WATER OPERATION AND MAINTENANCE

BULLETIN NO. 123

March 1983

IN THIS ISSUE

UNITED STATES DEPARTMENT OF THE INTERIOR
Bureau of Reclamation

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 maintance 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 Bureau offices are reminded to notify their Suggestions Award Committee when a suggestion is adopted.

* * * * *

Division of Operation
and Maintenance Technical Services
Engineering and Research Center
P O Box 25007
Denver CO 80225

Cover photograph:

Inlet transition to Havasu Pumping Plant; the primary feature to the Central Arizona Project. When completed, it will lift water 251 m (824 ft) at a rate of 84 951 L/s (3000 ft^3/s) to the 10.9-km (6.8-mi) long Buckskin Mountain tunnel.

SI METRIC

WATER OPERATION AND MAINTENANCE
BULLETIN NO. 123

March 1983

INTRODUCTION

Use of portable operators for gate valves saves time and eases the exercising burden of dam tenders. See page 1.

The article beginning on page 5 describes the advantages of having engineers, trained as divers, inspect underwater dam dewatering facilities.

A recent Review of Operation and Maintenance examination of the Gering-Fort Laramie Irrigation District facilities revealed that proper operation and maintenance practices minimizes problems. See article on page 13.

The results of effective drainage of deteriorating lands in the Tulare Lake basin are described in the article on page 14.

Proper procedures for entering confined spaces are pointed out on page 17.

PORTABLE OPERATORS FOR GATE VALVES[1]

Many of our Bureau outlet works, especially those with municipal and industrial outlets, have small (less than 900-mm (36-in)) manually operated gate valves with corresponding small handwheels which are very difficult to operate. Because of this, the requirement to exercise gates at least annually is sometimes ignored. This is especially true at dams with multilevel outlets where gate changes for different elevations are infrequent. One such site was discovered during a recent Review of Operation and Maintenance examination. At this particular dam (Foss), the gates were exercised as required but with great difficulty. Subsequent to the review, the authors investigated means to power the handwheels and ease the exercising burden on the dam tenders. The municipal outlet works at Foss Dam (the example used in the following exhibit) consists of four trash racked intake structures at different elevations, four concrete-encased 600-mm (24-in) outside diameter steel outlet pipes, and a gate chamber housing four 600-mm (24-in) wedge gate valves with 300-mm (12-in) handles.

The following writeup and diagrams are based on information supplied by the E. H. Wachs Company, Wheeling, Illinois. The unit referenced is the "Wachs Pow-R-Drive Portable Valve Operator Model P-1 Reversible." Overall costs with attachments are about $2,250. This is not intended to be an endorsement for Wachs Company as other manufacturers undoubtedly have similar operators for sale.

The model cited supplies 949 n·m (700 ft-lb) of torque at 26 r/min. A double worm reducer is available which doubles the revolutions to 52 r/min but cuts the torque to 474.5 n·m (350 ft-lb).

For this particular installation, a 25- to 29-mm (1- to 1-1/8-in) tapping adapter was required. Various sizes of adapters, 20 mm, 21 mm, 22 mm, 24 mm, and 29 mm (3/4 in, 13/16 in, 7/8 in, 15/16 in, and 1-1/8 in) are available if your needs require same.

For the example cited, it was determined that the time required to open or close one valve would be 2 minutes with this device.

[1] This article written especially for this bulletin by Neil J. Gillis, Water O&M Branch; Lonn A. Rodine and Wolfgang A. Sattler, Mechanical Branch, Bureau of Reclamation, E&R Center.

Exhibit

PORTABLE VALVE OPERATOR

For operating the four 600-mm (24-in) wedge gate valves in the municipal outlet works, the following general information is offered:

1. The suggested portable valve operator (fig. 1) weighs approximately 40.8 kg (90 lb). To transport the portable operator to the location of the valves, we suggest utilizing two people or a dolly.

2. The electric version of this portable operator will require a power supply of 15 amperes, 115 volts alternating current at the location of the valves.

3. The portable operator is provided with a 25-mm (1-in) square hole in the mandrel. The 25- to 29-mm (1- to 1-1/8-in) adapter will adapt to a 29-mm (1-1/8-in) female connection.

4. Removal of the valve handwheels will expose a 29-mm (1-1/8-in) square drive on the horizontal shaft.

5. Mount the portable operator on the horizontal shaft using the 25- to 29-mm (1- to 1-1/8-in) adapter. Again, it may be necessary to utilize two people to lift the unit into place.

6. We suggest getting the valve operator with the optional revolution counter. After establishing the number of revolutions required to fully open or close a valve, the operator should use the counter to stop the motor before the valve locks in the fully open or closed position.

7. If the primary use of the portable operator is at the four valves, we suggest that it be stored and secured in a locking cabinet in the gate chamber.

8. We also suggest use of an operator support brace fabricated from a 50-mm (2-in) pipe, fastened to the floor with permanent expansion anchors, see figure 2.

9. For safety reasons, we suggest that retaining hardware such as a set screw on the adapter to horizontal shaft and a locking collar retaining the operator mandrel to the adapter be used. It is also recommended to use the valve operator with illustrated brace (fig. 2) since hand-held operation may be hazardous.

