PMSTPCOL PEmails

From: Tonacci, Mark
Sent: Thursday, February 24, 2011 6:57 AM
To: Akstulewicz, Frank
Cc: STPCOL
Subject: FW: beam shear
Attachments: Beam Shear 02223011.doc

Frank – here is the last issue for escalation from STP.

Mark

From: Head, Scott [mailto:smhead@STPEGS.COM]
Sent: Wednesday, February 23, 2011 6:35 PM
To: Tai, Tom; Tonacci, Mark; Wunder, George
Subject: FW: beam shear

Mark

Here is the last one.

Thanks

Scott

Hearing Identifier: SouthTexas34Public_EX
Email Number: 2649

Mail Envelope Properties (E09C30551FD42442BA284ECF9858105F950E09B029)

Subject: FW: beam shear
Sent Date: 2/24/2011 6:56:34 AM
Received Date: 2/24/2011 6:56:35 AM
From: Tonacci, Mark

Created By: Mark.Tonacci@nrc.gov

Recipients:
"STPCOL" <STP.COL@nrc.gov>
Tracking Status: None
"Akstulewicz, Frank" <Frank.Akstulewicz@nrc.gov>
Tracking Status: None

Post Office: HQCLSTR02.nrc.gov

Files	**Size**	**Date & Time**
MESSAGE	315	2/24/2011 6:56:35 AM
Beam Shear 02223011.doc	35906	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

The NRC Staff has indicated that it will issue the following new RAI:

> The internal forces used to determine the required strength of the structural members are generated with the help of SAP2000 models. These forces are subsequently post-processed to verify the sections and specify the concrete reinforcement. By referencing ACI 349-97, Section 11.12, "Special provisions for walls", in- and out of plane shears are averaged along selected cut lines. Staff did not agree with the code interpretation and requests STP to provide technical basis for not performing the concrete strength calculations based on design strips which envelope the member forces instead of averaging them.

The following is a brief discussion of why the applicant's approach for beam shear design is acceptable.

- Per SRP 3.8.4, design of safety-related concrete structures other than containment shall be in accordance with ACI 349-97 code with supplementary guidance by Regulatory Guide (RG) 1.142. However, the SAP2000 models mentioned in the RAI are finite element analysis models. Neither the SRP 3.8.4 nor RG 1.142 provides any guidance on design of concrete structures using finite element analysis.

- ACI 349-97 and its parent code ACI 318-89 revised 1992 also do not provide any explicit guidelines for beam shear design when designs are based on finite element analysis.

- The code provisions for shear are provided in Section 11 of the ACI 349-97 with special provisions for slabs and footings noted in Section 11.12. The following is noted in Section 11.12 of the ACI 349-97:

  > **11.12—Special provisions for slabs and footings**
  >
  > **11.12.1** The shear strength of slabs and footings in the vicinity of columns, concentrated loads **or reactions** is governed by the more severe of two conditions:
  >
  > **11.12.1.1** Beam action where each critical section to be investigated **extends in a plane across the entire width**. For beam action the slab or footing shall be designed in accordance with 11.1 through 11.5.

  Shear at the supports are the reactions to the applied loads, thus per Section 11.12.1, provisions of Section 11.12.1.1 are applicable. Based on Section 11.12.1.1 the design of walls and slabs for beam shear are performed using the average beam shear across the entire width of the supports. The resulting design capacity of the wall is sufficient to carry the entire shear load with all applicable safety margins.

- Whenever finite element analysis is used, even for simple two way slabs or walls, the calculated beam shear along the supports will not be uniform. Depending on the aspect

ratio of the slab or wall and support boundary conditions, the beam shear at one location of the support can be significantly higher than the beam shear at other locations of the same support.

- The current industry practice for design of slabs and footings based on the ACI code provisions is based on average beam shear along the entire support length. Analysis of any such designs using finite element analysis will show uneven beam shear distribution along the supports, yet these designs have proven to be safe. This point is demonstrated by comparing analysis results from finite element analysis for a uniformly loaded flat slab with those from manual calculations presented in an example problem in one of the most widely used concrete design textbooks by Salmon and Wang. The beam shear from the finite element analysis at the critical section is more than 3 times the average beam shear. The textbook solution uses the average beam shear for design of the slab.

If the NRC staff's position is, as implied by the RAI, that the beam shear design must vary along the wall length to account for variation in beam shear along the supports, the result would be redistribution of shear ties and possibly the addition of more reinforcement. This would increase rebar congestion and the risk of inadequate concrete placement and degraded concrete quality without any compensating safety benefit.

Conclusion:

Our approach for beam shear design based on average of the beam shear across the entire length of the support meets ACI 349-97 code, R.G. 1.142,and SRP 3.8.4 requirements, and is consistent with industry practice. .

Schedule Impact:

Implementation of the approach requested by the staff for all affected site-specific structures will require significant effort with duration of about 12 to 16 weeks.