## SLOPE ENGINEERING REFERENCE LISTS O. Hungr, May, 2008

### Landslide Classification

Cruden, D.M. and Varnes, D.J. 1996. Landslide Types and Processes. *In* Landslides Investigation and Mitigation. Transportation Research Board, US National Research Council, Turner, A.K. and Schuster, R.L. (editors). Special Report 247, Washington, DC 1996, Chapter 3, pp. 36-75.

Goodman, R.E. and Bray, J.W., 1976. Toppling of rock slopes. Procs., ASCE Specialty Conference on Rock Engineering for Foundation and Slopes, Boulder, Colo., Vol.2

Hutchinson, J.N. 1988. General report: morphological and geotechnical parameters of landslides in relation to geology and hydrogeology. In Proceedings of the 5th International Symposium on Landslides, Lausanne, Vol. 1, pp. 3–35.

Hungr, O., Evans, S.G., Bovis, M., and Hutchinson, J.N., 2001. Review of the classification of landslides of the flow type. Environmental and Engineering Geoscience, VII:221-238.

Sharpe, C.F.S., 1938. Landslides and related phenomena. Columbia University Press, N.Y.

Varnes, D.J., 1978. Slope movement types and processes. *In* Landslides, Analysis and Control. National Academy of Sciences, Nat. Res. Coun., Washington, DC., Special Rep. 176:11-33.

## Methods of Slope Stability Analysis

Bishop, A. W. 1955. The Use of the Slip Circle in the Stability Analysis of Slopes. Geotechnique, Vol. 5, No. 1, pp. 7-17.

Dawson, E.M., Roth, W.H. and Drescher, A., 1999. Slope stability analysis by strength reduction. Geotechnique, 49:835-840.

Duncan, J.M., 1996. Soil slope stability analysis In Landslides Investigation and Mitigation. Transport. Research Board, N.R.C. Spec. Report 247, Washington, DC 1996, Chapter 3, pp. 337-371.

Fredlund, D.G. and Krahn, J., 1977. Comparison of Slope Stability Methods of Analysis. Canadian Geotechnical Journ., 14:429-439.

Hammond, C., D. Hall, S. Miller and P. Swetik. 1992. Level 1 stability analysis (LISA), documentation for Version 2.0. U.S.D.A., For. Serv., Moscow, ID, Intermountain Res. Sta. Gen. Tech. Rep. INT-285.

Hoek, E., 1987. General two-dimensional slope stability analysis (Sarma Method). In Brown, E.T., Ed., Analytical and Computational Methods in Engineering Rock Mechanics. Allen and Unwin, London, p.95-128.

Hungr, O. 1987. An Extension of Bishop's Simplified Method of Slope Stability Analysis to Three Dimensions. Geotechnique, Vol. 37, No. 1, pp. 113-117.

Hungr, O., E M. Salgado, and P.M. Byrne. 1989. Evaluation of a Three-Dimensional Method of Slope Stability Analysis. Canadian Geotechnical Journal, Vol. 26, pp. 679-686.

Janbu, N. 1968. Slope Stability Computations. Soil Mechanics and Foundation Engineering Report. Technical University of Norway, Trondheim.

Morgenstern, N. R., and V. E. Price. 1965. The Analysis of the Stability of General Slip Surfaces. Geotechnique, Vol. 15, No. 1, pp. 79-93.

Sarma, S. K. 1973. Stability Analysis of Embankments and Slopes. Geotechn'que, Vol. 23, pp. 423-433.

Spencer, E. 1967. A Method of Analysis of the Stability of Embankments Assuming Parallel Inter-slice Forces. Geotechnique, Vol. 17, No. 1, pp. 11-26.

Terzaghi, K., 1943. Theoretical Soil Mechanics. John Willey and Sons, NY.

#### **Soil Properties**

Bishop, A.W. and Bjerrum, L., 1960. The relevance of the triaxial test to the solution of stability problems. In Procs., ASCE Research Conference on the shear strength of cohesive soils, Boulder, Colo., 437-501.

Canadian Foundation Engineering Manual, Canadian Geotechnical Society. Not available on the web, but can be ordered from the CGS, or through bookshops.

Ladd, C.C., 1991. Stability evaluation during staged construction. ASCE Journal, GE 117: 540-607

Lambe, T.W., and Whitman, R.V., 1979. Soil Mechanics, John Wiley, N.Y..

