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Interior Landscape Techniques and Its Contribution to The Interior Places Environmentally

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KEYWORDS:
indoor plants, interior landscape, indoor air quality, indoor environment, interior gardens techniques, ecological material,

***Abstract*— Understanding the benefits of interior landscape can help environmental sustainability as a major concern within interior design field because over the life cycle of a building, ecological interior design can reduce negative effects and increase beneficial benefits on environmental systems.**

Humans have used technological advancements to improve their work environment where they spend most of their time separated from nature and urban landscaping. This affects users' health and causes diseases such as sick building syndrome (SBS), the users' comfort and work performance because of the pollutant emitted from the office equipment.

Previous research has demonstrated the importance of indoor plants in enhancing indoor environmental quality and decreasing all major forms of urban air pollution especially the CO_2 level which has a direct impact on human health, therefore the case study relied on measuring the CO_2 ratio at two different closed spaces in the same condition with and without plants to document the difference results between the two spaces in the CO2 levels which was the office with plants present a lower level of CO_2 than the office without plants by 45%.

Therefore, it is essential to identify the correct design criteria for the indoor plant inside the building with respecting the internal vacuum function and comfort of users. The interior landscaping is a practice of designing, installing and maintaining greenery elements inside the building that needs to take into account all the architectural design principles.

I.INTRODUCTION

THE Modern artificial environments impaired the connection between the humans and their natural Environment. The ability to promote this relationship is done through building environment solutions and encouraging the connection between the occupants and natural elements in their physical work environment. It supposedly affects their performance positively and therefore their overall well-being.

The research focuses on the indoor environment based on creating the feel of nature, and a view that leads to a suitable working environment for employee. A working environment that provides comfortable conditions for employee to do their work optimally is a fundament requirement for a healthy

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requirement. It reduces complaints and absenteeism and increases productivity.

Previous studies prove that the interior landscape has a synonyms impact on the internal environment. Indoor green plants have created a lot of attention because of the physiological and psychological benefits they provide to people.

The majority of past research has focused on plants' alleged ability to improve indoor air quality by eliminating indoor air pollutants, improving indoor air quality by removing volatile organics from the air, lowering dust levels, and lowering carbon dioxide levels in buildings. Another significant impact for indoor plants has been suggested as effective passive acoustic insulators that reduce sound level through the reflection, dispersal and absorption of interference of sound waves.

This green revolution of interior landscape designs could not be ignored aesthetically or environmentally and could be used it at the interior design field.

The Research Problem

Pollutants in the interior environment can have a variety of negative consequences. It's been connected to a slew of negative health impacts, including headaches, respiratory issues, recurrent colds and sore throats, and eye discomfort. Long-term consequences could include an increased risk of cancer.

The Research Aims

Exploiting the productive benefits of interior landscaping to create ecological and healthy indoor spaces for the occupants.

II.METHODOLOGY

1- Theoretical Study:

A -The link between interior landscape and the occupant psychology

- Behavior: (psychology, productivity and aesthetics).
- General: (environmental science)

B- The interior landscape systems and its designs (construction, material, light and maintenance)

2- Applied Study:

Choose an office at an administration building and apply on it the interior landscape elements:

The purpose of the study was to see if there were any effects of indoor plants on participants' comfort in the workplace. The administrative building of the Talkha fertiliser factory for fertilisers in Dakhalia, Egypt, has two similar offices on the first floor. Each office had one window that faced the street. It produced consistent indoor lighting settings, one with and one without the presence of a plant. Measure equipment: "CO2 measurement device": the experiment depends on the CO2 concentration different ratio among the two condition plant present and the plant absent.

III.LITERATURE REVIEW

In buildings with mechanical ventilation, indoor air quality (IAQ) has been a source of concern. The vast bulk of earlier work was categorised based on aspects of the indoor environment. The purpose of a heating, ventilation, and air conditioning (HVAC) system is to provide thermal comfort, circulate outdoor air to inhabitants, and remove contaminants [1] and deterioration in indoor air quality lowers human comfort, health, job satisfaction, and worker efficiency, and eventually reduces productivity. The major aspects that influence interior environmental quality and conflict in terms of energy conservation are indoor air quality and thermal comfort. With the advancement of interior modern design, architects are increasingly focusing on natural ecological and aesthetic characteristics [2].

