# Pro-GET-onE

# Proactive synergy of inteGrated Efficient Technologies on buildings' Envelopes:

# An overview

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

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6th Jeffrey Cook Workshop in Desert Architecture
25 November 2019, Beer-Sheva, Israel

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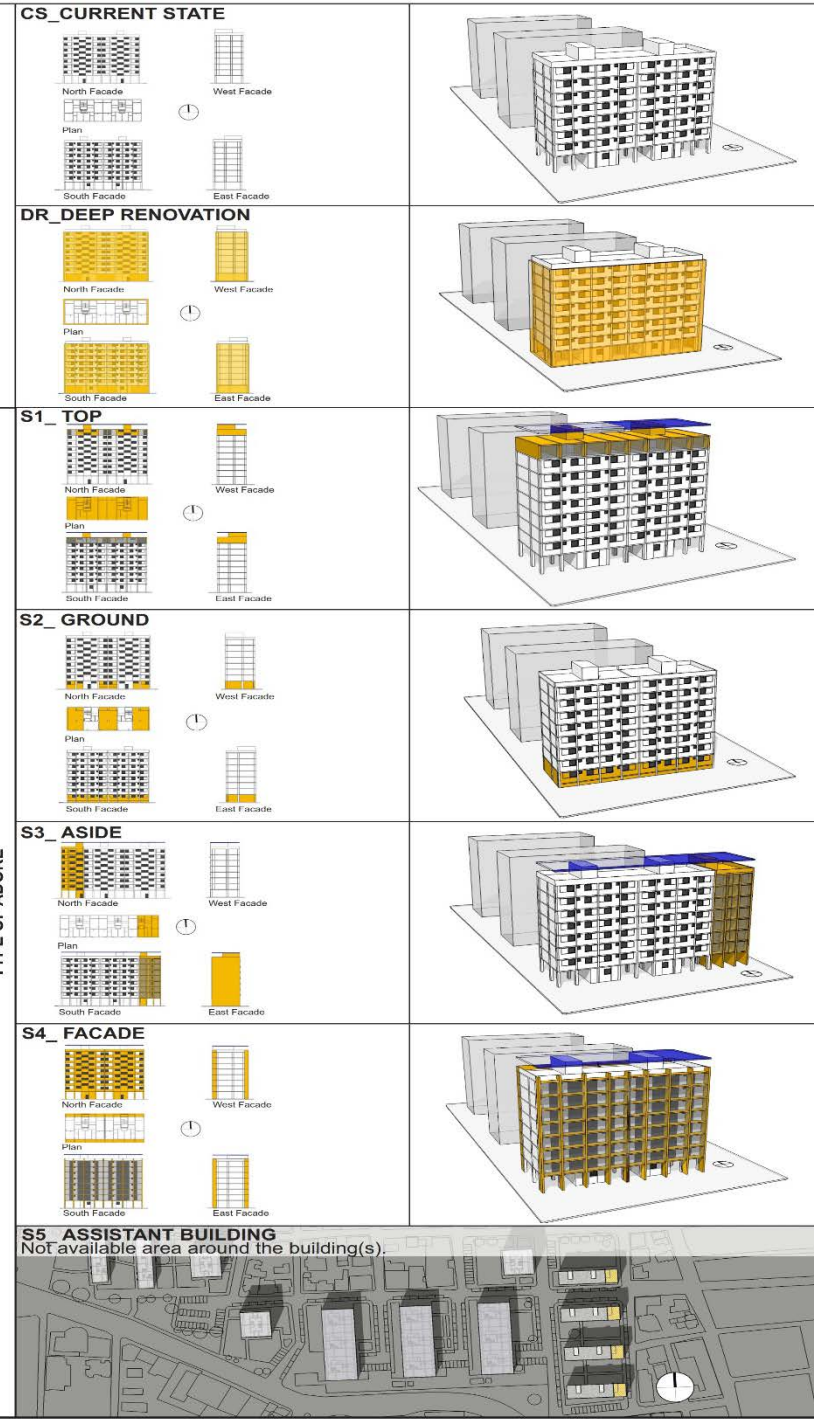
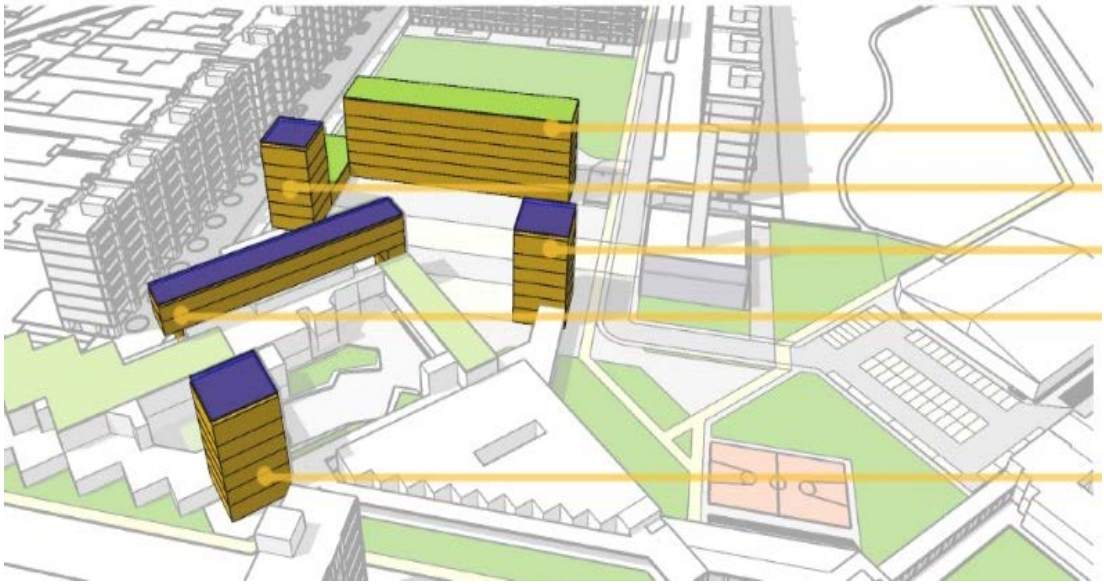
FINAL REMARKS

