Corrosion

Randy Beals

Of All The Issues That Influence Mg Use

Corrosion,

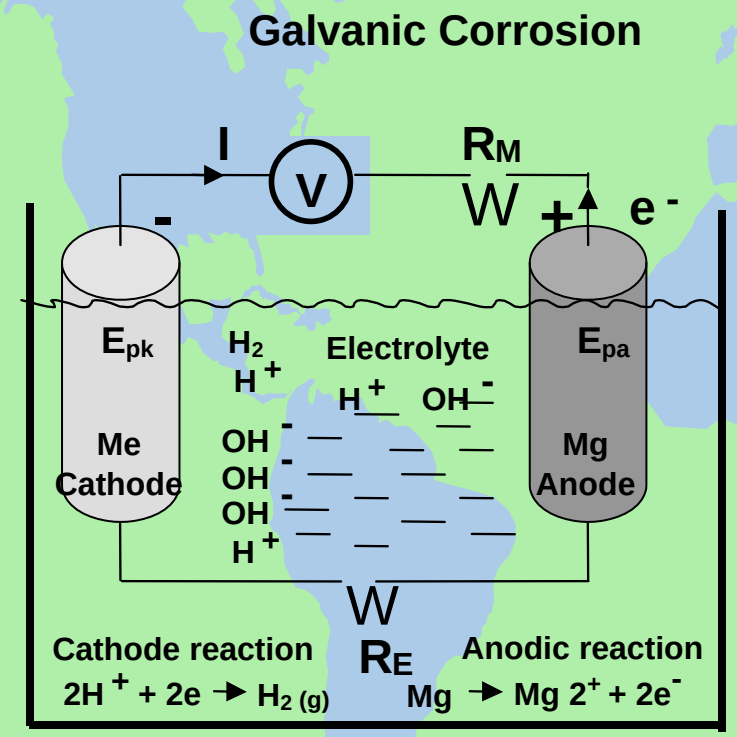
And Bimetallic Corrosion Associated With Fastening,

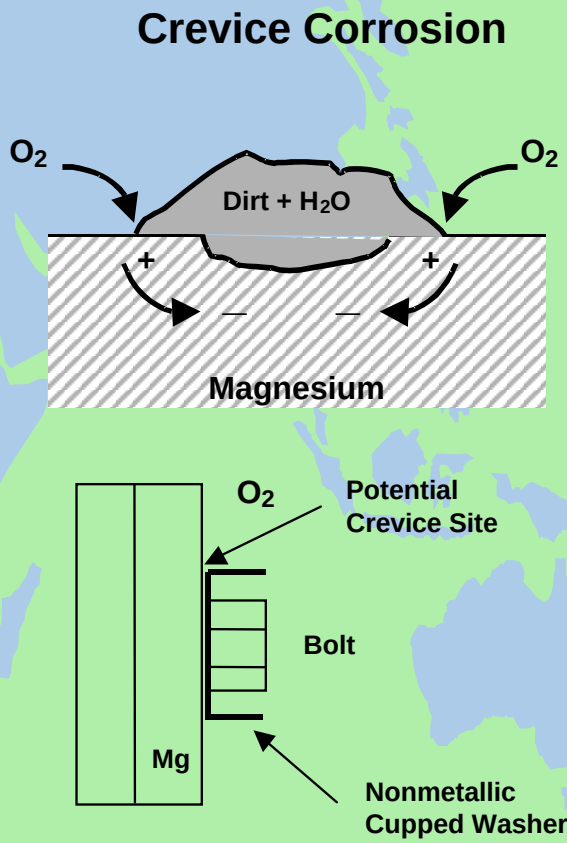
Are The Least Friendly

General Corrosion is Not the Problem

- **ASTM B117 salt spray tests**
- **Magnesium alloys: AZ91D, AM60B, AM50A, AE42 and AS21 showed lower corrosion rates than aluminum alloy A380**
- **Magnesium alloy AM20 showed higher corrosion rates than A380.**

