

Persian translation of this paper entitled:

مبانی طراحی پردیس دانشگاهی براساس مطالعات رفتاری، نمونه موردی: دانشگاه صنعتی نوشیروانی  
is also published in this issue of journal.

## Fundamentals of University Campus Design based on Behavioral Studies

### Case Study: Noshirvani University of Technology

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Received: 09/04/2019 ; revised: 02/08/2019 ; accepted: 2019/23/09 ; available online: 21/05/2020

#### Abstract

**Problem statement:** In the evolution of higher education complexes, there has always been a combination of indoor and outdoor spaces, and many examples of this can be seen in Iran, European, American and Asian countries. Research shows that college campuses have a significant impact on creating quality educational environments and can help create a sense of attachment to higher education institutions. However, the design of university campuses in Iran is often based on predetermined designs without considering the behaviors and needs of users of such spaces. Identifying and evaluating students' needs and desires and the reasons for their use / non-use of academic spaces can help create meaningful spaces.

**Research objective:** This study attempts to revise the design of university campuses based on behavioral studies. The case study is the campus of Babol Noshirvani University of Technology. The purpose of this study is to identify the factors that influence campus design and strategic management of the campus in a way that impacts students' use of campus spaces (Noshirvani University of Technology) and increase their desirability for static and social activities.

**Research method:** The selected methodology is qualitative and based on observations and perceptions of behaviors and interviews with students.

**Conclusion:** The results show that the maximum activity occurs in the green spaces and paths between faculties. Quiet spaces are more desirable for activities such as study and concentration. Considering the locations where furniture is installed and designing different types of furniture based on student activities and the climate can increase the desirability and effective use of students in campus open spaces. In this regard, paying attention to the design of the edges can play an effective role in university campuses located in dense urban spaces.

**Keywords:** *Landscape Architecture, University Campuses, Behavioral Studies, Outdoor Design, Babol Noshirvani University of Technology.*

#### Introduction and problem statement

Beyond what is known as the era of university

development in terms of quantity, there is a need for campus and university open space design to be reconsidered in the light of new approaches.

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Campuses can provide a suitable environment for social interaction and improve the quality of students' daily lives and can also promote educational quality (Hanan, 2013; Strange & Banning, 2001). Education is a social activity and takes place in outdoor spaces of the campus as much as indoor spaces. Public spaces on campuses do not have the restrictions of classrooms and students behave much more freely. Outdoor environments that enhance interactions between students in each faculty and different faculties and the amount of exchanged information between students have the potential to maximize the learning process in the formal environment of indoor teaching spaces (Hanan, 2013).

However, the development of open spaces (in universities) is often the responsibility of professionals such as the universities technical offices, and users of these spaces are usually not involved in the planning and design processes. Therefore, decisions related to physical-environmental, functional-behavioral, and aesthetic-visual factors are often the responsibility of the designers of such complexes. The designers of outdoor spaces often design campus spaces with their biased mindset rather than incorporating future users' needs into their design (Abu-Ghazze, 1999). Given the growing number of students in recent years, it is essential to create a vibrant social environment considering the functional-behavioral factors. While planning to make changes or adding elements to the existing spaces on campuses, a thorough evaluation of how the spaces are being used seems necessary. Therefore, students' points of view need to be collected and analyzed so that the patterns of use of open spaces can be better understood (Abu-Ghazze, 1999; Yin, 2003). The researcher intends to answer the fundamental question of how physical design and management strategies of the campus of Noshirvani University of Technology campus can support students' static (sitting and standing) activities and social interactions. The purpose of this study was to evaluate and post-evaluate Noshirvani University of Technology campus as one of the scientific hubs of the country and to provide suggestions for improving the current quality in order to achieve the desired state. Although this research

is a specific case study and the results may not be generalizable to other university campuses located in cities with different climates, the chosen methodology can be applied elsewhere.

## Literature review

In recent years, extensive studies have been conducted on university campuses. Among these are the study of Jordan University's open spaces by Abu-Ghazze. Abu-Ghazze (1999) used a qualitative approach to determine user expectations and patterns of outdoor space use. The researcher examined the physical characteristics of the ten most commonly used types of outdoor space among the interviewees. Findings of this study suggest that spaces between campus buildings are the main spaces for student activities. Aydin & Ter (2008) in their studies on the campus of Seljuk University in Kenya, Turkey, identified two key elements that determine campus quality: (a) physical environment's characteristics (climatic features, location of the plaza, its relation to the surrounding, the relation between pedestrians and cavalcades in terms of accessibility, fixed elements / equipment in place, quality of open spaces, quality of landscapes and how they are maintained) and (b) features of the campus users which include behavioral-functional and visual qualities. Hanan (2013) evaluated the use of different open spaces on the ITB (Bandung Institute of Technology) campus and identified the factors that make meaning in campus open spaces. The results of the study showed that the open spaces along the main axis of the ITB campus have special meanings to students. Open spaces and green spaces between classes also played an important role in shaping students' extracurricular activities and social relationships. In another study by Speake, Edmonson & Nawaz (2013) at Liverpool Hope University, researchers sought to understand how students use the university's green spaces. The findings of the study showed that the green space of the university is welcomed and used by the vast majority of students and is recognized as an important and essential component of campus and the university's image. The aesthetic features of the campus and the design and management of spaces

affect the perception and use of green spaces. Most users preferred elaborated gardens and landscapes over pristine landscapes.

