Off-site construction
to simplify the energy transition in social housing

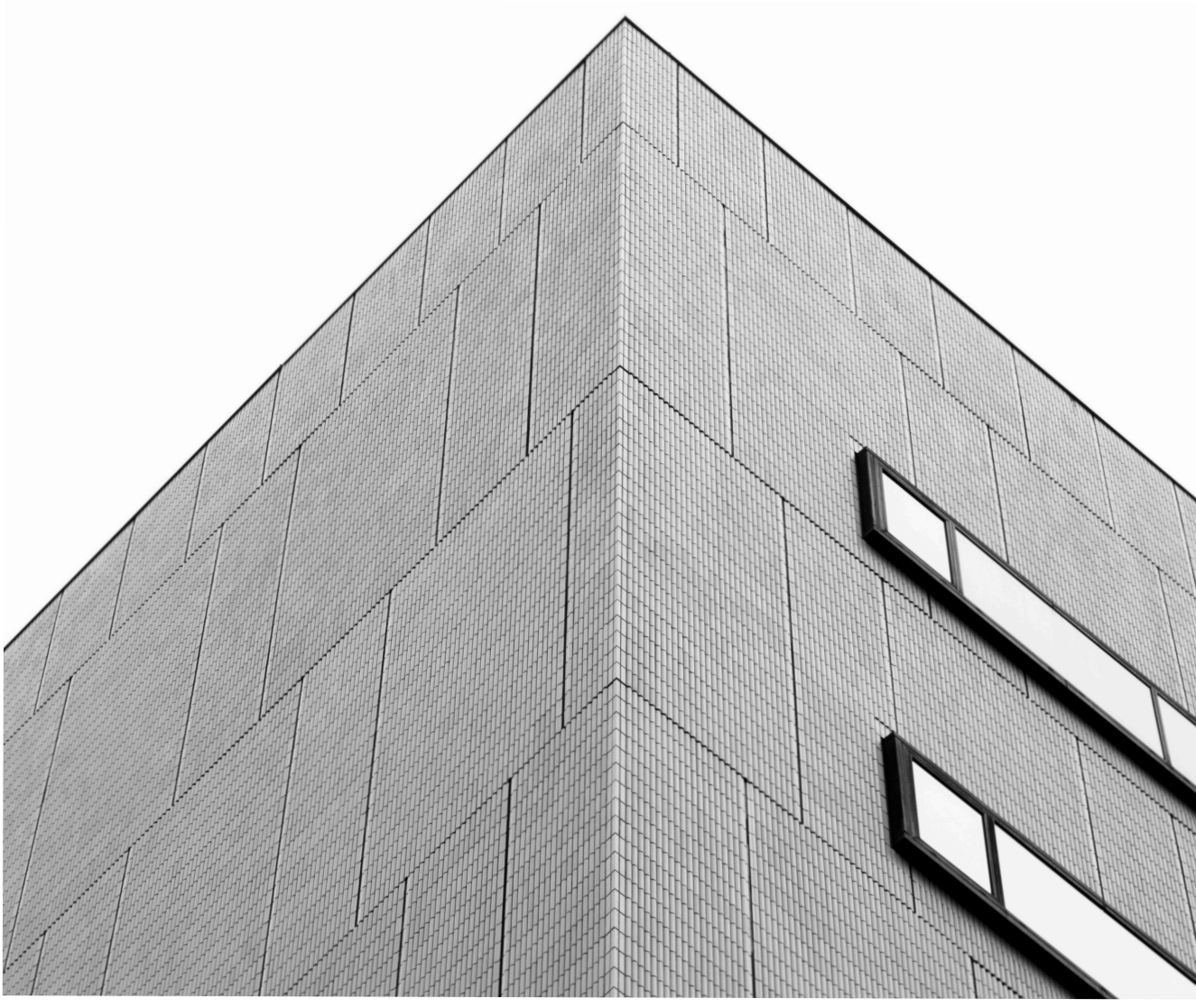
Funded by
the European Union

hit Arc ett ura
Fondazione / Torino

LURE

Off-site construction

to simplify the energy transition in social housing



Project: “Off-site construction to simplify the energy transition in social housing”
Project code: KA210-VET-CF7E01F5
Partners organization:
Fondazione per l’architettura / Torino - E10327024 - IT
Stowarzyszenie Laboratory for Urban Research & Education - E10339676 - PL

Summary

Abstract

The contemporary era is characterised by an increasing scarcity of resources in all forms, prompting a profound reflection on the way in which we live.

