

Sustainable residential housing for senior citizens – contemporary projects

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Abstract. This paper conforms to themes relating to the shaping of sustainable built environment. It tackles issues connected with the implementation of sustainable solutions in residential housing for senior citizens. It presents selected innovative implemented European projects of new buildings and modernisation projects of the existing development comprising the adjustment to the needs of the elderly and to the requirements of sustainable housing.

1 Introduction

Housing for senior citizens constitutes an important group of architectural projects due to the demographic processes we observe today. A considerable increase in the population of the oldest residents in the European Union states over two last decades has decided about a change in the senior citizen policy, economic policy, and about the need to adopt a new approach to the process of shaping spaces for this social group². In the process of designing housing environment for senior citizens, special attention is paid to solutions fostering their activity and integration with the society, as well as to their expectations pertaining to their life comfort.

There are numerous concepts of housing development being proposed to the elderly, adjusted to the degree of their independence and their lifestyle. The senior citizen policy in the European Union is geared towards promoting the model which is the most expected by the elderly, namely a model of living based in staying in their own environment (Aging in Place). Simultaneously, there is a broad offer of diversified forms of accommodation, e.g. supported, sheltered housing, community housing 50+, nursing and care homes. The examples of housing for senior citizens presented below constitute an attempt on the part of designers at finding answers to the needs of this social group. The projects illustrated herein at the same time comply with the requirements posed before the contemporary housing pertaining to the implementation of ecological, energy-efficient, and sustainable solutions³.

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²Ca. 20% of the European Union residents have reached the age above 65.

³The term of sustainable development was defined in 1987 in the Report of the UN World Commission on Environment and Development *Our Common Future*. These assumptions were developed within 'Agenda 21' (Earth Summit in Rio de Janeiro, 1992).

2 Actions for shaping ecological and sustainable buildings

The selected examples illustrate experiences of such European states as Denmark, Germany, Switzerland, England, Austria, Holland. They demonstrate different possibilities of actions that can be undertaken in order to design ecological and sustainable buildings.

They refer not only to newly implemented buildings and complexes. They also comprise the sanitation measures performed on the existing built environment, its maintenance, renovation, reconstruction, and adaptation to contemporary living standards⁴. Today these actions constitute a priority in terms of building a sustainable city. They are conducted in different scales. They comprise single buildings, as well as larger complexes. The goal is rational development of the existing building resources and land, as well as improvement of residents' comfort, particularly in city centres⁵.

In the course of the study, the examples of projects fell to three distinct groups:

- Transformation of the existing development (single buildings) by means of its sustainable modernisation (Fælledgården care centre, seniors' house in Landeck, senior's centre in Magdeburg),
- Sustainable revitalisation of housing estates taking the needs of senior citizens into account (housing estate of Caritas - Haus Neuwerk in Mönchengladbach, housing estate Gyldenrisparken in Copenhagen, housing estate Knikflats in Rotterdam),
- New projects (complex in Domat/Ems, complex in Steinfeld, City House in Munich, community housing in Winterthur, housing estate Darcy Gardens in Essex).

2.1. Transformation of the existing development. Modernisation measures – examples of solutions

The examples presented below are based on the principle of restoring technical, functional, and aesthetic values of buildings, taking into account – in different shares – the aspect of economy, ecology, as well as comfort of residents⁶. The world's leaders in this respect are Denmark, Germany, and Switzerland, as well as Austria and Holland.

Activities for sustainable modernisation (eco-modernisation, eco-revitalisation) are discussed below upon the example of the Fælledgården care centre, a home for senior citizens in Landeck, and transformations in the area of Wohnfabrik Solinsiemein St. Gallen, Switzerland.

The first example to be discussed is the one that represents Danish experiences. Measures for the modernisation of housing development for senior citizens conforms with Denmark's general strategy in terms of renovation of existing buildings, adopting energy-efficient solutions. It constitutes an element of the policy of the Danish government (National Energy Efficiency Action Plan, 2014), based on EU directives (Directive/2012/27/EU). The long-term priority of this policy is to liberate from fossil fuels by 2050 and to head towards a society based in 100% on renewable energy sources [2]. It is of crucial importance as today nearly 40% of energy consumption is attributed to housing environment. Besides the implementation of legal regulations and patterns of energy-efficient solutions, an important element of the strategy is an information campaign carried out amongst residents and designers.

