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SPACE SYNTAX ANALYSIS OF ADAPTIVE REUSE IN ANATOLIAN MADRASAHS

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SPACE SYNTAX ANALYSIS OF ADAPTIVE REUSE IN ANALOTIAN MADRASAHS

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M.Sc. THESIS EXAMINATION RESULT FORM

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SPACE SYNTAX ANALYSIS OF ADAPTIVE REUSE IN ANATOLIAN MADRASAHS

ABSTRACT

This study quantitatively analyzes the impact of the adaptive reuse processes of historic madrasah structures in Anatolia on their spatial configuration by employing the space syntax method. This research emerges from the need to measure the change in the syntactic identity of these structures, in contrast to traditional approaches that primarily focus on the physical preservation of historic structures. For this purpose, fundamental space syntax parameters such as integration, connectivity, and depth were comparatively examined using data obtained from analyses conducted on the original and refunctioned plans of the madrasahs. The analyses were carried out through visibility graph analysis (VGA) and convex space mapping methods.

The findings of the analyses indicate that, despite maintaining its centrality, the courtyard has transformed from a social focus to a controlled transition node. Another important result is the reversal of the public-private hierarchy. It was determined that the radial circulation system has transformed into a linear system in some structures as a result of the interventions.

In conclusion, this research contributes to the literature by presenting a numerical and objective evaluation model that goes beyond physical preservation, emphasizing the spatial logic of heritage structures within the broader context of sustainability.

Keywords: Architectural conservation, Anatolian madrasahs, adaptive reuse, space syntax analysis.

ANADOLU MEDRESELERİNDE UYARLANABİLİR YENİDEN KULLANIMIN MEKAN DİZİMİ ANALİZİ

ÖZ

Bu çalışma, Anadolu'daki tarihi medrese yapılarının yeniden işlevlendirilmesi süreçlerinin mekansal kurgu üzerindeki etkilerini mekan dizim metoduyla nicel olarak analiz etmektedir. Araştırma, tarihi yapıların adaptasyon sürecinde çoğunlukla fiziksel korumaya odaklanan geleneksel yaklaşımlara karşın, yapının sentaktik kimliğindeki değişimi ölçme ihtiyacından doğmuştur. Bu amaçla bütünleşme, bağlantısallık ve derinlik gibi temel space syntax parametreleri, medreselerin orijinal ve yeni işlevlerine ait olan planlar üzerinde gerçekleştirilen analizler sonucunda elde edilen veriler sayesinde karşılaştırmalı olarak incelenmiştir.

Analizler, görünürlük grafiği (VGA) ve dışbükey mekan haritası yöntemleriyle gerçekleştirilmiştir. Elde edilen bulgular, avlunun merkeziliğini korumasına rağmen sosyal bir odaktan kontrollü bir geçiş düğümüne dönüştüğünü göstermektedir. Diğer önemli bir sonuç ise kamusal-özel alan hiyerarşisini tersine çevrilmiş olmasıdır. Radyal sirkülasyon sisteminin, gerçekleştirilen müdahaleler sonucunda bazı yapılarda lineer bir sisteme dönüştüğü tespit edilmiştir.

Sonuç olarak bu araştırma, tarihi yapıların sürdürülebilirliği bağlamında fiziksel korumanın ötesine geçen, miras yapılarının mekansal mantığını gözeten sayısal ve nesnel bir değerlendirme modelini literatüre sunmaktadır.

Anahtar Kelimeler: Mimari koruma, Anadolu medreseleri, yeniden işlevlendirme, mekan dizimi analizi.

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NOMENCLATURE

Acronyms

ANP	Analytical Network Processing
FDM	Fuzzy Delphi Method
ICCROM	International Centre for the Study of the Preservation and the Restoration of Cultural Property
ICOMOS	International Council on Monuments and Sites
MCMD	Multi Criteria Decision Making
VGA	Visibility Graph Analysis

Symbols

Avg	Arithmetic Mean (Average)
D_k	D-value (Normalization constant for integration calculation)
H_1	First Hypothesis
k	Total Number of Spaces in the System
MD	Mean Depth
n	Sample Size (Number of analyzed buildings)
Q_1	Lower Quartile (First Quartile)
Q_3	Upper Quartile (Third Quartile)
R^2	Intelligibility (Coefficient of Determination)
RA	Relative Asymmetry
RRA	Real Relative Asymmetry
TD	Total Depth

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CHAPTER 1

INTRODUCTION

With its layered and rich history, Anatolia embodies the cultural, social, and architectural heritage of various civilizations. This unique geography, situated between East and West, has continuously fostered interaction and transformation across the centuries. Thus, the architectural heritage of Anatolia bears not only the material traces of past societies but also their intellectual and scientific perspectives. Among the crucial elements of this heritage are higher education buildings, which reflect the scientific and educational perspectives of the societies that built them. Higher education buildings are not only physical spaces where educational activities take place; they are also architectural works that bear the traces of the social, cultural, and technological developments of their era. They encapsulate how knowledge was transmitted and spatialized, reflecting the relationship between education and society. As architectural artifacts, madrasah structures provide insight into the ways spatial design responds to collective needs, hierarchies within a given cultural context. Thus, these structures hold a special place in architectural history and spatial organization studies because they reflect the spatial understanding, usage habits, and social needs of the periods in which they were built.

Madrasahs, where both scientific and religious education were conducted, hold a special significance as the earliest centers of higher education, first within the Islamic World beyond Anatolia and later within Anatolia itself. These structures' architectural typologies, typically organized around a courtyard, iwans, and student cells, evolved in response to functional, climatic, and cultural factors. However, as a result of the Law on the Unification of Education (Tevhid-i Tedrisat) enacted in 1924 to establish a unified national education system, madrasahs were closed. This led to the abandonment of these buildings, which consequently lost their educational function. In the following decades, in order to preserve these historic structures, extend their physical lifespan, and ensure their transmission to future generations as part of cultural sustainability, madrasahs were refunctioned through adaptive reuse. This conservation

approach aims to strike a balance between preserving cultural and architectural authenticity and meeting contemporary needs. In doing so, historic buildings are reintegrated into modern life.

However, assigning new functions to historic buildings may lead to spatial transformations. Therefore, examining how adaptive reuse interventions reshape the original spatial configuration of historical structures is crucial for understanding the impact of such transformations. In this context, the space syntax method provides a powerful analytical framework for objectively evaluating spatial organization.

This study focuses on the spatial transformation of historic madrasahs in Anatolia that have been adaptively reused for new purposes and employs the space syntax method, which was developed by Hillier and Hanson in the 1980s, as the analytical tool. Through comparative syntactic evaluation, the study aims to uncover how the introduction of new functions affects spatial configuration by revealing the changes, similarities, and differences between the old and new functions of these structures.

1.1 Problem Statement

Anatolian madrasahs, characterized by a spatial hierarchy shaped around courtyard and cells, often require spatial modifications when they are assigned new functions through adaptive reuse approach. However, existing assessment methods in the literature largely rely on subjective qualitative evaluations or physical conservation criteria. Quantitative frameworks are therefore necessary to objectively assess how functional transformations alter the spatial logic of heritage structures.

The core issue addressed in this study is the uncertainty regarding the extent to which new functions introduced through adaptive reuse modify or preserve the original spatial hierarchy, accessibility, and privacy of historical madrasah structures. Without a mathematical and objective analysis of these spatial transformations, debates on the suitability of new functions remain theoretical. The lack of a quantitative analysis based on numerical data hinders the development of evidence-based guidelines for future adaptive reuse projects, and this poses the risk of leading to interventions that

unwittingly destroy the spatial identity of the structure, even if they attempt to preserve its physical life.

1.2 Purpose of The Study

Addressing the gap in quantitative assessment identified through a literature review, this research aims to objectively analyze and quantify the spatial changes resulting from adaptive reuse interventions in Anatolian madrasahs constructed in different periods. The study seeks to reveal the transformation of the genotype, that is, the spatial logic, of these heritage structures.

The study specifically aims to:

- Quantify Spatial Change: By employing the space syntax method and analyses conducted with the depthmapX software, the study measures the transformation between the historical madrasah structure's original educational function and its current function through parameters such as integration, connectivity, and depth.

- Identify Functional Impacts: To determine the impact of different new functions, such as museum, commercial, and social uses, on the spatial systems of historical buildings.

- Evaluate Syntactic Compatibility: To assess whether the new function assigned to the structure aligns with or alters the original spatial hierarchy of the structure.

In this context, the following hypothesis, which constitutes the main argument of the thesis, is formulated:

H_1 : Adaptive reuse interventions lead to a reduction in the spatial qualities of the courtyard in historic madrasah structures.

1.3 Outline of The Study

This study consists of six main chapters in total. Analyzing the spatial transformation of refunctioned Anatolian madrasahs using the space syntax method, the research begins with an introduction chapter, where the study's purpose, method, and scope are

explained in detail. The second chapter provides the methodological and theoretical foundation of the study. In this chapter, the concept of adaptive reuse is discussed. Under this heading, the definition and rationale of adaptive reuse are explained. Furthermore, the factors influencing the selection of new functions in the adaptive reuse of historic buildings are examined, and finally, the advantages and disadvantages of adaptive reuse are evaluated, followed by an explanation of space syntax theory. Literature survey of the previous studies on the subject are also included in this chapter. The third chapter examines the historical development and unique spatial configurations of Anatolian madrasahs in detail. This chapter discusses the emergence, historical transformation, and development of madrasas, along with the architectural characteristics of those built during the Principalities, Seljuk, and Ottoman periods within Türkiye. The fourth chapter is the method and materials section. First, the basic concepts of space syntax, which form the basis of the study, are explained, followed by a detailed explanation of the software and methods used to conduct the VGA and Convex Map analyses. The materials section provides information about the selected historic madrasah structures. In the fifth chapter, selected madrasa buildings from different historical periods are analyzed in terms of their original functions and new functions assigned through adaptive reuse, using the space syntax method and depthmapX software. The results obtained from visual graph analysis (VGA) and convex map analysis are presented through quantitative data and graphical representations. The discussion section compares and interprets the differences between the original and new plans using the integration, connectivity, and depth parameters, as well as the maps. The conclusion chapter summarizes the findings, answers the research questions, and presents the study's contributions to the literature.

1.4 Method of The Study

The research consists of two stages, namely the data collection stage, which includes the literature review, where the selected field and sources related to the subject are examined, and the analysis stage, before the conclusion section, where the data is discussed. The analysis stage, which was carried out after the information collection stage, was carried out mathematically with the space syntax method using the depthmapX software. The data and graphics obtained with the space syntax method

were interpreted, and the similarities and differences between the structures were visualized. Thus, the changes that madrasa structures have undergone in the historical process were evaluated and tried to be revealed.

The research process was systematized into two main stages as the data collection stage and the analytical stage. In the first data collection stage, a detailed literature review was conducted. This phase involved examining sources related to the concepts of adaptive reuse and the space syntax methodology. In addition, historical and architectural documentation of the selected madrasahs was gathered through archival research and academic publications. The purpose of this stage was to define the fundamental parameters to be analyzed and to identify the knowledge gap that this study aims to address.

The second stage of the research constituted the analytical phase, in which the selected historic buildings were examined using the space syntax method, a quantitative spatial analysis approach developed to investigate how spatial configurations influence social interaction and accessibility. Space syntax was chosen as the primary analytical tool because it allows for the objective measurement and comparison of spatial relationships. The analyses were carried out using depthmapX software. In this process, two main types of analysis were employed as Visibility Graph Analysis (VGA) and Convex Map Analysis. For each selected madrasah, two sets of analyses were performed, one based on the plan representing its original education function and the other on the plan reflecting its new function. The data and graphics obtained with the space syntax method were interpreted, and the similarities and differences between the structures were visualized. Thus, the changes that madrasah structures have undergone in the historical process were evaluated and tried to be revealed with the selected method of the study (Figure 1.1).

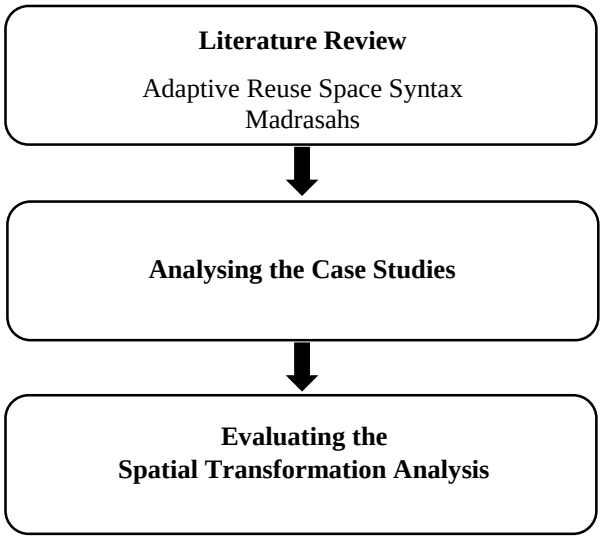


Figure 1.1 Workflow of the study

1.5 Limitations of the Study

This study is limited to madrasahs, which represent the earliest forms of higher education buildings constructed within the geographical boundaries of Anatolia. Despite their architectural or historical significance, madrasahs built outside Anatolia are excluded from the scope of this study. Furthermore, other institutions of higher education established during the Ottoman period, such as the Darülfünun and the Mühendishane-i Bahri-i Hümayun, are not included in this study. By defining these boundaries, the research aims to provide a focused analytical framework for the spatial transformations undergone by Anatolian madrasahs through adaptive reuse.

CHAPTER 2

LITERATURE SURVEY

2.1 Adaptive Reuse in Historic Buildings

2.1.1 The Concept of Adaptive Reuse

Architectural heritage, a part of cultural heritage, refers to structures and groups of structures that have survived to the present day and, through their inherent values, shape the identity of a society. Architectural heritage, which serves as a historical document, forms the collective memory of societies and plays a significant role in ensuring cultural continuity. The concept of conservation encompasses all efforts undertaken to preserve the unique qualities of architectural heritage and pass it on to future generations. Feilden defined conservation as "the process of preserving the tangible and intangible values of historical structures and transmitting them to future generations" [1]. In Türkiye, the Law on the Protection of Cultural and Natural Assets (2863) defines it as "the preservation, maintenance, repair, restoration, and functional change operations in immovable cultural and natural assets" [2]. The aim of conservation actions, which are recommended in the Burra Charter to be carried out according to the principle of minimum intervention as possible and to be reversible [3], is not only to protect historical structures that serve as a connecting bridge between the past and the present; but also to ensure historical continuity and maintain cultural identity by transferring the values of the structures to future generations. This is stated in Article 3 of the Venice Charter, which was published in 1964 and has a great importance in the conservation of historical structures, expressing the purpose of conservation as “to protect monuments as works of art and as historical documents” [4].

One of the intervention methods that can be preferred for the conservation of a historic building is adaptive reuse, as stated in the ICOMOS Turkey Architectural Heritage Conservation Declaration [5]. Adaptive reuse refers to the process of revitalizing a structure that has lost its original function, due to changing societal needs, as well as

economic or historical factors, but is still considered worthy of preservation. Through detailed research and analysis, such a building is assigned a new function and reintroduced into contemporary use. Bullen and Love stated that the process of selecting the new function to be given is a complex one involving location, heritage, architectural assets and market trends [6]. This conservation approach allows a historic building to survive even when its former function has become obsolete; thus, the structure is protected from decay and demolition, ensuring the continuation of its physical lifespan. Burden stated the following about adaptive reuse:

> The physical lifespan of buildings lasts much longer than their functions, and compared to their functions, the structure undergoes spontaneous change over a much longer period of time. Function becomes obsolete over time, both technologically and socially and culturally. Refunctioning buildings that have not yet reached their material lifespan, but have become substandard due to functional obsolescence, and if left unupdated, are abandoned and facing ruin, is called adaptive reuse [7].

In adaptive reuse, ensuring the comfort conditions required by the new users is just as important as preserving the historic structure itself. Spatial features that fail to meet the needs of the users will negatively impact the active use of the building. Consequently, if the structure cannot be refunctioned for active use, difficulties may arise in the public's acceptance of the new function, which in turn threatens the continuity and sustainable use of the building. Ultimately, the concept of adaptive reuse is about transforming a historic structure into a more effective and functional use. Therefore, the new function should be carefully selected, taking into consideration the existing spatial characteristics and the comfort requirements of future users, and potential needs that may emerge over time, while simultaneously preserving the authenticity and original values of the historic building. Shen and Langston emphasized that giving new life to heritage buildings not only provides benefits to communities but also contributes to the preservation of national heritage [8].

2.1.2. Reasons for Adaptive Reuse of Historic Buildings

Historic structures can lose their original functions over time as a result of evolving and changing societal needs. It is essential to ensure that these structures, bearing the

qualities of historical documents and embodying the economic, cultural, and social characteristics of the period in which they were built, as well as the construction materials and technologies of their time, are adaptively reused so that they do not reach the end of their physical lifespan, thereby enabling the transmission of their values to future generations. This not only preserves the historical structure but also contributes to intergenerational cultural continuity. In doing so, the historical, cultural and architectural values of the building are preserved, and it becomes suitable for its new function with the repairs and additions to be made [9]. The reasons for refunctioning historical structures will be discussed under three main headings based on the literature review: social causes, economic causes, and environmental causes.

2.1.2.1 Social Causes

Sociocultural changes occur in the structure of societies as they develop and change over time, resulting in shifts in lifestyles and cultural patterns that are also reflected in the spaces and structures produced and used by people [10]. Cheshire expressed this situation as "The transformational effect of consumption habits in social life can also lead to differentiation in space usage patterns and the functions of spaces." [11]. In response to emerging needs, new buildings may be constructed to accommodate new functions; however, it is also possible to reintegrate historical buildings that have lost their original functions by assigning them new uses and bringing them back into active utilization. Thus, the reuse of a historically and socially significant structure not only ensures the physical sustainability of the structure but also contributes to the sustainability of the tangible and intangible cultural heritage carried by the historical structure.

> We live in an era where conditions, values, and many other things are rapidly changing, and where social structure is shifting toward new forms and arrangements. Functions may change over time, but structures remain. This circumstance necessitates that both old and newly constructed buildings be opened to use in the future, this time from a different perspective [12].

2.1.2.2 Economic Causes

Another reason for the refunctioning of structures is economic causes. Demolishing a historical structure built in the past and constructing a new one in its place results in significantly more cost and energy consumption compared to refunctioning the existing one [13]. Moreover, it also negatively impacts the use of the world's limited natural resources. Conejos, Langston, and Smith stated that adaptive reuse strategies help promote the development of a sustainable built environment [14]. Therefore, refunctioning a historical structure also contributes economically to society. Another economic benefit derived from preserving and refunctioning a historical structure, rather than destroying its value through demolition, relates to tourism. Due to the values they embody, historic structures often become focal points of attraction for visitors. As a result, they play an important role in promoting tourism and generating economic gains for the local community. Thus, by ensuring the preservation and continued vitality of cultural assets, it contributes positively to tourism [15].

2.1.2.3 Environmental Causes

Environmental causes are one of the reasons for refunctioning historic structures. Monuments and historical buildings are inherently integrated with the environment in which they are built, and therefore, any change in the environment impacts these structures. The changes in the natural or artificial environmental conditions surrounding buildings over time can lead to changes in how these historical buildings are used and their relationship with their surroundings. As a result, the historic structures may lose their original functions or experience a weakening of the strong relationship they once had with their surroundings. While the values embodied in a historic building that has lost its original function can be preserved and perpetuated through adaptive reuse, the emerging need of its contemporary context must also be met to ensure the building’s sustainability [13]. For these reasons, the new function assigned to a historic building must be compatible with the current needs of its environment, and it must be acknowledged that the new function has the power to transform not only the building but also its surroundings. Reusing existing building stock contributes to environmental sustainability by conserving resources and reducing energy consumption [16].

2.1.3 Factors Influencing the Selection of a New Function Suitable for Historic Buildings

The Washington Charter stated that the new function to be given must be compatible with the character of the historic city or urban area [17]. The fact that revitalizing a historical structure that has lost its original function through the assignment of a new use will influence both the future of the structure and its surrounding environment must be taken into consideration. Therefore, the intervention methods to be determined during the adaptive reuse process of refunctioning a historical structure that has already acquired a place in the collective memory of the citizens should be carried out in a detailed and sensitive manner. As a result of the literature review, it has been observed that the factors influencing the selection of a new function compatible with a historic structure have been defined differently by various reserarchers. For example, Aytekin classified the factors affecting the selection of a new function as technical requirements, requirements related to use and circulation, environmental requirements, and spatial requirements [16]. According to Ygleasias, these factors are social needs, the region in which the building is located, its functional organization, volumetric and spatial characteristics, and its technical and architectural values [18]. Altınaoluk, on the other hand, classified them as the spatial formation of the building, the volumetric dimensions, the functional relationship organization, and the location of the building [12].

2.1.3.1 The Original Function and Spatial Configuration of the Building

During the adaptive reuse process of historic buildings that have lost their original function, one of the key factors in determining their new function is the original function of the historic structure and the spatial configuration shaped by this function. The relationship between the building's original function and its spatial configuration, along with the opportunities it provides and the restrictions it causes, forms the basis for decisions regarding the new function. According to Altınoluk, prior to determining a new function, the spatial configuration, volumetric dimensions, functional relationship schemes, and locational context of the historic building to be adaptively reused must be throughly examined [12]. The spatial and volumetric characteristics of the historic building to be preserved, such as the hierarchy of spaces, circulation areas,

and the visual connections between spaces should be carefully analyzed. At the end of this process, to preserve the authenticity of the building, new functions that require minimal intervention should be prioritized. Kaşlı stated on this issue, "In buildings that require preservation, the new function should be similar to the original one in order not to disrupt the authentic functional schemes of the spaces." [19]. This constitutes a significant step in achieving maximum benefit in the process, ensuring the sustainability of the new function without damaging the building's characteristics.

2.1.3.2 The Building's Location and Environmental Factors

The environment in which a historic building is built is another factor influencing the selection of a new function. In the adaptive reuse process, the building should not be considered solely from a spatial perspective [20]; rather, the new function should also be determined to ensure its harmony with both the natural and built environment. For instance, factors such as the climate, ecological characteristics, topography, and the relationship established with the natural surroundings plan an important role in the adaptive reuse of a heritage structure. Factors related to the built environment may include the functions of surrounding structures, the locations religious and education facilities [21], and access routes leading to the site. Another important consideration is that the environment cannot be considered independently of human presence. Within the social context, individuals with disabilities must not be overlooked; indeed, in absence of accesible circulation and road designs that ensure their inclusion in a historic building, its qualified and equitable use can not truly be asserted [13]. In this regard, each potential user of the building should be taken into account, and adaptive reuse interventions applied to the historic building should be determined to benefit all users inclusively.

2.1.3.3 Historical Factors

Historic buildings, which contribute to cultural continuity through their preservation and transmission to future generations, embody the social, economic, cultural, and aesthetic values of the period in which they were constructed. Therefore, the spatial understanding, ornamentation and details, construction techniques, and architectural style of a historical structure, which convey not only its architectural character but also

information about its historical identity, must be approached with great care during the adaptive reuse process. In this context, during interventions to refunction a building, attention should be paid to maintaining a balance between its monumental value and contemporary requirements, ensuring that the use value does not overshadow the historic value [20].

Moreover, the transformations that a building has undergone throughout its history are also important factors to consider when determining its new function. Additions and alterations made during different periods provide a multilayered identity to the historical building's physical life. Therefore, when assigning a new function to a historical building, its historical identity should be considered.

2.1.3.4 Societal Needs

Societal needs are one of the most decisive factors in determining the new function to be assigned to a historic building. Historic buildings that have lost their original function must be reconfigured in accordance with the economic and social requirements of the period and the prevailing contexual conditions [22]. In adaptive reuse, the objective is not merely to preserve the structure, but to ensure that it continues to serve as a living entity actively used by the members of contemporary society. Therefore, the community in which the historic building was built must be analyzed. Demographic structure, culture, and the social and economic conditions of a community define its needs. These needs are subject to change over time due to the changing and evolving nature of society. The needs of the local community shoould be identified, and the building should continue its existence by accommodating the function that reponds to those needs [13]. The new function assigned to the historic building must be capable of addressing these contemporary needs sp that the structure can continue its physical existence as an integral part of the community embraced by individuals of different age groups, genders, income levels, and lifestyles.

2.1.3.5 Legal Restrictions and Determinants

In the process of refunctioning the historical structure to be protected through adaptive reuse, examining the law and the historical process of the laws is also important in

terms of the city-space relationship [20]. Legal restrictions and determinants play not only a restrictive but also a guiding role in the process of refunctioning historic structures that have lost their original function. The registration status and conservation grade of a historic structure directly influence the nature and extent of interventions that can be applied. Since the limits of intervention to be made on the historical structure during the re-functioning process are determined in accordance with legal and architectural criteria, the limits for which functions the structure can be transformed also become clear [21]. The Venice Charter and the Burra Charter are important international regulations on the protection of historic buildings, and these regulations emphasize the reversibility of interventions to be implemented on historic structures. In Türkiye, the Law on the Conservation of Cultural and Natural Assets (Law No. 2863), enacted in 1983, constitutes the principal legislative framework for heritage conservation. Another important aspect to be considered under this heading is that, since the refunctioned structure is located within a protected site or conservation area, not only the historic structure but also the environmental interventions to be applied must be carried out in accordance with the legislation.

2.1.4 Advantages and Disadvantages of Adaptive Reuse in Historic Buildings

As a conservation approach that ensures the preservation and transmission of cultural heritage to future generations while simultaneously meeting contemporary needs, adaptive reuse has both advantages and disadvantages. This section discusses the impacts of adaptive reuse on historic structures.

The continued use of historic buildings through adaptive reuse contributes to the transmission of knowledge about past to future generations, thus preserving cultural memory. Through the conservation approach of adaptive reuse, advantages serving sustainability are generated while simultaneously preserving tangible and intangible heritage values and revitalizing urban spaces. Reusing the world's existing building stock, with its ever-decreasing limited resources, offers a more economical and sustainable alternative to new construction, as it enables the preservation of structures by adapting them to meet current comfort and functional requirements. Mohamed and Ark highlited that the adaptive reuse of existing structures effectively mitigates both the waste output from building demolition and the embodied carbon associated with

the energy consumption of new construction [23]. This creates a sustainable approach in terms of resources, energy, labor, and materials, resulting in environmental and economic efficiency. Another economic advantage is that refunctioned buildings, actively used by their users, have the ability to increase the economic activity in their area. Increased tourist activity in the area can contribute to the urban economy. Furthermore, by rescuing historical buildings from demolition and abandonment and then reintegrating them into the daily life of the community, adaptive reuse strengthens the community's sense of belonging and urban memory. These results can be cited as examples of the advantages of refunctioning.

However, interventions to be undertaken for the new function of a historic building must be decided and implemented with great precision. The original details and structural system of the historic building must not be damaged. If this process is not managed carefully, irreversible losses may occur in the building’s authentic features and identity. While adaptive reuse can provide economic benefits, it can also have negative consequences. Interventions motivated primarily by economic interests rather than cultural values should be avoided. In conclusion, it must be emphasized that the adaptive reuse process of historic buildings should be undertaken through careful planning and a strong conservation awareness, with all potential advantages and disadvantages thoroughly analyzed to ensure both the preservation and the sustainable use of cultural heritage.

In conclusion, adaptive reuse is not merely a technical intervention for the physical preservation of historical structures; it is a comprehensive and sensitive process that redefines the relationship between space and function to ensure sustainability. As discussed in this chapter, assigning a new function can prolong the lifespan of a structure while simultaneously leading to physical and functional changes that alter the original spatial configuration. Therefore, determining the extent to which these interventions preserve or disrupt the building's original spatial character requires objective assessment. To quantitavely measure these spatial transformations and reveal the syntactic logic behind the architectural changes, an analytical framework is essential. In this context, the following section introduces the Space Syntax theory.

2.2 Space Syntax Theory

Space syntax, a spatial analysis method developed by Bill Hillier and Julienne Hanson in the 1980s at University College London, encompasses the theories and techniques used to analyze the spatial functioning of structures and cities at different scales. This method aims to uncover how social structures influence the formation of space in a mathematical manner and to reveal how people perceive and utilize space. The theoretical foundations of this method were introduced in the book “The Social Logic of Space” [24], published in 1984. According to Hillier, while the most significant aspect of spatial organization is its ability to reflect cultural differences, the most critical indicator of perceiving cultural differences lies in spatial arrangements [24].

According to the theory of the mentioned method, social structure and space are in a bidirectional interaction. Atak describes this relationship in her study titled “Mekansal Dizim ve Görünür Alan Bağlamında Geleneksel Kayseri Evleri (Traditional Kayseri Houses in the Context of Space Syntax and Visibility Analysis)”, stating, "Space is expressed as a product influenced by society and social structure, while also being a factor that influences society and social structure [25]. Çil stated that analyzing the structure of a building using the space syntax method provides information about the social life style that creates the space [26].

Today, space syntax is utilized across a wide range of disciplines, including architecture, urban design, planning, transportation, interior design, archaeology, urban and human geography, anthropology, landscape architecture, and informatics [27]. Examples of its applications include:

- Analyzing the spatial organization of buildings and cities
- Examining spatial arrangements that emerge due to cultural differences and lifestyles among societies using the space syntax method [28]
- Optimizing urban transportation networks and understanding how people navigate within them
- Analyzing the impact of spatial configurations on crime rates
- Understanding visitor movement patterns in exhibition spaces such as museums and improving their experiences

- Investigating pedestrian movement to identify wayfinding, the perceptibility of spaces, and accessibility to shared spaces [25].

The space syntax method uses various tools and concepts for conducting analyses. Examples of these tools include transition graphs, convex maps, axial maps, and isovist maps. Peponis and Wineman also highlight that space syntax is a collection of techniques represented through graphs and emphasize that in the graphs drawn to understand spatial connections, the indicated axes, line lengths, and directions hold no significance [29].

Justified plan graphs, which are used to transform the relationships between physical spaces into a mathematical model, consist of nodes representing different spaces within a structure and lines representing transitions between these spaces. This approach enables an abstraction of the spatial configuration to be achieved.

2.3 Literature on Adaptive Reuse and Space Syntax

The literature review conducted for this study covers three principal research domains as the historical and architectural evolution of madrasahs, the adaptive reuse of historic buildings, and the space syntax method. Within this framework, the review focuses on the historical emergence of madrasahs, their typological changes over time, and their architectural characteristics in Anatolia. Furthermore, resources on adaptive reuse were examined to understand the reasons, principles, and effects of assigning new functions to historic buildings. The final topic covered is space syntax, including theoretical studies, methodological discussions, and applied studies, to form the analytical basis for the spatial assessment conducted in this study. By integrating these three topics, the literature review (Table 2.1) aims to establish a comprehensive framework for this study.

In Demiralp’s doctoral dissertation titled "Early Ottoman Madrasas (1300-1500)", the aim is to identify the differences between the architectural features of pre-Ottoman Anatolian madrasas and Ottoman madrasas, providing a comparative evaluation of these two periods. The emergence of madrasas, their transformation over time, and examples built in different regions are also examined. Detailed information is provided

on the madrasa structures included in the study and catalog, followed by a comparative evaluation under various thematic headings. However, the study focuses on the architectural and ornamental features of the structures. No analysis related to adaptive reuse or space syntax was conducted [30].

In Anameriç and Rukancı's study, "Education in Madrasas and Universities Between the 11th and 16th Centuries" it is stated that the divergence in the level of scientific advancement between the Eastern and Western worlds parallels the historical development of madrasas and universities. In this context, the study aims to reveal the interactions between these two distinct educational traditions by examining their similarities under the headings: The Emergence of Madrasas and Universities, Education and Instruction in Madrasas and Universities, and Interaction Between Madrasas and Universities. The study demonstrates that madrasah and university institutions shared key characteristics between the 11th and 16th centuries, such as a hierarchical staff structure and free education. However, the study does not address their architecture in detail. The research conducted does not provide a detailed analysis of the architecture of either institution [31].

In Malhis' 2015 study titled "Narratives in Mamluk Architecture: Spatial and Perceptual Analyses of The Madrassas and Their Mausoleums", space syntax is used to analyze the data of 14 Mamluk examples (1260–1517A.D.). Axial integration analysis, global integration, and izovist analyses of the madrassas are conducted. However, the buildings that were the subject of the study were not constructed in Anatolia. Additionally, the space syntax analyses conducted in this study were conducted solely on the original plans of the Mamluk madrasah structures. Issues related to re-functioning fall outside the scope of the study [32].

Çiğdem's master's thesis titled "An Analysis of Courtyard Typologies in Classical Ottoman Architecture" examines the use of courtyards in Classical Ottoman architecture, focusing on courtyard structures in mosques, caravanserais, and madrasas. Within this scope, the courtyards of Haseki Sultan Madrasa, Rüstem Paşa Madrasa, Süleymaniye Sani Madrasa, Süleymaniye Rabi Madrasa, Semiz Ali Paşa Madrasa, Cafer Ağa Madrasa, Selimiye Darülkurrası, and Gazanfer Ağa Madrasa are analyzed in detail along with their plans. Within the scope of the study, Haseki Sultan

Madrasah, Rüstem Paşa Madrasah, Süleymaniye Sani and Rabi Madrasahs, Semiz Ali Paşa Madrasah, Cafer Ağa Madrasah, Selimiye Darülkurra, and Gazanfer Ağa Madrasah are among the works examined. The locations and current functions of these historic structures were reviewed through their plans, sections, and these buildings' courtyards were analyzed. However, space syntax methodology was not employed during the analysis process [33].

In Soheili and Arefiyan's 2016 research titled "Analysis of Socio-Human Relations in the School Mosque Spaces in Qajar Majesty, Qazvin", space syntax methods are used to investigate the Sadr Madrasah and Salahiye Madrasah in Iran. Within the scope of the study, the spatial arrangements of the buildings and the social interactions within them were detailed. Connectivity, integration, depth, control, and choice analyses were performed. No analysis related to Anatolian historic madrasahs' adaptive reuse or space syntax was conducted [34].

The aim of Mısırlısoy & Günçe's 2016 study is to develop a holistic model for refunctioning heritage buildings that have lost their original function over time. Various adaptive reuse examples were examined based on the "factors influencing appropriate function decisions in the repurposing of heritage buildings," identified after a literature review and content analysis to propose a model. On-site observations and interviews were conducted with decision-makers for the selected projects. The model, developed based on the data obtained, not only facilitates the development of repurposing strategies, but also contributes to identifying problems in the decision-making process and assessing the suitability of existing uses for repurposed buildings [35].

In Malhis' 2017 study titled "The Spatial Logic of Mamluk Madrassas: Readings in the Geometric and Genotypical Compositions", the spatial development of Mamluks' madrassas throughout the Bahri and Burji periods (1260–1517 A.D.) were investigated. The paper engaged two sequential methods of analysis crossed by historical and contextual debates: formal-geometric on the one hand and morphological-syntactic related to space-syntax theory on the other. Within the scope of the study, integration ande depth analyses were performed. However, the buildings that were the subject of the study were not constructed in Anatolia. As in Malhis's

other study, the space syntax analyses conducted to examine the spatial logic of Mamluk madrasas were conducted solely on the original plans of the Mamluk madrasas. Issues related to reuse fall outside the scope of the study [36].

In Tunçok Sarıberbeoğlu's study titled “Syntactic Analysis of Spatial Behavior in Educational Buildings”, two educational buildings with different design schemes were analyzed using the space syntax method, focusing on the relationship between children and space. Within the scope of the study, isovist, visibility graohy integration, ans connectivity analyses were performed. Although the space syntax analyses do not address higher education structures either historic or contemporary, the chapter “The Physical Development and Design Criteria of Educational Buildings in Türkiye” examines the evolution up to the present day, including descriptions of higher education buildings from the respective periods [37].

In Öztürk's 2018 research titled “An Examination of Spatial Change Using the Space Syntax Method: The Case of Yıldız Technical University's Davutpaşa Campus” analyses of the aforementioned higher education facility were conducted. However, the axial and visual graph space syntax analyses were conducted on Yıldız Technical University Davutpaşa Campus, one of the contemporary higher education facilities of Türkiye. Within the scope of the study, axial integration, axial connectivity, intelligibility, and visual integration analyses were performed. Additionally, the buildings on the Davutpaşa Campus that were the subject of the study were constructed after the year 2000. Analyses conducted at the campus scale rather than the building scale did not examine the madrasahs, which are historical higher education buildings [38].

In C.-S. Chen et al.’s 2018 study titled “Evaluating the Adaptive Reuse of Historic Buildings Through Multicriteria Decision-making”, analyses were conducted on the Sun Yat-Sen Museum to optimize the evaluation process for the reuse of historical structures. The process was evaluated using integrated multi-criteria decision-making (MCDM). Following a literature review and case study analysis, evaluation criteria were developed using the fuzzy Delphi method (FDM). Analytical Network Processing (ANP) was then used to prioritize various alternatives for the reuse of the

Sun Yat-Sen Museum. Sensitivity analysis was then conducted to assess how the reuse alternatives would be affected under different scenarios [39].

Çınar Karakaya's master's thesis, titled “The Development of Accessibility in Hospital Buildings from a Chronological Perspective and an Examination of Two Examples Using the Space Syntax Method” focuses on the darüşşifas considered as higher education structures in the medical field of their time. The study provides information on the Divriği Darüşşifa from the Seljuk period and the Edirne Darüşşifa from the Ottoman period. However, space syntax analyses were conducted only on the Medipol Mega Hospitals Complex-General Hospital Building and Memorial Bahçelievler Hospital. Within the scope of the study, visual integration, visual connectivity, and visual step depth analyses were performed. Although information is provided on the Divriği Darüşşifa and Edirne Darüşşifa, analyses were not conducted on these heritage structures [40].

In the research article by Bayraktar and Eroğlu 2019 titled "From Madrasas to New Generation Educational Structures", the ideas underlying the architectural formation of madrasas are evaluated, focusing on approaches that can guide the design of new-generation educational spaces. Information is provided on education and madrasas within Islamic civilization. The architectural features of madrasas that may serve as a reference for contemporary educational structures are analyzed under various headings, including monumental portals, courtyards, and other key elements. The study indicates that the architectural spatial logic underlying historic madrasah structures, when adopted to new education instutions, has the potential to contribute to contemporary learning spaces. No analysis related to space syntax was conducted [41].

In Kazaz's 2020 study titled "Evaluations on Ispir Kadıoğlu Madrasa and Its Location in the Context of Ottoman Madrasas" the Ispir Kadıoğlu Madrasa, an architectural structure from the Ottoman period, is examined within the framework of Ottoman madrasa typologies, with an emphasis on identifying its characteristics. To achieve this, the study first explores the functional units, architectural features, and periodical variations of madrasas, beginning with those constructed in Anatolia prior to the Ottoman era. No analysis related to adaptive reuse or space syntax was conducted [42].

