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Research Article

A Research on Architects' Comfort Conditions in Working Enviroments

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ABSTRACT

Architects have difficult working conditions due to the profession of architecture and they stay in the working environment during intensive working hours. For this reason, it is important to improve the comfort conditions in the working environment for architects to feel physically and psychologically better. The aim of this study is to evaluate the comfort conditions in the working environment of architects working in Bursa. In the literature, the number of studies examining the physical comfort conditions of architects in the work environment is limited. Therefore, this study is important in terms of explaining the comfort conditions of architects in their working environment. In this direction, 203 architects were reached and a questionnaire was used as a data collection method. The questionnaire consists of 2 stages. The first phase includes demographic characteristics and the second phases includes questions about comfort conditions. When the comfort conditions of the architects were examined; it was seen that they were satisfied with the sub-factors of artificial lighting, indoor temperature and natural ventilation adequacy, indoor air quality, absence of bad odors in the working environment, seat ergonomics, equipment adequacy. However, they feel uncomfortable with the several auditory comfort conditions in the work environment. When the correlation between demographic characteristics and comfort conditions in the working environment is examined, the correlation coefficients are in the range of 0-0.20, indicating that demographic characteristics have a very weak or no relationship with comfort conditions in the working environment.

1. Introduction

Comfort is the state of achieving the highest level of satisfaction with minimum effort in human conditions. Comfort conditions are the most important factor in ensuring a good quality of life for users. People living in developed countries spend 90% of their time indoors [1]. In order to be physically and mentally healthy and productive, it is essential to provide comfort conditions in indoor environments. There are certain conditions that must be met in indoor environments to ensure comfort conditions. These conditions are thermal, acoustic, visual, indoor air quality and ergonomics [2].

With appropriate environmental conditions, businesses can expect reduced absenteeism, illness allowances and economic benefit complaints. Especially in developed countries, employee costs are higher than building costs [3-6]. There are many studies that examine the physical comfort conditions of the working environment. Gonzales et al. examined the impact of spatial and aesthetic values of office buildings and their surroundings on user satisfaction [7]. Dorgan and Dorgan argued that indoor environmental quality is important because employees are in the office for long periods of time. They found that there is a relationship between the health and productivity of the occupants and the physical quality of the environments [8]. Sunstrom et al. investigated

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the effect of environmental noise on employees' job satisfaction, job performance and environmental satisfaction. They found that user satisfaction decreases when ambient noise increases [9]. Leather et al [10] examined the effects of noise, air quality, temperature and lighting on employee psychology and work stress. Muhic and Butala investigated the effects of heating and air quality on users in an office building.

According to the results, the majority of the users expressed their dissatisfaction with the thermal environment and air quality. They observed that absenteeism was higher in offices with air conditioning [11]. According to Leaman's study, the productivity of users who are not satisfied with the air quality, lighting and noise conditions in offices is also affected [12]. Roelofsen concluded that the thermal environment and air quality are most effective on the productivity of office workers [13]. Whitley et al [14] found that office satisfaction is effective on the productivity of employees. They found a relationship between satisfaction with office conditions and job satisfaction and environmental control.

The profession of architecture is interdisciplinary with various business lines [15]. Architects have very difficult working conditions because of the structure of the architectural profession. Therefore, it is necessary to improve the comfort conditions in the working environment for architects to feel psychologically and physically well and to increase their productivity in the workplace. In this direction, a survey was conducted with 203 architects to measure the comfort conditions in the working environment of architects in Bursa. With this study, it is aimed to determine the comfort conditions of architects in their working environments [16].

2. Literature Review

2.1. Comfort conditions

Comfort can be defined as the feeling of well-being achieved by the possibilities of science and technology. For generations, human beings have made efforts to transform their environment into comfortable environments. However, with the developing environmental conditions and technology, comfort expectations change periodically. There are certain factors to improve comfort conditions in the working environment. These factors are visual, auditory and thermal comfort, indoor air quality and ergonomic conditions [16-17].

