EARTHQUAKE RISK ASSESSMENT AS THE INITIAL STEP FOR SENSIBLE AND POWERFUL PLANNING

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Abstract:

Earthquake risk assessment is the initial step for sensible and powerful planning and usage of earthquake risk reduction and additionally readiness activities as it helps understanding the basic issues and its extent. Before, design and mitigation strategies were frequently constrained to an accentuation on moderating the effects of individual hazards. In ongoing decades, a move towards creating strategies to survey and alleviate the effects of multiple hazards has happened. For the research work to be done in accounts the multi-storied buildings of Ahmedabad city of Gujarat. A significant portion of the information gathered was through essential overview. After the conception of the possibility of the topic, writing audit was completed to have a superior understanding of the issues, and the techniques and ways to deal with be utilized were chosen. The issues in the examination zone were broke down and contrasted and the prevailing situation in the regions where such kind of contextual investigations has been completed. This examination, therefore, attempts to understand how to address a portion of the hazards that are widespread in the city and build up an approach that can be received for other cities that have comparative issues using Remote Sensing information and Geographic Information System (GIS) methods.

***Keywords**: Earthquake, Risk, Assessment, Methods, planning, etc.*

1. INTRODUCTION

All hazards incorporate all conditions, ecological or artificial, that can possibly cause injury, disease, or passing; harm to or loss of hardware, framework administrations, or property; or social, monetary, or natural practical corruption. Thusly, "a first meaning of the term multi-hazard in a risk decrease setting could peruse as follows: the entirety of applicable hazards in a characterized zone". Nonetheless, regardless of whether a hazardous interaction is significant must be characterized by the particular setting of the individual zone and to the goal of the investigation. For example, a cut-off point for the hazard-related harms: Depending on the individual scale, an interaction is viewed as unimportant on the off chance that it causes harms under a specific point. The bigger the noticed zone, the higher is this cutoff point. Another model is given by the European Commission in their rules for risk assessment and mapping. These rules propose a bunch of standards for the assurance of all huge hazards at a national level. For instance, those dangers with a yearly likelihood of in any event 1% "and for which the results address huge expected effects, i.e.: number of influenced individuals more noteworthy than 50, financial and natural expenses about € 100 million, and political/social effect considered critical or intense [need to be taken into account]. Where the probably impacts surpass an edge of 0.6 % of gross national income (GNI) likewise more uncertain hazards or risk situations ought to be thought of (e.g., volcanic eruptions, tsunamis)". With regards to spatial arranging, important as indicated by various measures and limit the arrangement of considered cycles to "hazards that are intently attached to specific zones that are particularly inclined to a specific hazard," whereby omnipresent dangers, for example, shooting star impacts are barred. One test identified with multi-hazard risk examinations is identified with the way that while for some, if not most, single cycles a multitude of grounded approaches is accessible (kindly allude to audit articles accommodated snow torrential slides; for stream floods, and for avalanches, for meteorological, volcanic, and seismic hazards), many less investigations dissect multiple hazards. In outcome, experience with related issues is uncommon, and furthermore, standard methodologies are not accessible.

2. LITERATURE REVIEW

Ellingwood, (2007) examined that various modeling approaches were taken after to contemplate the framework level based models (SDOF systems) and part level based models (MDOF frame systems consolidating minute pivot connections and bar section joints). Additionally, extraordinary ground movements choice criteria have been utilized as a part of each investigation; for instance a few examinations utilized Gutenberg delayed repercussion primary stun connections to scale their post-quake tremors records, other utilized sensible ground movements recorded at various stations amid past multiple earthquake situations, and ultimately randomized successions of ground movements. Since various methodologies and suspicions have been utilized as a part of writing to display structures and to choose their connected ground movement successions; in this way, errors amongst results and conclusions for various investigations have been unmistakably watched.

Aschheim (2009) was the principal specialist who presented corrupting systems in his investigation on "the impacts of earlier earthquake harm on reaction of basic firmness debasing structures". The concentration was fundamentally to evaluate impacts of earlier earthquake harm on the pinnacle removal reaction of over than 20,000 SDOF oscillators. Takeda display was executed and utilized as a part of the hysteretic conduct of the SDOF systems. The model fused squeezed hysteresis and additionally firmness and quality corruptions. Eighteen ground movements that speak to various frequency substances, term, and the nearness or nonappearance of close field directivity impacts. The impacts of lingering removals due to earlier shaking were not considered in this investigation as was accepted to have immaterial impact on the reaction.

