

Environmental Satisfaction in Workspaces, a Qualitative Analysis of Employees for Comfort and Efficiency: Case of Nagpur, India

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Abstract: Various features of Built Environment have a strong association with human lives. It is the relationship between the individuals and the environment- how they perceive space and react to it. To achieve a proper interface between humans and built environment the user's physiological, sociological and psychological requirements should be taken care of. The study is focusing on the enquiry how people experience environmental conditions at workplace leading to the factors as comfort and efficiency. The indoor environmental dynamics in workplaces should follow functional as well as behavioural requirements. The paper reports the results from an empirical study of five randomly selected offices from the city of Nagpur, 2nd Capital of state of Maharashtra, India. The paper aims at revealing the association between two functional parameters as spatial and furniture and their behavioural impact on the occupants through a qualitative analysis. The sociological and psychological determinants refer to personal interaction levels, privacy, territoriality, crowding and the occupant's perception leading to set of spatial behavior. This is an emerging issue especially in Indian context and gaining importance as human beings are spending major time almost 60% of the day in working environment. This shall give an insight to designers while planning workspaces in similar conditions.

Index Terms: Sociological, Psychological, Workspace, Privacy, Perception

1. Introduction

Built environment refers to manmade surroundings and it is an established fact that the built environment strongly influences human lives and vice-versa. Human beings show environmental behaviour and attitudes depending on the physical setting wherein they are interacting. A quality space can be perceived, realized, understood ultimately enhancing, or reducing the comfort level of the user of the space [1]. User as human being plays a vital role and reacts in terms of responses to any kind of situation. The domain of study is focusing on the enquiry how people experience environmental conditions at 'workplace' concentrating on the impact factor as comfort and efficiency. To achieve a proper interface between humans and built environment the user's physiological, sociological and psychological requirements should be taken care of [2]. The paper elucidates on the qualitative analysis of the subjective opinions given by users based on their experiences in existing environmental conditions of five selected offices from the city of Nagpur, 2nd Capital of state of Maharashtra, India. The selected office spaces are distributed in various areas of the city as commercial, residential or mixed land use as commercial/residential.

Aim:

'The aim of this research is to investigate the association between user's psychology and behaviour in a particular set up or situation with the spatial conditions ultimately leading to enhancement of comfort and efficiency levels of the users'.

Objectives:

- To explore the functional and aesthetical parameters of built environment as enclosed spaces and their character pertaining to the comfort level of the user.
- To identify sociological, psychological and physiological determinants of human beings leading to functional efficiency and comfort.
- To evaluate user's comfort as a prerequisite for successful, sustainable and an effective impact on efficiency and comfort.

2. Literature Review

The existing literature available in the similar context has emphasized in general upon the fundamentals, theories and science of human behaviour and related themes and parameters. As the study is based on built environment and human behaviour, the research mainly focuses on the subjective responses of the users in given spatial conditions of the selected offices. Functional comfort and psychological comfort criteria as spatial planning and furniture, and their behavioral responses are dealt herewith.

2.1 Human Behaviour

Human behaviour is the population of behaviour exhibited by human beings and influenced by culture, attitude, emotions, values, ethics, authority, rapport, hypnosis and genetics [3]. Human beings perceive and react to a space of where they are a part of. There is essentially a relationship between the individuals and the environment. The environment itself also influences human behaviour. Both mental and physical stimuli affect behavioural responses. Perception of one's environment is affected by sociological needs, psychological state and individual difference. This aspect gets extended by Herzberg who developed a specific content theory of work motivation. On the basis of the study conducted for office workers in 1950, Herzberg came to a conclusion that there are two sets of factors at the work life, one is 'Hygiene Factor' and other called as 'Motivators' [3].

2.2. About the Workspace

Work spaces or office spaces are typically used for conventional office activities such as reading, writing and computer work. The main purpose of an office environment is to support its occupants in performing their job - preferably at minimum cost and to maximum satisfaction. With different people performing different tasks and activities, however, it is not always easy to select the right office spaces. To aid decision-making in workplace and office design, one can distinguish three different types of office spaces: work spaces, meeting spaces and support spaces [4]. The productivity and performance is individual, group or organizational, which leads to positive or negative impact. Positive is imposed speed and accuracy of the task performed [2] Negative is higher error rate, slower time for task completion and adverse effect on health of the workers [2]. Individual performance: Workspace desk, light conditions, variations in temperature and humidity, furniture, ergonomics and acoustics. Group performance: Work group size, proximity of team members shared space, floor layout and furniture, height and density of workspace partition. Organizational performance: Ease of access, common facilities and manageable distances [5].