* * * * *

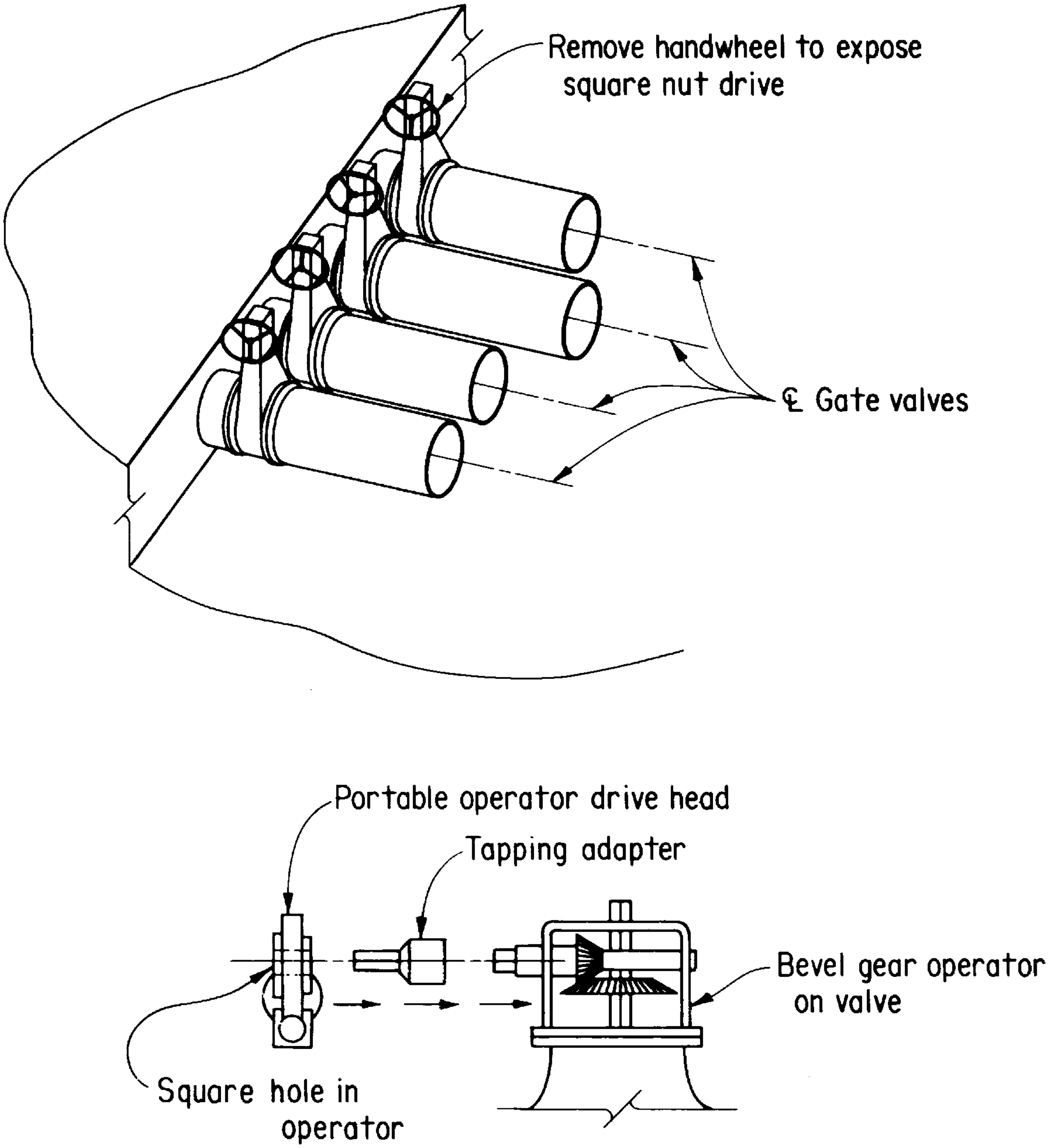
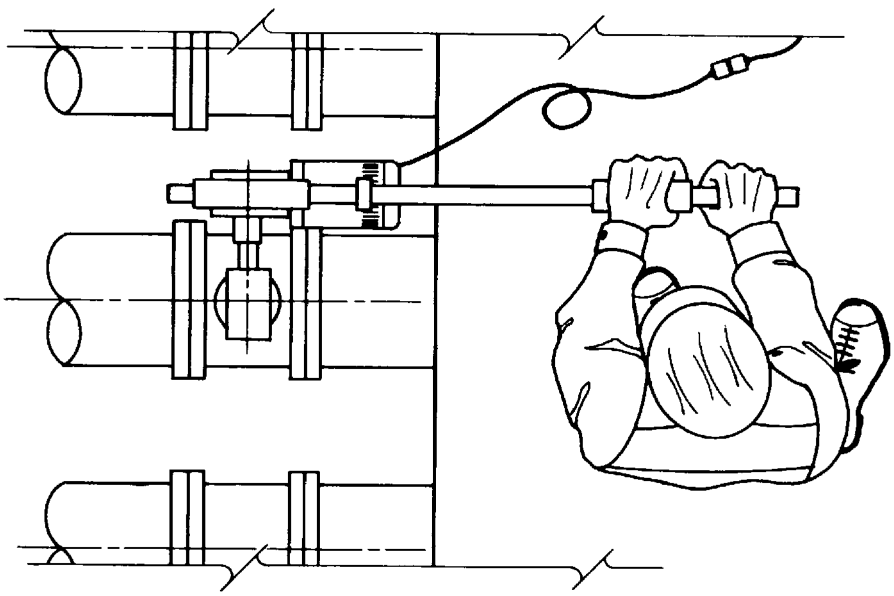
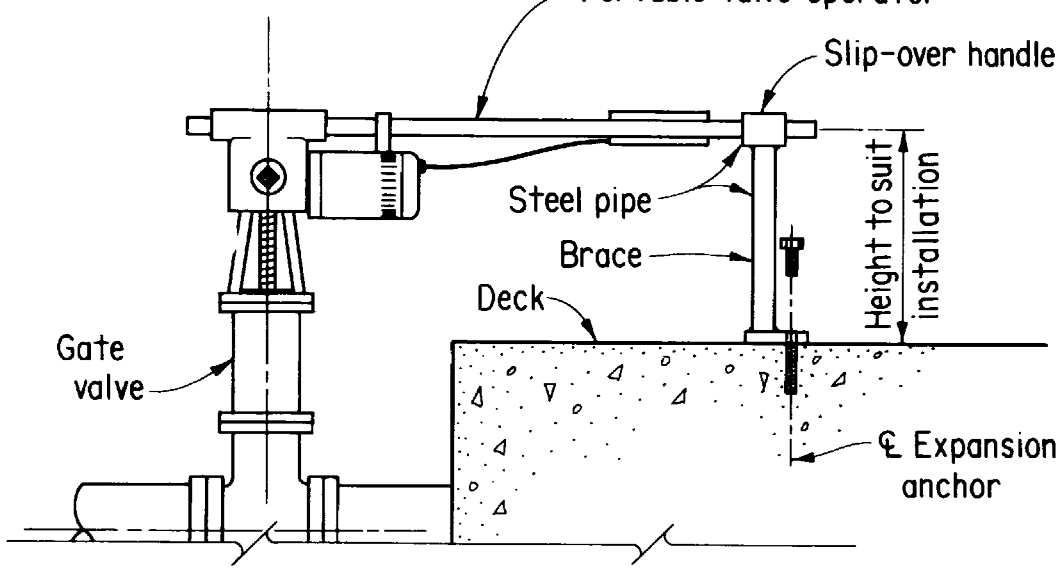


