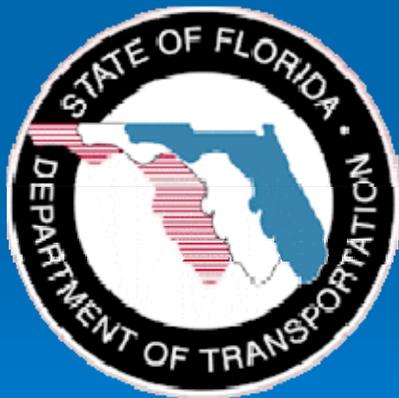


Corrosion Resistant Alloys for Steel Reinforcement in Concrete

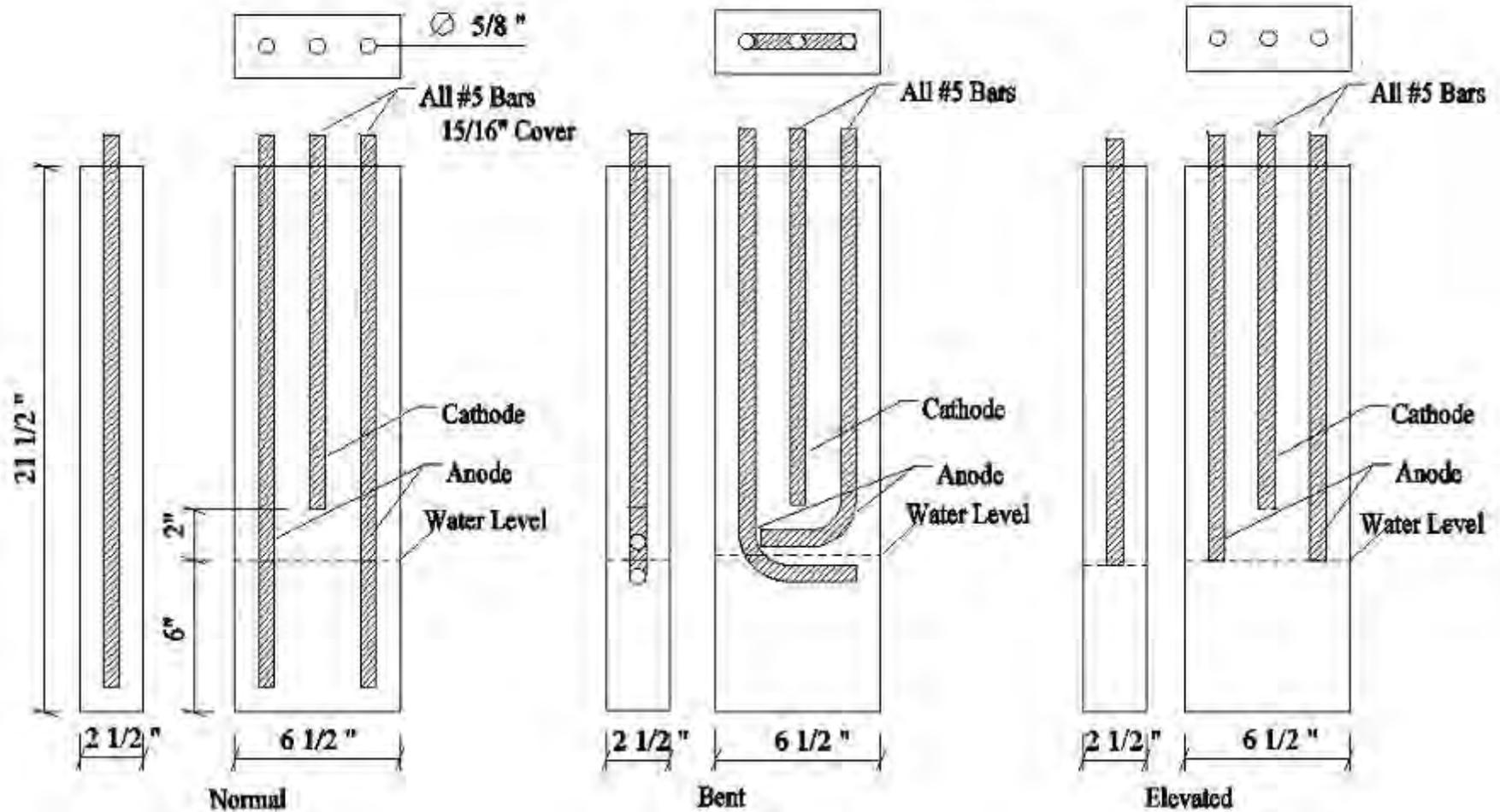
2012 Update

Mario Paredes, PE*
State Corrosion Engineer