Taher, (2010) expressed that every one of the previous examinations and papers explored gave contentions to the need of multi-hazard design and a couple of prescribed conceivable roads of research to enhance the design of such buildings; anyway none set clear suggestions that can be connected to ebb and flow construction hones. Just Dr. Rima Taher, who composed a paper specifying recommendations for enhancing building construction for Architecture for Humanity after the Haiti earthquake in 2010, spread out an arrangement of general rules for multi-hazard design. A significant number of Taher's proposals identify with building shapes and construction rehearses for low-rise structures no taller than two or three stories, yet the motivation behind his exploration is like that of this postulation: to distinguish particular areas of change in structural design to help in opposing the impacts of both wind and seismic hazards.

Eshrati et. al. (2015) expressed that Multi-hazards represent a genuine risk to human life. It can cause extensive harms. The assessment of the normal misfortunes due to multi-hazards requires a risk assessment. Multi-hazards risk assessment permits the distinguishing proof of the most jeopardized areas and recommends where additionally nitty gritty investigations must be completed. This examination means to give another system for Multi-hazard risk assessment that makes less demanding the similarity analysis of vulnerability for various hazards and records for conceivable activating impacts. Techniques utilized as a part of this exploration depend on hypothetical approach and documentation. Two types of hazards will be evaluated, in particular earthquake and fire following earthquake. Semi-quantitative and quantitative approach would evaluate risk rates at both local and nearby levels.

Ming et. al. (2015) examined that Risk assessment assumes an essential part in disaster risk management. Existing multi-hazard risk assessment models are frequently subjective or semi-quantitative in nature and utilized for relative investigation of provincial risk levels. They can't evaluate specifically likelihood of disaster misfortunes from the joint effect of a few hazards. In this exploration, a quantitative approach of multi-hazard risk assessment in view of vulnerability surface and joint return time of hazards is advanced to evaluate the risk of harvest misfortunes in the Yangtze River Delta area of China. The effect of solid wind and surge, the two most conspicuous agrarian hazards in the area, is dissected. The multi-hazard risk assessment process comprises of three stages. Initial, a vulnerability surface, which means the useful connection between the force of the hazards and disaster misfortunes, was constructed utilizing the yield misfortunes information for misfortunes caused by solid wind and surge in the ongoing 30 years. Second, the joint likelihood conveyance of solid wind and surge was built up utilizing the copula capacities. At long last, risk bends that demonstrate the likelihood of product misfortunes in this multi-hazard setting at four contextual investigation destinations were computed by the joint return time of hazards and the vulnerability surface. The risk assessment aftereffect of yield misfortunes gives a valuable reference to governments and insurance agencies to figure farming advancement designs and break down the market of agrarian protection. The multi-hazard risk assessment technique created in this exploration can likewise be utilized to quantitatively survey multi-hazard risk in different locales.

3. METHODOLOGY

Earthquake at intensities VII, VIII and IX on the Modified Mercalli scale were taken for the assessment of anticipated building damage. The standard formulated seismic intensity versus anticipated that damage should buildings based on the damage situation in Chobari in Bhachau Taluka of Kutch District of Gujarat was embraced for this contextual analysis. The seismic intensity versus expected damage was designed for a snappy assessment of building damage in the Indian subcontinent

Table 1: Seismic Intensity Vs Damage to Buildings

Building type	**Intensity VII**	**Intensity VIII**	**Intensity IX**
Mud and Adobe houses, random-stone constructions.	*Most have large deep cracks. Few suffer partial collapse.	Most suffer partial collapse.	Most show partial collapse. Few completely collapse.
Ordinary brick buildings, building with large block and prefab. Type, poor half timbered houses.	Many have small cracks in walls.	Most have large and deep cracks.	Many showpartial collapse. Fewcompletely collapse.
Reinforced buildings, well built wooden buildings.	Many have fine plaster cracks.	Most may have felt cracks in walls. Few may have deep cracks.	Many may have large deep cracks. Fewmay have partialcollapses.

*Most= about 75%, Many = about 50%, Few = about 5%

Buildings were characterized according to structure, material, breaks and uprooting/slant on the roof, roof material, proximity of the buildings to one another, and the stature of the buildings. The building structure is sorted into three classifications based on the existing conditions in the field with the consultation of neighborhood engineers and draftsmen. The three classes of buildings are: I) Reinforced Concrete Cement (RCC), ii) Load Bearing (generally blended material and block masonry) and iii) Conventional Wooden structures. Breaks were prominently seen in a large number of the block walls and relocation/slant seen in wooden buildings because of the mass development (landslide) predominant in pieces of the area. It is expected that buildings that have breaks on the wall, retaining/protection walls will have less protection from earthquake ground shaking.

