Lead-Free Painting:
Mystic River Bridge in Boston

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In the course of developing a nonlead painting program at the Massachusetts Port Authority for the Mystic River Bridge, a wide range of environmental problems was confronted and unusual systems of environmental protection for the abrasive blasting operations were developed. These problems and the project innovations are discussed below.

PROBLEMS ENCOUNTERED

The Mystic River (Tobin Memorial) Bridge in Boston, Massachusetts, is the first major bridge in the Northeast to be repainted in lead-free paint. It is the largest bridge in New England—2.5 miles long, double-deck, with cantilever truss at the center. At north and south ends are mile-long Charlestown and Chelsea viaducts that pass through communities where houses and schools are very close to the bridge, in some areas less than 50 feet from the bridge. Because of environmental concerns, these communities did not want more lead paint put on the bridge; at the same time the long life and better protection of some nonlead systems made them appear preferable, from a cost-benefit point of view, to lead systems.

The chief problem in switching to long-life nonlead systems like zincs is the need to sandblast the steel in order to apply them; this abrasive blasting itself can cause air pollution, including airborne lead, and water and soil pollution if the blasting is not well controlled. However, the controls developed during the 5 years since repainting began in 1978 have given good results and are adaptable to many other bridges where these environmental problems are threatening to stop use of abrasive blasting.

The project is significant not only because of the environmental and coatings-technology problems that had to be solved, but because problems with contractors and local community health concerns slowed the project and made it a battle site involving lawyers, politicians, health officials, and community groups. The state won one long court battle in which the integrity of the specification for the coating was the issue; a second short one was won in which lead poisoning of local inhabitants was the issue.

Along with visits and studies by a total of 11 different local, state, and federal agencies, the project survived constant visits from press and TV cameras; a visit by a NIOSH team that endorsed the project but wrote a report that was not too reassuring to the press and community; and prolonged studies of air quality and blood-lead levels in children, which concluded that air quality and lead-poisoning problems had in fact improved during the life of the project. Nevertheless, after the first three turbulent years, an uneasy peace finally settled in, and the project is now quietly nearing completion. Other Massachusetts bridges have now also switched to lead- free paint, and the Corps of Engineers has followed suit on two Cape Cod bridges.

PROJECT INNOVATIONS

The paint system that was chosen was three coats of chlorinated rubber with zinc primer. The repainting was confined to only those areas with severe corrosion: the handrail and walk assembly, the cantilever beams that project out beyond longitudinal girders, and the vertical supports, where roadway salting effects were most severe. These areas amounted to one-third to one-half of the bridge steel.

The procedure began with a spot blasting, spot priming and midcoat, and full topcoat for this limited area. The decision to spot blast was based on the

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desire to minimize both the costs and the pollution from blasting; however, later it was decided to switch from spot to full blasting of the limited areas when field experience proved spot blasting difficult to carry out and to monitor. The blast nozzle peppered sound paint in moving from one corrosion spot to another, which then required priming and led to many field disputes. It was also found that costs for full blasting, compared to spot blasting, were low because scaffolding and equipment were already in place.

Because both Charlestown and Chelsea viaducts slope from 50 to 150 feet high, anchored canvas could not be used to enclose the abrasive blasting, as is done on most small bridges and overpasses (sometimes the outside is sprayed with water to keep dust down); above 30 feet these canvases pick up wind like sails and tear readily. Instead, based on conversations with Bud Deesun, California's head of bridge maintenance painting, and on a visit to one of Deesun's projects in Monterey, we developed the procedure of using rigid, movable enclosures. There a contractor had constructed an enclosure that covered the handrail assembly and the longitudinal girder; it consisted of a rigid frame around the scaffolding and a canvas housing in which the blaster worked, and it rolled on wheels along the handrail. Flexible tubing at the bottom of the enclosure allowed the used abrasive to drop to a floating barge in the river 50 feet below.

Sandblasting dust and debris are exhausted from enclosure above the disposal truck (*left*) and through water scrubber (*right*) to purify air.

Below left:
View of sandblasting enclosures hung from upper level of Mystic River Bridge. Vertical supports were blasted with Vac-U-Blast equipment. On lower level and vertical support, sandblasting has been completed and midcoat applied.

Below:
View of viaduct portion of Mystic River Bridge with sandblasting enclosures hung at upper level. Recoating is in process at lower level. Flexible tubing connects to disposal truck and water scrubber below.

For the Mystic River Bridge repainting, a modification was made to this enclosure design: a mechanical suction device was added to exhaust the dust from the enclosure, which improved health and visibility conditions inside the booth. In the first contracts, the flexible tubing was connected to a disposal truck to catch heavy particles; an additional hose, a centrifugal exhaust fan to provide suction to pull the dust down, and a heavy cotton-canvas bag to trap fine particles were also attached. In later contracts were further improvements: metal sheathing was substituted on the enclosure to make it more durable (canvas and polyethylene were too easily shot out by misdirected blast guns), and a venturi water scrubber unit was added to catch fine particles and emit them as sludge.