* Florida Department of Transportation

3 Bar Tombstone Specimen Geometries



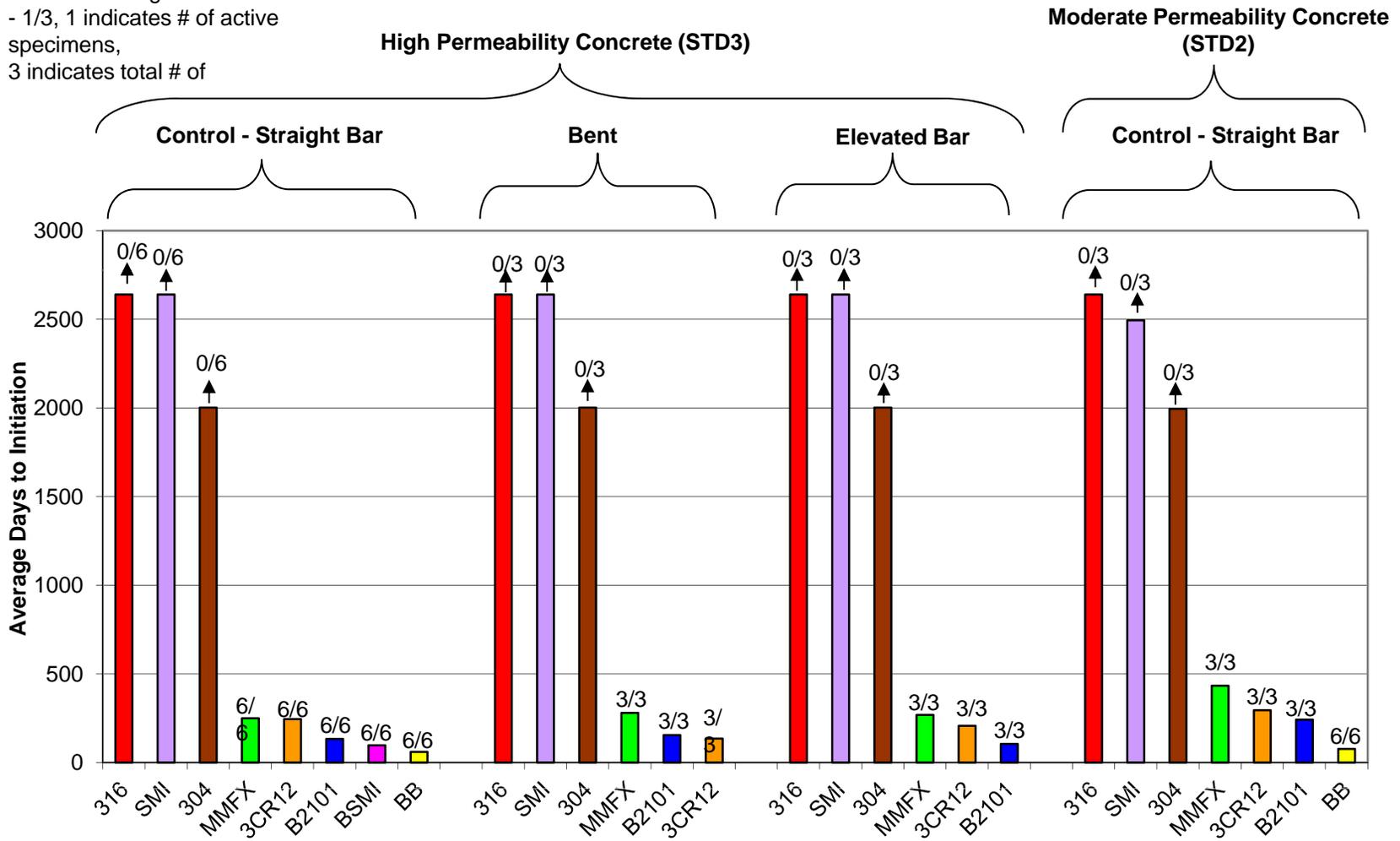
Laboratory 3-Bar Tombstone Specimens



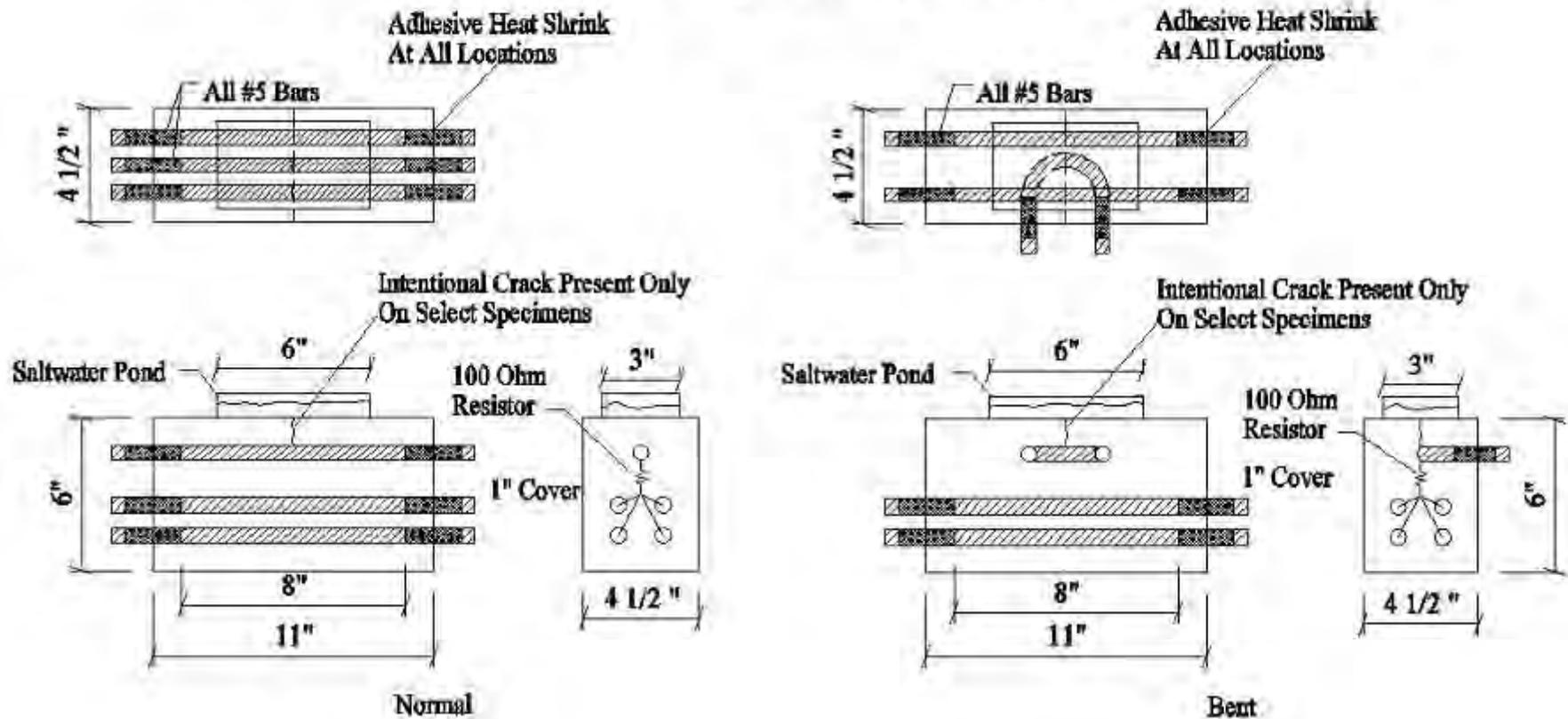
3-BAR TOMBSTONE PERFORMANCE

Notes:

- All bars as received.
- ↑ Indicates not all samples in the set have shown signs of corrosion
- 1/3, 1 indicates # of active specimens, 3 indicates total # of



