DESIGN CONSIDERATIONS FOR EFFICIENT WORK ENVIRONMENT IN CORPORATE OFFICES

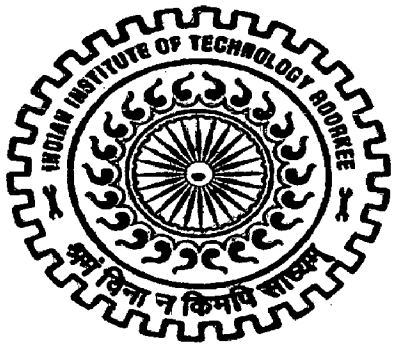
A DISSERTATION

Submitted in partial fulfillment of the requirements for the award of the degree of

MASTER OF ARCHITECTURE

By

MANISH KUMAR GUPTA



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JUNE, 2006

CANDIDATE'S DECLARATION

I hereby certify that the work, which is being presented in the dissertation, entitled **DESIGN CONSIDERATIONS FOR EFFICIENT WORK ENVIRONMENT IN CORPORATE OFFICES** in partial fulfillment of the requirement for the award of the Degree of **MASTER OF ARCHITECTURE** submitted in the **Department of Architecture & Planning** of the Indian Institute of Technology, Roorkee is an authentic record of my own work carried out during the period from July 2005 to June 2006 under the supervision of **Prof. Rita Ahuja.**

The matter embodied in this dissertation has not been submitted by me for the award of any other degree.

Place: Roorkee
Dated: June 26, 2006

(MANISH KUMAR GUPTA)

CERTIFICATE

This is to certify that the above statement made by the candidate **MANISH KUMAR GUPTA** is correct to the best of my knowledge.

Dated: June 26, 2006

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ABSTRACT

Designing a workspace for the present day competitive corporate world requires an integrated approach because now a day the work output or efficiency of the employees attains high importance, which in turn depends upon the user comfort, facilities, setup or directly the environment in which user works.

Conventionally, office design and distribution of space has been based more on status than work requirements. As work in the public sector becomes more information dependent, and shifts from dealing with products to working with people to provide services, work environments need to be flexible to enhance communication amongst employees, improve efficiency and productivity and respond to organizational change. Workplaces now have to accommodate work practices such as teleworking and provide flexible arrangements that require less space.

The Office of the Future incorporates into the workplace the latest innovations in interior design, furniture, and communications technology. It change the workplace to take advantage of new alternative ways of working, such as increasing emphasis on executive communication, teamwork, telecommuting, and other nontraditional ways of getting things done.

Efficiency or productivity depends upon the work environment, facilities and setup in which user works. Each person responds uniquely when confronted with a specific situation or environment. These responses are categorized as sociological, psychological and physiological—all of which are influenced by factors within the interior environment.

An attempt has been made to give design criteria with the integration of Physiological, sociological and psychological factors for healthy & productive workspace in which work efficiency and productivity can improves and also to give attention on the perception of office spaces.

In the end it proposes a set of design considerations to Architects, designers for designing efficient work environment in IT based corporate offices.

ACKNOWLEDGEMENT

It is difficult to put into a few words the gratitude I feel for the assistance rendered by many individuals and sources for the completion of this dissertation. However I take this opportunity to acknowledge those who have given their valuable suggestions in shaping this study into a cogent form.

I would like to express my deepest gratitude to my **guide Prof. Rita Ahuja,** for her guidance for shaping the outcome of this thesis, which she did taking a lot of time from her busy schedule.

My sincere thanks also go to Prof. S.Y.Kulkarni, Chairman DRC, Prof. P.K.Patel, Coordinator, M. Arch., Prof. R.Shankar, Head of the Department and all the faculty of Deptt. of Arch. & Planning for all the encouragement, help and assistance given to me during my tenure in Roorkee.

I would like to express my thanks to my seniors and friends exceptionally, Rajeev sir Rachit sir, Ashok sir, Arafat, Shobhit, Adhyas, Sandeep, Pradeep, Anupam, Shanee Harshit, Ajay & all batchmates for their expert comments, technical support, cooperation and making my stay at IIT, Roorkee a pleasurable and memorable experience.

The acknowledgements will not be completed till I express my regards and thanks to my Parents & family for their blessings and prayers for their encouragement and support.

Dated: June 26, 2006

(Manish Kumar Gupta)

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INTRODUCTION

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- Introduction
- Problem Identification
- Aim & objective
- Scope & limitations
- Research Methodology

CHAPTER 1

1.1 INTRODUCTION

In the present day competitive corporate world, the work output or efficiency of the employees attains high importance, which in turn depends upon the user comfort, facilities, setup or directly the environment in which user works.

Traditionally, office design and allocation of space has been based more on status than work requirements. As work in the public sector becomes more information dependent, and shifts from dealing with products to working with people to provide services, work environments need to be flexible to enhance communication amongst employees, improve efficiency and productivity and respond to organizational change.

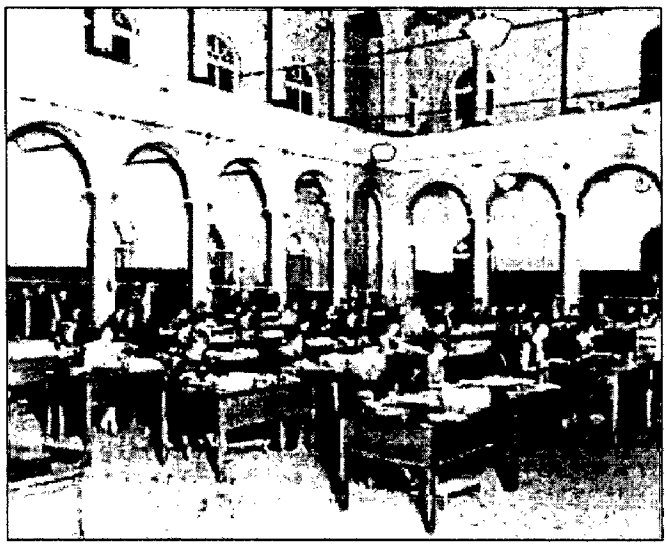


Fig. 1.1 Workplace: Traditional approach

Workplaces now have to accommodate work practices such as teleworking and provide flexible arrangements that require less space. Traditional attitudes towards the layout are being challenged with space now being allocated according to work function rather than grade.

Fig. 1.2 Workplace: Integrated approach

Work process, new communication techniques, and office spaces are crucial for the functioning of any organization. An integrated approach is a necessity. Information technology, organizational development, and facilities are now inseparable from one another and are all integral to the success of the user.

Efficient environment allows greater communication, more efficient use of space and increased flexibility with other aspects such as psychological, health constraints, privacy, acoustics and indoor environmental controls. There is also the consideration of requirements for people with a disability.

The right balance between efficiency and effectiveness can be achieved with a variety of workplace settings that have less to do with rank and status and more to do with the quality of space necessary for creative work and learning. Above all, a workplace should foster the way an individual works and allow the corporate culture of the future to evolve.

1.2 PROBLEM IDENTIFICATION

Traditionally, the office has been considered a relatively clean, safe, and healthy place to work. In recent years, however, corporate employees have expressed concerns about the office environment and their working conditions. These concerns are also reflected in complaints of discomfort, anxiety, irritation, and general job dissatisfaction and can be measured in terms of sick leave, absenteeism, and job turnover, ultimately affecting the efficiency, productivity & profitability of the corporate.

1.3 AIM & OBJECTIVES

1.3.1 Aim:

The study attempts to frame design considerations for efficient work environment in corporate offices.

1.3.2 Objective:

Keeping the above aim in view, following objectives have been identified

- To study of physiology, psychology, sociology & indoor environment in work places.
- To achieve proper space utilization in work places with respect to function and flexibility.
- To study technological changes in equipments & workspaces, which have an effect on work efficiency.

- To evaluate corporate offices with respect to factors affecting work efficiency.
- To frame design consideration for efficient work environment in corporate offices.

1.4 SCOPE & LIMITATIONS

This study deals with the physiological, psychological, sociological aspects & user's response to indoor environment, which have an effect on work efficiency in IT based corporate offices.

This study does not include the design of infrastructure & structure system for corporate offices.

1.5 RESEARCH METHODOLOGY

- Historical context of workspaces & changes with technology.
- Corporate culture & work environment.
- Basic human needs in a workplace.
- Study of Human behavior & the interior environment.
- Identification of areas & elements affecting efficiency in work environment.
- Literature survey.
- Preparation of checklist and questionnaire for survey.
- Case studies & survey to better understanding of contemporary trends & requirements in corporate office spaces.
- Inference & Analysis of different factors affecting work efficiency.
- Overview of advance technology related to efficient workspaces.
- Conclusions & framing design considerations for efficient work environment for corporate offices.

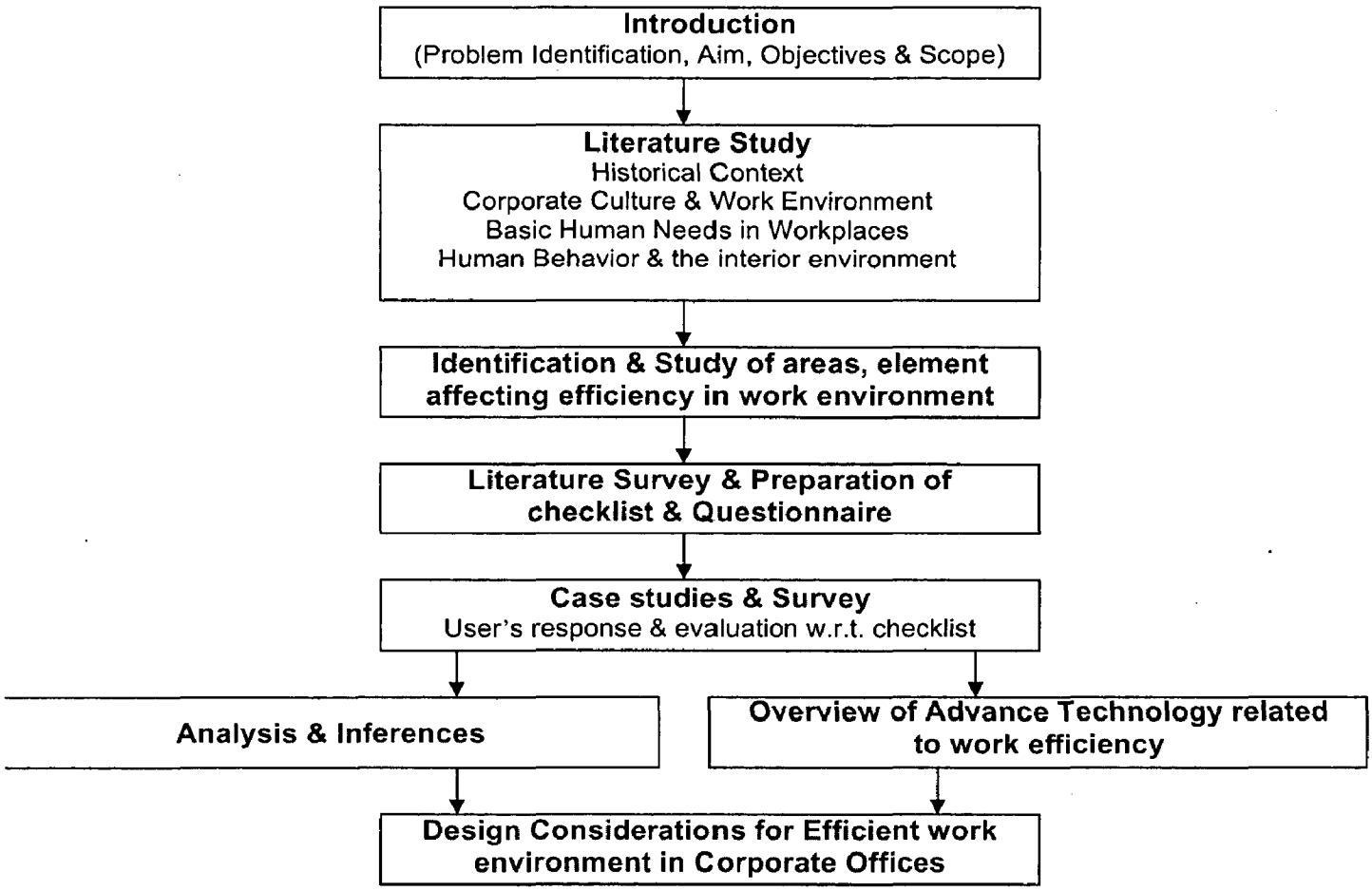


Fig. 1.3 Research Methodology

LITERATURE STUDY

Literature study gives the clear idea of the work already done in the field of study.
This study is done to understand corporate office work environment and different factors which affects work efficiency.

Topics covered in this chapter

- Historical context of workspaces & changes with technology
- Corporate culture & work environment
- Basic human needs in a workplace
- Human behavior & the interior environment
- Identification & study of areas, elements affecting efficiency in work environment.
- Overview of advance technology related to efficient workspaces

CHAPTER 2

2.1 HISTORY: THE OFFICE FACILITY & CHANGES WITH TECHNOLOGY

2.1.1 The Office Facility

Throughout history, people have met to exchange information, make decisions, develop plans, and to buy and sell goods or services. They may have conducted these activities while seated on a carpet, in the consulting room of a professional, or in an aristocrat's study. For businesses today, the office has become the setting of choice for the generation, coordination, and communication of information. It is a facility in which people can interact with each other, with their information, and with their information processing tools.

Our current concept of an office as a facility built especially for that purpose emerged in Europe in the mid-1800s. Office buildings of that time consisted of rooms that were rented to a single company or to several small firms for transacting clerical or executive business. Since the emergence of the single purpose office building, the office workplace has evolved with advances in construction technology, improvements in office equipment, and developments in organization theory.

Fig. 2.1 Federal office space in the Old Post Office 1900.

Source: www.steelcase.com

2.1.2 Changing Styles of the Office

Office designs from the middle of the nineteenth century to today have primarily served the rapidly increasing clerical and administrative components of business. As organizations became larger, their growing clerical and administrative workforce, which had previously been housed in private and shared quarters, was accommodated in ever-larger general-purpose office spaces. The placement of enclosed offices on the perimeter created sizable interior spaces that became known as bullpens. It was common to have dozens, even hundreds, of clerical work stations in these expansive interior spaces.

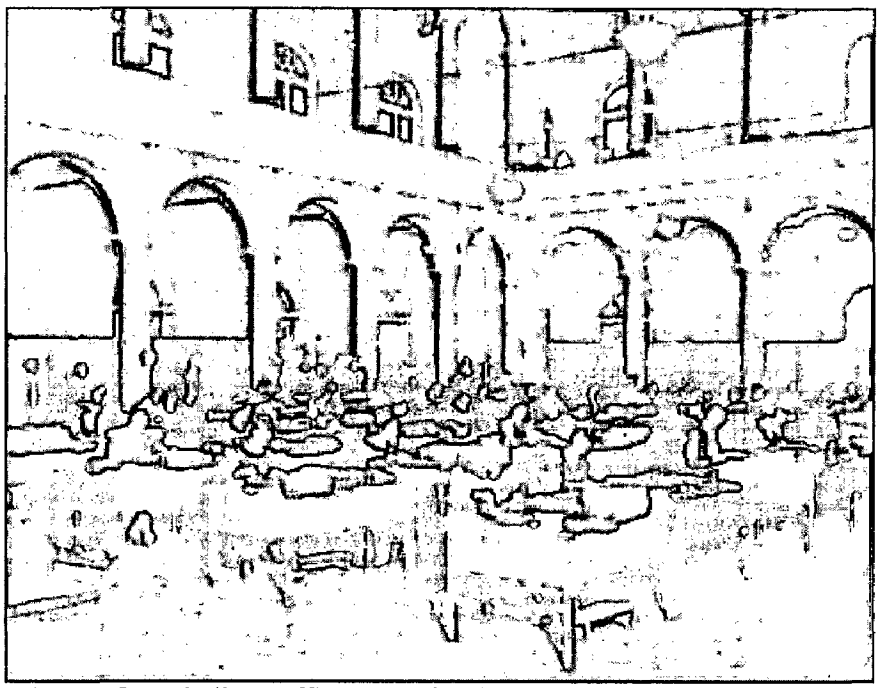


Fig. 2.2 Open bullpen office space for the General Accounting Office in the Great Hall of the Pension Building, 1926.
Source: www.steelcase.com.

Bullpen layouts consisted of a rigid arrangement of desks, usually in rows. They provided individual workers with no visual or acoustic privacy and were typically noisy, poorly lit, and uncomfortable places to work. Ergonomics was not considered an issue in the office. Unlike factory settings, there was little concern for matching office furnishings to the task or to the individual.

In the late 1950s, a new office design called the Burolandschaft (translated from German as "office landscape") was developed in Germany. Two brothers, Eberhard and Wolfgang

Schnelle, leaders of the Quickborner Team of management consultants, heavily promoted it. The office landscape design sought to provide flexible, interesting interiors that could easily be adapted to individual tastes and group needs. Layouts were spacious and used high-quality furnishings. Arrangements of live plants, artwork, and other unconventional devices were employed to divide the space into individual work areas.

The concept underlying this design was for the physical layout to reflect a democratic and liberated style of management as well as to provide high-quality interiors tailored to the occupants' needs. It was a philosophy that fit well with the architectural design ideas that came into trend in the United States and Canada during the 1960s.

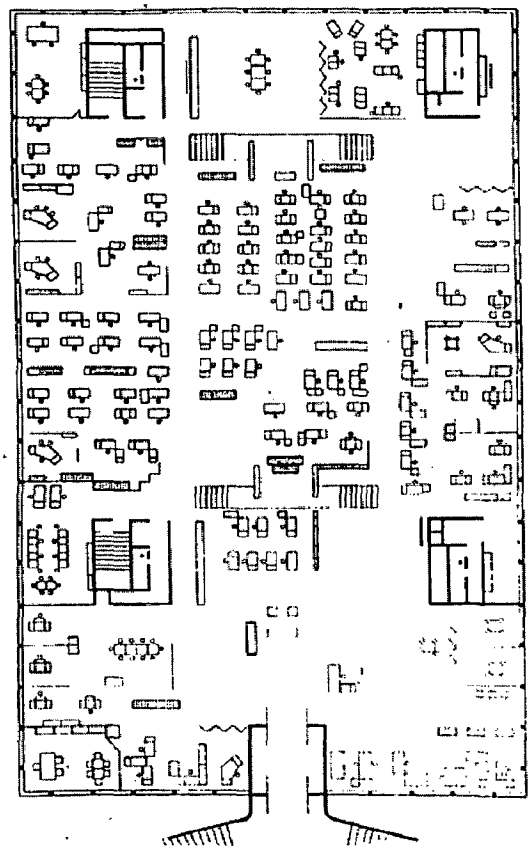


Fig. 2.3 The Open Office Layout.

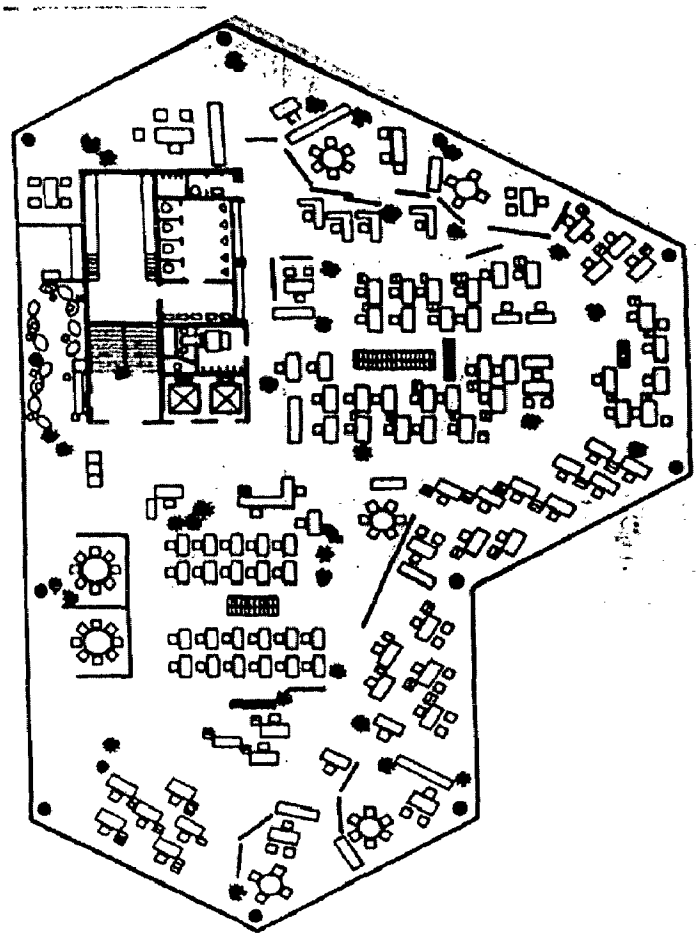


Fig. 2.4 The Office Landscape Layout.

At about that time, Robert Propst, a U.S. inventor researcher, was developing an unconventional approach to furnishing offices for Herman Miller, a major office furnishings manufacturer. His idea, called the "Action Office Furniture System," was to replace such traditional office furniture as desks and credenzas with furniture components and panels that could be assembled into a wide range of work settings. Work surfaces, storage units, and other elements were hung on freestanding panels, which could be arranged as needed to form a complete office work setting. It was the beginning of what today is called systems furniture.

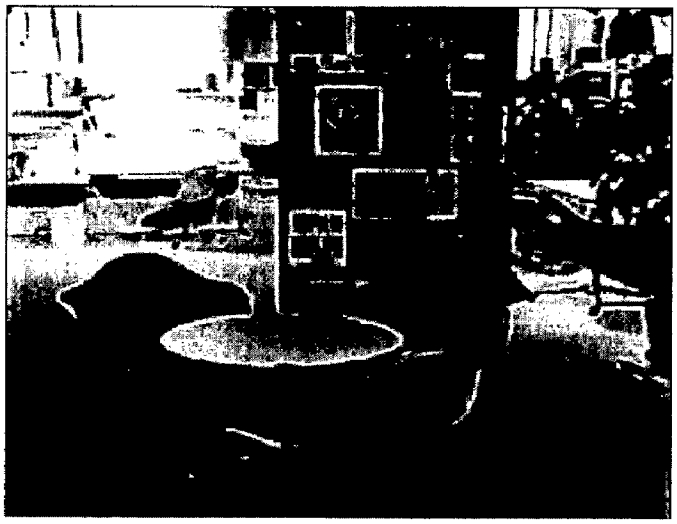


Fig. 2.5 Informal Meeting Area
Source: www.hermanmiller.com

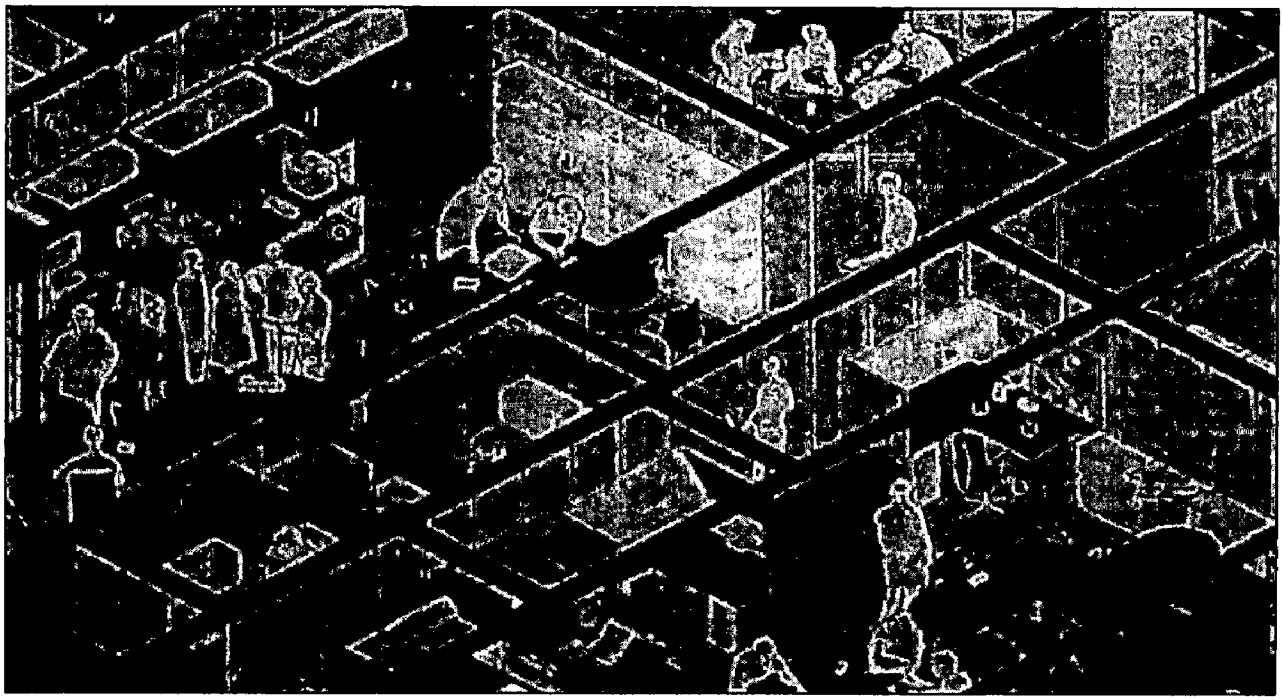


Fig. 2.6 Action Office System
Source: www.hermanmiller.com

As varying-height acoustic panels were introduced into the open office, floor-supported desks and storage units began to be integrated into the rectilinear panel system. This office

layout of "cubicles" offered slightly more privacy while retaining space efficiency. Hundreds of office furniture designs are now based on this concept.

The use of systems furniture to create large open-plan areas was a divergence from the original office landscape design envisioned by Propst and the Quickborner Team. The office landscape employed high-quality furnishings and provided spacious work settings. By contrast, the open-plan/systems furniture design was mainly used to increase the number of workers who could be housed in a given floor area.

Compared with the bullpen arrangement, an open-plan/ systems furniture approach offered more privacy, greater noise control, and more convenient storage of papers and files. However, most occupants still preferred the private or shared enclosed offices of the time. Proponents of the open-plan arrangement emphasized more open communication among office workers as a major benefit, even though occupants felt the lack of communication was not a significant problem. Early on, occupants of the new open plan layouts complained of a lack of privacy, noise distraction, and insufficient space.

2.1.3 Today's Office

It was the higher density of work settings that made the open-plan office most attractive to cost-conscious organizations. The goal was to squeeze as many people as possible into the minimum amount of space. Often, too little attention was paid to developing well designed, comfortable workplace environments. In the 1980s, systems furniture like desks, tables, and chairs that could be used interchangeably and could readily support personal computers began to replace fixed office furniture.

Nevertheless, it was not until the early 1990s, when downsizing, restructuring, and reengineering efforts rushed through the American workforce, that Propst's and Quickborner's business-driven approach really gained favor. The importance of having workspace that can adapt to the work needs, rather than adapting the work processes to fit the space, is once again being recognized.

Today, the change to open environments is less about saving on operations costs than about reaping long-term benefits such as increased productivity and efficiency. While significant savings still result, organizations adopting this tactic will more likely convert the saved space into informal meeting rooms, snack areas, and project rooms or reinvest it into workplace tools that the employees themselves have identified as important for improving their productivity.

More and more, the office environments of today's front-running businesses reflect the business goals and work habits of that organization and possess the flexibility and suitability that can adapt to rapid changes with minimal cost, while supporting high productivity and providing employee satisfaction.

2.2 CORPORATE CULTURE & WORK ENVIRONMENT

2.2.1 Corporate Culture

"Corporate culture is the pattern of basic assumptions and beliefs shared by members that guide their behavior. Through education and participation in work activities, people derive assumptions about "how the world works" and learn satisfactory ways to solve business problems".

Culture serves to bind and motivate people, and it governs organizational arrangements, shapes values, and influences the way information is processed. Understanding corporate culture is important because it can be both a catalyst and a constraint.

Regional, national, and global cultures, as well as differing industry cultures, constitute the backdrop for corporate culture. Simultaneously, subcultures form within an organization along functional and professional lines, such as marketing, finance, engineering, and research.

In companies today, new work groups such as cross-functional teams and external alliances are being created with increasing frequency. In the beginning, members often have trouble working together effectively, in part because they come from different subcultures and bring varying assumptions and norms—generally unstated—to the new situation.

2.2.2 Work Environment

Many people think of work environments simply as physical settings, something quite separate from the people, their work activities, and organizational structures. However, a holistic view of the workplace domain—considering people, production structures and processes, and place together—provides a better approach for understanding and responding effectively to dynamic problems in the workplace.

In the work environment, people, production, and place come together in continually changing patterned relationships. Ultimately, however, all three must be understood

together and coordinated as a whole in order to achieve effective organizational results, such as customer satisfaction and profitability.

In today's work environment, dealing with change is a major challenge. Because the core elements (people, production, and place) have an impact on key outcomes such as productivity, satisfaction, safety, and long-term effectiveness, a holistic understanding of the work environment can support positive changes and enhance an organization's chance of success.

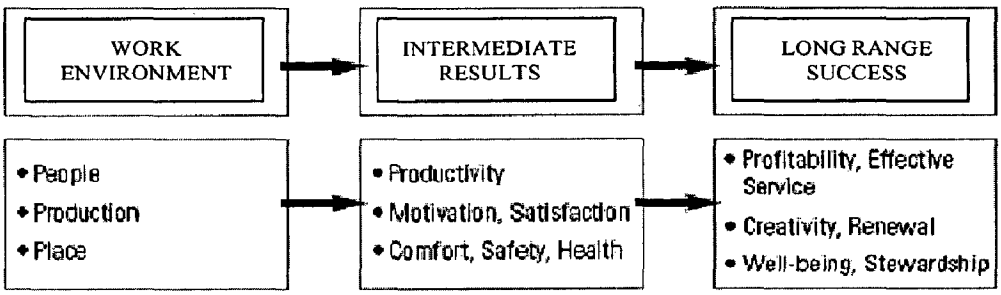


Fig. 2.7 Work environment & Productivity relation
Source: www.hermanmiller.com

2.3 BASIC HUMAN NEEDS IN A MOTIVATING WORKPLACE

In 1954, psychologist Abraham Maslow developed a foundational theory on motivation. He contended that every person has a basic set of needs that are, in effect, our wants and desires. As shown in figure, he organized these needs into five categories in ascending order, with each level building on the previous level.

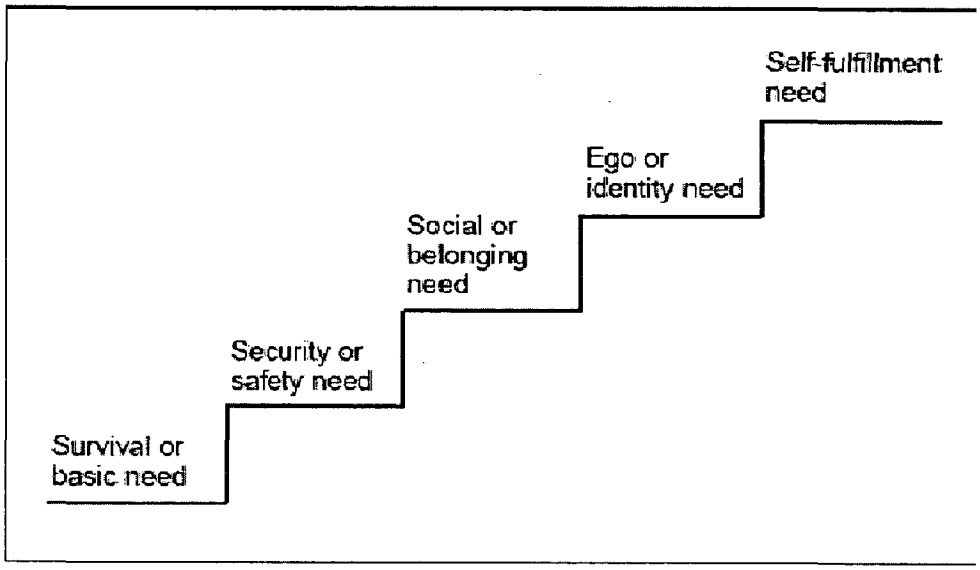


Fig. 2.8 Maslow's Hierarchy of Basic Human Needs

Maslow's premise was that as successive levels of need are satisfied, other needs emerge. We move from basic physical needs of survival to more complex needs. For example, a person must first have enough food to eat before he or she considers obtaining a higher-level educational degree. Or, we will make friends in our neighborhood only if we believe it is a safe place.

Some believe these step-by-step levels of needs are not really hierarchical and that certain ones can be met before others are fully satisfied. This may be especially true when trying to balance our work lives and personal lives.

Maslow's theory is a foundation upon which to build an understanding of the reasons we do what we do. As it regards managing knowledge, it provides an insight into how the workplace can parallel and support our motivational needs, which have an effect on the work efficiency.

2.3.1 Survival or basic need

The need to work in a building is a typical survival or basic need. There must be heat and light. The structure in which we work must protect us from the rain and shelter us from the cold. In our offices, we need a surface on which to work, a comfortable place to sit, and the required technology.

We expect the work environment to support the tasks we have to accomplish. We need places to put things. We need ways to find things quickly. This includes information that is stored electronically as well as on paper. We have phones, computers, fax machines, modems, and printers. Working with technology encourages a basic need for sufficient electrical, voice, and data outlets.

2.3.2 Safety or security need

Maslow's next need level has to do with safety and security. He states that once we have reached satisfaction with our need to survive, we strive to protect what we have attained. It is hard to grow and create new knowledge in an unsafe environment.

In the workplace, items like lockable storage and card-keyed access provide a measure of security. Ergonomic chairs and height-adjustable work surfaces encourage healthy posture and a feeling of well-being.

Thoughtful design allows for heavy traffic patterns to be diverted from areas that require high acoustical privacy. Acoustical privacy is also supported by appropriate integration of white noise and acoustical ceiling tiles. Strategic placement of privacy screens, high panels, and tall filing cabinets can block visual distraction.

Defining a department's spatial territory with the aid of entryways and designated landmarks can also support issues of security. Well-lighted parking lots help us feel safe while walking to our cars late at night. There is also the cultural aspect of security: When we leave things on our desks we expect them to still be there when we return.

2.3.3 Social or belonging need

Most of us spend a good deal of time at work. Many of our friendships began at work. We have things in common. We know the same people, have similar goals, and are often dependent on each other to meet project deadlines. We often share knowledge through

these informal networks. These same communities help balance our work and personal lives by providing opportunities to get our social needs met.

It is not uncommon to see people meeting in the cafeteria or continuing a discussion as they stand in a doorway or walk down the hallway. Office layout can encourage knowledge by locating people who work together near each other. Close proximity increases the odds they will see and talk to each other, build relationships, and generate new ideas.

Even when people work off-site (at a client's office, at home, in manufacturing plants, or in hotels) it is particularly important they have a place on-site where they can touch down and connect with the rest of the corporation.

A sense of belonging can encourage the sharing of knowledge. This can be supported by electronic bulletin boards and company newsletters. Simple recognition is important. We often noticed how good receptionists will include a person's name in a greeting. It's always, "Good Morning, Manish," or "Have a good afternoon, Manish." Hearing our own name helps us feel as if we belong.

The organizations where we work represent a part of the larger community. One of the first things people usually ask a stranger is, "Where do you work?" This sense of community is often transferred from the workplace to the greater community in which we live. This greater community fulfills Maslow's social need in a larger context.

2.3.4 Ego or identity need

The next level of motivational need refers to our ego and identity. Maslow states that these needs are never really fully satisfied, and that as certain levels of satisfaction are met, we unconsciously set new goals for ourselves.

Needs for status and recognition can take the physical form of a private office, distinctive furniture, a privileged location, a certain type of floor covering, an assigned parking space, or the size of our work space. Other symbols may include things like a nameplate, business cards, updated technology, or a leather chair. Access to a window and nice view has also been recognized as a sign of status.

People will often personalize their work areas with specific awards, degrees, and other symbols of achievement. They will share who they are by decorating their offices with family photos, artwork, and knickknacks.

Because this need is constantly evolving, it is especially important to be sensitive to how workplace changes will affect the individual. One way to do this is to establish agreed-upon protocols. Protocols help define ambiguities regarding how a space will be used. For example, surprises and threats to ego will be reduced by protocols that establish that certain conference rooms, once available only with a reservation, are now available to anyone on a first-come, first-served basis for just-in-time meetings.

Another suggestion relates to communication and encouraging people to be involved in decisions that relate directly to them. This can be accomplished by the use of surveys, simulation exercises, and focus groups. People will be more receptive to change if they have a voice in the decision-making process.

2.3.5 Self-fulfillment need

The self-fulfillment need is described as one of meeting a challenge and gaining a sense of accomplishment. This need has also been referred to as the ability to self-actualize and reach one's fullest individual potential.

In many ways the need for self-fulfillment is closely related to the ego or identity need. According to Maslow, neither one is ever fully satisfied. These two areas are especially important when considering the need to constantly generate new knowledge and creativity in the workplace.

Knowledge workers are people who, in the daily performance of their jobs, are responsible for the creation of knowledge. Information is their primary raw material. To retain knowledge workers, the workspace must not only support the tasks they currently have to accomplish, but also the tasks they aspire to accomplish. This need is the most difficult to support in many organizations.

