The Unswayed Archaeological Heritage Temples of Kathmandu Valley, Nepal

A Conceptual Review on Seismic Sequence

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Abstract— ***"In every earthquake we are losing a few good historical heritages"***

The diffusion of ancient Vernacular structures over Seismic behaviour, which includes multidisciplinary aspects of time and space, restoration & rehabilitation of damaged ancient historic structures and the aspects of damage tolerance, whose values are mostly attributed to the Archaeological, Architectural and Aesthetical (AAA)are the Prime objective of study which extends and throws light on meaningful testimonies of ancient act of construction with an effective and coherent knowledge of local technologies and material behaviour over centuries. The present review paper attempts to analyze the intrinsic qualities, constructional and technological aspects of ancient heritage temples from earthquake point of view: an important aspect, urges a study .

Based on an analytical study of architectural form and proportion (geometry), which largely provedfavourable for good seismic performances, the review would accomplish,Kathmandu Valley World Heritage Sites (KVWHS) of Nepal,"The Land Of Gods And Temples"as the area of study.However, the incomparable heritage Temple study would further lead to comprehend the principles of Architecture, Cultural Laws and Relics which can be adhered with effective architectural measures to protect these heritage temples from disaster and retain future sustainability. The Review paperendeavours detailed urbanism, past and present era, produced in a broad range of geographic areas, as well as methodological issues that inform or link the history of ideas and ancient sustainable practices by our ancestors. The pertinent intent of review is the effort to comprehend the disconnect between Architecture and Historic Archaeology of the Heritage building fabric.

Index Terms—Ancient Architecture,Unswayed Archaeology, Aesthetics, Cultural Heritage, Temples, Technology, Seismic hazard.

1 INTRODUCTION

Domination of disaster and urban transformation battlegrounds ancient Archaeological sites and levelling of such structures always have been an inevitable part. Attempt to erase the historical memory or silence history is equivalent to a **heritage War** which provides several debates among archaeologists, historians and architects making destruction more devastating.

According to the law on Cultural property [1] there is a very close relationship of Vernacular architecture with its natural environment. It is essential to protect this category of structures from destruction of earthquakes both professionally and comprehensively as the potential loss of these facilities is irreparable. The cultural property stock and law declares that the existing structure must have legal regulations for seismic protected constructions[2].

Further, The Athens Charter (1933) and The Venice Charter (1964) ICOMOS embedded International standards for researchers and experts with modelling assessment of seismic vulnerability and restoration techniques provided an essential input in depth of state of –the art[7,8].

Additionally, according to Hindu mythology a PurnaVastu or a perfect building is that which is properly oriented and constructed with carefully laid out norms to protect it from the evil forces of the nature, which include floods, storms, hurricanes and **earthquakes**. The 22nd chapter of BhramhaSamihita, which contains 107 chapters on science and technology, describes earthquakes **(Bhukamp**) and various aspects with reference to earthquake resistance of the buildings[3].

In seismic design the proportions of a building may be more important than its absolute size[2]. The Indian doctrine of proportions is designed not only to correlate the various parts of building in an aesthetically pleasing manner but also to bring the entire building into a magical harmony with the space[4].

Impact of heritage affects culture, values, spatial dimensions, tourism and education. **Heritage is sacred** and creates cultural identity of form, symbol and order helpful in sustainable development of architecture.

2HISTORICAL BACKGROUND

Ever since 1st century B.C, nearly 5000 years ago man started shaping sculptures and lead to development of twin civilizations of Indus valley, considered to be one of the oldest record of Urbanized Settlements and Heritage structures, which revealed sound technical engineered skills of ancient and Medieval people, who gradually assimilated indigenous knowledge of construction techniques[5].

Since, the time immortal, these rich heritage buildings have been facing the wrath of manmade cultural invasions, natural disasters and environmental degradation. However, they are the physical evidences of rich cultural values of our glorious past, which we inherit from our ancestors and are to be preserved in their authenticity i.e. aesthetic and historical values ensuring structural safety against extraneous actions [6].