Macrocell Slab Specimen Geometries



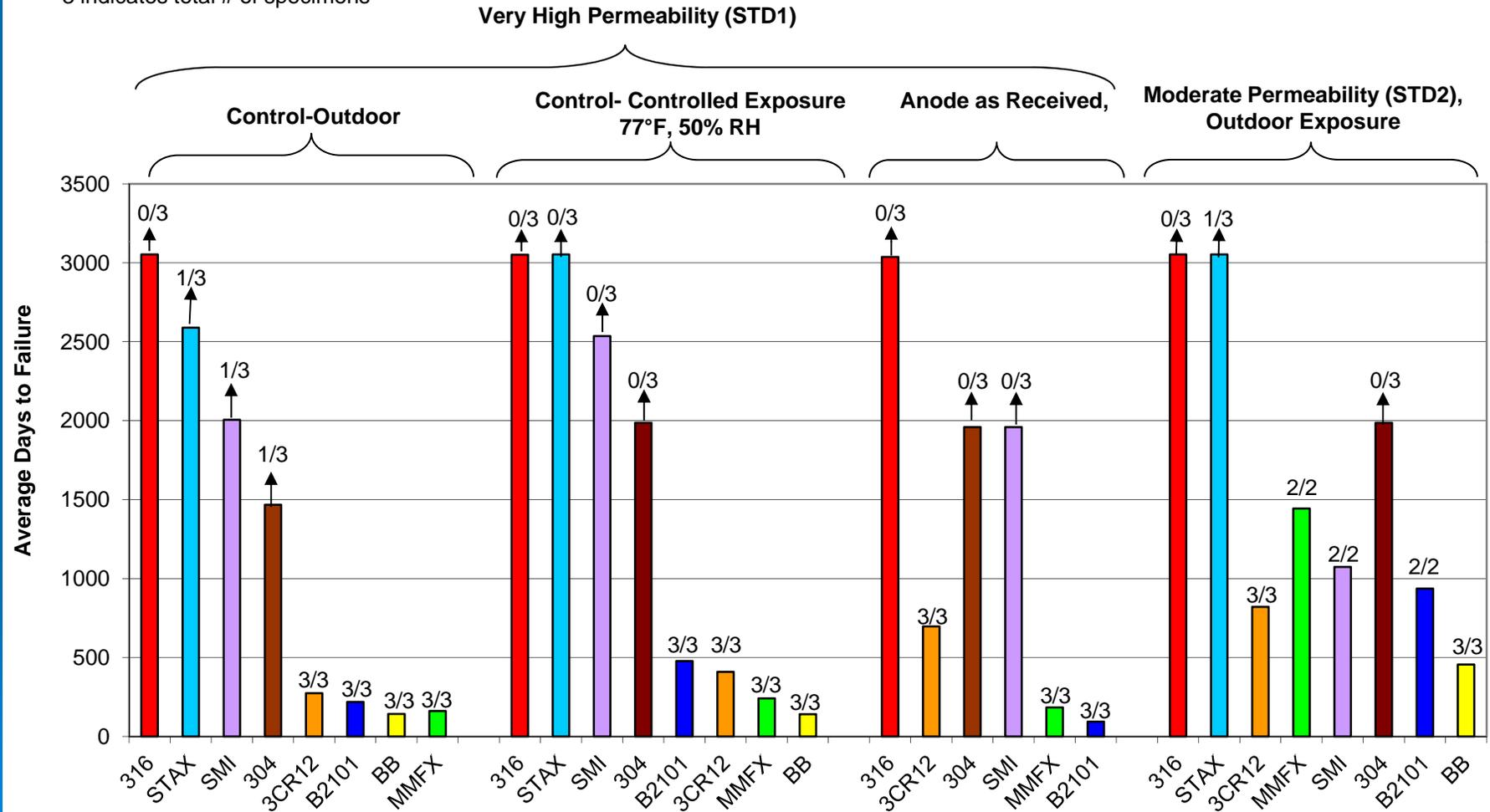
Macrocell Slab Specimens



Notes:

- All bars wire brushed
- ↑ Indicates not all samples in the set have shown signs of corrosion
- 1/3, 1 indicates # of active specimens, 3 indicates total # of specimens

