Transformation by Method of Sanation – Unregulated Residential Settlements of Sarajevo

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Abstract. In the second half of the 20th century, the industrialisation and deagrarianization of Bosnia and Herzegovina had a strong impact on the dynamics of urban development and economic growth of the post-war Sarajevo, which intensified immigration from its relatively underdeveloped regional environment. This was accompanied by accelerated housing construction, and it encouraged the spatial expansion of the city. Planning guidelines were set by the city administration and were based on the long-term development plans. They identified the disposition of urban functions necessary for housing, work, recreation and traffic, and the policy of building multi-residential buildings was aimed general social interest. At the same time, the planning activities neglected the actual socio-economic status of immigrants who had lesser opportunities for housing through the social distribution system of apartments, began the process of self-organized unregulated settlement construction with single-family houses on the city's slopes. This began an era of two parallel but controversial actions within town space: planned and unregulated housing construction. Spontaneous possession of the city's territory with unregulated construction today is characterised by: complex property-legal relations, high degree of construction, absence of public space, pedestrian communications and service functions, low quality of the infrastructure network, and that settlements are formed on unstable terrains and on active landslides. Since the consequences of the complexity of the situation cannot be addressed through radical urban transformation, we see an alternative in the idea of partial spatial interventions – transformation by method of sanation. Starting with the thesis that construction is always deeply connected to society's understanding of the function of space and the place of man in it, we have opened up a central question, and searching for answers is the basic goal of this paper: Is it possible to solve problems accumulated by decades within Sarajevo's unregulated residential settlements through means of transformation by method of sanation? Or: Can partial spatial interventions improve the overall quality of individual and social life? For the purpose of finding answers, we conducted an analysis of the causes of the formation and genesis of these settlements, as well as a series of problems produced by the accumulation of separate spatial interventions without elementary professional guidance. The results of this analysis showed that the answer to the questions asked can be positive, by establishing a critical relationship with the potential of the space of specific settlement sites, in terms of the degree of functional usability, correlation with utilities and user interactions with the environments they inhabit. We have concluded that it is precisely the potential of individual sites, by logically applying the transformation by method of sanation, will enable dual achievement – the merging the solution within the technical and structural aspect of potential landslides with the articulation of the public on new pedestrian communications. Also, it has been shown that the application of this method enables the typification of technical solutions, functions, contents, activities, urban design, and even the public itself. And this means that the conclusions on the characteristics of individual Sarajevo unregulated residential settlements, endangered by landslides, can offer general
1. Introduction

In the second half of the 20th century, after the Second World War, the former Yugoslavia developed rapidly into a modern socialist society. The state worked to form a new identity and national consciousness, and with high enthusiasm of the population and favourable economic climate, industry was strengthened and unemployment was reduced, a strong road network was built, housing conditions were improved and quality education was available to all.

In that post-war period of general progress, the industrialization of Bosnia and Herzegovina, followed by deagrarization, initiated an intensive process of immigration of the rural population to the cities. Sarajevo became the administrative centre of the Republic and underwent radical transformations in economic development, economic growth and, consequently, in population growth. This encouraged intensive housing construction, and that further spatial expansion of the city, according to directions of the city administration on the basis of long-term development plans. Within these plans, space was treated not only as a resource, a physical basis for expansion and general progress, but also as a determinant that stimulates and rationalizes growth at the same time. Based on the results of scientific research work in independent institutions, Sarajevo development planning was an integral process in which social, economic and spatial factors were equally treated and harmonized as determinants of the overall development strategy. Long-term development plans thus determined the disposition of urban functions necessary for housing, work, recreation and transport of people and goods, which defined the future of the city for several decades in advance. In this regard, the policy of construction of settlements with multi-residential buildings and distribution of apartments was directed towards the general social interest, and planners, designers, investors and contractors, coordinated action, achieved results that ranked Sarajevo among the cities of former Yugoslavia with the most rational implementation of this policy.

At the same time, the intensive process of influx of population to the city required quick decisions. While the city authorities expected that the plans themselves would be practically realized, the real social and economic structure of the society was neglected, which directly affected the activities of a large number of immigrants. Namely, those who failed to solve the problem of housing within the system of social distribution of apartments in settlements with multi-residential buildings, provided accommodation in Sarajevo mainly by individual, unregulated construction of single-family houses, thus forming entire settlements on the slopes of the city which (until 1990) occupied 2.500 ha of city territory. Thus began the era of two parallel, but completely opposite processes: planned social and

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1 In Bosnia and Herzegovina, in 1948, 72% of the population lived in rural communities, and by 1971 this percentage had dropped to 36.6% [1].