In light of the increasing necessity to reduce the environmental impact of the construction industry, European legislation is requiring the implementation of new environmentally-friendly technologies and approaches to reduce the energy consumption and environmental impact of the building stock.
Furthermore, the progressive impoverishment of families and the scarce supply of affordable housing on the market have led to a real social emergency and crisis of living that is affecting numerous countries across Europe and beyond.
These phenomena are significantly influencing the construction sector, as the majority of European buildings must be renovated in the near future, particularly social housing due to its pervasive energy poverty.

Climate change and the housing crisis are two issues that are well-known, but how can architecture provide with innovative and sustainable responses?
The twofold reflection on the future of living and the ecological transition is encountered along this path, through a research project that analyses the potential of off-site architecture for collective housing retrofit and new construction.
The project proposes a turnaround to innovate the construction sector by establishing new professions, skills and roles to cope with a constant scarcity of resources and demographic issues such as the ageing population and the increasing life expectancy.

Looking at the ecological transition: the European context

The European legislation (2020 'Renovation Wave' and the newest 2023-24 European Performance of Buildings Directive) requires new environmentally-friendly technologies and approaches to reduce the environmental impact and energy consumption of buildings, also setting the goal of having zero-emission EU building stock by 2050. This will impact the construction sector, as the majority of European buildings must be renovated in the years to come, in particular social housing due to its widespread energy poverty.

The progressive impoverishment of families and the scarce supply of affordable housing on the market, bring us to a real social emergency and crisis of living.
In addition, recent evidence has shown that low-income individuals and households tend to dedicate a larger share of their budget to fundamental goods such as energy and food, and they are the ones experiencing the highest rates of inflation with consequences in terms of poverty and inequality. Housing costs are part of this concern on the increasing cost of living. Expenditure on housing costs represents the highest share of household budgets in the vast majority of EU countries with an average 32.7% of total consumption expenditure. [1]
Moreover households account for 27% of final energy consumption in the EU and contribute to 21% of total greenhouse gas emissions. [2] Buildings are therefore the largest consumer of energy in Europe: heating, cooling and domestic hot water account for 80% of the energy citizens' consumption.
The construction sector contributes significantly to global climate change, accounting for about 23% of global greenhouse gas emissions and 37% of energy and process-related carbon dioxide (CO2) emissions.

Off-site construction is the only technique that makes building projects' delivery faster, cheaper, safer and greener (less waste and emissions), delivering low-carbon prefabricated buildings and reducing the embodied energy of a building by up to 30%.
Promoting off-site since the first step of the construction chain is important to reverse this trend and create a network of skilled professionals that look at green and inclusive alternatives in architecture.

1_ Eurostat, "Housing, food & transport: 61% of households' budgets". Data referring to 2020.

2_ Eurostat, "Greenhouse gas emission statistics - air emissions accounts". Data referring to 2021.

Italian and Polish overview

The increasing impoverishment of families and the scarcity of affordable housing on the market are creating a real social emergency and housing crisis. More and more households are exposed to energy poverty, especially low-income households living in energy-inefficient dwellings. This is compounded by other factors such as the loss of effectiveness of housing support policies due to a lack of public funding and inefficiencies in the management of existing assets.

One of the consequences of this is a progressive reduction in the supply of public housing, which has to contend with some critical factors such as the high percentage of owner-occupied homes that has always characterized the Italian property market.
However, the vast majority of houses, around 7 out of 10, are owner-occupied, which in Italy is considered a safe investment.
Nationally, public rental housing (Edilizia Residenziale Pubblica or ERP) is estimated to represent about 3.5% of the total housing stock in the country and is a permanent feature of our housing system. [3]

It includes about 900.000 units managed by public housing companies and municipalities. There is no centralized information on the energy performance of public housing, but the need to renovate public housing units is widespread - to the extent that an estimated 10% of the stock is currently vacant. In fact, more than half of the available EPCs are in classes F and G, indicating that the energy efficiency of housing in Italy is relatively low. [4]

Turin's social housing stock, most of which was built between the 1950s and 1980s (68% of the housing stock was built before 1981 and 14% after 1991), is spread over a large part of the urban area, with varying densities. There are 17.435 housing units, 63% of which are owned by ATC, 34.4% by the Municipality of Turin and the rest by the State Property Office, the Local Health Authority and the Ministry of Justice. [5]
This data confirms that around 35% of EU buildings are over 50 years old and almost 75% of the building stock is energy inefficient.

In terms of the labour market, construction remains one of the most vulnerable sectors in Italy. In 2022, construction is the sector with the highest number of fatal accidents, with 110 fatalities. Even for non-fatal accidents, the sector remains one of the most exposed, as confirmed by Inail data.

