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COST EFFECTIVE EVALUATION OF OUR ROADWAY BRIDGES

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As the nation's roadways grow older and more heavily travelled, the number of structurally deficient bridges is increasing. This fact has led to an increased emphasis on bridge rehabilitation. In order to effectively evaluate and determine the repairs and upgrading necessary to extend the service life of these bridges, a comprehensive bridge testing program must be established.

Bridge evaluation should always begin with a thorough visual inspection and delamination survey. This should be accompanied by well documented commentary and photography to detail any problem areas encountered. The initial visual examinations should be conducted by qualified inspectors (Certified Weld Inspector, welding engineer, corrosion engineer, structural engineer, concrete inspector, etc.) who are able to determine the scope of testing necessary to provide the information needed for a meaningful and valid engineering evaluation. Bridge inspection areas should include bridge and foundation protective structures, roadway approaches, concrete foundations, abutments and piers, timber framing, steel framing, concrete and masonry structures, structure roadways, concrete curbs and expansion joints.

At a minimum, all concrete and masonry should be inspected for cracking, spalling, disintegration and exposed reinforcing steel. Corrosion and loose, missing, bent, bowed or broken steel members should be noted.

After completion of the initial survey, nondestructive and/or destructive testing techniques can then be used to determine the integrity of structural members. Nondestructive testing techniques include Magnetic Particle (MT), Liquid Penetrant (PT), Ultrasonic (UT) and Radiographic examination of welds, microstructural replication of steel, and half-cell potential readings of reinforced concrete decks. Corrosion of reinforcing steel in concrete is a well-known problem contributing to the deterioration of bridge decks. Reinforcement corrosion is associated with the onset of concrete cracking and spalling and may cause a structure to be significantly weakened in terms of structural strength and safety. The phenomenon is thus a serious condition that can have great impact on the service life of reinforced concrete decks.

Chloride ions introduced to bridge deck concrete by external sources, such as de-icing salts or a marine environment, are often responsible for initiating corrosion of the reinforcing steel. Initially, the highly alkaline environment provided by concrete causes a "passive" ferric oxide film to form on the surface of the reinforcing steel. Steel that is covered with a "passive" film will corrode at a very slow (almost negligible) rate. In the presence of a sufficient concentration of chloride ion, however, the passive film on the reinforcing steel is destroyed and significant corrosion of the reinforcing steel can ensue.

Half-cell potential readings of uncoated reinforcing steel embedded in concrete bridge structures can be used to determine if the reinforcing steel is in the "passive" state or if it is actively corroding. This method is extremely useful because it can be performed at any time during the life of a bridge deck. Using this method, a comprehensive survey of a bridge deck can be performed in a relatively short period of time. The half-cell potential data obtained is used to establish equipotential contours from which the areas where the corrosion of reinforcing steel is likely can be determined.

The formulation of conclusions concerning the corrosion activity of embedded steel and its probable effect on the service of a structure is often dependent upon the use of other data in addition to half-cell potential measurements, including chloride ion content, depth of carbonation, rate of corrosion results and environmental exposure conditions.

To investigate the physical properties of in-service materials, some sort of destructive sampling may be employed. Examples include removal of concrete cores for determination of compressive strength and removal of steel sections for determination of tensile strength. Concrete samples removed from bridge decks can also be tested for chloride ion content. The depth of intrusion of chlorides can be established by this technique.

A comprehensive program including periodic maintenance, testing, meaningful engineering evaluation and cost effective rehabilitation of our nation's bridges must be established and maintained. A program of this type will direct tax dollars most effectively and help to insure the safety of the American public on the roadways.

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