The environmental aspects of the workspace include ambient conditions. The literature review deals with the major functional comfort criteria objectively and subjectively as spatial planning, furniture and ergonomics [5]. The psychological and behavioral parameters as motivation, job satisfaction and participation are also equally important to achieve desired results. Human responses to built environment as perception and cognition should reflect in spatial planning.

3. Workplace Selection and Sample

As stated the five offices are selected from the city of Nagpur, 2nd Capital of state of Maharashtra, India. Nagpur is centrally located city in the Vidarbha region of Maharashtra state of India. All major highways NH-6 and NH-7 and major railway trunk routes pass through the city. In recent years it has shown tremendous growth in commercial activity resulting in to establishments having their workspaces spread all over the city. A steady development is seen in IT sector and production units [6]. The city of Nagpur has typical seasonal pattern with three distinct seasons as winter, summer and rainy. Nagpur has typical hot and dry climatic conditions. Summers are extremely hot, lasting from March to June. May is the hottest month with the mean daily maximum temperature at 42.7°C (108.8°F) which may even reach up to 48°C [6].

The paper presents an empirical study of architectural including functional and related behavioral parameters of five selected office spaces along with a report of qualitative analysis with similar densities of working population as 0 to 25 no. of occupants using the office space. Five designed workspaces are selected randomly from Nagpur region as a part of administrative offices dealing with paper, coal, IT services and sale and purchase. The study is based on responses of sociological and psychological comfort criteria of the physical conditions present in the selected offices. The impact of functional and behavioral parameters on the performance of the occupants is the topic of study. The detailed evaluation is done related of above mentioned parameters for all the five offices. A general description with existing physical conditions is given in Table 1. The commonalities in the selected five offices are-

- All the selected offices are designed and having frame structure.
- Spatial arrangement: Combination of cabins, cubicles and open workstations (mixed arrangement).
- Furniture and ergonomics: Combination of custom made and modular furniture with adjustable seating arrangement. Material used is reconstituted wood, laminate and glass.
- Lighting condition: Combination of electric and natural lighting (mixed lighting).
- Air and thermal: Combination of natural and air-cooling/air-conditioning (mixed arrangement).
- The interiors are provided with Plaster of Paris (P.O.P.)/Gypsum board false ceiling.
- All the occupants are working on VDT (Visual Display Terminals).
- The floor height of the office spaces is ranging between 3.00mt to 4.00mt.
- The cabins are with glazed partitions, workstations with reconstituted wood.

Sr. No.	Case Study	Orientation	Type	Sample Size	Area of office Sq.Mt.	Overall Density Sq. Mt./person	Ratio of cabins/workstations	Independent building	Floor occupying space in building
1	Jain House(Paper)	North South	- Paper	11	190	15	46%-54%	√	
2	Jain House (Coal)	North South	- Coal	13	190	15	46%-54%	√	
3	I.T. Company	North South	- I.T.	15	160	10	8% - 90%		√
4	Automak	North South	- Manufactory	16	150	9	25% - 75%		√
5	Regards Solutions	East-West	I.T.	24	99	4	4% - 96%		√

Table 1: General Description about Selected Offices

3.2 Case Study I (Jain House Paper)

The office building is located in the eastern part of the city of Nagpur. The structure is an independent ownership building; three storied high “Image 5.1”. The office is occupying entire II floor of the building. The hierarchy is Director, 3 Managers, P.A. to Director, 5 workers and a Peon. Activity spaces in the office are Director’s Cabin, P.A. Cabin, 3 Manager’s Cabin, and 6 workstations, Reception, Meeting Room, Pantry and Toilet (Fig. 1, Image 1).

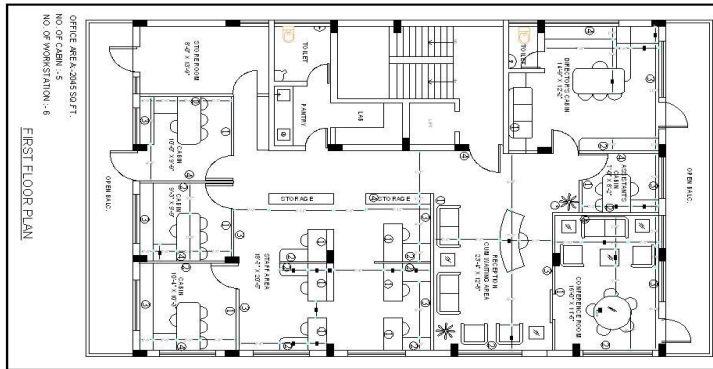


Figure1: Second Floor Plan Case Study II

Image 1: Jain House Paper

3.3 Case Study I (Jain House Coal)

The office is occupying entire III floor of the same as mentioned in case study I. The hierarchy is 3 Directors, 3 Managers, Chief Accountant, 7 Staff and a Peon. Activity spaces in the office are three Director’s Cabins, 3 Manager’s Cabins, and 7 workstations, Reception, Store room, Pantry and Toilet (Fig 2, Image 2).