Morgenstern, N.R., 1992. The evaluation of slope stability: a 25 year perspective. In Seed, R.B., and Boulanger, R.W., Eds, Stability and performance of slopes and embankments, ASCE Geotechnical Special Publication 31, 1:1-26.

NAVFAC, 1982. Design Manual: soil mechanics: U.S. Department of Defence, Design Manual DM-7.1, Dept. of the Navy, Washington, 360pp.

Stark, T.D. and Eid, H.T., 1997. Slope stability analyses in stiff fissured clays. ASCE Journal, GE 123:335-343

Skempton, A.W., 1985. Residual strength of clays in landslides, folded strata and the laboratory. Geotechnique, 35:3-1.

Skempton, A.W., 1964. Long term stability of clay slopes. Geotechnique, 14:75-101.

Terzaghi, K. and Peck, R.B., 1996. Soil mechanics in engineering practice, 3rd. edition. John Wiley& Sons, Inc.

# **Rock Properties and Rock Slope Stability**

Barton, N.R. and Choubey, V., 1977. The shear strength of rock joints in theory and practice. Rock Mechanics.

Cruden, D.M., 1989. Limits to common toppling. Can. Geotech. Journ., 26:737-742

Cruden, D.M. and Krahn, J., 1978. Frank rockslide, Alberta, Canada. in Voight, B., Ed., Rockslides and Avalanches, Elsevier, Amsterdam, 1:97-112.

Goodman, R.E., and Bray, J.W., 1976. Toppling of rock slopes. Procs. Specialty Conf. On Rock Engineering for Foundations and Slopes, Boulder, CO., Vol.2

Hendron, A.J., and Patton, F.D, 1985, The Vaiont Slide. US Corps of Engineers Technical Report GL-85-8.

Hoek, E., 2000. Practical Rock Engineering. Free download from http://www.rocscience.com/hoek/PracticalRockEngineering.asp

Hoek, E., and Bray, J.W., 1997. Rock Slope Engineering, 2nd. Ed. Inst. Mining and Metallurgy, London.

Hoek, E. and Brown, E.T., 1980. Underground excavations in rock. Inst. Mining and Metallurgy, London. (Chapter 6, strength of rock masses).

Hungr, O. and Evans, S.G., 2004. The occurrence and classification of massive rock slope failure. Felsbau, Vienna, Austria, 22:16-23.

## Strength Loss Mechanisms Leading to Rapid Failure

Byrne, P.M., Naesgaard, E. and Seid-Karbasi, M., 2006. Analysis and design of earth structures to resist seismic soil liquefaction. Keynote Paper, 59<sup>th</sup> Canadian Geotechnical Conference, Canadian Geotechnical Society, Vancouver.

Casagrande A (1976) Liquefaction and cyclic deformation of sands; a critical review. Harvard Soil Mechanics Series, No 88, p. 51

Castro, G., 1975. Liquefaction and cyclic deformation of sands. ASCE Journal of Geotechnical Engineering, 101:551-569.

Crawford, C.B., 1968. Quick clays of Eastern Canada. Engineering Geology, 2:239-265.

Dawson, R.F., Morgenstern, N.R. and Stokes, A., 1998. Liquefaction flow slides in Rocky Mountain coal mine waste dumps. Can. Geotech. Journal, 35:328-343.

Fukuoka, H., Sassa, K., Wang, G. and Sasaki, R., 2006. Observation of shear development in ring-shear apparatus with a transparent shear box. Landslides, 3:239-251.

Hungr, O., 2007. Dynamics of Rapid Landslides. Chapter 4 in "Progress of Landslide Science", Springer Verlag, Heidelberg, Germany, pp. 47-57.

Hunter, G.J. and Fell, R., 1992. Mechanics of failure of soil slopes leading to "rapid" failure. In L. Picarelli, Ed., Fast slope movements prediction and prevention for risk mitigation. Patron Editore, Bologna, 1:283-290.

Hutchinson, J.N., and Bhandari, R.K., 1971. Undrained loading, a fundamental mechanism of mudflow and other mass movements: Géotechnique, v. 21, p. 353–358.

Mc Roberts, E.D. and Sladen, J.A., 1985. Observations on static and earthquake liquefaction methodologies. Procs., 43<sup>rd</sup> Canadian Geotechnical Conference, Quebec City, Canadian Geotechnical Society, 1: 215-226.

Sassa, K., 1985, The mechanism of debris flows: San Francisco, California, Proceedings, XI International Conference on Soil Mechanics and Foundation Engineering, v. 1, p. 1173–1176.

