Visual reconstruction of Hampi Temple - *Construed* Graphically, Pictorially and Digitally

Reconstrucción visual (gráfica, ilustrada y digital) del Templo Hampi

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Resumen

El complejo del templo existente en Hampi (Karnataka, India) se ha estudiado, analizado y documentado extensivamente. El complejo se ha medido, dibujado y digitalizado siguiendo el trazado de sus bordes y vértices utilizando AutoCAD para generar dibujos en 2D. Los elementos gráficos obtenidos en 2D se han ampliado en 3 dimensiones utilizando para ello Google sketch-up. Esta herramienta se ha utilizado para facilitar la reconstrucción visual del templo con objeto de lograr recuperar la arquitectura del edificio en su forma original. El modelado virtual 3D/reconstrucción visual nos ayuda a visualizar la estructura en su forma original proporcionándonos una imagen holística del Imperio Vijayanagara en todo su esplendor. El proyecto se ha basado en la utilización de dibujos de Auto-CAD, ilustraciones, modelos digitales a partir de Sketch-Up y Kinect.

Palabras Clave: *RECONSTRUCCIÓN VISUAL, MODELO SKETCHUP, KINECT, ARQUITECTURA, TEMPLO, VIJAYANAGARA.*

Abstract

The existing temple complex in Hampi, Karnataka, India was extensively studied, analyzed and documented. The complex was measured-drawn and digitized by plotting its edges and vertices using AutoCAD to generate 2d drawings. The graphic 2d elements developed were extended into 3 dimensional objects using Google sketch-up. The tool has been used to facilitate the visual re-construction to achieve the architecture of the temple in its original form. 3D virtual modelling / visual reconstruction helps us to visualize the structure in its original form giving a holistic picture of the Vijayanagara Empire in all its former glory. The project is interpreted graphically using Auto-CAD drawings, pictorially, digitally using Sketch-Up model and Kinect.

Key words: *VISUAL RECONSTRUCTION, SKETCHUP MODEL, KINECT, TEMPLE ARCHITECTURE, VIJAYANAGARA.*

1. INTRODUCTION

The Hindu temple architecture is a typical trabiated style of construction based on grid design and symmetry. Specially the Southern region of India, where Vijayanagara style of Architecture is predominant in many well-known cities - HAMPI, Bellary district, Karnataka, being the capital city of Vijayanagara empire is the most developed, rich in heritage

and culture. Hampi is a beautiful village surrounded by lush green valley fed by Tungabhadra River. The city had fallen into destruction after Islamic invasion in 1565 and was re-discovered in 1800's by the British in the Madras presidency. From then onwards till today Hampi has been promoted as important archaeological site, also recognized by UNESCO. The Vijayanagara architecture is said to be culmination of Dravidian temple building tradition. The marvelous architectural design of the temple complex and its elements with the structural system using stone is an impeccable synergy between structural innovation and architectural expressions.
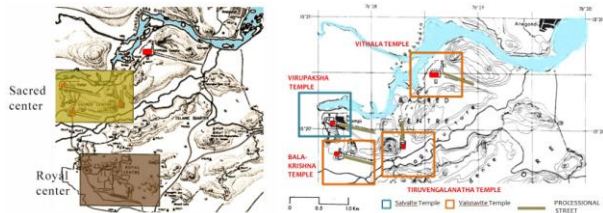

Figure 1: (a). Plan of Hampi Showing royal and sacred centers, (b). Four puras or districts in the sacred center of Vijayanagara showing Vithala temple and the bazaar street

The city is divided into royal and sacred centers as per the rituals and functioning of the spaces as shown in Figure 1. (a) We are focusing on the Vithala temple complex which is located in the sacred center of the Vijayanagara Empire.

The orientation of the temple proper, is to the normative east with Bazaar Street towards east and north. See Figure 1. (b) The *Vithala* temple - processional path in the east, the bank of the river in the north and west, hills in the south. The influence of *Srivaishnava* sect is seen at this temple complex which is revealed by observing minor shrines to the south, west and north. The study forms understanding social impact of the sect on the temple complex.

Visual re-construction based on a rigorous study and use of contexts: historic, social and cultural, architectural principles associated with the culture. It also uses modern tools for 3D modelling and reconstruction (such as Kinect) to bring aspects of the monuments to life.

