Evolution of prefabricated housing in a regional center, Kaluga, during the Soviet Era.

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KEYWORDS

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ABSTRACT

This research explores the evolution of prefabricated mass housing in Kaluga, Russia, between 1955 and 1991, a period marked by urgent post-World War II housing needs and significant ideological shifts within Soviet architecture. The study systematically investigates the distinct urban development strategies and architectural modifications implemented in Kaluga's prefabricated housing series, categorising them into three generations.

This paper proves the findings, that indicate progressive improvements in living standards, such as increased apartment sizes, larger kitchens, improved structural elements, and enhanced façade complexity. Notably, local architects creatively utilised decorative motifs inspired by regional embroidery, introducing distinctive visual diversity despite strict standardisation constraints.

However, economic and planning challenges limited comprehensive urban realisation, resulting in fragmented city development. Today, these aging prefabricated buildings, exceeding their intended lifespan, pose urban planning and heritage preservation dilemmas. This study underscores the necessity to document and preserve certain structures due architectural significance, highlighting the impact of Soviet-era urban planning on contemporary urban landscapes.

INTRODUCTION

During World War II (1939-1945), USSR suffered massive destruction, with over 1,710 towns and settlements erased. This devastation resulted in the loss of 70 million square meters of living space - equivalent to one-sixth of the country's urban housing stock—with at least another sixth severely damaged[1,p.19]. The war's aftermath created immense housing pressure across Soviet republics, with the RSFSR[1], Ukraine, and Belarus bearing the heaviest losses. The devastation was particularly severe in several major cities in the west of the country, including the city of Kaluga. The occupation by the Germain Nazis caused considerable damage to the city's infrastructure, necessitating extensive post-war reconstruction efforts in all sectors from industrial to housing[2].

Soviet architects began experimenting with prefabrication using large concrete panels in the 1930s. After World War II, they advanced this work by developing prefabricated *frame-panel* and large-panel construction systems. These housing designs reflected

1 RSFSR - Russian Soviet Federative Socialist Republic

the era's ideological shifts toward collectivism: bathrooms were replaced with shower-baths, and kitchens were minimized in favor of communal canteens. In the 1930s-1940s, the state's desire to give society an image of prosperity led to the construction of large but insufficient housing units. Housing was allocated by room, with only political figures and celebrities benefiting from "independent" accommodation. By the end of the 1940s, the style of the "Stalinist Empire" had become particularly uniform, hindering the introduction of prefabrication processes into architecture.

Analysis of construction sites in Moscow between 1947 and 1954 showed that inaccurate layouts and joint profiles slowed down component manufacturing and required on-site manual corrections. To maximize the benefits of prefabrication, buildings needed to move away from "neo-classical" design principles[3,p.24].

The construction industry suffered from wasteful spending, primarily due to architects incorporating excessive decorative elements in individually designed buildings. These architects were seen as obstacles to construction industrialization. The All-Union conference of builders, architects and workers in the building material industry in 1954, while being revolutionary in its impact on architecture, reflected an already growing sentiment. *N. S. Khrushchev* forcefully declared: "We are not against beauty, but against excesses..." [4, p.127]. He marked one of the first steps toward de-Stalinization of Soviet society, and criticized the use of porticoes, colonnades, moldings, and bas-reliefs as archaic remnants of the past."[4, p.128]. This shift toward standardized construction in the mid-1950s was both natural and necessary to reduce costs and accelerate housing production. *Khrushchev's* historic address at the All-Union meeting of builders established a new direction: mass housing construction would replace time-consuming individual designs with rapid standardization.

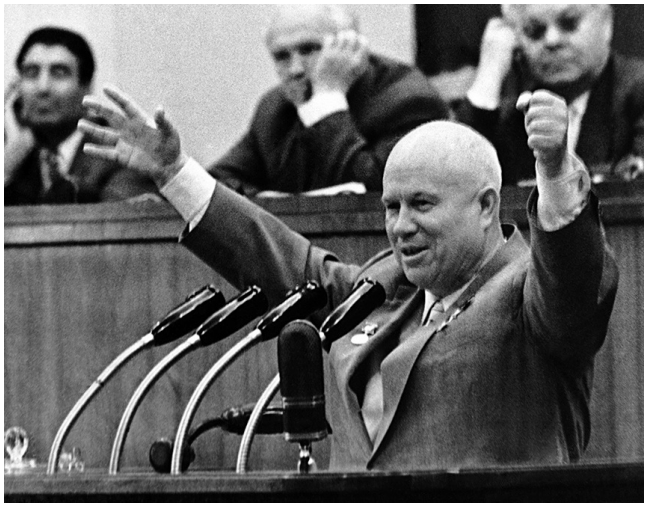


Figure 1. N. S. Khruschev: *First Secretary of the Central Committee of the CPSU (1953-1964)* [25]

This marked the year when the Soviet "Construction machine" began operating at full power, producing buildings at an unprecedented speed never seen before in the USSR. It was then that the first mass-produced building made its appearance in the city of Kaluga in the end of the decade.

This paper will study the development of prefabricated houses in Kaluga, a city located in the central part of the Russian Federation. Kaluga is considered a typical provincial regional capital with a current population slightly above 350,000 inhabitants[5]. The city represents a moderate medium-sized urban center across economic, social, and cultural parameters.

Kaluga serves as an ideal case study due to my personal connection to the city as my birthplace and my direct access to local archives through contacts at the city council. Much archival information was lost during the fall of the Soviet Union, leaving a significant knowledge gap in the history of urban and architectural development of the city in the late Soviet periods. Kaluga exemplifies the development patterns of post-WWII prefab housing common to other regional centers in central Russia, making it a representative example for broader analysis.

Additionally, many residential buildings constructed since 1960, at the moment, are nearing or have already surpassed 60 years of use, significantly exceeding their originally intended lifespan of 25-30 years. Although these structures remain in use, it is becoming increasingly clear that the time for their replacement is rapidly approaching. However, the city authorities currently lack a comprehensive system, adequate statistics, and other essential data regarding these buildings, which considerably complicates plan-

ning and decision-making processes.

This historical research explores the following research question: What were the design and urban principles and modifications made to mass prefabricated residential buildings *(Khruschevkas)* in Kaluga between 1955 and 1991? The research addresses the following sub-questions:

1. What distinctive urban development ideas emerged in Kaluga's while the mass construction of the prefabricated buildings, and how did these patterns evolve over time?
2. How did distinctive architectural features, design and structural principles in the prefabricated buildings in Kaluga evolve between 1955 and 1991?

To answer these questions, I identified all areas within Kaluga where prefabricated housing was developed during this period using governmental databases and archival maps. I then, cataloged all housing series built and registered in Kaluga and conducted a comparative study to analyze their similarities and differences across multiple key features. Finally, I present the conclusive thoughts amongst certain buildings that merit preservation based on their potential historical, architectural, or technical values.

CHAPTER 1: URBAN DEVELOPMENT

In order to understand how the city came to be what it was in the early 1960s, it is necessary to give a brief account of its history of the urban development.

The city was first mentioned in 1371 as a frontier outpost of ancient Russia, protecting the southwestern borders from foreign raids[6,p.14]. In 1777, Kaluga received the status of a provincial city, which required the development of a general plan.

The initial urban plan of Kaluga, designed by architect P. Nikitin[2] in 1778, uniquely combined fan-shaped, radial, and rectangular layouts into a unified structure. Its trapezoidal boundaries featured a defen-

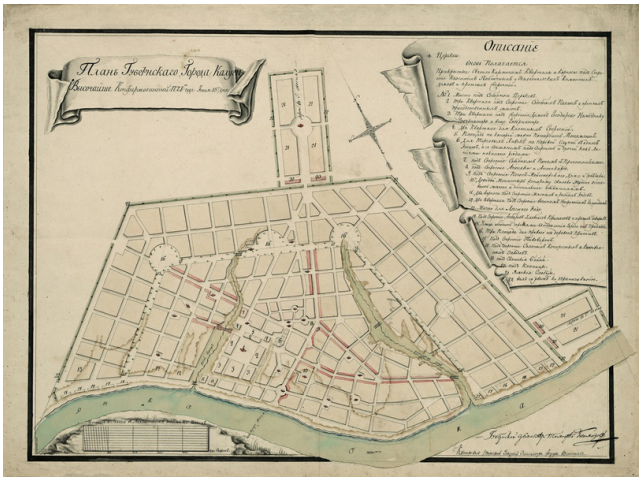


Figure 2. Masterplan of Kaluga, 1778. *The initial urban project by architect P. Nikitin was approved in 1778 by the state council in Saint Petersburg. It combined the methods of fan, radial and rectangular organisation of the urban structure. The city boundary was formed by a ditch and a rampart and had the outline of a regular trapezoid with adjoining territories of rectangular shape of two Yamskie slobods. The approved project regulated stone building in the central quarters and along the red lines of the main streets. The city did not receive a complete circular or radial system of planning. The network of its streets was later adjusted under the influence of two significant factors - the Oka River and the perpendicular road to Moscow, only forming a fan structure. However, in modern times, this is assessed as a monument of town-planning art* [26].

Figure 3. Map of Kaluga, 1909. *By the end of the 19th century, the city had fully developed the territory envisioned by the general plan. However, due to changes in transportation routes, Kaluga was found far away from major roads, which led to the loss of its status as an important transit hub. Despite this, the city developed as an industrial center - a railway station, factories, and warehouses were built, and brick construction of the central districts was completed* [26].

2 *Pyotr Romanovich Nikitin (1727–1784) was a Russian architect, known for creating master plans, street and building designs, and travel palaces in the cities of Tver, Kaluga, Torzhok, Mednoye, Borovsk, Kozelsk, and Maloyaroslavets.*

sive ditch and rampart, with adjoining rectangular areas for the *Yamskie slobods*. Although later street alignments were influenced by the Oka River and the main road to Moscow, forming a predominantly fan-shaped structure, today the plan is recognized as a significant historical monument in urban planning[6, pp.14-15].

After the October Revolution in 1917, Kaluga continued its industrialisation, following other cities of the newly formed Union of Soviet Socialist Republics. In the 1920s–1930s, old enterprises were modernised and new factories were built. This period finally secured Kaluga's status as an industrial city, which it maintained for a long period[6, p.15].

Before WWII in the 1940s, Kaluga's population was estimated at around 90,000 people[6, p.12]. During its short occupation period (October–December 1941), 20,000 inhabitants fled their homes and it caused considerable damage to the city's infrastructure, necessitating extensive post-war reconstruction efforts[2].

