

## Grout Line

### Overture

Fifteenth appointment with the Grout Line.

Also for this issue there are no technical papers or articles. Only a comment and consequent answer to September's article written by Giovanni Spagnoli MASc, related to the use of Jet-grouting for liquefaction mitigation. The comment is from G.K. Burke, P.E. – Vice President Engineering Hayward Baker Inc- Odenton-MD.

### Letter from G.K. Burke, Hayward Baker Inc.

Dear Paolo,

I was very excited to read an article of European origin on the subject of jet grouting in the September edition of The Grout Line. But after reading the article I am quite worried about some of these theoretical evaluations being used for design without proper support from research. To Mr. Spagnoli's credit, he does conclude more needs to be understood before applying CSR reductions. There is clearly insufficient evidence from research that a 10% area replacement ratio could reduce CSR by 50%. Designers should be cautioned against this until research gives more guidance.

The analogy with Wickiup Dam is clearly misplaced, as the design of the soilcrete zones was for 85% area replacement, and was intended for in-situ shear strength enhancement as structural elements.

The most widely applied CSR reduction directive comes from Baez and Martin, which is specific to reinforcing elements constructed of stone with shear modulus values far less than typical soilcrete modulus values.

I do not have an alternative recommendation, but more research is in order to offer guidance to application of rigid, brittle elements in the reinforcement aspects of liquefiable strata.

*Kindest Regards,  
HAYWARD BAKER INC.  
G.K. Burke, P.E.  
Vice President Engineering  
(gkburke@haywardbaker.com)*

### Response from Giovanni Spagnoli, Marine Geotechnics Leobenerstrasse

Dear Paolo,

I read Mr. Burke's comments and I am sorry to read that he did not appreciate my paper. My attempt was not to bring an absolute truth about this issue as I analyzed and compared works from other Authors. If I misplaced something I apologize.

What I wanted to point out is that I think jet grouting is not a way to mitigate soil liquefaction as we mean. As you know soil liquefaction takes place in sandy soil with a low relative density. By increasing the relative density there are MORE possibilities that the soil will not collapse under cyclic loading.

Thus, to avoid it, it is possible to densify the soil (e.g. dynamic compaction). My opinion is that jet grouting does not mitigate liquefaction as we think because it does not reduce shear stresses on the ground nor increase shear strength of the untreated part of soil. That is a very important point. In fact, if we would perform penetration tests in the areas between the jet grouted columns, we would not see an increase in penetration resistance. That means,

columns do not densify the in situ soil.

The earthquake shaking causes increasing pore water pressure which reduces the effective stress, and this reduces the shear strength of the sand. By densifying the soil, the response of the liquefied sand is determined by its relative density. Thus, dense sand performs in a much stiffer way when cyclic loaded.

*Best regards  
Giovanni Spagnoli, M.Sc.  
(spagnoli@uni-bremen.de)*

### Announcement

As every year is time to remind to everybody interested, that also this year, in June, there will be, the 30<sup>th</sup> Annual Short Course, *Grouting Fundamentals & Current Practice* (June 22-26, 2009) at the Colorado School of Mines in Golden, Colorado.

Information is available at [www.mines.edu/outreach/cont\\_ed/grouting](http://www.mines.edu/outreach/cont_ed/grouting). As usual, the Thursday afternoon Demo will be the highlight of the week. Attendance at the Demo only, is free of charge and all interested individuals are welcome.

For additional information, a part the Colorado School of Mine web page, I remind you that last year in March '08 I published an extensive presentation of the course. You can read it in the Grout Line Webpage at: <http://www.groutline.com/FinalMarch08.pdf>

Send your grouting papers, articles or comments to: *Paolo Gazzarrini, fax 604-913 0106 or paolo@paologaz.com, paologaz@shaw.ca or paolo@groutline.com.*

**Ciao!**