2 Sarajevo had the highest average population growth rate compared to all republican and provincial centres in the former Yugoslavia [2]. Thus, the number of urban population in Sarajevo, on a five-year average, from 1945 to 1985, grew by 9.1%, occasionally even by 18.4%. A particularly strong increase in immigration was recorded in the period from 1953 to 1961, when 36,692 new inhabitants moved to the city. This trend continued in the following periods, with a slightly reduced intensity. The primary motive for immigration was the possibility of employment (68%), the need for further education (14%), the desire for higher incomes (6%) and a better standard of living (5%) [3].

3 An apartment is an independent and functionally connected group of rooms, and a multi-residential building consists of at least two completely independent apartments. Single-family house consists of one functional apartment or (possibly) another for the second generation of the same family [4]. Multi-residential buildings are usually multi-storey.

4 The usual term in our country for all types of self-organization in the field of construction is illegal construction. Therefore, it is necessary to clarify the difference in the interpretation of the terms illegal and unregulated construction. Illegal construction is any construction that is carried out contrary to the rules prescribed by the valid spatial planning documentation (urban plans, regulatory plans and urban projects), which means that is prepared, officially adopted and approved. In contrast, unregulated construction is a form of self-organization in the field of construction in the city for which, by the city authorities, regulations on their treatment are not prescribed, which means that spatial planning documentation is either not prepared or officially adopted or approved (usually all together).
professional actions aimed at building settlements with multi-residential buildings, on the one hand, and self-organized, unregulated construction of single-family houses, on the other. Both, each in their own way, have significantly changed and are still changing the urban image of Sarajevo.

Spontaneous occupation of the city territory by unregulated construction, accumulation of separate spatial interventions without elementary professional guidance, today is generally characterized by: complex property-legal relations, high degree of construction, absence of public space, pedestrian communications and service functions, under capacity of the infrastructure network, and significant the number of these settlements are formed contrary to the climate and topography – on non insolated, steep and unstable terrains and on active landslides. The described complexity of the situation, in order to solve a number of problems that this situation produces, logically requires a radical urban transformation, but at the same time excludes it, because it does not offer real spatial possibilities for it. Therefore, the idea of partial spatial interventions – transformation by method of sanation, in an attempt to find individual solutions aimed at the overall improvement of the quality of life of the inhabitants of these settlements, is imposed as an alternative.

In this sense, starting with the thesis that construction is always deeply connected to society's understanding of the function of space and the place of man in it, we open a central question, and the search for answers is the main goal of this paper: Is it possible to solve problems accumulated by decades within Sarajevo's unregulated residential settlements through means of transformation by method of sanation? Or: Can partial spatial interventions improve the overall quality of individual and social life?

2. Causes of formation and genesis of unregulated residential settlements in Sarajevo

The dynamics of urban development, economic development and economic growth of post-war Sarajevo had a magnetic effect on the process of immigration from its, relatively underdeveloped, regional environment. The accelerated influx of population has become a quantitative basis for acute problems of housing and urban space consumption and a kind of test of „society's ability to assimilate the potential of new social energy“ [6]. This implied planning activities aimed at operationalizing the use of city land in accordance with the growing needs and interests of the city and its citizens.

Thus, the General Urban Plan of the City of Sarajevo (GUP, 1965-1985), based on the main postulates of the Athens Charter, gave a realistic program of proper spatial organization of the city. A clear distinction of urban zones has been established, based on four types of functions: housing, work, recreation and traffic. Therefore, the future of Sarajevo is defined by the purpose of the areas – zoning of urban space according to predetermined functions: connecting new settlements directly to existing ones, determining space for industrial and commercial centres, sports, recreation and entertainment and determining the corridors of all traffic systems. In addition, the nationalization of the land was carried out [2], which created the preconditions for preventing its unplanned exploitation for the purpose of construction.

In accordance with the Plan, the acute housing problem was solved by building a settlement with highrise multi-residential buildings, which achieved the necessary higher population densities. The concept of their rational (fast and extensive) construction was based on an urban matrix composition close to the simplified scheme of crane movement [2] and on the (relatively) low cost of the finished apartment. This planned policy of building settlements with multi-residential buildings, and within it the

5 Self-organization in the management of urban space is still present today, but in a form characteristic of the process of transition from socialist to capitalist social order (and thus in connection with the conflict between private and public domain) that began in Bosnia and Herzegovina at the end of the 20th century, and it is a topic that we will not pay special attention to in this paper. See: [5]!
distribution of apartments, was socially oriented and tended to self-governing decision-making of working people on issues of the policy itself, as well as its implementation.

