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(71)**Name of Applicant :**
1)G Pradeep kumar, Assistant professor/Civil Malla Reddy Engineering College (Autonomous)
Address of Applicant :Malla Reddy Engineering College (Autonomous) Maisammaguda, Kompally, Secenderabad, Telangana India 500100 Telangana India
2)B.Shruthi, Assistant professor/Civil Malla Reddy Engineering College (Autonomous)
3)V.Rajesh, Associate Professor/ Civil/ St. Martin™s Engineering College
4)Dr. D.V. Sreekanth, Professor/ Mechanical/ St. Martin™s Engineering College
5)J.S.S.K.Vasa, Assistant professor/Civil Malla Reddy Engineering College (Autonomous)
6)Talla Ram prasanna Kumar Reddy, Assistant professor/Civil Malla Reddy Engineering College (Autonomous)
7)Shyamala bhoomesh, Assistant professor/Civil Malla Reddy Engineering College (Autonomous)
8)Kande Vamsi Krishna Assistant professor/Civil Malla Reddy Engineering College (Autonomous)
(72)**Name of Inventor :**
1)G Pradeep kumar, Assistant professor/Civil Malla Reddy Engineering College (Autonomous)
2)B.Shruthi, Assistant professor/Civil Malla Reddy Engineering College (Autonomous)
3)V.Rajesh, Associate Professor/ Civil/ St. Martin™s Engineering College
4)Dr. D.V. Sreekanth, Professor/ Mechanical/ St. Martin™s Engineering College
5)J.S.S.K.Vasa, Assistant professor/Civil Malla Reddy Engineering College (Autonomous)
6)Talla Ram prasanna Kumar Reddy, Assistant professor/Civil Malla Reddy Engineering College (Autonomous)
7)Shyamala bhoomesh, Assistant professor/Civil Malla Reddy Engineering College (Autonomous)
8)Kande Vamsi Krishna Assistant professor/Civil Malla Reddy Engineering College (Autonomous)

(57) Abstract :
A concrete beam is a structural element that carries load primarily in bending. Bending causes a Beam to go into compression and tension. The loads carried by a beam are transferred to columns, walls, which is then transferred to foundations. The compression section must be designed to resist buckling and crushing, while the tension section must be able to adequately resist to the tension. Experimental based testing has been widely used as a means to analyses individual elements and the effects of concrete strength under loading. While this is a method that produces real life response, it is extremely time consuming, and the use of materials can be quite costly. The use of finite element analysis to study these components has also been used. Unfortunately, early attempts to accomplish this proceeding were also very time consuming and infeasible using existing software and hardware. In recent years, however, the use of finite element analysis has increased due to progressing knowledge and capabilities of computer software and hardware. It has now become the choice method to analyses concrete structural components.

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THE PATENTS ACT, 1970

(39 OF 1970)

THE PATENTS RULES, 2003

COMPLETE SPECIFICATION

(Section 10; rule 13)

A Detailed Analysis on Behavior of RCC Beam under Flexural Load

G Pradeep kumar	Mallareddy Engineering College, Maisammaguda, Kompally, Secenderabad, Telangana
B.Shruthi	Mallareddy Engineering College, Maisammaguda, Kompally, Secenderabad, Telangana
Mr V.Rajesh	St. Martin's Engineering College, Dhulapally, Kompally, Secenderabad
Dr. D.V. Sreekanth	St. Martin's Engineering College, Dhulapally, Kompally, Secenderabad
J.S.S.K.Vasa	Mallareddy Engineering College, Maisammaguda, Kompally, Secenderabad, Telangana
Talla Ram prasanna Kumar Reddy	Mallareddy Engineering College, Maisammaguda, Kompally, Secenderabad, Telangana
Shyamala bhoomesh	Mallareddy Engineering College, Maisammaguda, Kompally, Secenderabad, Telangana
Kande Vamsi Krishna	Mallareddy Engineering College, Maisammaguda, Kompally, Secenderabad, Telangana

The following specification particularly describes the invention and the manner in which it is to be performed:

A Detailed Analysis on Behavior of RCC Beam under Flexural Load

Field and background of the invention

Reinforced concrete structures are commonly designed to satisfy criteria of serviceability and safety. In order to ensure the serviceability requirement it is necessary to predict the cracking and the deflections of RC structures under service loads. In order to assess the margin of safety of RC structures against failure an accurate estimation of the ultimate load is essential and the prediction of the load-deformation behaviour of the structure throughout the range of elastic and inelastic response is desirable. Within the framework of developing advanced design and analysis methods for modern structures the need for experimental research continues. Experiments provide a firm basis for design equations, which are invaluable in the preliminary design stages. Experimental research also supplies the basic information for finite element models, such as material properties. In addition, the results of finite element models have to be evaluated by comparing them with experiments of full-scale models of structural sub assemblages or, even, entire structures. The development of reliable analytical models can, however, reduce the number of required test specimens for the solution of a given problem, recognizing that tests are time-consuming and costly and often do not simulate exactly the loading and support conditions of the actual structure.