The sustainable architectural design discussed many ways to improve the indoor environment. Therefore, the introduction of green plants in indoor spaces has raised a great amount of interest motivated by the positive physiological and psychological benefits for humans [3] and the aesthetic calming effect of greenery is used in research on the influence of indoor plants to improve indoor air quality and human psychological and physiological comfort. [4]

According to the previous studies indoor plants purify not only carbon dioxide (CO2), which is the main material for photosynthesis and thus survival, but also volatile organic compounds (VOCs) such as benzene (C12H18O), ethylbenzene (C8H10), xylene ((CH3)2C6H4), toluene (C7H8), trichlorethylene (C2HCl3), and formaldehyde (CH2O) it also purifies gaseous pollutants like carbon monoxide (CO), nitrogen dioxide (NO2), and sulfur dioxide (SO2). [24]

The dominant path of future interior design development is indoor ecological landscape design. Green roofs, green walls, and modest indoor planting are examples of internal landscaping design ideas that can be employed in enclosed spaces. [6] demanding adequate space and conditions that allow the indoor plant to live healthily without major maintenance requirements. Thereby consider the indoor garden as a good beginning for a healthier environment. [28]

IV.INTERIOR LANDSCAPE DEFINITION

Introducing plant life to enclosed spaces means the entire landscaping process by designing, selecting, and installing the ideal blend of colour, textures, and essential conditions.

Interior landscaping is the art and science of arranging and designing landscape features in interior environments for specific human needs. It's about the shape, scale, and placement of new innovations in the world of interior design.

Photo 5 of 7 in Check Out This Brooklyn Hotel's Dramatic Living Wall… | Living wall indoor, Plant office design, Brooklyn hotels (pinterest.es)

Interior plants and maintenance| Plantscaping & Blooms

JetBrains Offices - Saint Petersburg | Office Snapshots

Fig (1.2.3) show the interior landscape system is the collection of interconnected ecosystems among ecological and aesthetic elements.

A. The Purpose of the Indoor Plants

The indoor plants can provide the natural contact that people need, a high quality of indoor environment, and give the occupants the feeling of comfort by its effects as:

1- Emotional and symbolic: Keep people in contact with nature so they can be transferred to a naturalistic situation both intellectually and emotionally.
2- Sound, fragrances, and sensations had a sensuous effect on the mood delineators.
3- The architectural affect like providing privacy and architectural identification of the spaces.
4- Benefits in terms of aesthetics include the sculpture, frame, views, colours, and background.

V. INDOOR PLANTS EFFECT ON ENVIRONMENT

The environmental data for any close space can be measured by

1- Air temperature and relative humidity.
2- Carbon dioxide (CO2) concentration "Carbon dioxide CO_2 is harmless to humans except in the extremely high concentration". During photosynthesis, plants absorb carbon dioxide and replace it with oxygen, lowering carbon dioxide levels while boosting oxygen levels, making plants with a high photosynthesis rate more effective in light. The interior landscape can be utilized to balance the amount of (CO_2) in the air and absorb any other pollutant gases. It has the potential to improve indoor air quality and minimize all sorts of urban air pollution.

Indoor air pollution can lead to sick building syndrome (SBS); hence indoor plants are responsible for at least 75% of indoor environmental quality (IEQ). It minimizes all sorts of urban air pollution, including nitrogen and Sulphur oxides, carbon dioxide CO2, and air toxics, as well as volatile organic compounds (VOCs) emitted by plastics, synthetics in furniture, and furnishings.

Bill Wolverton's NASA research demonstrated that the plant could absorb pollutant gases like formaldehyde, benzene, and trichloroethane, which are released in small spaces by materials and human activities.

Interior Plants Reduce Dust

The ability of plants to remove dust is limited and depends on the number of plants installed; however, improving air quality keeps offices cleaner, reduces the risk of allergies, and helps to protect sensitive electronic equipment; however, the ability of plants to remove dust is limited and depends on the number of plants installed.

Introducing foliar plants to interiors, according to Virginia Lohr and Caroline Pearson-Mims' research, can minimize particle deposition on horizontal surfaces by up to 20%.

VI. INDOOR PLANTS EFFECT ON PRODUCTIVITY"

According to this research, more engaged and hence productive workforce appears to be linked to a high-quality work environment. On the other hand, a terrible working environment is likely to distract from an engaged workforce. Building occupants who can visually connect with exterior environments while completing everyday chores report increased satisfaction, attentiveness, and productivity.

Building occupants' productivity is highly dependent on their visual comfort. A sketch was done by Viktoria in her research (2015) to visualise the greenery office environments; the association between views and contentment in offices has been described in various articles.

