City of Garden Grove

Banner Pole Condition Assessment

Garden Grove, CA
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Contents

Introduction

HDR Engineering, Inc. (HDR) performed a corrosion condition assessment of 18 banner poles at eight different street locations within the city boundaries of Garden Grove, California (City). The City requested this assessment to address concerns over corrosion and the remaining useful life of the poles. HDR's scope of work was to perform a condition assessment of all banner poles throughout the city, characterize degradation mechanisms, and make recommendations for future monitoring and/or replacement activities.

Background Information

Corrosion is defined as the electrochemical reaction between a material, usually a metal, and its environment, which deteriorates the material. The four factors required for a corrosion cell are shown in Figure 1.

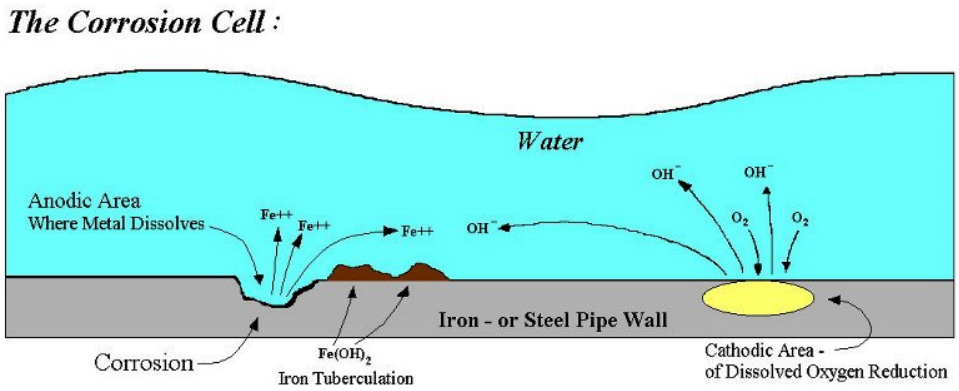

Figure 1 – Basic Corrosion Cell

The four factors are: the electrolyte, the conductive path, the anode and the cathode. A common electrolyte is water or moisture; the conductive path is any metallic material such as steel, the anode is the corroding material and the cathode is the reducing material. If any of them is removed, corrosion ceases.

There are a number of forms of corrosion. Uniform, galvanic, pitting, and crevice corrosion were observed in the banner pole assessment. These three forms were observed alone in some locations, and together in others, depending on environmental conditions. Defining characteristics for these three modes of corrosion are as follows:

Uniform Corrosion: Uniform corrosion (also known as "general corrosion") is the most common form of corrosion. This mode of corrosion is characterized by chemical or electrochemical reactions which proceed uniformly over the entire surface area, or a large fraction of the total area. General thinning takes place until failure.

Galvanic Corrosion: Galvanic corrosion (also known as “dissimilar metal corrosion”) refers to corrosion damage induced when two or more dissimilar metals are coupled in a corrosive electrolyte (typically soil or water). When a galvanic couple forms, one of the metals in the couple becomes the anode and corrodes faster than it would all by itself, while the other becomes the cathode and corrodes slower than it would alone. The driving force for corrosion is the potential difference between the different metals.

Pitting: A form of localized corrosion that results in pits in the metal surface. These pits may be small or large in diameter, but in most cases they are relatively small. Pits are sometimes isolated or so close together that they look like a rough surface. Extensive pitting may lead to the formation of holes in the surface of a metals.

Methodology

The condition assessment included visual assessment, probing with hand tools, photo-documentation, and ultrasonic thickness (UT) measurements for wall thickness loss. Assessments were limited to what could be reached/observed from the sidewalk or ground around the poles. No scaffolding, ladders, or lift equipment were used to make detailed examinations of upper surfaces on the poles. No examinations or assessments were performed on the banner cables attached to some of the poles.

Visual assessment of each banner pole consisted of an initial inspection of the surrounding area around each pole to evaluate the influences of irrigation, construction and installation, and other factors that could contribute to degradation. Following the site assessment, detailed assessments were conducted on the pole base, pole footing, hand-hole wire access plate, and pole interior (if accessible). Each pole was assigned a name based on site numbering and orientation with regard to other poles in the area.

Following the visual assessment, UT measurements were made at the base of the pole, 12 inches up from the base, and 24 inches up from the base. At each elevation, UT measurements were made on the north, east, south, and west quadrants of the pole. These measurements were made to determine if any significant metal loss had occurred. At some locations, measurements could not be made at the 12-inch and 24-inch elevations. In these cases, UT measurements were made at the 7-inch and 15-inch elevations.

