GLOSSARY OF TERMS

Abutment – A retaining wall that also supports a vertical load.

Active Pressure – Pressure causing a wall to move away from the soil.

Active Zone – The zone of an MSE wall where the soil tends to move outward toward the excavation or wall face.

Aggregate – Sand-, gravel-, cobble- and boulder-sized particles in well-defined mixtures used in paving, concrete and other applications where specified properties are needed. Aggregates are typically inorganic, natural (e.g., gravel), processed (e.g., crushed rock) or man-made (e.g., air-cooled blast furnace slag and expanded shale).

Aperture – An opening, such as a hole, gap or slit.

Aspect Ratio – The ratio of the length of reinforcing elements to the height of the wall for an MSE wall system.

Backfill – Earth or other material used to replace material removed during construction, such as behind retaining walls.

Backslope – The non-horizontal finish grade of soils behind a wall; typically expressed as horizontal distance to vertical height (H:V backslope); used in engineering calculations, backslope increases the design load on a wall.

Batter – As applied to walls, the difference between the wall face alignment and vertical. Batter can be expressed in degrees or ratio of vertical to horizontal. A lean of the wall face towards the retained fill is considered a positive batter, while an outward lean is considered a negative batter. Batter is often built into a wall by off-setting (or "setting back") successive courses of a wall by a specified amount.

Bearing Capacity – The pressure that a soil can sustain without failing.

Bodkin Joint – A connection of one layer of geogrid to another layer, or a wrap formed by connecting the geogrid to itself, using a bodkin bar woven through the geogrid apertures.

Caisson – An air- and water-tight chamber used as a foundation and/or used to work or excavate below the water level.

Centrifuge – An apparatus used to test reduced-scale models of engineering structures under the stresses and loading conditions that realistically duplicate prototype behavior.

Coefficient of Consolidation – A measure of the rate of change of volume during primary consolidation.

Cohesion – The state of cohering or sticking together.

Compaction – Densification of soil by mechanical means, involving the expulsion of excess air.

Compound Failure – A failure of a slope that involves slipping though differing components of material types instead of through a single component or material type, such as the case of a shear surface passing through both the shoring and MSE components of an SMSE wall system, or a shear surface passing through both the foundation and MSE wall component, for example.

Compression Index – The slope of the normal compression line (NCL) and critical state line (CSL).

Confining Stress – An applied force or system of forces that restricts movement.

Consolidation – Densification of soil by mechanical means, involving the expulsion of excess water.

Critical State – Theoretical state of a soil in which there is no change of mean effective stress, shear stress or volume with shear strain.

Critical State Line (CSL) – Idealized volume-pressure relationship for soil under critical state conditions.

Dead Load – An inert, inactive load, primarily due to the structure's own weight.

Dewatering – Lowering or reduction of the phreatic surface in surrounding strata by mechanical means such as pumping.

Dilatancy – The ability of particles to move up relative to each other under shearing forces defined by the ratio between the rate of volumetric strain and the rate of shear strain.

Drainage – The act or process of draining using a system of man-made or natural conveyances. Interception and removal of surface or groundwater. Conveyance of unwanted water from one point to another.

Easement – A right to use or control the property of another for designated purposes.

Eccentricity – The ratio of the distance between the foci to the length of the major axis describing the shape of a conic section.

Elastic – Returning to, or capable of returning to, an initial form or state after deformation.

Embankment – A raised structure constructed of natural soil from excavation or borrow sources.

Embedment – The buried depth requirements of a retaining wall where sufficient horizontal line to daylight is maintained. Embedment is included in total wall height.

Erosion – Detachment and movement of soil or rock fragments by water, wind, ice or gravity.

Excavation – A cavity formed by, or as if by, cutting, digging or scooping. There are minimum/maximum limits of excavation defined to meet a retaining wall design.

Extensible – Able to experience small deformation in any direction; the deformation of an extensible reinforcement at failure is comparable to or even greater than the deformability of the soil.

Face Drainage – A drainage system generally consisting of gravel and pipes located immediately behind the face of an MSE wall that prevents saturation of the reinforced soil.

Facing – A generic term given to the face of a retaining wall, used to prevent the backfill soil from escaping out from between the rows of reinforcement.

Fines – Silt- and/or clay-sized particles.

Flexural Rigidity – A geogrid's resistance to sag under its own weight.

