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The Beauty of New Urban Functions: Creating an Aesthetic Value or Using Existing Elements?

**Piękno nowych funkcji miejskich – tworzenie
wartości estetycznej czy wykorzystanie
istniejących elementów?**

Abstract

The paper aims to answer the question of how the aesthetic value of functions that appear as a novelty in contemporary urban space is given on the example of buildings intended for urban agriculture. Due to the fact that most of them are created as part of multi-functional facilities and constitute an extension of the existing infrastructure, the way they are shaped and the final aesthetic expression is the result of technical needs and capabilities. Natural beauty in the city has been, often by contrast, associated with the emergence of greenery, which is built spontaneously, creating principles that inspire the discovery of a perfect geometry, a harmony within each urban scale. Hence the potential for a new function, which, although its subject is nature, is nevertheless enclosed by architectural form by design. The last decade has brought the first realizations of agriculture integrated into the urban fabric and treated as an urban function, so it has not yet managed to develop its own clearly defined aesthetic. However, the influence of several basic

functions from which urban agriculture originates is clearly visible in this respect, i.e. intensive agriculture, industry, housing and recreation. These aesthetics are often in contradiction, but they already give the opportunity to pick out certain directions that are supposed to ensure a harmonious combination of seemingly contradictory elements. The use of the symbolism of a place, the existing characteristic elements that bear witness to local traditions, which are transformed for the new function, and their inscription, either by contrast or continuation in the existing urban context are often used tools. This analysis is based on examples of completed complexes and buildings for which it is possible to objectively assess the premises causing a sense of harmony or disharmony on various levels of reading space – physical, symbolic or historical. The discussed examples include housing developments, industrial and logistics functions, office and exhibition space.

Keywords: urban farming, rooftop farming, housing development, wielofunkcyjność, industrial development, revitalization

Abstrakt

Niniejszy tekst ma na celu odpowiedź na pytanie, w jaki sposób nadawana jest wartość estetyczna funkcjom, które pojawiają się jako nowość we współczesnych przestrzeniach miejskich na przykładzie budynków przeznaczonych na cele miejskiego rolnictwa. Z racji tego, że większość z nich powstaje jako element obiektów wielofunkcyjnych oraz stanowi rozbudowę istniejącej infrastruktury, sposób ich kształtowania oraz ostateczny wyraz estetyczny jest wypadkową potrzeb i możliwości technicznych. Piękno naturalne w mieście było, często na zasadzie kontrastu, kojarzone z pojawieniem się zieleni, która buduje się niejako samoistnie, tworząc zasady stanowiące inspirację dla odkrywania idealnej geometrii, harmonii w każdej z miejskich skal. Stąd też potencjał nowej funkcji, która, choć jej podmiotem jest natura, zostaje jednak z założenia obudowana formą architektoniczną. Ostatnie dziesięciolecie przyniosło pierwsze realizacje rolnictwa zintegrowanego z tkanką miejską i traktowanego jako miejska funkcja, dlatego nie zdołała ona wytworzyć jeszcze własnej, jasno zdefiniowanej estetyki. Wyraźnie jednak widać w tym zakresie wpływy kilku podstawowych funkcji, z których wywodzi się miejska agrokultura, tj. rolnictwa intensywnego, przemysłu, mieszkalnictwa i rekreacji. Estetyki te pozostają często w sprzeczności, jednak dają już możliwość wychwycenia pewnych kierunków, mających zapewnić harmonijne połączenie elementów pozornie sprzecznych. Wykorzystanie symboliki miejsca, zastanych elementów charakterystycznych, świadczących o tradycji lokalnej, które ulegają przeobrażeniu na potrzeby nowej funkcji i wpisanie ich, zarówno poprzez kontrast, jak i kontynuację w istniejący kontekst urbanistyczny, stanowią często wykorzystywane narzędzia. Niniejsza analiza będzie oparta

na przykładach zespołów i budynków zrealizowanych, dla których możliwa jest obiektywna ocena przesłanek wywołujących odczucie harmonii lub dysharmonii na różnych płaszczyznach odczytywania przestrzeni –fizycznej, symbolicznej czy historycznej. Wśród omówionych przykładów znajdują się zespoły zabudowy mieszkaniowej, przemysłowej, logistycznej, biurowej i wystawienniczej.

Słowa klucze: miejskie rolnictwo, farmy dachowe, zabudowa mieszkaniowa, wielofunkcyjność, zabudowa przemysłowa, rewitalizacja

Aims, thesis and methodology

The paper aims to answer the question of how the aesthetic value of functions that appear as a novelty in contemporary urban spaces is given on the example of buildings intended for urban agriculture. Due to the fact that most of them are created as part of multi-functional facilities and constitute an extension of the existing infrastructure, the way they are shaped and the final aesthetic expression is the result of users' needs and technical possibilities of individual adaptations and revitalizations. Natural beauty in the city was, often in contrast, associated with the appearance of greenery, which occurs spontaneously, creating rules that inspire the discovery of perfect geometry and harmony in each of urban scales. Hence the potential of the new function, which, although its subject is nature, is by definition encapsulated in an architectural form. Therefore, an important element of the conducted research was an attempt to answer the question whether this nature, present in the form of urban crops with its specific form, is able to influence the aesthetic dimension of the created architecture and what compositional elements are used in this case by new urban functions.

The main thesis the author puts forward is that although agriculture as an urban function has appeared in a modern form using the achievements of technology relatively recently, it has already managed to create some forms of coherent aesthetics based on the use of existing elements and their combination with forms associated so far with intensive farming. Agriculture in cities is the fulfilment of the need, also aesthetic, of bringing man closer to nature, even the one seen only to a limited extent, exposed through transparent façades as an expression of modernity, while being connected with nature. Hence the emphasis on the agricultural function in traditional forms. This aesthetics adopts common features regardless of the function with which it is associated, although elements specific to the part of architecture focused on direct

contact with the user or intended only for observation from the outside, without the possibility of interaction, can be distinguished. The distinction between functions related to agriculture occurs at a higher level of interdependence between their elements. In the case of default “contact” functions, i.e. agriculture and retail trade, these will be more often integrated with each other, not only in terms of use, but above all in terms of composition, giving rise to a new form of “transparent,” “exhibitionist” aesthetics, exposing a new value in space, but without the possibility of physical contact with it. This text also allows to show how this barrier of contact is maintained.

For the sake of the analysis the closed multifunctional buildings were selected, the main integrating element of which is indoor urban farming, combined with various types of commercial, residential, educational, industrial and agricultural functions. Moreover, the study is based on the examples of completed complexes and buildings for which it is possible to objectively assess the premises causing a sense of harmony or disharmony on various levels of spatial analysis – physical, symbolic, historical. The collected materials came both from professional and government websites. A valuable source of information were also the site visits undertaken in August and September 2022 and specific information obtained from the design offices and the investors and the facility owners.

An important part of the research was the comparative analysis of the data on institutional and market initiatives in the field of urban rooftop farming conducted in indoor facilities and related to commercial and logistic or residential functions. The results are presented in the further part of the paper. From the catalogue of examples, the most representative ones were selected¹ for a detailed case study analysis, in accordance with the adopted criteria. In this case, the qualitative research makes it possible to compare the basic parameters of the existing space and its valorization and to formulate general trends in the aestheticization of the analysed type of buildings and functions, and to extract the basic common features in terms of aesthetics assumed by the function.² Finally, the source and data interpretation method was applied to the evaluations of the case studies, both empirical and archival.³ The study was preceded by an

1 Robert K. Yin, *Case study research. Design and methods*. Applied Social Research Methods Series Volume 5 (London-New Delhi: SAGE Publications, 2002), 12.

