CLUBHOUSE DESIGN STRATEGY – DESIGN PRINCIPLES

May, 2022

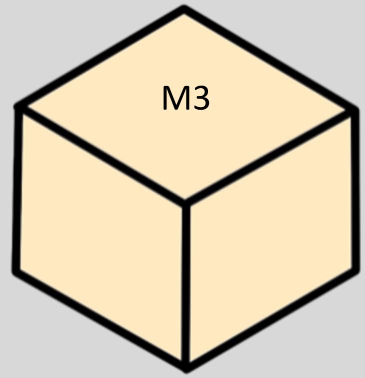
10-05-2022

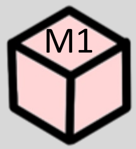
Source: Clubhouse at Meridian, NCR

1 DESIGN & MODULARITY

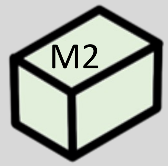
Module study for **"Need for cost efficient living"** segment as an example

Based on segmentation, every activity space is derived into modules which can be combined or split to form a lego block kind of exercise, which can further help in standardizing construction grid and explore options for space management.





VOLUME = 10 (L) X 10 (B) X 10 (H)
AREA = 10 (L) X 10 (B) = 100 Sq.ft

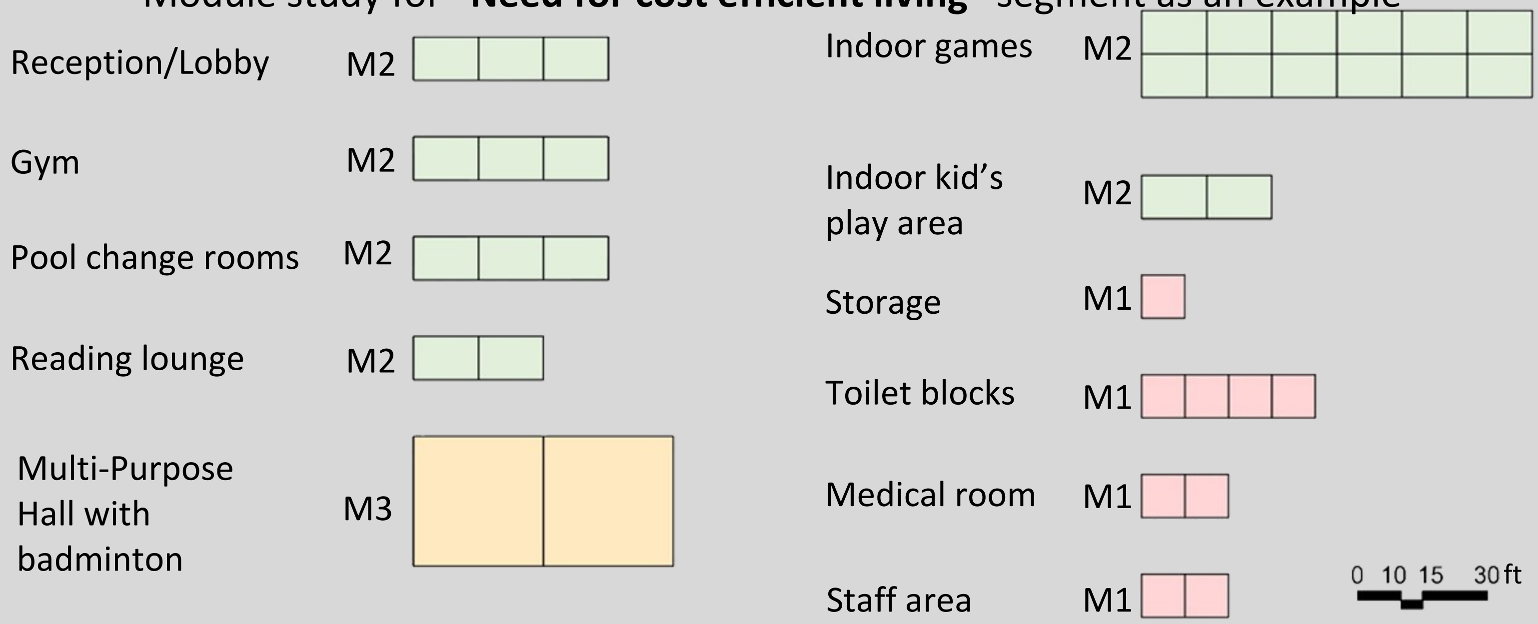


VOLUME = 10 (L) X 15 (B) X 10 (H)
AREA = 10 (L) X 15 (B) = 150 Sq.ft

Module Derivation for Value Seeker Segment

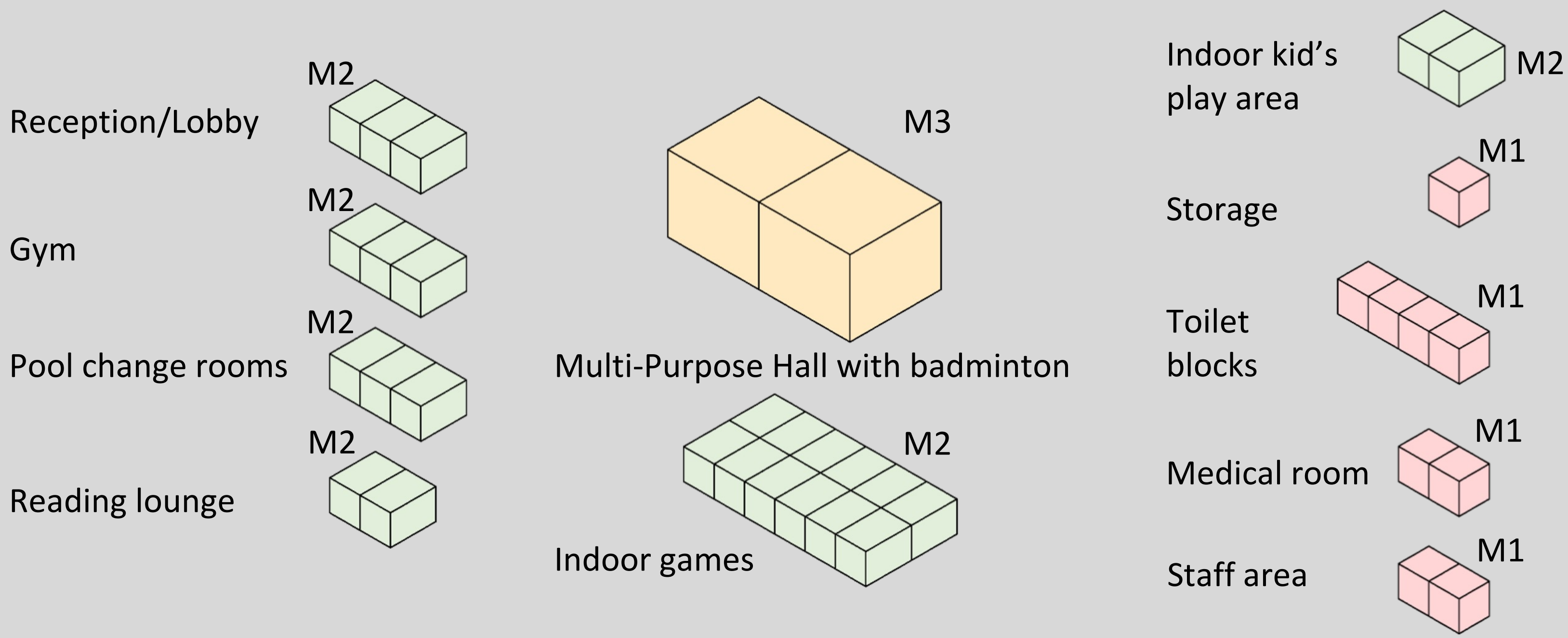
Sr.No.	Amenity Block (Must Have)	Block Size as per functional requirements				Module Type	No of Modules
		L	B	H	Area (LxB)		
1	Reception/Lobby	30	15	10	450	M2	3
2	Gym	30	15	10	450	M2	3
3	Pool Change Rooms	30	15	10	450	M2	3
4	Reading lounge	20	15	10	300	M2	2
5	Multi-Purpose Hall with badminton	60	30	25	1800	M3	2
6	Indoor Games (Carroms, Cards, Chess, darts and Table Tennis)	60	30	10	1800	M2	12
7	Indoor Kid's Play Area	20	15	10	300	M2	2
8	Storage Facility	10	10	10	100	M1	1
9	Toilet Blocks	20	20	10	400	M1	4
10	Medical Room	20	10	10	200	M1	2
11	Staff area (staff room, lockers, bathrooms-female+male)	20	10	3	200	M1	2

Module study for **"Need for cost efficient living"** segment as an example

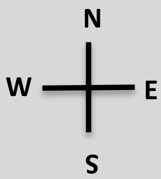


CLICK HERE FOR RELEVANT CAD BLOCKS

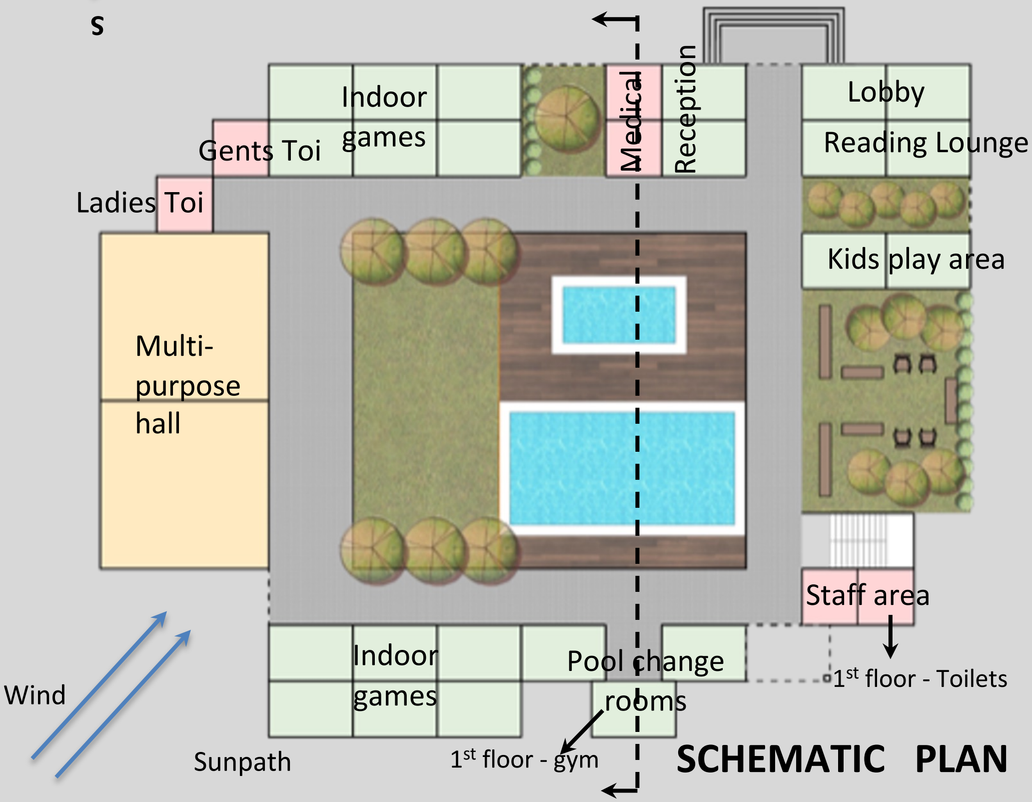
REQUIRED MODULES IN PLAN



REQUIRED MODULES IN 3D



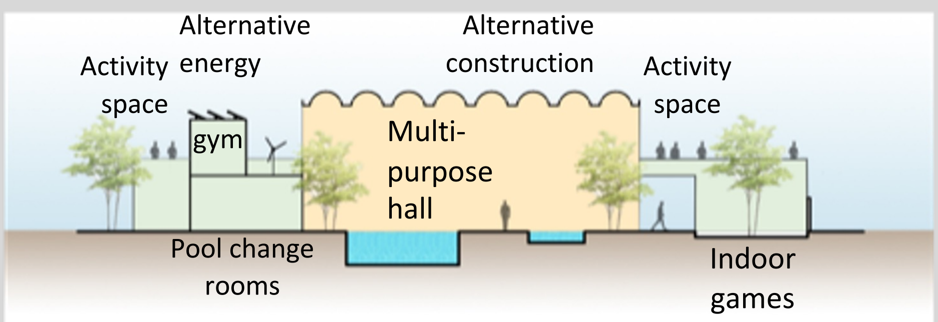
Module study for **“Need for cost efficient living”** segment as an example



SCHEMATIC PLAN

The modules as seen in plans divided as per their sizes and volumes.

Various permutations and combinations of these modules can be explored to arrive at a design layout which will justify all or at least major aspects mentioned hereafter in this document



SCHEMATIC SECTION

An Illustration of a typical cross sectional exploration of module arrangements to incorporate courtyards, ample usable space on terraces and rooftops for energy saving measures.

A number of such studies can be explored based on the guidelines mentioned hereafter in this document to achieve a holistic design development.

2 STRUCTURE & CONSTRUCTION MATERIALS

Structure & Engineering

Application of *alternative construction techniques* with *alternative materials* like compressed earth, fly ash, concrete and siporex blocks, alternative cement, GFRG panels etc. will generate savings in building costs. Use & application of *regional local materials* will not only enhance building & running costs but will also encourage local industry.

Consultant shall apply an appropriate mix of technique and alternative and regional materials, suitable to the segment and geography & derive a cost saving summary.

Alternative Construction Techniques: [Precast Construction]

Fig B8.1: Precast walls for the exterior of the building

Fig B8.1: Precast beams and columns

Fig B8.3: Precast flooring

PRECAST CONSTRUCTION

Precast concrete is a construction product produced by casting concrete in a reusable mold or "form" which is then cured in a controlled environment, transported to the construction site and lifted & set into place.

Advantages:
Precasting is great for producing large numbers of identical components. Since it is done in a purpose-built precasting yard or factory, it makes construction easier for the following reasons:

Construction of members can be done inside a climate-controlled structure, eliminating problems of rain, dust, cold, or heat.

Specialized formwork (moulds) can be built for doing many repetitions of the same component and in turn reduce time and money.

Specialized equipment can be used to make, move, and pour the liquid concrete.

Curing of the concrete can be done in a controlled environment to achieve maximum desired strength.

Since the components can be made beforehand, construction can be very quick and cost effective too.

Alternative Construction Techniques [Ferrocement]

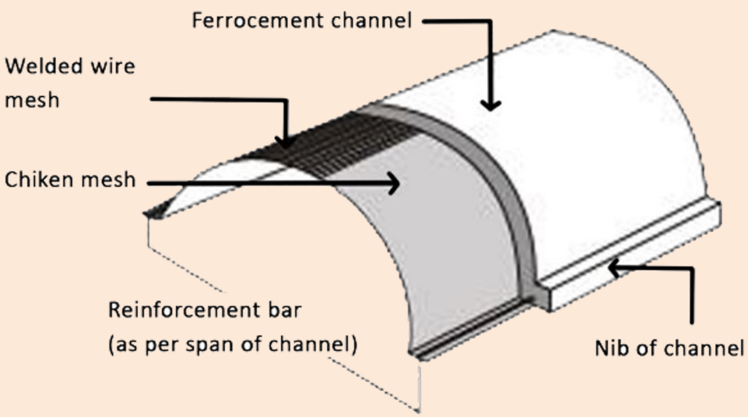


Fig B9.1: A typical ferrocement roof channel for long spans

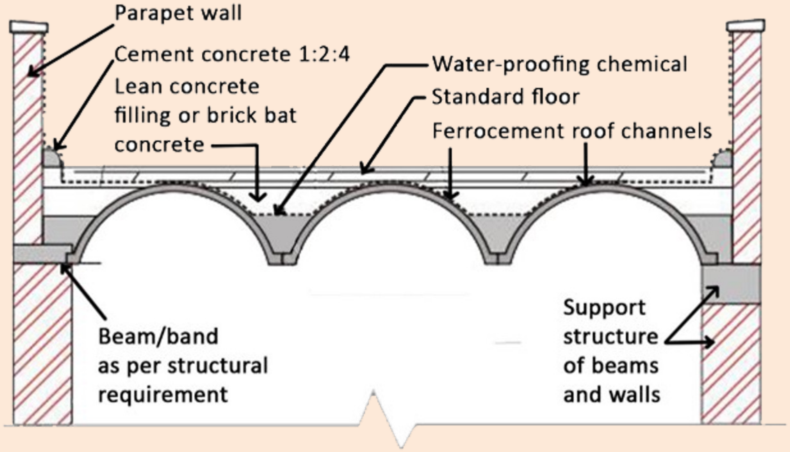


Fig B9.1: Ferrocement roof channel section with a flat top

FERROCEMENT TECHNOLOGY :

Ferrocement technology can be used for large and small spans to achieve a considerable cost saving.
Cavity wall and hollow floors can also be constructed with inbuilt reinforced framework.

Because of thin members, consumption of cement, sand and steel is reduced, which saves natural resources and its manufacturing cost.
Electricity and carbon dioxide emission is also reduced.
This technology is good for thermal insulation because of cavity walls, earthquake resistance and as site work is reduced, over all construction time can be reduced, too.

ROOFING CONSTRUCTION TECHNIQUES:

FERROCEMENT ROOF CHANNELS

A ferrocement roof channel is a longitudinal element, semi-cylindrical shaped.
It is easy to construct, uses less cement and steel than a conventional RCC roof can be prefabricated and is cheaper too.
(refer fig P9.1, fig P9.2)

Less use of cement and steel for any given section compared with RCC, with a corresponding reduction in self-weight.
A simplified installation practice compared to RCC.
The technique requires neither shuttering, nor a concrete mixer or a vibrator.
For a standard roof, ferrocement can help reduce construction cost by 35 % as compared to RCC.

