

uPVC Windows – Bringing a whiff of Fresh Air to Indian Constructions

About PVC :

PVC (Polyvinyl Chloride or Vinyl) is one of the three major thermoplastics, viz. Polypropylene (PP), Polyethylene(PE) and PVC being manufactured and used across the globe.

Globally , around 60% (~21 million metric tons) of PVC finds its way into infrastructure in the form of Water/SWR/Plumbing/Sewerage/ Drainage Pipes, Window & Door Profiles, Pre-fab Housing, Porta Cabins, False Ceilings, Wires & Cables, Floorings, Sidings & Claddings, Deckings, Fencing, Cable Trays & Channels, etc (Picture 1) thereby earning the name of **“Infrastructure Plastic”**.

Picture 1



To make PVC useful for various applications, additives such as thermal stabilizers, lubricants, processing aids, colourants, UV stabilizers, Plasticisers, fillers, etc. are added to it before processing to ensure good mechanical properties and weatherability. Due to this process, called “Compounding”, PVC becomes a highly versatile plastic making its processing possible to make the softest of products (plasticised or flexible PVC, i.e. fPVC) to the rigidest ones(unplasticised PVC, i.e. uPVC).

Background on Windows :

Windows in residential and commercial constructions in India, till recently, have merely been looked upon as simple carpenter assembled contraptions to fill the aperture in the wall, and were traditionally made of Wood, Mild Steel or Aluminium along with other materials like 2-3 mm glass, putty, gaskets and some basic hardware such as handles, shoot-bolts, hinges, etc. No organized thought seems to have been applied to develop Windows for Indian climate/s which would deliver lot more than filling just the aperture in the wall.

In keeping up with the global advancements in Fenestration Product (broad term for products filling the openings in the Building Envelope or

Shell) technology, we in India also have to progress and go up the learning and value curve so that windows can deliver higher inhabitant comfort , safety and aesthetics at affordable prices as well as restrict heat transfer / energy loss in commercial as well as residential air-conditioned spaces.

India seems to have taken the technology leap in Fenestration product technology with many specialist Indian and Global uPVC Window/Door system extruders and fabricators appearing on the scene. The innocuous Window is finally receiving the attention it deserves from Builders, Architects, Interior Decorators, Home Owners, Govt. Authorities (BEE-MoP, CPWD, etc) as well as other stake-holders.

Globally, **windows or “Window Systems” as they are called, are seen as the single most important area in the envelope or shell of the building for preventing energy loss.** Fenestration scientists and designers have made huge technical advancements in Window systems in order to prevent energy loss as well as to improve inhabitant comfort. Since per capita energy consumption in advanced countries is high, these Window systems have ensured huge energy savings and correspondingly lower emission of Green House Gases(GHG). In fact , a study undertaken in Europe in 2006 concluded that if energy inefficient Windows are replaced by energy efficient uPVC Windows , Europe will be able to meet GHG emission norms set as per Kyoto Protocol within lesser number of years, and that too, without looking at any other area of energy saving **(Potential to save Energy through use of Modern Window Systems in Europe – By Er. Marcus Hermes).**

Performance Expectations from Windows Systems in India:

In this context, the question that arises is- **What should be the parameters on which Windows should be evaluated and what should be the performance expectation from Window systems in India?**

In order to deliver optimum performance, Window design begins right from its orientation in a building or structure to ensure low/high solar heat gain (depending upon specific climate

of a place), daylighting (to conserve artificial lighting), noise attenuation, low dust ingress, air/water tightness, aesthetics, low maintenance requirements, security, and the like.

Accordingly, windows today are judged on the basis of following parameters (Picture 2):

u Value (W/m^2K) – This measures how well a window is able to prevent heat transfer across itself either from outside to inside, or vice-versa. The lower the u value, the better is the Windows insulating value. Today, State-of-the-art window making technology ensures u values of even $0.2 W/m^2K$, although this is not available in India yet.