2.1 Research Area

This **review paper elaborates impact of seismic behaviour on the ancient heritage Temples of Kathmandu Valley, Nepal.**

(Fig. 1).The prime and pertinent purpose of the paper is to highlight the problems and prospects connected with structural restoration and seismic protection in the areas significant to seismic hazards with special reference to the Seismic problems of such Heritage Monuments, as the damagecaused to the heritage

structures during earthquakes are never given first priority and most of the times go **unnoticed.**

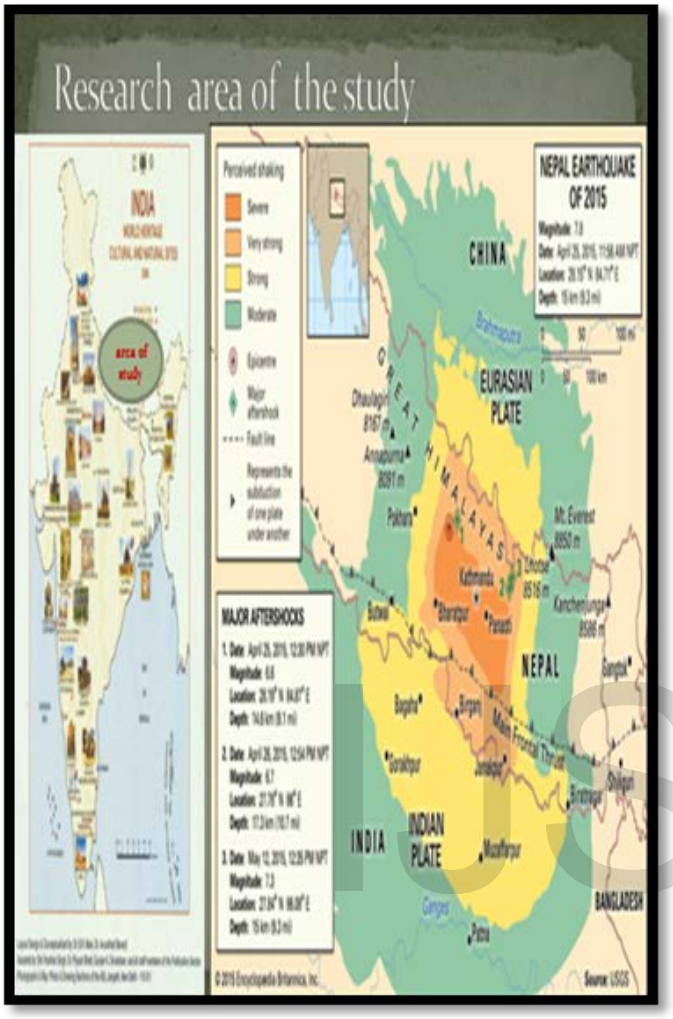

Fig. 1.Showing the area of study location and the seismic zone V of KV, Nepal, in the Himalayan ranges

2.2 Kathmandu Valley World Heritage Sites (KVWHS)

The Kathmandu valley was once a lake and was located between the seven holy rivers, was ruptured due to several earthquakes some 30,000 years ago and is still happening, SwayambhuPurana, UNESCO and ICOMOS [7],[8],[15], became on the fringe of history. The Himalayas are rising by 5mm per year due to shifts in continental plates making Kathmandu valley as the most seismic active zone V, releasing earthquakes, the most vulnerable disaster.(Fig. 1).

The seven heritage sites are described as "medieval royal temple complexes' (GoN, 1979) calling them Archaeologically, historically, culturally andreligiously very important to Kathmandu valley(Table 1).In 2007, UN removed Kathmandu valley from the list of World Heritage Sites in Danger as the Government of Nepal undertook series of conservation efforts in order to protect them.Later UNESCO again declared KVWHS in danger due to multiple seismic sequences in and around the valley.

Table No.1.

