

Geotechnical and Geoenvironmental Engineering Research Group

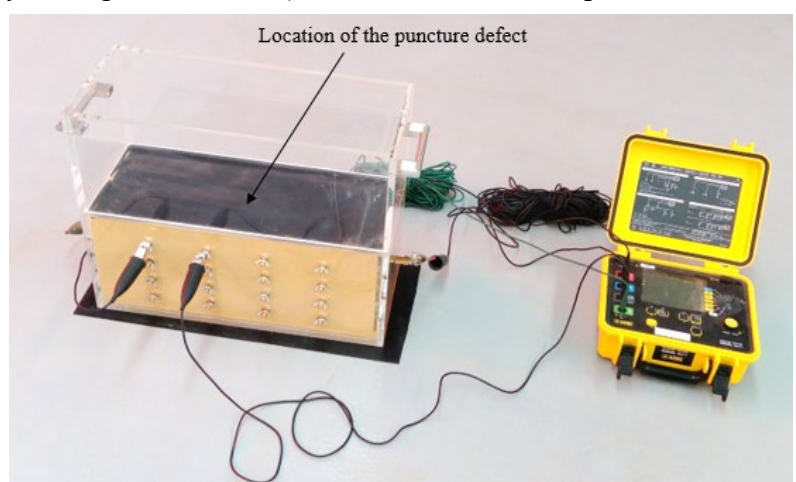
At the Geotechnical and Geoenvironmental Engineering Research Group, School of Engineering, Edith Cowan University, we work on cost-effective, environmentally friendly and sustainable solutions to the problems in the broad area of civil engineering practice known as the *Geotechnical and Geoenvironmental Engineering*. We collaborate with several global universities, research institutions, industries and individuals on academic and field projects.

Our Focus

Our current research focuses on several specific topics, such as geosynthetic applications in civil and mining engineering projects, fibre-reinforced soils, characterisation of geomaterials (soils and rocks), slope stability under static and dynamic loading conditions, engineered landfills, buried structures, static and dynamic earth pressures, utilization of mine and other wastes in construction, soil-structure interaction, pavement structures, and ground improvement techniques.



We have recently identified some new areas for extending our research focus, such as soil-cement (cement may be waste cementitious materials from industries), biocementation (changing loose/weak geomaterials to dense/hard geomaterials by biological activities), soil erosion and air pollution, waste management, effect of climate change on geomaterials and geotechnical structures, effect of sea level rise on tunnels and other buried structures, sustainable construction materials, reduction of carbon footprint in civil/geotechnical construction, geological aspects of geothermal energy, rehabilitation/closure of old mines and landfills, mine excavation and mineral processing (geotechnical/geoenvironmental engineering aspects), and analysis and design of tailing dams.



Our Research Success

We have recently developed many new engineering concepts for applications in field projects. Reinforced soil is a composite construction material formed by combining soil and reinforcement. Predicting the strength behaviour of the fibre-reinforced soils has been a challenging task for civil engineers since its development. This problem has been recently solved by developing a simple mathematical model that does not require the use of any software.

Analytical expressions for the total active and passive thrusts from the backfills have been quite popular among engineers for designing retaining structures since their development. In most real-life projects, the backfills are $c-\phi$ soils. Estimating the dynamic active thrust on the retaining structures from such soil backfills has not been possible by analytical methods considering both horizontal and vertical seismic loadings. The research group has presented analytical expressions for different field situations. *Shukla's generalized expression for seismic active thrust* (2015) and *Shukla's generalized expression for seismic passive resistance* (2013) are routinely used by practicing engineers worldwide for designing the retaining structures, in place of the classical Mononobe-Okabe (MO) expression (1924-1929), and Mononobe-Okabe-Kapila (MOK) expression (1962). Some of the special cases of Shukla's expressions (2013, 2015) developed earlier have also been described in significant details in US-based popular Geotechnical Engineering books as well as in the popular Soil Dynamics book. Recently, a full section (Sec. 14.13) has been included in the 10th edition (2022) of the most popular book titled, 'Principles of Geotechnical Engineering', Cengage, USA to describe Shukla's expression (2015). The researchers have started to compare their results obtained by numerical methods. Some researchers have also derived the Shukla's generalised expressions by different approaches for some special cases, as they can be seen at:

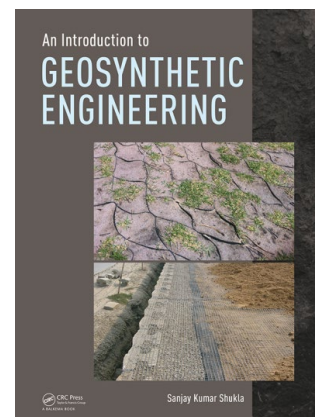
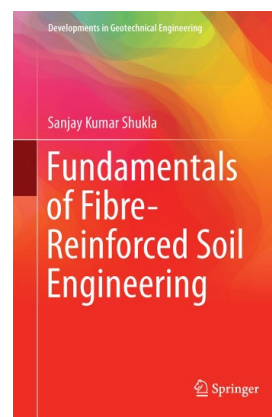
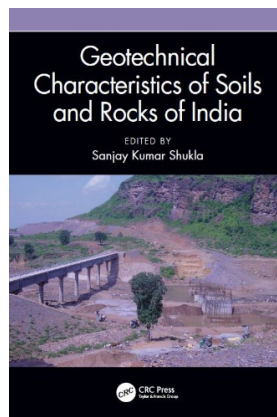
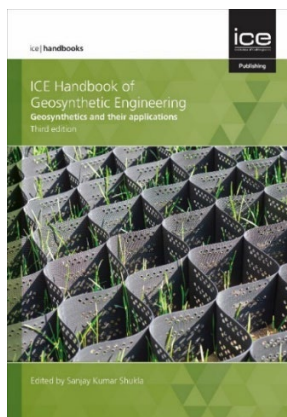
<https://link.springer.com/article/10.1007/s11204-019-09573-y>
<https://www.sciencedirect.com/science/article/abs/pii/S0267726118305669>

Other areas where our research group has created innovative research outcomes are strengthening the foundations by the *Shukla's wraparound technique* (developed during 2007-2008), seismic slope stability, mine stopes stability, soil arching concept, rock slope stability, airport pavement deflection, evaluation of elastic constants, buried conduits covered with geosynthetic-reinforced granular fills, mine waste utilization, electrical characterisation of geomaterials, and so on. Recently, a full section (Sec. 16.11) has been included in the 10th edition (2022) of the most popular book titled, 'Principles of Geotechnical Engineering', Cengage, USA to describe Sahoo and Shukla's design tables (2019) for slope stability analysis under earthquake condition.

Some selected publications are listed below (see the full publication list at:
<https://scholar.google.com.au/citations?user=XxhEDnMAAAAJ&hl=en>):

Recent Books

1. Shukla, S.K. (2022). *Geotechnical Characteristics of Soils and Rocks of India*. CRC Press, Taylor and Francis, London, ISBN 9781032010984 (Hardbound) & ISBN 9781003177159 (Ebook)
2. Shukla, S.K. (2022). *ICE Handbook of Geosynthetic Engineering*. 3rd edition, ICE Publishing, London, UK, ISBN: 978-0-7277-6500-0 (Hardbound) & ISBN: 978-0-7277-6501-7 (Ebook).
3. Shukla, S.K. (2017). *Fundamentals of Fibre-Reinforced Soil Engineering*. Springer Nature, Singapore, ISBN: 978-981-10-3061-1 (Hardbound), & ISBN: 978-981-10-3063-5 (EBook), DOI: 10.1007/978-981-10-3063-5.
4. Shukla, S.K. (2016/2017). *An Introduction to Geosynthetic Engineering*. CRC Press, Taylor and Francis, London, ISBN: 978-1-138-02774-9 (Paperbound) & ISBN: 978-1-4987-7809-1 (EBook).



