ENERGY EFFICIENCY IN ANCIENT ERA,

A case study of MaanSingh palace, Gwalior fort

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*Abstract :*We get intimate so much in modern approach that forgot the natural resources which we can be used in our designs. Now-a-days we can see the excessive use of artificial ways for thermal like HVAC (heat ventilation and air conditioning). If we go into our ancient era, we know that how they practices the passive way for air conditioning and heating. So we can grasp from our ancient heritage buildings to achieve thermal comfort in passive manner.
This paper discusses about the energy efficient solutions, that are be used in our ancient times. There is passive architecture we have, where we can discover techniques for energy efficient solution and also the ancient architectural practices which can be used for natural cooling and heating in today's architecture where we are lacking.

IndexTerms **- Modern approach, natural resources, HVAC, thermal comfort, energy efficiency, architectural practices**

I. INTRODUCTION

The Energy Efficiency, simply means the main purpose of it is to decrease the amount of energy which has its demand in modern technology, for example; to provide a thermal comfort in buildings, housing etc. people use the HVAC in excessive way which is also a big issue of energy loss because if we need that building consume less heating we provide air conditioning for their comfort. In today's scenario a large amount of energy is used in construction purposes and after then the electricity used inside is also the cause for energy demand. Day-by-day population is increasing which is the major cause of energy demand, so we need to find out the solution to decrease the use of energy. So we can save energy for the future.

There are so many ways and the one in which I am going to focus in this research, is the techniques which were used in the ancient times for the construction purposes. The design of the old buildings and techniques which they used in their designs. It is very impressive how they used the natural thermal comfort in their design. In their design no energy demands occurred and building performed on its own, the ventilation techniques, cooling in summer and heating in winter, is well performed. It is very impressive how it is works and remains cold even in summer and it made people amazed ,and made them think about the ancient builders how they could create such passive cooling buildings without having modern construction techniques. Last three decades has witnessed the most energy losses specially in summer, load of cooling requirements for building for providing thermal comfort. We can grasp the techniques which are followed by our ancestors and can implement in our modern building designs.

The term 'Passive Design' means a building which functions on natural energy such as sunlight, wind, temperature differences etc. There are some useful techniques for thermal comfort which is known as passive cooling techniques. These techniques were used to provide thermal comfort to the people who work or used that building and protect them from the heat and they can live comfortably without using electricity. The objective of this research is to find out the solutions which are used in our old heritage building for cooling and they are also energy efficient buildings. So what method they used in their design for thermal comfort without use of artificial energy. How we can implement these techniques in our modern architecture which are energy efficient so we can consume more and more energy?

II. BRIEF OF MAANSINGH PALACE

2.1 Location

Located at the north-east end of the fort, it is also known as maanmandir palace.

2.2 Architecture

Hindu and Mughal.

2.3 Duration of Construction

Between 1486 to 1516 by Tomar ruler, Maan Singh Tomar.

2.4 Architectural features

beautiful carvings of the wall and designs of that palace, it has geometrical patterns and animal figures in jaali in outer upper façade of palace and pierced stone jaali windows.

2.5 Floors

The palace has 2 open courtyards. This four storied palace has large rooms. Two storey above and two storey below the ground.

III. ABOUT GWALIOR

Gwalior is famous for its heritage buildings. It is the most visited tourist destinations. Historical buildings and different architectural style used in ancient buildings of Gwalior includes fort and palaces attracts the tourist most.
Gwalior climatology: Gwalior has sub-tropical climate with hot summer from late March to early July, the humid monsoon season from late June to early October, and a cool dry winter from early November to late February.

IV. PLANNING'S OF MAANSINGH PALACE

3.1 Exterior: The vast eastern face of the palace which measures in 300 feet in length and about in 80 feet in intervals by six around towers crowned with domed. The wall is inaled with enameled blue, green and tiles. Thickness of wall is 400mm. there are so many figures which carved in the jaali pattern like men, ducks, elephants, crocodiles, tress and tigers.

