March 2, 2016

Ms. Kate Thompson
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Texas Department of Insurance
333 Guadalupe Street | Austin, Texas 78701

Dear Kate,
Below are my notes and comments/suggestions as a result of my review of TDI Expert Panel Report entitled "A Proposed Methodology for Estimating Wind Damage to Residential Slab-Only Claims Resulting from a Hurricane Impacting the Texas Coastline". The Draft Report is generally good and in the right direction. I however have some questions, suggestions and comments on it.

1. It is stated in the Executive Summary and Introduction, "The purpose of the Panel is to advise TWIA concerning the extent to which a loss to insurable property was incurred as a result of wind, waves, tidal surges, or rising waters not caused by waves or surges" (Pages 1-1 and 2-1). However, it is not clear if the present report addresses this purpose. Specifically, the current report does not address loss due to waves, and rising waters not caused by waves and surge. Moreover, for a "slab" or "slab-only" claim, it is not clear how the claim is attributed to wind damages, surge or both. That is if after a storm passes, a residential building has collapsed and "washed away" for a slab-only claim, how much of the total loss is due to wind and how much of it is due to surge. Similarly, if the Damage Estimation Module (DEM) results in collapse and 100% loss due to wind and also results in collapse and 100% loss due to surge, then how the loss is paid by the possibly two policies (one for wind damage and one for surge/flood damage), knowing the total loss payments should be a maximum of 100% of replacement value of the residential building. If the report is not intended to do this attribution of losses to various storm hazard parameters (wind, waves, tidal surge, or raisin waters not caused by waves or surges), then the purpose statement need to be revised to clearly say what the purpose of the report is.
2. The report says TWIA or its insurance adjustment professionals are able to use the percent damage estimates to determine financial losses and insurance policy payouts Page 1-1. However, the report does not provide guidance how best this is done.
3. Although "Section 3 Overall Methodology" indicates that Hazard Module includes operational activities that yield significant wave height and wave period at each property (Page 3-1), DEM does not provide how such storm characteristics are used to estimate damage and losses due to waves, and how wave period is used.
4. The Overall Methodology Flowchart on Page 3-4 indicates that economic loss module includes interior & Content Loss. As indicated in Section 8 "Economic Loss Module", estimating contents losses based on the building damage obtained from the damage estimation module is difficult and the current report does not explicitly addresses this

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effort. It is suggested to revise the flowchart and even the report title to indicate that this report address residential "building" damage and losses.

5. As stated in Section 4 Hazard Module – Wind, the two main components of Hazard Module are a hurricane wind field model and storm surge and wave model. This indicates that the damage estimates are given for both storm surge and wave together and not separately. So as stated in above point 1, the purpose statement should be revised to indicate this.
6. In Figure 4-2 on Page 4-3, the scale on the horizontal axis should be shown. At least two dates or hours should be shown.
7. It is stated that the Panel recommends that TWIA procure a contract with a private firm, a university, a government agency, or some partnership thereof to provide the hazard time histories (Page 4-6). This indicates that this part of model/methodology has not been developed. However, Section 1 Executive Summary, Section 6 Damage Estimation Module and Section 7 Validation of Methodology indicate/imply that the proposed methodology has a Hazard Module that provides information about the wind speed, wind direction, storm surge height, waive height (and wave period?) along with their time histories. This indicates that the report is partly a project plan and has components that yet need to be developed. However, the wind damage estimation module has been developed and presented.
8. The Panel also recommends that TWIA commission between 40 and 60 mobile platforms to increase the volume and resolution of the potential measurements (Page 4-7). Again this is yet another component that needs to be developed. In addition on Page 5-3 it is stated that TWIA must set up contractual arrangements to rapidly model waves and surge post-evets. Furthermore, on Page 5-5, TWIA must make arrangements for coordination with Federal and state agencies that take data (physical measurements of waves and surge data), and should ensure that plans are in place for physical measurements either by other parties or as contracted by TWIA.
9. Based on the above bullets 7 and 8, this reviewer recommends to have a separate section or as part of Section 1 Introduction to develop a Project Plan and a flowchart indicating the various significant project activities envisioned and indicate which ones are addressed by this report and which ones need yet to be developed.
10. The variability and uncertainty in physical measurements of wind speed and direction (Page 4-6 Subsection 4.3 Physical Measurements of Wind) and waves and surge and heights and other characteristics (Pages 5-5 and 5-6, Subsection 5.3 Physical Measurements of Waves and Surge) should be addressed when calibrating and validating models or establishing estimates of the errors in model results.
11. As stated in Section 5.4 Surge and Wave Computation and Observations (Page 5-6), one of the most important aspects of claims adjustment for slab cases is the determination of weather slabbing caused by wind or waves/surge. It should be noted, however, that slabbing in some cases could be caused by both wind and waves/surge. Regardless, the report does not provide a methodology to address these questions and situations.
12. The Report on Page 5-7 states that in concert with parallel methods to estimate the probability of wind slabbing, this (i.e., probability of waves/surge slabbing) will help to

