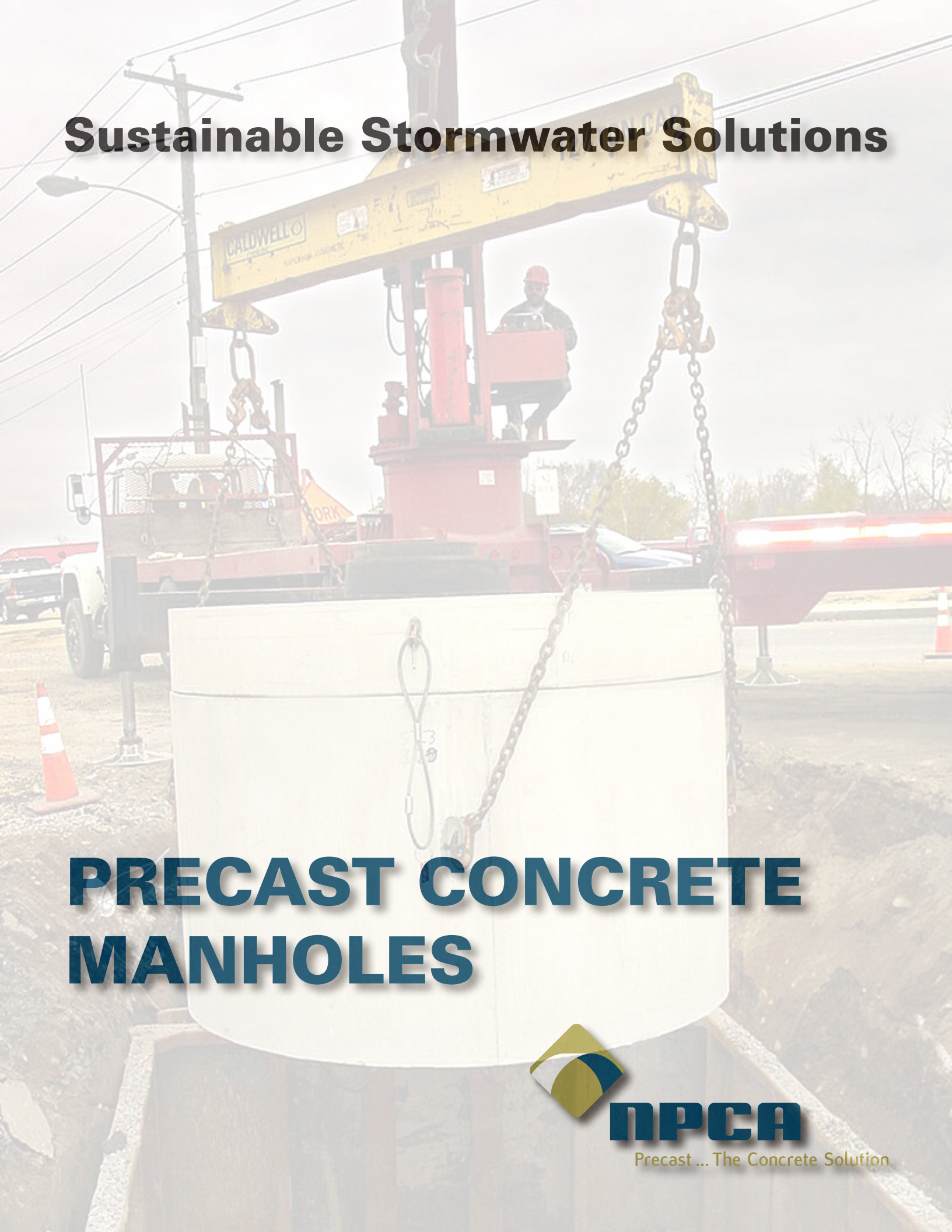

Sustainable Stormwater Solutions

PRECAST CONCRETE MANHOLES

NPCA
Precast ... The Concrete Solution

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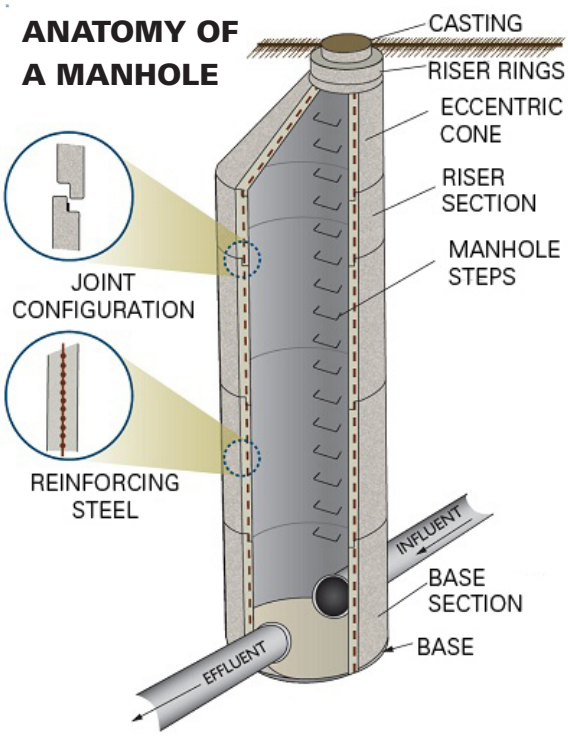

National Precast Concrete Association

With nearly 1,000 member companies, NPCA serves as the voice of the precast concrete industry in the United States and Canada. The industry includes a diverse mix of companies, from small single-plant manufacturers to multinational vertically integrated companies that operate in many sectors of the construction industry. NPCA provides an array of services to these manufacturers that include technical engineering support, the industry's largest certification program, safety programming, educational courses and a suite of print and online publications. In addition to services to members, NPCA provides specialized technical information to owners, contractors, engineers and designers on precast concrete products.

1320 City Center Dr., Suite 200, Carmel, IN 46032
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NPCA
Precast ... The Concrete Solution

WHY PRECAST CONCRETE?

Installation is Easy

Precast concrete manholes have become the construction industry's product of choice over cast-in-place concrete, brick and other non-concrete products for many reasons, not the least of which is ease of installation. Precast concrete manholes can be easily installed on demand and immediately backfilled. There is no need to wait for concrete or mortar to cure at the job site. The degree of soil compaction around the manhole and remaining trenches is never a problem, making installation faster and easier. Contractors are familiar with how to handle precast concrete manholes and can easily install them. Standard sealants and flexible joints are readily available and are vital to watertightness.

We're Talking Quality Here

