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Analysis Algorithm of Architectural Projects a Method for Architectural Reverse Engineering in Design Education

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Abstract: Considering and analyzing the ideas used in the earlier architectural designed projects is a considerable help for designers in the process of designing new buildings. Before starting design process, most architecture students do not come to a deep understanding on the works of the earlier architects and they just consider taking an overall look of books, magazines and websites would be sufficient. The present paper aims at presenting an algorithm of analysis of architectural buildings to recognize principles of designing and constructing in which reverse engineering idea has been applied. The method is based upon conducting qualitative interviews with the architectures that were experienced in professional activity and design teaching. The theoretical method of the research is based on reverse engineering and algorithms concepts and theories. The results of the research show that method of algorithm of analysis can be useful for three fields. First, in architecture design process that can be used by architecture students and professional designers. This is achieved through training and mental experience of principles of design processes in exquisite works of architecture. Second, it provides the essence for critics in order to do not suffice to a general look of architectural works and discuss further parameters in their reviews. Third, it facilities categorization of architectural works and the technologies used in them for further research about them.

Key words: Design process · Analysis of architectural works · Analysis algorithm · Architectural reverse engineering · Design education

INTRODUCTION

Assuming that a successful design requires an architectural look and study on various constructed architectural projects, architectural reverse engineering aims at achieving the most essential principles, which are applied in design of different projects. Architecture is a combination of art and technology whose artistic aspect should be experienced and its scientific aspect should be learned. Art and science should be matched for satisfying the needs of the users. Though artistic experience looks quite spontaneous at the first sight, an artist undergoes a wealth of mental experiences while attempting to create a work. On the way to create an artistic phenomenon, such as scientific works, an artist create his/her art by looking, studying, experiencing environment and earlier prominent works and analyzing into his/her subconscious and right and left brain hemispheres concurrent with brainstorms. Due to the presence of elements, techniques, concepts and special ideas that most artists pay attention to unconsciously and use them in their work, each artistic work is prominent similar to any other phenomenon. Studying the used phenomena and patterns regularly and systematically and finally using them in designing new phenomena lead to experiencing a created mind and improve results and effectiveness of a phenomenon. Such an issue is of paramount importance in architecture, which accompanies technology. Reverse engineering is a method that has already been focused on to achieve the patterns and techniques used in technologies. It has also brought about a wealth of positive results. Applying this method to study architecture of buildings leads to discovering the most important ideas and techniques used in prominent historical and modern architectural

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structures and using one or some of them together with improvement of architect's creativity in creating new works.

Architectural reverse engineering of a building does not mean copying it. However, a student receives comprehensive information of that building using correct use of reverse engineering. He / She will also be able to design a work similar to it or create changes in it by changing parameters. All these abilities provide him/her with some valuable mental experiences. After discussing the definitions available in reverse engineering, we study their application in architectural design.

Clark [1] has focused on a way of thinking about architecture that emphasizes what is in essence the same, rather than different. While architecture embodies many realms, the authors concentrate on built form. They made no attempt to discuss the social, political, economic, or technical aspects of architecture. The book includes analytic diagrams and formative ideas of contemporary designed architectural buildings. For every building, they have analyzed geometry, natural light, circulation, symmetry and so on by using simplified sketches. Unwin [2] in analyzing architecture has discussed the key elements of architecture and conceptual themes apparent in buildings. He describes ideas for use in active process of design breaking down the grammar of architecture into themes and moves.

The majority of books and studies concerning this field did not discuss construction process of buildings and their relationships with cities. Also they do not propose an organized method for analyzing buildings. Including many parameters in the analysis of an architectural work usually leads students to ambiguity and bewilderment. Therefore, creating an algorithmic and formulated method seems to be necessary for reviewing buildings.

Teaching architectural design in architecture schools is usually performed as sketches based on analysis process of a design subject. In this method, students become familiar with the issue within the form of a physical program and case samples before starting design. The training method of reverse analysis algorithm, which is used prior to design stage and in the phase of preliminary studies, is a method, which has already been used in engineering sciences. However, it has not been used in architecture in a formulated system. this method prepare an algorithm that clarifies buildings analysis instruction, Formulating details of the method have been carried out by the authors according to the practical and effective experiences achieved in architectural design courses.

