ANALYSIS OF STEEL SLAB BASE AND GUSSETED BASE FOR ECONOMY

[1]**Mr. Abdul Mobin Abdul Khalik Ansari** , [2]**Mr. Asjad Fazal Balbale** ,
[3]**Mr. Shubham Santosh Ghadigaonkar** , [4]**Mr. Vaishnav Anant Goregaonkar.**
[1]Undergraduate, [2]Undergraduate, [3]Undergraduate, [4]Undergraduate
[1]Civil engineering department,
[1]Anjuman-I-Islam Kalsekar Technical Campus, Mumbai, India

Abstract*— *Steel Column Bases are widely used in steel construction for relatively all columns. Column bases are often used in steel building, providing economical solutions under various loading conditions. Depending upon the loading conditions, the steel column bases are classified as slab base and gusseted slab base. However, both the column bases are proved to be economical based on the loading conditions. The ultimate capacity of column bases mainly depends on the local behavior of the components, the global behavior of the column as well as the internal forces in the connecting elements. Mainly while considering designing of both column bases the designing procedure is same, as mentioned in I.S. 800-2007 and it's observed that the selection of the column base plate depends upon the intensity of load, thickness of the base plate and economy. Many research and study has been made from past long years on column bases referring various parameters to make them more durable, capable enough to withstand heavy loads and economical. As per structure requirement an engineer have to select any one of these two i.e. either gusseted base or slab base. By referring all the literatures and research it has been found that, till date there has not been a specified range of loading which defines the shuffling of column bases based on economy.

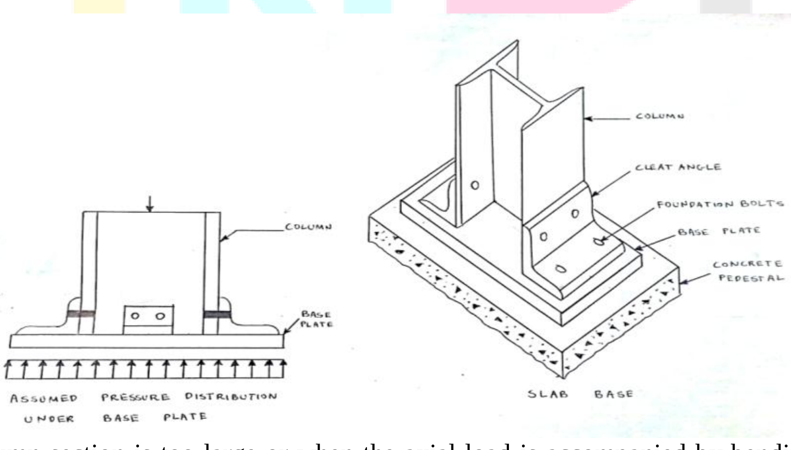
Index Terms*—*Slab base, Gusseted base, Steel structure.

I. INTRODUCTION

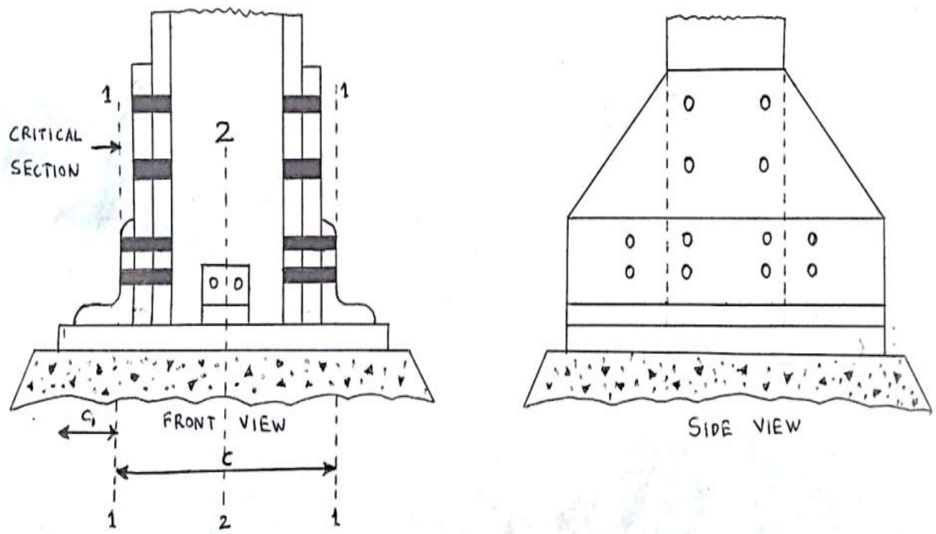
Column bases are structural elements used in the design of steel structures to transfer the column load to the footings. Steel columns are normally supported over concrete blocks. However, when the loads supported by these columns, are large and the bearing pressure of concrete from below is insufficient to resist the loads, they may fail. Therefore, it is a normal practice to distribute the column loads to steel base plates which are placed over these concrete blocks. A base plate also maintains the alignment of column in plan, verticality of the column and controls the column and frame deflections. In the column bases, intensity of pressure on concrete block is assumed to be uniform. The column bases shall be of adequate strength, stiffness and area to spread the load upon the concrete, masonry, other foundation or other supports without exceeding the allowable stress on such foundation under any combination of the load and bending moments. The main problems in the design of the column base are to determine the size of the plates and their thicknesses. The size is determined by the required bearing area on foundation; and the required thickness by the excess overhang.

