SMITHGROUP

AXON CAMPUS

International Green Construction Code (IgCC) 2015

Development Review (DR) Energy Analysis Report

SMITHGROUP

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Introduction

The proposed Axon campus is located near the Loop 101 freeway and N. Union Hill Drive in Scottsdale, AZ. The building is a new 5-story Class A office building and warehouse.

Methodology

To evaluate the total energy performance of the actual design whether meet the requirement of International Green Construction Code (IgCC) 2015, the hourly simulation baseline building model and proposed building model are built by IES Virtual Environment software, version VE2019 computer software.

The following systems and loads are included in the simulation: heating systems, cooling systems, fan systems, lighting power, receptacle loads, and process loads. The Baseline building was developed with the same architecture and zoning, receptacle power, occupancy, schedule of the actual design, but comply with the ASHRAE90.1 2013 standard refence design envelope and mechanical system.

In section 602.2, IgCC defines that the performance-based designs shall demonstrate a z EPI of not more than 50 as determined in accordance with equation shown below.

zEPI = 52 x (Proposed building performance/Baseline building performance) (**Equation-1**)

where:
Proposed Building Performance = The proposed building performance in source kBtu for the proposed design of the building and its site calculated in accordance with IgCC Section 602.2.1.

Baseline Building Performance = The baseline building performance in source kBtu for a baseline building and its site calculated in accordance with IgCC Section 602.2.1.

52 = a fixed value representing the performance of a baseline building designed to comply with ASHRAE Standard 90.1-2013.

Similarly, the CO_2e emissions associated with the proposed design shall be less than the associated with the standard reference design in accordance with equation shown below.
CO_2e pdp <= (zEPI x CO_2e bbp)/52 (**Equation-2**)

Local Climate

The climate of the Scottsdale area is hot and dry in the summer, while mild in winter. The ASHRAE 1% design conditions were used in the evaluation of this project, and are as shown below,
Heating Design Day Outdoor Temperature: 35.96 ℉
Cooling Design Day Outdoor Dry-bulb Temperature: 110.84 ℉
Wet-bulb Temperature: 70.16 ℉

Building Zoning

Building HVAC zones are defined as shown below for both baseline model and proposed model,

