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# LITERATURE REVIEW ON SEISMIC RETROFITTING OF RC FRAME STRUCTURE USING ENERGY DISSIPATION DEVICE

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## ABSTRACT

Earthquakes around the world are solely responsible for the destruction of lives and property in great numbers. To reduce such hazards, it is important to include standards that improve the seismic performance of structures. This article shows the change in reinforced concrete components that are exposed to loads due to seismic loads. Such unusable structures require immediate attention. And this was done with the shear wall mechanism in the software. It can be used as a seismic retrofit technique because it can be quickly applied to the surface of the damaged element without the need for a special bonding material, and it also requires fewer skilled workers compared to other retrofit solutions out there today. The bearing capacity of the beam column connection fitted with wall panels was found to increase. In this work we use an analytical approach. We use the csi etabs software for this.

**Keywords:** Shear Wall, Reinforced Concrete, Seismic Retrofitting, Retrofitted, Bonding And Beam-Column, Staad.Pro V8i.

## I. INTRODUCTION

Seismic reconditioning is the modification of existing structures to make them more resistant to seismic activity, ground movement, or ground failure due to earthquakes. This objective can be achieved by one of the following strategies, such as: B. reducing the seismic stress in the components and structures as a whole, increasing the capacities of the components, the stiffness, the resistance and the ductility are the basic parameters of reaction seismic factors that are taken into account when retrofitting. The choice of technique to be used, however, depends on locally available materials and technologies, cost considerations, length of work, and architectural, functional, and aesthetic considerations / limitations. Seismic reconditioning programs can be global or local, depending on the number of elements of the structures for which they are used. Global (structural level) retrofit methods include conventional methods (increasing the seismic resistance of existing structures) or unconventional methods (reducing seismic demand). Liner construction is the preferred reconditioning method. That can be used with the following techniques:

1. Embedding with fiber-reinforced polymers such as aramid fibers, carbon fibers, and fiberglass-reinforced composites.
2. Confinement with external steel cage techniques.
3. Inclusion with ferrocement. By comparison, modernization of wall panel technology has opened up new possibilities for effective structural system.

## II. LITERATURE REVIEW

### 1. Marc Badoux and James O. Jirsa, (jan 1990)

The use of steel brace systems to repair reinforced concrete frames that are seismically inadequate is being investigated. Diagonal braces provide an excellent approach for reinforcing and bracing existing buildings due to shear forces. From drift control to collapse avoidance, you can achieve a variety of remodelling goals. The designer can determine the force profile of the retrofitted structure and adjust the strength and stiffness as needed. Analytical studies are carried out to understand the behaviour of reinforcing frames, especially those with weak short columns, under periodic lateral loads. The inelastic buckling of the stanchions adversely affects the inelastic periodic behaviour of the reinforced frame. Instability can be prevented by elastically yielding at low axial loads or by using elastically buckling supports. Describes the benefits of changing the beams of a reinforced frame with weak short columns. The beam intensity can be reduced to address the more preferred (ductile) frame breakage mechanism. Combining brace and beam changes can significantly improve the inelastic behaviour of the brace frame.

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**2. Niels Peter hoj, and Marja - Kaarina Söderqvist (2009)**

A new methodology is presented to estimate the seismic or bearing capacity of existing homes with traditional on-site concrete construction systems. This is part of a multi-step methodology (step 2) for seismic assessment and refurbishment of existing buildings being developed by the author. This methodology is based on the concept of performance-oriented assessment (PBA) of existing buildings. Evaluate expected seismic strength, nominal extension, and maximum displacement of the building under consideration, taking into account the characteristics of various structural subsystems (frames, wall panels / shafts). Building load-bearing system. Based on these assessments, the expected behaviour and static load-bearing capacity of existing high-rise homes in various seismic scenarios can be assessed, taking into account the corresponding seismic loads of the building under consideration. The results of the approximate evaluation can be very well compared to the results of an "accurate" pushover analysis of the building under consideration performed using non-linear computer code.

**3. Giuseppe Oliveto and Massimo Marletta (june 2005)**

Seismic restoration of reinforced concrete buildings not designed to withstand earthquakes was planned. After briefly describing how seismic activity is described for design purposes, methods for assessing seismic vulnerability of existing buildings are presented. Traditional seismic retrofit methods are reviewed and their weaknesses identified. Modern methods and philosophy of seismic modernization, including basic energy dissipation and isolating devices, are revisited. The presentation is illustrated with case studies of actual buildings where traditional and innovative renovation methods have been applied.

**4. N. Lakshmanan (2006)**

Recent earthquakes in the Indian subcontinent have increased seismic zones in many parts of India. Additionally, ductility was an issue for all buildings designed and detailed using earlier versions of the code. Under these conditions, the earthquake resistance of existing buildings is very important. Seismic verification ultimately leads to the modernization of defective structures. For this purpose, the use of simple analysis and construction performance evaluation using the power spectrum approach or the displacement coefficient method is increasing. Before achieving uniformity of approach, there are several important issues to consider for inclusion in Indian regulations. This, in turn, requires a deep understanding of what is contained in ATC40 (ATC, 1996) or FEMA356 (FEMA, 2000) and appropriate changes depending on the terms of delivery. It is important to start and end discussions on this issue as soon as possible to achieve the desired results.

