

# Review Paper on Analytical Study on Retrofitting Technique of Rectangular Column With Different Wrapping Materials

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**Abstract-** Civil engineering structures may be damaged due various causes such as earthquakes, cyclones, blasting, etc. This kind of loading collapses the structure prematurely or causes extensive damage to them. When the damage is minor, it is possible to retrofit the structure. A review of the available literature has disclosed that umpteen numbers of retrofitting methodologies are available. Among them, efficient and effective method of repairing damaged structures is the application of Fiber Reinforced Plastics (FRP). In the past, several structures have been rehabilitated using the FRP techniques. This report describes a review of using the FRP techniques, their applications, case studies of repairing civil engineering structures, and appropriate concluding remarks.

## I. INTRODUCTION

Retrofitting is making changes to a current building to safeguard it from flooding or different risks, for example, over the top breezes and seismic tremors. You have effectively obvious an occasion of these adjustments, and you'll concentrate more inside the accompanying parts. In any case, you might be thinking at this factor why retrofitting is crucial. Why aren't houses and different buildings constructed in such a manner that they won't want these adjustments? One purpose is that construction technology, which includes both strategies and materials, keeps to improve, as does our know-how of dangers and their outcomes on homes. Many homes existing nowadays were built when little changed into known about where and how regularly floods and different hazardous activities would occur or how homes ought to be protected, and houses being built today may advantage from improvements based on what we study in the future. As a result, retrofitting has turned out to be an important and critical device in risk mitigation.

Jacketing of sections is made out of presented concrete with longitudinal and transverse support around the current segments. This kind of reinforcing improves the pivotal and shear power of sections while the flexural intensity

of segment and power of the bar segment joints keep on being the equivalent. It is likewise found that the jacketing of segments isn't effective for upgrading the pliability. A foremost advantage of column jacketing is that it improves the lateral load ability of the constructing in a fairly uniform and distributed way and as a result averting the attention of stiffness as inside the case of shear walls. This is how essential strengthening of foundations may be avoided. In addition the authentic function of the building may be maintained, as there are not any main changes within the unique geometry of the building with this technique.

## A. OVERVIEW OF RETROFITTING

Structural building structures can be harmed due different reasons which incorporate quakes, violent winds, impacting, and so forth. This sort of stacking breakdown the shape forthright or reasons tremendous damage to them. At the point when the harm is minor, it is conceivable to retrofit the structure. An evaluation of the to be had composing has uncovered that umpteen amounts of retrofitting systems are open. Among them, gainful and fruitful procedure for fixing hurt structures is the utilization of Fiber Reinforced Plastics (FRP). Previously, a couple of structures had been reestablished using the FRP techniques. This paper presents a huge chart of using the FRP techniques, their undertakings, relevant examinations of fixing basic structure systems, and appropriate wrapping up remarks

## II. STATE OF DEVELOPMENT

**Arif, M., Akhtar, et al.** Providing low price housing especially to center and low earnings organization each in rural and concrete regions is a serious country wide problem. The magnitude and acuteness of the troubles is glaringly greater said in urban areas. Also the traditional construction substances are becoming excessively costly day by using day. Innovative and low fee construction materials and techniques thereby come to be pressing need. Retrofiring might also serve as one such alternative. It has verified itself

as an high-quality fabric for low fee housing. It has high diploma of ductility and strength absorbing ability and has been increasingly used both in terrestrial and marine environments as a structural grade material device, which competes favorably with strengthened concrete and other constructing materials. Investigations on the use of pre-solid retrofitting factors in low price housing have proved the effectiveness of the material device beneath static conditions. The prefabricated retrofitting factors have also been used efficaciously in both residential and industrial buildings. It has been mounted in the studies pronounced that the retrofitting has achieved well under almost all the loading situations, whether it is tension, compression, flexure, shear, torsion, fatigue, effect or the dynamic loading. A large quantity of experimental and analytical research coping with retrofitting structural elements, having various shapes and sizes, subjected to exceptional loading conditions are suggested in literature. These researches have installed the fabric worthiness to be used in diversified applications and prove it to be a sturdy alternative to traditional construction material.

