

• by Phil Stephens, Strongwell Corporation

# Handholes and Underground Electrical Enclosures



*New requirements in the NEC<sup>®</sup> strive to help eliminate injuries.*

A warm summer night at an Ohio ballpark in July 2003 ended in tragedy for an 8-year old girl when she was accidentally electrocuted because she stepped on the metal cover of a damaged and improperly grounded pull box. A similar accident occurred that same year in Las Vegas when a tourist was killed because she walked on the energized cover of a traffic signal wiring enclosure. Yet another accidental electrocution occurred in New York City last year when a woman was killed while walking her dogs. Again, the culprit was an improperly grounded service enclosure.

Are these freak accidents or are they becoming more common as America's underground infrastructure ages and maintenance budgets are reduced? If events in Ohio, New York City and Las Vegas are any indication, tragedies like these are becoming what they should never be – all too common.

Metal covers are not the only danger, though, when it comes to failed underground handhole enclosures. Across the country, broken covers, warped plastic and damaged fiberglass enclosures threaten to expose high voltage wires and other dangerous equipment to the public. Not only does this create a huge safety risk, but it also creates costly repairs and a tremendous amount of potential liability for municipalities, electrical utilities and other users of underground enclosures.

A combination of factors led to the tragedy in Ohio, according to investigator John Loud of Exponent Failure Analysis Associates, the firm hired to investigate the cause of the accident.

Loud found that the metal cover on the enclosure was not bonded to ground. Also, the enclosure was not properly installed with a support base and had therefore been forced down into the ground by loadings imparted by the park's lawn tractor. The enclosure had sunk so far that

the metal lid was compressing the internal conductors. A lightning strike several weeks prior to the accident may have also contributed to the splice insulation fault that energized the cover.

"It was a senseless, tragic accident," commented Loud. "There was absolutely no need for it."

Loud also found that most of the other enclosures in the park, in addition to the one in question, had failed structurally.

"The strength of the enclosures installed at the park was not adequate because you could see a number of them had cracked."

Failed enclosures. Energized metal covers. Improper installations. You may wonder why underground enclosures cause so many problems for end users. The answer to that question is three-fold. First, until recently the underground enclosure industry did not have a national performance standard to follow for the testing of their products. Second, enclosures are made using various materials, designs and technologies. When coupled with the lack of a performance standard, it was easy for manufacturers to misunderstand and make misleading or false claims about the performance and appropriate applications for their enclosures. Last, until now underground enclosures were not addressed in the *NEC*<sup>®</sup>.

#### ANSI/SCTE 77-2002

The entire landscape for underground enclosures has changed thanks to the hard work of dedicated professionals in the Society of Cable Telecommunications Engineers, Underwriters Laboratories, Inc., the American National Standards Institute, and the National Fire Protection Association. Long before the tragic headlines of the past few years, these organizations worked to develop a national performance code that would include rigorous performance testing to help ensure safe, reliable under-

#### FROM THE 2005 NEC

##### **314.30 – Outlet, Device, Pull and Junction Boxes; Conduit Bodies; Fittings; and Manholes: Handhole Enclosures**

Handhole enclosures shall be designed and installed to withstand all loads likely to be imposed.

FPN: See ANSI/SCTE 77-2002, *Specification for Underground Enclosure Integrity*, for additional information on deliberate and non-deliberate traffic loading that can be expected to bear on underground enclosures.

- (A) Size. Handhole enclosures shall be sized in accordance with 314.28(A) for conductors operating at 600 volts or below, and in accordance with 314.71 for conductors operating at over 600 volts. For handhole enclosures without bottoms where the provisions of 314.28(A)(2), Exception, or 314.71(B)(1), Exception No.1, apply, the measurement to the removable cover shall be taken from the end of the conduit or cable assembly.
- (B) Wiring Entries. Underground raceways and cable assemblies entering a handhole enclosure shall extend into the enclosure, but they shall not be required to be mechanically connected to the enclosure.
- (C) Handhole Enclosures Without Bottoms. Where handhole enclosures without bottoms are installed, all enclosed conductors and any splices or terminations, if present, shall be listed as suitable for wet locations.
- (D) Covers. Handhole enclosure covers shall have an identifying mark or logo that prominently identifies the function of the enclosure, such as "electric." Handhole enclosure covers shall require the use of tools to open, or they shall weigh over 45 kg (100 lb). Metal covers and other exposed conductive surfaces shall be bonded in accordance with 250.96(A)

ground enclosures based upon the application. Their efforts brought about ANSI/SCTE 77-2002 *Specification for Underground Enclosure Integrity* – the first truly national performance standard for underground enclosures.