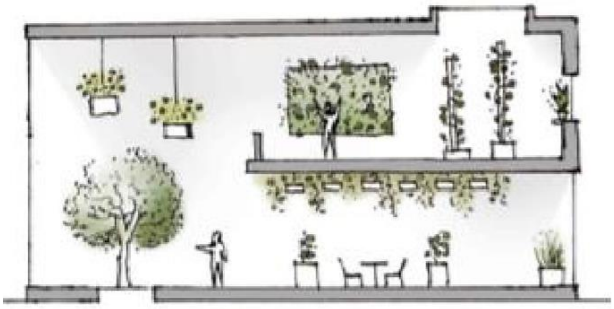


Fig (4) shows Indoor greenery sketch by Viktoria (2015)

Environmental psychologists believe that being connected to nature is a natural human function that aids in psychological healing. Employee happiness and motivation increase when plants are added to interior spaces. Many studies have looked at these impacts, and employee productivity has increased as a natural result of all the improvements that interior plants have contributed to the indoor environment.

VII. INDOOR PLANTS EFFECT ON ACOUSTICS"

One of the key benefits of indoor plants is that they have the ability to reduce noise levels in buildings. Plants absorb, diffract, and reflect sound very effectively.

The kind of plant, its form, size, and even the container can affect the sound attenuation qualities of plant displays.

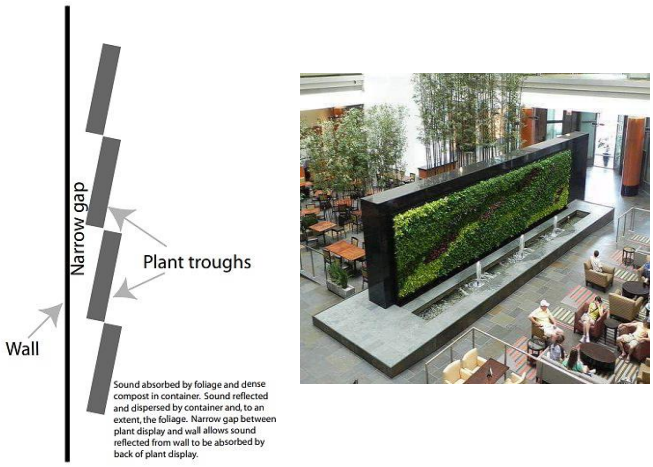


Fig (5.6) show the green wall effect on acoustic insulation [9]

VIII. INTERIOR LANDSCAPE TECHNIQUES

Interior landscaping is the art of creating a natural indoor atmosphere by planning, installing, and preserving natural components inside a structure, as well as arranging living plants.

A. Interior Landscape Elements

There are two types of the elements:

The first category is the soft landscape, and it consists of natural features such as plant species, shrubs, and grass. It necessitates upkeep, water, an appropriate temperature, and sunlight.

The second type is known as hard landscape, which consists of natural sources elements such as wood, stone, and other natural materials. It can help to maintain a healthy atmosphere while using the least amount of energy possible.

B. Interior Landscape Types:

Green walls, container gardens, plant beds, and enclosed inner courtyards are the most common types of internal landscaping. Depending on the size of the area and the interior design, the internal landscape can be one type or a combination of them to create a large one.

Fig (7) Green wall
UEB Builders Offices - Scottsdale | Office Snapshots

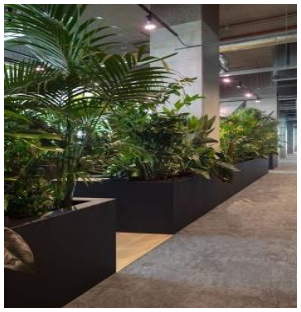


Fig (8) Containers and plant bed
Mendix - Moss Amsterdam

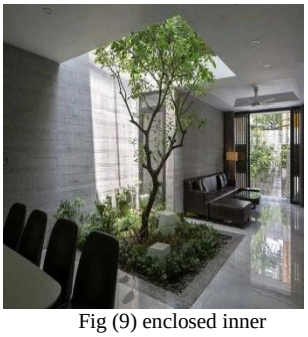


Fig (9) enclosed inner courtyards
Gallery of D House / ARO Studio - 15 (archdaily.com)

Interior landscaping is composed of construction elements that form the interior garden. It contests from the plant, water, lighting and insulation system and all are organized in different ways according to the scale of structure.

C. Green Walls:

It is the process of planting a wall that has no touch with the surface and is made up of a foundation structure, a substrate plant, and a water supply.