Galvanic Corrosion is the Issue





$$I = \frac{E_{pk} - E_{pa}}{R_e + R_m}$$

Re = Electrolyte Resistivity

Rm = Metal Circuit Resistivity

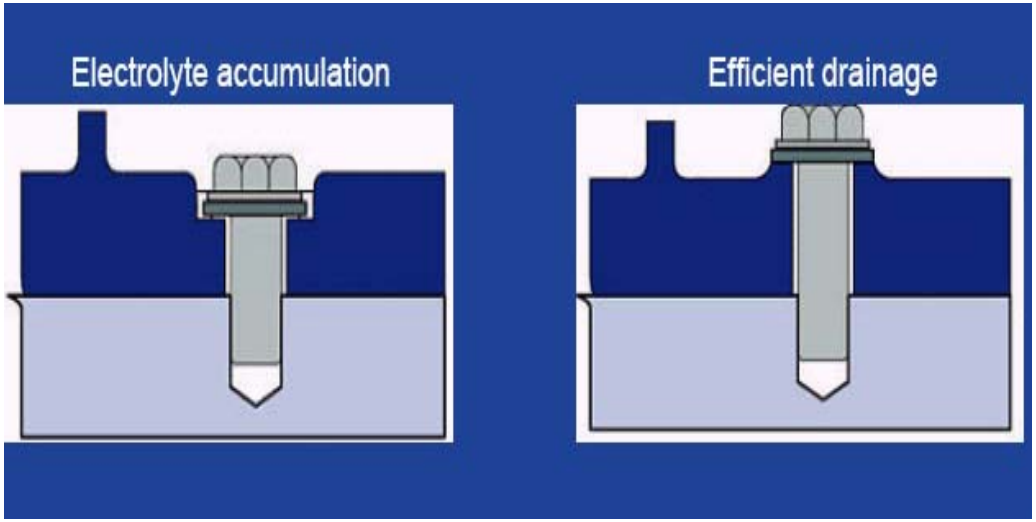
I = 0, when Re & Rm → α

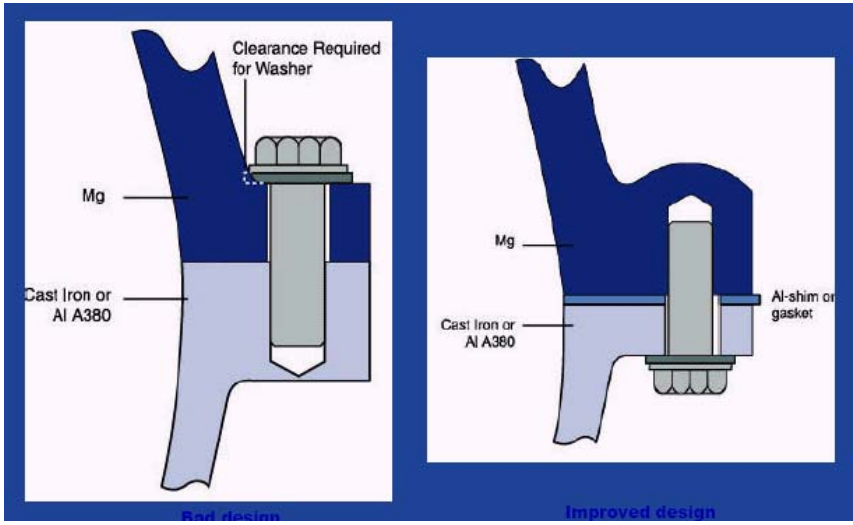
Ref: Hydro Magnesium

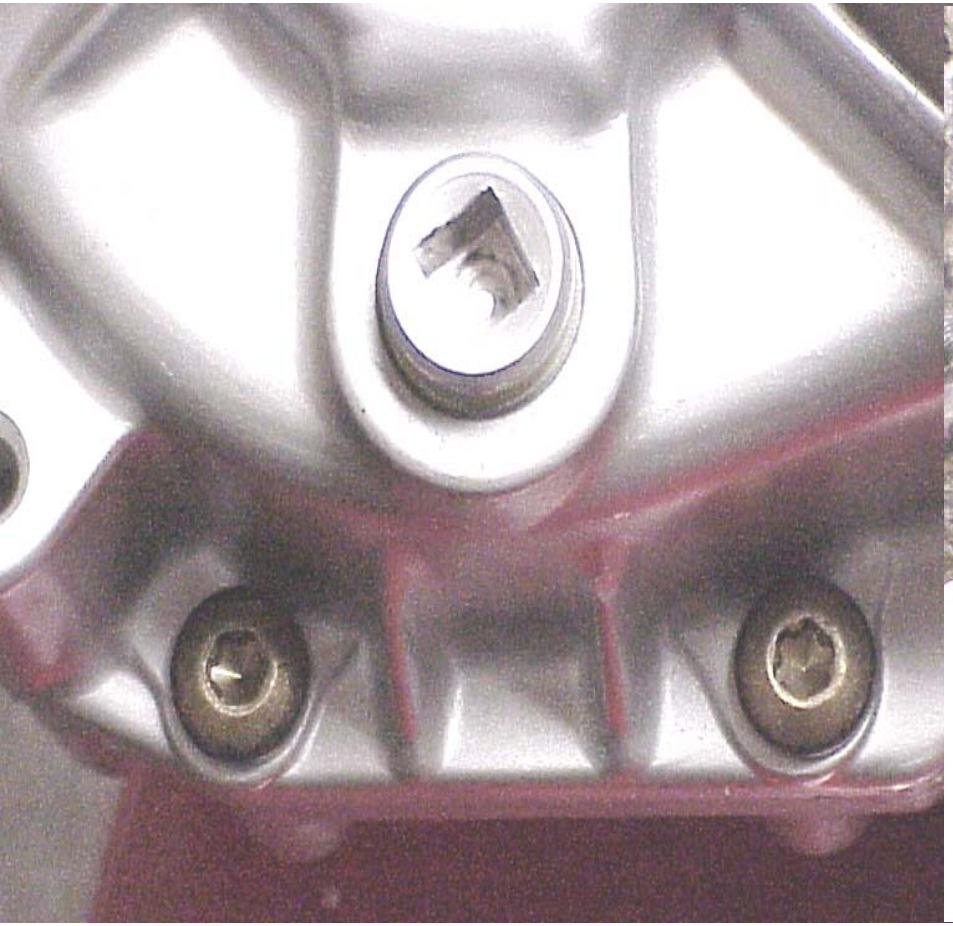
- **There are few low-cost green fasteners...chromate coated steel bolts are no longer allowable.**
- **“Friendly” designs to isolate moisture and Fe ions from interfaces are expensive and clumsy.... but possible**
- **Fastening Mg parts to a vehicle’s steel structure requires high loads (>90 Nm) in the US and Al fasteners are not strong enough. In EU lower loads (~ 40 N) are allowed and thus Al bolts can be commonly used**

