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From Glory to Ruins and Back — Conservation at the Mumbai Caves Since the Late 1800s

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(biography and contact information for author can be found at the end of this paper)

Abstract

With one of the longest caves in the country at Jogeshwari, more than 100 caves (making it one of the largest cave sites) at Kanheri, and the oldest cave in the region at Mahakali, the Mumbai group of caves in India present a range and magnitude like no other in the country. However, given their location within a metropolis, these sites face challenges with regard to their preservation due to their innate petrological composition and building typology. Apart from the vibrancy of the tales depicted through the sculptural and architectural idiom, the evolution and application of conservation techniques at these sites tell their own stories. This paper tries to piece these together along with other interesting insights through archaeological journals and the observations of people involved in the conservation of the rock-cut caves of Mumbai. By means of such a documentation and presentation of current issues and policies at the sites, the paper charts the unique preservation processes of rock-cut architecture in India.

Titre et Résumé

La renaissance de ruines et leur retour vers un passé glorieux : les travaux de restauration des grottes de Mumbai depuis la fin du XIX^{e} siècle

Le groupe de grottes de Mumbai, en Inde, comporte une des plus longues grottes du pays, à Jogeshwari, en ensemble de plus de 100 grottes, à Kanheri (ce qui en fait un des sites de grottes les plus vastes au monde), ainsi que la grotte la plus ancienne de la région, à Mahakali. L'étendue et l'importance de ces grottes sot inégalées à la grandeur du pays. Toutefois, l'emplacement de ces sites, au sein même d'une métropole, pose des défis de taille en matière de préservation, en raison, notamment, de leur composition pétrologique intrinsèque et de la typologie de la structure du réseau. Outre le fait que ces éléments sculpturaux et architecturaux idiomatiques assurent la vivacité des légendes qu'ils illustrent, les progrès réalisés dans le domaine des techniques de restauration et l'application de celles-ci sur les sites des grottes témoignent de leur propre histoire. Le présent article a pour but de rassembler ces divers éléments et d'autres aperçus d'intérêt glanés dans les journaux spécialisés en archéologie et les observations de différents participants aux travaux de restauration des grottes creusées dans le roc de Mumbai. Les données de l'article permettent aussi, au moyen de documents de ce type et de la présentation des questions actuelles et des politiques pertinentes en ce domaine, de retracer les procédés exceptionnels qui ont permis d'assurer le préservation des œuvres architecturales creusées dans le roc de l'Inde.

Introduction

The advent of Buddhism in India, from the 6th century B.C., led to one of the most spiritual phases in the country, with repercussions felt in the region spanning several centuries. That it also coincided with one of the most articulate forms of architecture that the country has ever witnessed, is testimony to the sheer magnitude of influence that the religion had on built form. This glorious awakening led to stupendous rock-cut enclaves such as those at Ajanta and Ellora in Aurangabad and the one at Elephanta near Mumbai, all of which have found recognition on the UNESCO World Heritage Site register. Although the caves of Mahakali, Mandapeshwar, Jogeshwari and Kanheri at Mumbai are perhaps not as architecturally prominent, with their own set of unique values (Figure 1) they deserve comparable recognition. However, being carved in close proximity to a burgeoning city has led to serious issues of damage to the caves due to erosion, abrasion and urban settlement. In addition to this, since rock-cut sites are inherently a singular architecture idiom, their restoration has generally baffled conservators and given way to trials and experimentation. The paper tries to weave together a record of such conservation actions through archaeological records, over a time span of a 100 years (1899 to 1999).

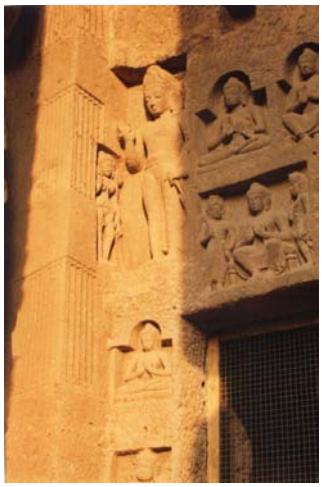

Figure 1: The sculpture and architecture at Kanheri work in unison to make it one of the most articulate rock-cut sights. Seen here is the sculptural decoration outside the prayer hall.