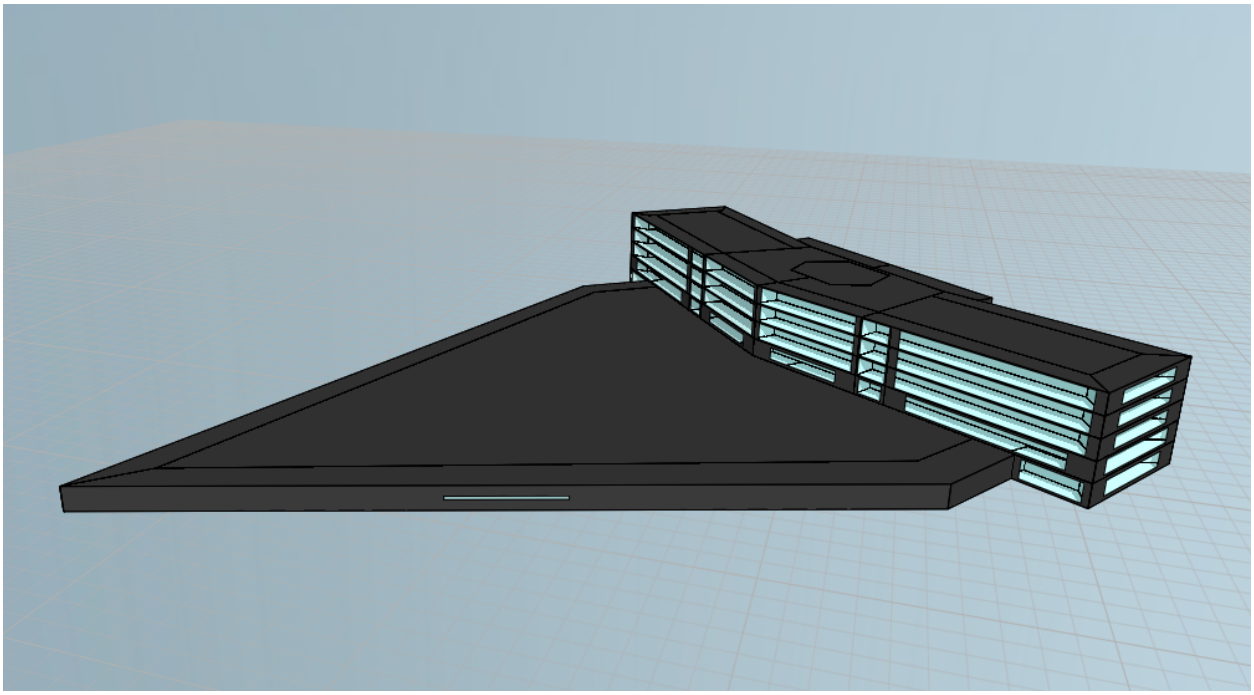

Figure1 - Building Block in IESVE Model

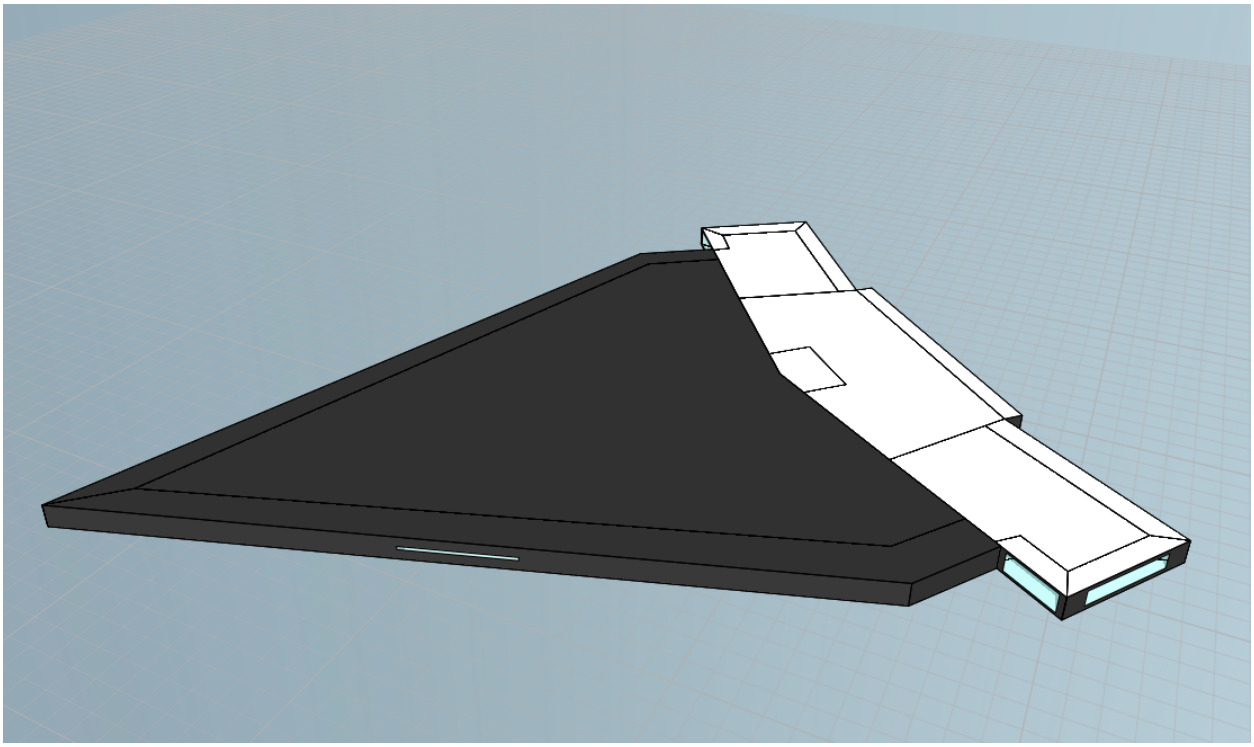

Figure2 – 1st Floor Zoning

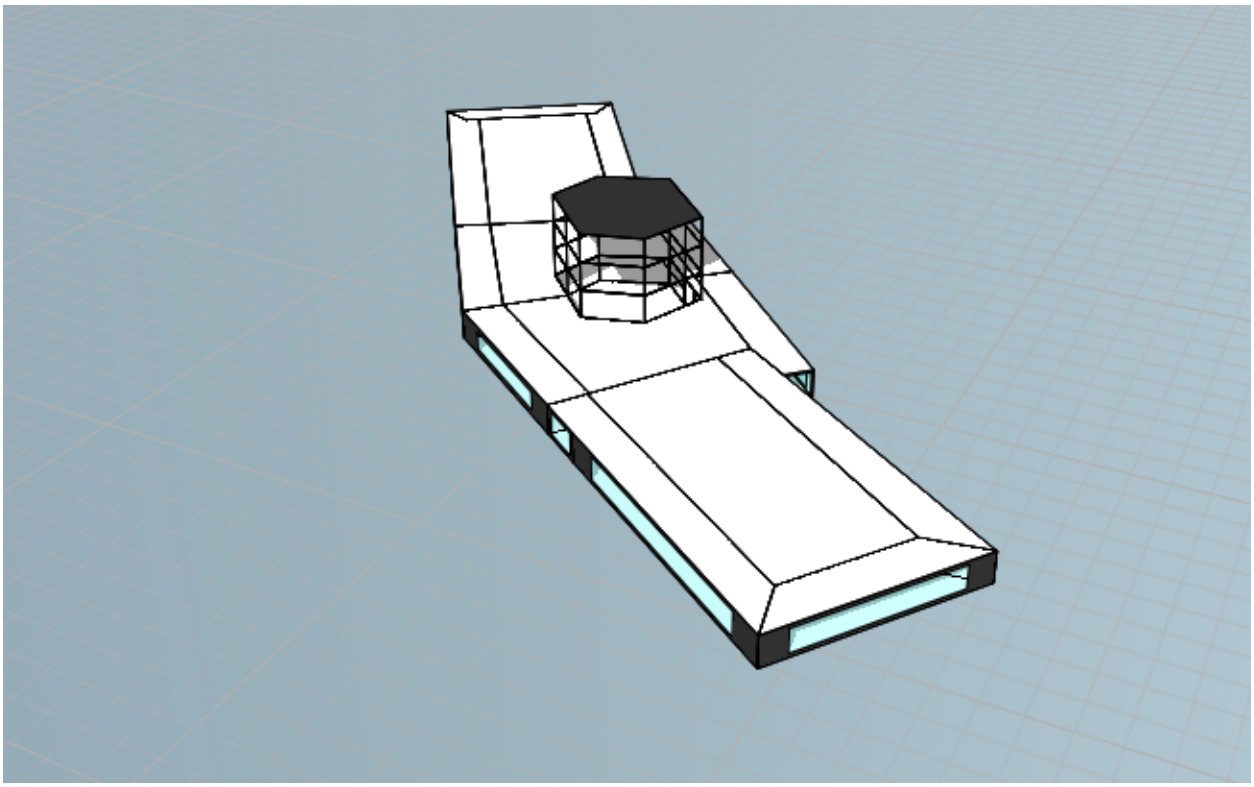

Figure 3 – 2nd Floor Zoning

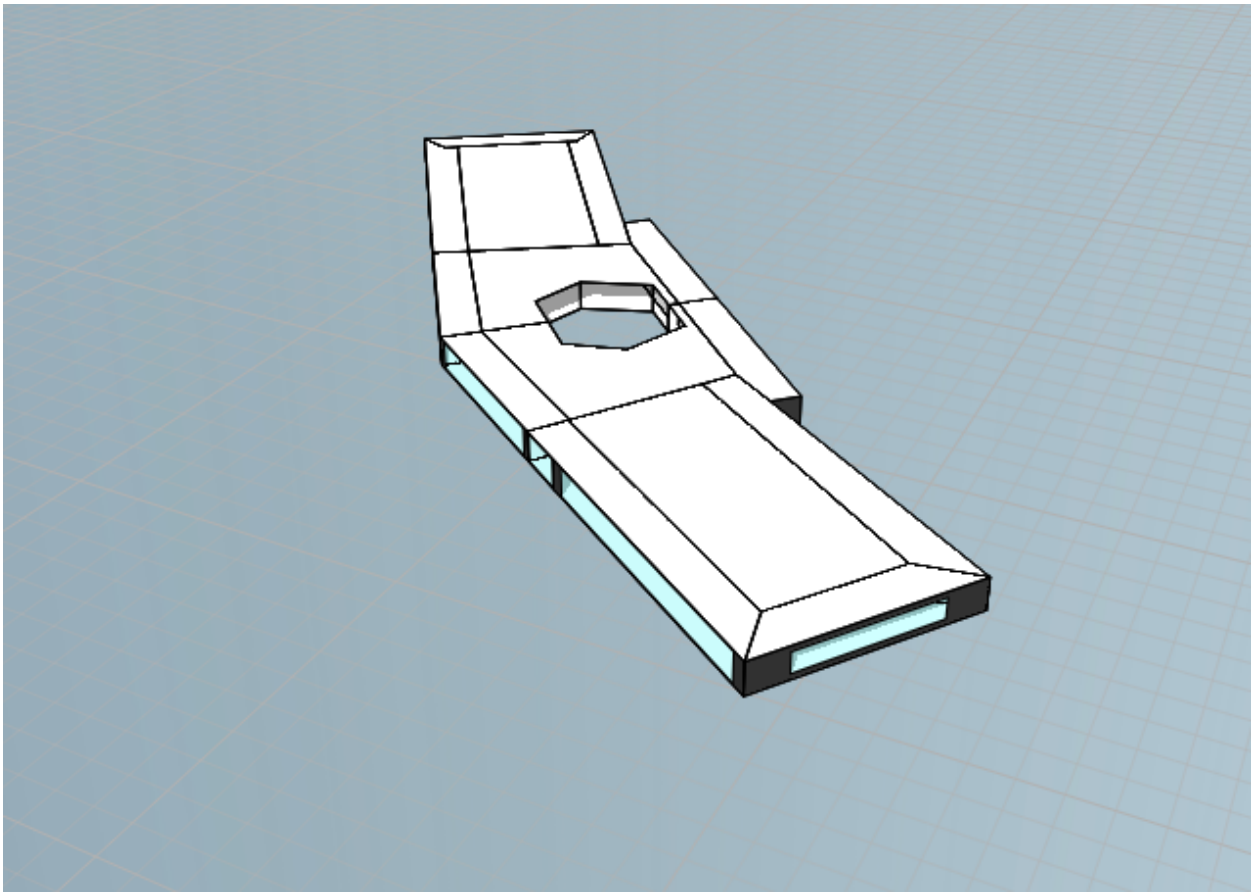

Figure 4 – 3rd thru 5th Floor Office and Conference Zoning

Each open space is composed of at least five zones: one perimeter zone for each orientation and one interior zone.

Envelope

The ASHRAE 90.1 -2013 Appendix G thermal envelope assembly requirement for CZ2, where Scottsdale is located has been applied to the Baseline model. The Construction Parameter Comparison is shown below.

Orientation	Proposed			Baseline		
	Above-grade wall area (ft²)	Vertical glazing area (ft²)	Vertical glazing area (%)	Above-grade wall area (ft²)	Vertical glazing area (ft²)	Vertical glazing area (%)
North	23526	11604	49.3	23526	8955	38.1
East	19455	8820	45.3	19455	7481	38.5
