

Att: Alameda Board of Education

Re: Preliminary Risk Assessment for moving Donald Lum Elementary School students

May 8, 2017

In deciding to move students from one site to another because of earthquake concerns there are so many risk variables to consider, it is hard to know where to start.

But in the short time that was available, I would like to share the findings of one scientific paper that analyzed the correlation between Cone Penetration Tests (CPTs) data and actual measured building differential settlement, after the Darfield 2010 Earthquakes in ChristChurch, New Zealand.

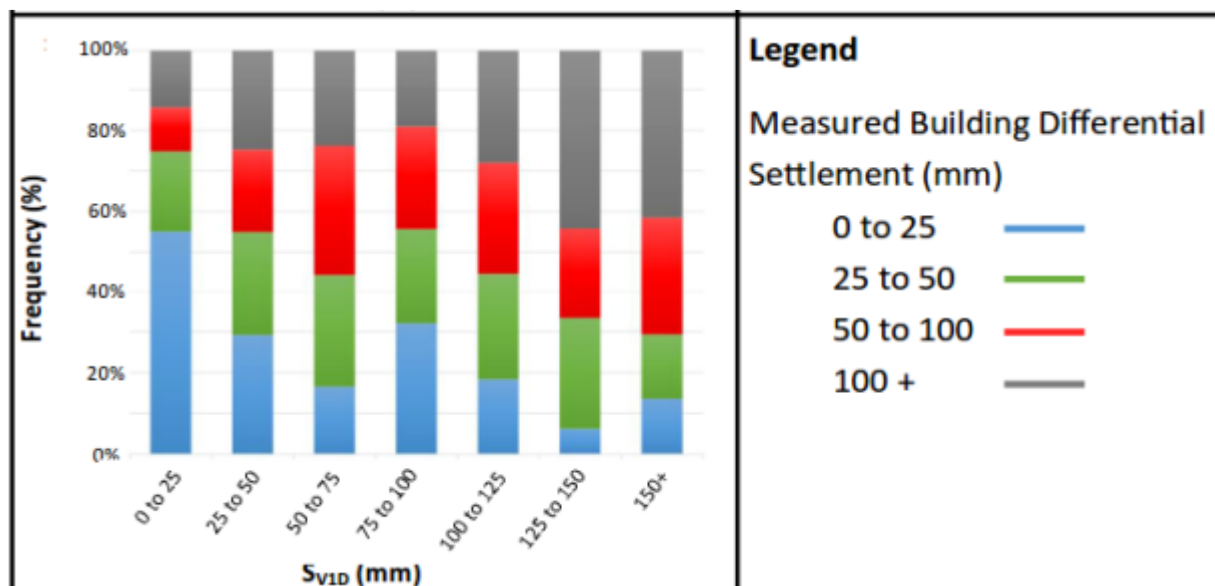
The strongest Darfield quake was magnitude 7.1, and particularly intense : Peak acceleration was 1.26 g. The intensity of the quake caused massive liquefaction that damages 51,000 buildings where 15,000 had to be torn down. **Noteworthy is that liquefaction caused massive damage, but claimed no lives.**

The paper that did the analysis is Chapman et al 2015 :

" Correlation of Differential Building Settlement with Predicted CPT based Liquefaction Vulnerability Parameters"

[https://secure.tcc.co.nz/ei/images/ICEGE15%20Papers/Chapman\\_431.00.pdf](https://secure.tcc.co.nz/ei/images/ICEGE15%20Papers/Chapman_431.00.pdf)

They analyzed the actual measured building differential settlement of about 1,500 buildings and compared that against the calculated differential settlement of thousands of CPT tests.



From this figure we can see that the calculated (from Cone Penetration Tests) settlement parameter Sv1d only loosely correlates with the actual measured building differential settlement.

If you move from a site that had a CPT calculated settlement of 4-5" (100-125mm) to a site that had a CPT calculated settlement of 1-2" (25-50mm) then you only decrease the risk of significant (>2" (50mm)) actual

building differential settlement by about 10%. In other words, you have a 45% chance of actually increasing the risk to students by moving.

Even more perplexing, if you move from a site that had a CPT calculated settlement of 3-4" (75-100mm) to a site that had a CPT calculated settlement of 1-2" (25-50mm) then you do not decrease the risk of actual building differential settlement at all. That means that you do not make anyone safer by moving.

For Lum specifically, Pacific Miller calculated CPT settlement of 4-8" for a very strong seismic event. We have not received the CPT numbers for the alternative school sites, but even if they come in low at 1-3" settlement, then there is only about 10% reduction in risk of significant building settlement during an actual earthquake if we move the students to other sites. In the bigger picture of all the other risk factors during an earthquake 10% is not statistically significant.

These are quite stunning findings that suggest that Cone Penetration Test results by themselves are a poor basis for a decision to move students from one site to another.

In simpler words, this means that based on the CPT data alone, if we have a seismic event where half of the buildings in Alameda come down, that there is about a 45% chance that Lum is still standing.

Also, it appears that the choice of foundation does not matter much for building differential settlement caused by liquefaction. Chapman et al 2015 writes :

No statistically significant differences were observed between measured BDS for Type A, B or C foundations within the HNZN and MOE dataset. This is consistent with the observations made in Rogers et al. (2015), which showed that the BDS is independent of foundation type.

In light of this evidence, I call upon ZFA to revise their recommendation to vacate the buildings, and I call upon District to revise their decision to move the students, and I call upon the Board to keep Lum open until the District presents better evidence before making the drastic and what appears to be a poorly founded decision to move the students to another site.



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