In this context, it is clear how an innovative process could control the risk associated with work phases, drastically reducing work-related injuries and fatalities.
Inevitably, the need for human resources, which are increasingly scarce in the sector, would be reduced or redesigned.

The Italian off-site project landscape is mainly developed on new construction projects (both single-family and multi-storey buildings). The most commonly used technologies are timber or hybrid timber-reinforced concrete-steel, while retrofit technologies are still almost unexplored. Off-site architecture offers various possibilities for innovation in the construction chain, which in Italy is currently static and rooted in traditional technologies and methods.

The green and digital transitions are an opportunity to address the shortcomings of the construction industry and make social housing projects more inclusive, effective, safer, faster and more environmentally friendly. What's more, off-site techniques, with their lower costs, can help to reduce the financial burden on the beneficiaries of social housing refurbishment, who typically cannot afford large investments.

3_ Istat, Population and Housing Census 2021.

4_ Sistema informativo sugli Attestati di Prestazione Energetica (SIAPE).

5_ Città di Torino, Osservatorio Condizione Abitativa XIX Rapporto - anno 2022.

In Poland, the construction industry is experiencing a gradual shift towards the use of prefabrication methods. Prefabrication involves the manufacture of building components in a factory and then transporting these components to the construction site for assembly. One of the most promising developments in this area is modular construction. This innovative approach involves the production of entire modules of a building in a factory, which are then transported and assembled on site. The potential of modular construction in Poland is considerable, as it can lead to faster project completion, cost savings and a reduction in environmental impact. However, despite its potential, the widespread adoption of modular construction in Poland faces several challenges. One of the main obstacles is the existing regulatory framework, which has not been fully adapted to this modern construction method. Regulations often lag behind technological advances, creating hurdles in the approval process and increasing the complexity of compliance. In addition, traditional construction practices are deeply ingrained in the industry, making it difficult to move towards a more modular approach.

On the other hand, in Poland, factories have sprung up near Toruń and Kraków to produce modular housing elements from wood or steel. Although their production is mostly exported to other Western markets, their location could be seen as a beacon and driver for change. With the right attention, they could be brought more into the domestic market, where they are not as widely used as in other countries where their customers are located.

In Poland, the use of prefabrication in construction is still somewhat limited and most prefabricated buildings are based on concrete wall systems rather than fully modular components. Projects that typically involve the use of prefabricated concrete walls, which are assembled on site to form the structure of the building, are being used in various residential and commercial buildings across Poland.

Although these methods improve durability, efficiency and quality compared to traditional construction techniques, they fall short of the full potential of modular construction. Unfortunately, there are currently restrictions in the law and building regulations that are very much in line with what is considered good practice. These are mainly related to adequate fire protection and the need to build lower structures, for example in timber. This is set to change in the coming years, as the government has recently launched a wider debate on the subject.

In summary, while Poland is making progress in integrating prefabrication into its construction industry, there is still a long way to go before the full potential of modular construction is realised. Overcoming legal and cultural barriers will be crucial to unlocking the benefits of this innovative construction method. As the regulatory framework evolves and the industry becomes more open to change, modular construction has the potential to revolutionise the way buildings are constructed in Poland.

Project objectives

The objectives are linked to the priorities chosen, as they aim to train architects and adapt their professional profiles to the changing skills arising from the wave of renovation in Europe. Building knowledge of off-site in architects will support its use in the partner countries Italy and Poland, contributing to a faster green transition in social housing, where decarbonization and energy efficiency are more urgent given the higher obsolescence of buildings. Currently, there are no common working standards and training options off-site for social housing.

Starting from the analysis of different good practices, the project will identify and design new transnational training content and professional tools to empower architects in off-site design for social housing. In this way, their work will respond to the environmental and social challenges of the social housing context, combining digital and collaborative technologies with innovative and high-performance materials. At the design stage, equal access to housing will be improved through cheaper and higher quality solutions that meet people's diverse needs. Off-site design will allow architects to escape conventional methods and adopt more flexible techniques. Buildings that respond to housing shortages can be adapted to different needs and the use of modular/prefabricated components can help reduce costs and materials.

Following these statements, the project aims to build a community of professionals who will:

- **Exchange good practices** on off-site architecture for social housing as a first step towards its wider adoption;
- **Promote the use of off-site construction** among European architects;
- **Increase the digitalisation** of the construction process thanks to a better use of digital tools (BIM, 3D printing, drones and robots) in off-site practices for social housing;
- **Support the digital and green transition** in the construction sector by promoting off-site construction as a sustainable and inclusive approach to the construction and the retrofit of social housing projects.

