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A REVIEW ON POST TENSIONING METHOD ON A BUILDING FRAME CONSIDERING SEISMIC LOAD AS PER I.S. 1893-I : 2002

Deepak Prajapati[*1] & Komal Bedi[2]

[*1&2]Alpine Institute of Technology, Department of Civil Engineering, Gram Chandesara Dewas Road Ujjain, Madhya Pradesh, India

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ABSTRACT

In high rise buildings, there are several lateral load resisting systems. The horizontal loads and gravity loads can be resisted by them, as they have very high in plane stiffness and strength. This makes these systems to be quite advantageous in many structural engineering applications. Many literatures are available which deals with the design and analysis of resisting systems. In this paper, the main focus is to carry out extensive literature survey and to determine the scope of work regarding Post tensioning method in analysis and design of a building frame. From the literature it is clear that Post tensioning members and other systems are effective in resisting lateral load which helps the building to sustain even under seismic loads. However, the scope of study is to investigate the effect of introducing post tensioning members in a building under lateral forces.

KEYWORDS: Analysis, Lateral load, resisting system, forces, review, design.

1. INTRODUCTION

Post-tensioning is the introduction of external forces to the structural member using high strength cables, strands or bars. The PT reinforcement is connected to the existing member at anchor points, typically located at the ends of the member, and profiled along the span at strategically located high and low points. When stressed, the tendons will produce upward forces (at low points) or downward forces (at high points) to create reverse loading on the member.

Post-Tensioning strengthening systems can be classified into two categories, External and Internal. External Post Tensioning involves exposed cables or steel bars that are anchored directly to the structure. Because the reinforcement is located outside the member, its use can be limited by fire rating and durability requirements. To improve durability, systems consisting of sheathed cables and coated anchors can be used. Alternately, the external cables can be placed inside plastic ducts and then filled with cementitious grout.

Finite element procedures are at present very widely used in engineering analysis, and we can expect this use to increase significantly in the years to come. The procedures are employed extensively in the analysis of solids and structures and of heat transfer and fluids, and indeed, finite element methods are useful in virtually every field of engineering analysis. The development of finite element methods for the solution of practical engineering problems began with the advent of the digital computer. That is, the essence of a finite element solution of an engineering problem is that a set of governing algebraic equations is established and solved, and it was only through the use of the digital computer that this process could be rendered effective and given general applicability. These two properties effectiveness and general applicability in engineering analysis-are inherent in the theory used and have been developed to a high degree for practical computations, so that finite element methods have found wide appeal in engineering practice.

2. PROBLEM STATEMENT

The high rise buildings now-a-days are provided with soft storeys for parking purpose. When such bulding is located in the earthquake prone area, can be subjected to heavy lateral forces. Due to the presence of soft storey

in a building, the lateral load resisting capacity of building decreases, thereby the stiffness of building decreases. This leads to sudden failure of structure. To increase the lateral strength and stiffness of a structure, lateral load resisting members are introduced in a structure, such that the building can sustain under the seismic loads.

Aim:

The investigation of the post tensioning members in tall structures has dissected utilizing examination programming Staad.pro which is a customary kind use in Structures. Post tensioning members are the sections resisting stresses loss occurring in a structure due to heavy loads. A writing survey is an evaluative report of concentrates found in writing identified with chose region. The writing identified with chose zone. The writing audit ought to depict, abridge, assess, and clear up the writing. A writing survey goes past the look for data and incorporates the distinguishing proof and enunciation of connection between the writing and field of research. While the type of writing audit may be shift with different kinds of studies. We have distinctive writing survey from papers, diaries, sites and google researcher.

3. LITERATURE REVIEW

Saadatmaneshet. al. (1994) Confinement reinforcement is generally applied to compressive members as lateral reinforcement with the aim of increasing their strength and ductility. In addition, lateral confinement prevents slippage and buckling of the longitudinal reinforcement

Frangou andPilakoutas(1995) Lateral reinforcement can be provided by using circular hoops, rectangular ties, jacketing by steel , FRP, ferrocement, etc. Because the total cost of replacement of the vulnerable structures is so overwhelming, the development of innovative rehabilitation and strengthening techniques is required to extend the life expectancy of many existing buildings and bridges. A number of repair and strengthening techniques are currently in use for reinforced concrete structures. Unfortunately, the majority of them is very expensive, time consuming and require the interruption of use of the structure whilst works are carried out. Hence, there is a pressing need for the development of improved, low cost, less disruptive techniques, which will make necessary interventions in many structures economically viable. It should be borne in mind that the cost of retrofitting buildings is the primary factor which deters many private owners from executing essential works.

Dilgeret. al. (2000) Recent earthquakes have revealed an urgent need to develop retrofit techniques for the existing buildings and bridges designed in accordance with old seismic codes so as to meet the requirements of current seismic design standards. Some of the common problems revealed by earthquakes such as Kobe (Japan 1995), Athens (Greece 1999) and Kocaeli (Turkey 1999) include inadequate confinement of concrete, leading to shear, anchorage and splice failures. It is well known and proven that lateral confinement improves the strength and ductility of concrete.

