Numerical Study on Nonlinear Behavior of RC Continuous Deep Beams

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Abstract. The aim of the study is to demonstrate the extent of the effect that occurs to continuous reinforced deep beams when performing a parametric study in terms of support settlement and different support conditions for dual span continuous deep beams (CDBs), in terms of failure load and failure mode, using the ANSYS 2020 nonlinear finite element program. As the parametric study relied on the laboratory study conducted by Yang et al. [8]. Six samples were taken from continuous reinforced concrete beams with two spans with the extension of the shear to the depth ratios (0.5, 1). This was done to ensure that the form was handled appropriately. The pre-owned model to research the behavior of deep RC girders under static support conditions with different beam heights. Whereas, it was observed that there is a marked variation in the value of the failure load under the influence of different support conditions and the support settlement that occurs in them. This inspection is characterized by real, conceivable results of support conditions and support settlement in presenting two span continuous reinforced concrete deep beams.

Keywords: continuous deep beams, finite element modeling, different support conditions, support settlement.

1. Introduction
Deep reinforced concrete (RC) beams are are important to specialists and designers in light of the fact that their utilization has gotten more common in structures and their solidarity is difficult to assess. Studies on simple deep beams can be found in the literature; however, little examination has focused in on the comportment of continuous deep beams. Typical applications of deep beams include transfer girders, pile caps, walls of rectangular tanks, bins, floor diaphragms, shear walls, folded plates and foundation walls. The definition of deep beam according to ACI Code 318-2014 [1] is a beam that has a net span ratio equal to or less than four times the overall beam height for even loading or twice the effective height of the beam from the front of the placement for beams with centralized loading (Wight et al., 2009) [2]. If the beams that have a short sliding span with a ratio of the shear range and effective height of less than 2.0 for beams with simple support (simply supported beam) or less than 2.5 for beams that have a long span continuous beam (Park et al., 1975)[3]. Keun-H. Y, et al., 2007 [4] examined 24 reinforced concrete continuous deep beams. The variables factors studied is shear span to depth ratio (a/h), concrete compressive strength and the sum and arrangement of shear reinforcement. shear reinforcement ratio were studied is (0.003 and 0.006) All beam samples had
width $b=160\text{mm}$ and depth $h=600\text{mm}$, while the length was varied according to shear span to depth ratio ($a/h$). The results show that the load capacity of shear reinforcement was greater in continuous deep beams than in simply supported deep beams when $a/h=1$. The vertical shear reinforcement had the greater effect than horizontal shear reinforcement. Sultan., 2003 [5] utilized the results of testing 261 deep beams, 106 of which were without reinforcement and the others with vertical or horizontal stirrups or both. The primary factors were the shear span to depth ratio ($a/d$), longitudinal reinforcement ratio, concrete compressive strength and vertical and horizontal web shear stress reinforcement. Results showed that, for beams with $a/d \leq 2.5$, these factors significantly effect on the ultimate shear strength of these beams. A kinematic model with two degrees of freedom and suitable material properties was presented by Rogowsky et al., 1983 [6] examined seven simply supported DB and seventeen two span CDB under concentrated loads. The tried samples are separated into three arrangement of similar shear span to depth ratio (shear span / depth). Ordinary arrangement comprised seven deep beams having different reinforcement modality. They inferred that the behavior ranged from brittle for beams without vertical web reinforcement to flexible for beams with large amount of vertical web reinforcement. The horizontal web reinforcement has no impact on the ultimate load capacity. Mohamed, et al., 2014 [7] examined twelve two-span CDB with and without web openings. Influencing factors were position and number of web opening in beam, the web openings was strengthening by using glass fiber reinforced polymer (GFRP) and the percentage of horizontal web reinforcement. The results obtained show that the presence of web square openings within an interior or exterior shear spans in deep beams had significant effects on the behavior of deep beams and ultimate load capacity. In more detail, the openings ought to be avoided from the critical shear load path joining the reaction and loading points. Yang et al., 2007 [8] experimentally examined twelve two-span reinforced concrete continuous deep beams samples to assess the impact of beam depth which is varied from 400 mm to 720 mm on shear strength capacity, concrete compressive strength. Beams had a similar longitudinal top and bottom reinforcement and no web reinforcement to evaluate the impact of changing the beam depth on the shear strength of such beams. All beams tested failed owing to a significant diagonal crack connecting the edges of the load and intermediate support plates. Salamy et al., 2005 [9] examined the conduct of reinforced concrete continuous deep beams by means of finite element analysis along with an experiments. The beams have effective depth from (400 mm to 1400 mm) and a shear span to depth ratio between (0.5 and 1.5). Lateral reinforcement ratio varies as follow, (0.0%, 0.4% and 0.8%) in the shear span. The results showed reliability of analysis in predicting deep beams behavior in terms of failure load, failure mode as well as crack propagation. The objective of this study is to investigate capabilities of the finite element simulation for further study on deep beam behavior instead of conducting expensive time consuming experimental works. This includes particularly members with possibilities of failing in shear as well as size effect by means of large-scale structures numerical simulation. Sabale., 2014 [10] utilized the ANSYS program to study the behavior of a reinforced concrete continuous deep beams of various shear span to depth ratio ($a/h$) under two loading points of 50kN. The targets of this investigation are to notice, breaking deflection, cracking of deep beams that subjected to two loading points of 50KN. To study the non-linear finite element analysis of the deep beam using ANSYS, that having different (L/D) ratios (1.5, 1.6, 1.71) and to study stress distribution of deep beam. Deflection of beams increases as shear span to depth ratio ($a/h$) decreases and as shear span to depth ratio ($a/h$) continue decreasing, then the failure load continue decreasing. Kumar and Ramadass., 2015 [11] The researcher conducted a study predict the shear strength for reinforced concrete continuous deep beams at ultimate state, using ANSYS programme; Two prediction models were used their shear strength at ultimate state. The accuracy of the predicted shear strength values dependent on ANSYS 12.1 software for the two test beams was compared with the corresponding experimental results. For beam samples $S0.3/0.5$ the shear strength is found to be 9.93% higher in magnitude, compared with the corresponding experimental results. For beam samples $S0.3/1.0$, the shear strength was found to be 9.65% higher in magnitude compared with the corresponding experimental results.
numerical examinations of the conduct of statically determinate reinforced concrete deep beams have been available previously, but few studies have considered continuous deep beams. In any case, practically no research could be found in the literature related to the effects of different support condition and differential support settlement on the behavior of continuous deep beams.