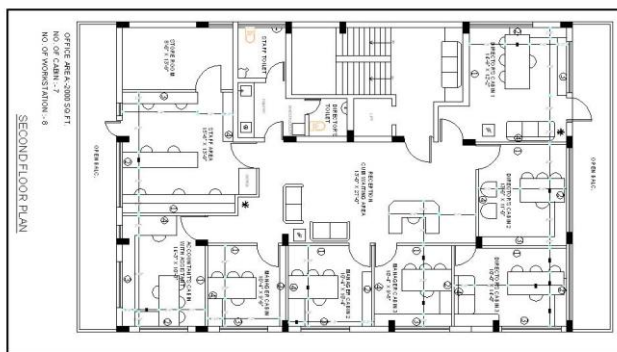


Figure 2: Third Floor Plan Case Study II

Image 2: Account’s Section

3.4 Case Study III (News Bharti)

The selected office is located in Information Technology Park in the western part of city of Nagpur and occupies floor space of a commercial building. The office is occupying a portion of I floor of the building. The hierarchy is 1 Director, 1Marketing Manager, 1 editor, 11 Staff and a Peon. Activity spaces in the office are 1 Director’s Cabin, 1Marketing Manager’s Cabin, and 22 workstations, Conference Room, Network room, Pantry and Toilet (Fig. 3). The office is IT Company which handles Web designing, Maintenance and News related activities.

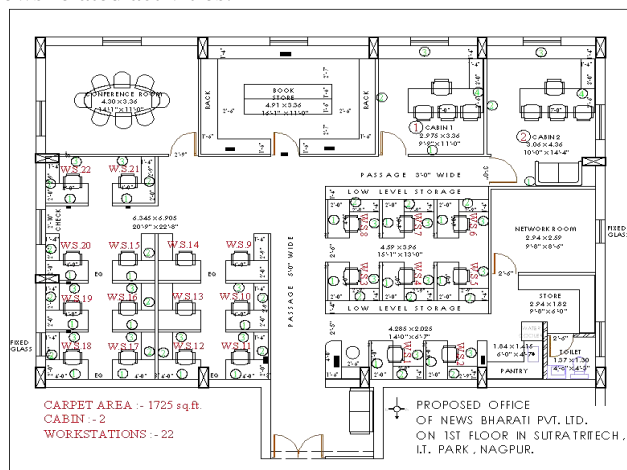


Figure 3: First Floor Plan Case Study III

3.5 Case Study IV (Automark)

The selected office is occupying 2nd floor of a large commercial complex in a highly commercial zone in the western part of city of Nagpur. The structure is an independent commercial building, six storied high. The office is occupying a portion of 2nd floor of the building. The hierarchy is 2 Directors, 2 Marketing Managers, 11 Staff and a Peon. Activity spaces in the office are 2 Director’s Cabins, 2Marketing Manager’s Cabins, and 15 workstations, Conference Room, Meeting Room, 3 additional cabins for audit purpose, Pantry and Toilet (Fig 4, Image 4).

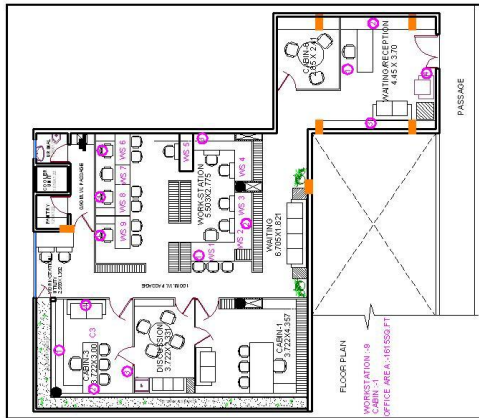


Figure 4: Second Floor Plan Case Study IV Image 4: Workstations

3.6 Case Study V (Regards Solutions)

The selected office is an IT Company occupying 2nd floor of a large commercial complex in a highly commercial zone in the western part of city of Nagpur. The office is occupying a portion of 2nd floor of the building. The hierarchy is 1 Director, 4 Marketing Managers, 19 Staff and a Peon. Activity spaces in the office are 1 Director’s Cabin, 22 workstations, Reception, Pantry and Toilet (Fig. 5, Image 5).

