Architectural Glass Trends

International Window Film Association Conference 2014

Arlington, Texas
March 1, 2014

Urmilla Jokhu-Sowell
Glass Association of North America
Objectives

- Introduction to Glass Association of North America (GANA)
- Architectural Glass
  - Trends, Considerations and Challenges
  - Existing Buildings Retrofit
- Industry Relations
GANA: Internal Activities

Glass Association of North America

Board of Directors

Glass Division
- Building Envelope Contractors Division
- Decorative Division
- Flat Glass Manufacturing Division
- Insulating Division
- Laminating Division
- Tempering Division
- Energy Division
- Fire-Rated Glazing Council
- Glazing Industry Code Committee
- Marketing and Communications Committee
- New Professionals Committee
- Protective Glazing Committee

Glass Division
- Building Envelope Contractors Division
- Education Committee
- Nominating Committee
- Technical Committee
- Building Information Modeling Committee
- Commercial Specifier Systems Manual
- Structural and Decorative Glass Committee
- Technical Committee
- Project Manager Reference Manual
- Top 10 Memories from Shop Drawing

Glass Division
- Insulating Division
- Education Committee
- Nominating Committee
- Membership Committee
- Technical Committee
- Building Information Modeling Committee
- Commercial Specifier Systems Manual
- Structural and Decorative Glass Committee
- Technical Committee
- Project Manager Reference Manual
- Top 10 Memories from Shop Drawing

Glass Division
- Laminating Division
- Education Committee
- Nominating Committee
- Membership Committee
- Technical Committee
- Building Information Modeling Committee
- Commercial Specifier Systems Manual
- Structural and Decorative Glass Committee
- Technical Committee
- Project Manager Reference Manual
- Top 10 Memories from Shop Drawing

Glass Division
- Tempering Division
- Education Committee
- Nominating Committee
- Membership Committee
- Technical Committee
- Building Information Modeling Committee
- Commercial Specifier Systems Manual
- Structural and Decorative Glass Committee
- Technical Committee
- Project Manager Reference Manual
- Top 10 Memories from Shop Drawing

Glass Division
- Insulating Division
- Education Committee
- Nominating Committee
- Membership Committee
- Technical Committee
- Building Information Modeling Committee
- Commercial Specifier Systems Manual
- Structural and Decorative Glass Committee
- Technical Committee
- Project Manager Reference Manual
- Top 10 Memories from Shop Drawing

Glass Division
- Laminating Division
- Education Committee
- Nominating Committee
- Membership Committee
- Technical Committee
- Building Information Modeling Committee
- Commercial Specifier Systems Manual
- Structural and Decorative Glass Committee
- Technical Committee
- Project Manager Reference Manual
- Top 10 Memories from Shop Drawing

Glass Division
- Tempering Division
- Education Committee
- Nominating Committee
- Membership Committee
- Technical Committee
- Building Information Modeling Committee
- Commercial Specifier Systems Manual
- Structural and Decorative Glass Committee
- Technical Committee
- Project Manager Reference Manual
- Top 10 Memories from Shop Drawing

Glass Division
- Energy Division
- Education Committee
- Nominating Committee
- Membership Committee
- Technical Committee
- Building Information Modeling Committee
- Commercial Specifier Systems Manual
- Structural and Decorative Glass Committee
- Technical Committee
- Project Manager Reference Manual
- Top 10 Memories from Shop Drawing

Glass Division
- Fire-Rated Glazing Council
- Education Committee
- Nominating Committee
- Membership Committee
- Technical Committee
- Building Information Modeling Committee
- Commercial Specifier Systems Manual
- Structural and Decorative Glass Committee
- Technical Committee
- Project Manager Reference Manual
- Top 10 Memories from Shop Drawing

Glass Division
- Glazing Industry Code Committee
- Education Committee
- Nominating Committee
- Membership Committee
- Technical Committee
- Building Information Modeling Committee
- Commercial Specifier Systems Manual
- Structural and Decorative Glass Committee
- Technical Committee
- Project Manager Reference Manual
- Top 10 Memories from Shop Drawing

