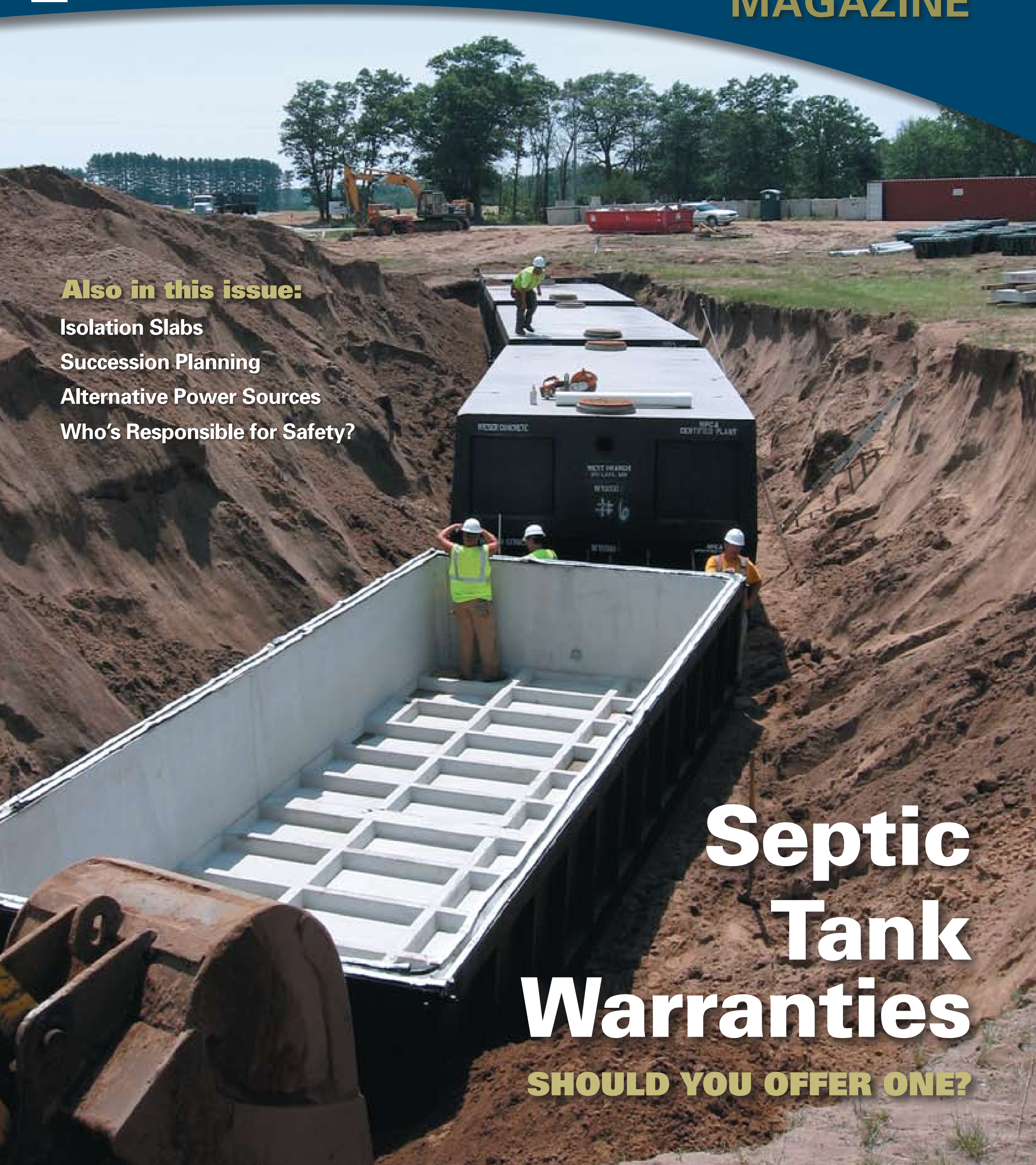
A PUBLICATION OF NPCA WWW.PRECAST.ORG MAR/APR 2009

precast inc.® MAGAZINE



Also in this issue:

Isolation Slabs

Succession Planning

Alternative Power Sources

Who's Responsible for Safety?

