<T> Inventing Tradition in Bhaktapur, Nepal: The Trajectories of Lime in Heritage Reconstruction[1]</T>

<AU> VANICKA ARORA</AU>

<AA>Lecturer, Department of History, Heritage & Politics, University of Stirling</AA>

</AU>MANAS MURTHY</AU>

</AA>PhD Candidate, Department of Architecture, University of Oregon</AA>

<A>INTRODUCTION</A>

<ABS> In the years that have followed the widespread devastation of the 2015 Gorkha Earthquake, built heritage has emerged as a key sector in the post-disaster recovery landscape of Nepal, receiving funding and expertise through both national and international sources.[2] Most international attention has been directed toward reconstruction of built heritage in the Kathmandu Valley, which along with being the political and economic center of the country is also home to some of the most globally recognized heritage and tourism destinations in Nepal. In particular, the UNESCO World Heritage Site of the Kathmandu Valley, a series of seven monument zones, namely the Durbar Squares in the historic capital cities of Kathmandu, Patan (Lalitpur), and Bhaktapur, as well as the religious ensembles of Swayambhu, Bauddhanath, Pashupati, and Changu Narayan, has been at the center of debates over the post-disaster reconstruction of built heritage.[3] Heritage conservation practitioners, both within Nepal and internationally have engaged in extensive debates surrounding issues of material and historic authenticity, as well as the appropriateness of materials, building technologies, and construction systems used in reconstruction. Considerable attention has also been paid to recurring practices

of reconstruction (and other forms of heritage restoration and repair) that have led to substantial change in building form and style over time.[4] Amid these ongoing debates, a recurring point of contention of practitioners working in Kathmandu Valley has been the use of lime mortars and plasters as a replacement for mud- (or clay-) based mortars.[5] This paper traces the evolution of the discourse over the past several decades that has legitimized lime as a "traditional" building material in ongoing heritage reconstruction and the conflicts that have arisen surrounding its usage in the aftermath of the 2015 Gorkha Earthquake. We argue that the Department of Archaeology (DoA) narratives and associated local policies promoting lime for the conservation and reconstruction of built heritage in the Kathmandu Valley functions as an "invented tradition."[6] We analyze how lime has been simultaneously classified as traditional and modern, vernacular and foreign by engaging with previous restoration projects as well as recent reconstruction of built heritage in the Bhaktapur Durbar Square.

<INSERT COT202307003_FIG1>

Historically Bhaktapur's built environment was primarily constructed of brick and timber structural systems with mud-based mortars and finishes. Since the 1980s, and particularly since the early 2000s, lime-based mortars have replaced mud in heritage conservation and reconstruction projects. Cement, steel, and silicone-based sealants, which were also introduced as alternatives to local mud-based construction during the mid- to late twentieth century in Nepal, in contrast are no longer in popular usage for conservation of historic buildings, even as they proliferate across the construction industry. Instead, lime continues to gain popularity among heritage practitioners in Nepal, particularly in the Kathmandu Valley, as an acceptable alternative to mud. This paper explores the specific material characteristics of lime and the narratives associated with its strength, durability, seismic performance, and aesthetic appeal that

contribute to its popularity. By tracing the historical trajectories through which the use of lime has been assimilated as a "traditional" practice, we illustrate the fluidity of building and rebuilding practices in South Asia, which are often characterized as being unchanging and monolithic.

In the aftermath of the 1934 Nepal-Bihar and 2015 Gorkha Earthquakes in Bhaktapur and the trajectories of post-disaster reconstruction which followed, we trace the introduction of lime alongside the evolution of construction practices as well as professional building conservation in Nepal. This paper will argue, following Eric Hobsbawm and Terence Ranger, that, contrary to popular narratives in the media and in heritage conservation discourses circulating in Nepal that often assume that lime is a traditional building, material, the "tradition" of lime has been invented and reinvented in the twentieth and twenty-first centuries.[7] The use of lime as a material for building conservation represents the confluence of multiple discourses and practices that have constructed a narrative of its benefits, contrasting it not only as a stronger alternative to mud but also as a more desirable alternative to cement. </ABS>

<TX>

<A>A TALE OF MUD, LIME, AND CEMENT IN THE KATHMANDU VALLEY</A>

The historic built environment that characterizes much of Kathmandu Valley is colloquially referred to as "Newar" architecture. Here the term "Newar architecture" is not merely used to reference an architectural style or an aesthetic characterized by tiered tiled roofs over brick masonry and timber-framed structures with elaborately carved timber elements. Nor is it limited to describing the compact and tightly knit built environment, cohesive skylines, and hierarchical

system of urban planning typical of Newar cities. Rather, it refers to an overarching tradition of planning and building practices, construction technologies, and rituals developed over several centuries by the Newars, an Indigenous group associated with much of the history, cultural practices, and built heritage of the region.[8] Although they make up just over 5 percent of the national population, Newars remain the majority inhabitants in Bhaktapur, comprising over 90 percent of the city's demographic.[9] Most of the city's planning and morphology represents a Newar approach, and many of the city's most sacred traditions have been codified and popularized under Newar rule, during the reign of the Malla dynasty from the twelfth to the eighteenth centuries. The Mallas are still venerated as ushering Bhaktapur's golden age, which refers to the seventeenth and eighteenth centuries, when most of Bhaktapur's most iconic built form was constructed (and reconstructed). This phase holds great significance among many of Bhaktapur's residents, as well as the municipality, and recent heritage restoration and reconstruction efforts in the city have focused on promoting a version of the Malla Newar aesthetic across the city.[10]

