



Podcast Introduction



Greetings

Welcome to our #28th Episode of the FGI Podcast Series.

My name is Tim Stark and I am a Professor of Civil Engineering at the University of Illinois at Urbana-Champaign.

My name is Jen Miller and I am the Coordinator of the Fabricated Geomembrane Institute or FGI.

On today's episode, we are going to focus on our April 13, 2021 webinar titled: "**Static and Seismic Veneer Stability Calculations**". I would like to quickly re-introduce our speaker:

Dr. Matasovic is a consulting engineer who consults in the areas geotechnical, geoenvironmental, and earthquake engineering. His expertise includes design and stability evaluation of waste and tailings containment systems, Superfund sites, and earthfill, rockfill, and tailings dams. Dr. Matasovic is a pioneer in developing evaluation and mitigation methods for the seismic design of solid and hazardous waste landfills.

1. *Does the recommendation to use coarse sand in cap systems for gas drainage also apply to sites located in areas of low seismicity?*
 - a. Yes, this recommendation applies to all sites with significant landfill gas generation. Gas extraction system failure is the second most common cause of composite cover failures.
2. *How about a geocomposite drainage layer? Geocomposite gas collection layer?*
 - a. Geocomposite is a viable alternative to granular layer for both drainage layer and gas collection layer. Drainage layers have to be designed and maintained, and their construction needs to be professionally monitored.
3. *Do you recommend using residual interface shear strength for stability analysis of final cover under seismic condition?*
 - a. Yes, but only on side-slopes of composite liner system (4H: 1V or steeper). Note: at relatively low confining stress, as representative of landfill cover, the difference between peak and large displacement (residual) shear strength is relatively low.
4. *What if we have to do a veneer analysis outside the US, specifically North West Africa? i.e., how do you pick design earthquake?*

- a. Most countries have an equivalent of the USGS and hence post, at a minimum, seismic hazard maps.
 - b. Global Seismic Hazard Assessment Program – They have a web site that may be used for select countries where this information does not exist or hasn't been updated in long time (<http://www.seismo.ethz.ch/static/GSHAP/index.html>).
 - c. I recommend performing a site-specific seismic hazard study using program EZ-FRISK (<http://www.ez-frisk.com/>). They have an "Africa" module. I further recommend using SHAKE2000 and or D-MOD2000 (www.geomotions.com) to perform site response/ seismic deformation analysis.
5. *The gas drainage layer is below the geomembrane, correct?*
- a. Correct; gas collection layer should be designed/constructed below geomembrane, (water) drainage layer above.
6. *In your take-aways slide: how do you calibrate the model?*
- a. Calibration is mostly required for 2D site response/seismic deformation models. These models should extend away from the slope (or other changes in geometry). The model extension should be representative of a horizontally-layered deposit that can be well-modeled with a 1D program. The 2D modeler is required to demonstrate that, in free-field, his model can replicate the response of the profile as calculate with a much simple/ well-established 1D model (e.g., D-MOD2000 or SHAKE2000; www.geomotions.com).
7. *Is there a minimum side slope you would recommend for preliminary design assumptions when assessing the stability of the capping layer?*
- a. Yes, 4H:1V is recommended for preliminary design when capping with a composite liner system; 3H:1V otherwise.
8. *Why would an ET cover have a smaller stability criteria (6") than a composite cover (36")? An ET cover seems like it would be easier to fix than a composite cover should displacement occur. Wouldn't a larger displacement on a composite cover potentially lead to ripping the liner?*
- a. ET covers are typically designed for a 12-in. stability criterion; sometimes for 6 in. (depends upon jurisdiction and several other factors, e.g., how well will vegetation be established and maintained). There are two major considerations related to the establishment of performance-based seismic stability criteria: (i) potential for release of contaminants; and (ii) ease of repair. A 12-in. (or 6-in.) crack in ET cover can result in release of contaminants (e.g., landfill gas can escape). Landfill gas escape is not likely to occur if cover soil of a composite cover slips (unless HDPE/LLDPE ruptures, and that is unlikely). There are other considerations related to ET covers – e.g., infiltration through cracks, erosion within and in the vicinity of cracked area, ...

9. *In your research, have you observed whether certain texturing profiles, distribution or pattern of geomembrane cover texturing to provide greater residual or peak shear strength in conjunction with the resin type and asperity height?*
- Yes, higher the asperity height is → more (shear) resistance one gets; Stiffer the membrane (i.e., HDPE vs. LLDPE) → more (shear) resistance one gets (asperities are not likely to shear-off).
10. *Do you recommend using interface shear strength when analyzing the stability of the final cover under seismic conditions?*
- Interfaces are the weakest planes within the profile, so answer is “YES.”
11. *How is landfill cap stability influenced by the landfill base liner system when it too has similar geosynthetic layer interfaces - is there a dampening effect?*
- Yes, there is a so-called “base isolation effect,” with composite liner behaving as a “base isolator.” There is a paper on that topic (reference below). This paper will be posted on both FGI and Geomotions.com web sites.
- Kavazanjian, E., Jr. and Matasovic, N. (1995), “Seismic Analysis of Solid Waste Landfills,” In: Geoenvironment 2000, ASCE Geotechnical Special Publication No. 46, Vol. 2, pp. 1066 1080.
12. *You recommended coarse sand in the gas venting layer. Any concerns with using a geocomposite in the gas venting layer?*
- It depends on the in-place gas extraction system – if modern system is in place and is (or will be) well maintained and operated, geocomposite is a fine alternative. I would like to note, however, that I have seen many more landfill gas-induced failures of composite covers (and ET covers, where vegetation was destroyed) than seismically-induced failures.
13. *How should the liner system be reasonably incorporated in the response analysis (non-linear and linear)?*
- Please see the response to question 3 above. Note that this cannot be done within the equivalent linear analysis.
14. *In your presentation you recommended a max. slope height when using the infinite slope method. I have used the infinite slope method for designing coal ash landfills where the waste (ash) is placed under controlled conditions and compacted. Would this scenario allow for a longer max. slope height when considering the infinite slope method?*
- It depends. My colleague Rick Thiel and I noticed that “problems” start when composite cover has a run longer than 150 ft (issues with drainage, settlement, trench stability and, ... remember the video I showed at the beginning of my presentation). However, the infinite slope equation has many applications outside of the composite cover world and hence longer runs may be appropriate.
15. *Have you had the opportunity to use the Macedo procedure on Olympic View Landfill?*

- g. No, I have not. I note, however, that these authors have a relatively recent spinoff of their procedure crafted specifically for subduction events (the 2011 Nisqually event that shook the Olympic View Landfill was a subduction event). Reference is below; because of the copyright laws, I can't post it on my web site, but if you e-mail me, I will e-mail you back.

Bray, J.D., Macedo, J., and Travasarou, T. (2018), "Simplified Procedure for Estimating Seismic Slope Displacements for Subduction Zone Earthquakes," ASCE Journal of Geotechnical and Geoenvironmental Engineering, Vol. 144, No. 3, 13 p.

Thanks to Neven for joining us again and that is all the time that we have today.....

If you have any additional questions or would like additional information, please contact Neven at nmatasovic@geo-logic.com or email me & I will send your question to Neven at: fabricatedgeomembrane@gmail.com or visit the FGI website at fabricatedgeomembrane.com.