List of World Heritage Temples, Kathmandu Valley,Nepal, UNESCO ,2006

Table No.1. List of World Heritage Temples, Kathmandu Valley, Nepal, UNESCO, 2006

S.No.	World Heritage Temples kathmandu valley	Year of origin	Earthquake Damage scale		
			Style	1934	2015
1.	Changu narayan Temple ,Hilly Site *(UNESCO, WHS)*	4th Century B.C.	2 tiered pagoda style temple	Moderate Damage	Moderate Damage, main temple safe
2.	Bouddhanath stupa, Hilly Site *(UNESCO, WHS)*	5th Century B.C.	Largest domical stupa with gold glidded spire	Undamaged	Spire completely damaged, stupa remained intact
3.	Pashupati Nath Temple Flat terrain, on the banks of Bagmati river.*(UNESCO, WHS)*	Early 5th Century B.C.	3 tiered pagoda style main hindu temple and cremation site	Undamaged	Undamaged
4.	Swoyamnhu Nath *(UNESCO, WHS)*	6th Century B.C.	Round dome shaped temple	Moderate Damage	Moderate Damage
5.	Patan Durbar Square Char Narayan Temple	15th Century A.D.	Shikhara style temple	Damaged	Completely Damaged
6.	Bhaktapur Durbar Square	16th Century	Shikhara style temples	Damaged	Undamaged
7.	Kathmandu Durbar Suare	11th,15th,17th	2,3 Tiered Pagoda style	Completely damaged	Completely Damaged

Additionally, the newer craftsman developed their indigenous methods of seismic design along with geometry, ornamentation and effect of material and methods (DOA, 2007).The tiered temple architecture was the most influential style which developed in Kathmandu valley (Table 1.)

2.3 Department of Archaeology (DoA), Nepal

The seven **Monument Zone (MZ)** of Kathmandu valley having outstanding universal values, were locally and internationally recognized by UNESCO, 2006 as the Kathmandu Valley World Heritage Sites of Nepal are in danger(Table1). Additionally**, after the 25th April 2015, the**Gorkha Earthquake which impacted greatly on the Cultural heritage of Nepal, especially affected some 17 % of the KVWHS /Properties. The 12th May 2015 was also a major Cultural Catastrophe.

However, some structures did not follow the traditional Newari techniques during restoration after the 1934 Nepal – Bihar earthquake. The conservation of heritage structures were found with Neo- Classical work/domes, plasterwork, floral motifs etcwith cement mortar,this completely collapsed in 2015 earthquake (KVPT and DoA,Nepal). It was also noticed that the

heritage structures like Temples, palaces, rest places did not suffer as much catastrophic damage as residential settlement did (case of Bhaktapur Durbar Square).

Overall, the city's rich cultural loss of a poor nation came to a risk of losing vernacular architecture and tourism – the prime source of revenue generation .If these are rebuilt using modern material and styles, this wealth of sub –surface heritage, needs protection from intrusive interventions as well offers unique opportunity to develop a better understanding of globally significant outstanding universal value in Architectural Archaeology.

The DoA, GoN and Ministry of Culture, Tourism and civil Aviation, 2017,C121 bis, guidelines urges Recovery Master Plan (RMP) within an overall revitalization program and requests to develop an Integrated Management Plan (IMP) for the heritage sites damaged due to earthquake and calls on the international community, researchers, architects and archaeologists, as earthquakes are a regular feature of the Kathmandu valley, therefore demands a detailed study as a research work for each and every monument to diagnose the major damage for the treatment, reconstruction or rehabilitation and finally the cyclical conservation.

Department of Archaeology is the major authority for all the above concerns; without DoA's monitoring reports, projects would not be completed and considered authorized.

3 Scope

Based on the above technical workshops on the conservation of KVWHS properties by UNESCO / DoA / GoN 2004 [15], declared 8 WHS world heritage sites in danger,(Table 1)out of which seven WHS are in KV, Nepal.
Hence , the author understands the urgent need of research in archaeology ,unique art and architecture, iconographies etc inhabiting religious spirit with an uncountable impression/ experience of the divine realm with principles of symbolic diagrams and recitation of philosophical literature through Architectural geometry.

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3.1 Tourism and Heritage

"Tourism is a double edged sword", Litvin,S.W.

UNESCO, 2012, provided statistics on cultural, natural and mixed sites that tourism has a direct impact of visitors on heritage infrastructure. Tourism changes the local, social, political and financial economy of a community. Mass tourism demands infrastructure facilities in and around the heritage sites along with additional recreation and commercial services. Further, in the case of conservation of KVWHS, which Nepal inherits from the very past 1st century B.C. onwards having cultural, religious and Architectural values seems to be worth preserving for our future generations as an aspect of qualitative values for sustainable development, apparently to be achieved. Millenium Development Goals(MDG), 2015 agenda demands conservation study on heritage temples, which could help in developing a stronger tourism and fill the gap of heritage war.

