



Delaney Square Parking Structure,
Orlando, FL

STEEL:

.....
It's Worth Another Look

BY PHILIP G. RAHRIG



Lowes Headquarters Parking Garage



Given the state of rising costs for concrete construction materials, protracted delivery schedules for precast, and shrinking maintenance budgets, many owners are requesting a viable alternative parking structure design. Steel is such an alternative and although surrounded by many misconceptions, its strengths position it as a long-term solution and worth another look.

TOP TEN

For a number of qualitative performance-related reasons, steel design and in particular hot-dip galvanized steel design is considered. Hot-dip galvanizing has for over 150 years provided corrosion protection to myriad structures.

TOP TEN REASONS TO GIVE (GALVANIZED) STEEL PARKING STRUCTURES ANOTHER LOOK

Number 10: Galvanized steel has demonstrated a verifiable durability for decades in a variety of environments, including coastal and industrial. (See Figure 1)

Number 9: Castellated beams often used in steel design create an open and light-filled atmosphere where patrons feel safer.

Number 8: Galvanized reinforcing steel in decks means no unsightly spalling and no corroding seams between deck panels.

Number 7: Steel garage construction schedules are shorter.

Number 6: Galvanizing of 60'-80' girders is now common, accommodating almost all designs. The actual turnaround time to galvanize is usually less than five working days.

Number 5: Steel designs are overall lighter in weight, meaning fewer and/or smaller caissons.

Number 4: Galvanized coatings are aesthetically appealing not only for the structural members but for stairways, exterior mesh panels, and guardrails.

Number 3: Painting structural steel means costly, scheduled maintenance and lost revenue. Galvanized steel is maintenance-free for 50-80 years.

Number 2: Life-cycle costs of galvanized steel frame parking structures are two to three times less than precast. Life-cycle costs of galvanized steel frames are two to five times less than painted structural steel frames.

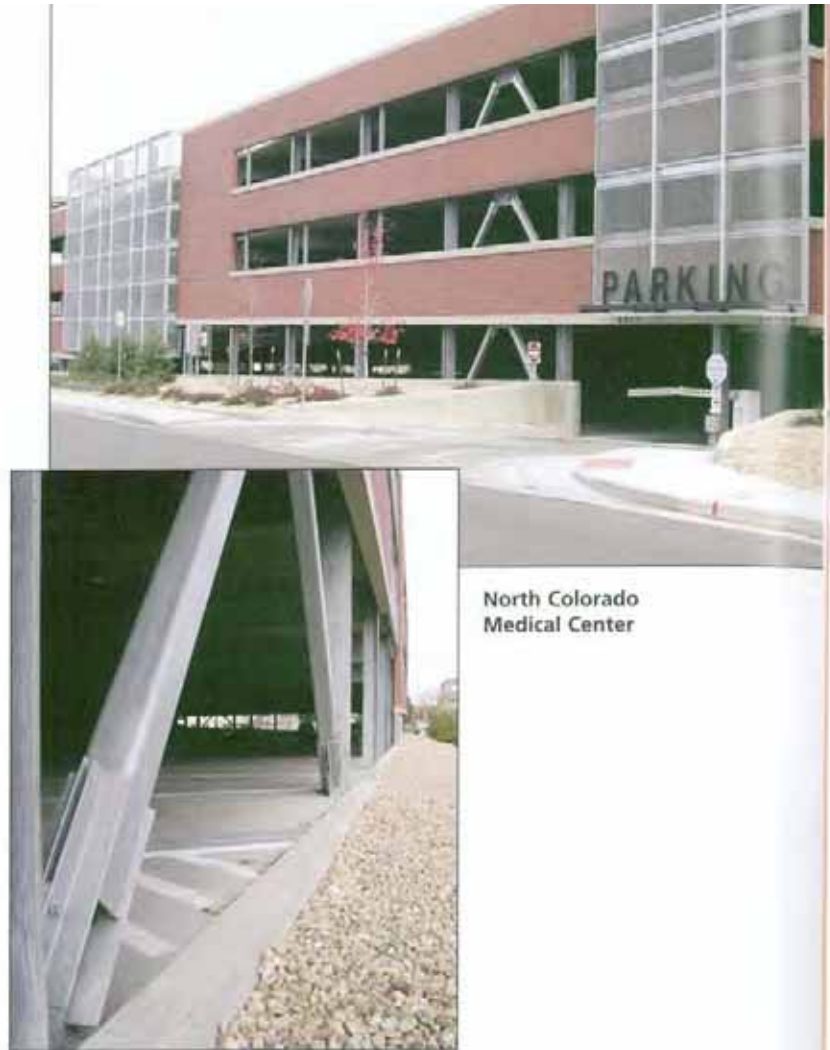
Number 1: Galvanized steel framing is initially 10%-20% less expensive than precast construction.

