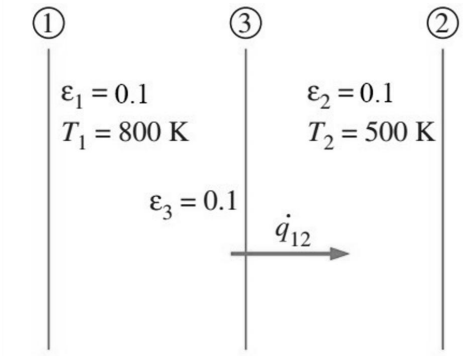
WEEK6-LIU JIAJI

TASK1



$$\dot{q}_{net_{1-2}} = \frac{\dot{Q}_{net_{1-2}}}{A} = \frac{A\sigma(T_2^4 - T_1^4)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1} \div A$$

$$= \frac{\sigma(T_2^4 - T_1^4)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1}$$

$$\approx 1035.82 \ \frac{W}{m^2}$$

The new heat transfer rate should be 1% of the $\dot{q}_{net_{1-2}}$,

$i.e., \dot{q}'_{net_{1-2}} = \dot{q}_{net_{1-2,\,n\,shiels}} = \frac{1}{100} \times \dot{q}_{net_{1-2}}$,

$$\dot{q}_{net_{1-2,\,n\,shiels}} = \frac{\dot{Q}_{net_{1-2,\,n\,shields}}}{A} = \frac{A\sigma(T_2^4 - T_1^4)}{\left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1\right)\left(\frac{1}{\epsilon_{3,1}} + \frac{1}{\epsilon_{3,2}} - 1\right)\cdots\left(\frac{1}{\epsilon_{n,1}} + \frac{1}{\epsilon_{n,2}} - 1\right)} \div \mathrm{A}$$

$$= \frac{\sigma(T_2^4 - T_1^4)}{\left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1\right)\left(\frac{1}{\epsilon_{3,1}} + \frac{1}{\epsilon_{3,2}} - 1\right)\cdots\left(\frac{1}{\epsilon_{n,1}} + \frac{1}{\epsilon_{n,2}} - 1\right)}$$

Autem, $\epsilon_1 = \epsilon_2 = \epsilon_3 = \cdots = \epsilon_n = 0.1$

Substitute $\epsilon = 0.1$ for $\epsilon_1, \epsilon_2, \epsilon_3, \ldots, \epsilon_n$, *and introduce to the equation*:

$$\dot{q}_{net_{1-2,\,n\,shiels}} = \frac{\sigma(T_2^4 - T_1^4)}{(n+1)(\frac{1}{\epsilon} + \frac{1}{\epsilon} - 1)} = \frac{1}{\mathrm{n}+1} \times \frac{\sigma(T_2^4 - T_1^4)}{\frac{1}{\epsilon} + \frac{1}{\epsilon} - 1}$$

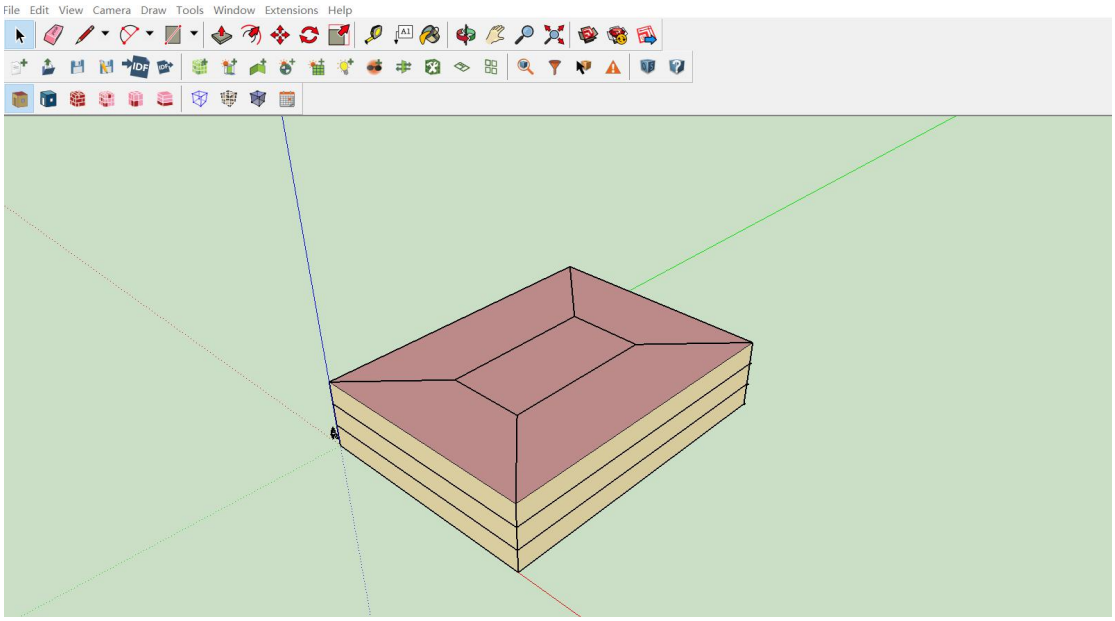
$$Since\ \dot{q}'_{net_{1-2}} = \dot{q}_{net_{1-2,\,n\,shiels}} = \frac{1}{100} \times \dot{q}_{net_{1-2}} = \frac{1}{100} \times \frac{\sigma(T_2^4 - T_1^4)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1} = \frac{1}{100} \times \frac{\sigma(T_2^4 - T_1^4)}{\frac{1}{\epsilon} + \frac{1}{\epsilon} - 1}$$

