TURN UP THE HEAT! THE ADVANTAGES OF OUTDOOR CABLING PROTECTION

By Gerald Myers

The information superhighway is expanding with no end in sight: cities going wireless; academic, corporate, and industrial campuses demanding high-load 24/7 connectivity; service bundling that puts multiple communications options at consumers' fingertips; and rural areas coming to experience telecommunications capability on par with their urban counterparts. Natural disasters and the continuing threat of terrorist activity contribute other serious factors to rising demands for range and capability; with the centrality of telecommunications to responsive municipal, regional, and federal incident-response operations, equipment protection is paramount. The faster communications systems can get up and running in an emergency, the more competently a region can respond to those affected.

As networks quickly expand and are increasingly relied upon, telecommunications and datacom infrastructure must meet the pace without incurring daunting facilities expenses or running into prohibitive zoning restrictions.

Outdoor cabling enclosures have long provided solutions for sheltering and protecting equipment, but, until recently, enclosure technology has not kept up with other cabling business advances. Enclosures built of composite materials now offer many functional and fiscal advantages for telecom, datacom, and other cabling businesses, especially in extreme environments, inclement and variable weather, and a nation concerned about disaster preparedness.

Each of these conditions presents potential problems for steel and metal-clad equipment shelters; taken together, they pose serious long-term threats to conventional enclosures, inducing exhaustive repair and replacement activity and additional fuel expenditures, as well as putting valuable equipment and network functionality at risk. Composite materials, on the other hand, are formulated to perform consistently despite harsh environmental factors. Enclosures relying on composite construction have the added ability to be tailored to specific applications, making them capable of protecting equipment against potential disasters, for example.

AN ARCTIC CASE STUDY

The environmental extremes of Alaska provide an ideal place to evaluate the benefits of composite shelter technology in a wide range of circumstances. In 2002, GCI, a full-service, Alaska-based telecommunications company that provides local and long-distance telephone, cable television, Internet and specialized private-line services to its customers, extended its offerings to several remote northern villages. The population is small – roughly 2,000 across nine villages – but the conditions are not to be taken lightly.

"It's quite cold in the winter and quite hot in the summer up there – it's not uncommon to get 50° to 60°F below zero in the winter and close to 100°F in the summer, so it's an extreme swing. And it's dry, and you have pretty severe thunderstorms that go through," said Dan Boyette, GCI's director of project engineering, who ultimately decided on Alkan Shelter's composite containers

Protect sensitive equipment with a solid shelter.

to protect the company's equipment. "These shelters do quite well handling the swings and extreme weather conditions," Boyette said.

The 8-by-8-foot and 8-by-12-foot shelters were built with epoxy-fiberglass composites to house electronics. Set on gravel pads, the enclosures are mounted with satellite antennae; the protected equipment connects to local power grids to provide Internet to the schools, public-access services, and telehealth/ConnectMD, a broadband data connection linking these rural communities with medical expertise. GCI plans to provide long-distance telephone service to these villages in the near future. In the four years the shelters have been in operation, Boyette said they've required very little maintenance.

"One of the reasons we used that fiberglass design is that they are really quite low maintenance; they're gel coated on the outside so you don't have to paint them, and on inside they have a finish on the walls that washes easily and also doesn't need painting or retreating. The maintenance requirements are really quite minor in regards to the buildings," he said.

ADVANTAGES OF STRUCTURAL COMPOSITES

Low maintenance requirements and corrosion-resistance are two of several major benefits of composite equipment shelters. They also provide a significantly lighter structural material for the same level of strength as conventional metallic materials. Overall, composites carry significant cumulative advantages over conventional metal enclosures in strength, durability, longevity and overall product life-cycle costs.

These attributes are sought by telecommunications companies, according to a University of Alaska, Fairbanks, marketing research study that surveyed Alaskan operators about relocatable communications shelters.[1] The majority of those surveyed used steel or other metal or wood-framed fiberglass shelters for their communications equipment, and most relied on these shelters to house equipment versus personnel, although many mentioned they would value a shelter that was more comfortable to work from. According to the study, the most frequently cited problems found in existing shelters included leaks, ventilation/insulation issues, lack of durability/longevity and size/outgrowth. In identifying attributes for a future shelter, the surveyed businesses prioritized the following:

- **Top-tier attributes**
- **Portability (lightweight for ease of transport primarily by truck and helicopter)**
- **Longevity of the shelter and ruggedness**
- **Ability to handle extreme weather conditions**
- **Second-tier attributes**
- **Controlled internal environment**
- **Size options**
- **Comfortable to work from**
- **Uninterrupted power supply (battery-backed generator and/or solar)**

Study participants also mentioned low maintenance, snow and floor loading, flexibility, and quality engineered construction as important considerations for communications shelters.

