

May 19, 2011

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NEESR

Subject: Anchor Design Examples (PCI vs. MathCAD)

Dear Dr. Zhao:

I have tested the PCI-MathCAD design tool to 4 problems given in the PCI Design Handbook. The program appears to be identical to the PCI solution as presented in Part I of this report. Part II presents the differences in their results using problem 8 from ACI 355 design samples. I am now trying to understand Euro Code. Thank you.

Sincerely,

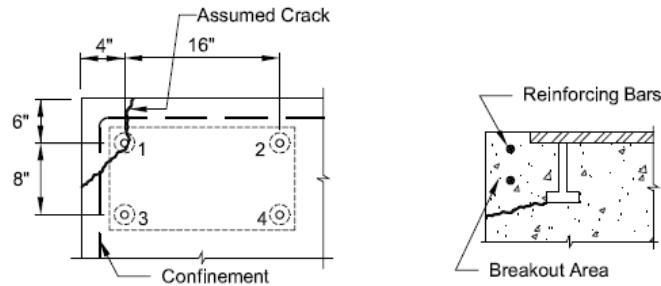
Aquilino O. Dael
BSCE-Structural

PART I. PCI vs. MathCAD

Example 6.5.4.1 Tension Strength of Stud Groups

Given:

A flush-mounted base plate with four headed studs embedded in a corner of a 24 in. thick foundation slab.
 4 – ¾ in. diameter headed studs welded to ½ in. thick plate.
 Nominal stud length = 8 in.
 $f'_c = 4000$ psi (normal weight concrete)
 $f_y = 60,000$ psi

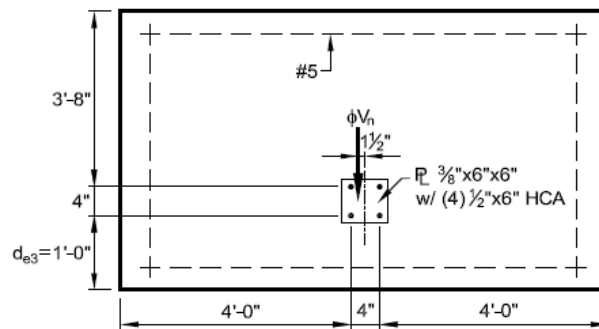


Mode of Failure in Tension	PCI 6 th ed (kip)	MathCAD 14 (kip)
Steel	85.8	85.8
Concrete Breakout	37.2	37.2
Concrete Pullout	99.1	99.1
Side-Face Blowout	NA	52.0

Example 6.5.5.1 Headed Concrete Anchor Front Edge Failure Mode

Given:

Plate with headed studs as shown, placed in a position where cracking is unlikely. The 8 in. thick panel has a 28-day concrete strength of 5000 psi. The plate is loaded with an eccentricity of 1½ in. from the centerline of the stud group. The panel has #5 confinement bars around the perimeter of the panel.

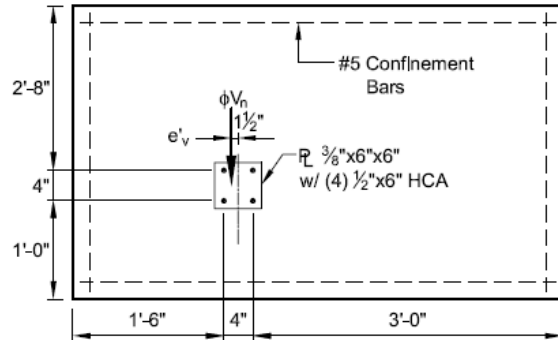


Mode of Failure in Shear	PCI 6 th ed. (kip)	MathCAD 14 (kip)
Steel Strength	33.8	33.8
Concrete Breakout	16.3	16.3
Concrete Pryout	Not calculated	36.9

Example 6.5.5.2
Headed Concrete Anchor Corner Failure Mode

Given:

Plate with headed studs as shown, placed in a position where cracking is unlikely. The 8 in. thick panel has a 28-day concrete strength of 5000 psi. The panel has #5 confinement bars around the perimeter. The plate is loaded with an eccentricity of 1½ in. from the centerline of the stud group.