3.2 Importance of Spatial Location of Heritage Temples

The Newari culture, heritage and archaeology of KV has a sensual impact to its spatial or geographical location as these temples govern the Newari customs and traditions, religions and festivals, architecture and archaeology, demarcated for Nepalese society. Because of the strong historical past the significance of these Heritage Temples must not go through any alterations in any form, be it change in spatial area, Religious values, architectural geometry or aesthetic appearance. The authenticity of these religious sites must continue with their ancient cultural values and customs. Any susceptible change be it a disaster in which the temple got damaged, undamaged or partailly damaged as the case may be, the spirituality of religious monument zone needs to be retained by preserving the sensual impact.

3.3 Geometry, Function and Design

From architecture point of view, the prime intent and emphasis should be form, design and geometry of Heritage temples which need not to be altered at all. However, it is found in most of the WHS of KV in MZ that the original character and testaments of some temples remained **unswayed** even after the disaster (**Nepal-Bihar 1934, earthquake or the 2015 Gorkha seismic attack)** becomes an important aspect in terms of authenticity. However, the concept of adaptive reuse of ancient heritage monuments can be applicable to palaces, forts etc but in no case to the heritage religious structures (temples, mosques or others) in any aspect to be altered by geometry, function, design or material even after or before any disaster to address the tangible organic heritage, traditions and techniques comprised to the Nepalese Heritage architecture.

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3.4 HISTORIC HERITAGE AND DISASTER FACTOR

Disasters are caused by an earthquake, landslide, tsunami etc or a combination of hazards, where vulnerability is experienced by the heritage site or structure which learns to survive or gets perished. In Kathmandu mainly 2 types of disasters primarily appear: **earthquakes and dampness(Fig. 3.).** Most often it is also comprehended that vulnerability of disasters on an archaeological site /structure is not only due to the disaster itself but can be caused due to change in climatic conditions, uncontrolled spread of human habitat and constructions, decay of heritage materials and methods, unappropriate structural geometry, sensitive zonation (seismic in case of Kathmandu valley) and expiration age of heritage and nonheritage structures.

4 SURVIVAL OF HISTORICAL STRUCTURES POST EARTHQUAKE, (CONCERN OF EXPERTS FROM MULTI- DISCIPLINES).

To address this problem, the current work offers a simple methodology, similar to those in the building codes, that rationally evaluates and compares all the possible rehabilitation techniques for any particular historical building. The evaluation process is based on the seismic risk mitigation, added value to each technique in contrast with its adverse affects on AAA values of the buildings.

5 LITERATURE REVIEW

5.1 Seismic Behaviour and Performance of Heritage Structures

Experience of many historical earthquakes has confirmed the adequacy and **good behaviour** of several **traditional techniques** in the event of an earthquake. The examination of the damage pattern after the Armenia earthquake in **1988** [9] or the Gorkha Earthquake,Nepal,**1255, 1408, 1810, 1833, 1934, 1980, 1988 and in 2015** [9],[10] and many more, showed that destruction was caused mainly due to reinforced concrete buildings or of mixed construction (masonry with reinforced concrete).Masonry buildings floors and roofswith timber, Stone,Adobe (traditional materials)suffered only slight damage. Seismic-resistant horizontal timber elements embedded in the masonry, as well as timber floors tying the structure and simple volumetric configurations were a few reasons. Traditional timber framed structures with different infill materials in Turkey also showed better performance than new reinforced concrete buildings in the **1999** Marmara Earthquake [11]. In the Lijang,**1996**earthquake China, traditional buildings remained intact while the modern ones collapsed [12]. During the **2005**Kashmir earthquake, damage on the Indian side of the border was much less, as the performance of the timber-laced traditional construction, which were much frequent on this side, performed very well and presented no, or very little, damage[13]. Experiences of earthquakes in last decades in semi urban and urban parts of India (Uttarkashi**1991,** Latur**1993**, Jabalpur **1997**, Chamoli**1999**, and Bhuj**2001**) have caused deep concern with regards to seismic hazards and resulting risk caused heavy economicallosses[14].

Fig. 3. Seismic Hazard Impact on heritage temples of KV,Nepal. Extreme right: the unsawayedPashupatiNath Temple.

