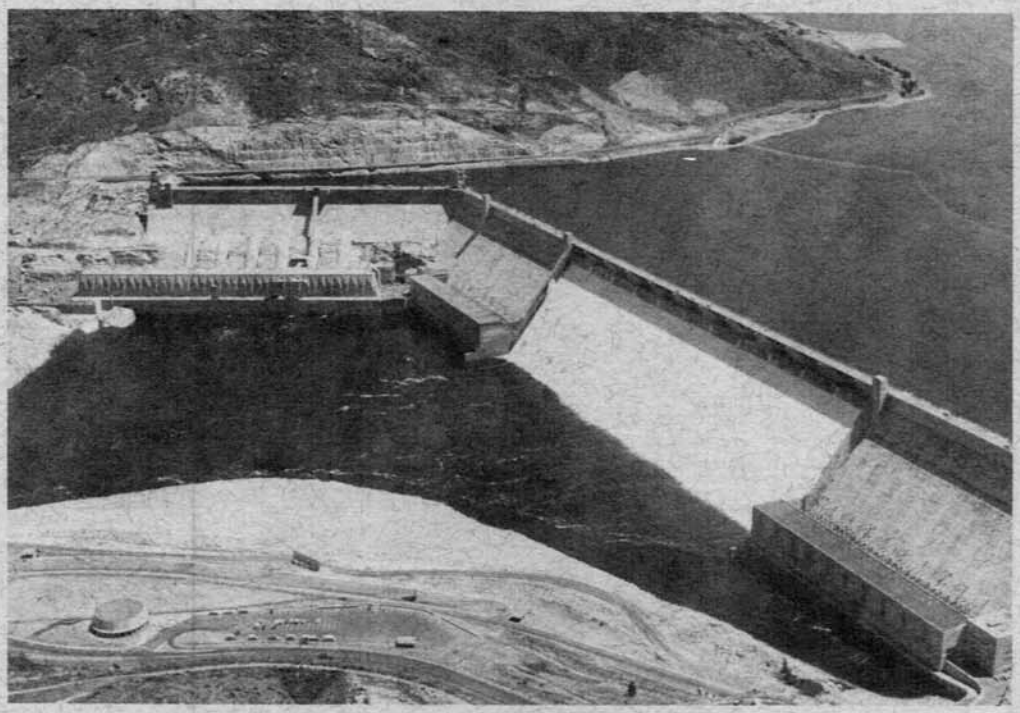
WATER OPERATION AND MAINTENANCE

BULLETIN NO. 113

September 1980



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UNITED STATES DEPARTMENT OF THE INTERIOR
Water and Power Resources Service

The Water Operation and Maintenance bulletin is published quarterly for the benefit of those operating water supply systems. Its principal purpose is to serve as a medium of exchanging operation and maintenance information. It is hoped that the reports herein concerning laborsaving devices and less costly equipment and procedures will result in improved efficiency and reduced costs of the systems for those operators adapting these ideas to their needs.

To assure proper recognition of those individuals whose suggestions are published in the bulletins, the suggestion number as well as the person's name is given. All Service offices are reminded to notify their Suggestions Award Committee when a suggestion is adopted.

Any information contained in this bulletin regarding commercial products may not be used for advertisement or promotional purposes and is not to be construed as an endorsement of any product by the Water and Power Resources Service.

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Division of Operation
and Maintenance Technical Services
Engineering and Research Center
Denver, Colorado 80225

Cover photograph:

Columbia Basin Project, Washington. An aerial view of Grand Coulee Dam looking east, showing the Third Powerplant and, in the lower left corner, the Visitor Arrival Center.

On November 6, 1979, the Bureau of Reclamation was renamed the Water and Power Resources Service in the U.S. Department of the Interior. The new name more closely identifies the agency with its principal functions–supplying water and power.

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WATER OPERATION AND MAINTENANCE
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INTRODUCTION

The installation of self-storing collapsible handrails at Grand Coulee is a timesaver, as well as a very effective safety device. See article on page 1.

Ochre clogging of drains has developed into a very serious problem. The article on page 3 describes ongoing research on this problem.

Spraying chemicals from an air-conditioned tractor cab can be dangerous. Use a filter. See page 6.

A well-lit area reduces vandalism temptation, but how can you keep it well lit? The protective device on page 7 is one solution.

The article on page 9 describes a very economical floating breakwater system for boating safety.

Page 10 points out the need for safety belts on tractors.

The articles on pages 11 and 14 give two solutions to the graffiti problem.

You are issued only one pair of feet, protect them. Wear those safety shoes. See page 16.

