APRIL 2015

Glass in Facades

The Essential Selections

Andy Dean

BSc (Hons), FCIOB, FSE

Head of Façade Engineering

WSP | Parsons Brinkerhoff

Safety Design in Buildings Kuwait Conference

Radisson Blu Kuwait, Wednesday, April 22, 2015

WSP | PARSONS BRINCKERHOFF

Course Description

Glass selection is an extremely important phase of the design process. It is actually a combination and often a balance of performance characteristics. In this presentation we will address four of the key safety-related aspects of glass selection – fire safety, breakage, security and solar performance. The intention is to provide the listener with some of the key requirements and also resources pursuant to assisting them in this regard.

Presenter

Andy has over 25 years of experience in the field of Building and Construction, ranging from structural testing within the nuclear industry to fire testing.

Having established the Dubai Facade Technology Centre and Laboratory in 1997, and operated it for 10 years, he has particular knowledge of heavy structures testing and weathertightness testing of cladding, curtain walling and building envelope systems; and business in the Middle East.

Andy is a Fellow of the Chartered Institute of Building, Fellow of the Society of Façade Engineers (CIBSE) and member of the Glass and Glazing Federation; holding committee positions in the local chapters of these organisations.

As a façade consultant he continues to provide input into the UAE code and is a regular speaker at industry technical seminars across the region.

Learning Objectives

1. *Considerations for glass selection*
2. *Glass selection considerations for fire safety*
3. *Glass selection considerations for breakage*
4. *Glass selection considerations for security*
5. *Glass selection considerations for solar control*

The purpose of this presentation is to convey technical knowledge to the conference participants.

The presentation also contains slides with text that summarise the content of the presentation and the main learning objectives.

These may be used to update CPD records for relevant organisations including the Chartered Institute of Building (CIOB).

