BEST: International Journal of Management, Information Technology and Engineering (BEST: IJMITE)
ISSN (P): 2348-0513, ISSN (E): 2454-471X,
Vol. 4, Issue 1, Jan 2016, 49-60

WATER AS ELEMENT IN ARCHITECTURE

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ABSTRACT

Water as element in architecture can be studied in various ways and its perspectives in defining a space, The analysis done on water, as in how it plays an important role as element in architectural design and aspects segregated as physical, dimensional and sensory effects (auditory, visual, touch and texture).water(water body) defines space according to its size, placement and proportion, its consideration is done where it can alter the microclimate of place creating the comfort condition for which it is opted in hot and dry climate since Mughal period ,also defined as important aesthetic element in landscape architecture, where various aspects of water .the concepts of using it has resulted in evolution of space to different level, adapting water bodies for creating comfortable climate ,urban water front developments and various passive design techniques, that lead to define it as necessary element. Importance of water is studied where it's analyzed from a macro level at urban scale to micro level as microclimate modifier for comfort. The element (water) plays role in various aspects making this paper reveal its character and flexibility as important element in architecture

KEYWORDS: Microclimate, Comfort, Aesthetic Element, Passive Design, Macro Level, Urban Waterfront

INTRODUCTION

Water is the most fascinating substances in the universe because of its features, appearance, and its important design characteristics consist in its movement, sound and reflection. Pure water is like odourless, colourless, and tasteless whereas considering it as element in landscape where water often appears in different colours from opaque dark to rich blue colour. The colour of water changes with lighting where water acts as reflective surface, example: Taj Mahal getting reflected on banks of river Yamuna, Its properties activates all the senses and also creates opportunities of recreation facilities, viewing water and experiencing it can be relatively passive when its seen in context of scenery, it expresses various qualities like aesthetic- nature, unity, variety, vividness, visual assessment as landforms created near the banks of river by water. Sound also can be a unique experience where it stimulates the human senses and the flow depicts the energetic motion which reflects dynamism, It shows two extremities where it also tends to be calm and in dynamic motion with aggressive character on other side. "Water in nature serves as a source of inspiration when designing urban plazas and fountains" (Halprin, 1981).

It's also given importance symbolically as purifying substance; as we see historically it has been part of rituals associated with human life, birth, marriage, and death, beyond certain level it symbolizes purity (devotional) , sanctity related to culture and has relation to the term associated with rebirth.

Water plays a key role in certain landscapes as it is used extensive key feature of French garden design where many round pools and long rectangular pools of water are incorporated, water adds symmetry and tranquility to the scene,

cascades and fountains are common features that are used as features for unity, variety, and vividness, it also plays important role in visual perception and defining its importance as element.

WATER AS A PRIMARY LANDSCAPE ELEMENT

Usual colour obtained is due to the materials suspended in it for example Colorado (red) river is because of the mud it carries gains red colour, There is subtle sound of single drops falling and hitting the water surface, the gushing sounds, thundering roar created by waterfall. This feature makes water reveal its presence even if it's hidden in the forest. The water is formless and occupies the shape which it fits in, there are some vernacular houses where water bodies are placed in courtyard to cool and humidify the incoming air, the features of it is considered for various life sustaining-activities, practical aspects like bathing, cooking washing clothes etc. Being the element in landscape it creates landforms, visual character, erosion and various other effects all these values changes the human perception towards looking up to water as key element.

HISTORY

The use of water has been in practice since Mesopotamian period .The study reveals that Egyptians, had engraved on tomb, walls the features like water ponds with fish and lotus flowers these were depicted thousands of years ago. In Rome water ponds were an important part of villas in Pompeii. The Chinese gardens and the landscapes created by the poets and painter of those times considered water as vital element hence the scenes depicted had pools waterfalls creeks fountains and wells they were fascinated by the glitter that is created from water and illusion created by the pool .

The water in Byzantium Is symbol of life, health and civilization which even played eminent role in the everyday life of by zantine folks. The people considered water as a central and important element of paradise, in which they had imagined a blooming gardens with four rivers, the area with public spaces were used as therapeutic places by name Aghilaos or Pithia it was considered that they would cure pain. The fountains being natural infrastructure were used in creating public spaces like luxurious baths, these places also acted as public interactive space where the people would share their ideas view etc. hence the water bodies and facilities were of greater symbolic value

WATER AS ELEMENT IN MUGHAL ARCHITECTURE

The arrival of Muslims in India, in Twelfth century AD onwards, merged the local and immigrated architectural techniques which led to the result of astounding indo Islamic style, passive cooling techniques used by them in buildings were merged together to provide new ways to cope up to the extreme climatic condition (hot and dry).

