

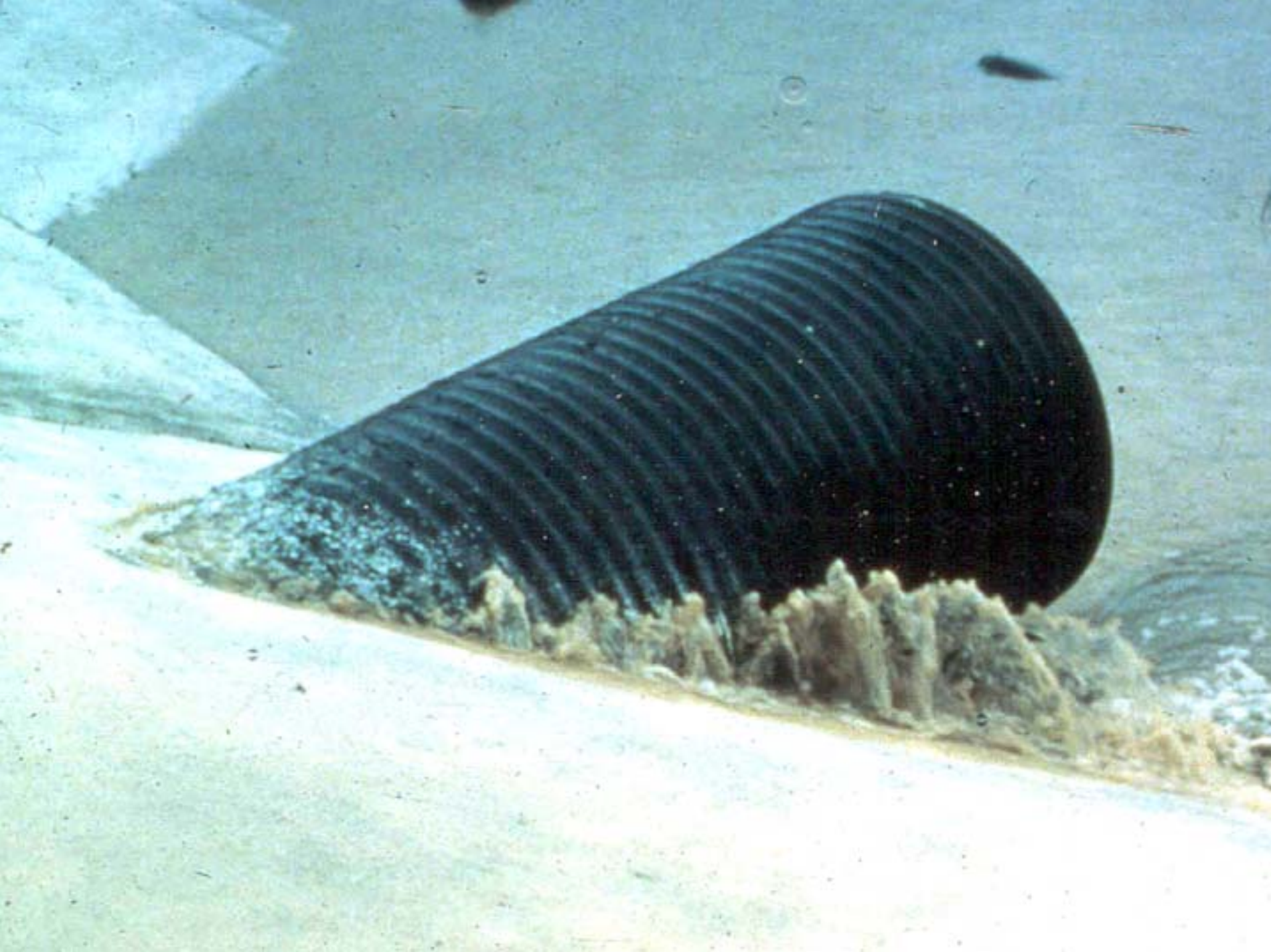
DAM FAILURES and **CONSTRUCTION** **INSPECTION**

by
Hal Van Aller
Maryland Dam Safety





Embankment Dam Schematic











DEC 11 2001







**Anti-seep
collars do
not
prevent
seepage
failures!**





**78 inch CMP viewed
from downstream**



**Failed PVC pipe with
anti-seep collar**





What caused these failures?



- Design
- Construction
- Inspection
- All of the above??



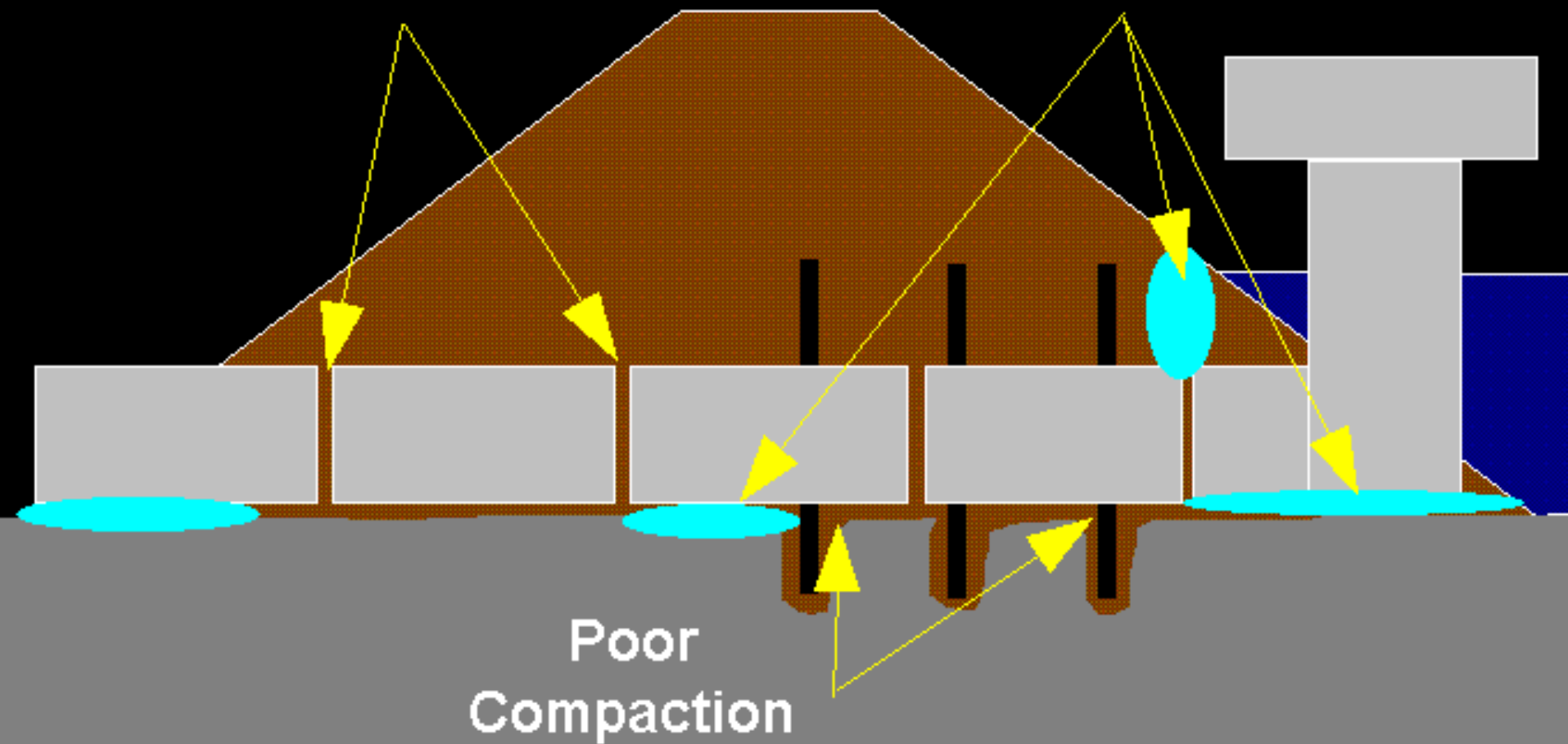
Spillways are “Confined Space”