In July 1944, the Kaluga Region was formed, and for the first time in history, Kaluga became a regional center, necessitating a significant expansion plan. The updated general plan of Kaluga was approved in 1949, with city expansion planned to the North, away from the city center. Large territories in the area of Malinniki, Mayakovsky and Chrustalny settlements were allocated for the needs of individual housing construction and according to the general plan "the main unit of development became the "Quarter"[3] .

The general plan was not fully implemented due to the lack of capacity of construction organisations and shortage of construction materials at the time. The housing stock by 1960 amounted to about 900.000 sqm, while no more than 10.000 sqm of living space was commissioned per year. The buildings were built two and three storey high, with an exception - four storeys[6,p.15].

Contrary to the approved plan, industrial enterprises were built in unplanned areas, hindering residential development on the left bank of the Oka River. The extensive construction of low-rise housing expanded the urban area, making it difficult to improve city infrastructure and provide adequate transport and engineering services to residential and industrial zones. Furthermore, residential buildings and cultural facilities were constructed within industrial facilities' sanitary protection zones, despite existing regulations[7].

As mentioned earlier, following *N. S. Khrushchev's* speech and the subsequent acquisition of a license for prefabricating concrete panels from "Raymond Camus et Cie" in the late 1950s, the Soviet Union initiated large-scale mass production of prefabricated concrete panels, leading to widespread residential construction across every region[3].

In USSR, the year 1958 was rather significant because, since it marked the appearance of the first mass large panel series were introduced with the famous K-7 *series*, which is sometimes labelled as "the first panel *Khruschevka*", located in the ninth quarter of Cheryomushki district, in Moscow[8, pp.163-171].

The decree passed by the Council of Ministers of the USSR in 1954, allowed around 6.000 factories to be built in order to produce easy-to-assemble reinforced concrete elements. Kaluga, as a regional centre was assigned to develop its House Building Plant - *DSK* [4] as well[8, p.103]. Thus, the construction of the new neighbourhoods was carried out by Kalugastroy, a major subdivision of PSMO Kalugastroy - Kaluga House-Building Plant. Prefabricated concrete elements for the new houses in the city were manufactured at the Turyninsky *DSK* and Kurovskoy Plant for the houses in the surrounding villages and settlements. KZSM - Kaluga building materials plant[5] produced sand-lime bricks near Silikatny micro-district, OBP - Olgovsky Brick plant producing red clay bricks and AZB - Azarovo Brick Plant producing both red clay bricks and expanded clay-sand-cement blocks[9][10].

Year 1960 marks an important moment of the urban development in Kaluga, with its first mass production housing project. It was set to be erected in the

3 *russ. Квартал*

4 *russ. ДСК - Домостроительный комбинат*

5 *russ. КЗСМ - Калужский Завод троительных Материалов*

micro-distict, also named Cheryomushki, following the one from Moscow with *series* 1-335 and 1-447 of a total area of 60,000 sqm[11]. Unlike the city centre, which was already developed with one and two storey wooden houses, this new area was undeveloped despite its proximity to the city centre[10].

Figure 4. *Photo of micro-district Cheryomushki few years after its completion, 1966* [27]

This area was known for a remarkably new approach in urban planning, introducing a new planning unit "*micro-district*"[6], instead of the old "Quarter" [6,p.15]. This novelty for the city, was regulated in a new General Plan of Kaluga, that was approved by the Council of Ministers of the *RSFSR* in 1966[6, p.15]. The implementation of this plan cancelled the former decree of the General Plan issued in 1949[7].

It took into account new approaches to the formation of residential development as *micro-district*. The plan established protective green zones between residential and industrial areas, prohibited construction in sanitary zones, and prioritized environmental safety. The development focused on multi-story residential buildings, especially five stories and above. Each new residential *micro-district* was designed to include essential infrastructure - schools, hospitals, kindergartens, and retail facilities within walking distance[7].

The leading concepts were creating a car-free inner zone and "planning parameters of short distances" , so that the maximum distance to community facilities was not allowed to exceed 500m and the road infrastructures determined the boundary between the two micro-districts[8, p.152].

That is why, in addition to housing, a hospital, secondary school, technical school, gym, bookstore, kindergarten and outdoor sports grounds were simultaniously constructed in Cheryomushki.

Figure 6. *Ice-skating in micro-district Cheryomushki, 1967* [27]

In principle, the structure of *micro-districts* was determined by three main factors: sun orientation, topography, and assembly crane logistics. As prefabricated buildings had to follow standardised designs, it significantly limited urban planning to merely meeting basic requirements[8, p.153]. Moreover, since Kaluga is located on a rather flat terrain, characterised as "smooth with no sudden changes in altitude", the formation of the urban ensemble within the microdistricts was simplified to a greater extent[12].

The new General Plan of 1966 was also visionary, and established the city's primary development directions for the following 20–25 years[7]. While in 1965, only 170.000 people were officially registered as citizens in Kaluga, the plan supposed to increase it up to 200-250 thousand people by 1980[6, p.16]. It proposed

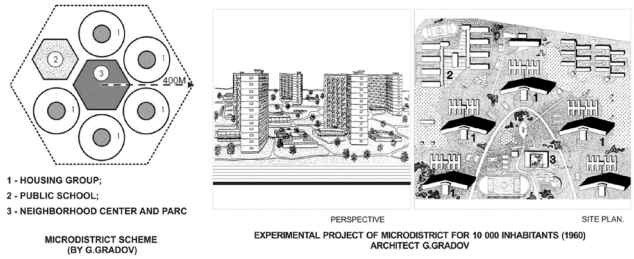


Figure 5. *Micro-district concept explanation* [28]

6 *russ. Микрорайон*

the city to expand with the urban development area up to 4.800 hectares, and thus, initiated mass construction in the Northern and Eastern areas first[7].

The newly formed *micro-districts* Silikatny, Severny and Azarovo were planned to inhabit up to 20.000 people[6, p.16]. Following the construction of the brick factory in the Silikatny *micro-district* in 1971, mass residential development occurred, with five-storey *series* 1-335 and 1-447 dominating the area. Soon, both Silikatny and Severny have acquired a negative reputation due to frequent incidents involving local residents.

Severny *micro-district* developed around the Azarovo Brick Plant, with housing for factory workers constructed nearby, amidst the surrounding forest. The district has a rather nondescript appearance, characterized by uniform buildings predominantly from *series* 1-447, which contributed to its monotonous visual identity.

The development in the eastern part of Kaluga initiated the construction of two *micro-districts*: Turynino, featuring housing *series* 1-464, 1-447, and 1-335A, and the 906th Base, built exclusively with *series* 1-447. Similar to neighborhoods in the northern part of the city, these areas became rather unfavorable to live in.

Unlike the neighbourhoods designed earlier in 1960s, namely Malinniki, sqr. Mayakovsky and Chrustalny, new areas all featured similar urban plan development principles of a *micro-district*, implemented in Cheryomushki.

Figure 7. *Photo the first 9-story building in Kaluga on Proletarskaya 133, 1969* [13]

A significant milestone was Kaluga's first 9-story building. Built on Proletarskaya Street in 1970, *Series* 114-85 it became a magnet for local youth who were eager to ride its elevators - the only ones in the whole city at that time[13].

Another distinct urban development type are 11 pararel rows of housing located in the central part of the city, on the street S. Razina. Five and nine story *series* 1-335A were constructed in 1974-1977 through demolition of traditional one storey wooden houses. This stark, utilitarian open-block ensemble has long dominated the skyline of the southern city centre.

Figure 8. *Photo str. S. Razina, 1975-1985* [28]

The transition of urban development onto the right bank of the Oka River, launched the new Pravoberezhny *micro-district* to appear on the free territories of the right bank of the Oka River. It was supposed to inhabit up to 40% of the city population and the key feature was to develop simultaneously the residential and industrial functions[6, p.16]. The right-bank and left-bank parts were connected by two bridges with a construction of a reservoir in the floodplain of the Yachenka River to the west of the city centre[6, p.16].

With some delay, due to economic recess in the Soviet Union in late 1970s, the first houses of unknown *series* in the Pravoberezhny *micro-district* were completed in 1982. The novel feature in the urban planning was the new 'grid' block arrangement, that formed a completely new urban ensemble. This residential structure based on tetrahedron grid formed complex formations using T-shaped and cross *sections*[14]. One of the possible reasons for this development type is

the prevailing wind direction, which blows from the west and south-west. This way, the inner courtyard of the block is protected from the winds.

A similar approach was used in developing the Annenki micro-district. Altough it has a clear silhouette of an strip development type , common to all *micro-districts* of 1960s and 70s, later it was updated with a nine-story semi-circular building, which is usually refered as the "wall-house" of unknown *series*, being oriented in the same direction, and completed in 1989.

By the early 1980s, the existing areas had reached its capacity for new construction, necessitating further expansion. Moskovskaia Street, which connects the city center to the highway leading to Moscow,

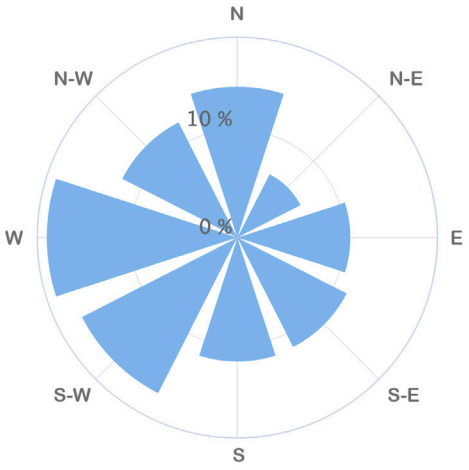


Figure 9. *Wind rose of Kaluga* [29]

Figure 10. *Pravoberezhny district under construction, 1987-1988. using a tetrahedral grid out of block-sections to shielded the inner-courtyard of the block from the prevailing wind* [27].

remained largely undeveloped despite being a major transportation artery. Two micro-districts were simultaneously planned along this corridor[9].

First, the expansion included the area between SPTU-13[7] and the village of Ermolovo. In 1982, the Kubyaka *micro-district* was developed, primarily consisting of 9-story *series* 111-83 buildings, and became home to over 16,000 residents[9]. This district had strong infrastructure, with extensive green spaces that buffer the area from the busy road, yet in some areas, the buildings are located in a closed perimeter, forming absolutely identical courtyards.

Figure 11. *micro-district Kubyaka under construction, 1990* [27]

North of it, the Baikonur *micro-district*, developed in the 1980s, was built by the Ministry of Defense of the USSR for former rocket scientists. The neighborhood consisted of three courtyards with 7 storey houses *Series* 111-101 and 9-story houses unknown *series* at the corners. The same *series* were also erected in the true city named Baikonur[8], and in Vlasikha in Moscow region, where the Strategic Missile Forces headquarters are located[15]. While the district brought several thousand new residents to the city, it lacked proper infrastructure. Later, *series* 111-101 buildings were constructed in other parts of Kaluga, mainly on the periphery of the city centre.

