

TOMLINSON NEW OFFICE
100 Nortel Drive, Ottawa, ON

**ENERGY MODELLING
FOR
BUILDING PERMIT APPLICATION**

PREPARED BY:
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INTRODUCTION

Part 12 of the Ontario Building Code requires new buildings to meet the minimum energy standards as set out in the MMAH Supplementary Standard SB-10, “Energy Efficiency Requirements”.

The purpose of this report is to illustrate compliance with SB-10 for building permit application.

Division 3 of SB-10 applies to commercial buildings constructed after December 31, 2011. There are multiple compliance paths listed within Division 3.

The compliance path selected for this report is to illustrate energy efficiency levels conform to ASHRAE 90.1-2010, “Energy Standard for Buildings Except Low-Rise Residential Buildings” as modified by Chapter 2 of Division 3.

METHODOLOGY

Energy modeling is used to illustrate compliance with ASHRAE 90.1-2010. The modelling software used is Version 1.11 of Open Studio for graphical user input and Version 8.5.0 of Energy Plus as the simulation engine.

An SB-10 baseline building model was first simulated to determine energy consumption using minimum SB-10 code requirements for building envelope construction and equipment selection. This energy model will be referred to in the report as the “SB-10 building”.

Next, the baseline model was modified using the proposed envelope constructions and equipment for Tomlinson’s new office. The Tomlinson new office model was simulated to determine energy consumption. This energy model will be referred to in the report as the “Tomlinson Building”.

WEATHER FILE

For both models, the Ottawa CWEC weather file was used to perform a simulation for an entire model year. The site ground reflectance was specified as 0.2 for each month of the year. The site was defined as flat and unobstructed.

Six (6) warm-up days were used to reach steady state conditions before the simulation year started. For each of the 8760 hours simulated, six (6) timesteps were used per hour. The temperature convergence tolerance value was specified as 0.4K.

BUILDING GEOMETRY AND THERMAL ZONES

The building geometry was identical for both the SB-10 and Tomlinson building models.

A four storey office building was simulated. There is a three storey atrium located near the middle of the building. For the purposes of simulation, nine thermal zones were used. Four thermal zones on both the north and south sides of the building. A single thermal zone was used to represent the atrium.

A graphical representation of the thermal zones is provided.

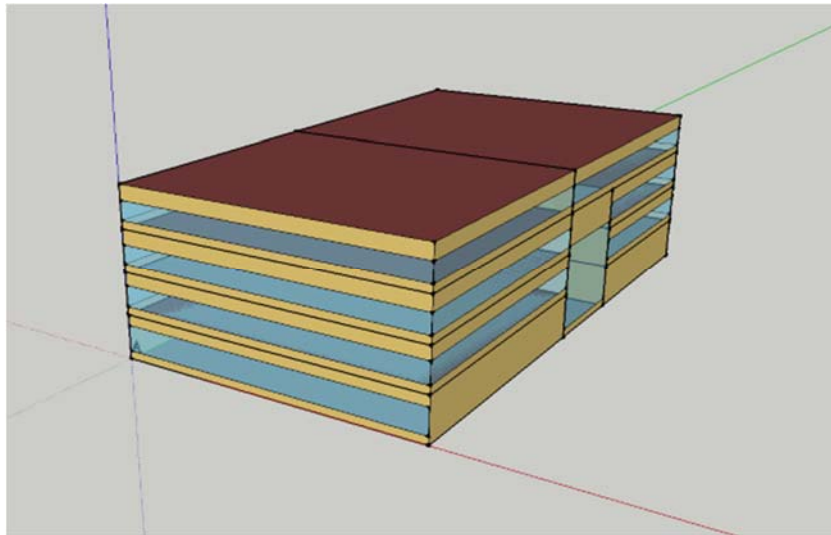


Figure 1: Thermal Zones (9 Total)

BUILDING ENVELOPE CONSTRUCTION AND FENESTRATIONS

For the SB-10 building, the building envelope maximum assembly 'U' values dictated for Climate Zone 6 of SB-10 were used. The building envelope construction types include wall, roof and fenestrations. The percent fenestration area for the SB-10 building is 40% as required by code.

