VISUAL DEFECTS: CAUSE AND EFFECT

FAILURES CAUSED BY POOR-QUALITY FRP CAN CAUSE COLLAPSE, LIABILITY, AND MASSIVE REPAIR COSTS.

Delamination

Delamination refers to the separation of internal layers within a composite laminate. Delamination significantly undermines structural performance in pultruded structural members, which depend heavily on the integrity of interlaminar bonding to transfer shear and compressive loads. Once delaminated, the part loses its ability to effectively transmit stresses, rendering it incapable of fulfilling its intended load-bearing function.

Structurally, delaminated sections exhibit markedly reduced stiffness and are prone to premature local or global buckling, particularly in compression-critical elements such as columns. This degradation in structural integrity often leads to early failure under service conditions. Additionally, delaminated regions can act as moisture traps, allowing fluids or contaminants to infiltrate, which further accelerates material degradation and compromises long-term durability.

Discoloration due to Under-Curing

Under-curing in pultruded parts reduces mechanical properties, including compromised tensile, shear, and flexural strength. This often stems from poor fiber-matrix bonding, which disrupts stress transfer and promotes premature delamination.

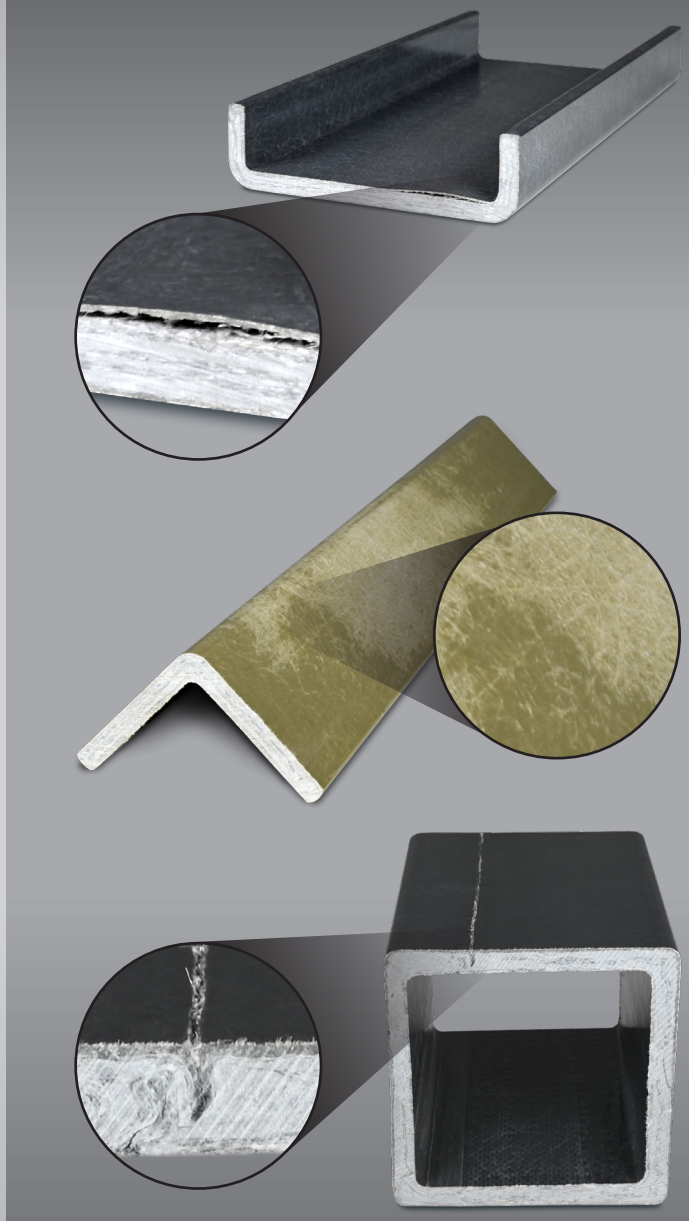
The material also becomes thermally unstable, risking distortion or warping in service. These factors collectively escalate the risk of defect propagation, ultimately leading to early failure.

Because of these hidden structural risks, preventing and detecting under-curing through process control and QA testing are essential for ensuring long-term performance and safety.

Cracks

A crack is a visual separation that occurs internally or penetrates down from the pultruded surface to the equivalent of one full ply or more of reinforcement. Cracks act as stress concentrators with localized stress magnification. This makes crack propagation under cyclic loads (fatigue) almost inevitable.

The presence of cracks significantly reduces the predictability of structural performance. Once introduced, they compromise the ability to accurately estimate the maximum failure load, often leading to premature and potentially sudden failure under service conditions.



When material performance is unpredictable, the long-term success of a project is at risk. Inferior materials can fail without warning, potentially leading to structural collapse, product liability, and extensive downtime.

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