

HORT 367 - Landscaping

Landscape

“A landscape may be defined as any area, either big or small, on which it is possible or desirable to mould a view or a design”.

Landscaping means the process of making a garden or other piece of land more attractive by altering the existing design, adding ornamental features, and planting trees and shrubs.

Landscape gardening

It may be described as the application of garden forms, methods and materials with a view to improve the landscape. The art of designing is known as “Landscape Architecture,” although the older term “Landscape gardening” is also popular.

Important considerations of gardening:

- 1. A garden has to be one's own creation and not an imitation, giving due consideration to the local environment.*
- 2. Overcrowding of the plants should be avoided.*
- 3. Take advantage of natural topography while designing garden*
- 4. Perfect harmony of different components is the essence in landscape gardening.*
- 5. Before planning a design one must be sure for what purpose the garden is – utility or beauty or both.*

Importance of Landscape Gardening

The landscape gardening is not only aesthetic which is meant to beautify places but also functional and important. Surroundings make a significant contribution to our quality of life. The word ‘landscape’ does not only mean attractive scenery, but represents a rich historical record of natural features, molded by human activity over the centuries. It forms the context for our everyday lives and is reflected in our literature, music and painting.

- The art of landscape gardening will involve considering the total environment of any new development and then shaping it using natural elements such as landform, trees, shrubs, and water to form a pleasing harmony.**

This can make a constructive contribution to the improvement rather than the destruction of environment.

- *Plants that form an important element in landscape design aid in reducing the pollution of the environment and minimizing some of the effects of heat, sound, wind, air etc.*
- *Plants absorb carbon dioxide and release oxygen during photosynthetic process and purifying the air.*
- *Plants with thick foliage also trap pollutants, which are later on washed away by the rains.*
- *Some plants, such as Hydrangea, Mustard, and Hyacinth absorb toxic material from the environment they are in.*
- *Plants can block, diffuse, guide or channel winds. Plants can be used to direct wind so that the wind flushes out the polluted air.*
- *Plants control erosion caused due to excessive wind, rain or snow. Plants with good branching and deep root system and also those with fibrous surface roots help reducing the loss of fertile top soil.*
- *Plants reduce radiated heat thereby bringing down [temperature](#).*
- *In winter, deciduous [trees](#) which shed their leaves allow lights to pass through, thereby warm the [space](#)*
- *Scope of ornamental gardening and landscaping*
- *Gardening which was only an art and science in the earlier days has now emerged as a huge industry.*
- *With the importance and need of gardening in improving and conserving the environment being strongly felt now, the concept of landscaping and gardening is growing rapidly.*
- *Ornamental gardening and landscaping has expanded as a multi-faceted industry encompassing activities such as propagating and rearing ornamental plants, landscaping, production of growing media, pots and other accessories, etc.,*
- *Employment generation opportunities and simultaneously promoting activities that would improve the environment.*
- *Principles of Landscape Gardening*
- *Initial Approach*

- *A good designer should design the landscape in the available space .*
- *The natural topography should be retained.*
- *Fencing, should be such that it looks natural as far as practicable and it should not obstruct any natural view.*
- *For example, if there is natural forest scenery or a hillock just outside the boundary, it should be incorporated in the garden design in a thoughtful manner so that it appears to be a part of the garden.*
- **Axis**
- *This is an imaginary line in any garden around which the garden is created striking a balance.*
- *In a formal garden, the central line is the axis.*
- *At the end of an axis, generally there will be a centre of attraction, although other architectural features such as bird-bath or sundial can also be erected at about the midpoint*
- **Focal Point**
- *A focal point in every garden is a centre of attraction which is generally an architectural feature focused as a point of interest such as statue, fountain, rockery etc.*
- **Mass effect**
- *The use of single plant species in large numbers in one place is done to have mass effect.*
- *One should see that such mass arrangements do not become monotonous; the sizes of masses should be varied.*
- **Unity**
- *Unity in a garden is very important and will improve the artistic look of the garden.*
- *Unity has to be achieved from various angles.*
- *First, the unity of style, feeling, and function between the building and the garden has to be achieved.*
- *Secondly, the different components of the gardens should merge harmoniously with each other. The aim is to create an overall impression of the garden rather than blowing*

up some special features.

- *Lastly, it is of prime importance to achieve harmony between the landscape outside and the garden.*
- *A garden laid out in complete defiance of the local conditions may look exotic, but is not a successful garden. Example, cacti planted in a seashore garden is completely out of place as these are inhabitants of dry localities.*
- *To achieve a unity between the building and the garden it is a common practice to train creepers on the front porch which cover the rudeness of the masonry work and also bring the building closer to nature. For the same reasons, foundation plantings are also done.*
- *A foundation planting broadly means the planting of bushy plants near the foundation of the building.*
- **Space**
- *The aim of every garden design should be such that the garden should appear larger than its actual size.*
- *One way of achieving this is to keep vast open spaces, preferably under lawn and restrict the plantings in the periphery, normally avoiding any planting in the centre.*
- *But if any planting has to be done in the centre the choice should be a tree which branches at a higher level on the trunk (or the lower branches are removed), and not a bushy shrub.*
- *Such planting will not obstruct the view or make the garden appear smaller than its size.*
- *Another suggestion to create the illusion of more space in a large public garden is to alternate large lawns followed by a group of trees. A large open space planted haphazardly all over with trees looks smaller than its size.*
- *The techniques of creating an illusion of more space are also referred to as 'Forced Perspective.'*
- **Proportion and Scale**
- ***Proportion in a garden may be defined as a definite relationship between different elements. For example, a rectangle having a ratio of 5:8 is considered to be of pleasing proportion. As this ratio comes down the form looks neither a square nor a rectangle***

and the design becomes undesirable.