COLLAPSIBLE HANDRAILS – GRAND COULEE DAM [1]

Grand Coulee Dam personnel have installed self-storing collapsible handrails over access hatchways in the left and right powerhouses, pumping plant, and roadway on top of the dam. This innovation is very convenient and provides positive protection in areas which had been quite hazardous. Conventional handrails require storage facilities, assembly for use, disassembly, and return to storage following each use.

The hatchways are rectangular openings that are used for access to lower levels for maintenance and equipment installation and removal of equipment. When the hatchway is not in use, a hatch cover is laid over the opening with the collapsible railing in a folded position.

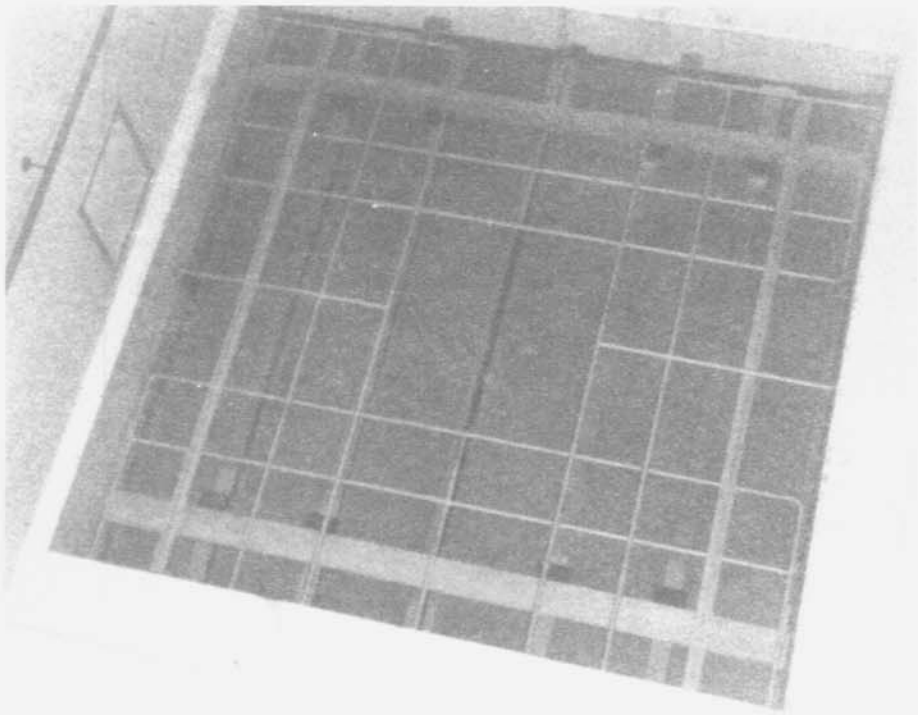

Figure 1.–Self-storing safety rails in the down or stored position.

When the hatchway is to be used, the hatch cover is removed by crane, exposing the collapsible handrailing. Workmen use rods with hooks on the end to engage the handrails, raising them to the upright position. After the work is accomplished, the railings are lowered

[1] Article provided by the Grand Coulee Project Office, Grand Coulee, Washington.

to their stored position. The railings in their lowered position also serve as a safety device blocking the hatchway until the hatch cover is replaced.