In the research of Semerci and Özkafa titled “Analysis of Space and Facade Quality in Anatolian Seljuk Madrasahs: The Example of Konya Madrasahs”, an attempt was made to determine the originality and contributions to the city of Karatay Madrasah, Ince Minareli Madrasah and Sırçalı Madrasahs built in Konya during the Anatolian Seljuk Period. After focusing on the formation of madrasah architecture, the historical change and development of madrasah architecture, the architectural features of Anatolian Seljuk madrasahs were also emphasized. In the study, visuals documentation and architectural drawings of the selected madrasahs were used to analyze the selected madrasahs’ interior and exterior. The research identified the alterations that had occurred in these heritage buildings. A scoring system was developed based on established exterior and interior criteria, groupings were made according to specific score ranges, and the degree to which the structures preserved their authenticity was determined. However, the space syntax method was not employed to analyze the spatial changes in the structures [43].

Elsorady’s 2020 research, “Adaptive Reuse Decision Making of a Heritage Building Antoniadis Palace, Egypt“, aims to identify the reasons for criticism regarding the building's authenticity and integrity. Interviews were conducted with primary and secondary stakeholders and local communities to obtain diverse perspectives on the process. Furthermore, Egyptian legislation and regulations were examined. To better understand successful adaptive reuse practices, a comparative analysis was conducted with the Hasan Pasha Inn in Diyarbakır and the historic buildings in Limassol, Cyprus [44].

The focus of Has’ 2022 research titled “Determining Density in the Historical Region with Space Syntax Analysis, Erzurum City Center Example” is to determine the change of the route of the historical places in Erzurum City Center by comparing the present and past accessibility and integration depending on the expansion of the city. The area where the study was conducted includes Yakutiye Madrasa, Caferiye Madrasa, and Çifte Minareli Madrasa. Within the scope of the study, axial integration and segment integration analyses were performed. However, since the research was conducted at the city scale rather than at the building scale, data on the mentioned structures could not be obtained by space syntax analysis [45].

In Türk's research titled "A Proposal for a Method to Preserve the Historical Urban Fabric and Architectural Spaces for the Future; The Case of Sivas", Sivas Central District and the area within the city walls of the Sivas historical city center were analyzed using space syntax method. Within the scope of the study, axial connectivity, axial integration, choice, intelligibility, and synergy analyses were performed. The designated study area includes significant structures such as Şifaiye Madrasah, Gök Madrasah, Çifte Minareli Madrasah, and Buruciye Madrasah, with historical information on these buildings provided within the context of the city's historical development. However, the analyses conducted using the space syntax method were performed at the urban scale, not at the building scale, and there are no specific analyses about the aforementioned historical madrasahs [46].

Filiz Karakuş's 2022 study, "Evaluation of Adaptive Reuse in the Context of Sustainability: Cases from Kasramonu, Türkiye", aims to evaluate the success of adaptive reuse practices in five historic caravanserais in Kastamonu that have lost their original functions and to analyze their contribution to the sustainability of the historic environment by using methods such as archival and literature review, on-site surveys and observations, and survey data analysis. Evaluation criteria were established according to international conservation regulations and standards, and adaptive reuse practices were evaluated in line with these criteria [47].

Within the scope of Şimşek's research titled "Evaluatıng the Impacts of Refunctioning on Ottoman Medreses in Istanbul" the refunctionalization practices implemented in selected madrasahs were comparatively examined by considering the original plans and architectural features of the buildings, as well as their current uses, architectural features, and visuals. The study only focused exclusively on Ottoman madrasahs located in Istanbul, and the space syntax method was not employed [48].

In Dağ Gürcan's 2024 doctoral research titled "The Spatial Syntax Analysis of Iwan Structures in Central Asian and Near Eastern Turkish Architecture Between the 10th and 15th Centuries", one of the objectives was to investigate the continuation, discontinuation, or transformation of the use of the iwan in various building types. The study involved of 68 iwan structures from different periods, geographies, and functions. Within the scope of the study, visibility graph connectivity, integration,

mean depth, convex map connectivity, integration, mean depth, and isovist analyses were performed. The connectivity, integration, and mean depth parameter values of the entire spatial system, the central space, the main iwan, the entrance, and the side iwans were determined, and the spatial data were compared and interpreted in relation to the analysis values. However, the analyses conducted on selected iwan structures from different building types are limited only to the original plans. This study, which is not limited to madrasas, does not include any analysis of adaptive reuse or plans for current use [49].

In Acar's doctoral thesis titled "An Examination of Fine Arts Faculties Using the Space Syntax Method and a Model Proposal for Flexible Space Design" selected fine arts faculties were analyzed using depthmapX, one of the space syntax analysis software. Within the scope of the study, axial connectivity, axial integration, axial depth, and intelligibility analyses were performed. After calculating values for connectivity, integration, depth, and visibility, the spatial potentials were determined. Accordingly, the establishment dates of the fine arts faculties were first identified, focusing on those established in or after the year 2000. Among the faculties founded after this date, those with the highest number of common departments were selected, and the study was conducted within these areas. The model created based on the data obtained after the space syntax analyses revealed that in order to design fine arts faculties flexibly, the integration, connectivity and perceptibility values of the spaces should be high and the depth value should be low. The space syntax analyses conducted in the study were applied to faculties of fine arts, which are contemporary higher education institutions in Türkiye. However, historical madrasah structures were excluded from the scope of the study [50].

Sırma conducted a study titled "An Examination of the Spatial Characteristics of Healthcare Buildings Using the Space Syntax Method", aimed at analyzing the spatial configuration of healthcare buildings from different periods and assessing the spatial legibility and accessibility of these structures based on the analyses. Within this scope, darüşşifas that have historically functioned as both hospitals and higher education institutions were also examined. Within the scope of the study, visibility graph connectivity, step depth, integration, intelligibility, and synergy analyses were

performed. The analyses were performed using the depthMapX software on structures including the Izzettin Keykavus Darüşşifa, Gevher Nesibe Darüşşifa, Sultan Bayezid II Darüşşifa, and Süleymaniye Darüşşifa's original plans, as well as republican period hospitals and contemporary city hospitals [51].

In the thesis titled "Sustainable Reuse of Brutalist Architecture: Developing a Heritage-Conscious Evaluation Sytem" by Avcıoğlu, the aim is to explore methods for the sustainable adaptive reuse of brutalist buildings while preserving their historical value. The methodology adopted in the study includes a literatüre review, the proposal of a new evaluation system, and a case study. In this context, various sustainability certification systems were examined, and their shortcomings were identified. Bsed on the data obtained, a new heritage-conscious evaluation system was developed and subsequently tested on the Marxer Pharmaceutical Research Institute [52].

Kutlu et al., in their study titled "Spatial Configuration and Urban Identity: Analysing Cultural Change in Mardin's Madrasas", examined the spatial organisation of Şehidiye Madrasah, Zinciriye Madrasah, and Kasımiye Madrasah in Mardin. The study employed space syntax methodology, using convex map analysis, justified plan graph, and visual graph analysis to evaluate parameters such as integration, connectivity, mean depth, and control value. The findings indicate that circulation spaces exhibit high levels of integration and control, while prayer spaces reflect privacy and spatial hierarchy through increased spatial depth, revealing a hybrid spatial configuration aligned with local cultural values in Mardin's madrasahs. The study does not address changes in plan configurations before and after adaptive reuse interventions, focusing exclusively on the original spatial layouts of the structures [53].

Kol's thesis, "Comparing Green Building Certification Systems for Evaluating Adaptive Reuse of Heritage Buildings: The Case of Boğaziçi University Gözlükule Research Center" addresses the issue that most green building certification systems are designed for new buildings and lack the flexibility to meet the challenges of heritage buildings. It examines the potential for achieving green building certification through adaptive reuse, one of the ways to ensure the sustainability of heritage buildings. The research methodology consists of two phases: data collection-case analysis and a comparative evaluation of the "Boğaziçi University Gözlükule Research Center"

building, designated as a case study, against certification systems. The study concludes by identifying key strategies for a successful adaptive reuse process [54].

The literature review (Table 2.1) revealed that studies employing the space syntax method to mathematically analyze the transformation in the spatial configurations of refunctioned historic madrasah structures in Anatolia, which were built in different periods, are nonexistent. This gap in the literature formed the basis of the study.

Table 2.1 Summary of literature review

Author	**Year**	**Study Title**	**Method**
Yekta Demiralp	1997	Erken Dönem Osmanlı Medreseleri (1300-1500)	Examining examples built in different regions, and comparative evaluation
Hakan Anameriç & Fatih Rukancı	2008	XI.-XIV. Yüzyıllar Arasında Medrese ve Üniversitelerde Eğitim	Literature review, historical & comparative analysis
Shatha Malhis	2015	Narratives in Mamluk Architecture: Spatial and Perceptual Analyses of the Madrassas and Their Mausoleums	Space syntax analysis
Abdullah Çiğdem	2016	Klasik Dönem Osmanlı Mimarisinde Avlu Tipolojilerinin İncelenmesi	Typological analysis, plan-based comparative evaluation
Jamaleddin Soheili & Ensieh Arefiyan	2016	Analysis of Socio-Human Relations in the School Mosque Spaces in Qajar Majesty, Qazvin	Space syntax analysis
Damla Mısırlısoy & Kapan Günçe	2016	Adaptive reuse strategies for heritage buildings: A holistic approach	On-site observations and interviews with decision-makers, developing a model to identify problems in the decision-making process and assessing the suitability of existing uses for repurposed buildings
Shatha Malhis	2017	The Spatial Logic of Mamluk Madrassas: Readings in the Geometric and Genotypical Compositions	Formal-geometric analysis, space syntax analysis
Mine Tunçok Sarıberberoğlu	2018	Eğitim Binalarında Mekansal Davranışın Dizimsel (Sentaktik) İrdelenmesi	Space syntax analysis, behavioral analysis
Özge Öztürk	2018	Mekan Dizimi Yöntemiyle Mekansal Değişimin İncelenmesi Yıldız Teknik Üniversitesi Davutpaşa Kampüsü Örneği	Space syntax analysis
Chia-Sheng Chen & Yin-Hao Chiu & Lichiu Tsai	2018	Evaluating the Adaptive Reuse of Historic Buildings Through Multicriteria Decision-making	Integrated multi-criteria decision-making, fuzzy delphi method, and analytical network processing

Table 2.1 (continued) Summary of literature review

Funda Çınar Karakaya	2019	Hastane Binalarında Kronolojik Açıdan Erişilebilirliğin Gelişimi ve Mekan Dizimi Yöntemi ile İki Örnek Üzerinden İnceleme	Space syntax analysis
Maide Berfu Bayraktar & Bahtiyar Eroğlu	2019	Medreselerden Yeni Nesil İdeal Eğitim Yapılarına	Conceptual architectural analysis
Emriye Kazaz	2020	Osmanlı Medreseleri Bağlamında "İspir Kadıoğlu Medresesi" ve Konumu Üzerine Dğerlendirmeler	Typological analysis, historical architectural evaluation
Fatih Semerci & Ayşe Özkafa	2020	Anadolu Selçuklu Medreselerinde Mekan ve Cephe Kalitesinin Analizi: Konya Medreseleri Örneği	Visual documentation, architectural analysis, scoring-based evaluation
Dalia Elsorady	2020	Adaptive Reuse Decision Making of a Heritage Building Antoniadis Palace, Egypt	Interviews with primary & secondary stakeholders and local communities, comparative analysis
Ahmet Cuneydi Has	2022	Determining Density in the Historical Region with Space Syntax Analysis, Erzurum City Center Example	Space syntax analysis
Haydar Türk	2022	Tarihi Kent Dokusu ve Mimari Mekanların Geleceğe Taşınmasında Bir Yöntem Önerisi; Sivas Örneği	Space syntax analysis, method proposal
Filiz Karakuş	2022	Evaluation of Adaptive Reuse in the Context of Sustainability: Cases from Kasramonu, Türkiye	Archival and literature review, on-site surveys and observations, survey data analysis, and evaluation criteria
Muradiye Şimşek	2023	Evaluatıng the Impacts of Refunctioning on Ottoman Medreses in Istanbul	Comparative architectural evaluation
Ayşenur Dağ Gürcan	2024	10-15. yy. Arasında Orta Asya ve Yakın Doğu Türk Mimarisinde Eyvanlı Yapıların Mekân Dizimsel Analizi	Space syntax analysis, comparative evaluation
Hediye Acar	2024	Güzel Sanatlar Fakültelerinin Mekan Dizimi Yöntemiyle İncelenmesi ve Esnek Mekan Tasarımına Yönelik Model Önerisi	Space syntax analysis, model proposal
Saliha Sırma	2024	Sağlık Yapılarının Mekânsal Özelliklerinin Mekân Dizim (Space Syntax) Yöntemi İle İrdelenmesi	Space syntax analysis, comparative evaluation
Burak Avcıoğlu	2025	Sustainable Reuse of Brutalist Architecture: Developing a Heritage-Conscious Evaluation Sytem	Literature review, examining various sustainability certification systems, the proposal of a new heritage-conscious evaluation system.

Table 2.1 (continued) Summary of literature review

İzzettin Kutlu & Ruşen Ergün & Aslan Nayeb	2025	Spatial Configuration and Urban Identity: Analysing Cultural Change in Mardin's Madrasas	Space syntax analysis
Şimal Kol	2025	Comparing Green Building Certification Systems for Evaluating Adaptive Reuse of Heritage Buildings: The Case of Boğaziçi University Gözlükule Research Center	Data collection and comparative scoring across four different green building certification systems: LEED (USA), BREEAM (UK), DGNB (Germany), and YeS-TR (Turkey)

CHAPTER 3

DEVELOPMENT OF MADRASAHS

The word "madrasah" means "place where knowledge is learned" in Arabic. There are various opinions regarding the purposes of establishing madrasahs. One of them is as follows: “The main purpose of establishing these institutions is the need to defend the sects (mezhep) to which the sultans or emirs are subject and to continue their teachings." [55].

The earliest structures known as madrasah began to appear in the Khorasan and Transoxiana (Mâverâünnehir) regions (Figure 3.1) in the 10th century [56]. However, the tradition of madrasah in Turkic-Islamic states originated with the Karakhanids. Islamic historians contend that the first madrasah in Islam was the Nizamiya Madrasah, built in Baghdad by the vizier of the Great Seljuk Sultan Alp Arslan, Nizam al-Mulk. Nizamiya Madrasahs were not limited to being built only in Baghdad; they were constructed in numerous locations including Nishapur, Isfahan, Balkh, Mosul, and Basra. The first madrasah which was built by the Turks in Anatolia is Yağıbasan Madrasah (Figure 3.2). It was built in Tokat by Danishmendids in the 12th century.



Figure 3.1 Khorasan region [57]



Figure 3.2 Yağıbasan Madrasah [58]

Before the construction of madrasahs, mosques served both as places of worship and educational institutions. In a school type known as "halka", teachers would gather their students around them in mosques to provide instruction, and the history of this type of education dates back to the Prophet Muhammad in the hadiths [55]. This education model, which generally provides only religious education and whose curriculum is not subject to control, changed with the establishment of madrasahs. Madrasahs provided education at both intermediate and advanced levels. In other words, individuals who had graduated from elementary schools (sıbyan mekteb) could pursue further education in madrasahs.

Initially providing religious education with courses such as tafsir, fiqh, aqidah, and hadith, the curriculum of madrasahs began to evolve during the Anatolian Seljuk period to include disciplines such as logic, philosophy, astronomy, mathematics, medicine, and cosmology in addition to religious studies. Furthermore, specialization in education was observed for the first time in the madrasahs built during the Anatolian Seljuk period, and the names of the madrasahs were chosen within the framework of this subject [59]. Those who taught in madrasahs were called "mudarris" their assistants were referred to as "muid" and the students were known as "talebe." While

there is no definitive information on whether students in Anatolian Seljuk madrasas had specific titles according to their levels, during the Ottoman period, beginners in madrasah education were called "suhte" (or softa), and those who advanced to the level of Sahn-ı Seman Madrasah were referred to as "danışmend" [60]. Additionally, since madrasahs were charitable foundations (vakıf), education provided within them was free of charge [55].

3.1 Madrasahs Built Outside Anatolia

3.1.1 Karahans Period

Madrasahs, educational institutions of Turkic-Islamic origin, began to be established during the Karakhanid period. The establishment of these institutions was influenced not only by the educational activities in temples initiated by the Uighurs but also by the desire to strengthen the beliefs of Turkic tribes newly converted to Islam [61]. During this period, the administrators of madrasahs were referred to as "fakih", while the teachers were called "mudarris." Moreover, the selection of these individuals was carried out by scholars in Samarkand. The first modern madrasah in the medieval Islamic world was founded by Tamgaç Khan Ibrahim in Samarkand in 1066 [62]. With its endowment charter and institutional features, the madrasa holds the distinction of being a pioneering institution in the medieval Islamic world in a modern sense [63]. The fact that the building has an iwan–based plan scheme indicates that the first examples of iwan madrasahs date back to the Karakhanid period [64].

Tamgach Khan Ibrahim Madrasah, which holds the distinction of being a pioneering example in the medieval Islamic world in a modern sense, was constructed in 1066 [64]. The architectural structure modeled on the Tamgach Han İbrahim Madrasah (Figure 3.3, Figure 3.4), the four-iwan plan scheme, is attributed to the Buddhist Vihara known to belong to the Karluks in the VIIth and VIIIth centuries [63]. The entrance provided through a small domed space surrounded on four sides by vaults represents another innovation seen in the period [64].

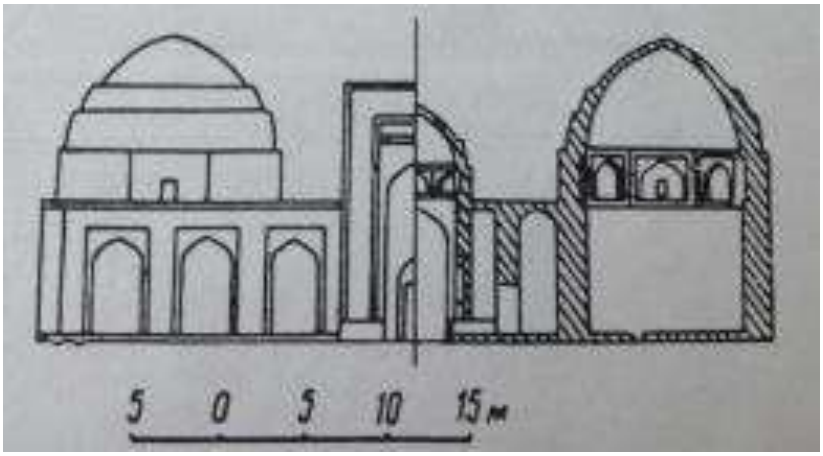


Figure 3.3 Section of Tamgach Khan Ibrahim Madrasah [62]

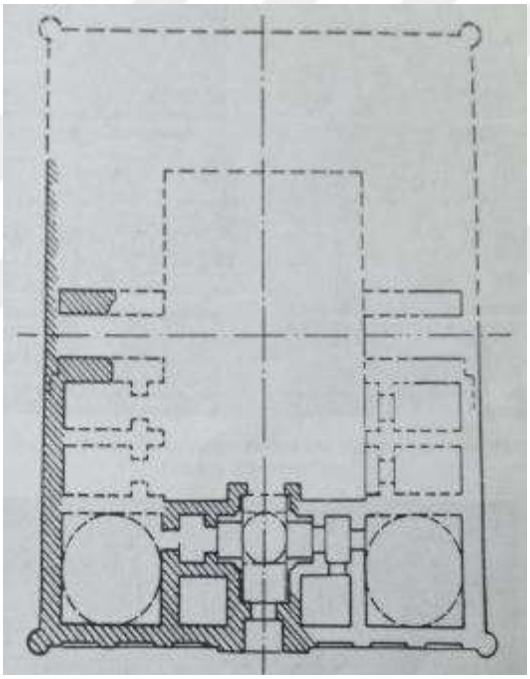


Figure 3.4 Section of Tamgach Khan Ibrahim Madrasah [62]

3.1.2 Ghaznavid Period

Education was also given importance during the Ghaznavid period, and as a result of this, madrasahs were built. However, there are no architectural examples that have survived to this day. While the existence of four madrasas named Beyhakiyya, Saidiyya, Abu Sa'd al-Estirabadi, and Abu Ishaq al-Isfara'ini [64], which are known to have been founded during the reign of Sultan Mahmud [65], is known, there is a lack

of information regarding their architectural features, and in addition, it is mentioned that there was a madrasah in the complex built by Arslan Zamzam, the governor of Tus of the Ghaznavids, in Sengbest, but it is not possible to have accurate information from the sketch of these ruins, which were available in 1913 [66].

3.1.3 Great Seljuk Period

Developments such as the establishment of madrasahs by the state and the detailed determination of the madrasah organization (teşkilat) took place during the Great Seljuk period [55], and in this context, the Great Seljuk era holds a very significant place. The Great Seljuks, who believed that the strengthening of the Sunni sect against Shiism could only be achieved with the help of educational institutions [67], built madrasah buildings with iwans and an open courtyard [68].

Islamic historians consider Nizam al-mulk, the vizier of the Great Seljuk sultans Alp Arslan and Maliksah, was the founder of the madrasah instution, as he commissioned the construction of the Nizamiye Madrasah in Baghdad [55]. Nizamiye Madrasahs were also built in various locations such as Nishapur, Isfahan, Belh, Mosul, and Basra.

The earliest madrasahs whose ruins have survived to the present day are the Hargird and Rey Madrasahs, which were built in the four-iwan plan scheme during the Great Seljuk Period. These madrasahs are very important as they shed light on the plan schemes of the madrasahs that have not survived to the present day.

Aslanapa states that, apart from the Rey and Hargird Madrasahs, no madrasah buildings from the Great Seljuk Period have survived to the present day [64]. The plan schemes of Hargird (Figure 3.5) and Rey Madrasahs shed light on the Nizamiye Madrasahs, which were important structures of the Great Seljuk period. Godard's studies have revealed that the square courtyrad of the Hargird Madrasah contains an iwan centered on each of its fours sides; the largest iwan is located on the qibla axis, the lateral iwans on the sides are narrower, and the smallest iwan, serving as the entrance hall, is located directly opposite the largest iwan [69]. However, Creswell argues that this structure belongs to a mosque, not a madrasah [65].

Rey Madrasah (Figure 3.6) has a four-iwan plan scheme, with the north-south iwans being smaller and built symetrically in comparison to the east-west iwans [64]. Creswell contends that the structure resembles a house and argues that there are no student cells in the structure [64].

These madrasahs have a four-iwan plan scheme and it is estimated that Nizamiye Madrasahs may also have the same arrangement [64]. However these madrasas, which were built during the reign of Melikshah, are in ruins today.

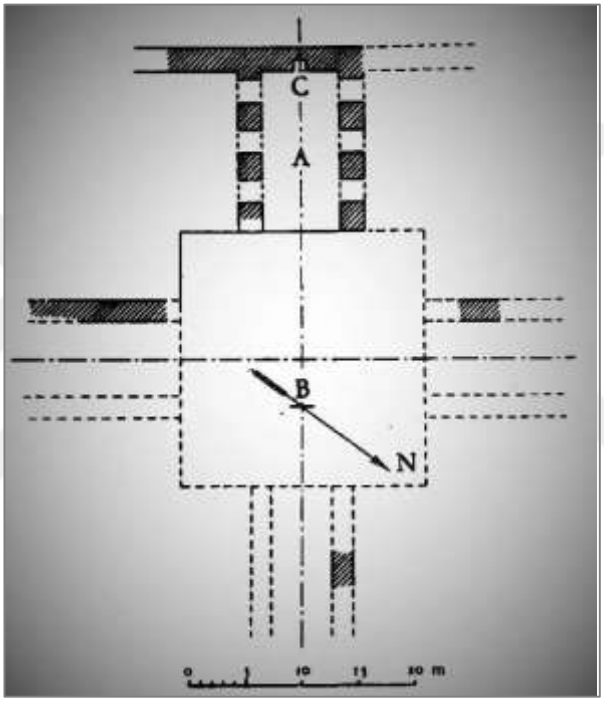


Figure 3.5 Hargird Madrasah [69]

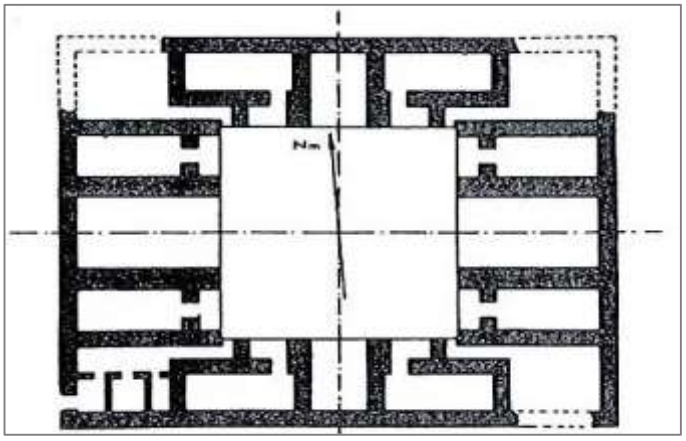


Figure 3.6 Rey Madrasah [70]

3.2 Madrasahs Built In Anatolia

Beginning in the 11th century, the Turkic tribes that migrated into Anatolia established first Turkmen principalities such as Danishmendids, Artuqids, Saltuqids, and Mengujeqids, thereby producing the earliest examples of Tuskish architectural Works in the Anatolia [64]. Anatolian madrasahs, the first examples of which were built by the Danishmends and Artuqids, developed in two plan types as domed and iwan schemes [67]. Domed madrasahs, which were formed by covering the courtyard with a dome, constitute the earliest plan scheme observed in Anatolia, as exemplified by the Yağıbasan Madrasah built in Tokat during the Danishmend period [64].

3.2.1 The First Period of Anatolian Principalities

Yağıbasan Madrasah (Figure 3.7), which is the oldest madrasah built in Anatolia, was built during the Danishmend period. The plan of the madrasa, which was constructed as a single-storey building, is organized around a central courtyard defined by Kuran as "a focal point that brings together the various units of madrasa" [55]. There are student cells, classrooms, and other rooms around the courtyard of the madrasah (Figure 3.8), which was built using rubble stone, cut stone and brick. Yağıbasan madrasah, which was built by utilizing the walls of Niksar Castle, is a structure that is skewed on one side because it is subject to the castle walls following the curves of the hill on which it sits, but in fact it is a four-cornered structure [42].

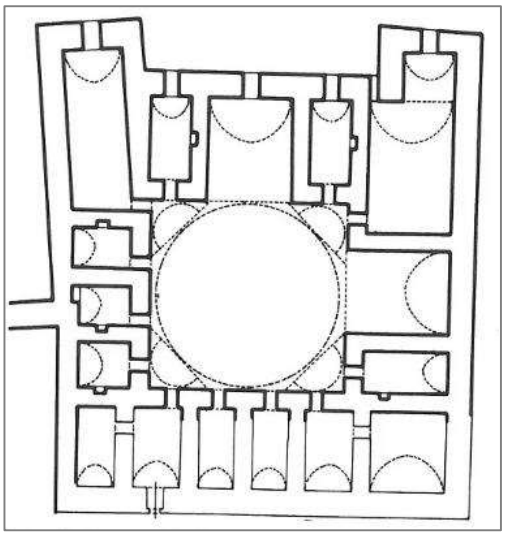


Figure 3.7 Yağıbasan Madrasah [71]



Figure 3.8 Interior of Yağıbasan Madrasah [72]

There are different opinions about the construction date of Diyarbakır Zinciriye Madrasah, also known as Sincariye Madrasah, which is located southwest of the Grand Mosque [59]. According to some researchers, the madrasah (Figure 3.9) was built in 1198 during the reign of Kutbuddin Muzaffer II Sökmen of the Artuqids, while other researchers argue that it may have belonged to the period of Malik Salih Necmeddin, one of the Ayyubid rulers, in 1236. A fragment of an inscription on the south-west wall of the madrasah reveals that its architect was Isa Abu Dirhem [42].

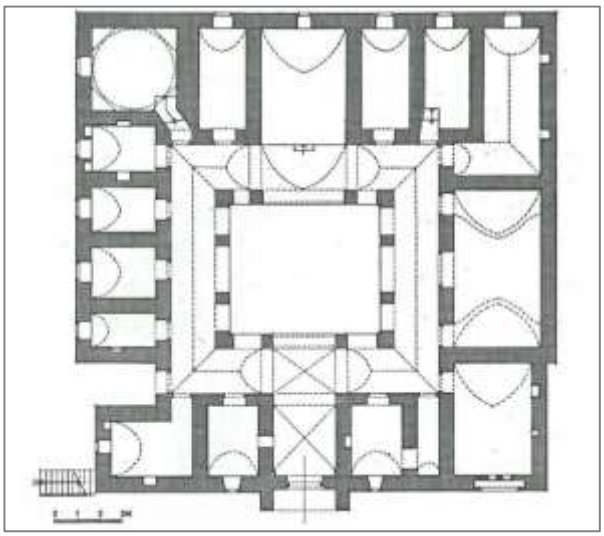


Figure 3.9 Plan of Zinciriye Madrasah [64]

In the construction of the madrasah, which has 2 eiwans in the plan scheme, colored stone, and brick were used as materials, as well as smooth-cut stone (Figure 3.10). Also, there is a pool in the middle of the open courtyard of the madrasah.



Figure 3.10 Courtyard and riwaqs of Zinciriye Madrasah [73]

3.2.2 Anatolian Seljuk Period

The Anatolian Seljuks adopted and developed the open and closed-courtyard madrasah schemes that had appeared in Anatolia prior to their rule. The madrasah buildings of the period were built as single or two-storey buildings. Kuran states that the four-iwan scheme, the fundamental element of the Great Seljuk madrasahs, did not form the fundamental architectural principle of Anatolian Seljuk madrasahs, and that apart from the characteristics such as construction of the buildings with stone, monumental portals, and pointed arches, these period's buildings did not adhere to strict formal rules [55]. Aslanapa stated that the domed rooms on both sides of the large iwan, first seen in the Atabey Ertokuş Madrasa, were repeated in the Seljuk period madrasas [64]. Also, another significant innovation is the first appearance of a kümbet in a madrasah structure, as seen at the Gevher Nesibe Darüşşifa [64].

The structure built in Kayseri is also known as the Çifte Madrasah. Consisting of two adjoining buildings with an open courtyard, one of the madrasah sections is a medical

madrasah (education) while the other is a healing center (hospital). The 4-eiwan plan scheme was used in both buildings (Figure 3.11, Figure 3.12). There is a barrel vault covered narrow passage that connects the hospital to the madrasah section. All four sides of the courtyard in the madrasah are covered with riwaqs [42].

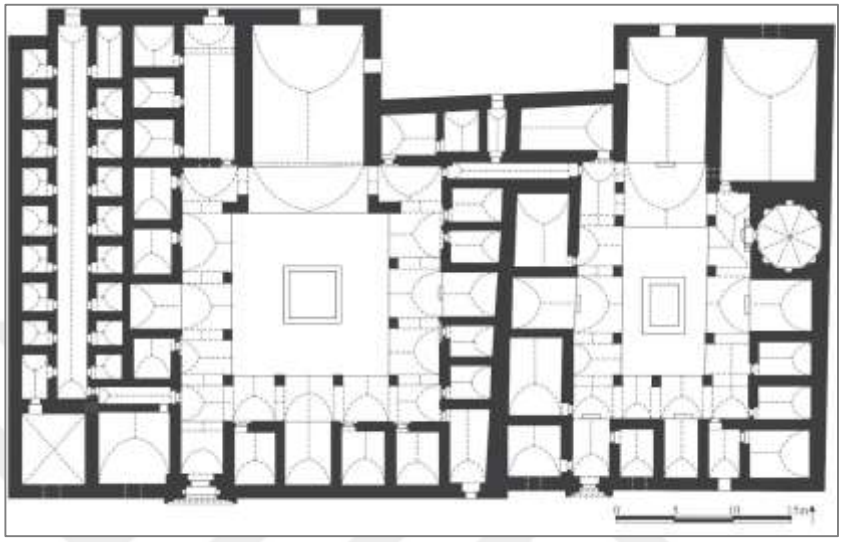


Figure 3.11 Plan of Kayseri Gevher Nesibe Sultan Madrasah [74]



Figure 3.12 Kayseri Gevher Nesibe Sultan Madrasah [74]

According to the inscription of the Karatay Madrasah built in Konya, it was constructed in 1251. Karatay Madrasah (Figure 3.13, Figure 3.14), which is a madrasah with a central dome, is one of the most important structures of Anatolian Seljuk period with its architecture and especilly tile coverings [59]. The entrance of

the building, which was built with a closed courtyard, a single eiwan, and without riwaqs (Figure 3.15), is not directly opposite the main eiwan, but in the left corner [42].



Figure 3.13 Konya Karatay Madrasah [75]



Figure 3.14 Interior of Konya Karatay Madrasah [76]

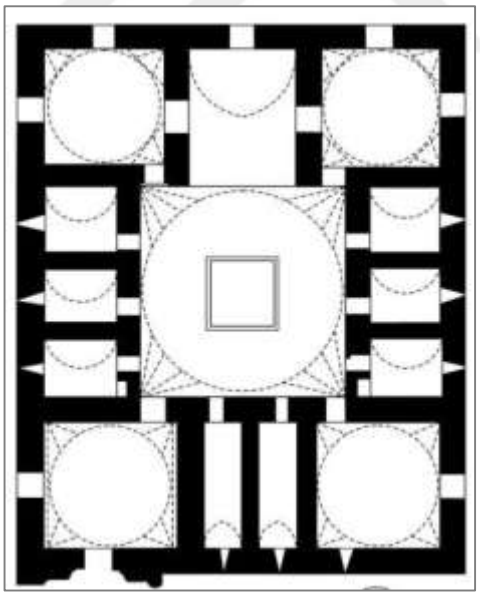


Figure 3.15 Plan of Konya Karatay Madrasah [71]

3.2.3 The Second Period of Anatolian Principalities

After the dissolution of the Anatolian Seljuk, several principalities were established, including the Karamanids, Germiyanids and the Ottomans. Yetkin notes that one of the most significant transformations introduced during the second period of Anatolian principalities, while bringing certain innovations to Seljuk architecture and ornamental practices, is the simplification of portals; however, he also emphasizes that the portal of Niğde Ak Madrasah represents an important innovation through its narrowing and vertical elongation under Ilkhanid influence [67]. Aslanapa, on the other hand, states that the Seljuk architectural tradition remained most vibrant within the Karamanid principality [64].

Ahmet Gazi Madrasah, which was built by Mentese Bey Ahmet Gazi, is the only building in Beçin whose construction inscription has survived to the present day. It is located northwest of Orhan Mosque [42]. The madrasah (Figure 3.16, Figure 3.17), which has a plan scheme of four iwans and a courtyard without riwaqs, contains the tombs of Ahmet Gazi and an unidentified person in the main eiwan. The spaces on both sides of the main eiwan are classrooms, and student cells are planned around a rectangular courtyard. The fountain, which is adjacent to the eastern wall of the eastern classroom space from the outside, was built later [42].

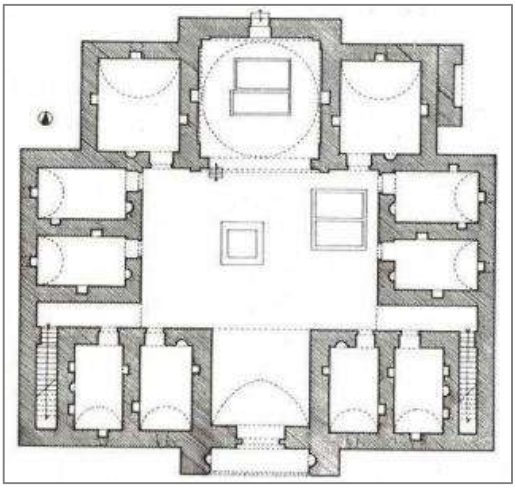


Figure 3.16 Plan of Ahmed Gazi Madrasah [62]



Figure 3.17 Ahmed Gazi Madrasah [62]

3.2.4 The Ottoman Empire Period

Madrasahs were frequently constructed as part of larger complexes during the Ottoman Empire period. However, there are also instances of standalone madrasahs, such as the Sultan Selim Madrasah in Istanbul. In terms of plan scheme, a common plan involves arranging the student cells in a 'U' shape, known as the U Plan Type.

Some buildings, adapted to their specific terrain, exhibit student cells arranged in an 'L' shape, referred to as the L Plan Type. Classical Ottoman Period madrasahs typically are single-storey structures centered around courtyards. Rectangular plans are predominantly used for these courtyards. An exceptional case is the Rüstem Pasha Madrasah, which has an octagonal plan (Figure 3.18).

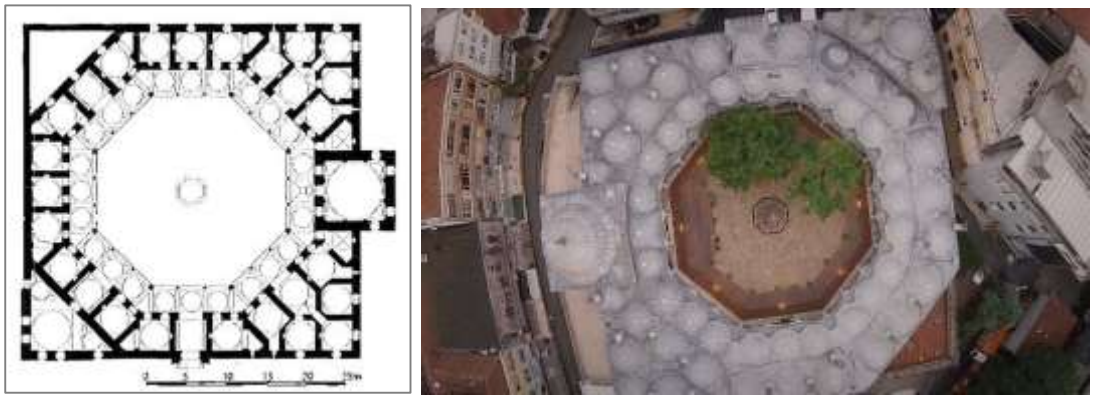


Figure 3.18 Rüstem Pasha Madrasah plan and bird's eye view of the madrasah [62]

In terms of materials, stone and brick are combined in a complex masonry pattern. Key components of the madrasah include riwaqs, student cells, and classrooms. Each student cell, intended for student use, contains a oven and niches and, is designed with a square plan covered by a dome. A distinguishing characteristic of classical-period madrasahs is that the classrooms of the madrasah are constructed as separate buildings from the main structure. These classrooms generally have a square plan and are covered with domes. Some classrooms also served as masjids. The entrances to the madrasah are designed with riwaqs resembling eiwans, and the main portals are relatively simple, lacking the grandeur and intricate ornamentation typical of Seljuk Period madrasahs' portals. Ornamental elements within the student cells include door and window wings, and ovens.

Süleyman Pasha Madrasah (Figure 3.19) in Iznik is considered to be one of the pioneering Ottoman madrasahs with its architectural features such as domed student cells surrounding a "U" shaped courtyard, porticoes and a courtyard wall with window openings on the fourth side of the courtyard [56]. On the other hand, in Ottoman madrasah architecture, Haseki Hürrem Sultan Madrasah, with its U-shape plan scheme, a classroom placed on the axis of symmetry opposite the entrance, and square cells covered with domes, is considered to be a madrasah layout that is mostly used in the Ottoman Empire period madrasah structures [77].