As the ANSI standard was being developed, the NFPA was also working proactively to increase the safety and reliability of handholes. NFPA recognized that while the equipment and wires that go into underground handhole enclosures had to meet the Code, the enclosures themselves had not been addressed. The NFPA then took steps to bring handhole enclosures into the Code; the result of this action can be seen in the 2005 *NEC*.

New section 314.30 of the 2005 Code provides requirements for applying underground handhole enclosures in electrical systems. Section 314.30(D) specifically requires all conductive surfaces to be bonded per section 250.96(A), which will help prevent accidents like the ones in New York, Las Vegas and Ohio. 314.30 goes further than the bonding requirement, though. 314.30(A) requires that the size of the enclosure must meet 314.28(A) for conductors at 600 V or less and 314.71 for conductors over 600 V. 314.30(B) states that raceways and cable assemblies are required to extend into the enclosure but are not required to be fastened to the enclosure. 314.30(C) addresses the issue of enclosures without bottoms by requiring all enclosed conductors and any splices or terminations to be listed as suitable for wet locations. One of the key objectives of 314.30 is to impose minimum requirements for the structural integrity of the handhole enclosure.

### Structural Integrity

As defined in Article 100 of the 2005 *NEC*, a handhole enclosure is “an enclosure identified for use in underground systems, provided with an open or closed bottom, and sized to allow personnel to reach into, but not enter, for the purpose of installing, operating, or maintaining equipment or wiring or both.” The job of the handhole is to mechanically, as opposed to environmentally or electrically, protect its contents. In other words, the enclosure must maintain structural integrity while in service. It is therefore critical to select an enclosure that is suitable for the application. Again, the lack of performance standards, the variety of materials and designs, and the sometimes misleading performance claims made by manufacturers led to much confusion in the past about how to do just that. Now, however, the 2005 *NEC* provides clear guidance on the issue in its Fine Print Note found in 314.30. The FPN states: “*See ANSI/SCTE 77-2002, Specification for Underground Enclosure Integrity, for additional information on deliberate and non-deliberate traffic loading that can be expected to bear on underground enclosures.*”

Simply put, the FPN instructs specifiers and end users to use the ANSI standard as their guide to selecting an enclosure that will “withstand all loads likely to be imposed”

and remain safe and reliable for the intended application.

### Testing and Tiers

ANSI/SCTE 77-2002 is an appropriate performance specification rather than a construction specification, meaning that any properly designed and constructed enclosure could potentially meet the ANSI standard regardless of the materials of construction. A copy of the standard may be purchased from ANSI or it may be viewed in PDF form on SCTE’s website at [www.scte.org/documents/pdf/ANSISCTE772002WG40001.pdf](http://www.scte.org/documents/pdf/ANSISCTE772002WG40001.pdf).

To meet the ANSI standard, enclosures must pass a battery of physical, environmental and internal equipment protection tests to ensure long, reliable service life with minimal maintenance. These tests include: three position structural testing of both the enclosure and cover to simulate typical non-deliberate vehicular loadings; accelerated service per ASTM D 756; chemical resistance per ASTM D 543; simulated sunlight exposure per ASTM G 154; impact resistance per ASTM D 2444; water absorption per ASTM D 570; and flammability resistance per RUS (USDA Rural Utilities Service) specification PE-35 and RUS 7 CFR 1755.910, paragraph xiii.

While all of the tests listed above are important to ensure long-term performance, the heart of ANSI/SCTE 77-2002 lies in the three position structural test and the load requirements chart, which are illustrated in Table 1 and Illustration 1. The standard also provides specific instruction on how to properly conduct the three position structural test.

The ANSI standard defines loading requirements for enclosures based upon anticipated loads and separates these requirements into Tier levels defined by the application. As shown in the chart, the end user now has straightforward instruction that if he has a sidewalk application, he needs to select an enclosure that meets, at a minimum, the loading requirements for Tier 5 or Tier 8, depending on the potential that the enclosure has of being run over by a vehicle. To make it easier for end users or contractors to determine the correct Tier level of enclosures, some of the leading manufacturers have taken the initiative to emboss Tier designations directly onto the covers of their enclosures. This visual aid helps eliminate confusion and the possibility of misapplication when enclosures are pulled from pre-existing stock.

