UNDERSTANDING ANCIENT INDIAN KNOWLEDGE OF SCIENCE AND TECHNOLOGY IN TERMS OF ARCHITECTURAL WONDERS

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The big challenges for the young architects in the developing country like India are to express a cultural identity of their local qualities in their cities. Globalisation increases the limit of cultural borders, customs and earthly differences. Although the current curriculum is in much more scanned format yet does not promise for a positive response for the conflict. Although today we have well educated civil engineers and trained architects yet we witness hazards due to collapsing of buildings, bridges, flyovers and shocking piercing of roads. Since as an Indian, we have rich knowledge of mathematics, science and technology from ancient era and the proof is our splendid and marvellous heritage in the form of sculptures, structures and architectural benchmarks. This architectural knowledge would help a lot to young architects to universalise the architectural repertoire valid for all without much regard to any identical hurdles. This paper draws and examines the development and knowledge of ancient India about science and technology of architecture and its influences, also sketches the relevance to draw attention of modern man to the need for look back to learn how can we live and make harmony with nature. This would lead us to live a sustainable, bright, happy, healthy and safe future to our forthcoming generation.

Keywords: Architecture, God particle, Harappa civilisation, Sculpture, Rock-cut, Sustainable architecture, New urbanism, New classical architecture, Eco cities, UNESCO world heritage

Introduction

We are living in the twenty-first century where everything is possible. We have all the modern scientific theories, knowledge and technology and there is no strange if we will be successful to find out the God Particle in upcoming years. Still, when we walkout on the roads, face unavoidable traffic jam, despite having all the modern machinery and techniques, people die due to collapsing of under-construction as well as constructed over bridges and buildings. Streets are full of overflowing sewage waters. Although we have well educated civil engineers as well government authority yet there is no town planning. In fact, we are living in a very haphazard way.

According to an old saying, food, clothes and shelter are the most prominent basic need of mankinds and shelter is one of the most basic physiological needs. The journey of men go from the dwelling in the caves to carving out temples in mountains; they have modified shelter with every passing era. Indian architecture is really a fascinating fusion of both art and science. It has crossed the limits of engineering and design from strategically placed astronomy towers to impressive and awe-inspiring tombs. And the most important thing is that all these happened without the aid of modern machinery and machines. So, take a break and stop, just move U-turn towards the past and know its ability to do what we cannot even with modern tools and technology. Here, I would

like to mention a few architectural wonders of ancient India such as Braihadeeswara temple of Tamilnadu, Khajuraho groups of monuments, ruins of Hampi, Veerupaksha and Lepakshi temples in Karnataka, Konark's Sun temple, Odisa, Stupas (specially Sanchi), Mahabodhi temple, Monolithic wonder statue of Gomateshwar, Iron pillar of Delhi, Champaner-Pavagarh archaeological parks, Bhimbetaka, Kailashnath temple, Kanheri, Ajanta, Ellora and Elephanta caves, Mahabalipuram, Rani Ka Vav and, of course, the first of firs test Harappa and Moahanjodaro town planning and drainage system.

Brief Discussion about Science and Architecture of a few Structures

So, let's analyse the splendid and incredible town planning and drainage system of the Harappa civilisation. Today we are 'so called' most civilised generation on the Earth, most technosevy and innovative mind holder species. Intelligence Property Rights and Patent culture are the focus of current era, yet we are suffering with invalid, unreliable and unsustainable infrastructure. Just think how the benchmark town planning and infrastructure was possible even before five thousand years had approximately. Is it not fascinating that at that time the cities of Harappa and Mohenjo-Daro were distinguished by the orientation of streets and buildings according to the cordial direction: east-west and north-south and fortification all around. There were large gateways at various entry points of the cities and as the most outstanding feature of the civilisation are well laid out streets and side lanes. At present time, it is common to see people campaigning to make others understand assimilate civic sense but civic sense of Harappan people was really adorable; no encroachment on the street was to be seen even the width of these street was in a set ratio.

