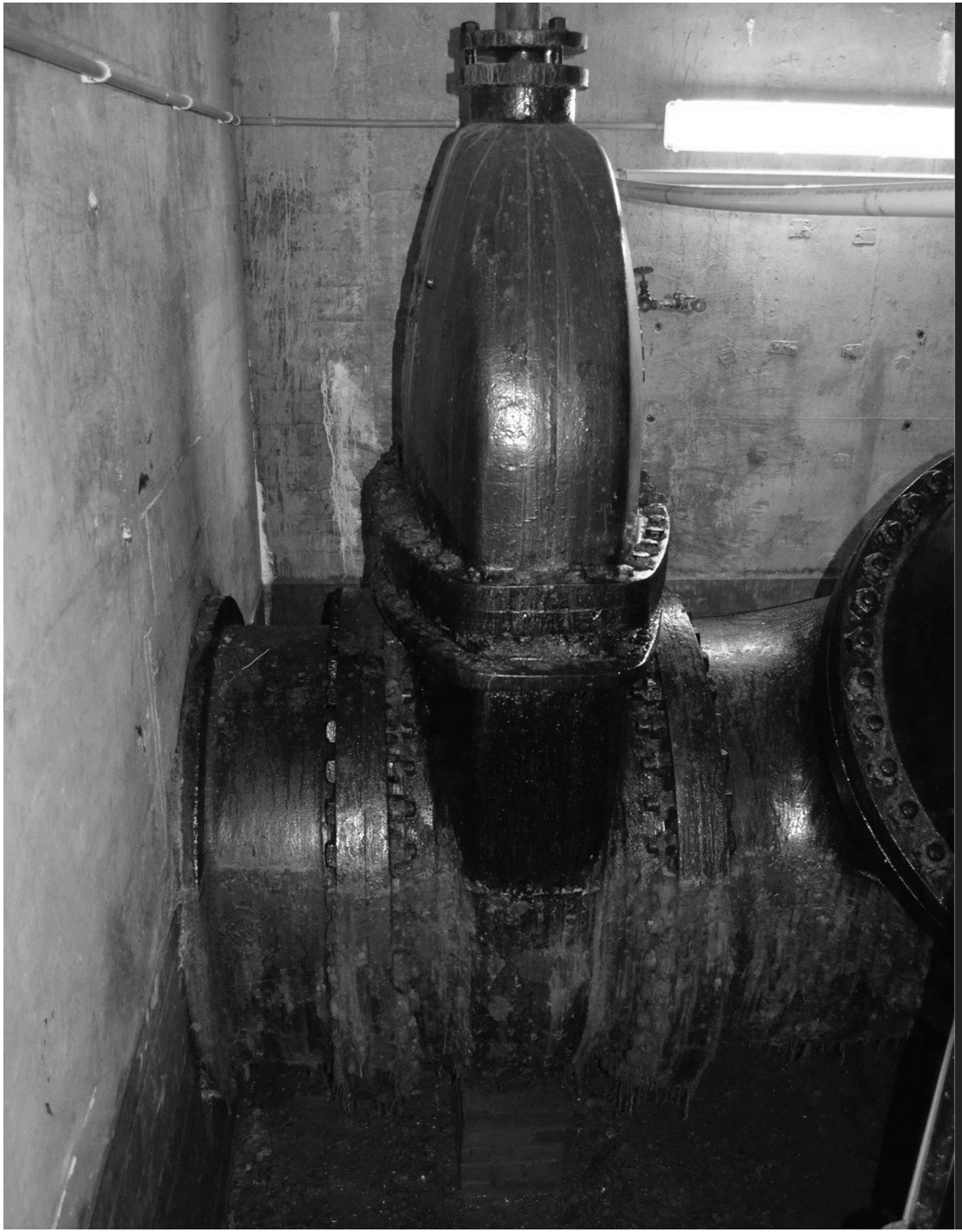

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OTCO
Water Distribution Workshop
November 4th, 2020

Large Valve Replacement in a Distribution System

Stantec

Agenda

1. Selecting a Large Valve
2. Existing Valve Assessment
3. Modifying Existing Structures
4. Consider Constructability
5. Isolating Valves for Replacement

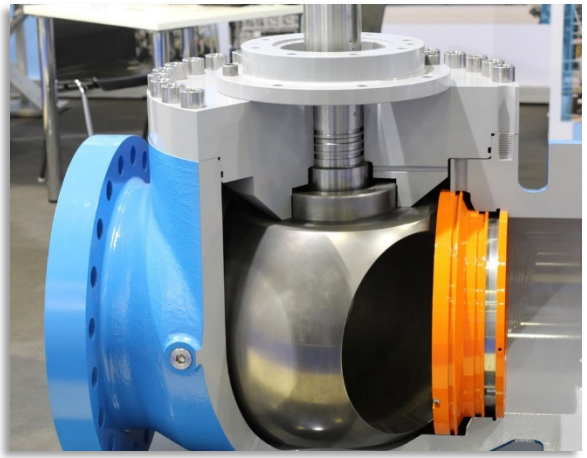
Image credit: NASA

Image credit: Crispin Valve

Selecting a Large Valve

Valve Types – What to Consider

- Control Needed
  - Isolation (Gate or Butterfly)
  - Throttling (Ball or Cone)
- Water Chemistry Concerns
  - Are there solids in the water (e.g. Lime)?
  - Is there potential for corrosion?
- Transient Analysis (Water Hammer)
- Space Limitations
  - Lay Length
  - Vertical Clearance