- *There is no set rule with respect to scale and proportion in a garden, ultimately the design should look pleasant. It is better to have an ad-hoc design first and then try it out on the actual spot.*
- *If the design looks appealing as well as pleasing, it is implemented. When a shrubby border has to be planted the outer design is marked by arranging a rubber hose or thick wet rope in different designs on the spot and the one, which looks best, is adopted.*
- *Judgment of scale and proportion fully depends on the individual experience and the thorough knowledge of plants*
- **Texture**
- *The surface character of a garden unit is referred to as texture.*
- *The texture of the ground, the leaves of a tree or shrub will all determine the overall effect of the garden.*
- *Generally, the texture is of three types' viz., fine, medium and course. The texture of plant depends on its leaf size, arrangement of branches and compactness of canopy.*
- *Moreover, the texture can also be classified as rough and smooth based on the appearance. A. gulmohar is a fine textured tree when in full leaf, whereas Spathodea companulata is a coarse textured tree.*
- *The placement of all these various textures with harmony and contrast has to be achieved to get the ultimate desirable effect.*
- **Light and Time**
- *In a garden the time factor is very important. The garden design should be planned in such a way that in the afternoon it is possible to sit in a shaded place from where the best part of the garden should be visible.*
- *The growth habits of the plants play a vital role in choosing the right place for them in the garden and according the layout has to be planned.*
- **Tone and Colour**
- *In a landscape garden, the permanent backdrop is the green tones of the various trees and shrubs.*

- *It is possible to lay out a garden with subtle tone of entirely white or yellow flowers, but at the same time making it charming also. Another important point is that it is better to have masses of a single colour against a mixture of colours.*
- *A bed of roses containing only a single colour of say red, yellow, or pink has a much softer tone and beauty than a bed containing a mixture of colours. A good garden architect should have the knowledge of colour wheel and colour schemes for charming colour in the garden.*
- **Mobility**
- *In a temperate zones, the garden changes colour very sharply and contrastingly from one season to the other thus symbolizing mobility or movement. As for example, many trees in the temperate zones attire themselves with wonderful hues due to the changes in their leaf colour in the autumn.*
- *In most parts of Tropical India, though these contrasting changes cannot be achieved, it is possible to bring in some subtle changes.*
- *For example, to create some symbol of movement, trees such as Bengal or Indian Almond (*Terminalia catappa*) which changes its leaf colour into striking red twice annually before falling or *Lagerstroemia flos-reginae* which also changes the colour of the leaves to coppery shade in the autumn before shedding, or *Madhuca indica* and *Ficus religiosa*, the new foliage of these appearing as coppery red in the spring, should be planted in some parts of the garden. This, in addition, improves the landscape.*
- *The mobility can also be achieved by raising flowering annuals of different colour in form of flower beds. Changing the position of potted plants may also bring mobility in the garden.*
- *The movement and clattering of birds will bring life and mobility to the garden. Large trees and bird-baths attract birds. For the smaller birds, the safety of shrubberies is needed to protect them from large predator birds.*
- *Some plants, bearing berries, such as *Ficus infectoria* and *Syzygium cumini* (Syn. *Eugenia jambolana*), can also be planted in some remote corners though they may not look very ornamental. Flowering trees such as *Bombax malabaricum* (silk cotton) or *Erythrina* also attract birds when in bloom.
*The seasonal flowers will bring in the motion and movement of colourful butterflies.**
- *Fountains or even a lawn sprinkler and streams in a garden also serve the objective of movement.*

- *The lily pools should be filled with coloured fish, the movement of which will be an added attraction.*
- **Style**
- *Lastly, one has to decide about the style to be adopted for a particular garden. Every garden **designer has to invent his own style of gardening** commensurate with his budget, taste and the nature of the site, ease of maintenance.*
- *One can develop his own design only when he studies carefully all the garden styles of the world and grasps the underlying principles in them*

STYLES OF GARDEN

Formal Garden

A formal garden is a garden with a clear structure, geometric shapes and in most cases a symmetrical layout.

Informal Garden

It is naturalistic and usually includes asymmetrically placed design elements.

The key features of formal design are:

The design is stiff as everything is done in a straight and narrow way.

*If there is a plant on the left hand side of a straight road, a similar plant must be planted at the opposite place on the right hand side i.e., **mirror image of each other**.*

The plan is symmetrical with square, rectangular and roads cut at right angles.