Selected Research Papers

1. Otieno, F. and Shukla, S.K. (2023). An insight into failure of iron ore mine tailings dams. *International Journal of Mining, Reclamation and Environment*, UK, Vol. 37, No. 2, pp. 127-147, DOI: 10.1080/17480930.2022.2159295.
2. Rajabian, A. and Shukla, S.K. (2023). Stability analysis of anchor-reinforced soil slopes with Taylor's stability chart. *International Journal of Geomechanics*, ASCE, USA, Vol. 23, No.2, pp. 04022278:1 - 04022278:12, DOI: 10.1061/(ASCE)GM.1943-5622.0002619.
3. Jain, A., Mittal, S. and Shukla, S.K. (2023). Use of polyethylene terephthalate fibres for mitigating the liquefaction-induced failures. *Geotextiles and Geomembranes*, UK, Vol. 51, No. 1, pp. 245-258, DOI: 10.1016/j.geotexmem.2022.11.002.
4. Singh, M., Trivedi, A. and Shukla, S.K. (2022). Evaluation of geosynthetic reinforcement in unpaved road using moving wheel load test. *Geotextiles and Geomembranes*, UK, DOI: 10.1016/j.geotexmem.2022.02.005. (SECOND TOPMOST DOWNLOADED ARTICLE on 16 May 2022 in the last 90 days)
5. Raja, M.N.A. and Shukla, S.K. (2022). An extreme learning machine model for geosynthetic-reinforced sandy soil foundations. *ICE Geotechnical Engineering*, UK, Volume 175, Issue 4, pp. 383-403 DOI: 10.1680/jgeen.19.00297. [TOPMOST cited article on 17 January 2023]
6. Raja, M.N.A. and Shukla, S.K. (2021). Predicting the settlement of geosynthetic-reinforced soil foundations using evolutionary artificial intelligence technique. *Geotextiles and Geomembranes*, UK, Vol. 49, No. 5, pp. 1280-1293, DOI: 10.1016/j.geotexmem.2021.04.007. (TOPMOST downloaded on 16 May 2022; 17 January 2023 in the last 90 days)

7. Raja, M.N.A. and Shukla, S.K. (2021). Experimental study on repeatedly loaded foundation soil strengthened by wraparound geosynthetic reinforcement technique. *Journal of Rock Mechanics and Geotechnical Engineering*, China, Vol. 13, No. 4., pp. 899-911, DOI: 10.1016/j.jrmge.2021.02.001.
8. Khan, M.U.A. and Shukla, S.K. (2021). Numerical investigation of the structural response of a conduit buried within a soil slope. *Transportation Geotechnics*, Netherlands, Vol. 30, No. 100614, DOI: 10.1016/j.trgeo.2021.100614.
9. Raja, M.N.A. and Shukla, S.K. (2021). Multivariate adaptive regression splines model for reinforced soil foundations. *Geosynthetics International*, UK, Vol. 28, No. 4, pp. 368–390, DOI: 10.1680/jgein.20.00049.
10. Raja, M.N.A. and Shukla, S.K. (2020). Ultimate bearing capacity of strip footing resting on soil bed strengthened by wraparound geosynthetic reinforcement technique. *Geotextiles and Geomembranes*, UK, Vol. 48, No. 6, pp. 867-874, DOI: 10.1016/j.geotexmem.2020.06.005.
11. Khan, M.U.A. and Shukla, S.K. (2020). Load-settlement response and bearing capacity of a surface footing located over a conduit buried within a soil slope. *International Journal of Geomechanics*, ASCE, USA, Vol. 20, No. 10 (04020173), pp. 1-11, DOI: 10.1061/(ASCE)GM.1943-5622.0001807.
12. Pandey, L.M.S. and Shukla, S.K. (2020). Detection of leakage of MSW landfill leachates through a liner defect: experimental and analytical methods. *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, USA, Vol. 146, No. 8: 04020060, pp. 1-11, DOI: 10.1061/(ASCE)GT.1943-5606.0002288.
13. Sahoo, P.P. and Shukla, S.K. (2019). Taylor's slope stability chart for combined effects of horizontal and vertical seismic coefficients. *Géotechnique*, UK, DOI: 10.1680/jgeot.17.p.222.
14. Pandey, L.M.S. and Shukla, S.K. (2019). Development of an innovative liner leak detection technique. *Geotechnical Testing Journal*, ASTM, USA, DOI: 10.1520/GTJ20170292.
15. Pandey, L.M.S. and Shukla, S.K. (2019). An insight into waste management in Australia with a focus on landfill technology and liner leak detection. *Journal of Cleaner Production*, Netherlands, Vol. 225, pp. 1147-1154, DOI: 10.1016/j.jclepro.2019.03.320.
16. Bharathi, M., Dubey, R.N. and Shukla, S.K. (2019). Experimental investigation of vertical and batter pile groups subjected to dynamic loads. *Soil Dynamics and Earthquake Engineering*, UK, Vol. 116, No. 1, pp. 107-119, DOI: 10.1016/j.soildyn.2018.10.012.
17. Aria, S., Shukla, S.K. and Mohyeddin, A. (2019). Numerical investigation of wraparound geotextile reinforcement technique for strengthening foundation soil. *International Journal of Geomechanics*, ASCE, USA, Vol. 19, No. 4: 04019003, pp. 1-15.
18. Raj, D., Singh, Y. and Shukla, S.K. (2018). Seismic bearing capacity of strip foundation embedded in $c-\phi$ soil slope. *International Journal of Geomechanics*, ASCE, USA, Vol. 18, No. 7: 04018076, pp. 1-16.
19. Borana, L., Yin, J.H., Singh, D.N., Shukla, S.K. and Hua-Fu, P. (2017). Influences of initial water content and roughness on skin friction of piles using FBG technique. *International Journal of Geomechanics*, ASCE, USA, Vol. 17, No. 4: 04016097, pp. 1-14.
20. Shukla, S.K. (2015). Generalized analytical expression for dynamic active thrust from $c-\phi$ soil backfills. *International Journal of Geotechnical Engineering*, UK, Vol. 9, No. 4, pp. 416-421, DOI: 10.1179/1939787914Y.0000000076.
21. Shukla, S.K. (2013). Generalized analytical expression for dynamic passive earth pressure from $c-\phi$ soil backfills. *International Journal of Geotechnical Engineering*, UK, Vol. 7, No. 4, pp. 443-446, DOI: 10.1179/1939787913Y.0000000001.

