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Reading Archaeological Values in Urban Heritage Sites with GIS: The Case Study Ancient City of Side

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Abstract

As a result of successive settlement processes, cities change with each new period, bringing with them the components of the previous period along with their differences. This change naturally also contains the accumulation of the different components of each period. In order to protect cities and their components and ensure the continuity of this protection, the information contained within cities must be comprehensively and accurately read and understood. In this context, this study aims to examine the perceptibility of archaeological values in urban site areas within a Geographic Information System (GIS) environment. Raw data is converted into usable information by transferring it to GIS for analysis. The application was carried out in the ancient city of Side, which was selected as the sample study area. Data obtained from the field and various sources were transferred to the GIS environment and analyzed. Based on the analyses, purposeful inquiries and evaluations were made. The results regarding the inclusion of GIS in the conservation process were presented.

Keywords

GIS; Archaeological Heritage; Conservation; Urban Component; Visibility

1. Introduction

Cities are constantly evolving and changing as a result of settlement and human actions. The formation, change, transformation, and continuity of cities have created a shared memory from the past to the present (Rossi, 2006) [1]. This shared memory encompasses many different periods that have overlapped or coexisted up to the present day. Each period requires the coexistence of the previous and subsequent components of the culture belonging to the memory. For this reason, understanding each period is crucial for the historical continuity and identity of multi-layered cities (Altınöz, 2002) [2]. According to Feilden and Jokilehto (1998), cities are the product of different historical periods and specific social, cultural, anthropological, geographical, and economic relationships (Feilden and Jokilehto 1998) [3]. In this context, to understand the city, it is first necessary to understand the

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social, cultural, geographical, and economic values of the periods related to the city. In addition to the cultural accumulation of societies, cultural continuity is also important. In this case, each period reflects its own way of life in the space and becomes a link in the chain of culture (Madran, 1997) [4]. As Feilden and Jokilehto (1993) also point out, historic centers are components of a larger whole. They should be approached not as static objects or for the purpose of attracting tourists, but as part of contemporary life in the context of today (Feilden and Jokilehto (1998) [3].

Cities must continue to change and develop in order to thrive in the future, just as they have always done in the past. This means striking a balance between the desire to preserve the past and the need to update/renew for the future (A European Code of Good Practice, 2000) [5].

In this context, it is crucial to establish a comprehensive and accurate foundation for the information obtained to understand cultural values. To protect and ensure the continuity of conservation, the information must be evaluated systematically and rationally within the scope of the conservation decisions and projects to be developed. At this point, Geographic Information Systems (GIS) offer many advantages in terms of spatial data collection, structuring, analysis, evaluation, storage, and sharing, and are a very important tool for making and implementing conservation decisions.

1.1. Problem Definition

Multilayered cities are the result of the coexistence of successive past periods and contemporary life. For this reason, remnants of past periods are intertwined with the subsequent period. This relationship is sometimes strong, sometimes very weak, and eventually breaks down and disappears over time. In this case, the cultural asset becomes alienated from its surroundings and detached from the contemporary context. Historical and archaeological layers, which are elements of collective memory/coexistence and the character of the city, are threatened with extinction as a result of these circumstances. In this regard, integrating the cultural heritage of the past with the contemporary context, correctly understanding the data it provides, comprehensively and systematically collecting the information obtained, analyzing it, and reinterpreting it has become an important conservation issue.

In this study, the settlement of Selimiye, selected as the sample study area, and the ancient city of Side within this settlement, are cities with a multi-layered structure similar to many other Anatolian cities. As a settlement where archaeological remains from different periods, traditional structures from the recent past, and modern development coexist, it contains multidimensional and dynamic information. The legal process that began with the International Planning and Tourism Competition organized by the Ministry of Tourism in 1968 marked an important turning point for Side in terms of the city's development. Tourism, which was a strategy to support economic development in the 1970s, is currently managed in an inadequate and inaccurate manner. This situation exceeds the city's usage limits and jeopardizes its sustainability. Development policies determined by local and official authorities mostly ignore the historical background that defines the city's multi-layered character or they prioritize tourism-oriented use solely for economic gain. The root cause of this situation, where the concept of preservation has failed to integrate with the development of the city, lies in the failure to properly recognize the cultural heritage and the stratified city in which it exists. The information it provides is either not obtained at all or collected and processed in an inadequate and non-forward-looking manner using incorrect methods, which not only fails to contribute to inevitable urban development but is also seen as an obstacle.

In this context, the problem addressed in this study is the issue of perceiving the archaeological values within the urban site area in Side, which contains multidimensional and diverse types of data, within the urban fabric. In light of this problem, this article focuses on converting raw data into usable information through its collection, structuring, analysis, evaluation, storage, and sharing. The study involves the process of establishing a complete, usable, manageable, and updatable information system.

In order to ensure a sustainable approach to conservation, cultural values must be considered within the context of the present day. The continuity of each period's urban identity and its social, cultural, geographical, and economic significance must be evaluated for today and the future. As stated in the Ename Charter (2008), prepared within the scope of ICOMOS's Perception and Presentation of Cultural Heritage Sites, the contribution of each period should be considered for the importance and meaning of a cultural heritage site. During the interpretation process, even if a specific period and theme are highlighted, every period in the site's history—its contemporary context and significance—should be considered [6]. Judging cultural heritage solely based on the architectural and

physical characteristics of a particular period prevents contemporary society from engaging with diverse cultural layers.

It is crucial that data obtained from cultural heritage is comprehensive, usable, and updatable. The study aims to examine the visibility of archaeological assets within the urban fabric of Side, located within an urban site area, using Geographic Information Systems (GIS). In this study, raw data collected for the accurate understanding and perception of cultural/archaeological assets, which play an important role in the decision-making and implementation process of conservation, are stored by being converted into usable information in a systematic and renewable information system. To this end, the data obtained is structured and analyzed using the database created in the GIS environment.

Each layer within the site has its own values, issues, and potentials. The layers are processed by analyzing individually using a database created with Geographic Information Systems. Thematic maps were created as a result of the analyses. Evaluations are made by querying these maps. Based on the new information obtained from these evaluations, the study includes inquiries and conclusions regarding the visibility of archaeological assets. The research question of this article is based on an experiment in applying GIS to the process of collecting, analyzing, and transforming data into usable information—a crucial step in making conservation decisions. Accordingly, this study does not involve offering any conservation proposals and questioning previously taken conservation decisions in the ancient city of Side, the study area, within the framework of current conservation policies.

1.2. GIS As a Method and Technique for Data Collection and Evaluation in The Conservation Discipline

Geographic Information Systems (GIS) are an environment where spatial data is created, collected, structured, analyzed, evaluated, stored, shared, and monitored [7]. It is used as a very important tool in terms of the making decisions of conservation and implementation of them. The act of conservation itself is complex and multidimensional in nature [8]. GIS, which enables the systematic and updatable processing of this complex and multidimensional information obtained during the conservation process, can also be effectively used in the interpretation phase of this information. The fact that GIS has a flexible database is crucial in terms of the adaptability of all collected data to different and constantly changing technologies.

GIS is also defined as an integrated computer program used to display and manage information about geographic locations, and to analyze and model their spatial relationships [9]. According to the definition provided by ESRI, GIS provides a framework for collecting and organizing spatial data and related information about its display and analysis. As defined by Dueker and Kjerne (1989), GIS is described as a specific type of information system. According to the definition, the GIS database contains spatial data that can be defined as points, lines, or polygons [10]. At this point, the purpose of GIS is to manage data related to these points, lines, or polygons, and to perform analyses and queries on this data [11].

In GIS, the ‘graphics/mapping database’ and ‘relational database’ interfaces work in a connected manner. In her article, Altınöz (2010) states that 'Thanks to this interconnected working state of the interfaces, spatial data containing spatial/geographic location and geometric properties, and attribute data containing descriptive properties of spatial objects found in the GIS environment as reflections of the real world possess, are integrated into the system as a whole". Spatial data are classified under different feature classes based on their attribute data and the shapes in which they are represented. These different feature classes exist as different layers in the GIS environment. Spatial data relates to graphic features such as digitized maps, aerial photographs, and satellite images, while attribute data relates to descriptive or statistical features. Spatial data is represented on two different geographic data models, vector and raster, to define spatial relationships. The vector model, which is stored according to specific coordinate (x, y) values, is divided into point (such as peak points), line (such as distance), and polygon (such as area) data. On the other hand, the raster model is data represented by cells [12].

GIS first emerged conceptually in 1963 with the Canadian GIS project led by Roger Tomlinson [13], while its use in the field of protection began in the 1990s [8]. The effective use of GIS as a tool for information production and management in the field of conservation is a process carried out jointly by conservation experts and systems experts. The basic steps to be followed in this process are listed by Altınöz (2010) as follows:

—Project definition

This stage involves determining the project's problem, purpose, and scope based on the characteristics of the cultural heritage that is the subject, along with its surroundings, conservation issues, the scope of the work, and the data sources to be used.

—Creation of the project's spatial database

Creating a logical model in the GIS environment and designing the database according to the data types required for the project's conservation process; defining spatial objects, feature classes, geometric expressions, and attribute data groups according to data type, data needs, analysis processes, and criteria; collecting data from different sources to be used in the study is carried out at this stage.

—Data entry and configuration

This stage involves correcting the maps to be used as a base in the project, converting them into a coordinate-based format; digitizing the collected raw data and transferring it to the system; and configuring the data according to the designed database.

—Data analysis and evaluation

At this stage, thematic maps are created from the data; queries are performed on attribute and spatial data; spatial models are produced.

—Presentation and sharing of results

This stage involves the presentation and sharing of results in the form of GIS maps, reports, and forms in digital, printed, or web formats as part of the analysis and assessments that will support the conservation process.

—Monitoring and updating

At this stage, data is updated at regular intervals; the information is continuously monitored throughout this management process and updated as necessary [8].

1.3. Side As a Case Study

No clear information has yet been obtained regarding the earliest history of Side [14]. In contrast, the ancient geographer Strabon describes the city as a colony of Kyme (Namurt Port), one of the cities of Western Anatolia [15]. Although its founding date is uncertain, Mansel dates the city to the second wave of colonization -7th century BC-. However, the fact that there were no cultural or religious ties between the main city (Kyme) and its colony (Side) in later periods reduces the likelihood that this dating is correct. Based on certain evidence he presented, Mansel undoubtedly accepted that Side was one of the oldest cities in Southern Anatolia [14]. Coin inscriptions dating back to the 6th century BC and stone inscriptions from the 3rd-2nd centuries BC prove that a language based on an ancient Anatolian language was spoken in Side and written in its own unique script. Arrianos, the historian of Alexander the Great, states that the first people to arrive in Side (the Greeks) were the Cymelians quickly forgot their own language and began to use the local language [16]. This situation shows that the city was not founded by the Cymelians, in other words Side was not a colonial city, but that they came to Side as immigrants. In this regard, it is possible to say that the city was founded before the arrival of the Cymelians [17].

Urban development activities of Side increased in the 2nd and 3rd centuries AD with political relaxation and the development of agriculture, seafaring, and trade, and the city's wealthy contributed to the reconstruction of buildings and the repair of existing ones [18]. The fact that it is referred to as a ‘metropolis’ in inscriptions from the 2nd and 3rd centuries AD supports the idea that the city was the provincial capital [14]. The 2nd and 3rd centuries were a golden age for Pamphylia and Side. Neither before nor after this period did the city experience such significant development or attain such a level of wealth and prosperity. Monuments and structures built during this period, some of which still stand today, attest to this fact [14]. As Ammianus (2004) [19] states, it is known that in the mid-3rd century, the Goths moved towards to the Pamphylian coast as part of their raids that encompassed the entire Anatolian coast. According to Nolle (1993) [20], these Gothic attacks also included Side [21]. Mansel (1978) [14] states that towards the end of the 3rd century, the city's golden age gradually began to lose its character. Mansel (1978) [14] suggests that, as a result of these attacks on the city, the Philippus Attius wall, which passes behind the theatre stage building and has rectangular towers made of recycled stones, was constructed around the middle of the 4th century for defense and to reduce the size of the city (Apart from Arif Müfid Mansel, some researchers have proposed different dates for this city wall. Foss (1996) [22] dates the wall to the 7th century, while Yıldırım (2013) [21] states that it was built in a later period). It is stated that the city was

divided in two by this wall and that a large part of the population was subsequently relocated to the south, towards the sea [14].

In addition to the lack of clear information regarding the beginning of Christianity in Side, it is noted that the city took on the form of a new Christian city with the prohibition of paganism and the strengthening of Christianity from the 4th and 5th centuries onwards [21]. According to Mansel (1978) [14], Side was the capital of the Eastern Pamphylia region in religious terms during the 5th and 6th centuries— although this is often described as a period of turmoil for Pamphylia —and experienced its final golden age. It is possible to say that natural disasters and epidemics, which caused a significant decline in the city's population in the 6th century, also led to the deterioration of the city's economy [21]. As a result of the Arab raids in the 7th century, Side, Attaleia, and Syllion were besieged [20]. In addition to Mansel's (1978) [14] statement that Side began to suffer damage from these raids, that the destruction and devastation occurred during the Arab raids in the 10th century, and that the city was abandoned, Yıldırım (2013) [21] predicts that Side, with its declining population and weakened economy, would not pose a serious threat to the Arab army. He argues that instead of being completely abandoned, the city served as a settlement providing fresh water and provisions for Arabs who occasionally visited the region. The 12th-century Arab geographer Idrisi, who visited Side, noted that the city was in ruins and that its small population had settled on a hilltop in 'New Antalya' [23]. The settlement completely ceased when Seljuks got the city in the 13th century [24]. In the late 19th and early 20th centuries, Cretan immigrants were settled in the southern part of the city, between the theater and the sea, establishing the village of 'Selimiye' [14].

Based on surface surveys, excavations, and historical research conducted on the city, it is possible to find traces of different periods in the historical process of Side. This study has processed the data obtained into four physical periods: Hellenistic, Roman, Byzantine, and Late Ottoman. The study uses the coding system developed by Arif Müfid Mansel for the structures [14] (Figure 1).

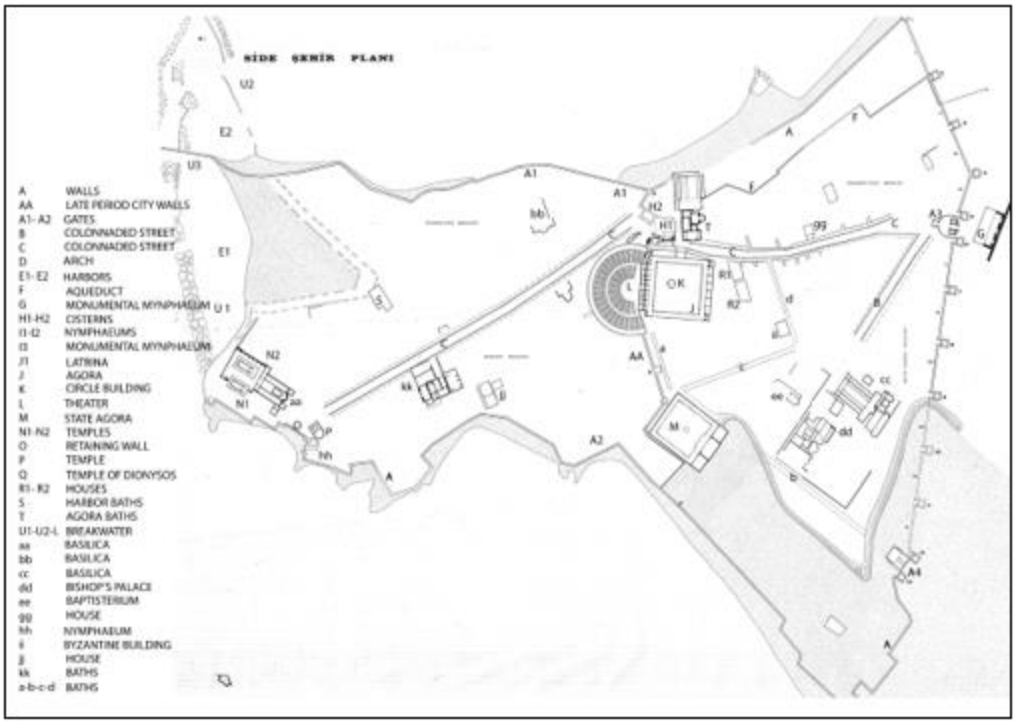


Figure 1. Archaeological remains in the city [14].