The researcher conducted Yang et al.2007 [8] tests on four continuous reinforced concrete deep beams (L5-40, L5-60, L10-40, L10-60) with (a/h) ratios equal to (0.5, 1) respectively. These Beams were tested experimentally with support condition RHR (two exterior roller supports; interior hinge support). Tables 1 show the properties of the L series. Details for experimental beams L is shown in

![Diagram of beam setup](image)

**Figure 1.** Details of the tested beam (L) and support conditions all dimension in (mm)

**Table 1.** Test beams specifics (Yang et al.2007 [8]) in mm.

| samples | Fc' | a/h | h   | a   | d   | bw  | L   | Ast = A'st | $\rho_s = \rho'_s$ |
|---------|-----|-----|-----|-----|-----|-----|-----|------------|------------------|
| L5-40   | 32.4| 0.5 | 400 | 200 | 355 | 160 | 400 | 574        | 0.01             |
| L5-60   | 32.4| 0.5 | 600 | 300 | 555 | 160 | 600 | 861        | 0.01             |
| L10-40  | 32.1| 1   | 400 | 400 | 355 | 160 | 800 | 574        | 0.01             |
| L10-60  | 32.1| 1   | 600 | 600 | 555 | 160 | 1200| 861        | 0.01             |

hint: $f_c'$ = compressive strength about concrete, $a/h$ = ratio of shear span to depth, $h$ = depth, $a$ = shear span, $d$ = effective depth, $bw$ = width of beam, $L$ = span of beam, $Ast$ = steel area of bottom longitudinal, $A'st$ = steel area of top longitudinal, $\rho_s$ = ratio of steel area bottom longitudinal, $\rho'_s$ = ratio of steel area top longitudinal; all dimensions in mm.

