Project 7475 - PROMINENT

PRediction Of daMage evolution IN ENgineering sTructures

Faculty of Engineering University of Kragujevac

Institute for Information Technologies University of Kragujevac

https://prominent.kg.ac.rs/

ABOUT PROMINENT

- PROMINENT – innovative research project focused on the development of **PAK-DAM**, an advanced FEM software tool powered by the **Phase-Field Damage Model (PFDM)**. 🖥️ ⚙️
- The project combines **computational mechanics, experimental testing, and material characterization** to improve prediction of damage initiation, crack growth, and structural failure in engineering structures. 🧪 📊
- Its applications range from **bridges, dams, and buildings to the automotive, aerospace, and energy industries**. 🚗 ✈️ 🏗️

Figure 1. MATEST servo-hydraulic testing system used for mechanical testing specimens

a) b)

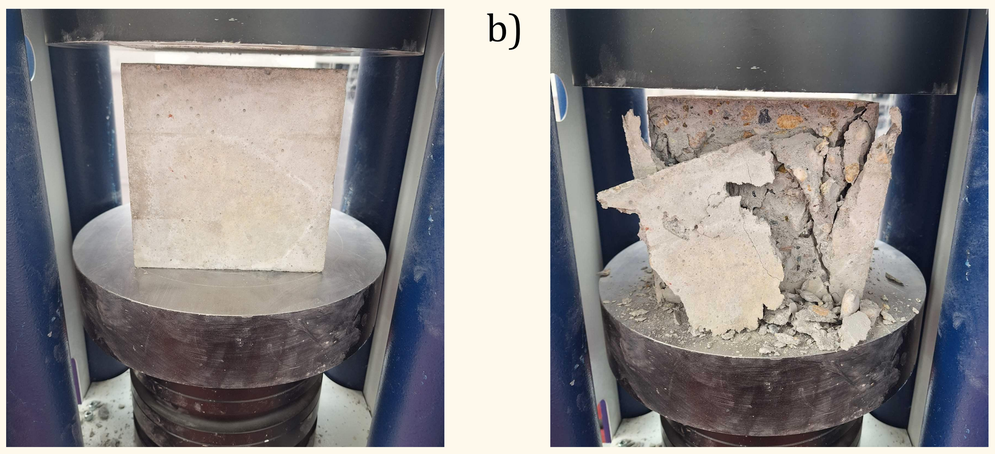

Figure 2. Concrete specimen positioned in the hydraulic press a) prior to testing and b) after compression testing, showing crack formation and failure

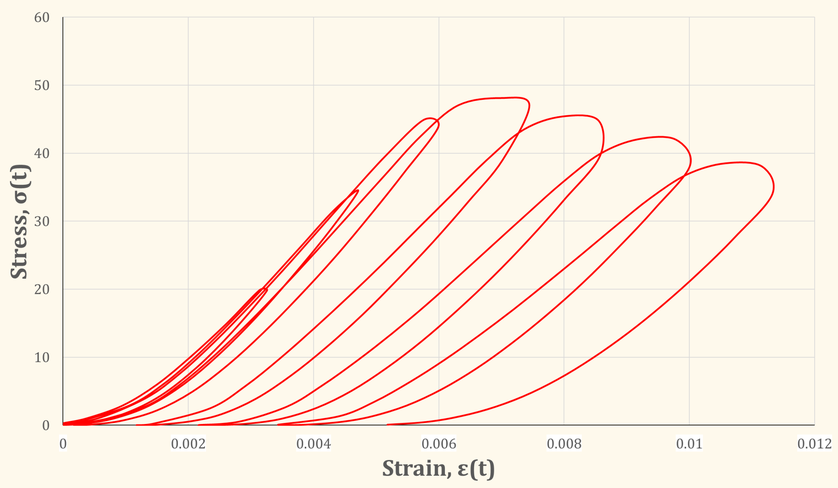

Figure 3. Stress-Strain curve for uniaxial cycling loading of concrete specimen

🎯 MAIN OBJECTIVE

The project aims to:

- Develop and improve PFDM algorithms for metals and concrete
- Create the PAK-DAM software for accurate damage and failure prediction
- Perform experimental testing for calibration and validation of material models
- Integrate simulations and experiments for advanced engineering applications 📈

📚 PROMINENT RESULTS

Key project results include:

- Development of theory, numerical algorithms, and user manuals for PAK-DAM
- Experimental databases for metals and concrete materials 🧪
- Validation of simulations through comparison with laboratory testing 📊
- Delivery of PAK-DAM executable software and FORTRAN source code 💻
- Application of the developed tool to real engineering and industrial case studies 🏭

a) b)