Nonetheless, Vernacular constructions are extremely vulnerable to earthquake damage and they need awareness and protection. The use of poor materials, the scarcity of resources of generally poor communities and poor maintenance, among other factors previously discussed, highly increase their seismic vulnerability. In any case, **emphasis on traditional building techniques is therefore justified** because, their potential resilience to earthquakes is considerable and worthy to be studied and recognized. **Vernacular architecture is an outstanding inheritance from which different architectural solutions can be found**[15]. Understanding traditional reinforcement techniques and simple rules for safe earthquake resistant architecture can also prevent people to perceive the buildings where they are living as potentially hazardous. It can also contribute to its successful application to retrofit surviving examples is respectful to their identity.

5.2 Methods

Mathematically, the main available strategies, including limit analysis, simplified methods, FEM macro or micro-modelling and discrete element methods(DEM) are considered with regards to their realism, computer efficiency, data availability and real applicability to large structures. It has been addressed that in spite of the modern developments, the study of historical buildings is still facing significant difficulties linked **to computational efforts**, possibility of **input data acquisition** and limited **realism of methods**[1].

Henceforth, this review paper analyzes a few Literatures related to the above concerned issues:

5.3 Dusko & Nedeljko, 2015 [17].

Dusko&Nedeljko,2015, studies defined the 3 categories of seismic constructions as

A) Cultural property
B) Cultural heritage of great importance
C) Cultural heritage of extreme significance.

Based on above evaluation of seismicity the appropriate methodology established by Dusko&Nedeljko, included quantitative analysis of collapse with earthquake specificity of 500 and 1000 year return period, especially for **(C) cultural heritage of extreme significance**. In addition, to this,bore hole drilling,Vp (velocity of propogation),Vs waves trough were used as investigation technique of cracks, soil & bedrock etc by use of non-destructive techniques.

5.4 Asterisis, Douko, Moujolo, 2017

Asterisis, Douko, Moujolo, 2017, investigated the seismic behaviour of ancient monuments to avoid structural collapse and destruction during strong earthquakes. Asterisis et al., suggests **Mortar as historically oldest** structural masonary material. They strongly reveal the fact that mortar joint act as planes of weakness during the seismic attack. Additionally, the historical timeline reveals the fact of using horse hair, straw and even human blood in mud bricks as fibrous reinforcement techniques to be significantly added in engineering practice and educational curriculum suggested by the Authors[18]. **In particular, Asterisis etal., described detailed methodology for KaisarianiMonastry'sByantine**church in **Athens, Greece** as a case study included dynamic structural & Historical experimentation, material characteristics, (XRD) X-Ray diffraction & advanced diffractometers provided information regarding the mineralogical composition of materials in the monuments. Furthermore, N-type Schmidt hammer test, MIP (Mercury intrusion porosimetry sourced by proceq[18],[19] were also used **as a Methodology to inspect the Seismic hazard.**

5.5 Comparative Analysis of Similar types of works

The performance shown during past earthquakes can be considered to improve the understanding on the seismic capacity. The history of the building constitutes a unique experiment occurred in true scale of space and time. In a way, knowledge of historical performance is an essential dimension of the building and must be considered integrated in the Review. The following effects linked to history may have had influence on the structural response and existing damage, Construction process, architectural alterations, additions, destruction in occasion of conflicts (wars) natural disasters (earthquake, floods, fires ...) and long-term decay or damage phenomena.

5.5.1 Ganapathy and Rajarathnam, 2010

The **Bureau of Indian Standards** (2001) categorized T.N.(Tamil nadu) region under Seismic **zones II & III** with 73% and 27% respectively, having range of (M_{max})6.0 to 5.0 in Richter scale. **Ganapathy (2010)** studied the catalogue of historical earthquakes on multi-religious pilgrimage sites and eight UNESCO World Heritage sites by using remote sensing satellite imagery lineament techniques based on geological, seismological and geophysical data for various Cultural heritage sites of T.N.[20]. However, (Ganapathy and Rajarathnam) suggests that Chennai city and surrounding sites are prone to seismic amplifications, could be a matter of study in near future. Thus,their study reveals the fact that the frequent earthquake activity of North- East & West part of T.N. closely matched with the regional seismic zonation prepared by BIS, 2002. However, **special attention** shall be required for South-Eastern & North- Eastern region in future research studies situated in the thick alluvial sediment (bedrock) may receive higher amplifications even during moderate earthquake,hence demands a detailed micro-seismic zonation study[21].

