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Study of Retrofitting Structure on Existing, Extant or Current & Real Building in C.G.

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Abstract: ***Retrofitting decreases or reduces the susceptible, sitting duck, thin-skinned or assailable of devastation, destruction or illness of an existing, extant or current, actual building structure during a future, accident or spoilage. Ambition & objective of this research to corroborate, empower or sustainable a framework, Skelton or interrelation to surfeit the requirements of the invulnerability for any structure. Thus a proposed retrofit implementation can be said to be successful if it result an increase in strength &resiliency capacity of the structure which is greater than the demands imposed by strength of structure during following cases- During Earthquake, during flood, During earth vibration, During cyclones, During blasting in mining fields***

Keywords: Retrofitting on Existing Structures

1. Introduction

Retrofitting is the method of refashion or reform of any structure which are damaged by the following causes.(vibrations of the earth,floods,seismic waves, cyclones movement of wind pressure). It is also new or remodel parts which are equipped or trained into or onto existing or extant structure or building.so retrofitting is a basically a planning for modifying or remodel of any extant structures. The concepts of alternations to extant building structures differ from new planning through an important condition. India is one of the most earthquakes, undulation or seism'sprostrate countries in the world & has experienced several major or moderate earthquakes during the last 15 years. About 50-60% area of the country is assailable, destruct during moderate earthquakes are noted by the past years.

2. Earthquake in Chhattisgarh, India

2.1 Earthquake History

Chhattisgarh has very low rates of seismic activity. In recent years, tremors from earthquakes in neighboring states have been felt, most notably in 1969. Minor seismic activity has been recorded (2) in the vicinity of Chiraikund and Muirpur along the border with Madhya Pradesh. A few faults which form the eastern section of the Narmada-Son Fault Zone have shown movement during the Holocene epoch (2). Another active fault (2) is the Tatapani Fault which trends in an east-west direction in the vicinity of Manpura in Sarguja district. In the south, the Godavari fault, which forms the northern flank of the Godavari Graben run through the southern part of the state and is also active (2).

2.2 Seismic Hazard

The seismic hazard map of India was updated in 2000 (4) by the Bureau of Indian Standards (BIS). The main change in the map for the state of Chhatisgarh was the merging of Zones I and II under which much of the state falls. A sliver of the district of Dantewara lies in Zone II. Parts of the northern districts of Bilaspur, Janjgir, Jashpur, Korba, Korea and Sarguja lie in Zone III. Since the earthquake database in India is still incomplete, especially with regards to earthquakes prior to the historical period (before 1800 A.D.), these zones offer a rough guide of the earthquake hazard in any particular region and need to be regularly updated.

Bilaspur: Normal life in city was jolted out of gear for about 15-20 seconds as the city felt the tremors of earthquake at around 11.50am on Saturday. Tremors were also felt across the state of Chhattisgarh. Fortunately no loss of life or property was reported from anywhere.

1) Largest Instrumented Earthquake in Chhattisgarh 10 October 2000 - Surta-Ambikapur area, Chhattisgarh, mb 4.5 (7). 23.060 N, 82.917 E, D=005.4 kms, 06:11:32 UTC (3). This event is located to the north-east of Korba. This event had an ML of 3.7 (3).
2) Significant Earthquakes in Chhattisgarh: The following list briefly outlines known earthquakes in this region which either had observed intensities of V or higher (historical events) or had known magnitudes of M4.5 or more (instrumented events).
3) 12February 1996 - Lemru area, Chhattisgarh, ML 4.3 (7). 22.616 N, 82.893 E, D=033.0, OT=20:39:54 UTC (7). This event is located to the north-east of Korba.
4) 10 June 2001 - Ambikapur area, Chhattisgarh, ML 3.6 (3). 23.030 N, 83.154 E, D=016.5 kms, 01:12:18 UTC (3)
   Felt in Ambikapur and the adjoining areas.
5) 13 April 2007 - Jaldega-Dharamjaygarh area, Chhattisgarh, M 3.122.700 N, 83.200 E, D=010.0 kms, OT=11:49:42 UTC
6) 16 years ago 4.5 magnitude, 33 km depth Baikunthpur, Chhattisgarh, India

A mild earthquake struck the southern Chhota Nagpur Plateau to the north of Dharamjaygarh in Chhattisgarh, India, on 13 April 2007 at 17:19 PM local time. It had a magnitude of M?=3.1 and was felt strongly in parts of the region.