The high strength-to-weight ratios of composite materials have contributed to some of the strongest, lightest structures available today and offer tangible benefits for telecommunications companies. For example, the superior strength of composite shelters can protect sensitive equipment from extreme heat, cold, and impact while their lighter weight requires less fuel and the ability to use smaller material handling equipment. This saves in transportation costs and contributes to composite shelters' small logistical footprints, making them especially well suited to the remote locations that often go hand-in-hand with harsh environments.

Unlike metal equipment shelters, composites have a roughly 30-year shelf life, which, combined with their low-maintenance requirements and inherent corrosion resistance, contributes to their low overall life-cycle costs. These combined advantages can be attributed both to the properties of composite materials themselves and to the specialized designs such materials allow.

MATERIAL STRENGTHS AND DESIGN FLEXIBILITIES

Polymer matrix composites (PMCs), also known as fiber-reinforced plastics (FRPs), are the most common composite materials used in structural designs. The PMC category includes a variety of matrix materials and fiber reinforce-

ALKAN SHELTER, LLC – DESIGNING COMPOSITE SHELTER SOLUTIONS FOR A WORLD OF DEMANDS

Structural composites technology is garnering increased interest in many industries, including defense and homeland security, emergency response, oil and gas, scientific exploration, and telecommunications. These sectors will continue to demand high productivity, mobility, and flexibility while trying to cut back on superfluous logistics, fuel, and infrastructure repair and replacement costs – operational considerations that favor the standard adoption of composite shelters for equipment storage, command centers, and work-in/live-in space.

Communications capabilities, in particular, are central to virtually every major industry today, and outdoor composite protection for these vital network components can keep connectivity robust in the harshest of environments and in locations threatened by natural and terrorist events.

Alaska-based Alkan Shelter, LLC, the composite shelter company whose shelters have protected sensitive equipment from the Arctic to Antarctica, designs its products to handle just such a range of conditions. Its Rigid Wall Communications Shelter provides low-maintenance protection for GCI telecommunications equipment in remote northern Alaska villages, and its custom, tower-mounted Specialty Equipment Shelter houses ITT Industries, Inc.'s sensitive electro-optical equipment in high-security environments in the lower 48 states.

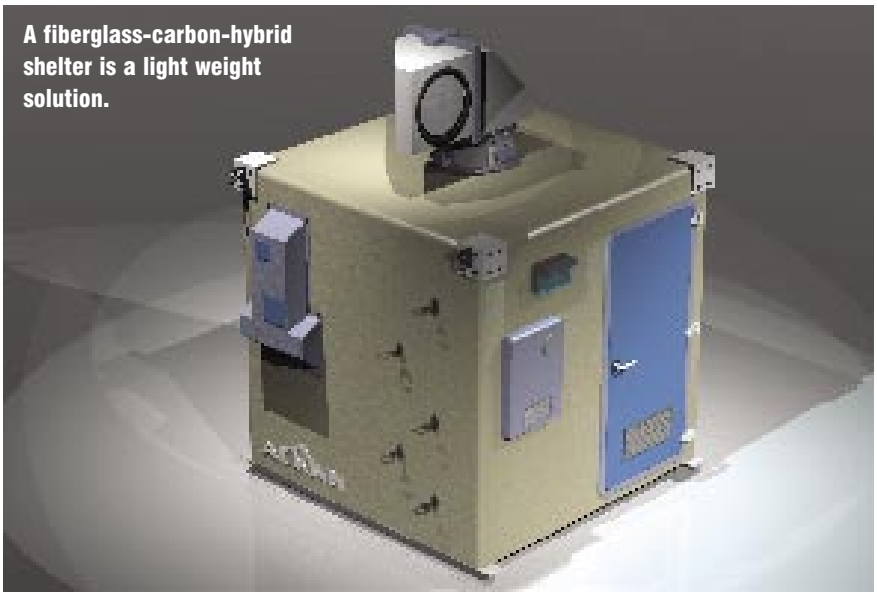
Alkan's composite technology and structural design improves product effectiveness by applying high-performance materials to architectural and engineering principles. The results are used for a variety of applications and configurations – from equipment shelters and 9-high stackable military tactical shelters to mobile command centers and 972-square-foot modular, extendable shelters. The company designs every product to satisfy end-user requirements and applies the lessons of its broad experience to each shelter solution. Above all, Alkan makes a point of working closely with clients to meet their needs with its standard product designs and custom composite solutions. Additional information can be found on their Web site at www.alkanshelter.com.

ments, each able to be combined in innumerable ways depending on the requirements of the end application. For high-performance shelters, epoxy resin matrices are ideal; their chemical configuration makes for a stiff material capable of resisting water ingress and temperature extremes. This translates into exceptional resistance to harsh environmental and chemical conditions, while the material's behavior during its curing process further minimizes internal stress and improves tensile strength, stiffness, and resistance to fatigue and degradation. In a sandwich construction, epoxy PMCs also exhibit high electrical insulation.