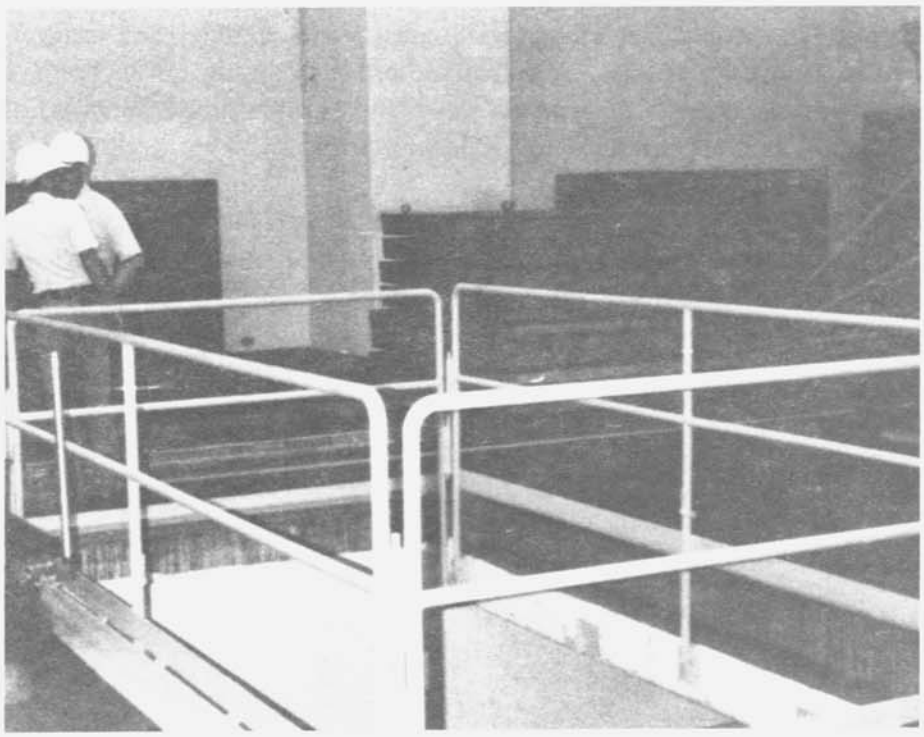

Figure 2.–Self-storing safety rails in upright position to protect access hatch.

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REHABILITATION OF OCHRE- (IRON-) CLOGGED AGRICULTURAL DRAINS [2]

The Lower Missouri Region recently completed a research study, under the Service's Open and Closed Conduit Systems program, to rehabilitate ochre- (iron-) clogged agricultural drains.

Ochre clogging of subsurface drains has become a serious problem for irrigation districts in the Western United States, and as a result, a matter of concern to the Water and Power Resources Service. The irrigation districts have had drains fail due to ochre clogging in North Dakota, Washington, Kansas, and Nebraska. Clogging of subsurface drains by ochre sludge is not limited to the Western United States but is widespread throughout North America and Europe. Ochre is more than just deposits of iron oxide hydrate precipitated from water containing ferrous iron. Under natural formation, such as that found in drains, ochre is a sticky gelatinous mass containing Fe^{-3}, iron-reducing bacteria, organic matter, sand, and sometimes manganese and magnesium. Its color varies from yellow to dark reddish brown. As it ages, it becomes darker in color, granular, and hard. One of the most common filamentous-type iron precipitating bacteria is known as Gallionella ferruginea. The organism is easily identifiable with its twisted ribbons of ferris hydroxide. The twisted ribbons look like strings of beads under normal magnification, but with the advent of the scanning electron microscope, the true form can be seen.

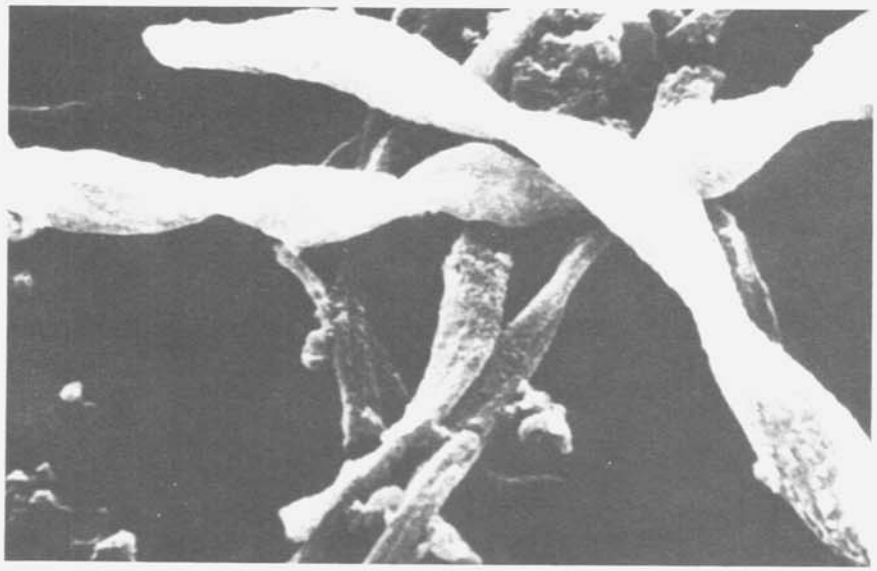

Figure 3.–Gallionella ferruginea.

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[2] Written by William A. Lidster, Lower Missouri Region, Water and Power Resources Service, Denver, Colorado.

Ochre in agricultural drains has probably been present for a long time but was largely undetected until recently because of unfamiliarity with the problem. The role of the bacteria and the physical and chemical factors contributing to the formation of ochre is now reasonably well understood, but there are few long-term satisfactory techniques of predicting ocherous sites in advance of drainage, and techniques for removal of ochre from clogged drains are limited.