3. Materials and Methods for Retrofitting

Retrofit of Structures Using Modern Materials

Current research on advanced materials in civil engineering is mainly concentrated on super charged concrete and steel, and fiber reinforced plastic (FRP) composites. FRP composite, complex or compound materials have perspicacity a continuous increase of use in structural substantiate and overhaul applications around the world in the last fifteen years. High specific prudery and specific weight combined with superior environmental durability of these materials have made them a collide alternative to the conventional substantiate methods. It was shown through experimental and analytical studies that externally bonded FRP composites can be applied to various structural members including columns, beams, slabs, and walls to improve their structural performance such as stiffness, load carrying capacity, and ductility. FRP composites, combined have enjoyed varying degrees of success in different types of applications.

In general, applications that allow complete wrapping, enfolding of the member with FRP have witness to be efficacious. Enfolding of columns to increase their accessload and deformation capacity is the most effective, use full and most commonly used method of retrofitting with composites. However, certain performance and failure mode issues regarding different wrapping configuration and fiber orientations, still need to be well understood. When wrapping is difficult or not allowed, such as when strengthening beams, slabs, or walls, success of the method is sometimes hindered by premature de-bonding failures. The performance of beams strengthened using pultruded FRP plates in various configurations.

Techniques for Strengthening

Prevailing Techniques for Strengthening Primary aim of strengthening a structure is to increase its load bearing capacity with respect to its previous condition. Only those aspects related to flexure are discussed here. Established techniques which have been in use successfully for a number of years are recognized as follows:

1) Over Slabbing
2) Sprayed Concrete with Additional Reinforcement
3) Steel Plate bonding
4) External Prestressing

Over Slabbing

In this technique, a plain or reinforced concrete slab is overlaid on top of the existing slabs or beams to increase the section dimension in order to increase flexural strength. To ensure the composite action between the two, dowels or shear studs may be installed. This method in particular may be advantageous when the member needing strengthening possesses reinforcement near or equal to balanced steel. However, as the flexural strength of a reinforced concrete member is usually limited by the capacity of the reinforcement rather than by the capacity of the concrete, over-slabbing may therefore, be of no significant value. Any strength increase may be offset by the increase in dead load. "DRITSOS ET AL" has concluded that the chances of interface failure are increased when the existing beam is over-reinforced and the depth of the overlay is too deep. This observation further limits the scope of its use. Apart from disruption to use of the structure, extensive surface preparation is required.

Sprayed Concrete With Additional Reinforcement

Sprayed concrete is a mixture of cement, aggregates and water which is projected into place at high velocity from nozzle. Many names have been associated with sprayed concrete including spray concrete, shotcrete and gunite. In the USA the "American Concrete Institute" described shotcrete as "mortar or concrete conveyed through a hose and pneumatically projected at high velocity onto a surface". In the UK Gunite is referred to "sprayed concrete where the aggregate size is less than 10mm, and where the size of aggregate exceeds 10mm, it is termed as shotcrete".

Strengthening of beams deficient in flexure is accompanied by addition of reinforcing steel in the tensile zone. The method is, therefore, sometimes referred to as tensile overlay. The method essentially requires removal of concrete cover, cutting recesses if necessary to accommodate additional bars, either by providing sufficient anchorage length in the concrete, or by steel plates and bolts with anchoring yokes. Once the whole system is in place concrete is sprayed to the desired thickness. It is essential to have a satisfactory bond between existing and new concretes as the evaluation of new concrete section is based on the same principles as those of normal reinforced concrete. Apart from the capability of the joint to transfer shear stresses without relative movement, differences in creep and shrinkage properties of old and new concrete need careful evaluation. It is reported that most shotcrete durability failures do not involve failures of the material itself, but generally there is a peeling off sound shotcrete because of bond failure. The Department of Transport suggested the use of sprayed concrete where the reinforcement is not too congested.

