6D

Sustainable Design & BIM Technology

BY

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03/09/2018

Green building basics ?

Sustainability can be defined as the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs.

Green building is the practice of creating structures and using processes that are environmentally responsible and resource efficient throughout a building's life cycle. That life cycle respectfully analyzes and integrates site selection through design, construction, operation, maintenance, renovation and deconstruction. The practice expands and also complements the classical building design concerns of economy, utility, durability, and comfort.1

- **INTIAL COST**
- **LIFE CYCLE COST**
- **PAY BACK TIME**

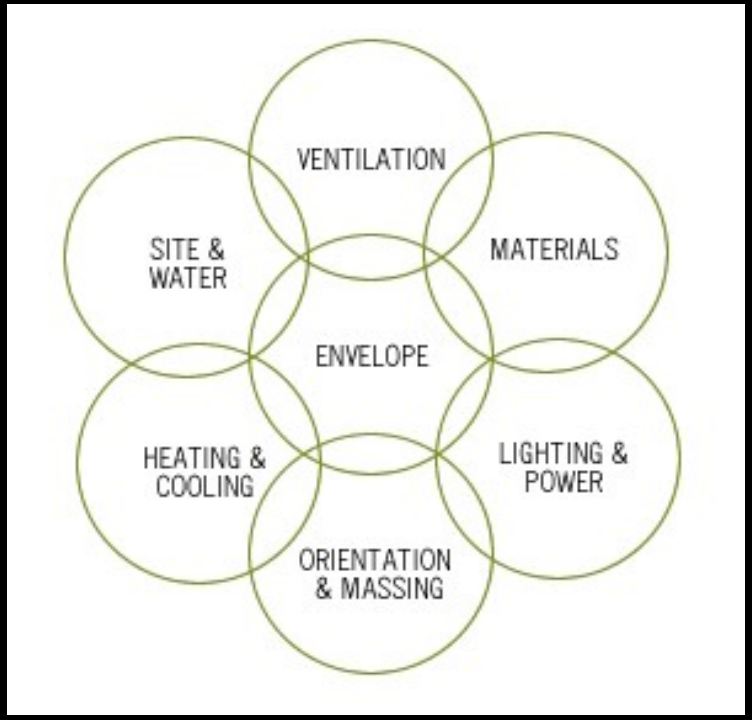
Impacts of Buildings and Construction

Commercial construction requires the greatest quantity of resources in the building industry. While this study looks at green building across several product types within construction, the impacts from commercial construction in the United States include:

- 72% of electricity consumption2
- 39% of energy use3
- 38% of all carbon dioxide (CO_2) emissions4
- 40% of raw materials use5
- 30% of waste output (136 million tons annually)6
- 14% of potable water consumption7

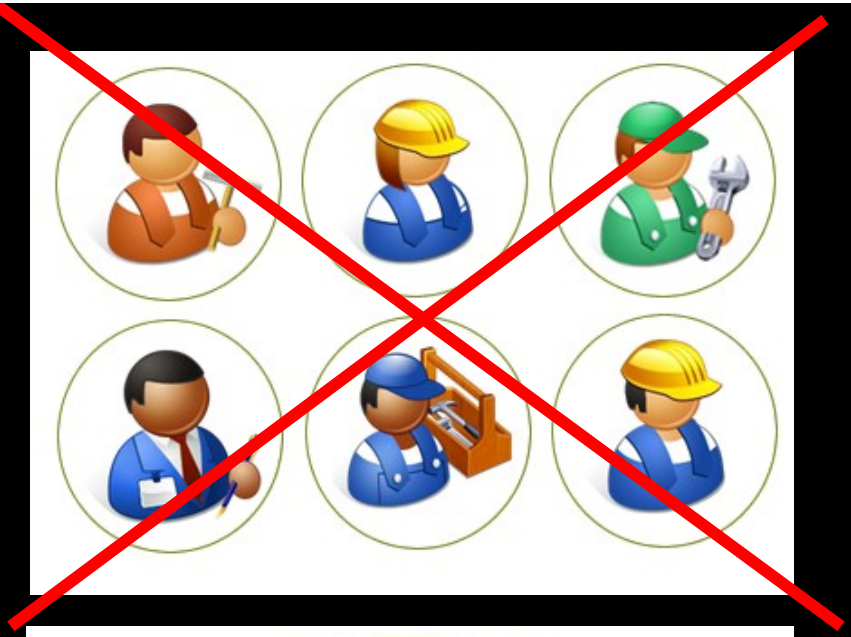
So sustainability isn't energy reduction only

- Materials
- Energy
- Water
- Construction
- Hvac
- System
- Site
- Comfort
- Infrastructure



