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Assessing the Quality of Open Spaces in Mass Housing Projects: The Case of Alexandria

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Rising population numbers across the globe are putting pressure on the housing supply, which is leading governments to resort to social housing. However, the governments of developing countries are more prone to address pressing shortages through standardized mass housing projects, which results in significant mismatches between the attributes of the housing and the needs of the residents. The evaluation of open spaces is a topical research approach, and open spaces are significantly responsible for the quality of mass housing projects. However, years after their construction, it may be seen how their selected urban form has led to very different living situations. A comparison of the quality of open spaces is made possible by identifying a typology for the urban form selected for each project. In this research, we will assess the quality of open spaces in mass housing projects based on the spatial configuration of the project on the urban scale. Identifying a typology of the urban form adopted by similar-scale mass housing projects will guide the evaluation of the open spaces in each project. The physical attributes of the open spaces are the focus of the assessment. The simultaneous analysis of all the physical attributes permits a final assessment of each mass housing project's open spaces quality.

Introduction

This paper targets urban quality and especially open spaces, which is a revisited focus of study emerging from the literature on the topic. Preceding researchers have considered urban issues in broad terms.[1] The most unresolved disputes in these studies to date are inaccessibility, single-functional use, and obscurity in urban density.

According to Perez, the open space layout substantially affects the urban quality of housing projects. Regardless of the vagueness of the term "quality",[2] Carmona identified certain features that improve open spaces, and the most relevant of these features are described as being diverse, engaging, social, balanced, and resilient.[3] These values are based on the concept that urban design has great responsibility in the promotion of more livable, secure and inclusive

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1. P. Hall, "Regeneration Policies for Peripheral Housing Estates: Inward- and Outward-looking Approaches," *Urban Studies* 34, no. 56 (1997): 873-890.

2. J. Perez-Igualada, "The Idea of superblock in Modernist Housing Estates of Valencia (1956-1971)," ZARCH 8 (2017): 132-143.

3. M. Carmona, "Principles for Public Space Design, Planning to Do Better," *Urban Design International* 24, no. 1 (2019): 47-59.

neighborhoods. The responsibility of urban design and its direct impact on the development of public spaces with quality is in line with the international urban agenda.[4] This research approach, debated by other researchers,[5] is a consequence of a methodology based on the prospective users of the open spaces. Between the various aspects that can cause discrepancies in the way each housing project develops, it is valuable to investigate the physical dimension of the urban quality of open spaces of housing projects.[6]

Existing urban analysis methods are only partially applicable when addressing the questions posed by open spaces in mass housing projects. Many of these methods concentrate on incomplete results,[7] and are not adjusted to the specific features of mass housing projects.[8]

To deal with this issue, this research will utilize hybrid methodology called UR-Hesp presented by Sergio García-Pérez.[9] This approach uses current methodologies yet adjusts them explicitly to mass housing projects.

Methodology

The research starts with the identification of a mass housing project classification method based on urban form taxonomy. By clarifying the categorization proposed by Berghauser,[10] which used a multivariable density calculation to identify different urban forms, the research analyses three representative case studies using the methodological approach presented by Sergio García-Pérez[11] to diagnose the quality of open spaces. Through the basic elements that define the open spaces, the proposed methodology works with nine 'physical' variables.

4. UN-Habitat, *Global Public Space Toolkit. From Global Principles to Local Policies and Practice* (UN-Habitat: Nairobi, 2015).

5. F. Wassenberg, *Large Housing Estates: Ideas, Rise, Fall and Recovery* (Amsterdam: IOS Press - Delft University Press, 2013).

6. C. Díez Medina, and J. Monclús, "Dealing with Mass Housing Estates Legacy: The Need of Specific Diagnoses from an Urban Design Perspective," in *Proceedings 24th ISUF 2017 - City and Territory in the Globalization Age*, 309-322 (Valencia: Universitat Politècnica València, 2017).

7. B. Hillier, *Space is the Machine: A Configurational Theory of Architecture* (London: Space Syntax, 2007).

8. M. Berghauser Pont, and P. Haupt, *Spacematrix: Space, Density and Urban Form* (Rotterdam: nai010 Publishers, 2010).

9. S. García-Pérez, V. Oliveira, J. Monclús, and C. Díez Medina, "UR-Hesp: A Methodological Approach for a Diagnosis on the Quality of Open Spaces in Mass Housing Estates," *Cities* 103 (2020): 102657.

10. Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form*, 2010.

11. Perez-Igualada, "The Idea of superblock in Modernist Housing Estates of Valencia (1956-1971)," 2017.

Urban Form Classification

Berghauser[12] presented a methodology using four variables to measure built density, the four variables are globally acknowledged in urban development practice: floor space index (FSI), illustrating the built environment intensity; ground space index (GSI), defining the compactness of an urban block or area based on the coverage of the area with buildings; building height (L), i.e., the average number of stories; and open space ratio (OSR), also referred to as spaciousness, a measure of the intensity of unbuilt spaces. Each spatial solution or urban form develops a distinctive pattern of the density variables and therefore has an exclusive position in the Spacemate diagram (Figure 1).

