Seismic Risk Analysis To Power Generation And Distribution Network And Remedy

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Abstract- *The experience of past earthquakes shows that, although damages of the Electrical network installation are very extensive in length and area, they are infrequent. But the significance of these installations makes their protection and stability more important. According to the investigation about past earthquakes and the transmission lines condition in our country, some of them will probably have considerable damages. Utilization of hydraulic potential energy and thermal energy by construction of power plants which are generally situated at some remote locations and are far from consumption ports, necessitate the establishment of transmission system (lines) and substations. Due to vastness of regions and existence of different conditions attributed to the ground, the outbreak of various incidents, such as earthquake is probable. Although the damages , inflicted upon power utility system are not significant, but interruption in production of electrical energy and transmission of this energy at any moment and profound investments , requires a special attention to observe the behaviour and responses of current seismic forces. This research work concentrate on the study about "seismic retrofit planning methods, seismic upgrading design for power network facilities based on the foreseen seismic risk assessment of electrical power generation and distribution systems.*

Keywords- At least Six keywords or phrases in alphabetical order, separated by commas. Provide up to 6 keywords, 9 size, bold, itali

I. INTRODUCTION

Electric Fence (Power Lines) is used to transmit and distribute electric energy from it source of production, the generating station, to the load centers for further transmission and distribution. Transmission towers are constructed using angle section members which are eccentrically connected .It is strong enough to withstand a number of forces namely; its own weight, the pull of conductors wires at the top of the tower, the effect of seismic on the conductors and earth wires and the effect of seismic on the tower itself. The proper planning and preparation must be adhered to when working near to or on the structure. The structure must also be adequately designed to not only support the weight of the wires and structure but also to safely transfers forces and moments from the structure to its foundation. Before the construction of electric transmission lines, structural analysis should be done to ensure the safety of the verify by experimental methods. In theoretical and computer analysis, several assumptions and idealization as well as some basic calculations need to be considered. But in experimental method of physical model of the structure want to be made available and data gathering set-up is the basic requirement for the anticipated good experimental results. The study focused on loading aspects on a typical electric overhead Fence (Power Lines) structures. It mainly concerns on loading behavior and its magnitude onto the structure as well as it basic response related to that particular loading. On tower a maximum loading conditions, related critical elements are also be highlighted.

A electricity Fence (Power Lines) is a tall structure usually a steel lattice tower, used to support an overhead power line. In electrical grids, they are generally used to carry high voltage transmission lines that transport bulk electric power from generating station to electrical substation. The utility poles are used to support lower-voltage sub transmission and distribution lines that transport power from substations to electric customers. They come in a wide variety of shapes and sizes. Typical height ranges from 15 to 55 m though the tallest are the 380 m towers of a 2,656 m span between the island jintang and cezi. The other materials may be used like concrete and wood rather than steel.

There are four major categories of transmission towers i.e. suspension, tension, terminal and transposition. Some transmission towers combine these basic functions. Electric towers and their power lines are often considered to be a make of visual pollution. The Methods to reduce the visual effect of tower include undergrounding

II. LITERATURE REVIEW

Kamran Fallahi (Aug 2004)

The data of past earthquakes shows that, although damages of the Electrical network installation are very extensive in length and area, they are infrequent. But the purpose of these installations makes their protection and stability more important. According to the experience about past earthquakes and the transmission lines condition in our country, some of them will probably have considerable damages. Since earthquake is unpreventable, the necessity of reliable, fast and simple method to retrofit of the existing installations is obvious. Therefore, Finding practical retrofitting methods for vulnerable installations and preventing them from further damages by improving design methods is of special significance. Study of earthquake damages is an important factor for modifying the design and construction on earthquake resistance systems. In earthquakes technical and non-technical installations experience a real test. This will reveal their strengths and weaknesses and would be an appropriate experience for designers. Because, when the loads imposed on a structure reaches the design load, calculation and theoretical errors, code's weaknesses, construction problems, etc. are revealed in form of local or global problems.

