



POLITECHNIKA POZNAŃSKA

ACPS 2021: ARCHITECTURE, CITY, PEOPLE, STRUCTURE
ENERGY-SAVING ORIENTED APPROACH TO URBAN COMPOSITION
WOJCIECH SKÓRZEWSKI



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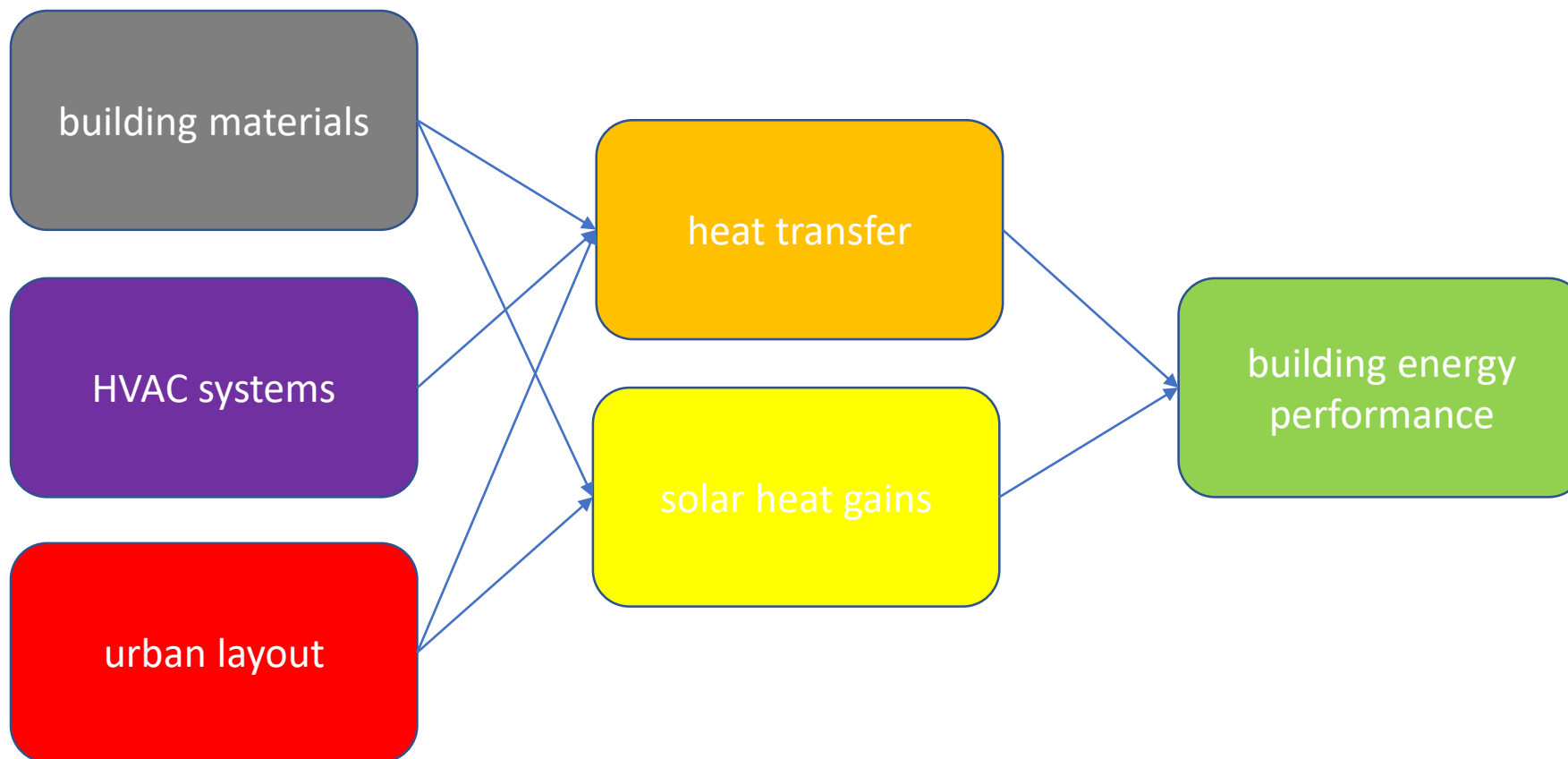
Energy-saving oriented approach to urban composition

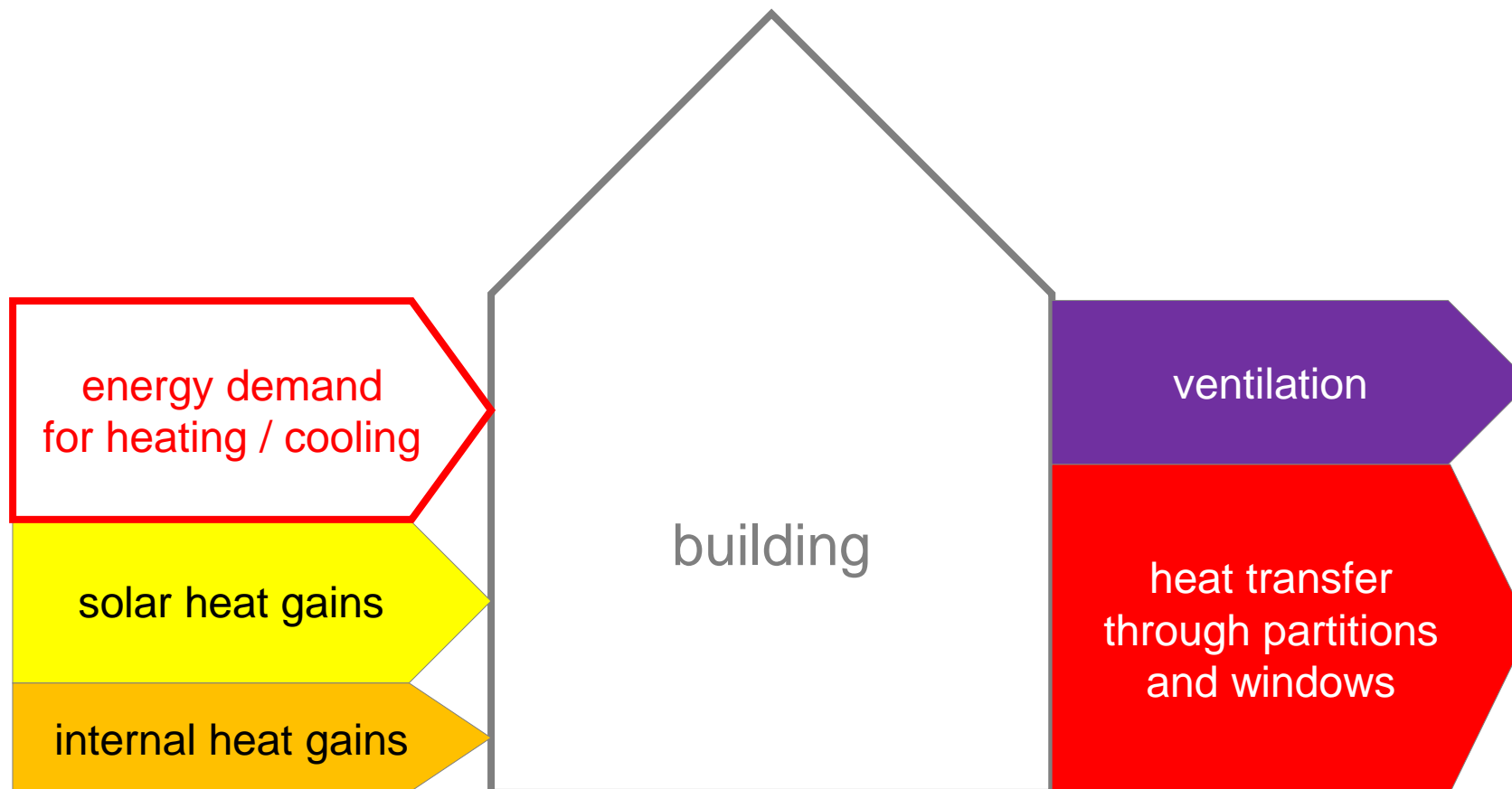
– a comparative analysis of different building layouts

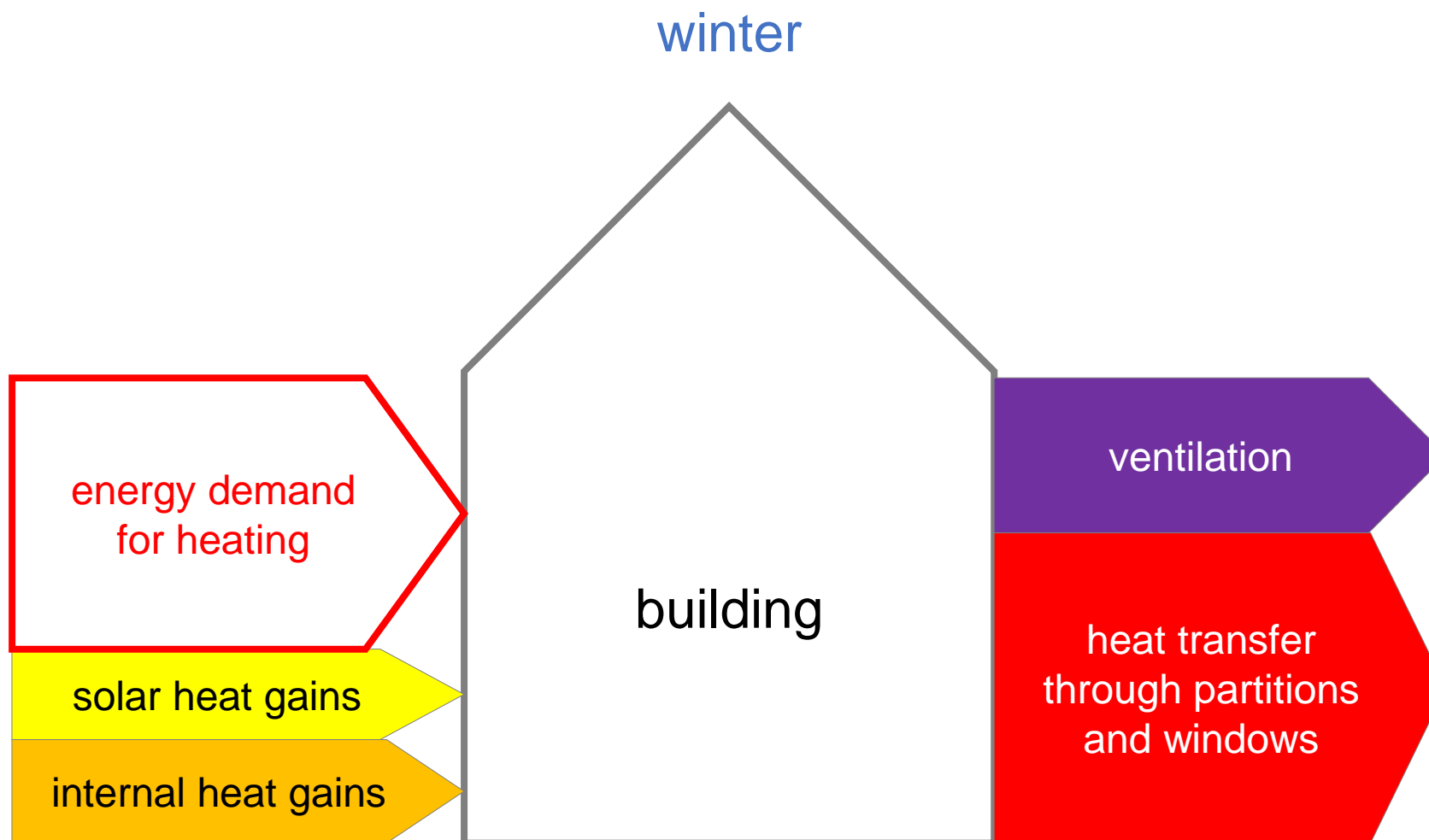
Energooszczędne podejście do kompozycji urbanistycznej

– analiza porównawcza różnych układów budynków

PhD Engineer in Architecture Wojciech Skórzewski

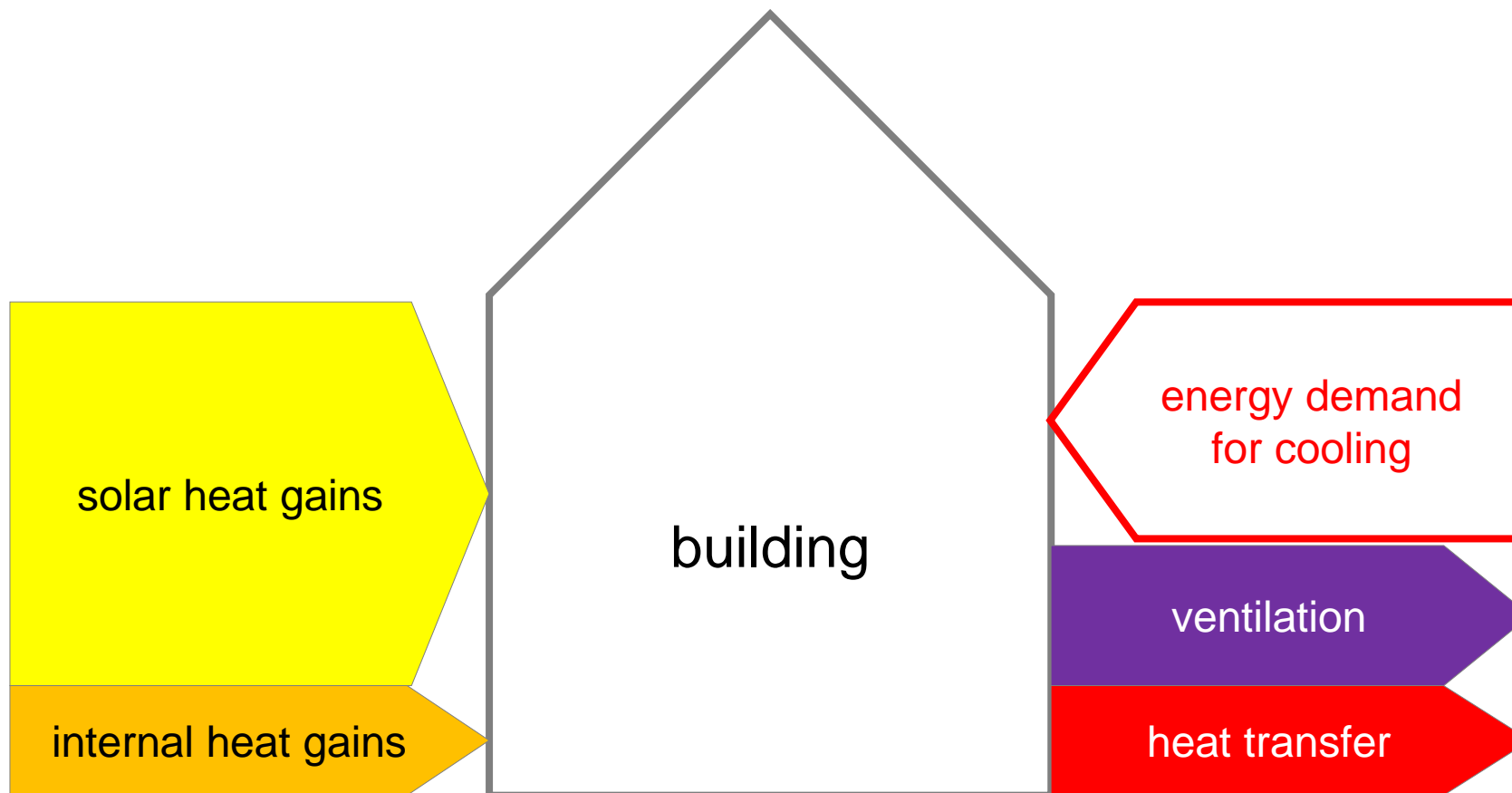








summer





Solar heat gain

Amount of passive solar heat gains:

$$Q_s = r \cdot g \cdot A_g \cdot G \text{ [kWh/year]}$$

in this equation:

Q_s – total amount of passive solar gains

r – reduction coefficient, including the solar incidence angle, shading and dirt

g – Total Solar Energy Transmittance of the glazing

A_g – glazing area

G – total solar radiation during the heating season



Solar heat gain

Amount of passive solar heat gains:

$$Q_s = r \cdot g \cdot A_g \cdot G \text{ [kWh/year]}$$

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r – reduction coefficient, including the solar incidence angle, shading and dirt

g – Total Solar Energy Transmittance of the glazing

A_g – glazing area

G – total solar radiation during the heating season

depending on the facade orientation
towards the directions of the world



Solar heat gain

Amount of passive solar heat gains:

$$Q_s = r \cdot g \cdot A_g \cdot G \text{ [kWh/year]}$$

in this equation:

Q_s – total amount of passive solar gains

r – reduction coefficient, including the solar incidence angle, shading and dirt

g – Total Solar Energy Transmittance of the glazing

A_g – glazing area

G – total solar radiation during the heating season

depending on the other objects
(including buildings) in the surroundings

depending on the facade orientation
towards the directions of the world



Research assumptions

Comparative analysis of energy performance carried out on several variants of building layout.

Software: **Sketchup + OpenStudio**

Calculated parameters:

1. Annual Building Sensible Heat Gain Components:

- Window Heat Addition [GJ]
- Window Heat Removal [GJ]
- Opaque Surface Conduction and Other Heat Removal [GJ]

2. Peak Cooling Sensible Heat Gain Components:

- Window Heat Addition [W]

3. Peak Heating Sensible Heat Gain Components:

- Window Heat Removal [W]
- Opaque Surface Conduction and Other Heat Removal [W]



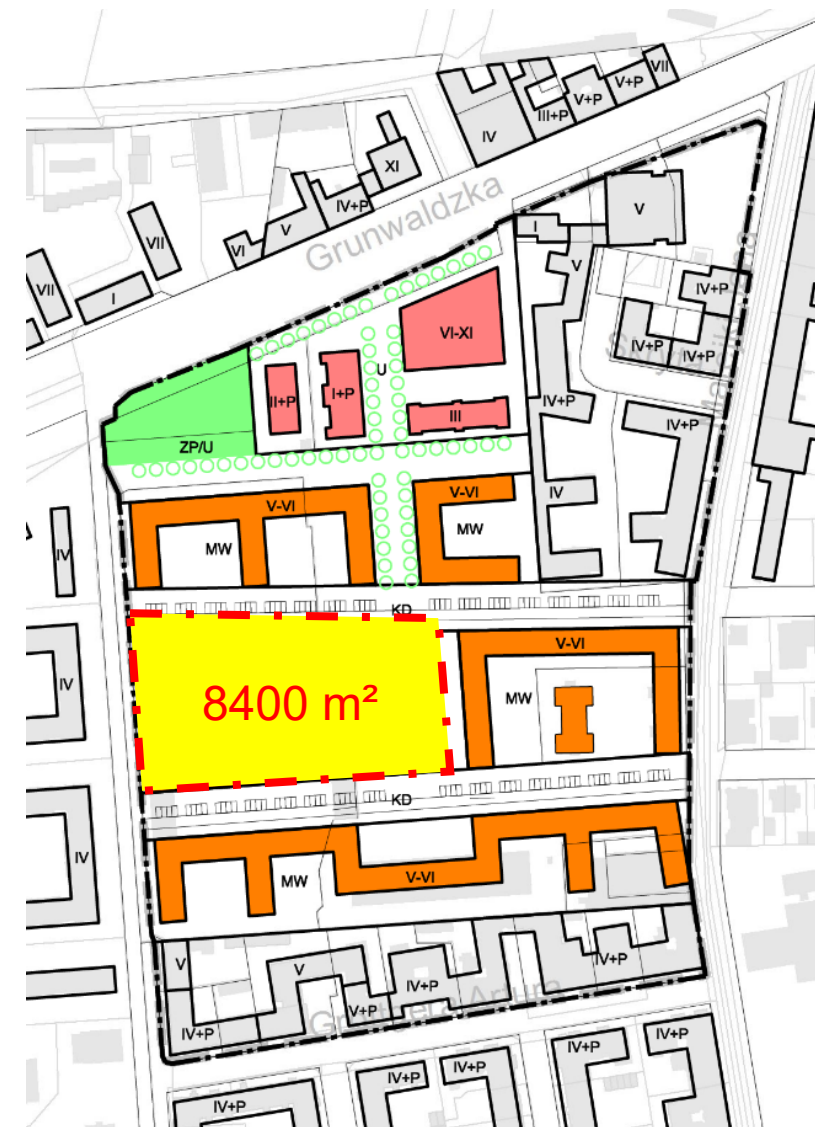
Research assumptions

Energy analysis performed on the 3d model of an **exemplary urban building quarter** in Poznań, ul. Ułańska.