Note that these assessments did not include structure-to-soil potential measurements nor soil corrosivity measurements as all of the banner poles are embedded in concrete.

Results and Discussion

Description of Poles

A total of 18 banner poles at eight street locations were assessed. Ten of the poles were made of galvanized, welded steel; one was made of welded steel coated with paint, and the balance were made of cast concrete coated with Marbelite (a cement overlay product). All of the poles

were conical in shape with precast concrete foundations level with the ground. Pole bases were either embedded in concrete or anchored by bolts secured to a welded flange, with the exception of one pole that was embedded directly in soil. The two foundation types are shown in Figure 2.

Figure 2 – Flanged Metal Pole with J-bolts (Left), Cast Concrete Pole Embedded in Concrete (Right)

Data plates, where present and legible, typically included manufacturer and a serial or model number of the pole. The most commonly found manufactures were Hawley Industries and Pacific Union Metal Division. Five of the sites had one or two steel cables connected between the poles for banner attachment. Some of the banner poles also had street signs attached.

Assessment Findings

Site #1 – Deodora Drive, North of Westminster

Site #1 included two banner poles, one each on the east and west sides of Deodora Drive (Figure 3). Both poles were fabricated from welded steel and had a black coating. Both poles were located in a park, but were approximately two feet away from irrigation sprinklers. Both poles were bolted directly to the concrete sidewalk.

Coating delamination was observed in places on the west banner pole. Light uniform corrosion was observed at points of coating failure. No severe or through-wall corrosion damage was observed. The inside of the west pole could not be examined.

Coating was intact and no external surface corrosion was observed on the east pole. No severe or through-wall corrosion damage was observed. The end flange included a weep hole to allow moisture to exit the inside of the pole. This hole appeared to be partially plugged with corrosion product.

The average of all UT measurements on the east pole was approximately 0.36-inch. The average of all UT measurements on the west pole was approximately 0.38-inch. The complete set of UT data is shown in Table A1.

Figure 3 – East Banner Pole (Left), West Banner Pole (Right), Site #1

Site #2 – Harbor Boulevard South of Garden Grove Boulevard

Site #2 included three banner poles, one each on the east and west sides of Harbor Boulevard, and one in the median between lanes (Figure 4 and Figure 5). All three poles were fabricated from welded steel and had a grey coating. The east and west poles were bolted directly to the concrete sidewalk. The pole in the median was bolted directly to a concrete footing. There was a steel cable connecting all three poles together. Both the east and west poles were more than five feet away from the nearest irrigation sprinklers. The pole in median was less than one foot away from irrigation sprinklers.

Areas of flaking paint were observed on both the east and west poles. In many areas where paint was missing, the underlying galvanized coating had also failed, allowing both uniform and pitting corrosion to occur on the outer surface. No severe or through-wall corrosion damage was observed on either pole. Most of the observed corrosion damage on the east pole was located approximately five feet above the ground. The majority of corrosion on the west pole was located on the lower portion of the pole near the flange. The internal surfaces could not be examined on either the east or west pole. The concrete around the west banner pole was cracked, possibly from loading due to tension from the steel cable attached to the top of the pole and/or deficiencies in anchor depth.

The pole in the median did not show signs of external corrosion but did show signs of flaking paint. The underlying galvanized coating appeared to be protecting the pole from corrosion at points of coating damage/degradation. The galvanized coating was intact on visible portions of the interior of the pole, protecting the interior surfaces from corrosion.

The average of all UT measurements on the east pole was approximately 0.39-inch. The average of all UT measurements on the west pole was approximately 0.41-inch. The average of all UT measurements on the pole in the median was approximately 0.22-inch. The complete set of UT data is shown in Table A1.

Figure 4 – East Banner Pole (Left), West Banner Pole (Right), Site #2

Figure 5 – Exterior and Interior Surfaces of Median Banner Pole, Site #2

Site #3 – Main Street, South of Stanford Avenue

Site #3 included two banner poles, one each on the east and west sides of Main Street, connected by a single steel banner cable (Figure 6 and Figure 7). Both poles were fabricated from welded steel and had a grey coating. The poles were bolted directly to the concrete sidewalk. Both the east and west poles were over six feet away from irrigation sprinklers.

Chips and other areas of coating failure were observed on both poles. At points of coating failure, the underlying metal surface had suffered uniform corrosion. The majority of corrosion damage on the east banner pole was located on the lower ten feet of the pole. Damage was particularly

significant at the base. Some areas of pitting and uniform corrosion were observed under the street sign straps where the paint had been scraped off. No severe or through-wall corrosion damage was observed.

