# Column Equivalency & Composite Structural Behavior of the InnovaPanel® System

## Understanding the Structural Behavior of InnovaPanel

One of the most important engineering distinctions regarding the InnovaPanel system is that it should not be viewed as a simple insulated panel or non-structural cladding assembly. Based on its tested behavior, structural composition, and measured load-deflection response, the system behaves more similarly to:

- A wide composite compression column
- A stressed-skin structural panel
- A composite box-section wall assembly

rather than:

- A conventional non-structural insulated panel system

This distinction is critical when evaluating how the system participates in the structural load path of a building.

---

## 1. Wide Composite Compression Column Behavior

### Structural Analogy

Under axial compression loading, the InnovaPanel behaves similarly to a very wide composite column section. Rather than relying solely on discrete framing members to resist gravity loads, the panel distributes axial forces across the entire composite assembly through interaction between:

- Magnesium oxide cement facings
- Integrated SPF framing members
- Structural adhesive bond interaction
- Stabilized EPS foam core

The structural behavior is analogous to a built-up composite compression member where the skins act similarly to flanges, and the stabilized core helps maintain section geometry and prevent localized instability.

---

### Composite Axial Load Sharing

Unlike conventional framed walls, where:

- studs carry most axial loads
- Sheathing primarily acts like bracing

The InnovaPanel assembly develops load-sharing across the full panel width.

This means:

- axial stresses are distributed
- stress concentrations are reduced
- Localized stud overloading is minimized
- the full wall section participates structurally

The tested compression performance strongly suggests effective composite action between skins, framing, and core stabilization.

---

# 2. Stressed-Skin Structural Panel Behavior

## Structural Mechanics

The InnovaPanel system behaves similarly to a stressed-skin panel assembly, a concept widely used in:

- aircraft structures
- cold-formed steel diaphragms
- structural insulated panel systems
- bridge deck systems
- torsion box structures

In stressed-skin construction:

- The exterior skins resist in-plane stresses
- The core stabilizes the skin against buckling
- The composite section develops stiffness far greater than individual components acting independently

---

## Role of the MgO Skins

The MgO facings function structurally as:

- continuous compression/tension skins

- in-plane shear transfer surfaces
- lateral stability elements.

These facings significantly increase:

- flexural rigidity
- in-plane shear stiffness
- buckling resistance
- diaphragm behavior

The testing demonstrated:

- extremely low drift
- minimal deflection
- stable load transfer characteristics

which are all indicators of strong stressed-skin composite action

---

# 3. Composite Box-Section Wall Behavior

## Structural Equivalency

The InnovaPanel wall system can also be understood as functioning similarly to a shallow composite box-section.

This occurs because:

- The two structural skins are separated by the foam core
- The spacing between skins increases the section modules
- The core stabilizes the skin
- The assembly resists both axial and lateral loads as one integrated section

This is similar in principle to:

- box beams
- torsion boxes
- insulated sandwich panels
- aircraft wing structures

---

## Increased Structural Efficiency

Separating structural skin dramatically increases:

- moment of inertia
- stiffness
- buckling resistance

without substantially increasing weight.

This is one of the major reasons why lightweight composite structures can achieve:

- very high stiffness
- high load capacity
- low deflection

despite using less material mass than traditional systems.

---

## 4. Why InnovaPanel Is Structurally Different from Non-Load-Bearing Structural Insulated Panels

Traditional non-structural insulated panels generally:

- serve only thermal functions
- rely on independent framing for structural capacity
- do not develop significant composite structural action
- cannot independently function as primary load-bearing elements

In contrast, the InnovaPanel system demonstrated:

- measurable axial compression resistance
- high shear/racking resistance
- low drift under loading
- stable composite structural behavior

The ASTM E72 test indicates the system is capable of participating directly in:

- gravity load resistance
- Lateral Load Resistance
- diaphragm action
- shear wall behavior
- structural load transfer

---

## 5. Load-Bearing Structural Wall Function

### Gravity Load Path

In building applications, the InnovaPanel system can function as a load-bearing wall assembly by transferring vertical loads through:

1. MgO structural skins
2. Internal SPF framing
3. Composite skin-core interaction
4. Continuous bearing at support and foundations

Rather than concentrating loads at isolated studs, the composite behavior allows for load distribution across the wall section.