Historically, mud is fundamental to Newar architecture and has served as a basic building material not only in Bhaktapur but across the Kathmandu Valley and the interior hinterland of Nepal. Its geological abundance and variation in the form of clayey and lacustrine soils were valuable materials in the production of bricks and mortars.[11] The most significant innovation in Newar building materials and technologies, among mud-based building components in terms of its aesthetics and structural characteristics, was the *dachchi apa*, a type of high-quality, wedge-shaped, polished brick, which was traditionally fired at extremely high temperatures. The quality of the clay and high firing produced precise unit dimensions and a glazed finish. When expertly laid in wall construction, they produced a flush plane. Other types of brick include the *ba apa*

(patterned brick) and *ma apa* (infill brick), while the most widespread roofing material was the clay *jhingati* (single-locking roof tile).[12] In addition to being fired as brick and roof tiles, mud was typically boiled, mixed, and worked into mortars for masonry. Various organic additives selected for their binding and adhesive qualities would be added to the mud mortar.[13] Used in conjunction with complex timber structural systems, mud is therefore part embedded in the historical tradition of building in the region.

Lime, on the contrary, is not a locally abundant material in Kathmandu Valley. In the Terai region of Nepal toward the southern part of the country, however, historically lime has been used in construction in a manner similar to that seen in northern India. According to various historical accounts, lime was introduced into the valley, mostly in the form of plasters, during the nineteenth and twentieth centuries, under the Rana regime.[14] The Rana period, which spans from 1846 to 1951, saw a substantial shift in the geopolitics of the country, but additionally it was characterized by a shift in architectural vocabulary and style, moving from the Newar building systems to larger-scale buildings that incorporated neoclassical influences from Europe and Mughal architectural influences from India.[15]

While some building materials continued to be in use, new materials and technologies were introduced, including lime in the form of plasters and mortars. The lime plaster referred to colloquially in the valley as *bajra* was first used by the Ranas in their palatial complexes and other grand edifices. The Ranas' neoclassical style is characterized by lime-plastered facades as well as "a completely new plastering technique . . . based on the large use of air-hardening lime mortar."[16] *Bajra* closely resembles the fine finish of stucco plasters used in Europe, but it also bears a resemblance, in terms of composition and finish, to *surkhi*-based plasters from India, where *surkhi* referred to brick dust. *Surkhi*-based plasters and lime mortars in India often

incorporated coarse brick dust, lime, and other organic adhesive agents such as molasses, jute fibers, black gram, and resins, and a similar composition has been identified in both textual accounts and material analysis of samples from Rana-period buildings.[17] The use of lime mortars and plasters was restricted to palatial complexes and public buildings during the Rana regime, and they were only occasionally used by the affluent classes for building their homes. As recent material analysis suggests, lime mortar was used in addition to mud mortars in Rana palaces, as an additional reinforcement layer in the masonry.[18] For the majority of the valley's inhabitants, construction practices still centered on the use of mud as mortars, plasters, and floor finishes in homes up until the first three decades of the twentieth century. Two sets of architectural systems were therefore simultaneously in use, the everyday mud-based Newar architecture, common to the valley, juxtaposed to the elite neoclassical Rana architecture, restricted to palatial complexes and buildings of significance.

A shift in attitudes toward building materials and technologies in Nepal was brought about in the middle of the twentieth century. We speculate that there are two main reasons for this, the first of which was the 1934 Nepal-Bihar Earthquake, and the second, the growing popularity of cement across the world. In January 1934, the catastrophic Nepal-Bihar Earthquake caused widespread destruction. The entire Kathmandu Valley was severely impacted, with hundreds of individual buildings reduced to piles of rubble. more than six thousand houses in Bhaktapur were damaged in the earthquake, and 177 temples and public buildings collapsed or were damaged significantly.[19] In the wake of the disaster, Nepal's ruling family and administrative authorities looked abroad for stronger reconstruction materials and technologies and for examples of large-scale post-earthquake recovery. Following its own catastrophic earthquake in 1923, Japan's reconstruction efforts became a reference point for Nepal. In a

dramatic departure from traditional building materials and construction systems, Japan's reconstruction efforts had relied extensively on contemporary materials including cement and steel. In Nepal, there were similar calls for modern technologies and materials as viable alternatives to mud-based construction.

