

11.10.6.4.2 Design Life Considerations

The provisions of Article 11.5.1 shall apply.

11.10.6.4.2a Steel Reinforcements

Steel soil reinforcements shall comply with the provisions of *AASHTO LRFD Bridge Construction Specifications*, Article 7.6.4.2, Steel Reinforcements.

The structural design of steel soil reinforcements and connections shall be made on the basis of a thickness, E_c , as follows:

$$E_c = E_n - E_s \quad (11.10.6.4.2a-1)$$

where:

E_c = thickness of metal reinforcement at end of service life as shown in Figure 11.10.6.4.1-1 (mil.)

E_n = nominal thickness of steel reinforcement at construction (mil.)

E_s = sacrificial thickness of metal expected to be lost by uniform corrosion during service life of structure (mil.)

For structural design, sacrificial thicknesses shall be computed for each exposed surface as follows, assuming that the soil backfill used is nonaggressive:

- Loss of galvanizing = 0.58 mil./yr. for first 2 years
= 0.16 mil./yr. for subsequent years
- Loss of carbon steel = 0.47 mil./yr. after zinc depletion

Soils shall typically be considered nonaggressive if they meet the following criteria:

- pH = 5 to 10
- Resistivity ≥ 3000 ohm-cm
- Chlorides ≤ 100 ppm
- Sulfates ≤ 200 ppm
- Organic Content ≤ 1 percent

C11.10.6.4.2a

Corrosion loss rates summarized in Yannas (1985) and supplemented by field data developed under other FHWA research studies have been used to establish the sacrificial thicknesses herein.

The backfill specifications contained in *AASHTO LRFD Bridge Construction Specifications*, Section 7, for MSE structures using steel reinforcements present minimum electrochemical requirements, which will generally ensure a mild to moderate potential for corrosion. Where deicing salts are used, adequate drainage provisions for salt laden runoff is required. In some cases, an impervious membrane may be required between the pavement structure and the select backfill. Criteria for evaluating potential corrosion losses are given in Elias (1990).

These sacrificial thicknesses account for potential pitting mechanisms and much of the uncertainty due to data scatter, and are considered to be maximum anticipated losses for soils which are defined as nonaggressive.

Recommended test methods for soil chemical property determination include AASHTO T 289-91 I for pH, AASHTO T 288-91 I for resistivity, AASHTO T 291-91 I for chlorides and AASHTO T 290-91 I for sulfates.

These sacrificial thickness requirements are not applicable for soils which do not meet one or more of the nonaggressive soil criteria. Additionally, these sacrificial thickness requirements are not applicable in applications where:

- The MSE wall will be exposed to a marine or other chloride rich environment,
- The MSE wall will be exposed to stray currents such as from nearby underground power lines or adjacent electric railways,
- The backfill material is aggressive, or
- The galvanizing thickness is less than specified in these guidelines.

If the resistivity is greater than or equal to 5000 ohm-cm, the chlorides and sulfates requirements may be waived. For bar mat or grid-type reinforcements, the sacrificial thickness listed above shall be applied to the radius of the wire or bar when computing the cross-sectional area of the steel remaining after corrosion losses.

Transverse and longitudinal grid members shall be sized in accordance with ASTM A 185. The transverse wire diameter shall be less than or equal to the longitudinal wire diameter.

Galvanized coatings shall be a minimum of 2 oz./ft.² or 3.4 mils. in thickness, applied in conformance to AASHTO M 111 (ASTM A 123) for strip-type reinforcements or ASTM A 641 for bar mat or grid-type steel reinforcement.

11.10.6.4.2b Geosynthetic Reinforcements

Within specific limits of wall application, soil conditions, and polymer type, strength degradation due to environmental factors can be anticipated to be minimal and relatively consistent from product-to-product, and the impact of any degradation which does occur will be minimal. This allows application of a single default reduction factor, *RF*, to the ultimate tensile strength to account for long-term strength losses, as described in Article 11.10.6.4.3b.

Where wall application limits, soil aggressiveness and polymer requirements are consistent with the conditions below, a single default reduction factor specified herein may be used:

- Poor performance of failure will not have severe consequences
 - The soil is considered nonaggressive
 - The polymer material meets the requirements provided in Table 1
- 1) *Structure Application Issues*: Identification of applications for which the consequences of poor performance or failure are severe shall be as described in Article 11.5.1. In such applications, a single default reduction factor shall not be used for final design.
 - 2) *Determination of Soil Aggressiveness*: Soil aggressiveness for geosynthetics shall be assessed based on the soil pH, gradation, plasticity, organic content, and in-ground temperature. Soil shall be defined as nonaggressive if the following criteria are met:

Each of these situations creates a special set of conditions which should be specifically analyzed by a corrosion specialist. Alternatively, noncorrosive reinforcing elements can be considered. Furthermore, these corrosion rates do not apply to other metals. The use of alloys such as aluminum and stainless steel is not recommended.

Requiring the transverse wire diameter to be less than or equal to the longitudinal wire diameter will preclude local overstressing of the longitudinal wires.

Corrosion-resistant coatings should generally be limited to galvanization.

There is insufficient evidence at this time regarding the long-term performance of epoxy coatings for these coatings to be considered equivalent to galvanizing. If epoxy-type coatings are used, they should meet the requirements of ASTM A 884 for bar mat and grid reinforcements, or AASHTO M 284 for strip reinforcements, and have a minimum thickness of 16 mils.

C11.10.6.4.2b

The durability of geosynthetic reinforcement is influenced by environmental factors such as time, temperature, mechanical damage, stress levels and chemical exposure, e.g., oxygen, water, and pH, which are the most common chemical factors. Microbiological attack may also affect certain polymers, although not most polymers used for carrying load in soil reinforcement applications. The effects of these factors on product durability are dependent on the polymer type used, i.e., resin type, grade, additives, and manufacturing process, and the macrostructure of the reinforcement. Not all of these factors will have a significant effect on all geosynthetic products. Therefore, the response of geosynthetic reinforcements to these long-term environmental factors is product specific.