One reason is that people cannot fully articulate exactly what they need to have satisfaction in this area. This is not as simple as asking for a comfortable chair or more files. It has to do with an inner sense of achievement, of meeting new challenges, and making new types of contributions. People often go to great lengths to get private thinking time. Sometimes we forward all calls to our voice mail and block out space on our calendars so we can have

2.4 HUMAN BEHAVIOR AND THE INTERIOR ENVIRONMENT

This study examines the relationship between individuals and their environment—how they perceive space and how they react to it. Perception of one's environment is affected by sociological needs, psychological state, and individual differences. The environment itself also influences human behavior. Both mental and physical stimuli affect behavioral responses. This study makes more awareness towards the matters which affect the occupants of a space.

2.4.1 Sociological Human Need

People's perception of their environment influences their social interaction within that environment. Social interaction can be discussed in terms of four concepts:

- **Privacy**
- **Personal interaction levels** (intimate, personal, social & public)
- **Territoriality, and**
- **Crowding.**

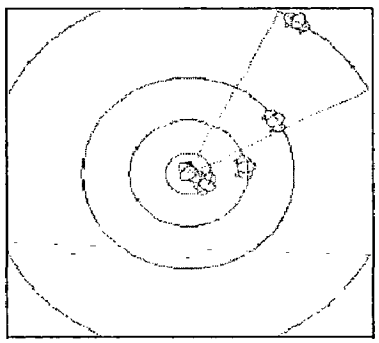


Fig. 2.9 Levels of space: intimate, personal, social, and public.

2.4.2 Psychological Human Response

Responses to the environment are complex and best understood in terms of three psychological stages of human behavior:

- **Perception**
- **Cognition, and**
- **Spatial behavior.**

a chunk of time to ourselves. Some people refuse to carry beepers or portable phones. We come in early and stay late because the office will be quiet and there will be few distractions. We do these things so we can concentrate and thus meet our needs for self-fulfillment.

Providing knowledge workers with more control over their environments is becoming a critical factor in today's organizations. This focus on user control is also an important factor in employee retention. Balancing work and personal lives is encouraged when people have the freedom to decide when and where to work.

Workplace design can support self-fulfillment by providing several types of spaces in which to work. Private enclaves are places where people can go to be alone. Dedicated project spaces encourage teams to leave information out so that it can be quickly shared with others. This ability to see information at a glance enables new team members to be brought up to speed quickly on a current project. It encourages spatial memory and a sense of persistent information. Casual spaces for groups, located near a bank of individual workspaces, allow for quick ad hoc meetings. Social spaces and comfortable surroundings encourage reflection and conversation.

The culture of the organization has to support the individual's need for self-fulfillment. People need to feel they are trusted.

2.4.3 Perception and Aesthetic

Perception of the environment, and consequently the aesthetic appeal of that environment, involves the acquisition of information through our five senses. A person's experience in the environment is very complex. Individual differences such as sex, age and health, to name a few, are important determinants of behavioral responses to an environment. The designer must take into consideration the individuality of various occupants of an environment, their likes, dislikes and personal histories.

Color proves to be an important factor in the perception of an environment's aesthetic. If used carefully and skillfully, it can positively influence mood and behavior. A full range of psychological and emotional effects can be achieved through use of color.

2.4.4 Human Response to the Interior Environment

Each person responds uniquely when confronted with a specific situation or experience. These responses fall into three categories—sociological, psychological and physiological—all of which are influenced by factors within the interior environment.

Sociological determinants relate to the social needs and problems of the occupants. Factors that pertain to these sociological responses, including group dynamics and communication, should be considered during planning.

- **Group dynamics** (the interpersonal relationships among members of a small group)
- **Communication**

Psychological determinants in the planning of an interior environment relate to the psychological needs and concerns of the occupants. Key determinants are to be consider

- **Visual privacy,**
- **Acoustic privacy, and**
- **Aesthetic factors**

Physiological determinants relate to physical needs of the occupants. Factors to be considered during the planning phase that deal with physiological responses include

- **Functionality,**
- **Ergonomics,**
- **Life safety and health concerns**

2.5 IDENTIFICATION & STUDY OF FACTORS AFFECTING EFFICIENCY IN WORK ENVIRONMENT

It is a complex task to quantify what is the impact of physical workplace on efficiency/productivity because there are so many other things that also have a significant influence upon the ability of an individual to work:

2.5.1 Factors affecting workplace efficiency can be divided as follows:

1. **Organization**
    - Strategy,
    - Culture,
    - Ways of actions,
    - Image etc.

2. **Physical working environment**
    - Indoor Air Quality
    - Lighting
    - Color
    - Thermal Comfort: Temperature, Humidity
    - Ergonomics, Workstation Controls
    - Privacy: Visual, Acoustical, Informational, Territoriality
    - Interaction/Communication
    - Functional Efficiency: Space, Layout, Vision, Hearing, Stability, mobility

3. **Personal factors**
    - Physiology; gender, age, ethnic group etc.
    - Psychology: personality, expectations, experience etc.
    - Job skills, pride, goal setting etc.

4. **Motivating factors**
    - Pay
    - Training
    - Job security
    - Prospects

2.5.2 Factors affecting Physical Working Environment

A. INDOOR AIR QUALITY

Our awareness of the quality of indoor air has increased in recent years. Energy conservation programs spawned by world oil shortages have resulted in building design and operation changes. Buildings have been sealed and ventilation rates reduced to prevent the infiltration of un-tempered outside air (hot, humid air in the summer months and cold, dry air in the winter). These changes have conserved fossil fuels and operating costs, but they have also negatively affected indoor air quality.

Indoor air quality problems are generally classified as "sick building syndrome" (SBS) or "building-related illness" (BRI). Conditions associated with sick building syndrome are not easily traced to a specific substance, but are usually believed to result from some unidentified contaminant or combination of contaminants.

The symptoms associated with SBS include:

Eye irritation	Nose irritation
Irritation of the throat	Nausea
Mental fatigue	Cough
Respiratory infections	Dry skin
Erythema (skin reddening)	Headache
Hoarseness	Wheezing
Dry mucous membranes	Dizziness

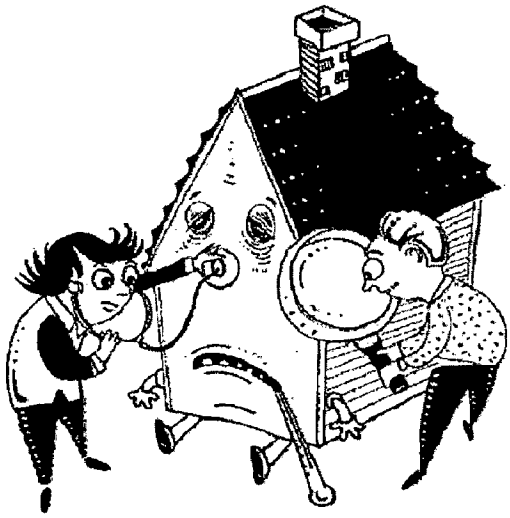


Fig. 2.10 Sick Building

The symptoms of sick building syndrome are relieved when the employee leaves the building and may be reduced or eliminated by modifying the ventilation system.

BRI describes specific medical conditions which have a known origin. These illnesses can be severe and, unlike SBS, can often be traced to a single contaminant source such as mold infestation and/or microbial growth in cooling towers, air handling systems, and water

damaged furnishings. Symptoms may not disappear when the employee leaves the building.

Building-related illnesses include:

~ Respiratory allergies

~ nosocomial (hospital) infection

~ Humidifier fever

~ Hypersensitivity pneumonitis

~ Legionnaires' disease

Signs and symptoms characteristic of exposure to chemical and biological substances include:

~ carbon monoxide

~ formaldehyde

~ pesticides

~ endotoxins

Sources of Indoor Air Pollution

Indoor air quality is affected by pollution from inside and outside of buildings and from poor ventilation.

Human metabolic activity, smoking, structural components of the building, building contents, biological contamination, office and mechanical equipment, and outside air pollutants that enter the building—all are sources of indoor air pollution.

Inside Air Contaminants

According to the National Institute for Occupational Safety and Health (NIOSH), USA approximately 4 percent of indoor air problems can be attributed to contamination from building materials and products. Formaldehyde can emit vapors from urea-formaldehyde foam insulation, particle board, plywood, and some glues and adhesives commonly used during construction. Other contaminants include fibrous glass, various organic solvents from glues and adhesives, and acetic acid used as a curing agent in silicone caulking.

Chemicals from copying machines, printers, ammonia and acetic acid from blueprint copiers, contribute to indoor air pollution.

Other inside contaminants include:

~ improperly applied pesticides

~ boiler additives

~ improperly diluted cleaning agents such as rug shampoo

~ tobacco smoke of all types

~ combustion gases from sources common to cafeterias and laboratories

~ cross-contamination from poorly ventilated sources that leak into other air zones

~ water damage to carpets or furnishings, or from standing water in ventilation system components

Outside Air Contaminants

According to NIOSH approximately 10 percent of indoor problems are due to contamination from outside the office space. Major sources are improperly located exhaust and intake vents and periodic changes in wind conditions.

One of the most common contaminants from outside is carbon monoxide gas from basement parking garages, re-circulated through the building ventilation system. Other outside contaminants include the by-products of construction or renovation, such as asphalt, solvents, and dusts.

Inadequate Ventilation

Inadequate ventilation is by far the largest problem associated with poor indoor air quality. Ventilation problems commonly encountered include:

~ insufficient outdoor air supplied to the office space

~ poor air distribution and mixing which causes stratification, draftiness, and pressure differences between offices spaces

~ extremes of fluctuations in temperature and humidity (sometimes caused by poor air distribution)

~ air filtration problems caused by improper or inadequate maintenance to the building ventilation system.

In many cases, these ventilation problems are created or exacerbated by energy conservation measures. Such measures include reducing or eliminating outdoor air; reducing infiltration and exfiltration; lowering thermostats in the winter and raising them

in the summer; eliminating humidification or dehumidification systems; and early shutdown and late start-up of ventilation systems.

B. LIGHTING

Light has a significant impact on our performance in the workplace. When you get it right, quality lighting can boost productivity and performance, reduce fatigue and eyestrain, and increase an organization's opportunity for success.

Inappropriate lighting can lead to a host of problems, ranging from eyestrain to serious musculoskeletal injuries. According to the Steelcase Workplace Survey, more than two-thirds of those responding indicated that they experienced serious physical problems associated with a poorly lit workplace.

Types of Lighting in Workplaces:

Ambient lighting

Ambient lighting provides the overall illumination in the work environment. There are two types of ambient lighting:

Direct ambient lighting that distributes most of its light directly downward. This is the kind of light you get from deep cell parabolics - a common type of direct ambient lighting found in most offices, institutions, and public spaces today.

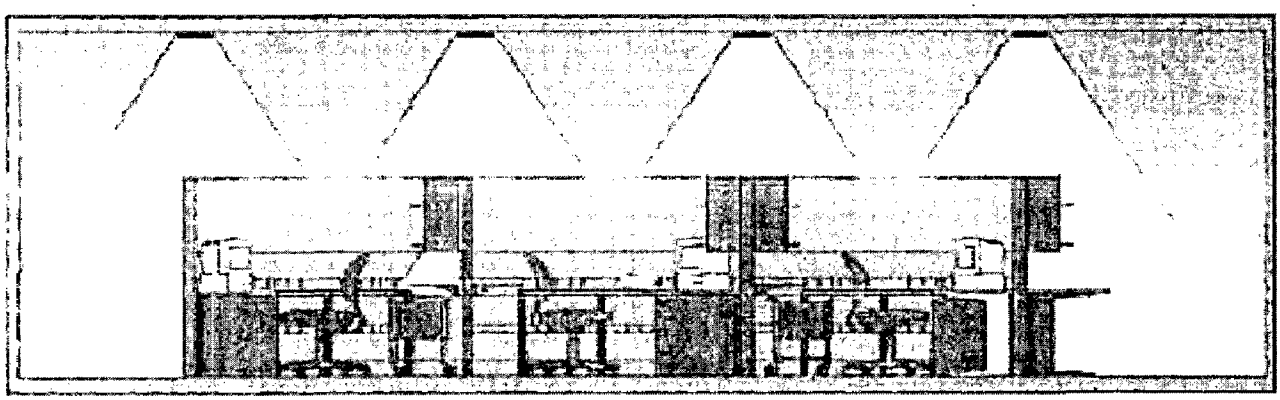


Fig. 2.11 Direct Ambient lighting

These lights help reduce some glare, but their effectiveness depends on where you happen to be positioned relative to the light source. Because these lights shine directly down, the pattern of light they emit frequently does not line up with the facility's furniture configuration.

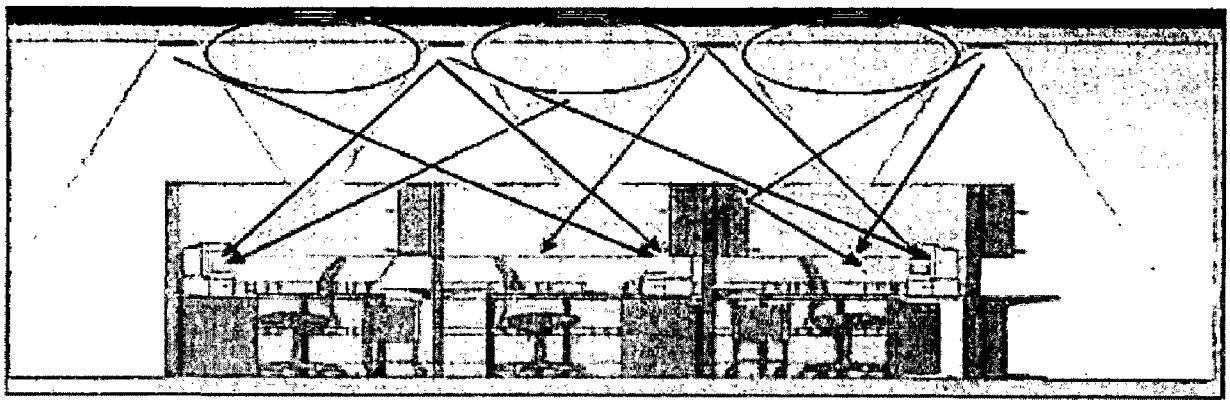


Fig. 2.12 Problems in direct ambient lighting

The result is a proliferation of shadows. In addition, walls near the ceiling remain relatively dark, and the ceiling's contrast creates hot spots that are a source of reflective glare. This is where most of the glare on computer screens comes from.

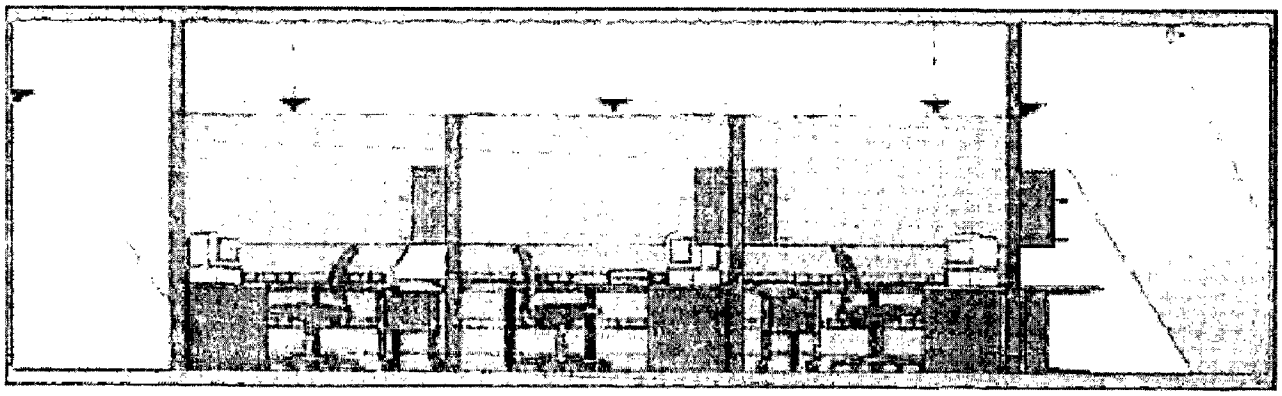


Fig. 2.13 Indirect Ambient lighting

Indirect ambient lighting distributes light upward and reflects off the ceiling. When applied, it can reduce direct and reflected glare to an absolute minimum. Its soft, diffused illumination has proven to be more comfortable for computer users than direct lighting sources like deep cell parabolics. Indirect lighting can create an overall sense of brightness.

Task lighting

Task lighting supplements ambient lighting by filling in shadows and provides additional light needed for focused work that requires higher light levels. Task lighting is playing an increasingly important role as ambient light levels are reduced due to the prominence of computer usage and the ecological importance of saving energy.

Accent lighting

Accent lighting completes the lighting environment and is a powerful element of a lighting system. It can be used very practically to provide fill light to finish and balance the ambient light. It can be used artfully to highlight unique objects or reinforce an aesthetic tone. It can draw people through a space or provide visual relief in areas without daylight. Skillfully applied, accent lighting can transform the perception of space.

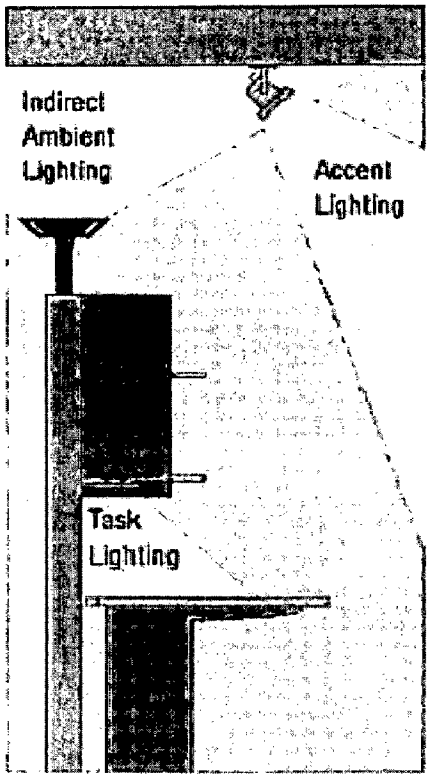


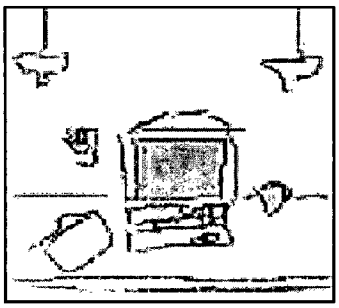
Fig. 2.14 Task & Accent lighting

Performance criteria for quality lighting:

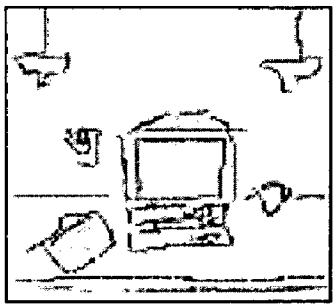
These criteria provide quantitative lighting standards based on the needs of specific tasks. Lighting designers use these criteria, along with qualitative criteria, as the basis for creating comfortably lit work environments without glare or extreme contrast.

Horizontal illuminance is the amount of light on horizontal surfaces, such as work surfaces. Light must be sufficient and uniform enough to allow you to read printed text, review drawings, and perform other tasks. Horizontal illuminance is effectively achieved by combining ambient and task light.

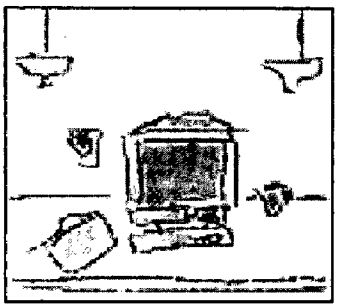
Vertical illuminance is the amount of light on vertical surfaces, such as office walls, computer screens, and paper placed on document holders. Lower and more uniform levels within the immediate work area are generally recommended because high vertical illuminances can cause veiling reflections on computer screens. Higher levels at strategic



Horizontal illuminance



Vertical illuminance



Ceiling luminance uniformity

Fig. 2.15 Illuminance

locations within the architectural environment are often recommended to contribute to a brighter, more pleasant workplace.

Ceiling luminance uniformity is the degree to which the light across the ceiling appears even. The more even it appears, the less chance you'll see it as reflected glare on your computer screen.

Glare

The two main goals of light design are to provide fully sufficient light and to create a pleasant and comfortable environment. In order to provide proper lighting conditions for a working environment, one has to take into account the problem of glare. According to Christoffesen J. (1995), *"generally glare can be described as a subjective phenomenon caused by the magnitude of visible noise interfering with the perception of visual information due to an uncomfortably bright source of light in the field of vision. Measuring the magnitude of glare is only possible by characterizations and assessments from the observer involved, together with the physical factors determining the magnitude of the sensation".*

The two types of glare mentioned in the literature are the disability and discomfort glare. Disability glare is caused when intraocular light scatter occurs within the eye, the contrast in the retinal image is reduced (typically at low light levels), and vision is partly or totally impeded (e.g., when the eye is confronted by headlights from oncoming automobiles)". Disability glare is often a problem in office buildings with large window areas. The sensation of annoyance caused by high or non-uniform distributions of brightness in the field of view is called discomfort glare.

Direction

The direction and diffusion of light are also important parameters for the provision of comfort in a working environment. Large amounts of diffuse daylight reduce the shadows and thus the ability of the occupant to evaluate the depth, the shape and the texture of the surface. On the other hand, a proper combination of diffuse and direct light can be proposed as the optimal comfort conditions. In office buildings day lighting systems that

can provide side lighting for horizontal tasks are more appropriate in comfort terms that overhead electric light installation.

C. COLOR

In the design of the optimum workplace, job performance, as it relates to employee satisfaction, is enhanced by colors that are stimulating, cheerful, and comforting. Because the work environment has a direct relationship to employee efficiency, colorless offices can be counterproductive.

Color in the workplace seems to have a psychological effect on individuals due to optical illusions and emotional experiences which colors trigger. Such emotional experiences may be positive or negative feelings which colors somehow link with earlier experiences.

Generally, dark colors are depressing and tiring while light colors are friendly and cheerful. Room colors must also be considered in light of the nature of the work to be accomplished. Routine work requires more exciting colors. Work requiring close concentration requires colors which are not distracting and which are restful.
Intense colors should be reserved for rooms such as entrance halls, restrooms and corridors. Strong colors may help brighten these areas, making them more cheerful.

The following is a list illustrating some of the most common human responses to different colors and color combinations.

- Reds are associated with tension and danger. They may add life and cheer to blends of blues and greens; but they generate unpleasant tensions when used with strong greens.
- Oranges share qualities of reds. They may be used to stimulate or modify otherwise neutral or cool color schemes.
- Yellows are the mildest of the warm colors and are often associated with cheerfulness.
- Greens are the cool colors closest to the warm on the color wheel. They are often perceived as peaceful.

- Blues are the coolest of the cool colors, suggesting rest, repose, calmness, and dignity. If overused they may be perceived as depressing and gloomy. Intense blue in small areas can be a helpful accent in warm and warm neutral color schemes.
- Violets fall between cool and warm colors. They are often perceived as artistic, suggestive, and sensitive but may be perceived as ambiguous or too strong.
- Black is a powerful accent color. It is often associated with—and suggests—weight, dignity, formality, and solemnity.
- Neutral colors tend to convey, in milder form, impressions of the hues that they contain. Neutral grays make background colors easy to live with but are subject to dullness, and sometimes appear monotonous.
- Whites and near whites suggest clarity, openness, and brightness. Whites are generally safe colors and can be used in large areas to a highly satisfactory effect if offset with small areas of chromatic color. Too much white can produce glare.

D. THERMAL COMFORT

The factors that influence the thermal comfort are divided to primary and secondary ones:

Primary Factors:

- Temperature
- Relative humidity
- Air Speed
- Clothing
- Perception of Thermal Comfort

Secondary parameters: other parameters such as state of health, level of physical activity, gender, and individual preferences influence perception of thermal comfort.

Temperature

Indoor climate conditions are among the most common complaints from office workers. An uncomfortable atmosphere can cause annoyance and even pain, depending on the degree of heat imbalance.

The effects of improper temperature include fatigue, sweating, respiratory discomfort, and changes in pulse rate. Too warm of an atmosphere leads to sleepiness, a decrease in

performance, and increased chance for error. An atmosphere which is too cool stimulates restlessness and reduces alertness and concentration.

Because productivity is related to a comfortable climate, it is important to keep the office at a pleasing temperature. Of course, individuals perceive temperature comfort levels differently. Recognizing that fact, the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) developed a voluntary standard (ASHRAE 55-1981) for temperature ranges. Compliance with the standard would yield temperatures satisfactory to 80 percent of the average population. Compliance would require:

- a range of 22° to 26°C for an average individual in the summer, and a range of 20° to 24°C in the winter
- relative humidity between 30 and 60 percent
- an average indoor air velocity of 0.25 meters per second or less in the summer, and
- an average indoor air velocity of 0.15 meters per second or less in the winter

Preferred air temperature may vary according to air velocity, clothing, muscular activity, and metabolism. Situational conditions can also affect comfort levels. Sitting near a glass wall or window on a hot or cold day may be uncomfortable, and sitting near heat producing equipment such as computers and copiers may cause discomfort.

E. THE SCIENCE OF ERGONOMICS

Ergonomics is the science of fitting the physical environment and the job to the worker's capabilities or limitations as well as to the tasks performed. Ergonomics programs can often prevent work-related Musculoskeletal Disorders (MSDs) that occur when there is a mismatch between the environment, the worker, and the task.

Musculoskeletal disorders are injuries and illnesses that affect muscles, tendons, nerves, cartilages, ligaments, joints, or spinal discs. Workers suffering from MSDs may experience less strength for gripping, less range of motion, loss of muscle function, and inability to do everyday tasks.

In developing ergonomics programs, ergonomists employ anthropometrics (the size, shape, and weight of people), biomechanics (the physical dynamics and limitations of people), and situational analysis (the social and physical task environment).

Even among a group of people of the same gender, age, and stature, there can be significant variation in bodily proportions.
An understanding of body size, weight, and gender characteristics is important in order to properly fit workers to the work environment and their tasks.

Architect should design for a broad range of characteristics to maximize the portion of the population that can most comfortably function in the spaces to be developed.

Diversified workers require versatile environments to support them. A work area that is modular and flexible allows users to change their environments to meet changing needs. Consideration also must be given to the location of equipment and machinery. Staff must be able to reach equipment and machinery comfortably to use it properly and safely.

Group anthropometric characteristics are considered when multi-occupancy workstations and seating must be shared due to multi-shift use. These workstations should be designed to support a full range of size adjustments to accommodate anyone from the largest male to the smallest female.
For individual organizations, an effective ergonomics design can:

- Reduce the risk factors for MSDs present in office and non-office work environments.
- Keep workers healthy, comfortable, injury-free, and productive on the job.
- Increase profitability by reducing the costs of workers' compensation, decreasing lost workdays, lowering turnover, reducing overtime, and decreasing the need to hire new workers to replace those who have been injured.
- Increase productivity and efficiency and help organizations use their assets more effectively
- Enhance the value of the furniture and equipment purchased for employees by training them to receive maximum benefit from these assets.
- Boost employee morale, since employees see that the organization cares enough about them to help protect them from injuries.
- Improve the quality of life for workers at the workplace.

F. PRIVACY

Privacy is a central regulatory human process by which persons make themselves more or less accessible to others. In an office environment, privacy may be manipulated through the use of partitions which protect the individual from physical, visual and acoustical intrusion. The plan of an office environment establishes the privacy level at which the office functions.

Privacy in terms of four overlapping components:

- Acoustical
- Visual
- Territorial
- Informational

Acoustical Privacy

"While some sounds may be meaningful to the person or group that creates them, those same sounds may be considered noise by the people they bother."-Workplace Privacy: Steelcase

People may feel they have acoustical privacy when they can work undisturbed by noise or when they can create noise of their own without disturbing other people.

A recent survey of office workers, co-sponsored by the American Society of Interior Designers, Steelcase, Armstrong World Industries, and other workplace industry manufacturers, found that

• 71% of respondents find noise the most significant workplace distraction

• 81% believe a quieter environment would help them be more productive

While people may be more easily bothered by sounds they can't control or don't expect, not all sound is bad. It can be bad if it's distracting people who are trying to concentrate on a task. It can be good when it motivates people to perform at higher levels. And while some people need high levels of quiet when they work, some people concentrate better with some sort of background hum. Having some background sound can help people feel more comfortable that what they're saying won't stand out against the backdrop of the office.

Just as too much noise can cause stress and impede productivity; too much quiet can actually interfere with the ability to focus. If it's so quiet you can hear the proverbial pin drop, the sound of that pin dropping will be distracting. Similarly, too much quiet can hamper effective communication. People may feel reluctant to discuss confidential information if they think other people will be able to understand their words.

Traditional drywall offices are not always a foolproof solution for people requiring conversational privacy. If the ceiling above a room isn't sealed, conversations may travel into adjacent work spaces.

Visual Privacy

"Too much visual privacy can lead to feelings of isolation. Too little visual privacy can leave people feeling exposed."-Workplace Privacy: Steelcase

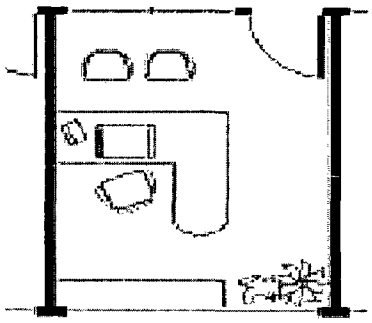


Fig. 2.16 Visual control is a key to visual privacy

Visual privacy addresses the ability to limit other's view of oneself. Inherent in human behavior is the tendency to avoid situations in which one can be watched without being aware of who is watching. Visual privacy can be achieved through the use of furnishings, partitions or walls. In a private space or an office, people will often orient their desk in order to visually control the doorway and achieve a visually private space on one side of the desk (Fig.). Similarly, people prefer to sit with a protected back, controlling the area they cannot see directly. In restaurants, the first seats to be filled are usually those along the walls. In outdoor spaces, people tend to sit against or beside objects such as trees and bushes rather than in the open.

Territorial Privacy

"Human beings have an innate need to stake claim to a piece of ground. And once we have it, we mark it and control access to it with fences, walls, and gates."-Workplace Privacy: Steelcase

Having a place to call our own often contributes to our sense of self-worth and personal identity.

The desire for territorial privacy carries into the office. People are running so much faster than before, juggling more projects, working longer hours, and dealing with more complex

information. They need a place where they can retreat, regroup, refuel. They need an environment where they can set out photos and plants, create piles of papers and books, put up their feet without getting in anyone else's way.

Teams also need some measure of territorial privacy. Members of a newly formed team may bond faster and enjoy greater cohesiveness if given a project room of their own. They may achieve this form of privacy in a dedicated room that is under their control. Or, they may claim an area on a temporary basis, enclosing their group with easels, rolling files, screens, and other privacy-enhancing tools.

Informational privacy

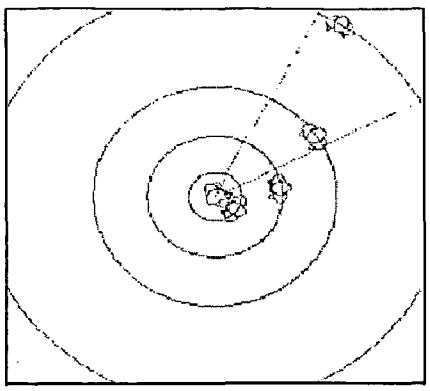
"When people have informational privacy, they feel comfortable that others won't interrupt a confidential meeting, and can't read confidential documents in their workspace." -Workplace Privacy: Steelcase

Achieving informational privacy may require having a door to close on a meeting and thinking twice about what is left in view when you're not in your workspace. It may require sitting at your desk in a way that approaching people can't read over your shoulder. It may involve having a drawer or other place to easily store documents so they can't be read upside down by someone sitting or standing in front of you.

Teams with sufficient informational privacy can benefit from uninterrupted conversation and smoother workflow. A team with an assigned project room — a room that locks and which they don't have to set up each time they come in or clean before they leave — can quickly pick up where they left off every time they meet.

G. INTERACTION/COMMUNICATION

Definition of an individual's **interaction levels** is one mechanism used in achieving a desired level of privacy. Besides needing enough space to move about and perform various tasks, each person moves within a domain that expands and contracts to meet individual needs and social circumstances. The size of a space determines perceptions, experiences, and uses of that particular environment.



People inherently distinguish their relationship with others in terms of distances, or spaces, between them. Edward T. Hall defines four distinct distances at which interpersonal transactions normally take place. These are categorized as intimate, personal, social, and public.

Fig. 2.17 Levels of space: Intimate, Personal, Social and Public.

- **Intimate space** is that area immediately surrounding the individual's body. This area is the most private and involves both physical and emotional interactions.
- **Personal space** is that area within which a person allows only select friends, or fellow workers with whom personal conversation is fixed.
- **Social space** is that area within which the individual expects to make purely social contacts on a temporary basis.
- **Public space** is that area within which the individual does not expect to have direct contact with others. The more intimate the spatial relationship, the more people resist intrusion by others. Personal space factors are important in establishing privacy requirements for interior design.

2.6 OVERVIEW OF ADVANCE TECHNOLOGY RELATED TO EFFICIENT WORKSPACES

2.6.1 Underfloor Air Distribution

Underfloor Air Distribution (UFAD) is a method of delivering space conditioning in offices and other commercial buildings that is increasingly being considered as a serious alternative to conventional ceiling-based air distribution systems because of the significant benefits that it can provide. This technology uses the open space (underfloor plenum) between the structural concrete slab and the underside of a raised access floor system to deliver conditioned air directly into the occupied zone of the building. Air can be delivered through a variety of supply outlets located at floor level (most common), or as part of the furniture and partitions.

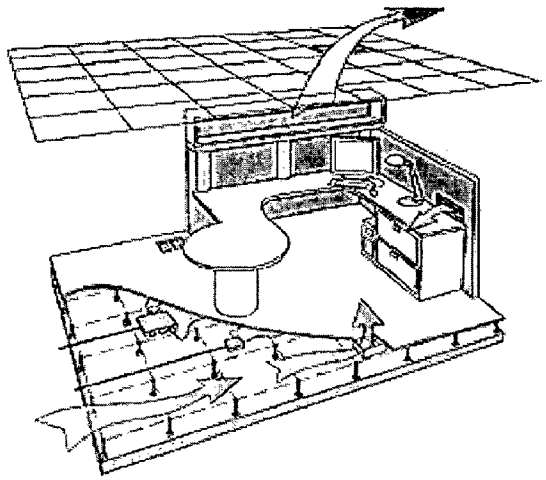


Fig 2.18 Underfloor Air Distribution

UFAD systems have several potential advantages over traditional overhead systems, including improved thermal comfort, improved indoor air quality, and reduced energy use. By combining a building's heating, ventilating, and air-conditioning (HVAC) system with all major power, voice, and data cabling into one easily accessible service plenum under the raised floor, significant improvements can be realized in terms of increased flexibility and reduced costs associated with reconfiguring building services. These raised floor systems are particularly appropriate for office buildings housing today's businesses with their typically extensive use of information technologies and high churn rates.

2.6.2 System Description

For purposes of introducing the concept of an underfloor air distribution system, it is instructive to identify how these systems differ from conventional ceiling-based air distribution systems. Fig. 2.19 and Fig. 2.20 show schematic diagrams of an overhead

system and an UFAD system, respectively, for a cooling application in an open-plan office building.

Historically, the approach to HVAC design in commercial buildings has been to supply conditioned air through extensive duct networks to an array of diffusers spaced evenly in the ceiling. As shown in Fig.2.19, conditioned air is both supplied and returned at ceiling level. Ceiling plenums are typically quite large to accommodate the large supply ducts that must fit through them. Return air is most commonly configured as an un-ducted ceiling plenum return. Often referred to as mixing-type air distribution, conventional HVAC systems are designed to promote complete mixing of supply air with room air, thereby maintaining the entire volume of air in the space (floor-to-ceiling) at the desired setpoint temperature and ensuring that an adequate supply of fresh outside air is delivered to the building occupants. This control strategy provides no opportunity to accommodate different thermal preferences among the building occupants or to provide preferential ventilation in the occupied zone.

