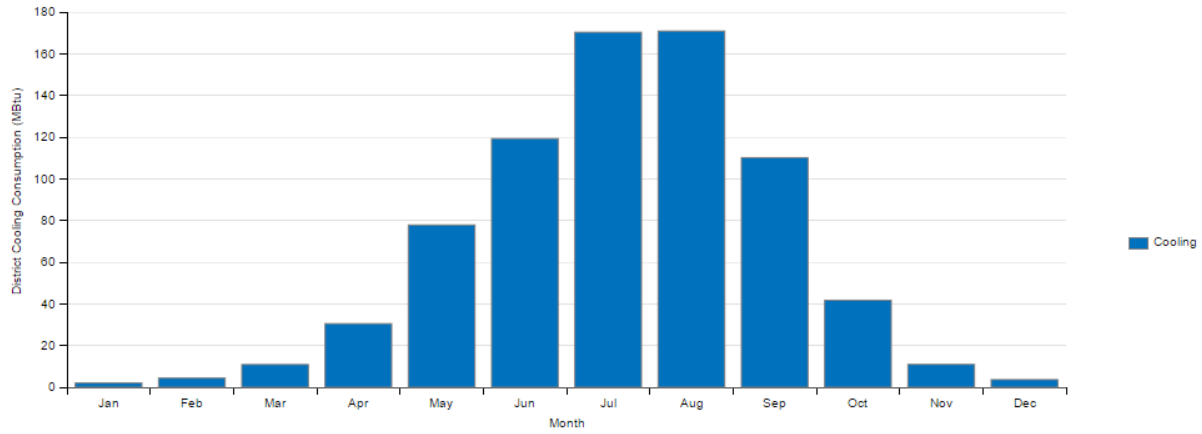


EUI - Gas - view table

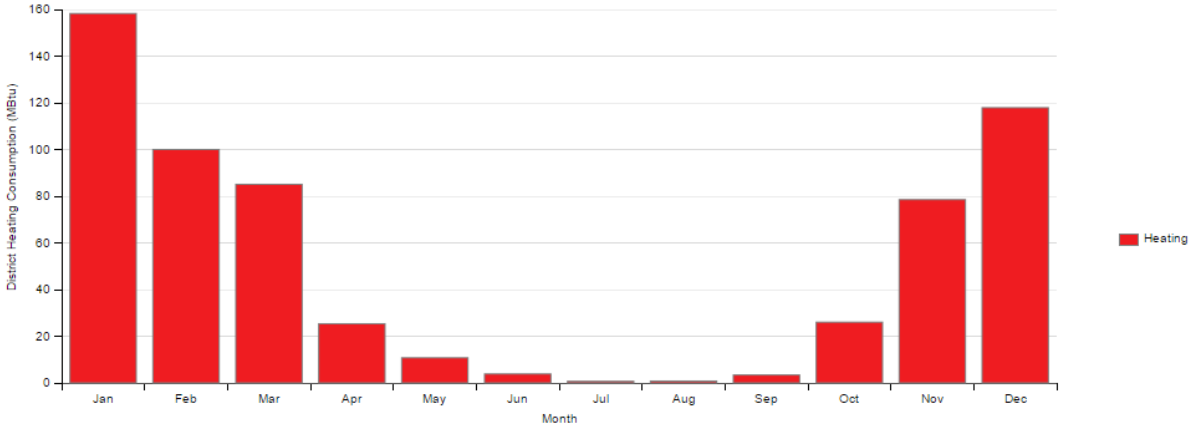
Electricity Consumption (kWh) - view table