Significant corrosion damage was observed on the base of the west banner pole. The sidewalk around the flange was stained with corrosion product. A weld repair of a hole in the west banner pole was observed approximately four-feet above the sidewalk on the west side of the pole. The weld repaired areas appeared to be intact with no significant corrosion damage.

The average of all UT measurements on the east pole was approximately 0.30-inch. The average of all UT measurements on the west pole was approximately 0.30-inch. The complete set of UT data is shown in Table A1.

Figure 6 – Corrosion on East Banner Pole, Site #3

Figure 7 – Rust Stains and Corrosion on West Banner Pole, Site #3

Site #4 – Chapman Avenue, West of Brookhurst Street

Site #4 included two banner poles, one each on the north and south sides of Chapman Avenue (Figure 8 and Figure 9). The poles were connected by two steel cables. Both poles were over four-feet away from irrigation sprinklers.

The lower portions of both poles were coated with a light pink paint. Minor uniform corrosion and pitting were observed on the external surface of the north pole. No severe or through-wall corrosion damage was observed. The end flange on the north pole included a weep hole to allow moisture to exit the inside of the pole. This hole appeared to be clean with no corrosion product.

Surface corrosion was more significant on the south pole than on the north pole. Coating failure and uniform corrosion were observed at an area approximately 10-feet off the surface of the sidewalk at a circumferential weld in the pipe used to fabricate the south pole. No severe or through-wall corrosion damage was observed. A slight bend was evident in the pole at this weld (Figure 10). The bend may have been caused by force from the steel cable, fabrication error, or other damage during shipping or installation.

The average of all UT measurements on the north pole was approximately 0.43-inch. The average of all UT measurements on the south pole was approximately 0.33-inch. The complete set of UT data is shown in Table A1.

Figure 8 – Corrosion Damage on North Banner Pole, Site #4

Figure 9 – Corrosion at Weld (Left) and Above Manufacturer's Label (Right), South Banner Pole, Site #4

Figure 10 – Bend in South Banner Pole, Site #4

Site #5 – Chapman Avenue, East of Valley View Street

Site #5 included two welded steel banner poles, one each on the north and south sides of Chapman Avenue (Figure 11 and Figure 12). Both poles were fabricated from welded steel and had a brown coating. Both poles were bolted directly to the sidewalk. The poles were approximately four-feet away from the nearest irrigation sprinklers.

Coating delamination was observed in places on the north pole. Light uniform corrosion was observed at points of coating failure. No severe or through-wall corrosion damage was observed. Several dents, apparently from vehicular collision, were observed on the east and west sides of the north pole. The damage did not appear to be significant, but the pole was not subjected to any formal structural analysis.

No corrosion damage was observed on the interior or exterior surfaces of the south banner pole. No severe or through-wall corrosion damage was observed. The lower section of the pole was coated with a layer of pink paint. Grooves were observed around the mounting studs on the flange at the base of the pole, but these grooves did not appear to be associated with corrosion.

The average of all UT measurements on the north pole was approximately 0.21-inch. The average of all UT measurements on the west pole was approximately 0.20-inch. The complete set of UT data is shown in Table A1.

Figure 11 – Dent and Corrosion Damage on North Banner Pole, Site #5

Figure 12 – South Banner Pole, Site #5

Site #6 – Brookhurst Street, South of Chapman Avenue

Site #6 included a single concrete banner pole located on the east side of Brookhurst Street (Figure 13). Evidence of a banner pole on the west side of the street was observed, but the pole on the west side was missing. The base of the east pole was embedded in the concrete sidewalk. The base was approximately 18 inches in diameter at the sidewalk and tapered in diameter with elevation up the pole. No steel cable was connected to the banner pole. The pole was over five feet away from irrigation sprinklers. No cracks were evident in the pole as observed from the sidewalk. Two holes that had been filled in with cement or putty were observed on the upper east side of the pole.

Figure 13 – Cast Concrete Banner Pole, Site #6

Site #7 – Euclid Street, North of Stanford Avenue

Site #7 included three cast concrete banner poles, one each on the east and west sides of Euclid Street (Figure 14), and one in the median between lanes (Figure 15). The three poles were connected with a single steel cable. The east and west poles were embedded in the concrete sidewalk. The pole in the median was embedded in soil, presumably above a concrete footing. The bases of the east, west, and median poles were approximately 21 inches, 18 inches, and 9 inches in diameter, respectively. All three poles tapered in diameter with elevation up the pole. The east and west poles were approximately four feet away from irrigation sprinklers. The pole in the median was directly in the path of irrigation water from sprinklers.