K. D. Pitilakis, T. D. Xenos, K. G. Kakderi, M. N. Alexoudi (july2007)

It has to be noted that seismic damages of power transmission systems, could spread extensively and very quickly causing blackout even in a national level. Then electric power supply is a time demanding process that could take several days to recover. On the other hand, power generation stations and high voltage towers have shown inherent ruggedness during earthquakes and suffer minor damages. In fact they experience major damages when they are located in ground failure prone areas. Ground failure induced damages to the foundations of high voltage towers is considered as the major reason for seismic damage to transmission lines, and it is usually limited. Damages to poles or towers usually result in localized power outages. On the other hand, substation failures can cause power outages that affect wide areas and critical systems. Such power outages can lead to severe indirect losses for electric power companies, especially in case of increased power demand. The seismic ris assessment of an electric power system includes a detailed inventory, an estimation of seismic excitation, a determination of the seismic capacity and the fragility of each element of the system and finally the calculation of its reliability. Monte-Carlo simulations can be used to correlate the failure modes of the system (dis connectivity, power imbalance) with the failed parts of the system within the service areas. This research study is focused on the seismic vulnerability assessment of transmission substations, critical nodes of an electric power transmission system. A new method is proposed herein for the vulnerability assessment of electric power substation using neural networks. Data of substations' elements seismic failures are used in training of the neural network and the results are validated with recorded data from Greek earthquakes.

Jonathan Z. Liang1 and Hong Hao (Oct 2008)

Transmission towers play an important role in the operation of a reliable electrical power system that is considered as a lifeline system. Transmission lines in PMA are mainly designed for wind loads in the transverse direction since steel lattice towers are deemed to be less sensitive to earthquake loads than most other types of structures However, seismic analysis of transmission towers is important as the response of transmission towers subjected to earthquake may exceed their response to wind loads. Several recent cases of damage to transmission towers during earthquakes have been reported,. Wire and wireless telephone communication were also interrupted and not restored until 36 hours after the earthquake It is unrealistic to assume that the transmission towers satisfy the performance requirement under damage-limitation earthquake and rare earthquake without adequate analysis. The performance requirement of fully operational under damage-limitation earthquake is assigned to lifeline system in many seismic codes to provide protection in the immediate post-earthquake period. It is also expected that after rare earthquake, lifeline systems can be successfully repaired and reinstated to full service in a short time. Therefore, reliability and safety of the transmission towers are essential to minimize the risk of disruption to power supply or communication. A study of the performance of transmission towers under damage-limitation earthquake and rare earthquake) is carried out to investigate the reliability and safety of the transmission towers. The results are compared with code provision and recommendations for the design of transmission towers.

Yusuke Sato and Tomomi Ishikawa (2012)

Even though Japan has experienced some of the world's largest earthquakes in recent years, notably the Kobe Earthquake in 1995 and the Tohoku Earthquake in 2011, there has been no record of a transmission steel tower collapsing because of seismic motion. However, during the 1995 Kobe Earthquake, the occurrence of an elastic response to ground motions on a tower was identified by a seismic response analysis. There is a possibility that some plastic tower response occurred during the Tohoku earthquake since peak ground accelerations (PGA) there were larger than those observed in the Kobe earthquake, but seismic resistance considering plastic response during a major earthquake was not estimated because transmission steel towers are designed for wind resistance and the nonlinear behavior of transmission steel towers during a seismic event has not yet been sufficiently investigated. Therefore, it is important to identify the limit state of transmission steel towers in order to provide protection against future giant earthquakes. In the present study, earthquake resistance of transmission steel towers is discussed with a comparative analysis of wind resistance data.