Tika Th E. and Hutchinson, J.N., 1999. Ring shear tests on soil from the Vaiont landslide slip surface. Geotechnique 49(1):59–74

Vallance, J., 2005. Volcanic Debris Flows. Chapter 10 in Jakob, M. and Hungr, O., Editors, Debris Flow Hazards and Related Phenomena. Springer Verlag, Heidelberg, Germany, in association with Praxis Publishing Ltd, 247-271.

Voight, B. and Faust, C., 1982. Frictional heat and strength loss in some rapid landslides Geotechnique, 32: 43-54.

### **Slope monitoring**

Crosta, G. B. and Agliardi, F., 2003. Failure forecast for large rock slides by surface displacement measurements, Canadian Geotechnical Journal, 40:176–191.

Dunnicliff, J., 1988. Geotechnical instrumentation for monitoring field performance. John Wiley, N.Y., 577 p.

Fukuzono, T., 1985. A new method for predicting the failure time of a slope. Procs., Fouth International Conf. And Field Workshop on Landslides, Tokyo, pp. 145-150.

Kane, W.F. and Beck, T.J., 2004. Instrumentation practice for slope monitoring. In: "Engineering geology practice in Northern California", US Association of Engineering Geologists.

Rose, N.D. and Hungr, O., 2007. Forecasting potential rock slope failure in open pit mines using the inverse-velocity method. International Journal of Rock Mechanics and Mining Science, 44:308–320

Voight, B. and Kennedy, B.A., 1978. Slope failure of 1967-1969, Chiquicamata Mine, Chile. In Voight, B., Editor., 1979. Rockslides and Avalanches, 2, Engineering Sites. Elsevier Scientific, Amsterdam.

Voight, B., 1989. Materials science law applies to time forcasts of slope failure. Landslide News, Number 3, Japan Landslide Society, Tokyo, 8-10.

#### Some Instrumentation Websites:

RST Instruments Roctest, Inc. Slope Indicator Company Wild Heerbrugg

#### Slope stabilization

Cedergren, H. R., Seepage, drainage and flow nets. John Wiley and Sons, N.Y., 478 pp.

Cornforth, D.H., 2005. Landslides in practice. John Wiley and Sons, Hoboken, N.J., 590 pp.

Hutchinson, J.N., 1984. An influence line approach to the stabilization of slopes by cuts and fills. Canadian Geotech. Journal, **21**:363-370

Leonards, G.A., Ed., 1962. Foundation engineering. Mc.Graw Hill, New York.

Naesgard, E., MacLeod, G. and Inglis, D.J., 1995. Shoring practices in Greater Vancouver, B.C. Procs., 48th. Canadian Geotechnical Conference, Vancouver, 1:117-137.

Peck, R.B., 1969. Deep excavations and tunneling in soft ground. Procs., Int. Conference on Soil Mechanics and Foundation Engineering, Mexico, pp225-280.

Poulos, H.G., 1995. Design of reinforcing piles to increase slope stability. Canadian Geotech. Journal, **32**:808-818.

Royster, D.L., 1980. Horizontal drains and horizontal drilling: an overview. Transportation Research Record 783, Nat. Academy of Science, Washington, D.C.

Zaruba, Q., and Mencl. V., 1969. Landslides and their control. Elsevier, Amsterdam, 205 pp.

### **Rock and Soil Anchors**

Post-Tensioning Institute (PTI), 2005. Recommendations for Prestressed Rock and Soil Anchors, 4th Edition

Sabatini, P.J., Pass, D.J. and Bachus, R.C., 1999. Ground anchors and anchored systems. Geotechnical Engineering Circular 4, FHWA-IF 99-015, 176 pp.

Littlejohn, G.S., 1977. Rock Anchors, state-of-the-art. Foundation publications, Brentwood, Essex, 50pp.

Dywidag Systems International (DSI), 2005. DYWIDAG Anchor System (Manual)

#### Landslide Hazard Mapping

Practices Code of British Columbia, Victoria, BC.

Brabb, E.E. 1991. The world landslide problem. Episodes, 14:1, 52-55. Casagli, N., Catani, F., Puglisi, C., Delmonaco, G., Ermini, L. And Margottini, C., An Inventory-Based Approach to Landslide Susceptibility Assessment and its Application to the Virginio River Basin, Italy. Environmental & Engineering Geoscience, X, 203–216.

Dearman, W.R., 1991. Engineering Geology mapping. Butterworth-Heinemann, London.