The programme

The aim of the project is to engage a group of 20 architects from Italy and Poland (10 per country) to stimulate debate, deepen their knowledge and come up with innovative project ideas for off-site construction to facilitate the energy transition in social housing.
The architects will improve their professional practices and pave the way for a widespread greening and digitalisation of their work, comparing and learning from the experiences of Poland and Italy within the framework of best practices in the European context.
Site and company visits will allow participants to discuss with policy makers, contractors and professionals the off-site solutions used in the renovation and new construction of social housing and their strategic contribution to achieving inclusiveness, aesthetics and sustainability.

The programme will cover the following topics:

- **Political and socio-cultural context**

In the light of the European housing crisis, the debate aims to explore and propose public policy solutions for public heritage to be upgraded and renovated. It will also explore the potential of collective and shared housing as architectural typologies and the benefits they can bring to urban management;

- **Environmental and socio-cultural context**

It focuses on energy poverty in the social housing stock and analyses the new trend of energy retrofitting according to the rules of the recent European Green Deal. Special attention is given to circularity in construction processes, material reuse and bio-construction;

- **Off-site design & processes**

Starting from the current state of the art, we will explore innovative construction technologies, materials and processes in off-site architecture and site management in the context of European best practice;

- **Digital design and industrialization**

What is process innovation?
The topic covers the role of process industrialisation and how established and emerging technologies in off-site construction, such as BIM technologies, 3D printing and robotics, can help to rapidly innovate the system.

International workshops

IT

The training programme is organised by the Fondazione per l'architettura / Torino and LURE with the contribution of several international guests with a transversal background on the topics of off-site construction for social housing. Guests will share their experience and knowledge on the subject, with insights from academic research and universities, public administration and business.

The programme proposes two international workshops to be held in Turin in October 2024 and in Warsaw in February 2025. Each workshop is divided into two days with a series of thematic lectures, practical design workshops and construction site or company visits.
The full programme also includes two dissemination workshops in each country in 2025.

The workshops aim to find a creative and 'visionary' response to the problem of energy poverty in Italian and Polish social housing and the implementation of the production chain for sustainable off-site technologies, exploring the emerging ones.
With the help of case studies and the analysis of international best practices, professionals will have to contribute to innovative proposals for the retrofitting of social housing with off-site technologies and provide public administrations with innovative and affordable applications and methodologies.

At the same time, architects will be actively involved in the production of a "Good Practice Handbook for Social Housing" and an "Off-site Practice Handbook for Architects", which will be published digitally.

PL

Partners and participants

"Off-site Construction to Simplify the Energy Transition in Social Housing" is a project by **Fondazione per l'architettura / Torino** and **Stowarzyszenie Laboratory for Urban Research & Education**, funded by the European Union within the framework of the Vocational Training Partnership KA210-VET (Erasmus+).

The aim of the project is to engage a group of ten Polish and Italian architects to stimulate debate, deepen their knowledge and come up with innovative project ideas for off-site construction to facilitate the energy transition in social housing.

Fondazione per l'architettura / Torino
was founded in 2002 on the initiative of the Association of Architects of Turin.
It promotes architecture as a discipline at the service of the quality of life.
The Foundation promotes interdisciplinary relations and acts as a bridge between the worlds of design, construction, technology and culture.
Its aim is to investigates present and future social needs, to study innovative responses and to implement concrete actions in the field, stimulating change and seeking tools to face the challenges of the future with awareness and responsibility.
The foundation works in various fields: vocational training, social projects, cultural projects and architectural competitions.
Fondazione per l'architettura / Torino is a member of the New European Bauhaus Community and Torino Social Impact, the platform that aims to experiment, together with companies and institutions, a new development strategy with a high social impact and technological intensity.

Stowarzyszenie Laboratory for Urban Research & Education (LURE)
is an urban think tank focused on research, education and development to provide answers to the challenges facing cities and the Green Deal agenda. Its team consists of architects and researchers working on innovative projects for cities.
LURE focuses on promoting sustainable urban development through innovative architecture and interdisciplinary perspectives in all urban dimensions.
LURE has experience in unleashing a new wave of innovative buildings and urban infrastructures oriented towards sustainable building materials, renewable energy solutions and water-related challenges.
LURE is part of the New European Bauhaus and a supporter of the Covenant of Mayors for Climate and Energy and has offices in 4 countries (Poland, Belgium, Romania and Spain).

thank you!

Visit the websites:
fondazioneperlarchitettura.it
lure.eu.com

Follow us on social media:
@fondazioneperlarchitettura