Depending upon loading conditions and to achieve economy the column bases are classified into two types, viz. Slab base and Gusseted slab base.

Slab bases are used where the columns have independent concrete pedestals and when the column is subjected to only direct loads of less intensity and no bending moment. Along with thick steel base plate there are also two cleat angles, which connects the flanges of the column to the base plate. In addition to these, web cleats are provided to connect the web of the column to the base plate and to guard against the possible dislocation of the column during erection. The ends of the column and also the base plate should be mechanized so that the column load is entirely transferred to the base plate.



Whereas, when the load on the column section is too large or when the axial load is accompanied by bending moments, usually a **Gusset base** is provided. A gusseted base consists of a base plate of reduced thickness, two gusset plates and cleat angles are placed on column flanges. The gusset plates and angles are placed on flanges with no. of bolts, or a couple of welded gusset bases used commonly for moderate loads. Gusset materials used in the base supports the base plate against bending along with increasing the bearing area and thereby consequently reducing the thickness of the base plate as compared to the slab base. This type of base may be considered to be rigid.



The function and purpose of column base plates are to provide a spread and distribution of column loads from the steel column to the concrete footing. In short, the base plate acts as an intermediate stress distributor. When the column load contains a moment, the base plate may require to design in such a way that to ensure uplift of the base plate does not occur, and which will be achieved by designing anchor bolts to resist the tensile forces.

II. LITERATURE REVIEW

Since past many years, research and studies has been done on steel column bases such as, when load is applied with a wide flange column, the area between the column flanges is often subjected to bending. For lightly loaded columns, the required plate dimensions are approximately equal to or smaller than the overall cross-sectional dimensions of the column, (Fling R.S. 1970). The author proposed the use of yield line theory and provided an equation that could calculate the minimum thickness of the base plate. It was also assumed that only the H-shaped portion of the base plate under the column was effective, (Stockwell, F.W.1975).

Further a graphic approach to design was presented by the author Bird, W.R. (1976), which provides rapid and accurate solutions for the design of steel bearing plates that could be expanded to cover all column sections and loading conditions. The experimental and analytical studies on axially loaded column were performed. The test results were compared with the allowable bearing stresses estimated from the AISC Specification. It was found that AISC Specification was conservative and a large factor of safety is more safe and desirable for the design of base plates than for beams and columns. Later a graphical aid for the design of base plates subjected to moments was provided. A triangular shape was assumed for the bearing stress distribution under the base plate, (DeWolf J.T. , Maitra N. 1978). The design aid is included in the AISC Design Guide No. 1 (DeWolf and Ricker, 1990).

Experiments were conducted to study the behavior of base plates under the action of axial loads and moments by eccentric loading on the column. And it was found that at the lowest eccentricity, cracking of the concrete controlled the failure, while at other eccentricities the primary failure mode was yielding of the base plate (Thambiratnam, D.P, Paramasivam, P. 1986). The factor of safety of the specimens that failed by yielding of the base plate, ranged from (1.09 to 1.89).Futher an experimental study was conducted to determine the value of the rigidity ratio at the column base (GL) and founded that the flexural stiffness of an exposed-type column base connection, which was generally considered as pinned condition, had a very beneficial effect on column stability and frame response, also the calculated column strength could be increased by up to 30% due to the change in the rigidity ratio. (Picard. et al. 1987). Larger base plate planar dimensions and the increase of the anchor rod size led to a slight increase in connection stiffness and some mild increase in moment capacity (Hon.et.al. 1988).A mathematical model, which determines the ultimate limit strength (ULS) of a column base connection, based on the limit analysis method was developed and comparison with experimental results was made for "fixed" and "pinned" connection cases. (Penserini, P & Colson, A. 1989).