There have been a number of measures tried by different investigators to prevent ochre clogging of drains. Some investigators have tried to promote the oxidation and precipitation of iron in the soils before it comes in contact with the drain. These methods used included surface liming, liming of drain trenches, and use of coarse filter materials. Other investigators have tried construction drains on steeper grades, studied various size water inlet holes, experimented with various materials to determine different adhesive tensions for ochre, submerging drain outlets, and trying various bactericidal filters.

The Service has experimented with mechanical roto rooters and hydraulic high-pressure jet cleaners. Since none of these methods has proven to be entirely satisfactory, the Service started experimenting with chemical methods of cleaning and rehabilitating ochre-plugged drains.

In 1976, the Service experimented with using SO_2 (sulphur dioxide) gas to clean and rehabilitate an ochre-clogged drain in the Columbia Basin Project. The SO_2 treatment consisted of cleaning the plugged drain with a high-pressure water jet cleaner to remove the immature or "loose" ochre, sealing off the drain outlet, and filling the pipe with a 2-percent solution of SO_2 gas by metering the gas into water and filling the drain with the acidic water solution. The acid formed by SO_2 penetrates the remaining ochre and can then be flushed down the drain. From this work, along with work of others, it was determined ochre could be successfully removed with SO_2 gas at reasonable costs. Although the SO_2 gas treatment was effective, it has major drawbacks. It is extremely dangerous to those working with it.

Due to the value of agricultural land and the initial cost of constructing subsurface drains, alternate economical methods must be found to rehabilitate ochre-plugged drains. One alternative is the use of dry pelletized sulfamic acid.

In September 1978, the Service initiated a cooperative effort with the University of Florida to evaluate a dry sulfamic acid, which was supposed to be safe to handle, in monitored bacterial growth chambers and determine satisfactory methods for neutralizing the dissolved ochre-acid solution. A field test was made in an ochre-plugged drain in the Kansas-Bostwick Irrigation District to verify the laboratory findings. The dry pelleted sulfamic was found to be safe to handle and appears to be promising for rehabilitating ochre-clogged drains at reasonable costs. The research produced a number of other factors to consider in the removal of ochre. A paramount consideration is the organic matter content of the ochre. Low organic content appears to be an essential prerequisite for using acid to remove ochre. Because

of this requirement, a colorimetric test was developed for estimating organic content in the ochre. The end results of the tests are to provide a guide to determine the strength of acid required to rehabilitate a plugged drain.

The Water and Power Resources Service is initiating a program to develop procedures for estimating the potential for ochre development. To determine areas conducive to ochre problems, infield chemical test procedures are being developed to measure ferrous iron. Knowing the environment conducive to ochre growth, it is anticipated a correlation can be found to define the problem areas in the field.

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CAB TRACTORS NEED FILTERS WHEN SPRAYING CHEMICALS [3]

It can be quite comfortable to apply pesticides from inside an air-conditioned tractor cab. However, there are some unexpected hazards which could possibly occur, says Charles Glover, Extension Agronomist at New Mexico State University.

The amount of air that is blown into an air-conditioned cab is somewhere between 141.5 and 353.9 L/s (300 and 750 ft^3/min). When this air is forced through an ordinary dust filter, it could concentrate the chemical in the cab at a much higher level than would exist without the enclosure of a cab.

The exposure to this level of chemical for a short interval may not be alarming, but extensive exposure could be damaging or even deadly, says Glover.

Cab intake filters that will filter out most farm chemicals are available. You should be sure your cab has the proper filter installed. The filter used should not only be adequate for filtering the particular chemical being used, but it should also be legally approved by the Mining Enforcement and Safety Administration.

Your filters should be checked periodically and changed if you have difficulty breathing or if the smell of the chemical is inside the cab.

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[3] Reprinted by special permission of Editor, Colorado Rancher and Farmer, from June 1980 issue.

REDUCING VANDALISM IN REMOTE AREAS [4]

Vandalism is widespread, but even more so in remote areas. A well-lit area reduces temptation.

Figure 4 illustrates a protective device for light bulbs. To protect the light bulb from vandalism, such as rocks and gun shots, etc., the bulb is placed inside a 76-mm (3-in), heavy duty pipe. This heavy duty pipe is a part of the reflector section, which is a separate item from the power standard pole. Replacing the light bulb is a simple task. By loosening three set screws, the reflector can be lifted off the pole, providing easy access to the bulb. A diagram of the device is shown on the following page.

