Ahom Monuments - An Architectural Marvel (New Perspective)

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Abstract: *The Ahom dynasty ruled Assam for more than six hundred years. During this long six hundred years the Ahom Kings took up lot of structural activities- both secular and religious, which are still seen all over the state, but the main concentration of their monuments is in Sivsagar. The early rulers used perishable materials for construction, but from the time of Rudra Singha (1696-1714), brick and lime mortar were used. The whole of Northeast falls in highly seismic zone and in the last 500 years at least 14 big earthquakes are recorded to have taken place in Assam. And, it is surprising to see that the extant monuments at Sivsagar have withstood at least 8 to 9 earthquakes (including the last one in 1950, which is believed to be one of the world's most devastating earthquakes). Even when the Assam type houses collapsed in that area, the Ahom monuments have withstood these with minor damages. This very fact gives an insight in to the fact that the Ahoms very judiciously used the available resources for making their structures earthquake resistant. This paper is a discussion on how the Ahoms were successful in making their structures earthquake resistant.*

Keywords: Ahom, Sivasagar, Temples, Architecture, Earthquake, *Jamuna, Rasendra*

Introduction

Sivasagar previously spelled Sibsagar ("the ocean of Lord Shiva"), is a town in Upper Assam, about 360 km (224 miles) north east of Guwahati. Sivasagar city is the administrative headquarters of the district. The district covering an area of 2668 square km comprises of two sub-divisions – *Sivasagar* and *Nazira*. It is bounded by the Brahmaputra River on the north, the Nagaland on the south, the Charaideo district on the east and the Jhanji River on the west. It is well known for its Ahom palaces and monuments.

Ahoms

The Ahoms, after whom Assam got its present name, established political and cultural unity and economic stability in this region for more than six hundred years (1228 CE - 1826 CE), which helped in the process of evolution of a new nationality and culture by bringing together various ethnic groups under one administration.

The Tai Ahoms are members of the Great Tai (Tai Yai) group of Peoples. In the year 1215 CE it is believed they migrated from Mong--Mao or Mong-Mao-lung (present Dehong Dai Jingpho Autonomous Prefecture of Southwestern Yunan Province of Peoples Republic of China), entered in to the upper Assam region of the Brahmaputra Valley through Patkai hills under the leadership of a Mao Shan Prince, named Chaulung Siukapha. He became the first king or Chao-Pha or Swargadeo (Lord of the Heaven) of the Ahom dynasty, who established the first Ahom capital at Che – Rai Doi or Charaideo and there after it was shifted 5 more times and out of this other four (4) were within Sivasagar district only. The Important Capitals of Ahom and the period of establishment are 1) Charaideo- established by Chau-lung Siu-ka-pha (1228-1268 CE); 2) Charaguwa- established by Sudangpha (Bamuni Konwar) 1397-1407 CE; 3) Garhgaon - established by the king Sulkenmung or Garhgayan Raja (1539-1552 CE); 4) - established by the king Sukhampha (Khora Raja) (1552-1603): 5) Rangpur (present Jaysagar locality) - established by the king Rudra Singha (1696-1714 CE) and 6) Jorhat- established by the prime minister Purnananda Buragohain, after Moamariyā uprising which vandalized the Rangpur city. During the long six hundred years the Ahom Kings took up lot of structural activities both secular and religious, which are still seen all over the state but the main concentration of it is in Sivsagar. The early structures of the Ahoms were of perishable materials and it was from the time of Rudra Singha (1696-1714) that the Ahoms started using brick and lime mortar as the medium of construction (Barpujari 1994: 339). As whole of Northeast falls in highly seismic zone, in the last 500 years at least 14 big earthquakes are recorded to have taken place in Assam (Hazarika 1990: 32-33) (The earthquakes took place in the years 1548, 1598, 1601, 1642, 1660, 1696, 1732, 1759, 1770, 1838, 1842, 1875, 1897, 1950). This very fact gives an insight in to the fact that the Ahoms very judiciously used the available resources for making their structures earthquake resistant. This is evident from the fact that the extant monuments at Sivsagar have withstood at least 8 to 9 earthquakes including the last i.e. 1950, Which is believed to be one of the world's most devastating earthquakes; when even the Assam type houses collapsed in that area, the Ahom monuments have withstood them with minor damages.