determine the source of slabbing. The Report however does not provide procedure or methodology on how to determine the source of slabbing (see above bullet 11).

13. The Report recommends that TWIA compute the probability of slabbing for residential construction using "Varian 5 of the methodology of Tomiczek et al (Page 5-6). This reviewer does not have this reference and resources to review the said methodology and to comment on it at this time.
14. Section 6 Damage Estimation Module, in it's entirely, seems to address damage estimates for wind loading only. However, the opening sentence of this Section on Page 6-1 states that damage to a structure caused by wind and the surge (no mention of waves here) is estimated in this module. This needs to be revised accordingly. Or Section 6 needs to be expanded to include damage estimates for waves/surge too.
15. It seems the Damage Estimation Module does not address load redistribution when a component or parts of it fails.
16. The Damage Estimation Module does not explicitly address missile impact.
17. The last paragraph on Page 6-1 is vague and not clear. It says "The Damage Estimation Module Recommends a specific philosophy in computing damage for slab …cases: the wind damage used to compute losses should be that which is predicted to have occurred up to the time when the structure is likely to have been destroyed by waves and surge. Of course, if slabbing was caused by wind, then all of this damage will be wind damage. Similarly, if winds were low up to the time of surge destruction, then wind damage will have been very low." There are several comments and questions about this paragraph".
    a. I believe "The Damage Estimation Module recommends" should be replaced by "The Panel recommends".
    b. There is no rationale given as to why the panel recommends this philosophy.
    c. What is the recommendation as to when both the wind speeds and waves/surge are high such that each alone can cause the collapse of a building?
    d. There could also be the following situation: when waves and surge are high enough to destroy a building while the winds are low. Alternatively at a close by location a similar building might survive the high waves and surge (for example located on higher grounds), but is destroyed when the high winds arrive. One could argue that the first building would have been also collapsed due to high winds, had it survived the high waves and surge.
    e. The sentence "the wind used to compute losses should be that which is predicted to have occurred up to the time when the structure is likely to have been destroyed by waves and surge" is not clear.
18. What is the "maximum probability of collapse due to surge and waves" in the first bullet on Page 1? Also what is the "maximum probability of collapse due to wind"? Shouldn't the maximum be deleted?
19. If the model predicts that the above maximum probability of collapse due to surge and waves is let's say 0.050, and the maximum probability of collapse due to wind is let's say 0.051, then given all the approximations in the two models (i.e., wind collapse probability and waves and surge collapse probability) and the fact the two models may

have different tolerance and error bands on their estimates; is it fair to say the structure is considered to have collapsed due to wind?