Examples of studies conducted at domestic universities include Gharavi- Al-Khansari's (2008) research. The purpose of this study was to evaluate the quality of the central campus of the University of Tehran and identify its strengths and weaknesses. Evaluation criteria in this study were extracted by examining theories related to university sites, city and urban spaces, and the idea of "university as a city", which is considered to evaluate the criteria of a good urban environment and a good city with the characteristics of academic environments. The result of the evaluation, suggest that the strengths of the campus outnumber the weaknesses, and the existing weaknesses can be remedied by providing solutions such as restoring the track, improving the vitality of the area and the facilities. Similarly, Mohamadzadeh & Rezaie (2017) evaluated the quality of open spaces in the central campus of Tabriz University by studying similar examples, and comparing the similarities of academic sites with urban spaces. In their study, the idea of "university as a city" was evaluated using the Likert scale scoring method. The results of this study indicate that the studied criteria were average at the Tabriz University campus. For example, in the criteria related to accessibility, traffic volumes, weakness of communication networks, lack of firefighting equipment and attention to design standards were identified as major weaknesses, and in the area of vitality, inadequate furniture, lack of social and welfare spaces are among the most identified weaknesses.

A limited number of studies have aimed to improve the quality of university open spaces for student learnability. Among these are "Effects of University Campus Landscapes on Learning Quality of Students" by Sharghi (2011). In His study, which was conducted on the campus of Shahid Rajaee University, Sharghi investigated those elements that enhance landscape design education and its management based Kaplan's Attention Restoration Theory in order to increase the educational quality of campus open spaces. The research findings showed that the designed spaces in the university have a better quality than the non-designed

spaces. Zarghami & Azemati (2013) studied the desirability of open spaces of academic environments for students. They identified the multi-functionality and variability of the space, the expansiveness of the green space, its possibility for socialization, the meaningfulness of the environment, the educability of the green spaces and the sense of place as the main factors related to the desirability of green spaces from a user's perspective. Despite valuable research on the impact of university campuses on the quality of education, there has been limited research on improving the quality of campus design based environment-behavior research using organized behavioral mapping.

### **Babol Noshirvani University of Technology**

Babol Noshirvani University of Technology or Babol University of Technology is one of the state science and engineering universities affiliated to the Ministry of Science of Iran located in Babol, Mazandaran Province. The university was founded in 1969 by the living memory of late Seyyed Hossein Fallah Noshirvani with donation of 16 hectares of land and eleven thousand square meters of educational space. The university currently has five faculties, namely the School of Electrical and Computer Engineering, the Faculty of Civil Engineering, the Faculty of Mechanical Engineering, the Faculty of Chemical Engineering and the Faculty of Basic Sciences. The University has more than 200 faculty members and about 6,000 students, with a quarter of them graduate-students and the rest undergraduates. The University is accessible via a main entrance and a number of secondary entrances. The main entrance is dedicated to pedestrians (students) between early hours of the morning up to 5 p.m. and is separated from the cab entrance. Also, the student's main commuting routes are separated by barriers from the car commuting area (Fig. 1).

### **Theoretical framework**

The theoretical framework of this study is based on the field of Environment-Behavior Studies (EBS) and three theories; Barker's theory of "behavior settings", Gibson's theory of "environmental affordances", and Canter's theory of "place". Barker's theory of

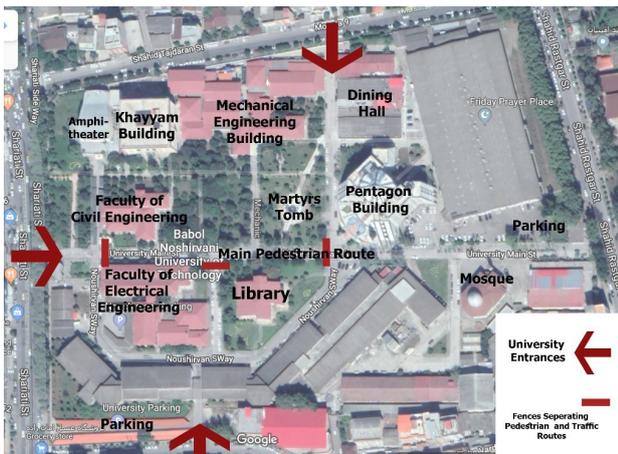


Fig. 1. Babol Noshirvani University of Technology's Site Plan: Source: www.maps.google.com

