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THE PARAMETRIC EVALUATION OF ENVIRONMENTAL IMPACTS TO ANALYZE SITE PLAN IN ARCHITECTURE (CASE STUDY: CITY OF KHOY)

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Abstract:

This article, by reviewing literature related to site analysis design processes and architecture theories, studies the Environmental Impact Analysis process in site analysis with a parametric approach. In other words, it is looking to answer the question of how we may employ modern computer approaches in the form of a parametric model to evaluate environmental factors that impact site plan analysis. This approach has not been yet investigate dusing this method and has only been analyzed and evaluated in the field of qualitative researches. In addition to understanding the effective factors in an urban environment, this paper tries to explain the role of physical elements in solving its problems. The goals of this study are gaining knowledge on effective environmental factors and characteristics of each one of them, determining the parameters that are effective in understanding these factors, and achieving a dynamic and digital solution for a parametric evaluation in site analysis. The paradigm used in this study, given its quantitative nature, will be the positivist paradigm. This research uses the quantitative approach and has been conducted by using computer simulations and modeling skills. The necessary inferences have been conducted through content analysis, Delphi method and desk review of documents. The findings of this paper demonstrate that in order to achieve success in the process of architecture designing in the present era, site analysis and design context should be placed in a creative, dynamic, and evaluated process and they should be employed through constructive and effective activities to creatively generate ideas in designing and to develop other design phases. In this condition, the great

ability of digital applications is considered as an important and motivating factor for architects. An architect, with full knowledge and awareness regarding the issue of designing and designing tools, can breed creativity in the right direction and reach a completely scientific and logical conclusion in solving a design problem.

1. Introduction:

The success of an architectural project depends on its relationship with the site and its surrounding environment, therefore, as a default, analysis and design should always be performed based on location and local characteristics. Site analysis has been considered as one of the main internal design sources for architects, landscape architects and urban designers. Factors such as soil types, location, bedrock depth, waste drainage, fresh water availability, street front proximity, views, sunlight direction, prevailing winds, access to the site may affect the design procedures (Rezaei, 2020; Hearn, 2003) .
Each site has a very special direction and solar views and often has a very clear character and atmosphere. These items are an opportunity to create a conceptual approach and a path to invent the building shape, layout, form and matter. After selecting the site, conducting analysis regarding access, site surface, vegetation, local texture, noise pollution, view, etc. can help the initial conclusion.
Site analysis is one of the most essential steps in the designing process of architecture which includes evaluating an existing potential site in relation to the development plan. Environmental impacts, the effects on the community and closely related characteristics, scheduling, and analysis of site and plan's environmental features identify the opportunities and limitations. An accurately performed site analysis is based on essential requirements, is very cost-effective for a sensitive environment and is considered a logical approach for project development. Analyzing a building plan, the capacities and capabilities that a site might have for it, along with an evaluation of political, regulatory and environmental issues show the development value of a piece of land (Hayes, 2014).
A look at the physical plans, architectural and building designs in many modern urban developments and mass housing or large-scale commercial complexes in and around the cities reveal that in most of them, there is a lack of close relationships with the site and context properties. In this regard and in each construction and development project, site design and analysis is considered a key step in a well- designed project. In fact, a complete analysis of a site and its surrounding context can lead to better design proposals, better and more coordinated implementation and ultimately higher-quality built environments (Lagro and James, 2013). Paying attention to the ground as an effective factor in impacting architecture and urban planning is not a new method or phenomenon, it is an old method that should not be ignored or gradually forgotten over time (Abedi and Iravani, 2015)..A building cannot be considered separately from its environment. Each building affects and is affected by the environment and they both interact with each other (Mehrabi, 2016).
The authors believe that the potentials and capacities in the design context, as a productive parameter in idea creation and project design, have not been fully utilized. The author also believes that more use of these factors will lead to the generation of diverse concepts suitable for the design context. As a result, the main question in this research is how to assess the environmental factors that impact architecture design and express it in the form of a parametric model using modern computer approaches to analyze the site plan? This research creates a digital and parametric model to examine the impact of environmental factors and their changes in the process of architectural design. It is also considered as part of the way to obtain ideas in the present context design. So far, there have been few scholars who conducted research in this way regarding the process of architectural site analysis; previous studies have been more involved with explaining and describing the site analysis process and dividing its various steps into phases. In this research, we will move toward the mentioned goal by detecting the parameters and environmental impacts that are involved in the design process, and especially in the stages of site analysis and parameters assessment. The goal is to obtain principles and an analytical pattern based on quantitative assessments in the form of a parametric model. Adhering to this model will guide the designers in obtaining basic ideas from the initial phases (Phase zero). This method can be called the

[1]EIA. The importance of this method becomes clear when we become aware of the outcome of this issue. What we mean by "outcome" is creating integration and cohesion in the environment. The assumption of this research is that paying attention to the surrounding physical context can have an effective role in development of architectural work. Also, the physical context of the design as one of the external restraints is the unique essence that makes architecture different from other products. Architecture is formed in the environment and an environment has geographical and cultural characteristics that are interconnected. That is why it is essential to understand all environmental, geographical and human factors to lay out the foundations that affect the architectural body (T White and Ahmadnejad, 2016). Paying attention to architecture context and design data are two of the primary tools of architects in the design process and define the main design approach. This approach leads to a wide manifestation of design options and will ultimately result in a more successful evaluation of solutions and more complete designs. One of the suitable solutions for an accurate examination of the design context is comprehensive attention to all the factors and parameters that affect the process of site plan design. This means that environmental impacts, whether they are caused by humans or nature, will be meticulously investigated. A comprehensive and sustainable approach to site plan design can reduce these impacts in the design context, both inside and outside the site (Lagro and James, 2013).

2. Material and methods:

The paradigm assumedin this study, given its quantitative nature, counted asthe positivist paradigm. Therefore, the researchers used a quantitative strategy and employed simulation and modeling. First, using desk research, the literature and previous studies were reviewed. By assessing the intended variables using simulation and modeling in the related software and creating a parametric model, the relation between the variables was then investigated. Itwas performed to investigate the impact of environmental factors in site analysis, to assess those factors and to examine the relations of these factors with the design context in the process of architectural design. Therefore, it was necessary to study the research variables more thoroughly. A Delphi method was thus conducted. As such, an expert panel including seven professional engineers and architects was interviewed deeply to select, set and control the main variables, factors and pre-models or scenarios. Given that, the research goal setto understand the impact of environmental variables on the design context, the initial variables included those that directly affected site design and assessment. The variables in this study included variables that hada higher priority and impact in the processes of architectural design and plan site design. These variables were: Sunlight direction and shadow casting (including sun exposure), noise pollution, appropriate access (or approach to the site, proximity to the street front), views and sights. After determining these parameters and designing an algorithm related to their calculations, all these calculations were eventually integrated with each other and the final analysis was provided to the user as a numerical matrix for optimal location. The simulation method in this research developed various models which were pre-tested by the professional panelists. The Table 1 demonstrates the simulation in comparison with the other methods.