**5. M. D. Symans, A.M.ASCE, F. A. Charney, F.ASCE, A. S. Whittaker, M.ASCE M. C. Constantinou, M.ASCE, C. A. Kircher, M.ASCE, M. W. Johnson, M.ASCE, and R. J. McNamara, F.ASCE**

This article provides an overview of current practices and recent advances in the application of passive energy dissipation systems for seismic protection of structures. Focus on the application of passive energy dissipation systems in the framework of building structures. The main topics presented include the basic principles of energy dissipation systems, a description of the mechanical behaviour and mathematical modeling of selected passive energy dissipating devices, the advantages and disadvantages of these devices, and the development of guidelines and design philosophy for structural analysis and design. It uses energy dissipation. Devices and design features unique to designs with energy dissipation devices. Several recent applications of passive energy dissipation systems are also presented.

**6. D. K. Baros and s. E. Dritsos (2008)**

Over the past decade, researchers have been dedicated to developing analytical procedures to accurately evaluate the seismic performance of existing buildings. Because of this, several standards have been published, but they do not adequately address the choice of a modernization strategy. In this article, we propose a procedure for comparing available strategies to select the optimal solution for an existing imperfect building. The procedure is based on calculating the extrusion curve of an unreinforced structure. It then evaluates the power spectrum considering the different upgrade scenarios and then uses it to evaluate strategies. The latter is based on the criteria for evaluating the key characteristics of a structural system and how each solution provides a benefit. At the final stage of the procedure, simplified rules are introduced to approximate the design of each modernization solution, which can be evaluated for applicability. The proposed procedure was applied

to two ideal buildings with different structural systems. Results indicate that less effective or inadequate rehabilitation strategies were correctly identified. The results are therefore considered acceptable in terms of identifying possible optimal strategies, but should be validated in the detailed design of the modified system.

**7. L. Di Sarno and G. Manfredi (2009)**

This paper illustrates the results of experimental tests and numerical simulations performed on an existing large-scale reinforced concrete (RCT) frame equipped with bracing brace (BRB). Experimental tests were carried out on two samples of large-scale reinforced concrete buildings designed for gravity loads only. Such frames have been subjected to cyclic thrusts to study their structural performance under seismic ground motions. The results of the experimental tests show the effectiveness of using the BRB to retrofit an RC frame designed for gravity loads. These results are also confirmed by comprehensive nonlinear static analyses and response history performed on an existing RC field frame building designed for gravity loads only and equipped with a compatible BRB. similar to those used for the tested large-scale framework. In one such sample building, BRBs were placed along the perimeter of the existing frames to minimize disruption to school function and to facilitate maintenance following major earthquake-related movements. The seismic performance evaluation of modern structural systems is illustrated in detail. The number of local and global responses presented. The benefits of the adopted modernization program are emphasized and other needs for BRB adoption are emphasized.

**8. FABIO MAZZA and ALFONSO VULCANO (2009)**

The nonlinear seismic response of substructure insulated framing buildings exposed to near-fault earthquakes is studied to analyze the effect of additional damping at the level of insulation systems commonly used to prevent oversized insulation. Numerical studies were performed with respect to a system with two degrees of freedom and multiple degrees of freedom representing a mid-rise building with isolated frames. A typical fully insulated five-story reinforced concrete (RC) flat frame model designed according to Eurocode 8 for soil type A. The bilinear model idealizes the behaviour of the frame elements. Artificial impact motion, artificially generated acceleration graphs (corresponding to EC8 response spectra for subsoil class A or D) and actual acceleration graphs (recorded on rocks and soils in nearby fault regions). The additional viscous damping of the base is suitable for controlling the displacement of the insulator, thus preventing large insulators. However, this does not guarantee the best performance of the superstructure in all cases in terms of structural and non-structural damage, depending on the frequency content of the seismic impact. Precautions should be taken for earthquakes near faults, especially for insulated structures located in the ground.

**9. Georgia e. Thermou, amr s. Elnashai, and stavroula j. Pantazopoulou (2010)**

This paper presents a novel approach to derive retrofit design (RDS) spectra for use in the preliminary design and evaluation of seismic retrofit scenarios for existing structures. The new spectral representation links the properties of the intervention method chosen as the basis for the reconstruction strategy with the ductility and strength requirements of the reconstruction structure. The methodology used to derive the RDS is based on the power spectral method, where the power curve is described as a parameterized ratio of global and local interventions in terms of underlying response values. The proposed spectrum provides direct insight into the complex relationship between the nature of the intervention method and the outcome of the on-demand upgrade scenario. In this way, alternative modernization solutions are evaluated efficiently. Case studies are used to illustrate the practical application of the new approach.