Footing – The soils, gravel and/or engineered materials used directly below a retaining wall.

Foundation – The portion of a structure (usually below ground level) that distributes the pressure to the soil or to artificial supports.

Friction Angle – A measure of the shear resistance of a soil due to the interlocking of soil grains and the resistance to sliding between the grains.

Frost Heave – An upthrust of ground or pavement caused by the freezing of moist soil.

Geogrid – A planar, polymeric (synthetic or natural) structure consisting of a regular open network of integrally connected tensile elements that may be lined or formed by extrusion, bonding, or interlacing which is capable of developing high tensile stresses with little deformation.

Geomembrane – A sheet of geosynthetic to act as a barrier to the movement of water or gas (including air).

Geostrip – A polymeric material in the form of a strip, with a width less than approximately 200 mm.

Geosynthetic – A planar product manufactured from polymeric material used with soil, rock, earth, or other geotechnical engineering related material as an integral part of a man-made project, structure or system.

Geotextile – A planar, permeable, polymeric (synthetic or natural) textile material that may be woven, non-woven, or knitted.

Global Stability – The factor of safety against an overall failure of a retaining wall or slope along a deep-seated slip surface passing beneath and behind a structure.

Grade, Finished – The completed surfaces of lawns, walks and roads brought to grades as designed.

Grade, Natural – The undisturbed natural surface of the ground.

Grade, Subgrade – The grade established in preparation for top surfacing of roads, lawns, etc.

Gravel – Granular material retained on a no. 4 sieve.

Groundwater – Generally, all water that is underground as opposed to on the surface of the ground. Usually refers to water in the saturated zone below the water table.

Height, Reinforced – A retaining wall, or the portion of a retaining wall cross section, that requires soil reinforcement to resist forces and loads.

Height, Total Wall – The vertically measured height of a retaining wall; includes the portion of the wall extending below the ground surface in front of the wall (subgrade).

Horizontal Line to Daylight – A horizontal line from the bottom of the wall to the intersection with the down slope.

Hydrostatic Pressure – The pressure at any point in a liquid at rest, equal to the depth of the liquid multiplied by its density.

Inboard – The upslope side of a roadway (or other feature) located in steep terrain.

Inextensible – Not able to deform in any direction; the deformation of the reinforcement at failure is much less than the deformability of the soil.

Infiltration – The movement of water downward from the ground surface through the upper soil.

In situ – "In-place"; without removal; in original location.

Lagging – Heavy planking used to construct walls in excavations and braced cuts.

Lateral Earth Pressure – Soil pressures that are exerted laterally (horizontally).

Leveling Pad – A gravel or concrete pad installed to create a level horizontal surface for facing construction.

Live Load – The weight of all non-permanent objects in a structure. Live load does not include wind or seismic loading.

Load – (See Surcharge).

Mechanically Stabilized Earth (MSE) – A retaining wall normally comprised of soil or aggregates stabilized by horizontal layers of reinforcement such as geogrids. The facing for such walls generally consist of precast concrete panels, concrete blocks or welded-wire. By industry convention, MSE walls have face inclinations of 70 to 90 degrees (near vertical). MSE slopes have inclinations of 70 degrees or less. For comparison, highway fill slopes typically have face inclinations of 34 degrees or less.

Normal Compression Line (NCL) – Idealized volume-pressure relationship for soil under normal compression.

Outboard – The downslope side of a roadway (or other feature) located in steep terrain.

Outfall – A pipe that discharges water.

Passive Pressure – A pressure acting to counteract active pressure.

Pervious – The property of a material that permits movement of water through it under ordinary hydrostatic pressure.

Plasticity – a soil is plastic if, like clay, when squeezed in the hand it does not break up.

Plasticity Index – A numerical measure of the plasticity of a soil. It corresponds to the range of moisture contents, expressed as percent water by dry weight of soil, within which the soil has plastic properties.

Pluviated – Also known as sand raining, placement of sand using a device called a pluviator held at a constant height. Holding the device at different heights achieves different relative densities.

Pluviator – A device made of sheet metal formed into a triangular funnel with a row of holes at the bottom of the instrument to release the sand (i.e., pluviate).

Poisson's Ratio – The ratio between the strain of expansion in the direction of force and the strain of contraction perpendicular to that force.

