

UNIVERSITY OF PÉCS  
FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY  
BREUER MARCEL DOCTORAL SCHOOL OF ARCHITECTURE

# PHD THESIS

to obtain the title of

**Doctor of Architectural Engineering**

Defended by

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## **Parametric Built-Environment Design for Post-Disaster Settlements:**

Parametric-Based Design Framework to Design Refugee  
Camp Built Environment, Utilising Hierarchical Order of  
Spatial Structure within Refugee Camps

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## THESIS I: STANDARDS REVIEW

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*While the standards have improved tremendously in the past 40 years and included various themes and indicators, the numerical measures could be more specific and specific, making design goals unobtainable and hard to achieve.*

*Numerical standards could be more coherent and realistic in the case of minimum space for a person. Moreover, it cannot be implemented, and lacking numerical design parameters is not supported by illustrative guidelines, making the standards ambiguous and unattainable in refugee camps design and planning practice.*

### SUB THESES: Existing standard

- The research scans five global built environments design standards, handbooks and design guidelines and trace their chronological development. The scanned standards and guidelines focus on various themes supporting refugees' safety, quality of life, and needs.
- It categorises refugee camps' built environment standards and investigated numerical standards, existing numerical standards, and their limitation.
- And investigates design guidelines limitations, planning conflicts, and discrepancies in refugee camps' design guidelines.

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### SUB THESES: Existing design methods

- This section analyses design methods and approaches
- Examine master plan approach, grid, and cluster layout, both their design elements and design,
- And analyse the structural hierarchy of the built environment and the modular arrangement of the refugee camp structure.

## **THESIS II: CASE STUDY**

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*While many refugee camps are assessed and analysed, the existing analysis focuses on qualitative methods. The lack of quantitative methods can be easily spotted in literature and the documentation of humanitarian organisations that are the leading party in most refugee camp reports. That can be linked to the absence of a comprehensive numerical database. A numerical database created to measure the qualities of the built environment can provide statistical proof of the characteristic fitness of refugee camps. At the same time, quantitative analysis can show an unprecedented correlation between design elements which can be used to develop new tools for refugee camp design which are more efficient and systematic.*

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SUB THESES: Establishing a numerical database of preceding cases of refugee camps

- A numerical database of 37 refugee camp cases established worldwide in various periods.
- Categorized refugee camps built-environment characteristics.

SUB THESES: Refugee camp built-environment characteristics

- The following section identify planned camps' general and population characteristics (urban density, population size, household size).
- In addition, it categorises built environment characteristics based on the design parameters and indicators.

SUB THESES: Urban structural hierarchy and refugee camp hierarchical structure characteristics

- The research studied the existing cases and compared their built environment characteristics with planning standards.

## **THESIS III: NUMERICAL CORRELATION**

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*While there is a significant number of new design standards and guidelines related to refugee camp designs and planning, the design constraints and built environment desired characteristics are in many standards ambiguous and cause high risk on design outcomes, this problem can be seen in many practices in refugee camp cases especially camps in the Middle East. Quantified built-environment characteristics can help establish new numerical guidelines and indicators that could support new design tools and methods, such as establishing a numerical guideline for plot and block area, form, and ratio.*

SUB THESES: Refugee camps design parameters

- This section continues to analyse different global design standards and guidelines, extract numerical measures, and compared them.
- In addition, it generates comprehensive numerical standards that include all numerical measures in various guidelines and assure their coherence.

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SUB THESES: Refugee camps design parameters, correlations, and constraints

- The created database is analysed to defined new parameters and examined 198 significant numerical unprejudicial correlations between established parameters. For example, the research found a strong negative correlation between urban density (Ud) and urban plot length (PL), which can be expressed mathematically.
- With the use of existing numerical standards and urban design theories, the correlation analysis establishes mathematical ranges for design element and correlations by defining design constraints.

## THESIS IV: FRAMEWORK DESIGN

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*Design approaches and tools applied to refugee camp designs and planning are traditional. Although there are many design standards, the start and end of the design process are structured in the standards and design guidelines. As a result, the design process can easily vary, causing significant shifts in the practice. A parametric framework focused on the structural hierarchy of refugee camp layout can offer a new design approach that helps establish a systematic method and tools for refugee camp design, allowing the design to be flexible and adaptable to different design stages and goals; the framework applies design standards, improves the design process, eliminates design errors, and improves the quality of living conditions for users.*

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SUB THESESES: Identity refugee camps built environment as a system

- The established numerical relations between built environment elements, enabling the researcher to model refugee camps as a system.