On the other hand, the planning solution neglected the concept of rationalizing the construction of settlements with single-family houses, planned to accommodate numerous immigrants of low socio-economic status. This type of housing, low population density, is generally a reflection of a high standard of living, so here too it implied a high cost of building facilities, landscaping and equipping settlements. In this segment, the adoption of the Plan was not accompanied by measures for its implementation in the sphere of rationalization of the use of urban construction land for this type of housing, economical construction of houses and construction technology [2]. So we witnessed a kind of paradox – the poorest builders were offered the most expensive solutions. The result was completely contrary to plan. In just three years after the adoption of the Plan, unregulated residential settlements with more than 12,000 single-family houses were built on land reserved for new settlements, industry, recreation and traffic corridors [7], which significantly increased the already pronounced shortcomings of the longitudinal development urban matrix.

Although Sarajevo was ranked among the cities of the former Yugoslavia with the most rational implementation of the policy of building settlements with multi-residential buildings, the influx of new population was still higher than the available and planned housing stock. This, with insufficient construction land in the Plan determined for settlements with single-family houses and with complicated and expensive procedures for obtaining building permits, made the new residents’ resort to usurpation of socially owned land intended for industry and construction of residential buildings without building permits [7]. Due to political and sensitive socio-economic issues, the city authorities did not oppose this phenomenon and it gradually grew into a serious limiting factor for the further economic development of the society.

In addition, the expansion of unregulated housing construction has been affected by numerous regulations on the allocation of apartment distribution to working people in socially-owned enterprises. Although, in accordance with the ideology of self-government, apartments were socially owned, these regulations favoured workers in higher positions and with a higher level of education. Thus, most of those who failed to solve the problem of housing in the system of social distribution met their needs through self-organized, unregulated construction. Furthermore, the nationalization of the land excluded private ownership, making it difficult or impossible to enter into possession of the plot and build on it with a permit. Renting housing was expensive, without price control and without the right and opportunity to appeal to tenants [8], and the possibility of buying an apartment was completely disincentive. In all of this, self-organized house building was a good way to invest in conditions of constant inflation [9].

We conclude that in Sarajevo at that time, the Plan did not determine spaces for the formation of settlements with single-family houses designed to meet the needs of builders, provide rational organization of city life and planned development of the city, nor did it establish a stimulating mechanism for allocating apartments in multi-residential buildings. And in the image of the city, regulated and unregulated residential settlements gradually approached and finally merged into a large heterogeneous unit (Figure 1).

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6 At the level of the former Yugoslavia, the Law on Allocation and Direction of Funds for Housing Construction (1954) was adopted, according to which 4% of the gross income of all employees and pensioners was allocated to housing funds. Although the funds were allocated by all, the apartments were allocated to the privileged [2].
3. Unregulated residential construction – a generator of numerous problems

Decades of usurpation of urban construction land, intended for planned development, have generated numerous problems with unregulated construction of settlements with single-family houses, which are still manifested in space and negatively affect the quality of life.

Formed (mostly) on the slopes, in the contact zone around the plain planned part of Sarajevo, these settlements are primarily characterized by complex property-legal relations. Namely, the slopes were agricultural and forest land, in the era of socialism they were turned into building-use intended for industry and nationalized in an attempt to prevent their unplanned exploitation. This meant that, by building a single-family house with or without a building permit, the right of ownership could not be acquired over that land. In the case of construction with a permit, it was possible to exercise the right of permanent use of land, the right of ownership over the building, as well as the right of payment of monetary compensation in the situation of demolition of a house positioned on a plot planned for another purpose. In the case of construction without a permit, all these rights were absent. As the problem was large-scale, the city authorities, instead of demolishing and in order to prevent the outbreak of social unrest, passed regulations on the subsequent legalization of buildings, ie. regulations on subsequent issuance of building permits and use permits [7]. It is precisely this pragmatism of the city authorities, that is, giving up the prompt preparation, adoption and approval of spatial planning documentation for slopes and agreeing to their urbanization in this way, that unregulated housing construction was legalized, which soon became a limiting factor for further planning development of Sarajevo (Figure 2a).

On plots of 200 to 800 m², most often 300 to 400 m², single-family houses of 60 to 70 m² of floor surface were built [9]. The rest of the plot was reserved for use for private purposes and in the form of an open space – a green area or garden. The boundaries of the parcels coincided, except in the areas intended for access communications, which indicates a high degree of settlement construction (Figure 2b). In addition, access communications were formed in such a way that a minimum of space on both sides of the border was excluded from each plot, which became the axis of the road, usually only four meters wide [9]. The reason is that access communications, before the construction of buildings, were not routed and builders gave the minimum necessary space for their construction in an effort to maximize the use of space within the plots for private use – parking, green yard or garden. The shortcomings of this approach, especially because it is a slope, were later manifested in the difficulty of passing vehicles, as well as in the reduced manipulative space at the entrances to the plots due to unsatisfactory, improvised radius for car movements (Figure 2c). Also, pedestrian communications, if there were any, were formed where the spatial possibilities allowed, along with car roads, on very narrow sidewalks. The lack of sidewalks was often compensated by concrete stairs without panelling, which posed a danger to pedestrians in bad weather, and positioned transversely in relation to car routes (Figure 2d). In addition to the above, these settlements also lacked facilities for accommodation of service functions,
so, only sporadically, the residential ground floors of single-family houses were converted into supply stores for needs on daily basis. We conclude that the described concept of unregulated spatial organization is directly related to the absence of public green areas, quality pedestrian communications and service functions and generally with limited spatial possibilities in the articulation of the symbolism of living in public space.