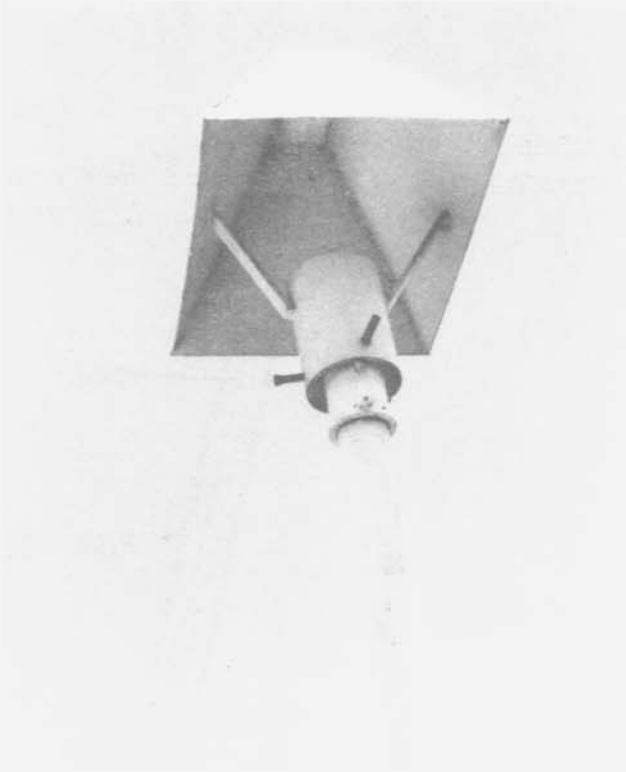

Figure 4.–Protective device for light bulbs.

[4] Material for this article provided by Mr. Gordon Johnston, Retired, Solano Irrigation District.

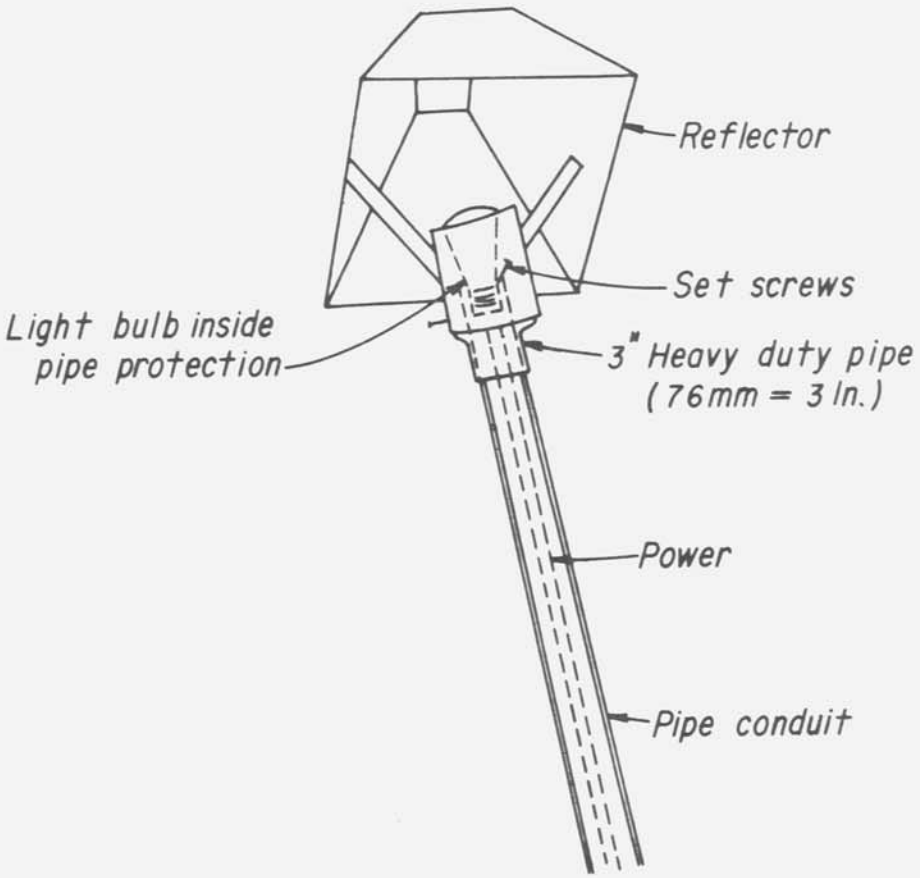

Figure 5.–Protective device for light bulb.

FLOATING BREAKWATER ADDS TO BOATING SAFETY [5]

A pilot project of the Idaho Park and Recreation Department should make boating safer on the southern end of the Cascade Reservoir.

The 1.6-km (mile) wide reservoir extends 27.4 km (17 mi) north from Cascade, a length that permits unusually large wave heights to be generated by the wind. Severe storms reportedly can come up within an hour and pose real hazards for fishermen who frequently could only beach their boats because docking or trailer loading was impossible.