It has a sort of enclosure or boundary.

Flower beds are arranged in geometric designs.

The arrangement of trees and shrubs is necessarily geometrical and kept in shape by trimming and training.

Other features like fountains, water pools, cascades etc. are used for further attraction

Demerits

Formal gardens have no 'secrets' and the element of surprise is lost.

However, **attractive focal points at terminal and intersecting points of paths and [roads](#) are provided to make the formal garden effective.**

Present day home gardens are laid out in formal design only at the frontage.

[Key features](#) of informal style / natural style

This style reflects **naturalistic effect** of total view and represents natural beauty.

It is **contrast** to [formal style](#).

Plan is asymmetrical according to the **land available** for making the garden.

Smooth curvaceous outlines are more appropriate.

Water bodies are more irregular in shape.

Features such as **hillocks, water falls, lakes, [islands](#), cascades, rocks, shola and rustic hutments** are provided to create rural effect.

Plants are appropriately grouped and they are **not trimmed**, so as to avoid **geometrical arrangements**.

Terraces: Terraces are components to maintain the [proportion](#) of land for **extended view irrespective of topography** of the area 7, 8 or 12 terraces symbolize 7 planets, 8 paradise and 12 zodiacal signs. The **entrance is located at the lowest terrace**. As the Mughal emperors came from a hilly country, the idea of building a garden in terraces came to them naturally.

Running water (Nahars): Water is the life and soul of Mughal garden. Love for **running water made the Mughals** to select sites **close to hill sides and rivulets** for their gardens.

The idea of constructing canals and tanks to keep the water brimming to the level of paths on either side was **borrowed from Persians**.

Water channels were paved with tiles of brilliant blue color to reflect the sky and give impression of depth.

Various patterns were used for paving the marble stones and style so that running water is thrown up and broken into ripples. At dusk, **tiny lighted lamps were placed behind the water falls** so that diffusion of [light](#) through the water creates a very pleasant sight

Site and design: A **perennial river, the slope of a hill and river banks** were the places **selected for this purpose**. A typical Mughal garden is square or rectangle in shape. It is not merely a garden but serves the **purpose of fort, residence and a place for recreation**.

High protecting wall: [Mughal gardens](#) are protected by a high strong wall. The **top of the wall is**

adorned with serrated battlements. The presence of high wall was for protection against enemy and hot winds of summer.

Entrance: Entrance is generally **tall and gorgeous.** **Doors are huge** and strong wooden structure studded with **heavy iron nails and spikes.** Heavy gates are provided to protect the kings and gardens from enemy attack.

Baradari: It is a canopied building with **twelve open doors** i.e., three in each direction. From baradari, one can sit and enjoy the **fresh breeze** and **watch dark clouds and birds in the sky.** The masonry pillars of baradari were **painted with designs of flowers in vases and the floor was furnished with thick carpets and cushions.**

Scented flowers: The flowers in [Mughal gardens](#) are mostly scented in nature and highly colourful. The colourful effects are created by **massing mixed coloured [annuals](#).** **Mixed colours have been preferred** rather than mono, complementary or contrast colours.

Types of Gardens

French garden

During the **sixteenth-century**, in France the court life was shrouded with stiff formality and exactness. To match with this formality, the French style of garden designs were also very intricate and artificial. Due to the **efforts of Le Notre who served in the Royal Garden of Louis XIV from 1643 to 1700, the art of garden design was elevated to a higher.** It was Le Notre who showed to the world the impact in **impressiveness of [scale](#) on garden design.** His main creations, the gardens at **Versailles**, have **avenues** which are **memorable for their tremendous length and width.** To design a garden at **Vauxe-le-Vicomte**, his first master piece, Le Notre had removed three villages to create his [vista](#). The moral of French garden style of Le Notre seems to teach the lesson "**how to think big**". The style of **Le Notre can be termed as an evolution and mastery of the art of formal garden in its perfection.** His style dominated the gardens of civilized Europe, for a long time.

Gardening in Mughal era

Among the Mughal emperors, Babar had high aesthetic sense and was fond of gardens and he made gardens at Panipat and Agra. Aram Bagh at Agra is still being well maintained by the Archeological Department. [Mughal gardens](#) are synonymous with [formal style](#) of gardening.

The **square or rectangular flower beds** are special features of [Mughal gardens](#).

Another important contribution was the [introduction](#) of **exotic plants like cypress, rose, carnation, narcissus, daffodils, lilies, tulips, etc.**,

Some of the famous gardens established by the Mughal rulers are listed below

Mughal Emperor	Gardens established
Akbar	Fatehpur garden, Sikri (Agra)
	Tomb garden, Sikandra (Agra)
Jahangir	Shalimar, Acbhalbal, Varinag (Kashmir)
	Itmad-ud-Daulah (Agra)
	Dilkusha garden, Lahore
Shan Jahan	Shalimar, Lahore
	Tai Mahal, Red Fort, Agra
	Red Fort, Delhi
Fadai Khan	Pinjore garden, Pinjore

Gardening during Post-independence period

There have been significant changes in the field of ornamental gardening during the post-independence era. Achievements have been made in all the important fronts viz. conscious [planning](#) for **improving total environment, commercial floriculture and teaching and research of ornamental horticulture**.

