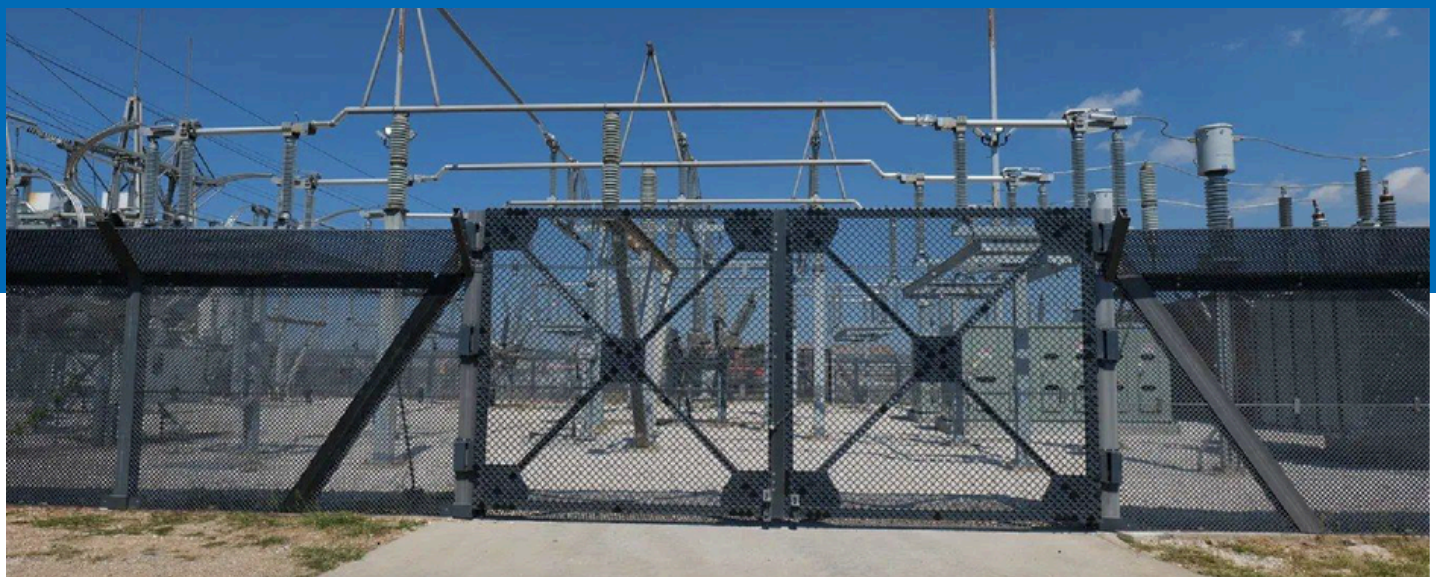
AIMS COMPOSITES

AIMS COMPOSITES | PROJECT CASE STUDY

Engineered ENC FRP Perimeter Security Fence

A Cat-5 hurricane-rated, fully non-conductive fiber-reinforced polymer fence and gate system designed, engineered, fabricated, and installed for a City of Houston electrical substation



The completed ENC FRP double-swing vehicle gate — two 20-foot leaves — closing off the substation perimeter. Every visible member, panel, and hardware cover is fiber-reinforced polymer.

Client	City of Houston
Construction Partner	Boyer (General Contractor)
Location	Houston, Texas (Gulf Coast)
Application	High-voltage electrical substation perimeter security fence
System	AIMS ENC fiber-reinforced polymer (FRP) fence & gate system
Scope	Design · Engineering (PE-sealed) · In-house fabrication · Field installation
Fence Height	10 ft, with a 45° anti-climb outrigger “bill”
Gates	20-ft double-swing vehicle gate (two 10-ft leaves)
Design Wind Speed	150 mph (ASCE 7-16, 3-second gust, Risk Category III)
Structural Seal	Texas-licensed Professional Engineer (TX Firm Reg. F-4167)

Project Overview

When the City of Houston needed to secure the perimeter of a high-voltage electrical substation on the Texas Gulf Coast, it turned to a single-source partner capable of taking the project from a blank sheet all the way to a finished, code-compliant installation. Working alongside general contractor Boyer, AIMS Composites designed, engineered, fabricated, and installed a complete ENC fiber-reinforced polymer (FRP) perimeter fence and gate system — a 10-foot-tall barrier topped with

a 45-degree anti-climb bill, base-plate-mounted to a concrete apron, and closed by a 40-foot double-swing vehicle gate built from two 20-foot leaves.

Two constraints drove nearly every decision on this project. First, the site is an energized electrical substation, where a conventional galvanized-steel or chain-link fence introduces an unwanted conductive path and a real safety and reliability concern. Second, the fence sits in open, hurricane-exposed Gulf Coast terrain, where wind loading — not gravity — governs the design. AIMS answered both with a system that is structurally engineered to extreme hurricane wind loads and electrically non-conductive from the outside in, with zero exposed outward-facing metallic surfaces anywhere on the barrier.