Because precast concrete products typically are made in a controlled environment, they exhibit high quality and uniformity. Variables affecting quality typically found on a job site – temperature, curing conditions, material quality and craftsmanship – are nearly eliminated in a precast plant.

Rough, Tough and Long-Lasting

Precast concrete strengthens with time, while other materials can deteriorate, experience creep and stress relaxation,

lose strength and/or deflect as they age. The load-carrying capacity of precast concrete is derived from its own structural qualities and does not rely on the strength or quality of the surrounding backfill materials. Studies have shown that precast concrete products can provide a service life in excess of 100 years. For severe service conditions, additional design options are available that can extend the life of the precast concrete product. This is extremely important when calculating life-cycle costs for a project.

Nasty Weather? No Problem

Precast concrete increases efficiency, because weather will not delay production of the manholes. In addition, weather conditions at the job site do not significantly affect the schedule, because less time is required to install precast compared with other construction materials, such as cast-in place concrete or brick.

Watertight – Darn Right

ASTM C478, "Standard Specification for Precast Concrete Manhole Sections," specifies the proper manufacture of quality, watertight precast concrete manholes. Standard watertight sealants and gaskets are available that are specially designed for use with precast concrete, making multiple-seam precast concrete manholes very easy to construct. Vacuum testing is an easy means of verifying water tightness, either in the plant or in the field, as detailed in ASTM C1244, "Test Method for Concrete Sewer Manholes by Negative Air Pressure (Vacuum) Test Prior to Backfill."