Summary of the invention

These complex phenomena have led engineers in the past to rely heavily on empirical formulas for the design of concrete structures, which were derived from numerous experiments. With the advent of digital computers and powerful methods of analysis, such as the finite element method, many efforts to develop analytical solutions which would obviate the need for experiments have been undertaken by investigators. The finite element method has thus become a powerful computational tool, which allows complex analyses of the nonlinear response of RC structures to be carried out in a routine fashion. With this method the importance and interaction of different nonlinear effects on the response of RC structures can be studied analytically.

The present study is part of this continuing effort and concerns the analysis of reinforced concrete beams, slabs, and beam-to-column sub assemblages under monotonic loads. When the maximum stresses in steel and concrete simultaneously reaches allowable value the section is called balanced section when the percentage of steel in a section is less than that required for a balanced section it is under reinforced section when the percentage of steel in a section is more than that required for a balanced section it is over reinforced section. An under-reinforced beam is one in which the tension capacity of the tensile reinforcement is smaller than the combined compression capacity of the concrete and the compression steel (under-reinforced at tensile face). As the tension steel yields and stretches, an "under-reinforced" concrete also yields in a ductile manner, exhibiting a large deformation and warning before its ultimate failure. In this case the yield stress of the steel governs the design. An over-reinforced beam is one in which the tension capacity of the tension steel is greater than the combined compression capacity of the concrete and the compression steel (over-reinforced at tensile face). So the "over-reinforced concrete" beam fails by crushing of the compressive-zone concrete and before the tension zone steel yields, which does not provide any warning before failure as the failure is instantaneous.

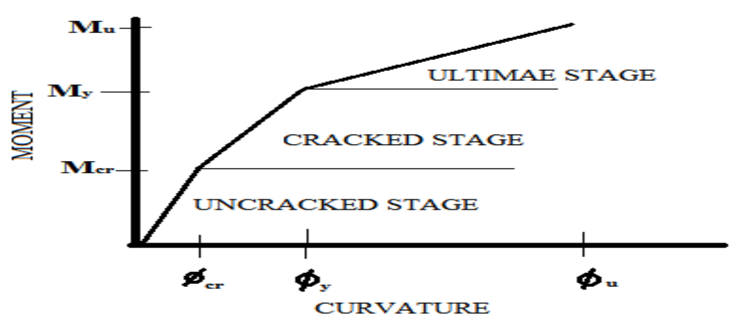
Brief description of the system

The present study is part of this continuing effort and concerns the analysis of reinforced concrete beams, slabs, and beam-to-column sub assemblages under monotonic loads. When the maximum stresses in steel and concrete simultaneously reaches allowable value the section is called balanced section when the percentage of steel in a section is less than that required for a balanced section it is under reinforced section when the percentage of steel in a section is more than that required for a balanced section it is over reinforced section. An under-reinforced beam is one in which the tension capacity of the tensile reinforcement is smaller than the combined compression capacity of the concrete and the compression steel (under-reinforced at tensile face). As the tension steel yields and stretches, an "under-reinforced" concrete also yields in a ductile manner, exhibiting a large deformation and warning before its ultimate failure. In this case the yield stress of the steel governs the design.

When the maximum stresses in steel and concrete simultaneously reaches allowable value the section is called balanced section when the percentage of steel in a section is less than that required for a balanced section it is under reinforced section when the percentage of steel in a section is more than that required for a balanced section it is over reinforced section. An under reinforced beam is one in which the tension capacity of the tensile reinforcement is smaller than the combined compression capacity of the concrete and the compression steel (under-reinforced at tensile face). When the reinforced concrete element is subject to increasing bending moment, the tension steel yields while the concrete does not reach its ultimate failure condition. As the tension steel yields and stretches, an "under-reinforced" concrete also yields in a ductile manner, exhibiting a large deformation and warning before its ultimate failure. In this case the yield stress of the steel governs the design. An over-reinforced beam is one in which the tension capacity of the tension steel is greater than the combined compression capacity of the concrete and the compression steel (over-reinforced at tensile face). So the "over-reinforced concrete" beam fails by crushing of the compressive-zone concrete and before the tension zone steel yields, which does not provide any warning before failure as the failure is instantaneous.

$$\frac{x_u}{d} = \frac{0.87 f_y A_{st}}{0.36 f_{ck} bd}$$

If a reinforced concrete beam is subjected to a monotonously increasing load, it will go through three distinct stages before complete failure. The moment – curvature relationship of a section of this beam illustrated these three stages as shown in figure below. Moment curvature relation



Moment-Curvature relation at a section.