Judgment should be applied when determining the appropriate Tier level needed for a particular underground enclosure application. For example, if an enclosure is installed in the sidewalk away from the curb, a specifier would usually determine that a Tier 8 enclosure would be the most suitable choice for the application. If that enclosure were located in the sidewalk next to a curb, though, where there is an increased likelihood of coming into contact with vehicles, it would be a smart choice to specify a Tier 15 enclosure.

| Application   | Loading Requirements |             |          |                    |
|---|----------------------|-------------|----------|--------------------|
| Light Duty<br>Pedestrian traffic only   | Vertical             | Test Load   | 13.3 kN  | 3000 pounds        |
| TIER 5<br>Sidewalk applications with a safety factor for occasional non-deliberate vehicular traffic                        | Vertical             | Design Load | 22.2 kN  | 5000 pounds        |
|   | Lateral              | Test Load   | 33.3 kN  | 7500 pounds        |
| TIER 8<br>Sidewalk applications with a safety factor for non-deliberate vehicular traffic.                                  | Vertical             | Design Load | 28.7 kPa | 600 pounds/sq. ft. |
|   | Lateral              | Test Load   | 43.1 kPa | 900 pounds/sq. ft. |
| TIER 15<br>Driveway, parking lot, and off-roadway applications subject to occasional non-deliberate heavy vehicular traffic | Vertical             | Design Load | 35.6 kN  | 8000 pounds        |
|   | Lateral              | Test Load   | 53.4 kN  | 12000 pounds       |
| AASHTO H-20<br>Deliberate vehicular traffic applications  | Vertical             | Design Load | 28.7 kPa | 600 pounds/sq. ft. |
|   | Lateral              | Test Load   | 43.1 kPa | 900 pounds/sq. ft. |
| Certified precast concrete, cast iron or AASHTO recognized materials  |                      |             |          |                    |

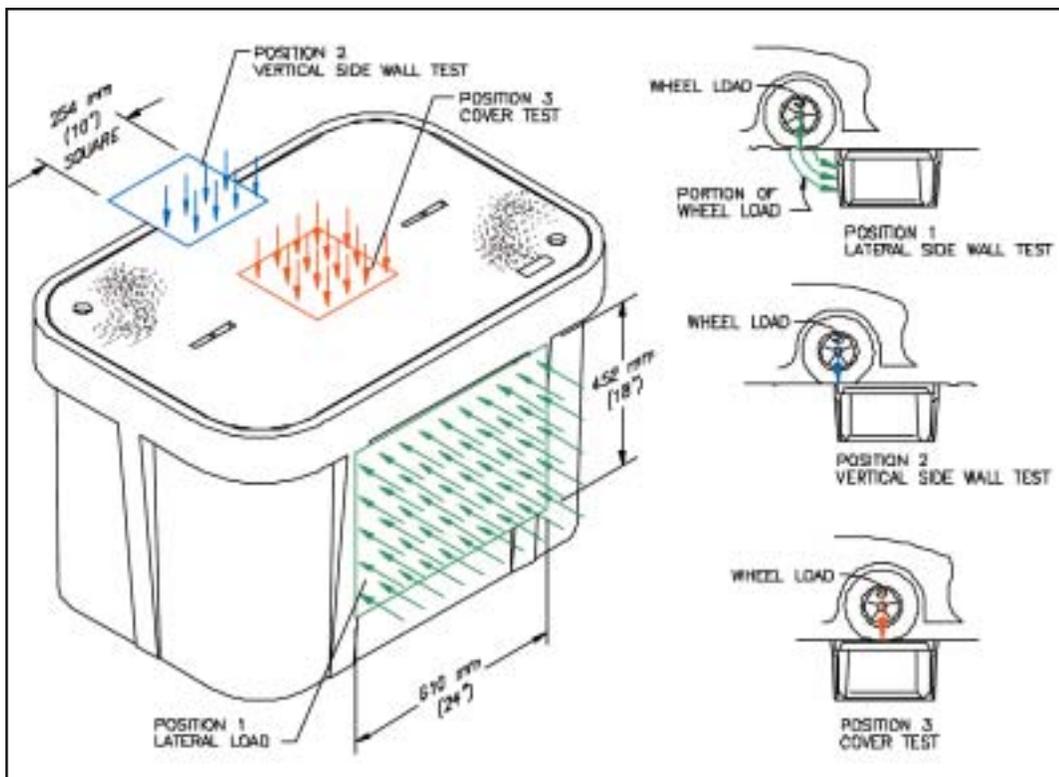
Table 1 - Design and Test Loads (From ANSI/SCTE 77-2002 *Specifications for Underground Enclosures Integrity*)

For another example, if an enclosure is being installed in a grassy area, the installer might first assume that a light duty enclosure would be strong enough for the application. If that enclosure will come in contact with a lawn tractor, however, it would be wise to install a Tier 8 enclosure instead. As the Ohio electrocution case demonstrated, the

effect of loads imparted by lawn tractors on underground enclosures should not be overlooked. In case of exposure to large farm tractors, a Tier 15 enclosure could even be considered. The enclosure location sketches found in this article can be used as a handy visual reference to help specifiers determine the proper Tier level needed for these and other scenarios. It's

always better to err on the side of caution in instances where the amount of non-deliberate traffic that an enclosure might encounter is in question.