Definitions of Theoretical Components: Before clarifying the concept of analysis algorithm, it should be defined the concepts and theories that supports the main idea. Then their application in subject will be discussed.

Analysis of Buildings: Analysis is the process of breaking a complex topic or substance into smaller parts to gain a better understanding of it [3]. It is meant deep thinking about an issue to understand it. Analysis of an effect (a building) includes examining mental or sensational aspects of a cause (its creator), which is usually carried out by applying architectural and psychological knowledge. Following issues should be considered while analyzing a building: accurate revision of plans, elevations, sections, openings, site plan, installations problems, form analysis, function, structure, climate, acoustics, topography, analysis of economic, social and cultural factors, historical records, obstacles and legal constraints [4]. Concept of building analysis makes us familiar with the all abstract and concrete components affecting on design process and its outcome as building, also architects attitudes and mentality toward the world and its effect on design.

Reverse Engineering: Reverse engineering (RE) is the process of discovering the technological principles of a device, object, or system through analysis of its structure, function and operation [5]. Analysis of performance, structure and function of designed structures is a type of architectural reverse engineering. In specifying goals, reverse engineering usually discuss applying changes the relevant product as the preliminary objects of reverse engineering.

There are some motivations for reverse engineering including (a) correcting, (b) misplaced documentation, (c) product analysis, (d) competition and (e) learning.. Reverse engineering can be done when documentation of a system for its design, production, operation or maintenance has shortcomings and original designers are not available to improve it. Another reason for using this method is academic/learning purposes. RE for learning purposes may be understand the key issues of an unsuccessful design and subsequently improve the design [6].the motivations b, c and e are the main concerns of this study. Table 1 shows a comparison between components of analysis of building and reverse engineering.

Algorithm: Algorithm is a repeatable process, which leads to a product using raw material and following specific instructions. By paying attention to the definition

Table 1: Studying the relationship between analysis of architectural building and reverse engineering (Authors)

Feature	Analysis of architectural building	Reverse engineering
Topic	Contemplating a topic	Discovery process
Approach	Analysis of work	Analysis of performance and structure
Objective	Discovering causal factors	Creating changes on product
Raw Material	Plan, Elevations, Sections, Openings	Structure
	Form, Function, Structure, Climate	Performance
	Economic, Social, Cultural	Function
Tools	Architecture and psychology knowledge	Knowledge and information

Table 2: Application of algorithm concept and analysis in architectural design (Authors)

Architecture	Concept of Algorithm	Analysis of Algorithm
Process of building analysis	Repeatability	Type of building
Building characteristics	Raw Material	Elements
Physical, Psychological, Aesthetical, Technological	Instruction	Prediction
Design approaches	Product	Understanding of principles

of algorithm term, we realize that the architectural analysis algorithm should have a certain steps and specific order similar to other algorithms. Therefore, the process of architectural design in design courses may have specific steps and orders too [7]. For instance, site plan analysis, urban issues related to the plan, concept, form, etc can be considered as an order pattern in design process. On the other hand, there are some steps, in proportion to the above steps, that are repeated. Analysis of climate in building analysis algorithm is studied once in climate section and another time in form analysis. Here, the effects of climate on design of structure form are analyzed.

Algorithm Analysis: There are generally different methods and algorithms to solve a problem. One algorithm may perform a pertinent action using different instructions in a shorter or longer time and/or using less or more work as compared with other algorithm. Hence, selecting a suitable and an effective algorithm has crucial importance in success and effectiveness of a program. Algorithms are known as a technology and scientists design, analyze and study them. Analysis of algorithms is a field of study that discusses efficiency of algorithms. Analysis of algorithms means prediction of the required sources that are used to implement an algorithm. They show efficiency or complexity of each algorithm by a function in which number of the required steps to execute algorithm is shown in terms of the length of input data [7]. By contemplating the above definitions and comply it with the topic under discussion, we realize that analysis algorithm should lead to an accurate understanding of an architectural building (Table 2).