behavioral environment, examines human behavior in relation to its physical setting [a milieu] (Barker, 1968). Perception is defined as the process of acquiring awareness and understanding sensory information, a combination of the content of a scene and the quick unconscious assessment of what can be done in the environment (Kaplan & Kaplan, 1989). Gibson's (2015) theory of environmental affordances proposes that the physical properties of a setting hold a set of affordances for activities and aesthetic experiences of the potential users (Lang, 1987). Gibson (2015) suggested that individuals identify opportunities for their activities in the environment by observing the affordances of each object in the environment or the environment itself. According to Gibson's theory of affordability, the environment that is preferred to other environments must fulfill the tasks that are important and meaningful to the individual. Another important theory is Canter's (1977) theory of place, which suggests that a setting is understood as an arrangement of its physical characteristics, the activities performed within it, and their associated meanings (Hashemnezhad, Heidari, & Mohammad Hoseini, 2013). This concept also implies that a similar physical environment might act as a series of behavioral settings including type of activities and behavior that occur within it at different periods of time (Lang, 1987). Meeting user needs is considered as one of the key elements in open space design. Attention to user needs is often seen as an urgent need before addressing issues such as budget, form, and

aesthetics (Francis, 2003). "User needs are defined as those features and experiences that people seek to use in the public space" (Francis, 2003: 4). Carr, Francis, Rivlin & Stone (1992) identified human needs in public spaces under the themes of "comfort", "relaxation", "passive participation", "active participation" and "discovery". Academic open spaces are very similar to urban open spaces in terms of buildings, open spaces and pathways. The success of a public open space depends on its use, and the popularity and use of a space largely depends on its location and design details (Cooper Marcus & Francis, 1998). Studies of public spaces indicate that an important first step in designing new open spaces is to identify efficient and inefficient factors in existing designs (Abu-Ghazze, 1999; Carr et al., 1992; Salama, 2008). In many new designs, it is not possible to provide functional solutions due to insufficient time to consider user needs. Such as any other public open spaces, campuses need to be designed and managed in order to meet the needs of their users. Hanan (2013) suggested that the first step in designing college campuses is to provide a place that is meaningful and responsive to needs such as comfort, relaxation and social interactions. Sense of comfort is one of the basic needs of human and is divided into physical, environmental, social and psychological comfort. Sense of comfort relates to a wide range of factors, from a sense of safety to familiarity and a sense of belonging to the environment, climate conditions, and other physical, environmental, psychological and social characteristics. Gehl (2011) divided activities in public spaces into three compulsory, optional, and social categories. In contrast to compulsory activities that are rarely influenced by the environment, optional activities take place when the time and place provide the setting for their occurrence. Social activities also depend on the presence of others in public spaces. The environmental quality of college campuses can greatly influence optional and social activities. In this regard Abu-Ghazze (1999) divided factors affecting the environmental quality of university campuses into three main categories: physical and environmental quality, which include the natural characteristics of the environment, functional and behavioral qualities

that include interactions between human behavior and the physical environment. These include the comfort of sitting areas, the availability of amenities such as food and drinks, and the degree that a space interacts with its adjacent buildings. The third category is visual and aesthetic qualities that constitute visual preferences based on visual emotions. Abu-Gazze's findings suggested that enhancing each of these qualities can lead to increased outdoor social interaction, and designers should consider these factors in design.

### Methodology

Behavioral mapping was developed by Ittelson et al. (1970). This tool was used to record field observations. Its purpose was to record behaviors that occur in space at a given time. This method links the design elements of the environment and behaviors in time and place. This method is usually applicable in small-scale environments that allow for easy viewing. The following are essential in conducting behavioral mappings: Having a scaled map of the area that will be observed, determining the behaviors to be studied, setting a schedule for observations, and defining the system in which the behaviors are to be observed (Bechtel & Zeisel, 1987). To conduct behavioral mapping, the campus was divided into small sections that could be easily seen by a person. This division (for behavioral mapping) was often made possible by the site's lines such as the courts and gardens. Architecture students were asked to select a part of the area for viewing as a group and were given a scaled map of the space. To give students more insight into the process of mapping activities, a detailed explanation was given to them. Students were asked to identify those who are involved in a static activity and to label the gender and type of activity they are involved in (sitting, standing, talking, eating, reading, talking on the cell phone and etc.) and mark where the activity took place. Field observations were conducted four days in two consecutive terms (fall and spring of 2018 and 2019) on the days of classes (Saturday to Wednesday) between 8am and 6pm (every hour). Each group of students recorded (part of the) static activities while walking around the campus spaces every hour. Field studies

were conducted only on non-rainy days and in sunny or cloudy conditions. Meanwhile, 122 students from different major of study were interviewed. Interviewees were selected randomly from students from different major of study when using open or closed campus spaces. Students were asked how often they use the university campus for social activities and for how long do they stay each time, whether they come individually or in groups, and which part of the environment they choose for their (individual and group) activities. They were also queried their reasons for choosing those spaces. Campus features that were either desirable or undesirable for individual and social activities were also questioned. Interviewees were asked to make suggestions for improving the campus environment, in order to make more use of it, and to provide an appropriate environment for social interaction (Fig. 2).

