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AN EXPERIMENTAL STUDY ON REHABILITATIONMETHODOFBEAM SUBJECTED TO CORROSION OF REINFORCEMENT

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Research Article

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ABSTRACT
It has been shown by prior study that the Rehabilitation Method of Reinforcement Method for Beams Subjected to Corrosion is very successful for experimental examination on restoring the strength of corrosion-damaged beams. With a moment capability of 6.21 kN-M, the beams were reinforced in shear to guarantee failure in flexure. This research included information on the corrosion-damaged beams discovered in shears and flexure, which is linked to the corrosion of reinforcement. The improvement methodology for weak inventory studies uses the stitching and meshing methods to recommend the best place to test that structure in the research region.

1. OVERVIEW

The Indian government recently surveyed around 1.7 lakh bridges. The Ministry of Road, Transport, and Highways of India conducted this study as part of its Indian Bridge Management System (IBMS) initiative. It was discovered that 6000 bridges in India are under structural crisis. In addition, there are several new and historic structures being constructed right now. As a result, maintaining the current concrete infrastructure—which includes many buildings and bridges—and constructing new, long-lasting, corrosion-resistant structures are enormous tasks. One of the most significant deteriorating processes that is often seen in concrete buildings is corrosion. The largest issue with durability that India is dealing with is corrosion of reinforcement. Approximately 3% to 4% of GDP is lost due to corrosion. India spent over 4 lakh crores a year on corrosion costs in 2019. This cost is rising with time as more buildings are constructed. 50% of the buildings undergo substantial repair within around 10 years, which is likely a very short time frame, and up to 50% of the construction money is really spent for some kind of repair. About 30% of the material is utilized for repairs, and 40% of the cement is used for repairs. The pace at which these two figures are rising is concerning. The Value of Rehabilitation Numerous studies have been conducted on the flexural and auditory behavior of broken beams restored using a variety of repair and rehabilitation techniques. There are several papers on strengthening and repairing damaged structural components. Here is a review and presentation of the literature on different beam repair and rehabilitation. 2. Research on Various Literature The utilization of three distinct kinds of epoxy resin materials, such as EXPACRETE SNE1, LAPOX B-47 and HARDENER K-46, and CONBEXTRA EP10, 65 & 120, for repairing reinforced concrete beams is examined by V. Bhikshma, M. Koti Reddy, and K. Sunita. Six M50 grade standard size beams measuring 1500 x 230 x 150 mm were produced. These beams were put through two-point loading tests after curing. It was discovered that beams failed when flexed to 90% of the ultimate load. After that, several kinds of epoxy resin materials were used to repair the broken beams. These beams were retested up to the maximum load after repair. Finding the best epoxy resin substance in terms of strength and cost was the goal of this study. Following testing of restored beam specimens for Flexure, it was determined that the EXPACRETE SNE1-repaired beams had a greater improvement in load-bearing capacity than those made of other epoxy resins. EXPACRETE was also shown to be chapter [1] when compared to other resins.

India is divided into a number of geographically distinct areas, each with its own climate. The most well-known natural phenomena that lead to the collapse of concrete buildings are corrosion of the reinforcements caused by carbonation and chloride. Because of the quick deteriorating process and the easy diffusion of the chloride ion, chloride assault is one of the most dangerous ways to harm RC structures [2]. India has a vast 7516.6-kilometer coastline. Consequently, the buildings in this area will be exposed to airborne chlorides, and the soil in these structures will likewise be rich in chlorides. Therefore, there is a chance that the foundation may corrode severely. Additionally, between 60% and 70% humidity might cause corrosion brought on by carbonation. Additionally, brown areas and cover spalling often indicate the advancement of corrosion. This implies that the repair must be done as soon as feasible. Therefore, a variety of techniques should be used to prevent corrosion and increase the structures' ability to support loads. One important tactic that is essential for improving and enhancing the effectiveness of fixing damaged structural components is structural rehabilitation. The degradation of reinforced concrete buildings, in addition to the disparity and cost of restoration measures, has sparked the development of novel repair materials and structural recovery techniques. [3]. Nezar N. Ismaeel, Hamza Riyad, and Wail Nourilden Al-Rifaie examined several methods for beam rehabilitation, including U-Ferrocement sections with bolts, U-Ferrocement sections with epoxy, U-Ferrocement sections with bolts and epoxy, and U-Nanomaterials. using epoxy and bolts. Twelve 2200 x 200 x 150 mm RC beams were cast, with two 12 mm diameter bars serving as compression reinforcement at the top and two 12 mm diameter bars serving as tensile reinforcement at the bottom. As shear reinforcement, bars with a diameter of 10 mm and a c/c of 250 mm were supplied. Because it was anticipated that the beams might break in flexure, they were reinforced in shear. After being repaired using a variety of methods, these beams were loaded to failure and retested. After being loaded to failure, the broken beams were restored using the various methods previously outlined. The failure behavior and load bearing capability of the beams before and after repairs were compared in a comparative study. Bolt-fitting the replacement components to repair the broken section of the laden beams produced excellent results when it came to supporting the maximum load [4]. A ferrocement layer was suggested by Sivagurunathan B. and Vidivelli B. as a way to strengthen the damaged RC beams. Eight 3200 x 250 x 125 mm beams were cast and put through a bending test. After undergoing bending tests, six beams were fixed by applying epoxy resins to ferrocement laminates. Following restoration, these beams underwent another test using the same bending configuration as previously. By employing epoxy resin glue to secure ferro cement laminates, six of these beams were reinforced and loaded to a predefined lowest level. To determine their final load-bearing capability, these restored beams underwent another flexure test. They came to the conclusion that since the ferrocement layer increased the ultimate load capacity, it might be used as rehabilitation material for buildings damaged by overloading [5].

