

GROUP T11

BASMA FADEL

ZAIN KOSSOUS

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TES PROJECT

DEC 17th 2019

PROF. BEHZAD NAJAFI

BUILDING GEOMETRY

OPEN OFFICE

occupancy: 10-15m² per person
~ 240-360 employees

INTERNAL HEAT GAIN

PEOPLE

| DEGREE OF ACTIVITY | TYPICAL APPLICATION |
|------------------------------|-----------------------------|
| MODERETLY ACTIVE OFFICE WORK | OFFICES, HOTELS, APARTMENTS |

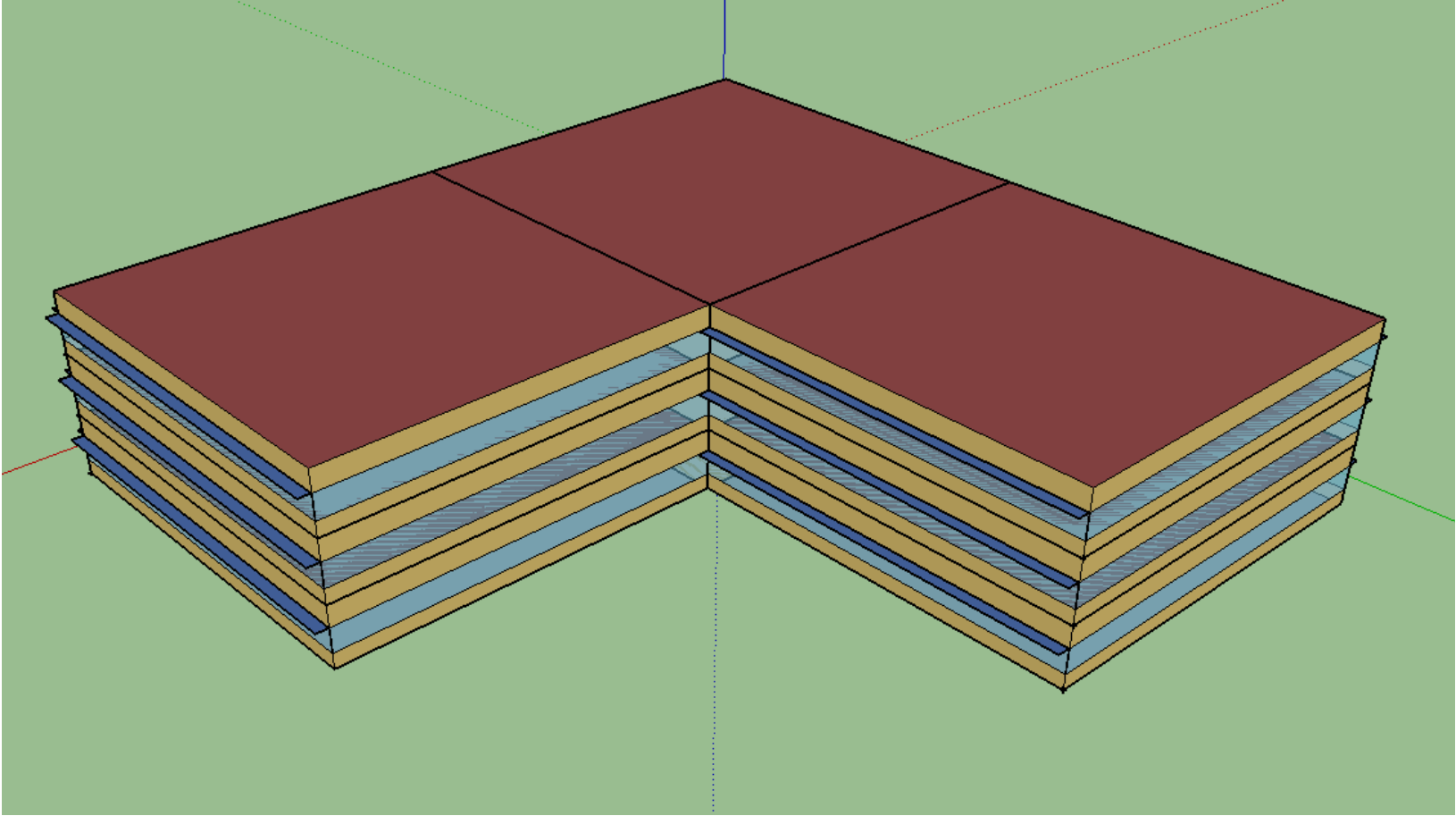
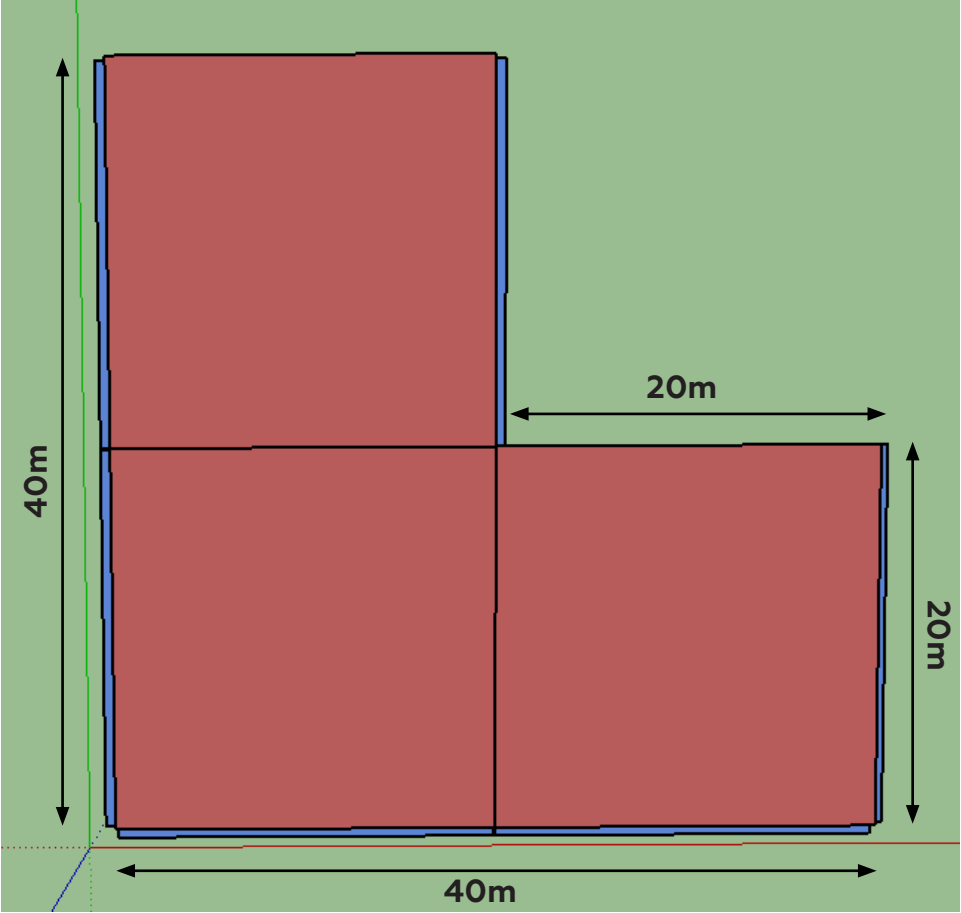
| TOTAL HEAT (W) | | |
|----------------|-------------------|-----------------|
| ADULT MALE | SENSIBLE HEAT (W) | LATENT HEAT (W) |
| 140 | 75 | 55 |

