International Journal of Latest Technology in Engineering, Management & Applied Science (IJLTEMAS)
Volume VII, Issue X, October 2018 | ISSN 2278-2540

Fatigue Strength in Flexure of Steel Fibre Reinforced Concrete- A Review

Chavan Milind Krishna[#], Prof. Patil Chetan Shankarrao[*]
[#]*Department of Civil Engineering of Sanjay Ghodawat Group of Institutions, Kolhapur, India*
[*]*Assistant Professor Department of Civil Engineering of Sanjay Ghodawat Group of Institutions, Kolhapur, India*

***Abstract*: - Now a day there is so many fibres are available in the civil engineering sector. Generally their behaviour is considered satisfactory if they withstand two million cycle of repetitive loading without distress or failure at the required mean stress level. The addition of fibre in the concrete mix improves the monotonic flexural strength, flexural fatigue strength, impact strength, shock resistance, ductility, and flexural toughness in concrete, besides delaying and arresting crack proportion. Fatigue is described by a parameter, which essentially represents the number of cycles the material can withstand under a given pattern of repetitive loading, before falling. This paper presents to study the behaviour of reinforced concrete beam cast at variations of quantity of steel fibre in the concrete matrix and subjected to fatigue loading.**

I. INTRODUCTION

Concrete is a widely used material that is required to withstand a large number of cycles of repeated loading in structures such as highways, airports, bridges, flyovers and other infrastructural engineering structures. The cyclic load may cause structural fatigue failure and there may be significant changes on the characteristics of materials such as stiffness, toughness and durability. Concrete contains numerous flaws, such as holes or air pockets, precracked aggregates, lack of complete bond between aggregate and matrix, etc., from which cracks may originate. In concrete members, cracking take place beyond the tensile strength of a material and generally propagate in a direction, which is perpendicular to the maximum tensile stress. The failure of many concrete structures is mainly caused by the fatigue ruptures of concrete.

Fatigue is a process of progressive and permanent material damage under repeated loading. Fatigue failure takes place under the influence of repetitive or cyclic load, whose peak values are considerably smaller than safe loads estimated on the basis of static load tests. In concrete, these changes are mainly associated with the progressive growth of internal micro cracks, which result in a significant increase of irrecoverable strain. At the macro level, this will manifest itself as changes in the material's mechanical properties. Fatigue loading is usually divided into two categories i.e. low-cycle and high-cycle loading. Low-cycle loading involves the application of a few load cycles at high stress levels. On the other hand, high cyclic loading is characterized by a large number of cycles at lower stress levels. Various approaches have been used in the fatigue life assessment of structural elements. A widely accepted approach for engineering practice is based on empirically derived S–N diagrams, also known as Wholer curves.

Relevance of Research:

Interest in the fatigue of concrete arises because structure such as concrete bridges, offshore elements and concrete pavements are loaded by cyclic forces. For example, concrete overlays for highway or bridge decks are expected to resist millions of cycles of repeated axle loads from passing traffic during their service lives. Airport pavements are subjected to a smaller number of repeated loadings during their design lives, ranging from about several thousand to several hundred thousand cycle of repeated loading.

Research is summarizes study to determine the fatigue and elastic characteristics of a steel fibre reinforced concrete. Changes in elastic properties which occur as the number of load application increases are studied and estimate of the variations that occur in the fatigue and elastic properties. In addition attempts are make to correlate fatigue life and tensile strength in order to provide a means of estimating fatigue behaviour from strength results.

II. LITERATURE REVIEW

Roger G. Slutter and Carl E. Ekberg (1958), Develop a report on Static and Fatigue tests on prestressed concrete railway slab, this report is principally concerned with the fatigue properties of prestressed pretensioned concrete members. A theoretical study of the fatigue resistance of such members is first presented, followed by description of laboratory test on six beams. A discussion and interpretation of the test result constitutes the balance of the report.

John A. Crumley and Thomas W. Kennady(1977), Develop a report on Fatigue and Repeated load Elastic characteristics of in-service Portland cement concrete, this report summarizes the results of an investigation of the resilient elastic and fatigue behavior of in-service concrete from pavements in Texas. Static indirect tensile tests were conducted in order to estimate the average tensile strength of each of the four projects tested. Repeated load indirect tensile tests were conducted to determine the fatigue and resilient characteristics and the relationship between fatigue life and stress/strength ratio. Deformation measurements were taken during fatigue testing in order to determine the resilient elastic properties of the material and the changes in these properties during the test period. In addition, estimates of the variation in fatigue life and elastic properties were made.

Tarun R. Naik et al. (1994), Present a report this report present the state of the art informaton with or without fly ash. The report include the informaton on the mechanism of the fatigue fracture, the factor affecting the fatigue behaviour, and fatigue models for the plain concrete. A number of studies have shows that concrete fatigue strength is significantly influenced by a large numbers of variables including stress range, rate of loading, load history, stress reversal, rest period, stress gradient, material properties, etc.The effect of these parametars on fatigue characteristics of concrete are addressed in this report.

Christos G. Papakonstantinou et al.(2001), Present a summary of an experimental invistigation, in which reinforced concrete beams were strengthened with glass fabrics (sheet) and subjected to fatigue loading. The comparison shows that the analyatical model provides rasonably accurate prediction of deflections, for both reinfored beams and reinforced concrete beams reinforced with composites. Although glass fiber composites were used for the evaluation, the model is also applicable to other types of fibers.