Septic Tank Warranties

SHOULD YOU OFFER ONE?

CONTENTS

MARCH/APRIL 2009

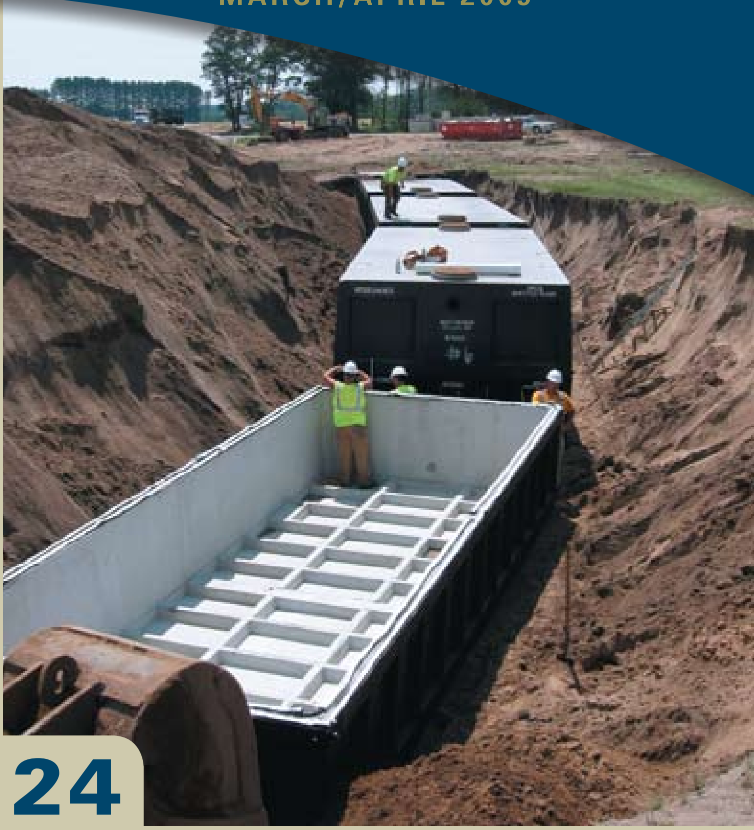
COVER STORY

Septic Tank Warranties

Precast septic tanks lining a ditch in Big Lake, Minn., are soon to be backfilled and forgotten as they perform flawlessly for decades to come. At least that's the way it should be – nobody likes the thought of sewage leaking out into the surrounding water table that may be tapped for potable water. Some precasters offer written warranties as an incentive when selling to contractors, while others stand behind their reputations and commitment to quality. Most can agree, however, that precast septic tanks should be the golden standard for reliability. But which school of thought will win the day as competition with manufacturers of other material becomes fiercer?

Story by Sue McCraven

Photo courtesy Wieser Concrete Products Inc.



FEATURES

DEPARTMENTS

precast inc.

STAFF:

Publisher: Ty Gable

Vice President of Marketing and Communication: Ron Fleming

Communication Director: Bob Whitmore

Managing Editor: Ron Hyink

Associate Editor: Michael Cook

Graphic Design: Molly Flick Tippner

Advertising Director: Brenda C. Ibitz

Technical Editor: Sue McCraven

Precast Inc. (ISSN 1940-9184 print, ISSN 1940-9192 online) is published bimonthly by NPCA.

Address your letters and comments to the editor:
Precast Inc./Editor
10333 N. Meridian St. Suite 272
Indianapolis, IN 46290
(800) 366-7731 • Fax: (317) 571-0041
E-mail: npca@precast.org
www.precast.org

NPCA is a trade association representing the manufacturers of plant-produced concrete products and the suppliers to the industry around the world.

PHOTO SHOWS ACTUAL VEHICLE LOADING ON AN ISOLATION SLAB OVER A GREASE INTERCEPTOR AT A FAST-FOOD ESTABLISHMENT. INSET SHOWS A CLOSE-UP OF A GREASE INTERCEPTOR/TRAP ACCESS.