Prerequisites of Analysis: Analysis of a building requires having comprehensive data about the building. Unfortunately, there are a few references to provide completed and useful information on a project, including preliminary sketches, primary and secondary concepts, theoretical concepts of project, different perspectives, plans, elevations and scaled sections, site plan and even technological issues, heating and cooling installations, etc. In these cases, we have to use different references. Writing books and articles on prominent architectural buildings based on analysis algorithm can be considered as an idea of the result of the present research.

Elements of Architectural Building Analysis: In this article we discuss prerequisites and elements of building analysis, including theoretical principles, concept, studying structures and urban scale, site plan analysis, form analysis, climate, structure, geometry, plan, elevations, space function and architectural standards, materials and architectural elements.

Theoretical Principles of Project: Different architects design with various feelings and attitudes. To start phase one of project, some of them use a philosophical base, as leadership, for decision-making. The theoretical principles and framework of architecture include a set and order of data and concepts that describe and explain architectural phenomenon, including architectural works and written thoughts. It does it for two purposes: 1-Generating a new architecture 2- criticizing the previous and available architecture [8].

An analyzer should first identify the architectural building style accurately, including historical or modern and present the major specifications of the relevant architectural style in a table similar to.

Concept: In a physicalist theory of mind, a concept is a mental representation, which the brain uses to denote a class of things in the world. This is to say that it is

Table 3: Table of conformity of characteristics of building with characteristics of style (Authors)

General Characteristics in that style (style name e.g high-tech, echo tech, classic,..)	Characteristic1	2	3	…	n
Specific characteristic in sample building					

Table 4: Table of analysis of concepts based on elements (Authors)

Concept type	Historical	Cultural	Structural	Natural	Climatic	Others
Concept of analyzed building						

Table 5: Table of analysis of ideas (Authors)

Ideas	Idea 1	Idea 2	Idea 3	Idea 4	….	Idea n
Ideas in analyzed building						

literally, a symbol or group of symbols together made from the physical material of the brain [9, 10]. Concepts are mental representations that allows us to draw appropriate inferences about the type of entities we encounter in our everyday lives [10]. Concept is similar to the core or a plat seed that contains the whole information concerning form features and growth stages of the plant. In architecture ideas are different from concepts. In fact, ideas can be transferred from one project to another; whereas, a concept is exclusively related to a project and it is unique. Orientation of a building, layout of a kitchen in a dwelling unit, methods to use natural airflow and the most suitable method to implement space order are among the ideas whose special usage in a project can be applied in a new project by complying. Formation background of a concept may be historical, cultural and structural or from nature etc. In addition, concept and idea section of a building analysis booklet should elaborate production steps of form and geometry using graphical tools and symbols. Preparing the tables like Table 4 and Table 5 is recommended in analysis of concept and ideas.

Studying buildings at an Urban Scale: Architectural building relations with the city, as a part and subsystem of a city, should not be ignored. It means that the users or owners of a building should not be considered only, but other city dwellers who may be affected by a building should be taken into account as well. Assume that all the buildings of a city are given to competent architects for design and each architect starts designing based on his/her mental ideas and concepts. Although each of these components might have been designed quite ingeniously, the overall components may lead to a shapeless, lack of identity, lack of unity and eligible collection required in an urban environment. Some of the most important issues to be considered in this section include: reviewing fundamental requirements of building, objectivity of a building with respect to urban per capita, building height and its proportion to the width of surrounding passages, studying the effect of building on the traffic of a region, main entrance of a building, how prominent it is and rate of its prominence, proportion of form and color and application of building with the neighboring buildings.

Site Plan Analysis: Apart from having an independent application, as a green space and landscape, a building site has undeniable effects on architecture. The question is how the topography and natural slope of a ground are applied. Has there been a certain idea? The issues to be considered in site analysis include hierarchy, rhythm and repetition, landscape, functions, public and private spaces and services, wind and light direction, positive and negative spaces, balance and symmetry, horizontal and vertical access, dissimilarity, dry and wet spaces, internal and external accesses, audio and visual pollutions, accesses, facade, neighborhoods and development feasibility, level difference and topography, distribution of functions and spaces in a site.