**D. G. Gaidhankar<sup>1</sup> et al.** Ferro cement is a sort of skinny wall bolstered concrete constructed of hydraulic cement mortar reinforced with intently spaced layers of continuous and relatively small size twine mesh". Mesh may be made from steel or other appropriate substances. The matrix may include discontinuous fibers. This definition ignores as crucial form of reinforcement currently in use in retrofitting i.e. The combination of metal rods and twine mesh. India has been recognized as a growing financial system which has a tendency to give upward thrust to a number of infrastructure developments especially the constructing projects. RCC is most widely used in all over world due to its high load sporting capacity however the fee of cement and steel is increasing day-by-day. So, we require a substitute to concrete which gives the electricity as that of RCC with low fee. In Ferro cement, hydraulic cement mortar with closely spaced small diameter cord meshes is used. To improve positive traits of retrofitting diverse materials along with admixtures, silica fumes, fly ash and fibers are used. Generally, the thickness of retrofitting degrees from 20 – 50 mm. Retrofitting is a twine mesh reinforcement impregnated with mortar to produce elements of small thickness, high sturdiness and resilience and, when properly shaped, high strength and rigidity. To skip these troubles and directly determine the reaction of retrofitting in unconventional applications, numerical simulations exploiting the Finite Element Method (FEM) have yielded crucial outcomes in current years.

**S. Dharanidharan et al.** A massive number of civil systems everywhere the worlds are in a nation of considerate deterioration today due to carbonation, chloride attack, etc.

Moreover numerous civil constructions are no longer considered safe due to growth load specifications inside the layout codes or due to overloading or due to beneath layout of existing systems or due to lack of best control. In order to keep efficient serviceability, older structures should be repaired or strengthened in order that they meet the equal necessities demanded of the structures built today and in future. These ends in the improvement of Ferro cement systems. Ferro cement is a kind of thin-wall reinforcement concrete commonly constructed of hydraulic cement mortar, reinforced with carefully spaced layers of continuous and relatively small diameter mesh.

**Hamid Eskandari et al.** Ferro cement, also called reinforced concrete, is acquired through blending cement with sand mortar and applying the mixture over a few layers of woven or welded steel mesh with small-diameter holes. It is widely used in shipbuilding, water and food garage tanks, water transport tubing, silos, roofs, urban and rural houses, and shape repair. Retrofitting's especially popular due to the fact its raw substances are available, it is easy to prepare and shape, and it's miles fireplace resistant. It is likewise recognized to promote the seismic resistance of masonry structures. Research has indicated the use of additives inclusive of fibers, silica, fly ash, and resin to growth the power of mortar in Ferro cement. Although the want for experimental research to offer the basis for layout equations continues however via making use of the FEM, can reduce the time and fee of otherwise costly experimental tests, and may higher simulate the loading and support situations of the actual structure. So to this give up the FEM is utilized by Nassif and Najm to investigate the conduct of retrofitting composite beams beneath a two-point loading system.

**Y. B. I. Shaheen, et al.** Ferrocement is kind of fortification cement. It typically made out of pressure driven concrete mortar reinforced with painstakingly divided layers of persistent and relatively little size string network. The work can be made from metal or other suitable materials (Blake, 2001). It is minimal effort, tough, climate obstruction, lightweight and particularly its flexibility contrasting with the strengthened solid (Ali, 1995). Their test outcomes showed that utilizing the retrofitting coat expands the hub load capacity and the hub firmness of fixing fortified solid segment when contrasted with the oversee segments. Kaish et al. (2011) and Xiong (2004) explored the chance of utilizing retrofitting coat in reinforcing of square fortified solid brisk segment

**Amlan K. Sengupta et al.** After the tremor in Bhuj, Gujarat, in 2001, there has been a purposeful exertion to address the seismic helplessness of existing structures in India. This paper is a piece of an undertaking, whose point is to advance

techniques to evaluate the seismic weakness of fortified solid three-to ten-storeyed, private and business structures and to propose retrofit measures for the basically inadequate structures. For the structures tended to in the task, the basic component insufficiencies are lacking shear limit, center restriction and rebar grafting of sections; deficient shear limit, rebar safe haven and plastic pivot turn capacity of shafts and insufficient control of pillar to-segment joints.. Without authority components in the piece and legitimate enumerating of the associations with the structure outline, there is absence of necessary activity of the horizontal burden opposing components. The neighborhood retrofit procedures of section, shaft, pillar to-segment joint, divider and establishment fortifying are inspected. Under worldwide retrofit techniques, the expansion of infill dividers, shear dividers and steel supports, and the decrease of the structure inconsistencies are referenced. A point by point contextual analysis is accounted for. In the end, issues relevant to retrofit are talked about.