### Data analysis

Information about students including their gender and the type of activity they were enrolled in was recorded into AutoCAD maps. Each activity was recorded individually in a single layer so that the relationship between the type of activity and the location of the activity could be analyzed by switching the layers on and off. The recorded information such as the number of activities and the type of activity in each of the selected areas indicate the extent to which the environment supports the specific activity. At the same time, the physical characteristics of each space that were dependent to their use were documented. These included: the location of the studied area (in relation to each school's buildings, Education sector's building, dining hall, the mosque and the library / the main route or secondary routes and traffic path), the amount and type of green spaces, benches, shading, visual access, and privacy (Fig. 3).

The responses recorded in the interviews were coded and categorized under (the factors influencing) the theoretical framework of the research. Frequency and repetition of specific topics in the answers to each question indicated the importance of that topic in students' minds. While the behavioral observations indicated the location of the activities, the interviews

were used as a tool to complete the observations. Interviews indicated factors influencing students' choice of places and reasons for not choosing less used spaces. Interviews also helped to understand the needs of students better and led to the identification of the current shortcomings.

### Results

The behavioral mapping recorded 1337 male students and 1144 female students in the spring. Similarly, 1123 male students and 998 female students were recorded in the fall. The main recorded activities included: standing, sitting, talking, using a cellphone, and fewer student were recorded while eating, reading

and mapping (surveying students). Most activities were recorded during student free time (rest-time) at noon and between classes. One the strengths and interesting points about the University campus is the separation of the main pedestrian routes and entrances via the car dominated areas and the southern entrance mainly used by vehicles. The access between most educational and non-educational spaces is through the main pedestrian and secondary axes, often surrounded by trees and green areas.

122 students (74 girls and 58 boys) participated in the interview. The majority of students were fairly positive about the campus environment. Students' satisfaction with campus open spaces averaged 6.9 out of 10. It

