



Risk Assessment for Amber Fort Area, Jaipur

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ABSTRACT: Disasters do happen, therefore being prepared is the best policy to manage these unavoidable events. Over the past few years, natural and man-made disasters have caused enormous damage to natural as well as cultural heritage across the globe. Some high profile examples include destruction at Bam (Islamic Republic of Iran) due to earthquake in 2003; Prambanan Temple Compounds (Indonesia) owing to earthquake in 2006 and city of Aleppo and Bosra (Syria) due to terrorism in 2015 and 2016. Amber fort, which has been inscribed as UNESCO world heritage site in 2013 is currently facing development pressures and increasing number of tourists are causing a threat to the Outstanding Universal Value of this complex. Climate change is also posing risks to this site in the form of heavy rains which can lead to subsequent floods and landslide. This study analyses the risks and vulnerabilities that Amber is facing at present and how technology can assist us in finding the solution. Space syntax is one such tool that can be used to foresee movement pattern with data-based evidence. These movement patterns will help in formulation of emergency evacuation plans in future. This study will focus on both qualitative and quantitative aspects of risk calculation and will try to provide solutions using space syntax analysis.

I. INTRODUCTION

Cultural heritage risk assessment and management implies a new paradigm for conservation, which is proactive rather than being reactive and is aimed at protecting the present of 'the past' by anticipating its future (Jigyasu, 2005). This paper focuses on risk assessment of Amber fort which was inscribed in world heritage list in 2013 under serial nomination "Hill Forts of Rajasthan". This fort is major tourist attraction point of Jaipur city and is currently prone to disasters like heavy rainfall and subsequent floods or landslides. Terrorism is also a threat and the staff needs to be prepared for such emergencies. Stampede or fire are some disasters which can be induced as after effect of earthquake, landslide or mismanagement or some rumor. So, first step in this direction can be studying the movement pattern of visitors and finding common gathering spaces. A risk management plan is the need of the hour with increasing risk of disasters and for preparing a risk management plan, a thorough assessment of all risks and vulnerabilities is the first step and this paper tries to deal with this aspect and also tries to analyse visitor movement pattern and connectivity of various spaces.

II. WHAT IS DISASTER

A serious disruption of the functioning of a society, causing widespread human, material, or environmental losses which exceed the ability of the affected society to cope using its own resources' (UNISDR, Terminology, 2007: Annex1).

Disasters are generally classified in two categories based on their source of origin i.e. man-made or natural disasters but it is important to understand the term disaster apart from the definitions given by experts and its relationship with another important term 'risk'. In most of the definitions, disaster is explained as a rigid linear objective reality with discrete pre, emergency and post disaster phases and a definite starting and ending point. But in real world, disaster is a complex phenomenon with various factors affecting and contributing to it. In fact, disaster has no precise starting and ending points. Such situations need to be seen in a continuum, as actions taken during various phases have an impact on each other. This means that we need to establish backward and forward linkages while deciding various actions and interventions at various stages (Jigyasu 2003).

Recent studies, moreover, have suggested that the heritage, in both its tangible and intangible forms, is not simply a passive entity exposed to potential damage in the event of a disaster, but has often a significant role to play in reducing the impact of disasters on lives, property, and livelihoods, before, during and after the disasters (recent example is Post Earthquake Recovery of Nepalese Cultural Heritage after Gorkha earthquake in April 2015.).

III. WHY RISK ASSESSMENT

In the context of heritage risk management, Risk assessment is determination of quantitative and qualitative value of risk associated to a concrete situation and estimating the probability of its occurrence and the consequences it can have on cultural heritage.

Risk management is the decision-making process following the risk assessment. It is based on identification, assessment and prioritization of risks. So risk assessment is the first step towards formulating a risk management plan.

Significance of Emergency evacuation plan:

Emergency evacuation plans are developed to ensure the safest and most efficient evacuation time for all expected residents of a structure. In our case, we need to consider the visitors at amber fort, administrative and security staff and the vendors. A benchmark 'evacuation time' is calculated for various hazards using simulations such as modelling the flow of visitors or by using best practices and regulations. Preparing an emergency evacuation plan helps in avoiding a panic driven incident like stampede and it also helps in reducing the after effects of a disaster.

IV. ABOUT AMBER FORT

Amber fort is representative of a key phase (17th century) in the development of a common rajput-mughal court style, manifested in the buildings and gardens added to Amber by Mirza Raja Jai Singh I.

This fort is inscribed as UNESCO world heritage site in 2013 under the serial nomination 'Hill forts of Rajasthan' along with five other forts.