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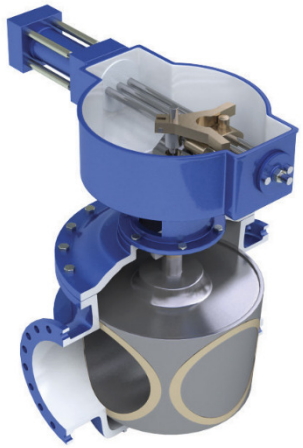

Image credit: DeZURIK

Regardless of Valve, all components including coatings, grease, etc. MUST meet NSF-61

Butterfly Valve

AWWA C504

- ☑ Lower cost with more manufacturers
- ☑ Shorter lay length & height = good for tight spaces
- ☒ The disc is always in the flow
- ☒ Chemicals (e.g. lime) can deposit on the disc which increases headloss and can impact seating
- ☒ Direct buried applications susceptible due deformation if flexible piping is used

  Valves > 36” should not be in a vault/MH with a flexible coupling so valve is not subjected to loads

- ☒ Quarter turn to close which can lead to water hammer if care not taken

Gate Valve

AWWA C500, AWWA C509, AWWA C515

- ☑ When open, clear flow path
- ☑ Life is 2-3x greater due to robustness, components out of flow
- ☑ Requires many turns = minimizes chances of water hammer (slow closure)
- ☒ Higher $$$
- ☒ Much Larger (height & lay length)

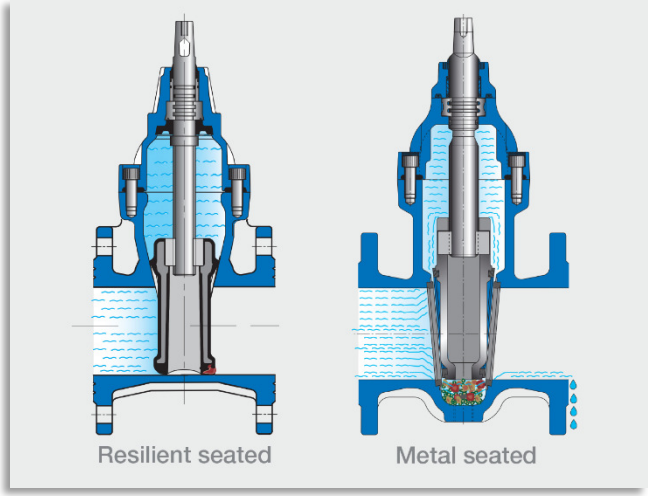

Image credit: AVK

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Structure or Direct Buried

Structure

- Easily accessible for O&M (CSE Required)
- Can remove/replace with minimal impact
- Reduced risk of corrosion (if structure is dry)
- Higher $$$
- Susceptible to flooding through manhole covers, valve leakage, etc.

Direct Bury

- Lower Cost
- No options for O&M – typically no action until failure
- Differential loads on the pipe can cause deformation of valve
- Additional corrosion protection required

Valve Orientation

When possible, implementing a valve exercise program improves operability and keeps valves flushed of debris

Butterfly

- The shaft is typically in the horizontal plane, but the actuator is vertical
- A vertical shaft can result in impurities collecting in the trunnion which leads to improper seating
    - Unable to maintenance trunnion if there is an issue

