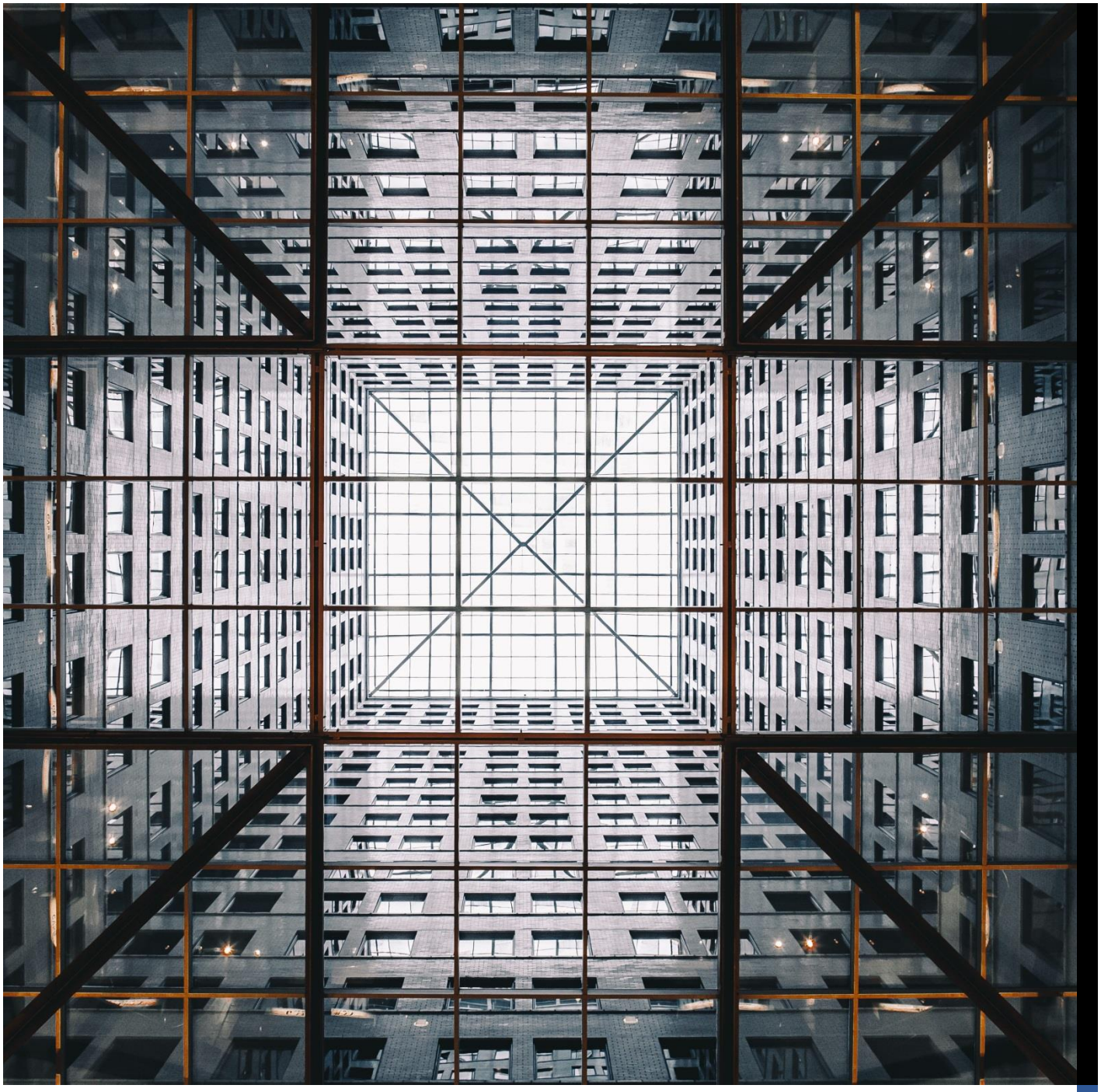

QUENCH PATTERN CHARACTERISTICS

VIRACON TECH TALK

Strain patterns, sometimes referred to as iridescence, anisotropy or quench patterns, are an inherent characteristic of heat treated glass. This document describes how strain patterns form as well as expected visual characteristics.

QUENCH PATTERN CHARACTERISTICS

STRAIN PATTERN FORMATION

In the production of fully tempered and heat-strengthened glass, the glass is heated close to its softening point and then cooled with high velocity blasts of air. This cooling process is also referred to as quenching. The quenching process creates compression at the glass surface and edges with compensating tension in the center of the glass thickness. The process inherently results in a slightly higher level of surface compression directly opposite the air nozzles. The higher level of surface compression produces slightly denser glass at these locations.

The slightly denser glass, combined with a complex light interference phenomenon, can cause areas of the glass to exhibit a darker appearance, especially through polarized light (Figure 1).

FIGURE 1: STRAIN PATTERN EXAMPLE

"When light from the sun, polarized by atmospheric conditions, passes through the heat-treated glass, it experiences a phase shift due to an optical phenomenon known as birefringence as a result of the stress induced by quenching" (GANA TD 05-0108).

The perceived dark spots or lines are visual effects of a strain pattern in the glass and are referred to by a variety of terms including: anisotropy, iridescence, leopard spots and quench pattern. A coating with more reflectance can accentuate the intensity of these dark areas. The intensity may be less for thinner and uncoated glass. The amount of polarized light in normal daylight varies based on the weather and the angle of the sun so the visibility of a strain pattern also varies. It is typically most noticeable at oblique angles or through polarized sunglasses (EN 12150-1:2000).

The pattern of the strain may vary from one manufacturer to another. However, the effect cannot be eliminated in heat-treated glass. According to ASTM, "a strain pattern, also known as iridescence, is inherent in all heat-strengthened and fully tempered glass. This strain pattern may become visible under certain polarized lighting conditions. It is a characteristic of heat-treated glass and should not be mistaken as a discoloration, non-uniform tint or color, or a defect in the glass. The strain pattern does not affect any physical properties or performance values of the glass" (ASTM C1048-18).

ASSESSING A STRAIN PATTERN

To assess strain pattern intensity it may be tempting to compare one building to another. Conclusions based on this could be misleading because the factors that influence the intensity of the strain pattern can vary widely. The comparison could involve two different types of glass and two different viewing conditions, such as highly polarized daylight vs. moderately polarized daylight (Figure 2), sunlit exposure vs. shaded exposure or daylight as background vs. the surface of an adjacent building.

FIGURE 2: NON-POLARIZED (LEFT) AND POLARIZED (RIGHT)

Valid comparisons can only be made when the glass is exactly the same, is viewed in transmission with daylight as the light source and where the degree of polarization and other daylighting characteristics are approximately the same.

During construction, certain conditions can cause the strain pattern to be visible. The pattern's prominence is often significantly reduced once construction is complete. The addition of interior building elements and exterior landscaping can contribute to reducing the pattern's visibility.

REFERENCES

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