5.5.2 Agarwal, S.K. 2005

Rehabilitation actions and strategies of prestigious buildings damaged during Seismic attack of 26th Jan 2001, and discussed Bhuj earthquake in the study. Agarwal reviewed the critical modes of failures commonly encountered during past earthquakes by using Non-Linear analytical design tools, nevertheless particular attention is required for the heritage buildings which are found on very soft or liquefiable soils[22].

5.5.3 Building Configuration and Seismic Design, 1981.

Building configuration and seismic design suggests the architectural building system development and National technical information service also included several important seismic design decisions and not to constrain the designer's freedom but to fill the void by involving simple non-mathematical terms, in the way in which the architecture of building affects its ability to withstand earthquake and provide good practice in seismic design, is addressed to a dual purpose [23].Additionally, the study includes discussion of ground motion, configuration problems and their solutions act as a bridge between the professional designers and researchers.

There are number of non-linear analytical design tools available for seismic evaluation and retrofitting of existing structures, even then many structures are evaluated using relatively simple force based methods that have little or no explicit consideration of realistic displacement demands from ground motion, displacement compatibility among dissimilar elements, non-linear response, failure modes etc. There is a**need to bench mark** these procedures so that results obtained are reliable and consistent. **Code specified** values of seismic coefficients and response spectra cannot be simply extended to heritage buildings while deciding the seismic action on these structures. The characteristics of the ground motion expected at the site must be taken into account and site-specific response spectra are to be generated. Particular attention is required for the heritage buildings founded on very soft or liquefiable soils.

Despite of advances in the field of modelling, experimentation and understanding the subject of seismic rehabilitation, published guidelines and standards, engineers must continue to temper their decisions with experience and judgement, primarily based on past experiences of failures of real structures under earthquake loading. Seismic rehabilitation of heritage structures is a highly specialized operation and requires close cooperation of experts of archaeology, architecture, surveying, structural engineering, geo-technical engineering and chemical engineering and should be supported by computation methods and well-equipped laboratories [22].

6 QUESTIONS

The above discussion directs this review to describe a few of our known questions.

What do we really need ? The religious/historic temples or the today's scientific/modern context.

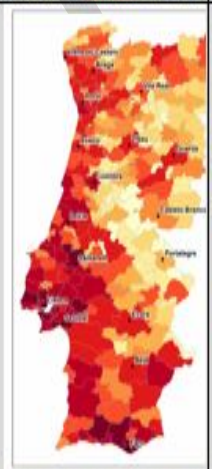
Should we address the heritage aspirations with modern scientific technology or retain the ancient architectural techniques?

Should there be any change permitted?

Why we are always looking for advanced technologies for strengthening our precious monuments?

Why some structures fell during the disaster and some did not ?
Lastly, **What** is the significance of heritage temples ofKV ,Nepal: today and tomorrow?

6.1 Based on above Questions AComparative Graphical Tabular Review of Seismic Framework and behaviour for Various Historical Monument Zones in the World have been analysed and further discussed in section 7.