Over the years, it became clear that the main pro-

7 Kaluga College of Service and Design - the base school of the 'Kaluzhanka' sewing factory

8 Baikonur - former Leninsk, is a closed city in Kazakhstan, serving military and aerospace purpose. Currently is rented out to Russia.

posals of the General Plan of 1966 remained unrealized. By 1985 neither the population, nor the planning structure and settlement system of the city did not correspond to the existing urban planning situation at all[6, p.16]. Only insignificant construction was carried out in the settlements of Malinniki, Olgovka, Azarovo, Dubrava, Annenki, Kaluga-II, Turynino. The scattered nature of small neighbourhoods caused difficulties in their transportation and cultural services[6,p.16].

The city center and its close periphery became an urban patchwork, featuring mixed development types ranging from the early *series* 1-335 and 1-447 to the later *Series* 83, *Series* 85 and *Series* 86. While these buildings were initially introduced in separate *micro-districts* to form a consistent urban structure, their placement in the city center and its periphery as infill developments between existing houses slightly disrupted the urban fabric and city structure originally envisioned by P. Nikitin in the 1777 Masterplan.

In the city centre, the predominant part of new housing construction was developed through demolition and densification of "low-value" one-story buildings. The densification of residential development led to the impossibility of constructing transportation routes planned by the general plan and to the lack of free territories for the development of social and cultural services[6,p.16].

CHAPTER 2: DEVELOPMENT OF ARCHITECTURAL AND DESIGN PRINCIPLES

Series remained a continuous factor throughout every stage of Soviet mass housing construction. This term refers to a certain range of construction elements, called the *nomenclature of articles*, and architectural solutions or standard designs assembled from those articles, known as the nomenclature of standardized designs. *Series* were not finite systems - they evolved and were extended with new designs and *block sections*. These iterations of *series* were called modifications. The exact number of *series* is unknown, but estimates suggest between 400 and 500 *series* that were introduced and applied across the Soviet Union[8, p.164].

In general, the advances in construction and design methdology of the buildings, introduced new ranges of standard designs. These stages are conventionaly termed *generations*, and there are three *generations* known and identified to these days. Each series were assigned a special *climate class* and geological conditions, in which they were able to be erected, following the norms of *SNiP* [9]. Kaluga was placed in the "temperate" climatic region, the *climatic zone* II5, with low level of seismic hazards, in normal engineering and geological conditions.

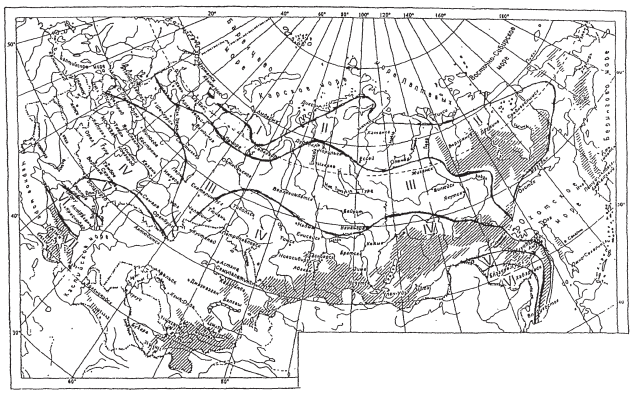


Figure 12. *Map of Climatologic Regions according to SNiP 23-01-99 [30]*

Due to the lack of a structured recording system for building *series* in Kaluga, this research focuses only on series that were found in the national housing catalogue and could be identified through their visual characteristics. As a result, 15 distinct *series* were identified for in-depth study. The chapter systematically examines various series, based on four primary categories: apartment layout / living standards, construction materials / structural design, accessibility / comfort features, and architectural / aesthetic elements. Using a comparative table (Appendix A) as a basis, all *series* are analysed to identify patterns and evolutionary trends both within and across *generations*.

Overall, five different construction methods emerged over the decades: brick (masonry), large-block, large-panel, pre-cast frame, and spatial unit construction (using prefabricated three-dimensional

9 Construction Norms and Rules. russ - Строительные Нормы и Правила (СНиП)

elements). In Kaluga, only four of these methods were used: brick masonry, large-block, large-panel, and incomplete pre-cast frame construction.

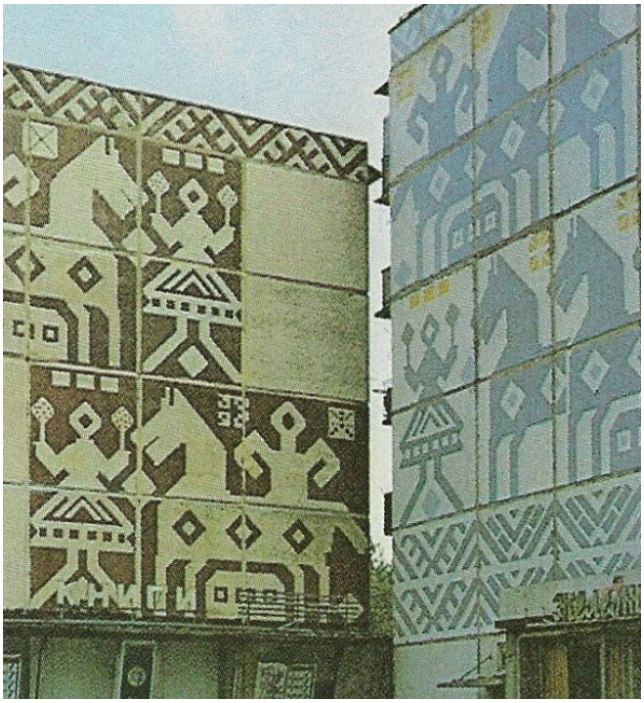
The first three methods require load-bearing walls running in several directions. These walls could be positioned in three ways: longitudinally, transersely, or along the facade. Transverse load-bearing walls severely limited replanning opportunities within individual apartments, with every modification requiring approval from local building authorities. Longitudinal wall placement, while offering more flexibility, required load-bearing facades and created complications with floor slab installation.

1st generation: (1955[10]-1983)

The earliest *generation* of mass-produced houses is often called "*Khrushchevka*," referring to five story prefabricated housing with mediocre comfort and structural characteristics, featuring tiny living spaces, kitchen areas under 6.3 m², poor sound and thermal insulation, and monotonous exterior appearance.

Series 1-335 was one of the first to be built in Kaluga in the *micro-districts* Cheryomushki, Chrustalny, and Silikatny. It was the only building type constructed with an incomplete precast concrete frame: the technique carried from the Stalinist era. While it set records for low construction costs and quick assembly time, it was ultimately considered the least successful of all first-*generation* residential building *series*[16].

Among all designs, *series* 1-464, another widespread building type, offered the fewest renovation possibilities since every transverse wall was load-bearing. Though it achieved the most efficient panel production process through extensive standardization, its unclad concrete panels identical even on stairwells, created a notably monotonous appearance. This *series* appeared less frequently in Kaluga than in other Soviet cities, being built only in a few peripheral *micro-districts.*



Figures 13&14. *str. Lenina 37: illustrates a vivid scene from a traditional peasant wedding, depicting riders with the bride's dowry and a dancing woman holding flowers. The recurring chest beneath the horse's feet symbolizes the bride's dowry* [17].

Figures 15&16. *Traditional embroidery, woman symbolising both the Great Goddess of Life and Fertility depicted with a 'tree of life'* [17].

10 While unofficial records state that the first Khrushchevka in Kaluga appeared in 1960 with the development of the Cheryomushki micro-district, the national database indicates that the first building dates to 1955. However, this earlier date cannot be verified.

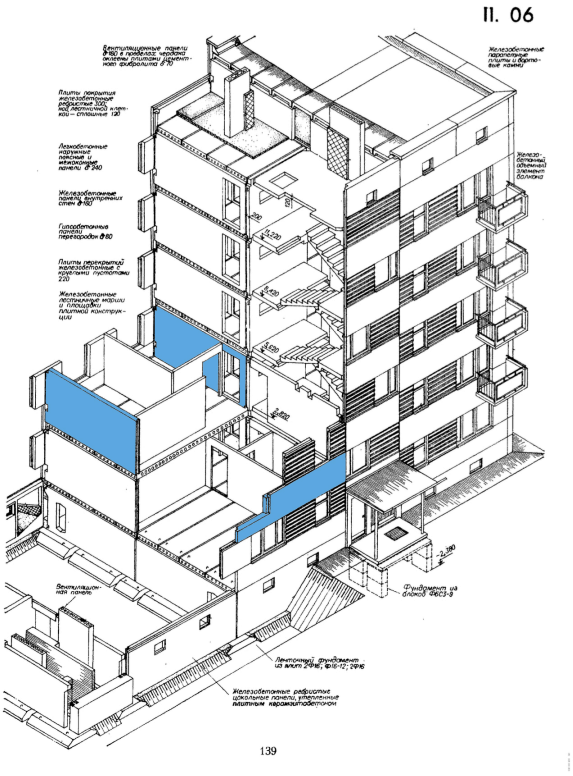


Figure 17. *Axonometric Structural scheme. Transverse inter-apartment and facade walls* [31]

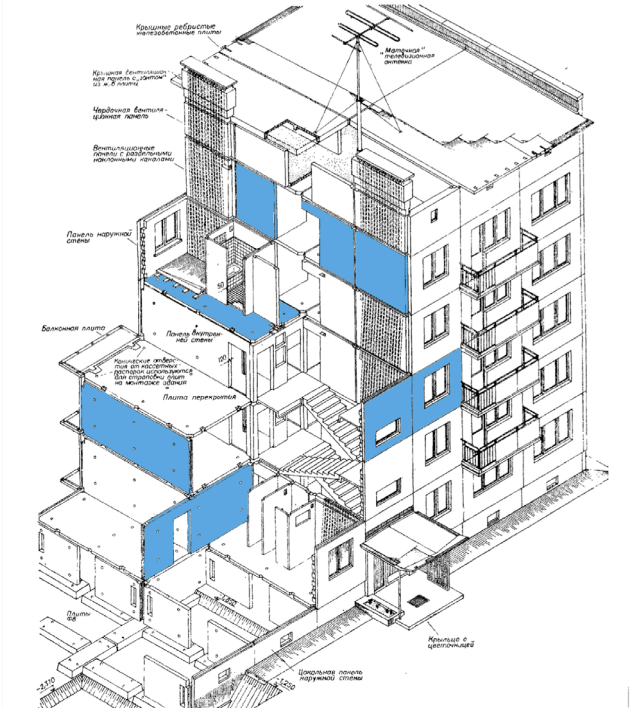


Figure 19. *Axonometric Structural scheme. Longitudinal and every transverse walls* [31]