Figure 1.–Portable valve operator.



HAND HELD OPERATION



NOTE: Brace can be placed in one of four positions.

Figure 2.–Brace supported operation.

INSPECTION AND MAINTENANCE OF DAM DEWATERING FACILITIES[2]

Thomas J. Collins

Emergency dewatering of dam pools has come under closer scrutiny due to recent Federal and State dam safety legislation. Many dam dewatering facilities have not been operated in years and because they are partially hidden below water, their conditions are unknown. The dam operator often questions whether gates and valves can be opened, and fears that once opened they may not close. Located in the reservoir, often these control towers are not readily accessible and since testing their operation could mean risking a water supply or recreational pond, they are not often checked. Their ability to function properly in an emergency or even for routine maintenance cannot be assured.

To determine the condition of dam gates and dewatering structures before trying to operate them, Collins Engineers uses engineer-divers on its staff to make inspections of dewatering towers and gate facilities. The inspection team is equipped with boats to get to the tower structures, rigging and safety equipment for internal inspections, and diving equipment to inspect the submerged portions of the facilities.

Many years ago, engineers who are now members of our staff began personally conducting diving inspections because commercial divers had neither fully realized the engineering significance of what they observed nor possessed the technical vocabulary to describe precisely underwater conditions to an engineer above water. One of the most important benefits is that the engineer-diver is able to work with the client's staff on a technical level.

After completing the initial inspection, the engineer-diver can make a first-hand, on-site recommendation as to the advisability of operating the control mechanisms. The diver can remove minor debris from the immediate area of the gate to help ensure successful opening and closing. During the inspection, the diver can also make a few simple repairs such as reconnecting a stem, tightening a stem nut set screw, or cleaning debris out of gate guides.

If gate operation is feasible, the engineer-diver can reinspect the closed gate to insure that it has seated properly. If the gate does not close properly, the divers can place materials to reduce the leaking until more permanent repairs can be made.

Figures 5 through 8 depict four typical types of dewatering facilities. A number of variations and combinations of the features of each have been devised which have special characteristics but investigations of a number of dewatering facilities have indicated some potential problems common to all.

[2] Reprinted by special permission of Editor, Public Works, from December 1982 issue. Thomas J. Collins is a Professional Engineer with Collins Engineers, Inc., Chicago, Illinois.

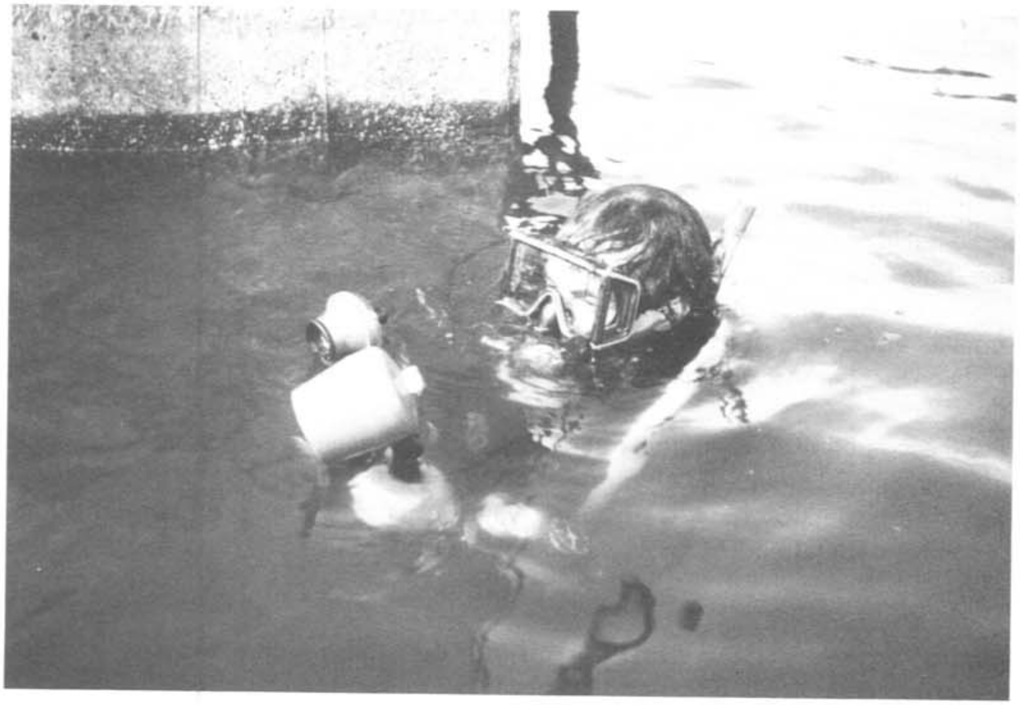


Figure 3.–Underwater camera and strobe light enables the engineer-diver to document his observations of dam dewatering facilities. Underwater video is also employed.

