Sustainable Green Façade for Better Performing Buildings in India

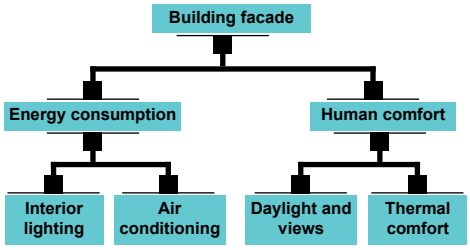
Far more than an aesthetic cover, building façade plays a major role in reducing building energy consumption and improve occupants' comfort and well-being. This makes sense in the construction industry to look at more holistic approach when it comes to façade design and deployment. A thoughtful façade can meet high expectation of performance for evolving green construction industry, owners and occupants. But equally important is to know what factors contribute to the façade design.

The dominant factors while designing sustainable façade are location, site condition, climatic condition, orientation, sun path, function, building application, design and materials. These factors are not new to our building design; however, adopting such factors coupled with strategic use of daylight, glare control, shading, high-performance glazing and super windows improvise performance of a building overall and offers great opportunity to improve human comfort too.

A good façade can act as a deciding factor of the overall performance of the building.

KEY CONSIDERATIONS FOR A SUSTAINABLE FAÇADE DESIGN:

Façade can typically influence the building energy consumption and the human interaction with the environment.



Infosys Ltd - Juniper Building (Ascendas) - Pune

As depicted in the flow chart, façade has to be designed keeping in both human comfort and the influence of the energy consumption.

ENERGY CONSUMPTION

Façade can play a role in influencing interior lighting design and air conditioning load.

Interior lighting load: A façade designed to bring in optimum daylight into the building can significantly reduce the artificial lighting load. Again the interior design should support the intent. Typically window to wall ratio, window assembly design, glazing properties and interior design should all work in unison to provide adequate daylight into the building. Over illumination is also an issue resulting in glare and excessive heat leading to increase in HVAC load and occupants discomfort. A balance has to be struck between heat and light in the design.

Air conditioning load: The main energy guzzler can be tamed with a good façade design. The conduction heat gain analysis of different façade components enables us to know the best combination of the materials that can bring in less heat into the building.

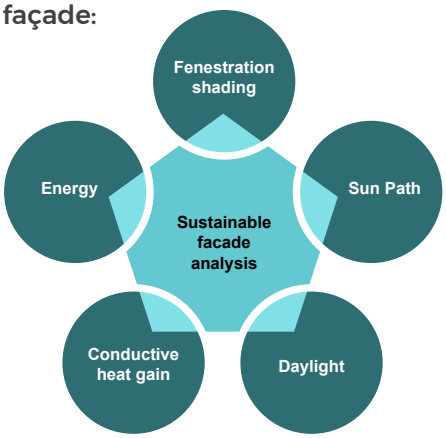
Heat gain from wall + Heat gain from Roof + Heat gain from Glazing assembly = Conductive heat gain through facade

Sun path analysis, shading analysis and orientation determines the amount of heat getting into the building. Further, the neighbouring buildings and permanent structures also play a role in façade design.

HUMAN COMFORT

The occupants in the building should have direct benefit from the façade. Even though intangible, the views to exterior, glare free daylight can influence the health of occupants. Further, cross ventilation design would encourage mixed mode operation of the building during favourable weather condition. People can opt for outdoor air than air conditioning.

Analysis required for a sustainable façade:



Façade Lighting:

What LEED Green Building Rating systems say?