EQUIPMENT

HEAT GIVEN OFF DUE TO INEFFICIENCY FROM COMPUTERS, PRINTERS, FANS.. etc

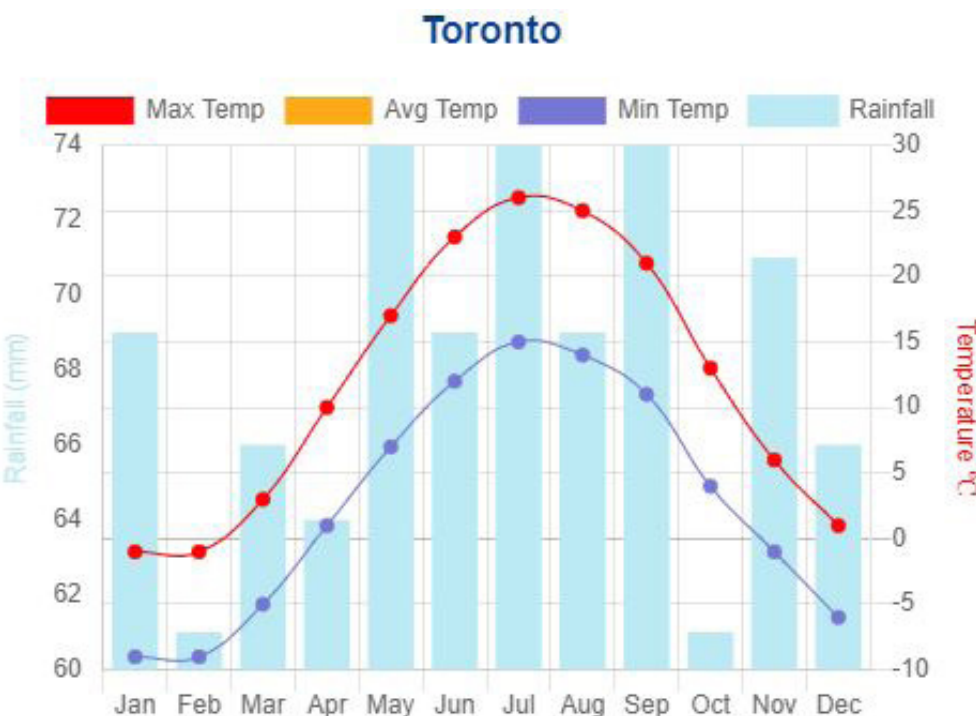
LIGHTING

RECOMMENDED LED LIGHTING



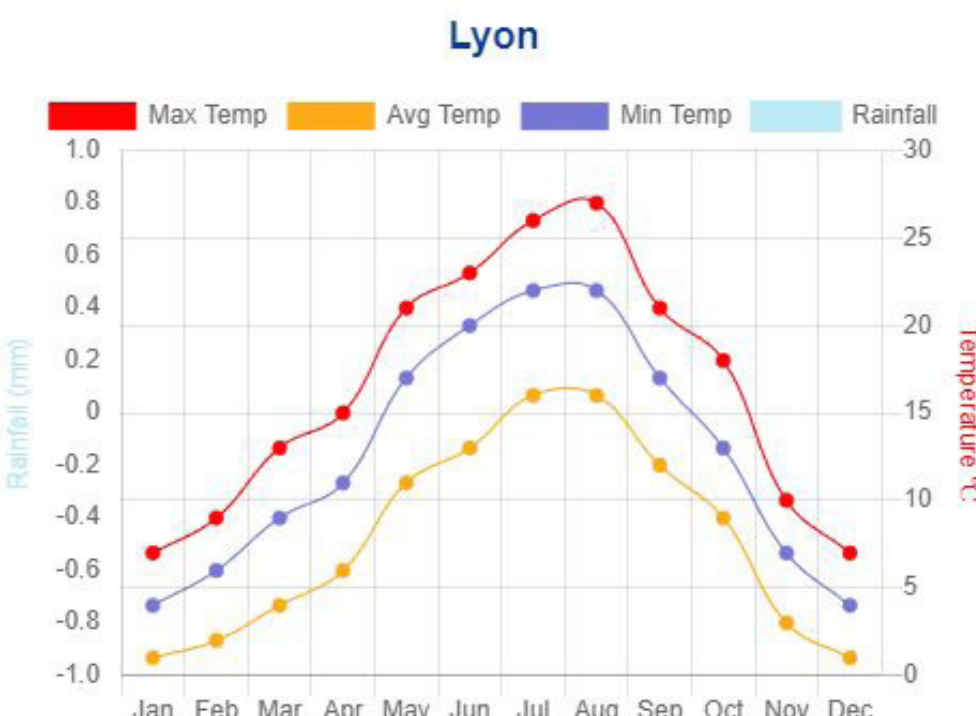
CASE STUDY CITIES

TORONTO



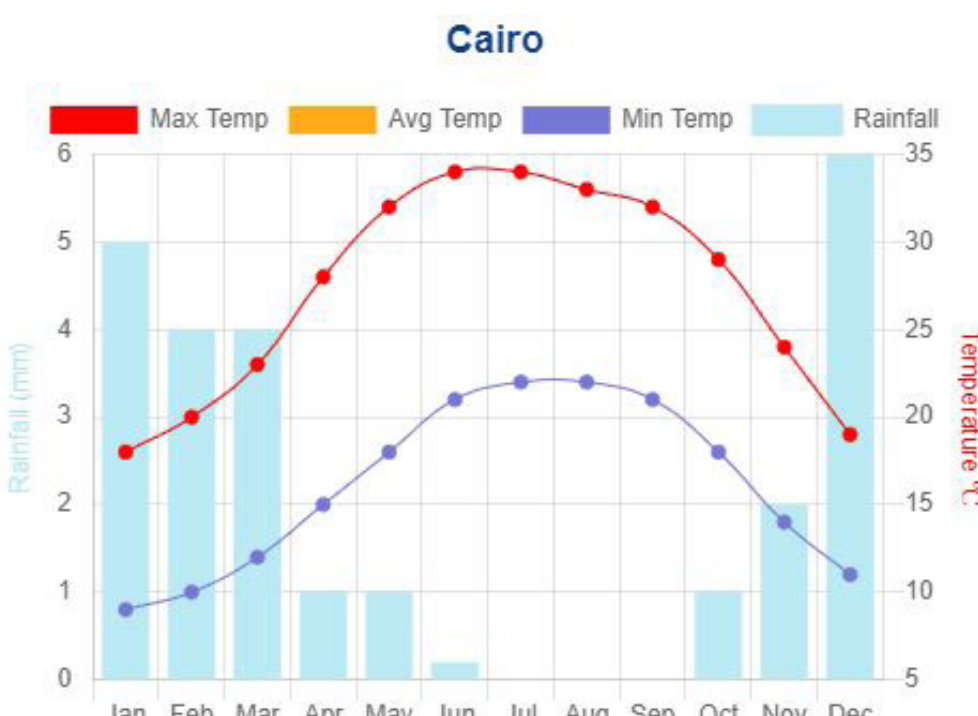
Lake Ontario takes some of the edge off Toronto's humid continental climate. Summer (June to August) tends to be hot and very humid, while winter (December to February) is severe with heavy snowfall. The average maximum temperature in January is -2°C , while the average maximum temperature in July is 27°C . Rainfall tends to occur throughout the year, but summer, though the sunniest season, is also usually the wettest.