Single-family houses, most often floors: ground floor, first floor and attic and with gabled or hipped roof surfaces, are mostly constructed according to standard projects from the catalogue of the design bureau „Dom” from Sarajevo and „Investprojekt” from Belgrade [2]. This is the main reason why their spatial articulations do not have the characteristic traditional identity components of Sarajevo's sloping mahalas from the Ottoman period of the city's development, they only visually and aesthetically superficially resemble the traditional precedent. In reality, with connotations of historical significance in modest decorations, they are „a phenomenon that in its character partly possesses elements of modern forms of vernacularity” [9] (Figure 2).

Figure 2. a) Legalised unregulated construction on slopes (Feb 2021); b) High degree of slope construction (Feb 2021); c) Narrow traffic and pedestrian areas (Feb 2021); d) Alternative settlement pedestrian communications (Feb 2021)

Decades of unregulated housing construction have caused numerous problems in the infrastructure network, especially water supply and sewerage, making them under capacitated in relation to the increased needs. Namely, self-organized builders connected their facilities to these networks end masse, and sometimes even built parts of the system on their own initiative7. This endangered the city's water supply, because the water supply network was not dimensioned to accommodate a large number of new connections, as well as storm water and sewage drainage networks, which led to damage to pipelines, cracking and shearing of pipes, water leaks and uncontrolled supply of soil material. Since unregulated settlements are mostly built on steep and unstable terrains, unfavourable geological structures and geotechnical characteristics, the consequences of all described activities in space are visible in the occurrence of a large number of landslides, which is a problem we want to point out.

3.1. Landslides
Landslides are a special type of soil erosion in which the main transport factor is gravity. They form on sloping terrains where, at some depth, there is a clay layer. Due to excessive wetting, it becomes slippery, and the surface layer soaked with water becomes heavier, loses cohesiveness and begins to slide on the lower clay layer. They can also be created by cutting the surface layer with construction works [10] (Figure 3a). Landslides are very diverse phenomena in shape, size and movement speed. According to the geological structure in which they occur, we can distinguish instability in soil (rotational landslide, translational landslide, debris flow, debris avalanche, earthflow, creep, lateral spread) and rock mass (block slide, rockfall, topple) [11] (Figure 3b).

The occurrence of landslides is influenced by many factors: 1. increasing the slope of the terrain (undermining the foot of the slope by the erosive action of the river or torrent, pouring material on the

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7 According to the data of KJKP „Vodovod i kanalizacija” (Waterwork and sewage company) (2002), 48 km of unplanned laid external water supply lines and the same number of lines in the sewerage network were registered [7].
Upper parts of the slope, digging longer cut-offs or cuts on the lower part of the slope, 2. change in groundwater level (along the foot of the slope, changes in vegetation on the surface of the terrain – deforestation and turning pastures into arable land, climate change – heavy rainfall after prolonged drought, poor drainage of surface water, uncontrolled distribution of water on the slope), 3. reduction of soil strength in the slope (weakening due to changes in its physical and mechanical characteristics, caused by natural processes), 4. additional load on the slope (construction of plateaus, embankments, formation of landfills and tailings, construction of facilities) and 5. lack of regulation plan of communal infrastructure, and dilapidated and damaged water supply and sewerage network [12] (Figure 3c).

Figure 3. a) Elements of landslide [11]; b) Instability in terrain and rock bedding [11]; c) Examples of unstable slopes [12]

Unregulated residential settlements in Sarajevo, built mainly in the eluvial-deluvial cover on the sloping parts of the city and where the deposits form unstable terrains, are naturally predisposed to landslides [13]. And the interaction of natural and anthropogenic factors – conversion of agricultural and forestry into construction land, high degree of construction, pedestrian and road communications traced without basic professional guidance and constructed with inadequate cross and longitudinal sections of road construction, uncontrolled connection to water supply and sewerage network and sewer and drainage of rainwater through open channels along communications, made it possible that today, in the narrower city territory, we have 559 registered landslides [10]. The alarming data indicates the necessity of drafting proposals – technical measures for the purpose of rehabilitating existing and preventing the occurrence of new landslides in the scope of these settlements, and thus the multiple negative consequences they bring (Figure 4).
4. Transformation by method of sanation