Several gardens in different cities have been laid out to provide active and passive **recreational facilities and to improve the environment**. Important gardens are **Budha Jayanti Park (New Delhi), Rose garden (Chandigarh and Ludhiana)**.

These gardens deviate from the traditional [Mughal gardens](#) in their layout. As a general rule, **landscaping of public and private buildings has become an integral part of [planning](#)**. State departments pertaining to urban, archeological and tourism development are actively involved in improving the total environment by conscious [planning](#) and planting.

Gardening in British era

English gardens are the most beautiful gardens among all European gardens. The reasons are that the UK enjoys **the typical grassland climate with well distributed rainfall** which is

favourable for the growth of herbaceous perennials. Since they were ruling many countries, valuable plant collection was possible from diverse areas.

The key features of British gardens in India are:

i) lawn

ii) rockery and

iii) herbaceous border.

Lawn: Grass lawn is a principal feature of English garden. A lawn can be of any shape and it may be plain or undulating. It can be laid by seed, turfing or plastering.

Rockery: It is the second important feature of an English garden. There are various types of rockeries.

Cold weather rockery of annuals like Alyssum, Calendula, Candytuft, Dianthus, Ageratum, Gaillardia, Verbena, Zinnia.

Rockery of succulents for dry areas.

Rockery of ferns in humid areas.

Herbaceous border: Flower beds or borders are characteristic feature of a British garden. The **height of the plant, time, duration and overall colour scheme are taken into consideration.**

Japanese gardens

Japanese gardens style is '**nature in miniature**' which enables them to meditate, be in harmony with nature even while they are busy with daily routine. Both the Persian and Japanese garden designs were based on their respective **ideas of heaven**. One most admirable feature of the Japanese garden is that while other major styles of gardening of the **world changed radically** or fallen into disfavor, the Japanese continued the same style for centuries but still remained popular. This can be attributed to the special relation of **the Japanese gardens to nature**.

A most important teaching of the Japanese garden is possibly that "**unless a garden has an air of peace it's not worth a place visiting**. It should be a place where **the mind finds rest and relaxation.**"

Forms or types of Japanese gardens

A Japanese garden may either be in the form of a **large public park or a small family garden**. The Japanese gardens are further classified based on positions, shape, and purpose. The important types are:

Hill garden

Flat garden

Tea garden

Passage garden

Sand gardens

TERRACE GARDENING

A **terrace garden** is a **garden** which is established on a **terrace, roof**, or patio, usually in a house where there is limited **gardening** space.

a **terrace** is an element where a raised flat paved or gravelled section overlooks a [prospect](#). A raised terrace keeps a house dry and provides a transition between the [hardscape](#) and the [softscape](#)

It is the set of activities that one does to grow food in unused spaces of one's home that is conducive to grow food. Technically one can grow everything from **cereals, pulses to herbs**. But growing cereals and pulses in terraces and balconies for consumption is a little far-fetched as of today.

Growing of **vegetables and a few fruits in unused spaces** of one's home. And since these are grown **mostly in containers** it is also known as **container gardening**.

As **urban open areas are shrinking** in size every day the only real viable place that one can grow one's **own vegetables** then becomes the balcony. If you are lucky to live in an independent house with a terrace then there is nothing like it.

A 30 square feet balcony can yield sufficient green leaves and a few vegetables while a terrace of **1000 sq feet** can fulfill **50% vegetable requirements of a family of four**. All it takes is some planning and imagination to utilize the available area and resources efficiently and effectively.

Recycling is Organic

A Kitchen garden is not only a place where food is grown; it is also a place where all the food waste from home is recycled. According to a survey about **six meals are wasted per week per household in the US**. [In India itself about 40% of the food is wasted](#) according to United Nations Development Program. That's a huge deal of food to be wasted. And having a kitchen garden at home ensures that one's home becomes a zero food waste home as all food waste is typically recycled back to feed the plants.

Contemporary.

Contemporary terrace gardens, in addition to being in the garden and landscape, often occur in urban areas and are [terrace architecture](#) elements that extend out from an apartment or residence at any floor level other than ground level. They are often discussed in conjunction with [roof gardens](#), although they are not always true roof gardens, instead being balconies and decks. These outdoor spaces can become lush gardens through the use of [container gardening](#), automated [drip irrigation](#) and [low-flow irrigation systems](#), and outdoor furnishings.

VERTICAL GARDEN

The lack of vegetation in urbanized areas, as result of human establishments, directly affects the quality of life, from physical and aesthetical point of view. The construction of vertical gardens is recommended both in **interiors and especially in the exterior of buildings**. By applying these technologies, any kind of area can be used at its maximum capacity, obtaining **aesthetic valences, benefic for environment and human health**. Even if the **price of constructing and maintaining** the vertical gardens is higher than a classical landscape it's **compensated by the environmental benefits, raising the vegetation surfaces, with impact for reducing the pollution effect**. The new modern concepts for landscape development are keen on **using any kind of concrete or glass, turning them in real vertical gardens**, being possible to overcome the development of the urban areas making a smooth transition for a healthy green urban environment.