$$i.e., \quad \frac{1}{\mathrm{n}+1} \times \frac{\sigma(T_2^4 - T_1^4)}{\frac{1}{\epsilon} + \frac{1}{\epsilon} - 1} = \frac{1}{100} \times \frac{\sigma(T_2^4 - T_1^4)}{\frac{1}{\epsilon} + \frac{1}{\epsilon} - 1} \qquad n = 99$$

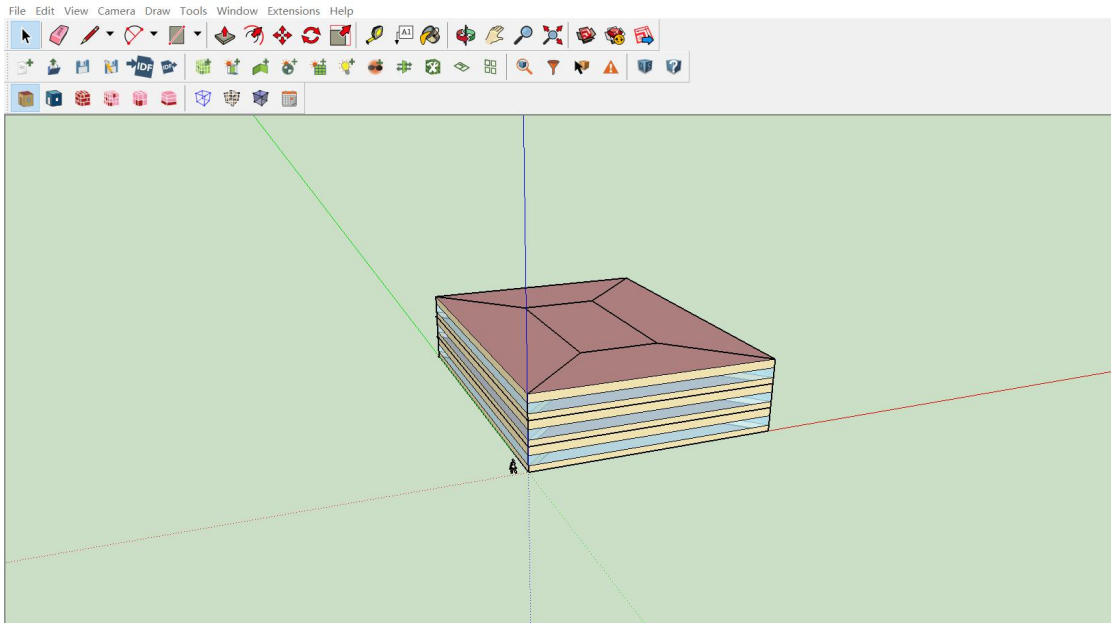
To have the new heat transfer rate be 1% of the previous rate without any shields, we need 99 shields which $\epsilon = 0.1$

Q.E.D.