Copyright Materials

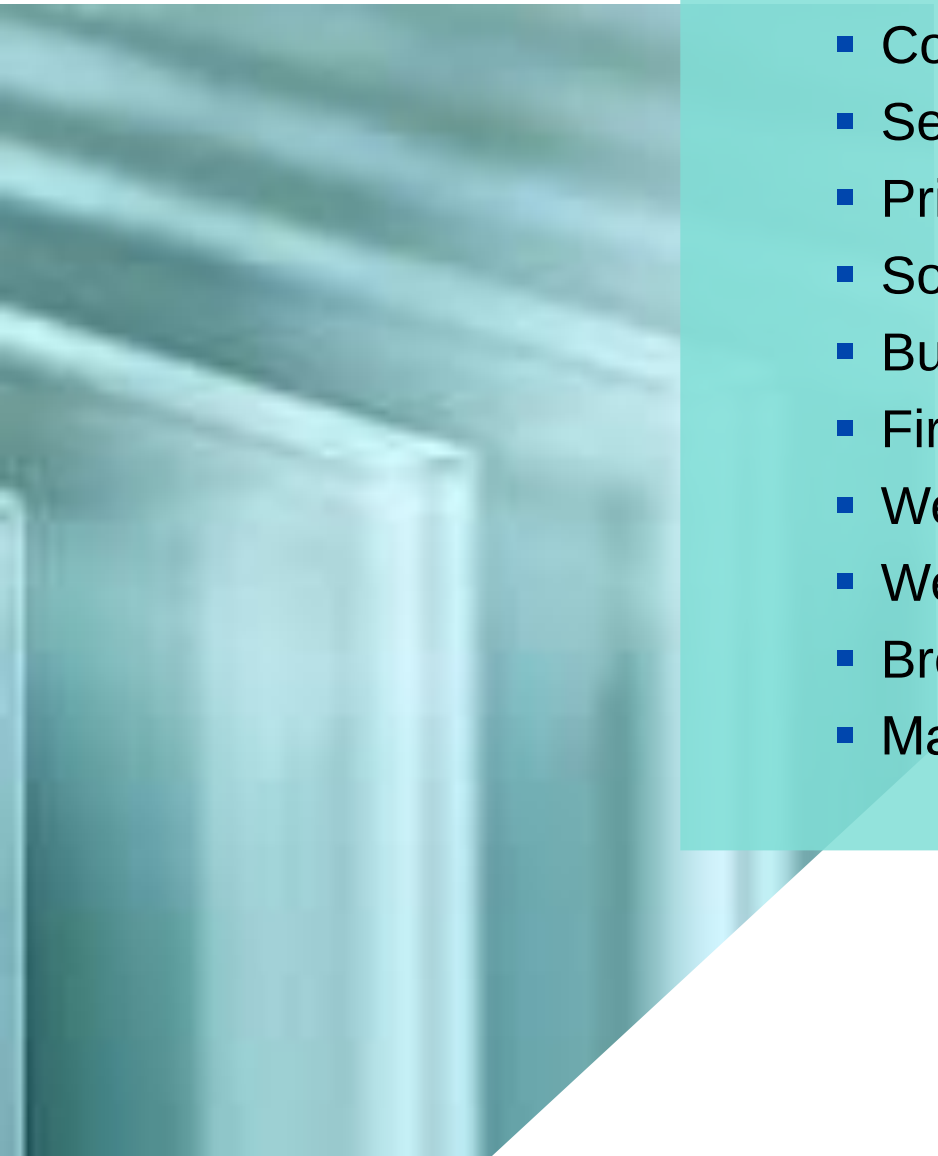
GLASS SELECTION

→**AGENDA**

- →*Glass selection factors*
- →Fire
- →Breakage
- →Security
- →Solar control

WSP | PARSONS BRINCKERHOFF

GLASS SELECTION



→ **Glass Selection Factors**

- Colour
- Security
- Privacy
- Solar control
- Building function
- Fire safety
- Weather
- Weight
- Breakage
- Many more…

WSP | PARSONS BRINCKERHOFF

GLASS SELECTION

→ **Glass Selection Factors**

- Colour
- Security
- Privacy
- Solar control
- Building function
- Fire safety
- Weather
- Weight
- Breakage
- Many more…

WSP | PARSONS BRINCKERHOFF

KEY GLASS SELECTION FACTOR 1 - FIRE

→**Fire Safety**

→Key Glass Selection Factors

→Fire

→Breakage

→Security

→Solar control

WSP | PARSONS BRINCKERHOFF

REACTION TO FIRE vs FIRE RESISTANCE

Source: Exova Warringtonfire

Reaction to Fire

- Fire development
- Usually materials
- Various measurement formats

- Ignitability
- Surface spread of flame
- Smoke development
- Toxicity
- Combustibility

WSP | PARSONS BRINCKERHOFF

REACTION TO FIRE

Source: Khaleej Times

Current Issues

- Misleading claims (from several parties)
  - 2-hour fire resistance – nonsense
  - Partially tested (small scale not large scale)
  - The issues are now known
- Existing building stock
  - Needs quantification
  - Needs prioritisation
  - Needs a risk assessment for each building
  - Needs penalties and enforcement

