In Memoriam: Chandrakant S. Desai

In Memoriam: Chandrakant S. Desai

Musharraf Zaman, Ph.D., F.ASCE
School of Civil Engineering and Environmental Science, Univ. of Oklahoma, Norman, OK 73019.

John P. Carter, Ph.D.
School of Engineering, Univ. of Newcastle, Newcastle, NSW 2308, Australia.

Jian-Hua Yin, Ph.D.
Dept. of Civil and Environmental Engineering, The Hong Kong Polytechnic Univ., Hong Kong, China. ORCID: https://orcid.org/0000-0002-7200-3695.

Marco Barla, Ph.D., M.ASCE
Dept. of Structural, Geotechnical and Building Engineering, Politecnico di Torino, corso Duca degli Abruzzi 24, Torino 10129, Italy. ORCID: https://orcid.org/0000-0002-4589-0524.

Richard J. Bathurst, Ph.D., M.ASCE
GeoEngineering Centre at Queen's-RMC, Dept. of Civil Engineering, Royal Military College of Canada, Kingston, ON, Canada K7K 7B4 (corresponding author). ORCID: https://orcid.org/0000-0002-5176-5287. Email: bathurst-r@rmc.ca

https://doi.org/10.1061/IJGNAI.GMENG-13627

Chandrakant S. Desai. (Image provided by the family.)

On March 28, 2025, Chandrakant S. Desai, University of Arizona Regent's Professor Emeritus, died peacefully in Tucson, Arizona, after several weeks of illness. He was the founding editor-in-chief of the *International Journal of Geomechanics*, which became an American Society of Civil Engineers (ASCE) journal in 2003 and is published by the Geo-Institute. He served in this capacity until 2008 and then as the advisory editor of the journal.

He was born on November 24, 1936, in a farming village in Nadisar, Gujarat, India. He graduated from the University of Bombay's Victoria Jubilee Technical Institute with a baccalaureate degree in civil engineering in 1959 and received his master's and doctorate degrees from Rice University in Houston and the University of Texas at Austin in 1966 and 1968, respectively. Before joining the Virginia Tech faculty in 1974, Prof. Desai worked as a research civil engineer at the U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. Subsequently, he moved to the University of Arizona (UA) in 1981 as a professor of civil engineering and engineering mechanics and was named Regent's Professor in 1989—the highest distinction given by the University of Arizona. He retired from UA in 2012 as Regent's Professor Emeritus.

Prof. Desai is recognized internationally for his significant and outstanding contributions in research, teaching, applications, and professional societies across a wide range of topics in engineering. The topics in which he made major contributions include material (constitutive) modeling, laboratory and field testing, and computational methods for interdisciplinary problems in engineering related to geomechanics, geotechnical engineering, structural mechanics, structural engineering, soil–structure interaction and earthquake engineering, coupled flow through porous media, and electronic packaging.

Prof. Desai authored, co-authored, or edited 25 books and 20 book chapters in the areas of the finite-element method and constitutive modeling and published more than 350 papers in well-reputed journals and conferences of international scope.

Prof. Desai's research on the development of the innovative disturbed state concept (DSC) for constitutive modeling of materials and interfaces or joints has been widely accepted for research and teaching in many countries. In conjunction with the nonlinear finite-element method, it provides an innovative and alternative approach for the analysis and design of complex nonlinear problems in engineering.

Prof. Desai's book *Introduction to the Finite Element Method* (co-authored by J. F. Abel), published in 1972, was the first formal textbook on the subject in the United States and second internationally. It has been translated into several languages worldwide. He also authored the first textbook, *Elementary Finite Element Method*, which is widely used for introducing this powerful method to undergraduate students.

In 1977, Prof. Desai edited, with John Christian as co-editor, the first book on *Numerical Methods in Geotechnical Engineering*, which deals with problems from geotechnical and structural engineering in a unified and easy-to-understand manner. This one-of-a-kind edited book has been used extensively by the academic community and practitioners.

Understanding, testing, and defining the behavior of materials that compose engineering systems are essential to finding realistic and economical solutions. His book *Constitutive Laws for Engineering Materials* (co-authored by H. J. Siriwardane), published in 1984, is considered pioneering on the subject and is used worldwide in teaching and research. In 2001, Prof. Desai authored *Mechanics of Materials and Interfaces: Disturbed State Concept*, which presents a detailed theoretical treatment of the DSC and shows that it can provide a unified and simplified approach for the mathematical characterization of the mechanical response of materials and interfaces.