There were no signs of cracking on the exterior of either the east or west pole as observed from the sidewalk. Small cracks were observed in the interior of the pole in the median. These cracks had exposed steel reinforcement in two locations. Corrosion product was observed below both of these cracks.

Figure 14 – East Banner Pole (Left), West Banner Pole (Right), Site #7

Figure 15 – Corrosion of Reinforcing Steel in Banner Pole in Median, Site #7

Site #8 – Garden Grove Boulevard at Hope Street

Site #8 included two cast concrete banner poles, one each on the north and south sides of Garden Grove Boulevard (Figure 16 and Figure 17). The poles were connected with two steel cables. The base of each pole was embedded in the concrete sidewalk. The bases were approximately 18 inches in diameter at the sidewalk and tapered in diameter with elevation up the pole. Both banner poles had metal straps to hang street signs, but only the north pole had a street sign attached. An unknown type of coating had been applied to one side of the south pole. Both poles were over four feet away from irrigation sprinklers.

No cracks were observed on the exterior of either the north or south pole. A small superficial crack was observed on the interior of the north pole. The concrete around the south banner pole was cracked, possibly from loading due to tension from the steel cable attached to the top of the pole and/or deficiencies in anchor depth.

Figure 16 – Interior Crack in North Banner Pole, Site #8

Figure 17 – South Banner Pole, Site #8

Conclusions and Recommendations

Most of the banner poles inspected generally appeared to be in serviceable condition, but several are in need of coating repair or more significant service.

Based on the recent assessment, it is recommended that several maintenance and repair operations be performed on the banner poles. General recommendations for all the banner poles include the following:

- Repair areas of coating damage on the welded steel banner poles to prevent further corrosion damage to the exterior surfaces;
- Inspect the interior of banner poles that could not be opened during the recent inspection for corrosion and other forms of degradation;
- Adjust irrigation sprinklers so that they do not wet the banner poles; and
- Put banner poles on an annual inspection and maintenance program. Such a program should include inspections for cracking and corrosion damage, and touch-up coating repair to areas of damage sustained through normal operations, pedestrian traffic, hanging of banners, etc.

Specific recommendations include the following:

- At Site #4 (Chapman Avenue, West of Brookhurst Street), replace the existing banner pole on the south side of the street prior due to damage (bend in pole).
- At Site #5 (Chapman Avenue, East of Valley View Street), replace the existing banner pole on the north side of the street due to damage (dents from automobile collision).
  At Site #7 (Euclid Street, North of Stanford Avenue), assess rusting steel reinforcement observed on the interior of the pole for structural stability. If reinforcement is not significantly corroded and pole is deemed structurally stable, repair mortar around reinforcement to prevent further water intrusion and corrosion. If rusting reinforcements are structurally compromised, replace the pole.

Closure

HDR's services have been performed with the usual thoroughness and competence of the engineering profession. No other warranty or representation, either expressed or implied, is included or intended.

Please call if you have any questions

Sincerely,
HDR ENGINEERING, INC.

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NACE Certified Corrosion Specialist
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Enc: Table A1 – UT Measurements