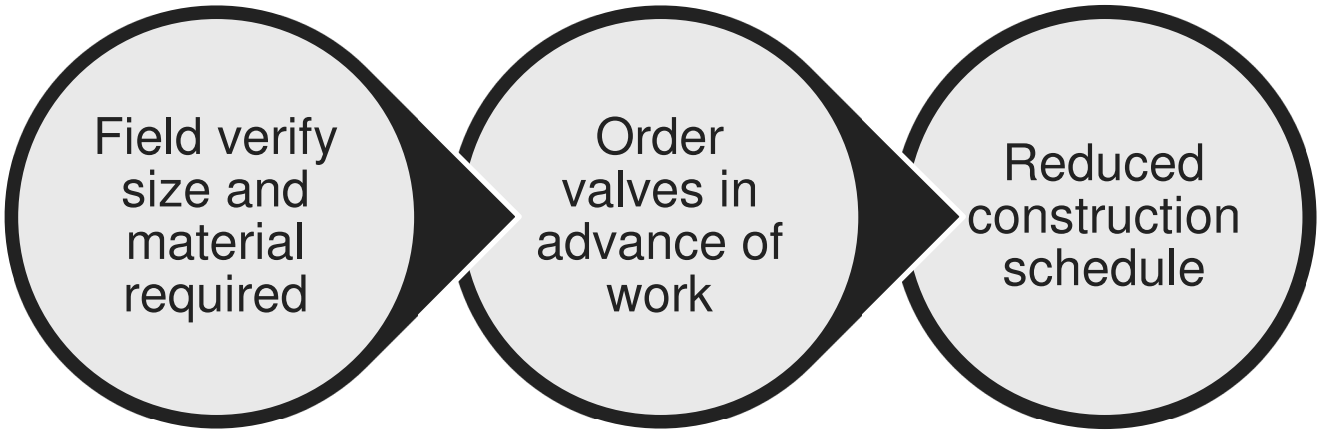
Gate

- Vertical orientation is preferred to prevent impurities (e.g. lime precipitate) from collecting in the bonnet
- However, valve is typically installed in the horizontal due to height constraints

Vertical orientation increases valve longevity and allows for easier O&M

Valve Procurement

- Valve standardization
- Determine critical needs and controls early
- Begin coordination with manufacturers during design
- Get quotes for lead times for accurate construction scheduling
- Do the valves need to meet The American Iron and Steel (AIS)?



Cathodic Protection (CP) – Yes or No?

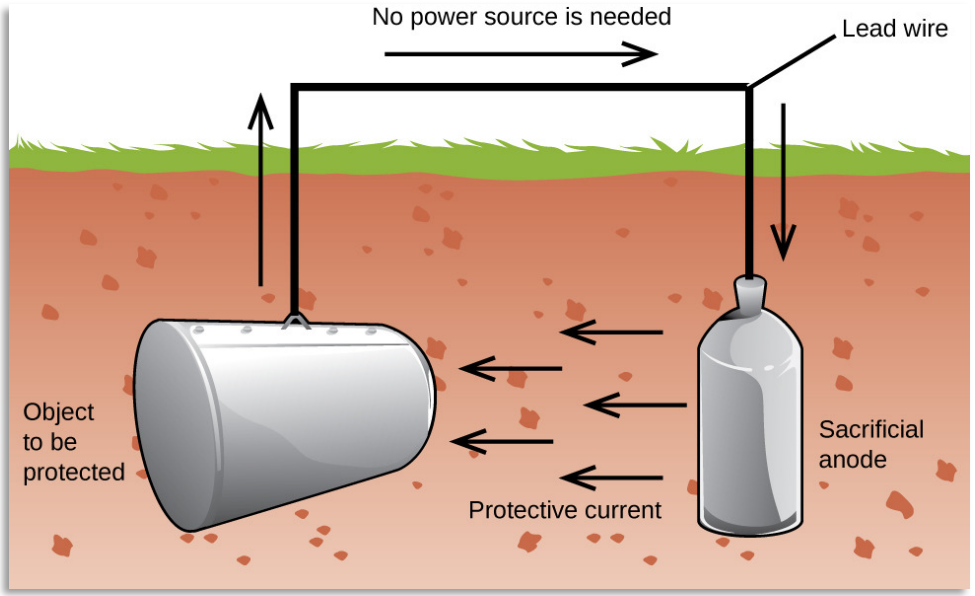
- Sample soil to determine if the environment is corrosive (Soil Resistivity)
- Two types of Cathodic Protection:
  - Galvanic (Sacrificial Anode)
  - Impressed Current (ICCP)
- Other options to mitigate corrosion include flange isolation kits, coatings, wrapping, etc.

Corrosion is one of the leading causes of pipeline failure; using CP can reduce the need for costly repairs and/or replacement

Galvanic (Sacrificial Anode)

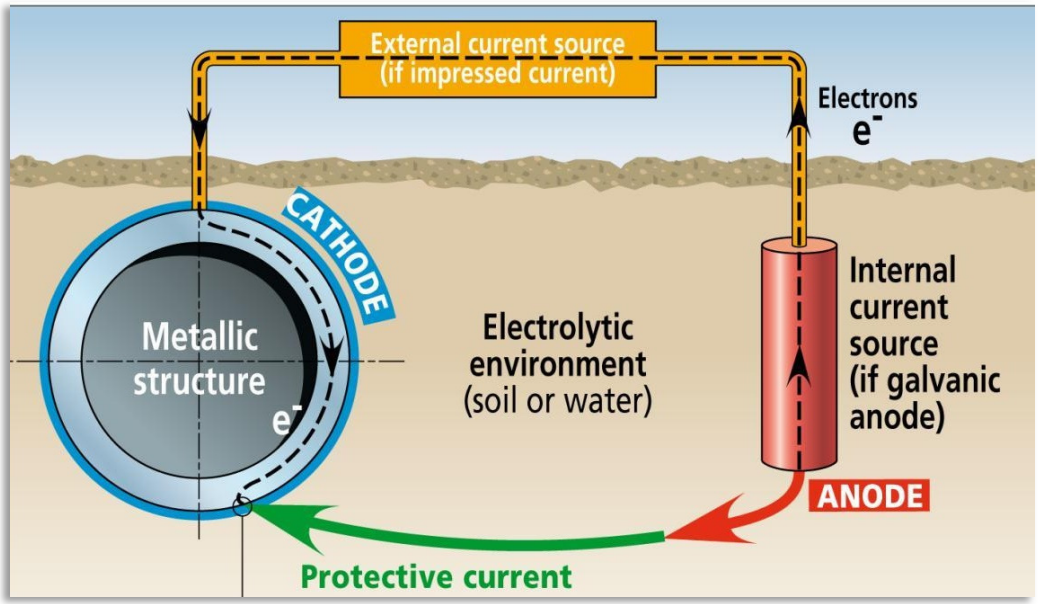
- Easy installation
- Low maintenance
- No external power

