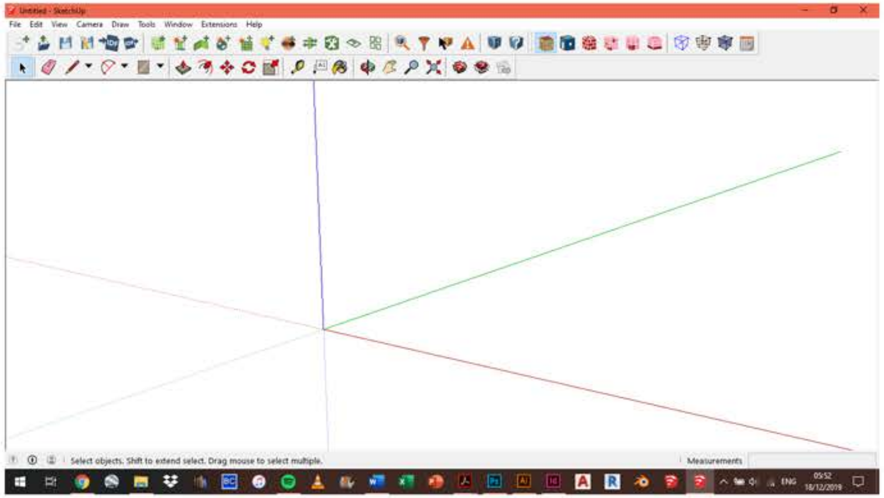
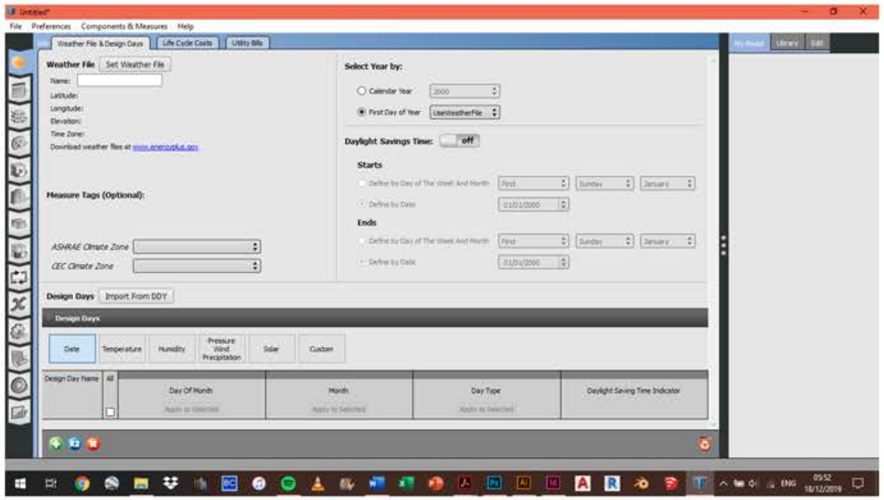
INTRODUCTION