Although unbaked mud bricks and mud-based mortars were cited as one of the reasons for the widespread damage in the 1934 Nepal-Bihar Earthquake, Major General Brahma Shumsher Jung Bahadur Rana, a member of the ruling family, noted that the high-fired, precisely dimensioned *dachchi apa* bricks laid in an interlocking system reduced the need for mortars and plaster performed better.[20] He also noted that lime-plastered walls, already in use by the time, may have performed better structurally than mud-plastered ones. Following this preliminary reporting on the performance of building stock in the wake of the earthquake, Rana proposed a series of recommendations for the reconstruction of houses, advocating for the use of modern technologies, including iron reinforcements and cement and lime as a replacement for mud mortar. Other suggestions included reducing building heights, door and window sizes, and ornamentation:

> The roof should be light as possible. Those who cannot get corrugated iron sheets may use the tin of kerosene oil containers. The tin affords protection from rain. The rich may build their house with *reinforced concrete or lime plaster* and lintels placed over doors and windows. Common men may build walls with mud, but the house must be low in height. The poor may build small houses or huts, using light material for the roof.[21]

<INSERT COT202307003_FIG2>

Rana's recommendations failed to acknowledge that the *dachchi apa* and other types of fired and polished bricks had previously been used only by dominant-caste households and were more expensive. Furthermore, to maintain a visual architectural hierarchy in Newar settlements, sumptuary laws prohibited marginalized castes from using such specialized bricks. Furthermore, while Rana's recommendations promoted the use of stronger, modern materials for domestic buildings, the period of recovery that followed the 1934 earthquake was fraught with scarcity of resources, including building materials, which meant that construction quality remained variable and that economically deprived communities continued to rebuild with mud.[22] At the same time, the post-earthquake reconstruction of temples, palace buildings, and rest houses began to depart from the Newar architectural systems, owing to the political priorities of the Rana regime and its desire to reinforce the distinctly new aesthetic (fig. 2). Several *shikhara* (spire) style Newar temples built of brick and mud mortar were reconstructed in brick with a mix of mud and lime mortars and finished in lime plaster. *Shikhara*s were replaced with domes, carved timber elements replaced with arches in brick. The physical devastation of the 1934 Nepal-Bihar Earthquake coupled with the changes wrought by the Rana regime are now perceived as a double-layered loss of Newar built heritage. The replacement of *shikhara*s with domes, the lime plastering, and the introduction of neoclassical details to façades, resulted in a significant aesthetic departure from the traditional terra-cotta brick facades of the Malla era.

By 1951, the trajectories of post-disaster recovery following the 1934 earthquake in Nepal began to merge with the official end of the Rana regime and the first attempts at establishing a democratic government in Nepal. International borders were formally opened, and a concerted effort was made to build intergovernmental partnerships in the interest of national development. The change in political regime, accompanied by the opening of borders, meant that

cement could now be imported freely into the country, and newer construction technologies based on cement and reinforced cement concrete gained popularity in urban centers. Across the world, cement was increasingly growing in popularity as a material alternative to mud and lime, given its structural strength and ability for mass production. Cement was used both as a binding agent in mortars and plasters and in reinforced cement concrete (RCC) structural systems. Cement-based solutions were becoming popular particularly with the affluent classes across the Kathmandu Valley as cement was imported from India and other countries.[23] Between 1934 and 1951, both lime and cement were used as alternatives to mud in the reconstruction of heritage structures.

<A>LIME VERSUS CEMENT: INTERNATIONAL PRACTICES OF CONSERVATION IN BHAKTAPUR</A>

<INSERT COT202307003_FIG3>

Following the establishment of a democratic government in 1951, the Department of Archaeology was set up in Nepal in 1952, modeled on the Department of Archaeology in India. The DoA signaled the first attempt at a unified national approach to the conservation of built heritage. Various approaches to archaeology, building documentation, and material conservation were introduced in Nepal through India as well as through other international partnerships, in the absence of a "formal" approach to heritage conservation within the country. Several international experts and missions visited Nepal in this period, documenting archaeological sites and engaging in conservation projects, but during the first few years there was an absence of a systematic

codification of "appropriate" materials and technologies across the region. This meant that individual conservation projects widely varied in approach, materials, and technologies.

In the latter half of the twentieth century, increasing interest in heritage conservation and archeology paralleled an intensification of the discourse regarding the negative impacts of modernization and tourism on heritage precincts in the valley (fig. 3). The material transformation of the historic built environment there along with rapid urban expansion resulted in increased national scrutiny and international critique of the state of cultural heritage in Nepal. Nineteenth-century European travelers to Nepal had crafted a Orientalist and picturesque narrative of a remote and exotic place of beautiful ruins.[24] Through this lens, twentieth-century international development organizations continued to valorize and classify the valley's built heritage as symbolic of an immutable past, which was now at risk of being permanently lost to modernity and urbanization.[25] It was in this period that the official codification of heritage conservation practices began gaining traction, predominantly led by international experts and institutions. Two particular interventions have had a long-lasting impact on conservation in Bhaktapur. The first was a series of interventions undertaken by UNESCO (in partnership with the United Nations Development Program, or UNDP) in the 1970s and 1980s in Kathmandu Valley. The second was the Bhaktapur Development Project (BDP), a German-government-funded urban regeneration intervention that was planned and executed between 1974 and 1983. According to John Sanday, who led the UNESCO-UNDP mission, the opening of Nepal's borders put the country and its culture at risk from the "ever-increasing influence of the modern world and the impact of tourism."[26] Protection was proposed for the entire city, which "convey[ed] the image of a medieval city with all its indigenous elements still alive," with new development proposed to be undertaken (only) outside "the historic town."[27] The strategy, driven

by a deeply Western ontology, focused on maintaining the historic and material authenticity of Bhaktapur's core, and emphasized the use of "traditional" materials and construction practices.