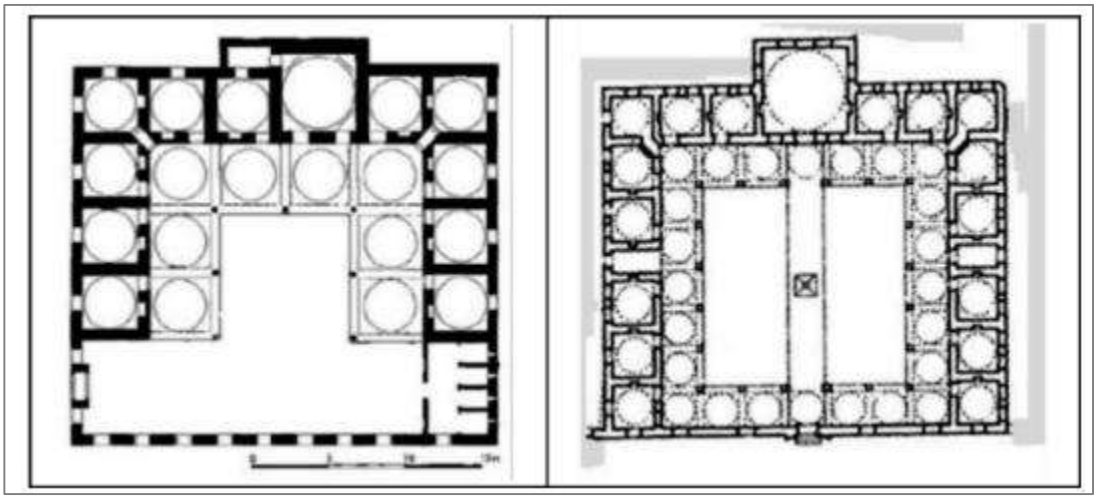


Figure 3.19 İznik Süleyman Pasha Madrasah's plan and Haseki Hürrem Sultan Madrasah's plan [78]

The use of the eiwan, a significant feature in Anatolian madrasah architecture prior to the Ottoman period, persisted in some structures with variations. In this regard, analyzing the relationship between the courtyard and riwaqs reveals that there were substantial changes in courtyard planning before and after the Ottoman period madrasahs. Before Ottoman period, the courtyards were inner courtyards, and their connection with the outside was provided only through the portal, while in the Ottoman Empire era, the use of the outer courtyard and the connection between the inner courtyard and the outer courtyard came to the fore [56].

According to the relationship between the student cells and the courtyard in the early Ottoman madrasahs, the plan schemes are divided into four groups: examples where the student cells are placed on two sides, three sides and four sides of the courtyard, and unusual (isolated) examples (Figure 3.20) [59].

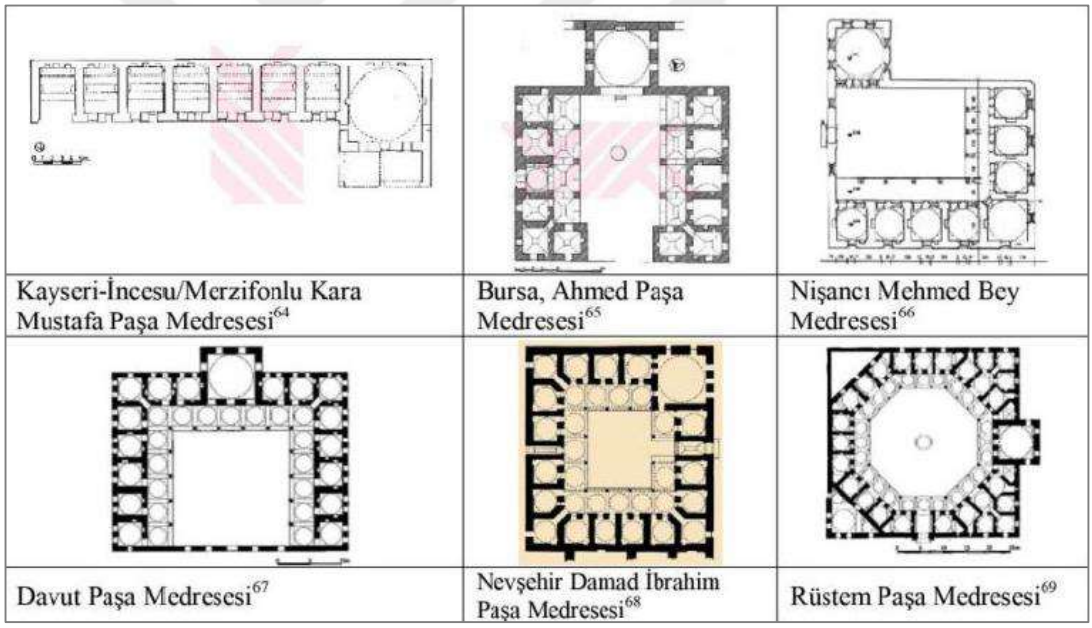


Figure 3.20 Different examples of Ottoman Period Madrasah typologies [77]

In conclusion, this chapter examines the historical evolution and architectural characteristics of historic madrasah buildings in Anatolia, emphasizing their typology centered around courtyard, iwans, and student cells. These primary institutions of higher education structures possess a spatial hierarchy, and understanding this unique spatial logic is a prerequisite for evaluating how they respond to contemporary

adaptive reuse interventions. The following chapter discusses the study's methodology, space syntax, alongside the selected structures that form the basis of the research.

CHAPTER 4

METHOD AND MATERIAL

4.1 Method

This section outlines the research methodology used to analyze the case studies. Since understanding the fundamental components of the methodology is crucial for correctly interpreting the analysis results, the chapter firstly presents information on the parameters, provide mathematical values, examined in the spatial syntax analysis. Following this, the technical steps involved in conducting VGA and Convex Map Analysis usingthe depthmapX software are explained.

For the space syntax analyses, which constitute the methodological framework of this study, the case studies were selected as the first step. Subsequently, a detailed literatüre review was conducted to identify both the original plans of the structures and the plans corresponding to their contemporary use. The plan images obtained through this research were transferred into AutoCAD, where two-dimensional drawings were produced. Both the original and current plan drawings were then exported from AutoCAD in DXF format and imported into the deothmapX software for analysis. The analyses yielded visual maps and quantitative syntactic parameters. The resulting data were compiled, and the spatial transformations experienced by the structures were examined and interpreted accordingly (Figure 4.1).

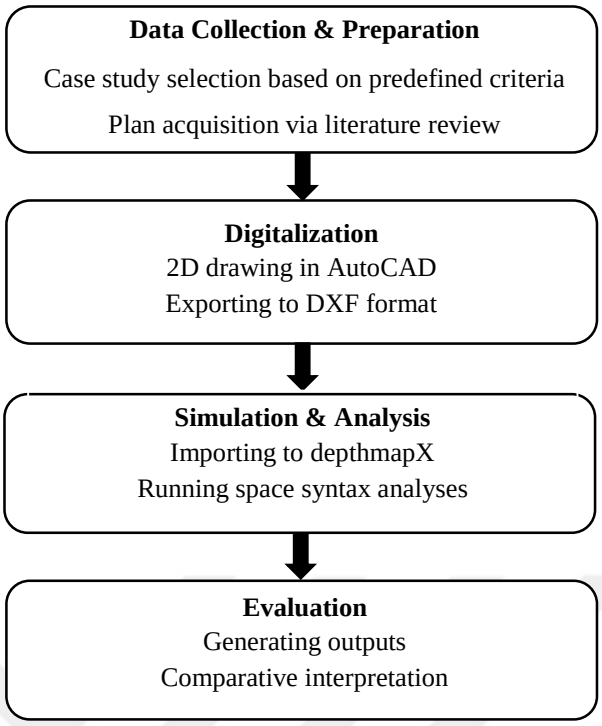


Figure 4.1 Workflow of the method

4.1.1 Concepts Used in Space Syntax Theory

4.1.1.1 Connectivity

Connectivity, a local measure, is defined in the UCL Space Syntax dictionary as “Connectivity measures the number of spaces immediately connecting a space of origin.” [79]. This measure indicates the number of different neighboring spaces to which the referenced space has direct access.

4.1.1.2 Depth

According to Hillier's definition, the total number of spaces traversed to reach any given space within a system represents its "depth" [80]. If a space has a low depth value, it is considered a "shallow space," characterized by lower privacy; conversely, if a space has a high depth value, it is referred to as a "deep space," which indicates higher privacy.

4.1.1.3 Mean Depth

Mean depth, which represents the average number of steps required to reach all other spaces in a system from a given space, is calculated by dividing the total depth of the system by the number of spaces. This measure helps determine how accessible or isolated a node is within the system.

If "k" represents the total number of spaces in the system:

Mean Depth (MD): Total Depth / The Total Number of Spaces – 1

MD: TD / k - 1 [28]

4.1.1.4 Integration

Integration, which is a global parameter, represents the average depth of a space to other spaces within the system, and thus, it can be understood how accessible a space is compared to other spaces. In other words, a space with a high integration value is more integrated into the system and more accessible [80].

Spaces with the highest levels of usage and the greatest likelihood of encounters between individuals are defined as "integrated spaces," while areas that are more isolated from the structure and have low usage potential are referred to as "segregated spaces" [81].

4.1.1.5 Intelligibility (R^2)

The concept of intelligibility, which can be analyzed as a result of the relationship between connectivity and integration values, is defined as the level at which users can identify and generate ideas about the entirety of a space and the relationships between spaces.

If connected spaces are also integrated spaces, the spatial relationship is strong, or the system is intelligible [82]. Based on numerical analyses, the R^2 value, which expresses the level of intelligibility, reaches its maximum when it equals one. However, as the R^2 value drops below one, the intelligibility of the spaces begins to decrease [81].

4.1.1.6 Relative Asymmetry / Relative Average Depth (RA)

Relative asymmetry, defined in the UCL Space Syntax Dictionary as "Relative asymmetry compares how deep the system is from a particular point with how deep or shallow it could theoretically be. This is a theoretical way of normalizing total depth", shows the integration of the space with the system (integration rate). This concept, which can also be considered as a measurement of integration, gives correct results in systems of the same size; however, more than one transformation must be made in systems of different sizes [83].

k: Total number of spaces in the system and MD: mean depth;

Relative Asymmetry (RA): $2(MD - 1) / k – 2$

The Relative Asymmetry (relative depth) value obtained as a result of the calculation takes a value between 0 and 1. A high value indicates that the system is deep and spaces tend to be separate; while a low value indicates that the system is shallow and spaces tend to be integrated in the system [24].

4.1.1.7 Real Relative Asymmetry (RRA)

Real Relative Asymmetry (RRA), used when comparing systems of different sizes, is based on the idea that when comparing structures with different numbers of spaces, the effect of the numerical majority of spaces in the system on the RA of any given space must be removed to obtain an accurate result [28].

Real Relative Asymmetry is calculated as follows, with "Dk" being the numerical data that varies according to the number of spaces in the table of values prepared by Hillier and Hanson for systems of different sizes:

Real Relative Asymmetry (RRA) = RA / Dk

The resulting value can range from 0 to 1, and unlike Relative Asymmetry, it may also exceed 1. This indicates that if the value is greater than 1, the space exhibits a segregated structure, while a value closer to 0 suggests a tendency toward integration [24].

4.1.2 Software Used in Space Syntax Theory

In the space syntax method, various software programs such as Axman, Ajax, Confeego, and Depth Map are utilized. Axman is used for axial line analysis of both axial city maps and interior spaces; Ajax is used to calculate integration and accessibility values in the analysis of spaces; Confeego is used to calculate integration, axial lines, and depth values in maps of different scales [27]. Depth Map, on the other hand, is a software developed based on two fundamental concepts: visibility field analysis [84] and spatial syntax theory [24], and is used in space syntax analyses [25].

Two types of analyses can be performed with depthmapX software: Visibility Graph Analysis and Convex Map Analysis. Convex map analysis only considers whether there is access between spaces (examining the relationships between different spaces in the structure) and does not address the measurements of openings in the space, whereas visibility graph analysis also considers the measurements of openings between spaces, representing and visualizing them [83].

4.1.3 Steps of Spatial Analysis Using DepthmapX

4.1.3.1 Steps of Visibility Graph Analysis

To perform analysis in depthmapX, the initial step involves exporting plans drawn in Autodesk AutoCAD into DXF format. This conversion ensures the plans are compatible for analysis in the depthmapX software. Subsequently, the plans are imported into depthmapX by selecting the “File” menu, then choosing the “New” command (Figure 4.2), followed by the “Map” menu and the “Import” command (Figure 4.3). At the end of these steps, the plans exported from AutoCAD in DXF format are successfully imported into depthmapX.

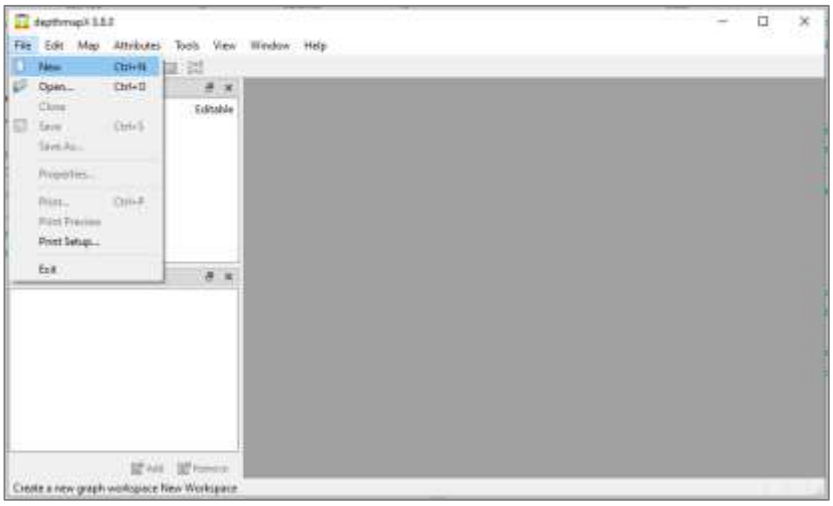


Figure 4.2 Applying the “new” command

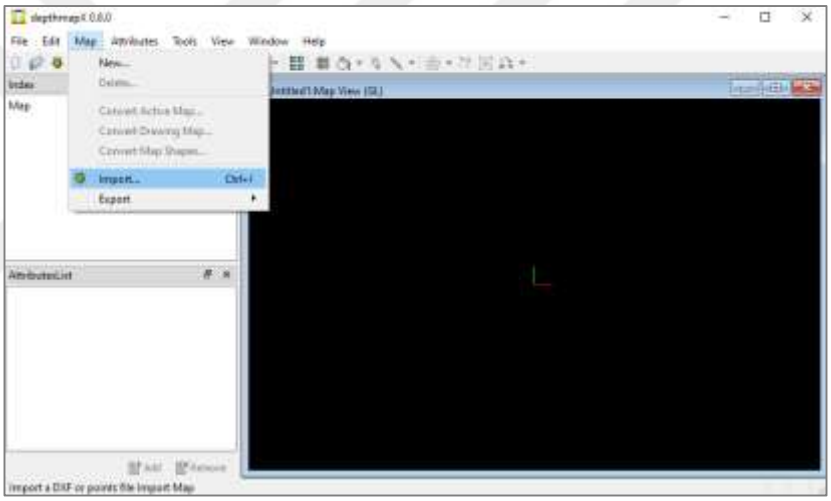


Figure 4.3 Applying the “import” command

To proceed with the analysis, the grid setup must first be established. This is achieved by sequentially applying the steps: “Tools,” “Visibility,” and “Set Grid”. This process allows the user to define a grid interval (Figure 4.4) for the analysis [83]. The working area can then be filled using either the “Fill” tool for a single-step fill or the “Pencil” tool to fill incrementally (Figure 4.5). For this operation to succeed without errors, the boundaries of the area must be completely enclosed.

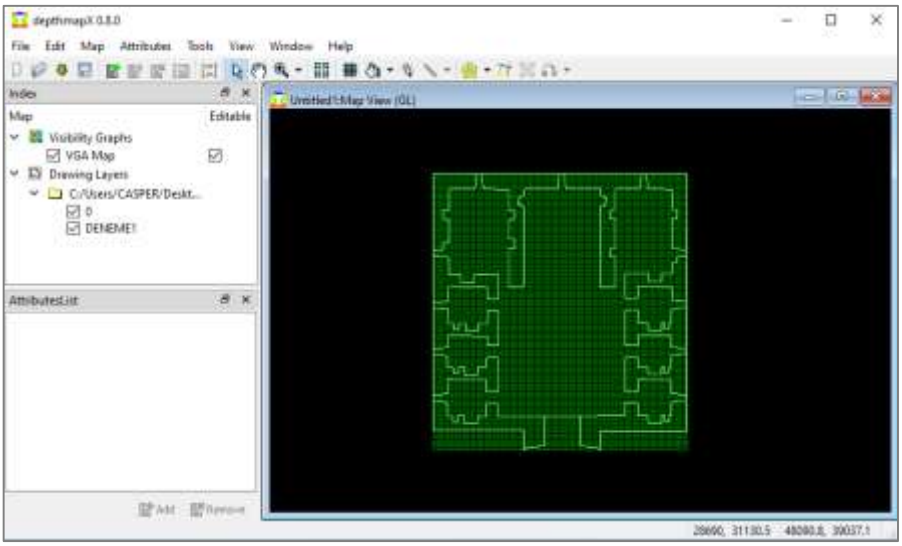


Figure 4.4 Setting grids at the software

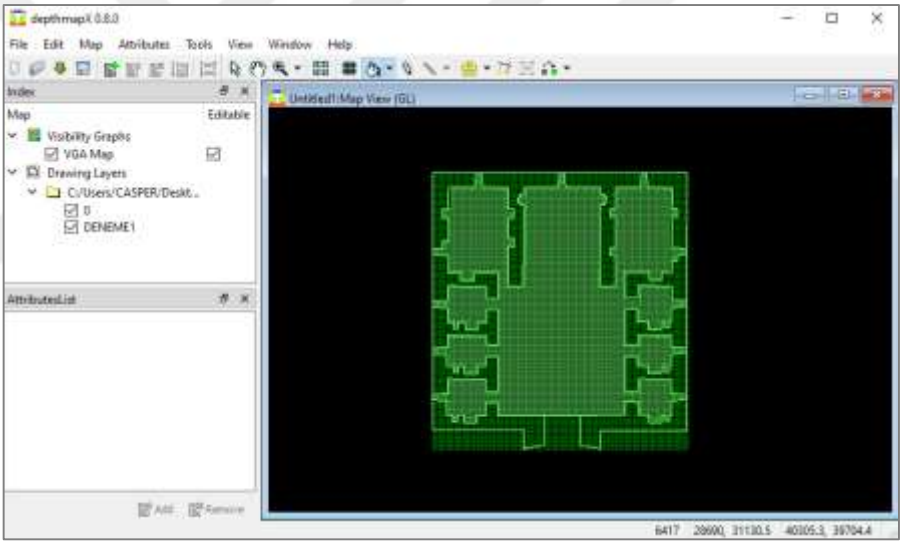


Figure 4.5 Filling the grids

After these steps, to create the visibility graph, the “Tools” menu is selected, followed by “Visibility” and then the “Make Visibility Graph” commands. DepthmapX calculates the visible regions from each grid point and generates the graph accordingly. In visibility graphs, the numerical data are represented by varying colors: red and yellow shades indicate high values, while blue and its shades represent low values (Figure 4.6).

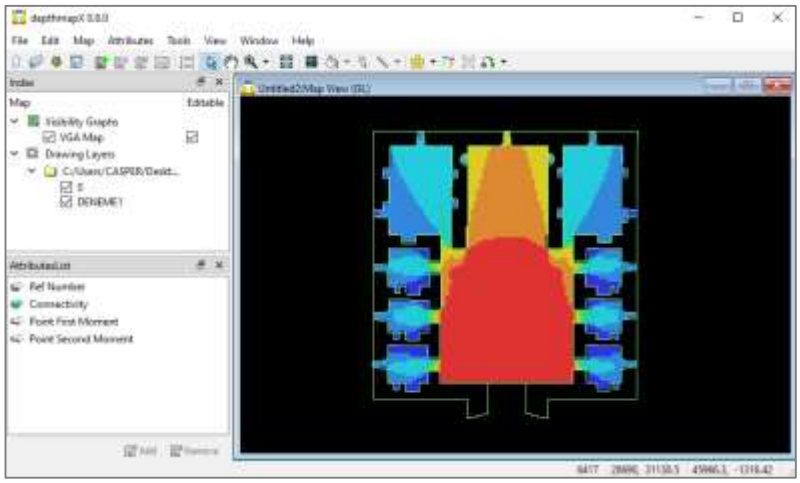


Figure 4.6 Connectivity analysis at the software

For the measurement of the graph, the commands “Tools” and “Run Visibility Graph Analysis” are executed sequentially. Graph measurements are categorized into four groups: ready-made measurements (obtained at the moment the graph is generated), global measurements (derived from information at all corners of the graph), local measurements (derived from immediate neighbors of each vertex), and metric measurements (calculated using physical distances) [25].

The ready-made measurements include connectivity, distant distance, total distance, and mean distance. Local measurements encompass control value and clustering coefficient. Global measurements involve integration, mean depth, relative asymmetry, real relative asymmetry, graph size, entropy, and relative entropy. Metric measurements consist of metric mean depth and distributed integration [27].

4.1.3.2 Steps of Convex Map Analysis

The initial steps for conducting convex space analysis are identical to those for visibility graph analysis. Subsequently, a grid system is established using the “Set Grid” command. At this stage, the software automatically creates a layer setup for visibility analysis. However, as the focus is on convex space analysis, this layer setup is disregarded. Instead, the “Map” menu is used to select “New,” followed by “Convex Map” (Figure 4.7) to create an appropriate layer configuration for the analysis [25]. After this, the “Polygon Drawing Tool” command is selected, and polygons

representing the convex spaces in the plan to be analyzed are drawn. Once the polygons are drawn, the next step in convex space analysis involves establishing connectivity relationships between spaces by linking them. For this purpose, the "Connectivity" command is selected first. Then, the "Link" command is used to connect spaces that have transitional relationships.

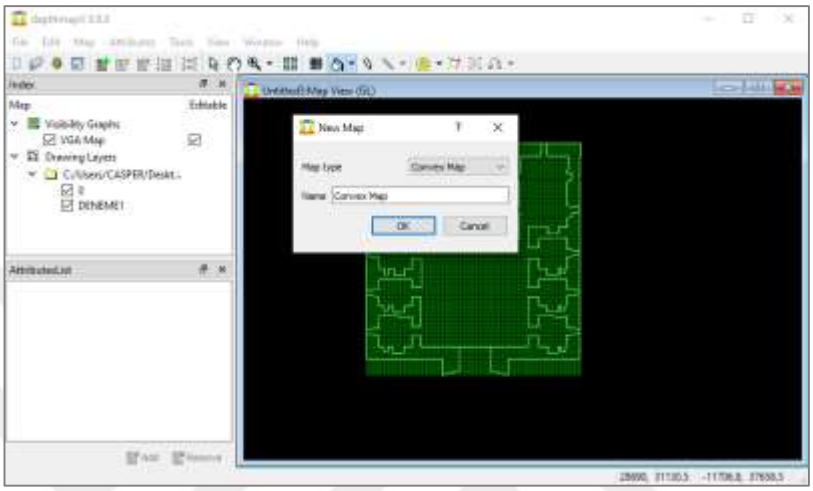


Figure 4.7 Applying the "New Map" command

To execute the analysis, the "Select" command is chosen from the toolbar. Subsequently, the "Tools" menu is accessed, and the commands "Axial / Convex / Pesh" and "Run Graph Analysis" are selected in sequence to complete the analysis (Figure 4.8).

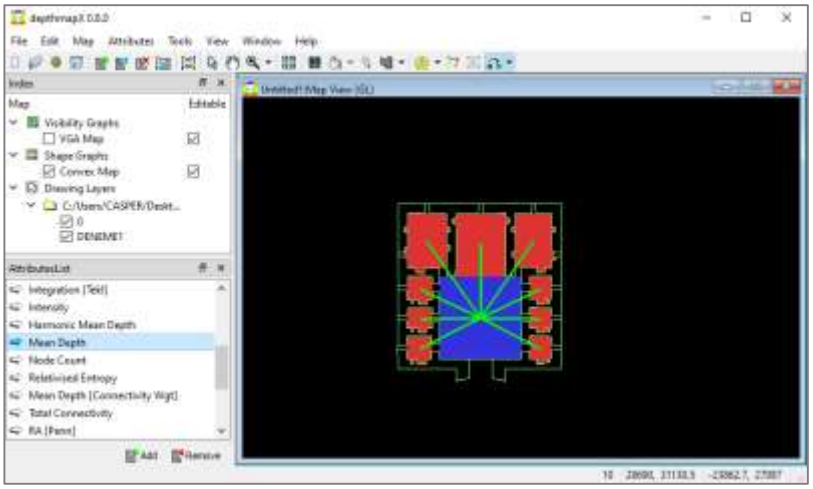


Figure 4.8 Mean depth analysis at the software

Consequently, this part of the study has outlined the theoretical framework and methodological tools of Space Syntax, emphasizing its ability to transform spatial relationships into numerical and objective data. This method offers a scientific approach to reading the social logic of space by focusing on key parameters such as integration, connectivity, and mean depth, and by employing visibility graph analysis (VGA) and convex map analysis. After selecting the analytical perspective from which to examine spatial configuration, information on the historical madrasah structures in Anatolia that were the subject of these analyses and whose comparative analyses were conducted is presented in the following part of the research.

4.2 Material

This study, conducted to examine the spatial transformation caused by adaptive reuse in historical madrasah structures, analyzes Sırçalı Madrasah, Karatay Madrasah, İnce Minareli Madrasah, Rüstempaşa Madrasah, Vacisiye Madrasah, Sahabiye Madrasah, Şehzade Mehmet Madrasah, Rabi Madrasah, Süleyman Paşa Madrasah, and Hacı Beşir Ağa Darulhadis. The selection of the historic madrasah structures examined in this study was shaped by the criteria derived from the literature review and the methodological requirements of space syntax analysis. Since the primary aim of the study is to investigate the spatial transformation of historic madrasah structures in Anatolia following adaptive reuse interventions, the study focuses on buildings that underwent significant changes in their spatial configuration, from their original plans to their current functional layouts. As a result of the literature review, historic madrasah buildings in which no plan alterations could be identified, whose original or current plans were inaccessible, or for which only schematic representations were available were excluded from the case study selection (Appendix A). As a result of the literatüre review, fifty five adaptively reused historic madrasah structures were identified. Of these, thirty were excluded from the study due to the unavailability of plans corresponding to their current use; eight were excluded because only schematic representations of their current plans could be accessed; and seven were excluded because no spatial interventions affecting the analytical results were identified in either their original or current plan.

Accordingly, the selected structures (Table 4.1) were identified through a detailed literature review documenting spatial changes such as alterations in circulation patterns, the addition or removal of spaces, the reorganization of functional zones, or modifications introduced during the adaptive reuse process. To ensure geographical and cultural coherence, the scope was limited to madrasahs built within the borders of Anatolia. Moreover, to address the architectural diversity and chronological development of madrasah structures in Anatolia, examples from different historical periods such as the Principalities Period, the Anatolian Seljuk Period, and the Ottoman Period were selected.

Table 4.1 List of the selected case studies

Name	Date of Construction	Location	Architect	Current Function
Sırçalı Madrasah	1242	Konya	Tuslu Mehmet Efendi	Ground Floor: Museum of Funerary Monuments. Upper Floor: Directorate of Surveying and Monuments
Karatay Madrasah	1251	Konya	**?**	Tile Works Museum
Ince Minareli Madrasah	1258-1279	Konya	Kelük bin Abdullah	Stone and Wooden Works Museum
Sahabiye Madrasah	1267	Kayseri	?	Booksellers' Bazaar
Vacidiye Madrasah	1314	Kütahya	?	Kütahya Museum
Süleyman Paşa Madrasah	1335 - 1359	Bursa	?	Tile and Ceramics Bazaar
Şehzade Mehmet Madrasah	1543 - 1548	İstanbul	Mimar Sinan	Suffa Foundation Social and Cultural Center
Rüstempaşa Madrasah	1550-1551	İstanbul	Mimar Sinan	Bediüzzaman Sadi Nursi Museum
Rabi Madrasah	1550 - 1557	İstanbul	Mimar Sinan	Turkish Academy of Sciences Building
Hacı Beşir Ağa Darulhadis	1734	İstanbul	?	Şehbal Education, Culture and Art Center

4.2.1 Sırçalı Madrasah

The Sırçalı Medrese (Figure 4.9), located in Konya, is one of the madrasas built during the Anatolian Seljuk period. It was designed in 1242 by the architect Tuslu Mehmed Usta [85]. The building was constructed as a two-storey structure with an open courtyard and two iwans. On the ground floor, the spaces surrounding the central colonnaded courtyard include the main iwan and entrance iwan, winter classrooms, student cells, the tomb, and other service rooms. For the analysis of the building, a

convex space analysis, based on accessibility relations dependent on human movement, and a visual graph analysis, which relies on the visual perception of a moving observer from eye level [25], were carried out.



Figure 4.9 Sırçalı Madrasah (Photograph by the author, 2025)

4.2.2 Karatay Madrasah

Karatay Madrasa (Figure 4.10), constructed in 1251 in Konya, exemplifies the closed courtyard madrasa plan type and is a single-storey structure. As one of the significant madrasa buildings of the Seljuk period, the layout allows access to the courtyard immediately after entering through the main entrance. The student cells are arranged around the courtyard. Adjacent to the main iwan of the building are two domed spaces: one served as the winter classroom, while the other houses the tomb of Celaleddin Karatay, a statesman of the Anatolian Seljuk dynasty [86].



Figure 4.10 Karatay Madrasah (Photograph by the author, 2025)

4.2.3 Ince Minareli Madrasah

The İnce Minareli Madrasa (Figure 4.11), constructed during the Seljuk period by the architect Kelük bin Abdullah [43], is an example of the closed-courtyard type madrasas. The structure is single-storey and designed with a single iwan. Its courtyard, which contains a pool, is covered by a dome. On both sides of the iwan are classrooms, which are also domed spaces.



Figure 4.11 İnce Minareli Madrasah [87]

4.2.4 Rüstempaşa Madrasah

Rüstem Paşa Madrasa (Figure 4.12, Figure 4.13) in Istanbul, commissioned by Grand Vizier Rüstem Paşa and designed by the renowned architect Mimar Sinan, was constructed in the 16th century during the Ottoman period as a single-storey madrasa. Its plan consists of an octagonal courtyard, twenty-two student cells, a main classroom (Figure 4.14), a space assumed to have been designed as a bath-toilet (gusülhane-hela), and an additional unit located on the southern façade of the building, which various scholars have interpreted either as a kitchen or a bath [88]. The roofing system of this latter space, believed to have functioned as a kitchen or bath, is distinct from that of the other parts of the madrasah.



Figure 4.12 Entrance facade of Rüstempaşa Madrasah (Photograph by the author, 2025)



Figure 4.13 Rüstempaşa Madrasah [89]

4.2.5 Vacidiye Madrasah

Vacidiye Madrasa in Kütahya (Figure 4.14), belonging to the group of closed-courtyard madrasas, was constructed as a single-storey building with two iwans. After passing through the entrance iwan, one reaches the courtyard, which is flanked on both sides by student cells. The main iwan, functioning as the summer classroom, is accompanied on either side by domed winter classrooms. The architect of the structure remains unknown [90].



Figure 4.14 Vacidiye Madrasah [91]

4.2.6 Sahabiye Madrasah

Sahabiye Madrasa (Figure 4.15), a single-storey, open-courtyard structure, was constructed during the Seljuk period. The building contains four iwans. The domed chamber adjacent to the main iwan served as a mosque, while the other room functioned as a winter classroom [92]. The courtyard, surrounded by student cells, is enclosed on three sides by porticoes.



Figure 4.15 Sahabiye Madrasah [93]

4.2.7 Şehzade Mehmet Madrasah

Şehzade Mehmet Madrasa (Figure 4.16, Figure 17) was built by Mimar Sinan during the Ottoman period [94]. The building, accessed from its side façade, includes twenty student cells, a classroom that slightly projects from the façade, the iwan located directly opposite the entrance, and the toilets. The courtyard is enclosed on all four sides by riwaqs.



Figure 4.16 Entrance of Şehzade Mehmet Madrasah (Photograph by the author, 2025)



Figure 4.17 Courtyard of Şehzade Mehmet Madrasah [95]

4.2.8 Rabi Madrasah

The Rabi Madrasa (Figure 4.18), constructed by Mimar Sinan between 1550 and 1557, is part of the Süleymaniye Complex [94]. Due to the slope of Dökmeciler Street (Figure 4.19), the madrasa features a stepped courtyard surrounded by arcades. Around this courtyard are student cells and a classroom. The classroom is designed separately from the cells and, like the student cells and arcades, is covered with a dome (Figure

4.20). Symmetrically aligned with the entrance of the building are wet areas, including baths and toilets.



Figure 4.18 Entrance facede of Rabi Madrasah (Photography by the author, 2025)



Figure 4.19 Cell domes of Rüstempaşa Madrasah (Photograph by the author, 2025)



Figure 4.20 Rabi Madrasah [96]

4.2.9 Süleyman Paşa Madrasah

The İznik Süleymanpaşa Madrasa (Figure 4.21), an example of early Ottoman architecture, features a U-shaped plan. Surrounding its open courtyard are eleven student cells and the main classroom. A direct passage connects the space thought to have served as the mudarris's room to the classroom [97]. This arrangement allowed the mudarris to enter the classroom without passing through the student quarters.



Figure 4.21 Süleyman Paşa Madrasah [98]

4.2.10 Hacı Beşir Ağa Darulhadis

Constructed during the Ottoman period, the Hacı Beşir Ağa Darulhadis (Figure 4.22) was built on a sloping terrain. The entrance to the madrasa is provided from Balcı Yokuşu Street, leading first into the courtyard. This porticoed courtyard is surrounded by student cells, a library, and a classroom-mosque unit arranged in an “L” shaped configuration. The library and classroom, both covered with domes, are interconnected [99]. During its function as a madrasa, direct access from the classroom to the library was ensured. Toward the rear garden of the structure, lavatories and a laundry facility were positioned.



Figure 4.22 Hacı Beşir Ağa Darulhadis [100]

CHAPTER 5

THE ANALYSIS OF SELECTED MADRASAHS THROUGH SPACE SYNTAX

In this study, which examines the spatial configuration changes of historical Anatolian madrasah structures following adaptive reuse, variables such as hierarchy, privacy, and visual perception are addressed. Therefore, Axial Analysis, which focuses on urban fabrics and long distance networks, and Isovist Maps, which analyze the structure from a single viewpoint, were not used in this study. Instead, VGA (Visual Graph Analysis), which examines the visibility and perception of spaces by considering all possible points within the structure, and Convex Map Analysis, which treats each space as a convex polygon and allows for the processing of circulation relationships between these polygons, were employed.

In this research, the case studies were analyzed using the space syntax method through the depthmapX software, based on three core parameters as connectivity, integration, and mean depth. The integration parameter was examined to determine whether the space with the highest social interaction potential, which in the original plan layout functioned as the social core of the building and held the highest integration value, had shifted as a result of the interventions carried out for the new function. This analysis aimed to identify whether the social focal point of the building had changed.

The connectivity parameter was employed to assess the adjacency relationships between spaces within the structure configuration. Any changes in this parameter resulting from the interventions influence the outcomes of the other parameters and provide quantitative insights into whether permeability and privacy within the building have been altered. Mean depth analyses were conducted to examine changes in privacy and accessibility levels within the spatial layout following the interventions implemented to accommodate the structure's new function. This approach made it possible to assess whetheher the accessibility, reachability, and varying degrees of spatial privacy required by the new function correspond to or conflict with the building's original spatial configuration.

5.1 Findings

5.1.1 Sırçalı Madrasah

Within the scope of the study, space syntax analyses were conducted on Sırçalı Madrasah. The original plan of the building and its analysis values are presented in Figure 5.1 and Table 5.1. The plan and analysis values for the building's current function are shown in Figure 5.2 and Table 5.2.

