PMTurkeyCOLPEm Resource

From: Franzone, Steve <Steve.Franzone@fpl.com>
Sent: Wednesday, March 30, 2016 12:16 PM
To: McKirgan, John
Cc: Comar, Manny; TurkeyCOL Resource
Subject: [External_Sender] FW: TP Audit Summary - March 30th, 2016
Attachments: Turkey Point Audit Summary.docx

Per Manny's request.

Thanks to you and your staff.
Steve Franzone
NNP Licensing Manager - COLA
"Opportunities are usually disguised as hard work, so most people don't recognize them." ~ Ann Landers
561.904.3793 (office)
754.204.5996 (cell)

From: vaughn thomas [mailto:vaughnvt@hotmail.com]
Sent: Wednesday, March 30, 2016 11:43 AM
To: sicariam@westinghouse.com; Franzone, Steve
Subject: TP Audit Summary - March 30th, 2016

Hearing Identifier: TurkeyPoint_COL_Public
Email Number: 1148

Mail Envelope Properties (DEC707C5CF603B4AA6194131A65C7C525A22A24D)

Subject: [External_Sender] FW: TP Audit Summary - March 30th, 2016
Sent Date: 3/30/2016 12:15:57 PM
Received Date: 3/30/2016 12:16:07 PM
From: Franzone, Steve

Created By: Steve.Franzone@fpl.com

Recipients:
"Comar, Manny" <Manny.Comar@nrc.gov>
Tracking Status: None
"TurkeyCOL Resource" <TurkeyCOL.Resource@nrc.gov>
Tracking Status: None
"McKirgan, John" <John.McKirgan@nrc.gov>
Tracking Status: None

Post Office: GOXSA1810.fplu.fpl.com

Files	**Size**	**Date & Time**
MESSAGE	1236	3/30/2016 12:16:07 PM
Turkey Point Audit Summary.docx	22470	

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

Turkey Point Audit Summary
March 30th, 2016

Q1. FEM Validation

This morning we continued to discuss the finite element model used by the applicant to support their application. Of the items discussed included:

(i) The boundary conditions imposed on the model (**Resolved**)
We discussed the appropriateness of fixing the boundary at the basemat, instead of at the ground level. Issue of passive soil pressure effects were discussed. The applicant agreed to look into it to assess its influence. The applicant presented the maximum displacement for an edge impact for Case 2W, showing it's much smaller than the displacements induced by passive soil pressure load. Accordingly, the fixed base boundary condition used in the FEM is conservative, thus, acceptable.

(ii) Shear stress distribution function (**Resolved**)
The NRC staff requested FEM output on the function. The applicant agreed to provide plots of shear stress distributions along the support for edge and corner impacts. The applicant presented a plot on shear stress distribution for the case 2W. Although the peak of 143 psi exceeds the allowable 112.77 psi, the average stress over the effective length amounts to only 88.76 psi <112.77 psi. Thus, this issue is resolved.

(iii) Test cases using the FEM Program (**Open**)
The applicant discussed the use of SC beam testing performed at Purdue University to bench mark the FEM they developed. The NRC staff, however, considered this not too close to our case under consideration. The Staff provided a paper documenting a test program similar to our case. The staff thus recommended to perform a test case of the ABAQUS FEM against the test data presented in the paper. The reason for the staff recommendations is as follows:

> The wall response caused by corner and edge impacts from the design hurricane auto missile are developed using the ABAQUS computer code that incorporates shell elements capable of modeling the discrete reinforcing pattern within the finite element formulation. These analyses are intended to provide a description of the load transfer from the impacting time history force to the wall and supporting structure.
>
> As part of the benchmarking process, the applicant compared the predicted response of tests performed on beam elements to analytical results computed using ABAQUS and the elements (and associated options) that were used in the evaluation of the edge and corner impacts described above. It is not clear to the staff that the behavior of the elements, which represent beam behavior of the test results well, will conservatively/adequately represent the behavior of slabs loaded by a concentrated force near support points.

Test data developed at Delft University (ref. Lantsoght, E. 2013) for conditions very similar to the wall configuration of the Auxiliary building have recently been made available. Since the stress state in slabs are generally different than those seen in beams and there is a question as to whether the element will predict accurate or conservative responses there is the need to perform a validation check of the FEM model and selected element to confirm that the observed behavior seen in the tests are well represented.

The applicant agreed to demonstrate the applicability of the selected element type to represent the behavior of concentrated forces applied to walls near their supports by comparing analyses results to test data for a selected test specimen from Reference 3. The test specimen selected is S11 with a load place at the center of the slab dimension b (mid edge impact) shown in Figure 2 of Ref. 3. The a/d value, dimensions and materials should be consistent with Table 2 for test S11. Required results are the comparison of analytical ultimate load to test value. Additionally, the distribution of shear (kip) across the beam near the support (~d/2 from face of support) shall be provided and compared to the distribution of shear predicted from a linear elastic model of the system. These distributions will be consistent with the time of the ultimate load. A comparison of stress of the integrated over the b dimension between the elastic and non-linear models will be provided. Ultimate load will be associated with the point where additional displacement of the slab does not correspond to a significant increase in applied load. A COV of +/- 30% in the comparison of analytical results to test data is consistent with the COV indicated in the test literature and will be used to assess acceptability of results.