Plot size: 70 x 125 m

Plot area: 8400 m²

For the purposes of comparative analysis, there are the same urban indicators adopted for different variants of the designed development.





Research assumptions

Design assumptions:

office building

building height: 17.5 m (5 storeys x 3,5 m)

built-up area: 4 800.0 m²

gross floor area: 24 000.0 m²

window to wall area ratio: 0,3

building width: 15.0 m



Research assumptions

Thermal zones:

Type: 189.1-2009 - Office - ClosedOffice - CZ4-8

Loads:

| | | |
|---------------------|-------|-----------------------|
| People: | 0.05 | people/m ² |
| Interior lights: | 10.65 | W/m ² |
| Electric equipment: | 6.90 | W/m ² |



Research assumptions

Construction materials:

External walls (layers listed starting from external side):

- acrylic/mineral thin-layer plaster
- graphite polystyrene d=15cm $\lambda=0,031$ W/mK
- silicate blocks d=18cm $\lambda=0,51$ W/mK
- cement-lime plaster

$U=0.187$ W/m²K



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Research assumptions

Construction materials:

External windows:

$$U_w = 0.62 \text{ W/m}^2\text{K}$$

$$\text{SGHC}^* = 0.40$$

* Solar Heat Gain Coefficient



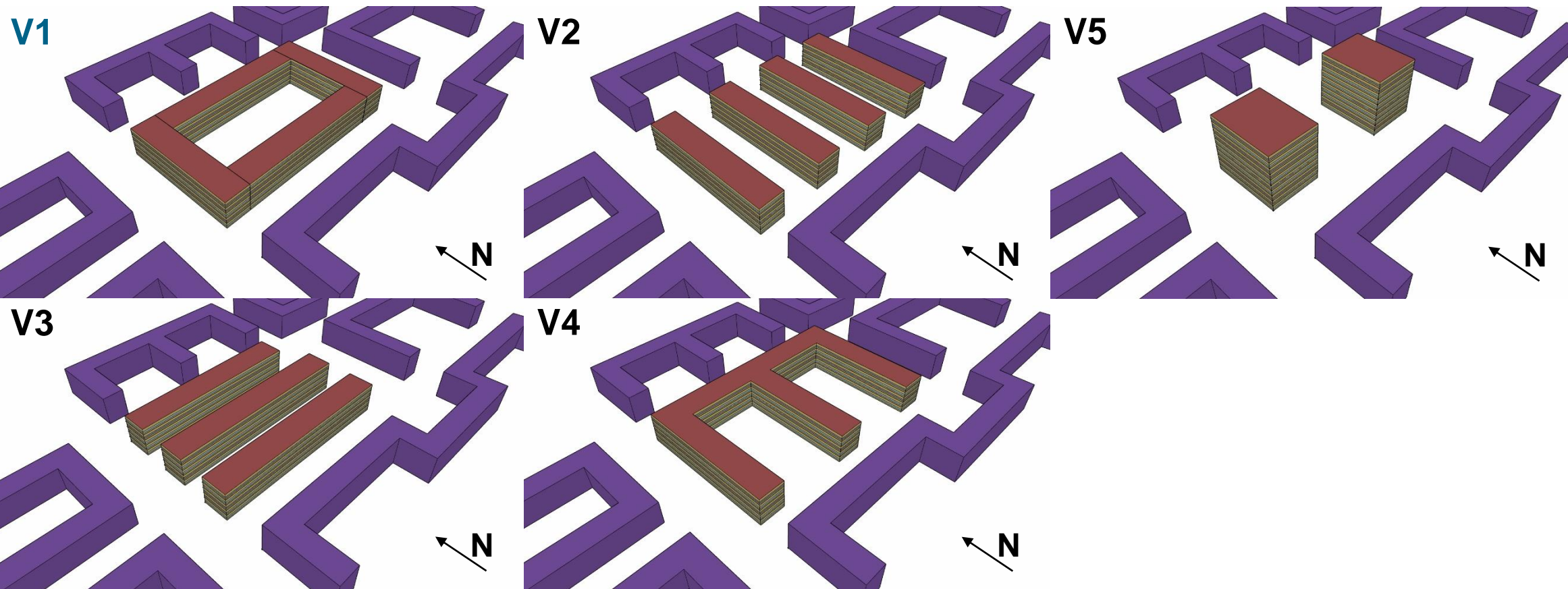
Research assumptions

Construction materials:

Floor slab (layers listed starting from external side):

| | | |
|----------------------------|--------|----------------------|
| concrete slab | d=10cm | $\lambda=1,311$ W/mK |
| graphite polystyrene | d=15cm | $\lambda=0,031$ W/mK |
| carpet pad | | |
| U=0.193 W/m ² K | | |

Layout variants



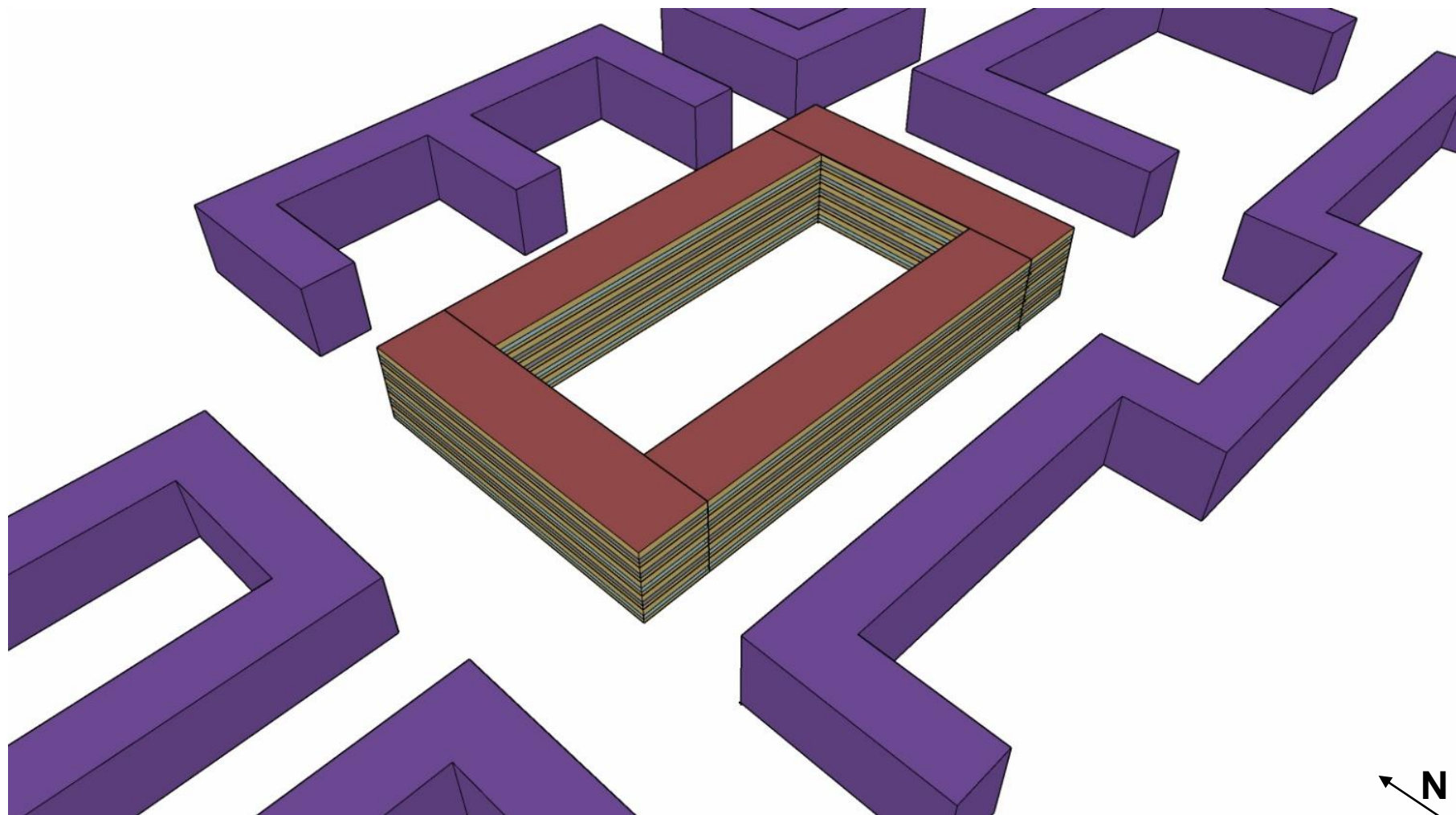


Variant 1

Building layout:

Frontage
buildings around
central courtyard

5 storeys





Variant 1

Annual Building Sensible Heat Gain Components

Results:

| | HVAC Zone Eq & Other Sensible Air Heating [GJ] | HVAC Zone Eq & Other Sensible Air Cooling [GJ] | HVAC Terminal Unit Sensible Air Heating [GJ] | HVAC Terminal Unit Sensible Air Cooling [GJ] | HVAC Input Heated Surface Heating [GJ] | HVAC Input Cooled Surface Cooling [GJ] | People Sensible Heat Addition [GJ] | Lights Sensible Heat Addition [GJ] | Equipment Sensible Heat Addition [GJ] | Window Heat Addition [GJ] | Interzone Air Transfer Heat Addition [GJ] | Infiltration Heat Addition [GJ] | Opaque Surface Conduction and Other Heat Addition [GJ] | Equipment Sensible Heat Removal [GJ] | Window Heat Removal [GJ] | Interzone Air Transfer Heat Removal [GJ] | Infiltration Heat Removal [GJ] | Opaque Surface Conduction and Other Heat Removal [GJ] |
|-------------------------|---|---|---|---|---|---|--|--|---|------------------------------|---|---------------------------------------|---|--|-----------------------------|--|--------------------------------------|--|
| THERMAL ZONE: SPACE 101 | 2.942 | -149.174 | 0.000 | 0.000 | 0.000 | 0.000 | 36.807 | 130.320 | 123.544 | 57.481 | 0.000 | 0.828 | 0.001 | 0.000 | -28.382 | 0.000 | -125.944 | -48.423 |
| THERMAL ZONE: SPACE 102 | 3.865 | -183.840 | 0.000 | 0.000 | 0.000 | 0.000 | 47.349 | 167.555 | 158.843 | 63.478 | 0.000 | 1.064 | 0.002 | 0.000 | -36.417 | 0.000 | -161.716 | -60.181 |
| THERMAL ZONE: SPACE 103 | 2.832 | -145.920 | 0.000 | 0.000 | 0.000 | 0.000 | 36.780 | 130.320 | 123.544 | 53.229 | 0.000 | 0.828 | 0.001 | 0.000 | -28.285 | 0.000 | -126.001 | -47.326 |
| THERMAL ZONE: SPACE 104 | 3.224 | -188.644 | 0.000 | 0.000 | 0.000 | 0.000 | 47.194 | 167.555 | 158.843 | 71.642 | 0.000 | 1.064 | 0.002 | 0.000 | -36.583 | 0.000 | -162.452 | -61.842 |
| THERMAL ZONE: SPACE 201 | 2.776 | -160.041 | 0.000 | 0.000 | 0.000 | 0.000 | 36.876 | 130.320 | 123.544 | 62.578 | 0.000 | 0.821 | 0.001 | 0.000 | -29.261 | 0.000 | -127.045 | -40.568 |
| THERMAL ZONE: SPACE 202 | 3.518 | -197.111 | 0.000 | 0.000 | 0.000 | 0.000 | 47.402 | 167.555 | 158.843 | 69.787 | 0.000 | 1.056 | 0.001 | 0.000 | -37.580 | 0.000 | -163.288 | -50.180 |
| THERMAL ZONE: SPACE 203 | 2.541 | -158.075 | 0.000 | 0.000 | 0.000 | 0.000 | 36.837 | 130.320 | 123.544 | 60.633 | 0.000 | 0.821 | 0.001 | 0.000 | -29.133 | 0.000 | -127.145 | -40.343 |
| THERMAL ZONE: SPACE 204 | 2.677 | -200.227 | 0.000 | 0.000 | 0.000 | 0.000 | 47.213 | 167.555 | 158.843 | 77.183 | 0.000 | 1.056 | 0.001 | 0.000 | -37.787 | 0.000 | -164.121 | -52.392 |
| THERMAL ZONE: SPACE 301 | 3.000 | -165.100 | 0.000 | 0.000 | 0.000 | 0.000 | 36.938 | 130.320 | 123.544 | 69.324 | 0.000 | 0.814 | 0.001 | 0.000 | -29.286 | 0.000 | -127.112 | -42.442 |
| THERMAL ZONE: SPACE 302 | 3.437 | -204.114 | 0.000 | 0.000 | 0.000 | 0.000 | 47.396 | 167.555 | 158.843 | 81.959 | 0.000 | 1.047 | 0.001 | 0.000 | -37.598 | 0.000 | -163.745 | -54.779 |
| THERMAL ZONE: SPACE 303 | 2.723 | -164.367 | 0.000 | 0.000 | 0.000 | 0.000 | 36.891 | 130.320 | 123.544 | 68.871 | 0.000 | 0.814 | 0.001 | 0.000 | -29.159 | 0.000 | -127.253 | -42.385 |
| THERMAL ZONE: SPACE 304 | 2.705 | -205.286 | 0.000 | 0.000 | 0.000 | 0.000 | 47.222 | 167.555 | 158.843 | 86.528 | 0.000 | 1.047 | 0.002 | 0.000 | -37.783 | 0.000 | -164.476 | -56.354 |
| THERMAL ZONE: SPACE 401 | 5.965 | -158.518 | 0.000 | 0.000 | 0.000 | 0.000 | 37.300 | 130.320 | 123.544 | 78.280 | 0.000 | 0.808 | 0.003 | 0.000 | -28.659 | 0.000 | -125.451 | -63.590 |
| THERMAL ZONE: SPACE 402 | 6.421 | -195.090 | 0.000 | 0.000 | 0.000 | 0.000 | 47.753 | 167.555 | 158.843 | 96.393 | 0.000 | 1.039 | 0.004 | 0.000 | -36.790 | 0.000 | -162.044 | -84.079 |
| THERMAL ZONE: SPACE 403 | 5.581 | -159.299 | 0.000 | 0.000 | 0.000 | 0.000 | 37.271 | 130.320 | 123.544 | 78.500 | 0.000 | 0.808 | 0.003 | 0.000 | -28.505 | 0.000 | -125.554 | -62.666 |
| THERMAL ZONE: SPACE 404 | 5.908 | -196.692 | 0.000 | 0.000 | 0.000 | 0.000 | 47.691 | 167.555 | 158.843 | 99.383 | 0.000 | 1.039 | 0.004 | 0.000 | -37.015 | 0.000 | -162.326 | -84.386 |
| THERMAL ZONE: SPACE 501 | 43.122 | -133.411 | 0.000 | 0.000 | 0.000 | 0.000 | 38.252 | 130.320 | 123.544 | 84.900 | 0.000 | 0.992 | 0.006 | 0.000 | -25.817 | 0.000 | -195.263 | -66.640 |
| THERMAL ZONE: SPACE 502 | 49.125 | -164.980 | 0.000 | 0.000 | 0.000 | 0.000 | 49.026 | 167.555 | 158.843 | 111.321 | 0.000 | 1.275 | 0.000 | 0.000 | -33.296 | 0.000 | -251.695 | -87.173 |
| THERMAL ZONE: SPACE 503 | 41.972 | -136.462 | 0.000 | 0.000 | 0.000 | 0.000 | 38.233 | 130.320 | 123.544 | 90.730 | 0.000 | 0.992 | 0.006 | 0.000 | -25.779 | 0.000 | -195.461 | -68.089 |
| THERMAL ZONE: SPACE 504 | 48.633 | -165.129 | 0.000 | 0.000 | 0.000 | 0.000 | 49.026 | 167.555 | 158.843 | 110.433 | 0.000 | 1.275 | 0.000 | 0.000 | -33.333 | 0.000 | -251.746 | -85.557 |
| Total Facility | 242.966 | -3431.480 | 0.000 | 0.000 | 0.000 | 0.000 | 849.456 | 2978.747 | 2823.873 | 1572.632 | 0.000 | 19.488 | 0.043 | 0.000 | -646.447 | 0.000 | -3209.840 | -1199.394 |



Variant 1

Results:

Peak Cooling Sensible Heat Gain Components

| | Time of Peak {TIMESTAMP} | HVAC Zone Eq & Other Sensible Air Heating [W] | HVAC Zone Eq & Other Sensible Air Cooling [W] | HVAC Terminal Unit Sensible Air Heating [W] | HVAC Terminal Unit Sensible Air Cooling [W] | HVAC Input Heated Surface Heating [W] | HVAC Input Cooled Surface Cooling [W] | People Sensible Heat Addition [W] | Lights Sensible Heat Addition [W] | Equipment Sensible Heat Addition [W] | Window Heat Addition [W] | Interzone Air Transfer Heat Addition [W] | Infiltration Heat Addition [W] | Opaque Surface Conduction and Other Heat Addition [W] | Equipment Sensible Heat Removal [W] | Window Heat Removal [W] | Interzone Air Transfer Heat Removal [W] | Infiltration Heat Removal [W] | Opaque Surface Conduction and Other Heat Removal [W] |
|-------------------------|-----------------------------|--|--|--|--|--|--|---|---|--|-----------------------------|--|--------------------------------------|--|---|----------------------------|---|-------------------------------------|---|
| THERMAL ZONE: SPACE 101 | 07-JUN-06:01 | 0.00 | -255186.23 | 0.00 | 0.00 | 0.00 | 0.00 | 305.84 | 1118.91 | 2893.34 | 12859.80 | 0.00 | 0.00 | 238775.62 | 0.00 | -0.00 | 0.00 | -767.28 | 0.00 |
| THERMAL ZONE: SPACE 102 | 29-JUN-06:01 | 0.00 | -319194.11 | 0.00 | 0.00 | 0.00 | 0.00 | 393.22 | 1438.60 | 3720.01 | 3680.68 | 0.00 | 0.00 | 310292.07 | 0.00 | -0.00 | 0.00 | -330.46 | 0.00 |
| THERMAL ZONE: SPACE 103 | 02-AUG-06:01 | 0.00 | -248778.59 | 0.00 | 0.00 | 0.00 | 0.00 | 305.84 | 1118.91 | 2893.34 | 3148.51 | 0.00 | 0.00 | 241365.40 | 0.00 | -0.00 | 0.00 | -53.40 | 0.00 |
| THERMAL ZONE: SPACE 104 | 29-JUN-06:01 | 0.00 | -319200.27 | 0.00 | 0.00 | 0.00 | 0.00 | 393.22 | 1438.60 | 3720.01 | 4250.17 | 0.00 | 0.00 | 309728.77 | 0.00 | -0.00 | 0.00 | -330.51 | 0.00 |
| THERMAL ZONE: SPACE 201 | 07-JUN-06:01 | 0.00 | -252840.96 | 0.00 | 0.00 | 0.00 | 0.00 | 305.84 | 1118.91 | 2893.34 | 13195.48 | 0.00 | 0.00 | 236096.70 | 0.00 | -0.00 | 0.00 | -769.30 | 0.00 |
| THERMAL ZONE: SPACE 202 | 02-AUG-06:01 | 0.00 | -321037.83 | 0.00 | 0.00 | 0.00 | 0.00 | 393.22 | 1438.60 | 3720.01 | 3359.11 | 0.00 | 0.00 | 312198.34 | 0.00 | -0.00 | 0.00 | -71.46 | 0.00 |
| THERMAL ZONE: SPACE 203 | 02-AUG-06:01 | 0.00 | -250963.08 | 0.00 | 0.00 | 0.00 | 0.00 | 305.84 | 1118.91 | 2893.34 | 3390.64 | 0.00 | 0.00 | 243310.00 | 0.00 | -0.00 | 0.00 | -55.65 | 0.00 |
| THERMAL ZONE: SPACE 204 | 02-AUG-06:01 | 0.00 | -321293.87 | 0.00 | 0.00 | 0.00 | 0.00 | 393.22 | 1438.60 | 3720.01 | 3820.70 | 0.00 | 0.00 | 311992.81 | 0.00 | -0.00 | 0.00 | -71.47 | 0.00 |
| THERMAL ZONE: SPACE 301 | 07-JUN-06:01 | 0.00 | -254104.87 | 0.00 | 0.00 | 0.00 | 0.00 | 305.84 | 1118.91 | 2893.34 | 13776.61 | 0.00 | 0.00 | 236781.82 | 0.00 | -0.00 | 0.00 | -771.65 | 0.00 |
| THERMAL ZONE: SPACE 302 | 02-AUG-06:01 | 0.00 | -322399.49 | 0.00 | 0.00 | 0.00 | 0.00 | 393.22 | 1438.60 | 3720.01 | 3842.74 | 0.00 | 0.00 | 313079.20 | 0.00 | -0.00 | 0.00 | -74.28 | 0.00 |
| THERMAL ZONE: SPACE 303 | 07-JUN-06:01 | 0.00 | -255921.16 | 0.00 | 0.00 | 0.00 | 0.00 | 305.84 | 1118.91 | 2893.34 | 23444.51 | 0.00 | 0.00 | 228930.40 | 0.00 | -0.00 | 0.00 | -771.84 | 0.00 |
| THERMAL ZONE: SPACE 304 | 02-AUG-06:01 | 0.00 | -322557.30 | 0.00 | 0.00 | 0.00 | 0.00 | 393.22 | 1438.60 | 3720.01 | 4006.50 | 0.00 | 0.00 | 313073.27 | 0.00 | -0.00 | 0.00 | -74.29 | 0.00 |
| THERMAL ZONE: SPACE 401 | 07-JUN-06:01 | 0.00 | -254332.72 | 0.00 | 0.00 | 0.00 | 0.00 | 305.84 | 1118.91 | 2893.34 | 14579.89 | 0.00 | 0.00 | 236208.67 | 0.00 | -0.00 | 0.00 | -773.92 | 0.00 |
| THERMAL ZONE: SPACE 402 | 02-AUG-06:01 | 0.00 | -322961.51 | 0.00 | 0.00 | 0.00 | 0.00 | 393.22 | 1438.60 | 3720.01 | 4231.88 | 0.00 | 0.00 | 313254.88 | 0.00 | -0.00 | 0.00 | -77.07 | 0.00 |
| THERMAL ZONE: SPACE 403 | 07-JUN-06:01 | 0.00 | -257288.77 | 0.00 | 0.00 | 0.00 | 0.00 | 305.84 | 1118.91 | 2893.34 | 23840.93 | 0.00 | 0.00 | 229903.96 | 0.00 | -0.00 | 0.00 | -774.21 | 0.00 |
| THERMAL ZONE: SPACE 404 | 02-AUG-06:01 | 0.00 | -323237.08 | 0.00 | 0.00 | 0.00 | 0.00 | 393.22 | 1438.60 | 3720.01 | 4547.12 | 0.00 | 0.00 | 313215.23 | 0.00 | -0.00 | 0.00 | -77.09 | 0.00 |
| THERMAL ZONE: SPACE 501 | 02-AUG-06:01 | 0.00 | -253327.99 | 0.00 | 0.00 | 0.00 | 0.00 | 305.84 | 1118.91 | 2893.34 | 7203.98 | 0.00 | 0.00 | 241915.35 | 0.00 | -0.00 | 0.00 | -109.42 | 0.00 |
| THERMAL ZONE: SPACE 502 | 02-AUG-06:01 | 0.00 | -322387.15 | 0.00 | 0.00 | 0.00 | 0.00 | 393.22 | 1438.60 | 3720.01 | 4931.03 | 0.00 | 0.00 | 312044.55 | 0.00 | -0.00 | 0.00 | -140.26 | 0.00 |
| THERMAL ZONE: SPACE 503 | 30-JUN-06:01 | 0.00 | -255802.71 | 0.00 | 0.00 | 0.00 | 0.00 | 305.84 | 1118.91 | 2893.34 | 24718.53 | 0.00 | 0.00 | 227000.51 | 0.00 | -0.00 | 0.00 | -234.42 | 0.00 |
| THERMAL ZONE: SPACE 504 | 02-AUG-06:01 | 0.00 | -322533.29 | 0.00 | 0.00 | 0.00 | 0.00 | 393.22 | 1438.60 | 3720.01 | 4964.10 | 0.00 | 0.00 | 312157.64 | 0.00 | -0.00 | 0.00 | -140.27 | 0.00 |
| Total Facility | 02-AUG-06:01 | 0.00 | -5738286.87 | 0.00 | 0.00 | 0.00 | 0.00 | 6990.59 | 25575.05 | 66133.47 | 106588.23 | 0.00 | 0.00 | 5534536.51 | 0.00 | 0.00 | 0.00 | -1536.97 | 0.00 |



Variant 1

Peak Heating Sensible Heat Gain Components

Results:

| Time of Peak {TIMESTAMP} | HVAC Zone Eq & Other Sensible Air Heating [W] | HVAC Zone Eq & Other Sensible Air Cooling [W] | HVAC Terminal Unit Sensible Air Heating [W] | HVAC Terminal Unit Sensible Air Cooling [W] | HVAC Input Heated Surface Heating [W] | HVAC Input Cooled Surface Cooling [W] | People Sensible Heat Addition [W] | Lights Sensible Heat Addition [W] | Equipment Sensible Heat Addition [W] | Window Heat Addition [W] | Interzone Air Transfer Heat Addition [W] | Infiltration Heat Addition [W] | Opaque Surface Conduction and Other Heat Addition [W] | Equipment Sensible Heat Removal [W] | Window Heat Removal [W] | Interzone Air Transfer Heat Removal [W] | Infiltration Heat Removal [W] | Opaque Surface Conduction and Other Heat Removal [W] |
|--------------------------------------|---|---|---|---|---------------------------------------|---------------------------------------|-----------------------------------|-----------------------------------|--------------------------------------|--------------------------|--|--------------------------------|---|-------------------------------------|-------------------------|---|-------------------------------|--|
| THERMAL ZONE: SPACE 101 13-DEC-06:01 | 564549.43 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 551.72 | 1118.91 | 2893.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1307.69 | 0.00 | -1893.09 | -565912.62 |
| THERMAL ZONE: SPACE 102 13-DEC-06:01 | 725736.28 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 709.35 | 1438.60 | 3720.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1667.01 | 0.00 | -2433.98 | -727503.26 |
| THERMAL ZONE: SPACE 103 13-DEC-06:01 | 564722.89 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 551.75 | 1118.91 | 2893.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1295.93 | 0.00 | -1893.06 | -566097.90 |
| THERMAL ZONE: SPACE 104 13-DEC-06:01 | 723479.63 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 708.99 | 1438.60 | 3720.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1681.90 | 0.00 | -2434.41 | -725230.92 |
| THERMAL ZONE: SPACE 201 13-DEC-06:01 | 542345.88 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 548.07 | 1118.91 | 2893.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1332.52 | 0.00 | -1899.72 | -543673.96 |
| THERMAL ZONE: SPACE 202 13-DEC-06:01 | 697833.76 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 704.76 | 1438.60 | 3720.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1695.00 | 0.00 | -2442.38 | -699559.73 |
| THERMAL ZONE: SPACE 203 13-DEC-06:01 | 543102.98 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 548.19 | 1118.91 | 2893.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1325.58 | 0.00 | -1899.58 | -544438.26 |
| THERMAL ZONE: SPACE 204 13-DEC-06:01 | 692198.69 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 703.84 | 1438.60 | 3720.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1710.87 | 0.00 | -2443.41 | -693906.86 |
| THERMAL ZONE: SPACE 301 13-DEC-06:01 | 542811.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 548.14 | 1118.91 | 2893.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1347.50 | 0.00 | -1902.10 | -544122.04 |
| THERMAL ZONE: SPACE 302 13-DEC-06:01 | 696143.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 704.48 | 1438.60 | 3720.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1718.92 | 0.00 | -2445.86 | -697841.98 |
| THERMAL ZONE: SPACE 303 13-DEC-06:01 | 542722.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 548.13 | 1118.91 | 2893.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1338.92 | 0.00 | -1902.11 | -544041.45 |
| THERMAL ZONE: SPACE 304 13-DEC-06:01 | 686799.61 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 702.95 | 1438.60 | 3720.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1727.74 | 0.00 | -2447.55 | -688485.87 |
| THERMAL ZONE: SPACE 401 13-DEC-06:01 | 601941.38 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 557.75 | 1118.91 | 2893.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1319.32 | 0.00 | -1893.24 | -603298.81 |
| THERMAL ZONE: SPACE 402 13-DEC-06:01 | 768886.32 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 716.30 | 1438.60 | 3720.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1680.80 | 0.00 | -2435.15 | -770645.28 |
| THERMAL ZONE: SPACE 403 13-DEC-06:01 | 601468.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 557.67 | 1118.91 | 2893.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1307.91 | 0.00 | -1893.33 | -602836.89 |
| THERMAL ZONE: SPACE 404 13-DEC-06:01 | 763074.97 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 715.37 | 1438.60 | 3720.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1697.43 | 0.00 | -2436.30 | -764815.21 |
| THERMAL ZONE: SPACE 501 20-FEB-06:01 | 663688.91 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 566.51 | 1118.91 | 2893.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2704.44 | 0.00 | -6529.28 | -659033.94 |
| THERMAL ZONE: SPACE 502 13-DEC-06:01 | 852472.52 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 728.37 | 1438.60 | 3720.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1608.20 | 0.00 | -4259.26 | -852492.03 |
| THERMAL ZONE: SPACE 503 20-FEB-06:01 | 663670.79 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 566.51 | 1118.91 | 2893.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2704.84 | 0.00 | -6529.29 | -659015.42 |
| THERMAL ZONE: SPACE 504 13-DEC-06:01 | 852369.97 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 728.37 | 1438.60 | 3720.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1609.32 | 0.00 | -4259.27 | -852388.36 |
| Total Facility 13-DEC-06:01 | 13289256.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 12667.22 | 25575.05 | 66133.47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -29870.76 | 0.00 | -49839.20 | -13313921.83 |

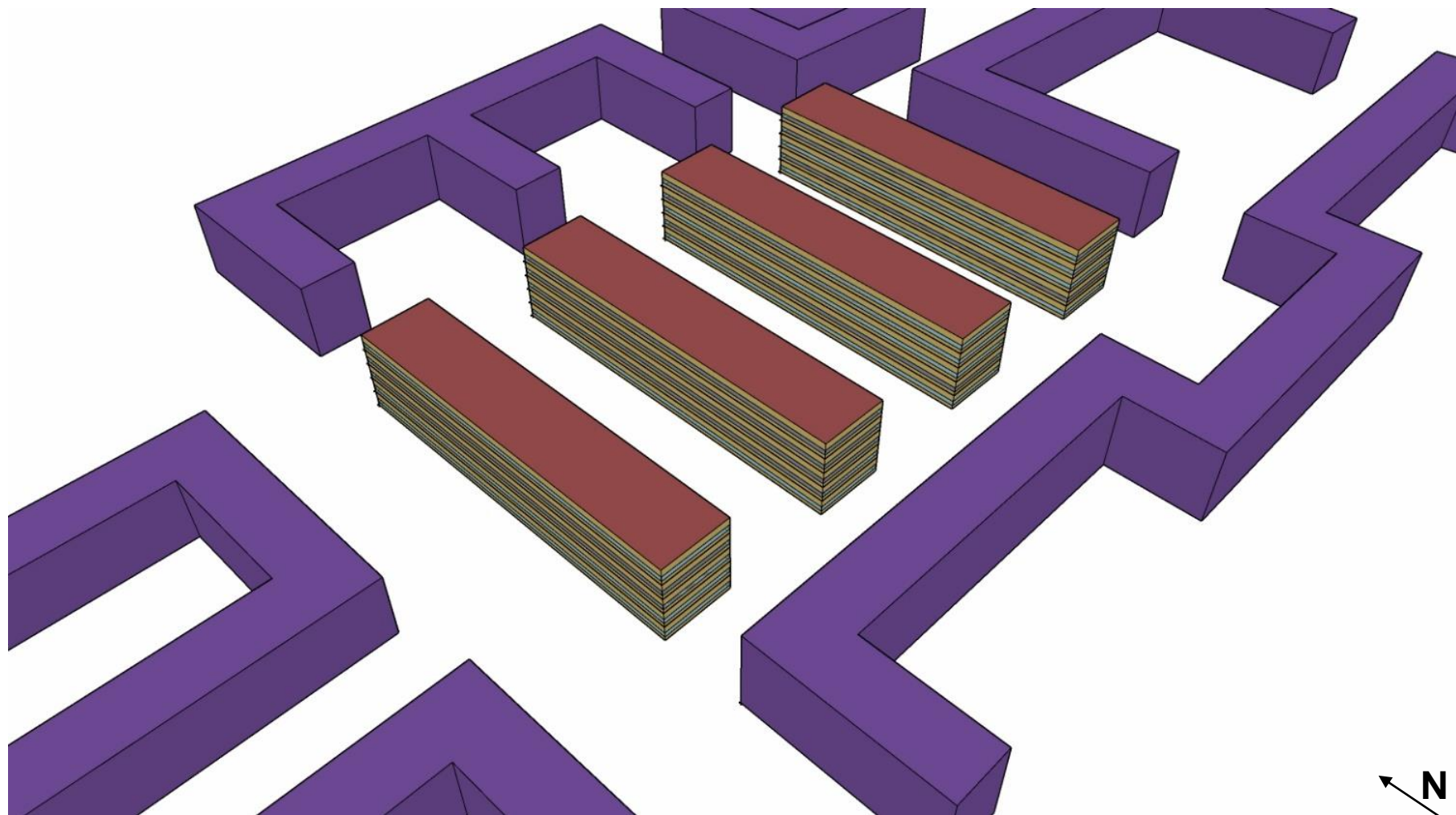


Variant 2

Building layout:

4 parallel
buildings along
the north-south
axis

5 storeys





Variant 2

Annual Building Sensible Heat Gain Components

Results:

| | HVAC Zone Eq & Other Sensible Air Heating [GJ] | HVAC Zone Eq & Other Sensible Air Cooling [GJ] | HVAC Terminal Unit Sensible Air Heating [GJ] | HVAC Terminal Unit Sensible Air Cooling [GJ] | HVAC Input Heated Surface Heating [GJ] | HVAC Input Cooled Surface Cooling [GJ] | People Sensible Heat Addition [GJ] | Lights Sensible Heat Addition [GJ] | Equipment Sensible Heat Addition [GJ] | Window Heat Addition [GJ] | Interzone Air Transfer Heat Addition [GJ] | Infiltration Heat Addition [GJ] | Opaque Surface Conduction and Other Heat Addition [GJ] | Equipment Sensible Heat Removal [GJ] | Window Heat Removal [GJ] | Interzone Air Transfer Heat Removal [GJ] | Infiltration Heat Removal [GJ] | Opaque Surface Conduction and Other Heat Removal [GJ] |
|-------------------------|---|---|---|---|---|---|--|--|---|------------------------------|---|---------------------------------------|---|--|-----------------------------|--|--------------------------------------|--|
| THERMAL ZONE: SPACE 505 | 7.592 | -182.437 | 0.000 | 0.000 | 0.000 | 0.000 | 42.653 | 148.937 | 141.194 | 85.693 | 0.000 | 0.950 | 0.003 | 0.000 | -38.622 | 0.000 | -151.647 | -54.313 |
| THERMAL ZONE: SPACE 506 | 11.747 | -185.841 | 0.000 | 0.000 | 0.000 | 0.000 | 42.963 | 148.937 | 141.194 | 104.892 | 0.000 | 0.943 | 0.003 | 0.000 | -38.161 | 0.000 | -150.244 | -76.430 |
| THERMAL ZONE: SPACE 507 | 59.387 | -162.460 | 0.000 | 0.000 | 0.000 | 0.000 | 43.838 | 148.937 | 141.194 | 120.371 | 0.000 | 1.153 | 0.007 | 0.000 | -34.803 | 0.000 | -229.506 | -88.111 |
| THERMAL ZONE: SPACE 508 | 7.157 | -183.506 | 0.000 | 0.000 | 0.000 | 0.000 | 42.611 | 148.937 | 141.194 | 87.316 | 0.000 | 0.950 | 0.003 | 0.000 | -38.621 | 0.000 | -151.863 | -54.174 |
| THERMAL ZONE: SPACE 509 | 12.061 | -181.127 | 0.000 | 0.000 | 0.000 | 0.000 | 42.994 | 148.937 | 141.194 | 98.040 | 0.000 | 0.943 | 0.003 | 0.000 | -37.893 | 0.000 | -150.036 | -75.112 |
| THERMAL ZONE: SPACE 510 | 7.226 | -165.055 | 0.000 | 0.000 | 0.000 | 0.000 | 42.451 | 148.937 | 141.194 | 70.053 | 0.000 | 0.966 | 0.003 | 0.000 | -37.500 | 0.000 | -150.123 | -58.149 |
| THERMAL ZONE: SPACE 511 | 7.807 | -169.451 | 0.000 | 0.000 | 0.000 | 0.000 | 42.638 | 148.937 | 141.194 | 67.182 | 0.000 | 0.958 | 0.001 | 0.000 | -38.596 | 0.000 | -151.174 | -49.495 |
| THERMAL ZONE: SPACE 512 | 7.670 | -155.648 | 0.000 | 0.000 | 0.000 | 0.000 | 42.522 | 148.937 | 141.194 | 58.222 | 0.000 | 0.966 | 0.003 | 0.000 | -37.365 | 0.000 | -149.639 | -56.858 |
| THERMAL ZONE: SPACE 513 | 7.462 | -156.140 | 0.000 | 0.000 | 0.000 | 0.000 | 42.499 | 148.937 | 141.194 | 59.220 | 0.000 | 0.966 | 0.003 | 0.000 | -37.377 | 0.000 | -149.747 | -57.014 |
| THERMAL ZONE: SPACE 514 | 7.291 | -177.833 | 0.000 | 0.000 | 0.000 | 0.000 | 42.575 | 148.937 | 141.194 | 78.462 | 0.000 | 0.958 | 0.000 | 0.000 | -38.749 | 0.000 | -151.622 | -51.212 |
| THERMAL ZONE: SPACE 515 | 7.254 | -158.667 | 0.000 | 0.000 | 0.000 | 0.000 | 42.463 | 148.937 | 141.194 | 62.509 | 0.000 | 0.966 | 0.003 | 0.000 | -37.371 | 0.000 | -149.978 | -57.307 |
| THERMAL ZONE: SPACE 516 | 7.549 | -169.663 | 0.000 | 0.000 | 0.000 | 0.000 | 42.617 | 148.937 | 141.194 | 67.748 | 0.000 | 0.958 | 0.000 | 0.000 | -38.600 | 0.000 | -151.274 | -49.466 |
| THERMAL ZONE: SPACE 517 | 7.141 | -172.051 | 0.000 | 0.000 | 0.000 | 0.000 | 42.574 | 148.937 | 141.194 | 71.385 | 0.000 | 0.958 | 0.001 | 0.000 | -38.596 | 0.000 | -151.517 | -50.026 |
| THERMAL ZONE: SPACE 518 | 7.477 | -187.654 | 0.000 | 0.000 | 0.000 | 0.000 | 42.628 | 148.937 | 141.194 | 90.597 | 0.000 | 0.950 | 0.003 | 0.000 | -38.814 | 0.000 | -151.867 | -53.447 |
| THERMAL ZONE: SPACE 519 | 7.841 | -182.154 | 0.000 | 0.000 | 0.000 | 0.000 | 42.672 | 148.937 | 141.194 | 84.852 | 0.000 | 0.950 | 0.003 | 0.000 | -38.612 | 0.000 | -151.559 | -54.120 |
| THERMAL ZONE: SPACE 520 | 11.840 | -181.215 | 0.000 | 0.000 | 0.000 | 0.000 | 42.983 | 148.937 | 141.194 | 98.427 | 0.000 | 0.943 | 0.003 | 0.000 | -37.880 | 0.000 | -150.091 | -75.136 |
| THERMAL ZONE: SPACE 521 | 11.510 | -182.144 | 0.000 | 0.000 | 0.000 | 0.000 | 42.956 | 148.937 | 141.194 | 100.052 | 0.000 | 0.943 | 0.003 | 0.000 | -37.889 | 0.000 | -150.227 | -75.332 |
| THERMAL ZONE: SPACE 522 | 59.749 | -161.466 | 0.000 | 0.000 | 0.000 | 0.000 | 43.845 | 148.937 | 141.194 | 120.402 | 0.000 | 1.153 | 0.007 | 0.000 | -34.770 | 0.000 | -229.350 | -89.694 |
| THERMAL ZONE: SPACE 523 | 59.521 | -161.464 | 0.000 | 0.000 | 0.000 | 0.000 | 43.843 | 148.937 | 141.194 | 120.459 | 0.000 | 1.153 | 0.007 | 0.000 | -34.762 | 0.000 | -229.372 | -89.508 |
| THERMAL ZONE: SPACE 524 | 59.117 | -161.931 | 0.000 | 0.000 | 0.000 | 0.000 | 43.837 | 148.937 | 141.194 | 120.996 | 0.000 | 1.153 | 0.007 | 0.000 | -34.755 | 0.000 | -229.464 | -89.082 |
| Total Facility | 374.396 | -3437.907 | 0.000 | 0.000 | 0.000 | 0.000 | 858.162 | 2978.747 | 2823.873 | 1766.878 | 0.000 | 19.876 | 0.066 | 0.000 | -749.737 | 0.000 | -3330.301 | -1303.987 |