For the Tomlinson building, the building envelope maximum assembly 'U' values were based on the proposed constructions. The proposed constructions include the ground floor perimeter walls, curtain wall, spandrel panel and roof. The percent fenestration area for the Tomlinson building is approximately 50%.

HVAC EQUIPMENT

Conditioned air is supplied to the building by three separate air handling units (AHUs). There is an AHU serving the four floors on the north side of the building. Another AHU

serving the four floors on the south side of the building. And the third AHU serves the atrium. All three AHUs use a variable speed fan and variable air volume (VAV) boxes located throughout each floor to provide zoned temperature control.

For the purposes of simulation, each floor is modelled as a single zone with VAV control. Refer to the HVAC schematics below.

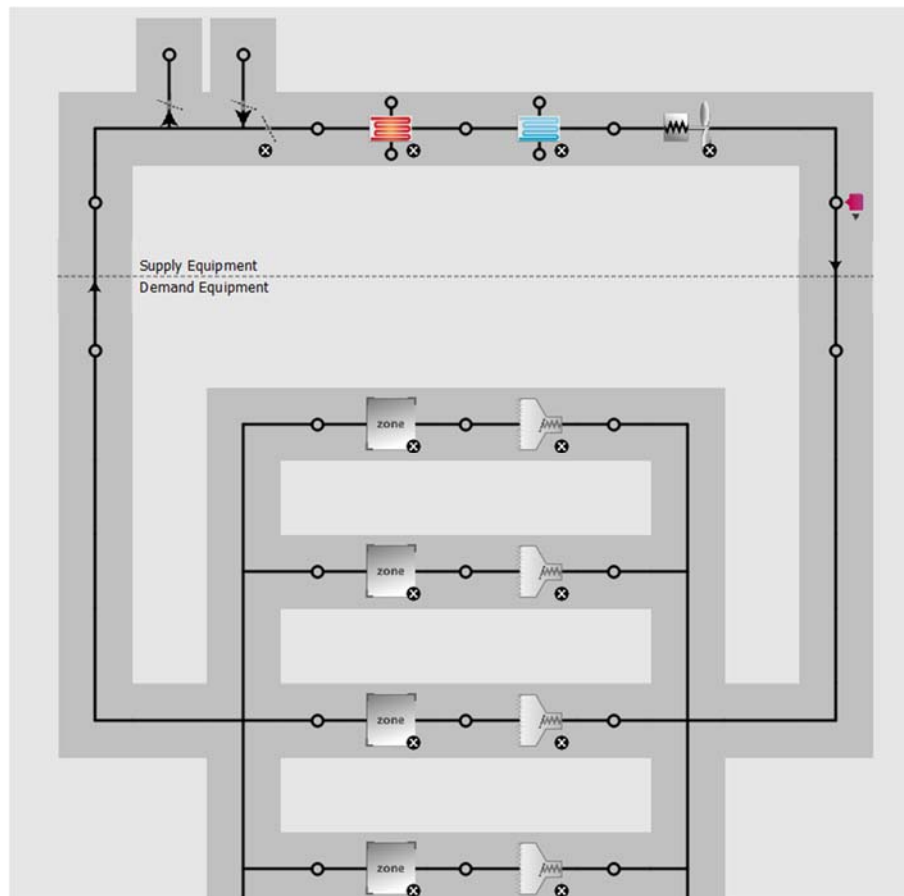


Figure 2: North Office Space Air Handling Unit with Zone Per Floor

Each AHU is equipped with an outdoor air intake and exhaust for ventilation. The ASHRAE 62.1 “Ventilation for Acceptable Indoor Air Quality” airflow rates were used for both building simulations. The minimum outdoor air requirement is 5 cfm per person and 0.06 cfm per square foot of floor space. Because both the supply and return air are provided from the ceiling a zone air distribution effectiveness of 0.8 was used.

