Part B-2

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4. CV of the researcher

Dr. Lenganji Simwanda, PhD

Postdoctoral Research Fellow, Czech Technical University in Prague,

Email: lenganji.simwanda@cvut.cz; lenganjisimwanda@gmail.com

Google Scholar Link: My Profile

ORCID Profile: My Profile

Website: https://lenganjisimwanda.com/

Education

- 2022-12 **Ph.D. in Civil Engineering**, Stellenbosch University, South Africa.
  Dissertation: Structural reliability of ultra-high-performance fibre-reinforced concrete (UHPFRC) structures.
- 2020-12 **M.Eng in Structural Engineering**, University of Zambia, Zambia.
  Dissertation: Finite element modelling of UHPFRC beams exposed to fire.
- 2018-12 **B.Eng in Civil & Environmental Engineering (With Distinction),** University of Zambia, Zambia.
  Final year dissertation: A drive towards cost-effective structural design in reinforced concrete; A comparative study of BS 8110: 1997 And Eurocode 2 in Zambia.

Research Experience

- 2024 **Postdoctoral Research Fellow (2 years)**, Czech Technical University in Prague

  Research focus: Probabilistic modelling and sustainability-driven assessments of UHPC and industrial cooling towers and Collaborating with Czech cooling tower owners to develop lifecycle optimization frameworks integrating Bayesian updating and machine learning. Participated in the following grants/task groups:

  - Machine Learning for Multiscale Modelling of Spatial Variability and Fracture for Sustainable Concrete Structures (AI4FRACTURE)- implemented Bayesian updating of carbonation depth model using Cooling Towers as a case study.
  - Stochastic Interaction of Climatic Actions in Structural Reliability- Implemented some machine learning models for predicting snow coefficients on glass roofs.
  - Others: joined as a member of the fib Commission 3 Task group 3.1 looking at Existing Concrete Structures- contribution on innovative concrete materials (UHPC).

- 2023 **Postdoctoral Research Fellow (6 months)**, University of South Africa.

  Research focus: Data-driven methods for CFST and CFDST columns under combined torsion and compression.

  Mentor: Prof. Bolanle Ikotun, Department of Civil and Environmental Engineering and Building Sciences.

- 2023 **Consolidoc Postdoctoral Research Fellow (6 months)**, Stellenbosch University.

  Research focus: Structural reliability of ultra-high-performance fibre reinforced concrete structures.

  Mentor: Prof. Nico De Koker, Department of Civil Engineering.

Teaching Experience

- 2023 **Part-Time Lecturer**, Civil and Environmental Engineering, University of Zambia.
  - Theory of Structures Course for bachelor's students; gave lectures and guided student-centred tutorial sessions. Marked and graded exams for 108 students
- 2023 **Part-Time Lecturer**, Civil and Environmental Engineering, University of Zambia.
  - Advanced design of Reinforced Concrete Structures Course for master's students; gave lecture sessions. Marked and graded exams for 16 students
- 2020-2023 **Teaching Assistant**, Civil Engineering, Stellenbosch University.
  - Theory of Structures and Strength of Material Courses for bachelor's students; I was an instructor for a week and gave lectures for that week in Strength of materials, I also assisted students during tutorials via the student-centred learning approach.
- 2017– 2019 **Part-time Tutor**, University of Zambia, Zambia.
  - Statics and introduction to mechanics of materials bachelor's course; I assisted students in tutorials and graded quizzes and assignments of 150 students.

Industrial Experience

- 2025 **Design Engineer**, V-CON s.r.o, Valbek group, Prague, Czech Republic. Design/Detailing and review of Temporary Structures for Bridges, Design/Detailing and Review of Bridges to Eurocodes. Every other duty related to designer engineer.
- 2021-2024 **Part-Time Senior Structural/Geotechnical Engineer**, Blendscope Engineering Consultants, Lusaka, Zambia. Design/Detailing and review of industrial/building structures. Geotechnical investigations (Field tests and Report writing), Assessment/technical approval of building sites. Every other duty related to Structural/Geotechnical engineer.
- 2020-2021 **Part-Time Geotechnical and Structural Engineer**, Milestones Engineering Consultants, Lusaka, Zambia. Design/Detailing and review of building structures/culverts, Geotechnical Investigations for bridges/buildings (Field & Laboratory tests, Report Writing). Every other duty related to Structural/Geotechnical engineer.