Table 1. Comparative analysis of simulation research and other kinds of research (Mishra and Patnayaka, 2015).

Item Particulars	Simulation Research	Logical Argumentation Research	Experimental Research	Qualitative Research
Concept	Develop a model to streamlinereality	Totally logic and interpretation based	Evaluate the validity and reliability of any object	People descriptive oriented
Objectives	To create avirtual world to know about the real worlds cenario.	To know the facts by developing alternative interpretation of reality	To know the facts by developing and testing theories for specific item	To know the facts by socially constructed reality
Research Goal	Development of objects about the behavior of complex system	Develop interpretative and theoretical understanding	Identify the formallinks between the objects and test theory	Describe situation holistically,including public participation
Variables	Pre-determined and also emerge during research	Emerging during research	Pre-determined	Emerging during research
Data Analysis	Descriptive, quantitative and qualitative	Descriptive	Parametric	Descriptive
Participant's Role	Both artificial and real	Directly involved	None	As informant
Researcher's Role	External audience during the process of research	Theoretical interpreter	External audience	Interactive participant and observer
Relation with the environment	Mix of positive and negative	None	Socially & economically friendly but non-sensitive towards environment	None
Target Discipline	Artificial sciences	History based	Natural Science	Social and Cultural
Architectural Example	Building simulation, cost benefit analysis, object based parameter analysis	Analysis of Architectural history and previous theory (Rao, 1988)	Material testing upon fixed parameters	Different planning theory based on public participation

3. Theory:

3.1. Context Appraisal:

Vitruvius considers three principles, form, structure and function, as the main components in designing architectural projects. Jean-Nicolas-Louis Durand believes that the program shapes the form of architecture. However, he referrers to features of site as the practical as pect sin design processes. Viollet-le-Duc names the site or the context of a project as the second significant factor for designing after program. Rezaei has divided these factors into external and internal sources (Table 2) (Rezaei, 2020).

Table 2. Contexts that inform the architectural design process(Rezaei, 2020).

External Design Contexts	Internal Design Contexts
Social Issues **Cultural aspects** **Similar projects** **Sense and meaning** **History** **Philosophy** **Place and context** **City and urban concepts** **Moral and political agenda** **Sciences** **Arts**	Program and function Dimensions and measures Standards, rules and regulations Legal terms and conditions (zoning, height, proximity to the street front, FAR) Hierarchy and circulations Site (soil, bedrock, drainage, fresh water availability, views, sunlight direction, prevailing winds, etc.) Structure Materials Costs Client's opinion

In the opinion of the users of a building, a site and the constructions made in it are the same. A good design responds to the natural qualities of the site turns the site into a place in which human satisfaction has been taken into account. Site analysis is a critical step in the process of architectural design. Site analysis means evaluating an existing or a potential site according to the development plan, environmental impacts, the effects the project has on the community and the adjacent buildings, the plan and the project budget. In site analysis, limitations and opportunities for development, planning and environment are identified. If the site analysis is performed accurately, it can lead to a cost-effective, environment-sensitive and reasonable process in the project development.

Since employers become more aware of the environment and legal supervision increased, a comprehensive environmental evaluation of a site has gained more significance. Employers want to prevent costs and health hazards resulting from the environmental pollution of a project site and also costs that might be paid to avoid the destructive impacts of their activities on the environmental resources. State and local government are more unitedly and effectively applying environmental controls in the development process (Hayes, 2014). Analyzing a building construction plan and the ability of the site to accommodate that building, along with political, environmental and legal assessments determine the value of a piece of land.

3.2. Site Analysis Process:

Site dimensions, projected land use and planning requirements have a major effect on the amount of work needed for site analysis. Other key factors include site location, shape, topography, access, the complexity of neighborhood issues, facilities and site-related environmental issues. Planning and design based on the content of the site require gaining information on the site and its components. This means

that in order to perform an activity or applying a specific use, a set of information related to one or several components will be useful. However, another set of information will be needed for another activity and use. In order to decide which components need to be prepared or analyzed and which components should be ignored, four factors must be considered (Lagro and James, 2013):

* Suggested uses of the site
* Present conditions inside and outside the site
* Requirements for obtaining a license and approval
* Cost of data collection and analysis

These factors also determine the scope of knowledge and site analysis. During site analysis, architects are often looking for a potential that turns the project into an acceptable component in a community. The site analysis team should be able to have a good influence on the community and effectively communicate with its representatives.

3.3. Site Analysis Framework:

Most presented definitions divide the site analysis process into different steps in a structural and integrated approach. The traditional stages to do this include selecting the site, establishing the building and placement of facilities. However, in an extensive design process, site analysis and selection include selecting the location of the construction site, preparing an inventory, conducting an analysis, concept development and design implementation. Site analysis is a sub-system during the design process. In fact, there are some major factors in the design process that form the nature of site selection and analysis. Therefore, this study states that site analysis can be divided into several interactive categories. The site analysis framework starts with the idea that site analysis can be divided into several steps and each step represents the analytical measures taken at that point in time. As a comprehensive approach, this framework combines the mentioned steps and investigates the interactions between them. Climate, geology, hydrology, topography, vegetation, social and cultural background and economic conditions are the most obvious steps. The environment category consists of the following two sub-categories: biological and physical sub-categories. Regarding the investigation of each group, several major factors are identified. These factors include temperature, wind speed, wind direction in the climate category. Due to the uniqueness of each project site and the complexity of the mentioned process, the mentioned framework cannot necessarily follow the determined categories respectively. The following Fig. 1 provides an overview of the site analysis framework (Kumari, 2013).