There is a hydronic heating and cooling coil within each AHU. Heating water is provided by boilers located within the mechanical penthouse. Chilled water is provided by a chiller located on the roof. Both the heating and chilled water plants were modelled, refer to their schematics.

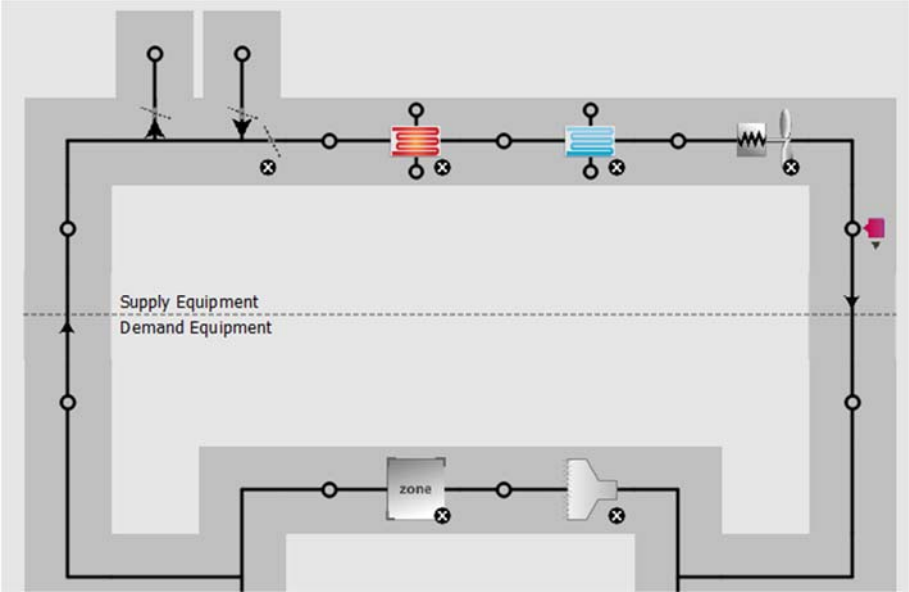


Figure 3: Atrium Air Handling Unit

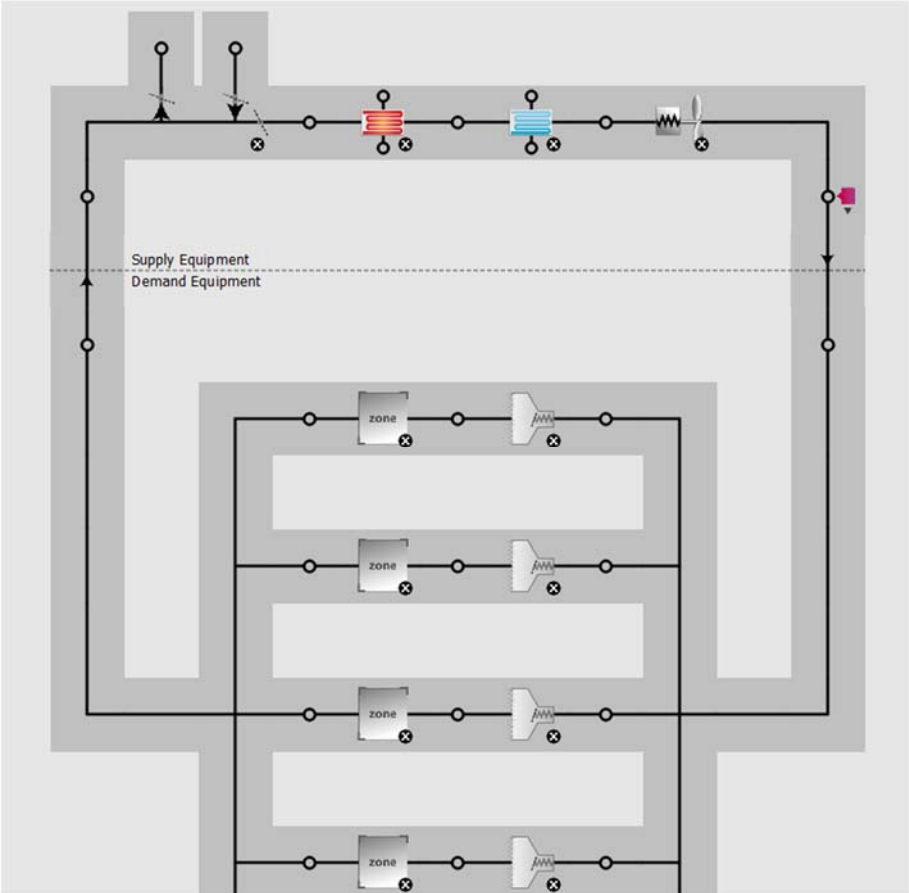


Figure 4: North, Atrium and South Air Handling Units with Zone per Floor

Both buildings were simulated using similar equipment, the exception being the equipment efficiencies of the Tomlinson building were higher than minimum code requirements. The minimum required boiler efficiency as per SB-10 is 80% whereas the boilers being installed in the Tomlinson building have an efficiency of 96%. Similarly, a more efficient chiller will be used within the Tomlinson building.

The temperature setpoint in each zone was defined using a separate cooling and heating schedules with nightly and weekly setbacks.