The disturbed state concept (DSC) is a unified constitutive modeling approach for engineering materials that allows for elastic, plastic, and creep strain; microcracking and fracturing; and stiffening or healing, all within a single hierarchical framework. Its capabilities go well beyond other available material models and lead to significant simplifications for practical applications. Typically, available models account for one factor at a time; however, the disturbed state concept (DSC) within the hierarchical single-surface (HISS) plasticity framework can allow for numerous factors simultaneously and in an integrated manner.

In 2013, Prof. Desai authored, with Musharraf Zaman as co-author, *Advanced Geotechnical Engineering: Soil–Structure Interaction Using Computer and Material Models*, in which he introduced modern computer-based methods for solving complex geotechnical engineering problems considering such factors as in situ stress, stress paths, volume change, discontinuities and microcracking (initial and induced), strain softening, and liquefaction. The details of these methods (finite-element, finite-difference, analytical, and semianalytical) were presented for one-, two-, and three-dimensional problems. In addition, various constitutive models for geologic media and interfaces, from simple to advanced, were discussed, and numerical examples were included along with exercises or partial solutions for several problems.

In 2023, Prof. Desai edited, along with Yang Xiao, Musharraf Zaman, and John Carter as co-editors, *DSC/HISS Modeling Applications for Problems in Mechanics, Geomechanics, and Structural Mechanics*, which provides readers with comprehensive information including the basic concepts and applications of the DSC/HISS modeling for a wide range of engineering materials and contacts. Specifically, it presents a new and simplified way to learn characterizations and behaviors of materials and contacts under various conditions. In addition, it offers modeling choices applicable to different materials, including geologic materials (clays, sands, rocks), modified geologic materials (structured soils, overconsolidated soils, expansive soils, loess, frozen soils, chemically treated soils), hydrate-bearing sediments, and others.

Prof. Desai was also the founding editor of the *International Journal for Numerical and Analytical Methods in Geomechanics* from 1977 to 2000, published by John Wiley, United Kingdom.

Prof. Desai was the founding president of the International Association for Computer Methods and Advances in Geomechanics (IACMAG). He is credited with introducing the interdisciplinary definition of geomechanics that involves various areas such as geotechnical engineering, rock mechanics, statics and dynamics of interacting structures and foundations, flow through porous media, geoenvironmental engineering, natural hazards such as earthquakes, landslides, and subsidence, petroleum engineering, offshore and marine technology, geological modeling, geothermal energy, ice mechanics, and lunar and planetary systems. He served on the editorial boards of 14 journals and also served as chair or member of committees of various national and international societies and conferences.

Prof. Desai was involved in consulting work for the solution of practical problems for several private, public, and international agencies. For example, he served as a consultant for UNESCO, in which he was involved in computer analysis and design for the Narmada Sardar Sarovar Project in India, tunneling projects in the Himalayas, and development of testing equipment for the Central Material Testing Laboratory in India.

The body of Prof. Desai's research, publications, and professional work has been seminal and original. He has significantly changed the direction of research, teaching, and design applications for civil and other engineering disciplines. He received many national and international awards and recognitions including the Distinguished Member Award by the American Society of Civil Engineers; the Distinguished Alumni Award from his alma mater, Victoria Jubilee Technical Institute; the Nathan M. Newmark Medal by the Structural Engineering and Engineering Mechanics Institutes, ASCE; the Karl Terzaghi Award by the GeoInstitute, ASCE; the Diamond Jubilee Honor by the Indian Geotechnical Society, India; the HIND Rattan (Jewel of India) Award by the NRI Society, India; the Meritorious Civilian Service Award by the U.S. Army Corps of Engineers; the Alexander von Humboldt Stiftung Prize by the German government; the Outstanding Contributions Medal by the International Association for Computer Methods and Advances in Geomechanics; the Meritorious Contributions Medal by the Czech Academy of Sciences; and the Outstanding Contributions in Electronic Packaging Award by the American Society of Mechanical Engineers (ASME). For excellence in teaching, he also received the Five Star Teaching Award and the El Paso Gas Foundation Faculty Achievement Award at the University of Arizona.

