

# THE DELTA ADVANTAGE

Design Topics for Precasters

Volume 3, Issue 3

November 2000

## Reinforcing Openings

### *A practical approach*

We are often asked how to determine the appropriate way to reinforce openings in walls, floors and top slabs. A review of the ACI code reveals 2 methods for addressing openings in slab systems.

Article 13.4.1 states that "Openings of any size shall be permitted in slab systems if shown by analysis that the design strength is equal to the required strength...". Essentially, this means the first method is by analysis. We accomplish this by breaking the slab down to a system of integral beams and transferring the loads from the openings to the beams.

Figure 1 shows a slab with two hatch openings separated by a strip in the center of the slab. This type of configuration might warrant an analysis of the center strip as an integral beam with sufficient flexural capacity to carry approximately half of the total dead and live load applied to the entire slab.

Article 13.4.2 states "As an alternate to special analysis as required by 13.4.1, openings shall be permitted in slab systems without beams only in accordance with 13.4.2.1 through 13.4.2.4". These articles indicate that openings of any size shall be permitted in various strips provided the total amount of reinforcement required for the slab without openings is maintained. This is accomplished by replacing the bars interrupted by the opening, half on each side. Depending upon the size and location of the opening, an additional check for shear may be in order if the supporting edge is significantly reduced by the opening.

Figure 2 shows a single hatch opening in the corner of the slab. No special analysis would be necessary in this case since the interrupted bars can simply be placed either side of the opening. However, two sides of the opening rest above the wall of the structure and are considered to be fully supported. Therefore, no additional bars are needed over the supports. Diagonal trim bars should be placed around all openings to contain any cracks that may develop, particularly in square or rectangular openings.■

## New Phone System

Delta's new phone system went on-line on September 29, 2000. Among the new features of the system is Direct Inward Dialing which means that individual phone numbers have been assigned to everyone in the office so that there is no need to dial extensions. Let us know if you have not received a directory and we will get one out to you.■

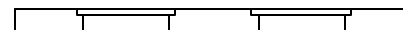
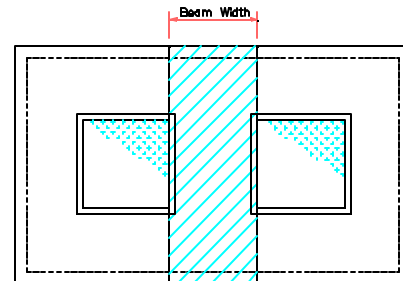


Figure 1

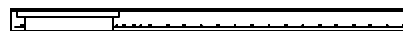
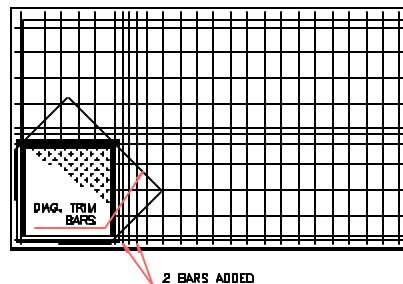


Figure 2

## Here We Grow Again

Stuart Gorka, EIT has accepted the position of Assistant Engineer and began working for Delta Engineers on October 23. Stuart is a graduate of Penn State University in Civil Engineering and has spent the last 2 ½ years working for the engineering department at Structural Reinforcing Products. Stuart will be working on various precast projects. Nick Ioannisci has also recently joined our firm. Nick is a graduate of the University of North Carolina, Charlotte and will be working primarily on precast building projects.■

Prepared by: Ronald E. Thornton, PE  
Delta Engineers, P.C.  
164 Court Street  
Binghamton, New York 13901

Ph. (607) 231-6612  
Fax (607) 231-6650  
E-mail: [thornton@deltaengineers.com](mailto:thornton@deltaengineers.com)  
Web: [www.deltaengineers.com](http://www.deltaengineers.com)



## DELTA ENGINEERS, P.C.

164 COURT STREET, BINGHAMTON, NY 13901  
TEL: (607) 231-6612 FAX: (607) 231-6650  
E-MAIL: rthornton@deltaengineers.com  
Internet: www.deltaengineers.com

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*Delta Engineers, P.C. provides specialized services to the precast/prestressed concrete industry including:*

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- *Structural design and analysis*
  - *Erection plans*
  - *Detailed shop drawings*
  - *Plant automation consulting*
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### Proud Members of



## Featured Project

Tunnel – Ramp E Under Rt. 460 and Industrial Park Dr.  
Montgomery County, Va.  
Produced by: Rotondo Precast, Fredericksburg, Va.  
Structural Design: Delta Engineers, P.C.

This project included approximately 127' of 32' span x 24'-2" rise and 200' of 32' span x 21'-8" rise tunnel. A total of 68 segments were cast, each as two 3-sided elements with a center joint. Elements weighed 28.5 tons each. The completed structure was graded and paved inside and contained a cast-in-place barrier wall.



**Bottom 3-sided unit being set into position.**

*Please send us your project photos to be featured here*

Delta Engineers, P.C.  
164 Court Street  
Binghamton, New York 13901

ADDRESS CORRECTION REQUESTED

«FirstName» «LastName»  
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