Alternative Construction Techniques [Shell roofs+ Parametric roof]

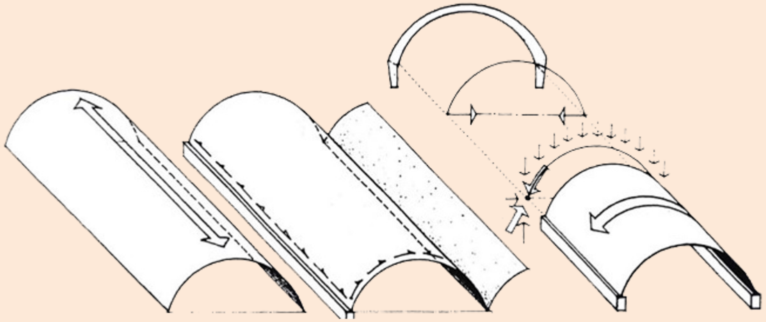


Fig B10.1: Barrel shell

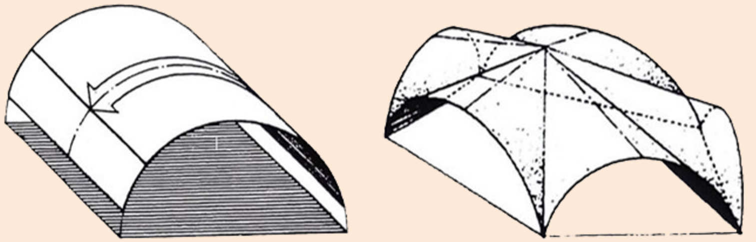


Fig B10.2: Cylindrical surface, Transitional surface

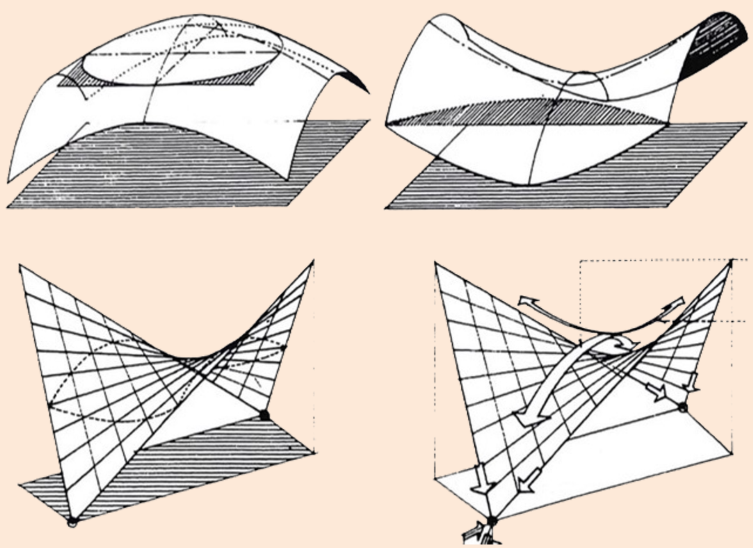


Fig B10.3: Parametric roof

Shell roofs are a thin, curved folded plate structure, shaped to transmit applied forces by compressive, tensile and shear stresses acting in the plane of the surface.
A shell can sustain relatively large forces if uniformly applied and distributed.
Types of shell roofs that can be used are as follows:

Barrel shell is a rigid cylindrical shell structure. If the length of a barrel shell is three or more times its transverse span, it behaves as a deep beam with curved section spanning in the longitudinal direction.
If it is relatively short, it exhibits arch-like action. (refer fig P10.1)

Apart from the commonly used barrel vaults,
flattened cylindrical or transitional curved roofs can be explored depending upon space & volume to be covered. (refer fig P10.2)

Their geometrical profiles facilitate clearstory light to be drawn inside the enclosed spaces, thus making these forms functionally viable too.

PARAMETRIC ROOF

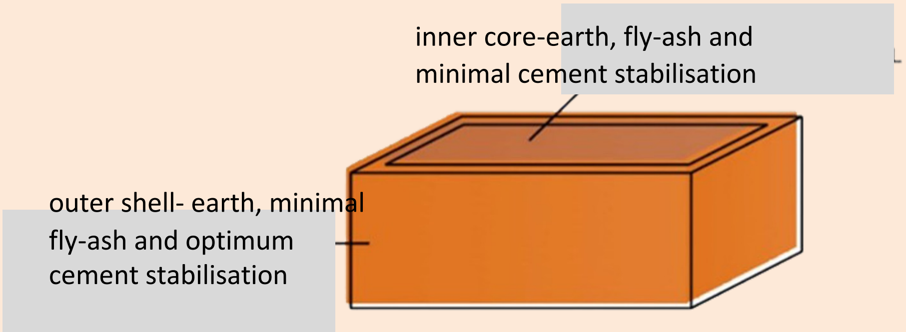
Some roof shapes based on parametric designs and defined geometry, can be seen as a good option for cost effective and high design value roofing systems.
(refer fig P10.3)

These roof types may be comparatively tedious for
resolving their structural workability and may require skilled labour.

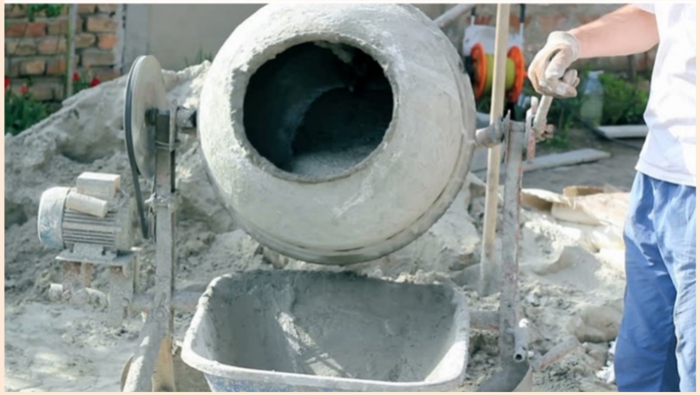
However, these Thin structures help reduce material costs and add good design values.

For large span zones, shell roof types can be explored depending upon form and function.
The roofs will also add a lot of design value by virtue of their interesting shapes.

Alternative Construction Materials

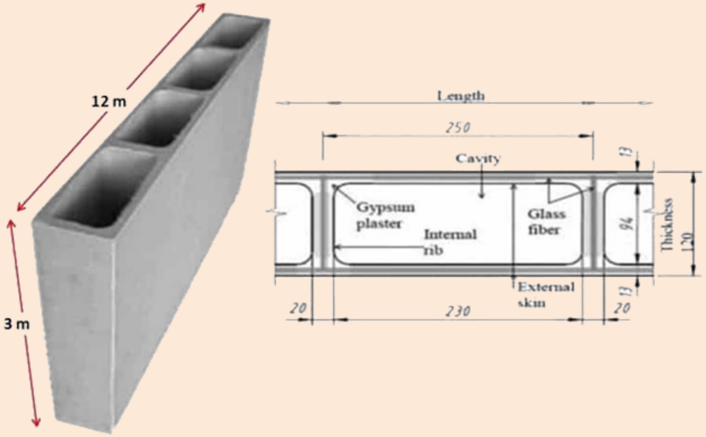


Standard Composition of Compressed Earth Block



Blended Composite Cement
Blended Portland Cement

Flyash blocks

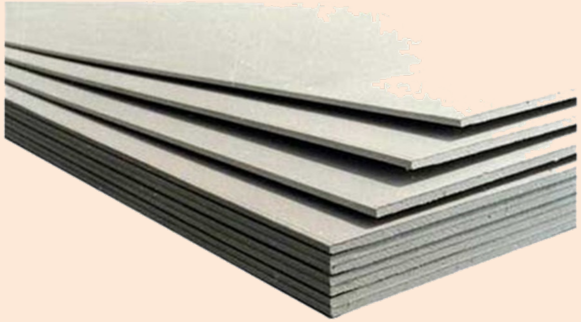


GFRG Panel and its cross section

Alternative Construction Materials & Local Materials

Autoclaved Aerated Concrete Blocks

Siporex Blocks



Fiber Cement Board

<table>
<tr><th>REGION</th><th>LOCAL MATERIALS</th></tr>
<tr><td>NCR</td><td>Sandstone, Slate, Makrana Marble, Rajnagar & Agaria marble, Andhi Marble, Yellow marble, Bidasar, Ambaji White marble, Indian green marble, Sandstone, Kota stone</td></tr>
<tr><td>Pune</td><td rowspan="2">Makrana Marble, Rajnagar & Agaria marble, Andhi Marble, Yellow marble, Bidasar, Ambaji White marble, Indian green marble, Sandstone, Kota stone, slate, limestone, Yellow limestone</td></tr>
<tr><td>Mumbai</td></tr>
<tr><td>Bangalore</td><td>Granite, Sandstone, Slate, Shahabad Stone, Limestone, Laterite, Felsite</td></tr>
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Summary of Savings

Sr. No.	Activity/Element	Proposed Savings
1	Compressed Earth Blocks	30% cheaper than country fired bricks consumes 5 times less energy to be built than of wire cut brick masonry and 15 times less energy than fired country bricks
2	Fly Ash Blocks and Panels	Fly Ash blocks are lighter in weight, less than 40% the weight of conventional bricks, while providing the similar strengths and costs 20% less than traditional clay brick manufacturing.
3	Alternative Cement	10% water saving can be done, Fewer repairs hence lower maintenance cost
4	Glass Fibre Reinforced	10% water saving can be done, Fewer repairs hence lower maintenance cost
5	Gypsum (GFRG) Panel	10% water saving can be done, Fewer repairs hence lower maintenance cost
6	Autoclave Aerated Concrete Blocks	About 55% reduction in weight of walls can be obtained when compared to that of walls made with clay bricks.
7	Siporex Blocks	Due to light weight, the dead loads on supporting structures / foundations reduces substantially
8	Fibre Cement Boards	Cement boards significantly reduce the exterior maintenance required
9	Local Materials	Locally available materials can significantly reduce energy use and pollution
10	Precast Construction	Precasting is great for producing large numbers of identical components
11	Ferrocement	Ferrocement can help reduce construction cost by 35 % as compared to RCC.
12	Shell roofs	Shell Roof provides an economiuc solution to RCC salb by providing 30% to 40% cost reduction on roof over RCC slab without compramising the strength
13	Parametric roof	Thin structures help reduce material costs

3 MEP

MEP Engineering

In context with site, region & appropriate orientation of the building with sun path, adding architectural features like louvers/sunshades to avoid glare and optimize daylight and employing passive cooling techniques and ventilation would further reduce operating costs. Further, using solar pumps, solar lighting and heaters would have an overarching benefit. Assess various features that fit best in this segment mix.

Inputs from Landscape consultant for biophilic design and having a green surround the clubhouse would impact the overall microclimate and hence can be used to calculate the overall HVAC requirement.

<u>On assessment of all design techniques and applying them to the final net zero design output, final cost derivation shall be submitted, showing savings in construction and savings over long term energy costs.</u>

Renewable Energy

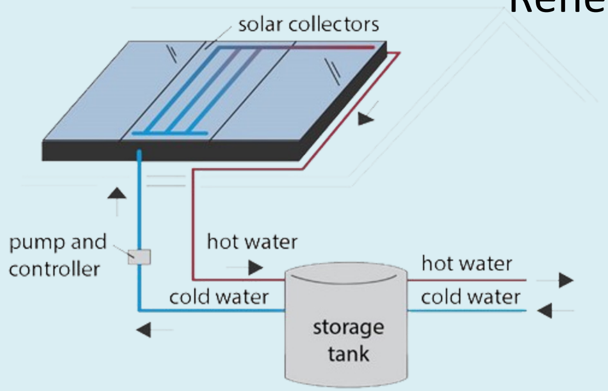


Fig C1.1 : Solar water heater

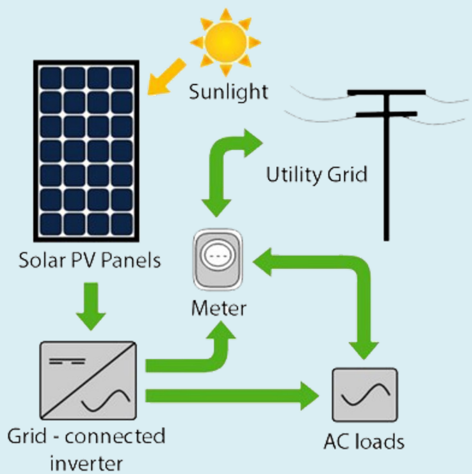


Fig C1.2 : Solar PV

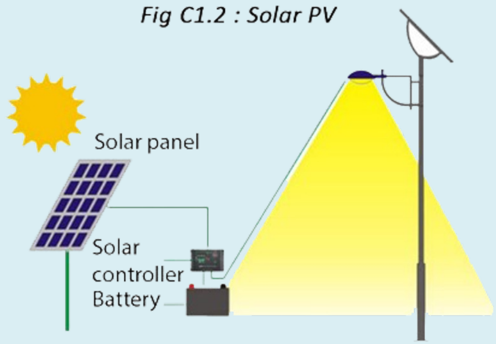


Fig C1.3 : Solar street light

RENEWABLE ENERGY OPTIONS :

Technologies which have gone through qualifying tests and pilot scale testing in the field so as to be bankable projects, following renewable energy technology options can be considered for proposed clubhouses.

SOLAR WATER HEATERS :

One of the most commonly used renewable energy options these days. Should be a must provision across all locations. (refer fig C1.1)
Solar cookers for cafeterias and restaurants can be explored to further reduce the load on grid supply.
It is estimated that for a 200 litre/day capacity solar water heater an average of 9,000 rupees can be saved annually.

SOLAR PV PANEL SYSTEM :

With the help of this system, lighting load upto 1KW can be easily achieved. Further, excess can be connected to the main grid.
This system can prove to be beneficial for common area lighting as well as for running small pumps for landscape, etc. (refer fig C1.2)

SOLAR SIGNAGE AND STREET LIGHTING :

Solar Energy can be used for illumination of signages and street lights. This is a tried and tested technology and can be a must provision across all locations.
If solar energy is used for lighting, then consumption of electricity can be saved.
Useful for street lights, solar lanterns, lighting systems, garden lights, etc.
(refer fig C1.3)
Currently, in the Indian context, the PV panel usage can be around 18% to 22% cost effective as compared to connection with the standard grid. (This is derived considering high initial setup costs.)

Considering the power crisis in our country, exploring options of renewable energy can be a sustainable approach in the long term

For clubhouse projects, the exact hot water required should be calculated and then compared to the standard gysers to understand necessity of using these alternate techniques

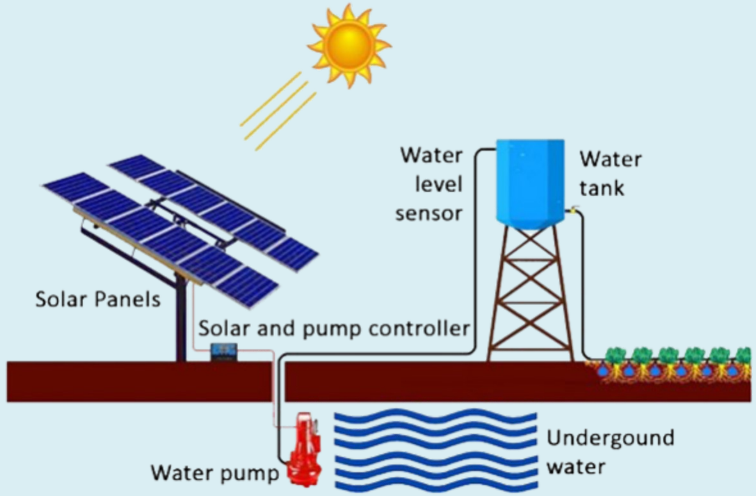


Fig C2.1 : Solar pump

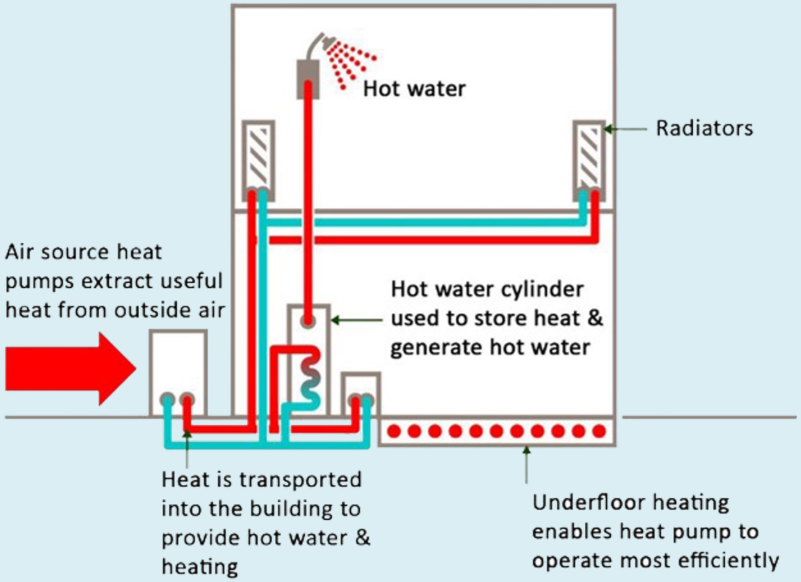


Fig C2.2 : Water heat pump

SOLAR PUMP :

For pumping water, solar pumps can be used and
consumption of electricity can be reduced.
(refer fig A2.1)
It will work for 8hrs a day which should suffice the
requirement.

For a 3KW system, after 5 years, break even, a
thumb rule of Rs.4500 saving per month on electricity bill can be achieved.

ENERGY SAVING ELECTRICAL FIXTURES & GADGETS:

Use green or five star rated electronic gadgets like TV screens, kitchen equipment, etc.

Use of LED fittings to save electricity should be a must.

HVAC systems, CCTV's and other technical systems, preferences should be given for energy efficient
devices to save electricity.

WATER HEAT PUMPS :

This can be a good option as a single unit will work for air conditioning and for converting cold water to hot water.
Energy can be saved because of its dual use.
(refer fig A2.2)

Despite of the high initial cost, after a payback period of 5 years, an average saving of 33% can be achieved with this system.

