Draft Document – GIB – (Oversized IGUs - Draft 1 – (Insert date 01.16.19)
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National Glass Association & Glass Association of North America

Glass Informational Bulletin (Doc. #)-XXXX

Oversized IGU Guidelines for Handling, Storage and Installation

Introduction

Recent architectural trends emphasize an increasing desire to bring more natural light into the working environment. As designers adapt to these new demands, the size of insulating glass units (IGU) specified is getting larger and larger. This GIB will highlight the issues that these large oversized IGU bring to the fabricator and installer and that should be considered before starting a project.

What defines what is an Oversized IGU?

There are a number of factors that should be considered such as unit size, total weight (dead load) of the IGU, aspect ratio, total unit thickness and

For discussion purposes, we will define an oversize IGU as follows:

- Over 50 ft^2 (4.65m^2), or (I was thinking 60 but open to challenge)
- Over 300 pounds (136 KG) (I was thinking 350)
- Any single dimension over 144" (leverage and clearance in a short base dimension orientation)
- Shape or bent unit same or different?

Application considerations and limitations

Storage/Handling

- Receiving
  - To make oversize IGU, the fabricator will need to evaluate existing infrastructure to ensure that crane load capacitity and bridge height are sufficient to allow offload of Jumbo (Define Jumbo?) size input glass that may be needed to construct these large IGU. As oversize is defined above jumbo's wouldn't be required to reach the classification of "Oversized." Soften phrasing up to say, If Jumbo input is required? Adjust phrasing or even rename to include overweight? Oversized tends to point toward dimensions but a unit can meet weight requirements and still be under the size requirement.
  - Dock type evaluation? This is a stretch and might be implied but you might have the crane, you might have the height but you might not have the dock well clearance to accommodate these trucks. This would mostly apply to older

buildings. Agree with Jon. There could easy be several building stops between fabrication and installation.
    - The storage location for input glass should be checked (Rated?) to be sure that the racks/slots can accommodate the weight and sizes being considered. Secured racks to floor if suggested by rack manufacturer?
- Equipment
    - Can the existing equipment, such as vacuum load/unload assist, fork lifts, tuggers Safely handle the heavier weights?
    - Do you need additional suction cup frames in areas to safely offload the glass? (Can you get it off the tempering furnace or cutting table?)
    - Consider deflection of larger glass during fabrication. (i.e. when picking up mono glass from horizontal to vertical either manually or with a suction cup frame). Some frames have a recommended limit of dimensions by glass thickness is the cups are focused in the center.
    - Does the plant layout need to be changed to allow movement of larger racks/boxes/crates around the manufacturing facility?
    - Are A-frames rated for heavier weights and taller glass?
    - Discuss understanding furnace and IG press size limitations.
    - Vertical insulation strong recommendation?
- Packaging
    - Are there any special packaging needs that will be triggered by the larger, heavier IGU?
    - Dive in deeper? i.e. Overhang on racks or skinnier crates pose tipover risks.
    - Care should be taken to try to evenly distribute the weight in the crate during loading. (limiting th loading of tall and wide units with several smaller units pack to one side.
    - Ensure the density of interleave is maintained. Larger units require more interleaving to spread the load.
    - Lumber considerations in crates. 1" bys up to a 2" by. There are a lot of shaky crates shipped. Expanding on Jon's thought, call out a standard grae for wood used in the crate? A higher grade wood will hold together better, especially if chain slings are used.
- Transportation
    - Special transportation needs should be evaluated.
        - Trailer types (Includes A-Frames?)
        - Routing from fabricator to next step (jobsite, additional fabrication, etc.). In regards to height?
        - Additional securement requirements?

- Jobsite handling/storage
    - Flat bed vs drop in
    - Special equipment for unloading (would this include cleats on crates for unloading?) New sling sizes for larger glass?
    - Capacities for suction cup frames
    - Clearances required for boom trucks (Feet come out to form a wider base)

    - Adequate weather protection during storage
    - Securement of glass on the site to limit tipover risks
    - Evaluate site access with larger glass if installed from the inside
    - Discuss seal stress associated with handling large and heavy units incorrectly.
- **Design**
  - System Compatibility – Melissa Szotkowski
  - Windload – Melissa Szotkowski
  - Deflection – Melissa Szotkowski
  - Glazing Detail
  - Setting Block size and durometer
  - Gaskets size and durometer in overhead applications.
  - Sightline Analysis – Melissa Szotkowski
  - Edge Pullout system – Melissa Szotkowski
  - Aspect Ratio
  - Color consistency across elevation
  - Other considerations (types of applications, acoustics, safety glazing effects, security, energy, availability, etc.) – Julie Schimmelpenningh
- **Installation – reference GANA Glazing Guidelines**
  - SSG - Urmilla
  - Setting Blocks - Urmilla
  - Framing Systems
- **Standards/Tolerances – Rob Carlson & Steve Dean**
  - Inspection Criteria
  - Proper Viewing Guidelines
  - Fabrication Limitations

Oversized IGU Fabrication Limitations:

Insulating glass units are fabricated using a variety of processes, ranging from completely manual to very sophisticated automated assembly lines. Regardless of the procedures used, very large insulating glass units can present challenging issues in handling and assembly. It is important to discuss and review the proper inspection and viewing criteria of these units with the fabricator in advance of production to understand acceptable tolerances and areas where the quality of the glass may deviate from what is acceptable with standard sized IGUs.