LEED

All building facade and landscape lighting shall be automatically shut off between midnight and 6 a.m.
LPD should maintained below the LPD prescribed by ASHRAE 90.1 2010

Building Façade LPD				
Zone 0	Zone 1	Zone 2	Zone 3	Zone 4
No allowance	No allowance	0.1 W/ft^2 for each illuminated wall or surface or 2.5 W/lin.foot for each illuminated wall or surface length	0.15 W/ft^2 for each illuminated wall or surface or 3.75 W/lin.foot for each illuminated wall or surface length	0.2 W/ft^2 for each illuminated wall or surface or 5 W/lin.foot for each illuminated wall or surface length

Lighting Zone	Description
1	Developed areas of national parks, state parks, forest land and rural areas
2	Areas predominantly consisting of residential zoning, neighbourhood business districts, light industrial with limited nighttime use and residential mixed use areas
3	All other areas
4	High-activity commercial districts in major metropolitan areas as designated by the local jurisdiction

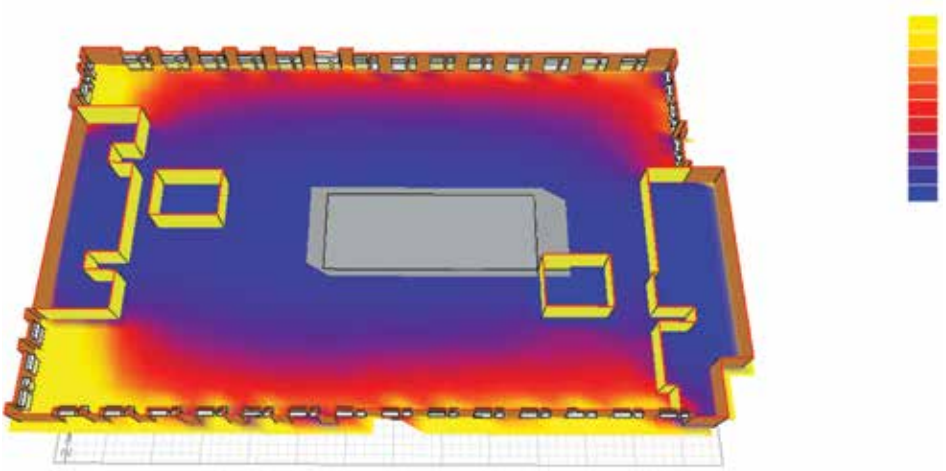
HDFC Bank, Bhubaneswar

Aveda Meta, Bengaluru - IGBC Gold pre certified contemporary corporate office spaces

VR mall, Chennai

UL - Cyber Park, Kerala

Day Lighting



Day lighting penetration image with lux level in work plan of interior

Day lighting is a controlled admission of natural light into a building to reduce electric lighting load and energy load. It helps create productive environment for building occupants, while reducing building energy costs. A day lighting system coupled with a daylight-responsive lighting control system when there is adequate ambient lighting provided from daylight alone, reduces electric lighting power. Further, the fenestration/location of windows in a building are designed to avoid the admittance of direct sun to avoid glares by providing shade. The day analysis simulation showed building is sufficiently day lit with light ingress from South and West. The Lux levels at the perimeter areas is also restricted to around 500 Lux because of Light shelves.

Below mentioned are suggestion which proved beneficial in a commercial building while addressing daylight in a building

- Use DGU with lower SHGC < 0.2 , relax for North
- Maximise the benefit of day lighting by choosing higher VLT>0.3
- Plan separate day lighting controls design overhangs directly located above the window head
- Use separate controls for lighting in areas near windows
- Use automatic controls to turn off lights when not in use
- Use two-layer glazing; day light window and view window
- Maximise the benefit of day lighting by choosing higher VLT>0.45 for North
- More day light realised if we use light colour ceiling and flooring system
- Preferred window to wall ratio is 20% to 30%

SHADING

The principle behind shading is to mitigate solar heat gain by reducing the amount of sunlight transmitted into the building. This can reduce maximum peak demand power for cooling equipped with manually controlled blinds, light shelves, overhangs and lighting controls.

To understand how shading plays crucial role in optimizing solar gains, shading analysis has to be carried out. Higher depth shading devices may not be required in few cases. Shading optimisation is possible by doing shading analysis in the design stage itself.