Common Problems

The owner must be concerned with both the condition of the concrete tower or inlet structure and the gate mechanism.

For the tower, concrete distress–spalling, scaling, and cracking – must be diagnosed. Often these conditions are visible and most severe near the surface, but their extent below the waterline cannot be determined without an underwater investigation. Unless the limits of the distress are known, the engineer cannot properly evaluate its structural significance or develop meaningful maintenance and repair policies.

The gate mechanisms must be inspected for evidence of physical damage and deterioration and should be operated periodically through their full range. Gate components to be inspected include the lifting mechanism, stem, stem guides, stem guide brackets and attaching bolts, stem nut and set screw or pin, gate disk, gate guides, wedges, stops, seats, trash racks, and bar screens. The environment in which the gate components are located is often conducive to severe corrosion and ice damage. Periodic operation of the gates also removes accumulated silt which could eventually build up and prevent operation.

Special Problems

Gates Inside Dry Towers

Gates inside dry towers (fig. 4) are normally accessible for inspection from ladders in the tower. These gates operate against an unseating head so it is important that the wedges be properly adjusted to seal the gate. Even slight seepage through the gate or through deteriorated tower walls can be significant. A moist atmosphere developed in a partially closed tower encourages corrosion of stem guides and gates. Because corrosion can also weaken metal rungs of access ladders, inspectors should enter cautiously and always wear a safety line tended from above.

After a thorough visual inspection of the equipment inside the tower, the gate might be opened with some confidence that it will function properly and can be closed. It is possible, however, that debris on the bottom of the pool or floating near the surface could become caught in the opened gate and prevent closing.

If the tower is equipped with outside trash racks or screens that can be raised, they should be checked before opening the gate. When there are no screens or racks, divers can make an underwater inspection of the tower and remove nearby debris that could be pulled into an open gate. Otherwise, the reservoir level could be significantly lowered before the obstruction preventing gate closure could be removed.

Figure 4.–Gate inside a dry tower has become severely corroded after years in a moist atmosphere. If emergency dewatering were needed, usefulness of the gate would be questionable.

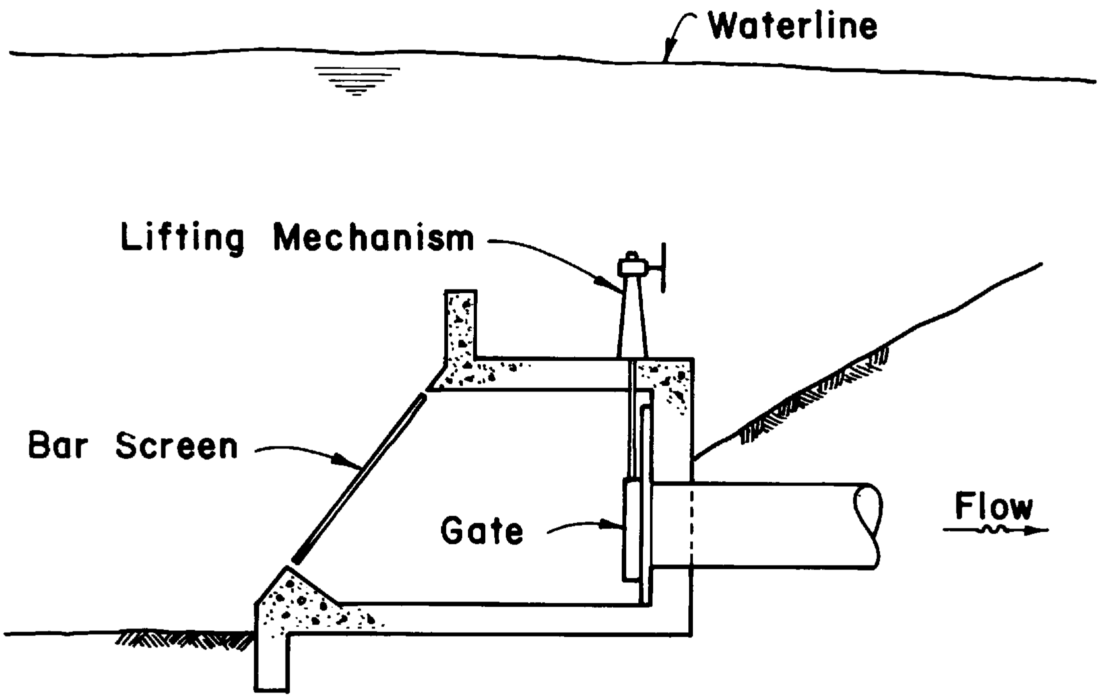


Figure 5.–Submerged outlet control.

Gates Inside Wet Towers

Gates inside wet towers (fig. 7) are normally inaccessible. When the water is at normal pool elevation, only the lifting mechanism and the top portions of the stem can be seen. Depending upon the characteristics of the dewatering conduit, the water level in the tower may drop when the gate is open so that portions of the gate can be inspected. If the gate itself is in poor condition or if the stem guides are not functioning properly however, it may not be possible to close the gate after opening it.

By making an underwater inspection of the gate and stem appurtenances before dewatering, an engineer-diver can ensure that the gate stem is firmly attached to the gate; that the stem guides are properly alined; that the stem guide brackets are secure to the tower walls; and that there is no debris at the bottom of the tower that could block the gate.