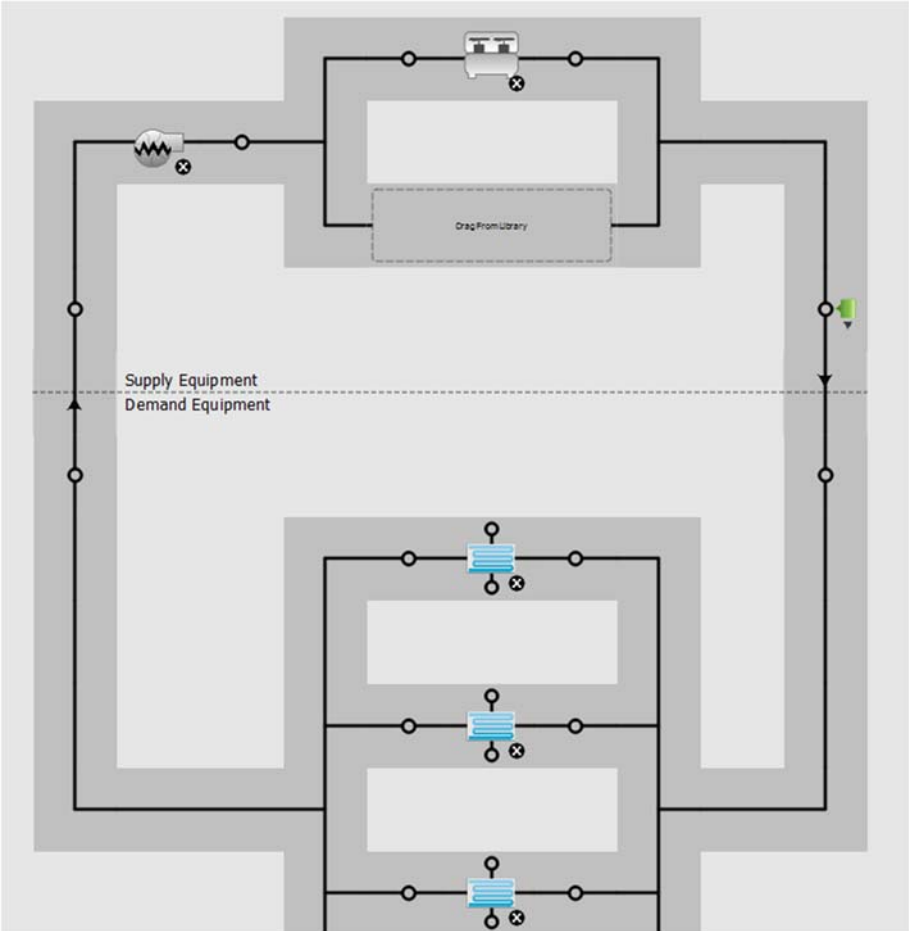


Figure 5: Cooling Plants

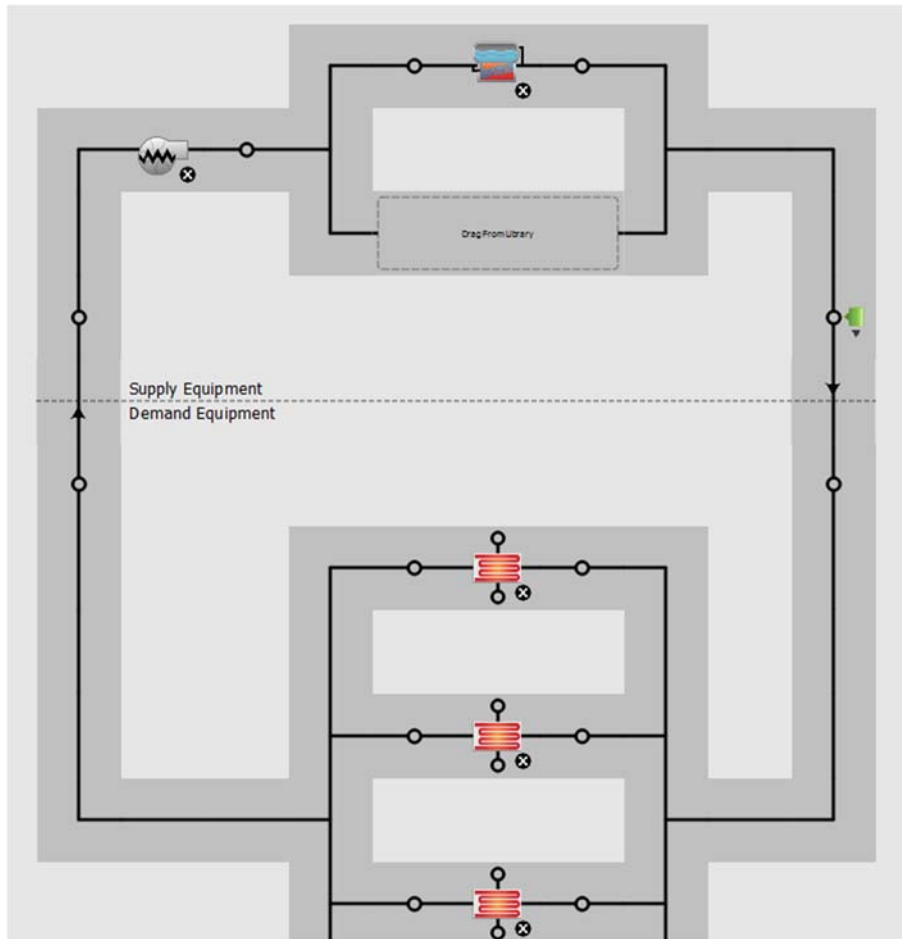


Figure 6: Heating Plant

OCCUPANT LOAD

The simulation for the SB-10 and Tomlinson building used the same total occupancy of 200 people distributed throughout the building as per the proposed use. The same occupant schedule was used for both simulations. The heating load for each occupant was also identical, defined as 477 BTU.

LIGHTING LOAD

The AHRAE 90.1-2010 maximum allowable lighting load is 0.98 watts per square foot. This value was used for the SB-10 building simulation. The proposed lighting fixtures for

the Tomlinson building will be more efficient. On average, the lighting load within the Tomlinson building will be 0.7 watts per square foot, this value was used for the simulation. The lighting schedule was identical for both simulations.

ELECTRICAL EQUIPMENT LOAD

There is no maximum allowable electrical equipment load in ASHRAE 90.1-2010 as it depends on the use of the building. For the purposes of the simulations, the same electrical equipment load of 1 watt per square foot was used. The schedule for the electrical equipment was also identical.