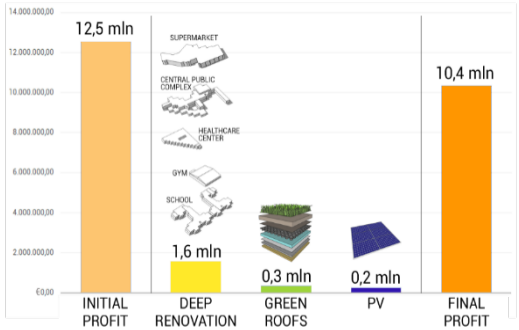
# Concepts (and inspirations)

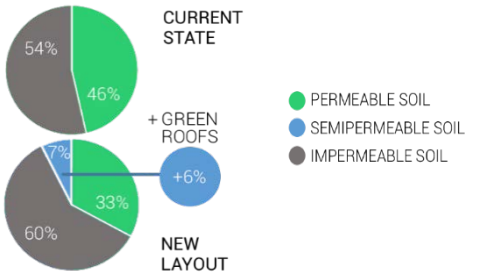
BRACADABRA

Assistant Buildings' addition to Retrofit, Adopt, Cure And Develop the Actual Buildings up to zeRo energy, Activating a market for deep renovation

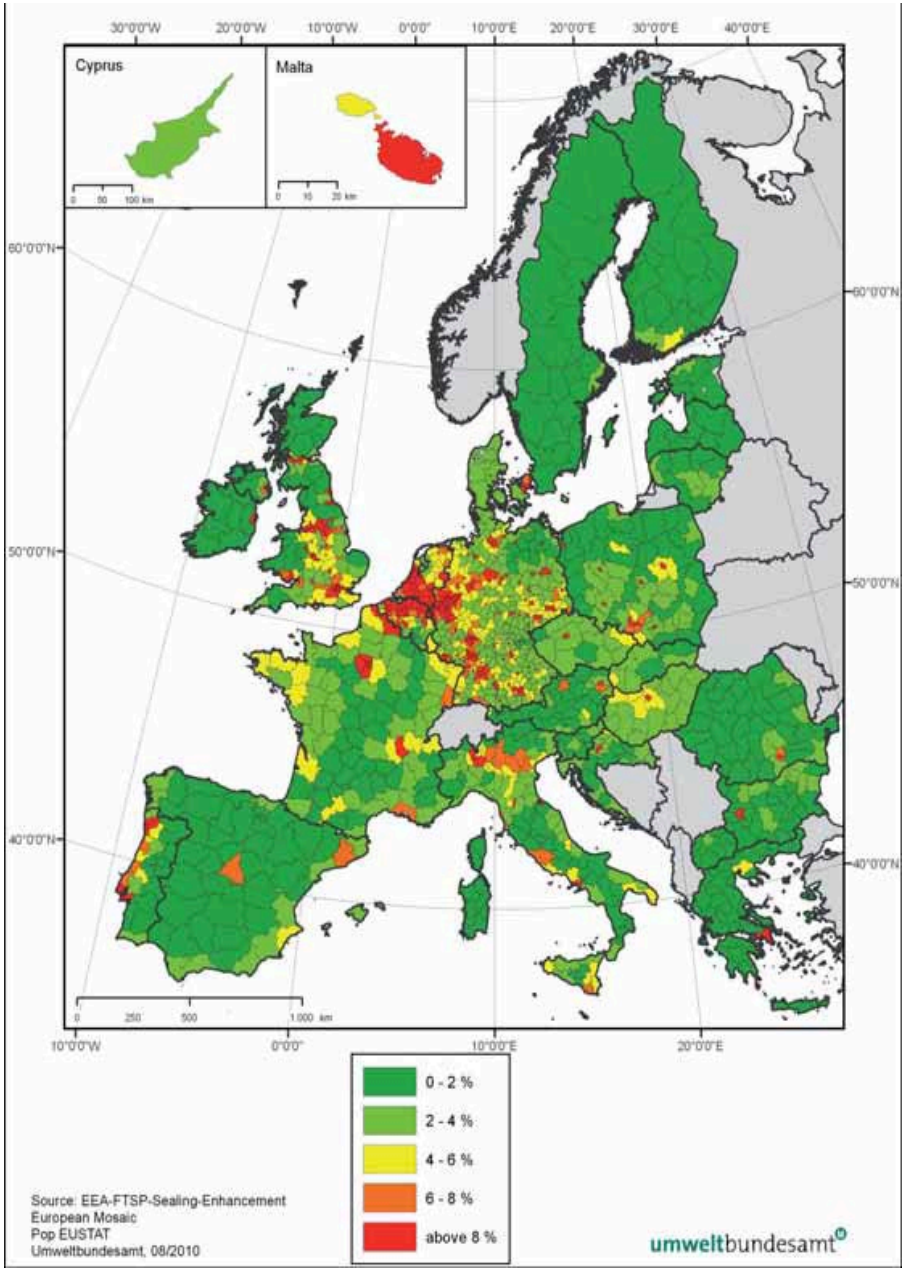




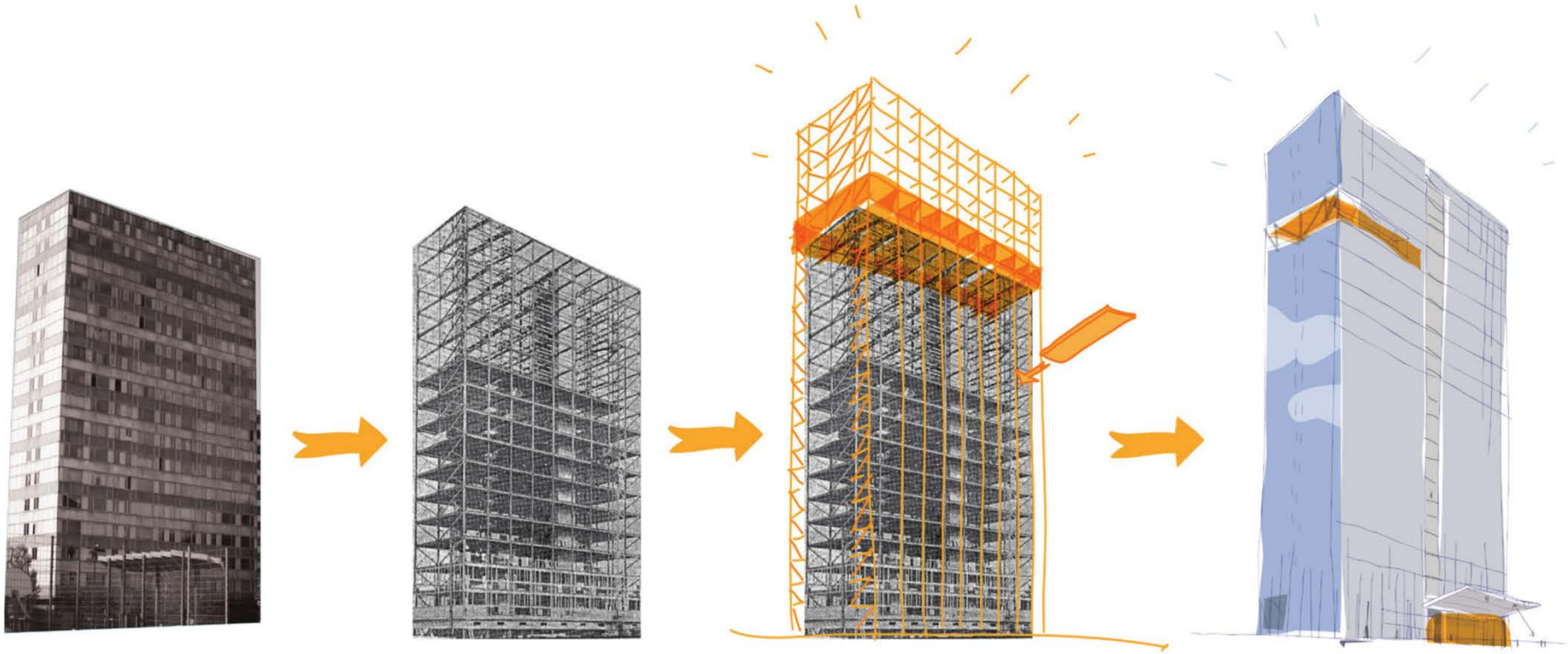
# Concepts (and inspirations)