LYON



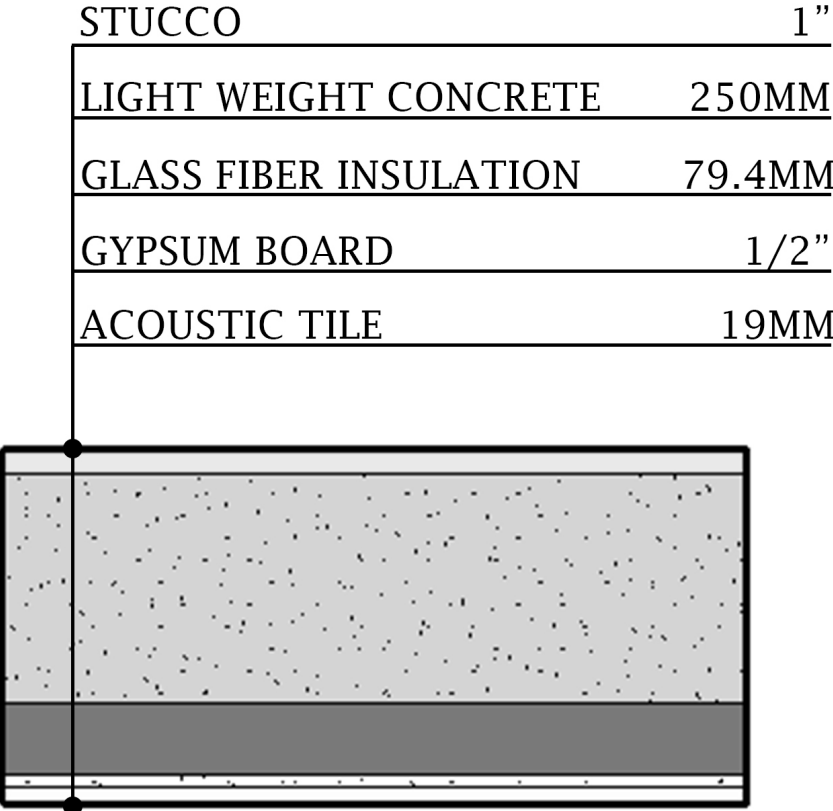
Lyon has a humid subtropical climate influenced by its position in the Rhône Valley. Winters (December to February) are cold, with average temperatures around 2°C and winds that make the temperature seem lower. Snow and freezing rain are common. Summers (June to August) are warm and sunny, with average temperatures between 14°C and 28°C , although temperatures can occasionally climb as high as 35°C . Precipitation is fairly steady throughout the year, with an average of 8-10 rainy days per month, although Lyon receives nearly 2,000 hours of sunshine per year.