Will Sit Tight Without Tie-Downs

With a specific gravity of 2.40 and superior frictional resistance, precast concrete manholes resist buoyant forces better than all other manhole materials. Fiberglass has a specific gravity of 1.86 and HDPE has a specific gravity of 0.97, requiring the use of tie downs and ultimately increasing project costs and installation headaches. With the many advantages over alternative products, precast concrete

SUSTAINABLE BENEFITS OF PRECAST CONCRETE

Recycling

Precast plants reuse formwork, in itself a conservationist practice. Offsite casting significantly reduces construction waste that would otherwise be generated on the job site. In addition, cementitious materials used in concrete often contain manufacturing byproducts such as fly ash and blast furnace slag that would otherwise find their way to a landfill. Wastewater at the plant can be recycled for use in manufacturing. Steel used for concrete reinforcement is typically comprised of 95% post-consumer recycled content.

Reduced Site Impact

Since precast concrete manholes are manufactured off site and delivered on demand, there is a significant reduction in truck traffic, dust, noise and debris from formwork associated with poured-in-place products. Because precast concrete manhole components are modular and standardized, they are installed in a quicker fashion and also result in reduced construction times and energy usage, less noise and fewer emissions from on-site equipment.

Regional Natural Materials

The cement used in concrete is made from common natural materials such as limestone and clay. Most cement plants rely on nearby limestone quarries, keeping transportation distances to a minimum. Aggregates used in the manufacturing of precast concrete manholes are also generally extracted and manufactured regionally.

Durability

Concrete is a very strong and durable material, which is a significant sustainable attribute. It will not rust, rot or burn and has a service life of in excess of 100 years.

LEED PROPERTIES OF PRECAST CONCRETE

LEED for New Construction and Major Renovation 2009 Scorecard

Precast concrete manholes are a smart choice for projects applying for LEED certification. Most of the credits shown also qualify for additional "Innovation in Design" points that are tied to exemplary performance of the credit listed.

SITE DEVELOPMENT: PROTECT OR RESTORE HABITAT

(Sustainable Sites Credit 5.1)

Precast concrete manholes are plant cast and are delivered to the site ready to set so they require very minimal site disturbance to install.

STORMWATER DESIGN: QUANTITY CONTROL

(Sustainable Sites Credits 6.1 and 6.2)

Most stormwater management plans will require manholes in the design to properly handle the stormwater runoff. Precast concrete manholes function as an integral part of any stormwater system and can be counted on to perform exceptionally for many decades.

CONSTRUCTION WASTE MANAGEMENT: DIVERT 50% (75%) FROM DISPOSAL

(Materials and Resources Credits 2.1 and 2.2)

Precast concrete manholes are plant-cast and are delivered to the site ready to set, creating minimal to zero amounts of on-site water material.

RECYCLED CONTENT: 10% (20%) (POST-CONSUMER PLUS ½ PRE-CONSUMER)

(Materials and Resources Credit 4.1 and 4.2)

Precast concrete manholes may contain supplementary cementitious materials such as fly ash and blast furnace slag, adding to the project's recycled content goals.

REGIONAL MATERIALS: 10% (20%) EXTRACTED, PROCESSED & MANUFACTURED REGIONALLY

(Materials and Resources Credit 5.1 and 5.2)

The vast majority of materials that go into the manufacturing of precast concrete manholes are available within a 500-mile radius of the precast plant.

CASE STUDY

A Precast Concrete Stormwater Solution

When city officials in American Fork, Utah, approved construction of a 175-acre commercial center, a primary concern for the city's engineers was the environmental effect it would have on a 45-acre wetland right next door.

PEPG Engineering project engineers designed a sophisticated stormwater runoff treatment system for its new commercial center, which would be the home for big box stores like The Home Depot, Wal-Mart, Kohl's and a 12-screen Cinemark Theater. Since the commercial center's runoff would wash straight into the protected Mitchell Hollow Wetland Conservation area, the challenge was more than just a regulatory annoyance; it was a legitimate environmental concern.

Coexisting With Conservation

To avoid the problem of purging during high flows, engineers specified a two-stage oil and sediment separator. The two-stage unit includes a bypass for large storm events so that when flows exceed capacity, water runs through the unit without disturbing accumulated sediments and oil, keeping pollutants out of downstream waters.