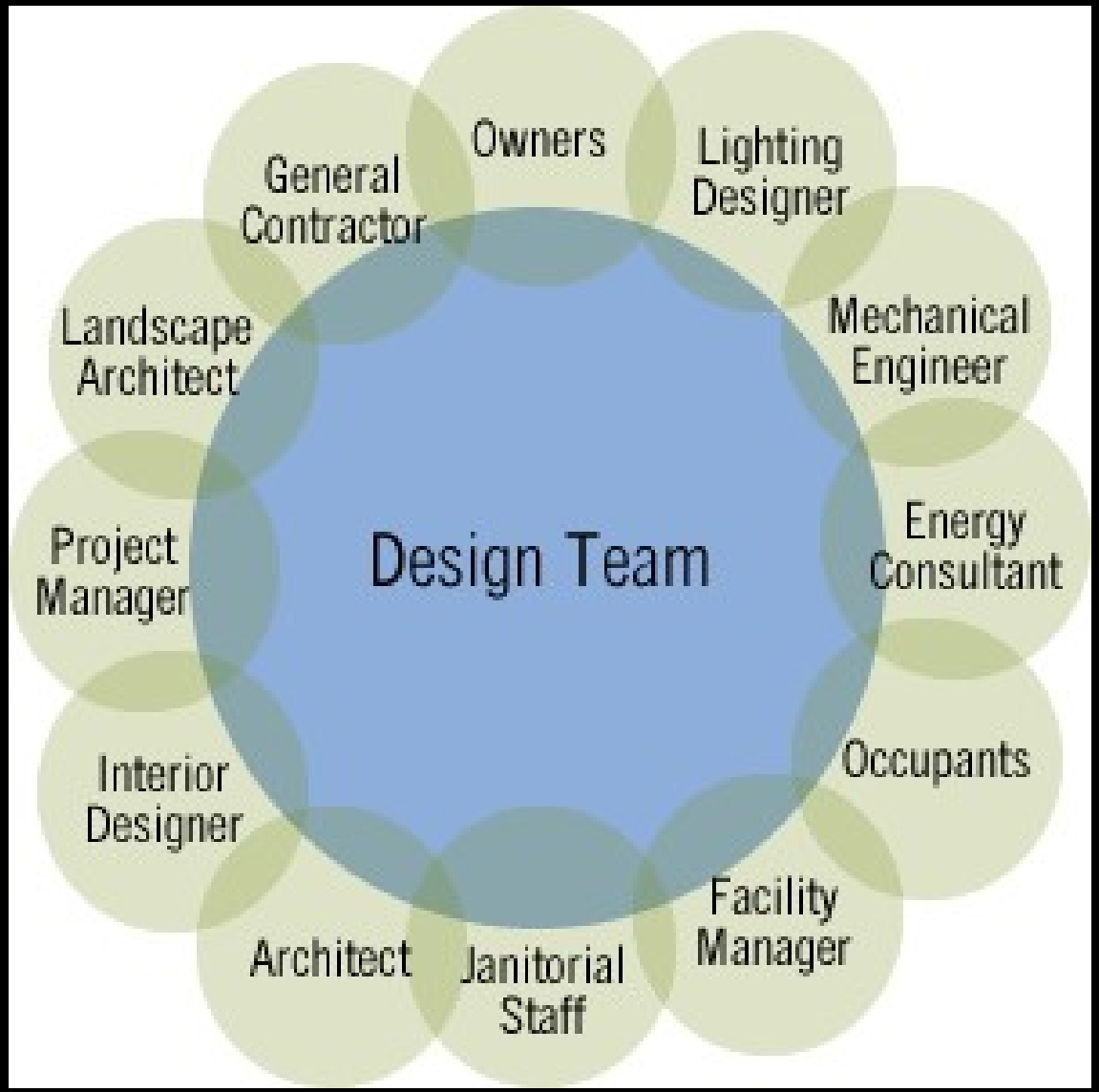
Convention Method

- •WASTING TIME
- • OVER COST
- •NO FACILITY
- •NO ACCURATE CALAULATION
- • CLASH

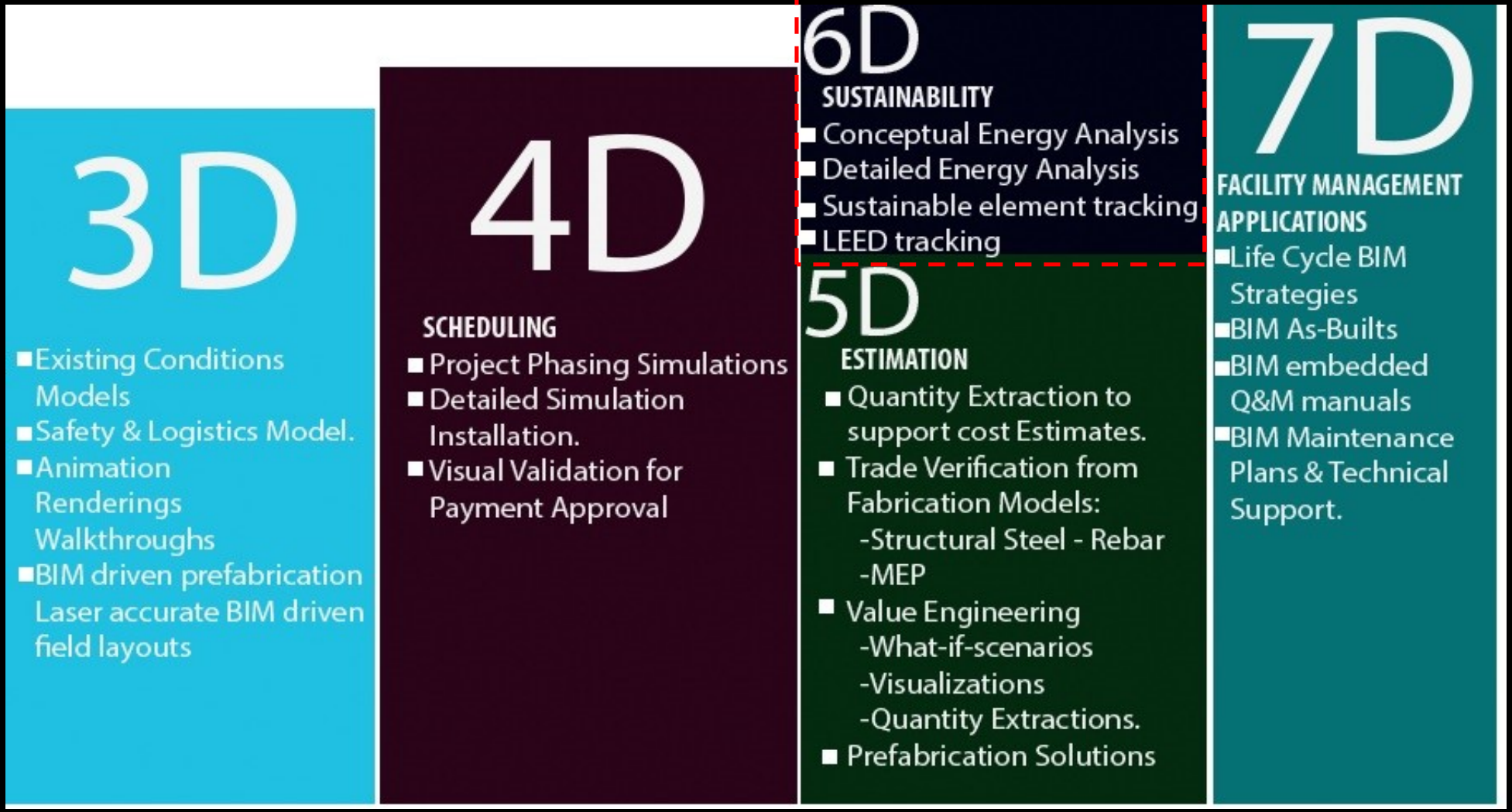


Integrated Method

Integrated Method = BIM



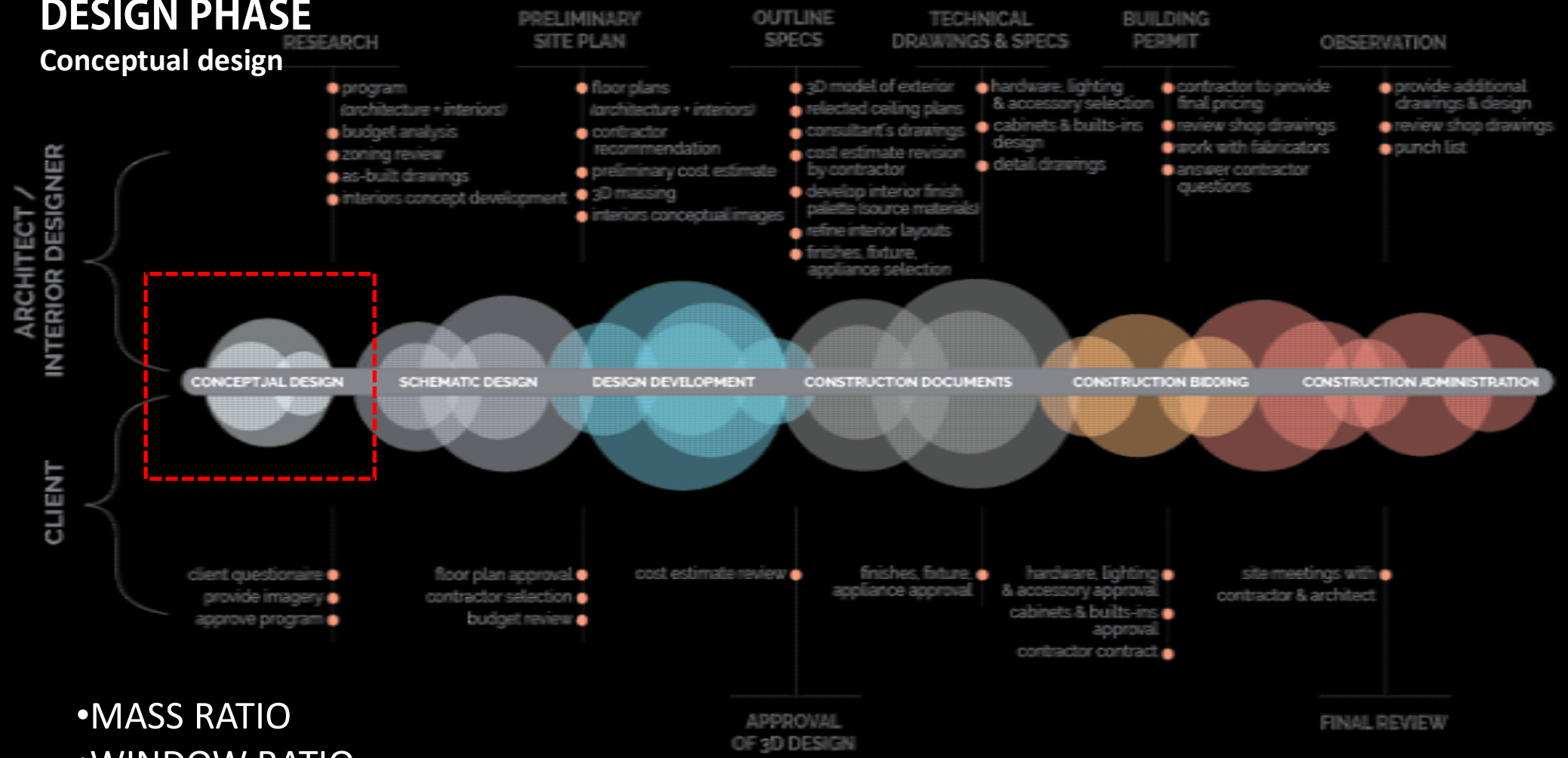
BIM DEMINSIONS



- Conceptual Energy Analysis
- Detailed Energy Analysis
- Sustainable Energy element Tracking
- Leed Tracking