Day light optimization

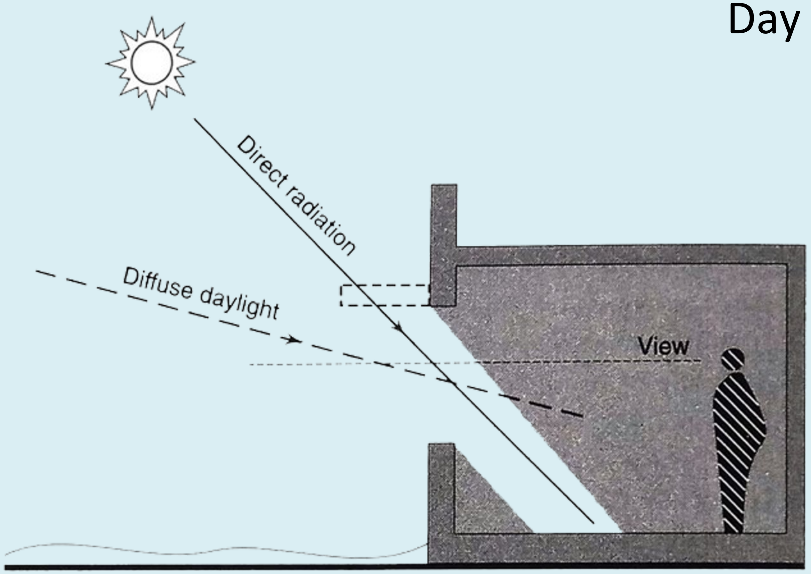


Fig C3.1 : Sun shading

Locationwise sunpath studies should be encouraged to explore efficient use of available daylight

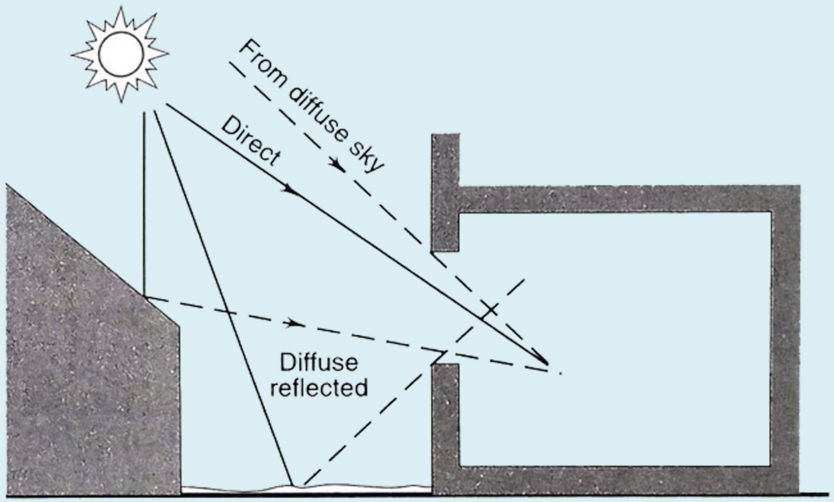


Fig C3.2 : Components of light entering a room

DAYLIGHTING :

In the last few decades, the option of artificial light as an alternative to daylight has been considered which has led to the abandonment of the natural outdoor environment to provide light and ventilation.

The variability and subtlety of daylighting is pleasing to the user in contrast to the relatively monotonous environment produced by artificial light.
It helps to create optimum working conditions by bringing out the natural contrast and color of
objects & has a major effect on the appearance of space.
Integration of daylighting with artificial lighting brings about considerable savings in energy consumption.

SUN SHADING

Solar radiation entering a room can consist of high
intensities of radiation from direct sun or diffuse sky which causes discomfort glare which affects user's visual performance.
Shading can therefore reduce the peak heat gain and improve the natural lighting quality of the interior by controlling the levels of daylight received.
(refer fig. A3.1)

DAYLIGHT ANALYSIS

The light entering a building may be considered as comprising three separate components:
(refer fig. A3.2)

1. Direct Sunlight
2. Light from the diffuse sky
3. Diffused reflected light from the ground and other buildings

In overheated regions, component 1 should be
eliminated which can be achieved by building
geometry, fixed/moving shading devices.

Simple measures taken while designing buildings, can help in optimization of the abundant day light available in most parts of our country throughout the year...!!

Day light optimization

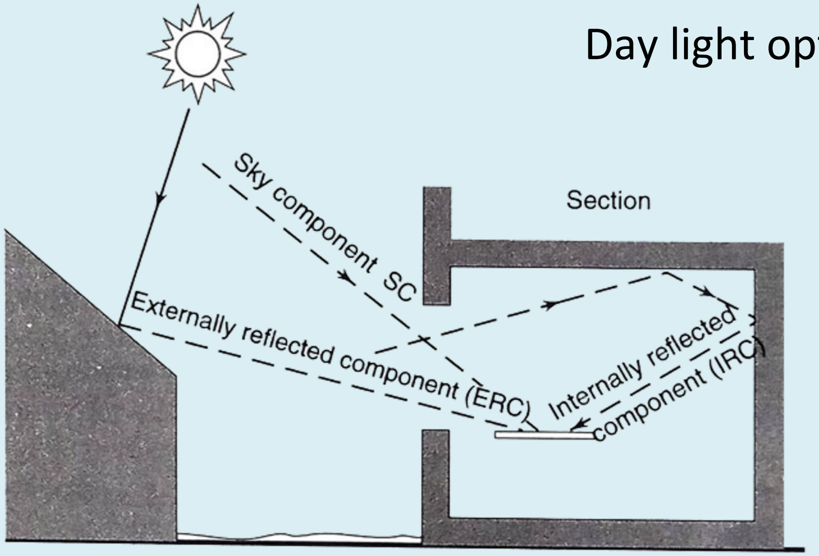


Fig C4.1 : Components of diffused light falling in a room

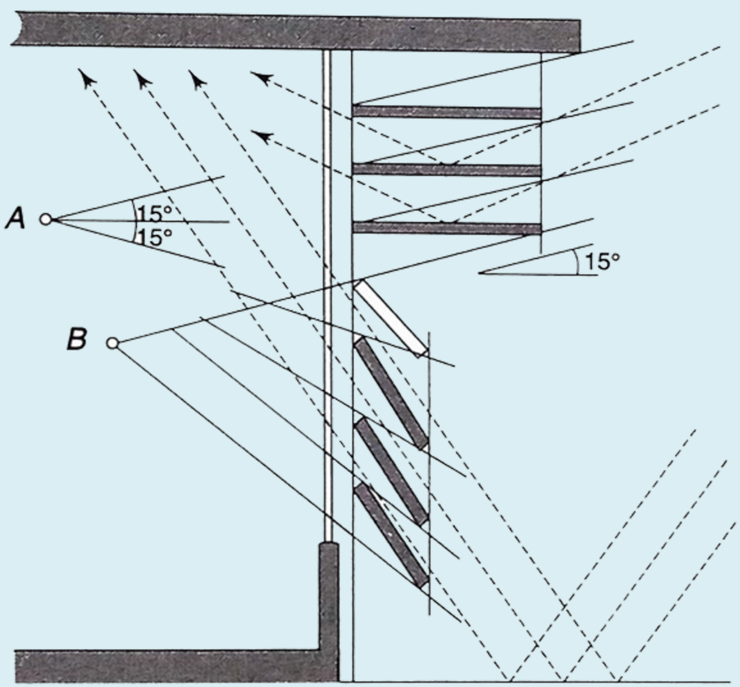


Fig C4.2 : louver system to reduce glare

In the case of light falling on to a point within the building, it can also be broken down into three
components : (refer fig. A4.1)
1.Sky component (SC)
2.Externally reflected component (ERC)
3.Internally reflected component (IRC)
The aspect of visual comfort is important relatively to the quantity of light. In overheated climates, there may be psychological association between glare and thermal discomfort.
Hence, glare should be controlled.
Three guidelines offered to cater this issue are :
1.Permit view of sky and ground near to horizon only within 15 degree above and below horizon.
2.Exclude view of bright ground and sunlight louvers or surfaces of shading devices.
3.Daylight should be preferably be reflected from the ground and louvre surfaces onto the ceiling which itself should be of light color.
Fig A4.2 shows an arrangement which satisfies the above requirements without impeding ventilation.
For a 15 degree transmission, in a region with good sunlight an average 2 hours of artificial light usage can be reduced considering longer hours of natural light penetration.
Elements which must be incorporated into the building design at an early stage to achieve good daylighting are :
Orientation, space organization and geometry of the space to be lit.
Location, form, and dimensions of the fenestrations through which daylight will enter.
Location and surface properties of internal partitions that affect daylight distribution by reflection.
Location, form, and dimensions of shading devices that provide protection from excessive light and glare
Light and thermal characteristics of the glazing materials.

Solar heat optimization

BUILDING DESIGN

Solar and non-solar heat:
While designing and specifying the factors of solar & non-solar heat should be considered to reduce the heat gain by internal spaces.

a. Solar heat –
Direct solar heat coming from visible and non-visible light.
Impacts areas with direct sunlight like south and west facing facades.

b. Non-solar heat –
Conduction : temperature difference between inside and outside.
Convection : Hot air outside or air gap between IF units.
Long wave infra red : Solar heat that is absorbed by objects and re-radiated.
(refer fig.C5.1)

Passive solar heating is important and should be analyzed in line with local temperature and content.

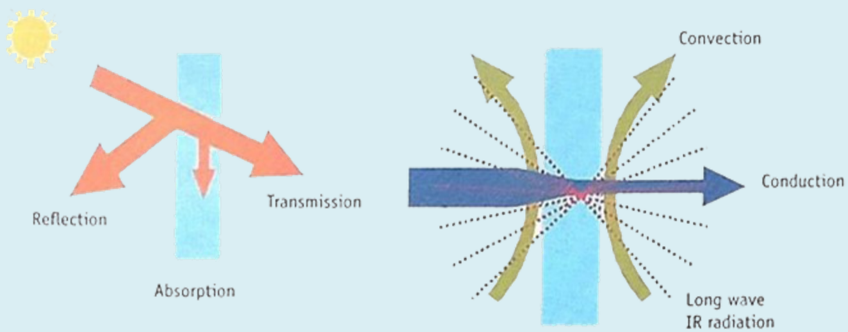


Fig C5.1: Solar and Non solar heat

It is estimated that glazing accounts for about 40% of the heat loss/gain in a typical building. Using proper glazing can reduce this 40% by as much as 80-90% leading to an overall energy savings of around 30-35%

Solar heat optimization

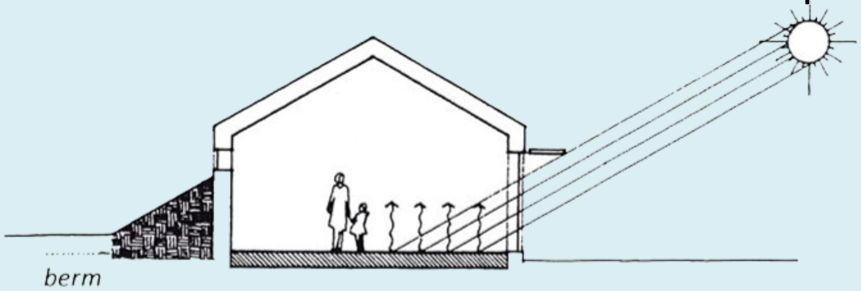


Fig C6.1: Passive solar heating and berm

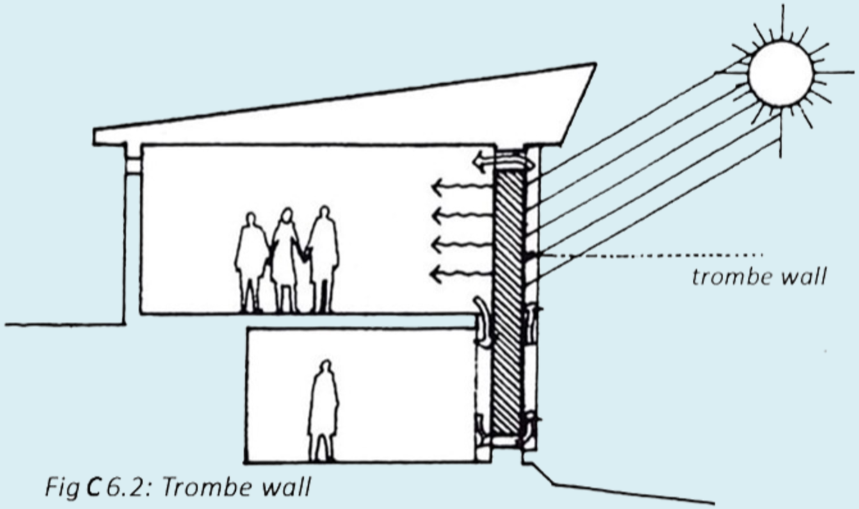


Fig C6.2: Trombe wall

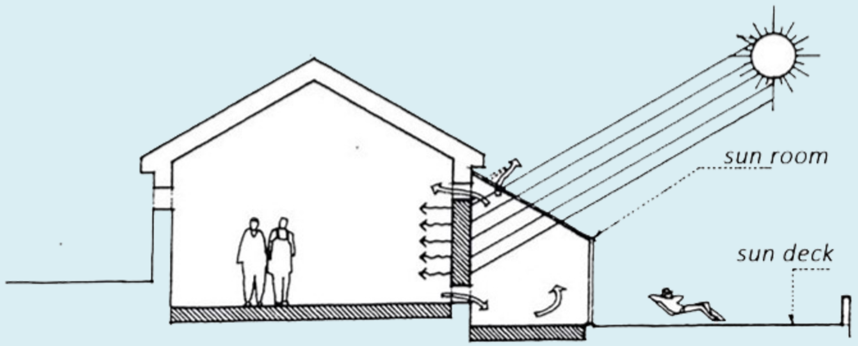


Fig C6.3: Solarium and solar room

SOLAR HEAT OPTIMISATION

1.) Passive solar heating :
A solar heating system using a building's design, construction and the natural flow of heat to collect, store and distribute solar energy with minimal use of fans or pumps (refer fig.C6.1)

2.) Berm :
A bank of earth placed against one or more exterior walls of a building as protection against extremes in temperature. (Refer C6.1)

3.) Trombe wall :
A glass fronted exterior masonry wall that absorbs solar heat for radiation into the interior of the building, usually after a time – lag of several hours.
(Refer fig. C6.2)

4.) Solarium :
A glass enclosed porch, room or gallery used for sun bathing or for therapeutic exposure to sunlight.

5.) Solar room :
A glass enclosed porch or room oriented to admit large amounts of sunlight. Also called sun parior or sun porch (Refer fig. C6.3)

For either or all above measures studies depending upon the climatic zone say that 2-3 degrees drop in internal temperature can be achieved. Considering a 10% increase in construction cost, these measures can still prove to be cost effective for clubhouses designed for a span of 20-25 years lifecycle.

Solar heat optimization

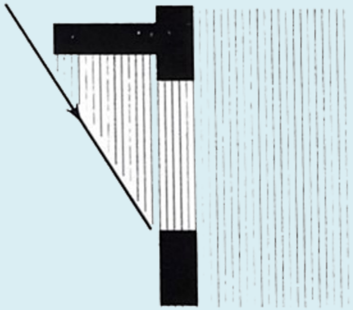


Fig ***C7.1***: *Fixed Overhang*

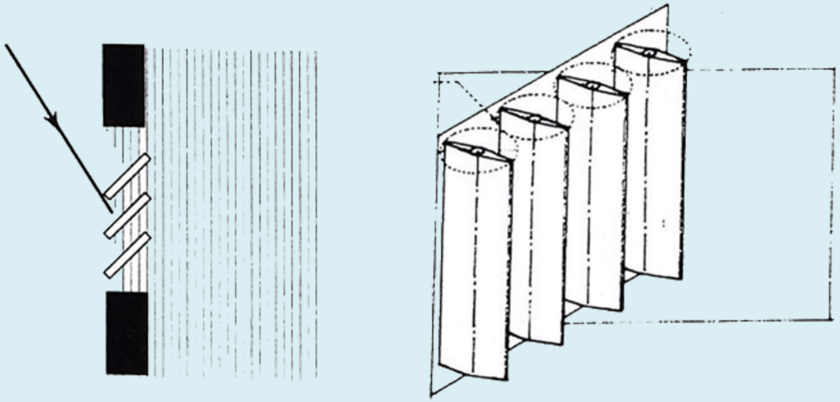


Fig ***C7.2***: *Louvres*

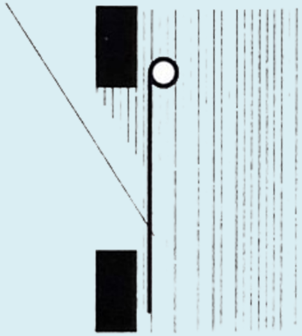


Fig ***C7.3***: *Moveable blinds*

SOLAR HEAT CONTROL BY FENESTRATION

1.) Fixed overhangs :
Overhangs designed as per opening proportions & sunlight inference can be good protection to walls and openings from rain without compromising on view and air movement
(Refer fig. C7.1)

2.) Louvers :
Fixed or adjustable louvers can be used effectively to reduce solar gain and at the same time facilitate wind movement. (Refer fig. C7.2)

3.) Movable blinds or curtains :
In air conditioned buildings, where the outside air temperature will be above room temperature, windows will be glazed and the question of airflow does not rise. In this case, an opaque or translucent blind could be considered as a mean of reducing cooling load, effects of direct radiation on occupants and glare. (Refer fig. C7.3)

Location based sun path studies should be carried out to understand which of the above measures to be employed and which façade of the building. A thumb rule says that, in the Indian context, the southwest façade should be addressed with 450-600mm width sun shading devices.

Fenestration methods described here should be used as per given case scenario to optimize heat gain.

Solar heat optimization

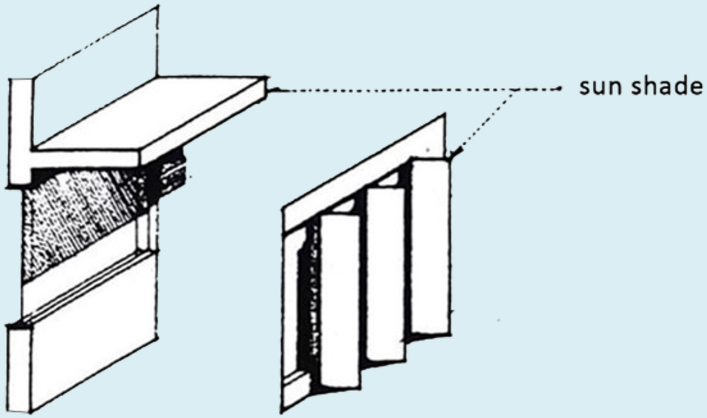


Fig C8 .1: Moveable blinds

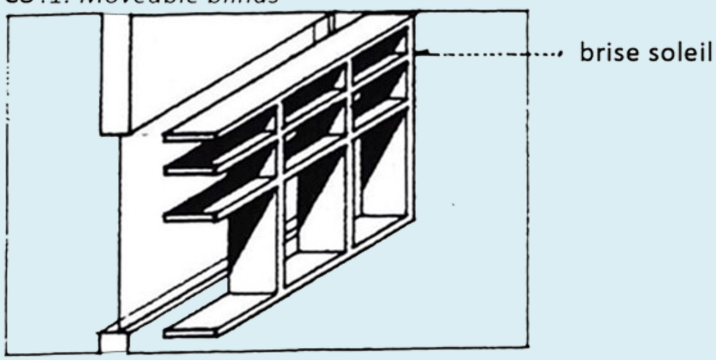


Fig C8 .2: Moveable blinds

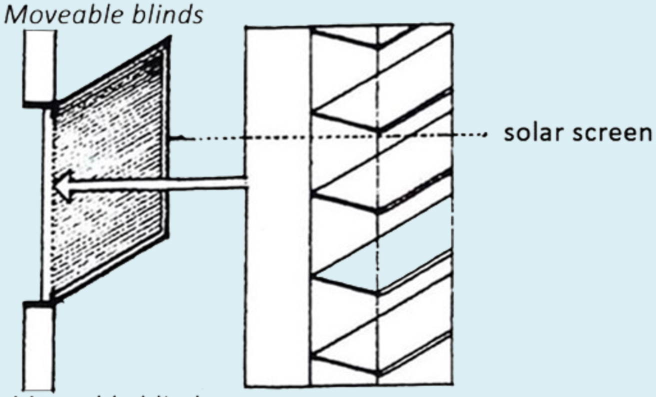


Fig C8 .3: Moveable blinds

SOLAR HEAT CONTROL BY FENESTRATION

4.) Sunshade :
Any of various exterior devices consisting of fixed horizontal or vertical fins angled to shield a window from direct sunlight (Refer fig. C8.1)

5.) Brise Soleil :
A screen, usually of louvers, placed on the outside of a building to shield the windows from direct sunlight (Refer C8.2)

6.) Solar screen :
A panel of miniature external louvers for shading a window from direct sunlight and glare while allowing a high degree of visibility, daylighting, ventilation, visual daytime privacy and insect protection (Refer fig C8.3)

Location based sunpath studies should be carried out to understand which of the above measures to be employed and which façade of the building. A thumbrule says that, in the Indian context, the southwest façade should be addressed with 450-600mm width sunshading devices.