2. Materials and Method

An information system for architectural conservation has been created to enable the storage, geographical location, and analysis and evaluation of spatial and qualitative relationships of a large amount of data from various studies and sources related to the field of study, in a common environment. The preparation of the information system in the GIS environment consisted of four main stages.

- Preliminary preparation and fieldwork
- Database creation and topology setup

- Data entry and data structuring
- Data analysis, evaluations, and presentation

The first stage is the preliminary preparation and fieldwork phase. During this stage, literature and archival research was conducted to gather information about Side's historical development, urban, architectural, and archaeological characteristics, and conservation and planning efforts carried out to date. The types of data to be provided in the field were determined by considering the aims and objectives of the study. In the fieldwork, data was collected on the physical, functional, visual, and social characteristics of the study area and its components, based on existing maps and zoning plans for conservation purposes. The next stage is the creation of the database in the GIS environment. It involves database design, correcting and coordinating the maps to be used as a base map in the project, defining spatial objects, feature classes, geometric expressions, and feature data groups according to data type, data needs, analysis processes, and criteria. The third stage involves data entry and structuring. In this stage, the collected raw data was digitized and transferred to the system, and the data was structured according to the designed database. The final stage involves analyzing, evaluating, and presenting the data. Within this scope, thematic maps and graphical summaries have been created from the data. Queries were performed based on attribute and spatial data. Within the framework of analyses and evaluations that will contribute to the conservation process, GIS maps, graphics, and reports were presented in digital format or in print.

2.1. Preparation and Evaluation of Data Related to the Study Area in a GIS Environment

2.1.1. Preliminary Preparation and Fieldwork

The documents, maps, old and current photographs, and verbal information required in line with the problem, objective, and method determined within the scope of the study have been identified. First, the current map of Side was obtained from the Manavgat Municipality. The Conservation-Oriented Zoning Plans prepared to date were obtained from the Antalya Regional Council for the Conservation of Cultural Property. During the literature review phase, data related to scientific studies such as excavation reports, drawings, and published texts from previous years, as well as old and current photographs and written sources, were obtained from the archives of the Side Excavation Directorate. Information regarding the physical, functional, visual, and social characteristics of the built environment and components, and its open spaces and components of the ancient city of Side, was collected through fieldwork based on the current map and conservation-oriented zoning plan.

2.1.2. Creating the Database

Feature classes, geometric expressions, and attribute data groups have been determined according to data type, analysis processes, and criteria. Within the scope of this study, the data to be processed in the GIS environment are available in two different geographic data models: raster and vector. First, the base map 1:1000 with local coordinate system obtained from Manavgat Municipality was imported into the ArcGIS environment to create the base layer to be worked on (Figure 2). The Side (Antalya) Ancient City Conservation Oriented Revision Zoning Plan, approved in 2014, Arif Müfid Mansel's (1978) Side City Plan, and the 2016 satellite image of Side sourced from Google Earth were georeferenced on base map with the local coordinate system, and projection adjustments were made (Figure 3, Figure 4, Figure 5). Thus, the base map, the Conservation Oriented Revision Zoning Plan, the Mansel City Plan, and the satellite image taken in 2016, which will serve as the basis for analyses, inquiries, and evaluations in the study, have been loaded into the database as a raster data model.

In order to facilitate the perception of archaeological values within the urban site in Side, analyses based on collected data have been determined. These analyses are primarily categorized under two main headings: data related to the built environment and data related to open spaces. Data related to the built environment includes all ancient remains, traditional structures, and contemporary buildings within the site. Analyzing the location, function, number of floors/heights of all structures within the urban site is crucial in order to see the relationship between archaeological values and their surroundings, as well as their transformation throughout history. Public and private open spaces, as well as ancient and contemporary roads, constitute data related to open spaces. Analyzing the use and density of open spaces within the urban site, vehicle and pedestrian traffic, function, and physical condition is necessary to ensure that archaeological values are perceived as a whole within the context of urban components. During the database creation phase, the layers and their column headings are determined in accordance with the framework established above. The structure and operation of the database are designed to meet the requirements of the analyses of data related to the built environment and open spaces.



Figure 2. The base map with local coordinate system transferred to the ArcGIS environment.

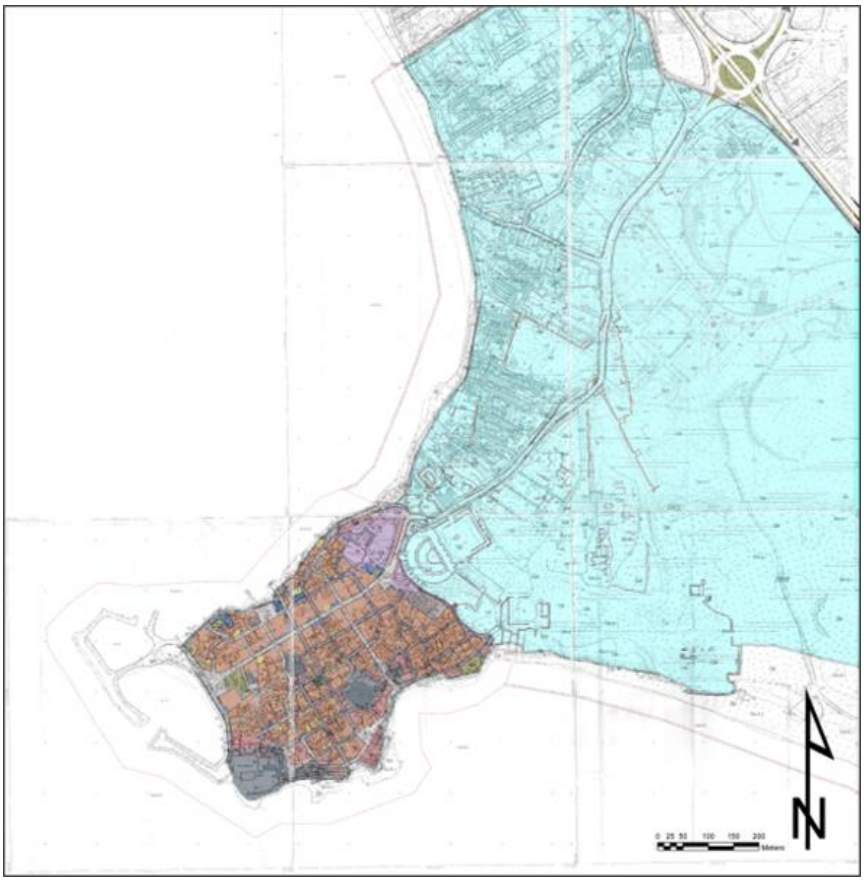


Figure 3. Coordinating the 2014 Side Ancient City Conservation Revision Zoning Plan in the ArcGIS environment and overlaying it with the base map.

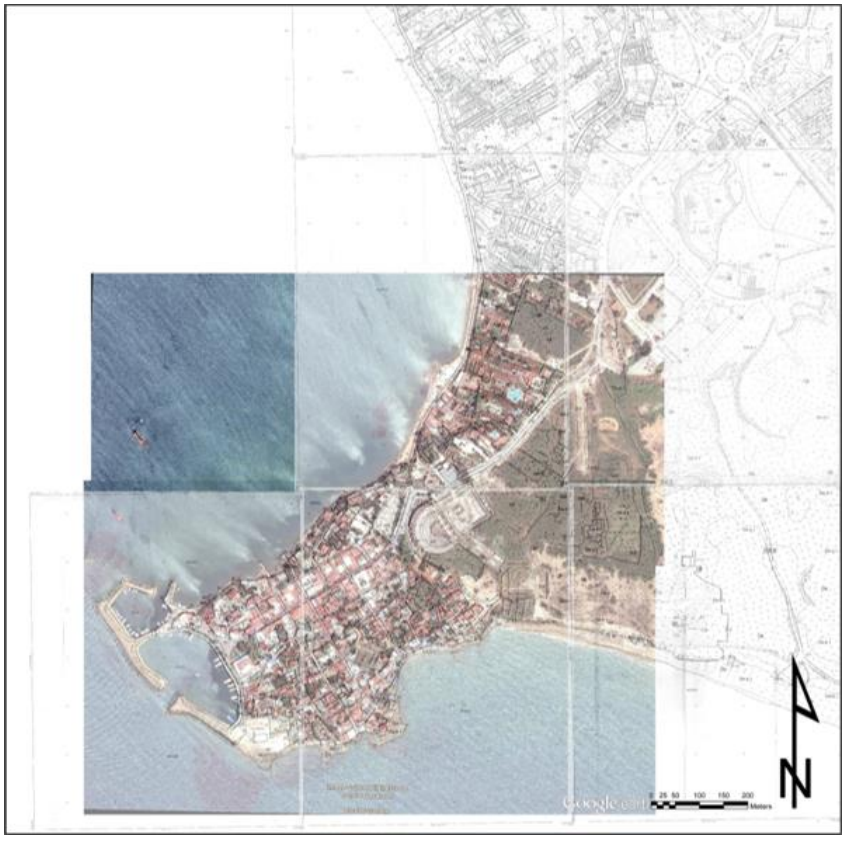


Figure 4. Coordinating the aerial photograph in *jpg format in the ArcGIS environment and overlaying it with the base map.

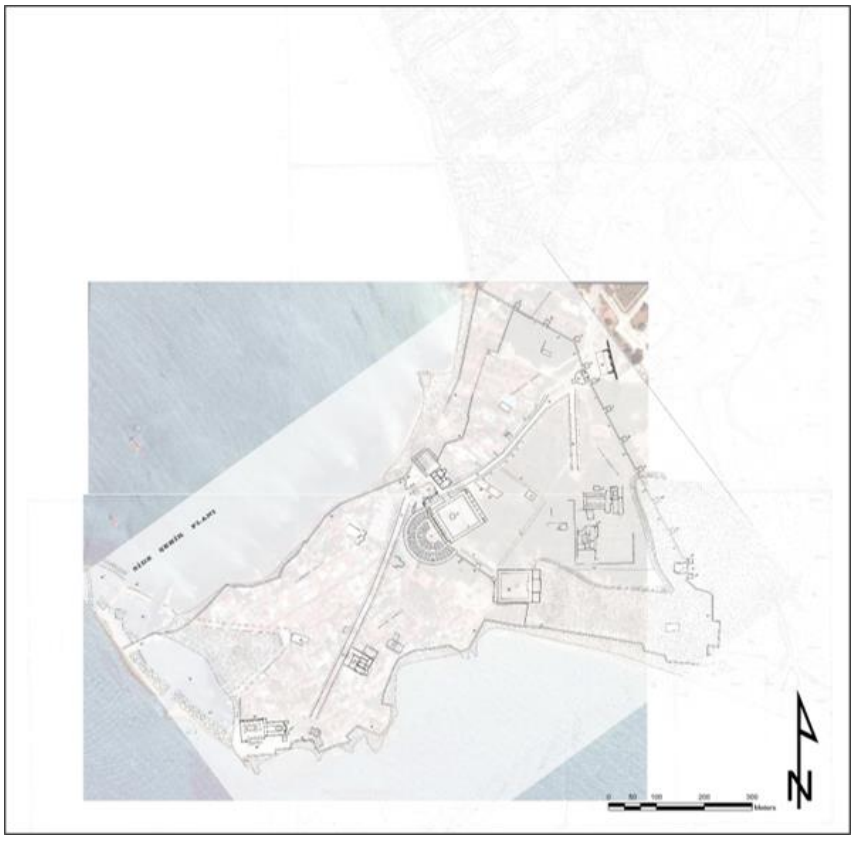


Figure 5. Coordinating Mansel City Plan in ArcGIS and overlaid with other maps and aerial photograph.

The data format for storing vector data has been specified as ShapeFile. For each layer to be created, the appropriate data type has been selected from point, line, and polygon data types. Based on the data obtained, preliminary layer classifications were made and it was deemed appropriate to use polygon data for structures, land use, open areas, and fill layers; polyline data for transportation and ancient road layers; and point data for vehicle entry control points. A projection system has been defined for each vector layer. All data (raster and vector) must be in the same projection system belonging to Side. Layers are stored in the database with the extensions .shp, .dbf, and .shx. *shp, the file that stores the graphic data related to the layer; *dbf, the file that stores the attribute information related to the graphic data; *shx is the index file that establishes the relationship between the graphic data and the textual data. For Side, the first phase involved creating layers for land use, structures, open spaces, transportation, vehicle entry control point, ancient road, and reclaimed land. (Figure 6, Figure 7).

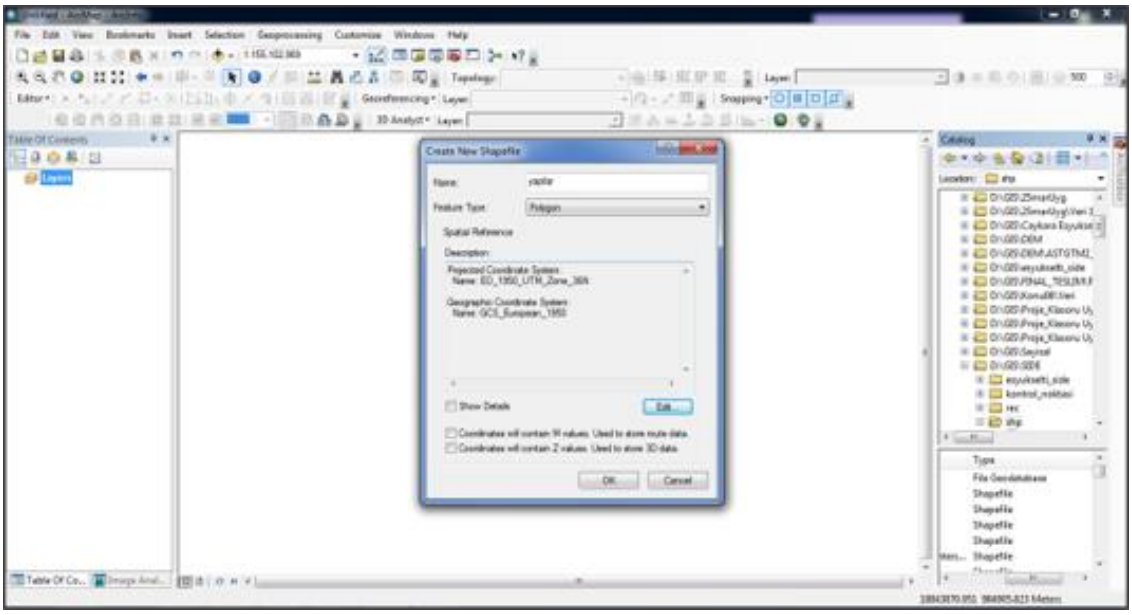


Figure 6. Creating the 'yapilar' (structures) layer as an area (polygon) in ShapeFile format.

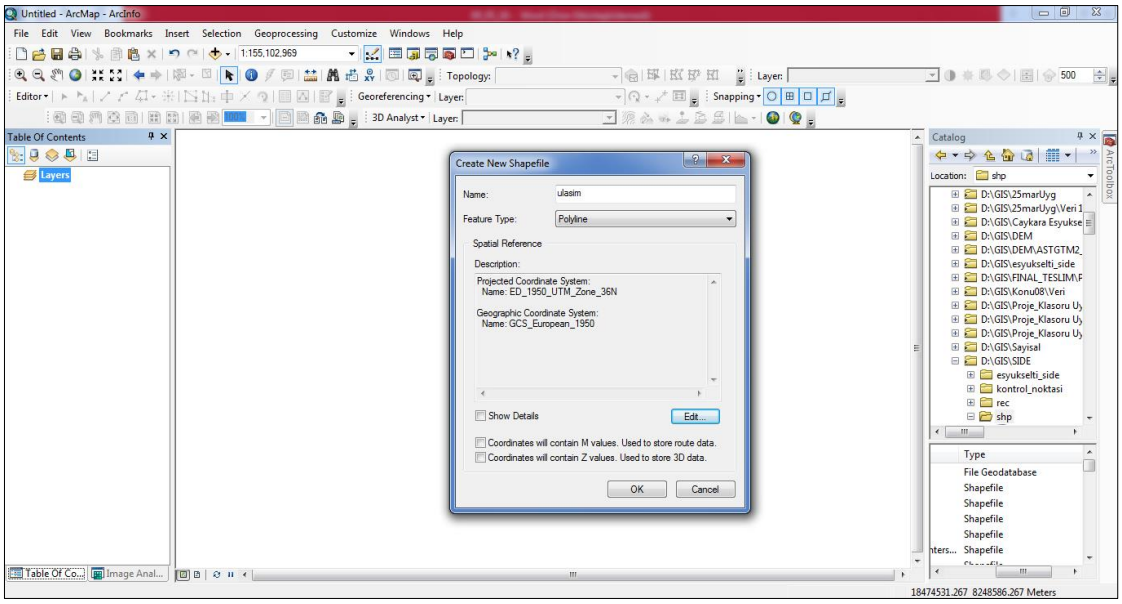


Figure 7. Creating the 'ulasim' (transportation) layer as a polyline in ShapeFile format.