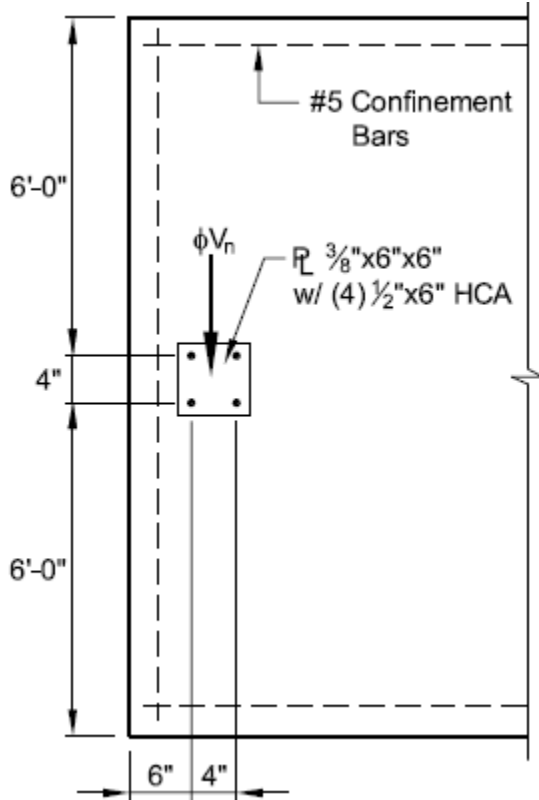


Mode of Failure in Shear	PCI 6 th ed. (kip)	MathCAD 14 (kip)
Steel Strength	33.8	33.8
Concrete Breakout	13.7	13.6
Concrete Pryout	Not calculated	36.9

Example 6.5.5.3
Headed Concrete Anchor Side Edge Failure Mode

Given:

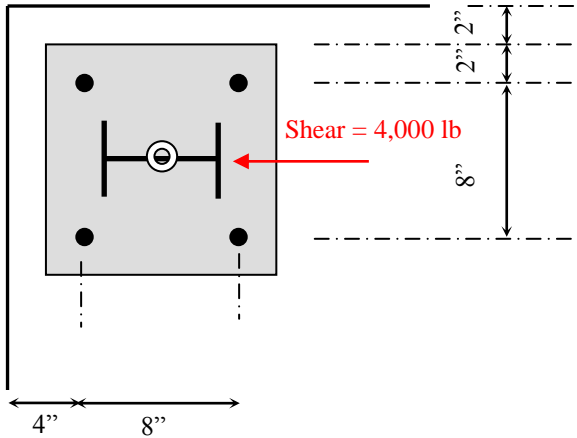
Headed Stud Plate as shown. The 8 in. thick reinforced concrete panel has a 28-day concrete strength of 5000 psi. The panel has #5 confinement bars around the perimeter. It is placed in a position where cracking is unlikely.