---

### Lateral Load Resistance

The panel also functions as a lateral-force-resisting system capable of resisting:

- wind loads
- Hurricane Uplift Forces
- seismic shear
- diaphragm transfer loads

The measured racking resistance and low drift values indicate:

- strong in-plane stiffness
- efficient shear transfer
- good overturning resistance when properly anchored

---

## 6. Structural Advantages Over Reinforced Masonry

### Reduced Structural Weight

One of the most significant advantages of engineering is weight reduction.

| System | Approximate Weight |
|---|---|
| Reinforced CMU | 40–50 psf |
| InnovaPanel | ~8–12 psf |

This reduction in deadload produces major structural benefits:

- reduced seismic forces
- reduced overturning moments
- reduced footing sizes
- lower soil bearing pressures
- reduced transportation loads

- easier erection and handling

---

## 7. Seismic Advantages

Because seismic base shear is proportional to building mass:

$$V = C_s W$$

$$V = C_s W$$

Reducing structural weight directly reduces:

- earthquake demand
- diaphragm forces
- overturning
- foundation stresses

This provides a major advantage over heavy masonry systems.

---

## 8. Construction Efficiency Advantages

Compared to reinforced masonry construction, the InnovaPanel system offers:

- dramatically faster installation
- reduced labor dependency
- reduced skilled trade requirements
- integrated insulation and structure
- reduced curing delays
- reduced moisture exposure during construction.

Panels can arrive:

- precut
- numbered
- fabrication-ready

allowing much faster project completion.

## 9. Hurricane & High-Wind Performance

The composite behavior of the InnovaPanel also benefits high-wind design because:

- Lower dead loads reduce overturning
- continuous skins improve load distribution
- composite action increases stiffness
- reduced drift improves envelope performance

The low measured deflections under very high loading indicate:

- strong load transfer continuity
- stable structural behavior
- excellent lateral rigidity

---

## 10. Engineering Interpretation

Based on the ASTM E72 testing and observed structural behavior, the InnovaPanel system should be viewed not as a simple insulated cladding panel, but as:

- a lightweight composite structural wall system
- capable of participating directly in both gravity and lateral load resistance
- functioning similarly to a stressed-skin composite wall assembly
- while delivering significant advantages in:
    - weight reduction
    - construction efficiency
    - energy performance
    - seismic response
    - and hurricane resilience

The structural performance demonstrated by the testing suggests the system occupies a unique position between:

- traditional reinforced masonry
- structural insulated panel systems
- and advanced lightweight composite structural assemblies

**Intellectual Property Reservation**
All concepts, engineering approaches, assemblies, configurations, details, manufacturing methods, structural concepts, testing methodologies, and proprietary system integrations described herein remain the exclusive intellectual property of InnovaPanel and its affiliates. No license, ownership interest, manufacturing right, engineering right, or commercialization right is granted or implied by the distribution of this document.

**Product Differentiation Notice**
The InnovaPanel system is a proprietary composite structural building technology utilizing unique material formulations, structural assemblies, reinforcement strategies, manufacturing methods, and engineered system interactions. The performance characteristics described herein are specific to the InnovaPanel system and shall not be assumed, transferred, compared directly, or applied to conventional SIP products, generic MgO panels, OSB SIP systems, or other panelized construction products not manufactured and engineered by InnovaPanel.

**Engineering Disclaimer**

This document presents a conceptual engineering feasibility study intended for preliminary evaluation and design discussion only. The final design requires project-specific engineering, code analysis, fire-resistance evaluation, and approval from the project's Structural Engineer of Record.