The three-position test is the best indicator of an enclosure's overall strength. The first position tests how an enclosure's lateral sidewall withstands soil surcharges as a vehicle approaches the enclosure. The second position tests how an enclosure withstands vehicular loading applied directly onto a vertical sidewall, and the third position tests vehicular loading applied to the center of



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Illustration 1 - Product Test Positions (from ANSI/SCTE 77-2002 *Specifications for Underground Enclosures Integrity*) simulate all loadings likely to be imposed upon the enclosure.

the enclosure's cover.

In the past, some underground enclosure manufacturers would use only the results from the center of the cover test to tout the strength of their enclosures. This practice was misleading since no mention was made of lateral or vertical sidewall strength. If the enclosures were weak in those areas, end users were none the wiser and enclosures that were not strong enough for certain applications were installed anyway. This issue was one of the main drivers for the development of the ANSI standard, which now spells out that enclosures must be tested at all three positions in order to meet the standard.

The load chart in ANSI/SCTE 77-2002 will also help eliminate the misleading practice by some enclosure manufacturers of using test loads (the minimum ultimate failure load) rather than design loads (the expected load plus a safety factor of 1.5) to promote the strength of their enclosures. This misleading practice can lead to dangerous failures because test loads do not provide a factor of safety. End users therefore might unknowingly put enclosures in applications that push loading ratings dangerously close to, or even past, the limits of the enclosures. Now, however, ANSI compliant enclosures must meet design loads that have a 1.5 safety factor built in.

Having the ANSI standard in place is a great step forward for end users of underground enclosures. However, the chance for product misrepresentation still exists unless enclosures are tested to verify that they meet all of ANSI/SCTE 77-2002's testing requirements. If end users are not able to perform the tests for themselves, the least costly way to verify compliance with ANSI is to rely on testing conducted by third party organizations such as Underwriters Laboratories, Inc. Some enclosure manufacturers have submitted products to UL for testing and the enclosures that meet all of the testing requirements may now be UL Listed to the ANSI standard. While the *NEC* does not explicitly require third party listing, it is the most responsible and least costly way to ensure the safety of the public while minimizing liability.

### Materials + Construction Methods = Performance

As stated earlier, any properly designed and constructed enclosure could potentially meet the ANSI standard regardless of the materials of construction. However, different materials, methods of construction and design geometries will give different characteristics to the finished product and have a great deal to do with its lifecycle performance. A basic understanding of these subjects will help end-users select enclosures that are most suitable for their application. The following information provides a guide to the most common materials and manufacturing methods for underground enclosures on the market today and their advantages and disadvantages.

### Concrete Enclosures

Concrete enclosures have been used for years in underground construction projects. The first concrete enclosures were created using wooden forms where concrete was poured in place to create the enclosure. This method was labor intensive and extremely expensive so precast concrete enclosures were developed as a more cost effective alternative. Today, precast concrete enclosures are widely used. While the quality can vary depending on the manufacturer, precast concrete enclosures are generally strong and are available in a wide variety of sizes from regional manufacturers across the country.



**A cracked cover is a failed cover because its design performance capability has been compromised.**

However, precast concrete enclosures have lifecycle cost and performance issues that must be considered before being specified. Cost is greatly dependent on the size of the enclosure; small enclosures can initially be relatively inexpensive but can be prone to breakage and chipping. The cost for larger enclosures increases dramatically because thicker walls are required to maintain structural integrity. High transportation and installation costs are also a drawback, as most precast concrete enclosures are so heavy that cranes or other special equipment are often needed to set the larger sized units.

Perhaps the biggest disadvantage of precast concrete lies in its material properties – concrete is very brittle. The practice by some manufacturers of sending 10% more product than ordered to allow for breakage during shipment is a strong testament to this characteristic. Concrete is also a porous material – it absorbs up to 9% water by weight – which can lead to spalling (chipping) caused by freeze/thaw cycles. In a saltwater environment and in soils with high alkaline content, con-

crete deteriorates without notice. This combination of brittleness, porosity and susceptibility to alkaline attacks commonly results in enclosures that are cracked or completely broken apart – in which case their performance is compromised.

Cracked covers are a common sight regardless of whether you're in Portland, Maine or Los Angeles, California. Some end users attempt to bypass this problem by using steel covers. When properly bonded, steel is a good compromise. However, as was the case in all three of the accidents mentioned earlier in this article, environmental weathering, structural damage to the enclosure, improper installation, or some combination of these is possible over time and may lead to enclosures becoming unbonded. If wiring then becomes damaged and makes contact with the conductive enclosure, death or injury can result. The use of nonconductive covers would be a safer choice, which could possibly save lives. In fact, some cities have recently instituted programs to replace steel covers with nonconductive polymer concrete covers in an effort to reduce the chance of accidental electrocutions.