Glazing

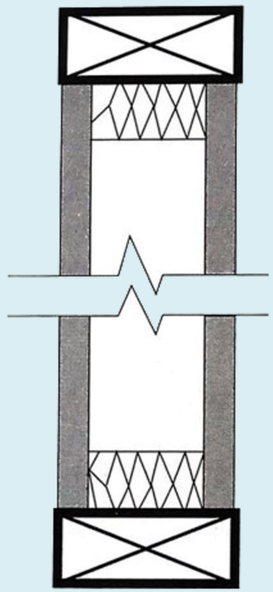


Fig C9 .1: Double Glazing

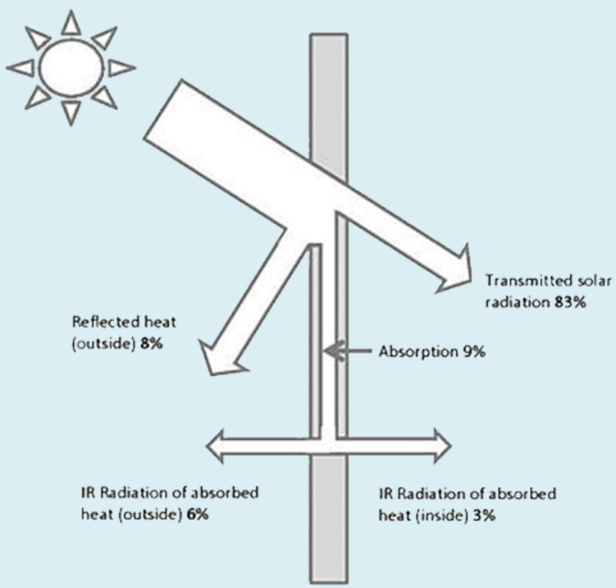


Fig C9 .2: Absorbing Glass

1). Regular transparent glass:
This type of glazing permits high proportion of visible light penetration (88-90%) as well as penetration of a large proportion of the solar radiation striking it (77-86%).
(10mm Toughened glass : Rs.120/sq.ft)

2). Double Glazing:
This consists of two sheets of glass with space in between, sometimes filled with air or other gases, or vacuum. The main advantage of this type of cross section is its ability to reduce heat transfer from one pane to the other, both by conduction and by radiation (Refer fig. A7.1).
(10mm DGU : Rs.350/sq.ft)

3). Absorbing glass:
This glass is made of two layers of glass with a layer of absorbing material between them or of glass coated with one of the various varnishes. Absorbing glass significantly prevents fading of colors, moderates light penetration into the room and reduces overall radiation (Refer fig. A7.2)
(10mm glass : Rs. 180/sq.ft)

4). Dark glass:
This type of glass reduces both the light and the radiation penetrating it, but a relatively large amount of radiation is absorbed by the glass causing the temperature of the glass surface to rise. Dark glass could be a solution for buildings which require maintaining a certain filtration of penetrating daylight while also retaining large openings.
(10mm glass : Rs.180/sq.ft)

Glazing

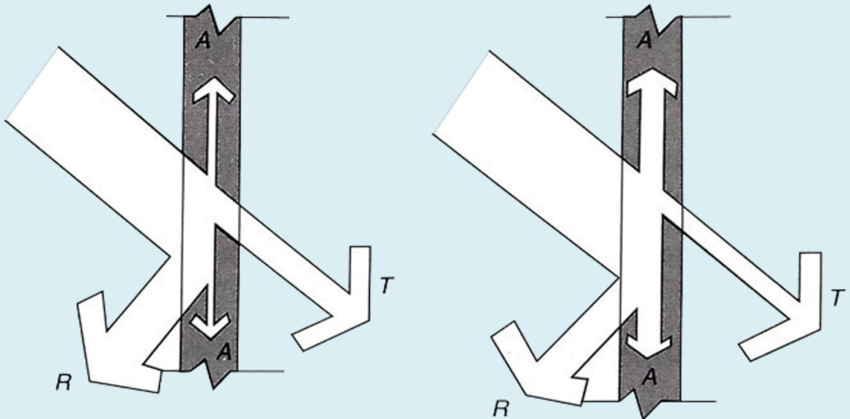


Fig C10.1: Reflective glass

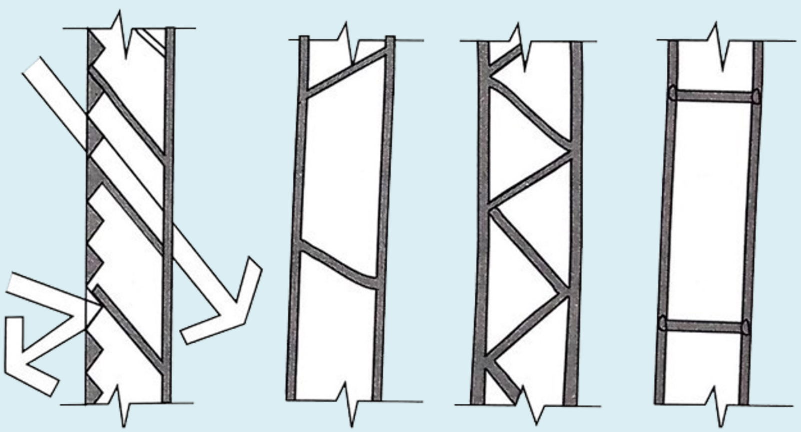


Fig C10.2: Various sections of available polycarbonate sheets

5.) Reflective glass (mirror) :

This material will most significantly reduce penetration of radiation from the reflecting side to the non-reflecting side. Such glazing could be used in cases where it is desirable to maintain eye contact with the outside as well as to prevent penetration of radiation (Refer fig. C10.1)

[10mm : Rs.120/sq.ft]

6.) Polycarbonate :

This material permits penetration of light (about 85%), heats up less than glass and withstands mechanical blows. The material is flexible and it is possible to utilize it for curved surfaces.

A double polycarbonate sheet has extruded sheets of polycarbonate formed as double skin sheets with spacers between them. (Refer fig.C10.2)

[10mm : Rs.110/sq.ft]

7.) Heat retarding glass coating ;

Heat retarding glass coating can be applied on glass windows or glass facades to block partial solar heat coming through it. This coating is almost colorless and is suitable for hot climatic conditions and help to reduce consumption of electricity.

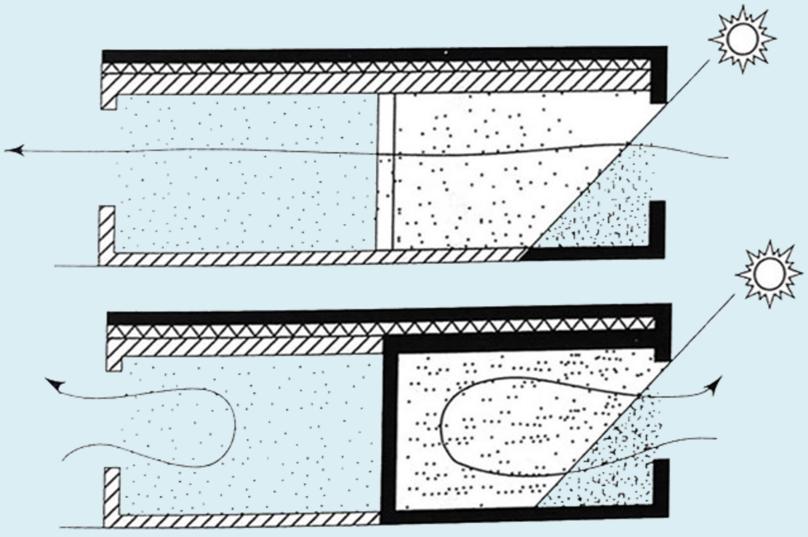
This coating allows more daylight than tinted or reflective films, reducing the use of interior lighting. It also reduces operating cost of fans and conditioners.

[10mm : Rs.110/sq.ft]

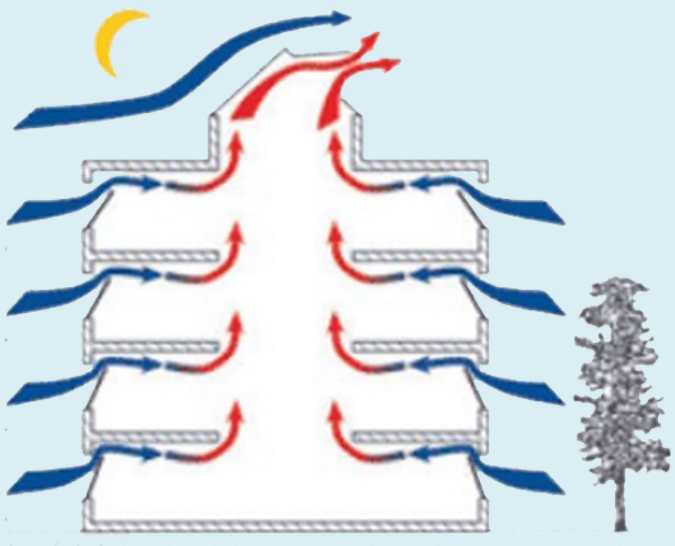
Summary of Savings

Sr. No.	Activity/Element	Proposed Savings
1	Renewable Energy	It is estimated that for a 200 litre/day capacity solar water heater an average of 9,000 rupees can be saved annually. For a 3KW system, after 5 years, break even, a thumb rule of Rs.4500 saving per month on electricity bill can be achieved. Despite of the high initial cost, after a payback period of 5 years, an average saving of 33% can be achieved with this system.
2	Daylight Optimisation	For a 15 degree transmission, in a region with good sunlight an average 2 hours of artificial light usage can be reduced considering longer hours of natural light penetration.
3	Solar heat Optimisation	It is estimated that glazing accounts for about 40% of the heat loss/gain in a typical building. Using proper glazing can reduce this 40% by as much as 80-90% leading to an overall energy savings of around 30-35%
4	Glazing	This coating allows more daylight to enter the strucutre thus reducing the use of interior lighting. It also reduces operating cost of fans and conditioners.

Alternative cooling



D1.1 : Diagram showing the potential difference in performnce of a single sided and cross ventilated spaces in distributing solar heat build up through the building



D1.2 : Stack ventilation

PASSIVE AND LOW ENERGY ARCHITECTURE

Use of passive draft evaporative cooling systems will be beneficial.

Use of low energy building materials can reduce heat gain one third of the existing buildings without reduction of life or comfort.

CROSS VENTILATION

Since cross ventilation distributes heat more evenly through the structure (refer fig D1.1),
it should be incorporated in the clubhouses.

Outdoor breeze creates air movement through the building interior by the 'push-pull' effect of positive air pressure on the windward side and negative pressure (suction) on the leeward side.
Thus, good natural ventilation can be achieved by
locating openings in opposite pressure zones.

STACK EFFECT

Also, natural ventilation can be enhanced by using tall spaces called stacks in the building.
(refer fig D1.2)

With openings near the top of stacks, warm air can escape whereas cooler air can enter the building through the openings near the ground.

Simple techniques of passive cooling & cross
ventilation can help in almost 1/3rd heat gain by the structure, in turn reducing load on HVAC systems.

Alternative cooling

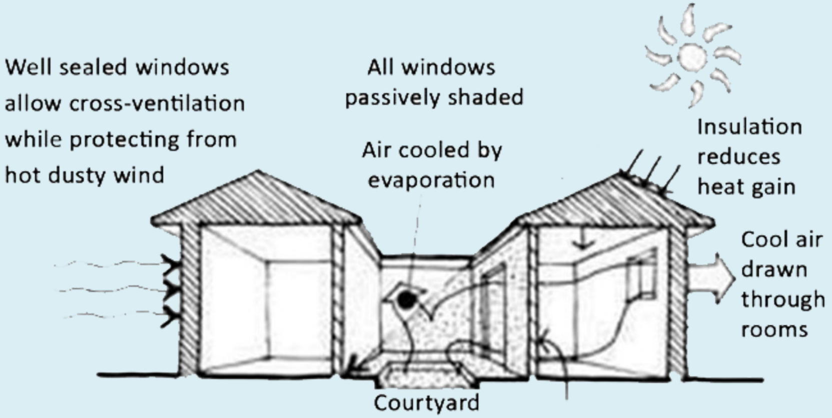


Fig D2.1 : Courtyard planning.

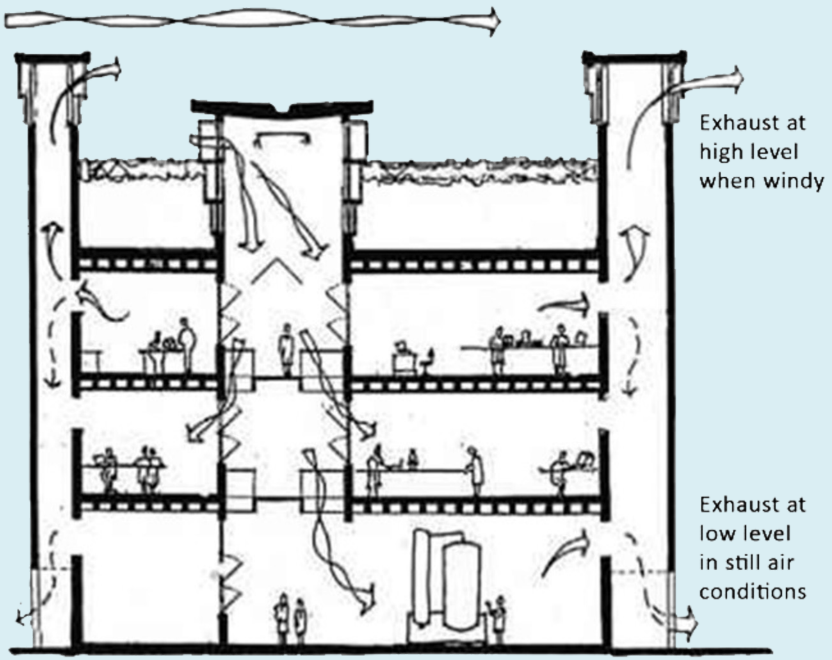


Fig D2.2 : Passive downdraft cooling.

COURTYARD PLANNING

Due to incident solar radiation in a courtyard, the air gets warm and rises. Cool air from the ground level flows through the louvered openings of rooms surrounding a courtyard, thus producing air flow.
At night, the warm roof surfaces get cooled by convection and radiation.
If the roof surfaces are sloped towards the internal courtyard, the cooled air sinks into the court and enters the adjoining rooms through low level openings, gets warmed up and leaves the room through higher level openings. (refer fig V2.1)

PASSIVE DOWNDRAFT COOLING

In this system, wind catchers guide outside air over water bodies, inducing evaporation and causing a significant drop in temperature before the air enters the interior. (refer fig V2.2)
Such wind catchers can become primary elements of architectural form also.

WIND TOWER

In a wind tower, during the day, the hot air enters the tower through the openings, gets cooled, and thus becomes heavier and sinks down.
During the night, cool ambient air comes in contact with the bottom of the tower through the rooms.
The tower walls absorb heat during daytime and release it at night, warming the cool night air in the tower.
Warm air moves up and draws cool night air through the openings into the building.

For multistoried club house setups, vertical stack system and wind towers can be used to get ambient internal temperature

Courtyard planning can prove to be very effective in the Indian conditions

Alternative cooling

MEP

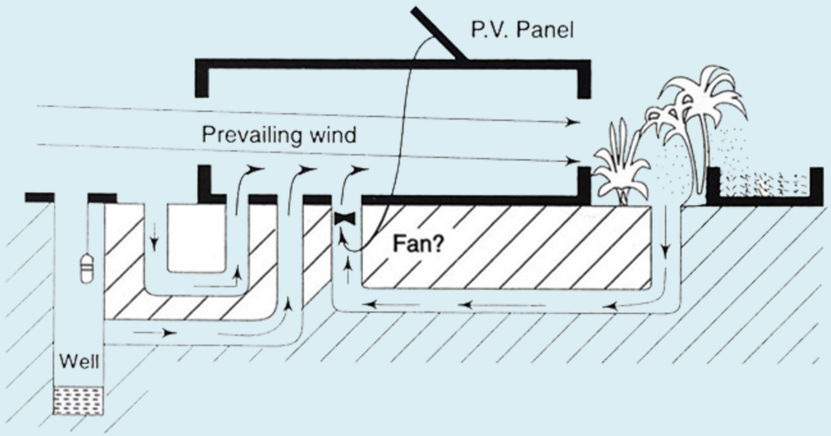


Fig D3.1 : Earth coupling, naturally conditioned air and PV fans

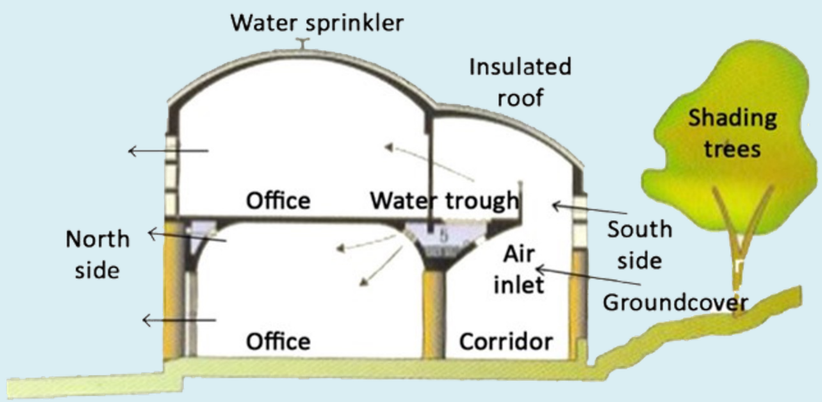


Fig D3.2 : Evaporative cooling

EARTH AIR TUNNELS

At a depth of about 4m below ground, the temperature inside the earth remains nearly constant round the year and is nearly equal to the annual average temperature of the place.