INITIAL COST

Once the qualitative analysis reveals that a galvanized steel frame is maintenance-free for decades and does prevent corrosion for many decades, even in harsh coastal climates, the owner's next step in the decision process is to develop the quantitative analysis and evaluate exact initial costs. Table 1 below illustrates the cost of hot-dip galvanized frame design compared to precast concrete design.

LIFE-CYCLE COST

Although the initial cost of galvanized steel is favorable to precast concrete, responsible design requires the investigation of other coatings to protect the steel from corrosion. Although not necessarily the case, various



North Colorado Medical Center

TABLE 1
Initial Costs

City	Concrete Cost (\$/sq. ft.)	Concrete Cost ¹ (\$/sq. ft.)	HDG Cost Range ² (\$/sq. ft.)
Atlanta	33.85	37.77	28.65 - 32.23
Baltimore	37.21	42.04	31.70 - 35.66
Boston	46.28	48.84	38.50 - 42.80
Charlotte	not available	32.32	25.86 - 29.09
Chicago	43.43	47.19	36.25 - 40.78
Cleveland	40.34	42.42	33.10 - 37.24
Denver	38.14	40.48	31.45 - 35.38
Dallas	33.68	35.66	27.74 - 31.20
Detroit	42.11	45.33	34.98 - 39.35
Kansas City	41.30	43.73	34.01 - 38.26
Los Angeles	42.91	45.12	35.21 - 39.61
Miami	34.81	36.59	28.56 - 32.13
Minneapolis	45.03	47.40	36.87 - 41.59
New Orleans	34.73	36.50	28.48 - 32.05
New York	52.49	55.73	43.29 - 48.70
Philadelphia	45.83	48.33	37.66 - 42.37
Pittsburgh	39.05	42.33	32.55 - 36.62
St. Louis	41.68	43.22	33.96 - 38.21
San Francisco	48.84	51.42	40.10 - 45.12
Seattle	41.74	44.02	34.30 - 38.59
National Average	41.23	42.25	33.38 - 37.57

¹ RSMeans, Build Construction Data

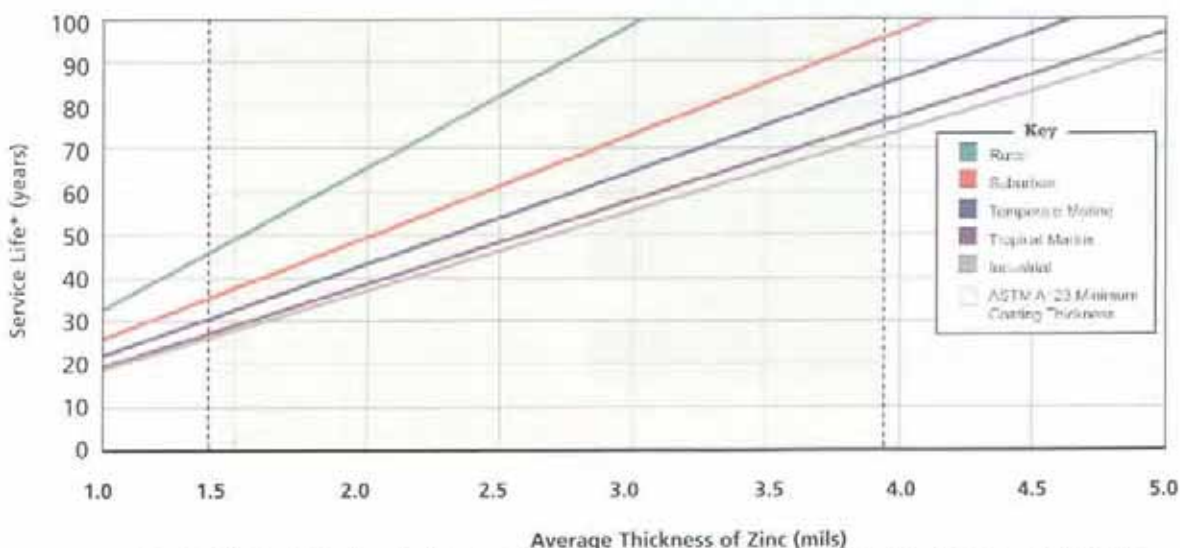
² Parking Structure Cost Outlook for 2007 - "An Inconvenient Truth," Joey D. Rowland, P.E.