The Real Dirt on Isolation Slabs

Engineering analysis proves that isolation slabs do not protect underground tanks from vehicular loads and, in fact, serve to increase loading on the underlying tank.

BY ERIC BARGER AND RONALD THORNTON, P.E. | PHOTOS COURTESY ERIC BARGER

On a rainy spring morning at a highway service station in the Midwest, a plumbing contractor drives his truck across the parking lot to pick up his fast-food order. As his truck rolls onto the concrete slab above the restaurant's grease interceptor, the truck plunges into the underground tank. The resulting trauma from the fall causes a serious back injury to one of the truck's occupants. An injury lawsuit ensues that involves the restaurant owner, utility contractor, architect, engineer, installation contractor and precast manufacturer.

To prevent accidents like the one just described, this article provides important information for precast concrete tank manufacturers and specifying engineers.

Light-duty precast concrete underground tanks with a cast-in-place concrete isolation slab over the top have long been used as a means to lower material cost in vehicular traffic areas and deep burial applications. This use of an isolation slab with a light-duty tank, however, introduces several problems that may adversely affect structural integrity and watertight performance.

The effects and consequences of using a tank not properly designed for vehicular loads can be catastrophic to public safety and the watertightness of the tank. The ramifications of using tanks that are not designed for vehicular loads, however, may not be readily apparent. Understanding how vehicular loads affect the structural integrity of an underground tank and knowing what design solutions are acceptable for vehicular traffic loads are essential for identifying and preventing problems before they occur.

Slab self weight and insufficient stiffness

An isolation slab may seem like a common-sense solution to an everyday problem and, in fact, such a slab does provide some distribution of wheel loads. However, engineering analysis clearly shows that the isolation slab does not completely shield the light-duty tank from traffic-rated loads. Instead, traffic loads are transferred directly onto the underground tank, because the isolation slab is not stiff enough to prevent slab deflection on compressible soil. Structural and performance failures may take years before they are noticed during routine inspections because most of the tank is filled with water and hidden from view. This structural inadequacy of isolation slabs elevates the importance of ensuring that properly designed tanks are built to handle the anticipated loads prior to installation.

Concrete isolation slabs are commonly 6 to 12 inches thick (150 to 305 mm) and extend at least 12 inches into undisturbed soils around the perimeter of the tank. There are several reasons why isolation slabs can expose the tank to damage from extra loads due to vehicular traffic:

- First, the slab's self weight increases the dead load on the tank, making the problem worse.
- In addition to inherent structural problems, an isolation slab may provide a ready pathway for inflow and infiltration of groundwater into the tank.
- Finally, the slab may apply significant point loads on certain parts of the tank top due to contact with risers and cleanout extensions.

Understanding tank loading

An understanding of how weight affects an underground tank and its different components will help identify potential problem areas that lead to structural and performance failure. These loads include but are not limited to:

- Soil/earth;
- Asphalt;
- Concrete sidewalks;
- Concrete isolation slab;
- Grade rings;
- Manhole frames and covers;
- Manhole sections; and
- Often the least thought-of component: the weight of the tank itself.

Loads that impact the top of the tank are transferred to the bottom of the tank in the form of upward bearing pressure, in addition to the weight of the tank itself. The tank's side and end walls are affected by the increased lateral loads due to wheels adjacent to the tank; this is known as a lateral surcharge load.

The structural capacity of a non-traffic-rated tank can be found by referring to ASTM C1227, "Specification for Precast Concrete Septic Tanks." In section 6.1.4, it is stated that "unless heavier loads are expected, the minimum live load at the surface for the design shall be 300 psf (14.4 kPa)." Therefore, the isolation slab must not allow the H20 wheel load to exceed 300 psf on the surface of the non-traffic-rated tank.

Engineering analysis of isolation slabs

An engineering analysis was conducted in order to better understand the effectiveness of concrete isolation slabs. The engineering analysis can be broken down into three parts:

CLOSE-UP OF DEFLECTION-INDUCED CRACKING IN AN ISOLATION SLAB.