2. INFLUENCE OF RITUALS ON ARCHITECTURE AND VICE-VERSA

The temple complex at Hampi, *Srirangam* and *Kanchipuram* of Vijayanagara style of architecture have minor shrines of the *Alvars* of Srivaishnava sect. Apart from the *Alvar* shrines, they included feeding houses and endowments to support *utsavams*.
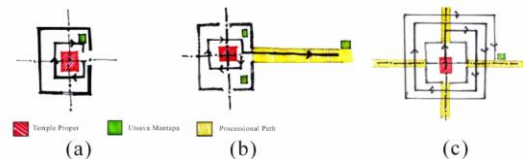

Figure 2: Comparative analysis of the utsava mandapa with respect to the processional path in different temples. (a) Nataraja Temple, Chola Period, (b) Vithala temple, Vijayanagara period (c) Madurai Temple, Nayaka period
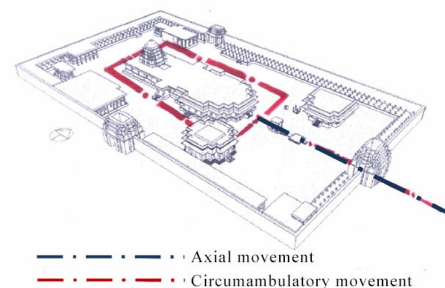

Figure 3: View of Vithala temple complex showing the processional path of the deity, Plan of the Vithala temple complex
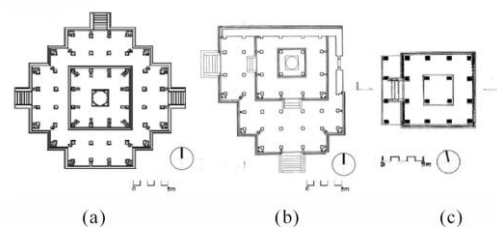

Figure 4: (a). Plan of South-East Kalyana Mandapa, (b). Plan of North-East Utsava Mandapa, (c). Plan of Utsava Mndapa at the end of Bazaar Street
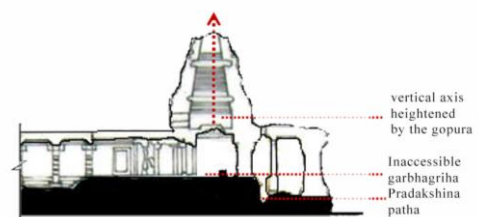

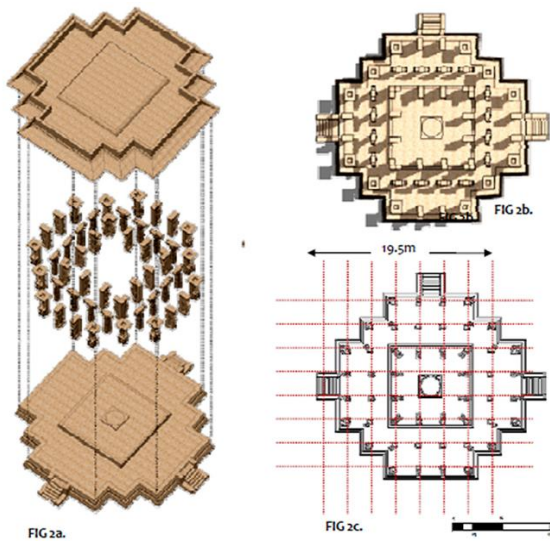*Figure 5: Section of the temple proper*

Figure 6: Plans and View of the South-East Kalyana Manatap

Figure 7: Development of the Vithala temple complex over the years showing the proportion

The utsava *murthi's* were taken on processional path during special occasions. The processional path circumvents the temple complex apart from the axial one as shown in Figure 3. This influences architecture directly in its special organization of the temple complex. The *kalyana mantapa* in *Vitthala* temple has double plinth as shown in Figure 4, 5, and 6 where, the deity's marriage is performed at the center of the mantapa. Again we observe the influence of ritual on Architecture. The *Uyyala mantapa* at the north-east of the temple complex, again has a second plinth attached to the northern part of the mantapa. The cloisters around the temple provide shelter to the pilgrims when the rituals take place in the temple complex.