Analysis of Form: Form of a building is the most artistic manifestation of architecture. An architectural building is eventually a physical body and it is not recognized without apparent form. Therefore, although the definitions of architecture and architectural form or shape in architecture are very close, they are not completely overlapped. Hence, the process leading to the creation of form, shape or appearance in architecture is exactly the same [11], In the steps of form analysis, students are recommended to do their best to simplify forms and divide forms into geometrical volumes through manual sketches. This can be done by placing a piece of transparent paper on perspectives, plans and sections. Following items are discussed for a more accurate analysis: The main idea of forms is discussed in the interaction with 1-building function, 2-concept, 3-nature, 4- climate, 5-consumed construction materials, 6- structure (relationship between structure and architecture), 7-symbols and 8-its

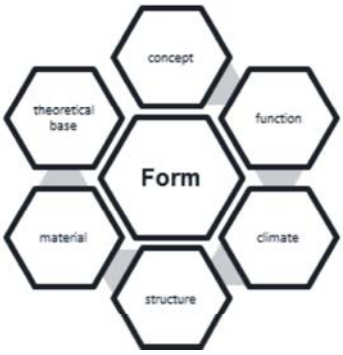

Fig. 1: Some of effective factors on architectural form analysis (authors)

architectural theoretical bases (Figure 1). Each specific form is constructed more conveniently using some special construction materials. It will have special visual effects as well. In different volumes, the proportion of external surface to volume can be used in contact with climatic problems. Sometimes, the main idea is form of structure; sometimes, architectural forms are symbols of a specific method or historical period. Similarity, dissimilarity, coordination of form with surrounding forms at urban or regional scales should be analyzed. To analyze the question whether the main form of a building is a combination of the Platonic volumes, we should study the forms in terms of classifying them into central, linear, radial, collective and network forms[4]. To study thinness of form, proportion of the height of the highest part of a form to floor area should be calculated. In addition, the attached and omitted elements should be studied to reach a favorable form. Studying a form in terms of transparency and solidity, filling and emptying volumes, symmetry and balance, repeated and abstract elements should be considered.

Climate and Architecture: Different features of each climate greatly influence formation of cities and their architectural type. Climatic features should be used for minimizing the usage of mechanical heating and cooling systems in controlling internal spaces of a building [12]. In analyzing climate, answering the following questions can be helpful.

- How effective was climate of the pertinent region in forming the overall form of a building?
- Was climate one part of the main ideas shaping the overall form and concept of building?
- How is the overall orientation of a building in a site in contrast with light-grasping and winds direction?
- How were density, compactness/expansion of a plan and proportion of the external level of a building solved in proportion to its volume in connection with the climate of the region?
- How many openings are there? What are the surface areas of openings of the building in accordance with the climate?
- How is the humidity condition of the ground? How is it solved using architecture?
- How is thermal capacity and durability of the used raw materials in accordance with the architecture?

Study of Structure: Recent advancements in the field of producing raw materials, techniques of construction and methods of structure calculations have created new options in architecture design and developed its domain considerably. These new options do not make modern conditions free from providing fundamental principles that have always formed bases of a favorable architecture [13]. The principles include balance, stability, strength, function, economy and aesthetic. Therefore, we elaborate fundamental principles of structure in analysis algorithm as well. A building analyzer should answer the following questions:

- As each type of structure is more appropriate for specific applications (for instance tent structures for exhibitions), to what extent attentions have been paid to the appropriateness of type of structure to application?
- On what basis have the materials been selected? Selecting structure materials usually corresponds to economic, climatic, firefighting, etc issues. Some special forms of structures can only be constructed by special materials.
- Has the building structure architectural and formal concepts? Is it principally known as an architecture concept?
- Center of gravity of a building should be placed as low as possible. How much this point has been taken into consideration? Therefore, in architecture design, the spaces that impose much live load to the building, like swimming pool, library and conference room should be constructed on low stories.
- What system should structure elements, including foundation, column, beam and ceiling be based upon?
- To what extent are the axes as per construction architecture?