⁴ This topic is tackled by M.A. Wołoszyn, who emphasises that the revitalisation process comprises comprehensive measures, adjusting existing structures to the contemporary socio-cultural, functional, technical, and economic requirements. More on this subject: [1, p. 34]

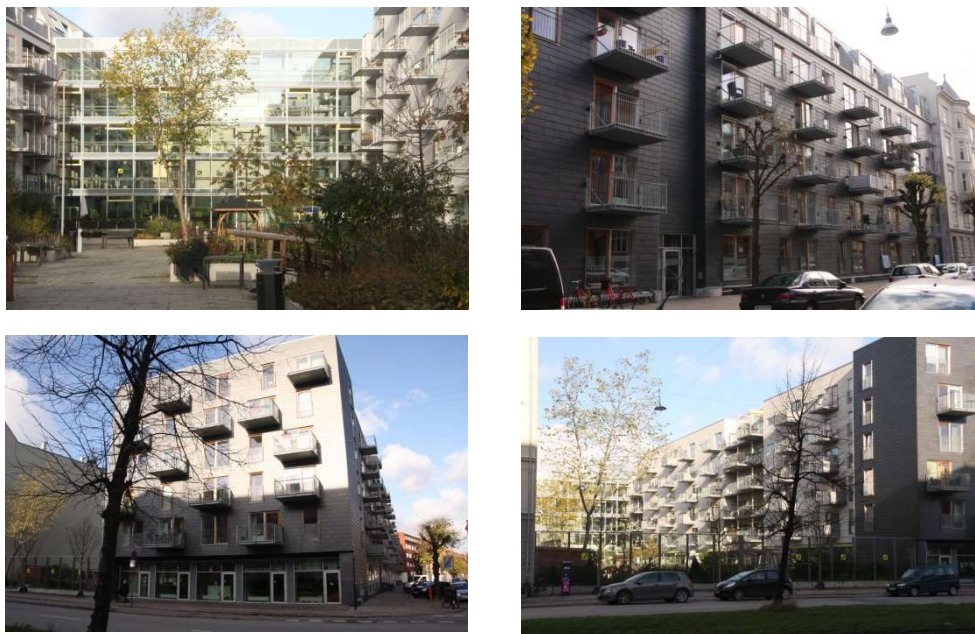


Fig. 1,2,3,4 Fælledgården care centre, Copenhagen (photo by M.Strzelecka-Seredyńska)

The **Fælledgården housing estate** is regarded as a good example of sustainable architecture. It is the largest housing complex for senior citizens in Denmark. It is located in Copenhagen, in the attractive district of Østerbro, surrounded by multi-family quarter development, in the close vicinity of the biggest park in the city and sports facilities. This five-storey building was erected in the 1970s in the prefabricated technology.

Within the scheme of the modernisation undertaken in 2011 (architects: JJW Arkitekter) the building was adjusted to low-energy standards according to the BR10 guidelines. Additionally, functional changes corresponding to the contemporary needs of the residents were introduced[3].⁷

The goal of the energy-efficient reconstruction was to reduce energy consumption. The building was given a compact form and a new structure of ventilated façades (natural slate). The building was equipped with an active harvesting solar energy system based solar thermal collectors and photovoltaic roof modules (900 m²). A controlled ventilation system with heat recovery was introduced. Ecological solutions adopted here comprise the introduction of green roofs on parts of the building, the reduction of water consumption, and making use of rainwater. A new sensory garden fosters rehabilitation and rest of senior residents[4].

Senior citizens' home in Landeck (Austria, arch: Gharakhzadeh & Sandbichler architekten, 1999 -2004) constitutes an example of an energy-efficient renovation (green sanation) of a building from 1976. The goal was to adjust the present, uneconomical structure of the building to the contemporary energy-efficient standards and functional needs, as well as to reduce the costs of its utilisation. The renovation was divided into three

⁷ BR10 was a set of norms determining standards of low-energy buildings in force until 2015 and 2020.

The Fælledgården housing estate was adjusted to the standards determined for 2020. More on this subject:[3]

stages. They comprised the reconstruction of the elevation together with windows replacement (1999), reconstruction of interiors and change of the structure of the apartments (2004), and installation of solar collectors for heating water.

Energy efficient solutions comprised the thermal insulation of the building, and the introduction of new structural elements of the façades. They were made of wood and covered with copper coatings. Good illumination of interiors allows to minimise the use of artificial lighting. Large glazed areas on the southern wall in combination with the use of the thermal mass of reinforced-concrete walls and ceilings foster passive recovery of solar energy[5].

