

ACI SUBCOMMITTEE 350-F – SEISMIC PROVISIONS
MINUTES OF MEETING

March 23, 2010 – Chicago, IL

<u>ATTENDANCE:</u>	
<u>MEMBERS</u> Andrew Minogue Reza Kianoush Larry Tabat Rolf Pawski Sanjay Mehta Risto Protic Carl Gentry Tony Galterio Ramon Lucero Bill Sherman Chuen-Shiow Chen	<u>ASSOCIATE MEMBERS</u> Karl Kuebitz Kevin Monroe Atis Liepens Victor Pavon Manny Sinha <u>CONSULTING MEMBERS</u> <u>OTHER 350 MEMBERS</u> Satish Sachdev Sal Marques <u>VISITORS</u> Nazar Sabti

1. CALL TO ORDER

- A. Agenda Approved
- B. Minutes of New Orleans Meeting of November 10, 2009 Approved
- C. Correspondence & General Announcements

2. UNFINISHED BUSINESS

- A. Seismic provisions of pedestal tanks (Pawski, Munshi, Mehta and Kianoush).
 - Rolf provided a presentation on pedestal tanks.
 - Looked at effects of sloshing of pedestal tanks.
 - Rolf will provide a proposal on pedestal tanks for the Pittsburgh convention.
- B. Report from Task Group (Kuebitz, Kianoush, Munshi and Mehta) on Resolution of negatives on the Subcommittee Letter Ballot 350-F-09-01 that closed on 6-16-09. Slosh Equations- Ballot Items 35030-f-0-131-Chapter 7 Code and 35003-f-0-132 Chapter 7 Commentary.
 - See attached correspondence regarding sloshing.
 - For corners of tanks, there is an increase in sloshing from Reza's research. Proposed wording for commentary will be presented by Reza and will be sent out for balloting.
 - Motion to leave equations for rectangular and circular sections but change "but need not exceed" to "in lieu the simplified equation (7-1), dmax may be calculated using equation (7-2)." for rectangular tanks and "but need not exceed" to "in lieu

the simplified equation (7-3), d_{max} may be calculated using equation (7-4).” For circular tanks. “I” will be added to equations 7-2 and 7-4. **Motion Passed.**

- Revise R7.1 Commentary to the following... “Two sets of equations are provided to calculate the vertical displacement of the fluid surface. Equations (7-1) and (7-3) are a simplified and conservative approach consistent with ASCE/SEI 7 (2005). Equations (7-2) and (7-4) are taken from TID-7024 (see Chapter 10, References) including the corrected Appendix F which addresses an integration error in the published θ_h equation for cylindrical containers. The variable θ_h , defined in TID-7024, is equivalent to C_c as defined in this document.” **Motion Passed.**
- Karl and the Task Group will address site specific and importance factor for sloshing. After discussion, removal of importance factor from sloshing equations should be prepared as a code change. Also add note in code change - For application of importance factor on sloshing height/freeboard, refer to governing building code

C. Resolution of negatives on the main Committee Letter Ballot 350- 09-05 that closed on 8-10-09 (2 ballot items, 7 and 8).

Main Committee Ballot 09-05

ITEM #7

- Negative from Lucero – **Resolved in New Orleans** – “The proposed change is to modify C_t for both the main portion of the code (chapter 9) and Appendix B. I have no objections with the propose change in the main body of the code ($C_t = C_i$); however, the proposed change in the Appendix does not correlate to the proposed change in the main body of the code. The proposed change to C_t in Appendix B does not reflect the decrease in the vertical acceleration of the structure beyond T_s . I would suggest either modifying the C_t equation in Appendix B to correlate to the one in section 9 of the code ($C_t = C_i$) and/or modify the equation in section 9 to read “ $C_t=S_d s$ ” for rectangular tanks. As a separate item, has any one performed a parametric study on rectangular tanks to determine if their vertical period would merit a reduction in the applied seismic force, and/or will it be the same result as the circular tank, which we concluded that the vertical period is always in the short range?” Negative Persuasive. Proposal - Revise Appendix B to be “ $C_t = C_i$ ” for Equation B-14. Motion Passed.
- Editorial from Cunningham. – **Resolved in New Orleans** Persuasive. Motion Passed
- Negative from McCarthy – “I am informed that the original proposal discussed in Seismic subcommittee included modifications to both rectangular and circular tanks.

The current proposal does not address the rectangular tank. In other words, vertical acceleration response coefficients for circular tanks using Appendix B would be much higher than the rectangular tank, if the proposed changes are accepted. It is necessary to know the reasons for this difference. Did parametric study for rectangular tanks use the same methods and assumptions as parametric study for circular tank? Did both studies use the same response spectrum? If not, then the proposal should be withheld /revised until both studies use the same benchmarks.” Negative is withdrawn by McCarthy by phone since this was addressed by the additional ballot.