Fig. 2: The relationship between structure and other elements of analysis (Authors)

- How was the relationship between structure and performance considered?
- If a structure has extensive openings, how will cover opening be solved? What are its effects on architecture form?
- Does the overall form of the structure is part of the forms, which resist against earthquake?

Figure 2 shows the relationship between a structure and other effective elements.

Geometry: As a forming idea to determine building form, geometry follows principles of plan and space. Geometry has a single form; however, as a forming idea, it should be for form-related decisions in some surfaces of central design. The major usage of this idea would be the merge of the geometric basic shapes as forms or space to determine the overall composition of a building. Therefore, a building may be circular, square, triangular, hexagonal, octagonal, or any certain geometrical shape. Though the geometrical shape does not integrate all parts of a building, it is necessary for the basic shape to be prominent and tangible [1]. Some of the major points that analyzer should pay attention to them are

- Geometric analysis of plan with different sketches and intersection of volumes and the method to solve them
- Studying geometrical and golden ratios on plans
- Dimensional study of length-to-width ratio and more detailed geometry of the plan, such as geometry, spaces like rooms, corridors, etc
- Dimensional study of elevation, width-to-height ratio, height-to-crossing ratio, etc
- Visual analysis of elevation with sketch, studying combination of geometrical shapes, proportions and scales
- Studying the ratio of overall area of openings of facade to the overall area of facade
- Studying the relationship and geometrical similarities of plan and elevation and section; plan, section and elevation include common conventions for horizontal and vertical images of buildings. The use of a plan or section leads to proving volume understanding. It means that a single line in each of them has a third dimension. Such an interaction and dependency of one to another can be used as a design strategy.

Plan, Elevation, Section, Space Function and Architecture Standards: The most important prerequisites of an architecture plan design include drawing of spaces connections diagram and generating physical program of a project. In architecture reverse engineering, we draw reverse diagram through the designed plan and generate reverse physical program of the project. Considering surface area of each space in square meter and knowing if a surface area is in accordance with architecture standards provides students with very useful practical information on function of spaces, space connection and their standard aspects and empower his/her mind for designing plans. Among other issues that are disregarded in the design process of phase one plans of architecture would be the relationship between furniture and height of spaces interacting with construction, structural and installations issues.

For example, squat pan or toilet seat are placed in a place where there is exactly a structure beam beneath it and the height of false ceiling is determined without paying attention to slope of sewer pipes. Studying the architecture standards of the available plans is also another approach for making students familiar with the international architecture standards and regulations. Other issues to be considered in reverse engineering of architecture plan and elevation are as follows:

- Density (ratio of the sum area of all plans to the total area of land)
- Space per capita (how many square meters of each space are allocated for one person?)
- Ratio of areas of non-useful spaces to the useful spaces
- How to connect and partition internal spaces (solid or transparent partitions, changes on ceiling or floor, etc)
- Circulation

- Height codes of plan, site plan, height between floor and floors of stories and their reasons
- Materials used in internal spaces in proportion to space function
- Materials used for elevation and its reasons (climate, earthquake, etc)
- Coordination of facade with neighboring facades
- Ration of openings areas of facade to the total area of facade

Study of Materials: Aesthetic, proportion, stability and resistance of a building depend on putting materials as per the principles. This is realized as a result of a deep understanding of materials function. Choosing materials is one of the most important and delicate duties of a competent architect. There are many architectural artistic forms that look inelegant (each form looks elegant with a special material), do not possess sufficient stability and durability and eroded over time due to misusing materials [14]. In addition, the material used in buildings is directly related to the function of the designed spaces. The type of the material used inside spaces differs from the one used for building premises and facade. Even the material of different functional spaces differs from one another. The material used for the floors of laboratories with chemical applications should endure such chemical material [15]. The material used in music hall should be capable of absorbing or reflecting sounds [16]. While preparing a comprehensive list for building materials, a building analyzer should answer the following questions:

- How type of the used materials and their colors conform to the overall form and concept of a building?
- How acoustic are the used materials? What is the thermal load capacity of them?
- To what extent was the principle of buildings lightening against earthquake taken into consideration?
- Are façade materials capable of enduring natural rainfalls, changes of temperature and earthquake?
- What percentage of the materials is vernacular? To what extent were the materials conform to the region's climate?