TYPICAL PROBLEMS

Open
Joints

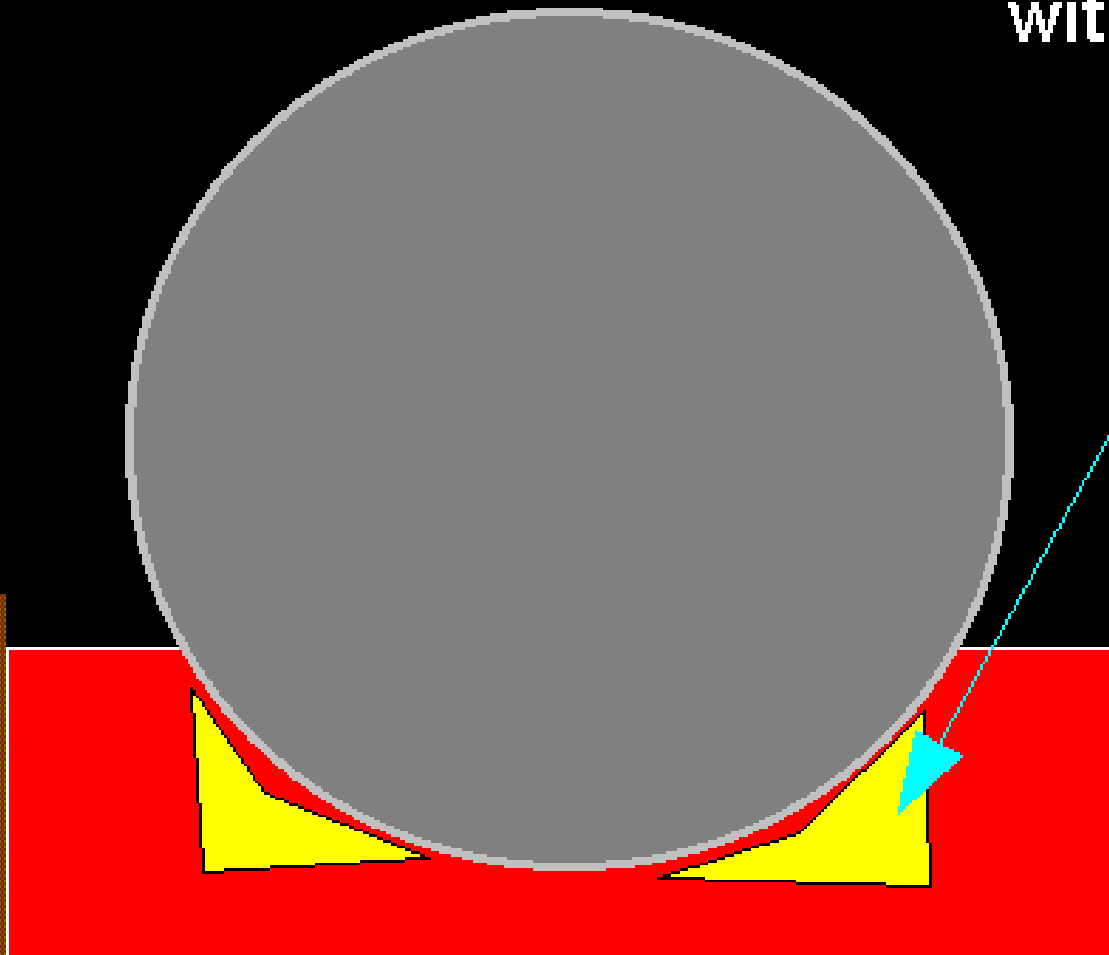
Sinkholes
and voids





ГОР

Proper compaction in haunch area is critical, but difficult to do with cohesive soil

