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Design and Analysis of Hollow Triangular Foundation

Sanket Bagal
UG Students,
Department of Civil Engineering,
SND College of Engineering & Research Center, Babhulgaon,
Yeola, Nashik, Maharashtra, India.

Paritosh Dandwate
UG Students,
Department of Civil Engineering,
SND College of Engineering & Research Center, Babhulgaon,
Yeola, Nashik, Maharashtra, India.

Amol Pawar
UG Students,
Department of Civil Engineering,
SND College of Engineering & Research Center, Babhulgaon,
Yeola, Nashik, Maharashtra, India.

Gaurav Taralkar
UG Students,
Department of Civil Engineering,
SND College of Engineering & Research Center,
Babhulgaon, Yeola, Nashik, Maharashtra, India.

Prof. Kasliwal.S.S
Assistant Professor,
Department of Civil Engineering,
SND College of Engineering & Research Center,
Babhulgaon, Yeola, Nashik, Maharashtra, India.

ABSTRACT:
In this paper, we have designed and analyzed the "Hollow triangular foundation" by analytically (manually) and by using software STAAD PROV8i. Hollow triangular foundation selected according to the load distribution mechanism .This load is distributed in between 40^0 to60^0 so that we assume 45^0 plane of failure. In our footing structure we had provided the Steel and concrete only along this 45^0 plane.It will help to reduce the excess concrete used outside of the failure plane and also from interior of the footing .So that it saves concrete up to 33.27% hence it reduces self-weight of footing .This footing will help us to study the load distribution.

Keywords:
Hollow Triangular Foundation, Sloped footing, Flexural member, Ground beam, Load, Reinforcement.

1. INTRODUCTION:
The Foundation whose geometry is selected based on actual load distribution mechanism and also in which hollow portion is provided is called as hollow triangular foundation. Hollow triangular foundation is a new concept in a structural design. The load distribution is a inclined fashion this angle may varies 40 to 60^0. Hence we have selected the failure plane along 45^0,as load is distrusted in inclined fission so we provide steel and concrete only along this plane.

In our footing we have divided the whole footing in three parts,
1) Inclined Slab.
2) Beam below the inclined Slab.
3) Ground resting Beam.

The load from the column is distributed through the inclined slab from slab it is transfer to beam and from this beam load is transmitted to the ground resting beam. From beam load is finally given to the underground soil. As concrete and steel only along inclined plane so that extra outside portion of concrete and middle concrete part is removed .Hence economical construction of footing is achieved.

2. LITERATURE REVIEW:
Dr. Pusadkar Sunil Shaligram .(2011)[1]He carried out work on shell strip footing situated on reinforced layer sand .Shell footings are economical in terms of material compared with conventional footing. The performance of weak soil is improved by geo synthetic material at proper position below the footing Shaikh Mohmad Ahmed(2015)[2]

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In this paper he carried out work on shell foundation. This foundation is suitable where heavy super structural load to be transmitted on weaker soil. M. Ramesh (2015)[3]In this research paper he carried out experimental study on conical shell footing. The shell footing are capable of supporting higher vertical loads ,better load settlement characteristic .The conical shell footing with peak angle 90^0 to 126.88^0 is casted and model test is carried out.

3. METHODOLOGY:

ANALYSIS AND DESIGN OF HOLOW TRIANGULAR FOUNDATION:

According to limit state method theory, in a hollow triangular foundation three type of loads are acting Which are Self weight ,Axial load ,Upward soil pressure while considering axial load some torsion moment is also taken into consideration in a inclined slab of footing the check for bending is provided by us. Incase of beam below slab, we had given the check for shear and torsion for additional reinforcement are provided,

1) Pu=ultimate axial load in KN
2) Tu= torsional moment in KN/m
3) Pu upward =upward soil pressure in KN/m^2.

Assumption of data,

1) Load on column Pu=1000KN
2) Size of column =300x300m
3) Size of footing =1.2x1.2m
4) Depth of footing below ground =1.2m

Problem Statement:

Design of hollow triangular foundation for a column of sixe 300x300mm carrying 1000KN of Ultimate load with self-bearing capacity 250KN/m^2 and having M20 grade of concrete and Fe 415 steel use for construction.

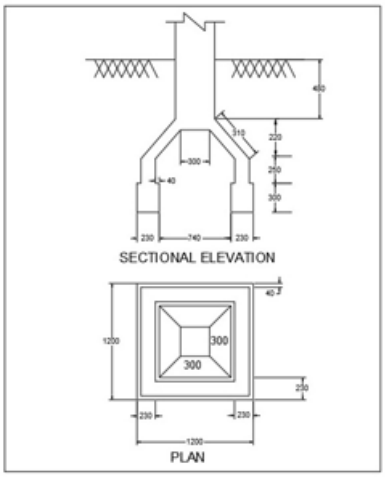

Fig 1:-Components in loading diagram

Step I:-Design of Inclined Slab:

We consider the incline slab as fixed support trapezoidal slab. Thought it is trapezoidal we consider it as purely rectangular slab. We have design the slab by limit state method by considering Dead Load & Uplift Soil pressure .we had given check for bending, we get following result.