#### **Precast Monolithic Polymer Concrete Enclosures**

Precast polymer concrete enclosures have been around for more than three decades. This breed of enclosures was developed by several manufacturers in the underground enclosure industry as a high tech way to correct some of the inherent problems with precast Portland cement concrete. The endeavor was successful and the performance of polymer concrete enclosures in the field has been well proven.

The materials from which polymer concrete enclosures are made – selectively-graded aggregates, a polymer resin system and fiberglass mat for additional strength and rigidity – give these enclosures a number of performance advantages over other types of non-concrete enclosures sold today. When good geometry is combined with these materials, manufacturers are able to design thinner and lighter-weight polymer concrete enclosures, which still exhibit properties typical of bulkier Portland cement concrete enclosures. Their lightweight characteristic makes this type of enclosure relatively easy to handle and install. Even with the largest polymer concrete enclosures, installers can use the same equipment that dug the hole to set the enclosure. This can provide tremendous cost and time savings because cranes and other special equipment don't have to be rented and scheduled for the installation.

Polymer concrete enclosures also differ from Portland cement concrete in that the material is non-porous and therefore absorbs virtually no water. This characteristic protects these enclosures from spalling caused by freeze/thaw cycles. The polymer resin also provides excellent corrosion and impact resistance properties. Additionally, these monolithic enclosures are made with



Compared to precast Portland cement concrete, precast polymer concrete is lighter in weight, stronger and more cost effective to install because the equipment used to dig the hole can be used to set the enclosure..

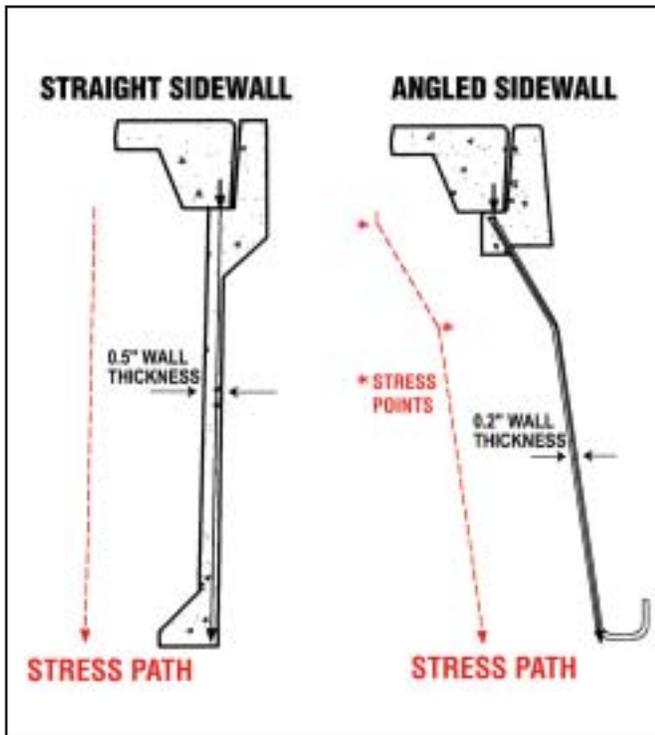
matched surface tooling to ensure consistent quality from part to part. Reduced installation and maintenance costs and a long life cycle make polymer concrete enclosures a cost competitive choice when all factors are considered.

#### **Dissimilar Materials (FRP/Polymer Concrete) Enclosures**

Dissimilar materials enclosures, where a sprayed-up or laid-up fiberglass body is embedded into a polymer concrete collar, were developed to cut the cost of monolithic polymer concrete enclosures. Dissimilar materials enclosures are a good idea in theory. They feature two high quality materials and are lightweight, corrosion resistant, and won't absorb water. In actuality, however, any cost savings



Sprayed-up fiberglass and wood make up this failed dissimilar materials enclosure. Lack of strength was an obvious issue in this application.



**Illustration 2 – Straight sidewalled enclosures transfer loads without causing additional stresses to the structure.**

is minimal and product performance may be sacrificed.

Much like a Hollywood set, dissimilar materials enclosures look great from a distance but behind the scenes there may be very little to support them. The combination fiberglass base and polymer concrete collar and cover that comprise dissimilar materials enclosures can be problematic for several reasons. First, the fiberglass bases are made utilizing a spray-up or hand-lay-up production method using a one-sided open mold. Because the process does not involve matched surface tooling, inconsistencies in sidewall thickness may likely result. Second, fiberglass bases, while very strong, are at times too flexible and the sidewalls can deflect inward over time as a result of soil pressures. If enough deflection occurs, the sidewalls could collapse or cause the polymer concrete ring to crack, thus causing enclosure failure. Last, the materials of construction are problematic because fiberglass and polymer concrete have different coefficients of thermal expansion (CTE). When materials with different CTEs are bonded, the materials expand and contract at different rates during temperature fluctuations. This expansion/contraction differential causes stress that may result in cracking and/or delamination.