**Edoardo Cosenza et. al.** Seismic retrofitting of landmark structures calls for consistence with prohibitive imperatives identified with the upkeep of one of kind inventive and auxiliary highlights. Any imagined intercession need to accomplish auxiliary execution yet regardless regard the appearance and basic system of the legitimate and be as negligibly obtrusive as could be expected under the circumstances., composites might be useful, as exhibited through the case investigate introduced on this paper. Fiber-strengthened plastics FRPs were utilized for the plan, investigation, and set up of the retrofit for the medieval ringer tower in Serra San Quirico Ancona, Italy. A FRP tie contraption is applied to the interior segments and moored at the base through a fortified solid chunk, unbiased of the pinnacle's establishment. The mediation improves the seismic capability of the structure and is completely temporary as it tends to be evacuated by warming the FRP with a warm air stream. The plan technique comprised of fundamental limited component reproduction and on-site online auxiliary appraisal. Adequacy is assessed by method of a difference of nonlinear static investigations weakling of the retrofitted and one of a kind frameworks. At last, seismic danger markdown is registered by utilizing thinking about probabilistic seismic danger on the site. Establishment issues and the current look of the shape likewise are talked about.

**Komal Bedi et. al.** The retrofit framework is a well-known term that can comprise of many medicines, including: upkeep, recovery, recuperating and reproduction. Choosing the exact treatment approach is a remarkable endeavor required inside the retrofit procedure and should be chosen by and by for every task. Contingent upon task destinations, security and

upkeep of structures may include a variety of various specialized contemplations, alongside fire life wellbeing, geotechnical dangers and cures, enduring and water penetration, auxiliary execution under seismic tremor and wind loads. Conservation is portrayed on the grounds that the way of utilizing measures to continue the predominant structure, respectability, and materials of a notable property. Restoration alludes to the way toward making new utility for an advantages through fix, changes and increments while holding those capacities which pass on it's verifiable, social, or compositional qualities. Reclamation is the methodology of as it ought to reestablish an assets as it existed at a chose timeframe. Recreation is characterized on the grounds that the demonstration of repeating a things at a particular term of time.

**Giuseppe Oliveto et. al.** Seismic retrofitting of developments helpless to tremors is a current difficulty of wonderful political and social importance. The greater part of the Italian structure stock is at risk to seismic movement regardless of whether situated in districts that have for quite some time been thought about of over the top seismic danger. During the past thirty years moderate to inordinate quakes have come upon in Italy at terms of five to ten years. Such exercises have obviously demonstrated the weakness of the building stock especially and of the assembled condition when all is said in done. The seismic risk inside the locales, where those tremors have come to fruition, has been perceived for quite a while as a result of comparative events that occurred in the past. The seismic retrofitting of strengthened solid homes not, at this point intended to withstand seismic development is mulled over. After to sum things up presenting how seismic development is portrayed for format purposes, techniques for surveying the seismic helplessness of existing homes are introduced. The traditional strategies for seismic retrofitting are checked on and their feeble focuses are recognized. Present day techniques and ways of thinking of seismic retrofitting, comprehensive of base seclusion and force scattering gadgets, are audited. The introduction is represented through case examination of genuine structures where customary and dynamic retrofitting techniques were applied. Keiji Kitajima “Research And Development Of Response-Control Retrofitting Techniques By Means Of Friction Damper”

The Hyogoken-Nanbu Earthquake which happened in January 1995 made incredible harm structures having poor quake opposing limit that were planned dependent on the norms set up before the reception of the New Seismic Design Code (the current code of Japan). As an exercise gained from the experience, a law concerning the advancement of seismic retrofitting of structures was executed in December of that year trying to advance seismic conclusion and seismic retrofit

of existing structures. The reason for this examination is to build up a seismic retrofitting technique which expands tremor opposing limit of the structure by retaining the vitality, which is contribution to the structure during a quake, with dampers which are added to the structure. This paper first gives a framework of the examination, breaks down the reaction attributes of structures retrofitted with dampers, and presents instances of damper retrofitting of structures of preliminary plan. It at that point portrays trial concentrates on unit execution test for grating dampers, on the association between the current structure and damper-supports, and on a pseudo-powerful test on fortified solid edges retrofitted with dampers.