The second ancient wonder is Vijaystambh and Brihadeeswara temple. It is the place where walls sing and sculptures dance. These were not built by the stone merely but the pride of the people. Vijaystambh is 112 feet high and could collapse by self load. But it still stands just because it was designed as central chamber and outer gallery and joint through sty case. Who thought that science could take such an inspiring and beautiful shape. The thousands years old temple of Lord Shiva that is Brihadeeswara is located in Thanjavur, Tamilnadu. It is a fine example of the Dravadian architecture built by Raja Chola I. It is two hundred and sixteen feet high and more than one hundred and thirty thousand tonnes of granite is said to have been used to build it. The surprising thing is that there is neither a mountain nor a rocky hill for approximately 60 kilometres around Thanjavur. The architecture of this place is based on interlocking; also known as puzzle technique. It means placing one stone with the one just to lock it without using cement stucco plaster or any adhesive. There is nothing between two stones. It has been seen that many monuments like London's Bigben, Italy's Leaning Tower are tilting with time but even after thousands of years, this temple is absolutely straight. This is because it's puzzle or interlocking technique. The other reason is that the base of the temple is so wide that has kept it straight. The other speciality of the temple is that it was built without digging the Earth, means on a plain land. It is such a superb architecture. The stone placed at the top of the temple, known as Kumbham, weighs around 81 tones and

is carved out of a single rock. I wonder how they would have placed this single stone at the top. Those days when they had no cranes to lift the stones, they made about 6 km long ramp. Elephants, horses, buffaloes and labourers together carried the stone to the top of the temple.

The next wonder is Kailashnath temple. It is the high point of the Hindu temples undoubtedly. There are columned galleries, three-storey high large sculpted panels and alcoves containing enormous sculptures. In attempting to recreate this version of paradise, the ancient craftsmen and artists of Ellora came up with something of an architectural marvel. It is the largest monolithic structure in the world carved at a single rock. Normal temples built from base to upward which The Kailash temple was from top to downward. Further, Ajanta Caves are, of course, the splendid paragon of ancient Buddhist civilisation, filled with paramount tranquility. These exemplify the unsurpassed imaginative power and engineering excellence of the bygone era. The architects of these projects were so proficient that some of the caves they excavated reach almost hundred feet into the rock.

The Khajuraho groups of monuments are a vast complex of Jain and Hindu temples. It is a UNESCO world heritage site and blending of art and science can be seen here.

The pride of Odisha Konark Sun temple is also a wonder where even stones speak up in prayers. One marvels the fascinating architecture and erotic sculpture of the Konark Sun temple. Elaborately carved wheels, walls and pillars of the Sun Chariot styled temple is the main attraction. There are 24 carved wheels, each of them three metres in diameter, pulled by seven horses. And the wonder of the temple is none other than the Sun dials. A beautiful blending of science, architecture and devotion can calculate time to exact minute even today! Is it not amazing. The wonder architects and engineers continue to be baffled by its architecture and engineering skills.

Now, come to the ruins of Hampi, the lasting testament to the grandeur of the Vijaynagar Empire. It is also a UNESCO world heritage site. It has mainly speculating temples like Vithala, Veerupakshi, Lepakshi temples, Grand Lotus mahal and Ganesha temple. One of the gems of Hampi is the Veerupakshi temple. The attraction of it is nine-tiered eastern gateway, which is at 50 metres, well proportioned and incorporates some earlier structures. Gateway has a brick super-structure and a stone base. Veerupaksha temple looks like geometric expression. Fractals are the foundation of this expression (repetition across different scales are called fractals). Is not that beautiful.

A timeless story carves in rock of the Elephanta caves. These stunning archaeological remains of the elephanta caves echo the story of rich dynasties that ruled the place at that time. This is a beautiful blending of sculpture, art and aesthetic beauty. Sprawling from the entrance to the back colossal cave, one measures to an elegant height of thirty-nine metre and it is enough to drench one in the splendid and vast world of rocks and architecture. The ancient Indians had a great sense of water harvesting. Rani ki Vav, Pandav and Kanheri caves are a few examples of the rich knowledge of those people. A temple turned upside down to worship water in Rani ki Vav. To worship

hallowed water of Saraswati river, this was built by Rani Udaymati in eleventh century AD. It is 64 metre long, 20 metre wide and 27 metre deep and runs downwards up to a length of seven storieys and is also a beautiful example of subterranean architecture. With the central theme the ten incarnations of Lord Vishnu, this entire storey came up with 800 structures. All of which represent human, nymphs, gods and the kings in varying forms of skill. It is an astonishing fact that in those times, it acted as a natural coolant. Just think about the level of scientific and architectural prowess it would have taken to conjure up a monument in an inverted temple of the impeccable style.