The phenomenon of transformation, in general, presupposes a change in shape, appearance, state and properties. In the context of transformations of urban spatial structures, we observe these phenomena in relation to the city and the flow of understanding the development and growth of its physical structures, especially from the standpoint of urban form as a socially acceptable expression of spatial organization. In this sense, urban-structural transformations are multifaceted, and are reflected in: 1. aesthetic, design, functional and constructive changes in buildings and matrices of the city, 2. changes in the traffic system (all types and levels of road and pedestrian roads), 3. changes in the way of life (as a lifestyle, work, entertainment, education, cultural activities), 4. changes in the way of using public spaces (squares, streets, parks), 5. socialization and communication, 6. use of technological innovations in construction, 7. artistic design of urban structures and 8. overall effort to improve living conditions in the human environment. That is, urban transformations imply a continuous process of organizing and building (with upgrading) certain functional and physical conditions, as well as spatial frameworks suitable for the concentration of people and complex manifestations of their lives. They are related not only to technical, but also to socio-social issues, because the concentration itself (people and physical structures) is a consequence/form of social relations. Therefore, any change in the urban context must be directly predicted based on the existing state of physical structures and socio-social sphere, and must have a sufficiently large, but also relatively observable, time distance and functional concept of capacity assumed for future, not only existing needs [14].

In that sense, the previously described spatial manifestations of self-organized, unregulated construction on the slopes of Sarajevo and the related state of the socio-social aspect of living in public space, logically imply a comprehensive urban transformation. However, limited spatial possibilities exclude it and, in an attempt to find technical solutions aimed at the overall improvement of the quality of life of the inhabitants of these settlements, offer an alternative only in partial spatial interventions, in the transformation by method of sanation.

Sanation is a minimal new construction or renovation and it is an intervention that is carried out in order to improve basic living conditions, when it comes to one or only a few buildings or a smaller spatial coverage within the observed (larger) unit. It is a form of physical transformations and implies the application of redesign methods based on purpose and function. That is, the transformation by method of sanation is as a partial redesign – an intervention on only one segment within the entire complex, and that can be carried out without changing the existing content or adding new content to the existing physical structure. In addition to interventions on damage to buildings due to natural disasters or acts of war, sanation is the most common method of transformation of buildings and (parts) of spatial units that mitigate the consequences of unregulated construction. And any proposal to mitigate the consequences of a difficult life, if articulated by architecture, is the most humane form of human-space interaction through urban redesign [14].
Following the above, as the biggest problem of unregulated residential settlements, built on unstable and terrain with a slope of unfavourable geological structure and geotechnical characteristics, we noticed the occurrence of landslides. In addition to the usual technical measures implemented to rehabilitate existing and prevent new landslides, our primary goal is to develop proposals for stabilization of the terrain, which would simultaneously enable the formation of better pedestrian communications and articulation of missing public spaces. As a potential and starting point for this type of spatial interventions, we see in the transformation of staircases as public residential pedestrian communications and positioned in the direction of sliding terrain. We believe that such a proposal, modified in accordance with the geomorphological characteristics of individual spatial scopes, could be applied to several locations, i.e. in all settlements where geo-exploration works confirm the presence of less demanding kinematic conditions for terrain movement.

4.1. Stabilization of the terrain
Sanation of existing or prevention of new landslides is done with the aim of reducing the forces that drive landslides, or with the aim of increasing the resistance forces of the soil or rock mass. Before drafting a sanation project, it is important to conduct thorough engineering-geological surveys of landslides and collect data on geometry, geological-geotechnical composition and physical-mechanical parameters of soil and hydrogeological data on groundwater level needed to determine measures to stabilize the terrain. These measures are divided into four basic groups: 1. modification of the slope geometry, 2. formation of supporting structures, 3. surface and depth drainage and 4. internal slope reinforcement. The best results in landslide sanation are achieved by a combination of different types of sanation measures, which together must ensure the maximum effect in terrain stabilization [15].

Modification of the slope geometry involves removing the soil from the top of the sliding body, thus reducing the forces that drive the movement and increasing the stability factor. Removed material can be replaced with another, lighter and more slip-resistant. The second principle of modification involves loading the foot by pouring material, which prevents the body of the landslide from moving on its base and provides stability as a counterweight in the form of barriers, berms or embankments. The third principle of modification implies the transfer of material from the top of the sliding body to the foot, and thus reducing the slope and increasing the stability [12].