A function column has been opened for the attribute data of the land use layer set as a geometry feature (polygon). For attribute information belonging to the layer of structures created with the polygon feature: the parcel number, type, period, original function, current function, number of floors, physical condition, Mansel code (the code assigned to archaeological structures in the city plan created by A. M. Mansel), and height columns have

been opened. Columns for usage, type, and current function have been added to the attribute information of the open spaces layer in the city, which is of the polygon type. The transportation layer is a polyline feature. For attribute data, columns for material, width, vehicle density, and pedestrian density have been opened. For attribute data of the ancient road layer, which is a polyline feature, columns for type, period, and physical condition have been opened. In this regard, a database has been created to be worked on for data entry and digitization of maps (Figure 8, Figure 9). Creating appropriate spatial definitions for the layers is crucial for ensuring error-free progress in the next steps. This is because incorrect definitions will result in incompatibility with the input data, leading to erroneous or even unsuccessful queries. To create a well-structured database, the names given to columns must be concise and clear. Long and complex headings hinder the proper management of data as it grows over time.

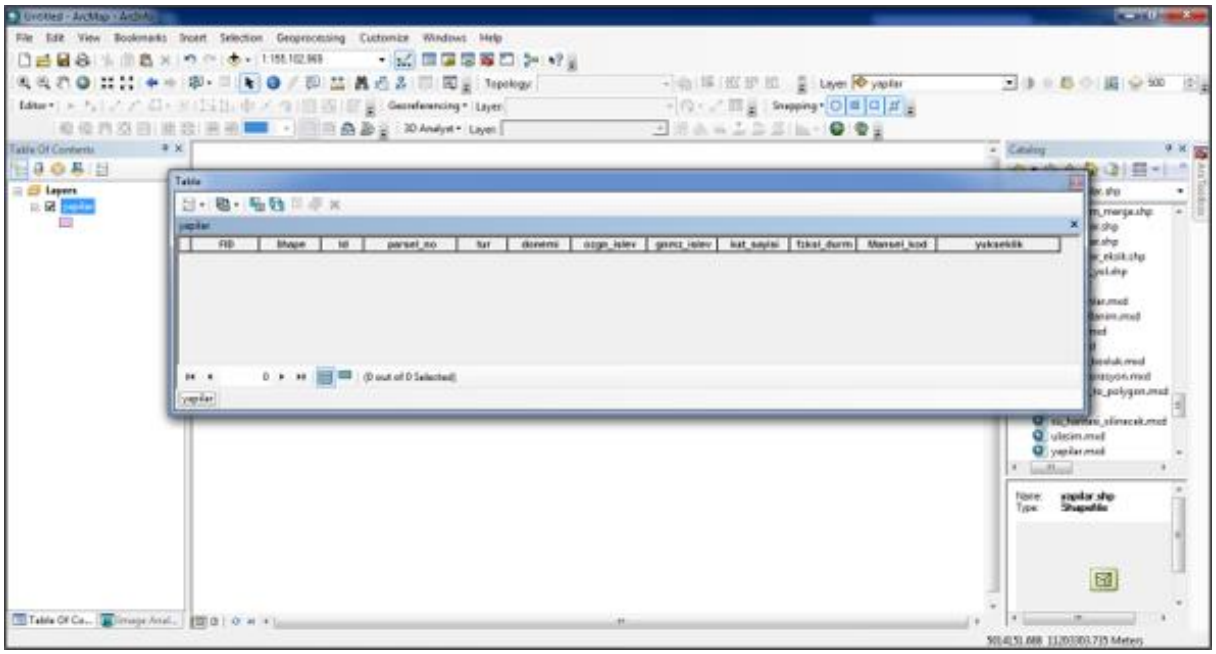


Figure 8. Columns created for attribute data belonging to the 'yapilar' (structures) layer.

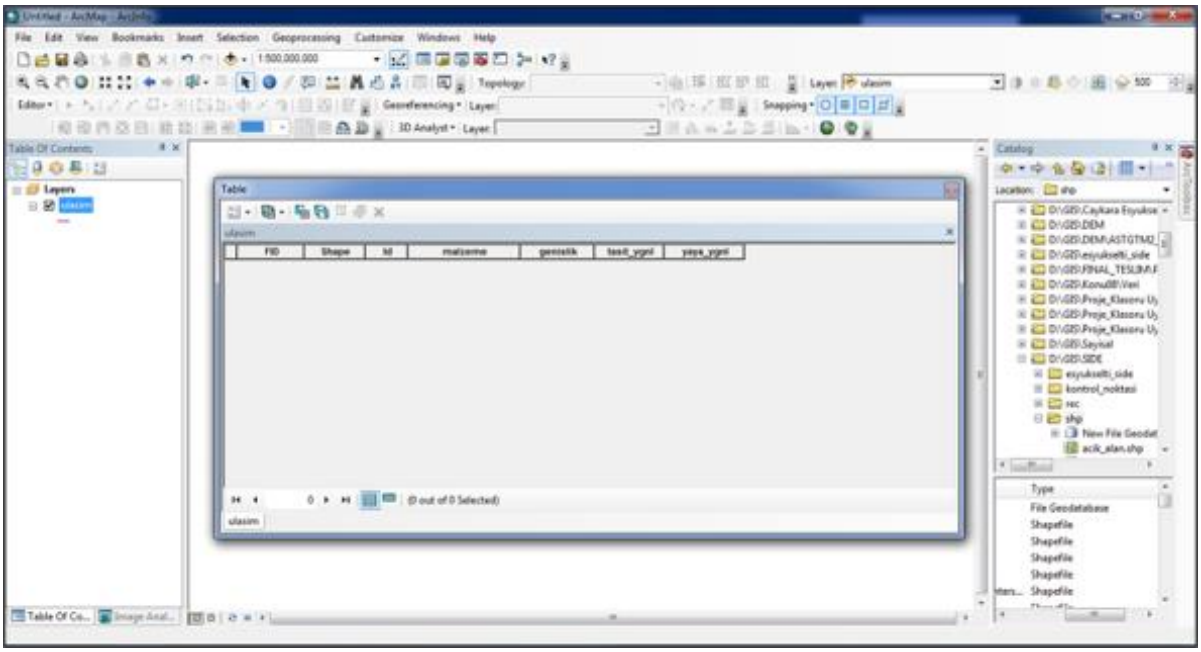


Figure 9. Columns created for attribute data belonging to the 'ulasim' (transportation) layer.

2.1.3. Data Entry and Data Structuring

In order to understand the archaeological values within the urban site in their urban context, it is necessary to analyze the periodical location, function, number of floors, open space usage, and vehicle and pedestrian density based on data related to the built environment and open spaces. This analysis is essential for conducting physical, visual, and functional assessments of the area. In this regard, the data collected for Side must first be transferred to the designed database.

At this stage, raw data obtained from the field and various sources has been transferred to the database created based on this data, in accordance with the system structure. The existing coordinate map, the revision zoning plan for protection purposes, satellite photographs, and the Mansel city plan were used as a base. Archaeological remains, traditional civil architecture, and modern structures located within the built environment of Side have been digitized. Information regarding the parcel numbers, types, periods, original functions, current functions, number of floors, physical conditions, and heights of the structures has been entered into a previously designed attribute table (Figure 10). Information about the city's open spaces, their usage, types, and current functions has been transferred to the attribute table (Figure 11). Information about the type, density, material, and width of the transportation network has been entered into the columns (Figure 12). For roads used in ancient times, information about the type, period, and physical condition of the road has been transferred to the attribute table (Figure 13). At any stage of the study process, new information obtained has been entered into the attribute tables, and the tables have been updated.

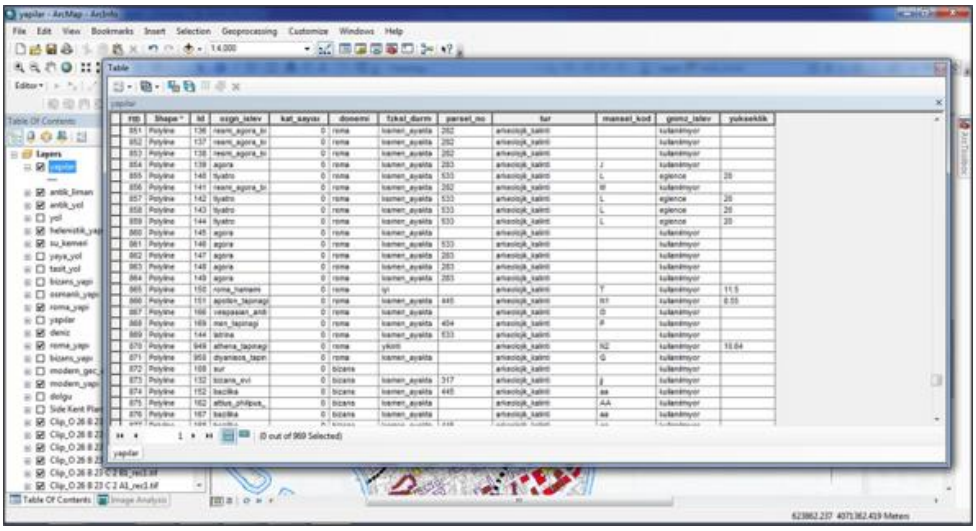


Figure 10. Entering data into the attribute table created for the structures layer.

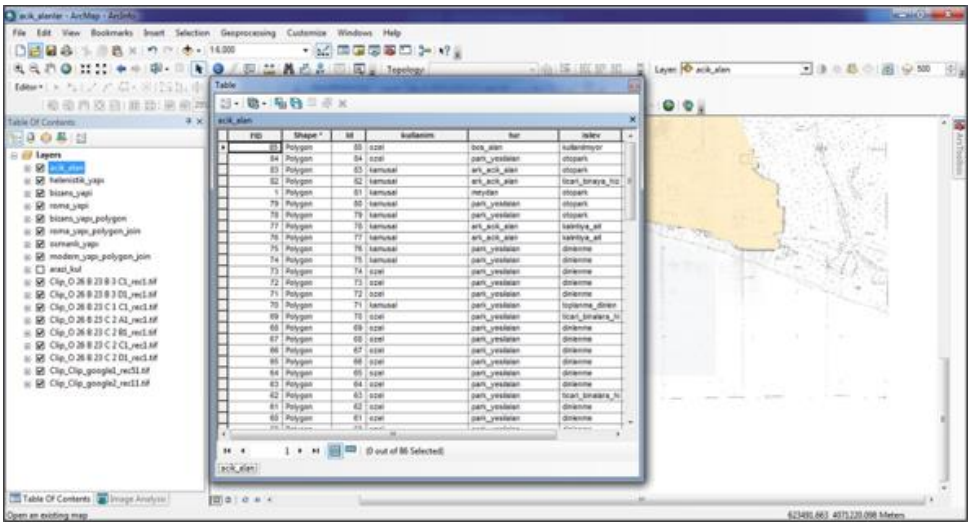


Figure 11. Entering data into the attribute table created for the open areas layer.

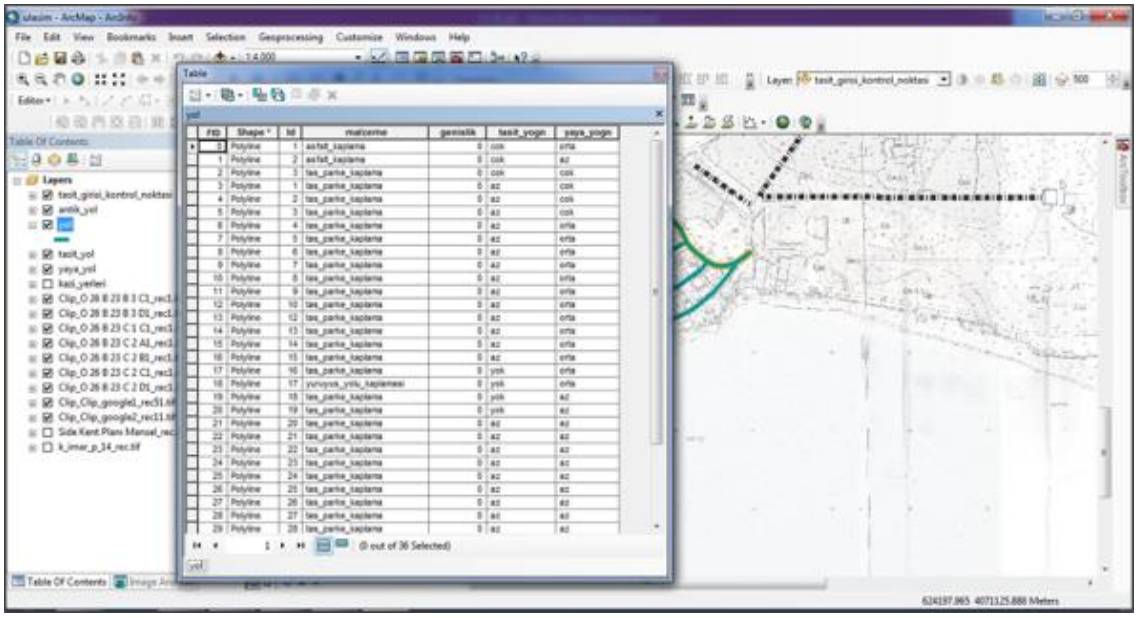


Figure 12. Data entry into the attribute table created for the transportation layer.

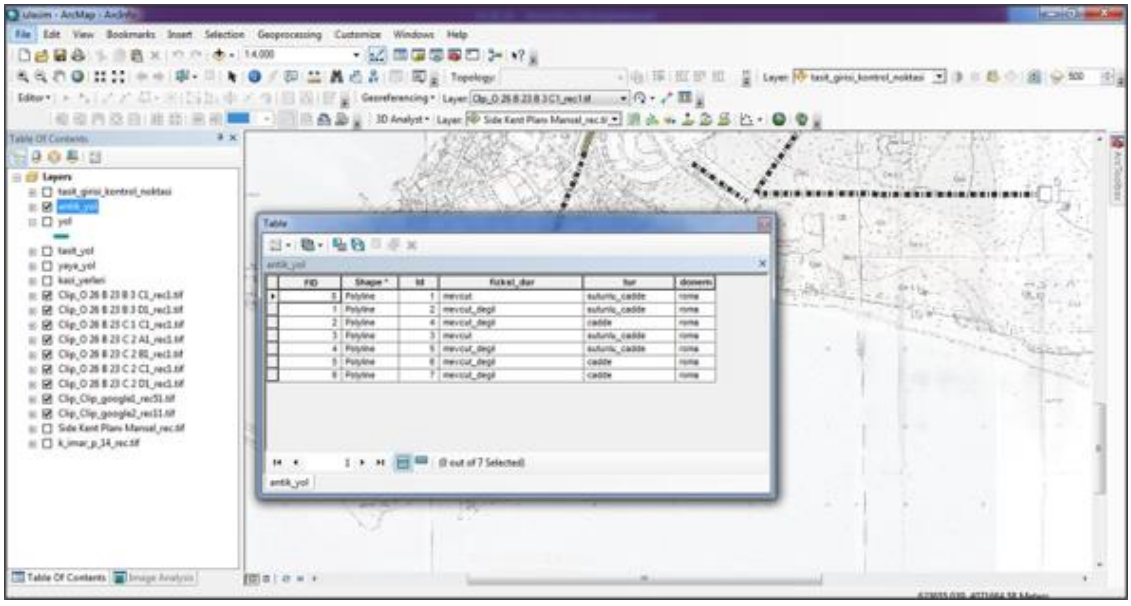


Figure 13. Data entry into the attribute table created for the ancient road layer.