Water in Islam also has unique meaning where its major element in the eternal gardens of paradise described as water gushing in the garden of heaven (Sura 55).

The buildings were built to give thermal comfort to the people as the artificial control leads to large consumption of energy for which India was not advanced therefore the possibilities of consuming the naturally available led to innovative ways like,

- Maintaining the internal environment of spaces to make them comfortable.
- Controlling the microclimate.
- Procuring and manufacturing of materials for construction.

These above mention points would be responsible to make building more sustainable.

Climatic Characteristics

The areas ruled by Mughals in north India had hot and dry conditions for two third of the year and humid season appeared for the remaining one third the diurnal changes observed is from 11-12 degree Celsius in hot and dry season and in cool and dry the range narrows up to 3-6 degree, the humidity level reaches 95% during wet period, hot and dusty winds blow during dry season.

Climatic Consideration

The consideration for the changes in microclimate was addressed outside the building as it would control the inner temperature or heat gain, the external air was treated to improve the micro climate of the region, vegetation was added to improve the quality of outer spaces by evapotranspiration which adds water vapours to the air and brings down the temperature keeping the internal comfort to an optimum level. Hence water bodies (still, moving) were added to the palaces for improving the humidity in hot and dry region, inside building with *Nahar-i-Bahisht* (canal of paradise) the water flows through the internal spaces modifying the internal environment. Mughals also used water channels and their building improve microclimate of region

Figure 1: Water body at Fatehpur Sikhri, Agra

Source: Ali, A 2012 Passive Cooling and Vernacularism in Mughal Buildings in North India, Aligarh, Uttar Pradesh

WATER AS AESTHETIC ELEMENT IN LANDSCAPE ARCHITECTURE

Water as an aesthetic factor and its significance varies from person to person it depends on the perception field of the observer. The role of water is lentic, lotic, large extent, small extent sweet or sea water, troubles or calm, the aquatic element creates bridge between the subjects like literature and landscape, the water related landscape values are derived from existing water as element (Spitalas 2000, Eleftheriadis 2006).

Various features of water is as follows: The sound of water, the movement of rivers, waterfalls waves etc., the colour of water and coats, The reflections on the water surface The possibility of expanding biotopes of certain species, The opportunities of emphasizing structural materials and lighting, all contribute water as aesthetic element.

UNDERSTANDING WATER BODIES ON BROADER ASPECTS

Water bodies like rivers, lake, coastal regions play a major role in development of city these water front's creates extensive opportunity and have potential to become culture and heritage hubs , their position on the banks of river or lakes attract the people from city and also encourage the tourism, therefore these water fronts have emerged to be the live core of the cities for different developments and accordingly the area of waterfront can be considered to develop lake front , River front or sea front development.

Urban Waterfront Regenerations

The word " WATERFRONT" means the urban area which is in direct contact with water , these area are usually dedicated or occupied by the port activities and their infrastructure where there is no public intervention , natural water bodies play major role in linking up -the relation of space to the folk of particular area ,this relation can be stated and satisfied as water is one of the most important element of visual and psychological comfort, it builds the relation between the aesthetics and functionality of place.

The reason regarding the attraction towards such urban front development is purely depended on the visual comfort due to landscape, water flow and the serene environment which relaxes the mind, the water in motion adds on to the serenity this feature of water creates vibrancy and excitement to the space, but the stagnant water creates a mirror effect in the available space causing reflection. The area where the water spreads out extends the horizon and gives widened effect.

Water in the urban areas serves dual purpose as aesthetics factor and functional effects, comfort, noise control, circulation effect and development of reflection. All these results as the climate is comfortable with huge water bodies as water surfaces cools the air by means of increase in the moisture ,wide surfaces of regional scale regulate air temperature to the surrounding area.