2. FINITE ELEMNET MODELING

ANSYS 2020 software [12] was used to model models to simulate the structural response of the previously described reinforced continuous deep beams [8]. The resulting models were validated against all relevant experimental results. From another side that,Concrete is a semi weak material that shows distinctive conduct in compression and tension. A review of the literature revealed a lack of numerical models capable of analyzing the behavior of deep RC beams with different support conditions and support settlement. Therefore, Thus, one of the objectives of this study is to develop models of non-linear FE to anticipate the presentation of continuous Numerically reinforced concrete continuous deep beams with different support condition and settings for the differential support settlement. Solid material modeling with or without reinforcing .ANSYS 2020 provides an element.
known as a SOLID 65. To represent concrete, which contains eight nodes (8 nodes), each node has three degrees of freedom of movement (u, v, w) towards the main axes (x, y, z) respectively. These elements have the ability to represent the crushing concrete when exposed to Compression and cracking of concrete under tension. This element has the ability to simulate the non-linear behavior of concrete by representing the crushing and cracking of concrete in three directions as well as plastic deformation and creep [12]. SOLID185 was used for bearing plates and steel supports in the beam models. The element is defined by eight nodes having three degrees of freedom when translating each node in the x, y, and z directions. Steel plates have been added at the support and the bearing point in finite element models (as in actual beams) to provide more evenness of stress distribution over the support area and the loading point, which will affect the convergence [13]. LINK180 is element that can be used in a variety of engineering applications. This item can be used for modeling trusses, sag cables, couplings, springs, etc. The 3D spar element is a uniaxial tension-compression element with three degrees of freedom at each node: translations of nodes in the x, y, and z directions. In this study, to simulate the behavior of steel reinforcement that acts as the main steel strengthener in resisting bending stresses [13].

2.1. MATERIALS MODELING

2.1.1 CONCRETE

The ANSYS 2020 program requires a uniaxial stress-strain relationship for concrete in the compression process. The model was shown in Figure 2. And the following equations for calculating the multi-linear isotropic stress-strain [13]. The modulus of elasticity of concrete was calculated for each beam using the tangent slope of the stress-strain curve through the zero stress-strain point. It is calculated by the equations (4) and the rupture modulus ($f_r$) for concrete. It is calculated by the equations (5), Based on ACI 318-08 specification [1] (units MPa).

\[ f_c = \frac{E}{1 + \frac{E}{f_c}} \]

\[ f_r = \frac{0.3 f_c}{E} \]

**Figure 2.** Compressive uniaxial stress-strain curve for concrete [13]
\[ f = \frac{E_C \epsilon}{1 + \left( \frac{\epsilon}{\epsilon_o} \right)} \]  
\[ \epsilon_1 = \frac{0.3 f_c'}{E_C} \]  
\[ \epsilon_o = \frac{2 f_c'}{E_C} \]  
\[ E_C = 4730 \times \sqrt{f_c'} \]  
\[ f_c = 0.62 \times \sqrt{f_c'} \]

Where

\( f \) = Stress at any strain (\( \epsilon \)), MPa  
\( \epsilon \) = Strain at stress (\( f \))  
\( \epsilon_1 \) = Strain at the compressive strength, (0.3 \( f_c' \))  
\( \epsilon_o \) = Strain about ultimate compressive strength, \( f_c' \)  
\( E_C \) = elastic of Modulus, Mpa

In ANSYS 2020 program used the value of Poisson’s ratio equal to 0.2 is used [14] and coefficients of Shear transfer was assumed to be 0.7 for the closed cracks and 0.3 for the opened cracks. Used stiffening factor of Tension (TC) was assumed to be 0.4

2.1.2 STEEL REINFORCEMENT AND STEEL PLATES

SOLID 185 was used to represent the plate and used an elastic modulus value of 200,000 MPa and a Poisson ratio value of 0.3. LINK180 steel reinforcement is assumed to be an ideal plastic material that is flexible and identical in tension and compression. The values of the modulus of elasticity and the yield stress of the steel reinforcement were the same as those used in the tests in modeling the finite element in the steel reinforcement.

This paper relates to reinforced concrete continuous deep beams that were used by the authors in the published paper by Yang et al. [8] As a further evaluation and verification of the proposed FE model constructed with ANSYS 2020 programme [12]. The model obtained was reliable enough to be used as a substitute for destructive tests for beams similar to the ones tested, but also provides details on the test beam support types.

2.2. MESHING

In order to obtain accurate results from the FE model, Figure 3 shows the model finite element mesh, loading, and support simulation. The grid size was chosen as 50 mm in the X-Y directions, and 40 mm in the Z direction and assumed Fully bond between the steel reinforcement element nodes and concrete element nodes.
3. NUMERICAL ANALYSIS: VERIFICATION OF FINITE ELEMENT MODEL

A comparison between the numerical analysis and experimental was performed. This examination included load-deflection response and failure load. The parametric investigation included support settlement and different support conditions with various heights and shear span to depth of beams.