S.P. Singh and S.K. Kaushik (2002), Presents a study on the fatigue strength of steel fiber reinforced concrete (SFRC). An experimental program was conducted to obtain the fatigue-lives of SFRC at various stress levels and stress ratios. Sixty seven SFRC beam specimens of size 500x 100 x 100 mm were tested under four-point flexural fatigue loading. Fifty four static flexural tests were also conducted to determine the static flexural strength of SFRC prior to fatigue testing. The specimens incorporated 1.5% volume fraction of corrugated steel fibers of size 0.6 x 2.0 x 30mm. Concept of equivalent fatigue-life, reported for plain concrete in literature, is applied to SFRC to incorporate the effects of stress level S, stress ratio R and survival probability LR into the fatigue equation. The results indicate that the statistical distribution of equivalent fatigue-life of SFRC is in agreement with the two-parameter Weibull distribution. The coefficients of the fatigue equation have been determined corresponding to different survival probabilities so as to predict the flexural fatigue strength of SFRC for the desired level of survival probability.

S. P. Singh et. al. (2008), Gives results of an investigation conducted to study the fatigue strength of steel fiber reinforced concrete (SFRC) containing fibers of mixed aspect ratio are presented. Approximately eighty one beam specimens of size 500 mm x 100 mm x 100 mm were tested under four-point flexural fatigue loading in order to obtain the fatigue lives of SFRC at different stress levels. About thirty six static flexural tests were also carried out to determine the static flexural strength of SFRC prior to fatigue testing. The specimens incorporated 1.0, 1.5 and 2.0% volume fraction of corrugated steel fibers. Each volume fraction incorporated fibers of two different sizes i.e. 2.0 x 0.6 x 25 mm and 2.0 x 0.6 x 50 mm by weight of the longer and shorter fibers in the ratio of 50% - 50%. Fatigue life data obtained has been analyzed in an attempt to determine the relationship among stress level, number of cycles to failure and probability of failure for SFRC. It was found that this relationship can be represented reasonably well graphically by a family of curves. The experimental coefficients of the fatigue equation have been obtained from the fatigue test data to represent the curves analytically.

M. Heeralalet. al. (2009), Present investigation on the flexural fatigue behaviour of steel fiber reinforced recycled aggregate concrete (SFRRAC). This study gets important in view of the potential for the demolished concrete to serve as a source of quality aggregate feed stock in variety of structural and non structural application. This is a continuation of a series of a series of investigations being conducted aimed at optimizing the utilization of recycled aggregate concrete in rigid pavements. A total of 72 specimens of 100mm x 100mm x 450mm were cast and tested for flexural under both static and fatigue loading. The parameters of investigation included the different replacement of recycled aggregate in natural aggregate, presence of steel fiber and difference steel levels. The study showed that the recycled aggregates can be used in rigid pavements also and the inclusion of the fibers can benefit the fatigue performance of recycled aggregate concrete.

Gurbir Kaur et al. (2012), Studied that the statistical distribution of flexural fatigue life data and flexural fatigue strength of the steel fiber reinforced concrete (SFRC) containing blends of limestone powder (LP) and silica fume (SF), the influence of these inserts on the flexural fatigue performance of concretes is probed. Concrete mixes were proportioned to replace 30% cement with these mineral inserts in different trends. The flexural fatigue performance of plain concrete (PC) and SFRC of comparable fiber size, as reported in previous studies is made to compare with the fatigue performance of present mixes to demonstrate the effect of addition of LP and SF as partial replacement of cement. It has been ascertained that distribution of fatigue life of concretes under study can be modeled by two-parameter Weibull distribution. The increased values of shape parameter for concretes containing mineral inserts correspond to its more homogenous micro-structure as compared to control concrete. The pozzolanic and filler effect of SF in the cement improves the bulk matrix and strengthens the interfaces between fiber and cement paste and aggregate and cement paste. The modified pore structure of LP based concretes is attributed to its filler effect. The fatigue life data has also been presented in the form of S-N diagram and the two-million cycles fatigue strength/endurance limit for mixes was estimated.

Bo Liu et. al**.** (2014), Carried fatigue test on three SRC girders were carried out in Tongji University. The test specimens, testing program as well as experimental result are presented. The fatigue failure characteristics of the SRC girders are described in detail and compared with the static failure characteristics. It was found that the failure cracking was initiated at the weld toe of shear studs on the tension flenge of welded H section steel inside the SRC girder and then crack propogated along the flange width and the web height until the girder lost loading capacity due to lacking of enough cross section. The fatigue strength of the welded H-section steel played a key role in the fatigue strength of SRC girders. Suggestions for the improving the fatigue strength of SRC girders and fature research work are proposed finally.

Summary of Literature:

In this literature study the tensile, compression and flexural tests are conducted. Steel fibres have been added crack patterns are to be reduced and increase the structural strength and ductility. Finally the test results are conducted increase the ductility, energy absorption capacity and decrease in damage index of steel fibre reinforced concrete. If added steel fibre benefit the fatigue performance of concrete

III. CONCLUSION

From above discussions and study of all literature reviews and implementing proper methodology we can determine all the elastic constants of steel fibres reinforced concrete under repeated loads in flexure. We can estimate the variation in these properties for influence of the quantity of fibres. We can determine the changes in the elastic properties due to repeated loads for steel fibre reinforced concrete.

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