CAIRO

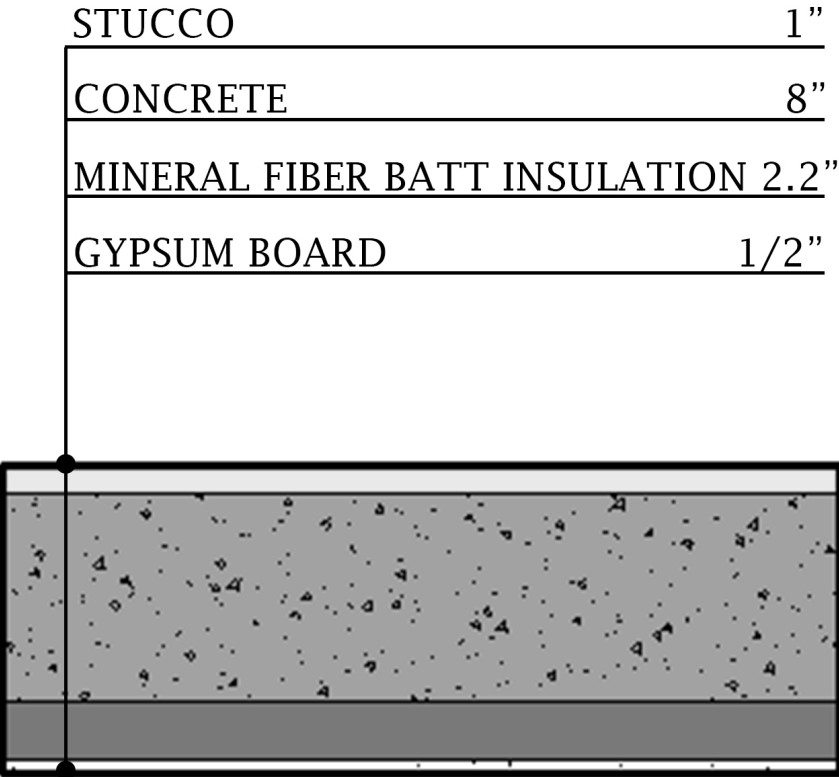


Egypt has a desert climate and the weather in Cairo is always warm, or hot, and the nights cool. There are only two seasons: a very hot summer, with average temperatures reaching 35°C between May and October, and a mild winter from November to April. Cairo is very dry, receiving on average only about a centimetre of rain a year, but it does have high humidity levels in summer due to its location by the Nile River.