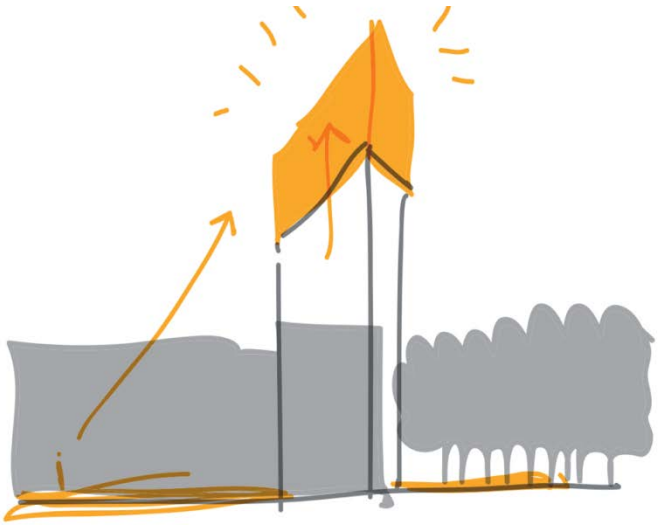



On the basis of data produced by the European Environment Agency in the context of Corine Land Cover (CLC) for the years 1990, 2000 and 2006, Prokop et al. (2011) has estimated that the detected land take between 1990 and 2000 in the EU was around 1 000 km/ year – **an area larger than the city of Berlin** – 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

