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PLANNING AND ANALYSIS OF IRRIGATION TUNNEL

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Abstract - *The paper deals with the planning and analysis of airrigation tunnel. The tunnel is designed in D shape. D shape resembles like rectangular shape in the bottom portion called benching and the semicircular shape in the top portion called heading.*

The tunnel is laid in rock surface is about 10Kms. The width of the tunnel is 6.5m and the height of the tunnel is 7.15m. The sequence of the project that we followed are estimation of water quantity discharge, arrival of cross section, analysis of cross section, design of cross section, rate analysis of tunnel cross section. The drawing plan is done using AutoCAD software.

The analysis is carried out using Staad pro software. Staad pro analysis is mainly used to evaluate load. Design procedure is done as per IS codes.

Keywords:Irrigation tunnel, AutoCAD plan, staad pro analysis, rate analysis.

1.INTRODUCTION *(Size 11 , cambria font)*

Tunnel can be defined as underground passages made without removing the overlying rock or soil. It serves as many functions – Highway, Rail road or rapid transit artery; pedestrian passage way, fresh water conveyance, cooling water supply, waste water collector, underground storage or transport, hydro power generator, utility corridor etc. A tunnel can be located in any of a variety of places – under mountains, cities, rivers, lakes, sea estuaries, straits, or bays.

A tunnel is constructed in one of innumerable media-soft ground, mixed face, rock, and uniform, jumbled, layered, dry, wet, stable, flowing, and squeezing.

1.1. *SCOPE AND OBJECTIVE*

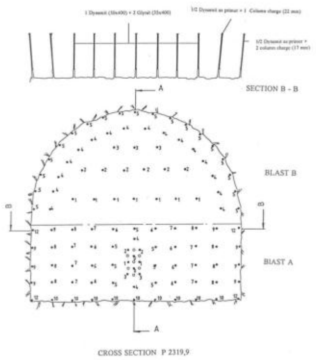
The ultimate objective is

- To analyze and design the irrigation tunnel that provides water for drought areas.
- To use AutoCAD and Staad pro software effectively to design and analyze the various components of the tunnel and also by manual design.
- To learn the staad pro Software.
- To learn the AutoCAD software.
- To perform a job in a challenging environment for better achievement.

1.2. *Drilling patterns*

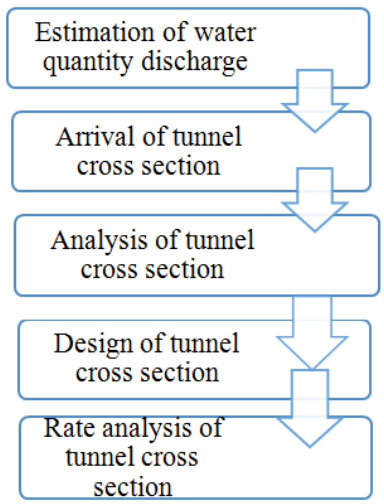
- Horizontal wedge cut
- Pyramid cut
- Fan cut
- V cut

Among the various above drilling Patterns we adopted V cut drilling pattern for our analysis purpose.



1.3 Methodology

The following are the works to be done in this project.



2.PLAN

2.1 Plan of tunnel

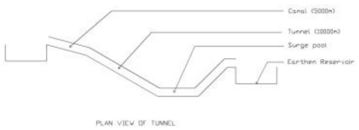


Fig 2.1. Plan view of tunnel

2.2. Cross section

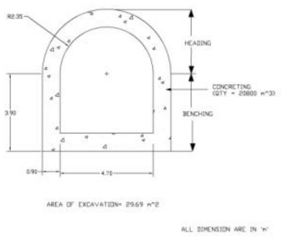


Fig 2.2 cross section

2.3. 3D view of tunnel

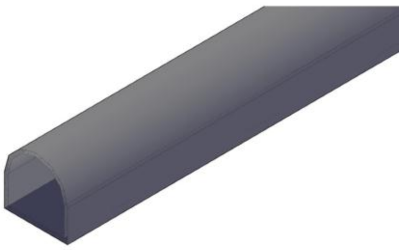


Fig 3.3. 3D view of tunnel

3.ESTIMATION DETAILS

3.1.ESTIMATION OF WATER QUANTITY DISCHARGE

Area of *excavation* = $(6.5 \times 3.9)+(\pi \times (2.35/2)^2)$
= $29.69\ m^2$
Area of water flowing = (4.7×3)
= $14.10\ m^2$
Discharge of water, Q = AV
Assume, V = 1.5 m/s
Q = 14.10 x 1.5
Q = $21.15\ m^3/s$