DESIGN PHASE

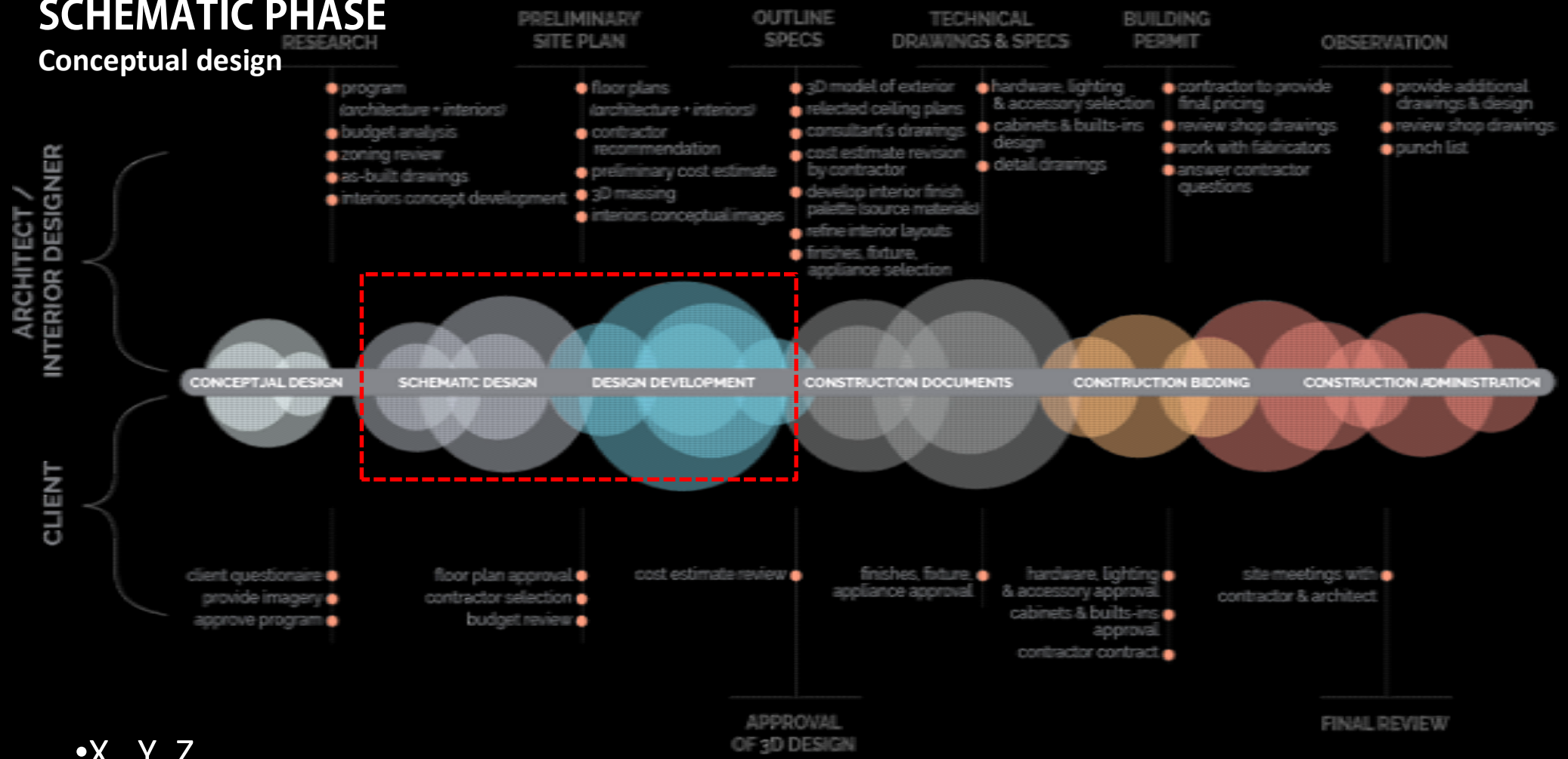
Conceptual design



- MASS RATIO
- WINDOW RATIO
- BASICS MATERIAL
- ATRUIM OR NOT
- PREFABRICATED CONCRETET OR NOT

SCHEMATIC PHASE

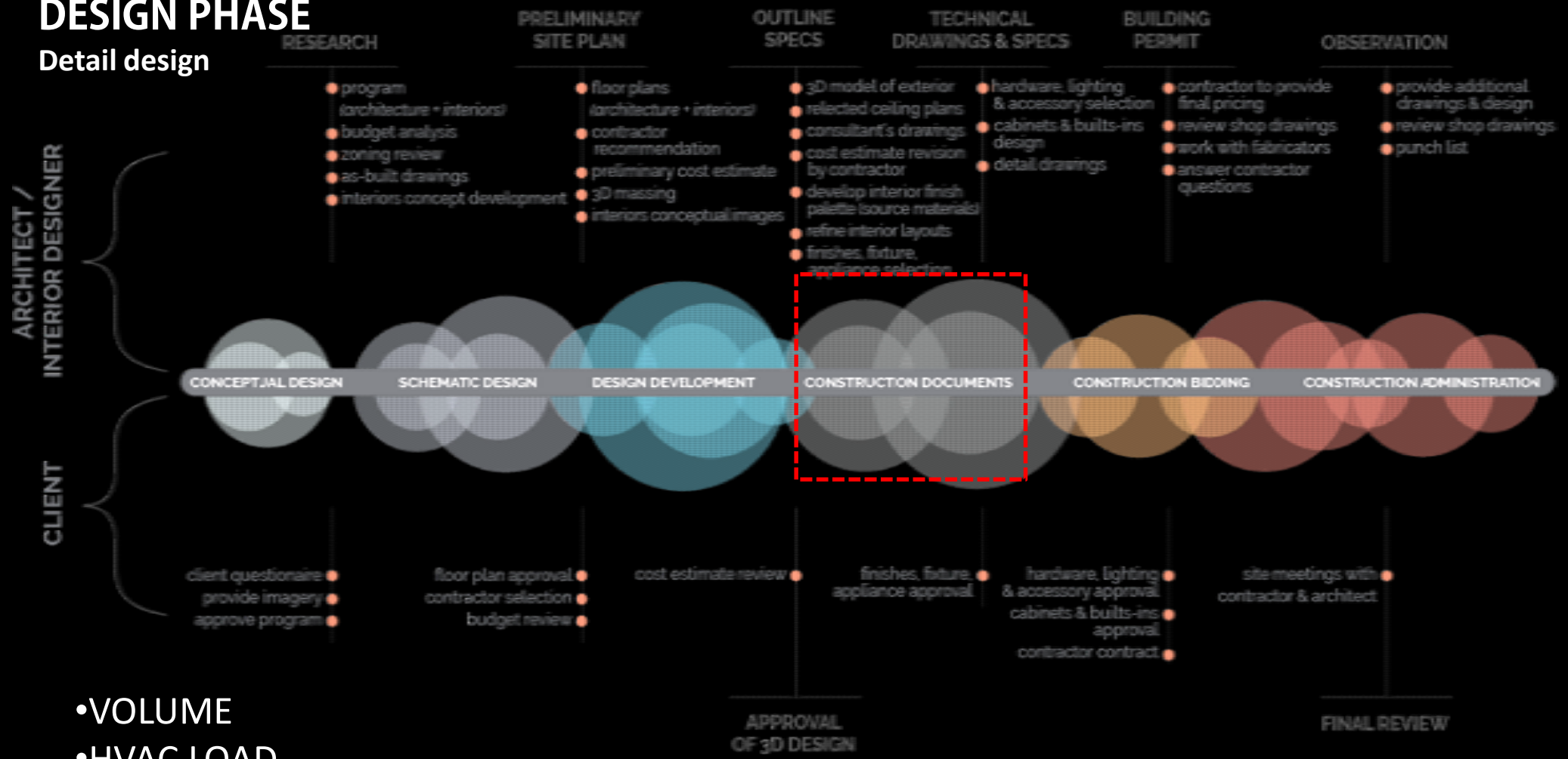
Conceptual design



- X , Y ,Z
- MATRIAL LAYER S
- SYSTEM INSTALATION
- ROOF

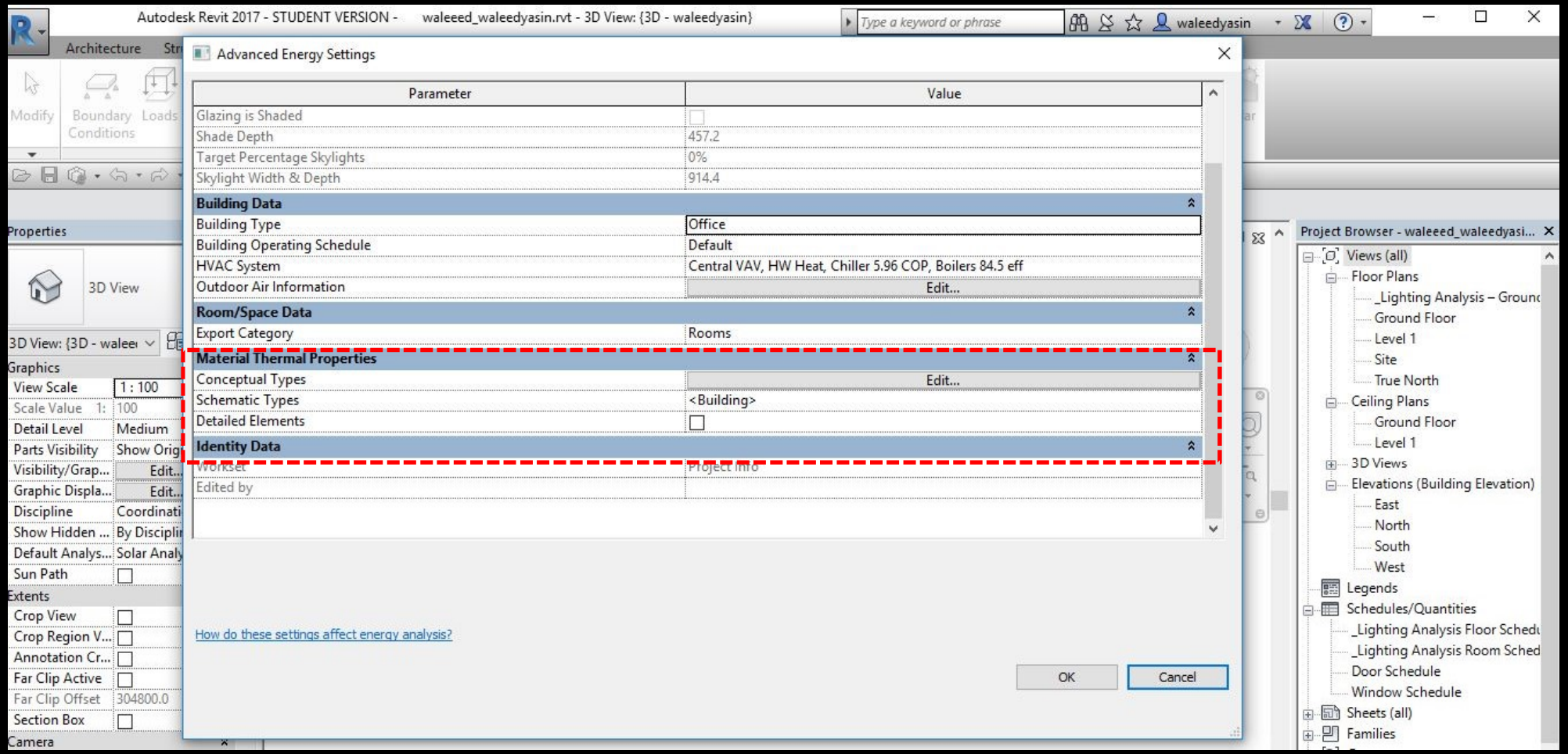
DESIGN PHASE

Detail design



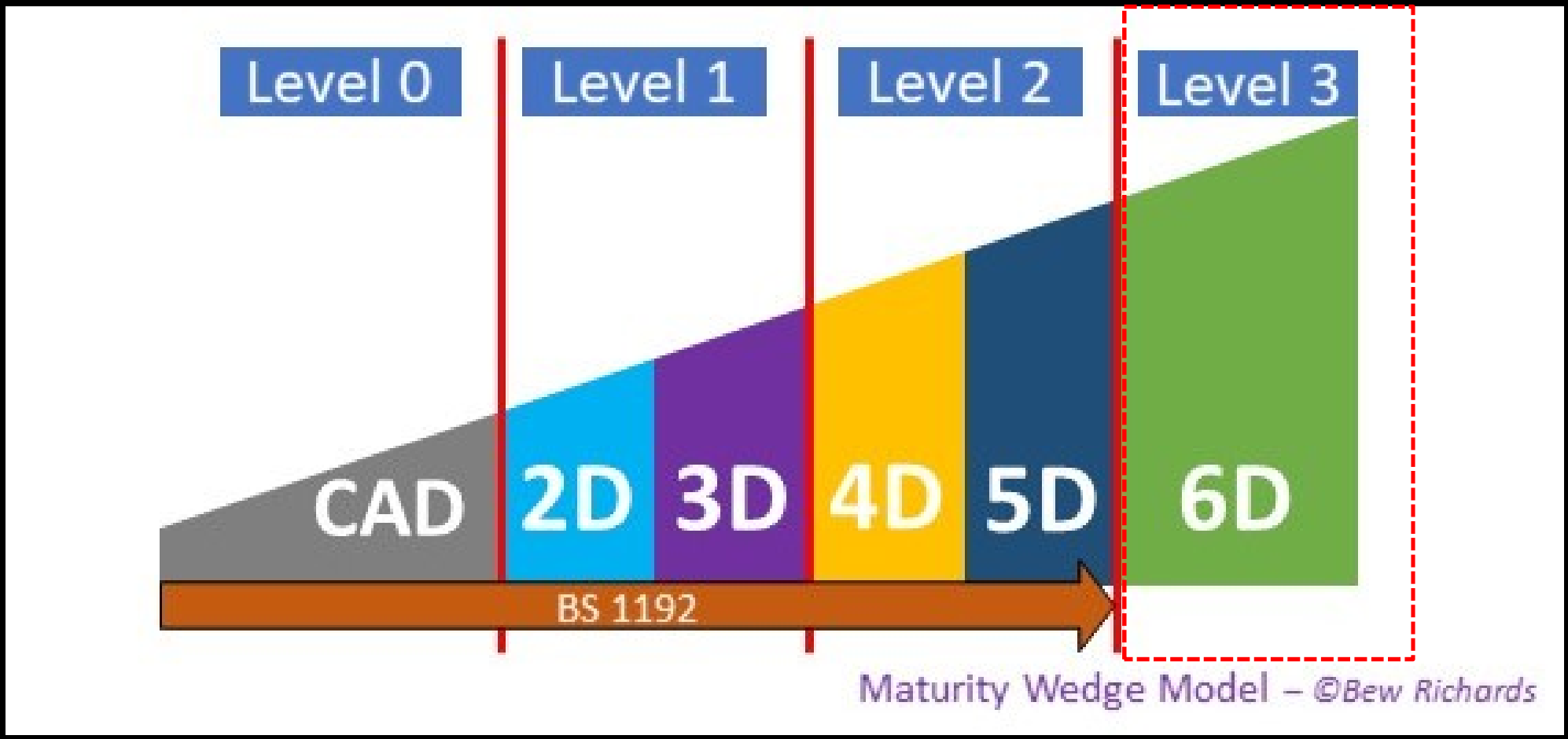
- VOLUME
- HVAC LOAD
- THERMAL COMFORT
- EUI
- HEAT TRANSFER
- DOCUMENTATION

REVIT PRACTICE



- CONCEPTUL TYPES
- SCHEMATIC TYPES
- DETAILED ELEMENT

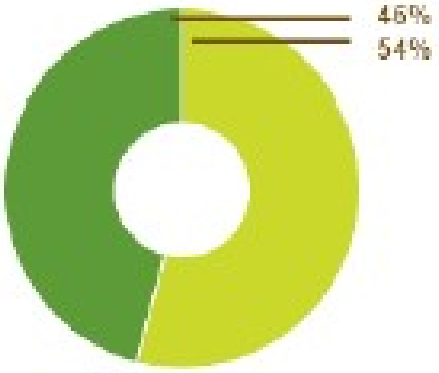
LEVEL OF BIM



- WE NEED LANGUAGE TO TRANSFER DATA TO OTHER SOFTWARE

Concept of environmental Calculation

ENERGY CONSUMPTION
HVAC LOAD
THERMAL COMFORT



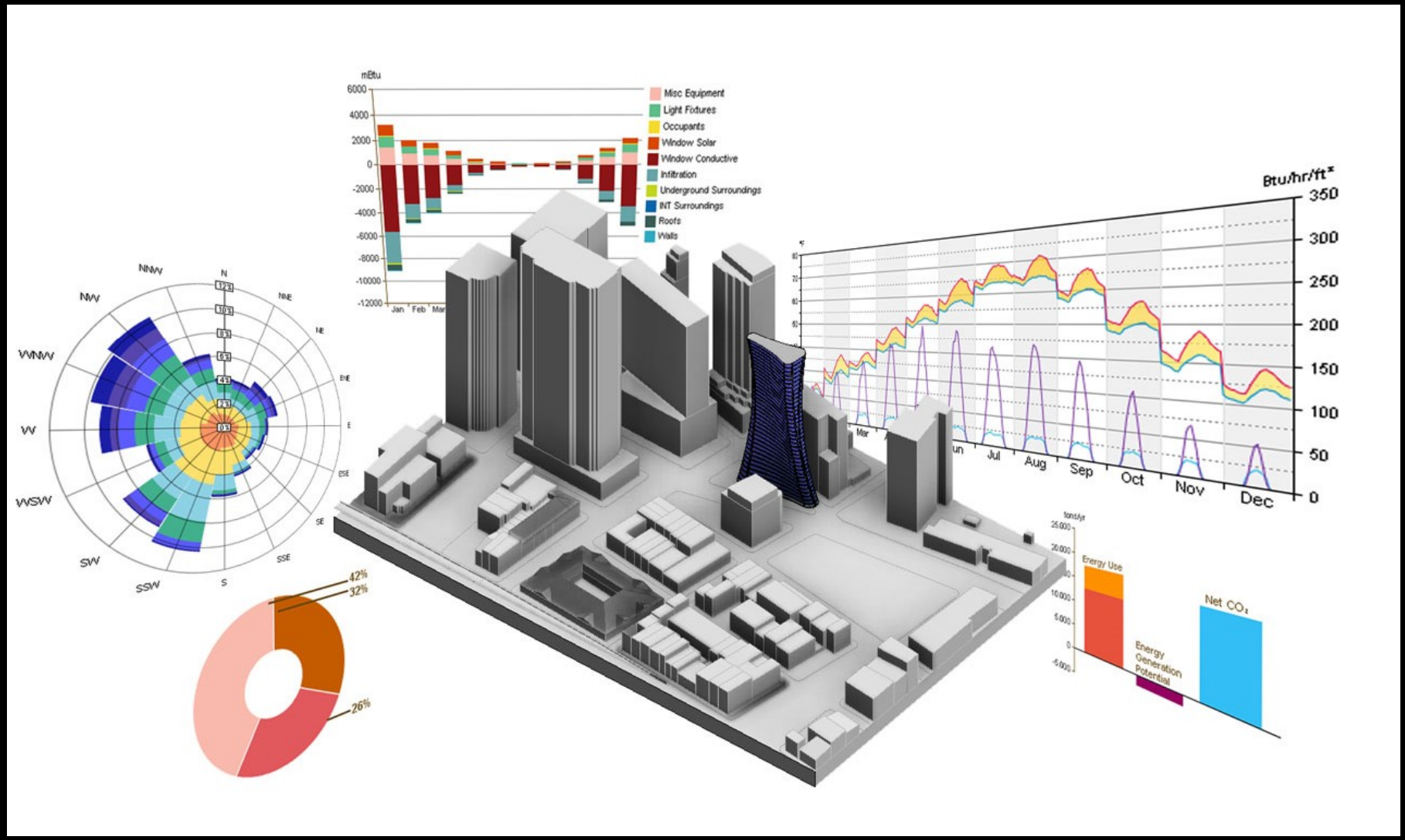
Electricity	54%	$6,483	45,113	kWh
Fuel	46%	$1,512	137,873	MJ
		$7,995		