Vertical Gardening is a special kind of urban gardening suitable to small spaces, particularly for **decorating the walls and roofs in various styles**. This is an alternative method for gardening by **expanding the scope of growing plants in a vertical space**. Intensive urbanization has left hardly any horizontal space for outdoor gardens. **Green walls are not only spectacularly beautiful, but also helpful in enlivening the ambiance**. Green walls can absorb heated gas in the air, lower both indoor and outdoor temperature, providing a healthier indoor air quality as well as a more beautiful space.

Types of vertical greening system:

1. Green façade

2. Living/green wall

- i) Modular green walls
- ii) Vegetated mat wal

Green facades:

Green facades are a type of green wall system in which **climbing plants or cascading groundcovers are trained to cover specially designed supporting structures**.

Plants are either grown in the ground or in the elevated containers where they are watered and fertilized. Green facades are a type of green wall system in which climbing plants or cascading groundcovers are trained to cover specially designed supporting structures. Rooted at the base of these structure, in the ground, in intermediate planters or even on achieving full coverage. Green facades can be anchored to existing walls or built as freestanding structure, such as fences or columns

Green walls / Living walls :

Living wall system **composed of pre-vegetated panels, vertical modules or planted blankets that are fixed vertically to a structural wall or frame.** These panels can be made of **plastic, expanded polystyrene, synthetic fabric and support a great diversity of plants species** (eg: a lush mixture of ferns, ground covers, perennials and edible plants).

Constructed from pre-vegetated panels, vertical modules or planted blankets (vegetated mat wall) that are fixed to structural framework or to a **wall Made from steel framework, plastic, expanded polystyrene and synthetic fabric to support a variety of diversity and density of plant species Tend to require more maintenance such as fertilizer and water than green facade systems that are planted into the ground.**

Modular green wall : Vertical Garden Modules is made up of **recycled poly propylene material.** It has attractive look, highly durable in nature and it can be easily installed. It provides instant solution for making garden in your residing place.

Vegetated mat wall :

This system, pioneered by Patrick Blanc, is composed of two layers of synthetic fabric with pockets filled with the plants and growing media .The fabric walls are supported on a framework and backed by a waterproof membrane against the building wall Nutrients and water are delivered through an irrigation system at the top of the wall

Building and installation of Green walls:

Green wall system vary greatly in their design and construction from DIY projects to modular green wall systems. This heading provides information on

Structures and components for green wall system

Suitable Plants

Growing media

Irrigation and plant nutrition

General considerations for green walls

Structures and components for green wall system

- **Frontpanel**
- **Bottom drainage tray**
- **Geo textile pouch**
- **Stabilizers**
- **Sidepanel**
- **Hanging hook**

Indoor Green walls/ For shaded areas

Plants suitable for vertical garden :

Outdoor plants *Peperomia, Syngoniums, Philodendron, Epipremnum, Begonia, Anthuriums, Nephrolepis, Chlorophytum, Lantana, Pilea, Rheo discolor, Cuphea, Fittonia, Spathiphyllum, Schefflera*

Indoor Green walls/ For shaded areas

<i>Herbaceous perennials</i>	<i>Pepromia, Syngoniums, Philodendron, Epipremnum, Pepromia, Begonia, Anthuriums, Chlorophytum, Pilea, Rheo discolor, Fittonia, Spathiphyllum, Schefflera</i>
<i>Shrubs</i>	<i>Schefflera, Ficus spp</i>
<i>succulents</i>	<i>Rheo discolor, Zebrina pendula, Setcreasea purpurea</i>
<i>Ferns</i>	<i>Nephrolepis</i>

For Outdoors/Exterior Green walls

<i>Herbaceous perennials</i>	<i>Asparagus spp., Pileamicrophylla, Alternanthera, Mentha spp.</i>
<i>Succulents</i>	<i>Jade plant, Sedums, Portulaca</i>
<i>Shrubs</i>	<i>Dusty miller, Cuphea</i>
<i>Ground covers</i>	<i>Baby's tear, Callisarepens</i>
<i>Grass like foliage forms</i>	<i>Ophiophogon, Dianellatasmanica</i>

rowing media:

Requirements:

Weightless media

High Water holding capacity

High Nutrient holding capacity

Good Porosity

Neutral pH

Cocopeat, Perlite, Sphagnum moss, vermiculite, vermicompost, shredded bark and leaf molds are the common media combinations used. Soil is not used since it increases the weight of the green walls.

There are three types of growth media used in living walls:

Loose media

Mat media

Structural media.