How did the Ahoms do this? In this paper this fascinating aspect of the Ahom architecture is discussed, which was not given a thought earlier and this too is at a hypothesis, for it has to be established by further scientific research.

Ahom Architecture

In Sivsagar alone there are more than 170 tanks, of which many have dried up and encroached upon. The tanks that are extant have a very typical architecture. The tank is always at an elevated area compared to the surroundings. On one (sometimes two) of the bank of the tank are the temples/structures, numbering one to four maximum. Around the tank almost at equi-distance runs a moat at a lower level (about 2-3 m) about 45 m wide. Seeing them I was compelled to think that this arrangement was not without any purpose. And I believed that it had to do something with earthquakes and the local geomorphology. This contention was further strengthened by two events:-

1. In the month of January 2014 had taken a team of Civil engineering and Earth Sciences professors for consultancy in connection with conservation of the Maidam at Charaideo, Sivsagar. There while discussing the soil type it was revealed by Dr. T.V Bharat on visual observation that the soil contained a mineral called montmorillonite which is expansive in nature and behaves like the black cotton soil i.e. it is homogeneous when humid and cracks appear when dry.

2. In the month of March 2014, I had given an interview to Assam Tribune about the immediate threat to the monuments of Assam in which I had postulated that only those monuments are surviving in Sivsagar which had the water bodies intact around it. And the very next month (April) the Dy. Director, Directorate of Archaeology, Assam came to my chamber and narrated about a long crack along the Naupukhri Sivdule (A state protected monument in Sivasagar) which was 180 or so feet long 6-7 feet deep and 30-40 cm wide (Figs. 1 and 2). The condition of the water body was inquired and it was informed that the adjacent tank was given on lease to the fishery department and they had emptied the tank to de-silt it. It was recommended by me that nothing was to be worried, as the crack was along the temple and not across it, so just take some truck load of earth and fill in the crack with water pressure and that will do the job. But they did not heed to my advice, instead went to IIT, Guwahati and IIT Guwahati gave them a project proposal to investigate in to it. By this time it was June, monsoon had set in and the tank was replenished. It was seen that the crack had automatically come close leaving a scar on the surface due to uneven settlement.

Figure 1: General View of Na-Pukhuri, Sivadol, Jaysagar

Figure 2: Earth Surface Showing the Crack

One of the ASI Guwahati Circle protected sites Dhandi in Gohapur, Bishwanath District had collapsed in the earthquake of 1897, a survey of the area showed that the water bodies of the temple had completely dried up due to silting and encroachment by the villagers, which is presumed to be the cause of its collapse.