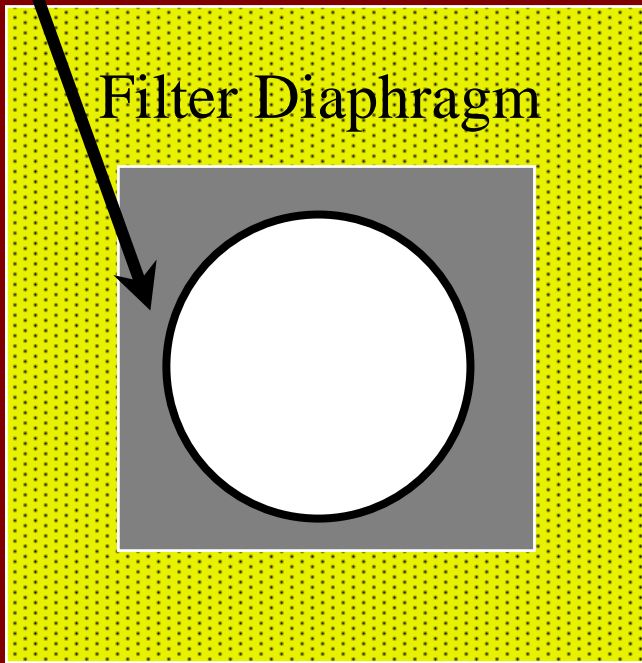


Pipe Installation in Dam

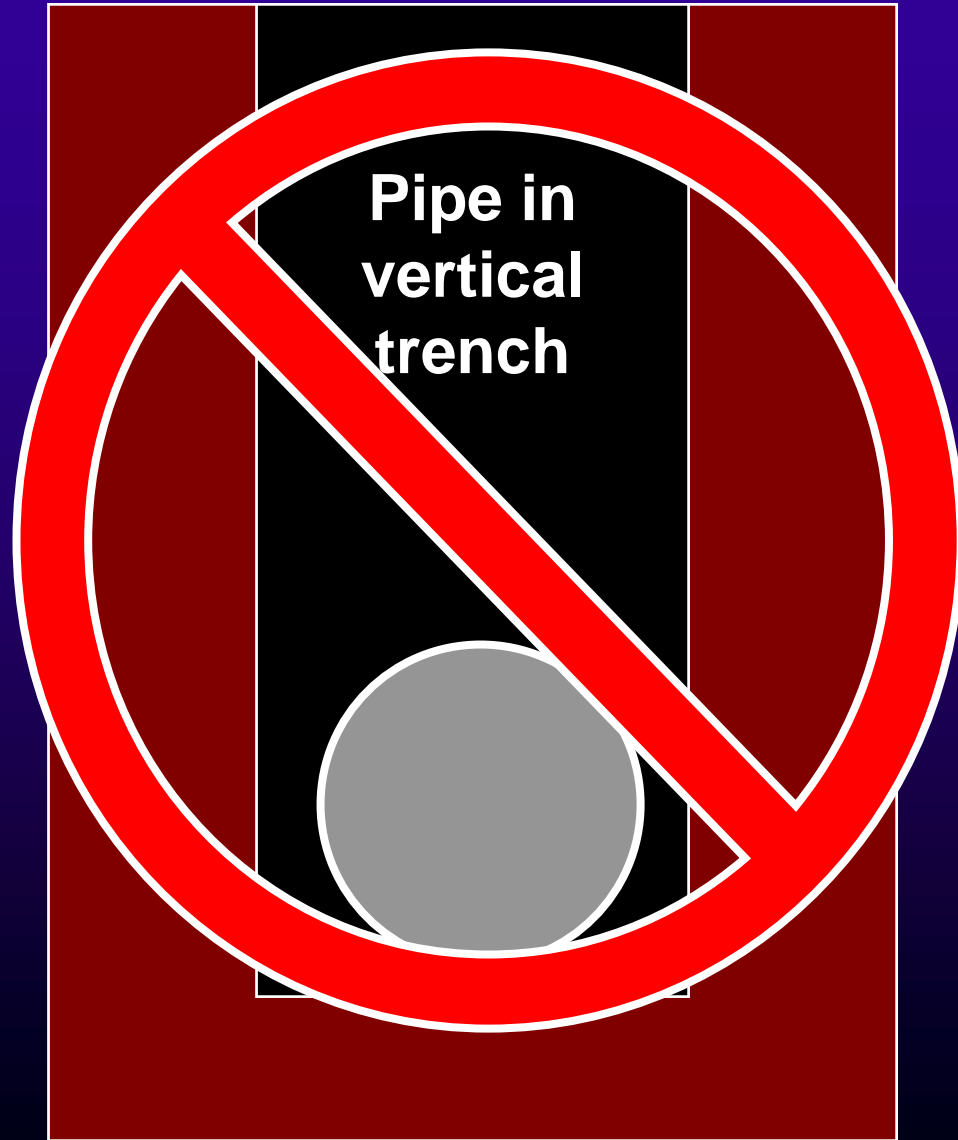
Dam Embankment

Flowable Fill

Filter Diaphragm



Pipe in
vertical
trench







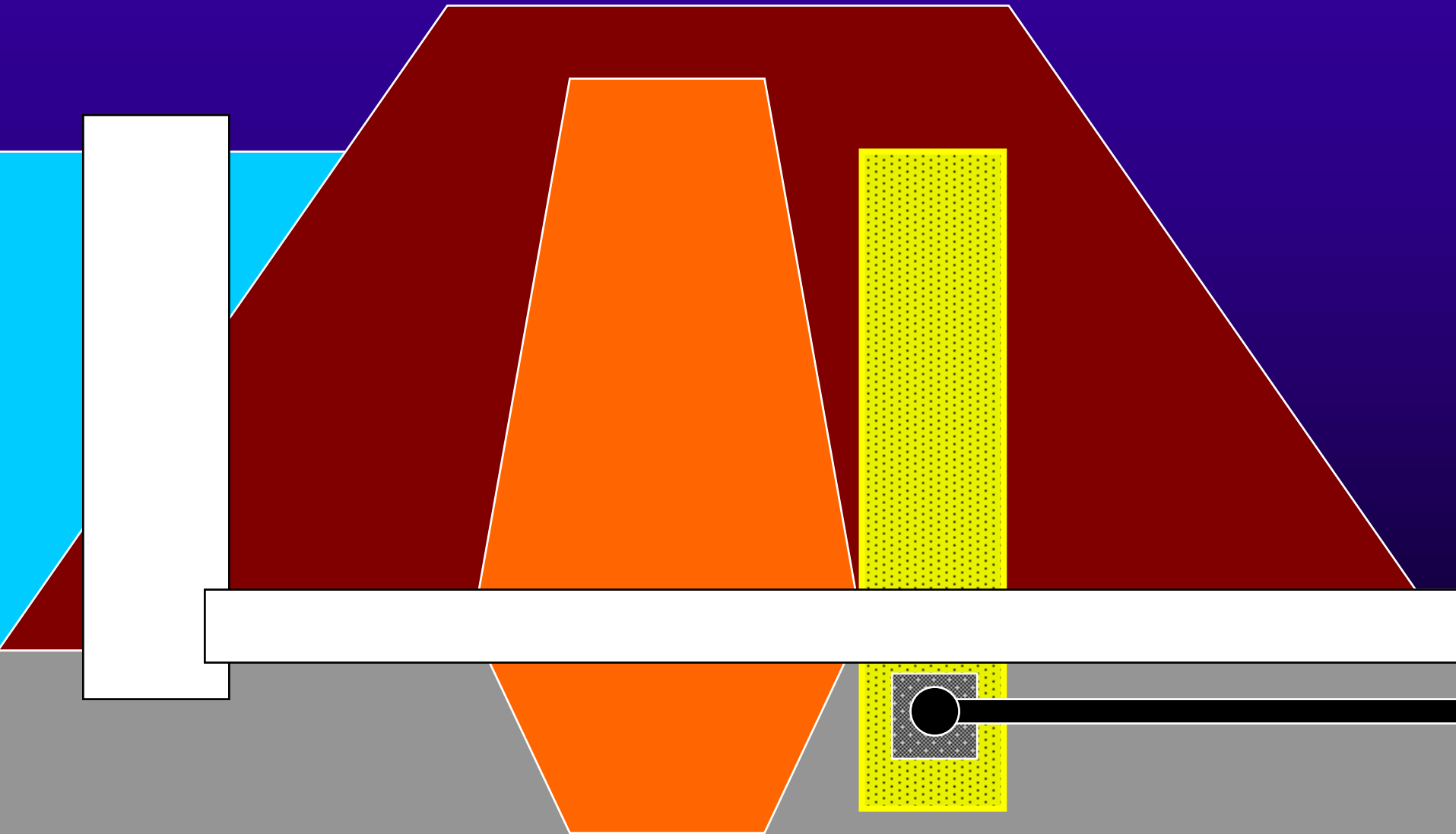


15 ft





FILTER DIAPHRAGM





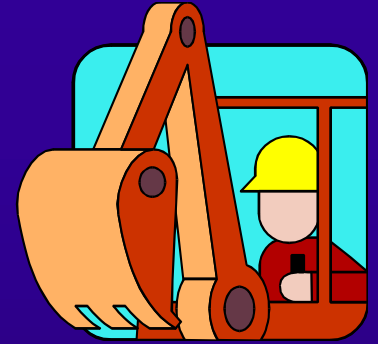






CONSTRUCTION

Experienced contractor desired

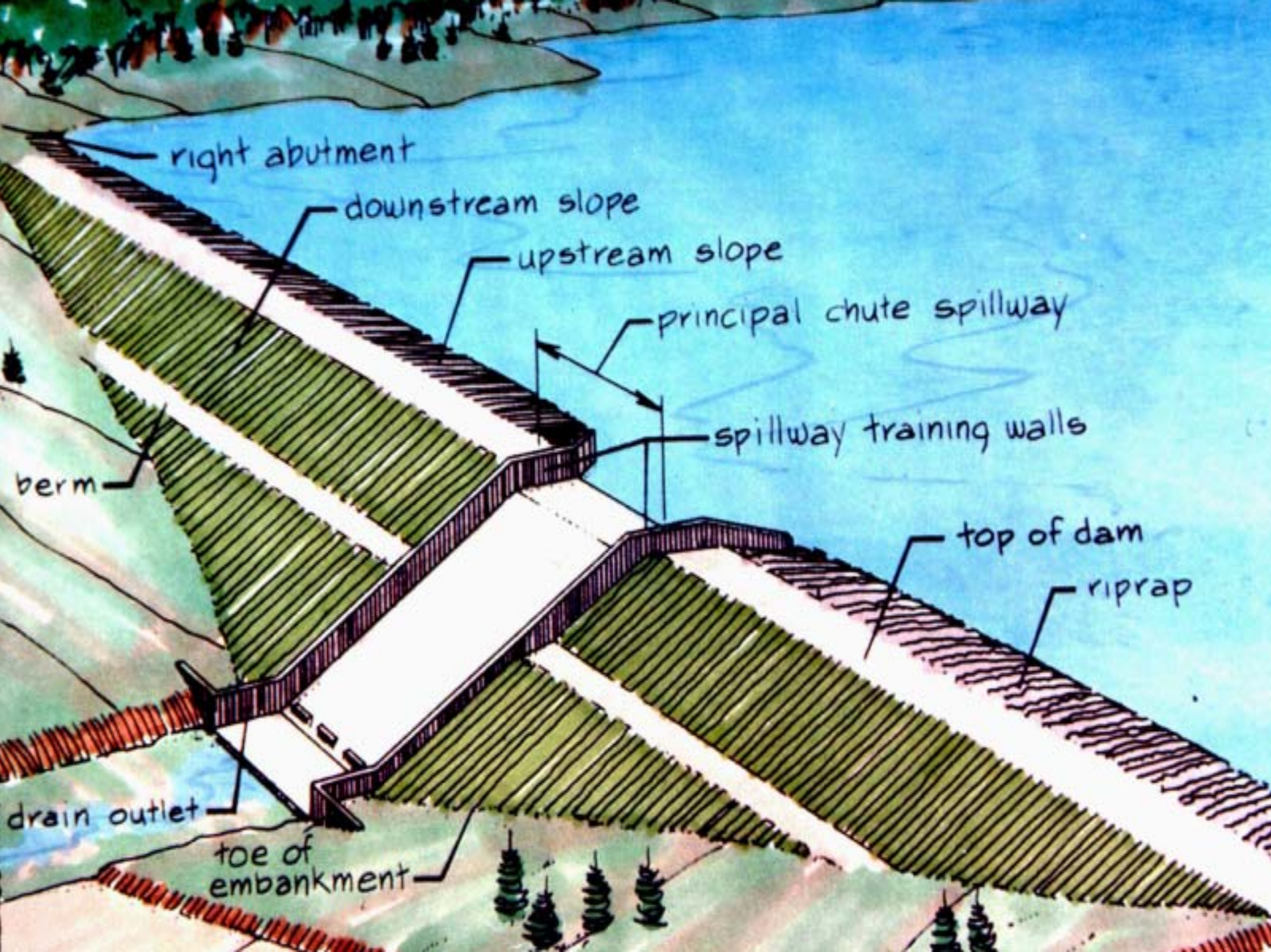


- **must realize that ponds are different from roads and utilities**
- **must work with design engineer**
- **compaction along spillway is critical-- don't construct embankment and then cut trench**
- **spillway joints must be watertight**

Alternative Designs

- **Avoid large diameter CMP**
- **User weir or drop box structure**
- **If pipes unavoidable, use:**
 - **Concrete pressure pipe (min. ASTM C-361)**
 - **Complete concrete cradle or flowable fill**
 - **Watertight joints**
 - **Filter diaphragm**
- **Avoid combining pond with road embankment**