Research Method

It is a qualitative research. The study has the chief characteristics of a document based analytical research. Researcher collected information through comprehensive literature review and content analysis of the published work about ancient Indian knowledge: mathematics, science and technology.

Result and Discussion

It is a very common feeling of happiness on seeing the beauty of buildings but a very few persons think about the ancient science and technology used. Sculptures and architecture of past time, huge water harvesting system or skyscrapping buildings and unique rock-cut structures had been made without any modern technology or machinery. Such architecture has their own interesting stories. Just Imagine how scientific and brilliant those minds were who thought all these at that time! amazingly, the shadow of science of that era is more impressive than the picture of today!

High-tech equipments and tools are the necessity of current era in building construction. This is why, we see the modern marvels like Burj Khalifa of Dubai and Tokyo's Skytree. But even when the advanced equipment like cranes and transportation technology were not there, even then stunning architectural structures were constructed in India. I have discussed a few of them a earlier. Here, at this stage, I would like to discuss the implications of my study. The relationship between the architecture and mathematics is so deep that could not be recognised as two different subjects for many decades. The knowledge of mathematics and architecture in India was so progressive and hence we can see there were different principles and mathematics behind each different architecture. The enormous and marvel architecture of ancient time give us message of civic sense, and secondly, the human values like cooperation, coordination, foresightedness, energy, courage and, of course, sustainable living with nature. We travel these places just for fun and refresh ourselves during holidays and do not listen their silent voice generally. We are organising Conferences on Climate change and Global Warming like COP, Earth Summit and many more. We take oath to control the increasing level of temperature, level of GHGs into environment, etc, but not ready to compromise with unscientific and unsustainable use of technology for development.

If those people were aware about water harvesting and natural cooling system four to five thousands year ago, why cannot we?

If they could carve the rock without using dynamite, why cannot we?

If they could construct marvels of town planning without a bit of encroachment, why cannot we?

I discussed about a few gems from the architectural mine of ancient India. It is a long list of such examples from ancient to modern India till eighteenth century. We need to learn from them to attain the SDG 2030. And, in my point of view, there is no other way to live sustainably without leaving our monotonous attitude about development like: *Apna to kaam chal rha hai na!*

Conclusion

The paper concludes that we cannot escape the pride that we feel whenever someone mentions the word India, wherever we go, whoever we are and whatever we are doing. And yes, we would be the richest country if the culture, heritage, mathematics, science and technology were a currency. We have faced countless invasions and wars, conquest and peace keeping eras. These metamorphosed our society, polity and as well geography. But, through all of these the one and only thing that has still remained constant is the architectural and artistic prowess of the masters. Their sheer genius and beauty of architecture and science has not dimmed hitherto. Among the many wonders of the world, it is the phenomenon of cutting to sheer, solid natural rock for preparing remarkable architect structures and sculptures. Though this is found in the many parts of the world but nowhere else to be found around us and the variety of rock cut structures that have been found in India. From the beginning of recorded history, it is fascinating to see how closely man has worked with nature. He looked for solace and support and found spiritual contentment in the sun and the sky, in fire and water. Man replicated the beauty of nature on materials we found in nature, colouring it with his own emotion and feelings, and thus was born art. The art became sustainable through the use of brain. The need of present time is to learn from our past and apply their knowledge in present for giving our forthcoming generation a bright, happy, healthy, safe and sustainable future. It is time to understand how the ancient sustainable architectures can give base to the new urbanism, new classical architecture and eco-cities. Such knowledge will contribute much to the education of new and young aspiring minds in globalisation.

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