Geological Classification – The Influence of Material on Architecture

The Mumbai caves are broadly classified under the category of “Basalts” or the “Deccan trap”, after the region in which these are found abundantly, and are volcanic igneous rocks formed as a result of extensive eruptions in the Cretaceous and Eocene periods of the Mesozoic era. The caves of Kanheri and Mandapeshwar are carved into the hill face comprising of amygdaloidal

basalt. Amygdaloidal basalt has the strength of 600 kg/sq. cm, offers ease of dressing, is non-porous, the vesicles are not interconnected and it is free from divisional planes (Gaitonde, 2005).

On the other hand, the Mahakali caves are carved in a more friable form of rock known as volcanic breccia, consisting of coarse to medium grained rock in a matrix of finer material. Carved in a weaker rock are the caves of Jogeshwari, cut in pyritic volcanic tuff, containing sulphides of iron or copper and iron. The rock is extremely soft, being volcanic ash, and is therefore inherently vulnerable to the action of moisture and soluble salts.

All the cave sites of Mumbai are listed in the national register of heritage sites with the Archaeological Survey of India (ASI) as its custodians, who are primarily responsible for their maintenance, restoration and promotion.

Mumbai Caves – Their Description and Setting

Carved over 475 m above sea level, the caves of Kanheri were excavated from the 2nd century B.C. to the 10th century A.D. and are the only Buddhist monastic centre where a continuous progression of the faith and architecture is observed as an unbroken legacy. With over 110 excavations evident in the form of a magnificent prayer hall (Figure 2), several shrines, residential cells, ritualistic enclosures, storage granaries etc., it is one of the largest Buddhist enclaves in the country, all carved within an enchanting natural landscape. Falling within a designated National Park, it is relatively protected with over 9000 hectares separating it from dense neighbouring development. It is, however, the strains of visitor pressure that are gradually eroding its ancient courtyards and natural setting.

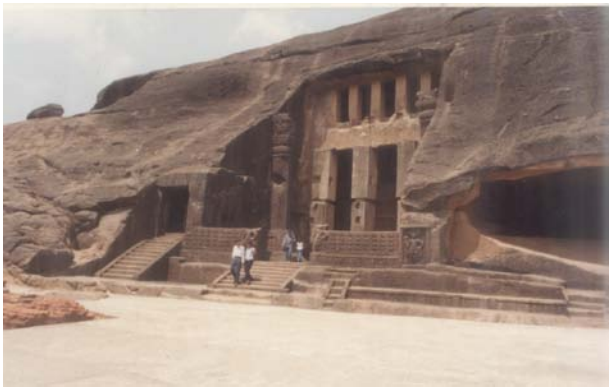

Figure 2: The wide courtyards at Kanheri provide perfect spill outs for numerous users and a foreground for appreciation of its carving.

The Mahakali caves, another Buddhist site, were excavated in between the 2nd and the 6th centuries in two groups on a hillock that used to overlook a few water bodies and undulating grasslands. Currently this group of caves, comprising of 4 caves along one mountain face and 15 (Figure 3) on the other side, overlooks a dense squatter settlement and the high powered

multi-billion dollar software hub of Mumbai. This disparity of land use and economic fortunes is reflected in this site's treatment, as it gets routinely ignored for conservation measures in lieu of its more prolific cousins. The most significant excavation at Mahakali is the uniquely shaped *chaitya* cave or prayer shrine with its singular plan form.

Figure 3: The small complex at Mahakali is evocative of a tiny monastic hamlet in pristine natural setting.

With the exact date of excavation unknown (several scholars believe it to be carved in the 6th century claiming the 8th century inscription at the site to be a later addition), the Jogeshwari cave is the longest cave in western India, with its length extending 75 m from east to west. The cave is cut in a low lying mound with steps leading downwards to almost a depth of 8 m. Jogeshwari is considered to be the precursor to Elephanta, with comparable sculptural and architectural expression. Earlier surrounded by rice fields and mango orchards, this cave is now completely engulfed within a slum settlement, with some houses even built atop the historic cave with sewage water dripping down its ancient sculpture.