WSP | PARSONS BRINCKERHOFF

REACTION TO FIRE vs FIRE RESISTANCE

Source: Exova Warringtonfire

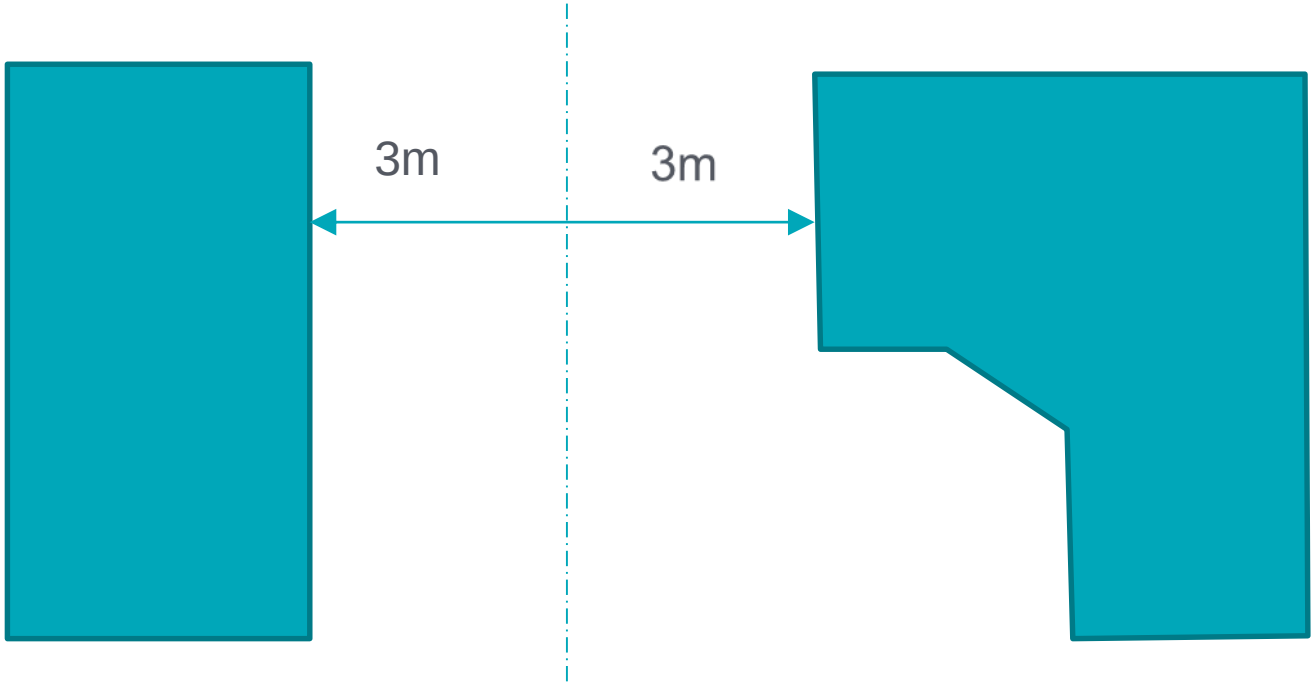
Fire Resistance

- Preventing a fully-developed fire from getting from one compartment into an adjacent one
- Compartmentation – internal fire spread
- Usually systems
- Walls, doors, windows, floors, ceilings, penetration seals
- Measured in time (temperature, integrity, structural)

WSP | PARSONS BRINCKERHOFF

THE REQUIREMENT FOR FIRE RESISTANCE

- Preventing flame spread out of, or into, a building
- Protecting an essential space



- Consider the performance type that you need
- More frequently an internal requirement (internal partitions)

WSP | PARSONS BRINCKERHOFF

FIRE RESISTANCE CLASSIFICATIONS

Classifications

- **E Integrity only**
- **EW Integrity with radiation limitation**
- **EI Integrity with insulation**

Sources:

Exova Warringtonfire
Effectis

WSP | PARSONS BRINCKERHOFF

MAIN FIRE RATED GLASS TYPES (1)

Main Types (1)

- **Wired**
  E30, safety glass, double glazed, can be sprayed, multi-directional, clear or opaque
- **Tempered borosilicate**
  E120, safety glass, double glazed, multi-directional, no wires
- **Ceramic**
  E240, can be safety glass, double glazed, can be sprayed, no wires
- **Light-weight laminated**
  E60 or EW60, safety glass, double glazed, multi-directional, no wires
- **Modified tempered soda lime silicate**
  E60 or EW30/60, safety glass, double glazed, no wires

MAIN FIRE RATED GLASS TYPES (2)

Main Types (2)

- **Resin & PVB laminated**
  E60 or EW30/60, safety glass, double glazed, multi-directional, no wires

- **Intumescent & gel laminated**
  EI 120, safety glass, double glazed, can be sprayed, multi-directional

- **Points to consider**
  Expense, lead times, thicknesses, weight, sprayable? (collapse), insulation, multi-directional, colour

KEY GLASS SELECTION FACTOR 2 - BREAKAGE

→**Breakage**

→Key Glass Selection Factors

→Fire

→Breakage

→Security

→Solar control

GLASS BREAKAGE FACTORS

Considerations

- Proximity to pedestrians
- Overhead, inclined, vertical
- Thermal environment
- Building location
- Building use
- Weight
- Colour
- Quality
- History of breakage
- Existing problem
- Sensitivity
- Others…