The construction will consist of a layer of water and electrical systems, as well as a layer of substrate beneath the plant. All layers should be well-supported and resistant. Soil or hydro culture can be utilized as a substrate.

It comes in two varieties, *the first* of which is known as green facades: It is based on the use of climbing or hanging plants along a wall, with the plants having the ability to grow upwards the vertical surface. *The second* type is called living walls and they can be classified as a continuous or modular according to their application method

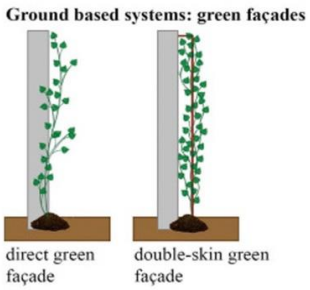


Fig (10) green facades systems[10]

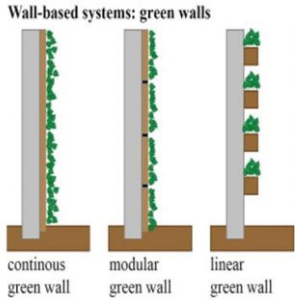


Fig (11) green walls systems[10]

Fig (12)
Rustic Office Spaces : rustic office (trendhunter.com)

Fig (13)
Photo 5 of 7 in Check Out This Brooklyn Hotel's Dramatic Living Wall… | Living wall indoor, Plant office design, Brooklyn hotels (pinterest.es)

Fig (12.13) shows the different designs for green walls

The benefits of the green walls are:

- Energy conservation by keeping the building cooler in the summer and warmer in the winter.
- Increasing sound insulation and lowering noise levels.
- Filtering contaminants to improve air quality.
- Improving productivity.

D. Small Indoor Planting (Containers or Bed):

Single or several planters can be used for indoor planting. It must be well insulated, and water must be removed using a drainage system and an automatic irrigation system. Single plants or plants that cover the entire floor can be utilized in planters and plant beds to increase the leaf surface.

As a result, features that improve the interior space, such as air filtering, encrusting, producing oxygen, increasing humidity, and cooling the air through transpiration, may be improved.

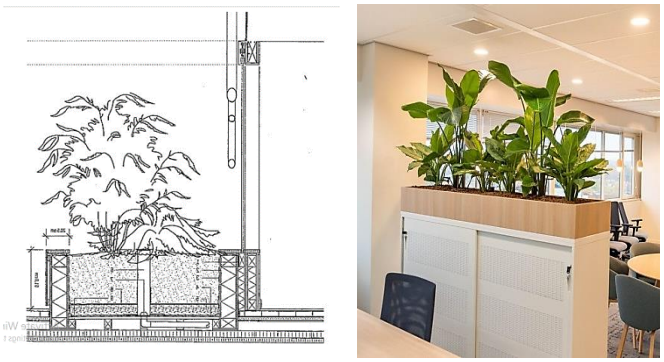


Fig (14.15) show the planting bed [7]

Hydroponic container:

A hydroponic container can be set up in a number of different ways, but they all function in the same way:

The water tank is located at the bottom of the structure, with shelves and plants stacked on top. The fertilized water from the tank is pumped to the plants, where it filters and returns to the original water tank.

The hydro culture systems have many advantages that make them more effective than the potting soil such as:

- No soil is required because inert stones are a hygienic, odor-free, and environmentally friendly product Pebbles can be cleaned and re-used multiple times.
- Hydro culture containers that are watertight reduce overwatering and leakage. A gateway and a water gauge that shows the minimum and maximum water level are used to introduce water.
- Using hydro culture to reduce the risk of mould growth. The pebbles' top layer remains dry.
- Hydro culture containers keep a water reservoir full by absorbing only the moisture required by the plants. Plants require less watering as a result of this.
- Reducing the number of transplants that are necessary. Nutrients and water are always available to the plant. Hydro culture plants' roots are usually smaller than those of other plants.