PROGETONE

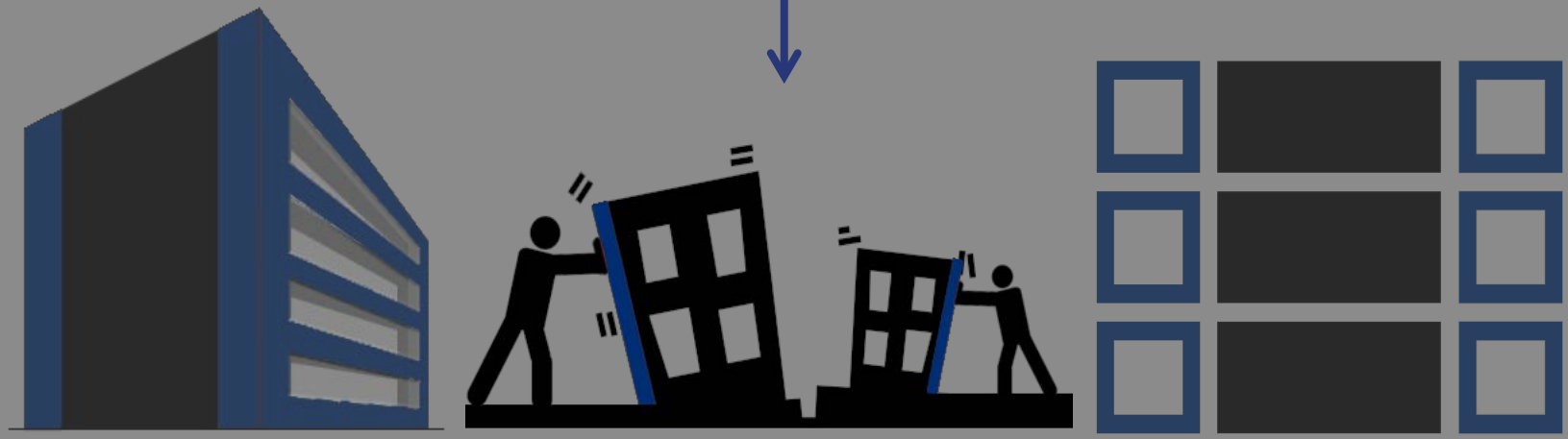
# “GET” system

## InteGrated Efficient Technologies

Envelope

Attractiveness

Structure



**ENERGY IMPROVEMENT**

**SEISMIC STRENGTHENING**

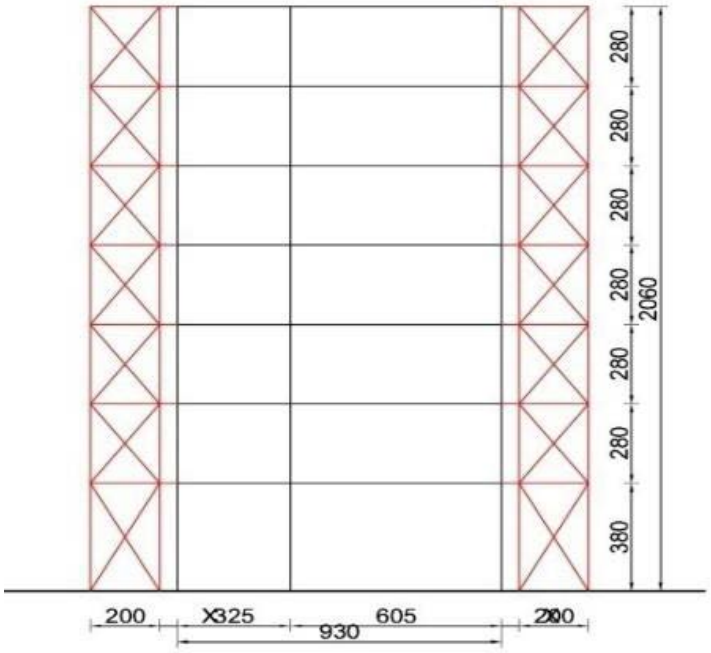
**FACADE ADDITION**

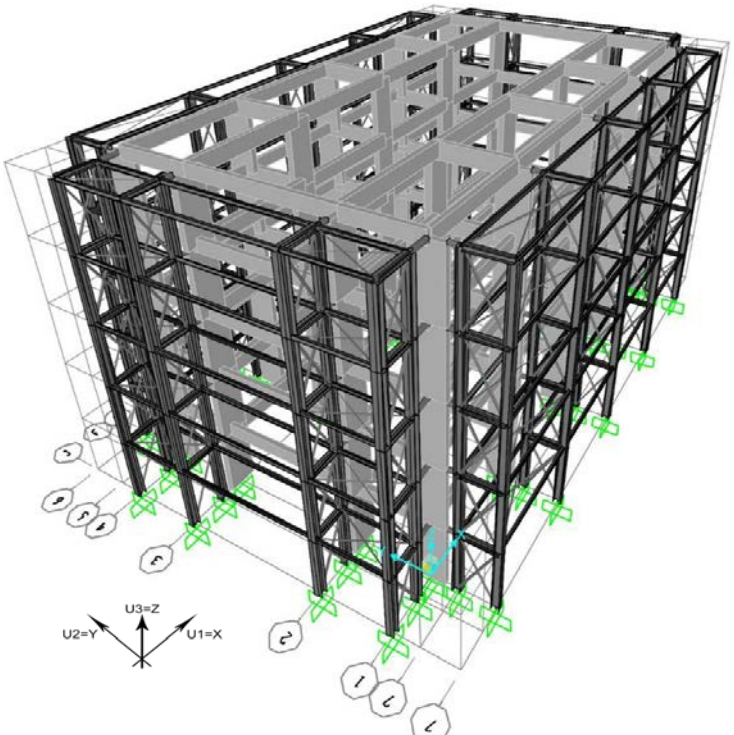
# Innovation/Ambition

## Seismic/structural requirements

**Multi-Benefit solutions for:**

- **Structural-seismic requirements;**
- **Energy requirements;**
- **User-orientated requirements.**



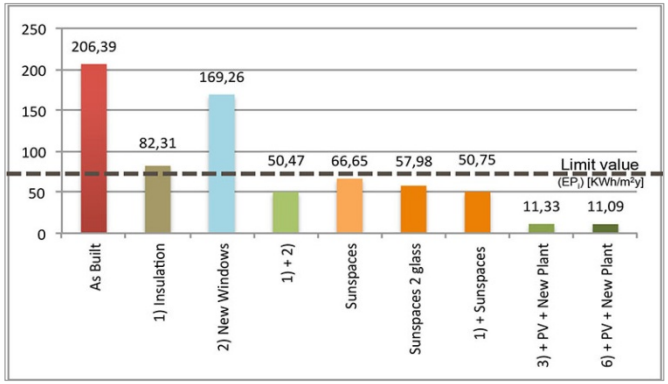

Preliminary simulations modelling using FEM software (EN 1998), performed for different residential buildings, have shown an overall reduction of horizontal displacements of the retrofitted structures from 15% up to 60% and more.