- Evaluation of the structural capacity of a non-traffic-rated (light-duty) tank;
- Determination of how H20 traffic-rated loads are applied to an underground tank; and
- Review of how an isolation slab distributes the vehicle loads in a manner that will not exceed the structural capacity of the non-traffic-rated tank.

The weight of a single H20 axle is 32,000 pounds (14,500 kg) with an impact factor of 1.2, at 1 to 2 feet below grade (0.3 to 0.6 m). If the allowable live load is 300 psf (14.4 kPa), the size of the isolation slab will need to be at least 128 square feet (12 square meters). To calculate: 128 = (32,000 x 1.2 / 300). Using a slab of this size, according to common-practice thinking, would reduce the wheel loads to an acceptable level that is equal to the allowable design load for a non-traffic-rated tank (300 psf). However, this rationale only holds true if the slab is stiff enough to distribute the loads evenly.

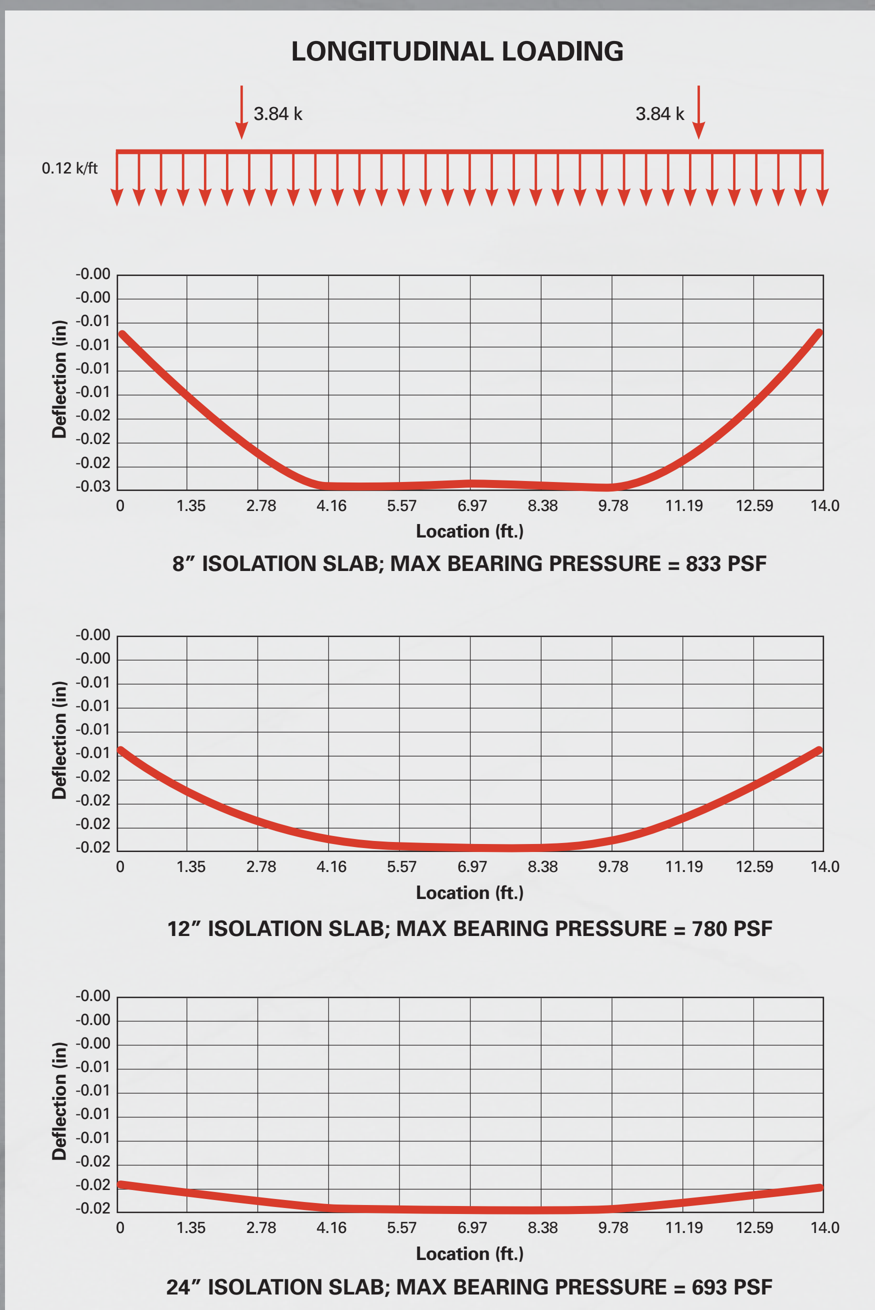


FIGURE 1

Analyzing the actual distribution of the wheel loads, the slab was modeled as a beam on an elastic foundation using typical values for Modulus of Elasticity, *E*, of cast-in-place concrete (3,122 ksi [21,530 MPa]) and a sub-grade modulus of the soil, k_s, (231 pci [6.4 kg/cm^3]). Slab thicknesses of 8, 12 and 24 inches (200, 305 and 610 mm) were used in the analysis. Two wheels were placed on the longitudinal cross section and one wheel placed in the transverse cross section (see Figures 1 and 2).

The 8-inch-thick (200-mm) slab transferred more than 830 psf (39.7 kPa) loading on the top of the tank, which exceeded the allowable load on the non-traffic-rated tank by 2.7 times. The 12-inch-thick (305-mm) slab transferred more than 780 psf (37.3 kPa) loading on the top of the tank. Again, the loading was more than 2.5 times the allowable load on the non-traffic-rated tank. The 24-inch-thick (610-mm) slab had the best results but still transferred more than 690 psf (33.0 kPa) to the top of the non-traffic-rated tank, easily doubling the maximum allowable load of a non-traffic-rated tank.

