

Sub task 12.3.2 - Edifici con strutture composte acciaio-legno

Sub task 12.2.3 - Durabilità

UR11: UNINA/Faggiano – Responsabile scientifico: Prof. Beatrice Faggiano

Componenti di Unità di ricerca: PhD Eng. Giacomo Iovane

GENERAL CONTEXT OF THE RESEARCH

OBJECTIVES AND ACHIEVEMENTS

Goals of the research

- Design criteria proposal;
- Evaluation of the mechanical behavior of the connection

Methodology

- Analytical study;
- Monotonic numerical analysis.

Main issues

- Suitability of steel collar for composite timber-concrete system

FUTURE IMPROVEMENTS

- Extension of the numerical analysis;
- Cyclic experimental test;
- Improvement of the collar system details;
- Robustness design.

EXPERIMENTAL CAMPAIGN

Steel collar [mm]

Timber beam [mm]

Assembly

Faggiano et al., 2021

DECIVIL - LISBON

Push-out test 2004-2005

Rectangular specimen with single collar (new pine)

Push-out test 2006

Rectangular specimen with double collar (new pine)

Bending test 2007

Rectangular section composed beam with collars (new pine)

PROHITECH 2004-2009

Application of the collar system: Diplomatic Hall of Royal Palace (Naples)

PROHITECH 2004-2009

Push-out test 2004-2005

Circular specimen with single collar (antique chestnut)

Bending test 2010

Floor composed with circular section beams (antique chestnut)

STEEL COLLAR CONNECTION FOR COMPOSITE TIMBER-CONCRETE FLOORS

DESIGN CRITERIA: CAPACITY DESIGN

Overstrength factor: $\Omega_{max} = \Omega' \cdot \Omega''$

Design forces: $S_{Ed} = S_{Ed} \cdot \gamma_{Ed} \cdot \gamma_{Ed}$

Phase 1: Bolts tightening - Bolts in tension

$\Delta' = \frac{N_{t,Ed}}{N_{t,Rd}} = \frac{N_{t,Ed}}{N_{t,Rd}}$

Phase 2: Service condition - Bolts in shear

$\Delta'' = \frac{V_{Ed}}{V_{Rd}} = \frac{V_{Ed}}{V_{Rd}}$

GENERAL CONTEXT OF THE RESEARCH

OBJECTIVES AND ACHIEVEMENTS

Goals of the research

- Identification of main hybrid structural typologies;
- Preliminary seismic design of hybrid framed systems.

Methodology

- Numerical analysis.

Main issues

- Non-dissipative structures: Timber structures (T) are the lightest
- Structural mass increases with increasing load
- Dissipative structures: For TS and SS D-, X- and V-CBF frame types the dissipative design criteria cannot be applied

FUTURE IMPROVEMENTS

- Non-linear incremental static and dynamic analysis;
- Extension of the study to multi-storey and multi-span structures;
- Development of design guidelines.

PRELIMINARY SEISMIC DESIGN OF HYBRID FRAMED SYSTEMS

CASE STUDY & DESIGN DATA

STRUCTURAL TYPES

GEOMETRICAL FEATURES

FLOORS

LOADS

MATERIALS

TYPE OF ANALYSIS

MASS COMPARISON: DISSIPATIVE VS NON DISSIPATIVE STRUCTURES

CLT $\alpha_s = 0.53 \text{ kN/m}^2$

TCC $\alpha_s = 1.30 \text{ kN/m}^2$

SCC $\alpha_s = 2.41 \text{ kN/m}^2$

GENERAL CONTEXT OF THE RESEARCH

OBJECTIVES AND ACHIEVEMENTS

Goals of the research

- Provide a survey form to increase the knowledge on heritage timber structures conservation;
- Application of the form to a case study.

Methodology

- Application of the proposed survey form to case studies.

Main issues

- Suitability of the survey form for heritage timber constructions;
- In-depth knowledge of the heritage timber constructions state of conservation.

FUTURE IMPROVEMENTS

- Improvement of the form;
- Application of the form to a larger sample of heritage timber constructions;
- Digitalization of the form.

ICOMOS – ITALIAN INTERNATIONAL COUNCIL ON MONUMENTS AND SITES: IIWC

ICOMOS

Materials

Mission

Purpose

Description of the draft IIWC FORM

Scope

Building analysis

Typological and technological survey

Assessment of the state of conservation

THE IIWC SURVEY FORM FOR EXISTING TIMBER STRUCTURES

Example of application of the card: Royal Palace (Naples)

Building Component (BC)

Structural Unit (SU)

Structural member (SM) and node (SN)

GENERAL CONTEXT OF THE RESEARCH

OBJECTIVES AND ACHIEVEMENTS

Goals of the research

- Definition of procedures and development of models for on-site assessment of ancient timber members made of CS-FNL.

Methodology

- Wood mechanical characterization.

FUTURE IMPROVEMENTS

- Refining of the statistical models by reprocessing the dataset with appropriate outlier detection and removal techniques, also AI-based, particularly for species like Chestnut;
- Extension of the sample size and validation of the proposed models.

ON-SITE ASSESSMENT

Geometrical and Technological Survey

Wood Mechanical Characterization

NDT-DT Correlation

Visual Strength Grading (VSG)

Non-Destructive Test (NDT)

Acoustic Test (AT)

Vibrational Test (VT)

Drilling resist. method (DRM)

NDT

DT

EXPLORING CORRELATIONS BETWEEN NON-DESTRUCTIVE AND DESTRUCTIVE TESTS

Manzanini et al., 2025 – WCTE

Building Strength

Dynamic Acoustic HOE

Dynamic Vibration HOE

Global HOE

Local HOE

Mean drilling resistance measure

Mean drilling resistance measure

Dynamic Vibration HOE

10 UNIVERSITIES

15 DEPARTMENTS

UNINA

UNIBAS

UNICAL

UNICAMPANIA

UIKE

UNIRC

UNIPA

UNISALENTO

UNISARNO

INTERUNIVERSITY NETWORK

It combines expertise in the fields of forestry science, technology, architecture and timber engineering

PURPOSE AND SCOPE OF APPLICATION

FRAMEWORK AGREEMENT WITHOUT FINANCIAL CHARGES

Network laboratory for forestry sciences, technology, architecture and timber engineering to collaborate on study, research and training activities

DEVELOPMENT OF THE FOREST-WOOD SUPPLY CHAIN

Promote the development of the supply chain in Southern Italy through sustainable forest resource management (SFM) processes, technological and industrial research

VALORIZATION OF LOCAL RESOURCES

Mitigate the amount of wood imported from abroad by exploring the possibility of obtaining wood-based products from local species of the Southern Apennines

SYNERGY BETWEEN SUPPLY CHAIN SECTORS

Create collaboration between forest owners, primary processing companies and construction companies to create products from local wood structures

MAIN REFERENCES

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