INTEGRATING PATH TECHNOLOGIES INTO MILITARY FAMILY HOUSING
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Status Report on Frost-Protected Shallow Foundations for Housing at Fort Drum, NY

Prepared for

Partnership for Advancing Technology in Housing

By

Newport Partners, LLC

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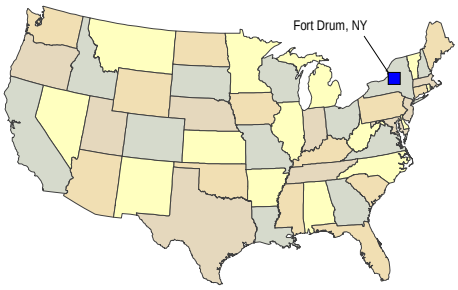
Introduction and Objectives

The overall objective of the Partnership for Advancing Technology in Housing (PATH) military project is to develop a strategy for PATH to integrate innovative technologies into military family housing. Activities include working with military personnel, developers and contractors and others involved in the construction and operation of military family housing. The outcomes of the project will include a strategic plan for PATH to integrate technologies into military homes and topical reports on issues, requirements, and considerations surrounding the use of various technologies. Technical support will be provided throughout the project to educate the military and contractors about PATH technologies and to assist them in the evaluation and integration of new technologies. This report focuses on progress from technical assistance activities being provided to a contractor building homes for military families at Ft. Drum, New York

Site Location and Description

The site is located on military property on-base at Ft. Drum near Watertown, New York. Ft. Drum is home to the U.S. Army's 10th Mountain Division.



Under the privatization approach to building military family housing, the private sector construction and management team, in this case Actus Lend Lease (Actus), will build and maintain the properties over a long-term lease period. The project will include 845 new homes. The new homes are almost all duplexes and include a mix of three, four, and five bedroom models.

The frost-depth in the area is approximately 60 inches. Thus, in the surrounding market, the typical foundation is a basement. In order to build a cost-effective home, Actus was interested in alternatives to a full-basement. However, the local frost depth would typically either preclude the use of a slab-on-grade or require extensive costs to do so.

PATH Involvement and Approach

PATH's involvement at Ft. Drum arose out of meetings between Newport Partners LLC and Actus staff during the summer of 2005. While discussing opportunities for PATH at other installations, the Actus staff indicated that they were interested in frost-protected shallow foundations (FPSF) at Ft. Drum as an alternative to more costly deep foundation systems.

A FPSF is a foundation system that uses insulation around the footings and walls to prevent the soils from experiencing frost heave. They allow the footing to be 12 to 16 inches below grade even in extremely cold climates. FPSFs have been used successfully for over 30 years throughout Scandinavia and some parts of the United States. However, the Actus senior management expressed some significant reservations about the FPSF technology and its use in a climate as harsh as Ft. Drum. Further, the designer was concerned that the foundations would be exposed during cold weather prior to heating of the home. PATH was asked to help address these concerns so that Actus could move forward with the technology and to assist in optimizing the design and construction of the foundations.

Newport Partners initially addressed the concerns related to the FPSF technology in harsh (cold) climates. We conducted a review of the assumptions used for an initial design at Ft. Drum See Figure 1). The ASCE consensus design standard for FPSFs was used as the starting point (ASCE 32-01, *Design and Construction of Frost-Protected Shallow Foundations*, American Society of Civil Engineers). In order to meet energy code requirements and the ASCE requirements, the designer at Ft. Drum had specified insulation consistent with a 2500 Air Freezing Index (AFI). However, using the ASCE standard, the AFI at Ft. Drum is just under 2000, meaning that the design added a higher factor of safety than was already built into the design manual. Further, we reviewed weather data from NOAA and determined that the actual AFI at Ft. Drum was less than 1800. The map in the ASCE manual already had an inherent conservative nature to it. Thus, the effective 2500 AFI is almost 40% higher than the historical weather conditions would have required for a 100 year return interval.