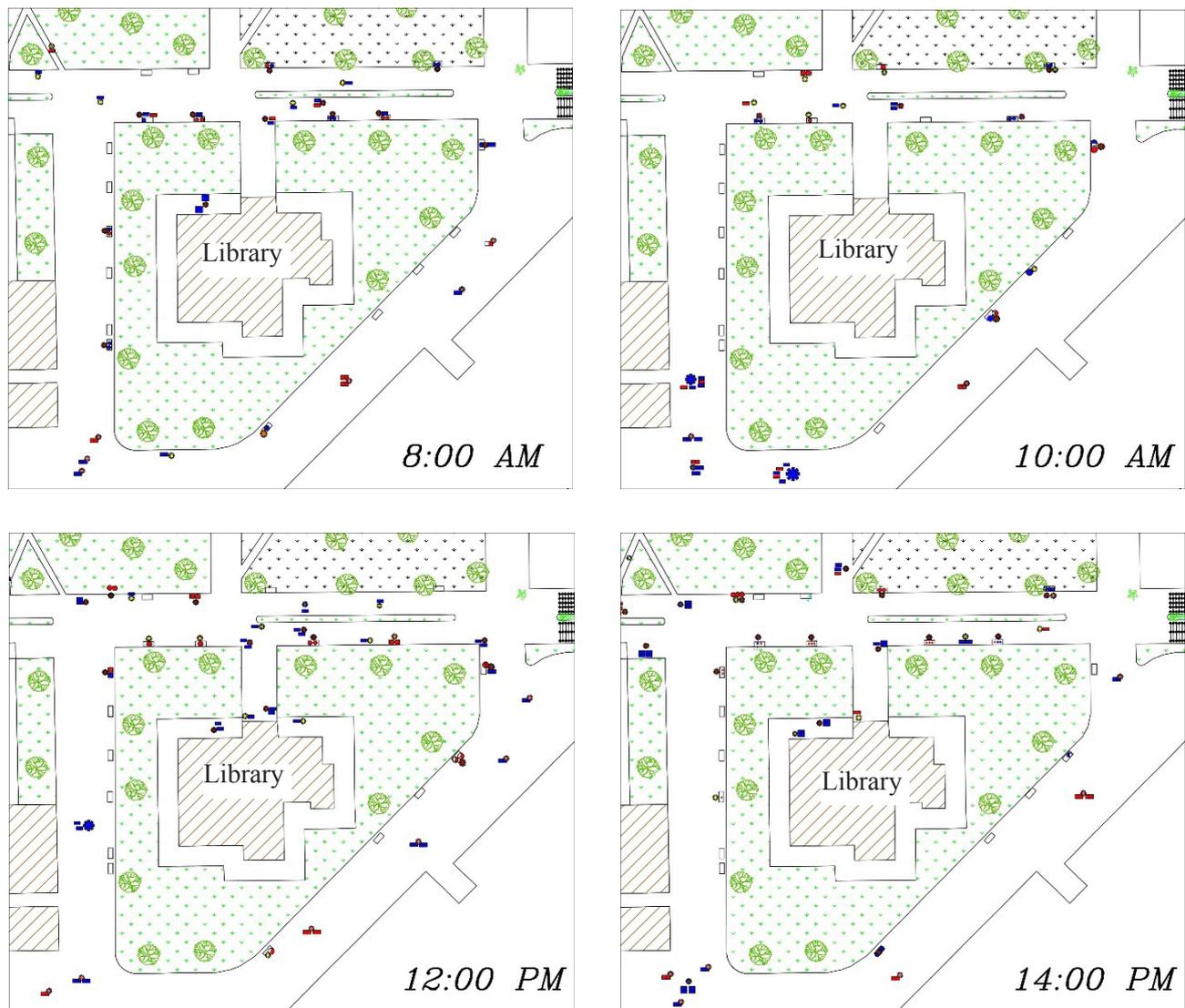


Fig. 2. Behavioral mapping of the area around the library including the main path and the Southern Street at even times of the day (Spring). Source: author.

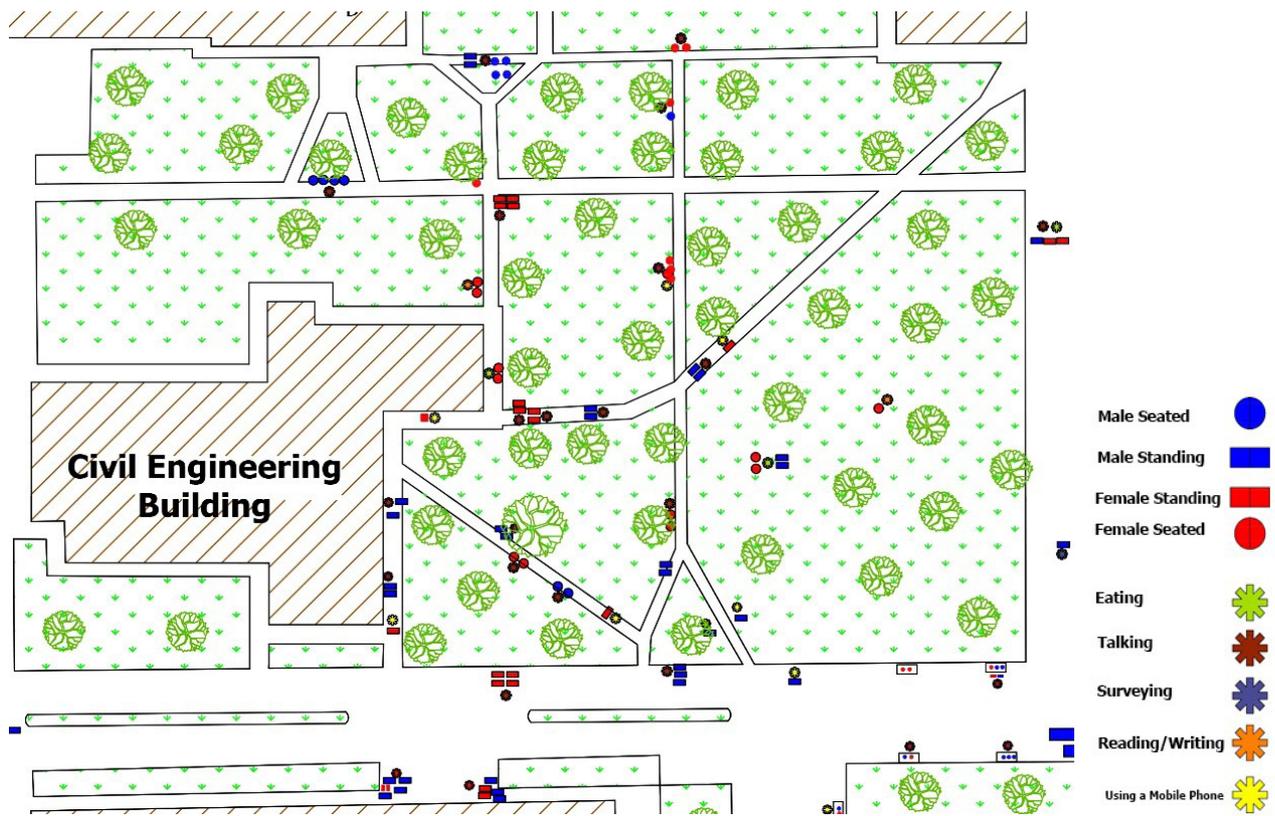


Fig.3 . Student activities recorded at 3 pm (autumn) on routes and green spaces around the Faculty of Civil Engineering’s building. Source: author.