**10. Stefano Pampanin and Umut Akguzel (2011)**

The need for simple and cost-effective seismic retrofit solutions for existing reinforced concrete (RC) buildings, particularly those designed before the 1970s, prior to the introduction of modern seismic code provisions and capacity design principles has been recognized as a critical socio -political priority at the international level. Similar to what was pursued for the design of new structures, a performance-based approach has to be adopted when assessing the vulnerability and defining the retrofit strategy for existing buildings. In this contribution, an overview of recent evidence-based developments in the field of fibre reinforced polymer strengthening of existing RC frame systems has been presented. Based on experimental tests, and analytical–numerical results as well as experience from onsite applications, particular focus will be given to the discussion on feasibility and

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efficiency of low invasive implementation techniques targeting the exterior corner joints of a building in order to guarantee minimum interruption to the functionality of the building

**11. Miao Cao, Liyu Xie, Hesheng Tang, Naoki Funaki and Songtao Xue (2011)**

This paper describes the entire renovation process for a damaged, passively controlled building. A hybrid modification plan using tin rubber bearings to replace damaged oil dampers is proposed and tested within size requirements and cost budget. Structural identification and non-linear dynamic analysis were performed to verify the effectiveness of the hybrid remodeling program. When the refurbishment is complete, the upgraded building with tin rubber isolators will perform better than the original building with oil dampers from recent earthquakes. Finally, this article discusses the performance of damping systems based on performance-based design concepts. The performance level of the energy dissipator should be determined according to the performance level of the building for the seismic repair plan. Structural safety aspects and the modification process after damping or deterioration of the damping device need to be considered in the future.

**12. Simi Hoque (2012)**

This paper evaluates the energy performance of a single-family home using three standard simulation software widely used in the United States: REM Design, Energy Gauge, and Treat. It examines the results of each simulation run and the reason for the difference in the results. The inputs for each of the different simulation engines are heating, cooling, and heating loads; characteristics of the building shell; gas leak; and power consumption. The paper highlights the differences in data entry for the three packages and analyses which parameters produce the most variation in the results. It also highlights areas where the capabilities provided by the tools and entities used to define simulation models can be improved. Relevant standards and guidelines are needed for building simulation so that variations in modelling and analysis can be taken into account and the energy performance of buildings can be quantified with accuracy and precision. higher accuracy.

**13. Yoshiro Kobatake (2012)**

High-strength, lightweight and high-strength carbon fibers have been used for seismic recovery and reinforcement of many existing reinforced concrete structures. The authors have been studying carbon fiber and seismic reinforcement technology that uses these effects to improve seismic resilience since 1984. We have developed three types of seismic reinforcement methods for building columns, chimneys and bridge columns. After the Great Hanshin Awaji Earthquake in 1995, the amount of seismic upgrades using CFRP increased significantly. This document is divided into 7 sections. Section 2 introduces the carbon fiber used and the product shape. Sections 3 to 6 describe seismic reinforcement using CFRP. Section 3 provides an overview of the method. Section 4 describes the renovation process. Section 5 provides a brief description of research and development. Section 6 describes usage and construction records.

**14. Min-Ho CHEYA, J. Geoffrey CHASEb,John B. MANDERc, Athol J. CARRd (2012)**

The seismic performance of the ASI (Added Floor Isolation) system is being investigated on a 12-story torque rack. The newly added and insulated upper layer on top of the existing structure collapses to act as a large tuning mass attenuator (TMD) to overcome the size limitation of the tuning mass, resulting in “12+2” and “12+4”. » Number of floors in a building. The insulation layer is optimally designed based on the TMD Optimal Design Principle as a basic design strategy, which includes passive flexible laminated rubber bearings to separate two or four upper layers from a conventional sub-superstructure system. Performance statistics are provided for 30 seismic records in 3 sets of the SAC project. Timeline analysis is used to calculate various response characteristics and mitigation factors for a wide range of seismic hazard intensities. The results show that the ASI system can effectively manage the seismic response to multi-degree-of-freedom (MDOF) systems over a wider range of ground motions without cumbersome additional mass. Specific results include identifying differences in the number of additional layers where the proposed insulation system removes energy.

**15. Ismail (2013)**

In earthquake-prone areas, many buildings need to be modernized. In some cases, carbon fiber reinforced polymers/resin (CFRP), steel jackets and concrete coats can be applied as recovery methods. Several studies have been developed with this technology in recent years. In addition, there are guidelines for the design of modernized systems of existing structures. However, reliable methodologies must be taken into account for

structural analysis of these modernized structures. In some cases, the code requires nonlinear analysis to verify the proposed renovation design. In this study, an attempt was made to study the seismic behavior of a typical existing building in Cairo by performing static thrust analysis before and after the modernization of concrete columns. reinforcement, section steel or carbon fiber reinforced composite polymer (CFRP). coat. The sample building selected represents almost all of the construction defects typical of buildings built before recent earthquake-resistant design codes. To investigate the possibility and effectiveness of using these systems, a comparative study was performed. A comparison was made between a typical reinforced concrete frame building and the same building after renovation with CFRP containment, steel elements and concrete cladding. Using nonlinear (boost) static analysis, performance levels of structural members are evaluated for all structures. As a result of the structural analysis, it is possible to have significantly greater lateral displacement and slightly higher lateral resistance than the original performance by lining the columns of the building with CFRP panels. On the other hand, moderately larger lateral displacement and higher lateral drag when using the steel case were observed. In the case of reinforced concrete lining, lateral strength and stiffness have been significantly increased, as well as significantly improved lateral displacement.