Fellowships and Grants

- 2024.02-present **CTU Global Postdoctoral Research Fellowship** *890*'000 CZK for one year.
- 2023.06-2024.06 **UNISA Postdoctoral Research Fellowship** 180'000 ZAR for half year.
- 2023.01-2023.06 **Stellenbosch University Consolidoc Postdoctoral Fellowship**. 100'000 ZAR for 6 months

Research Interests

Civil and Structural Engineering; Net-Zero Carbon, Sustainability; Artificial Intelligence; and Risk, Reliability, and Resilience

Skills

Python, PyTorch, Scikit-learn, TensorFlow, GitHub, Kaggle, Data Processing and Management

Awards and Honours

- **2025** – **Outstanding Presentation Award**, *1st International Conference on Artificial Intelligence in Structural Engineering*, Torino, Italy. Awarded for the presentation *"Generative Design and Optimisation of UHPC Mixes Using Variational Autoencoders, Ensemble Learning and Genetic Algorithms."*
- 2019-Rankin consulting Engineer's Award for the **Best Graduating Student** in Civil and Environmental Engineering, University of Zambia.
- 2016-Engineering Institution of Zambia's award for the **Best overall third year in the School of Engineering** and Kiran & Musonda Associates award for the best third year student in the department of civil engineering, University of Zambia.

Foreign Languages

- English (Fluent)
- French (Intermediate)

Journal publications (published)

Google scholar profile: Link to profile

A full list of publications is given below.

1. Silewu, K.; Kahanji, C.; Simwanda, L.; Sykora, M. Intelligent Data Driven Ensemble Approaches for Bending Strength Prediction of Ultra-High Performance Concrete Beams. *Bulletin of Computational Intelligence* **2025**, *1* (1), 31–52.
2. L. Simwanda, A.B Davida, O.B. Olalusi, I.B Muhit, M. Sykora. Shear capacity prediction and reliability analysis of CRC beams via generative modeling and ensemble learning, Engineering Applications of Artificial Intelligence, Vol. 157, pp. 111085, doi: 10.1016/j.engappai.2025.111085
3. Simwanda, L., Dr, PhD, Sykora, M., Assoc. Prof. ,. PhD, & Lenner, R., Assoc. Prof. ,. PhD. (2025). Full and Semi-Probabilistic Analysis of Ultra-High-Performance Concrete Beams in Bending via Machine Learning. Structural Engineering International, 1–15. doi: 10.1080/10168664.2025.2500458
4. M. M. Madirisha, L. Simwanda, and R. P. Mtei, "Predicting the hydrogen storage capacity of alumina pillared interlayer clays using interpretable ensemble machine learning," Int. J. Hydrogen Energy, vol. 120, pp. 354-364, 2025. doi: 10.1016/j.ijhydene.2025.03.216.
5. Amika, A.U., Haas, T.N., Simwanda, L. Reliability-based assessment of a multilinear regression model for estimating the ultimate load of eccentrically loaded slender circular CFDST columns. *Structural Concrete*, 2025. doi: 10.1002/suco.202400418
6. Simwanda, L., Ikotun, B.D., Ilunga, F.M., Onyari, E.K. "Epistemic uncertainties in torque capacity prediction models for circular CFDST members", *Journal of Construction Steel Research*, 2025, volume 226, pages 109299, doi: 10.1016/j.jcsr.2024.109299

