



February 20, 2002

Dr. Sherri Dunlap
Harris County Flood Control
9900 Northwest Freeway
Houston, Texas 77092

Re: Articulating Concrete Block Revetment Systems: Stability Performance Values

Dear Dr. Dunlap:

Recent full-scale testing of articulating concrete block (ACB) revetment systems has brought attention to certain issues that warrant discussion among manufacturers, designers, contractors, and project owners regarding the interpretation of performance data for use in ACB selection and design. As a consulting engineering firm involved in this discipline, Ayres Associates would like to provide the following observations and recommendations:

1. **Performance Indicators.** Full-scale hydraulic testing is typically used to quantify the performance threshold of a particular style of block system. Since the later 1980s, boundary shear stress has been recognized as a primary indicator of block system performance. Recent tests conducted since 1999 using greater embankment heights than those of the initial studies suggest that velocity is also of fundamental importance in determining block system performance.
2. **Performance Extrapolations.** It has been industry-accepted practice to use full-scale hydraulic testing data to estimate performance to blocks of the same style, but different thickness from the tested block. Recent test results suggest that the theoretical force-balance equation used for this extrapolation tend to be conservative (i.e., underestimate performance) when estimating performance of thicker blocks based on tests of thinner blocks. However, when used to estimate performance of thinner blocks from tests of thicker ones, it appears that the current equation overestimates performance of the thinner blocks. This latter case could lead to underdesign and ultimately, damage to the block installation, drainageway, and appurtenant structures.
3. **Drainage Layers.** It appears that the use of a granular or synthetic drainage layer between the block and the geotextile can significantly enhance the stability of an ACB system as reported from full-scale laboratory test data. When a drainage layer is used in laboratory testing, it should be considered part of the system and used in field applications also.
4. **Bed Slopes.** In laboratory testing, the channel slope in the direction of flow (e.g., bed slope) is typically very steep. This is done to create supercritical flow conditions and severe hydraulic stresses that ultimately will reach the system's stability threshold as flow is increased. Historically, bed slopes have ranged from 5H:1V (20 percent) to as steep as 2H:1V (50 percent) for use in determining the performance values of block systems. However, because slope steepness affects both shear stress and velocity, recent tests suggest that the bed slopes in field applications should not be steeper than the bed slopes used in the testing program.

Dr. Sherri Dunlap
Page Two
February 20, 2002

Each of these issues require further research and investigation before the effect on stability design can be truly quantified. This can be accomplished as more data become available, whether through privately sponsored testing or through future government-funded research. However, in the meantime we believe it is important for everyone in the ACB industry to understand these issues and to consider them within the context of existing stability design procedures. Given sound engineering judgment on a project-by-project basis, our opinion is that reasonably conservative revetment installations will consistently result.

If you have any questions or need additional information, please contact us, or e-mail Mr. Paul Clopper at clopperp@ayresassociates.com.

Sincerely,

Owen Ayres & Associates, Inc.

Paul E. Clopper, P.E.
Manager, Water Resources

David M. Frick, Ph.D., P.E.
Executive Vice President

PEC/DMF/sp