GIORNATA AIRI PER L'INNOVAZIONE INDUSTRIALE 2018
PREMIO OSCAR MASI PER L'INNOVAZIONE INDUSTRIALE 2017

Horizon 2020
European Union Funding
for Research & Innovation

Enabling technologies and innovative solutions for sustainable cities

The Jury appointed by AIRI – Italian Association for Industrial Research – has awarded the Prize Oscar Masi, reserved for AIRI members in the category Public Research Bodies and University, to the Construction Technologies Institute of the National Research Council of Italy for its active involvement in the framework of Project H2020 RE^4 "REuse and REcycling of CDW materials and structures in energy efficient pREfabricated elements for building REfurbishment and construction" (GA No. 723583), as Linked Third Party of the partner STRESS s.c.ar.l.

RE^4 is a 42-month research project (09/2016 – 02/2020) coordinated by CETMA (www.cetma.it), that brings together 13 partners from the scientific and industrial community (ACCIONA INFRAESTRUCTURAS S.A., RISE RESEARCH INSTITUTES OF SWEDEN AB, CDE GLOBAL LIMITED, CREAGH CONCRETE PRODUCTS LIMITED, FENIX TNT SRO, THE QUEEN'S UNIVERSITY OF BELFAST, ROSWAG ARCHITEKTEN GESELLSCHAFT VON ARCHITEKTEN MBH, STAM SRL, STRESS SCARL, National Taiwan University of Science and Technology, VORTEX HYDRA S.R.L., ASSOCIATION DES CITES ET DES REGIONS POUR LE RECYCLAGE ET LA GESTION DURABLE DES RESSOURCES). The project is funded under the EU Research and Innovation programme ***Horizon 2020***.

The primary goal of the project is to develop the concept of energy-efficient prefabricated building designed to be *easily* assembled and dismantled for future reuse, made of materials recycled from ***CDW (Construction and Demolition Waste)***, ranging from 50% to 65% for the medium replacement of the mineral fraction.

Reliable technologies and strategies need to be developed in order to:

- increase the percentage of recycled materials and reused structures;
- increase the technical and economic value of CDW-derived materials and structures;
- minimize future CDW coming from the next generation of buildings;
- increase buildings' energy efficiency.

Along with the other partners of the project, the Construction Technologies Institute – CNR contributes to the activities detailed below.

METHODOLOGY

TECHNICAL AND SCIENTIFIC PURPOSES (WP1, WP2, WP3, WP4, WP5)

INFORMATIONAL PURPOSES (WP5, WP6, WP7)

COMMERCIAL OBJECTIVES (WP6, WP7, WP8)

WP1 Mapping and analysis of CDW reuse and recycling in prefabricated elements

WP2 Strategies for innovative sorting of CDW and reuse of structures from dismantled buildings

WP3 - Innovative concept for installation and disassembly of eco-friendly prefabricated elements

WP4 Technical characterisation of CDW-derived materials for the production of construction elements used in buildings

WP5 Development of precast components and elements from CDW

WP6 Pilot level demonstration of CDW-based prefabricated elements

WP7 Life-cycle and HSE analysis and certification/standardization strategy definition

WP8 Dissemination

WP9 Project management

ATTIVITA' ITC - CNR

Task 3.2 e 3.3 Progetto di elementi prefabbricati da utilizzare nella ristrutturazione/nuova costruzione di edifici residenziali o commerciali

Il contributo più promettente per il raggiungimento degli obiettivi descritti è fornito dalla crescita del **settore della prefabbricazione**.

La produzione di elementi prefabbricati, mediante una completa automazione del processo, può **ridurre il consumo di materiale** (fino al 70%) e creare condizioni per la costruzione continua durante l'anno, indipendentemente dalle condizioni climatiche. È ampiamente dimostrato che l'uso di elementi prefabbricati **riduce la produzione di rifiuti** (fino al 50%) rispetto alle pratiche di costruzione convenzionali.