**Yuan-Zhu Xin et. al.** This paper is Intertrochanteric femoral fractures are associated with substantial morbidity and mortality, particularly deaths of approximately 30% of elderly patients within 1 year and significant functional loss in numerous patients. Of several implants widely available for fixation, the ideal implant for unstable intertrochanteric fractures remains controversial because these fractures are associated with poor-quality bone mass and systemic disorders. To date, the use of double tapered, standard rectangular stems in the treatment of unstable intertrochanteric fractures has not been investigated in a bio mechanical point of view.

**Hossein Askarizadeh et. al.** This paper is Technology advances lead to modern thermo therapeutic methods which involve different techniques such as laser, radiofrequency, focused ultrasound, and microwaves for heating biological tissues in a safe manner. For example, the laser beam is focused to the tumor site by an objective lens for thermal therapy. One of the challenges in thermal therapy methods is delivering the appropriate volume of heat to the specified section of the patient's body. In order to have a successful thermo therapeutic operation, pre treatment planning, image-guided surgical control, and post-treatment monitoring are necessary. The objective of this procedure is to predict the tissue temperature field and identify the damaged tissue regions as accurate and appropriate as possible. Thus accurate prediction of temperature distributions, damaged regions and heat transfer rate in biological tissues during the thermal treatment processes is important both for treatment planning and for designing new clinical heating systems. Dual-phase-lag (DPL), thermal wave (TW), and Pennes models of bioheat transfer equation are utilized in treating the transient heat transfer problems in skin tissue considering a customary heating condition in thermal therapy applications.

**Yusuf N. Chanchangi et. al.** This paper is Photovoltaic technology penetration is experiencing noticeable progress. However, its performance is significantly

affected by soiling, which is influenced by several factors such as site characteristics, weather, tilt angle and surface orientation, surface material and dust properties. This indoor study investigates the effect of soiling on photovoltaic modules, focusing on dust properties and PV surface materials as influencing factors. A Solar simulator, spectrometer and SEM/ EDX were used to characterize and investigate the effect of accumulation of 13 different samples (ash, bird droppings, carpet dust, cement, charcoal, clay, coarse sand, laterite, loam soil, salt, sandy soil, stone dust and wood dust) on PV performance. The findings develop upon previous studies on the effects of dust particle accumulation on PV performance by using more dust samples and applying more rigorous techniques. The results show that charcoal appears to have the worst degradation effect on PV performance with about 98% reduction in short circuit current while salt seems to have the least impact with about 7%. The influence of 2 PV surface materials (acrylic plastic and low iron glass) on dust accumulation were Examined, and results show that the acrylic plastic accumulates more dust when compared to low iron glass. Results also show that dry deposition has a reduced adhesion to the coupons compared to wet deposition. The findings could be used in selecting PV farm sites by avoiding areas with high pollution, and it could stimulate

**Samy Abu-Salih et. al.** This paper is this work presents an analytical study of the electromechanical post buckling of a spherical elastic thin film electrode that is bonded to a spherical dielectric compliant substrate. The compliant substrate is bonded to an inner rigid, fixed and electrically grounded spherical electrode. As will be shown, when the applied voltage reaches a critical value, the film buckles into a well ordered periodic surface patterns. The electromechanical post buckling problem will analytically be solved for the one-dimensional, square checkerboard, hexagonal and herringbone periodic patterns. This work studies the effect of different geometry and material parameters on the selection and wavelength of the preferred/stable surface pattern of the buckled film. As will be deduced, the preferred buckling pattern can be determined to be either hexagonal or herringbone pattern depending on the geometry and material parameters of the film/substrate system. Furthermore, we study the effect of nonlinear stiffness of the compliant substrate on the electromechanical behavior of the film. The simplicity of generating and removing elastic surface wrinkling's by On/Off voltage switching sufficiently increases the potential of the electromechanical buckling response to be employed in different MEMS application, such as, micro sensors, micro optical switches and deformable micro mirrors.