22. Shukla, S.K. and Sivakugan, N. (2013). Load coefficient for ditch conduits covered with geosynthetic-reinforced granular fill. *International Journal of Geomechanics*, ASCE, USA, Vol. 13, No. 1, pp. 76-82, DOI: 10.1061/(ASCE)GM.1943-5622.0000181.
23. Shukla, S.K. (2011). Dynamic active thrust from $c-\phi$ soil backfills. *Soil Dynamics and Earthquake Engineering*, UK, Vol. 31, No. 3, pp. 526-529, DOI: 10.1016/j.soildyn.2010.10.001.
24. Shukla, S.K., Sivakugan, N. and Singh, A.K. (2010). Analytical model for fiber-reinforced granular soils under high confining stresses. *Journal of Materials in Civil Engineering*, ASCE, USA, Vol. 22, No. 9, pp. 935-942, DOI: 10.1061/(ASCE)MT.1943-5533.0000081.
25. Shukla, S.K., Gupta, S.K. and Sivakugan, N. (2009). Active earth pressure on retaining wall for $c-\phi$ soil backfill under seismic loading condition. *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, USA, Vol. 135, No. 5, pp. 690-696.
26. Shukla, S.K. and Kumar, R. (2008). Overall slope stability of the prestressed geosynthetic-reinforced embankment on soft ground. *Geosynthetics International*, UK, Vol. 15, No. 2, pp. 165-171.
27. Shukla, S.K. and Yin, J.H. (2003). Time-dependent settlement analysis of a geosynthetic-reinforced soil. *Geosynthetics International*, UK, Vol. 10, No.2, pp. 70-76.
28. Shukla, S.K. and Chandra, S. (1996). A study on a new mechanical model for foundations and its elastic settlement response. *International Journal for Numerical and Analytical Methods in Geomechanics*, USA, Vol. 20, No. 8, pp. 595-604.
29. Shukla, S.K. and Chandra, S. (1995). Modelling of geosynthetic-reinforced engineered granular fill on soft soil. *Geosynthetics International*, USA, Vol. 2, No. 3, pp. 603-618.
30. Shukla, S.K. and Chandra, S. (1994). A generalized mechanical model for geosynthetic-reinforced foundation soil. *Geotextiles and Geomembranes*, UK, Vol. 13, No. 12, pp. 813-825.