Solar Heat Gain Coefficient (SHGC) – This measures how well a window blocks heat caused by sunlight. It is expressed as a number between 0 and 1. The lower the SHGC, the less solar heat the window transmits.

Visible Transmittance (VT) – This measures how much light comes through the window. VT is expressed as a number between 0 and 1; the higher the number, the more light is transmitted.

Air Leakage (AL) cfm/sq ft – When air infiltrates through cracks in a window, heat gain from outside or cooling loss from inside can happen. AL rating is expressed as the equivalent cubic feet of air passing through a square foot of window area. The lower the value, the lesser the AL.

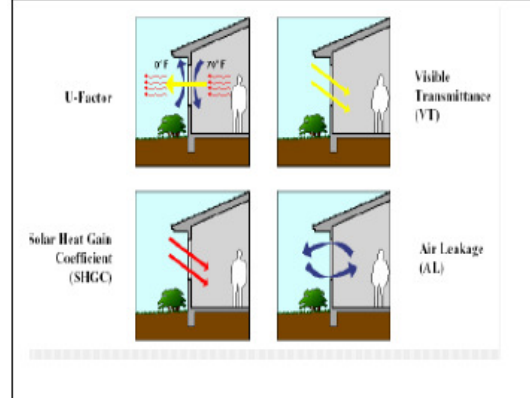
Water Tightness – This measures how much water can infiltrate through cracks/joints in a window. This is an important test for coastal and/or heavy rain areas.

Noise Attenuation or Reduction – Due to their better sealability and product integrity, well designed Windows ensure that noise from outside does not come into habitable area. This property is important for Hospitals, Hotels, Educational Institutions, buildings close to noise centres, and even offices and residences, etc.

Wind Load Suitability – Windows have to withstand higher wind loads particularly in windy locations, coastal areas, high rises, etc.

Windows of today are designed and reinforced to withstand even 3000 Pascals of wind speed (equivalent to 245 km/hr of wind velocity) or even higher.

Picture 2 : Window Evaluation Parameters



India being a continental sized country, one comes across all climatic extremes. It is, therefore, important to understand what performance should be delivered by windows in each of the five officially designated climatic zones into which India is divided, as tabulated below in Table 1:

Table 1

Desired Zonewise Window Performance in Indian Context

Climatic Zone	Solar Heat Gain (SHGC)	Heat Transfer (u value)	Air Tight	Water Tight	Heavy Squall &/or Rain	Comfortable to Touch	Noise Reduction	Dust Reduction	Condensation Free
Hot-Dry	Should Prevent	Low u value required	Yes	Yes	Should Withstand	Yes	Yes	Should not let in dust	NA
Humid-Warm	Should Prevent	Low u value required	Yes	Yes	Should Withstand	Yes	Yes	Should not let in dust	NA
Composite- Hot in Summer, Cold in Winter	Should Prevent in Summer, Allow in Winter	u value may not be as low as in above	Yes	Yes	Should Withstand	Yes	Yes	Should not let in dust	Yes in winter
Temperate	Should Prevent when hot, allow when cold	u value may not be as low as in above	Yes	Yes	Should Withstand	Yes	Yes	Should not let in dust	Yes
Cold	Should Allow	Low u value required	Yes	Yes	Should Withstand	Yes	Yes	Should not let in dust	Yes

What are uPVC Windows ?

uPVC Windows are so called since the frames used in these windows are made of multi-chambered rigid Poly Vinyl Chloride(PVC) Profiles (extruded through highly expensive precision dies). Before being corner welded (conventional framing material cannot be corner welded), the Galvanized steel reinforcements are inserted into the uPVC Profiles for additional strength and screw hold-

fastness. They can be single or double, or even, triple glazed with air, gas or vacuum in between the glazings using EPDM Rubber/flexible PVC double gasketing for air-water tightness . The glass can be simple float or tempered/toughened or laminated shatterproof glass with spectrally selective or low emissivity coatings, etc.