Location:	cairo
Weather Station:	53159
Outdoor Temperature:	Max 36°C/Min: -24°C
Floor Area:	287 m²
Exterior Wall Area:	89 m²
Average Lighting Power:	9.69 W / m²
People:	11 people
Exterior Window Ratio:	2.83
Electrical Cost:	$0.14 / kWh
Fuel Cost:	$1.16 / Therm

Electricity EUI:	283 kWh / sm / yr
Fuel EUI:	1,079 MJ / sm / yr
Total EUI:	2,097 MJ / sm / yr

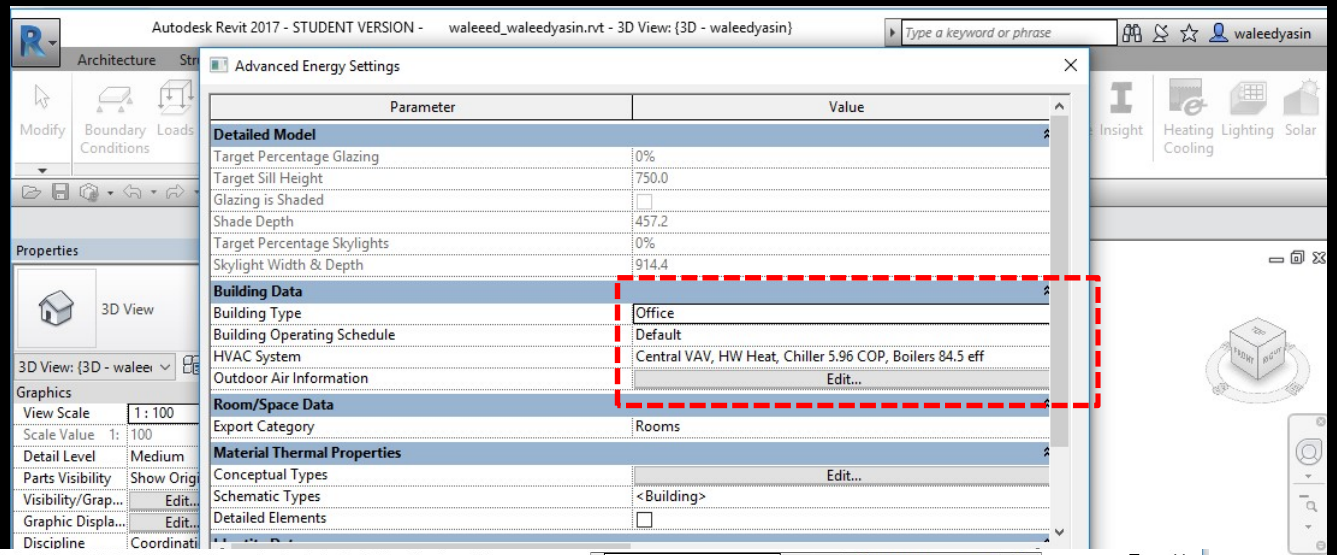
HOW ??

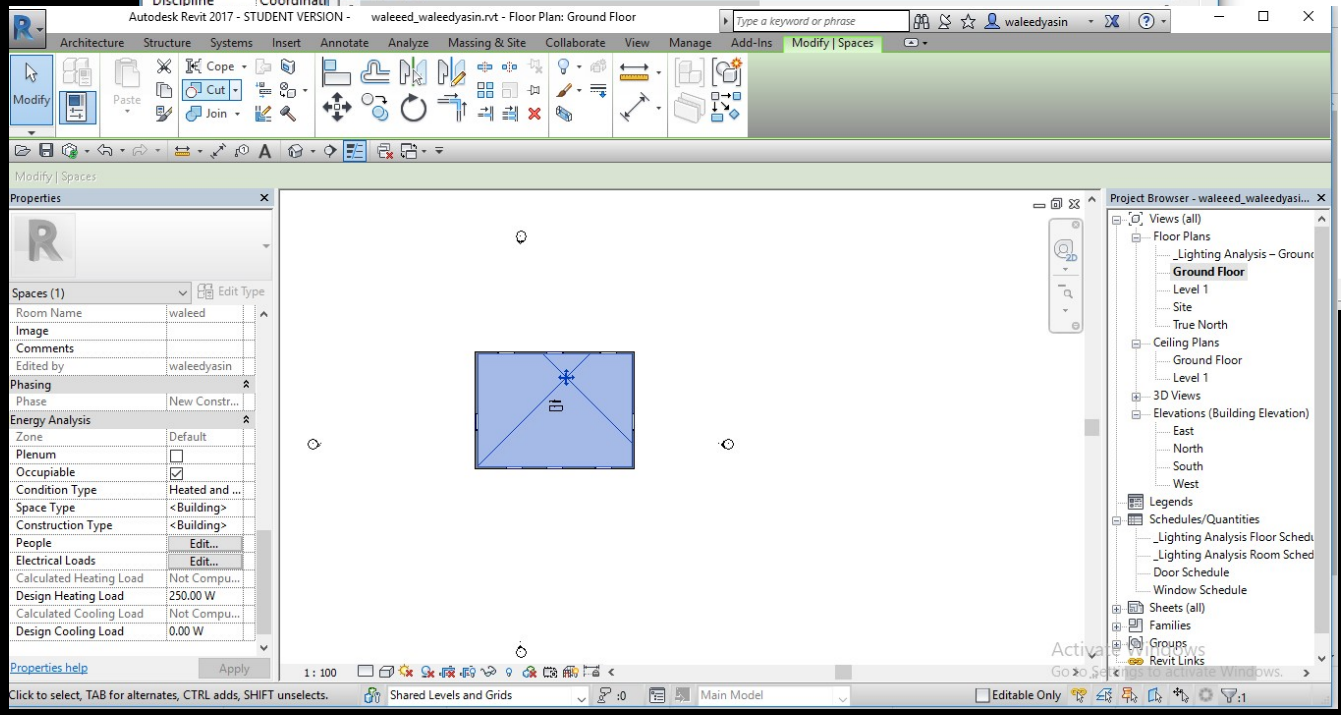
- •GBxml — GREEN BUILDING XML
- •COBie — CONSTRUCTION OPERATION BUILDING INFORMATION EXCHANGE
- •IFC — INDUSTRY FOUNDATION CLASS



ENERGY CONSUMPTION - HVAC LOAD - THERMAL COMFORT

- FUNCTION
- OCCUPANCY
- CONSTRUCTION
- LIGHTING
- SCHEDULE
- HVAC SETPIONT
- DEMOSTIC WATER
- MECHANICAL VENTILATION
- NATURAL VENTILATION
- INFILTRATION
- (ACH)



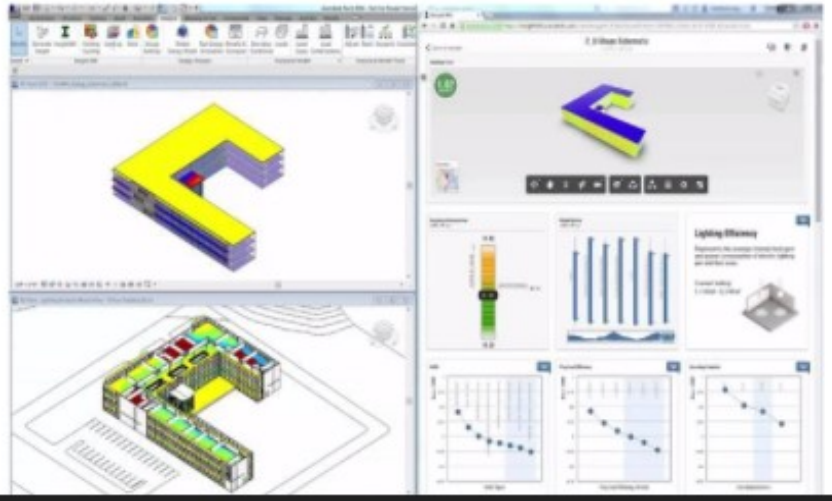


GBxml

What is Green Building XML (gbXML)?