shows the university’s relatively successful efforts in the separation between car and pedestrian spaces, the extent of the university’s open spaces and the amount of green spaces and vegetation inside them and their maintenance. The presence of numerous green spaces and the abundance of trees in the grassy spaces between colleges has been cited as the main positive point of the campus. The type of vegetation, which is mainly fruit trees (tangerines), oranges and pine is welcomed by students. According to some students, the presence of orange and tangerine trees in the open-air campus and their crop in the fall creates group activities and therefore create vitality. Suggestions were also made by students about planting a variety of fruit trees and seasonal and flowering plants. Data analysis (observation and interviews) show that most students frequent the campus to spend their leisure time. More and more students were observed in groups, than alone. Most groups have a population of three to five members, and a smaller number of groups have two and six members. However, the number of

benches installed in the area did not meet the needs of the groups, and students in groups of three and more use the grass in between the colleges (if not wet) and the edges of the routes between the colleges for leisure and social interaction. The reasons that these spaces are favored by students are the presence of green and wooded areas, shading, their proximity to classrooms and providing wide views, which allows students to monitor the main routes and the complex. “Since vision is one of the most important tools for human beings to get information of the environment, wherever this feeling does not work well, other activities decrease dramatically. This is why people do not show tendency to go to places above or higher than their vision. They do not tend to sit where one cannot see the surroundings properly” (Pakzad, 2017). As a result, spaces behind the colleges are less used for group activities (except during exam times and because of the need for quiet space). Contrary to the frequency of outdoor use in the front spaces of colleges, only a few number of activities occur in spaces behind the college

buildings or car-dominated spaces, used by staff (routes and parking). Although a number of benches have been installed alongside the main car route and in the parking lots, they are less frequented by students (12%) due to the presence of cars and their traffic as well as the perceived distance to college buildings (Fig. 4).

Student use of campus open spaces is highly dependent on weather conditions. 93% of the students mentioned this in the interview. Most students stated that they did not use outdoor space on rainy days due to the lack of sheltered and semi-open spaces on campus and instead spend their leisure time in their classroom and the university's dining hall. Adding semi-open spaces such as pavilions to the campus was one of the main suggestions by most students. Also, the grass areas between the courts have relatively good vegetation cover and shade in warm seasons. These spaces are highly used by students in the spring. On the contrary, benches that have been installed in paths that lack vegetation and shade, make them less usable on sunny and warm days. Another interesting point is the difference between the locations selected for activities in hot and cold seasons and how they change in relation to the shade and sunny spots. Findings indicate that most students sat in the shade of trees in hot spring hours and in the afternoon hours, while sitting in shady spots in autumn was less important. The Mediterranean climate of Northern Iran and its heavy rains during the fall, spring and winter seasons, makes the grass surfaces often wet and unusable for several days after rain, greatly affecting students' tendency to use them (Fig. 5).

Incorporating spaces for group study in the exam season was also among the students' demands. In general, the university campus is not a designated place for students to study freely.

However, many students use routes with less pedestrian traffic, corners, and faculty backyards to study and review textbooks during the exam seasons. For example, the open space around the library is favored for activities such as reading because it has less pedestrian traffic. In this regard, students have made suggestions to improve the Library's environment for their desired activities. For example, Somayeh, a female student in the field of Industrial Engineering, commented:

"In the backyard of the library, there is only a grass covered area. A number of covered desks and benches can be installed within the area so that students can study while using the open space."

In addition, some students emphasized the need to increase the visual and spatial connectivity of the library, dining hall and buffet building with open spaces around it. For example; by using transparent and permeable walls and integrating those buildings with semi-open and green spaces one can add to the vibrancy of the campus. Hadi, a Civil Engineering student, believes that by adding tables and chairs and planting trees in front of the dining hall, it can be improved. A high percentage of interviewees (80%) considered lack of adequate seating as the biggest weakness of the campus. In their viewpoint, the number of benches installed in the open spaces of the campus did not meet students' needs and many students emphasized the need to increase the number of seating.

Some students believe that replacing the old concrete and brick benches that are placed individually along the main and secondary paths and have a linear arrangement could improve campus open spaces.

