Emergency Housing & SIP's role

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Introduction:

Post-disaster emergency housing response is an opportunity to lay seeds for high performance – by increasing energy efficiency, structural robustness, improved building standards and ultimately improved design standards. It is also a good opportunity to introduce new systems and technology that inherently meet these goals to insure that "the rebuild" will not repeat the past shortcomings. Additionally, the deployment of new technologies should help insure that future additions and growth, which will be impeded by a natural lack of human resources to inspect and maintain higher code compliance, will meet all new performance standards.

The research at the Federation of American Scientists has been two-fold in the area of post-disaster housing: researching SIPs as affordable housing after hurricane Katrina, and researching improving standards and high performance for post disaster housing.

This document was prepared for the response after the Chinese Earthquakes in Sichuan province. It contains basic information regarding Structural Insulated Panels (SIPs) and their structural robustness (with commentary of the US testing issues) and contains information regarding disaster housing post-Katrina (with best lessons learned).

Some of this work has transitioned into helping the industry with standards (particularly moving to an ISO certification process), testing standards for seismic capacities (technically SIPs are not allowed by the code for seismic use), and ultimately moving the industry to other non-wood options (such as non-wood options like James Hardie's fiber cement and even Chinese Magnesium-oxide board).

Recommendations for China:

If SIPs are chosen for use in rebuilding Sichuan, the SIPs should be manufactured and obtained locally to the event area. However, the US certification process and standards should apply and be adopted. This will involve inspection and, potentially, testing of new products (at a cost not to exceed $60,000 US). Because most of the starter materials come from China (i.e. the adhesive and the polystyrene beads that get expanded into EPS, the US should not simply supply the energy to expand the beads, the wood (90% of the US SIP industry is wood based) and the lamination. Rather Chinese resources should be leveraged and the US role should be in helping transfer best practices, standards and know how. However, an extensive search of local resources in China and benchmarks used in Quality Assurance and Quality Control (QA/QC) should yield vendors and manufacturers who could easily manufacture to US standards and companies willing to supplement existing procedures to comply with the required US standards.

Enclosed within are the following presentations and resources:

1. About FAS's Building Technology Program (http://fas.org/programs/energy/btech/about/About%20FAS%20BT.pdf)

2. Structural Insulated Panels (SIPs)
    a. Pankow CSIP Information Kit by FAS (http://www.fas.org/programs/energy/btech/new_technologies/Addendum%20C.pdf)
    b. Winter Panel SIP presentation (attached)
    c. Commentary about SIP's use in seismic codes by the APA (attached)
    d. Interim Report from Khalid Mossalam on SIP capacities (http://www.ce.berkeley.edu/~mosalam/research/sips/SIPsReport_2007_12_27.pdf)
    e. APA SIP Information (http://www.apawood.org/pdfs/download_pdf.cfm?PDFFilename=managed/H650.pdf)
    f. BASF Information on SIPs Life Cycle (http://www.highperformancecommunity.com/files/pdf/SIPs_Brochure.pdf)
    g. SIP code and testing issues by FAS (http://fas.org/programs/energy/btech/about/Product%20Approval.pdf)

3. Emergency Housing Resources, all by FAS
    a. The Afghan Housing Crisis: Can New Technology Make a Difference? (http://www.fas.org/faspir/2003/v56n2/housing.htm)
    b. FAS, the Mississippi Emergency Management Agency, and the Alternative Housing Pilot Program (http://fas.org/programs/energy/btech/emergency_housing/mema_and_the_ahpp.html)
    c. Two & a Half Years Later: Surviving the FEMA Aftermath… (http://www.fas.org/programs/energy/btech/about/Surviving%20the%20FEMA%20Aftermath.pdf)
    d. FAS Suggestions for Proper Procurement of Emergency Housing Units (http://fas.org/programs/energy/btech/emergency_housing/procurement_suggestions.html)
    e. High Performance Manufactured Housing – Success Stories from MS's Response to Hurricane Katrina (http://www.eesi.org/briefings/2008/051408_manuf_housing/051408_manuf_housing_notice.html)

2c Commentary about SIP's use in seismic codes by the APA:

Issues Associated with the Code Acceptance of SIPs

Prescriptive SIPs have been adopted by the *2007 Supplement to the 2006 International Residential Code* (IRC). These prescriptive SIPs are limited to wall applications. In addition, by default, the IRC is limited to low seismic design categories (A through C) and for wind speed up to 130 miles per hour.

For SIPs used beyond the limitations indicated above or if SIPs are not manufactured in accordance with the prescriptive code requirements, the code acceptance is typically based on a code evaluation report issued by the ICC Evaluation Service (ICC-ES) to the SIP manufacturer. ICC-ES conducts product evaluation in accordance with an acceptance criteria (AC) approved by the ICC-ES Evaluation Committee composed of selected building officials around the country. As of today, proprietary SIPs have been evaluated based on AC04, *Acceptance Criteria for Sandwich Panels*, and AC05, *Acceptance Criteria for Sandwich Panel Adhesives*. In recent years, however, ICC-ES has expressed concerns that AC04 and AC05, which were originally developed for metal-facing sandwich panels, are no longer adequate for SIPs with oriented strand board (OSB) facing materials.

Therefore, a new acceptance criteria, AC236, *Acceptance Criteria for Structural Insulated Panels with Wood-based Sheathing Facers and Foam Plastic Cores*, was drafted by ICC-ES in 2003, but failed to be adopted by the ICC-ES Evaluation Committee due to the lack of support from the SIP industry. It is generally considered by the SIP industry that the draft AC236 is too onerous and will require a significant amount of new testing for compliance with the new criteria.

One substantial issue with AC04 and AC05 is that it does not address the requirements for high seismic design categories (D and E), such as in California, Oregon, Washington, and Alaska where SIPs are viable products. There is a new AC130, *Acceptance Criteria for Prefabricated Wood Shear Panels*, which can be used to develop design information for high seismic design categories. However, ICC-ES has been reluctant to adopt the AC130 methodology partly because of the pending AC236 development. Therefore, up to point in time, all ICC-ES evaluation reports on SIPs have not specifically recognized the use of SIPs in high seismic design categories. This really imposes a considerable restriction to the market access of SIPs in West Coast.

In the last few years, several SIP manufacturers have tested quite a few full-size assemblies under test protocols designed to simulate seismic loading. Unfortunately, these tests were conducted with proprietary SIP systems and most data are not available to the public. Therefore, it is very difficult to develop generic design information for commodity SIPs systems even if the SIPs industry has a good faith in addressing the application of SIPs in high seismic design categories. It is generally recognized by the SIP industry that a concerted effort is required to develop generic information before SIPs can be widely used in construction. An American National Standard for SIPs that is under development by APA – The Engineered Wood Association in working with the Structural Insulated Panel Association (SIPA) will serve as the consensus product standard for SIPs. Obviously, more research is needed to systematically evaluate and enhance the performance attributes of SIPs. A research project underway at the Penn State by Professor Memari is headed toward this direction.

An area of research that could be beneficial to SIP industry is the use of pseudo-dynamic analysis to study the system performance of SIPs under seismic loading. This has been carried out by Professor Khalid of the University of California in Berkeley. While this research is still not widely known in the engineering community, a successful program could change the methodology adopted in AC130 for evaluating the SIPs for code compliance. This is especially important when the SIP industry reactivates the development of AC236 in 2008.