2 Linda Groat and David Wang, *Architectural research methods* (Hoboken: John Wiley & Sons Inc., 2013), 215218.

3 Elżbieta Niezabitowska, *Metody i techniki badawcze w architekturze* (Gliwice: Wydawnictwo Politechniki Śląskiej, 2014), 159-160, Niezabitowska, *Metody i techniki badawcze w architekturze*, 187-189.

analysis of the latest literature on the subject and supplemented with the field research and graphical analysis.⁴ The facilities were analysed on the basis of descriptive documentation and iconographic material available. In specific cases, a study trip and photographic inventory were also made.

Introduction

The development of urban functions is a continuous process, which has been going on uninterruptedly since the emergence of cities as a form of spatial development. It has always reflected the current state of society, its achievements and needs. Until the end of the 18th century, it proceeded relatively slowly, being rather an evolution of form resulting from a change in the rank of mutual connections within the city and its relationship with the political system. Only the industrial revolution brought about a real, rapid change in the functional layer of the city, so clear that it required the first serious redefinition of the urban function. Along with the simultaneous technical development in basically all spheres important for the functioning of the city – from technical infrastructure to defence systems, the emergence of new materials and construction techniques, to the expansion of the social class system – there was a process of significant changes aimed at updating and adapting the space to a number of requirements resulting from the rapid spatial development of existing cities and the need to establish new ones.

At the current stage of human development this process is also progressing, but it is rather related to the rapidly increasing number of people and the resulting change in the proportions between urbanized and non-urbanized areas in the world and the state of the environment. Currently, compared to the functional changes of an industrial city, much less emphasis is placed on functional zoning, grouping of complementary functions and separation from the antagonistic ones, but on multifunctionality, accessibility and limiting the extreme necessity of constant movement, transport of people, goods and services to meet basic needs. Hence, the functions related to the implementation of sustainable development assumptions are gaining importance, which so far did not exist at all or did not occur in urban areas, such as multifunctional facilities, and not only those with complementary functions, related to energy production, especially from renewable sources, development and recovery raw materials from municipal waste, as well as, what will be the main

4 Groat and Wang, *Architectural research methods*, 141–170.

element of considerations in this text – urban agriculture and related to it: distribution and urban fruit and vegetable processing.

The last decade brought the first implementations of agriculture integrated with the urban fabric and treated as an urban function, which is why it has not yet managed to create its own, clearly defined aesthetics. However, the influence of several basic functions from which the urban agriculture originates makes that these aesthetics are often contradictory. Such a division, however, enables to identify clear directions, which are to ensure a harmonious combination of seemingly contradictory elements into a single architectural complex, creating together thoroughly multifunctional objects. The use of the symbolism of a place, the existing characteristic elements, testifying to the local tradition, which are transformed for the needs of the new function and inscribing them, both through contrast and continuation into the existing urban context, are often used tools in the case of linking complexes on an urban scale with the existing urban tissue.

The current state of research

Agriculture integrated with architectural structures has been a topic of research since the early 2000s, when there was actually a clarification of the subject from earlier conceptual and theoretical explorations. It is now accepted that the most promising direction is the creation of highly efficient hydroponic structures, based on renewable energy sources generated on site, similarly extracting the water necessary for plant growth recovered in a closed loop from the functions that agriculture accompanies.⁵ The most technologically advanced research currently conducted is concerned with the search for exemplary technical and spatial solutions in the experimental environment. The most recognizable

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- 5 Danielle Gould and Ted Caplow, “8- Building-integrated agriculture: a new approach to food production”, in: *Woodhead Publishing Series in Energy, Metropolitan Sustainability*, ed. F. Zeman (Sawston: Woodhead Publishing, 2012), 147–170.
Ana Nadal et al., “Building-integrated rooftop greenhouses: an energy and environmental assessment in the mediterranean context”, *Applied Energy*, 187/1 (2017): 338–351.
Burkhardt von Elsner et al., “Review of Structural and Functional Characteristics of Greenhouses in European Union Countries, Part II: Typical Designs”, *Journal of Agricultural Engineering Research*, 77/ 2 (2000): 111–126.
Bernard J. Bailey and Zaid S. Chalabi, “Improving the cost effectiveness of greenhouse climate control”, *Computers and Electronics in Agriculture*, 10/ 3 (1994): 203–214.
Dilip Jain and Gopal Nath Tiwari, “Modeling and optimal design of evaporative cooling system in controlled environment greenhouse”, *Energy Conversion and Management*, 43, No. 16, 2002: 2235–2250.

example at present is the ICTA-ICP research building at the campus of Universitat Autònoma de Barcelona in Cerdanyola, by DATAAE and HARQUITECTES,⁶ tested both in terms of the technology used and the functioning of the facility itself.⁷ One of the global trends started around 2010 is the use of the roof space of existing buildings with various primary functions in order to introduce rooftop farming (RTF) as open or, more often, enclosed greenhouses⁸ which, however, does not function as a social or experimental gardens, but for a typically commercial profit.

Current trends in the form of buildings themselves and the way they are internally organised have been very much influenced by the realisation of a building with a non-residential but office function, combined with plant cultivation in an enclosed environment. The Pasona Urban Farm headquarters located in Tokyo, which is actually a conversion of an existing office building, was designed by Yoshimi Kono and Yi-han Cao of Kono Designs in 2010.⁹ In this case, the cultivated vegetation is both an element of the site's identification system, consciously raising the prestige of the place, but also an element that constructs the space and influences the microclimate of the different functional zones.¹⁰

Of the analyzed facilities, only one has already been described in the literature, but only in terms of its role as an example of circular architecture. According to the analysis of H. Ping Tserng, Cheng-Mo Chou and Yun-Tsui Chang, Bart van Bueren, Mark Leenders i Torbjörn Nordling the agricultural function in Taisugar Circular Village is an element of

6 <https://www.archdaily.com/636587/research-center-icta-icp-uab-h-arquitectes-dataae> (access: 1 May 2023). Esther Sanyé-Mengual, Jordi Oliver-Solà, Juan Ignacio Montero and Joan Rieradevall, "An Environmental and Economic Life Cycle Assessment of Rooftop Greenhouse (RTG) Implementation in Barcelona, Spain. Assessing New Forms of Urban Agriculture from the Greenhouse Structure to the Final Product Level", *The International Journal of Life Cycle Assessment*, 20/3 (2015): 350–366.

7 Ercilla-Montserrat Mireia, Izquierdo Rebeca, Belmonte Jordina, Montero Juan Ignacio, Muñoz Pere, De Linares Concepcion and Rieradevall Joan, "Building-Integrated Agriculture: A First Assessment of Aerobiological Air Quality in Rooftop Greenhouses (i-RTGs)", *Science of The Total Environment*, 598/ 15 (2017): 109–120.

Marius Balas, Jelena Nolic, Ramona Lile, Mihaela Popa and Roxana-Mariana Beiu, "Intelligent rooftop greenhouses and green skyline cities", *SWS Journal of Earth and Planetary Sciences*, 1/ 2 (2019): 15–28.

<https://www.archdaily.com/636587/research-center-icta-icp-uab-h-arquitectes-dataae> (access: 1 May 2023).

8 Devi Buehler and Ranka Junge, "Global Trends and Current Status of Commercial Urban Rooftop Farming", *Sustainability*, 8/11 (2016): 1108, 2.