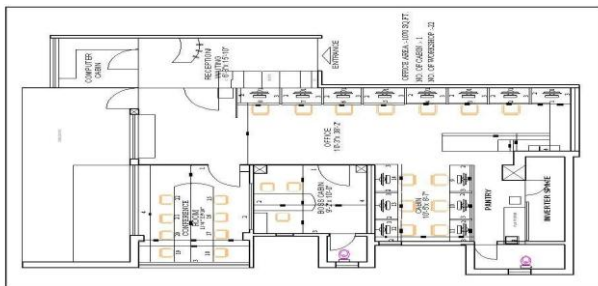


Figure 5: Second Floor Plan Case Study Image 5: Workstations of Case Study V

4. Method

The paper presents the qualitative analysis of the subjective opinions given by users based on their experiences in existing environmental conditions of five selected offices from the city of Nagpur, 2nd Capital of state of Maharashtra, India. The data collection is done through a survey, categorized as Qualitative, Observations and Interviews of the employees. The selected offices are visited minimum of four days and maximum of eight days in person for a period of 8 hours, from 10am to 6pm. General information about occupants demographic and anthropometric characteristics such as age, height, weight and gender are collected. As per the objectives set for the study, parameters related to sociological, psychological and physiological needs are identified leading to comfort and efficiency of the users. Physiological needs: Functional comfort, spatial arrangement, furniture and ergonomics. Sociological Needs: Social density, crowding, intimate space, personal space, social space and public space. Psychological needs: Perception, cognition, connectivity, interaction, autonomy, privacy, spaciousness and territoriality. The dependent variables are the occupants of the selected offices giving response to the physical conditions provided to them. Qualitative survey is done by giving a five-point questionnaire (45 questions) concerning their perception about the space they are using. The questionnaire is based on the literature studied on the parameters and following Likert scale with the extreme as totally disagrees to totally agree. The range is from 1 totally disagree to 5 totally agree and 3 being neutral. Questions are related to above said parameters and to understand how office users experience present day environment and their preferences for better conditions. The questions focused on appropriateness of location of seating, sufficiency of space, crowding versus privacy, visual and physical connectivity, seating arrangement regarding spatial planning. Flexibility of furniture, space for storage and display, ratio of table to chair, posture, type of seating, accessibility to ancillary activities, height of partition, layout of furniture are asked related to furniture and ergonomics. The occupants are thoroughly observed for a period of minimum four and maximum eight days from 10am to 6pm.

5. Data Analysis and Results

Qualitative survey involves research questions posed to the occupants that resulted in a set of responses, how occupants opined about their comfort and efficiency levels related to functional and behavioral parameters as spatial, furniture and ergonomics. Analysis based on qualitative data is done for the five workspaces with a sample size of 0 - 25 based on spatial parameters.

Factor	Company wise Scores (pooled average scores) on a 5-point scale on 2 parameters(companies with less than 25 workstations)
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	Regards Solutions	Jain House (Paper)	Jain House (Coal)	News Bharti	Automark
Spatial arrangement	2.99	4.01	2.93	3.69	3.72
Furniture/ Ergo.	3.18	3.61	2.91	3.31	3.46

Table 1: Company wise Scores on a 5-point scale on 2 parameters

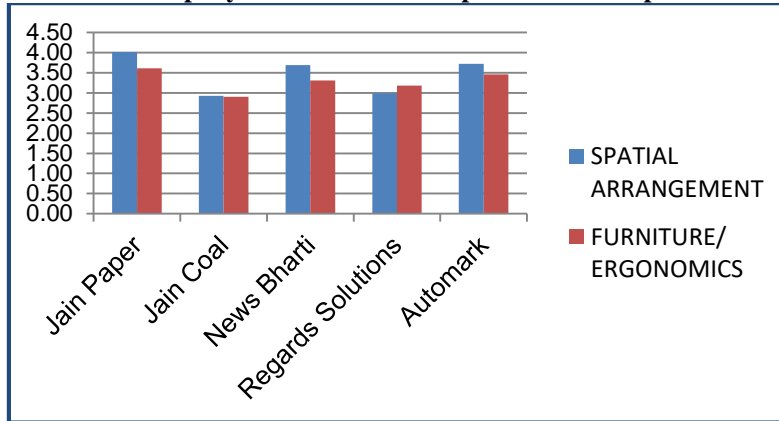


Figure 6: Employees views: Scores on a five point scale (users up to 25)