Distortion, surface blemishes, color uniformity, and glass size and alignment all may require extra attention to create an IGU that meets or exceeds the required quality standards of a project. Areas of fabrication that may require additional consideration are as follows:

Handling:
As stated in the previous section, as insulated glass units get larger the weight of the unit increases significantly. The size, shape, and nature of glass are such that it is difficult for more than two people to manually lift a single Lite/IGU at the same time. With this in mind, it is easy to see how even a typical IGU can quickly exceed a person's lifting capacity. Even one lite of an oversized IGU can be sufficiently heavy, or large in size, that the challenges of manually lifting/transporting the

glass from different operations in the fabrication process can result in damage to the glass or coating in the way of chips, scratches, rubs, and other defects.

While automated lifting systems do exist and are commonplace in the world of IGU fabrication, these systems may not be designed to handle the additional weight associated with oversized IGUs or may be isolated to only certain areas of a fabricator's shop. Equipment needed to lift the weight and size of larger IGUs can often require extensive, costly, infrastructure and space and may be so specialized as to not perform well (or at all) when fabricating standard sized insulated glass units.

Cutting:
Glass types associated with the production of oversized IGUs may only be available in certain stock sheet sizes that result in very poor cutting yields (as little as one lite per stock sheet). Poor yield can add cost both from increased material waste and the increased handling time associated with retrieving, cutting of the glass, and the disposal of excess material. Communicating in advance with fabricators and material suppliers to understand the sizes of available products can significantly reduce cost and lead-time on a project.

While many coating suppliers are now offering Low-E coated glass in jumbo sheet size, not all fabricators have equipment (storage, cutting, retrieval) to accommodate this larger size of glass. The equipment and space required to process the cutting of jumbo glass can represent a significant investment to many fabricators and could reduce the number of fabricators available to produce a project.

Fabrication:
Oversized IGU projects requiring glass fabrication in the way of holes, notches, and/or polishing can create significant challenges to a fabricator.

Equipment used in the fabrication process may be limited on the size of glass it can handle or may require additional personnel to operate safely when fabricating large lites. While special consideration must always be given to coated glass requiring fabrication, this becomes a much greater concern when the lites are large due to the extremely fragile nature of soft-coated glass.

Units requiring fabrication that also contain laminated glass can create an even bigger challenge to fabricators due to limitations in perfectly matching and aligning oversized lites during the laminating process and could result in a compounding mismatch alignment of edges, holes, and notches.

Tempering:
As discussed in the previous section, larger insulating glass units are more likely to require heat-treating of the glass (either heat strengthening or tempering) to resist design wind loads and thermal stresses. Larger heat treated glass is also more likely to have distortion due to the inherent bow and/or warp incurred during the heat treating processing. Consistent production and orientation of heat treated glass is necessary to avoid glass and/or coating damage to the surfaces within the sealed air cavity due to contact caused by the inherent bow of heat treated glass.

Additional processing time per lite, or running fewer pieces at a time, may be required to minimize this increase in distortion.

As it is with the cutting process, yield is very critical to the time and cost associated with the tempering process. Depending on the furnace size and the glass size, it may only be possible to run one lite at a time. Coated products and heavy glass products add significant time to the tempering process that could result in additional cost and longer lead times due to the reduction in throughput.

Other processes necessary to the production of heat-treated glass may also be affected by oversized lites. Seaming/sanding of the glass edge, a necessary process prior to the heat treatment of glass, may require additional handling that could lead to increased surface defects; especially when working with coated glass products.

Special consideration of roller wave orientation may be required due to restrictions on available furnace width.

Regardless of the glass flatness, the degree of reflected distortion perceived is largely due to the characteristics or symmetry of the object being reflected. Linear objects (such as building curtain walls and telephone poles) and moving objects (such as cars) may appear distorted. In the case of oversized, IGUs this perception can become amplified due to the larger area and increased viewing angles.

Specified Bow limits may not adequately define, or control, the distortion that may become apparent after glazing. The factors noted above, may have a larger influence on the perceived reflected distortion than that which is caused by bow from the heat-treating process. Consultation with suppliers and the viewing of full-size mock-ups, under typical job conditions and surroundings is highly recommended for evaluation of reflective distortion in oversized IGUs containing heat-treated glass.

