Performance Guideline for Buried Aluminum Structural Plate Structures

Anna West, Kevin Williams & Phil Carroll – Atlantic Industries Limited

Introduction
Although aluminum structural plates have been in the marketplace for over 50 years, few design guidelines exist to guide the design or installation of such structures. First developed in 1962, aluminum structural plates are fabricated from 6061-T6A aluminum. Although these plates are anodized for surface protection, the plates are not bonded to the concrete surface as in other systems, and the plates are not anodized to a greater degree than most metal plating systems. As a result, the plates are not bonded to the concrete surface as in other systems, and the plates are not anodized to a greater degree than most metal plating systems.

Objectives
- To create a practical performance guideline for designing and installing aluminum structural plate systems in residential and nonresidential environments.
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Laboratory Testing
Testing was completed at a load rate of 2.5 mm/min until failure.

Field Inspections
Field inspections were completed at aluminum structural plate structures across New Brunswick.

Results of abrasion resistance testing:
- Abrasion testing was completed following the procedures defined by ASTM D695 (2001) and an accelerated abrasion test apparatus.

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Performance Guideline
Service Life
Service life of aluminum structural plate is dependent on the environment – primarily pH, resistivity, and abrasion. FGD develops an equation for determining the service life of an aluminum structural plate based on a first order degradation model.

SL = ln(1000) / (T_p)

Where:
- SL = Service life (in years) when subjected to a constant load and corrosion
- T_p = Time to failure (in years)
- R = Concentration of HCl in ppm
- A = Concentration of KCl in ppm

The above equation implies that provided localized corrosion does not penetrate the entire thickness of an aluminum structural plate, the stress and structural integrity of a structure is unchanged. Table for R and T values can be found in the publicly available state, Florida Department of Transportation, Pipeline Code various service life performance and Environmental (1992).

Factors
- Hot-galvanized plates are more desirable for aluminum in less aggressive environments (i.e., harsh sun) due to their superior strength and corrosion properties.
- Aluminum structures, manufactured from aluminum, are most resistant to high chloride (≤ 250 ppm), soft water and brackish water applications.
- Alumina and stainless steels are alternatives to aluminum in aggressive applications requiring high strength and corrosion resistance.

Contact with Concrete
- Aluminum can be cast with concrete (i.e., columns or slabs), provided none of the following criteria are met or are not the potential for the materials to be exposed to a non-corrosive or non-corrosive environment.
- Structures in non-corrosive environments.
- Any of the above criteria have been satisfied, aluminum must be bonded (i.e., with a bond breaker) to prevent exposure and variable service of the component.
- Separate aluminum concrete to prevent chemical corrosion or breakdown and to prevent flaking of the concrete by one of the following two means:
  - Cool water for one hour to minimize the exposure of the aluminum to extreme corrosion.
  - Placing the materials in a non-corrosive environment.

Aluminum structural plate samples with continuous exposure:
- Samples following 1000 lb in exposure to salt spray to maintain the ASTM F1147 (2001) on HDG steel with aluminum structural plate.
- Water test results cannot be exclusively relied upon to determine the effectiveness of design test, that test results shall be substantiated by the literature contained in the literature review.
- Aluminium cathode measurements:
- Held at a load rate of 2.5 mm/min until failure.
- Additional aluminium structural plate samples shown in the literature review.
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