Retaining structures (retaining and walls made of prefabricated elements, gabions and buttresses) are built to prevent erosion of the landslide foot due to erosion or for its load in cut or cut parts of the terrain and increase slip resistance [15]. Supporting structures also include piles that are driven into a fixed, solid surface: a) in shallow landslides, 1/2 the length of the piles deeper than the bottom of the sliding body and b) in deep landslides, 2 to 5 m deeper than the bottom of the sliding body. Piles are driven along the transverse profiles, perpendicular to the direction of sliding or in a chessboard layout, if a larger number of them are applied [12]. The materials for their manufacture can be wood, reinforced or prestressed concrete and steel.

Surface and deep drainage aims to drain surface and groundwater in a way to reduce hydrostatic pressure, hydrodynamic impact and thrust, which together reduce the weight of the material on the slope and increase slip resistance. For the reception and drainage of precipitation and surface water from the body of the landslide and its hinterland, open or closed drainage channels are used, placed in stable parts of the terrain and with slight longitudinal slopes. The greatest stability of the terrain is achieved by extending the channel down the slope, but thus drainage cannot cover a larger area, so the side branches are made on both sides of the main drainage channel. All collected water is drained to the nearest recipient (city network or watercourse) [12]. To reduce the amount of groundwater, small-diameter vertical wells are drilled or self-draining and large-diameter vertical wells with gravity drainage, as well as subhorizontal and subvertical wells, drainage tunnels, galleries and trenches. Drainage can also be done by vacuum, siphons and electroosmosis [15].
The internal strengthening of the slope is effectively achieved by landscaping the terrain. The plant cover protects the soil from weight loss, and also serves as a biological pump, because in the process of evapotranspiration it releases the soil from excess water. Thus, vegetation has a dual function: it dries out layers of terrain and strengthens the soil with a root system that acts as a reinforcing mesh. For stabilization of surface and shallow landslides, it is recommended to plant grass first, then hedges, and only then trees [12].

4.2. Staircase – an element of terrain stabilization and a generator of the public

The proposal for the transformation of existing or construction of new staircases is aimed at creating technical elements for stabilizing the terrain with surface and shallow landslides, which would simultaneously enable the formation of better settlement pedestrian communications and articulation of missing public areas. Their spatial composition and position within the settlement would depend on the geomorphological characteristics of individual localities, leaving the possibility of modification in relation to the positions of active landslides and in accordance with the capacities of the space in general.

Guided by the idea that urban (re)design makes it possible to achieve the most humane form of interaction between man and his living environment, we believe that the stairs should be designed to allow movement and people with disabilities. This is achieved by a combination of stairs and ramps, a slope of up to 6% [16], and in accordance with the required number of steps and ramp lengths, to ensure easier movement (Figure 5a).

Reinforced concrete structures of stairs and ramps should follow the slope and be positioned so as to avoid the boundaries of active landslide zones. On terrains with surface and shallow landslides, stairs and ramps should be considered as structures that will minimally load the bearing soil, provide unstable soils and prevent further slipping. This may include modifying the slope geometry by transferring the material from the top of the sliding body to the foot, thereby reducing the slope of the terrain and increasing stability.

In order for stairs and ramps to have a smaller share of their own weight in the total load of the structure and the base, concrete substructures would not be made along their entire length, but only on platforms, so pile foundations would be made only on platforms. The sizing of reinforced concrete piles is conditioned by geomechanical characteristics and is the subject of load-bearing capacity calculation, and the constructive logic is such that piles sporadically pierce the ground and strengthen stairs and ramps, which further secure the ground and prevent slipping (Figure 5b).

Acceptance and drainage of rainwater and surface water can be solved by placing drainage canals in the construction of stairs and ramps, in special troughs. To achieve the greatest stability of the terrain, on both sides of the main canal it is necessary to place a network of side branches, with slight longitudinal slopes and extended down the slope. The main drainage canals would be further connected to the city network (Figure 5c). This system can also be supported by adding drainage pumps at locations in settlements with a higher risk of flooding. The described soil drainage procedure is a common method in landslide stabilization and requires careful design and construction planning of details, and sizing based on calculations (Figure 5d).
Landscaping the terrain, along with the construction of stairs and ramps, would be an effective way to strengthen the slopes, i.e. additional drying of soil layers and soil consolidation. In our climate, planting plant cover of red and white clover (lat. *Trifolium pratense* and lat. *Trifolium repens*), alfalfa (lat. *Medicago sativa*) and bird's-foot trefoil (lat. *Lotus corniculatus*) and re-forestation with alder trees (lat. *Alnus*), willows (lat. *Salix*), poplars (lat. *Populus*), birches (lat. *Betula*), acacias (lat. *Robinia pseudoacacia*) and ash (lat. *Fraxinus excelsior*) proved to be the most suitable in stopping the sliding process. These plants reduce the humidity of the clay soil to a depth of 2.5 m, and the groundwater sucked by the roots of the trees moves to the canopy at a speed measured in m/h, after which it evaporates into the atmosphere. In addition, the root system strengthens the soil and acts as a reinforcing mesh, because it reaches deep into the ground, 6 to 12 m, and at a distance of 8 to 12 m from the tree [12].