Product geometry is an important factor in the performance of an enclosure and it is an area where many dissimilar materials enclosures come up short. Many manufacturers of this type of enclosure design their products using numerous angles. Much like the nature of electricity, when load stresses are applied to the enclosure

in the field, they seek the most direct path to the ground. If enough load is applied, the enclosure may fail at the stress points, as shown in Illustration 2. Serious consideration should be given to selecting enclosures with straight sidewalls. These enclosures are engineered to transfer vertical loads uniformly in a straight line to the earth without causing additional stresses to the structure. Straight-walled designs are, therefore, more likely to provide long-term reliability and performance.

### Thermoplastic Enclosures

Thermoplastic enclosures are the weakest members of the underground enclosure family and are, therefore, intended for use only in areas that are completely protected (i.e. not subject to any chance of encountering more than pedestrian loads). These enclosures are made using an injection molding process and manufacturers are able to produce large quantities of product at a relatively low cost. Thermoplastic enclosures offer outstanding chemical resistance and are very lightweight, but they suffer greatly because of their weakness and tendency to deflect. As with concrete enclosures, deficiencies in the



material properties make cracked and severely deflected thermoplastic enclosures a common sight. Even in areas that are not exposed to heavy loads, the sidewalls of thermoplastic enclosures deflect from soil surcharge alone, often badly enough so that covers cannot be put back on once removed. Thermoplastic enclosures are also affected by hot and cold temperatures; becoming too flexible or too brittle, respectively. All in all, thermoplastic enclosures may not be a great long-term investment from a safety and performance standpoint because of their short life cycle.

## Location Factors

In addition to performance issues, construction materials, and production methods, end users must also have a thorough understanding of where underground enclosures should be placed – and where they should not. The basic question that end users must ask before specifying enclosures is whether the enclosures will be placed in a deliberate or a non-deliberate traffic application.

If the answer is a deliberate traffic application, which is defined as an application in any location where vehicular traffic is expected and planned for on a routine basis at any time during the enclosure's lifespan, then end users need to understand that concrete enclosures with cast iron frames and covers should be used. Other materials, such as steel and aluminum, may also be used because they have well-defined engineering design codes for a basis of performance. End users sometimes mistakenly use AASHTO (American Association of Highway and Transportation Officials) standards to specify non-concrete enclosures. This is an error because enclosures made of polymer composite materials, including thermoplastic, dissimilar polymer materials, and monolithic polymer concrete enclosures, are not covered by AASHTO or any other established design code for deliberate traffic applications and should never be placed in that type of situation.

If the answer is a non-deliberate traffic application, which is defined as an application in any location where intentional vehicular traffic is not anticipated or the chance of vehicles routinely driving over the enclosure is remote, then specifiers and end users should rely on ANSI/SCTE 77-2002 as their guide to selecting proper enclosures for the application. A look back at the Application column in the loading chart of the ANSI standard shows brief descriptions of five different types of applications. This information should be used as a guide to where enclosures meeting the respective Tier levels should be placed.

As a supplement to the ANSI standard, the sketches on the next two pages show examples of non-deliberate vehicular applications where the use of polymer composite enclosures may be acceptable.

## Solid Footing for Enclosures is Essential

After the appropriate underground enclosures are selected for the application, the job isn't complete until the enclosures are properly installed. The *NEC* addresses some of these installation issues in 314.30(B – D). However, neither the *NEC* nor ANSI/SCTE 77-2002 goes any further in addressing proper installation of underground enclosures. Installers should be aware, then, that there are some good engineering practices to follow to help ensure long-term performance and integrity of enclosures.

ILLUSTRATION 4



After the appropriate location for the enclosure is selected and the conduit or pipes are installed or located, the hole must be excavated to the proper depth. Installers should always excavate the hole at least 6" – 8" deeper than the depth of the enclosure to allow for the placement of a minimum 6" of gravel in the bottom of the hole. The gravel base should always extend past the sidewalls of the enclosure, as shown in Illustration 4. The gravel acts as a French drain and also provides a support base to help prevent the enclosure from sinking. Once the enclosure is positioned on top of the gravel and the elevation is checked, the enclosure is ready for back-filling.