This method involves extensive surface preparation, and disruption to use of the structure is inevitable with this technique. Full advantage of the additional reinforcement can only be taken if the cross-section has sufficient capacity to incorporate additional reinforcement without becoming an over-reinforced section.

Steel Plate Bonding

This method of strengthening which materialized with the development of epoxy resin is about 39 years old and is now used in almost all parts of the world. In this method of enhancing flexural capacity, mild steel plates are bonded to the soffit of the beam by an epoxy adhesive. There is practically no increase in depth of member or in its dead weight. The method is versatile, flexible, economical and expedient. The behavior of resulting composite system largely depends on the inter-layer bond between concrete and plate. The thickness of the plate needs special attention on relatively thick plates can initiate horizontal cracking and plate separation. With increase width, there is a risk of defects in adhesive, and with increasing thickness of the adhesive; the slip between the reinforcing element and concrete becomes greater. Anchor plates are needed where the width-thickness ratio of the plate is less than 50:1 due to production of high stresses near the ends of the plates leading to premature failure. The technique cannot be used where the member shows any sign of reinforcement corrosion.

External PreStressing

External Pre-stressing is defined as pre-stress produced by cables which are placed outside the structure over a great part their length and which, except at the deviators and at anchorage zones has no relation the shape of the concrete structure.

The advantages over plate bonding technique include:

- Less susceptibility to weather conditions during repair
- Elimination of surface preparation
- Easy installation
- Use on any structural material
- Use on structures contaminated on chlorides.

Strengthening with external unbounded pre-stressed tendons is now a widely used method; however, its use has been restricted in the developing world because of its sophistication, skill required and lack of experience in designing, handling and application.

4. Newer Techniques for Strengthening

Newer techniques are sometimes derived through already existing techniques and sometimes advances in different aspects of newer material pave the way for introduction of newer techniques. Two such techniques which have shown some promise of their future development are:

- Externally Bonded FRP Composites
- Ferrocement
- Fiber Composite Plate & Tendons

Recent developments in the field of plastics and composites have resulted in the manufacturing of high strength fiber reinforced plastics (FRP), with strength and fatigue properties higher than those of steel. The fiber could be glass fiber, aramid fiber or carbon fiber.

If two dissimilar materials which have to have composite action are to be used structurally, it is necessary for designer to have a thorough understanding of the mechanical and service material properties of the components, the method of joining, the composite action and failure mechanism and overall structural analysis of these systems.

Glass, aramid and carbon fiber composites may be considered for strengthening applications with particular regard to plate bonding.

5. Methods

Two primary methods are used to attach FRP composite materials to concrete structures (and to masonry, timber, and even metallic structures) for "retrofitting" purposes.

One method employs per-manufactured rigid FRP strips (approximately 4 in. (100 mm) wide and in. (1.6 mm) thick) that are adhesively bonded to the surface of the structural member.

The other method, known as "hand lay up", consists of in situ forming of the FRP composite on the surface of the structural member using flexible dry fiber fabrics or sheets of width approximately 6 to 60 in. (150 to 1500 mm) and liquid polymers.

In recent years a new variant of the pre-manufactured strip method called Near Surface Mounting (NSM) has been developed. In this method, a thin, narrow FRP strip (3 by 18 mm) or small-diameter round FRP bar (6 mm) is inserted and then bonded adhesively into a machined groove at the surface of the concrete member.

FRP retrofitting has been used with bridge and building structures to strengthen static and quasi-static loads (such as increases in dead or live load in a bridge or building structure), and for dynamic loads (such as strengthening for improved seismic or blast response in a bridge or building structure). FRP composites have been used successfully for flexural strengthening of concrete beams and slabs, shear strengthening of concrete beams, and axial strengthening and ductility enhancement of concrete columns.

6. Advantages

All structural problems have more than one technical solution, and final selection will ultimately rest upon an economic evaluation of the alternatives. Enlightened clients will ensure that this evaluation includes of the total cost that will be incurred during the minimum initial cost.