Utilizing its patented process for filling old tire casings with polystyrene foam, Topper Industries, Inc., of Vancouver, Washington, built and installed two floating breakwaters made of the tires. The two extend from the shoreline at an angle and overlap to create a protected launch ramp harbor. One breakwater is 76.2 m (250 ft) long; the other 137.2 m (450 ft).

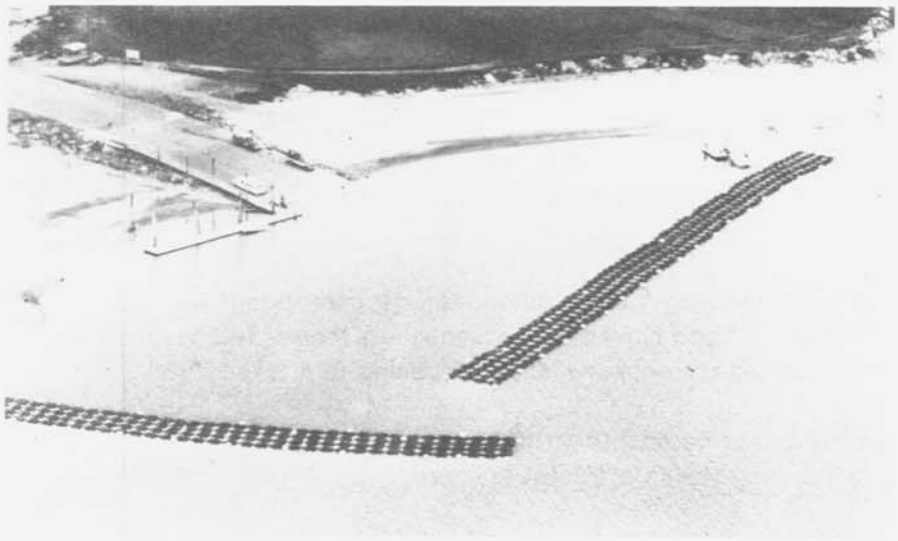

Figure 6.–Long mats of foam-filled tires form a haven for boaters on Cascade Reservoir.

The floating breakwater system is not only more economical than a permanent concrete structure, but poses less maintenance problems since the Topper breakwater has the flexibility to withstand the reservoir's virtually solid freeze in the winter. Although this breakwater will be left anchored in place during the winter, it could be towed to shore and reanchored in the spring.

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[5] Reprinted by special permission of Editor, Public Works, from April 1980 issue.

JUMP FROM UPSET?
BACK TIP ALLOWS THREE-FOURTH SECOND TO ACT [6]

It's too uncomfortable. It's too hot to wear a seat belt. I can't stretch if I wear it. If I get in an accident, I'll just jump from the tractor.

When it comes to wearing tractor seat belts, excuses abound. To many, seat belts are a headache. But as Ordie Hogsett, University of Illinois extension safety specialist, puts it, if the tractor tips and the operator's head hits the cab's roof, the headache will be even worse.

"The operator will rattle around in the cab like a marble in a tin can," Hogsett says.

More than half the fatalities in tractor accidents result from overturns, and many could have been prevented if operators had been wearing seat belts. If the operator does not wear a seat belt, the effectiveness of the tractor's rollover protection structure (ROPS) is reduced.

(ROPS is a frame that prevents tractors from tipping over more than 90 degrees–in most cases. In those instances when a tractor keeps rolling over and over, the frame protects the operator.)

Many people see no need for seat belts because they assume they have enough time to jump from the tractor if it tips over, Hogsett says. Others figure they can hold tight to the steering wheel.

"But these people are ignoring human limitations," Hogsett points out. For example, in a backwards tip, the tractor hood can hit the ground in less than 1-1/2 seconds. The operator then has 3/4 of a second to realize what is happening and take action.

Also, anyone who assumes he can hold onto the steering wheel has no conception of the force exerted on the operator in a tractor tip-over.

But seat belts not only protect the operator during tractor upsets; they are an important safeguard when the tractor is taken into highway traffic.

Hogsett points to the case of a train that struck a tractor being driven by a youth. The train hit the front end of the tractor and ripped the machine in half. But the youth walked away from the accident. He had been wearing a seat belt.

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[6] Reprinted by special permission of Editor, Nebraska Farmer, from May 17, 1980 issue.

EASY-TO-CLEAN NOISE BARRIER SOLVES GRAFFITI PROBLEM [7]

Graffiti has long been a community problem. For thousands of years, messages have been scratched, drawn, penciled, and painted on walls the world over. But a wall in Columbus, Ohio, is successfully thwarting the destructive forces of graffiti.