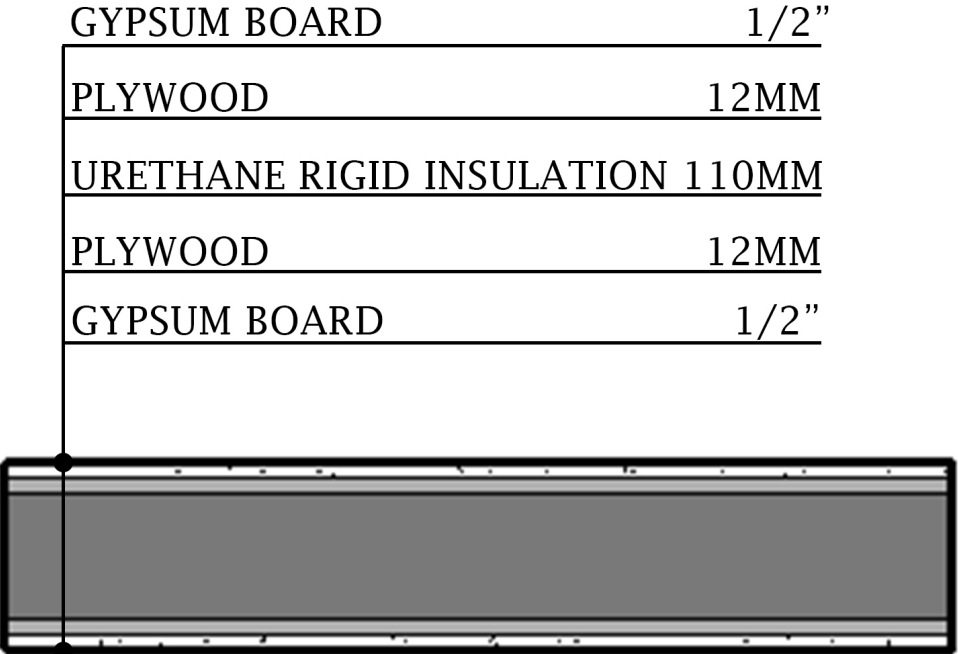
WALL TYPES



WALL 1



WALL 2



WALL 3

EXTERNAL WALL U-VALUES
R-VALUE THE UNIT THERMAL RESISTENCE OF A WALL

WALL 1

| MATERIAL (OUTSIDE) | R- VALUE (m2·C/W) |
|----------------------------------------|------------------------------------|
| STUCCO 1 INCH | 0.037 |
| LIGHTWEIGHT CONCRETE 250mm | 1.463 |
| GLASS FIBER INSULATION 79.4mm | 2.189 |
| GYPSUM 0.5 inch | 0.079 |
| ACCOUSTIC TILE 19mm (INSIDE) | 0.32 |

U=1/R
R=0.037+1.463+2.189+0.079+0.32
R=4.088
U=1/4.088=0.2446

WALL 2

| MATERIAL (OUTSIDE) | R- VALUE (m2·K/W) |
|-----------------------------------------------|------------------------------------|
| STUCCO 1 INCH | 0.037 |
| CONCRETE 8 INCH | 0.12 |
| MINERAL FIBER BATT WALL INSULATION 56.66mm | 1.472 |
| GYPSUM 0.5 inch (INSIDE) | 0.079 |

U=1/R
R=0.037+0.12+1.472+0.079
R=1.708
U=1/1.848=0.585

WALL 3

| MATERIAL (OUTSIDE) | R- VALUE (m2·K/W) |
|-----------------------------------------|------------------------------------|
| GYPSUM 0.5INCH | 0.079 |
| PLYWOOD 12mm | 0.1038 |
| URETHANE RIGID WALL INSULATION 110mm | 4.243 |
| PLYWOOD 12mm | 0.1038 |
| GYPSUM 0.5 inch (INSIDE) | 0.079 |

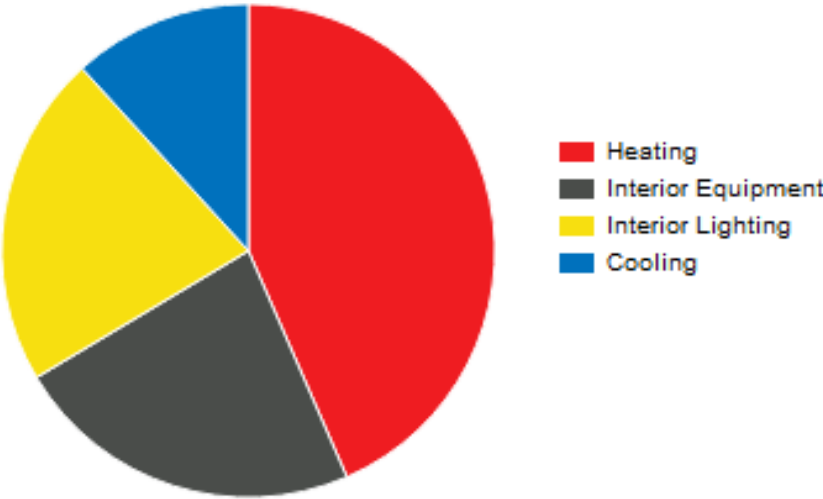
U=1/R
R=0.079+0.1038+4.243+ 0.1038+0.079
R=4.609
U=0.217

THEREFORE, WE CONCLUDE THAT WALL 3 IS THE BEST IN TERMS OF THERMAL RESISTENCE DUE TO HAVING THE LOWEST U-VALUE.