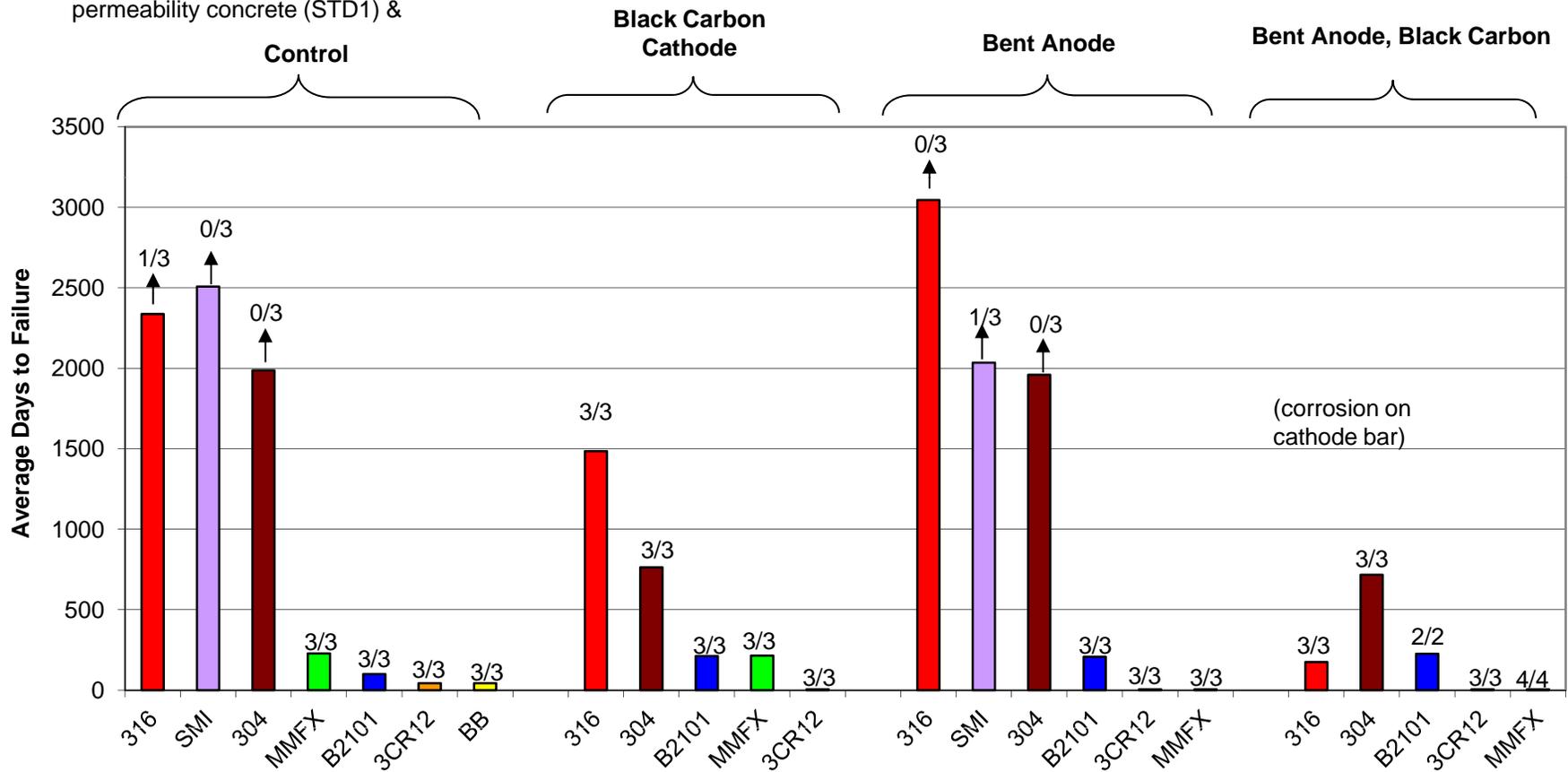
Macrocell Slab Specimens Performance Effects of Environment, Concrete, & Preparation on Time to Corrosion



Macrocell Slab Specimens Performance Effects of Cracked Concrete on Time to Corrosion

Notes:

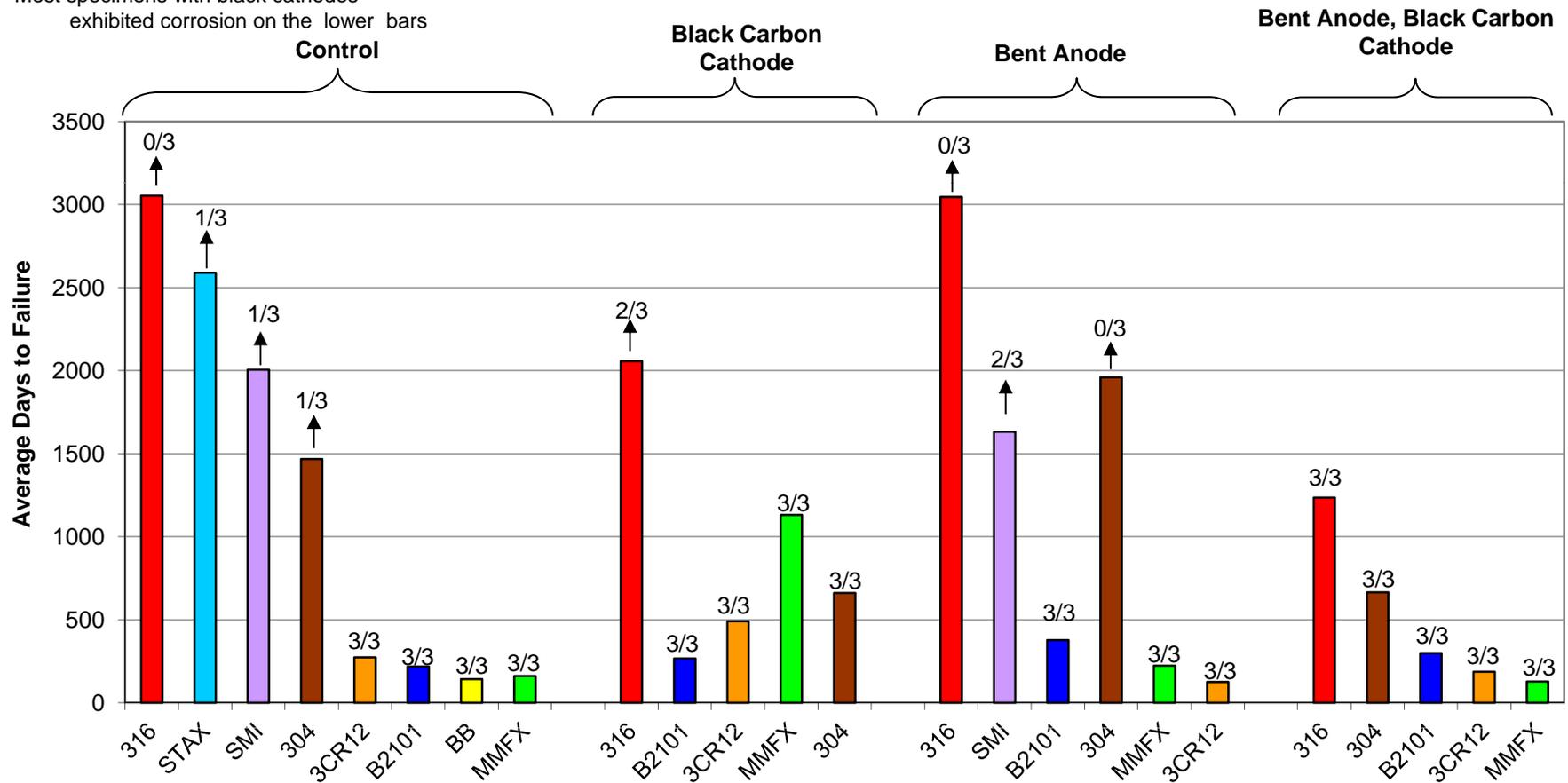
- All bars wire brushed
- ↑ Indicates not all samples in the set have shown signs of corrosion
- 1/3, 1 indicates # of active specimens, 3 indicates total # of specimens
- All specimens cast using very high permeability concrete (STD1) &