Studying Architectural Elements: There are various sections in studying architectural elements, which are different in terms of compatibility of design and structure. Major elemnts of buildings, including stairs, elevators, openings, ducts and other architecture elements have been specifically been discussed here.

Stairs: Undoubtedly, stairs are of the major and problematic parts of a building in designing plan and constructing a building. Stairs are the vertical connection of spaces; they play crucial roles in making people comfortable, going up and saving life of people in case of fire. One of the pages of analysis algorithm booklet discusses staircases. The following points should be put on the agenda urgently.

- Form of plan of stairs (two-way, three-way, round staircases and other forms) and functional or aesthetic reasons to use these types of staircases
- Calculating area of stairs case space in each plan and ratio of their spaces to plan area
- Tread or riser (stairs convenience formula) and total number of stairs
- Number of stringers at every height level and number of stairs in each stringer and compatibility with standards
- Materials used in structure, stairs finishing and staircase space (in terms of function, erosion, fire, etc)
- Conformity of standards to width of landing, rails height and their quality
- Checking emergency egress stairs according to architectural standards

Elevators: The important questions that should be considered at the time of elevators analysis are as follows:

- How many elevators are there in the building? What is the capacity of each elevator (in terms of number of people)?
- How many stops does it have?
- On what floors does it start and stop?
- How is population analysis of the building on different floors?
- Is it a two-way or a one-way elevator?
- How are its material and transparency condition?
- How wide is the corridor in front of the elevator? What is the ratio of width to depth of the elevator?
- At what height levels is the main traffic located?

Checking Openings, Ducts and Other Architecture Elements: The major points to examine architecture elements are as follows:

- Checking forms and dimensions of the openings and length-to-width ratio at different levels
- Checking executive details of walls and material and the way to use walls as separators and compatibility with building energy regulations

- Checking construction details of roof
- Checking false elements of architecture and decorator
- Checking floors, especially false floors and their heights
- False ceiling, its height, used materials and their building method; checking height of spaces, finished floor and under false ceiling
- Specifying number, area and reverse communicating diagram of the main and secondary ducts (in connection with wet places such as bathrooms, etc)
- Checking installations diagram of ducts with wet spaces
- Checking connections of ducts with installations spaces, etc
- Checking and calculating ratio of ducts area on each floor to plan area
- Checking heating, cooling and electrical installations
- Checking light and water in building and green space
- Smartness of spaces
- Energy in building (noise, thermal and humid insulations)
- Architectural and construction firefighting methods in a building
- Sewage and water drain in building
- Special technologies of execution and special executive problems at the time of construction

CONCLUSION

Building analysis algorithm or architectural reverse engineering is a logical method to understand form, space, architecture, function, materials and even an effective method to select construction methods of building and connections of these elements. The result of analysis algorithm would be a booklet containing 11 subjects, images, sketches, diagrams and related tables. In fact, the booklet is an architectural and technical ID for the analyzed building. By repeating the steps of algorithm for spaces with different (historical and modern) functions, including residential, educational, touristic, spiritual, etc, students will gain a mental image of the process of architecture design. While going through the algorithm steps, they will require study, deep insight to buildings and drawing, all of which would improve their knowledge and artistic and technical creativity. While teaching in architectural design courses, the authors have tested the process and gained positive results that confirm effectiveness of such teaching method. In addition, generating analysis algorithm booklets in a formal and academic manner on prominent buildings will be used