The above two events, assessment of the Archaeological Survey of India's site and some other sites in Sonitpur and Sivsagar made my contention even firmer that the Ahom architects had an in-depth idea about the geological and soil conditions of the area. There are reference to it in the Changrung Phokanar Buranji (Handique 2007) as to how the sites were identified with perennial spring first and then the planning of the area was done accordingly (Barpujari) (In the chronicles of the period it is stated that the selection of the site for a proposed tank depends on an expert known as the *maticheleka* or the soil-tester who undertook a scientific experiment for locating a perennial spring for keeping the water level of the tank constant. Another notable feature is that most of the tanks excavated by the Ahom rulers still maintain an water-level much higher than the topography of the land around them. The chronicle very categorically states that boulders were used for making the foundation which was called the *Garvha* (Handique 2007: 43-47). So from the above it is seen that the Ahom Engineers used Boulders and earth/clay to fill up the foundation trench and over that the super structure was built of brick in lime mortar, unlike the regular practice of having similar material as the super structure in the foundation. Further, it is seen that the level of the foundation was always in level with that of the level of the water in the main tank and the distance between the two was not much and the level in the tank was maintained year round. It is said that mercury, which is locally known as *para* or *rah* (*rasa*), was poured in these tanks at the time of excavation. Though the technique is already lost, Barbarua (Barbarua 2006: 436) mentioned that after the completion of the tanks excavations, in a copper cylindrical glass, the mercury was buried at the tank's bottom. The quantity of the mercury was unknown as the technique was lost. It is also said that the mercury protected the water from growth of weeds and the water always remained crystal clean and the water level never fell. (The technicians who poured the *rah* or mercury at the bottom of the tank were known as *Rasendra*. The *Rasendras* were Brahmins by cast and their family was known as *Rasendra Ghar.* They were helped by a *Khel* called the *Rah-dhala-khel.* They helped the *rasendra* to produce the *rah* and pour/place them in to the tank). This kept the foundation of the structures moist throughout the year and acted like a sponge/elastic to absorb the earthquake shocks. Further, as discussed earlier the water in the tank and moat (locally called *Jamuna*) kept the land around the temples moist throughout the year and prevented development of cracks, in the event of dry spell. The same during my visit to Deccan College, Post Graduate and Research Institute in September 2014 discussed the findings and my contentions with Dr. Sabale (Professor. Sabale Pandurang Digamber. Head, Department of Environmental Archaeology. Deccan College Post Graduate and Research Institute, Pune. He has expertise on Environmental Archaeology (Geoarchaeology), Geology, Geophysics, Sedimentology, Remote Sensing, Geomorphology) and he agreed with my views that the use of the water bodies, different materials, difference in level of the water bodies were meant for protection from earthquakes but suggested that with a more detailed scientific study the same could be said with more certainty. (Earthquake shaking and damage is the result of three basic types of elastic waves. Two of the three propagate within a body of rock. The faster of these body waves is called the primary or P wave. Its motion is the same as that of a sound wave in that, as it spreads out, it alternately pushes (compresses) and pulls (dilates) the rock. These P waves are able to travel through both solid rock, such as granite mountains, and liquid material, such as volcanic magma or the water of the oceans. The slower wave through the body of rock is called the secondary or S wave. As an S wave propagates, it shears the rock sideways at right angles to the direction of travel. If a liquid is sheared sideways or twisted, it will not spring back, hence S waves cannot propagate in the liquid parts of the earth, such as oceans and lakes.

The actual speed of P and S seismic waves depends on the density and elastic properties of the rocks and soil through which they pass. In most earthquakes, the P waves are felt first. The effect is similar to a sonic boom that bumps and rattles windows. Some seconds later, the S waves arrive with their up-and-down and side-to-side motion, shaking the ground surface vertically and horizontally. This is the wave motion that is so damaging to structures.

The third general type of earthquake wave is called a surface wave; reason being is that its motion is restricted to near the ground surface. Such waves correspond to ripples of water that travel across a lake. Surface waves in earthquakes can be divided into two types. The first is called a Love wave. Its motion is essentially that of S waves that have no vertical displacement; it moves the ground from side to side in a horizontal plane but at right angles to the direction of propagation. The horizontal shaking of Love waves is particularly damaging to the foundations of structures. The second type of surface wave is known as a Rayleigh wave. Like rolling ocean waves, Rayleigh waves wave move both vertically and horizontally in a vertical plane pointed in the direction in which the waves are travelling.