Therefore, ambient air ventilated through a tunnel in the form a pipe will get cooled in summer and warmed in winter. (refer fig V3.1)

EVAPORATIVE COOLING

In evaporative cooling, the heat of the air evaporates water, thereby cooling the air, which cools the spaces of the building.
(refer fig V3.2)

Increase in contact with water and air increases the rate of evaporation.

The presence of a water body near the building or in the courtyard can provide a cooling effect.

WINDPOWER

1)Use of multi-bladed wind pumps with rotor uptill 7.5 meter dia and well depths uptill 50m.

2)Use of wind chargers uptill 4kW.

3)Use of wind generators based on overseas technology with considerable indigenisation uptil 0.5 MW for a single machine with a farm configuration uptill 10MW.

4)Use of wind generators uptill 200kW in a single machine of indegenous design (BHEL)

Small Windmills : Small windmills can be installed on the terraces of the buildings can be used which avoids air/noise/water pollution and are easy to install.

Advantage : There is no need of operational attendance. Various promotional schemes are offered by government for its installation.

Solar and Windmill Hybrid lighting :

Small windmills along with solar panels can be installed on terrace to generate electricity.

With these measures, dependency upon mechanical cooling (AC) can be considerably reduced for at least 10 months of the year.

Incoming wind can be harvested in multiple ways to either achieve a cooling effect or to generate alternative energy.

Built form planning

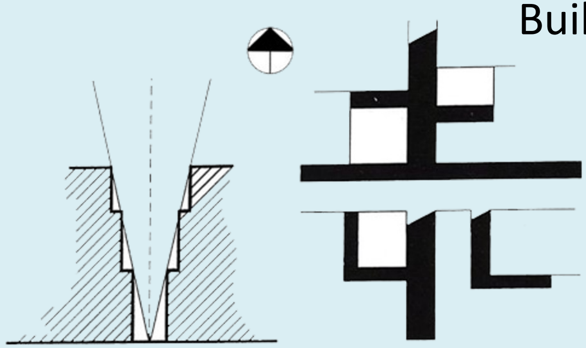


Fig D4.1 : Street widths in hot climates - narrow north-south streets minimize eastern and western radiation

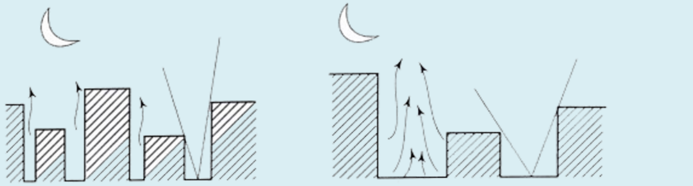


Fig D4.2: Greater the exposure of the walls and ground to sky, more the heat loss

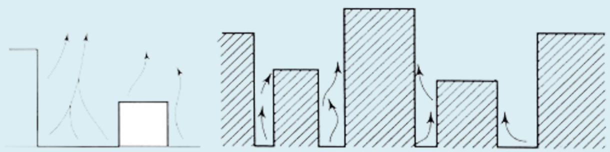


Fig D4.3 : Compact planning in modern context

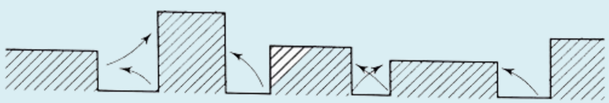


Fig D4.4 : Decrease in heat loss by compact planning in cold climates

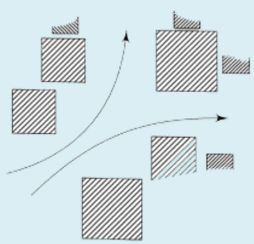


Fig D4.5 : Arrangement of building blocks to maximize airflow

BUILDING ORIENTATION AND STREET WIDTHS

The amount of radiation recieved on the street (and to the lower floors) is determined by the street width and building orientation. Modulating the street width and building orientation can thus, control solar radiation. (refer fig V4.1)

Small street width to building height ratio ensures narrow streets with shading which is preferable in hot-dry climate to minimize heat gain. In cold climates, wide streets, mainly east-west streets allow buildings to recieve sun. Thus, here, building blocks can be compactly planned with low building heights to enable heat gain. In warm-humid climates, streets can be oriented to utilize natural wind patterns.

Building envelope and fenestration :

The building envelope and its components like roof, walls, fenestration and shading, finishes materials and construction techniques affect heat gain. Thus, using correct methods to treat them for advantage would be beneficial.

OPEN SPACES AND BUILT-FORM

Open spaces should be in conjunction with built-form. Together, they can allow free air movement and increased heat loss or gain. (refer fig V4.2)

In hot-dry climates, compact planning with little or no open spaces would minimize both heat gain as well as heat loss. The size and scale of open spaces should be optimized. (refer fig V4.3)

In cold climates, open spaces should be small preferably with compact planning. (refer fig V4.4)

In humid climates, buildings should not be attached to one another. Streets and open spaces should be oriented considering wind pattern. Funnel effect can be used to maximize airflow within the complex. (refer fig V4.5)

At clubhouses with scattered building plan, the block arrangement and adjacent open spaces layout can help achieve a good passive cooling effect and help reduce operational costs.

Built form planning

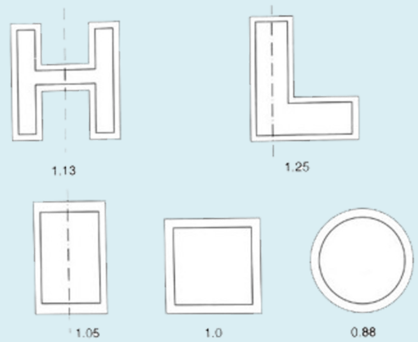
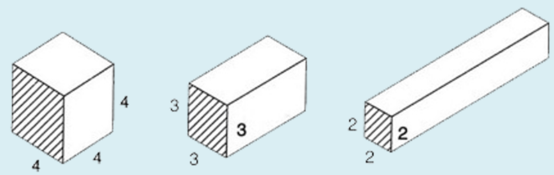


Fig D5.1 : Different plan forms having different P/A ratio



Solid shape type	*Surface area (S)*	*Volume (V)*	*Ratio (S/V)*
a	96	64	1.5
b	103.2	64	1.61
c	136	64	2.13

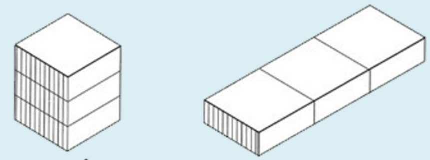


Fig D5.2 : Minimizing the surface area to volume ratio minimizes heat transfer

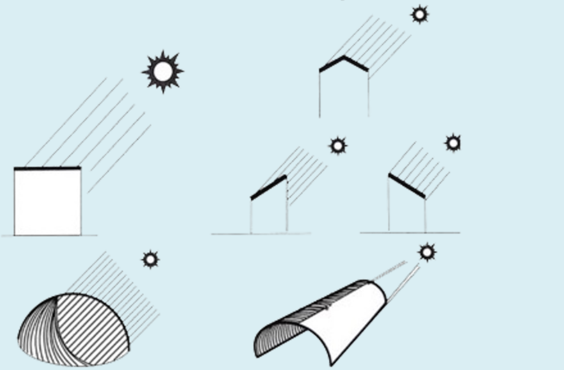


Fig D5.3 : Roof forms and their areas of exposure

PLAN FORM

The planform of a building affects the airflow around and through it. It could either aid or hinder natural ventilation. The perimeter to area ratio of the building is an important indicator of heat loss and gain. it therefore, plays a role in ventilation, heat loss and heat gain. (refer fig V5.1)

In hot climates, P/A ratio should be kept to a minimum to cause minimum heat gain.

SURFACE AREA TO VOLUME RATIO

The surface area to volume (S/V) ratio (three dimensional exploration of the P/A ratio) is an important factor determining heat loss and gain.

In hot-dry climates, S/V ratio should be as low as possible to minimize heat gain.

In In warm-humid climates, the prime concern is creating airy spaces which might not necessarily minimize the S/V ratio. (refer fig V5.2)

Depending upon the location and size of the clubhouse project, the built form planning can be reconsidered to reduce or increase heat gain.

ROOF FORM

The roof can be used as a source of daylight into the building. Its form and overhangs also affect air movement patterns. They can either increase or decrease the scope for natural ventilation. (refer fig V5.3)

In any climatic context, the roof can be used to enhance the light levels indoors. The nature of the roof light would change the climatic context.

In overheated area, roof lighting would be shaded to prevent heat gain. (refer fig V5.4)

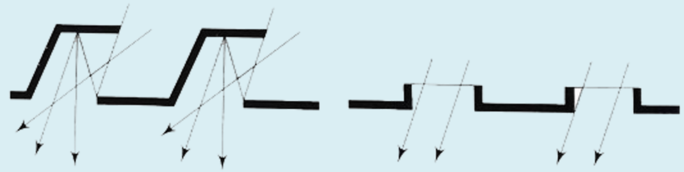


Fig D5.4 : Roof as a light source

Roof cover

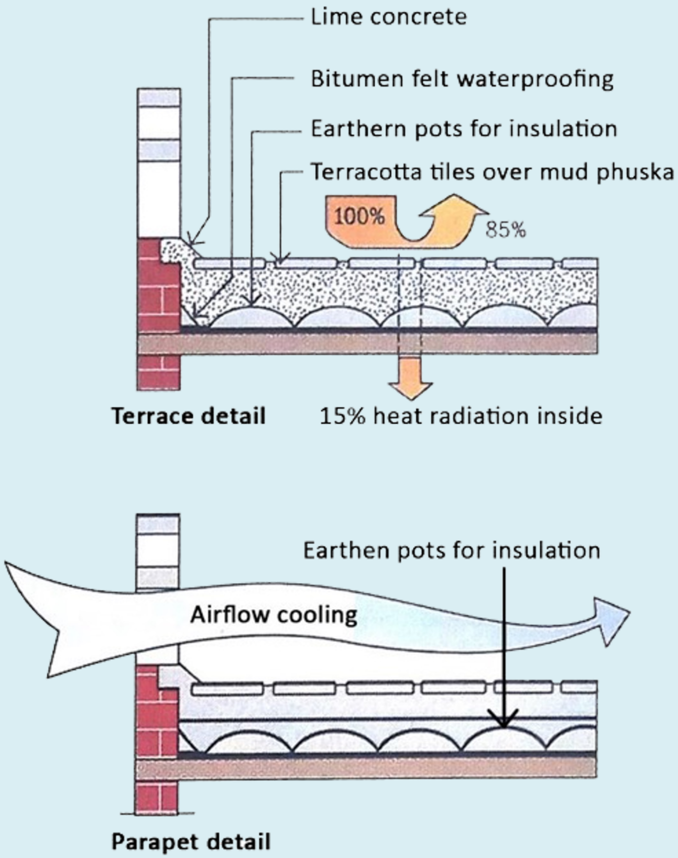


Fig D6.1 : Roof detail showing use of earthern pots for insulation

A well designed building roof can be good for insulation and around 15-20% heat gain from the top surfaces can be reduced.

The roof recieves significant solar radiation and plays an important role in heat gain/losses, daylighting, and ventilation. Therefore, proper roof treatment is beneficial.

A few roof protection methods are as follows :

1)A cover of deciduous plants can be provided. Evaporation from leaf surfaces will keep the rooms cool.

2)The entire roof surface can be covered with inverted earthern pots. It is also an insulating cover of still air over the roof. (refer fig V6.1)

3)A removable cover is an effective roof-shading device. This can be mounted close to the roof in the day and can be rolled up to permit radiative cooling at night.

The upper surface of the canvas should be painted white to minimize the radiation.

4)Effective roof insulation can be provided by using vermiculite concrete. It has proved to reduce roof conduction by 60%

5)Broken China mosaic can be used as top most layer in roof for reflection of incident radiations.

MATERIALS AND CONSTRUCTION TECHNIQUES

Roof material determine the amount of heat transfer through the roof inwards or outwards as well as the time taken for this heat transfer to take place.

Material with low embodied energy :

Strain on conventional energy can be reduced by use of low-energy materials, efficient structural design, and reduction in transportation energy. This can reduce the energy content of buildings.

(refer fig V6.2)

Thermal Insulation :

When building requires mechanical heating, insulation is preferable whereas cooling insulation will reduce the space-conditioning loads.

Location of insulation and its thickness are important. (Use of 40mm thick expanded polystyrene insulation on walls and vermiculite concrete insulation on the roof has proved to bring down space-conditioning

Vegetation and Surrounding

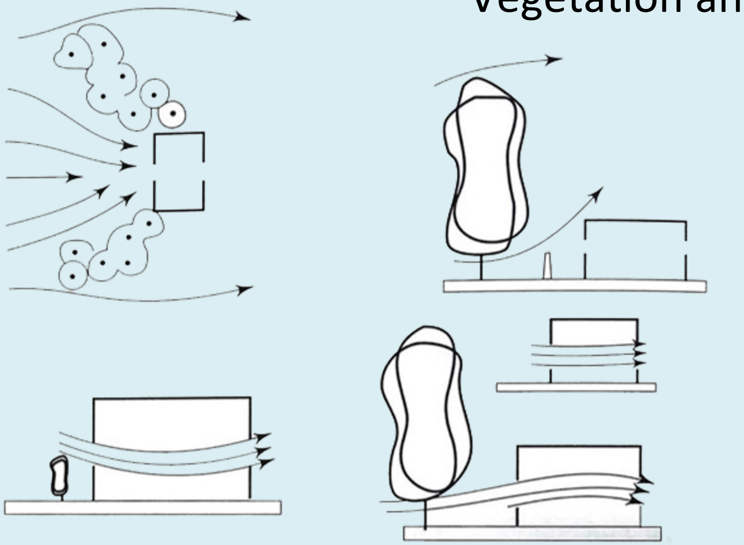


Fig D7.1 : Vegetation increasing, decreasing and directing air flow

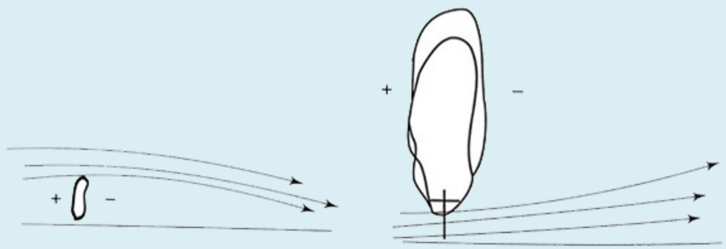


Fig D7.2 : Vegetation causes pressure differences which shifts the air path

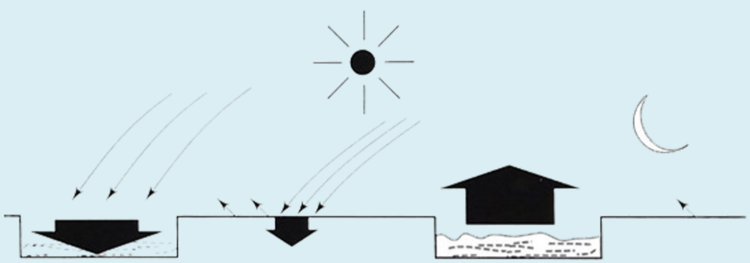


Fig D7.3 : Water bodies absorb much heat during the day and re-radiate it at night

VEGETATION PATTERN :

Vegetation, and trees in particular, provide effective shade and reduce heat gain. It also causes pressure differences, thereby, increasing and decreasing air speed or directing airflow. Thus, they can be used to direct air into the building or deflect away.
(refer fig V7.1, fig V7.2)

Planting deciduous trees in hot-dry climates provide
comforting shade in summer, cutting off hot breeze and shed foliage in winters allowing sun. Evergreen trees can be used in cold climates to cut off breeze. In warm-humid region, vegetation can be used to maximise air flow.

These measures if considered during planning of landscape and surrounding areas can alter the micro climatic effect at least by 2 degrees without any increase in construction cost.

WATER BODIES :

Water absorbs relatively large amounts of radiation. They also allow evaporative cooling. As a result, during the daytime, areas around water bodies are generally cooler. At night, however, water bodies
release relatively large amount of heat to the
surroundings. This heat can be used for warming purposes. (refer fig. V7.3)

In hot-dry climates, water bodies can be used both for evaporative cooling as well as minimizing heat gain. Taking into account wind pattern and vegetation, they can be used to direct cool breeze into the house. A roof pond minimizes heat gain through the roof.

Building surroundings play a major role in creating a micro climate.
Based on context and site forces, the surroundings can be effectively planned.

Vegetation and Surrounding

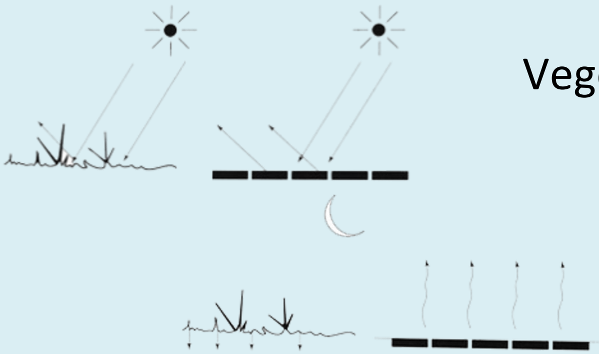


Fig V8.1 : Different ground materials reflect, store and absorb heat to different angles

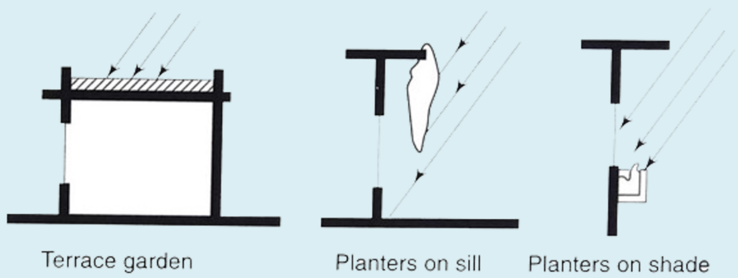


Fig D8.2 : Integration of vegetation in the building to minimize heat gain

These measures for integration of vegetation or allowing air to circulate inside the building should be incorporated in the design stage so as not to increase any cost of construction.