Green Building XML:

"Language" to help minimize human involvement, translation errors, and dramatically increase productivity when transferring building information from one software tool to another

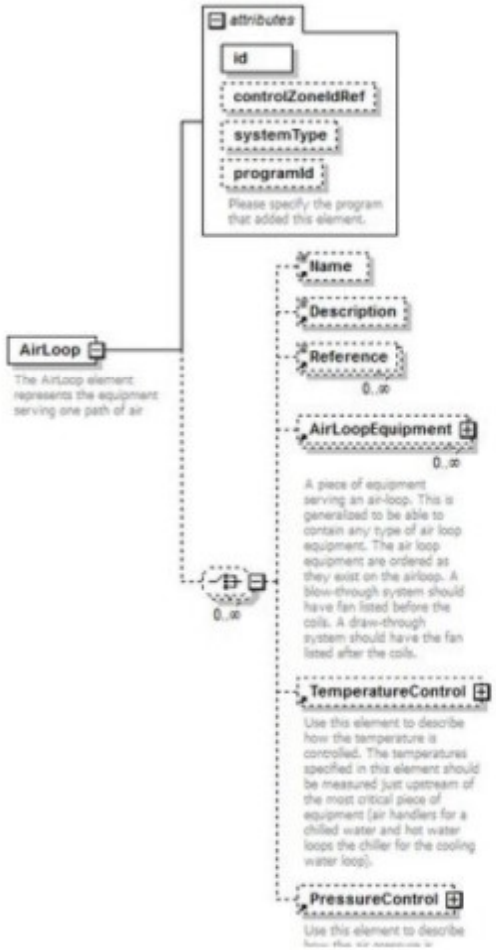


DATA TRANSFER

Click to save a picture to your desktop.

Data Capabilities

- 3D planar polygon geometry
- 2D rectangular polygon geometry
- Space boundaries (1st & 2nd)
- Opaque constructions and materials
- Thermal and emission properties
- Costs including LCA (embodied, first, and future)
- HVAC equipment
- Glazing, shades, and their operation
- Internal and external equipment
- Energy, power, efficiencies, water use, physical characteristics
- Lighting and controls
- Schedules



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  <Location>
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  <Building buildingType="Office" id="aim0013">
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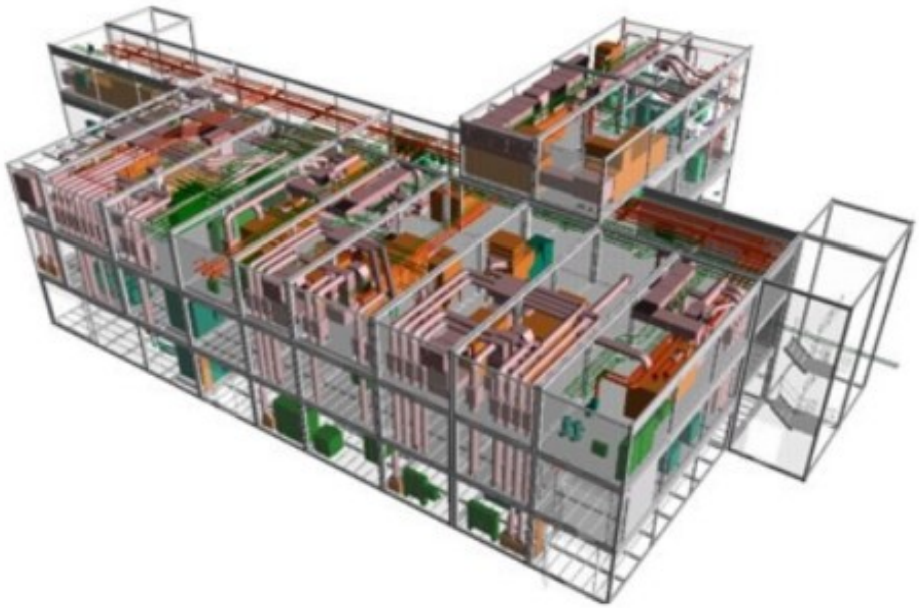
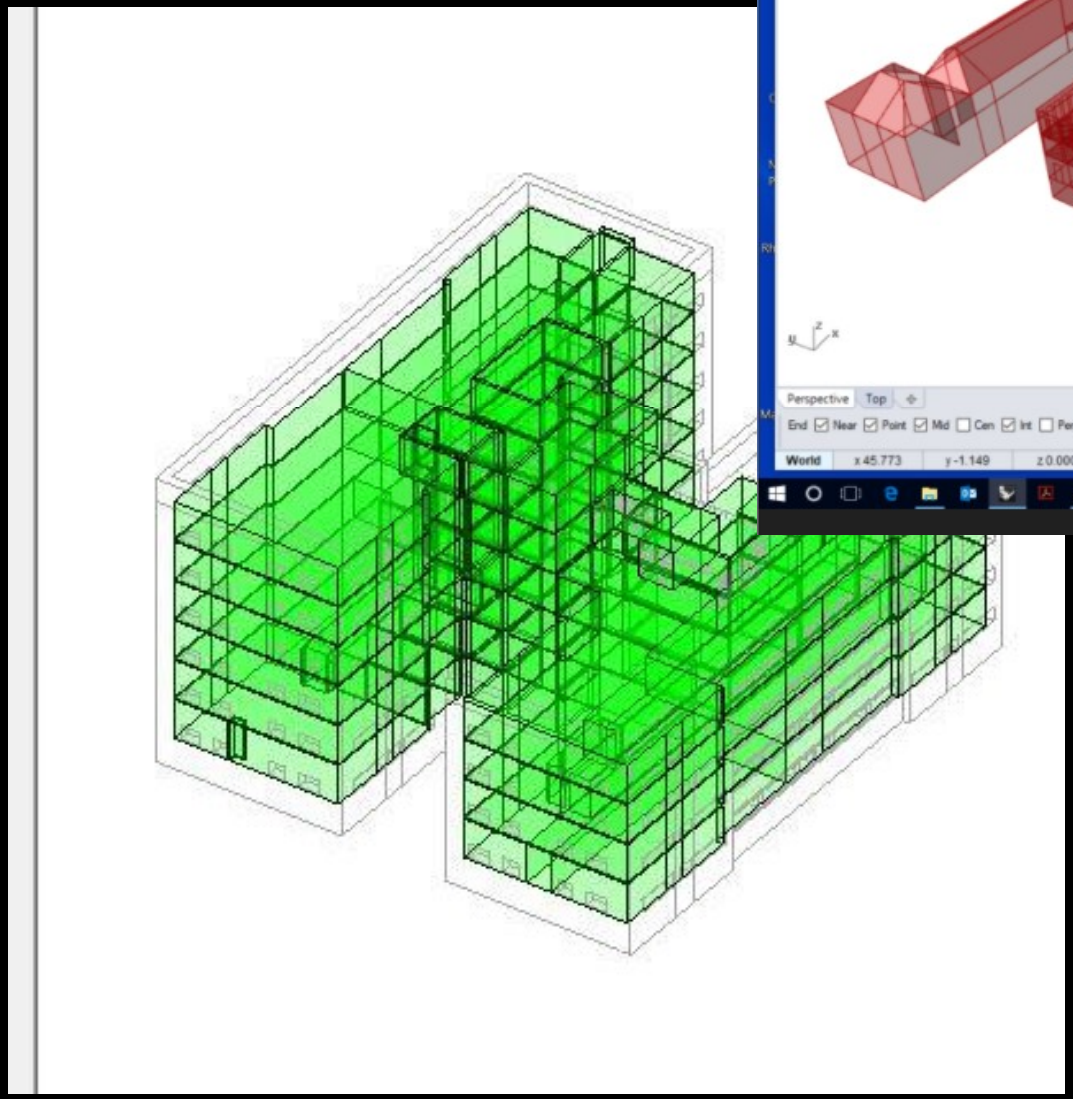
ADVANTAGE OF GBxml

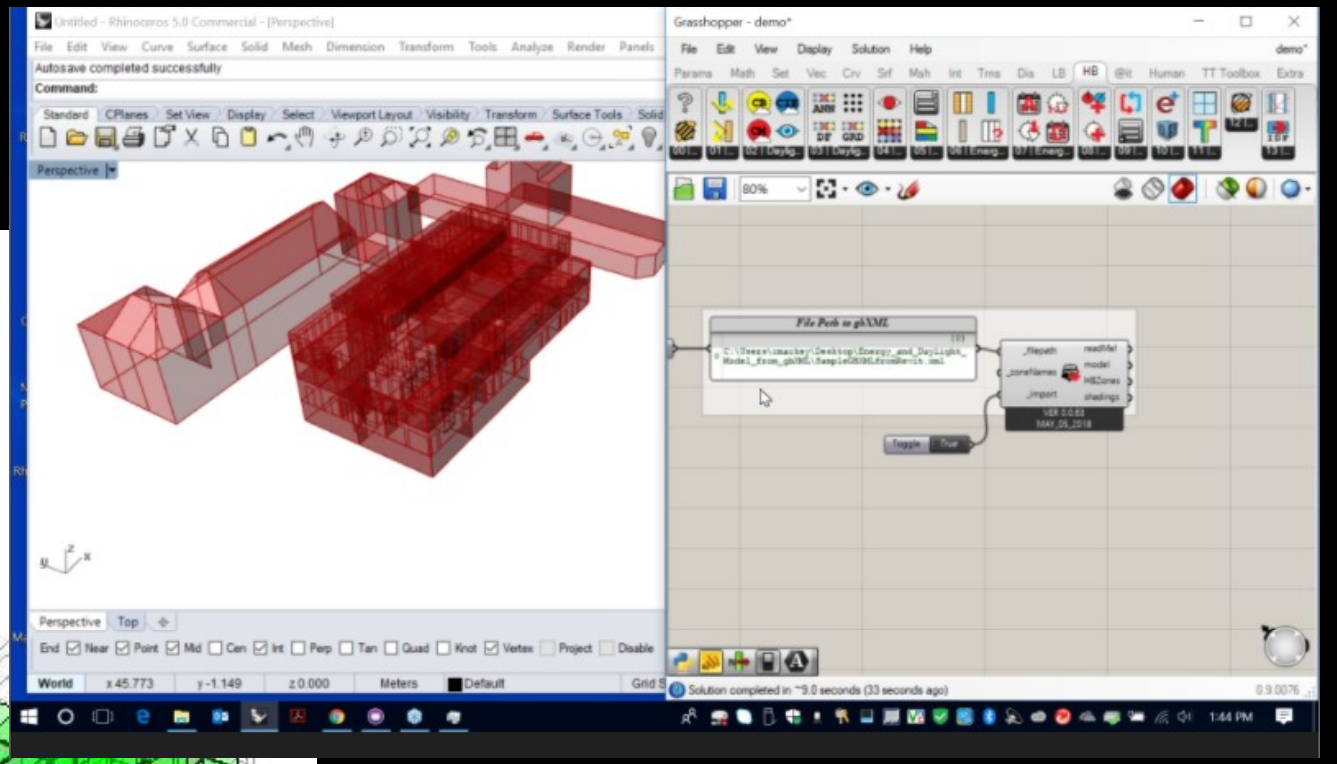
Why gbXML?

- Facilitate the transfer of building information stored in CAD-based BIM to engineering analysis software tools
- All in the name of helping architects, engineers, and energy modelers to design more energy efficient buildings



GBxml to Design Builder





GBxml grasshopper

IMPACT OF 6D

- PROTCOL
- BXP
- LOD
- BOQ
- EXPORT FORMAT

3. Project Scope and Goals

The below Goals are considered the major BIM Goals for the current project phases and can be developed & extended due to project requirements.