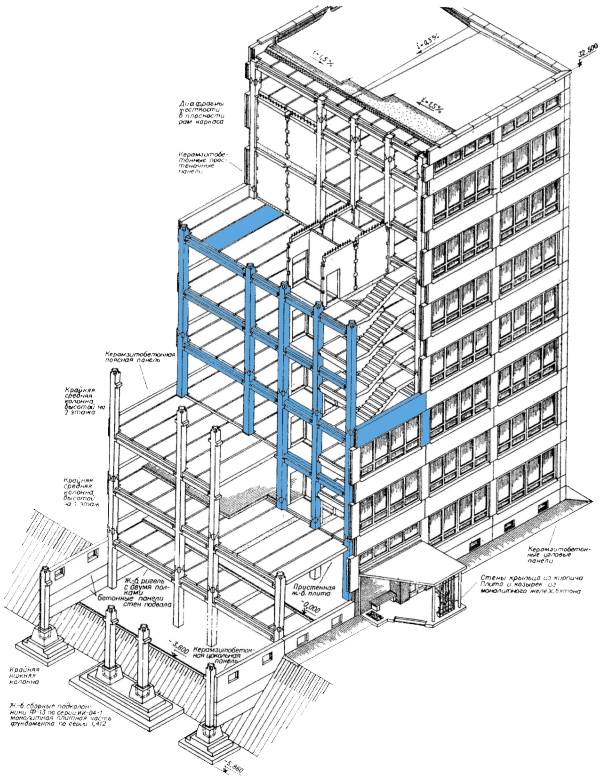


Figure 18. *Axonometric Structural scheme. Incomplete frame* [31]

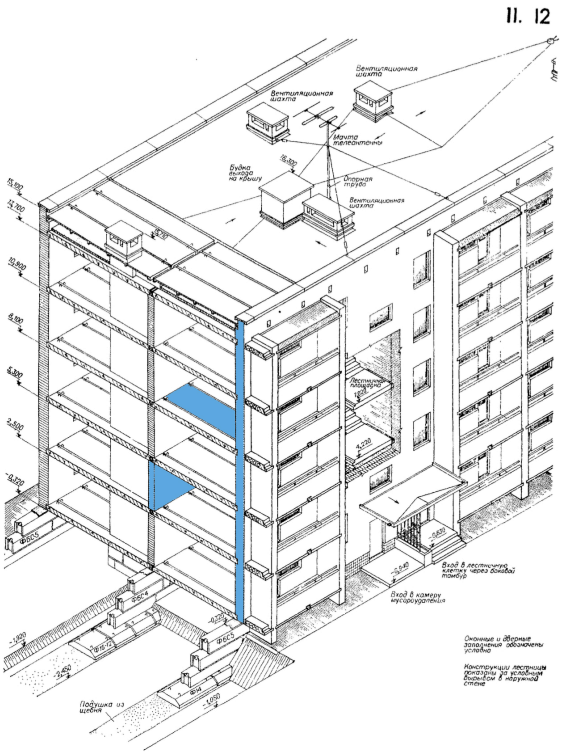


Figure 20. *Axonometric Structural scheme. Masonry longitudinal and facade walls* [31]

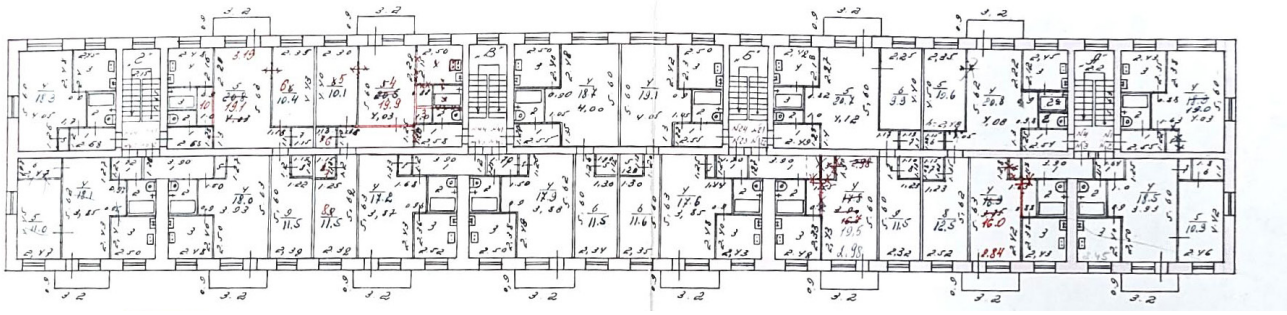


Figure 21. *Series 1-447, str. Bolotnikova 1 (Cheryomushki micro-district). Floor plan* [32]

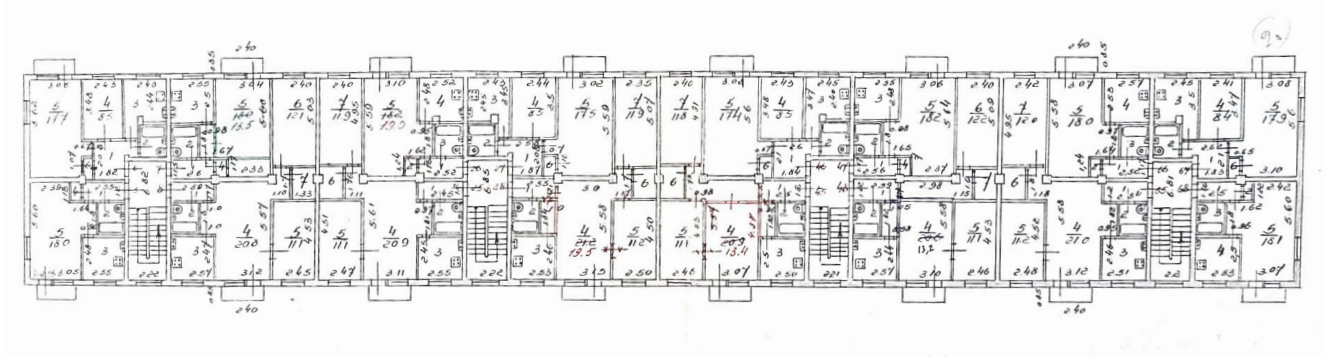


Figure 22. *Series 1-335, str. Zhukova 46 (Cheryomushki micro-district). Floor plan* [32]

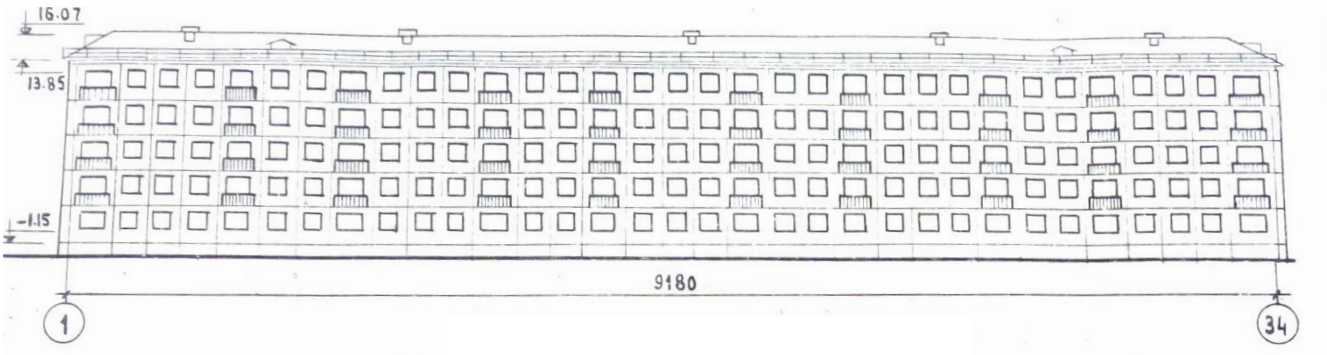


Figure 23. *Series 1-335, str. Bolotnikova 1 (Cheryomushki micro-district). Elevation* [33]

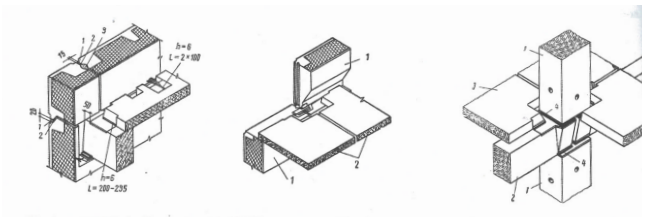


Figure 24. *Structural connections of series 1-335* [8].

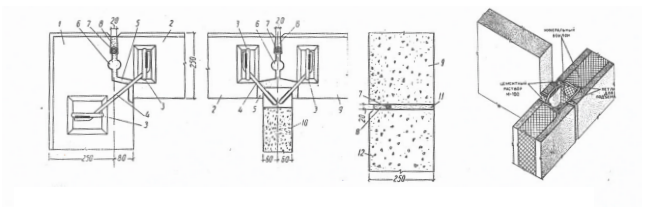


Figure 25. *Structural connections of series 1-467* [8].

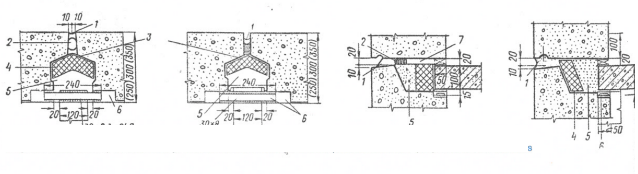


Figure 26. *Structural connections of series 1-464* [8].

Series 1-447, constructed using the masonry construction method was another widespread *series* in Kaluga. It had a distinctive feature of a small window between the kitchen and bathroom, measuring approximately 40 cm in height and positioned near the ceiling. This window served two purposes: it provided ventilation and natural light to improve bathroom hygiene, and during the frequent power outages in 1960s, it allowed enough daylight into the bathroom for basic functions like using the toilet and sink.

A distinctive feature of apartment layouts in this *generation series*, was the *Vesnin Apartment* technique, which aimed to increase living space by eliminating hallways and resulted in creating interconnecting rooms. In these floor plans, the living room served as the core of the apartment, with the kitchen and bedroom accessed directly through this space.

Architects, constrained by standardisation in prefabricated panel construction, tried to creatively experimented with facade ornamentation as a primary means of diversifying buildings visually. In Kaluga, a distinctive feature was the use of ceramic tiles assembled into geometric patterns reminiscent of local traditional embroidery, prominently featuring motifs such as riders, trees, flowers, mythical birds, and female figures. These ornaments were only used on the *series* 1-335 and 1-335A built in years between 1966 and 1972 in the northern part of the city centre[17].