**16. Y. Daniel a, O. Lavan b (march 2014)**

This paper presents a formal methodology for optimizing the seismic design of a multi-tuned mass damper (MTMD) for multi-mode control of irregular 3D buildings. The total weight of all TMDs is kept to a minimum, while floor drift and total acceleration are limited to acceptable values to ensure a performance-based design. For this, a first-order optimization method is applied and the required gradient is derived analytically and efficiently. All constraints are first normalized to valid values and combined into one constraint on the maximum. Then use the conjugate method to efficiently generate the gradient. The results show that when properly designed, MTMDs can mitigate both structural and non-structural damage from earthquakes. Thus, it could potentially represent a multi-hazard mitigation strategy for both wind and earthquakes.

**17. O. Lavan, M. ASCE (jan 2015)**

His thesis presents a formal optimization methodology for the seismic reinforcement design of irregularly shaped 3D buildings. The damping coefficient of a potentially placed viscous damper in a given possible location and the stiffness of the supporting strut are considered design parameters. The objective function is to minimize the cost function of the buffer while limiting the various responses of interest to acceptable values when excited by filtered white noise (e.g. drift between layers at each location individually, total acceleration at each location). Constraints are added. Separately, the strength of each buffer, the stress of each support bracket, the force/force of each structural member, the shear of the base, the overturning moment at the base, the shock absorber force and the lateral restraint on the cross-section of the strut, etc.). For this, a first-order optimization method is used. The constraints on the various normalized responses are reduced to a single constraint on the maximum and the required gradients are derived analytically and efficiently using the method of conjugation analysis. Therefore, estimating the constraint slope, regardless of the number of response or design variables that are considered to be constrained, requires one additional analysis or so of computational effort. This efficient design allows you to study the effect of size limiting on bands with and without stress limiting.

**18. Antonio Formisano, Federico M. Mazzolani (june 2015)**

In this paper, a new process to select the optimal solution for both the seismic modernization of the existing reinforced concrete buildings and the elevation of the existing constructions was realized by using three different multi-criteria, decision making methods (MCDM) (TOPSIS, ELECTER and VIKOR). The application procedure was faced with two case studies. The first intervention was studied on a modernized real-size 3D RC structure with various seismic protection devices mainly based on metallic materials, whose performance has been experimentally evaluated. experience in a previous research project. All applied MCDM methods gave the same results, namely the preferred role of shear aluminium plates for seismic retrofitting of the analysed structure. On the other hand, various traditional and innovative building systems have been examined to increase the number of floors of existing masonry buildings. The effectiveness of these interventions in improving facility building behaviour was demonstrated on a typical building in southern Italy. The results of

the study, obtained using three tested MCDM methods, provided cold-formed steel systems as the optimal solution due to their preconditions of being lightweight, economical and durable.

**19. Hanan Al-Nimry, Musa Resheidat and Saddam Qeran (2015)**

An experimental indexing method for rapid assessment of seismic vulnerability of reinforced concrete frame buildings in Jordan is proposed. This method is intended to determine whether low- and mid-rise residential buildings are safe or need a more detailed assessment. After a quick visual check, the building is assigned a Basic Capacity Index (BCI), five performance tuning tools are identified and multiplied by the BCI to give a building capacity index (CI), A power index lower than the limit value of the IC indicates that an armoured building can suffer moderate damage from earthquakes while a higher value implies that minor, if any, damage will occur. Set the basic evaluation parameters; Forty BA frame buildings were selected, designed and analysed using nonlinear static analysis and combined effects of the insert walls. The effects of seismic, local conditions, horizontal anomalies (backspace and obscurity), longitudinal anomalies (soft floor on ground floor) and overhang on the seismic activity of local buildings were examined. check. The rubric is designed and used to rate and rate 112 sample buildings. About 40% of the buildings studied need detailed assessment to better identify their seismic vulnerabilities.

**20. André Furtado, Hugo Rodrigues, Humberto Varum and Aníbal Costa (dec 2015)**

Seismic vulnerability assessment and strengthening of existing buildings is an urgent and priority topic, as evidenced by recent earthquakes around the world, particularly in southern Europe. Several architectural decisions made in 1970 affect the seismic vulnerability of these structures in relation to the general design and construction practices of the time, especially seismic design. The purpose of this study is to study various reinforcement methods for implementation in existing buildings with potentially controlled behaviors by soft floor mechanisms under seismic influences, based on numerical analysis. The effectiveness of masonry filled panels is studied and the seismic safety of buildings is evaluated. We also test different reinforcement methods, including RC column sheathing, adding shear and non-shearing steel struts, and adding RC shear walls to modify/remove reactions such as soft floors. The results of the reinforced building are compared to the results of the original design minus the structural efficiencies for each type of reinforcement technology employed. The cost of each solution is determined and compared to the market value of the building.