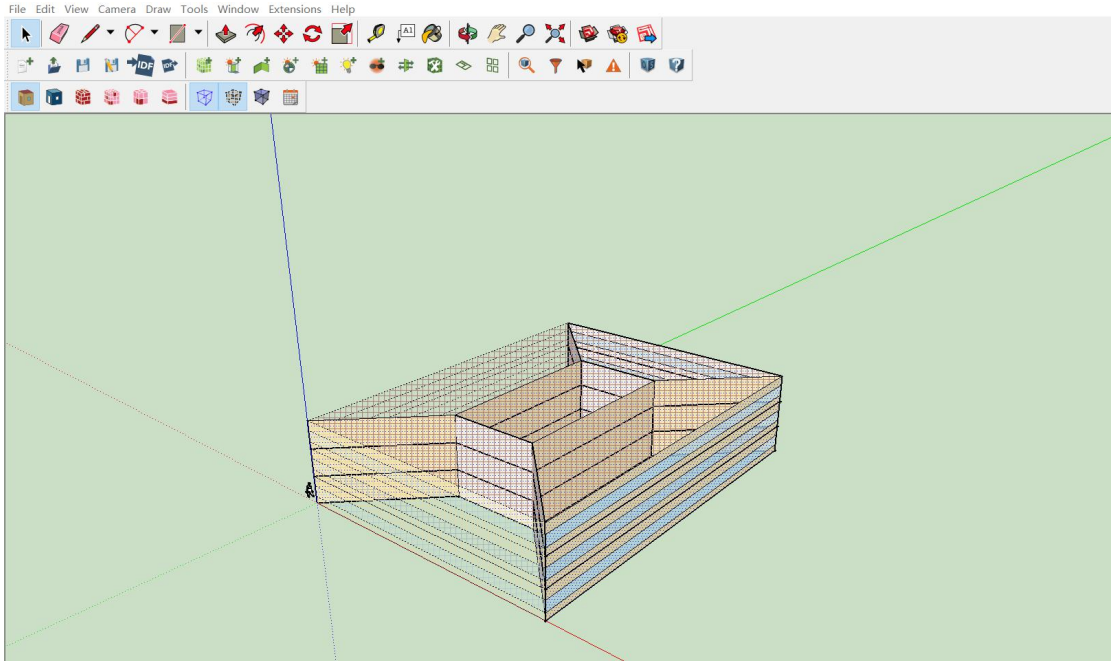
TASK2



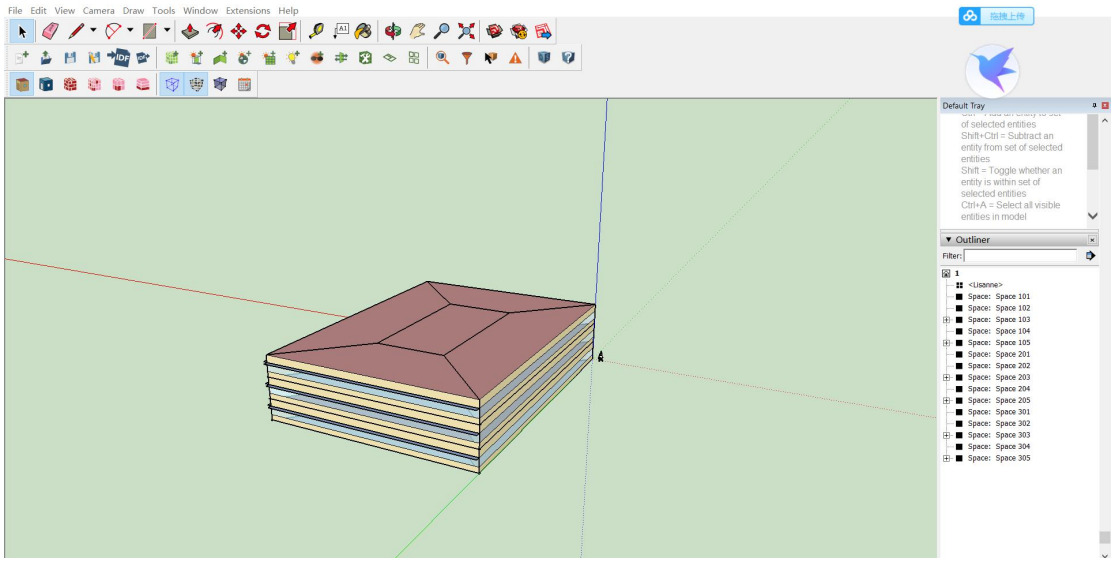
Create two rectangles, let the large rectangle include a small rectangle, and then connect the corresponding corners.