Lakefront Development

The development of lakefronts typically includes the following activities:

a. Boating, b. various rides c. Restaurants d. Walkways

The scale of urbanization and industrialization had led to the encroachment of land keeping cities and town with least avenues for recreation activity or green space, with the proposal of the water front would provide residents with new opportunities and awareness and these space turn as congregational space and would attract morning walkers and after-work runners. To utilize the space turning it livelier even the coastal areas shall be accommodated for recreational purpose.

Waterfront A space where water (i.e. river, lake, sea, ocean) meets with urbanized land, creating a unique spatial interface, the cities seek waterfront as a place of pubic enjoyment which serves the function in more than one purpose it should be a place active all the time with the leisure activities, place to play improve the quality of life in all possible aspects like social cultural and economic

FACTORS CONTRIBUTING TO THE RESURGENCE OF WATERFRONT DEVELOPMENT

Available Land: The water front adds up to the economic increment of the land value hence we should be

ambitious towards improvement of such water bodies

Cleaner Water and Land: The above-mentioned feature adds for the feature of water body in urban environment.

The Historic Preservation Movement: Waterfront can also feature to preserve historic structure as add on to the urban environment.

Citizen Activism and Leadership: Citizens can play major role in reclaiming the waterfronts and redevelopment can be carried on in same aspect

Urban Revitalization: Revitalization also leads towards the progress of urban down towns and also lead towards the residential developments, increased value of real estate.

GENERAL PRINCIPLES OF WATER DEVELOPMENT

Waterfront development planning are guided by four priorities:

Balanced land use; respect towards limited resources; improved public accessibility; and safeguarding for environmental quality.

The general principles for waterfront development are set out below

- Interconnected, linear waterfront development with broad public access
  - Encouraging the use of the riverfront greenway as a daily commuter path and recreational amenity.
  - Demonstrating the connection between access, greenway development and market demand.
  - Creating visually pleasing edge which is coherent in character
- Protection and enhancement of the natural riverfront environment
  - Documenting the ecological state of the waterfronts in order to preserve this environmentally diverse natural habitat.
  - Preventing and, where possible, eliminating inappropriate uses and practices from the rivers' edge.
  - Protecting existing natural areas from development
- Reclaim the city's identity as one of the best water cities
  - Raising public expectations of what the city's waterfront offers.
  - Attracting people, investment and the best aspects of urban living to the Waterfront.

ADVANTAGES & BENEFITS OF WATERFRONT DEVELOPMENT

The benefits and advantages by developing such waterfronts have economic benefits, social benefits and environmental benefits the benefits are as follows.

- Such developments leads to the job opportunities to the nearby skilled and unskilled people. Hence creating job opportunities.

- The projects can be creating revenue to the government- hence government will be able to earn in turn. The commercial space like shops restaurants, sport activities, transportation and boating are the facilities which can be leased out or giving it to private players to operate.
- Development of tourism in the particular takes with the progress of water front development, tourism can also be improved in this aspect by having sports facilities, entertainment arenas, developing shopping areas etc.
- Economic spin-off's –leads to improvement as catalyst for redevelopment and the spaces also gets renewed
- It also helps in preservation and restoration of certain unique features of space where human environmental connections can be worked out
- Improving the water conservation practices and maintaining the flow of river through large city
- Beautification of the wate front naturally will provide the public open space for leisure and recreation
- Encouraging recreational activities like activities like walking, jogging, biking, sports activities, etc.

Improving the life quality and revitalization of the neighbourhood

CASE STUDY-1

The river of Sabarmati flows from north to south splitting Ahmedabad in almost in two equal parts it has served as main source of water for long years and had no place as recreational space hence the perspective to treat the water bodies was restricted only to its basic purpose.

The river was also being encroached, abused and neglected and over population one of major cause, which led environmental degradation, the pollution caused was causing major health hazard to the city. The river was in accessible and was flooded as there was no proper infrastructure available.

The use of water was done for many purposes as it was used as: Source for drinking water,

Recreational space, place to gather, place for poor to build their hutments place for traditional market to be held, washing and drying clothes.