PRIORITY (HIGH/ MED/ LOW)	BIM Outcome	GOAL DESCRIPTION	POTENTIAL BIM USES
		• Eliminate Field Conflicts	

6. Project Deliverables

BIM SUBMITTAL ITEM	FORMAT	NOTES
3D BIM model	RVT&DWG	
3D Coordination Model & Reports	RVT, NWF	
4D Planning Model & Simulation	NWF&AVI	
3D Enriched BIM Model (GIS Data)	RVT&DWG	
5D Cost Model & Analysis reports	NWF	Additional formats may be needed according to required analysis reports
Method Statement Simulation	NWF,AVI & JPEG	
Site Utilization 4D Simulation	NWF&AVI	

1. Planed Models

Model Name	Model Content	Project Stage	Authoring Company	Authoring Company
Architectural Model	All architectural objects, costing data and quantity takeoff	All project stages starting from the schematic design stage (Relevant to project stage LOD)		Autodesk Revit
Structural Model	Structural Stabs, Structural columns, structural framing, retaining and shear walls, foundations, costing data and quantity takeoff			Autodesk Revit
Interior Model	All interior finishes and furniture elements			Autodesk Revit
Mechanical Model	Mechanical systems, equipment and load information			Autodesk Revit
Electrical Model	Electrical systems, equipment and load information			Autodesk Revit
Plumbing Model	Plumbing systems, equipment and load information			Autodesk Revit
Coordination Model	All discipline models			Autodesk Navisworks

1. Software Version

BIM USE	SOFTWARE	VERSION
3D Modeling	Revit	2017
3D Coordination	Revit, NavisWorks	2017
4D Modeling	NavisWorks	2017
Visualization	3DS Max, NavisWorks	2017
Cost Estimation	NavisWorks	2017
Method Statement Simulation	NavisWorks	2017
Site Utilization Planning	Civil 3D, NavisWorks	2017

FACILITY → ECG

DOCUMENTATION → IBEX

Bim role

Designer

- Factors of design by mass
- surrounding factor
- concept
- volumetric study
- build in revit

Environmental Designer

- Massing ratio
- Window ratio
- Conceptual analysis

Civil

- Accessibility
- infrastructure
- construction (covering - method)
- 4d simulation for construction
- materials