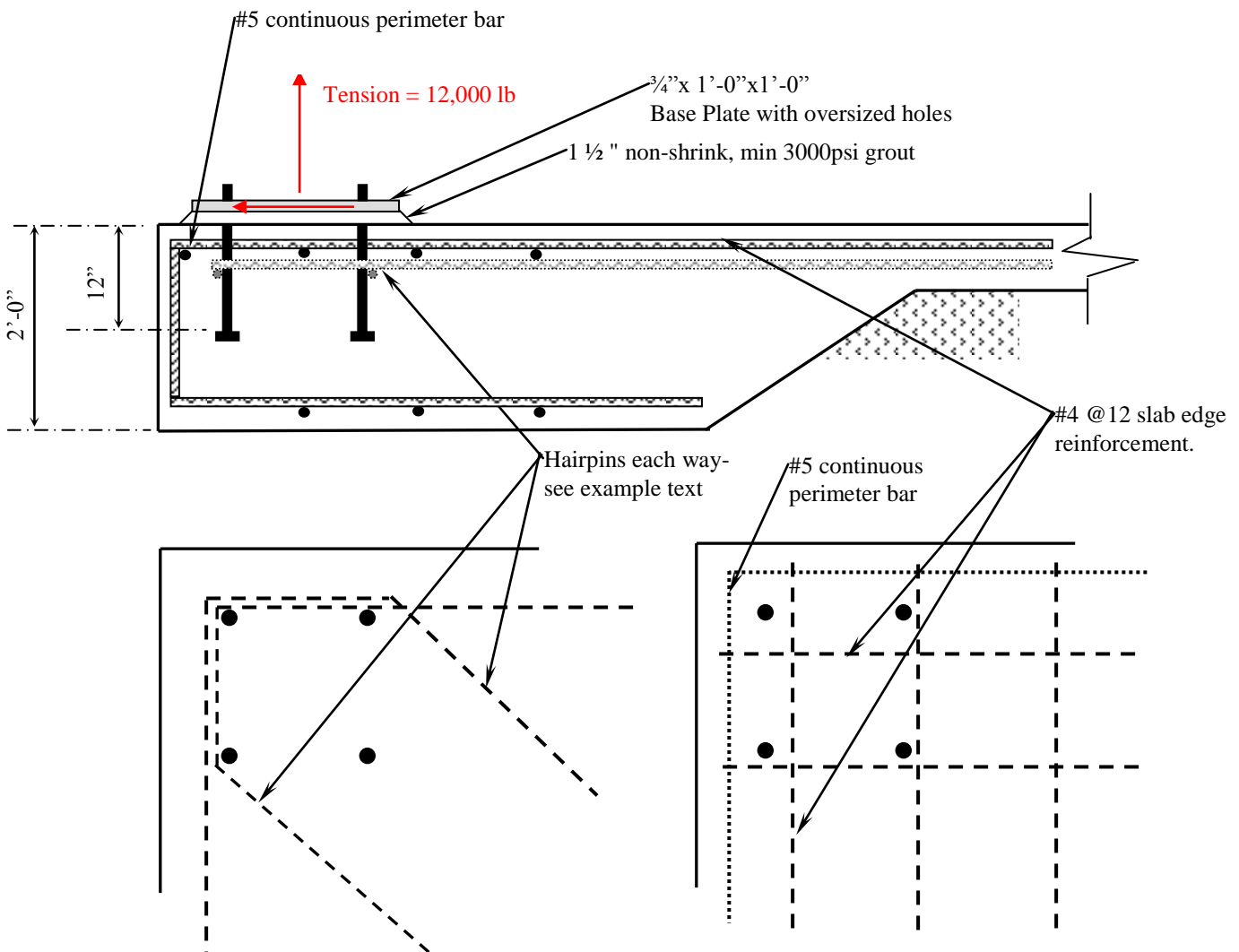
Mode of Failure in Shear	PCI 6 th ed. (kip)	MathCAD 14 (kip)
Steel Strength	33.8	33.8
Concrete Breakout	28.2	28.14
Concrete Pryout	Not calculated	36.9

PART II. ACI vs. PCI

Example 8 – Group of Anchors in Tension and Shear with Two Free Edges, and Supplemental Reinforcement



Check the capacity of a fastener group with four $\frac{3}{4}$ " diameter ASTM F1554 Grade 55 cast-in anchor rods embedded 12" using hex nuts into the 2'-0" thick, $f'_c = 3000$ thickened slab made of normal-weight concrete to support a factored shear of 4 kips shear and simultaneous uplift of 12 kips. The plate is symmetrically placed at the corner. Seismic forces are not a consideration. 60 ksi reinforcement.



SUMMARY AND COMPARISON				
Mode of Failure in Tension	ACI 355 (kip)	PCI 6 th ed. (kip)	Europe (kip)	New Zealand (kip)
Steel	75.150	75.15		
Concrete Breakout	20.550	27.247		
Concrete Pullout	43.950	65.923		
Side-Face Blowout	26.460	28.348		

SUMMARY AND COMPARISON				
Mode of Failure in Shear	ACI 355 (kip)	PCI 6 th ed. (kip)	Europe (kip)	New Zealand (kip)
Steel Strength	31.280	65.13		
Concrete Breakout	4.890	12.928		
Concrete Pryout	41.000	69.946		