7. Gatheeshgar, P., Ranasinghe, R. S. S., Mohotti, D., Meddage, D. P. P., & Simwanda, L. (2024). Machine learning prediction of web crippling strength in cold-formed steel beams with staggered slotted perforations. Structures,71:108079, doi.org/10.1016/j.istruc.2024.108079
8. David, A.B.; Olalusi, O.B.; Awoyera, P.O.; Simwanda, L. Suitability of Mechanics-Based and Optimized Machine Learning-Based Models in the Shear Strength Prediction of Slender Beams Without Stirrups. Buildings 2024, 14, 3946. https://doi.org/10.3390/buildings14123946
9. Amika AU, Haas TN, Simwanda L. Multilinear regression model for predicting the ultimate load of slender circular CFDST columns subjected to concentric and eccentric loading. Structural Concrete. 2024. https://doi.org/10.1002/suco.202400417
10. Simwanda, L., Gatheeshgar, P., Ilunga, F. M., Ikotun, B. D., Mojtabaei, S. M., & Onyari, E. K. (2024). Explainable machine learning models for predicting the ultimate bending capacity of slotted perforated cold-formed steel beams under distortional buckling. Thin-Walled Structures, 112, 112587. https://doi.org/10.1016/j.tws.2024.112587
11. Chandrasiri D, Gatheeshgar P, Ahmadi HM, Simwanda L. Numerical Study of Thermal Efficiency in Light-Gauge Steel Panels Designed with Varying Insulation Ratios. Buildings. 2024; 14(1):300. https://doi.org/10.3390/buildings14010300
12. L. Simwanda, P. Gatheeshgar, BD. Ikotun, M. Bock, FM Ilunga, EK. Onyari, "Reliability analysis of shear design provisions for cold formed steel sections", Journal of Construction Steel Research, 217 (2024): 108656, doi.org/10.1016/j.jcsr.2024.108656.
13. Simwanda L, Ikotun BD. Prediction of Torque Capacity in Circular Concrete-Filled Double-Skin Tubular Members under Pure Torsion via Machine Learning and Shapley Additive Explanations Interpretation. Buildings. 2024; 14(4):1040. https://doi.org/10.3390/buildings14041040
14. L. Simwanda, N. De Koker, C. Viljoen, and AJ. Babafemi, "Structural reliability of ultra-high-performance fiber reinforced concrete beams in shear" Structural Concrete, 2023; 24(2): 2862–
15. 2878. https://doi.org/10.1002/suco.202200342
16. L. Simwanda, C. Kahanji, and F. Ali, "Numerical simulation, parametric analysis and design of
17. UHPFRC Beams exposed to fire", Structures 52,1-16 (2023), doi.org/10.1016/j.istruc.2023.03.155.
18. L. Simwanda, N. De Koker, C. Viljoen, and AJ. Babafemi, "Bayesian calibration and reliability of UHPFRC beams in fire", Structural Safety 103, 102352 (2023) https://doi.org/10.1016/j.strusafe.2023.102352
19. L. Simwanda, N. De Koker, and C. Viljoen, "Structural reliability of ultra-high-performance fibre reinforced concrete beam in flexure", Engineering Structures 244, 112767 (2021), https://doi.org/10.1016/j.engstruct.2021.112767

Conference proceedings (published)

1. Silewu, K., Kahanji, C., & Simwanda, L. (2025). Explainable machine learning prediction of the flexural capacity of UHPFRC beams. In Engineering materials, structures, systems and methods for a more sustainable future (1st ed., p. 5). CRC Press. https://doi.org/10.1201/9781003677895-130
2. Simwanda, L., Lehký, D., Šomodíková, M., & Sýkora, M. (2025, June). Probabilistic assessment of cooling towers under carbonation-induced corrosion using a categorical boosting machine learning model. In Proceedings of the 20th fib Symposium (16–18 June 2025, Antibes, France).
3. Simwanda, L., Ikotuna, B. D., Ilunga, M., Onyari, E., & Perampalam, G. (2024). Prediction of the torsional capacity of CFDST steel columns using extreme gradient boosting tree-based machine learning technique. In Proceedings of the 15th Nordic Steel Construction Conference (paper No. 99). Luleå, Sweden, June 26–28. https://doi.org/10.5281/zenodo.12522918
4. Perampalam, G., Idongesit, U., Bock, M., Dimopoulos, C., & Simwanda, L. (2024). Shear behaviour of cold-formed stainless steel lipped channel sections with web holes. In Proceedings of the 15th Nordic Steel Construction Conference (Paper No. 100). Luleå, Sweden, June 26–28. https://doi.org/10.5281/zenodo.12123993