Research Team

Research Group Leader

Sanjay Kumar Shukla, PhD, MTech, BSc Eng, F.ASCE, FIEAust, FIEIndia, FIGS, CPEng NER, APEC Engineer, IntPE(Aus)

Founding Editor-in-Chief, *International Journal of Geosynthetics and Ground Engineering*, Springer Nature, Switzerland

Senior Editor (Civil and Environmental Engineering), *Cogent Engineering*, Taylor and Francis, UK

Regional Editor (Australia) as an Editorial Board Member, *Soil Mechanics and Foundation Engineering*, Springer, Moscow, Russia

Book Series Editor, *Geot. Characteristics of Soils and Rocks around the World*, Taylor & Francis, USA

Book Series Editor, *Lecture Notes in Civil Engineering (LNCE)*, Springer, Switzerland

Founding Geotechnical and Geoenvironmental Engineering Research Group Leader, Discipline of Civil Engineering, School of Engineering, Edith Cowan University, Joondalup, Perth, Australia

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Registered Chartered Professional Engineer in Civil and Geotechnical Engineering, Engineers Australia; APEC (Asia Pacific Economic Cooperation) Engineer in Civil Engineering; International Professional Engineer in Civil Engineering, International Engineering Association (IEA)

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Lecturer and Coordinator, Discipline of Civil Engineering

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Research Profile: <https://scholar.google.com/citations?hl=en&user=EWA4cv8AAAAJ>

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Research Profile: https://scholar.google.com.my/citations?user=KL3_7OIAAAAJ&hl=en

ResearchGate Profile: <https://www.researchgate.net/profile/Nuha-Mashaan>

Current PhD Candidates

Mr Francis Otieno, PhD Candidate, Edith Cowan University, Joondalup, Perth, Australia
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Ms D.Y. Ghaley, PhD Candidate, Edith Cowan University, Joondalup, Perth, Australia
Mr M.K. Kalara, PhD Candidate, Delhi Technological University, Delhi, India
Mr Y. Kumar, PhD Candidate, Delhi Technological University, Delhi, India
Mr K. Gaur, PhD Candidate, Delhi Technological University, Delhi, India
Ms Surya M., PhD Candidate, Amrita Vishwa Vidyapeetham, Coimbatore, India
Mr. V. Vijayan, PhD Candidate, Amrita Vishwa Vidyapeetham, Coimbatore, India
Mr. R. Maurya, PhD Candidate, Amity University, Noida, India.
Mr. A. Dixit, PhD Candidate, Harcourt Butler Technical University, Kanpur, India
Ms A.M. Mohammed, PhD candidate, Universiti Putra Malaysia (UPM), Malaysia

Supervisory Team Collaborations

Dr Ashutosh Trivedi, Professor, Delhi Technological University, Delhi, India
Dr K.M. Mini, Professor & Chairperson (Civil Engg.), Amrita Vishwa Vidyapeetham, Coimbatore, India
Dr Dhanya Sathyan, Assistant Professor, Amrita Vishwa Vidyapeetham, Coimbatore, India
Dr Deepesh Singh, Associate Professor, Harcourt Butler Technical University, Kanpur, India
Dr Madhuri Kumari, Professor and Dy. Director (P&IR), Amity University, Noida, India
Dr Haslinda Binti Nahazanan, Associate Professor, Universiti Putra Malaysia (UPM), Malaysia

Former Postdoctoral Candidates

Dr G.L. Le, Edith Cowan University, Joondalup, Perth, Australia, currently at the Department of Civil Engineering, Can Tho University, Can Tho, Vietnam
Dr P.K. Sharma, Edith Cowan University, Joondalup, Perth, Australia, currently at the Department of Civil Engineering, Indian Institute of Technology, Roorkee, India
Dr V.A. Sawant, Edith Cowan University, Joondalup, Perth, Australia, currently at the Department of Civil Engineering, Indian Institute of Technology, Roorkee, India