Variant 2

Results:

Peak Cooling Sensible Heat Gain Components

| | Time of Peak {TIMESTAMP} | HVAC Zone Eq & Other Sensible Air Heating [W] | HVAC Zone Eq & Other Sensible Air Cooling [W] | HVAC Terminal Unit Sensible Air Heating [W] | HVAC Terminal Unit Sensible Air Cooling [W] | HVAC Input Heated Surface Heating [W] | HVAC Input Cooled Surface Cooling [W] | People Sensible Heat Addition [W] | Lights Sensible Heat Addition [W] | Equipment Sensible Heat Addition [W] | Window Heat Addition [W] | Interzone Air Transfer Heat Addition [W] | Infiltration Heat Addition [W] | Opaque Surface Conduction and Other Heat Addition [W] | Equipment Sensible Heat Removal [W] | Window Heat Removal [W] | Interzone Air Transfer Heat Removal [W] | Infiltration Heat Removal [W] | Opaque Surface Conduction and Other Heat Removal [W] |
|-------------------------|-----------------------------|--|--|--|--|--|--|---|---|--|-----------------------------|--|--------------------------------------|--|---|----------------------------|---|-------------------------------------|---|
| THERMAL ZONE: SPACE 505 | 02-AUG-06:01 | 0.00 | -288514.19 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 4059.87 | 0.00 | 0.00 | 279589.91 | 0.00 | -0.00 | 0.00 | -70.55 | 0.00 |
| THERMAL ZONE: SPACE 506 | 07-JUN-06:01 | 0.00 | -294293.80 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 27904.44 | 0.00 | 0.00 | 262397.96 | 0.00 | -0.00 | 0.00 | -943.55 | 0.00 |
| THERMAL ZONE: SPACE 507 | 30-JUN-06:01 | 0.00 | -293421.99 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 28982.87 | 0.00 | 0.00 | 259782.35 | 0.00 | -0.00 | 0.00 | -278.18 | 0.00 |
| THERMAL ZONE: SPACE 508 | 02-AUG-06:01 | 0.00 | -288939.70 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 5131.56 | 0.00 | 0.00 | 278943.77 | 0.00 | -0.00 | 0.00 | -70.58 | 0.00 |
| THERMAL ZONE: SPACE 509 | 07-JUN-06:01 | 0.00 | -293675.84 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 27280.99 | 0.00 | 0.00 | 262403.38 | 0.00 | -0.00 | 0.00 | -943.49 | 0.00 |
| THERMAL ZONE: SPACE 510 | 02-AUG-06:01 | 0.00 | -285099.84 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 3611.47 | 0.00 | 0.00 | 276618.53 | 0.00 | -0.00 | 0.00 | -65.11 | 0.00 |
| THERMAL ZONE: SPACE 511 | 02-AUG-06:01 | 0.00 | -286894.25 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 3373.37 | 0.00 | 0.00 | 278653.74 | 0.00 | -0.00 | 0.00 | -67.82 | 0.00 |
| THERMAL ZONE: SPACE 512 | 29-JUN-06:01 | 0.00 | -283604.13 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 3547.31 | 0.00 | 0.00 | 275435.13 | 0.00 | -0.00 | 0.00 | -313.26 | 0.00 |
| THERMAL ZONE: SPACE 513 | 29-JUN-06:01 | 0.00 | -283602.74 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 3555.57 | 0.00 | 0.00 | 275425.48 | 0.00 | -0.00 | 0.00 | -313.26 | 0.00 |
| THERMAL ZONE: SPACE 514 | 02-AUG-06:01 | 0.00 | -287829.83 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 3807.12 | 0.00 | 0.00 | 279155.65 | 0.00 | -0.00 | 0.00 | -67.88 | 0.00 |
| THERMAL ZONE: SPACE 515 | 02-AUG-06:01 | 0.00 | -285106.63 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 4359.47 | 0.00 | 0.00 | 275877.32 | 0.00 | -0.00 | 0.00 | -65.12 | 0.00 |
| THERMAL ZONE: SPACE 516 | 02-AUG-06:01 | 0.00 | -286858.64 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 3366.68 | 0.00 | 0.00 | 278624.83 | 0.00 | -0.00 | 0.00 | -67.82 | 0.00 |
| THERMAL ZONE: SPACE 517 | 02-AUG-06:01 | 0.00 | -287408.95 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 4529.32 | 0.00 | 0.00 | 278012.53 | 0.00 | -0.00 | 0.00 | -67.86 | 0.00 |
| THERMAL ZONE: SPACE 518 | 02-AUG-06:01 | 0.00 | -289011.23 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 4236.63 | 0.00 | 0.00 | 279910.24 | 0.00 | -0.00 | 0.00 | -70.58 | 0.00 |
| THERMAL ZONE: SPACE 519 | 02-AUG-06:01 | 0.00 | -288523.94 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 4039.56 | 0.00 | 0.00 | 279619.97 | 0.00 | -0.00 | 0.00 | -70.55 | 0.00 |
| THERMAL ZONE: SPACE 520 | 07-JUN-06:01 | 0.00 | -293651.69 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 27288.41 | 0.00 | 0.00 | 262371.81 | 0.00 | -0.00 | 0.00 | -943.49 | 0.00 |
| THERMAL ZONE: SPACE 521 | 07-JUN-06:01 | 0.00 | -293785.25 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 27330.89 | 0.00 | 0.00 | 262462.91 | 0.00 | -0.00 | 0.00 | -943.50 | 0.00 |
| THERMAL ZONE: SPACE 522 | 30-JUN-06:01 | 0.00 | -293327.34 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 28983.96 | 0.00 | 0.00 | 259686.60 | 0.00 | -0.00 | 0.00 | -278.17 | 0.00 |
| THERMAL ZONE: SPACE 523 | 30-JUN-06:01 | 0.00 | -293312.01 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 28984.14 | 0.00 | 0.00 | 259671.08 | 0.00 | -0.00 | 0.00 | -278.17 | 0.00 |
| THERMAL ZONE: SPACE 524 | 30-JUN-06:01 | 0.00 | -293396.73 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 28981.95 | 0.00 | 0.00 | 259758.00 | 0.00 | -0.00 | 0.00 | -278.18 | 0.00 |
| Total Facility | 02-AUG-06:01 | 0.00 | -5771604.98 | 0.00 | 0.00 | 0.00 | 0.00 | 6990.59 | 25575.05 | 66133.47 | 142299.78 | 0.00 | 0.00 | 5532234.03 | 0.00 | 0.00 | 0.00 | -1627.94 | 0.00 |



Variant 2

Peak Heating Sensible Heat Gain Components

Results:

| | Time of Peak (TIMESTAMP) | HVAC Zone Eq & Other Sensible Air Heating [W] | HVAC Zone Eq & Other Sensible Air Cooling [W] | HVAC Terminal Unit Sensible Air Heating [W] | HVAC Terminal Unit Sensible Air Cooling [W] | HVAC Input Heated Surface Heating [W] | HVAC Input Cooled Surface Cooling [W] | People Sensible Heat Addition [W] | Lights Sensible Heat Addition [W] | Equipment Sensible Heat Addition [W] | Window Heat Addition [W] | Interzone Air Transfer Heat Addition [W] | Infiltration Heat Addition [W] | Opaque Surface Conduction and Other Heat Addition [W] | Equipment Sensible Heat Removal [W] | Window Heat Removal [W] | Interzone Air Transfer Heat Removal [W] | Infiltration Heat Removal [W] | Opaque Surface Conduction and Other Heat Removal [W] |
|-------------------------|-----------------------------|--|--|--|--|--|--|---|---|--|-----------------------------|--|--------------------------------------|--|---|----------------------------|---|-------------------------------------|---|
| THERMAL ZONE: SPACE 505 | 13-DEC-06:01 | 710927.97 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 641.31 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1738.08 | 0.00 | -2299.06 | -712117.57 |
| THERMAL ZONE: SPACE 506 | 13-DEC-06:01 | 746653.32 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 646.99 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1735.58 | 0.00 | -2294.08 | -747856.06 |
| THERMAL ZONE: SPACE 507 | 20-FEB-06:01 | 759601.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 647.44 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -3667.43 | 0.00 | -7743.43 | -753423.12 |
| THERMAL ZONE: SPACE 508 | 13-DEC-06:01 | 709342.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 641.06 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1737.61 | 0.00 | -2299.41 | -710531.71 |
| THERMAL ZONE: SPACE 509 | 13-DEC-06:01 | 746574.18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 646.97 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1716.18 | 0.00 | -2294.10 | -747796.31 |
| THERMAL ZONE: SPACE 510 | 25-JAN-06:01 | 728282.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 644.57 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2707.76 | 0.00 | -3409.97 | -727394.52 |
| THERMAL ZONE: SPACE 511 | 13-DEC-06:01 | 710247.41 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 641.20 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1704.89 | 0.00 | -2296.22 | -711472.93 |
| THERMAL ZONE: SPACE 512 | 25-JAN-06:01 | 742514.86 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 646.89 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2662.14 | 0.00 | -3406.56 | -741678.48 |
| THERMAL ZONE: SPACE 513 | 25-JAN-06:01 | 735499.28 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 645.74 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2670.35 | 0.00 | -3408.26 | -734651.83 |
| THERMAL ZONE: SPACE 514 | 13-DEC-06:01 | 709900.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 641.14 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1726.40 | 0.00 | -2296.29 | -711104.29 |
| THERMAL ZONE: SPACE 515 | 08-FEB-06:01 | 726626.36 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 645.25 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2362.48 | 0.00 | -3021.44 | -726473.11 |
| THERMAL ZONE: SPACE 516 | 13-DEC-06:01 | 710019.63 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 641.16 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1704.47 | 0.00 | -2296.27 | -711245.49 |
| THERMAL ZONE: SPACE 517 | 13-DEC-06:01 | 709349.58 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 641.06 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1708.59 | 0.00 | -2296.41 | -710571.06 |
| THERMAL ZONE: SPACE 518 | 13-DEC-06:01 | 710520.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 641.25 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1748.40 | 0.00 | -2299.15 | -711699.31 |
| THERMAL ZONE: SPACE 519 | 13-DEC-06:01 | 711144.17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 641.34 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1736.99 | 0.00 | -2299.01 | -712334.94 |
| THERMAL ZONE: SPACE 520 | 13-DEC-06:01 | 746415.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 646.95 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1716.49 | 0.00 | -2294.13 | -747637.05 |
| THERMAL ZONE: SPACE 521 | 13-DEC-06:01 | 745464.21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 646.80 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1718.70 | 0.00 | -2294.35 | -746683.38 |
| THERMAL ZONE: SPACE 522 | 20-FEB-06:01 | 759621.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 647.44 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -3666.81 | 0.00 | -7743.42 | -753443.70 |
| THERMAL ZONE: SPACE 523 | 20-FEB-06:01 | 759613.32 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 647.44 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -3667.05 | 0.00 | -7743.42 | -753435.71 |
| THERMAL ZONE: SPACE 524 | 20-FEB-06:01 | 759597.42 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 647.44 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -3667.46 | 0.00 | -7743.43 | -753419.40 |
| Total Facility | 13-DEC-06:01 | 14609982.55 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 12882.30 | 25575.05 | 66133.47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -34181.42 | 0.00 | -52431.77 | -14627960.18 |

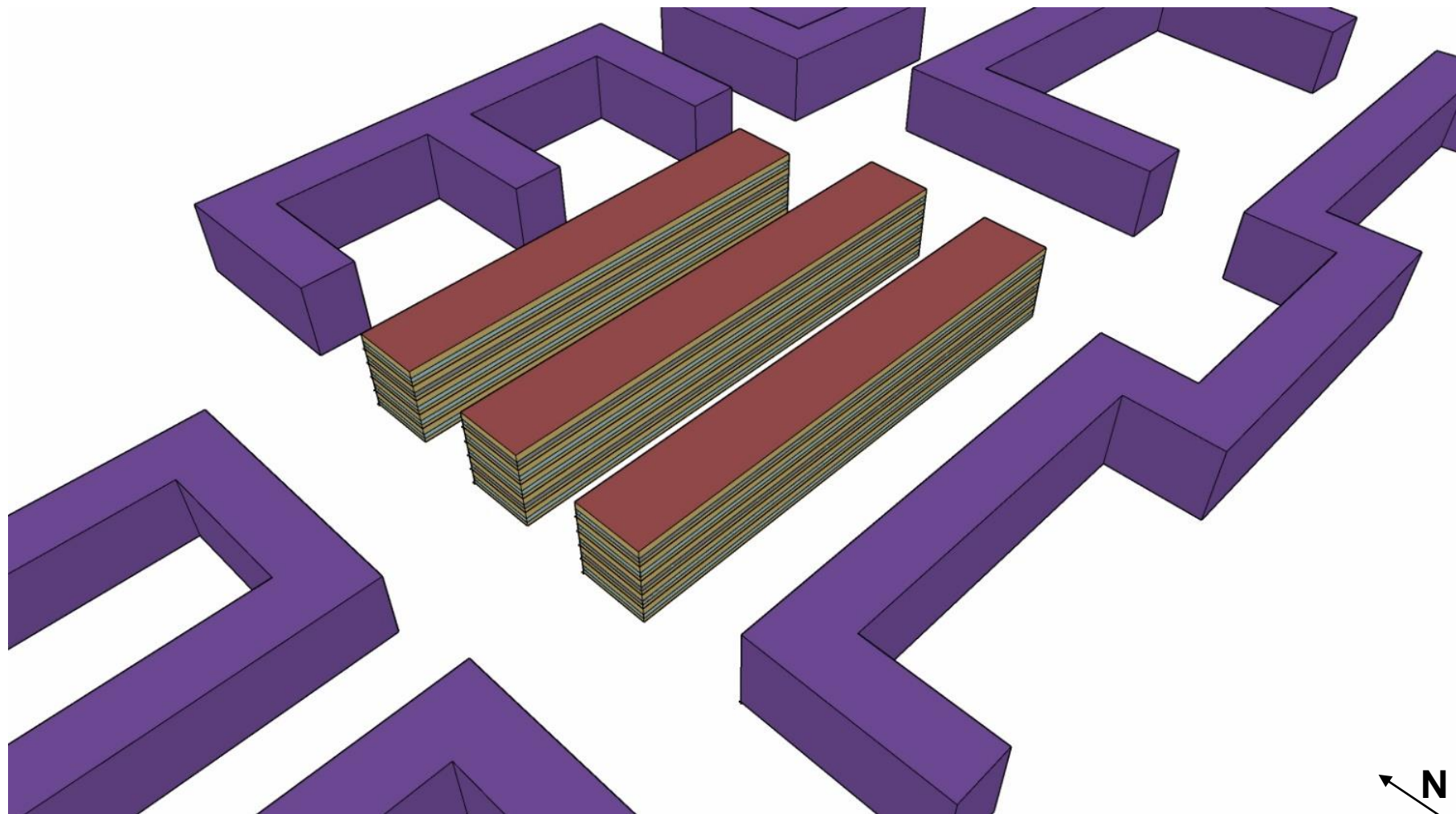


Variant 3

Building layout:

3 parallel
buildings along
the east-west axis

5 storeys





Variant 3

Annual Building Sensible Heat Gain Components

Results:

| | HVAC Zone Eq & Other Sensible Air Heating [GJ] | HVAC Zone Eq & Other Sensible Air Cooling [GJ] | HVAC Terminal Unit Sensible Air Heating [GJ] | HVAC Terminal Unit Sensible Air Cooling [GJ] | HVAC Input Heated Surface Heating [GJ] | HVAC Input Cooled Surface Cooling [GJ] | People Sensible Heat Addition [GJ] | Lights Sensible Heat Addition [GJ] | Equipment Sensible Heat Addition [GJ] | Window Heat Addition [GJ] | Interzone Air Transfer Heat Addition [GJ] | Infiltration Heat Addition [GJ] | Opaque Surface Conduction and Other Heat Addition [GJ] | Equipment Sensible Heat Removal [GJ] | Window Heat Removal [GJ] | Interzone Air Transfer Heat Removal [GJ] | Infiltration Heat Removal [GJ] | Opaque Surface Conduction and Other Heat Removal [GJ] |
|-------------------------|---|---|---|---|---|---|--|--|---|------------------------------|---|---------------------------------------|---|--|-----------------------------|--|--------------------------------------|--|
| THERMAL ZONE: SPACE 101 | 8.370 | -221.490 | 0.000 | 0.000 | 0.000 | 0.000 | 58.258 | 204.789 | 194.141 | 84.731 | 0.000 | 1.321 | 0.000 | 0.000 | -49.795 | 0.000 | -203.932 | -76.392 |
| THERMAL ZONE: SPACE 102 | 9.138 | -207.314 | 0.000 | 0.000 | 0.000 | 0.000 | 58.399 | 204.789 | 194.141 | 67.423 | 0.000 | 1.321 | 0.005 | 0.000 | -49.595 | 0.000 | -203.008 | -75.294 |
| THERMAL ZONE: SPACE 103 | 8.677 | -194.525 | 0.000 | 0.000 | 0.000 | 0.000 | 53.099 | 186.172 | 176.492 | 69.510 | 0.000 | 1.202 | 0.004 | 0.000 | -45.376 | 0.000 | -185.325 | -69.927 |
| THERMAL ZONE: SPACE 201 | 7.988 | -237.362 | 0.000 | 0.000 | 0.000 | 0.000 | 58.347 | 204.789 | 194.141 | 94.516 | 0.000 | 1.310 | 0.000 | 0.000 | -51.409 | 0.000 | -206.177 | -66.143 |
| THERMAL ZONE: SPACE 202 | 9.394 | -226.776 | 0.000 | 0.000 | 0.000 | 0.000 | 58.541 | 204.789 | 194.141 | 80.547 | 0.000 | 1.310 | 0.005 | 0.000 | -51.054 | 0.000 | -205.041 | -65.852 |
| THERMAL ZONE: SPACE 203 | 8.943 | -211.931 | 0.000 | 0.000 | 0.000 | 0.000 | 53.237 | 186.172 | 176.492 | 81.182 | 0.000 | 1.192 | 0.000 | 0.000 | -46.802 | 0.000 | -187.178 | -61.307 |
| THERMAL ZONE: SPACE 301 | 7.478 | -248.974 | 0.000 | 0.000 | 0.000 | 0.000 | 58.306 | 204.789 | 194.141 | 113.460 | 0.000 | 1.299 | 0.004 | 0.000 | -51.448 | 0.000 | -206.992 | -72.060 |
| THERMAL ZONE: SPACE 302 | 9.401 | -239.928 | 0.000 | 0.000 | 0.000 | 0.000 | 58.561 | 204.789 | 194.141 | 98.052 | 0.000 | 1.299 | 0.004 | 0.000 | -51.065 | 0.000 | -205.689 | -69.561 |
| THERMAL ZONE: SPACE 303 | 8.983 | -222.490 | 0.000 | 0.000 | 0.000 | 0.000 | 53.261 | 186.172 | 176.492 | 94.330 | 0.000 | 1.183 | 0.003 | 0.000 | -46.916 | 0.000 | -187.727 | -63.287 |
| THERMAL ZONE: SPACE 401 | 11.527 | -241.834 | 0.000 | 0.000 | 0.000 | 0.000 | 58.667 | 204.789 | 194.141 | 134.382 | 0.000 | 1.289 | 0.000 | 0.000 | -50.398 | 0.000 | -205.177 | -107.386 |
| THERMAL ZONE: SPACE 402 | 14.157 | -237.790 | 0.000 | 0.000 | 0.000 | 0.000 | 58.912 | 204.789 | 194.141 | 123.647 | 0.000 | 1.289 | 0.005 | 0.000 | -50.067 | 0.000 | -204.012 | -105.065 |
| THERMAL ZONE: SPACE 403 | 13.341 | -220.386 | 0.000 | 0.000 | 0.000 | 0.000 | 53.575 | 186.172 | 176.492 | 118.306 | 0.000 | 1.173 | 0.005 | 0.000 | -46.222 | 0.000 | -186.203 | -96.248 |
| THERMAL ZONE: SPACE 501 | 68.825 | -207.529 | 0.000 | 0.000 | 0.000 | 0.000 | 60.047 | 204.789 | 194.141 | 153.676 | 0.000 | 1.578 | 0.002 | 0.000 | -45.843 | 0.000 | -313.883 | -115.801 |
| THERMAL ZONE: SPACE 502 | 72.500 | -205.180 | 0.000 | 0.000 | 0.000 | 0.000 | 60.108 | 204.789 | 194.141 | 149.884 | 0.000 | 1.578 | 0.002 | 0.000 | -45.613 | 0.000 | -313.237 | -118.970 |
| THERMAL ZONE: SPACE 503 | 66.665 | -189.549 | 0.000 | 0.000 | 0.000 | 0.000 | 54.646 | 186.172 | 176.492 | 140.767 | 0.000 | 1.436 | 0.001 | 0.000 | -42.100 | 0.000 | -285.559 | -108.971 |
| Total Facility | 325.387 | -3313.057 | 0.000 | 0.000 | 0.000 | 0.000 | 855.962 | 2978.747 | 2823.873 | 1604.413 | 0.000 | 19.780 | 0.040 | 0.000 | -723.704 | 0.000 | -3299.138 | -1272.264 |



Variant 3

Peak Cooling Sensible Heat Gain Components

Results:

| | Time of Peak {TIMESTAMP} | HVAC Zone Eq & Other Sensible Air Heating [W] | HVAC Zone Eq & Other Sensible Air Cooling [W] | HVAC Terminal Unit Sensible Air Heating [W] | HVAC Terminal Unit Sensible Air Cooling [W] | HVAC Input Heated Surface Heating [W] | HVAC Input Cooled Surface Cooling [W] | People Sensible Heat Addition [W] | Lights Sensible Heat Addition [W] | Equipment Sensible Heat Addition [W] | Window Heat Addition [W] | Interzone Air Transfer Heat Addition [W] | Infiltration Heat Addition [W] | Opaque Surface Conduction and Other Heat Addition [W] | Equipment Sensible Heat Removal [W] | Window Heat Removal [W] | Interzone Air Transfer Heat Removal [W] | Infiltration Heat Removal [W] | Opaque Surface Conduction and Other Heat Removal [W] |
|-------------------------|-----------------------------|--|--|--|--|--|--|---|---|--|-----------------------------|--|--------------------------------------|--|---|----------------------------|---|-------------------------------------|---|
| THERMAL ZONE: SPACE 101 | 29-JUN-06:01 | 0.00 | -389955.15 | 0.00 | 0.00 | 0.00 | 0.00 | 480.60 | 1758.28 | 4546.68 | 4750.05 | 0.00 | 0.00 | 378842.93 | 0.00 | -0.00 | 0.00 | -423.39 | 0.00 |
| THERMAL ZONE: SPACE 102 | 29-JUN-06:01 | 0.00 | -390061.70 | 0.00 | 0.00 | 0.00 | 0.00 | 480.60 | 1758.28 | 4546.68 | 4250.29 | 0.00 | 0.00 | 379449.20 | 0.00 | -0.00 | 0.00 | -423.35 | 0.00 |
| THERMAL ZONE: SPACE 103 | 30-JUN-06:01 | 0.00 | -356288.06 | 0.00 | 0.00 | 0.00 | 0.00 | 436.91 | 1598.44 | 4133.34 | 9233.43 | 0.00 | 0.00 | 341072.79 | 0.00 | -0.00 | 0.00 | -186.85 | 0.00 |
| THERMAL ZONE: SPACE 201 | 02-AUG-06:01 | 0.00 | -393240.16 | 0.00 | 0.00 | 0.00 | 0.00 | 480.60 | 1758.28 | 4546.68 | 4602.73 | 0.00 | 0.00 | 381943.46 | 0.00 | -0.00 | 0.00 | -91.60 | 0.00 |
| THERMAL ZONE: SPACE 202 | 02-AUG-06:01 | 0.00 | -392997.08 | 0.00 | 0.00 | 0.00 | 0.00 | 480.60 | 1758.28 | 4546.68 | 4276.03 | 0.00 | 0.00 | 382027.07 | 0.00 | -0.00 | 0.00 | -91.58 | 0.00 |
| THERMAL ZONE: SPACE 203 | 02-AUG-06:01 | 0.00 | -358319.24 | 0.00 | 0.00 | 0.00 | 0.00 | 436.91 | 1598.44 | 4133.34 | 5687.79 | 0.00 | 0.00 | 346546.47 | 0.00 | -0.00 | 0.00 | -83.71 | 0.00 |
| THERMAL ZONE: SPACE 301 | 02-AUG-06:01 | 0.00 | -395382.04 | 0.00 | 0.00 | 0.00 | 0.00 | 480.60 | 1758.28 | 4546.68 | 6613.08 | 0.00 | 0.00 | 382078.66 | 0.00 | -0.00 | 0.00 | -95.27 | 0.00 |
| THERMAL ZONE: SPACE 302 | 02-AUG-06:01 | 0.00 | -395113.87 | 0.00 | 0.00 | 0.00 | 0.00 | 480.60 | 1758.28 | 4546.68 | 6171.11 | 0.00 | 0.00 | 382252.45 | 0.00 | -0.00 | 0.00 | -95.25 | 0.00 |
| THERMAL ZONE: SPACE 303 | 02-AUG-06:01 | 0.00 | -359740.46 | 0.00 | 0.00 | 0.00 | 0.00 | 436.91 | 1598.44 | 4133.34 | 6099.98 | 0.00 | 0.00 | 347558.82 | 0.00 | -0.00 | 0.00 | -87.03 | 0.00 |
| THERMAL ZONE: SPACE 401 | 02-AUG-06:01 | 0.00 | -396199.96 | 0.00 | 0.00 | 0.00 | 0.00 | 480.60 | 1758.28 | 4546.68 | 7306.52 | 0.00 | 0.00 | 382206.73 | 0.00 | -0.00 | 0.00 | -98.86 | 0.00 |
| THERMAL ZONE: SPACE 402 | 02-AUG-06:01 | 0.00 | -396087.26 | 0.00 | 0.00 | 0.00 | 0.00 | 480.60 | 1758.28 | 4546.68 | 7232.82 | 0.00 | 0.00 | 382167.72 | 0.00 | -0.00 | 0.00 | -98.85 | 0.00 |
| THERMAL ZONE: SPACE 403 | 02-AUG-06:01 | 0.00 | -360551.99 | 0.00 | 0.00 | 0.00 | 0.00 | 436.91 | 1598.44 | 4133.34 | 7012.12 | 0.00 | 0.00 | 347461.48 | 0.00 | -0.00 | 0.00 | -90.31 | 0.00 |
| THERMAL ZONE: SPACE 501 | 02-AUG-06:01 | 0.00 | -395649.49 | 0.00 | 0.00 | 0.00 | 0.00 | 480.60 | 1758.28 | 4546.68 | 8105.61 | 0.00 | 0.00 | 380934.65 | 0.00 | -0.00 | 0.00 | -176.33 | 0.00 |
| THERMAL ZONE: SPACE 502 | 02-AUG-06:01 | 0.00 | -395479.89 | 0.00 | 0.00 | 0.00 | 0.00 | 480.60 | 1758.28 | 4546.68 | 7936.32 | 0.00 | 0.00 | 380934.32 | 0.00 | -0.00 | 0.00 | -176.31 | 0.00 |
| THERMAL ZONE: SPACE 503 | 02-AUG-06:01 | 0.00 | -359924.54 | 0.00 | 0.00 | 0.00 | 0.00 | 436.91 | 1598.44 | 4133.34 | 7558.34 | 0.00 | 0.00 | 346358.26 | 0.00 | -0.00 | 0.00 | -160.76 | 0.00 |
| Total Facility | 02-AUG-06:01 | 0.00 | -5730391.48 | 0.00 | 0.00 | 0.00 | 0.00 | 6990.59 | 25575.05 | 66133.47 | 91930.25 | 0.00 | 0.00 | 5541364.14 | 0.00 | 0.00 | 0.00 | -1602.02 | 0.00 |



Variant 3

Peak Heating Sensible Heat Gain Components

Results:

| Time of Peak (TIMESTAMP) | HVAC Zone Eq & Other Sensible Air Heating [W] | HVAC Zone Eq & Other Sensible Air Cooling [W] | HVAC Terminal Unit Sensible Air Heating [W] | HVAC Terminal Unit Sensible Air Cooling [W] | HVAC Input Heated Surface Heating [W] | HVAC Input Cooled Surface Cooling [W] | People Sensible Heat Addition [W] | Lights Sensible Heat Addition [W] | Equipment Sensible Heat Addition [W] | Window Heat Addition [W] | Interzone Air Transfer Heat Addition [W] | Air Heat Addition [W] | Infiltration Heat Addition [W] | Opaque Surface Conduction and Other Heat Addition [W] | Equipment Sensible Heat Removal [W] | Window Heat Removal [W] | Interzone Air Transfer Heat Removal [W] | Infiltration Heat Removal [W] | Opaque Surface Conduction and Other Heat Removal [W] |
|--------------------------------------|---|---|---|---|---------------------------------------|---------------------------------------|-----------------------------------|-----------------------------------|--------------------------------------|--------------------------|--|-----------------------|--------------------------------|---|-------------------------------------|-------------------------|---|-------------------------------|--|
| THERMAL ZONE: SPACE 101 13-DEC-06:01 | 976599.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 881.64 | 1758.28 | 4546.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2215.41 | 0.00 | -3099.66 | -978470.72 |
| THERMAL ZONE: SPACE 102 25-JAN-06:01 | 987211.35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 884.24 | 1758.28 | 4546.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -3483.00 | 0.00 | -4612.02 | -986305.54 |
| THERMAL ZONE: SPACE 103 25-JAN-06:01 | 915038.13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 806.63 | 1598.44 | 4133.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -3230.84 | 0.00 | -4208.08 | -914137.63 |
| THERMAL ZONE: SPACE 201 13-DEC-06:01 | 951375.51 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 877.55 | 1758.28 | 4546.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2254.13 | 0.00 | -3109.15 | -953194.73 |
| THERMAL ZONE: SPACE 202 13-DEC-06:01 | 953955.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 877.96 | 1758.28 | 4546.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2237.88 | 0.00 | -3108.61 | -955791.73 |
| THERMAL ZONE: SPACE 203 13-DEC-06:01 | 874184.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 799.28 | 1598.44 | 4133.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2077.37 | 0.00 | -2837.52 | -875800.42 |
| THERMAL ZONE: SPACE 301 13-DEC-06:01 | 948514.92 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 877.09 | 1758.28 | 4546.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2297.06 | 0.00 | -3113.81 | -950286.10 |
| THERMAL ZONE: SPACE 302 13-DEC-06:01 | 953985.33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 877.97 | 1758.28 | 4546.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2274.24 | 0.00 | -3112.66 | -955781.36 |
| THERMAL ZONE: SPACE 303 13-DEC-06:01 | 874190.95 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 799.28 | 1598.44 | 4133.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2100.63 | 0.00 | -2841.22 | -875780.16 |
| THERMAL ZONE: SPACE 401 13-DEC-06:01 | 1007307.90 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 886.50 | 1758.28 | 4546.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2277.44 | 0.00 | -3105.17 | -1009116.74 |
| THERMAL ZONE: SPACE 402 13-DEC-06:01 | 1012188.53 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 887.27 | 1758.28 | 4546.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2269.09 | 0.00 | -3104.10 | -1014007.57 |
| THERMAL ZONE: SPACE 403 13-DEC-06:01 | 924386.57 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 807.29 | 1598.44 | 4133.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2097.96 | 0.00 | -2833.95 | -925993.73 |
| THERMAL ZONE: SPACE 501 08-FEB-06:01 | 1043457.72 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 890.23 | 1758.28 | 4546.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -3104.29 | 0.00 | -7058.74 | -1040489.87 |
| THERMAL ZONE: SPACE 502 08-FEB-06:01 | 1043484.89 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 890.23 | 1758.28 | 4546.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -3094.88 | 0.00 | -7058.74 | -1040526.46 |
| THERMAL ZONE: SPACE 503 08-FEB-06:01 | 948828.52 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 809.30 | 1598.44 | 4133.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2853.41 | 0.00 | -6434.17 | -946082.02 |
| Total Facility 13-DEC-06:01 | 14384408.33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 12846.04 | 25575.05 | 66133.47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -32799.94 | 0.00 | -51766.85 | -14404396.09 |

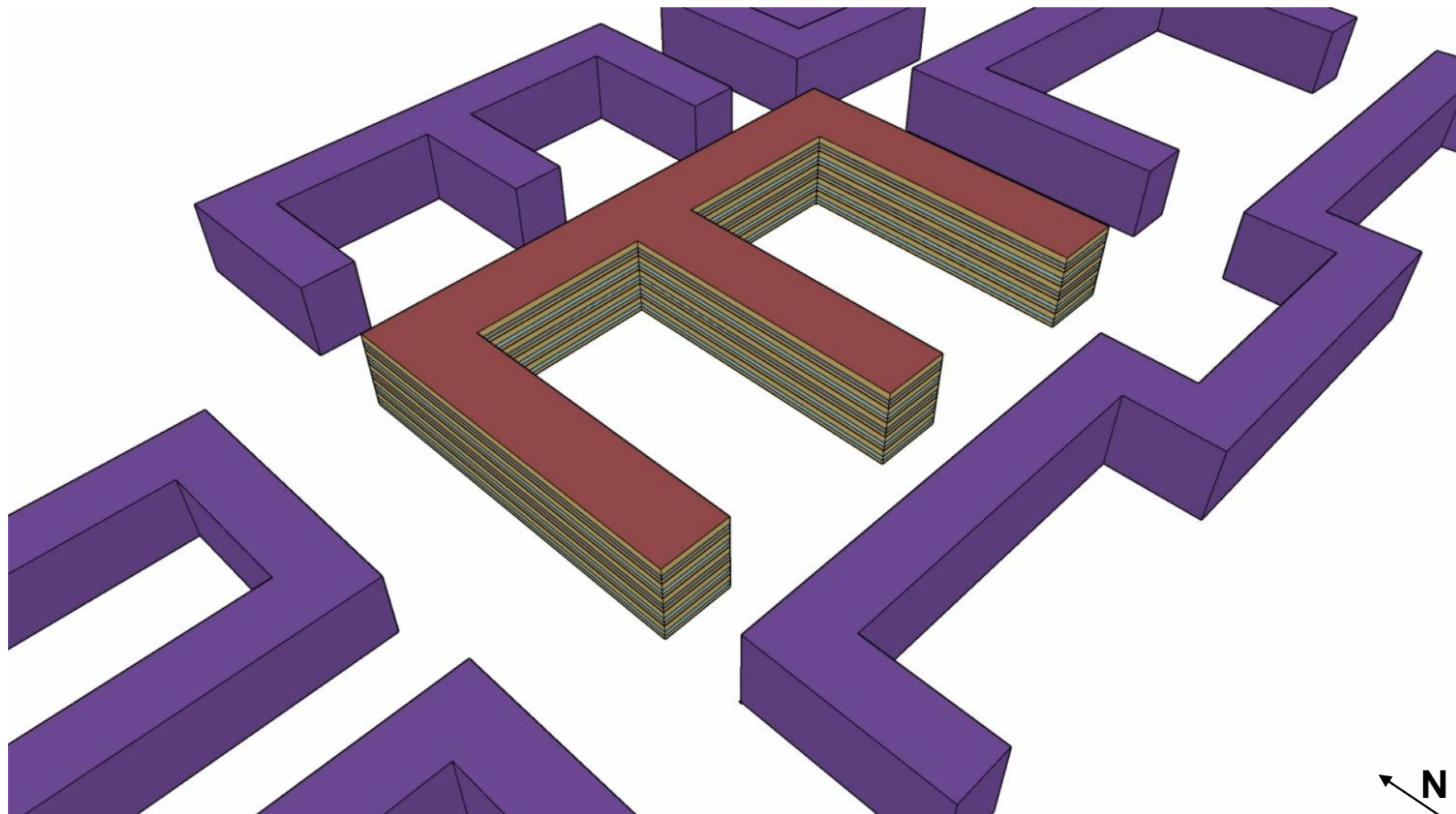


Variant 4

Building layout:

Comb-shaped
buildings with 2
semi-open
courtyards

5 storeys





Variant 4

Annual Building Sensible Heat Gain Components

Results:

| | HVAC Zone Eq & Other Sensible Air Heating [GJ] | HVAC Zone Eq & Other Sensible Air Cooling [GJ] | HVAC Terminal Unit Sensible Air Heating [GJ] | HVAC Terminal Unit Sensible Air Cooling [GJ] | HVAC Input Heated Surface Heating [GJ] | HVAC Input Cooled Surface Cooling [GJ] | People Sensible Heat Addition [GJ] | Lights Sensible Heat Addition [GJ] | Equipment Sensible Heat Addition [GJ] | Window Heat Addition [GJ] | Interzone Air Transfer Heat Addition [GJ] | Infiltration Heat Addition [GJ] | Opaque Surface Conduction and Other Heat Addition [GJ] | Equipment Sensible Heat Removal [GJ] | Window Heat Removal [GJ] | Interzone Air Transfer Heat Removal [GJ] | Infiltration Heat Removal [GJ] | Opaque Surface Conduction and Other Heat Removal [GJ] |
|-------------------------|---|---|---|---|---|---|--|--|---|------------------------------|---|---------------------------------------|---|--|-----------------------------|--|--------------------------------------|--|
| THERMAL ZONE: SPACE 525 | 29.482 | -720.247 | 0.000 | 0.000 | 0.000 | 0.000 | 170.666 | 595.749 | 564.775 | 368.219 | 0.000 | 3.712 | 0.002 | 0.000 | -135.933 | 0.000 | -581.089 | -295.334 |
| THERMAL ZONE: SPACE 526 | 15.097 | -668.601 | 0.000 | 0.000 | 0.000 | 0.000 | 168.350 | 595.749 | 564.775 | 262.678 | 0.000 | 3.804 | 0.005 | 0.000 | -134.484 | 0.000 | -583.102 | -224.266 |
| THERMAL ZONE: SPACE 527 | 14.291 | -716.359 | 0.000 | 0.000 | 0.000 | 0.000 | 168.740 | 595.749 | 564.775 | 288.126 | 0.000 | 3.772 | 0.003 | 0.000 | -138.786 | 0.000 | -588.288 | -192.019 |
| THERMAL ZONE: SPACE 528 | 15.363 | -741.430 | 0.000 | 0.000 | 0.000 | 0.000 | 169.041 | 595.749 | 564.775 | 319.418 | 0.000 | 3.742 | 0.000 | 0.000 | -138.753 | 0.000 | -588.607 | -199.299 |
| THERMAL ZONE: SPACE 529 | 200.184 | -616.873 | 0.000 | 0.000 | 0.000 | 0.000 | 174.858 | 595.749 | 564.775 | 418.818 | 0.000 | 4.553 | 0.026 | 0.000 | -123.109 | 0.000 | -899.161 | -319.795 |
| Total Facility | 274.417 | -3463.509 | 0.000 | 0.000 | 0.000 | 0.000 | 851.655 | 2978.747 | 2823.873 | 1657.258 | 0.000 | 19.584 | 0.036 | 0.000 | -671.065 | 0.000 | -3240.246 | -1230.713 |



Variant 4

Peak Cooling Sensible Heat Gain Components

Results:

| | Time of Peak {TIMESTAMP} | HVAC Zone Eq & Other Sensible Air Heating [W] | HVAC Zone Eq & Other Sensible Air Cooling [W] | HVAC Terminal Unit Sensible Air Heating [W] | HVAC Terminal Unit Sensible Air Cooling [W] | HVAC Input Heated Surface Heating [W] | HVAC Input Cooled Surface Cooling [W] | People Sensible Heat Addition [W] | Lights Sensible Heat Addition [W] | Equipment Sensible Heat Addition [W] | Window Heat Addition [W] | Interzone Air Transfer Heat Addition [W] | Infiltration Heat Addition [W] | Opaque Surface Conduction and Other Heat Addition [W] | Equipment Sensible Heat Removal [W] | Window Heat Removal [W] | Interzone Air Transfer Heat Removal [W] | Infiltration Heat Removal [W] | Opaque Surface Conduction and Other Heat Removal [W] |
|-------------------------|-----------------------------|--|--|---|---|--|--|---|---|--|--------------------------------|---|--------------------------------------|--|---|-------------------------------|--|-------------------------------------|---|
| THERMAL ZONE: SPACE 525 | 07-JUN-06:01 | 0.00 | -1163704.54 | 0.00 | 0.00 | 0.00 | 0.00 | 1398.12 | 5115.01 | 13226.69 | 75885.86 | 0.00 | 0.00 | 1071675.67 | 0.00 | -0.00 | 0.00 | -3596.81 | 0.00 |
| THERMAL ZONE: SPACE 526 | 02-AUG-06:01 | 0.00 | -1136573.89 | 0.00 | 0.00 | 0.00 | 0.00 | 1398.12 | 5115.01 | 13226.69 | 13696.31 | 0.00 | 0.00 | 1103385.94 | 0.00 | -0.00 | 0.00 | -248.18 | 0.00 |
| THERMAL ZONE: SPACE 527 | 02-AUG-06:01 | 0.00 | -1147206.01 | 0.00 | 0.00 | 0.00 | 0.00 | 1398.12 | 5115.01 | 13226.69 | 14264.33 | 0.00 | 0.00 | 1113460.50 | 0.00 | -0.00 | 0.00 | -258.64 | 0.00 |
| THERMAL ZONE: SPACE 528 | 07-JUN-06:01 | 0.00 | -1157536.43 | 0.00 | 0.00 | 0.00 | 0.00 | 1398.12 | 5115.01 | 13226.69 | 69243.61 | 0.00 | 0.00 | 1072138.85 | 0.00 | -0.00 | 0.00 | -3585.85 | 0.00 |
| THERMAL ZONE: SPACE 529 | 02-AUG-06:01 | 0.00 | -1158379.54 | 0.00 | 0.00 | 0.00 | 0.00 | 1398.12 | 5115.01 | 13226.69 | 36641.59 | 0.00 | 0.00 | 1102503.22 | 0.00 | -0.00 | 0.00 | -505.09 | 0.00 |
| Total Facility | 02-AUG-06:01 | 0.00 | -5755894.98 | 0.00 | 0.00 | 0.00 | 0.00 | 6990.59 | 25575.05 | 66133.47 | 125989.15 | 0.00 | 0.00 | 5532767.28 | 0.00 | 0.00 | 0.00 | -1560.55 | 0.00 |



Variant 4

Peak Heating Sensible Heat Gain Components

Results:

| | Time of Peak {TIMESTAMP} | HVAC Zone Eq & Other Sensible Air Heating [W] | HVAC Zone Eq & Other Sensible Air Cooling [W] | HVAC Terminal Unit Sensible Air Heating [W] | HVAC Terminal Unit Sensible Air Cooling [W] | HVAC Input Heated Surface Heating [W] | HVAC Input Cooled Surface Cooling [W] | People Sensible Heat Addition [W] | Lights Sensible Heat Addition [W] | Equipment Sensible Heat Addition [W] | Window Heat Addition [W] | Interzone Air Transfer Heat Addition [W] | Infiltration Heat Addition [W] | Opaque Surface Conduction and Other Heat Addition [W] | Equipment Sensible Heat Removal [W] | Window Heat Removal [W] | Interzone Air Transfer Heat Removal [W] | Infiltration Heat Removal [W] | Opaque Surface Conduction and Other Heat Removal [W] |
|-------------------------|-----------------------------|--|--|---|---|--|--|---|---|--|--------------------------------|---|--------------------------------------|--|---|-------------------------------|--|-------------------------------------|---|
| THERMAL ZONE: SPACE 525 | 13-DEC-06:01 | 2832484.72 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2563.07 | 5115.01 | 13226.69 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -6205.51 | 0.00 | -8781.26 | -2838402.72 |
| THERMAL ZONE: SPACE 526 | 13-DEC-06:01 | 2671044.74 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2537.20 | 5115.01 | 13226.69 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -6152.91 | 0.00 | -8779.63 | -2676991.10 |
| THERMAL ZONE: SPACE 527 | 13-DEC-06:01 | 2580058.33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2522.27 | 5115.01 | 13226.69 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -6262.96 | 0.00 | -8809.02 | -2585850.33 |
| THERMAL ZONE: SPACE 528 | 13-DEC-06:01 | 2584699.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2523.02 | 5115.01 | 13226.69 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -6314.95 | 0.00 | -8819.58 | -2590429.44 |
| THERMAL ZONE: SPACE 529 | 20-FEB-06:01 | 3033395.38 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2589.77 | 5115.01 | 13226.69 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -12936.73 | 0.00 | -30129.57 | -3011260.54 |
| Total Facility | 13-DEC-06:01 | 13700101.36 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 12735.32 | 25575.05 | 66133.47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -30895.88 | 0.00 | -50476.22 | 13723173.10 |

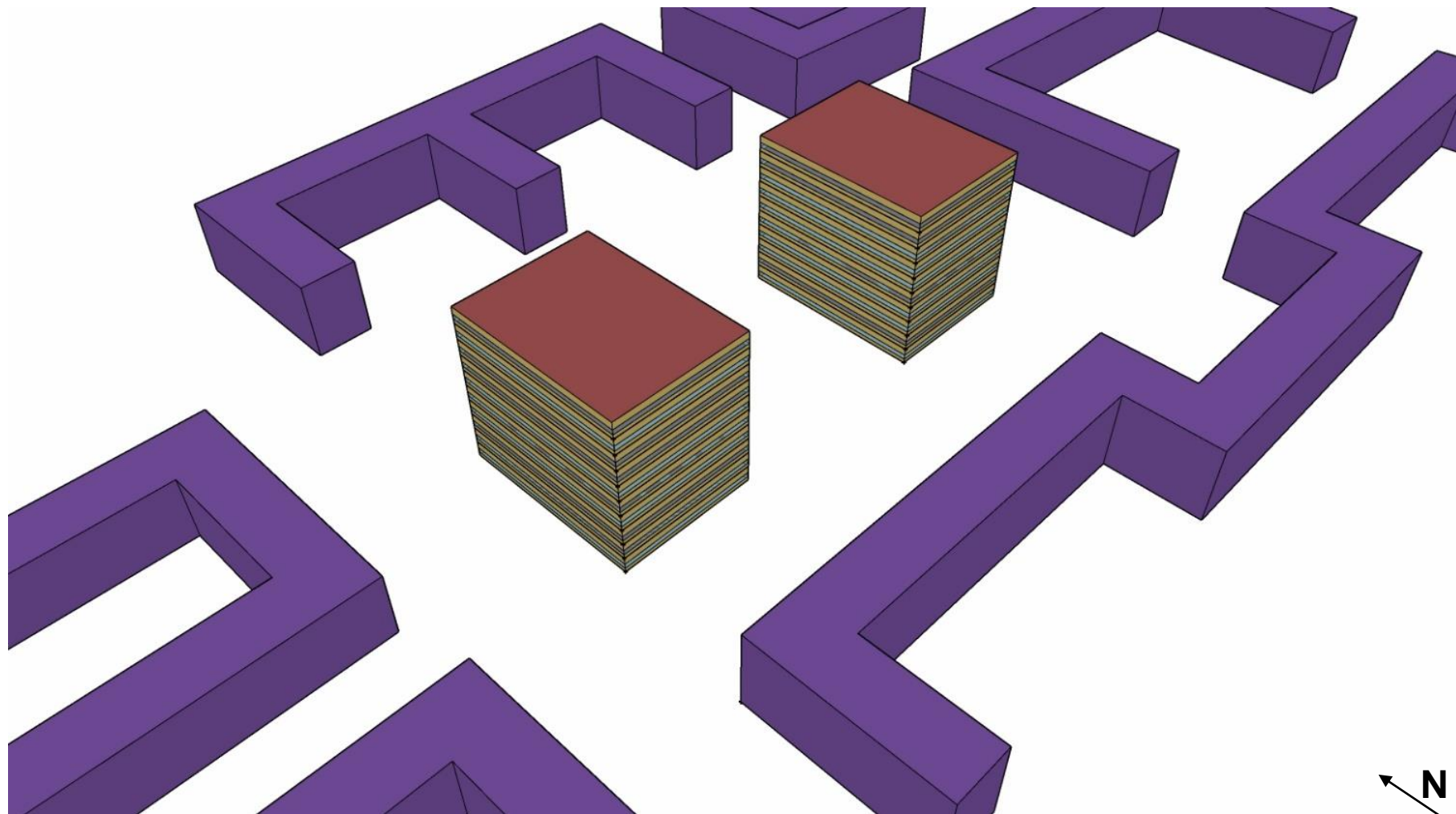


Variant 5

Building layout:

2 free-standing
buildings

10 storeys





Variant 5

Annual Building Sensible Heat Gain Components

Results:

| | HVAC Zone Eq & Other Sensible Air Heating [GJ] | HVAC Zone Eq & Other Sensible Air Cooling [GJ] | HVAC Terminal Unit Sensible Air Heating [GJ] | HVAC Terminal Unit Sensible Air Cooling [GJ] | HVAC Input Heated Surface Heating [GJ] | HVAC Input Cooled Surface Cooling [GJ] | People Sensible Heat Addition [GJ] | Lights Sensible Heat Addition [GJ] | Equipment Sensible Heat Addition [GJ] | Window Heat Addition [GJ] | Interzone Air Transfer Heat Addition [GJ] | Infiltration Heat Addition [GJ] | Opaque Surface Conduction and Other Heat Addition [GJ] | Equipment Sensible Heat Removal [GJ] | Window Heat Removal [GJ] | Interzone Air Transfer Heat Removal [GJ] | Infiltration Heat Removal [GJ] | Opaque Surface Conduction and Other Heat Removal [GJ] |
|--------------------------|---|---|---|---|---|---|--|--|---|------------------------------|---|---------------------------------------|---|--|-----------------------------|--|--------------------------------------|--|
| THERMAL ZONE: SPACE 1001 | 39.332 | -148.775 | 0.000 | 0.000 | 0.000 | 0.000 | 43.552 | 148.937 | 141.194 | 89.478 | 0.000 | 1.077 | 0.002 | 0.000 | -26.074 | 0.000 | -221.163 | -67.558 |
| THERMAL ZONE: SPACE 1002 | 39.235 | -149.195 | 0.000 | 0.000 | 0.000 | 0.000 | 43.549 | 148.937 | 141.194 | 89.802 | 0.000 | 1.077 | 0.002 | 0.000 | -26.071 | 0.000 | -221.223 | -67.306 |
| THERMAL ZONE: SPACE 101 | 1.160 | -174.106 | 0.000 | 0.000 | 0.000 | 0.000 | 41.610 | 148.937 | 141.194 | 60.891 | 0.000 | 0.933 | 0.002 | 0.000 | -29.038 | 0.000 | -140.387 | -51.194 |
| THERMAL ZONE: SPACE 102 | 1.086 | -173.459 | 0.000 | 0.000 | 0.000 | 0.000 | 41.569 | 148.937 | 141.194 | 60.361 | 0.000 | 0.933 | 0.002 | 0.000 | -29.026 | 0.000 | -140.516 | -51.080 |
| THERMAL ZONE: SPACE 201 | 0.735 | -188.287 | 0.000 | 0.000 | 0.000 | 0.000 | 41.556 | 148.937 | 141.194 | 65.476 | 0.000 | 0.925 | 0.001 | 0.000 | -30.054 | 0.000 | -141.911 | -38.571 |
| THERMAL ZONE: SPACE 202 | 0.683 | -187.793 | 0.000 | 0.000 | 0.000 | 0.000 | 41.515 | 148.937 | 141.194 | 65.065 | 0.000 | 0.925 | 0.001 | 0.000 | -30.044 | 0.000 | -142.044 | -38.438 |
| THERMAL ZONE: SPACE 301 | 0.515 | -198.112 | 0.000 | 0.000 | 0.000 | 0.000 | 41.416 | 148.937 | 141.194 | 71.574 | 0.000 | 0.918 | 0.000 | 0.000 | -30.422 | 0.000 | -142.903 | -33.117 |
| THERMAL ZONE: SPACE 302 | 0.490 | -198.748 | 0.000 | 0.000 | 0.000 | 0.000 | 41.394 | 148.937 | 141.194 | 71.913 | 0.000 | 0.918 | 0.003 | 0.000 | -30.427 | 0.000 | -142.985 | -32.686 |
| THERMAL ZONE: SPACE 401 | 0.426 | -204.183 | 0.000 | 0.000 | 0.000 | 0.000 | 41.346 | 148.937 | 141.194 | 77.368 | 0.000 | 0.911 | 0.001 | 0.000 | -30.600 | 0.000 | -143.493 | -31.907 |
| THERMAL ZONE: SPACE 402 | 0.418 | -206.737 | 0.000 | 0.000 | 0.000 | 0.000 | 41.335 | 148.937 | 141.194 | 80.222 | 0.000 | 0.911 | 0.001 | 0.000 | -30.672 | 0.000 | -143.550 | -32.058 |
| THERMAL ZONE: SPACE 501 | 0.412 | -207.425 | 0.000 | 0.000 | 0.000 | 0.000 | 41.323 | 148.937 | 141.194 | 80.731 | 0.000 | 0.903 | 0.000 | 0.000 | -30.628 | 0.000 | -143.846 | -31.602 |
| THERMAL ZONE: SPACE 502 | 0.408 | -210.820 | 0.000 | 0.000 | 0.000 | 0.000 | 41.316 | 148.937 | 141.194 | 84.355 | 0.000 | 0.903 | 0.000 | 0.000 | -30.637 | 0.000 | -143.902 | -31.754 |
| THERMAL ZONE: SPACE 601 | 0.445 | -208.498 | 0.000 | 0.000 | 0.000 | 0.000 | 41.339 | 148.937 | 141.194 | 82.577 | 0.000 | 0.896 | 0.000 | 0.000 | -30.596 | 0.000 | -144.007 | -32.288 |
| THERMAL ZONE: SPACE 602 | 0.442 | -211.889 | 0.000 | 0.000 | 0.000 | 0.000 | 41.333 | 148.937 | 141.194 | 86.115 | 0.000 | 0.896 | 0.000 | 0.000 | -30.575 | 0.000 | -144.064 | -32.389 |
| THERMAL ZONE: SPACE 701 | 0.559 | -207.050 | 0.000 | 0.000 | 0.000 | 0.000 | 41.410 | 148.937 | 141.194 | 83.547 | 0.000 | 0.889 | 0.002 | 0.000 | -30.494 | 0.000 | -143.897 | -35.094 |
| THERMAL ZONE: SPACE 702 | 0.555 | -209.852 | 0.000 | 0.000 | 0.000 | 0.000 | 41.404 | 148.937 | 141.194 | 86.396 | 0.000 | 0.889 | 0.002 | 0.000 | -30.472 | 0.000 | -143.953 | -35.099 |
| THERMAL ZONE: SPACE 801 | 0.921 | -200.912 | 0.000 | 0.000 | 0.000 | 0.000 | 41.615 | 148.937 | 141.194 | 84.613 | 0.000 | 0.882 | 0.001 | 0.000 | -30.147 | 0.000 | -143.150 | -43.954 |
| THERMAL ZONE: SPACE 802 | 0.915 | -202.894 | 0.000 | 0.000 | 0.000 | 0.000 | 41.609 | 148.937 | 141.194 | 86.595 | 0.000 | 0.882 | 0.001 | 0.000 | -30.122 | 0.000 | -143.200 | -43.916 |
| THERMAL ZONE: SPACE 901 | 3.232 | -183.977 | 0.000 | 0.000 | 0.000 | 0.000 | 42.198 | 148.937 | 141.194 | 87.258 | 0.000 | 0.875 | 0.001 | 0.000 | -29.211 | 0.000 | -140.568 | -69.939 |
| THERMAL ZONE: SPACE 902 | 3.210 | -185.097 | 0.000 | 0.000 | 0.000 | 0.000 | 42.193 | 148.937 | 141.194 | 88.385 | 0.000 | 0.875 | 0.001 | 0.000 | -29.187 | 0.000 | -140.608 | -69.903 |
| Total Facility | 95.182 | -3857.807 | 0.000 | 0.000 | 0.000 | 0.000 | 834.583 | 2978.747 | 2823.873 | 1582.723 | 0.000 | 18.420 | 0.024 | 0.000 | -594.496 | 0.000 | -3011.370 | -869.853 |



