

# Assefa Jonathan Dereje

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## Research Highlights

- Expertise in seismic retrofit of existing RC structures including experimental testing, numerical modeling, and nonlinear seismic performance evaluation.
- Optimizing seismic retrofitting solutions considering various uncertainties
- Development of Machine Learning models such as XGB, Random Forest and Artificial Neural network for assisting Seismic retrofitting
- Development of a ground motion selection algorithm for site-specific ground motion records in nonlinear time history analysis.
- Innovative hybrid damper design combining metallic yielding and viscoelastic dampers to enhance seismic performance.

## Education

Sungkyunkwan University, Suwon, South Korea

Combined M.s Ph.D. in Civil, Architectural and Environmental System Engineering, Feb, 2024.

Dissertation: "Machine learning-assisted seismic retrofit design and optimization framework"

Advisor: Professor Jinkoo Kim (President of Earthquake Engineering Society of Korea Mar, 2019- Feb, 2021)

Addis Ababa University, Addis Ababa, Ethiopia

B.SC in Civil Engineering, Jul, 2015

Thesis: "Software Development for the Structural Design of Structural Elements to the Ethiopian Building Code Standards"

Advisor: Melakou Seyoum

## Professional Experiences

### Structural Engineer

FasilGiorgisconsult Architects and Engineers

Dec, 2015 - Feb, 2018

### Structural Analysis and Design

- Conducted structural analysis and design using software tools such as SAP2000, ETABS and SAFE
- Designed reinforced concrete structural elements including beams, columns, slabs and foundations for residential, commercial and industrial projects.
- Optimized steel roof system designs to achieve efficient structural performance, considering factors such as span, loadings and deflection criteria, and architectural requirements.
- Performing structural peer reviews and providing technical guidance to design teams
- Collaborating with contractors to resolve constructability issues and provide field engineering support.

Department of Civil, Architectural and Environmental System Engineering, Sungkyunkwan University

### Research assistant

Mar, 2018– Feb, 2014

### Seismic retrofit methods

- Proposed seismic retrofit methods such as self-centering post-tensioned precast concrete frames with friction dampers (SC-PC-FD) and hybrid dampers that combines a metallic yielding damper and a high-damping viscoelastic damper.
- Conducted comprehensive experimental tests to evaluate the effectiveness and performance of the retrofit methods.
- Proposed and validated analytical models of proposed seismic retrofit methods using the experimental results.
- Developed curve fitting algorithms to calibrate analytical model parameters.

### Optimization applications

- Applied optimization algorithms to determine optimal design parameters for seismic retrofit projects.
- Developed customized optimization frameworks considering various constraints and multiple objectives.
- Incorporated robustness and uncertainties in the design process to improve the reliability of retrofit solutions.
- Utilized parallel processing to reduce computational time in the optimization framework.

### **Seismic response evaluation**

- Developed analytical models that accurately capture the dynamic response and performance of retrofitted structures.
- Utilized advanced analytical methods, such as nonlinear time history analysis.
- Investigated the seismic performance of retrofitted structures using IDA, and fragility analysis.
- Proposed a ground motion selection algorithm incorporating a multi-objective optimization scheme enabling efficient selection of site-specific ground motion records for nonlinear time history analysis.

### **Seismic damper response evaluation using AI**

- Developing machine learning models to predict the hysteretic response of viscoelastic dampers.
- Utilizing machine learning models to predict analytical model parameters of viscoelastic dampers.
- Utilizing explainable AI to understand and interpret predictions of the developed machine learning model's hysteretic response of viscoelastic dampers predictions.

## **Publications**

Google Scholar profile: <https://scholar.google.com/citations?user=sdTi7CsAAAAJ&hl>