It is clearly shown from the resulting calculations and deflection diagrams that the thicker the slab, the more evenly the wheel load is distributed. In all cases, however, the resulting maximum pressure is still well in excess – more

TYPICAL ISOLATION SLAB CONSTRUCTION OVER A GREASE INTERCEPTOR AT A COMMERCIAL SITE.

than double in the best-case scenario – of the allowable 300 psf (14.4 kPa). The engineering evaluation discredits the rationale that an isolation slab decreases the load placed on the non-traffic-rated tank in traffic applications.

There is no practical means to make a non-traffic-rated tank into one that is traffic-rated with an isolation slab. It is recommended that all tanks subjected to traffic be specifically designed for maximum anticipated loading. Such designs must consider not only the additional loading, but also lateral surcharge loads on the sidewalls and upward bearing pressure applied to the base slab.

Recommended tank design

Tanks are only as strong as the loads for which they are designed. As proven by engineering analysis, the use of an isolation slab to shield a light-duty tank from vehicular or deep burial load should not be allowed. Proper tank design without an isolation slab holds advantages for the installer, manufacturer and the public. The burden of liability in cases where a tank experiences a failure (described at the beginning of this article) will be placed on the installer and manufacturer, fairly or not. In today's world, the reality is that liability is a big concern for manufacturers and for public relations. In addition, all tank designs should be certified by a professional engineer in the state where the product is installed.

To ensure public safety and successful installation of a tank in a vehicular traffic area, the tank should be designed to withstand vehicular traffic loadings without the use of an isolation slab. Despite the long-standing practice of using isolation slabs in vehicular traffic areas, now is the time for manufacturers to eliminate this faulty design and improve the structural integrity and watertightness of precast concrete underground tanks. In properly designing underground tanks for site loading conditions, manufacturers will minimize product liability and improve public safety. ▪