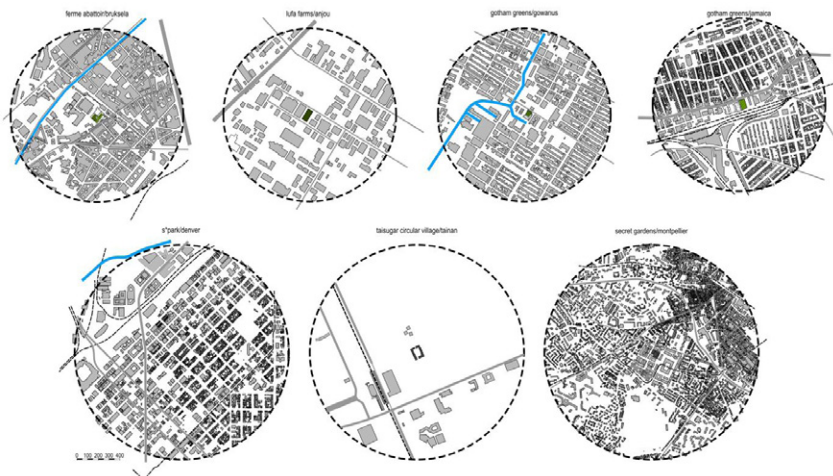
9 <https://konodesigns.com/urban-farm/> (access: 10 May 2023).

10 Justyna Kleszcz, *Bio-polis. Wizja miasta nie-antropocentrycznego* (Zielona Góra: Oficyna Wydawnicza Uniwersytetu Zielonogórskiego, 2020), 149–152.

the circular economy strategy in the field of landscape architecture, and was considered as such,¹¹ omitting a significant element of the impact of the new function on the aesthetic expression of the created building. Other, less strict forms of linking housing development in cities with agriculture are subject to a broader analysis, including various types of cooperatives – from community gardens to city farms using elements of land development,¹² which are an attempt to create a healthy living environment in cities.¹³ Currently, the research is also being carried out on other possible functional relationships between urban agriculture and residence, industrial production or trade.

The case studies

Figure 1. Morphological Analysis of the Selected Examples of Analysed Objects (elaborated by the author).



11 H.-Ping Tserng, Ceng-Mo Chou and Yun-Tsui Chang, “The Key Strategies to Implement Circular Economy in Building Projects- A Case Study of Taiwan”, *Sustainability*, 13/2 (2021): 754.

Bart van Bueren, Mark Leenders and Torbjörn Nordling, “Case Study: Taiwan’s pathway into a circular future for buildings”, *IOP Conference Series: Earth and Environmental Science*, 225 (2019), 012060.

12 Aleksandra Nowysz, “Modernist Projects of Community-Based Urban Farms in Residential Areas A Review of Agrarian Cooperatives in the Context of Contemporary Urban Development”, *Buildings*, 11/8 (2021), 369.

13 Brian Berry and Adam Okulicz-Kozaryn, “Dissatisfaction with City Life: A New Look at Some Old Questions”, *Cities*, 26/3 (2009): 117–124.

Gotham Greens

The urban farms collectively known as Gotham Greens¹⁴ operate as a nationwide commercial enterprise, forming an urban network of vegetable-production facilities throughout the US.

Originally operating only around New York, the enterprise quickly developed into a nationwide network, locating their facilities further and further away west of the country in Chicago, Colorado and California. Subsequent greenhouses showed a tendency to increase the cultivation area until they reached the strategic size of 9,300 m² of cultivated area with approximately 1,300 m² of auxiliary area.

An urban farm in Greenpoint¹⁵ in Brooklyn was established in 2011 as the first commercial hydroponic rooftop farm. It was designed by New York architect Giuseppe Rosario Anzalone on the rooftop of a two-storey industrial building. The cultivation area is relatively small, at approximately 1,400 m². The farm pioneered the idea that crops be fully separated from the external environment, which allowed for the implementation of energy and water-recovery systems, and in the cultivation itself – natural pollination (the bumblebee population) as well as the elimination of pesticides and artificial fertilizer. The rooftop facility in the shape of a typical, modular greenhouse was built as a steel frame, with the use of installation systems ensuring full control of the internal microclimate. A significant amount of the energy necessary for this purpose is provided by the roof PV system that covers the remaining roof footprint, in addition to the greenhouse. Access to the building is provided by two staircases from the ground floor. One of them is an existing staircase, the other was erected on the eastern side, slightly interfering with the internal structure of the „host” building. The „parasitic” function consists of a modular vegetable greenhouse with a packing/storage-space module adjacent to the farm facility on the northern side.

Gowanus,¹⁶ located also in Brooklyn, was established in 2013, on the rooftop of the Whole Foods Market, as the first facility to sell fresh produce grown there not by means of an open market, but in a commercial

14 April Philips, *Designing Urban Agriculture. A complete Guide to the Planning, Design, Construction, Maintenance, and Management of Edible Landscapes* (Hoboken: John Wiley & Sons Inc., 2013), 261–263.

15 Gotham Greens Farms Llc and Viraj Puri, *Gotham Greens Farms, Llc sustainable urban CEA. Final Report prepared for The New York State Energy Research and Development Authority*. New York: NYSERDA 11113, 2011, 1–44, <https://www.nyserda.ny.gov/-/media/Files/Publications/Research/> (access: 31 March 2023).

16 <https://www.gothamgreens.com/our-farms/> (access: 31 March 2023).

retail facility. The cultivation area also remains relatively limited at around 1,900 m². The concept itself very well aligned with the idea of revitalizing the Gowanus estate, located in south-western Brooklyn, which was named after the canal constituting the axis of the industrial and office zone. This area, bordering several housing estates, is formally situated within this zone.¹⁷ The original design assumed the construction of a commercial facility simultaneously with a rooftop farm that would be interconnected functionally and operationally, along with the adaptation and renovation of the existing, historic Coignet building.¹⁸ The building, despite its limited size, is an immensely important monument of New York's industrial heritage as the city's earliest example of a structure made of reinforced concrete, poured on site. It was a showroom for the New York & Long Island Coignet Stone Company. It was for this reason that it was included in the construction design concept.¹⁹ The functional program of the building complex includes, in addition to large-area retail space and the rooftop farm, also several eateries of various types, located on the ground floor and on the level of the greenhouse.²⁰

Jamaica in Queens District is Gotham Greens largest rooftop farm in New York City and it was launched in 2015 on the roof of the historic Ideal Toy Company factory. Pullman 1 in Chicago is the first Gotham Greens rooftop farm to be built outside New York City. It was completed in 2015 on the roof of the Method Products factory, which produces ecological cleaning agents and components for urban agriculture, in the industrial area of Chicago. The factory building complex was designed as the LEED-Platinum standard²¹ certified by William McDonough + Partners. Pullman 2 is another rooftop farm developed in Chicago and inaugurated in 2019. The former Ryerson Steel industrial halls were adapted to create it. It has the largest farming area so far, measuring over 9300 m². Gotham Greens' latest rooftop farm, launched in 2019, is Providence in

17 <https://www1.nyc.gov/assets/planning/download/pdf/plans-studies/gowanus/gowanus-framework-full.pdf> (access: 31 March 2023).

18 <https://gowanuscanalconservancy.org/> (access: 31 March 2023).

19 *Gowanus Institute for Research, Planning and Development, A Study of Whole Foods Market's Use Variance Application to Build a Regional Store in Gowanus Brooklyn*, ed. Nathan Elbogen, Jessica Fain and Ariel Krasnow (New York: The Gowanus Institute for Research, Planning and Development, Rev. 1.0, 2011), <https://semspub.epa.gov/work/02/157541.pdf> (access: 31 March 2023).
<https://brooklyneagle.com/articles/2019/08/29/coignet-building/> (access: 31 March 2023).