- [1] Dereje, A. J., Chun, S. and Kim, J. (2024). Machine Learning-Based Prediction of Mechanical Properties of Viscoelastic Dampers. *Applied soft computing* (Submitted).
- [2] Dereje, A. J., Javidan, M. M., Ahn, T. S., & Kim, J. (2023). Experimental and analytical study of a seismic energy dissipation device made of butterfly-shaped steel plates and viscoelastic pads. *Journal of Building Engineering*, 108251.
- [3] Dereje, A.J. and Kim, J., 2023. An enhanced ground motion selection algorithm for seismic safety assessment of structures. *Soil Dynamics and Earthquake Engineering*, 165, p.107709.
- [4] Dereje, A.J. and Kim, J., 2023. Robust seismic retrofit design framework for asymmetric soft-first story structures considering uncertainties. *Structural Engineering and Mechanics*, 86(2), pp.249-260.
- [5] Dereje, A.J. and Kim, J., 2022. Optimal seismic retrofit design method for asymmetric soft first-story structures. *Structural Engineering and Mechanics*, 81(6), p.677.
- [6] Dereje, J.A., Eldin, M.N. and Kim, J., 2021. Seismic retrofit of a soft first story structure using an optimally designed post-tensioned PC frame. *Earthquakes and Structures*, 20(6), p.627.
- [7] Javidan, M.M., Dereje, A.J. and Kim, J., 2023, December. Seismic retrofit of low-rise structures using rotational viscoelastic dampers. In *Structures* (Vol. 58, p. 105403). Elsevier.
- [8] Eldin, M.N., Dereje, A.J. and Kim, J., 2020. Seismic retrofit of framed buildings using self-centering PC frames. *Journal of Structural Engineering*, 146(10), p.04020208.
- [9] Eldin, M.N., Dereje, A.J. and Kim, J., 2020. Seismic retrofit of RC buildings using self-centering PC frames with friction-dampers. *Engineering Structures*, 208, p.109925

## **Scholarship**

Outstanding International Student Scholarship Award, Sungkyunkwan University (SKKU), South Korea (Mar, 2018)

## **Software tools developed**

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[1] J. Kim, **Assefa Jonathan Dereje**, developers; Optimization tool for seismic retrofit using viscoelastic dampers (OTVED) (점탄성 댐퍼를 이용한 내진보강 최적설계 툴)". C-2022-031994 Aug 16, 2022.  
<https://www.cros.or.kr/>

[2] J. Kim, **Assefa Jonathan Dereje**, developers; OSRAS: Optimization tool for Seismic Retrofit of Asymmetric Structures (비정형 구조물 내진보강 최적설계 툴)". C-2022-004491 Jan,11,2022.  
<https://www.cros.or.kr/>

[3] J. Kim, **Assefa Jonathan Dereje**, developers: Piloti Structure Retrofit Optimization Tool (PSROT) (최적화기법을 이용한 필로티 구조물 내진보강 해석 툴)". C-2020-035792 Oct 16, 2020.  
<https://www.cros.or.kr/>

## **Presentations**

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[1] **Dereje Jonathan**, Jun, Seungho, Kim, Jinkoo," Optimum quantity and locations of seismic retrofit devices based on multi-purpose optimization" *Proceedings of EESK Conference 2021*, South Korea, 2020.

[2] **Dereje Jonathan**, Jun, Seungho, Kim, Jinkoo "Seismic retrofit of Piloti-type structure using PC frame." *Proceedings of EESK Conference 2020*, South Korea, 2020.

## **Certifications and licenses**

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[1] Mathematics for Machine Learning Specialization. Completed October 1, 2021. Coursera.org by Imperial College.  
<https://coursera.org/share/804cba7004fcf97f297cdc885fae0fe5>

[2] Object-Oriented Design. Completed February 20, 2021, at Coursera.org by the University of ALBERTA.  
<https://coursera.org/share/d66e7de3da9cc1973e9f416a31dc8a06>

[3] Introduction to Computer Science. Completed January 21, 2015, at edx.org by Harvardx.  
<https://verify.edx.org/cert/6023cac046db4e39a1bc50f2477fb709>

[4] Mechanical Behavior of Materials. Completed December 19, 2014 at edx.org by MITx.  
<https://verify.edx.org/cert/9450a0eb3f784f10bcf94cb74de5ae77>

## **Skills**

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- **Programming Languages:** Python, MATLAB, C++
- **FEM software:** OpenSees, SAP2000, ETABS, SAFE, ABAQUS
- **CAD & BIM software:** SketchUp, AutoCAD, Fusion360
- **Graphics software:** Adobe Illustrator
- **Language:** English (Professional Proficiency), Amharic (Native Proficiency)

## **Reviewer**

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- **Structures**