PLPAK NEWSLETTER

Your host to the latest progress and updates

BE4E in 2012

Since its first edition in Jan. 2012, BE4E newsletters have presented different news about BE4E and PLPAK. The news included our latest published papers, consulting services and external cooperation (e.g. with NTUA). The last edition in 2012, will present an overview of the materials published through the whole year.

i- The consulting services

BE4E consulting services have recived many types of strutural elements in this year (slabs and foundations) that need accurate and fast modeling we reprenstent them from figures (1) to (6).

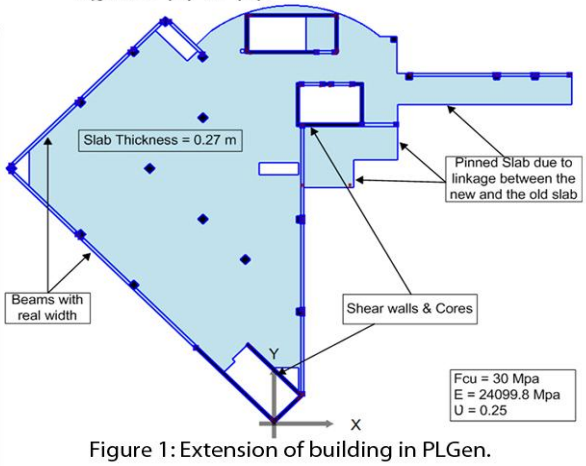

Figure 1: Extension of building in PLGen.

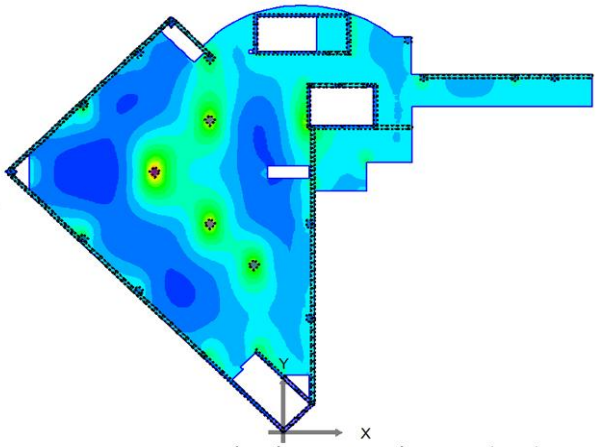

Figure 2: Moment distribution in x-direction (Mxx).

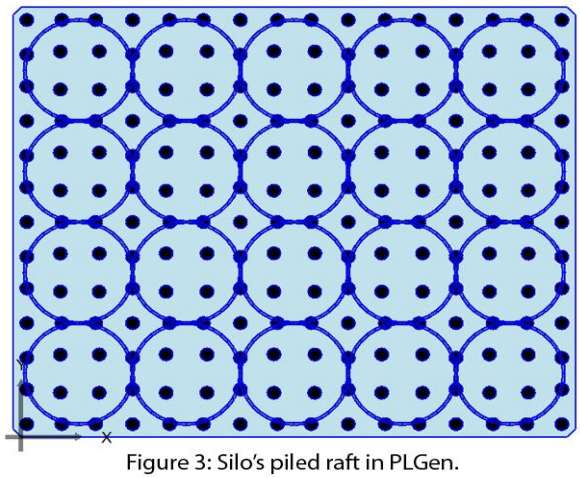

Figure 3: Silo's piled raft in PLGen.

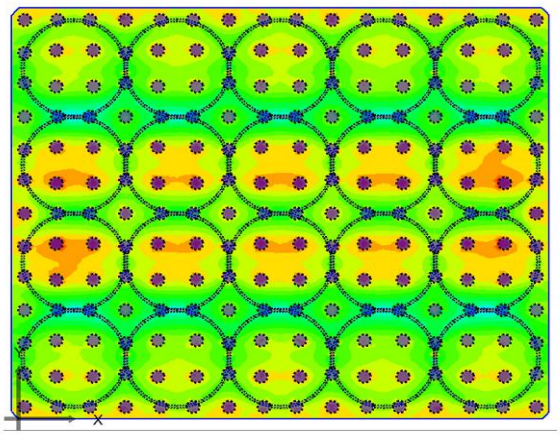

Figure 4: Moment distribution in y-direction (Myy).

