







WHAT IS BUILDING ENVELOPE?

A building envelope: is the physical separator between the conditioned (indoors) and unconditioned (outdoors) environment of a building. It is sometimes used synonymous with building enclosure but the latter term also includes the broader aspects of appearance, structure, safety from fire and security. It can take many forms and compositions, but basically it may be composed of the following components:

- ✓ Floors (Below-Grade Systems)
- ✓ Walls (Walling Systems)
- ✓ Roofs (Roofing Systems)
- ✓ Fenestration (Glazing Systems)
- ✓ Shading Elements

A building envelope is everything that separates the internal building from the external environment, including the roof, doors, windows, floors, and walls. Good insulation in the walls, high-efficiency windows, and sufficiently sealed gaps increase the effectiveness of the envelope.



FUNCTIONS OF BUILDING ENVELOPE

Depending on many aspects of the building architectural form, the building envelope plays an essential role in “sheltering” the building occupants. The Five basic functions of a building envelope are:

- ✓ Weather Barrier
- ✓ Air Barrier
- ✓ Thermal Barrier
- ✓ Alien Barrier!
- ✓ Structural.

It means that the building envelope provides resistance to the following: Air (wind/air leakage), Heat (hot/cold) ,Light (indoor/outdoor),Noise (in/out) ,Loads (dead/live/wind) ,Intrusion (safety/security/privacy)



A BUILDING ENVELOPE IS A SYSTEM

A Building Envelope is a Sub-System of the Whole-Building. It is not just a wall/roof/floor/window/ door... but, A SYSTEM!

It can be considered as a sub-system of the building. And, by turn, it is composed of various sub-systems. By applying the “Systems Thinking” approach, we find that building envelope is not only providing a “shelter” to building occupants but also contributing to the overall building performance.

Usually, we think of building performance in terms of energy saving and we think a better building envelope is improving only the energy performance. However, when measuring the performance of a building by a green building rating system (such as LEED or GSAS), it is not a surprise that the building envelope is affecting various performance criteria. For instance, the following areas can be improved by applying a better building envelope:



A BUILDING ENVELOPE IS A SYSTEM

- ✓Prevention of heat loss/gain and reduce Energy demand
- ✓Urban Function and Cultural Identity
- ✓Architectural Innovation and Advanced Technologies
- ✓Sustainable Source as a Green Building element

Building Envelope is vital section of Building Science

A "BETTER" BUILDING ENVELOPE?
The performance of the Building Envelope con- tributes (negatively of positively) to the overall building performance. The role a building envelope plays in buildings is very similar to the role the skin plays in a human body! There are many factors that will help an architect defines a proper building envelope:

Location (Climate Zone) ,Season (summer/winter), Operating Conditions (temp./humidity/...) ,Appearance (color/texture/SRI/...) Thickness ,(Composition/Layers) Materials (conductivity/ appearance/...) Thermal Break (u-value/details/...) Air Leakage (details/sealing/...) Maintenance Frequency (commissioning/ cleaning/repairs/retrofits/...)



REGULATIONS AND CODES:

On a related aspect, the building envelope is also regulated at different levels:

International Standards:
2015 IECC (International Energy Conservation Code, by International Code Council (ICC), Section C402 - Building Envelope).

Local Codes/Building Regulations
ASHRAE Standard 90.1 (ANSI / ASHRAE / IES Standard 90.1-2016 -- Energy Standard for Buildings Except Low-Rise Residential Buildings (5.2.1. Insulation, 5.2.2. Fenestration and Doors, 5.2.3. Air Leakage, ...).

Project Spec's/Developer Requirements Green Building Codes



BUILDING ENVELOPE & GREEN BUILDING

Building envelope has direct impact to several aspects of Green Building criteria. It affects (negatively or positively) the ability of a building to meet certain green building requirements/criteria. Two of the common green building rating systems, namely LEED & GSAS, have been analyzed to figure out the relationship between building envelope and the overall performance of the whole building.