20 <https://www.brownstoner.com/services/closet-cabinet-specialists-nyc/d55819cb01e-dd/whole-foods-market-214-3rd-street-brooklyn-ny-11215/> (access: 31 March 2023).

21 <https://www.archdaily.com/484412/william-mcdonough-designs-ultra-clean-manufacturing-facility-for-method> (access: 31 March 2023).

Rhode Island. It was erected as a green-field facility on a plot previously owned by General Electric.

The Baltimore urban farm was created as a reconstruction and extension of the former Bethlehem Steel Mill plant in Sparrows Point, Maryland²² with an area of 9300 m², and, unlike the above-mentioned examples, was located in the suburbs, directly outside the city limits. The building the farm was located on – the Bethlehem Steel Mill factory – was constructed at the end of the 19th century and was bought by the owners, from whom it took its name in 1916.²³ During this time, Sparrows Point became a global steel-production centre. The facility served its original function until 2012. It is the first of a new type of industrial farm – its purpose is to deliver fresh vegetables to the 10 closest states. It also seems to be the herald of a new trend in urban agriculture – focused on mass, if not industrial, production of fresh produce, but without the need for long- term storage and transport – that is, intended for quick distribution within a very limited range.

The expansion of the agro-industrial function, in accordance with the original assumptions to reduce drastically the distance between crop-production location and the greatest concentration of recipients of the produce, which came down to the implementation of a new function in the exact city centres in the case of North American cities, ceased to fulfil the originally assumed function. Currently, the areas of functioning districts or suburban industrial zones are selected for the location of new urban farming facilities, linking the agricultural function with a well-developed extra-urban transportation network, and not with the location of residential areas, i.e. with the factor of fresh food availability, which lay at the foundation of the idea of combining the functions in scope. This feature is well observable in the case of the most modern Denver Metro urban-farming facility, located in Aurora, Colorado. Developed in 2020, it was erected in front of the market hall and the Stanley city market, next to the former express way of the Denver Stapleton Airport area, now turned into a pedestrian street. It is one of the smallest facilities built so far. The farming zone, with an area of approx. 2800 m², was completed following the design developed by the company in earlier facilities. The greenhouse takes up 4 out of 5 modules. The extreme outer

22 <https://www.commercialsearch.com/news/gotham-greens-greenhouse-replaces-bethlehem-steel-mill/> (access: 31 March 2023).

23 <https://thepursuitofhistory.org/2021/12/22/sparrows-point-from-steelmaking-to-distribution-center-hub/b> (access: 31 March 2023).

module comprises basic supplementary functions related to employee service, cultivation technology and storage.

Lufa Farms

The first Lufa Farms rooftop farm was built in 2011.²⁴ It was founded by Lauren Rathmell and Mohamed Hage on the roof of the company's headquarters in Ahuntsic – Cartierville, Montreal (Canada), as a superstructure on top of the existing factory space. The farming area is 2900 m². Canadian farms rely on a distribution model different from the above-mentioned one – the produce is sold in the form of subscription: individually composed weekly food baskets distributed within the city by the company's own fleet of electric cars. Additionally, several self-pickup points have been set up in commercial or eat-in facilities, available within a 3-hour drive from Montreal to cities such as Sherbrooke, Quebec City, Shawinigan and Gatineau, so that the produce is not cold-stored at any stage in the food-production process, which dramatically reduces the cost of transportation and storage to next to nothing. Simultaneously, the company launched cooperation with lesser local food producers thus establishing a form of an on-line marketplace, where produce from various manufacturers is offered and delivered by means of the company's distribution network. Such a model of trade, thanks to the diversification of not only the offer, but above all the type of urban crops, results in significant seasonality of the merchandise, which further increases its attractiveness. Due to the adopted model of direct, fragmented distribution, the first urban farm was located directly above the distribution centre and the administrative part.

Another farm came to existence in Laval on the outskirts of Montreal in 2013. The location of a greenhouse on the rooftop of a complex of industrial, commercial and office buildings located in an industrial district adhering to residential housing confirms the evolution of the localisation concept for this type of facilities towards the touchpoints between functions with well-developed logistics facilities and transportation, and residential zones – where the target recipients of green produce are housed. In 2017, the third largest urban farm was established in Anjou, also in the suburbs of Montreal. Currently, the fourth greenhouse is under construction in Ville Saint-Laurent with a target farming area of

24 <https://www.treehugger.com/green-food/second-lufa-farms-rooftop-urban-farm-opens-laval-quebec-canada.html> (access: 31 March 2023).

15 218 m², set up as a local centre for green produce and food redistribution in an industrial district, though built from scratch on the basis of a proven industrial-agro-distribution building model. Currently, in view of food-supply problems facing the inhabitants of the island of Montreal, Lufa Farm is being analysed as both the largest and the most influential fresh-produce supplier on the local market. The commercial success of such a farm concept has resulted in extensive analysis of its influence on the structure and type of production carried out by smaller traditional farms in the immediate vicinity, which have been supplying the city with fresh vegetables and herbs so far.²⁵

Abattoir BIGH

Abattoir BIGH is an urban farm designed by ORG Architects built on the roof of the Foodmet market hall in Brussels, in a shopping district, famous for holding fairs, numerous trade halls and the only craft slaughterhouse located in the city centre. The construction of the farm was launched in 2016, the outdoor garden was established in 2017, while the greenhouse and fish-farming facilities were completed in 2018. The pisciculture now involves commercial breeding of striped perch, while simultaneously providing herbs, tomatoes and lettuce, but due to the recirculating production in the aquaponic system it is possible to implement natural pollination and exclude the use of chemical plant-protection products. The specific location of the farming facility allowed for the implementation of limited processing of fish and herbs and its subsequent sale on the spot.²⁶ The scope of the facility's impact, determined by the scale of sales of its crops, covers the area of the Brussels agglomeration, within but not exceeding the range of 12–15 km from the place of production. The facility is involved in a relatively most diverse type and manner of agricultural production.

Significantly, the building was erected as the first stage of the revitalization process of over 10 hectares of the 19th-century municipal slaughterhouse and the NV Abattoirs et Marchés d'Anderlecht-Cureghem cattle

25 Monica Allaby, Graham K MacDonald and Sarah Turner, "Growing pains: Small-scale farmer responses to an urban rooftop farming and online marketplace enterprise in Montréal, Canada", *Agriculture and Human Values* 38/ 3 (2020): 677–692.

26 <https://bma.brussels/wp-content/uploads/2018/12/> (access: 31 March 2023); <https://www.architectural-review.com/buildings/foodmet-abattoir-brussels-belgium-by-org-architecture/10036765.article> (access: 31 March 2023).

market. The Foodmet hall of 21 000 m²²⁷ was developed as an extension of the existing fresh market, which belonged to the original building complex. Designed and built between 2009-2015, also by the ORG Permanent Modernity²⁸ studio, its importance may be noticed in that it was intended to supplement and constitute temporary forms of space arrangement, adapted to the needs of the multicultural community of immigrants constituting the majority of the residents of this part of Anderlecht,²⁹ turning it into a multi-purpose, roof-covered fresh market. Foodmet's key function, besides providing open trade space for the sale of fresh meat and vegetables, may be seen in the rooftop farm characterized by its diversified structure. The administrative and social facilities have been made independent of the remaining bulk of the building (including its independent commercial part) by separating standalone communication divisions. The functional program of the facility was enhanced with an element of social importance. The farm-to-table restaurant on the ground floor has been integrated with the entrance area, whose array of rooms acts as an airlock in this case. The kitchen facilities have direct access to the rooftop crops. Similarly, the consumption hall was connected to the cultivation area by an open terrace on the roof of the building.