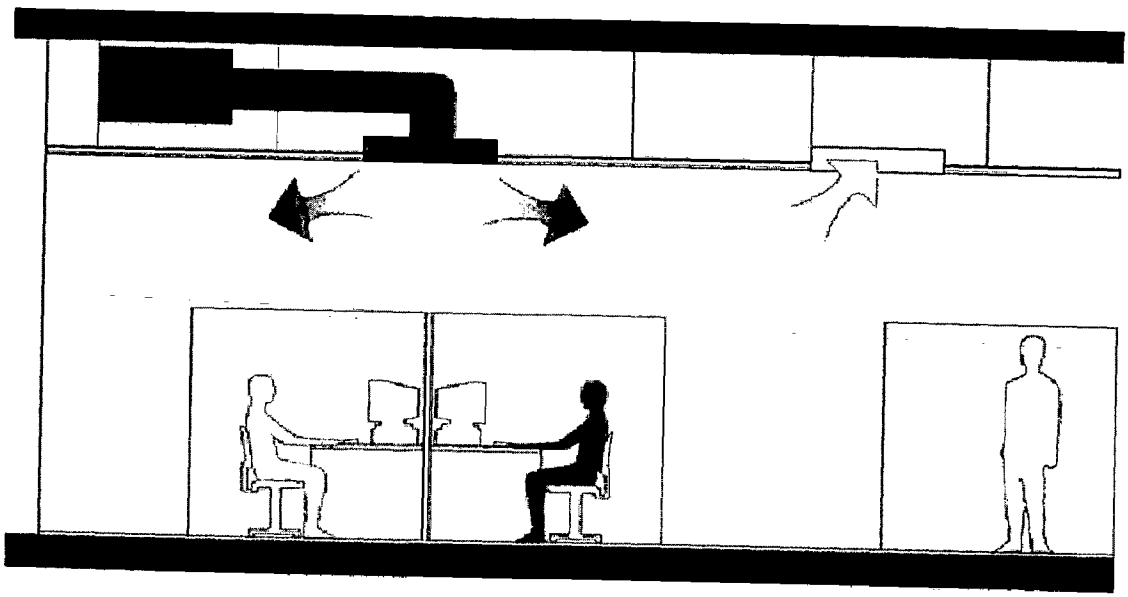


Fig. 2.19 Conventional overhead air distribution system

With UFAD systems, conditioned air from the air handling unit (AHU) is ducted into the underfloor plenum where it typically flows freely to the supply outlets. Underfloor systems are generally configured to have a relatively large number of smaller supply outlets, many in close proximity to the building occupants, as compared to a conventional overhead system. Outlets may be floor diffusers, as shown in Figure 2.20, or, particularly when part

of a task/ambient conditioning (TAC) system, desktop or partition outlets equipped with individual control. If the outlets are adjustable, this arrangement provides an opportunity for nearby occupants to have some amount of control over thermal comfort conditions in their local environment. Air is returned from the room at ceiling level (un-ducted plenum return is shown). This produces an overall floor-to-ceiling air flow pattern that takes advantage of the natural buoyancy produced by heat sources in the office and more efficiently removes heat loads and contaminants from the space, particularly for cooling applications. In contrast to the well-mixed room air conditions of the conventional overhead system, stratification is actually encouraged above head height where increased temperatures and higher levels of pollutants will not affect the occupants.

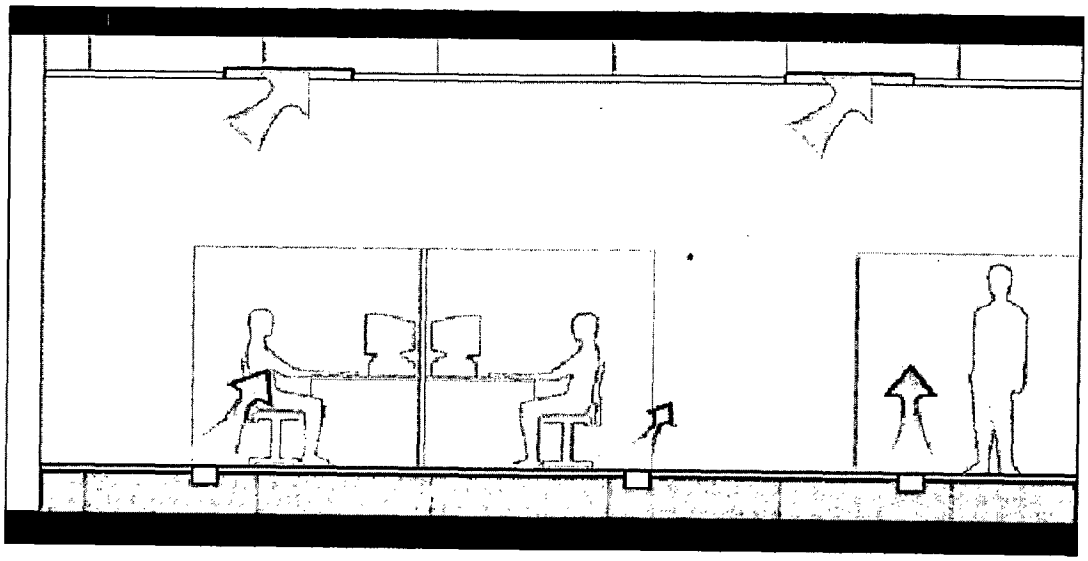


Fig. 2.20 Underfloor air distribution (UFAD) system

Although not shown in Fig. 2.20, there are three basic approaches to configuring the supply-air side of an UFAD system:

1. pressurized underfloor plenum with a central air handler delivering air through the plenum and into the space through passive grills/diffusers;
2. zero-pressure plenum with air delivered to the space through local fan-driven supply outlets in combination with the central air handler; and
3. in some arrangements the supply air is ducted through the underfloor plenum to the supply outlets, although in this last configuration certain energy and cost benefits may be reduced compared to the first two approaches.

2.6.3 UFAD Technology Benefits

UFAD systems have several potential advantages over traditional ceiling-based air distribution systems. Well-engineered systems can provide:

1. **Improved thermal comfort**. By allowing individual workers to have some amount of control over their local thermal environment, individual comfort preferences can be accommodated.
2. **Improved ventilation efficiency and indoor air quality**. Some improvement in indoor air quality can be achieved by delivering the fresh supply air near the occupant at floor or desktop level, allowing an overall floor-to-ceiling air flow pattern to more efficiently remove contaminants from the occupied zone of the space.
3. **Reduced energy use**. Energy use can be reduced through a variety of strategies including controlled thermal stratification, higher supply air temperatures, and reduced static pressures in the underfloor plenum.
4. **Reduced life cycle building costs**. Raised access flooring provides maximum flexibility and significantly lower costs associated with reconfiguring building services.
5. **Reduced floor-to-floor height in new construction.** UFAD systems can lead to reduced overall service plenum heights compared to conventional overhead systems. A single large overhead plenum to accommodate large supply ducts can be replaced with a smaller ceiling plenum for air return combined with a lower height underfloor plenum for un-ducted air flow and other building services.
6. **Improved occupant satisfaction and productivity.** Research evidence is mounting that occupant satisfaction and productivity can be increased by giving individuals greater control over their local environment.

2.6.4 Typical Office Work Space

The diagram below shows a typical workspace conditioned by an underfloor air distribution system and identifies the system components that contribute to operation at the local workstation level.

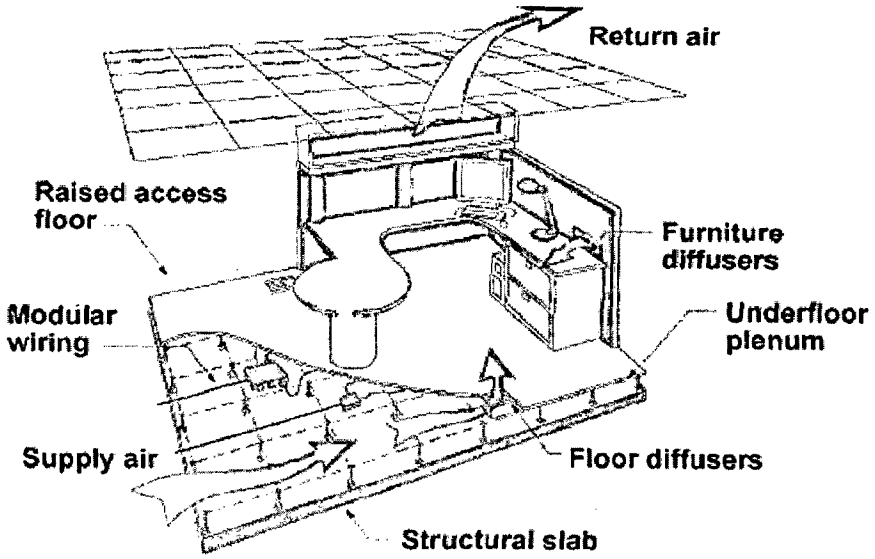


Fig 2.21 UFAD-Typical Office Workspace

2.6.5 Raised Floor

A typical raised floor consists of modular, load-bearing, concrete-filled steel floor panels 0.6 m x 0.6 m (2 ft x 2 ft) square supported on pedestals at a height of 0.3 - 0.46m (12 - 18 in.) above the concrete structural slab of the building. The pedestals are glued to the structural slab and the panels are typically attached with a screw to a pedestal at each corner, allowing them to be easily lifted and removed for access to cabling or equipment within the underfloor plenum.

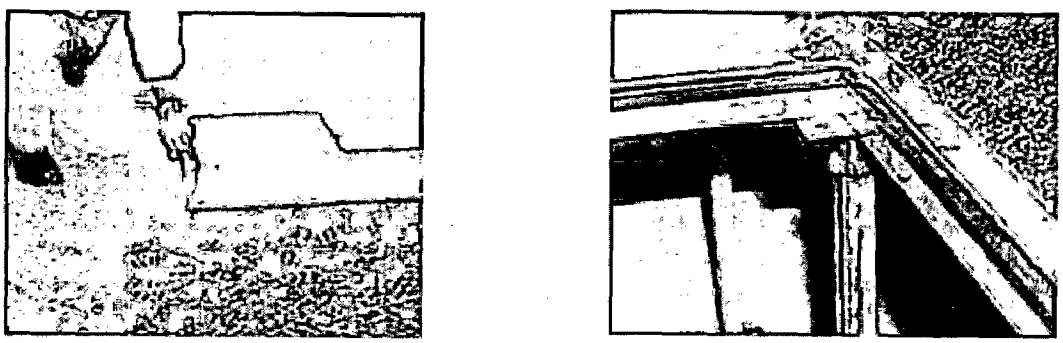


Fig 2.22 UFAD-Raised Floor

Openings can be cut in the panels for workstation connections to voice, power and data cabling, or for the insertion of UFAD floor diffusers. Many raised floors have carpet tiles laid on top, to provide a finished surface, which also permit the easy insertion of corresponding openings. Such flexibility is important considering the high churn rates of contemporary buildings.

2.6.6 Modular Wiring

Most contemporary office buildings are equipped with a raised floor for the purpose of routing voice, power and data cabling to each workspace. By integrating an UFAD system within the plenum created by a raised floor, an integrated services-distribution zone, or technology platform, is created which, in contrast to ceiling-based HVAC, reduces the costs of installing two separate systems of ducting and cabling, one overhead (air) and one underfloor (voice, power and data).

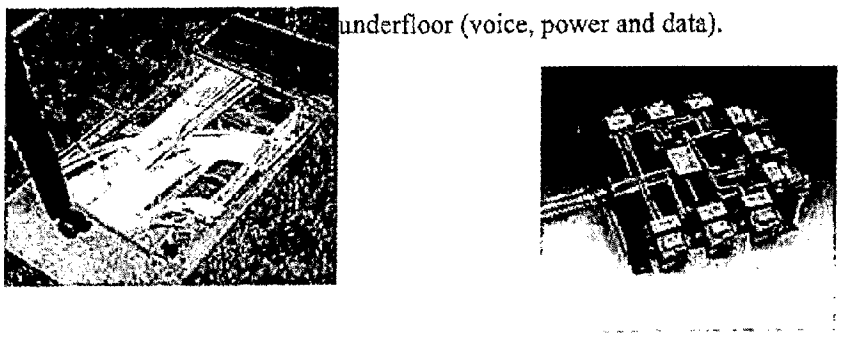


Fig 2.22 UFAD-Modular Wiring

Underfloor modular cabling easily facilitates technology upgrades, equipment expansion, changes in office layout and maintenance work as access floor panels can be simply removed, replaced or changed by in-house personnel. The quick access to cabling and flexibility of routing options reduces restrictions typically encountered with ceiling-based systems. These include limited scope for alternative space planning or expansions in equipment loading due to the location of HVAC, power and telecommunications inlets/outlets.

2.6.7 Supply Air

Supply air containing at least the minimum volume of outside air is filtered and conditioned to the required temperature and humidity. It is then delivered by the AHU to an underfloor plenum, traveling through a shorter distance of ductwork than for ceiling-

based systems. Within the plenum, air flows freely and enters the workspace through diffusers at floor level or as part of the furniture or partitions. Because the air is supplied directly into the occupied zone, supply outlet temperatures are generally maintained no lower than in the range of 17-20°C (63-68°F) to avoid uncomfortably cool conditions for the nearby occupants. Under suitable climate conditions, this greatly increases the availability of outside air economizer use and also allows higher cooling coil temperatures to be used, if desired, thereby increasing chiller efficiencies.

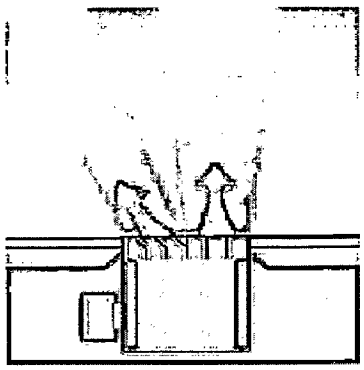


Fig 2.23 UFAD-Supply Air

Improved indoor air quality is expected by delivering the fresh supply air near the occupant at floor or desktop level, allowing an overall floor-to-ceiling air flow pattern to more efficiently remove contaminants from the occupied zone of the space. Under cooling conditions, an optimized strategy is to control supply outlets to allow mixing of supply air with room air only up to head height (6 ft [1.8 m]). Above this height, stratified and more polluted air is allowed to occur. The air that the occupant breathes will have a lower percentage of exhaust compared to conventional uniformly mixed systems. Another benefit of providing local air supply is that it improves air motion in the space and prevents the sensation of stagnant air conditions, often associated with poor air quality.

2.6.8 Structural Slab

Because the supply air in the underfloor plenum is in direct contact with the concrete structural slab, a number of energy- and cost-saving strategies are possible with underfloor air distribution systems. The underfloor thermal mass also has the effect of providing a consistent cool air temperature reservoir (for cooling applications), making UFAD systems extremely stable in their operation.

Thermal storage strategies can be used in temperate climates (cool night air temperatures, low humidity), where ventilating the underfloor plenum with nighttime air (termed nighttime pre-cooling, or night ventilation) effectively cools the slab overnight. During the following day's cooling operation, higher supply air temperatures from the mechanical system can be delivered to the underfloor plenum, thereby reducing refrigeration loads for at least part of the day. This 24-hour thermal storage strategy benefits from lower off-peak utility rates, extends the hours of economizer operation, and enables potential downsizing of equipment.

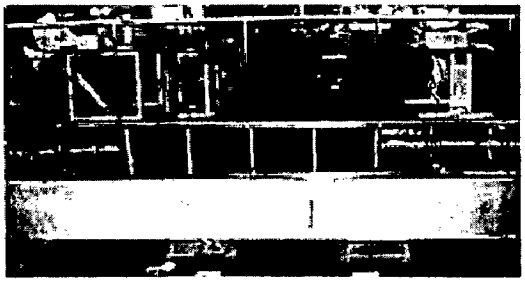
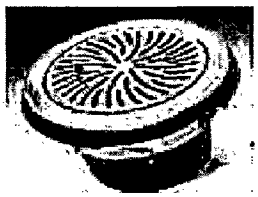


Fig 2.24 UFAD-Structural Slab

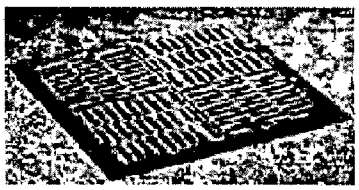
2.6.9 Diffusers

Floor-based Diffusers

Floor-based diffusers can be positioned anywhere within an office plan, as all models are designed to be installed in a single raised access floor panel, typically 0.6 m (24 in.) square. This configuration allows maximum flexibility in placing a floor diffuser, provided the locations of any underfloor HVAC components are taken into account.



Swirl diffusers



constant velocity floor diffuser

linear floor grills

Fig 2.25 UFAD-Diffusers

Swirl floor diffusers are the most commonly installed type of diffuser in UFAD systems, other options include square-grill diffusers. Swirl diffusers are generally installed as passive diffusers, requiring a pressurized underfloor plenum.

Linear grills are typically used only in perimeter zones, as shown in the fig, and often incorporate finned-tube heating elements for winter heating periods.

Furniture-based Diffusers

Diffusers that are more frequently associated with TAC systems - as they provide a high degree of individual control- are typically installed above the floor, as part of the furniture or partitions. Air is delivered to these TAC diffusers through flexible ductwork or other passageways that are either integrated into the furniture or immediately adjacent to it.

Occupant Control

Within a standard office space, under the uniform well-mixed temperatures of a conventional ceiling based system there will be some occupants who are too cool, others too warm. As an example, a person walking around continuously in an office will experience an effective temperature of the environment approximately 3 to 5°F (2 to 3°C) warmer than that of a person sitting quietly at their desk, depending on their respective clothing levels. User-controlled diffusers enable occupants to fine tune conditions in their workstation, thereby accommodating the significant variations in individual comfort levels that may occur due to differences in clothing, activity and personal preferences.

2.6.10 Underfloor Plenum

An underfloor plenum is the open space between a structural concrete slab and the underside of a raised access floor system. Commonly used as the service plenum for distributing power, voice, and data cabling, in UFAD systems supply air is also delivered through this space. The installation process for both air and cabling systems are similar, reducing the construction costs associated with conventional practices of separating overhead air and standard methods of cable management. An accessible service plenum located directly below the floor has proven to be very effective for cable management. In the case of UFAD systems, it not only allows fresh conditioned air to be delivered near the occupants, but also provides an opportunity for occupants to have control over this air flow.

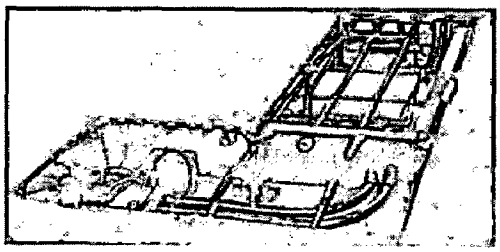


Fig 2.26 UFAD-Underfloor Plenum

2.6.11 Return Air

Warm, more polluted air is removed from the room near ceiling level (typically through return grilles located in a suspended ceiling, or through high side-wall grilles if no ceiling plenum is present) for optimal operation of the UFAD system. This supports an overall floor-to-ceiling air flow pattern that takes advantage of the natural buoyancy produced by heat sources in the office and more efficiently removes heat loads and contaminants from the space.

A certain portion of return air is mixed with primary air from the AHU to achieve desired air temperatures and humidity, and enable reduced energy costs. In many climates to achieve proper humidity control, conventional cooling coil temperatures must be used (producing a coil leaving temperature of 55°F (12.8°C)). In this situation, a return air bypass control strategy can be employed in which a portion of the return air is bypassed around the cooling coil and then mixed with the air leaving the coil to produce the desired warmer supply air temperature (63-68°F [17-20°C]).

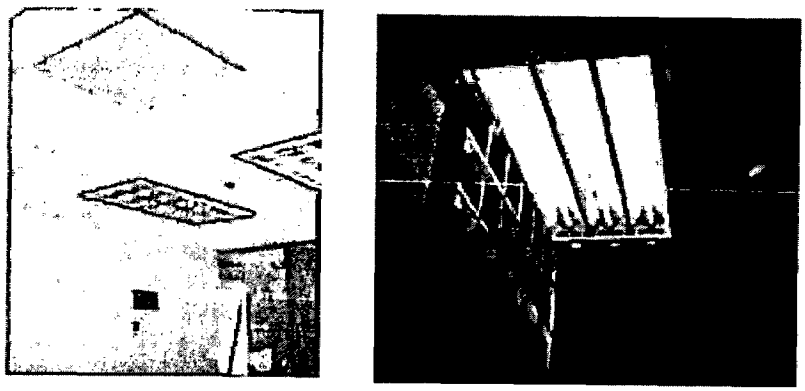


Fig 2.27 UFAD-Return Air

STUDY OF STANDARD FOR OFFICE SPACES

The aim is to study of various standards and guidelines given by different organizations for office workspaces and different aspects related to efficient work environment.

Topics covered in this chapter

- Equal Opportunity Facilities, Designing for Universal Accommodation (Source: Herman Miller)
- Office Ergonomics Handbook (Source: Occupational Health Clinics for Ontario Workers Inc.)
- Workplace Privacy: A Changing Equation (Source: Steelcase)
- Prevention of IAQ Problems in Offices (Source: Aerias, USA)

CHAPTER 3

3. STUDY OF STANDARDS AND GUIDELINES

- Equal Opportunity Facilities, Designing for Universal Accommodation (Source: Herman Miller)
- Office Ergonomics Handbook (Source: Occupational Health Clinics for Ontario Workers Inc.)
- Workplace Privacy: A Changing Equation (Source: Steelcase)
- Prevention of IAQ Problems in Offices (Source: Aerias, USA)

3.1 EQUAL OPPORTUNITY FACILITIES, DESIGNING FOR UNIVERSAL ACCOMMODATION (Source: Herman Miller)

3.1.1 Aim

Universal design is the idea of designing for the widest possible range of ability with as few barriers as possible. The following section offers some practical suggestions for making facilities more accessible.

3.1.2 Layout

It is difficult to generalize about basic floor plans, but a more barrier free layout might require that facility managers evaluate the most commonly traveled routes with mobility limitations in mind.

- get together to interact easily and informally.
- an accessible path to conference rooms.
- get to common areas such as a cafeteria or a copy machine room.

3.1.3 Office furniture

This is of course, another highly complex factor because of the many choices available. Facility managers can narrow those choices by remembering that versatility and adjustability are fundamental concepts in universal design. Systems furniture with panel systems that have a wide selection of hanging components adjustable in small increments can support a variety of individual work styles and limitations.

3.1.4 Desks

- Feature adjustability of height and angle of work surface are best; electronic adjustment is ideal.
- For knee-well width, a minimum of 30 inches will ensure enough space to accommodate the width of most wheelchairs.
- A desk with a minimum knee-well depth of 19 inches allows the person who uses a wheelchair footrest to sit comfortably at the desk without the footrest bumping the back wall of the desk.
- As for work surface depth, 38 inches is the maximum, since deeper work surfaces make it difficult for a person with limited reach to retrieve objects from the outer edge.
- Work surfaces should be no more than two inches thick; otherwise, once the work surface has been raised high enough to fit a wheelchair underneath, the top surface will be uncomfortably high.
- Matte or eggshell work surfaces are better than glossy ones, since the glare from highly reflective surfaces causes problems for those with perceptual disabilities or visual limitations by making the objects they *can* see less recognizable.

3.1.5 Storage

- Units should feature *U*-shaped handles that are four and one half inches wide with a one-and-one-half-inch clearance on the inside.
- Push latches that involve no grasping or pulling motions are the easiest types for people with manual limitations to operate because, as with *U*-shaped pulls, they require very little fine motor movement.
- Employees can arrange their own storage for accessibility. They should place most-used or bulkiest items between 36 and 48 inches above floor level and within at least six inches less than arm's length.
- Movable storage units reduce the amount of mobility required to gain access to storage.
- Open storage is preferable to closed storage for ease of access. If that is not available, side-hinged doors are preferable to doors that must be lifted or lowered.

3.1.6 Chairs

- Chairs need to be of good quality, properly fitting, adjustable;
- Chairs should allow the sitter to place both feet flat on the floor—many standard chairs are too high for smaller people.
- Chairs should also feature backrests and seat angles that adjust to support forward leaning and reclining postures.
- The extent and ease of adjustment are critically important. If adjustments require turning the chair over and wrestling with a stubborn release knob, most people won't bother, and the potential ergonomic benefits are lost.
- Some chair features can enable people with arthritis or other mobility limitations (including those associated with pregnancy) to rise from a chair more easily. These features include firm padding; long, firm armrests with a large grip area; and a large base so that users can place their feet directly under the body when rising.
- Locking casters and lift mechanisms—features taken from hospital or geriatric products—can help those with more extreme limitations.

3.1.7 Lighting

Proper lighting levels are important to prevent eyestrain for everyone, not just for those with visual limitations.

- The optimal ambient level is 300 to 500 lux,
- This lower ambient level should be supplemented with individually controlled task lighting. Older people, for instance, generally need more light than younger people.
- Workers, working with computers—should be able to adjust not only intensity but also angle in order to provide enough illumination while avoiding glare.
- Windows should be fitted with blinds whenever glare or strong backlighting might be a problem.
- The need for more light for older eyes can intensify glare problems, so older people especially need control over their lighting in order to achieve a comfortable situation.

3.1.8 Computer Ergonomic

Computers bring a number of ergonomic challenges into the office. Besides positioning the chair and work surface comfortably and achieving proper lighting configuration, the computer components themselves must be properly positioned.

- Keyboards should be movable and adjustable (0 to 15 degrees from horizontal) and not positioned too high—wrists should be flat and relaxed.
- The computer screen's center should be positioned 10 to 15 degrees below the line of sight.
- All glare, from windows, lights, and light-colored surfaces, should be reduced as much as possible. Dark-on-light displays are preferable to minimize glare as well.
- For radiation, a distance of about an arm's length from the screen is currently considered acceptable.
- Adjustable computer equipment used knowledgeably is important for everyone in order to prevent cumulative trauma injuries and eyestrain. But older workers, especially, need flexibility in their computer setups.
- Older people often wear bifocals, so that objects must be low and close or high and farther away in order to appear clear. So the ability to adjust the position of their equipment should be built into the workstations, along with the ability to adjust lighting.

3.1.9 Floors, doors, and walls

Floors, doors, and walls seem like mere background to those without disabilities, but they can become troublesome obstacles.

- Marking changes in level with contrasting color or brightness in order to warn those with vision limitations of the change in level.
- Thin, unpadded, loop-pile carpeting is easiest for those using crutches, walkers, or wheelchairs.
- Phone and electrical outlets should be positioned within easy reach rather than down near the floor.
- Slow-opening automatic doors reduce chances of injury and allow people to get in and out in plenty of time.

- Sound absorbing panel systems, carpeted floors, and certain wall materials help absorb general background noise.
- Individual workstations should have as much enclosure as possible in order to keep relevant sounds in and distracting sounds out.
- A sound-reflective material placed where the worker speaks on the phone or holds conferences helps that person hear his or her own voice better—so that she or he does not speak too loudly—and also helps the person hear others.

3.1.10 Emergency systems are the one element in the workplace that currently must be universal in design.

- Redundant alarms, which are auditory, visual, and tactile, can be perceived by everyone.
- Alarms should be placed close to emergency exits so that they can be used for guidance to the exit.
- Evacuation routes should be clearly marked with the access symbol.
- Informing local emergency services of specific needs for assistance is also an important measure.

It is tempting to look for the "good enough" facility solutions that merely comply with the law. But disabilities are not the exceptional circumstance they used to seem, and those responsible for facilities will have to seek more comprehensive, long-term solutions.

3.2 OFFICE ERGONOMICS HANDBOOK

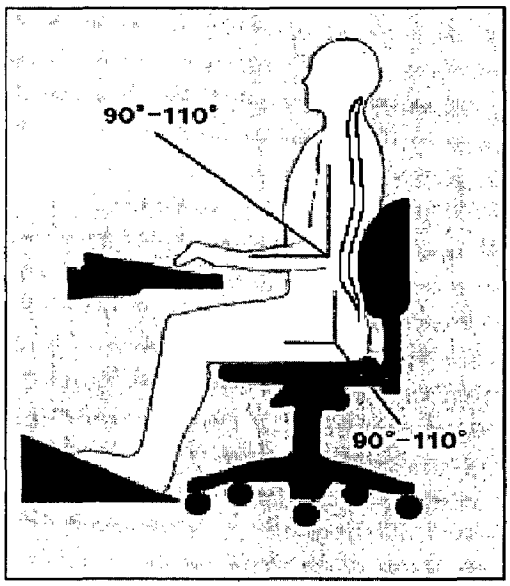
(Source: Occupational Health Clinics for Ontario Workers Inc.)

3.2.1Aim:

- Recommends practical and inexpensive ways to improve workstation layout and lighting
- Explains how to ensure good posture.

Check your posture

- Forearms held horizontally at about a 90-degree or right angle at the elbow, with your shoulders and upper arms relaxed
- Wrists in a neutral (straight) posture
- Head upright over your shoulders in a relaxed position, with your eyes looking slightly downward
- Backrest supporting your lower back, pelvis, and the natural curve of your spine
- Thighs resting horizontally with a 90- to 110-degree angle at the hips
- Feet fully supported by the floor or a footrest.



This silhouette shows the optimal angles and position of joints for sitting at a computer workstation. A posture that changes within a comfortable range is the best posture.

Fig. 3.1 Sitting Posture

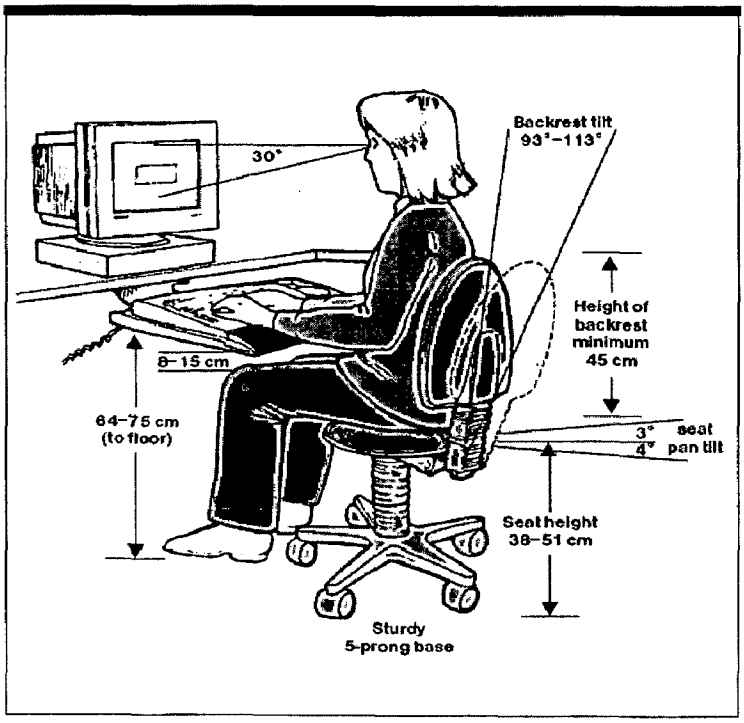
3.2.2 Adjust your chair

To adjust your chair to the proper height, raise or lower it so that:

- With your *forearms* horizontal and at right angles to your upper arms, your elbows just clear the top of the work surface you're using (desk or keyboard tray)
- Your wrists are *straight* when you place your hands on the keyboard or mouse

Footrest

- Have a non-slip surface large enough for both feet to rest comfortably (about 30 cm by 30 cm or one square foot).
- Be sloped to allow a comfortable ankle position when the feet are resting on it.
- You should be able to adjust the slope between 10 and 20 degrees.
- Be stable enough so it doesn't slide or move when your feet are on it.

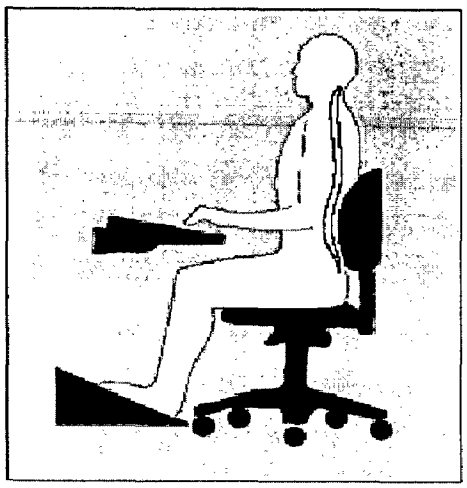


This drawing shows the recommended dimensions and adjustment ranges for the chair, monitor, keyboard, and work surfaces. The operator in this drawing is using good posture.

Fig. 3.2 Workstation Dimensions & Posture

Backrest

- The lower part of the backrest (the lumbar support) of your chair should support the curve of lower back.
- If your backrest is adjustable, raise or lower it so the lumbar support fits snugly against lower back.
- You should also be able to adjust your backrest forward and backward so that it is at an angle of 93 to 113 degrees.



The lower part of the backrest should support the curve of your lower back.

Fig. 3.3 Back Rest Position

Armrests

- When they help support your forearms or elbows, the armrests on your chair help take the stress off your shoulders and back.
- Your forearms should rest comfortably on the armrests, with your shoulders relaxed.
- Remove armrests if they prevent you from placing your chair at a comfortable typing or viewing distance from the screen.

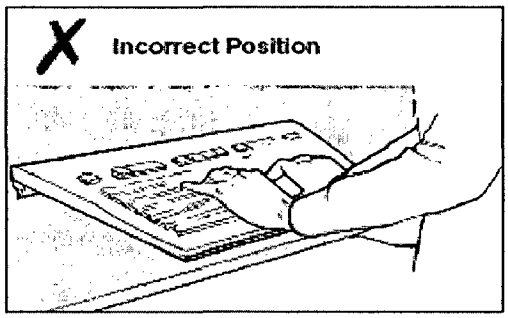
3.2.3 Computer Workstation:

Computer monitor

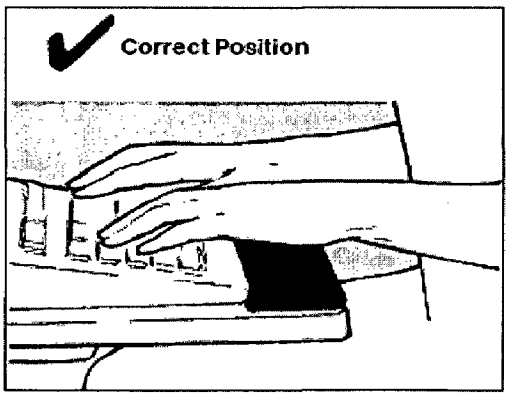
- The distance between your eyes and the screen should be about arm's length.
- The top line of text on your computer screen (not the top of the monitor) should be at eye level,

Keyboard

- Adjust your keyboard surface up or down so that your wrists are straight when your fingers are on the middle row of keys.
- Your work surface should be just below your elbows, with your forearms parallel to the floor.



Don't bend your wrists up (shown) or down while keyboarding.

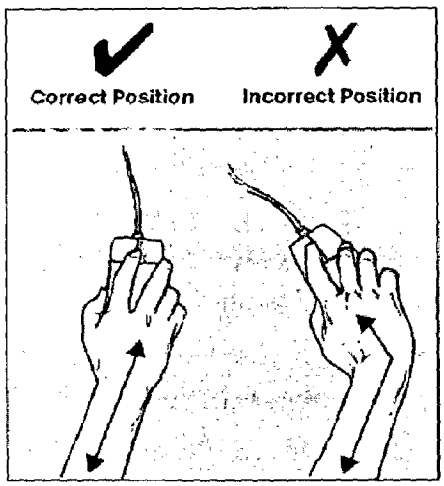


If your wrists are straight while keyboarding, you decrease the risk of injury.

Fig. 3.4 Keyboard Position

- Keep 5 to 10 centimeters (two to four inches) of space in front of the keyboard to rest your hands or to place a palm or wrist support.
- Keep your mouse at the same height and as close to your keyboard as practical.

- You may have to obtain a rest (extension to the keyboard surface) especially for your mouse as some computer furniture doesn't have room to place the mouse in the preferred position.
- Make sure you have enough space to move the mouse freely.

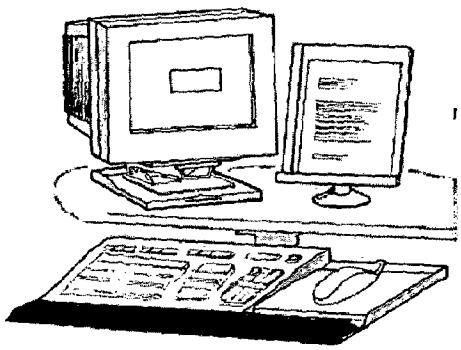


Keep your wrist straight during mouse work. Don't bend your wrist from side to side. Try to move your whole arm instead.

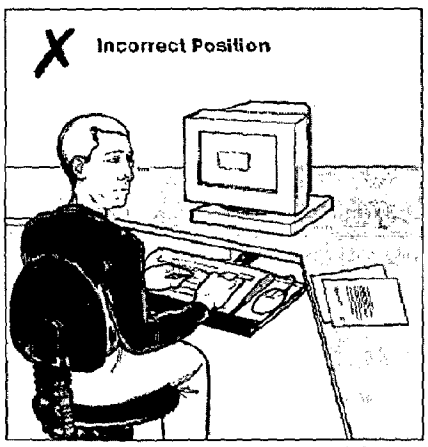
Fig. 3.5 Wrist Position

Documents

- Poor placement of the documents you look at while keyboarding may lead to muscle discomfort or eyestrain.



- If work is mostly data input, move the monitor to one side and place the document in front of you, at the same height and viewing distance as the monitor.



Poor placement of documents while keyboarding can lead to awkward postures.

Fig. 3.6 Document Placement

Organization of the work area

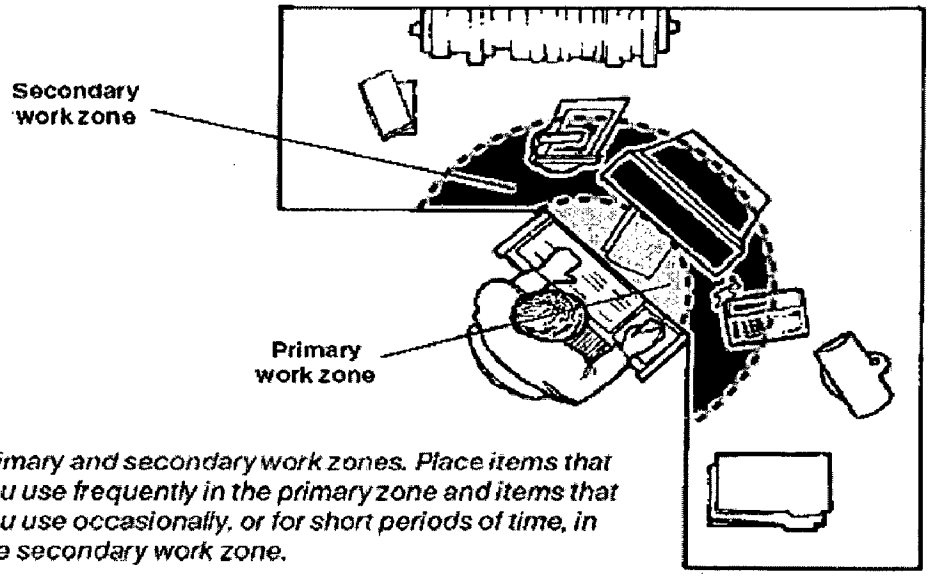


Fig. 3.7 Organization of Work Area

- The primary zone is your usual work area and is within easy reach (up to 30 centimeters or 12 inches from you).
- The secondary work zone is the area of occasional use (30 to 50 centimeters or 12 to 20 inches from you).
- Place materials and equipment that you use very infrequently in the area beyond the secondary zone.