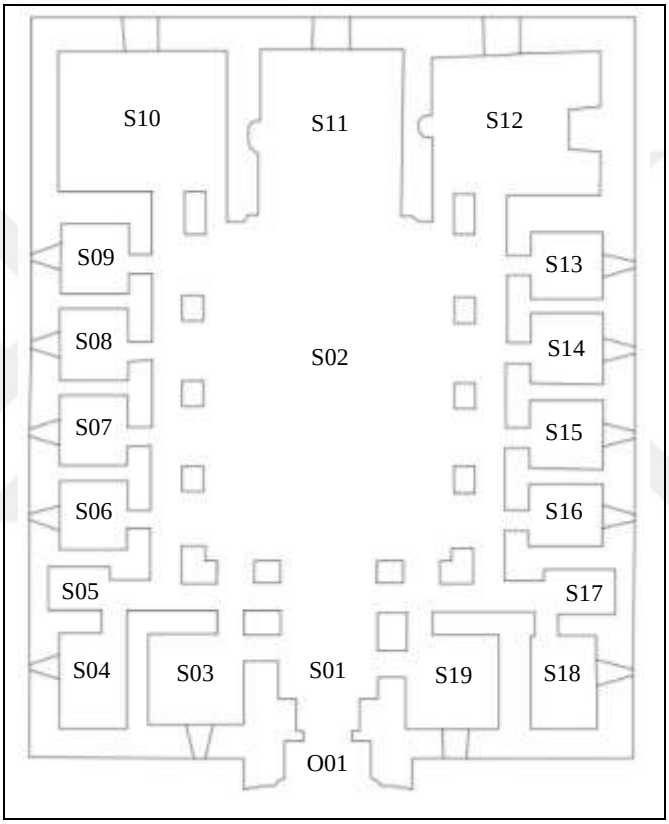


Figure 5.1 Plan of Sırçalı Madrasah

Table 5.1 Analysis values of Sırçalı Madrasah

Space	Connectivity	Integration	Mean Depth
O01	1	1.0402535	2.9473684
S01	2	2.0257571	2
S02	16	12.829794	1.1578947
S03	1	1.8328277	2.1052632
S04	1	1.0402535	2.9473684
S05	2	2.0257571	2
S06	1	1.8328277	2.1052632
S07	1	1.8328277	2.1052632

Table 5.1 (continued) Analysis values of Sırçalı Madrasah

S08	1	1.8328277	2.1052632
S09	1	1.8328277	2.1052632
S10	1	1.8328277	2.1052632
S11	1	1.8328277	2.1052632
S12	1	1.8328277	2.1052632
S13	1	1.8328277	2.1052632
S14	1	1.8328277	2.1052632
S15	1	1.8328277	2.1052632
S16	1	1.8328277	2.1052632
S17	2	2.0257571	2
S18	1	1.0402535	2.9473684
S19	1	1.8328277	2.1052632

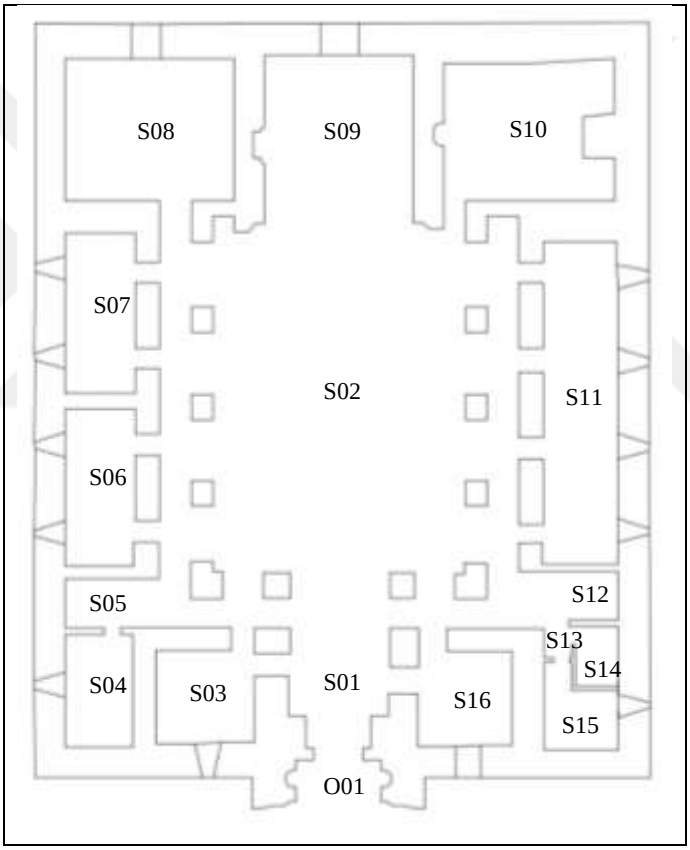


Figure 5.2 Plan of Sırçalı Madrasah's new function

Table 5.2 Analysis values of Sırçalı Madrasah's new function

Space	Connectivity	Integration	Mean Depth
O01	1	0.83629727	3.1875
S01	2	1.4635203	2.25
S02	11	4.1814866	1.4375
S03	1	1.3304729	2.375

Table 5.2 (continued) Analysis values of Sırçalı Madrasah's new function

S04	1	0.83629727	3.1875
S05	2	1.4635203	2.25
S06	1	1.3304729	2.375
S07	1	1.3304729	2.375
S08	1	1.3304729	2.375
S09	1	1.3304729	2.375
S10	1	1.3304729	2.375
S11	1	1.3304729	2.375
S12	2	1.8294003	2
S13	3	1.084089	2.6875
S14	1	0.69691443	3.625
S15	1	0.69691443	3.625
S16	1	1.3304729	2.375

In the maps obtained as a result of the convex space analysis, the spaces are categorized according to their degree of integration, with red representing the most integrated space in terms of accessibility, and dark blue representing the most segregated space.

In the convex space analyses conducted, the courtyard (S02) was the most integrated space in terms of accessibility in both the madrasah and museum plans. This is visible in red on the convex space integration map. As can be seen from the convex space analyses, changes occurred in the analysis results after the changes made to the madrasah's current functional plan. As a result, the integration value of the spaces containing the staircase became higher than many other spaces in the new plan layout (S05, S12), and this is shown in light blue in the analysis. Furthermore, while both spaces (S05, S17) had the same integration value in the madrasah function, the situation changed in the plan belonging to the new function. This is due to changes in the integration parameter following the changes to the wet area layout in the new function. Additionally, while the restrooms (S14, S15) are shown in dark blue in the analysis, the integration value of the common area (S13), which connects to two wet areas, is higher than that of the restrooms and is shown in light blue. The visible area analyses performed range from red to dark blue: red represents the most integrated areas in terms of visibility, while dark blue represents the most isolated areas. The most integrated area in terms of visibility at Sırçalı Madrasa, both in the madrasa-function plan and the museum-function plan, is the center of the courtyard (Figure

5.3), as seen in the integration map (Figure 5.4). The most integrated areas are the iwans and porticoes within the building.



Figure 5.3 Courtyard of Sırçalı Madrasah (Photograph by the author, 2025)

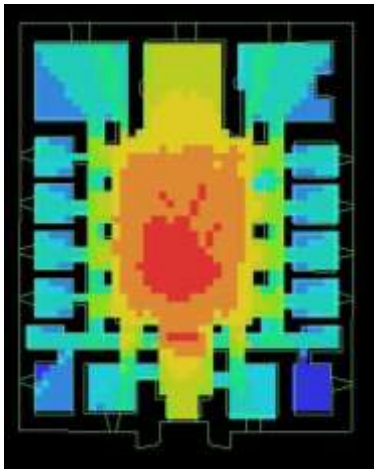
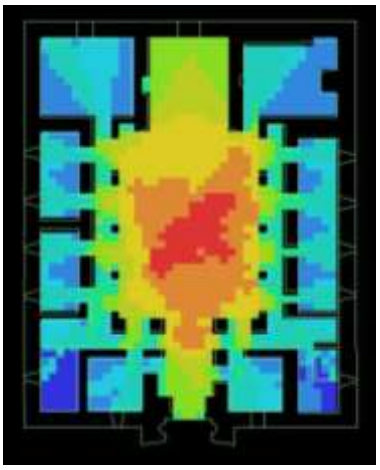
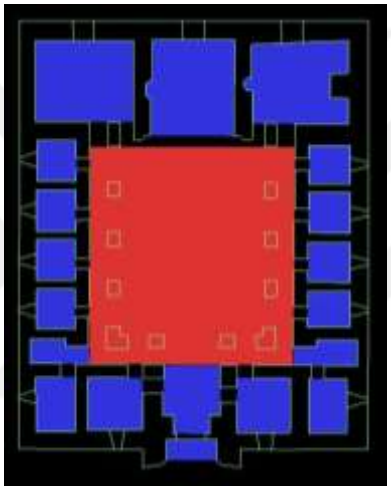
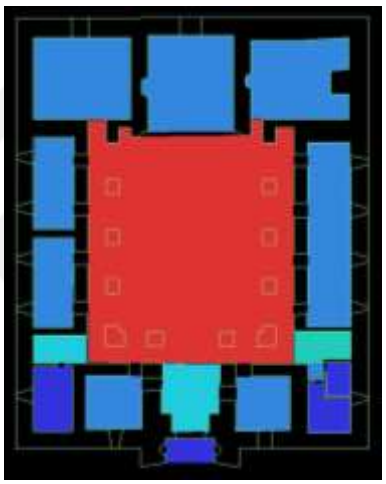
	Madrasah Function	New Function
VGA		
Convex Map Analysis		

Figure 5.4 Sırçalı Madrasah's integration analysis

As can be seen in the red color in the convex space analysis and the visible area analysis, the courtyard is the space with the highest connectivity value in the Sırçalı Madrasa. The result is the same in both the madrasa's plan and the current museum plan. This indicates a strong connection between the courtyard and the other spaces of the madrasa. As seen in the convex space analyses, the analysis results have changed after the changes made to achieve the madrasa's current museum plan. As a result, the spaces containing the staircase and the common area connecting to the two wet areas are the spaces with the highest connectivity value in the new plan layout. This is reflected in the light blue tones in the analysis (Figure 5.5).

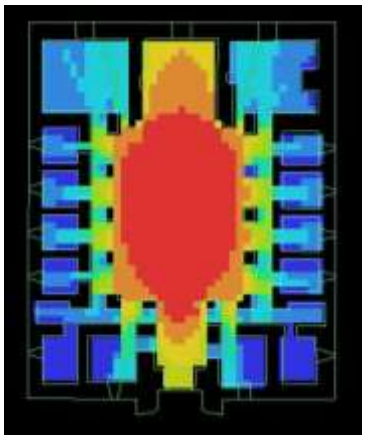
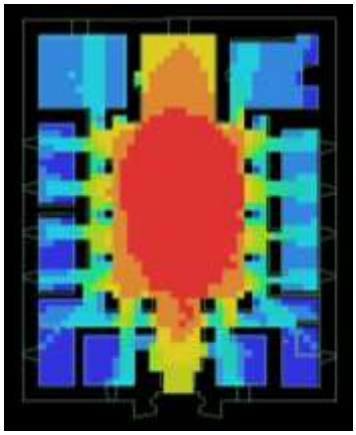
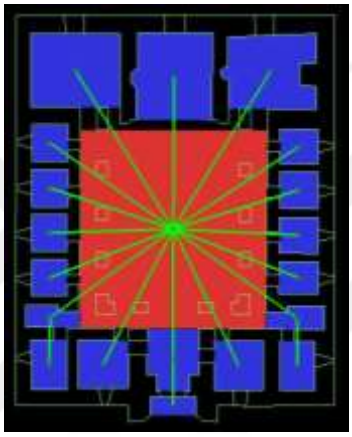
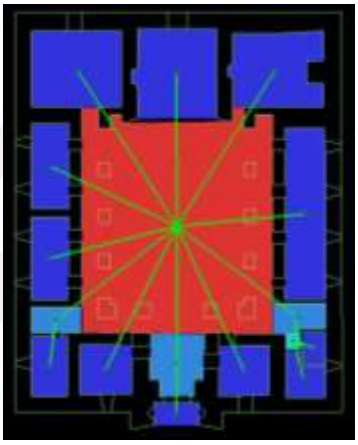
	Madrasah Function	New Function
VGA		
Convex Map Analysis		

Figure 5.5 Sırçalı Madrasah's connectivity analysis

In the depth analyses (Figure 5.6), red represents high depth, meaning areas with high privacy, while dark blue represents low depth. According to the visible area analysis and the convex space analysis, the space with the lowest depth in terms of accessibility is the courtyard in both the madrasah and museum plans, and this is indicated by dark blue on the map. Following changes made to the museum function, differences have occurred in the spaces with the highest depth. This is reflected in the convex space analyses. Spaces with the highest depth have lower accessibility and are indicated by red in the analyses.

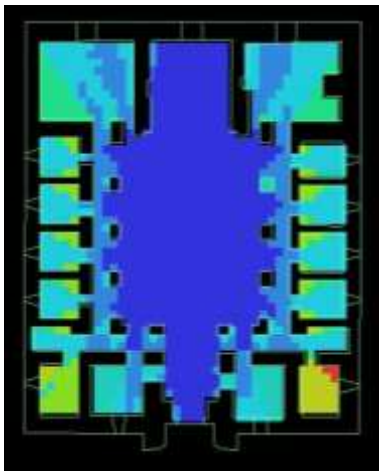
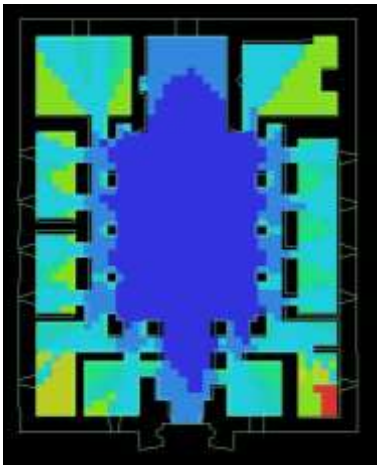
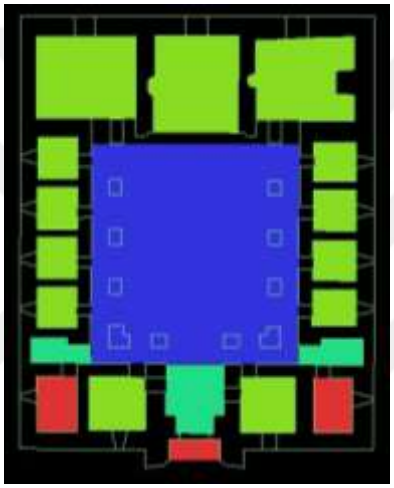
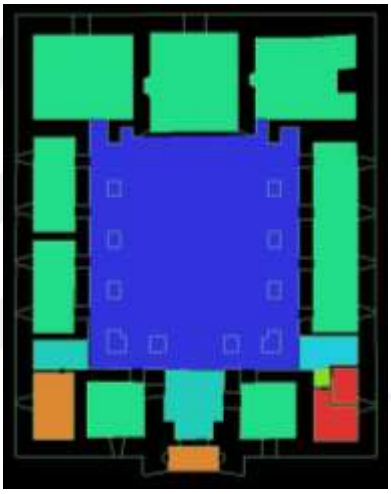
	Madrasah Function	New Function
VGA		
Convex Map Analysis		

Figure 5.6 Sırçalı Madrasah's mean depth analysis

5.1.2 Karatay Madrasah

Within the scope of the research, space syntax analyses were conducted on Karatay Madrasah. The original plan of the building and the corresponding analysis values are presented in Figure 5.7 and Table 5.3. The plan and analysis values for the building's current function are shown in Figure 5.8 and Table 5.4.

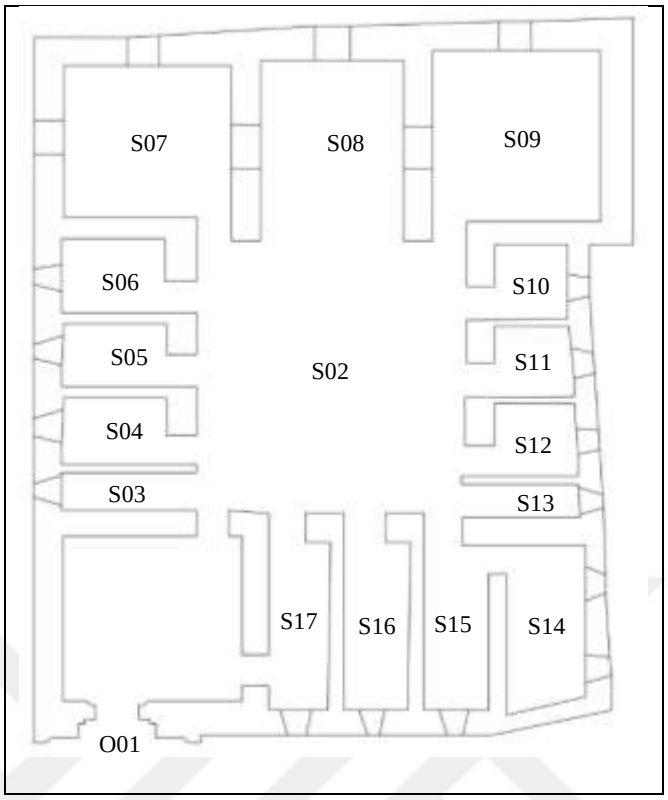


Figure 5.7 Plan of Karatay Madrasah

Table 5.3 Analysis values of Karatay Madrasah

Space	Connectivity	Integration	Mean Depth
O01	1	1.0408187	2.8235295
S01	3	2.1510253	1.8823529
S02	15	16.13269	1.1176471
S03	1	1.7925211	2.0588236
S04	1	1.7925211	2.0588236
S05	1	1.7925211	2.0588236
S06	1	1.7925211	2.0588236
S07	1	1.7925211	2.0588236
S08	1	1.7925211	2.0588236
S09	1	1.7925211	2.0588236
S10	1	1.7925211	2.0588236
S11	1	1.7925211	2.0588236
S12	1	1.7925211	2.0588236
S13	1	1.7925211	2.0588236
S14	1	1.0082932	2.8823528
S15	2	2.0165863	1.9411764
S16	1	1.7925211	2.0588236
S17	2	2.0165863	1.9411764

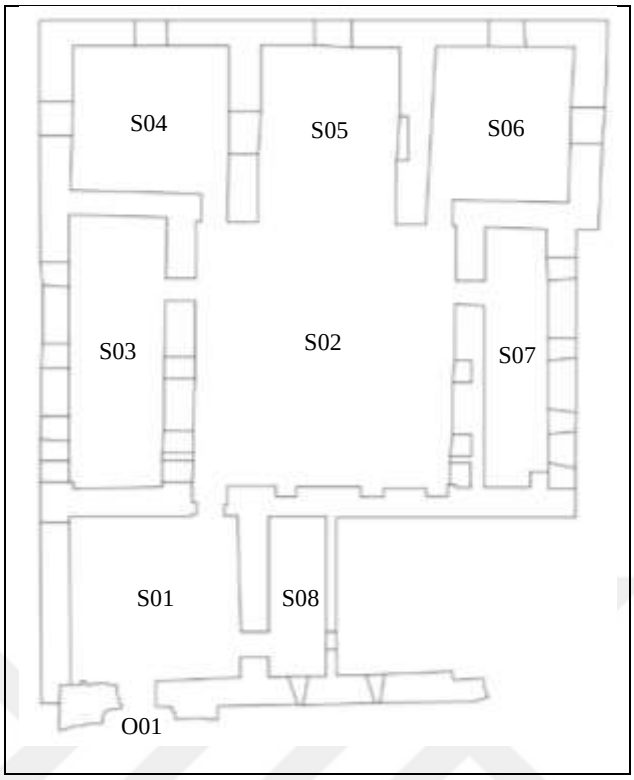


Figure 5.8 Plan of Karatay Madrasah's new function

Table 5.4 Analysis values of Karatay Madrasah's new function

Space	Connectivity	Integration	Mean Depth
O01	1	0.73918515	2.5
S01	3	1.7740444	1.625
S02	6	4.435111	1.25
S03	1	0.98558021	2.125
S04	1	0.98558021	2.125
S05	1	0.98558021	2.125
S06	1	0.98558021	2.125
S07	1	0.98558021	2.125
S08	1	0.73918515	2.5

In the convex space analysis related to accessibility, the most integrated space in both the original madrasa plan and the current use as the "Tile Artifacts Museum" is the courtyard (Figure 5.9), which is indicated in red on the map (S02). Changes in the plan due to the new function have resulted in alterations in the parameter values. This is reflected in the analysis of the current plan, where the entrance space of the madrasa (S01) becomes one of the spaces with the highest integration values in the new layout, causing its color to shift from dark blue to lighter blue tones.



Figure 5.9 Courtyard of Karatay Madrasah (Photograph by the author, 2025)

According to the data obtained from the visual (VGA) analysis, the space with the highest visual integration in both the original madrasa and the current museum is the central part of the courtyard, as indicated by red-orange colors in the analyses. However, changes in the plan have also affected the integration values obtained from the visual analysis. This effect is particularly observed in the main iwan classrooms (S08, S05), the cell adjacent to the entrance (S17, S08), and in the cells repurposed as exhibition areas (S03) and storage (S07) after the removal of intermediate walls. As a result of the decreased integration value of the iwan, its color shifts from orange to green; in the cell adjacent to the entrance, the color changes from light blue to dark blue; and in the exhibition spaces, areas with low integration values are increasingly represented by dark blue. This pattern can be observed in the visual integration map (Figure 5.10).

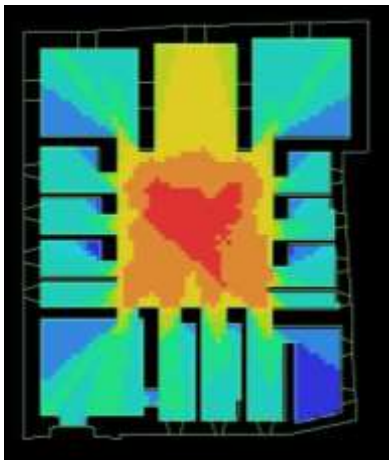
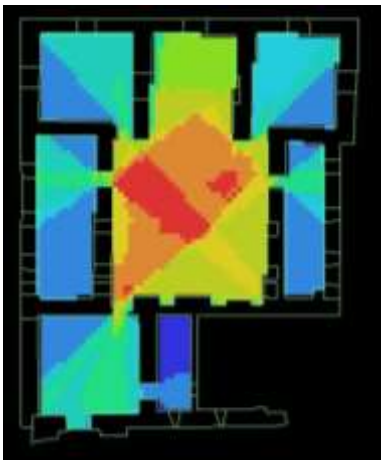
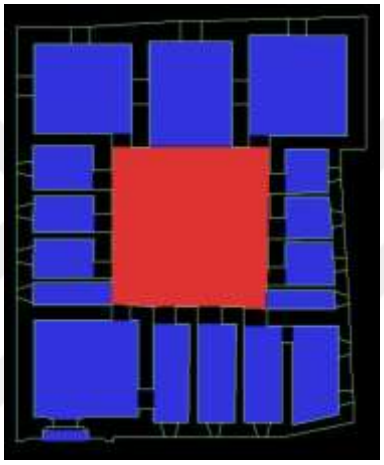
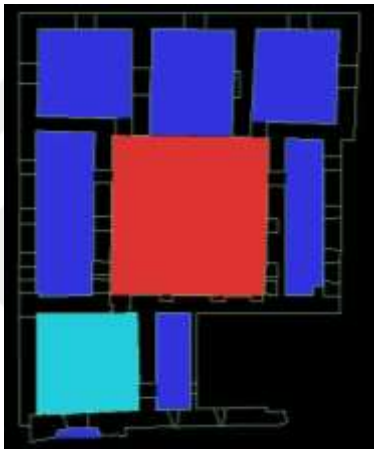
	Madrasah Function	New Function
VGA		
CONVEX		

Figure 5.10 Karatay Madrasah's integration analysis

In both the convex space and visual analyses, the courtyard remains the space with the highest connectivity for both the madrasa and the current museum function, as indicated by red on the maps. This demonstrates the strong relational structure of the courtyard with other spaces in the building. In the original madrasa, the courtyard shows high connectivity as it directly relates to the student cells, the tomb (S07), the iwan classroom, and the winter classroom (Figure 5.11) (S09). In the current museum layout, however, changes in the plan have made the entrance space one of the areas with high connectivity in the new layout, indicated by light blue in the analysis. The impact of plan modifications is also observable in the visual connectivity analysis, where the red areas representing high connectivity in the courtyard have decreased. Moreover, a cell that was originally directly connected to the courtyard now exhibits

reduced connectivity in the current museum plan, represented by dark blue (Figure 5.12).



Figure 5.11 Current use of Karatay Madrasah's winter classroom (Photograph by the author, 2025)

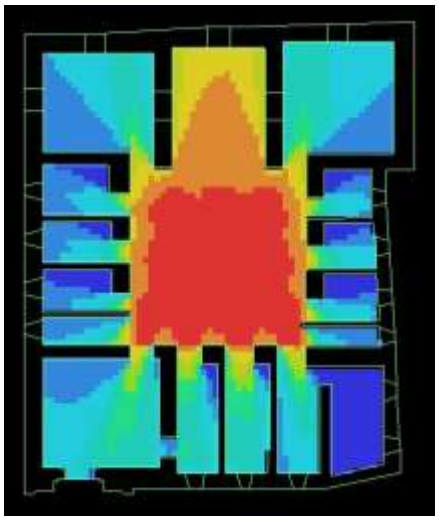
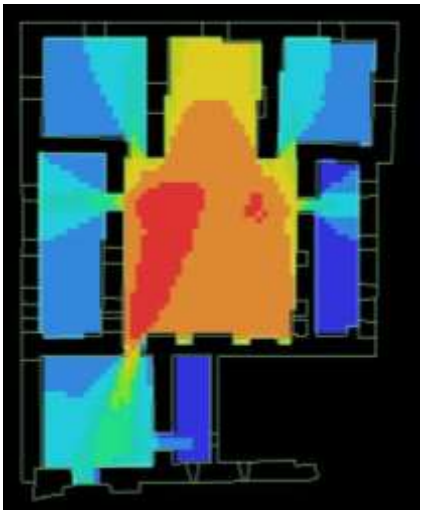
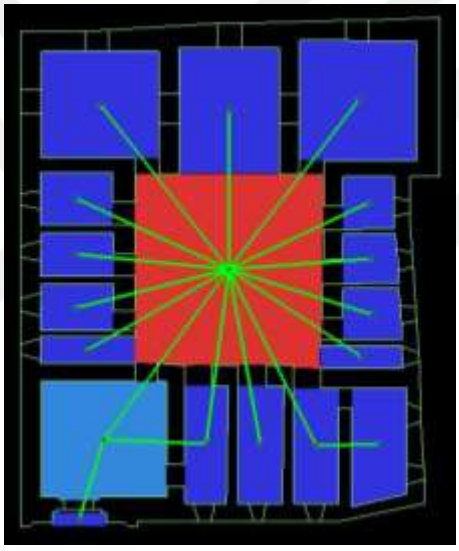
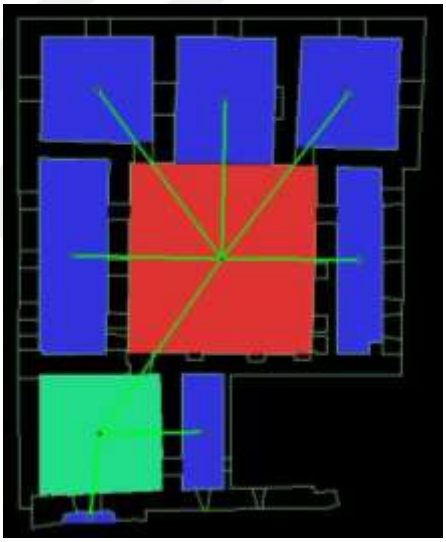
	Madrasah Function	New Function
VGA		
Convex Map Analysis		

Figure 5.12 Karatay Madrasah's connectivity analysis

According to the data obtained from the visual area (VGA) analyses, the space with the lowest depth value is the courtyard. This holds true for both the madrasa function and the current museum function, and it is represented in dark blue in the analyses. Changes in the plan are observable in the depth analyses of the current layout. The area represented in dark blue, indicating the low depth value of the main iwan classroom, has decreased, while the cells used as storage and exhibition spaces (Figure 5.13) show an increase in areas represented by green to yellow colors. Areas with high depth values, indicated in red, correspond to the northern space in the original madrasa plan, whereas in the museum layout, the space immediately adjacent to the entrance

exhibits this condition. These changes are also reflected in the convex space analyses through the use of different colors (Figure 5.14).



Figure 5.13 Exhibition space (Photograph by the author, 2025)

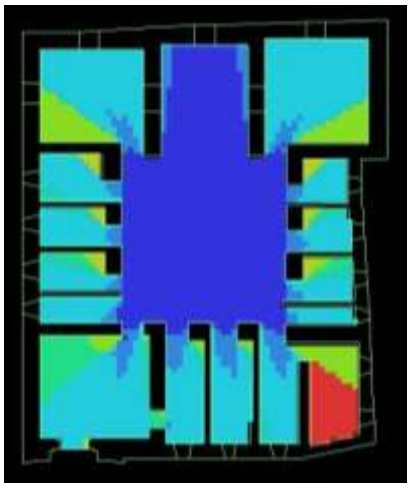
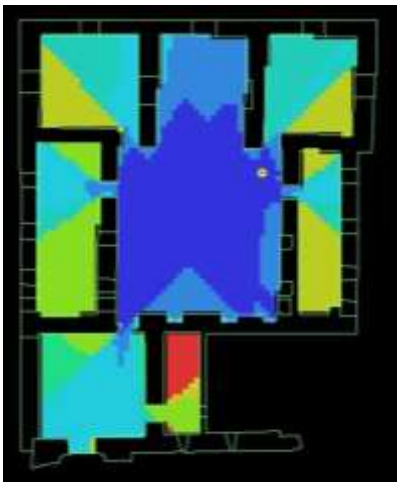
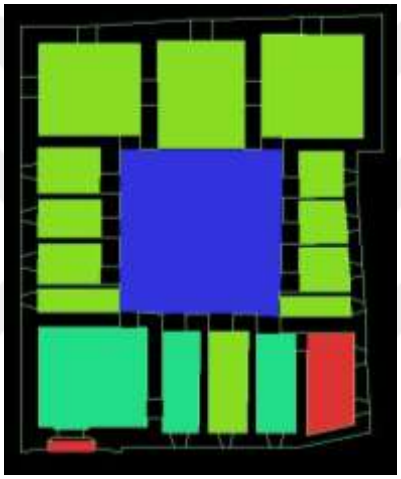
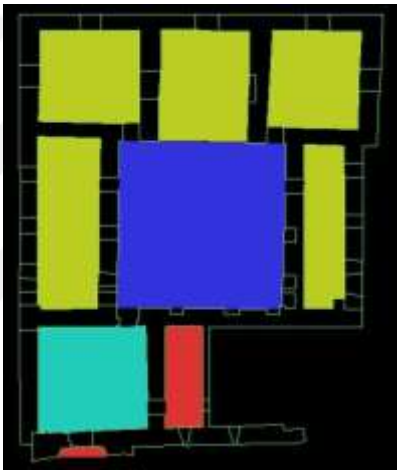
	Madrasah Function	New Function
VGA		
CONVEX		

Figure 5.14 Karatay Madrasah's mean depth analysis

5.1.3 Ince Minareli Madrasah

Within the scope of the study, space syntax analyses were conducted on Sırçalı Madrasah. The original plan of the building and its analysis values are presented in Figure 5.15 and Table 5.5. The plan and analysis values for the building's current function are shown in Figure 5.16 and Table 5.6.

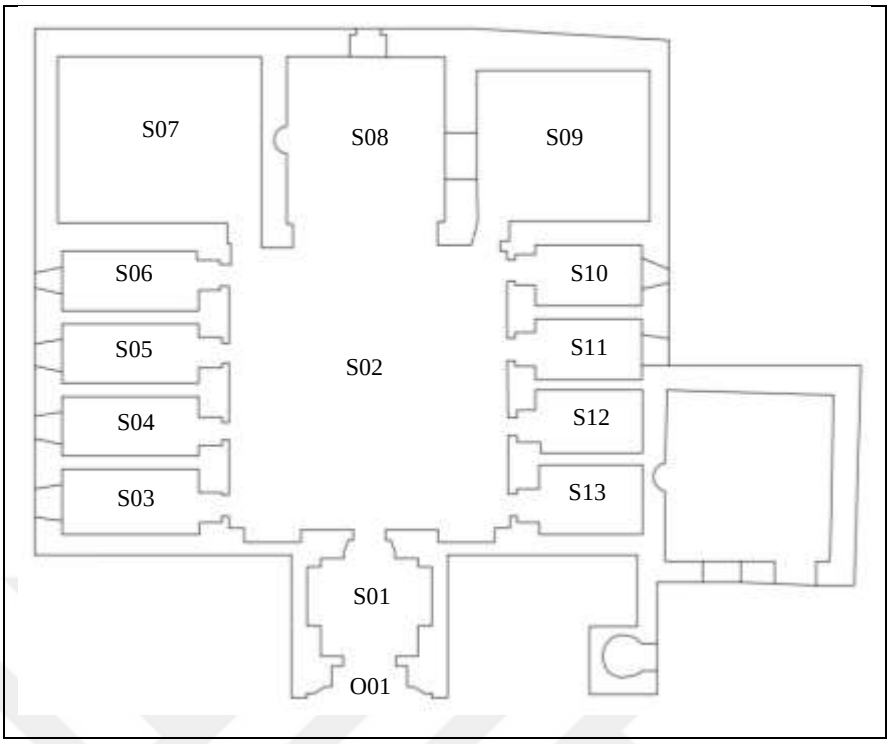


Figure 5.15 Plan of İnce Minareli Madrasah

Table 5.5 Analysis values of İnce Minareli Madrasah

Space	Connectivity	Integration	Mean Depth
O01	1	0.90480542	2.7692308
S01	2	1.8918658	1.8461539
S02	12	20.810526	1.0769231
S03	1	1.6008096	2
S04	1	1.6008096	2
S05	1	1.6008096	2
S06	1	1.6008096	2
S07	1	1.6008096	2
S08	1	1.6008096	2
S09	1	1.6008096	2
S10	1	1.6008096	2
S11	1	1.6008096	2
S12	1	1.6008096	2
S13	1	1.6008096	2

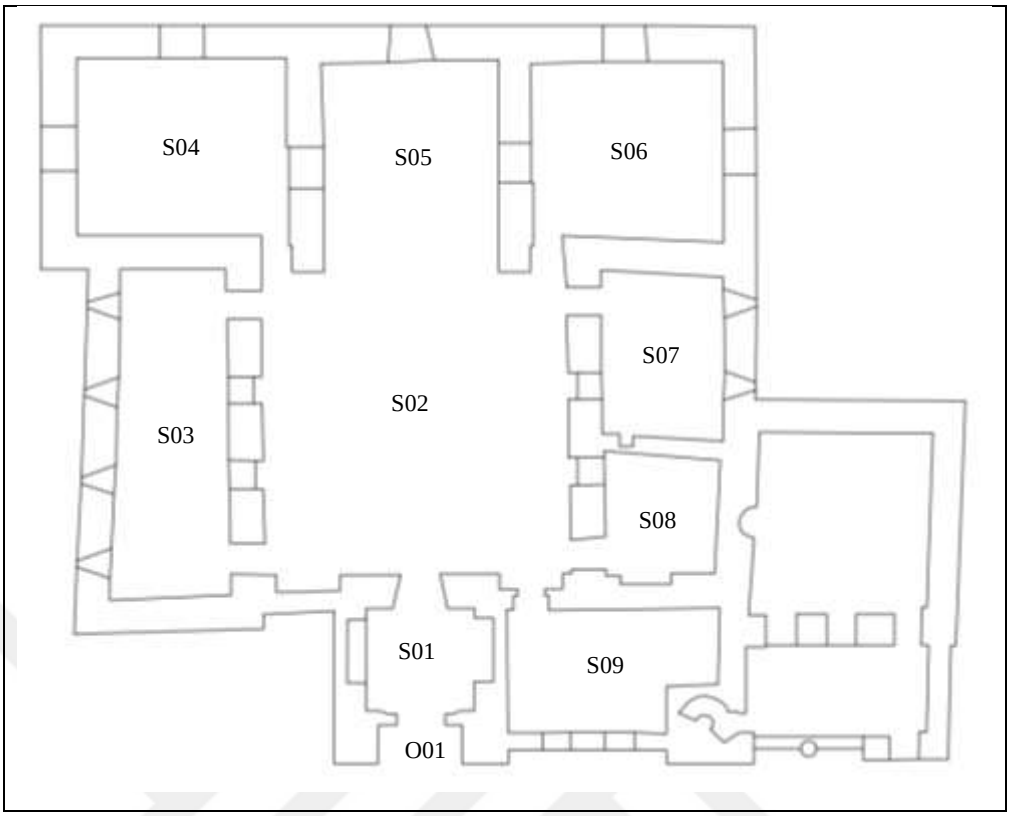


Figure 5.16 Plan of İnce Minareli Madrasah's new function

Table 5.6 Analysis values of İnce Minareli Madrasah's new function

Space	Connectivity	Integration	Mean Depth
O01	1	0.73333335	2.6666667
S01	2	1.5714285	1.7777778
S02	8	11	1.1111112
S03	1	1.2222222	2
S04	1	1.2222222	2
S05	1	1.2222222	2
S06	1	1.2222222	2
S07	1	1.2222222	2
S08	1	1.2222222	2
S09	1	1.2222222	2

The integration data obtained from the visual area analyses demonstrate, through the red–orange color spectrum, that the courtyard is the most integrated space in both the madrasa function and the current museum function (Figure 5.17). The newly created space, formed by enclosing the area between the entrance and the minaret, has led to changes in the integration values, similar to the shifts observed in connectivity. Another factor contributing to this transformation is the conversion of cells into

exhibition and storage spaces through the removal of partition walls. As a result of these modifications, the most integrated zones of the courtyard, indicated in red, have shifted in position, extending toward the entrance space and the newly created area.

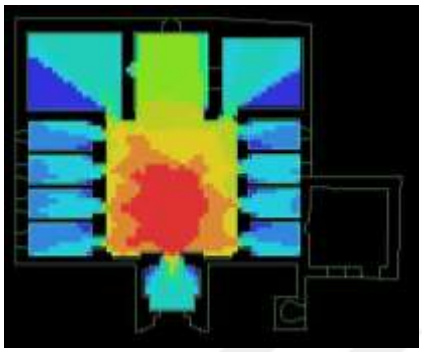
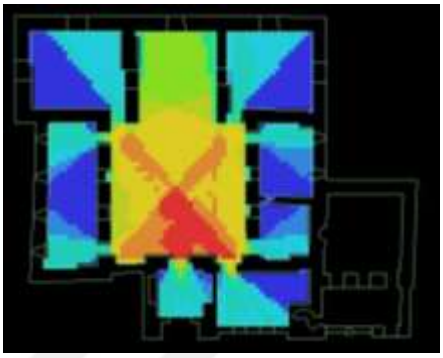
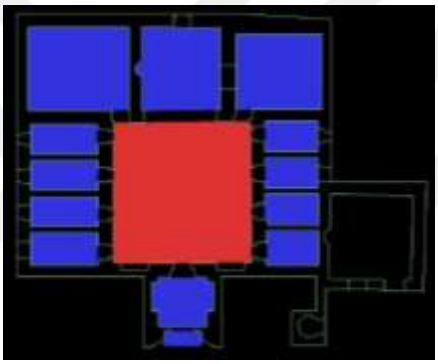
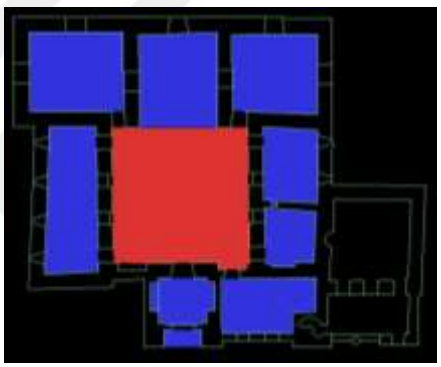
	Madrasah Function	New Function
VGA		
CONVEX		

Figure 5.17 İnce Minareli Madrasah's integration analysis

In the convex space analyses (Figure 5.18), spaces with high connectivity values are represented in red, while those with low values are shown in dark blue. In the İnce Minareli Madrasa, constructed in Konya, the convex space analyses reveal that the courtyard (S02) is the space with the highest connectivity value. This result is consistent in both the original madrasa function and the current museum plan. The courtyard demonstrates high connectivity due to its direct relationship with multiple different spaces.

However, alterations in the plan have led to changes in the overall connectivity values of the building. As seen in the convex analyses, the original eight cells were transformed into three larger spaces after the removal of the partition walls. These new spaces currently function as exhibition areas (S03, S07) and storage (S08) for the

museum. Another significant alteration occurred with the closure of the area between the entrance space (S01) and the mosque's minaret, resulting in the addition of a new space to the structure. This newly created space (S09), now used as an exhibition hall in the museum, differs from the madrasa layout by having direct access from the courtyard. Consequently, in the new plan, the connectivity values of these redefined spaces increased, which is reflected in the convex analyses by their color shift from dark blue to lighter blue.

In the visual area analyses, the courtyard remains the space with the highest connectivity value, indicated by red–orange. Following the plan modifications, the connectivity value of the iwan (S08, S05) has also changed. While in the madrasa plan the iwan was represented within the yellow–green spectrum, in the current museum plan it is depicted in red–orange. This indicates that, as a result of the spatial transformations, the iwan has become one of the highly connected spaces within the new functional system.