The simulated schedules used are shown below.

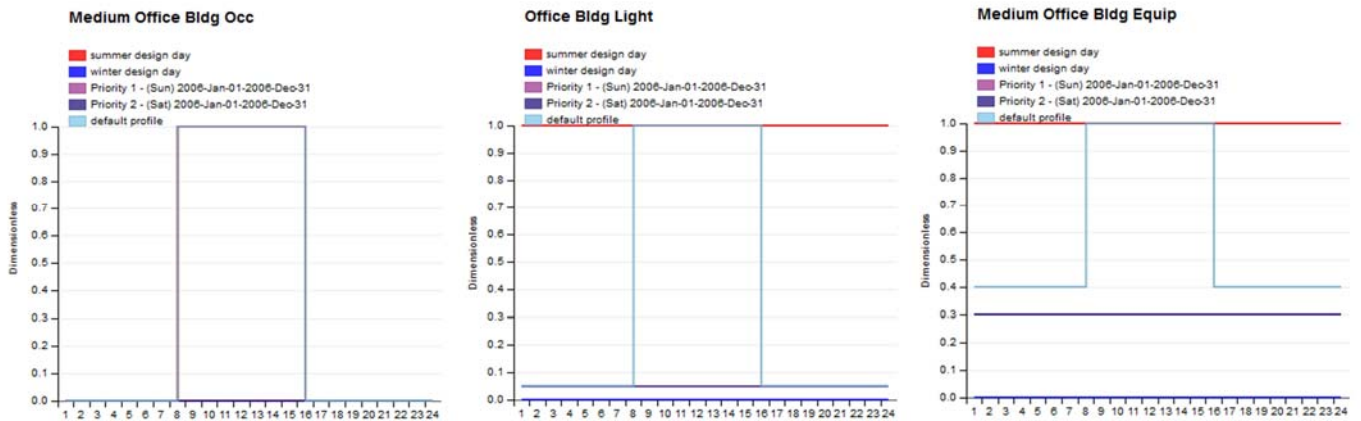


Figure 7: Simulation Schedules

SIMULATION RESULTS

With all the required input parameters defined, the SB-10 and Tomlinson buildings were simulated for an entire model year to determine energy consumption.

A sensitivity study for simulation time-steps was first performed using 1-minute, 5-minute, 10-minute time-steps. The simulation time for the 1-minute time-step is much

greater than the simulation time for the 10-minute time-step. The results for the 10-minute time-step differed by less than 1% from 1-minute time-step, and therefore a 10-minute time step was used for subsequent simulations to minimize computing time because the results were stable at this time-step.

The monthly electrical and natural gas consumption for the SB-10 building are shown in Figure 5. Electrical consumption is separated by end usage type as per the legend.

Similarly, the monthly electrical and natural gas consumption for the Tomlinson building is shown in Figure 6.