D.Y. Wang et. al. (2000) Studied the working of one monolithic connection and 4 precast prestressed unbonded post-tensioned concrete connections under reversed cyclic loading. Such parameters as PT initial post-tensioning force, PT eccentric position and PT anchor length are discussed. Results of experiment indicate that these elements have desirable seismic characteristics, restoring characteristics and have an ability to undergo large nonlinear displacements with little damage. In this paper a detailed analysis as resilience, ductility, energy dissipation etc are carried out. The objective of this test is to develop guidelines for precast structure in regions of earthquake zone.

Sonuvaret. al.(2004) Nowadays, most of the strengthening strategies are based on global strengthening schemes as per which the structure is usually strengthened for limiting lateral displace-ments in order to compensate the low ductility In these schemes, global behaviour of the system is transformed. Another approach is modification of deficient elements to increase ductility so that the deficient elements will not reach their limit state conditions when subjected to design loads However, the latter strategy is more expensive and harder to implement in cases of many deficient elements which is the reason that the global strengthening methods have been more popular than element strengthening.

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Sonuvaret. al.(2004) In some other researches, the use of wing walls, attached to two sides of columns was investigated. The systems strengthened with wing walls exhibited ductile behaviour Steel bracing for RC frames has also been used to reduce drift demands. Bracing can either be implemented inside the frame or applied from outside the system.

Albanesiet. al.(2006) Among the global strengthening methods, addition of RC infill is the most popular one. Many researchers have focused on this subject and found that installation of RC infills greatly improve lateral load capacity and stiffness of the structure Even in cases of application to damaged buildings, the infill method yields satisfactory results

Ohmura et. al.(2006) Post-tensioned steel bracing is also an efficient alternative for vulnerable framed buildings and it compensates structural irregularities. Experimental results for another alternative, knee bracing with shear links replaced with masonry infills, lead to improvement in energy absorption capacity. Although, each of these methods satisfactorily increased the strength and stiffness, all of them with the exception of external steel bracing require construction work inside the building, which means disturbance of users and results in the buildings being out of service. Consequently, research efforts in this field have shifted their focus to new methods that could overcome this difficulty.

Kaplan et. al.(2009) The precast panel infill method, which causes less disturbance for the building occu-pants, has been investigated and found to be an efficient solution for strengthening of existing structures. Despite causing some architectural problems, some other researchers perpendicularly installed RC shear walls outside the building. This kind of shear walls were also applied to precast skeletal structures with an external diaphragm at the roof level.

T. Nagaeet. al. (2012) Analyzed a three-dimensional earthquake simulation test on a full-scale, four-story, prestressed concrete building was conducted using the E-Defense shaking table facility. The seismic force-resisting system of the test building comprised two post-tensioned (PT) frames in one direction and two unbonded PT precast walls in the other direction. The test building was subjected to several earthquake ground motions, ranging from serviceability level to near collapse. The behavior of the wall direction of the building under several ground motions is simulated using nonlinear response history analysis of practical structural engineering models, and the 2D simulation results are compared with the test results. Conducted analytical simulations are in good correlation with the test results for the important engineering parameters with some discrepancies.

P.C. Louteret. al. (2014) studied that structural glass researchers have developed an innovative safety concept for glass beams. This safety concept shows some analogy with post-tensioned concrete; glass beams are post-tensioned by unbonded steel tendons which are anchoraged at the beam ends. In this way the load-bearing capacity is enhanced and safe failure behaviour is obtained. Four methods to transfer the post-tensioning forces to the glass beam ends have been developed and tested in compression tests. Results show the level of pre-stress that can be applied is strongly dependent on the alignment of the edges of the beam ends. Eventually the validity of the post-tensioned glass beam concept has been examined by bending tests on scale models. Results show a gradual thus safe failure behaviour and a significant residual strength of these glass beams.

D. Nobel et. al. (2015) Studied The effect of prestress force magnitude on the dynamic properties of uncracked prestressed concrete structures is something that has been widely debated among researchers to date. The effect of pre- and post-tensioning force magnitude on the natural bending frequencies of cracked prestressed concrete structures is something that is more established, and widely agreed upon. This paper describes the results of dynamic impact testing on damaged posttensioned concrete beams. The natural bending frequency of the cracked beams were determined through experimental modal analysis. Dynamic impact response signals were obtained at different levels of post-tensioning force for the cracked beams. The Fast Fourier Transform was implemented and a peak picking algorithm was subsequently used to determine the natural bending frequencies of the beams. The relationship between prestressing force and natural frequency for both the cracked and uncracked beam sections was determined. The results for the cracked beams were compared to the results for the same uncracked beam sections. A marked difference in vibration behaviour was observed for the cracked

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beams between the nonfully prestressed and the fully prestressed case. Conclusions from the study are drawn and have profound implications in the fields of system identification and structural health monitoring in pre- and post-tensioned concrete structures.