³ American Institute of Steel Construction - estimate

paints are generally viewed as initially less expensive than hot-dip galvanizing and while initial cost is often the decisive factor when selecting a corrosion protection system for a steel garage, there are other costs that dwarf this initial funding outlay. Those costs are associated with a series of scheduled maintenance costs necessary to protect the steel from corrosion over the planned service life. For maximum protection of the asset, plans should be based on an ideal maintenance cycle. For paint systems an ideal cycle calls for touchup, maintenance painting and full-repainting prior to visual evidence of substrate steel corrosion. However, on most projects a practical, less rigorous cycle is used and this means maintenance is conducted when the coating has deteriorated to the point where the project looks to be in disrepair and iron oxide (rust) is visibly evident. For a hot-dip galvanized corrosion protection system, maintenance is normally not required.

To determine the timing of practical maintenance, most paint coating systems have been tested in a laboratory using accelerated corrosion mechanisms. To be sure, if the testing indicates a touchup painting should be performed in year eight, a maintenance paint

FIGURE 1
SERVICE LIFE CHART FOR HOT-DIP GALVANIZED STEEL



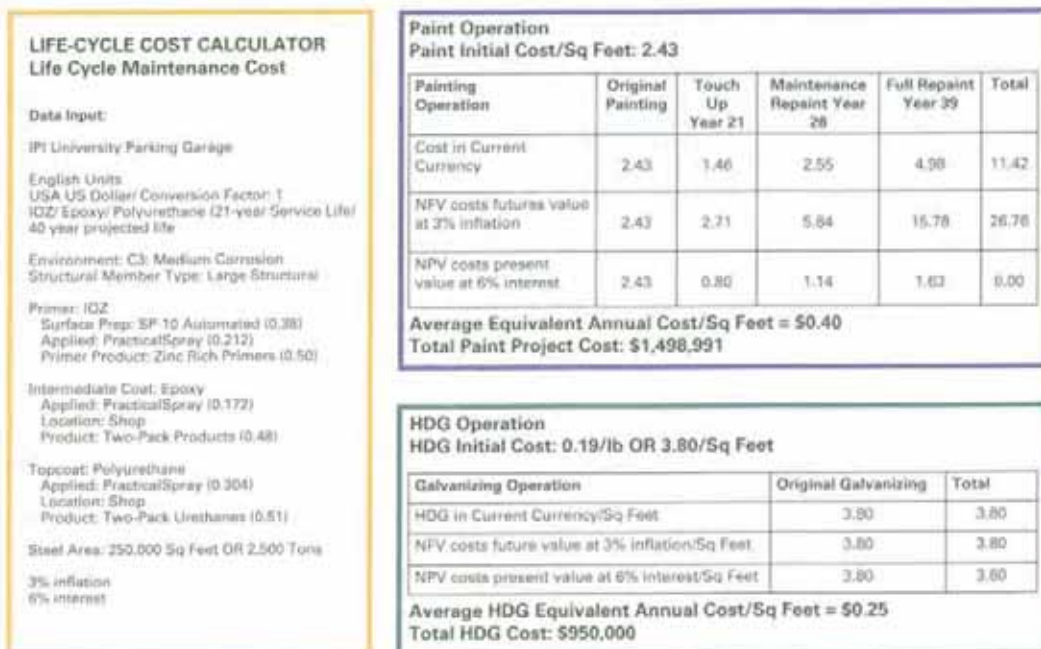
*Service life is defined as the time to 5% rusting of the steel surface 1 mil = 25.4µm = 0.56pz/ft²

applied in year 13, and a full repaint in year 18, the actual project may require maintenance according to the wear and tear on the project and the toll environmental corrosive elements have taken. That may mean earlier than planned maintenance based on the accelerated testing.