Variant 5

Results:

Peak Cooling Sensible Heat Gain Components

| | Time of Peak {TIMESTAMP} | HVAC Zone Eq & Other Sensible Air Heating [W] | HVAC Zone Eq & Other Sensible Air Cooling [W] | HVAC Terminal Unit Sensible Air Heating [W] | HVAC Terminal Unit Sensible Air Cooling [W] | HVAC Input Heated Surface Heating [W] | HVAC Input Cooled Surface Cooling [W] | People Sensible Heat Addition [W] | Lights Sensible Heat Addition [W] | Equipment Sensible Heat Addition [W] | Window Heat Addition [W] | Interzone Air Transfer Heat Addition [W] | Infiltration Heat Addition [W] | Opaque Surface Conduction and Other Heat Addition [W] | Equipment Sensible Heat Removal [W] | Window Heat Removal [W] | Interzone Air Transfer Heat Removal [W] | Infiltration Heat Removal [W] | Opaque Surface Conduction and Other Heat Removal [W] |
|--------------------------|--------------------------|---|---|---|---|---------------------------------------|---------------------------------------|-----------------------------------|-----------------------------------|--------------------------------------|--------------------------|--|--------------------------------|---|-------------------------------------|-------------------------|---|-------------------------------|--|
| THERMAL ZONE: SPACE 1001 | 02-AUG-06:01 | 0.00 | -288352.82 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 7400.03 | 0.00 | 0.00 | 276160.63 | 0.00 | -0.00 | 0.00 | -142.79 | 0.00 |
| THERMAL ZONE: SPACE 1002 | 02-AUG-06:01 | 0.00 | -288401.94 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 7399.56 | 0.00 | 0.00 | 276210.22 | 0.00 | -0.00 | 0.00 | -142.80 | 0.00 |
| THERMAL ZONE: SPACE 101 | 02-AUG-06:01 | 0.00 | -284108.18 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 3295.79 | 0.00 | 0.00 | 275935.77 | 0.00 | -0.00 | 0.00 | -58.33 | 0.00 |
| THERMAL ZONE: SPACE 102 | 29-JUN-06:01 | 0.00 | -283404.79 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 3247.11 | 0.00 | 0.00 | 275503.53 | 0.00 | -0.00 | 0.00 | -280.80 | 0.00 |
| THERMAL ZONE: SPACE 201 | 02-AUG-06:01 | 0.00 | -286337.71 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 3429.47 | 0.00 | 0.00 | 278034.06 | 0.00 | -0.00 | 0.00 | -60.78 | 0.00 |
| THERMAL ZONE: SPACE 202 | 07-JUN-06:01 | 0.00 | -286624.04 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 14398.84 | 0.00 | 0.00 | 268130.43 | 0.00 | -0.00 | 0.00 | -840.18 | 0.00 |
| THERMAL ZONE: SPACE 301 | 02-AUG-06:01 | 0.00 | -287331.01 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 3615.18 | 0.00 | 0.00 | 278844.05 | 0.00 | -0.00 | 0.00 | -63.18 | 0.00 |
| THERMAL ZONE: SPACE 302 | 07-JUN-06:01 | 0.00 | -288978.66 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 14689.99 | 0.00 | 0.00 | 270196.51 | 0.00 | -0.00 | 0.00 | -842.80 | 0.00 |
| THERMAL ZONE: SPACE 401 | 02-AUG-06:01 | 0.00 | -287682.71 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 3811.26 | 0.00 | 0.00 | 279002.04 | 0.00 | -0.00 | 0.00 | -65.54 | 0.00 |
| THERMAL ZONE: SPACE 402 | 07-JUN-06:01 | 0.00 | -290148.13 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 15196.76 | 0.00 | 0.00 | 270861.76 | 0.00 | -0.00 | 0.00 | -845.35 | 0.00 |
| THERMAL ZONE: SPACE 501 | 02-AUG-06:01 | 0.00 | -287879.18 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 3925.51 | 0.00 | 0.00 | 279086.61 | 0.00 | -0.00 | 0.00 | -67.89 | 0.00 |
| THERMAL ZONE: SPACE 502 | 07-JUN-06:01 | 0.00 | -290847.95 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 15338.23 | 0.00 | 0.00 | 271422.63 | 0.00 | -0.00 | 0.00 | -847.87 | 0.00 |
| THERMAL ZONE: SPACE 601 | 07-JUN-06:01 | 0.00 | -288465.73 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 13731.25 | 0.00 | 0.00 | 270649.67 | 0.00 | -0.00 | 0.00 | -850.15 | 0.00 |
| THERMAL ZONE: SPACE 602 | 07-JUN-06:01 | 0.00 | -291129.71 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 15356.65 | 0.00 | 0.00 | 271688.45 | 0.00 | -0.00 | 0.00 | -850.35 | 0.00 |
| THERMAL ZONE: SPACE 701 | 07-JUN-06:01 | 0.00 | -290289.37 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 15359.82 | 0.00 | 0.00 | 270847.33 | 0.00 | -0.00 | 0.00 | -852.74 | 0.00 |
| THERMAL ZONE: SPACE 702 | 07-JUN-06:01 | 0.00 | -291194.62 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 15351.70 | 0.00 | 0.00 | 271760.78 | 0.00 | -0.00 | 0.00 | -852.81 | 0.00 |
| THERMAL ZONE: SPACE 801 | 07-JUN-06:01 | 0.00 | -290684.40 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 15351.68 | 0.00 | 0.00 | 271253.00 | 0.00 | -0.00 | 0.00 | -855.23 | 0.00 |
| THERMAL ZONE: SPACE 802 | 07-JUN-06:01 | 0.00 | -291112.80 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 15348.54 | 0.00 | 0.00 | 271684.57 | 0.00 | -0.00 | 0.00 | -855.27 | 0.00 |
| THERMAL ZONE: SPACE 901 | 07-JUN-06:01 | 0.00 | -290206.66 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 15486.71 | 0.00 | 0.00 | 270642.65 | 0.00 | -0.00 | 0.00 | -857.65 | 0.00 |
| THERMAL ZONE: SPACE 902 | 07-JUN-06:01 | 0.00 | -290422.13 | 0.00 | 0.00 | 0.00 | 0.00 | 349.53 | 1278.75 | 3306.67 | 15484.77 | 0.00 | 0.00 | 270860.07 | 0.00 | -0.00 | 0.00 | -857.67 | 0.00 |
| Total Facility | 07-JUN-06:01 | 0.00 | -5762651.06 | 0.00 | 0.00 | 0.00 | 0.00 | 6990.59 | 25575.05 | 66133.47 | 234009.16 | 0.00 | 0.00 | 5448284.77 | 0.00 | 0.00 | 0.00 | -18341.98 | 0.00 |



Variant 5

Peak Heating Sensible Heat Gain Components

Results:

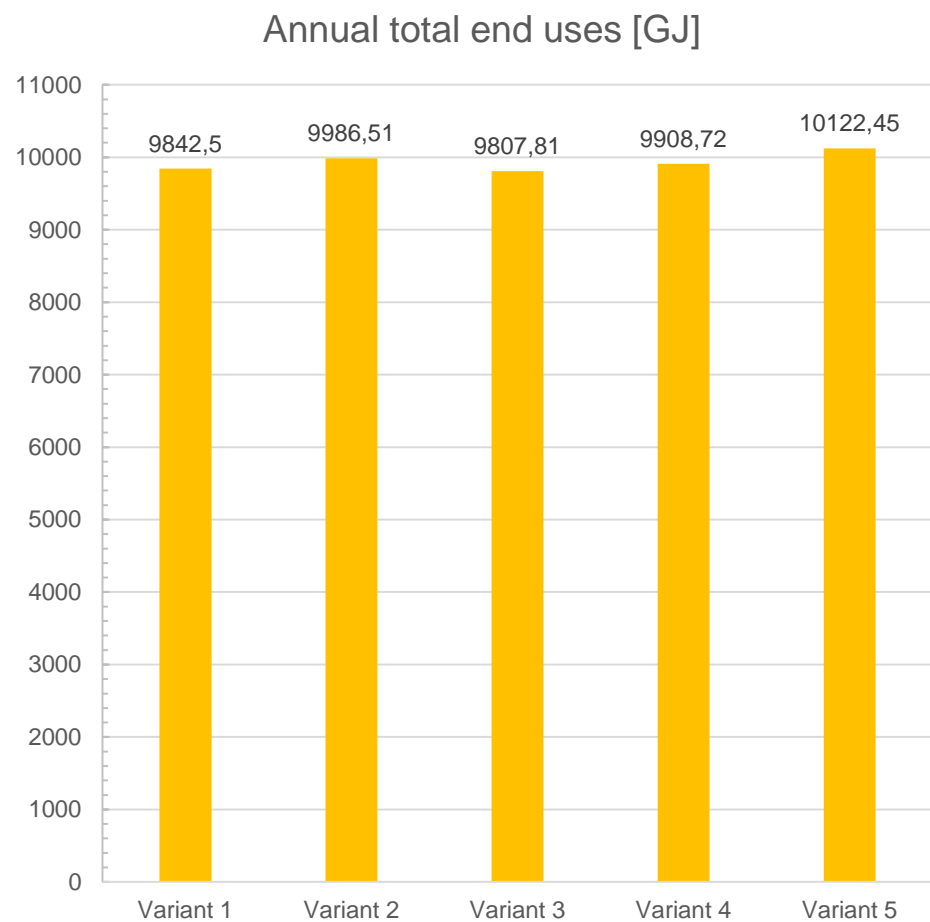
| | Time of Peak (TIMESTAMP) | HVAC Zone Eq & Other Sensible Air Heating [W] | HVAC Zone Eq & Other Sensible Air Cooling [W] | HVAC Terminal Unit Sensible Air Heating [W] | HVAC Terminal Unit Sensible Air Cooling [W] | HVAC Input Heated Surface Heating [W] | HVAC Input Cooled Surface Cooling [W] | People Sensible Heat Addition [W] | Lights Sensible Heat Addition [W] | Equipment Sensible Heat Addition [W] | Window Heat Addition [W] | Interzone Air Transfer Heat Addition [W] | Infiltration Heat Addition [W] | Opaque Surface Conduction and Other Heat Addition [W] | Equipment Sensible Heat Removal [W] | Window Heat Removal [W] | Interzone Air Transfer Heat Removal [W] | Infiltration Heat Removal [W] | Opaque Surface Conduction and Other Heat Removal [W] |
|--------------------------|--------------------------|---|---|---|---|---------------------------------------|---------------------------------------|-----------------------------------|-----------------------------------|--------------------------------------|--------------------------|--|--------------------------------|---|-------------------------------------|-------------------------|---|-------------------------------|--|
| THERMAL ZONE: SPACE 1001 | 20-FEB-06:01 | 756411.72 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 647.44 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2728.92 | 0.00 | -7301.65 | -751614.01 |
| THERMAL ZONE: SPACE 1002 | 20-FEB-06:01 | 756384.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 647.44 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -2729.23 | 0.00 | -7301.66 | -751586.32 |
| THERMAL ZONE: SPACE 101 | 13-DEC-06:01 | 536324.26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 612.62 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1385.39 | 0.00 | -2086.04 | -538050.87 |
| THERMAL ZONE: SPACE 102 | 13-DEC-06:01 | 534870.84 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 612.38 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1383.85 | 0.00 | -2086.26 | -536598.53 |
| THERMAL ZONE: SPACE 201 | 13-DEC-06:01 | 498119.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 606.22 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1418.01 | 0.00 | -2094.43 | -499798.69 |
| THERMAL ZONE: SPACE 202 | 13-DEC-06:01 | 495872.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 605.84 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1414.21 | 0.00 | -2094.76 | -497554.61 |
| THERMAL ZONE: SPACE 301 | 13-DEC-06:01 | 456120.76 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 599.17 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1458.81 | 0.00 | -2102.93 | -457743.63 |
| THERMAL ZONE: SPACE 302 | 13-DEC-06:01 | 453574.52 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 598.75 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1454.92 | 0.00 | -2103.26 | -455200.50 |
| THERMAL ZONE: SPACE 401 | 13-DEC-06:01 | 435103.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 595.64 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1485.15 | 0.00 | -2108.34 | -436690.67 |
| THERMAL ZONE: SPACE 402 | 13-DEC-06:01 | 433448.53 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 595.36 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1485.86 | 0.00 | -2108.55 | -435034.90 |
| THERMAL ZONE: SPACE 501 | 13-DEC-06:01 | 428374.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 594.50 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1496.46 | 0.00 | -2111.88 | -429946.27 |
| THERMAL ZONE: SPACE 502 | 13-DEC-06:01 | 427512.45 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 594.36 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1496.48 | 0.00 | -2111.99 | -429083.77 |
| THERMAL ZONE: SPACE 601 | 13-DEC-06:01 | 432388.73 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 595.18 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1497.45 | 0.00 | -2114.07 | -433957.82 |
| THERMAL ZONE: SPACE 602 | 13-DEC-06:01 | 432031.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 595.12 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1497.31 | 0.00 | -2114.12 | -433600.79 |
| THERMAL ZONE: SPACE 701 | 13-DEC-06:01 | 451738.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 598.44 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1485.90 | 0.00 | -2114.27 | -453321.88 |
| THERMAL ZONE: SPACE 702 | 13-DEC-06:01 | 451602.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 598.42 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1485.58 | 0.00 | -2114.29 | -453185.99 |
| THERMAL ZONE: SPACE 801 | 13-DEC-06:01 | 503163.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 607.06 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1452.66 | 0.00 | -2109.86 | -504793.03 |
| THERMAL ZONE: SPACE 802 | 13-DEC-06:01 | 503109.98 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 607.05 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1452.27 | 0.00 | -2109.87 | -504740.32 |
| THERMAL ZONE: SPACE 901 | 13-DEC-06:01 | 613641.60 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 625.36 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1381.52 | 0.00 | -2094.95 | -615375.92 |
| THERMAL ZONE: SPACE 902 | 13-DEC-06:01 | 613623.80 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 625.36 | 1278.75 | 3306.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -1381.49 | 0.00 | -2094.95 | -615358.13 |
| Total Facility | 13-DEC-06:01 | 10211687.53 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 12161.71 | 25575.05 | 66133.47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -28641.25 | 0.00 | -45304.80 | -10241611.70 |



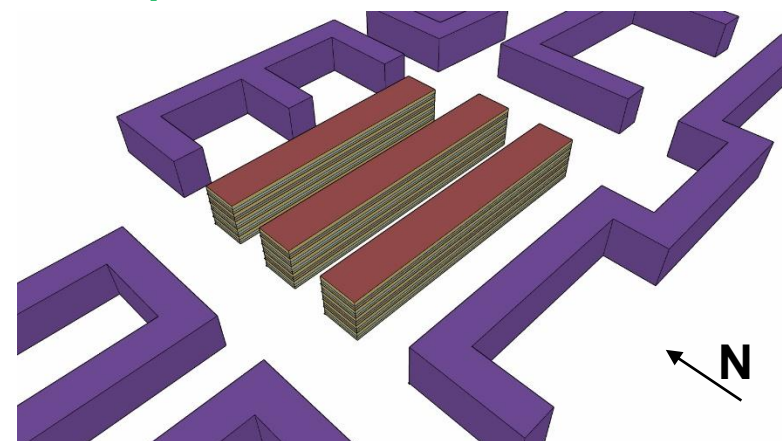
Results

| | Annual: | | | Peak cooling: | | Peak heating: | | | Total end uses: | | |
|-----------|---------------------------|--------------------------|---|---------------|--------------------------|---------------|-------------------------|--|-----------------|--------------|------------|
| | Window Heat Addition [GJ] | Window Heat Removal [GJ] | Opaque Surface Conduction and Other Heat Removal [GJ] | date | Window Heat Addition [W] | date | Window Heat Removal [W] | Opaque Surface Conduction and Other Heat Removal [W] | Heating [GJ] | Cooling [GJ] | Total [GJ] |
| Variant 1 | 1572.632 | -646.447 | -1199.394 | 02-AUG | 106588.23 | 13-DEC | -29870.76 | -13313921.81 | 246.90 | 3792.98 | 9842.50 |
| Variant 2 | 1766.878 | -749.737 | -1303.987 | 02-AUG | 142299.78 | 13-DEC | -34181.42 | -14627960.18 | 380.06 | 3803.83 | 9986.51 |
| Variant 3 | 1604.413 | -723.704 | -1272.264 | 02-AUG | 91930.25 | 13-DEC | -32799.94 | -14404396.09 | 330.58 | 3674.61 | 9807.81 |
| Variant 4 | 1657.258 | -671.065 | -1230.713 | 02-AUG | 125989.15 | 13-DEC | -30895.88 | -13723173.10 | 278.80 | 3827.30 | 9908.72 |
| Variant 5 | 1582.723 | -594.496 | -869.853 | 07-JUN | 234009.16 | 13-DEC | -28641.25 | -10241611.70 | 96.82 | 4223.01 | 10122.45 |

