Design features in CP

Essentials are:

- estimate anode output & life span
- From above, calculate anode spacing and hence number of anodes to protect the entire structure

The anode current output can be obtained from Ohm's law: $\Delta V = I_a R$ Where ,

$\Delta V = E_{Protection\ (steel)} - E_{working\ (anode)}$

E_{protn} is determined by designer; its value must be adequate to protect over its life expectancy.

Other variables

- $E_{working\ (anode),}$ value is supplied by manufacturer
- R, is the anode resistance. Usually calculated using standard formulae which depend on the shapes of the anode in addition to resistivity of the environment.
- for slender, stand-off anodes (at least 30cm from structure),
- $R = P\ (\ln \frac{4l/r}{} - 1)/2\ \pi\ l$
- Where P is the resistivity of the environment, l is the length of anode, r is the radius of anode

S A - other shapes

- Flush mounted plate anodes, for which

  R = P/2S, where S is the mean length of the sides of the anode

- For bulkier shapes, $R = P/0.58A^{0.727}$

  or R = P 0.315/A, where A is the exposed area of the anode.

- In reality, the formulae give differing results. The choice of a formula is thus, a matter of experience with a particular anode design.

Anode current, I_a

- I_a is usually calculated for the dimensions of the anode when it is 40% consumed.
- From these considerations, we can obtain values for the followings: the anode current output, I_a., the current required to protect a unit area of bare structure (steel), I, the area of the structure at risk.
- It is then possible to calculate the number of anodes required to protect the structure or if the structure is coated, the number of anodes to protect it, assuming, X% deficiency in the coatings.

Number of anodes

- the spacing of the anode can be determined to give, an approximately uniform current density over the structure.
- If i is the current density needed for the desired protection, then,
- $i = \frac{I}{A}$ where A is area of the structure at risk.
- Thus, $i \times A = I$ (structure)
- i, current density for protection are usually given.
- $\frac{I_{structure}}{I_{anode}} =$ no of anodes

Anode lifetime

- The anode lifetime, L can be obtained using Faradays laws:
- $$L = \frac{W}{I_a E} \times U$$ where,

W is the weight, in gm, of the anode, I_a is the anode current output in amperes, E is the capacity of the anode in Kg/A year and it depends on the equivalent weight of the anode material and its efficiency, etc.

- U is the utilization factor. It is the amount of material consumed compared to the initial weight when the remaining material fails to deliver current. Usually, U is taken as 0.9