Fig (16.17.18) show the different applications for hydroponic containers
The Best Hydroponic Garden Kits | The Family Handyman

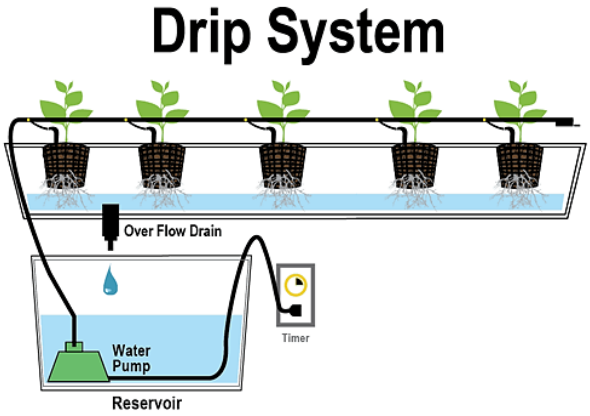


Fig (19) shows the hydroponics drip system [11]

E. Open and Enclosed Inner Courtyards or Patios:

The building's inner courtyards are open or enclosed places that are encircled by the building itself. These types of gardens are tailored to the users' preferences and encourage social interaction.

If the roof structure doesn't provide enough shade, light should be given by screening devices or sun control glasses.

Fig (20.21) show the inner courtyards design

IX. SUSTAINABLE MATERIAL

Interior landscape design should be created of locally available materials such as mud, wood, stone, and green concrete as the best option for green buildings, or using clay plaster instead of gypsum plaster.

Using eco material in the interior landscape design benefits are:

- Using the least amount of materials to achieve the best impact.
- Creating a new form of art and the ecological environment.
- By utilizing the technology structure to absorb heat and cool, ventilate, and cool.
- All organic materials should be reused, and all plastic products, including grow pots and trays, should be recycled.
- Energy conservation materials are:

- Materials that require less energy during construction.
- Materials that reduce cooling loads.
- Products that conserve energy like CFL lamps.

X. LIGHT SYSTEMS IN THE INTERIOR LANDSCAPE

Diffuse natural lighting is used through skylight windows, light shelves, and clerestories to improve the work environment while also conserving energy.

Indoor plants should be put according to the amount of light they receive and their specific needs. The wavelength of light is more important to plants than other aspects. Leaves reflect the light spectrum's red and blue wavelengths, which are the most important energy sources for plants, but yellow and green wavelengths supply very little energy.

As a result, plants near windows are exposed to the sun's entire spectrum of light wavelengths. In addition, to develop properly, numerous plants that receive little or no natural light must be fed supplemental light from artificial sources such as:

- Blue wavelength light for foliage growth.
- Red wavelength light for flowering and fruiting
- Plants have little use for green wavelengths and reflect them back, which is why leaves appear green.

A. Artificial Lighting:

The available artificial Plant Lights are: "Incandescent/Fluorescent /Induction / HID – Metal Halide – High Pressure Sodium – Ceramic Metal Halide / LED"

TABLE (5)
SHOWS DIFFERENT KINDS OF PLANTS ACCORDING TO THE AMOUNT OF LIGHT [12]

Low light plants receive between 50 and 250 footcandles.	Medium-light plants intensity plants prefer 250 to 1,000 footcandles	High-light plants These plants need at least 1,000 footcandles
 Chinese evergreen (Aglaonema)	 Bird's nest fern	 Schefflera Arboricola – Dwarf Umbrella Tree
 Dragon tree (Dracaena marginata	 Christmas cactus	 White Bird of Paradise
 Spider plant (Chlorophytum comosum)	 African violet	 yucca plant

The minimum level of illumination is 1200 foot-candle hours from the lighting sources.

XI. MAINTENANCE PROCESS

Plants in the inside must be cared for by professionals. If interior plants are neglected, their benefits might quickly deteriorate. Stressed, pest-infested, or drought-stricken plants restrict transpiration by sealing the pores in their leaves.

Fertilizer inputs are quite low on their list of priorities. It should be considered in the interior design that maintenance workers can easily access supplementary lighting systems and that the associated continuing expenditures and design aspects have been considered for the successful usage of biological controls. The whole planting area, including electrical and plumbing entry points, has been waterproofed.

As a result, regular actions in the maintenance process should include evaluating soil moisture levels, cutting and cleaning all leaves, keeping optimum nutrition levels, and controlling insect and disease infestation. A service program will be implemented by skilled horticulture technicians as part of the maintenance.