6. Discussions

From the “Table 1 and Fig.6” it is observed that amongst the five companies, the average scores given by employees of Jain House (paper) are high (scores > 3.5) on a five point scale on two parameters as spatial arrangement furniture and ergonomics. This clearly indicates that the spatial arrangement in the office is meeting the requirements of the users. The reasons attributed are, office in an independent building occupying full floor, low density, creating an effect of spaciousness and less crowding. Comparatively the next best ratings on the 5 parameters of architectural study are received by the News Bharti and Automark Company. Regards solutions and Jain Coal received relatively low rating on spatial arrangement and Furniture and Ergonomics (with a score less than 3) by their employees. Reasons being high density, space crunch and noise due to printing machine kept in working zone. High level of interaction is creating disturbance for the occupants.

The occupants of five selected companies have rated on a five point scale on two architectural parameters as spatial, furniture/ergonomics and related sociological and psychological parameters. The subjective ratings are leading to the factors for enhancement of comfort and efficiency of the occupants of the five offices. The questionnaire for spatial arrangement, furniture and ergonomics focused on aspects related to spatial organization and related behavioral issues. Considering the results in “Table 1 and Fig.7” it is seen that, Jain House (paper) has received high scores on all the parameters as compared to other offices.

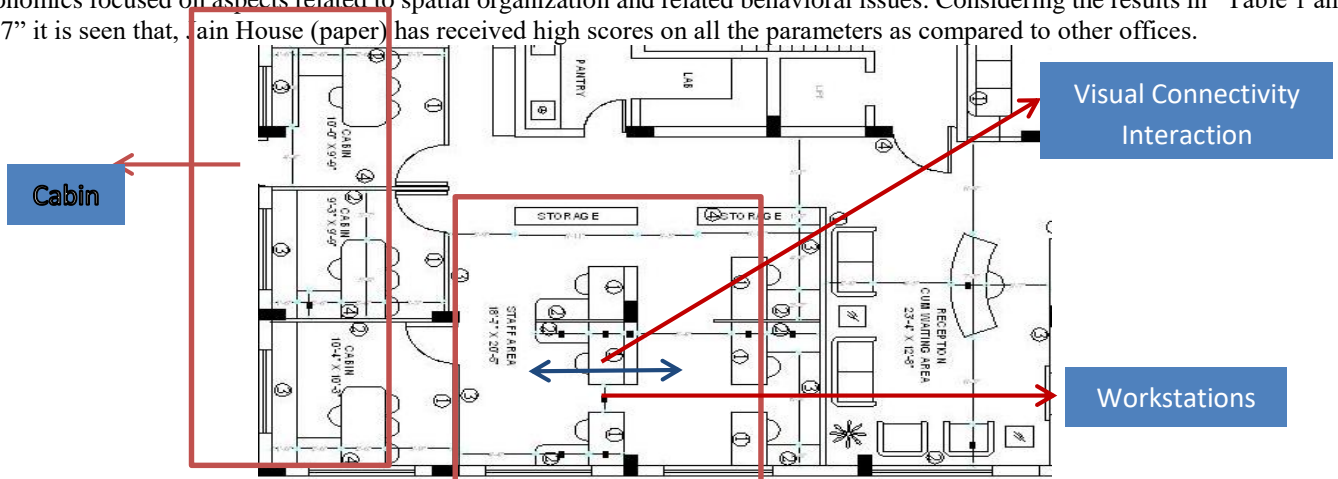


Figure 7: Position of workstations and cabins (Jain Paper)

From this point of view, the spatial plan of Jain House (paper) is compared with Automark whose occupants have rated lower than for Jain House (paper) to understand the reasons for high rating given by the occupants. “Table 1”, Fig. 7” shows the spatial organization of workstations which helps to enhance interaction amongst the occupants as compared to Automark “Fig.8”

