

C-CAPP: Lightweight Integrated Composite Panels Push the Limits of Pre-Assembly and High-Performance



C-CAPP Panel with Architectural Finish ©Clark Pacific 2013

The Design and Value Engineering Challenge

The design-build team for a high-rise residential project in downtown Los Angeles were hitting hurdles. The façade system for their 23-story, highly-visible hotel, predominately metal panel and glass curtain wall, was not penciling out. The owner and design-build team tasked Clark Pacific to come up with a solution that would meet the budget and high-performance needs (including continuous insulation “ci” requirements) of the project without compromising the aesthetics of their design.

The Solution

Clark Pacific’s preconstruction team, working with long-time strategic glass partner, AGA (Architectural Glass and Aluminum, Livermore, CA), came up with multiple options for the design team. The solution chosen was a façade comprised of multi-colored and finished Clark Composite Architectural Precast Panels (C-CAPP) that are pre-insulated and pre-glazed at the precast plant as part of the assembly and sent to the jobsite ready for interior finishing after installation.

Each composite panel consists of:

- 2¼” – 3” of integral three-color and multi-finish mesh-

reinforced concrete skin (5500psi average compressive strength);

- 2” of NCFI spray foam insulation (two-component, self-adhering polyurethane closed cell foam system with 2pcf core density provides an R-value of 6.8/inch, an air and vapor barrier, high STC rating and high resistance to bacterial or fungal growth);
- 1.5” offset, 4” deep light gauge and tube steel engineered frame system with galvanized pins to connect the skin to the frame and provide window support;
- AGA custom designed thermally broken window assembly for minimal heat/cold transmittance with anchors designed specifically for precast panels (Glass selected was high performance tinted, Low E glass, accented with custom color spandrel inserts);
- Return air HVAC vents, LED lighting connections;
- Joint sealants (Dow Corning® 790 and 795 for panel-to-panel and panel-to-window mullions, respectively).



Interior Panel View with Spray Foam Insulation ©Clark Pacific 2013

Putting the System to the Test

Performance mockup tests were conducted at Construction Consulting Lab West (Ontario, CA). After standard pre-test tune ups and adjustments, industry recommended ASTM and AAMA tests were performed including air infiltration, structural wind loading to 100, 150 and 200% of design loads (70-131mph winds), cyclic static and dynamic water penetration at 12.0 psf (68.5mph wind), elastic and inelastic in-plane seismic movement up to 1.5" at the floorline for 3 cycles and vertical live load deflections. No structural damage to the mockup occurred and designs were verified. No uncontrolled water leakage occurred into the mockup under design loading and elastic movement.

Meeting the Continuous Insulation Requirement

A final challenge presented to Clark Pacific was the question whether a pre-insulated, panelized system meets the intents of 'ci' requirements in ASHRAE 90.1 and California's Energy Code since the joints themselves would not receive the spray foam application and only a single line of backer rod and caulking were used. And would the pins connecting the skin to the frame create a thermal bridge?



Performance Mockup ©Clark Pacific 2013

on a Net Zero Energy project in Northern California where the pre-insulated version of the system was initially used. Their findings:

"Our extensive 3D modeling of the C-CAPP system shows that the effect of the intermittent rod anchors is negligible on thermal performance and that therefore, the spray foam insulation can be considered as a layer of 'continuous insulation' as defined in both ASHRAE 90.1 and the California Energy Code. (...) Furthermore, we determined that the effect of not insulating across the C-CAPP panel joints is less than 2% for the field of wall and less than 5% across edge-of-slab conditions that have fire/smoke seals. (...) Given the above findings of our thermal analysis that there is only a minor thermal penalty for interrupting the continuous insulation at panel joints, we maintain our recommendation to not install spray foam across panel joints so that the movement between panels is not restricted."

Summary

Clark Pacific's Composite Architectural Precast Panels delivered the aesthetic and budgetary goals. Pre-glazing and pre-insulation can deliver a state-of-the-art precast solution for design-build teams looking for cost-effective façade assemblies. 

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Dynamic Water Penetration Test of Mockup ©Clark Pacific 2013

ASHRAE 90.1 defines "ci" as "Insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior or is integral to any opaque surface of the building envelope."

Building enclosure consultants Simpson, Gumpertz and Heger (San Francisco) had already been retained to analyze the issue for Clark Pacific