Storage

- Workstation storage areas include overhead cupboards, book shelves, filing cabinets, and desk drawers.
- Store materials under your desk; don't clutter your leg space. You need room under your desk to vary your leg posutre throughout the day.

Lighting

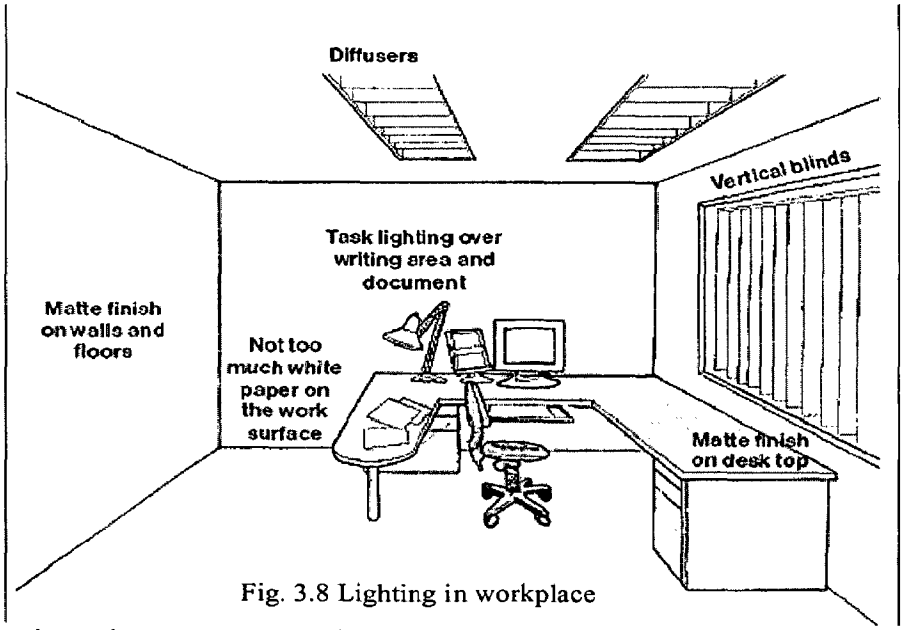


Fig. 3.8 Lighting in workplace

- Monitor glares control: Brightness and contrast adjusted
- Light-colored background on color monitor
- Monitor placed so that your line of sight is parallel to the window
- Monitor at right angle to work surface

3.3 WORKPLACE PRIVACY: A Changing Equation (Source: Steelcase)

With thoughtful planning, it's possible to augment elements of physical privacy (walls, panels, sound barriers) with the right mix of protocols (rules, guidelines, standards) to achieve the nature and level of privacy desired. For the physical setting, it's important to analyze employees' functional privacy needs and provide work settings with an appropriate range of privacy options.

Acoustical Privacy

- Build in some quiet spaces where people can retreat.
- Think integration: a high-absorption ceiling system and acoustical panels to absorb sound, vertical acoustical barriers for blocking sound, a sound masking system to cover sound.
- Separate noisy areas from quiet areas.
- High-pitched sounds like voices travel best in a straight line; minimize intrusions by blocking direct sight lines between people.
- Locate phones on opposite sides of adjacent workspaces so occupants face away from each other when talking on the phone.
- Seal openings in ceilings above rooms to prevent sounds from leaking through.
- Too much clutter on acoustical panels can diminish acoustical properties.

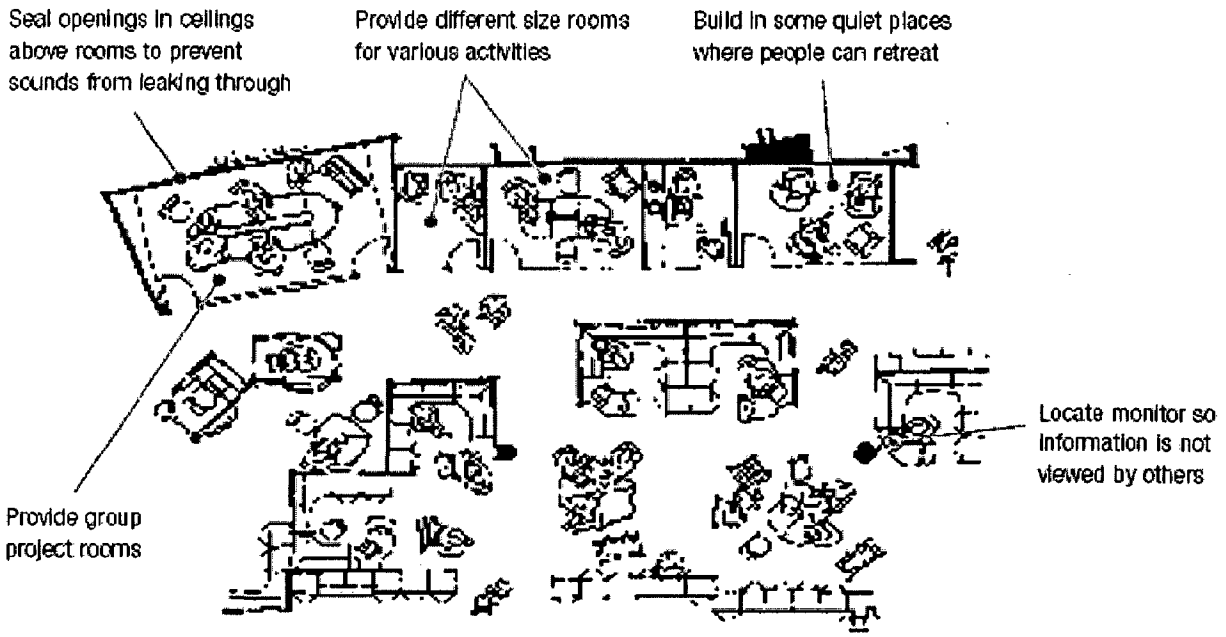


Fig. 3.9 Privacy in workplace -1

Visual Privacy

- Lay out space to direct general traffic away from work areas.
- Analyze people's functional needs for standing-height privacy vs seated height privacy.
- Use taller partitions, file cabinets, stacked screens, and upper storage components to provide standing height privacy.
- Use lower partitions, screens, or storage units for seated height privacy.
- Install window blinds or curtains in spaces with glass walls.
- Use opaque barriers where higher visual privacy is required.

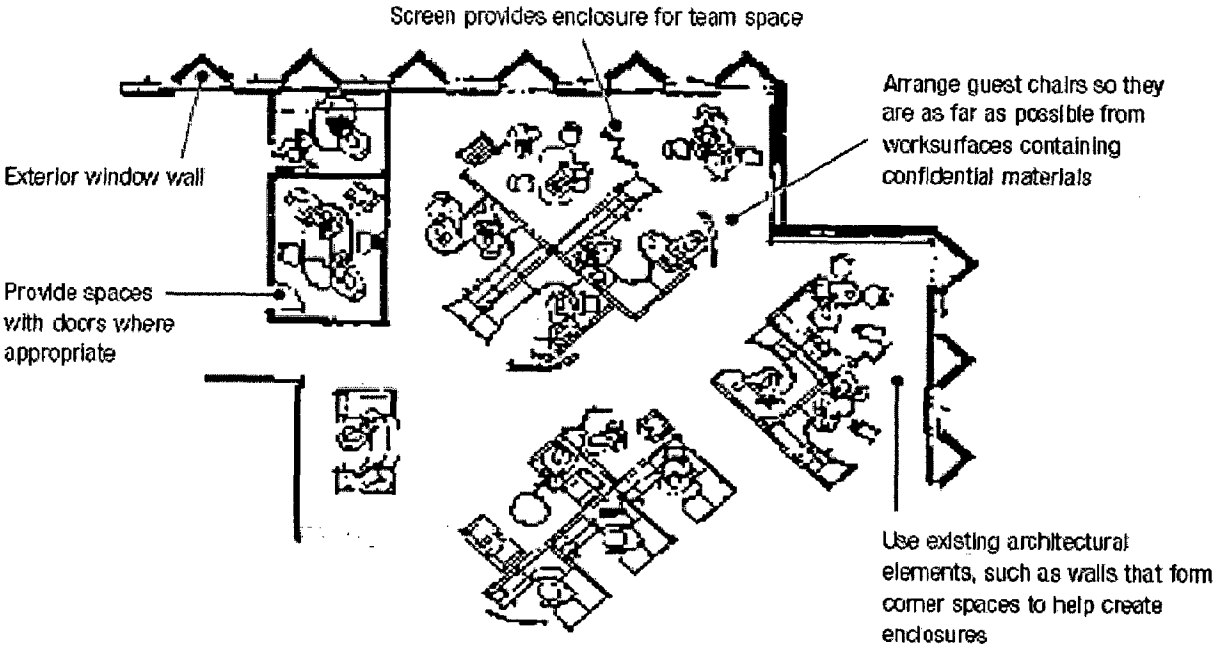


Fig. 3.10 Privacy in workplace -2

Territorial Privacy

- Establish clear boundaries between workspaces
- Locate team members near each other
- Lay out space to direct general traffic away from work areas
- Use existing architectural elements, such as walls that form corner spaces, to help create enclosure
- Orient workspaces so individuals don't face main aisles
- Isolate workers from main traffic patterns

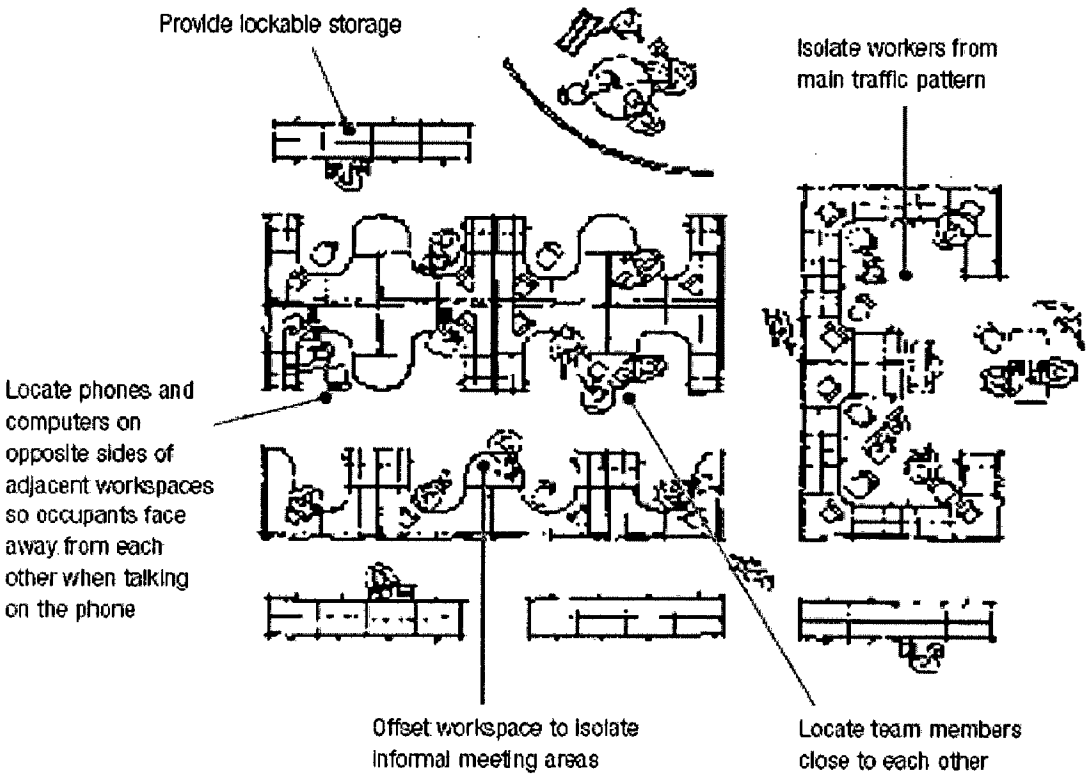


Fig. 3.11 Privacy in workplace -3

Informational Privacy

- provide spaces with doors where appropriate
- isolate workers from main traffic patterns
- place monitors in opposite corners of adjacent, low-boundary workspaces
- use screensavers on computer monitors
- provide lockable storage arrange guest chairs so they are as far as possible from work surfaces containing confidential materials.

3.4 PREVENTION OF IAQ PROBLEMS IN OFFICES (Source: Aerias, USA)

Preventing indoor air problems involves:

1. Control the pollutants and their sources

- Use less toxic, substitute maintenance materials (adhesives, paints and sealants, caulks, cleaners); art and writing supplies (markers, paints, cleaners); and graphic materials (formaldehyde-free carbonless paper, and odor-free transparencies).
- Only use the amount of chemicals that are absolutely needed and then use less toxic substitutes or eliminate the need for their use through other measures.
- Do not rely on widespread use of pesticides to control pests. Manage sources of pests and if pesticides are needed, choose carefully and use during unoccupied periods.
- Do not use chemicals such as pesticides and microbial agents in air handling ducts.
- Do not use fragrant deodorizers or odor masking chemicals and control use of personal care products that can generate VOCs and odors.
- Do not use ozone-generating air cleaners.
- Use furnishings and indoor materials that are low-emitting such as adhesives, carpets, hard surface flooring, desks, wallcoverings, and textiles. These can be sources of formaldehyde and other VOCs. Low-emitting materials are available and can be specified for use. Many formaldehyde-free products are available.
- Use low-emitting equipment such as printers, photocopiers, and computers. These can be sources of ozone, particles, and VOCs and need to be minimized. Printing equipment should be placed in well-ventilated areas.
- Conduct pollutant-producing activities during hours of non-occupancy such as roofing, painting, installation of flooring, heavy cleaning (stripping of floors and carpet cleaning), and remodeling. Make sure indoor areas are flushed of pollutants and odors before re-occupancy.
- Keep cars and delivery trucks away from outdoor air intakes.
- Keep all drain traps filled with water to prevent sewer gas odors.
- Clean the offices regularly. Carpets and upholstered furniture should be vacuumed daily with a high-efficiency filtering system. Hard floors should be mopped daily.

- Carpet cleaning should be conducted once or twice a year using systems that effectively remove allergens, mold, and dust and that do not contribute moisture. Carpets should be dry within 24 hours of the cleaning.
- Clean up all spills immediately. Dry all areas within 24 hours.
- Control sources of moisture that could lead to biological growth such as mold and fungi. Prevent water leaks and report all signs of excessive moisture (standing water; condensation on walls, windows, air supply grates; and discolored spots on walls and ceiling tile).
- Do not allow smoking in workspace, provide separate smoke zone.

2. Have good and proper ventilation with enough outside air.

- Ensure that outside air intakes are free from obstruction and clear of pollutant sources such as trash bins, cooling towers, vehicular exhaust, building exhaust vents, bird droppings, and debris.
- Ensure that outdoor air is entering intake vents
- Make sure filters are in place and they properly fit
- Make sure a maintenance and inspection plan is in place to service HVAC (air-conditioning) units to keep them free of water, clean and in good operating condition.
- Keep air ducts clean and dry
- Change air filters regularly and use a high-efficiency filter (30% minimum) if the ventilation system is powerful enough for one.
- Make sure enough outside air is being delivered to indoor areas and that it meets outdoor air specifications according to ASHRAE for the number of occupants. This is typically expressed in CFM of air per person. Carbon dioxide can be measured in an office to estimate if enough outside air is being delivered to the occupied spaces.
- Don't block any intake or return vents in rooms
- Provide local exhaust ventilation that vents to the outside for areas where there may be higher levels of pollutants and odors such as in bathrooms, chemical storage areas, copying and printing areas, and some vocational classrooms for activities such as welding.

3. **Maintain acceptable environmental conditions**

- Keep humidity levels between 40 and 60% for comfort and to prevent growth of mold, fungi, and dust mites
- Keep temperatures between 72° F and 76° F
- Control draftiness
- Prevent glare and/or direct sunlight from shining in

CASE STUDY

Topics covered in this chapter

- Case study 1. Alcatel, Gurgaon
- Case study 2. Sapient, Gurgaon
- Case study 3. Upshot, Chicago
- Case study 4. eEmerge, New York
- Case study 5. Clickthings, New York
- Observations of Case Studies

CHAPTER 4

4.1 DESIGN ANALYSIS OF CASE STUDIES

From literature study it is identified that the efficient work environment in corporate offices can be achieved with the help of following factors:

- Ergonomics, Workstation Controls
- Functional Efficiency: Space, Layout
- Indoor Air Quality
- Interaction/Communication
- Privacy: Visual, Acoustical, Informational, Territoriality
- Lighting
- Thermal Comfort: Temperature, Humidity
- Color

The following case studies will be analyzed for the above said points to frame the design considerations for efficient work environment in corporate offices:

- Case study 1. Alcatel, Gurgaon
- Case study 2. Sapient, Gurgaon
- Case study 3. Upshot, Chicago
- Case study 4. eEmerge, New York
- Case study 5. Clickthings, New York

4.2 CASE STUDY 1. ALCATEL, GURGAON

Located at Fortune Towers Plot No. 406, Phase - III, Udyog Vihar, Gurgaon. Alcatel is a European firm having 56,000 employees in 130 countries. Alcatel is a leading provider of end-to-end telecommunications and Internet based solutions in India.

4.2.1 General Information

Total Area = 4800.00sqm approx

No. of floors = 4

No. of Employees = 320

Workstation Layout: enclosed workstation

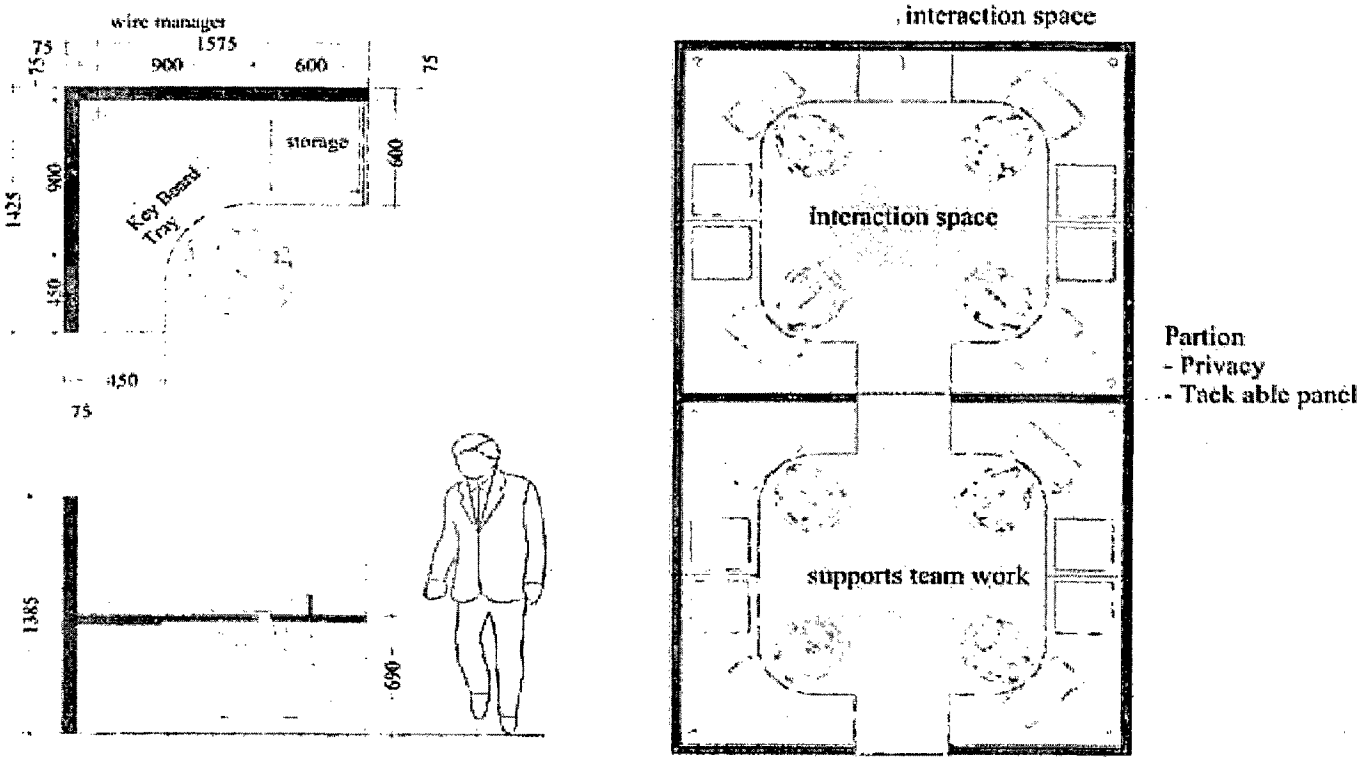


Fig 4.1 Workstation layout

The building having four level, one basement & three other floors. Conceptually space is divided into two part, one work zone and other recreational i.e. basement floor. Other floors levels are used for workstations, offices & meetings rooms.

4.2.2 Reception/Administrative desk:

The dull & uni color reception at the entrance with conventional waiting area at one corner, fails to impress any visitor & employee. Existence of Reception lobby just to fulfils the formality of welcome. No attachment or feel of entering in a multinational corporate building.

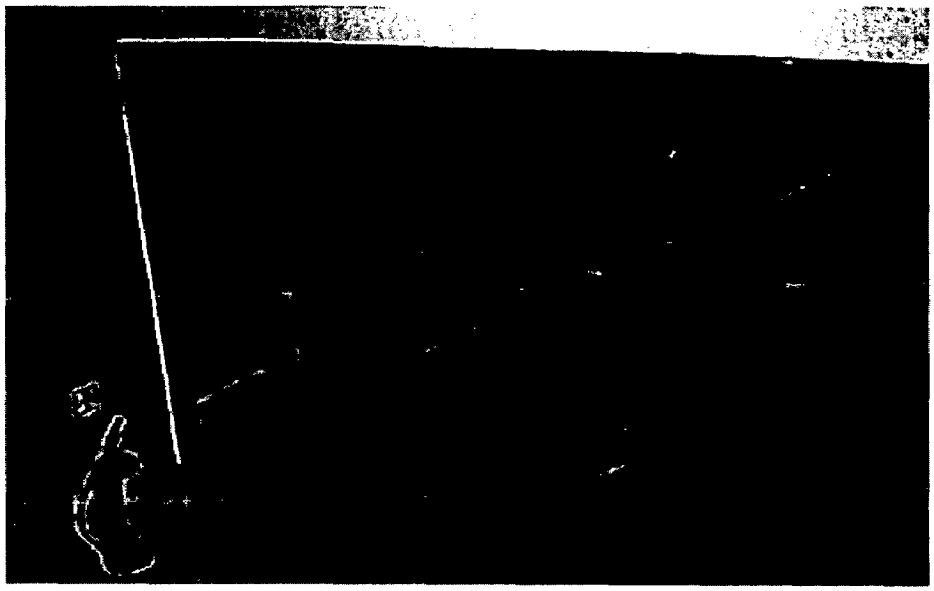


Fig 4.2 Reception Alcatel

Fig 4.3 Administrative Desk

On each work floor, well equipped administrative desk provide official information & support like printing, fax, copier into the space.

4.2.3 Workstations & Offices:

Contrary to the reception lobby, working area is well lit & colorful. Most of the employees work at cube workstations. Enclosed offices are reserved for senior team managers.

Workstations (5'0' x 5'0') have tack able panels on two sides which help in giving privacy & focus on work.

Private office 10' x 8' with one side screen wall which gives privacy as well as vision.

Setup of computer system on workstation is not efficient, employees facing problem in using the keyboard & mouse.

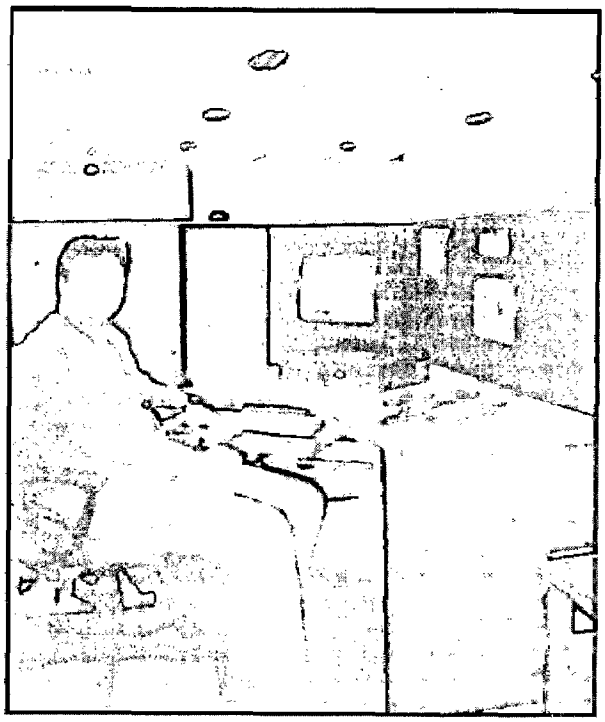
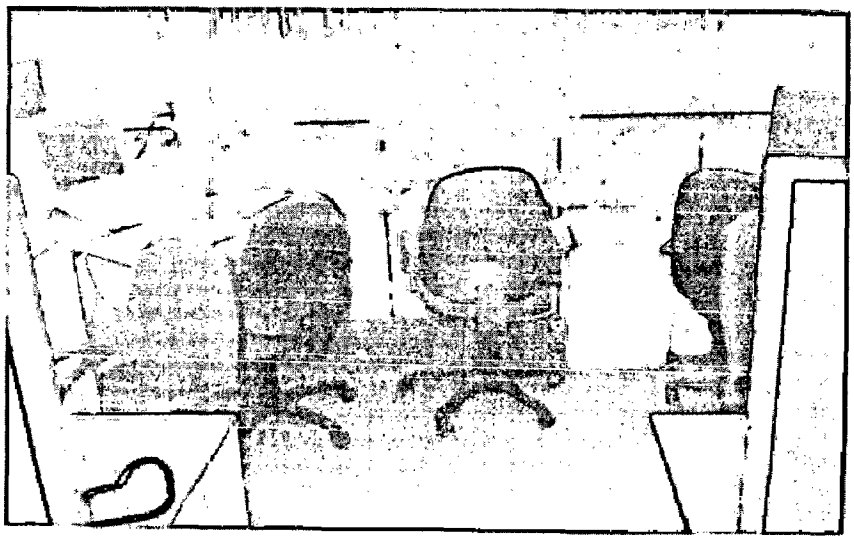


Fig 4.4 Workstation View

A small work surface is created between workstations, used as a means of interaction.



Workstations near the peripheral wall enjoys outside view & natural light.

Desk storage for keeping different official & personal documents & belongings.

Fig 4.5 Workstation Cluster

4.2.4 Meeting/Conference Rooms:

To keep attachment and social belongingness designer named different rooms & areas. Whole scheme is based on an education like training room named as Taxila, Aryabhatta, Bhaskar & Charak. Meeting rooms named as Charankya.

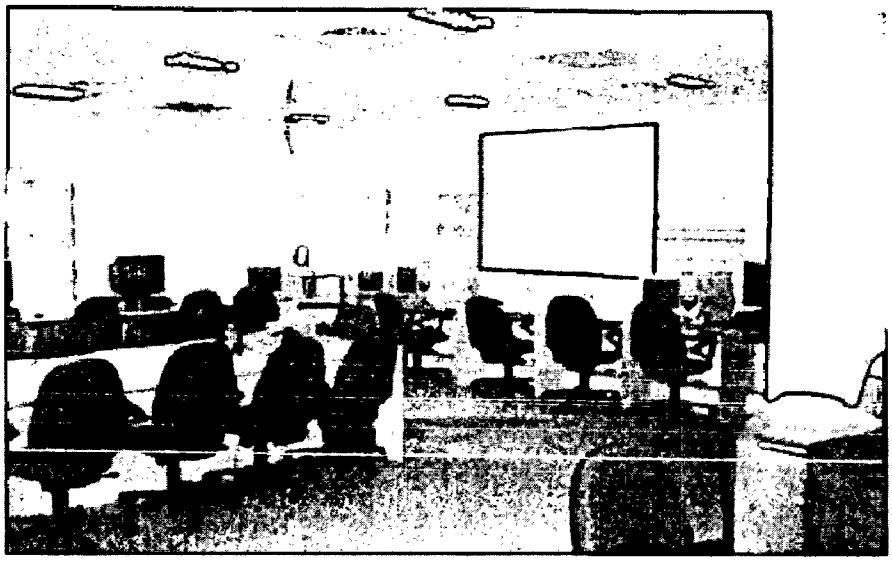
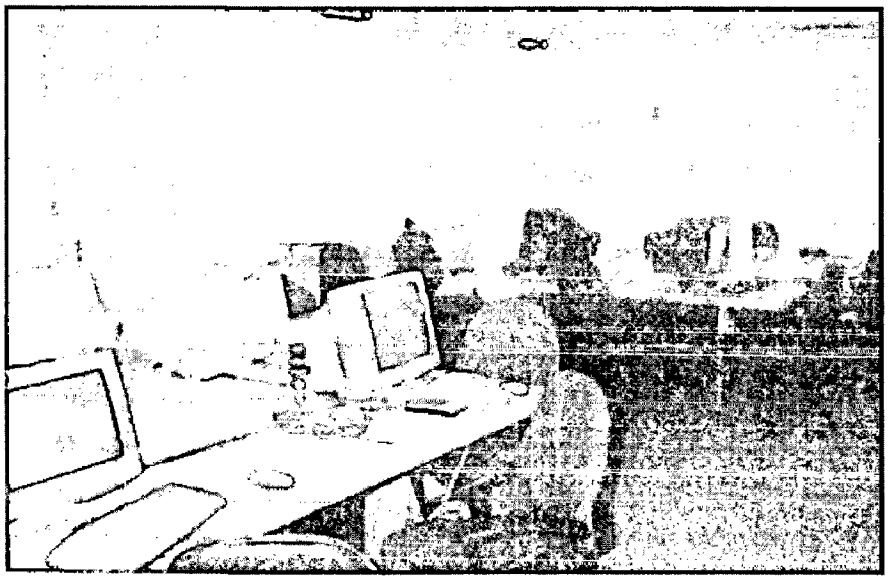


Fig 4.6 Training/conference Room



All training & meeting rooms are well equipped according to function.

Fig 4.7 Training Room

4.2.5 Recreational Facilities:

Oorja, as name itself suggest, area is totally devoted for recreation & refueling the employees.

Bright colors & lighting give a refreshing environment which helps employees to get relaxed and recollecting thoughts for efficient work.

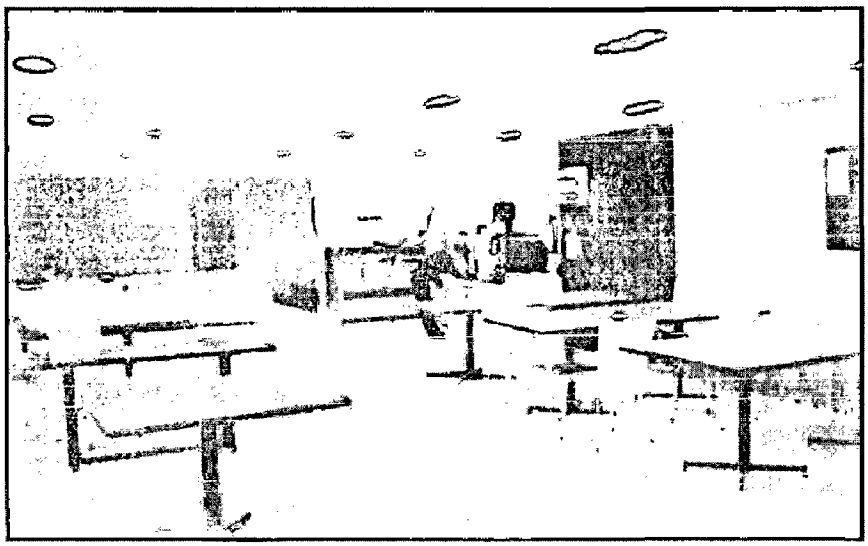


Fig 4.8 Cafeteria

There are spaces for reading, eating, drinking & playing with a lively & calm environment which helps someone to get away from the work pace.

4.2.6 Others:

There are some spaces created for informal interaction like in between corridors.

All floors are centrally air conditioned through ceiling based ductwork. Centralized control system for temperature lighting & air movement, individual control for employees at workstation is not available.

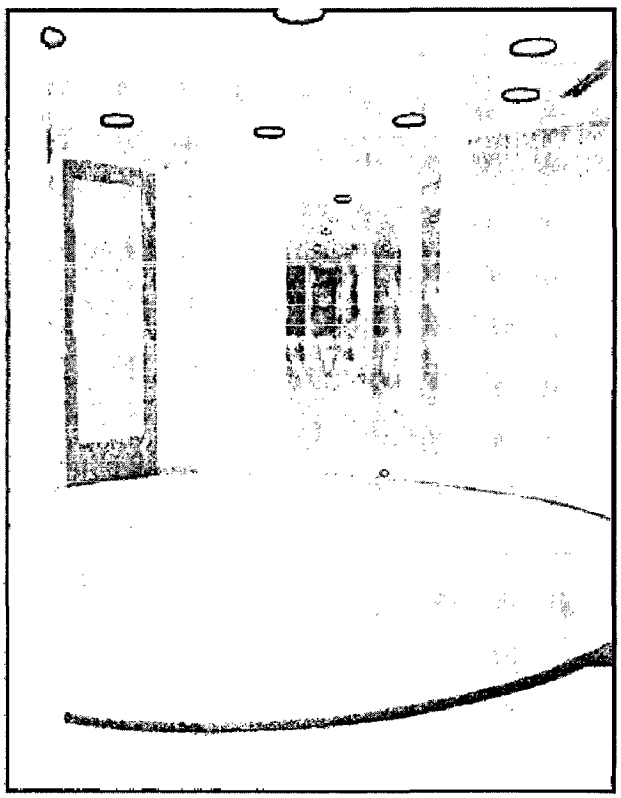


Fig 4.9 Lobby

Centrally operated Lighting system and fixtures are used in order to provide efficient and appropriate lighting in corridors, workstations & other areas.

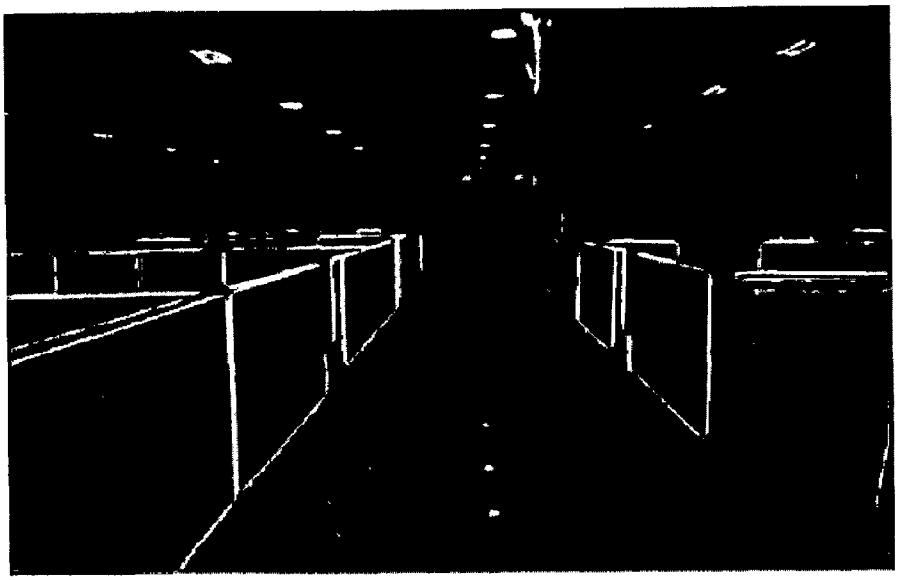


Fig 4.10 Workspace View

4.2.7 INFERENCES

- Centrally located service core helps in movement, vision & efficient use of facilities.
- Panels on three sides of workstation helps in visual & acoustical privacy but extended flexible layout makes way for interaction between employees.
- Tack able panels fulfil function as well as feel of personalization.
- Centrally control lighting & air conditioning helps in energy conservation but sometimes employee needs a control over it for efficient environment.
- Combination of colors, texture & patterns create a live environment but too many colors & patterns are not good for workstation.
- Recreational spaces helpful in improve work efficiency.
- Giving names of different rooms & spaces on some theme create an attachment, sense of belongingness with the space/room.

4.3 CASE STUDY 2. SAPIENT, GURGAON

Located at Sapient Towers, D&E DLF Cyber Greens, DLF City Phase III, Sector 25-A, Gurgaon. A multinational software development consultancy organization.