Former PhD Candidates

Dr M.U.A. Khan, Edith Cowan University, Joondalup, Perth, Australia
Dr M.N.A. Raja, Edith Cowan University, Joondalup, Perth, Australia
Dr A. Jain, Indian Institute of Technology, Roorkee, India
Dr M. Singh, Delhi Technological University, Delhi, India
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Dr E. Baah-Frempong, Edith Cowan University, Joondalup, Perth, Australia
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Dr Shunxing Liang, Edith Cowan University, Joondalup, Perth, Australia
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Dr L.M.S. Pandey, Edith Cowan University, Joondalup, Perth, Australia
Dr F.A. Kuranchie, Edith Cowan University, Joondalup, Perth, Australia
Dr M. Kazi, Edith Cowan University, Joondalup, Perth, Australia
Dr L. Borana, The Hong Kong Polytechnic University, Hong Kong
Dr C.H. Ting, James Cook University, Townsville, Australia

Awards (selected only)

- 2021 *Edith Cowan University Aspire Award Winner* being the WA's Brightest Mind from the Business Events Perth, which is supported by the Government of Western Australia, Perth, Australia.

2021 Edith Cowan University Aspire Award Winner Dr Sanjay Kumar Shukla

Meet Dr Sanjay Kumar Shukla; Associate Professor of Civil Engineering and Research Group Leader of ECU's Geotechnical and Geo-environmental Engineering Research Group, who's work is leading to a more sustainable future for the mining and resources industry, and winner of the 2021 Edith Cowan University Aspire Award.



YouTube link: <https://youtu.be/WacEtrUJzZY>

Business Events Perth links: <https://www.businesseventspertth.com/aspire-program/awards/edith-cowan-university-aspire-award/>

<https://www.businesseventspertth.com/articles/post/western-australian-excellence-recognised-in-2021-aspire-awards/>

2021 ECU Aspire Award Winner

Tuesday, 26 October 2021

Thanks to Business Events Perth and the Aspire Program, ECU academic staff member Dr Sanjay Kumar Shukla has been awarded \$5,000 to attend an international conference in his field. The Aspire Awards support ECU's researchers, academics and professionals to attend international conferences, share knowledge and connect with industry leaders all over the world.

Winner: Dr Sanjay Kumar Shukla

Dr Shukla's field of research in geosynthetics (construction materials used to achieve sustainability in ground infrastructure projects) and their applications, falls into one of our key research themes: Natural and Built Environments. This is one of our four key research priority areas where we seek to understand, harness, build and protect environments for sustaining people, place and planet.

Dr Shukla has made a significant contribution to his research areas authoring over 275 research papers and articles, and authoring/editing 23 books. At a global level, he is the only author of several books related to geosynthetics.

Dr Sanjay Kumar Shukla leads the International Journal of Geosynthetics and Ground Engineering and has been an integral part of ECU and the School of Engineering for over a decade (since 2009).

"Winning the 2021 Aspire Award is very special to me. I plan to attend the 12th International Conference on Geosynthetics in Rome, Italy during 17-21 September 2023 with support from this award. This highly prestigious conference is organised by the International Geosynthetics Society (IGS), USA, every four years. I will have an opportunity to establish new collaborations, and share my knowledge and experience with researchers, practising engineers and other professionals working globally in geosynthetic engineering. This supports the sustainable development of ground infrastructures in civil, mining, agricultural and aquacultural engineering as we have been focusing on developments in Australia," said Dr Shukla.



ECU Aspire Award winner Dr Sanjay Kumar Shukla (centre) with Professor Arshad Omari, Senior Deputy Vice-Chancellor (right), and Business Events Perth CEO, Gareth Martin (left).