4. ANALYSIS

A city isn't defenseless against only one specific hazard and totally liberated from other hazards. Simultaneously, hazards are interlined with one another. For instance, an earthquake may cause fire and landslide. It is therefore, essential to investigate the diverse potential phenomenon that can cause unfavorable effects on a city. This is the concept of multi-hazard analysis. By definition, risk is the normal damage of a specific hazard. The multiple hazard maps are often called composite, synthesis or overlay map, are a magnificent tool for fomenting the consciousness of natural hazards and for analyzing vulnerability and risk, particularly when combined with the mapping of basic facilities.

Multi-hazard mapping is typically completed with new land use and metropolitan improvement in mind. Significant information on individual natural hazards in a study area may show up on maps with varying scales, inclusion, and detail; however these maps are hard to use in risk analysis because of the inability to conveniently overlay them on one another for study. Information from a few of them can be combined in a single map to give a composite image of the greatness, recurrence, and area of effect of the relative multitude of natural hazards.

4.1 The Approach

The study surveyed three kinds of hazards and the vulnerability of the buildings and population to show up at a Multi-hazard risk map. Various hazards to be specific, earthquake, fire and landslide were investigated individually. The result of the multi hazard analysis is combined to set up a multi-hazard map. Then the vulnerability of population in the study area is evaluated and finally, the result of the multi-hazard is the result of the multi-hazard risk map.

4.2 multi-hazard analysis

As has been examined in the previous piece of the section, the hazards were classed into various categories from high to low. The measure of weight that is given to a certain factor and the manner in which this factor is characterized is profoundly abstract. Weight esteems ranging from 1 (low) to 10 (high) were given to various levels to all the hazards. The various hazards with their weighted qualities were combined into a hazard map. The three hazards types were thought to be of a similar position, however in true a few hazards seriously affect human action. The following shows the ranking of the various classes for various hazards. The most noticeably terrible situation is mulled over while assessing the multi-hazard. For instance, for the situation of earthquake the most noticeably terrible scenario i.e., damage at Intensity IX in the Modified Mercalli Scale is taken for the analysis. So additionally, a similar criterion is applied to both fire hazard (exceptionally high and high fire hazard) and landslide hazard (high landslide hazard).

Table 2: Hazard Rankings of Different classes

Sl No	Hazard	Class	Weight
1	Landslide	High	10
		Moderately High	6
		Low	2
2	Earthquake	Complete Collapse	10
		Partial Collapse	8
		Large Cracks	6
		Small Cracks	4
		No Damage	0
3	Fire	Very High	10
		High	8
		Moderate	6
		Low	2

With the spatial operation tools in GIS environment, the various hazards with various classes were added to show up at various combinations of hazards. The equation utilized for the calculation of multi-hazard is given underneath:

Multi_Hazard=[Ln_Haz+Eq_Haz+Fr_Haz]

Where, Ln_Haz=LandslideHazard

Eq_Haz = Earthquake Hazard Fr_Haz = Fire Hazard

A Matrix for each two hazard combination was created based on the weightage esteem given in Table 3. The scope of the yield esteems were then arranged into three categories: I) High Hazard (14-20), ii) Moderate Hazard (7-13) and iii) Low Hazard (0-6). The Subsequent figures underneathshows the combination of hazard in form of matrix

Table 3: Building Damage and Fire Hazard Matrix

Fire Hazard and Bldg Damage				
Bldg_Dam\ Fire	**VH_Fire**	**H_Fire**	**Mod_Fire**	**Low_Fire**
Compt_Coll	H	H	H	M
Part_Coll	H	H	M	M
Large_Cr	H	M	M	M
Small_Cr	H	M	M	L
No_Dam	M	M	L	L

Table 4: Building Damage (Earthquake) and Landslide Hazard Matrix

Building Damage and Landslide			
Bldg_Dam\ L_Slide	**High_Slide**	**Mod_Slide**	**Low_Slide**
Compt_Coll	H	H	M
Part_Coll	H	H	M
Large_Cr	H	M	M
Small_Cr	H	M	L
No_Dam	M	M	L

Table 5: Landslide Hazard and Fire Hazard Matrix

Fire and Landslide				
L_Slide\ Fire	**VH_Fire**	**H_Fire**	**Mod_Fire**	**Low_Fire**
High_Slide	H	H	H	M
Mod_Slide	H	M	M	M
Low_Slide	M	M	L	L

Where:

H = HighHazard

M = Medium Hazard L = LowHazard

The combination of the hazards was done using ArcGIS spatial inquiry operation. The quantities of buildings that are under various hazard combinations are given in the Table 6 underneath.