**21. Y. Frank Chen Junsheng Liu & Yun Shi (2016)**

Most available seismic retrofitting methods have certain degree of difficulty to be implemented on site and are thus more expensive. A relatively new retrofitting technique coupling the conventional braces with the recently developed viscoelastic dampers is proposed to improve the seismic performance of deficient structures in more effective and efficient way. The relatively new damper is tubular in shape as opposed to the flat shape seen in the conventional dampers. The effectiveness of the proposed retrofitting technique is validated through the three-dimensional finite element analyses performed on real structures, in which three different brace configurations (diagonal, X and K) and small to strong earthquakes are considered. The vibration periods, inter-storey drifts and formation sequences of plastic hinges are compared to each other between the original and the retrofitted structures. The study results show that the energy loss due to the proposed retrofit scheme is significant, especially for type X-reinforced systems. The proposed retrofit method also changes the overall framing behaviour from a strong looking weak column to a weaker beam, which is a more desirable strong column. It shows that the modernized structure meets the modern requirements of seismic design. The proposed retrofit method has proven to be easier and more cost-effective to install.

**22. Paolo Foraboschi (oct 2016)**

This thesis presents the structural improvement of a public, school building that did not guarantee any security against collapse under gravity loads and was designed taking into account the effects of earthquakes. The upgrade design took full advantage of the properties, capabilities and capabilities of steel, which has been used in a wide variety of forms and functions - namely cold-formed components, thin-walled profiles, welded elements, horizontal and vertical structures, concrete. In the activity presented here, no numerical calculation was used as a means of structural design. play, steel structures particularly suitable for the preservation and improvement of the architecture of the 20th

**23. Massimiliano Ferraioli and Alberto Mandara (oct 2016)**

This paper deals with the problem of seismic restoration of a multi-building structure belonging to the Avellino Hospital Centre (Italy). First, the paper presents preliminary investigations, in situ measurements and laboratory tests, and seismic assessments of existing fixed base structures. After studying different strategies, the basic insulation turned out to be the most suitable, as well as the ability provided by the shape of the building to easily create an insulating interface at ground level. The article presents the design project, construction process and details of the isolation intervention. Some facility-specific insulation problems for seismic modernization of some building structures have been alleviated. Finally, a seismic assessment of the basic isolated building was performed. The seismic response was assessed by a nonlinear chronological analysis, using BoucWen's famous model as the constitutive law of isolated supports. For reliable dynamic analyses, a series of natural accelerations compatible with the acceleration spectrum of the Italian code were first selected and then applied along the two horizontal directions. The final results were used to solve several important problems of seismic response of multi-layer insulated building structures at the base: random torsional action and potential impact during strong earthquakes.

**24. Simon Petrovčič & Vojko Kilar (June 2016)**

Appropriate seismic retrofitting measures for buildings belonging to the monument are limited due to the severe restrictions on the extent to which such buildings may be modified. The contribution examined the potential for seismic retrofitting of non-reinforced masonry structures (URMs), which belong to a valuable architectural heritage for the implementation of foundation insulation. A new methodology was used to model URM buildings for this purpose. It is based on an equivalent frame model with plastic hinges. A typical Neo-Renaissance masonry case study with pedestal insulation is presented and compared to the behaviour of the building in its original condition. A sophisticated approach has been proposed to select the appropriate seismic device based on the nonlinear static (pushover) analysis of such buildings and the desired seismic levels with reference to legally compliant damage limit conditions. In addition, incremental nonlinear dynamic analysis was used to estimate which seismic safety improvements could be achieved at different seismic intensities using the basic seismic isolation system used.

**25. Antonio Di Cesare and Felice Carlo Ponzo (mar 2017)**

This paper presents a design method for assessing the mechanical properties of a historical energy dissipation brace system (EDB) for seismic retrofitting of existing reinforced concrete framed buildings prior to seismic stress, and if necessary, the building. Adjusts the rigidity and strength of. Its height. To illustrate the application of the proposed method and its ability to include most devices in energy dissipation with similar ductility needs, we examined a simple benchmark structure and performed a nonlinear dynamic analysis. Another purpose of this paper is to propose a simplified approach for the design of loss systems based on linear analysis with appropriate operating coefficients to achieve widespread acceptance of passive control techniques. To achieve this goal, the improvement in structural performance by adding an EDB system designed using the above procedure is estimated considering 1000 case studies designed with various combinations of key design parameters. it was done. Analytical formulation of behavioral coefficients to reinforce buildings has been proposed.