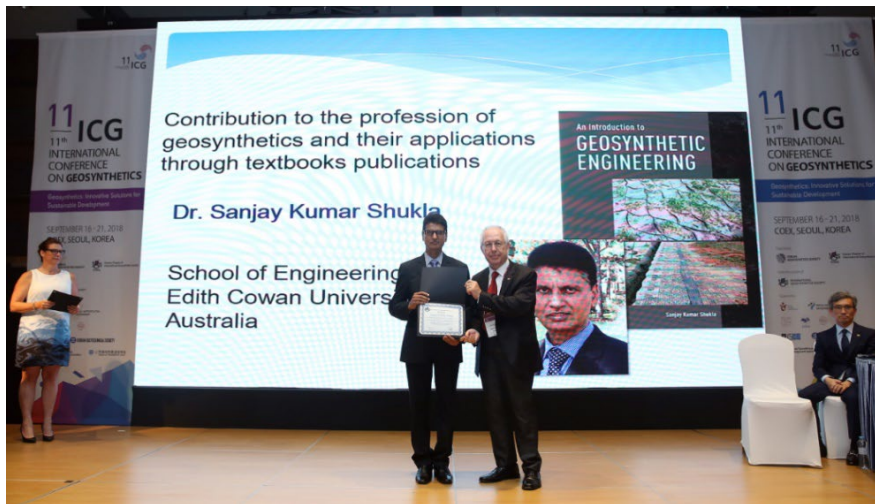
Related Media

1 YouTube Video

Launch Viewer

ECU news story: <https://intranet.ecu.edu.au/staff/news/overview/2021/10/2021-ecu-aspire-award-winner>

- *IGS Award (2018)* from the *International Geosynthetics Society (IGS)*, USA in recognition of outstanding contribution to the development and use of geosynthetics during the 2014-2017 IGS award period, received in concert with the IGS General Assembly and the International Conference on Geosynthetics (ICG) at Seoul, South Korea on 19 September 2018.



This is the most prestigious of all the IGS Awards. This award is given out every four years in concert with the IGS General Assembly and the International Conference on Geosynthetics.

<https://www.geosyntheticssociety.org/awards/>

<https://www.geosyntheticssociety.org/igs-awards-2014-2017/>

Geosynthetics expert honoured

Friday, 02 November 2018

Associate Professor Sanjay Kumar Shukla's contribution to the field of geosynthetics was recognised with a major international award recently.

Professor Shukla was awarded the International Geosynthetics Society (IGS) Award at their recent conference at Seoul in recognition of his outstanding contribution to the development and use of geosynthetics during 2014-2017.

The IGS Award is given out every four years, and being the most prestigious award, is considered to be the Nobel Prize for the field of geotechnical and geoenvironmental engineering.

Professor Shukla said it was a great honour to receive the award.

"I was thrilled to receive the IGS Award, it is wonderful to receive this kind of recognition from my peers in the field of geosynthetics, which protect the environment, and provide innovative and sustainable solutions to infrastructure problems," he said.

Visit the [IGS website](https://www.geosyntheticssociety.org/) for more information.



A/Prof. Sanjay Kumar Shukla

- *IGS-Z-Tech Biannual Best Paper Award* (2016) from the *Indian Geotechnical Society* for the best paper published in the *Indian Geotechnical Journal* (Springer), New Delhi, India.



Global Research Leadership Research

Dr Sanjay Kumar Shukla, the Founding Geotechnical and Geoenvironmental Engineering Research Group Leader at the School of Engineering, Edith Cowan University, established an international team of world-leading researchers in 2014 to lead the research in the area of geosynthetics and ground engineering at the global level by establishing the *International Journal of Geosynthetics and Ground Engineering* as its Founding Editor-in-Chief with new concepts and several special features of practical importance. This journal is published by Springer Nature, Switzerland, a highly reputed global publisher. This journal has been benefiting the researchers and practising engineers worldwide significantly in several ways and has become the first publication platform for publishing the high-quality research works and engineering practices. In the Category, Engineering Geological, the **FIRST Impact Factor** (IF) (Clarivate/Web of Science) in **2022** for the *International Journal of Geosynthetics and Ground Engineering* (IGGE), a **Q1** journal by Scopus, is **2.9**.



More details about this journal can be found at:

<https://www.springer.com/journal/40891>

The researchers and innovators of the world are following the Shukla's seven research mantras as detailed at:

<https://link.springer.com/article/10.1007/s40891-022-00419-6>

These proved mantras can be downloaded FREELY. They are helping everyone to create a happy, healthy and sustainable research environment as we need in the 21st century and beyond. The Australian media highlighted these mantras through a long conversation, which is available at:

<https://www.theaustraliatoday.com.au/learn-the-seven-research-mantras-for-success-in-the-academic-world/>
<https://www.youtube.com/watch?v=pYtLhdvoPI4>

Contact Details of the Research Group Leader

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If you are interested in applying to ECU for the PhD degree or want to discuss solutions to site-specific industrial/research problems in geotechnical and geoenvironmental engineering, you may contact the research group leader.