Sourabh Rajoriya, K.K. Pathak, Vivekanand Vyas (Sept 2016)

A transmission tower is a tall structure also called as electricity Fence (Power Lines) is usually a steel lattice tower used for supporting overhead cables. It is used in high AC and DC voltage and come in various shapes and sizes. These structures built to carry one or two circuits, although some transmission towers are also built to carry more than two circuits like three and four. Each circuit consists of three phases. Electric Fence (Power Lines) supports the phase conductors & earth wires of a transmission line. The necessity of electric power consumption has continued to enhance the rate of demand for developing countries. Electric Fence (Power Lines) structures are one of the important power supply structure. Transmission towers are necessary for the purpose of conveying electricity to various regions of the nation. one or two circuits are carried by the structure although some Fence (Power Lines)s are also built to carry three or four circuits. This has led to increase in the structure of power stations and consequently increase in power transmission lines from the inducing stations to the various other corners where it's needed. Inter-connections between systems are increasing enhance reliability and economy.

Jusoh, H. A. Ghulman, T. S. Mandourah, C. C. Tan (Oct 2017)

In this paper loading aspects on a typical electric transmission Fence (Power Lines) structures are focused. The main focus on loading behavior of the structures, its magnitude as well as it basic response related to that particular loading. In maximum loading conditions of the structure, the related critical elements of structures are also be highlighted. Several case studies were considered in investigating the behavior of structure under certain loading conditions.

III. METHODOLOGY

The methodology adopted for the present study is divided into four parts. (1) To study the behavior of electric fence (Power lines) (2) Analyze the effect of various types of loads as per IS recommendations. The mathematical model is evaluated using a computer-based tool, STAADpro or SAP2000software. (3) To observe the effect on maximum height. This part aim to identify the potential benefits and challenges associated with using STAADpro or SAP2000software electric fence (Power lines). (4)Test different model for electricity fence (Power lines).

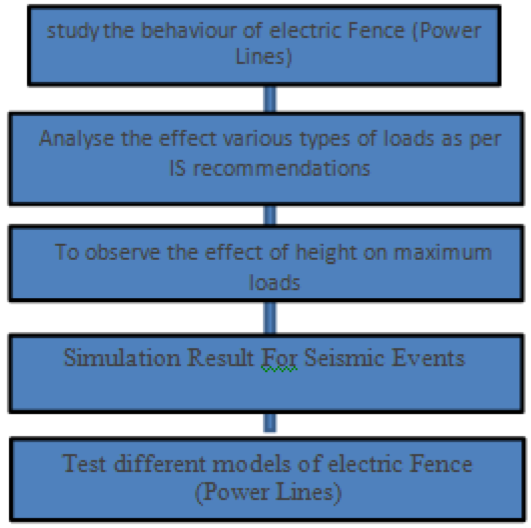


Figure 1 Methodology

IV. MODELING OF ELECTRIC FENCE (POWER LINES) WITH DIFFERENTHEIGHTS:

This study includes comparative study of behavior of Electric Fence (Power Lines) / transmission tower with different geometrical configurations under seismic forces. A comparison of analysis results such as axial stress, deflection, support reaction, support moment and bending stresses have been carried out. An Electric Fence (Power Lines) / transmission tower for a medium soil condition is modeled. The various techniques used while modeling the structure in Staad pro v8i, to make the models as per geometric Shape of Structure are stated below:

1. Modeling of the selected Electric Fence (Power Lines) / transmission tower is done in Staad pro. V8i Software.
2. Twelve models, with three geometric shape (Variation in Height) of the Electric Fence (Power Lines) / transmission tower with different Seismic zone with required specification and parameters were made.
3. IS 1893 (Part 1) : 2002 is considered for seismic loading calculation to be applied to the models.
4. 4.As the height of the model was varies it was difficult to calculate Time Period of the models manually so the time period of the structures was retrieved from the software and was put into while applying the loading to the structures.