This initiative is attributed to P. T. Perminov, chief architect of Kaluga (1964 - 1984), along with architects M. Polyanichko, E. Kireev, and a master of traditional folk embroidery from Tarusa M. Gumilevskaya. She gathered local embroidery patterns and integrated them into building ornamentation, bridging Kaluga's historical heritage with contemporary urban aesthetics [18].

A more simple, yet iconic eight-petalled rosette, representing the sun and fire, was among the most frequent symbols, prevalent in Kaluga's 19th-century traditional embroidery, appeared some time later on many 9-storey buildings of the 1980s[17].

2nd generation: (1968 - 1998)

Only three *series* of the second *generation* were erected in Kaluga, all being *modifications* of their "parent" series. This was likely due to the production capabilities of *DSKs*, which were typically limited in the types of reinforced large concrete panels and blocks they could manufacture. The *series* 1-335A, 1-447C,

Figure 27. *str. Suvorova 147. Camomile pattern on the wall [34].*

Figure 28. *Eight-petalled rosette - a specific solar sign, meaning both the sun and fire in combination with the city emblem [17].*

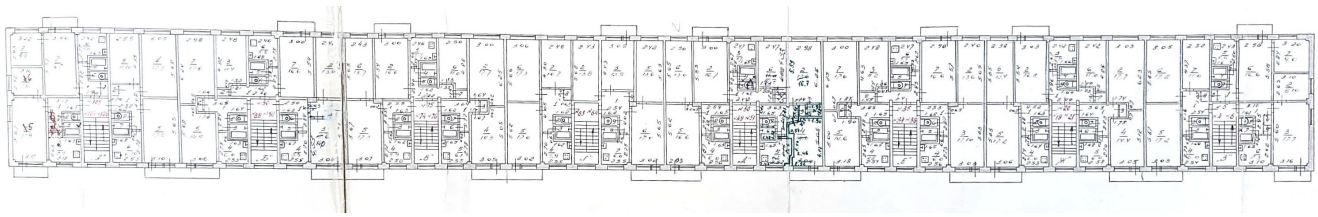


Figure 29. *1-335A, str. Razina 89 (city centre). Floor plan [32]*

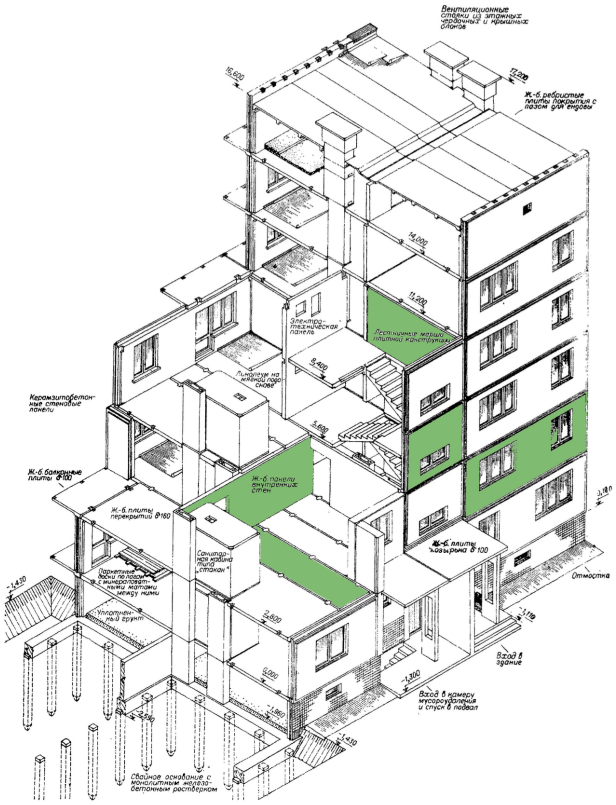


Figure 30. *Axonometric Structural scheme. Longitudinal and facade walls with larger spans* [31]

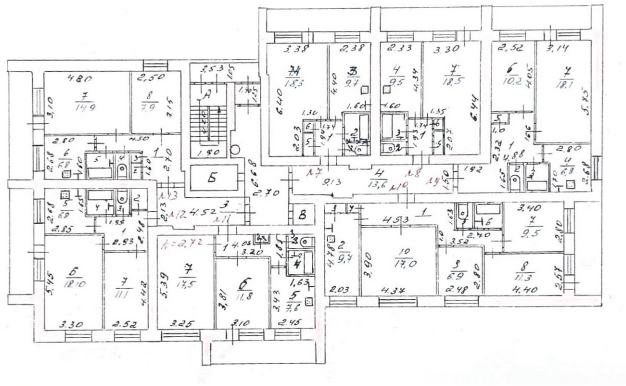


Figure 31. *series Э93, str. Tsiolkovskogo 60 (city centre). Floor plan* [32]

and 1-464A were introduced to the city. Surprisingly, even the least successful *series* 1-335 received a *modification* (1-335A), which retained the same structural methods and technical specifications as its predecessor. In fact, all series of this *generation* maintained identical technical and structural specifications as their original versions. The main difference was their height, with five and nine stories.

3rd generation: (1977-2000)

With the introduction of third-*generation series*, urban patterns based on first and second *generation* standard designs were abandoned. The solution to monotonous architecture came through the *block-sectional method*. The smallest unit of urban development was no longer the entire building, but a single *block-section* instead. These smaller sections served as building blocks for assembling structures of varying heights, configurations, and orientations. The Pravoberezhie *micro-district* exemplifies this pattern, though most houses of these *series* in Kaluga were built as infill developments in the city center and existing districts.

In this *generation*, there was greater emphasis on structural durability. Both structural elements and joints underwent refinement in the new *series*. Although the structural schemes remained the same, *Series* 111-83, was developed for already existing *DSKs* that used to produce large concrete panels for *series* 1-335 and 1-335A, and introduced new larger panels. The structural span in the transverse direction became 600cm, instead of 320cm creating greater opportunities for apartment replanning, since only inter-apartment transverse walls were load-bearing.

While the most radical innovation of previous

Figure 32. *Series 83, str. Tul'skaya 21 (city centre). Floor plan* [32]

generations, which had been designed to extend living areas, became a major source of inconvenience for its residents. Therefore, apartment designs in this *generation* returned to more traditional layout techniques and the number of *interconnected rooms* was reduced to a minimum. Due to privacy reasons, it was more desirable to access all rooms from the separate hallway. To achieve this, the main living room was placed at the back of the apartment, while the smaller bedroom was positioned next to the kitchen.

Based on all identified characteristics, *series* Э93, which consisted of only three tower blocks at the city entrance, can be considered the most successful form of mass housing. Its location was carefully chosen - the prominent position along the main route from Moscow made it highly visible to every tourist entering Kaluga.

INTERGENERATIONAL COMPARISON:

Ultimately, several clear trends and notable deviations emerge when conducting an intergenerational comparison of the prefabricated housing series in Kaluga. Overall, a prominent trend is that mass-produced housing gradually became more comfortable and functional for residents over time. The complexity and duration of construction also increased, indicating a shift towards more serious architectural and engineering solutions. The second *generation series* were the least represented, primarily consisting of *modifications* to earlier first *generation* houses.

Early prefabricated buildings were uniformly five stories tall. However, their subsequent *modifications*, notably *series* 1-335A and 1-447C, introduced both five- and nine-floor variants, although a nine-story building was less economically feasible due to mandatory elevator installation and, preferably, garbage disposal systems.

Figure 33. *Ensemble erected in late 1970s with three tower blocks series Э93* [27]

Ceiling heights generally remained constant, varying from 2.48m to 2.55m, likely depending on slab thickness and connection methods to load-bearing walls. The notable exception was series 111-83, which introduced an unprecedented 2.7m ceiling height, aligning Kaluga closer to the standards of Moscow and other large capitals.

Apartment sizes and kitchen areas notably expanded primarily within the third *generation series*, offering residents increased living standards and amenities. There were far less *intercommunicating rooms*, ensuring more privacy to residents.

There was no clear preference for a specific load-bearing structural system. After encountering difficulties with the incomplete precast concrete frame in *series* 1-335, Soviet architects continuously experimented with various load-bearing wall configurations. Initially, these variations limited possibilities for future apartment replanning. In later series, particularly *series* 83 and *series* 114-86, architects favoured transverse load-bearing walls that made only inter-apartment walls structural, thereby enabling greater flexibility for internal apartment modifications.

Throughout the study period, the building types remained predominantly panel and brick constructions, which were the most widespread. Large-block houses appeared mainly during the 1960s and 1970s in *series* 1-439A and 1-467. By the third generation, preference had decisively shifted toward exclusively panel or brick houses, which might be due to the unfavorable exterior appearance of large-block houses, not preferred by many Soviet citizens. As time went on, high amount of inter-block joints started to look more unappealing on those series.

A gradual evolution occurred, shifting toward modern 22cm hollow-core floor slabs in later series, replacing earlier, less practical 10cm reinforced con-

crete panels. This modification considerably improved an overall living comfort. Although, the technical specification of precast concrete facade panels saw numerous variations between series, ranging from 1-layer expanded clay aggregate concrete to blocks of reinforced concrete, there is no a clear linear trend.

Same is applied to bricks, although, brick structures provided better thermal insulation compared to panel and block buildings, due to their increased wall thickness and improved thermal properties. This might be caused by limited amount of the *DSKs* in Kaluga, which could only produce a certain type of concrete panels and bricks.

Another evident trend was the gradual rejection of balconies in favour of loggias. Initially, buildings featured only balconies, not even consistently in all apartments. Later, designs integrated both balconies and loggias, eventually transitioning exclusively to larger loggias, sometimes providing two loggias in four-bedroom apartments. This shift was likely due to residents frequently glazing balconies independently, negatively impacting facade aesthetics and causing structural failures, as original designs did not accommodate the additional glazing weight, leading occasionally to balcony collapses with frequent casualties[19].

Facades also progressively became more intricate. Early *series*, 1-335 and 1-335A, featured decorative Tarus ornaments that were primarily superficial. However, third-*generation series* like 111-101, Э93, 114-85, and 114-86 introduced greater facade depth and diversity through varied loggia placements, especially facilitated by brick construction in *series* 114-85 and 114-86. Panel-based *series* 111-101 and 111-83 incorporated decorative patterns on loggia panels, though these decorations were not uniquely local.

CONCLUSION:

The evolution of prefabricated housing in Kaluga mirrors broader trends in Soviet urban and architectural planning between the 1960s and late 1980s. Driven by urgent post-WWII housing needs and economic limitations, Kaluga adopted Khrushchev's vision for rapid mass housing production, implementing R. Camus's prefabricated concrete panel system.