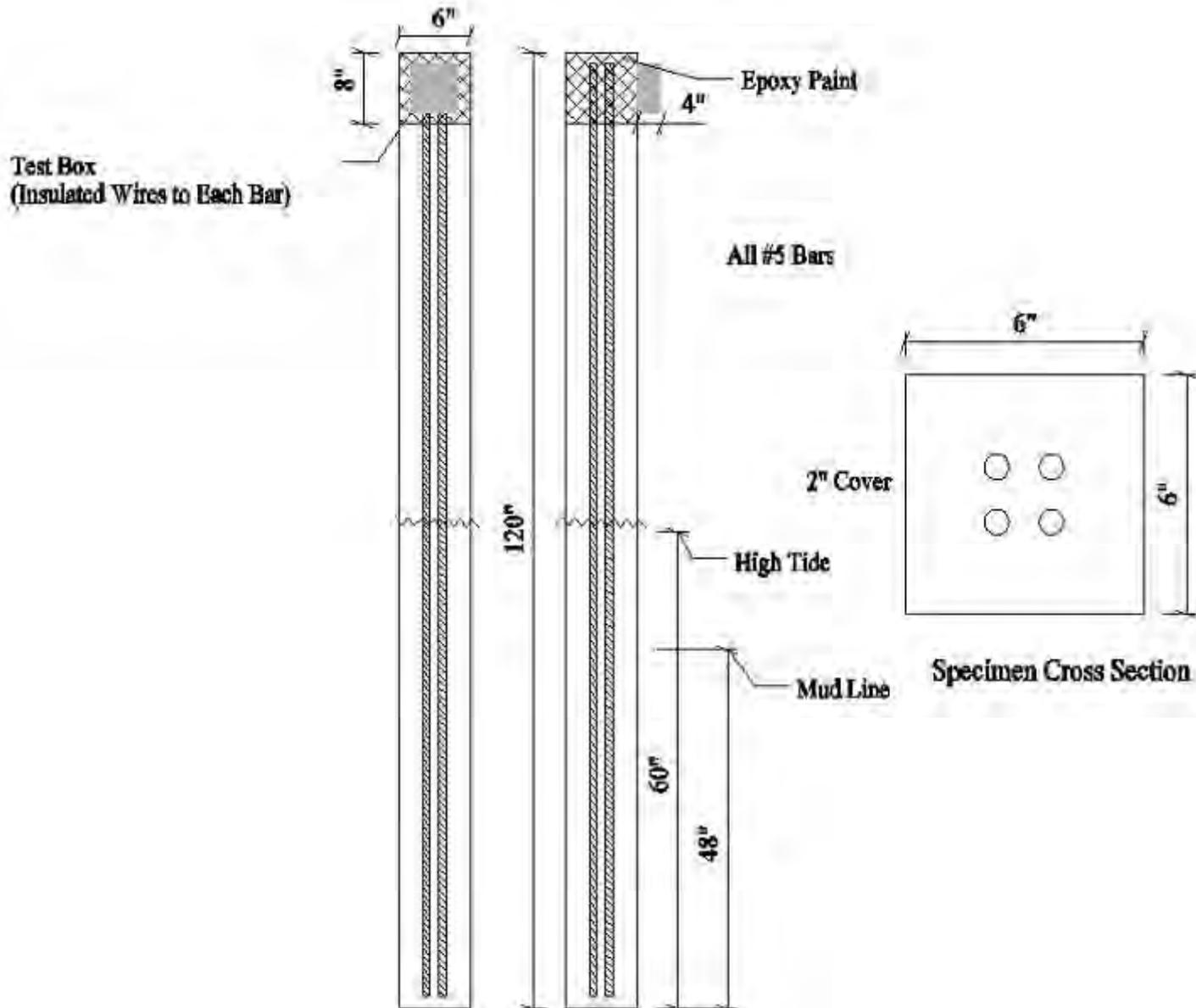
Notes:

- All bars wire brushed
- ↑ Indicates not all samples in the set have shown signs of corrosion
- 1/3 1 indicates # of active specimens, 3 indicates total # of specimens
- All specimens cast using very high permeability concrete (STD1) & exposed outdoors
- Most specimens with black cathodes exhibited corrosion on the lower bars

Macrocell Slab Specimens Performance Effects of Anode Configuration & Cathode Material on Time to Corrosion