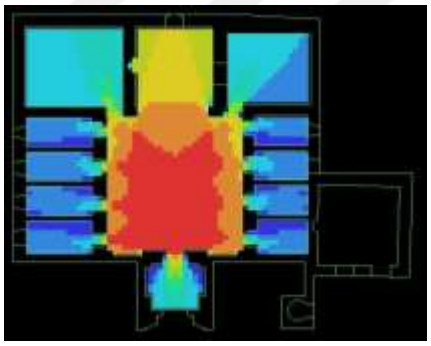
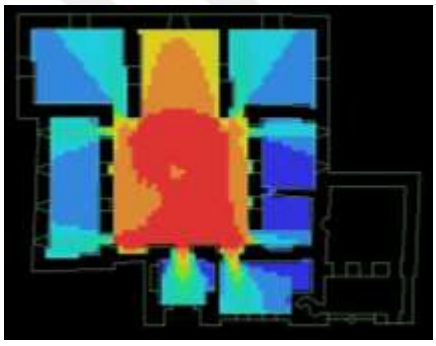
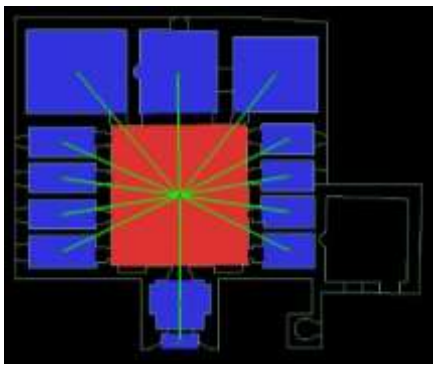
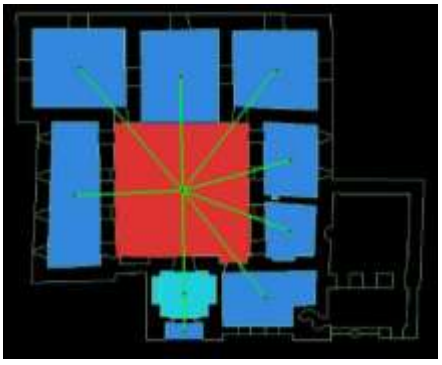
	Madrasah Function	**New Function**
VGA		
Convex Map Analysis		

Figure 5.18 İnce Minareli Madrasah's connectivity analysis

In the convex space analyses of the İnce Minareli Madrasa, spaces with high depth values are represented in red, while those with low values are indicated in dark blue. The analyses reveal that the courtyard is the space with the lowest depth value (Figure 5.19). This finding is also supported by the results of the visual area analyses. However, modifications to the plan have led to noticeable changes in the depth values. In the original madrasa plan, the areas with the highest depth values, represented in red on the visual depth map, were confined to small zones within the student cells. In the new layout, these spaces have been redefined as storage and exhibition areas, leading to an increase in the extent of the red-colored zones. Furthermore, in the spaces located on either side of the main iwan, which originally served as classrooms and are currently used as the museum's "Stone Artifacts Exhibition" halls, the areas represented in orange have expanded, indicating higher depth values in the current configuration.

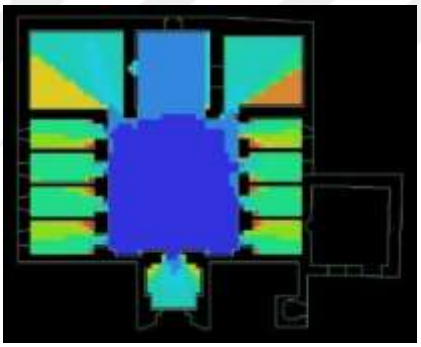
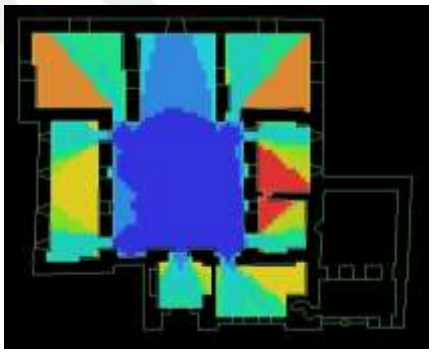
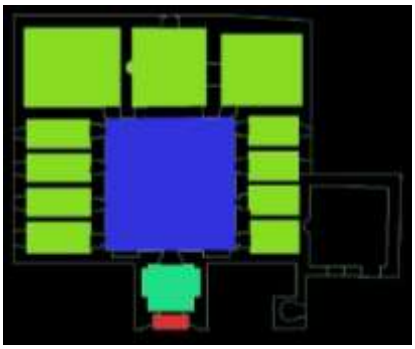
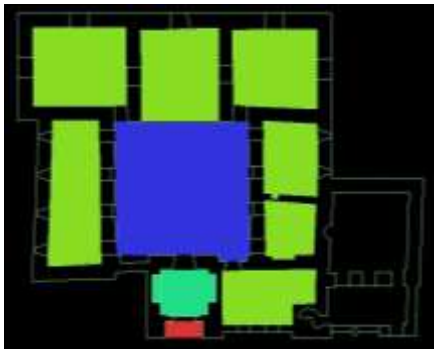
	Madrasah Function	**New Function**
VGA		
CONVEX		

Figure 5.19 İnce Minareli Madrasah's mean depth analysis

5.1.4 Rüstempaşa Madrasah

Within the scope of the research, space syntax analyses were conducted on Rüstempaşa Madrasah. The original plan of the building and the corresponding analysis values are presented in Figure 5.20 and Table 5.7. The plan and analysis values for the building's current function are shown in Figure 5.21 and Table 5.8.

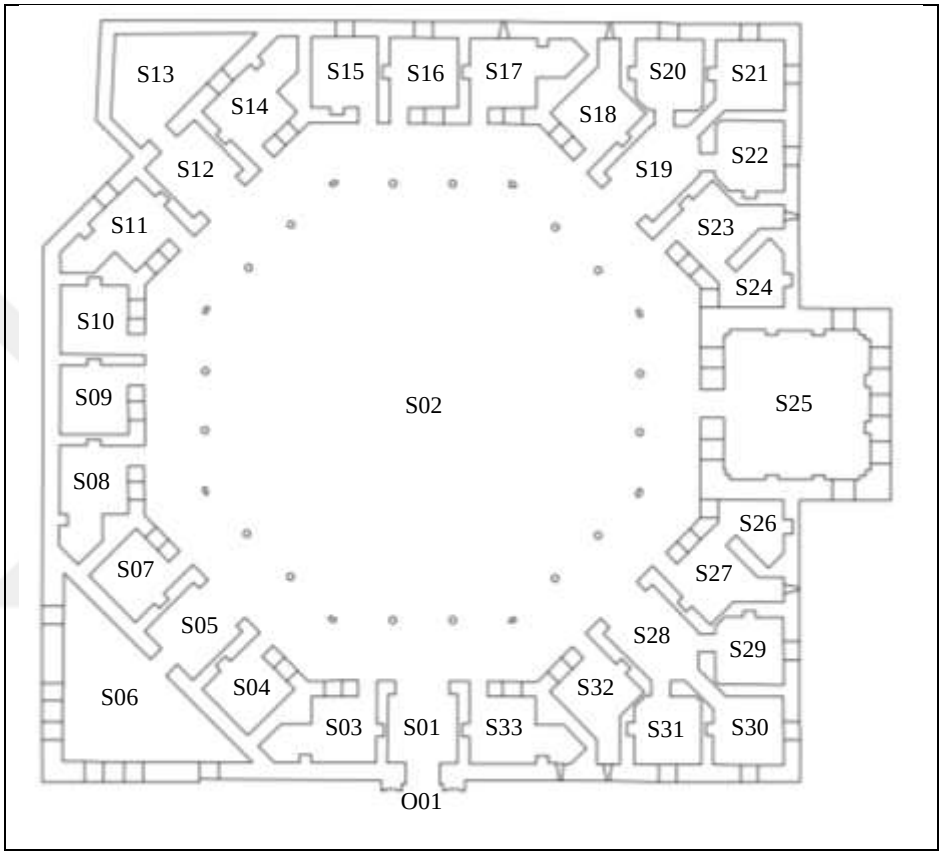


Figure 5.20 Plan of Rüstempaşa Madrasah

Table 5.7 Analysis values of Rüstempaşa Madrasah

Space	Connectivity	Integration	Mean Depth
O01	1	1.2176538	3.2121212
S01	2	2.1680176	2.2424242
S02	22	8.0807934	1.3333334
S03	1	2.0671797	2.3030303
S04	1	2.0671797	2.3030303
S05	2	2.1680176	2.2424242
S06	1	1.2176538	3.2121212
S07	1	2.0671797	2.3030303
S08	1	2.0671797	2.3030303
S09	1	2.0671797	2.3030303
S10	1	2.0671797	2.3030303
S11	1	2.0671797	2.3030303
S12	2	2.1680176	2.2424242
S13	1	1.2176538	3.2121212
S14	1	2.0671797	2.3030303
S15	1	2.0671797	2.3030303
S16	1	2.0671797	2.3030303
S17	1	2.0671797	2.3030303
S18	1	2.0671797	2.3030303
S19	4	2.4023979	2.121212
S20	1	1.2882423	3.090909
S21	1	1.2882423	3.090909
S22	1	1.2882423	3.090909
S23	2	2.1680176	2.2424242
S24	1	1.2176538	3.2121212
S25	1	2.0671797	2.3030303
S26	1	1.2176538	3.2121212
S27	2	2.1680176	2.2424242
S28	4	2.4023979	2.121212
S29	1	1.2882423	3.090909
S30	1	1.2882423	3.090909
S31	1	1.2882423	3.090909
S32	1	2.0671797	2.3030303
S33	1	2.0671797	2.3030303

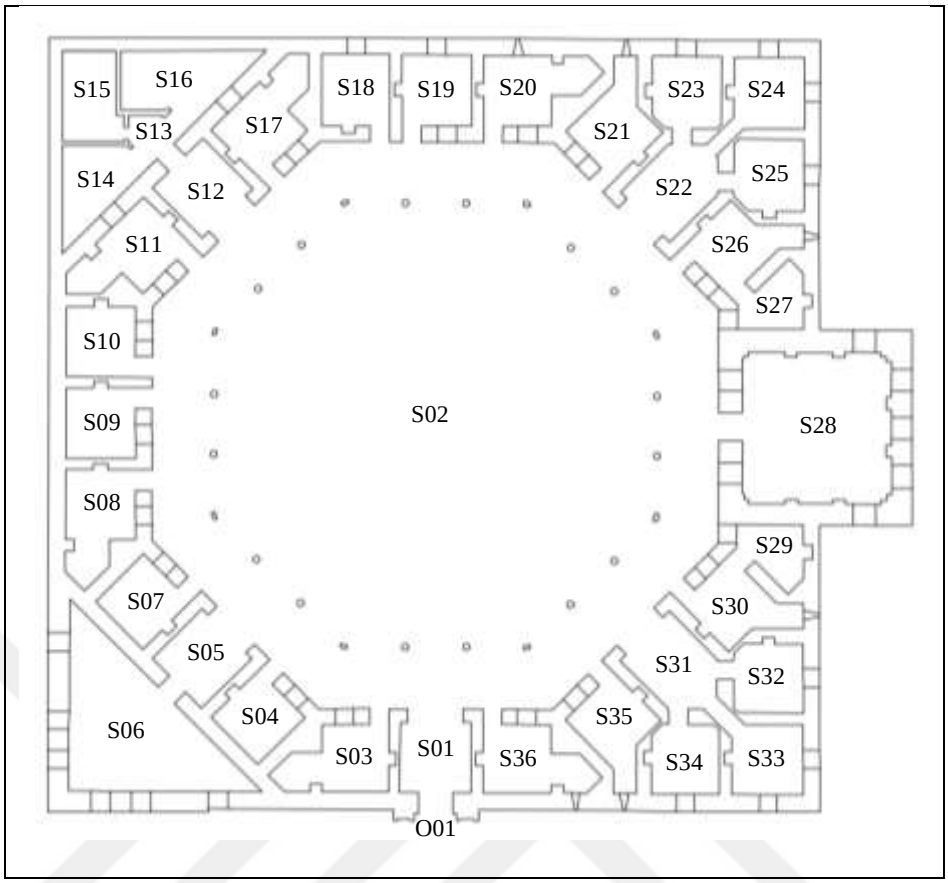


Figure 5.21 Plan of Rüstempaşa Madrasah's new function

Table 5.8 Analysis values of Rüstempaşa Madrasah's new function

Space	Connectivity	Integration	Mean Depth
O01	1	1.1872503	3.3611112
S01	2	2.0183253	2.3888888
S02	22	5.9362512	1.4722222
S03	1	1.9406976	2.4444444
S04	1	1.9406976	2.4444444
S05	2	2.0183253	2.3888888
S06	1	1.1872503	3.3611112
S07	1	1.9406976	2.4444444
S08	1	1.9406976	2.4444444
S09	1	1.9406976	2.4444444
S10	1	1.9406976	2.4444444
S11	1	1.9406976	2.4444444
S12	2	2.2935517	2.2222223
S13	4	1.3824147	3.0277777
S14	1	0.93440992	4
S15	1	0.93440992	4
S16	1	0.93440992	4
S17	1	1.9406976	2.4444444
S18	1	1.9406976	2.4444444
S19	1	1.9406976	2.4444444
S20	1	1.9406976	2.4444444
S21	1	1.9406976	2.4444444
S22	4	2.1938319	2.2777777
S23	1	1.2458799	3.25
S24	1	1.2458799	3.25
S25	1	1.2458799	3.25
S26	2	2.0183253	2.3888888
S27	1	1.1872503	3.3611112
S28	1	1.9406976	2.4444444
S29	1	1.1872503	3.3611112
S30	2	2.0183253	2.3888888
S31	4	2.1938319	2.2777777
S32	1	1.2458799	3.25
S33	1	1.2458799	3.25
S34	1	1.2458799	3.25
S35	1	1.9406976	2.4444444
S36	1	1.9406976	2.4444444

In the convex space analyses conducted in relation to accessibility, the most integrated space of both the madrasa and the museum is the courtyard, as represented in red on the maps in Figure 5.22. In the madrasa function, the most segregated spaces as shown in dark blue are the student cells located in the corners (S20, S21, S22, S29, S30, S31)

and adjacent to the iwan (S24, S26), as well as the bath-toilet (gusülhane-hela, S13) and the kitchen-bath unit (S06). In the museum function, however, the newly added spaces also display low integration values. Furthermore, modifications to the plan have altered the integration values of certain spaces. In the new layout, circulation spaces that directly connect to the courtyard and provide access to the rooms behind, as well as two cells located near the iwan, exhibit increased integration values, a shift represented in the analyses by light blue tones.

The finding that the courtyard is the most integrated space of both the Rüstem Paşa Madrasa and the Bediüzzaman Said Nursi Museum is also supported by the results of the visual area analysis, where the integration map shows the courtyard rendered in red, orange, yellow, and green tones. The other spaces within the plan, by contrast, display lower integration values and are expressed in shades of blue to dark blue.

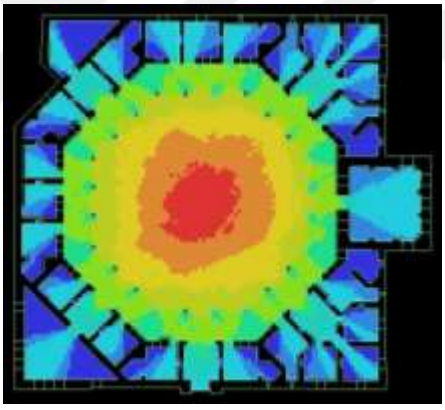
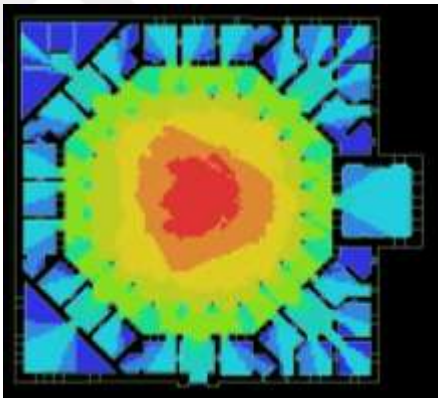
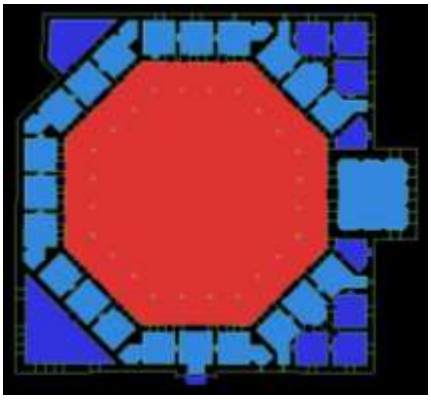
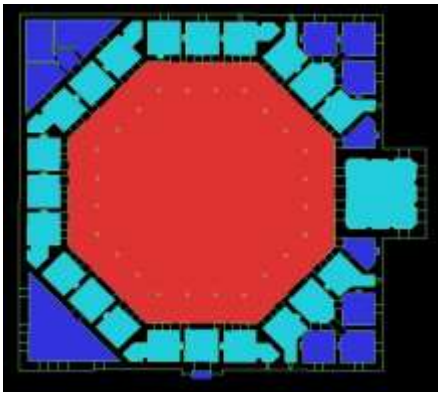
	Madrasah Function	**New Function**
VGA		
Convex Map Analysis		

Figure 5.22 Rüstempaşa Madrasah's integration analysis

According to the space syntax method, the space with the highest connectivity value in the Rüstem Paşa Madrasa is the courtyard, represented in red in the convex space analyses for both the original madrasa plan and its current museum function (Figure 5.23). In the madrasa layout, the circulation spaces (S19, S28) that provide access to the corner cells follow the courtyard (S02), whereas in the museum plan, an additional space (S13) that provides access to the wet areas is also included in this category. These highly connected spaces are represented in light blue in the convex analyses of both plans. In the visual area analyses, the highest connectivity values, indicated by red and orange, are observed within the courtyard. The arcaded (riwaq) section of the courtyard, however, is represented in yellow, reflecting a lower connectivity value compared to the rest of the courtyard. This result is consistent in the analyses of both functional layouts. The condition in which the courtyard has high connectivity in the convex analysis but a lower connectivity in the arcaded section in the visual analysis can be explained by the presence of columns within the courtyard, which obstruct sight lines and thus reduce the visual connectivity values.

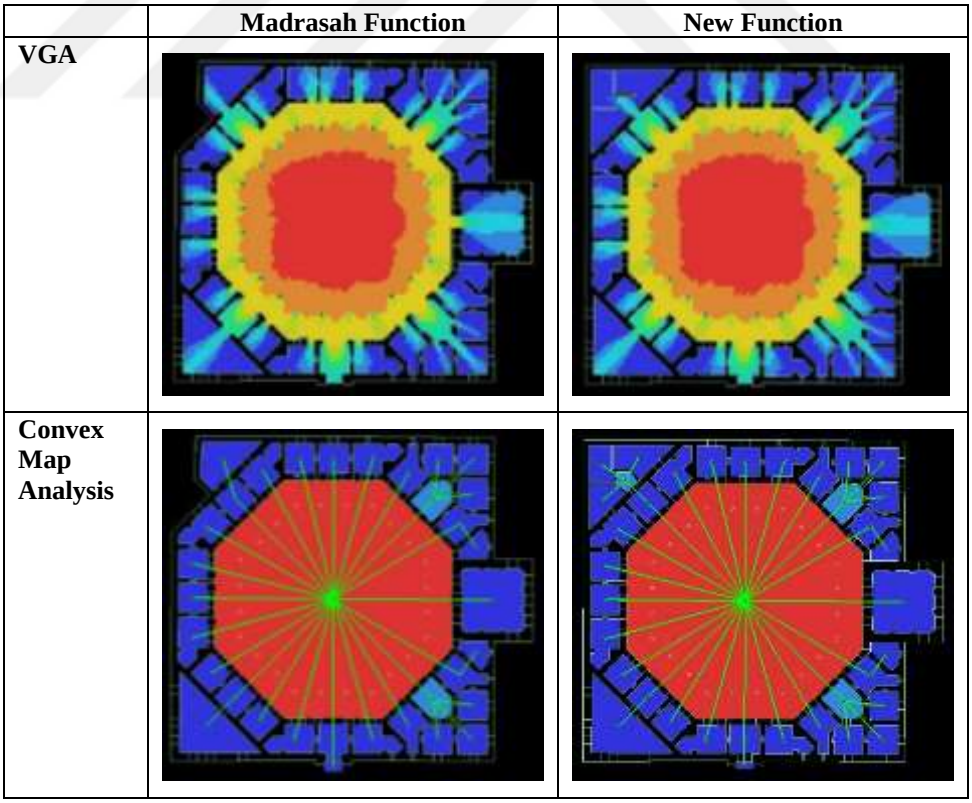


Figure 5.23 Rüstempaşa Madrasah's connectivity analysis

Within the framework of the space syntax method, a low depth value indicates a low degree of privacy. In the convex space analyses, the lowest depth value as represented in dark blue is observed in the courtyard in both the madrasa and museum plans. In the madrasa plan, the spaces with the highest depth values, shown in red, include the bath-toilet (gusülhane-hela), the corner student cells, and the cells adjacent to the iwan (Figure 5.24). As a result of modifications to the building's plan, differences emerge in the depth analysis. In the current museum function, the highest depth values as indicated in red appear only in the newly added lavatory units (S14, S15, S16). Other spaces with relatively high depth values, represented in yellow, are the corner cells, the cells adjacent to the iwan, and the triangular space of the museum (S06). In the visual area analysis, the madrasa function shows the highest depth values in the cells adjacent to the iwan, represented in red. In the museum function, these cells remain highly deep spaces, with the addition of the women's restroom area also exhibiting high depth values. In both plans, the courtyard consistently presents the lowest depth value, represented in dark blue.

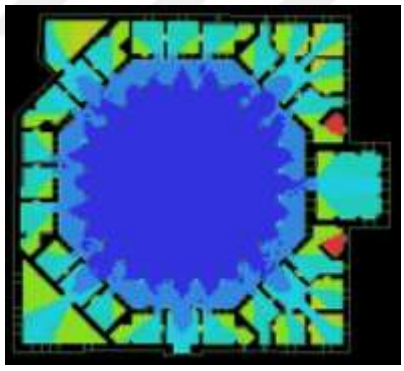
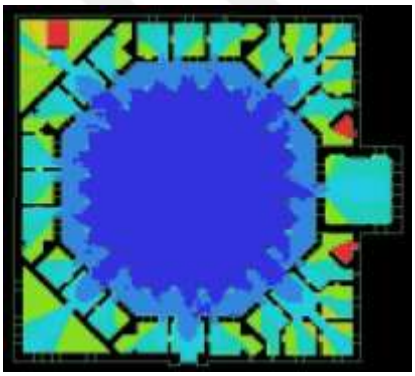
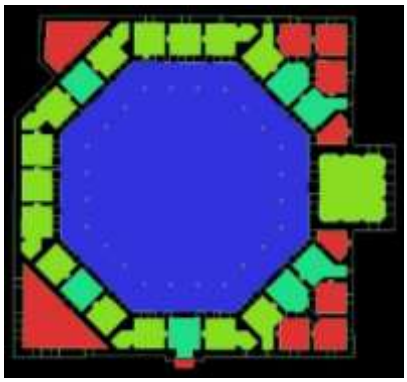
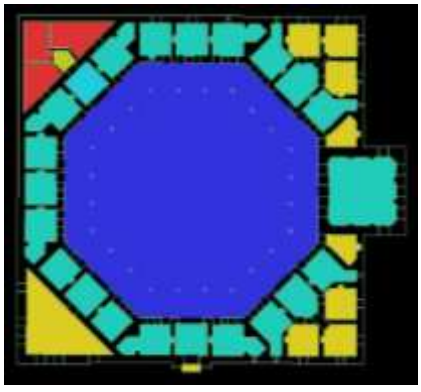
	Madrasah Function	**New Function**
VGA		
CONVEX		

Figure 5.24 Rüstempaşa Madrasah's mean depth analysis

5.1.5 Vacidiye Madrasah

Within the scope of the study, space syntax analyses were conducted on Vacidiye Madrasah. The original plan of the building and its analysis values are presented in Figure 5.25 and Table 5.9. The plan and analysis values for the building's current function are shown in Figure 5.26 and Table 5.10.

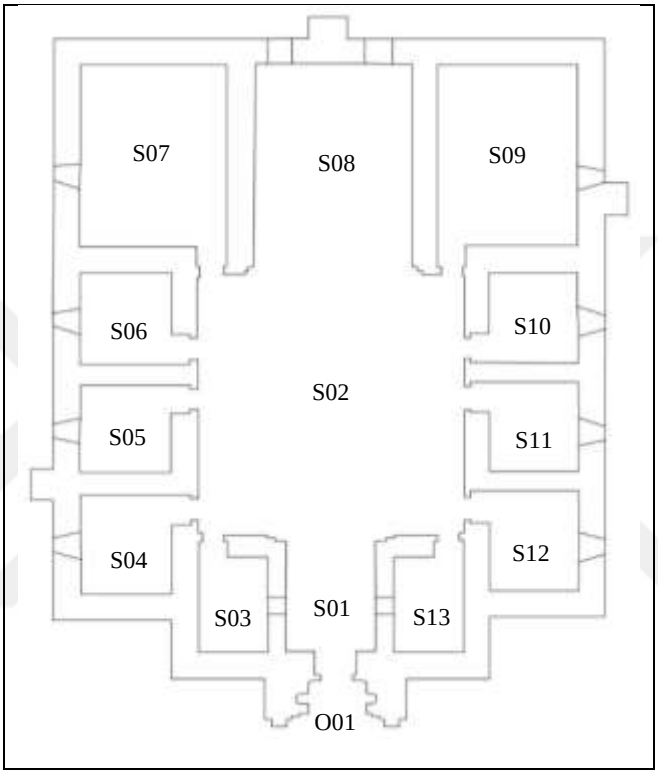


Figure 5.25 Plan of Vacidiye Madrasah

Table 5.9 Analysis values of Vacidiye Madrasah

Space	Connectivity	Integration	Mean Depth
O01	1	0.90480542	2.7692308
S01	2	1.8918658	1.8461539
S02	12	20.810526	1.0769231
S03	1	1.6008096	2
S04	1	1.6008096	2
S05	1	1.6008096	2
S06	1	1.6008096	2
S07	1	1.6008096	2
S08	1	1.6008096	2
S09	1	1.6008096	2
S10	1	1.6008096	2
S11	1	1.6008096	2
S12	1	1.6008096	2
S13	1	1.6008096	2

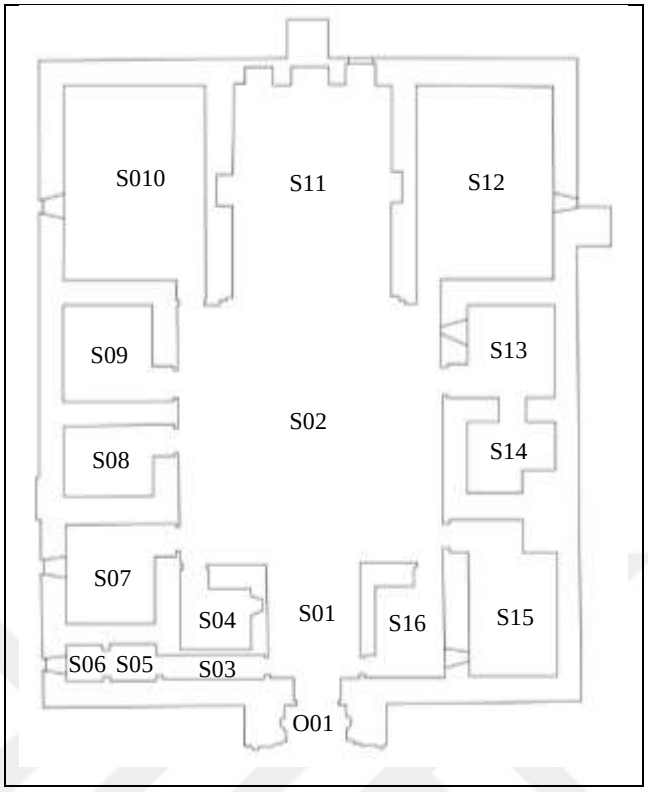


Figure 5.26 Plan of Vacidiye Madrasah's new function

Table 5.10 Analysis values of Vacidiye Madrasah's new function

Space	Connectivity	Integration	Mean Depth
O01	1	0.97568017	2.875
S01	3	1.9513603	1.9375
S02	11	3.6588006	1.5
S03	2	1.1257849	2.625
S04	1	1.2726263	2.4375
S05	2	0.75052321	3.4375
S06	1	0.54204452	4.375
S07	1	1.2726263	2.4375
S08	1	1.2726263	2.4375
S09	1	1.2726263	2.4375
S10	1	1.2726263	2.4375
S11	1	1.2726263	2.4375
S12	1	1.2726263	2.4375
S13	2	1.3938289	2.3125
S14	1	0.81306684	3.25
S15	1	1.2726263	2.4375
S16	1	1.2726263	2.4375

The analyses indicate that the most integrated space of the madrasa is the courtyard, as shown in red in Figure 5.27. The most segregated spaces within the system, however, are the newly created room in the museum plan (S14) and the toilet (S06),

both represented in dark blue. These are followed by the lavatory and the corridor providing access to the wet areas.

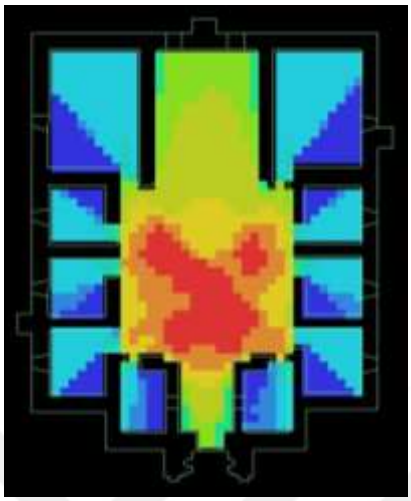
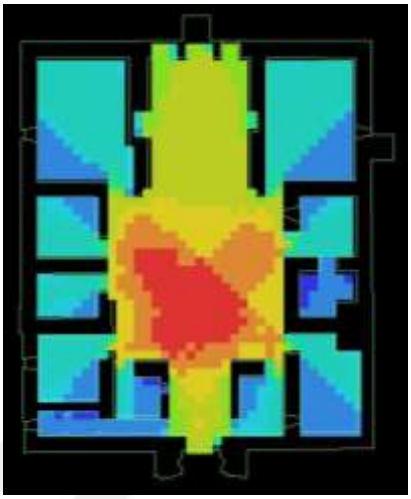
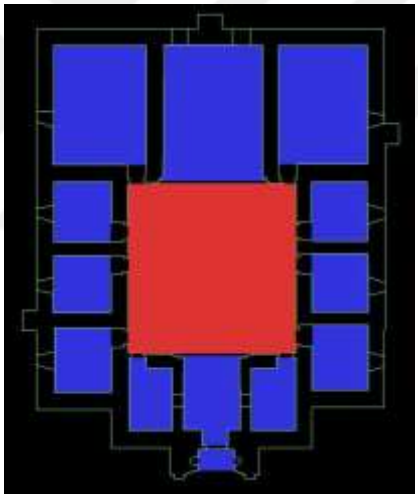
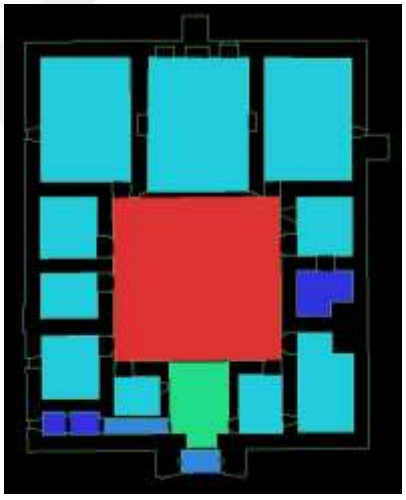
	Madrasah Function	New Function
VGA		
CONVEX		

Figure 5.27 Vacidiye Madrasah's integration analysis

In the convex space analyses, spaces with high connectivity values are represented in red, whereas those with low connectivity values are expressed in dark blue. Within this framework, the analyses of the Vacidiye Madrasa in Kütahya demonstrate that the courtyard (S02) is the space with the highest connectivity value in both its original madrasa function and its current use as the Kütahya Museum, as indicated in red on the maps (Figure 5.28).

The changes introduced by the new function, however, have affected the results of the connectivity analyses. The removal of the walls between the cells has created direct transitions between the spaces (S13, S14), increasing their connectivity values, which in turn appear as light blue in the analyses. Another significant modification observable in the connectivity analysis of the museum plan concerns the wet areas. From the entrance iwan, one can reach the lavatory (S05) via a corridor (S03), and subsequently the WC (S06). This newly established spatial sequence alters the connectivity values of the structure, increasing the integration of these spaces, which are also represented in light blue in the analysis.

In the visual area analyses, the courtyard again emerges as the most connected space, represented in red, a result consistent in both the madrasa and museum functions. The courtyard is followed by the entrance iwan (S01), which displays a high connectivity value represented in orange on the visibility map. By contrast, the new space created through the removal of the cell walls exhibits a lower connectivity value, represented by a large dark blue area. This is due to the fact that the space no longer connects directly to the courtyard, but instead is accessed indirectly through another intermediate space.

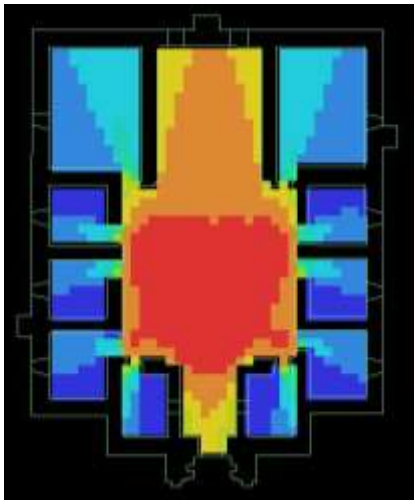
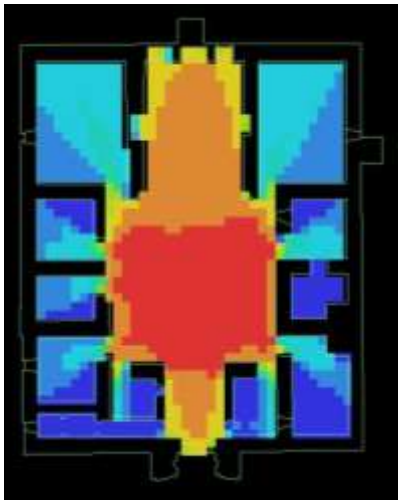
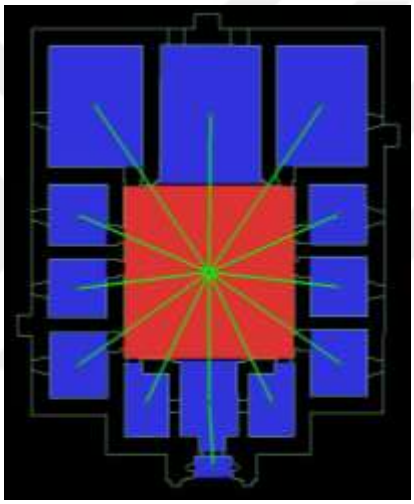
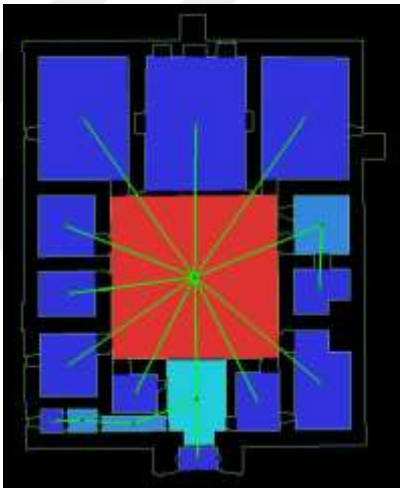
	Madrasah Function	New Function
VGA		
CONVEX		

Figure 5.28 Vacidiye Madrasah's connectivity analysis

According to the results of the convex space analyses, the courtyard is the space with the lowest depth value in both functional layouts, whereas the toilet represents the space with the highest depth value in the analysis of the new function. In the madrasa function, all spaces apart from the courtyard are represented in red, indicating high depth values (Figure 5.29). By contrast, in the current use, depth values are expressed in a range of colors. In this layout, the lavatory follows the toilet as the space with the next highest depth value, succeeded by the newly created room, represented in yellow–green, and the corridor, expressed in green–blue, with comparatively lower depth values. In the visual area analyses, the spaces with the highest depth values, indicated in red, are located in the student cells and in the room adjacent to the iwan (S09) in the

madrasa plan. This condition, however, changes in the new functional layout. In the current plan, the red-colored zones representing high depth within the cells have disappeared; instead, red appears only in the newly created space, which has no direct access to the courtyard. The space with the lowest depth value in both plans is the courtyard, represented in dark blue on the visibility analysis map. In addition, in the museum function, the main iwan is also included among the spaces with low depth values.

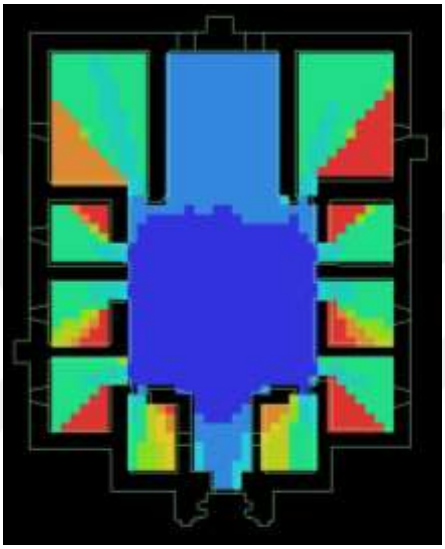
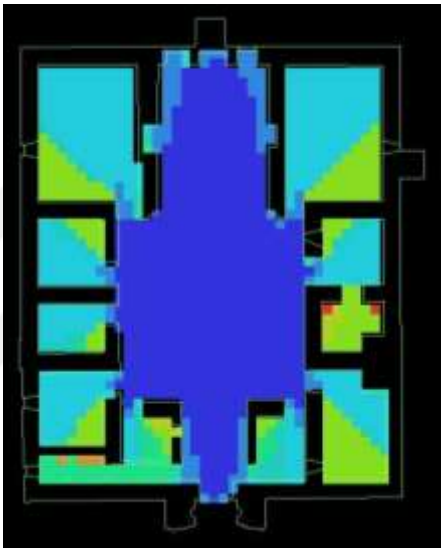
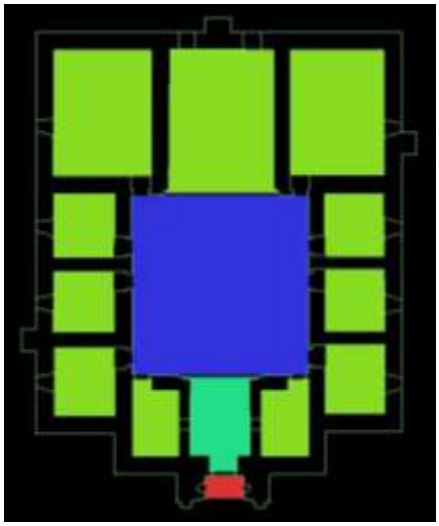
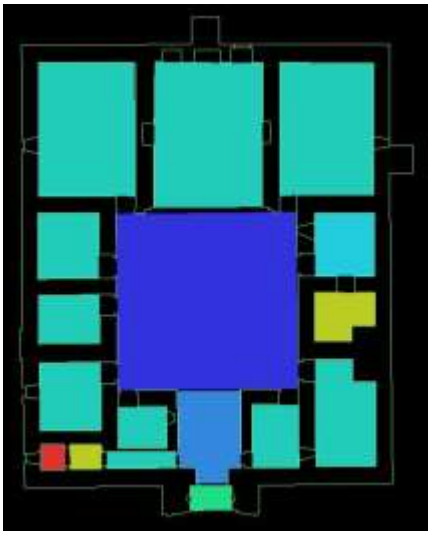
	Madrasah Function	**New Function**
VGA		
Convex		

Figure 5.29 Vacidiye Madrasah's mean depth analysis

5.1.6 Sahabiye Madrasah

Within the scope of the study, space syntax analyses were conducted on Sırçalı Madrasah. The original plan of the building and its analysis values are presented in Figure 5.30 and Table 5.11. The plan and analysis values for the building's current function are shown in Figure 5.31 and Table 5.12.