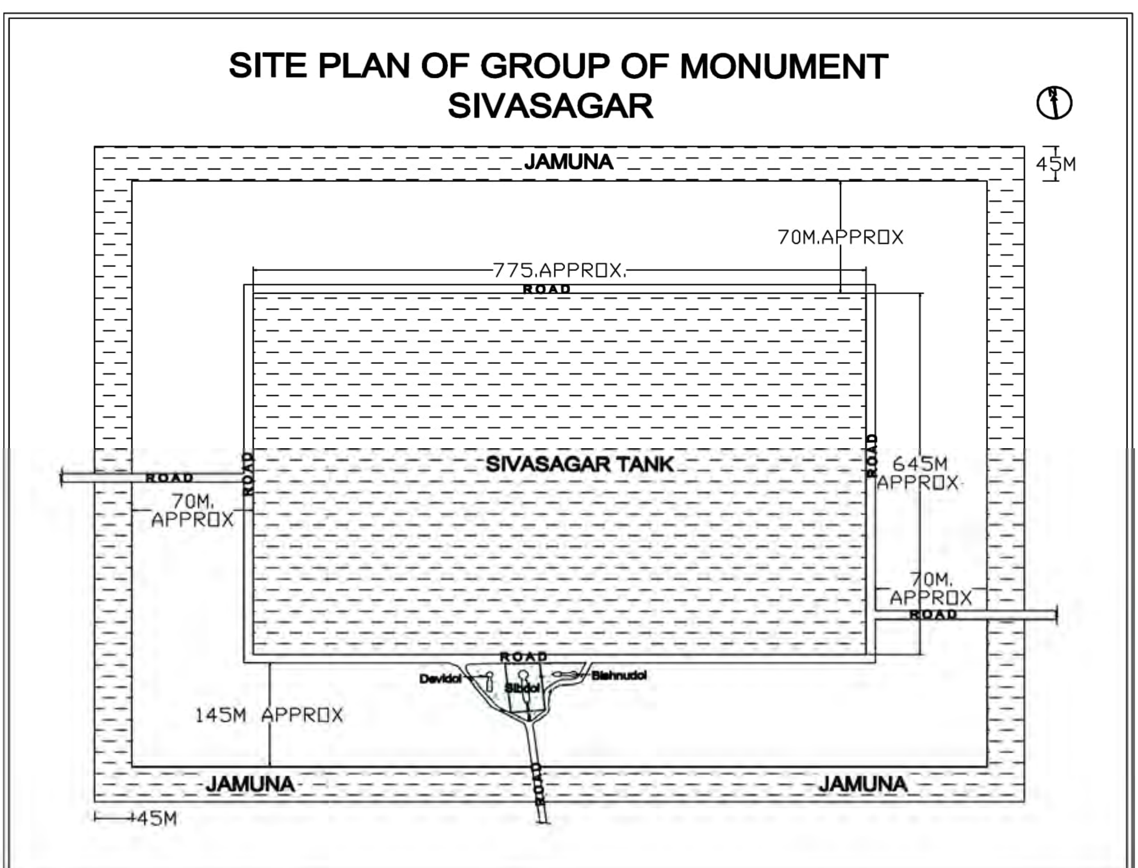

Figure 3: Plan of Sivasagar

Figure 4: Google Map of Jaysagar, Sivasagar

Surface waves travel more slowly than body waves (P and S); and of the two surface waves, Love waves generally travel faster than Rayleigh waves. Love waves (do not propagate through water) can effect surface water only insofar as the sides of lakes and ocean bays pushing water sideways like the sides of a vibrating tank, whereas Rayleigh waves, because of their vertical component of their motion can affect the bodies of water such as lakes. P and S waves have a characteristic which effects shaking: when they move through layers of rock in the crust, they are reflected or refracted at the interfaces between rock types. Whenever either wave is refracted or reflected, some of the energy of one type is converted to waves of the other type. A common example; a P wave travels upwards and strikes the bottom of a layer of alluvium, part of its energy will pass upward through the alluvium as a P wave and part will pass upward as the converted S-wave motion. Noting also that part of the energy will also be reflected back downward as P and S waves).

Figure 5: Google Map of Gaurisagar

For detailed study Sivsagar's ground plan was taken (Fig. 3) [as from the Google images (Pl. 4 - 6) it is seen that the plans are almost the same] and one temple each from the three ASI protected complexes was taken (Figs. 7-9). It is seen that the tank are rectangular with the temples on the longer side. (Pl. 4-6 and Fig. 3). The distance between the tank and the moat (*Jamuna*) is same on three sides and on the side of the temples the distance is almost double. At Jaysagar as the structures are on two sides, it is seen the width of the land between the structures and the moat is wider on two sides and narrow on the other two sides. (Figs. 3, 7-9). The distance between the structures and the tanks is less than half of that between the tank and the moat. (Figs. 3, 7-9). Level of the foundation of the structure and the water level in the tank is almost at the same level even today. (Figs. 3, 7-9). The foundation of the structure was made with river boulders and earth/clay, over which the superstructure was raised. The moats are located at a lower level by about 3 to 4 m. (Figs. 3, 7-9). The width of the moats (*Jamuna*) is 45 m in all the three cases. (Figs. 3, 7-9).