20. The two bullets 1 and 2 on Pages 6-1 and 6-2 do not clearly relate to the preceding paragraph.
21. With regard to the flowchart given on Page 6-2 Figure 6-1, there are two comments/questions: How does one uses the component damage estimates to probability of wind or waves/surge slabbing? Also it seems that the lower dashed link from the dashed Damage Estimate for Building Components from Damage functions box on the right-hand-side to the lower solid box of Damage Estimate for Economic Loss Module.
22. As stated by the Panel, First-Order, Second-Moment, Mean Value (FOSM-MV) has its short coming and could cause erroneous results for nonlinear limit states and cases dealing with non-Gaussian random variables. First-Order Reliability Methods (FORMS) or other structural reliability methods should be used instead.
23. The bulleted list on Page 6-3 should correspond to Subsections 6.4.1 through 6.4.11. It seems Wall Stud Plate Connection, Roof-to-Wall Connection and Shear Wall Capacity are missing from this bulleted list. It is not clear in which subsection Roof Framing which is listed here is addressed.
24. It is not clear how the probabilities of failure of each of the components and structural systems computed by Eq. 6.3 are combined to compute probability of collapse for slob-only cases. For example how the probability of roof cover failure is related to probability of collapse?
25. How does the model address possible correlations among various random variables? Use of Eq. 6.4 clearly ignores correlations.
26. As indicted by the Report on Page 6-5 a component probability of failure is used as a proxy for damage rate. Then the Report provides a description of when this approximation is valid. If TWIA intends to use the presented methodology for settling claims on a case by case basis, this approximation is not valid. If the methodology is used by TWIA for portfolio loss estimation, then this approximation maybe valid.
27. The example on top of 6-6 seems to be problematic. I believe the on second line from the top, “10 of 100” should change to “9 of 100”.
28. Page 6-38 in Subsection 6.4.4 as indicated, the nailing pattern required by the WFCM is 6:12. Comparing this pattern with nailing pattern required for roof center field of the panel of 6:6, indicates a reduction of 50% in nailing and not 76% as stated there. “76%” should change to 50% and thus the Damage Estimation Module should use 70 psf instead of 106 psf.
29. On top of Page 6-42 it is stated that since wall heights below 10 ft. can use both SYP and SPF, the ultimate bending stress for #2 SYP and SPF are averaged and yield 4998 psi. Whereas I get the average of #2 SYP and SPF to be (1100+775)/2=937.5, and thus 1.84x2.54x937.5=4381.5 psi, instead of 4998 psi. I believe this should be corrected and the corresponding standard deviation of 2109 psi should also be corrected.

30. In second paragraph of Subsect 6.4.9, it seems there is a factor of 3 used to go from 155 lbs to arrive at 465 lbs. And similarly a factor of 3 is used to arrive from 138 to arrive at 414 lbs at the connection. This factor 3 needs to be explained and its basis given
31. On Page 6-43 second paragraph, the straight line equation of 101.46X+685.29, where X is the roof span to arrive at values given in Table 6-16 for various spans. I however calculate slightly different values when I use this equation. For example for 12 feet span I get 101.46(12)+685.29=1903 and for 36 feet span I get 4,338 lbs, which are different from 1908 and 4341, respectively. Either the linear equation needs to be modified or Table 6-16.
32. At the second to last row of Table 6-17, "See table 5-16" needs to be changed to "See Table 6-16".
33. Based on previous comments and suggestions, some of the entries in this Table, might need to be updated.
34. On page 6-55:
    a. The last sentence of the third paragraph needs to be changed to FEMA developed two formulas for calculating interior damages due to the roof covering and roof sheathing elements". That is to insert "interior" and "due" in this sentence.
    b. Similarly, the next paragraph should change to "The estimated interior loss caused by".
    c. Similarly, L_{rc} should be defined as "interior loss due to loss of roof cover"
35. On page 6-56:
    a. The condition for third line of definition of f_3 should change to $R_{rc} > 0.5$
    b. Generally the value of interior of the building V_1 is not a parameter that the insurance companies collect, and thus is not available.
    c. Similarly, L_s should be defined as "interior loss due to loss of roof sheathing"
    d. Generally the value of roof framing V_{rf} is not a parameter that the insurance companies collect, and thus is not available.
    e. The sentence above current Eq. 6-15 should change to "The estimated interior loss caused by broken windows and doors is"
    f. Eq.6-15 has a missing V_1
    g. Similarly, L_w should be defined as "interior loss due to loss of windows and door glazing"
    h.
36. On top of Page 6-57:
    a. the paragraph should start with "The HAZUS interior loss due to windows door damage is a function of …"
    b. The last sentence paragraph should change to "The total interior loss is the sum of:$L_{rc} + L_s + L_w \leq V_1$ (the total value of interior)
37. Comparing the results given for properties located in Florida (Tables 7-2 through 7-10) with those given for properties located in Texas (Tables 7-12 through 7-20), the proposed model gives the same model damage estimates for this two sets of properties located in Florida and Texas. It known the properties in Florida, especially those located

