

INTEGRATING PATH TECHNOLOGIES INTO MILITARY FAMILY HOUSING



Report on Army Housing at Fort Campbell, Kentucky

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 to integrate innovative technologies into military family housing. Activities include working with military personnel, developers, contractors, and others involved in the construction and operation of family housing. The outcomes of the project will include a strategic plan for PATH to implement and site-specific 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 of new technologies and their integration into the design and production of homes. This report focuses on progress from technical assistance activities being provided to a contractor building and revitalizing homes for military families at Fort Campbell, Kentucky.

Site Location and Description

The site is located on military property at Fort Campbell near Clarksville, TN. This is about one hour driving time northwest of Nashville. Fort Campbell is home to the 101st Airborne Division “Screaming Eagles.”

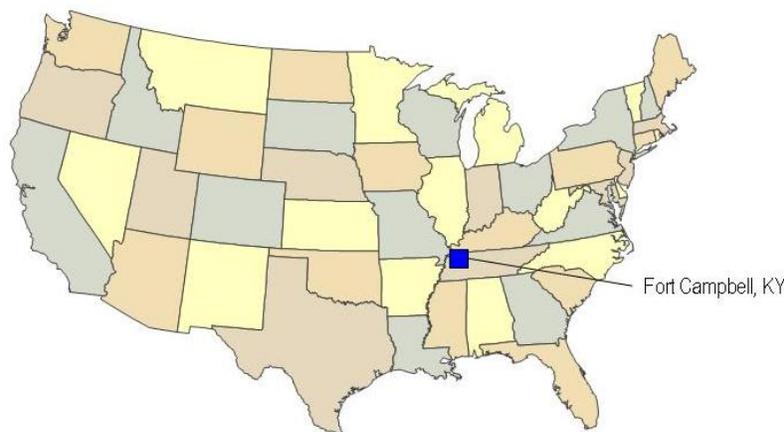


Figure 1 – Map Highlighting the Location of Fort Campbell, KY

Under the privatization approach to building military family housing, the private sector construction and management team, in this case Actus Lend Lease, will build and maintain the properties over a long-term lease period. The first phase of the project (which started in 2003) will include about 2000 new homes and renovation of over 2000 existing homes. The new homes on this site are both replacements of existing homes and new expansion. Some of the new homes are shown in Figure 2.



Figure 2 - New Homes under Construction at Fort Campbell

The initial sets of homes were constructed using wood stick-framed walls, slab foundations, and open-web floor trusses (for multi-floor units). However, homes currently under construction are now using light-gauge steel walls that are panelized at an on-site plant by Dietrich Residential Construction.

Target Technologies and Approach

PATH's involvement at Fort Campbell began during a workshop at Boston University on the Army's Connected Home project. The Connected Home project is a research program designed to improve the services and connectivity between soldiers, their families, and service providers. Staff at the RCI (Residential Communities Initiative-the Army's privatization program for housing) suggested PATH could provide input into the Connected Home Project on building technologies that would compliment the activities being conducted by Boston University.

The goal of PATH in the Connected Home project was to encourage the use of practices and technologies that improve energy efficiency. Newport Partners (Newport) and Actus Lend Lease (Actus) identified several support activities that would allow us to identify and implement energy saving technologies. This included establishing baseline electric usage for homes to identify areas for improvement including education of occupants, new technologies, and even billing practices to encourage conservation.

One large set of homes at Fort Campbell is composed of duplexes built to EPA Energy Star specifications, yet they consistently used more electricity than predicted. Our first activity was to run energy simulations on the homes using REM/Design simulation software. The REM/Design results for five homes are shown in Table 1.

Table 1 - Fort Campbell REM Design Summary Results

	306 A - Meter 2244	307 B - Meter 2246	3842 B - Meter 2247	3883 A - Meter 2243	3850 B - Meter 2242
Annual Energy Cost (\$/yr)					
Heating	395	390	390	395	388
Cooling	117	112	112	116	105
Water Heating	175	175	175	175	175
Lights & Appliances	352	352	352	352	352
Total	1038	1029	1029	1038	1019
Avg. Monthly (Gas and Electric charges)	87	86	86	87	85
<i>Electric Only (\$)</i>					
Heating	15	15	15	15	15
Cooling	117	112	112	116	105
Water Heating	0	0	0	0	0
Lights & Appliances	317	317	317	317	317
Total	448	444	444	448	437
Avg. monthly	37	37	37	37	36

The REM/Design simulations in Table 1 are annual averages based on historical weather data. Newport Partners staff subsequently developed a monthly baseline of these results reflecting monthly heating and cooling degree days. However, actual home energy use retrieved from utility bills was still much higher than the simulated monthly baseline, especially during the shoulder seasons (spring and fall). During the peak cooling season, the modeled baseline usage and actual usage were comparable.