5. Simwanda, L., & Sykora, M. (2024). Prediction of moment capacity of ultra-high-performance concrete beams using explainable extreme gradient boosting machine learning model. In Proceedings of the CEACM S4ML 2024 Conference, June 19-21, Prague, Czech Republic.
6. Simwanda, L., Sykora, M., & Markova, J. (2024). Model uncertainty in European UHPC standards: Insights from SIA-2052 and NF P18-710 flexure models. In Proceedings of the 4th Central European Congress on Concrete Structures, September 22-24, Mikulov, Czech Republic.
7. Simwanda, L., & Sykora, M. (2024). Resistance model uncertainty in non-linear finite element analyses of ultra-high-performance reinforced concrete beams in flexure. In Proceedings of the Fifteenth International Conference on Computational Structures Technology, special session: Advances in Safety Assessment through Numerical Analyses, September 4-6, Prague, Czech Republic. http://dx.doi.org/10.4203/ccc.9.9.3
8. L. Simwanda, N. De Koker, C. Viljoen, and AJ. Babafemi, "Structural reliability of existing RC beams strengthened with UHPFRC tensile layers", Proceedings of the 19th International Probabilistic Workshop 2022 26:191, 197 (2022). 2022, https://ojs.cvut.cz/ojs/index.php/APP/article/view/8409

Manuscripts (submitted/under review/accepted)

1. L. Simwanda, P. Gatheeshgar, M. Sykora, P. Sejkot, AB David, OB Olalusi. Local buckling strength prediction of slotted cold-formed steel beams using ensemble learning, *(*Accepted*), Journal of Constructional Steel Research, Elsevier.*
2. Paul Awoyera, Lenganji Simwanda, Hybrid and Ensemble Machine Learning Models for Predicting Strength Characteristics of Concrete Incorporating Recycled Aggregates, under review in *Results in Engineering, Elsevier.*
3. Simwanda, L.; David, A.B.; Perampalam, G.; Olalusi, O.B.; Sykora, M. Optimization of Interlayer Bond Strength in 3D-Printed Concrete Using Response Surface Methodology and Artificial Neural Networks. *Buildings* 2025, Under Review.
4. Kannan, T., Simwanda, L., Thirunavukkarasu, K., Sifan, M., Pologanathan, K., Kamalaseelan, K., Lingaretnam, J., & Popo-Ola, S. (2025). Interpretable ensemble learning for predicting web-crippling strength of cold-formed steel sigma sections under end-two-flange loading [submitted for publication]. *Advances in Structural Engineering*.
5. Simwanda, L., Sýkora, M., Kolisko, J., & Markova, J. (2025*).* Model uncertainty in bending capacity models for ultra-high-performance concrete beams reinforced with steel rebars [Under Review]. *Structural Safety*.
6. Morudu, K. N., Ikotun, B. D., Simwanda, L., & Zimbili, A. O. (2025). Reliability analysis of studded shear connectors in composite slabs subjected to shear loading [Manuscript submitted for publication]. *Journal of Constructional Steel Research, Elsevier.*
7. Gatheeshgar, P., Pathirana, D., Bock, M., & Simwanda, L. (in press). Influence of web holes on critical elastic web crippling strength of cold-formed steel sections with web holes. In Proceedings of the International Colloquium on Stability and Ductility of Steel Structures (SDSS 2025*)*, 8–10 September 2025, Barcelona, Spain. *ce/papers*. Ernst & Sohn / Wiley.
8. Simwanda, L., Markova, J., Sykora, M., & Thiis, T. K. (in press). Automated ensemble machine learning models for roof snow load estimation of heated flat roofs. *Structural Integrity Procedia*. Elsevier. To appear in *Proceedings of the 23rd International Conference on Modelling in Mechanics 2025*, Prague, Czech Republic.
9. Sykora, M., Holicky, M., Markova, J., Simwanda, L., & Valik, A. (in press). On modelling of snow and wind loads – Pilot investigation of Czech meteorological records. *Structural Integrity Procedia*.

Elsevier. To appear in *Proceedings of the 23rd International Conference on Modelling in Mechanics 2025*, Prague, Czech Republic.

10. Simwanda, L., & Sykora, M. (2025, September 14–17). Generative design and optimisation of ultra-high-performance concrete mixes using variational autoencoders, ensemble learning, and genetic algorithms [Manuscript submitted for presentation/publication]. In *Proceedings of the First International Conference on Artificial Intelligence in Structural Engineering (ARTISTE 2025)*, Torino, Italy.