Agrotopia

The greenhouse and research centre on urban agriculture in Roeselare, Belgium, built between 2015 and 2022, was designed by the team of META architectuurbureau and van Bergen Kolpa architects³⁰ and is currently the largest facility of its kind in Europe. The facility was created by superstructuring the existing REO Veiling – agricultural auction market with agricultural, educational and research functions with an

27 <https://orgpermod.com/architecture/projects/abattoir-foodmet> (access: 31 March 2023).

28 <https://orgpermod.com/architecture/projects/abattoir-foodmet> (access: 31 March 2023).

29 <https://www.architectural-review.com/buildings/foodmet-abattoir-brussels-belgium-by-org-architecture/10036765.article> (access: 31 March 2023); Justyna Kleszcz, "Miejsce tabu – miejsce niezbędne. O budowaniu tożsamości osiedla opartego na funkcjach wstydlivych na przykładzie belgijskiego Cureghem / A place of taboo – a necessary place. About building an identity of a housing estate based on shameful functions on the example of Belgian Cureghem", *Housing Environment* 39 (2022): 20–32.

30 <https://www.archdaily.com/976252/agrotopia-research-center-for-urban-food-production-van-bergen-kolpa-architects> (access: 31 March 2023).

https://www.dezeen.com/2022/02/04/rooftop-greenhouse-agrotopia-urban-agriculture-architecture-belgium/?li_source=LI&li_medium=bottom_block_1#/ (access: 31 March 2023).

elevated public space placed between enclosed cultivation area in which 4 different climate zones have been created independently.³¹ This creates a buffer zone around the perimeter of the superstructure and separates the crops from the actual façade. A separate, two-storey entrance area with a public space for visitors means that the cultivation area cannot actually be seen through the façade. In this case, the effect of the transparency of the greenery through the façade and its visual impact on the surroundings has been reduced through the use of a box-in-box layout. Hence the even more pronounced monumentalism of the building, where the green element no longer serves to soften the perception. As in the previous examples, the very shape and form of the greenhouse elements serves to accentuate the presence of the new function. In this case, this was done by rhythmically curving the front façade and doubling the height and also undulating the part of the building lying on the side of the express-way for the purpose of vertical cultivation, creating an additional accent in the space, clearly visible also from the perspective of the road. At the same time, however, it is as self-sufficient as possible, with its own rainwater storage facilities and using a renewable source of heat – a nearby waste incinerator operating nearby and serving the city. The facility was funded by the Flemish Government Architect's Pilot Projects for a Productive Landscape (PPPL).³²

31 Semi Park, "Rooftop Greenhouse Agrotopia", *Space* 655/6 (2022): 20–27.

Van Bergen Kolpa + META, "Agrotopia Research Center, Roeselare (Belgium)", *Architectura Viva* 243/4 (2022): 70–74.

32 <https://www.vlaamsbouwmeester.be/nl/subsite/productief-landschap/projecten> (access: 1 May 2023). Pieter T'Jonck, "Een serre om van te duizelen", *A+ Architecture in Belgium* 294, No. 02–03 (2022): 20–23.

Figure 2. Evolution of the Plan Form of Analysed Facilities. The Section for Cultivation is Marked in Green (elaborated by the author).



S*Park, Denver, USA

Completed in 2018, the S*Park development in Denver was designed by Tres Birds studio for Westfield Company as a commercial multi-family housing estate. A low-rise 2-3 storey development encompassed an entire quarter on the Curtis Park Neighborhood in the form of a low-rise high-density development, offering a large typological and size variation in internal layouts.³³ This is reflected in the form of the housing itself. The south side of the quarter has been dedicated to an agricultural function. An elevated community greenhouse has been placed on the roof of the catering unit, which is the main recipient of the agricultural production. The whole development is adjacent to a community garden, where crops are grown on raised beds.

The interior of the quarter, intended for pedestrian traffic only, has been well landscaped: a storm water runnel and detention pond, with areas also designated for bird and insect habitat as recreational and park greenery. The effect of reducing electricity demand has been achieved by placing photovoltaic panels on unused roofs.

The facades, designed to emphasize the additive nature of the volumes, have been clad with a brick structure in various shades, wood and sheet metal in natural colors. The brick facades have been designed to support the plants. The process of 'overgrowing' the wall itself has not been forced by appropriate planting, but left to the estates' natural ageing process.

Secret Gardens

The 2021 Secret Gardens housing project is the winning entry in the competition for a section of the new Creative City ZAC EAI located in Montpellier, France, as part of the SERM/SA3M closed competition. It was designed by a consortium of Vincent Callebaut Architectures, Bouygues Immobilier Languedoc-Roussillon, Vestia Promotion and Emmanuelle Navarro Architecte on the site of the former military infantry school l'Ecole d'Application de l'Infanterie (EAI), based in Montpellier since 1967 and located on a site that was also previously a military site, created by the merger of l'Ecole d'Application de l'Infanterie in la Sarthe

33 <https://www.archdaily.com/942654/s-star-park-tres-birds> (access: 1 May 2023).
<https://tresbirds.com/S-PARK> (access: 1 May 2023).

and l'École Militaire d'Infanterie.³⁴ In 2010, the site ceased to have a military function due to the merger of the EAI with l'École d'Artillerie in Draguignan and the transfer of teaching there. This allowed the release of more than 35 hectares of the site, together with the existing infrastructure, in order to transform it into an open urban structure and create the 'ÉcoQuartier'³⁵ regeneration area approved by the French Ministry of Ecological Transition.³⁶

One of the stages of the revitalisation process became the realisation of the competition premise. The complex of multi-family housing was designed with the assumption of creating a mixed – use structure, combining commercial and social development (30% of the planned 117 flats were social housing), respecting the tradition of the place and in close connection with the agricultural function solved both at the level of individual gardens and communal greenhouses, recovering grey water and rainwater in the estate in order to use it for irrigation of crops. At the same time, this is the first time that such clear and direct attention has been paid at the design stage to elements of ecology and sustainability, understood not only in its technical aspects but also as a general concern for human well-being in the place where people live, and a conscious reduction in the estate's carbon footprint through solutions introduced at this stage. The estate, as the only one of the discussed examples, has also already been designed based on the experience of searching for a hypermobile, multifunctional and variable space, able to meet all the needs of the resident without delegating them outside the development complex, thus building on the experience of the time of the Covid-19 pandemic. The estate is to be completed in 2024.

The estate has a very elaborate structure and the introduced greenery typology. In addition to private gardens on balconies and ribbon-shaped plant pots around all of the façades, gardens for the flats on the ground floor and terraces belonging to the flats on the top floors (roofed or not), there are also forms of social greenery, intended for all residents regardless of the type flat they occupy. These include rooftop gardens, a 'built-in forest' inside the courtyard, rooftop greenhouses and indoor growing areas. The morphological and functional diversity, as well as the adaptability of the plan itself (a designed hypermultifunctionality) found its expression in the way of shaping the external expression of the building.

34 <http://www.ecoquartiers.logement.gouv.fr/operation/2187/> (access: 1 May 2023).

35 https://www.montpellier.fr/uploads/Document/51/WEB_CHEMIN_7409_1246367442.pdf (access: 1 May 2023).

36 <http://www.ecoquartiers.logement.gouv.fr/operation/2187/> (access: 1 May 2023).