- Galvanic CP involves uses a sacrificial anode
- Sacrificial anode is typically magnesium, zinc, aluminum and has less negative electrochemical potential than the pipe (typically steel)
- The sacrificial anode undergoes oxidation rather than the pipe.
- Sacrificial anodes have limited life-spans and will corrode until fully consumed.



Impressed Current

- ICCP uses sacrificial anodes connected to an external DC power source
- The DC power supply provides the current to drive the electrochemical reaction
- A transformer-rectifier connected to AC power can be used in the absence of DC
  - Alternatively, power sources such as wind or solar can be used



- Effective for a larger area
- Longer-term Protection
- Easier control & monitoring
- Effective in high resistivity environments

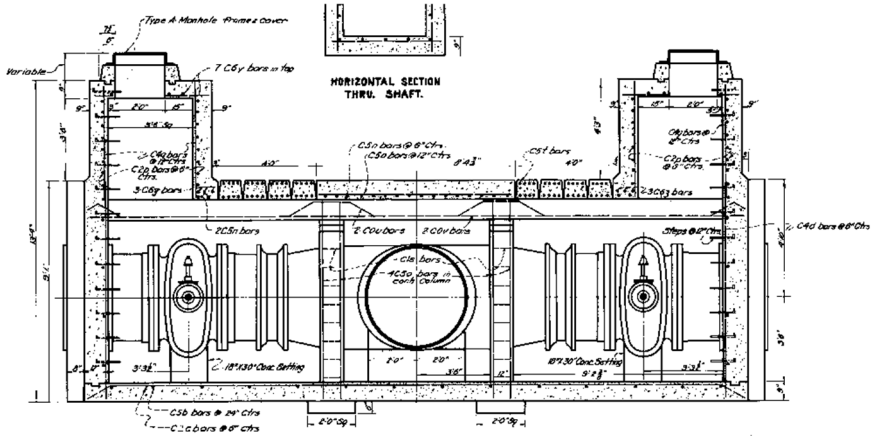
Existing Valve Assessment

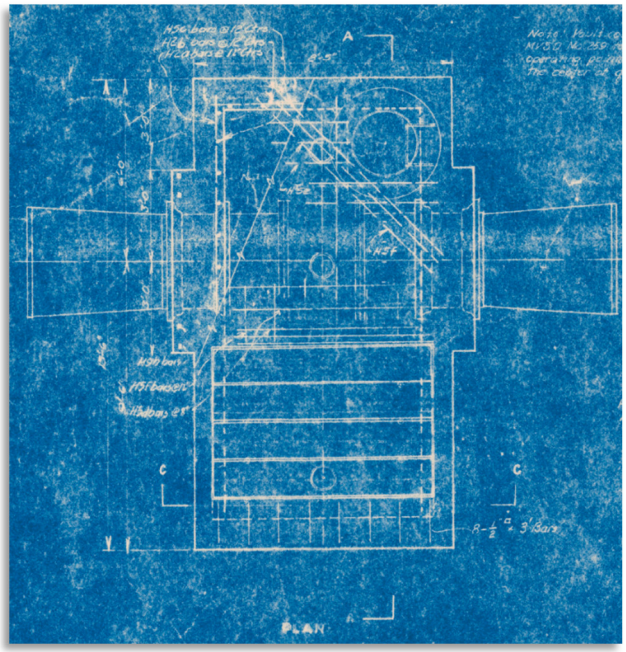
Condition Assessment

- Existing information is a key tool for determining valve condition
- Valve typically can't be removed for inspection, so condition assessments are limited to the following:
  - Visual Inspection
  - Leakage Testing
  - Actuator Testing
- 3D Structure Scanning
- Utility Surveys

Review Existing Information

- Does the utility have record drawings available?
- How old is the valve?
- Is there a valve exercising program in place?
- Has the utility identified which valves are operable
- Have there been past inspections and/or replacements?