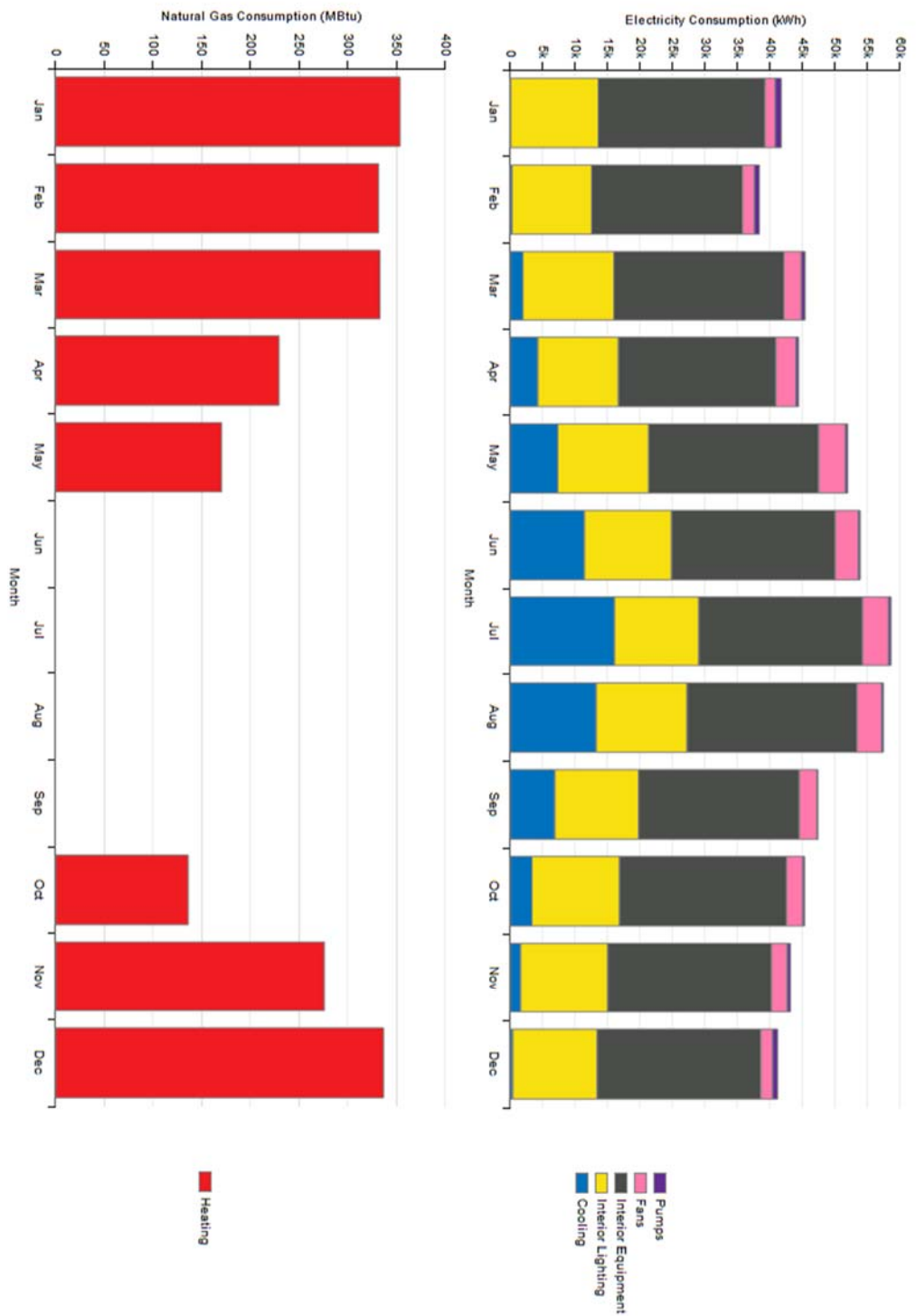


Figure 8: SB-10 Building Monthly Consumption

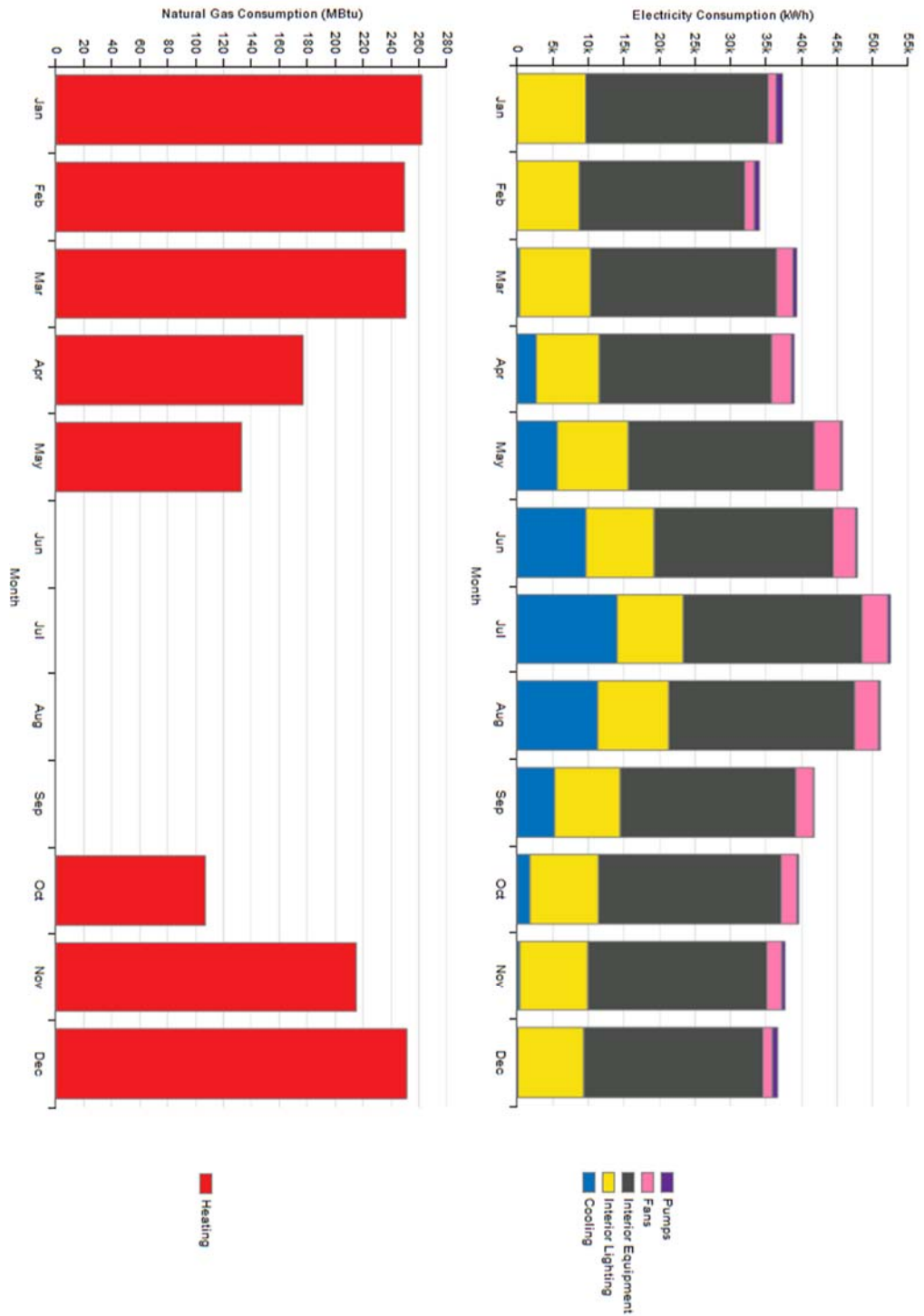


Figure 9: Tomlinson Building Monthly Consumption

The table below provides a comparison of the total energy use for both the SB-10 and Tomlinson buildings. Based on the simulation results using the provided information from the building designers, the Tomlinson building uses 22% less net site energy than the SB-10 building.

Building Name	Net Site Energy (kBTU)	Net Site Energy/Area (kBTU/ft ²)
SB-10	4,103,328	60.95
TOMLINSON	3,360,002	49.91

CONCLUSION

The Tomlinson building meets Part 12 OBC/SB-10 requirements for minimum energy efficiency requirements using the ASHRAE 90.1-2010 compliance path as modified by Chapter 2, Division 3 of SB-10.

The energy efficiency improvements can be attributed to higher efficiency boilers, chiller and lighting. With respect to the building envelope, the 'U' value of the Tomlinson roof is higher than minimum code requirements, however the combined 'U' value of perimeter surfaces (combination of walls and fenestrations) was not as high as the 'U' value specified by code.

The energy model verified the Tomlinson buildings total energy efficiency is 22% better than minimum code requirements.

The conclusions presented represent the best judgment of the consultant based on the available information.