Preserving Winnipeg's Water Supply

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Repairs to the Winnipeg Aqueduct

Outline – Repairs to Winnipeg's Aqueduct

- Introduction & Background
- Original Construction
- External Repairs
- Internal Repairs
- Where are we today?

- Winnipeg is a city of 750,000 people
- Water is supplied through a 90 mile long
 aqueduct
- Entirely gravity feed



- The aqueduct travels through multiple geographies
 - Sand, swamp, under rivers, through forest
- Winnipeg water use is 85 million gallons/day
- Aqueduct Capacity 100 million gallons/day



Original Construction



Some Aqueduct Stats

- Totally unreinforced concrete arch construction
- Built between 1915 1919 for \$17,000,000
- This is \$390,000,000 in today's dollars
- No road access to the route

"An uncomplicated design, patterned after ancient stone/masonry architecture, was developed - a dish-shaped concrete floor covered with a parabolic-shaped shell. The un-reinforced concrete arch construction provided excellent durability and stability."







AQUEDUCT CONSTRUCTION, MILE 76





Repair Program



Why were repairs needed

- Engineering investigation done in the early 1990's
- It was determined that
 - After 75 years the concrete for most part was in good condition
 - No corrosion damage (no rebar)
 - Inside surface showed only minimal signs of erosion
 - The Winnipeg water demand was very near the limit of the aqueduct (at 85%)

Why were repairs needed

External

- Some deterioration of the concrete on the exterior of the aqueduct due to sulfate attack in high sulfate soil areas
- Had deteriorated the concrete in some places to a depth of 50%

Why were repairs needed

- Internal
 - The Winnipeg water demand was very near the limit of the aqueduct (at 85%)
 - Water was leaking out of the aqueduct at about 15% (thus no additional capacity)
 - The options were considered
 - build an additional aqueduct
 - or to seal leaks

Sealing the leaks was chosen

Repairs

- Repairs done over 12 years
- All work was done during 3 week (or less) shutdowns in the fall
- Many cases only access by rail

External Repairs



External Repair Program

- Excavate around pipe
- Remove deteriorated concrete
- Add reinforcing steel (even though the original has none)
- Shotcrete new concrete







Internal Repairs



Internal Repair Program

- Seal Crack and Joints to reduce leakage
- Several crack sealing methods were evaluated
 - Route and seal
 - Surface applied sheet waterproofing
 - Epoxy injection
 - Polyurethane chemical grouting

Polyurethane chemical grouting was chosen

Internal Repair Stats

- Repairs done over 9 years
- Approximately 150,000 feet of cracks and joints were injected
- This is almost 30 miles of injection
- Using over 25,000 gallons of Polyurethane

(And over 25,000 ports)

Multiple contracts per year for 8,000 to 12,000 feet of injection

Internal Repair Challenges

- Access points were only 2 ½ feet diameter
- There were 1 mile apart
- Some of the aqueduct was only 5'4" in height



Internal Repair Challenges

- Access points were only 2 ½ feet diameter
- There were 1 mile apart
- Some of the aqueduct was only 5'4" in height
- All work was remote
- There was still some water flowing the aqueduct (much from leaking in)
- Needed to be ventilated and lit
- Moving material and equipment
- Snow Storms























































Summary

- Repairs to the entire length of Aqueduct completed over 12 years
- Decreased leakage from 15% to less than 5 %
- Allows the present aqueduct to provide sufficient water supply for Winnipeg
- Due to conservation the water demand has actually decrease in the past few years

Thank You

Winnipeg's Water Supply is Preserved for years to come

Questions



