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## Wafflemat™ Foundation System and the New International Building Code Requirements

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### EXECUTIVE SUMMARY

By January 1, 2008, most states, including several in the Western US (e.g., California, Hawaii, Montana, Utah, Wyoming and Washington) put into effect the changes adopted in the 2006 IBC. In regard to foundations, the required changes in post-tensioned slab-on-ground designs due to the new building code are making foundations more expensive, especially in expansive soils. The WAFFLEMAT Foundation System, however, becomes an even more attractive design alternative than it was under the old guidelines, because as an engineered system, it already accommodates the new design recommendations and requires no major modifications to bring it into compliance.

### INTERNATIONAL CODE COUNCIL

The International Code Council (ICC) arose from the drive to consolidate the various code standards that were in use in the United States. The objective was to develop a single set of comprehensive and coordinated model building code for use throughout the nation, for the purpose of "protecting the health, safety, and welfare of people by creating better buildings and safer communities" (ICC Vision Statement, 2007).

Advantages of a single unified code standard are numerous and varied, with benefits to builders, designers, and code enforcers. Municipalities across the country have recognized the value of adopting the ICC codes. In May 2007, the International Code Council (ICC) announced that, with legislation signed in Hawaii, the new "I-Codes" would now be safeguarding Americans in all 50 states.

### **PTI'S 3RD EDITION NOW DESIGN STANDARD FOR POST-TENSIONED SLAB FOUNDATIONS**

This year's essentially universal adoption of the *International Building Code 2006* Edition results in some significant changes for the design of post-tensioned slab foundations. The most notable change is that the IBC now incorporates, by reference, the current design recommendations of the Post-Tensioning Institute.

The International Building Code, 2006 Edition, states: "Section 1805.8.2 Slab-on-ground foundations. Slab-on-ground, mat, or raft foundations on expansive soils shall be designed and constructed in accordance with WRI/CRSI *Design of Slab-on-Ground Foundations* or PTI *Design and Construction of Post-Tensioned Slabs-on-Ground*. Exception: Slab-on-ground systems that have performed adequately in soil conditions similar to those encountered at the building site are permitted subject to the approval of the building official."

This incorporation by reference has the advantage of streamlining adjustments to the code, bypassing the regular 3-year cycle of IBC updates. Consequently, any changes, modifications, or updates to the design parameters for slabs-on-ground as recommended by WRI/CSRI or PTI are now immediately considered "part of the code."

As a result, previous building code-approved design standards for slabs-on-ground, many of which were based on the 2nd Edition of PTI's *Design and Construction of Post-Tensioned Slabs-on-Ground*, are no longer acceptable. The current standard is *Design of Post-Tensioned Slabs-on-Ground*, 3<sup>rd</sup> Edition (2004). The 3rd Edition, according to PTI, "... contains a major revision in the determination of geotechnical design parameters, and extensive editorial revisions and clarifications."



The 3<sup>rd</sup> Edition continues: "PTI believes the recommendations presented in this publication provide economical post-tensioned foundations that meet intended strength and serviceability requirements. Application of these recommendations results in foundation designs that have exhibited satisfactory performance for more than twenty-five years."

The thought may occur that if the standards presented in previous versions of PTI's design recommendations gave satisfactory performance for over two decades, the justification for "a major revision in determination of geotechnical design parameters" is perhaps not particularly compelling. However, the revision is now part of the adopted International Building Code, and must be complied with.

#### **COST COMPARISON: TRADITIONAL SLAB VS. WAFFLEMAT**

Because of the changes in geotechnical design parameters in the IBC, concrete slab foundations must now be designed to be stronger, stiffer, and more resistant to edge lift and center lift. Under the new code, the influence of  $e_m$  and  $y_m$  is effectively doubled. This typically means deeper footings, larger, deeper beams or thicker slabs, especially for uniform-thickness slabs. With the recent increases in the cost of concrete, traditional designs are now noticeably more expensive because more concrete must go into the slab.

The WAFFLEMAT foundation, however, remains essentially unchanged in light of the new standards imposed by the 2006 Edition of the IBC. Because WAFFLEMAT is an engineered foundation system, and is already compatible with the new building codes, it does not require substantial modifications. This results in even greater potential cost savings for time and materials, when compared with ribbed slabs or uniform thickness slab foundations.

#### **WAFFLEMAT NOW "GREENER" THAN EVER**

Finally, WAFFLEMAT provides, because it uses less concrete, a 20% to 40% reduction in greenhouse gas emissions when compared to slabs designed under the old code (see "*Lowering the Carbon Footprint When Using WAFFLEMAT System for Concrete Slab Foundations.*" Sam L. Altshuler, P.E., M.E., Board Certified Environmental Engineer. February, 2007.

[www.pacifichousingsystems.com](http://www.pacifichousingsystems.com). "News" — "White Papers").

The increase in concrete required to make traditional ribbed slabs or uniform-thickness slabs compatible with the new design guidelines also adds to CO<sub>2</sub> greenhouse gas emissions for those designs, making WAFFLEMAT even more environmentally friendly by comparison.

## CONCLUSION

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This year's essentially universal adoption of the *International Building Code 2006 Edition* results in some significant changes for the design of post-tensioned slab foundations. In regards to foundations, the required changes in post-tensioned slab-on-ground designs due to the new building code are making foundations more expensive, especially in expansive soils. The WAFFLEMAT, however, becomes an even more attractive design alternative than it was under the old guidelines, because as an engineered system, it already accommodates the new design recommendations and requires no major modifications to bring it into compliance.

The patented system (US Patent 5,540,524) has, since 1995, over 7 million sf of residential foundations installed without a single failure.

## APPENDIX | The WAFFLEMAT



The WAFFLEMAT foundation forming system creates a post-tensioned foundation especially for expansive soils. It offers the ease of constructability of a Uniform Thickness Foundation, along with the efficiency of a Ribbed Foundation.

The system sits on pad grade, and comes in either 8 "or 12" high 19" x 19" thermal grade heat resistant WAFFLEBOXES (note: the boxes are made of recycled plastic and are "environmentally friendly"). The WAFFLEMAT is created by connecting a series of bottomless WAFFLEBOXES together, and evenly spacing them throughout the footprint area. A five inch post-tension reinforced concrete slab is then monolithically poured, the bottomless WAFFLEBOXES allowing for any expansive soil movement. The pour also creates concrete beams running through the footprint and perimeter.



The system can be easily installed. The plumbing is brought up through the WAFFLEBOXES with rebar reinforcement. The slab set up and pour is a two-day or less process, eliminating trenching and reducing soil preparation by providing less over excavation and re-compaction, reducing building cycle-time.

The WAFFLEMAT possesses the greatest floor stiffness of any system in its class, with sufficient strength to resist differential swelling resulting from landscaping practices, surface drainage or flooding from any source. In addition, the WAFFLEMAT does not require presoaking underlying soil pads, and there is no need for footings – meaning, no earth spoils. And, since the WAFFLEMAT slab is typically 12" above grade, it provides the option of no gravel, sand, or moisture barrier.



The WAFFLEMAT, first installed in 1995, has been used in over 7,000,000 square feet of residential living space without one reported structural failure.