A Spacemate diagram is a graph that can show all four variables with FSI on the y-axis and GSI on the x-axis; OSR and L are slopes that spread out at the top of the diagram. By plotting a large number of observations (i.e. neighborhoods) on a Spacemate diagram, Berghauser (2019) credibly displayed that different urban forms cluster on the graph (Figure 1).[13]

Spacemate methodology revealed that the multivariable density concept composed of four density variables offers a method to define urban forms, which, separately, these variables are incapable of doing. The variables used are recognized indicators of density and their calculation method is explained here.[14]

1- $GSI_x = B_x/A_x$

where B = footprint (m^2), A = area of site (m^2), x = scale level

2- $FSI_x = F_x/A_x$

where F = gross floor area (m^2), A = area of site (m^2), x = scale level

A third variable can be developed using FSI and GSI: average building height (i.e., number of floors) (L), using the following equation: $L_x = FSI_x/GSI_x$

Another variable that can be derived from FSI and GSI is spaciousness (also called open space ratio, OSR), which provides an indication of the intensity of use of the unbuilt space, and it may be calculated using the following equation: $OSR_x = (1\text{-}GSI_x)/FSI_x$

12. Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form*, 2010

13. Berghauser Pont, J. Forssén, M. Haeger-Eugensson, and A. Gustafson, "Increasing Cities' Capacity to Manage Noise and Air Quality Using Urban Morphology," in *ISUF 2019 XXVI International Seminar on Urban Form: Cities as Assemblages.*

14. Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form*, 2010.

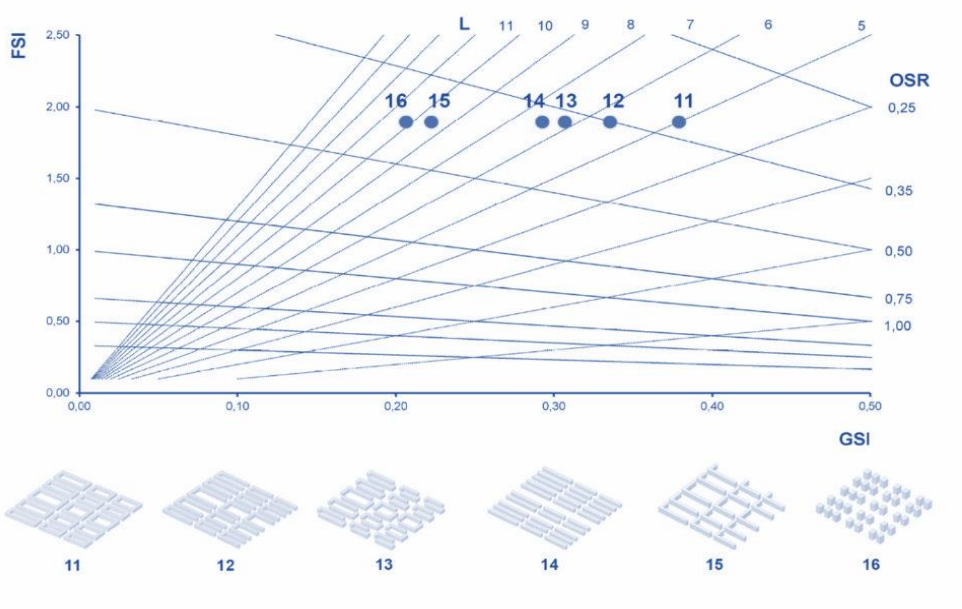


Figure 1. *Spacemate Diagram Showing Different Urban Forms*
Source: Berghauser 2019.

The theoretical cases selected for the study are the three archetypes: semi-closed perimeter building blocks (case 13), slab buildings (case 14), and point buildings (case 16). From earlier empirical studies[15] we know that these types are found in different positions in the Spacemate diagram, where the closed building block (case 11) has the highest GSI and the point building (case 16) has the lowest GSI (Figures 1 and 2).

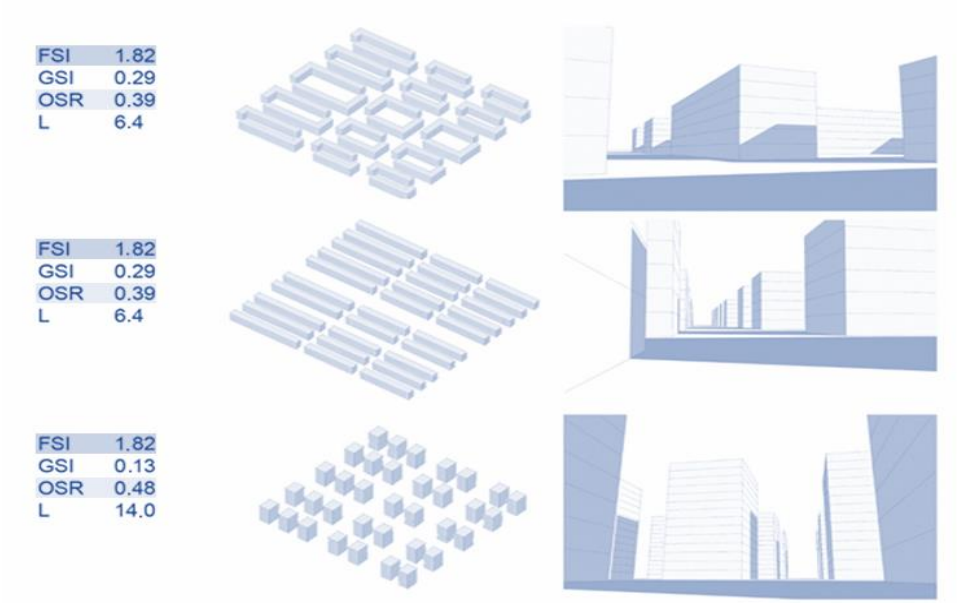


Figure 2. *Density Variable Calculations for the Three Archetypes*

15. Ibid.

Selection of Case Studies

The selection of the case studies was based on the following considerations:

1- Size factor: the three selected cases are developments including over one thousand residential units, which is typical of mass housing projects.[16]
2- Representativeness factor: as the reviewed literature shows how open spaces are categorized into three archetypes[17] the researcher selected the three case studies as representatives of each type.
3- Socioeconomic factor: all three cases are projects built on state-owned land and implemented by public-private partnerships for low-middle income Egyptian families.[18]

Case Study

In this paper, three mass housing projects were selected in the city of Alexandria in Egypt. These three projects are representative of the market-oriented approach, in which the state cooperated with private companies/banks to supply housing units for a targeted market segment.