**26. W. Leonardo Cortés-Puentes, Dan Palermo (2017)**

Shape memory alloy (SMA) tension struts were developed as a modification device to improve the seismic response of defective reinforced concrete squat shear walls. Three SMA struts made of pure tension and two struts made of steel connected only by tension were constructed and repeatedly loaded. The stanchions consisted of SMA or rebar members, centrally located in the brace system and connected to rigid hollow steel structural elements. A total of four links were used in the test, two SMA links and two rebar links. A super elastic nickel titanium rod capable of absorbing large non-linear expansion was used for the SMA connection. Other SMA compounds, on the other hand, used nickel-titanium shape memory sticks, which were incapable of relieving stress after relaxation. The deformed rebar was attached to the steel link, but there is considerable residual elongation in the inelastic load area. Testing has shown that the pseudo-yield point and fracture strength of SMA struts, as well as the energy dissipation capacity, are comparable to those of steel struts. In addition, the SMA orthotic device experienced excellent stretch recovery. Testing and retesting of the SMA

bracket has demonstrated its potential to act as a resettable corset. A supplementary nonlinear finite element analysis was performed to evaluate the use of stanchions to enhance the seismic response of reinforced concrete shear walls. Analysis showed that SMA braces can improve lateral strength capacity, energy dissipation, and recentring of reinforced concrete shear walls while reducing the strength and stiffness loss associated with shear damage.

**27. Georgia E. Thermou and Manousos Psaltakis (2017)**

Recent earthquakes have shown the fragility of non-ductile reinforced concrete (RC) buildings, which are flawed in the stiffness and mass irregularities of floor plans and elevations. This paper presents a design methodology for seismological upgrades of inferior R.C. that are sensitive to rotation. building. This methodology first eliminates the effect of torsional coupling on the modal period and shape, then modifies the lateral response shape of the building in each direction to optimize the distribution of drift between floors along the height of the building. The purpose is to realize. The case study shows the actual application of the proposed methodology.

**28. Antonio Di Cesare and Felice Carlo Ponzo ( 2017)**

Sustainable development has been a hot topic in many areas of science for the past two decades. The constructed environment is an integral part of society, and sustainable buildings play a central role in the spirit of overall sustainability. To emphasize the importance of incorporating sustainability into seismic retrofitting, three different refurbishment methods (underfloor insulation, concrete lining, and steel lining) were evaluated for one building. A typical 4-story RC school building during the 1994 Northridge earthquake. Using a performance-based design approach, the goal of the refurbishment was to get the building up and running quickly with reasonable filling efficiency. Compliant with FEMA guidelines, it can be used as a civil protection space. The results show that modernization of concrete or steel can control floor deflection to comply with maximum tolerances, but building performance and the resulting damage are below efficiency targets. Required capacity. Moreover, given the human and economic losses, these remodelling options do not provide a sustainable structure in the event of a major earthquake in the future. Base insulation, on the other hand, ensures a state-of-the-art sustainable structure that not only achieves the desired performance goals, but also significantly reduces economic and human loss.

**29. Fardad Haghpanah, Hamid Foroughi & Reza Behrou (oct 2017)**

Over the past twenty years, sustainable development has become a hot topic in many scientific fields. As the built environment is a major component of society, sustainable construction plays an important role in the whole mentality of sustainability. To highlight the importance of incorporating sustainability into seismic rehabilitation, three different renovation methods (subfloor insulation, concrete cladding and steel cladding) were evaluated for a single building. home. Typical 4-story RC school building during the 1994 Northridge earthquake. Using a performance-based design approach, the goal of the renovation was for the building to operate at an immediately appropriate level of pump efficiency. i.e. Follow FEMA guidelines so it can be used as a disaster shelter. The results show that although retrofit concrete or steel can control ground deflection to achieve the maximum allowable value, the building performance and resulting damage fall short of the effective target. desired capacity. In addition, in terms of human and economic losses, these retrofit options will not provide a sustainable structure should a strong earthquake occur in the future. On the other hand, the insulation of the base not only meets the desired performance target, but also provides a modern and durable structure, greatly reducing economic and human losses.

**30. Shanshan Wang, A.M.ASCE ; and Stephen A. Mahin , F.ASCE (2018)**

The feasibility and cost-effectiveness of various retrofit techniques to improve the seismic performance of an existing 35story steel building are examined. Three types of supplemental energy dissipation devices are used in conjunction with basic retrofit measures to achieve the collapse prevention performance objective of current standards. Devices considered include fluid viscous dampers (FVDs), viscous wall dampers, and buckling restrained braces. The placement of the devices was kept the same in all three cases, considering overall architectural, programmatic, and constructability issues. The mechanical characteristics of the devices were selected using a simplified approach to achieve the same overall effective damping ratios and story drifts

consistent with the targeted collapse prevention performance objective. The results of the nonlinear dynamic analysis indicate that the FVD design was the most effective for this design in achieving its performance goals and provided the most cost-effective means of improving the design behaviour and reducing economic losses for major safety level 2 seismic hazard events. Future research requirements related to the use of additional energy dissipation devices in existing buildings are also discussed.