Glass Division
- Marketing and Communications Committee
- Education Committee
- Nominating Committee
- Membership Committee
- Technical Committee
- Building Information Modeling Committee
- Commercial Specifier Systems Manual
- Structural and Decorative Glass Committee
- Technical Committee
- Project Manager Reference Manual
- Top 10 Memories from Shop Drawing

Glass Division
- New Professionals Committee
- Education Committee
- Nominating Committee
- Membership Committee
- Technical Committee
- Building Information Modeling Committee
- Commercial Specifier Systems Manual
- Structural and Decorative Glass Committee
- Technical Committee
- Project Manager Reference Manual
- Top 10 Memories from Shop Drawing

Glass Division
- Protective Glazing Committee
- Education Committee
- Nominating Committee
- Membership Committee
- Technical Committee
- Building Information Modeling Committee
- Commercial Specifier Systems Manual
- Structural and Decorative Glass Committee
- Technical Committee
- Project Manager Reference Manual
- Top 10 Memories from Shop Drawing

---

What GANA Does for the Glass and Glazing Industry and You!

Glass Informational Bulletins published/re-published in 2013-2014

- Bird-Friendly Glass
- Coastal Glazing and Turtle Codes
- Glass Floors and Stairs
- Green Aspects of Mirror
- Importance of Fabrication Prior to Heat-Treating
- List of Color and Appearance Properties
- Marking and Labelling of Architectural Laminated Glass – Methods for Measuring Optical Distortion in Heat-Treated Flat Glass
- Proper Procedures for Fabrication of Flat Glass Mirrors
- Recommended Applications for Heat-Treated Architectural Glass
- Recyclability of Architectural Glass
- Security Glazing in Schools

Ball Drop Specification and Test Method ASTM designations:
- F3006-2013 - Specification for Ball Drop Impact Resistance of Laminated Architectural Flat Glazing
- F3007-2013 - Test Method for Ball Drop Impact of Laminated Architectural Flat Glazing

Advocacy in 2013-2014
- Window to Wall Ratio
- Dynamic Glazing
- IBC/IECC
- Glass Breakage in Balcony

Updated Feb 2014
GANA: External Activities

- AAMA - American Architectural Manufacturers Association
- AIA – American Institute of Architects
- ANSI Z97 Committee – American National Standards Institute
- ASCE – American Society of Civil Engineers
- ASHRAE – American Society of Heating, Refrigerating, and Air-Conditioning Engineers
- ASTM International – American Society of Testing and Materials
- BEMA – Bath Enclosure Manufacturers Association
- BOMA – Building Owners and Managers Association
- CSI – Construction Specification Institute
- CPSC 16 CFR 1201 – Consumer Product Safety Commission
- EWC/ASE – Efficient Windows Collaborative/Alliance to Save Energy
- GICC – Glazing Industry Code Committee
- GlassBuild
- GlassCon Global
- GPD – Glass Performance Days
- Glasstec
- GreenBuild
- HPBCCC – High Performance Buildings Congressional Caucus Coalition
- ICC – International Code Council
- IGCC – Insulating Glass Certification Council
- IGMA – Insulating Glass Manufacturers Alliance
- ISO – International Standards Organization
- IWCA – International Window Cleaners Association
- IWFA – International Window Film Association
- NFRC – National Fenestration Ratings Council
- NGA – National Glass Association
- NIBS – National Institute of Building Sciences
- PGC International - Protective Glazing Council International
- SGCC – Safety Glazing Certification Council
- USGBC – United States Green Building Council
- WDMA – Window and Door Manufactures Association
GANA: Education Resources

- 10 Manuals
- 6 AIA presentations
- Blueprint Reading Course
- Videos
- White Papers
- GANA Safety Bulletins
- 50+ Glass Informational Bulletins
- Standards, Specifications, Best Practices

www.glasswebsite.com
Architectural Glass: Trends, Considerations and Challenges

- Energy Performance:
  - Increased stringency
  - Tuning the building envelope
  - Daylighting

- Building Performance:
  - Laminated Glass
  - Acoustics optimization

- Aesthetics/Design:
  - Larger Sizes of Glass Units
  - Decorative Glass

Courtesy of Enclos Studio
Energy Performance: Increased Stringency

All of Alaska in Zone 7 except for the following Boroughs in Zone 8:
- Bethel
- Dillingham
- Fairbanks North Star
- Nome
- North Slope