1-Mostafa Kamel Complex (Housing for Military Officials)

Built-in the early eighties, the complex is a mass housing project basically built for middle-class military officials, but later remaining units were sold to the public. The project is suitably located in the central district, with clear views of the Mediterranean Sea for the first two rows of apartment towers (Figure 3). The project is composed of 97 towers, where all towers have 16 floors, and each floor is composed of 4 residential units, which totals more than 6,000 housing units on 58 feddans (approx. 244,500 m^2) of state-owned land.[19]

Figure 3. *Photos of the Mostafa Kamel Complex*

16. F. Urban, *Tower and Slab: Histories of Global Mass Housing* (Routledge, 2013).
17. Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form*, 2010
18. CAPMAS, *CAPMAS - Online Data Management System*. 2021; Y. Shawkat, *Egypt's Housing Crisis: The Shaping of Urban Space* (Cairo: AUC Press, 2020).
19. CAPMAS, *CAPMAS - Online Data Management System*, 2021.

2-Faisal City (Bank-Financed Housing)

The project was built in the early eighties after the establishment of the Faisal Islamic bank in Egypt (a Saudi-owned bank) in 1979. The project was built on 36 feddans (approx. 151,000 m^2) of state-owned land and unit ownership was financed through the bank for low to middle-income classes. The project is composed of 82 towers, where all towers have 11 floors, and each floor is composed of 6 residential units (Figure 4). The project includes more than 5,000 housing units.[20]

Figure 4. *Photos of Faisal City Project*

3-Borg Al-Arab - District 1 (Agricultural Engineers Housing)

Borg Al-Arab's mass housing project for industrial workers and agricultural engineers is one of the very few relatively successful housing projects built in the desert. The project was developed to encourage industrial workers and agricultural engineers to move closer to the state's wide agricultural desert reclamation project in Borg Al-Arab (Figure 5). The project is composed of 73 apartment buildings, where all buildings have 5 floors, and each floor has 4 residential units, which totals more than 1,400 housing units on 55 feddans (approx. 233,000 m^2) of state-owned land.[21]

Figure 5. *Photos of Borg El-Arab - District 1*

20. Ibid.
21. Ibid.

Adaptation of the UR-Hesp Methodological Approach

Unlike other social or public housing open spaces assessment methodologies, the UR-Hesp methodology aims to minimize the number of variables used to assess the physical features of open spaces within housing projects. Sergio García-Pérez[22] organized the nine selected variables around the fundamental urban fabric morphological components, which are roads, plots and buildings. These variables are combined based on international debate on the methods of assessment of open spaces. Quantitative approaches use the variables: integration, permeability, density and building diversity, while Qualitative approaches use local choice, functional mix, eye level design, plot structure, and type of open space.

Contrasting the original UR-Hesp methodology, which evaluates urban transformation by taking a chronological approach tackling the project from its initial design to its current status. In this paper the methodology takes an urban form taxonomy perspective to assess the quality of the open spaces of the mass housing project, as the three selected Alexandrian projects were not transformed from an urban morphological perspective.

Based on the UR-Hesp assessment technique, all nine physical qualities were evaluated for each of the case studies, employing field research and observation to gather data necessary for the evaluation of each physical quality.

As a conclusion to the methodology, the simultaneous analysis of all the variables permits a final assessment of each mass housing project's open spaces either as Obsolete, which represents inconsistency between supply and demand, or as Resilient, which is when the physical features are able to adapt to current and future demands.

Integration

Integration investigates the location of a mass housing project within the urban fabric on the city scale. It analyses the configuration of roads and streets and the urban accessibility level of the project. Space syntax theory and physical approach were adapted in the original UR-Hesp methodology, however, in this study we adapt Location-based dimensions, which assess the journey time and/or costs between locations of activity.[23] Based on Hillier[24] locations that tend to be considered as outlying in the city's central urban fabric cause connectivity problems, which entails that the less peripheral a housing project is, the more quality it offers.

Housing project integration scores are first calculated on the city scale, considering the average journey time from the project to the city center using different modes of transport according to five categories ranging from 'very short' to 'very long'. Afterwards, the quality of integration is categorized as 'good' (very

22. García-Pérez, Oliveira, Monclus, and Diez Medina, "UR-Hesp: A Methodological Approach for a Diagnosis on the Quality of Open Spaces in Mass Housing Estates," 2020.

23. Geurs, K. and Bert Wee, *Accessibility Evaluation of Land-Use and Transport Strategies: Review and Research Directions*. *Journal of Transport Geography* 12 (2004): 127-140.

24. Hillier, *Space is the Machine: A Configurational Theory of Architecture*, 2007.

short and short trips), 'standard' (average trips) or 'poor' (long and very long trips).

Average journey times for each location to the city center were estimated using Google Maps at different times of the day and then the average was obtained. The mean journey time in Alexandria is 25 minutes.[25] Accordingly, poor integration quality was achieved in Borg El-Arab with average travel times at 55 minutes (very long trips). While Faisal City residents had to travel around 30 minutes on average to reach the city center (average trips). And Mostafa Kamel residents could reach the city center in less than 10 minutes, which represents good integration quality.