3. STRONG ROLE OF GEOMETRY IN INDIAN TEMPLE ARCHITECTURE

The Indian temple architecture inoculates high level of geometric Proportions. Different types of proportions can be analyzed from the plan and the elevation of the temple complex in 1505 AD, the main shrine was built and the *prakara* around it such that the center of the *Garbha Griha* (Sanctum Sanctorum) falls at the center of a square as shown in Figure 7.
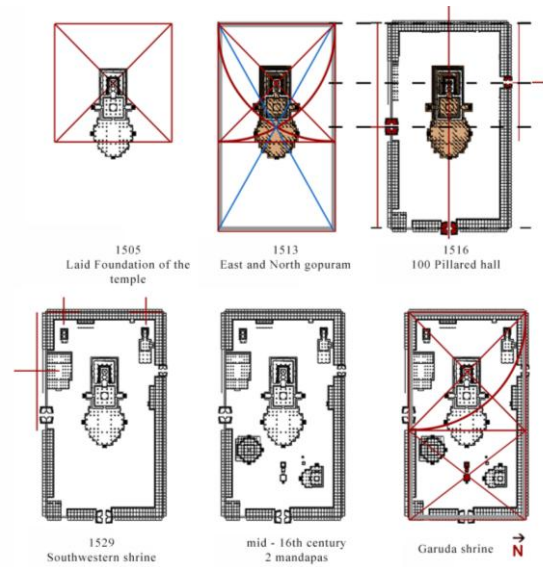
The Shrine dedicated to garuda (stone chariot) is at the center of a rectangular portion adjacent to the square mandala. The garuda fall at the central axis of the garbha griha, the northern gopuram also along the central axis of the garbha griha to the other side and the southern gopuram is along the axis of the center of the rectangular enclosure.

With garbha griha as the center, the 9 square mandala inscribed as shown in Figure 8, the Amman shrine and the mantapa (100 pillared hall) fall outside the mandala. The 2.4mx2.4m grid is taken from inside the temple complex, when it is extended outside the temple complex, we see that the other mantapas and structures fall with same grid.
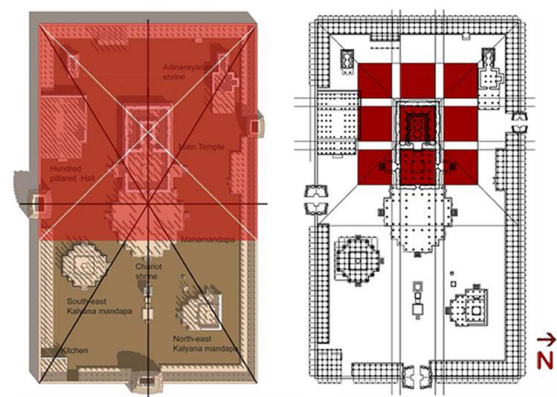

Fig 8 Vithala temple complex showing the 9 square mandala

4. TEMPLE IN THE URBAN CONTEXT

Generally, the temple complex is located in a prominent position in the urban context and also the town will negotiate the caste differences, whereas here in Hampi, this general rule does not hold good to a large extent.

In Vijayanagara empire caste differences are expressed by ritual accessibility to the different parts of the temple. The cults such as Srivaishnavism proliferated a sense of community where the kings built different mantapas and a grand scheme of temple district itself to explain the scale at which the festivals might have been celebrated. The connectivity between different temple complex and other important structures is by the processional path of the festivals. The bazaar streets are developed along these paths. Unlike the temple of Madurai and other chola temples, the development pattern is not concentric, it is more linear in Vijayanagara Empire.
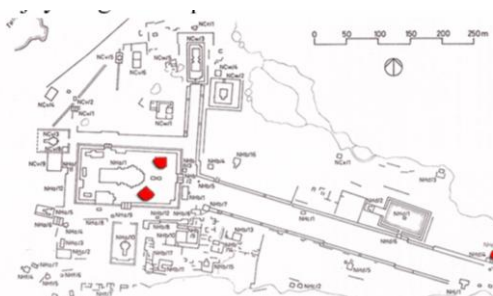
Figure 9: Vithala temple complex showing the bazaar streets.