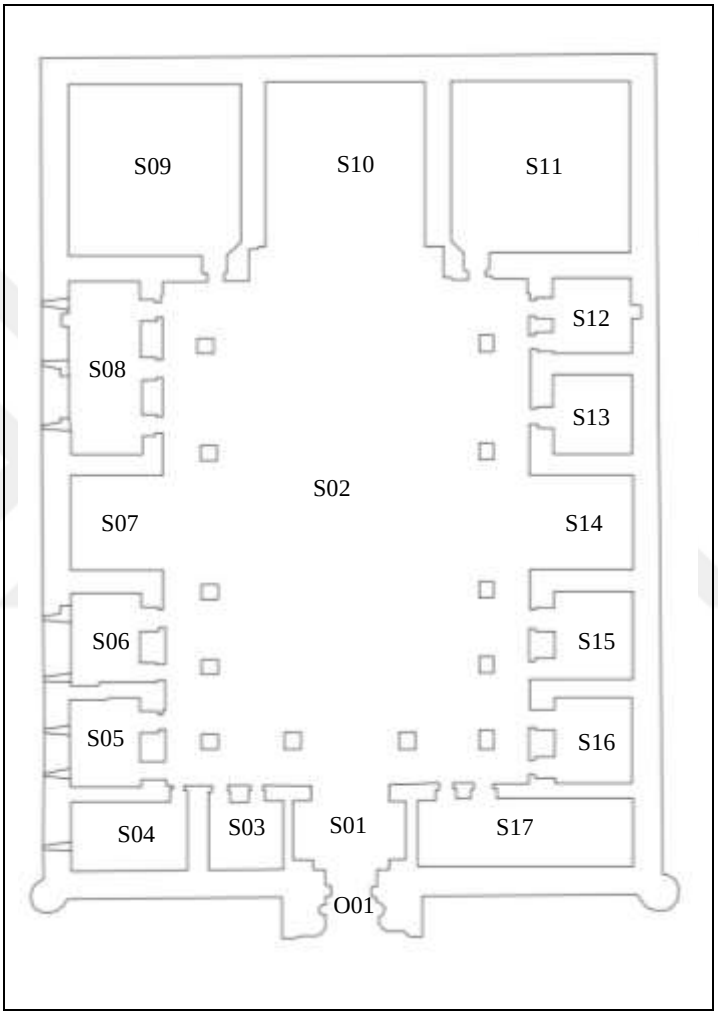


Figure 5.30 Plan of Sahabiye Madrasah

Table 5.11 Analysis values of Sahabiye Madrasah

Space	Connectivity	Integration	Mean Depth
O01	1	1.0408187	2.8235295
S01	2	2.1510253	1.8823529
S02	16	32.265381	1.0588236
S03	1	1.8979635	2
S04	1	1.8979635	2
S05	1	1.8979635	2
S06	1	1.8979635	2
S07	1	1.8979635	2
S08	1	1.8979635	2
S09	1	1.8979635	2
S10	1	1.8979635	2
S11	1	1.8979635	2
S12	1	1.8979635	2
S13	1	1.8979635	2
S14	1	1.8979635	2
S15	1	1.8979635	2
S16	1	1.8979635	2
S17	1	1.8979635	2

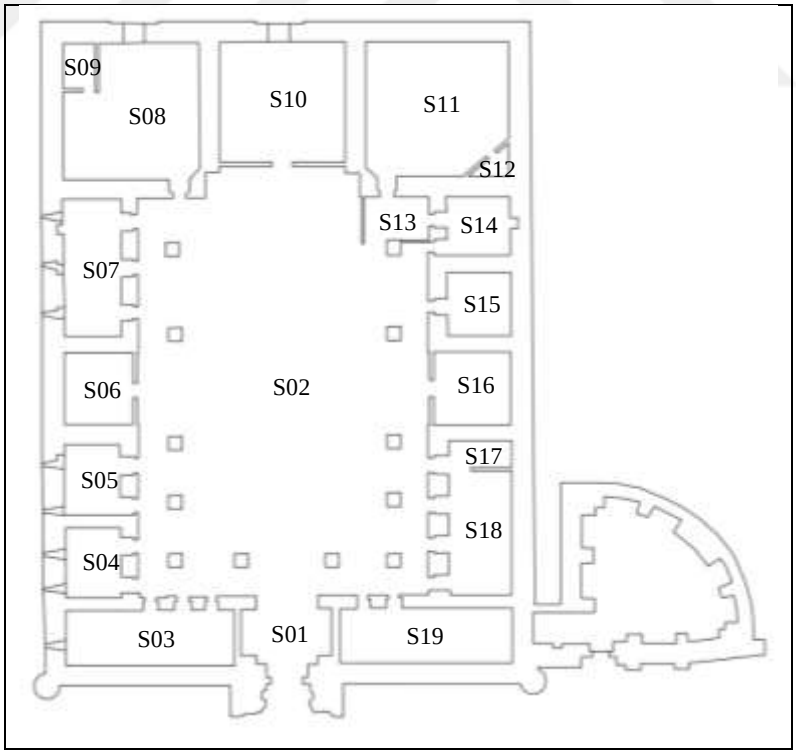


Figure 5.31 Plan of Sahabiye Madrasah' new function

Table 5.12 Analysis values of Sahabiye Madrasah's new function

Space	Connectivity	Integration	Mean Depth
O01	1	0.96223456	3.1052632
S01	2	1.7495173	2.1578948
S02	14	6.414897	1.3157895
S03	1	1.6037242	2.2631578
S04	1	1.6037242	2.2631578
S05	1	1.6037242	2.2631578
S06	1	1.6037242	2.2631578
S07	1	1.6037242	2.2631578
S08	2	1.7495173	2.1578948
S09	1	0.96223456	3.1052632
S10	1	1.6037242	2.2631578
S11	2	1.0691495	2.8947368
S12	1	0.71276635	3.8421052
S13	2	1.9244691	2.0526316
S14	1	1.6037242	2.2631578
S15	1	1.6037242	2.2631578
S16	1	1.6037242	2.2631578
S17	1	0.96223456	3.1052632
S18	2	1.7495173	2.1578948
S19	1	1.6037242	2.2631578

In the convex space analyses, the most integrated space in terms of accessibility in the Sahabiye Madrasa is the courtyard, observed in both the original madrasa plan and the current museum function, as represented in red on the convex space integration maps. The analyses indicate that modifications made to adapt the madrasa to its current function as the "Book Bazaar" have led to changes in the spatial integration values. The iwans have been enclosed with glass, resulting in a decrease in the integration value of the main iwan, reflected by a shift from green–yellow to blue in the analyses.

Some partition walls between the student cells have been removed, increasing the integration values of these newly connected spaces, represented in light blue in the analyses. Additionally, certain areas within the shops have been subdivided into offices and storage rooms. Some offices were later fitted with mezzanine floors, creating vertical circulation spaces. These offices, storage rooms, and circulation areas (S19, S12, S17) exhibit low integration values and are considered segregated spaces within the system, represented in dark blue in the analyses (Figure 5.32). Furthermore, a new spatial intervention was introduced to the courtyard's layout: the entrance of the shop adjacent to the iwan was extended toward the courtyard (S13), creating a space

that is more integrated than the existing shop, and thus represented in light blue in the analyses.

In the visual area analyses, red represents the most visually integrated areas, while dark blue indicates the most segregated points. In the Sahabiye Madrasa, the courtyard remains the most visually integrated space in both the madrasa plan and the current "Book Bazaar" function. Following the courtyard, the next most integrated spaces are the porticoes and the entrance iwan.

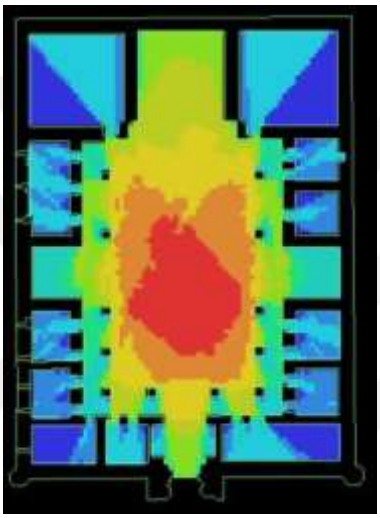
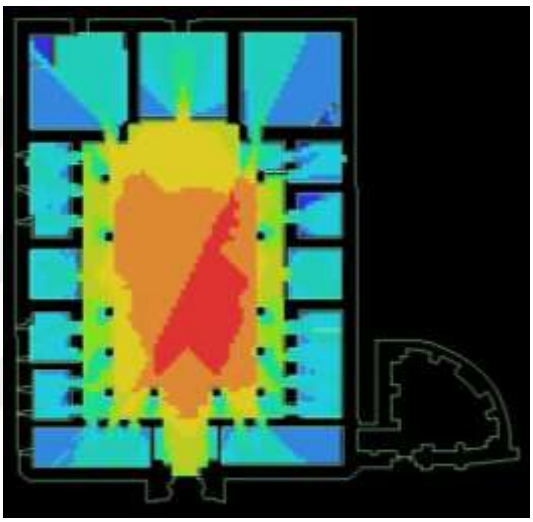
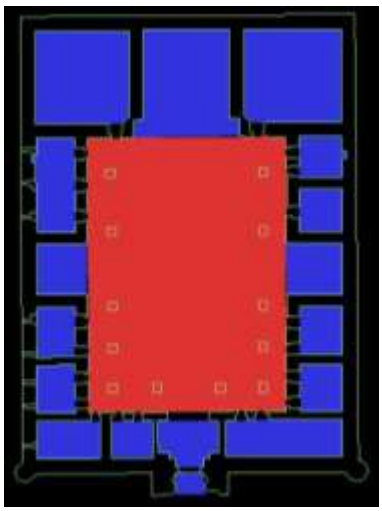
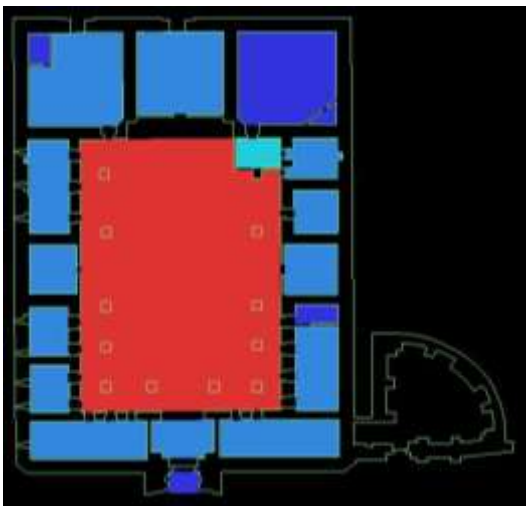
	Madrasah Function	**New Function**
VGA		
Convex		

Figure 5.32 Sahabiye Madrasah's integration analysis

In both the convex space analysis and the visual area analysis, the courtyard (S02) of the Sahabiye Madrasa appears as the space with the highest connectivity value, indicated in red (Figure 5.33). This is observed in both the original madrasa plan and the current plan, which accommodates the market function. This demonstrates the strong relational structure of the courtyard with the other spaces of the madrasa. The porticoes, which appear in yellow in the visual area analysis but in red in the convex space analysis, can be explained by the visual obstruction caused by the columns within the courtyard, which limit direct sight lines. As observed in the visual area analyses, changes made to adapt the madrasa to the market function have resulted in alterations in connectivity values. Specifically, enclosing the iwans with glass has led to a decrease in their connectivity values. This is reflected in the convex space analyses of the current use, where these areas are represented in shades of light to dark blue.

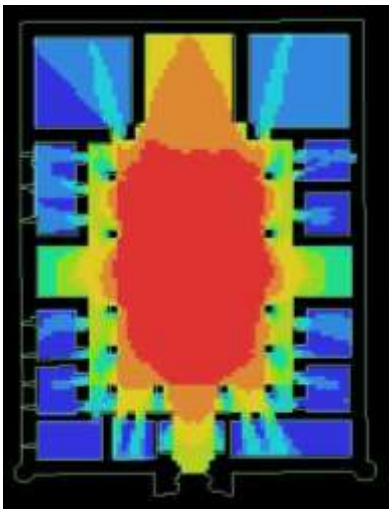
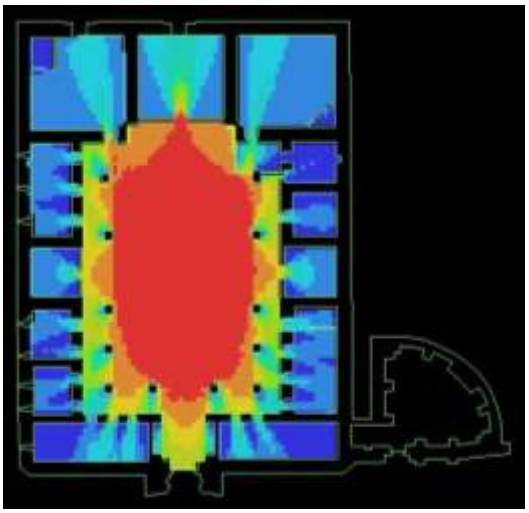
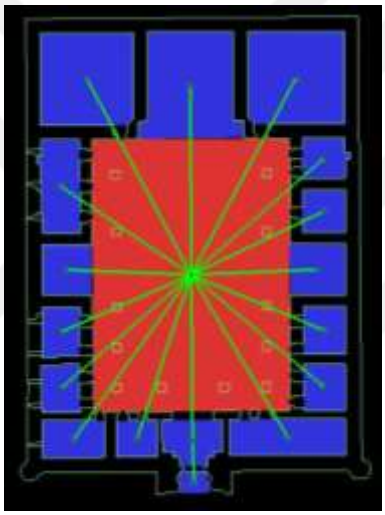
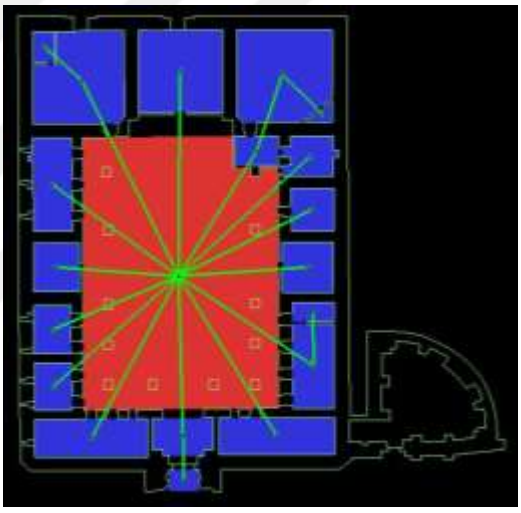
	Madrasah Function	New Function
VGA		
Convex		

Figure 5.33 Sahabiye Madrasah's connectivity analysis

In the depth analyses, spaces are represented by a color spectrum ranging from red to dark blue according to their depth values. Both the visual area analysis and the convex space analysis indicate that the space with the lowest depth value, in terms of accessibility, is the courtyard in both the madrasa plan and the current market function. This is represented in dark blue on the maps.

Following the modifications made to adapt the Sahabiye (Sahip Ata) Madrasa to the "Book Bazaar," differences emerge in the spaces with the highest depth values. In the current plan, the space with the highest depth value, represented in red in both the visual area and convex analyses, is the storage area of the bookstore (S12). The depth

value of the bookstore, which occupies the former winter classroom, has decreased compared to its original madrasa function as a result of the plan changes. Other spaces with reduced depth values due to the new function include the office (S09), created by dividing the former mosque space, and the area containing the stairs leading to the mezzanine of another bookstore (S17). These spaces are represented in yellow in the new depth analyses (Figure 5.34).

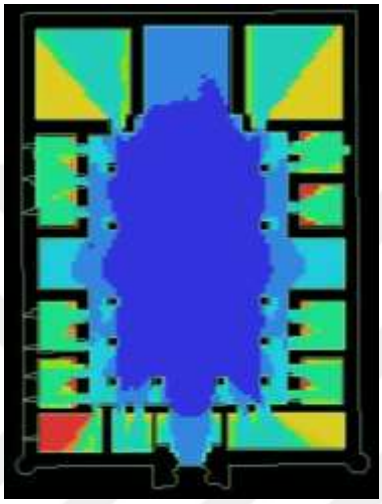
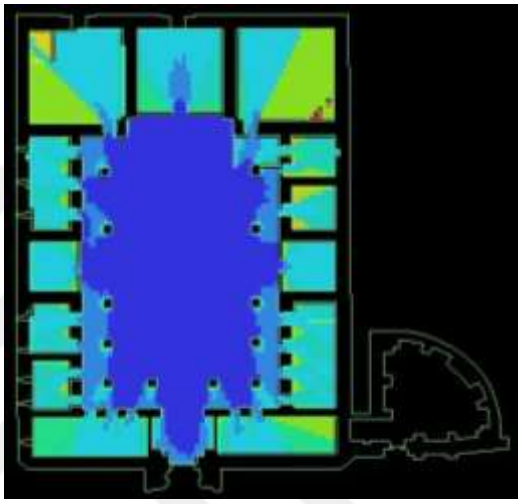
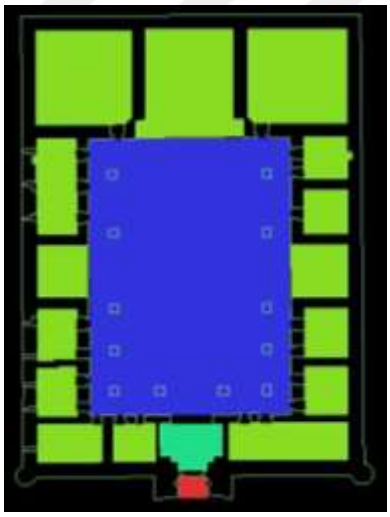
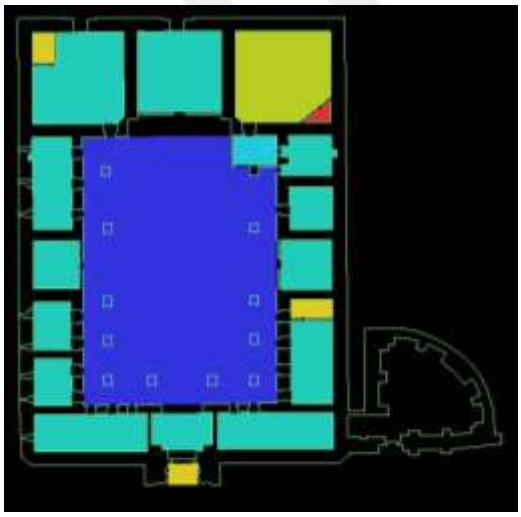
	Madrasah Function	**New Function**
VGA		
Convex		

Figure 5.34 Sahabiye Madrasah's mean depth analysis

5.1.7 Şehzade Mehmet Madrasah

Within the scope of the study, space syntax analyses were conducted on Şehzade Mehmet Madrasah. The original plan of the building and its analysis values are

presented in Figure 5.35 and Table 5.13. The plan and analysis values for the building's current function are shown in Figure 5.36 and Table 5.14.

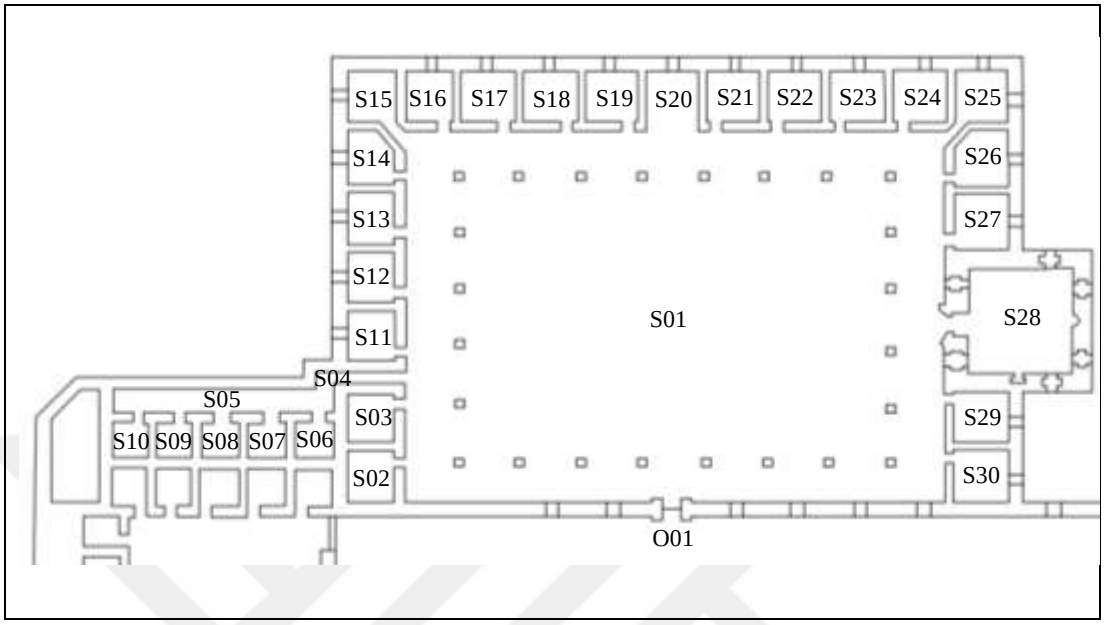


Figure 5.35 Plan of Şehzade Mehmet Madrasah

Table 5.13 Analysis values of Şehzade Mehmet Madrasah

Space	Connectivity	Integration	Mean Depth
O01	1	1.9310595	2.3333333
S01	24	7.0220346	1.3666667
S02	1	1.9310595	2.3333333
S03	1	1.9310595	2.3333333
S04	2	2.7586565	1.9333333
S05	6	1.6434549	2.5666666
S06	1	1.0163471	3.5333333
S07	1	1.0163471	3.5333333
S08	1	1.0163471	3.5333333
S09	1	1.0163471	3.5333333
S10	1	1.0163471	3.5333333
S11	1	1.9310595	2.3333333
S12	1	1.9310595	2.3333333
S13	1	1.9310595	2.3333333
S14	1	1.9310595	2.3333333
S15	1	1.9310595	2.3333333
S16	1	1.9310595	2.3333333
S17	1	1.9310595	2.3333333
S18	1	1.9310595	2.3333333
S19	1	1.9310595	2.3333333
S20	1	1.9310595	2.3333333
S21	1	1.9310595	2.3333333
S22	1	1.9310595	2.3333333
S23	1	1.9310595	2.3333333
S24	1	1.9310595	2.3333333
S25	1	1.9310595	2.3333333
S26	1	1.9310595	2.3333333
S27	1	1.9310595	2.3333333
S28	1	1.9310595	2.3333333
S29	1	1.9310595	2.3333333
S30	1	1.9310595	2.3333333

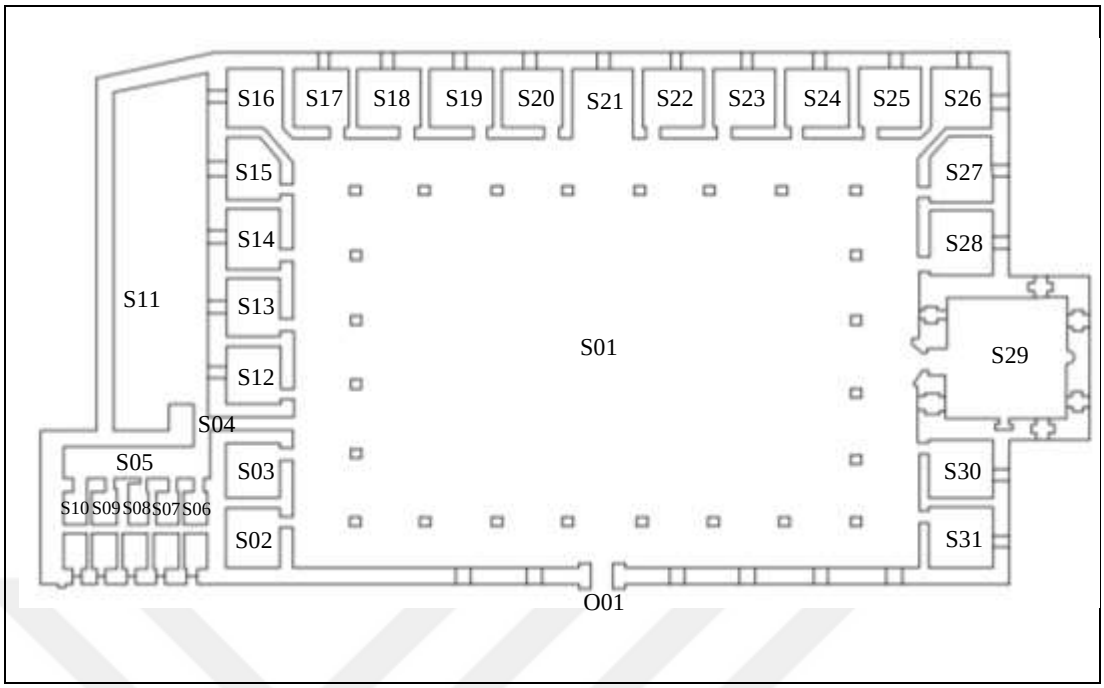


Figure 5.36 Plan of Şehzade Mehmet Madrasah's new function

Table 5.14 Analysis values of Şehzade Mehmet Madrasah's new function

Space	Connectivity	Integration	Mean Depth
O01	1	1.9304764	2.3548386
S01	24	6.7566676	1.3870968
S02	1	1.9304764	2.3548386
S03	1	1.9304764	2.3548386
S04	3	2.8957148	1.9032258
S05	6	1.6891669	2.5483871
S06	1	1.0394874	3.516129
S07	1	1.0394874	3.516129
S08	1	1.0394874	3.516129
S09	1	1.0394874	3.516129
S10	1	1.0394874	3.516129
S11	1	1.3979312	2.8709676
S12	1	1.9304764	2.3548386
S13	1	1.9304764	2.3548386
S14	1	1.9304764	2.3548386
S15	1	1.9304764	2.3548386
S16	1	1.9304764	2.3548386
S17	1	1.9304764	2.3548386
S18	1	1.9304764	2.3548386
S19	1	1.9304764	2.3548386
S20	1	1.9304764	2.3548386
S21	1	1.9304764	2.3548386
S22	1	1.9304764	2.3548386
S23	1	1.9304764	2.3548386
S24	1	1.9304764	2.3548386
S25	1	1.9304764	2.3548386
S26	1	1.9304764	2.3548386
S27	1	1.9304764	2.3548386
S28	1	1.9304764	2.3548386
S29	1	1.9304764	2.3548386
S30	1	1.9304764	2.3548386
S31	1	1.9304764	2.3548386

In the convex space analysis, the most integrated space in both the madrasa plan and the plan corresponding to the building's new function is the courtyard, represented in red on the convex space map shown in Figure 5.37. The service yard created as a result of modifications in the plan exhibits low integration values and is therefore represented in dark blue in the analysis. This indicates that the newly introduced space is one of the most segregated spaces within the system. According to the visual area analysis, the space with the highest visual integration value in both functional layouts is also the courtyard, as shown in red–orange in the analyses. This is followed by the arcades, while the student cells, the iwans (S20, S21), and the classrooms (S28, S29) exhibit lower integration values and are represented in blue. The modifications in the plan also affect the integration values obtained from the visual area analyses. Consequently, the

orange area representing high integration in the center of the courtyard in the madrasa function analysis is no longer present in the analysis for the current use. This result indicates that the most integrated areas of the madrasa have shifted toward the entrance of the building. This shift can be observed directly on the visual area integration map.

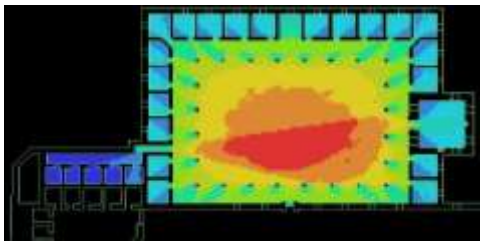
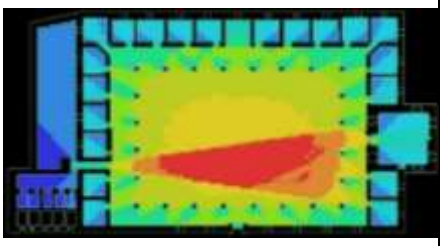
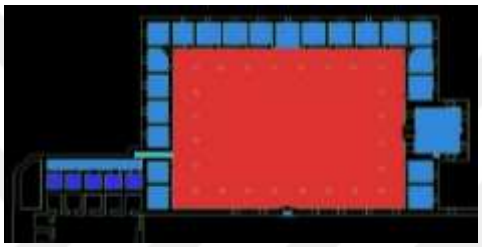
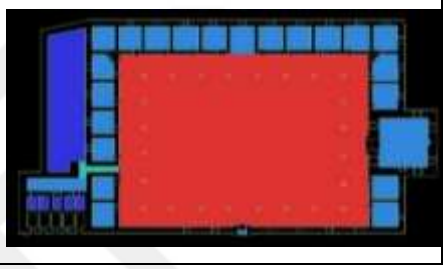
	Madrasah Function	New Function
VGA		
Convex		

Figure 5.37 Şehzade Mehmet Madrasah's integration analysis

In both the convex space analysis and the visual area analysis, the courtyard is the space with the highest connectivity value, represented in red, for both the madrasa function and the current socio-cultural center managed by the foundation. This result is due to the courtyard (S01) having direct connections with numerous spaces, including the student cells, the iwan, and the classroom, in both functional layouts. Another space with a high connectivity value, represented in light blue in analyses for both functions, is the lavatory (S05), resulting from its connections to multiple toilets. In the building's current function, a service yard (S11) has been added behind the wet areas and the cells. Due to the newly created space having access only through a corridor (S04) connected to the courtyard, it exhibits a low connectivity value and is represented in dark blue in the convex space analysis of the current plan.

In the visual area connectivity analyses, the areas with the next highest connectivity values after the courtyard are the arcades, represented in yellow, consistent in both functional layouts. These results are illustrated in the analyses shown in Figure 5.38.

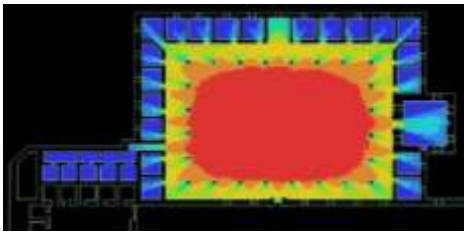
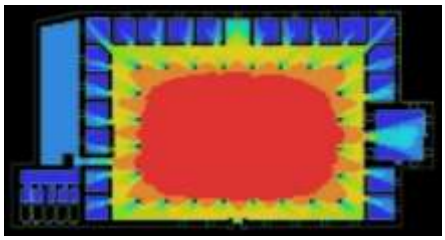
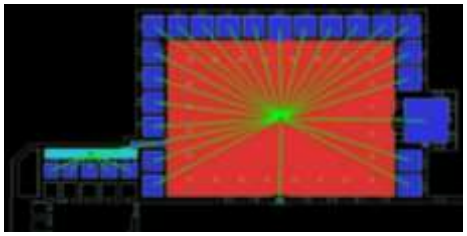
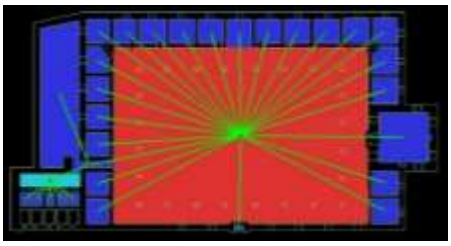
	Madrasah Function	New Function
VGA		
Convex		

Figure 5.38 Şehzade Mehmet Madrasah's connectivity analysis

According to the analyses conducted for both the madrasa function and the building's new function, the space with the lowest depth value (i.e., the least private space) is the courtyard. This is represented in dark blue in the visual area analyses. The spaces with the highest depth values are the wet areas (S06, S07, S08, S09, S10).

Following the interventions made in the plan, changes in the building's depth values can also be observed in the convex space analyses. In the madrasa function, the sequence of spaces from highest to lowest depth values is: toilets, lavatory, student cells, iwan, classroom, and courtyard. In the new function, the sequence is modified as: toilets, service yard, lavatory, student cells, iwan, classroom, and courtyard. These changes are visually represented by the use of different colors in the convex space analyses shown in Figure 5.39.

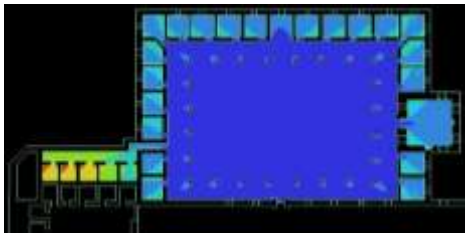
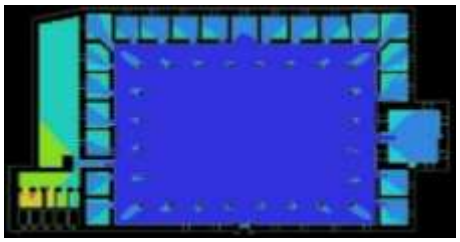
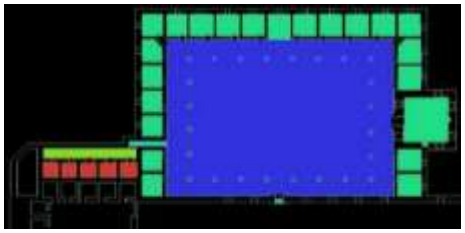
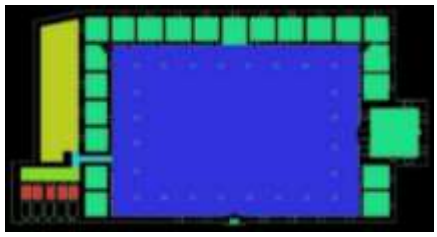
	Madrasah Function	New Function
VGA		
Convex		

Figure 5.39 Şehzade Mehmet Madrasah's mean depth analysis

5.1.8 Rabi Madrasah

Within the scope of the study, space syntax analyses were conducted on Rabi Madrasah. The original plan of the building and its analysis values are presented in Figure 5.40 and Table 5.15. The plan and analysis values for the building's current function are shown in Figure 5.41 and Table 5.16.