Both the BDP and UNESCO-UNDP interventions effectively introduced European principles of conservation to Bhaktapur, which included a focus on written and graphic documentation, and discussions of heritage values. Many of the conservation principles introduced through these interventions were antithetical to the way buildings were locally built, rebuilt, repaired, and cared for. Both interventions also included substantial experimentation in terms of materials, technologies, and overall approaches to building conservation, as international heritage practitioners attempted to address the unique structural and construction aspects of Bhaktapur's historic built environment. These interventions were promoted as examples of international conservation principles that would simultaneously rectify past "errors" of the work undertaken by the DoA (and prior to that) and "improve" local building practices. For example, the BDP project team's assessment of structural collapses in historic buildings highlighted inadequacies of traditional building techniques: the weakness of mud and brick foundations, the lack of damp proofing, and absence of rigid structural roof members. Some of these issues were raised by local experts as well. Yogeshwor Krishna Parajuli, one of the local architects engaged in the project, commented that it was these failings in traditional building practices that "create(d) the impression of [Bhaktapur buildings] being very old even though very few have a fabric older than 100 years or so."[28] Sanday, who worked on conservation projects across the Kathmandu Valley, expressed similar impressions.[29]

The views of experts engaged in both projects were deeply Eurocentric and Orientalist. They privileged Western forms of knowledge and expertise, particularly with regard to structural strength and material performance. Emphasis was placed on the idea of physical "permanence"

over the continuity of recurring building practices. The approaches to building construction and restoration by both UNESCO consultants and the BDP team were in stark contrast to local practices of care and repair prevalent in Nepal, which stemmed from a belief of cyclic renewal. However, even as modern materials and technologies were introduced in Bhaktapur (and across the valley) by both international interventions, there was an acknowledgment of the existing traditions of building. As a result of this recognition, even though several interventions employed new techniques and materials, local craftspeople were engaged. This meant that through the UNESCO-UNDP and BDP interventions, a form of repurposing of traditional crafts was initiated for the specific purpose of restoration, such as Sanday's experiments with *telia* bricks, along with two experienced craftspeople, seen as a renaissance of traditional knowledge.[30]

Simultaneously, to prolong the life of historic buildings, early conservation efforts undertaken by the DOA, and well into the BDP, UNESCO-UNDP phase, had also used cement and RCC for improved structural resilience and synthetic damp-proof courses for waterproofing, while introducing lime for its benefits over mud. Mud and mud mortars were considered too porous, allowing for the germination of seeds and organic material prevalent in such mortars. Even while inserting a silicone-based damp-proof course, mud was found to be too porous to form a clean layer. Especially as the newer constructions in Bhaktapur continued to grow taller and had greater spans, with the advent of modernization, mud-based construction was deemed increasingly impractical, even for repairs and partial restorations. Within a few years of their introduction, concrete and silicone interventions had begun to cause their own issues as impervious, rigid materials that were often incompatible with the flexible construction systems of the valley. It was at this juncture that lime began to become increasingly popular as a material

for conservation, as a porous alternative to cement and silicone, but also as a stronger alternative to mud.

In addition to building techniques, the BDP, UNESCO-UNDP phase also established several building materials supply chains and expertise partnerships (with India in particular) that institutionalized the use of lime and other new conservation practices. For use in specialized conservation projects across the Kathmandu Valley, new material supply chains and crafts experts were imported from India and established as standard practice, enshrined in policy. For instance, in the case of the Hanuman Dhoka pilot project undertaken by UNESCO in the city of Kathmandu, "bulk orders were made for cheaper goods from India. . . . Original samples of some chemicals were obtained from Europe. . . . [S]ubsequently, suppliers were located in India."[31] Other chemicals and modern treatment compounds were also sourced from India, such as Karmex (a powerful herbicide meant to kill off vegetation in the mud) and Siltreet (a silicone solution meant to waterproof roof tiles).[32] These labor and material supply chains had a significant impact on reordering the construction ecology in the valley. As Bonapace and Sestini note, most of the workers employed (at the time of their research) at the kiln of Thimi, "the biggest in Nepal for special brick production," came from India.[33] These interventions had a profound and long-lasting impact on construction technologies; material and labor supply chains; and the discourse around aesthetics, authenticity, and structural resilience of historic buildings in Bhaktapur, and the valley at large. In the years that followed, between cement and lime, for the purposes of building conservation, lime was preferred, owing to its association with traditional materials, to the extent that it offered an acceptable degree of change to the fabric, without compromising on water resistance and structural resilience.

Below we briefly discuss two restoration and reconstruction endeavors undertaken in the 1970s and 1980s to contrast the concerns surrounding material and technologies. The first is the dismantling and restoration of the Vatsala Durga Temple undertaken as a pilot project by UNESCO-UNDP, and the second is the reconstruction of the Chyasilin Mandap undertaken by architects who were also responsible for the BDP.