Ultimate Moment	10.38KN.m
Ultimate Shear force	100KN
Main Steel	100mm#@95mm c/c (4nos)
Distribution Steel	8mm#@275mm c/c (5nos)

Step II:-Design of Beam supporting slab:

We had also, design the beam which support the slab, we had design the beam for shear and torsion and we get following result,

Ultimate Moment	2.5KN.m
Ultimate Shear force	4.5KN
Main Steel	5-12mm# bar
Anchor bar	2-12mm # bar
Shear R/F	8mm# 2 legged stirrups @220mm c/c

Step III:-Design of Ground Resting Beam :

We had also design the ground resting beam this beam is design for upward soil pressure and for axial load from above beam .we had also given check for upward soil pressure .we get following result

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Ultimate Moment	20.84KN.m
Ultimate Shear force	21.47KN
Main Steel	4-12mm# bar
Anchor bar	2-12mm # bar
Shear R/F	8mm# 2 legged stirrups @225mm c/c

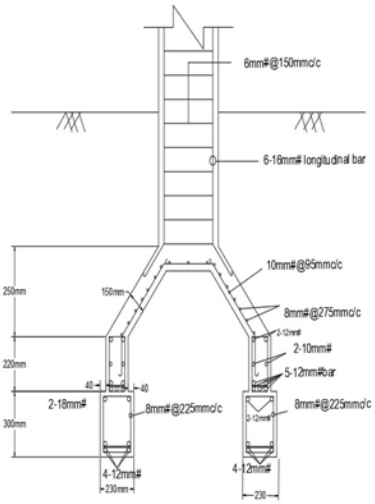

Figure 2:-R/F details of hollow triangular foundation.

Comparative Analysis of Hollow Triangular Foundation:

For the analysis of hollow triangular foundation structure, we have design one footing by analytically and software (STAAD-Pro)

[A] STAAD –Pro results:

1) Design of Incline Slab

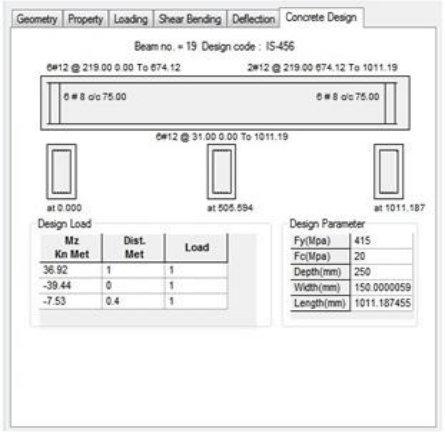

Figure 3 :-R/F details of incline slab

[2] Design of Beam Supporting Slab:

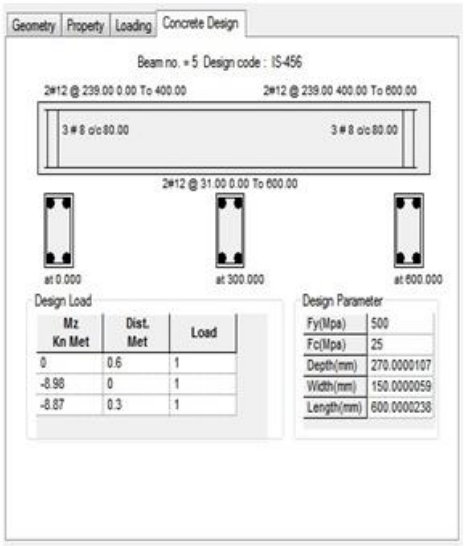

Figure 4:-R/f detail of Beam Supporting Slab

[3]Design of Ground Resting Beam:

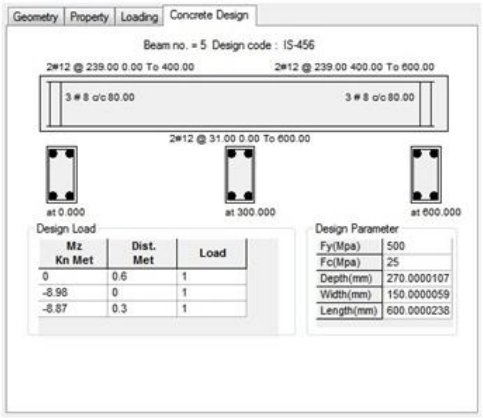

Figure 4:-R/F details of Ground Resting Beam

4.Comparison between Manual & Software Analysis:

[A] Software Result:

Member	Main Steel	Anchor Bar	Shear R/F
Incline slab	5-10MM#	5-8MM#(dist.steel)	----------
Beam below slab	2-12mm#	2-12mm#	2#8mm@80 mmc/c
Ground resting beam	2-12mm#	2-12mm#	2#8mm@80 mmc/c

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Member	Moment (KN.m)	Shear Force(KN)
Incline slab	39.40	75.89
Beam below slab	8.98	166.08
Ground resting beam	8.98	25.58

[B]Manual Result:

Member	Main Steel	Anchor Bar	Shear R/F
Incline slab	4-10MM#	5-8MM#(dist.steel)	----------
Beam below slab	5-12mm#	2-12mm#	2#8mm@225mm c/c
Ground resting beam	4-12mm#	2-12mm#	2#8mm@220mm c/c

Member	Moment (KN.m)	Shear Force (KN)
Incline slab	10.38	100
Beam below slab	2	4.5
Ground resting beam	20.84	21.47

4. CONCLUSION:

Through this paper, following conclusions are drawn.

1. The result obtained by manual design and software design are varying ,so modification is dimension of footing is required.
2. It gives clear idea about load distribution in footing.
3. Crack pattern are easily studied by Hollow Triangular Footing.
4. As this a new concept and not enough Data is available on this topic , we just carried out small part of it Further work may be done in future on this topic .

5. ACKNOWLEDGEMENT:

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6. REFERENCES:

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[4] Campione & F Cannela (2017) "Simplified Model for Compressive response of RC column footing with various cross sections."

[5] IS:456-2000 Code of Practice for design of reinforced Structure.