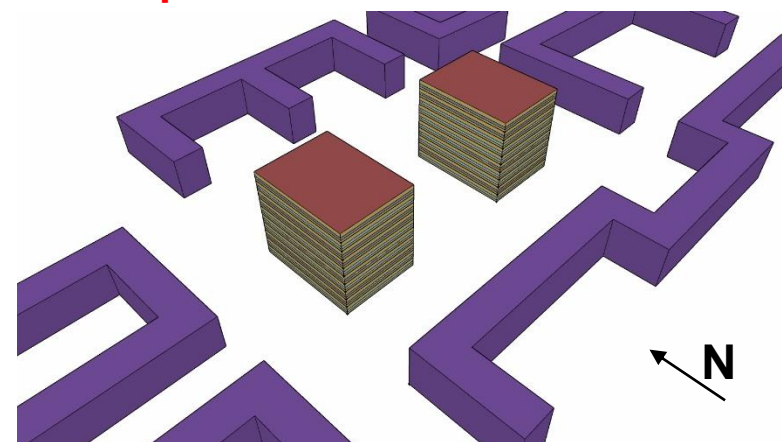
Variants 1-5 comparison



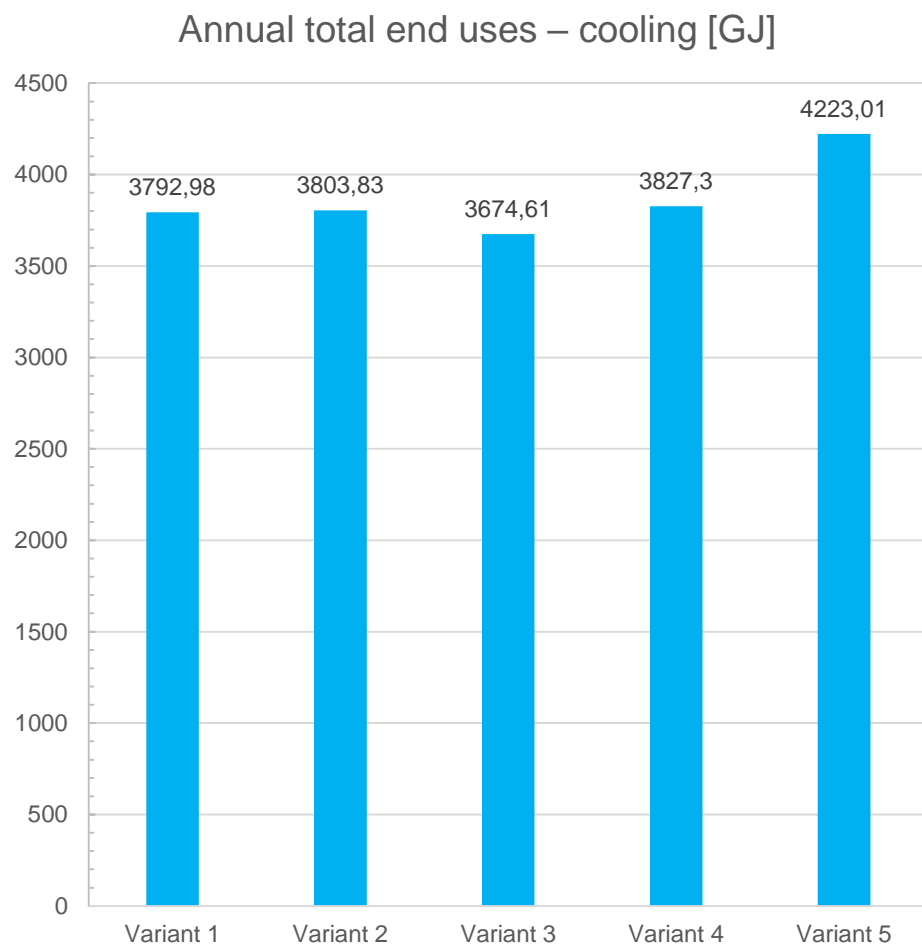
Most profitable: Variant 3



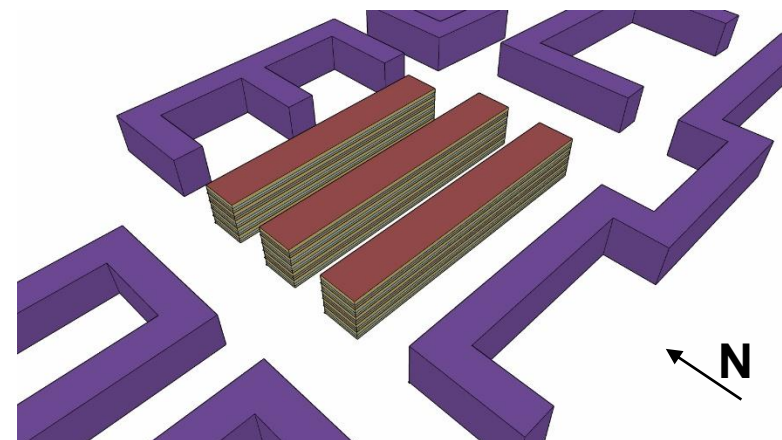
Least profitable: Variant 5



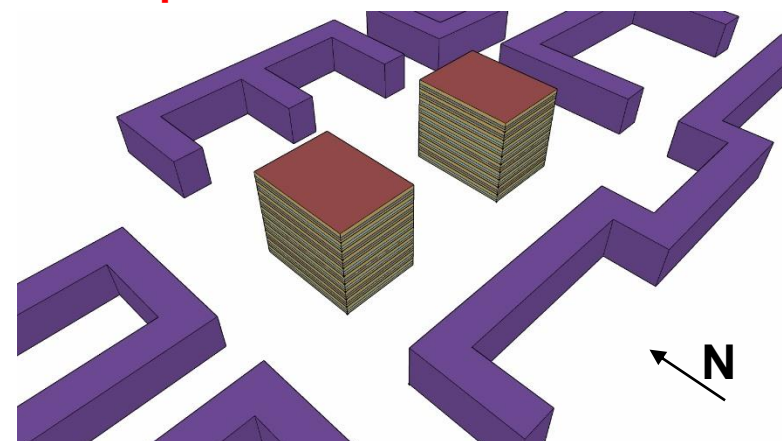
Variants 1-5 comparison



Most profitable: Variant 3

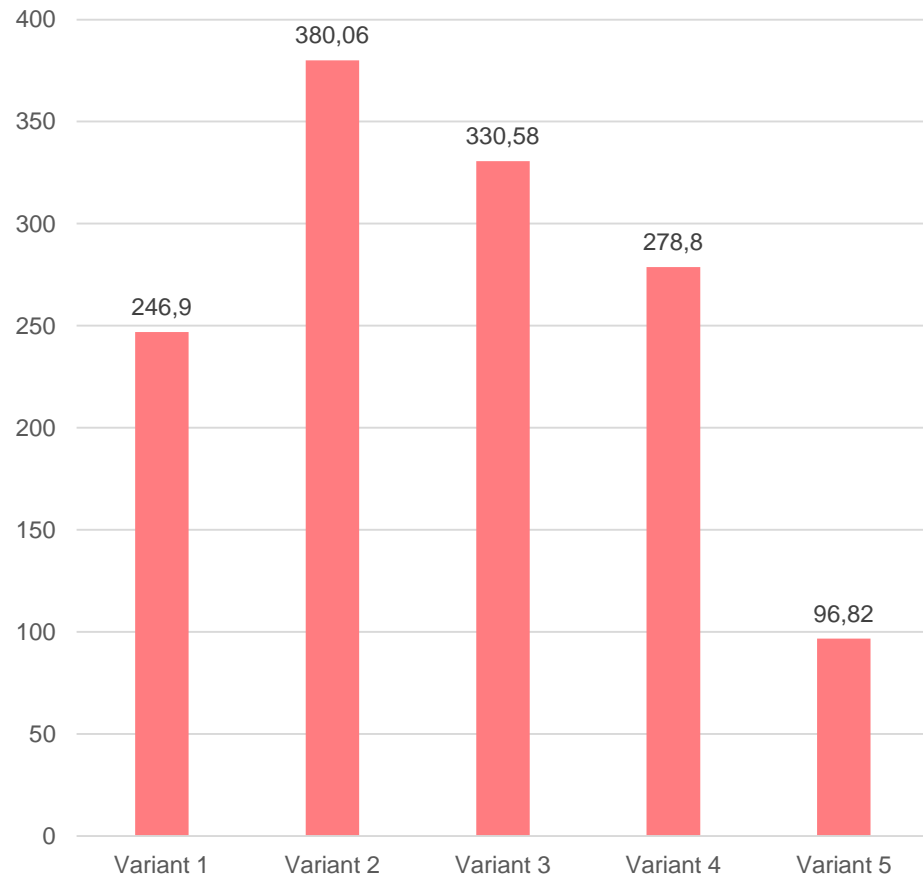


Least profitable: Variant 5

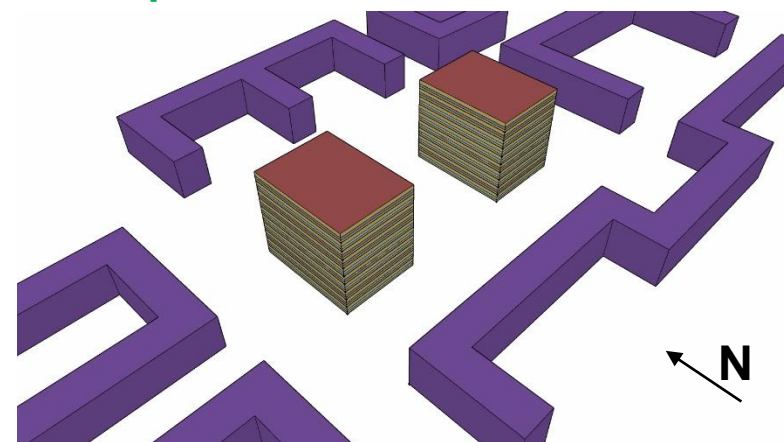


Variants 1-5 comparison

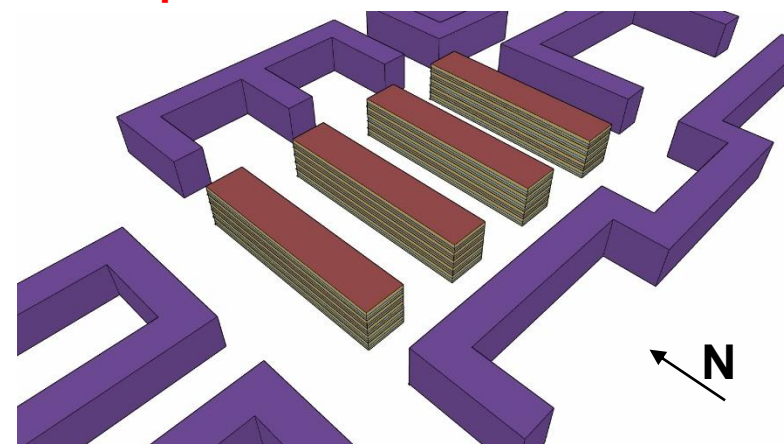
Annual total end uses – heating [GJ]



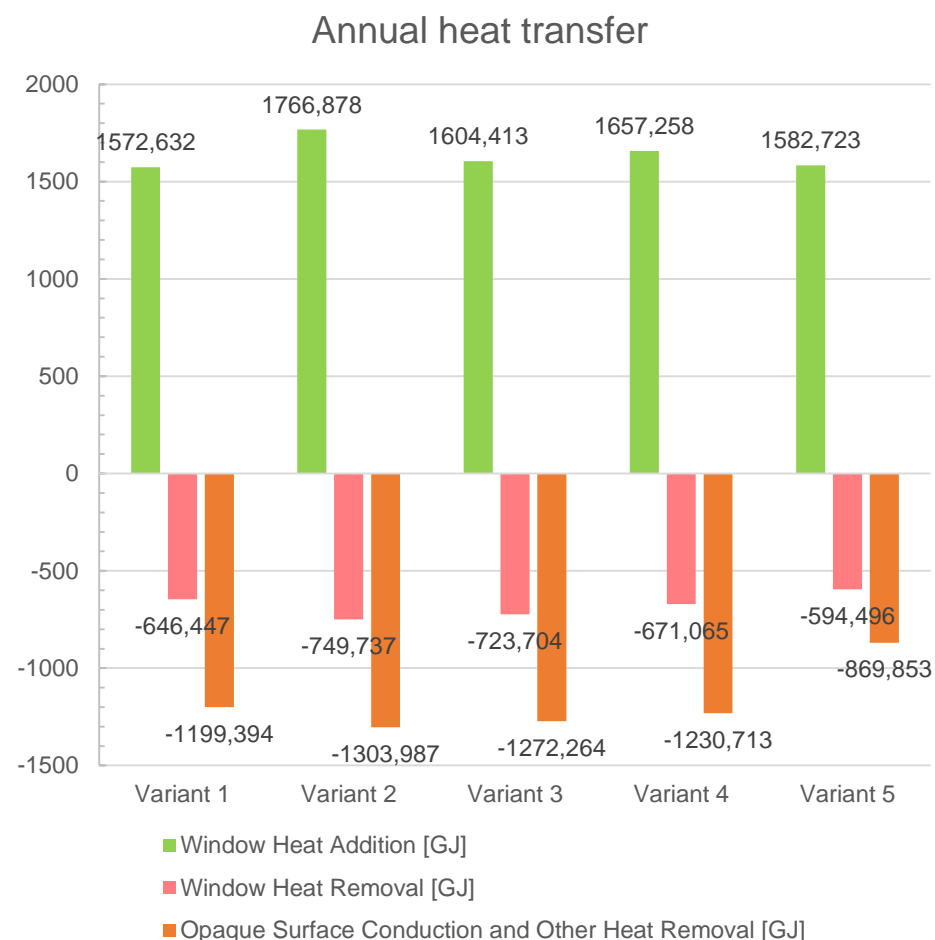
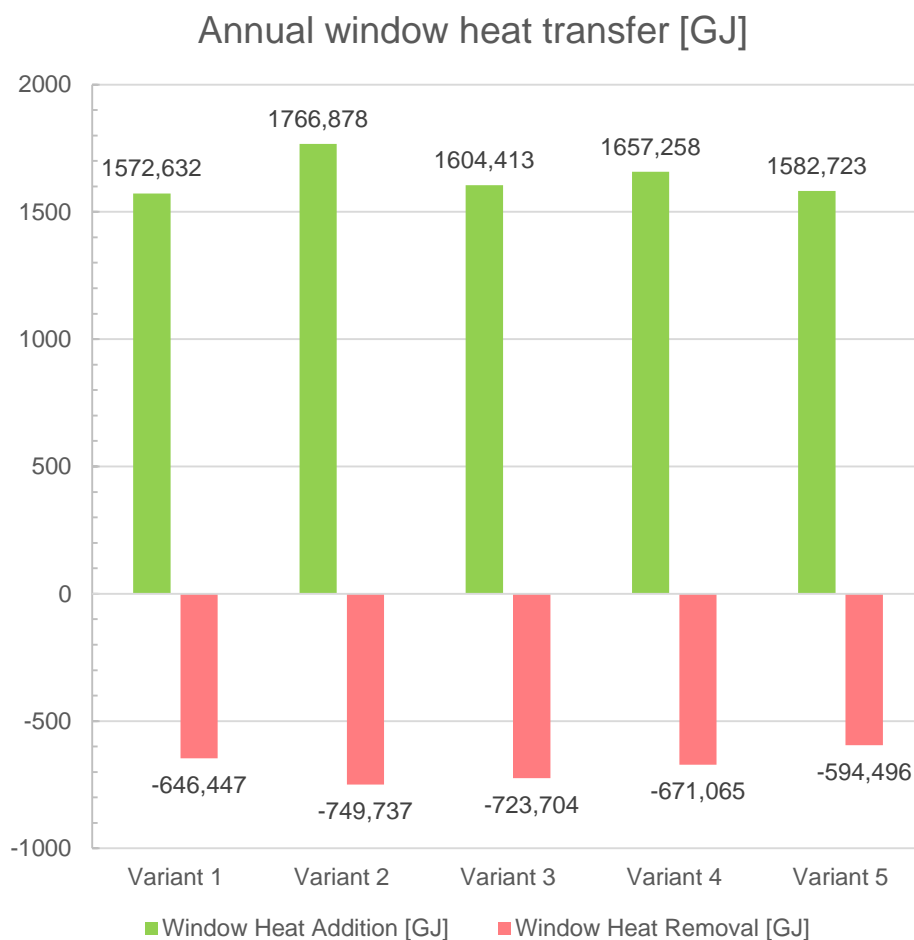
Most profitable: Variant 5



Least profitable: Variant 2



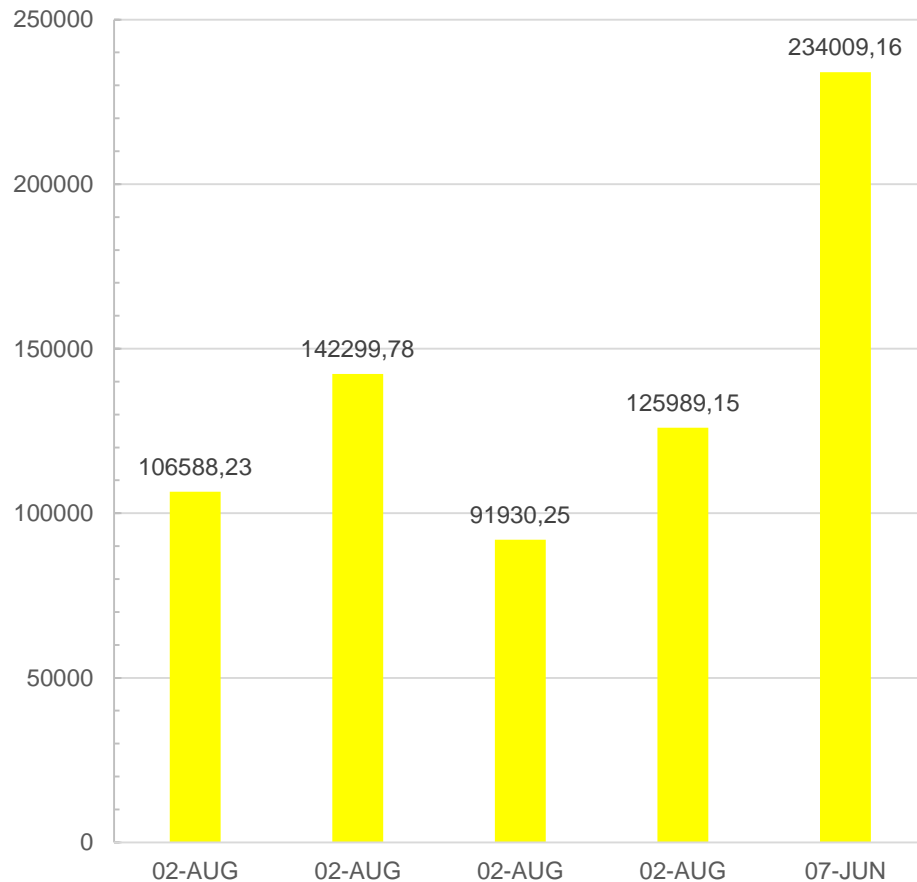
Variants 1-5 comparison



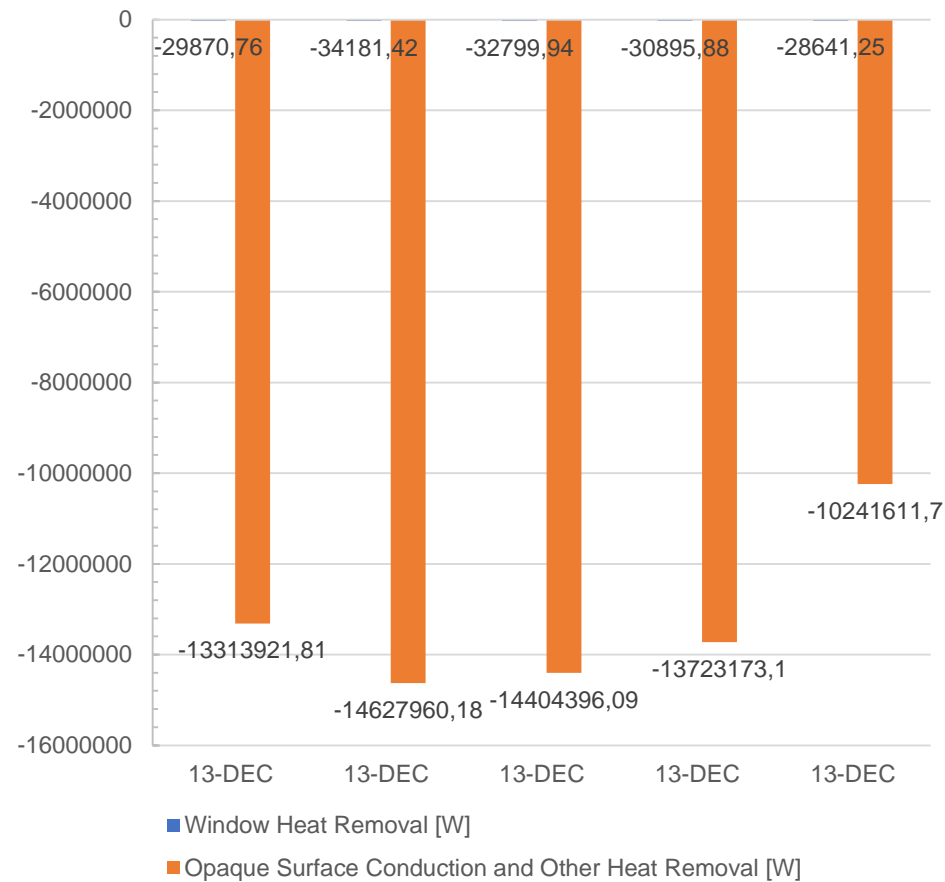


Variants 1-5 comparison

Window Peak Heat Addition [W]



Peak Heat Removal





POLITECHNIKA POZNAŃSKA

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ENERGY-SAVING ORIENTED APPROACH TO URBAN COMPOSITION
WOJCIECH SKÓRZEWSKI



WYDZIAŁ
ARCHITEKTURY

Thank you for attention

Dziękuję za uwagę

PhD Engineer in Architecture Wojciech Skórzewski



Poznan University of Technology



Faculty of Architecture

Institute of Architecture and Spatial Planning

Department of Architecture of Work
and Recreation Places

wojciech.skorzewski@put.poznan.pl

Politechnika Poznańska

Wydział Architektury

Instytut Architektury
i Planowania Przestrzennego
Zakład Architektury
Miejsc Pracy i Rekreacji