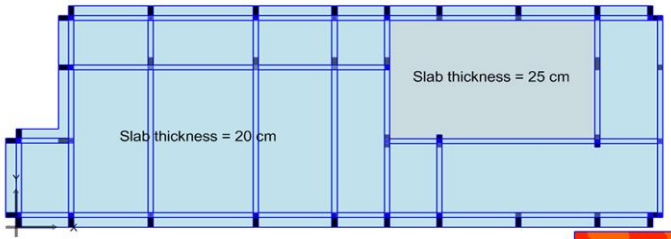

Figure 5: Multi-thickness slab in PLGen

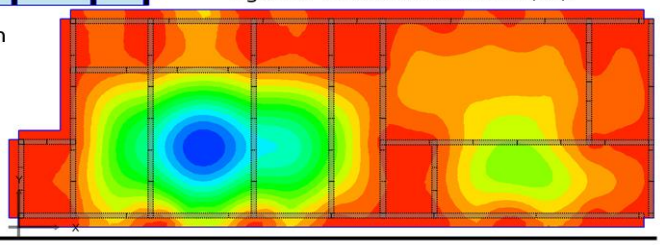

Figure 6: Vertical deformation (Uz).

New coming: Boundary elements tutorials by Prof. Dr. Youssef F. Rashed

You can now register on our website for more exclusive features related to boundary element analysis in structural engineering. Connect via this link: www.be4e.com , or you could use the following code on the right .

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Research and developments: RnD@be4e.com

Customer support: support@be4e.com

DEVELOPMENT

The PLPAK software is in constant development to meet the needs of industrial and research purposes. Updates to the software will be posted monthly.

EDITORS

Mostafa E. Mobasher

Mahmoud El Galad

Youssef F. Rashed

ii- The PLPAK at the National Technical University of Athens (NTUA), Greece

Professor Youssef Rashed (BE4E principal and technical director) visited the NTUA in July 2012, he met professors T Katsikadelis, M Papadrakaikis, V Plavris & L Stavridis and discussed about the development and strengths of the PLPAK and boundary element techniques.

Photo1: Professor Y Rashed with Professor L Stavridis

Photo2: Professor Y Rashed with Professor S Mehanny, M Papadrakaikis and V Plavris

Photo 3: Professor Y Rashed with Professor T Katsikadelis

iii- Published Papers based on the PLPAK

Engineering Structures – Vol. 33, Issue 10, JULY 2011, Pages 2919-2930

A PROBABILISTIC BOUNDARY ELEMENT METHOD APPLIED TO PILE DISLOCATION PROBLEM

Samer Sabry F. Mehanny, Sameh S. F. Mehanny, Youssef F. Rashed

In this paper a probabilistic approach where the boundary element method is efficiently to study the random shift of a given pile within a particular pile cap from it's original position on selected output design parameter such as pile loads and bending moments in the pile cap.

ARTICLE IN PRESS

Engineering Structures

A probabilistic boundary element method applied to the pile dislocation problem

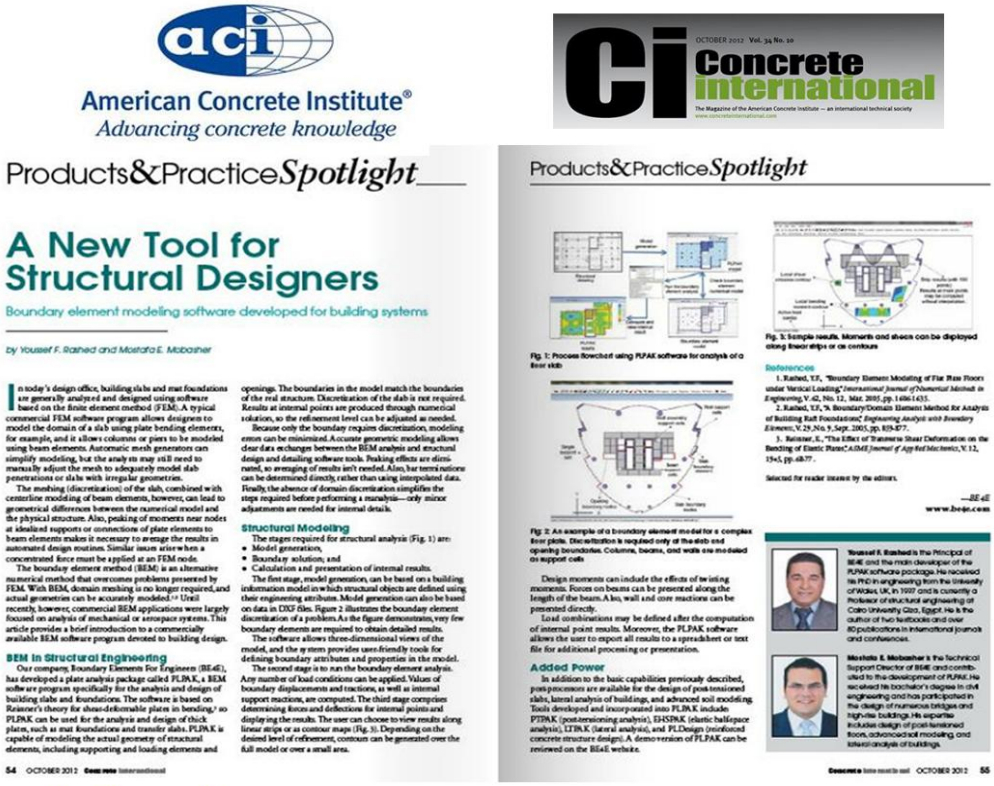
Samer Sabry F. Mehanny, Sameh S.F. Mehanny, Youssef F. Rashed