The potential advantages of FRP composites plate bonding are as follows:

Strength of Plates: FRP composites plates may be designed with components to meet a particular purpose and may comprise varying proportions to different fibers. The ultimate strength of the plates can be varied, but for strengthening schemes the ultimate strength of the plates is likely to be at least three times the ultimate strength of steel for the same cross-sectional area.

Weight of Plates: The density of FRP composite plates is only 20% of the density of steel. Thus composite plates may be less than 10% of the steel weight with same ultimate strength. Apart from transport costs, biggest saving arising from this is during installation. Composite plates do not require extensive jacking and support system to move and hold in place. The adhesive alone will support the plate until curing has taken place. In contrast, fixing of steel plates constitutes a significant proportion of the works costs.

Versatile Design of Systems: Composite plates are of unlimited length, may be fixed in layers to suit in two directions may be accommodated by varying the adhesive thickness.

Reduced Mechanical Fixing: Composite plates are much thinner than steel plates of equivalent capacity. This reduces peeling effects at the ends of the plates and thus reduces the likelihood of a need for end fixing. The overall depth of the strengthening scheme is reduced, increasing head-room and improving appearance.

Durability of Strengthening System: There is the possibility of corrosion on the bonded face of steel plates, particularly if the concrete to which they are fixed is cracked or chloride contaminated. This could reduce the long term bond. Composite plates do not suffer from such deterioration.

Improved Fire Resistance: Composite plates are a low conductor of heat when compared to steel, thus reducing the effect fire has on the underlying adhesives. Theit chars rather than burns and the system thus remain effective for a much longer period than steel plate bonding.

Maintenance of Strengthening System: Steel plates require maintenance and painting and access costs as well as the works costs. Composites plates will not require such maintenance, reducing the whole life cost of this system.

Ability to Pre Stress: The ability to pre-stress composites opens up a whole new range of applications for plate bonding. The plate bonding may be used to replace lost pre-stress and shear capacity of the section be increased by the longitudinal stresses induced. Formation of cracks be inhibited and the serviceability of the structure enhanced. Strengthening of materials such as cast iron also becomes more practicable.

7. Disadvantages

Cost of Plates: Fiber reinforced composite plates are more expensive than steel plates of the equivalent load capacity.

Mechanical Damage: FRP composite plates are more susceptible to damage than steel plates and could be damaged by determined attack, such as with an axe. Fortunately, if damage should occur to expose FRP composite plate, such as by a high load, repairs can be undertaken much more easily then with a steel plate. A steel plate may be dislodged, or bond broken over a large area, which would damage bolt fixing and necessitate complete removal and replacement. However, with FRP composite plate bonding the damage is more likely to be a localized, as the plate is thinner and more flexible. With FRP composite, the plate may be cut the top with an appropriate lap.

8. Ferrocement

Ferro cement is said to be the first form of reinforced concrete. Ferro cement is the type of reinforced concrete which uses wire mesh rather than heavy rods and bars as the primary part of its metal reinforcement, and uses sand and cement mortar rather than a mixture of cement, sand and gravel as the primary part of its concrete mixture. Cement and sand mortar having a ratio of 1:2 is impregnated in the mesh reinforcement either by hand or by shotcrete to produce almost a fabric of steel packed and coated with mortar.

Although there are many obstacles to the greater use of ductility is attracting researchers to exploit its potential. Ferro cement have no apparent advantage over any other type of reinforced concrete either in direct tension or flexure, but it has a high level of control over cracking provided by the close spacing and specific surface area of the wire reinforcing mesh.

9. Conclusion

In this research paper we are studying in details about the retrofitting & retrofitting methods & materials. And we get by this article retrofitting is the most useful method for modifying any type of existing building or structure.

I also find that retrofitting method is most commonly used in seismic zones where seisms is more common nd the possibilities of earthquake is more and Chhattisgarh state of India is leading in zone-II & zone-III so in this zone very less chances of the earthquake. So there more possibilities of safety for any type of structure.

So if we are using the retrofitting method in structure of Chhattisgarh state in any district, it may be more useful and provide the more strength to the structure from the future problems.

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