And finally, the constructions of staircases and ramps provide the possibility of forming public spaces in settlements in the form of platform extensions, shaped as platforms and in positions that do not interfere with the intimacy of the inhabitants of the surrounding single-family houses. They would be positioned on (potentially) flat parts of the terrain and paved, and apart from planting vegetation and trees⁸, they would not have a constructive significance in stabilizing the terrain⁹. The platforms would form arranged „inner courtyards” – common public spaces of all residents of unregulated settlements that have the spatial capacity for their articulation. Other available spaces of each individual settlement could be turned into public park areas, whose vegetation would additionally provide unstable lands and prevent further slipping (Figure 6).

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⁸ Afforestation of the terrain with the mentioned botanical species implies precise planning of the afforestation location in relation to the drainage system and the construction of the staircase, due to the potential of endangering technical structures by the development of the root system.

⁹ Depending on the position on the ground, the platforms can be designed in combination with retaining walls, piles or embankments in the landslide foot and as elements of terrain stabilization.
5. Results and discussions

The analysis of the causes and genesis of unregulated residential settlements in Sarajevo showed that the root of their current numerous problems lies, paradoxically, in the city authorities' attempt to improve the quality of life of the inhabitants of the fast-growing city from the second half of the 20th century. The tracing of the path to a better future started with the development of long-term development plans by determining the spatial dispositions of primary urban functions, for the implementation of which the nationalization of land was carried out. This meant the confiscation of property from landowners – privately owned agricultural and forest land and its conversion into social ownership – construction land intended for industry. The industry further generated the need for labor and, related, the accelerated influx of rural population – a pressure that could not be compensated in time by building settlements with multi-residential buildings or symbolically planned areas for living in single-family houses. Thus, the under capacity of the housing stock, along with the disincentive policy of distribution of socially owned apartments, led to the usurpation of the nationalized land by the new population and the beginning of the trend of unregulated construction in Sarajevo. The question is how this is possible. The essence is in the fact that the land with limited right of use has increased in value due to nationalization, so the previous owners had a practical benefit from their sale. The sale was illegal and based on an informal agreement between the two parties, as only the right of use could be traded, which made the bulky city bureaucracy almost impossible. And that's where the circle closes. The nationalization of land became counterproductive – it was supposed to prevent the unplanned exploitation of urban spaces for the purpose of construction, but in reality it encouraged and finally confirmed it with subsequent legalizations of self-organized construction. That is, it has been shown that spatial planning plans and laws on the use of construction land determine the obligations of socio-political communities in the preparation of spatial planning documentation, thus contributing to the raising of urban and general spatial culture. However, issues of overall spatial issues require far greater social and organizational-administrative engagement, because plans and laws are only the initial impetus in a series of actions that must follow in order to achieve the desired goal.

In a short period of time, densely built unregulated residential settlements usurped the slopes in the contact zone around the lowland planned part of the city and became a limiting factor for economic development, increasing the shortcomings of Sarajevo's longitudinal development matrix. This referred primarily to the impossibility of further proper distribution of the functions of the centrality – social, economic and technical-infrastructural. These functions, generally defined by the quality, level, and gravitational circle of availability, centralize space, and where their impact is weak, an impact zone of another centre occurs. The essence of this planning principle is balanced controlled development (of the city) in order to make the accessibility of urban functions as efficient as possible. As the number of inhabitants grows over time, the capacities of the functions of the centrality become insufficient, because they progress much more slowly in time compared to housing. This can cause city centres, for a longer period of time, to remain within the same spatial units, which makes communication difficult. Then the city, through planning activities, seeks new positions of centres for the purpose of better urban
organization, and the quality, levels and gravitational zones of the functions of centrality. In the case of Sarajevo, unregulated residential settlements usurped nationalized land planned for further deployment of central functions, leading to a structural division of the city into housing, work, and recreation zones and difficult communication. This was in contradiction with the initial concept of development of centres in the direction of forming a multi-layered zoning – multifunctional urban units with the contents of housing, economy, sports and social infrastructure, and good traffic connections. Quite logically, the unregulated settlements themselves were thus deprived of basic central functions. In addition, the sudden increase in population could not be followed by adequate development of centres on the (geomorphologically conditioned) longitudinal direction, so the functions of higher-level centralities remained situated in the inner city, which resulted (and still is) in long daily migrations.