Chatwin, S.C., D.E. Howes, J.W. Schwab and D. Swanston. 1994. A guide for management of landslide-prone terrain in the Pacific Northwest. BC Min. For., Land Man. Handbook No. 18, Victoria, BC.

Howes, D.E. and E. Kenk. 1996. Terrain classification system for British Columbia (2nd revised edition). BC Min. Environ., Victoria, BC Manual 10.

Pack, R.T., 1997. New developments in terrain stability mapping in B.C. Procs., Forestry Geotechnique and resource engineering, 11th annual Vancouver Geotechnica Society Symposium, BiTech Publishers, Van., 3-16

Resource Inventory Committee, Government of British Columbia, Victoria, B.C. 1996.Terrain Stability Mapping in BC: A Review and Suggested Methods for Landslide Hazard and Risk Mapping - Final Draft.

Ryder, J.M., 1995. Resource Inventory Committee, B.C. Government, guidelines and standards to terrain geology mapping in B.C.

Soeters, R. and VanWesten, C.J., 1996. Slope instability recognition, analysis and zonation. In Turner, A.K. and Schuster, R.L., Eds., 1996. Landslides, investigation and mitigation. Transportation Research Board Special Report 247, Washington, D.C., pp. 129-177.

VanWesten, C., 1993. Geographic Information Systems in Slope Stability Zonation. International Institute for Aerospace Survey and Earth Sciences (ITC), Publication 15, Entschede, Netherlands, 245p.

#### Landslide Risk Assessment

BGC Engineering Inc., 2006. Berkley Landslide Risk Management, Phase 1 Risk Assessment. Unpublished report to the District of North Vancouver, British Columbia, 30pp. (Available on www.dnv.org –natural hazards programs and reports)

Canadian Standards Association, 1991. Risk analysis requirements and guidelines. CAN/CSA Standard Q634-91, Toronto.

Cave, P., 1992. Hazard acceptability thresholds for development approvals by local government. In. Geologic Hazards in British Columbia, B.C. Geological Survey Branch Open File 1992-15, Victoria.

Hungr, O. and Rawlings, G., 1995. Terrain hazards assessment for planning purposes: Cheekye Fan, B.C. Procs., 48th. Canadian Geotechnical Conference, Vancouver, B.C. 1: 509-517.

Hungr, O., 1997. Some methods of landslide hazard intensity mapping. Procs., Landslide Risk Workshop, R.Fell and D.M. Cruden, Eds., Balkema, Rotterdam.

Fell, R., Ho, K.K.S., Lacasse, S., Leroi, E., 2005 . A framework for landslide risk assessment and management. State of the Art Paper #1. In Hungr, O., Fell, R., Couture,

R., Eberhardt, E., Eds.. Landslide Risk Management. Proceedings, Vancouver Conference 3, 26. A.A. Balkema Publishers, Rotterdam.

Lateltin, O., 1997. Naturgefahren. Berücksichtigung der Massenbewegungsgefahren bei raumwirksamen Tätigkeiten Empfehlungen. Bundesamt für Raumplanung BRP, Bundesamt für Wasserwirtschaft BWW, Bundesamt für Umwelt, Wald und Landschaft BUWAL, Bern, Switzerland, (in German and French).

Lee, E.M. and Jones, D.K.C., 2004. Landslide risk assessment. Thomas Telford Books, London, 450 p.

Sobkowicz, J., Hungr, O. and Morgan, G.C., 1995. Probabilistic mapping of a debris flow hazard area. Procs., 48th. Canadian Geotechnical Conference, Vancouver, B.C. 1:519-

Rasmussen, N.C., 1975. Reactor safety study. US Nuclear Regulatory Commission Washington, D.C.

Vick, S., 2003. Degrees of Belief. Subjective Probability and Engineering Judgement. ASCE, 455 pp.

Whitman, R.V., 1984. Evaluating calculated risk in geotechnical engineering. ASCE, Journal of Geotechnical Engineering, 110:145-185

Wong, H.N., 2005. State of the Art Paper #8, Landslide risk assessment for individual facilities. In Hungr, O., Fell, R., Couture, R., Eberhardt, E., Eds., Landslide Risk Management. Proceedings, Vancouver Conference. A.A. Balkema Publishers, Rotterdam.

Wong, H.N., Ko, F.W.Y., 2006. Quantitative risk assessment of landslide hazards at Fu Yung Shan Tsuen, Tsuen Wan, Hong Kong. Landslide Study Report LSR 3/2006, Planning Division, Geotechnical Engineering Office, Hong Kong, 185 pp.