2.1.1. Thermal comfort

Thermal comfort can be defined as a sense of psychological and physical comfort in terms of ambient conditions such as temperature, air flow rate and humidity. In order to sustain people's lives in a healthy way, body temperature must be kept at a normal temperature. There are various factors that determine the body's heat balance. These factors are environmental factors, personal factors and heat balance systems. While environmental factors need to be determined from outside, personal factors are determined by the individuals themselves. Environmental factors are temperature, humidity, air flow rate and air quality. Personal factors are body surface area, activity and clothing. Apart from these factors, there are parameters that are difficult to assess. These include national geographical location, body and active structure, age, gender, changes in thermal values, heart rhythm, menstrual cycle, colors used indoors, type of food consumed, air pressure and number of users [18].

There are many studies on thermal comfort. Lan [19] investigated the effects of thermal comfort changes on employees' job performance and emotions. It was observed that employee performance decreased when the environmental temperature was neutral. At high temperatures, participants felt uncomfortable and had to spend more effort to maintain their job performance with negative emotions. In their study, Bajc et al [20] emphasized the importance of proper ventilation during the winter season to achieve a healthy and productive working environment and optimal thermal comfort levels. Wargocki et al [21] found that in conditions of bad indoor environmental quality, employee performance can drop by 100% and cause absenteeism.

2.1.2. Visual comfort

Visual comfort is the provision of visual perception to the satisfaction of the individual. Visual comfort of the users is important in terms of physiological and psychological aspects by increasing the working efficiency, confidence and perception level of the individuals. In order to make visual comfort conditions appropriate in a workplace; first of all, the level of illumination in the environment must be sufficient. The fact that daylight is an unusable light source when it comes directly into the working environment and excessive brightness negatively affects the user's eye comfort.

For this reason, the way the light is received into the space is important. The user's psychological and visual needs are positively met with an appropriate lighting design. Research on users has shown that there are positive effects when sufficient natural lighting is provided in an office environment. These positive effects are; increase in the amount of production in the input, decrease in work accidents, decrease in fatigue-irritability, increase in working speed, decrease in lighting-related costs and increase in academic success rate [2].

Studies have shown that designing for efficient daylighting is one of the most important approaches in high-performance modern buildings [22-23]. In order to get the most out of daylight individually, interior design should ensure the visual comfort of users [24].

2.1.3. Acoustic comfort

Acoustic comfort is defined as the state of being satisfied with the auditory conditions in the environment [1]. Environmental problems have emerged with social change. Noise is one of these problems [25]. Noise can be defined as physiologically undesirable, disturbing, unpleasant and physically irregular sounds [26]. The average acceptable outdoor noise value is determined by WHO as 55 dB(A) decibels. Above this threshold, depending on the function of the environment inside the building, machine and man-made noises occur. The indoor noise level limit values of commercial buildings are shown in Table 1 [27].

Table 1. Indoor noise level limit values of commercial buildings

Usage Area		Closed Window Leq (DBA)	Open Window Leq (DBA)
Commercial buildings	Big Office	45	55
	Meeting rooms	35	45
	Computer rooms or large typewriters	50	60
	Game rooms	60	70
	Private office (hands-on)	45	55
	General office (account, writing departments)	50	60
	Business centers, shops, etc.	60	70
	Commercial storage	60	70
	Restaurants	45	55

Uncomfortable working environment conditions that occur when auditory comfort is not provided can lead to dissatisfaction with the overall workplace environment, loss of production and increased workplace work [28-30].

2.1.4. Indoor air quality

Indoor air quality is defined as air in which pollutants are not at the level of harmful combinations in the air in accordance with the rates determined according to ASHRAE 62-1989 and 2001 standards and 80% or more of the people in the environment are satisfied with the air quality. The quality of the air that people need indoors varies according to the type of use, user density and duration of use. However, the rate of air exchange required depends on the use, outdoor air quality, location of the place, emission levels of harmful and malodorous materials that make up building components and furniture, and the ventilation system used in the building [31]. Among the studies on indoor air quality, Wargocki et al. [32] and Kosonen et al. [4] found that work performance improved with improved air quality.