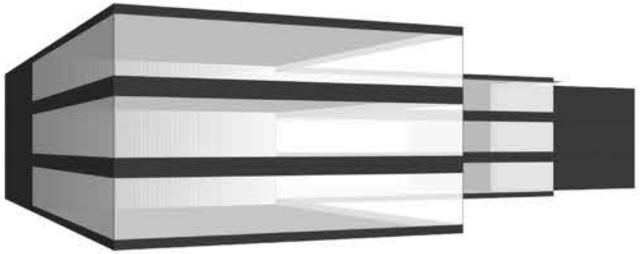
THE Open Studio SOFTWARE



DESIGN OF THE BUILDING

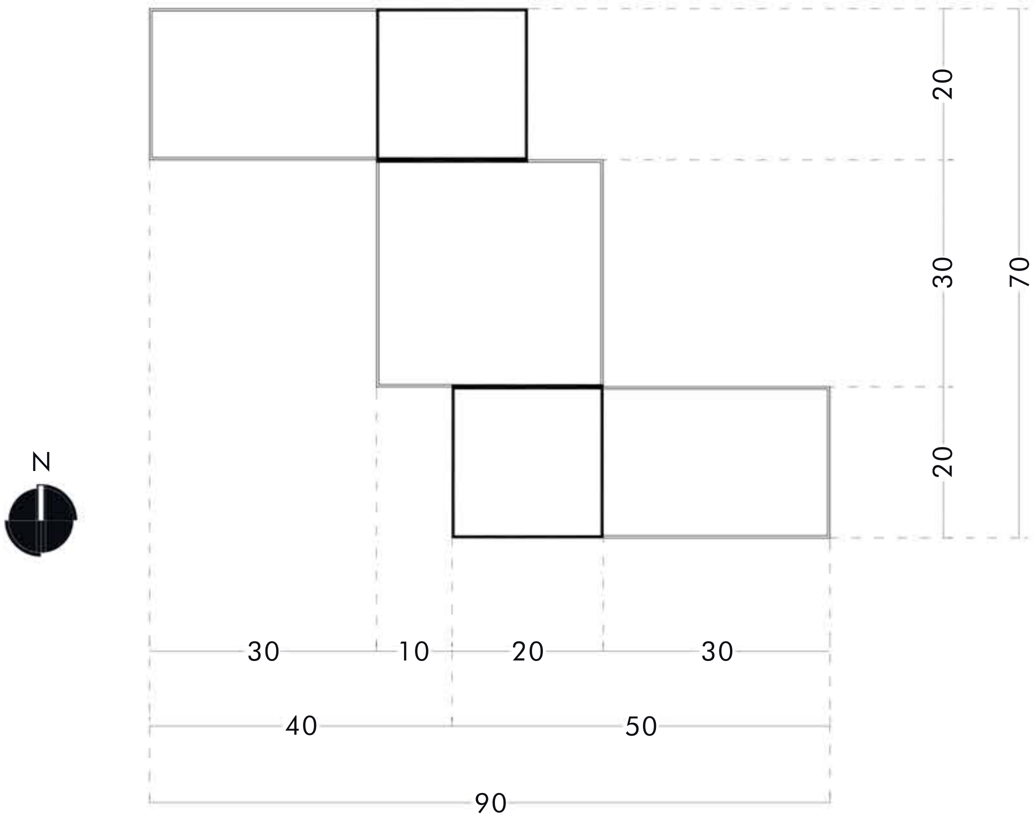
ANALYSIS OF THE BUILDING PERFORMANCE

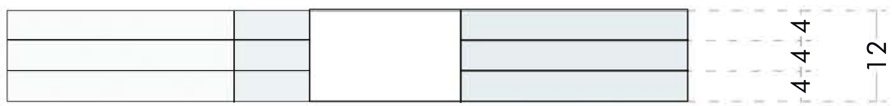


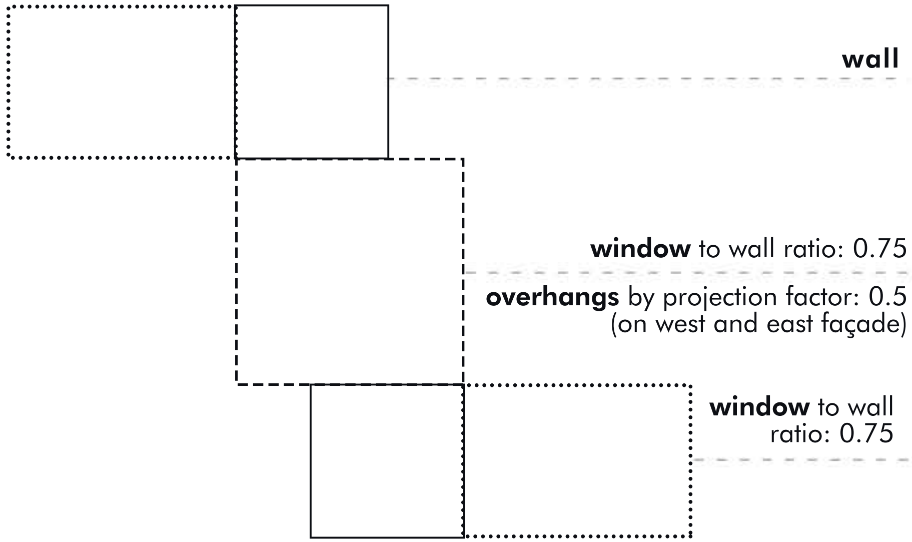


THE BUILDING

GEOMETRY AND CHARACTERISTICS