3.1. Load-Deflection Response

To verify the continuous deep beam model using (ANSYS 2020), a comparison of the deflection response between the load and the extension from the test results was explained. Figure 4 shows the comparison of the numerical and experimental curves of the load deflection of the mid-span deflection of the reinforced concrete continuous deep beams.
From the observation of the deflection curves of the load with the failure load, it was found that there is a good agreement between the results of the numerical analysis with the results of the laboratory analysis for the continuous reinforced deep beams. The comparative data are summarized in Table 2. The mean ratio of the experimental final failure load to the numerical final failure load (predicted by ANSYS) was 0.946. Overall, the load curve and skew from the experiment and FEM analysis were in very good agreement. The following Figures 5, show the Shear stress and vertical stress in concrete for continuous deep beams for (L5-40), (L5-60), (L10-40), (L10-60). Likewise, the following Figures 6, show the stresses in the steel reinforcement when the deep beam fails, as the stresses in the steel reinforcement did not reach the yield stress in the back face of deep beams (L5-60), (L10-40), (L10-60) due to cracking the concrete in the front face of the beam, but the stresses in the steel reinforcement did reach the yield stress in the back face of deep beam (L5-40).

Figure 4. Comparison between the numerical analysis and experimental load-deflection curves of the studied reinforced concrete continuous deep beams (L5-40),(L5-60),(L10-40),(L10-60)
Table 2. The mean ratio of the experimental final failure load to the numerical final failure load (Pu) of continuous deep beams

| Sample     | Pu(KN) Experimental | Pu(KN) Ansys | $P_{u,Exp} / P_{u,Ansys}$ |
|------------|----------------------|-------------|---------------------------|
| L 5 - 40   | 1529                 | 1577        | 0.969562                  |
| L 5 - 60   | 1635                 | 1685        | 0.970326                  |
| L 10 - 40  | 717                  | 792         | 0.905303                  |
| L 10 - 60  | 880                  | 936         | 0.940171                  |
| Mean       |                      |             | 0.946                     |

(A) Shear stress in (L5-40)  
(B) Vertical stress in (L5-40)  
(C) Shear stress in (L5-60)  
(D) Vertical stress in (L5-60)
Figures 5 show the Shear stress and vertical stress in concrete for continuous deep beams for (L5-40), (L5-60), (L10-40), (L10-60).
Figures 6. show the stresses in the steel reinforcement for continuous deep beams for L(5-40), L(5-60), L(10-40), L(10-60).

When a comparison is made with respect to the beam (L 10 - 40 ) between the use of a 25 mm wide mesh and a 50 mm wide mesh when modeling the model by numerical analysis, The following Figures 7. show it was found that there is no significant difference between them in terms of load-deflection curves, and a 50 mm width mesh was used for the speed in the solution and overcoming the smoothness that might give an error in the analysis Numerical for other models.

Figures 7. Comparison between a 25 mm wide mesh and a 50 mm wide mesh load-deflection curves of the studied reinforced concrete continuous deep beams.
### 3.2 diagonal cracking and failure mode

From observing the forms of failure and cracks that appeared by using the program, it was found that the patterns of cracks in this shape indicate that the deep beam fail in the same way. Although the crack patterns presented in Figures 8. are in a distorted form, it can be seen that the total crack patterns obtained through finite element analysis exactly match the total crack patterns obtained through the laboratory when examining the models with Note the test indicating that the applied load has reached a peak. Immediately before failure, the two spans exhibited roughly the same cracking patterns. Cracking pattern development was significantly influenced by both the $a/h$ ratio and section depth. For $a/h = 0.5$, a first diagonal crack developed in the mid-depth of the concrete strut within the internal shear range, and that was followed by the first flexural failure in the sagging region immediately. As the load increased, more bending and diagonal cracks were formed and a diagonal crack expanded to join the load edges and intermediate support plates. A diagonal crack has occurred within the outer shear range near the failure load. For beams having $a/h = 1$, the first notch originated vertically in the hose region, followed by a diagonal notch in the inner shear band and then a vertical crack in the sag region. Rarely, diagonal fissures are developed within the outer shear range, showing different failure patterns than those observed in beams with $a/h = 0.5$. 