South	32854	16972	51.7	32854	14071	42.8
West	24531	11759	47.9	24531	9453	38.5
Sum	100366	49155	49.0	100366	39960	39.8

	Baseline		Proposed	
	U-value	R-value	U-value	R-value
Category	Btu/hft2F	hft2F/Btu	Btu/hft2F	hft2F/Btu
Ground/Exposed Floor	0.038	30	0.038	30
Internal Ceiling/Floor	0.19	4	0.19	4
External Wall	0.083	R13+R3.8 c.i.	0.07	13 c.i.
Roof	0.039	25 c.i.	0.26	40 c.i.

	Baseline			Proposed		
	Whole Window U-value	SHGC	Area	Whole Window U-value	SHGC	Area
Category	Btu/hft2F		% of Wall	Btu/hft2F		% of Wall
Clear Window	0.57	0.25	39.8%	0.3	0.15	49%

Operational Hours

The operation setting for Baseline and Proposed model are same.

The facility will be occupied between 8am-6pm from Monday to Friday; 9am-5pm in Sat and 10am-4pm in Sun.

Cooling/heating Setpoint: 75/70F when occupied, 80/60F when unoccupied.

Internal Heat Gain

The building electrical power of receptacle and lighting is simulated as table shown below,

Space Use		Conference	Corridor	Lobby	Manufacturing	Office
Baseline Internal Gains	Lighting(W/SF)	1.23	0.66	0.9	1.29	0.98
	Receptacle (W/SF)	1	0.2	0.5	1	1.5
	Occupancy (SF/person)	20	N/A	6.67	50	20
Proposed Internal Gains	Lighting(W/SF)	1	0.66	0.9	1	0.75
	Receptacle (W/SF)	1	0.2	0.5	1	1.5
	Occupancy (SF/person)	20	N/A	6.67	50	20

Mechanical System

The mechanical system for proposed model is same as baseline model, whose system type based on ASHREA 90.1-2013 Appendix G3.1.1A table requirement. The building will be conditioned by a variable air volume (VAV) water-cooled chilled water system. Centralized air handling units will provide conditioned air to single-duct VAV terminal units with electric reheat.

The chilled water system will consist of high efficiency chillers, cooling towers and pumps. The chillers will be centrifugal type with crossflow cooling towers. Base mounted end-suction pumps will be used in the chilled water and condenser water systems.