Prof. Desai enjoyed almost 56 years of married life with Patricia Lynn Porter, whom he met at the University of Texas at Austin. They traveled the world together, read books together, and supported each other daily. He has two children. His son, Sanjay, and his daughter, Maya, along with her husband, Sean, and children (Lois Mira and Vernon Jay), live in Worcester, Massachusetts. He loved when Maya and her family would visit, as he encouraged them to eat Indian snacks and try laughing yoga with him.

With Prof. Desai's passing, the geomechanics community worldwide lost a giant who cannot be replaced. The community will miss him profoundly.

In recognition of his professional achievements and contributions to the *International Journal of Geomechanics*, papers and special collections authored or co-authored by Prof. Desai that appear in the *International Journal of Geomechanics* are listed at the end of this article.

References

Akbari Garakani, A., S. M. Haeri, C. S. Desai, S. M. Hosein Seyed Ghafouri, B. Sadollahzadeh, and H. Hashemi Senejani. 2019. "Testing and constitutive modeling of lime-stabilized collapsible loess. II: Modeling and validations." *Int. J. Geomech.* 19 (4): 04019007. https://doi.org/10.1061/(ASCE)GM.1943-5622.0001386.

Alyounis, M. E., and C. S. Desai. 2019. "Testing and modeling of saturated interfaces with effect of surface roughness. II: Modeling and validations." *Int. J. Geomech.* 19 (8): 04019097. https://doi.org/10.1061/(ASCE)GM.1943-5622.0001460.

Amin Soltanianfard, M., C. S. Desai, L. Zhang, M. Hosseinali, V. Toufigh, and M. Ghaemian. 2024. "Experimental investigation and constitutive modeling of rock-like specimens' interface with the effect of roughness based on 3D printing." *Int. J. Geomech.* 24 (2): 04023283. https://doi.org/10.1061/IJGNAI.GMENG-8823.

Desai, C. S. 2005. "Constitutive modeling for geologic materials: Significance and directions." *Int. J. Geomech.* 5 (2): 81–84. https://doi.org/10.1061/(ASCE)1532-3641(2005)5:2(81).

Desai, C. S. 2007. "Unified DSC constitutive model for pavement materials with numerical implementation." *Int. J. Geomech.* 7 (2): 83–101. https://doi.org/10.1061/(ASCE)1532-3641(2007)7:2(83).

Desai, C. S., and J. Y. Chen. 2006. "Parameter optimization and sensitivity analysis for disturbed state constitutive model." *Int. J. Geomech.* 6 (2): 75–88. https://doi.org/10.1061/(ASCE)1532-3641(2006)6:2(75).

Desai, C. S., S. K. Pradhan, and D. Cohen. 2005. "Cyclic testing and constitutive modeling of saturated sand–concrete interfaces using the disturbed state concept." *Int. J. Geomech.* 5 (4): 286–294. https://doi.org/10.1061/(ASCE)1532-3641(2005)5:4(286).

Desai, C. S., S. Sane, and J. Jenson. 2011. "Constitutive modeling including creep- and rate-dependent behavior and testing of glacial tills for prediction of motion of glaciers." *Int. J. Geomech.* 11 (6): 465–476. https://doi.org/10.1061/(ASCE)GM.1943-5622.0000091.

Desai, C. S., and Z. Wang. 2003. "Disturbed state model for porous saturated materials." *Int. J. Geomech.* 3 (2): 260–265. https://doi.org/10.1061/(ASCE)1532-3641(2003)3:2(260).

Haeri, S. M., A. Akbari Garakani, H. R. Roohparvar, C. S. Desai, S. M. H. Seyed Ghafouri, and K. Salemi Kouchesfahani. 2019. "Testing and constitutive modeling of lime-stabilized collapsible loess. I:

Experimental investigations." *Int. J. Geomech.* 19 (4): 04019006. https://doi.org/10.1061/(ASCE)GM.1943-5622.0001364.
Jia, Y., B. Xu, C. S. Desai, S. Chi, and B. Xiang. 2020. "Rockfill particle breakage generated by wetting deformation under the complex stress path." *Int. J. Geomech.* 20 (10): 04020166. https://doi.org/10.1061/(ASCE)GM.1943-5622.0001789.
Liu, M. D., J. P. Carter, and C. S. Desai. 2003. "Modeling compression behavior of structured geomaterials." *Int. J. Geomech.* 3 (2): 191–204. https://doi.org/10.1061/(ASCE)1532-3641(2003)3:2(191).
Ouria, A., C. S. Desai, and V. Toufigh. 2015. "Disturbed state concept–based solution for consolidation of plastic clays under cyclic loading." *Int. J. Geomech.* 15 (1): 04014039. https://doi.org/10.1061/(ASCE)GM.1943-5622.0000336.
Singh, D. N., C. S. Desai, and M. M. Zaman. 2011. "Special issue on environmental geotechnology: Contemporary issues." *Int. J. Geomech.* 11 (2): 83–83. https://doi.org/10.1061/(ASCE)GM.1943-5622.0000081.
Toufigh, V., C. S. Desai, H. Saadatmanesh, V. Toufigh, S. Ahmari, and E. Kabiri. 2014. "Constitutive modeling and testing of interface between backfill soil and fiber-reinforced polymer." *Int. J. Geomech.* 14 (3): 04014009. https://doi.org/10.1061/(ASCE)GM.1943-5622.0000298.
Varadarajan, A., K. G. Sharma, C. S. Desai, and M. Hashemi. 2001a. "Constitutive modeling of a schistose rock in the Himalaya." *Int. J. Geomech.* 1 (1): 83–107. https://doi.org/10.1061/(ASCE)1532-3641(2001)1:1(83).
Varadarajan, A., K. G. Sharma, C. S. Desai, and M. Hashemi. 2001b. "Analysis of a powerhouse cavern in the Himalaya." *Int. J. Geomech.* 1 (1): 109–127. https://doi.org/10.1061/(ASCE)1532-3641(2001)1:1(109).
Wang, J.-H., C. S. Desai, and L. Zhang. 2019. "Soft soil and related geotechnical engineering practice." *Int. J. Geomech.* 19 (11): 02019001–1. https://doi.org/10.1061/(ASCE)GM.1943-5622.0001494.
Xiao, Y., and C. S. Desai. 2019a. "Constitutive modeling for overconsolidated clays based on disturbed state concept. I: Theory." *Int. J. Geomech.* 19 (9): 04019101. https://doi.org/10.1061/(ASCE)GM.1943-5622.0001474.
Xiao, Y., and C. S. Desai. 2019b. "Constitutive modeling for overconsolidated clays based on disturbed state concept. II: Validation." *Int. J. Geomech.* 19 (9): 04019102. https://doi.org/10.1061/(ASCE)GM.1943-5622.0001475.
Xiao, Y., C. S. Desai, and H. Liu. 2021a. "Special collection on testing and modeling on particle breakage for granular soils." *Int. J. Geomech.* 21 (11): 75–88.
Xiao, Y., Z. Sun, C. S. Desai, and M. Meng. 2019a. "Strength and surviving probability in grain crushing under acidic erosion and compression." *Int. J. Geomech.* 19 (11): 04019123. https://doi.org/10.1061/(ASCE)GM.1943-5622.0001508.
Xiao, Y., Y. Sun, W. Zhou, J. Shi, and C. S. Desai. 2022. "Evolution of particle shape produced by sand breakage." *Int. J. Geomech.* 22 (4): 04022003. https://doi.org/10.1061/(ASCE)GM.1943-5622.0002333.
Xiao, Y., Y. Wang, C. S. Desai, X. Jiang, and H. Liu. 2019b. "Strength and deformation responses of biocemented sands using a temperature-controlled method." *Int. J. Geomech.* 19 (11): 04019120. https://doi.org/10.1061/(ASCE)GM.1943-5622.0001497.
Xiao, Y., C. Wang, H. Wu, and C. S. Desai. 2021b. "New simple breakage index for crushable granular soils." *Int. J. Geomech.* 21 (8): 04021136. https://doi.org/10.1061/(ASCE)GM.1943-5622.0002091.
Xiao, Y., B. Wu, X. Jiang, L. Wang, and C. S. Desai. 2024. "Avalanches and fractures in biotreated calcareous sands." *Int. J. Geomech.* 24 (5): 04024061. https://doi.org/10.1061/IJGNAI.GMENG-9514.
Xiao, Y., Z. Yuan, C. S. Desai, M. Zaman, Q. Ma, Q. Chen, and H. Liu. 2020. "Effects of load duration and stress level on deformation and particle breakage of carbonate sands." *Int. J. Geomech.* 20 (7): 06020014. https://doi.org/10.1061/(ASCE)GM.1943-5622.0001731.