Northwest Arctic
Southeast Fairbanks
Wade Hampton

Yukon-Koyukuk

Zone 1 includes Hawaii, Guam, Puerto Rico, and the Virgin Islands
Energy Performance: Increased Stringency

- Lower U-factor (W/m²-K or Btu/hr-ft²-F) in colder climates
  - Measure of insulating performance including
    - Conduction; Convection; Radiation

- Roomside low-e coatings (4th surface)
  - Double glazing with two low-e coatings on 2nd and 4th surfaces
  - U-factor almost as low as triple glazing at much lower cost and weight!
    - (Center of glass U = 0.20 vs. 0.18 for triple glazing)
Energy Performance: Increased Stringency

- Lower SHGC (Solar Heat Gain Coefficient) in southern climates
- High VT (Visible Transmittance) with low SHGC, where suitable
- Medium VT and mild reflectance to balance daylighting and glare control, visual comfort
- SHGC (driven by the codes)
  - Fraction of incident solar radiation entering the building, compared to an unglazed opening of the same size
  - Not just direct solar transmittance. Also includes fraction of absorbed solar radiation that is re-emitted, conducted, or convected into the building (“inward flowing fraction”)
  - Affects both cooling and heating loads
Energy Performance: Tuning the Building Envelope

- Reflectivity
- Not the 80’s mirror-like
- Use of multiple products to complement design and purpose
- Appropriate VT
- Glare control
Energy Performance: Daylighting

- Studies have shown in spaces with improved daylight and/or views:
  - Increased real estate value, rental rates
  - 6% increased retail sales
  - 20% increased in office worker cognitive test rates
  - 39 additional work hours per year in office worker productivity
  - 9-16% improved performance on visual memory tests (but glare decreased it by 17%)
  - 15% decreased absenteeism in office workers
  - Decreased office worker turnover
  - 21% increase in student test scores
  - 22% reduced development of surgical post-op delirium
  - Reduced length of hospital stay by 2.6 days
  - 22% less pain medication in post-spinal surgery patients
  - Reduced depression, improved sleep
Energy Performance: Daylighting

- 40-50% of total energy consumed in buildings is for electric light and to remove the heat it produces.
- If done right, a building with 50-60% WWR and daylight controls will outperform a building with 30% WWR and no controls.
- Daylighting is complicated with many factors:
  - Building type
  - Function of the space
  - Window and space geometry
  - Glare control and shading
  - Interior reflectances and furniture layout
  - Balance between solar gain and visible light
  - Lighting control type

- *Daylighting is about the right amount of light, not the highest amount of light.*
Energy Performance: Daylighting

- Is this good daylighting if all the blinds are closed?
  - Most recent trend is to find balance
  - Medium VT and low SHGC to balance daylighting, visual comfort, solar gain
  - Optimize distribution to maximize penetration and minimize contrast glare
  - Light shelves, etched / fritted glazing, sun shades
Energy Performance: Daylighting

- Integrated approach to shading, glare control, daylighting, and even power production

- Photovoltaic sunshades
- Light shelves and/or light redirecting films
- Sunshades

Courtesy of EFCO, YKK, Colt Intl
Building Performance: Laminated Glass

- Laminated Glass: two or more lites bonded together by one or more interlayers
  - Safety
  - Structural Performance
  - Impact Resistance
  - Earthquake Resistance
  - Security/Forced Entry Resistant
  - Bullet Resistant
  - Blast Resistant
  - Solar-Control
  - Ultraviolet Radiation
  - Sound Control
  - Specialty Applications (Zoo, Aquariums)
Building Performance: Laminated Glass

- Safety and Security/Forced Entry Resistant
- Blast
- Bullet

Courtesy of Kawneer Company, Protective Glazing Manual
Building Performance: Laminated Glass

- Aquariums and Zoos
- Overhead/Sloped Glazing
Building Performance: Laminated Glass

➢ Acoustic Optimization

Courtesy GANA Glazing Manual
Building Performance: Laminated Glass
Aesthetics/Design: Bigger and Larger

- Designers and architects like BIG
- Up to 168” in North America
- Entrances and Lobbies