District Cooling Consumption (MBtu) - view table



District Heating Consumption (MBtu) - view table



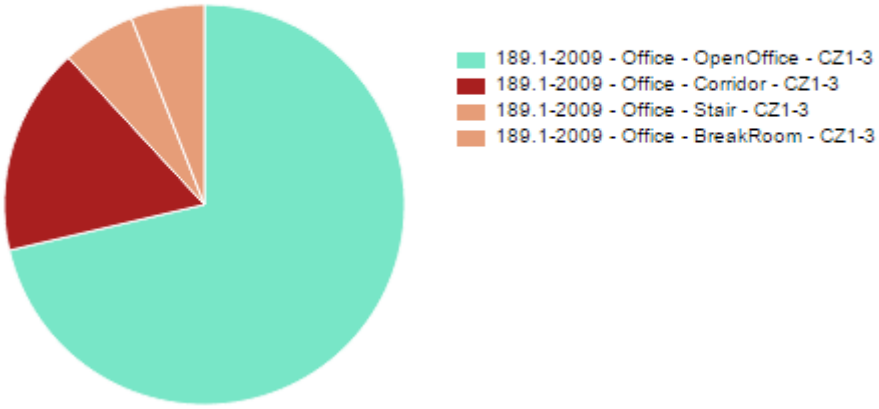
Base Surface Constructions

Construction	Net Area (ft^2)	Surface Count	R Value (ft^2*h*R/Btu)
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 2-5	30,785	11	24.73
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 3	16,181	60	8.77

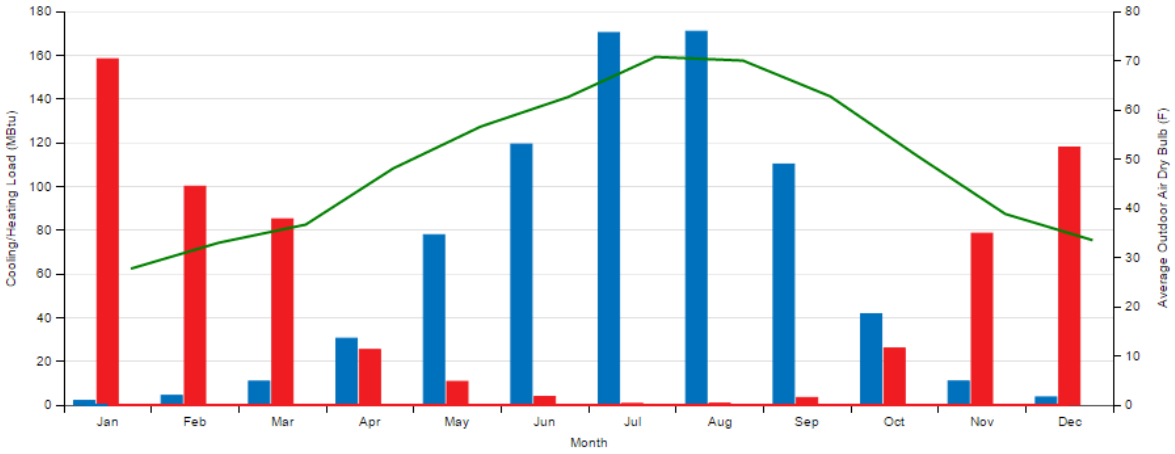
Sub Surface Constructions

Construction	Net Area (ft^2)	Surface Count	U-factor (Btu/ft^2*h*R)	SHGC	VLT
ASHRAE 189.1-2009 ExtWindow ClimateZone 3	10,787	60	0.55	0.25	0.32

Space Type Breakdown - view table



Monthly Load Profiles - view table



Office Building, Chennai:

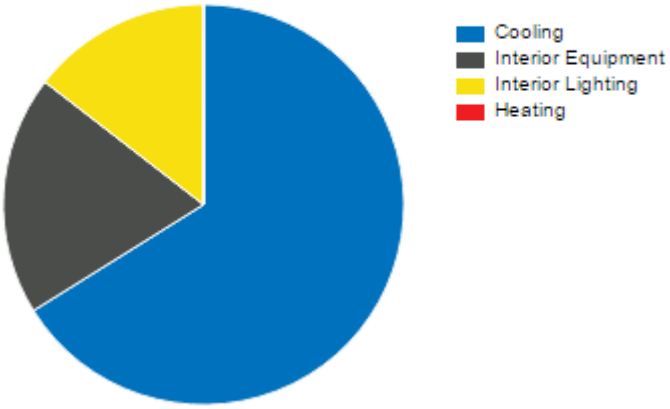
Building Summary

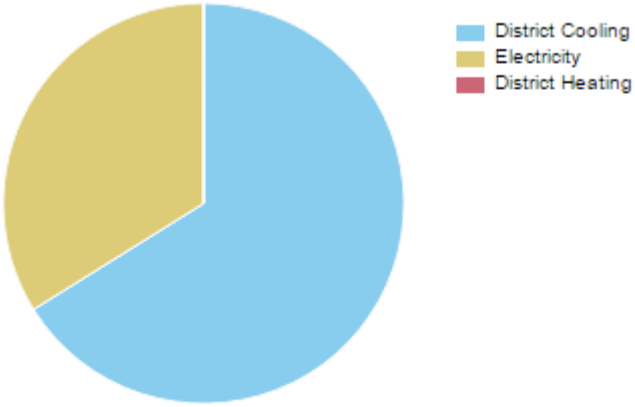
Data	Value
Building Name	Building 1
Total Site Energy	6,152,499 kBtu
Total Building Area	92,354 ft^2
Total Site EUI	66.62 kBtu/ft^2

Weather Summary

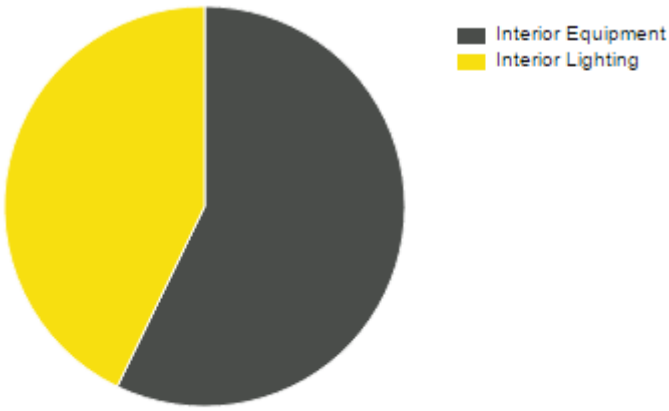
	Value
Weather File	CHENNAI - IND IWEC Data WMO#=432790
Latitude	13.00
Longitude	80.18
Elevation	52 (ft)
Time Zone	5.50