CHUTE SPILLWAYS SCHEMATIC



right abutment

downstream slope

upstream slope

principal chute spillway

spillway training walls

top of dam

riprap

berm

drain outlet

toe of embankment





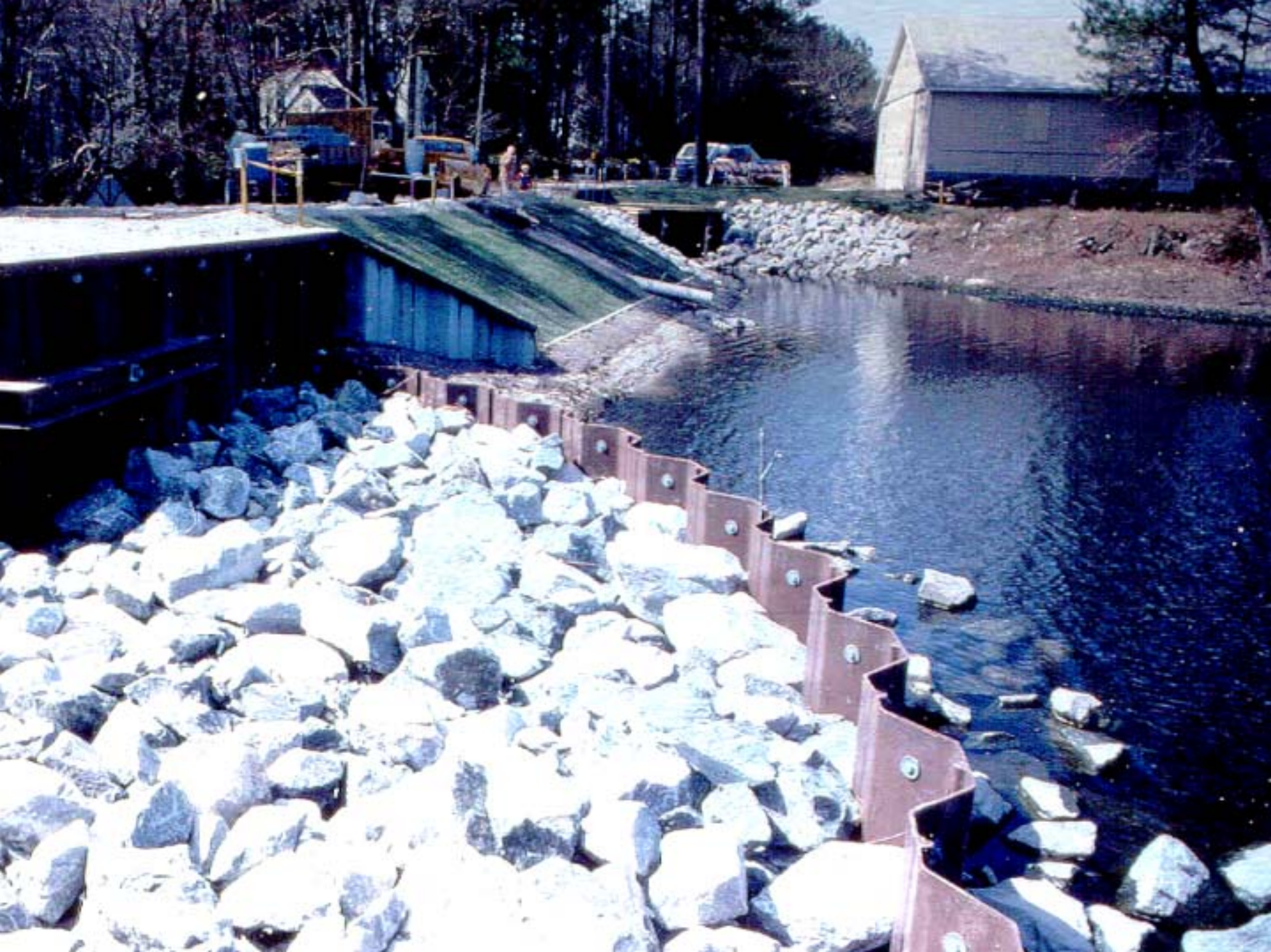
JUN 5 2001



**CMP spillway on steep slope
through dam embankment**







Do's and Don'ts for Pond Design and Construction

- Don't use anti-seep collars to “stop” leakage
- Do use filter diaphragms
- Don't allow spillway installation in trench
- Do require watertight joints
- Do inspect each pipe joint as it is put together so it can be redone if necessary
- Do consider alternative spillway design that eliminates pipe through dam or foundation

Inspection

More than just testing Compaction!

- Inspector should:
 - work for the design engineer, not the contractor
 - understand design assumptions and effects of unanticipated conditions
 - not allow deviation from design without design engineer's approval
 - observe and document: pipe mfg marks, joint type, gasket material and size, and installation procedure

Foundation

- Proof rolling
- Inspection by Geotechnical Engineer

Compaction

- Use STANDARD Proctor (ASTM D-698 or AASHTO T-99)
- Do Not use MODIFIED Proctor (ASTM D-1557 or AASHTO T-180)
- Nuclear gage readings need to be corrected to match lab moisture & density

Utility Conduits

(water, sewer, gas)

- Pipes through the dam must meet spillway requirements
- No granular backfill for pipes parallel to the dam axis

Pre-cast riser structures



Anchor Plates

Movement



Leaky Joints



Concrete Pipe Installation

- Pipe supports
- Clean and Lubricate joints
- Lubricate Gasket
- Tension Gasket
- Full concrete cradle, not just bedding
- If not o-ring gaskets then owner and engineer must approve