Figure 10: Vithala temple complex from Bazaar Street

5. SPATIAL ORGANIZATION OF PARTS OF THE TEMPLE

The temple plan is an elongated plan with the longer direction along principal axis as shown in Figure 11. The platform on which the deity is installed is at the higher level than the *prakara*/circumambulatory levels. The other mantapas like kalyana mantapa, *uyyala* mantapa,

and 100 pillared hall are kept at a little lower level than the sanctum sanctorum. The ceiling height at the center of the mantapa is raised and also the plinth at the center.
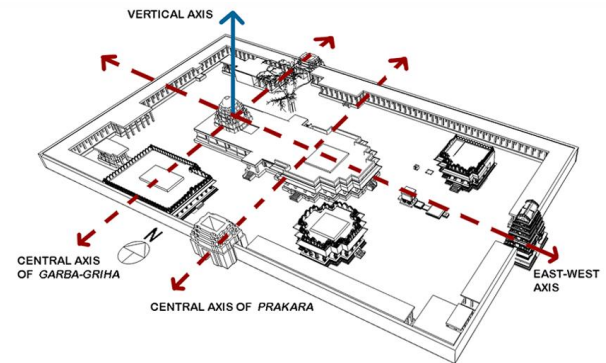
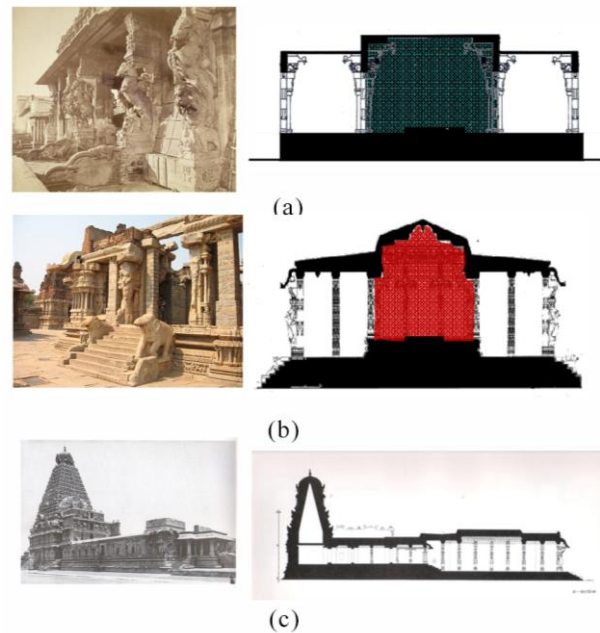*Figure 11: View of Vithala temple complex showing axes.*

Figure 12: (a) Plinth of Nayaka, Madurai temple (b). Plinth of Vijayanagara, Vithala temple, (c), Plinth of Chola, Brihadeshwara temple

Compared to Chalukya, Chola and Nayaka temples in the Vijayanagara style, the height of the base (plinth/Adhisthana) is very predominant as shown in Figure 12. The scale and visual penetrability in this style increases by reducing the heights of mantapas in elevations without compromising on majesty, but the height of the Vimana is kept as the tallest in the complex.

At the east entry of the temple complex a stone chariot built in the form of a temple Vimana. It was originally enshrined with a Garuda the vehicle of Lord Vishnu. The original pictures show the cell with shikhara and the kalasha. It is a monolithic structure in giant granite block with four wheels carved in stone at the base and sculptured panels on the vertical surface.
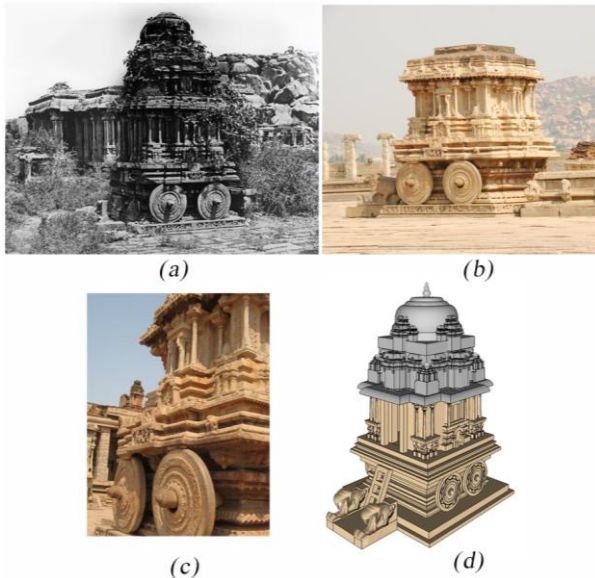

Figure 13: (a). Greenlaw's picture, (b). Existing stone chariot image, (c). Detailed image, (d). Visually re-constructed image (an attempt)

Mahamantapa along the axis of the main temple has a pillared hall with three entrances. The pillars are of four types (earlier mentioned).In addition there are exceptionally beautiful musical pillars which gives the sound of musical notes and musical beats. Also the huge sculpture panels depicting the story of *Mahabharatha.* Refer Figure 14.