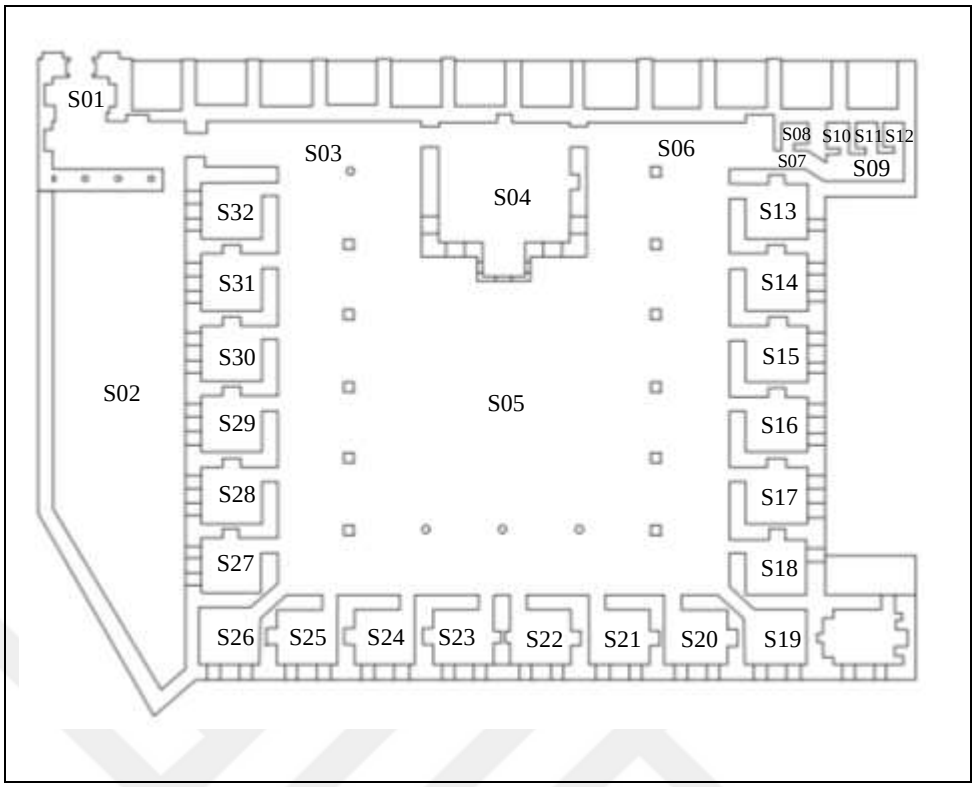


Figure 5.40 Plan of Rabi Madrasah

Table 5.15 Analysis values of Rabi Madrasah

Space	Connectivity	Integration	Mean Depth
O01	1	0.84121364	4.15625
S01	3	1.2137511	3.1875
S02	1	0.84121364	4.15625
S03	3	1.9758738	2.34375
S04	2	1.4160429	2.875
S05	22	4.2481289	1.625
S06	3	2.2962859	2.15625
S07	3	1.464872	2.8125
S08	1	0.95463568	3.78125
S09	4	1.0236455	3.59375
S10	1	0.74528575	4.5625
S11	1	0.74528575	4.5625
S12	1	0.74528575	4.5625
S13	1	1.6659329	2.59375
S14	1	1.6659329	2.59375
S15	1	1.6659329	2.59375
S16	1	1.6659329	2.59375
S17	1	1.6659329	2.59375
S18	1	1.6659329	2.59375
S19	1	1.6659329	2.59375
S20	1	1.6659329	2.59375
S21	1	1.6659329	2.59375
S22	1	1.6659329	2.59375
S23	1	1.6659329	2.59375
S24	1	1.6659329	2.59375
S25	1	1.6659329	2.59375
S26	1	1.6659329	2.59375
S27	1	1.6659329	2.59375
S28	1	1.6659329	2.59375
S29	1	1.6659329	2.59375
S30	1	1.6659329	2.59375
S31	1	1.6659329	2.59375
S32	1	1.6659329	2.59375

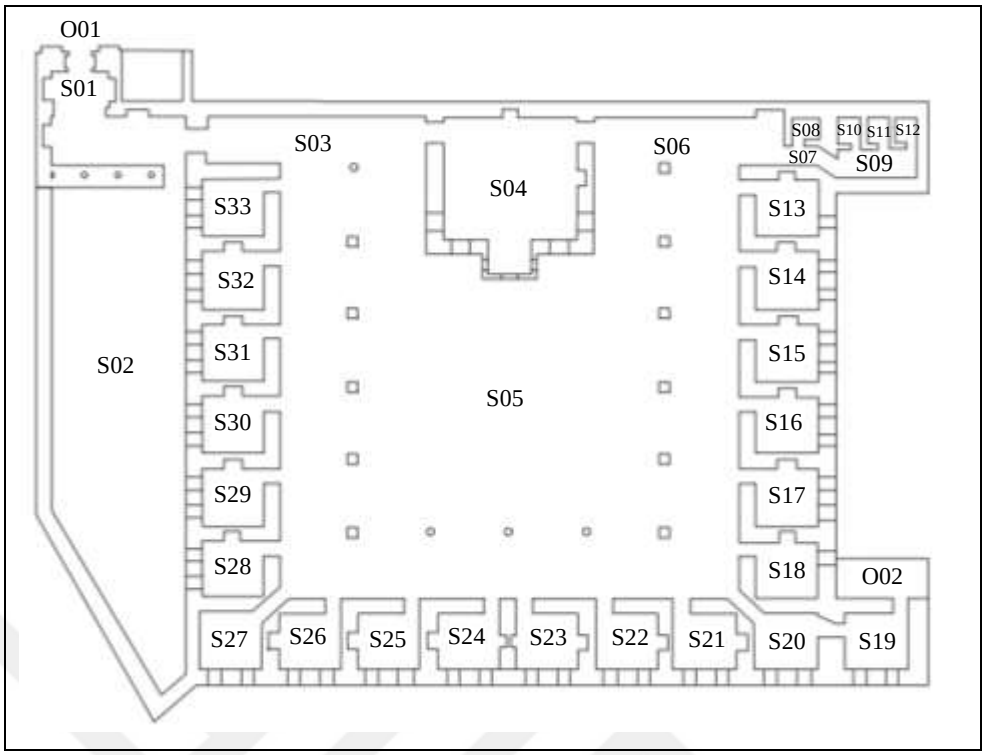


Figure 5.41 Plan of Rabi Madrasah's new function

Table 5.16 Analysis values of Rabi Madrasah's new function

Space	Connectivity	Integration	Mean Depth
O01	1	0.84415621	4.2352943
O02	1	0.80049294	4.4117646
S01	3	1.2059374	3.2647059
S02	1	0.84415621	4.2352943
S03	3	1.9345245	2.4117646
S04	2	1.385928	2.9705882
S05	22	4.0372686	1.6764706
S06	3	2.2108853	2.2352941
S07	3	1.4285721	2.9117646
S08	1	0.94752222	3.8823528
S09	4	1.0093172	3.7058823
S10	1	0.74285746	4.6764708
S11	1	0.74285746	4.6764708
S12	1	0.74285746	4.6764708
S13	1	1.6581639	2.6470587
S14	1	1.6581639	2.6470587
S15	1	1.6581639	2.6470587
S16	1	1.6581639	2.6470587
S17	1	1.6581639	2.6470587
S18	1	1.6581639	2.6470587
S19	2	1.1187612	3.4411764
S20	2	1.785715	2.5294118
S21	1	1.6581639	2.6470587
S22	1	1.6581639	2.6470587
S23	1	1.6581639	2.6470587
S24	1	1.6581639	2.6470587
S25	1	1.6581639	2.6470587
S26	1	1.6581639	2.6470587
S27	1	1.6581639	2.6470587
S28	1	1.6581639	2.6470587
S29	1	1.6581639	2.6470587
S30	1	1.6581639	2.6470587
S31	1	1.6581639	2.6470587
S32	1	1.6581639	2.6470587
S33	1	1.6581639	2.6470587

The integration data obtained from the convex space analyses indicate that the courtyard is the most integrated space within the system in both the madrasa function and the building's current function, represented in red (Figure 5.42). Following this, in both plans, the next most integrated space is the circulation area connecting the wet areas to the classroom, represented in green in the analyses. The most segregated

spaces in the system, in the madrasa function plan, are the garden, toilets, and bath. However, as a result of interventions in the plan, this situation changes. According to the convex space integration analyses for the building's new function, the most segregated spaces are the garden, toilets, kitchen, and the area in front of the meeting room (O02), represented in dark blue. The integration value of the meeting room itself is lower than that of the cells and is therefore represented in a darker blue relative to the cells. The modifications also affect the results of the visual area integration analyses, similar to the convex space analyses. The inclusion of the meeting room into the system increases the integration value of the cell providing circulation to this space, which is therefore represented in yellow in the analyses.

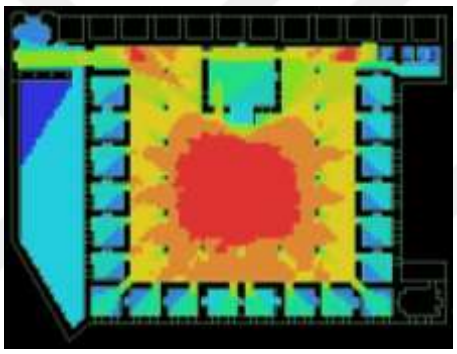
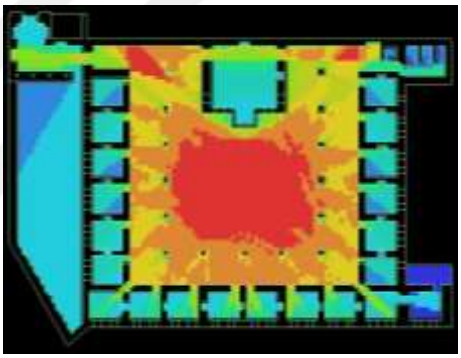
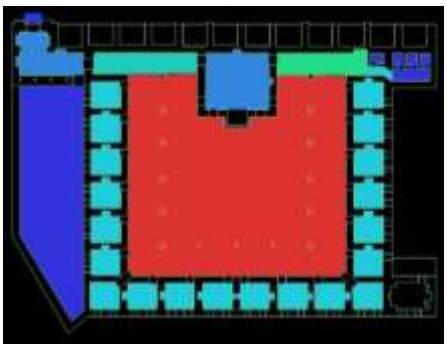
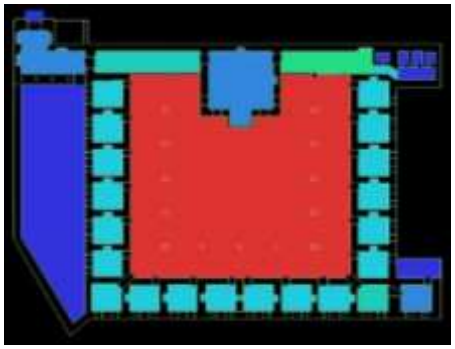
	Madrasah Function	**New Function**
VGA		
Convex		

Figure 5.42 Rabi Madrasah's integration analysis

In the convex space analyses conducted for the Rabi Madrasa, the courtyard (S05) exhibits the highest connectivity value. This is represented in red on both the original madrasa plan and the plan corresponding to the building's current function. Despite the courtyard having multiple connections to different areas, it does not provide direct access to the classroom, which is designed as a bay window structure (S04). Access to

the classroom is instead provided via circulation spaces (S03, S06) connecting both the madrasa's entrance and the wet areas. The next space with the highest connectivity value is the arcade in front of the student cells. Another highly connected space, as observed in both the former and current functions, is the lavatory (S09), due to its connections to multiple toilets. As a result, the lavatory is represented in light blue in the convex space analysis (Figure 5.43).

Following modifications to the plan for the building's new function as the Turkish Academy of Sciences Building, a connection was established from a corner cell to the adjacent space (S19) located between the Salis Madrasa and Rabi Madrasa, overlooking the garden. This connection does not exist in the madrasa function plan. As seen in the convex space analyses, these newly created spaces exhibit low connectivity values and are represented in dark blue. After the intervention on the partition wall, this new space is currently used as a meeting room.

In the visual area analyses, the space with the highest connectivity value, represented in red–orange, is the courtyard. The student cells, classroom, toilets (S10, S11, S12), and the space formerly used as a bath but currently functioning as a kitchen (S08) have lower connectivity values and are represented in dark blue in both analyses. The garden accessible from the building's entrance (S02) is represented in light blue in the analyses.

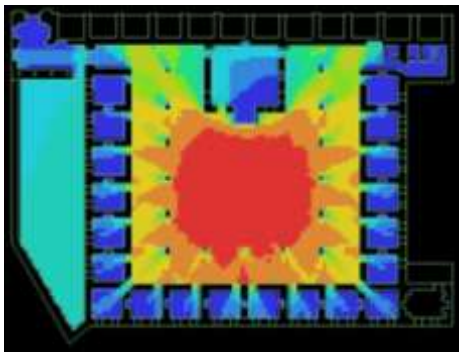
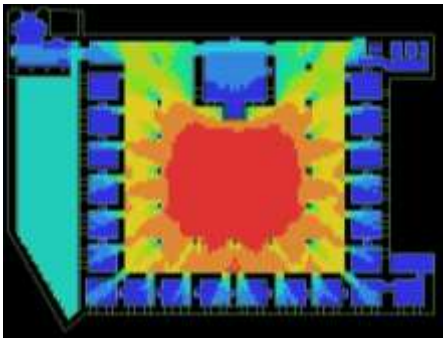
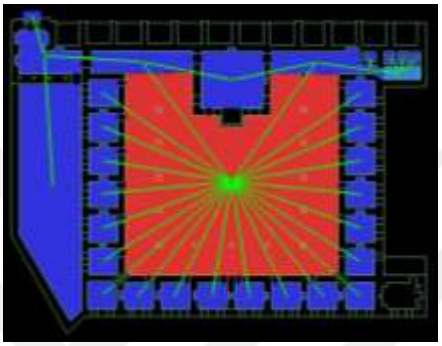
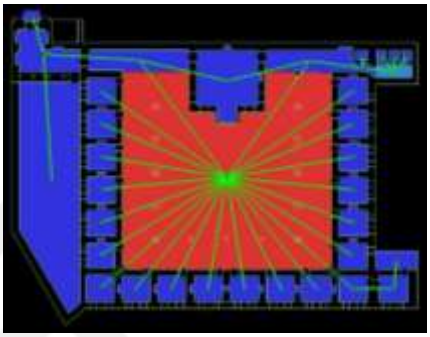
	Madrasah Function	New Function
VGA		
Convex		

Figure 5.43 Rabi Madraah's connectivity analysis

In the convex space analyses conducted for the Rabi Madrasa, spaces with high depth values are represented in red, while spaces with low depth values are represented in dark blue (Figure 5.44). The space with the lowest depth value, i.e., the least private space, is the courtyard, observed in both the madrasa function and the building's new function. This finding is also supported by the visual area analyses.

The spaces with the highest depth values in the madrasa are the toilets and the garden, represented in red in the analyses. However, modifications to the plan have led to changes in the depth analysis results. In the plan corresponding to the new function, the toilets remain among the spaces with the highest depth values, represented in red, while the garden shows a decreased depth value and is therefore represented in orange. The area in front of the meeting room, however, now exhibits high depth values, also represented in red.

These findings are further supported by the visual area depth analyses. In the madrasa function plan, the areas with the highest depth, represented in red on the depth map,

are the toilets. In the plan for the new function, these high-depth areas additionally include the space in front of the meeting room. Furthermore, as a result of the interventions, the space formerly used as a bath shows a decreased depth value; in the new plan, this space functions as a kitchen and is represented in green, indicating a lower depth value.

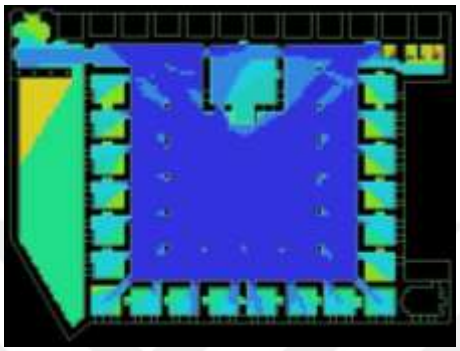
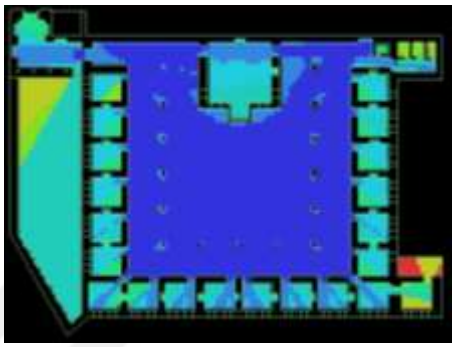
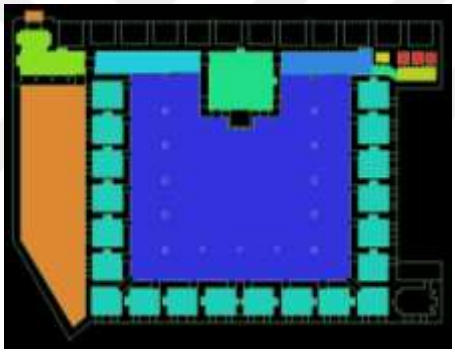
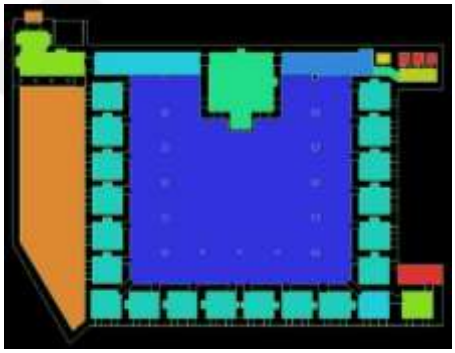
	Madrasah Function	New Function
VGA		
Convex		

Figure 5.44 Rabi Madrasah's mean depth analysis

5.1.9 Süleyman Paşa Madrasah

Within the scope of the study, space syntax analyses were conducted on Süleuman Paşa Madrasah. The original plan of the building and its analysis values are presented in Figure 5.45 and Table 5.17. The plan and analysis values for the building's current function are shown in Figure 5.46 and Table 5.18.

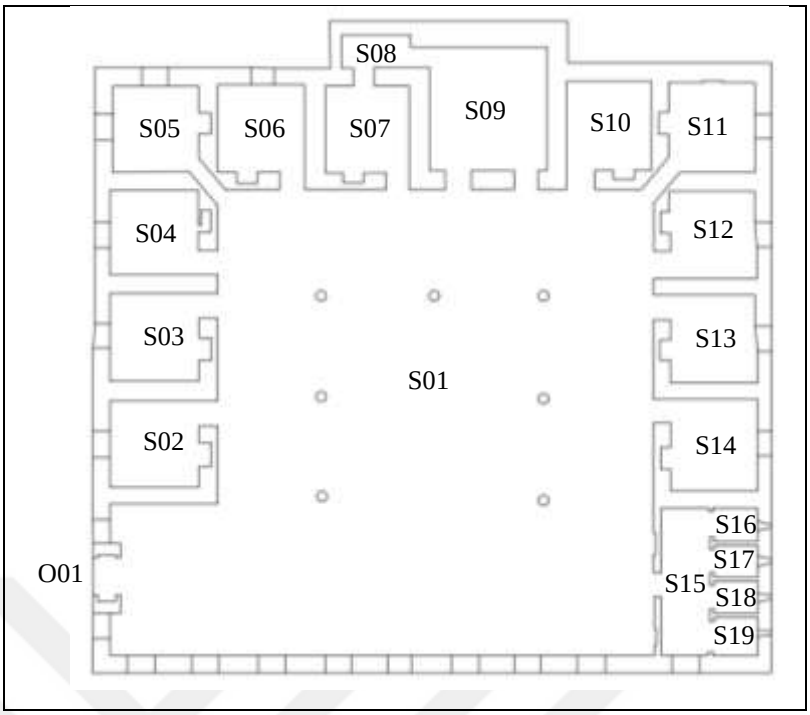


Figure 5.45 Plan *of* Süleyman Paşa Madrasah

Table 5.17 Analysis values of Süleyman Paşa Madrasah

Space	Connectivity	Integration	Mean Depth
O01	1	1.6734514	2.2105262
S01	14	7.6978765	1.2631578
S02	1	1.6734514	2.2105262
S03	1	1.6734514	2.2105262
S04	1	1.6734514	2.2105262
S05	1	1.6734514	2.2105262
S06	1	1.6734514	2.2105262
S07	2	1.8328277	2.1052632
S08	2	1.0402535	2.9473684
S09	2	1.8328277	2.1052632
S10	1	1.6734514	2.2105262
S11	1	1.6734514	2.2105262
S12	1	1.6734514	2.2105262
S13	1	1.6734514	2.2105262
S14	1	1.6734514	2.2105262
S15	5	2.5659587	1.7894737
S16	1	1.1663449	2.7368422
S17	1	1.1663449	2.7368422
S18	1	1.1663449	2.7368422
S19	1	1.1663449	2.7368422

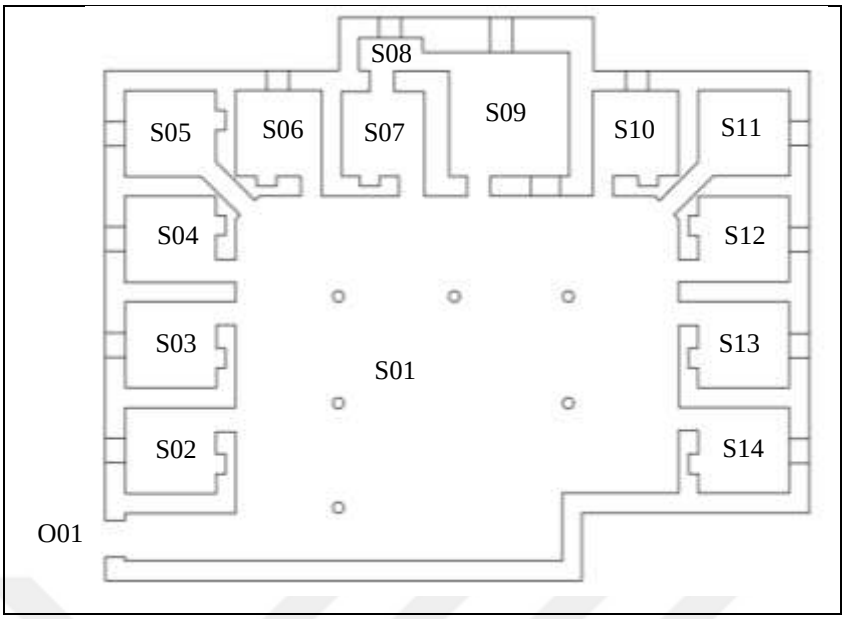


Figure 5.46 Plan of Süleyman Paşa Madrasah's new function

Table 5.18 Analysis values of Süleyman Paşa Madrasah's new function

Space	Connectivity	Integration	Mean Depth
O01	1	1.6812503	2
S01	13	23.537504	1.0714285
S02	1	1.6812503	2
S03	1	1.6812503	2
S04	1	1.6812503	2
S05	1	1.6812503	2
S06	1	1.6812503	2
S07	2	1.9614588	1.8571428
S08	2	1.0233698	2.6428571
S09	2	1.9614588	1.8571428
S10	1	1.6812503	2
S11	1	1.6812503	2
S12	1	1.6812503	2
S13	1	1.6812503	2
S14	1	1.6812503	2

In both the madrasa and bazaar analyses, the most integrated space of the building is the courtyard, which appears in red in the convex space map presented in Figure 5.47. The müderris' room (S07), the classroom (S09), and the lavatory display higher

integration values compared to other spaces, and therefore appear in lighter shades of blue in the analyses. Following the alterations in the plan, variations in the integration values of the building have been identified. This situation is also evident in the visual integration map.

While the courtyard's uncolonnaded section consistently appears in red in both plans, indicating its status as the most integrated area, in the plan representing the bazaar function of the building, the number of areas with high integration values (depicted in orange) has decreased. The colonnaded spaces that provide circulation between the courtyard, cells, and classroom constitute another area with high integration values, as demonstrated in both visibility integration maps.

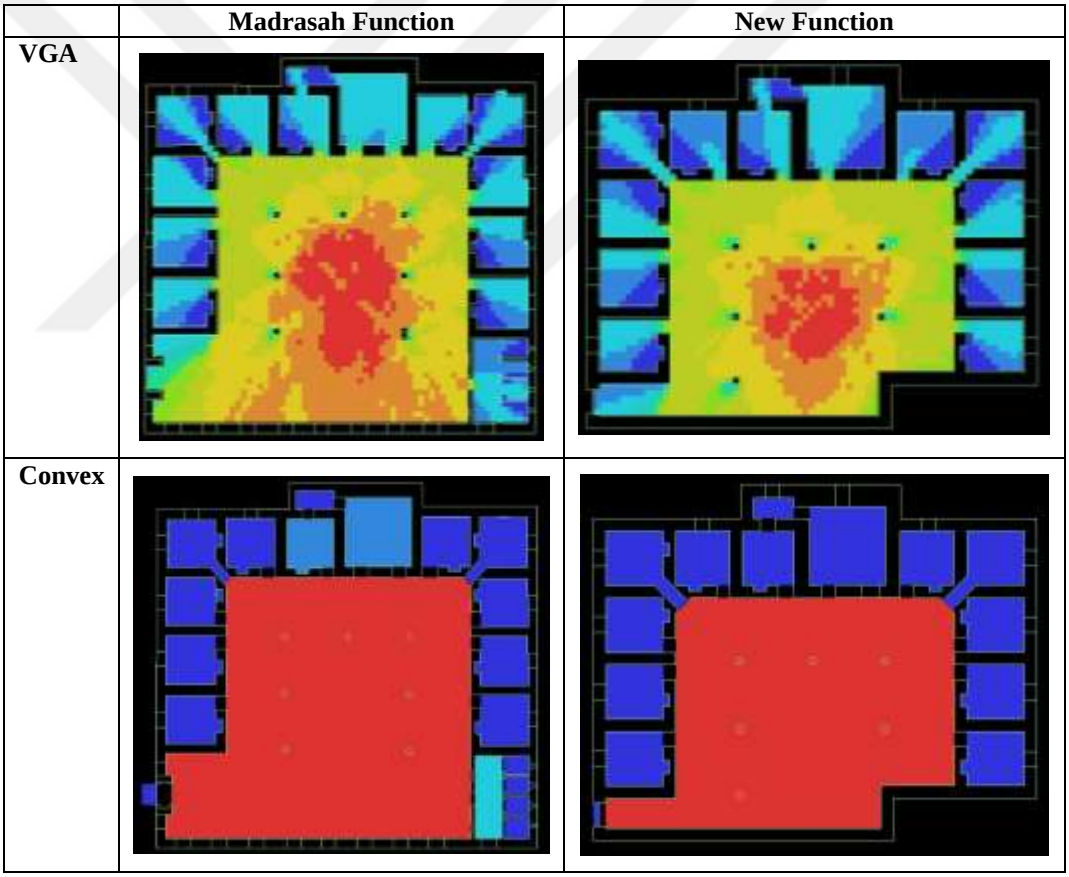


Figure 5.47 Süleyman Paşa Madrasah's integration analysis

In the convex space analyses, spaces with high connectivity values are represented in red, while those with low values are represented in dark blue. In the case of the İznik Süleymanpaşa Madrasa, the analysis demonstrates that the courtyard (S01) possesses

the highest connectivity value. Accordingly, the courtyard is represented in red both in the analysis of the madrasa plan and in the analysis of its later function as the “Tile and Ceramics Bazaar” (Figure 5.48). The toilets (S16, S17, S18, S19), identified in the madrasa plan, exhibit low connectivity values and are therefore represented in dark blue. The lavatory space (S15), which provides access to the toilets, demonstrates a relatively higher connectivity value due to its direct relationship with both the courtyard and the toilets. For this reason, in the convex space connectivity analyses of the new function, it is represented in light blue.

In the visual graph analyses, the courtyard again emerges as the space with the highest connectivity value and is represented in red on the visibility map. This is followed by the colonnaded section, which demonstrates high connectivity and is represented in orange. This result is consistent across both the madrasa and the bazaar plans. However, due to interventions in the plan, a decrease in connectivity values is observed in the classroom and entrance spaces in the current function. As shown in Figure 43, the classroom is represented in dark blue, while the entrance is depicted in blue, indicating their reduced connectivity values.

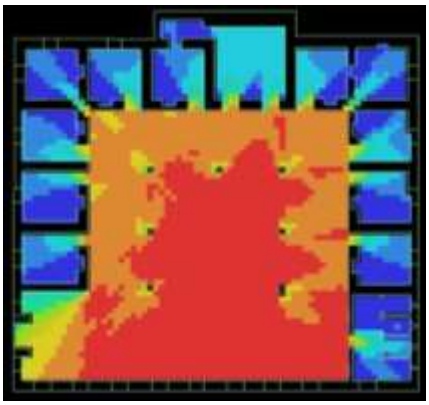
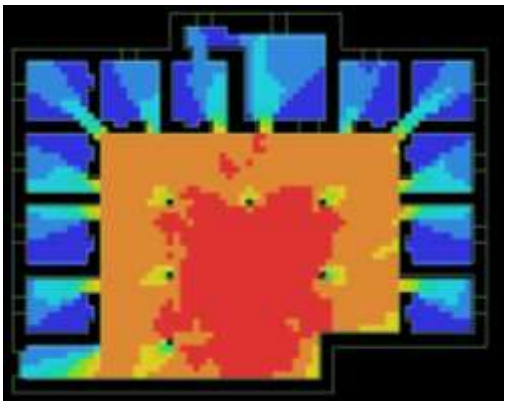
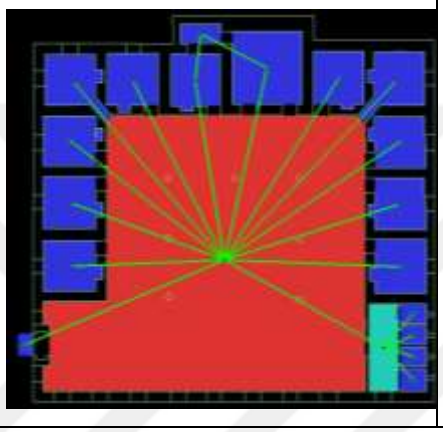
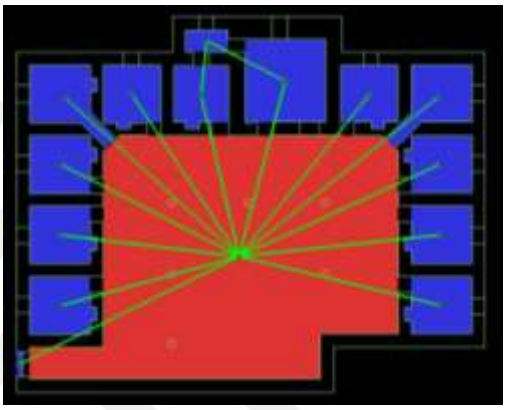
	Madrasah Function	New Function
VGA		
Convex		

Figure 5.48 Süleyman Paşa Madrasah's connectivity analysis

According to the data obtained from the analyses conducted for both functions, the space with the lowest depth value is the courtyard, while the space with the highest depth value is the passage (S08) that provides access from the cell to the classroom. This result indicates that the passageway holds the highest degree of privacy and seclusion in terms of accessibility. In the madrasa function, the depth value ranking of the spaces, from highest to lowest, is as follows: the passage area connecting the classroom and the müderris' room, the toilets, the cells, the lavatory, and the courtyard. In the convex space analysis of the building's new function, however, this ranking has changed to: the passage area connecting the classroom and the müderris' room, the cells, the müderris' room and the classroom, and the courtyard. This situation is also illustrated in the analyses by the different color representations in Figure 5.49.

In the visibility graph analyses, the spaces with the highest depth values, expressed in red, are observed in the toilets within the madrasa-function plan, whereas in the bazaar-

function plan they appear along the axis where the müderris' room and the classroom are located. Another difference observed after the modifications is the decrease in the depth values of the porticoes. While they were represented in dark blue in the first analysis, their depth values decreased, and in the new analysis they are expressed in light blue.

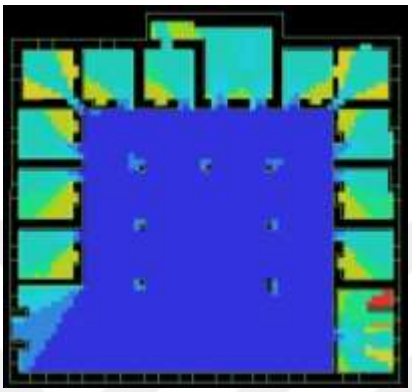
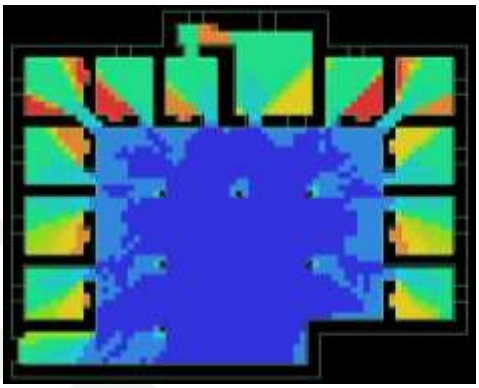
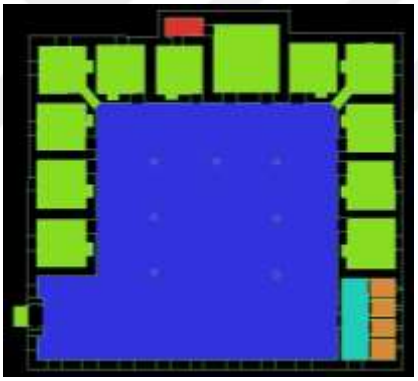
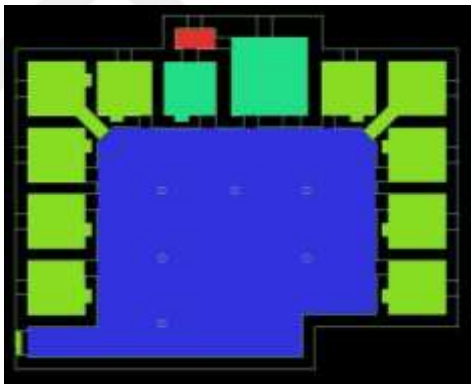
	Madrasah Function	New Function
VGA		
Convex		

Figure 5.49 Süleyman Paşa Madrasah's mean depth analysis

5.1.10 Hacı Beşir Ağa Darulhadis

Within the scope of the study, space syntax analyses were conducted on Hacı Beşir Ağa Darulhadis. The original plan of the building and its analysis values are presented in Figure 5.50 and Table 5.19. The plan and analysis values for the building's current function are shown in Figure 5.51 and Table 5.20.

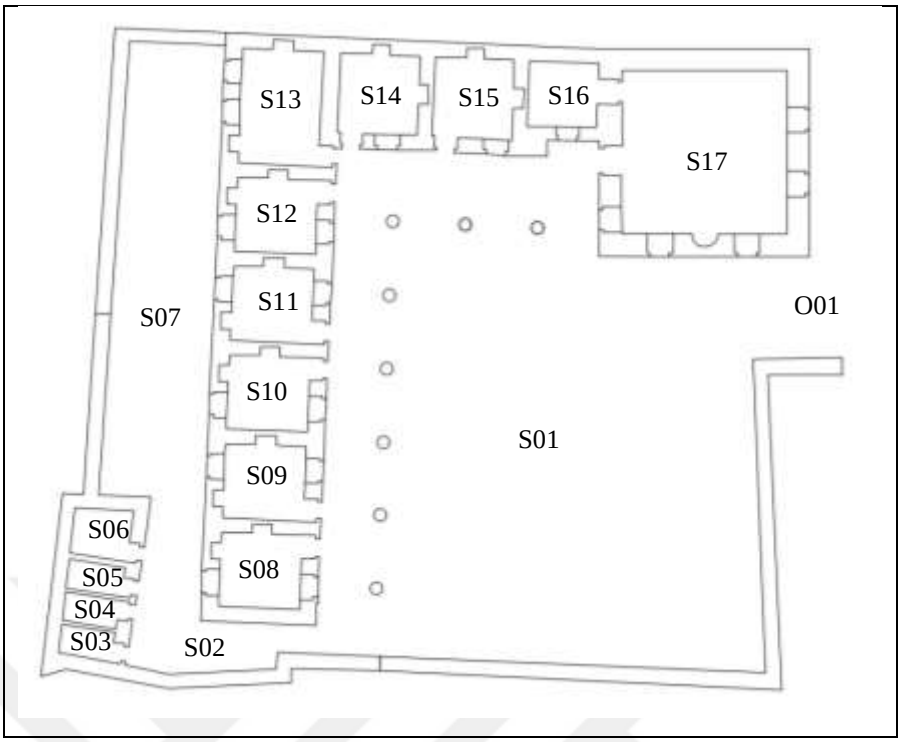


Figure 5.50 Plan of Hacı Beşir Ağa Darulhadis

Table 5.19 Analysis values of Hacı Beşir Ağa Darulhadis

Space	Connectivity	Integration	Mean Depth
O01	1	1.4666082	2.2941177
S01	11	5.3775635	1.3529412
S02	6	2.6887817	1.7058823
S03	1	1.152335	2.6470587
S04	1	1.152335	2.6470587
S05	1	1.152335	2.6470587
S06	1	1.152335	2.6470587
S07	1	1.152335	2.6470587
S08	1	1.4666082	2.2941177
S09	1	1.4666082	2.2941177
S10	1	1.4666082	2.2941177
S11	1	1.4666082	2.2941177
S12	1	1.4666082	2.2941177
S13	1	1.4666082	2.2941177
S14	1	1.4666082	2.2941177
S15	1	1.4666082	2.2941177
S16	1	0.89626056	3.1176472
S17	2	1.6132691	2.1764705

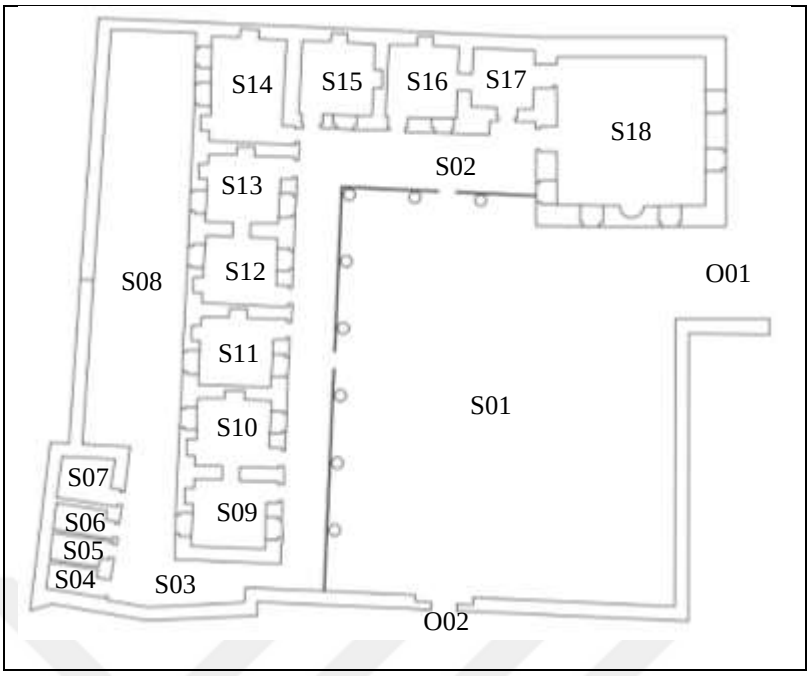


Figure 5.51 Plan of Hacı Beşir Ağa Darulhadis' new function

Table 5.20 Analysis values of Hacı Beşir Ağa Darulhadis' new function

Space	Connectivity	Integration	Mean Depth
O01	1	0.98690724	3.0526316
O02	1	0.98690724	3.0526316
S01	3	1.8328277	2.1052632
S02	12	5.4984832	1.3684211
S03	6	2.5659587	1.7894737
S04	1	1.1663449	2.7368422
S05	1	1.1663449	2.7368422
S06	1	1.1663449	2.7368422
S07	1	1.1663449	2.7368422
S08	1	1.1663449	2.7368422
S09	2	1.6037242	2.2631578
S10	2	1.6037242	2.2631578
S11	1	1.5395753	2.3157895
S12	2	1.6037242	2.2631578
S13	2	1.6037242	2.2631578
S14	1	1.5395753	2.3157895
S15	1	1.5395753	2.3157895
S16	2	1.6037242	2.2631578
S17	3	1.6734514	2.2105262
S18	2	1.6037242	2.2631578

The convex space analyses reveal that, in terms of accessibility, the courtyard emerges as the most integrated spatial unit within Hacı Beşir Ağa Madrasa. However, following the modifications made to the plan, the porticoes appear as the most integrated areas in the new functional layout, represented in red on the convex integration map (Figure 5.52). In its madrasa function, the least integrated and thus the most segregated spaces of the complex are the lavatories (S03, S04, S05, S06) and the library.

In the integration analysis conducted for the structure's contemporary function, it was determined that the courtyard experienced a decrease in its integration value and, accordingly, is represented in dark blue on the diagram. The results of the visibility graph analysis further support the convex space analysis by likewise identifying the courtyard as the most integrated spatial element within the madrasa layout.