Polyethylene – A polymeric substance formed by the addition of long chain molecules made up of repeat carbon and hydrogen atoms, belonging to the polyolefin family of thermoplastics. Products formed with high-density polyethylene include automobile battery casings, gasoline containers, polymeric liners for hazardous waste landfills and geogrids by certain manufacturers.

Polymer – A substance or compound that features high molecular weight derived by the addition of many smaller molecules of the same kind.

Positive Mechanical Connection – Structural connection of retaining walls specifically designed to mechanically connect facing elements to MSE reinforcement with a low-strain, end-bearing connection device that is not dependent on friction for connection strength.

Pullout Resistance – For soil nails, pullout resistance refers to the capacity of the soil nail to resist outward forces along the axis of the soil nail which may cause the nail to be removed or "pullout" from the surrounding strata. The resistance to soil nail pullout is affected by soil or rock type and strength, contractor installation methods, drillhole diameter, and roughness and cleanliness of the drillhole.

PVC Pipe – A type of smooth wall thermoplastic pipe manufactured using polyvinyl chloride, which is widely accepted for drainage applications due to its cost, longevity and chemical resistance.

Reinforced Fill – Retaining wall backfill that contains reinforcing material to create the structure.

Reinforced Slope – Man-made mechanically stabilized earth (MSE) slopes consisting of soil stabilized by planar reinforcing elements. Facing treatments ranging from natural vegetation to welded-wire are applied to prevent erosion. MSE slopes can be built much steeper than ordinary slopes due to the inclusion of the reinforcing elements, also called "steepened slopes." Slopes are normally considered to be inclined at 70 degrees or less with respect to the horizontal.

Reinforcing Elements (Reinforcements) – A generic term that encompasses all manmade elements incorporated in the soil to improve its behavior (i.e., geotextile sheets, geogrids steel strips, steel grids, etc.).

Resistant Zone – The zone of an MSE wall where the reinforcing elements in the soil tend to resist outward movement of the wall.

Retained Backfill – The fill material located behind the reinforced backfill zone in a conventional MSE wall.

Retaining Wall – A wall built to hold back earth allowing adjacent areas to be at different elevations. Wall inclinations are typically 70 to 90 degrees with respect to the horizontal.

Rotational Failure or Slide – A failure of a slope that involves slipping of the earth on a curved surface.

Sand – Granular material passing through a no. 4 sieve but predominantly retained on a no. 200 sieve.

Scour – Erosion caused by rapid flow of water.

Shear Strength – A measure of the ability of a soil to resist forces that tend to separate it from its position on a slope and cause it to move.

Shoring System – A generic term for a retaining wall used to provide vertical or near-vertical temporary support of an excavation.

Slope – The face of an embankment or cut section; any ground whose surface makes an angle with the horizontal plane.

Slope Stability – Consideration of a slope's propensity to fail as a result of several potential failure mechanisms including rotational slips, compound slips and translational slides.

Soil Nail – Steel bars placed in drilled holes and then grouted in place for slope support, providing passive resistance.

Soil Reinforcement – Tensile reinforcing elements usually placed in horizontal layers in soil so that the resulting composite soil is stronger than the original unreinforced soil.

Soil Stabilization – The act of improving soil properties by inclusion of reinforcing elements, chemical substances, compaction or other methods.

Soldier Pile – An upright pile (or steel H-shaped beam) driven vertically into the ground to provide support for lagging.

Surcharge – Weight or load acting in, on, or near a retaining wall that impacts its ability to perform. Surcharge loads must be included in the design and engineering of retaining walls.

System – A solution consisting of a variety of specialty products and engineering services, including engineering, technical assistance and specifications. Systems provide greater value to a customer because they remove the need to independently source each of the component materials. Also known as a "packaged solution."

Tensile Load – A pulling force or stress.

Tensile Strength – The ability of a material to withstand tension; a term often used as an abbreviation for ultimate tensile stress. It is much higher than the greatest safe stress.

Tension Crack – A small break or crack in a soil mass from a tensile load, often exposed at the surface.

Translational failure – A slide occurring along a bedding plane or other plane of weakness where the mass moves parallel to the plane.

Uniaxial – Having one direction; or, relating to or affecting one axis. Having tensile strength in one direction only. The single direction stretching of perforated cast sheet or cast net.

Uniformity Coefficient – A ratio of the particle size corresponding to 60 percent finer to the particle size corresponding to 10 percent fine that helps to classify soils.

Weep Pipe – A pipe that connects to behind-the-wall drainage allowing collected water to drain.