Along Ohio Route 315, just north of Ohio State University, the city's first steel highway noise barrier will not only reduce the sound of highway traffic but also provide a pleasant appearance for residents and travelers alike. The 1.2 to 4.6-m (4 to 15-ft) high wall is constructed of "Steelox" panels manufactured by the Metal Products Division of Armco Steel Corporation, Middletown, Ohio. The panels are covered with a Colonial Red coating of "Tedlar" PVF film, a protective plastic film made by the DuPont Company

The construction of Route 315 is a joint effort of the Federal, State, and city governments, and area residents were asked for their ideas on a variety of noise barrier designs. The city decided that concrete barriers were open targets for graffiti, which would create a neighborhood eyesore. Such barriers would need frequent and costly maintenance to retain the good appearance demanded by the community.

Figure 7.–Besides being easy to clean, the steel highway noise barrier will shield neighborhood from traffic noise.

Instead, the city chose the Armco barriers because of a wide selection of colors, the shadowbox design, and a surface from which graffiti could be cleaned easily. The more than 1524-m (5,000 lineal ft) of wall that border both sides of the roadway through the residential

[7] Reprinted by special permission of Editor, Public Works, from March 1980 issue.

area can be cleaned with a commercial solvent, because the tough plastic coating resists paint, lipstick, ink, and tar. It also provides excellent corrosion protection for galvanized steel, giving it longer life.

The ease of cleaning the wall was demonstrated recently when city and state government people visited the wall to witness the removal of graffiti. A commercial cleaning solvent removed spray paint that had defaced two sections of the barrier for approximately 2 months. The cleaning completely restored the wall to its original condition without a trace of damage to the chemically inert coating.

Figure 8.–Wall panels of steel highway noise barrier are covered with washable plastic film to permit easy graffiti removal.

According to Ted Stitt, Environmental Supervisor for Ohio Department of Transportation, the wall is an experimental project to provide a comparison with a concrete wall erected earlier this year in an adjoining suburb. That wall was defaced with paint and a search is currently underway for an inexpensive way to clean it. Since the concrete wall has no protective coating, the primary option is the expense of painting the entire surface.

Another important point of comparison between the concrete and the steel walls is the ease of construction. Because Armco uses lightweight preengineered steel components, contractors can use smaller installation crews and lighter equipment than would be possible with other types of barriers. Also, the panels can be installed in locations where a low "dead load" is required, such as on bridges or in poor soil conditions.

The high-density steel used is especially good for reflecting sound. According to the manufacturer, the barrier panel achieves a minimum 23.5 decibel transmission loss in the truck noise spectrum based on results from ASTM E90-75 test procedures.

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TANK HAS GRAFFITI-RESISTANT EXTERIOR [8]

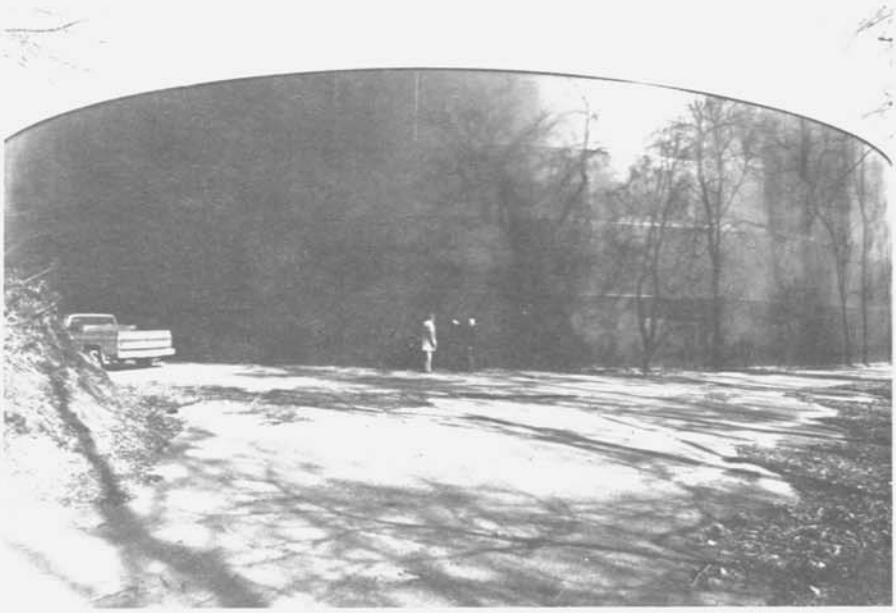

Figure 9.—An invitation to graffiti artists, such as this tank, demands special mark-resistant coating.