4.3.1 General Information

Total Area = 6400.00sqm

No. of floors = 7 No. of Employees = 410

Workstation Layout: open workstation

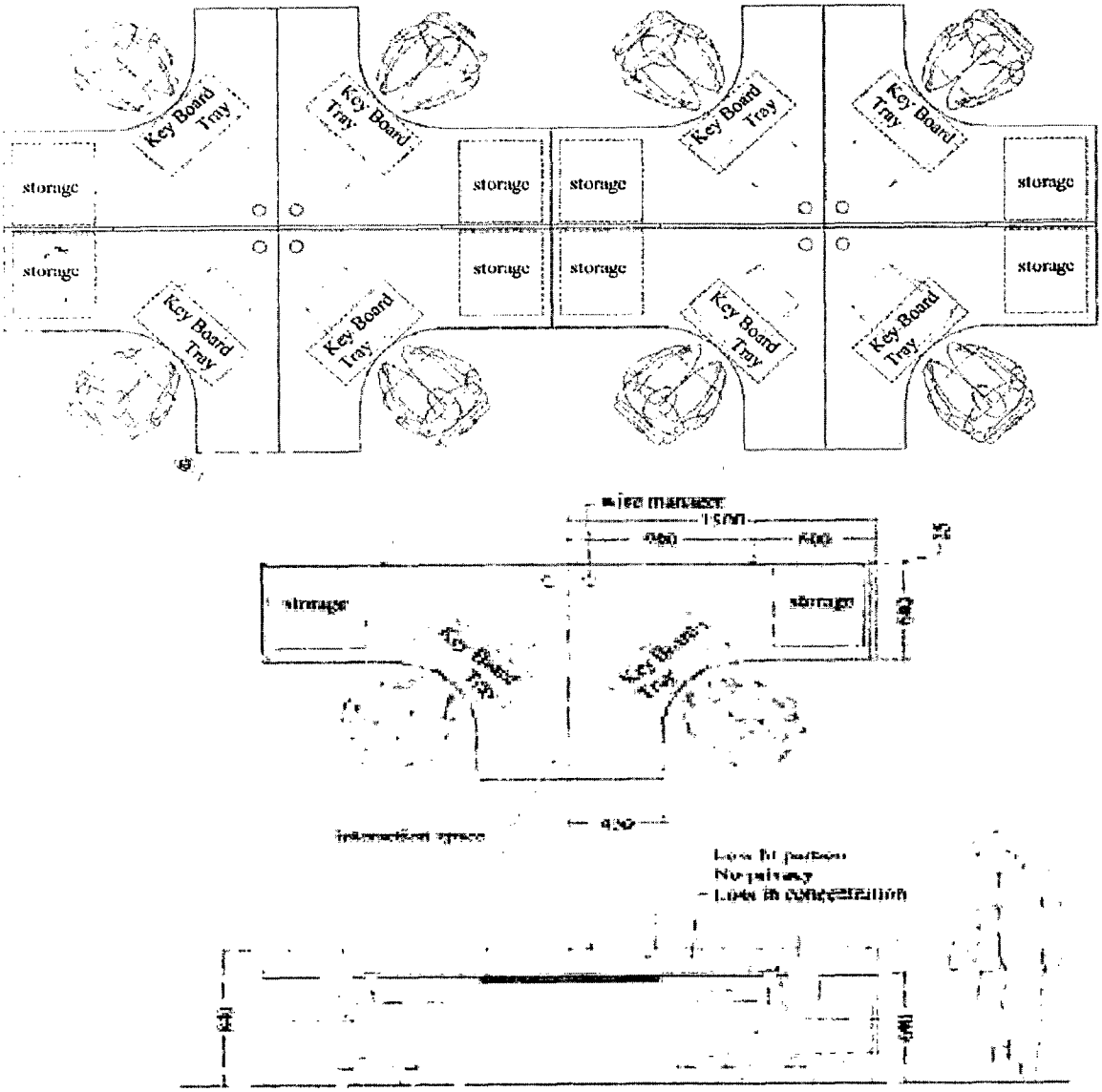


Fig 4.11 Workstation layout

4.3.2 Reception/Administrative desk:

The reception area greets visitors, but because of unemotional color scheme whole area looks reserved.

One corner of the lobby used as conventional waiting area.

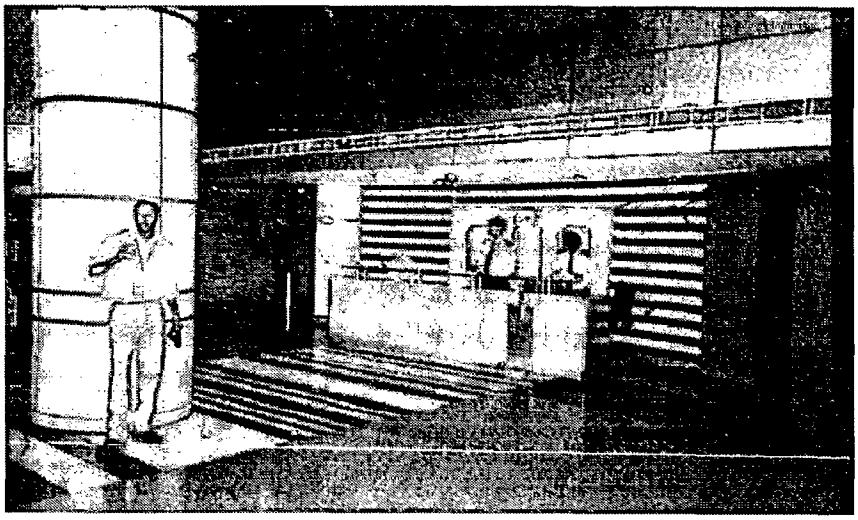


Fig 4.12 Reception Area

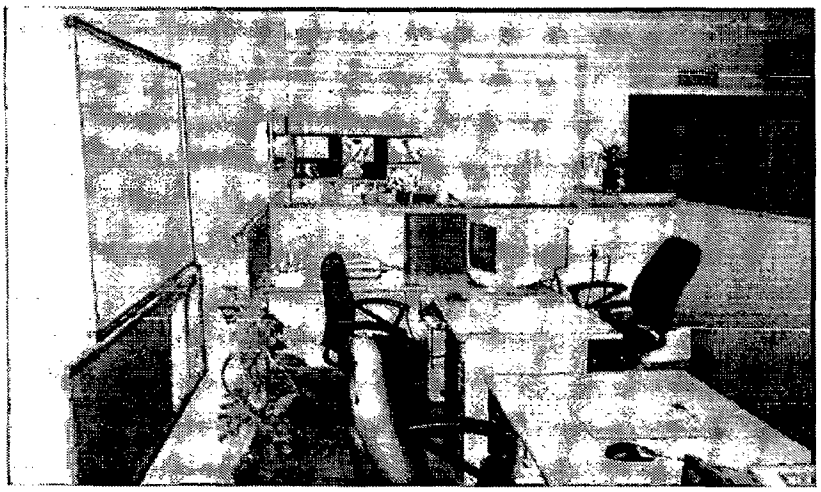
Reception area fails in develop any affection or sense of belongingness with employees.

There is no display area regarding company or any other information whiterest.

4.3.3 Workstations & Offices:

Sapient supports open work culture, most of the employees work at open workstations. Low height partitioned spaces are reserved for senior team managers.

In a monotonous environment, workstations of 5'6" x 5'6" with 4'6" high partition are placed along the wall.



Each workstation has tack able panel & small storage under the desk.

Few planters are placed near the workstation & common area to make environment lively.

Fig 4.13 Low Ht Partition Workstation

Hydraulic chair can helps in height adjustment but keyboard & mouse setup is not fit for long run.

Open workstations for other employees are clustered in such manner that they create a small surface for dialogue & discussion.

Desk storage provides for keeping different official & personal documents/belongings.

Fig 4.14 Open Workplace

Common storage space also provide for additional things.

Sufficient lighting is available but glare on monitor screen affect the productivity.

Provision of partition between clusters of workstation, is not satisfying the condition of privacy.

4.3.4 Meeting/Conference Rooms:

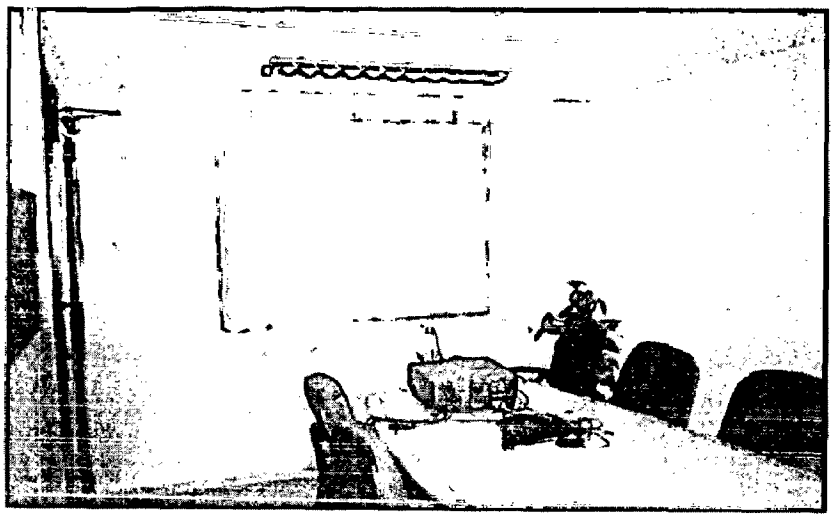


Fig 4.15 Meeting Room

Different types of meeting/interaction area are developed as per the requirement & function.

Lighting in meeting/training rooms creates glare on display panel which effect directly in productivity.

Strategic location of meeting/training rooms increase efficiency & ease in accessibility.

There is scope of improvement in equipment & layout for more efficient use.

Exchange of dialogues & ideas indirectly give assistance in valuable output.

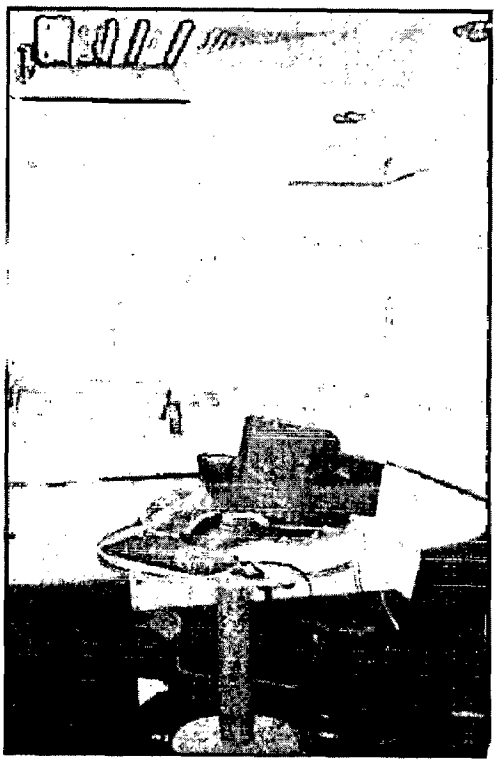


Fig 4.16 Training Desk

4.3.5 Recreational Facilities:

The organization provides best recreational facilities to the employees. Combination of colors & textures used to create calm & relaxed environment includes coffee café, lunch lounge.

Fig 4.17 Cafeteria

There are also facilities for T.T. & Gym which give encouragement to employees toward physical fitness also that directly affect the working efficiency.

4.3.6 Others:

Different spaces like reception, lobby lift core, workstations, breakout spaces & meeting rooms are strategically sited with respect to the function, spatial requirement and accessibility.

All floors are centrally air conditioned through ceiling based ductwork, providing proper ventilation & air movement.

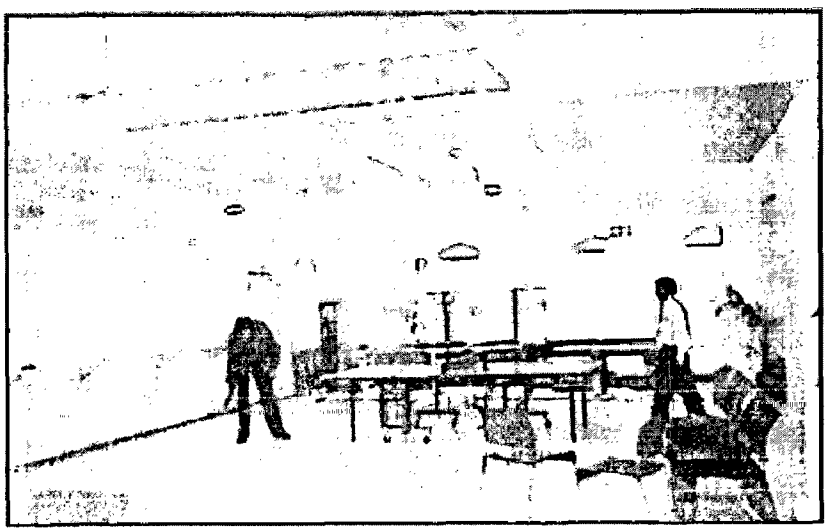


Fig 4.18 Sports Facilities

Natural lighting & outside view makes recreational area more peaceful & lively. Centralized control air conditioning & lighting, but individual control for employees at workstation is not available.

Absence of individual task lighting & glare on monitor screen show insensitive approach of lighting design in work area.

4.3.7 INFERENCES

- Reception area is lacking in presenting character of multinational corporate.
- Open workstation can helpful in interaction communication between employees but sometimes problem privacy occurs.
- Improper lighting design create glare on monitor screen.
- Centrally control lighting & air conditioning helps in energy conservation but sometimes employee needs a control over it for individual comfort level.
- Insufficient technical support/system can create obstruction in efficient use.
- Setup of computer system is not follows the standards of office ergonomic.
- Recreational facilities & spaces helpful in regain energy in between hectic work schedule.
- Access to daylight & out side view has a positive effect on work efficiency.
- Giving names of different rooms & spaces on some theme create an attachment, sense of belongingness with the space/room.

4.4 CASE STUDY 3. Upshot Corporate Headquarter, Chicago

Upshot, a progressive and rapidly growing IT marketing agency in Chicago.

4.4.1 General Information

Total Area = 5219.00sqm

No. of floors = 2

No. of Employees = 320

Workstation Layout: enclosed workstation

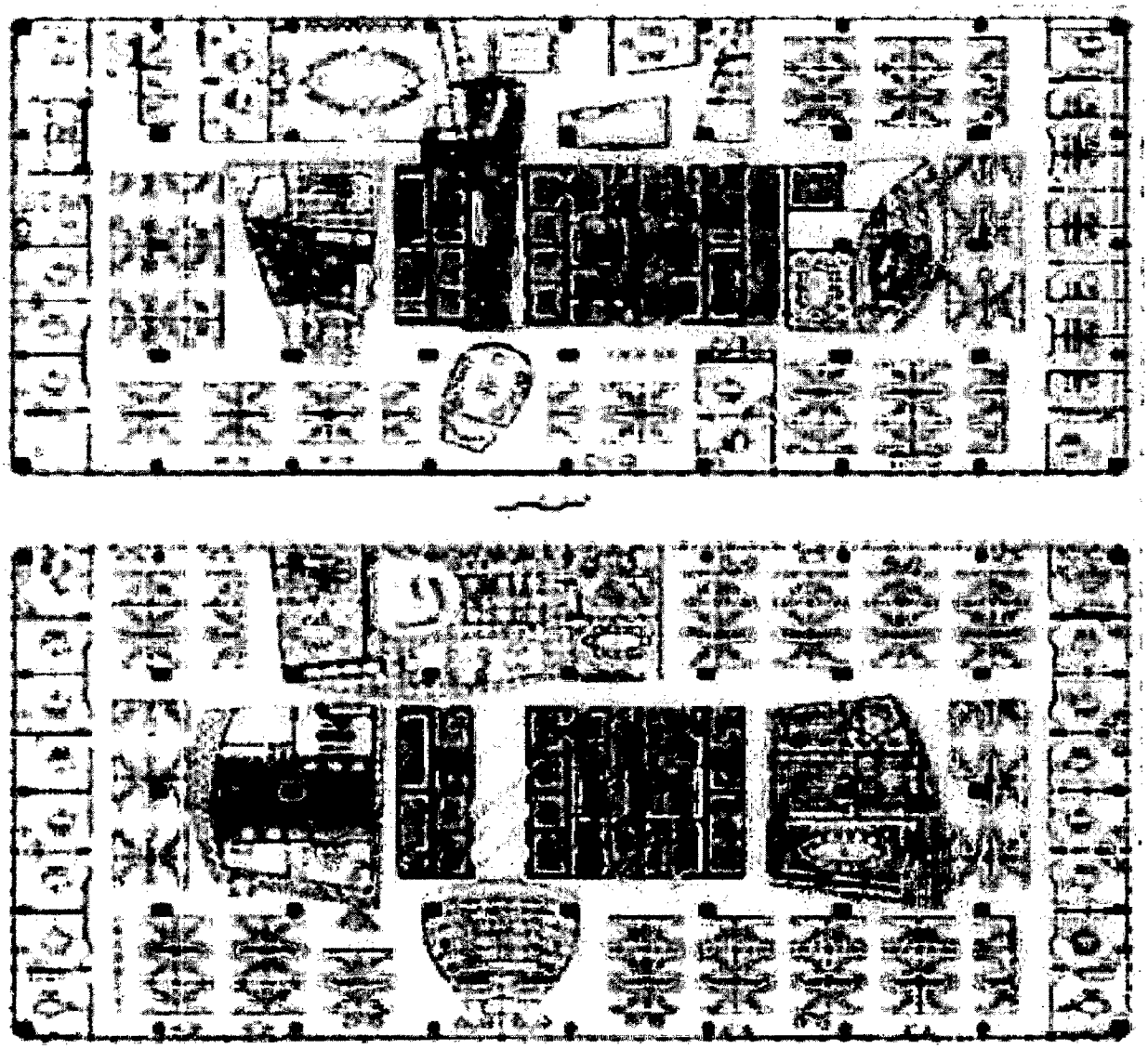


Fig 4.19 Layout Plan

4.4.2 Reception/Administrative desk:

The conventional, corporate glass box base building is juxtaposed when the elevator doors open to the first of two Upshot floors and enter the reception area.

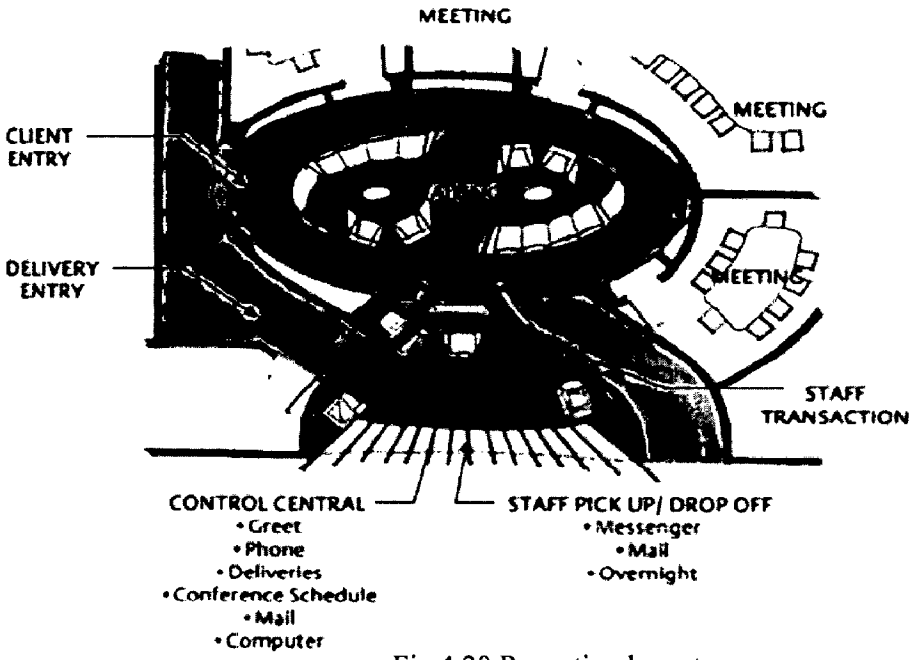


Fig 4.20 Reception layout

Employees and visitors are flooded with color, movement, video and music that plays full working hours; all of these senses are bombarded.

Fig 4.21 Waiting Area

A board lights up the centralized air conditioned reception area with rotating messages, greeting.

In the lobby, a signage billboard that depicts something is speeding through the tunnel, so as to feel like you are catapulted into the space.

Using very few right angles, the design team utilized curved walls that are painted with various pattern and colors. This keeps a sense of orientation.

4.4.3 Workstations & Offices:

Most of the employees work at open workstations. Enclosed offices are reserved for vice president & senior vice president.

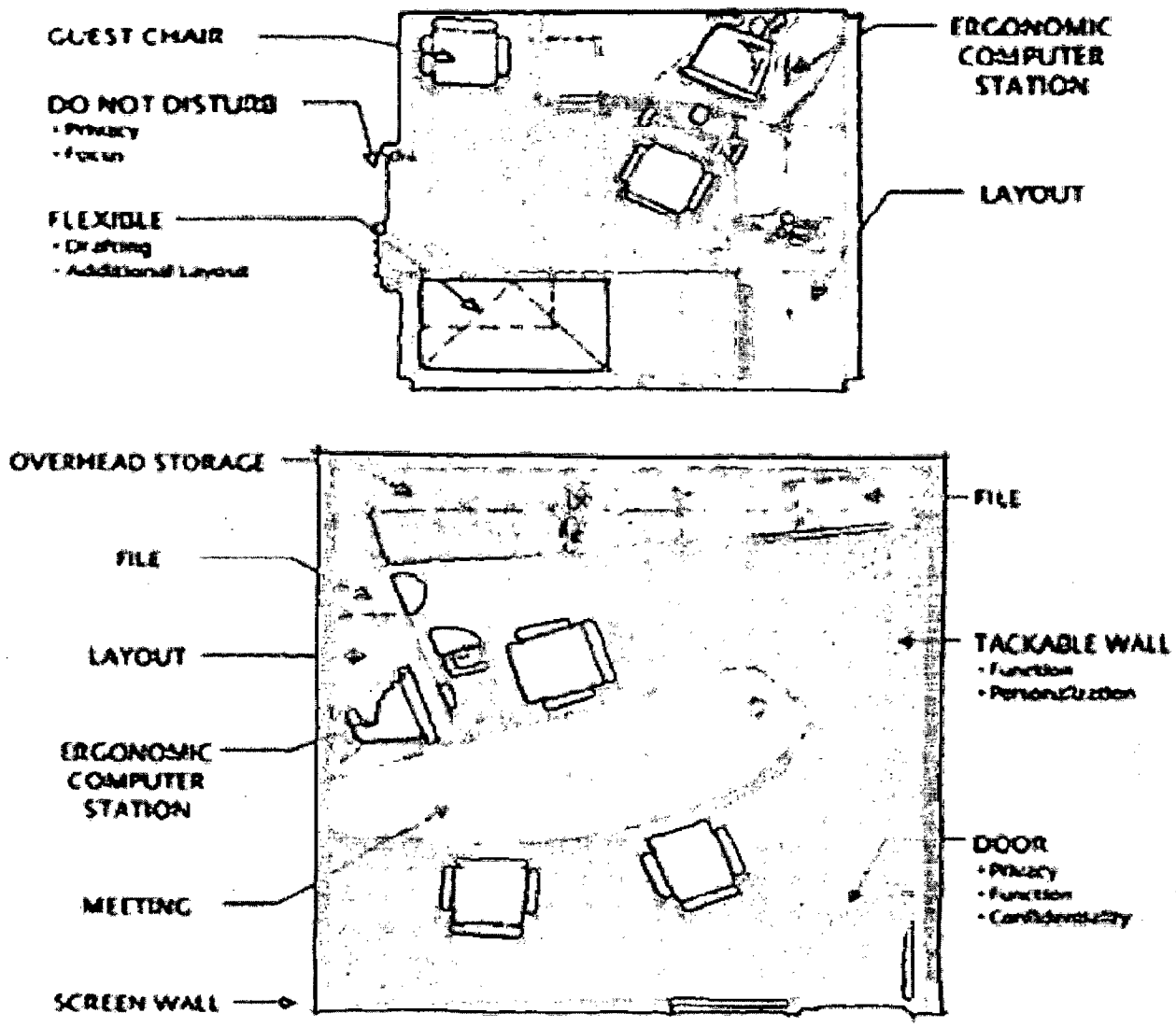


Fig 4.22 Workstation & Office Layout Plan

Well equipped Workstation 7' x 7' with 5'6" high partition panel on three sides which helps in giving privacy & environment to concentrate on work.

Private office 10' x 10' with one side screen wall which gives privacy as well as vision.

Ergonomically designed computer table fixtures with adjustable chair for better working conditions.

A small flexible working surface projection used as a means of interaction between workstations.

Desk & overhead storage for keeping different official & personal documents & belongings.

Fig 4.23 Informal Interaction Space

4.4.4 Meeting/Conference Rooms:

Small informal meeting areas are develop near the workstations.

Whole scheme is based on an energy concept and to excite employees. Different rooms, named by function, offer distinct meeting and technological interactions. An informal talks happens in Spark, a team meeting in ignition or Plug; and client presentation in Reactor

Unconventional combination of colors, patterns and textures used by designer to create energy and excitement.

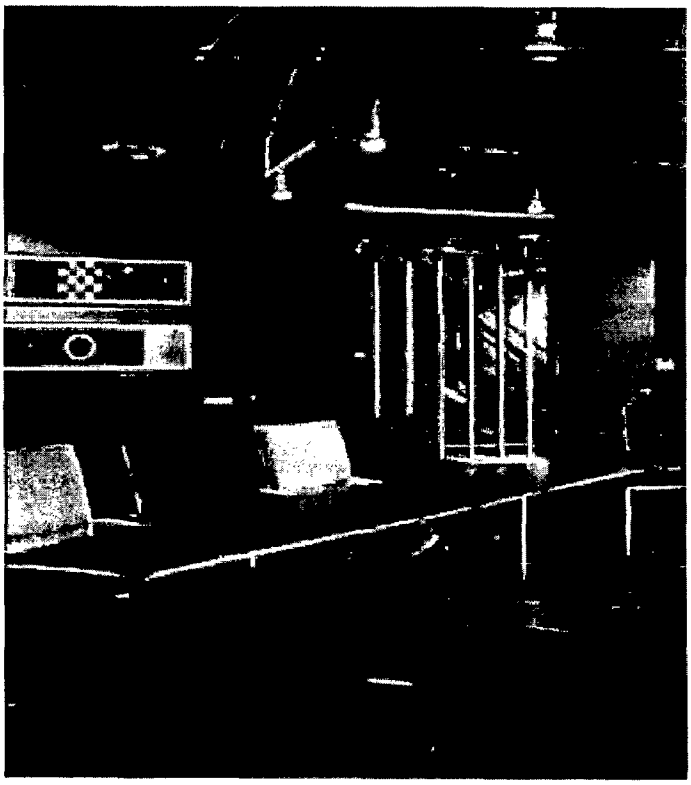


Fig 4.24 Colorful Meeting Room

4.4.5 Recreational Facilities:

The Hang Out area is totally devoted for recreation & refueling the employees.

Fuel doubles as the lunch lounge and after hours bar with the beer tap.

There are spaces for reading, sleeping, eating, drinking with a lively & calm environment which helps someone to get away from the work pace and collect a thought.

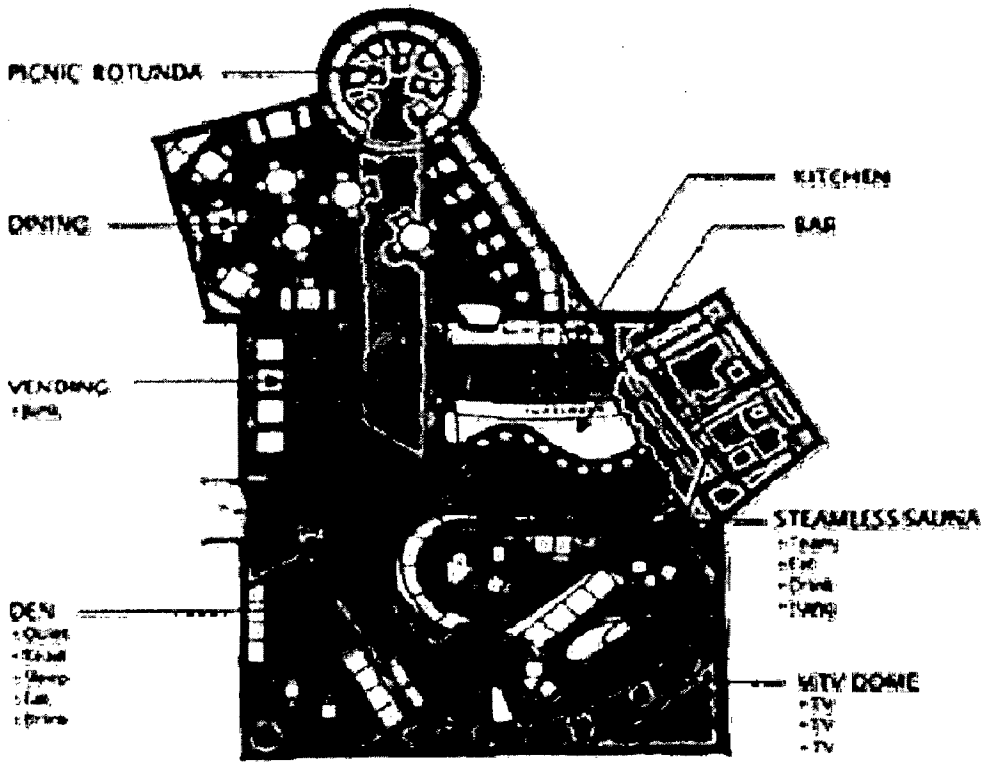


Fig 4.25 Layout & view Recreational Area

4.4.6 Others:

Different spaces like reception, lobby lift core, workstations, breakout spaces & meeting rooms are located with respect to the function & spatial requirement.

Both floors are centrally air conditioned through ceiling based ductwork, providing exposed duct & diffusers. Centralized control system for temperature & air movement, individual control for employees at workstation is not available.

Centrally operated Lighting system and fixtures are used in order to provide efficient and appropriate lighting.

4.4.7 INFERENCES

- Centrally located service core helps in movement, vision & efficient use of facilities.
- Greeting & messages at reception desk give sense of social belongingness to visitor & employee.
- Panels on three sides of workstation helps in visual & acoustical privacy but extended flexible layout makes way for interaction between employees.
- Tack able panels fulfil function as well as feel of personalization.
- Centrally control lighting & air conditioning helps in energy conservation but sometimes employee needs a control over it for efficient environment.
- Combination of colors, texture & patterns create a live environment but too many colors & patterns are not good for workstation.
- Recreational spaces helpful in improve work efficiency.
- Giving names of different rooms & spaces on some theme create an attachment, sense of belongingness with the space/room.

4.5 CASE STUDY 4. eEmerge, New York

eEmerge was established by one of the leading building organization which provides fractional office space for high-tech, startup multinational software development companies.

4.5.1 General Information

Total Area = 2000.00sqm approx

No. of floors = 1

No. of Employees = 120

Workstation Layout: open workstation

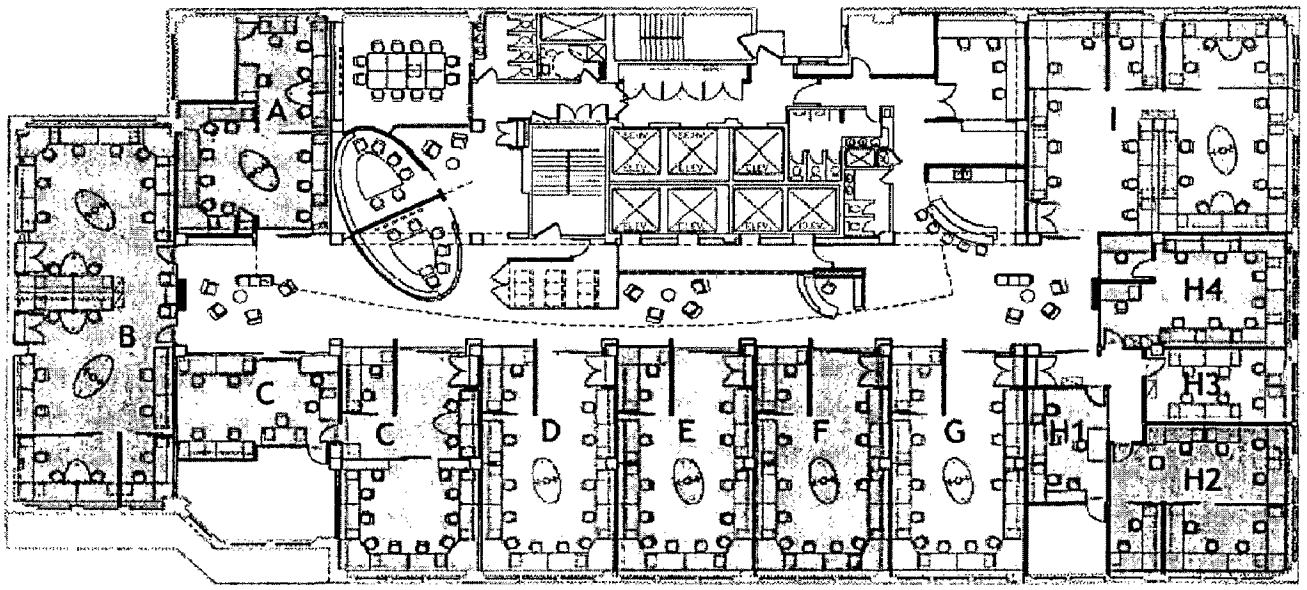


Fig 4.26 Layout Plan

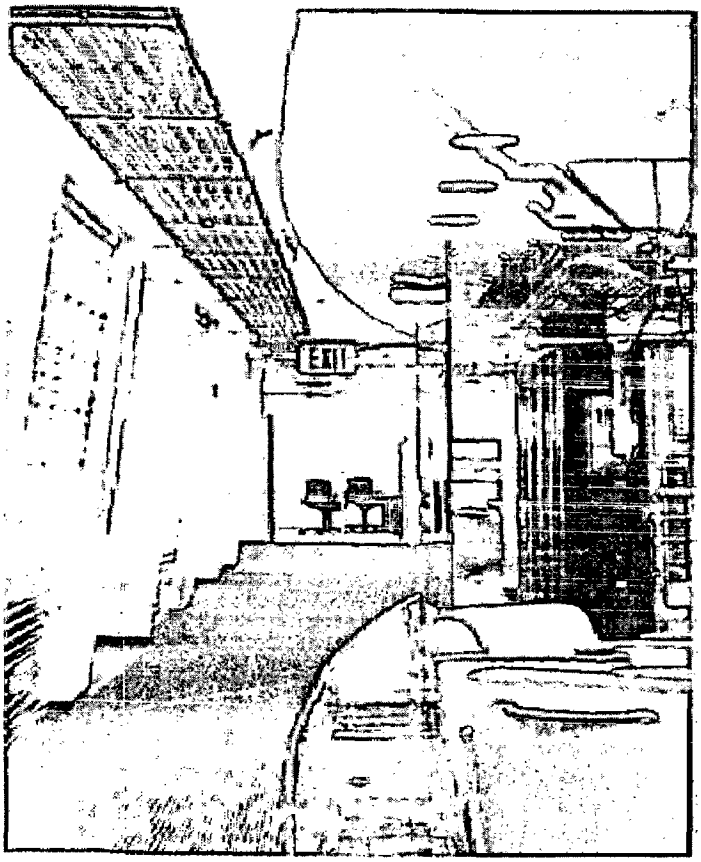
Conceptually, the floor space is divided into two zones: the concentrated work zone, which includes nine office suites, and the interactive zone with core support areas including meeting rooms, coffee bar and break out areas.

4.5.2 Reception/Administrative desk:

The brightly lit & colorful reception area includes a thirty-six-inch plasma screen with company logo and greeting.

Colors, lighting and furniture in reception lobby itself give warm welcome to visitors & employees.

Fig 4.27 Reception & Waiting Area



A glass enclosed server room provide a focal point to the reception/waiting area.

Different flooring types creates divison of space between reception/waiting area & walkway.

The image of space is formal and primary with the use of pure geometric forms and vivid colors such as red and yellow.

Fig 4.28 Corridor

4.5.3 Workstations & Offices:

All work zone spaces are planned in more valuable perimeter space which confirms that each inhabitant get access to perimeter & natural light.

Each work suite is subsequently divided to include both enclosed offices & open workstation. Enclosed offices for senior team managers and information sensitive user and open & flexible workspace hold a higher density of digital user.