2.1.5. Ergonomics

Ergonomics is a branch of science that examines the suitability of the working environment for individuals to be productive while working by complying with safety and health conditions at work. While ensuring the organization and design of the working environment according to the individual factor, human-machine-environment harmony is prioritized [33]. In 1949, the word "ergonomics" was first used in England and spread to countries in Europe. In the USA, the word "human engineering" was used as the equivalent of ergonomics [34]. Ergonomic design is a type of design that aims to increase the quality of the product and the efficiency of the work process in the environment formed by the work and the individual. Anthropometric design, one of the ergonomic design methods, is the most widely used method in the field of architecture as it is related to human dimensions and body [35].

In a review of ergonomics-related studies, Rivilis et al [36] found moderate evidence that ergonomic interventions can reduce the number of sick days, workers' compensation demands and musculoskeletal symptoms. Brewer et al [37] found mixed evidence of the impact of office interventions on visual health and musculoskeletal symptoms among computer users.

3. Material and Method

Comfort conditions in the working environment are important for the organization and employees to feel physically and mentally comfortable. Therefore, this study aims to evaluate the impact of comfort conditions in the working environment on architects. Sample of this study consists of architects in different working environments in Bursa, Türkiye. For this study, questionnaire was used as a data collection tool. The questionnaire was applied online and the questionnaire form was created on Google Forms. On the basis of the number of architects working as architects in Bursa, the minimum sample size should be 177 participants. Accordingly, a total of 203 architects, 117 women and 86 men, were reached in Bursa. The sample size is appropriate for the validity and reliability of the study [16]. The evaluation criteria and score ranges of the answers are shown in Table 2.

Table 2. The evaluation criteria and score ranges of the answers

Likert Scale	Options	Ranges	Evaluation Criteria
5	Absolutely agree	4.20-5.00	very high level
4	I agree	3.40-4.19	high level
3	Undecided	2.60-3.39	medium level
2	I do not agree	1.80-2.59	low level
1	I strongly disagree	1.00-1.79	very low level

Table 3. Normality test on survey factors

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Stat.	df	Sig.	Stat.	df	Sig.
Internal satisfaction	.122	203	.003	.939	203	.009
External satisfaction	.126	203	.000	.951	203	.000
Overall satisfaction	.141	203	.000	.912	203	.000
Thermal comfort	.147	203	.000	.952	203	.000
Visual comfort	.225	203	.002	.893	203	.007
Auditory comfort	.146	203	.000	.952	203	.000
Indoor air quality	.182	203	.000	.912	203	.00
Ergonomics	.141	203	.000	.936	203	.000
Economic factors	.138	203	.0015	.942	203	.0027
Psycho-social factors	.108	203	.000	.957	203	.000
Organisational-managerial factors	.146	203	.000	.924	203	.000

Before analyzing the scales, reliability and normality distribution were examined and some tests were conducted. It was aimed to use the correct analysis methods in the analysis of the data. Normality test, kurtosis and skewness coefficient values were used to analyze the

distribution of the data. For the normal distribution of the data, the sig. values of the Kolmogorov-Smirnov and Shapiro-Wilk tests should be > 0.05, and the kurtosis and skewness coefficient values should be between -1.5 and +1.5 [38-39]. However, as a result of the normality tests, the p (asmp. Sig.) values of the scales are <0.05. Skewness and kurtosis coefficients are not between -1.5 and +1.5. As a result of the findings, it was determined that the data distribution was not normal. The normality test is shown in Table 3 below.

SPSS 23.0 program was used to analyze the data obtained from the sample with the questionnaire. Analysis methods such as descriptive statistics, Spearman Correlation analysis and Mann Whitney U test were used to examine the impact of several factors on the samples.

4. Findings

The findings of the study show that architects are satisfied with the comfort conditions of the environment in which they work. In this study, Likert-type 5-point scale was used and overall comfort conditions value was found as 3.40 out of 5. This value is at a high level according to the criteria shown in Table 2. The values of "*visual comfort*", "*indoor air quality*" and "*ergonomics*" which consist of general comfort values were at a high level, while the values of "*thermal comfort*" and "*acoustic comfort*" were at a medium level. Figure 1 shows the average distribution of comfort conditions.