**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

GET SYSTEM

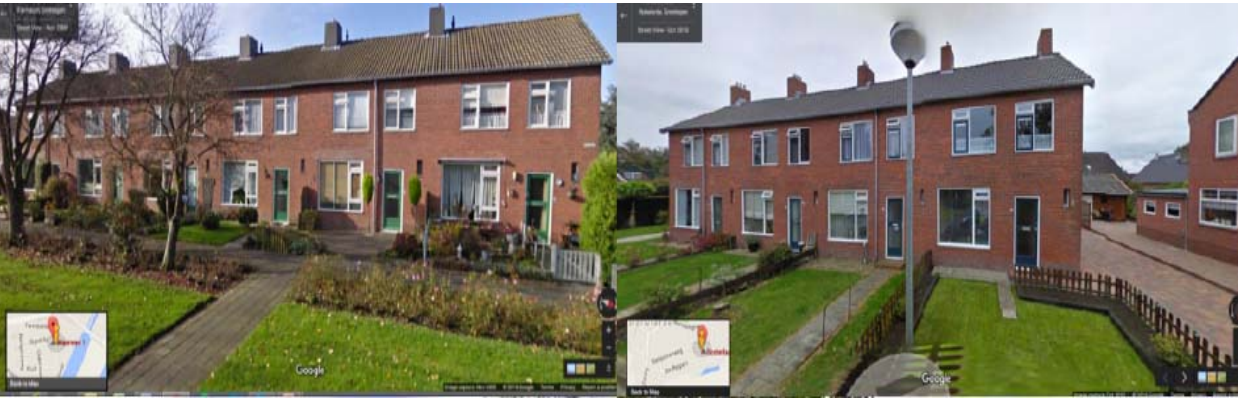
GET SYSTEM LIGHT

| | SINGOLA 10,5 mq | DOPPIA 20 mq | SPAZI COMUNI varie |
|---|---|---|---|
| EXTRA ROOM | Addizione 4,1 mq | Addizione 10 mq | |
| SERRA | Addizione 4,1 mq | Addizione 10 mq | Addizione variabile |
| BALCONE | Addizione 4,1 mq | Addizione 10 mq | Addizione variabile |