TOTAL EXTERNAL WALL AREA CALCULATION

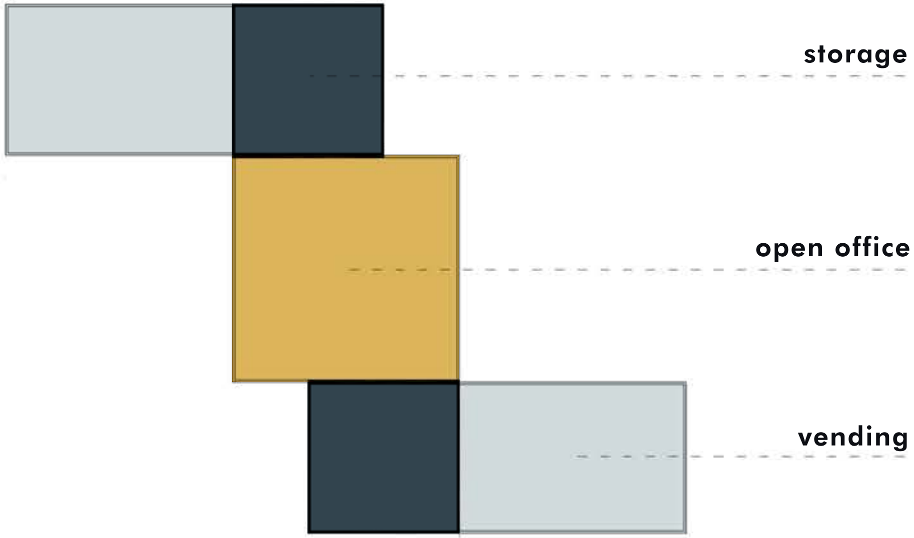
Let's start by considering just the first storey

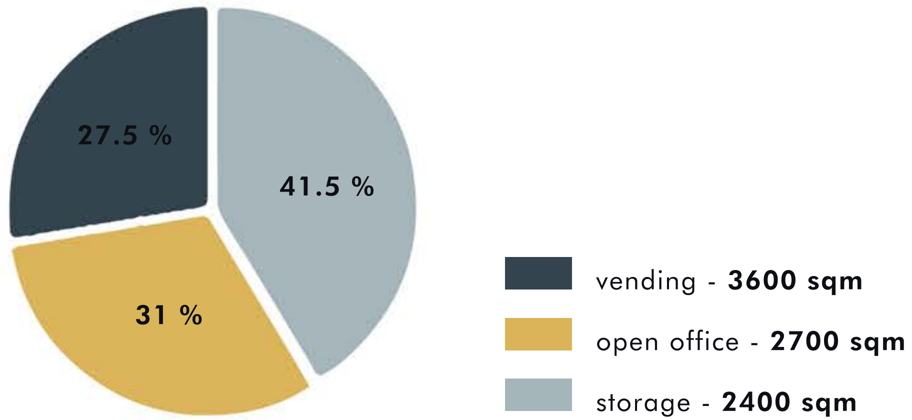
STORAGE: area of storage façade = area of storage external wall
Area of storage external wall = 20m x 4m x 4 = 320 m^2