2.1.4. Data Analysis, Evaluation, and Presentation

After the data entry was completed, the system became ready for analysis, querying, and evaluation based on spatial and attribute data. A digital topographic terrain model of Side was obtained from the contour line information acquired from the existing map transferred from the CAD environment to the GIS environment. Thematic maps containing elevation, slope, and aspect information of Side were produced from this raster data (Figure 14, Figure 15, and Figure 16)

Thematic maps have been created using attribute data related to archaeological sites, traditional architecture, modern structures, past and present transportation, and public and private open spaces in the city. By querying different spatial and attribute data together, assessments of problems, values, and potential related to the city and its components were made. In this context, the analyses were queried under two headings in the next section: analysis of data related to Side's built environment and open spaces.

x

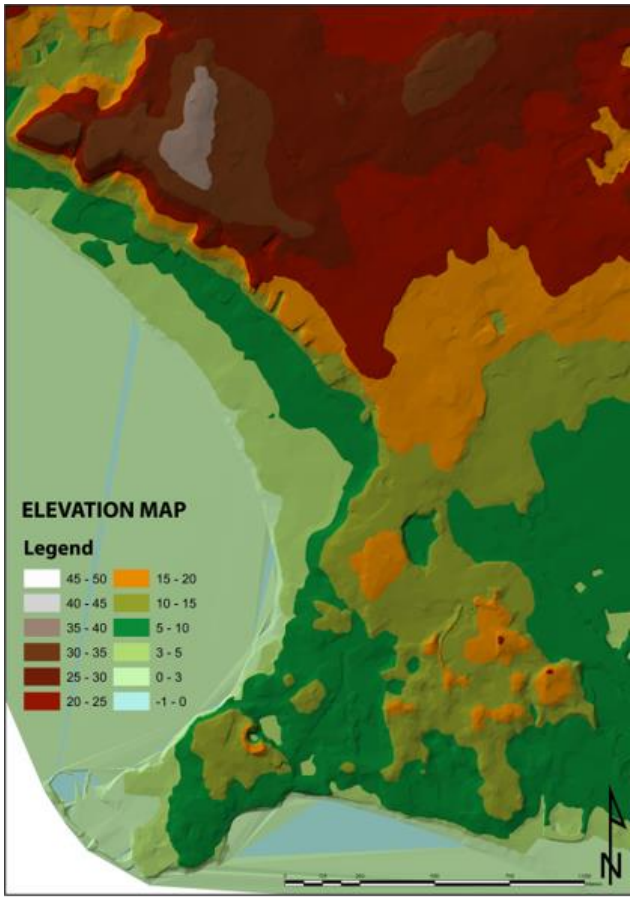


Figure 14. Elevation map.

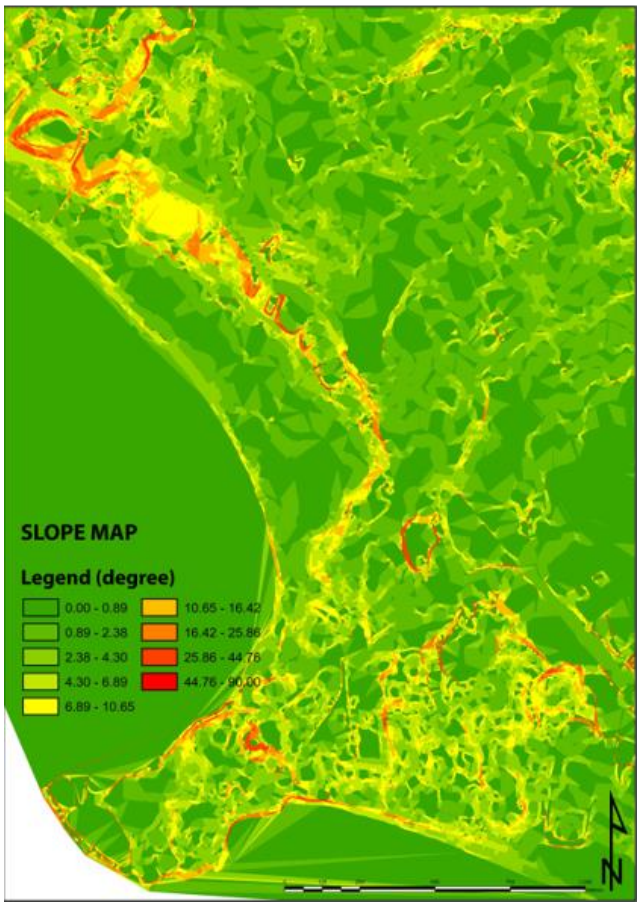


Figure 15. Slope map.

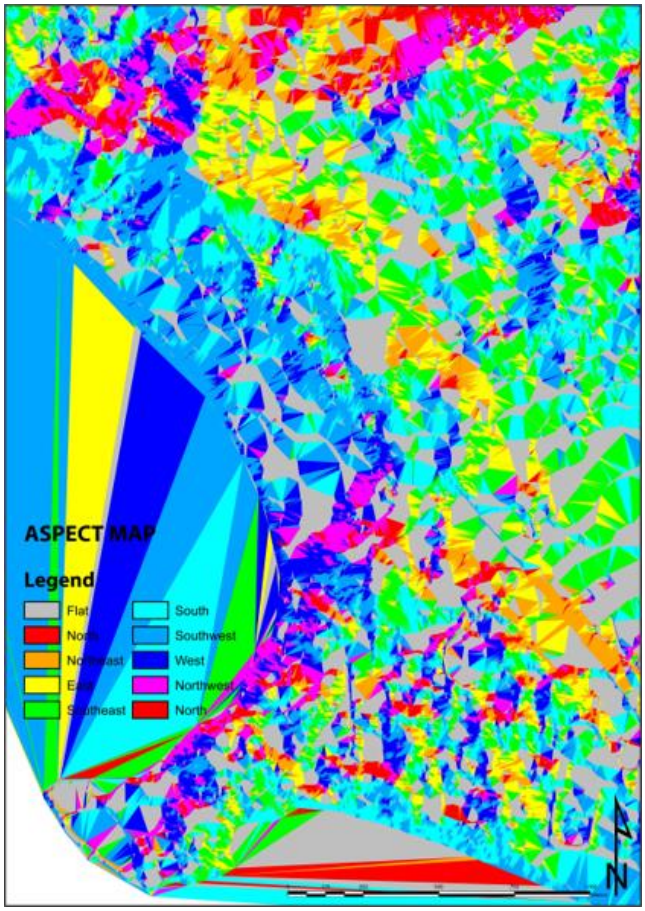


Figure 16. Aspect map.

3. Results and Discussion

3.1. Analysis of Data Related to the Built Environment

Archaeological remains, traditional structures, and recent buildings constitute the built environment of Side. Thematic maps have been produced for each period, illustrating the physical structure of the city throughout its historical development. These period maps enable the analysis of the locations of ancient remains, traditional buildings, and modern structures throughout the city's historical process. The maps, prepared for each period, are designed to examine the changes and transformations in the city's built environment over time.

These maps were created using the period information for each structure in the attribute table within the structures layer. Each period of the city was examined using the period maps created.

The available data on the city's structure from the Hellenistic period includes land and sea walls, columned streets, and city gates (Figure 17).

During the Roman period, when a comprehensive urban planning approach was followed, buildings were constructed along the main axes. Theater (L), Nymphaeum (G), Commercial Agora (J), Temple of Tyche (K), Latrina (J1), State Agora (M), Agora Baths (T), Great Baths (kk), Harbor Baths (S), Temple of Athena (N1) Temple of Apollo (N2), Temple of Men (P), Temple of Dionysus (Q), aqueduct (F), fountains within the walls (I1, I2), cistern (H1), Monument of Vespasian (I3), Arch (D) are structures from this period that have survived to the present day.. C Street, one of the columned avenues forming the city's main axes, connects the city gate with the city center, where the agora, theater, baths, cisterns, and fountains are located. It leads from the center towards the harbor and temples at the southern tip of the peninsula (Figure 18).

Within the scope of this study, the wall of 'Phillipus Attius', for which no precise construction date is available but which is known to belong to the late period, divides the city in two. After the wall was built, the city limits were reduced (Figure 19).

During the Byzantine period, when numerous religious structures were built, the city became a bishopric center. There was no physical change in the layout of the streets and buildings. With the city's transformation into

a Christian city, a new basilica (aa) was built at its southern end. Later, when the basilica lost its function, a new small church was built in the central nave of the structure. The Bishop's Palace (dd) and the cc basilica at the end of the columned street extending south from the city's main entrance gate, the ee church within the complex of buildings to the west of the palace, and the bb church, of which only some wall fragments remain today, are Byzantine structures (Figure 20).

The village of Selimiye was established in the late 19th century on the site of an ancient city that had been uninhabited for a long time, with settlers arriving from the island of Crete. The new city plan, which completely transformed the city's structure, features a grid plan system. This new layout, created during the Ottoman period and completely different from the grid system of the ancient period, is the source of the urban layout used today (Figure 21). The overlapping of two different plan layouts is a component of its multi-layered structure. With the start of tourism activities in the city, rapid construction increased, resulting in the city becoming a densely populated area (Figure 22).

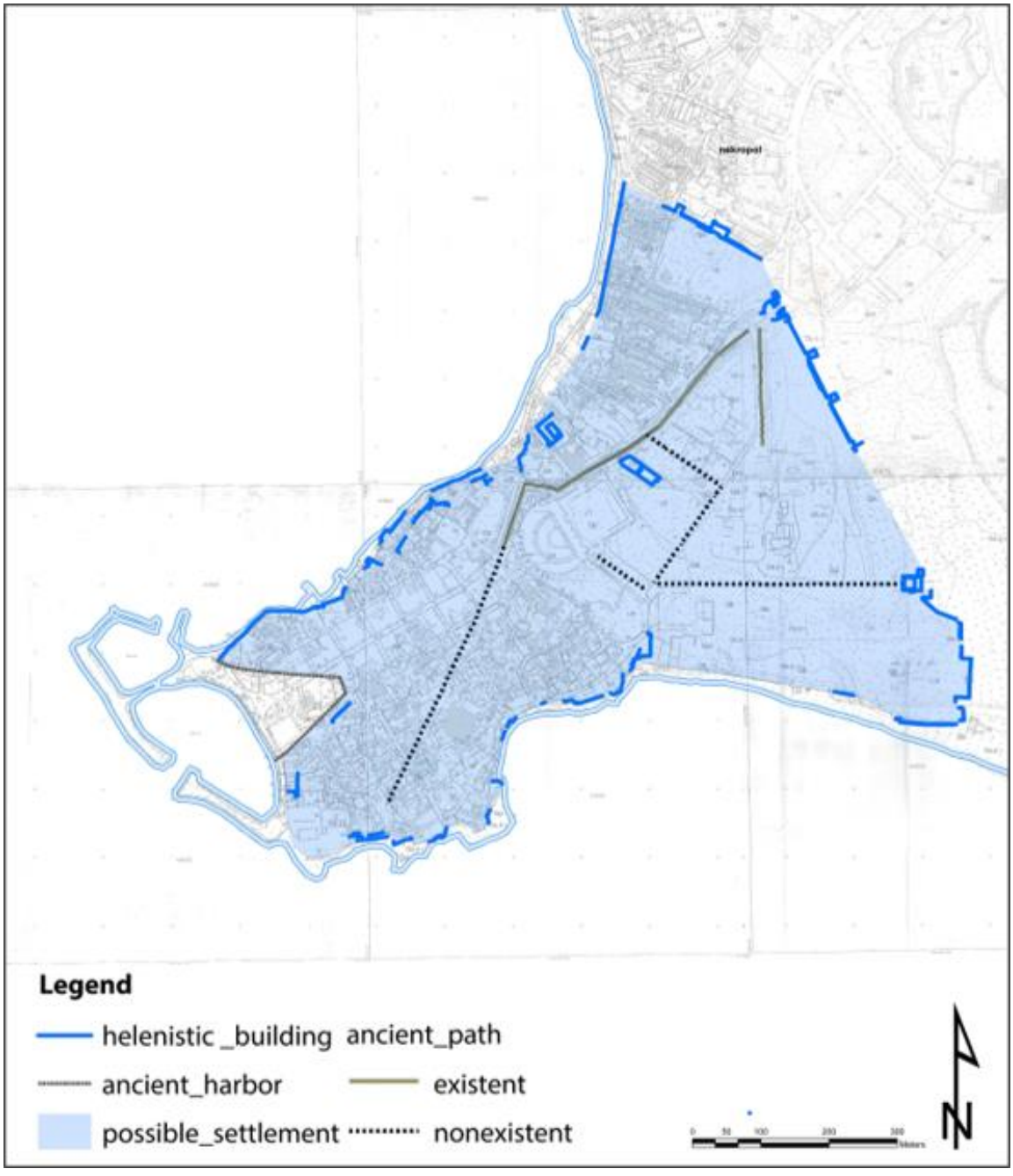


Figure 17. Remains from the Hellenistic period and possible settlement area.

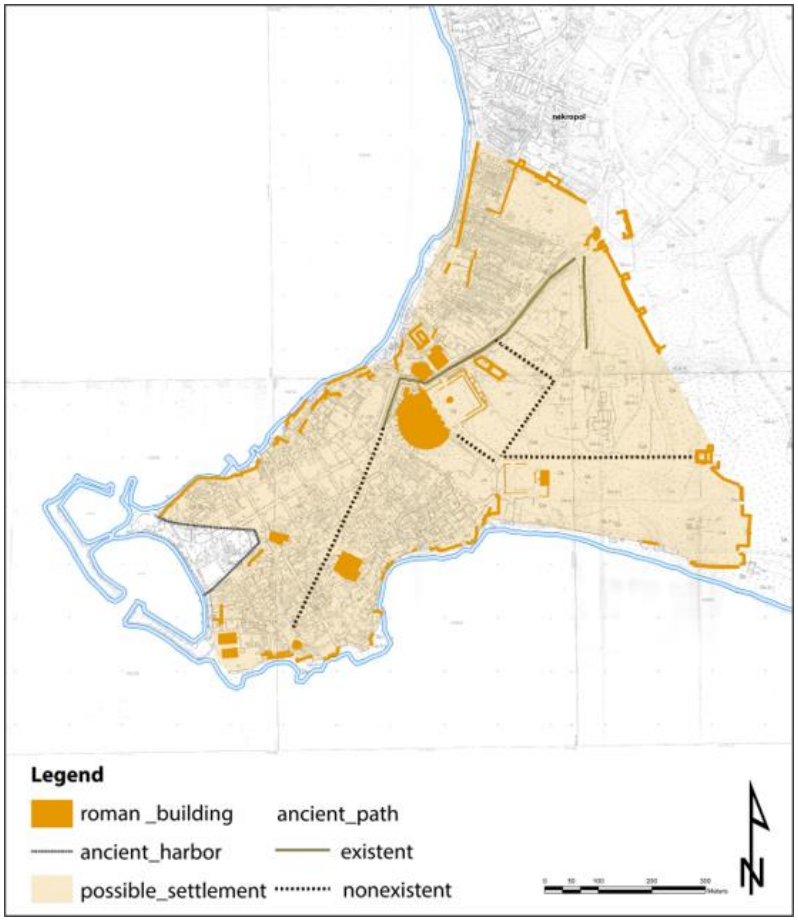


Figure 18. Remains from the Roman period and possible settlement area.

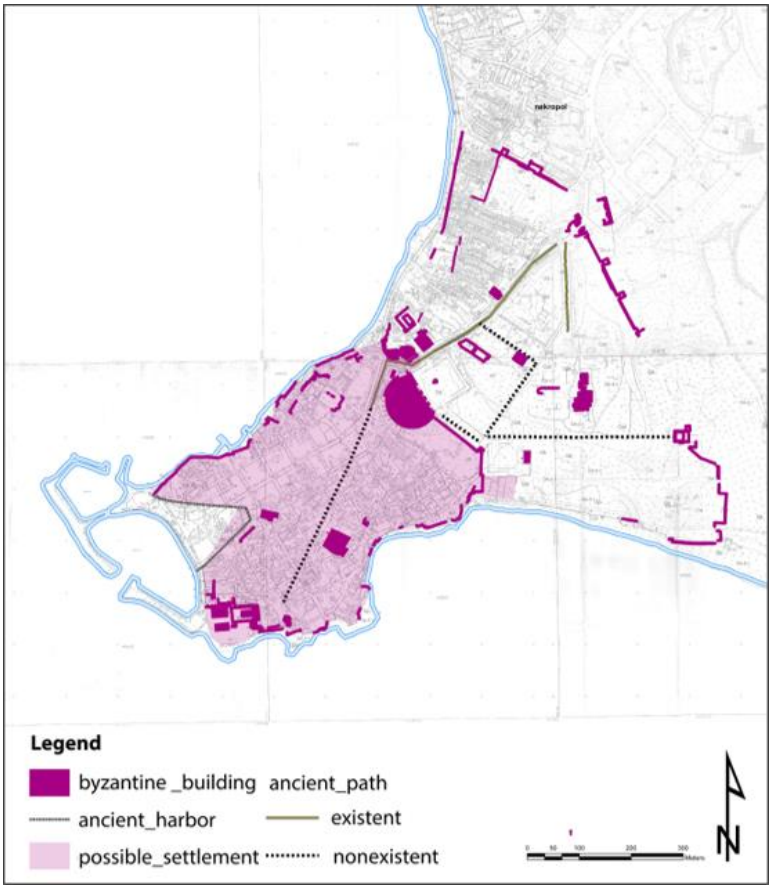


Figure 19. The potential settlement area that shrank after the construction of the Wall of Phillipus Attius.