The tests of interest are described in the following references:

1. Lantsoght, E., van der Veen, C., Walraven J, “Shear in one-way slabs under concentrated load close to support”, ACI Structural Journal, 110-S24
2. Lantsoght, E “Shear in one-way slabs under concentrated load close to support”, PhD Dissertation, Technische Universiteit Delft, 14 June 2013
3. Lantsoght, E., “Shear tests of reinforced concrete slabs and slab strips under concentrated loads”, 9th fib International PhD Symposium in Civil Engineering, July 2012

Q2. This issue is closed because the applicant stated that DLF is not used in its analysis.
Action: applicant to update RAI 6544 – TPG-GW-GLR-002 accordingly.

Q3. This issue is closed because the applicant agreed to remove Table 5, “DLFs of Critical Exterior Walls,” in its response to staff RAI (RAI 6544 – TPG-GW-GLR-002). Action: Applicant to provide a draft markup that reflects the change.

Q4. This issue is closed because the applicant explained the dimensions, the boundary conditions, and the frequencies of the walls in its calculation (TPG-1000-CCC-001, Rev 1).

Q5. The applicant agreed to include the 2 additional walls (4W and 5W) as described in APP-GW-GLR-133. Action: If the results are found to be bounded by the other 5 walls already evaluated by hand calculations, no further actions are required. Applicant to provide the draft results.

Q6. The statement, "One-way shear does not govern in edge and corner impacts," is open. Action: the applicant to demonstrate the cases where one-way shear does not govern using the test case results from Q1.

Q7. The applicant confirmed that beam support element was included in the model. The plot used the line to represent beam element; but the off-set was taken into account in the computations. So this issue is resolved.

Q8. Table B-1 of the Report, Column 4 for one-way by hand calculation used DFL = 1, inconsistent with the ACI code spec based on "equivalent static" approach. Confirmatory Item: The applicant committed to revise Table B-1, TPG-GW-GLR-002 to show consistent comparisons.

Q9. Action: The applicant to demonstrate how the damage indices; and the relationship between damage indices and distribution of shear reaction from the shear stress distributions on 2 cases (1 case for one-way and another for two-way) are defined using the test case results from Q1.

Q10 The Wind load Vwind Evaluation issue is resolved because the applicant agreed to use the Importance Factor of 1.15 used by the DCD in the wind pressure equation as specified in ASCE 7. As a result, the applicant agreed to update its calculation (TPG-1000-CCC-001) to reflect the change for walls in RAI 6544 – TPG-GW-GLR-002 in addition to walls 4W and 5W in APP-GW-GLR-133. This issue is status as a Confirmatory Item.

Q11. The applicant demonstrated the the Vmissile can be divided by the entire wall area by using the one-way beam action. Thus, this issue is resolved based on the specification in Section 11.12.1.1 of ACI 349-01.

Q12. The applicant successfully defined the maximum load Rm and how it was calculated. Section 5.1.8, "Allowable Ductility with Flexure – Automobile Missile," Table 5-6, "Ductility of Walls due to Automobile Impact," of the applicant's calculation TPG-1000-CCC-001 adequately address the flexure ductility of the walls.

Action: Applicant to confirm the shear ductility factor and the elastic regime using test case results from Q1.

Q13. This issue is resolved because the applicant explained that the equation (Vu = Rm/ (2L or 2W)) is applicable when the load is applied at the center of the beam based on the simply-supported beam theory.

Q14. The applicant stated that DLF is not used in its analysis, thus the equation (Vu = (V_{wind} + $V_{missile}$)/ (2L or 2W)) is valid. As a result, this issue is resolved.

Q15. The applicant stated that DLF is not used in its analysis. Therefore, this issue is resolved.

Q16. This issue is resolved because Table 5-4, “Wall Properties,” of the applicant’s calculation (TPG-1000-CCC-001) showed the values of b_0/d used to calculate the punch shear capacity for the walls.

Q17. Shear stress calculations using effective width: The applicant provided a plot of the shear stress distribution along the beam width for the edge impact at 2W. Although the peak of 142 psi exceeds the allowable 112.77 psi, the averaged stress over the effective width amounts to only 88 psi. Thus, this issue is resolved.

Q18. Action: The applicant to provide basis for the shear ductility factors showing the stress state; and it remains in the elastic range using the test case results from Q1.

Q19. Action: The applicant to determine the ultimate one-way and two-way shear capacity and show the stress state using test case results from Q1.