Mep

- Lighting calculation
- Hvac load
- Water
- system

Facility

Documentation

Case Study -1

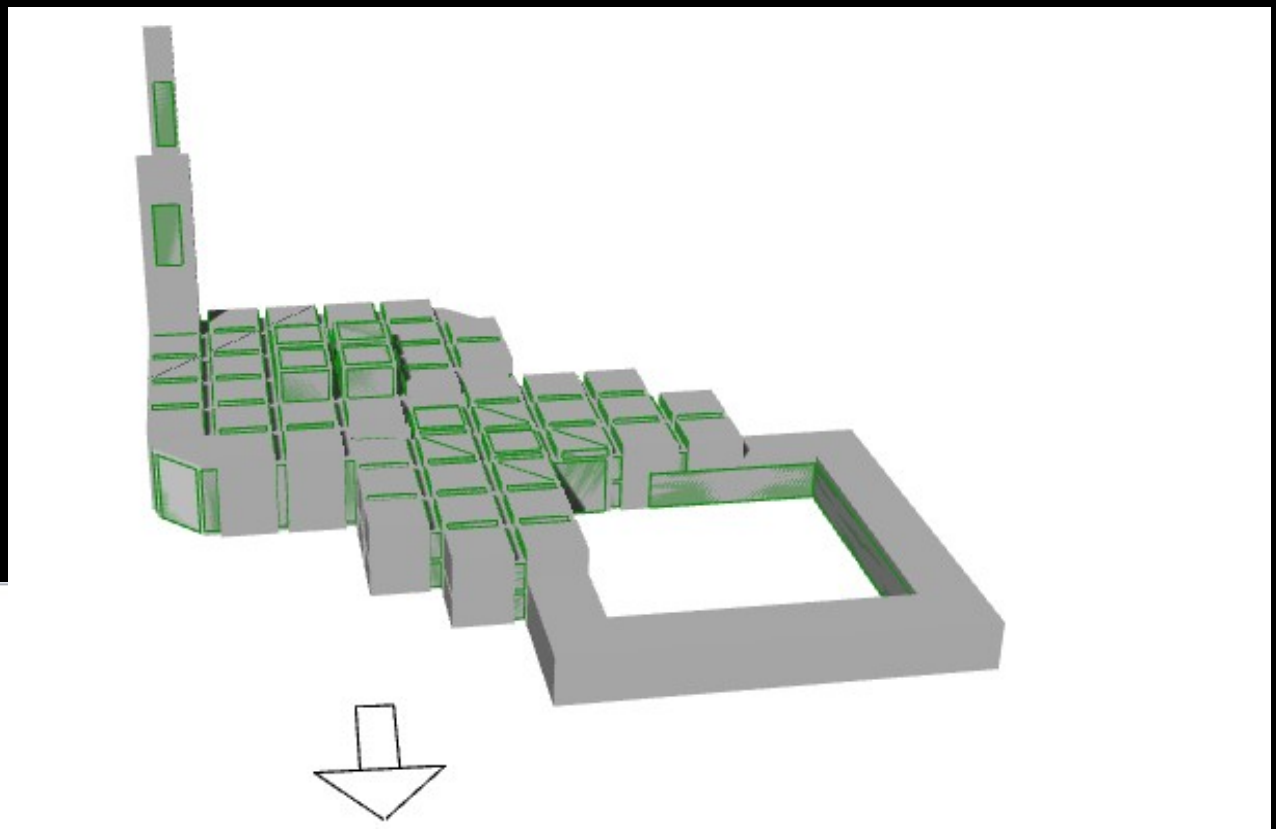
•GPRS MOSQUE

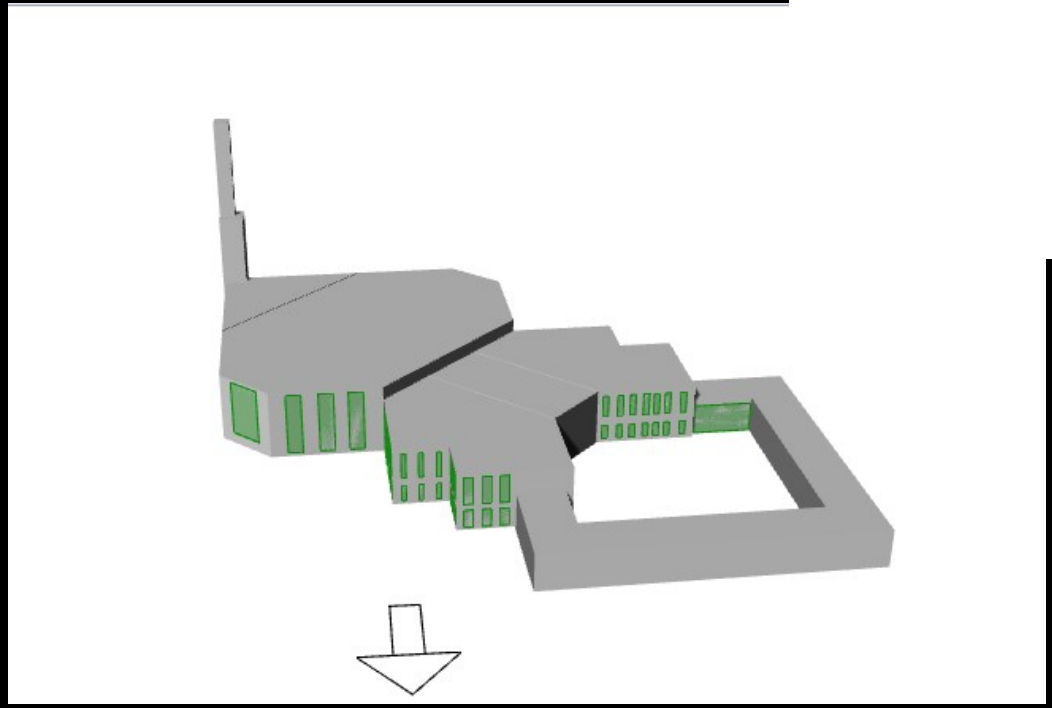
•PROBLEMS

•FOOT PRINT AREA OVER 10 .000MS

•ZONES OVER 50

•MASSING

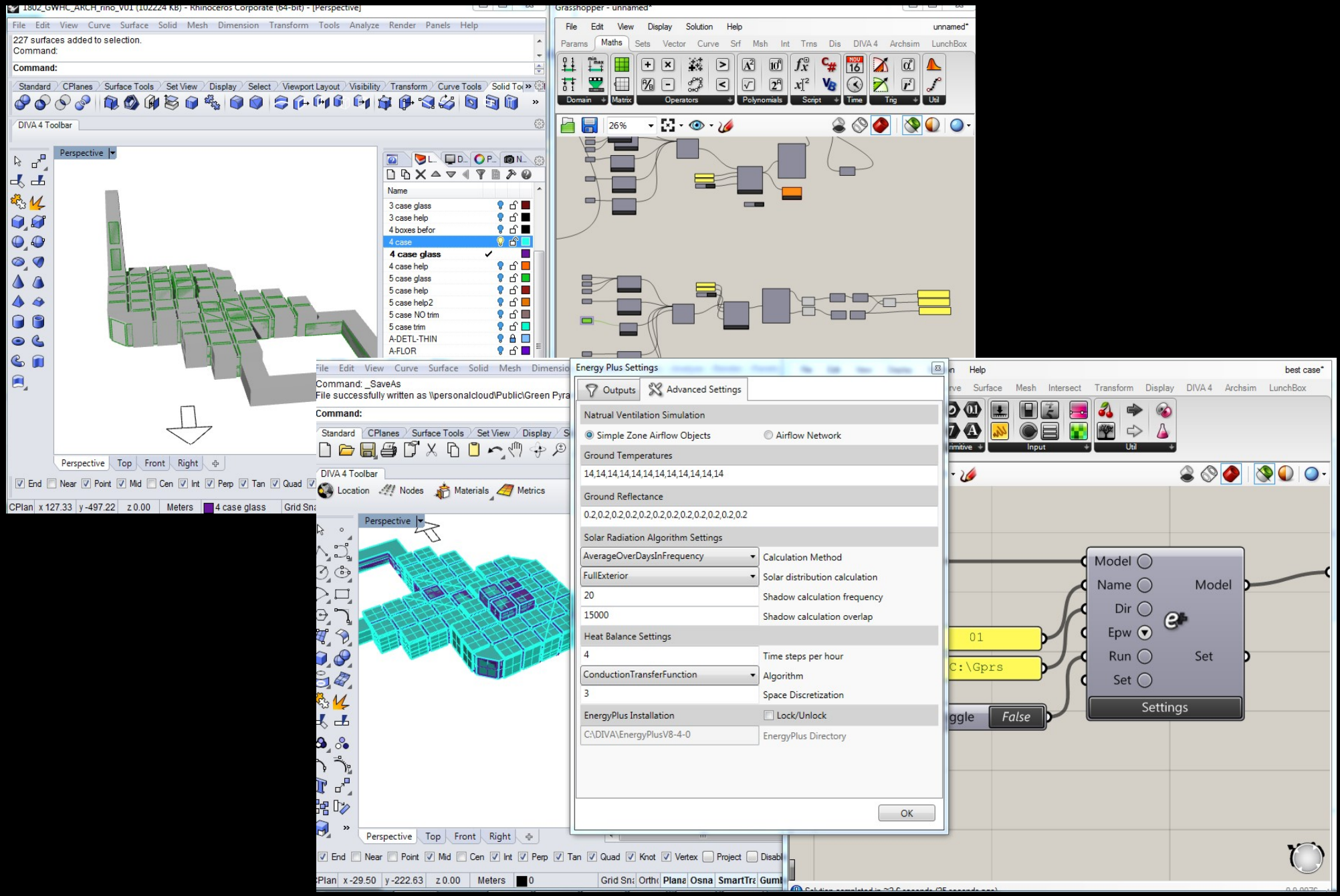




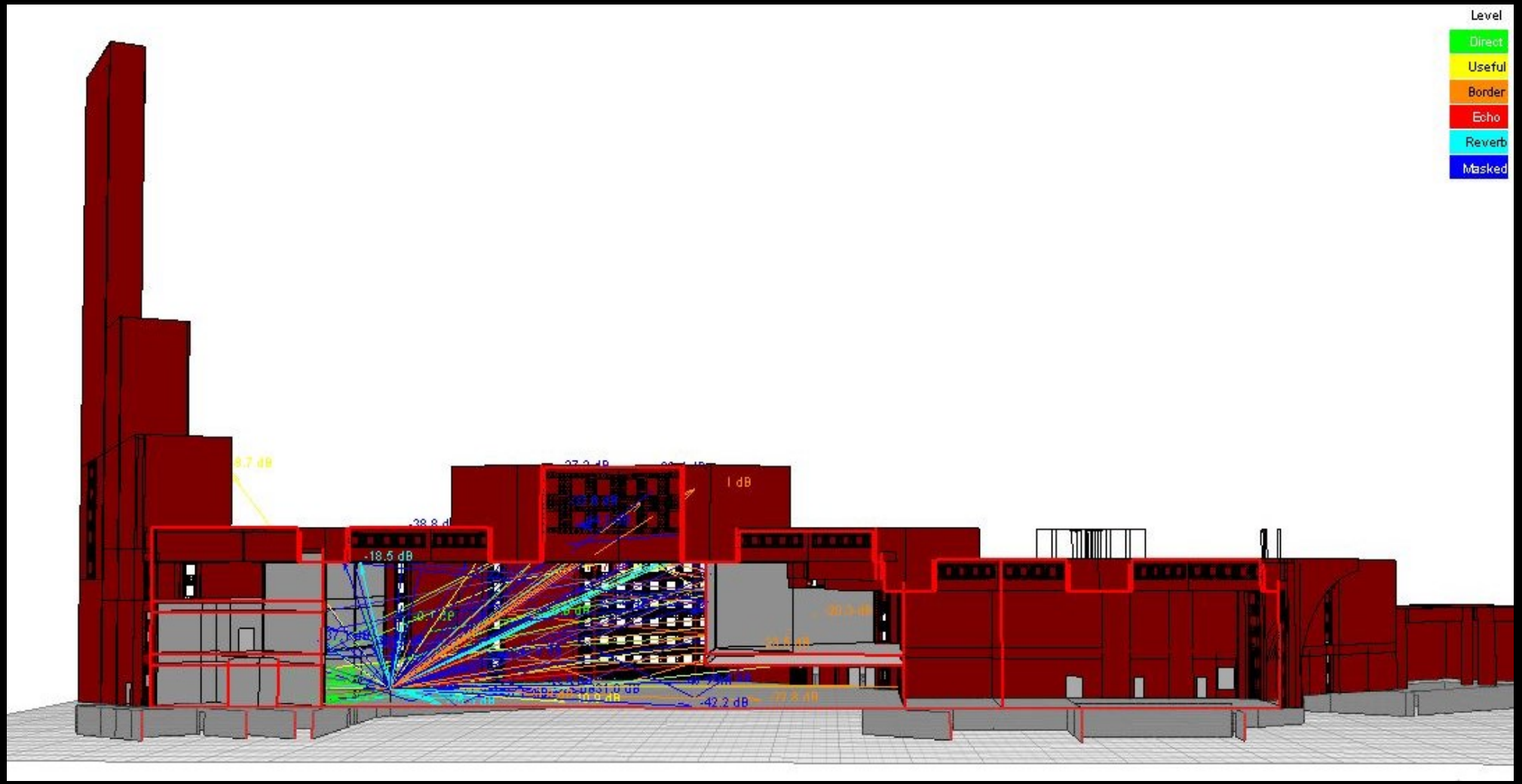
•BEST PRACTICE

OLD . REBUILD THE DESIGN IN GRASSHOPPER

NOW . EXPORT GBxml

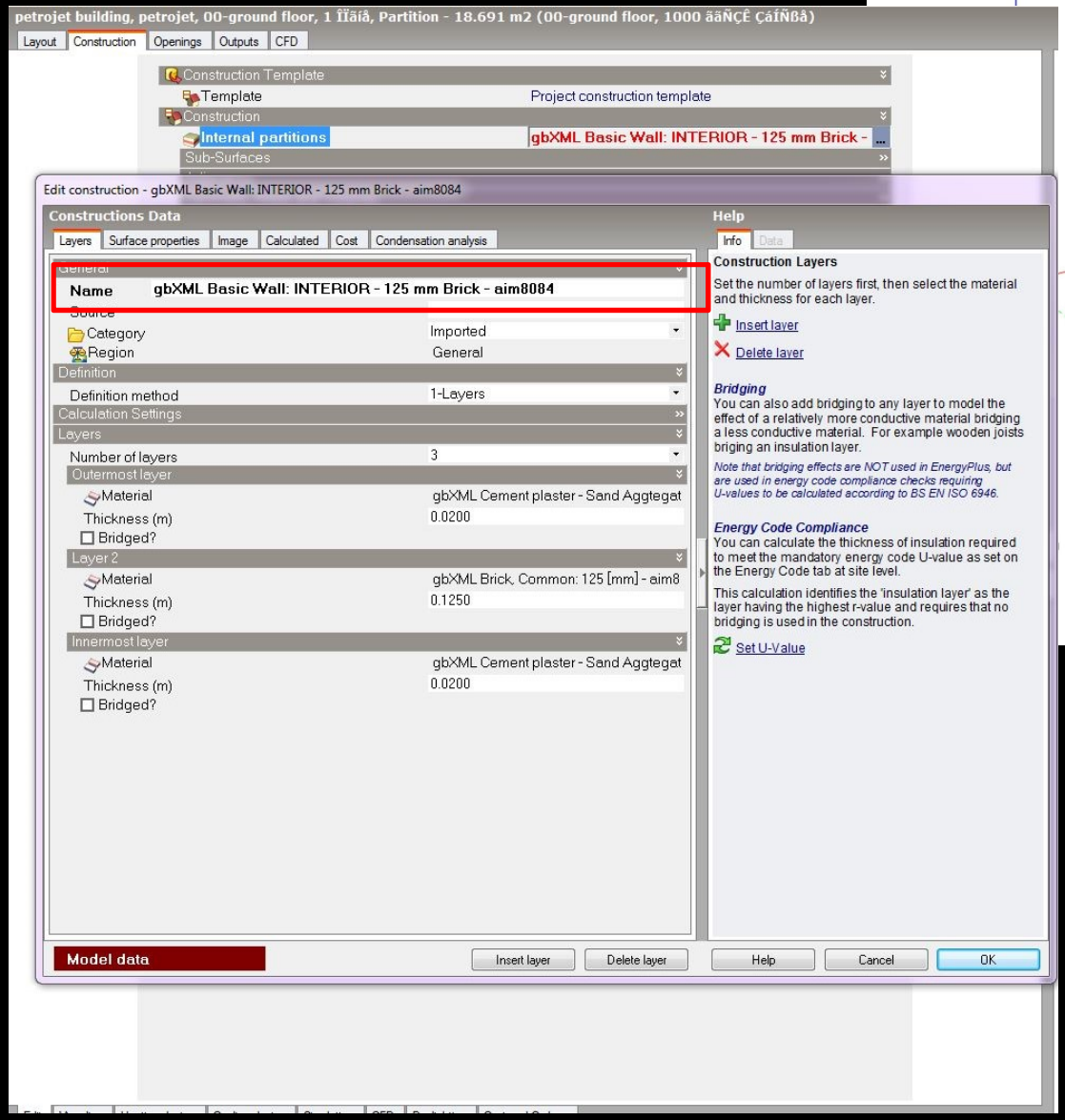

Energy Plus Settings
Outputs
Advanced Settings
Natrual Ventilation Simulation
Simple Zone Airflow Objects
Airflow Network
Ground Temperatures
14,14,14,14,14,14,14,14,14,14,14,14
Ground Reflectance
0.2,0.2,0.2,0.2,0.2,0.2,0.2,0.2,0.2,0.2,0.2,0.2
Solar Radiation Algorithm Settings
AverageOverDaysInFrequency
Calculation Method
FullExterior
Solar distribution calculation
20
Shadow calculation frequency
15000
Shadow calculation overlap
Heat Balance Settings
4
Time steps per hour
ConductionTransferFunction
Algorithm
3
Space Discretization
EnergyPlus Installation
Lock/Unlock
C:\DIVA\EnergyPlusV8-4-0
EnergyPlus Directory
OK
Model
Name
Dir
Epw
Run
Set
Model
Set
Settings
False
Perspective
Top
Front
Right
DIVA 4 Toolbar
Location
Nodes
Materials
Metrics