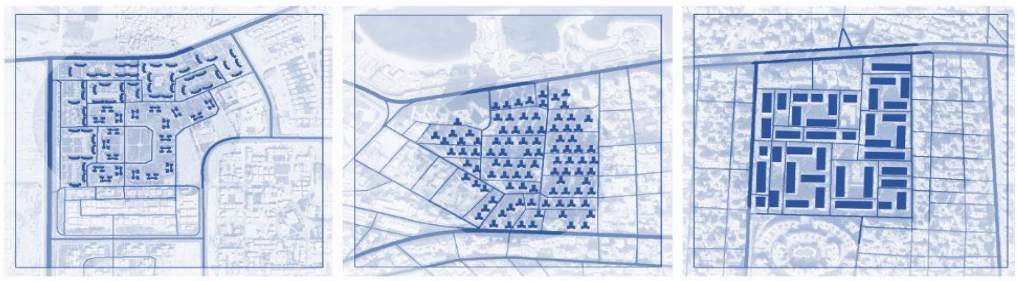
Permeability

Permeability evaluates the degree of a housing project's connectivity with the surrounding urban fabric. It studies the configuration of barriers, represented in natural or man-made peripheries, and entry points or axes that allow access to the housing project.

Permeable housing projects have fewer urban barriers and more opportunities for development around the project's peripheries, which facilitates the approach of resources, encouraging social inclusion.[26]

Permeability is the outcome of compounding a qualitative approach, which compares the result with its district scale average integration, and a quantitative approach, which acquires the number of connections between the housing project and the rest of the urban fabric on the perimeter.[27]

Similar to the categorization of integration above, the result is presented on a scale of five categories from 'very high' to 'very low' (Figure 6). The scale of cases discussed in this study range from those with a permeable connection every one hundred meters, classified as having a 'very high' permeability value, to those that have a 'very low' permeability value. In this way the quality is classified as 'good' (very high and high permeability), 'standard' (average permeability) or 'poor' (low and very low permeability).



Borg El-Arab: Poor permeability Mostafa Kamel: Standard permeability Faisal City: Good permeability

Figure 6. *Permeability Quality in the Three Selected Case Studies*

25. CAPMAS, *CAPMAS - Online Data Management System*, 2021.

26. G. Sun, C. Webster, and A. Chiaradia, "Ungating the City: A Permeability Perspective," *Urban Studies* 55, no. 12 (2018): 2586-2602.

27. García-Pérez, Oliveira, Monclus, and Diez Medina, "UR-Hesp: A Methodological Approach for a Diagnosis on the Quality of Open Spaces in Mass Housing Estates," 2020.

Local Choice

Local choice outlines the type of spatial structure consisting of the road and pedestrian network and its arrangement within the local network on the neighborhood scale.

The urban theories based on the separation of vehicular and pedestrian traffic have had a fundamental impact on urban complexity.[28] However, although in many mass housing projects there is a clear hierarchy in their vehicles road networks, their internal spatial structures are not so hierarchically planned, as they form spatial grids very close to the hierarchical logic of the traditional city. Consequently, the examination of the internal road and pedestrian network is based on current research projects that consider hierarchy not as a problem in itself, but how it corresponds to the final configuration. This arrangement can affect the co-presence of inhabitants in the open space and can encourage more social encounters between residents.[29]

The quality of the local road network can be assessed using the Space Syntax methodology, the study focuses on the ability of the network to generate local betweenness centrality, that is, the ability of the road network to be chosen as origin and destination points in local pedestrian movements. The result is presented on a time, context and dynamic scale. In the scale used in this research, local choice calculation delimits a radius of 800 m, which is the distance that a person can walk in 10 min (Figure 7). Again, five categories have been set up for each time and context situation, from 'very high' to 'very low', with the quality being classified as 'good' (very high and high), 'standard' (average) or 'poor' (low and very low) local choice.[30]

Borg El-Arab: Poor local choice | Mostafa Kamel: Standard local choice | Faisal City: Good local hoice

Figure 7. *Local Choice Quality in the Three Selected Case Studies*

28. C. Buchanan, *Traffic in Towns: A Study of the Long Term Problems of Traffic in Urban Areas* (Routledge, 2015).

29. L. Marcus, "Spatial Capital and how to Measure it: An Outline of an Analytical Theory of the Social Performativity of Urban Form," in *Sixth International Space Syntax Symposium*, 5-1. Istanbul Technical University, 2007.

30. García-Pérez, Oliveira, Monclus, and Diez Medina, "UR-Hesp: A Methodological Approach for a Diagnosis on the Quality of Open Spaces in Mass Housing Estates," 2020.

Functional Mix

Functional mix in the context of this research is a method to quantitatively and qualitatively demonstrate use patterns through the study of residential and non-residential plots. Higher functional diversity induces activities performed by inhabitants that help to create vitality in an open space.[31]

Assessment of functional mix in housing projects can be performed by applying the Simpson index to locations built for private (residential use) and public (non-residential uses) through the classification of mutually exclusive categories (Figure 8).[32]

The outcomes present the existing status of both the functional mix and of their type and locations (facilities and services inside or outside the housing project and non-residential activities in specific areas or ground floor commercial premises). The level of variation on the Simpson index ranges from 'very high' – less than 0.6 – to 'very low' – more than 0.9. Subsequently, quality of the functional mix is evaluated as 'good' (very high and high) 'standard' (average) and 'poor' (low and very low).[33]