The objectives which help to uplift this river front development is as follows:

- Environmental Improvement
- Creating network of public open spaces
- Providing adequate public access to the river
- Rehabilitation of the slums
- Rehabilitation of Gujari Bazaar
- Rehabilitation of Dhobis (Washer men)
- Creating vibrant urban neighbourhood
- Recreational Activities

The basic infrastructure Constituted of diaphragm Wall, anchor slab, Ghats and ramps ,retaining wall, staircases and ramps, extension of outfalls, interceptor sewage &, junction chamber, pumping station, pier protection of existing bridges

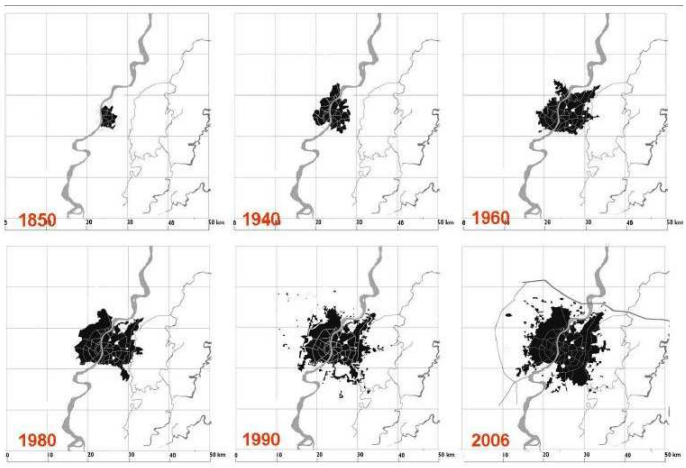

Figure 2: Sabarmati and Growth of Ahmedabad

Source: http://urbanmobilityindia.in/Upload/Conference/b84df2be-cebe-4e83-a741- c6eb4c97f5c9.pdf

ENVIRONMENTAL IMPROVEMENT

- Interceptor sewer system ensures the flow of clean water in the river
- Water in the river almost retains almost for the whole year
- The rate ended water of 12.5 million cubic meter stored helps in recharge of ground water aquifers
- Biodiversity park in kept intact by plantation of 20,000 etc. as green area and parks
- Recreation opportunities like zip line, amphibian bus, floating restaurant, ferry service

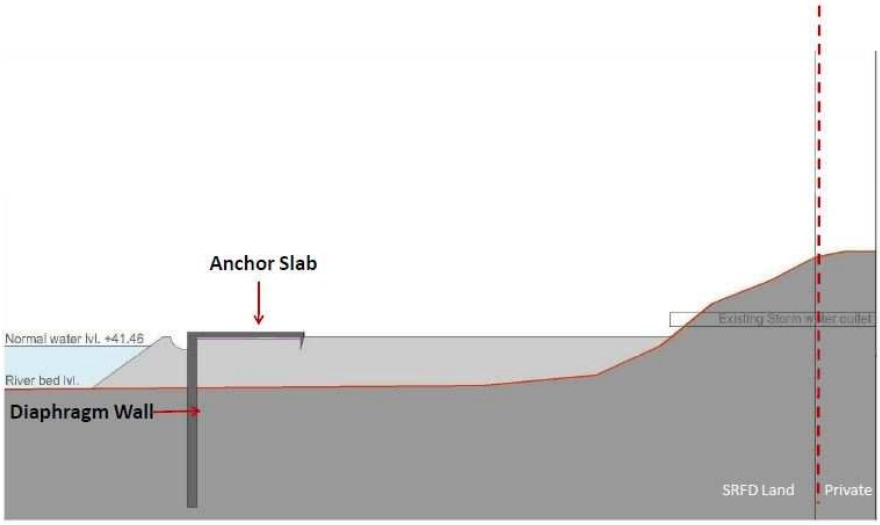

Figure 3: The Image Shows the Diaphragm Wall Added and Being Anchored To Ground

Source: http://urbanmobilityindia.in/Upload/Conference/b84df2be-cebe-4e83-a741- c6eb4c97f5c9.pdf

KEY LEARNING FROM THE PROJECT

The neglected and abused river was brought back to its original form, the resource to the city by utilizing the resources of the river itself, to convert the abandoned -land of riverbed and nuisance at the centre of the city into; people's attraction, tourist destination to create infrastructural and recreational facilities. To transform the city more liveable with environmental improvement and inclusive development.