XII. CHARACTERISTICS OF SOME DIFFERENT INDOOR PLANTS

TABLE (6)
NEEDS OF SOME INDOOR PLANTS [25]

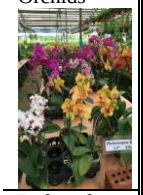
PLANT NAME	Light needs	Maintain needs	Irrigation needs	Description
Areca Palm 	Medium "indirect light"	medium	Watered every 2 or 3days	It is a medium sized palm tree. It has a pinnate type leaves
Aloevera 	high	low	Watered about once every two weeks	It is a herb with succulent and erect leaves.
Peace Lily 	Medium "indirect light"	medium	Watered about once a week	It has a dark green leaves and white flowers.
Snake Plant 	low	low	watered once a month	It gets name because of the shape of its leaves Sansevaria trifasciata (syn.S.zeylandica)
Orchids 	medium	high	need a lot of watering	It requires higher humidity than the most other indoor plants
Lady palm 	low		Enough to keep the soil lightly moist	It is easy to grow has hand shape leaves. The foliage forms a dense canopy above clumps of sturdy stems

TABLE (7)
SHOWS O_2 AND CO_2 CONCENTRA TIONS FOR THE BEST DIFFERENT AIR PURIfiCATION PLANTS [13]

Air Purification Plants	O_2 Concentration (%)		CO_2 Concentration (%)		CO_2 /O_2 of plants for a given fixed time
	T= 0 h	T= 7 h	T= 0 h	T= 7 h	Ratio
Areca Palm	18.56	21.33	428	19	3:1
Aloevera	19.12	21.07	428	418	5:1
Peace Lily	19.00	20.62	428	420	4:1
Snake Plant	19.00	2100	429	419	5:1
Orchids	19.00	21.10	429	421	4:1
Lady palm	19.00	21.32	427	419	3:1

XIII. CASE STUDY

A. Case Study for Existing Building Called (The Administrative Building of the Fertilizer Factory for Fertilizers

The Methodology:

The point that is applied is served by selecting an existing building. It should be a polluted atmosphere and an administration building with a large number of tenants.

Talkha fertilizers factory is famous with air pollutants for the surrounding environment and it causes uncomfortable for the people around it.

The goal is to make the indoor atmosphere more comfortable and healthy for users without consuming a lot of energy and see if there were any effects of indoor plants on participants' comfort in the workplace.

The steps were choosing an office at an administration building which is "The administrative building of the Talkha fertiliser factory for fertilisers in Dakhalia, Egypt" and apply on it the interior landscape elements.

It has similar offices on the first floor, we chose two offices each one has one window that faced the street. It produced consistent natural indoor lighting settings; the experiment would be about comparing the CO_2 concentration only at each one taken in consideration one with and one without the presence of a plant.

Measure equipment is the "CO_2 measurement device" because the experiment depends on the CO_2 concentration different ratio among the two condition plant present and the plant absent.

The suggested plants should vary in types from place to place. Start from the entrance and reception to small offices. The research picks the offices where the most users work in to show the purpose of the research.

Therefore, the used plants were peace lily plant as a basic plant because it is abundantly present and inexpensive. The peace lily plant was placed beside the window but not directly to the sun light. The direct sun light may burn their leaves and dry out their flowers. It may need daily watering in a dry climate and one or twice a week in a humid climate.

We used some reaper plants too to put by the window because it requires direct sunlight, and watered about once a week. The plant has a significant CO2 reduction effect and may remove pollutants like formaldehyde (CH2O) and xylene from the atmosphere (C8H10) according to table (7).

Fig (22) Reaper plant

Fig (23) Peace lily plant

Site Analysis:

Fig (25) shows the proximity of the factory to the administration building and its impact on its indoor environment and the pollution caused by the factory to the area where the adminstration building is located.

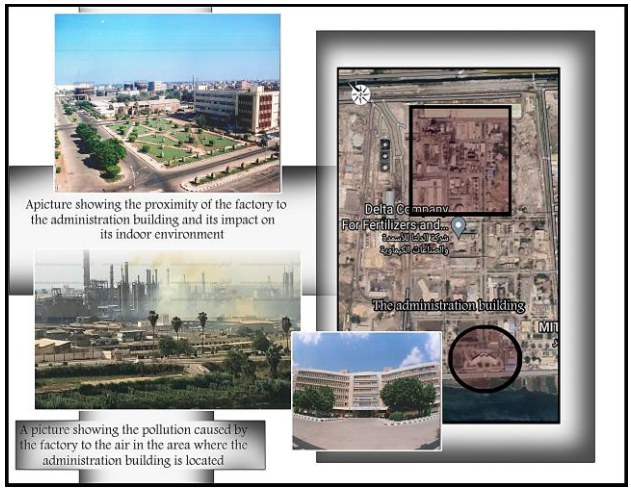


Fig (24) the site analysis

Fig (25) Top view of the building

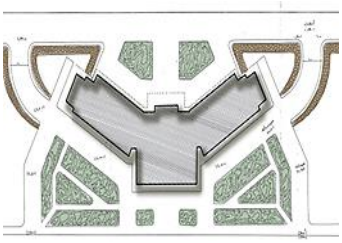


Fig (26) The site plan design

Site Plan:

Fig (27. 28) The administrative office of the fertilizer factory for fertilizers.