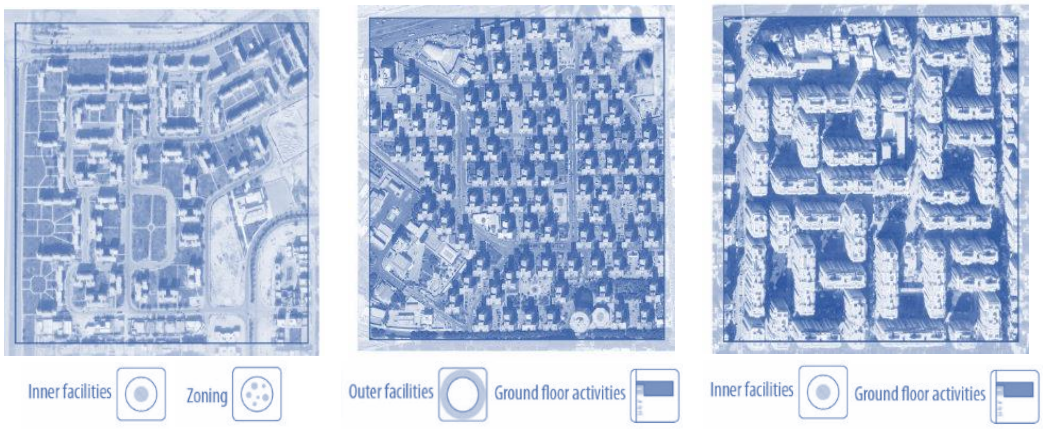


Figure 8. *Functional Mix Quality in the Three Selected Case Studies*

31. B. Mashhoodi, and M. Berghauser Pont, "Studying Land-Use Distribution and Mixed-Use Patterns in Relation to Density, Accessibility and Urban Form," in *ISUF 2011: 18th International Seminar on Urban Form: Urban Morphology and the Post-Carbon City* (Montreal, Canada, 26-29 August 2011).

32. K. Dovey, and E. Pafka, "What is Functional Mix? An Assemblage Approach," *Planning Theory & Practice* 18, no. 2 (2017): 249-267.

33. García-Pérez, Oliveira, Monclus, and Diez Medina, "UR-Hesp: A Methodological Approach for a Diagnosis on the Quality of Open Spaces in Mass Housing Estates," 2020.

Typology of In-Between Spaces

This physical attribute quantitatively analyses the area provided for in-between spaces and categorizes it through separate types. A balanced degree of open space is able to encourage social interactions, which is related not only to the extent of the space, but also to its alignment, more detected open space has more quality.[34]

The categorization of open spaces in this research is quantitatively performed with the 'spaciousness' variable (Open Space Ratio), which compares the open space area for public use to the floor area ratio.[35] This suggests a viewpoint of not only the extent of open space but also of its sufficiency with respect to the total built area. The empirical studies on urban fabric state that acceptable values of spaciousness fall between 0.06 and 0.3.[36] The results are classified in five levels that range from 'very high' (under 0.3) to 'very low' adequacy (over 0.9). Then, as Minoura[37] proves empirically, the enclosure of open spaces can affect their use, sense of ownership and management. To specify the degree of enclosure, the structure of open spaces is analyzed through the exclusive definition of three archetypes of residential open space ('closed or semi-closed', 'inter-block', and 'indeterminate' spaces, from the highest to the lowest level of enclosure). 'Good' quality is reached if both very high or high levels of spaciousness and enclosure happen concurrently (Figure 9). Housing projects reach 'standard' quality if at least their spaciousness and enclosure score average levels. All other possibilities achieve 'poor' quality values.[38]

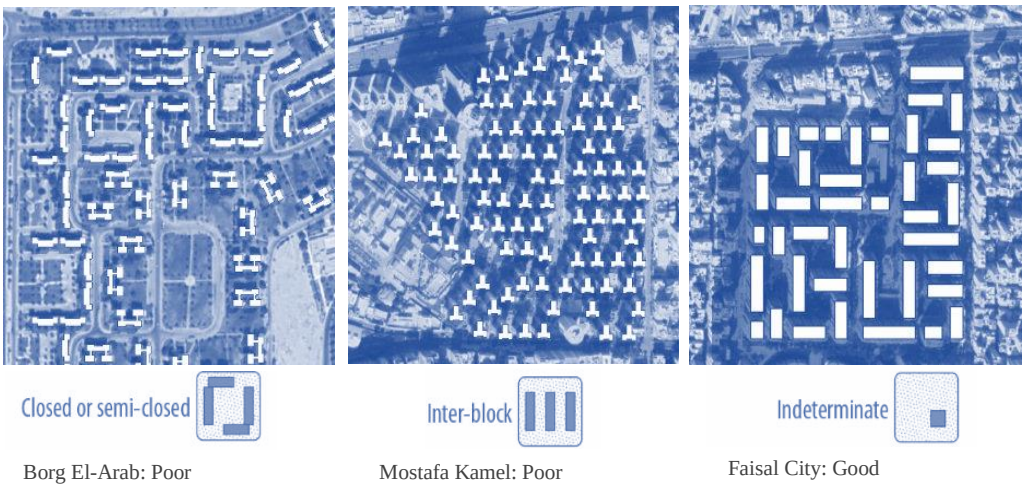


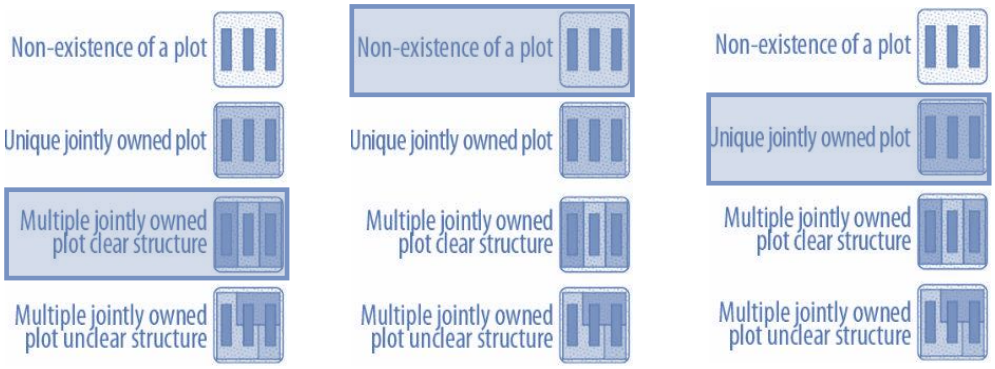
Figure 9. *Typology of In-Between Spaces in the Three Selected Case Studies*

34. Wassenberg, *Large Housing Estates: Ideas, Rise, Fall and Recovery*, 2013.
35. Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form*, 2010.
36. García-Pérez, Oliveira, Monclus, and Diez Medina, "UR-Hesp: A Methodological Approach for a Diagnosis on the Quality of Open Spaces in Mass Housing Estates," 2020.
37. E. Minoura, *Uncommon Ground. Urban Form and Social Territory* (Stockholm: KTH Royal Institute of Technology, 2016).
38. García-Pérez, Oliveira, Monclus, and Diez Medina, "UR-Hesp: A Methodological Approach for a Diagnosis on the Quality of Open Spaces in Mass Housing Estates," 2020.