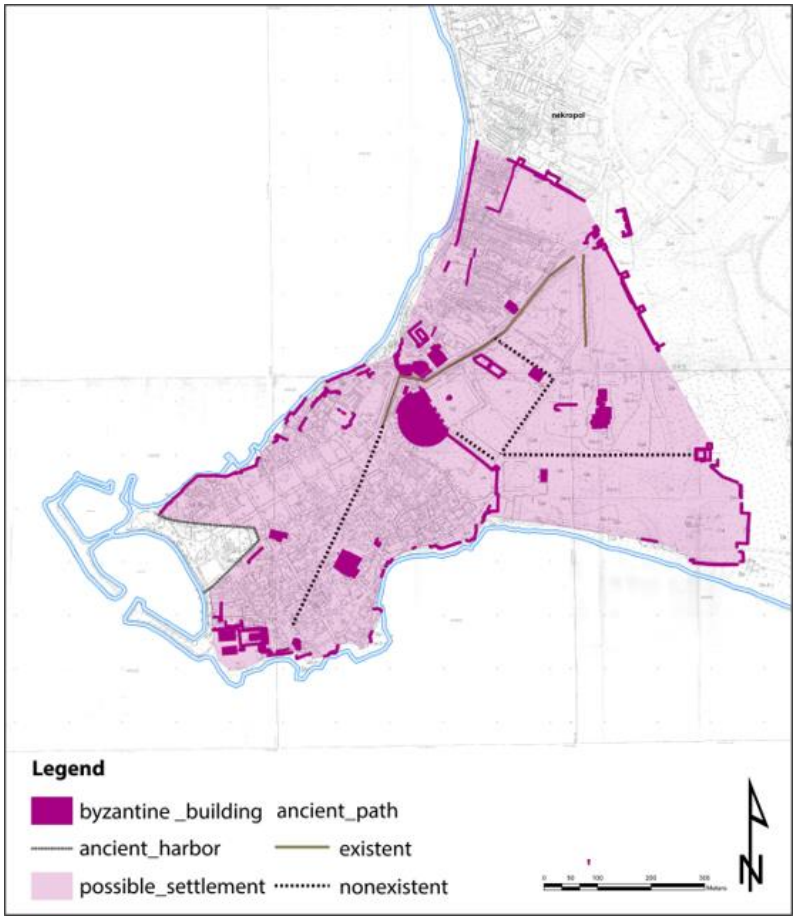


Figure 20. Remains from the Byzantine period and possible settlement area.

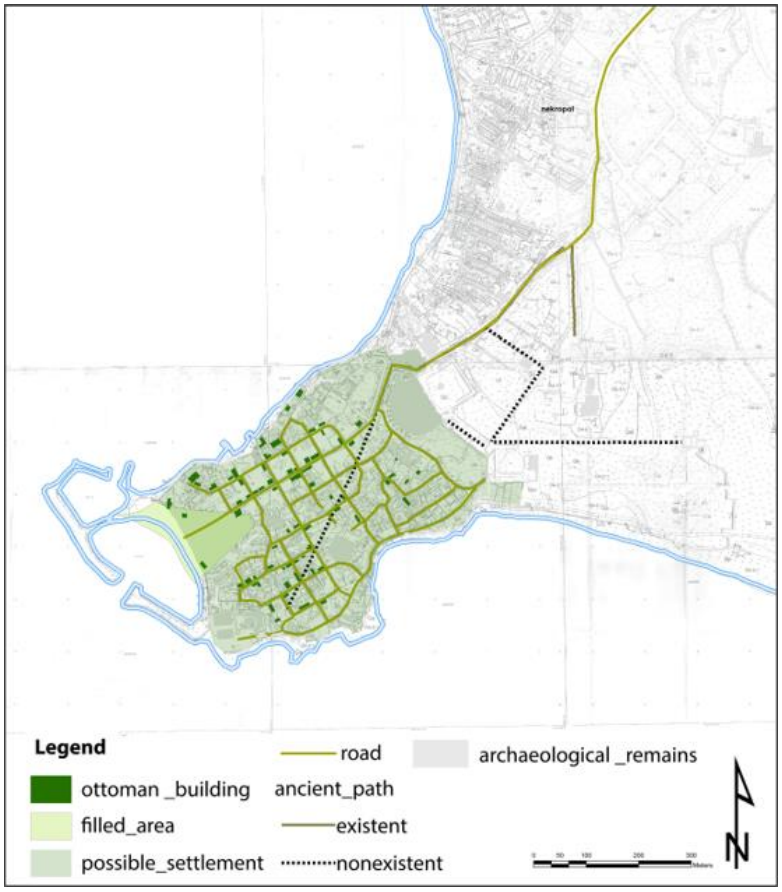


Figure 21. Selimiye village and settlement plan established for Cretan immigrants.

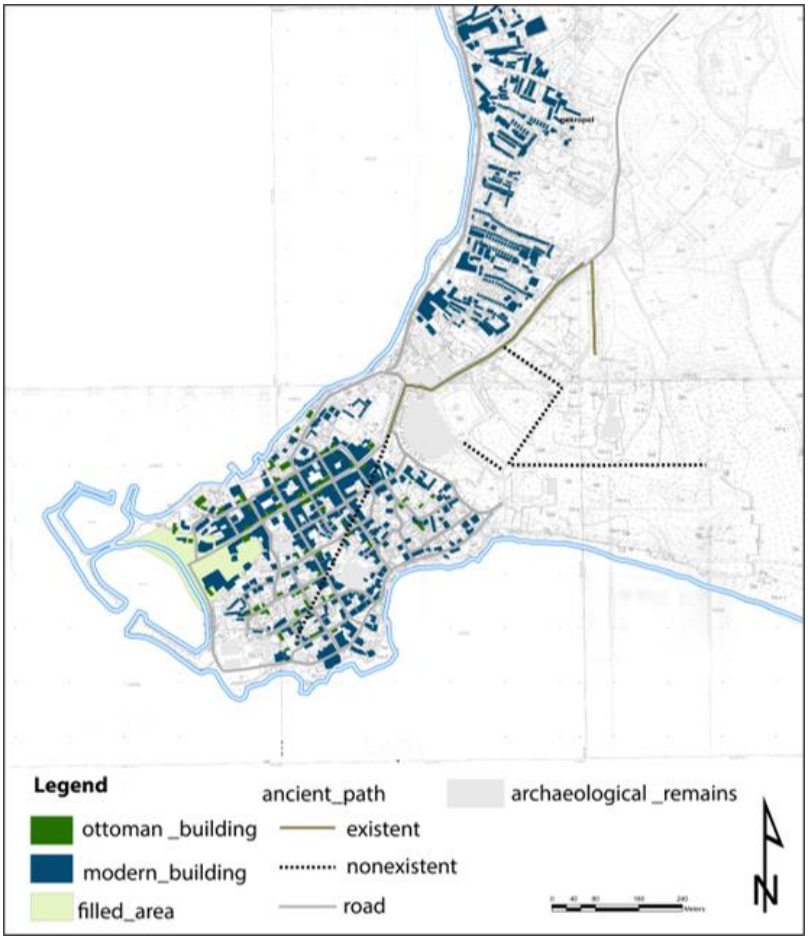


Figure 22. Modern buildings and city plan of today.

When considering the city's old aerial photographs from the 1950s and 1960s and its current state, it is evident that the city's open spaces have decreased over time (Figure 23). The development of tourism activities in the 1970s, which was a strategy to support economic growth, led to accelerated urbanization. It is possible to say that this dense and irregular construction has been effective in disrupting the city's balance between built up areas and open spaces. It is possible to understand that the city's usage intensity has increased considerably from the thematic map showing the current status of solid and volid pattern of the city, created using the spatial and attribute information of buildings in the GIS environment (Figure 24).



Figure 23. Photographs from the 1960s and 2015 showing the increase in construction density (Side Excavation Archive).



Figure 24. Thematic Map and its graph showing Solid-Void Analysis.

The functions of all structures within the urban site throughout history have been analyzed to examine the functional relationships between archaeological assets and surrounding structures. The functional transformations of archaeological remains and surrounding buildings are crucial for assessing the integrity and perceptibility of archaeological values within the urban context. Accordingly, the created functional thematic maps provide information on the positive and negative functional interactions between archaeological assets and surrounding structures.

In this context, another thematic map produced based on the information in the function column of the attribute table of the structures layer is the function map. Function maps have been prepared for each period using the period information in the attribute table. In this case, it has been observed that the defensive use of land and sea walls and city gates belonging to the Hellenistic period continued into the Roman period (Figure 25).

In light of the remains that have survived from the Roman period to the present day, it is possible to discuss the functions of trade, housing, religion, administration, toilet, bath, fountain, cistern, and theater (Figure 26). By the Byzantine period, however, changes in the functions of some structures had become apparent. The most significant of these was the use of the enclosed spaces of the theater building as chapels for religious purposes. It is understood that the functions of trade, housing, religion, administration, toilets, bath, fountain, and cistern continued during the Byzantine period (Figure 27). In the late 19th century, during the Ottoman period, the influx of Cretan immigrants led to a significant increase in residential activity in this long-uninhabited city (Figure 28). During this period, it was observed that the archaeological remains had completely lost their original functions. When examining the current functions of all structures in the area, it was determined that the majority of their use was for commercial purposes. These were identified as establishments serving gastronomic and entertainment activities, such as restaurants, cafes, bars, and nightclubs. It has been determined that the density of structures used for accommodation by tourists comes after those used for commercial purposes. The Side Museum, the Gendarmerie Station, and the Post Office buildings are also structures used for administrative purposes. The only structure used for religious purposes is the Selimiye Mosque. As can be seen from the current building function map in Figure 29, it is possible to say that the commercial function is concentrated along the main axis extending from opposite the theater building to the port. This density also brings with it problems of parking areas, heavy vehicular and pedestrian traffic. In the coastal areas of the southwestern and northeastern ends of the peninsula, there are guesthouses, motels, and hotels serving as accommodation.

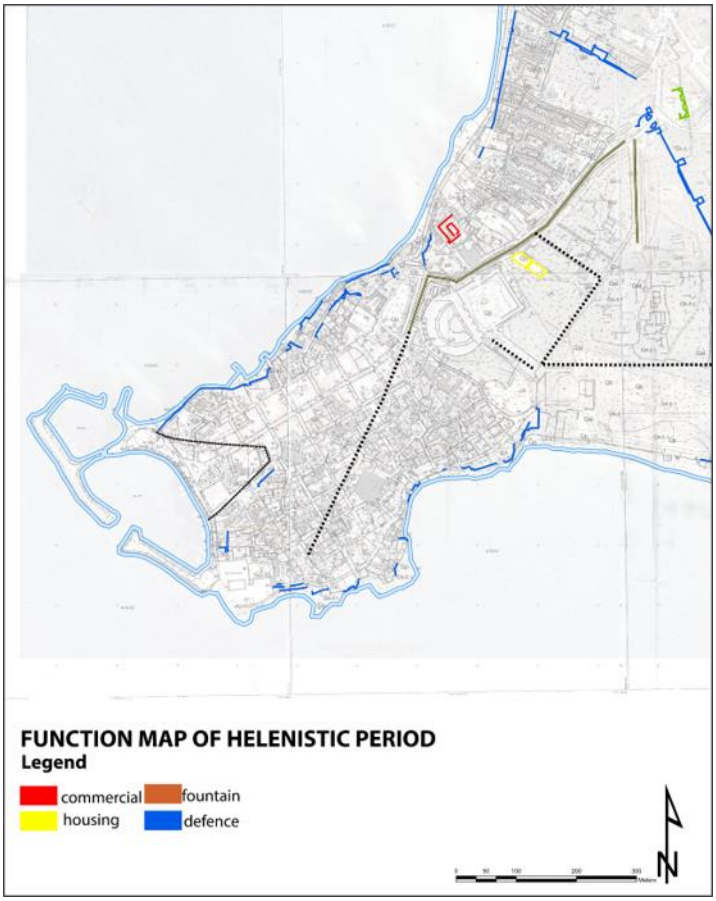


Figure 25. Function map of Hellenistic Period structures.

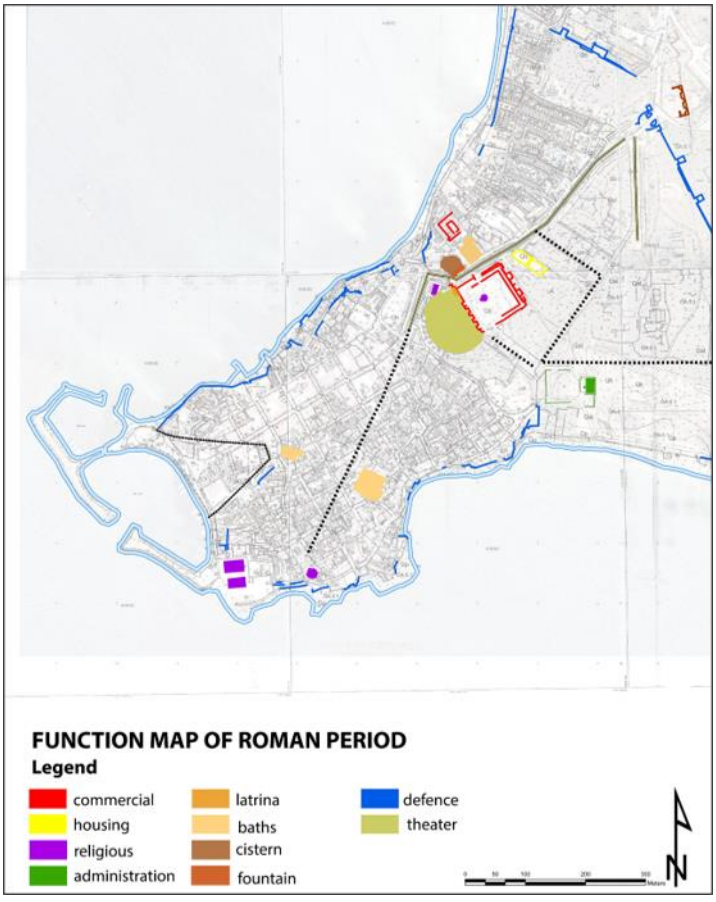


Figure 26. Function map of Roman Period structures.

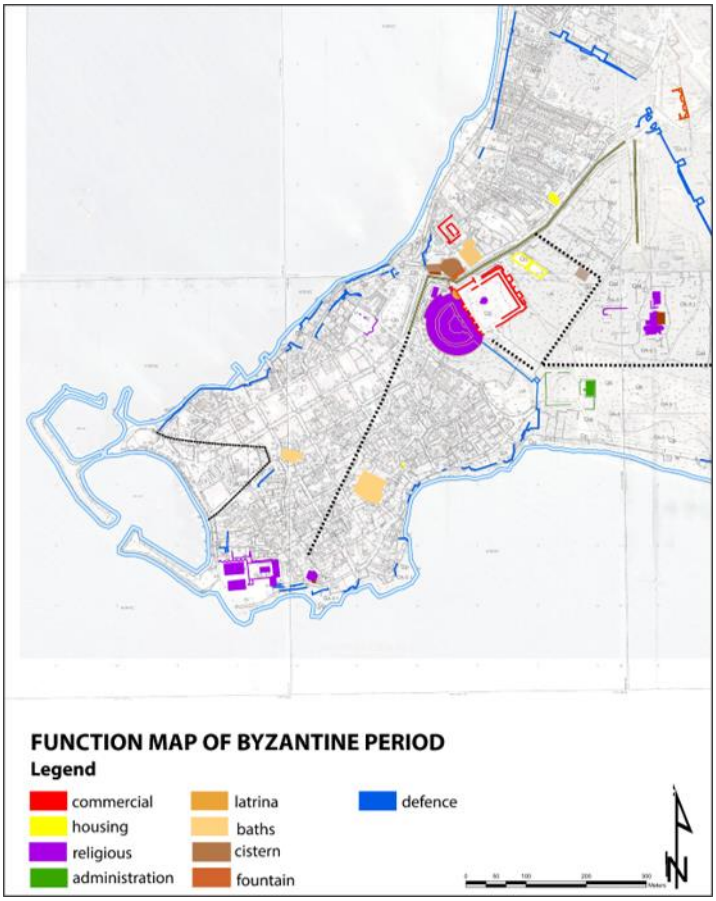


Figure 27. Function map of Byzantine period structures.