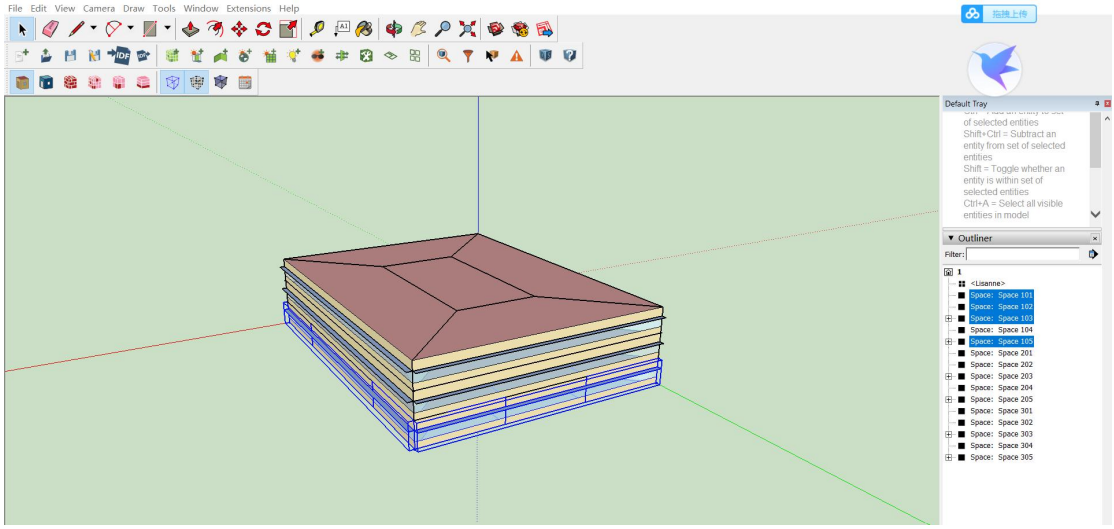


Create buildings and windows.

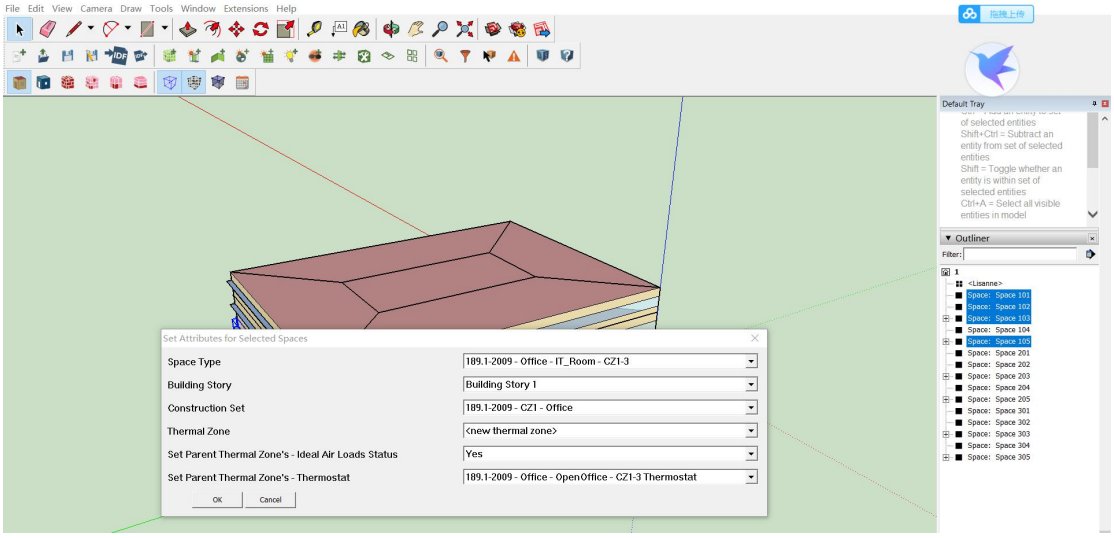


Add overhang to create external shading.