Early prefabricated buildings were uniform, simple, and practical, predominantly five-story structures designed for rapid assembly. Through following decades, prefabricated housing in Kaluga progressively evolved, showcasing noticeable improvements in comfort and aesthetic diversity. Architectural innovation was modest but evident. Urban planning principles also matured significantly, moving towards comprehensive *micro-districts*; a system intended to create a truly egalitarian society where everyone had the same opportunities and needs - a vision the state worked to implement across the nation and an ideal that was still captivating Soviet citizens in the 1960s.

Many planned urban expansions were unrealized due to economic constraints, resulting in patchwork development and compromised infrastructure integration, diverging from initial masterplan visions.

Despite the complete industrialisation of the construction process, there was still an example of local diversity that could become a true work of art which could tell its citizens a lot about the history of Kaluga region and the lives of its historic figures.

Although many consider prefabricated buildings aesthetically unappealing, there is an urgent need to document and catalog certain structures before their demolition due to their architectural and historical significance addressed in the paper. Securing these buildings will preserve Kaluga's unique architectural heritage and could serve as a model for similar preservation efforts across other cities in the country. As of now, out of 275 buildings listed in the cultural heritage site, none are mass prefabricated buildings completed after 1955.

[Word count: 5050 words]

REFERENCES:

[1] G. D. Andrusz, Housing and urban development in the USSR. 1984. doi: 10.1007/978-1-349-05218-9.

[2] “Оккупация Калуги 1941 год.” [Online]. Available at https://web.archive.org/web/20160901224927/http://kompas-kaluga.ru/historyitem/2347. [Accessed: 12-Mar-2025]

[3]. N. Solopova, “La préfabrication en URSS : concept technique et dispositifs architecturaux,” 2001. [Online]. Available: http://www.theses.fr/2001PA081897

[4]. V. N. Gorlov, “N.S. KHRUSHCHEV’S SPEECH AT THE ALL-UNION CONFERENCEOF BUILDERS IN DECEMBER 1954 AS ONE OF THE FIRST STEPSIN THE DIRECTION OF DE-STALINIZATION OF SOVIET SOCIETY,” Bulletin of the Moscow State Regional University (History and Political Science), no. 2, pp. 126–131, Jan. 2018, doi: 10.18384/2310-676x-2018-2-126-131.

[5] City government of Kaluga: Statistics. [Online]. Available at https://www.kaluga-gov.ru/o-kaluge/razvitie-goroda/statistika/19312/ [Accessed: 20-Mar-2025]

[6] "Amendments to the General Plan of the Kaluga city district with regard to the location of the facility of the Penitentiary Department of the Federal Penitentiary Service, background materials, Vol. 1, 2022" [Online]. Available at https://www.kaluga-gov.ru/gradostroitelstvo/generalnyy-plan-goroda/deystvuyushchaya-redaktsiya/3173/ [Accessed: 19-Feb-2025]

[7] "About the General Plan of the City of Kaluga, year 1966" [Online]. Available at https://vk.com/wall385626794_18480 [Accessed: 18-Feb-2025]

[8] P. Meuser and D. Zadorin, Towards a typology of Soviet mass housing: Prefabrication in the USSR 1955 – 1991. 2016. [Online]. Available: https://lib.ugent.be/en/catalog/rug01:002238477

[9] “Калужские кубинцы.” [Online]. Available at https://kgvinfo.ru/novosti/kultura/kaluzhskie-kubintsy/. [Accessed: 13-Mar-2025]

[10] N. Almazov, private conversation, Jan. 2025.

[11] “Новости Калуги и Калужской области: главные новости на сегодня | Комсомольская Правда в Калуге - KP.RU,” KP.RU - Комсомольская Правда. [Online]. Available at http://www.kaluga.kp.ru/. [Accessed: 14-Mar-2025]

[12] Details, "What kind of relief prevails in the Kaluga Region. The Mysterious Relief of the Kaluga Region: A Journey through Hills and Valleys," Telegraph, Jan. 02, 2025. https://telegra.ph/Kakoj-relef-preobladaet-v-Kaluzhskoj-oblasti-Zagadochnyj-relef-Kaluzhskoj-oblasti-Puteshestvie-po-holmam-i-dolinam-01-02?ysclid=m8c0f12p91784829187

[13] M. Kaluga, “Первые девятиэтажки в Калуге 70-х,” Sep. 12, 2024. [Online]. Available at https://m.ok.ru/group/70000004102989/topic/157439445390669 [Accessed: 9-Mar-2025]

[14] A. V. Kalabin, “TYPES OF RESIDENTIAL DEVELOPMENT. THE MODERN STATE,” Академический Вестник УралНИИпроект РААСН, no. 4(35), Dec. 2017, doi: 10.25628/uniip.2017.35.9409.

[15] K. Salnikov, "Baikonur" Photos of Kaluga and Kaluga region, May 14, 2012. [Online]. Available at https://kalugafoto.net/kaluga/raony-kalugi/137-bakonur?ysclid=m6z3i1fwww334527551 [Accessed: 15-Mar-2025]

[16] “Series 1-335 - flat layout with dimensions, BTI and other information.” [Online] Available at https://gsps.ru/home_series/1-335.php [Accessed: 19-Mar-2025]

[17] “Kaluga neighbourhoods: Soviet panel buildings with pagan motifs,” Society - News - Kaluga Perekrestok Kaluga. [Online]. Available at https://www.kp40.ru/news/society/34514/. [Accessed: 10-Mar-2025]

[18] “Khrushchev shirt as a Kaluga brand.” [Online]. Available at https://media.kalugahouse.ru/s/xrushevskaya_rubashka_kak_kaluzhskij_brend/ [Accessed: 10-Mar-2025]

[19] “В Калуге демонтируют 15 опасных балконов,” Калуга 24, Apr. 20, 2021. [Online]. Available at https://kaluga24.tv/news/033665?ysclid=m8hhqakj7q173147469 [Accessed: 20-Mar-2025]

References used for analysis of the urban development:

[20] “Section: Districts, Neighbourhoods,” KP40, Kaluga, Russia. [Online]. Available: https://www.kp40.ru/articles/districts-neighbourhoods/. [Accessed: 15-Feb-2024].

References used for technical spesiciations of mass housing series:

[21] "Catalogue: Series of houses" [Online]. Available at https://kaluga.domclick.ru/almanach/catalog?utm_referrer=https%3A%2F%2Fyandex.ru%2F

[22] "Housing stock" [Online]. Available at https://dom.mingkh.ru/kaluzhskaya-oblast/kaluga/

[23] "Housing stock" [Online]. Available at https://jkhdom.com/dom/serii

[24] “ПроВокруг,” YouTube. [Online]. Available at http://www.youtube.com/@provokrug

References used for pictures and illustrations:

[25] "Dear Nikita Sergeevich..." [Online]. Available at: https://rodina-history.ru/2019/10/14/nikita-sergeevich-hrushchev-v-dnevnikah-sovetskih-liudej-toj-epohi.html?utm_referrer=https%3A%2F%2Fwww.google.com%2F

[26] “План Калуги” [Online]. Available at https://retromap.ru/_1419122_z15_54.511787,36.261045

[27] “Retro photos of mankind’s habitat.,” [Online]. Available at: PastVu. https://pastvu.com/

[28] A. Andrianova, Architecture of Soviet Housing and Main Soviet Urban Planning Concepts, Research, May 2015. DOI: 10.13140/RG.2.1.5147.5366.

[29] “Weather Archive in Kaluga (Russia), monthly climate, rose wind in Kaluga.”[Online]. Available at: https://world-weather.ru/archive/russia/kaluga/?ysclid=m8nm375t19278610602. [Accessed: 1-April-2025]

[30] Maps of SP 131.13330.2018 “Construction Climatology” (Updated Edition of SNiP 23-01-99), Gidrotgv.ru. [Online]. Available: https://gidrotgv.ru/karty-sp-131-13330-2018-svod-pravil-stroitelnaya-klimatologiya-aktualizirovannaya-redakciya-snip-23-01-99/. [Accessed: 31-Mar-2025].

[31] I.A. Shereshevsky, Design of Civil Buildings, stereotyped edition. Moscow: Architecture-S, 2005.

[32] BTI of Kaluga city.

[33]Современная типовая архитектура [Modern Standard Architecture], VKontakte, Community page. [Online]. Available: https://vk.com/tiparh. [Accessed: 29-Mar-2025].

[34] M. V. Fekhner, Kaluga, Goroda SSSR, 1971.

GLOSSARY:

Central Committee of the CPSU: (Central Committee of the Communist Party of the Soviet Union) was the highest administrative and decision-making authority of the Communist Party of the Soviet Union (CPSU) between Party Congresses. It was responsible for directing the Party's policies, ideology, and governance of the Soviet Union. The Central Committee elected the Politburo and Secretariat, which managed day-to-day political and administrative affairs. Its decisions significantly influenced all aspects of Soviet life, including economic planning, urban development, housing policies, and architectural regulations.

Block section: A block section is the smallest compositional unit of a building that can function independently or combine with other block sections to create buildings of varying layouts. Typically comprising one or two sections, block sections have been fundamental to many mass housing series since the early 1970s.

Climatic zone (region): A climatic zone comprises regions with similar weather conditions. The Soviet Union was divided into four climatic zones, ranging from very cold (I) to hot (IV). These zones were further divided into three to five sub-regions, each marked with a letter. Each edition of SNiP included both general regulations and specific requirements for different climatic zones and sub-regions. These requirements covered aspects like lighting, ventilation types, ceiling heights, room sizes, and summer-use spaces. While zone boundaries and specific requirements changed over time, the consideration of climatic differences remained central to Soviet housing policy.

Communicating room: A communicating room serves as a passageway to other living spaces within a dwelling. According to SNiPs of 1958 and 1962, only the main living room in Soviet apartments could function as a communicating room, providing direct access to one or two bedrooms and the kitchen. This feature was prevalent in first-generation standard designs. However, communicating rooms became less common in second-generation series. Additionally, new requirements specified that kitchens must be accessed directly from the entrance hall. The 1971 SNiP stated that all rooms be isolated, effectively eliminating communicating rooms.

DSK: Domostroitel'nyy Kombinat, or DSK for short, is an organization that constructs residential buildings using prefabricated methods. DSKs manage every stage of construction - from producing industrial components to transporting materials, assembling structures, and delivering completed building parts. While most DSKs specialize in large-panel system construction, they can also employ other industrial building methods.

