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Report submitted to First National Panel Corporation
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Executive Summary

A preliminary analysis has been conducted to examine the structural integrity of a residence constructed with FNPC panels used for both interior and exterior walls. This analysis provides an overview of realistic design goals using proven techniques and available materials. Apart from the FNPC panel technology, only astute design is required to achieve superior performance with a single-story structure using standard techniques and materials. To date, no known residential building system has been tested or can achieve the performance levels of the FNPC system. A building using FNPC panels can withstand 200+ MPH sustained winds without major structural damage. The walls can withstand 300+ MPH sustained winds, providing the possibility of a safe room within a residence to protect inhabitants during a storm. Resistance to flying objects cannot be reliably predicted. A rigorous test regimen is indicated but the performance levels for this structural design exceed all limits of existing test protocols. New testing techniques should be developed in association with recognized authorities.

Analytical Considerations

Compared to other building techniques, the FNPC panel system can offer enhanced resistance to degrading effects from causes such as wind, earthquake, fire and water. However, maximizing resistance to wind damage may compromise the ability to withstand earthquakes because the very fastening techniques used to optimize one situation tends to de-optimize another.

This analysis specifically addresses the wind-resistant properties of a well-designed structure. The results are generalized pending appropriate testing to verify these conclusions.

Since a building is a system of components just as a chain comprises of a series of links, we must look at the whole picture to draw meaningful conclusions. In general, the roof structure is the weakest link with respect to wind damage so some assumptions about the roof must be included in a building design analysis to classify the building's performance.

Below are the general parameters of the building:

1- Single story 50ft wide x 32ft deep rectangle. Adding a garage does not materially affect the results.
2- At least 1 interior wall running side to side approximately down the center
3- At least 2 interior walls running front to back
4- Maximum interior wall spacing: 16ft
5- Wall height: 10ft or less
6- Roof geometry: 4 face hip with 6-in-12 pitch and 18" maximum soffit.
7- Terrain: Generally flat plain
8- Compressive strength of concrete panels: 2500 psi minimum
9- The structure is erected on a conventional concrete pad without special features. A basement does not compromise the overall system integrity.
10- This structure can be erected on a pad built on stilts without compromising system integrity.

We will address design issues in order of importance.

1- The roofing system is most important. To maximize the wind resistance of a structure, certain design compromises may be necessary. These might include eliminating wall offsets and soffits. Delaminating of the roof usually begins with the soffits so careful design, choice of materials and installation techniques are essential. The most vulnerable part of a roof structure is the leading edge on the windward side. Uplifting forces can reach 250 pounds per square foot (psf) and higher, tapering off somewhat as we move back from the leading edge. Careful choice of the roofing system, how it is fastened to the walls and using aerodynamic principles can substantially improve its performance to beyond 250 MPH. In considering a roofing system, one must take into account the delaminating forces on the outer covering and the decking as well ass the tendency of the trusses to separate from the walls.

2- Resistance to racking of walls that are parallel to the wind direction, so-called shear walls, is the next consideration. Racking is the tendency of these walls to change their shape from rectangular to parallelogram in shape. This phenomenon affects both interior and exterior walls that serve the purpose of resisting the tendency of the windward wall to be pushed over from the incident wind. In stick-built structures, resistance to racking is provided primarily by sheeting that is applied to the outside of the studded walls. Under racking load, the fasteners tend to tear in the studs, losing their grip and allowing distortion in the wall. While walls built with 2 foot wide FNPC panels do not individually suffer from this fastener shortcoming, they still can give way to racking forces by way of interpanel slippage.

3- Anchoring the structure is of fundamental importance to this design scenario. It is unacceptable for a structure to be impervious to damage yet become detached from the ground. Good anchoring prevents the roof from separating from the structure and eliminates racking effects which can lead to building damage and even failure.

4- Bending or bowing of the exterior walls inward from the lateral wind forces can be an issue. The strength of the FNPC panels makes this a minor issue. A 200 MPH wind produces approximately 110 psf of lateral force on a wall that is perpendicular to the wind velocity or about a ton of force on an FNPC panel. The top steel plate of FNPC walls and recessing panels into the pad are what mitigates this effect.

5- Resistance to flying objects is fundamentally better with FNPC panels than stick-built or cinder block construction. However it is impossible to reliably predict this property without rigorous testing. It is difficult to estimate the velocity of airborne debris in storm conditions because shape, density, size and rigidity all come into play. Current testing standards are limited to 135MPH winds and 90MPH flying objects. There are coatings that can render FNPC impervious to penetration by most flying debris up to panel failure if this consideration is of paramount importance.

6- Wall openings such as windows and doors can compromise overall building integrity by providing entry points for wind. Modern window systems can withstand tremendous wind velocities and are quite impervious to normal flying debris. However, the only effective solution to maintain building integrity in extremely high winds is to cover these openings with some form of mechanical curtain or shutter, either manual or automatic. Once 200+MPH winds enter through an opening, rapid pressure changes can produce what amounts to explosive forces on the roof, doors and windows. A 1 psi pressure differential produces 144 lb force on each square foot.

7- Building height can be a factor in resisting high winds for residential structures. Surface winds experience drag forces when in contact with the ground but these effects diminish rapidly with height to a point where wind speeds are significantly higher only 30 feet above ground. Greater wall height gives the lateral wind forces more leverage to deliver racking forces to shear walls (the walls that are in line with the wind direction) especially for solitary buildings in the open. Single story buildings are best.

Conclusions

The FNPC panel design uses a top-down anchoring system. The plurality of vertically disposed holes in each panel provides up to 8 anchoring positions in each 2 ft wide panel. This feature leads to a structural system capable of withstanding sustained winds of 200+ MPH with the walls capable of withstanding 300+MPH. This specification relies on the choice of efficacious readily-available subsystems for roofing, windows and doors.

Essential to the overall design objective is the lightweight, strong FNPC wall panel system, which incorporates an integral unbroken structural steel element as a top plate. This results in monolithic walls free from racking effects with the option of tying down the roofing system to a point beyond catastrophic failure of the whole structure. Where appropriate, the use of 4-foot wide panels at the junction of two walls simplifies anchoring. If necessary, the roof can be attached in a manner allowing removal without disassembly. This feature complements the fact that the FNPC panel system can be disassembled for expansion or re-installation at another location.

The appropriate roofing system is based on closely-spaced steel trusses covered with robust decking attached with conventional fasteners and augmented with adhesives. Waterproofing of the roof is advantageously provided with "Peel and Stick" membranes applied directly to decking. The top layer covering can be protected from separation with appropriate adhesives and conformal coatings so that shedding cannot occur no matter what the system. Aerodynamic principals can be used to substantially reduce uplift forces on the roof further increasing its sustainability in winds even beyond 200MPH.

Conformal coatings and mesh systems incorporated into wall elements can prevent secondary emission of debris and control propagation of cracks from fractures caused by impact. Even though a wall panel may become severely cracked or otherwise damaged by flying debris, the structural integrity of the damaged panel will remain intact. This is particularly important for an internal safe room.

With best choices for the roofing system, the weakest remaining link in the building is the protection of window and door openings. Inhabitants should withdraw to a safe room especially if protective window treatments are neglected.

This building system exceeds the limits of all known residential systems and exceeds the limits of all known test facilities.

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