- Uncracked concrete stage – elastic stresses
- Cracked concrete stage – elastic stresses
- Ultimate strength stage

UNCRACKED CONCRETE STAGE

At small loads, the maximum tensile stress in concrete is less than its modulus of rupture. The entire section acts as a homogeneous section with compression on one side and tension on the other. Bending stresses can be calculated on the gross properties of the cross section using the formula:

$$\frac{\sigma}{y} = \frac{M}{I} = \frac{E}{R}$$

Where,

M = bending moment which is less than or equal to cracking moment of the section

I = gross moment of inertia

E = young's modulus of elasticity of concrete

R = radius of curvature of the section

y = distance of the fiber under consideration from the centroidal axis

σ = bending stress

CRACKED CONCRETE STAGE

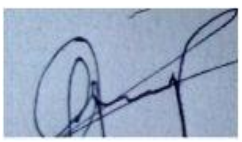
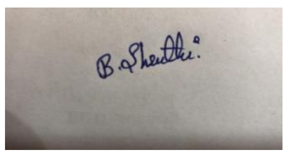
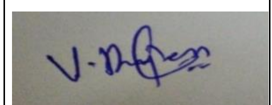
If the load is gradually increased such that bending moment exceeds the cracking moment of the section, it is assumed that all of the concrete on tension side has cracked. Reinforced bars in the tension zone begin to resist the tensile stresses induced by the applied moment. Inspite of the fact that concrete has cracked, one of the most important assumption in reinforced concrete design is that there is perfect bond between steel and concrete. Hence, at a given level, strains in steel and concrete are equal and their stresses are in proportion to the ratio of their moduli of elasticity. The stress and strain distribution for this stage was shown in Fig 3 and 4 moments are shown. The analysis of such a section is carried out using the working stress design method.

ULTIMATE STRENGHT STAGE

If the load is further increased such that stress in tensile steel exceeds its yield stress at a given section, it is assumed to be in its ultimate of collapse stage. The failure occurs as soon as the concrete strain in compression become equal to its ultimate strain, that is, 0.0035. The analysis of such a section is carried out using the ultimate strength of limit state design method.

We Claim

1. We achieve high compression strength and Flexural strength Reinforced concrete is a composite material made up of concrete and steel, two materials with very different physical and mechanical behaviour.
2. Concrete exhibits nonlinear behaviour even under low level loading due to nonlinear material behaviour, environmental effects, cracking, biaxial stiffening and strain softening.
3. Reinforcing steel and concrete interact in a complex way through bond-slip and aggregate interlock.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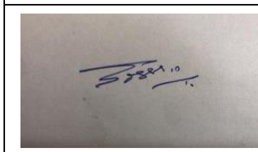	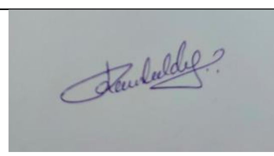	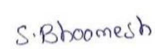	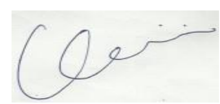
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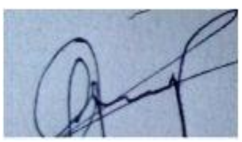	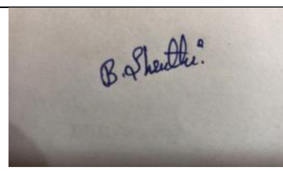	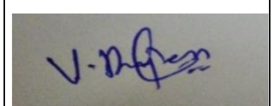	
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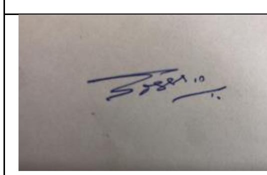	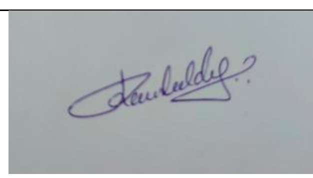	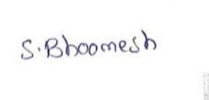	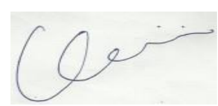
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