New protective coatings were recently applied to the exterior and interior of a 37.8-ML (10-million gal) capacity steel reservoir serving 30,000 families in the Monroeville, Pennsylvania area. The tank, owned and operated by the Monroeville Water Authority, was built in 1963.

The original coatings, supplied by Koppers Company, Inc., Pittsburgh, were in excellent condition, with minor exceptions. There were graffiti marks on the exterior and minor corrosion of metal purlins inside the tank.

The new protective coatings also were supplied by Koppers. Bitumastic Super Tank Solution was applied to both the interior roof and girders. The base of the tank, coated with 70-B hot enamel originally, needed spot repairs using the same material on only 2 percent of the area.

After sandblasting the graffiti-marred areas of the tank's exterior, a coat of Koppers Pug Primer followed by two coats of Rustarmor 500 were applied forming a tough, flexible elastic film with long-term weathering properties. Finally, a graffiti-resistant clear coating, Koppers GrafPruf, was applied up to a 4.9-m (16-ft) height around the tank exterior. This material

[8] Reprinted by special permission of Editor, Public Works, from May 1980 issue.

is a water-based, one-component coating that has the quality of forming a hard, clear film over most new and previously painted surfaces. Once cured, the coating will resist graffiti and a number of staining elements.

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YOU CAN "SELL" SAFETY SHOES [9]

Foot protection, like so much of safety, is a matter of common sense. You have the know-how to reduce accidents and injuries. You know how materials should be stacked. You know how metal should be handled. And, you have the means of protecting yourself against accidents that occur even though you have done what you could to prevent them. Here, of course, is where safety footwear comes into the picture.

Failure to wear safety shoes, like failure to use other personal protective equipment when needed, is a form of chance taking. Unfortunately, the law of averages catches up with chance takers. Wear your safety shoes at work and for chores around the home that call for foot protection.

Making certain that appropriate foot protection is used can be a difficult assignment for supervisors. Workers complain that safety shoes are uncomfortable, too heavy, etc.

Here are some common complaints and ways to answer these objections:

- **They hurt**. If your toes are cramped in shoes that are too small, they will hurt. Often your feet spread out past the edges of your shoe's sole. With a steel toe cap, your toes have no place to go. If your feet tend to spread, you may need a larger size or width in safety shoes than in street shoes. When choosing foot protection have a qualified sales person fit them. Try on both shoes and walk around a bit to be sure they are comfortable.

- **They're too heavy**. Know how much a steel toe cap weighs? About as much as a pair of rimless glasses or an average wristwatch–42.5 grams (an ounce and a half). Steel toe safety shoes are definitely not much heavier than street shoes.

- **They're too stiff**. Unless a shoe is fitted improperly, this should not be a problem. Bend a pair of street shoes and you'll see the toe does not bend as much as you might think. However, a shoe with a steel insert for sole puncture protection, may be a little less flexible. Heavier footwear, where less flexibility is expected, usually has this type of protection.

- **They are too cold or too hot**. Most modern footwear has a layer of felt or some other material to keep toes warm in winter and cool in summer. Ask the sales person what type of insulation is provided around the toe cap. Although styles are more limited, extra protection is available for temperature extremes. Wearing appropriate socks is also important.

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[9] Reprinted from Industrial Supervisor, January 1980.

- **They are not stylish**. Today's safety shoes come in almost every imaginable style—from dressy wing tips, loafers, and pumps, to western-style boots, jogging shoes, and hiking boots. However, we must not lose sight of the reason for safety shoe protection. For example, two hiking boots may look alike, but may provide very different levels of protection. Ask your sales person to explain the protection each style offers and look for the ANSI Z41 stamp inside the footwear.

- **The steel cap doesn't cover all the toes**. Generally this is true. However, most toe fractures involve the first and second toes and the steel cap covers these toes.

- **The steel cap collapses and injures the toes**. No one's quite sure how this idea got started, but a lot of people believe it. Imagine what would happen without toe protection.

- **They are a tripping hazard**. No more than any other work shoe. This objection usually arises when metatarsal protection is required. With such an addition to the shoe, tripping, particularly when climbing ladders, is more likely. Workers must walk more cautiously when wearing metatarsal protection.

- **They are not readily available**. Sometimes this is a problem. However, many companies have in-plant shoe stores and others arrange for a shoemobile to visit periodically. Regional distribution centers for safety footwear can be located by contacting manufacturers.

- **They cost too much**. This depends on the protection included, style, quality, and place of purchase. Through quantity purchases and company discounts, safety footwear sometimes actually costs less than street shoes.

Remember, you are only issued one pair of feet.

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