
Manhole Rehabilitation

A. Introduction

Manhole deterioration is a problem that is becoming much more prominent as public infrastructure ages and the number of manholes in service increases. Concrete manholes are often susceptible to attack by sulfuric acid, which eats away at the concrete surface and eventually the steel reinforcing in the manhole, creating the potential for collapse. Brick manholes also deteriorate as the mortar joints are eaten away and begin to leak. Collapsing and leaking manholes require attention to avoid possible street collapses and other problems.

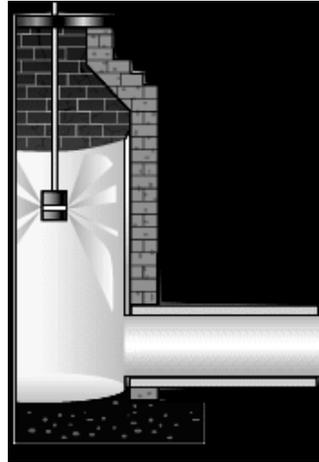
In certain circumstances, manhole rehabilitation, rather than replacement, may be a preferred option. Several rehabilitation techniques are described below. While many other rehabilitation techniques and products are available, the ones listed below are included in the SUDAS Specifications.

B. Corrosion Resistant Chimney Sealant

1. **Typical Applications:** A brush applied, corrosion resistant, aromatic urethane sealant is utilized for sealing existing manhole chimneys, which are showing signs of infiltration or deterioration due to sulfuric acid attack.
2. **Description of Process and Materials:** The existing surface is prepared by removing all protruding brick, mortar, and other debris. The manhole chimney is sandblasted and pressure washed. Active leaks in the chimney area are sealed with hydraulic cement prior to application of the sealant. The area is then primed, the sealant is mixed, and applied with a brush or trowel. The sealant forms a flexible membrane over the chimney area, which seals out infiltration and protects the area from further chemical attack.

C. Centrifugally Cast Mortar

1. **Typical Applications:** Centrifugally cast mortar linings are utilized to rehabilitate and extend the life of existing manholes, which are still structurally sound, but are experiencing groundwater infiltration and/or moderate deterioration due to the presence of sulfuric acid. This rehabilitation method is used for lining both brick and mortar and concrete manholes.
2. **Description of Process and Materials:** The lining process begins by first cleaning the existing manhole walls of any loose material or debris. This is normally accomplished by washing the interior surface of the manhole with a high pressure washer. Any actively leaking joints or cracks are plugged with hydraulic cement. Next, a rotating applicator is lowered into the manhole. As mortar is pumped through the applicator, it spins with sufficient speed to cast the mortar against the manhole wall. The mortar is of sufficient stiffness that it sticks to the wall without sloughing. As the rotating applicator is raised through the manhole, the entire interior surface of the manhole is coated. Multiple passes of the applicator are made until the desired liner thickness is achieved. The centrifugal casting process creates a slightly rough "orange peel" surface. Normally, the mortar should be smoothed with a brush or trowel to ensure a solid bond to the existing manhole and to create a more finished appearance.

Figure 14C-3.01: Centrifugally Cast Mortar Application

Source: APM Permaform

After the liner has been applied to the walls of the manhole, the bench and invert are rehabilitated with the application of 3 inches of hand applied mortar.

If the manhole is being rehabilitated due to deterioration caused by attack by sulfuric acid, an epoxy lining should be applied to protect the new liner from future attack. Typically, this epoxy lining is applied using a rotating centrifugal applicator or an airless sprayer to prevent air entrainment.

The mortar used for the lining process is a high strength, high build corrosion resistant mortar with a 28 day compressive strength of 10,000 psi (24 hours = 3,000 psi). The epoxy coating consists of a two-component, 100% solid epoxy formulated for use in sewer systems.

3. **Design of Liner Thickness:** It should be emphasized that centrifugally cast liners are not intended to be structural in nature. They are only to be applied to existing manholes, which are structurally sound but beginning to deteriorate due to infiltration and/or chemical attack. The liners act to stop any further deterioration of the existing manhole.

The design of the liner thickness is highly dependent on several factors, including the depth of the water table, traffic loads, and time of opening to traffic. Traffic should be kept off of the area surrounding the manhole for a minimum of 12 hours. The longer the liner has to cure and gain strength prior to applying traffic loads, the thinner the liner may be as indicated in the table below.

Table 14C-3.01: Liner Thicknesses
(Based upon a 48 inch diameter manhole)

| Time to opening to Traffic | Manhole Depth (feet) | Minimum Liner Thickness (inches) |
|-----------------------------------|-----------------------------|---|
| 12 hrs (min) | 0 to 30 | 1.25 |
| 24 hrs | 0 to 30 | 1.00 |
| 7 days | 0 to 15 | 0.75 |
| 7 days | 15 to 30 | 1.00 |

Source: J. Pitt, 1995

D. In-situ Manhole Replacement

1. **Typical Applications:** In-situ manhole replacement is utilized to rehabilitate existing manholes that are severely deteriorated due to infiltration or chemical attack and are no longer structurally sound.

Since the process results in a new structure inside the manhole, it may even be utilized on structures that are completely missing portions of the walls or bench. Forms are available for both round and rectangular manholes and can be custom fabricated for other odd shaped structures.

2. **Description of Process and Materials:** In-situ manhole replacement consists of constructing forms inside an existing manhole and pouring new walls, which are structurally independent of the existing walls.

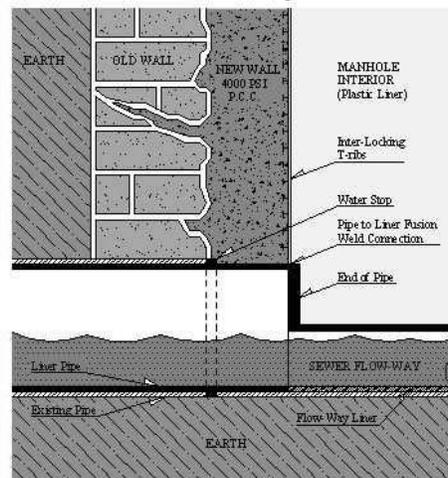
In-situ manhole replacement begins by removing any loose material or debris. If steps are present, they are cut off at the wall. Pipe extensions through the structure are placed to maintain flow during construction. If significant infiltration is present, it should be controlled by plugging holes with hydraulic cement. After the manhole has been prepared, steel forms are erected inside of the manhole, creating a 3 inch gap between the existing manhole wall and the new form.

If previous manhole deterioration was the result of chemical attack, a plastic liner may be placed around the exterior of the forms. This plastic liner will eventually form the inside surface of the new wall. The liner has ribs on the back side to anchor it into the concrete.

After the forms have been erected and the plastic liner secured, if applicable, the annular space between the forms and the existing wall are filled with 4,000 psi concrete. When the concrete has cured sufficiently, the forms are disassembled and removed. If a plastic liner is utilized, any joints in the material are fusion welded to create an airtight seal.

The bench of the manhole is then overlaid by hand with 10,000 psi concrete and epoxy coated. Sand is spread over the wet epoxy coating to create a non-slip surface. The final step is to remove any pipe extension through the manhole and properly seal around any manhole penetrations.

Figure 14C-3.02: In-situ Manhole Replacement (AP/M Permaform)



Source: AP/M Permaform