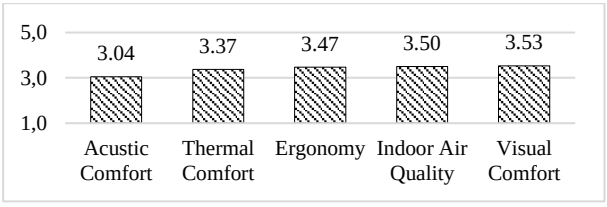

Figure 1. The average distribution of the levels of comfort conditions

When the comfort conditions sub-parameters were analyzed, it was seen that some values were higher than the average value. These values are "indoor temperature" (*thermal comfort)*, "natural lighting" and "artificial lighting"(*visual comfort*), “indoor acoustics”(*acoustic comfort*), "indoor air quality", "natural ventilation" and "absence of bad odors"(*indoor air quality*), "seat ergonomics", "equipment size" and "equipment adequacy" (*ergonomics*). These values are at a high level based on the evaluation criteria in Table 2. The frequencies and percentages of comfort conditions are shown in Table 4.

Table 4. Frequency and percentage of comfort conditions

Parameter		Measures				
		1	**2**	**3**	**4**	**5**
Indoor temperature	Freq.	0	22	14	160	6
	%	0	10.8	6.9	78.8	3
Indoor temperature caused by seasonal temperature changes	Freq	0	78	38	80	6
	%	0	38.4	18.7	39.4	3
Amount of humidity	Freq	0	31	77	92	2
	%	0	15.3	37.9	45.3	1
Natural lighting	Freq	1	34	37	123	7
	%	0.5	16.7	18.2	60.6	3.4
Artificial lighting elements	Freq	0	27	42	125	8
	%	0	13.3	20.7	61.6	3.9
Indoor acoustics	Freq.	1	34	50	113	4
	%	0.5	16.7	24.6	55.7	2
Mechanical systems’ noise	Freq	3	133	30	33	3
	%	1.5	65.5	14.8	16.3	1.5
Outdoor noise	Freq	4	72	51	69	5
	%	2	35.5	25.1	34	2.5
Speech privacy	Freq	0	47	60	90	5
	%	0	23.2	29.6	44.3	2.5
Indoor air quality	Freq	1	26	51	120	4
	%	0.5	12.8	25.1	59.1	2
natural ventilation	Freq.	1	21	29	147	4
	%	0.5	10.3	14.3	72.4	2
Artificial ventilation	Freq.	1	33	55	111	2
	%	0.5	16.3	27.1	54.7	1
Absence of bad odor	Freq	2	26	58	110	6
	%	1	12.8	28.6	54.2	3
Seat ergonomy	Freq	3	33	37	124	5
	%	1.5	16.3	18.2	61.1	2.5
Computer at eye level	Freq	0	44	40	110	6
	%	0	21.7	19.7	54.2	3
equipment’s size	Freq	1	28	39	128	6
	%	0.5	13.8	19.2	63.1	3
Equipment adequacy	Freq.	1	31	42	122	6
	%	0.5	15.3	20.7	60.1	3

When parameters of comfort conditions in the working environment were analyzed, it was found that some values were lower than the average value. These values are "seasonal indoor temperature" and "humidity" (*thermal comfort)*, "outdoor noise" and "speech privacy" (*acoustic comfort*), "artificial ventilation" (*indoor air quality*) and "eye level" (*ergonomics*). These values are medium level according to the criteria in Table 2. The "mechanical system noise value"(*acoustic comfort*) is at low level. Average distributions of comfort conditions sub-parameters are shown in Figure 2.