Mandapeshwar cave lies at the outskirts of Mumbai and its dense rock and sculptural imagery make it an interesting study of cave form and the oldest in the region. Unfortunately it was severely mutilated in the 16th century and large portions of the sculpture and its articulate pillars were damaged. The contemporary issues that the Mandapeshwar cave faces are those of a century old litigation and surrounding settlement pressure.

It is evident from the descriptions of the cave sites that these once secluded enclaves have been thrust into mainstream urban life, with contested spaces and visitor pressure as the primary issues for concern. These have escalated the endemic issues of weathering and deterioration, through inherent salt water movement as well as use of solvents and restoration methodologies that have aided in this.

Past Interventions – Lessons in Hindsight

With the establishment of the Archaeological Survey of India in 1862, a process to list and study the monuments of India was begun. The beginning years are marked with forays only at

popular sites with minimal or no work initiated at the Mumbai caves. This period was also manifest with issues of working out legalities, acquisitions and trying to mitigate a system for management.

The early 20th century began with the passing of the *Ancient Monuments Preservation Act* in 1904. The stirrings of a few conservation actions were felt at the Mumbai cave sites too with non-invasive actions initiated at Mahakali and Kanheri such as removal of vegetation, introduction of fencing and cleaning of graffiti. The following account of conservation actions at the Mumbai caves is compiled from the Journals and Progress Reports of the ASI, with additional remarks about their present status and efficacy. A two-pronged conservation strategy was devised, of which the first was preservation of deteriorated stone using applications and preservatives and the second was to strengthen mutilated pillars by providing support.

Accordingly in 1915 a new stone preservation process was tried out at Kanheri with the application of *Szerelemey's stone liquid*. Szerelemey, a Hungarian resident in England, devised a process whose primary premise was the coating of surfaces with alkaline silicate soluble in hot water which on slight decomposition would provide an impermeable layer to the degenerated stone after hardening of the soluble glass. This would prevent the action of water to enter into the stone, thereby circumventing any salt water movement within the monument. Another coating comprising of bitumen and ingredients of common paint followed this application (apparently such a coating was even carried out slightly earlier at the Houses of Parliament in England). A year later it was reported by the Executive Engineer that there was no marked improvement of the applied stones, nor was there any difference as conclusions could not be drawn in such a short span of time. Hence, although the efficacy of this application methodology was questionable it continued to be recommended in want of alternative preservation solutions as the only means of repairs possible. Vulnerable areas such as inscriptions, disintegrating surfaces of sculptures and structural members not severely affected were treated.

With regard to the structural members, another strategy was adopted since these were critical to both the aesthetic and structural integrity of the monuments. Due to the ravages of time and nature, the pillars had severely diminished. Some had completely fallen, while others had surviving capitals and bases, but with entirely missing central portions. In order to build the profile of the pillars large blocks of stone in like colour were used to fashion replacements with minimal joints (Figure 4). Hence the repairs were authentic in terms of material but the masonry construction jarred the monolithic lines of the original. For the next two decades such works and stone preservative applications were employed along with routine maintenance works.