Year, Title, authors	Location - Zone	Purpose of study	Desirable methods	Related graphics & drawings	Gaps addressed/ Concluding analysis
1996 Seismic Analysis of Safety Evaluation of Taj Mahal, India, [24]	Monument lies in Tectonic zone – III, Uttar Pradesh, India. 16TH Century	Retrofitting Seismic analysis for Fixed & flexible base conditions under occasional Earthquake loads.	3D Mathematical Models, using IS Codes	 Seismic Analysis of Taj Mahal	Study related to foundation soil material was effectively executed, for this Wonder of the world. However, Geometric configuration analysis still needs to be addressed for the monument.
August 1-6, 2004, Seismic Retrofitting Of Mani Mandir Complex At Morbi, Gujarat, India [25]	Complex lies in Tectonic Zone – IV, Gujrat, India .	Retrofit program for Conservation principles, minimum intervention consonance heritage character of the building were important considerations for study.	3D Models using design software program 'ETABS', diagonal bracing on underside of floor slabs for diaphragm action,	 Plan of Mani Mandir Complex	Measures such as cross-pinning and end pinning have been recommended to improve the seismic behaviour of walls, to be applied on weather sheds and stone pillars of the temple.
2005, An overview of seismic strengthening techniques traditionally applied in vernacular architecture [26,27]	The area with numerous heritage monuments lies in Seismic Tectonic zone – V, Lisboa, Portugal ,	To study the Probabilistic Seismic Hazard Analysis identification and reference of traditional construction solutions and detailing ,to improve the seismic performance of vernacular constructions in the zone.	A recent regional attenuation law derived for Portuguese seismo tectonic environment, based on a finite fault non-stationary stochastic seismological model calibrated for the region (Carvalho et al., 2008).	 Seismic prone regions in Portugal selected as case studies	As a final consideration one may say that pre-normative studies for seismic Portuguese Standard should be supported by continuous research projects that incorporate up to date seismic hazard and risk knowledge and that allow a more frequent revision of this Standard.

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2012, Application of Ancient Earthquake Resistant Methods in Modern Construction Technology [28,29]	Severe seismic hazard zone Istanbul, Turkey, 4th Century A.D.	To analyze Tall column structures and how layered cut stones have prevented seismic waves to enter the structures in ancient heritage monuments.	Three layer stone system an analytical investigation to show that how this obelisk could survive for more than 17 centuries.	 Ormetash Obelisk with its orthostat stones that goes back to 17 centuries ago hit by 80 earthquakes	The article paper explained some details of the analytical procedure to prove why layered cut stones have prevented seismic waves to enter the structures in ancient structures. Further, investigation can be done as to how this method can be applied in modern earthquake resistant construction technology.
2015-16 Earthquake destruction in Nepal ,A Case Study of Bhaktapur Durbar Square, Nepal [30,31]	Cultural heritage sites of KVWHS* in the Kathmandu Valley. Seismic Zone – V Himalayan Region.	Traditional Newari construction techniques, materials ,the destruction of monuments by earthquake.	Simple force based methods and 3D mathematical models using satellite imagery techniques ,	 Study of Bhaktapur Durbar Square, Nepal	The author suggests that further research will be in between traditional technology and the adapted new technology which will maintain the International Law and can also safe guard the historical heritage monuments from any kind of unpleasant natural disasters , Needs expository documentation is yet to be completed
25th April, 2015 The Gorkha Earthquake, Kathmandu [32]	HIMALAYAN REGION to be the most seismically active region in the world. The Monument zone (MZ) of the Conservation study area.	Modern Technology Innovations of the Industrial Revolution: affecting Urban life style, the traditional Parameters of Ancient Architectural Heritage and Energy Efficient Planning trends are vanishing.	It is Envisioned an urgent need of Instrumentation ,Experimentation and monitoring of Heritage structures to study the dynamic properties and safe guard them.	Kathmandu described as " Land of Gods & Monuments"[33] 	 Pashupatinath Temple solemnly stands—unharmed by April 25th ,2015's earthquake in Nepal. The Pashupatinath Temple is safe, and it has developed no cracks.". Source : Niels Gutschow, an expert on urban history and temple conservation in Nepal. [32]

7 DISCUSSIONS

The prime **objective** to review the above literatures was to comprehend the principles that governed the seismic retrofit program. Accordingly, archaeologists, architects, historians and those responsible for cultural aspects of the society must develop a kind of sensitive attitude towards any restoration plan for these treasures. The review also observed that the main **difficulty i**n seismic rehabilitation of historical monuments is the d**ominance of ambiguous but compelling AAA values of the structure** that comes across with the transparency and ease of structural and earthquake engineering techniques in reducing seismic hazard risk on buildings. The **gap** between these two different classes of problems is similar to the gap between art and science and reconciliation can be achieved only based on morals. In fact, there is a **need to add another dimension** to the concept of historical values, their **life expectancy** regarding the earthquake hazard risk in the respective region.

7.1 Issues

Cultural heritage is a passive victim of disaster, Jigyasu . R. ICORP.

Does Cultural heritage discourse stands only for aesthetics and tourism or should it be retained for persisting Ancient Cultural values in future generations as well?