Figure 14: (a). Existing Mahamandapa image, (b). Reconstructed view of Mahamandapa

The structure of the mantapas is highly developed having different types of ornamented columns to support the roof slab. The doubly curved sunshade in monolithic stone forms a transitional element between column and roof slab as shown in Figure 15.

Figure 15: South East Kalyana mandapa.

The highly carved plinth of the mantapa in two levels having two sets of columns of varying heights supporting the ceiling. Innovation of T-beams corbelling of brackets and development of complete columns are contribution of vijayanagara style to the structural system. The corbelled brackets (Vallapoo Capitals) as shown in Figure 16. Supporting the roof beams are characteristic features of Vijayanagara Style. The cusped arches and development of parapet is the integral part in elevation which again structurally holds the roof in place.
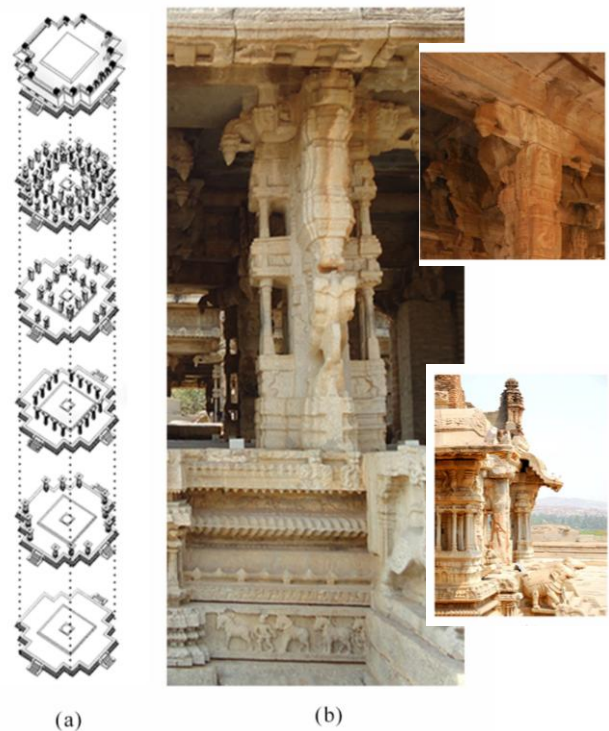

Figure 16: (a) Vallapoo Capital, (b).Doubly curved sunshade below roof slab (c). Development of columns, (d). Column with plinth

7. GRAMMAR OF COLUMNS AND DESIGN ELEMENTS

Basically, we have four types of columns. One with *Yali,* other with sculpture panels and yet another with miniature musical pillars etc. as shown in Figure 17. The *Yali* column is a development from the 13th century Tamil tradition temple architecture. Basically, the Vijayanagara columns have two parts. One is the core shaft and the other is the figural column.
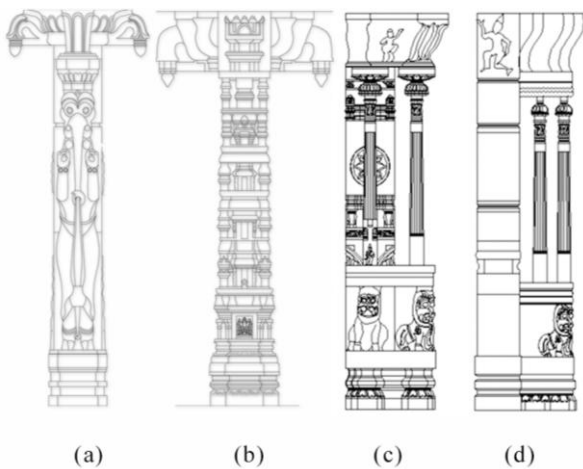

Figure 18: Development of composite columns

The columns play a major role in vijayanagara architecture bringing out the characteristic of vijayanagara style. The columns are usually monolithic granite stone with a single base, sculpture/pillared shaft with a vallapoo capital (resembling banana flower). The columns are made complex by the addition of miniature columns on two sides and three sides to the core. Because of this character the mantapa looks filled with crop of columns. But the cloisters in the temple complex and bazaar colonnade are kept simple. Refer Figure 18, 19.