Why uPVC Windows !

uPVC Windows are widely used across the globe, from the deserts of Arizona to the coldest parts of Scandinavia/Russia, from the hot environs of Gulf to the tropics of Malaysia, Thailand as well as very extensively in China, S.Korea, Taiwan , and many more Geographies. In fact Europe and North America mainly use **uPVC Windows** in their new constructions as well as for replacement. This is due to their good aesthetics, durability, noise proofness, low maintenance requirement, best air & water tightness, and their ability to provide excellent thermal insulation , thereby helping save air-conditioning power costs in homes, offices and commercial centres.

uPVC Windows come with a very high-quality surface finish, soft-contoured profiles and a variety of styles to meet the needs of the most demanding architects, designers and users.

The environmental benefit of using **uPVC Windows** instead of wood and metal windows is phenomenal. Due to their ability to conserve energy throughout their life-time (from raw-material stage to in-use stage) , **uPVC Windows are recognized as Green Windows** thereby scoring over traditional framed windows.

As a matter of fact, **many European and North American Governments are giving financial incentives to encourage their citizens to switch over to "Energy and Environment saving double/triple glazed uPVC Windows"**.

uPVC Windows are the best fit for all weather conditions prevalent across India - from salty humid corrosive air of coastal areas to sub-zero temperatures of Ladakh to heavy rains of Cherapunji to the hot dust storms of Central India to the cyclonic gale winds of Orissa coast to the extremely hot deserts of Thar in Rajasthan.

The usage of uPVC Windows in India is growing fast and is presently estimated at 5-6% of total market of about Rs.6000 cr (Source - "Windows & Doors around the world – The global market for Fenestration Products" - By Kenneth Long).

Comparison of uPVC with other framing materials - Table 2

		uPVC	Wood	Aluminum	Steel
Raw Material		Made from 57% common salt, unlimited availability	Limited availability due to environmental concern	Extracted from Bauxite ore – limited availability	Extracted from Iron Ore
Energy Consumption		Low Embodied energy, Low energy consumption during extrusion	Low Energy consumption similar to PVC	Embodied energy, 7.5 times high energy consumption during extrusion	Higher than PVC but lower than Aluminum
Convenience in Installation		Easy	Fair	Fair	Poor
Usage	Does it Peel, corrode, rot or warp in bad weather	Never	yes	yes	yes
	Does heat or cold transmit through the material	No	Only if kept dry	yes	yes
	Is it cool all year?	Yes	Only if kept dry	No	No
	Will it require painting or other maintenance?	Never	Only if kept dry	Yes if scratched	yes
	Will scratches show as a different colour under the paint	No	Yes	Yes	yes
	Does soap and water cleaning make material look new again	Yes	No	No	No
Aesthetics	Excellent	Good	Good	Poor	
Waste Disposal		up to 95% after separation from Hardware and reinforcement	Recycling difficult as profiles are treated with paint, silicon and various protection coatings	Separation of Alu and plastic parts difficult	Low value
Life Time		50-100 years, PVC windows are in market since 50 years	Have to be painted & maintained	40 Years with adequate surface coatings	5-10 years with maintenance
Flash Ignition Temp.		400 °C	210 °C		
Self Ignition Temp.		450 °C	400 °C		
Needle Flame Test			Ignitable in 10 seconds		

Advantages of using uPVC Windows from Indian point of view:

a) Do not allow rains to come in due to their double gasketing and water drainage design - **Ideal for rainy and coastal locations**

b) Do not let outside heat in (or inside heat out in cold climate) thereby providing inhabitant comfort & **saving heating/cooling energy to the extent of 20-25%** due to insulating multi-chambered profile and **air-tight** sealing design ; Also comfortable to touch in hot as well as cold climate; are condensation free – **Ideal for cold locations. e.g. Siachen, as well as**

hot locations like Thar desert. **Conventional windows end up cooling air outside the room leading to higher power bills.**

c) Provide Sound & Dust insulation , reducing noise to the extent of 20-30 decibels thereby providing user comfort – **Ideal for Schools, Colleges, Canteens & Messes, Hospitals , Community Centres, etc.**