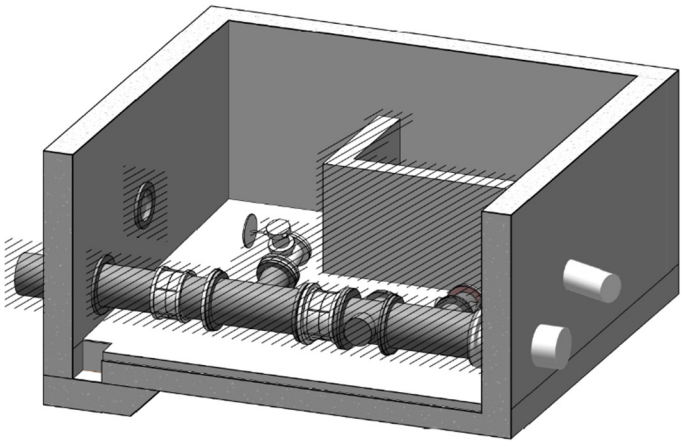


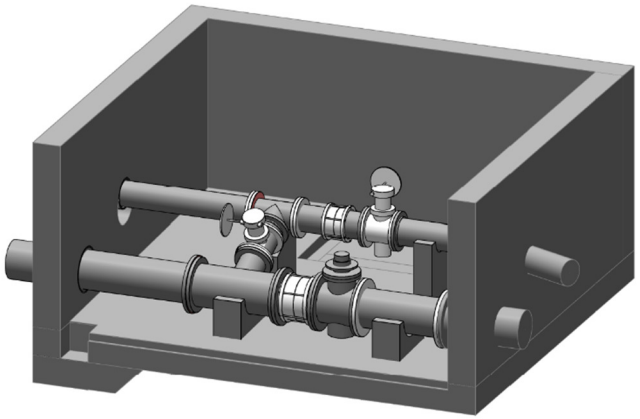
Physical Inspection

- Visually inspect concrete, piping, and valves
  - However, looks can be deceiving (e. valves may look okay but gear boxes can be internally corroded and seized)
- Perform a valve leakage test
  - Listen for leakage – if valve is closed, the microphone should not detect sound (acoustic emission testing)
- Valve Actuators
  - Motor operated can be tested for over-torqueing/overloading
  - Manual are particularly susceptible to over-torqueing and breakage because hydraulic wrenches are often used
- Perform field measurements to verify lay lengths and workable area for replacement valves

3D Scanning & Utility Survey

- If detailed measurements are required and can't be performed manually, then a 3D scan can be completed.
  - The 3D scan recreates internal components of a vault
- Utility survey is critical to avoid damage during construction
  - Utility conflicts likely exist, so early identification during design is important
  - Once identified, the design engineer can work with utilities to ensure relocation and/or protection





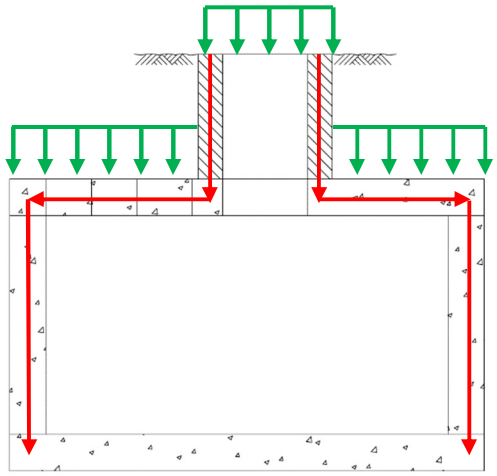
Modifying Existing Structure

Options to Remove Valves

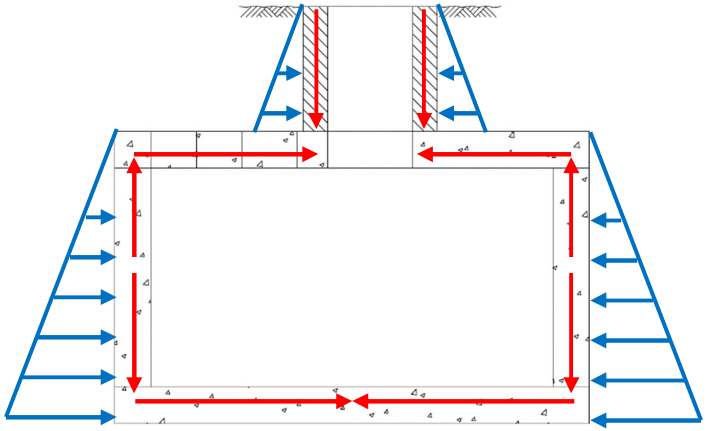
- Existing Hatches? Sufficiently Sized?
- Removable top slab?
- Structure Modification – Most likely method for removal

Existing Structure Modifications

- If existing information is limited, structural finesse is required when considering structure modifications
- Considerations for investigation i.e. non-destructive or destructive testing
- OBC Chapter 34 requirements:
  - Main concern is altering load path
  - Altering load path could reduce the carrying capacities by distributing forces to elements that were not originally designed to take the load
- In some cases the desired modification alters the load path which triggers code implications additional structural changes → more $$



Section View – Gravity Loads



Section View – Lateral Loads

Modifications to Existing Vaults

Where cost implications push decisions of modifications, there are various ways to keep costs low.