Sreenivasa Prasad (2016) stated that Post-tensioned slabs are a preferred method for industrial, commercial and residential floor slab construction. The increasingly extensive use of this method is due to its advantages and its nature of easy application to a wide variety of structure geometry and design solutions. The use of post-tensioned floor slabs and reinforced concrete core walls has become increasingly popular in high-rise construction. In spite of the simplicity of its basic concepts and well known advantages, the application extent of post-tensioning solutions cannot be considered harmonized in the different areas and structural applications. In fact, for various reasons, it appears that the potential offered by p*re stressing is far from being exploited, especially in building structures field. In many cases where post-tensioning would provide a superior solution, it happens after all that a more conventional non-pre stressed solution is often selected. Economics of the post-tensioning slab system are discussed including relative material contents, speed of construction, and factors affecting the cost of post-tensioning. Finally, a discussion on the flexibility of post-tensioned building structures in terms of future uses, new floor penetrations and demolition is presented.

Rafal and Magdalena (2016) Analyzed that the Construction of buildings is often associated with creation of the large, free from supports spaces in the lower floors with dense structural system on the upper floors. To transmit the load from the upper floors to the foundation, transfer slabs and beams are constructed. They are heavily loaded, bended and sheared components, which require a significant height of cross-section. The use of prestressing reduces cross-section height of reinforced concrete transfer elements. The Warsaw office and service building completed last year in the part situated above the W-Z route tunnel, contains 6 posttensioned transfer beams with 1.80×1.60m cross-section and variable span in the supports axes from 23.80 to 28.20m. Beams represent foundation for five storey building. The paper presents basic principles of design, results of deformation of the structure during erection obtained from theoretical FEM model and measured as well as applied technology.

Nabil s. et. al. (2017) Studied the effect of post tensioned cables on strengthening steel frames and improving their load carrying capacity, giving more resistance against the external load (dead plus live or wind load). Different types of frames are analyzed: simple frame, double bay frame and double story frame. The analysis and the results are obtained using ANSYS finite element (FE) program. Different techniques were used to apply post tensioning to steel frame. Comparisons are made between these techniques to determine which technique is better in strengthening each type of frame. The results show that using post tensioned cables increases significantly the load capacity of the steel frame.

RafalSzydlowski and Barbara Labuzek (2017) Analyzed that design of modern an architectural building structures requires the use of slender and free from numerous supports slabs. The most suitable solution for above requirements are the post-tensioned slabs with unbounded tendons. Slabs prestressed by unbounded tendons are successfully used worldwide for several decades. During that time many recommendations dealing with the forming of geometry and prestressing, dimensioning and erection technology were issued. During the recent years prestressed slabs characterized by span and slenderness substantially exceeding recommended limitations were designed and erected with success in Poland. During the slabs erection and in two years of their using, the deflection of three oversized slabs were monitoring. In spite of designed the slabs significantly larger and slenderer than the recommended maximum value of span and span to depth ratio, the deflection of the slabs is definitely far from the limit value. The research shows the geometry, characteristic and deflection of erected slabs and conclusion. Description of a very large span slab (21.3m), that was designed regarded to the information obtained from the previous realization.

K Bednarz (2018) Analyzed the method for correct construction of large span, slim post-tensioned concrete slabs is conditioned by an appropriate cross-section selection. It is generally accepted that the thinnest slab can be constructed using the full cross-section as the largest compression stress storage. However, completely different cross-sections may help to overcome large spans. The paper presents the results of the computational

analysis of several types of cross-sections (full, with internal relieving inserts and ribbed) in the application to a post-tensioned slab with a span of 15.0m. Based on the results presented, appropriate conclusions were drawn.

Rahul singhet. al. (2018) Studied that In this fast-paced and competitive world, building sector is at the apex of the growth of any country. Highrise buildings are admired by every human being. Traditionally the construction of a building is done by RCC but in present world, construction of high rise buildings is done by Post-Tensioning. In RCC, the economic expenditure is very high in commercial and institutional buildings because of more material required in construction and hence, Post Tensioned building proves to be more economic and durable. Post-Tensioned building saves quantity of steel and concrete as compared to RCC and increases clear span in rooms. Through this paper, the emphasis is to design a posttensioned building using ETABS and SAFE. ETABS stand for Extended Three-Dimensional Analysis of a building systems. The main purpose of this software is to design multi-storeyed building in a systematic process which will be in accordance with Indian Standard design codes.

Abbas abdulmajeedallawiet. al. (2018) Studied The structural behavior of Segmental Precast Post-tensioned Reinforced Concrete (SPPRC) beams largely depends on the behavior of the joints that connect between the segments. In this research, series of static tests were carried out to investigate the behavior of full-scale SPPRC beams with different types of epoxy-glued joint configurations; multi-key joint, single key, and plain key joint. The reference specimen was monolithically casted beam and the other specimens were segmental beams with five segments for each one. The general theme from the experimental results reflects an approximate similarity in the behavior of the four beams with slight differences. Due to the high tensile strength of the used epoxy in comparison to concrete, cracks at joints occurred in the concrete cover which was attached to the epoxy mortar.

4. CONCLUSION

The literature review has suggested that use of a finite element modeling of the building frame. So it has been decided to use Staad.pro for the Finite Element Modeling. With the help of this software study of building structure has been done. Staad.pro also helps in Finite Element Modeling in view of that different type of forces can apply to get the actual results.

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