GLASS BREAKAGE

Heat Treatment

- Annealed (float)
- Heat strengthened (HS)
- Fully tempered, toughened (FT)

GLASS BREAKAGE

- Annealed (Float):
- + Not expensive
  + Can be cut
  + V. low distortion
  + No NiS effect
- - Long shards
  - Low impact res.
  - Thermal cracks
  - Not a safety glass (for most thicknesses)

WSP | PARSONS BRINCKERHOFF

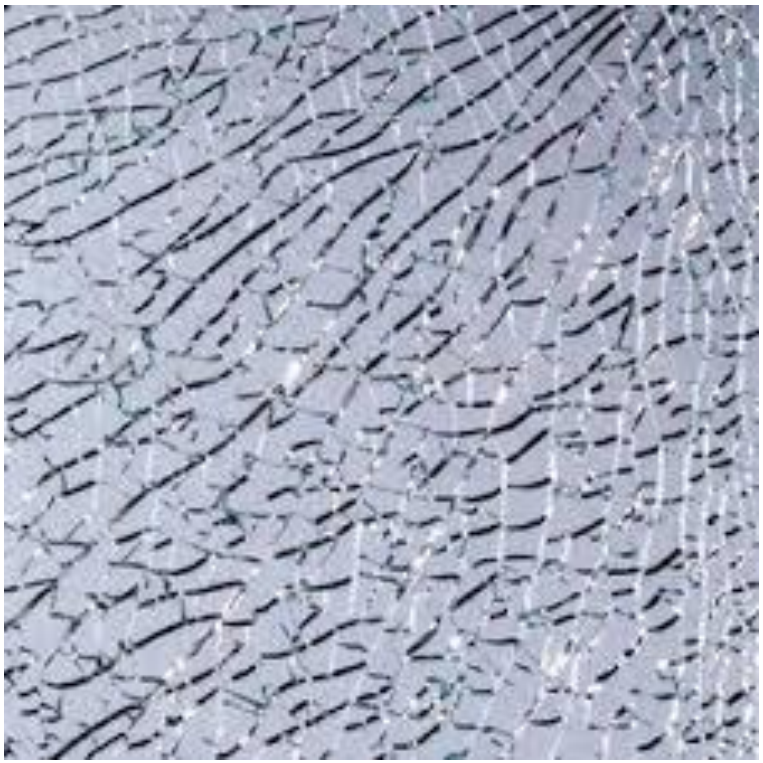
GLASS BREAKAGE

- Heat Strengthened (HS):
- + Relatively in expensive
  + Low distortion
  + Rare NiS effect
  + No thermal cracks
  + Improved impact resistance

- - Long shards
  - Not a safety glass (for most thicknesses)