Nevertheless, the original concept was adhered to—enclosing the abrasive blasting to contain both dust and used grit, letting heavy particles fall into one container, and exhausting the fines to be captured in another. The fine particles provide respirable forms of lead, which are most hazardous and are therefore desirable to capture. (Flow rate for the scrubber is about 10,000 cubic feet per minute to process the dust of two enclosures, which may be as high as 150 feet above the scrubber. Pressure drop across collecting nozzle is 5 inches of water, which has been adequate to remove most of the respirable particles.)

Another innovation on the project was use of vacuum-blast nozzles for work on high vertical supports where enclosures were difficult to build. These units incorporate the vacuum into the nozzle itself and are usually used only in shops. The Y-shaped nozzle has blasting grit shooting into the nozzle from one hose and high-suction air pulling it away through another. The vacuum blasters performed well, but the operation requires a high level of inspection; because the blasters are heavy and hard to move because of the suction, workers are inclined to pull them away from the surface and use them as regular blast nozzles, thereby eliminating the air-pollution advantages of the units. Another disadvantage is that progress is slow—about one-fourth that of regular blast units. Devel-

Vacuum blaster in operation (photograph from Vac-U-Blast International).

opment of these vacuum units to enable them to move easily across rivet heads, flange edges, and angles would make them much more useful for bridge work.

The enclosure system captures 80 to 85 percent of airborne dust and lead, and virtually all of the blasting grit used in the sandblasting operation. It is also convenient to use for spray painting when wind conditions make it likely that passing cars will be sprayed. Damage to cars is a serious problem to contractors because they now must pay a $200 deductible per car on insurance policies.

The types of pollution that could have shut down or endangered the project and the standards required for each are given in Table 1.

During 1979 and part of 1980, half of the Charlestown viaduct was completed without incident. In fact, early on the project received an award from the American Lung Association as an outstanding clean-air project. However, in 1980 a strong community reaction emanated from residents who thought that dust and grit escaping from the apparatus were hazardous, which led to the project being visited virtually daily by 11 federal, state, and city agencies, as well as the television, radio, and press media. A full environmental and worker study was done by NIOSH at the request of local citizens; 24-hour air monitoring in the vicinity of the project was initiated to calm public reaction; and a suit for $500 million for health and environment damage was filed by local groups. All these tests were eventually passed successfully and, in fact, with commendation for the overall environmental benefits of the project.

Costs for the 1.5 million square feet of work will total about $6 million. About 15 percent of the total is estimated to be cost of environmental protection. For cost-comparison purposes, the cost of a lead-paint system, which we had bid as an alternate, was only about 10 percent less (this system called for a brush-off blast, whereas the nonlead system called for near-white).

The department became convinced that calling for high-quality blast is advisable for tall bridges, because access accounts for the greatest cost, and the longer paint life and fewer inspection disputes are important benefits.

Another decision that proved to be a good one was to focus only on the corroded areas and to blast those members 100 percent rather than spot blast. It is also advisable to do "background" air testing before starting and to keep air monitors going during the project for continued reassurance of environmental and neighborhood groups that all guidelines are being met. The air testing prescribed to meet the federal standard requires 24-hour monitoring by high-volume air samplers (fixed samplers with filters). Servicing and filter analysis cost about $100 per day. Portable units can be used for short-term spot checking.

Few projects have been subjected to as much scrutiny as this one. Nevertheless, the success of the project in standing up to this scrutiny and the apparent indication that the paint system will provide the planned 10- to 15-year life have made it a rewarding project, and one that has probably made a permanent change in bridge painting in this part of the country.

Editor's Note: A new Cooperative Research Programs (CRP) publication, NCHRP Report 265: Removal of Lead-Based Bridge Paints, *addresses the environmental and physical problems of safely and effectively removing lead-based paints from structural steel. A review of existing information with specific application to bridges, and suggested improvements in environmental data, equipment, and overall removal operations are presented in the report.* NCHRP Report 265 *is now available from TRB.*

Table 1. Standards Affecting Project Operations.

Standard	Source
1. Airborne lead (avg.—over 3 months): 1.5 microgram/cubic meter of air.	Federal
2. Dust: No visible emissions or nuisance. Total suspended particulates—260 microgram per cubic meter of air (max. 24-hr concentration not to be exceeded more than once a year); 75 microgram per cubic meter annual geometric mean.	State and City
3. Water: No dumping of any material in navigable waters.	Federal
4. Soil: No standard, but EPA advises removal if lead content over 1,000 ppm, and city advises no planting of edibles in soil with that lead content.	City and Federal
5. Noise: 50 decibels max. (requires whisperized compressor).	City
6. Workers: Blood-lead levels over 50 microgram per deciliter require move to lead-free site.	Federal
7. Disposal of used blasting material (approximately 200 tons): 1979 and 1980: classified hazardous by state due to 1/4-1/2 percent lead content and leachability (zero limit allowable); later passed a new test for leachability level of 5 miligram per liter (allowable concentration in new Federal Standards issued May 1980).	State and Federal