Similar assumptions constituted the foundation for the energy-efficient renovation of senior citizens' centre in Magdeburg, Germany, erected in the 1970s⁸.

An example of measures relating to the adaptation of the existing industrial development to the programme of housing for senior citizens is a complex of the community housing 'Wohnfabrik Solinsieme' in St. Gallen, Switzerland (Archplan AG, 2002)⁹[8].

The concept of the design combines in itself social requirements (living comfort) with the requirements of economy and ecology¹⁰. A new functional structure is created by independent residential units and shared recreational spaces. Ecological standards are implemented by means of a number of energy-efficient solutions, such as active systems of solar energy recovery in the form of roof collectors, intended for domestic water heating. The interior design makes use of healthy ecological materials.

2.2.Sustainable revitalisation of housing estates

Actions for sustainable revitalisation are described below upon the examples of the Gyldenrisparken housing estate in Copenhagen and the Knikflats housing estate in Rotterdam.

The measures undertaken at the **Gyldenrisparken** housing estate (Amager, Copenhagen, Denmark, arch. WitrazArchitects, Vandkunsten and Wissenberg, 2006 – 2014) aimed to adjust the existing residential buildings and green areas to the contemporary standards. By means of adjusting the space to the needs of all age groups, the economic and ecological factors were taken into account.

This social housing estate, built in the 1960s, consists of 4-storey multi-family buildings made of reinforced-concrete prefabricated panels. The renovation of the buildings brought about an improvement in the functional structure of the apartments (432 residential units). Introduction of additional thermal insulation of façades and large window openings allowing more light inside was aimed at the reduction of the energy consumption for heating purposes (by 20%).

Thanks to the introduction of a residents stimulating programme in the form of new structures: a pre-school, and a nursing home for senior citizens, as well as a new concept of the development of the area around the buildings in the form of arranged greenery and recreation zones, the designers reached the goal of social sustainability, as well as the living standards corresponding to those in force in other districts of Copenhagen.

Pro-ecological solutions were adopted in both new projects. The pre-school was built according to the passive standards (high insulation of 30-40 cm, airtight envelope structure). A large surface of glazed elevations facing the south aims to harvest solar

⁸ Cf.: [6, p.1263] and [7, p. 95]

⁹ The factory building, located in the city centre, dates back to 1880.[8, p.86]

¹⁰ In 2007 the design won the award of the Die Age Stiftung foundation, which promotes good living conditions for the elderly and the search of diversified forms of residence for senior citizens in Switzerland.

energy. In the walls facing the north small window openings were introduced. The energy-efficient solutions allowed to reduce the energy consumption for the heating purposes by 50%. Additionally, a green roof was applied, which absorbs rainwater and protects the building from overheating in summer. A green roof and an ecological wall envelope structure made of wood (heat-treated wood) were applied in the nursing home for senior citizens, as well [9].



Fig. 5,6,7,8 Gyldenrisparken, Copenhagen (photo by M.Strzelecka-Seredyńska)

The Knikflats housing estate in Rotterdam (area of Ommoord, Rotterdam, arch. Big stadsonwerp, 2000- 2008) is an example of revitalisation of a housing estate aimed to make use of the existing substance by means of its sanitation. It was planned to adjust it to contemporary residential standards, simultaneously maintaining the identity and tradition of this area in the city¹¹.

The Knikflats complex was built in the 1960s, within the perimeter of the district of Ommoord. The modernisation covered four residential units (700 apartments). The concept of the reconstruction of two buildings comprised the introduction of changes in the functional layout of the apartments to adjust them to the needs of the elderly residents. Ground floors of the buildings were reconstructed, too, and transformed into independent segments addressed to senior citizens, accessible directly from the ground level. Designers proposed to depart from typical standards of social housing. It was also assumed that the changes introduced should not result in increasing the costs of the apartments, which should still be affordable for their previous users. Changes in the space surrounding the buildings were introduced, as well, in order to improve the residents' sense of comfort and to

¹¹Currently, Rotterdam implements a programme geared towards the implementation of the concept of a green, healthy, and dynamic city based on sustainable development (Programme on Sustainability and Climate Change). It also comprises the maximum use of renewable energy sources (sun, wind), the introduction of innovative forms of management, and a strategy for the renewal an exposition of its architectural heritage.

stimulate their activity. This example can be classified as representing a model which is the most widely accepted nowadays – staying in one’s own environment (Aging in Place)¹². This concept conforms with activities for social sustainability in the contemporary city.