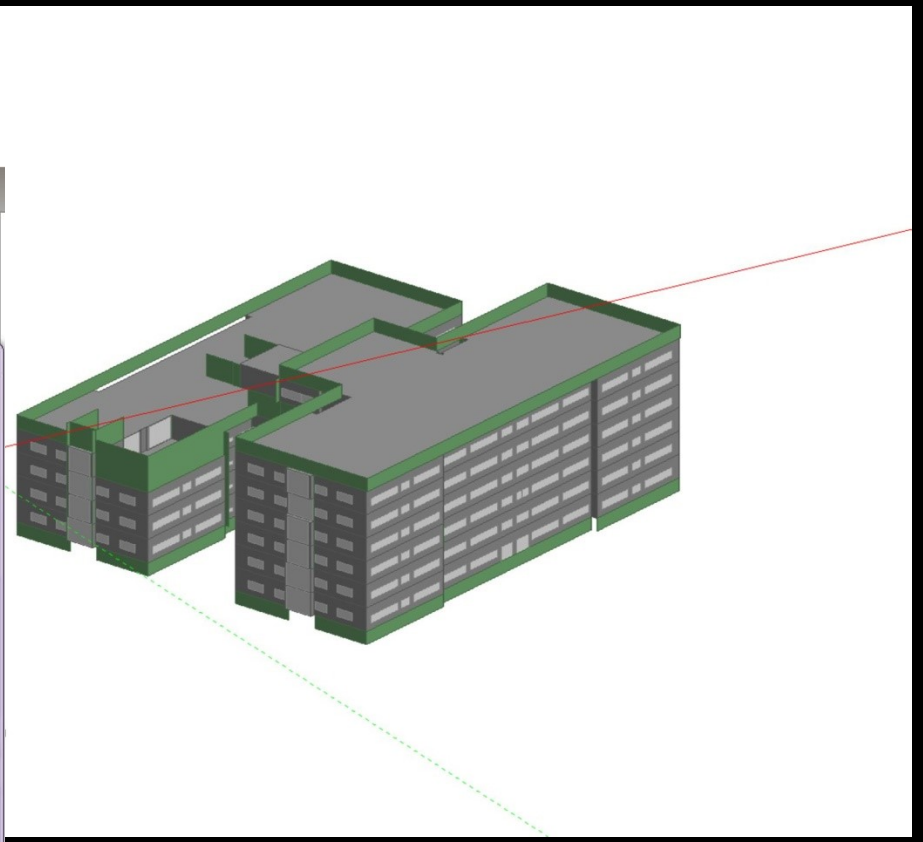
Acoustics

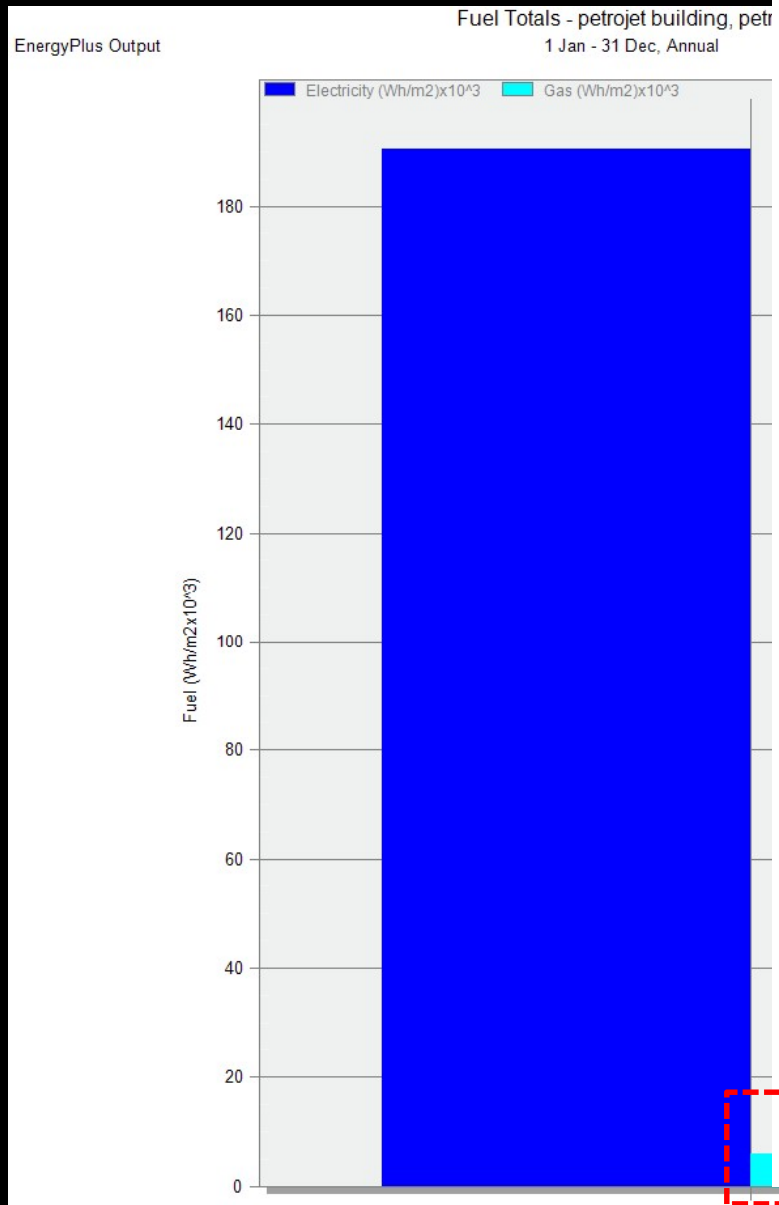

Level
Direct
Useful
Border
Echo
Reverb
Masked
1 dB
-18.5 dB
-42.2 dB

Case Study -2

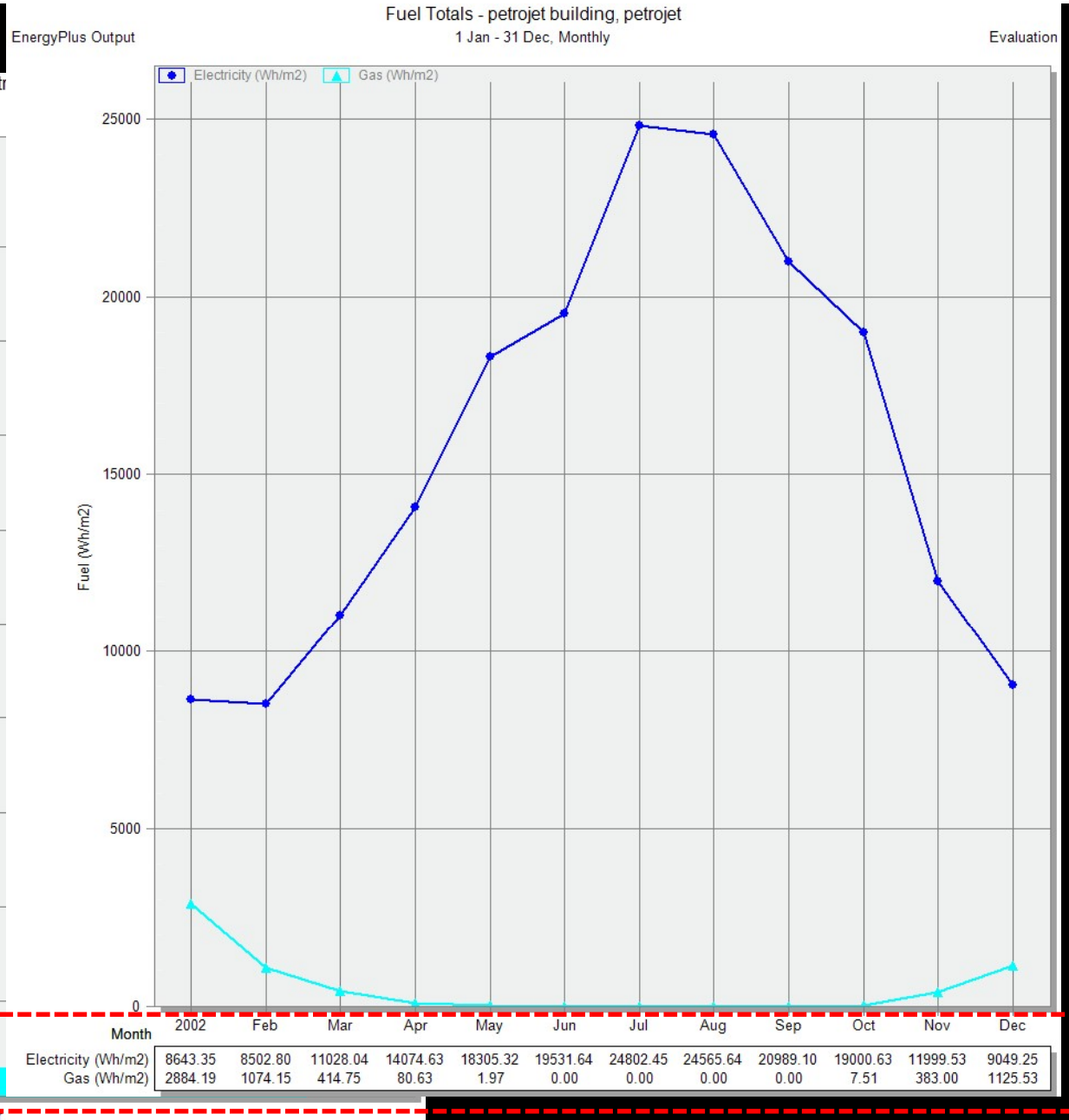
- Petrojet







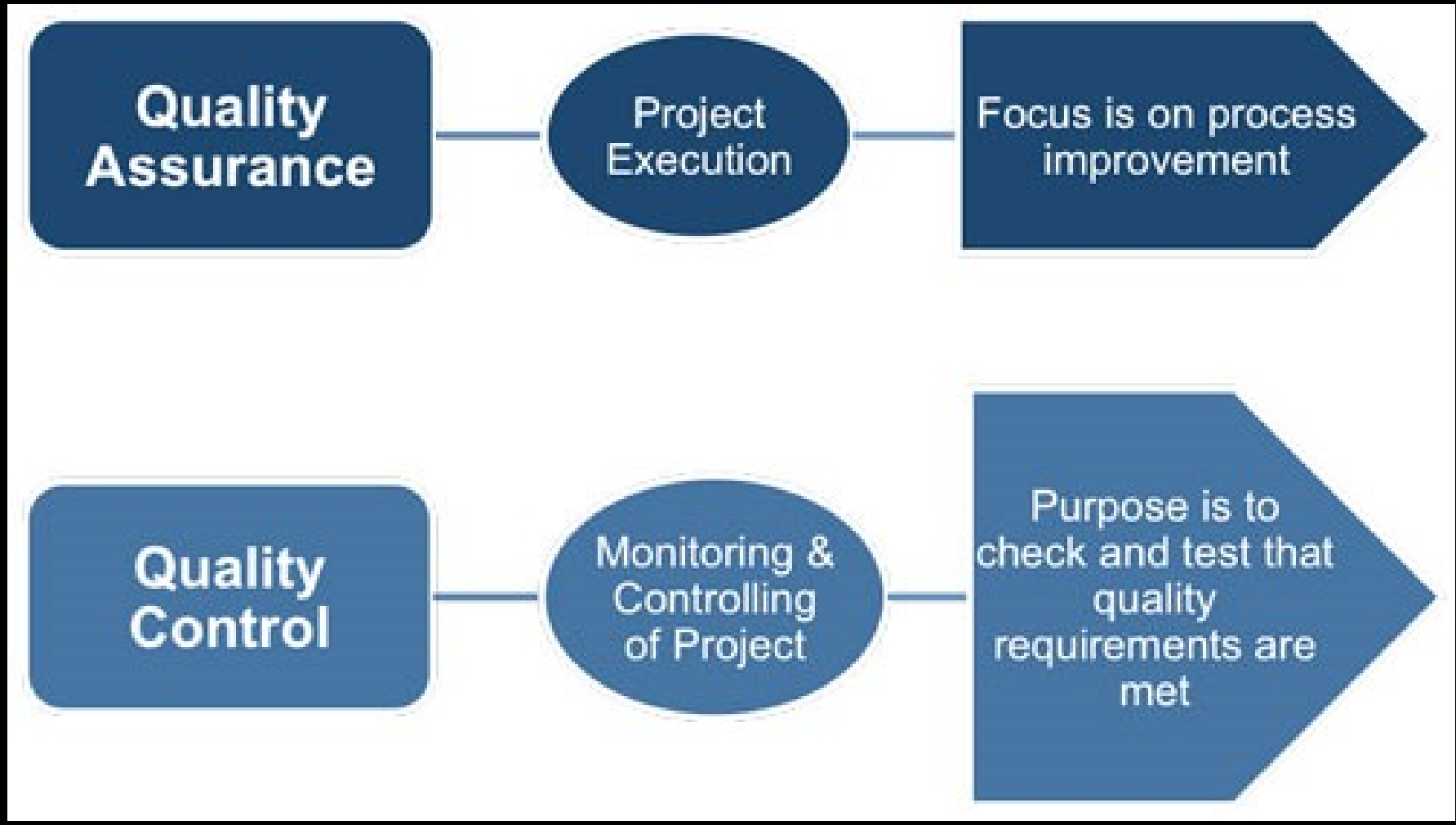
Electricity (Wh/m2)x10^3	190.49
Gas (Wh/m2)x10^3	5.97



Month	2002	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Electricity (Wh/m2)	8643.35	8502.80	11028.04	14074.63	18305.32	19531.64	24802.45	24565.64	20989.10	19000.63	11999.53	9049.25
Gas (Wh/m2)	2884.19	1074.15	414.75	80.63	1.97	0.00	0.00	0.00	0.00	7.51	383.00	1125.53

Quality control & Quality assurance

- ENERGY SUMILATION DEPENDED ON QUALITY CONTROL



MOVING FROM BIM TO FIM