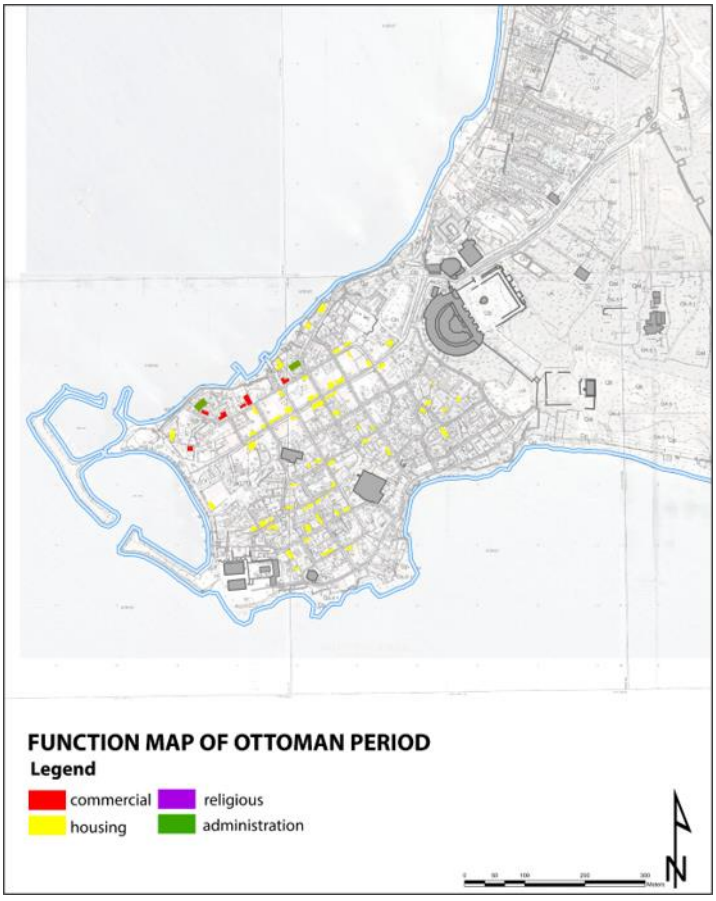


Figure 28. Function map of Ottoman Period structure.

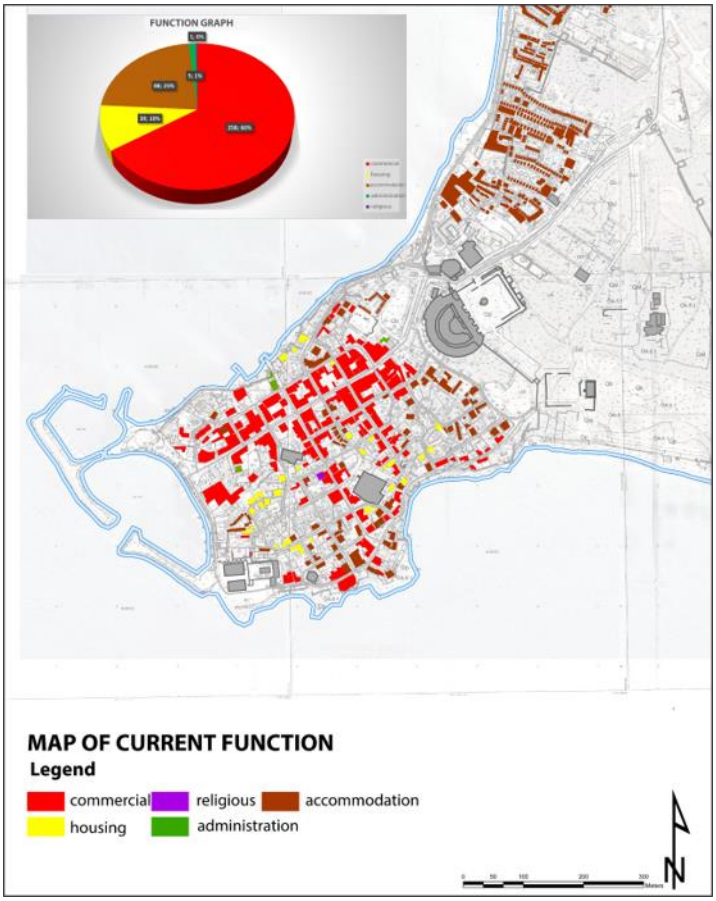


Figure 29. Function map of current structures.

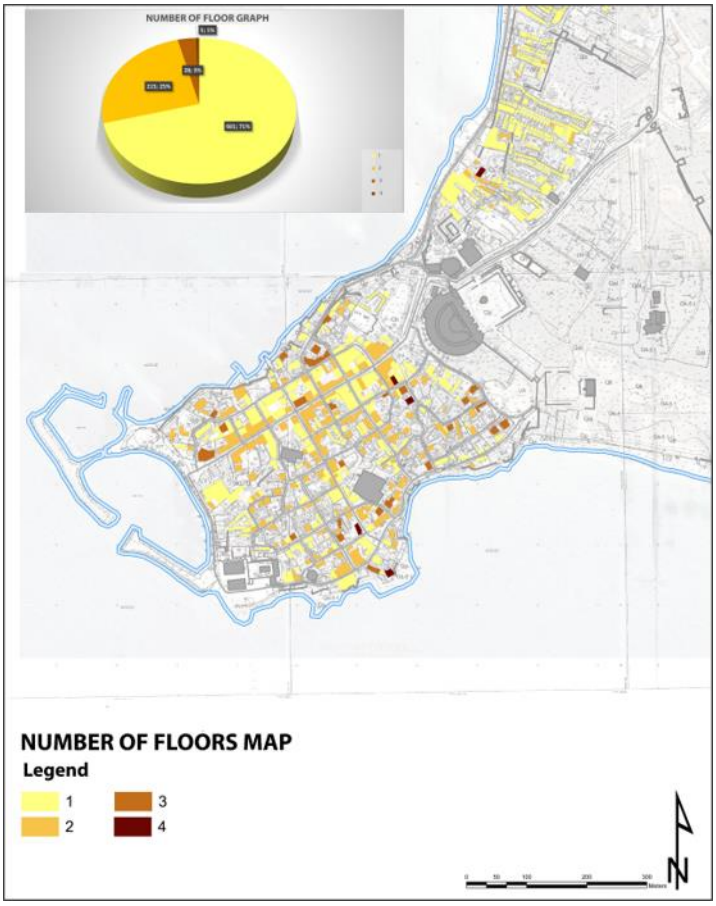


Figure 30. Number of floors map of traditional and modern buildings and its graph.

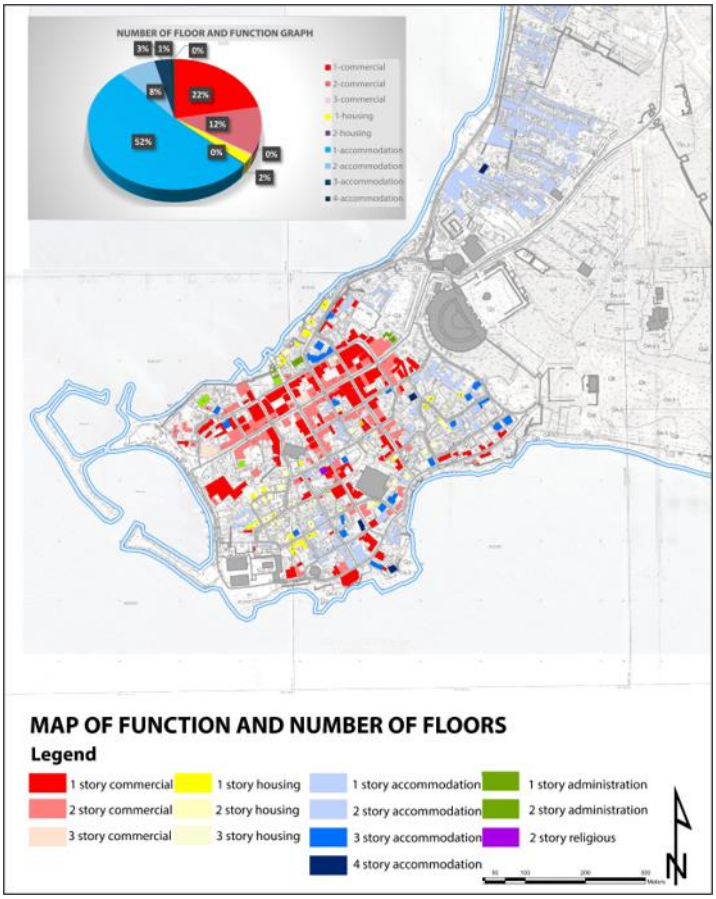


Figure 31. Map analyzing the relationship between function and number of floors.

The number of floors in traditional structures and modern buildings has been analyzed to assess the visibility of archaeological values within the urban site and to question their perceptibility. Height data must be analyzed to establish the perceptibility threshold of archaeological values.

For these reasons, another attribute information belonging to the structures transferred to the database is the number of floors. The number of floors analysis has been performed on traditional buildings and modern period structures. No number of floors survey was conducted for the ancient remains. Based on the data obtained, the heights of some ancient remains have been entered into the system. According to the number of floors map in Figure 30, it was observed that the vast majority of structures are one or two stories tall. Three- and four-story structures also exist. When the number of floors map and the functional map of modern buildings are overlaid, it is observed that buildings with commercial functions are mostly single-story, while some have been elevated to two stories with the upper floor used for different functions. It was observed that the three and four-story buildings were mostly motels and hotels used for accommodation. It was determined that the residences within the area were generally two-story houses with gardens (Figure 31).

3.2. Analysis of Data Related to Open Spaces

Roads, squares, parks, or green spaces, along with open areas belonging to archaeological remains and their surroundings, constitute Side's existing open spaces. The use and density of open spaces within the urban site, the vehicle and pedestrian traffic, function, and physical condition have been analyzed to ensure that archaeological values are perceived holistically within the urban context. Open space analyses were required for the physical and visual assessments to be carried out in subsequent stages.

Therefore, in the open space thematic map prepared based on the data obtained from the field, open spaces are divided into two main groups according to their use: public and private (Figure 32). Roads, squares, parks or green areas, and open spaces belonging to archaeological sites are defined as publicly used open spaces. Private open spaces, on the other hand, consist of the gardens and courtyards of residential and accommodation facilities. As can be seen from the map, private open spaces cover a relatively small area.

An examination of old and new aerial photographs of Side, along with the resulting map of open spaces, reveals that gardens and courtyards have significantly shrunk in size due to building density and the need for new spaces. Public parks and green areas form a relatively small portion of the city. Based on information obtained from the thematic map, it has been observed that a large proportion of public open spaces consist of open areas related to archaeological remains.

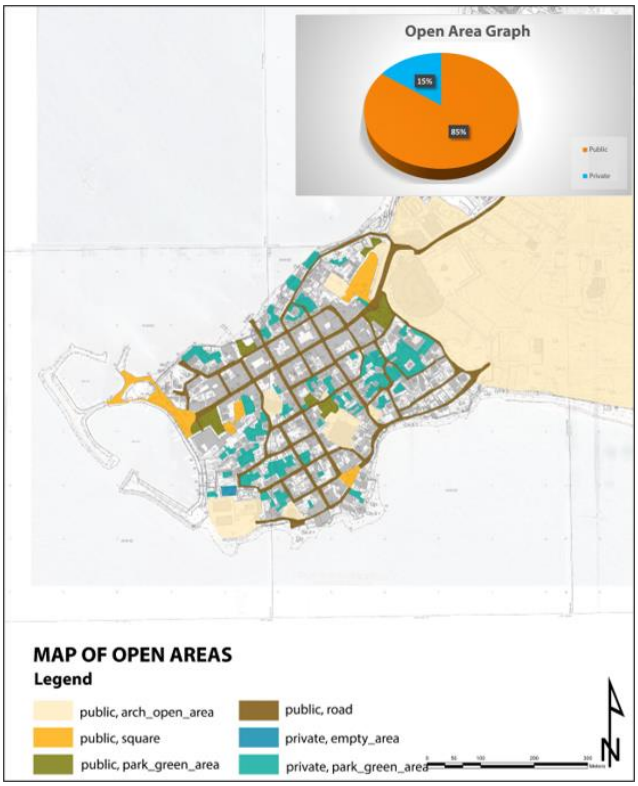


Figure 32. Map analyzing the relationship between function and number of floors.

A thematic map of vehicle and pedestrian density has been created from the roads layer generated with information on the period, type, current status, material, pedestrian and vehicle usage of the roads transferred to the database (Figure 33). The colonnaded street, extending from the city's main entrance gate to the theater, and continuing from the theater to the vehicle control point and then disappearing from that point onward, is one of the city's roads that has survived from antiquity to the present day. The grid-pattern road network on the peninsula emerged during the Ottoman period with the establishment of the village of Selimiye. An intersection analysis was performed in a GIS environment between the columned street that remains within the city, which no longer exists today, and modern structures, based on data obtained from the Mansel City Plan transferred to the database. The newly created intersection map provided information on the structures located on the ancient road (Figure 34). Furthermore, this analysis concluded that the urban road network established during the Ottoman period was completely different from that which existed in ancient times.

As can be seen from the pedestrian and vehicle density map obtained, Side's heaviest vehicle traffic is visible from the entrance gate to the main street within the city. Even if vehicle traffic is controlled within the peninsula, vehicles can still reach every street within the city. The use of the columned street by vehicles causes significant problems for this ancient road. Vehicles passing through the Arch structure on Columned Street are causing serious physical damage to the archaeological remains. This heavy vehicle traffic also brings with it the problem of parking. Parking areas located in the city's open spaces, close to archaeological remains or on top of them, constitute another significant problem.

As shown in the Figure 33, the main street leading to the port is where pedestrian traffic appears to be the heaviest in Side. Especially in the summer season, the peak in pedestrian traffic in the evening hours brings with it many negative effects.

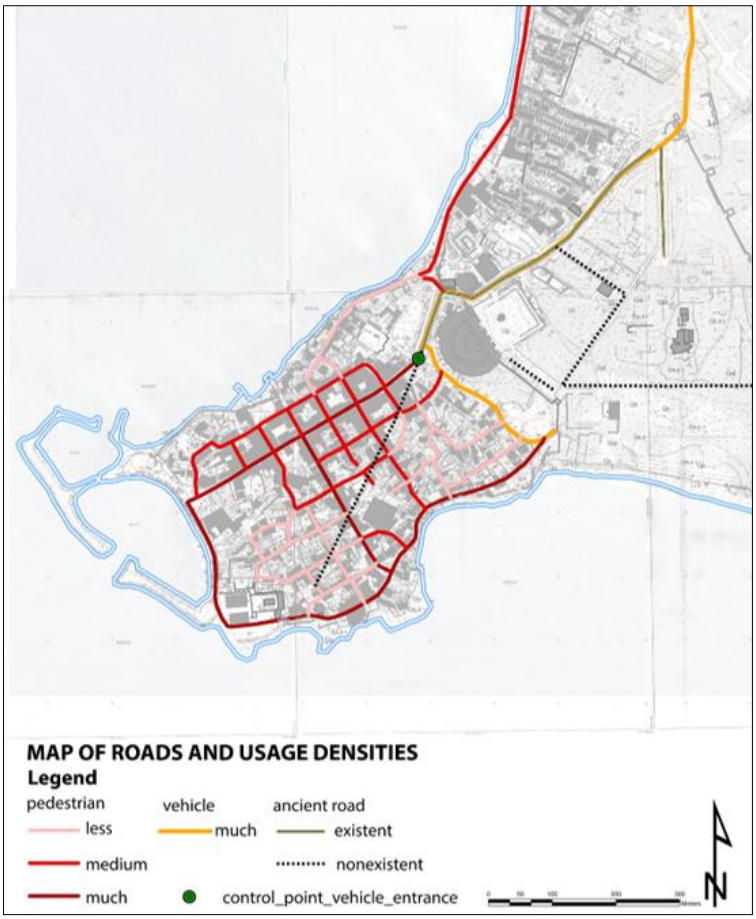


Figure 33. Map showing roads and usage densities.