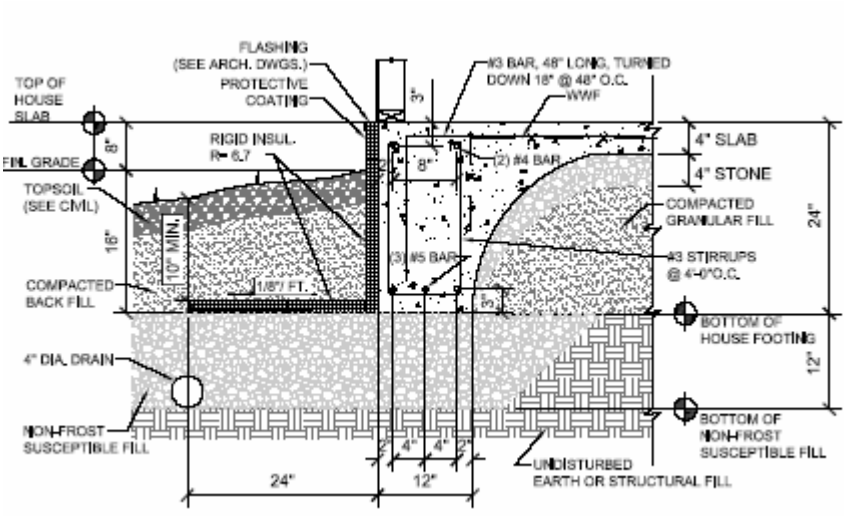


Figure 1: Initial foundation design at Ft. Drum (waiting for updated detail from Actus.)

In most cases, conservative assumptions of this magnitude do not change the final design of a FPSF very much, if at all. However, the 2500 AFI mark in the FPSF design is somewhat of a tipping point where the requirements change dramatically. At 2500 AFI, the design moves from just using vertical insulation on the exterior wall and footing to adding a horizontal section of insulation at the bottom of the footing. We concluded that, although it may be necessary to meet energy code requirements, the horizontal insulation adds a significant safety factor to the FPSF. Informing Actus of the conservative design for the FPSFs helped to remove concerns over the use of this PATH Technology.

The issue related to protection of the slab prior to the building being heated was addressed by applying an approach similar to requirements for an unheated building in the ASCE standard. In this case, temporary insulation is placed over the slab surface to protect it until construction resumes or the building is heated. The insulation could be placed under the slab and left in place permanently or it can be placed on top and reused on subsequent foundations. The construction manager confirmed that this approach will be used on slabs that are left exposed during colder weather.

Status as of February 2006

Eighty-eight building pads had been readied for construction as of the beginning of February 2006. A site visit on February 1 was made to document efforts on the first group of 15 foundations (30 duplexes) that were at various stages of completion.

One of the contractors is using insulating concrete forms (ICFs) for the foundation stemwall (See Figures 3 and 4). The ICFs form an integral corner without the need for any special attachments of the insulation at the top or between vertical sections on the wall.

Figure 3 – Vertical and horizontal insulation

Figure 4 – ICF forming integral corners

In order to speed up the production schedule, a second contractor was also working at the site, but was using conventional concrete forms (see Figure 5). We met with the designer and Actus staff on site to address how to attach the insulation for these walls. Based on the discussions, the plans will require a mechanical fastener (similar to as shown in Figure 6) at 24 inch intervals along the top of the vertical insulation and at the end of each section. A fastener will also be

provided down the walls at 8 inch intervals at corners. The fasteners will be in addition to the adhesive used with the insulation as recommended by the manufacturers.

Figure 5 – Conventional concrete forms

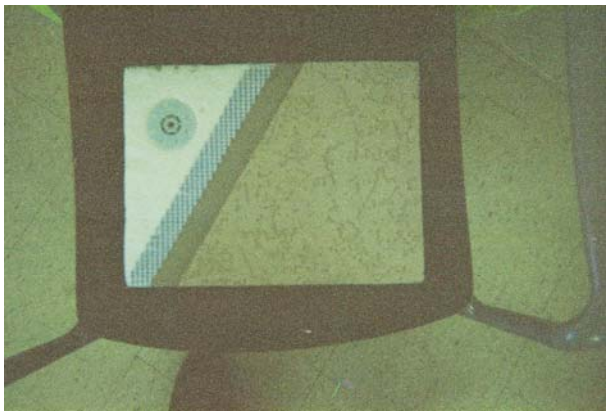


Figure 6 – Typical mechanical fastener on sample board

All construction activities in this climate are difficult in winter months. Thus, the garages are conditioned so they can also employ the FPSF design for heated buildings. In addition, soils surrounding the foundation need to be kept unfrozen before and during construction independent of the type of foundation. This is typically achieved using coverings placed over a flexible conduit system that is heated with a glycol-based fluid. This is shown in Figure 7.

Figure 7 – Temporary tubing and covering used to keep slab area from freezing during construction

FPSF savings at Ft. Drum

Estimates indicate that the FPSF used at Fort Drum reduced the cost of the foundation by $6000 per duplex or $3000 per home compared to a conventional slab foundation. There are likely to be greater savings and reductions in cycle time as the construction crews become more experienced with the requirements of this technology.

Acknowledgements

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