Membership to Societies and Associations

- Since 2024 Member of International Federation of Concrete (fib) Task Group 3.1, Commission 3, Existing Concrete Structures.
- 2023 Professional Engineer (PrEng) and Registered Engineer (REng), Engineering Institution of Zambia.
- 2022 Student member of the Society of Fire Protection Engineering since 2022.
- 2022 Associate member of the South African Institution of Civil Engineering (AMSAICE).

Selected academic services.

- President of the Society of Fire Protection Engineering student chapter, Stellenbosch university, 2022 academic year.
- Member of International Federation of Concrete (fib) Task Group 3.1 - Reliability and safety evaluation: full-probabilistic and semi-probabilistic methods for existing structures, Commission 3 Existing Concrete Structures.
- Member of conference editorial board of special session "CST-S15: Advances in Safety Assessment through Numerical Analyses" of the Fifteenth International Conference on Computational Structures Technology to take place in 4-6 September 2024 in Prague, Czech Republic.
- Guest editor of special issue in Buildings Journal MDPI titled "Emerging Trends in Machine Learning for Structural Engineering: Innovations and Applications", April 2024- December 2025
- I review and have reviewed for the following Journals: Building Engineering, Thin-walled Structures, Journal of Constructional Steel Research, Nature's Scientific Report's, Structural Concrete fib Journal, Engineering Structures, Results in Engineering, Multiscale and Multidisciplinary Modeling, Experiments and Design , International Probabilistic Workshop, Structures, SAICE Journal, Materials Proceedings, Innovative Infrastructure Solutions, Research on Engineering Structures and Materials, Iranian Journal of Science and Technology, Transactions of Civil Engineering, University of Zambia Journal of Natural and Applied Sciences, Scientia Iranica.

Co-supervision of PhD projects

- Amika Usungo (2022-2024) on *informal basis*, **parameter ranking, predictive modelling, and reliability assessment for the ultimate load capacity of eccentrically loaded slender circular concrete-filled double-skin tubular (CFDST) columns**, Stellenbosch University)
- Judah Mwanangombe (2024-2026) on *informal basis*, **Uncertainty quantification, machine learning and reliability assessment of provisions for cold-formed steel built up columns considering global, local-global, and distortional buckling limit states**, University of south Africa)

Co-supervision of MEng projects

- Mutakwa Sikazwe (2025-current), on *informal basis*, **An explainable machine learning approach to assessing the influence of chord yield-to-tensile stress ratio on the static strength of unstiffened CHS k-gap joints under static axial loading**, University of Zambia)
- Job Kapundu (2024-2025), on *informal basis*, **A deep learning model for predicting the bond strength between fibre reinforced polymer reinforcement and ultra high-performance concrete**, University of Zambia)
- Kennedy Silewu (2024-2025), on *informal basis*, **Explainable machine learning prediction of flexural capacity of ultra-high performance concrete**, University of Zambia)
- Kagiso Ntate Morudu (2023-2025), **Reliability analysis of studded shear connectors in composite slabs subjected to shear loading**, University of South Africa)
- Mweetwa Mulongo (2021-2022) on *informal basis*, **Numerical Investigation of Steel Reinforced Bamboo Scrimber Beams**, University of Zambia)

Co-supervision of BEng projects

- Percy Kholofelo Moila (2023-2024), **Evaluating the significance use of rubberized concrete using finite element analysis**, University of South Africa)
- Kulani Dinivha Kennedy (2023-2024**, Investigating the sliding of mass concrete river bridge footing**, University of South Africa)
- Brian Mphaza (2021-2022), *on informal basis*, **Finite element based post-fire residual compressive strength of masonry walls**, Mulungushi University)

Seminars, Colloquia and talks (non-conference proceedings)

2025 – *Generative Design and Optimisation of UHPC Mixes Using Variational Autoencoders, Ensemble Learning and Genetic Algorithms*. Presented at the *1st International Conference on Artificial Intelligence in Structural Engineering*, Torino, Italy. Awarded *Outstanding Presentation Award* for excellence in delivery and research impact.