Comparing one system to another can be

an arduous number crunching exercise further complicated by the various performance characteristics each coating system provides. A three-coat inorganic zinc-epoxy-polyurethane system may have initial durability, while hot-dip galvanizing provides corrosion protection inside hollow structural sections, and alkyds may be the standard of past projects. But,

FIGURE 2



¹ NACE Paper #06318 Expected Service Life and Cost Considerations for Maintenance and New Construction Protective Coating Work, Helsel, Melampy, & Wissmar, KTA-Tator, Inc. 2006.

Although the initial cost of galvanized steel is favorable to precast concrete, responsible design requires the investigation of other coatings to protect the steel from corrosion.

once the field is narrowed to a couple of optimal coating systems according to desired performance, it is important to use all the financial tools and models available to quantify future costs as accurately as possible, especially with maintenance budgets shrinking and substantial long-term costs.

One tool is the Life-Cycle Cost (LCC) Calculator now available at www.galvanizingcost.com. As the URL implies, this site will compare the initial and life-cycle costs for over thirty (one, two, or three coat) paint systems to hot-dip galvanizing. A unique feature of the software is it allows the user to customize the input to fit his/her particular project exactly. Input variables include total size in tons or square feet, surface preparation type, structural steel component size (small, medium, large), and planned service life of the project. The calculator allows the user to input in either metric or English units.

The primary driver and input variable of the life-cycle cost calculation is the corrosion data for the project's environmental location. If a parking structure is in a rural area, corrosion rates are low because of lower corrosive elements in the air. For a garage in an industrial area, aggressive corrosion may be initiated by sulfide and chloride emissions from production plants including high levels of automobile/truck exhaust. There are four input options for the environment and all correspond to categories described in ISO 12944-2 "Classification of Environments."

The financial component of the LCC Calculator is also customizable and based on standard net future value (NFV) and net present value (NPV) calculations where the time value of money is considered. The user selects what rate of inflation is projected over the life of the project in order to determine the value of money at each maintenance time, and the average interest rate future expenditures on maintenance could earn, i.e. lost opportunity cost. Both are used to calculate the more easily understood and meaningful average annual equivalent cost (AEAC) for each coating system being

modeled for any specific project.

$NFV = \text{initial cost}[(1+i)^n]$, where i = inflation; n = project life in years

$NPV = NFV[1/(1+i)^n]$, where i = interest rate; n = project life in years

$AEAC = NPV[i(1+i)^n/(1+i)^n - 1]$, where i = interest rate; n = project life in years

The information on cost of each paint system and its practical service sequence in years for each of the ISO environments is contained in a database. Based on the user's selection of a particular coating system, the software accesses the appropriate field and incorporates the data into the life-cycle calculation. There are two options for the cost information of hot-dip galvanizing, also resident in a database. The user may either select the default, which is a U.S. average cost, or input any number in \$/lb. or \$/kg., based on market information in his/her locale.

Output of the LCC Calculator includes a printable summary of all selected input as well as tables containing the initial, NPV, total project, and AEAC for the coating system and hot dip galvanizing. (See Figure 2) The LCC Calculator output is available in US dollars or in any country's currency. The currency conversion is real time, making the LCC Calculator useful for export/import projects. ■

Philip G. Rahrig has been the executive director of the American Galvanizers Association for the past 13 years. He has worked in all facets of market/product promotion and positioning, as well as in technical support. Additionally he is responsible for worldwide coordination of objectives with international organizations with common industry interests, such as the European General Galvanizers Association, the International Zinc Association and the American Zinc Association. His prior experience includes 10 years with U.S. Steel Distribution Division.

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