<INSERT COT202307003_FIG4>

<B>The Vatsala Durga Temple: Lime</B>

The Vatsala Durga temple is a *shikhara*-style stone temple located in the Bhaktapur Durbar Square (fig. 4). It was inscribed as a category A monument in 1975 on Bhaktapur's list of sixty-two monuments and sites. It is an uncommon typology in the Newar building vocabulary, and thus its aesthetics are intrinsically linked with its value as a heritage "monument."

Archeological investigations revealed that the temple was constructed and reconstructed multiple times, using a range of materials including mud-based mortars, cement-based mortars, chemical sealants, and lime. Originally commissioned by King Bhupatindra Malla at the end of the seventeenth century, a sizeable portion of its *shikhara* collapsed as a result of the 1934 Nepal-Bihar Earthquake. The newly formed DoA led the temple reconstruction in the 1950s.[34] Following these repairs, the temple continued to suffer substantial structural issues. According to UNESCO consultant John Sanday, the structural issues were in part attributed to the "hastily executed" restoration and the recurring growth of a large *peepal* (ficus) tree in its masonry joints. The temple was thus identified for partial dismantling and reconstruction as part of the UNESCO-UNDP intervention.

The 1978 intervention under Sanday's supervision focused on fixing past construction issues and replacing the mud-based mortar with lime mortar, a stronger "traditional" material. Sanday's assessment focused on the damage inflicted by the root systems of the *peepal* tree that had taken firm hold in the temple's masonry. The restoration process involved the targeted dismantling of portions of the temple, the use of arsenic injections to poison the root systems, and the repositioning of the stones once the roots were declared "inactive," had dried, and had shrunk. The introduction of lime-based mortar into the Vatsala Durga temple, replacing the original mud, was presented as not only a stronger building material in the face of future earthquakes but also as insurance against the resurgence of the *peepal* and other vegetation. Any remnants of the *peepal*'s root system left behind in the temple's structural system could thus be controlled from growing back. Between the UNESCO-UNDP restoration and the 2015 Gorkha Earthquake, small-scale repairs were undertaken for the temple; however, in the earthquake, most of the temple collapsed into rubble.

<B>The Chyasilin Mandapa: Cement</B>

The Chyasilin Mandap is an octagonal pavilion built in the seventeenth century, during the Malla era, which gradually fell into disrepair in the nineteenth and early twentieth centuries. The pavilion collapsed in the aftermath of the 1934 Nepal-Bihar Earthquake, and many of its decorative elements were repurposed for various other buildings at the time. Following the completion of the BDP, its reconstruction was proposed, planned, and executed under the supervision of project architects Gotz Hagmüller and Niels Gutschow. Hagmüller and Gutschow pressed for the reconstruction of the pavilion, which they claimed was the "jewel in the crown of the whole Durbar Square," despite initial resistance from representatives of the DoA in the 1980s, who expressed a desire to focus on the heritage that was still standing in the square.

Hagmüller and Gutschow, however, successfully argued that the pavilion acted as a formal "hinge" between the east and west portions of the square, and it was needed to complete the urban ensemble of the Durbar Square.[35]

Little documentary or physical evidence of the pavilion was available, with traveler accounts from the early twentieth century serving as the main reference point for the reconstruction. In the absence of detailed photographs or drawings, a significant amount of conjecture was involved in planning for the pavilion's reconstruction. One of the most significant departures made in the updated version was its structural design. Hagmüller and Gutschow consulted with an expert on earthquake-resistant structures and developed an internal framework of columns and trusses in steel encased in deep cement concrete foundations.[36] The steel framework was concealed behind the concrete on the ground level but exposed on the upper story, to identify it as a modern intervention. The approach undertaken by the architects received mixed reviews by conservation professionals, who fiercely debated how Hagmüller and Gutschow's structural and material interventions compromised the building's authenticity and its overall aesthetics. For locals, the new pavilion was a significant departure in style, particularly the contemporary aesthetics of steel and cement concrete juxtaposed to the tiled roofs and carved timber elements, and the Chyasilin Mandap's reconstruction continues to be a matter of debate (fig. 5).[37] Nevertheless, it survived the 2015 Gorkha Earthquake unscathed, while several other heritage structures that had been restored and reconstructed during the same period collapsed into rubble.

<INSERT COT202307003_FIG5>

Since the completion of the BDP in 1983, Bhaktapur built heritage conservation has been under the purview of the Bhaktapur Municipality and of the DoA. In 2004, the municipality introduced an entrance fee to the historic core of Bhaktapur. The purpose of the fee was to establish a revenue stream to fund conservation and maintenance in the precinct and also to support other civic infrastructure through a heritage-based model. In addition, the municipality has strictly codified the construction of new residential buildings in the precinct to conform to a "neo-Newar" style. Under these building codes new construction is allowed to use RCC for structural purposes as long as façades maintain the appearance of glazed brick tiles and simplified architectural decorations expressive of traditional Newar architecture. While RCC has become the material of choice for new construction, for most listed heritage buildings, particularly within the UNESCO World Heritage Site boundary, lime has become the "traditional" material of choice for brick and stone masonry. Local bylaws encourage the use of lime *surkhi* mortar as a material for pointing masonry in residential buildings, and as newer construction replaces older buildings, this aesthetic gets reinforced over time.