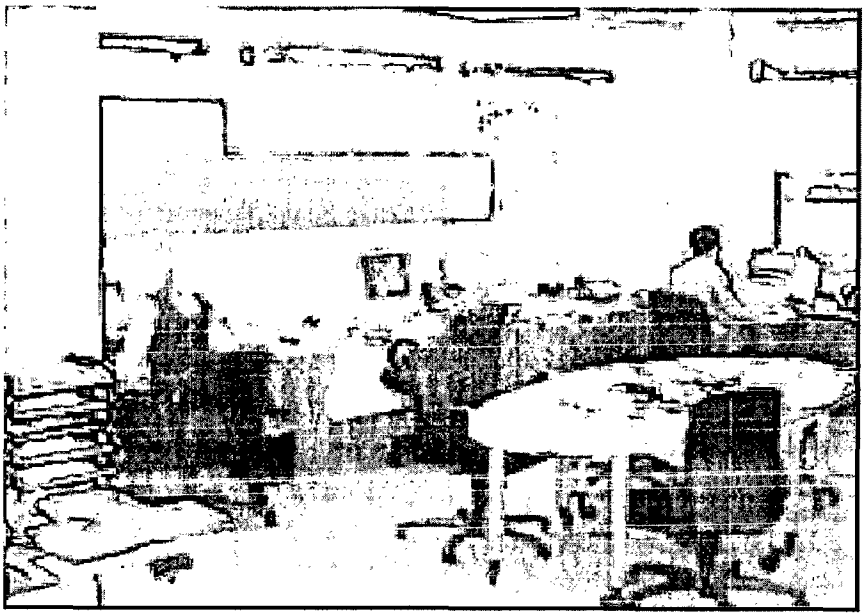


Fig 4.29 Open Workstation Layout

Each work suite has variety of lighting type to help out in provide glare free well lit work space. Rigid setup of monitor & keyboard is just fit for working but not satisfying ergonomic standards.

Absence of individual storage space with open workspace create a mess & cause inconvenience in working.

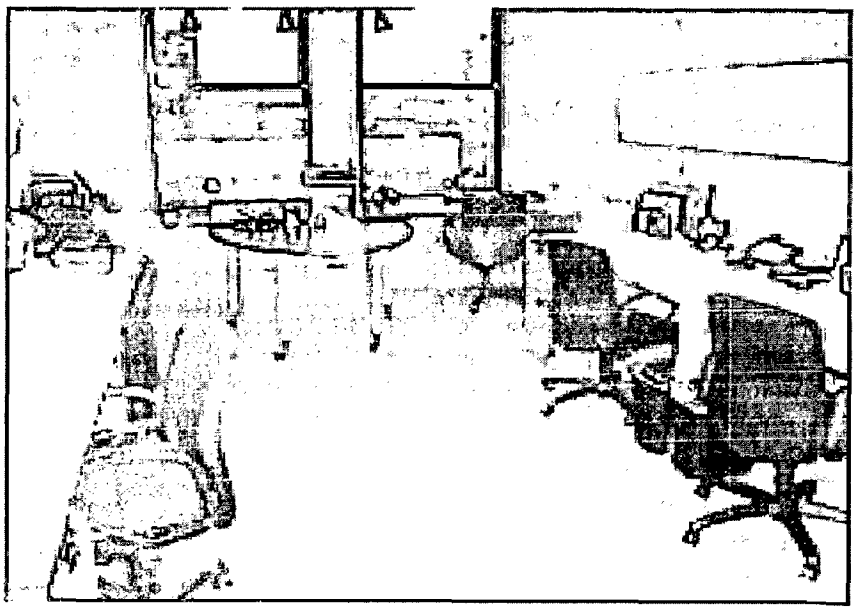


Fig 4.30 Open Workspace

4.5.4 Meeting/Conference Rooms:

Small interactive space is provided in each work suite.

The interactive space is designed with a sense of openness, well lit with natural & artificial lighting. All meeting rooms are well equipped according to use & functioning.

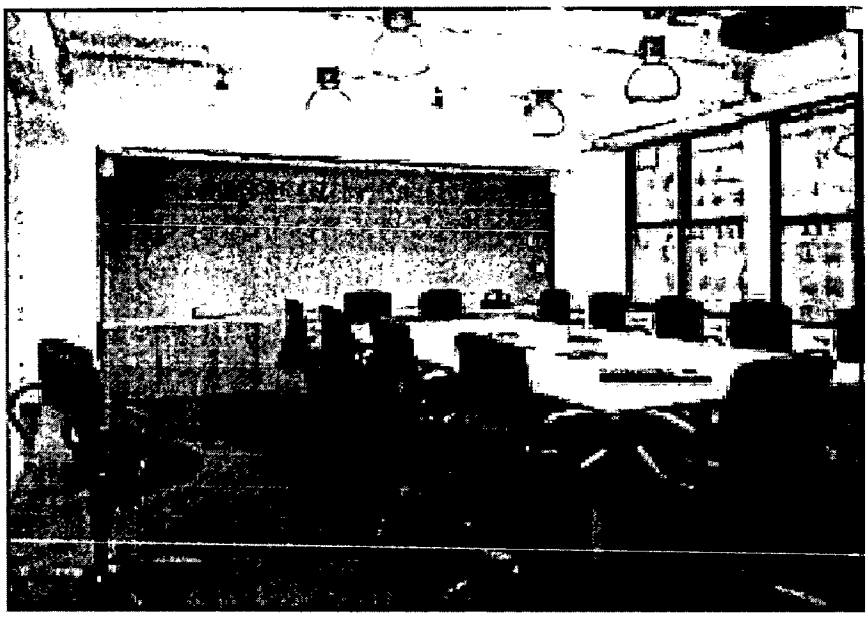


Fig 4.31 Conference Room

Elliptical i-room (idea room) is for in-house technical discussion & presentations.

Fig 4.32 I-Room for Tech Discussions

4.5.5 Recreational Facilities:

The break-out space is to get away from the hectic work schedule and to get recharged with energy & thoughts.

The coffee bar & pool table works as platform for informal interaction & discussion.

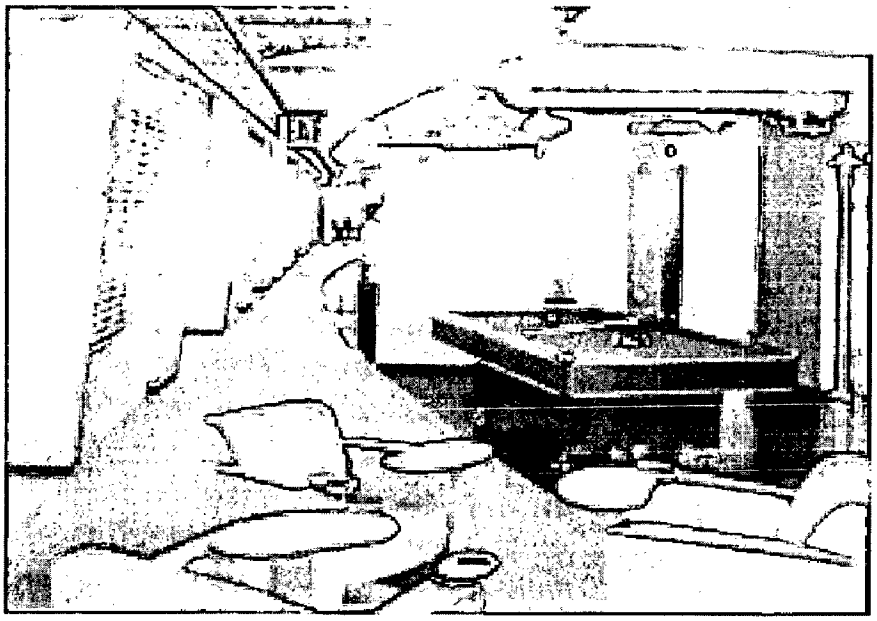


Fig 4.33 Recreational facilities

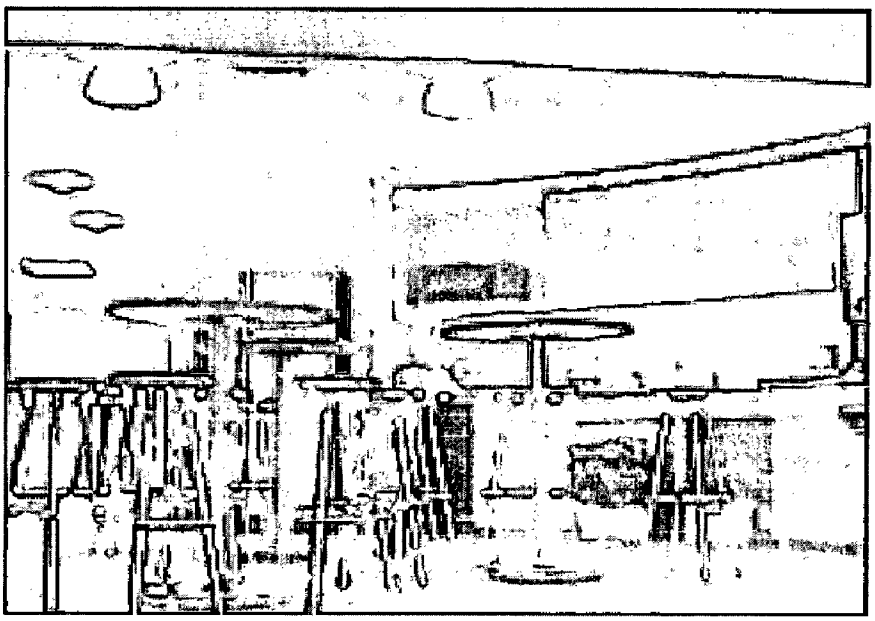


Fig 4.34 Cafeteria

These types of informal interactive spaces create a social connection between employees which support friendly & productive work environment.

4.5.6 Others:

Strategic layout of core services, reception, work suites & breakout spaces facilitate efficient use & easy movement of user.

Whole floor area is centrally air conditioned through ceiling based ductwork, supported by proper ventilation & fresh air movement.

Use of task light & accent light as per requirement build up environment for efficient working.

Productivity decreases because of lack of privacy in terms of acoustical, visual, informational & territoriality.

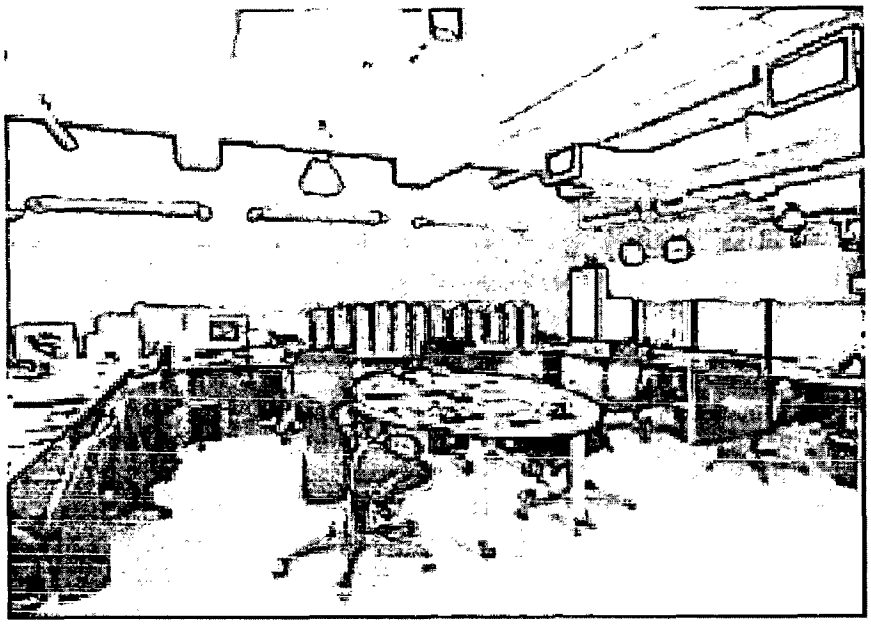


Fig 4.35 Interaction Space within workstations

4.5.7 INFERENCES

- Greeting & messages at reception desk give sense of pride & social belongingness to visitor & employee.
- Usage of vivid colors, combination of material & texture create energetic environment.
- Strategic zoning of work area, core service and recreational facilities offers efficient use.
- Open workstation can helpful in interaction communication between employees but sometimes problem privacy occurs.

- Individual task lighting supports in improving work efficiency.
- Centrally control lighting & air conditioning helps in energy conservation but sometimes employee needs a control over it for efficient environment.
- Setup of computer system is not follows the standards of office ergonomic.
- Recreational facilities & spaces helpful in regain energy in between hectic work schedule.
- Individual access to daylight has a positive effect on work efficiency.

4.6 CASE STUDY 5. Clickthings, New York

Clickthings, a multinational software development company. Clickthings requested office that would project their forward thinking, attitude towards productive work environment, while at the same time suggest a stable presence to their clients and employees.

4.6.1 General Information

Total Area = 1858.00sqm approx

No. of floors = 2

No. of Employees = 250

Workstation Layout: enclosed workstation

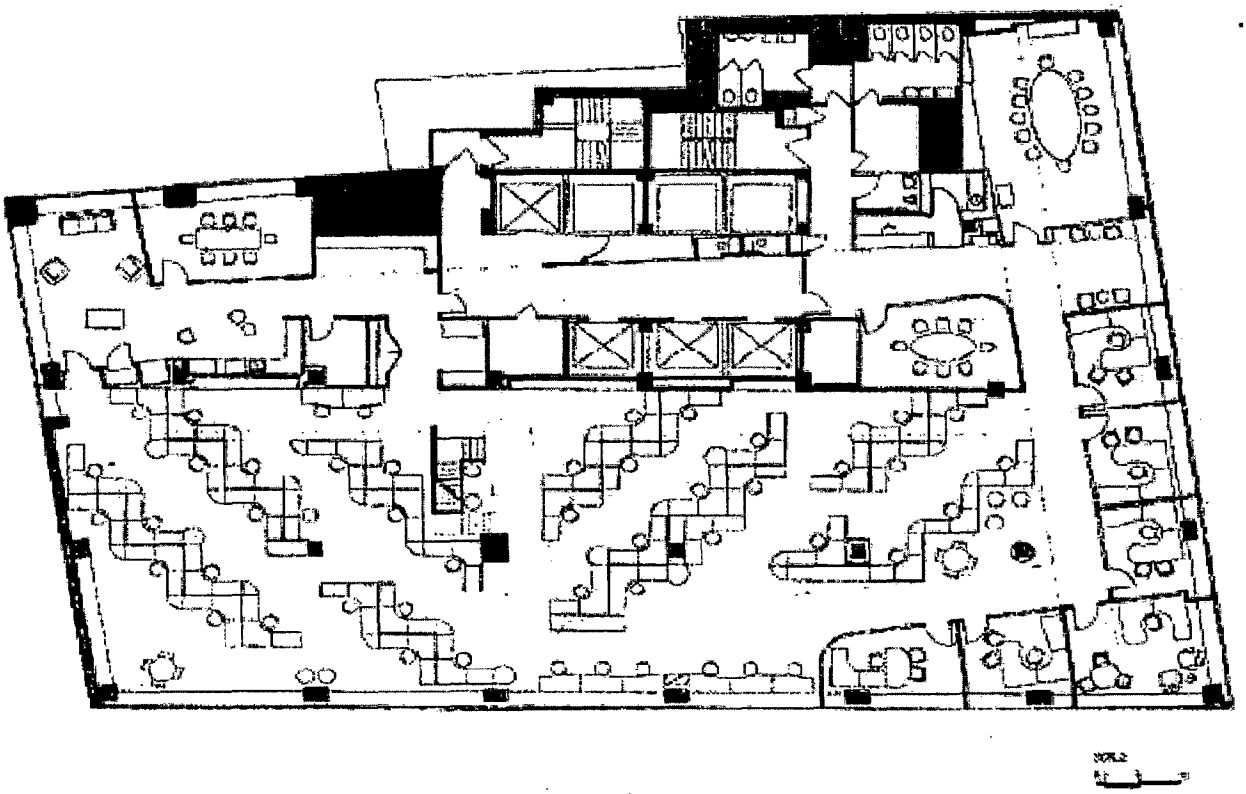


Fig 4.36 Layout Plan 1

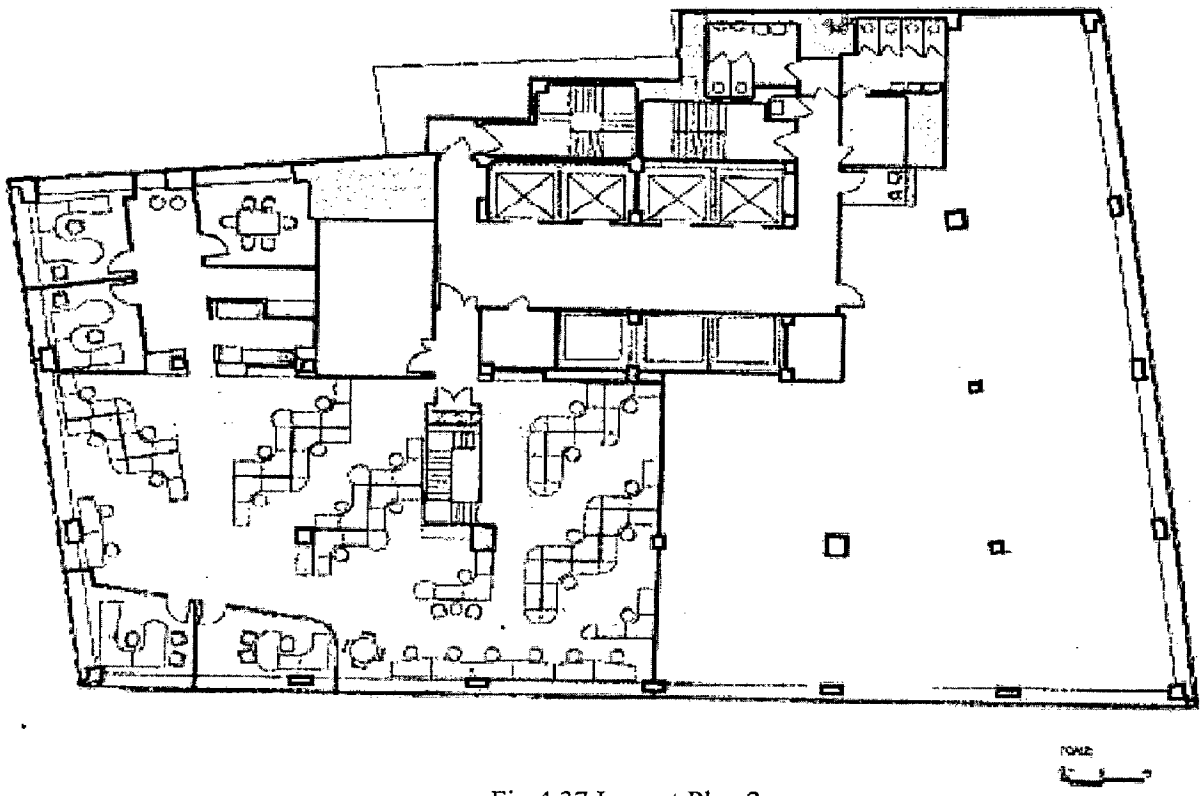


Fig 4.37 Layout Plan 2

4.6.2 Reception/Administrative desk:

The design team established two zones within the space. The first zone is the public face including reception with interactive media walls and large conference hall.

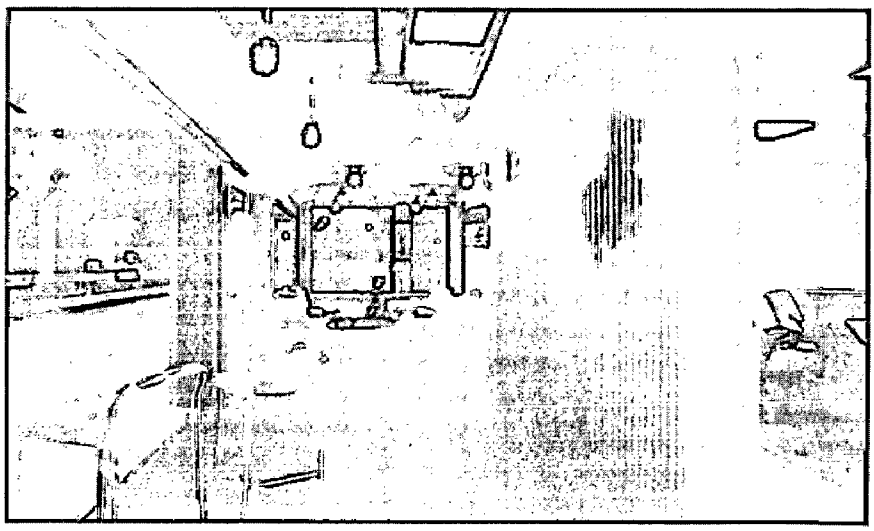


Fig 4.38 Entrance Lobby & Waiting Area

The reception area is situated on axis with the elevators and leads to large perimeter windows with broad views of south seaport and east river.

A continuous boldly orange color painted wall with galvanized metal floor welcome boldly. Some greetings and company information on interactive wall panels build affection.

4.6.3 Workstations & Offices:

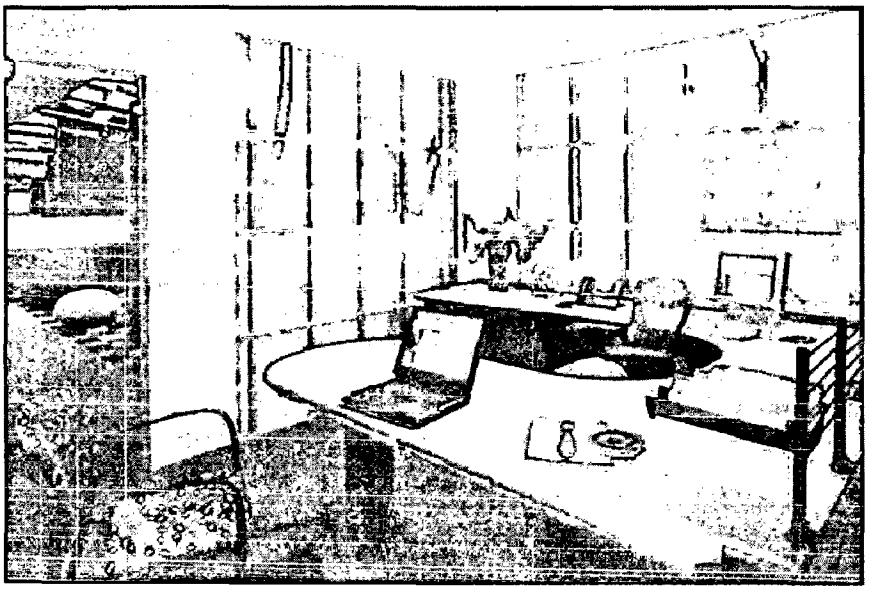


Fig 4.39 Private Office

The second zone consists of open office workstations, private offices, informal meeting areas, and a multipurpose play room.

much effort was placed on representing the unrestricted & open atmosphere of the company.

Private offices are kept to minimum. Privacy walls were necessary for information sensitive user & senior managers. A new light weight, free standing panel system is used in open workstations.

A typical workstation of 7'0" x 7'0" L shaped module which, when

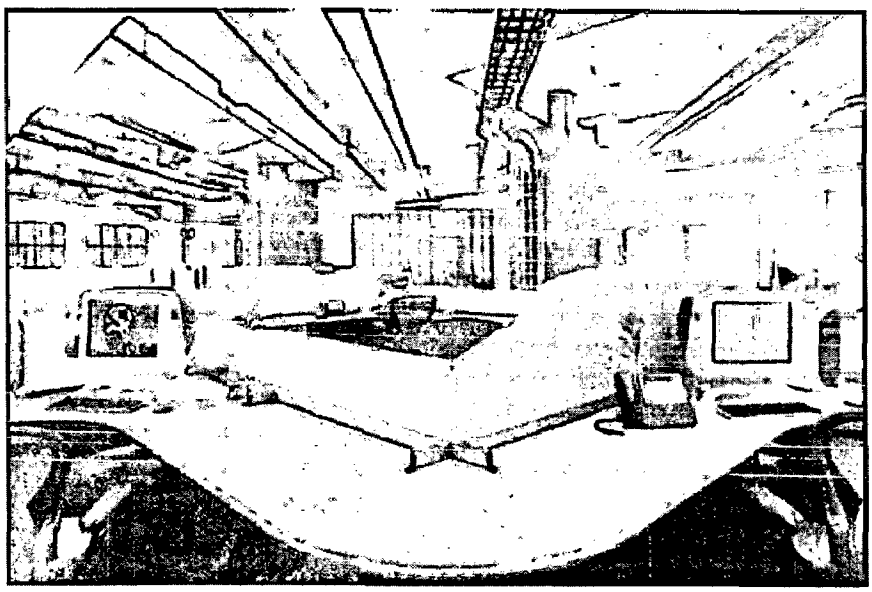


Fig 4.40 View-Workspace

arranged in continuous rows, provides uninterrupted surface for shared dialogue, and shared equipment.

The system's thin panels are translucent, curved, or minimized in height allowing continuous sight lines throughout the space.

The open office incorporates nonlinear circulation pattern, informal work areas and visibility to perimeter windows.

4.6.4 Meeting/Conference Rooms:

Spontaneous meetings and conversation nooks are incorporated into the voids that are created within the system furniture clusters. The conference room, located in the more public zone, has high tech audio/visual presentation capabilities and flexible furniture so that individual presentations or office wide meetings can happens here.

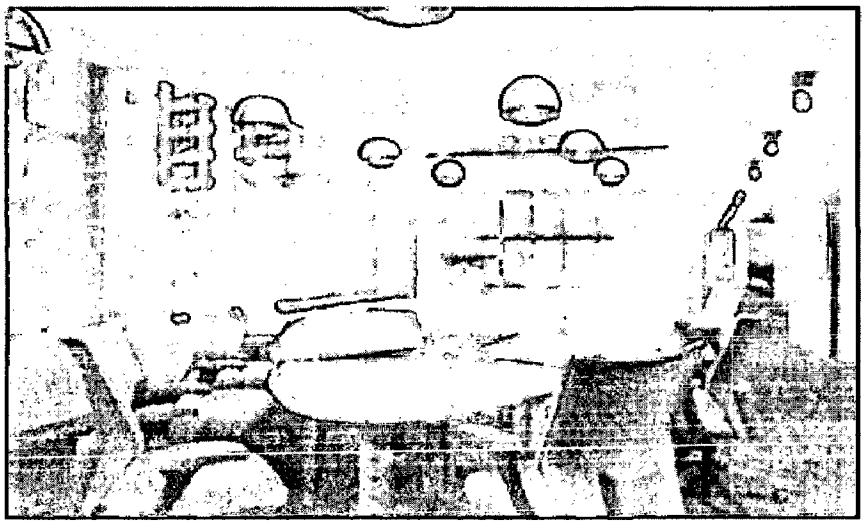


Fig 4.41 Flexible Conference Room

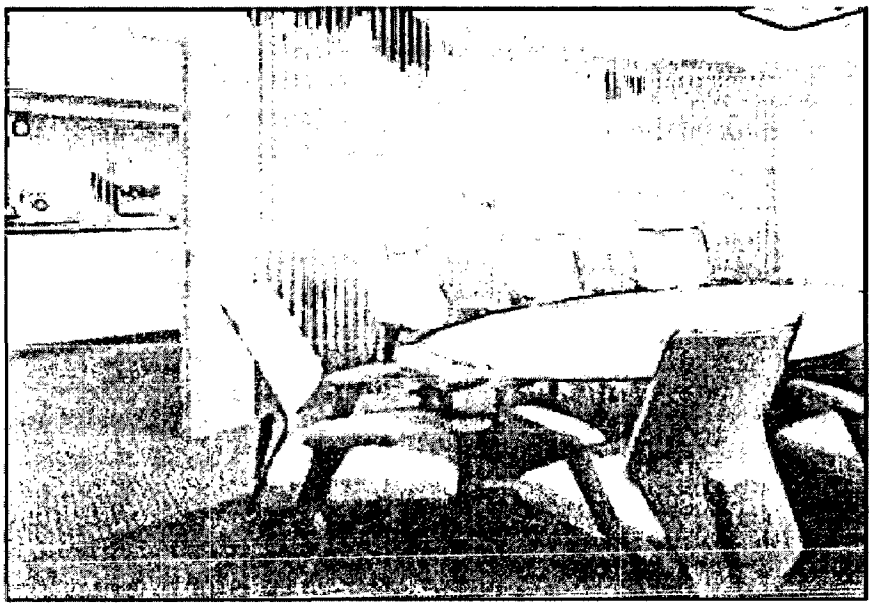


Fig 4.42 Meeting Space

4.6.5 Recreational Facilities:

Some informal talks are outfitted with traditional tables and chairs, comfortable lounge seating, and even low, egg shaped stools where employees can perch during breaks.

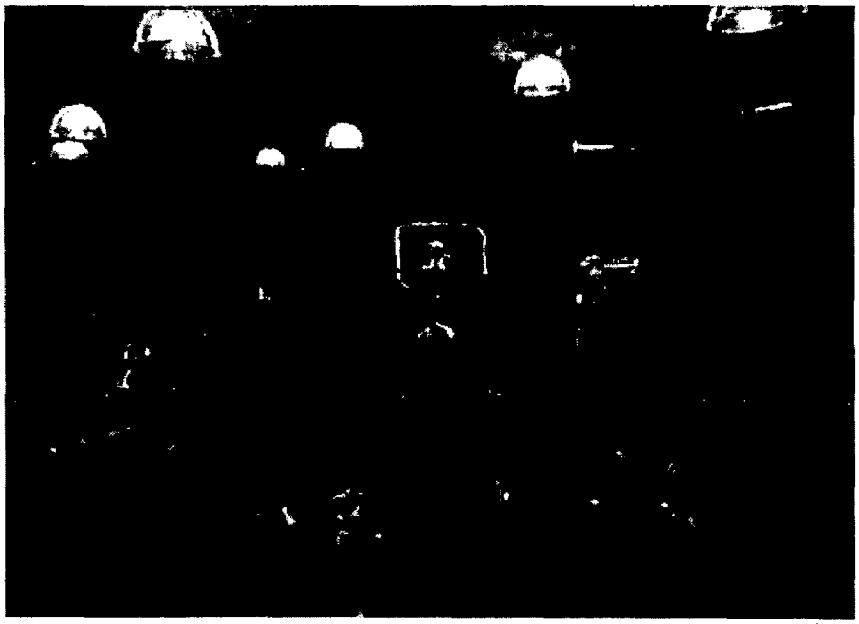


Fig 4.43 Recreational Area

The boldly colorful & brightly lit multipurpose room with artificial & natural light through perimeter windows gives break from fast pace work style. The multipurpose room in the rear is outfitted with a kitchen, game tables, televisions, and lounge furniture. Inexpensive materials such as plastic laminates and vinyl tiles were used here, but by mixing multiple pattern and colors together, the effect is both playful and sensible.

4.6.6 Others:

The combination of colors, textures and material is very sensible and cheerful. Material selected for total office space include embossed vinyl flooring, maple veneer panels, translucent extruded PVC panels, and galvanized metal deck. The ceiling is left high and open and is outlined by flooring planes of hung acoustical tile. Ductwork and cable trays are exposed as feature elements.

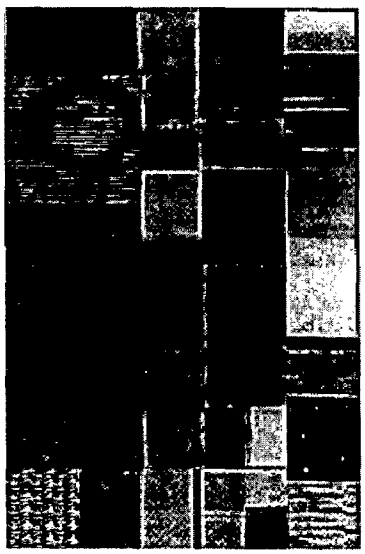


Fig 4.44 Texture & Patterns

Translucent extruded PVC panels and galvanized metal deck are used and simply screwed to metal studs in private offices.

Combination of artificial/natural light, outside views & bright colors create a live working environment, but sometimes exposure builds, problem regarding privacy, glare on monitor screens or even difficult to concentrate on work.

4.6.7 INFERENCES

- Combination of vivid colors & texture create energetic environment.
- Greetings and company information on interactive wall panels build affection.
- Workstation modules strategically arranged in continuous rows provides uninterrupted surface for shared dialogue, and shared equipment.
- Provision of spaces for informal & formal interaction make better work environment.
- Open workstation can helpful in interaction communication between employees but sometimes problem privacy occurs.
- Mixing multiple pattern and colors together, the effect is both playful and sensible.
- High tech audio/visual presentation capabilities and flexible furniture provide productive output.

4.7 OBSERVATIONS OF CASE STUDIES

- Workstation setup according to ergonomic standards, layout & space helpful in achieving healthy & efficient work conditions.
- Good air quality, acoustics and lighting system provides healthy work environment.
- Adequate recreational facilities are important for regaining energy & thought in between tight work schedule.
- Equal individual access to daylight, outside view, privacy & aesthetics increase work efficiency.
- Controls over workplace services, systems, and components to adjust thermal, lighting, acoustic, and furniture systems make efficient work condition for individual & team.
- Strategic zoning of work area, interaction spaces, recreational facilities and core service provides functional efficiency.
- Combination of bright colors, texture & material helpful in creating live & energetic work environment.
- High tech systems for heating, air conditioning, lighting, power, security, and telecommunications systems/equipment and backup capabilities improve work efficiency.
- Flexible workplace configurations and components that occupants can move themselves to accommodate change.
- Brand/company identity, character, greeting & message boards develops sense of place, feeling of personalization, belongingness, sense of pride, dedication which plays an important role in work efficiency.

SURVEY ANALYSIS

Topics covered in this chapter

- Criteria for selection of field sites & general information
- Survey Questionnaire result
- Observations

CHAPTER 5

5.1 CRITERIA FOR SELECTION OF FIELD SITES & GENERAL INFORMATION

The variety of approaches and data would provide, in the end, a more complete picture of existing work environment in IT based offices.

The steps in the process involve

5.1.1 Literature review

5.1.2 Review of the available standards and associated materials

5.1.3 Interviews, Review, and Input

5.1.4 Site Visits and Review

Site visits were made to corporate offices, with the intent of observing work environment in IT based offices in the NCR region. Further, the site visits provided the opportunity to collect unstructured data from respondents. In doing so, the surveyor asked the same general questions at each site. Responses to these questions often led to follow-up questions, which provided additional information and data.

5.1.5 Final Findings and Recommendations

Final findings and recommendations is given based upon the preceding research methodology.