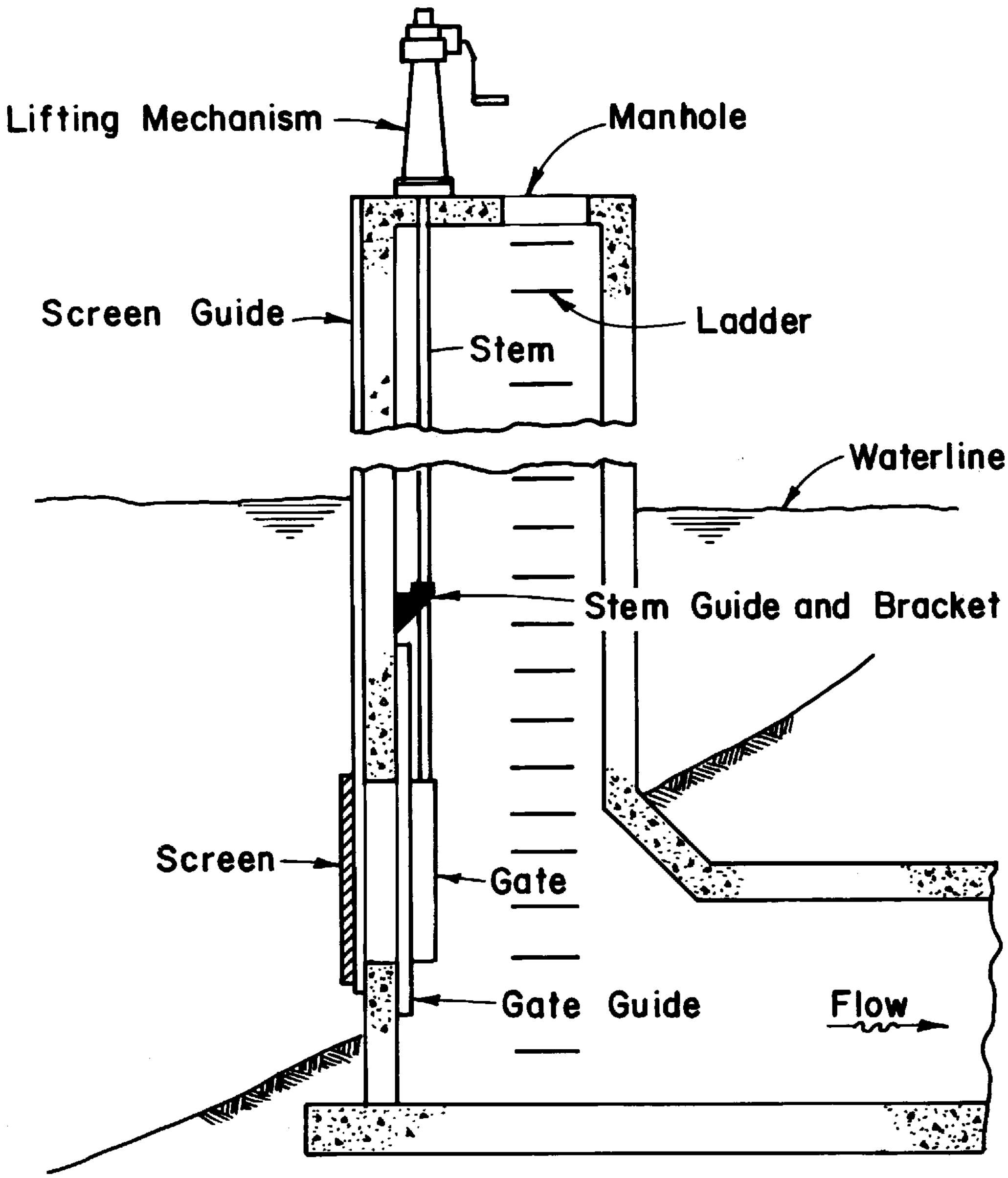


Figure 6.–Gate inside dry tower.

