

Glass Selection factors for Constructing Aesthetically Pleasing Facades

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Contents

- Considering the parameter for designing glass for super structures.
- Considering the specifications for glass structures in façades.
- Ensuring the performance of the structures to enhance economic returns.

Considering The Parameters

- **Building Parameters**

- Type of building
- Hours of Usage
- Location and Surrounding environment

- **Façade Parameters**

- Type of façade
- Glazing System

- **Glazing Parameters**

- Energy
- Light
- Sound
- Others .

Building Parameters

- **Type of Building and it's usage**

- Offices
- Shopping
- Residential
- Hotel
- Airport, rail station
- Stadium, museum

- **Hours of use**

- 24 hours
- Only day
- Only night

- **Location and surrounding environment**

- Climatic conditions
- Orientation with respect to sun
- Noisy?
- Good panoramic view? (day, night or both).

Façade Parameters

▪ **Type of Facade**

- Aluminum Curtain wall
- Aluminum structural glazing
- Bolted structural glazing
- Double skin
- Sloped glazing
- Complex shapes

▪ **Glazing System**

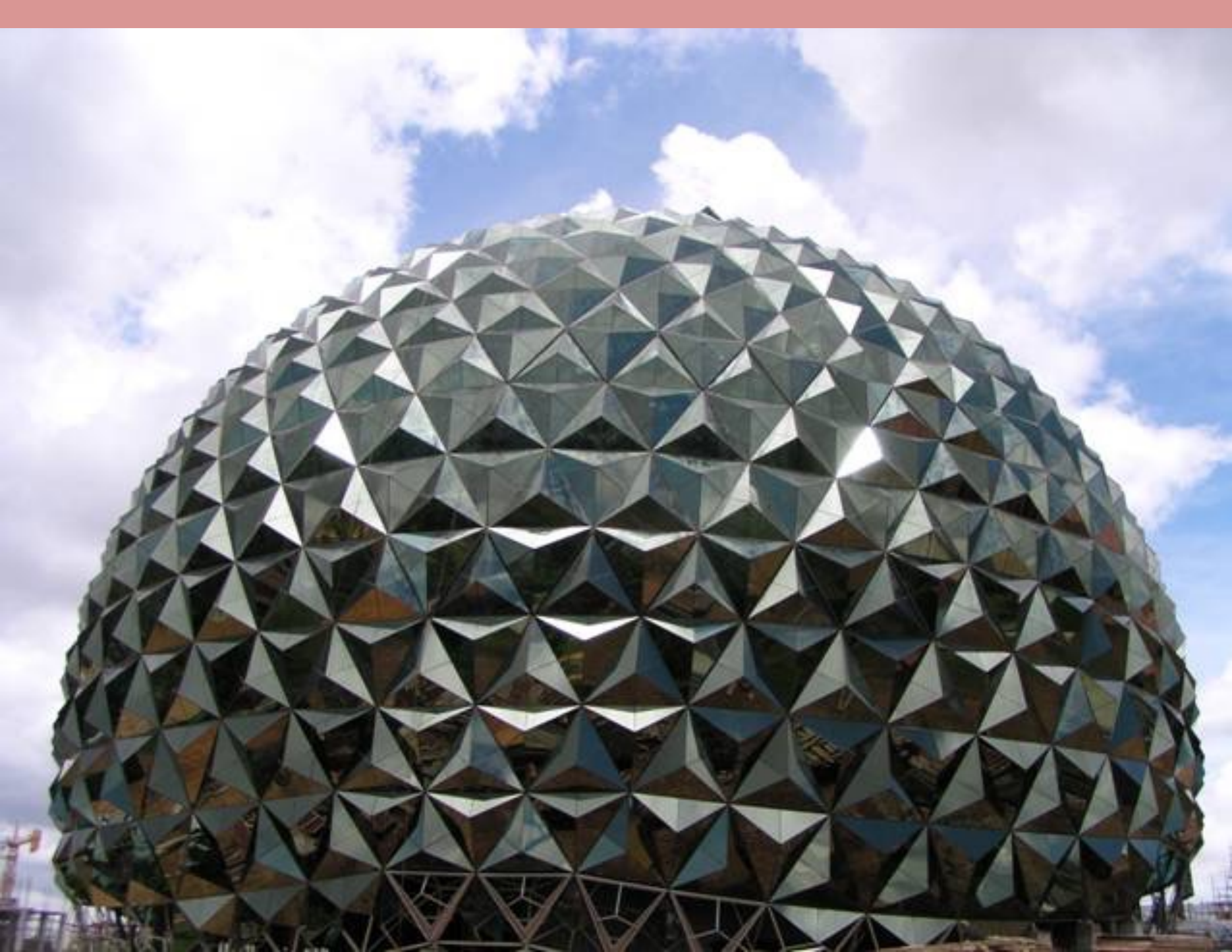
- Unitized or semi unitized
- Mechanical anchoring or only structural silicon
- Combining glass and other materials or only glass
- The type of glazing requirement will be different for different façade types as in following pictures.