- Removal of concrete elements to allow for interior equipment work, then replacing elements (conc/rebar) exactly as they were initially constructed
- Localize proposed structural changes to areas with minor impacts to load paths

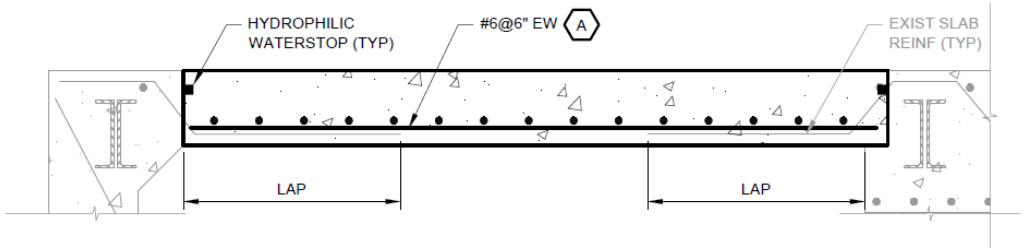


Figure 1: Working exist rebar into replaced concrete once interior work is complete

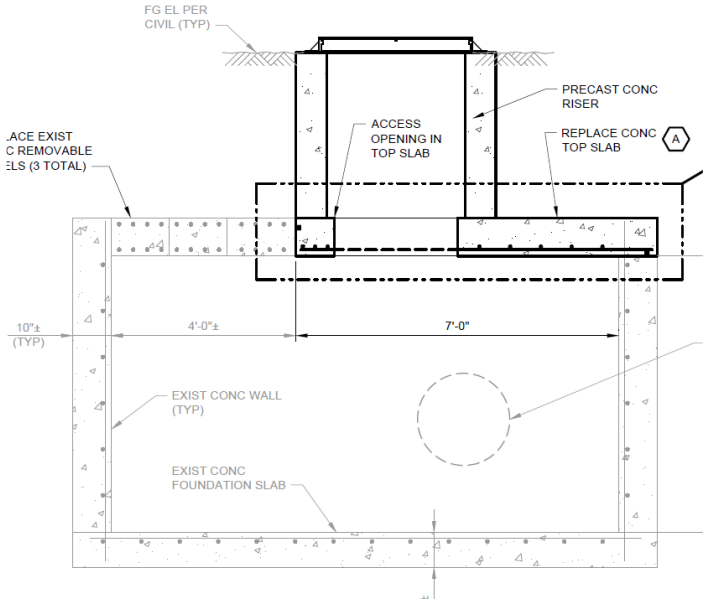


Figure 2: Small change of opening and riser addition/relocation

Existing Thrust Blocks

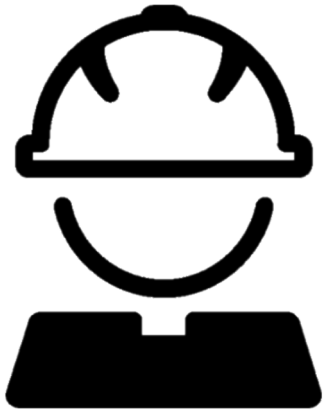
- Thrust blocks need to be installed against undisturbed soil to maintain proper soil loading
- If pockets are created around an existing thrust block during excavation, grouting/concrete can be used for remediation
- Thrust blocks are not always required if piping has restraint system.
  - The restraint system uses soil pressure and mechanical restrained joints to prevent separation.

Consider Constructability

Design with Contractor in Mind

What can be done to improve construction efficiency?

- **Reduces cost**
- **Minimizes community disruption**
- **Avoids project delays**
- **Reduces risks of service disruption**

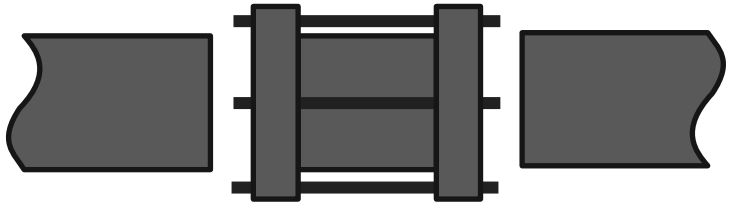


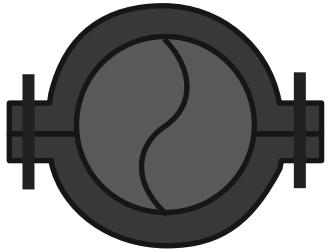
Design Flexibility

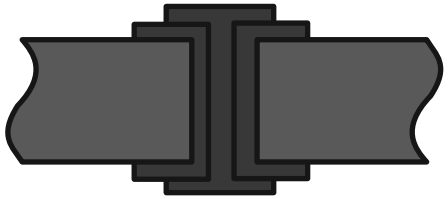
- Replacing valves in structures can be challenging due to limited footprint (“pinned” on either end)
- Couplings can offer “wiggle” room during installation
  - Bolted Sleeve (Dresser Style)
  - Grooved (Victaulic)
  - Dismantling Joint
  - Butt strap weld (Steel Pipe)