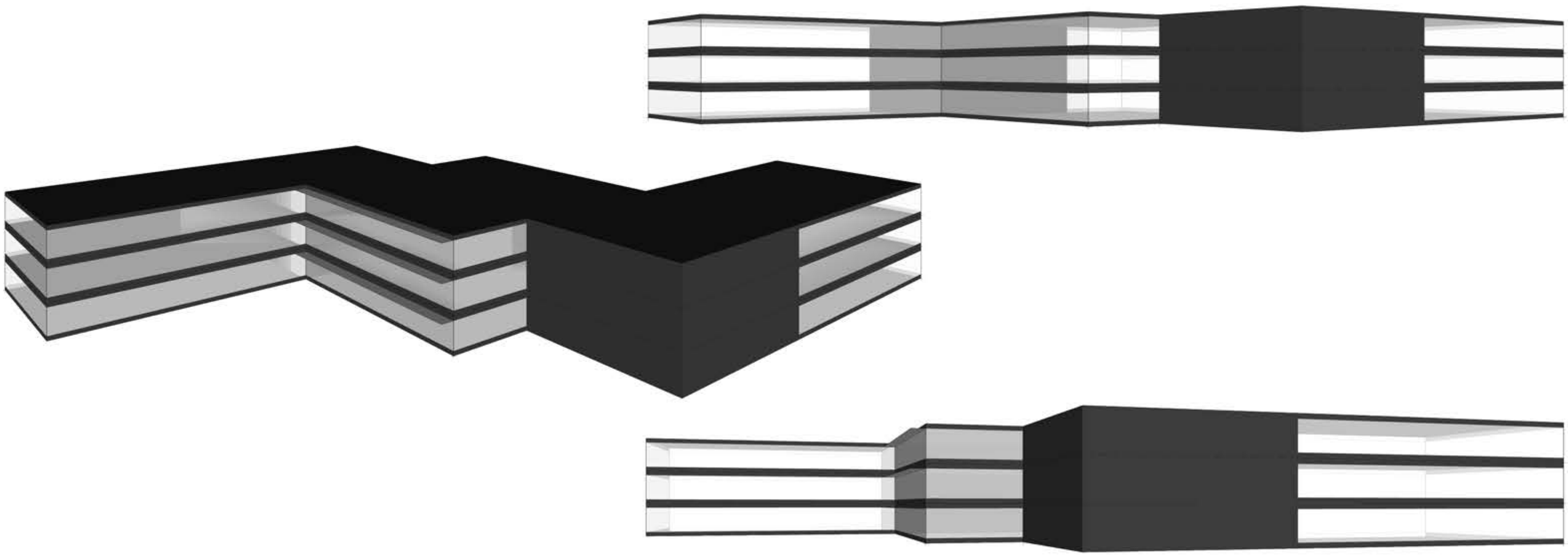
OPEN OFFICE AND VENDING: window to wall ratio 0.75
Area of open office and vending façade = (30m x 4m x 6) + (20m x 4m x 2) + (10m x 4m x 2) = 960 m^2
Area of open office and vending external wall = 960 m^2 x 25/100 = 240 m^2

Total external wall area for one storey = 320 m^2 + 240 m^2 = 560 m^2
All the storeys are the same

Total external wall area = 560 m^2 x 3 = **1680 m^2**


storage
open office
vending


27.5 %
41.5 %
31 %
vending - 3600 sqm
open office - 2700 sqm
storage - 2400 sqm



THE LOCATION

NYC - STOCKHOLM - ALEXANDRIA

NYC

STOCKHOLM

ALEXANDRIA

LOCATION

United States of America

LATITUDE: **40.78**
LONGITUDE: **-73.97**
ELEVATION: **57 m/sealevel**

WORST CASE SCENARIOS

WINTER DESIGN DAY: **21.01**
MINIMUM DRY BULB TEMPERATURE: **-10.7 °C**
SUMMER DESIGN DAY: **21.07**
MAXIMUM DRY BULB TEMPERATURE: **31.1 °C**

LOCATION

Sweden **I** Europe

LATITUDE: **59.65**
LONGITUDE: **17.95**
ELEVATION: **61 m/sealevel**

WORST CASE SCENARIOS

WINTER DESIGN DAY: **21.02**
MINIMUM DRY BULB TEMPERATURE: **-17.8 °C**
SUMMER DESIGN DAY: **21.07**
MAXIMUM DRY BULB TEMPERATURE: **27.1 °C**