The appearance and spatial composition of single-family houses, mostly built according to standard projects, are a reflection of the socio-economic status of the then new inhabitants of Sarajevo. Of poorer means and with reminiscences of their native rural landscape, they preferred to build houses on separate plots and thus clearly mark „their own territory”, contrary to the laws of living in multi-residential buildings. Guided by feelings and circumstances, they formed densely packed physical structures of slope settlements that today have an identity visually and aesthetically close to the identity of mahalas from the Ottoman period of Sarajevo’s development. However, they have no points of contact with them. They developed their own urban context, spatial compositions defined by houses of equal design principles, neglecting the cultural aspect and traditional values of the urban ambience in which they fit. This new urban context contains elements or associations of the tradition of living in a rural landscape and, contrary to the principle of continuity in the experience of the city, they have created (and are creating) a new direction – elements of modern forms of vernacularity.

Analyzing further unregulated residential settlements, we realized that the result of all self-organized interventions in the area is the occurrence of landslides, an acute problem that directly or indirectly endangers the lives and property of residents. The usual technical measures, which are taken in order to stabilize the terrain and reach the level of equipment appropriate to the urban area, are certainly part of our proposal to mitigate the multiple negative consequences of soil erosion. However, the concept of improving the overall quality of life requires holistic ideas, thoughtful, planned, with clear goals, especially when it comes to the quality of individual and social life, social interactions and identification of man with the space he inhabits. Also, the incentives for this can be a reflection of the need for changes in the program of land use or the need for technological innovation in terms of modern urban-architectural interventions. Thus, this concept implies the application of a comprehensive urban transformation, observed from the aspect of socio-economic, socio-political, technical-technological, morphological-structural and functional spatial development. That is, it implies a complex treatment of all influential factors that lead to the transformation of space, as well as finding guidelines for their quality implementation, realization and final exploitation by users. Here it is important to notice and characterize the common denominators that read the context of the observed locality and the potentials of the (urban) environment. In that sense, the analysis showed that today’s concept of spatial organization of Sarajevo’s unregulated residential settlements is the result of spontaneous actions that went their own way, ignoring the valid urban-architectural doctrines. This resulted in a number of problems whose solution cannot be found in a comprehensive urban transformation, but only in partial spatial interventions, in transformation by method of sanation. We see it in the process of combining the technical aspect of landslide remediation with the articulation of the symbolism of living in public space, with the need to recognize the local framework of spatial expressiveness as a reference place that individuals and groups can experience and call their own. The basic assumption is that new materialized structures in these settlements – organized spatial forms of pedestrian communications in the form of stairs and ramps – can stimulate the emergence and development of a new public in its active and symbolic context. Their social role could be significant, as they open up the possibility of creating a new substance to experience the flow of an individual’s life within the local community. And the
improvement of the overall quality of life would thus be reflected in contrast to the current state in which, without formal public spaces, the lives of individuals and families flow in their separate micro-worlds. But, regardless of honourable intentions, the indivisibility of the spatial form of pedestrian communications is not a guarantee that an adequate social matrix will develop on such foundations, just as the prescription of social dimensions of the public does not have to guarantee the survival of a certain idea of articulating public space.

6. Conclusions
Starting with the thesis that construction is always deeply connected with society's understanding of the function of space and the place of man in it, the aim of this paper was to search for an answer to the question: Is it possible to solve problems accumulated by decades within Sarajevo's unregulated residential settlements through means of transformation by method of sanation? Or: Can partial spatial interventions improve the overall quality of individual and social life? To this end, we conducted an analysis of the causes of the formation and genesis of these settlements, as well as a number of problems produced by the accumulation of separate spatial interventions exempted from planning orientation. We concluded that the answer can be affirmative, but that it requires the formation of new views in the direction of perceiving spatial potentials, and not only the shortcomings of unregulated settlements. It is clear that the far-reaching consequences of non-compliance with relevant procedures in deciding on urban space, and in connection with the subsequent legalization of anti-contextual self-organized construction, today cannot be removed by strong, energetic moves of their complete transformation. This is possible only by establishing a critical attitude towards the potentials of specific localities of settlements, in terms of the degree of their functional use, correlation with utilities and user interaction with the environment, in order to combine the technical aspect of landslide sanation with public articulation on new pedestrian communications. It turned out that the logical method for achieving this goal is the transformation by method of sanation and that its application enables the typification of technical solutions, functions, content, activities, urban design, and even the public itself. This means that conclusions about the characteristics of individual Sarajevo settlements, endangered by landslides, can offer general guidelines for the development of design concepts of overall improvement, within them, the quality of individual and social life – the most humane form of human-space interaction through urban (re)design.

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