The detailed information of mechanical system is shown below,

Model Input			Baseline	Proposed
Mechanical System	Air Side	Terminal Unit	Single Duct VAV Box	Single Duct VAV Box
		Reheat	Electric Reheat	Electric Reheat
		Total AHU Fan Design Flow Rate (CFM)	356,627	383,371
		AHU Fan Design Pressure (INWG)	8	5
		AHU Cooling Coil Air Supply T (F)	55	55
		Fan Control	VFD	VFD
	Water Side	Design Chiller Efficiency (KW/ton)	0.56 (Based on ASHREA90.1-2013)	0.547
		Waterside Economizer	Yes	Yes
		Condenser	Cooling Tower	Cooling Tower
		Chilled Water Supply T (F)	44	44
		Chilled Water Delta T (F)	12	12
		Pump Control	VFD	VFD

Analysis Results

Results of the analysis are summarized in Table shown below.

Site Energy Usage Breakdown	Interior Lighting (MBtu)	Receptacle Equipment (MBtu)	Space Heating (MBtu)	Space Cooling (MBtu)	Heat Rejection (MBtu)	Interior Central Fans (MBtu)	Pumps (MBtu)
Baseline	4099	4752	765	3951	1348	2582	307
Proposed without PV panel	3271	4752	1061	3781	849	2141	256

Energy Usage	Electricity (MBtu)	Saving
Baseline	17804	
Proposed without PV panel	16111	9.51%
Proposed with PV panel	15628	12.22%

Based on IgCC table 602.2.1.1 Electricity Generation Energy Conversion Factors by EPA eGRID Sub-region, this project in AZNM should use the energy conversion factor 3 .10 to calculate Source Energy Usage, which is summarized in Table shown below.

Source Energy Usage Breakdown	Interior Lighting (MBtu)	Receptacle Equipment (MBtu)	Space Heating (MBtu)	Space Cooling (MBtu)	Heat Rejection (MBtu)	Interior Central Fans (MBtu)	Pumps (MBtu)
Baseline	12706	14731	2371	12248	4178	8006	953
Proposed without PV panel	10141	14731	3289	11722	2631	6636	793

Source Energy Usage	Electricity (MBtu)	Saving
Baseline	55192	
Proposed without PV panel	49944	9.51%
Proposed with PV panel	48446	12.22%

The proposed building design energy reduction can reach up to 9.51%. In addition to the saving above, this project has additional 3% energy saving from PV panel installation and application, so it is 12.22% energy saving totally it achieves. According to Equation-1, its zEPI value is 45.6, which is not more than 50 as IgCC requirement.

Based on IgCC table 602.3.1 *Electricity Emission Rate by EPA eGRID Sub-region*, this project in AZNM should use CO_2e rate 0.671 kg/kWh to calculation CO_2e emission, which is shown below.

CO2e Emission Calculation	Site Electricity (MBtu)	Electricity Emission Rate(kg/kWh)	CO_2e emission (kg) =Site Electricity * Electricity Emission Rate		(Zepi *CO_2e bbp)/52
Baseline	17804	0.671	CO_2e bbp	3500312	3072433
Proposed	15628	0.671	CO_2e pdp	3072433	N/A

As a result, the CO_2e emissions associated with the proposed design is less than the associated with the standard reference design in accordance with Equation-2, CO_2e pdp <= (zEPI x CO_2e bbp)/52.

In summary, based on above energy performance and CO_2e emissions analysis, per IgCC section 602.2, this building will comply with IgCC2015.

City of Scottsdale
International Green Construction Code (IgCC)

Development Review (DR) Checklist

This is an abbreviated checklist for IgCC compliance measures that need to be addressed during the DR process. Please refer to the building plan review checklist for complete IgCC compliance requirements.

1. HEAT ISLAND MITIGATION
    a. Please refer to attached sheet DR1.3 for heat island mitigation approach and calculations.

2. ENERGY COMPLIANCE PATH
    a. Refer to the attached preliminary energy report indicating the energy reduction of the building from the baseline requirements.

3. ONSITE RENEWABLE ENERGY SYSTEM
    a. To comply with the 2015 IgCC renewable energy requirement of not less than 3% of the project's annual energy consumption through on-site renewable energy, the design includes 30,000 SF of roof top solar panels.
    b. The estimated energy usage of the building based on the preliminary energy report is 4,721 MWh. The solar system is required to provide 142 MWh. A solar system of 7,636 square feet is required to meet this energy production. This is based on 11 watts per square foot of solar panel.

4. REFUSE AND RECYCLING COLLECTION
    a. Please refer to attached sheet DR6.1 for design approach to refuse and recycling collection.