

Analysis of Deep Beam Using Cast Software and Compression of Analytical Strain with Experimental Strain Results

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Abstract

Analysis of deep beam by using CAST software based on strut and tie method. As per ACI 318-05(Appendix -A). Design and casting of several deep beam using STM. Testing of deep beams in heavy structures laboratory for two point loading condition. Measurement of strain, load and deflection under controlled condition. Comparison of analytical flexure strain with experimental results.

Index terms— analysis of deep beam, CAST (computer aided strut and Tie) software, Deep beam, strut and tie method(STM), strain measurement, strain gauge, experimen

1 Introduction

Strut-and-tie modeling (STM) is an approach used to design discontinuity regions (D-regions) in reinforced and prestressed concrete structures. A STM reduces complex states of stress within a D-region of a reinforced concrete deep beam into a truss comprised of simple, uniaxial stress paths. Each uniaxial stress path is considered a member of the STM. Members of the STM subjected to tensile stresses are called ties and represent the location where reinforcement should be placed. STM members subjected to compression are called struts. The intersection points of struts and ties are called nodes. Knowing the forces acting on the boundaries of the STM, the forces in each of the truss members can be determined using basic truss theory. Strain obtained analytically by software was compared with strain recorded experimentally. II. Computer Aided Strut-And-Tie (Cast) Analysis

A research programme was recently conducted to advance the STM for overcoming the aforementioned challenges. In addition to making the design and analysis process using the STM more efficient and transparent, the research aimed to extend the basic use of the STM from a design tool to an analysis tool that can be used for evaluating member behavior and E-mails : kale.shree@gmail.com, sspatil1962@gmail.com, br_niranjana@yahoo.co.in there by making it possible to evaluate/validate/extend design code provisions (e.g. dimensioning rules and stress limits) of deep beam. By using a computer-based STM tool called CAST (computer aided strut-and-tie) was developed by Tjhin and Kuchma at the University of Illinois at Urbana-Champaign (2002). This tool is the subject of this paper. CAST facilitates the instruction activities for analysis of reinforced concrete deep beam by STM. This paper considers D-regions that can be reasonably assumed as plane (two-dimensional) structures with uniform thickness and the state of stress is predominantly plane (plane stress condition). Two point loading acting on the D-regions is limited to static monotonic, but can be extended to account for the degradation effects of repeated loading. Only strut-and-tie models that consist of unreinforced struts and nonprestressed reinforcement ties are considered. The primary failure modes of the D-regions are the yielding of ties, crushing of struts or nodal zones and diagonal splitting of struts. Failures due to reinforcement anchorage and local lateral buckling are not considered.

2 III. Analytical Modeling Of RC Deep Beam

The strut-and-tie model was analyzed using CAST software. Experimental and analytical deep beam model was having 0.7 m length, 0.4 m depth and 0.15 m thick. The materials properties obtained from material tests will be used for concrete and reinforcing steel in the models. By doing so, the strength reduction factor ϕ was set

3 EXPERIMENTAL WORK

to unity. The supports were modeled as a vertical reaction on the left support and a vertical and horizontal reaction on the right support. The software's capacity prediction feature was used to estimate the capacity using the provided steel reinforcement, concrete struts and nodal zones.

Additionally, the software has a feature that allows analysis of the nodes to ensure that geometry and stress limits are not exceeded. The estimated capacity according to CAST, the failure would occur by yielding of the diagonal tie. This is desirable in STM because it allows the member to fail in a ductile manner as the reinforcing bars yield first before failure, as opposed to brittle failure of the concrete strut. Since equilibrium of the truss with the boundary forces must be satisfied (step 2) and stresses everywhere must be below the limits (step 3 and 4), one can see that the Strut-and-Tie Method is a lower-bound (static or equilibrium) method of limit analysis.

3 Experimental Work

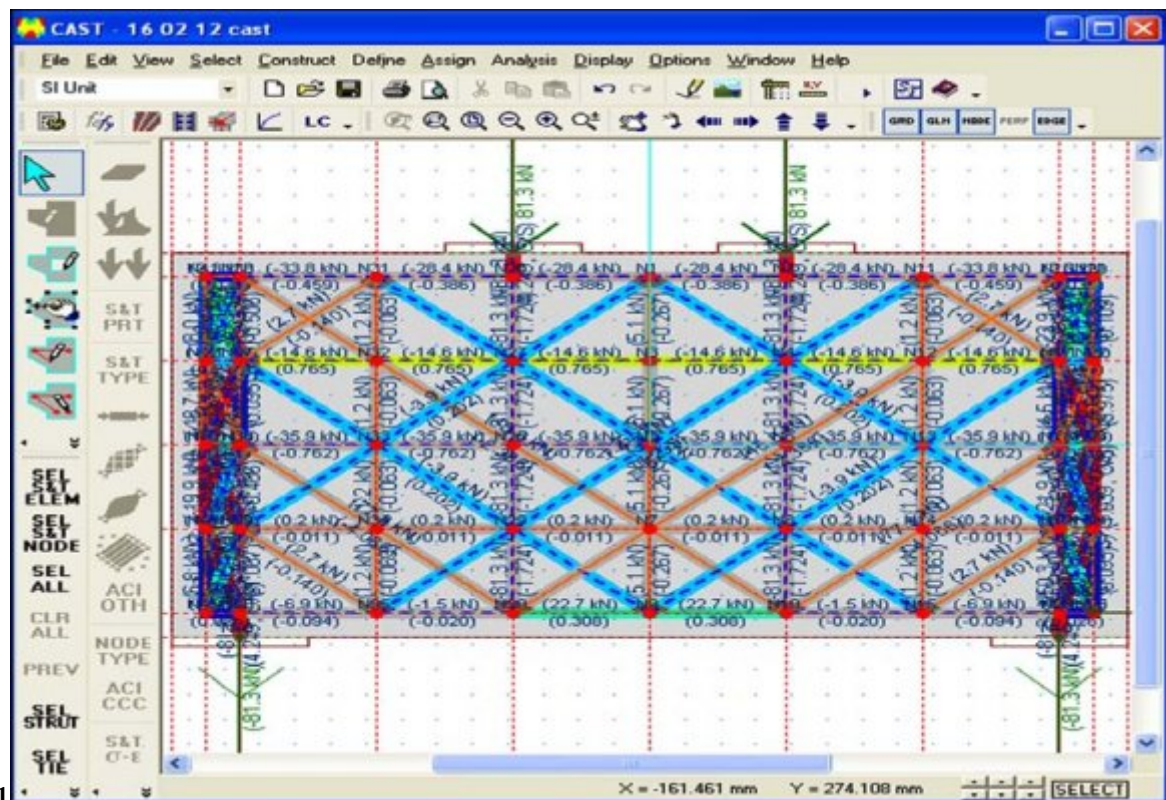
In experimental investigation of deep beam we have taken same size of deep beam of total length 700 mm, depth 400 mm and width 150 mm. Which were casted in concrete technology laboratory and curing was carried out for 28 days. M25 grade of concrete was used for deep beam. For application of load we have used 1000 kN capacity hydraulic heavy testing machine. To measure deflection dial gauge was placed at central position of bottom of deep beam. To measure strain along mid span we have used strain gauge at equally spacing from top to bottom. Analytical strain obtained By using cast software are tabulated in table ??.