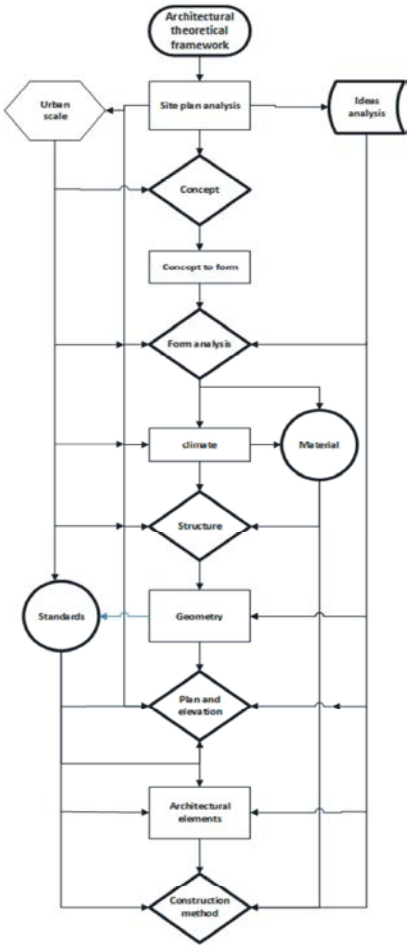

Fig. 3: Analysis algorithm of the building in architectural design (Authors)

appropriately by architecture topologists, critics and all researchers and those who are interested in this field of study. Analysis algorithm booklet is an important document for all prominent historical buildings in every country and causes more elaborated studies for architecture history researchers. This booklet, which is the top works of contemporary architecture, would be a very effective and basic material for architecture critics so that they take an overall look to architecture works and do not think that it would be sufficient to review form, method and culture in their critics [17]. For reviewing all works, it facilitates categorization of architectural works and even the technologies applied in every building. Comparing contemporary and traditional architectural works through their analysis algorithm will lead to discovering vernacular technologies applied in traditional buildings. The diagram of Figure 3 exhibits analysis algorithm of the work in designing architecture.

Table 6: Table of analysis process to reach reverse engineering (Authors)

Building analysis		Process	Elements and Tools	Objective
1	Theoretical Principles	Description and critic of works and thoughts	An order of data and concepts	Generating new architecture
2	Concept	Analysis of interacting effects of tools and project elements	History, culture, climate, aesthetic, structural, etc	Generating form and function
3	Urban Scale	Studying fundamental interactions of building at urban scale	per capita Proportion and coordination with environment, inputs, etc	An identified, unified and qualified collection in environment
4	Site	Analysis of landscape, environment and interactive effects with project	Topography and natural slope of ground	Using site potential in concept
5	Form	Analysis and creation with repetition of steps	Sketch and prototype	Set of form analysis in proportion to preliminary concept
6	Climate	Analysis of positive and negative climatic items	Thermal, humid, rainfall conditions and special factors	Using potential of climate in concept and preventing negative elements
7	Construction	Analysis of construction in proportion to requirements of form and function	New Constructional and technological data in proportion to project objectives	Using the effects of modern technology on concept
8	Geometry	Discovering geometry in proportion to requirements of form and function	Regular and irregular geometrical shapes	Achieving the geometry in proportion to form and function
9	Materials	Analysis of materials in proportion to requirements of plan	Information concerning modern materials in proportion to objectives of project	Using modern materials in proportion to concept conditions
10	Elements	Checking elements conditions in proportion to function and environmental variables	Step, elevator, door, wall, window, floor, ceiling, roof, etc	Correct use of elements to achieve functional objectives
11	Function	Process of analysis of plan, shear, frontage, etc in proportion to the earlier steps	Physical and psychological standards and other standards	Concept-function proportion based on earlier steps

Based on processes, tools and objectives, analysis of architectural works should lead to a product. This is true for all the elements of a work. The elements include theoretical bases, concept, reviewing building at an urban scale, site analysis, form analysis, climate, structure, geometry, plan, facade, section, space function and architectural standards, material and architectural elements, which are shown in Table 6

As the materials and items mentioned in Table 6 and diagram of Figure 3 are parts of an algorithm, we have to follow the algorithm rules, i.e. repetition of steps during design process (according to instructions) to achieve an appropriate product. For future researches, study and organizing of such algorithms with more concentration on space, interaction between spaces and social aspects of architecture. The space syntax theory can be applied in preparing analysis algorithm of spaces or with social aspects.

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