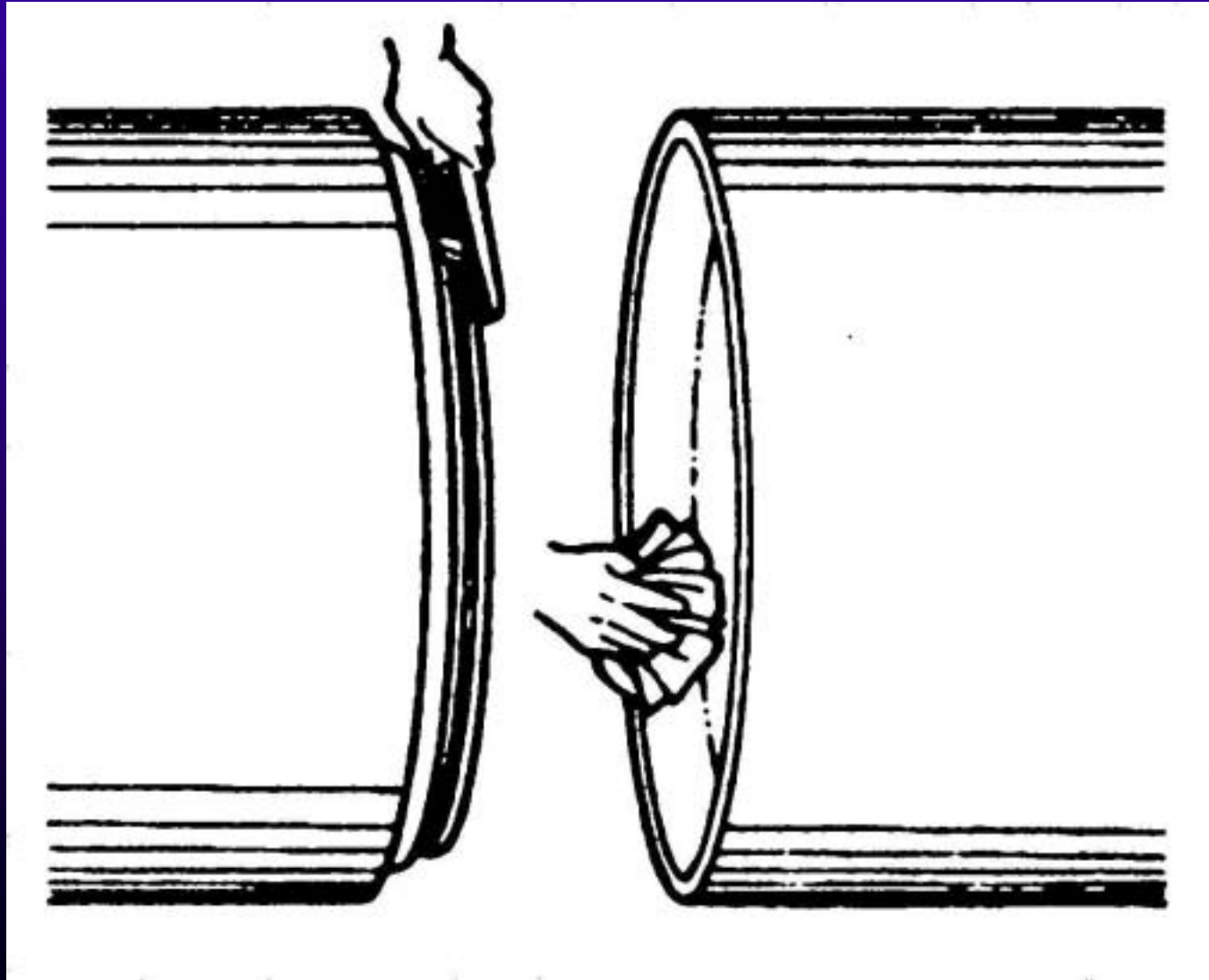
Prepare foundation and supports



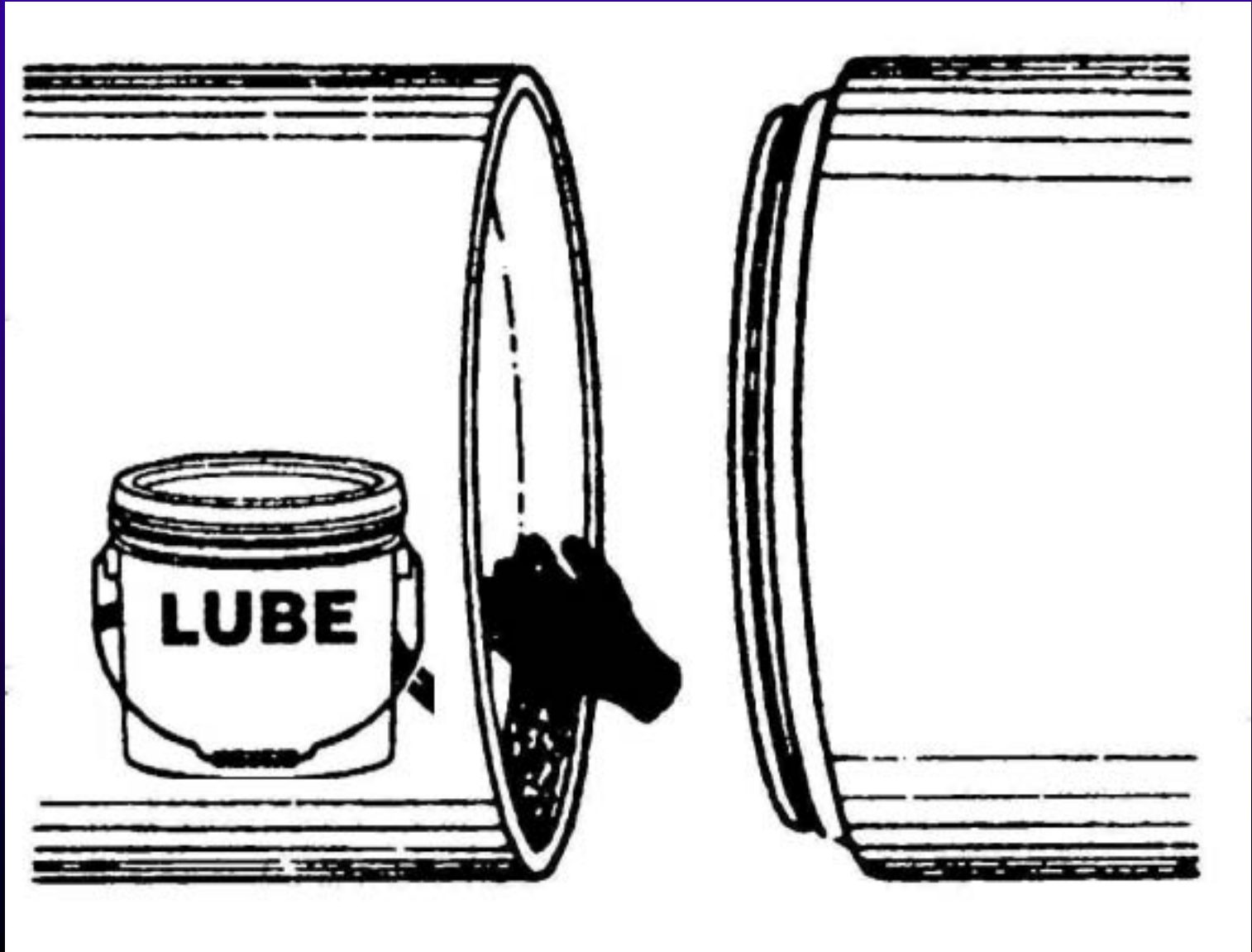
Mudmat is a good idea



Clean joints



Lubricate joints

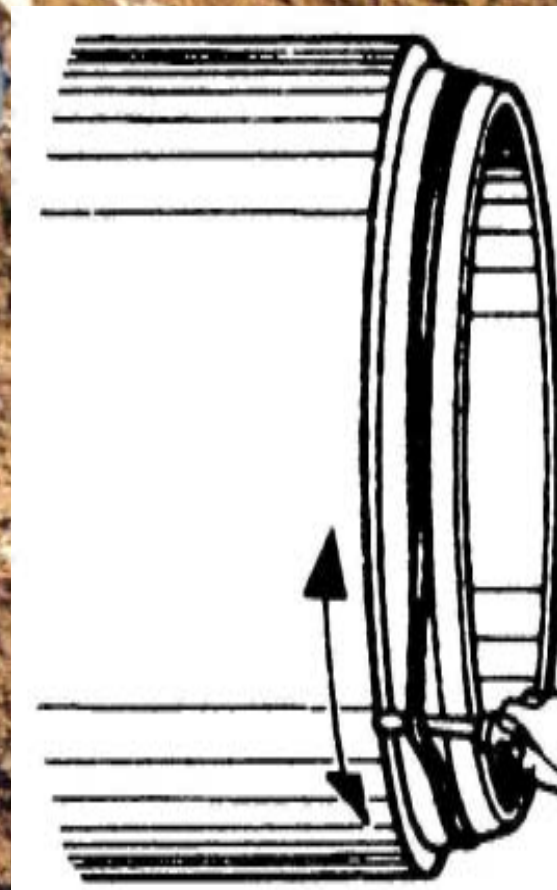


Lubricate o-ring

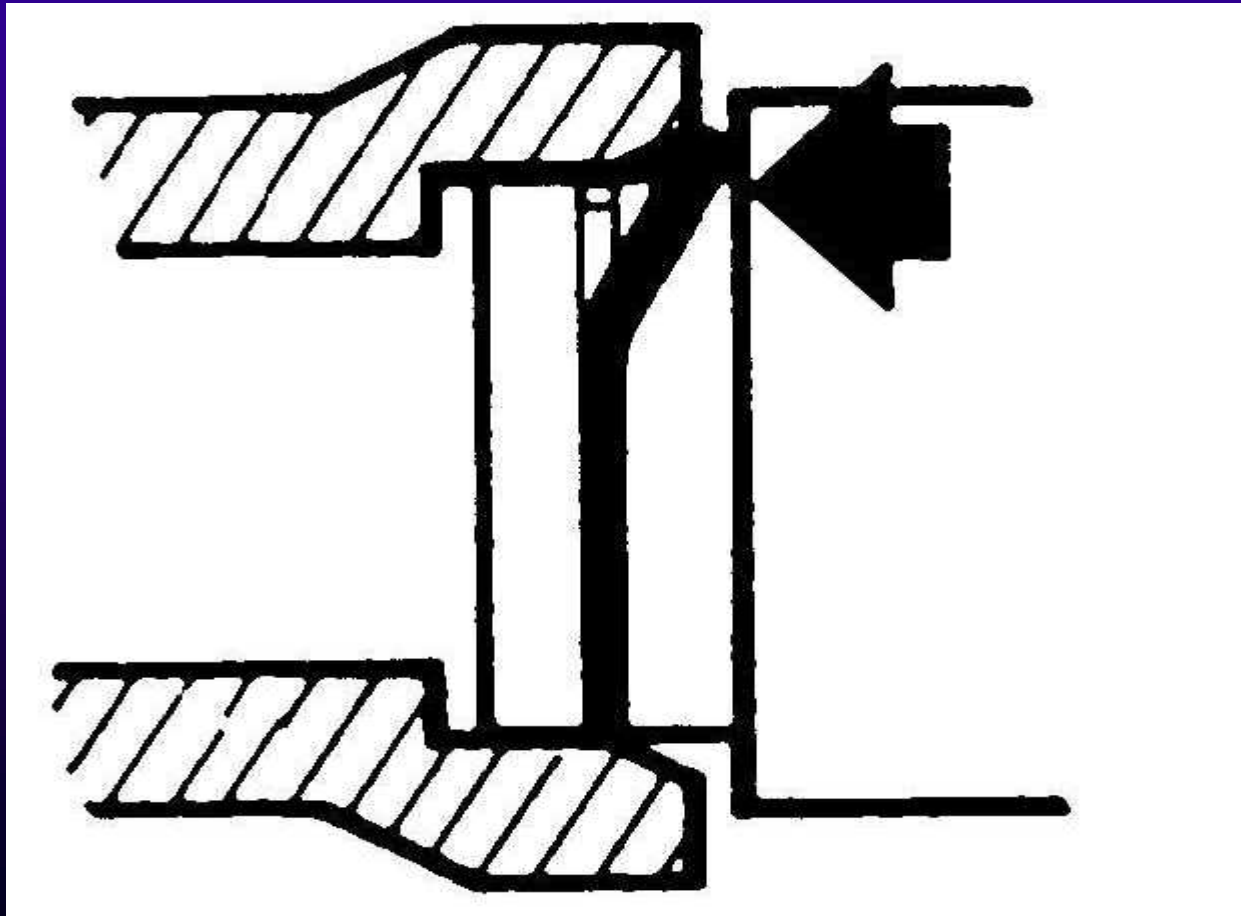




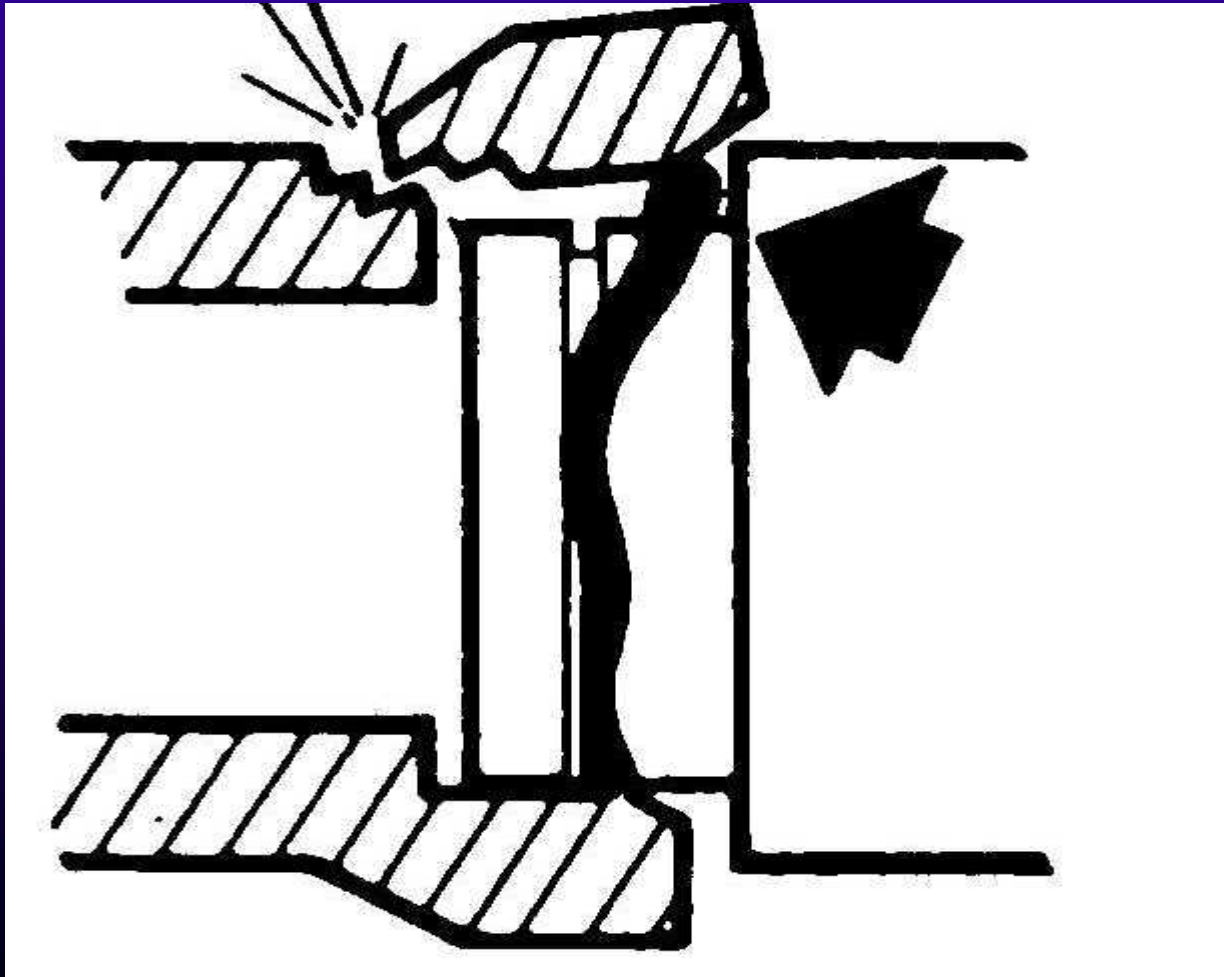
**Tension o-ring with
round-shaft
screwdriver**