5.2 SURVEY QUESTIONNAIRE RESULTS

5.2.1. a. Type of workstations

1) Enclosed (Cubical cluster) - 70%

2) Open - 30%

b. Layout

1) L-shaped - 80%

2) Rectangular Desk - 15%

3) Others - 5%

5.2.2. How is the area air-conditioned?

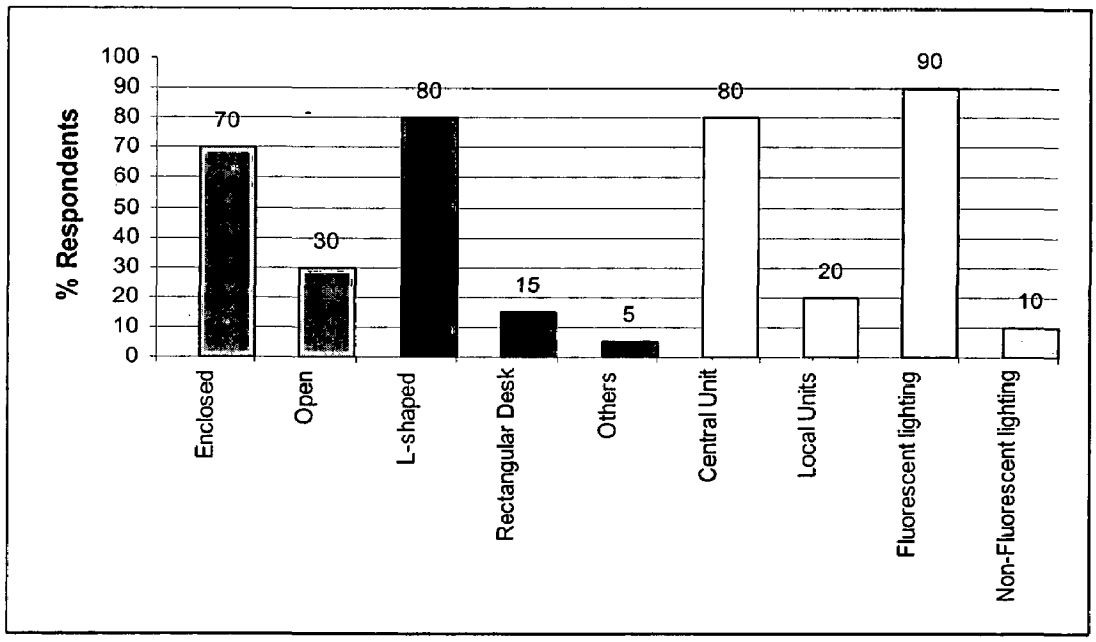
1) Central Unit - 80%

2) Local Units - 20%

5.2.3. How is the workstation lighted?

1) Fluorescent lighting - 90%

2) Non-Fluorescent lighting - 10%



Type
Layout
Air conditioning
Lighting

Fig 5.1 Workstation Type, Layout, Air conditioning & Lighting

5.2.4. Condition of Noise level at workstation:

1) Too much - 56%

2) Just right - 32%

3) Too little - 12%

5.2.5. Condition of Humidity level at work area:

1) Too much - 48%

2) Just right - 38%

3) Too little - 14%

5.2.6. Condition of Lighting at workstation:

1) Too much - 26%

2) Just right - 35%

3) Too little - 39%

5.2.7. Condition of Air movement at work area:

1) Too much - 12%

2) Just right - 33%

3) Too little - 55%

5.2.8. Condition of Temperature at work area:

1) Too much - 28%

2) Just right - 24%

3) Too little - 48%

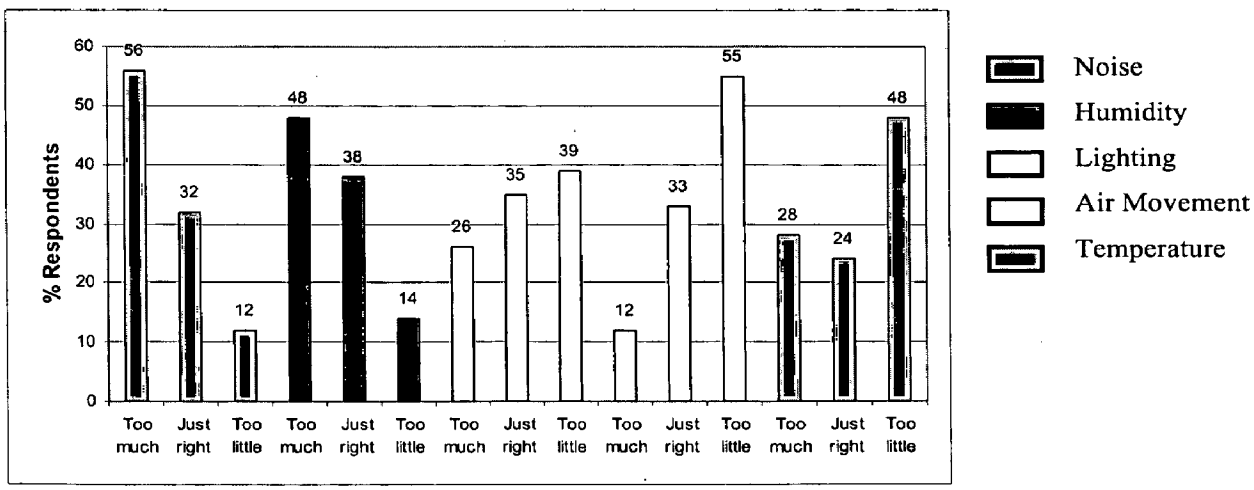


Fig 5.2 Noise, Humidity, Lighting, Air Movement & Temperature

5.2.9. Do they have to put on extra clothing for comfort?

1) Regularly - 30%

2) Sometimes - 45%

3) Never - 25%

5.2.10. Does the office air have an unpleasant odour?

1) Regularly - 30%

2) Sometimes - 40%

3) Never - 30%

5.2.11. Does the office air feel stuffy?

1) Regularly - 55%

2) Sometimes - 25%

3) Never - 20%

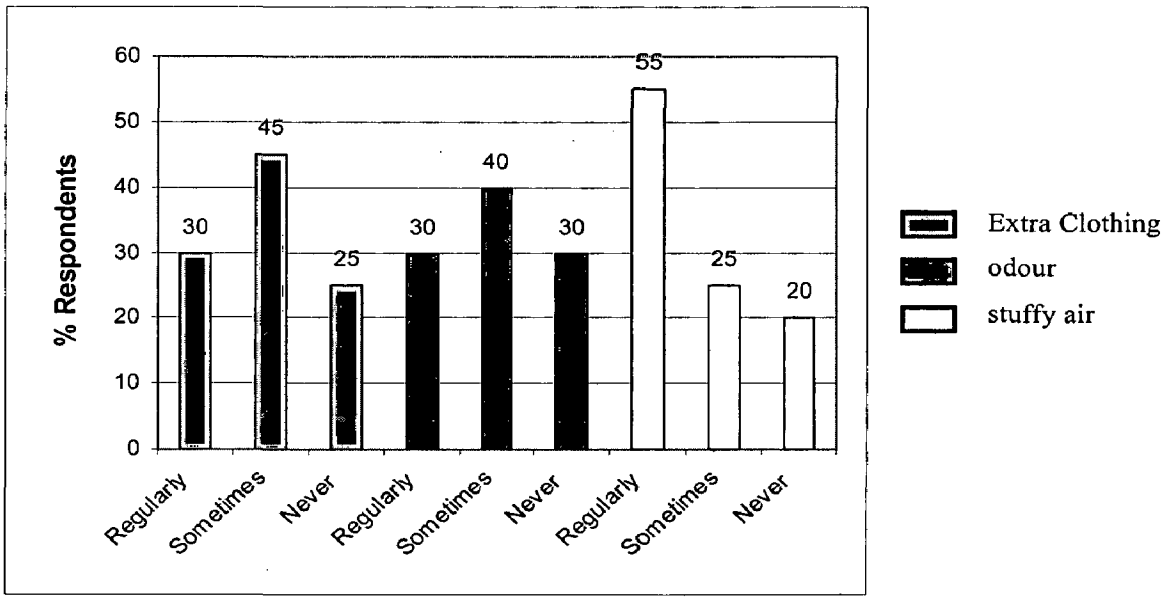


Fig 5.3 Extra Clothing, odour & stuffy air

5.2.12. Do you feel the problem regarding privacy?

1) Regularly - 45%

2) Sometimes - 30%

3) Never - 25%

5.2.13. How they feel about colors at workstation panels/work area?

1) Affect mood/concentration - 60%

2) Doesn't affect - 40%

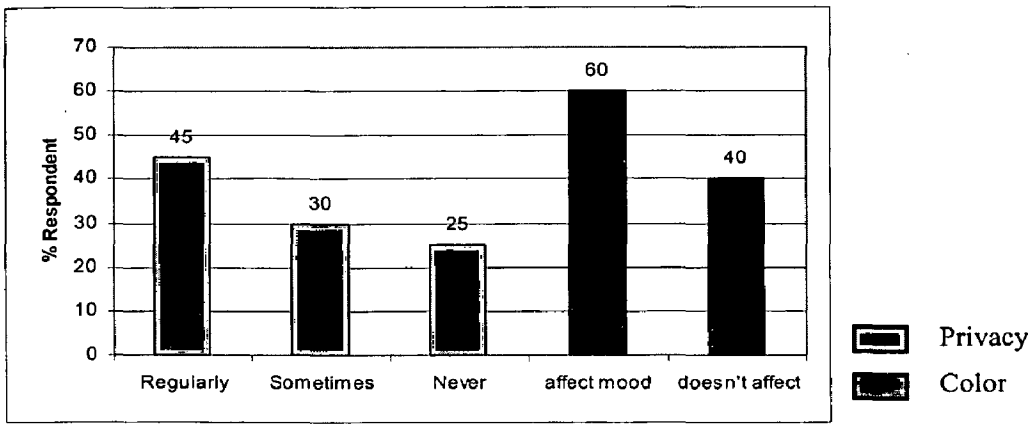


Fig 5.4 Privacy & Colors

5.2.14. How many times in a day you interact with others (formal)?

1) 0-2 - 45%

2) 3-5 - 45%

3) 6 & more - 10%

5.2.15. How many times in a day you visit informal area?

1) 0-2 - 55%

2) 3-5 - 30%

3) 6 & more - 15%

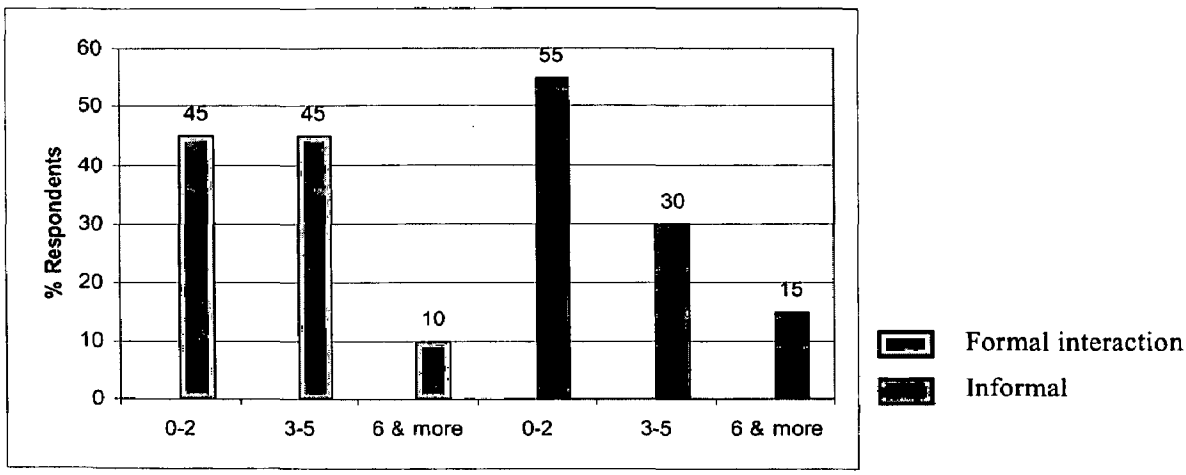


Fig 5.5 Formal interaction & visits to informal area

5.2.16. How you find the Physical stress experience in working conditions:

1) High - 35%

2) Moderate - 50%

3) Low - 25%

5.2.17. How you find the mental stress experience in working conditions:

1) High - 40%

2) Moderate - 45%

3) Low - 15%

5.2.18. How you find the Climate of cooperation in working conditions:

1) High - 25%

2) Moderate - 50%

3) Low - 25%

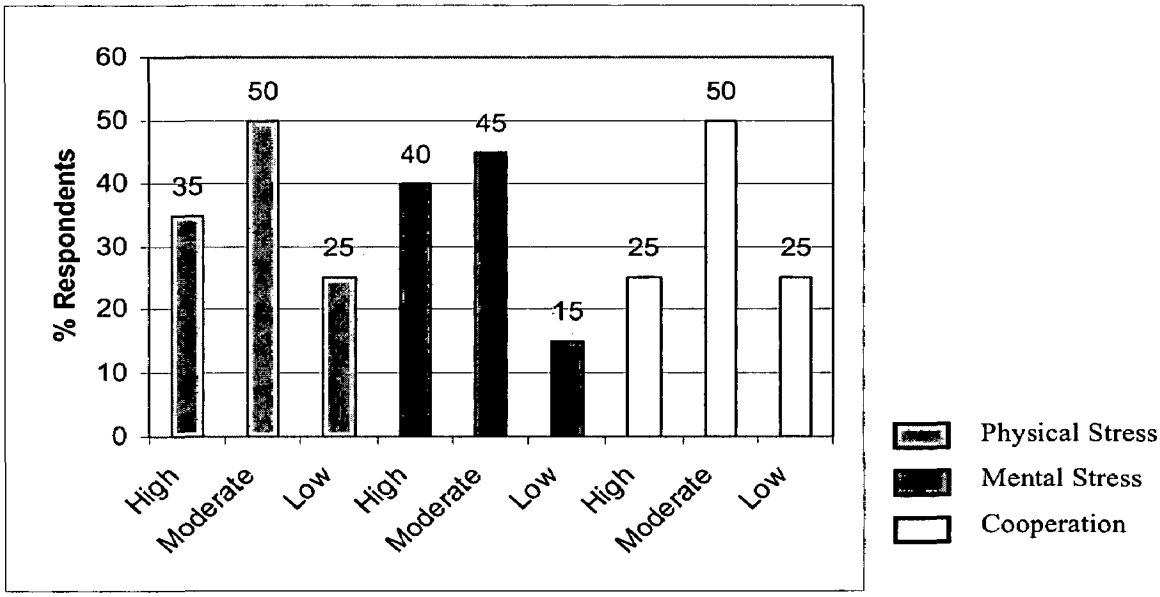


Fig 5.6 Physical Stress, Mental Stress & Cooperation

5.2.19. How they experience Headache at work during the past one month?

1) Daily - 20%

2) 2-3 times weekly - 55%

3) Less - 25%

5.2.21. How they experience Lethargy at work during the past one month?

1) Daily - 25%
2) 2-3 times weekly - 50%
3) Less - 25%

5.2.22. How they experience dizziness at work during the past one month?

1) Daily - 20%
2) 2-3 times weekly - 50%
3) Less - 30%

5.2.23. How they experience Nausea at work during the past one month?

1) Daily - 10%
2) 2-3 times weekly - 45%
3) Less - 45%

5.2.24. How they experience shortness of breath at work during the past one month?

1) Daily - 20%
2) 2-3 times weekly - 50%
3) Less - 30%

5.2.25. How they experience stuffy nose at work during the past one month?

1) Daily - 50%
2) 2-3 times weekly - 25%
3) Less - 25%

5.2.26. How they experience dry throat at work during the past one month?

1) Daily - 35%
2) 2-3 times weekly - 45%
3) Less - 20%

5.2.27. How they experience skin rash/itchiness at work during the past one month?

1) Daily - 20%
2) 2-3 times weekly - 45%
3) Less - 35%

5.2.28. How they experience eye irritation at work during the past one month?

1) Daily - 60%
2) 2-3 times weekly - 25%
3) Less - 15%

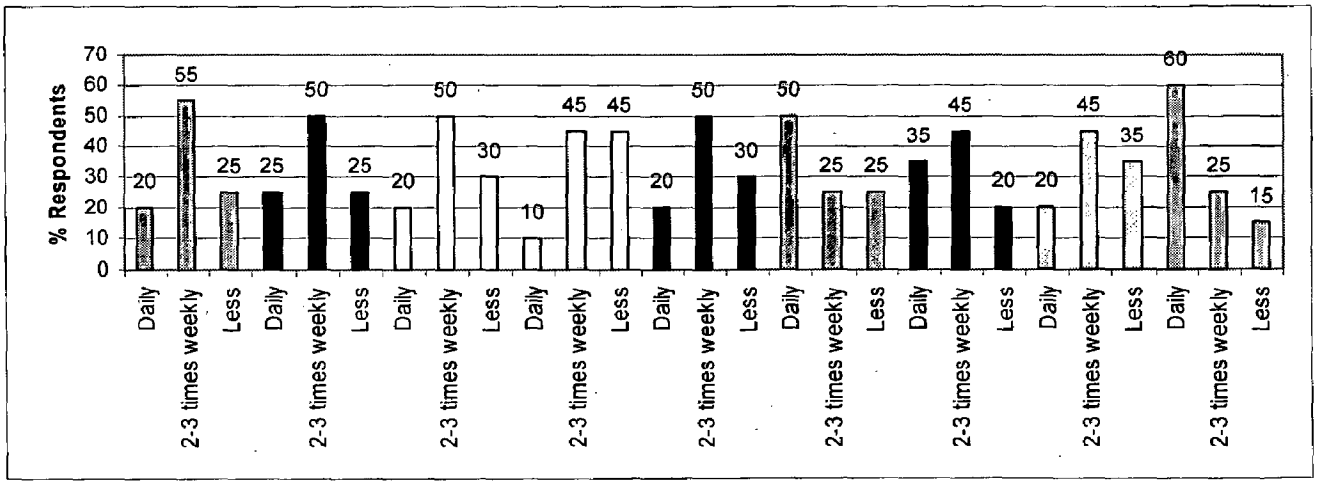


Fig 5.7 Symptoms

- Headache
- Lethargy
- Dizziness
- Nausea
- Short of Breath
- Stuffy nose
- Dry Throat
- Skin rash/itchiness
- Eye irritation

5.2.29. No. of leave in the past one month because of these complaints:

1) 0-1 - 40%

2) 2-3 - 50%

3) 4 & more - 10%

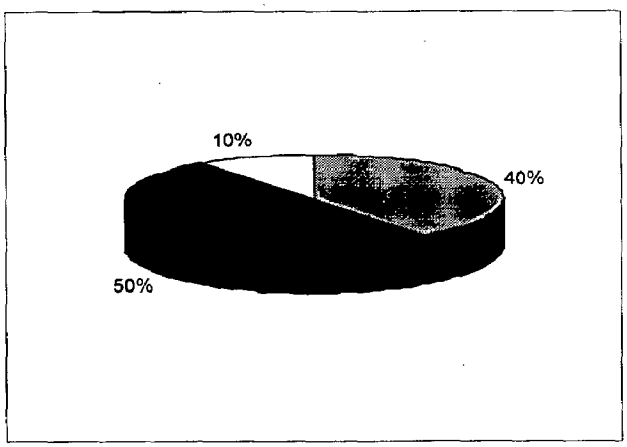


Fig 5.8 No. of leave

5.2.29. Problem with setup of keyboard, mouse & monitor.

1) Yes - 85%

2) No - 15%

5.2.30. Problem of glare on monitor screen.

1) Yes - 70%

2) No - 30%

5.2.31. Problem with chair & seating posture.

1) Yes - 70%

2) No - 30%

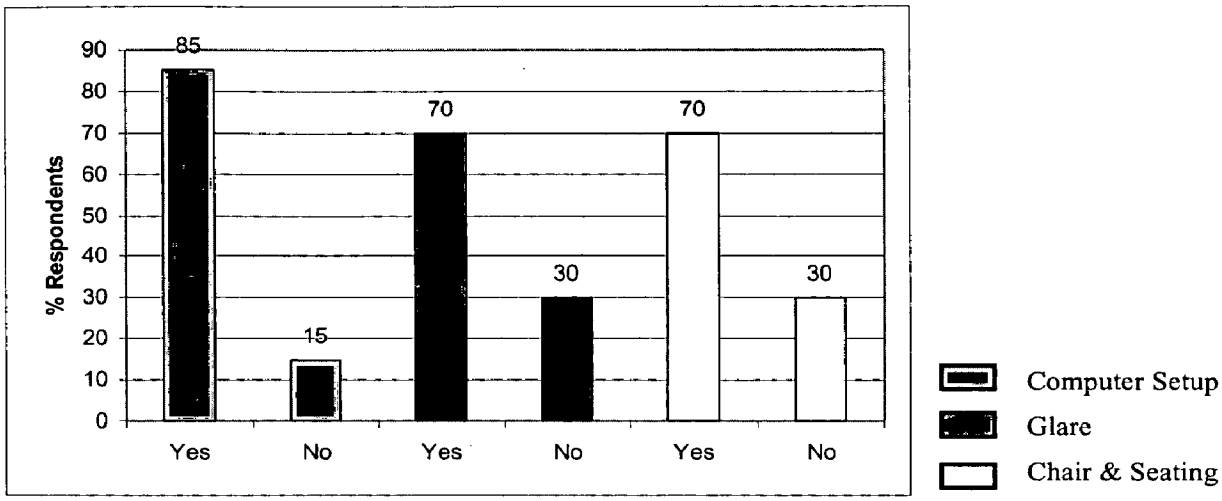


Fig 5.9 Problems with Computer Setup, Glare & Seating

5.3 OBSERVATIONS

This survey suggests that following design factors need an attention while planning and design of offices. It is also observed that by careful consideration, work efficiency and productivity can be improved up to a certain extent.

The factors are:

- Ergonomics: workstation, seating posture
- Poor indoor air quality
- Thermal comfort
- Improper lighting
- Lack in workplace privacy
- Color & aesthetics
- Problem of Glare
- Inadequate recreational facilities
- Inadequate interaction spaces (formal & informal)

5.2.33. Employees' opinion about present work environment on a scale of 10.

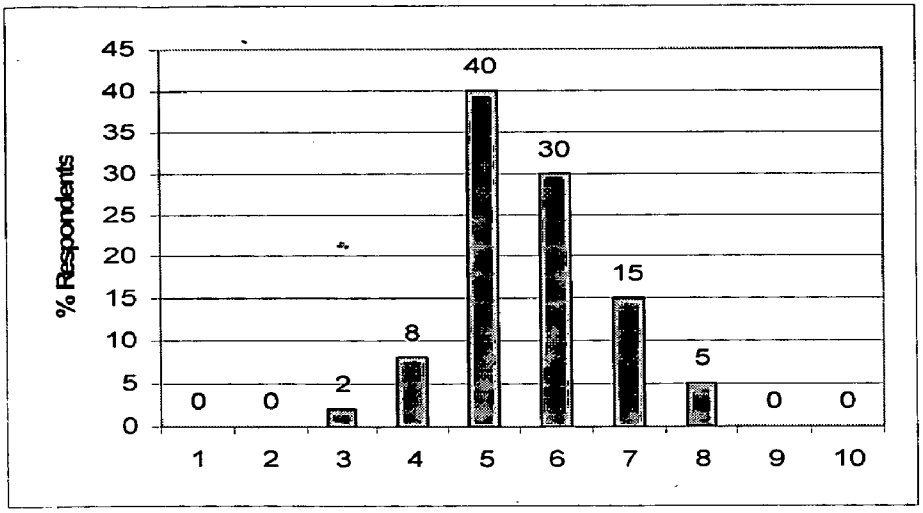


Fig 5.10 Employee's Opinion

5.2.34. Employees' opinion about factors affecting work efficiency

1) Indoor Air Quality - 1
2) Lighting - 6
3) Color - 8
4) Thermal Comfort - 3
5) Ergonomics, workstation, controls - 2
6) Privacy - 7
7) Interaction/Communication - 4
8) Functional Efficiency: space, layout - 5

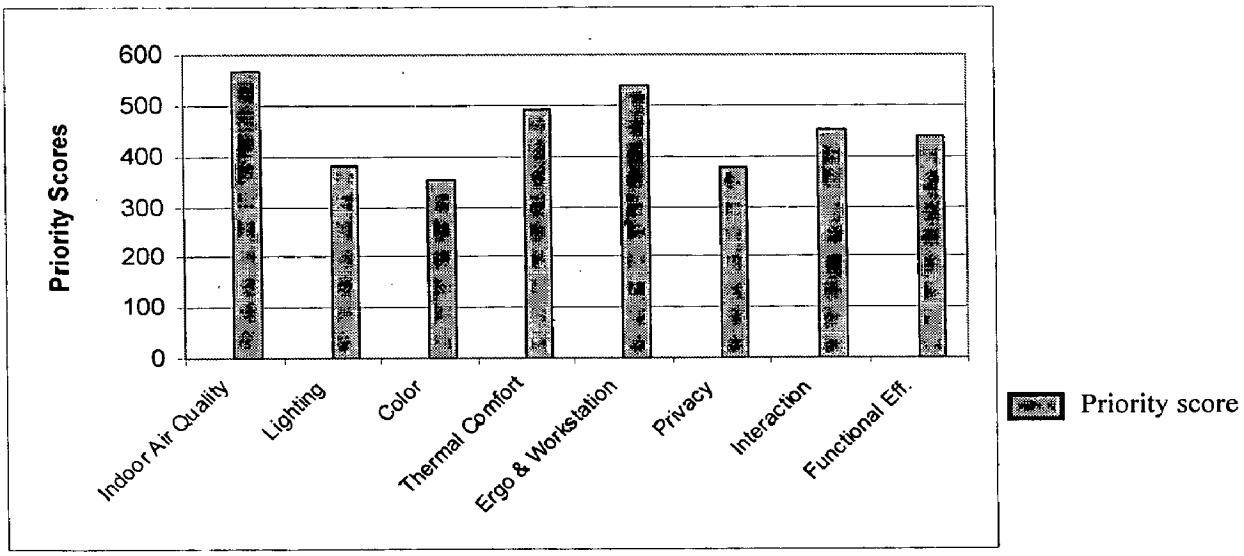


Fig 5.11 Priority Score

DESIGN CONSIDERATIONS

After the extensive literature study, field surveys and case studies of various office spaces, design consideration framed for efficient work environment in IT based corporate offices. These criteria can be directly inferred from the study of the preceding chapters.

Topics covered in this chapter

- Design Considerations
- Guiding Illustrations
- Conclusion

CHAPTER 6

6.1 DESIGN CONSIDERATION FOR EFFICIENT WORK ENVIRONMENT IN CORPORATE OFFICES

The following guiding principles help in developing an efficient & productive work environment in IT based corporate offices.

6.1.1 SPATIAL EQUITY

Design of the workplace should meet the functional needs of the users by accommodating the tasks to be undertaken without compromising individual access to privacy, daylight, outside views, and aesthetics. Specific requirements include

- **Natural Daylight**: Everyone should have access to natural daylight. This promotes good health and increases productivity.
- **Views**: Provide all employees with seated views to the exterior. This also promotes good health and productivity.
- **Fairness**: Space should be appropriate to the type of work conducted. Therefore, rank of hierarchy is neutral in space standards. This supports collaboration, mentoring, and knowledge sharing.

  In open plan office areas, provide adjustment for individual acoustic and visual privacy.
- **Multiple Work Settings**: Offer multiple approaches and solutions. This stimulates creativity and supports flexibility, knowledge sharing, and mentoring.

6.1.2 HEALTHFULNESS

Create workplaces with a clean, healthy building environment free of harmful contaminants and excessive noise, with access to clean air, light, and water. Specific requirements include

- **Air**: Provide clean, fresh air. Monitor and maintain air quality levels. A system that provides user control is ideal. Consider underfloor air supply.

  Use only construction materials and methods that will not contain or release harmful contaminants that could adversely affect indoor air quality during future modifications.

- **Ventilation**: Provide exhaust ventilation (and consider negative air pressure) per applicable codes and standards for all noxious fumes and odors, including those from copy areas, food preparation or storage, toilet, janitor's closets, battery/rectifier, & UPS rooms. Group like spaces together wherever possible.
- **Ergonomics:** Provide certified, ergonomically sound furniture, lighting, and equipment, including task chairs, variable-height work surfaces, computer monitor stands, adjustable keyboard trays, and adjustable, demountable task lights.
- **Restrooms**: All restrooms should be clean, maintained, and sanitary. Locate restrooms within easy travel distance from individual work areas.
- **Amenities**: A coffee bar, fitness center, health center, and day care center all provide a greater level of healthfulness and community.

6.1.3 FLEXIBILITY

Workplace configuration components should be easily adapted to organizational or work process changes, and should be readily restructured to accommodate key functional changes with a minimum of time, effort, and waste. Specific requirements include

- **Furniture Strategy**: For open-plan, use modular work surfaces that allow the most varied arrangements and that fit together to provide maximum surface area in the space provided.

  Avoid using free-form work surfaces that do not function and avoid panel-hung elements that cannot work with freestanding panels. Use panels that are appropriate to function and tasks. Explore the use of demountable wall systems instead of hard wall construction.
- **Kit-of-Parts Workstation:** Identify and select workstation and office furniture that should facilitates user adjustment and reconfiguration, including furniture, task lighting, power, data and communications connections, and air supply control.
- **Fluid Layouts:** Base layouts on function, not building grid; this encourages creativity and community. Provide free-standing, modular furniture components for all offices and workstations.

Work surfaces should be light enough to be moved by one person. Heavy furniture such as files, storage towers, and bookcases should be on wheels or other devices so that when fully loaded, one person can move them easily.

- **Technology:** Provide power, data, and communications services through plug-and-play systems with integrated cable management to the desktop that allows connections to be made easily, by the occupant, to serve components anywhere within the workstation. Consider wireless technology in conference and teaming spaces.
- **Meeting and Team Rooms:** Provide a variety of meeting spaces, such as a small meeting room for 4 to 8 people, medium room for 10 to 12 people, and large room for up to 20 people, separated by operable walls that can be opened to create larger conference rooms when needed. Provide for a central reservation system for all shared meeting facilities. These include:
  - Project/multi-purpose rooms;
  - Conventional meeting rooms. Supply with support tools, mobile easels, whiteboards, project screen, and tackable panels; and
  - Playful to invite innovative solutions.
- **Space Types Standards**: Create fewer space types. This will control costs, enable change, and foster an environment for diversity, innovation, and exploration.

6.1.4 COMFORT

Distribute workplace services, systems, and components that allow occupants to adjust thermal, lighting, acoustic, and furniture systems to meet personal and group comfort levels. Specific requirements include

- **Thermal Control**: Provide individual user control, within a reasonable range, of temperature and ventilation conditions at each workstation.
- **Lighting:** Provide individual user control of task and ambient lighting, including natural daylight.

- **Ergonomics:** Ensure all furniture and lighting is ergonomically sound. Provide components within the workstation enclosure that can be reconfigured by the user without tools or special expertise.

  Allow complete location flexibility for computer desk surfaces, storage elements, and computer monitor.

- **Multiple Work Settings:** Create a variety of work settings with varied types of seating to suit identified work types and individual needs.
- **Adequate Space:** Provide supportive office and worksurface space, which supports job function and technology for all employees.
- **Security**: Create an environment that should provide a secure place for all employees.

6.1.5 RELIABILITY

Workplace should supported with efficient, state-of-the-art heating, ventilating, air conditioning (HVAC), lighting, power, security, and telecommunication systems and equipment that require little maintenance and are designed with battery and/or greater back-up capabilities to ensure minimal loss of service or downtime. Specific requirements include

- Clean Air and Ventilation
- Lighting: Consider both natural and artificial lighting to meet needs.
- HVAC: Provide HVAC systems with effective ventilation and individual user control of temperature and air flow. Select systems that can be adapted to changing space configurations and uses without involving demolition and renovation work.
- Security: Provide building systems security and access control to adequately safeguard the physical health and safety of building occupants.
- Maintenance: Develop and implement a comprehensive maintenance program to keep all building systems and equipment in good operating condition and minimize breakdowns.

- System Confirmation: Commission all systems, especially ventilation and lighting systems, after installation to ensure they are providing the full benefit as intended.

6.1.6 SENSE OF PLACE

Workplace should show a unique character, appropriate organisation image, and business identity to enable a sense of pride, purpose, and dedication among both the individual and the workplace community. Specific requirements include

- **Graphics:** Provide well-designed signage and graphics to reinforce the identity of space and enhance the user experience.
- **Connectivity:** Ensure employees and visitors know that they are in a company space from the entrance to the workplace. This should include items such as signage, company logo, furniture, and lighting types. Company identity should exist from location-to location. This doesn't necessarily mean that everything has the same look or that you have to take a one size fits all approach.
- **Brand, Values, and Beliefs:** Make sure the space clearly demonstrates the organization Brand, Values, and Beliefs. Space should provide opportunities to express uniqueness without diminishing the company's World Class Brand, Values, and Beliefs.
- **Sense of Ownership:** Provide clean, attractive, accessible, functional spaces that occupants can take pride in showing to customers, colleagues, family, and friends.
- **First Impressions:** Provide amenities that are valuable to the building occupants and that enhance way-finding, image, identity, sense of pride, ownership, and community.
- **Color Scheme and Finishes:** Use color strategically to create desirable moods and themes. Create a calm work environment that promotes and encourages interaction, and stimulates creativity and innovative solutions.

  Accent colors and finishes can delineate function, and onstage/offstage areas, and can draw attention to particular aspects of the space (i.e., identity wall or conference center). Bring natural light into internal spaces.

6.2 GUIDING ILLUSTRATIONS

6.2.1 Reception

- Reception area should support the company identity.

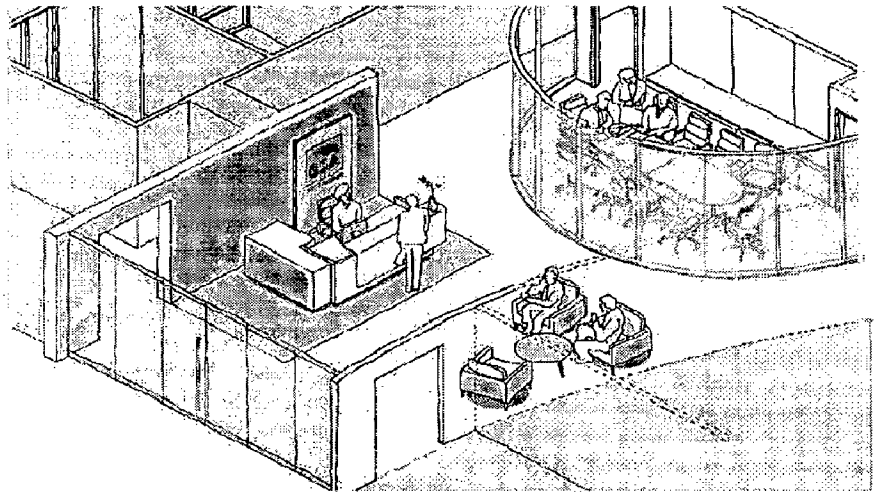


Fig. 6.1 Reception

The basic functions are

- Demonstrate the Hallmarks
- Create identity
- Greet
- Provide sign-in, tracking, gate keeping
- Provide services/hospitality
  - Phone/communication
  - Conference
  - Refreshments

Color and Material

- Careful consideration of the palette chosen should set the tone and character for the rest of the space. Ideally, the overall palette is neutral and crisp.
- Accent color and/or material can be strategically introduced at this point to create interest, show regional identity, or inspire way finding.

Graphics and Signage

- Graphics and signage are important elements of the entry sequence.
- Design, fabrication, and placement of identity, display, and environmental signage should be a well-thought-through and coordinated effort to enhance the company message.

6.2.2 Café and recreational Facilities

- The café should provide an opportunity for more than just physical refueling. It is a place for "mental refueling" as well. It demonstrates how organization thinks about their staff, and their needs throughout the day.

The basic functions of a cafe are

- To provide access to food, water, and social interaction–"a refreshing place to go;"
- To provide a place that can be used throughout the day for a change of scenery and a mental break to help clear your mind;
- To create a variety in seating, finishes, and colors (not like the other spaces); and

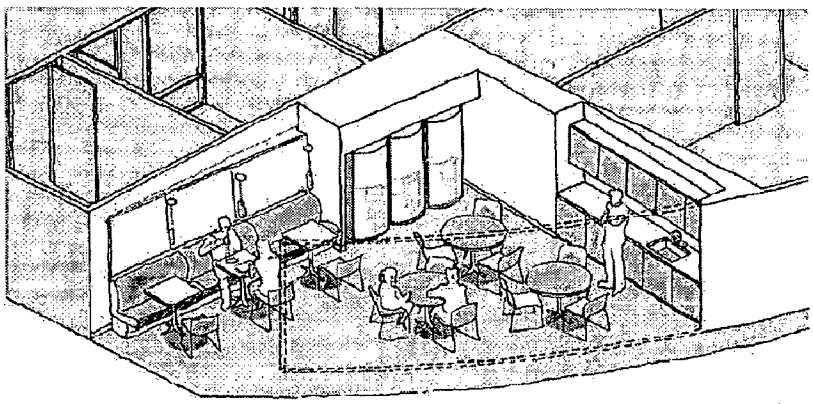


Fig. 6.2 Cafe

- To provide access to the kind of exterior spaces, sunlight, and plants that pertains to that specific area.
- To provide recreational area like sports, gym etc.

6.2.3 Large conference room

- The front of house conference room is the primary area where company representative and client interface. It should be well thought out and seamless in the way it functions.

A good conference room should provide:

- Good air quality and control
- Good lighting and controls for various formats

- Good technology interface (speaker phone, video capable, laptop, email connectivity)
- Access to food and beverage
- A professional image
- Good maintenance practices
- Access to power and data connections without crossing circulation paths
- Flexible components that can be easily rearranged to accommodate different needs
- Avoid large one-piece conference tables
- Good acoustic conditions

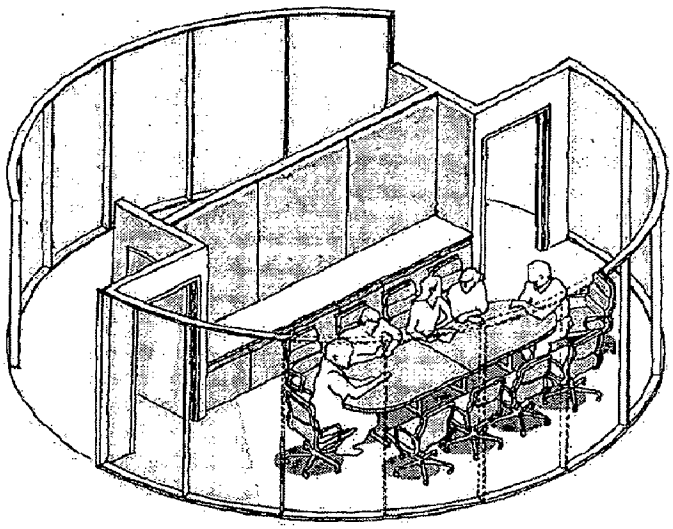


Fig. 6.3 Conference Room

Color and Materials

- The primary use of conference spaces should excludes the use of strong accent colors or intrusive wall art.
- Should Remember the users of these spaces will require a working environment with wall surfaces and colors which are suitable for visual projection, pin-up, and writing.
- Wall surfaces should be able to sustain tack marks, and potentially markers, without repainting.
- Should consider writable wall coverings as well as tack space, based on needs.

Acoustic Control

- Conference rooms doors and walls should go to the underside of deck for sound containment to and from the adjacent space.

6.2.4 Open Workspace

- This space plays an important role in creating efficient workplace. The important aspect should value: access to light and view, teamwork, adaptability, individual comfort, respect for resources, and professional atmosphere.
- Consider use of live plants to improve indoor air quality and user satisfaction.
- Use transparent or translucent vertical surfaces parallel to the windows to the greatest extent possible, especially above 48 inches in order to maximize light penetration into the space.
- Use limited parts and pieces, which are movable by the user.