Table 6: Combination of Hazards

Sl No	Code	Multi-Hazards	No. of Buildings
1	ELF	Earthquake, Landslide & Fire	187
2	EL	Earthquake & Landslide	127
3	EF	Earthquake & Fire	246
4	LF	Landslide & Fire	187
5	E	Earthquake	157
6	L	Landslide	433
7	F	Fire	252
8	NIL	No Hazard	622

There are 187 buildings that are confronted with the three hazards, i.e., earthquake, landslide and fire (EFL). The combination of earthquake and fire hazards (EF) has the greatest number of buildings with 246 buildings. The combination of earthquake and fire are inter-related, as in, an earthquake can cause fire, however this may not be valid in the other manner round. Landslide and Fire hazard combination is a coincidence. The odds of landslide causing fire or the other way around might be less. There are 187 buildings that are having the combination of both landside and fire hazards (LF). There is a likelihood that earthquakes can cause landslide, yet a landslide may not reason earthquake. The quantities of buildings that have the combination of earthquake and landslide hazards (EL) are 127 in number. There are numerous buildings that are prone one hazard. For instance, there are 433 buildings that are under high landslide powerless zone, trailed by 252 buildings in high fire zone, and 157 building in high earthquake zone.

5. CONCLUSION

The methodology of collecting information through historical information and field mapping is helpful on the off chance that likes Ahmedabad, Gujarat where there are no records of hazards. The utilization of remote sensing information, to be specific IRS-LISS III and PAN blend information, and anaglyph of ASTER information is discovered to be helpful in identifying the regional example of rocks and geomorphologic units. Be that as it may, it is beyond the realm of imagination to expect to distinguish landslide through helpless resolution satellite information, where the size of landslide are little and the developed is profoundly thick. Population at the ward level couldn't be profited since it was officially not pronounced. So estimation of population at the ward level was made based on the population of the city in 2001 registration. The figure of number of family unit in each building was gathered through the field overview.

REFERENCES

[1]. Li, Q., and Ellingwood, B. (2007). "Performance evaluation and damage assessment of steel frame buildings under main shock-aftershock earthquake sequences." J. Earthquake Engineering and Structural Dynamics, 36, 405-427

[2]. Aschheim, M., and Black, E. (2009). "Effects of prior earthquake damage on response of simple stiffness-degrading structures." J. Engineering Spectra, 15(1), 1-24.

[3]. Taher, R. (2010). "General Recommendations for Improved Building Practices in Earthquake and Hurricane Prone Areas." Architecture for Humanity.

[4]. Eshrati, Mahmoudzadeh, Taghvaei (2015): Multi hazards risk assessment, A New Methodology. International Journal of Health System and Disaster Management; Volume – 3, Issue – 2, pg: 79-88.

[5]. Ming, Xu, Ying, Juan ,Baoyin , Peijun (2015): Quantitative multi-hazard risk assessment with vulnerability surface and hazard joint return period; Stochastic Environmental Research and Risk Assessment, Volume - 29, Issue - 1, ISSN: 1436- 3240 (Print) 1436-3259 (Online): pg: 35-44.

[6]. Osman & El-Diraby (2011); Knowledge-Enabled Decision Support System for Routing Urban Utilities; Journal of Construction Engineering and Management, pg: 16, e-ISSN: 1943-7862.

[7]. Moghadam A. S and Tso W. K., "3-D Pushover Analysis for Damage Assessment of Buildings", JSEE, Vol. 2, No. 3 / 23, 2007.

[8]. Chopra A. K., Goei R. K and Chintanapakdee C., "Statistics of SDF-System Estimate of Roof Displacement for Pushover Analysis of Buildings", PEER Report 2001/16, Pacific Earthquake Engineering Research Center, College of Engineering, University of California, Berkeley, December 2001.

[9]. Jan S. T, Liu M.W. and Kao Y. C., "An Upper Bound Pushover Analysis Procedure for Estimating Seismic Demands of High Rise Buildings", Engineering Structures, Vol. 26, pp. 117-128, 2004.

[10]. Agarwal P., "DEIW Course series on Earthquake Engineering", IIT Roorkee, 2003