Table 1: Specifications used in modelling

Sr. No.	Parameters	Dimensions/Types		
		Case-I	Case-II	Case-III
1	Basedimension	6m	6m	6m
2	Heightoftower	45m	60m	75m
3	Numberofbays	4Nos.	4Nos.	4Nos.
4	Topdimension	2m	2m	2m
5	CantileverArm top dimension	2m	2m	2m
6	CantileverArm base dimension	4m	4m	4m
7	Steelsectionused	ISWB600	ISWB600	ISWB600
8	Soiltype	Mediumsoil	Mediumsoil	Mediumsoil

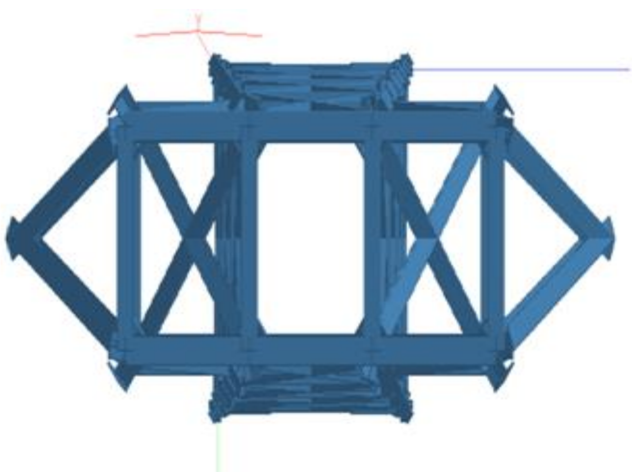
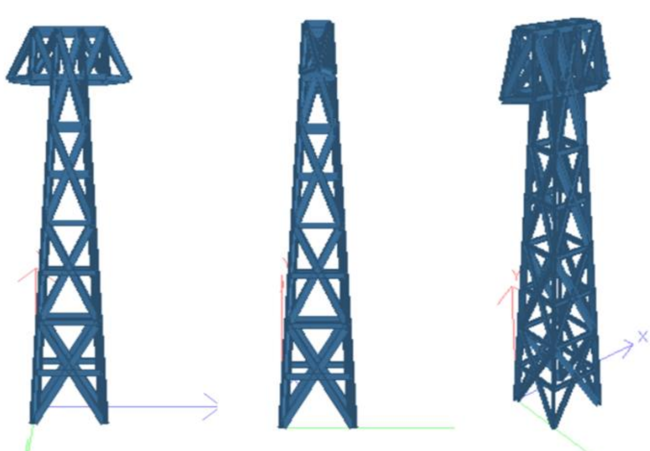


Figure 2: Plan of the Electric Fence (Power Lines) / transmission tower



X direction View Z direction View

Load caseno.	Load casedetails
1.	E.Q.INXDIRECTION
2.	E.Q.INZDIRECTION
3.	DEADLOAD
4.	1.7(DL)
5.	1.7(DL+EQX)
6.	1.7(DL-EQX)
7.	1.7(DL+EQZ)
8.	1.7(DL-EQZ)
9.	1.3(DL+EQX)
10.	1.3(DL-EQX)
11.	1.3(DL+EQZ)
12.	1.3(DL-EQZ)

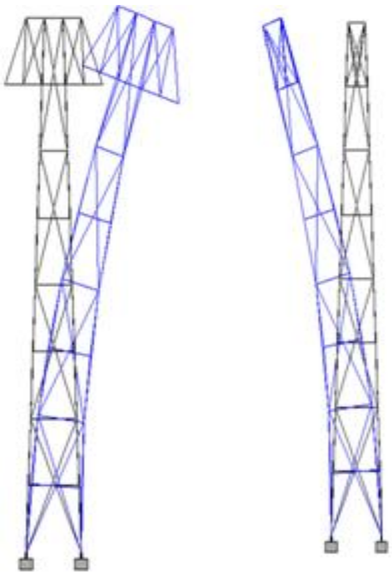
3D View Fig 4.2: Elevation of the Electric Fence (Power Lines) / transmission tower

V. TIME PERIOD &APPLICATION OFSEISMIC LOAD:

The equivalent static methods assume seismic coefficient, which depends on the natural time period of their vibration of the structure, the time period is required for earthquake resistance design of the structures and to calculate the base shear. Time period of the structure is been taken from the Staad pro software.