The system has another feature: a large storage capacity that incorporates two 60-inch precast concrete manholes instead of a smaller cast-in-place vault. Since the effectiveness of most water-scrubbing devices relies on a strict schedule of cleanup, the separation unit provides a big advantage to the small town's public works department. On average, the system requires cleaning only once a year.

The system includes three components: A primary precast concrete manhole set in line with the storm sewer pipe, the separator unit and a second manhole for storage.

Installation is Simple

The basic installation is simple: Dig, set two manholes, slip the separation unit in place and backfill. After the excavator digs a hole, the utility contractor places one manhole structure in line with the storm sewer pipe to act as a catch basin and then to the right or left to act as an overflow storage structure. Since the unit comes in both right-handed and left-handed configurations, it offers some flexibility around other utilities and obstacles.

The primary manhole has an outlet large enough for the separation unit to slip into place, with two pipes dropping into the catch basin and two outlets. Secondary pipes connect the unit to the storage manhole, and a reducer connects the unit to the storm sewer pipe. Gravel backfill supports all the components. After manhole frames bring the structures to finished grade, dirt backfill and paving complete the installation.

A precast concrete manhole-based stormwater system protects the wetlands next to this commercial development in American Fork, Utah.

Precast Advantages

According to Jim Schaefer, project engineer for Ames Construction, which built most of the utilities for the American Fork Commercial Center, it took less than a day to install each system. It's a good thing, given that the project required about 30 manholes. This contrasts sharply with the traditional cast-in-place system, which can take five to seven days for each installation when allowing for curing before backfill.

Project Profile

Project Name: American Fork Commercial Center

Owner: AFCC Limited, Salt Lake City, Utah

Engineer: PEPG Engineering, Draper, Utah

Contractors: HE Davis & Sons, Spanish Fork, Utah Ames Construction, Salt Lake City, Utah Geneva Rock Products, North Orem, Utah

Precast Manufacturer: Amcor Precast (a division of Oldcastle Precast Inc.), Ogden, Utah

INSTALLATION PROCEDURES

Lifting Apparatus

Use approved lifting slings that will adequately lift the weight of the units and that conform to OSHA standard 29 CFR 1910.184. The use of an approved or rated spreader bar is preferred. When lifting manhole bases and risers, make sure the chain or cable lengths are long enough to prevent contact with tongue-and-groove area, and are kept at appropriate lifting angles. Use wooden blocks between sling and manhole wall if necessary.

Recommended Manhole Bedding

Use a minimum of 6 inches of approved bedding material compacted to 90% proctor in an area not less than the base area, and preferably 6 inches beyond the outside radius of the manhole base. The area under incoming and outgoing pipes should be treated the same way to prevent shearing of pipes. Local ground conditions may require additional bedding thickness, according to the engineer's recommendations.

Setting Manhole Base

Set the manhole base on graded bedding according to job specifications, making sure boots or pipe openings match design elevations. Level the top of the manhole base in both directions.

Pipe Connections

Follow the manufacturer's recommendations for connections and check with the manufacturer if precast inverts are supplied.

Flexible Boot Connections – Clean the pipe surface and inside of boot. Insert the spring line of the pipe flush with the inside of the manhole wall or as allowed by jurisdiction, keeping the pipe centered in the connector. Install all take-up clamps(s) in the groove(s) if provided at the receiving end of the connector. Tighten the clamps to the recommended torque, which will vary depending on size and manufacturer's specifications. Any grouting that will inhibit the design/flexibility of the connector should be avoided.

Compression Type Connector – Cut a ¾-inch bevel on the end of the pipe to be inserted into the manhole. Clean the pipe surface and inside area of the connector. Lubricate the inside of the connector and exterior of area of the pipe being inserted with an approved lubricant. Center the beveled end of the pipe into the connector. Keeping the pipe level, push the pipe into the connector until it is flush with the inside of the manhole wall or as required by local specifications.

Mortar Joint – Locate the pipe into the opening to meet elevations. Using non-shrink mortar, completely fill voids around the pipe. Allow proper curing time before backfilling.

Pipe Stubs – Any pipe stubs installed in the manhole must be restrained from movement to prevent blowout resulting from groundwater or any testing. A minimum of a 5-foot stub length may be required.

