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From: Jamie Beaver
To: Mike Bailey
Date: 3/9/01 11:04AM
Subject: 3R - Embankment Subgrade Improvement Zones (HC Rational)

Mike,
Thought
~~Though~~ process through embankment stability analyses to define subgrade improvements.

Easier for me to write it out... I think this captures everything (I will not include this in my files for 3R in the event I have forgotten a step or something)...

Subgrade improvement governed by liquefaction. Our reanalysis of trigger liquefaction showed a reduced number of samples would liquefy using the lower PGA value from the PSHA/ProShake analysis. The reduced number of liquefiable samples resulted in a lower post-liquefaction undrained residual shear strength (PLURSS). However, the extent of liquefaction in the NSA did not change significantly (despite the reduced number of liquefying samples). Thus, our reanalysis showed a 120 foot wide subgrade improvement zone was needed (this gave us a 1.2 factor-of-safety for the liquefaction case). We decided at the time that the neet to widen subgrade improvements was predominantly due to the change in residual shear strength, with some contribution from the change to 1.8H:1V and clay to phi 30.

After our call with Bob Maruska, we went back and took a closer look at the effects of the clay going to 30 deg. (we thought this may have contributed enough that going back to 32 deg. was an acceptable way to avoid widening subgrade improvements per Maruska). We found this had no real effect on FS. Taking a closer look at subgrade improvement widths, we determined that 110 was a reasonable recommendation given a FS of 1.2 for 120 ft and a 1.2 for 100 ft, so we sent the fax to HNTB showing both options and leaving it to their decision.

For the area south of 156th in NSA, we showed a 120 ft wide subgrade improvement zone in the first fax to HNTB based on the results of the liquefaction case using PLURSS from the seismic reanalysis. We then took a closer look at the soil conditions and liquefiable blow counts and found the composite strength approach was appropriate for this area based on depth stratification of liquefiable blow counts.

For area north of west wall, we initially based our recommendation of NO subgrade improvements on our composite shear strength analysis. Based on board comments, we looked at PLURSS and relooked at extent of liquefaction from CPT input and defined a discrete zone. Found that subgrade improvements were needed. Location of liquefiable soil and constructability issues led us to extend west wall subgrade improvements north through interpreted extent of liquefaction. Tested a 100 foot wide subgrade improvement zone and liquefaction case >>1.1, steady state min was 1.45 and pseudo static case 1.07.

No subgrade improvements needed from ~~[illegible]~~ 189+50 to 205+00 for liquefaction case because we are comfortable with composite shear strength approach.

In general, pseudo-static case has FS near 1.0 or 1.1 for toe circular surfaces. Where subgrade improvements are located FS are generally near 1.1. Areas where no subgrade impr. are located FSs are near 1.0.

Bailey
EXHIBIT NO. 384
2-18-02
M. Green