Although actual climate conditions will differ from the historical data and can be the root cause of differences between actual and simulated energy use, the overall trends through several seasons led us to believe that the reasons for the discrepancies are occupant habits and/or large lighting and plug loads.

Another trend identified during the energy monitoring process was that extraneous night time loads accounted for 6-11% of the average home electricity consumption. Actus is currently looking into methods for delivering this information to occupants in hopes that they will be able to reduce consumption.

The next step was to determine the load(s) responsible for the over-usage so that they could be replaced, altered, or understood. Newport staff previously visited Fort Campbell in October 2005 to install Enetics electric load meters on the homes listed in Table 1 (see Figure 3 below). The Enetics load meters deliver data to a remote computer where it is analyzed to identify specific electric loads.



Figure 3 – Enetics Equipment Installed between Utility Meter and Meter Housing

Electric consumption for the month of December 2005 is shown in Figure 4 below. Winter heating electricity use tracked fairly well with simulations, but plug and lighting loads typically exceeded simulations by about 100%. Subsequent months showed similar patterns including clothes dryer usage and lighting/plug loads that were much higher than defaults built into the REM/Design and DOE II software modeling. As mentioned before, occupant habits greatly influence these types of uses. Although technology as discussed in subsequent text of this report can help to reduce these types of excessive loads, education of homeowners or occupants also must play an important role.

**Electricity Consumption
Dec 2005**

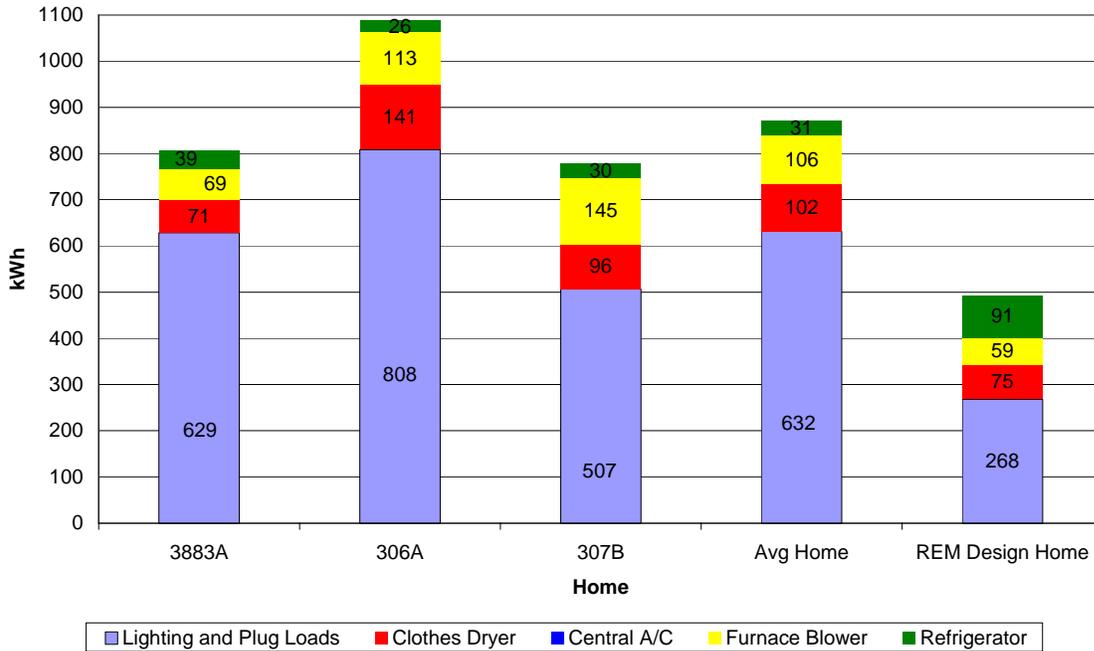


Figure 4 – Monthly Electricity Use of Homes by Load or Division.

During our visit to Fort Campbell, we inspected some of the homes and recorded characteristics or features in them. Among other items we noticed are a large number of fixtures and light bulbs in each unit. There were 7 ceiling fans w/light kits in each home, and each light kit contained three 60 Watt light bulbs. We advised Actus to replace all the bulbs in the homes with Compact Fluorescent Light (CFL) bulbs. CFLs use a much lower wattage to displace the same amount of lumens as incandescent bulbs (15W CFL = 60W incandescent). One drawback to using CFLs in the past was increased cost, however, the price of CFLs has fallen dramatically over the last couple years making them an attractive energy saving product.