As the model were Irregular in shape it was difficult to calculate Time Period of the models manually due to irregularity of shape with respect to height. For accurate natural time period of their vibration of the structure, the time period of the structures was retrieved from the software and was put into while applying the loading to the structures.

For transmission
Tower 45m:
Time period in second:



ForXdirection: 0.55401 For Z direction 0.055401 Fig 4.3 Time Period for tower 45 m

These values of time period of the structure is taken and the base shear as per Indian Code IS 1893 (Part 1) : 2002 is calculated respectively in both X and Z direction.

For Seismic loads in X directionFor Seismic loads Z Direction

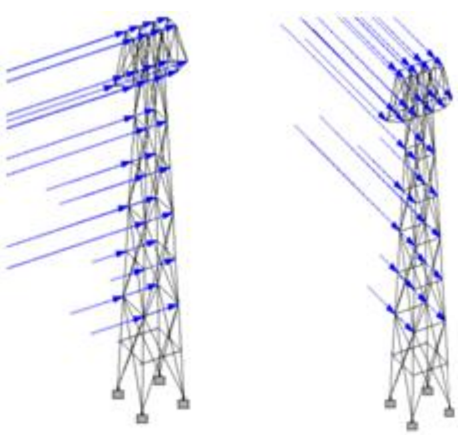


Figure:3 Application of seismic Load

Cases	Zones			
	Zone-II	Zone-III	Zone-IV	Zone-V
Case -I	9.059	13.724	20.079	29.701
Case -II	14.441	22.295	32.925	48.969
Case -III	21.328	33.231	49.289	73.491

Table 2:Load Case Details for Seismic Forces:

Cases	Zones			
	Zone-II	Zone-III	Zone-IV	Zone-V
Case -I	143.92	162.706	187.753	225.324
Case -II	126.562	141.797	162.112	192.583
Case -III	113.914	126.516	143.32	168.526

VI. RESULT & ANALYSIS

The behavior of Transmission towers under different loading conditions has been analyzed for four seismic zones with different parameters. Parametric and comparative study of all cases in terms of maximum deflection, maximum support reaction, maximum support moment, axial stress bending stress, combined stress and shear stress. Graphical and Tabular representation of data is discussed in this chapter.

VI. CONCLUSION & FUTURE SCOPE

The following are the salient conclusions of this study:

A. Deflection

Maximum deflection of tower which has 45m of height deviates between 9.059 to 29.701 mm, the tower which has 60m of height deviates between 14.441 to 48.969 mm and the tower which has 75m of height deviates between 21.328 to 73.491 mm, so it is clear that the deflection is critical for 75m high tower in all zones of seismic.

B. Support Reaction

Support reaction of tower which has 45m of height deviates between 144KN to 226 KN in X direction ,850KN to 1239KN in Y direction & 144KN to 226KN in Z direction, the tower which has 60m of height deviates 127 to 193kN in X direction , 949 to 1339 in Y direction & 127 to 193KN in Z direction and the tower which has 75m of height deviates between 114 to 167KN in X direction ,1049 to 1438KN in Y direction & 114 to 167 in Z direction

It is clear that the support reaction for 75m high transmission tower in seismic zone V in Y direction has larger value than 45 and 60m high transmission tower in all zones of seismic.

V. FUTURE SCOPE

In the present study, an attempt is made to study the behavior of electric Fence (Power Lines) structures of different heights with seismic consideration. The study can be further expanded to:

1. Carryout analysis by response spectrum method and further compare with seismic coefficient method.
2. After all analysis generate the criteria for selection of electric tower according to long Height, economy and safety purposes and make justifications.
3. Change in dimensions gives more deflections and analyzed.
4. The Electric Fence (Power Lines) also checks and verify for curvature effect.
5. Suitable selection of dimension of the tower.Cost comparison of Electric tower for varying dimensions

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