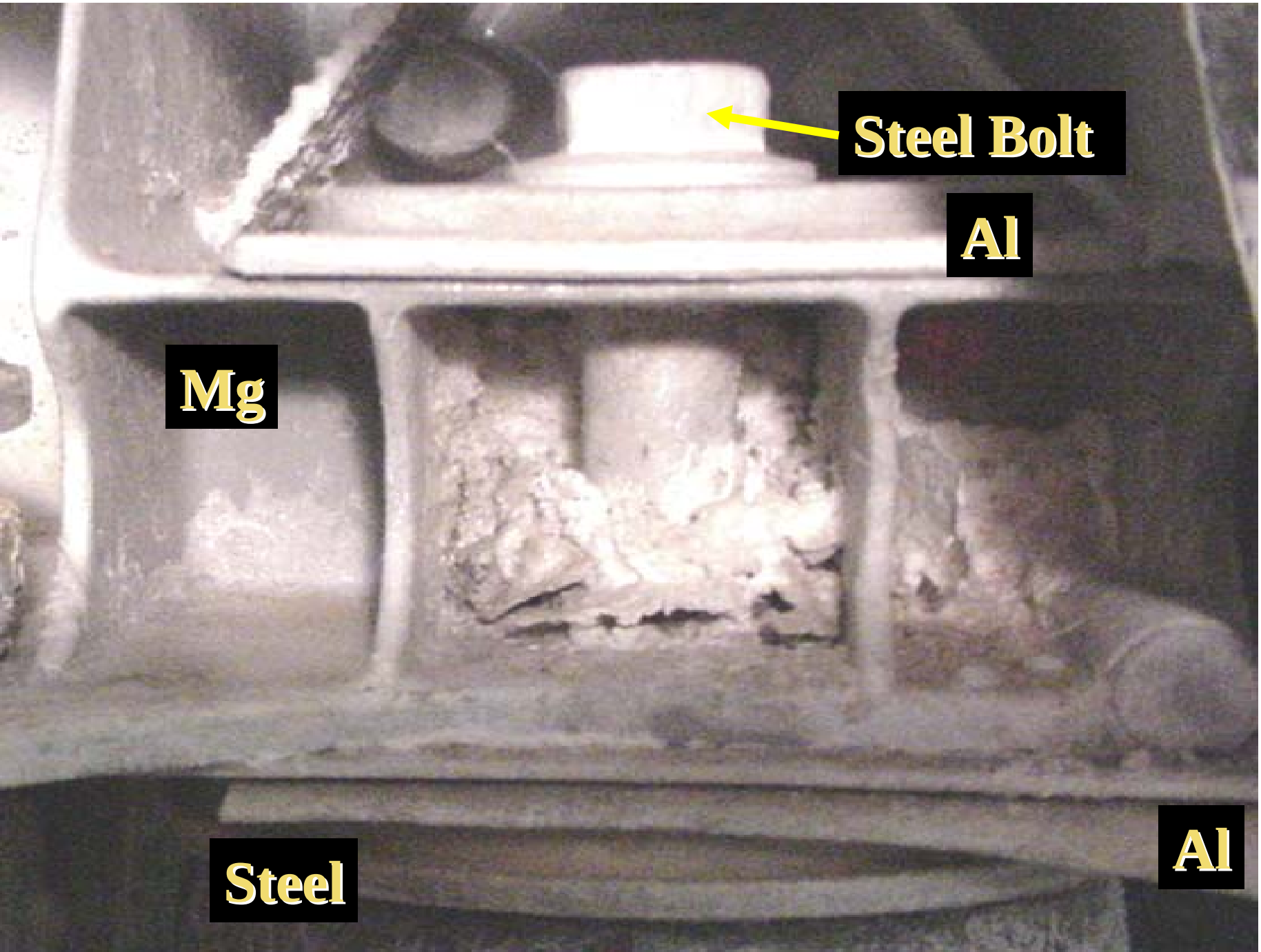
- **Eliminate electrolyte**
- **Break electric circuit**
  - **Plastic washers**
  - **Non-conductive coatings**
- **Reduce electropotential**
  - **5000/6000 series Al washers**