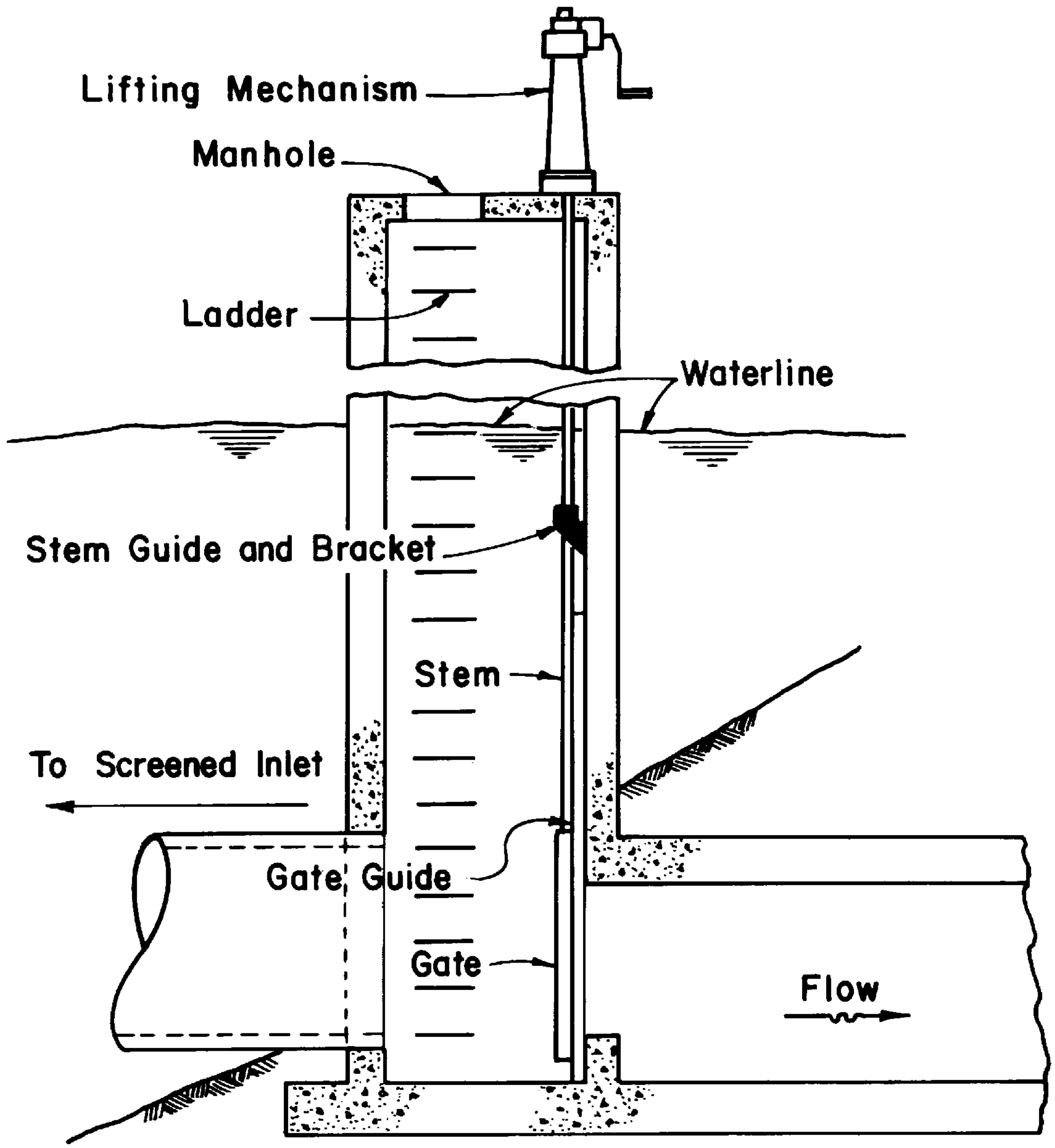


Figure 7.–Gate inside wet tower.

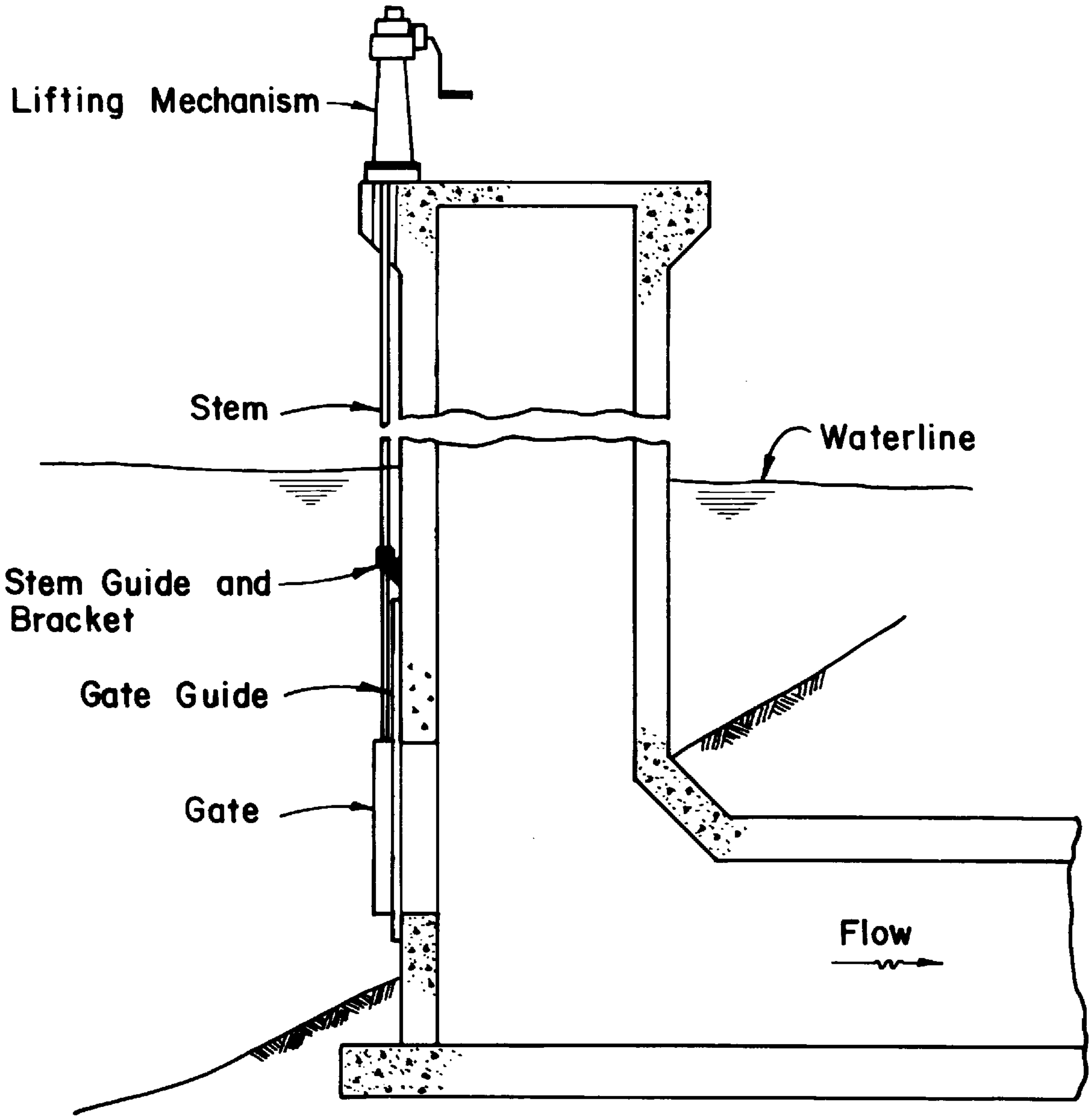


Figure 8.–Gate outside dry tower.

Gates Outside Dry Towers

Gates outside dry towers (fig. 8) and gates on upstream headwalls without towers are also inaccessible when the water is at normal pool elevation. Stem parts above water, the inside of the tower, the back side of the gate disk, and the wall thimble can be inspected but the gate guides and stem below water cannot be seen.

Outside bottom gates can become covered with silt and debris that collect at the base of the tower, but these conditions also cannot be viewed unless a diving inspection is made.