Wire-Formed Retaining Wall – Mechanically stabilized earth (MSE) retaining wall with facing elements manufactured from welded wire mesh.

ACKNOWLEDGEMENTS

The authors would like to recognize the efforts of Mr. Scott A. Anderson, Ph.D., P.E., who was the FHWA Contracting Officer's Technical Representative for this work. Mr. Anderson's guidance and input to development of this report has been invaluable. This report also benefited from the reviews provided by the FHWA Technical Advisory Panel members: Mr. Mike Adams, Mr. Rich Barrows, Mr. Daniel Alzamora, and Mr. Roger Surdahl.

The authors further acknowledge the efforts of Turner Fairbanks Highway Research Center staff under the direction of Mr. Mike Adams, and the research staff from the Department of Civil Engineering at the University of Colorado, notably Ryan Woodruff. Those who served as a review panel are, in alphabetical order: Mr. Andy Anderson, Tensar Corporation, Inc.; Dr. Hon-Yim Ko, University of Colorado; Mr. John Wolosick, Hayward Baker; Dr. Dobraslav Znidarcic, University of Colorado.

REFERENCES

1. American Association of State Highway and Transportation Officials (AASHTO). 2002. *Standard Specifications for Highway Bridges*, Seventeenth Edition. HB-17.

2. Elias, V., Christopher, B.R., and Berg, R.R. 2001. *Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, Design & Construction Guidelines*. Report No. FHWA-NHI-00-043. Federal Highway Administration, March. 394 pp.

3. Anderson, S.A. and Williams, J.L. 2002. Road stabilization and reconstruction adjacent to recurring landslide in Zion National Park, Utah. *ASCE Geotechnical Engineering in Transportation: More than Just Lines on a Map, 2002 Geotechnical Seminar, 4 October 2002, Denver, Colorado*. American Society of Civil Engineers.

4. Occupational Safety and Health Association (OSHA). 2003. *OSHA Excavation Standard Handbook,* (29 CFR Parts 1926.650 through 1926.652), Third Edition, J.J. Keller Associates (ed.).

5. Lawson, C.R. and Lee, T.W. 2005. Reinforced soil retaining walls with constrained reinforced fill zones. *Geo-Frontiers 2005, Austin, Texas.* ASCE Geotechnical Special Publication 140: Slopes and Retaining Structures under Seismic and Static Conditions. American Society of Civil Engineers.

6. Geotechnical Engineering Office (GEO). 2002. *Guide to Reinforced Fill Structure and Slope Design, Draft*. Geoguide 6. Civil Engineering Department, Government of the Hong Kong Special Administrative Region. 240 pp.

7. American Association of State Highway and Transportation Officials (AASHTO). 2003. *Standard Specifications for Transportation Materials and Methods of Sampling and Testing,* 23rd Edition. 3,692 pp.

8. American Society for Testing and Materials (ASTM). 2004. *Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils.* D4767-04.

9. American Society for Testing and Materials (ASTM). 2000. *Standard Practice for Obtaining Samples of Geosynthetics from a Test Section for Assessment of Installation Damage*. D5818-95.

10. Federal Highway Administration (FHWA). 2003. *Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects*. FP-03.

11. National Concrete Masonry Association (NCMA). 2002. *Design Manual For Segmental Retaining Walls*, Second Edition. J.G. Collin (ed.). 289 pp.

12. Sabatini, P.J., Bachus, R.C., Mayne, P.W., Schneider, J.A., and Zettler, T.E. 2002. *Geotechnical Engineering Circular No. 5 – Evaluation of Soil and Rock Properties*. Report No. FHWA-IF-02-034. Federal Highway Administration, April. 385 pp.

13. Mayne, P.W., Christopher, B.R., and DeJong, J. 2002. *Subsurface Investigations, Geotechnical Site Characterization Reference Manual.* Report No. FHWA NHI-01-031. Federal Highway Administration, May. 300 pp.

14. Arman, A., Samtani, N., Castelli, R., and Munfakh, G. 1997. *Subsurface Investigations Participants Manual*. (Training Course in Geotechnical and Foundation Engineering: NHI Course No. 13231, Module 1). Report No. FHWA-HI-97-021. Federal Highway Administration.