End Use - view table



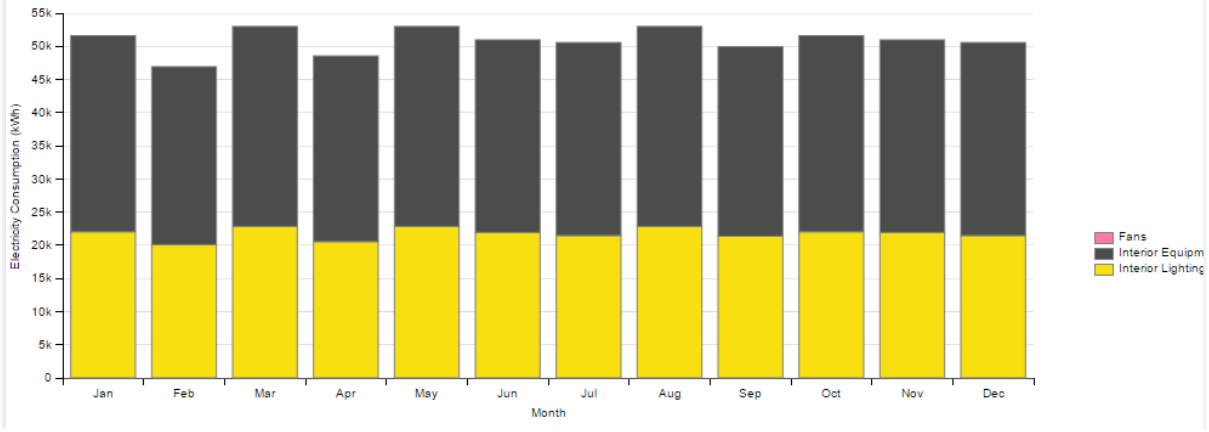


EUI - Electricity - view table

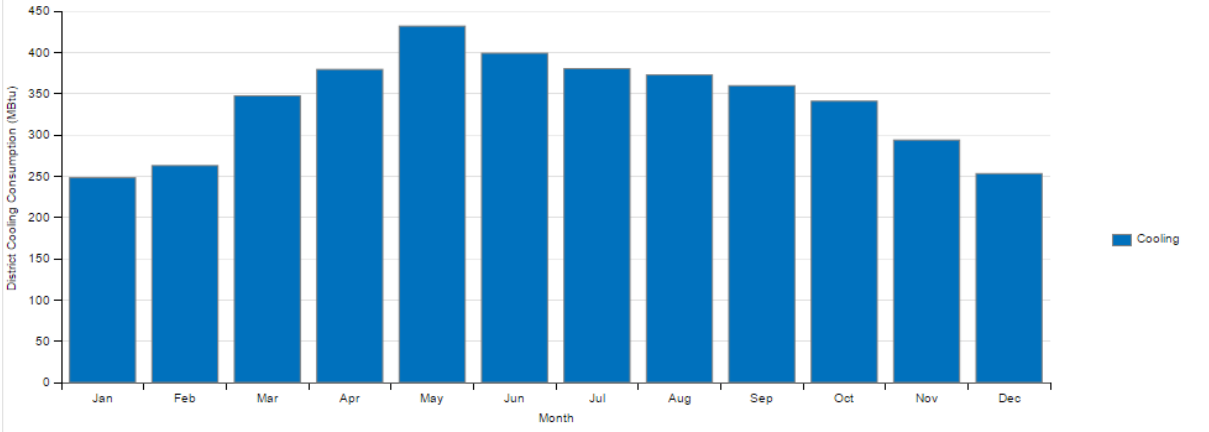


EUI - Gas - view table

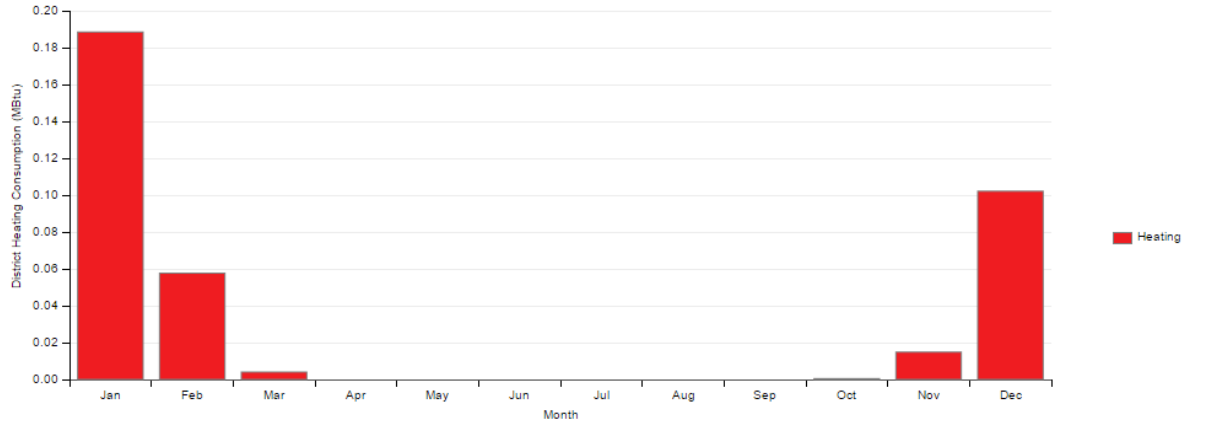
Electricity Consumption (kWh) - view table