further in south Florida, in average are better from those located in coastal locations in Texas. I believe the model should produce results way different for these two regions.

38. There seems to be a mistake in the entries in row for "85-90" in Table 7-12. If the number of damaged is 0, then entries for AVG D should be 0.0 too not 15.0. Similar situation for STDEV. If the given values for AVG D and STDEV D are correct, then value for N Damaged should be non-zero.
39. Damage and loss due to rising waters not caused by waves or surges was never addressed as addressed.
40. The reviewer observed a number of typos and inconsistencies. A partial list is given here. It is not guaranteed that this reviewer has found all of these in his review. It is the responsibility of the Panel to find all such typos and inconsistencies and remove them from the Final report:
    a. Page 4-2 Figure 4-1, in the bottom box, "Estimation" is misspelled.
    b. There seems to be a missing Eq. number on top of page 6-5 for the direction cosines. This equation should be (Eq. 6.5), which has been referenced numerously later in this Section 6.
    c. The equation number on bottom of Page 6-6 should change to (Eq. 6.6).
    d. On page 6-7 (and elsewhere) change the "exposure coefficient" for K_z to "velocity pressure exposure coefficient" to be consistent with ASCE 7-10.
    e. The equation number "(Eq. 5.7)" on top of Page 6-7 should change to "(Eq. 6.7)"
    f. The equation on top of Page 6-7 is missing z_g in the inequality condition given on the right-hand-side. The value of this variable is listed in Table 6-1 on Page 6-8.
    g. In the last paragraph on Page 6-7, change "exposure factor" to "velocity pressure exposure coefficient".
    h. In Table 6-1 on Page 6-8, in Column Nominal, "Equation 7" should change to Eq. "6.7"
    i. Include "()" and change Eq. 6.8 in the following manner to match ASCE 7-10 Equation 30.4-1:
    $$p = q_h[(GC_p) - (GC_{pi})]$$
    j. Include "()" and change Eq. 6.9 in the following manner to match ASCE 7-10 Equation 27.4-1:
    $$p = qGC_p - q_i(GC_{pi})$$
    k. Top of Page 6-11, change "Figure 6-1 and Figure 6-2" to "Figure 6-2 and Figure 6-3".
    l. On Page 6-14 shouldn't the stared note on the bottom of the table say $\theta \leq 27°$ instead of $\theta \leq 25°$ to be consistent with Table 6-5 on Page 6-15?
    m. On Page 6-29, both the reference to and equation Eq. 6-8 should change to Eq. 6-10.
    n. From Page 6-29 on in Section 6, most equation numbers and references to these equations have to be updated accordingly.
    o. Bottom of page 6-57: bottom of the page: "6:30" should change to "16:30"

Please do not hesitate to contact me if you have any questions. I am overseas now and will be back in San Francisco Bay Area next Monday.

Sincerely,
Masoud Zadeh, Ph.D., PE.