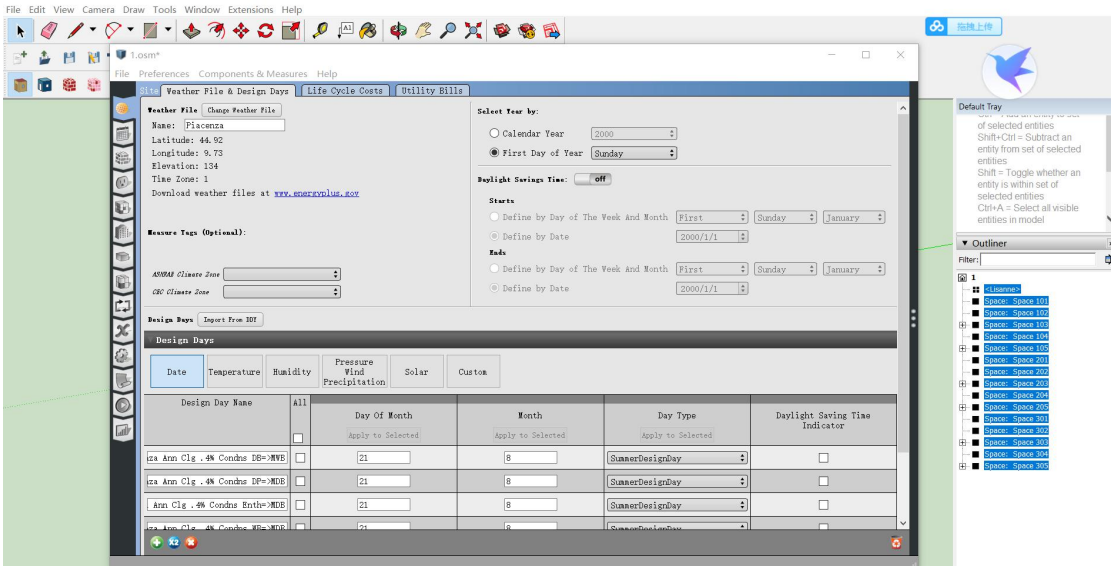




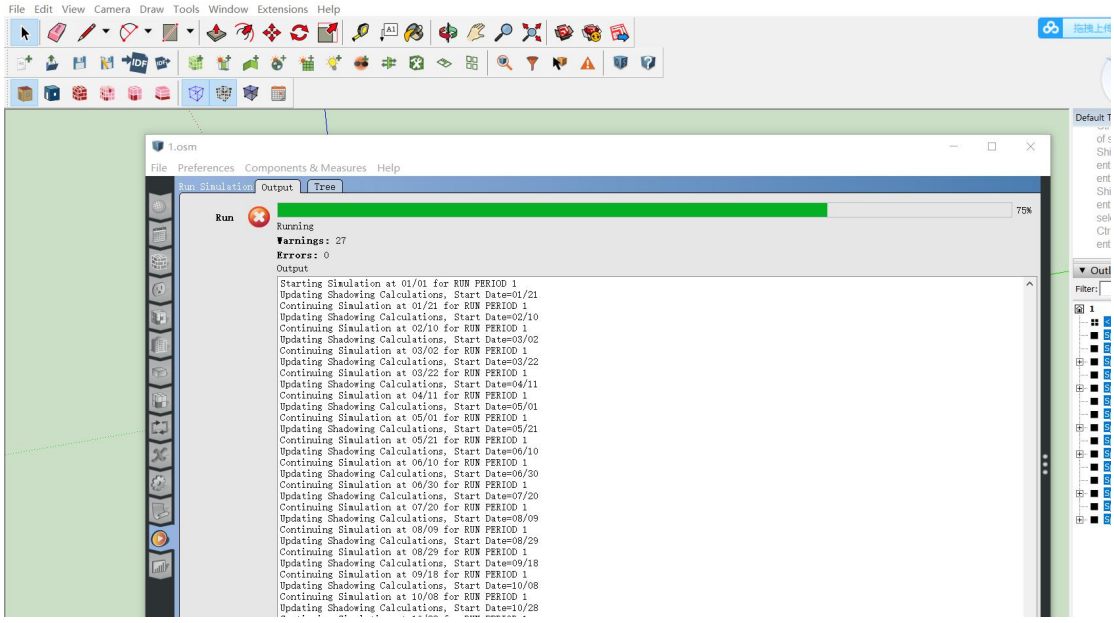
Select each face and add specifications.

