

## Failure of brittle materials

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The three standard theories of failure for brittle material are summarized below.

### Maximum normal stress (MNS) theory

Simply put, MNS theory predicts failure whenever

$$\sigma_1 \geq S_{ut} \quad \text{or} \quad \sigma_3 \leq -S_{uc}$$

Including a factor of safety  $n$ , failure is predicted when

$$\sigma_1 \geq \frac{S_{ut}}{n} \quad \text{or} \quad \sigma_3 \leq -\frac{S_{uc}}{n}$$

### Brittle Coulomb-Mohr (BCM) theory

Brittle Coulomb-Mohr theory is identical to the ductile Coulomb-Mohr theory, but with ultimate strengths.

With a factor of safety  $n$ , it predicts failure when

$$\frac{\sigma_1}{S_{ut}} - \frac{\sigma_3}{S_{uc}} \geq \frac{1}{n}$$

### Modified Mohr (MM) theory

Based on experimental results, MM theory predicts a less-conservative-than-BCM failure envelope with the prediction of failure if

$$\frac{(S_{uc} - S_{ut})\sigma_3}{S_{uc}S_{ut}} - \frac{\sigma_1}{S_{uc}} \geq \frac{1}{n}$$