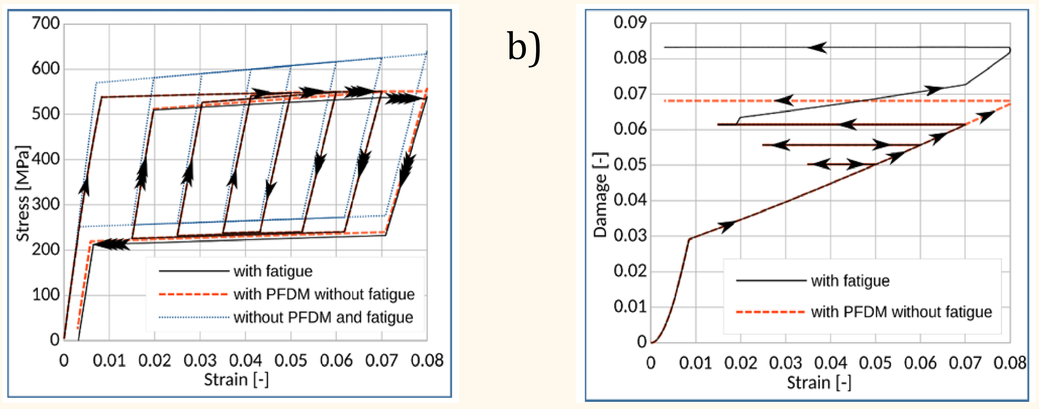

Figure 4. a) Stress-Strain curve and b) Damage-Strain curve for different options of PFDM and fatigue function implementation – sub-loop loading

a) b)

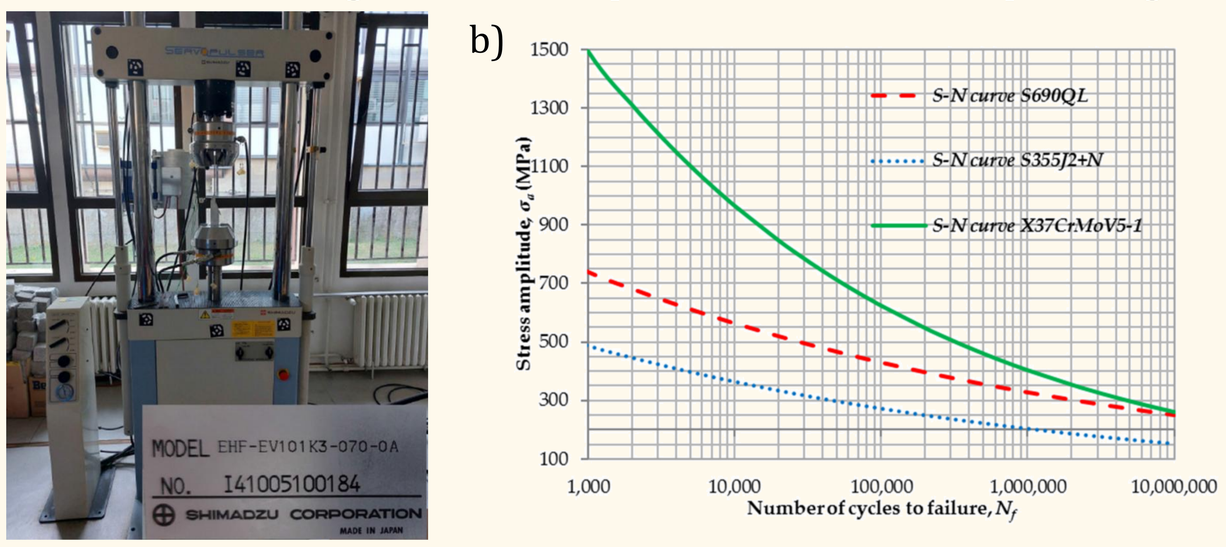

Figure 5. a) SHIMADZU servo-hydraulic machine; b) Comparison of semi-log S–N curves for S355J2+N, S690QL, and X37CrMoV5-1 steel grades

a) b) c)

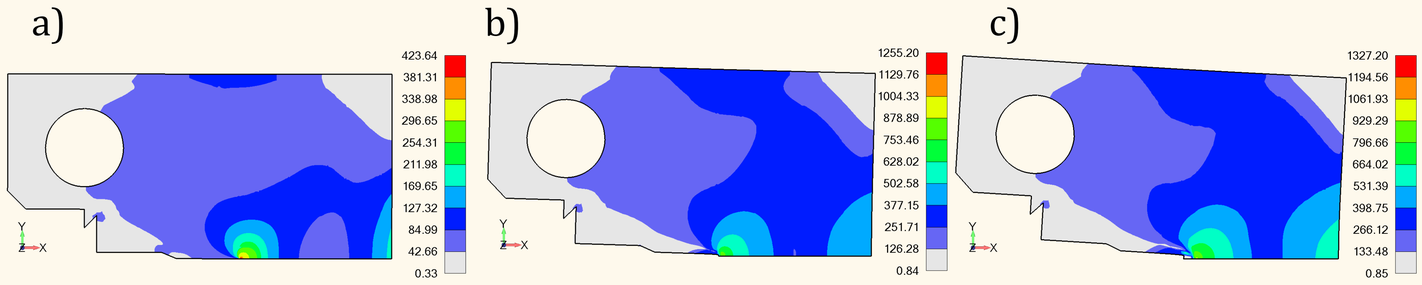

Figure 6. a) Equivalent stress in MPa at the 1st step; b) 15th step; and c) 30th step

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