Maximum Design Capacity

Specifying and producing HS-20 traffic-rated tanks in existing molds can be risky business

BY ERIC BARGER AND RONALD THORNTON, P.E.

A precast concrete company receives an order for an HS-20 traffic-rated grease interceptor to be set in a parking lot at a local restaurant. The dispatcher takes the order, and production manufactures a standard grease interceptor, except instead of using a 3- to 4-inch-thick top, they increase the thickness to 6 inches and add some extra rebar to the top. The tank is delivered and set in place days later with no one realizing that it may be inferior for this specific application and at risk for catastrophic failure. And as we all know, failure of a tank in a traffic-rated area brings along lawyers, poor public relations and a reputation that cannot be regained overnight, if ever.

Often it is necessary to install a grease interceptor or septic tank in a vehicular traffic area. The temptation for any tank manufacturer to use existing molds to produce the tank is very real, because investment in new molds specifically for traffic-rated applications is costly. Many factors add to the cost of a new traffic-rated product, and new molds are just the beginning of problems and extra costs relating to traffic-rated tanks.

Tanks designed to handle traffic-rated loads have thicker side walls, bottom and top, and require larger equipment to handle the additional weight; often the weight of a same sized capacity tank can double when going from non-traffic-rated to traffic-rated. A new truck, boom and rigging may be required to handle and deliver the larger and heavier traffic=-rated tank. Many tank manufacturers do not have overhead cranes to strip products out of the molds, and if they do, the cranes are generally sized at the limit of the manufacturer's heaviest product. Therefore, introducing a new product that is much heavier to production could also mean infrastructure upgrades to existing plants. An increase in concrete and a mix design with more portland cement for stronger 28-day ultimate strength is required for design specifications. Rebar must be cut and bent and placed precisely to ensure performance, which adds man-hours and material cost to the new product. Additional engineering is required to make sure the tank design is of sound quality to address any liability concerns. It can be an overwhelming feeling when a manufacturer starts a new product that varies greatly from anything he has produced in the past.

These factors lead to manufacturers using existing molds and increasing the thickness of the top slab in order to bypass the possibility of the increased cost of adding a new tank to the product line. The tank is delivered and put in traffic-rated service without any further thought. This is a long-standing accepted practice within the industry at all levels. Keeping the investment cost down by not having a traffic-rated mold for every non-traffic-rated mold on the production floor is important to a manufacturer watching the bottom line. Many manufacturers fear losing a sale to a competitor, because an engineered traffic-rated tank may be as much as two and half times the cost of a non-traffic-rated tank offered by a competitor who does not follow responsible practices.

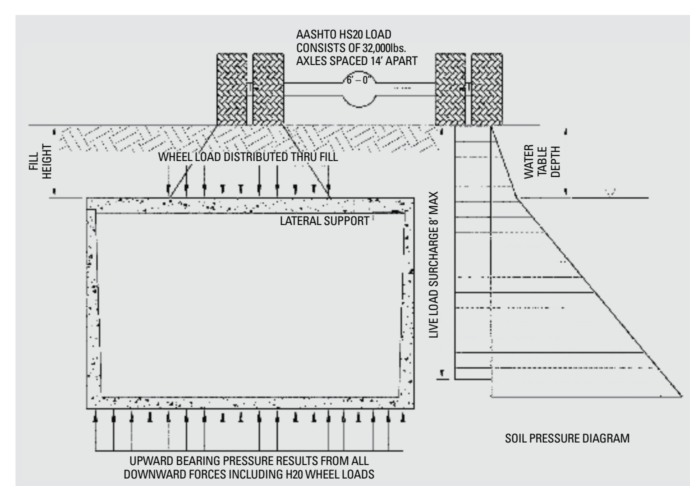
Can existing molds designed to produce structures for non-vehicular loads be engineered to accommodate H-20 traffic loads? Is this a safe and responsible practice, or is having separate product molds designed specifically for traffic rated loads even necessary?

What is HS20?

HS20 loading is defined by the American Association of Highway and Transportation Officials (AASHTO) as a vehicle with an 8,000-pound front axle and one or more rear axles weighing 32,000 pounds each and spaced at least 14 feet apart. Since the axle spacing is greater than the tank width, HS20 and H20 may be used interchangeably.

The entire tank is affected by the wheel load and not just the top slab. Wheels adjacent to the tank result in a lateral surcharge force in addition to normal soil loads, and the upward bearing pressure applied to the bottom slab results from all of the downward forces including the weight of the tank itself, soil loads above the tank lid, and all live loads.

A typical 1,500-gallon non-traffic-rated tank with a monolithic partition wall was chosen as the test subject for this analysis. This tank has been in use for more than 15 years as a non-



Impact Consideration for Manufacturers

- Thicker side walls, bottom and top
- Larger equipment to handle heavier product
- Major infrastructure upgrades may be needed
- Increased cost in mix designs that have higher 28-day strengths
- Man-hours to build the reinforcement grid

traffic-rated tank. The lid thickness is 6 inches with an average wall thickness of 4 inches and a bottom slab thickness of 4 inches.

When the original design was made, the thought of placing the tank in traffic areas was not an issue. As land becomes more valuable and parking space becomes increasingly larger, the need to install a grease interceptor under a parking space or vehicular traffic area becomes greater. The liability aspect alone is enough to deter some manufacturers altogether from producing a tank that can handle such loads. It is a fact that tanks have collapsed in drive-throughs, yards and parking lots where vehicular traffic was present, but the simple reason is because tank below was not engineered or built for such applications.

Engineering analysis demonstrates the tank initially designed for non-traffic use can be made into an HS-20 traffic rated tank with careful engineering and many preconditions. The conditions are:

1. 1 to 2 feet of soil shall be over the top of the tank.
2. No more than one axle or two wheels shall be over the tank at any one time.
3. The minimum concrete strength will be 5,000 psi compressive strength
4. The top slab thickness shall be increased to 6.5 inches. However, the bottom slab and wall thicknesses cannot be modified.
5. The tank contains a monolithic compartment wall.
6. The water table shall be at least 3 feet below grade when the tank is empty.
7. The walls are supported at the roof by an interlocking recess that is cast into the top slab.
8. Reinforcing bar size, spacing and location shall be installed per professional engineer recommendation.

With a maximum burial depth of 2 feet, it is clear that the versatility of the tank used in this analysis would be useful only in a narrow range of applications. There is a concern when burying a tank in a traffic area that the site may be raised in the future and/or the use may change. A business changing from a gas station to a truck stop would be an example of a drastic change that could cause the listed preconditions to be invalidated and the tank design to be inadequate in that situation. Designing for the worst-case scenario is not practical either. It is not just today that manufacturers have to address failures and costly litigation when a tank collapses or is damaged. Using thicker side walls, bottom and top will help engineers design a traffic-rated tank that enables everyone to rest easy. When site conditions change years after the tank is installed, will you be willing to accept the responsibility and possible litigation that would follow a structural failure?

Standard tank molds can, under certain conditions, be modified and designed to produce a tank approved for heavy traffic loads. However, making such modifications requires careful analysis and attention to detail, both in design and manufacturing. Each of the assumptions listed above are critical to the satisfactory performance of the traffic-rated tank when subjected to the loading conditions. Remember, the tank is not traffic-rated until a licensed Professional Engineer in good standing states the maximum design capacity in writing.

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.BargerAnd-Sons.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.