Courtesy Guardian Industries Corp.
Aesthetics/Design: Bigger and Larger

- Availability of Products
- Warranties
- Installation
- Glass Strength
- Wind Loads and Deflection

Courtesy Guardian Industries Corp.
Aesthetics/Design : Decorative Glass

Courtesy Walker Glass Ltd., Eastman Chemical, Bendheim
Aesthetics/Design : Decorative Glass

- Printed Glass
- Bird Friendly
- Color/image rendering
- Thermal stress
- Solar heat
- Diffused/scattered light
- Daylighting
Existing Buildings: Retrofit

- We often work hard on expensive new building technology, then ignore the vast amount of energy wasted in existing buildings!
  - 53% of commercial buildings have single glazing (2 billion ft²)
  - Over a 23 year period, only 6.7% replaced their windows
- New cost-effective technologies to add low-e glazing to existing single pane windows
  - Low-e storm windows in residential buildings
  - Sealed low-e retrofit system in commercial
  - Case study in Philly has shown 40-60% reduced energy use in perimeter zones
- Solar control and new low-e window films
Existing Buildings: Retrofit

- Double Skin Facades
- Not new, but high performance

Heat Recovery

Heat Extraction
Industry Relations – Opportunities for Collaboration

➢ Standards
  ➢ ASHRAE 90.1 & 189.1 – the entire industry joined together to fight WWR
  ➢ ANSI Z97.1 – Mirror
    ➢ IWFA is a member of ANSI

➢ Codes
  ➢ Glazing Industry Code Committee
    ➢ IWFA is a member of GANA

➢ Advocacy
  ➢ Protective Glazing Council (PGC) International
    ➢ GANA and IWFA are Executive Board members
GANA Relations and Collaboration

- ASTM International
- AAMA, IGMA, WDMA
- IWCA
- IGMA
- NGA
- PGC International - IWFA
GANA Relations and Collaboration

- GANA
- GICC
- AEC
- FCA International
- AAMA
- ECA
- IGMA
- IWFA
- NJ-GMCA
- NCGMA
- SCGMA
- WDMA
- WPGDA-NY
- 126 individual companies

Those opposed to ASHRAE 189.1 Addendum “am”

Not just fenestration industry:
- LBNL
- IALD
- U.C. Davis
- U. Michigan
- HMG
- Architects

Representing over 2500 companies
GANA: External Activities

- AAMA - American Architectural Manufacturers Association
- AIA – American Institute of Architects
- ANSI Z97 Committee – American National Standards Institute
- ASCE – American Society of Civil Engineers
- ASHRAE – American Society of Heating, Refrigerating, and Air-Conditioning Engineers
- ASTM International – American Society of Testing and Materials
- BEMA – Bath Enclosure Manufacturers Association
- BOMA – Building Owners and Managers Association
- CSI – Construction Specification Institute
- CPSC 16 CFR 1201 – Consumer Product Safety Commission
- EWC/ASE – Efficient Windows Collaborative/Alliance to Save Energy
- GICC – Glazing Industry Code Committee
- GlassBuild

- GlassCon Global
- GPD – Glass Performance Days
- Glasstec
- GreenBuild
- HPBCCC – High Performance Buildings Congressional Caucus Coalition
- ICC – International Code Council
- IGCC – Insulating Glass Certification Council
- IGMA – Insulating Glass Manufacturers Alliance
- ISO – International Standards Organization
- IWCA – International Window Cleaners Association
- IWFA – International Window Film Association
- NFRC – National Fenestration Ratings Council
- NGA – National Glass Association
- NIBS – National Institute of Building Sciences
- PGC International - Protective Glazing Council International
- SGCC – Safety Glazing Certification Council
- USGBC – United States Green Building Council
- WDMA – Window and Door Manufacturers Association
GANA Legislative Advocacy

• Members of National Association of Manufacturers

• GANA co-sponsored Hill visits on May 7-8, 2013 with the Protective Glazing Council International

• Energy Division Governmental Regulatory and Affairs Committee
  – 179D
Questions?
Thank you

Urmilla Jokhu-Sowell - Technical Director, usowell@glasswebsite.com
Thomas D. Culp, Ph.D. – GANA Energy Consultant/Birch Point Consulting, culp@birchpointconsulting.com