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Valuation of Steel Column Base- A Economical Case Study (under IS code 800-1984)

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CASE STUDY

Introduction

Steel column base consist of I- steel beam, stands vertically with cover plate and base with steel bearing plate, resting on concrete block as foundation. Steel column base is laterally supported with cleat and Web angle.

Steel column base is used as column base on which truss rests and truss roof covering is used as shade for railway station, bus stand, workshops and industry where large open area with shade in required. The valuation exists with cost and economy exists with least cost. As per the design of steel column base, the I-section, cleat angle, web angle and nut bolt costs remain same, but change depends on bearing plate size of square or rectangular shape. Also the least size of concrete block sets economy.

The steel column bearing steel base plate in volumetric way as well as the volume of concrete block decide the cost for economical valuation.

To cope with the technical title of paper, an illustration assuming data for column base has been made with its comparative study in tabulated form.

Illustration-A steel column ISMB-300 has been used for setting economy to bear axially load of 600KN fb=185N/mm^2, fCC =5N/mm^2, fsoil=1.8N/mm^2.

Solution: - Area of bearing plate=$\frac{\text{load}}{\text{stress}}$ =$\frac{600000}{5}$ =120000mm^2

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For square plate	For rectangular plate
1. Area of plate=120000mm^2 2. Size of plate=$\sqrt{120000}$=347mm=347mm 3. Actual area=347x347=120409mm^2 4. Incoming pressure intensity of bearing Plate w=$\frac{600000}{120409}$=4.98N/mm^2 5. Thickness of plate t=[$\sqrt{\frac{3w}{fb}}(A^2-\frac{B^2}{4})$ Here A=$\frac{347-140}{2}$=103.5=104mm B=$\frac{347-300}{2}$=24mm, t=29.3=30mm 6. Plate complete size=347x347x30mm 7. Volume of steel plate=3612270mm^3	1. Area of plate=120000mm^2 2. Area of plate=(300+2a)(140+2a)=120000 a=68mm Size of plate=436x276mm=120336 mm^2 3. w=$\frac{600000}{120336}$=4.98N/mm^2 4. t=$\sqrt{\frac{3w}{fb}}(A^2-\frac{B^2}{4})$ A=$\frac{436-300}{2}$=68mm B=$\frac{28\backslash 76-140}{2}$=68mm t=16.73=17=18mm 5. Bearing plate size=436x276x18mm 6. Volume of bearing plate=2166048mm^3

Steel saving by rectangular plate size=$\frac{3612270-2166048}{3612270}$X100=40%

8. Incoming load on foundation=600+60=660KN 9. Required area of concrete block=$\frac{660000}{1.8}$=366666.67 mm^2 10. Area=606mmx606mm 11. Thickness=$\frac{606-350}{2}$=128mm 12. Volume of concrete block=606x606x128=47006208mm^3 A cost saving in rectangular concrete=$\frac{59867292-47006028}{47006028}X100=27.36\%$ 13. Cost of concrete block=47006208/- 14. Cost of steel=3612270x60=216736200/- 15. Total cost=263742408/-	7. Incoming load=660KN 8. Area required=366666.67mm^2 Ratio of plate size=436:276=1.58:1 9. Size of concrete block=762mmx482mm 10. Thickness=163mm 11. Volume=59867292mm^3 12. Cost of concrete=59867292/- 13. Cost of steel=2166048x60=129962880/- 14. Total cost=189830172/-

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Percentage saving by Rectangular steel column base=$\frac{263742408-189830172}{263742408}$x100=28%

Another case study

Illustration 2-A steel column ISMB-300 has been used for setting economy to bear axially load of 700KN.The cover plates of size 320x16mm have been fixed with column flange fb=185N/mm^2, fCC=4.4N/mm^2, fsoil=1.8N/mm^2.

Area of bearing plate=$\frac{load}{stress}$ =$\frac{700000}{4.4}$ =159090.90mm^2=160000mm^2

For square plate	**For rectangular plate**
1.Size of plate=400mmx400mm Area of plate=160000mm^2 2. Actual pressure intensity of bearing Plate w=$\frac{700000}{160000}$=4.375N/mm^2 3. Thickness of bearing plate t=$\sqrt{\frac{3w}{fb}}(A^2-\frac{B^2}{4})$ Here A=$\frac{400-320}{2}$=40mm B=$\frac{400-(300+2x16)}{2}$=34mm See fig 7.14 t=10mm 4. Plate complete size=400x400x10mm 5. Volume of steel plate=1600000mm^3	1.Size of plate=395mmx407mm 2. w=$\frac{700000}{390x410}$=4.35N/mm^2 3. t=$\sqrt{\frac{3w}{fb}}(A^2-\frac{B^2}{4})$ A=B=$\frac{395-320}{2}$=37.5mm OR $\frac{407-332}{2}$=37.5mm See fig t=9 mm 4. Bearing plate size=395x407x9=1446885mm^3 5. Volume of bearing plate=1446885mm^3 6.Steel saving=9.57%
6. Concrete block size=$\frac{770000}{1.8}$=427777.8mm^2 Size=654mm=655mmx655mm 7. Depth of concrete block=$\frac{655-400}{2}$=128mm 8. Size=655x655x128mm 9. Valuation Steel=1600000x60=96000000/- 10. Cost of concrete block=54915200/- Concrete saving=$\frac{55331325-54915200}{54915200}$x100=0.75% 11. Total cost=150915200/-	6.concrete block size=$\frac{770000}{1.8}$=427777.8mm^2 Size of concrete block=645mmx665mm 7.Depth of concrete block=$\frac{645-395}{2}$=125mm or $\frac{665-407}{2}$ =129mm 8. Size=645x665x129mm 9. Valuation Steel=1446885x60=86813100/- 10. Cost of concrete block=55331325/-11.Total cost=142144425/- Saving=$\frac{150915200-142144425}{150915200}$x100=5.8%

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CONCLUSION

The case study-1 reveals that using of rectangular steel bearing plate in steel column base will save the cost by 35 to 40% with respect to square bearing plate. Though rectangular concrete block increased cost by 27% in this case however overall cost of rectangular steel column base has been saved cost by 28% by the illustrated condition.

In case study-2, steel saving by using rectangular plate remains 9.57% and concrete increasing cost by 0.75% exists with rectangular concrete block. Again total saving of cost in rectangular column base exist by 28%.Hence its concluded that rectangular size column base is economical over square column base. So it is recommended to use rectangular steel column base in place of square column base to set economy roughly by 28%. So the merger of steel structure designing is allowed to use rectangular steel column base to set economy while valuating the structure.

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