ArchitectureWeek.com









Glazing Parameters

- **Glass Design Factors**

- **Visual appearance**
- **Strength**
- **Light**
- **Ultra violet**
- **Safety**
- **Thermal breakage risk**
- **Deflection**
- **Acoustic**
- **Energy.**

For thousands of years, glass was thought of as something to look at

It was valued in making precious objects for decorating purposes

Glass really became useful when it was thought of as something to look through.

Glass Design Factors

• Visual appearance

- Colour as seen from outside and inside
- External reflection
- Internal reflection
- Optical distortion
- Spandrel vision harmony or contrast
- Ceramic printing
- Any mural or design statement
- Laminated glass with color PVB in transparent, translucent or opaque options
- Laminated glass with printed PVB
- Most important is the visual intent of the architect.

Visual intent

It is possible to combine various glass processes to achieve the visual intent
Ceramic printing and colour laminations are the new options.









Visual Distortions

• Optical Distortions

- Most visible when seeing reflection of another building in the facade
- Roller waves due to tempering and heat strengthening
- Has to be tempered unidirectional with roller waves to be horizontal
- Pressure difference between air or gas inside DGU and external atmosphere
- Should be pressure equalized for altitude differences beyond 1000m
- Planimetry of the façade
- More prominent in concave and very low in convex surfaces
- External reflection of the glass used.



Strength

■ Glazing or Support system

- Wind load
- Four side supported
- Two side supported
- Point fixing as in bolted structural glazing
- Size and span of the largest panel.

Strength

Glass
Tempered Glass
Heat Strengthened
Laminated
Double Glazed
Annealed

Strength
4 Times
2 Times
Single
More than one
Single

Light

- **Transmission**

- Very high for retail areas
- Optimum for office areas for minimum glare but reasonable amount of natural light

- **External Reflection**

- Higher external reflection will give a shiny metallic color look
- Lower external reflection may compromise on solar performance

- **Internal Reflection**

- Higher internal reflection will be like mirror at night
- Night use and residential buildings should have low internal reflection
- Most hard coated glasses will have more external and internal reflection as compared to sputter coated glasses.

Light

• **Static solutions**

- We can select any suitable range of values for light
- It will be optimum only at certain given external conditions
- It will not be intelligent to adapt to change in external lighting and sun conditions
- As all conventional glazing solutions are static

• **Dynamic solutions**

- There are glazing options available and under development which are intelligent
- To keep the best possible day lighting conditions
- These have to be dynamically changing shading devices
- External, internal or contained within the glazing itself.

Dynamic day lighting solution-1

External shading by movable louvers

Vertical glass louvers change angle with the sun condition

Maintains optimum daylight during the whole day time

Provision for manual override in select areas.







Dynamic day lighting solution-2

Glass integrated blind system

Motorized blinds are enclosed in double glazing and hermetically sealed with double seal, uses very little energy and runs on 12 volts

The system can be programmed to dynamically vary the light or vision during the different times of the day.





Dynamic day lighting solution-3

Electro chromic window. It makes the glass darker by applying a small voltage.
Currently made by only 2 companies in the world



Powering the dynamic systems

Photovoltaic modules

Both dynamic options can be powered by photovoltaic modules integrated with façade in some select areas or spandrels.



Light

■ **Ultra violet or UV**

- **Only 3% of the solar spectrum**
- **Burning sensation on human body**
- **Bad for human eyes**
- **Responsible for fading of curtains and upholstery**
- **PVB is the best filter for UV**
- **Glass laminated with PVB blocks 99% of incident UV**
- **Excellent value for premium housing and Hotels..**

Safety

- **Human Safety**

- Compliant to building codes
- For injury due to human impact
- Risk of fall through the glazing
- High density movement areas, public areas
- Seismic and cyclone prone areas

- **Risk of Contamination**

- Hospitals
- Blinds in DGU

- **Suitable glasses**

- Laminated is best
- Tempered is minimum
- Heat strengthened and annealed glasses are not safety glasses.



Thermal Breakage Risks

- When using Tempered or heat strengthened glass, there is no thermal breakage risk
- Risk only with annealed glass
- Heat absorption property of glass
- Spandrel Panels are more prone
- Get a check from glass supplier when using annealed glass.

Deflection

- Due to wind Load
- Glass thickness and type
- Tempered glass behaves best under deflection and can bend a lot before failure
- When designing for strength, check for allowable deflection
- In extreme wind load conditions, excessive deflection will cause fear or phobia for inhabitants
- Sufficient bite to consider edge pullout.