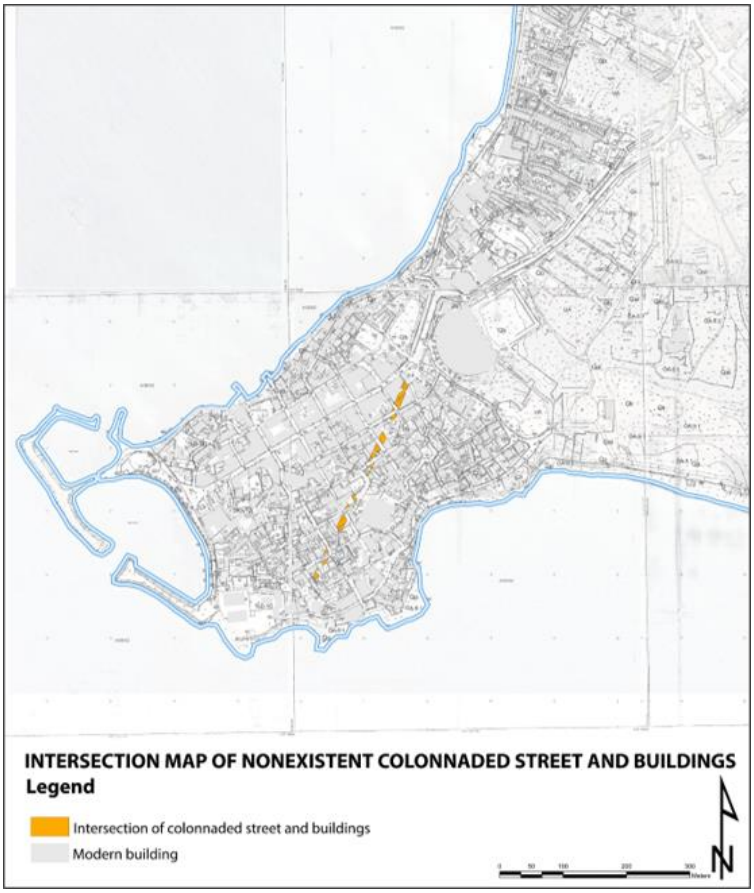


Figure 34. Map of the intersection of buildings with a non-existent colonnaded street.

3.3. Evaluation of Data Related to the Built Environment and Open Spaces

This study was conducted in Side, within an urban site area, on the perceptibility of archaeological values in urban site areas. It was conducted using a database created in a CBS environment as it aims to ensure that the archaeological assets within the urban site area are understood and perceived as a whole within their urban context. In line with the objective, data was collected, transferred to the information system, and analyzed. In this section, new information obtained through inquiries was evaluated in relation to the objective of the study. Considering archaeological assets individually causes isolating them from the urban context. Therefore, in order to correctly understand the relationship they establish with their surroundings, it is necessary to evaluate their physical, visual, and functional state.

Data on Side's built environment and open spaces were analyzed in a GIS environment as part of the study. For the built environment, thematic maps showing period, number of floors, function, and building density were produced; for open spaces, thematic maps showing the classification of open spaces and pedestrian and vehicle density were produced. In light of these analyses, it can be said that Side, except for the period between the 12th and 19th centuries, was continuously inhabited by many civilizations, and that the structures from the Ottoman period, along with the remains from the Byzantine, Roman, and Hellenistic periods, form the multi-layered structure of the city. The physical, visual, and functional evaluations of these structures, which are evidence of its historical period, were carried out using the thematic maps created in the previous stage.

During the physical assessment phase, the physical relationships between structures and their surroundings, as well as their accessibility, were examined. In this context, thematic maps generated from the structures layer and open spaces layer in the database were utilized.

Considering the building approach limits specified in the Side (Antalya) Ancient City Conservation-Oriented Revision Development Plan Provisions [25] (Article 5.15); 6-meter buffer zones were created around the archaeological remains within the city and 3-meter buffer zones were created around the city walls in the GIS environment (Figure 35). The buffers created have been overlaid on the current building map created under the heading Analysis of Data Related to the Built Environment. In the final map obtained, it was observed that buildings that exceeded the approach limits physically threatened archaeological assets and prevented access to the remains. However, it was understood that vehicles easily using the roads within the 6-meter buffer zone physically endangered the structure both with the vibrations they created and with the possibility of colliding with the structure (Figure 36, Figure 37).

During the visual assessment phase, the visual relationship and visibility of the structures with their surroundings were examined. At this stage, the perception distances of the structures were determined based on the elevation data obtained from various sources related to the archaeological remains and transferred to the database. As stated by Haris, C. W. and Dines, N. T (1998), the normal human field of vision has a vertical angle of 30 degrees. With this angle, twice the height of the structure is required to perceive the structure as a whole [26]. Buffers twice the height of each structure were created around them (Figure 38). The buffers obtained were superimposed on the modern structure map. In the final map, it was understood that modern structures entering the perceptibility area of the archaeological site negatively affect the visual relationship of the archaeological site with its surroundings and hinder its visibility (Figure 39). In addition, it is understood that the registered and unregistered traditional architectural structures within the visual perception area have a positive visual impact because they support the multi-layered character of the area by demonstrating urban integrity specific to their periods. The buffers created have been identified as vista points belonging to the structure by overlapping them with open spaces. Vista points are points of perception for structures, but they are also components that will determine the operation of the proposed route (Figure 40). Photos of vista points are linked to points on the map using the hyperlink command (Figure 41, Figure 42, Figure 43). Based on the attribute information transferred to the open space database, they have been classified as having positive or negative effects. Parking lots and roads within the perception area of the structures have been found to obstruct the visual perception of the ruins due to vehicle density. The open areas belonging to the ruins and unused empty areas, on the other hand, support the visual perception of the structure and are considered to have potential in line with the decisions and applications to be made regarding their protection.

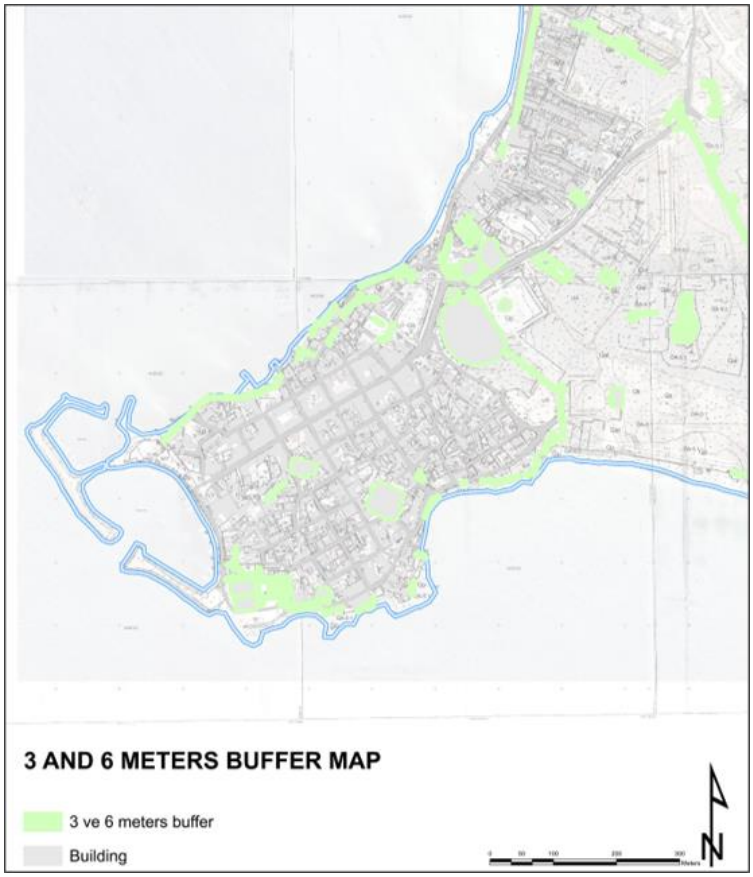


Figure 35. A buffer map showing the physical boundaries of archaeological remains.

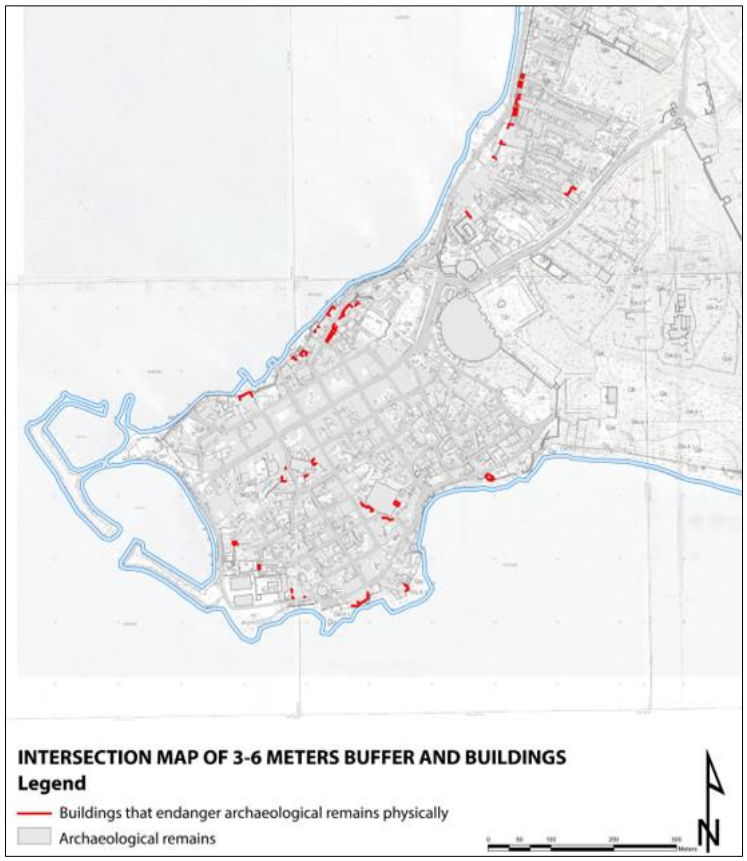


Figure 36. Map showing structures that endanger archaeological remains physically.

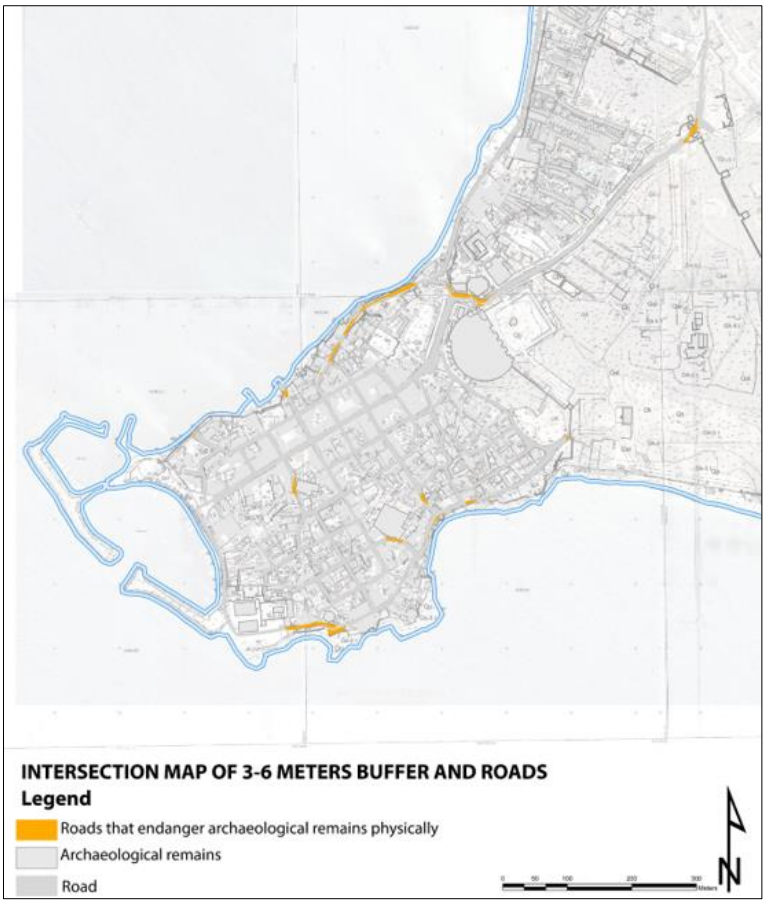


Figure 37. Map showing roads that endanger archaeological remains physically.

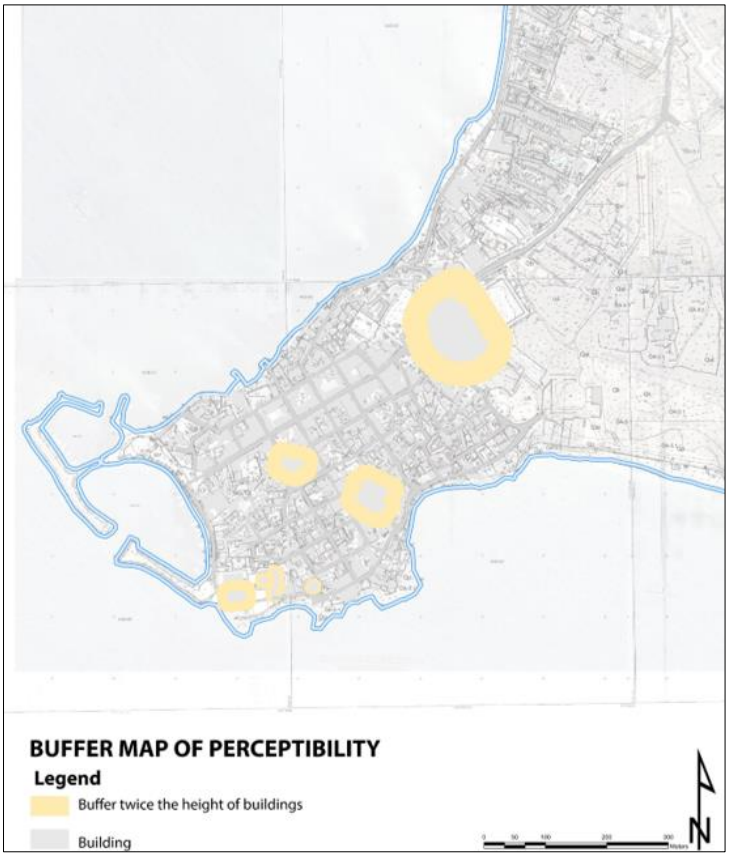


Figure 38. Buffer map showing the perceptibility limits of archaeological remains.

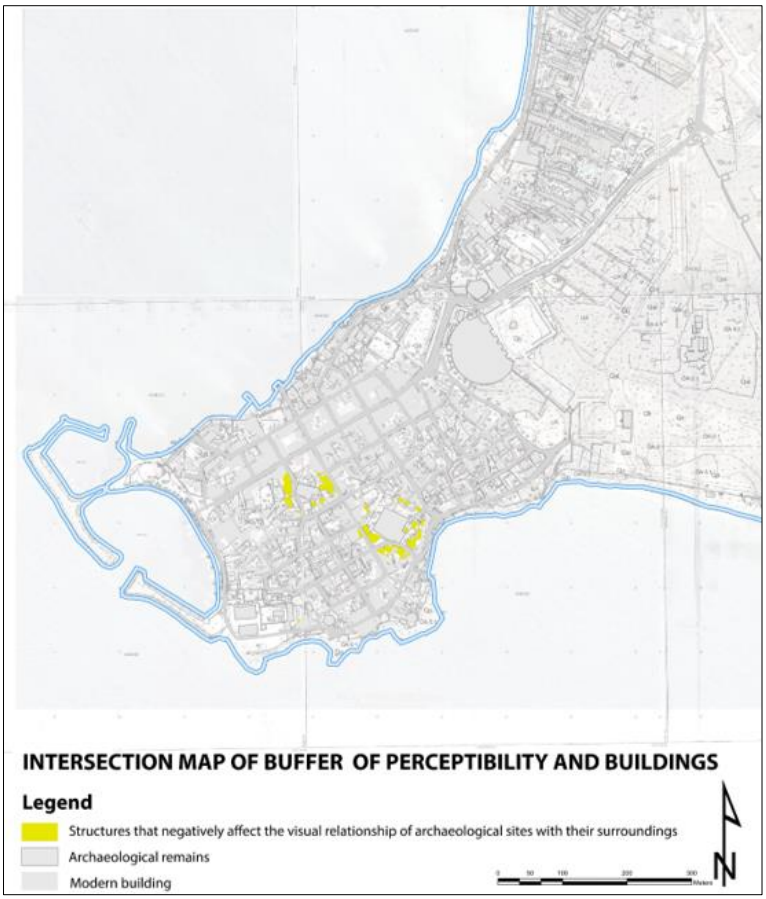


Figure 39. Map of modern structures that fall within the perceptibility limits of archaeological remains.