Table A1 - UT Measurements

City of Garden Grove
Banner Pole Assessment
HDR #10194013
10/3/2019

Site	Location	Banner Pole	Material	Construction	Distance to Irrigation (in)	Base Diameter (in)	UT Position	UT North	UT East	UT South	UT West	Notes
1	Deodora Dr., N. of Westminster	East	Welded/ galvanized/ painted steel	Flange bolted to concrete	24	8	Bottom/7 in.	0.308	0.3	0.695	0.66	Exterior hole in west base thought to prevent water bildup inside. No banner wire attached.
							12 in.	0.291	0.308	0.307	0.303	
							24 in.	0.276	0.284	0.299	0.312	
		West	Welded/ galvanized/ painted steel	Flange bolted to concrete	22	8	Bottom/7 in.	0.709	0.332	0.688	0.34	No banner wire attached.
							12 in. / 15 in.	0.295	0.306	0.33	0.52/ 0.326	
							24 in.	0.305	0.303	0.314	0.331	
2	Harbor Blvd., S. of Garden Grove Blvd.	East	Welded/ galvanized/ painted steel	Flange bolted to concrete	108	8	Bottom/7 in.	0.654	0.685/ 0.260	0.691	0.682	One steel banner wire attached.
							12 in.	0.29	0.258	0.319	0.29	
							24 in.	0.294	0.266	0.317	0.31	
		Median	Welded/ galvanized/ painted steel	Flange bolted to concrete	5	8	Bottom/7 in.	0.216	0.215	0.209	0.225	One steel banner wire attached. Some readings could not be read due to peeling paint. Access cover lid missing.
							12 in.	0.206	0.224	NA	0.224	
							24 in.	0.208	0.211	NA	0.221	
		West	Welded/ galvanized/ painted steel	Flange bolted to concrete	60	8	Bottom/7 in.	0.7	0.783	0.674	NA	One steel banner wire attached.
							12 in.	0.301	0.282	0.318	0.303	
							24 in.	0.309	0.291	0.297	0.3	
3	Main St., S. of Stanford Ave.	East	Welded/ galvanized/ painted steel	Flange bolted to concrete	76	8	Bottom/7 in.	NA	NA	0.294	NA	Flange plate flush with concrete. One steel banner wire attached. Flange approximately 0.5 inches.
							12 in.	0.309	0.31	0.293	0.312	
							24 in.	0.31	0.314	0.308	0.294	
		West	Welded/ galvanized/ painted steel	Flange bolted to concrete	76	8	Bottom/7 in.	0.334	0.298	0.307	0.304	One steel banner wire attached. Pole diameter tapers at 10 feet to approximately 6 inches.
							12 in.	0.289	0.299	0.31	0.286	
							24 in.	0.312	0.278	0.285	0.31	
4	Chapman Ave., W. of Brookhurst St.	South	Welded/ galvanized/ painted steel	Flange bolted to concrete	49	8	Bottom/7 in.	0.294	0.309	0.661	0.294	Nearby planter raised 15 inches. Two steel banner wires attached.
							12 in.	0.297	0.311	0.295	0.297	
							24 in.	0.297	0.299	0.309	0.307	
		North	Welded/ galvanized/ painted steel	Flange bolted to concrete	54	8	Bottom/7 in.	0.709	0.658	0.714	0.661	Two steel banner wires attached.
							12 in.	0.307	0.317	0.284	0.305	
							24 in.	0.304	0.311	0.293	0.312	
5	Chapman Ave., E. of Valley View St.	South	Welded/ galvanized/ painted steel	Flange bolted to concrete	47	8	Bottom/7 in.	0.226/ 0.202	0.205	0.2	0.205	No banner wire attached.
							12 in.	NA	0.196	0.194	0.195	
							24 in.	0.194	0.197	0.193	0.198	
5		North	Welded/ galvanized/ painted steel	Flange bolted to concrete	54	8	Bottom/7 in.	0.21	0.198	0.208	0.202	No banner wire attached. Large dent in east side with small dent on west side. Appears a car may have hit it.
							12 in.	0.201	0.227	0.202	0.198	
							24 in.	0.203	0.232	0.206	0.219	
6	Brookhurst St., S. of Chapman Ave.	East	Marbelite/ Cast Concrete	Embedded in concrete with access cover	62	18/ 9 taper	Bottom/7 in.					Only east pole. West pole appears to have been removed. No UT taken due to material. Two small holes appear to have been filled east side up the pole.
							12 in.					
							24 in.					
7	Euclid St., N. of Stanford Ave.	East	Marbelite/ Cast Concrete	Embedded in concrete with access cover	48	18/ 9 taper	Bottom/7 in.					One steel wire banner attached. No UT taken due to material.
							12 in.					
							24 in.					
7		Median	Marbelite/ Cast Concrete	Embedded in soil with access cover	0	9	Bottom/7 in.					One steel wire banner attached. No UT taken due to material. Access cover lid missing.
							12 in.					
							24 in.					
7		West	Marbelite/ Cast Concrete	Embedded in concrete with access cover	48	21/ 9 taper	Bottom/7 in.					One steel wire banner attached. No UT taken due to material.
							12 in.					
							24 in.					
8	Garden Grove Blvd., at Hope St.	South	Marbelite/ Cast Concrete	Embedded in concrete with access cover	44	18/ 9 taper	Bottom/7 in.					Two steel wire banner attached. No UT taken due to material.
							12 in.					
							24 in.					
8		North	Marbelite/ Cast Concrete	Embedded in concrete with access cover	64	18/ 9 taper	Bottom/7 in.					Two steel wire banner attached. No UT taken due to material. Access cover lid missing.
							12 in.					
							24 in.					