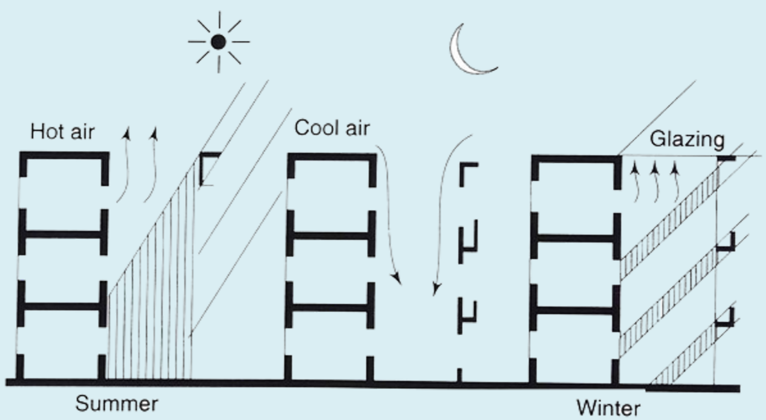


Fig D8.3 : Courtyard atrium - Integration of operable glazing at the roof level allows the courtyard to be converted into heat trap in winter

GROUND CHARACTER :

Depending on the ground surface, incident radiation can be absorbed, reflected, or stored and re-radiated later. (refer fig V8.1)
In other words, radiative heat gain could either be decreased, increased during the daytime or increased during the night time.
Depending on the climatic conditions, this could be used to our advantage.
In hot climates, ground surfaces should be preferably green in order to minimize heat gain. Where hard surfaces and paving are unavoidable, they should be rough but not very dark.
In cold climates, ground surfaces should preferably be paved dark but smooth.

PLAN ELEMENTS :

The role of vegetation, water bodies, radiative heat gain and air movement have been seen at the overall site level. These elements could be integrated with the building or the building complex for further benefits. In a sense, they can become elements of the design. Thus, plan elements can help in heating, cooling and even ventilation. (refer fig V8.2)

NATURALLY CONDITIONED AIR :

It is a good idea to condition the air that is being introduced in the space, naturally by using the above suggestions.
By adopting efficient methods of naturally conditioning air (refer fig V8.3), we can eliminate the need for mechanical cooling in the buildings, even in the hottest climates.
Successful natural ventilation can save huge amounts of money by avoiding the need for year round air conditioning with high installation & running costs.

Therefore, natural ventilation can be seen as a part of an holistic approach to the creation of passive , low energy buildings.
This can contribute enormously to creating lasting designs for better low energy, environmentally friendly buildings.

Walls and shading devices for cooling

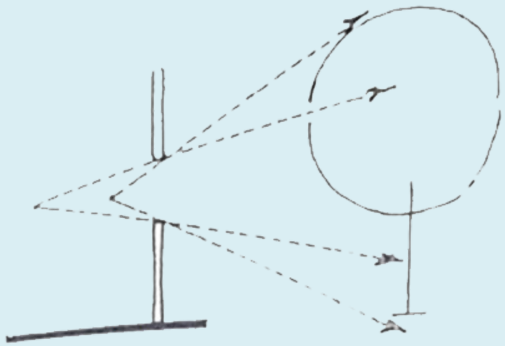


Fig D9.1: Window frames the view from inside

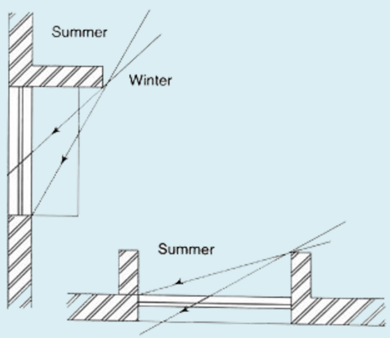


Fig D9.2: Window shades for composite zones

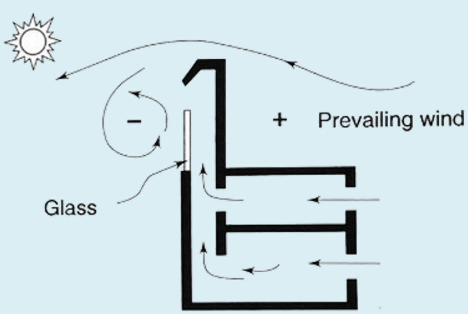


Fig D9.3: Dissipation of structural heat

1) Walls:
The heat storage capacity and heat conduction property of walls are key to meeting desired thermal comfort conditions. The wall thickness, materials and finishes can be chosen based on the heating and cooling needs of the building. Appropriate thermal insulation and air cavities in the walls reduce heat transmission into the building.

2) Air cavities:
Air cavities within walls or an attic space in the roof ceiling combination reduce the solar heat gain factor, there-by reducing space-conditioning loads. The performance improves if the void is ventilated. Heat is transmitted through the air cavity by convection or radiation.

3) Fenestration and shading:
The location of openings for ventilation is determined by prevalent wind direction. Openings at higher levels naturally aid in venting out hot air. Size, shape and orientation of openings moderate air velocity and flow in the room; a small inlet and a large outlet increase the velocity and distribution of air flow through the room.

4) Glazing systems:
Windows admit direct solar radiation and hence promote heat gain. This is desirable in cold climates, but is critical in hot climates. The window size should be kept minimum in hot and dry regions.

The vertical surfaces of a building can be treated and designed in ways to response to local climate conditions. These measures can certainly modulate temperature variations indoors and reduce HVAC loads.

Walls and shading devices for cooling

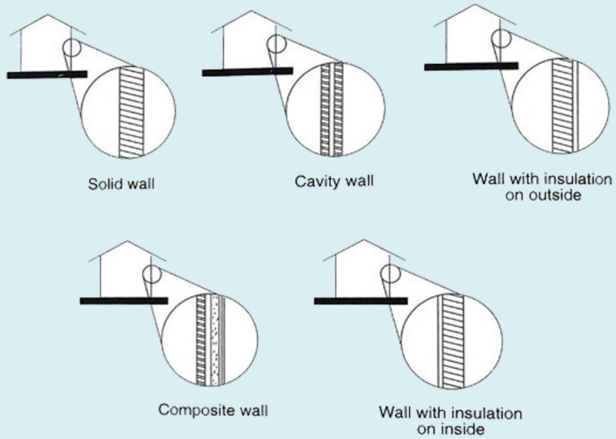


Fig D10.1

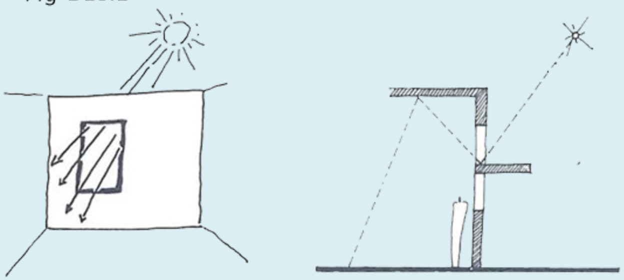


Fig D10.2 : Light is diffused by decreasing the ceiling height or by introducing system of horizontal edges/louvers in the upper portion of the structure

Fig D10.3: The low sill height enhancing communi-cation with the outside

WALLS AND SHADING DEVICES FOR COOLING

5). Shading devices:
Heat gain through windows is much higher as compared to that through solid wall. Shading devices for windows and walls thus moderate heat gains into the building.

The following are the types of shading devices;
a). Movable blinds or curtains- Block the transmission of solar radiation through glazed windows, especially on the east and west walls. For air-conditioned buildings, where the flow of outside air is to be blocked, they can reduce cooling load.
b). Overhangs and louvers- Block the part of the sky through which sunlight passes. Overhangs on south oriented windows provide effective shading from the high altitude sun.

6). Finishes:
The external finish of a surface determines the amount of heat absorbed or rejected by it. For example, a smooth and light color surface reflects more heat and light in comparison to a dark color surface.

7). Direct gain:
Direct gain system can be achieved by various forms of openings such as clerestories and skylight windows designed for the required heating. It is the most common passive solar system.

Walls and shading devices for cooling

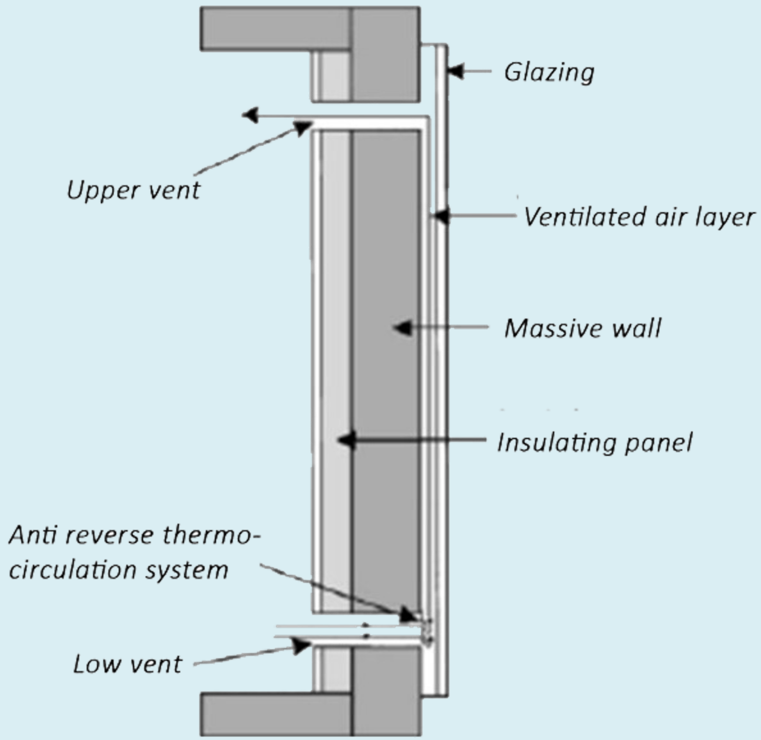


Fig D11.1: A typical cross section of a trombe wall

8). Trombe wall system for glazed facade:

In an indirect gain system, thermal mass is located between the sun and the living space. The thermal mass absorbs the sunlight that strikes it and transfers it to the living space. The indirect gain system uses 30%-45% of the sun's energy striking the glass adjoining the thermal mass.

A Trombe wall is a wall with vents provided at the top and bottom. It may be made of concrete or masonry and is usually located on the southern side of a building in order to maximize solar gains. The outer surface of the wall is usually painted black for maximizing absorption and the wall is directly placed behind glazing with an air gap in between.
(Refer Fig D11.1)

30% heat gain from solar energy can be reduced in this system.

Shading devices should be a part of the design vocabulary and in response to the climatic zone, sun path and prevailing wind movement.

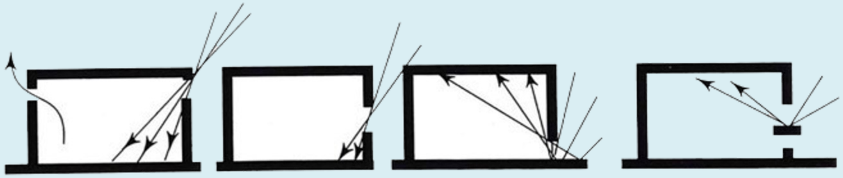


Fig D12.1: Effect of window position on light and ventilation. High windows allow for best distribution of light from overcast skies. Low windows allow an even distribution of ground reflected light. Middle windows allow for even ventilation but does not distribte the light as well.

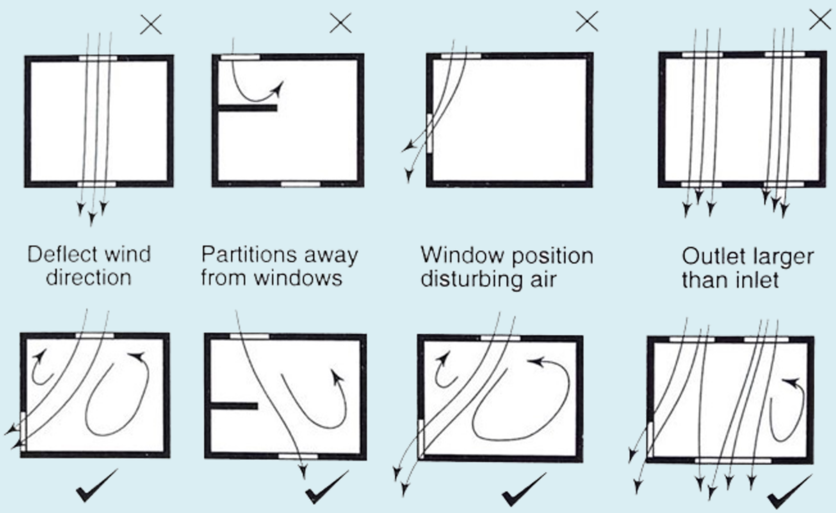


Fig D12.2 : Thumb rules for fenestration configuration

FENESTRATION

1)Fenestration pattern and configuration:

The fenestration pattern and configuration involve the area, shape, location and relative positioning of the windows. This would affect the air movement, daylight and glare indoors. If unshaded the area would also affect radiative heat gain. (Refer Fig V12.1)

In hot and dry climate smaller openings would allow sufficient daylight.

In warm humid climates, fenestration areas should be large to facilitate ventilation. Large overhangs would be desirable in cutting off diffuse solar radiation.

In cold climaes, fenestration should be large, unshaded but sealed.

The following are the basic thumb rules that can be followed;

Windows should be staggered rather than aligned (unless the incident wind is already at an angle).

Partitions should not be placed near windows causing an abrupt change of wind direction.
(Refer Fig V12.2)

The vertical surfaces of a building can be treated and designed in ways to response to local climate conditions. These measures can certainly modulate temperature variations indoors and reduce HVAC loads.

Fenestration

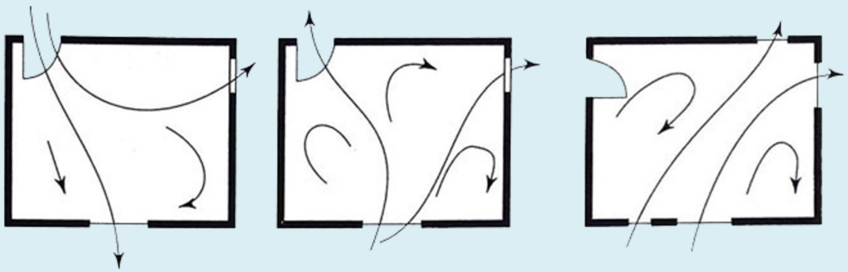


Fig D13.1 : An ideal case fenestration positioning - Windows are placed on two external walls with the door on one internal wall. If air is incident on any of the external windows, then the fenestration configuration not only ensures a good distribution of air but also a larger outlet area than inlet area. If air is incident on any of the other walls then the door could act as the inlet into the room.

2). Orientation of fenestration:

The orientation of the fenestration determines the amount of radiation on the opening. The orientation with respect to the air pattern could increase or decrease natural ventilation.

In hot-dry climates the fenestration should be oriented north .

In cold climates they should be facing south.
In humid climates they should be within 45 degree of the perpendicular to the direction of airflow.

The inlet and outlet should not be in a straight line, in order to maximize air flow.

Location wise, wind movement data should be studied for effective orientation of fenestration.

Fenestration

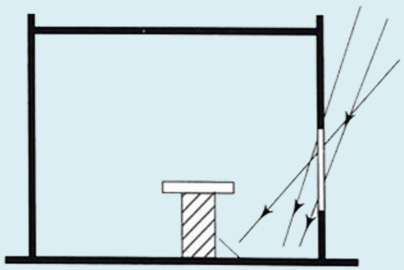


Fig D14.1 : Traditional window system without fenestration control system

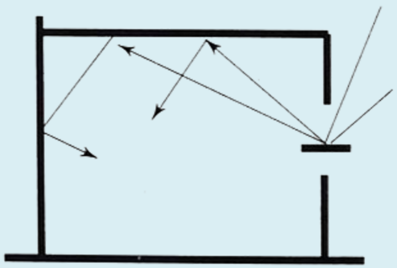


Fig D14.2: Fenestration where light reaches interiors of the room

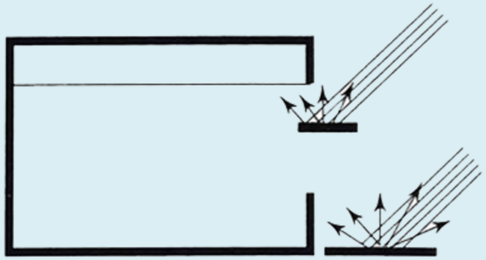


Fig D14.3 : Fenestration system with light shelves

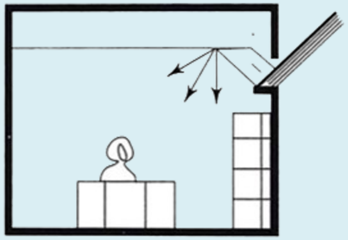


Fig D14.4: System with upper section windows

3). Fenestration Design for Radiation, Air movement and Daylight:

Glazing, shades, light shelves, flywire nets and the cross-sectional area of the windows can be important controls. They trap solar radiation, cut it off, increase daylight level, keep out insects, and modify air velocities. They are therefore, able to affect and control heat gain, daylight and ventilation.

The projection of the horizontal and vertical shades can be adjusted so as to cut off the sun. Also, it can ensured that during under heated periods the sun is allowed in.

Light shelves are horizontal projections in a window. With reflective upper surface it brings more light into the rear of a room.

Firefly nets help to reduce the air velocity indoors.

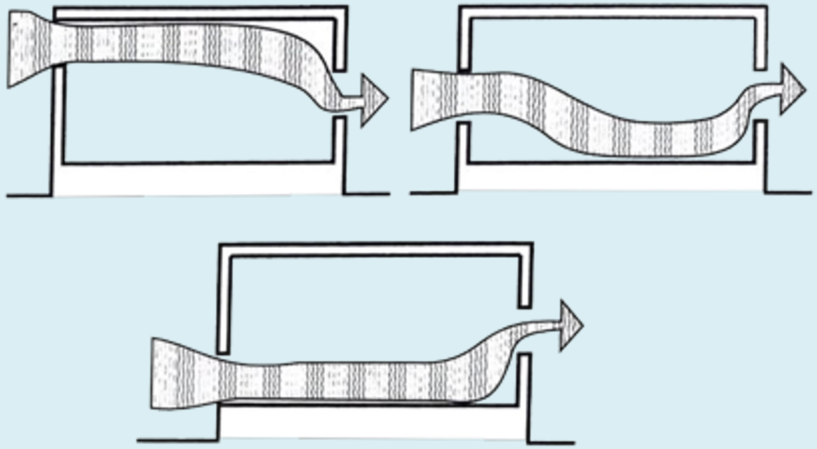


*Fig **D15.1**: Changing the location of the opening, the air flow pattern can be controlled*

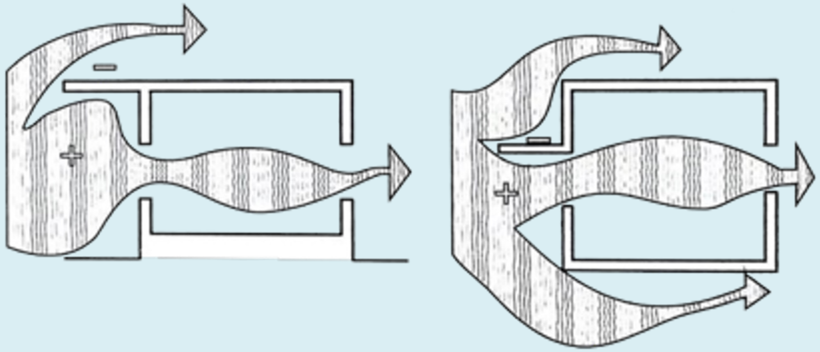


*Fig **D15.2**: An overhang or an awning increass air velocity through a window below them*

4.) Locating the openings for Ideal Ventilation :

Continuous air movement throughout the building will be ensured if there is no significant barrier (walls, internal partitions) between the entry and exit openings.