Frame construction system: A frame-panel system is a fully prefabricated construction method that divides building elements into load-bearing and enclosing components. The load-bearing structure consists of a frame with beams and columns, while light concrete panels serve as the enclosing elements.

Generation (of mass housing): A stage in the development of Soviet mass housing, defined by its adherence to specific SNiP editions, technological capabilities, and building composition principles. Each generation began with a decree from the highest Soviet organizations—the CPSU and CM USSR. The four recognized generations were: I (1958–1963), II (1963–1971), III (1971–1985), and IV (1985–). Although the fourth generation was officially launched in 1985, its implementation didn't begin until the mid-1990s.

Isolated room: An isolated room is a room that only communicates with one another room.

N. S. Khrushchev – Nikita Sergeyevich Khrushchev (1894–1971) was the First Secretary of the Communist Party of the Soviet Union from 1953 to 1964. His leadership marked a significant shift in Soviet domestic policy, especially in the realm of urban development and housing. Faced with a severe post-war housing crisis, Khrushchev initiated a massive campaign for industrialized, prefabricated housing construction to provide fast, affordable, and standardized apartments for millions of Soviet citizens. This led to the widespread adoption of panel housing (panelki), characterized by prefabricated concrete panels, minimal ornamen-

reforms fundamentally reshaped the architectural and urban landscape of Soviet cities, prioritizing efficiency and mass production over traditional aesthetics.

Khruschevka: Khruschevka is a colloquial name for a five story residential block, constructed on a mass scale in the late 1950s and 1960s and notorious for their poor quality of consturction. Khruschevka, was named after the Soviet leader N. S. Khruschev, who was the main ideologue behind their appearance. More specifically, Khruschevka refers to first generation buildings with Vesnin apartments and low ceilings.

Micro-district: A micro-district was the primary form of Soviet residential development and the fundamental planning unit of a Soviet city. Its core principle was to provide all essential daily facilities for residents within an area bounded by major transportation routes. Each micro-district typically included residential buildings alongside kindergartens, schools, grocery stores, parks, and sports facilities. Population size ranged from 6,000 to 20,000 inhabitants, varying based on location (whether in small or large cities), geographical features, and planning period.

Modification (of series): Modification is another name for standard designs and block sections that make up a part of nomenclature of a series.

Nomenclature of articles (of a series): is a totality of all construction articles used in series.

Series (of standard designs): A series is a collection of architectural designs unified by common construction methods, structural schemes, materials, and planning principles. More specifically, a series defines a catalog of construction components used to develop standardized designs. It functions as a self-contained system that allows little or no interchangeability with other series systems.

SNiP: Construction Norms and Rules is a collection of standardized regulations governing construction practices. First introduced in 1954, SNiPs were updated every five to fifteen years. One chapter of every SNiP focused on residential buildings, providing binding regulations for all housing construction until the next edition was published. Between 1954 and 1991, six editions were released. SNiPs were closely tied to the emergence of new generations of housing series.

Vesnin Apartments: A specific apartment configuration applied to standard sections of Gosstroi in 1957 and used widely in first-generation series. Named after its creator, the renowned Constructivist architect Victor Vesnin, who developed this configuration in 1943–1944. The key feature of Vesnin Apartments was using the main living room as a communicating space to access one or two bedrooms and the kitchen. The kitchen and entrance hall were reached through an alcove in the main living room, while a combined sanitary block, concealed behind the alcove, was accessible from the entrance hall. This configuration minimized auxiliary spaces, maximizing the apartment's living area. Though popular from 1957 to 1963, Vesnin apartments vanished from Soviet standard designs with the introduction of second-generation SNiP.

Yamskie Sloboda: A type of tax-privileged settlement in pre-modern Russia, typically inhabited by state-assigned coachmen known as yamshchiki. These settlements were strategically located along major transportation routes and supported the Yam system—an early state-run postal and transportation network responsible for the delivery of official correspondence, goods, and travelers. Residents of Yamskie Slobody were exempt from certain taxes in exchange for their lifelong service in maintaining communication and logistical infrastructure. The institution played a critical role in the administrative and spatial development of the Russian state from the 15th to the 18th century.

APPENDIX A:

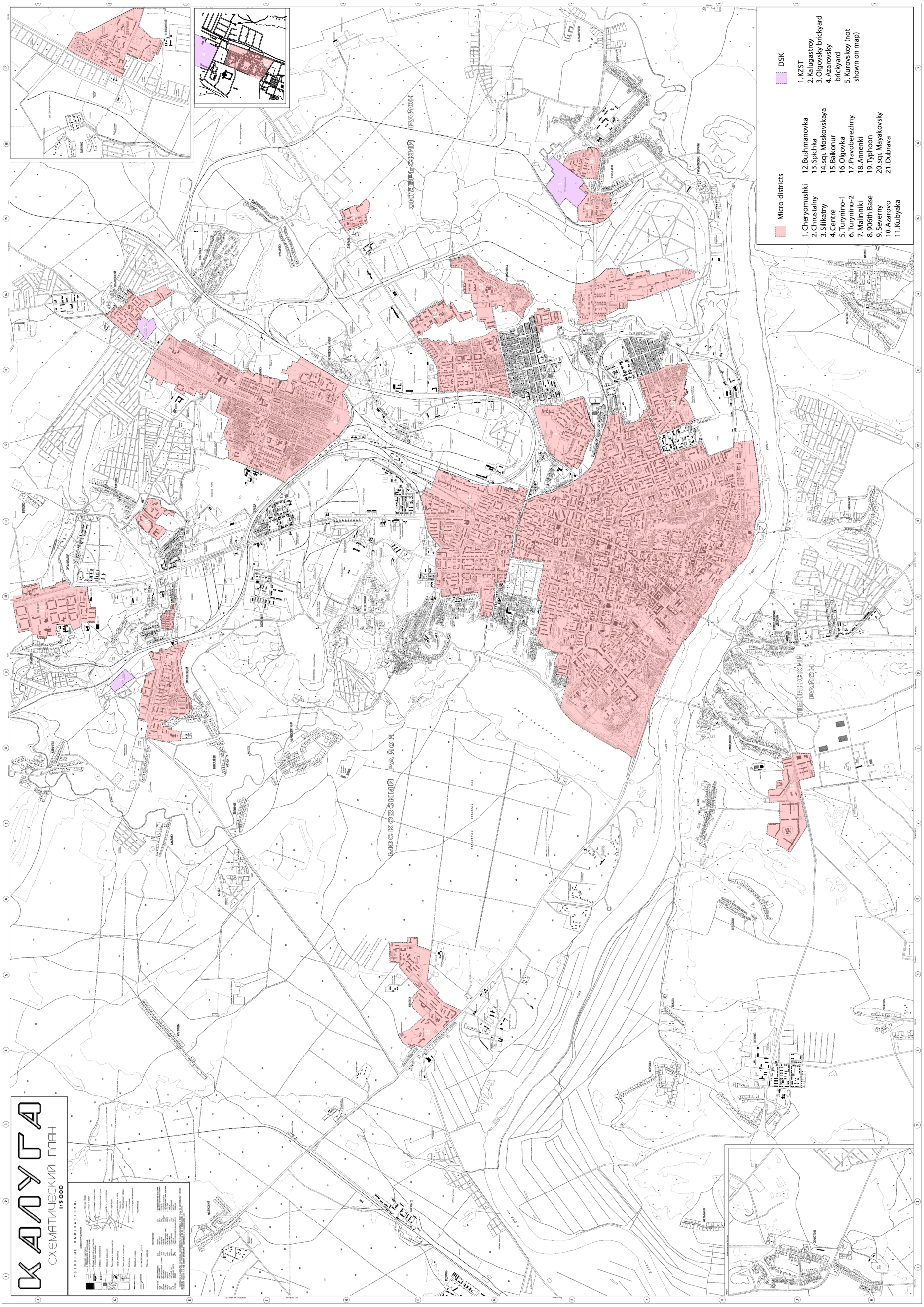


***Figure 34**. Nollie map of Kaluga with identified micro-districts and DSKs [self-made].*

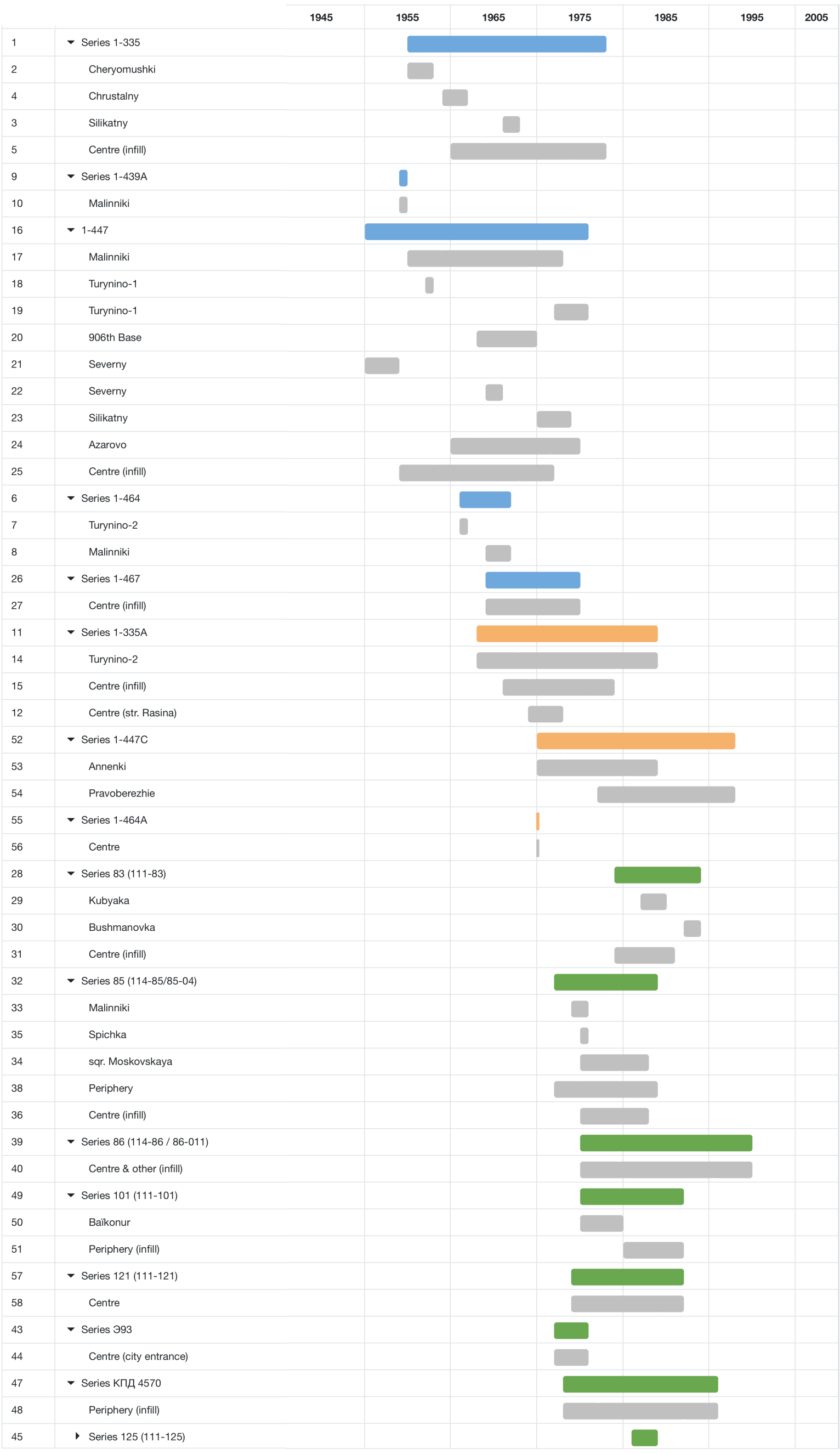


Figure 35. *Timeline of all identified series in Kaluga and their relation to micro-districts* [self-made].