Joint Installation

Butyl Gasket – Use only manufacturer-recommended sizes for specific diameters. Clean and inspect all tongue-and-groove surfaces. Surfaces should be free from all dust and debris. On tongue-up manholes, place the butyl material next to the vertical surface of the tongue. Wrap the material completely around the unit overlapping each end. Knead the ends together to form a unified splice. Make sure all protective paper is removed. Lower the bell end of next section making sure the steps are aligned (if applicable) into the final position. If the bell is up, place butyl material next to the vertical surface of the groove and follow the above procedure.

Confined O-Ring – Clean and inspect joint surfaces. Lubricate the joint surface liberally. Lubricate the O-ring gasket thoroughly before placing it into the confined groove space provided. Run a smooth, round object between the gasket and tongue around the entire circumference several times. Lower the lubricated end of the next section making sure steps are aligned into final position. Keep the sections level/plumb while setting to prevent rolling the gasket and breaking the bell.

Offset and Pre-Lubricated Gaskets – Install according to the manufacturer's specifications.

Precast Lift Hole Sealing (full penetration)

Lifting holes should be sealed by inserting a rubber plug or other approved material into the hole (if supplied) and/or filling with non-shrink mortar from both inside and outside.

Backfill Procedure

f you are vacuum testing, do the test before backfilling. Detecting leaks at this time is easy and repairs are simple. Distribute backfill around the manhole in equal proportions to prevent tipping. Compact the fill in lifts, the same as with a standard trench procedure. Backfill material should be clean and free of large rocks.

TESTING PROCEDURES

Vacuum Test Validates System Integrity

Vacuum testing is a quick, safe and practical way to validate manhole system integrity. Manhole sections can be tested at the precast concrete plant prior to delivery or on site prior to backfilling.

Many codes and specifications require that a vacuum test be performed after the manhole has been installed and backfilled. Testing after backfilling provides a degree of certainty that a watertight system has been installed. However, the major disadvantage is the fact that no industry standards exist for vacuum testing after the structure has been backfilled. Secondly, it is often difficult to determine the cause or locate and repair a system breech once the manhole has been backfilled.

The resolution to this problem is to perform a vacuum test before backfilling and, if necessary, after backfilling.

ASTM C1244, "Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill," has been developed to govern the proper vacuum testing procedure for testing concrete manholes. ASTM C1244 clearly states that a vacuum test "is intended to be used as a preliminary test to enable the installer to demonstrate the condition of the concrete manhole prior to backfill."

When utilizing ASTM C1244, a vacuum of 10 inches Hg is drawn on the manhole after all lift holes are plugged, and pipes entering the manhole are temporarily plugged and securely braced. The time is measured for the vacuum to drop to 9 inches Hg. The manhole is acceptable if the measured time meets or exceeds the values presented in Table 1 of ASTM C1244. If the manhole fails the initial test, it may be repaired by an approved method until a satisfactory test is obtained.

For more details on vacuum testing, please visit precast.org.

NPCA PLANT CERTIFICATION

Certify Excellence

From start to finish, the NPCA Plant Certification Program sets the highest standards for plant facilities, production operations and quality control procedures. NPCA certified plants are dedicated to manufacturing first-class products. To maintain their NPCA credentials, plants must pass periodic, on-site certification inspections.

The NPCA Plant Certification Program enables quality-conscious agencies, architects, engineers and users to identify and select high-quality precast concrete manufacturers. At no cost to specifiers, NPCA certification prequalifies manufacturers as companies capable of superior workmanship. You save money, because you do not need to spend valuable time and resources inspecting a plant to ensure that its products will meet or exceed your expectations. You also save time when you work with certified precast plants, because products arrive on the job site ready for installation. Material and labor costs are kept in check, because quality control starts before the work order reaches the precast plant.

The Certification Process

To become an NPCA certified plant, a precast concrete production facility must exceed a level of excellence defined by NPCA in accordance with relevant industry standards. Plant inspections are performed by an engineer from an independent, nationally accredited firm, and all certification applicants are graded on all critical aspects of plant operation. A standard grading schedule is used for all inspections to ensure uniformity. Inspections are performed during actual plant operation.