## How to Specify Enclosures

Although this article provides information regarding performance and placement issues for underground enclosures, without a solid underground enclosure performance specification (i.e. based upon ANSI/SCTE 77-2002), engineers and contractors may still find themselves with unsuitable and unsafe enclosures for their applications. The generic performance specification below is a good model to follow as it

### Enclosure With Walls 48" or shorter

Enclosures, boxes and cover are required to conform to all test provisions of ANSI/SCTE 77 "Specifications For Underground Enclosure Integrity" for Tier \_\_\_\_ (specify Tier 5, 8, and/or 15) applications. When multiple Tiers are specified the boxes must physically accommodate and structurally support compatible covers while possessing the highest Tier rating. In no assembly can the cover design load exceed the design load of the box. All components in an assembly (box & cover) are manufactured using matched surface tooling. All covers are required to have a minimum coefficient of friction of 0.05 in accordance with ASTM C1028 and the corresponding Tier level embossed on the top surface. Independent third party verification or test reports stamped by a registered Professional Engineer certifying that all test provisions of this specification have been met are required with each submittal.

### Generic Underground Enclosure Performance Specification

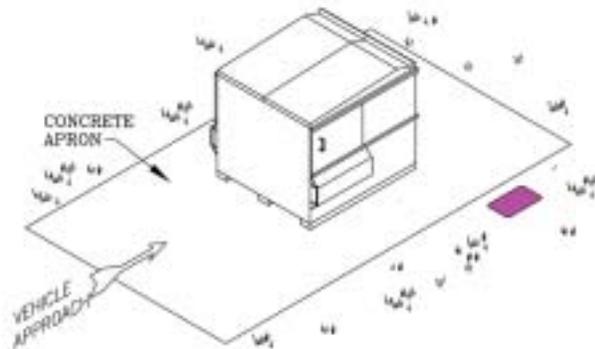
The enclosures shown in these sketches have been color coded to indicate the proper Tier level required for the application.

- Green = Pedestrian/Tier 5
- Magenta = Tier 8
- Blue = Tier 15



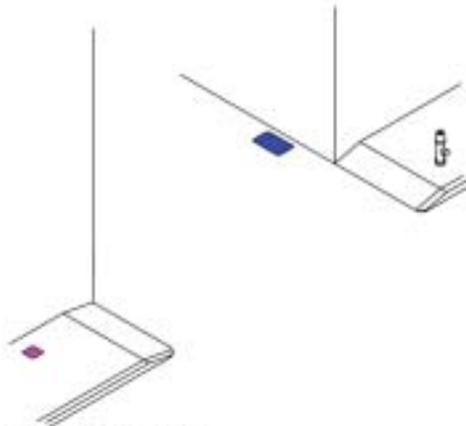
**RESIDENTIAL**  
(NON-DELIBERATE TRAFFIC)

Enclosures can be placed in grassy areas or sidewalks. They may also be placed in areas next to the structures or poles where it is unlikely a vehicle will run over the enclosure. Enclosures should not be placed in the street or driveway where deliberate traffic is anticipated.



**TRASH RECEPTACLE APPLICATION**  
(NON-DELIBERATE TRAFFIC)

In an area where a trash receptacle is placed, the enclosure should be placed away from the concrete that the receptacle is set on so that the receptacle will not be placed on the enclosure or the wheels of the truck will not roll over the enclosure. Even though the traffic expected on the concrete apron or in front of the receptacle is occasional, it is deliberate because the traffic is both intentional and heavy in nature.



**DUAL LANE ALLEY**  
(NON-DELIBERATE TRAFFIC)

In a single lane alleyway (at right), the enclosure should be placed in the center of the alleyway. This placement minimizes the possibility of the enclosure being run over. In a dual lane alleyway, the enclosure should be placed as close to the building as possible. Most of the time, two vehicles will not be in the alleyway at the same time, so the chances of the enclosure getting run over will be minimal. Knowledge of the location and expected traffic patterns should be used to determine if traffic would be deliberate or non-deliberate as defined previously.



**SINGLE LANE ALLEY**  
(NON-DELIBERATE TRAFFIC)

ensures that only enclosures that have been tested and verified by an independent third party to meet all test requirements of the ANSI standard will be specified.

**Not All Enclosures Are Created Equal**

Most engineers and contractors don't give much thought

to the enclosures they specify for their underground construction projects. Many think that an enclosure is an enclosure. Hopefully this article has demonstrated just how far that is from the truth.