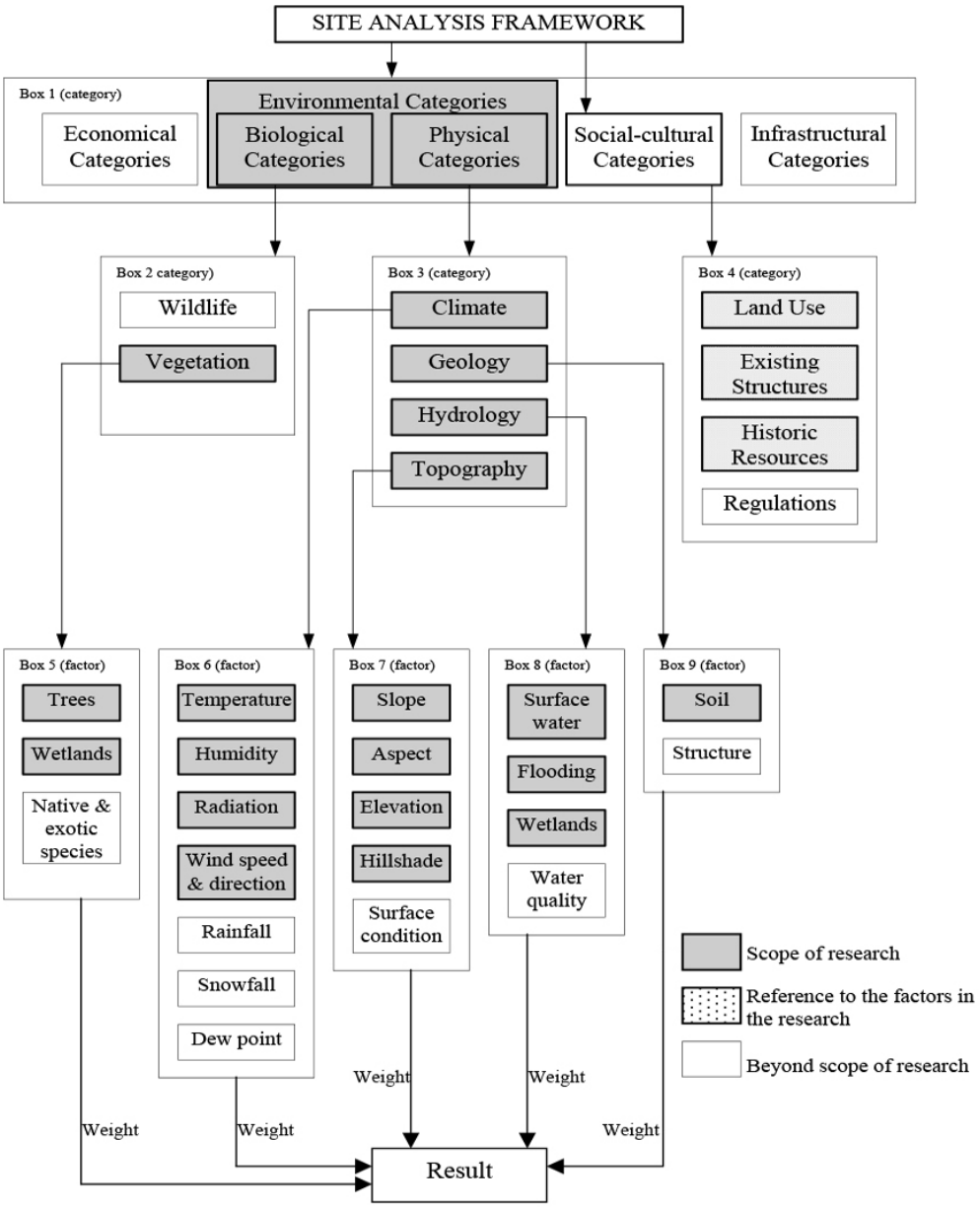

Fig. 1.Comparative Analysis of Simulation Research and Other Kinds of Research. [9, p. 38]

3.4. Site inventory:

The most important step in the process of architecture design is having a complete understanding of the planning context. Generally speaking, site analysis in architecture conducts researches (knowledge) and analyzes them. Development, reconstruction, and land management require information about a range of environmental and cultural systems. Our understanding of different cultural, biological, and physical phenomena is obtained through basic or applied researches. This scientific basis shapes the management theory, planning and land design. Site inventory is performed in several steps by a group of experts. The first step for any site is the preliminary visit. In such a visit, the goal is a quick and brief evaluation of the site and determining potential resources and significant properties of the site. The next step is preparing a base map. This map is used as a basis for creating a map of site components and properties, their analysis and also the next steps in planning and land design. Site inventory is performed based on numerous components, but the main items we discuss regarding site inventory and analysis include physical components, cultural components, and biological components (Fig. 2).

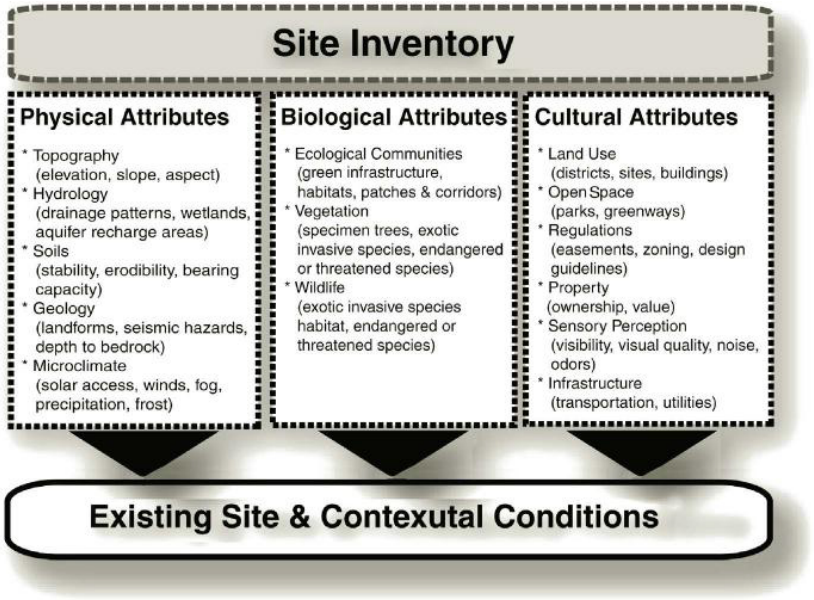

Fig. 2.The site inventory produces mapped data on the existing conditions of the site and its surroundings (Lagro and James, 2013).

3.5. Site Evaluation:

In this step, comprehensive evaluations are conducted, in necessary, to expand and develop the site analysis program. Testing the site physical features, site positive changes and site neighboring buildings are some of the items that might be the topic of these comprehensive evaluations. Deciding on how to perform the best evaluation of each area of land includes contemplating all the aspects that affect site analysis and evaluation. Nobody can be that much of an expert in identifying all the consequences individually. Every factor must be considered accurately. That is why the most effective analyses and evaluations are those that are performed in several contexts. Analyses that are conducted according to a specific plan and in order to coordinate them, different pieces of information from site analysis in different contexts are assessed according to that plan (Anne R and Higgins, 2004).Eventually and by concluding the items mentioned in relation to effective factors in site inventory and considering its basic parameters, we can present a more general categorization of these factors; using which, we will gain a higher level of understanding and get closer to the site analysis. By doing this, the more general parameters that are outside the domain of understanding and analysis in architecture will be eliminated and the main parameters in the field of architecture will be discussed.

3.6. EIA:

EIA is a method in which the impacts of a project or its operation on the environment are investigated and predicted so that, given our understanding of the conditions and type of impact, the operation gets implemented with the least impact on environment. Currently, the excessive activities of humans are a factor that is damaging nature and environment. Because of the needs of humans for food and energy, limiting these activities is not possible. That is why different countries are trying to shine a spotlight on the effects and consequences of these activities. This review and foresight is called [1]EIA. EIA impact assessment is done to prevent the project's negative impacts on the environment and to reduce costs. In EIA, the effects of the plan (project) on the environment are predicted to prevent damages to the environment. In this paper, the environmental assessment instruments are considered as the theoretic link between architectural study and environmental impacts. This evaluation method, with the ability for EIA, can create a link between a building and its environmental impacts. In addition to that, this link is

established through the relation between environmental impact considerations and a building's architecture design.