**31. Jiuk Shina, Jong-Su Jeonb (2019)**

Uncomplicated reinforced concrete building structures built prior to the 1970s were severely damaged and collapsed as a result of man-made (e.g. blast loads) due to inadequate column details. Structural defects can be addressed with fiber-reinforced polymer sheathing systems. In this study, the explosion characteristics of a simple low-rise building reinforced with a cladding system were investigated. Based on the investigation, an upgrade plan was developed to reduce blast damage and maximize the effectiveness of the retrofit system. Depending on the key parameters of the modified system related to the effects of restraint and bending stiffness, the upgraded model was varied and explosion simulations were performed under various loading scenarios. The effect of modernization was investigated in terms of the coefficient of closure and the coefficient of stiffness. As the impact of modernization parameters on the blast characteristics depends on the blast load, it is necessary to develop a modernization plan in terms of the expected blast load scenario.

**32. Girish Chandra Joshib, Shailesh Ghildiyalb, Piyoosh Rautelaa (2019)**

We used RapidVisual to assess about 67, 60, 36, 23, and 18% of the earthquake vulnerabilities in fire fighting, police, hospitals, schools, and local government buildings in Uttarakhand, which is prone to earthquakes in the Indian Himalayas. Screening (RVS). methodology. According to the survey, 71.86% of municipal buildings, 64.58% of schools, 62.08% of police stations, 56.25% of fire rescue services, 52.86% of hospitals in other departments and 61.68% of buildings were abolished immediately after the earthquake. Will be done. The rest of the facility will be severely overloaded and will mobilize resources for search, rescue, emergency medical care, emergency relief and recovery. The study highlights poor construction quality, poor maintenance, and violations of safety standards as the main reasons for increasing the vulnerability of the buildings under investigation. Therefore, in addition to the routine maintenance of public infrastructure and the introduction of measures to ensure the seismic safety of these buildings, priority, planned and timely demolition and reconstruction of Class 5 buildings, and detailed Evaluation is recommended. Renovation of Class 4 and 3 buildings.

**33. Arun M. Puthanpurayila, Oren Lavanb, Rajesh P. Dhakala (2019)**

In this paper, a first-order efficient multi-objective optimization scheme is applied to the design of viscous linear dampers for seismic modernization of frame buildings. The modernization cost function serves as one target while the expected loss is the other. Both of these goals are well understood by decision makers who may not be engineers. Plus, with the Pareto front for these two goals at hand, policymakers can make decisions with the big picture at their fingertips. To be able to achieve the Pareto front with reasonable computational effort, a first-order multi-objective optimization method is applied. The commands of the expected loss function, necessary for the optimization, are analytically calculated using a very efficient adjunct method. This greatly improves the computational efficiency of the methodology. The framing effect is illustrated by a four-story 2D frame and an eight-story asymmetrical 3D building.

**34. Vui Van Cao and Son Quang Pham1 (2019)**

The effectiveness of fiberglass/carbon-reinforced polymer (GFRP/CFRP) encapsulation at plastic hinges has been confirmed; however, their respective effectiveness in reducing seismic damage to deficient reinforced concrete structures is hardly comparable. This study aims to make this comparison, providing useful information for achieving the best FRP for the rehabilitation of reinforced concrete structures that are poorly loaded due to lack of transverse reinforcement. Poorly restrained reinforced concrete frames of 4 and 8 floors were chosen to represent the structures of low and mid-rise buildings. These deficient frameworks are then reinforced by CFRP/GFRP envelopes through extrinsic blocking. The inelastic time history and cumulative damage analysis of the original frame, CFRP and GFRP retrofit were performed. The damage of the pre-assembled CFRP and GFR frames is compared with each other and with the extent of damage to the original

frame. Comparative results show that CFRP and GFRP coatings on plastic hinges reduce damage significantly. More importantly, the GFRP envelope is more effective than the CFRP envelope at reducing a higher amount of cumulative damage stats. The findings can help decide what type of FRP to use for the prevention of poor quality reinforced concrete structures due to lack of transverse reinforcement.

**35. Gobirahavan Rajeswaran & Anil C. Wijeyewickrema (2019)**

Alternative design methods that can be conveniently adopted by practical engineers have been proposed to improve seismic performance using viscous dampers. Here, the response index of the refurbished building Un is calculated using Nonlinear Response History Analysis (NLRHA). Viscous damping properties are calculated by estimating the peak force of the viscous damper in terms of additional viscous damping and the peak shear force of the floor of the unrefurbished building. The currently available formulas are used for the displacement profile of the modified building and the equivalent system displacement of one degree of freedom (SDOF) to calculate the additional viscous damping. The effectiveness of the distribution of viscous damper constants proportional to the floor parameters is also investigated.