In the aftermath of the 2015 Gorkha Earthquake, stone masons and craftspeople worked to identify and sort individual pieces of stone from larger fragmented sections of the Vatsala Durga temple. Kaancha Ranjitkar, the craftsperson working on reassembling the temple, described how the introduction of lime mortar in a previous reconstruction had caused the temple to collapse into larger, more unwieldy fragments than would have been the case otherwise.[38] According to him, the adhesion of lime and occasionally silicone sealants to stone meant that instead of collapsing into individual stone pieces, the temple broke into larger, potentially more dangerous sections, even though the structure had the advantage of improved seismic resistance. He pointed out that mud-based mortars customarily used in Newar buildings would have ensured

greater flexibility and that when the building collapsed, it would have broken into individual masonry units. He maintained, however, that the skills needed to reconstruct the temple using mud mortars were nearly impossible to find, as was high-quality mud. For him, a lime mortar was a reasonable substitute in this scenario. For the municipality and DoA officials, as well as for the workers on site, lime has now become the de facto traditional binding agent for heritage buildings (fig. 6).

<INSERT COT202307003_FIG6>

The disastrous effects of Portland cement are now well understood in the conservation field. Its excessive strength and incompatible characteristics with historic masonry structures were identified as contributing factors in the damage caused by the 2015 Gorkha Earthquake.[39] Portland cement leaches water and structural integrity from older mortar and masonry, exacerbating differential strength between old and new materials. Lime-based mortars offer greater structural flexibility and have been found to perform better than mud-based mortars under seismic stress.[40] Seismic studies on lime have inspired engineering studies in Nepal that have corroborated the findings, effectively reifying the discourse around lime's superiority, further enhancing the narrative of lime as a "traditional" material.[41]

Following the 2015 Gorkha Earthquake, the focus on reconstruction has been driven by the Sendai Framework for Disaster Risk Reduction, which focuses on the idea of "Build Back Better," where "better" can refer to structural strength; the future resistance of reconstructed infrastructure in the face of disaster risks; and improved performance with respect to risks, including, in the case of Nepal, seismic risks. The benefits of lime over mud, in terms of aligning

with principles of Build Back Better, is one of the reasons why it has become enshrined in reconstruction guidelines.[42] Diminishing sources of high-quality mud have often been attributed as another reason, even as lime has been imported extensively from neighboring countries such as India. Within DoA and Bhaktapur municipality guidelines for heritage reconstruction, lime is enthusiastically promoted as a viable material. Local contractors, officials, and laborers describe lime as a traditional building material, even though its introduction in mortar is recent.

Ironically, now that lime has been widely promoted as a traditional building material across Kathmandu Valley, recent UNESCO-ICOMOS evaluations of post-disaster reconstruction have flagged multiple concerns around using lime, a "nontraditional" material to replace mud mortar. In the reports of both the 2017 and 2019 joint International Council on Monuments and Sites (ICOMOS) and International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM) Reactive Monitoring missions noted that in many places,

> the integrity of the urban and religious ensembles is being recovered progressively through reconstruction, utilizing traditional materials, methods, and skills. Proposed changes to the Public Procurement Act support this process. However, in some places, *authenticity has been affected by the introduction of new materials* (e.g., the addition of lime to mud mortar) and the reconstruction of some buildings based on conjecture instead of sufficient supporting evidence.[43]

Despite these concerns, the priority of increasing structural strength and creating a whole that is more likely to resist fragmentation in the face of the next earthquake has meant that lime has effectively replaced mud as the material of choice in Bhaktapur, specifically concerning buildings designated as heritage.

<A>CONCLUSION</A>

In the aftermath of the 2015 Gorkha Earthquake, reconstruction of heritage in Bhaktapur has repeatedly been referenced in local and national media as an exemplar of local leadership. The approach to post-disaster reconstruction of built heritage in the city is framed as being independent of international influence, actively engaging the local community, and following traditional ritual practices and approaches. Local satisfaction with the progress and approach to the reconstruction of heritage has been high, even as international heritage networks and organizations have expressed dissatisfaction over the lack of systematic documentation and a disregard for material and historic authenticity. Heritage experts, both within Nepal and internationally, have voiced their concerns about the speed, materials, and technologies being used in Bhaktapur's reconstruction and about a lack of adherence to UNESCO's World Heritage Convention and other international heritage charters. In this paper, we have problematized such simplistic and opposed accounts of traditional and modern, which position local traditions of construction and reconstruction as static and unchanging and also fundamentally opposed to modern international approaches to conservation. Instead, the examples in Bhaktapur illustrate that local traditions are often built upon and deployed through global discourses, in this case through the assimilation of international practices in the conservation of heritage at a local level.[44] The introduction of lime is a result of international interventions in conservation expertise, material and labor supply chains, and institutional policy. Its subsequent widespread adoption in Bhaktapur's post-disaster landscape, however, was made possible through local acceptance, assimilation, and authorization over time. Construction or reconstruction material usage in Bhaktapur has followed a particular historical trajectory which has been equally informed by local and global political economies and aspirations.