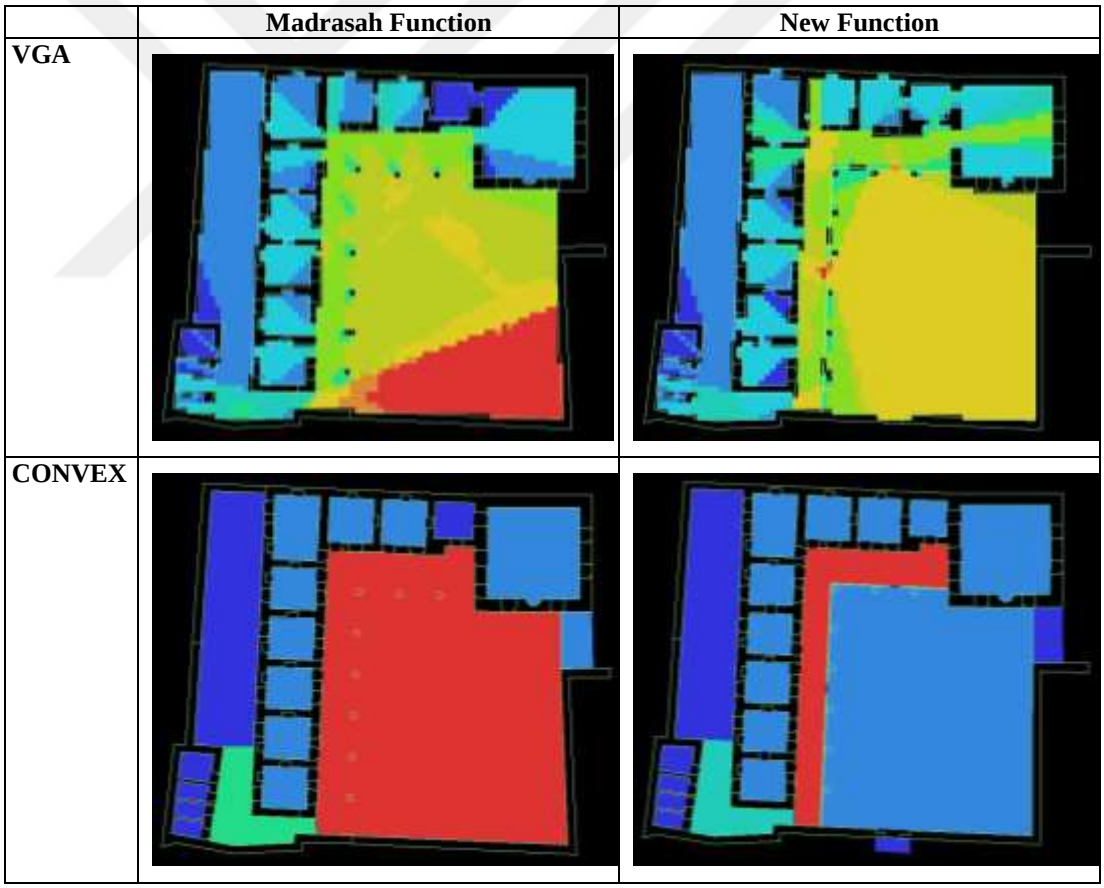


Figure 5.52 Hacı Beşir Ağa Darulhadis' integration analysis

As revealed in the convex space analysis, where the areas with the highest connectivity values are represented in red, the courtyard (S01) of Hacı Beşir Ağa Madrasa

constitutes the most connected spatial unit. Following the courtyard, the lavatories, the laundry facility, and the circulation zone (S02) connecting these spaces to the courtyard exhibit high connectivity values. Subsequently, the library (S17), which maintains a direct connection with the classroom-mosque unit, also demonstrates relatively high connectivity. By contrast, the remaining spaces, having lower connectivity values, are indicated in dark blue in the analysis corresponding to the madrasa's original plan.

Over the years, significant spatial modifications have been introduced to the plan. These include the enclosure of the porticoes with glass, the addition of a direct entrance to the library from the porticoed courtyard, whereas previously it could only be accessed through the classroom, and the removal of certain partition walls between cells to enhance circulation across spaces. As a result of these modifications, the convex space connectivity analysis of the new plan demonstrates notable shifts. In the current function, the porticoes (S02) emerge as the most connected spatial unit. Conversely, the remaining portion of the courtyard exhibits a reduction in connectivity. Furthermore, the library (S17), which in the new arrangement can now be accessed both from the porticoes and the classroom (S18), displays an increased connectivity value compared to its earlier function, and thus appears in light blue on the diagram. The classroom itself, however, shows a decline in connectivity, shifting from light blue to dark blue in the analysis (Figure 5.53).

The discrepancy between the porticoes appearing in red in the convex space analysis but in yellow in the visibility graph analysis can be explained by the presence of columns in the courtyard, which visually restrict spatial relationships. As observed in the visibility graph analysis, the alterations undertaken to adapt the madrasa into its contemporary function as the Şehbal Educational, Cultural, and Arts Center have also resulted in changes to connectivity values. Specifically, the enclosure of the courtyard porticoes with glass has reduced their connectivity, a condition reflected in the current visibility analysis, where these spaces are represented in light to dark blue tones.

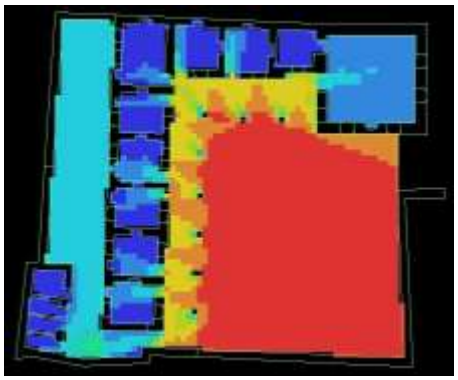
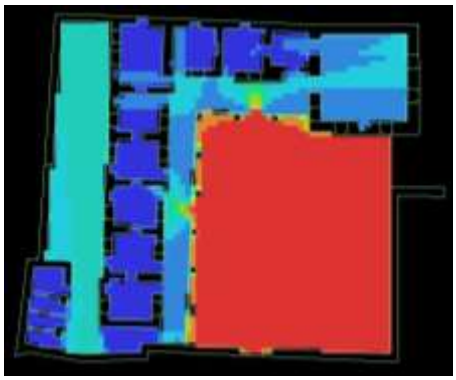
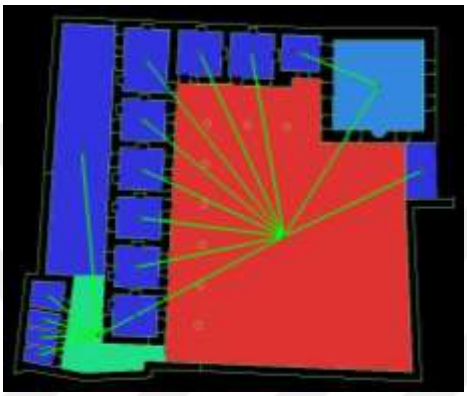
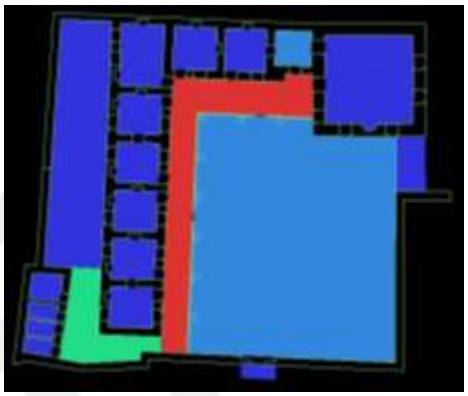
	Madrasah Function	New Function
VGA		
CONVEX		

Figure 5.53 Hacı Beşir Ağa Darulhadis' connectivity analysis

According to the convex space analysis conducted on the madrasa plan, the space with the highest depth value in terms of accessibility is the library. This outcome is represented in red on the diagram (Figure 5.54). Following the library, the sequence of spaces according to their depth values is as follows: lavatories, cells, classroom, and finally the courtyard. After the spatial modifications, the depth analysis of the new functional layout indicates that the lavatories became the most private areas of the system, represented in red. Conversely, the least deep, and thus the least private, space in the new plan is the portico, which has been enclosed with glass.

As with the other parameters, the structural alterations significantly affected the visibility graph depth analyses as well. In the new functional analysis, the depth value of the library decreased, leading to its representation in green-blue on the diagram. However, the persistence of the lavatories as among the spaces with the highest depth values remained consistent across both functional layouts.

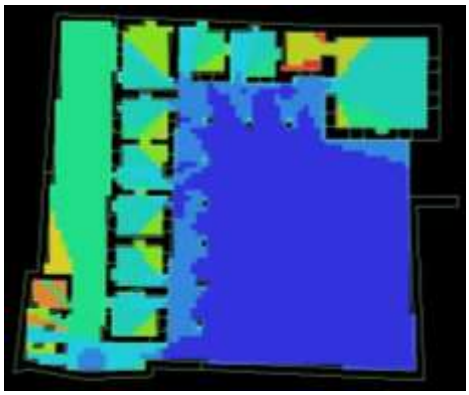
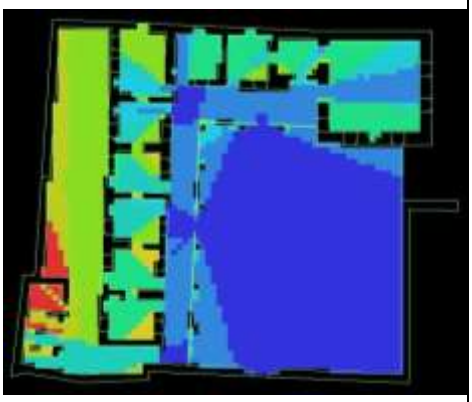
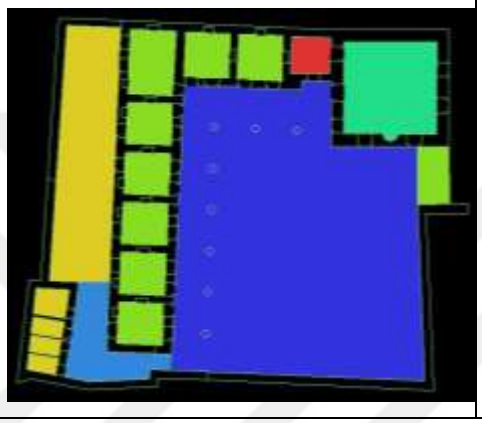
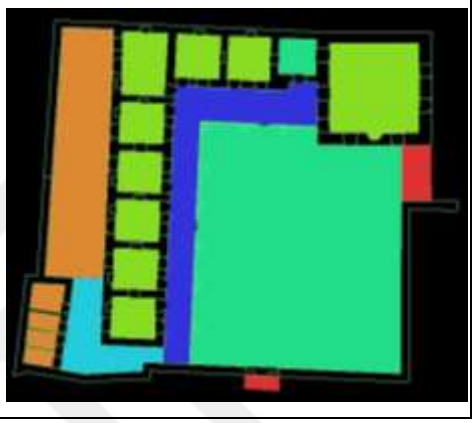
	Madrasah Function	New Function
VGA		
CONVEX		

Figure 5.54 Hacı Beşir Ağa Darulhadis' mean depth analysis

5.2 Evaluation and Discussion

This study aimed to quantitatively measure and evaluate spatial configuration changes in historic Anatolian madrasahs, which have undergone adaptive reuse, using the space syntax method. The comparative analysis of original and new functions through integration, connectivity, and mean depth parameters has revealed that adaptive reuse not only resulted in a functional change but also altered spatial logic. The analysis results indicate that although the physical integrity of the historic madrasah buildings has been preserved, significant changes occurred in their spatial hierarchy.

One of the most prominent findings of the analysis is that the courtyard, which served as the integration core and social heart in its original education function, retained its geometric centrality in the new functions. Furthermore, it remains the space with the highest integration value in the new plan systems of both the museum and the buildings

repurposed for functions other than the museum, confirming its persistent spatial dominance (Table 5.21, Table 5.22). In the historical madrasah buildings analyzed, it was determined that the courtyard consistently remained the space with the highest integration and connectivity values when compared to other spaces within the same system. This finding demonstrates that, regardless of the new function assigned to the building through adaptive reuse, the courtyard continues to serve as the spatial backbone of Anatolian madrasah typology.

Table 5.21 Courtyard parameter values in original and museum-adaptive plans

	Connectivity		Integration		Mean Depth	
	Old	New	Old	New	Old	New
Sırçalı Madrasah	16	11	12.829794	4.1814866	1.1578947	1.4375
Karatay Madrasah	15	6	16.13269	4.435111	1.1176471	1.25
İnce Minareli Madrasah	12	8	20.810526	11	1.0769231	1.1111112
Vacidiye Madrasah	12	11	20.810526	3.6588006	1.0769231	1.5
Rüstempaşa Madrasah	22	22	8.0807934	5.9362512	1.3333334	1.4722222

Table 5.22 Courtyard parameter values in original and non-museum adaptive plans

	Connectivity		Integration		Mean Depth	
	Old	New	Old	New	Old	New
Sahabiye Madrasah	16	14	32.265381	6.414897	1.0588236	1.3157895
Süleyman Paşa Madrasah	14	13	7.6978765	23.537504	1.2631578	1.0714285
Şehzade Mehmet Madrasah	24	24	7.0220346	6.7566676	1.3666667	1.3870968
Rabi Madrasah	22	22	4.2481289	4.0372686	1.625	1.6764706
Hacı Beşir Ağa Darulhadis	11	3	5.3775635	1.8328277	1.3529412	2.1052632

However, the experiental role of the courtyard has evolved. Historically, it functioned as a space where students socialized, transitioned to other spaces, and in some cases engaged in astronomy-related courses around the central pool. In its current state, it primarily operates as a transitional node within the new spatial configuration. Conducted depth analyses demonstrated that service areas such as restrooms consistently had the highest average depth values, preserving their privacy within the plan plane of the buildings' new functions.

Interventions such as functional subdivisions and the merging of multiple cells into single-purpose spaces have led to changes in the plan structure.. A critical observation

from the quantitative data is that some madrasah buildings exhibit a significant decrease in integration values in their adaptive reuse plans compared to their original plans. For example, at Vacidiye Madrasah, it decreased from 20.810526 to 3.6588006, and at Sırçalı Madrasah, it decreased from 12.829794 to 4.1814866. This mathematical phenomenon can be interpreted architecturally as follows: The decrease in integration values is not due to the courtyard losing its central role, but rather to the diversification of the spatial system due to adaptive reuse interventions. Consequently, although the courtyard continues to function as the most integrated space, the integration value has decreased as a result of the interventions within the spatial system. This transformation shows that the courtyard maintains its main position in the spatial system, even though its social load has decreased. On the other hand, the reason for the increase in the Süleyman Paşa Madrasah can be explained by the absence of service spaces in the new plan layout.

The study reveals patterns of spatial change between madrasahs converted into museums and those converted to non-museum functions, such as social or commercial (Table 5.23, Table 5.24). Museum functions often require larger and more flexible spaces for exhibitions. Consequently, this need was met by the absence of partition walls between student cells in the new plan system of some buildings, as seen in İnce Minareli Madrasah and Vacidiye Madrasah. Following the interventions, it was observed that the continuity of circulation required for museum exhibitions was achieved by merging the cells and thus fulfilled the spatial needs of the museum function. The absence of walls increased the connection between the intervened cells and simultaneously increased the depth of the accessed spaces. This is because, unlike the original layout, where each room was directly accessible from the courtyard, visitors must now move through a sequence of spaces to reach destinations. Thus, the radial circulation logic in the original system was disrupted, and the new museum function given to the building moved the building from a spatial logic in a "school" system to a logic in a controlled "exhibition route" system. Furthermore, the transformation of the cells, which were originally private living spaces, into public exhibition areas, transforming the "private" into "public display", demonstrates a complete reversal of the privacy hierarchy. This transformations shows that the gradual transition between public and private spaces has been altered.

Table 5.23 Classroom parameter values in original and museum-adaptive plans

	Connectivity		Integration		Mean Depth	
	Old	**New**	**Old**	**New**	**Old**	**New**
Sırçalı Madrasah	1	1	1.8328277	1.3304729	2.1052632	2.375
Karatay Madrasah	1	1	1.7925211	0.98558021	2.0588236	2.125
İnce Minareli Madrasah	1	1	1.6008096	1.2222222	2	2
Vacidiye Madrasah	1	1	1.6008096	1.2726263	2	2.4375
Rüstempaşa Madrasah	1	1	2.0671797	1.9406976	2.3030303	2.4444444

Table 5.24 Classroom parameter values in original and non-museum adaptive plans

	Connectivity		Integration		Mean Depth	
	Old	**New**	**Old**	**New**	**Old**	**New**
Sahabiye Madrasah	1	1	1.8979635	1.6037242	2	2.2631578
Süleyman Paşa Madrasah	2	2	1.8328277	1.9614588	2.1052632	1.8571428
Şehzade Mehmet Madrasah (?)	1	1	1.9310595	1.9304764	2.3333333	2.3548386
Rabi Madrasah	2	2	1.4160429	1.385928	2.875	2.9705882
Hacı Beşir Ağa Darulhadis	2	2	1.6132691	1.6037242	2.1764705	2.2631578

Some of the interventions observed in non-museum functions include the closing of riwaqs, which reduced the permeability previously provided through multiple access points between the courtyard and adjacent spaces, as well as the introduction of new spatial subdivisions and storage, as seen in the Sahabiye Madrasah. These modifications provided more controlled access to the spaces behind the riwaqs, which served different functions. Additionally, in historical Anatolian madrasah structures adaptively reused for commercial purposes, the courtyard continued to exhibit the highest integration values. This indicates that the courtyard facilitated the visibility and accessibility necessary for the shops, enabling customers to easily navigate. Also, in madrasah structures converted for commercial purposes, newly constructed partitions were used to meet contemporary spatial needs such as storage and offices. Consequently, the depth values of these newly formed spaces increased, and they began to function as more private spaces by creating new privacy zones in the public space.

In order to objectively reveal the spatial transformation resulting from adaptive reuse interventions, the parametric change ratios of the ten analyzed historical madrasah

buildings were evaluated by adopting the lower quartile (Q1), arithmetic mean, and upper quartile (Q3) values as threshold levels, and the buildings were subsequently grouped according to these thresholds (Table 5.25, Table 5.26, Figure 5.55). When the data are ordered from smallest to largest, the Q1 value represents the threshold that defines the lowest 25% of the distribution, while the Q3 value indicates the threshold for the highest 25% [101]. The arithmetic mean is obtained by summing all observed values and dividing the total by the number of observations. While the quartiles define the boundaries or extremes of the distribution, the average indicates the overall character of change within the group.

Table 5.25 Percentage change rates of courtyard parameters

Building Name	Change in Connectivity (%)	Change in Integration (%)	Change in Mean Depth (%)
Sırçalı Madrasah	-31.25	-67.40	24.14
Karatay Madrasah	-60	-72.50	11.84
İnce Minareli Madrasah	-33.33	-47.14	3.17
Vacidiye Madrasah	-8.33	-82.41	39.28
Rüstempaşa Madrasah	0	-26.53	10.41
Sahabiye Madrasah	-12.5	-80.11	24.26
Süleyman Paşa Madrasah	-7.14	205.76	-15.17
Şehzade Mehmet Madrasah	0	-3.77	1.49
Rabi Madrasah	0	-4.96	3.16
Hacı Beşir Ağa Darulhadis	-72.72	-65.91	55.60

Table 5.26 Quartile (Q1-Q3) and average values of parameter changes

Parameter	Q1	Average	Q3
Connectivity	-33.33	-22.53	0
Integration	-72.50	-24.50	-4.96
Mean Depth	3.16	15.82	24.26

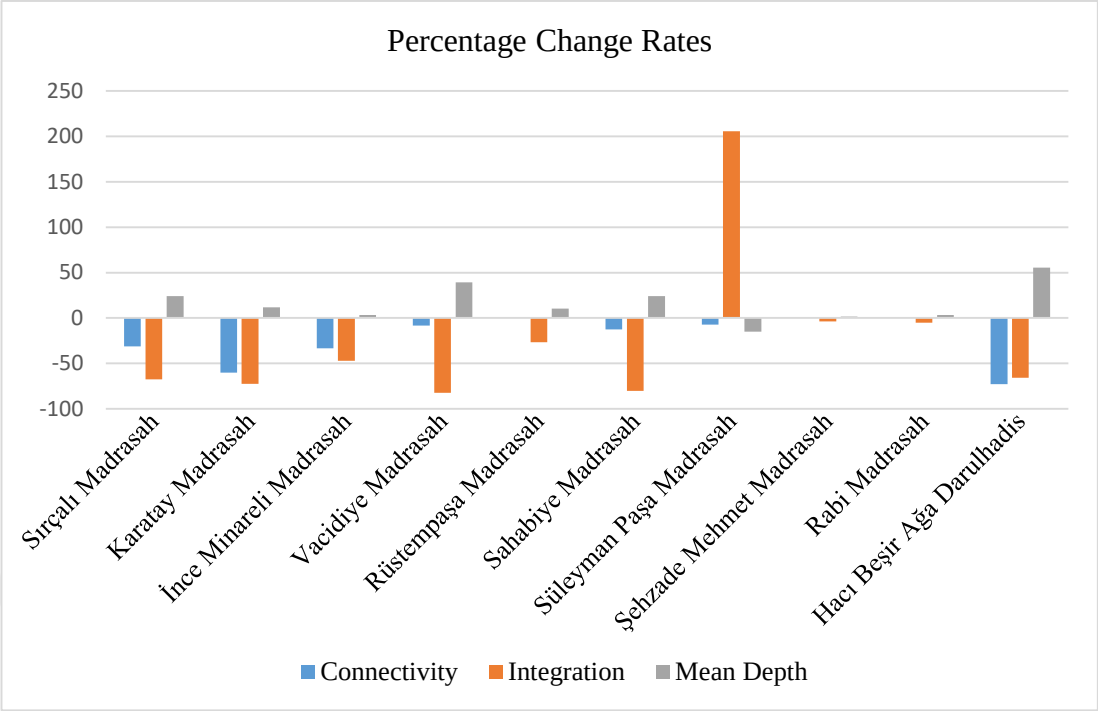


Figure 5.55 Percentage change rates of courtyard parameters

The analyses conducted on different madrasah structures reveal that post-intervention spatial configurations have undergone varying degrees of change. In buildings where the spatial system has been largely preserved, changes across all three parameters remain close to zero and below the 5% threshold, thus being considered negligible. These buildings emerge as the examples that most successfully retain the courtyard's original spatial genotype. Based on the values obtained from the analyses, Şehzade Mehmet Madrasah and Rabi Madrasah constitute this group.

Buildings in which at least one parameter dataset falls within the Q1-Q3 range or coincides with the threshold values constitute the group of partially transformed buildings. In this group, the analyses indicate that a systematic spatial transformation has begun. Rüstempaşa Madrasah, İnce Minareli Madrasah, and Sırçalı Madrasah are the historic buildings that fall into this category.

In buildings where the spatial system has undergone radical transformation, the parameter changes associated with the courtyard fall well below Q1 or significantly exceed Q3. The buildings identified as exhibiting theses extreme values are Süleyman

Paşa Madrasah, Hacı Beşir Ağa Darülhadis, Vacidiye Madrasah, Karatay Madrasah, and Sahabiye Madrasah.

The data obtained from the parametric analyses statistically confirm hypothesis H_1. This study demonstrates that adaptive reuse in historical madrasah structures should not be confined solely to physical conservation but must also examine how the new function aligns with the spatial context and how it reshapes the perception of existing spaces. By employing the space syntax methodology, the research establishes a link between architectural preservation and quantitative spatial analysis. The study contributes to the literature by providing a methodological framework for future adaptive reuse projects and argues that designers should consider not only the physical suitability of a new function, but also its impact on the hierarchy, accessibility, and social logic that shape the syntactic identity of the heritage building.

CHAPTER 6

CONCLUSION

This thesis addressed the lack of quantitative data in the literature examining the spatial effects of the reuse processes of historical madrasahs as a fundamental problem. To address this gap in the literature, the study aimed to analyze and objectively measure changes in the spatial logic of the structure using the space syntax method, based on the parameters of integration, connectivity, and depth, using the space syntax method. The scope of this study consists of historic madrasahs, which represent the earliest examples of higher education buildings in Anatolia. Accordingly, higher education buildings other than madrasahs, as well as madrasahs contructed outside Anatolia, were excluded from the research. The selection of the case studies was based on the identification of buildings whose plans had undergone alterations thorough adaptive reuse interventions that could influence the analytical results, and on the inclusion of structures from different historical periods. Within this framework, Sırçalı Madrasah, Karatay Madrasah, İnce Minareli Madrasah, Rüstempaşa Madrasah, Vacidiye Madrasah, Sahabiye Madrasah, Şehzade Mehmet Madrasah, Rabi Madrasah, Süleyman Paşa Madrasah, and Hacı Beşir Ağa Darulhadis were chosen as case studies, and VGA and convex map analyses were conducted on ehach.

This research aimed to demonstrate, using numerical data, the extent to which decisions implemented in the reuse processes of historical Anatolian madrasahs affected the structure's original spatial system. The detailed analysis of historical Anatolian madrasahs, which are heritage structures with deep roots, using space syntax provided a valuable set of case studies and comparative data to the limited literature in the field.

The results of the analyses demonstrate that physical conservation and spatial conservation are not the same. Altering the spatial configuration during interventions intended to ensure the physical continuity of a building may preserve its body while transforming its spirit (spatial genotype).

The VGA and Convex Map analyses conducted provided significant insights into the impact of repurposing on the spatial configuration of madrasah buildings. While the findings demonstrate that the courtyard is the most integrated space in both functions, it also loses its original function of social interaction and radiality, becoming a transitional node. Also, the analyses conducted on the madrasahs currently functioning as museums reveal a significant shift in the connectivity and integration values of their courtyard spaces. The results of the study indicate that 50% of the analyzed case studies fall into the category of radical transformation in terms of the spatial characteristics of their courtyard, 30% exhibit partial transformation, and 20% retain their original spatial qualities.

Altough museum functions are often considered the “safest” option for the adaptive reuse of heritage buildings, space syntax analyses reveal that in some cases they lead to the most evolutionary interventions. Conversely, historical madrasahs refunctioned with commercial uses have proven more succesful in preserving the radial logic of access inherent to these buildings. This phenomenon has been defined as the “museumification paradox”.

The analyses demonstrated that the interventions can lead to changes not only in the courtyard but also in the circulation logic of the buildings. For example, the radial configuration in the original plan of the Vacidiye Madrasah evolved into a linear system in the new function of the museum. However, this was not observed in all the historical madrasah buildings analyzed. In contrast, as in the Sahabiye Madrasah example, commercial and social functions tended to maintain the radial logic by using the courtyard as a distribution hub for users. However, interventions such as the closure of the porticoes have been found to reduce visual connectivity. Furthermore, the average depth parameter values obtained from the analyses demonstrated that the public-private hierarchy was reversed in the plans belonging to the new functions. The high privacy spaces required by the new function were no longer met through cells, the original architectural units of the building, but rather through newly created service or storage areas by dividing existing spaces.

As a result of the implemented interventions, the traditional configuration of "seclusion in the cell / social interaction in the courtyad" has largely disappeared. Space syntax data quantitavely demonstrate that the new functional schemes imposed on these historical buildings have led to a loss of spatial memory.

This research contributes to the literature in three areas by bringing together the disciplines of historical Anatolian madrasas, adaptive reuse, and spatial analysis. The study provides a quantitative evaluation framework that argues that adaptive reuse decisions should be considered not only on the basis of physical suitability but also their impact on the spatial identity of the building.

This research aims to demonstrate, using mathematical data, that not only preserving the historical form but also analytically analyzing the spatial experience of the new function to be assigned to the building is critical to architectural conservation practice. This research demonstrates the potential of repurposing practices to destroy the spatial logic of a building despite efforts to preserve its physical existence. Because the analyses and evaluations carried out have proven that maintaining the physical existence of a building does not mean preserving its spatial logic and social functioning.

For future studies, it is recommended that the space syntax findings be supported by user surveys. The relationship between visitors' perceptions of the structure, whether confusing or legible, and the values produced by syntactic parameters should be examined, thereby testing the psychological correspondence of the quantitative data.

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APPENDICES

Appendix A: List of the Examined Buildings.

Appendix A – List of the Examined Buildings

Table A.1 List of the examined buildings

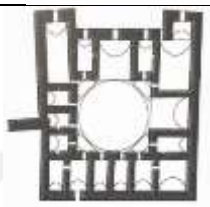
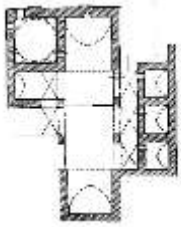
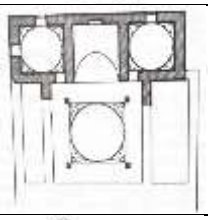
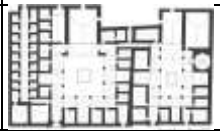
Name	Place	Year	Current Use	Original Plan	Current Plan
Çukur Madrasah	Tokat	1148 - 1157	Museum		Not accessible
Niksar Yağıbasan Madrasah	Tokat	1158	Visitor Site		Not accessible
Hatuniye (Sitti Radviyye) Madrasah	Mardin	1176 - 1184	Religious		Not accessible
Ali Gav Madrasah	Konya	12th c. - 13th c.	Education		Not accessible
Marufiye (Hacı Maruf) Madrasah	Mardin	13th c.	Unused		Not accessible
Şehidiye Madrasah	Mardin	13th c.	Religious		
Çifte Madrasah	Kayseri	1205 - 1206	Museum		Not accessible

Table A.1 (continued) List of the examined buildings

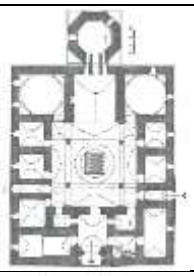
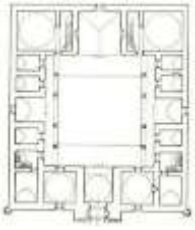
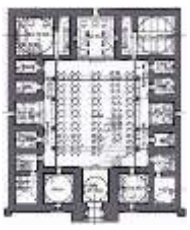
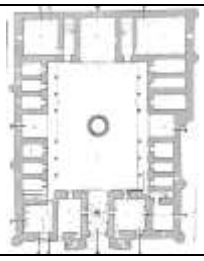
Ertokuş Madrasah	Isparta	1224	Unused		Not accessible
Sırçalı Madrasah	Konya	1242	Ground: Museum Upper: Admin		
Karatay Madrasah	Konya	1251	Museum		
İnce Minareli Madrasah	Konya	1258 - 1279	Museum		
Sahabiye Madrasah	Kayseri	1267	Trading		
Buruciye Madrasah	Sivas	1271	Trading		
Gök Madrasah	Sivas	1271	Museum		Not accessible

Table A.1 (continued) List of the examined buildings

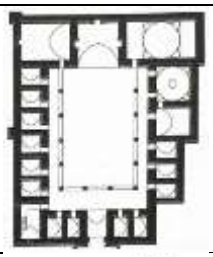
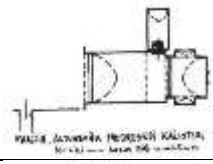
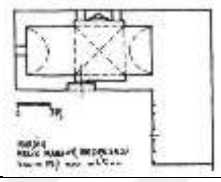
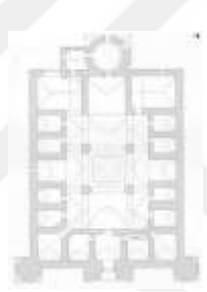
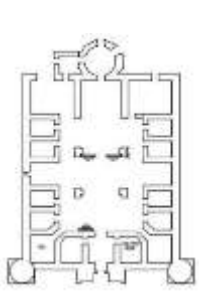
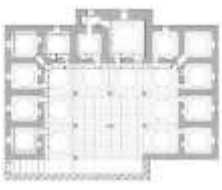
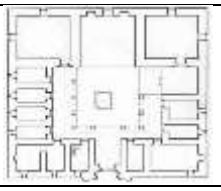
Gök Madrasah	Tokat	1277	Museum		Not accessible
Altunboğa Madrasah	Mardin	13th c. - 14th c.	Unused		Not accessible
Melik Mansur Madrasah	Mardin	13th c. - 14th c.	Religious		Not accessible
Yakutiye Madrasah	Erzurum	1310	Museum		
Vacidiye Madrasah	Kütahya	1314	Museum		
Süleyman Paşa Madrasah	Bursa	1335 - 1359	Trading		
Tol Madrasah	Karaman	1339	Exhibition		Not accessible

Table A.1 (continued) List of the examined buildings

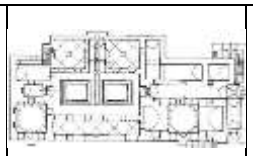
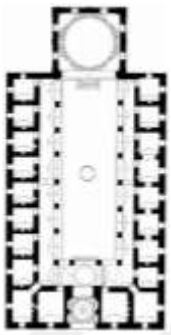
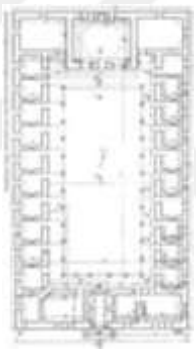
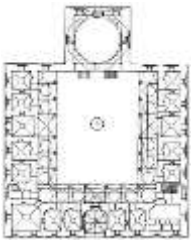
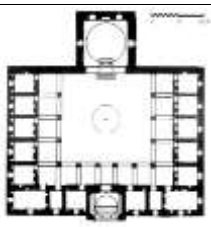
Zinciriye (İsa Bey) Madrasah	Mardin	1385	Trading		Not accessible
Yıldırım Madrasah	Bursa	1399	Unused		Not accessible
Yıldırım Darüşşifa	Bursa	1399 - 1400	Health care		Not accessible
Yeşil (Sultaniye) Madrasah	Bursa	1419	Museum		
Muradiye Madrasah	Bursa	1425 - 1426	Museum		Not accessible

Table A.1 (continued) List of the examined buildings

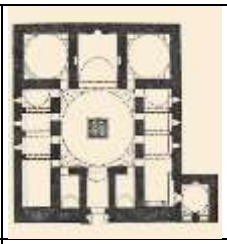
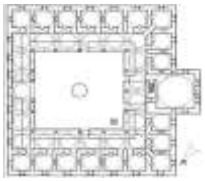
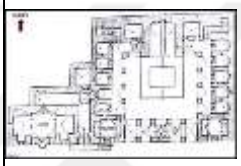
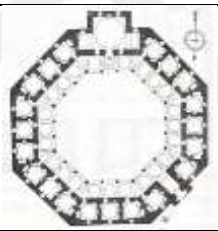
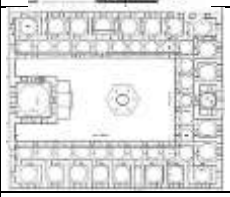
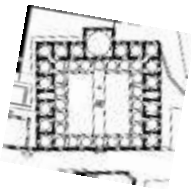
Gedik Ahmet Paşa Madrasah	Afyonkarahisar	1472	Education		Not accessible
Edirne Bayezid Madrasah	Yeniimaret/ Edirne	1484 - 1488	Museum		
Kasımiye Madrasah	Mardin	1487 - 1507	Museum		Not accessible
Kapıağa Madrasah	Amasya	1488	Education		Not accessible
Şah Sultan Hatun Madrasah	Mardin	15th c. - 16th c.	Unused		Not accessible
İstanbul Bayezid Madrasah	Fatih / İstanbul	1506 - 1508	Museum		Not accessible
Haseki Madrasah	Fatih / İstanbul	1539 - 1540	Education		

Table A.1 (continued) List of the examined buildings

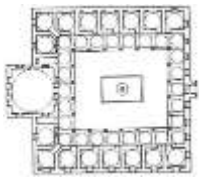
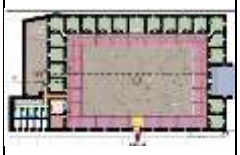
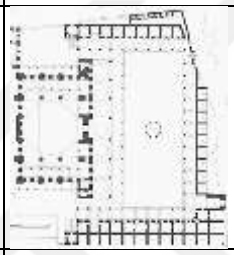
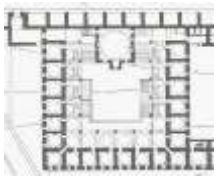
Mihrimah Sultan Madrasah	Üsküdar / İstanbul	1540 - 1548	Health care		
Şehzade Mehmet Madrasah	Fatih / İstanbul	1543 - 1548	Waqf		
Mihrimah Sultan Madrasah	Edirnekapı / İstanbul	1547 - 1548	Education		Not accessible
Yavuz Sultan Selim Madrasah	Fatih / İstanbul	1548 - 1550	Health care		Not accessible
Rüstem Paşa Madrasah	Fatih / İstanbul	1550 - 1551	Museum		
Rabi Madrasah	Fatih / İstanbul	1550 - 1557	Institution		

Table A.1 (continued) List of the examined buildings

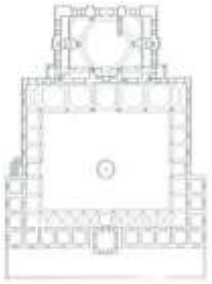
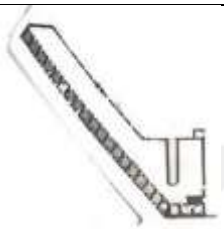
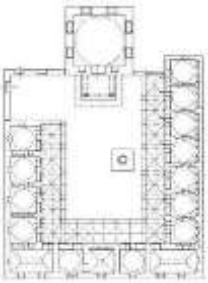
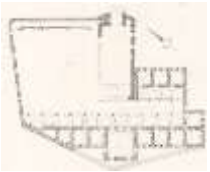
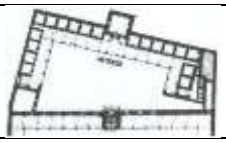
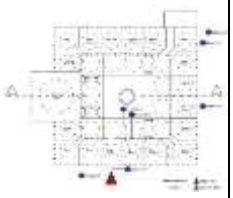
(Gazi) Kara Ahmet Paşa Madrasah	Fatih / İstanbul	1555 - 1562	Dorm		Not accessible
Süleymaniye Darülhadis	Fatih / İstanbul	1556 - 1557	Waqf		Not accessible
Caferağa Madrasah	Fatih / İstanbul	1559	Education		Not accessible
Hadım İbrahim Paşa (Esekapı) Madrasah	Fatih / İstanbul	1560	Health care		
Atik Valide Madrasah	Üsküdar / İstanbul	1570 - 1579	Waqf		Not accessible
Kılıç Ali Paşa Madrasah	Beyoğlu / İstanbul	1578 - 1580	Waqf		

Table A.1 (continued) List of the examined buildings

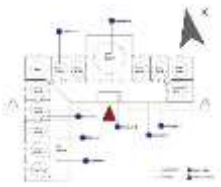
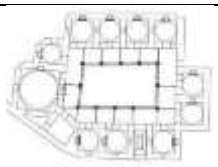
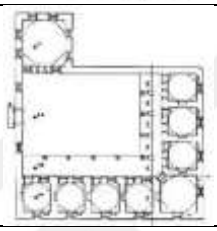
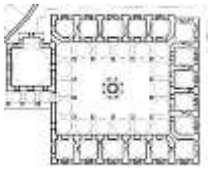
Şemsi Ahmet Paşa Madrasah	Üsküdar / İstanbul	1580	Library		
Kızlarağası Mehmet Ağa Madrasah	Fatih / İstanbul	1582	Institution		Not accessible
Nişancı Mehmet Paşa Madrasah	Fatih / İstanbul	1584 - 1589	Institution		Not accessible
Siyavuş Paşa Madrasah	Fatih / İstanbul	1591 (?)	Museum		
Koca Sinan Paşa Madrasah	Fatih / İstanbul	1594	Waqf		
Hadım Hasan Paşa Madrasah	Fatih / İstanbul	1597 - 1598	Trading		Not accessible
Sultanahmet Madrasah	Fatih / İstanbul	1609 - 1617	Waqf		

Table A.1 (continued) List of the examined buildings

Cedid Mehmet Efendi Madrasah	Fatih / İstanbul	1705 (?)	Trading		
Hacı Beşir Ağa Darülhadis		1735	Waqf		
Hamidiye Madrasah	Fatih / İstanbul	1780	Admin		

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ANKARA

Department of Architecture

Bilgesu ÜNALAN