Epoxy matrices are best reinforced with glass and/or carbon fibers for optimal performance. These fiber reinforcements help to spread load stress and add to the composites' strength and stiffness. Glass fibers bring to the final composite high tensile and compression strength and additional resistance to corrosion and fatigue. Because glass reinforcements excel in designs requiring impact-load resistance and electrical isolation, they are a particularly good, economical material for communications shelters and are a commonly used composite for this application.

Carbon fibers, though more expensive than fiberglass, offer especially high levels of specific stiffness and tensile and compression strength, in addition to corrosion and fatigue resistance. The relatively small diameter and greater fiber surface area of carbon fibers allow carbon composites to accommodate severe load stresses, accounting for their extreme strength. In fact, carbon fibers possess a strength-per-unit density that is two times that of aluminum and four times that of steel. Used selectively in hybrid designs with fiberglass composites, carbon fibers can significantly add to a structure's strength and durability.

The flexibility of composites, which can be molded into virtually any size and shape with fewer components, offers designers a broad scope in which to tailor designs for specific applications. For instance, composites lend themselves to monocoque designs, where the composite shell or skin provides the load-bearing strength. This not only eliminates the need for a heavy structural frame and frequent maintenance, it also makes the shelter stronger by spreading the structural strength over the entire unit. Weatherability, too, is significantly increased with monocoque design, which is seamless and, therefore, less susceptible to environmental degradation.



A fiberglass-carbon-hybrid shelter is a light weight solution.

Where metal equipment containers demand frequent upkeep and replacement, composite shelters are built operate for decades even in extreme, highly corrosive environments where shelter degradation is accelerated and costly. This, combined with composites' easy on-site repair and equipment-customization abilities, is an important consideration for telecommunications operators relying on outdoor enclosures to keep their networks protected, responsive, and expanding.

"This type of shelter is almost maintenance free," said Dr. Jack Townshend, special projects coordinator for the U.S. Geological Survey at the University of Alaska, Fairbanks, who evaluated an Alkan-built fiberglass-composite shelter for a National Science Foundation (NSF) polar research expedition. "I believe this type of shelter would be ideal for any climate, whether it's in the Arctic or in the tropics."

HIGH-PERFORMANCE APPLICATIONS

Composite shelters offer improved equipment protection for everyday telecommunications operations, from cabling and broadband to satellite and power lines, but they also accommodate high-performance specialty applications for which metal enclosures are simply untenable options given the value of the equipment inside. Severe outdoor environments are only one factor in protecting equipment effected by EM, RF, and magnetic interference and materials outgassing. Because of the mechanical properties and design possibilities of composites, as well as their ability to incorporate protective materials, composite shelters can be engineered to meet the requirements of especially sensitive equipment.

The fiberglass-composite NSF shelter, for example, was built to meet requirements for non-ferrous materials. Recently, ITT Industries, Inc., a global engineering and manufacturing company, procured a fiberglass-carbon-hybrid

composite shelter charged with housing high-performance equipment to operate 24/7 through years of variable weather.

According to Scott Higdon, vice president of business development, ITT's key selection criteria for this shelter included the enclosure's "ability to provide a safe environment – specifically thermal stability and low outgassing – for sensitive electro-optical equipment in various weather conditions." The company's vendor study also prioritized "light weight, to allow easy transportation and installation (high strength-to-weight ratio); the best value for the desired performance; and short delivery time and the willingness of the vendor to customize/communicate with us."

The fact that composite equipment shelters are seen as superior, life-cycle cost-effective solutions for highly specialized electronics systems, as well as for full-service domestic telecommunications services speaks to their versatility. The range of their use also

is a testament to network operators recognizing value in long-lived, exceptionally durable equipment "outposts" that require little maintenance and minimal logistics support. As communications infrastructure continues to advance and networks continue to grow – and as the need for extreme weatherability and rapid network recovery is repeatedly stressed – composite equipment shelters are poised to become an industry standard. ■

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(Footnote)

[1] David A Kozak, "All Weather Relocatable Complex – Arctic Marketing" (MBA market-research thesis, University of Alaska, Fairbanks, 1993).