The NPCA Certified Plant

Precast concrete plant operators committed to excellence seek NPCA certification. Plants committed to quality invest the time and resources necessary to meet the high standards demanded by the construction industry. Staffed by experienced personnel, plants complying with NPCA guidelines practice quality assurance at every step of the production process. These guidelines require procedures and products to be inspected during each phase of manufacturing to ensure compliance with rigid industry requirements. As a result, products from NPCA certified plants are characterized by high quality, uniformity and consistency. Each NPCA certified plant is also required to maintain an active plant safety program that meets or exceeds local, state, provincial and federal laws and the rules and regulations of the U.S. Occupational Safety and Health Administration (OSHA) and Canadian Centre for Occupational Health and Safety.

NPCA guidelines require certified plants to maintain extensive records to verify that materials used in the manufacturing process conform to appropriate specifications. Work orders, product drawings, equipment calibration records, aggregate and concrete test records, batching reports and product inspection reports are also required as management tools and quality assurance aids.

FIND A PRECAST CONCRETE MANHOLE PRODUCER

Whether you need a custom project or standard product, visit precast.org or call (800) 366-7731 to find the precast concrete manufacturers in your area. The "Find a Producer" button on our home page leads to a powerful search engine that will link you to the appropriate NPCA members based on your selection criteria.

NPCA is happy to provide the data and support that you need to incorporate the latest precast concrete products into your design. Check the Products & Info section of our website to find information based on product lines. Or, contact NPCA Technical Services directly either by email at tech1@precast.org or by phone at (800) 366-7731.

Want to reach the precast community, or connect with engineers, architects, specifiers and regulators who have in interest in precast concrete? Join us on Facebook (facebook.com/nationalprecast) and plug into the community. It's a daily discussion of all things precast.

MANHOLE DESIGN NOTES

- Applicable standard: ASTM C478, "Standard Specification for Precast Reinforced Concrete Manhole Sections"
- Typical sizes: 48, 60, 72, 84 and 96-inch diameters with other sizes available.
- Diameter of the manhole is typically based on the maximum pipe size and the minimum structural leg between pipe holes.
- Riser sections typically come in increments of 12 inches, up to 48 inches.
- Transition slabs may be used to reduce the manhole diameter over a larger base section to minimize costs.
- Holes in precast manhole concrete sections for influent and efffluent pipe connections can be cast during pouring, or cored after the product has cured. Holes may need to be gasketed with compression or flexible type connectors as described in ASTM C923 and C1478.
- The base may be poured monolithically or may have a separate base. An invert or flow channel can also be poured into the base section if required.
- Welded wire reinforcing or hoop steel is commonly used in precast concrete manholes. The minimum total wall reinforcing area required is 0.0025 times the internal diameter in inches per vertical foot as noted in ASTM C478.
- Base and top slabs must have a minimum reinforcement of 0.12 sq. in./ft in each direction for 6i-inch slab thickness.
- Joints in manhole sections are designed to resist passage of solids or fluids while tight enough to pass vacuum testing if required. Rubber gaskets and/or preformed mastic or butyl gaskets are used to seal the joint.
- Steps are installed during the manufacturing process, and must conform to requirements of the Occupational Safety and Health Standards, U.S. Department of Labor. Standard loads are outlined in ASTM C478 and C497.

ADDITIONAL RESOURCES

ASTM A48/A48M, "Standard Specification for Gray Iron Castings"

ASTM A185 / A185M, "Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete"

ASTM A496, "Specification for Steel Wire, Deformed, for Concrete Reinforcement"

ASTM A497/A497M, "Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete"

ASTM A536, "Standard Specification for Ductile Iron Castings"

ASTM A615/A615M, "Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement"

ASTM A884, "Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement"

ASTM C443, "Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets"

ASTM C478, "Standard Specification for Precast Reinforced Concrete Manhole Sections"

ASTM C497, "Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile"

ASTM C923, "Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals"

ASTM C990, "Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants"

ASTM C1244, "Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill"

ASTM C1478, "Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes, and Laterals"