LOCATION

Egypt **I** Africa

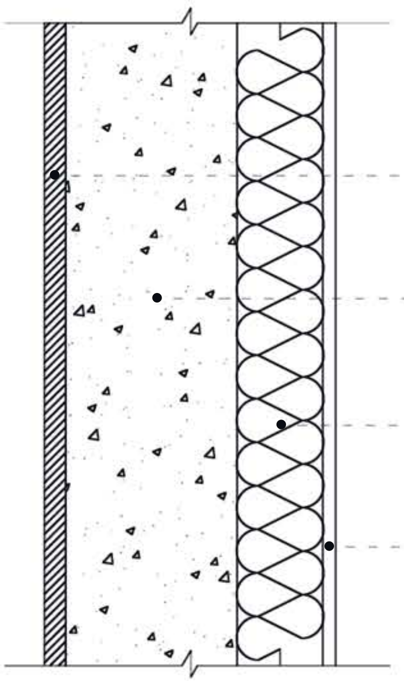
LATITUDE: **31.2**
LONGITUDE: **29.95**
ELEVATION: **7 m/sealevel**

WORST CASE SCENARIOS

WINTER DESIGN DAY: **21.01**
MINIMUM DRY BULB TEMPERATURE: **6.9 °C**
SUMMER DESIGN DAY: **21.08**
MAXIMUM DRY BULB TEMPERATURE: **33 °C**

THE WALLS

COMPOSITION AND U-VALUE



1. BASE CASE STUDY

wood 2.5 cm
R = 0.22 $m^{2}°C/W$

h. concrete 20 cm
R = 0.12 $m^{2}°C/W$

glass fiber insulation 9 cm
R = 2.52 $m^{2}°C/W$

gypsum 1.3 cm
R = 0.079 $m^{2}°C/W$

OVERALL HEAT TRANSFER COEFFICIENT (U-factor) CALCULATION

U = 1/R (overall unit thermal resistance)

U_{WOOD} = 4.55 $W/m^{2}°C$

$U_{CONCRETE}$ = 8.33 $W/m^{2}°C$

[Glass fiber insulation 2.5 cm: R = 0.70 $m^{2}°C/W$

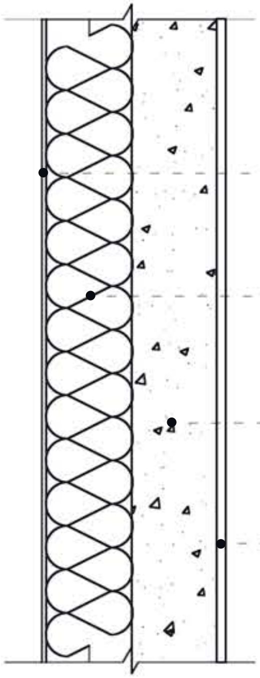
Glass fiber insulation 9 cm: R = (0.70/2.5) x 9 = 2.52 $m^{2}°C/W$]