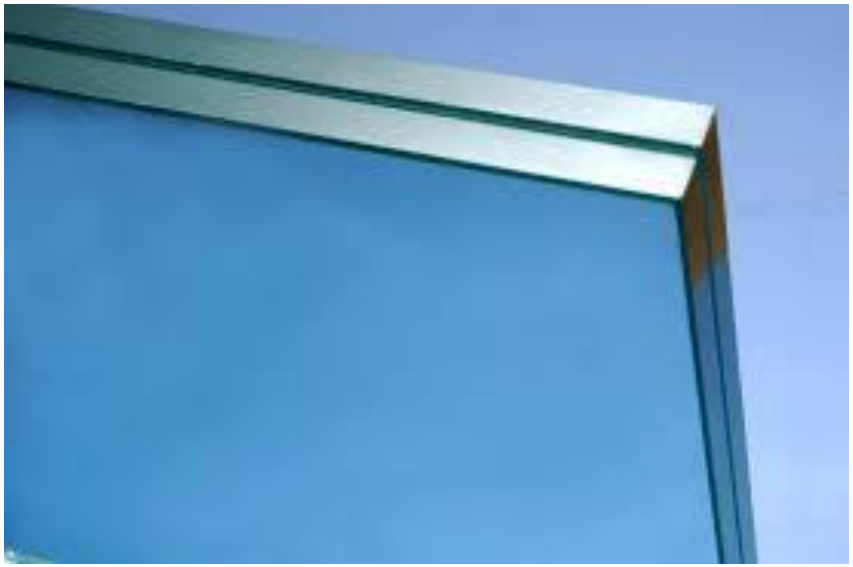
WSP | PARSONS BRINCKERHOFF

GLASS BREAKAGE



- Fully Tempered / Toughened (FT):
- + Relatively in-expensive
  + Good impact resistance
  + No thermal cracks
  + Small safer particles
  + A safety glass
- - NiS prone
  - Distortions likely
  - Readily collapses following fracture

GLASS BREAKAGE



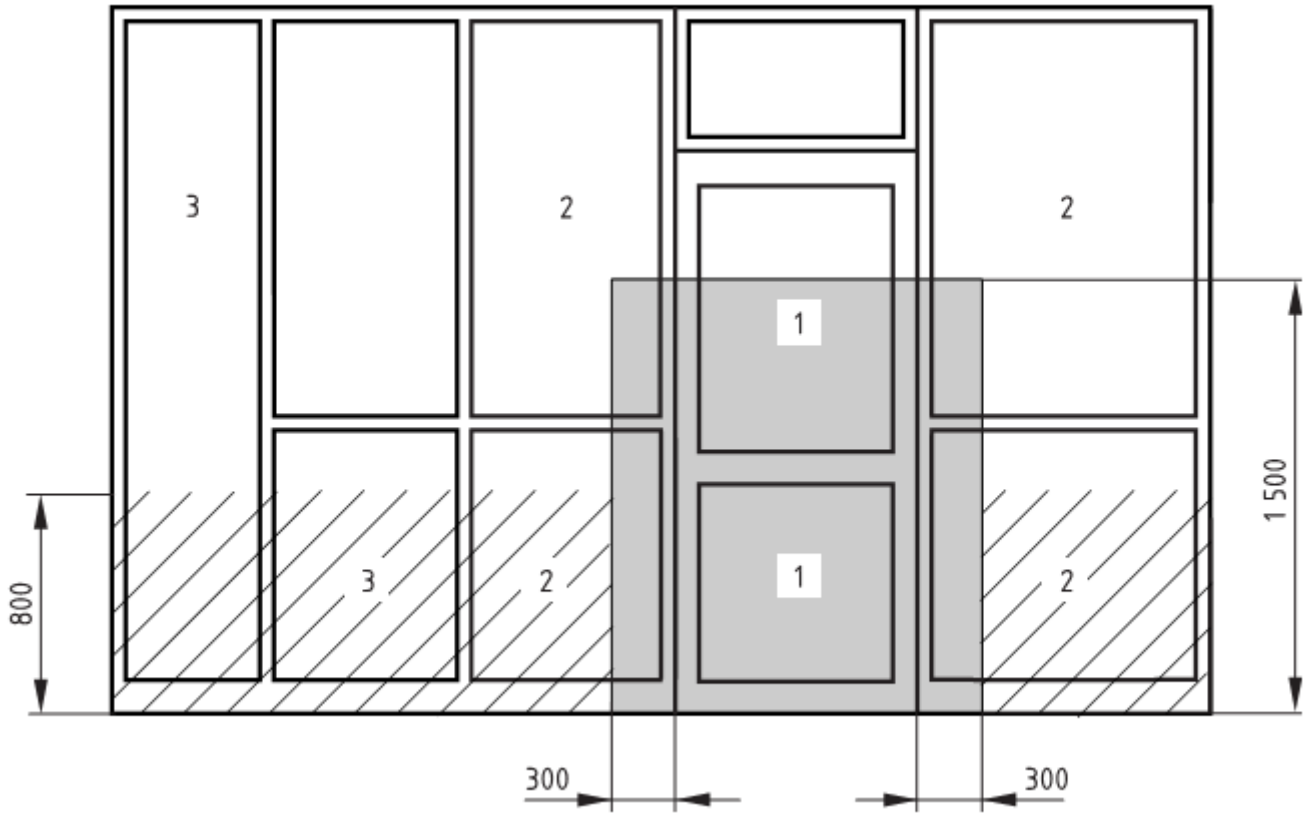
- Laminated:
  Takes on the properties of the plies
- + Integrity after impact
  (- not structural though, select very carefully)
  + A safety glass
- - Expensive
  - Interlayer type to be considered
    - PVB / EVA
    - SentryGlas