Why this matters at a substation

FRP is a dielectric — it does not conduct electricity. Building the entire barrier, including its hardware shrouds, out of FRP removes the fence as a conductive path, eliminates galvanic corrosion, and keeps the perimeter free of exposed metal that could carry induced or fault-related current. It is a purpose-built solution for an environment where an ordinary metal fence is a liability.

The Challenge

A corrosive, energized environment

Electrical substations combine three punishing conditions: constant exposure to weather, a highly corrosive coastal atmosphere, and the presence of energized high-voltage equipment. Traditional galvanized steel fencing degrades in this setting — the zinc coating sacrifices itself over time, and once it is gone the underlying steel corrodes, driving repeated maintenance and eventual replacement. More importantly, a metallic fence is electrically continuous. Near high-voltage bus work and switchgear, that continuity is a hazard: metal fabric and hardware can pick up induced voltage and provide a conductive path during a fault.

Hurricane-force wind loading

The site sits in flat, open terrain along the Texas Gulf Coast, directly in the path of major hurricanes. A 10-foot-tall barrier with a projecting top bill presents a substantial sail area to the wind, and the overturning moment it generates must be carried through the posts and into the anchorage. Any FRP solution had to be engineered — not simply assembled — to prove it could survive a design-level hurricane event and satisfy a licensed engineer's review.

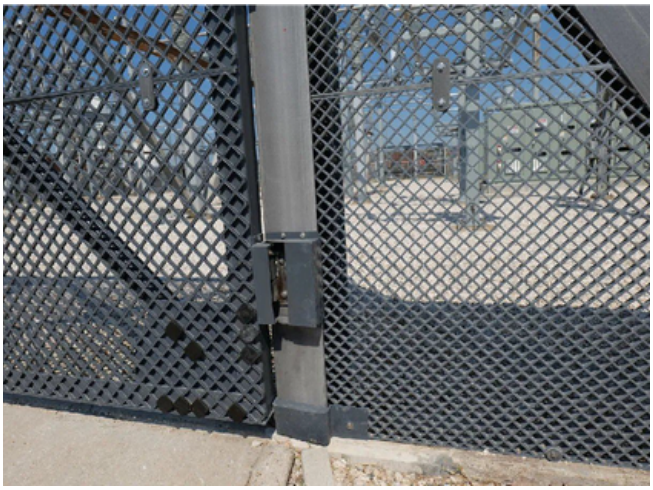
A long run of the 10-foot ENC FRP fence with the 45° anti-climb bill running continuously along the top. Open, hurricane-exposed Gulf Coast terrain made wind the governing load case.

The AIMS ENC FRP Solution

AIMS delivered a complete ENC FRP perimeter system in which every structural and infill component — posts, rails, expanded mesh infill panels, the 45-degree bill, and both gate leaves — is fiber-reinforced polymer. The infill is an expanded FRP mesh with roughly 80% open area, which does double duty: it resists cutting and climbing while dramatically reducing the projected wind load compared with a solid panel, allowing a lightweight, corrosion-proof material to span the required heights.

Zero outward-facing metallic surfaces

The defining feature of this installation is what you cannot see. Every outward-facing connection — the post base plates on the concrete apron, the gate hinges, the latch hardware, and the bracket connections — is shrouded in a custom FRP cover. The result is a barrier with no exposed metallic surface on its exterior: nothing that can conduct from the inside out, nothing to corrode at the connection points, and nothing to compromise the dielectric integrity of the system. The steel anchor rods that transfer load into the concrete are fully embedded in the apron and concealed beneath FRP base-plate covers at grade.



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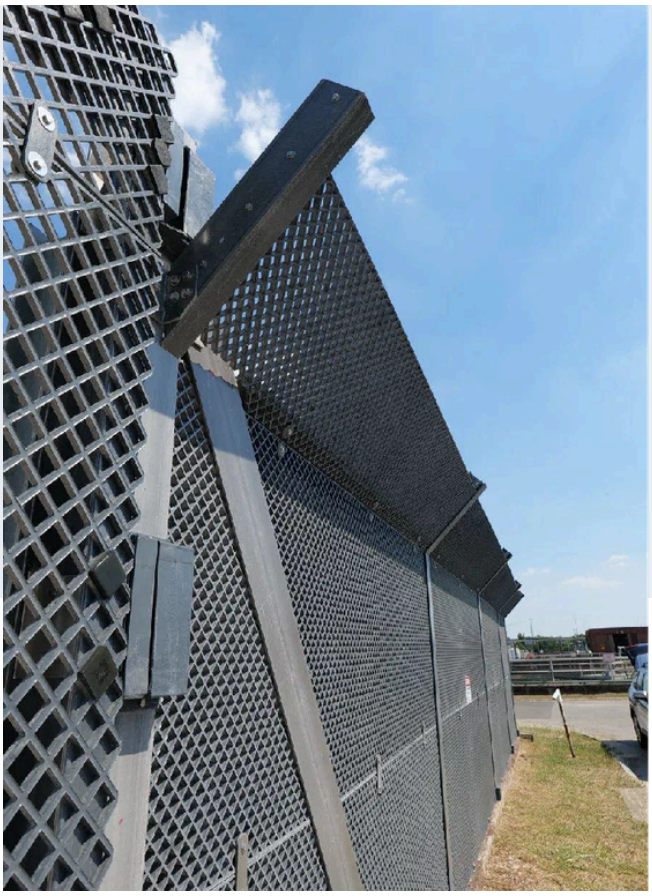
Post base plate concealed by an FRP cover where it meets the concrete apron.