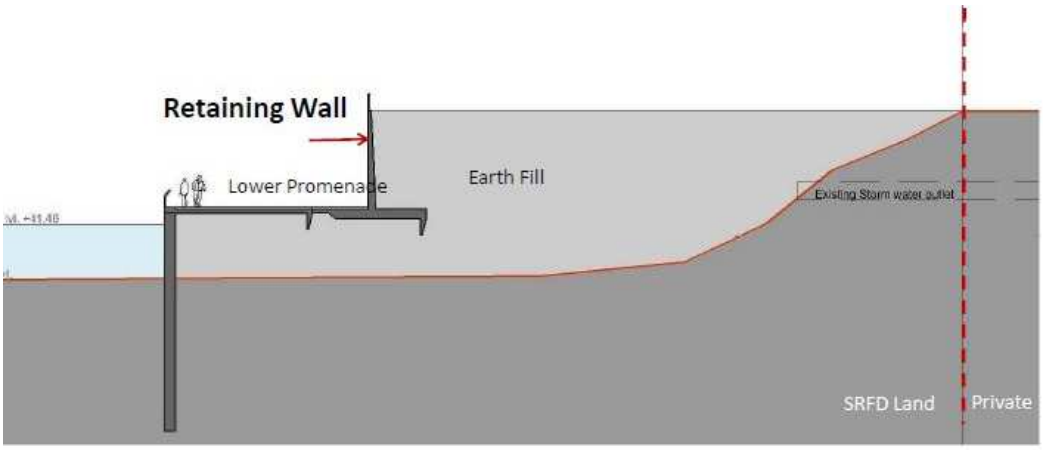

Figure 4: The Image Shows the Lower Promenade Retain Wall Which Retains the Soil on Either Side

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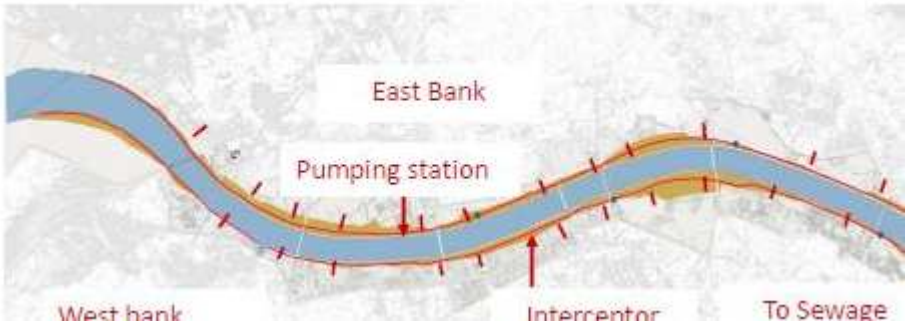

Figure 5: The Flow of Sewage to the River is Dipicted

Source: http://urbanmobilityindia.in/Upload/Conference/b84df2be-cebe-4e83-a741- c6eb4c97f5c9.pdf

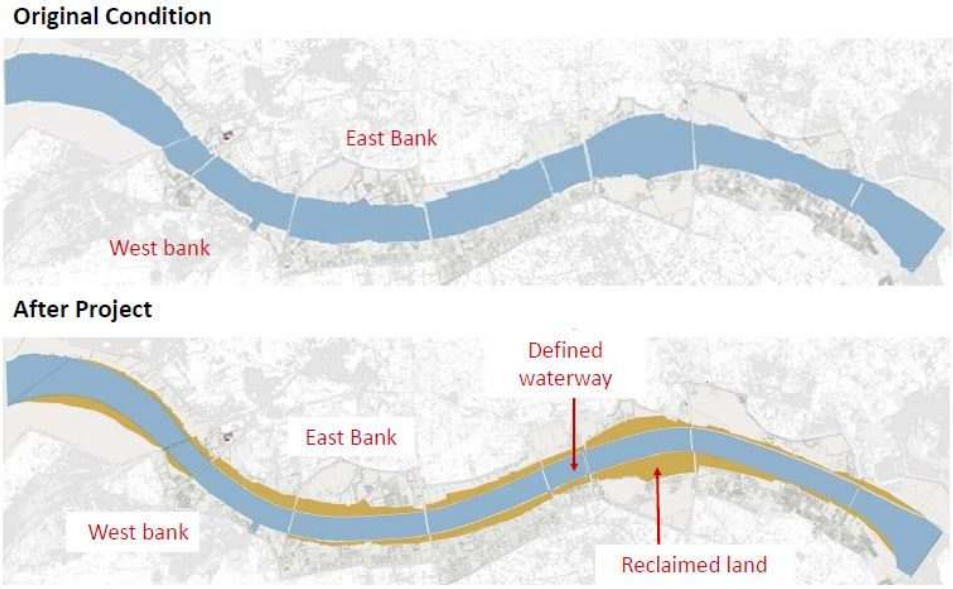

Figure 6: Comparison of Flow and Land Reclaimed Area near Sabarmati River Front

Source: http://urbanmobilityindia.in/Upload/Conference/b84df2be-cebe-4e83-a741- c6eb4c97f5c9.pdf