Plot Structure

As a physical attribute plot structure refers to the plot division selected and to monitoring how its spatial outline impacts the use and management of the open space. Well-defined physical boundaries and manifest property facilitate in maintaining the open space, which affects the comfort level of potential users.[39] The plot structure of mass housing projects is typically intangible, which results in vast spatial uncertainty between use and ownership.[40] This is the reason why plot structure directly affects open space quality.

Plot structure studies are regulated in Egypt using land registry records kept in each district's registration division. This facilitates the categorization of both the numerous owners and the assorted current plot situations by using four separate definitions. The owner is categorized as public, private, or unknown in each land plot. The plot conditions are the common space as the absence of a plot, the common space as a single jointly owned plot, the common space as a multiple jointly owned plot with a clear structure, and the common space as a multiple jointly owned plot without a clear structure (Figure 10). If both well-defined spatial structure and well-defined ownership occur, 'good' quality is realized. The quality is 'standard' if only a well-defined structure occurs; all other possibilities are rated as 'poor' quality.[41]



Borg El-Arab: Good Plot Structure

Mostafa Kamel: Poor Plot Structure

Faisal City: Standard Plot Structure

Figure 10. *Plot Structure in the Three Selected Case Studies*

39. Ibid.

40. K. Kropf, "Plots, Property and Behavior," *Urban Morphology* 22, no. 1 (2018): 1-10.

41. García-Pérez, Oliveira, Monclus, and Diez Medina, "UR-Hesp: A Methodological Approach for a Diagnosis on the Quality of Open Spaces in Mass Housing Estates," 2020.

Density

Density in the context of this research quantitatively classifies the physical density of the urban form through the definitions presented by Berghauser of building intensity (FSI: Floor Space Index), compactness (GSI: Ground Space Index) and Spaciousness (OSR: Open Space Ratio). In general, More intense and higher physical densities bring richer social interactions and economic opportunities.[42]

The literature has revealed a debate between authors who consider mass housing projects to be mostly low-density developments compared to the organic urban fabric,[43] and others who stated that high densities of mass housing projects are what distinguish them.[44] Accordingly, it is imperative to improve the calculation of existent densities, with regards to the degree of diversity in the selected mass housing projects. Nonetheless, all authors agree that mass housing projects exemplify a more open and fragmented form compared to the organic urban fabric of the city, and this is exactly one of the main features that cause obsolescence.[45]

Calculations for the three selected projects are done using Berghauser's[46] methodology (Table 1). Next the results categorize housing projects by type of physical density depending on the relative position they occupy on the Spacemate graph. Housing projects with similar spatial characteristics are classified together based on: coverage (from 'very low', under 15%, to 'very high', over 50%); floor area ratio (from 'low', under 1, to 'high', over 2); and, lastly, average height (from 'low', under 3 floors, to 'extreme', over 7 floors) (Figure 11). Considering the quality assessment approach,[47] 'good' quality is achieved when physical density is intense (high FSI) and compact (high coverage) without reaching extreme values. 'Standard' scores are given if at least FSI or coverage are not rated with a low value. 'Poor' is given to all remaining cases.

Table 1. *Calculations for the Density Variables for the Three Selected Case Studies*

Density Indicator	Faisal City	Borg El-Arab District 1	Mostafa Kamel Complex
B: Footprint	56100	29400	57600
A: Area Of Site	151000	233600	244500
F: Gross Floor Area	618000	147000	921600
L: Average Height	11	5	16
GSI: Ground Space Index (Coverage)	0.372	0.126	0.236
FSI: Floor Space Index (Building Intensity)	4.093	0.629	3.769
OSR: Open Space Ratio (Spaciousness)	0.154	1.389	0.203

42. Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form*, 2010.

43. D. Sims, *Egypt's Desert Dreams: Development or Disaster?* (Cairo: The American University in Cairo Press, 2014).

44. Wassenberg, *Large Housing Estates: Ideas, Rise, Fall and Recovery*, 2013.

45. MIT, *The Density Atlas*, 2011.

46. Berghauser Pont, Forssén, Haeger-Eugensson, and Gustafson, "Increasing Cities," 2019.

47. García-Pérez, Oliveira, Monclus, and Diez Medina, "UR-Hesp: A Methodological Approach for a Diagnosis on the Quality of Open Spaces in Mass Housing Estates," 2020.

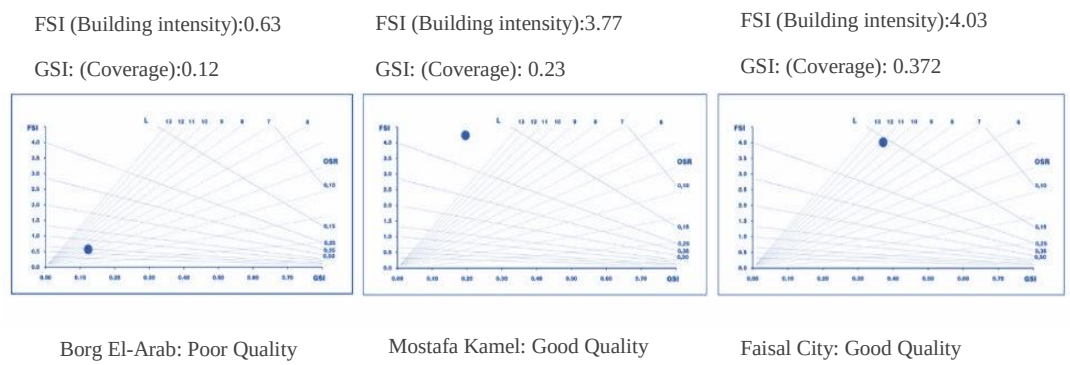


Figure 11. *Density Quality in the Three Selected Case Studies*

Building Diversity

Building diversity categorizes the similarity of the selected building types in each mass housing project and their replication. More diverse housing types are able to stimulate more social blending between inhabitants by evading standardized designs.[48]