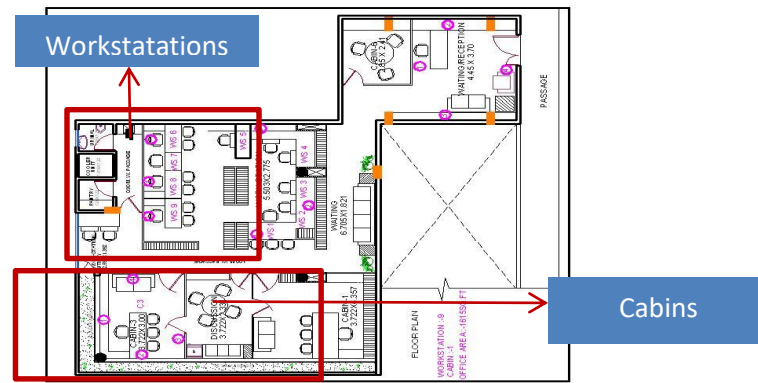


Figure 8: Position of workstations and cabins (Automark)

A similar study is done by Altman about privacy, personal space and crowding [7] and its positive and negative impact on the occupants. In both the offices the visual connectivity and physical connectivity with the visitors and the occupants in cabin is good due to nearness of the workstations and cabins. The distance traversed is 4mt maximum. Overall density for both the offices varies between 10 to 15 sq.mt./person, considered as low, adds to the effect of spaciousness and less noise. Ratio of workstation to cabins person wise is 46% to 54% in Jain House (paper). Compared to the two offices, Regards Solutions and Jain House (coal) have given poor rating on the two parameters as spatial, furniture and ergonomics. A linear arrangement of workstations and space crunch reduces interaction among the occupants and creates crowding effect adding to the discomfort “Image 9, Image 10”.

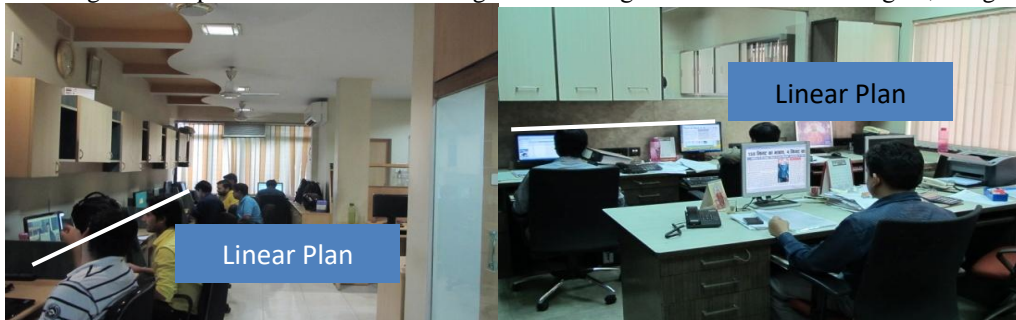


Image 9: Workstations of Regards Solutions

Image 10: Workstations of Jain House (Coal)

Density factor also plays an important role, which is ranging in between 4 to 7sq.mt./person. A similar study as an experimental survey is done on the relationship between density and task performance [8] stating that density does affect task performance. Responses are collected through questionnaires occupants of the selected offices about their opinion on the important architectural parameters to which the efficiency of work is related to. It is observed that, among the sampled respondents, 33 % opined that the prime aspect due to which efficiency and comfort get enhanced is spatial arrangement.

Based on the qualitative survey of five offices, it is evident that the major factors for enhancing comfort and efficiency levels are location of seating, sufficiency of space, crowding versus privacy, visual and physical connectivity, seating arrangement regarding spatial planning, flexibility of furniture, and space for storage, display and density.

7. Conclusions

- Architectural parameters as spatial arrangement, furniture and ergonomics and related behavioural parameters play a significant role in achieving comfort, satisfaction and enhancing efficiency of the occupants in a preferential sequence.
- It is preferred to have a combination of cabins and workstations (open office) to maintain hierarchy and privacy.
- Spatial arrangement of workstations placed opposite each other is favoured over linear arrangement. The layouts have an effect on better physical and visual connectivity, interaction amongst occupants and helps in enhancing the efficiency of the users.
- The internal lower physical distances up to 5 to 6mts are preferred for coordination with the successive hierarchy and also privacy.
- Density of workstations shall vary between 3sq.mt/person to 6sq.mt/person as it gives an effect of spaciousness, reduction in crowding also leading to better acoustical performance.
- Low heighted partitions (1.2mt.) separating the workstations are preferred over seating without partitions for needed privacy as well as interaction amongst the occupants. Partly panelled and partly glazed partitions are preferred over full length glass partitions for privacy, satisfaction and better environmental perception towards office ambiance.
- Type of seating preferred is an adjustable chair leading to better performance.

8. References

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