URBAN WATER BODIES TO BE DESIGNED FOR CLIMATE ADAPTATION

The water bodies function as cooling island in urban area this is due to the temperature variation several attempts have been made to study the micro climate of the city parks and gardens in situ measurements and meteorological station data has been used for precise information. This study deals with the example where water body is to be designed in such a that its creates wider impact on urban thermal environment and development in this regard may help as an ultimate tool for city planners and urban designers to maintain thermal environment in specific zones, the study has pictorial analysis and spatial information on land cover and land surface temperature this analysis is done by using Advanced Space borne thermal emission and Reflection Radiometer (ASTER) as pictorial analysis.

CASE STUDY-2

This study is based on Beijing (capital of China) which is densely populated with the population exceeding 19.7 million and 5 million automobiles obtained by analysis obtained on 2010, Hence the above situation has led to rapid urbanization and city expansion that started from 1980 which resulted in significant urban heat island effect. Previous studies have found that the mean daily temperature in urban areas is 4.6 degrees higher than in suburbs. Several data and description often considered in landscape design, includes the water body its area, geometry, location with reference to city centre and landscape found in surrounding areas these are the result found based on analysis.

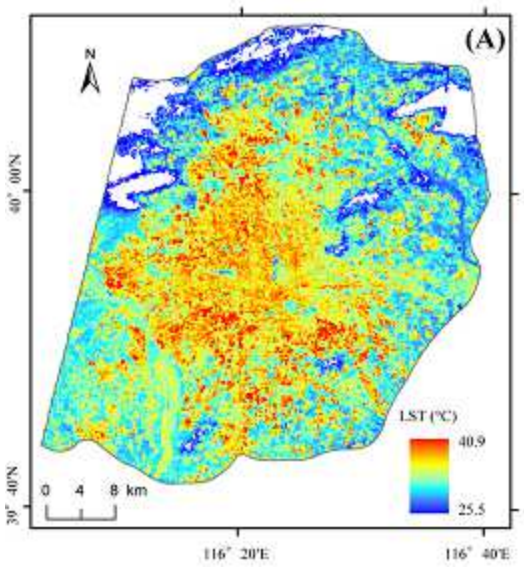

Figure 7: Map Shows Simulation Results Based on Temperature Effects

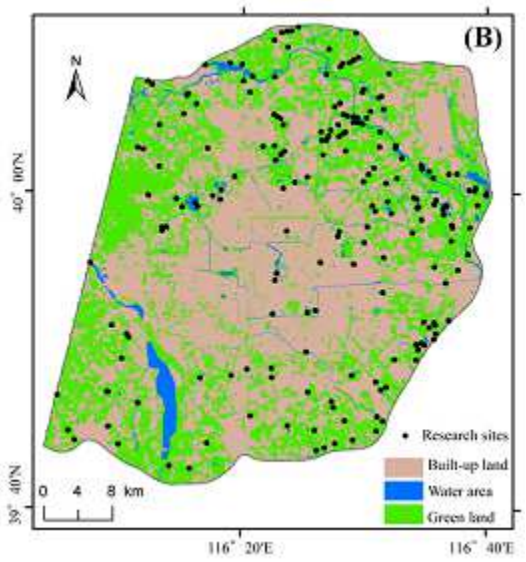

Figure 8: Map Shows Land Use Pattern and Percentage of Cover

Source: Sun. R and Chen, L 2011 *'How can urban water bodies be designed for climate adaptation?* Research Centre for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing.