Loose medium walls tend to be "soil-on-a-shelf" or "soil-in-a-bag" type systems. Loose medium systems have their soil packed into a shelf or bag and then are installed onto the wall. These systems require their media to be replaced at least once a year on exteriors and approximately every two years on interiors. Loose soil systems are not well suited for areas with any seismic activity. Repairs are only achieved by re-stuffing soil into the holes on the wall, which is both difficult and messy. Loose-soil systems should not be used in areas where there will be a lot of public interaction as they are quite messy and lose their soil little by little over time. Loose-soil systems with physical media erosion systems are well suited for all green wall applications.

Mat type systems tend to be either coir fibre or felt mats. Mat media are quite thin, even in multiple layers, and as such cannot support vibrant root systems of mature plants for more than three to five years before the roots overtake the mat and water is not able to adequately wick through the mats. The method of reparation of these systems is to replace large sections of the system at a time by cutting the mat out of the wall and replacing it with new mat. This process compromises the root structures of the neighbouring plants on the wall and often kills many surrounding plants in the reparation process.

Structural media are growth medium "blocks" that are not loose, nor mats, but incorporate the best features of both into a block that can be manufactured into various sizes, shapes and thicknesses. These media have the advantage that they do not break down for 10 to 15 years, can be made to have a higher or lower water holding capacity depending on the plant selection for the wall, can have their pH and EC's customized to suit the plants, and are easily handled for maintenance and replacements. They are the most robust option for a living wall for both exterior applications and for interior applications. They are also the best choice in areas where high-winds, seismic activity or heights need to be addressed in the design. Structural media are superior to the other media for their longevity and high-level of performance in a variety of circumstances. Depending on the installation, they do tend to be more expensive to install, but lower cost to maintain.

Irrigation and plant nutrition:

Green walls cannot be sustained without irrigation. Interruptions to the water supply are a common cause of plant failure on green walls. Systems designed with inbuilt irrigation should mitigate plant losses due to inconsistent moisture management, although errors can still occur. Automated, remotely controllable irrigation systems are used for walls in high profile locations, or in situations where access is challenging. Note that the quality, design and costs will vary between different systems. The most sophisticated systems enable the maintenance supervisor to keep track of the automated performance of the system, including the volume of irrigation delivered, its frequency, substrate moisture content, as well as pH and nutrient levels in the water supply. The settings can be overridden if needed; for instance, the frequency or duration of irrigation cycles may be increased on hot days. In hydroponic systems, plant nutrition is delivered by a fertilizer injection system that releases controlled doses of fertiliser into the irrigation system (fertigation). Management of fertigation systems and rates of delivery requires specialist knowledge, as it is more complex than fertilizing soil or growing media. Hydroponic systems require continual monitoring of pH, water hardness and total dissolved solids (TDS), and adjustment of these parameters where necessary.

Irrigation

The irrigation system is designed to minimize water consumption. It consists of an automation-unit with equipment for control of nutrient injection and irrigation cycles. When a surface has a variation of sun exposures, the irrigation is divided into segments in order to program it specifically for each part. Within the multi-layered felt surface a drip-tube is integrated. Water consumption varies with heat and sun exposure, but compared to normal green spaces or a lawn, the consumption is normally lower.

It averages between 2-5 l/m²/day.

For hydroponic green wall systems, the fertigation system may apply 0.5-20 litres of irrigation solution per square metre per day. Internal green wall requirements are at the lower end of this range, and external green walls at the higher end. Irrigation cycles typically last a few minutes and will be required several times a day. Keeping irrigation volumes low minimises waste and reduces run-off. Irrigation run-off may be captured in a tank at the base of the wall and recycled back through the green wall system. Green walls that use a high quality, water-retentive growing medium, and are not in an exposed or particularly hot location, may thrive on a weekly watering regime. In most simple, soil-based systems, including DIY systems, controlled release fertiliser is mixed in with the growing medium, rather than using a fertigation system. Irrigation must be available as soon as the plants are installed in the wall system. The irrigation system requires a water meter to monitor irrigation volume, and a pressure gauge to monitor the even application of water. The need for ongoing regular irrigation and the expectation that water will be used sustainably means that stored (harvested or recycled) water should be used whenever possible, so a pump is necessary.

Design / process:

Each vertical garden is given a unique design and selection of species. The composition of plants takes in consideration the specific environment where it will be built, such as the local- and micro climate, sun exposure and the surrounding context. The aim is to create a one of a kind and site-specific garden that stands beautiful through all the seasons of the year.

Garden Components

1. Lawn.

The lawn is the green carpet for a landscape. It provides a perfect setting for flower beds or shrubbery or specimen tree.

Grasses suitable for lawn making in India.

- 1. Buffalo grass or shade grass - *Stenotaphrum secundatum*.*
- 2. Korean grass - *Zoysia japonica*.*
- 3. Bermuda grass or Doob grass - *Cynodon dactylon*.*
- 4. Korean velvet grass - *Zoysia centifolia**

2. Shrub and Shrubby.

Shrubs form part of the framework of the garden and create a very pleasing picturesque effect if they selected and planted carefully. A shrubbery is a border planted with a different kind of shrubs.

Flowering Shrubs:

1. *Hibiscus rosa-sinensis*.
2. *Neerium indicum*.
3. *Ixora parviflora*.
4. *Bougainvillea*

Foliage Shrubs:

1. *Acalypha tricolor*.
2. *Codium variegata*.
3. *Manihot variegata*.