#### **Probabilistic Slope Stability**

Christian, J.T., Ladd, C.C., and Baecher, G.B. 1994. Reliability and probability in stability analysis. Journal of Geotechnical Engineering, ASCE, **120**: 1071–1111.

Duncan, J.M. 2000. Factors of safety and reliability in geotechnical engineering. Journal of Geotechnical and Geoenvironmental Engineering, ASCE, **126**: 307–316

El-Ramly, H., Morgenstern, N.R. & Cruden, D.M. 2002. Prob-abilistic slope stability analysis for practice. Can. Geotech. J. 39: 665-683.

Hoek, E., 2006. Chapter 8 in Practical Rock Engineering (available on line, Rockscience website)

Krahn, J., 2004. Slope stability modelling with SLOPE/W, Chapter 10. Software manual available on GEOSLOPE International web site.

Nadim, F., Einstein, H. and Roberds, W., 2005. Probabilistic stability analysis for individual slopes in soil and rock. State of the Art Paper 3, In Hungr, O., Fell, R., Couture, R., Eberhardt, E., Eds.. Landslide Risk Management. Proceedings, Vancouver Conference. A.A. Balkema Publishers, Rotterdam.

Whitman, V.W. 1984. Evaluating calculated risk in geotechnical engineering. Journal of Geotechnical Engineering, ASCE, 110:145–188.

## Landslides and Rainfall

Caine N (1980) The rainfall intensity-duration control of shallow landslides and debris flows. Geografiska Annaler Series A-Physical Geography 62: 23–27

Crosta GB, Frattini P (2001) Rainfall thresholds for triggering soil slips and debris flow. In: Mugnai A, Guzzetti F, Roth G (eds) (2001) Mediterranean Storms Proceedings of the 2nd EGS Plinius Conference on Mediterranean Storms. Siena, Italy, pp 463–487

Jakob M Weatherly H (2003) A hydroclimatic threshold for landslide initiation on the north shore mountains of Vancouver, British Columbia. Geomorphology 54(3–4): 137–156

Keefer DK, Wilson RC, Mark RK, Brabb EE, Brown WM-III, Ellen SD, Harp EL, Wieczorek GF, Alger CS, Zatkin RS (1987) Real-time landslide warning during heavy rainfall. Science 238: 921–925

Wieczorek, G.F., Glade, T., 2005. Climatic Factors Influencing Occurrence of Debris Flows. Chapter 14 in Jakob, M., Hungr, O., Eds., Debris Flow Hazards and Related Phenomena. Springer Verlag, Heidelberg, Germany, in association with Praxis Publishing Ltd, 325-362.

#### **Magnitude-Frequency Relationships**

Bak, P., Tang, C., Weisenfeld, K., 1987. Self-organised criticality: an explanation of 1/f noise. Physical Review Letters 59, 381–384.

Brardinoni, F., Church, M., 2004. Representing the landslide magnitude-frequency relation, Capilano River Basin, British Columbia, Earth Surface Processes and Landforms 29, 115–124, 2004.

Dai, F.C., Lee, C.F., 2001. Frequency-volume relation and prediction of rainfall-induced landslides. Engineering Geology 59, 253-266.

Guthrie, R.H., Evans, S.G., 2004a. Magnitude and frequency of landslides triggered by a storm event, Loughborough Inlet, British Columbia. Natural Hazards and Earth System Sciences 4, 475-483.

Gutenberg, B., Richter, C.F., 1954. Seismicity of the earth. 2nd ed. Princeton University Press, Princeton, N.J.

Guzzetti, F., Malamud, B.D., Turcotte, D.L., Reichenbach, P., 2002. Power-law correlations of landslide areas in central Italy. Earth and Planetary Science Letters 195, 169–183.

Hungr, O., Evans, S.G., Hazzard, J., 1999. Magnitude and frequency of rock falls and rock slides along the main transportation corridors of south-western British Columbia. Canadian Geotechnical Journal 36, 224-268.

Hungr,O., McDougall, S., Wise, M. and Cullen, M., 2008. Magnitude-frequency relationships of debris flows and debris avalanches in relation to slope relief. Geomorphology 96 : 355–365.

Malamud, B.D., Turcotte, D.L., Guzzetti, F., Reichenbach, P., 2004. Landslide inventories and their statistical properties. Earth Surface Processes and Landforms 29, 687-711.

Stark, C.P., Hovius, N., 2001. The characterization of landslide size distributions. Geophysical Research Letters 28(6), 1091–1094.