Field Specimen Geometry



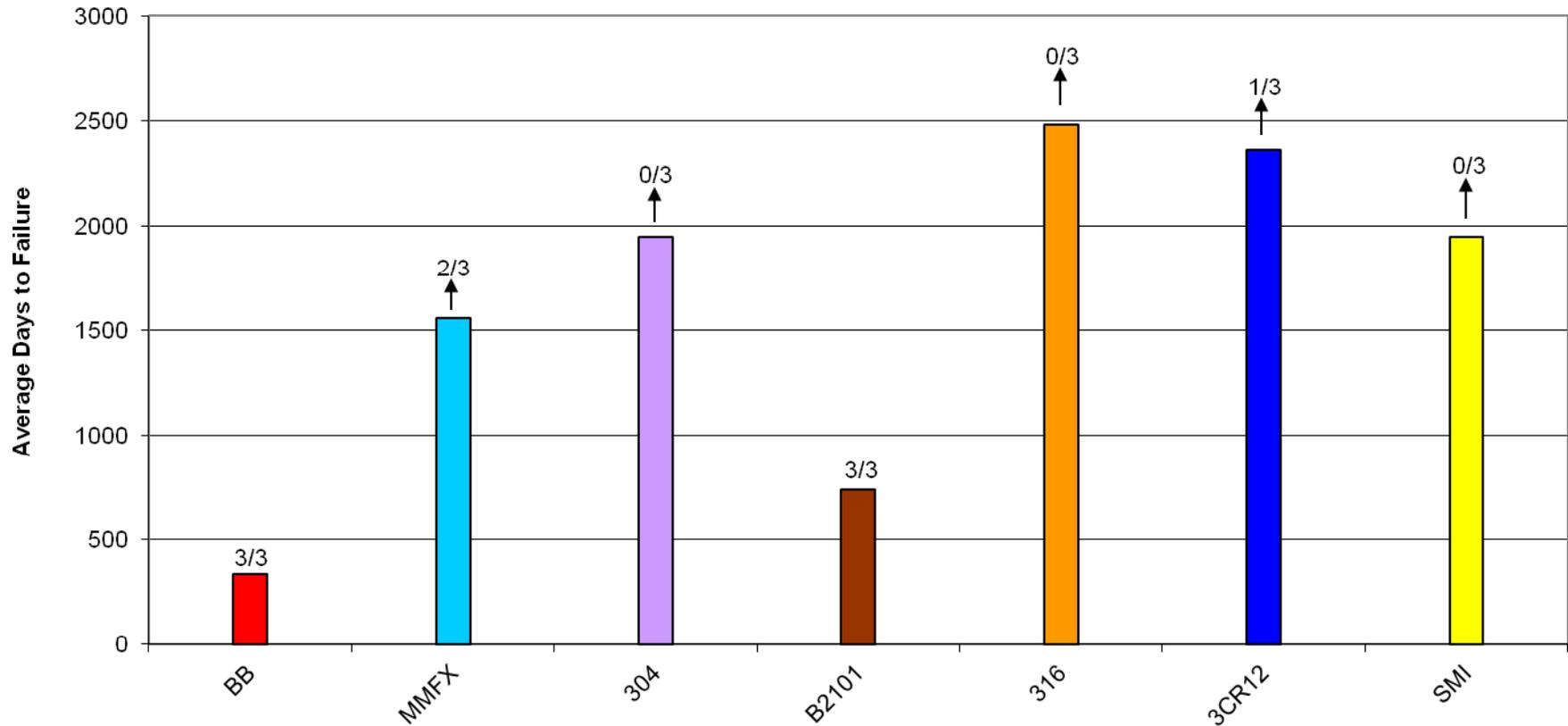
Field Specimens



CRESCENT BEACH FIELD SITE SPECIMENS AVERAGE DAYS TO FAILURE

Notes:

- ↑ Indicates not all samples in the set have shown signs of corrosion
- 1/3 1 indicates # of failed specimens, 3 indicates total # of specimens
- Failure determined by visual sign of corrosion induced cracking and/or corrosion bleed out



Florida DOT Policy

Florida has been looking for alloys that will not corrode even if the concrete is cracked, poorly consolidated, and/or with zero concrete cover.



Florida DOT Policy

- An alloy having a higher chloride threshold is not enough for Florida.
 - Some of the cost of the alloy has to be recovered by use of less cover or total cementitious or both.
 - We will still use slag and/or fly ash regardless.
- 

Florida DOT Policy

If mill scale properly removed

- FDOT will use if needed: 304, 316, 2205, or better. Any SS with a good amount of Mo.
- Rebar that shows promise pending further Research : 2304, Z-Bar, 2101, Basalt
- Rebar that FDOT has determined not to be good for use: MMFX, Enduramet, 3Cr12, ECR, galvanized, inhibitors

Florida DOT Policy

Combinations of black bar in the core and Corrosion Resistant Rebar on the outer reinforcement is possible.

Questions?