2024 Klokner Institute Seminar on **Ultra-High-Performance Concrete: Probabilistic models, Model Uncertainty, and Artificial Intelligence**, Klokner Institute seminar Room, Prague, Czech Republic (*shared how generative AI based of latent space VAE could be leveraged to optimize mix design of UHPFRC with objectives of minimizing carbon footprint and cost of UHPFRC while maintaining a good compressive strength*)

2024 Fib TG 3.1 meeting presentation on **Probabilistic Models for UHPC in Bending: A State-of-the-Art Perspective**. fib Task Group 3.1 Meeting, Torino, Italy (*shared the current knowledge and gaps on probabilistic models of UHPFRC in bending, and shedding some light and guidance for the Probabilistic Model Code 2020*)

2023 Seminar presentation on **Enhancing structural analysis with machine learning: CFDST columns in torsion**. CEE Departmental seminar, University of South Africa, Johannesburg, South Africa (*shared my conceptual framework for analysing and designing CFDST columns under torsion integrating data-driven ML approaches and Uncertainty quantification (model uncertainty and structural reliability)*

2021 PhD proposal colloquium on. **Structural reliability of UHPFRC structures**. Stellenbosch university, Stellenbosch, South Africa (*shared my proposed framework for conducting reliability analysis of UHPCFRC structures)*

2021 Directorate of Research and Graduate Studies seminar on **Finite element modelling of UHPFRC beams in fire**. Supervisors, University of Zambia, Zambia

2020 CE Departmental colloquium on **Updating reliability using health monitoring data,** Stellenbosch university, Stellenbosch, South Africa

Selected industrial projects (consulting)

I have been and am involved in various consulting geotechnical and structural engineering projects through Ken Structural Consulting Engineering, for a multitude of clients. Some key projects are listed here.

1. Structural assessment of steel-concrete footbridge bridge - 2025-06
2. Structural assessment of temporary structures for reconstruction of a steel trussed bridge, 2025-01/04
3. Structural assessment of railway bridge (steel trussed bridge carrying two railway track)- 2025-05
4. Structural assessment of railway bridge (steel plate girder bridge carrying one railway track)- 2025-02
5. Structural assessment of temporary structures for two concrete bridges, 2025-01/04
6. Structural design and detailing of the proposed office structure for Zenith Pipes Limited to be constructed in M-Phase New Kasama as part of their Phase 1 project, 2023-12
7. Structural design and detailing of the proposed warehouse structure for Zenith Pipes Limited to be constructed in M-Phase New Kasama as part of their Phase 1 project, 2023-12
8. Bearing capacity investigations for the proposed site in Maamba for development of a School and subcontracted by Bicon Zambia, 2023-05
9. Structural integrity assessment reporting of the existing structural members at National Breweries PLC - Zambia, 2023-02
10. Bearing capacity investigations for the proposed site of a water tank stand for Mulonga Water and Sewerage Company, 2022-01
11. Structural design and detailing of the proposed Lusaka West Bread of Life Church in Zambia, 2022-01 Structural design and reporting of a proposed sub-station in Chingola, 2022-11.
12. Structural design review of the proposed structural designs for the jaw crusher platform at Grizzly Mining Ltd in lufwanyama-Zambia, 2022-12
13. Structural member design and detailing of a steel structural frame for the proposed two storey flats to be built in woodlands. (Design was initially done in reinforced concrete and client requested the design to be re-done in structural steel), 2022-11.
14. Structural member design of a steel portal frame housing a 5Ton mobile crane for Kagem Emerald mine, 2022-11.
15. Structural member design and reporting of the proposed billboard for the Myrex Media Solutions group, 2022-11.
16. Structural member design and reporting of the proposed electronic billboard at Katuba Toll gate, 2022-
17. 10.
18. Structural member design and reporting of a steel portal frame housing a 20Ton mobile crane for Kagem Emerald mine, 2022-10.
19. Structural member design and detailing of a structural steel portal frame for the proposed warehouse for SIDDHARTH PATE, 2022-10.
20. Structural member design and detailing of a reinforced concrete frame for the proposed two storey flats to be built in woodlands, 2022-10.
21. Geotechnical investigations for several residential, commercial, and industrial buildings with Blendscope Engineering Limited, Since 2021.
22. Structural design and detailing of Kamloops mall, Lusaka, Zambia, 2018-06