Acoustic

• Glass

- Laminated is the first improvement
- Double glazed with dissimilar thickness panes
- Increasing the air gap improves acoustics
- Maximum mass and maximum asymmetry
- Single thick glass is nearly same as double or even triple glazed

• Total system

- Glass alone will not be enough
- Total glazing has to be designed with acoustic considerations
- Sealing is very important
- Proper and soft gasket materials have to be used with glass.

Energy

- **Solar radiation**

- Due to direct solar flux
- Addressed by reflection
- Addressed by shading

- **Thermal transfer**

- Due to temperature difference between outside and inside
- Addressed by insulation and lowering emissivity
- Lower U value achieved by DGU and Low-E Glasses

- **Total energy transmission**

- Combination of solar transmittance and thermal transfer
- Using the right glass and process.

Energy

• Shading

- Darker tints
- Multiple or thicker coatings
- External shading devices
- Internal shading devices
- Ceramic fritting
- Blinds in DGU
- Electro chromic glass

• Thermal transfer

- Double glazed
- Low-E glass
- High performance double silver and triple silver Low-E.

Ceramic fritting

Is achieved by applying special colored glass frit on glass and it fuses permanently into the glass during tempering or bending

• **Types commonly used**

- Solid color for spandrels
- Repetitive designs like dots, lines, blocks, patterns
- Graded patterns with higher opacity around spandrels
- Free flow design or images on facade

• **Application equipments**

- Roller coating
- Silk screen printing
- Spray painting
- Direct on glass digital printing.



帝囉婆吉姪娑他娑吉謹耶喇盧罰漫遮那
摩耶摩囉他婆豆娑帝墀唵悉羯沙多囉哆
河娑囉阿唵訶輸訶室地薩喇帝罰囉麼囉
罰婆摩悉阿悉朋悉佛利幡蘇樂慘跋麼夜
訶囉陀婆囉阿陀囉瑟囉嚩鉢佛陀罰耶
摩摩夜盧僧逝喻楞尼罰蘇囉囉耶摩南
婆醯娑醯阿孕藝馱那曳嚩耶舍娑囉無
利摩婆盧穆薩室婆婆數菩菩耶娑穆
勝醯訶迦法婆幡南夜怛提提呼訶帝
曷唎波帝耶薩囉無摩那夜薩盧南隸
馱陀迦娑哆耶那那怛菩輝啤無伊
孕摩羅婆那娑囉娑寫提婆盧喝醯
俱羯帝訶摩娑謹婆南夜耶摩囉伊





Heat strengthened glass v/s Tempered glass

- **Heat strengthened glass**

- Two times stronger than annealed glass but not a safety glass
- Lower roller waves
- Lower chances of spontaneous breakage
- Excellent when using laminated glass

- **Fully tempered glass**

- Four times stronger and must for point fixed glazing
- Classified as safety glass except for sloped glazing
- Higher chances of spontaneous breakages
- Roller waves can be controlled with new convection technology tempering plants
- Can be heat soaked for critical applications for reducing the spontaneous breakages.

Specifying Glass

- **Identify requirements needed from glass**
 - Based on nature of building
 - Energy and light requirements
 - Aesthetic requirements
 - Available options and their performance parameters
- **Identify processing required based on above and..**
 - Required strength due to wind load and glazing method
 - Acoustic requirement
 - Human safety
- **Specifying**
 - It is almost impossible to get the best of everything
 - Compromises are inevitable.

Specifying Glass

• **Compromises**

- **Compromise between solar control and light transmission**
- **Identify minimum light requirement and then look for the best glass options for solar control with these light requirements**
- **Strength, safety and aesthetics**
- **Acoustic and glazing weight**
- **Costs**
- **Has to be compliant to the codes.**

Specifying Glass

- **Wider choice for selection of basic glass**

- Give minimum and maximum allowable values for each spec
- Float manufacturer are few and each has a limited product range
- With the color and appearance being limited, the choice becomes still narrower
- Specifying a range will increase your options and competition
- Basic glass should be easily available and in suitable sizes for smooth supply and future replacements

- **Narrow options for processing of glass**

- There are nearly 100 glass processors in the country
- Validation for the processor is important
- Set out parameters for pre qualification and
- Must visit the facility and validate equipment, process, quality control and testing.

Ensuring the performance of the structures to enhance economic returns

• Returns from energy saving

- The best pay back period for spending extra on glass comes from using a DGU with one glass reflective and inner pane as Low-E

• Returns from better value

- Aesthetically pleasing facade with decent natural light and good energy conservational will get more value from users

• Returns from futuristic design and longer life span

- The façade should not become outdated in next 15 to 20 years and thus should have a longer life span.

**Thank you for
your attention.**

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