Progressive Collapse of Bridge Under Blast Loading

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Abstract- *Progressive collapse is a major threat causes a lot of demolitions of structure and leads to the loss and injury of lives. The most causes of the progressive collapse are earthquake and severe wind which ends up in gradual and sequent failure of number of components of the structure. This paper includes linear static analytical procedures. For linear static analysis loading is considered as per the Post Tensioning Institute (2001) recommendations and General Service Administration (2003) progressive collapse tips. Alternate path (AP) methodology is employed for progressive collapse analysis of the cable stayed bridge. The cable stayed bridges are shapely in SAP 2000 with numerous cable arrangements and studied the deflection of girder under blast loading condition. Also studied the axial forces developed in the cables under the cable loss. The results are taken with respect to the various cable arrangement and number of cable lost.*

Keywords- Blast loading analysis, Bridge, SAP 2000, Progressive failure

I. INTRODUCTION

Cable stayed and suspension bridges are the most important structure designed as platform for carrying folks and vehicles. Each of the bridges are held up by the cables, their modes of operations are terribly totally different. Cable stayed bridges are most cost effecive quicker to build and has greater stiffness. These bridges are subjected to blast masses causes progressive failure. Progressive collapse could be a major threat in such bridges. It is dynamic event caused by localized structural injuries, disturbing the initial load equilibrium causes vibrations within the structure therefore it either gets new equilibrium or collapses. The cable stayed bridges have 3sorts consistent with the cable arrangement system i.e. Harp, Fan and Radial. In this paper, the analysis of these three bridges against the progressive collapse is completed.

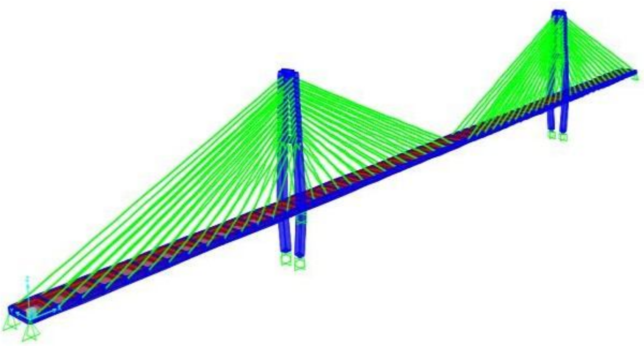

Fig. General Cable Stayed Bridge

II. OBJECTIVES

- To study the effect of linear static loading on cable stayed bridge with varied cable arrangements.
- To compare the axial cable forces and the deflection of girders under the progressive collapse mechanism.
- To find out the foremost stable cable arrangement against the progressive collapse.

III. STATE OF DEVELOPMENT

R. Das, A. D. Pandey, Progressive collapse, a structural failure, is triggered by a localized structural injury and eventually develops a sequence reaction leading to breakdown of a serious portion of the structural system. It's a dynamic event initiated by a release of internal energy because of the instant loss of a structural affiliate disturbing the initial load equilibrium and so, the structure vibrates till either a brand new equilibrium position is found or it collapses. Recent events, like the collapse of *Haeng-Ju Grand Bridge* in Seoul in 1992 throughout its construction highlighted the requirement to include progressive collapse into the design of major bridges. Bridges are primarily horizontally aligned structures with one main axis ofextension. Hence, the potential mechanisms of collapse are different as compared to buildings. In case of Cable-stayed bridges, the loss of cables should be measured as a possible local failure since the cross sections of cables are usually small, and therefore provide low resistances against accidental lateral loads stemming from vehicle impact or accidental actions. The loss of cables can lead to overloading and rupture of adjacent cables. In addition, the stiffening. girder shows compressive behaviour and a cable loss reduces its bracing against buckling.

The middle of the bridge deck and therefore the top of the pylons are the foremost vital points of a cable stayed bridge. The end cables of either facet of the bridge are the foremost vulnerable cables. Rupture in these end cables will increase the likelihood of a failure progression throughout the entire structure. Lesser the distance of the cable from the pylon, lesser is the chance of failure of the whole structure. A nonlinear static analysis alone is conservative in nature and so to trace the failure progression due to an initial failure of one or a lot of cables, the nonlinear dynamic analysis beginning with the initial stressed state given by the nonlinear static procedure is the best solution.