## **Rockfall Hazard Management**

Abbott, B., Bruce, I., Keegan, T., Oboni, F., Savigny, W. 1998. A Methodology for the Assessment of Rockfall Hazard and Risk Along Linear Transportation Corridors, In Proc., 8th Congress, International Assoc. of Engineering Geology. Vancouver, B.C.

Evans, S.G. and O. Hungr. 1993. The assessment of rockfall hazard at the base of talus slopes. Can. Geotech. J. 30:620-636.

Hungr, O. and Evans, S.G. 1989. Engineering aspects of rockfall hazard in Canada. Geological Survey of Canada, Open File 2061, 102 pages.

Pierson, L.A., Davis, S.A. and Van Vickle, R. 1990. The Rockfall Hazard Rating System: Implementation Manual. Technical Report FHWA-OR-EG-90-01, FHWA, U.S. Department of Transportation, 31 pp.

Ritchie, A.M., 1963. The evaluation of rockfall and its control. Highway Record. Vol 17.

Hoek, E., Practical Rock Engineering, Ch. 9 (available on line, Rockscience website)

### Landslide Runout Estimation

Abele, G., 1974. Bergsturze in den Alpen. Wissenschaftliche Alpenvereinshefte, No. 25, Munich (in German)

Corominas, J., 1996. The angle of reach as a mobility index for small and large landslides. Canadian Geotechnical Journal, 33:260-271.

Hungr, O., McDougall, S., Bovis, M., 2005a. Entrainment of Material by Debris Flows. Chapter 7 in Jakob, M., Hungr, O., Eds., Debris Flow Hazards and Related Phenomena. Springer Verlag, Heidelberg, Germany, in association with Praxis Publishing Ltd.

Hungr, O., Corominas, J., Eberhardt, E., 2005b. State of the Art Paper #4, Estimating landslide motion mechanism, travel distance and velocity. In Hungr, O., Fell, R., Couture, R., Eberhardt, E., Eds., Landslide Risk Management. Proceedings, Vancouver Conference. A.A. Balkema Publishers, Rotterdam

Li Tianchi, 1983. A mathematical model for predicting the extent of a major rockfall. Zeitschrift fur Geomorfologie, Neue Folge, 27:473-482

Rickenmann, D., 1999. Empirical relationships for debris flows. Natural Hazards, 19:47-77

Banks, D.C. and Strohm, W.E., 1974. Calculations of rock slide velocities. Procs., Congress ISRM, Denver, 2, pp. 839-847.

Hungr, O., Morgan, G.C. and Kellerhals, R., 1984. Quantitative analysis of debris torrent hazards for design of remedial measures. Canadian Geotechnical Journal, 21: 663-667.

Hungr, O., 1995. A model for the runout analysis of rapid flow slides, debris flows and avalanches. Canadian Geotechnical Journal, 32, pp. 610-623.

Koerner, H.J., 1976. Reichweite und Geschwindigkeit von Bergsturzen und fleisschneelawinen. Rock Mechanics, 8, pp. 225-256.

## **Rock Avalanche Mobility**

Heim, A., 1932. Landslides and human lives (Bergsturz und Menschenleben). N. Skermer, Editor, Bi-Tech Publishers, Vancouver, 196 p.

Hungr, O., 1991. Mobility of rock avalanches. Report of the Nat. Research Inst. For Earth Science and Disaster Prevention, Tsukuba, Japan, No. 46, pp.11-20.

Hsu, K.J., 1975. Catastrophic debris streams (sturzstroms) generated by rock falls. Bull., Geologica Society of America, 86, pp. 129-140

Scheidegger, A.E., 1973. On the prediction of the reach and velocity of catastrophic landslides. Rock Mechanics, 5, 231-236.

### **Debris Flow Mitigation**

Hungr, O., Morgan, G.C., Van Dine, D.F. and Lister, D.R., 1987. Debris flow defences in British Columbia. In J.E. Costa and E. Wieczorek, Eds., Debris Flow: Process, Description and Mitigation. GSA Reviews in Eng. Geology VII, 201-222.

VanDine, D.F., 1996. Debris flow control structures for forest engineering. Working Paper 22, B.C. Ministry of Forests Research program.

Jakob, M. and Hungr, O., Eds., 2005, Debris Flow Hazards and Related Phenomena. Springer Verlag, Heidelberg, Germany, in association with Praxis Publishing Ltd., Chichester, UK. (27 chapters, 720 pages).