TABLE (8)
THE BUILDING DESCRIPTION

Case study name	The administrative office of the fertilizer factory for fertilizers.
Site	Egypt, Dakahlia, Talkha.
The building function	Administrative building.
Establishment date	1975

The Floor Plan:

It has the main entrance, reception, two wings of offices, and the stairs. Designing the interior landscape is depending on the closed place that the engineers design.

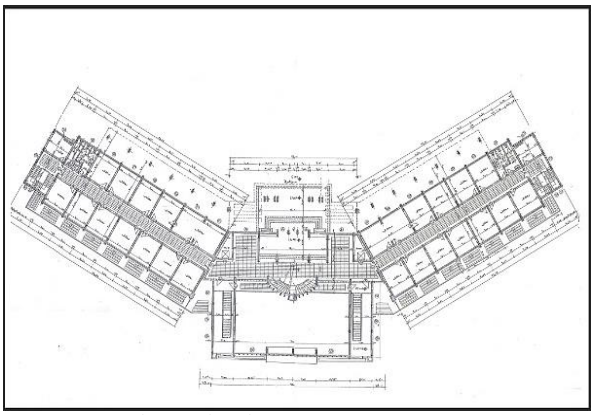


Fig (29) clarifies the first floor, which contains the entrance, the conference room, stairs hall, and two wings of offices.

Fig (30) clarifies the right wing of the offices that may be added to plants.

In order to find out the effect of improving the indoor air quality with indoor plants, the following experiments were conducted. The target offices selected were the same size 4.00 X500 m ($20m^2$) at the same floor with same number of employee that are three employees at the administration building. During each working period (from 8:00 a.m. to 3:00 p.m.), absent (without plants) and present (with plant) trials were performed.

The offices with and without plants:

Fig (31) shows the offices without plants

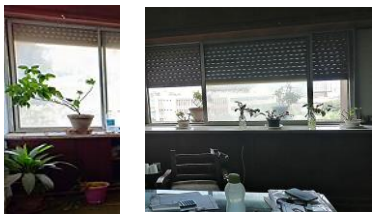


Fig (32, 33) show the other room with the suggested plants

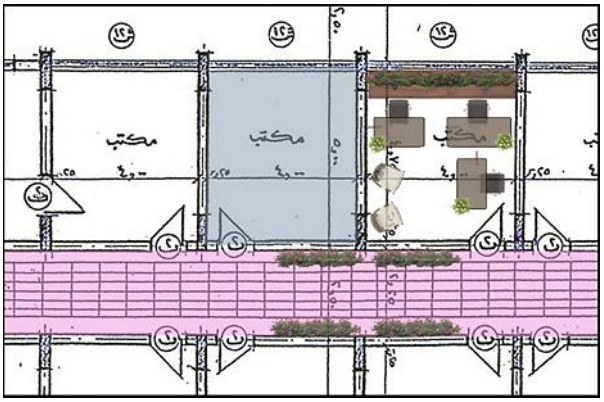


Fig (34) show the suggestion places for plants at the offices and passages

Fig (34) show the suggestion places for plants at the office according to its small area and the furniture used in it from the beginning.

B. Discussion:

In this experiment, CO2 is the principal indoor air pollutant in the office; therefore, study focuses on the CO_2 concentration only because of its negative effects on the human health and productivity

The study depends on CO_2 measurement equipment which was put in the place during the working time period and measured the CO2 level at the two places at the same time of the day.

The result from the equipment at the office with plant placement was (approximately 620 ppm) and at the situation without plant placement was (approximately 1220 ppm), So according to the CO_2 measurement equipment, the increase in CO2 concentration can be reduced in average 45% may be more.

The results depend on the plants types, lighting needs, watering needs and how we can provide it with its need with artificial needs if the natural possibilities would be unavailable and the necessary maintenance for them there for we can choose any kind of plants is suitable with the place and the occupant with a significant contribution from the landscape engineer.

The results of the experiment may vary from day to day because the factory, its maintenance, and its operating hours affect how much air pollution is present at any one time.