![Diagonal cracking and failure mode](image)

(A) Failure patterns and cracks (L5-40)  
(B) Failure patterns and cracks (L5-40)  
(C) Failure patterns and cracks (L5-60)  
(D) Failure patterns and cracks (L5-60)
4. Parametric Study

To conduct a parametric study, models that were studied using the numerical analysis software and validated above were used in order to further investigate the effect of a number of critical parameters that were not investigated in the experimental test that was implemented by Yang et al. [8] By this results that could be useful to designers and engineers and bridging the knowledge gap that currently exists in this research area. These parameters include the support conditions, as well as the location of the internal in mid support settlement and the edge support settlement by using spring stiffness.

4.1 The influence of support conditions on the behavior of the continuous deep beam

Figure 8. Failure patterns and cracks in L-series deep beam and comparison with failure patterns in the laboratory
In order to obtain and develop a parametric study to investigate the performance of deep span beams. The beams (L10-40, L10-60 and L10-72) were chosen as a typical model for numerical results as in this study the height was gradually increased from 400 mm to 720 mm. These beams are under different combinations of support conditions as tested by Yang et al. [8] Results from the laboratory, with two external roller and an internal hinge (RHR), were considered to simulate and examine the effects of the following three different groups of support conditions on their structural behaviors:

- **Hinged-Roller-Hinged** support set—H.R.H (two exterior hinged supports; interior roller support)
- **Hinged-Hinged-Hinged** support set—H.H.H (all three supports are hinged)
- **Hinged-Roller-Roller** support set—H.R.R (exterior hinged support; interior roller support, exterior Roller supports)

The effect of support conditions on the behavior of samples ((L10-40), (L10-60), (L10-72)) was examined numerically by changing the types of R.H.R test support to H.R.R support, H.R.H support and H.H.H support. The simulated performance numerically for (L10-40, L10-60, L10-72) samples is shown in **Figure 9**.

**Figure 9.** Responses of samples (L10-40, L10-60, L10-72) with three different sets of support conditions: Experimental (R.H.R, [8]) and numerical Load-deflection curves for samples (L10-40, L10-60, L10-72)
Figure 9 show that samples for continuous deep beams ((L10-40), (L10-60), (L10-72)) with three different sets of support conditions for each type of deep beam, support conditions reached in the case of HHH or RH has a higher load capacity and has greater rigidity than in experiment with RHR or HRR support conditions. The numbers also demonstrate that the numerical behaviors of the samples with any of the three numerical support groups were nearly identical. As summarized in Table 3, for cases of HRH, HRR and H.H.H support groups.

Through the results obtained through numerical analysis using different support conditions, the parametric study used the RC deep beam sample (L10-40) as a main model for the condition (H.H.H, H.R.R) and reached a full load of 1116 kN with an equal deflection of 1.106 mm. This represents a 54% increase in the total numerical load compared to the experimental total load of 724 kN, and a 15% decrease in numerical deviation compared to the experimental deflection of 1.3 mm. For the case of the support group (R.H.R, H.R.R), the samples reached a total load of (703,664) kN accompanied by a numerical deviation of (0.85, 0.79) mm. This represents a 2% reduction in the total numerical load compared to the total test load of 724 kN, and a 34% decrease in numerical aberration compared to the test deviation of 1.3 mm, and it can be concluded that when restricting samples using any combination of numerical support types of HRH or HHH , The beam became stiffer and stronger. The identical numerical behavior in terms of strength, stiffness and ductility comparison data was summarized in Table 3.

