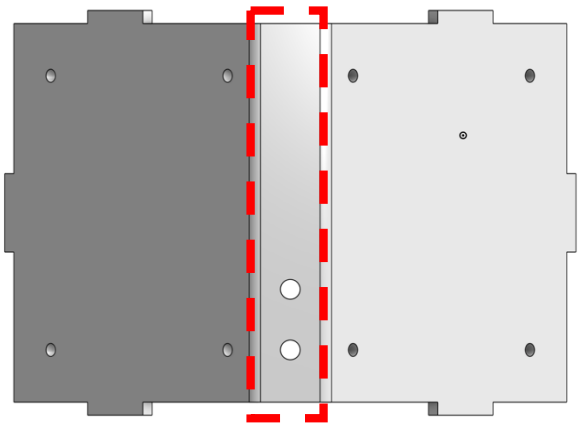
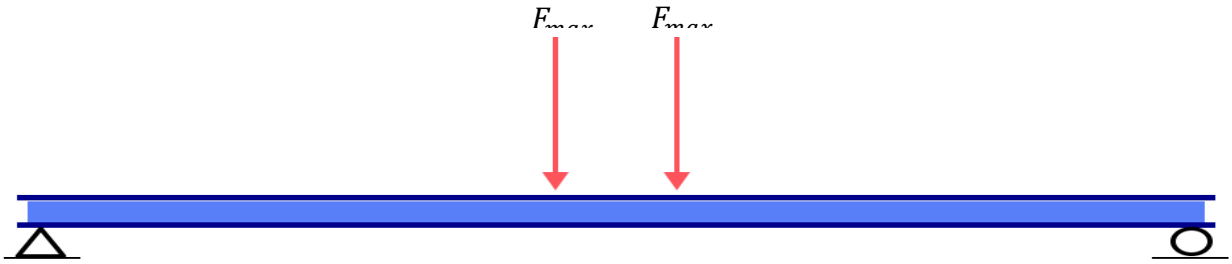
# XII. Appendices

## *Appendix A: Structural Analysis*

Back Face Integrity:




Assume: Beam, infinite plate

$$Flexural\ Modulus\ PC = \sigma_{flexPC} = 135\ ksi$$

$$\frac{d}{h} = \frac{0.190}{0.125} = 1.52$$

$$K_T \approx Ae^{b\left(\frac{d}{w}\right)} \approx 2.0243e^{-0.80821*\left(\frac{0.91}{0.571}\right)} = 1.5470 * 2\ (because\ 2\ holes)$$

$$I = \frac{1}{12} * b * h^3 = \frac{1}{12} * 0.571 * 0.125^3 = 9.29 * 10^{-5}\ in^4$$

$$M = F * d = 30 * 1.6175 = 48.53\ lb * in$$

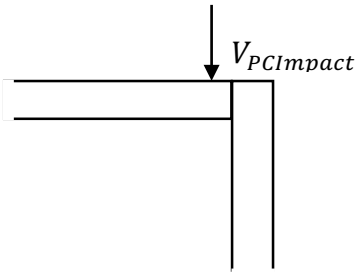
$$\sigma_b = \frac{My}{I} = \frac{48.53 * 0.0625}{9.29 * 10^{-5}} = 32.63\ ksi$$

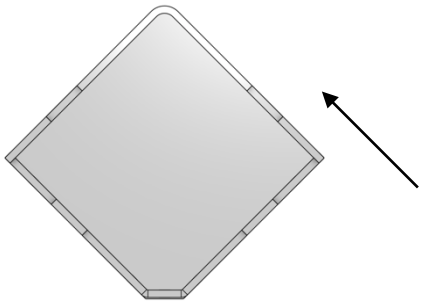
$$\sigma = \sigma_b * 2 * K_t = 100.97\ ksi$$

$$F_{max} = \frac{\sigma_{flexPC} * I}{l * y * 2 * K_t} = 40.1\ lbs$$

$$F_{max-total} = 2 * F_{max} = \mathbf{80.2\ lbs}$$

Shear at Joints:



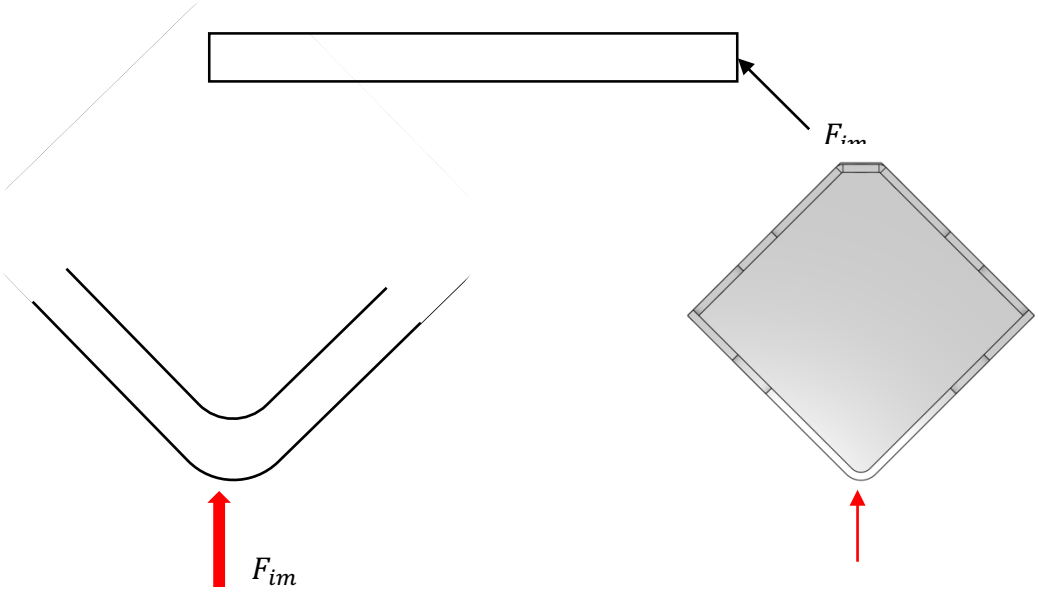



Assume: Beam

$$Bond\ Strength\ of\ General\ Solvent = \tau_s = 2400\ psi$$
$$I = 0.0203\ in^4$$
$$Q = 2.44 * 10^{-4}\ in^3$$
$$t = 0.125\ in$$
$$V_{max-solvent} = \frac{\tau_s I t}{Q} = \mathbf{25\ lbs}$$

$$\tau_{PC} = 9200\ psi$$
$$A = 0.09375\ in^2$$
$$V_{max-PC} = \tau_{PC} * A = \mathbf{863\ lbs}$$

Impact Force:

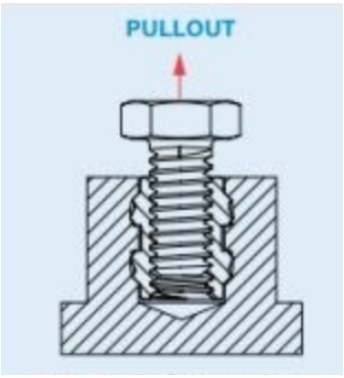



Assume: Beam, neglect air resistance, deformation of 0.25 inches upon impact, dropped from rest, mass of 2 lbs., height of 4 feet.

$$F_{impact} = 384\ lbs\ (from\ hyperphysics\ calculator)$$
$$V_{PCimpact} = F_{impact} * \cos(45°) = 272\ \text{lbs}$$
$$272\ lbs < 863\ lbs$$
$$\boldsymbol{V_{PCimpact} < V_{max-PC}}$$

When dropped from about **12.75 feet**, the impact force becomes about 1221 lbs. which is the maximum impact force that can be experienced before shearing the polycarbonate (from playing around with the impact calculator)

Pullout:




$$A_{shear} = \pi * d_{shear} * length\ of\ engagement = \pi * 0.190 * 0.125 = 0.0746\ in^2$$
$$F_{pullout} = \tau_{PC} * A_{shear} = \boldsymbol{686\ lbs}$$