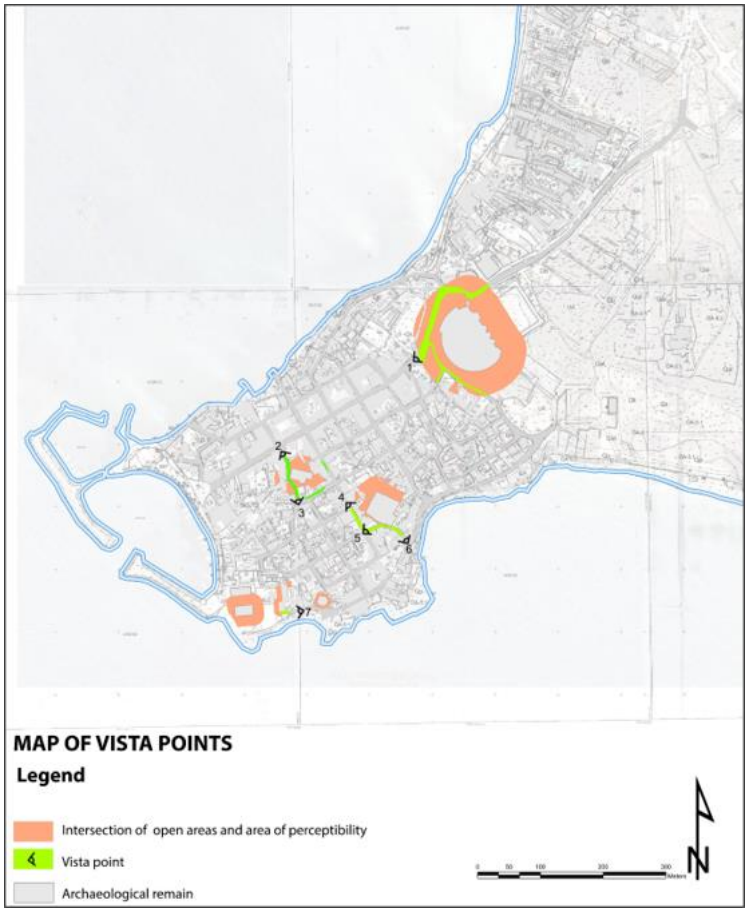


Figure 40. Map showing vistas (viewpoints).

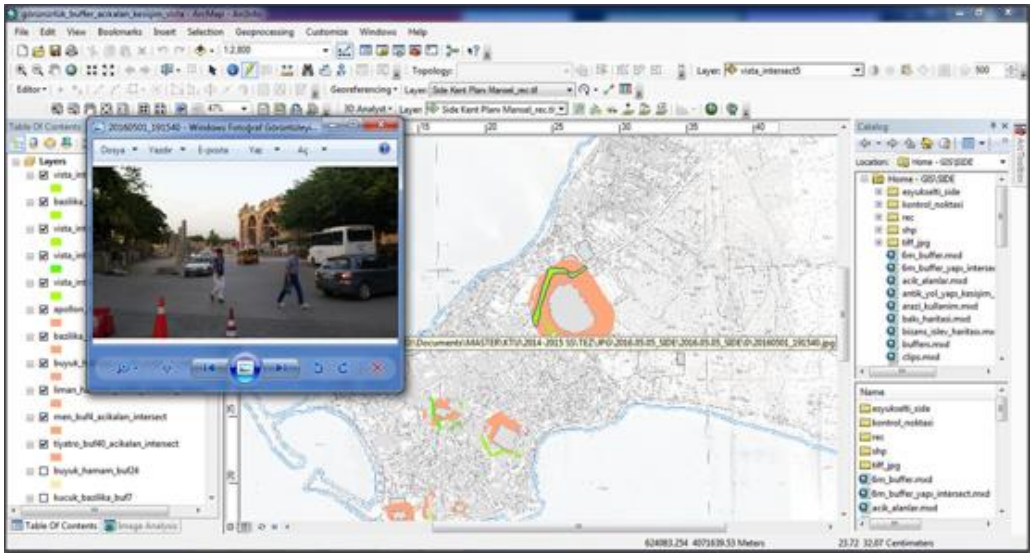


Figure 41. The image of Vista point number 1, linked to the database using the hyperlink command.

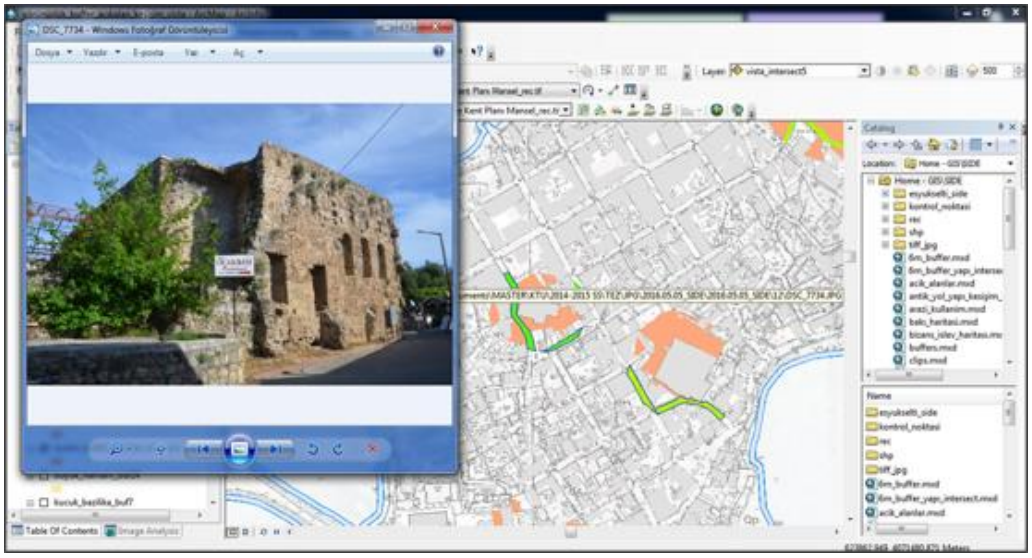


Figure 42. The image of Vista point number 2, linked to the database using the hyperlink command.

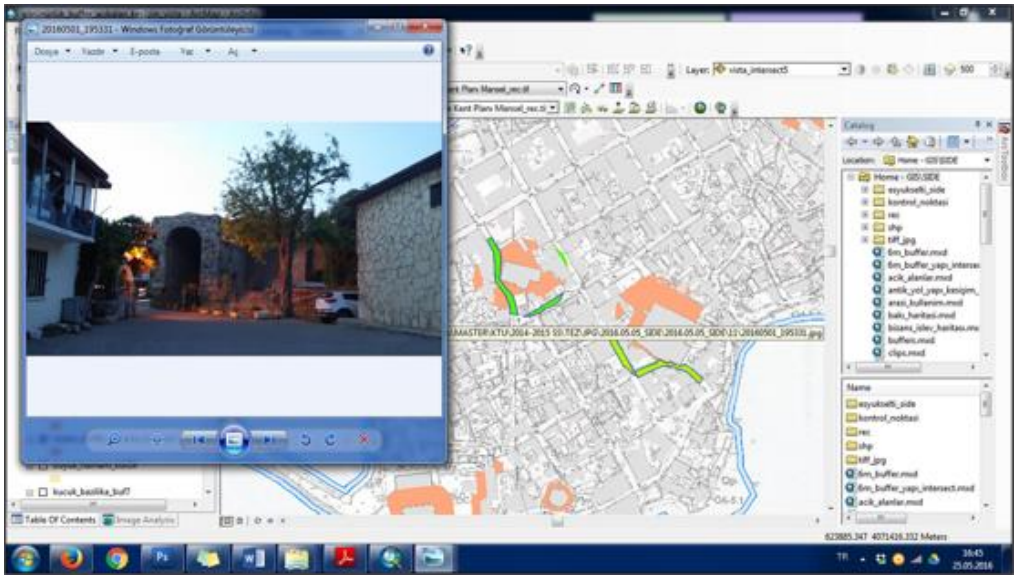


Figure 43. The image of Vista point number 3, linked to the database using the hyperlink command.

In the functional assessment, the functional compatibility of modern structures and open spaces that fall within the physical and visual boundaries of archaeological remains is examined. In this context, a functional map of modern structures intersecting with the physical and visual buffer zones around archaeological remains has been created (Figure 44). According to the map, it was observed that the functions of these structures within the buffer boundaries were predominantly commercial. As a result, the resulting intensive use was found to disrupt the physical balance of use of the archaeological remains. It was also understood that functional incompatibility causes the archaeological asset to become contextually disconnected from its surroundings.

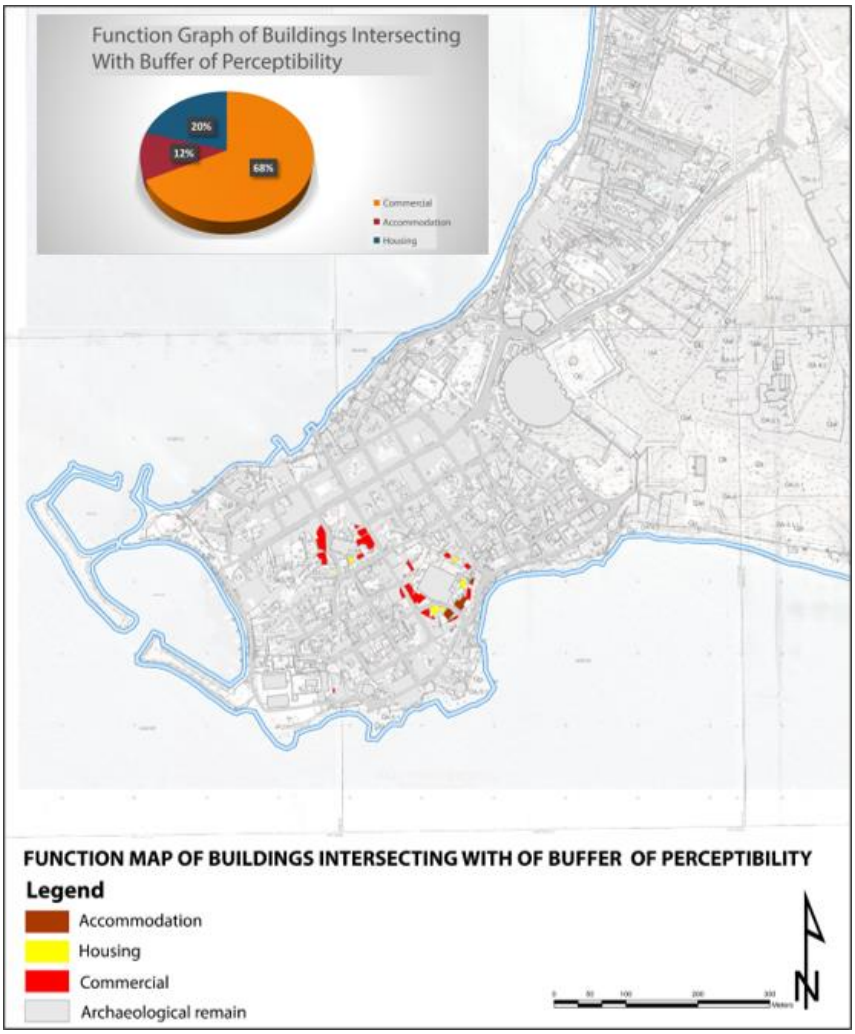


Figure 44. Function classification of modern structures within the physical and visual boundaries of archaeological remains and its graph.

4. Conclusion

Within the scope of this study, the transformation and storage of data obtained from urban archaeological sites into usable and updatable information, as part of the conservation process, was carried out using a GIS application on the ancient city of Side. In this context, the data was transformed into a format on which analyses and evaluations could be performed by transferring different types of data obtained from various sources related to Side into a database created in a GIS environment.

In the GIS environment, it was possible to perform analyses and queries simultaneously on multiple information groups belonging to Side stored in the database. It was experienced that the creation of the database, which is the first stage of working in the GIS environment, is quite important for the systematic and correct progress of the subsequent steps. Within the scope of the study, designing and creating the database accurately and completely and the long period of time allocated for the accurate transfer of the data obtained for Side to the system ensured that complex information could be accessed in a shorter time and used in a more systematic manner during the analysis and evaluation stages. In thematic maps prepared according to attribute data headers,

data has been visualized in an effective manner that includes as much data as possible. Within the scope of the study, the required analyses could be performed simultaneously with multiple data groups using thematic maps. This allowed for the evaluation of the results obtained by enabling the joint querying of different attribute data. Data in different formats were linked to each other using the hyperlink feature.

CBS has essentially enabled the conversion of numerous and complex data related to the Ancient City of Side into usable information and facilitated the processing of this information. By enabling the classification of data in different formats, it has become a highly useful management and storage tool. Any data can be stored in the system at any desired scope. Any data can be stored in the system in any desired scope. These diverse data types can be linked to each other using the 'hyperlink' feature. CBS creates an integrated environment where location-referenced data is linked to attribute data. This system provides a database that allows queries to be made between different data headings. This integrated environment is the result of bringing together different data produced by different software programs. For example, drawings prepared in the CAD environment belonging to Side, maps, plans, photographs, literature data obtained from various sources, and raw data collected from the field can be transferred and converted to the GIS environment. These stored data enable the creation of thematic maps with desired attribute headings, the interrelation of different layers, and the generation of new information through analysis.

The layers created for Side's built environment and open spaces, the thematic maps produced on them, and the queries made in relation to each other have enabled the physical, visual, and functional evaluation of the area. It is believed that the assessments obtained as a result of analyses will make a significant contribution to the formation of conservation decisions. As a result of these assessments, conclusions have been drawn regarding the problems, values, and potentials of Side. The presence of structures at a distance that physically endangers archaeological assets, their functional incompatibility, and their density cause the archaeological assets to be physically and semantically isolated from their surroundings. The analyses also revealed that vehicles using the physical boundaries of the archaeological site have caused, and risked causing, structural damage. These situations have been shown to have negative effects on the visibility of the archaeological site. On the other hand, a functional analysis of the thematic map created for the open spaces of Side revealed that archaeological remains have a considerable amount of space within their own open areas. Accordingly, open spaces belonging to archaeological sites have the potential to be transformed into usable areas in line with appropriate conservation decisions. Based on an analysis of pedestrian density data from a map of city roads, it can be concluded that the main street from the front of the theater to the harbor is the busiest street in terms of pedestrian use. It is thought that this intensive use, oriented through vista points obtained by overlaying a thematic map showing the perceptual boundaries of archaeological remains with a thematic map showing the open spaces of the city, could transform into a potential for presenting and making perceived archaeological assets within the urban site.

The ability to renew and update data is one of the important advantages of CBS. These changes and additions help ensure the continuity of conservation and create a sustainable conservation decision-making process. The information in the database can be continuously updated with the increasing archaeological data resulting from ongoing excavation work in Side. GIS produces information that can be shared via the internet or shared software. Thanks to this connected environment, the data can be used in different systems and projects.

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Conflict of Interest

The authors declare that there is no conflict of interest.

Author Contributions

Beyza Atalay Yıldırım: Conceptualization, Methodology, Software, Data curation, Field study, Writing-Original draft preparation, Writing-Reviewing and Editing; Murat Tutkun: Supervision, Methodology, Software, Writing-Reviewing and Editing, Validation.

Data Availability

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

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