Figure 17: Column types (a).Yali, (b). Sculpture, (c). Sculpture core And Miniature (d). Core and Miniature.

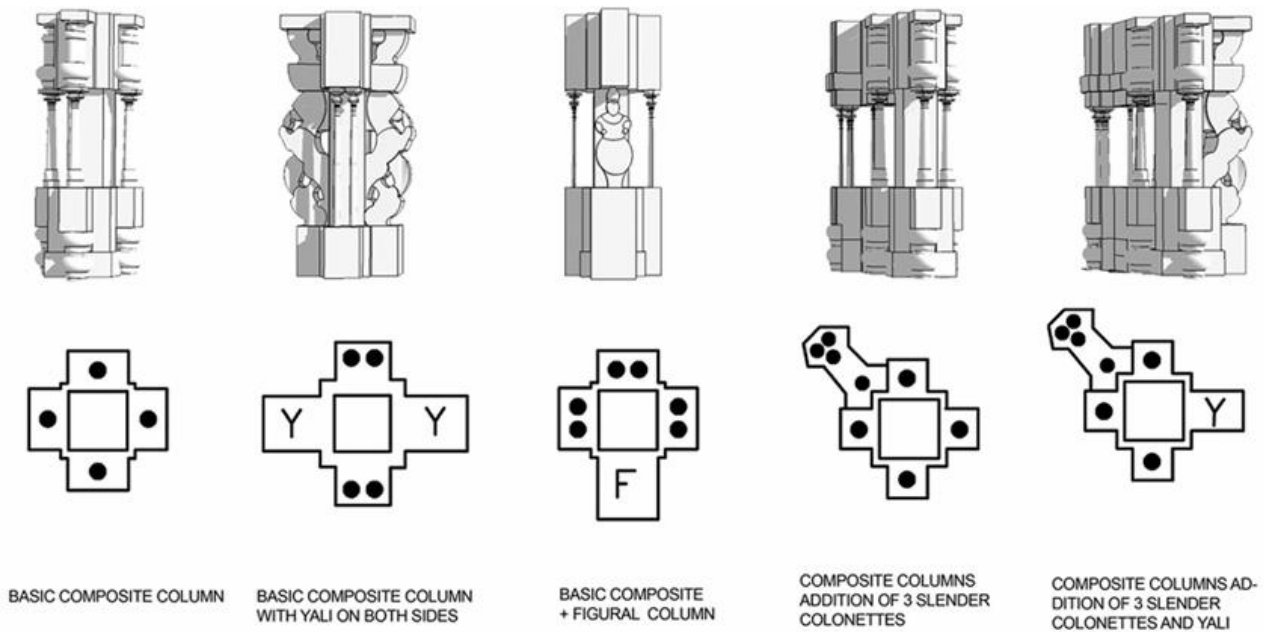*Figure 19: Additive grammar of composite columns*

8. PROCESS OF WORK

Virtual Heritage deals with the Digitization of Historic sites. Buildings and objects in order to further analyze the cultural art and artefacts as well as to preserve and share a record of their geometry and form.

Study of similar monuments, ancient texts on temple architecture and discussion with traditional craftsmen has made it possible to postulate the possible form.

The process of work involves a detailed study which includes literature study, photographic study, and comparative analysis of different monuments of the same period also in comparison with the pre and post vijayanagara.