15. Rocscience. 2000. *Slide 5.0* [software].

16. Farrag, K., and Morvant, M. 2004. *Evaluation of Interaction Properties of Geosynthetics in Cohesive Soils: Lab and Field Pullout Tests.* Report No. FHWA/LA.03/380. Federal Highway Administration, January. 95 pp.

17. Kimmerling, R.E. 2002. *Geotechnical Engineering Circular No. 6 – Shallow Foundations*. Report No. FHWA-SA-02-054. Federal Highway Administration, September. 310 pp.

18. Wright, S. 1990. *UTEXAS* [software].

19. Geo-Slope International. 2004. *SLOPE/W* [software].

20. ADAMA Engineering. 2005. *ReSSA* version 2.0 [software].

21. Anderson, M.G. and Richards, K.S. 1987. *Slope Stability – Geotechnical Engineering and Geomorphology*, Chichester: John Wiley & Sons.

22. Collin, J.G., Hung, J.C., Lee, W.S., and Manfakh, G. 2001. *Soil Slopes and Embankment Design Reference Manual.* Report No. DTFH61-97-C-00025. Federal Highway Administration, March.

23. American Society for Testing and Materials (ASTM). 2004. *Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions.* D3080-04.

24. Markland, J.T. 1972. *A Useful Technique for Estimating the Stability of Rock Slopes When the Rigid Wedge Sliding Type of Failure is Expected.* Rock Mechanics Research Report No. 19. London: Imperial College.

25. Hoek, E. and Brown, E.T. 1988. The Hoek-Brown failure criterion – a 1988 update. *Proc. 15th Canadian Rock Mechanics Symposium*, J.H. Curran (ed.). Civil Engineering Dept., University of Toronto, pp. 31-38.

26. Lazarte, C.A., Elias, V., Espinoza, R.D., and Sabatini, P.J. 2003. *Geotechnical Engineering Circular No. 7 - Soil Nail Walls.* Report No. FHWA0-IF-03-017. Federal Highway Administration, March.

27. Naval Facilities Engineering Command (NAVFAC). 1986. *Foundations & Earth Structures*. Design Manual (DM) 7.02, September. 196 pp.

28. Elias, V., Lukas, R., Bruce, D., Collin, J.G., and Berg, R.R. 2004. *Ground Improvement Methods Reference Manual*. Report No. FHWA NHI-04-001. Federal Highway Administration, July.

29. Armour, T., Groneck, P., Keeley, J., and Sharma, S. 2000. *Micropile Design and Construction Guidelines Implementation Manual Priority Technologies Program (PTP) Project*. Report No. FHWA-SA-97-070. Federal Highway Administration, June. 376 pp.

30. Barksdale, R.D., and Bachus, R.C. 1983a. *Design and Construction of Stone Columns Volume 1*. Report No. FHWA/RD-83-026. Federal Highway Administration, December. 210 pp.

31. Barksdale, R.D., and Bachus, R.C. 1983b. *Design and Construction of Stone Columns Volume II Appendices.* Report No. FHWA/RD-83-027. Federal Highway Administration, May. 45 pp.

32. Byrne, R.J., Cotton, D., Porterfield, J., Wolschlag, C., and Ueblacker, G. 1998. *Manual for Design and Construction Monitoring of Soil Nail Walls*. Report No. FHWA-SA-96-069R. Federal Highway Administration, October. 530 pp.

33. Sabatini, P.J., Pass, D.G., and Bachus, R.C. 1999. *Geotechnical Engineering Circular No. 4 – Ground Anchors and Anchored Systems*. Report No. FHWA-IF-99-015. Federal Highway Administration, June. 281 pp.

34. United States Steel (USS). 1970. *Steel Sheet Piling Design Manual*. September.

35. Golder Associates Inc. 1998. *Report on Design Methodology for Mechanically-Stabilized Earth (Mse) Fill Wall, Yosemite El Portal Road Reconstruction Project, CA-YOSE 16(1),* Prepared for Kiewit, DeLeuw, Cather, and FHWA-CFLHD, 15 December 1998.

36. Collin, J.G. 1986. *Earth Wall Design.* Ph.D. dissertation. University of California, Berkeley.

37. Vulova, C. 2000. *Effects of Geosynthetic Reinforcement Spacing on the Behavior of Mechanically Stabilized Earth Walls*. Ph.D. dissertation. Department of Civil Engineering, University of Delaware.

38. British Standards Institution (BSI). 1995. *Code of Practice for Strengthened/Reinforced Soils and Other Fills.* BS8006. Amended 1999. 161 pp.

