
ABSTRACT

The non-prismatic and nonlinear members like deep beams, dapped ended beam and corbels etc. Are not satisfied with normal beam theory. These structures generally fail by shear in spite of flexure and could not be possible to analyses and designed by normal beam theory. Strut and tie method is one of method can be used to design and analyses for non-prismatic and nonlinear member. This research paper deals with behaviour of corbels wrapped with FRP sheet under loading. In this methodology we have used specimen as corbel designed and analyzed as strut and tie method and tested in lab for monotonic loading. The test load is compared with design load. The result of corbels testing will be in term of load – deflection curves .from that comparison we can prove the strut and tie method would be a start-up solution for non prismatic and nonlinear member.

KEYWORDS: Corbel, Strut and tie method, FRP, Monotonic loading, Load-deflection curve, etc.

INTRODUCTION

In recent years, there has been an increasing effect in India to provide adequate civil engineering infrastructures for boosting the economic growth and development of the country. In the process of development, construction of new infrastructures has always attracted greater attention. However, the maintenance and retrofitting of existing infrastructure has also become increasingly important mainly due to the earthquake disaster everywhere in the world and more so in India. The issue of upgrading the existing civil engineering infrastructures has been one of great importance for over a decade. Failure of bridge decks, beams, girders and columns, buildings, parking structures and others may be attributed to ageing, induced degradation environmentally, poor design and/or construction, and also lack of maintenance to accidental events.

Composite structures are defined as structures built up by structural self-carrying sub element by shear connectors to form an interacting unit. Composite structures have seen widespread use in recent decades because of the benefits of combining the two construction materials. It is now generally recognized that the use of Fiber Reinforced Plastic (FRP) sheets, externally bonded reinforcement, is a practically efficient and technically sound method of strengthening.

Corbels

Corbel or bracket is a RC member is a short- cantilever used to support the reinforced concrete beam element. Corbel is structural element mostly used to support the pre-cast structural system such as pre-cast beam and pre-stressed beam. Mostly the corbel is casted monolithic with the column or wall element.

This chapter is describes the design procedure of corbel or bracket structure. Since the load from pre-cast structural element is large then it is very important to make a good detailing in corbel.

Fiber Reinforced polymer (FRP)

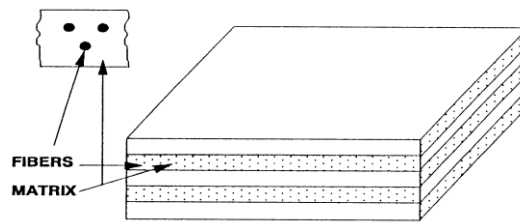
In the recent years, there have been considerable worldwide attentions among engineers for the fiber reinforced polymer (FRP) material in construction industry. These materials have more strength to weight ratio, effective resistance to corrosion, chemical resistance, electrically non-conducting, light-weight and also twice to four times as strong as steel in tension. Comparatively it is easy to use, fast, and results in small changes in structural

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size generally in the order of millimeters. It is expected to replace most of previous existing repairs and strengthening techniques. Because these materials can be applied while the structure is in use also.

FRP composite materials are made up of fibers (e.g. glass, carbon, Kevlar, etc.) bonded together with a resin matrix. For the composite materials discussed here, the fibers are long and continuous. The fibers provide the composites with their unique structural properties. To protect the fibers and to distribute the load among them the resin serves as the bonding agent. Depending in the type of application, the fibers can be oriented in different directions to enhance the mechanical properties of the composite in the desired directions. Fig. 3.3 shows a typical composite laminate with fibers oriented in the 0- and 90- degree directions. Such laminates usually contain several layers of fibers; the final product can be 1/16 to 1 in. thick, resulting in a relatively stiff plate.



COMPOSITE LAMINATE

Fig. 1: composite laminate and its constituents

Objectives

1. To examine experimentally the flexural strength of RC corbel using externally bonded Glass FRP sheets.
2. To study different failure pattern of corbel

Methodology

1. Material information and preliminary test.
There are three types of fiber which is mostly used for confinement. Their name and major properties are as follows

Properties of FRP

The main properties of Carbon, Aramid and E-Glass fibers are given in Table 1.

Table 1: Properties of FRP

Sr. No.	Property	Type of fiber		
		Carbon	Aramid	E-Glass
1	Tensile Strength (MPa)	4300 - 4900	3200 - 3600	600 - 1800
2	Modulus of Elasticity (GPa)	230 - 240	124 - 130	55 - 70
3	Strain at failure (%)	1.9 - 2.0	2.5 - 2.8	3.2 - 3.6
4	Specific gravity	1.76 - 1.78	1.44 - 1.46	2.56 - 2.58
5	Poisson's ratio	0.2	0.35	0.2
6	Density (kg/m ³)	1800	1440	2560

Experimental Program

Corbels were designed, so they are failed in flexure and strong in shear. To improve the capacity or performance level of a corbel, it is necessary to strengthen or retrofit the corbel in flexure. To improve the flexural strength, corbel were retrofitted at bottom and side face by using GFRP material. To achieve the required aim, the experimental program has been made. Designed corbel were cast. These corbels were classified into different groups. Out of these groups, first group was made of control beams.

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The two control unplated corbel (CC) failed at an ultimate load. Then take the average load of these corbels as the ultimate load. The corbels failed in conventional ductile flexure with yielding of the tension steel, followed by crushing of the concrete in the compression zone.

Mix Design

The bureau of Indian Standard, recommended a set of procedure for design of concrete mix, mainly based on the work done in national laboratories. The mix design procedure is covered in IS: 10262:2009. The method given can be applied for both medium strength and high strength concrete. The design stipulations required for the mix design are as shown in Table.

By using all properties of different materials, the mix design is carried out

Table 2.Design stipulation of for mix design

Sr. No.	Property	Design standard
1	Characteristics compressive strength required in the field at 28 days	30 MPa
2	Maximum size of aggregate	20 mm
3	Degree of workability	0.90 Compacting factor
4	Degree of quality control	Good
5	Type of exposure	Mild

CONCLUSION

The test result observed are approximately same, this can be prove that for non prismatic and non linear sections strut and tie method would be a better solution method. The use of FRP material increases load carrying capacity of the section.

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