Figure 6: Google Map of Sivasagar

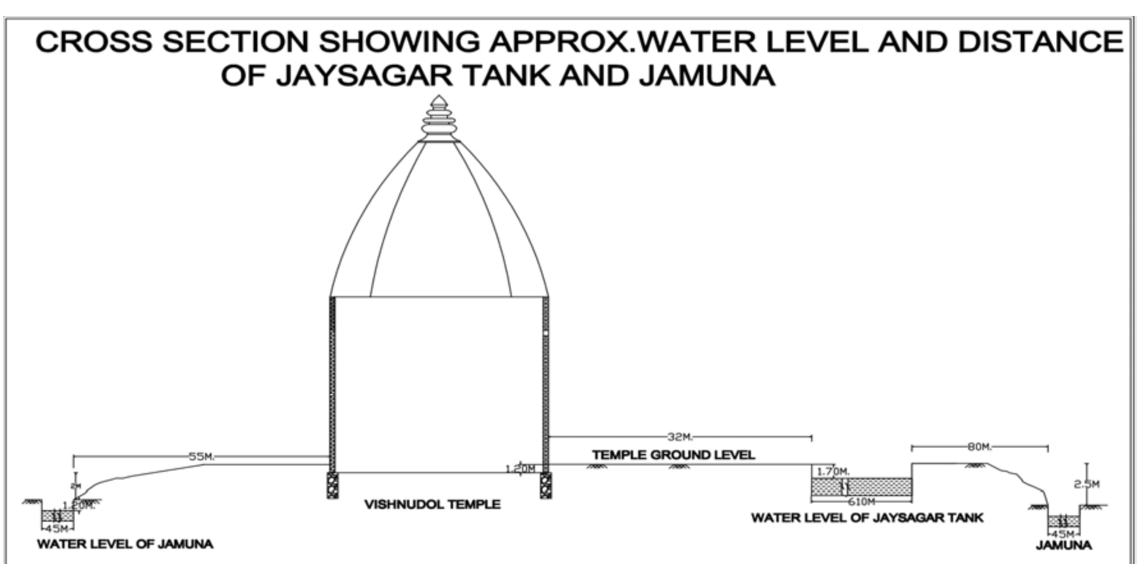

Figure 7: Cross-section of Jaysagar

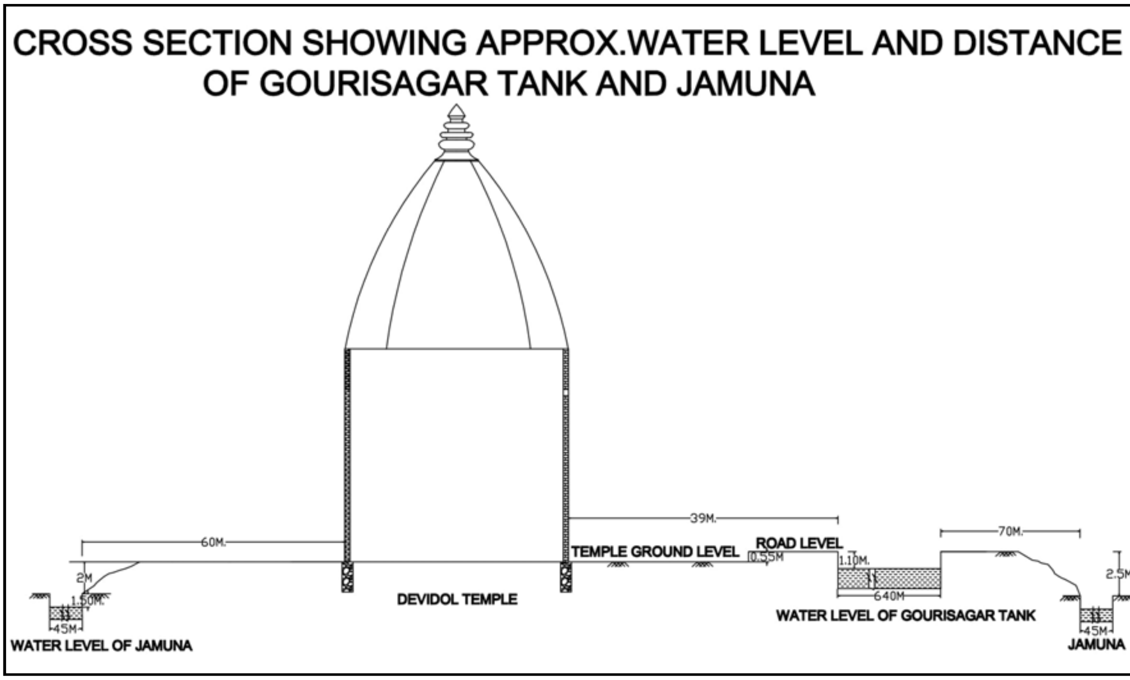

Figure 8: Cross-section of Gaurisagar

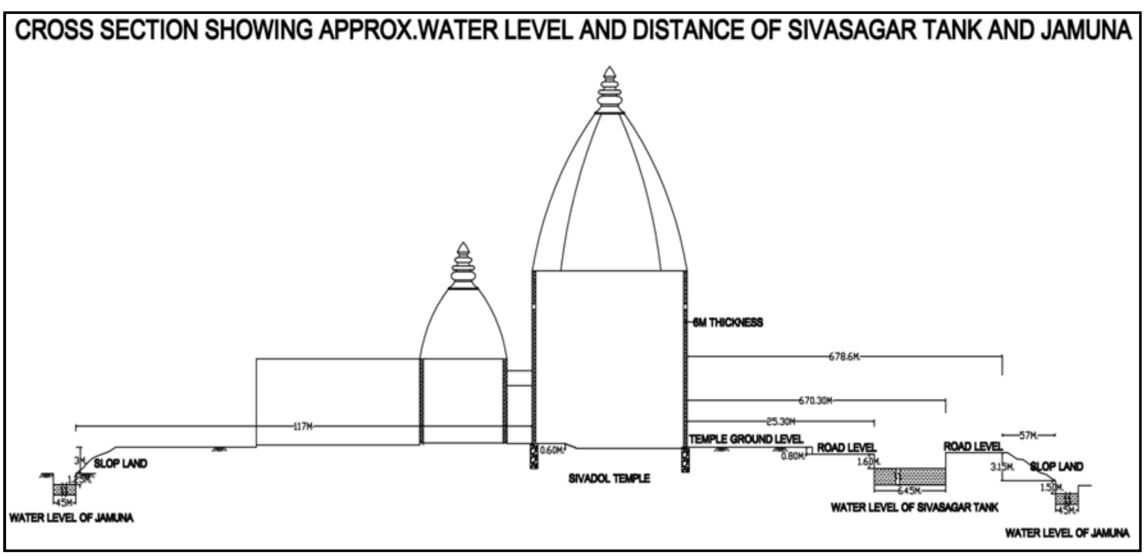

Figure 9: Cross Section of Sivasagar

Discussion

The Ahoms according to the chronicles inherited a tradition of large but impermanent buildings of timber and thatch, which were structurally perfect and aesthetically beautiful. The earliest records of this are found in the accounts of Shihab-ud-din Talish who accompanied the Mughal General Mir Jumla during his Assam campaign in 1662-63 CE (Barpujari 1994: 323). The permanent phase of construction using brick and lime started from the reign of king Rudra Simha (CE. 1696-1714) who in the absence of artisan in his kingdom imported one called Ghanashyam from Koch Bihar, who is believed to have taken up major construction works in Sivsagar and Charaideo

(Barpujari 1994: 324-25). It won't be out of place to mention that though the Ahoms ruled the Brahmaputra valley from the second quarter of the thirteenth century to the first quarter of the nineteenth century but their major building activities were confined to the eighteenth century (Barpujari 1994: 336). All the authors have discussed the splendors and achievements of various Ahom rulers but no one discusses as to how the Ahom artists learn the art of making the structures earthquake registrant. Barpujari (Barpujari 1994: 340) has mentioned in his book that "this (Siva daul) tall structure with its slender pinnacle survived the shocks of many great earthquakes, for which this region is notorious, and this indirectly proves its efficient workmanship" but did not care to apply to the whole planning. On the basis of the above observations it is seen that the Ahom architecture evolved over time but even the chronicles are silent about the construction of the tanks and the moats around them and they at all served any purpose. But knowingly or unknowingly the Ahom engineers had mastered the science of geology and seismology and judiciously used the available resources for defying the three basic types of elastic earthquake waves which causes the shaking and damage, thus allowing these edifices to survive more than 8-9 big earthquakes recorded during their period of existence. The above hypothesis is put up on the basis of visual and circumstantial evidences, which needs to be scientifically probed and confirmed.

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