Catskill Aqueduct

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I. Introduction

An aqueduct is a structure that steers water to a desired location. Aqueduct are constructed in order to fill the need of fresh drinkable, usable water. New York City at the time was experiencing a vast increase in population and fresh water supply was at a low [1]. The construction of the Catskill Aqueduct was so cherished and appreciated that celebrations were made in the form of pageants. The admiration of the aqueduct for its fresh water delivery was so great that the pageants were entitled "The Good Gift of Water" and these pageant consisted of 5 episodes emphasizing the importance of water to humanity [1]. The Catskill Aqueduct delivers fresh water to New York City from the Catskill Mountains, it is an engineered and designed man-made canal. A canal is at a natural slope or pitch and guides water downhill. An aqueduct does the exact same thing, except it is artificial and is specifically designed to control many factors like destination and rate of water flow. The Catskill Aqueduct system consists of tunnels and watersheds/reservoirs as its source of water. Although the aqueduct is not the only water supply system or the first, its necessity and engineering capabilities of the time made it stand out. The system was successfully completed in the year 1924 and has been deemed a great civic achievement for its immense size, use of gravity for water flow, inner-workings and the adaption of construction due to topography.

II. Catskill Aqueduct supply system-

The aqueduct consists of 2 reservoirs. These reservoirs are large bodies of water and is the supply in which the aqueduct takes water from. The reservoir is replenished by runoff, precipitation and in some cases from other reservoirs. The system consists of the Ashokan and Schoharie reservoirs.

1. **The Ashokan reservoir** is where the Catskill aqueduct begins, it was constructed and completed in the year 1905.
   - The Ashokan reservoir resides in the county of Ulster, within the town of Olive, Hurley. The reservoir is 73 miles north of New York City and 27 miles South of the Schohaire. It covers 8,315 acres of land with a maximum depth is 190 feet. The reservoir at full capacity holds about 122.9 billion gallons of water. [2]
2. **The Schoharie reservoir** is 27 miles North of the Ashokan and supplies when needed, unless at capacity.
   - The Schoharie reservoir resides in the county of Schoharie, within the town of Gilboa, Conesville. It is about 110 miles from New York City. The reservoir is formed by damming of the Schoharie Creek. At full capacity the reservoir can hold 17.6 gallons and consists of a single basin. The reservoir is about 6 miles length and 120 feet deep. [3]

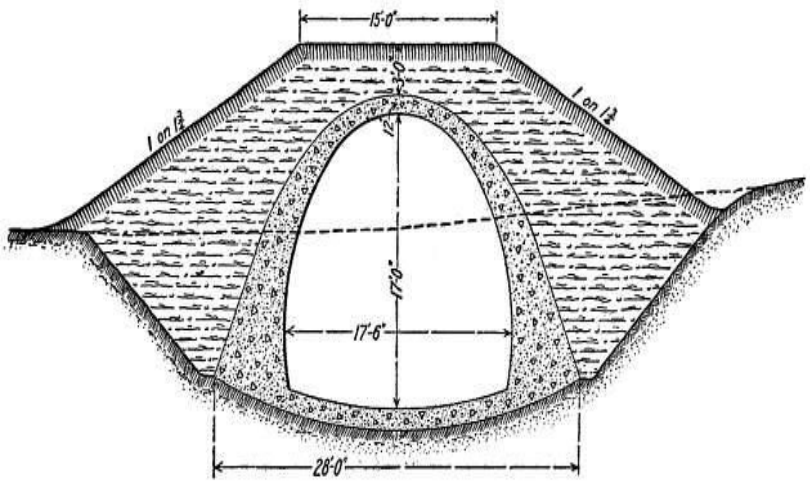
III. **The Catskill Aqueduct-**

Beginning at the Ashokan reservoir, the Catskill aqueduct is 92 miles long. The aqueduct obtains water from the Ashokan reservoir and travels downward. The aqueduct then channels the water to New York City (after a great distance) in 2 different tunnels. Named City Water Tunnels #1 and #2.

The aqueduct is made of mainly concrete. Used during the construction of the aqueduct was a mixture of Portland cement (most commonly used cement), sand, gravel and water. [4] The aqueduct consists of a total of 163 miles of aqueduct. There is 55 miles of cut and cover aqueduct (excavated land with the aqueduct tunneling covering it up; just on the surface), 28.5 miles of grade tunnels (tunnels that are above grade; above ground level), 35 miles of pressure tunnel (a tunnel engineered in a way to create hydraulic pressure. 6 miles of steel pipe siphons and 39 miles of pipe conduit. [4]

IV. **Cut-and-Cover**

These tunnels were built along hill slopes or flat lands. This was so because the terrain was suitable for an excavation below grade. The water that flow here are not pressurized and merely flow under the influence of gravity. The excavation grade was at a pitch to allow for flow, in areas of unsuitable trench work, as shown in Figure 1.