The ribbon-like nature of the balconies surrounding the entire building, the repetition of the compositional elements while at the same time significantly varying the depth of this band allows the internal structure to be adapted in the future according to the changing social needs of the residents. The concept itself referred to the notion of a biophilic city and a new form of architecture being an expression of this, hence the references to the intended compactness of the development and the assumed verticality of all its elements (including the accumulation of greenery).

The adopted main environmental objectives also had a significant impact on the form of the estate itself. The economy and low carbon footprint of the materials was achieved through the use of low-carbon concrete as both a structural element and a façade cladding, and the provision of thermal insulation from rice straw. A neutral façade color scheme was adopted, reminiscent of the colors of the earth, with rhythmic horizontal and vertical stripes resulting from the structure of the building, with wavy, ‘woven’ lines as a reference to the mesh interspersed with greenery – an element, according to the authors’ narrative, referring to an element of military camouflage nets to commemorate the site’s former military history.³⁷ The reduction in energy consumption has been achieved through the rigorous application of a path of the sun in the shaping of blocks, also facilitating natural ventilation, the centralisation of the technical rooms, the use of landscaping elements for rainwater retention, but also the use of open canopies over the green roofs for the installation of photovoltaic panels and the further use of the energy generated for living purposes and for maintaining the estate’s fleet of electric cars. There was also an element forgotten in commercially built housing estates, such as bicycle rooms with simple and convenient access from the ground floor of the building.

Taisugar Circular Village

The last of the analysed examples of housing estates was built between 2017 and 2021 in Wudong within the new urbanisation of Gueiren District in Taiwan. The multifamily housing complex was designed by Bio-Architecture Formosana³⁸ studio and the client was Taiwan Sugar Corporation, also entering the development market. The structure of the quarter is

37 https://vincent.callebaut.org/zoom/projects/210929_secretgardens/secretgardens_secretgardens_pl021 (access: 1 May 2023).

38 <https://www.bioarch.com.tw/work/taisugar-circular-village> (access: 1 May 2023).

characterized by a high volatility of the structure. The number of storeys varies in this case from 2 to 8, with an additional underground car park, as was the case in the other analysed examples of housing development.³⁹ The complex has a well-developed program of social functions related to shared workspaces, workshops, studios, a community kitchen and a small local market. Due to the adoption of circular economics assumptions, construction materials have been selected in such a way that, in addition to being close to production, they use elements that are possible to be reused as easily as possible. Hence the appearance of significant amounts of steel structures, façade sheets and wooden cladding.

It is the only one of the analysed examples that uses the element of rooftop greenhouses integrated into the structure of the building, rather than attached to the roofs. Hence, all the buildings have pitched roofs and are barn-shaped, as a form reminiscent of the traditional greenhouse shape. At the same time, photovoltaic panels have also been integrated in the roof plane on the side facing the strongest sunlight. The Wudong estate is the only one of the group to have greenhouses integrated into the body of the building, the location of which depends on the sun line and allows access to the crops directly from the general circulation routes, ensuring the fullest contact between nature and residents. The inner courtyard, also free of car traffic, provides space for cultivation, recreation and retention.

39 <https://www.archdaily.com/974658/taisugar-circular-village-bio-architecture-for-mosana> (access: 1 May 2023).

function. This trend is clearly visible especially in case of the residential function, where greenhouses never occupy the entire roof area.

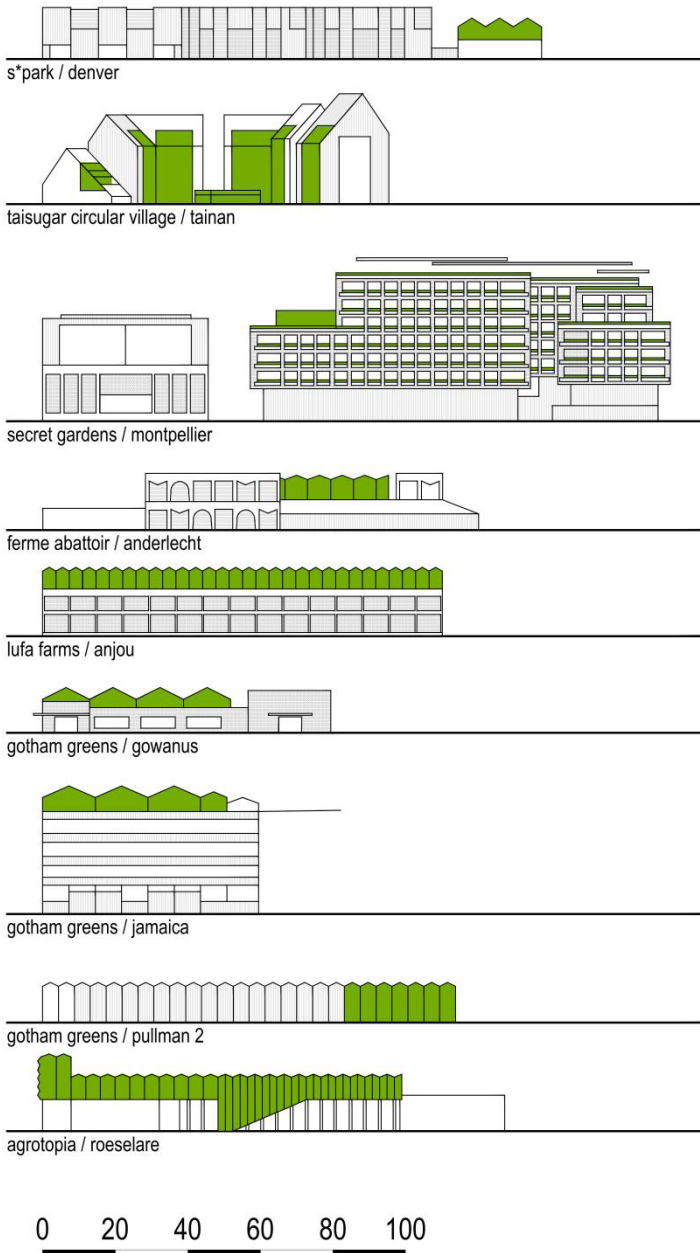
The additive form of roofs and the use of a clear contrast between building parts representing traditional agricultural functions is a constant element of each of the analysed examples. Only the latest projects, such as Taisugar Circular Village, show the possibility of further functional and formal integration, which manifests itself in the transition from additivity to unification of functions. The transparency necessary for cultivation is included more strictly in the way of composing the layout of buildings and causes that it undergoes compositional simplification. At the same time, the very form of the buildings in each case meets the assumptions of denser development in places already invested, which results in the formation of compact systems with relatively high buildings, but strictly implementing the recommendations resulting from the parameters of insulation, shading and ventilation necessary to obtain. Thus, a side effect of the whole process is much greater care for the environmental parameters of the space than in typical commercial solutions.