Auto-CAD drawings are generated and verified with the actual measurements on site, then taken to 3D modelling. Later visually re-constructed 3D models are also generated based on the analysis. Refer Figure 20.
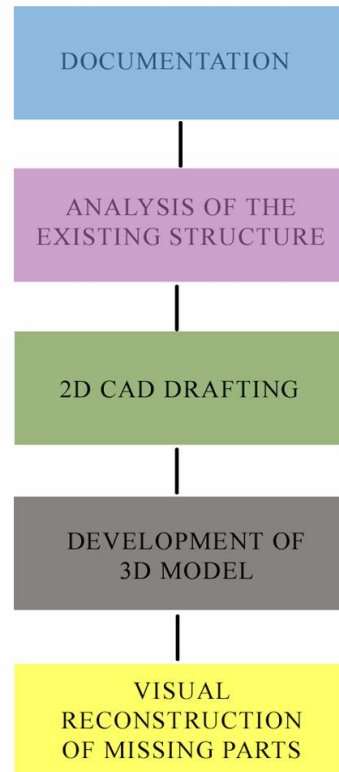

Figure 20: Process of re-construction

Figure 21: (a) Photo image of existing temple complex (b) Re-constructed view of the temple complex.

9. EVOLUTIONARY DEVELOPMENT AND RESEARCH

The 3D Virtual reconstruction is done for the temple complex in order to get deeper understanding of the monument in their original form. The visual reconstruction is done through study, documentation of the monument in ruins and comparing them to similar monuments of this period also with the help of ancient texts of temple architecture, discussion with traditional craftsmen.

Based on the study of proportions of existing building, all structures have been virtually reconstructed. The sculptured details have been understood from literature study from ancient treatise on temple architecture. These 3D models help us to do visual tours and also visualize the cultural and ritual activities along with temple structure, giving a holistic picture of the Vijayanagara Empire in all its former glory.
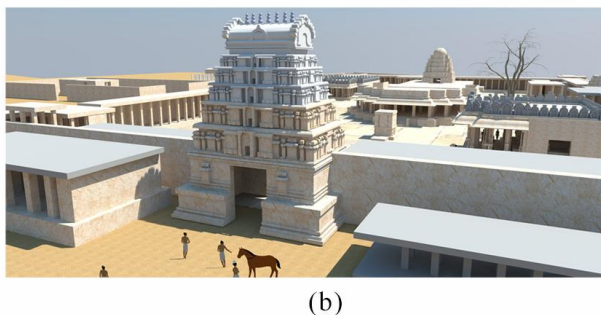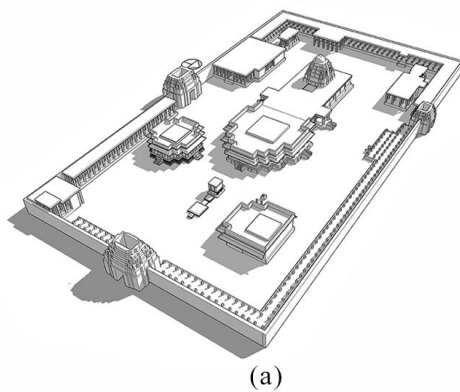

Figure 22: (a) Google Sketch-Up view of Vithala temple complex, (b) Re-constructed Vithala temple complex (an attempt)
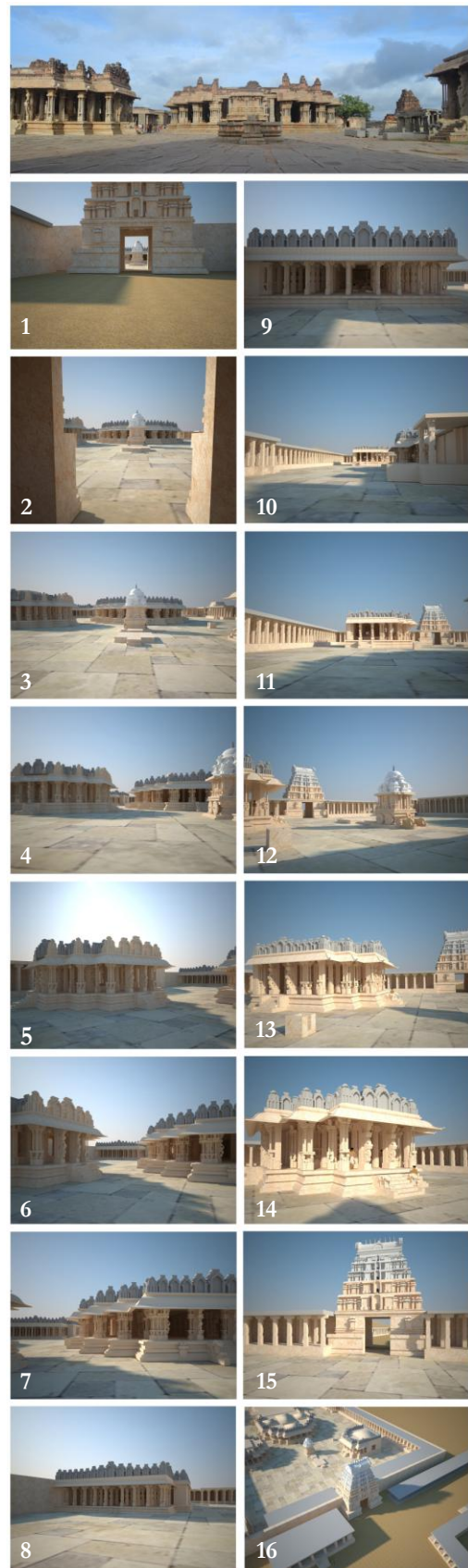