Submerged Outlet Control Works

Some small control works, such as the one shown in figure 5, have been constructed with gates, trash racks, and lifting mechanisms all located underwater. Generally, these mechanisms are in good condition because they are completely submerged but they cannot be inspected or operated except by using a diver. This type of gate can be difficult to operate even for a diver, because of the current created when it is opened.

Documenting the Inspection

The object of inspection is to provide the evaluating engineer with information he needs to assess the condition of the structure. This information can be provided to the engineer at the surface through still color photography, motion pictures, or video; but the views to be captured below water are controlled by the diver.

Collins Engineers have found that the inspection can be most effectively and efficiently accomplished when that diver is also an engineer. The engineer-diver can make an initial rapid and relatively inexpensive visual inspection and can pictorially record the significant conditions in a manner that best fits the project. Often a simple sketch and narrative is sufficient.

Specially sealed 35-millimeter cameras and strobe lights can be used for underwater still photography. When suspended materials in the water reduce visibility to a few inches, pictures can usually be taken by shooting through a clear acrylic plastic box filled with clean water. Underwater video cameras and video recorders can also be used for "real-time" above water viewing.

Any or all of these methods might be used for a specific job, although still color photography of significant conditions is usually most convenient. Photographs can most easily be included in reports and filed for review and comparison at a later date.

* * * * *

GERING-FORT LARAMIE IRRIGATION DISTRICT [3]

Proper operation and maintenance practices can benefit you as they did the Gering-Fort Laramie Irrigation District.

During the Bureau's scheduled Review of Operation and Maintenance examination of minor facilities of the Gering-Fort Laramie Irrigation District, an example of operational modification to avoid maintenance problems was cited by the manager. It has been observed that by properly operating some check structures, the erosion of the canal walls can be greatly reduced. By performing more checking in the center of the structure, more of the flow will run along the outside and is deflected back to the middle, thus reducing erosion downstream of the wingwalls.

Also, grading practices on O&M roads along canal banks can increase or decrease erosion problems. Where a windrow has been left on the outside edge of the road, stormwater will have a tendency to break through eroding the roadway. Preferred grading practices would be to spread the bladed material over the road and eliminate the windrow entirely, or leave the windrow on the inside edge of the road and slope the road to the outside to allow for better drainage.

* * * * *

[3] Information provided from Review of Operation and Maintenance Program 1982 Examination Report by Darrel E. Krause and Lowell F. Ploss, Bureau of Reclamation, Denver, Colorado.

DRAINAGE: THE OVERLOOKED WAY TO BOOST YIELDS, RECLAIM LAND [4]

Hartt Porteous

If middle eastern farmers 25 centuries ago had been able to do what J-W Farms on the Tulare Lake Basin is doing now with drainage, the course of history might have been drastically changed.

J-W Farms' 18-section project is the largest of its kind in the United States, and may suggest a course of action for other growers who have many acres of deteriorating land. Not only has it resulted in more fertile land, but the project began paying for itself the first year. The effect of drainage is clearly seen from air photographs, and also in the growing crop.

This project has the added attraction of being capitalized with money from the Federal Land Bank, so the returns are seen as worthy by both grower and lending institute. (At present it is judged that for a $250 an acre investment, an added land value of $650 is practical.)

Perched-water Problems

J-W Farms recently bought this old Tulare Lake land, reported to have been producing only marginally, because of the area's low cost of farming. J-W planned to change the production pattern for cotton and alfalfa, but found some formidable problems attached to draining the 0.6- to 1.2-m (2- to 4-ft) perched-water table this land has been subjected to.

For starters, the land is as level as a lake bottom suggests, and drainage needs slope. So several suppliers and engineering firms (True Engineering, Lidco drainage contractors, Wren-Oneal irrigation suppliers, C&J sump construction, Moosios Pumps, and ADS drainage pipe) were called in to assist in this 2-year project. Ed Gorman of Land Improvement Development Company was the principal contractor, as well as the manufacturer of high-density polyethylene drainage tubing.

The solution to the perched-water problem began with soil analysis and infiltration rate tests that showed it would be possible to place plastic tile-type piping at 152.4-m (500-ft) intervals. This is considered far apart for many soils, but was found to be practical with the unexpectedly permeable lake-bottom land.

Butch Brisco, J-W agri-drainage engineer and project coordinator, found such a drainage project would have been impossible in the time allotted without preliminary enginering being completed with the aid of aerial photography and knowledgeable drainage engineers. Even after thorough preliminary engineering, some unexpectedly tough construction was thrust upon C&J sump construction.

The high standing water level meant that the 6.7-m (22-ft) deep collection sumps could not be constructed normally. So round concrete caissons were built on top of the ground and sunk into position as the mud was excavated from inside the caisson with a clamshell. The caisson then sank slowly as concrete pouring continued, reaching its final resting place in record time.

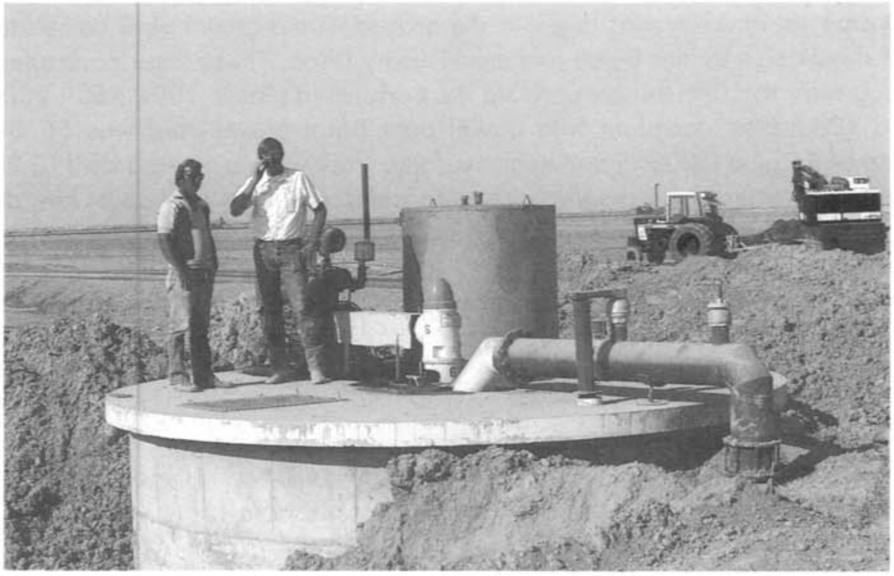


Figure 9.–Butch Brisco, J-W's agri-drainage engineer and project coordinator, and Ed Gorman of Land Improvement Development Company, survey the work as it progresses from atop one of the 6.7-m (22-ft) deep concrete sumps.