Mis-aligned o-ring ...

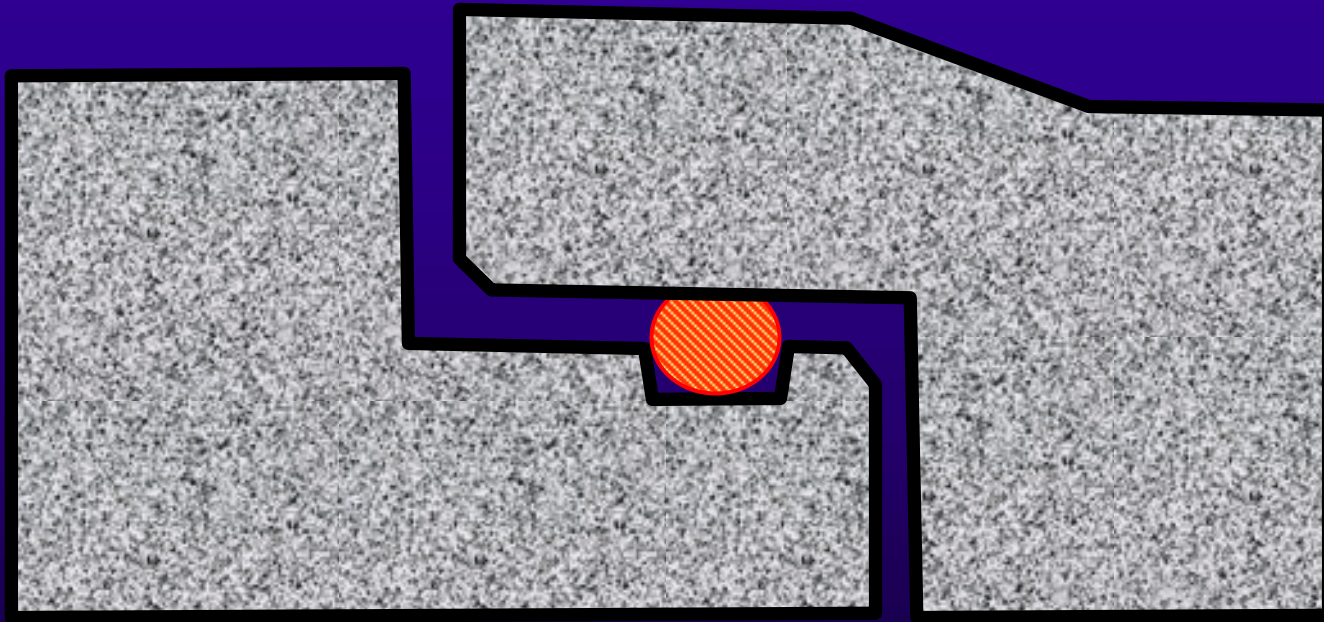


...causes broken bell



Gaskets for Concrete Pipe

Traditional O-ring joint



- Deep joint allows for substantial extensibility
- Symmetric design accommodates internal or external pressure

Newer “Profile Gaskets”

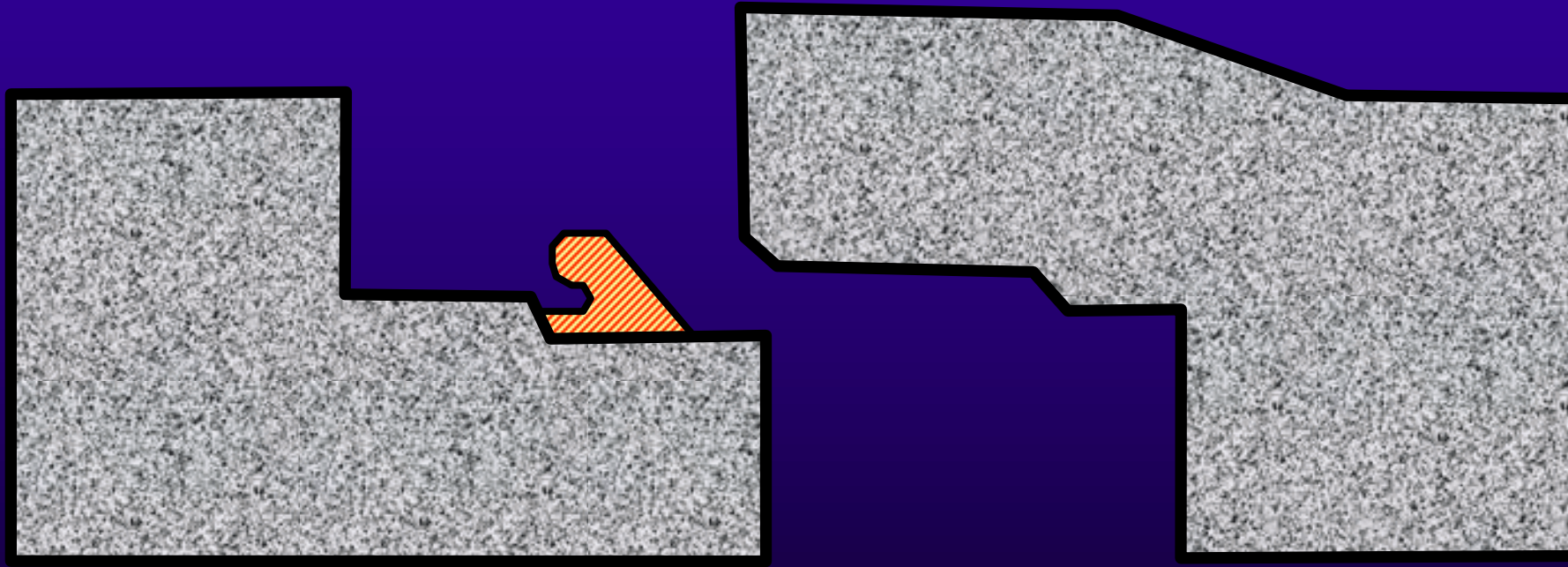


Press-Seal Gasket Company states these “advantages” over o-rings:

- **Stepped joint is cheaper to manufacture than groove for confined o-ring gasket**
- **Easier to install, less force needed to “home” joint**
- **Less bell breakage**

Gaskets for Concrete Pipe

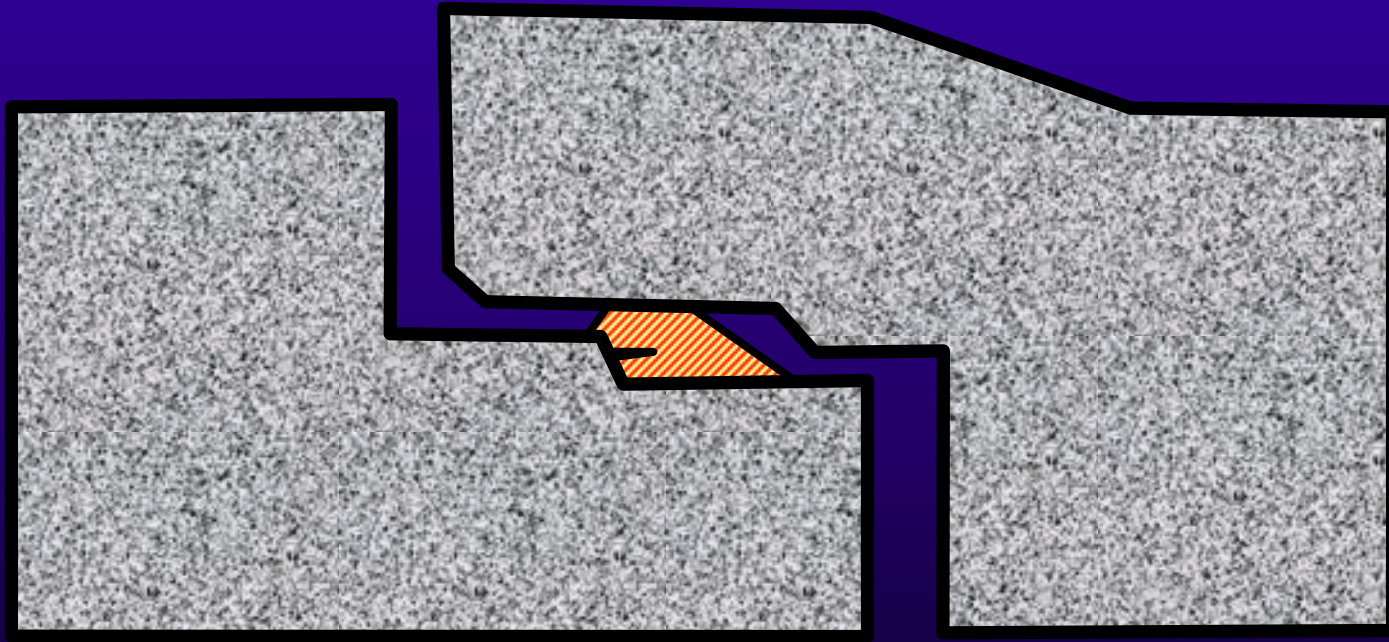
New style "Profile Joint"



- Smaller joint separation allowance
- Designed for internal pressure

Gaskets for Concrete Pipe

New style "Profile Joint"