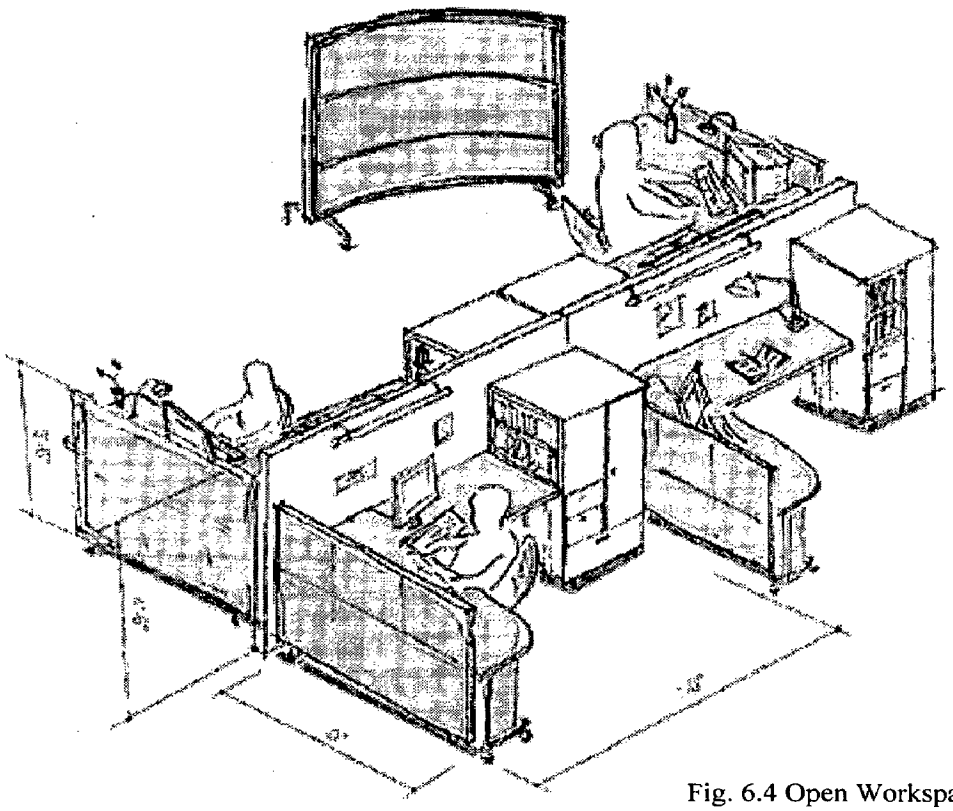
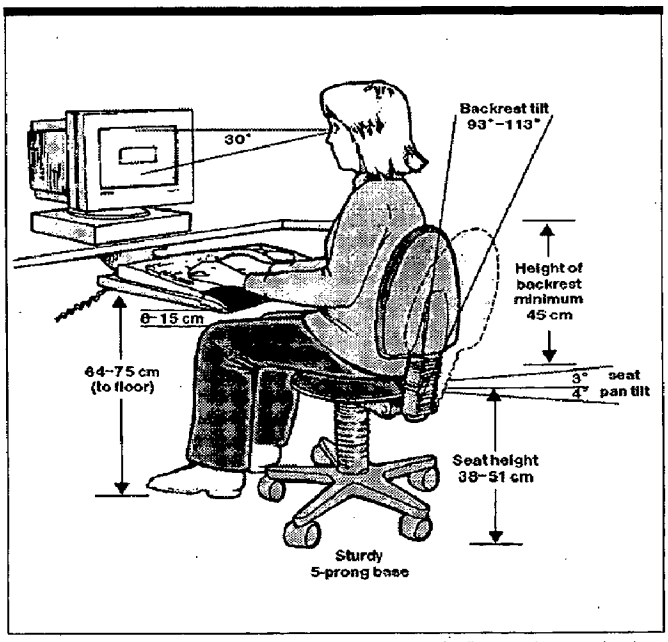


Fig. 6.4 Open Workspace

- Use tall mobile storage components that do not block light and views of others.
- Consider using storage towers on wheels which can replace overhead flipper bins or shelves; overhead bins and shelves block light and views, decrease configuration flexibility, and make space feel tighter.
- Provide good ergonometric seating and computer peripherals.

- Provide effective and sufficient lighting arrangement such as indirect ambient Lighting, task and accent lighting.



This drawing shows the recommended dimensions and adjustment ranges for the chair, monitor, keyboard, and work surfaces. The operator in this drawing is using good posture.

Fig 6.5 Workstation Dimensions & Posture

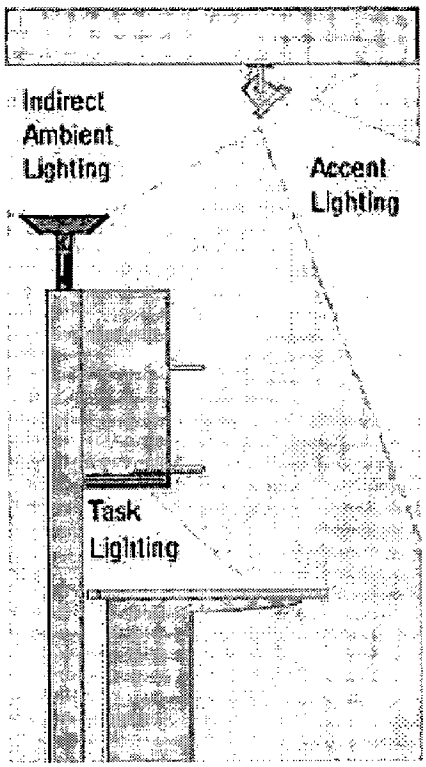


Fig. 6.6 Task & Accent lighting

- Reconfigure to allow for different levels of teaming;
  - Four-person team
  - Two-person team
  - Individual

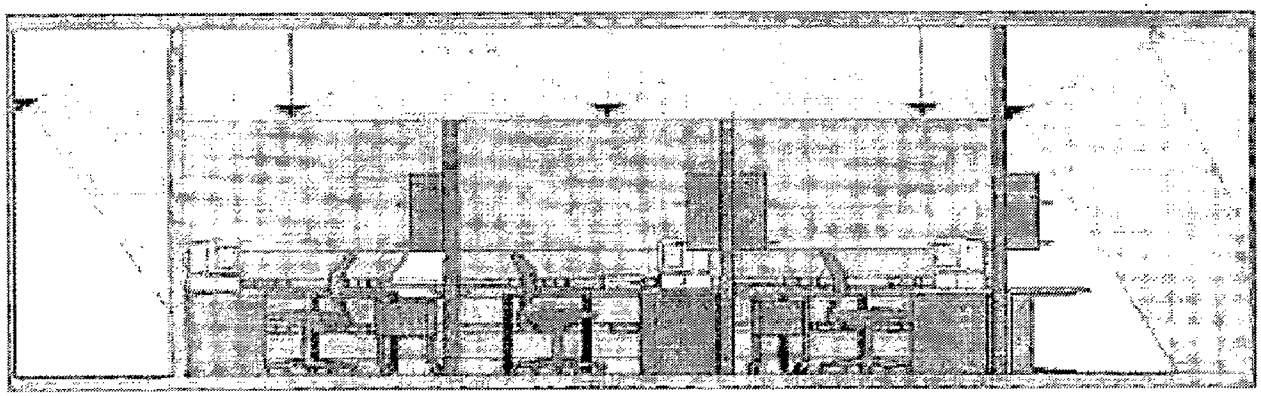


Fig. 6.7 Indirect Ambient lighting

Color and Material

- Choices for furnishings should be predominately neutral in color to allow for ease in reconfiguration.

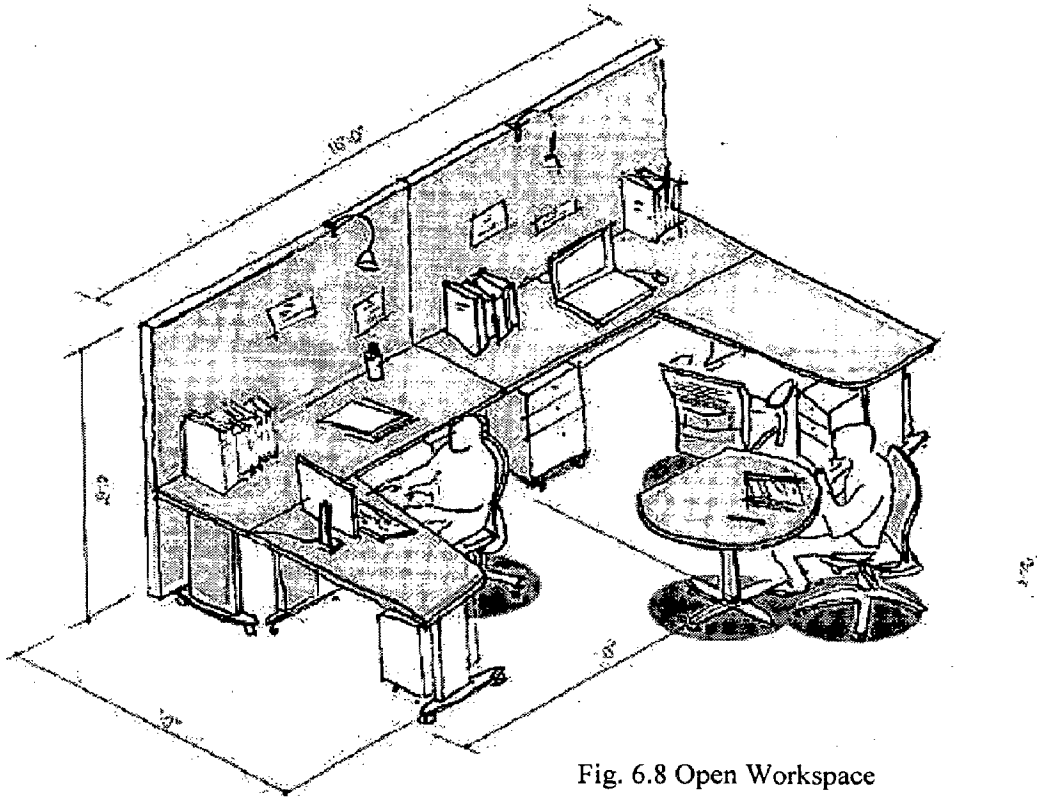


Fig. 6.8 Open Workspace

- Worksurfaces should be light in color to maximize light reflectance and reduce contrast.
- Upholstery colors and materials should be selected with maintenance and reconfiguration in mind.
- Architectural accent color and materials are more easily controlled and provide more visual impact. Ideally, the overall palette is neutral and crisp.
- Accent color and/or material can be strategically located to create interest, show regional identity, or stimulate way-finding.

Acoustic Control

- Workstations should be clustered in quantities of four in order to maintain adequate acoustic and visual separation.
- Maintaining a work environment that is not too densely packed is key to providing a healthy, professional, and aesthetically pleasant environment.

- Workspace should be design to provide Privacy in terms of acoustics, visual, informational and territorial.

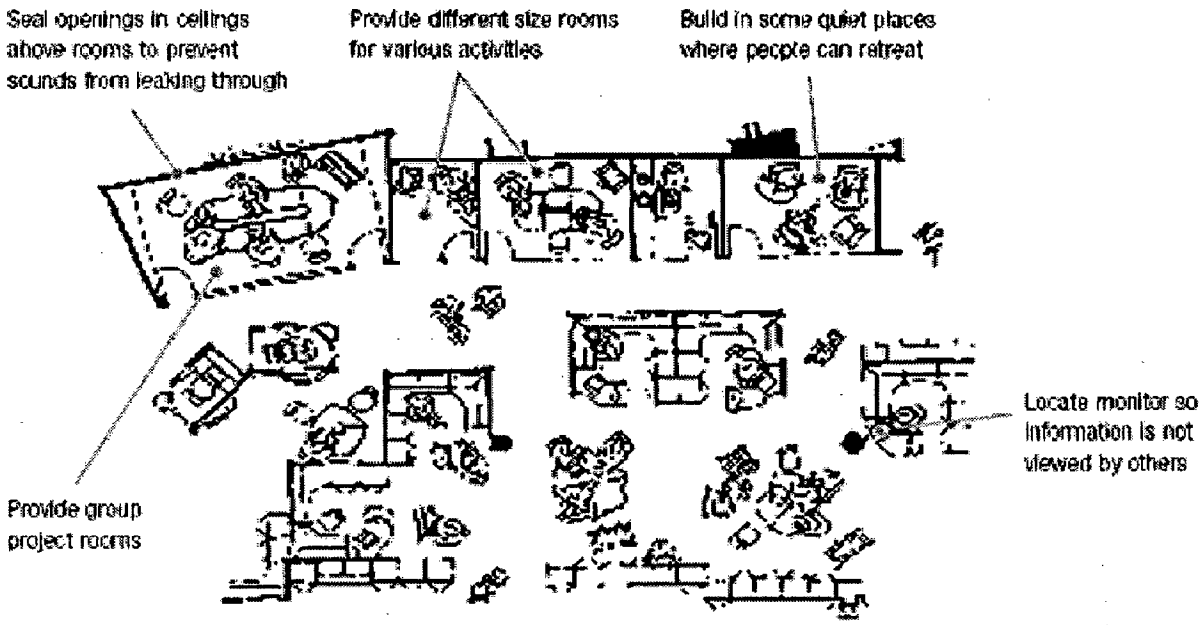


Fig. 6.9 Privacy in workspace -1

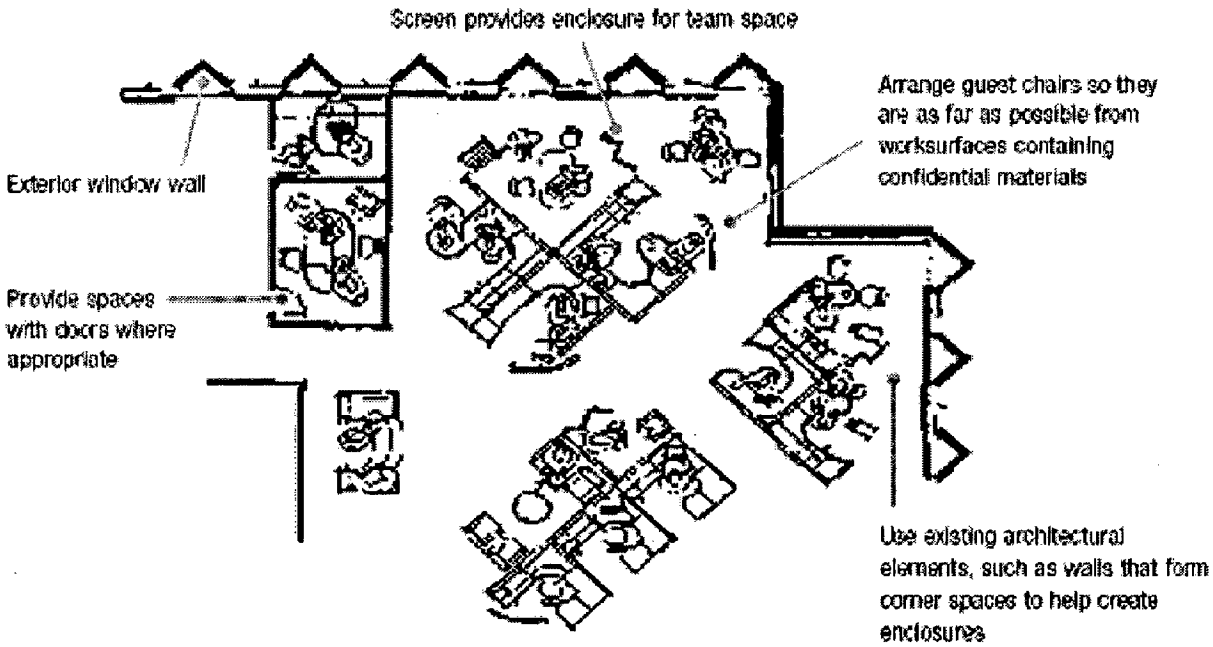


Fig. 6.10 Privacy in workspace -2

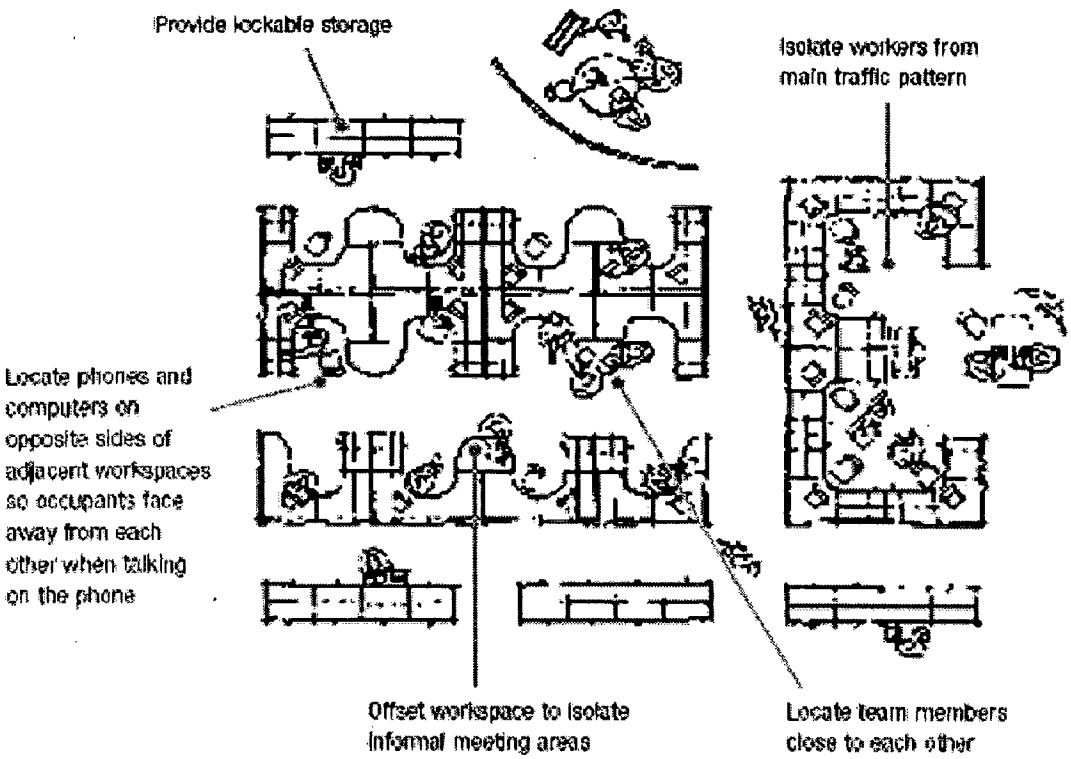


Fig. 6.11 Privacy in workspace -3

6.2.5 Closed workspace

- It should well-organized, non-hierarchal, and accessible.

This should have these functional characteristics

- Interior location to allow for maximum penetration of natural light and view for open plan associates.
- 10' x 12' footprint accommodates most closed work functions.
- Glass front is important part.
- Two guest maximum.
- Offices are available for other uses when not in use by primary occupant.
- Unassigned offices to be used as team areas, visitor stations, conference call areas (not to be used to permanently house two people).
- Vertical Storage on back wall (not side to prevent crowding).
- Smart outlet placement.

Color and Material

- The palette of colors and materials selected for the closed workspace should be consistent with that in the open spaces.
- Furnishings should be interchangeable with that of the open workspace.

Demountable Walls

- Demountable walls are an excellent option for closed workspaces.
- A planning strategy that minimizes the number of closed office standards also allows for a cost effective application of movable walls.
- This is especially so when glass fronts are incorporated.

6.2.6 Closed Office as Team Room

- These are small conference rooms in the Offstage zone that are not scheduled. Functionally they should provide
- Accommodation for small groups of two to four (can be same as office footprint),
- Speaker phone access,
- Acoustic privacy,
- Pin up and writing surface,
- Smart outlet placement, and
- Furnishings which can be easily used for visitor office.

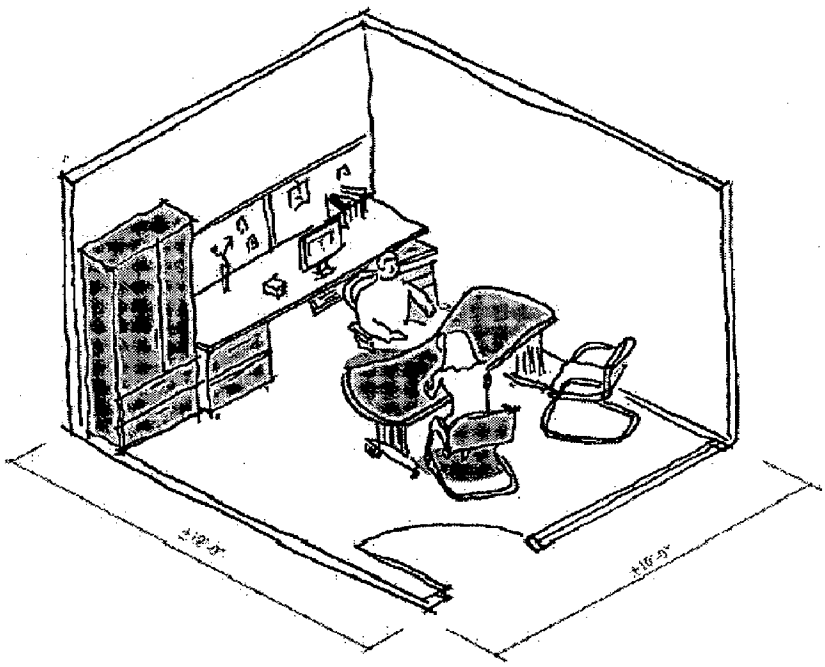


Fig. 6.12 Closed Office

6.2.7 Shared support (files, equipment)

- This is an accessible area for shared support such as files and printers, which are a necessary part of everyone's workplace.
- it should be universal design

- Maintaining the shared support areas.
- Being purposeful, consistent, and equitable.

Color and Material

- Consider materials for continuous worktops that are sustainable.

6.2.8 Team areas

- These are spontaneous collaboration areas in the offstage zone that do not need to be scheduled.
- It is used primarily when a small group of two to three needs to review their work for coordination purposes and to share ideas.
- It is the most visual and energized demonstration of collaboration that can be planned in the office.

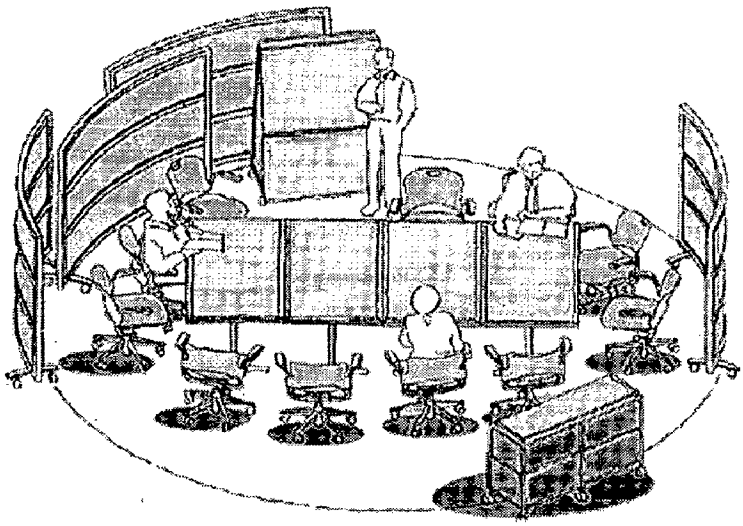


Fig. 6.13 Team Area

- Flip chart or writing surface
- Responsive lighting and ceiling treatment
- Smart outlet placement—raised floor benefit
- Windows/view—promotes innovation and creativity

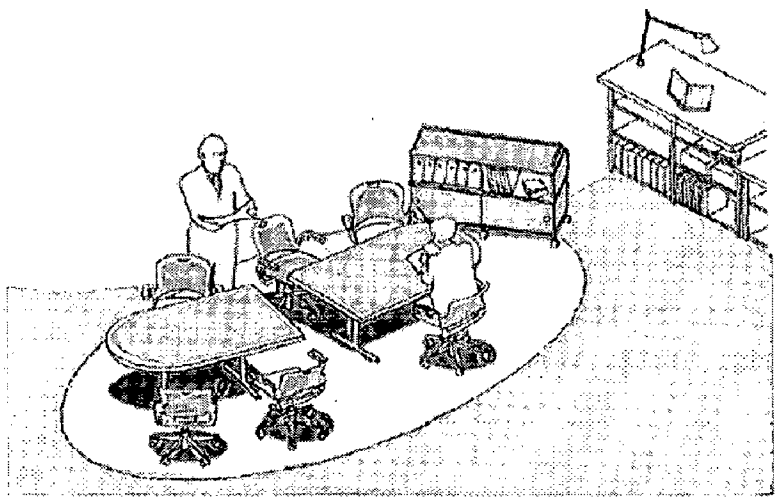


Fig. 6.14 Team Area

Color and Material

- Open team areas are an excellent opportunity to introduce accent color and materials.
- It could be a change in flooring material, color, and texture.

Furniture Selection

- It is also a chance to introduce unique pieces of furniture that facilitate collaboration such as mobile supply carts and seating that is different than that at the work areas.

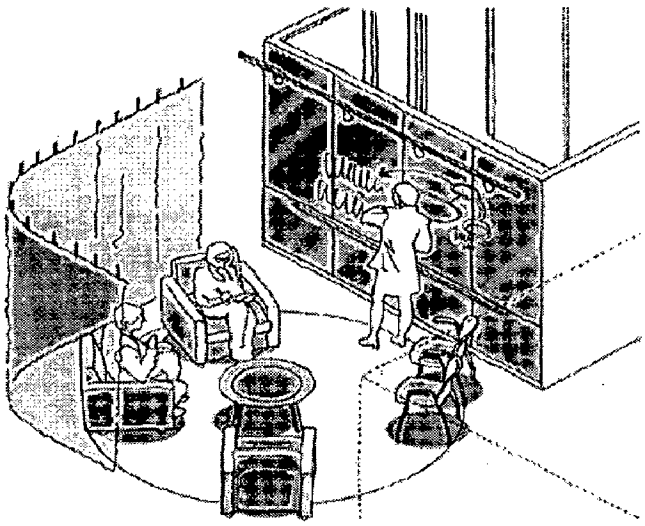


Fig. 6.15 Team Area

6.3 CONCLUSION:

Each person responds uniquely when confronted with a specific situation/environment. These responses fall into three categories - Physiological, Psychological and Sociological. To create an efficient and healthy work environment architect should consider all these factors.

Efficient work environment in corporate offices can be developed by the following concepts.

- **Spatial Equity**
- **Healthfulness**
- **Flexibility**
- **Comfort**
- **Reliability**
- **Sense of Place**

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APPENDIX I

QUESTIONNAIRE FOR BUILDING OCCUPANTS

To the occupant: This short questionnaire has been given to you to help in assessment of working condition & affect on work efficiency in the office environment. Your answers will remain confidential. Please complete the form as accurately as possible before returning to me. Thank you.

Surveyor: **Manish Kumar Gupta** M. Architecture, IIT-Roorkee E mail: ar_mgupta@yahoo.co.in

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1. Personal information

1.1 Sex: Male / Female

1.2 Age:

1.3 Marital status: Single / Married

1.4 Income:

1.5 Ethnic group: Indian / Other

2. Environmental conditions

2.1 Type of workstation: Enclosed cubical / Open concept

Workstation layout : L shaped/rectangular desk/(if other mention)

2.2 No. of people who share your workstation:

2.3 How is your area air-conditioned?

Central unit / Local unit

2.4 How is your workstation lighted?

Fluorescent lighting / Non-fluorescent lighting

2.5 Please indicate if you work with or near the following equipment:

Computer - Everyday / 2-3 times weekly / Never

Photocopier - Everyday / 2-3 times weekly / Never

Fax machine - Everyday / 2-3 times weekly / Never

2.6 Please rate the following conditions at your workstation:

Noise - Too much / Just right / Too little

Humidity - Too much / Just right / Too little

Lighting - Too much / Just right / Too little

Air movement - Too much / Just right / Too little

Temperature - Too hot / Just right / Too cold

2.7 Do you have to put on extra clothing for comfort?

Regularly / Sometimes / Never

2.8 Does the office air have an unpleasant odour?

Regularly / Sometimes / Never

2.9 Does the office air feel stuffy?

Regularly / Sometimes / Never

2.10 Do you feel the problem regarding privacy?

Regularly / Sometimes / Never

2.11 What is the color of your workstation panel/work area?.....

2.12 How do you feel about colors at your workstation panels/work area?

Affect mood/concentration/doesn't affect

2.13 How many times in a day you interact with others (formal)?_____

2.14 What type of informal interaction space available in your office?

Café/recreation Sports facility/NA/_____ if any other

2.15 How many times in a day you visit informal area? _____

3. Nature of occupation

3.1 No. of hours spent per day at your main workstation:

3.2 Please rate how you find the stress in your working conditions:

Physical stress experience - Low / Moderate / High

Mental stress experience - Low / Moderate / High

Climate of cooperation at work - Low / Moderate / High

3.3 What is your job category?

Managerial / Professional / Secretarial/ Other (if Other, specify):

4. Health complaints

4.1 Please indicate your experience of the following symptoms at work during the past one month:

Headache - Daily / 2-3 times weekly / Less

Lethargy - Daily / 2-3 times weekly / Less

Dizziness - Daily / 2-3 times weekly / Less

Nausea/vomiting - Daily / 2-3 times weekly / Less

Shortness of breath - Daily / 2-3 times weekly / Less

Stuffy nose - Daily / 2-3 times weekly / Less

Dry throat - Daily / 2-3 times weekly / Less

Skin rash/itchiness - Daily / 2-3 times weekly / Less

Eye irritation - Daily / 2-3 times weekly / Less

4.2 No. of days in the past one month that you had to take off work because of these complaints:

4.3 When do these complaints occur?

Mornings / Afternoons / No noticeable trend

4.4 When do you experience relief from these complaints?

After I leave my workstation / After I leave the building / Never

4.5 Please indicate if you have any of these medical conditions:

Asthma? Yes, on medication / Yes, not on medication / No

Allergy? Yes, on medication / Yes, not on medication / No

Sinus? Yes, on medication / Yes, not on medication / No

Migraine? Yes, on medication / Yes, not on medication / No

5. Office Ergonomics

1. Can the height, seat and back of your chair be adjusted? Yes/No
2. Does your chair provide support for your lower back? Yes/No
3. Do your armrests allow you to get close to your workstation? Yes/No
4. Do you take stretch breaks every 30 minutes? Yes/No
5. Are your keyboard, mouse and work surface at your elbow height? Yes/No
6. Are frequently used objects within easy reach? Yes/No
7. When using your keyboard and mouse, are your wrists straight and your upper arms relaxed by your sides? Yes/No
8. Is your mouse at the same level and as close as possible to your keyboard? Yes/No
9. Is your monitor positioned directly in front of you and at least an arm's length away? Yes/No
10. Is your monitor height slightly below eye level? Yes/No
11. Are your monitor and work surface free from glare? Yes/No
12. Do you have a desk lamp for reading or writing documents? Yes/No
13. Do you take regular eye breaks from looking at your monitor? Yes/No
14. Is your document ramp or vertical holder positioned directly in front of you? Yes/No

6 Others

6.1 Give priority to the factors affecting your work efficiency. (1 for highest and so on)

- Indoor Air Quality _____
- Lighting _____
- Color _____
- Temperature, Humidity _____
- Ergonomics, Workstation Controls _____
- Privacy _____
- Interaction/Communication _____
- Functional Efficiency: Space/Layout _____
- _____ _____ (mention if any other)
- _____ _____

6.2 Rate your present work environment on a scale of 10 _____

APPENDIX II

COMPUTER WORKSTATION CHECKLIST

Name of Organisation_____ **Date**_____

A. Body Position

1. Head is directly over shoulders	Yes ☐	No ☐
2. Shoulders are relaxed	Yes ☐	No ☐
3. Elbows are at 90° angle resting comfortably at side	Yes ☐	No ☐
4. Wrists are straight, floating over wrist rest	Yes ☐	No ☐
5. Knees are at 90° angle or greater	Yes ☐	No ☐
6. Feet flat on floor or supported by footrest	Yes ☐	No ☐

B. Workstation

1. Work surface area is adequate for computer and materials	Yes ☐	No ☐
2. Keyboard and mouse are directly in front of the operator	Yes ☐	No ☐
3. Keyboard and mouse are at comfortable height	Yes ☐	No ☐
4. Monitor is placed arm's length away from and directly in front of operator	Yes ☐	No ☐
5. Top of monitor screen is slightly below eye level	Yes ☐	No ☐
6. Chair has adjustable height and seat back	Yes ☐	No ☐
7. Seat back is adjusted to support lumbar region of back	Yes ☐	No ☐
8. Document holders are used to position documents close to monitors	Yes ☐	No ☐

C. Glare Reduction

1. Screen contrast and brightness are adjusted	Yes ☐	No ☐
2. Screen is positioned away from or at right angles to windows	Yes ☐	No ☐
3. Screen is tilted down slightly to reduce glare from overhead lighting	Yes ☐	No ☐
4. Lamps and other lighting are positioned to minimize glare	Yes ☐	No ☐
5. Window coverings are adjusted to reduce glare from outside light	Yes ☐	No ☐

APPENDIX III

CHECK LIST FOR IAQ PROBLEMS IN OFFICES

Name of Organisation_____ **Date**_____

A. Health problems associated with Indoor Air Pollution

1. Headaches?	Yes ☐	No ☐
2. Itchy, watery, or burning eyes?	Yes ☐	No ☐
3. Feelings of confusion or dizziness?	Yes ☐	No ☐
4. Breathing problems such as coughing or shortness of breath?	Yes ☐	No ☐
5. Nasal congestion?	Yes ☐	No ☐
6. Dry, sore throat?	Yes ☐	No ☐
7. Drowsiness?	Yes ☐	No ☐
8. Skin rashes?	Yes ☐	No ☐
9. Increased allergies and respiratory disease?	Yes ☐	No ☐
10. Increased asthma attacks?	Yes ☐	No ☐
11. Fatigue?	Yes ☐	No ☐

B. Office Inspection

1. Office is dirty or dusty	Yes ☐	No ☐
2. Office is not cleaned or vacuumed thoroughly and regularly	Yes ☐	No ☐
3. Debris can be seen falling from the air supply	Yes ☐	No ☐
4. Air supply has condensates or black soil on it	Yes ☐	No ☐
5. Any new furnishings or electronic equipment?	Yes ☐	No ☐
6. Scented cleaners are used to clean the office	Yes ☐	No ☐
7. Trash is not emptied every day	Yes ☐	No ☐
8. Food is kept in office overnight	Yes ☐	No ☐
9. Office has pests such as cockroaches	Yes ☐	No ☐
10. Pesticides are used in the office	Yes ☐	No ☐
11. Chemicals are used in the office	Yes ☐	No ☐
12. People can smell chemicals or other odors when they enter the office	Yes ☐	No ☐
13. Spills are not cleaned up immediately	Yes ☐	No ☐
14. Permanent markers or other graphic materials are used	Yes ☐	No ☐

15. Photocopiers, laser printers, photo processing in the office Yes ☐ No ☐

16. Perfume, aftershave, or other strong odors are present Yes ☐ No ☐

17. Water gets backed up in the drains or toilet leaks occur Yes ☐ No ☐

18. There are leaks around or under office sinks and/or water fountains Yes ☐ No ☐

19. There is condensate on windows, window sills, or window frames Yes ☐ No ☐

20. There are musty odors Yes ☐ No ☐

21. Indoor surfaces of exterior walls not free of condensate Yes ☐ No ☐

22. There are brown stains or discoloration of ceiling tiles or walls Yes ☐ No ☐

C. Comfort Measures

1. Some parts of the office are drafty or stale Yes ☐ No ☐

2. There is direct sunlight shining in on workers or there is a glare Yes ☐ No ☐

3. Humidity levels above 60% or below 40% Yes ☐ No ☐

4. There are complaints that areas sometimes smell "stuffy" or "musty" Yes ☐ No ☐

5. There are complaints about the temperature (too hot or too cold) Yes ☐ No ☐

6. There are complaints of excessive noise or crowding Yes ☐ No ☐

D. Ventilation System

1. The outside air intake is located near a source of pollutants such as a loading dock, near an exhaust vent, trash bin, or cooling tower Yes ☐ No ☐

2. Air supply or return vents in are blocked with furniture, books, or other obstacles Yes ☐ No ☐

3. Windows do not open Yes ☐ No ☐

4. There are fiber glass liners inside the air ducts Yes ☐ No ☐

5. There is odor coming from the toilets Yes ☐ No ☐

7. Odors concentrate in certain areas or stairwells Yes ☐ No ☐

8. There is a smell of chemicals or fragrances Yes ☐ No ☐

9. There is an odor of mold or mildew Yes ☐ No ☐

10. Are there any activities in the office that generate pollutants and odors, like scientific experiments, blueprinting, or photography dark rooms? N/A ☐ Yes ☐ No ☐

11. Is there an exhaust fan or fume hood in those offices or areas that have these activities? N/A ☐ Yes ☐ No ☐

12. Fume hoods are in good repair; not cracked, broken, or pulling away from the ceiling or wall

N/A ☐ Yes ☐ No ☐

13. People are trained in how to properly use exhaust fans or fume hoods

N/A ☐ Yes ☐ No ☐

14. Exhaust fan is used properly during activities that create pollutants

N/A ☐ Yes ☐ No ☐

15. There is an exhaust fan above high volume photocopiers N/A ☐ Yes ☐ No ☐

16. Odors from office activities are not noticeable in the hallway N/A ☐ Yes ☐ No ☐

STUDY OF STANDARD FOR OFFICE SPACES

The aim is to study of various standards and guidelines given by different organizations for office workspaces and different aspects related to efficient work environment.

Topics covered in this chapter

- Equal Opportunity Facilities, Designing for Universal Accommodation (Source: Herman Miller)
- Office Ergonomics Handbook (Source: Occupational Health Clinics for Ontario Workers Inc.)
- Workplace Privacy: A Changing Equation (Source: Steelcase)
- Prevention of IAQ Problems in Offices (Source: Aerias, USA)

CHAPTER 3