d) Do not Rust, Corrode, Rot or Swell , are Termite proof, need no Painting – Ideal for coastal and rainy locations

e) Design flexibility and versatility - Any shape, form and size can be made; can be customized to blend with the architecture of the building

f) Stylish , elegant and aesthetically pleasing - Available in a choice of colours, printed patterns, laminates and colourcoordinated grilles (white is the best suited colour for Indian weather conditions)

g) Easy to fabricate and install - Can be drilled, nailed, sawed, etc. and no finishing needed. **Save manufacturing and installation time and labour.**

h) Durable & Long Life - Have high impact strength, dimensional stability and weather stability ; Do not fade or get discoloured ; Water and chemical resistant ; No warpage or expansion/contraction due to changes in humidity

i) Look new year after year - No paint or varnish needed; occasional cleaning with soap and water. **White uPVC Windows make old buildings look new.**

j) Secure - Safety locking arrangements and metal reinforcements meet the common standards for forced-entry resistance

k) Meet stringent Fire safety requirements – PVC is inherently flame retardant, difficult to ignite and resists sustained burning

l) Convenient cleaning - Tilt in sashes allow for safe and easy Cleaning from inside. Windows

open effortlessly and balances never need adjusting

m) Act as Project Differentiator from a **Builder's perspective**

n) Increase asset and resale value from a **home-owner's perspective**

o) Save Forests and Environment - **Replacement for Wood and Energy Intensive metals**

p) Made from plentiful natural resource - 57% of PVC comes from common salt

q) Can be recycled at the end of their useful life

Indian Development on Building Code:

The issuance of first ever Energy Conservation Building Code (ECBC) by Bureau of Energy Efficiency, Ministry of Power, Govt. of India in May'07 has been a path-breaking initiative of the Central Govt. The code is applicable to **Building Envelope** and four other areas of building construction.(HVAC, Service Hot Water Heating & Pumping, Interior & Exterior lighting, Electrical Power & Motors) and **propounds to save energy in buildings by laying down a performance rating framework to be achieved by incorporating/use of materials/components which conserve energy during the life time** of the building. **ECBC 2007 recommends the use of low u value Energy Saving uPVC Windows in Indian constructions .**

Energy and Environment saving uPVC Windows can also help in **earning Credits in IGBC LEED rating** of buildings. IGBC LEED rating system goes much beyond ECBC. It evaluates and rates buildings from their total environmental impact right from Siting, Orientation, Consumption of Material/Energy over the life-time, Generation of Waste & its disposal over the life-time, and the like.

One can , therefore , safely say that uPVC Windows are the **"Windows of Choice for Constructions of yesterday, today and tomorrow"**.

Standards & Testing in India

Presently uPVC Windows in India are made as per international standards. However, it is understood that uPVC Window Door Manufacturers Association (UWDMA) is in the process of submitting an India centric draft standard to BIS . Further , Bureau of Energy Efficiency (BEE), Ministry of Power, Govt. of India is in the process of setting up **Thermal Performance Testing Centres for Windows at Centre for Environment Planning & Technology (CEPT - a Deemed University) , Ahmedabad and JadHAVpur University, West Bengal** which should pave the way for **Energy Star Rated Windows and other Fenestration Products in India.**

Conclusion:

PVC Windows are increasingly becoming the material of choice for achieving economic and environmental balance as well as meeting higher demands on inhabitant comfort . With natural resources dwindling fast, traditional products are becoming more expensive. At the same time the requirement of building materials is increasing many folds. uPVC Windows and other PVC Products are making an enormous contribution to many different aspects of infrastructure development and hence need to be on every Architects, Interior Decorators or Builders wish list.

By :

**Ravi Koul Jalali & Aruna Kumari ,
BD-Polymers, Reliance Inds. Ltd.,
Cell No. : 9987034001
E-mail : R.K.Jalali@ril.com**