It comprises of approximately 30 hectares of land area with the proposed buffer zone having an additional area of 498 hectares including part of the Nahargarh Wildlife Sanctuary and the entire town of Amber located down in the valley below the Fort.

i. Brief History

Amber Fort is located in a valley formed by a range of Aravallis known as Kalikho Hills and placed on the hill below the connecting fort of Jaigarh, a few kms to the north of the city of Jaipur. The primary function of Amber Palace was as the seat of power of the Kachchwaha Rajputs and the capital of the Dhoondhar region of Rajasthan. The complex, which served residential, official and religious functions, is an example of a fortified Rajput palace structure, which in layout and architectural style is strongly influenced by Mughal architecture.

Its distinctive contribution is the representation of a key phase (17th century) in the development of a common Rajput-Mughal court style, embodied in the buildings and gardens added to Amber by Mirza Raja Jai Singh I. The immediate defense structures of the fort are added to the nominated property which elaborates the self-defense mechanism of the fort.

ii. Risks and vulnerabilities

Amber fort alone contributes to almost one-third of the city's total revenue from tourism. Every day, nearly 4000 tourists visit this site and it is Currently under developmental pressures, tourism being one of the important ones. Hence, Amber Development and Management Authority(ADMA) invites consultancies for preparing Risk management plan and visitor management plan.

The annual footfall is supposed to reach 20,00,000 by 2017.

Table 1: List of disasters considered.

Disasters	Terrorism	Earthquake	Stampede
Reason for consideration	Status of world heritage site and no. of visitors	Structural stability of fort is uncertain, increasing incidents of earthquake in surrounding region.	Limited access, religious gathering, can occur as an after effect of other disasters
Relevant Example	Temple of bel, Palmyra, 2015	Char Narayan Temple, Patan, Nepal	Chamunda Devi temple stampede, Mehrangarh fort, jodhpur,2008

So the fort is facing a continuous increasing pressure of tourism. Carrying capacity is a conceptual tool for managing tourism pressure in heritage sites worldwide. To identify other risks and vulnerabilities that this site is facing at present, various approaches can be used like individual perceptions, social representation (can be found out by conducting surveys) and objective assessment.

By objective assessment of the site we enlist the disasters that have a probability of occurrence and can impose a risk to the build heritage and life of the tourists and staff. After site inspection and expert opinion, it is found out that disasters like heavy rains and fire need not be considered. Even though there is probability of occurrence of heavy rains due to erratic rainfall pattern in last few years owing to climate change but the drainage system of this fort is very well maintained and there are no such places where water logging is happening. Similarly, there are chances of fire due to large no. of electrical appliances for light and sound show but the risk associate is very low as maximum built heritage is made of stones.

V. METHODS OF RISK ASSESSMENT

In the quantitative approach, the level and magnitude of risk can be calculated based on three criteria:

- A: probability or extent of damage happening
- B: degree of loss of value and integrity as a result of the impact
- C: fraction of the assessed area susceptible to the threat, and the extent of its vulnerability.

One factor that plays a role in risk assessment with the ABC criteria is the inclusion of loss in value in the equation.

Risk assessment relates directly to values and loss in integrity. At the area and site element level, it is recommended to carry out a value-centered assessment covering individual elements under assessment. The significance of the whole site needs to be taken into account. This way of assessing the relative value of the studied area will show the priority areas for mitigation decision-making and action later in the risk assessment process. The Risk Management Australian / New Zealand Standard (Standards Australia/Standards New Zealand, 2004), as applied by CCI-ICN and ICCROM) states that:

$$A \text{ (probability)} + B \text{ (loss in value)} + C \text{ (fraction susceptible)} = \text{magnitude of risk}$$

This assessment of magnitude should take into consideration the impact of these risks not only to the site and site element’s physical attributes, but also to visitors, researchers and stakeholders as well as the landscape of sites. However, the model and most of the forms used have been designed to assess the magnitude of risks on physical aspects of the property, and assessing the risk to people and nature might need to be tackled differently and separately. Urban researchers (Hillier 1998; Peponis, Ross and Rashid 1997; Caria, Serdoura, and Ferreira 2003; Eisenberg 2005 and many others) have shown that along with other applications, space syntax can also be a good predictor of movement, so it can be used to prepare visitor circulation plan and evacuation plan for Amber fort.