The need for a systematic method for the evaluation of environmental impacts of a project or plan has been felt for decades. The process of EIA was invented as a tool for this goal in the early 70s in the USA. Since then, the use of EIA has widely increased over the world and this method has been developed for decision-making at different levels of communities and companies. The EIA process has been used in numerous projects and plans in various scales. This process has been employed in local development plans and projects and also for solving regional and even international problems. In the 1990s, management of environmental issues became an important matter in companies. In this regard, the need for analytical tools in the related systems has increased in order to identify the reasons for environmental problems in technical systems, and the use of EIA has also grown. The preliminary processes of EIA mostly focus on the presence of potential environmental pressure or load and its impacts on the environment. The EIA process uses a more complex method that, in addition to containing environmental documents and statements, includes the processes related to those documents from the perspective of public participation. Therefore, social impacts have been considered in EIA and a systematic method has been created to find a solution with little environmental impacts that is accepted by all (or as many as possible) involved beneficiaries (Anderson, 2000).One of the important concerns is making sure that the information obtained from EIA has the necessary quality for decision-makers and plan-makers. In a way that they trust the findings and feel that they can act based on them. In the following, we will discuss the principles and applications of EIA.

3.6.1. The Goals of EIA:

Numerous goals have been defined for EIA that will affect the method and scope of this research. Determining the objectives depends on who the user is and how the results will be used. The goals of using EIA have been described by Morgan as follows (Morgan, 1998).

Its main goal is predicting the important and potential impacts of suggested measures on natural systems (water, soil, climate, biologic system, and human health), human systems (place of residence and substructures), social and economic systems (work, education, entertainment, and health services) and cultural systems (beliefs, art, literature).

EIA should preferably be performed before the project is designed and before the site location is fixed. Otherwise, if EIA shows that significant side effects will occur in a way that cannot be mitigated to an acceptable level, the project might change or may even be discarded. This will lead to a waste of money and time for all the parties involved. Therefore, EIA is a process and not something that can be done at once. EIA should be performed during the project designing and decision-making and it should be integrated with them, such that it will affect many of the process steps for a considerable amount of time. Its goal should not just be providing a report for the final confirmation step Abaza et al. (2004).

3.6.2. EIA Principles and Methodology:

The EIA process is consisted of several stages. This process, like other learning processes, has a cyclic mode. The suggested sequence for different steps of EIA has been shown in the following figure and the arrows represent possible repetitions. There are no standardized methodologies for EIA. Anyway, a framework of principles to guide strategies, methods, and techniques has been more or less accepted by the association of scientists and has been included in the laws and directives of different countries and European Union. Therefore, this research is not an opinion or a step-by-step instruction to implement EIA; it reflects the comments and suggestions made in many countries for conducting studies regarding EIA and shows the scientific demands for employing EIA. The EIA process can explained in several steps; the content of which depends on the research goal and nature. Many researchers including Anhava and kolehmainene mention the economic advantages of starting the EIA process before designing a technical project and emphasize the early start of the EIA start in development projects (Anhava and kolehmainen, 1994).

One of the important steps in the EIA of a project is predicting changes in the regional environment. After detecting the type, significance and amount of impacts, the changes that will occur if the project is

implemented should be predicted. For this purpose, the regional environmental conditions in the case of project not being implemented and the future of the region if the project is implemented will be investigated as very desirable, desirable, suitable, unsuitable, and unacceptable. In this part of the study, the future conditions of the region if the project is implemented or not will be compared and predictable changes from the current situation will be investigated. Using the results obtained from the computer software and site analysis using EIA, the zoning of the site project will be obtained in terms of suitable and unsuitable places. The number of options in each project can be different. This can be determined according to the project type, suggested locations and environmental conditions. The next step is selecting the superior option. This is performed by various methodologies.

4. Results and Discussion:

In this project, we are looking to investigate the effect of environmental parameters on the characteristics of the design context. Through this, we can figure out and express the relation and the impact of parameters. Knowing these impacts, an architect can have a better understanding of the topic and obtain more efficient and optimal forms. For this purpose, the parameters of interest are first introduced and classified. Then the regulations among them are identified and a parametric model is formed based on these relations. Here, we are dealing with two types of environmental and physical parameters. For more clarification, these parameters will be discussed in two parts. On the other hand, some of the design parameters are independently determined and some are dependently specified based on the initial values and pre-existing relations between them. Based on this, we can take into account the division between dependent and independent variables.

4.1. The Parametric Evaluation of the Plan:

Based on the definition of the project subject and what was stated regarding the principles and the components of the parametric design, here we will discuss the determination of parameters, laws and ultimately we will describe the assessment model. Given that the present study belongs to the positivist paradigm and employs simulation and computational techniques, we decided to briefly explain the steps and results and to stick to the minimum statement of preliminary assumptions and the topic theory. We previously mentioned the design argument, principles, components and requirements. Here, we use the explained items to describe the components of the parametric model. The parameters of interest are categorized and defined. The regulations and relations governing parameters will be determined and a parametric model is created. Based on the initial conditions and relations, the required class of answers is extracted. Then, the selected outcomes and the reason for their selection will be explained and the next sections discuss assessments and their analysis.

4.2. Site Selection:

The present study, after reviewing and determining the factors impacting the environment in the site analysis, assesses them and the number of their impacts on the design context. For this purpose and in order to assess and display them in the design context, given the knowledge we had of the selected site in the city of Khoy, the current tomb of Shams Tabrizi in Khoy was selected as the context for assessment and analysis. It is obvious that any other place in the world can replace this site because the analysis and algorithms are comprehensively and completely designed and can be generalized for any other climate or region (Fig. 3).

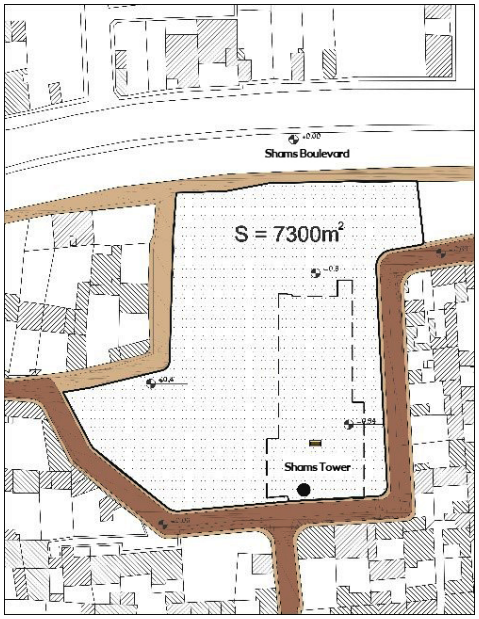

Fig. 3. The selected site and context for assessment and analyzing effective environmental parameters. City of Khoy.

4.2.1. Assessing the Parameters:

In this step, the parameters are determined not just based on a certain regulation and formula. This formula can be obtained using the laws of artificial intelligence. This means that it is determined based on what the designer had in mind as the design laws and the optimal condition is calculated by the computer by considering the special conditions of each project as the inputs. This research aims to employ this level of parametric method in a part of the project. For this purpose and in order to obtain the parameters, in addition to the ability to determine these values arbitrarily provided to the architect, it will be possible to take advantage of the computer's ability to perform logical processes in the architecture (Table 3).