3.2.QUANTITY OF CONCRETING

Area of concreting = Area of excavation- Area of water flowing
= 29.69 – 14.10
= $15.59\ m^2$
Quantity of concreting
for 10km = 15.59 x 10000
= $155900\ m^3$

4. STAAD PRO ANALYSIS

Analysis is the process of determination of forces in the members of the structures due to external loads acting on it.

Load used

1. Dead load
2. Liveload
3. 1.5 (dead load+ live load)

Plate thickness used

1. Top roof 350mm
2. Side walls 250mm

Type of concrete used is M40 grade
Type of steel used is Fe500 tmt bar

4.1.Post processing results

The result output in graphical form is represented as below

4.1.1. Dead load:

The selfweight of the reinforced wall element is taken as dead load of slab and in addition the top layer and side layer of rock also considered for the study

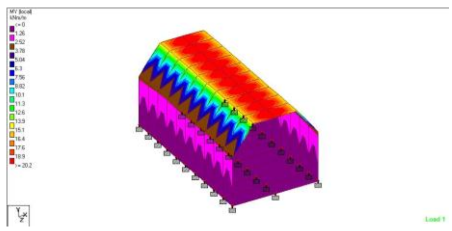


Fig 4.1.dead load

4.1.2. Max moment 1.5(DL+LL)

Factored combination load of 1.5(Dl+LL) is considered.

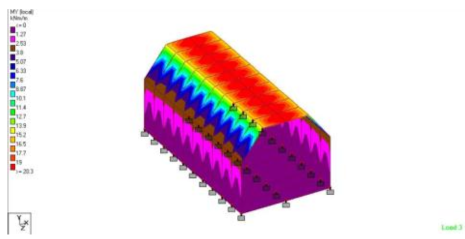
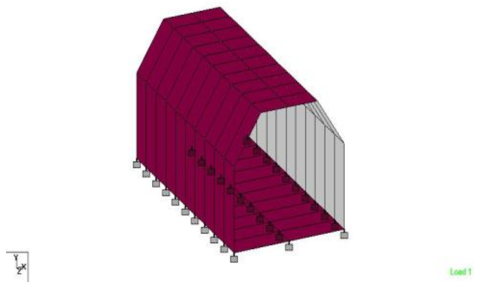


Fig 4.2.max moment

4.1.3.Live load

Load due to any movement at top of the tunnel or additional pressure caused by water is used for the live load.



4.1.4.Displacement

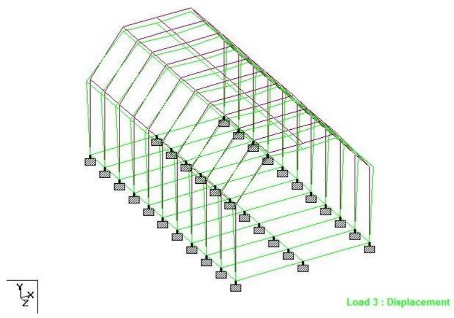


Fig 4.4. Displacement

4.1.5.Loading details of the baseslab in tunnel.

The portion of the slab is divided in to multiple portion and support condition is given for analysis