Base-plate mounting to a concrete apron

Rather than direct-burying posts, the system is base-plate-mounted to a continuous concrete apron. Each FRP post lands on an anchored base plate, transferring wind-driven shear and overturning moment into the concrete through a designed adhesive-anchor group. This approach gives a clean, inspectable connection, keeps the FRP out of direct ground contact, and let the engineering team explicitly verify the anchorage to code — as described in the next section.



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Security detailing

At 10 feet tall with a 45-degree outward-canted anti-climb bill, the barrier is built to deter and delay intrusion. The expanded FRP mesh resists cutting far better than woven chain-link, and the continuous bill removes any easy purchase at the top of the fence. The double-swing vehicle gate carries the same mesh, bill, and diagonal bracing as the fixed runs, so there is no weak point at the opening.

Engineering & Structural Design

This was an engineered structure, not a catalog fence. AIMS developed the design and had it independently analyzed and sealed by a Texas-licensed Professional Engineer, with the full construction drawing package, wind design report, and anchor calculations stamped and sealed for the City of Houston.

Wind design basis (ASCE 7-16)

The fence was designed to a 150 mph design sustained wind speed — a 3-second-gust speed under ASCE 7-16 for a Risk Category III structure in Exposure Category B. That places the system's design basis squarely in major-hurricane (Category 4–5) wind territory. The wind design report confirmed flat terrain with a topographic factor of 1.0, and the ~80% open mesh was accounted for in the projected wind area applied to the model.

Design code	ASCE 7-16
Risk Category	III
Exposure Category	B
Design wind speed	150 mph
Topographic factor, K_2	1.00 (terrain classed as flat)
Infill	Expanded FRP mesh, ~80% open area

Finite-element analysis

The fence and gate framing were modeled and analyzed in SkyCiv Structural 3D as a linear-static system under the governing wind case. The posts are custom pultruded FRP wide-flange members (nominal 6-inch section, cross-sectional area 6.51 in^2, strong-axis moment of inertia 40.4 in^4, design modulus of elasticity 1,100 ksi). Under the ultimate wind loading, the analysis returned the following governing demands:

Response quantity	Governing value	Location
Max. bending stress	≈ 5.0 ksi	Post base
Max. lateral deflection	≈ 5.4 in	Post top
Base overturning moment	≈ 5.56 kip-ft	Center post
Base shear	≈ 1.2 kip	Center post

These demands are well within the capacity of the pultruded FRP sections, and the flexible-by-design nature of FRP allows the barrier to shed extreme wind energy through controlled deflection rather than brittle failure.

Anchorage design (ACI 318)

Because the entire system is base-plate-mounted, the connection to the concrete apron is critical. The anchorage was designed to ACI 318 using Hilti PROFIS Engineering and independently sealed. Two base-plate configurations were engineered to suit the post loads — a nominal 6-inch and a nominal 8-inch footprint — each using a group of four adhesive anchors: Hilti HIT-HY 200 injection adhesive with ASTM F1554 Grade 36 threaded rod (5/8-inch and 3/4-inch diameter), embedded 7.25 to 8.625 inches into a 30-inch-thick, 3,000 psi concrete apron. The governing load case was 0.9 dead load plus wind, producing a base moment of roughly 66,800 in-lb at the most heavily loaded post.

Base-plate configuration	Anchor / embedment	Peak utilization
Nominal 6-in footprint	5/8″ rod, 8.625″ embed	98% — OK
Nominal 8-in footprint	3/4″ rod, 7.25″ embed	89% — OK

Every failure mode checked — steel strength, adhesive bond, concrete breakout, pryout, and combined tension-plus-shear interaction — passed. The sealed calculation package concludes, for both configurations, that the fastening meets the design criteria.

Why this matters at a substation

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Fabrication & Installation

With the design sealed, AIMS fabricated the ENC FRP components in-house — posts, rails, expanded-mesh panels, the 45-degree bill, both gate leaves, and every custom FRP hardware cover — controlling quality and fit before anything reached the field. On site, AIMS crews set the anchored base plates to the concrete apron, erect the runs and bill, hang and align the double-swing vehicle gate, and install the FRP shrouds over all outward-facing hardware. The finished barrier ties cleanly into the existing site, wrapping the substation in a continuous, uniform perimeter.

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A solutions Based FRP engineering Company

This project demonstrates what AIMS Composites brings to demanding infrastructure work: the ability to take a challenging FRP application from concept through PE-sealed engineering, in-house fabrication, and field installation, all under one roof. For utility, industrial, and municipal owners facing corrosive, energized, or high-wind environments, an engineered ENC FRP fence system is not a compromise — it is the better solution.