Later on many computer aided programs and FEM (Finite Element Analysis) Models were also developed for analysis and design of steel column bases. Three-dimensional finite element analysis was carried out on exposed-type column base plate connections under column axial loads and moments, with the help of a special purpose analysis program, FEABOC (Finite Element Analysis of Bolted Connections) and was found that FEABOC was far good at bringing out the effective results than the classical analytical methods (Thambiratnam, D.P., et .al. 1989). Effects of different base plate thicknesses and load eccentricities were investigated using a two-dimensional linear elastic finite element analysis tool. And it was found that the finite element method could be a powerful tool for the study of column base plates under various loading conditions and for the development of more realistic design methods, (Krishnamurthy, N. & Thambiratnam, D. P. 1990).A computer program named ROMB 96 (Rotation and Moment at the column Base) was developed based on the factors that could significantly affect the connection deformation capacity in the post-elastic range (i.e. instability and strain hardening effects), (Balnut, N. & Moldovan, A. 1997). An iterative numerical method for solving frictional contact between a loaded elastic body (column) and a rigid obstacle (column base plate) was presented, which was illustrated by means of a numerical example of a two-dimensional finite element model of a column base connection, (Kontoleon M.J. & Baniotopoulos, C. C. 2000).

After studying above Literature review it's found that very less research work has been done on column bases using IS code 800:2007. A need for proper constraints for selecting the type of column bases was felt. There is not any defined or specific range of loading to select the Slab base or Gusseted Slab base by considering Economy. This unclear situation to decide the parameters for selecting either gusseted base or slab base is attempted to solve through this project.

III.REFERENCE

[1] Bird, W. R. (1976). "Rapid Selection of Column Base Plates",*Engineering Journal*, AISC,Volume 13, No. 2, Second Quarter, pp. 43-47.

[2] Balut, N. and Moldovan, A. (1997). "A Model for the Behavior of Column Base Connections", *Proceedings of the Second Conference STESSA*, Kyoto, Japan.

[3] DeWolf, J. T. (1978). "Axially Loaded Column Base Plates",*Journal of the Structural Division,*ASCE, Vol. 104, No. ST5, May, pp. 781-794.

[4] Duggal, S.K., "Limit State Design Of Steel Structures", McGraw Hill Education Pvt. Ltd., New Delhi, India.

[5] Fling R. S. (1970). "Design of Steel Bearing Plates",*Engineering Journal*, AISC, Vol. 7, April,pp. 37-40.

[6] Hon, K.K. and Melchers, R.E. (1988). "Experimental Behavior of Steel Column Bases" *Journal of Constructional Steel Research*, Vol. 9, Paper No. 143, pp. 35-50.

[7] Indian Standard Code IS 800-2007, Bureau of Indian Standards, New Delhi, 110002, India.

[8] Kontoleon, M. J., and Baniotopoulos, C. C., (2000). "Computational Aspects on the Frictional Unilateral Contact Problem Arising on Steel Base Plate Connections",*Computers and Structures*, Vol. 78, pp. 303-309.

[9] Krishnamurthy, N. and Thambiratnam, D. P. (1990). "Finite Element Analysis of Column BasePlates",*Computers and Structures*, Vol. 34, No. 2, pp. 215-223

[10] Maitra, N. (1978). "Graphical Aid for Design of Base Plate Subjected to Moment",*EngineeringJournal*, AISC, Vol. 15, No. 2, Second Quarter, pp. 50-53.

[11] Penserini, P. and Colson, A. (1989). "Ultimate Limit Strength of Column-Base Connections", *Journal of Constructional Steel Research*, Vol. 14, pp. 301-320.

[12] Picard, A., Beaulieu, D., and Perusse, B. (1987). "Rotational Restraint of a Simple Column Base Connection," *Canadian Journal of Civil Engineering*, Vol. 14, pp. 49-57.

[13] Stockwell, F. W. Jr. (1975). "Preliminary Base Plate Selection",*Engineering Journal*, AISC,Vol. 12, No. 3, Third Quarter, pp. 92-99.

[14] Thambiratnam, D. P. and Paramasivam, P. (1986). "Base Plates under Axial Loads andMoments",*Journal of Structural Engineering*, ASCE, Vol. 112, No. 5, pp. 1166-1181.

[15] Thambiratnam, D. P. and Krishnamurthy N. (1989). "Computer Analysis of Column Base Plates," *Computers and Structures*, Vol. 33, No. 3, pp. 839-850.