39. Tatsuoka, F., Tateyama, M., and Murata, O. 1989. Earth retaining wall with a short geotextile and a rigid facing. *Proceedings, 12th ICSMFE*, 1989, International Society of Soil Mechanics and Foundation Engineering, volume 2. pp. 1311-1314.

40. Tatsuoka, F., Murata, O., and Tateyama, M. 1992. Permanent geosynthetic-reinforced soil retaining walls used for railway embankments in Japan. *Geosynthetic-Reinforced Soil Retaining Walls: Proceedings of the International Symposium on Geosynthetic-Reinforced Soil Retaining Walls, Denver, Colorado, 8-9 August 1991*, Jonathan T.H. Wu (ed.). Rotterdam, Netherlands [Brookfield, VT]: A.A. Balkema, pp. 101-130.

41. Murata, O., Tateyama, M., Tatsuoka, F., Nakamura, K., and Tamura, Y. 1991. A Reinforcing Method for Earth Retaining Walls Using Short Reinforcing Members and a Continuous Rigid Facing. *Proceedings, Geotechnical Engineering Congress*, ASCE Geotechnical Special Publication 27, pp. 935-946.

42. Tateyama, M., Murata, O., Watanabe, K., and Tatsuoka, F. 1994. Geosynthetic-reinforced retaining walls for bullet train yard in Nagoya. *Proceedings, Recent Case Histories of Permanent Geosynthetic-Reinforced Soil Retaining Walls*, Fumio Tatsuoka, Dov Leshchinsky (eds.). Rotterdam, Netherlands [Brookfield, VT]: A.A. Balkema, pp. 141-150.

43. Tatsuoka, F., Tateyama, M., Uchimura, T., and Koseki, J. 1997. Geosynthetic-reinforced Soil Retaining Walls as Important Permanent Structures. *Proceedings of the Conference on Mechanically-Stabilized Backfill*, Jonathan T.H. Wu (ed.). Rotterdam, Netherlands [Brookfield, VT]: A.A. Balkema, pp. 3-24.

44. Segrestin, P. 1994. GRS Structures with Short Reinforcements and Rigid Facing – Discussion of Previous Papers Published by Prof. F. Tatsuoka, M. Tateyama and O. Murata. *Proceedings, Recent Case Histories of Permanent Geosynthetic-Reinforced Soil Retaining Walls.* Fumio Tatsuoka, Dov Leshchinsky (eds.). Rotterdam, Netherlands [Brookfield, VT]: A.A. Balkema, pp. 323-342.

45. Brandl, H. 1998. "Multi-anchored Soil Retaining Walls with Geosynthetic Loop Anchors." *Proceedings of the 6th International Conference on Geosynthetics, Atlanta, Georgia*. Industrial Fabrics Association International (IFAI), volume 2: pp. 581-586.

46. Lin, C.C., Hsieh, T.J., Tsao, W.H., and Wang, Y.H. 1997. "Combining Multi-nailings with Soil Reinforcement for Construction." *Mechanically Stabilized Backfill: Proceedings of the International Symposium on Mechanically Stabilized Backfill, Denver, Colorado, 6-8 February 1997*, Jonathan T.H. Wu (ed.). Rotterdam, Netherlands [Brookfield, VT]: A.A. Balkema, pp. 255-257.

47. Bastick, M.J. 1990. Reinforced Earth Narrow Walls and Abutments Correlation of Measured Performance with Design. *Performance of Reinforced Soil Structures: Proceedings of the International Reinforced Soil Conference*, organized by the British Geotechnical Society and held in Glasgow on 10-12 September 1990. Alan McGowan, Khen Yeo and K.Z. Andrawes (eds.), pp. 59-63.

48. Itasca. 1998. *Fast Lagrangian Analysis of Continua* (*FLAC*), Version 3.40 [software].

49. Woodruff, R. 2003. *Centrifuge Modeling for MSE-Shoring Composite Walls*. Thesis, Master of Science, Department of Civil Engineering, University of Colorado, Boulder.

50. Thomas, D.B. 1997. *Analysis of Geosynthetic-reinforced Soil Walls with a Truncated Base*. Thesis, Master of Science, Department of Civil Engineering, University of Colorado at Denver.