ARTICLE INFO

ABSTRACT

iv- PLPAK in Concrete International

The PLPAK has appeared in the magazine of the American Concrete institute.
October 2012, Vol.34 No.10 Pages 54,55.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Products&PracticeSpotlight

A New Tool for Structural Designers

Boundary element modeling software developed for building systems

by Youssef F. Rashed and Mostafa E. Mobasher

In today's design office, building slabs and mat foundations are generally analyzed and designed using software based on the finite element method (FEM). A typical commercial FEM software program allows designers to model the domain of a slab using plate bending elements, for example, and it allows columns or piers to be modeled using beam elements. Automatic mesh generators can simplify modeling, but the analyst may still need to manually adjust the mesh to adequately model slab penetrations or slabs with irregular geometries.

The meshing (discretization) of the slab, combined with centerline modeling of beam elements, however, can lead to geometrical differences between the numerical model and the physical structure. Also, peaking of moments near nodes at idealized supports or connections of plate elements to beam elements makes it necessary to average the results in automated design routines. Similar issues arise when a concentrated force must be applied at an FEM node.

The boundary element method (BEM) is an alternative numerical method that overcomes problems presented by FEM. With BEM, domain meshing is no longer required, and actual geometries can be accurately modeled.[1-3] Until recently, however, commercial BEM applications were largely focused on analysis of mechanical or aerospace systems. This article provides a brief introduction to a commercially available BEM software program devoted to building design.

BEM in Structural Engineering

Our company, Boundary Elements For Engineers (BE4E), has developed a plate analysis package called PLPAK, a BEM software program specifically for the analysis and design of building slabs and foundations. The software is based on Reissner's theory for shear-deformable plates in bending,[4] so PLPAK can be used for the analysis and design of thick plates, such as mat foundations and transfer slabs. PLPAK is capable of modeling the actual geometry of structural elements, including supporting and loading elements and openings. The boundaries in the model match the boundaries of the real structure. Discretization of the slab is not required. Results at internal points are produced through numerical solution, so the refinement level can be adjusted as needed.

Because only the boundary requires discretization, modeling errors can be minimized. Accurate geometric modeling allows clear data exchanges between the BEM analysis and structural design and detailing software tools. Peaking effects are eliminated, so averaging of results isn't needed. Also, bar terminations can be determined directly, rather than using interpolated data. Finally, the absence of domain discretization simplifies the steps required before performing a manalysis—only minor adjustments are needed for internal details.

Structural Modeling

The stages required for structural analysis (Fig. 1) are:

- Model generation,
- Boundary solution, and
- Calculation and presentation of internal results.

The first stage, model generation, can be based on a building information model in which structural objects are defined using their engineering attributes. Model generation can also be based on data in DXF files. Figure 2 illustrates the boundary element discretization of a problem. As the figure demonstration, very few boundary elements are required to obtain detailed results.

The software allows three-dimensional views of the model, and the system provides user-friendly tools for defining boundary attributes and properties in the model.

The second stage is to run the boundary element analysis. Any number of load conditions can be applied. Values of boundary displacements and tractions, as well as internal support reactions, are computed. The third stage comprises determining forces and deflections for internal points and displaying the results. The user can choose to view results along linear strips or as contour maps (Fig. 3). Depending on the desired level of refinement, contours can be generated over the full model or over a small area.

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Fig. 1: Process flowchart using PLPAK software for analysis of a floor slab

Fig. 2: An example of a boundary element model for a complex floor plate. Discretization is required only at the slab and opening boundaries. Columns, beams, and walls are modeled as support cells

Fig. 3: Sample results. Moments and shears can be displayed along linear strips or as contours

Design moments can include the effects of twisting moments. Forces on beams can be presented along the length of the beam. A bar, wall and core reactions can be presented directly.

Load combinations may be defined after the computation of internal point results. Moreover, the PLPAK software allows the user to export all results to a spreadsheet or text file for additional processing or presentation.

Added Power

In addition to the basic capabilities previously described, post-processors are available for the design of post-tensioned slabs, lateral analysis of buildings, and advanced soil modeling. Tools developed and incorporated into PLPAK include PTPAK (post-tensioning analysis), EHSPAK (elastic halfspace analysis), LTPAK (lateral analysis), and PLDesign (reinforced concrete structure design). A demo version of PLPAK can be reviewed on the BE4E website.