The east side glazing is critical

Outer glass name	Outer glass thick-ness	Space size	Space medi-um	Inner glass name	Inner glass thick-ness	Col-our	Light trans-mis-sion (%)	Light reflec-tion external (%)	Light reflec-tion inter-nal (%)	Solar fac-tor/ Solor heat gain co-effi-cient (SF/ SHGC)	Shad-ing co-ef-ficient (SC)	U Value (W/ sqm K)	Relative heat gain (RHG-W/ sqm)
SKN 154 II	6	12	Air	Plani-lux	6	Neu-tral	50	18	26	0.26	0.3	1.5	214
SKN 154 III	6	12	Air	Plani-lux	6	Neu-tral	67	10	12	0.38	0.44	1.6	308
St 120	6	12	Air	Plani-lux	6	Me-tallic	18	32	30	0.22	0.25	2.6	190

Table 1: Heat gain to interior space due to glazing

at morning hours. Low SHGC low VLT glass coupled with shading device is a good option for the east façade to reduce the solar gains and direct solar radiation. West façade, post 3:00 P.M. is difficult to shade fully, hence low SHGC low VLT glass coupled with shading device is a good option to reduce the solar gains and direct solar radiation. North façade is generally self shaded and no exterior shading is required for the glazing.

GLAZING

The simplest method to maximise daylight within a space is to increase the glazing area. However, three glass characteristics need to be understood to optimise a fenestration system [Table 4]

- U value
- Shading coefficient and
- Visual transmittance

Summary of general façade specification:

Building gets overheated during the day due to solar heat gain. Below are recommended parameters to enhance occupant comfort and reduce cooling load:

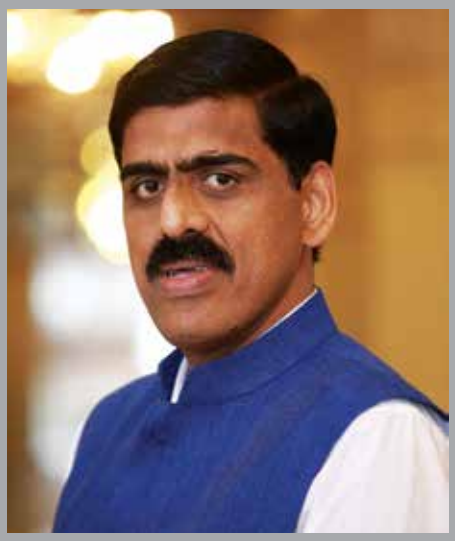
- Glazing <30% non north & <50% north
- >60% day lit areas
- 90% views with proper placing of interiors
- Open office culture
- Closed cabins on the interior space
- Day lighting and view glazing
- Shading to minimise glare – Non North
- Light shelves to distribute day lighting deep in the interior spaces
- Roof with over deck insulation and high reflective paints / tiles
- Heat gain from building skin <1.0 watt/sq ft
- EPI <100 units/sq m/year

NetApp, Bengaluru - innovative office spaces

CONCLUSION:

To optimise overall building operating cost, there is need to have proper strategies to reduce conductive heat gain (unit measures in watts/sq ft) and later work on optimising active energy component such as HVAC, lighting, elevators and escalators, computers and other equipment in the building. Many high performance projects demonstrated EPI of <90 units/sq mt/year with improved strategies on both the façade and building materials and equipment. Day light percentage, shading factor, light shelves and types of glazing are the features in façade design capable of responding to building energy consumption in economical means, besides wall and roof options coupled with insulation.

An ideal case scenario in the Indian context climate, north façade can have a maximum benefit of daylight, with little higher SHGC minus shading. South facade features with lower SHGC glass of north adding shading. However, east and west façade require high performance glass, shading and minimum window to wall ratio. These are some of the ways in building design which contributes towards sustainable façade design.



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M Selvarasu, Managing Director – LEAD Consultancy & Engineering Services (India) Pvt. Ltd., is one of the market leaders in India for MEP and green design. He is a renowned sustainable consultant having more than 26 years of rich experience in the industry. Selvarasu is one of the founding members of World GBC & Indian GBC, and has performed energy audit for more than 200 industries and buildings. LEAD Consultancy is a leading firm in providing MEP design services and green building consultancy for major corporate in India and abroad. He has delivered more than 400 milestone sustainable projects in the country and provides technical advice to both the IGBC & USGBC.