**Gilad Mulian a et. al.** This paper presents an experimental study of the dynamic deboning failure mechanism in FRP plated beams. The experimental study is accompanied by an analytical/numerical study. The focus in the experimental investigation is on the dynamic aspects of the brittle, rapid, and abrupt failure mechanism and on its characterization and quantification. The experimental technique is based on four point bending tests of FRP plated steel beam specimens. The main dynamic monitoring technique uses high-speed digital photography with rate of 88,050 frames per second. The analytical and numerical aspects of the investigation use an extended high order layered beam theory with a physical modeling resolution that considers nucleation and evolution of the deboning mechanism in each physical interface. This is achieved by using cohesive interfaces and a specially tailored finite element formulation that is based on the theory. Digital image processing of the experimental results reveals and quantifies the dynamics of the interfacial failure with propagation velocities in the order of 100–1000 m/s and duration of less than 0.2 ms. The results reveal the dynamic nature of the failure process and provide an experimental benchmark for its consideration. They also provide direct experimental data for supporting and validating the theory and for determining the fracture energy and length scale parameters of the cohesive interfaces. With that, the combined experimental and theoretical study further explores the dynamic features of the failure mechanism...

**Reza Mirzaeifar et. al.** In this paper, the pseudo elastic response of shape memory alloy (SMA) helical springs under axial force is studied both analytically and numerically. In the analytical solution two different approximations are considered. In the first approximation, both the curvature and pitch effects are assumed to be negligible. This is the case for helical springs with large ratios of mean coil radius to the cross sectional radius (spring index) and small pitch angles. Using this assumption, analysis of the helical spring is reduced to that of the pure torsion of a straight bar with circular cross section. A three-dimensional phenomenological macroscopic constitutive model for polycrystalline SMAs is reduced to the one-dimensional pure shear case and a closed-form solution for torsional response of SMA bars in loading and unloading is obtained. In the

Next step, the curvature effect is included and the SMA helical spring is analyzed using the exact solution presented for torsion of curved SMA bars. In this refined solution, the effect of the direct shear force is also considered. In the numerical analyses, the three-dimensional constitutive equations are implemented in a finite element method and using solid elements the loading unloading of an SMA helical spring is simulated. Analytical and numerical results are

compared and it is shown that the solution based on the SMA curved bar torsion gives an accurate stress analysis in the cross section of the helical SMA spring in addition to the global load deflection response. All the results are compared with experimental data for a Nitinol helical spring.

**Yousef A. et. al.** This paper is volume of the infrastructure that needs upgrading, strengthening and/or repair is growing worldwide. The traditional techniques of rehabilitation are faced with challenges from new materials and methods that offer convenience in application and lesser degree of financial constraints to the owner. The new advances made with fiber reinforced polymer (FRP) composites, because of their many advantages over steel and other conventional materials, have provided engineers with stimulus in circumventing the difficulties associated with the traditional techniques of rehabilitation process. Although the applicability of the new materials and techniques are verified by more than ten years of field applications and a bulk of experimental data, many engineers, owners, architects and contractors still have hesitation in taking the full advantage of these materials. Some of the major reasons behind this hesitation are: the absence of code of practice, standards, guidelines for design and detailing, and the lack of clear understanding of the structural performance of the composite structure under short- and long-term loads. Although, it might be argued that the material cost of FRP is about 5 to 10 times than that of steel, the total cost of retrofitting with FRP materials in general is more economical as compared to steel.

**Shinya Miyahara et. al.** Lead-Bismuth Eutectic (LBE) is used as a spallation neutron target and coolant material of Accelerator Driven System (ADS), and many kinds of elements are produced as spallation products via spallation reactions in LBE of ADS. It is important to evaluate the release and transport behavior of the spallation products in the LBE coolant system of ADS from the viewpoints of the radiological hazard both in the cases of normal operation and accident.

The physicochemical configuration of the spallation products is essential to evaluate the release and transport Behavior because the physical and chemical properties such as solubility in LBE and volatility depend on the configuration.