Good designs can eliminate corrosion

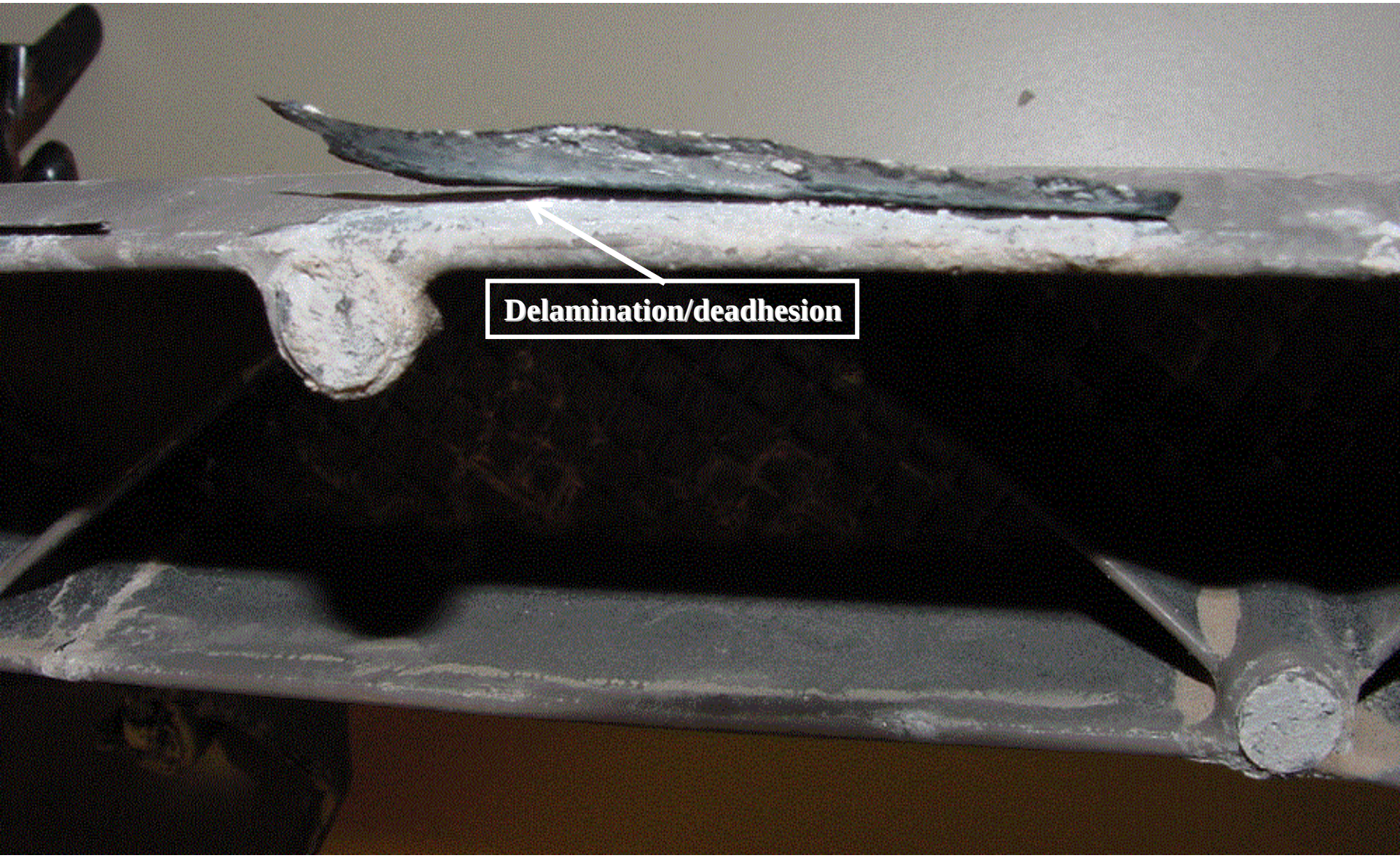







Steel Bolt
Al
Mg
Steel
Al

Coatings



- **Better mechanical property databases are required for FEA deformation/crash modeling.**
- **CAE filling models for HPDC do not describe how to modify gate designs and filling profiles (shot speed & pressure) and how to control porosity throughout all cross-sections in all locations.... unlike LP/G DC**

- **Test bar databases are widely available, but are not statistically related to HPDC component processing conditions, nor actual component mechanical properties at different locations**
- **Component mechanical property databases (such as for FEA) are closely held within individual companies and not widely available.**

Magnesium HPDC structures are inhomogeneous. Are their properties inhomogeneous too?