3.2 Interior: In the interior there are two courtyards surrounded by rooms roofed over with various designs and beautifully decorated by the perforated screens, cornices, geometricalpatterns, carving, and floral patterns with the use of colored enameled tiles.

V. MATERIALS

Material which used are energy efficient. Colored tiles which used for aesthetic purpose will exported from Afghanistan which named as ceramic mosaic lapaslasolie which is capable of resist high specific heat capacity and they used sand stone in building which has low thermal conductance and absorb heats it has tendency of absorb specific heat capacity and high resistance value and remains cool in hot and dry climate.

VI. ORIENTATION OF BUILDING

Palace is oriented in well mannered and in symmetric form and put perforated jaali on nort or east or west side so the maximum wind intake easily and flow easily through channel(gallery) of all four side. In south they put jaali in upper façade.

5.1 Volume and openings-

They make thick wall which play a major role in keep the building cool. The thickness of interior wall is 400mm.
The openings of palace is like first they set a small openings after that they left space for crossings and again they set small openings which open in the open rooms with courtyard.

5.2 Temperature difference-

I check the temperature in outer and inside of building I find huge difference in temperature. Outer temperature of building is 36'c-37'. Inner temperature is 31'c-31.9'c and in below ground storey is 28'c-28.2'c.

VII. TECHNIQUES AND ELEMENTS USED BY OUR ANCESTORS-

6.1 Jaali: Another strange features of Mughal architecture for thermal comfort which makes the internal space cool is also known as lattice screen. Jaali is for ornamental purpose or geometric pattern which is used for privacy purpose when sunshine light came in internal space it is not clearly visible for outsider and it also controls the air flow and lower down the temperature. In MaanSingh Palace different types of jaali used but the thickness of all jaali is 3cm.
6.2 Pavements: pavements are made up of sand stone.
6.3 Wall: Wall is made by sand stone and thickness of wall is 400m.
6.4 Courtyards: It is open area often surrounded by walls or buildings. It is placed in centre part of palace so it performs well for cross ventilation of air. Wind direction of fort is from north.
6.5 Gallery: They provide double wall in first floor rooms contain courtyard which seems a gallery. First wall contain jaali and in second wall they leave hollow space in square shape with some distance of 300mm*300mm. It allows the wind to move inside the building with a greater force. Small opened window in inner wall also increase the velocity of air. When the air with a greater velocity into wide space,so it lower down the temperature of inside space of palace.

VIII. OBSERVING ASPECTS

The placing of jaali in palace is very well from north side and wind also flow from north in Gwalior and whole palace facades consist perforated jaalis which have its own impact on building to maintain the inner temperature and make the inside space cool and provide good thermal comfort thickness of wall also maintain the temperature and keep the building cool. Courtyard in inside the building also play a vital role and lower the inner temperature. Material which used in building is also a energy sufficient and resist heat like the wall is made up of sand stone is enough thick to resist heat and provide good thermal effect. Jaali lighten up the

interior in day and also protect from the direct heat radiation of the sun, so temperature will not increase, it create a gallery space perfectly so the air can easily move in all over the rooms and make them cool.

IX. CONCLUSIONS

It can be concluded that in ancient buildings they used such good passive cooling techniques for providing thermal comfort in all seasons. Modern buildings are lack in these things and consume so much energy for artificial cooling. The architectural style and passive cooling techniques used by ancestor is not only used for the purpose of aesthetic, it is also provide thermal comfort and doesn't consume energy. The building is also energy efficient. It is important to focus on Gwalior heritage building so we can implement these techniques in modern building and also try to find out the way to use these techniques in modern building because of this we can also make the building energy efficient and green building. We can plan the building in which we provide jaali and courtyard for thermal comfort and also fix or set the jaali and window where the direction of air flow so the air can easily intake and make the rooms cool. And give courtyard between the rooms or buildings so easily warm air exit or cool air intake by window or jaali. And also give shade according to sun direction.

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