**36. Christos Giarlelis (Senior Structural Engineer), Dimitrios Koufalis (Structural Engineer) & Constantinos Repapis (Associate Professor) (2019)**

Seismic isolation, which is commonly used in new construction, is used for seismic retrofitting of 5-story reinforced concrete buildings. This building is a frame structure that represents a house designed in Greece and Southern Europe in the 1960s and 1970s, and therefore follows the old generation code. Response spectrum analysis performed for seismic assessment of structures using the EC8 code provisions revealed inadequate structural performance and inadequate load-bearing capacity of many structural components. Therefore, seismic retrofitting of structures is required and the use of friction pendulum system bearings above the foundation level is being considered. Numerous linear and non-linear analyzes have been performed, and the results show that the overall seismic performance of the building is significantly improved, but intervention is required only at the ground floor and foundation level. We will explain the effectiveness and applicability limits of this modification method. It has been concluded that seismic retrofitting of existing buildings using seismic isolation is an effective approach. This improves the level of performance compared to traditional approaches. Therefore, this should always be seen as an alternative to traditional remodelling techniques.

**37. Jishuai Wang, Tong Guo, Lianglong Song, and Yongsheng Song (2020)**

This paper presents a performance-based seismic design method of a moment-resistant RC frame with a Self-Centring Tension Buffer with Friction Damping (FSTBFrame). The structural configuration and theoretical model of the FSTB are introduced, and the digital model of the FSTB is established and confirmed by cyclic load tests of an FSTB sample. Based on the equivalent linear approach, the seismic design process is developed and verified through 3, 6, 9 and 12-story structures with different design performance goals. Numerical models of the FSTB framework are established and used to verify whether design performance goals are being met through nonlinear dynamic analyzes using design ground motion (DBE). . The research results show that the FSTB frame can achieve the expected level of performance in terms of phase drift, residual phase drift and baseline clipping, and the maximum phase offset and redundancy of the RC frame can be achieved. can be significantly reduced after installing the FSTB.

**38. Mahesh Babu Addala, Suresh Bhalla & Alok Madan (2020)**

This paper presents a new hybrid passive control device, consisting of an elastic damper and a friction damper connected in parallel, to mitigate the effects of wind and seismic events. The two components are joined together using a new locking mechanism, allowing the action of one or both components depending on the deformation of the device. This provides innovative two-phase power dissipation and together exploits the unique strengths of the two dampers. The response of a hybrid single-degree of freedom (SDOF) damping system is expressed as a linear system using an equivalent linearization technique, including all relevant parameters such as additional stiffness, reduction Additional shock and locking mechanism. To determine the influence of different parameters of the hybrid device, normalized force and normalized displacement were determined according to the SDOF linear hybrid damping system and further used to obtain the force reduction factor for the system. multiple degrees of freedom (MDOF) with a hybrid device. Then, the proposed design

approach to control structural response by hybrid equipment was applied to a six-story reinforced concrete (RC) building. The responses of the Ordinary Momentary Frame System (MRF) and the Hybrid Device Momentary Frame System (MRHDF) were compared using non-linear time series analysis. The performance of the MRHDF system is superior to that of the MRF system. Hybrid equipment can effectively reduce the dynamic response of the building, especially in terms of floor drift, residual drift, ground shear and ground acceleration. In addition, the proposed design approach is very simple compared to the response modifier approach. This hybrid device configuration shows improved performance for achieving multiple targets in wind/seismic events of real structures.

## III. GAP OF STUDY

There are many techniques that are used to recondition existing structures with poor seismic loads with the help of dampers and pedestal insulation; it is necessary to do more field, such as the use of shock absorbers. Also taking into account the suitability of these shock absorbers for earthquake mitigation. There are some evaluations to perform for different structure responses, which are described below:

¬ Comparison of more than basic insulation and energy dissipation device buffers in RC building structures.

¬ Evaluation of various parameters in a poorly framed structure using EDD.

¬ Little work has been done on the use of basic insulators and shock absorbers.

¬ Check the optimal VFD position for steel frame

## IV. CONCLUSION

This document has provided a discussion of the key features of the most widely used passive energy dissipation devices and an explanation of the current code-based approach to analysing and designing structures with such devices. The interest of the building construction community in the use of these devices in retrofit and new building applications is evident in the relatively rapid growth of applications since the mid-1990s. This move towards a growing number of implementations coincided with the development of guidelines for the analysis and design of structures containing the devices. Although each type of passive energy dissipation device serves primarily to dissipate energy, its mechanism for this leads to markedly different hysteresis behaviour and thus to performance of the structure to which it is attached. The basic properties of the device in terms of its displacement and / or dependence on speed must be taken into account in the analysis and design process, as explained in ASCE 41. The determinations allow static and dynamic linear analysis under certain conditions. These methods use equivalent linear properties of an assumed elastoplastic thrust capacity curve together with an effective damping ratio to predict the response of the structure. Alternatively, nonlinear static and dynamic analysis methods are available in determinations and are sometimes required. Finally, the introduction of energy dissipation devices within a building structure creates a number of analysis and design problems that must be considered by the structural engineer, but which are not directly addressed in code-based documents. Some of these problems have been briefly presented in this article.

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