Stainless steel buckling restrained braces for seismic-resistant re-centring frames (RECENT)

SCOPE

The project aims at developing a design process for an innovative damage-tolerant structural system, i.e. a structure where damage experienced during a severe earthquake can be easily repaired, with application to buckling restrained braced frames, and by demonstrating experimentally the feasibility of an innovative, high-ductility "dry" buckling restrained brace with stainless steel core.

SUMMARY

Current seismic design primarily targets life safety, accepting both structural and non-structural damage during design-level earthquakes. This approach reduces initial construction costs but results in significant material losses and difficult repairs over the building's lifetime. At the same time, stakeholders increasingly expect structures to remain functional and suffer minimal damage after an earthquake, which has driven interest in advanced structural solutions.

Among these solutions are base isolation, energy-dissipating devices, and self-centring systems. Although effective, they are rarely used in Romania due to high costs and the complexity of design and maintenance. A simpler and more accessible alternative is represented by buckling restrained braced frames (BRBFs), which feature high energy dissipation capacity and ductile seismic behaviour.

The project aims to develop a novel type of buckling restrained brace with a stainless steel core to enhance ductility and fatigue life. Both a conventional version with a mortar-filled tube and a simpler, "dry" version, less sensitive to fabrication tolerances, will be investigated. Additionally, a design procedure for dual frames with re-centring BRBFs will be developed, based on simplified rules compatible with existing codes and validated through advanced nonlinear analyses.

RESEARCH TEAM

Politehnica University of Timisoara (Coordinator)

Zubic Design (Partner)

IMPLEMENTATION PERIOD

11.02.2025 – 31.12.2026

OBJECTIVES

- Development of a novel buckling-restrained brace with stainless steel core. Fabrication of the steel core from stainless steels aims at improving the ductility and fracture life of the BRB. Two BRB typologies will be investigated: a "conventional" one using mortar-filled a steel tube and a "dry" one. The latter one targets a less labour-intensive solution, also less sensible to fabrication tolerances.
- Development of a design procedure for re-centring dual buckling restrained braced frames. The design procedure will consist in simplified "code-compatible" rules, and validated through advanced design using non-linear static analysis.

RESULTS

- Development of monotonic and cyclic constitutive models for mild carbon steel and stainless steel
- Preliminary design and FEM-based development of “dry” buckling-restrained braces with a mild steel core
- Preliminary design and FEM-based development of “dry” buckling-restrained braces with a stainless steel core
- Design and fabrication of specimens for base material testing
- Preparation of execution drawings and fabrication of the experimental setup and BRBs
- Tensile and low-cycle fatigue tests on base materials

DISSEMINATION

- Iosim, D.-D., Stratan, A., and Sato, A. (2025). Seismic Design of Buckling Restrained Braced Frames Using European and Japanese Approaches. Proceedings of the International Colloquium on Stability and Ductility of Steel Structures (SDSS 2025), 8–10 September 2025, Barcelona, Spain. https://sdss2025.upc.edu/
- Iosim, D.-D., Stratan, A., and Zub, C.-I. (2025). FEM-Based Design of a Hybrid Steel-Timber Buckling Restrained Brace. International Scientific Conference Civil Engineering and Building Services (CIBv 2025), 6–7 November 2025, Brașov, Romania. https://cibv.unitbv.ro/
- Zub, C.-I., Stratan, A., and Iosim, D.-D. (2025). On the Calibration of Combined Hardening Model for Structural Steels. International Scientific Conference Civil Engineering and Building Services (CIBv 2025), 6–7 November 2025, Brașov, Romania. https://cibv.unitbv.ro/
- Iosim, D.-D. (2025). PhD Symposium 2025 of the Department of Steel Structures and Structural Mechanics (CMMC). 12 June 2025, Politehnica University of Timișoara. https://indico.upt.ro/event/15/

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CONTACT

Aurel Stratan
Politehnica University of Timișoara
Faculty of Civil Engineering
Department of Steel Structures and Structural Mechanics
str. Ioan Curea nr.1
300224 Timisoara
Romania
tel: +40.256.403923
email: aurel.stratan@upt.ro