Pro-GET-onE
Proactive synergy of inteGrated Efficient Technologies on buildings’ Envelopes: An overview

Call: H2020- EE-10-2016-IA- Innovation action

Dr. M.N Assimakopoulos, Associate Professor
Group Building Environmental Studies, Physics Department, NKUA, Greece

6th Jeffrey Cook Workshop in Desert Architecture
25 November 2019, Beer-Sheva, Israel
(concepts and) INSPIRATIONS
OBJECTIVES
CONTEXT FOR REPLICABILITY
INNOVATION/AMBITION
THE CASE STUDY
RESULTS SO FAR
FINAL REMARKS
Assistant Buildings’ addition to Retrofit, Adopt, Cure And Develop the Actual Buildings up to zero energy, Activating a market for deep renovation.
On the basis of data produced by the European Environment Agency in the context of Corine Land Cover (CLC) for the years 1990, 2000 and 2006, Prokop et al. (2011) has estimated that the detected land take between 1990 and 2000 in the EU was around 1 000 km/year – an area larger than the city of Berlin – or 275 hectares/day, is consumed increased by nearly 6%. From 2000 to 2006, the rate of land take decreased to 920 km/year (252 hectares/day), while the total settlement area increased by a further 3%. This corresponds to an increase of almost 9% between 1990 and 2006 (from 176 200 km. to 191 200 km.)

http://www.eea.europa.eu/publications/COR0-
Concepts (and inspirations)

.... URBAN BUILDINGS
Gypsum Forum Brussels
27 September 2017

Dethier Architecture
Where we started from...

- One integrated systems with
  - greater efficiency
  - attractiveness
  - marketable renovation

Can only be achieved through a **holistic and integrated set of technologies**, in which all the different requirements (**energy, structural, functional**) are optimally managed

- **Energy and non-energy related benefits** coupled in a same target to help the market uptake of energy transition
InteGrated Efficient Technologies

Envelope

Attractiveness

Structure

ENERGY IMPROVEMENT

SEISMIC STRENGTHENING

FACADE ADDITION

“GET” system
Innovation/Ambition
Seismic/structural requirements

Multi-Benefit solutions for:
- Structural-seismic requirements;
- Energy requirements;
- User-orientated requirements.

Preliminary simulations modelling using FEM software (EN 1998), performed for different residential buildings, have shown an overall reduction of horizontal displacements of the retrofitted structures from 15% up to 60% and more.
External structures providing existing building (5) with: strengthening by GET structure (2), energy saving and plug-and-play plant distribution (1, 4, 6) increased comfort and living areas for residents, additional new units (3).

**Innovation/Ambition**

**Energy requirements**

The **GET structure** to be combined with **energy** (and space) needs (new volumes – sunspaces and buffer zones- and insulation on existing envelopes) (up to 70% EnSa)

GET can be equipped with several installation plants

**Plug and play solution**
User orientated requirements

- **SINGOLA**
  - 10.5 mq
  - Extra Room: Addizione 1.1 mq

- **DOPPIA**
  - 20 mq
  - Addizione 10 mq

- **SPAZI COMUNI**
  - Addizione variabile

---

**MATERIALI**
- LAMIERA STRATIFICATA
- LAMIERA FORATA
- ALLUMINIO BIANCO
- POLICARBONATO
- ALLUMINIO NATURALE
- GRES
- LEGNO TECNICO
Case studies

Groningen area

Brasov

Reggio Emilia
Case study
SEISMIC STRENGTHENING OF EXISTING STRUCTURE THROUGH EXTERNAL 3D EXOSKELETON

External exoskeleton:
- Steel transversal frames connected with hinged beams;
- Cylindrical hinge + UPN profiles to connect the two structures.

Exoskeleton’s global results:
- Reduces the torsional behavior in the main vibrating modes;
- Reduces the floor displacement, so the damage for earthquakes can be easily minimized;
- Taking part of the horizontal forces, increases the base shear capacity of the structure, reducing stresses in the existing building.
SEISMIC STRENGTHENING OF EXISTING STRUCTURE THROUGH EXTERNAL 3D EXOSKELETON

PERFORMED SEISMIC ANALYSES

GREEK CASE STUDY

Initial State (IS-ATH)

Project Solution (PS-ATH)

Static Pushover Analysis

Capacity Curve

Control point displacement (m)

Base shear (kN)

SPA_IS-ATH_Y

SPA_PR-ATH_Y

Linear Dynamic Analysis

- Limit State SD, IS-ATH \( \rightarrow \) C/D = 42%
- Limit State SD, PS-ATH \( \rightarrow \) C/D = 86%

Improvement of 44%

About of seismic safety index, calculated as the ratio between the acceleration of capacity and the acceleration of demand, the application of the exoskeleton leads to an increase in stiffness of around 45% from the initial state. As a consequence, we have a limited reduction in structure displacements.
Simulation Results for the all case studies

Energy Savings

- GREECE
- ROMANIA
- ITALY

GET 1
GET 2
GET 3
EXTRA-ROOM
SUNSPACE
BALCONY
Life Cycle Assessment with a GET-renovation vs baseline (Demolition And New Built)

<table>
<thead>
<tr>
<th>Source</th>
<th>Product Material – Transport to site – End of life</th>
<th>Operational Energy</th>
<th>Life cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>As built</td>
<td>Kg CO₂/m²<em>y Kg CO₂/m²</em>y Kg CO₂/m²<em>y Kg CO₂/m²</em>50 y Kg CO₂/m²*50 y</td>
<td>150 54 2700 2850</td>
<td></td>
</tr>
<tr>
<td>Demolition and new construction Ecoinvent</td>
<td>Kg CO₂/m²<em>y Kg CO₂/m²</em>y Kg CO₂/m²<em>50 y Kg CO₂/m²</em>50 y</td>
<td>1005 11 540 1545</td>
<td></td>
</tr>
<tr>
<td>Demolition and new construction Greekstudy</td>
<td>Kg CO₂/m²<em>y Kg CO₂/m²</em>y Kg CO₂/m²<em>50 y Kg CO₂/m²</em>50 y</td>
<td>760 11 540 1300</td>
<td></td>
</tr>
<tr>
<td>ATHENS GET renovation (best option) GET calculation (LIMA)</td>
<td>Kg CO₂/m²<em>y Kg CO₂/m²</em>y Kg CO₂/m²<em>50 y Kg CO₂/m²</em>50 y</td>
<td>173 11 540 713</td>
<td></td>
</tr>
<tr>
<td>ATHENS GET renovation (worse option) GET calculation (LIMA)</td>
<td>Kg CO₂/m²<em>y Kg CO₂/m²</em>y Kg CO₂/m²<em>50 y Kg CO₂/m²</em>50 y</td>
<td>266 12 590 856</td>
<td></td>
</tr>
</tbody>
</table>
increase the **co-benefits of energy renovation**, increase the **expected lifetime of the buildings**, increase the **desirability of transformation** from users and owners to stimulate the **excellence in energy performance** up to the **ambitious nZEBs** targets in the most **inefficient buildings** of the modernity (the majority of EU buildings)
No technological innovation without Supporting Legislative Policies
Follow us

www.progetone.eu

Twitter - @ProGETonE
Facebook - @ProgetonE
Instagram - progetone_project