2.3. New projects

Amongst new projects of sustainable housing estates for senior citizens, the complex of **Neuwerk Caritas-Haus** w Mönchengladbach (arch. RongenArchitekten, 2003), intended for 80 residents, deserves special attention. It is regarded as the first nursing home for senior citizens built in compliance with the standards of passive buildings. These standards strictly determine energy parameters of buildings.

In the Neuwerk Caritas-Haus project these standards are manifested in a compact form of the building and perfect thermal insulation of the external walls, as well as low heating costs. The designers’ priority was to aim to reach the maximum comfort of life for the elderly, especially in terms of the air quality inside, as a result of the application of a controlled ventilation system. A flexible floor plan allows to combine individual residential units to adjust them to the changing structure of the residents.

The Neuwerk Caritas-Haus complex referred to above served as an experimental field for a design of another complex for senior citizens, **St. Josef Caritas-Haus** (arch. Rongen Architekten, Mönchengladbach-Giesenkirchen, 2008-2010).

The project comprises the renovation of two existing buildings from the 1960s, which are combined with new modular development. The new structure is regarded as the first example of combining the prefabricated steel modular system (3.89 m x 15.25 m, 3.20 m) with the passive housing standards in the design of a nursing home. The ready-made modules consisted of two apartments with bathrooms. The adopted system allowed to limit the time of construction works [11].

A residential model which is alternative to the nursing homes discussed above is the **senior citizens’ complex in Domat/Ems**, Switzerland (arch. Dietrich Schwarz, 2003-2004). It consists of individual residential units with access to care services. This four-storey building consists of two-room apartments. It is characterised by a compact, energy-efficient form. Pro-ecological solutions applied here comprise energy-efficient systems and technological solutions. They satisfy Swiss criteria of passive and low-energy construction. The building is divided into zones. Near the north facade there are passageways and staircases, which constitutes a form of insulation and a climatic buffer zone.

The apartments for senior citizens face the south. Residential premises are linked with winter gardens, which are covered by a transparent façade with glass panels that harvest solar energy in line with the passive principles. Harvesting solar energy according to the passive principles is also fostered by the very structure of the building – reinforced-concrete ceilings and well-insulated brick walls. Heat pumps and active solar systems are applied so as to reduce heat consumption for the purposes of heating the building interiors and water [7, p.78].

Yet another project, **the nursing home for senior citizens in Steinfeld**, Austria (arch. Dietger Wissounig Architects, 2005), conforms with the concept of a low-energy building. This three-storey complex, designed around a shared, glazed, central atrium, has a sparing, compact form.

The role of a buffer climatic zone, shielding the ground floor of the building from the north, is played by the service outlets. Sustainable standards are implemented by e.g. the

¹²The concept of buildings revitalisation in Ommoord was presented within the scheme of exhibitions ‘Architecture of Consequence - Dutch Designs for the Future’ (2009), prepared by the Netherlands Architecture Institute for the International Biennale of Architecture in São Paulo [10].

introduction of energy-efficient material-related, as well as structural solutions. Good thermal insulation of the external walls are used, along with a massive, reinforced-concrete structure of the building, which together with the glazed atrium plays an important role in the passive concept of the solar energy harvesting.

Air is fed to the ventilation systems through an internal atrium. It is initially heated or cooled by means of geothermal collectors, Active, collector-based solar systems and an energy-efficient, controlled artificial lighting system were introduced, as well. The solutions listed above allowed to reduce the energy consumption by 30% compared to other buildings of the type.

Ecological solutions manifest themselves in the application of healthy construction products, e.g. wood, structural elements and envelopes of the external walls and inside the building. Rainwater from the secondary circuit, after treatment, is used, as well [12, p. 117; 7, p. 104].

When discussing energy concepts in the process of shaping of housing development for senior citizens, one needs to emphasise proposals of shared spaces covered with glazed roofs (atria, winter gardens, internal courtyards). They aim to harvest renewable solar energy, and at the same time they constitute a recreation zone filled with greenery. Such solutions include the aforementioned project based in Steinfeld, as well as a number of other realisations, e.g. the home for senior citizens located in the district of Hornwerkin Deventer (arch. KCAP Architects & Planners, 2008, Holland), as well as the nursing home in Maria Gail near Villach, Austria (arch. D. Wissounig Architekten, 2010).