LEED (Leadership in Energy & Environmental Design) is a globally recognized green building rating system developed by USGBC (United States Green Building Council). LEED is adopted in Qatar for a large number of projects, mainly in Education City and Msheireb Downtown Doha project.

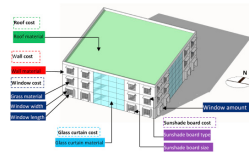
Both systems are performance-based, using a point-based mechanism to award projects more points for performing better in several performance categories. The following is a summary of our findings, which reflects the importance of the building envelope in achieving higher performance under LEED & GSAS:



CASE STUDY 2- GLAZING SELECTION



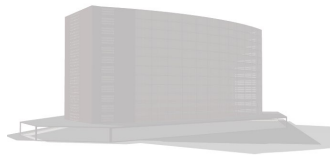
- ✓ Study of Thermal integrity of building envelop
- ✓ Access different option to be used for building skin
- ✓ Observe the trade-off between using different material and their capital and operating cost
- ✓ Its Acts as a preliminary model for doing complex sensitivity analysis
- ✓ Study the different glass option with there respective thermal properties
- ✓ Serve the aspect of Multivariate analysis



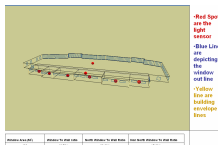
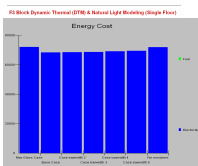
CASE STUDY 1 - WINDOW TO WALL RATIO DETERMINATION



GOAL: The analysis was based on the fact that using less glazing would create lesser heat load due to low out side heat gain i.e. Solar and Skin



CASE STUDY 1 - WINDOW TO WALL RATIO DETERMINATION



- ✓ Typical floor of the envelop.
- ✓ Light Sensor are placed in the form of Red Dots
- ✓ The glazing has been varied from 0% WWR to 100% WWR

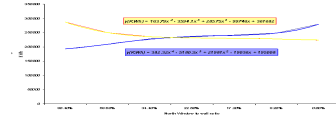
- ✓ Hourly Energy Simulation has been done by setting the required parameters
- ✓ The total metered energy consumption has been evaluated

RESULTS

Parameter Summary for Each Case (Alternatives)

	Light (kWh)	Cooling (kWh)	Window w Area (m ²)	Window To Wall ratio	North Window To Wall Ratio	Non North Window To Wall Ratio
Max glass case	193277	207111	792	62.80%	80.40%	44.50%
Base Case	208970	200210	399	45.76%	66.60%	15.60%
Case 2	228298	208122	267	22.98%	34.40%	10.90%
Case 3	235169	203540	180	16.10%	25.60%	93.00%
Case 4	241868	230642	120	12.80%	17.20%	83.00%
Case 5	246270	227837	93	8.00%	8.20%	77.00%
Case No windows	279969	224109	0	0.00%	0.00%	0.00%

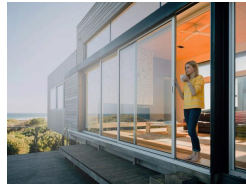
Total Window to wall ratio vs. kWh/year in Cooling and Lights (F3)



CASE STUDY 2- GLAZING SELECTION

GOAL:

- What is the best and the poorest glazing option available? And how far are they in terms of relative operational efficiencies.
- Why not to use an inexpensive glass and what will be the financial consequences of operation.
- What percent operational efficiencies would we get if we use a better glass compare to a notional building façade
- What are the figures of relative saving in \$, INR for all the ten façade options? What is the total electricity bill for building with all the ten façade options?
- What are the losses associated with the operations of building in kWh/m².Yr considering all the ten façade options?



BUILDING ENVELOPE OPTIMIZATION

- What are the individual breakup of energy component acting on the building like solar gain, glazing heat transfer and HVAC cooling etc with all the ten options?
- What kind of weather really represent the weather that act on the subject building. ASHARE guidelines.
- What are the life cycle cost (LCC) for the different option compared with notional option What is the pay back with 3% to 4% energy inflation over the period of 25 year?