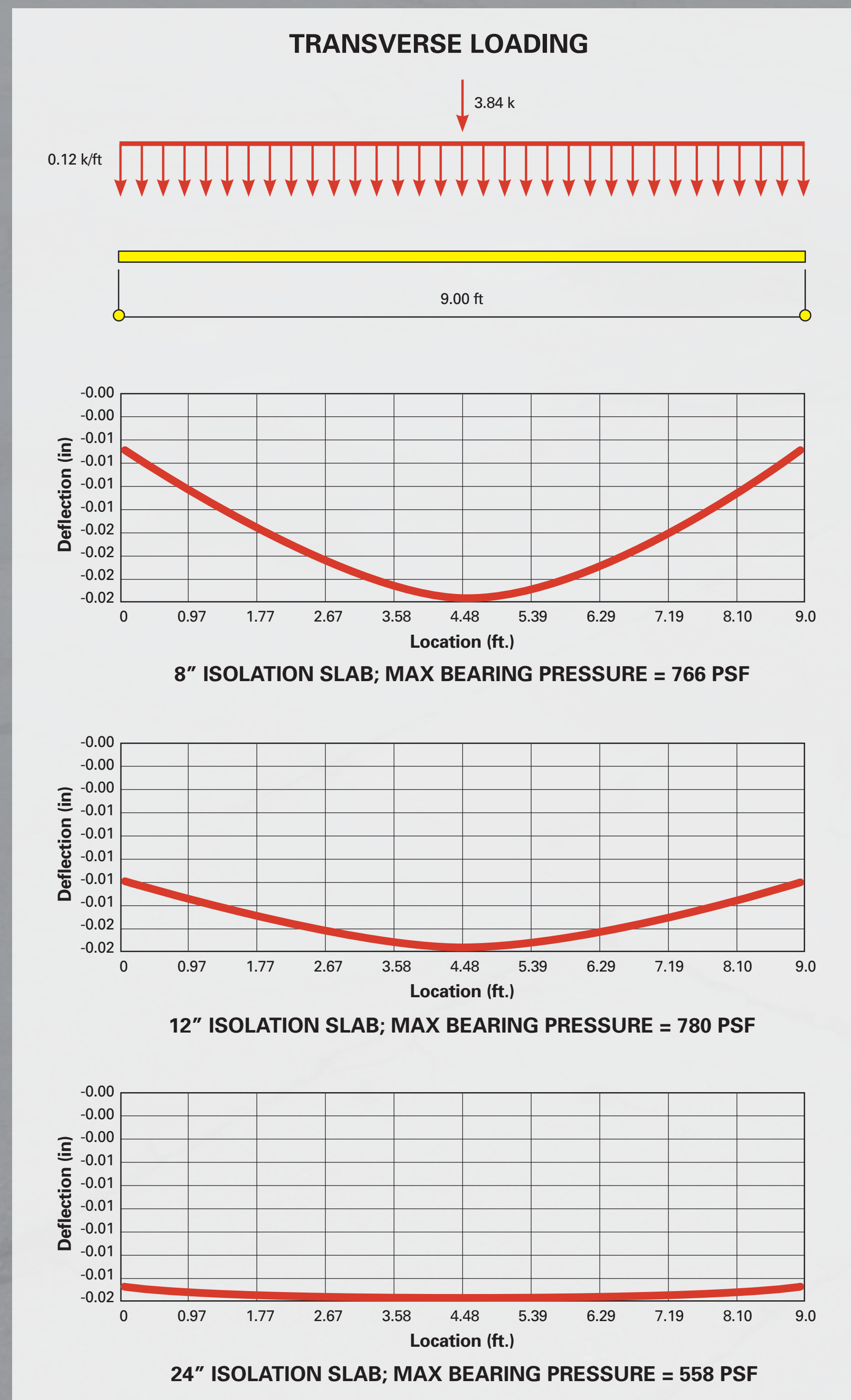


FIGURE 2

Eric Barger is president of Barger & Sons Inc., a manufacturer of septic tanks, grease traps, pump tanks, catch basins and other precast concrete products, based in Lenoir City, Tenn. He currently serves on NPCA's board of directors as well as NPCA's Educational Foundation. Visit his company's Web site at www.BargerAndSons.com.

Ronald Thornton, P.E., is a project manager for Delta Engineers in Binghamton, N.Y., with more than 25 years of experience in the concrete industry. He has extensive experience in the design, manufacture and installation of precast products for use in state, municipal and private projects. Thornton currently serves on the NPCA Utility Product Committee as well as the ASTM C27 Committee.