It is about the influence of plants planted in offices was investigated, and the target office was determined to be more comfortable in a sustainable environment.

XIV. CONCLUSION

Indoor plants not only create a pleasing aesthetic green effect that improves human comfort, but they help filter the indoor air. Furthermore, it is intended to assist the human body in more sensitively perceiving indoor air quality.

The adoption of indoor plants into interior areas will become more active as awareness of sustainability grows.

According to the research the interior plants have an environmentally impact on the indoor places by raising its efficiency by reducing the CO_2 concentration that impact directly on the occupant's health and productivity. Therefore, the indoor plants can be apart from the interior landscaping systems as the green walls, planting beds small or large designs put on consideration the environmental factors as light and irrigation and the aesthetics factors as color and shape and all the designing factors as the occupants' movement and the scale of the structure.

XV. RECOMMENDATIONS

Creating the office planting space needs to Study:

- Architectural and design development by form, structure, and material.
- The boundaries, apertures, vertical links, horizontal links, and Grouping to achieve creative and communicative effects.
- Lighting and shading.
- Thermal insulation and glazing lighting.
- Water features, soil strata, and vegetation zone.
- Humidity, evaporation, and temperature control.
- Acclimatization and maintenance.

For the normal offices with small spaces, the study chooses a small leaf volume plant. It can be enough to improve the quality of small space and can create a visual connection between the indoor and outdoor space and dampening noise that is a part of a route system.

Ideas Could Be Applied to the Offices:

The offices and the passages are very small places and have many users because of the number of offices. Moreover, every office has at least three occupants, so small indoor may be used for planting because it doesn't need space for its installation such as potted plants, plant curtain, small wall planting and small planting beds.

Fig (35) show some interior plants ideas to apply

The design consideration check list:

1- Aesthetical (human visual perception and recreational landscaping).
2- The visual design element and principles. The plant color and form must harmonize with the office decor.
3- Choose different plants according the different nature of the interior. Plants must be able to adapt to interior environment "temperature and humidity".
4- Seasonal fluctuations governing the duration of daylight and the angle of the sun.
5- Boost occupancy and the air circulation for the plants.
6- Take caring of the general health of the plant.
7- Analyze the occupants' movement in the closed place and its design with plant.
8- Take care of the suitable Light design for the plant.

The design has to protect the flooring, walls, stairs and furniture from any damage up on installation

AUTHORS CONTRIBUTION

Amany Ahmed Mohamed Abd Elfattah,

1- Conception and design of the work.
2- Data collection and tools.
3- Data analysis and interpretation.
4- Methodology.
5- Drafting the article.

Lamis Elgizawi and Nanees Abd Elhamid Elsayyad,

1- Conception of the work.
2- Methodology.
3- Supervision.
4- Critical revision of the article.

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Title Arabic:

انظمة تنسيق النباتات الداخلية وتأثيرها على الفراغات الداخلية بينيا.

Arabic Abstract:

خلال السنوات السابقه لقت المخاوف العامة بشأن جودة الهواء الداخلي قدرا كبيرا من الإهتمام، وأصبحت الفراغات الداخليه شبه معزولة عن البيئه الطبيعية الخارجية، وملوثه نتيجة إستخدام مواد بناء وتشطييات مصنعه، فكان الإتجاه للتصميم البيني لمراعاة إحتياجات المستخدمين النفسية والصحية من أولويات التصميم.

لذا تهدف الورقة البحثية لإيجاد حل بيني بأقل تكلفة عن طريق إستخدام النبات الداخلي، ودراسة تأثيره علي نسبه ثاني أكسيد الكربون في الهواء وتقليل نسبة التلوث بأقل درجة ممكنه.

النباتات الداخليه اثبتت قدرتها علي تحسين جودة الهواء الداخلي ومساعدتها في تقليل المواد الكيميائيه المتطايره وتقليل نسبة ثاني أكسيد الكربون ، وفوائد صحيه متعدده من النواحي البدنية والنفسية.

إعتمد البحث علي المراجع والبحوث العلمية السابقة بهذا المجال ودراسة تطبيقية إعتمدت علي جهاز قياس نسبة ثاني أكسيد الكربون في الأماكن المغلقة، تم وضع الجهاز في غرفتين مختلفتين في نفس في التوقيت ونفس الحالة البيئية ونفس عدد المستخدمين وأظهرت النتيجة أن الغرفة بوجود النبات أقل في نسبة ثاني أكسيد الكربون ب ٤٥ % عن الغرفة الأخري.