3. Climbers and Creepers.

Climbers and Creepers are used to grow against or over walls, trellises, arches, pergolas, pillars or any large trees. Climbers may be weight or light depending upon the woods it produces. Creepers are those plants which are unable to climb vertically on their own because of their weak stems.

Climbers:

1. *Bougainvillea*.
2. *Ficus ripens*.
3. *Jasminum grandiflorum*.
4. *Quisqualis indica*.
5. *Wood rose*.
6. *Clitoria ternatea*.

Creepers:

1. *Morning glory*.
2. *Asparagus*

4 Flower bed

Several flowering annuals and herbaceous perennials can be grown in beds and borders. Flower beds are simple designs can be laid out on the outskirts of the lawn along the foundation of buildings, the path leading to the entrance of the house and on sides of footsteps. Flower Borders are continuous beds of more length than width containing plants of heterogeneous character as flower beds which are composed of plants of one kind only. These borders can be on the sides of the path, walks or in front of shrubberies and trellises with climbers

5 Hedges

A good live hedge is essential to enclose a garden. Ornamental hedges planted in the garden with attractive foliage or flowering shrubs. These are pruned to maintain the height of 50-65cm. This will help to divide the garden into a number of parts each will have its own distinct features.

6. Walks and Paths

All these should occupy minimum space and not too many in number. Paths may be made of earth, brick, concrete or paved. Paved paths are effective in a formal garden. Paving can be done on flat stones or concrete slabs or bricks

7. Rockery

This is intended to bring together in a shorter space an idea of mountain or alpine garden with plants growing in the crevices of rocks. This is elevated structure resembling a miniature mountain range or slope of a hill with few dominant peaks or valleys.

Some of the Cacti & Succulents used in rockery are Agave, Aloe vera, Sedum, Yucca.

Ferns: Nephrodium, Polypodium.

Flowering: Vinca rosea, Verbena.

8. Carpet Beds.

In a large public garden close-growing plants like Verbena or Alternanthera are used to form certain designs or letters. Foliage plants are better suited than flowering plants as they stand severe clipping much better. Carpet beds require constant attention and need not allowing them to overgrow

9. Topiary.

Certain plants are often trimmed to shapes of animals or birds..etc. Shrubs are well suited for bending and withstand frequent trimming for developing topiary. Shrubs like Casuarina, Bougainvillea, Cupressus are suitable for Topiary work

10. Suncken Garden

This garden goes down through a series of terraces to a small pool or a fountain at a bottom. In the terraced flower beds, the lawn is laid out. This form of garden taking advantages of a natural depression. It breaks the monotony of a flat ground of the garden.

11. Arches and pergola

Arches are generally erected over walks, usually at the entrance and are two meters in height.

Pergolas are series are arches connected over a walk

12. Trophy:

The arrangement of potted colorful foliage or flowering shrubs and flowering annuals or herbaceous perennials around a tree or any central objects such as a statue. These potted plants often arranged in tires.

13. Edges:

These are materials of any description which is used in gardens for dividing beds, borders from the roads, walks or paths demarcating spaces allotted for particular purposes as flower beds. Dwarf growing plants up to 20-30cm height such as Eupatorium, Alternanthera which should stand frequent trimming.

14. Trees:

Trees are formed the main framework of the garden. Generally planted along the boundaries. A spreading tree is an ideal feature for picnic ground in the formal garden.

Specimen Trees-Araucaria cookie, Plumeria alba

and Plumeria rubra.

Shady Trees-Azadirachta indica, Ficus religiosa.

Flowering trees-Cassia fistula(Yellow), Spathodea campanulata.

Checking Air pollution-Morus sp, Plumeria acutifolia.

Screening purpose-Eucalyptus, Polyalthia longifolia.

15. Garden Adornments:

There are several adornments and accessories such as fountains, garden seats, statues, ornamental posts and pillars, trellises, hanging baskets, tubs, vases and urns with plants make the garden more enjoyable. Playing a fountain is an interesting feature in the garden and garden seats are made of stones, concrete or metal are placed under a tree. Arbors serve as support to several beautiful plants and dispel monotony in the garden.

15. Avenue

An avenue is the row of trees grown on both sides of roads. Shade and beauty are the sole criteria to be considered while selecting avenue

trees. The trees should also be selected according to the length and breadth of the road.

Arboretum

Growing of different species of trees in one place is called 'Arboretum'. The trees form the main frame work of the garden. Group of trees in one place will help to give depth to the garden. Trees are very fascinating because of their graceful appearance and the abundance of bloom. They are grown for their economic importance or aesthetic value or both.

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LAWN AND LAWN MAKING

A lawn is an area where grass is grown as a green carpet for a landscape and is the basic feature of any garden. It serves to enhance the beauty of the garden, be it larger or smaller. Proper lawn maintenance plays a crucial part in any landscape design. A beautiful well maintained lawn can make the entire landscape look good, whereas a lawn that is not maintained can completely ruin it's beauty.