Laminating:
Oversized IGUs incorporating the use of laminated glass may present a multitude of challenges to fabricators and glaziers due to the increased weight and visual distortion that come with adding another lite(s) of glass to the unit construction.

The increased thermally and mechanically applied loads associated with oversized glass, often require multiple plies of heat-treated glass to be used in the laminate construction. Compounding inherent distortion characteristics (roller wave, bow, warp, and strain pattern) of heat-treated glass combined with internal variations in the interlayer thickness may accentuate the appearance of perceived visual distortion when viewing images through or in reflection from laminated glass and it is recommended that a full-size mock-up be viewed under typical job conditions for evaluation of distortion.

While laminates are most often constructed in a climatized cleanroom setting, it should be noted that the additional surface area associated with oversized laminates presents a much bigger challenge to preventing and eliminating surface contaminates that may become trapped between the glass and the laminate during the layup process.

Insulating:

In structural silicone glazed(SSG) IGUs additional secondary seal, also known as a deep pocket siteline, may be required to meet design loads for a given IGU size and makeup. Oversized units can add considerable time to the application of the secondary seal depending on the size of the unit and the depth of the pocket. Most IG line dosing pumps can only hold so much material before having to stop and recharge – large deep pocket units may have to stop and recharge multiple times adding considerable time to the production process and greatly reducing the overall throughput of the line. The charging and recharging of the dosing pump may also result in an increased amount of small separations between thee primary secondary sealants.

Fast, efficient argon or krypton gas filling in an automated process typically takes place at the pressing stage of the IGU construction and requires that the entire unit fit inside the automated pressing system. Oversized IGUs requiring gas fill that exceed the length of the press must be hand filled after the spacer has been applied, a process that adds considerable time to the insulating process whether performed online or offline of the automated IGU manufacturing equipment and who's time is directly related to the size of the IGU.

As IGUs become larger the handling and placing of a flexible box spacer becomes increasingly difficult. Some variation in the uniformity of the parallel alignment of the spacer to the edge of the glass is to be expected in oversized IGUs. With increased glass size there will be an Increase in the number of spacer joints/welds. Ruptures in the spacer welds and seals may occur during the layup process due to the increased flexibility of the large spacers.

Variations in PIB primary sealant application may also see an increase in oversized IGUs as the flexibility of the spacer creates challenges to the application process and may require additional manpower.

Suction cups lifting IGU's off of an automated line are typically only supporting the outer lite of glass and, in the case of a slower curing silicone secondary seal, are relying exclusively on the shear strength of the primary sealant (PIB) to prevent the other lite from falling. This becomes a much greater issue when one or more of the lites in an IGU construction is that of heavy or laminated glass.

Muntin bars used in oversized IGUs, depending on the number and location of grid, could become more likely to touch one or the other surfaces of glass due to the flexibility of the muntin bar as it gets longer. Touching of the muntin bar to one or both of the glass surfaces could reduce the efficiency of the unit or result in damage to the interior surface of the glass.

Decorative:

As IGUs become larger, certain limitations to the fabrication of decorative glass (digitally printed and silk screened) may apply.

Standard patterns applied using traditional silkscreen techniques may become increasingly costly and difficult or may not be possible due to equipment limitations and the challenges associated with managing and handling the increased screen and frame sizes required to print oversized glass. Fabricator should be consulted early on in the design phase to discuss available decorative options.

Custom patterns or images spanning multiple lites of oversized glass may also create design-processing challenges due to the large nature of the files required for high quality printing. As digital printing continues to grow in popularity as a means for decorating glass limitations in quality and uniformity across a large lite should be discussed with the fabricator in advance. Just as it is with laminated glass, increased print time and exposure of large printed areas prior to heat-treating create a high potential for surface contaminates. Decorative operations using printed films laminated between the surface of the glass may not be possible on pieces over a certain size due to limitations in film size availability.

- **Testing – Steve Dean**
- **Applicable certifications – Julie Schimmelpenningh**
  - IGCC?
  - ISO?
  - ANSI?
- **Warranty?**
- **Education emphasis**

(Body Text - Formatting of bullets / indentions will be addressed by staff to provide uniformity with other bulletins.)

(Reference applicable standards, test methods or other resources including the publishing organization and full name of the standard in the body of the text -- provide contact information for the organization in an end note[1]).

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(Reference any related GANA Glass Informational Bulletins and test methods in the closing and incorporate the sentence below.)

Consult www.glasswebsite.com for additional Glass Informational Bulletins and flat glass industry reference resources.

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[1] (Insert organization name, address, city, state, zip code and website address)