The façade materials used and their colors do not differ significantly from typical solutions used in contemporary architecture, but in general one can distinguish a clearly visible economy of formal solutions and references to natural rather than highly processed materials. This reference is made both in the type of materials (brick, including recycled ones, wood, greenery, steel) and in the colors themselves. Each of the discussed solutions, apart from the glass and steel structures of the greenhouse, is maintained in neutral earth colors (beige, sienna, terracotta) or in shades of gray. The adopted colors are to be a manifestation of the facilities' inclusion in the trend of pro-environmental and pro-ecological solutions by maintaining the stereotype of the basic association of natural colors with ecology. Only the latest solutions, both in the field of adapted post-industrial buildings and housing complexes, move away from the aesthetics adopted in this way towards the actual ecology of the material solutions used, their simplicity and universality, enabling the reuse of facilities and their components, no longer based on the mere association of the concept and a certain stylistic convention. The materials used can be recycled or even rebuilt after disassembly. Therefore, unless the project concerned the adaptation of existing buildings with a reinforced concrete structure, this material is rarely used. A recurring element of the composition is the raised rooftop urban farm - a greenhouse, which appears significantly above the line of sight, creating a city garden visible from the height, but inaccessible. The adopted façade composition scheme in selected examples is shown in the abovementioned figure. Depending

on the function accompanying urban agriculture, transformations of the aesthetic convention of facilities evolve in two ways. In the case of commercial, service and industrial functions, the form of buildings is becoming simplified over time. A clear modularity of the solution is established, which is a reflection of the clarification of the functional scheme of the interior, and a unified color scheme becomes universal and is possible to be used in any location, thus constituting the architecture of the background. This aesthetics is represented by both the simplest facilities, such as the latest projects of the Gotham Greens network, or more complex and unique ones, such as Agrotopia in Roeselare, which takes the ascetic, even sharp form of a glass and reinforced concrete, industrial structure – a nature factory.

The opposite direction is taken by the changes linking the agricultural function with housing development. The first examples clearly refer to the scheme adopted in commercial buildings, with a distinctive form of roof greenhouses above the usual usable levels, up to an attempt at full integration of functions – embedding the agricultural function (greenhouses) into the body of the building from the side that is best lit or using greenery as a finishing material for the façade and covering the roof of the facilities.

Figure 4. Diagram Showing the Method of Composing the Façades of Selected Existing Multifunctional Urban Farms. The Part Intended for Cultivation is Marked in Green (elaborated by the author).



Summary

This analysis has shown that the new urban function, which is professionalized and commercialized agriculture, intended to actually meet the food needs of a larger group of people. Although it developed in a modern form in the last decade, it has already begun to create its own aesthetics, referring to utilitarian patterns of beauty. The rationality and usefulness of the discussed solutions is manifested in the lack of exaggerated aesthetics of the first adapted and superstructured buildings. Only further development and progressive standardization and rationalization of the adopted solutions resulted in the conscious adoption of certain forms referring to the archetype of a house, a greenhouse, but also to a very strong connection of the aesthetics of the buildings in question with a typical industrial facility with an extensive logistic area, in which a light and transparent, but just as repeatable – a new feature. This principle, resulting from the technical reasons for ensuring the best insulation of crops grown systematically in an indoor, artificial environment, is maintained in each of the discussed examples. Also, multifunctional housing complexes related to urban agriculture continue this principle, although the form of the buildings is much more deeply rooted in the tradition and aesthetics of modern housing and results from local conditions, so it takes much more diverse forms. It is also from this group that solutions aimed at further integration of functions and the use of farming greenery as an element of spatial composition originate. Utilitarian beauty, resulting from the usefulness of each of the emerging functions, although it originated from the combination of already known elements, has already managed to create its own canon, in which the main determinants of the beauty of the form are its additivity and readability in the adopted spatial solutions.

Bibliography

Books and Monographs

- Groat Linda and Wang, David, *Architectural research methods* (Hoboken: John Wiley & Sons Inc., 2013).
- Kleszcz Justyna, *Bio-polis. Wizja miasta nie-antropocentrycznego* (Zielona Góra: Oficyna Wydawnicza Uniwersytetu Zielonogórskiego, 2020).
- Niezabitowska Elżbieta, *Metody i techniki badawcze w architekturze* (Gliwice: Wydawnictwo Politechniki Śląskiej, 2014).

Philips April, *Designing Urban Agriculture. A complete Guide to the Planning, Design, Construction, Maintenance, and Management of Edible Landscapes* (Hoboken: John Wiley & Sons Inc., 2013).

Yin Robert K, *Case study research. Design and methods (3rd ed.)* Applied Social Research Methods Series Volume 5 (London–New Delhi: SAGE Publications, 2002).

Articles

Allaby Monica, MacDonald Graham K. and Turner Sarah, “Growing pains: Smallscale farmer responses to an urban rooftop farming and online marketplace enterprise in Montréal, Canada”, *Agriculture and Human Values* 38/3 (2020): 677–692.

Bailey Bernard J and Chalabi Zaid S, “Improving the cost effectiveness of greenhouse climate control”, *Computers and Electronics in Agriculture* 10/3 (1994): 203–214.

Balas Marius, Nolic Jelena, Lile Ramona, Popa Mihaela and Beiu Roxana-Mariana, “Intelligent rooftop greenhouses and green skyline cities”, *SWS Journal of Earth and Planetary Sciences* 1/2 (2019): 15–28.

Berry Brian and Okulicz-Kozaryn Adam, “Dissatisfaction with city life: A new look at some old questions”, *Cities* 26/3 (2009): 117–124.

Buehler Devi and Junge Ranka, “Global Trends and Current Status of Commercial Urban Rooftop Farming”, *Sustainability* 8/11 (2016): 1108, 2.

Bueren van Bart, Leenders Mark and Nordling Torbjörn, “Case Study: Taiwan’s Pathway into a Circular Future for Buildings”. *IOP Conference Series: Earth and Environmental Science* 225 (2019): 1–6.

Ercilla-Montserrat Mireia, Izquierdo Rebeca, Belmonte Jordina, Montero Juan Ignacio, Muñoz Pere, De Linares Concepcion and Rieradevall Joan, “Building-Integrated Agriculture: A First Assessment of Aerobiological Air Quality in Rooftop Greenhouses (i-RTGs)”, *Science of The Total Environment* 598/15 (2017): 109–120.

Gould Danielle, Caplow Ted, “8- Building-integrated agriculture: a new approach to food production”, in: F. Zeman, ed., *Woodhead Publishing Series in Energy, Metropolitan Sustainability* (Sawston: Woodhead Publishing, 2012), 147–170.

Jain Dilip and Tiwari Gopal Nath, “Modeling and optimal design of evaporative cooling system in controlled environment greenhouse”, *Energy Conversation and Management* 43/16 (2002), 2235–2250.

Kleszcz Justyna, “Miejsce tabu – miejsce niezbędne. O budowaniu tożsamości osiedla opartego na funkcjach wstydlivych na przykładzie belgijskiego Cureghem / A Place of Taboo – a Necessary Place. About Building an Identity of a Housing Estate Based on Shameful Functions on the Example of Belgian Cureghem”, *Housing Environment* 39 (2022): 20–32.