Table 3. Parameters assessed by the research in the parametric assessment of the design context.

Variable Parameter	Dependent Variable	Independent Variable	Outputs
Design Context and Site	Number of analyze cells	Site mesh	2D Cells 3D Cells Site Analyze Points
	Dimensions of analyze cells	Number of stories	
View	Site analyze points	Site mesh	Inward view Outward view
		Surrounding buildings	
	-------	Landmarks	
	Sight	Green space	
		Distant landscapes	
Sunlight	Site analyze points	Shading Objects	Lighting of the

	3D cells		building walls Lighting of the site context
	Start month		
	Start day		
	End month		
	End day		
	File and climate information of the region		
Noise Pollution	Site analyze points	Noise pollution production centers	Produced noise pollution
	Noise pollution production capacity		
	Noise pollution production hours		
	Noise pollution coefficient		
Access	3D cells	Access path	Appropriate access rate
	--------	Passage width	
	Passage access degree	One-way or two way passage	

4.3. Environmental Parameters:

4.3.1. View:

Examining the view and perspective of the design context means visually recognizing the key points of the site. The project architect, by performing the necessary examinations, considers the view of pedestrians and riders inwardly and outwardly, and based on this, determines the location of the representative points in the architectural plan. Of course, it should not be forgotten that the view of the user inside the building to the outside and around the site is also of particular importance. In this study, we will examine the view and landscape according to various variables, which are: land slope, surrounding buildings, green spaces, landmarks (historic and valuable buildings) and view to distant landscapes (Fig. 4).

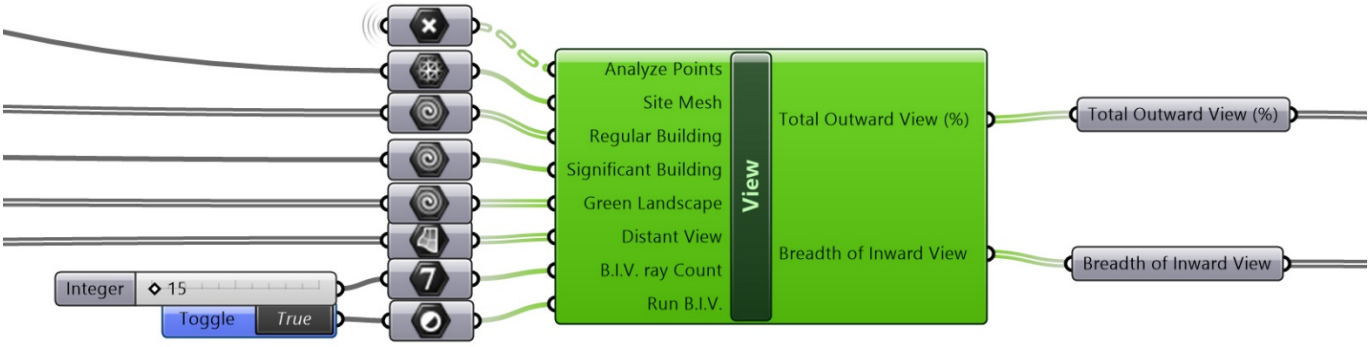

Fig. 4.Algorithm of the site view based on input dependent and independent variables.

4.3.2. Sunlight (Sun)

In this part, the climatic location of the project is reviewed. The amounts of light and sunshine angle and shading are determined and analyzed. There may be many natural and artificial elements in a site that should be taken into consideration in designing. Some of these elements directly and some indirectly affect designing. In this project, we will present an analysis of the sunlight based on various variables that include: shading objects (including buildings and vegetation, start day, end day, start month and end the month of the project, the regional weather information and file) (Fig. 5).

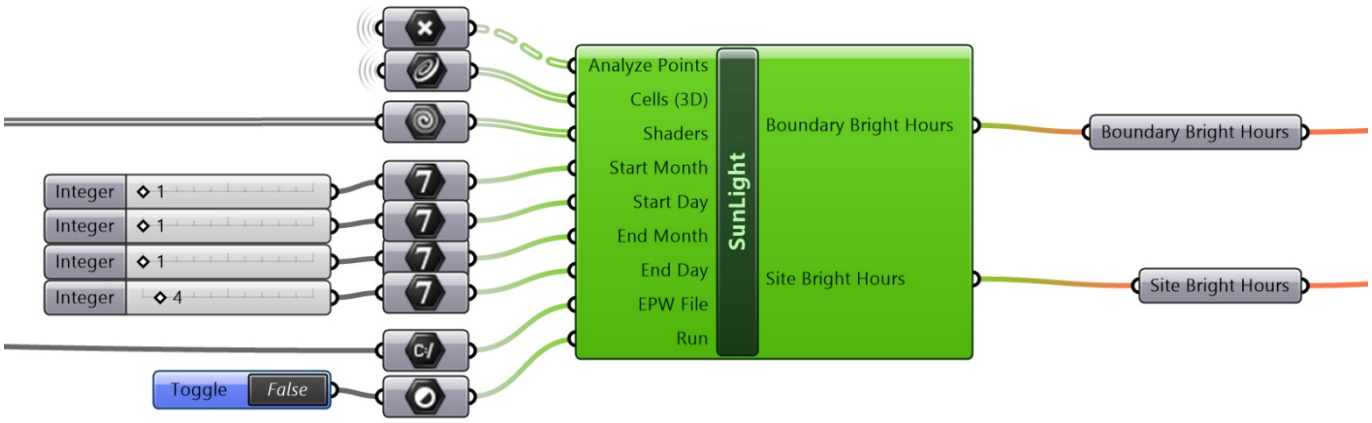

Fig. 5.Algorithm of the lighting of the building wall and the site context based on input dependent and independent variables.

4.4. Physical Parameters:

4.4.1. Noise Pollution:

In this step, the designer visits and directly observes the project site and, by studying items such as: adjacent neighborhoods, architectural fabric and patterns of the neighborhood and region, examines and records the general conditions of the surrounding buildings. In this project, we will analyze the amount of noise pollution using various variables that include: noise centers or noise pollution generation, pollution load and power in decibels, hour count or noise pollution generation and ultimately a factor that can be considered for each source according to the power of the noise pollution generation source (Fig. 6).