ANNUAL OVERVIEW

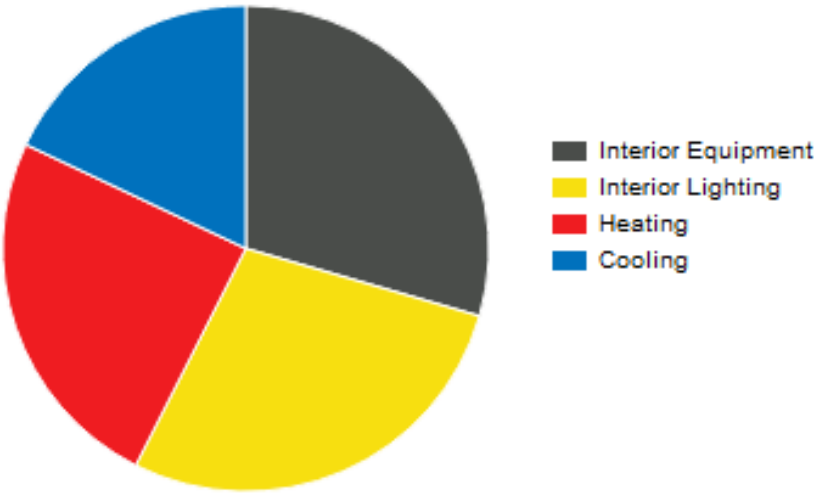
TORONTO

ANNUAL HEATING 841,145kBTu
ANNUAL COOLING 227,855kBTu



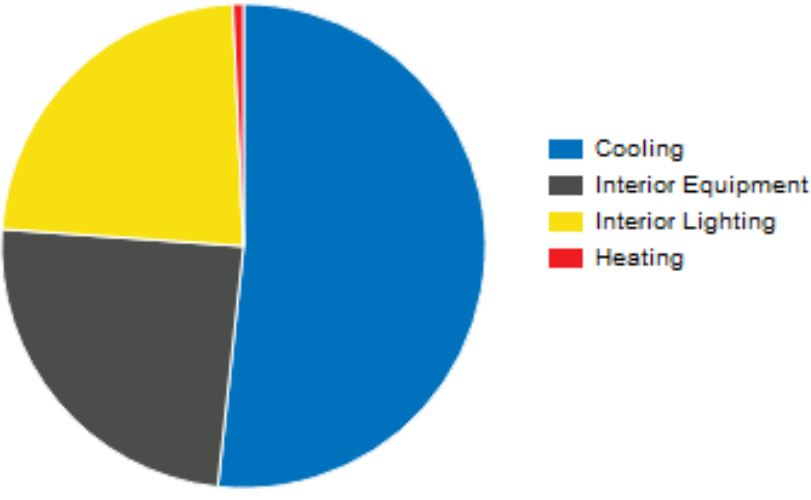
LYON

ANNUAL HEATING 370,369kBTu
ANNUAL COOLING 271,038kBTu



CAIRO

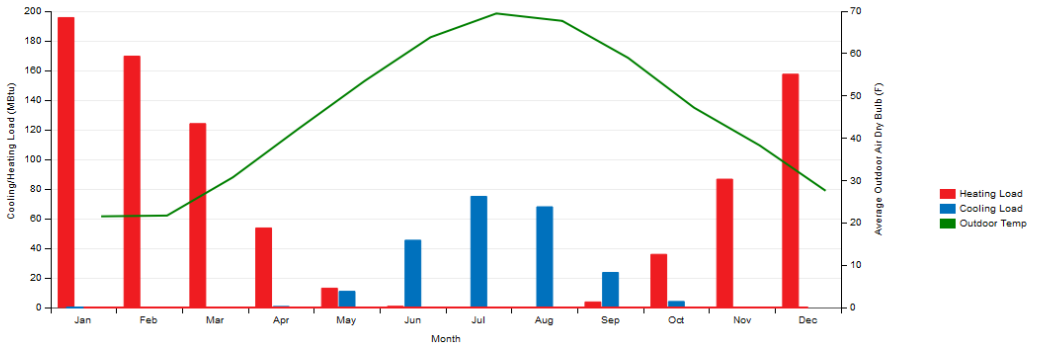
ANNUAL HEATING 12,862kBTu
ANNUAL COOLING 941,742kBTu



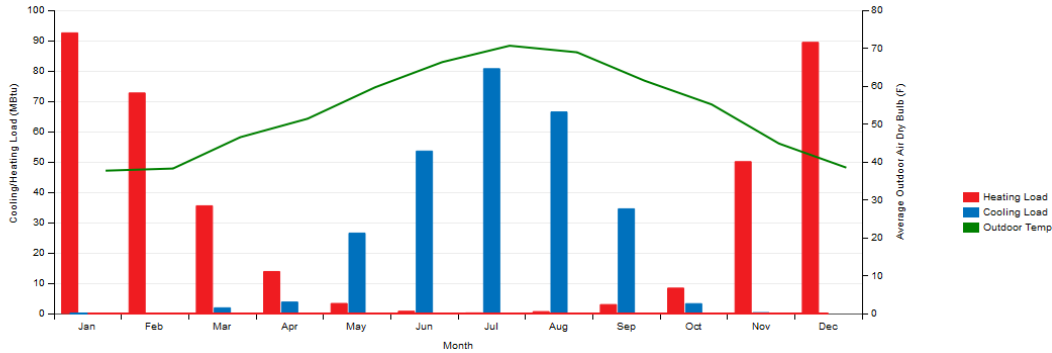
MONTHLY LOAD CONSUMPTION

UNIT: kBTu > The amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit

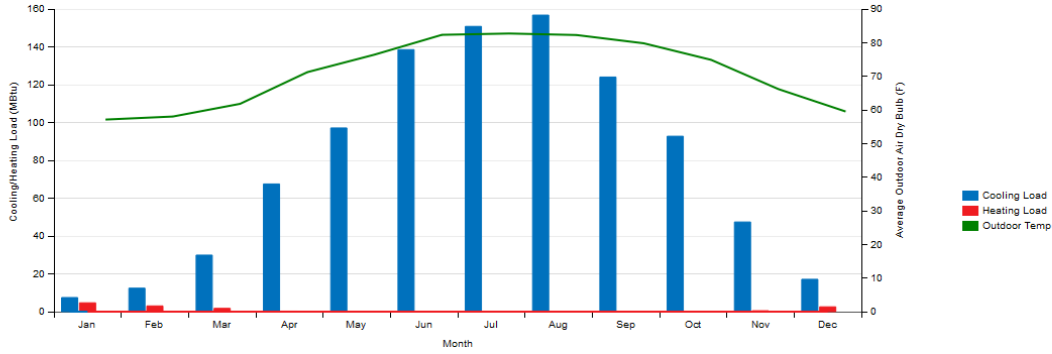
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|----------------------------------|-------|--------|--------|------|-------|-------|-------|-------|-------|-------|-------|--------|
| Average Outdoor Air Dry Bulb (F) | 21.5 | 21.7 | 30.8 | 42.3 | 53.5 | 63.8 | 69.5 | 67.7 | 59.0 | 47.2 | 38.3 | 27.6 |
| Cooling Load (MBtu) | 0.0 | 0.0 | 0.0 | 0.74 | 10.93 | 45.41 | 75.01 | 67.99 | 23.67 | 4.08 | 0.02 | 0.0 |
| Heating Load (MBtu) | 195.7 | 169.65 | 124.14 | 53.7 | 13.05 | 0.85 | 0.27 | 0.29 | 3.76 | 35.88 | 86.64 | 157.48 |



| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|-------|
| Average Outdoor Air Dry Bulb (F) | 37.7 | 38.3 | 46.5 | 51.4 | 59.6 | 66.3 | 70.6 | 68.9 | 61.4 | 55.2 | 44.8 | 38.5 |
| Cooling Load (MBtu) | 0.0 | 0.0 | 1.88 | 3.78 | 26.53 | 53.57 | 80.73 | 66.47 | 34.53 | 3.25 | 0.3 | 0.0 |
| Heating Load (MBtu) | 92.54 | 72.73 | 35.52 | 13.85 | 3.32 | 0.75 | 0.21 | 0.63 | 2.95 | 8.38 | 50.08 | 89.42 |

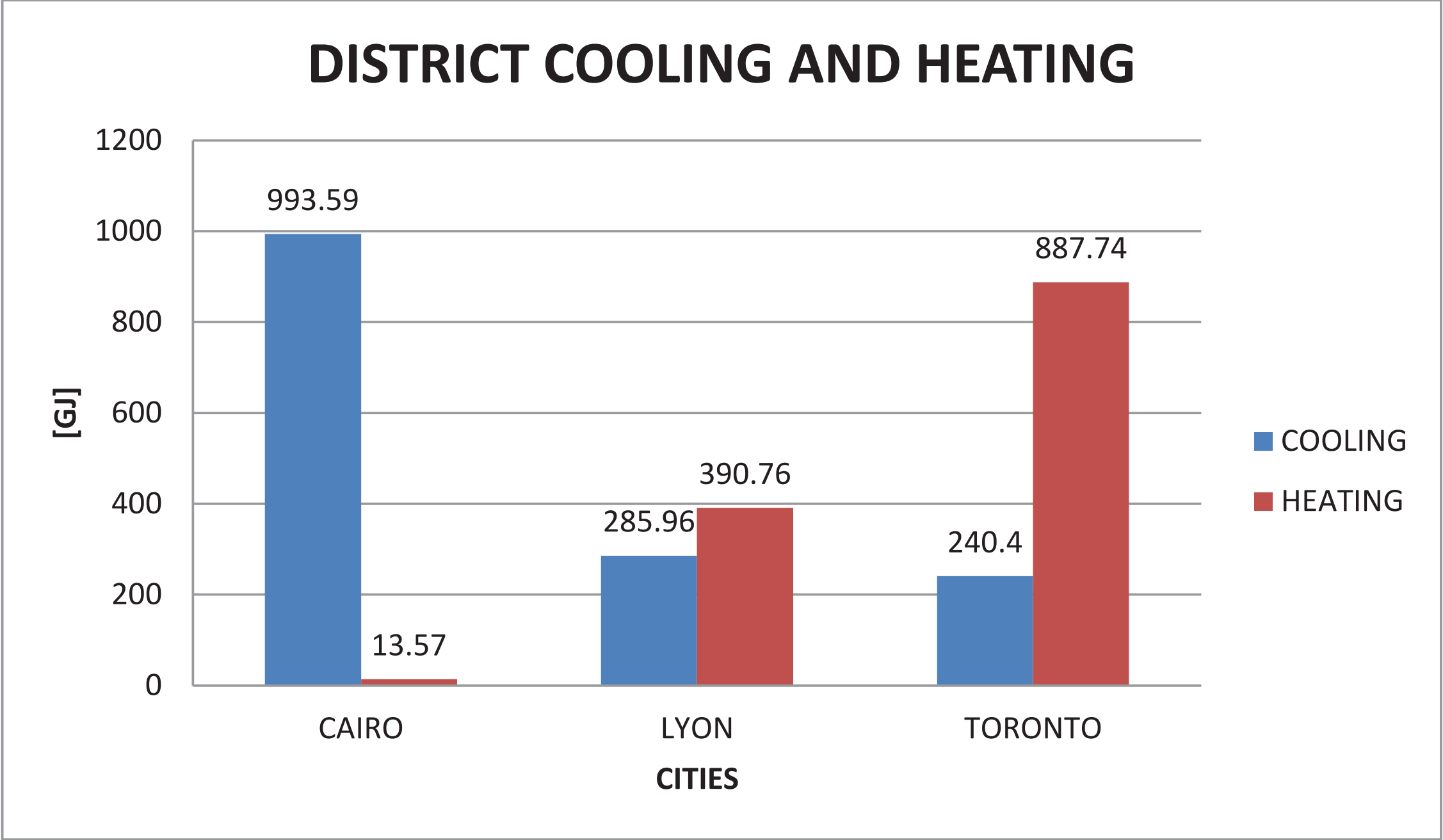


| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|----------------------------------|------|-------|-------|------|------|--------|-------|--------|--------|-------|------|------|
| Average Outdoor Air Dry Bulb (F) | 57.1 | 58.0 | 61.8 | 71.2 | 76.4 | 82.3 | 82.7 | 82.3 | 79.8 | 74.9 | 66.2 | 59.5 |
| Cooling Load (MBtu) | 7.46 | 12.42 | 29.89 | 67.5 | 97.1 | 138.52 | 150.8 | 156.77 | 124.03 | 92.74 | 47.4 | 17.1 |
| Heating Load (MBtu) | 4.68 | 3.04 | 1.75 | 0.27 | 0.07 | 0.0 | 0.0 | 0.0 | 0.0 | 0.02 | 0.48 | 2.55 |