Nadal Ana, Llorach-Massana Pele, Cuerva Eva, López-Capel Elisa, Montero Juan Ignacio, Josa Alejandro, Rieradevall Joan and Royapoor Mohammad, “Building-Integrated Rooftop Greenhouses: An Energy and Environmental

- Assessment in the Mediterranean Context”, *Applied Energy* 187/1 (2017): 338–351.
- Nowysz Aleksandra, “Modernist Projects of Community-Based Urban Farms in Residential Areas A Review of Agrarian Cooperatives in the Context of Contemporary Urban Development”, *Buildings* 11/8 (2021): 369.
- Park Semi, “Rooftop Greenhouse Agrotopia”, *Space* 655/ 6 (2022): 20–27.
- Procaccini Giulia and Monticelli Carol, “A Green Roof Case Study in the Urban Context of Milan: Integrating the Residential and Cultivation Functions for Sustainable Development”, *Water* 13/2 (2021): 137.
- Sanyé-Mengual Esther, Oliver-Solà Jordi, Montero Juan Ignacio and Rieradevall Joan, “An Environmental and Economic Life Cycle Assessment of Rooftop Greenhouse (RTG) Implementation in Barcelona, Spain. Assessing New Forms of Urban Agriculture from the Greenhouse Structure to the Final Product Level”, *The International Journal of Life Cycle Assessment*, 20/3 (2015): 350–366.
- T’Jonck Pieter, “Een serre om van te duizelen”, *A+ Architecture in Belgium* 294/2–3 (2022): 20–23.
- Tserng H.-Ping, Chou Ceng-Mo and Chang Yun-Tsui, “The Key Strategies to Implement Circular Economy in Building Projects- A Case Study of Taiwan”, *Sustainability*, 13/2 (2021): 754.
- Van Bergen Kolpa + META, “Agrotopia Research Center, Roeselare (Belgium)”, *Arquitectura Viva* 243/4 (2022): 70–74.
- Elsner von Burkhardt, Briassoulis Demetrios, Waaijenberg Dries, Mistriotis Antonis, von Zabeltitz Chr, Graud Jean, Russo Giovanni and Suay-Cortes Ricardo, “Review of Structural and Functional Characteristics of Greenhouses in European Union Countries, Part II: Typical Designs”, *Journal of Agricultural Engineering Research*, 77/2 (2000): 111–126.

Internet Sources

- “Agrotopia Research Center for Urban Food Production / van Bergen Kolpa architects + META architectuurbureau”, *ArchDaily*, <https://www.archdaily.com/976252/agrotopia-research-center-for-urban-food-production-van-bergen-kolpa-architects> (access: 15 May 2023).
- Aouf Rima Sabina, “Agrotopia is a giant rooftop greenhouse built atop an existing building” 04 Feb 2022, *Dezeen*, https://www.dezeen.com/2022/02/04/rooftop-greenhouse-agrotopia-urban-agriculture-architecture-belgium/?li_source=LI&li_medium=bottom_block_1#/ (access: 15 May 2023).
- BaF, “Taisugar Circular Village”, <https://www.bioarch.com.tw/work/taisugar-circular-village> (access: 10 May 2023).
- Croghan Lore, “A history of the Coignet Building as it re-enters the market. The little landmark surrounded by a huge Whole Foods is for sale again”. *Brooklyn Daily Edge*, August 18, 2019, <https://brooklyneagle.com/articles/2019/08/29/coignet-building/> (access: 31 March 2023).

- Gowanus Institute for Research, Planning and Development*, “A Study of Whole Foods Market’s Use Variance Application to Build a Regional Store in Gowanus Brooklyn”, eds. Elbogen Nathan, Fain Jessica and Krasnow Ariel (New York: The Gowanus Institute for Research, Planning and Development, Rev. 1.0), <https://sempub.epa.gov/work/02/157541.pdf> (access: 31 March 2023).
- Gagiuc Anca, “Gotham Greens Greenhouse Replaces Bethlehem Steel Mill”. Commercial Property Executive. 2 March 2020. <https://www.commercial-search.com/news/gotham-greens-greenhouse-replaces-bethlehem-steel-mill/> (access: 31 March 2023).
- Gotham Greens Farms Llc and Puri, Viraj, *Gotham Greens Farms, Llc sustainable urban CEA. Final Report prepared for The New York State Energy Research and Development Authority*. <https://www.nyserda.ny.gov/-/media/Files/Publications/Research/> (access: 31 March 2023).
- Gotham Greens, “Our Farms. Cultivating Cities, and Growing Veggies Too”. *Gotham Greens* <https://www.gothamgreens.com/our-farms/> (access: 31 March 2023).
- “Jardins secrets”, https://vincent.callebaut.org/zoom/projects/210929_secretgardens/secretgardens_secretgardens_pl021 (access: 10 May 2023).
- Keesling Donna, “Sparrows Point: From Steelmaking to Distribution Center Hub”. *The Pursuit of History*. December 22, 2021, <https://thepursuitofhistory.org/2021/12/22/sparrows-point-from-steelmaking-to-distribution-center-hub/> (access: 31 March 2023).
- Kono Design, “Pasona Urban Farm”, <https://konodesigns.com/urban-farm/> (access: 10 May 2023).
- Locci Sandrine, “Communique de presse. Site de l’Ecole d’application de l’infanterie de Montpellier Le Maire de Montpellier, Hélène MANDROUX, lance un appel à idées innovantes pour la reconversion du site”, 2009, https://www.montpellier.fr/uploads/Document/51/WEB_CHEMIN_7409_1246367442.pdf (access: 10 May 2023).
- Ministère de la Transition Écologique, “Ecole d’application de l’infanterie – EAI”, <http://www.ecoquartiers.logement.gouv.fr/operation/2187/> (access: 10 May 2023).
- Mok Kimberley, “Fresh & City-Grown: Montreal’s Second Rooftop Urban Farm Opens”. *Treehugger. Sustainability for All*. October 11, 2018, <https://www.treehugger.com/green-food/second-lufa-farms-rooftop-urban-farm-opens-laval-quebec-canada.html> (access: 31 March 2023).
- NYC Department of City Planning. “Gowanus: A Framework for a sustainable, inclusive, mixed-use neighbourhood”, New York: NYC Department of City Planning, 2018, 80, <https://www1.nyc.gov/assets/planning/download/pdf/plans-studies/gowanus/gowanus-framework-full.pdf> (access: 31 March 2023).
- ORG Permanent Modernity, “Abattoir Foodmet”, <https://orgpermod.com/architecture/projects/abattoir-foodmet> (access: 31 March 2022).
- “Pilotprojecten Productief Landschap”, <https://www.vlaamsbouwmeester.be/nl/subsite/productief-landschap/projecten> (access: 10 May 2023).

- “Research Center ICTA-ICP UAB / H Arquitectes + DATAAE”. *ArchDaily*. 2015, <https://www.archdaily.com/636587/research-center-icta-icp-uab-h-arquitectes-dataae> (access: 10 May 2023).
- Rosenfield Karissa. “William McDonough Designs Ultra ‘Clean’ Manufacturing Facility for Method” *ArchDaily*, March 07, 2014, <https://www.archdaily.com/484412/william-mcdonough-designs-ultra-clean-manufacturing-facility-for-method> (access: 31 March 2023).
- Scape/ Landscape Architecture DPC. „Gowamus Lowlands – Master Plan. Draft 2019”, New York: Gowamus Canal Conservancy, 2019, 56, <https://gowamus-canalconservancy.org/> (access: 31 March 2023).
- “S*Park / Tres Birds” 30 Jun 2020. *ArchDaily*, <https://www.archdaily.com/942654/s-star-park-tres-birds> (access: 10 May 2023).
- “Taisugar Circular Village / Bio-architecture Formosana” 06 Jan 2022. *ArchDaily*, <https://www.archdaily.com/974658/taisugar-circular-village-bio-architecture-formosana> (access: 10 May 2023).
- “S*Park”, <https://tresbirds.com/S-PARK> (access: 10 May 2023).
- “Whole Foods Market”, <https://www.brownstoner.com/services/closet-cabinet-specialists-nyc/d55819cb01eded/whole-foods-market-214-3rd-street-brooklyn-ny-11215/> (access: 31 March 2023).
- Wilkinson Tom, “Foodmet Abattoir, Brussels, Belgium, by ORG Architecture”. *The Architectural Review*, <https://www.architectural-review.com/buildings/foodmet-abattoir-brussels-belgium-by-org-architecture/10036765.article> (access: 31 March 2023).