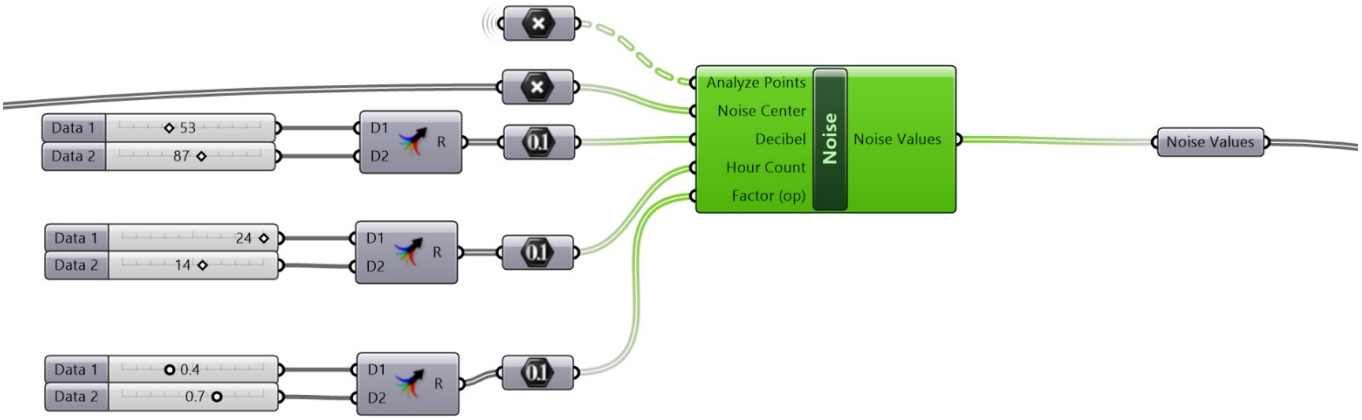

Fig. 6.Algorithm of noise pollution impacting site context based on input dependent and independent variables.

4.4.2. Access:

Grading the passages around and leading to the project site is one of the important issues in site analysis. At this stage, the relation between the site and the main and secondary passages is studied, which can be done through the presence in the site, aerial photographs and land position maps. By determining the main and secondary accesses (streets and alleys), lighting, their current condition and the resulting noise pollution, the architect can take these factors into account when designing and locating different parts in the plan. For example, doing this step will have a very significant impact on determining the main entry

point of the project. In this study, we will examine access according to various variables, which are: length and width of the passage, degree and amount of traffic, passage use (for example: main street, side street, alley, dead end, etc.), type of traffic in the passage (one-way or two-way) (Fig. 7).

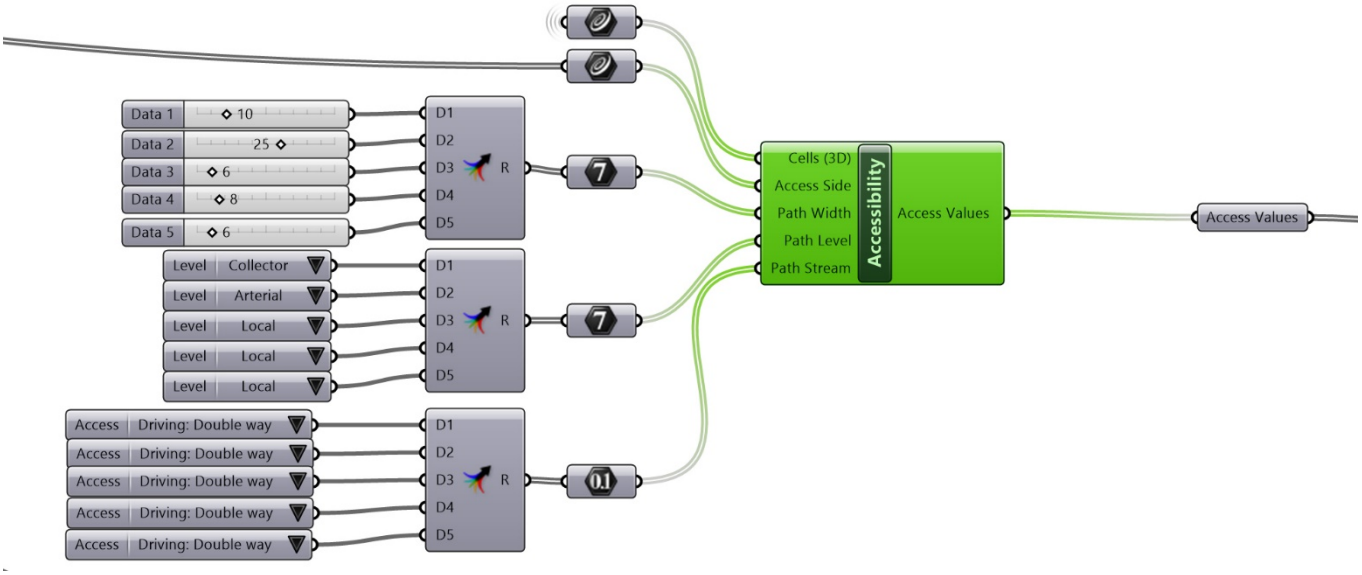

Fig. 7. Algorithm of proper access to design context based on dependent and independent variables.

In all the mentioned parameters above whose variables were specified, one variable among all parameters has a constant presence: The Analyze Points Factor. Two variables in two of the parameters (i.e. sunlight and accessibility) are also the same, which is the 3D cells of the site. These variables have been created based on the site mesh production algorithm. Four variables have been considered in order to generate this algorithm, namely site main mesh, number of stories, number of analyzed cells, and size of the analyzing cells. In order to achieve this goal, we created an algorithm, using the Grasshopper Software and considering variables affecting this parameter, which has the ability to analyze the site main mesh. Using this algorithm, we will able to extract 2D and 3D cells and site analyze points (Fig. 8).

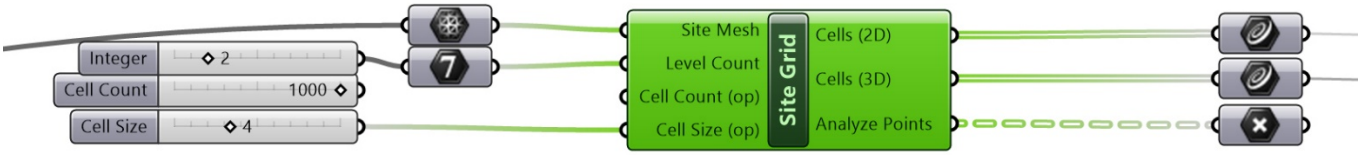

Fig. 8. Algorithm of production of site cells and site analyze points based on receiving site main mesh and dependent and independent variables.

Among all the algorithms we have so far discussed, this algorithm is of more priority and importance. Because if this algorithm is not created and produced, we will not be able to create other algorithms to evaluate environmental and physical parameters of the design context. This is because this algorithm will be the basis for all analyses and other algorithms receive their view, sunlight, access, noise pollution, cells and analyze points from this algorithm, i.e. Site Grid.

4.4.3. Findings:

In EIA-based site analysis, after dividing the site into fields and determining the impact of each field on the design context, we will need to visually display and evaluate the suitable and unsuitable points for design and construction. In this part and using an algorithm, we will evaluate the outputs and analyses we have reviewed so far and present it to the user as a guide and a citable matrix. The inputs of this

algorithm are exactly the outputs of algorithms that were discussed earlier. The outputs of this algorithm include numerical colored matrices that can guide the project designer in locating and designing the project and enables him to evaluate the best and worst points of the site for design from different directions (Fig. 9).