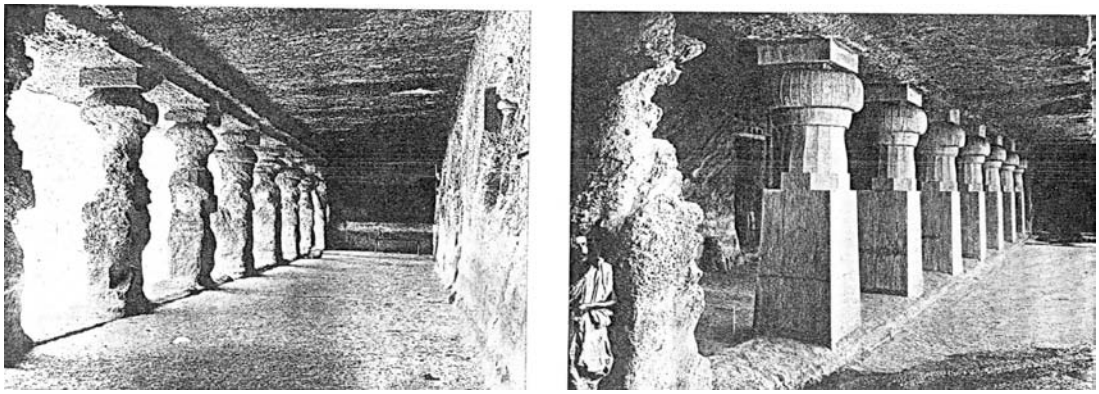

Figure 4: Observed here are before and after restoration images of the pillars in stone. (Image copyright – Archaeological Survey of India)

Petrologic studies were undertaken in 1935 and it is stated that since many of these were discovered choked up with drift earth and debris and were flooded by the access of water either from outside or by percolation from the rock inside, the interiors too had suffered heavily through sub-aerial weathering. The Archaeological Chemist, M. S. Vats, reported that, *"There is no doubt that the whole rock is saturated with sea-salts, which gradually concentrate at the exposed surface and crystallize there under favourable atmospheric conditions. The soft portions of the rock (i.e. the seams and deposits of ash or tuff) succumb to the action of the salts most readily. The processes of hydration, carbonation, oxidation and alteration of carbonates into sulphates, are accompanied by great increase in volume, and if these happen to be of a local nature, the pressure exerted thereby is sufficient to shatter the rock"* (ASI, 1937). Subsequently he recommended waterproofing applications to prevent excessive damp, consolidation of decaying parts by impregnation with suitable materials and periodical cleaning of the surface with brushes or jets of air to remove salt laden dust, followed with regular washing out of salts from affected parts by means of water jets.

The next decade and a half saw sporadic activity at the Mumbai caves due to the turbulent economic situation as well as political instability. The years following independence were focussed on transfer of organisational mechanisms and re-enacting existing laws. In case of the Kanheri caves, the government acquired the land around the caves and converted it into a national park, thereby protecting the caves and its surroundings from development. The 1950s saw the advent of chemical preservation, as part of which wet paper pulp application for the elimination of salts followed with preservation with a thin solution of 'Gelva'-polymerised vinyl acetate resin was adopted.

Another petrologic study was initiated at the caves of Jogeshwari and Kanheri in 1954 to devise mechanisms for their preservation. In case of the Jogeshwari cave it was felt that it was already in an advanced state of decay as the rock was extremely soft volcanic ash, inherently vulnerable to moisture and soluble salt action, where thick layers of gypsum were found coating the surfaces, hastening the decay and deterioration of the caves, as there was little doubt that due to the percolation of rain-water the gypsum had moved from outside into the interior of the caves

(ASI, 1955). It was recommended that the most important sculpture at Jogeshwari be detached and moved to a museum before it was too late. Fortunately this was never implemented and the cave continues to hold its sculptural integrity to this day.

The 1960s heralded ferocious construction activity in the city and it was only a matter of time before use of cement percolated in restoration works. The ease with which diminished profiles of pillars could be built up using reinforced cement concrete (reinforced with steel) with no joints was felt to be the ideal solution for monolithic examples. Purists, propounding the use of like material, could not counter the use of cement as the repaired work was stable, cost-effective and much better matched than stone. In addition to that, the dexterity of working with cement meant that not much of the original material had to be hacked out and several succeeding applications could be prepared to build up the profiles (Figure 5). However, the deleterious action of salts in Portland cement had not been accounted for. The presence of moisture within the monuments led to the eventual corrosion of the reinforcement, resulting in splitting of the cement work within a decade (Figure 6). However, the custodians contended that since all new work needed to be reversible, repaired work in cement had a limited life span and hence conformed to international charters such as the Burra and Venice charters. As a result of this pro-cement era, extensive repairs to ancient floors, door jambs, sculpture, pillars, overhangs, walls and other areas were blatantly undertaken using reinforcement cement concrete.