The categories of traditional and modern do not adhere to a simple, linear temporality, where certain periods of history may be devoid of one or the other. We have shown how in each phase of Bhaktapur's past, from the advent of the Ranas, the opening of Nepal's borders, and through the BDP, UNESCO-UNDP phase, specific assemblages of technologies, knowledge regimes, and practices have been framed as either traditional or modern. The Ranas adopted modern building techniques and materials, following the neoclassical style, in a bid to move beyond the traditional forms of architecture in the valley. The BDP, UNESCO-UNDP phase, on the contrary, framed the march of modernity and tourism as a risk to the heritage of Nepal. The evolution of the neo-Newar style is a direct outcome of the ongoing dialogue between tradition and modernity expressed through the adaptation of traditional Newar aesthetics and forms that have become part of Bhaktapur's built environment. Modern regimes of urban planning, disaster risk management, and heritage conservation are entrenched in the post-disaster reconstruction of heritage; however, specific traditions are continually deployed and created through reconstruction as well.

The lack of historical evidence on the extent of the use of lime preceding the Rana regime has a significant bearing on the claims that might be made for its introduction to the valley's mainstream construction practices. There is little concrete evidence that determines the precise entry points of lime as a building material in Nepal, and this area merits research both in terms of tracing historical archives and analyzing building materials across the country. However, irrespective of its origins, the deployment of lime and its adoption in mainstream construction practice is not just a result of the local availability of the material or the preservation of Indigenous building crafts. Nor is it purely based on the techno-scientific claims of engineers and conservation professionals about its mechanical properties under earthquake stress, proving its

superiority over both mud and cement. In the end, the trajectory of lime's rise to prominence is much more complex. A combination of factors, ranging from resource availability to local government policy and practice; international institutions; and the globalizing discourse on heritage conservation that have reordered materials supply chains; construction technology knowledge regimes, and labor practices, have all contributed to the inscription and establishment of lime as a "traditional" material practice in the Kathmandu Valley.

<A>NOTES</A>

[1] We borrow the term "inventing tradition" from Eric Hobsbawm and Terence Ranger, eds., *The Invention of Tradition* (Cambridge: Cambridge University Press, 2012).

[2] Christiane Brosius and Axel Michaels, "Vernacular Heritage as Urban Place-Making: Activities and Positions in the Reconstruction of Monuments after the Gorkha Earthquake in Nepal, 2015–2020; The Case of Patan," *Sustainability* 12, no. 20 (2020): 8720.

[3] For details, see also Dipendra Gautam, "Seismic Performance of World Heritage Sites in Kathmandu Valley during Gorkha Seismic Sequence of April–May 2015," *Journal of Performance of Constructed Facilities* 31, no. 5 (2017): 601–703.

[4] UNESCO World Heritage Centre, "Mission Report: Kathmandu Valley (Nepal)," in *UNESCO World Heritage Committee 41st Session, Krakow, Poland* (Paris: UNESCO, 2017).

[5] Ibid.

[6] Hobsbawm and Ranger, *The Invention of Tradition*.

[7] See Hobsbawm and Ranger, *The Invention of Tradition*. Also see Vanicka Arora, "Reconstructing Memory and Desire in Bhaktapur, Nepal," in *"Invisible Cities" and the Urban Imagination*, ed. Benjamin Linder, Literary Urban Studies (Cham: Palgrave Macmillan, 2022), https://doi.org/10.1007/978-3-031-13048-9_16.

[8] The earliest records of Newar society date back to the fifth century and refer to a civilization with its roots in the plains of what is now northern India. Newars are not strictly an ethnic and linguistic group, as several ethnic groups coalesced in the region. They are considered the

original inhabitants of Nepal Mandala, a nation (or autonomous region) marked by the beginning of the Nepal era in 879 CE. See Mary Shepherd Slusser, *Nepal Mandala: A Cultural Study of the Kathmandu Valley* (Princeton, N.J.: Princeton University Press, 1982), 649.

[9] National Planning Commission Government of Nepal, Population Distribution by District, 2021, accessed November 8, 2022, https://npc.gov.np/en/population_distribution.

[10] Manoj Suji, Bina Limbu, Nabin Rawal, Prakash Chandra Subedi, and Jeevan Baniya, *Reconstructing Nepal: Bhaktapur—Heritage and Urban Reconstruction* (Kathmandu: Social Science Baha, 2020), https://soscbaha.org/wp-content/uploads/2020/04/reconstructing-nepal-bhaktapur.pdf.

[11]Sudarshan Raj Tiwari, *Temples of the Nepal Valley* (Kathmandu: Himal Books, 2005), 165.

[12] Ibid.

[13] Anna Tsoupra, Monalisa Maharjan, Dora Teixeira, Antonio Candeias, Cristina Galacho, and Patrícia Moita, "A Multi-analytical Characterization of Mortars from Kathmandu (Nepal) Historical Monuments," *Separations* 9, no. 8(2022): 205, https://doi.org/10.3390/separations9080205.