SECTION OF "CUT-AND-COVER" AQUEDUCT, BUILT OF CONCRETE, WITH COVERING OF EARTH

Figure 1. The dimensions of these cut-and-cover aqueduct were typically 17'-0" tall and 17'-6" wide. The tunnel was built and lined with concrete, to allow easy water flow, and was covered by ambient earth rocks and soil. [5][6]

V. **Grade Tunnels**

These tunnels are on ground surface and are set an even steeper pitch compared to the cut-and-cover aqueduct. One of the reasons for the praise of the aqueduct system was due to

many of these types of tunneling. The pathway from the Ashokan reservoir to New York City is not a short and gentle one. These tunnels were driven through mountains and hills and were situated just like the cut-and-cover tunnels. The dimension however is much shorter due to financial reasons.

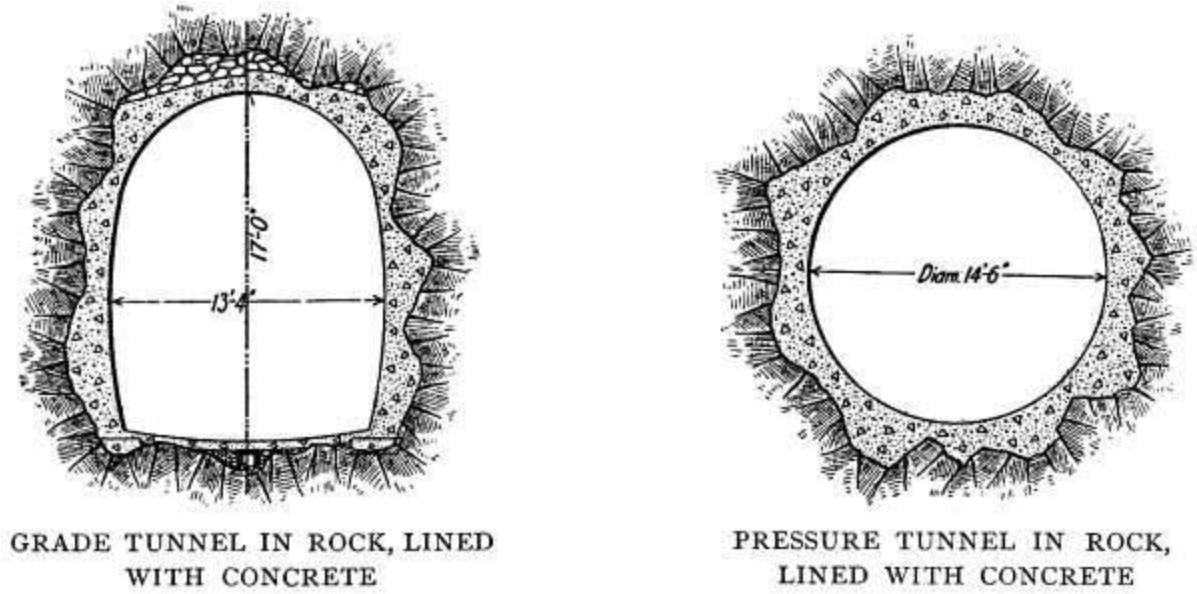


Figure 2. Grade tunnel example are to the left and Pressure tunnel to the right. Grade tunnels are typically 13'-4" wide and 17'-0" tall. These tunnels were also lined with concrete and surrounded by earth. Grade tunnels due to design for optimal pressure and water flow had a typical diameter of 14'-6". [5][7]

VI. **Pressure Tunnel**

The engineers surveying the landscape saw certain portions of the terrain as an advantage at times and used it to create these pressure tunnels. These pressure tunnels had to be built underneath valleys, streams and homes. This was due to the natural grading of the terrain and as not to disturb the above ground surface. The terrain was too flat for water to flow and so the water in the tunnel needed to be under great pressure. These tunnels were constructed deep underground and by the combination of the immense weight and momentum of water heading to these tunnels, the pressure was created, and water was to flow.

VII. **Steel Pipes**

These tunnels spanned great distances, through mountains and rough terrains. However there were situations in which the construction of a concrete tunnel was deemed excessive. Factors like quantity of water, distance and the type of bedrock needing to be plowed through also favored the use of large steel pipes [5].

These pipes were encased with concrete and were used to pass through tough terrain. The pipes were used to create pressure for the water. The pipes are shorter in diameter and shrinks the circumference and so effects water flow.

VIII. **Conclusion**

The Catskill Aqueduct is indeed a great accomplishment. It's importance, not only those of New York City but to all of the those receiving water from the aqueduct, are empathized when this civic construct transports, what it has been called, the "Good Gift of Water".

References

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