

## MAY 2014 MEETING

Wednesday, May 14, 2014 (1.0 PDH)

### LOCATION:

#### Hess Club

5430 Westheimer  
Houston, Texas 77056  
713-627-2283  
(Business casual dress code required)

### TECHNICAL PROGRAM

#### Design, Manufacture, and Installation Guidelines of Precast Concrete Segmented Piles for Foundation Underpinning

By The Structural Committee of The Foundation Performance Association Houston, Texas (Document [FPA-SC-08 Rev. 1](#))

Speaker:

[Karl Breckon, P.E.](#) President, [BEC-LIN Engineering, LLP](#) Tel. 281-664-8440.Cell. 832-435-1108

Karl Breckon, FPA Member, Past President and Chair of Structural Subcommittee # FPA-SC-08, has over 30 years of experience in major refinery, chemical, manufacturing, petrochemical, power plants, bridge and civil projects, commercial and residential engineering / design, and investigations to diagnose problems, both domestic and foreign, including executive, project management, project engineering, planning, scheduling, estimating, and cost control, in the home office and in the field.

Mr. Breckon formed BEC Engineering, LP in September of 2002, with a partner to provide engineering services. In January 2011 BEC Engineering, LP merged with Lin Engineering, Inc. to form a new company named BEC-LIN Engineering, LP. Projects performed by BEC-LIN Engineering, LP included structural engineering / design, civil engineering / design, surveying, and construction management, including providing consulting and inspection services to diagnosis problems and recommend suggested repairs.

### PRESENTATION SUMMARY

To an audience of 60, Mr. Karl Breckon, P.E. presented the committee paper "Design, Manufacture, and Installation Guidelines of precast Concrete Segmented Piles for Foundation Underpinning". Underpinning by driving precast concrete segmented piles is the most common method of lifting malperforming concrete foundations in Texas and other areas of the United States. These repair systems provide an economical means for extending the life of homes and other low rise buildings that were founded on moving soil. Because of the widespread use of this type of the foundation repair, in 2004 the FPA Structural Committee appointed Mr. Breckon to chair its FPA-SC-08 ad hoc subcommittee, which published the Revision 0 paper to standards current at that time. The paper was updated to Revision. 1, was again peer-reviewed, and published in March 2014.



Segmented pre-cast piles are typically 6" diameter cylinders 12" long. The piles are driven one after another by stacking and pressing the individual piles one after another in a vertical column. The piles rely on skin friction for load capacity and not end bearing. The segmented piles are not typically capable of resisting lateral loads. Additionally, extreme changes in soil moisture content may occur at depths (the active zone/depth to constant suction: pF) deeper than the driven piles which may permit future foundation movement.

The committee found that the IBC permits the use of driven segmented pile technology as follows:

- Under IBC (2012) Section 104.11 Alternative materials, design and methods of construction and equipment, states “The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. An alternative material, design or method of construction shall be *approved* where the *building official* finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, *fire resistance*, durability and safety.”
- The IBC (2012) Commentary Section 104.11 states, “The code is not intended to inhibit innovative ideas or technological advances. A comprehensive regulatory document, such as a building code, cannot envision and then address all future innovations in the industry. As a result, a performance code must be applicable to and provide a basis for the approval of an increasing number of newly developed, innovative materials, systems, and methods for which no code text or referenced standards yet exist. The fact that a material, product, or method of construction is not addressed in the code is not an indication that such material, product or method is intended to be prohibited. The building official is expected to apply sound technical judgment in accepting materials, systems, or methods that, while not anticipated by the drafters of the current code text, can be demonstrated to offer equivalent performance. By virtue of its text, the code regulates new and innovative construction practices while addressing the relative safety of building occupants. The building official is responsible for determining if a requested alternative provides the equivalent level of protection of public health, safety and welfare as required by the code.”
- Under Chapter 18, Soils and Foundations, in Section 1810.1.4 Special types of deep foundations, IBC (2012) states, “The use of types of deep foundation elements not specifically mentioned herein is permitted, subject to the approval of the *building official*, upon the submission of acceptable test data, calculations and other information relating to the structural properties and load capacity of such elements. The allowable stresses for materials shall not in any case exceed the limitations specified herein.” Because Precast Concrete Segmented Piles have not been specifically mentioned by IBC, this deep foundation system is allowed by IBC provided the building official approves the submission, if applicable.

Considering the information contained in the references above, it is the opinion of the committee that the use of Precast Concrete Segmented Piles for repair of foundations by underpinning are in compliance with the IBC.

The typical application of precast concrete segmented piles is to raise an out-of-level slab-on-ground concrete foundation suffering differential settlement toward a more level, or as-built condition. Precast concrete segmented piles will usually not be able to resist the uplift forces to the foundation due to swelling soils if the soil is in contact with the existing foundation system. Because this repair system relies upon using the weight and stiffness of the above structure to drive the piles, this system has a depth of refusal that varies. In the Houston area, driven depths average 12'-16' however driven depths up to 75' in some areas are not uncommon. If the pile cannot attain sufficient penetration into stable soils, then it may not be resistant to potential movements that occur due to swelling or shrinking of the soil in the movement zone.

Mr. Breckon discussed additional topics such as interconnecting segments, lateral loads on piles, applicable codes and standards, use of geotechnical investigations, pile element nomenclature, access holes, tunneling, pre-drilling, water jetting, leaving post-lift voids below the slab, under slab plumbing leak testing, submittals to expect of repair companies, quality assurance and quality control, warranties, material specifications, and installation steps.

The committee paper may be viewed by [clicking here](#).

A copy of the presentation slides may be viewed by [clicking here](#).

To read summaries of previous FPA presentations by Karl Breckon, please click:

September, 2005 - [Guidelines for the Specification of Precast Concrete Segmented Piles for Foundation Underpinning](#)