Mass housing projects were commonly portrayed as a formal standardized physical arrangement with low diversity in terms of the building types offered and the executed urban solutions. This was a result of essentially economic circumstances and the relevance of specific ideological principles. These conditions usually produced projects that were labeled as monolithic.[49] However, diversity is presently received as a positive characteristic capable of creating more inclusive spaces by providing inhabitants the opportunity to choose that did not exist before.[50] While diversity can be apprehended from various aspects (social, economic, etc.), in this research we are only seeking the physical dimension.

Diversity is evaluated through the Simpson index using the same method of assessment as the functional mix.[51] This index can be summarized in just one variable: the abundance of building types. First, the index values are represented on a scale of five classes from 0 to 1, from the most 'diverse' (values between 0 and 0.2) to the most 'standardized' (values between 0.8 and 1). Then quality is evaluated as 'good' (very high and high) 'standard' (average) and 'poor' (low and very low) building diversity.[52]

48. Buchanan, *Traffic in Towns: A Study of the Long Term Problems of Traffic in Urban Areas* (Routledge, 2015).

49. L. Lees, "Commentary," *Environment and Planning* A, 42, no. 10 (2010): 2302-2308.

50. MIT, *The Density Atlas*, 2011.

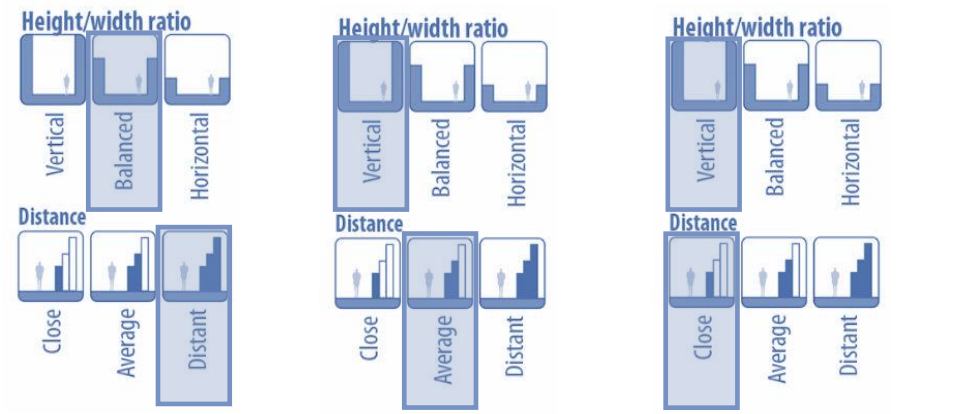
51. Dovey and Pafka, "What is Functional Mix? An Assemblage Approach," 2017.

52. García-Pérez, Oliveira, Monclus, and Diez Medina, "UR-Hesp: A Methodological Approach for a Diagnosis on the Quality of Open Spaces in Mass Housing Estates," 2020.

Eye Level Design

Eye level design investigates the physical features in the assemblage between a building and an open space. The suitability of this assemblage to the human scale, its dimension, and mobility improve the comfort of inhabitants and an appealing built environment facilitates the occurrence of social interaction.[53]

The classification of 'eye level' design is based on the detailed study of typical spaces inside housing projects. The study of eye level design is centered on the human dimension of each space between the housing blocks, regarding the height/width ratio ('horizontal' if they have a substantially wide proportion; 'balanced' based on a 1:1 ratio; and 'vertical' if they have a substantially narrow proportion).[54] Furthermore, it focuses on the porosity of the built edge on the ground or street level; the results are categorized based on the size of the edge per unit area and the edge's quality, from 'active' (over 15 doors every 100 meters) to 'inactive' (from 0 to 2 doors every 100 m). 'Good' quality of 'eye level' design is realized when a balanced height/width ratio, a close distance and >20% of active façades appear. 'Standard' quality is realized if at least one partial variable is 'good' (scale and distance or porosity of the built edge), whereas the other possibilities are rated as 'poor' quality (Figure 12).



Borg El-Arab: Good eye-level design

Mostafa Kamel: Standard eye-level

Faisal City: Poor eye-level design

Figure 12. *Eye-Level Design Quality in the Three Selected Case Studies*

53. Urban, *Tower and Slab: Histories of Global Mass Housing*, 2013.

54. V. Oliveira, *Urban Morphology. The Urban Book Series* (Cham: Springer International Publishing, 2016).

Table 2. *A Comparative Table Combining the Nine Physical Variables and the Quality Results*

Comparative Discussion

Summarized in Table 2, the following discussion provides the essence of the adopted methodology as a process of forming comparative views of multiple case studies and investigates the possibility of using the methodology for decision-making.

Regarding integration, Borg El-Arab illustrated the lowest integration as it was part of a much bigger unsuccessful development in the desert, while the other two projects were adequately integrated within Alexandria's urban fabric. Again, the lack of permeability in the case of Borg El-Arab lent the feeling of a ghost town to the streets and paths of the project, but the other two projects were tolerably permeable for the surrounding urban fabric, even though both of them were outlined from the north by a strong edge (The railway line in the case of Faisal, and the coastal highway in the case of Mostafa Kamel).