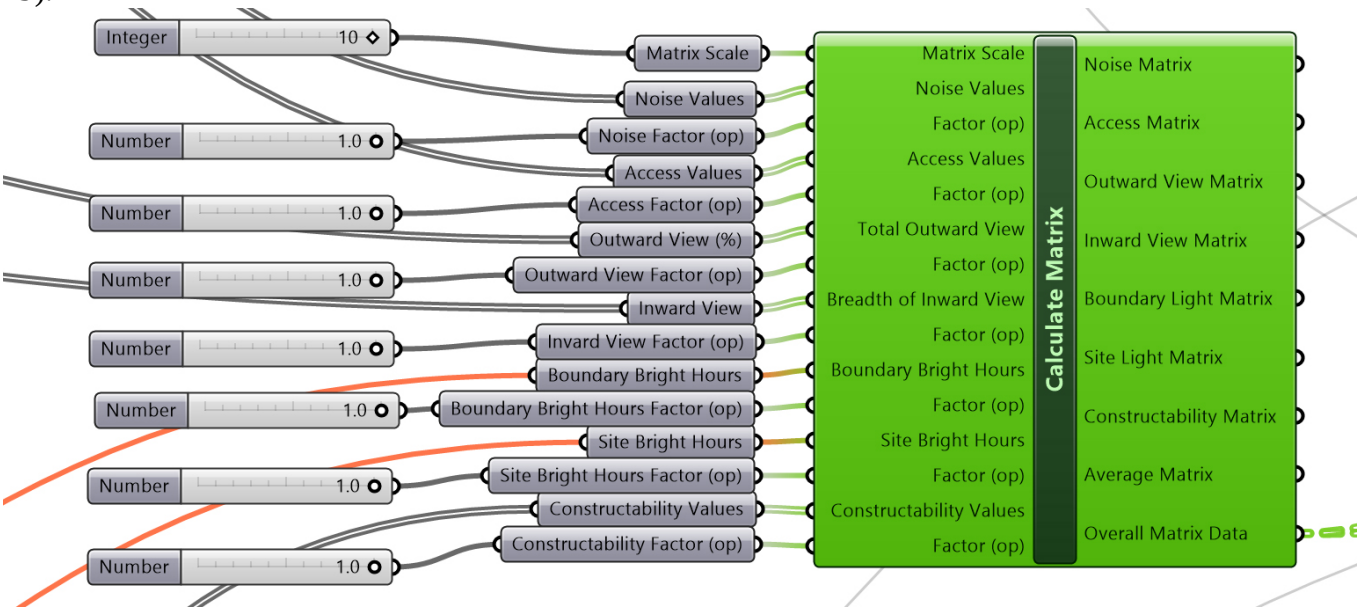

Fig. 9. Data evaluation and assessment algorithm and numerical and visual display of analyses in site analysis.

As it can be seen in the image above, all the effective environmental parameters that have been studied have the ability to provide analytical and matrix-like output and, and the user can prepare all the analyses separately. But the most important output in this part which gives us the final result is the average matrix output. The average matrix is the final result and the results of all the analyses that have been conducted based on sunlight, noise pollution, view, optimal access are available to us as final data (Fig. 10).

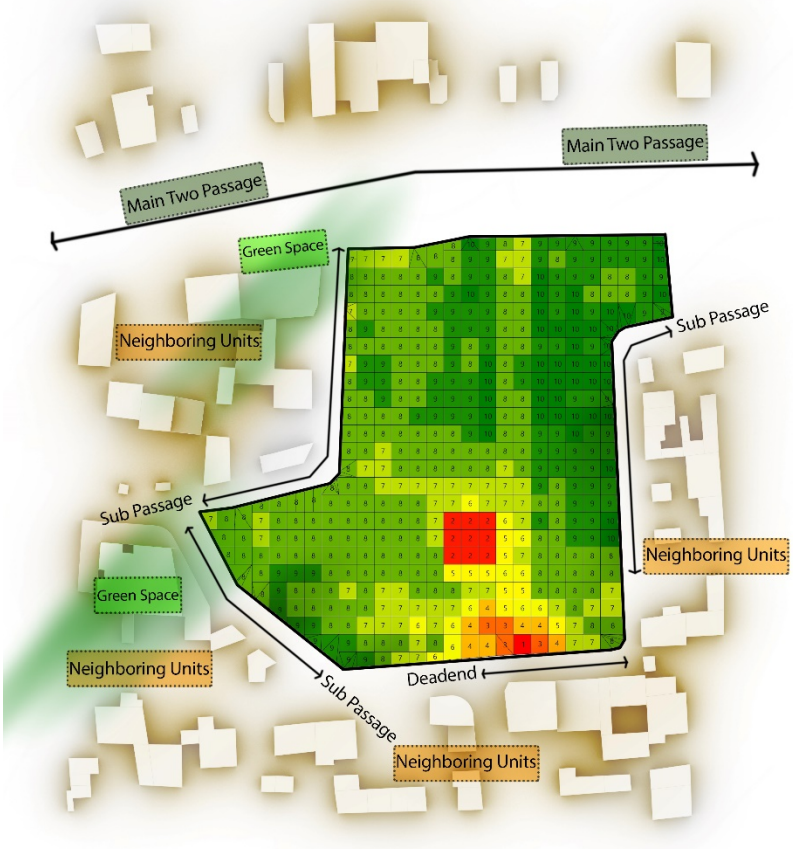

Fig. 10. Mean numerical colored matrix. Determining the site layout based on the best and worst points of the site in order to design and build based on effective environmental parameters (lighting and shading, noise pollution, view and desirable access).

As you can see in the above Figure, the site is divided into fields using analyze cells and each field has its related score and point. These fields are categorized in a range from very desirable to unacceptable for construction. In a way that the ranges 0-2, 2-4, 4-6, 6-8, and 8-10 represent unacceptable, unsuitable, acceptable, desirable, and very desirable, respectively (Table 4).

Table 4. Score range for analyze points and their assessment to determine suitable points for construction, derived from Leopold matrix.

Range	Priority for construction
0-2	Unacceptable
2-4	Unsuitable
4-6	Acceptable
6-8	Desirable
8-10	Very desirable

Now, we can have a 3D mean analysis matrix, along with this assessment. In this way, based on the construction priority in different parts of the site and the degree of constructability in the site, the evaluation matrices move in height but based on the height and construction restrictions in the area (Fig. 11) and (Fig. 12).