GLASS BREAKAGE

- Laminated:
  + Allows blending of properties
- - Interlayer to be chosen carefully
- - Extreme caution when FT used overhead / inclined
- - Delamination
- - Potential for structural creations
- Films

GLASS BREAKAGE

→ **Critical Locations**



KEY GLASS SELECTION FACTOR 3 - SECURITY

→**Security**

→Key Glass Selection Factors
→Fire
→Breakage
→Security
→Solar control

WSP | PARSONS BRINCKERHOFF

SECURITY - GLASS AS A BARRIER

- Against what?:

- Manual attack
- Weather / impact
- Ballistic attack
- Explosion pressure

WSP | PARSONS BRINCKERHOFF

SECURITY - GLASS AS A BARRIER

- Manual attack
  - various implements
- Weather / impact
  - storms, windblown items
- Ballistic attack
  - various weapons and calibres
- Explosion pressure
  - intentional
  - accidental

SECURITY - GLASS AS A BARRIER

- All specialist selections requiring specific testing and evaluation…
- Consider also,
  - the frames
  - the wall
  - proximity
  - overall security – other openings / risks

KEY GLASS SELECTION FACTOR 4 - SOLAR

→**Solar Control**

→Key Glass Selection Factors

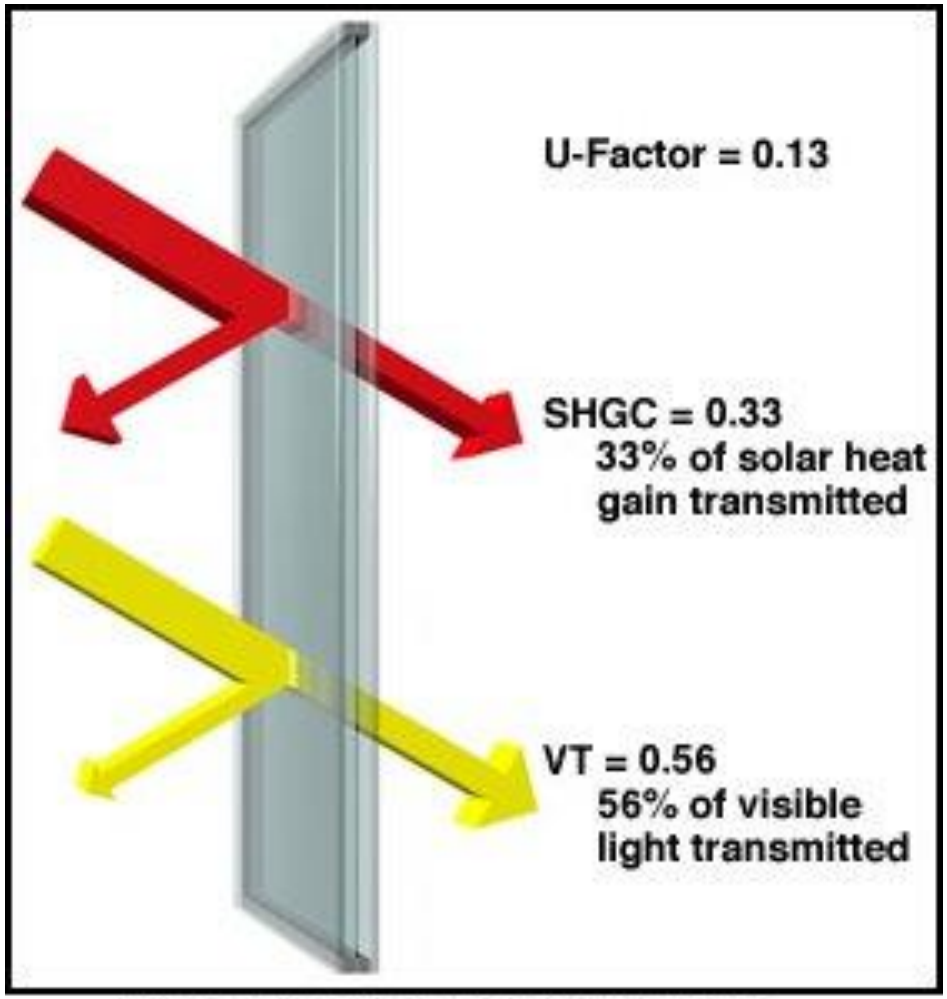
→Fire

→Breakage

→Security

→Solar control

U-VALUE, VLT, SHGC

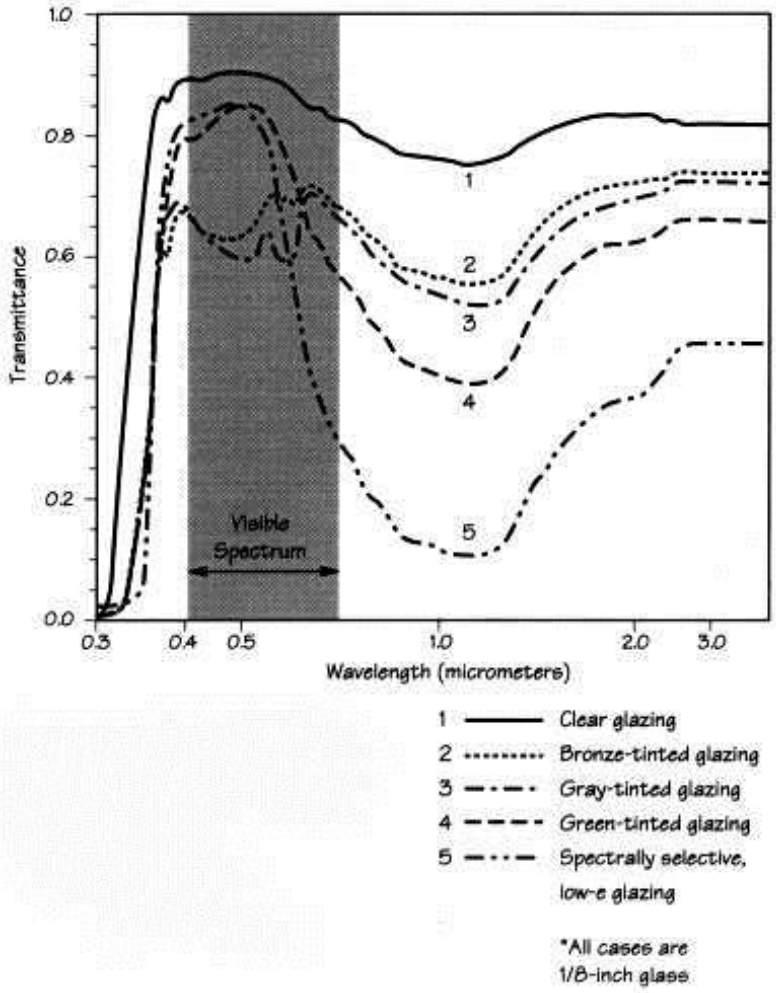


Credit: Efficient Windows Collaborative

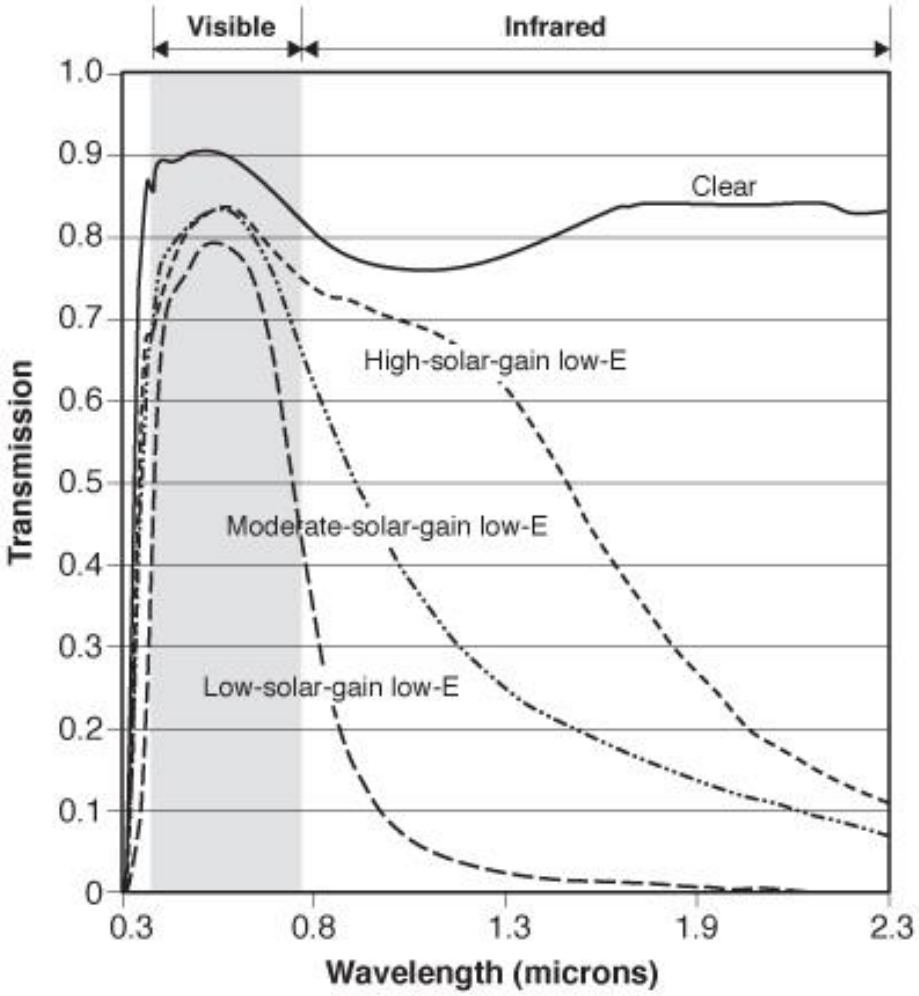
- U-value (transmittance (OHTC))
  - λ (lamda) = thermal conductivity or efficiency (W/mK)
  - Resistance (m^2K/W)
  - 1/R = U-value (W/m^2K)
- Visible light transmission
  - the proportion of light from the visible spectrum passing through the glass
  - may or may not be combined with the effect of fritting
- Solar heat gain coefficient = g value
  - total solar energy transmittance
  - SHGC = SC x 0.87 (approx)

SPECTRAL SELECTION GENERALLY

→ **General glass types**



Low E types



WSP | PARSONS BRINCKERHOFF

SOLAR CONTROL (+) FACTORS

Considerations

- Low comfort = stress
  = health issues
  - too much light - glare
  - closed curtains – no view
  - reduced productivity in schools and offices
  - patient recovery in hospitals
  - unhappy people

- The (+)…
  - Acoustics – sleep and relaxation
  - Fresh air
  - Performance – environmental pollution
  - Many other factors – many people related

WSP | PARSONS BRINCKERHOFF

GLASS SELECTION

→RECAP

- → *Glass selection factors*
  – many and varied
- → Fire
  – mainly fire resistance but several classifications
- → Breakage
  - chose glass types carefully and consider blending with laminates
- → Security
  - consider modes of attack but don't forget the whole
- → Solar control
  - stress is a patient killer – we can improve our lives with wise choices

WSP | PARSONS BRINCKERHOFF

Thank you

Andy Dean
BSc (Hons), FCIOB, FSE
Head of Façade Engineering
WSP | Parsons Brinkerhoff
+971 50 654 1037
andy.dean@wspgroup.com

WSP | PARSONS BRINCKERHOFF