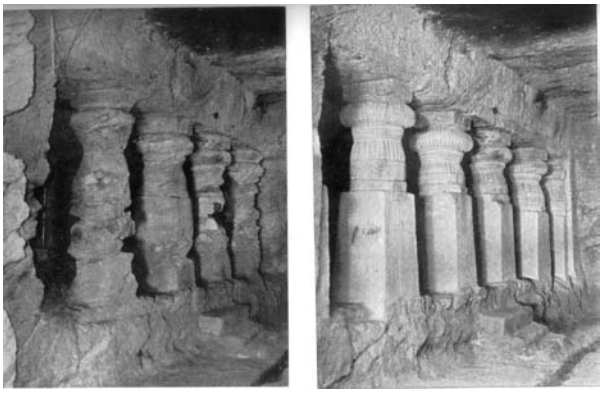

Figure 5: Before and after images of Jogeshwari pillars post restoration using cement concrete (Image copyright – Archaeological Survey of India)

Figure 6: Corrosion of steel within the repaired matrix gave rise to eventual issues of splitting and spalling

In the early 1980s, preservation work included treatment of the porous rock at Jogeshwari with epoxy resin followed by a coat of cement slurry. In 1986, the stone sculptures and walls at Kanheri, covered with thick growth of moss and lichen, were cleaned using 1% solution of ammonia and “idipol” (ASI, 1987). “Polycide” was used as fungicide to prevent vegetation growth and finally the cleaned portion was preserved with 1% Acrypol - P (a waterproofing compound) in toluene. In 1987, the vegetation growth at Kanheri was removed with the help of 1% aqueous ammonia and non-ionic detergent. After the chemical cleaning, a 3% aqueous solution of zinc silico-fluoride was sprayed followed by preservative of 5% solution of Acrypol in toluene. The interior covered with a thick layer of dust, dirt, bird droppings etc., was also chemically treated (ASI, 1988). In 1993, the stone inscriptions were cleaned using a solution of ammonia and non-ionic detergent. To prevent early cryptogamous re-growth, 1% solution of sodium pentachlorophenate was applied on the cleaned surface (ASI, 1994).

Chemical treatment and preservation work to stone inscriptions etc., was continued in 1994 by using aqueous solution of ammonium hydroxide and non-ionic detergent for cleaning purpose, while sodium pentachlorophenate and poly(vinyl acetate) (Vinnapas EP1) were used as fungicide and preservative coat respectively (ASI, 1995). These treatments were repeated in the following years, but the efficacy was debatable as the benefits could not be ascertained in such a short span of time.

Current Issues – A Struggle for Survival

In the first few years of the early 21st century, restoration along the same lines as in the 90s with use of ammonium hydroxide as a cleaning agent and poly(vinyl acetate) (Vinnapas EP1) as a preservative coat was carried out. However, the prohibitive costs and large surfaces required to treat has limited the use of poly(vinyl acetate) (Vinnapas EP1) to more significant areas such as sculpture and inscriptions. Repairs to damaged pillars and those that have cracked or spalled post repair continue to be restored with reinforced cement concrete.

However, an added dimension has contributed to the concerns of the caves at Mumbai – that of growing population and settlements in close proximity to these ancient enclaves. Kanheri survives in a better condition primarily on account of being ensconced within a national park, but is severely affected due to growing numbers of visitors every year, most of whom are unaware or negligent of its importance. Vandalism in the form of graffiti and misuse, along with picnicking within historic caves continues. Jogeshwari has suffered the most as it is caught firmly in the grip of a dense slum settlement that holds its religious sentiment in regard, but is inconsiderate of its historicity and persists in gradual abrasion of its fabric through dumping sewage water and debris. The slum settlement around Mahakali caves too threatens to take over the site, the only surviving clear space for miles around this densely built neighbourhood. Mandapeshwar continues to mull in its ruins with no end to its litigation issues, thereby preventing any action at the site due to a status quo. It was evident that unless urgent intervention was initiated the caves would eventually succumb.