Parameter / 1st Generation	**Series 1-335**	**Series 1-439A**	**Series 1-447**	**Series 1-464**	**Series 1-467**	**Parameter / 2nd Generation**	**Series 1-335A**	**Series 1-447C**	**Series 1-464A**	**Parameter / 3rd Generation**	**Series 83 (111-83)**	**Series 85 (114-85, 85-04, ...)**	**Series 86 (114-86, 86-011,...)**	**Series 101 (111-101)**	**Series 125 (111-125)**	**Series КПД-4570**	**Series 393**
Micro-districts	Cheryomushki, Chrustalny, Silikatny, Centre	Malinniki	Cheryomushki, Malinniki, Turynino, 906th Base, Severny, Silikatny, Azarovo, Centre	Turynino, Malinniki	Centre	Address	Centre, Turynino	Centre, sqr. Moskovskaya	n. d.		Centre, Kubyaka, Bushmanovka	Malinniki, Spichka, sqr. Moskovskaya, Centre	Centre, sqr. Moskovskaya, Peryphery	Baïkonur, Peryphery	Centre, Peryphery	Centre, Peryphery	Centre
Apartment Layout & Living Standards						**Apartment Layout & Living Standards**				**Apartment Layout & Living Standards**							
Average 1bd apartment size (m^2)	30.4-31.69	30.5-32.2	28.0-32.0	28.0	30.5-32.2	Average 1bd apartment size (m^2)	30.0-33.0	28.0-32.0	30.0-31.0	Average 1bd apartment size (m^2)	34.0-39.0	27.0-35.0	27.0-35.0	34-36	33.0	27.0-29.0	37.0
Kitchen size (m^2)	6.3	5.0-5.6	5.0-5.6/6	5.8	6.4	Kitchen size (m^2)	5.5	5.0-5.6/6	6.0	Kitchen size (m^2)	8.0	6.5-9.5	8-8.5	8.4-8.7	8.0-10.0	4.8-5.9	8-11
Ceiling height (m)	2.54	2.48	2.5	2.5	2.5	Ceiling height (m)	2.50-2.55	2.5	2.5	Ceiling height (m)	2.7	2.48	2.5	2.52	2.55	2.5	2.6
Bathroom type	Connected	Connected	Connected	Connected	Connected	Bathroom type	Connected	Connected	Detached	Bathroom type	Detached	Connected	Connected	Detached	Connected	Detached	Detached
Balcony	Yes, starting from 1st floor	Yes	Yes, starting from 1st floor	Yes	Yes, starting from 1st floor	Balcony	Balconies or Loggias not in every apartment	Yes, starting from 1st floor	Yes	Balcony	Logias	Balconies and Loggias in every apartment	Loggias in every apartment	Loggias in every apartment	Balconies and Loggias in every apartment	Balconies	Huge loggias in every apartment
Construction Materials & Structural Design						**Construction Materials & Structural Design**				**Construction Materials & Structural Design**							
Structural type	Large Panel	Large Block	Brick	Large Panel	Large Block	Type	Large Panel	Brick	Large Panel	Type	Large Panel	Brick	Brick	Large Panel	Large Panel		Brick
Span (mm)	260, 320	240, 320	600	260, 320	320,, 640	Span (mm)	260, 320	600	260, 320	Span (mm)	300, 600	312, 630	n/a	320	320, 640	320	n/a
Number of floors	5	5 (apartments at GF)	5	5	2 or 5	Number of floors	5 or 9	5 or 9	5 or 9	Number of floors	9	5 or 9	5 or 9	9	5	5	12 or 14
Apartments per stairwell	4	4	4	4	4	Apartments per stairwell	4 or 5	4	3 or 4	Apartments per stairwell	4 or 5 or 6	4	4 or 6	4	4	3	7
Load-bearing structure	Incomplete frame: column+beam and exterior walls.	Load bearing walls: Longitudinal + facade	Load bearing walls: Longitudinal + facade	Load bearing walls: every traverse + longitudinal walls	Load bearing walls: Longitudinal + transverse inter-apartment + facade (larger grid spacing)	Load-bearing structure	Incomplete frame: column+beam and exterior walls.	Load bearing walls: Longitudinal + facade	Load bearing walls: every transverse + longitudinal walls	Load-bearing structure	Load bearing walls: Longitudinal + transverse inter-apartment + facade	Load bearing walls: transverse inter-apartment + facade (larger grid spacing)	Load bearing walls: longitudinal	Load bearing walls: transverse inter-apartment	Load bearing walls: longitudinal + facade	Load bearing walls: Longitudinal + transverse	Load bearing walls: transverse inter-apartment + facade
Exterior wall specifications	-30cm: 2-layer RC walls	40cm: Large lightweight concrete panels	38-40cm: seven slit or porous hole clay or silicate bricks + RC panels	- 21cm: 1-layer lightweight concrete - 268mm in height	22cm: large blocks of lightweight RC. 1-layer expanded clay aggregate concrete.	Exterior wall specifications	-30cm: 2-layer RC walls -40cm: 1-layer expanded clay concrete walls	38-40cm: seven slit or porous hole clay or silicate bricks + RC panels	- 21cm: 1-layer concrete - 35cm: 3-layer concrete	Exterior wall specifications	?cm: 3-layer RC panels	51cm: 2-layer solid clay brick	51cm: 2-layer solid clay and silicate brick		25 or 30cm (need to check): 1-layer panels of strip (two-row) cut from cellular or lightweight concrete	30cm or 32cm: expanded clay aggregate concrete	64, 51 and 38 cm: read clay bricks
Inter-apartment partition wall specifications	8cm: Gypsum concrete panels	20cm: 8cm gypsum slag + 4 air + 4 gypsum slag	8cm: Gypsum concrete panels	12cm: continuous single layer heavy concrete panel	27cm double RC panels	Inter-apartment partition wall specifications	8cm: Gypsum concrete panels	8cm: Gypsum concrete panels	12cm: continuous single layer heavy concrete panel	Inter-apartment partition wall specifications	35cm: 3-layer RC panels + insulation from polystyrene foam	51cm: on floors 0-2 38cm: on higher floors	8cm gypsum slag		16cm RC panel	16cm RC panel or 32cm multiple whole concrete panel	38 cm: read clay bricks
Floor specifications (cm)	RC panel 10cm	RC panel (?)	RC hollow core slabs 22cm	RC panel 12cm	RC hollow core slabs 22cm	Floor specifications (cm)	RC panel 10cm	RC hollow core slabs 22cm	RC panel 12cm	Floor specifications (cm)	RC panel 12cm	RC hollow core slabs 22cm	RC hollow core slabs 22cm		RC hollow core slabs 22cm		RC hollow core slabs 22cm
Accessibility & Comfort Features						**Accessibility & Comfort Features**				**Accessibility & Comfort Features**							
Elevators	No	No	No	No	No	Elevators	1-passenger	No	No	Elevators	1-passenger	1-passenger (in 9 storey houses)	1-passenger (in 9 storey houses)	Yes	1-passenger	No	1- passenger, 1-cargo-passenger
Garbage disposal	No	No	No	No	No	Garbage disposal	Yes	No	No	Garbage disposal	Yes	Yes	Yes	Yes	No	Sometimes	No
Thermal insulation	None	None	Good	None	Satisfactory	Thermal insulation	None	Good	None	Thermal insulation	Satisfactory	Good	Good	Satisfactory	Poor	Good	Good
Sound insulation	Poor	Satisfactory	Good	Satisfactory	Satisfactory	Sound insulation	Poor	Good	Poor	Sound insulation	Satisfactory	Good	Satisfactory	Good	Satisfactory	Good	Good
Architectural & Aesthetic Features						**Architectural & Aesthetic Features**				**Architectural & Aesthetic Features**							
Façade design	- Ceramic Tiling: light blue or light grey - Unclad: grey, white, yellow and beige paint.	Unclad: grey, white, yellow and beige paint.	Bricks: grey (silicate - lime-sand mix) or red (clay) bricks	Unclad: grey, white, yellow and beige paint.	Unclad: yellow and beige paint.	Façade design	- Ceramic Tiling: light blue or light grey - Unclad: grey, white, yellow and beige paint.	Bricks: grey (silicate - lime-sand mix) or red (clay) bricks	Unclad: grey, white, yellow and beige paint.	Façade design	Large or small ceramic tiling: dark blue, light blue, or light grey	Bricks: grey (silicate - lime-sand mix) or red (clay) bricks	Bricks: grey (silicate - lime-sand mix) or red (clay) bricks	Ceramic Tiling: light blue or light grey + red paint	Ceramic Tiling: light blue or light grey	- Ceramic Tiling: light blue or light grey - Unclad: grey, white, yellow and beige paint.	Bricks: red clay bricks
Decorative elements	None	None	None	None	None	Decorative elements	None (Tarus ornaments)	None	None	Decorative elements	None	Brick ornaments	Brick ornaments	Yes, last floor	None	None	None
Roof type	Flat or pitched	Four-pitched	Four-pitched with attic	Flat, no attic	Flat	Roof type	Flat or pitched	Flat, with attic	Flat, no attic	Roof type	Flat	Flat	Flat	Flat	Flat	Flat	Flat
Replanning opportunities	High	High	High	Low	Moderate	Replanning opportunities	High	High	Low	Replanning opportunities	Moderate	Moderate	High	Moderate	High	Low	Moderate

Figure 36. *Collective table with technical information of the series [self-made].*