$U_{INSULATION}$ =0.40 $W/m^{2}°C$

U_{GYPSUM} = 12.66 $W/m^{2}°C$

U_{TOTAL1} = 4.55 + 8.33 + 0.40 + 12.66 = **25.94 $W/m^{2}°C$**

U_{TOTAL1} X $A_{TOTALWALL}$ = 25.94 $W/m^{2}°C$ X 1680 m^{2} = 43579.2 W/°C



2. LIGHTER WALL

metal 0.5 cm
R = 0 $m^{2}{}^{\circ}C/W$

glass fiber insulation 9 cm
R = 2.52 $m^{2}{}^{\circ}C/W$

l. concrete 10 cm
R = 0.27 $m^{2}{}^{\circ}C/W$

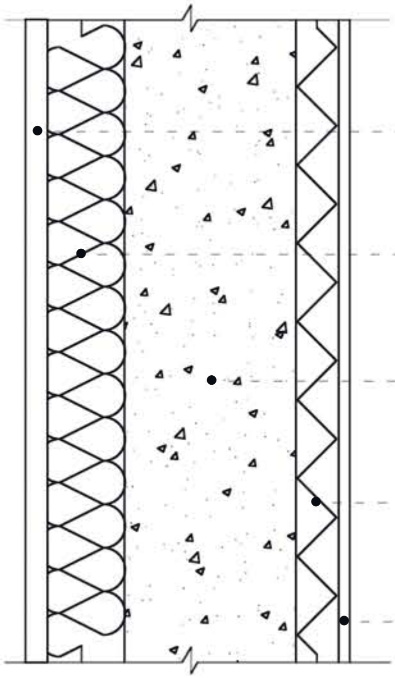
plywood 1.3 cm
R = 0.11 $m^{2}{}^{\circ}C/W$

OVERALL HEAT TRANSFER COEFFICIENT (U-factor) CALCULATION

U_{METAL} = 0 $W/m^{2}{}^{\circ}C$
$U_{INSULATION}$ = 0.40 $W/m^{2}{}^{\circ}C$
$U_{CONCRETE}$ = 3.7 $W/m^{2}{}^{\circ}C$
$U_{PLYWOOD}$ = 9 $W/m^{2}{}^{\circ}C$

U_{TOTAL1} = 0 + 0.40 + 3.7 + 9 = **13.1 $W/m^{2}{}^{\circ}C$**

U_{TOTAL1} X $A_{TOTALWALL}$ = 13.1 $W/m^{2}{}^{\circ}C$ X 1680 m^2 = 22008 $W/{}^{\circ}C$



3. THICKER WALL

plaster 2.5 cm
R = 0.037 $m^{2}{}^{\circ}C/W$

glass fiber insulation 9 cm
R = 2.52 $m^{2}{}^{\circ}C/W$

h. concrete 20 cm
R = 0.12 $m^{2}{}^{\circ}C/W$

acustic insulation 5 cm
R = 0.32 $m^{2}{}^{\circ}C/W$

gypsum 1.3 cm
R = 0.079 $m^{2}{}^{\circ}C/W$

OVERALL HEAT TRANSFER COEFFICIENT (U-factor) CALCULATION

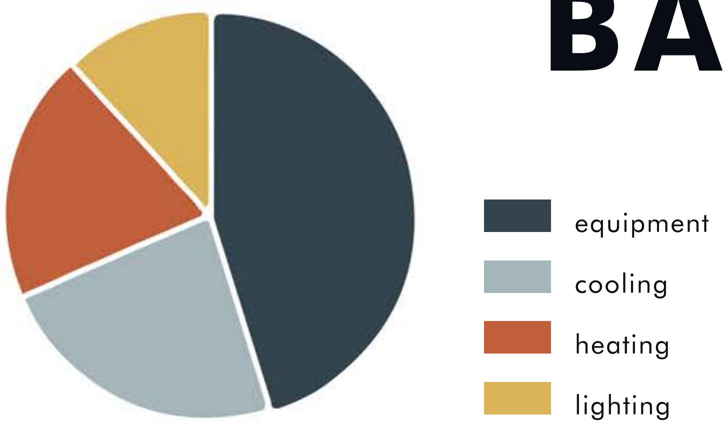
$U_{PLASTER}$ = 27 $W/m^{2}{}^{\circ}C$
$U_{INSULATION}$ = 0.4 $W/m^{2}{}^{\circ}C$
$U_{CONCRETE}$ = 8.33 $W/m^{2}{}^{\circ}C$
$U_{ACUSTIC}$ = 3.13 $W/m^{2}{}^{\circ}C$
U_{GYPSUM} = 12.66 $W/m^{2}{}^{\circ}C$