The lawn not only harmonizes with a decor of the drawing room, but also sets of a suitable background for a specimen tree or a shrub, as well as for colourful beds and borders. The position of the lawn largely depends upon the layout of the garden in relation to the house. In general lawn should be wide open with access to direct sunshine, especially in front of a rockery and a water pool.

Site and Soil

After choosing the site, the next important factor for consideration is the size and shape of the lawn. The preparation of site includes digging, leveling and enriching the soil with organic manures or by amending with fertile soil. If the soil is very heavy, coarse sand may be added by removing subsoil to a depth of 20 cm. The ideal soil pH should be 5.0 to 5.6. If it is very acidic 500 g/m² lime should be added and to clayey loam or alkaline soil gypsum of the same quantity may be added. Provision of drainage for excess rain water should be made if the ground is not sloppy.

Levelling

The site should be thoroughly levelled with spade, pebbles and weeds are handpicked. The soil is rolled with a roller. Weeds especially nut grass should not be allowed to grow and should be removed with roots for at least 2 to 3 times.

METHODS OF LAWN MAKING

1. Seeding

*The most popular grass suitable for seeding is "Doob" grass (Cynodon dactylon). It has the fast spreading mat forming habit, radially forms roots at the nodes, the foliage is dark green, narrow with parallel veins. A lawn from seed is thought of only when grass roots are not available. About **30 kg of seed is required for planting one hectare**. The soil should be reduced to fine tilth and given a light rolling. The site should be divided into suitable small squares or rectangles, the **seeds are mixed with double the quantity of finely sieved soil** and should be rolled again and watered liberally with rose can. The **seeds take four to five weeks for germination**. Care should be taken not to flood the site. For the first few times, the grasses are cut with a scythe. Lawn mower may be used for easy maintenance and for its spreading.*

3. Turfing

The turfs are nothing but pieces of earth with compact grasses on them. These turfs should be cut uniformly in squares from a place where the grass is short, compact and free from weeds. These turfs should be placed on the prepared ground site, side by side and beaten down flat with a turf beater. The cavities in between should be filled with fine soil. The entire turfed area should be rolled and watered liberally. This is the most expensive way of lawn making.

4. Turf plastering

*The doob grass can be procured in large quantities free from weeds and **chopped properly into small bits of 5-7 cm long. Two baskets of chopped grass** pieces should be mixed well with **one basket each of garden soil and fresh cow dung and a shovel full of wood ash with required quantity of water to form a thick pasty** substance. This mixture is then spread uniformly on the surface of a previously wetted perfectly leveled ground to a **thickness of at least 2.5cm and** watering should be done with a rose can. The next day, ground should be **rolled and the grass should be allowed to spread. The grass will shoot up in a fortnight.** To start with, cut with a scythe and after three months, use the lawn mower.*

5. Dibbling roots

This is the cheapest but time consuming method. Small pieces of grass roots should be dibbled 10– 15cm apart in a leveled ground when it is wet after rain. The roots spread and grow underground in the course of six months making a fairly compact lawn by frequent mowing, rolling and watering.

After Care: *It includes rolling, mowing, watering and restoration of patchy places, which should be done regularly.*

Fertilizing the lawn thrice a year is adequate to maintain rich greenness.

*Application of **urea or ammonium sulphate at the rate of 1 kg / 50 sq. m** during February - March, June - July and October - November is quite beneficial.*

*At times well **decomposed compost at 10 kg / 10 sq. m area** will be sufficient as topdressing.*

Weeds should be removed as soon as they appear, otherwise they spread, seed multiply and overpower the grass. Fill the gaps with grass roots and fine soil. In the absence of rain, watering is done regularly at weekly intervals.

A mower should not be employed until a firm green sward has been formed. The grass is first cut with sickle and the surface is then rolled. Heavy roller should be used frequently but not when the ground is either too wet or dry.

*Mowing should be done at brief intervals and never allow to produce seed stalks. Avoid cutting the grass too short as this can damage the grass, inhibit a deeper root system from setting up and give rise to weeds. Different grasses have different heights at which they can grow best, so make sure you enquire about this from the vendor or your landscaping company. **The ideal height of most grasses is 3 to 4 inches. Removing more than one-third of the grass leaf in a single cutting is not recommended.** Mow only on dry grass and not when the grass is wet. Make sure your mower's blade is a new and sharp before starting a fresh mowing session. To ensure smoothness make sure you change the mower's oil once or twice during mowing season.*

Once in a year rake the lawn before rain and top dress with rich mixture of decomposed manure and soil. This will accelerate the grass with new vigorous growth.

to ensure adequate penetration.

The best time to water the lawn would be during the early hours of morning. Watering during this time will allow the water to reach the roots without evaporating. Mid afternoons may lead to water getting evaporated soon and watering at night times can give rise to the possibilities of diseases. While watering, care should be taken to

spread the water homogeneously across the lawn without over flooding or missing certain areas/spots. If the lawn is placed on heavy slopes make sure that the water does not run-off. Several applications of water would be necessary for such surfaces