51. Lee, K., Jones, C.J.F.P., Sullivan, W.R., and Trolinger, W. 1994. Failure and Deformation of Four Reinforced Soil Walls in Eastern Tennessee. *Géotechnique*, 4(3): 397-426.

52. Liang, R.Y. and Almoh'd, I.M. 2004. Monitoring Results of an Instrumented, Mechanically-Stabilized Earth Wall, Comparison with Current Practice. *Transportation Research Record: Journal of the Transportation Research Board*, No. 1868, pp. 53-67.

53. Meyerhof, G.G. 1963. Some Recent Research on the Bearing Capacity of Foundations. *Canadian Geotechnical Journal*, 1(1): 16-26.

54. Christopher, B.R., Holtz, R.D., and Allen, T.M. 1990. Instrumentation for a 12.6 m high Geotextile-reinforced Wall. *Performance of Reinforced Soil Structures: Proceedings of the International Reinforced Soil Conference*, organized by the British Geotechnical Society and held in Glasgow on 10-12 September 1990. Alan McGowan, Khen Yeo and K.Z. Andrawes (eds.), pp. 73-78.

55. Thamm, B.R., Krieger, B. and Lesniewska, D. 1990. Full scale test of a geotextile reinforced soil wall. *Performance of Reinforced Soil Structures: Proceedings of the International Reinforced Soil Conference*, organized by the British Geotechnical Society and held in Glasgow on 10-12 September 1990. Alan McGowan, Khen Yeo and K.Z. Andrawes (eds.), pp.241-245.

56. Zornberg, J.G., Sitar, N., and Mitchell, J.K. 1998. Performance of Geosynthetic Reinforced Slopes at Failure. *Journal of Geotechnical Engineering*, 124(8): 670-683.

57. Ko, H.Y. 1988. Summary of the State-of-the-art in Centrifuge Model Testing. *Proceedings, International Conference Centrifuges in Soil Mechanics*, James and Schofield (eds), pp. 11-18.

58. Zornberg, J.G., Mitchell, J.K., and Sitar, N. 1997. Testing of Reinforced Slopes in a Geotechnical Centrifuge. *Geotechnical Testing Journal*, 20(4): 470-480.

59. Turner Fairbanks Highway Research Center (TFHRC). Undated. *Laboratory Test Results on FHWA Mortar Sand*. Internal correspondence.

60. American Society for Testing and Materials (ASTM). 2001. *Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.* D4595-86(2001).

61. TRI/Environmental, Inc. 2003. Geotextile Test Results. Letter to Jim Collin of The Collin Group, dated 26 July.

62. American Society for Testing and Materials (ASTM). 2000. *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).* D698-00ae1.

63. Das, B.M. 2004. *Principles of Foundation Engineering*, Fourth Edition. Pacific Grove, CA: Thomson/Brooks/Cole. 828 pp.

64. PLAXIS b.v. 2002. *PLAXIS 2D* – [software]. (Version 8, Finite Element Code for Soil and Rock Analyses). P.O. Box 572, 2600 AN DELFT, Netherlands.

65. Allen, T.M., Bathurst, R.J., Holtz, R.D., Walters, D. and Lee, W.F. 2003. A New Working Stress Method for Prediction of Reinforcement Loads in Geosynthetic Walls. *Canadian Geotechnical Journal*, 40: 976-994.

66. Seed, R.B. and Duncan, J.M. 1983. *Soil Structure Interaction Effects of Compaction-induced Stresses and Deflections*, Report Number UCB/GT/83-06. University of California, Berkeley, 425 pp.

67. Duncan, J.M., Byrne, P., Wong, K.S. and Mabry, P. 1980. *Strength, Stress-strain And Bulk Modulus Parameters for Finite-element Analysis of Stresses and Movements in Soil Masses*, Report No. UCB/GT/80-01. Department of Civil Engineering, University of California, Berkeley.

68. Golder Associates. 1996- . *Goldnail* [software]. Redmond Washington.

69. California Department of Transportation (CALTRANS). 1999-. *Snailz* [software]. Periodically updated on the Web at http://www.dot.ca.gov/hq/esc/geotech/request.htm.

70. Kramer, S.L. 1996. *Geotechnical Earthquake Engineering*. New Jersey: Prentice Hall.

71. Federal Highway Administration (FHWA). 2003. *Section 255 – Mechanically Stabilized Earth Walls. Special Contract Requirements*. www.cflhd.gov/design/scr.cfm.