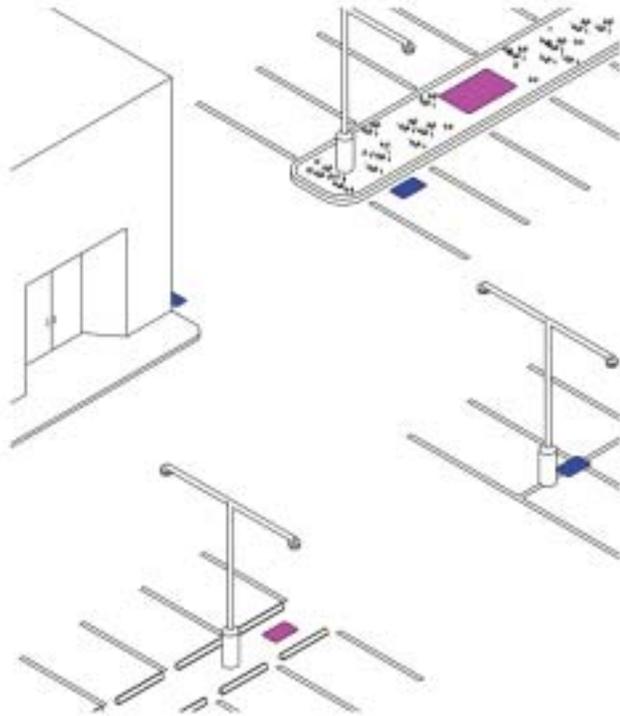
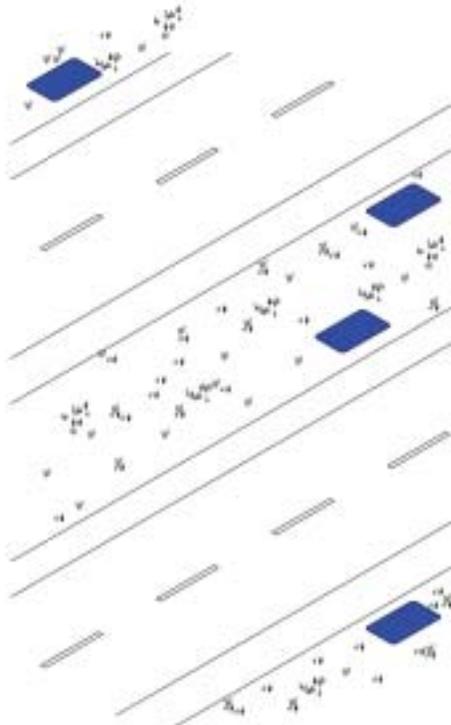
There are huge differences among the various types of enclosures sold today and taking the time to understand

## PARKING LOTS

(NON-DELIBERATE TRAFFIC)

Enclosure applications:

- In the front center of a parking space with the enclosure placed so that the tires of the vehicle will straddle the enclosure.
- In the grassy area where the parking lot ends.
- Placed along side and close to the lighting pole.
- Placed between the parking curbs where the possibility of running over the enclosure is remote. This enclosure could be placed anywhere between the parking curbs.
- Along the building but not in front of a door or pick up area where vehicular traffic would be expected.



## DIVIDED HIGHWAY

(NON-DELIBERATE TRAFFIC)

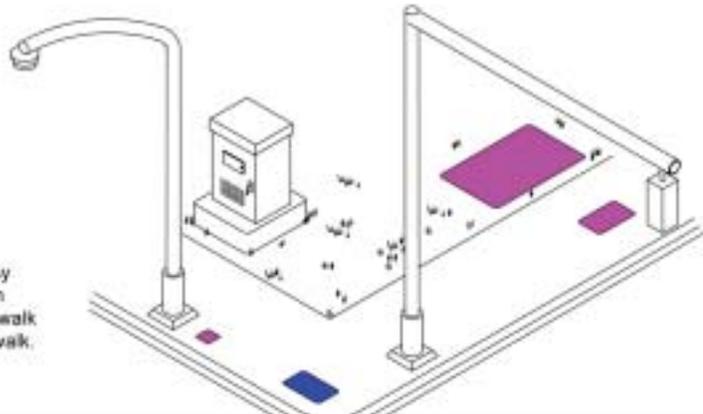
On a divided highway, the enclosure should be placed in any area that is not paved and where deliberate traffic is not expected. They can be placed in the grassy median or off the shoulder of the highway.

**NOTE:** The paved shoulder of the highway is normally considered a deliberate traffic location because it may be used as a breakdown lane or may be used as a lane in heavy traffic periods or in times of construction. Therefore, an enclosure should never be placed in the paved shoulder of a road or in the road itself. The enclosure should be placed off the shoulder, in the grassy area.

## SIDEWALK & GRASSY AREA

(NON-DELIBERATE TRAFFIC)

An enclosure can be placed in any grassy area and in most sidewalks. However, an enclosure should not be placed in a sidewalk where a driveway crosses over the sidewalk.



those differences and then to specify enclosures that are safe and reliable for the intended application is the responsibility of every underground construction professional who uses them. Doing so can not only reduce potential liability but it just might save lives as well. As the 2005 NEC shows, there is now very little mystery behind

selecting proper enclosures as long as specifiers use ANSI/SCTE 77-2002 as their performance guide. ⚡

*John Loud, principal engineer for Exponent Failure Analysis Associates (Menlo Park, CA), also contributed to this article.*