A few numbers of students stated that the form of the benches (without backrest) allows them to sit in two different directions (facing main paths or green courts). However, numerous students proposed the need for installing different types of furniture in the campus, especially benches with backrest and tables, which students can use to study and eat. The type of materials and design of furniture were also among the items that some interviewees (15%) found to be in need of modification. Observations show that existing benches do not meet the needs of larger groups (groups with more than three members) and that some members of the groups are forced to stand up for better interaction. Even in areas where special arrangement makes it possible for students to face each other, the long distance and the paths crossing between them reduces the quality of social interactions (Figs. 6 & 7).

## Conclusion

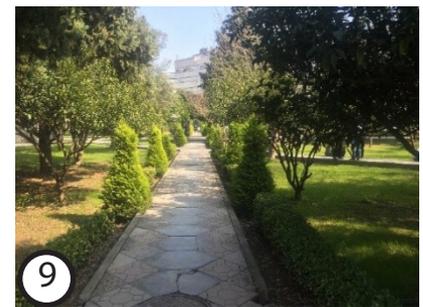
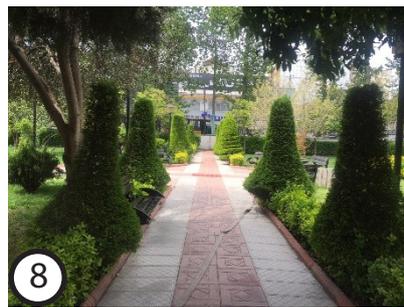
College campuses have a significant impact on creating quality educational environments and



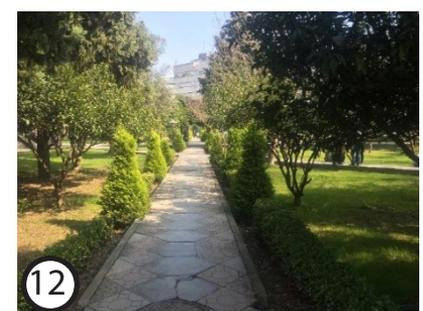
The green spaces in front of the Building of School of Civil Engineering play a significant role in students' group activities.



The edges provide a suitable setting for social interaction.



Arrangement of vegetation and planting along the edges may limit student's use of them.



Students use the edge of the gardens in front of the Khayyam building to sit and talk.

Fig. 4. Landscape images of Noshirvani University of Technology. Photo: Maryam Lesan, 2019.

can help to create a sense of belonging for higher education institutions. These spaces are the basis of students' social interactions and can help enhance the learning process in the classroom. The campus of Noshirvani University of Technology has unique and positive characteristics that affect students'

daily use of campus spaces and their degree of social interaction. By recognizing, preserving and enhancing them and by addressing and removing the deficiencies within, one can add to the richness of the complex (as a context for static and social activities). The main advantages of the campus include



Benches on routes without shade of trees are less welcomed by students on hot, sunny days. In contrast, benches under the shade of trees and naturalistic and shady paths are favored by students in summer.



Heavy rains and flooded courts between college buildings make them unusable on many days of the year.

Fig. 5. Landscape images of Noshirvani University of Technology. Photo: Maryam Lesan, 2019.

the relative separation of car and pedestrian routes, good accessibility, and the existence of green spaces and trees between colleges. The main disadvantages of the complex include lack of space for individual and group study on site, lack of adequate number of benches, furniture selection and arrangement without considering behavioral patterns of the users, and lack of attention to climate in designing the campus and their buildings. In this regard, the following measures are necessary: Some sections of traffic routes and parking lots can be allocated to pedestrian spaces used by students. It is also important to consider the location of benches on the site. Benches places in parking lots create a less favorable place for students and are less used. Therefore, these benches can be moved to more active sections of the site. It is also necessary to allocate spaces for students to study on campus open spaces. For example, the path to the library can be considered as an outdoor study area and tables and benches could be added. Considering new places on the campus where furniture could be installed is only possible in limited spaces in the current situation. This is due to keeping appropriate

distance between benches (privacy). Therefore, in order to increase seating spaces, it is necessary to pay attention to the architecture of the edges and to increase the width of the paths and to separate movement spaces from seating areas by changing the materials or design patterns. In this regard, increasing the width of the paths (routes) can create more comfort and safety for people sitting on the edges of the paths. In addition, the arrangement of furniture and benches in some places must be changed in order to accommodate social interactions of groups of three or more. For this purpose, using parallel or L-like forms can be effective. Lastly, it is necessary to consider the climate and rainfalls in designing activity focal points. Adding porches or lounges in front of campus buildings or on top of benches and seating allows for outdoor use in different climates. In addition to the functionality of the complex, paying attention to the visual beauty of the campus and the views and sights at activity focal points (sitting and standing) can have a positive impact on increasing social activities. In this regard, the campus could benefit from vegetation planting design using a variety of plants.