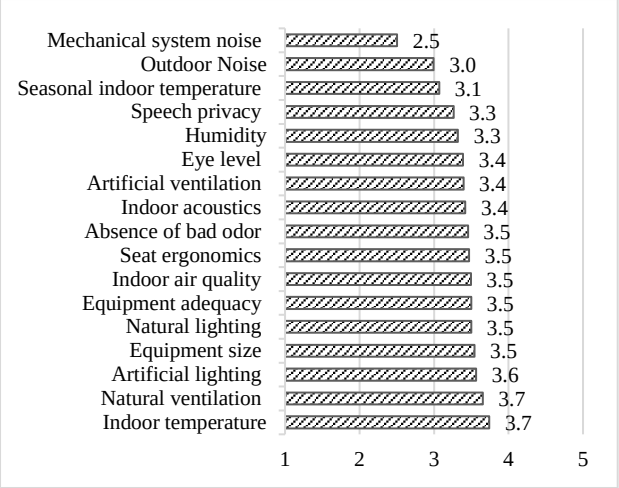

Figure 2. Average distributions of comfort conditions sub-parameters

Based on the findings, architects do not feel comfortable acoustically in the environment where they work. The fact that the acoustic comfort value is low in the research and the values of mechanical system noise and outdoor ambient noise, which are sub-factors of acoustic comfort, have the lowest values is evidence of this fact.

Thermal comfort parameters show that architects are at a medium level about thermal comfort in the working environment. Architects who were satisfied with the indoor temperature were undecided about the seasonal indoor temperature and humidity in their working environment. Especially the values of "seasonal indoor temperature" is remarkable with a value of 3.06 out of 5.

There was a statistically weak correlation between demographic variables (age, professional experience, type of organization, average working hours, working style, working order) and comfort parameters with values between 0-0.39. Thermal comfort level had the strongest statistical correlation with average working hours and the weakest statistical correlation with the number of employees. Auditory comfort level had the strongest statistical correlation with working organization and the weakest statistical correlation with working style. Table 5 shows the correlation analysis between comfort conditions and demographic characteristics.

Table 5. The correlation analysis between comfort conditions and demographic characteristics

Parameter	Avg. working hours	Working order	Working time (year)	Age	Pro. exp.	Way of working	Type of Organization
Thermal Comfort	0.228	-	-	-	-	-	-
Seasonal indoor temperature	0.185	-	-	-	-	-	-
Amount of humidity	-	-	-	-0.184	-0.165	-	-
Acoustic Comfort	-	0.209	-	-	-	-0.076	-
Mechanical system noise	-	0.175	-		-	-	0.208
Ergonomics	-	-	-	-	-	-0.172	-
Equipment size	-	0.162	-		-	-	-
Seating Ergonomics	-	0.181	-	-	-	-	-
Equipment adequacy	0.185	0.154	0.167	0.159	-	-0.187	-

(0.00) - (0.20)= Very weak relationship, (0.21) - (0.40)= Weak relationship, (0.41) - (0.59)= Medium relationship, (0.60) - (0.79)= High relationship, (0.80) - (1.00)= Very high relationship

5. Conclusion

Comfort conditions in the working environment can have positive or negative effects on employees. It is important for the organization and employees to feel physically and mentally comfortable. Companies can expect a reduction in absenteeism, illness permissions and economic benefit complaints when appropriate environmental conditions are provided. Therefore, this study aims to evaluate the impact of comfort conditions on architects. In this study, architects' comfort conditions in the working environment are moderate or high, except for some acoustic comfort parameters.

Working equipment and physical working positions are important for architects, who spend most of the day sitting in front of a computer, to feel physically and mentally well. Everything such as posture, the chair they use, the position of the computer, the arrangement of other work

equipment affects the physical health and productivity of office architects who do not have much mobility during the day. In addition, it is seen that if the indoor air quality in the working environment is not good, fatigue will occur and productivity will decrease. In cases where thermal comfort, visual comfort and acoustic comfort conditions are low, physical and mental health problems of the users can also cause disruptions in their work. Therefore, improving comfort conditions in buildings will make users feel better and be more productive.

Article Information Form

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The Declaration of Research and Publication Ethics
The author of the paper declare that he comply with the scientific, ethical and quotation rules of SAUJS in all processes of the paper and that they do not make any falsification on the data collected. In addition, he declare that Sakarya University Journal of Science and its editorial board have no responsibility for any ethical violations that may be encountered, and that this study has not been evaluated in any academic publication environment other than Sakarya University Journal of Science.

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