Couplings

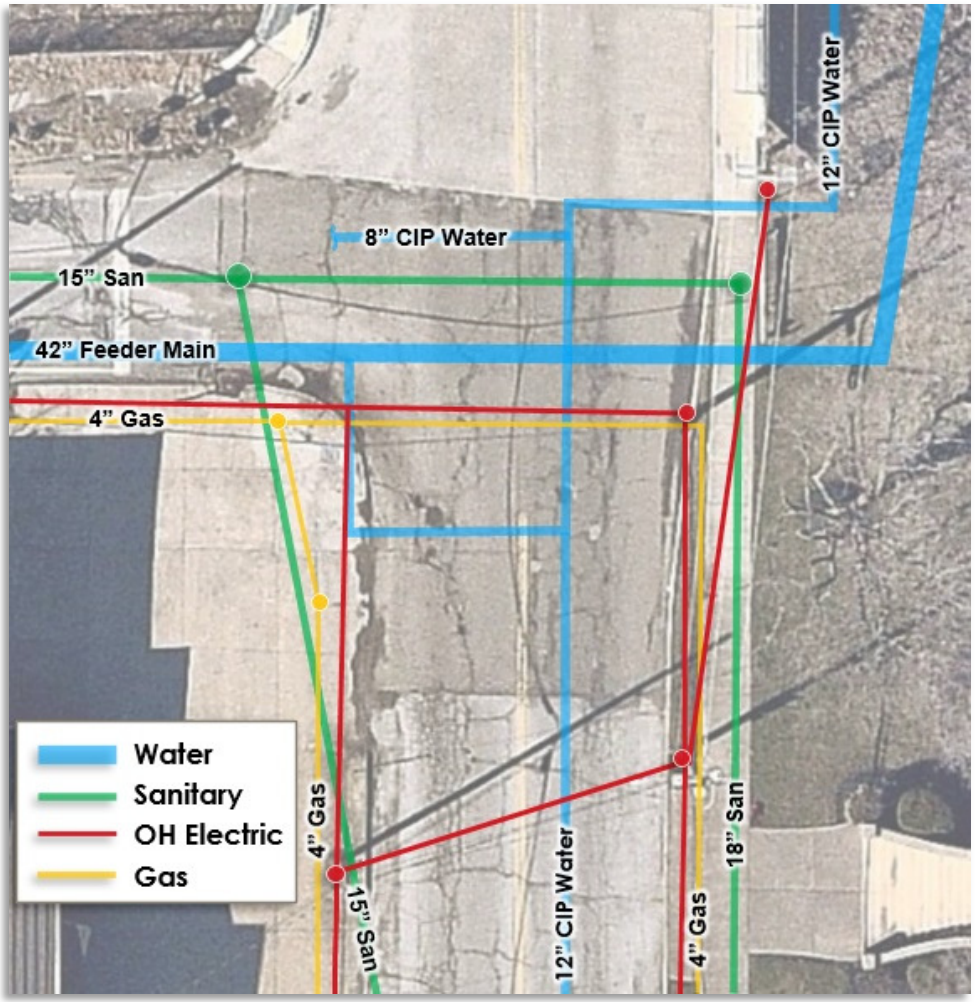
- Bolted Sleeve (Dresser Style)
  - Inexpensive, can be restrained
  - Prone to leaking
- Grooved (Victaulic)
  - Doesn't typically leak, easy removal, restrained joint
- Dismantling Joint
  - Designed specifically for applications that require valves, etc. to be removed regularly
- Butt strap weld (Steel Pipe)
  - Doesn't leak, rigid and restrained







Existing Utilities

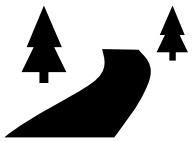


- Critical to identify existing utilities early during design
- Contractor to field verify before proceeding
- Support or relocate depending on type of service in conflict, size of utility, and location relative to construction

Community Impacts

- Traffic disruption

- Disruption to water service



- Interference with driveways

Maintenance of Traffic

- Develop maintenance of traffic plans early
- Minimize lane shutdowns when possible; be cognizant of pedestrian traffic as well
- Utility construction can be completed outside of working hours
- Line stops require in significant excavation and can impact traffic patterns for the duration of the project