- Schema strutturale scelto: **pareti a taglio + travi e colonne con connessioni cerniera.**
- Gli elementi sono progettati in modo da rappresentare **scenari di carico e dimensioni tipiche/ricorrenti** sulla base delle informazioni fornite dai diversi partner/Paesi.
- Le connessioni sono sostituibili.
- Elementi completamente riutilizzabili, **flessibilità nell'utilizzo**, che permette applicazioni in diverse configurazioni ed estensioni.
- Campo di applicazione: **uso residenziale o commerciale**.

ITC-CNR ACTIVITY

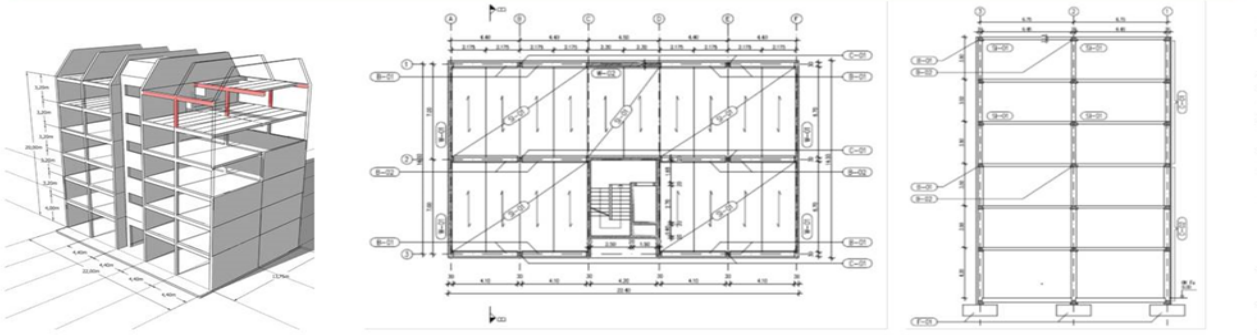
Task 3.2 and 3.3 Design of prefabricated elements for residential or commercial building refurbishment/construction

The enhancement of the **prefabrication sector** is the driving force towards the achievement of the objectives described.

The fully automated production of prefabricated elements may **reduce the consumption of materials** (by up to 70%) and lay the basis for an all-year-round production, regardless of weather conditions.
There is strong evidence that the use of prefabricated elements **reduces the production of waste** (by up to 50%) compared to conventional construction practices.

- Structural pattern: **shear walls + beams and columns with hinged beam-to-column joints**.
- The elements are designed to represent **load scenarios and typical/recurring dimensions** based on the information provided by the different partners/countries.
- Joints are replaceable.
- Fully reusable elements, **flexible use**, allowing for applications in various configurations and dimensions.
- Field of application: **either residential or commercial use**.

Task 3.2 e 3.3 Progetto di elementi prefabbricati da utilizzare nella ristrutturazione/nuova costruzione di edifici residenziali o commerciali



Task 3.2 and 3.3 Design of prefabricated elements for residential or commercial building refurbishment/construction

TRE DISEGNI

Task 3.4 Modellazione numerica a supporto della progettazione e per la previsione delle prestazioni dei prototipi

Analisi numeriche e definizione di **modelli strutturali** finalizzati a:

A. Supporto alla progettazione di elementi non strutturali
   1. Ottimizzazione del progetto al fine di garantire il minimo spessore per pannelli non portanti che garantisca il migliore compromesso tra riduzione del peso dell'elelemnto e resistenza alle azioni da peso proprio e laterali (vento, sisma).
   2. Ottimizzazione/confront di diverse condizioni di vincolo al contorno (connessioni pannello-struttura) che limitino l'interazione tra struttura primaria (portante) e struttura secondaria (non portante)

B. Previsione del comportamento meccanico dei prototipi (simulazione di azioni statiche e dinamiche sull'intero sistema strutturale)