In order to increase air speed at entry opening, roof-level overheating or vertical fins may be added at the side of the window. Window sashes opening on vertical or horizontal pivots allow reflection and control of air current direction.

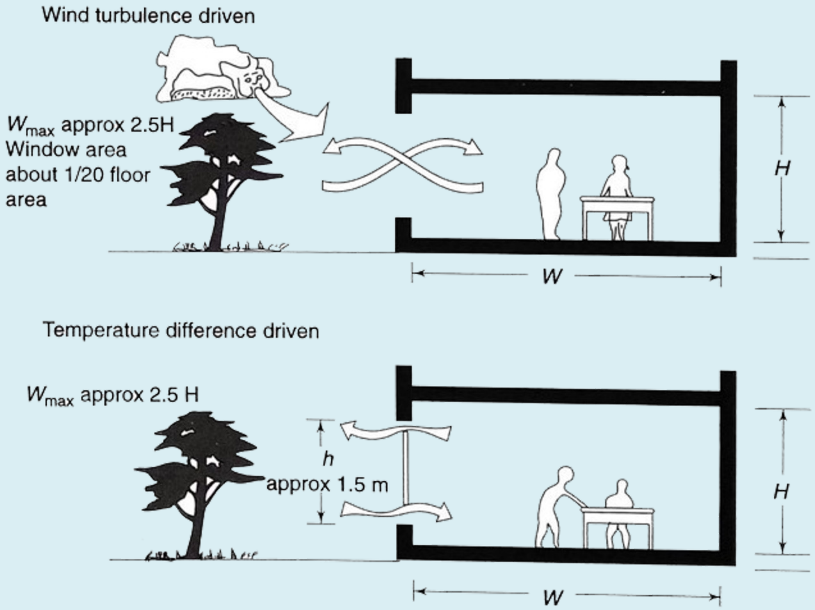


*Fig **D16.1** : Single-sided ventilation*

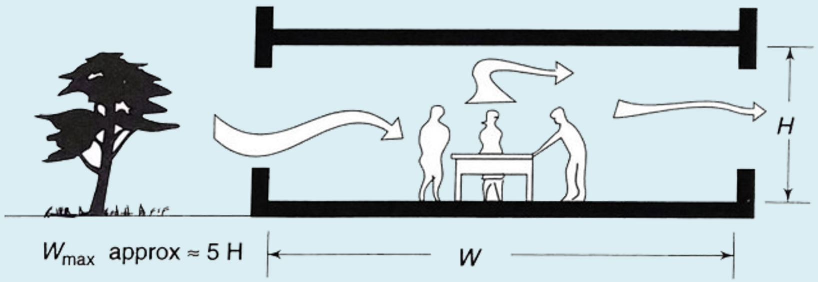


*Fig **D16.2** : Double-sided ventilation*

5.) Modulating openings for single sided ventilation and double sided ventilation :

Single sided ventilation occurs when large ventilation openings, such as doors and windows are situated on one external wall only.

Exchange of air takes place by wind turbulence, by outward openings interacting with the local external airstreams, and by local stacks created due to the presence of trees, landscape or other barrier.

The formula shown in fig. D16.1 can be used as thumb rule for opening sizes.

Double sided ventilation occurs when inflow and outflow openings in external walls have an internal flow path between them.

Flow characteristics are determined by the combined effect of wind and temperature difference.

Fenestration

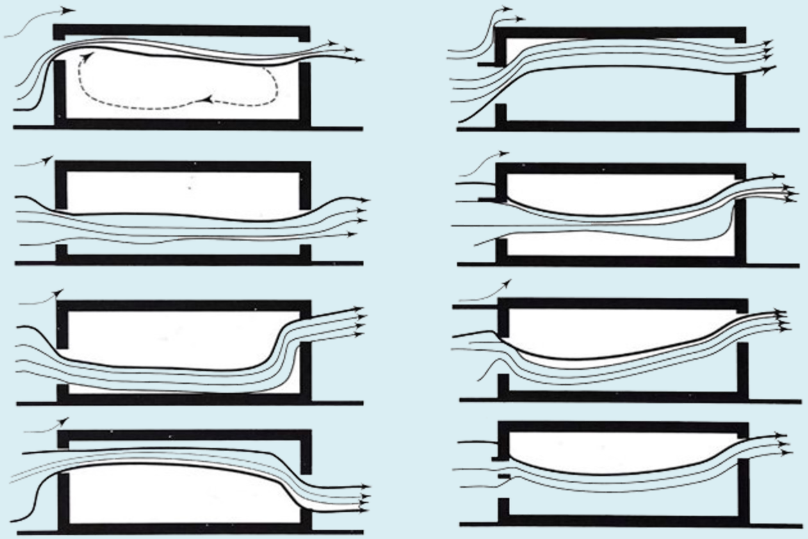


*Fig **D17.1**: Effects of different types of window openings and sun shades*

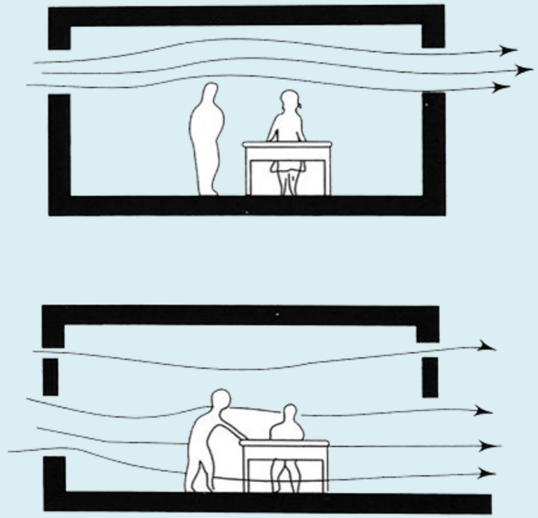


*Fig **D17.2**: Always consider the occupant of the room*

6). Design of Openings for Ventilation:

Particular care should be taken to enable room occupants to vent hot air at the top of a room and introduce fresh air lower down. This sets up a dynamic air movement within the room pumped by the heat stratification within the space.

7). Building form and orientation:

Care should be taken to get the wind data for a site, and to walk to the site to get an idea of how much of that wind will be available to the building.

All the above measures for fenestration, placement and design should be considered as integral part of design development to optimize the use of mechanical ventilation.

Summary of Savings

Sr. No.	Activity/Element	Proposed Savings
1	Alternative cooling	Dependency upon mechanical cooling (AC) can be considerably reduced for at least 10 months of the year.
2	Built form planning	Depending upon the location and size of the clubhouse project, the built form planning can be reconsidered to reduce or increase heat gain.
3	Roof Cover	A well designed building roof can be good for insulatuion and around 15% to 20% heat gain from the top surfaces can be reduced
4	Vegetation and surroundings	The measures for integration of vegetation or allowing air to circulate inside the building should be incorporated in the design stage so as not to increase the cost of construction
5	Walls and shading devices	30% heat gain from solar energy can be reduced in this system.
6	Fenestration	The measures regarding fenestrations can certainly modulate temperature variations indoors and reduce HVAC loads.

Rainwater harvesting

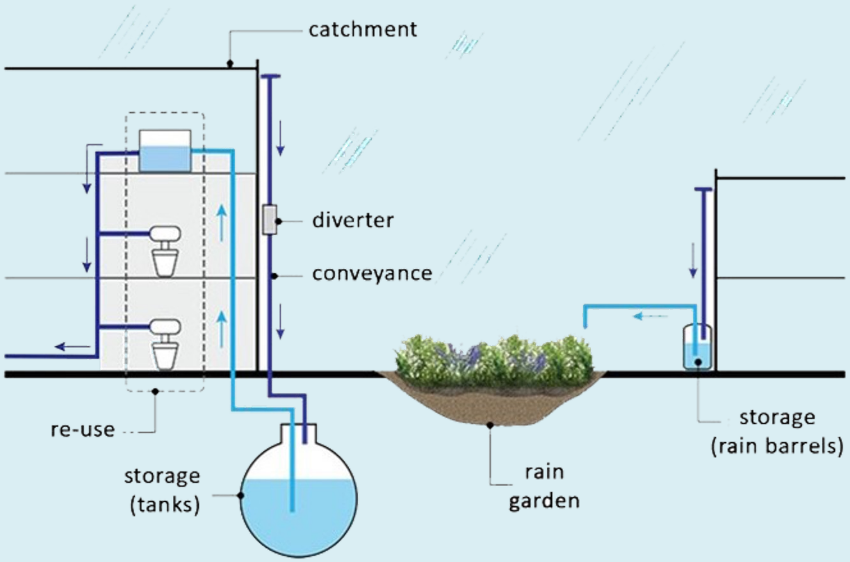


Fig E1.1: A typical example of rainwater harvesting

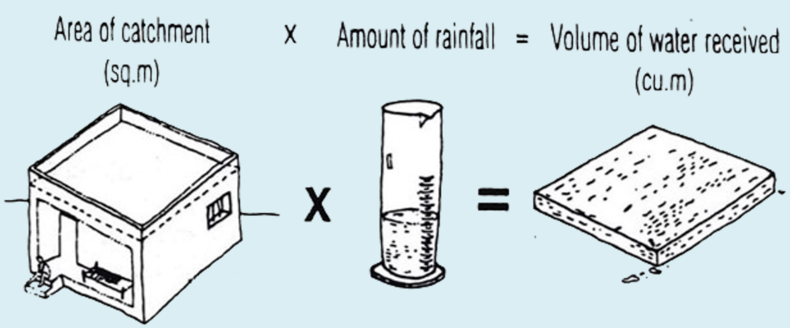


Fig E1.2: How much water do we get in the form of rain?

RAINWATER HARVESTING

1) It can be a good practice for all club house premises to collect rainwater for further usage or plan its disposable in a way that the surrounding groundwater gets recharged. If it is well harvested, large water saving and ground table recharge is possible.

1) A study highlights that existing bore well points to benefit from well designed ground water recharge system.

Thumb rule to understand how much water can be collected :

The total amount of water that is received in the form of rainfall over an area is called the rainwater endowment of that area. Out of this, the amount that can be effectively harvested is called the water harvesting potential.

Water harvesting potential = Rainfall (mm) x Collection efficiency

Rainwater harvesting can be practiced across all clubhouse locations in India for a sustainable approach.
Study of local rainfall statistics is crucial.

Rainwater harvesting

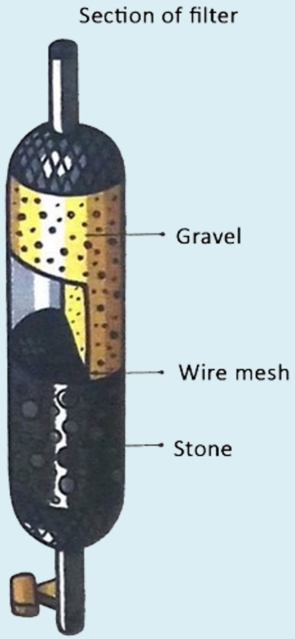


Fig E2.1: A typical section of a filter

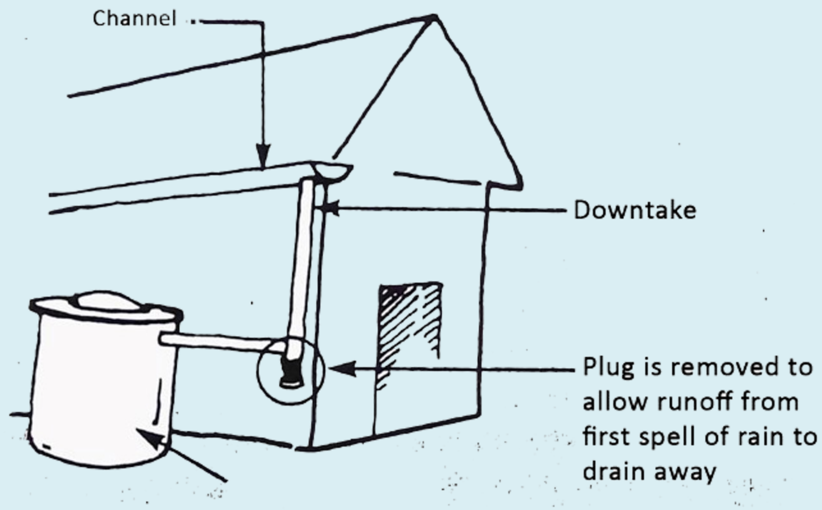


Fig E2.2: A typical first flush device used traditionally

Area of plot	=	100 sq.m
Height of rainfall	=	0.6m (600mm)
Volume of rainfall	=	Area of plot x Height of rainfall
	=	100 sq.m x 0.6 m
	=	60 cu.m (60,000 litres)

Assuming that only 60% of the total rainfall is effectively harvested.

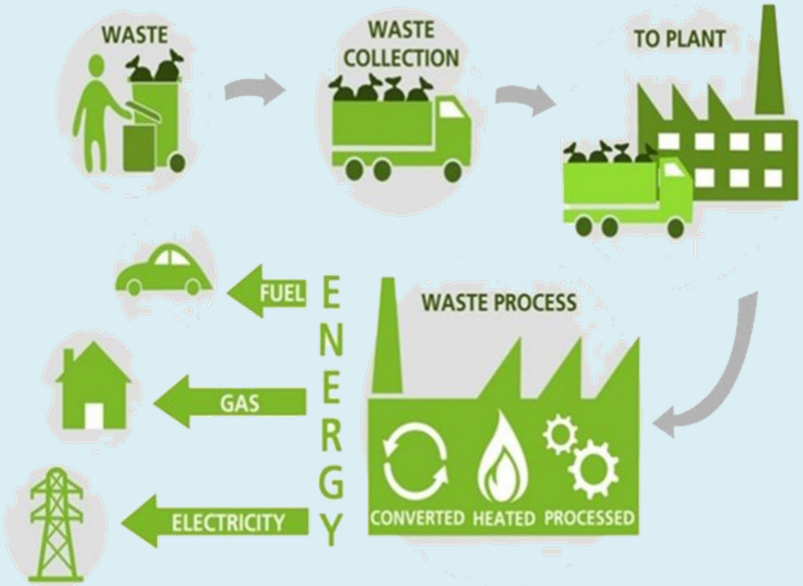
Volume of water harvested = 36,000 litres (60,000 litres x 0.6)

4) The water can be harvested by leading it into your well or tube well through a filter.

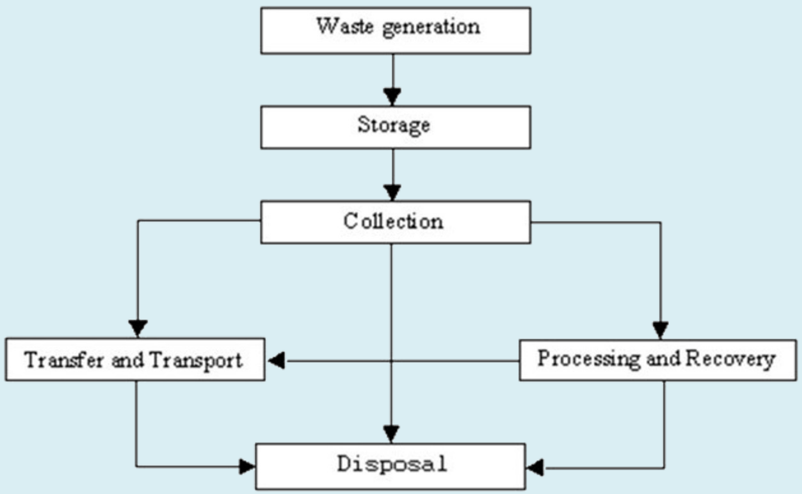
5) A first flush device can be used to ensure runoff from the first spell of rain to be flushed out. This can reduce the load on filtration mechanism & hence save maintainance cost.

Upto 60% of the rainwater can be harvested.

Waste management



FigE3.1: Figure explaining the transformation of waste to different forms of energy



FigE3.2: Waste management

Waste management can be seen as an activity for a more social and sustainable approach.
It can be set as an integral part of the clubhouse management system and following measures can be taken for this cause :

1) Vermicompost:
It is portable and economical & can be kept indoor or outdoor. It has low initial investment and low maintenance cost. Hence, can be used in all sites of clubhouses.

2) Biomass:
Biomass technique can be used to generate power which can be further used to operate smaller gadgets like water pump, kitchen exhaust, etc. in turn reducing the maintenance cost.

3) Segregation of waste:
Segregation of waste at collection point for every clubhouse should be mandatory. Organic waste can be used in the premises itself for landscape maintenance and other waste can be handed over to trusted recycle/disposal agencies.

4) Drainage disposal:
Grey water from kitchen basins and black water or sewage can be collected separately and treated at clubhouse level. The treated grey can be used for gardening, flushing and cleaning cars with due care.

Waste management can be an activity involving society members during the operation stages. An ideal setup can be learning and interactive space for kids as well as adults apart from being a socially responsive initiative.

Focused plantation

Fig E4.1 : Green wall

Fig E4.2 : Roof garden

Fig E4.3 : Peepal tree (native tree)

Right selection of plants and right ways of plantation can help achieve a more holistic environment.

GREEN WALLS

Use of green was as partitions and dividers.
They are light weight, easy to install and can be good sound barriers. (refer Fig J4.1)

ROOF GARDENS

Modular roof gardens can be kept on the terraces which will add to the green quotient and also help in reducing heat gain. (refer Fig J4.2)

NATIVE PLANTS

Plants, trees, shrubs or ground covers which are native to the locality under consideration (refer Fig J4.3) should be used or preferred because...
They are climatically and ecologically appropriate.
Once settled, they survive on lesser water quantity.
They are highly resistant to pest attacks.
They increase habitat for local birds, insects, animals, and can control soil erosion.