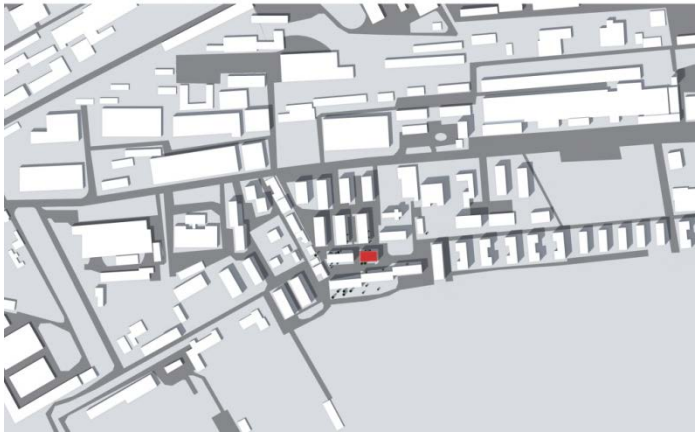
MATERIALI

- LAMIERA STIRATA
- LAMIERA FORATA
- ALLUMINIO BIANCO
- POLICARBONATO
- ALLUMINIO NATURALE
- GRES
- LEGNO TECNICO

# Case studies



Groningen area



Brasov

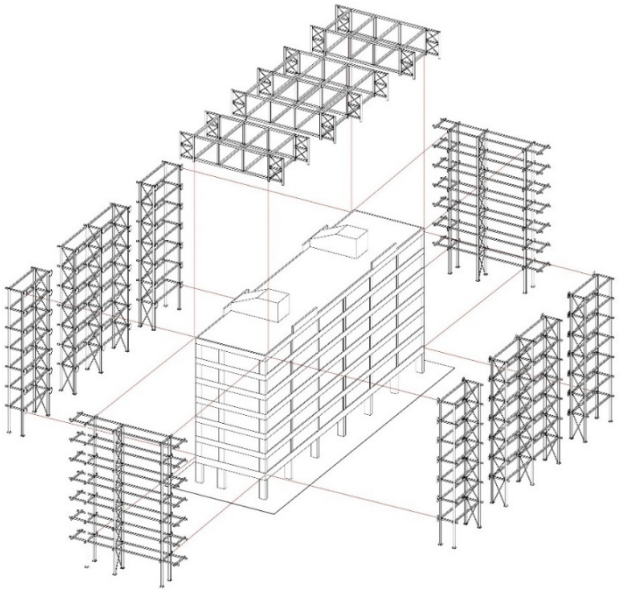
Reggio Emilia

# Case study

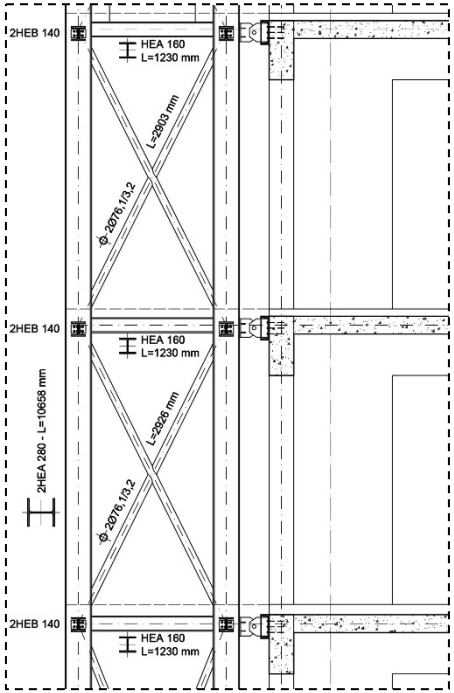
# Case study

# Case study

# SEISMIC STRENGTHENING OF EXISTING STRUCTURE THROUGH EXTERNAL 3D EXOSKELETON



Axonometric scheme




Vertical cross section

External exoskeleton:

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

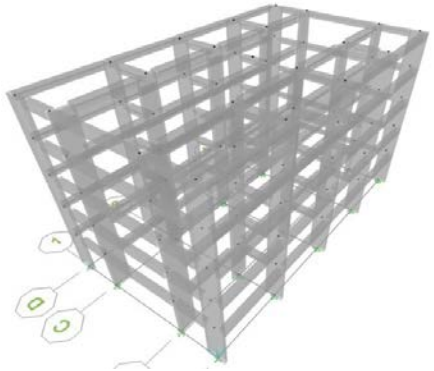
Exoskeleton's global results:

- 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.

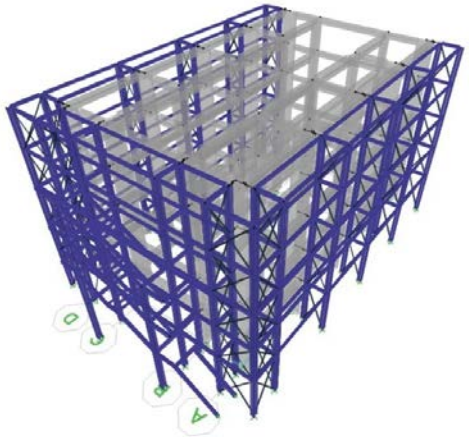
# SEISMIC STRENGTHENING OF EXISTING STRUCTURE THROUGH EXTERNAL 3D EXOSKELETON

## GREEK CASE STUDY

Initial State (IS-ATH)

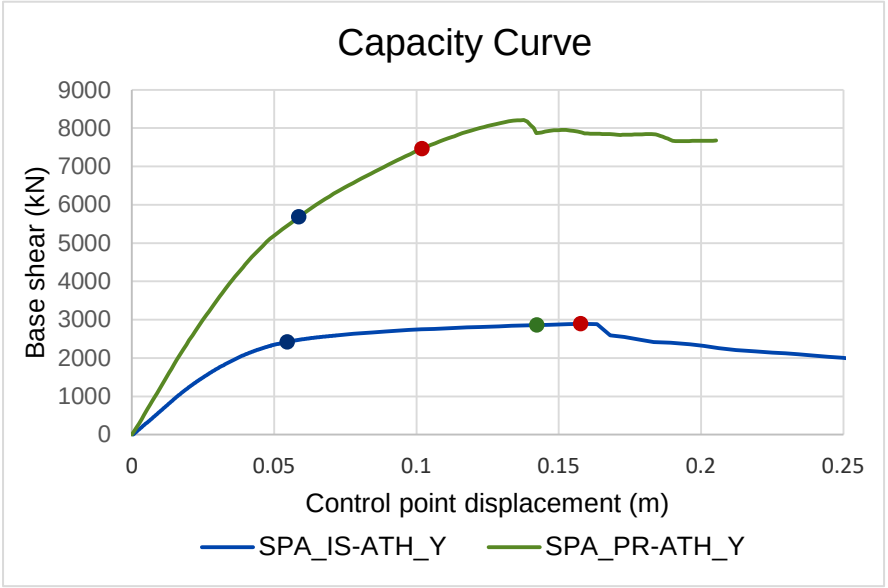


Project Solution (PS-ATH)