The area of the water body has greatest effects and has negative co relation with the water body area. As result its noted that square and round shaped water bodies intensifies their cooling effect, dense built up area increase the LST around water bodies which result in high cooling efficiency, the result also reflected that some physical properties of thermal transmission between the water bodies and surrounding landscape at local scale is more moist compared to neighbourhood areas, these water bodies tend to absorb more sensible heat compared with rural areas and cool ambient temperature is also gained due to evaporation therefore the water bodies and vegetation maintain cooling effect. Even built up proportions were found to impact the microclimate along with the surrounding water bodies, this study has shown that, water bodies along with appropriate landscape in design and planning helps to improve the cooling effect and reduce the critical concerns of global warming related to extensive urbanization.

PASSIVE COOLING TECHNIQUE

These below mentioned techniques help in modifying the microclimate of space hence resulting in comfortable indoor temperature and atmosphere.

a External cooling external cooling through humidification can be achieved by keeping the surfaces of roofs and / or walls moist. (E.g. lawn sprinkler) The surface temperature -can be reduced by up to 30°C. However, the water consumption is excessive in this process.

b. Evaporative coolers Air cooling and humidification or simple air conditioning devices are important means of internal cooling. Warm and dry air passing over water is cooled by evaporating the water. Evaporative coolers have a limited effect and should only be used in relatively dry climates.

c. Moist matting An open weave matting of vegetable fibre (straw) is stretched on a wooden frame and is kept moist. The matting should be as fine as possible, placed in front of windows and in the path of the natural airflow. The natural airflow should not be reduced and can also be supported by a fan. The damp matting humidifies and cools the air as well as filters out the dust.

d. Earthenware pots: Another simple system entails the use of large, porous earthenware pots filled with water which seeps through the walls of the pot moistening the outside and, as it evaporates, cools the passing air

e. Wet charcoal and water pools- In wind catchers, beds of wet charcoal over which the air passes before entering the room, are sometimes used. The same principle can be applied by channelling breezes over pools or water sprays before they enter buildings. A spray pond is more effective than a still pool of the same size and has the additional advantage that the air is not only cooled, but also cleaned by binding the dust particles. Availability of water and maintenance aspects should not be neglected

f. Roof pond- a water body covering the roof functions similarly to a soil cover: it minimizes the diurnal temperature range. It is a technically demanding and expensive solution. It also requires the daily attention of the users and is not very suitable for hot-arid regions of the Third World.

Source: CT. Lakshmanan B.Arch., M.C.P.

PASSIVE DOWN DRAFT COOLING TECHNIQUE

This concept comes from vernacular architecture which is being used since thousands of year, Iran has such best vernacular buildings which follow this technique for ventilation, The towers plays important role where the rate of evaporation to supplement the use of thermal mass for cooling takes place as part of ventilation strategy In the past 20 years, the demand for passive downdraft buildings using evaporative cooling to provide the performance of the natural ventilation is extensively preferred. The ventilation follows particular path where it starts from particular height and the air cools as it moves down because of difference in temperature and movement in wind direction as well as change of velocity, hence towers are designed to bring in the hot air as it travels through the chimney the surrounding humidified bricks would lower temperature hence enhance the indoor air by cool air and lowering temperature.

The exhausted air at high level combines with solar and wind effects enhancing the buoyancy effect, dampers and controlled openings modulate the air flow to meet the temperature requirement of indoor temperature. This kind of system

is usually used in hot and dry climate and this technique doesn't work well in humid condition because the capacity of air to release heat through the evaporation of water. This system depends on two basic factors for its effectiveness: (1) amount of cooling of the ambient air achieved, and (2) the rate at which this conditioned ambient air replaces the stale air within the building.

The former can be easily achieved by increased air water contact zone. This factor usually dictates the height of the tower and in turn, influences the massing of the building design. Example: Inspector General of Police (IGP) Complex, Gulbarga.

CONCLUSIONS

Water as element is been used and specified in various levels right from macro to micro level and the studies and case study prove that the water as water body, waterfronts and as microclimate modifier has reduce the dependency if utilised in particular favourable climate (hot and dry) where it can provide effective cooling creating comfort, it has its roots embedded right from the start of the civilization and has proven to evolve in different phases and create comfort for particular climatic conditions. Various aspects of psychological healing and impacts on senses have also proven to be with positive results hence the study gives the basic analysis where water can be used as element in Architecture, where it compromises the requirement to favour a space with its best possible aspect hence it can be considered as one of the primitive and important element in changing the visual perception and microclimate which in turn favours sustainability aspect consideration and its implementation in Architecture.

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