Shefna L Sunamy, Binu P, Dr. Girija K, Seismically Designed building has inherent ability to resist progressive collapse. Nonlinear static analysis reveals that hinge formation starts from the location having maximum demand capacity ratio. To avoid the progressive failure of beams and columns, caused by failure of specific column, adequate reinforcement is required to limit the DCR within the acceptance criteria. To mitigate progressive collapse associate alternate load path must be provided. The alternate load path like, providing bracing at floor level and increasing size of column at the outer face may be adopted well.

A. Fatollahzadeh, M. Naghipour, The critical cable of the bridge during different earthquakes will vary. Determination of this cable is based on ALP method and comparison of maximum force for adjacent cables. Altogether earthquakes, the critical cables are the middle ones which have the largest axial force in service condition. Therefore, it is essential to pay rather more attention to those cables in design procedure. Unlike service condition in which three cables removal are required to trigger progressive collapse, however throughout Tabas and Bam only two cables rupture result in subsequent failures of different cables. Since fatigue, corrosion and differentsuch issues (due to rough surroundings) typically often occur, the degraded condition of the foremost cable-stayed bridges are extremely doubtless, thus, destruction of those structures due to cable failure are close. Progressive collapse that happens by failure of two critical cables throught associate earthquake can be avoided by the employment of base isolation. This application can limit the amplitude of axial force vibration and forestall reaching ultimate final force. Because the most critical situation was studied during this experiment, all other situations yield the constant results.

Y. Liu, B. Han, Ma Xiao, in step with the authors, the explanations inflicting the bridge progressive collapse may well be divided into 3 aspects, (i) suprising events, like collision with overweigh vehicles, exploration, and earthquake, (ii) the degradation of structure performance, together with corrosion and creep result, and (iii) the improper design or the incorrect construction methods. Two sorts of failure progression were declared. First was the Bearing-failure type; that included; (a) Reduction of statically indeterminacy degree, and (b) Internal force distribution. The Guangdong Jiujiang Bridge collapsed because of sailing fault as a sand stuffed ship collided with one among the piers, that resulted into failure of the adjacent four continuous spans. Secondly, partial-failure type, wherever "partial" means that some load-bearing elements of bridge structures. Because of the failure of those members, the structural stiffness and internal forces would change, leading to progressive collapse. The Xiaonanmen Bridge collapsed in 2001 as a result of stress corrosion of burst hangers when being stricken by associate overweight truck. Cai et al (2012)

IV. CONCLUSION

Seismically Designed building has inherent ability to resist progressive collapse. Nonlinear static analysis reveals that hinge formation starts from the location having most demand capacity ratio. To avoid the progressive failure of beams and columns, caused by failure of particular column, adequate reinforcement is needed to limit the DCR within the acceptance criteria. To mitigate progressive collapse an alternate load path needs to be provided. The alternate load path like, providing bracing at floor level and increasing size of column at the outer face may be adopted well.

REFRENCES

[1] R. Das, A. D. Pandey, "Progrssive Collapse of a Cable stayed Bridge", 12th international conference on vibration issues, Elsevier ICOVP 2015.

[2] Shefna L Sunamy, Binu P, Dr. Girija K "Progressive Collapse Analysis of A Reinforced Concrete Frame Building" International Journal Of Civil Engineering And Technology, Vol 5 No. 12 2014 pp. 93-98

[3] Uwe Starossek,"Typology of progressive collapse", Elsevier Engineering Structures 29 (2007) 2302–2307

[4] Fatollahzadeh, M. Naghipour, "Analysis of Progressive Collapse in Cable-Stayed Bridges due to Cable Failure during Earthquake", International Journal of Bridge Engineering (IJBE), Vol. 4, No. 2, (2016), pp. 63-72

[5] J.G. Cai., Y.X. Xu, L.P. Zhuang, "Comparison of various procedures for progressive collapse analysis of cable-stayed bridges", Journal of Zhejiang University-Science A, 2012.

[6] Y. Liu, B. Han, Ma Xiao, "Advances in Progressive Collapse of Bridge Structures", Pacific Science Review, 2011.

[7] J Cheng, J Jiang,"Aerostatic Stability of Long Span Cable-Stayed Bridges:Parametric Study", Tsingua

Science and technology, ISSN 1007- 0214, 16/21 pp201-205 Volume *, Number 2, April 2003.

[8] P. Zhang, B. Chen, “Progressive Collapse Analysis of Reinforced Concrete Frame Structures in Linear Static Analysis Based on GSA”, Third International Conference on Intelligent System Design and Engineering Applications, IEEE 2013.