## PERFORMED SEISMIC ANALYSES

Static Pushover Analysis




Linear Dynamic Analysis

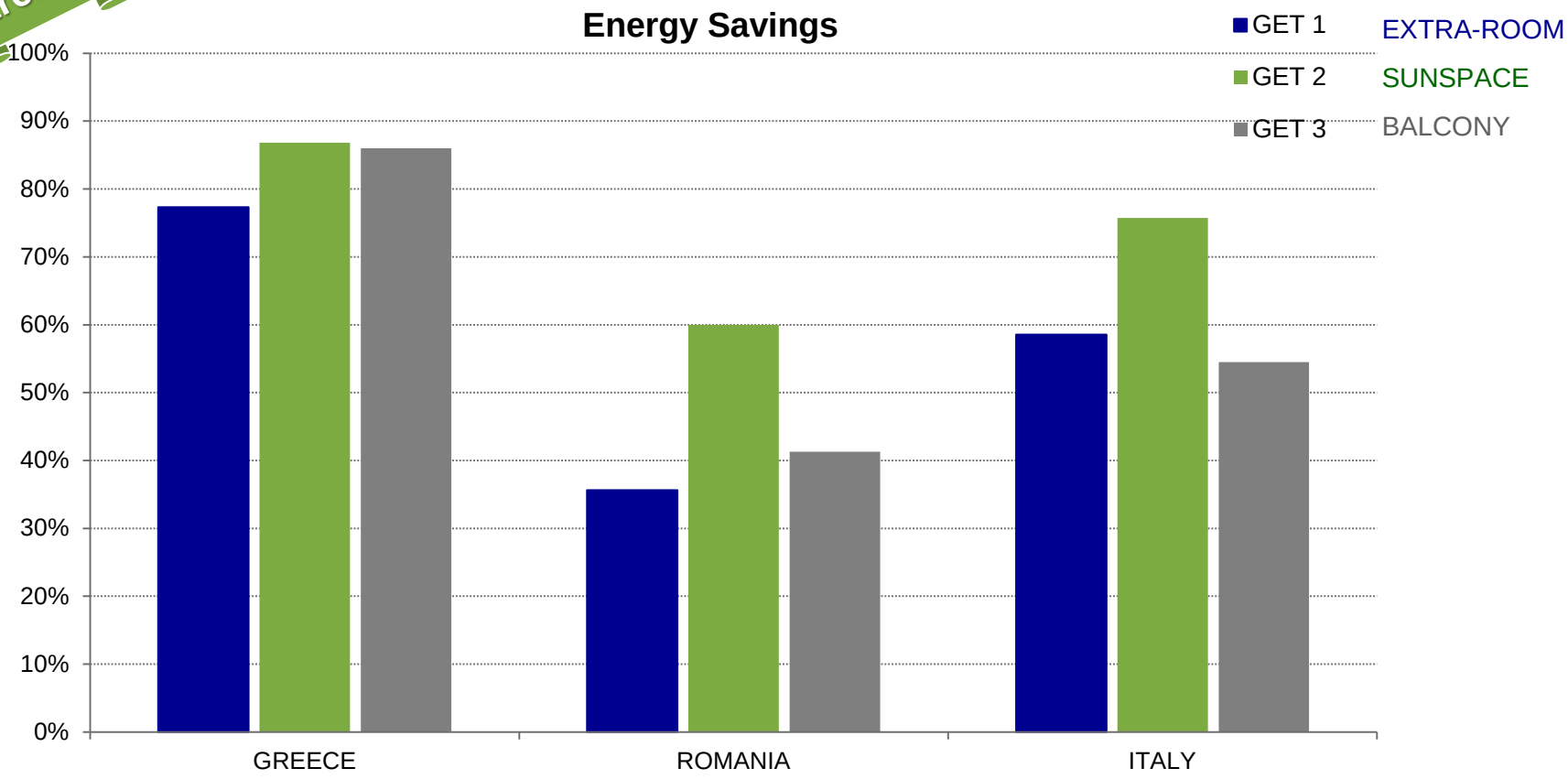
- Limit State SD, IS-ATH → C/D = 42%
- Limit State SD, PS-ATH → C/D = 86%

} 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

Strength



# Life Cycle Assessment with a GET-renovation vs baseline (Demolition And New Built)

| | Source | Product Material – Transport to site – End of life | | | Operational Energy | | Life cycle |
|---|---|---|---|---|---|---|---|
| | | Kg $CO_2$ /$m^2$*y | Kg $CO_2$ /$m^2$*y | Kg $CO_2$ /$m^2$*y | Kg $CO_2$ /$m^2$*y | Kg $CO_2$ /$m^2$*50 y | Kg $CO_2$ /$m^2$*50 y |
| As built | | 150 | | | 54 | 2700 | 2850 |
| Demolition and new construction | **Ecoinvent** | 1005 | | | 11 | **540** | **1545** |
| Demolition and new construction | **Greekstudy** | 760 | | | 11 | 540 | 1300 |
| ATHENS GET renovation (best option) | **GET calculation (LIMA)** | 173 | | | 11 | 540 | **713** |
| ATHENS GET renovation (worse option) | **GET calculation (LIMA)** | 266 | | | 12 | **590** | **856** |

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)

# INNOVATION/
# AMBITION
# VS
# BARRIERS

**No**
**technological innovation**
**without**
**Supporting Legislative Policies**

ProGETonE

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