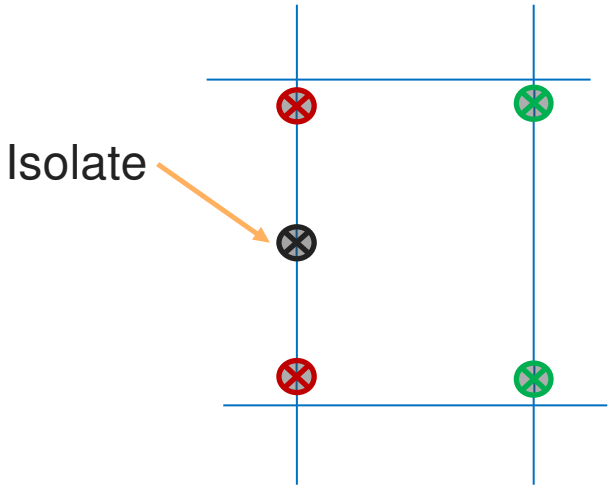
Water Service

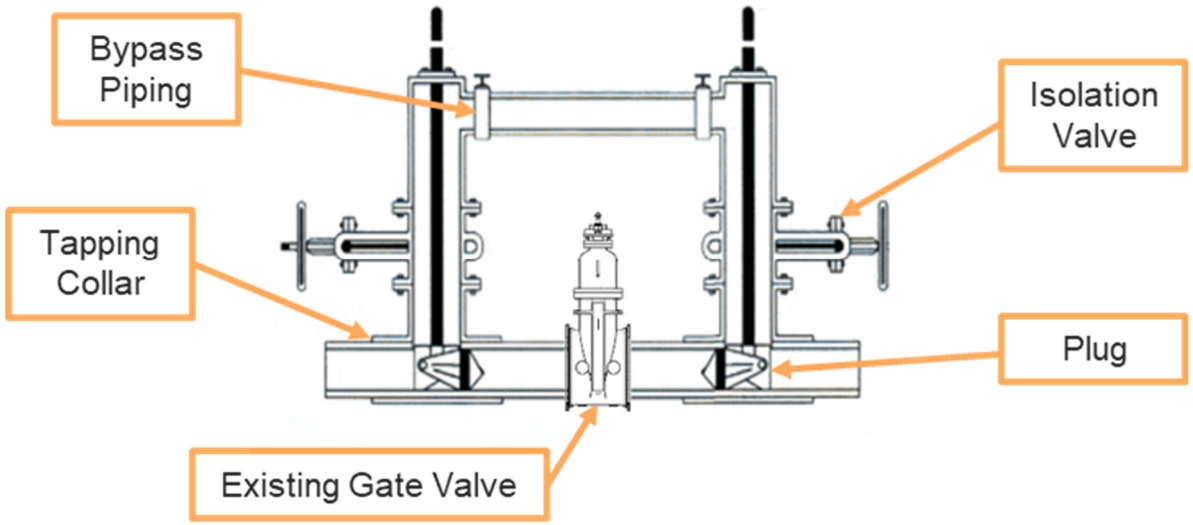
- Identify what users will be interrupted during construction
- Determine if the distribution system has interconnects that can back-feed users
- If no interconnect, then bypass or temporary services will be needed

Isolating Valves for Replacement

Isolation Valves for Replacement

1. Isolation using distribution system valves (verify required valves are functional)
2. Line stops & bypass





Line Stop Installation

- Line stops should be installed in center of pipe length
- Verify pipe condition, material, and operating pressure (tapping can be challenging for pipes like PCCP)
- Thrust block at each location

Line Stop – Excavate Piping

Line Stop – Tapping Collar

1

2

3

Line Stop – Thrust Block

1

2

Line Stop – Main Tapping

1

2

3

4

Line Stop – Rig Attachment

1

2

3

4

Line Stop – Completion Plug

1

2

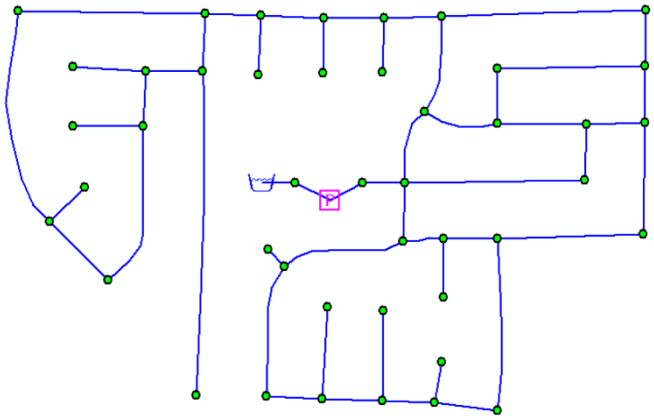
Water Distribution System Model

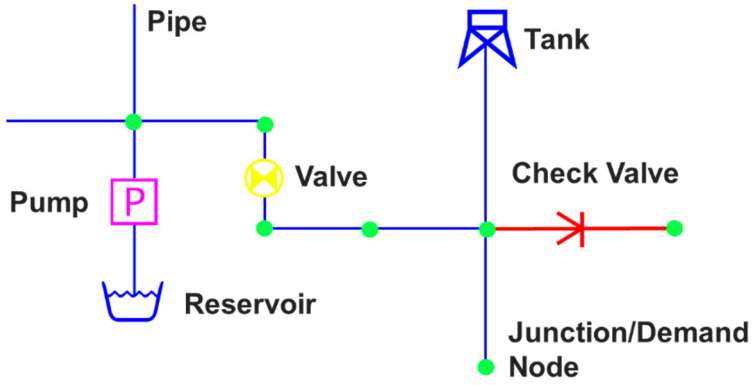
- ✓ Simulates existing conditions and operations
- ✓ Simulates future or 'what if…" scenarios
- ✓ Helps plan new facilities and troubleshoot and water quality evaluations

Information to Develop WDS Model

- ✓ GIS
- ✓ Record Drawings
- ✓ SCADA Data

A model can be used to evaluate a distribution isolation plan when large water mains need to be temporarily removed from service





Questions?

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