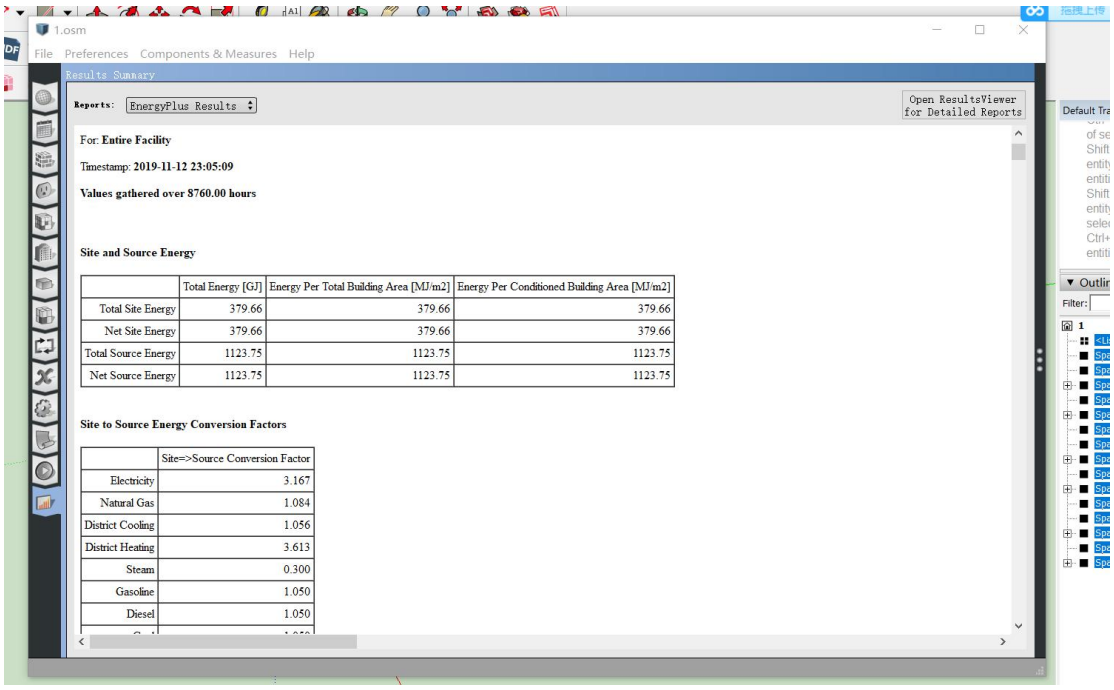


Choose Default Tray and click Outliner and Set Attributes for Selected Space.



Add weather data, then run the plugin and wait for the results.


File Edit View Camera Draw Tools Window Extensions Help
1.osm
File Preferences Components & Measures Help
Run Simulation
Output
Tree
Run
75%
Running
Warnings: 27
Errors: 0
Output
Starting Simulation at 01/01 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=01/21
Continuing Simulation at 01/21 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=02/10
Continuing Simulation at 02/10 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=03/02
Continuing Simulation at 03/02 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=03/22
Continuing Simulation at 03/22 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=04/11
Continuing Simulation at 04/11 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=05/01
Continuing Simulation at 05/01 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=05/21
Continuing Simulation at 05/21 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=06/10
Continuing Simulation at 06/10 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=06/30
Continuing Simulation at 06/30 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=07/20
Continuing Simulation at 07/20 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=08/09
Continuing Simulation at 08/09 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=08/29
Continuing Simulation at 08/29 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=09/18
Continuing Simulation at 09/18 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=10/08
Continuing Simulation at 10/08 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=10/28


1.osm
File Preferences Components & Measures Help
Results Summary
Reports: EnergyPlus Results
Open ResultsViewer for Detailed Reports
For: Entire Facility
Timestamp: 2019-11-12 23:05:09
Values gathered over 8760.00 hours
Site and Source Energy
Total Energy [GJ] | Energy Per Total Building Area [MJ/m2] | Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy | 379.66 | 379.66 | 379.66
Net Site Energy | 379.66 | 379.66 | 379.66
Total Source Energy | 1123.75 | 1123.75 | 1123.75
Net Source Energy | 1123.75 | 1123.75 | 1123.75
Site to Source Energy Conversion Factors
Site=>Source Conversion Factor
Electricity | 3.167
Natural Gas | 1.084
District Cooling | 1.056
District Heating | 3.613
Steam | 0.300
Gasoline | 1.050
Diesel | 1.050