Table 3. Summary of the result of the parametric study

| Sample | Support condition | Numerical result | Experimental result | Ratio |
|--------|-------------------|------------------|---------------------|-------|
|        |                   | Total Load $P_{FE}$ KN | MidSpan Deflection $\Delta_{FE}$ mm | Total Load $P_{Exp}$ KN | MidSpan Deflection $\Delta_{Exp}$ mm | $P_{FE}/P_{Exp}$ | $\Delta_{FE}/\Delta_{Exp}$ |
| L 10 – 40 | R.H.R            | 703              | 0.85                | 724              | 1.3                  | 0.97             | 0.65            |
|          | H.R.R            | 664              | 0.79                |                    |                      | 0.92             | 0.6             |
|          | H.R.H            | 1116             | 1.106               | 1116             | 1.106               | 1.54             | 0.85            |
|          | H.H.H            | 1116             | 1.106               |                    |                      | 1.54             | 0.85            |
| L 10 – 60 | R.H.R            | 908              | 1.14                |                    |                      | 1.02             | 0.712          |
|          | H.R.R            | 936              | 1.19                | 883              | 1.6                  | 1.06             | 0.74            |
|          | H.R.H            | 1205             | 1.17                | 1205             | 1.17                 | 1.36             | 0.73            |
|          | H.H.H            | 1205             | 1.17                |                    |                      | 1.36             | 0.73            |
| L 10 – 72 | R.H.R            | 995              | 1.53                |                    |                      | 0.98             | 0.55            |
|          | H.R.R            | 1040             | 1.4                 | 1008             | 2.1                  | 1.03             | 0.66            |
|          | H.R.H            | 1341             | 2.75                | 1341             | 2.74                 | 1.33             | 1.3             |
|          | H.H.H            | 1341             | 2.74                |                    |                      | 1.33             | 1.3             |

Hint: R.H.R: Roller-Hinged-Roller support set; H.R.H: Hinged-Roller-Hinged support set; H.H.H: Hinged-Hinged-Hinged support set; H.R.R: Hinged-Roller- Roller support set; Mid-span deflection at total load.
4.3. The Support Settlement Effect Of Samples (L5-40, L10-40)

The effect Support Settlement on behavior of samples (L5-40, L10-40) was examined numerically by changing the position of Support Settlement. The test location for the mid support as well as for the external support. Simulated performance numerically for samples (L5-40, L10-40) are shown in Figure 10.

Figures 10. Responses of samples (L5-40, L10-40) with different k Stiffness sets of support Settlement The test location for the mid support as well as for the external support: Experimental (R.H.R, [8]) and Load curves of numerical deviation of samples (L5-40, L10-40)

Figures 10 show that samples (L5-40, L10-40) with Support Settlement, when the differential settlement location at mid of support of sample (L5-40) It is seen that the load capacity increases nearby 6% and increases deflection by about 60% when increases the value of K stiffness from 50 KN/mm to 200 KN/mm It is seen that the load ultimate capacity increases and decreases deflection .when the differential settlement location at external edges of support of sample (L5-40) It is seen that the load capacity decreases by about 6% and increases deflection by about 60% when increases the value of K stiffness from 50 KN/mm to 200 KN/mm It is seen that the load capacity increases and decreases deflection .when the differential settlement location at mid of support of sample (L10-40) It is seen that the load ultimate capacity increases by about 28 % and decreases deflection by about 70% when increases the value of K stiffness from 50 KN/mm to 200 KN/mm It is seen that the load ultimate capacity increases and decreases deflection .when the differential settlement location at external edges of support of sample (L10-40) It is seen that the load ultimate capacity increases by
about 14% and decreases deflection by about 10% when increases the value of K stiffness from 50 KN/mm to 200 KN/mm. It is seen that the load ultimate capacity increases and decreases deflection.

5. Conclusions

1. The results of the continuous reinforced concrete deep beam experiment and FEM analysis by ANSYS 2020 were in very good agreement. The mean experimental ratios of the expected values of the final load equal to 0.946.

2. ANSYS 2020 can monitor and represent the shape and spread of cracks during loading to failure. Diagnosis of failure patterns for all beams by finite element corresponds well to experimental observations.

3. Numerical FE model was developed and verified, for the simulation of the performance of two continuous reinforced deep beam samples with different height and with two rollers and a hinged support. The model numerically predicted total load strengths and deflections that were nearly identical to the values of the test outcomes.

4. The study was dealing with the scope of numerical simulation to obtain an exploration of the effect of different groups of support conditions on the performance of test samples using the numerical model that was developed in the first task. Three different sets of support conditions were considered in each of the three test specimens listed above: the support case sets with hinged roller hinges (H.R.H), hinged hinged hinged support case (H.H.H), and the support case sets with hinged roller roller (H.R.R).

5. Increasing the shear span to the total height reduces the final load capacity. More specifically, increasing the shear span to depth (a / h) by about 0% to 100% reduces the final capacitance of the deep beam load by about 100%.

6. When increases the value of K stiffness from 50 KN/mm to 200 KN/mm. It is seen that the load capacity increases and decreases deflection depend on location of differential settlement.

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