The residential complex for senior citizens in Winterthur, Switzerland (arch. H. Hubacher Architekten 2010) was designed as a community housing facility, intended for people aged 50+. It was located in the area of one-family buildings. It is characterised by a simple, energy-efficient form with large windows [13, p.948]. The project obtained the Swiss building assessment certificate Swiss MINERGIE®-P-ECO. This means that the residential building satisfies specific requirements in terms of energy-efficiency standards (energy consumption) and low burden for the natural environment, as well as certain social requirements. This assessment system attaches great importance to health-related issues and to the living comfort, including the microclimate and the quality of air inside, the application of ecological, healthy construction products, protection of residents against noise, as well as providing sufficient quantity of natural light¹³.

The group of new housing complexes designed with regard to ecological solutions, including energy-efficient ones, comprises the complex for **senior citizens Darcy Gardens** in Dagenham in Essex, United Kingdom (arch. MEPK Architects, 2008). It consists of bungalows intended for independent residence, and a two-storey central complex arranged in a corridor layout with 36 apartments, additionally furnished with medical care premises. The location in the middle of one-family development area fosters integration of the elderly with other generations. The architecture, opened up towards greenery, with green roofs, conforms with the requirements of ecology. Energy-efficient solutions are manifested in the use of renewable energy sources – the sun and the wind. This goal is served by the installation of collector panels and wind turbines¹⁴.

¹³ The MINERGIE®-P-ECO standards combine the requirements of the MINERGIE ECO and MINERGIE -P standards, MINERGIE ECO is a method of assessing newly erected as well as modernised buildings, based on criteria relating to energy-efficient and ecological construction, as well as satisfying social requirements. MINERGIE, MINERGIE-P, MINERGIE-A, on the other hand, focus predominantly on guidelines relating to effective energy saving in civil engineering. In Switzerland the certificates referred to above are held by more than ten thousand buildings [14].

¹⁴It constitutes a combination of a flexible attitude in designing apartments for senior citizens with different degrees of independence.

intended for senior citizens, the housing complex implemented in Concoret, France (arch. Nomade Architectes, 2013), deserves attention, too. It constitutes one of the latest realisations, implemented within the scheme of the EHPAD programme, which comprises a network of homes intended for senior citizens who are independent and who require constant care¹⁵. It was the first complex for senior citizens (44 apartments) in France to be granted the BBC (Bâtiment Basse Consommation) Effinergie award for achievements relating to obtaining relevant thermal efficiency indicators (low energy consumption building). The requirements of the Bâtiment Basse Consommation – Effinergie certificate cover the assessment of the building in terms of the CO2 emission level, the application of renewable energy sources, the compactness of the form, the applied insulation.

3 Summary

The examples presented in this paper correspond to different models conforming with the requirements of ecology and economy. The social factor is also of key importance for making design-related decisions. It is manifested in the search for a standard of a functional, healthy, and safe apartment and its surroundings, taking into account the mental and physical comfort of the elderly.

Architects implement the principle of sustainable development in architectural and urban design in many different ways. Design concepts satisfy the assessment criteria of sustainable buildings to different extents. The projects discussed in this paper refer to standards, norms, and certificates applicable in individual countries (e.g. MINERGIE®-P - ECO, BBC Effinergie, Passive House). Designers also make references to regional construction patterns and to the local climate. References to the local climate usually assume the form of making use of renewable solar and wind energy. Solar energy is harvested by means of active and passive systems. In passive systems an important role is played by the southern exposition of residential buildings, with large windows, as well as the application of different structures of solar façades. Combining apartments and winter gardens and the application of glazed internal courtyards is also promoted. Additionally, zoning is introduced in building interiors.

Energy-efficient standards in designing buildings for the elderly are also expressed in the selection of the very structure of buildings and their envelopes, as well as in the materials applied, the insulation of external walls, the orientation of buildings according to cardinal directions, proposing their compact form, equipping them with control installation systems (artificial lighting, heating and ventilation systems).

Ecological criteria are also satisfied by means of applying healthy construction materials, rational raw materials management (e.g. recycling, biodegradation, geothermal energy), making use of rainwater.

The social aspect of sustainable housing manifests itself in taking humanist values into account. The priority in this respect is the stimulation of activity of senior citizens and allowing their integration with other social groups, inside the designed buildings, as well as in the space of the city. The designing process covers residents' participation. The solutions referred to above are implemented in new buildings addressed to senior citizens, as well as within the scheme of sustainable renovation of the existing structures.

¹⁵EHPAD (Établissement d'hébergement pour personnes âgées dépendantes) covers new projects and nursing homes arranged by means of adaptation of existing buildings. They operate as public, public-private, or private facilities.

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