Some examples of widely used local species in the Indian context :

Trees : Acacia chundra, Accacia horrida, Accacia mellifera, Pamburus missionis.

Shrubs : Gmelina asiatica, Carissa spinarum, Phoenix humilis, Securinega leucopyrus.

Creepers : Ziziphus oenoplia, Toddalia asiatica, Caesalpinia zeylanica, Pterolobium hexapetalum.

Plantation around clubhouse premises should be focused around their functional aspects and contextual references

Water management

Fig E5.1 : Minimise lawn, use sprinklers

Fig E5.2 : Drip Irrigation system

Fig E5.3 : Ponds made for curing on flat surfac

Fig E5.4 : Avoid large water force, use low pressure pumps for curing

Water management should be critically viewed and practiced while planning, developing and distributing it in the clubhouse premises.

WATER SAVING IN LANDSCAPE

1)Reduce manicured lawn area.
(A thumb rule says 25%of total out doors area can be maximum under lawn .)
2)Use of sprinklers will help reduce water wastage.
(refer Fig J5.1)
3)While planting, grouping of plant species as per their water consumption can be effective.
4)Drip irrigation to be a minimum requirement.
(refer Fig J5.2)

Some studies suggest drip irrigation can help save 15% water in urban neighbourhoods.

WATER SAVING DURING CONSTRUCTION

1) Minimize the use of potable water during construction activity.
2) Concrete structures should be covered with cloth/gunny bags for curing.
3) Ponds should be made for curing, to avoid water flowing away from flat surface.
(refer Fig J5.3)
4) Distribute water storage floor wise or section wise to reduce wastage.
5) Use pumps with low pressure for curing. (refer Fig J5.4)
6) Using solar pumps to pump water for curing can be a good option.
7) Promote use of plasticizers to be mixed in concrete to reduce water consumption.
8) Using tested recycled water can be a more sustainable option.

Water saving practices during maintenance of landscape and during construction activities should be followed to save substantial amount of water

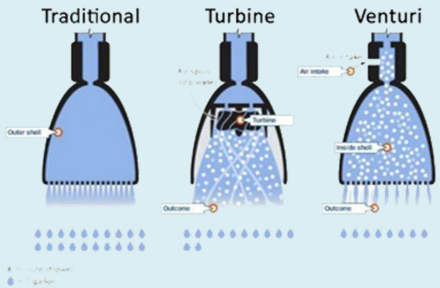


Fig E6.1 : Water saver shower systems

Fig E6.2 : EWC with dual flush tank

Fig E6.3 : Water saver sensor driven taps

WATER SAVING BY RIGHT SELECTION OF FITTINGS AND FIXTURES

Using water saving fitings and fixtures will not only help in saving water, but also energy required to heat and pump hot water.
Water flow variation can be studied as per following examples :

a)Taps or Bibcocks:
Water discharge through normal taps -
approximately 12-15 litres/minute at 3 bar pressure.
Water discharge through tap with aerators - 16litres/minute at 3 bar pressure.

b)Showers:
Water discharge through normal shower –
@20-25 litres/minute at 3 bar pressure. Water discharge through shower after putting various flow restrictions - 8litres/min to 10litres/min depending upon kind of shower. (refer Fig J6.1)

c) EWC : use EWC with dual flush tanks
Dual flush tanks can be fitted with 3 litres and 6 litres water flowper use.
(refer Fig J6.2)
This will considerably reduce water consumption during evey flush.

d) Flush valves : use dual flush valves
Dual flush valve : Can be fitted with 3 litres or 6 litres water flow per use.

e) Basin taps :
For basins, sensor driven taps can be provided to save water.
(refer Fig J6.3)

Option for waterless urinal should be considered.
These fixtures are readily available in brands like Kohler, Jauquar, etc.

Water management

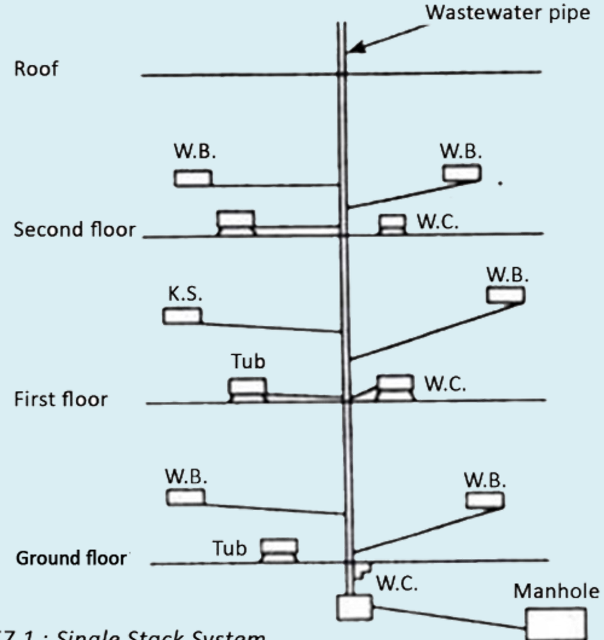


Fig E7.1 : Single Stack System

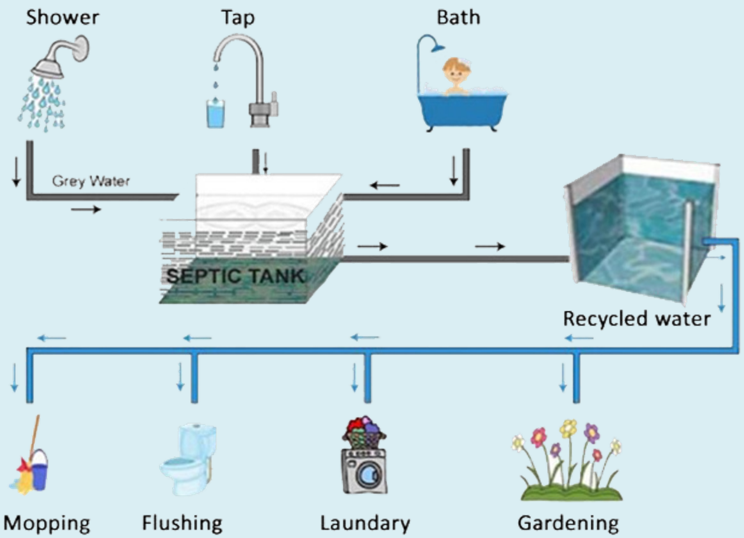


Fig E7.2 : Waste water recycling use

EXPLORE POSSIBILITIES OF USING A SINGLE STACK SYSTEM :

In this shower, basin & kitchen drains are brought down along with WC drain in a single downtake system as against the usual two pipe systems.
(refer Fig J7.1)

This can help to save material and time and hence cost too.

This system is widely used in the western countries, but in the Indian context, a plumbing & sanitation consultant's expertise is recommended as grey & black water gets mixed here.

USE OF WASTE WATER RECYCLING UNITS FOR CLUBHOUSE SETUPS :

Use of Such units can help recycle 80% of the waste water coming from cafe / restaurant kitchens.

It can also help save large amount of water discharge from toilets, showers and pool areas.

Water treatment from such units costs less than 5paise/litre and treated water can be used for
gardening, floor cleaning, etc. (refer Fig J7.2)

In large clubhouses, multiple such units can be
installed to decentralize activity and recycle up to 80% of discharged waste water.

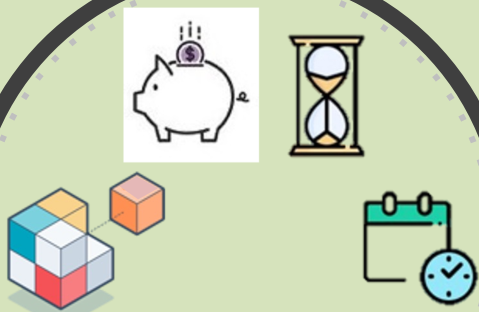
Optimization of down take pipe systems can be a cost saving option.
If water can be recycled efficiently, 70-80% water can be reused.

Summary of Savings

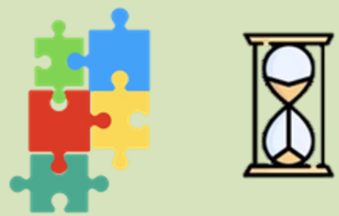
Sr. No.	Activity/Element	Proposed Savings
1	Rainwater harvesting	Upto 60% of the rainwater can be harvested
2	Waste management	This practice can be an investment for the environment
3	Focused Plantation	Right selection of plants and right ways of plantation can help achieve a more holistic environment.
4	Water management	Some studies suggest drip irrigation can help save 15% water in urban neighbourhoods

4 CASE STUDIES

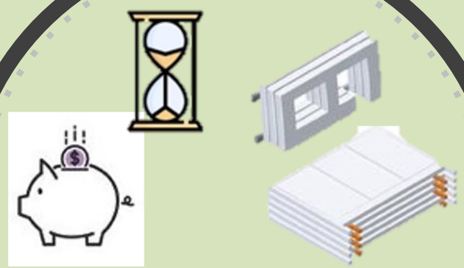
Implementation of Clubhouse at Godrej Ananda



MOSA WITHIN THE CLUBHOUSE



MODULAR APPROACH



PRE – CAST TECHNOLOGY

MOSA is housed within the clubhouse, thereby reducing cost of MOSA structure. This saves time as Club is partly ready at beginning of project and once launch is over, can be completed for handover in time.

Modular approach – helps save time in planning as pre-defined modules make it easier for consultant to develop the clubhouse design.

This saves time and cost through repeating the moulds created.
Each mould can be used for 7 projects.
Rs. 7 lakhs spent on Bagalur pre-cast moulds and the same has been used at RGA and Whitefield as well and can be used at 4 more projects.

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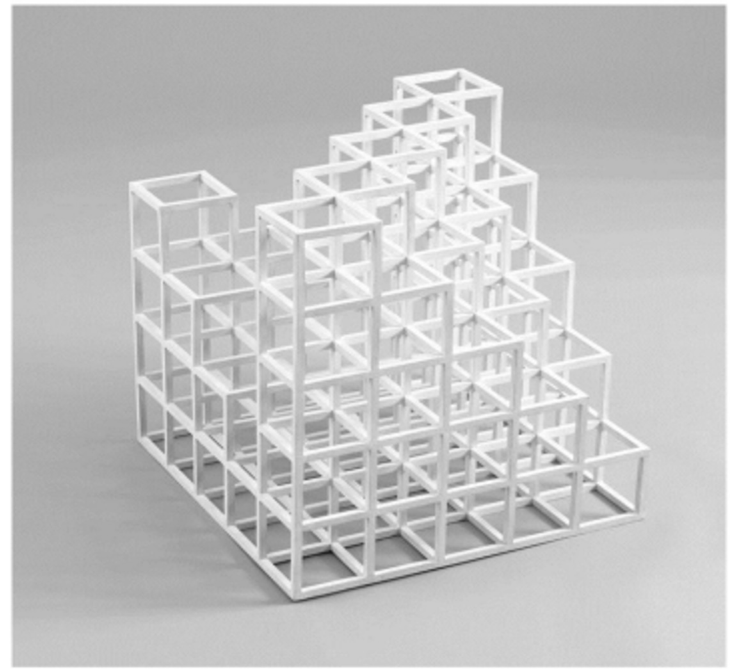
Modular approach to structure: Pre-cast construction technology



Flexibility Modularity Scalability

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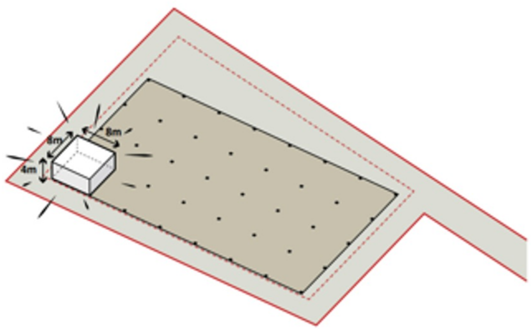
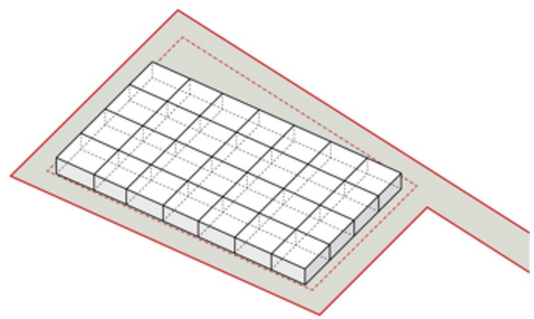
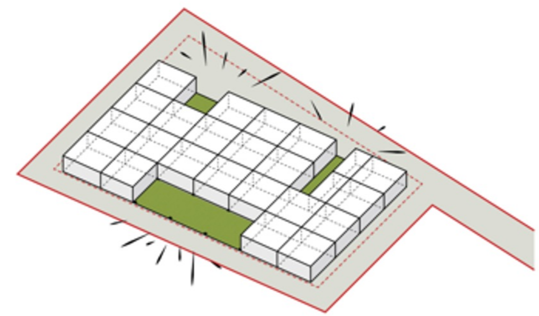
Modular approach to form



THE 'TYPICAL' MODULE Optimized for prefabrication and standardization, leads to speedy construction



DEPLOYMENT Modularity allows an articulated deployment of the typical module across the site



GREEN POCKETS Modularity allows an articulated deployment of the typical module with the creation of 'Pocket' gardens within the complex

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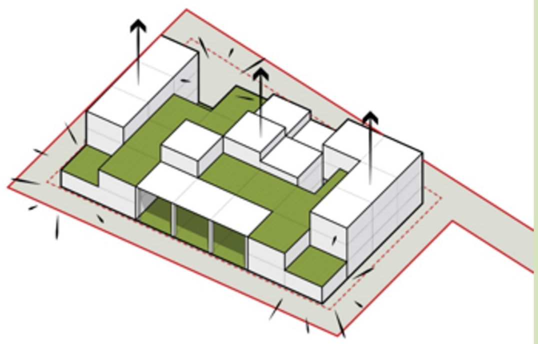
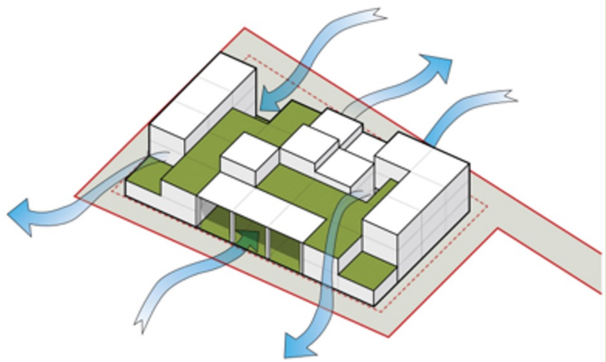
Modular approach to structure: A CUBOID EXERCISE



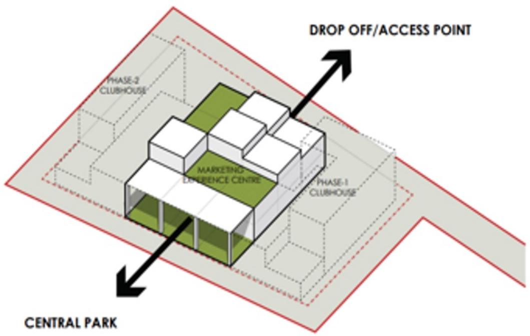
VERTICAL ARTICULATION

Freedom in vertical stacking allows the creation of 'Active' rooftops



A 'BREATHING' BUILDING

The 'Framework' structure creates a 'Porous' building that can be 100% naturally ventilated by allowing the prevailing breezes through its depth



A 'WALKTHROUGH' BUILDING

Using modularity, permits the construction of discreet portions of the building in different stages

CASE STUDY

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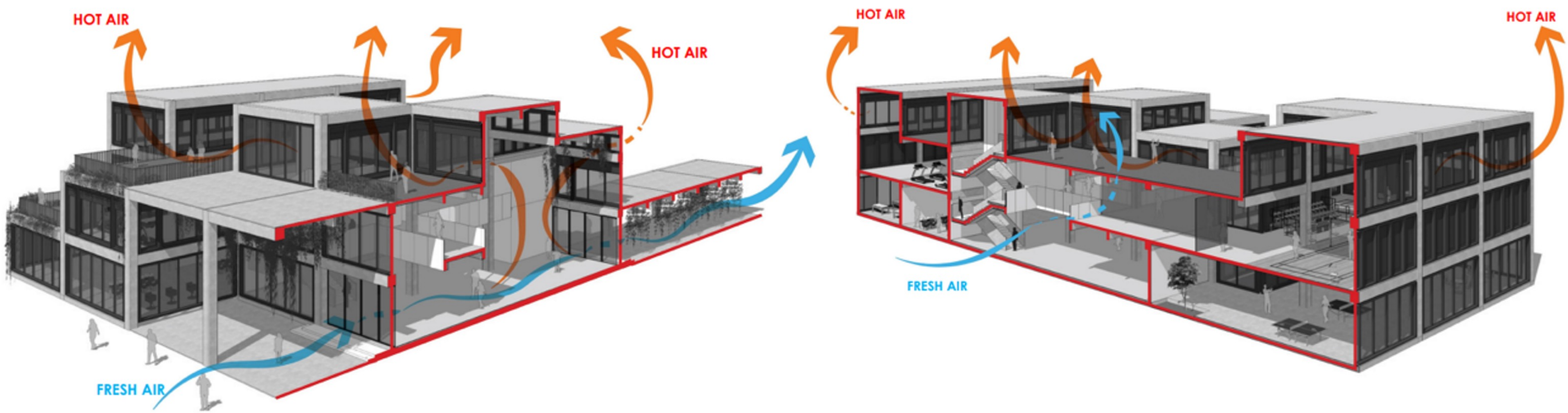
Floor plans

Godrej Ananda, Bangalore

Energy reduction through passive cooling techniques



NATURAL VENTILATION
Energy Saving

The 'Framework' structure creates a 'Porous' building that can be 100% naturally ventilated by allowing the prevailing breezes through its depth . The vents at the higher-level help exhaust the hot air and maintain thermal comfort.

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MOSA as a part of the Clubhouse

Ananda (Bagalur) Clubhouse

CASE STUDY

Godrej Whitefield & RGA-Tech, Bangalore

MOSA is a part of these Clubhouses

Clubhouse @ Whitefield

Clubhouse @ RGA

THANK YOU

RESEARCH & PRESENTATION: SHIVANI MRINAL SATYAN