**A. Garijo et. al.** In this paper we consider analytic planar differential systems having a first integral of the form  $H(x, y) = A(x) + B(x)y + C(x)y^2$  and an integrating factor  $(x)$  not depending on  $y$ . Our aim is to provide tools to study the period function of the centers of this type of differential system and to this end we prove three results. Theorem gives a characterization of is chronicity, a criterion to bound the number of critical periods and a necessary condition for the

period function to be monotone. Theorem Bis intended for being applied in combination with Theorem Ain an algebraic setting that we shall specify. Finally, Theorem CIS devoted to study the number of critical periods bifurcating from the period annulus of an isochrones perturbed linearly inside a family of centers. Four different applications are given to illustrate these results. The period function of the center assigns to each periodic orbit in Pits period. If the period function is constant, then the center is said to be isochronous. Since the period function is defined on the set of periodic orbits in P, in order to study its qualitative properties usually the first step is to parameterize this set. **Georges et. al.** In the present work an analytical model based on the improved shear-lag model was established for a bonded lap joint under a harmonic axial force, where a void is implanted in the overlap. The adherents were considered to be made from Aluminum while the adhesive was an epoxy with viscoelastic behavior. The model was validated using a 2D finite element model through ABAQUS software and the resonant axial frequencies where accurately predicted. The effect of the central voids size as well as the void's position and the loss factor of the adhesive on the modal behavior and also on the adhesive shear stress distribution and the level of the maximum adhesive stress was investigated. The light weight structure, time saving fabrication and good stress repartition over a wide area are the main reasons that have made from bonding an attractive method for the industrials to re- place standard joining methods. Though, the mechanical characterization of such heterogeneous structures constitutes nowadays a hard challenge for many scientists and researchers. One of the most complex studies in this field are the analytical models due to the diversity of the materials, behaviors, geometries, conditions and assumptions residing in bonded assemblies.

**Jodawat et. al.** all these methods have been shown to effectively increase the axial load capacity of columns. The experimental study was carried out on RC column on designed and detailed using IS 456:2000 provisions. The concrete mix design being performed after conducting numerous material test and cube test to validate expected strength as per specified grade of concrete. The trial testing conducted to estimate load at 1st crack and failure load for normal RC column with capturing displacement using dial gauges at regular load increment in UTM. The loading conditions are decided based on failure load to induce cracks in column under 85% loading of the failure one. In all fifteen specimen casted and tested with three samples for failure load estimation, three samples each for plate jacketing & angle battening system and three samples each for plate jacketing & angle battening with column preloaded to 85% of its failure load. The angle batten system proves to be better compared to

full plate retrofitting in terms of load carrying capacity and enhancing confinement effect.

### III. CONCLUSION

This paper focuses only on the literature review of previously published studies. The findings of this paper are A large quantity of experimental and analytical research coping with retrofitting structural elements, having various shapes and sizes, subjected to exceptional loading conditions are suggested in literature. To skip these troubles and directly determine the reaction of retrofitting in unconventional applications, numerical simulations exploiting the Finite Element Method (FEM) have yielded crucial outcomes in current years experimental research to offer the basis for layout equations continues however via making use of the FEM, can reduce the time and fee of otherwise costly experimental tests, and may higher simulate the loading and support situations of the actual structure utilizing the retrofitting coat expands the hub load capacity and the hub firmness of fixing fortified solid segment when contrasted with the oversee segments Under worldwide retrofit techniques, the expansion of infill dividers, shear dividers and steel supports, and the decrease of the structure inconsistencies are referenced. A point by point contextual analysis is accounted for. In the end, issues relevant to retrofit are talked about. The angle batten system proves to be better compared to full plate retrofitting in terms of load carrying capacity and enhancing confinement effect.

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- [41] Shear Walls Hoang Dang-Vu , Jiuk Shin and Kihak Lee
- [42] Comparison of Retrofitting Techniques for Existing Steel Moment Resisting Frames.
- [43] Dimitrios G. Lignos<sup>1</sup>, Carlos Molina-Hunt<sup>2</sup>, Andrew D. Krebs<sup>3</sup>, Sarah L. Billington<sup>4</sup>
- [44] Retrofit of Reinforced Concrete Deep Beams with Different Shear Reinforcement by Using CFRP.  
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