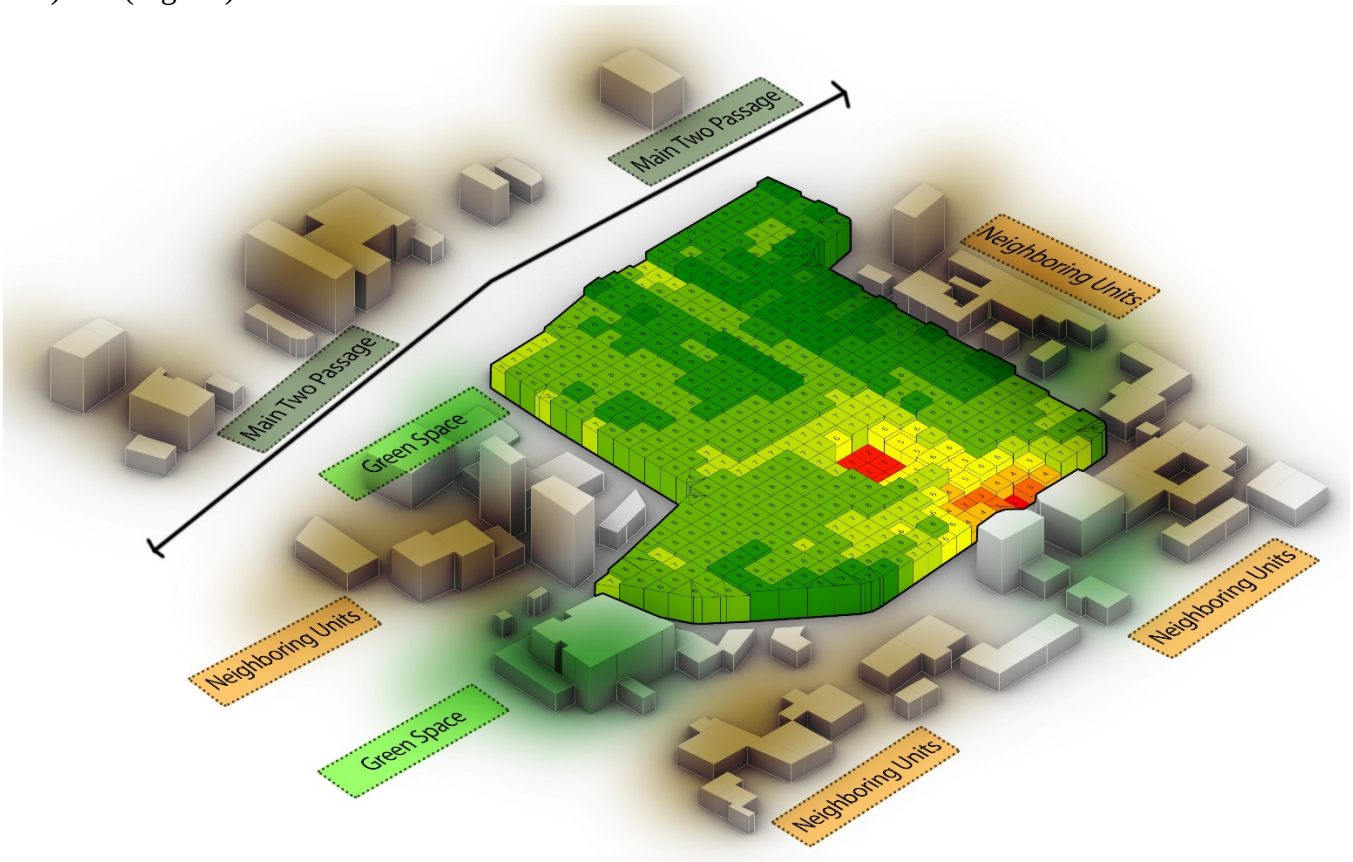

Fig. 11. Given this assessment, which is quite accurate and citable, the designer can employ this matrix as a guide for optimal design in all areas. This matrix can even help the designer as a guide to start designing as a preliminary producer to generate ideas and concepts.

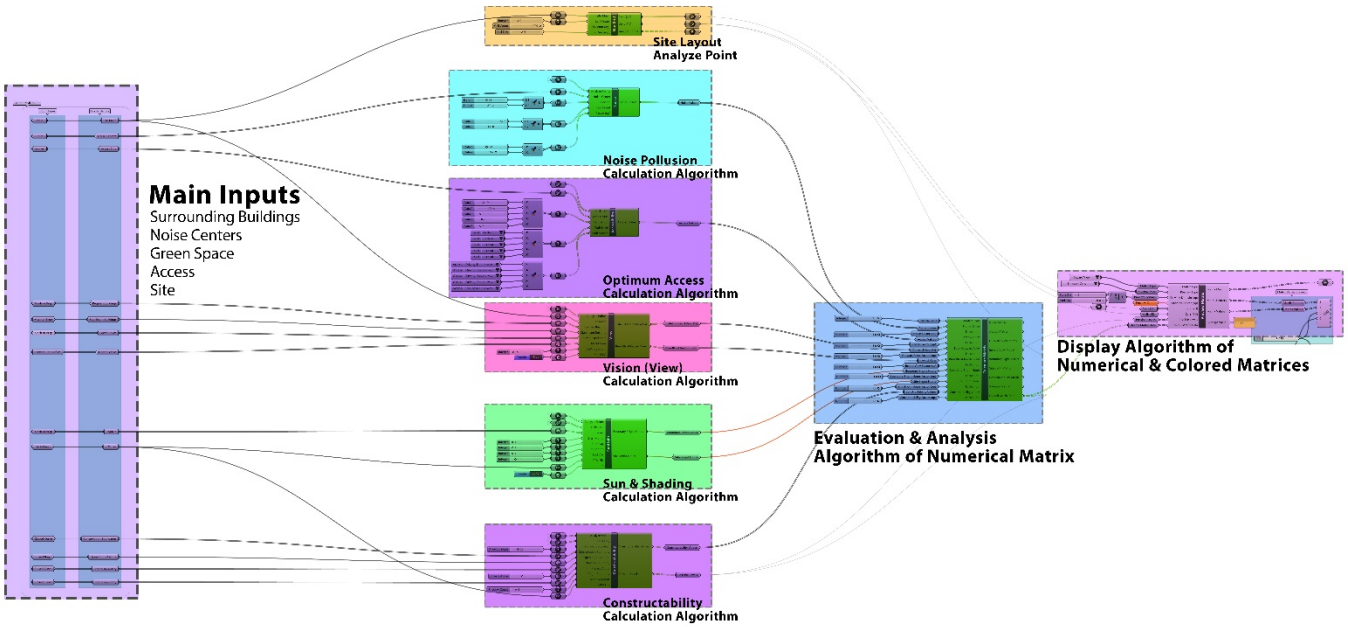

Fig. 12. An overview of the site analysis algorithm using EIA.

5. Conclusion:

Based on what we reviewed in this study, site analysis in the process of architectural design is investigated according to many factors. And in order to achieve them, we need a complete evaluation system and an accurate understanding of that system. Also, because it is essential to be familiar and have complete knowledge of digital tools in order to succeed in the process of architectural design and correct utilization of software in this process, there is a need for an organized standard based on which this process can be controlled and organized. In this way, recognizing the problem of design, evaluation system and selected software, as well as their characteristics and methods of application is essential. In order to succeed in the architectural design process in the present era, site analysis and design context must be placed in a creative, dynamic and evaluated process, and their constructive and effective activities in the creative growth of other phases of design and idea generation in design should be taken advantage of. In this case, the high capability of digital software is one of the important and motivating factors for architects and the architect can breed creativity in the right direction by being aware of the design problem and design tools, and achieve a completely scientific and logical result in solving the design problem.

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Footnotes:

[1]Environmental Impact Assessment