Figure 23: Frames from visually reconstructed video around the main shrine.

10. TEXTURE MAPPING IN KINECT

Contribution from IIT Delhi using Google Sketch-Up models: Texture mapping is a graphic design process in which a two-dimensional (2D) surface called a texture map or image is mapped to a polygon or wrapped around a three-dimensional (3D) object. Thus, the object acquires a surface texture similar to that of the 2D image. Example refer Figure-24.
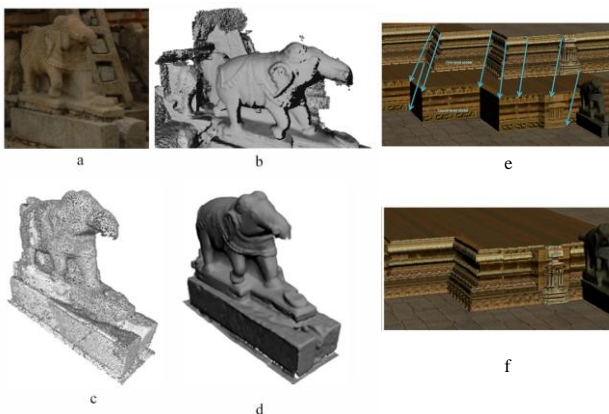

Figure 24: (a). The elephant part of the chariot, (b).The point cloud, (c). Filtered and sub-sampled point cloud (d).Surface reconstructed 3D model. (e).The arrows shows the corresponding points. (f).Registered fine and coarse-level models
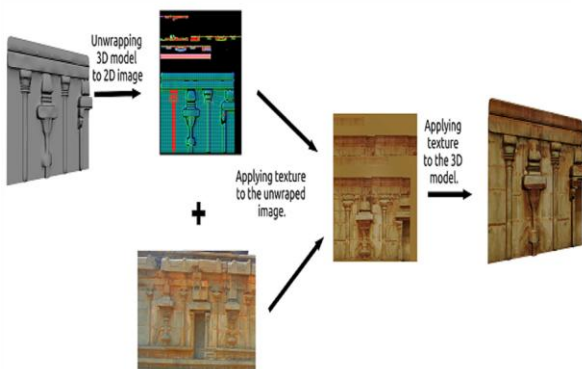

Figure 25: An example of UVW texture mapping.

11. KINECT MODEL: COURSE TO FINE 3D RECONSTRUCTION

The registration of the coarse and fine level 3D models is done in Auto-desk 3ds Max software interactively. This is carried out by overlaying coarse 3D model on the fine 3D model. The Figure 24(e) shows fine and coarse- level modes which need to be registered.

The corresponding points in the fine and coarse level models are given in 3ds Max. The Figure 24(f) shows the registered models. During the process of fine-level 3D reconstruction with Kinect sensor, it is not possible to reconstruct the entire monument at time because of performance issues. Hence the monument is reconstructed part by part and registered in 3ds Max interactively.

12. CONCLUSION

In the span of two centuries, Vijayanagara emperors have built thousands of temples. The temple complex is a complicated structure with different types of mantapas, variety of columns, evolved parapet details and high level of scale and proportion. Rituals and cultural activities have high influence on architecture. The characteristics of Vijayanagara style such as doubly curved sunshade, different types of columns, double plinth and turrets are very evident.

The study and analysis have been concluded with 2D Auto-CAD drawings and 3D Google Sketch-Up models of the visually reconstructed elements of the temple complex.

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