Formed concrete cradle





**Cradle
poured
against
soil**



**Poor
installation**











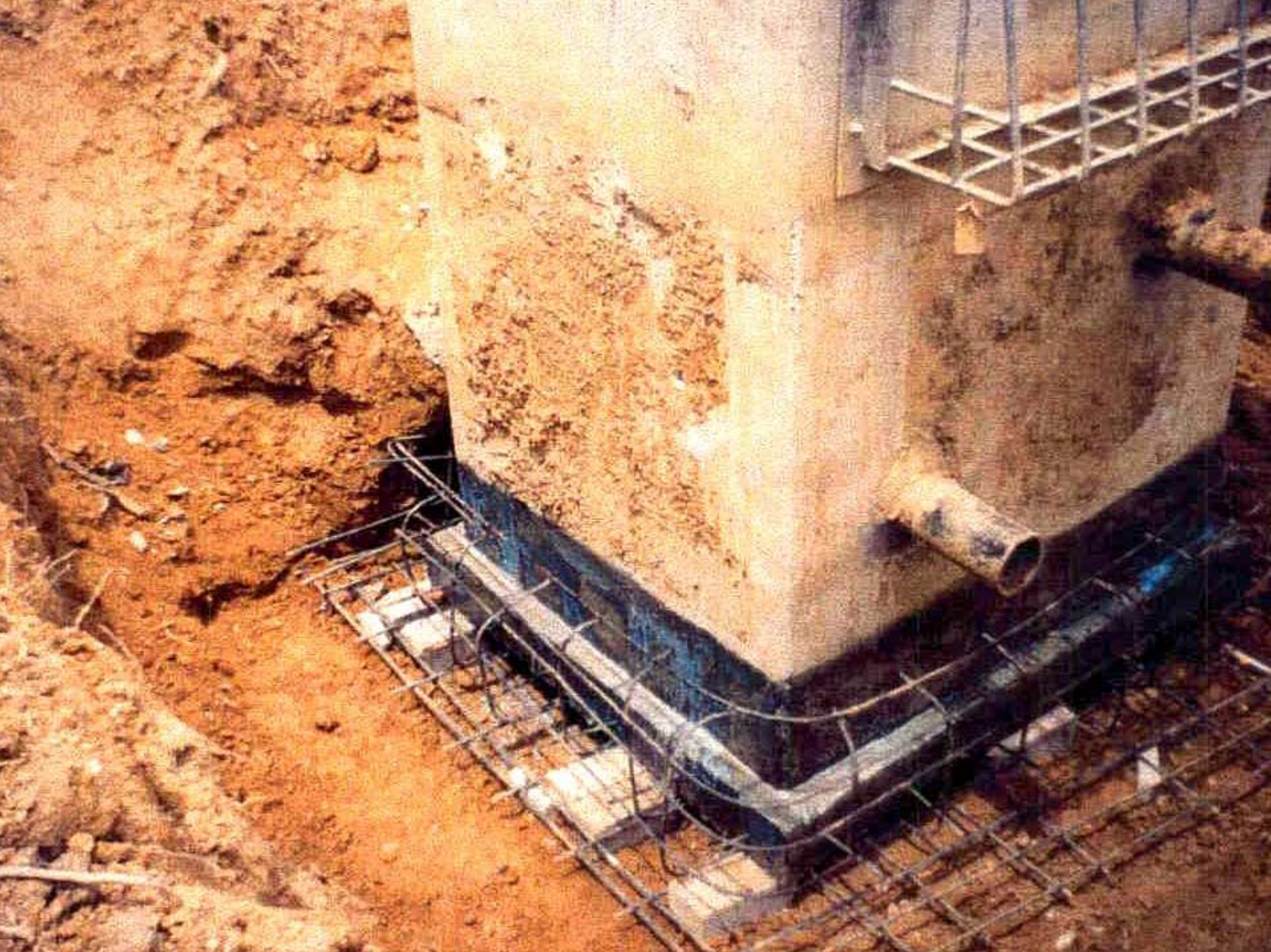
Weir Elev
=150.57

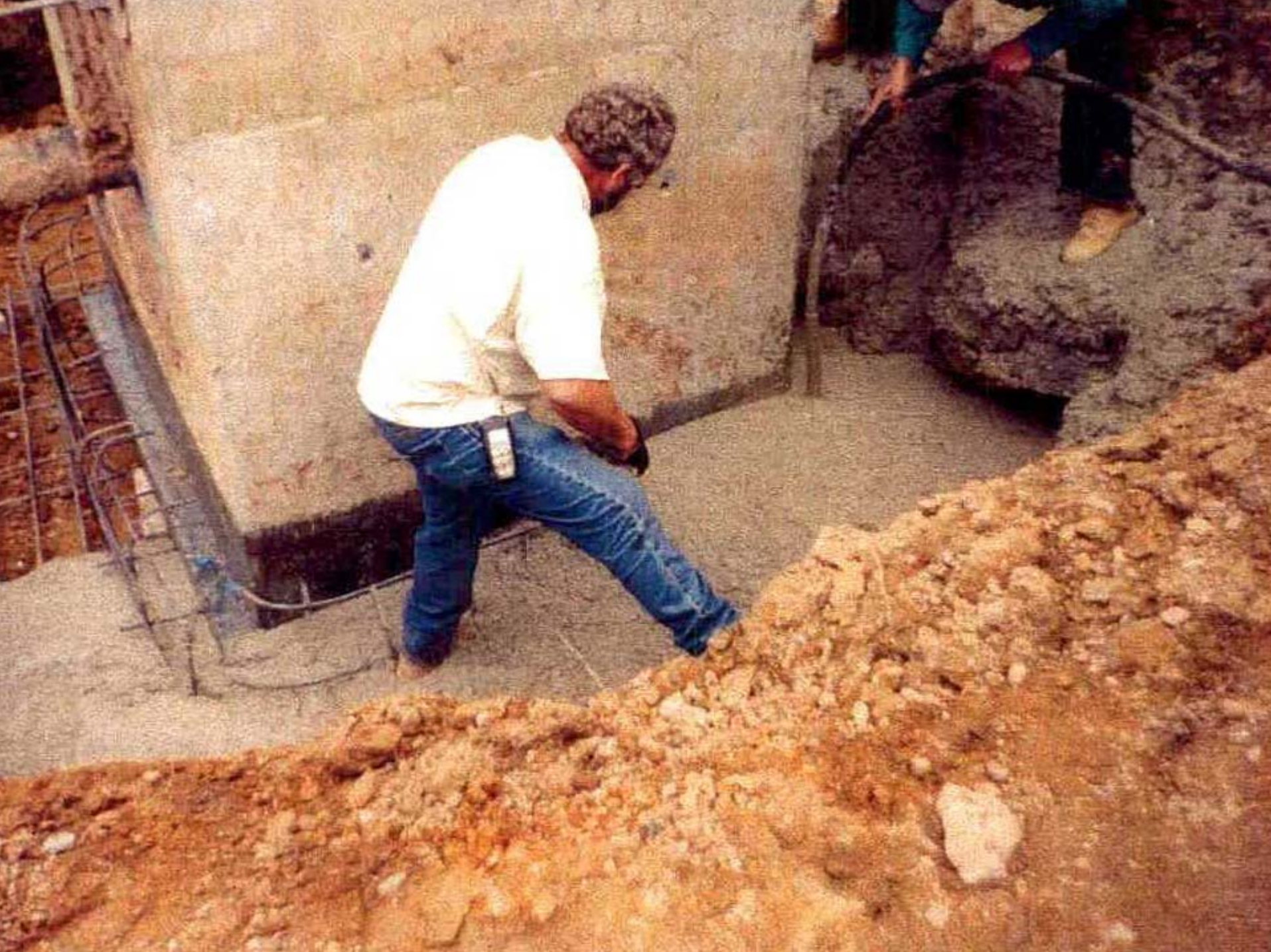








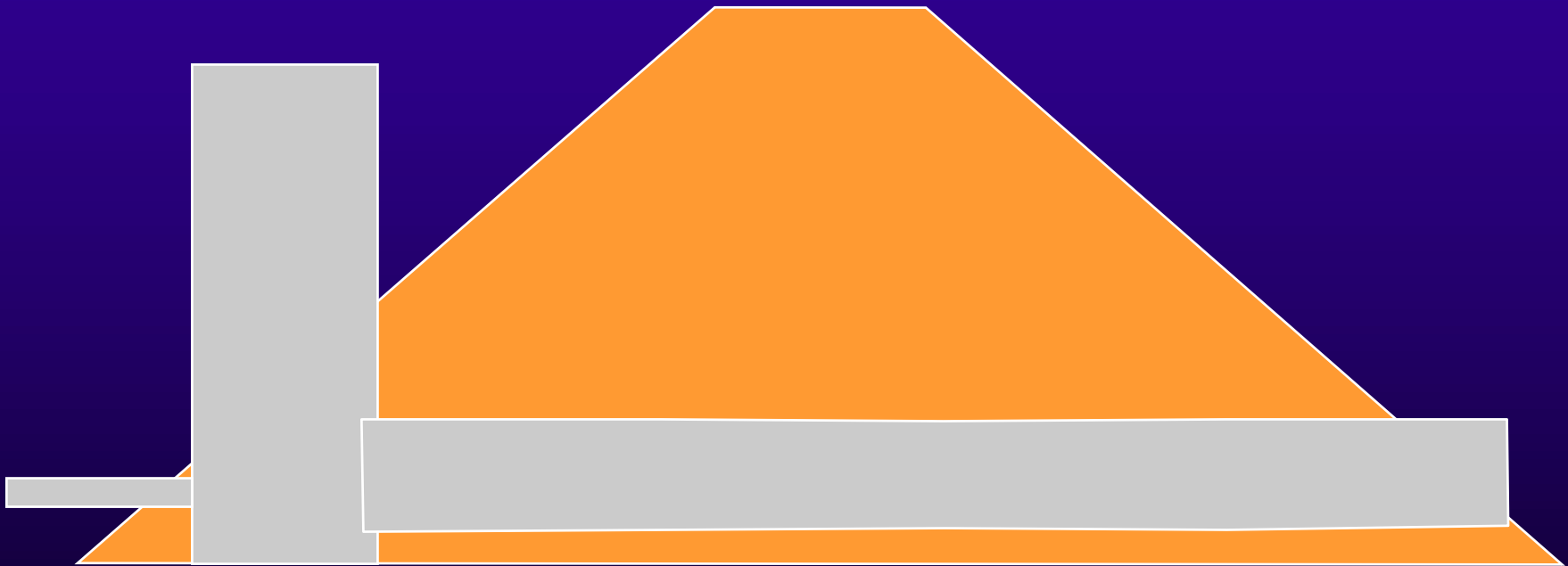






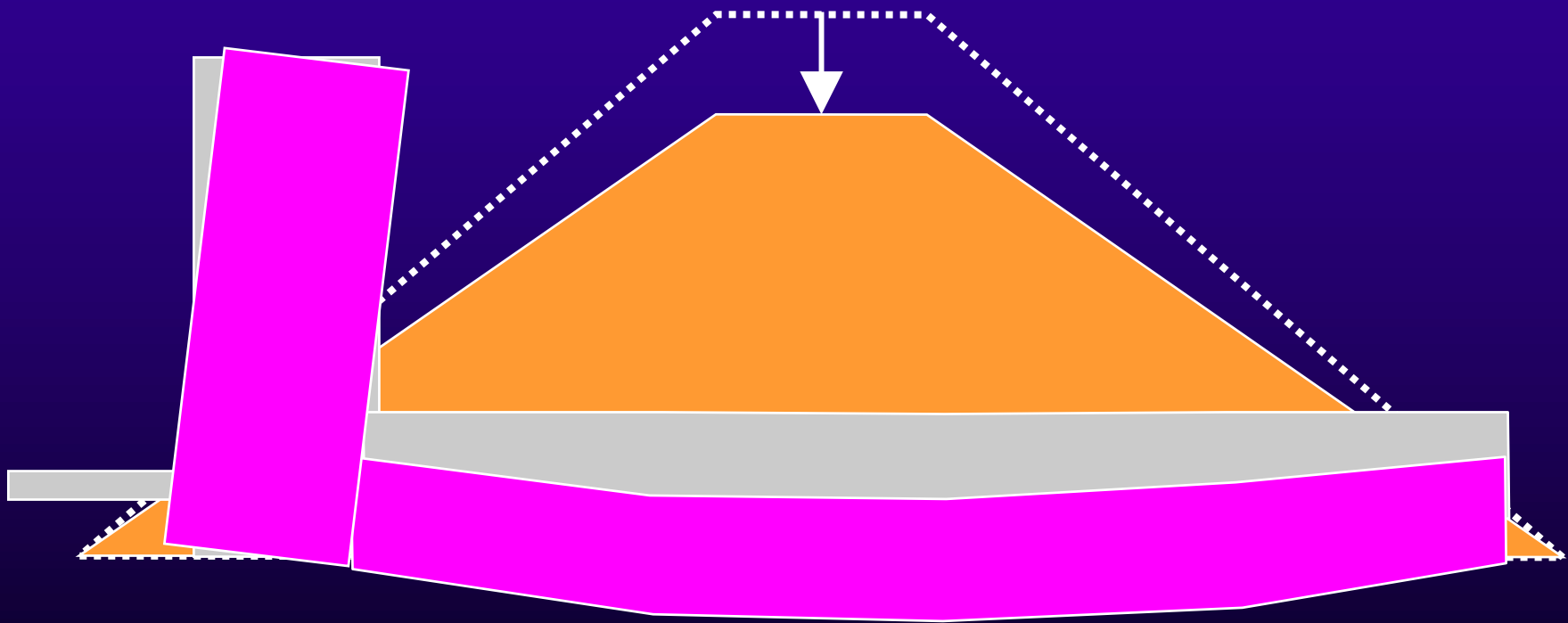
Take Pictures!

Dam on Soft Foundation



Spillway pipe at end of construction





**Same pipe after excessive
foundation settlement**