Historic Temples keeps alive the valuable built heritage categorized either Organic or Inorganic including the cultural laws to protect these sites against structural violence, symbolic architecture, violence of traditional customs and religion.

It is also observed that modern analytical **design procedures cannot and should not be extended to the use of indigenous construction technologies** due to uncertainties in material properties. However, prescriptive design and construction procedures based on current knowledge can be developed so as to provide the minimum level of safety to these constructions. It is also seen that the use of indigenous earthquake-resistant construction technologies provides an excellent opportunity for large-scale construction of earthquake-resistant structures in developing countries at relatively low cost. **However, there is a need to greatly expand the research and development activities in this field to further improve these technologies and make them acceptable** [34].In spite of the modern developments, the study of historical buildings is still **facing significant difficulties linked to computational effort, possibility of input data acquisition and limited realism of methods** [35].

8 CONCLUSION

"Preparing for the unknowable",TheEconomic Times,

(13th October 2005)

A living heritage site is created by a community, which is closely linked to its functions, activities happening in and around the sacred structure. Additionally, these become places for commercial interaction : in architecture a street or a square. At the time of an event (festival or cremation) it is the responsibility of the authorities to facilitate safe, sufficient and smooth functioning for the visitors / worshippers which are increasing day by day and ensure the protection of both man and monument along with a sustainable historic environment.

On the other side, there is a need to look after the originality, consistency and beauty of the system by avoiding any unwise strengthening intrusion. The later puts the Architect in check and assures restricting the inflicted damage to the historical values of the monument. These values are mostly attributed to the Archaeological, Architectural and Aesthetical aspects of the building (hereinafter, AAA values) and should be defined independently by a wide range of expertise and/or authorities related to these issues.

Hence forth, it becomes an important issue as to why our heritage structures/ temples need a regular monitoring from the threatens of safety, sanctity and sentiments. According to (smith,1978), Kathmandu valley is bedded horizontally with fluvial lacustrine clay and sand due to which liquification in the soil occurs causing earthquakes. The earthquakes recorded over the last 800 years of magnitude greater than 8 richter scale occurs on an average of 80 years span(Department of Mines and Geology, GoN). The religious monument be it Temples , Charity's, Bahals, Palaces ,Patis and Sattals with regular or irregular forms , difference in mass and height ratios, with organic or inorganic materials and methods must undergo a cyclical renewal process of sustainable reconstruction.

Safeguarding cultural heritage sites from earthquakes has become a grave concern to all architects, archaeologist in respect to construction and ornamentation.

In conclusion, Earthquakes have been the predominant cause of devastation of our rich heritage all around the world. For centuries, these structures have periodically suffered strong seismic actions and have undergone a kind of natural selection, so that only those that were well designed and constructed have survived. The paper reviews the critical modes of failures commonly encountered during past earthquakes. In regards, to the seismic rehabilitation, the concept of preserve and reveal, the aesthetic and historical values of the structures should be kept in mind in addition to the safety. At most, only local improvement of the original structural system should be accepted and must be kept unchanged. The original materials and authentic documents are to be respected. This imposes on the specialists responsible for rehabilitation, a duty, to consider what limitations these considerations place on the choice of techniques and materials, of repair and strengthening. The thorough knowledge of the properties of the original materials used is prerequisite so that the compatibility of the new materials and technology used for rehabilitation with the original ones can be ensured along with long term durability.

Vernacular architecture is an outstanding inheritance from which different architectural solutions can be found. Understanding traditional reinforcement techniques and simple rules for safe earthquake resistant architecture can also prevent people to perceive the buildings where they are living considered as potentially hazardous. It can also contribute to its successful application to retrofit surviving examples is respectful to their identity.

The review paper concludes with a list of challenges stated above, a complex and extensive concern which requires appropriate mitigation measures in multiple aspects like regular assessment, monitoring and maintenance, avoiding resemblance of historic structure with imitation of materials and facades considering them to traditional, falsification of culture by laws, inherent heritage knowledge are a threat to the authenticity and integrity of heritage and community both.

There is an urgent need of adequate research with specialized architects and archaeologists providing wonderful documentation and theoretical understanding to address heritage in disaster risk with future sustainable plans and safeguard heritage of the society as whole.

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