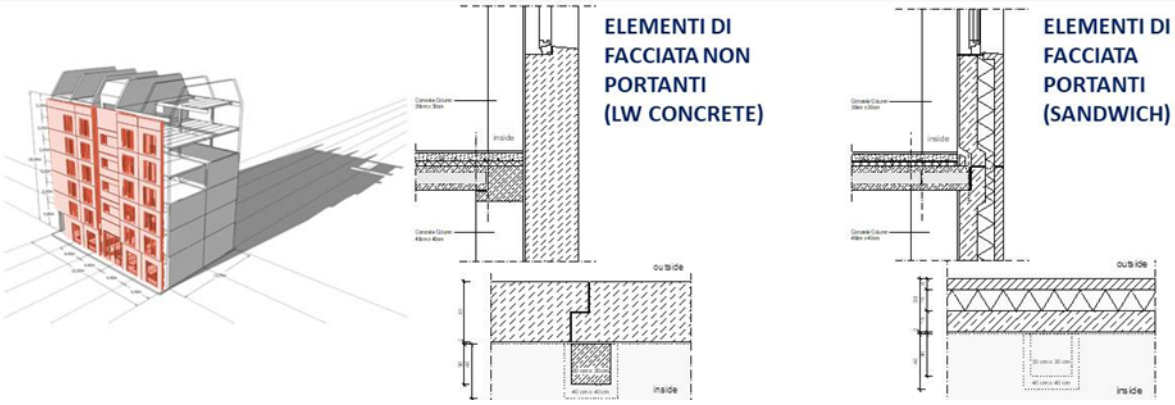
Task 3.4 Numerical modelling to support design and prototype performance prediction

Numerical analyses and definition of **structural models** aimed at:

A. Supporting design of non-structural elements
   1 Optimizing design in order to that the minimum thickness of non-load-bearing panels ensures the best compromise between reduction of the element's weight and resistance to the action of both horizontal loads and dead weight actions (wind, earthquake).
   2 Optimizing and comparing the various boundary constraints (panel/structure joints) limiting the interaction between primary (load-bearing) structure and secondary (non-load-bearing) structure.

B. Prediction of the mechanical behaviour of prototypes (simulation of static and dynamic actions on the whole structural system).

Task 5.5 Prove per la valutazione delle prestazioni meccaniche e di durabilità di elementi prefabbricati di grandi dimensioni (elementi di facciata)



Task 5.5 Tests for the evaluation of the mechanical and durability performance of large prefabricated elements (façade elements)

NON-LOAD-BEARING FAÇADE ELEMENTS (LW CONCRETE PANELS)

LOAD-BEARING FAÇADE ELEMENTS (SANDWICH PANELS)

Task 5.5 Tests for the evaluation of the mechanical and durability performance of large prefabricated elements (façade elements)

MECHANICAL TESTS ON THE COMPONENT, BEFORE AND AFTER AGEING

Façade elements	**Method**	**Standard**
Flexural strength	Resistance to wind actions to be evaluated according to ETAG 034 or ETAG 017	*Vertical building elements -- Impact resistance tests – Impact bodies and general test procedures* *BUILDING CONSTRUCTION – GUARDRAIL SYSTEMS AND RAILS FOR BUILDINGS*
Impact resistance	Impact resistance tests	
Horizontal linear load	To be developed according to ISO DIS 12055	

Task 6.2 Construction and testing of prototypes made with prefabricated elements

SEISMIC TESTING: Tests performed with shaking tables aimed at the characterization of the seismic behaviour of components or whole system.

EQUIPMENT
TEST CARRIED OUT ON THE INDIVIDUAL COMPONENT
TEST CARRIED OUT ON THE SYSTEM

- Two horizontal degrees of freedom;
- Dimensions of each table: 3m x 3m;
- Maximum load: 200 kN;
- Frequency range: 0 – 50 Hz;
- Peak ground acceleration at maximum load: 1.0 g;
- Peak ground displacement: ± 250 mm;
- Maximum overturning moment: 1250 KNm

For further information about the project RE^4 please visit http://www.re4.eu