ITEM #8

- Editorial from Cunningham. “Since equation (9-40) is deleted, remainder require renumbering.” Persuasive. Motion Passed
- Editorial from Cunningham. “Revise Section R9.4.3 to read as follows” implies that the current second paragraph is deleted because it’s not included in what follows. It should not be deleted. **Non-persuasive.** Motion Passed
- Negative from Cunningham. “Just prior to Equation (9-43)...delete “Tv” in the phrase ‘For all periods, Tv’”. The result of this change might not make sense since, for example, Tc and Ti are also periods. Even if it’s not technically incorrect, the result is awkward. Since Ci corresponds to Ti, Cc corresponds to Tc, and Tv corresponds to Ct” (per R9.4), it isn’t necessary to include “For all periods, Ti, Tc, or Tv” for any of Ci, Cc, and Ct. Therefore, delete: “For all periods, Ti”, “For all periods, Tc”, and “For all periods, Tv”. Equations (9-41), (9-42), and (9-43) do not require such (non-qualifying) statements preceding them. If it is felt that it needs to be clear that the equations apply for all periods, add a single statement preceding the three equations which would be: “For all periods:” **Persuasive** – Revise the following sentence in 9.5 as follows: “The seismic response coefficients **C_i**, **C_c**, and **C_t** shall be determined from Eq. (9-41), (9-42), and (9-43), respectively, for all periods.” Motion Passed.
- Negative from McCarthy – “I am informed that the original proposal discussed in Seismic subcommittee included modifications to both rectangular and circular tanks. The current proposal does not address the rectangular tank. In other words, vertical acceleration response coefficients for circular tanks using Appendix B would be much higher than the rectangular tank, if the proposed changes are accepted. It is necessary to know the reasons for this difference. Did parametric study for rectangular tanks use the same methods and assumptions as parametric study for circular tank? Did both studies use the same response spectrum? If not, then the

proposal should be withheld /revised until both studies use the same benchmarks.”

Negative is withdrawn by McCarthy by phone since this was addressed by the additional ballot.

- Negative from Lucero – “In the last paragraph of the proposed change to section 9.5, we have deleted the reference to site specific vertical response spectrums when available. Please note that it is possible for the site specific vertical response spectral acceleration to be larger than that of the horizontal site specific response spectrum acceleration. Therefore, I would propose not deleting this sentence from section 9.5, and modifying the second to last sentence of the proposed paragraph as follows: “...response acceleration corresponding to T_i . When a 5% damped, site-specific vertical response spectrum is available, S_{aM} shall be determined from that spectrum for all periods, as required for periods less than T_s . For” Similarly in Appendix B, Section B.4, I would recommend modifying the last sentence of the proposed change as follows: “When a 5% damped, site-specific vertical response spectrum is available, C_t shall be determined from that spectrum for all periods, as required for periods less than T_s .” **Persuasive**. Revise as follows:

In Section **9.5**, revise the second paragraph to read as follows:

“For periods less than or equal to T_s , S_{aM} shall be taken as the spectral acceleration obtained from the site-specific spectra at a period of 0.2 seconds, except that it shall not be taken less than 90% of the peak spectral acceleration at any period larger than 0.2 seconds. For periods greater than T_s , S_{aM} shall be taken as the spectral response acceleration corresponding to T_i . When a 5% damped, site-specific vertical response spectrum is available, S_{aM} in equation (9-43) shall be determined from that spectrum as required for periods less than T_s . For vertical acceleration at-of circular tanks, for all periods S_{aM} shall be as required for periods less than T_s . For rectangular tanks, C_t shall be determined in accordance with Section 9.4.3.”

In **Appendix B**, Section **B.4**, replace the first paragraph with the following:

“When site-specific procedures are used, the design response spectrum shall be determined as follows:

For periods less than or equal to T_s , C_i shall be taken as the spectral acceleration obtained from the site-specific spectra at a period of 0.2 seconds, except that it shall not be less than 90% of the peak spectral acceleration at any period greater than 0.2 seconds. For periods greater than T_s , C_i shall be taken as the spectral response acceleration corresponding to T_i from the 5% damped site-specific spectrum. C_c shall be taken as the spectral response acceleration corresponding to T_c from a 0.5% damped site-specific spectrum or as 150% of the spectral response acceleration corresponding to T_c from the 5% damped site-specific spectrum. ~~C_t shall be determined in accordance with Section B.3. When a 5% damped, site-specific vertical response spectrum is available, C_t shall be determined from that spectrum as required for periods less than T_s .~~ For vertical acceleration of circular tanks, for all periods C_t shall be as required for periods less than T_s . For rectangular tanks, C_t shall be determined in accordance with Section B.3.”

Ramon will develop a code change proposal to add S_{avM} .

3. NEW BUSINESS

A. Distribution of convective pressure (Sherman)

Revisited Negative from Sanjay on Item #1 on Subcommittee Letter Ballot 350-F-09-03 that closed on 10-22-09 (4 ballot items).

ITEM #1

Negative from Sanjay – “It is much better to just insert ≥ 0 at the end of equation for PCY in Fig R5.3.3. Re-writing the equation as suggested changes the distribution of convective forces along the wall; and in many cases of practical importance, it gives much higher value of convective hoop stress at the top of the wall as compared to both actual equation and current approximation in ACI 350.3.” Negative found persuasive. Motion Passed Fig R5.3.3 will add the ≥ 0 to resolve the negative.

This will be deferred to New Business. A task group of Reza and Kevin will look into running examples for the linear approximation to come up with a proposed equation.

In addition, the parabolic equations will be provided in 350.3.

B. Response modification factor for multi-cell tanks (Sherman)

Bill Sherman will come up with a code proposal change on R-factors for interior walls that are not exposed to soil. Also need to define what “buried” is for R-values.

C. Future Code changes

Carl will work on Multi-Cell tanks for 350.3. A task group (Carl, Kevin and Chuen-Shiow) was formed to prepare an outline for discussion at the next meeting.

4. LIAISON REPORTS

A. ASCE and BSSC (Munshi)

Javeed was not present at the meeting at the time of the liaison report.

5. COMMITTEE REPORT TO MAIN COMMITTEE

A. Identify information to be reported during Wednesday’s Full Committee Meeting

6. ADJOURN

Andrew Minogue