The present issues and findings around the usage of UHPFRC as a repair material for concrete structural elements were examined by Mohammad A. Al. Numerous UHPFRC characteristics were noted, including flexural strength, fire resistance, coefficient of thermal expansion, and durability. These UHPFRC mechanical characteristics were contrasted with those of High Performance Concrete and normal concrete. Additionally, the impact of steel fiber on the beam's flexural capacity was investigated. A higher percentage of steel fiber in UHPFRC increased the beam's stiffness and load-bearing capability. The ultimate load capacity of both damaged and undamaged RC beams is increased by 1.99 and 2.77 times, respectively, by strengthening with UHPFRC, according to the results [6]. The use of reinforced self-compacting concrete jackets for the repair of shear-damaged RC beam specimens was studied by Constantin E. Chalioris and Constantin N. Pourzitidis. Five beams were positioned and subjected to monotonic loads to demonstrate shear failure. The damaged specimens were retested under two-point bending loads after being kept in thin, reinforced jackets. Stirrups made of U-shaped 5 mm bars were used to couple the beams. The lower three sides of the beam were covered with a concrete jacket that was 25 mm thick. The capacity of the repaired beams was totally recovered, indicating that the jacketing technique is the most effective approach [7]. E. M. Lofty investigated the use of two methods to fortify buildings because of the seismic impact. Rehabilitation techniques include externally bonded FRP composites and external steel plating. Ten 2500 x 250 x 150 mm concrete beams were put through a two-point bending test. Finally, it was determined that reinforcing beams with steel plates was successful since it increased the structural parts' stiffness and strength [8]. Shrikant Kale and Sudhir Patil investigated how corrosion affected the RC beams' flexural, torsional, and shear strengths. The impressed current approach is used to accelerate corrosion. M20 grade concrete beams were cast using regular Portland cement. The beams were tested on a Universal Testing Machine (UTM) to determine their flexural strength, ultimate load, shear strength, and deflection behavior before and after corrosion. This research examines how corrosion affects several beam parameters depending on varying corrosion levels of 0%, 3%, 6%, and 9%, respectively. According to this, the Ultimate Load for 9% corrosion is much lower than that of the controlled specimen (0% corrosion). Additionally, the corrosion impact lowers the beams' shearcapacity and moment carrying capacity [9]. The findings of the post-repair flexural response of reinforced concrete beams affected by corrosion and subsequently repaired using various FRCM techniques were presented by Mohammed Elghazy, Ahmed ElRefai, Usama Ebead, and Antonio Nani. Nine beams in all were tested, including six corroded and repaired beams, one corroded and unrepaired beam, and two twobeams that were either corroded or mended. These beams underwent two stages of corrosion: phase one, or short-period beams, underwent 210 days of accelerated corrosion before being repaired, and phase two, or long-period beams, underwent 70 days of corrosion, were repaired by FRCM, and were then exposed to accelerated corrosion for an additional 140 days. It was shown that using FRCM to repair corrosion-damaged beams significantly decreased the rates of corrosion. The beam's flexural strength and strength were enhanced by the use of FRCM. However, the majority of the repaired beams that were exposed to corrosion failed to meet the ACI-318-14 serviceability requirement for crack width [10]. Gap in Literature Numerous variables, such as humidity, environmental impacts, overloading, water seepage, low-quality construction materials, poor craftsmanship, etc., cause building components to lose strength quickly, which leads to corrosion and ultimately member failure. Previous studies have been conducted on the restoration of different architectural components. Additionally, beam rehabilitation using a variety of techniques has been done in the past. They are repaired using a variety of techniques, including the use of epoxy resins, fibers, binders, grouting, jacketing, traditional techniques, etc. Research on fixing corroded beams caused by both natural and man-made factors is required. The research should be taken into consideration for improving the corroded beams' characteristics by using a variety of techniques. In order to investigate the effects of corrosion on RC beams, an experimental setup for corrosion of reinforcement is being developed. Establishing an effective technique for beam rehabilitation resulting from reinforcement corrosion is the primary goal of this work.

FINALRESULTS

Thecorrodedbeamwasrehabilitatedwithacombinationofstitching+meshingmethod,which provides the best load-carrying capacity and thus moment capacity among all the methods employed. The application of a Ferro-cement layer made of mesh + high strength serves as explanation for the combination method's high strength. The repair mortar contains few hairline cracks and is held up by U-type bars. After it was discovered that the beam had more than 10% corrosion, CFRP wraps and laminates were used to restore it. The restored beamis is in good functioning order.

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