Figure 10.–A lasar-controlled "ditchwizard" development by the Dutch and modified by Land Improvement Development Company digs a trench for perforated plastic pipe.

The plastic tile pipe, meanwhile, was dug into the ground with a gravel pack completely surrounding it, by machines developed by the Dutch and modified by Lidco. These laser-controlled ditch wizards dug a 2.1- to 3.0-m (7- to 10-ft) trench, and laid the perforated plastic 100-, 150-, 200-, and 300-mm (4-, 6-, 8-, and 12-in) pipe complete with gravel pack (total gravel used was 55, 340 mg (61 000 tons), at the rate of 1524 m (5000 ft) per machine daily. They were powered by 313 200-W (420-hp) engines, which drove high-speed digging chains to completely lay and cover the drainage tubing at the rate of 7.6 m (25 ft) per minute.

The varying depth of drainage pipe was to provide slope to allow collection of the water into the 6.7-m (22-ft) deep concrete sumps. All pipe connection, between differing pipe sizes and sumps, were made using backhoes after the pipe was in place.

The sumps, topped by a 150-mm (6-in) concrete top, have automatic start-stop diesel engines complete with fuel and oil supply to lift sump water into four 64.7-ha (160-acre) holding ponds. There the water will evaporate at the rate of about 690 750 m^3 (560 acre-ft) per year. Other drained water is taken by a drainage district.

Immediate Results

With a project this size, part of which was completed last year, some results were expected right away. Aerial photographs indicate that the once-bare spots in a field are completely covered over with good green growth in some cases, and are shrinking in other tougher spots. There are no yields as yet to go by, but Brisco says the current condition of the cotton planted on land drained last year seems to indicate a production of at least a half bale more than last year. He confidently says he expects a bale and even a bale-and-a-half increase as the land attains the fertility that tests say it should have.

Butch Brisco and J-W Farms owners say they think the project is going to better the outlook and production of this lake-bottom land, and the production on a great many similarly affected acres in California and throughout the country.

* * * * *

CONFINED SPACES – ENTER WITH CARE [5]

One of the most frequently performed and potentially dangerous maintenance tasks is entry into a confined space.

So many variables can be introduced that can turn a confined space atmosphere from a safe into a hazardous atmosphere that this subject warrants its own discussion. Therefore, the thrust of this article will be proper procedures to follow in order to effect the safe entry, accomplish the job-tasks, and exit the confined space safely.

To begin, let us define confined space. A confined space would be any tank, kettle, tower, vessel, bin, tank truck, rail car, pipeline, boiler, duct work, tunnel, or sewer that has a limited access opening (such as a hatch, manhole, small door, and so on).

Also defined as confined spaces are any pits, excavations, dikes, and so on that are open at the top but are over 1.5 m (5 ft) in depth and are areas of known or suspected asphyxiating or toxic chemical releases.

Any entry into a confined space should be considered potentially hazardous until certain conditions have been met:

1. Written work permit.–In order to assure that the proper measures are taken to guarantee a safe atmosphere, some type of written checkoff system, such as a safe work permit, should be utilized. This written system should provide all persons involved with information that covers areas such as: Location and description of work; description of chemical substances involved; safety equipment required; safety precautions required; atmospheric test results; necessary approval signatures from management; and a signoff section for the servicing department.

2. Securing area.–Before any entry into a confined space, the area must be secured. This involves blanking or disconnecting all chemical lines feeding into the confined space and locking out all electrical equipment.

3. Decontaminate or clean.–The equipment or area should be decontaminated or cleaned. This may involve purging, flushing, neutralizing, or other processes.

4. Ventilation.–Before entering a confined space, a positive method of ventilation should be provided. This system is generally preferred over natural ventilation.

5. Atmospheric testing.–Before entry into a confined space, the atmosphere should be tested for oxygen levels, combustibility, and toxicity. After initial testing, oxygen monitoring should be continuous. A retest for combustibility should also take place periodically.

---

[5] Reprinted from National Safety Council's "Today's Supervisor," November 1982 issue. Article by Gary Lopez, Supervisor of Safety and Health, ICI Americas, Inc., Wilmington, Delaware.

6. Protective equipment.–All protective equipment required for work in the confined space by the safe work permit should be utilized before and during entry into the confined space.

7. Watcher.–A person must always be posted outside a confined space. This worker may pass tools and check airline sources, but should have no other job that will take attention away from the persons in the confined space. The watcher must have a means to summon aid in the event of an emergency. This could be a warning horn, a radio, or some similar type of communications device.

At no time should the watcher enter the confined space until the summoned aid or rescue team has arrived at the scene to provide assistance. The watcher or any rescuers who are going to enter the confined space should always have an air supply separate from the supply of those within the confined space, in the event that people in the confined space lost consciousness due to failure of their air supply.

Special circumstances of some confined space entries may dictate additional measures.

It is a good practice to train employees periodically on what your company practices on confined space entry involve. This includes how safety equipment is utilized, especially in regard to rescue and escape.

* * * * *

GPO 839-284