Conclusions – Temporary Measures to Increase Permanence

Fearing the complete extinction of centuries old treasures, a public interest litigation was filed in 2005 by a local non-governmental organisation, Janhit Manch (www.janhitmanch.org), against the custodians. A directive was issued by the Mumbai High Court to the ASI for quick action and an experts panel comprising of architects, historians, archaeologists, officials of the ASI, Mumbai Corporation, stakeholders etc. was appointed. One of the first actions initiated was the preparation of a Conservation Plan (Gaitonde, 2006) for the cave sites; the recommendations of which were adopted by the ASI. A visitor management and information dissemination system was installed at Kanheri, with increase in security lessening the issues of vandalism and improving visitor facilities. Mahakali was fenced in and a landscape scheme has been recently mooted to improve the perception of the site. An alternative repair methodology using combination mortars and lime is being tried out.

The challenges with Jogeshwari have been uphill and the conservators had to face stiff opposition from the locals, who are faced with eventual relocation. One of the first actions was the removal of tonnes of garbage from the cave top; the operation lasting several days with over 9 trucks of debris removed (Figure 7). A drain on top of the cave was isolated and realigned so the issue of percolating water has been resolved. The next step is removal of the most critical slums directly affecting the cave structure, which is proving to be a thorn in the flesh, as there is much political backing against this move. Careful restoration in the form of cleaning using poultice applications at vulnerable areas has been initiated. Since sufficient evidence directly indicating the benefits of consolidants on exterior surfaces under diverse and uncontrolled conditions is not available, surface applications have not been approved as yet. These and other actions are part of the conservation plan which aims to provide a much needed respite and a fresh lease of life for these tormented and priceless monuments.

Figure 7: It was the first time in decades that the courtyards of Jogeshwari were exposed again after piled debris and dirt was removed.

References

Archaeological Survey of India, 1864 to 1919, *Progress Reports of Archaeological Survey of India, Western Circle,* Government of India Publications

Director General, 1953 to 2001, Archaeological Survey of India, *Indian Archaeology – A Review,* Government of India publications, New Delhi

Gaitonde, Brinda, 2005, *Conservation of Rock-cut monuments in the vicinity of Mumbai,* M Arch. (by research) level thesis, University of Mumbai

Gaitonde, Brinda, 2006, *Conservation of Rock-cut monuments of Mumbai,* Archaeological Survey of India, Mumbai Mini-Circle

Materials and Suppliers

Vinnapas EP1 by Wacker (www.wacker.com) - Poly(vinyl acetate)

Author Biographies and Contact Information

Brinda Gaitonde Nayak earned a Masters in Architecture from Sir J.J. College of Architecture in Mumbai, India with a thesis on *Conservation of Rock-Cut Caves in Mumbai*. She was subsequently commissioned to prepare a conservation report on these caves and was appointed to the experts panel of the Mumbai High Court to look into their preservation and upkeep. Brinda co-founded THE BOMBAY HERITAGE WALKS (an organization that conducts architectural walking tours in Mumbai) on World Heritage Day in April 1999. In 2006, she was awarded the Charles Wallace India Trust fellowship to undertake 2 months of training in the United Kingdom on management of World Heritage Sites. During the course of her conservation practice, several of the projects that she has worked on have won awards. Brinda divides her time between the United States and India, and continues to be a consultant on Indian projects.

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Brinda Gaitonde Nayak a obtenu une maîtrise en architecture du Sir J.J. College of Architecture, à Bombay, en Inde, avec une thèse intitulée *Conservation of Rock-Cut Caves in Mumbai*. On lui a par la suite demandé de produire un rapport sur la restauration de ces cavernes, et elle a été choisie pour participer aux travaux du groupe d'experts de la Haute Cour de justice de Bombay pour en étudier la préservation et l'entretien. M^{me} Gaitonde Nayak a cofondé THE BOMBAY HERITAGE WALKS (une organisation qui offre des visites guidées à pied des œuvres architecturales de Bombay) lors de la Journée mondiale du patrimoine, en avril 1999. En 2006, elle a reçu la bourse Charles Wallace India Trust, qui lui a permis de suivre une formation de deux mois au Royaume-Uni sur la gestion des sites du patrimoine mondial. Dans l'exercice de sa profession de restauratrice, plusieurs des projets auxquels elle a participé ont été primés. M^{me} Gaitonde Nayak partage son temps entre les États-Unis et l'Inde, et elle reste consultante pour le compte de projets indiens.

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