

Tyfo® Fibrwrap® Systems

For Blast Hardening and Mitigation



Using Glass, Aramid, and Carbon Fiber Reinforced Tyfo® Materials
combined with our Tyfo® Epoxy Matrices

Concept Description

Composites are ideal for many blast hardening and mitigation applications. The large strain capacities provide ductility with the addition of only fractions of an inch in additional member thickness.

Candidates for Tyfo® Fibrwrap® Systems include embassies, chemical plants, petroleum plants, control rooms, grain storage/processing facilities, and other structures associated with possible blast loading.

Structural members that can be enhanced include, but are not limited to, walls, columns, beams, slabs, and roof panels. Many existing elements are designed only for gravity loads and are vulnerable to the reversing loads that cause eventual collapse in many blast situations. The composites can be applied to provide the additional strengthening not inherent in gravity design.

An additional asset of composite systems, particularly the aramid composite systems, is the toughness that is required to survive projectiles that are associated with blast loading. In addition to the toughness, the composite will also act to localize damage.



Chicago Facility unreinforced CMU wall designed for an additional 150 psf load

Design of The Tyfo® Fibrwrap® Systems

Fyfe Co. LLC can provide, at no obligation, any level of required composite material design assistance to engineers for blast applications. These designs can provide for life-safety, service loads, or other required performances. Each application is unique and requires individual attention to requirements and details.

The connections of composite laminate blast applications are critical for the successful performance of the entire system. Connections can incorporate composite connections such as the Tyfo® JT System and composite anchors or use conventional construction materials such as steel connections and epoxy anchors.

Tyfo® Viscoelastic Dampers may also be used with the composite systems to dissipate additional energy in many structural elements. These dampers can be manufactured to meet specific requirements of individual projects.



▶ 2 *North Carolina A&T State University out-of-plane wall testing – distributed load*

Tyfo® Fibrwrap® Systems

- ▶ Add strength and ductility to minimize damage and prevent collapse.
- ▶ Are versatile and can accommodate most conduit, machinery and other obstacles during the installation process with additional localized strengthening if required.
- ▶ Can be used on external surfaces for protection from projectiles.
- ▶ Enhance the blast performance of —
 - Ceilings/Slabs
 - Walls
 - Columns
 - Beams
 - Many other structural elements
- ▶ Extensive testing has been performed with various loading conditions. Testing reports are available upon request.
- ▶ Are low profile and lightweight.
- ▶ Can include an Underwriter's Laboratories and Warnock Hersey tested fire coating. Our Tyfo® FC/F coating satisfies ASTM E-84 and ASTM E-119.
- ▶ Can be finished to match adjacent elements.



The Tyfo® System enhances the blast performance of beams and columns



Tyfo® Viscoelastic Dampers in combination with the Tyfo® System results in additional blast mitigation

Tyfo® Viscoelastic Dampers

Typically applied at connections or points of energy concentration, Tyfo® dampers can be individually designed to accommodate the required performance and space constraints associated with particular requirements.

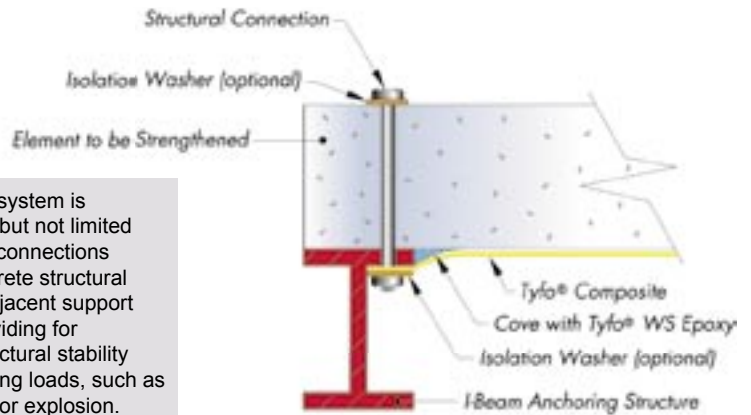
Two 4' x 20' (1.2 m x 6 m) concrete roof panels with the Tyfo® SEH System being applied to one side only



Four hundred pounds of Anfo at 100 foot offset

U.S. Patent No.: 6,138,420
"Blast-Resistant Building"

The patented system is comprised of, but not limited to, reinforced connections between concrete structural panels and adjacent support members providing for increased structural stability under fluctuating loads, such as during a blast or explosion.



Tyfo® Blast-Resistant Building Connection



Actual film footage of blast test conducted on Tyfo® System at EMRTC, New Mexico

Test Results

The wrapped panels performed well in the test. The unwrapped panels had a V-shaped crack through failure. The test report is available upon request.

For Technical Papers, Test Reports, and a List of Installations contact —

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