[14] See, for instance, Caterina Bonapace and Valerio Sestini, *Traditional Materials and Construction Technologies Used in the Kathmandu Valley* (Paris: United Nations Educational, Scientific and Cultural Organization, 2003). John Sanday, *Building Conservation in Nepal: A Handbook of Principles and Techniques; Report* (Paris: United Nations Educational Scientific and Cultural Organization, 1978). Sāphalya Amātya, *Monument Conservation in Nepal: My Experience with the World Heritage Sites of Kathmandu Valley* (Kathmandu: Vajra Publications, 2007).

[15] Bonapace and Sestini, *Traditional Materials and Construction Technologies*.

[16] For instance, additions and modifications made to the Kathmandu Royal Palace. See Bonapace and Sestini, *Traditional Materials and Construction Technologies*, 127.

[17] For textual descriptions, see Bonapace and Sestini, *Traditional Materials and Construction Technologies*. For material analysis, see Tsoupra et al., "A Multi-analytical Characterization."

[18] Tsoupra et al., "A Multi-analytical Characterization," 205.

[19] Brahma Shumsher Jung Bahadur Rana, *The Great Earthquake of Nepal, 1934*, 2nd ed., trans. Kesari Lall (Kathmandu: Ratna Pustak Bhandar, 2013).

[20] Ibid.

[21] Ibid., 97 (emphasis added).

[22] Yogesh Raj, "Management of the Relief and Reconstruction after the Great Earthquake of 1934," *Studies in Nepali History and Society* 20, no. 2 (2015): 375–422.

[23] Ibid. Also see Dipendra Gautam, Hugo Rodrigues, Krishna Kumar Bhetwal, Pramod Neupane, and Yashusi Sanada, "Common Structural and Construction Deficiencies of Nepalese Buildings," *Innovative Infrastructure Solutions* 1 (2016): 1–18.

[24] Henry Ambrose Oldfield, *Sketches from Nipal: Historic and Descriptive* (1880; Delhi: South Asia Press, 2018); and Gustave Le Bon, *Voyage to Nipal*, trans. N. Mauven and C. Leslie, vol. 1 (1931; Bangkok: White Orchid Press, 1981).

[25] Edward W. Said, *Orientalism* (New York: Pantheon Books, 1979).

[26] Sanday, *Building Conservation in Nepal*, 1.

[27] Ibid.

[28] Yogeshwor Krishna Parajuli, *Bhaktapur Development Project: Experiences in Preservation and Restoration in a Medieval Town (1974–1985)* (Patan: Bhaktapur Development Project Planning Office, 1986).

[29] Sanday, *Building Conservation in Nepal*.

[30] Bonapace and Sestini, *Traditional Materials and Construction Technologies*, 42.

[31] Sanday, *Building Conservation in Nepal*, 101.

[32] Ibid., 115.

[33] Bonapace and Sestini, *Traditional Materials and Construction Technologies*, 41.

[34] Sanday, *Building Conservation in Nepal*.

[35] Niels Gutschow and Gotz Hagmuller, "The Reconstruction of the Eight-Cornered Pavilion (Cyasilin Mandap) on Darbar Square in Bhaktapur—Nepal," *Ancient Nepal* 123 (1991): 1–9.

[36] Gotz Hagmüller and Suresh Shrestha, *The Eight Cornered Gift: Why Was the Mandap Not Destroyed This Time?* (Kathmandu: Asianart, 2015), https://www.asianart.com/articles/mandap/index.html.

[37] Ibid.

[38] Personal communication with Kaancha Ranjitkar, April 2019.

[39] Randolph Langenbach, "Earthquakes and Masonry: What Can Be Learned from Nepal?," *Terremoti e murature: Xosa si può imparare dal Nepal* (2017): 11–25, 19.

[40] Javier Lanas and José I. Alvarez-Galindo, "Masonry Repair Lime-Based Mortars: Factors Affecting the Mechanical Behavior," *Cement and Concrete Research* 33, no. 11 (2003): 1867–76.

[41] Rukshana Shrestha, Sristi Koju, and Rameswor Shrestha, "Performance of Lime Mortar in Reconstruction of Monuments of Bhaktapur," in 2nd International Conference on Earthquake Engineering and Post Disaster Reconstruction Planning, Bhaktapur, Nepal, April 25–27, 2019, 185–88.

[42] Build Back Better was originally identified as a slogan in Bill Clinton, *Lessons Learned from Tsunami Recovery: Key Propositions for Building Back Better* (New York: Office of the UN Secretary-General's Special Envoy for Tsunami Recovery, 2006). Since then, it has been enshrined in international disaster management policies such as the one issued by United Nations Office for Disaster Risk Reduction (UNISDR), *Sendai Framework for Disaster Risk Reduction 2015–2030*, in *Proceedings of the 3rd United Nations World Conference on DRR*, Geneva, https://www.preventionweb.net/publication/sendai-framework-disaster-risk-reduction-2015-2030.

[43] UNESCO World Heritage Centre, *Mission Report: Kathmandu Valley* (Paris: UNESCO, 2017), https://whc.unesco.org/en/list/121/documents/ (emphasis added).

[44] Vanicka Arora, "Reconstruction of Heritage in Bhaktapur, Nepal: Examining Tensions and Negotiations between the 'Local' and the 'global,'" *Disaster Prevention and Management* 31, no. 1 (2022): 41–50, https://doi.org/10.1108/DPM-03-2021-0093.