References

1. Rashed, Y.F., "Boundary Element Modeling of Flat Plate Floors under Vertical Loading," *International Journal of Numerical Methods in Engineering*, V. 62, No. 12, Mar. 2005, pp. 1686-1435.
2. Rashed, Y.F., "A Boundary/Domain Element Method for Analysis of Building Raft Foundations," *Engineering Analysis with Boundary Elements*, V. 29, No. 9, Sept. 2005, pp. 859-877.
3. Reissner, E., "The Effect of Transverse Shear Deformation on the Bending of Elastic Plates," *ASME Journal of Applied Mechanics*, V. 12, 1945, pp. 69-77.

Selected for reader interest by the editors.

—BE4E
www.be4e.com

Youssef F. Rashed is the Principal of BE4E and the main developer of the PLPAK software package. He received his PhD in engineering from the University of Wales, UK, in 1997 and is currently a Professor of structural engineering at Cairo University Giza, Egypt. He is the author of two textbooks and over 80 publications in international journals and conferences.

Mostafa E. Mobasher is the Technical Support Director of BE4E and contributed to the development of PLPAK. He received his bachelor's degree in civil engineering and has participated in the design of numerous bridges and high-rise buildings. His expertise includes design of post-tensioned floors, advanced soil modeling, and lateral analysis of buildings.

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v- BE4E Website (www.be4e.com)

In 2012 many users have visited our website and make their registeration to be able to be linking with our services. In Figures (7) and (8) show diagrams for the visitors in our website taffic which has noticeably incerased.

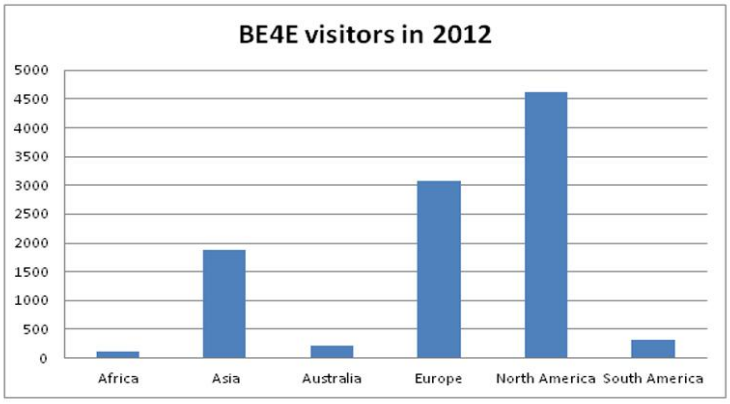


Figure 7: Bar chart for the visitor at each continent

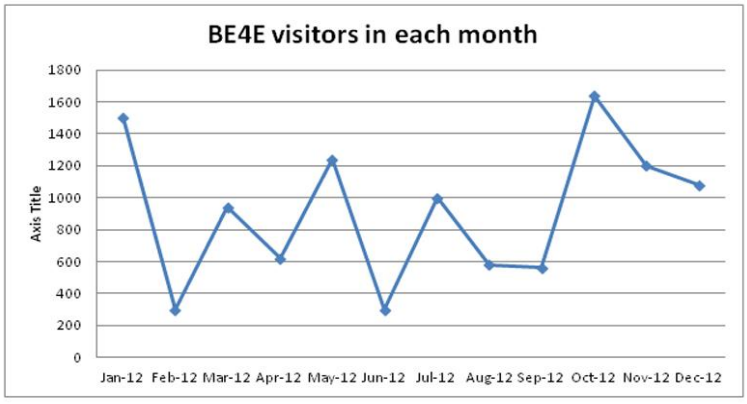
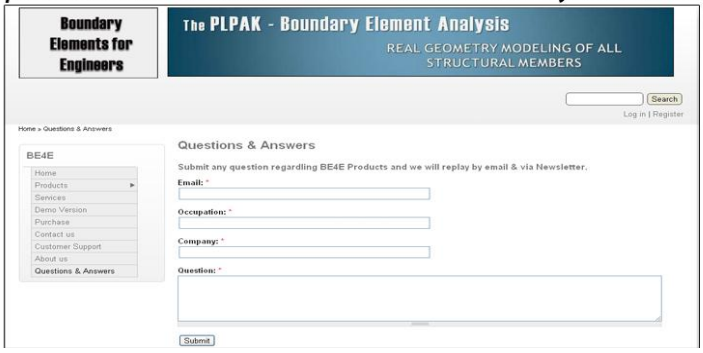


Figure 8: Line chart for the visitor in each month

Merry Christmas & Happy New Year 2013

In need of more questions answered?

We are always on the alert to answer your queries and support your smooth transition to a better boundary element sense in analysis. Send us any queries or comments to our new [Questions & Answers] page and await our reply in the coming issue! *http://www.be4e.com/site/node/56* The form which you can fill out is shown betow:



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