The selection of furniture is often singular and they have linear arrangements. This type of furniture does not allow larger groups to socialize easily while sitting. Even where a particular layout allows students to face each other, the long distance and crossing paths between the furniture reduces the quality of social interactions



Fig. 6. Landscape images of Noshirvani University of Technology. Photo: Maryam Lesan, 2019.

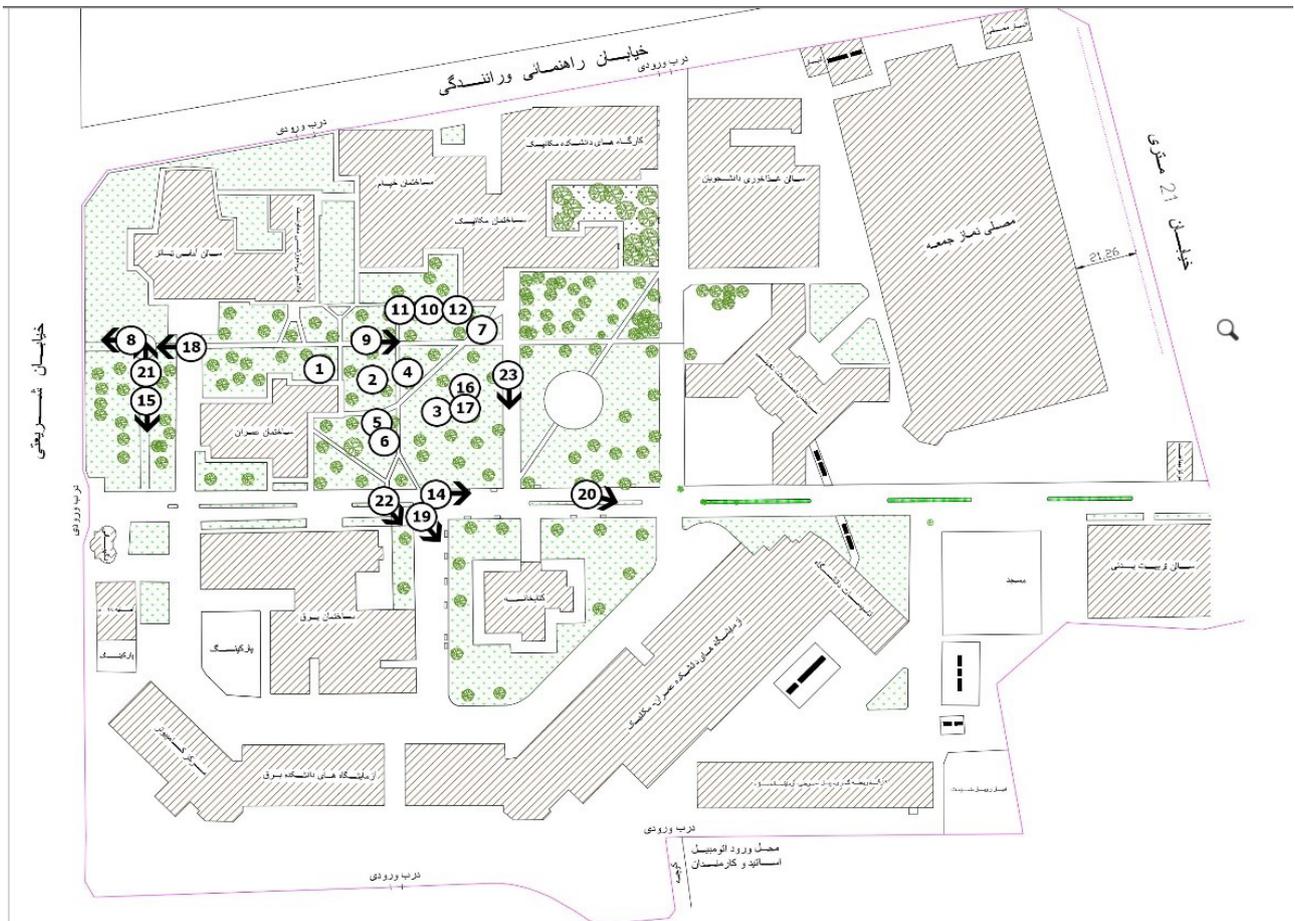


Fig. 7. A guide for landscape images of Babol Noshirvani University of Technology. Source: author.

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### HOW TO CITE THIS ARTICLE

Lasan, M. (2020). Fundamentals of University Campus Design based on Behavioral Studies, Case Study: Noshirvani University of Technology. *Bagh-e Nazar*, 17(84), 45-56.

DOI: DOI: 10.22034/bagh.2020.178167.4059

URL: [http://www.bagh-sj.com/article\\_104437.html](http://www.bagh-sj.com/article_104437.html)