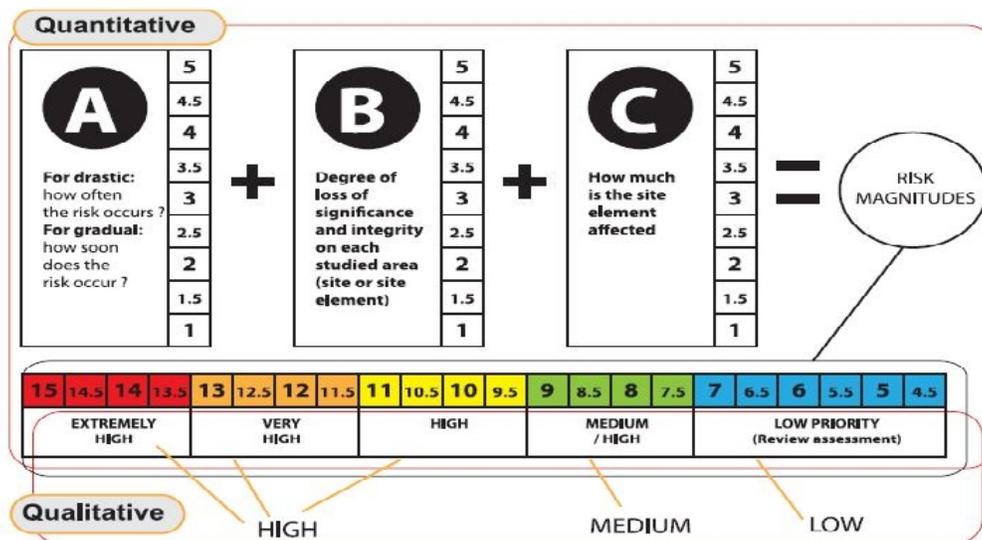


Fig. 1. Magnitude of risk.

Types of Space Syntax Modelling

In **node analyses**, the space syntax model consists in a 'connectivity graph' of nodes and lines (vertices and edges in mathematical terms) where the nodes usually represent a room, while the lines (or edges) represent connections between the spaces. Node analysis is particularly useful for studying dwellings since they usually consist of enclosed spaces (rooms) connected by doors or door-like openings.

In **axial-line analyses**, the space is represented by straight lines, so-called axial-lines. In brief, the space to be examined is modelled by 'fewest and longest straight lines covering all convex spaces'. (Hillier and Hanson, 1984, p. 91-92) Each line is considered as a node in a connectivity graph and for crossing lines the respective nodes are defined as connected. Axial-line modelling

captures basic features of continuous spaces such as the outdoor space between buildings in a city, a space that is a 'net' of long and intersecting 'street-spaces'. Therefore, axial-line modelling is often applied in urban analyses.

In **visual-field analyses**, the spatial elements on which the calculation is based are 'visual-fields' or 'isovists'. For spaces not known in advance by the persons being present (spaces where 'what you know is what you see') or spaces where people's movements have the character of 'free-float', visual fields as well as axial-lines are likely to be relevant kinds of modelling. Visual-field analyses are often applied for studying spaces that are complex and overlapping but not 'street-alike', for instance public squares in cities and indoor space of buildings like museums or shopping malls.

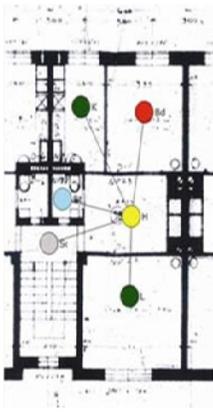


Fig. 2. Node analyses.



Fig. 3. Visual-field Analyses.

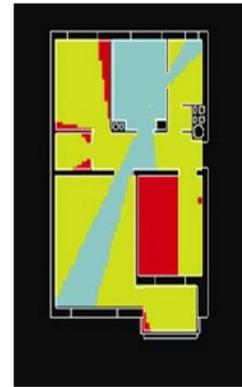


Fig. 4. Axial- line analyses.

VI. SIMULATING STUDIES AND RESULTS

Most real spaces can be analyzed by any of the three kinds of modelling mentioned above. However, as the different kinds of modelling capture somewhat different aspects of space, some modelling is likely to be more relevant than other. Which kind of modelling that might be best in a particular study, depends on the kind of space that is examined as well as on the subject of interest. In our case, as the fort is a maze of interconnecting spaces and a hierarchy of courtyards and *verandahs*, axial analysis will help in better understanding the spaces and visitor's flow. Normally we use radius 2 for calculating local depth within walkable urban regions. The following two values are important in axial map analysis:

- Integration is representative of potential destinations in the system. These destinations are highlighted as red and appear in the shallowest areas of the graph. Segregated spaces fall within the range of blue.
 - Choice represents through-movement potentials in the system where busy routes are highlighted by red
- The Palace is divided into four main sections each with its own entry gate and courtyard. So these sections are considered separately for axial and visual field analysis. Main entry is through the Suraj Pol (Sun Gate) and Chand Pol (moon gate) which leads to Jaleb Chowk, the first main courtyard. This was the place where armies would hold victory parades This courtyard have maximum visual connections as there are no major built structure in-between. It was built during Sawai Jai Singh's reign (1693-1743 A).