SUB THESESES: Top-down design framework

- The following section proposed a design framework that focuses on receiving the design of a refugee camp as a system from a top-down design approach—focusing on the layering of different systems to achieve the final camp layout.

## **10 DISCUSSION AND CONCLUSION**

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## **10.1 REFUGEE CAMP REVISED**

This research explores refugee camp design and suggests new tools and guidelines to make the best design decisions in a given situation. First, the research examines the development of refugee camps' design standards and planning guidelines and tracks their chronological development to understand the roots of standards and guidelines. Later it investigated different sets of standards developed by diverse humanitarian organisations to understand the inherited problems within the standards.

Second, the research analyses existing camps from different geographical locations established at different periods to understand current practices and assess the quality of cases; the research results indicate an inadequate implementation of design standards that can be found in generally 40% of refugee camp cases. Third, the research tested built environment parameters correlation and identified 198 correlations that are significant to the system modelling process. The correlation analysis shows that the urban block is one of the most significant design elements in the refugee camp design outcome since it is correlated with 17 design parameters.

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## **10.2 CODING FOR REFUGEE CAMPS**

The research suggests generating designs for routes, urban patterns, and layouts using modular design and a spatial hierarchy of refugee camps. Furthermore, the research proposes an approach to combine numerical case study analysis in addition to numerical refugee camp design standards to identify design parameters and draft parameters' potential relationships and constraints, which enable the use of parametric tools and parametric design methods to help solve the inherited design problems of refugee camps.

As expressed in this research, the focus was mainly on the physical elements of the refugee camps and quantifying the elements in a way to achieve computational relationships and focus on the existing standards but do not suggest developing new urban patterns or regulations. Nevertheless, this

system can be further extended to its fullest potential based on the following premises:

- Rather than using only physical elements to base the design on, additional parameters regarding social and economic, in addition to cost and sustainability, can be further studied and added to the design system.
- Opening the potential for using different urban patterns that can be created in a program or a code base still does not jeopardise the design's time, cost and quality since they are pre-settings of the system.
- The design framework creates a future for coding and programming new tools specific to refugee camps based on the elements and constraints of its design process and standards. It can be a newly established design tool tailored for camp designers and planners in the future.

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The resulting design framework consists of grid network formation, allowable block dimensions and optimising street network. While the aforementioned is a conceivable system of general design principles and methodologies, it has not been feasible for this research to suggest specific alterations to particular design codes or to prescribe answers to specific design problems. The system would need to be developed entirely with a particular rule set, adapted to each specific context of geography or professional specialisation before it could be used in future applications. This eventually suggests diversity and divergence of potential ways, just as the most fundamental ideas, like shelter units, have been used (similarly, yet the designer can enter and escape the design process at any stage of the design

The research can be helpful for designers and planners that want to use traditional design methods and elements but incorporate new optimisation and analysis tools since the research focused on modifying inherited design



concepts of defining refugee camps as a system composed of related components rather than a set of selfstanding elements.

### **10.3 GUIDELINES CAN BE EASILY IMPLEMENTED AND MODIFIED AT ANY STAGE OF THE DESIGN**

Generating numerical design guidelines is efficient and can significantly impact the design result. The numerical guidelines of refugee camps can be adapted for different organisations and locations. Moreover, the numerical standards can be developed in the future based on new design demands, paradigms, tools, policies and regulations required to design camps.

### **10.4 ANALYSIS IS FLEXIBLE**

Because there is always a chance to add more analysis to and enhance the design based on the limitation of the design cases, analysis can be adapted based on the different design briefs and requirements, and in the future, give the possibility to adjust additional tools.

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### **10.5 THE GOAL OF SYSTEM MODELLING IS TO OPTIMISE DESIGN RESULTS, NOT TO RECREATE THE SYSTEM**

The refugee camp system modelling framework aims to create a simple model for assessment, and the design aims to create the best design regardless of the method used in the given design limitations. Therefore, subsystems and layers of the system can be studied in simplified and separate environments and later combined and optimised to achieve the best results. Moreover, it is always important to keep in mind that the model of the system, regardless of its accuracy, is still not absolute and must not be dealt with as a final result but rather as a design recommendation of the system itself.