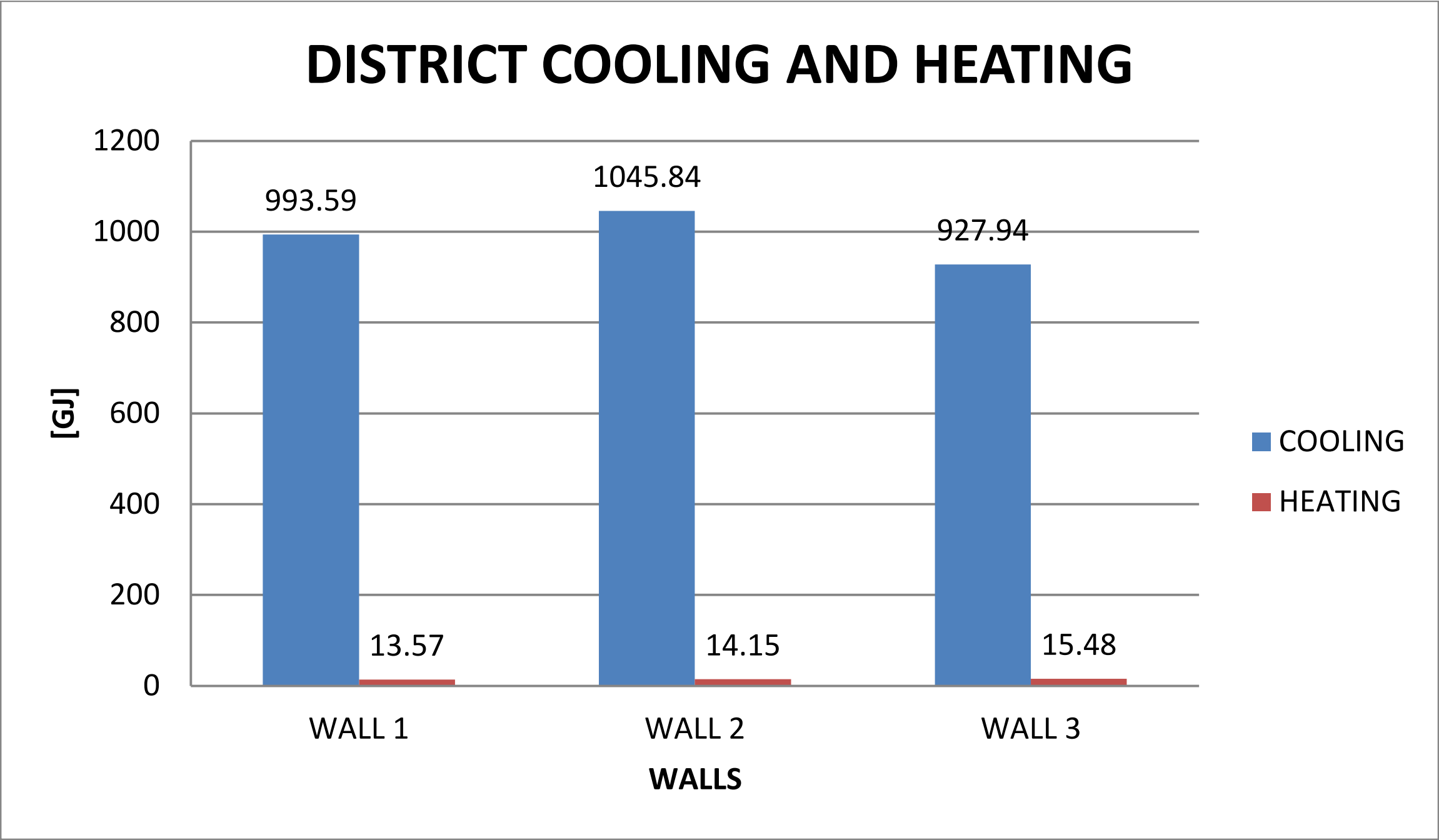
COMPARING RESULTS (ENERGY +)

UNIT: GJ > gigajoule (GJ) is the equivalent to 1 billion joules. It is a unit of work or energy and is equal to the work done by a force of one newton acting through one metre.



COMPARING DIFFERENT WALLS IN CAIRO

UNIT: GJ > gigajoule (GJ) is the equivalent to 1 billion joules. It is a unit of work or energy and is equal to the work done by a force of one newton acting through one metre.



CONCLUSION

TORONTO



More energy is consumed on heating a building in Toronto due to its harsh climate. Thicker insulation is required for Toronto's typical long winters in order to reduce on overall yearly heating costs. We recommend using Urethane Rigid Wall Insulation in Toronto since it has the highest R-value therefore is most efficient in terms of thermal resistance.

LYON



Lyon consumes the least amount of energy in terms of heating and cooling a building. This is because it has the lowest ΔT (difference between indoor and outdoor temperature) compared to the other extremes we chose.

CAIRO



More energy is consumed on cooling than heating. Shading devices are more necessary in Cairo in order to reduce solar heat gain therefore reducing cooling costs. We recommend using Fiber Glass Insulation in Cairo since it is the least expensive and has the lowest R-value.