U_{TOTAL1} = 27 + 0.4 + 8.33 + 3.13 + 12.66 = **51.52 $W/m^{2}{}^{\circ}C$**

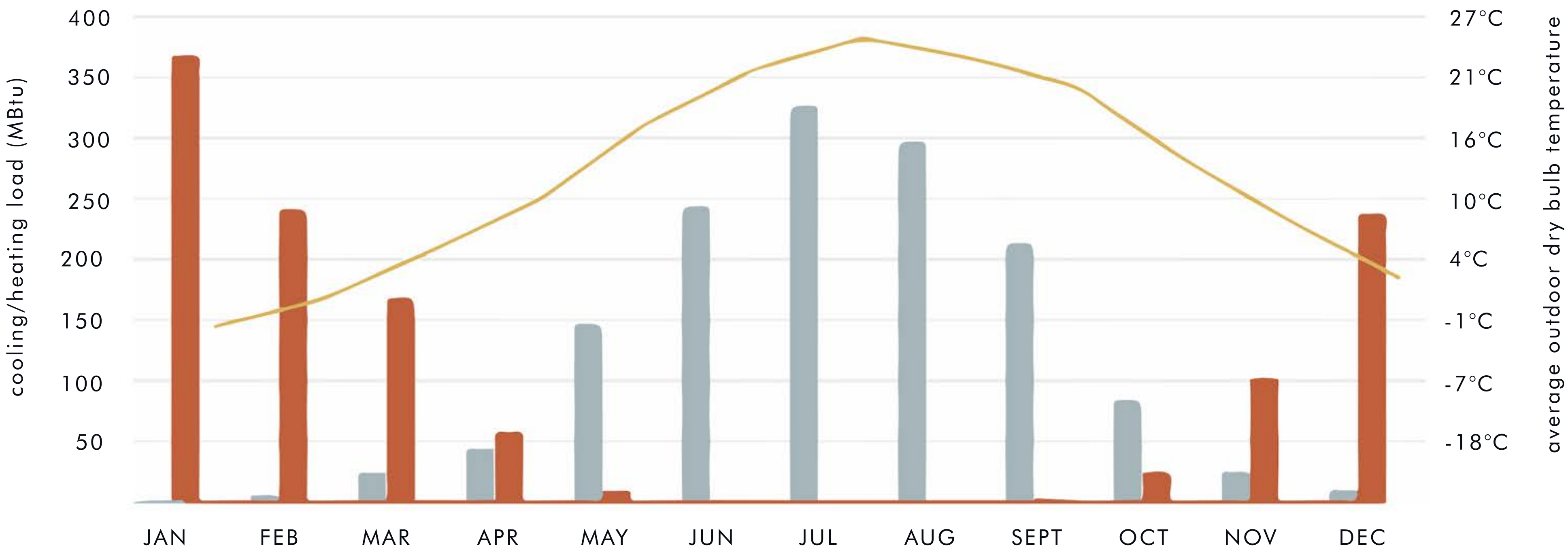
U_{TOTAL1} X $A_{TOTALWALL}$ = 51.52 $W/m^{2}{}^{\circ}C$ X 1680 m^2 = 86553.6 $W/{}^{\circ}C$

BASE CASE STUDY

NYC - WALL1



ENERGY USE - ANNUAL OVERVIEW



HVAC MONTHLY LOAD PROFILE

THE RESULTS

CONFRONTATION AND CONCLUSIONS

WALL 1

	NYC	Stockholm	Alexandria
HEATING [GJ]	1272,45	2046,03	69,2
COOLING [GJ]	1489,63	591,1	2950,96
TOTAL [GJ]	2762,08	2637,13	3020,16

WALL 2

	NYC	Stockholm	Alexandria
HEATING [GJ]	1256,67	2042,18	66,5
COOLING [GJ]	1487,56	584,96	2953,28
TOTAL [GJ]	2744,23	2627,14	3019,78

WALL 3

	NYC	Stockholm	Alexandria
HEATING [GJ]	1252,59	2018,16	66,18
COOLING [GJ]	1490,49	591,18	2955,52
TOTAL [GJ]	2743,08	2609,34	3021,7

The results reflect the different climates of the cities

The best performance of the walls is in Stockholm

THE BEST WALL IS WALL 3