In above table 1, shows experimental strain at mid span of deep beam at definite incremental loading at various depth to understand the nature of strain.

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Figure 1:



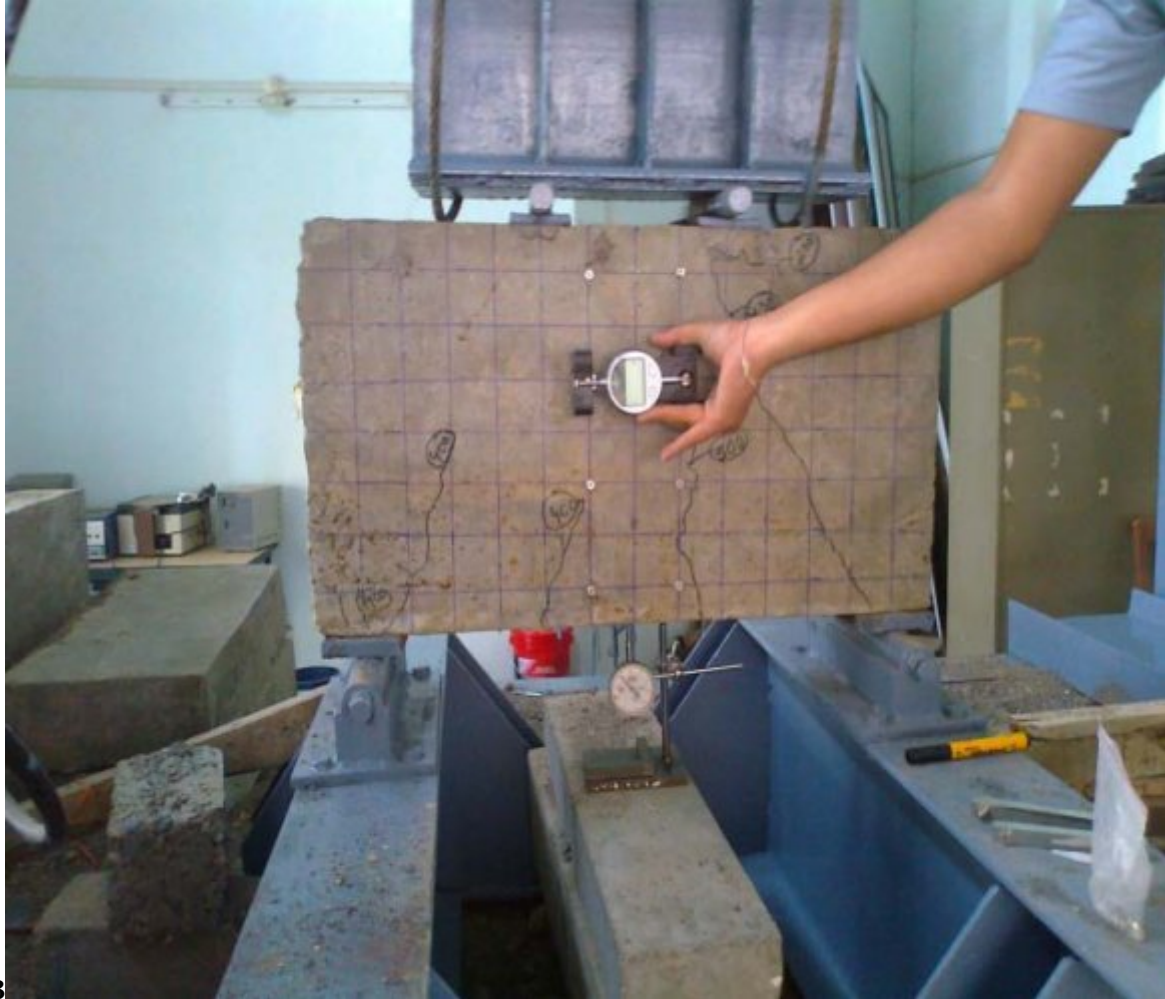
1

Figure 2: Figure 1 :



2

Figure 3: Figure 2 :



3

Figure 4: Figure 3 :

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