Actus replaced the incandescent bulbs with CFLs in an initial set of two homes in April 2006. One home had 41 bulbs and the other 56.

- ◆ Home 3883A: Forty one 60W replaced with 14W generic brand CFLs; two 75W replaced with 20W General Electric (GE) CFLs. Total potential demand reduction: 1996 Watts (76% potential reduction).
- ◆ Home 3851B: Fifty six 60W replaced with 13W GE CFLs; two 75W replaced with 20W GE CFLs. Total potential demand reduction: 2742 Watts (78% potential reduction).

Simply installing the CFLs reduced the potential lighting demand (difference between all incandescent lights “on” and all CFLs “on”) by about 77% for both homes. Because lighting loads were not measured directly, but were lumped together with plug loads, it was only possible to estimate the actual reduction in demand resulting from replacing the bulbs. Homes 3883A and 3851B showed an average lighting and plug load demand reduction of 176 Watts for the week after CFLs were installed compared to the week preceding the installation.

Making an assumption that this demand reduction is entirely attributable to lighting (and not plug loads), and applying this demand reduction to an entire year, the electricity use should be reduced by an average of 1542 kWh for each home. It is important to remember that these demand and electricity reduction numbers are estimates only, as they were not measured directly. Actual results will vary according to monthly lighting loads and tenant habits. Actus plans to compare the historical data for electric consumption of the homes against their current usage to more accurately determine how much CFLs are reducing the overall consumption. If the savings continue to be verified, they will replace the bulbs in more existing homes, and will use CFLs in their new construction fixtures as well.

Other Technologies under Consideration

Actus is interested in building comfortable, attractive, yet efficient housing for military families. For quality control purposes, we recommended they purchase a Blower Door to assist with air sealing. The blower door would provide Actus with valuable information regarding where they should focus more effort to reduce air leakage.

Newport also offered suggestions on several other items related to housing at Fort Campbell. One suggestion was to add foam insulation to the exterior of the steel wall panels being used for new home construction. Currently the builder is only applying a weather barrier and siding to the exterior of the panels – the lack of a thermal break could cause “ghosting” on the interior wallboard in the future (ghosting is when particles or dark lines appear on interior wallboard at stud locations due to temperature differences across the surface of the wall). Another suggestion for the same set of homes was to reduce the length of the bathroom ventilation duct runs. With lengths reaching 25 feet and numerous turns and angles, their standard vent fans will be unable to adequately remove moisture from the bathrooms. By reducing the length of the run through sidewall vents, potential problems can be minimized.

Over the next several months, Actus will continue to monitor the homes at Fort Campbell looking for trends in the data that could lead to future design alternatives that increase energy efficiency and comfort within the home. By reviewing the future home designs and making changes now, Actus will be able to incorporate technologies and design principles that help conserve energy, reduce construction costs, and prevent moisture issues (among many others).

The last two items currently under consideration by Actus include providing educational opportunities for occupants, and installing thermostats with high and low stoppage points (e.g., minimum cooling setting at 76 degrees, maximum heat setting at 72) to reduce heating and cooling costs. If Actus is able to educate occupants on their excessive utility consumption trends, the occupants may in-turn pay better attention to conservation and eventually reduce overall consumption. To be successful, it may be necessary to offer incentives to those occupants who conserve energy.

Benefits

Replacing incandescent bulbs with CFLs has begun to show benefits for Actus. Assuming each home reduces annual electric consumption by an average of about 1540 kWh through the use of CFLs, each home could cut \$93 off its yearly energy bill (at the current rate of \$0.06 per kWh). Should Actus decide to replace the bulbs in 2500 homes, then they would realize an annual savings of over \$232,000. The savings are expected to grow given the current environment where the outlook for energy prices indicates continued increases in the future.

Another benefit of PATH's involvement that was not anticipated at the outset is related to the connections in the electric panel and service. When results from monitored electric use showed excessive consumption, a crew was sent to the home to evaluate the HVAC and electrical systems. The HVAC equipment was found to be operating within manufacturer specifications. However, the breakers in the electric panel box and the neutral lug strap were loose. The draw on the system was reduced from about 30 amps to 5.7 on the neutral by tightening the loose connections. Actus is now discussing ways to check the connections on homes on a periodic basis.

Even though direct technical assistance at Fort Campbell is coming to an end, the participation of PATH will continue to reap benefits in the future. Actus plans to continue monitoring the homes in search of better alternatives and ways to continually upgrade the homes. Through the help of PATH, they now realize that even minor and affordable changes to the design or product choices can make a significant difference in the overall performance of the home.

Acknowledgements

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