Node	L/C	Fy kN
1	3 COMBINATION LOAD CASE 3	82.348
2	3 COMBINATION LOAD CASE 3	82.348
5	3 COMBINATION LOAD CASE 3	82.346
6	3 COMBINATION LOAD CASE 3	82.346
37	3 COMBINATION LOAD CASE 3	142.517
38	3 COMBINATION LOAD CASE 3	144.553
39	3 COMBINATION LOAD CASE 3	144.467
40	3 COMBINATION LOAD CASE 3	144.459
41	3 COMBINATION LOAD CASE 3	144.452
42	3 COMBINATION LOAD CASE 3	144.459
43	3 COMBINATION LOAD CASE 3	144.467
44	3 COMBINATION LOAD CASE 3	144.553
45	3 COMBINATION LOAD CASE 3	142.519
46	3 COMBINATION LOAD CASE 3	142.517
47	3 COMBINATION LOAD CASE 3	144.553
48	3 COMBINATION LOAD CASE 3	144.467
49	3 COMBINATION LOAD CASE 3	144.459
50	3 COMBINATION LOAD CASE 3	144.453
51	3 COMBINATION LOAD CASE 3	144.459
52	3 COMBINATION LOAD CASE 3	144.467
53	3 COMBINATION LOAD CASE 3	144.553
54	3 COMBINATION LOAD CASE 3	142.519
55	3 COMBINATION LOAD CASE 3	35.911
56	3 COMBINATION LOAD CASE 3	35.911
84	3 COMBINATION LOAD CASE 3	71.822
85	3 COMBINATION LOAD CASE 3	71.822
86	3 COMBINATION LOAD CASE 3	71.822
87	3 COMBINATION LOAD CASE 3	71.822
88	3 COMBINATION LOAD CASE 3	71.822
89	3 COMBINATION LOAD CASE 3	71.822
90	3 COMBINATION LOAD CASE 3	71.822
91	3 COMBINATION LOAD CASE 3	71.822
92	3 COMBINATION LOAD CASE 3	71.822

144.553

Maximum shear force = -20.268kN

144.467

Minimum bending moment = -20.231kNm

144.459

5. RATE ANALYSIS OF TUNNEL

5.1. BASIC DETAILS

1	Cross Sectional Area =	14.1m^2
2	Average Pull / Cycle=	1.5m
3	Quantity / Blast =	14.1x1.5
4	No of Holes Drilled=	16 Holes
5	Avg Depth of Holes=	7'=2.1m
6	Drilling length/Cycle=	2.1mx16

5.2.Total Cycle Hours / Blast

No of Jack Hammers Used=	4 Nos
Drilling Time=	3hrs 45min
Blowing Time=	7min
Blasting material Loading & Blasting=	45min
Defuming=	44min
Primary Scaling=	16min
Mucking=	3hrs 49min
Secondary Scaling=	1hr 02min
Survey(Profile Marking)=	31min
Pipeline & Drilling Arrangement=	25min
Total Hours / Cycle	**11hrs 15min**

5.3.RATE DETAILS

S. No	DESCRIPTION	TOTAL RATE IN Rs.	RATE PER CUM IN Rs.
1	Man power(Drilling and Blasting)	10990	519.62
2	Explosives per blast	17560.7	830.29
3	Drill rods	731.80	34.6
POL			
4	Excavator{Tata hitachi}	1321.40	62.47
5	Compressor	2826.61	133.65
6	Tippers	499.432	23.61
7	Generators	3691.18 9	174.52
8	Jumbo	38.88	1.84
MACHINERIES			
9	Excavator{Tata hitachi}	2232.42	446.48
10	Compressor	456.75	91.35
11	Tippers	4063.50	135.45
12	Generators	579. 08	57.92
13	Jumbo 14.10m^2	894.16	149. 03
14	Jack hammers 1.5m	150.10	5
15	Ventilation	1127.41	225.48
16	Pipe lining	246.6	82.2
17	Dewatering	-	3
18	Dewatering pipeline	236.56	63.64
19	Miscellaneous	154. 04	51.35
TOTAL			3993.6 9

Total rate analysis per cum is Rs.3993.69/-

6.CONCLUSION

The conclusion of this paper are given as,

- All the drawings in this project were drafted using AutoCAD 2007 software.
- The analysis of irrigation tunnel is done by using Staad pro software.
- Using the staad pro software we learnt the load calculations and withstanding capability of the tunnel.
- The complete rate analysis of men, materials and machineries for this project was done according to the schedule of rates.
- And also the estimation of water quantity discharge and the quantity of concreting was done.
- From this project, the complete procedure for constructing the tunnel analytically was learnt. This has created a good awareness about the entire process of tunnel construction.

7. REFERENCES

[1] IS 456-2000, Plain and Reinforced concrete – Code of Practice.
[2] IS 875-(Part-1):1987, Indian Standard code of practice for design loads (Dead Load), second reversion, New Delhi.
[3] IS 875-(Part-2):1987, Indian Standard code of practice for design loads (Live Load), second reversion, New Delhi.
[4] IS 5878 Part II /Section-2 for Dewatering of tunnel.