The local choice of roads in Faisal was the clearest and showed the highest connectivity with the surrounding urban fabric, while in the case of Mostafa Kamel the roads were arranged to have more internal connectivity and Borg El-Arab had an additional, separate arrangement of roads. Concerning 'plots', both Borg El-Arab and Mostafa Kamel exhibited a low level of functional mix as in both of these projects non-residential functions were mostly allocated separate zoning. However, in the Faisal project, non-residential functions were arranged proportionately in the site, beside the ground floor retail activities.

The plot structure of open spaces in all three case studies was a crucial aspect in the management and maintenance of the open spaces. Although Borg El-Arab is a low-income class project, and most of the units are rentals, the open spaces are well maintained due to the clear well-defined structure of the plots. To the contrary, the middle-income well-situated project of Mostafa Kamel showed no clear plot structure, which resulted in a no man's land feeling and that was reflected in the quality of the open spaces.

The three case studies were selected essentially as a representative of the three archetypes of in-between spaces: Semi-enclosed, Inter-block and Indeterminate. Hence, the open space ratio (OSR) of each project was calculated as an indicator of spaciousness of the open spaces. All three projects are considered spacious compared to the surrounding urban fabric, yet Borg El-Arab is spacious to the extent that it impaired the quality of the open space.

With regard to density, Mostafa Kamel and Faisal displayed similar values with good placement on the Spacemate density graph as their coverage (GSI) and building intensity (FSI) match reasonably with their spaciousness (OSR). Nevertheless, Borg El-Arab's density values were lacking because of the low building intensity and the too high spaciousness. It is imperative to consider this attribute as one of the significant points, as the value of density could have a crucial impact on decision-making based on objective data regarding possible intensification improvements. Borg El-Arab could benefit from such an intensification strategy keeping in mind the question of integration as a priority. Most state-led mass housing projects in Egypt lack building diversity, which was clearly illustrated in Mostafa Kamel with only one model being replicated 97 times to form the project.

Concerning the eye level design analysis, the research was concerned only with the human scale and the porosity of building boundaries at ground level. As both Mostafa Kamel and Faisal include towers of more than ten floors, in narrower streets the view to the sky is limited. Additionally, in Faisal ground floor activities are plenty, which causes unwanted social interaction in some areas due to the proximity between residential and non-residential activities.

Based on the extensive assessment of the nine physical attributes for the three selected case studies, it is clear from the comparative discussion how each attribute negatively affected each case. Following the adapted UR-Hesp methodology, a final evaluation for each representative case should be presented while highlighting which attribute influenced the project the most.

Even if all the nine physical attributes critically impact the quality of open space, some attributes had a strong negative impact on each case study. Borg El-

Arab was profoundly affected by the lack of integration and permeability due to the selection of the project location. The future intended plan was that surrounding developments would improve the quality, but due to the fragile success of the project, the acclaimed future never happened. Mostafa Kamel is a prototype of how current mass housing projects are being built in Egypt, the standardized apartment building that is repeated and indeterminately arranged in the site, which harms eye level design and building diversity directly. The lack of a clear plot structure decreases the sense of ownership for the residents, which directly affects the maintenance of the open space. The Faisal project has satisfactory open space quality even if the eye level design was affected by the height and proximity of the towers. For these reasons, the Borg El-Arab and Mostafa Kamel projects are both evaluated as obsolete because of their substandard quality of open spaces, while Faisal's project is finally appraised as resilient (Table 3).

Table 3. *Results Obtained by Applying the UR-Hesp Methodology on the Three Case Studies*

		Borg El-Arab		Mostafa Kamel		Faisal City	
		Partial result	Final result	Partial result	Final result	Partial result	Final result
Integration		Very low, Q1	P	High, Q4	G	Average, Q3	S
Permeability		Very low, Q1	P	Average, Q3	S	Average, Q3	S
Local choice		Low, Q2	P	Average, Q3	S	High, Q4	G
Functional mix		Very low	P	Low	P	High	G
Typology of in-between space	OSR* Archetype	Very low, 1.39 Semi-closed	P G	Very High, 0.20 Indeterminate	G P	Very High, 0.15 Inter-Block	G S
Plot structures		Clear physical structure but not clear property	S	Not clear physical structure	P	Clear physical structure	S
Density	FAR COV	Very low, 0.63 Very low, 12%	P	High, 3.77 Average, 23%	G	High, 4.09 Average, 37%	G
Building diversity		Average, 0.50	S	Very low, 0.99	P	Average, 0.50	S
'Eye-level' design	Scale and distances Boundaries	Balanced / Distant 11% active	G	Vertical / Average 2% Inactive	P	Vertical / Close 65% active	P

P: Poor quality, S: Standard quality and G: Good quality.

Conclusion

This research presents a methodological adaptation of the UR-Hesp methodology, where the focus of assessment was to compare mass housing projects based on the urban form implemented, aiming only at the physical attributes defining open spaces within mass housing projects. The methodology merges qualitative and quantitative approaches on diverse scales. Verification of the methodology was performed through three Egyptian case studies. The representativeness characteristics of the case studies are adequately balanced to allow for future replications of the methodology.

Likewise, this research is not lacking limitations. The application of this methodology shrinks the complexity of reality to a simplified analytical model dealing only with physical attributes. This approach based on quality assessment

of various urban forms could help decision makers to build better future physical environments. However, physical improvements are not an assurance of success, but changes in other dimensions can be generated by these improvements.

The results of this research should be revisited after future studies have been performed that tackle social vulnerability, socio-economic indicators analysis and environmental concerns. Since there are many features that can affect the quality of mass housing projects, open space quality should not be the only factor when analyzing urban quality, but it is an important element that can act as a trigger of improvement for urban regeneration projects or future urban developments.

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