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**Creators of Human settlement**

Créateurs d'habitat urbain

Erbauer menschlicher Siedlungen

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**1. INDIAN HERITAGE IN THE SCIENCE OF STRUCTURE**

India not only constructed large structures thousands of years ago but also developed science of these structures. Raja Bhoj of eleventh century from a town Dhar in Madhya Pradesh wrote a treatise on town planning, construction of temples, ghats, palaces and several other types of structures. Basic principles about structures and specifications and procedure of construction are mentioned in the book entitled SAMARANGAN SUTRADHAR - a creator of human settlements. This expert was known as STHAPATI i.e. a combined Architect and Engineer or a creator. Engineers of that generation knew that a structure is affected by rains, founding soil, wind and effects of environment. Life of structure depends upon life of joints which are aged by heat and humidity. A structure must have utility, aesthetics and durability. Life of structures was planned to be 500 to 1000 years for public structures like temples and ghats. Stone and lime with admixtures to enhance durability of lime were used. A paint for 1000 years life was also evolved. Instructions about selection of appropriate materials like stone, lime, timber are given. In this short article author describes basic principles in two public structures - Temples and ghats. Ghat is a stone structure with steps and platforms built from bed level to above highest flood level of river almost equal to spread of town along the river. Art, culture and learning developed in the temples and along ghats, the focal points of the town. Many ghats and temples built 1000 years ago are in excellent condition today.

**2. TEMPLES**

Temple being place of worship must have attractive shape and pleasant surroundings. It must be tall enough to be visible from everywhere in the town. Shape of temple was inspired and evolved from tall pine trees in Himalaya and tall conical and beautiful mountain peaks, since these have survived for years against rain, wind and seismic effects. A tall structure has to withstand:

(a) The effect of wind which causes larger forces at higher level. Similarly seismic effect is more on tall structures. Therefore smaller width at top and wider base width are the requirements for stability, besides wider foundations; (b) The rainfall must quickly drain away from the structure. Regions where rainfall is more must have steeper slopes. Where rainfall is less, flat shape of dome is alright. All these technical

requirements evolved the shape of pinnacle of temples. Beside these technical requirements some philosophical requirements were kept in view. When a wider shape converges into a point, attention of a viewer is naturally attracted and he unknowingly concentrates at the point as he approaches from a distance. The process of meditation starts automatically. This causes concentration of the energy of the viewer who is relieved of many petty troubles and with this enlightened mood he would enter the temple and pray. Thus a pinnacle satisfied the technical as well philosophical requirements. That is why places of worship of all religions in the world have tall pinnacles. The shapes of pinnacles however vary. In Middle East countries rainfall being scanty Dome shape was appropriate for the situation. Mosques generally have dome shape but a pinnacle at the top. Many tall temples are founded on soil. Depth of foundation for 60 M high temple is not more than 6M. It is seen that about 30M to 60 M around the tall structure is a stone pavement with 300 to 600 mm thick large stones laid at slopes to drain away water. This apron around the tall structure have saved it from soil disturbances besides providing clean space for congregations.

### 3. GHATS

Ghats are used for taking bath, washing clothes and collecting drinking water. Such ghats are built across Ganges, Krishna, Godavari and Narmada and many other rivers in India. A study of these ghats has brought out some interesting technical aspects: (a) Towns in India are generally established on concave banks since pool of water is available at this scourable bank in summer and this was necessary to the habitants of town. If the town is on convex bank, one has to walk through sand on this silting sandy bank to get water; (b) Rock is not available in the bed of many rivers. The soil/sand banks on concave side erode during flood and for the safety of town the banks have to be protected; (c) It is not economical to provide deep foundations for temples and such tall structures. Shallow foundation and protection around was the alternative; (d) Ghats as floating apron act as protection work for the town from erosion of banks, besides bathing, washing or meeting places for town population; (e) Size of stones used in Ghat is found to be larger at places where velocity is high since smaller stone may be uprooted due to velocity. Some ghats are even thousand years old.



### 4. GHATS & TEMPLES

Ghats and temples are the land mark of Indian culture. Fine arts, learning of various subjects developed in the surroundings of rivers, ghats and temples. Hardwar, Maheshwar, Ujjain, Nasik and Wai towns have beautiful ghats. Ghats and temples built by Engineers promoted human settlements in India. Ancient prayer of engineers at inauguration was "God of rains, God of earth, God of wind and the God of environments be kind and protect these structures."

[ Temples & Ghats at Wai in Maharashtra place known for Sanskrit learning and eminent Pandits even today ]