Fig. 5. Amber fort.

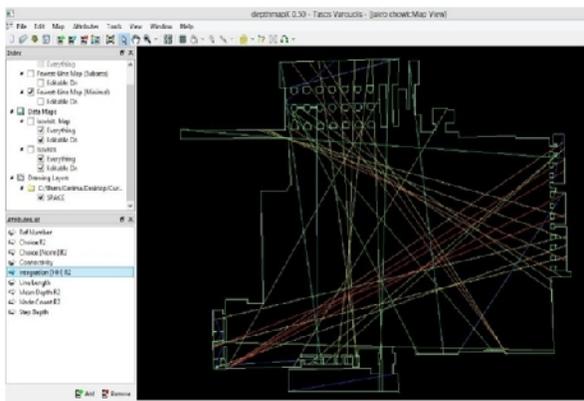


Fig. 6. Axial analysis- integration value (Jaleb chowk).

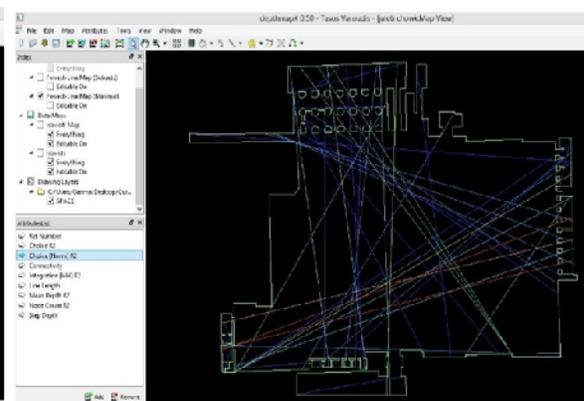


Fig. 7. Axial analysis- choice value (Jaleb chowk).

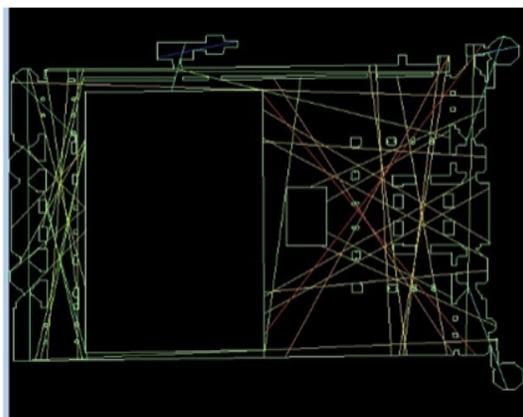


Fig. 8. Axial analysis- integration value (Diwan e khas).

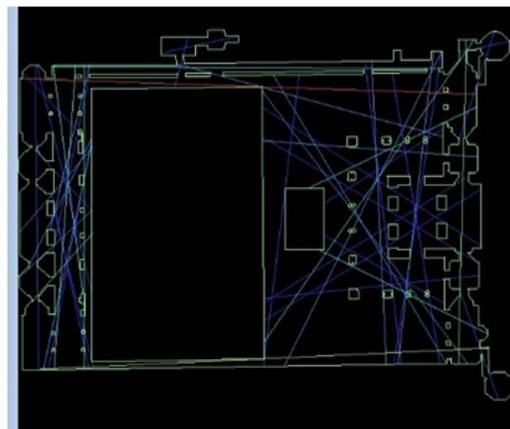


Fig. 9. Axial analysis- choice value (Diwan e khas).

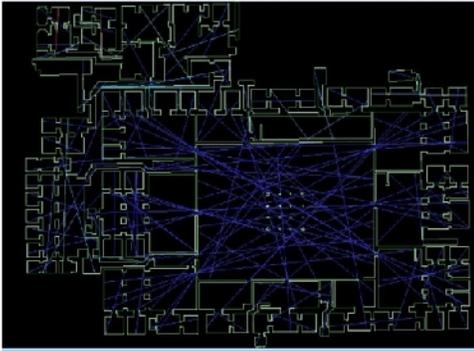


Fig. 10. Axial analysis- integration value (Man Singh palace). **Fig. 11.** Axial analysis- choice value (Man Singh palace).

By examining the results of axial analysis we can conclude that there will be movement issues in Man Singh palace due to its narrow corridors and as privacy was the guiding principle in its construction, it will be a task to prepare an evacuation plan for this area.

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