District Cooling Consumption (MBtu) - view table



District Heating Consumption (MBtu) - view table



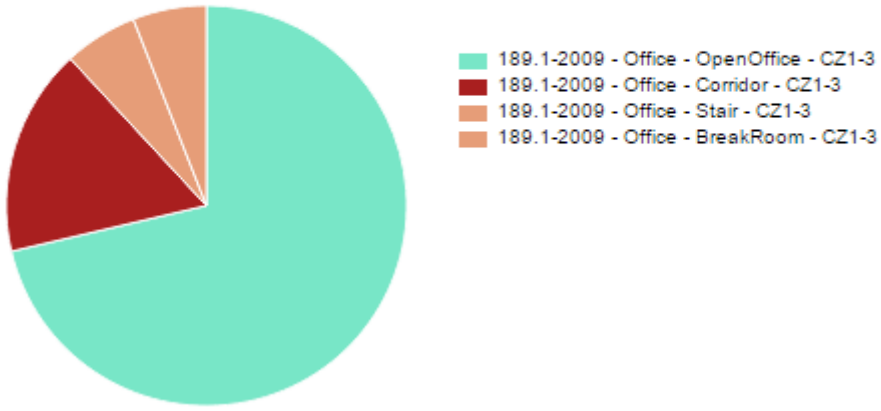
Base Surface Constructions

Construction	Net Area (ft^2)	Surface Count	R Value (ft^2*h*R/Btu)
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 2-5	30,785	11	24.73
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 3	16,181	60	8.77

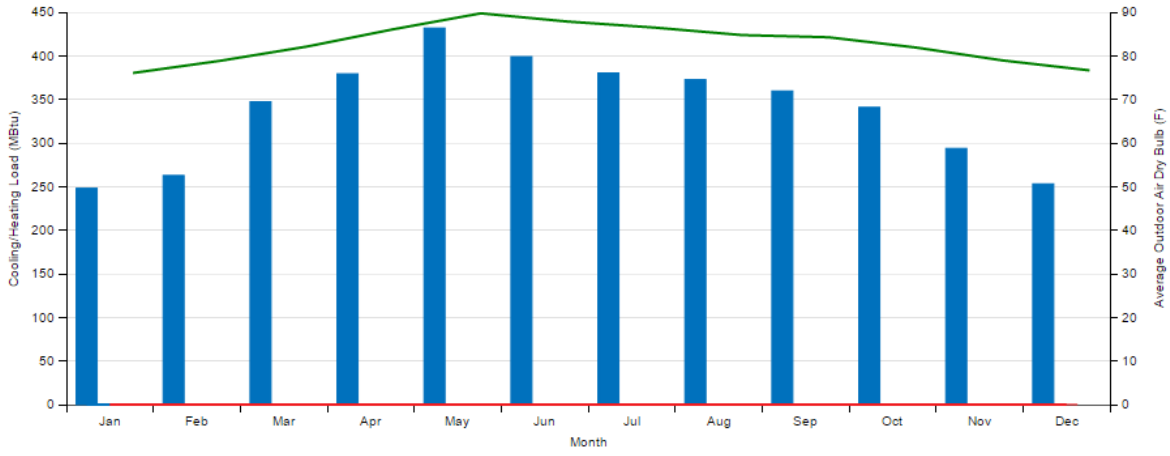
Sub Surface Constructions

Construction	Net Area (ft^2)	Surface Count	U-factor (Btu/ft^2*h*R)	SHGC	VLT
ASHRAE 189.1-2009 ExtWindow ClimateZone 3	10,787	60	0.55	0.25	0.32

Space Type Breakdown - view table



Monthly Load Profiles - view table



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