

Construction and Analysis of Flyover by BRTS (Bus Rapid Transit System)

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ABSTRACT

This paper deals with the construction details of flyover work. which is supposed to make grade separation at intersection and make free movement of traffic. By construction of flyover in vizag town it makes an easy way for the communication of railway station and RTC complex. Also to divert the railway passengers directly to the Railway station, and also clear off the railway station passengers. Flyover is proposed at the heart of the city. Is is mainly used as diverts of Traffic in city.

In this paper for the construction of flyover several Investigation survey, design & execution of four lanes carriage way flyover, two lane carriage way underpass of the City. This paper also includes different stages in the flyover construction such as Traffic studies, Soil investigations, Mix design of concrete used. It is a part of BRTS (BUS RAPID TRANSIST SYSTEM) with this system a lot of traffic pollution may cleared and a direct way to the railway station without much obstructions.

Keywords : Traffic Diverts, Grade separation, BRTS, Flyover, pile Foundation, Soil investigation.

1. INTRODUCTION

1.1 General

Due to increasing traffic in the city of destiny a flyover is proposed at the heart of the city. Work on much talked about Asilmetta flyover in the city has begun. The construction of flyover to ease traffic congestion at the nerve centre of the city has been on the cards for more than three years now. It finally is being launched as a part of Bus Rapid Transit System (BRTS) under which two corridors are proposed.

The flyover will come up between Vemanmandir on

the Asilmetta side and the DRM's office covering a distance of 1.1 km.

Under investigation survey, design & execution of four lanes carriage way flyover, two lane carriage way underpass of Asilmetta junction along the improvements from DRM office to Vemanmandir on pt corridor under BRTS in vizag on the basis of Engineering, procurement & construction is done.

1.2 Details of the Project

The project investigation, survey, design and execution of four lanes carriage way flyover, two lane carriage way underpass of Asilmetta Junction along the improvements from DRM office to Vemanmandir on Pendurthi Corridor under BRTS in Visakhapatnam on the basis of engineering & construction.

Project cost : Rs.6121.50lakhs

Agt. Contract value : Rs.6313.4lakhs

Name of the contractor: M/S MVR Infra projects Pvt Ltd.

1.3 Salient Features of flyover

Length of bridge portion = 706.75m

Length of retaining wall approach towards DRM office = 254.50m

Length of retaining wall approach towards vemanmandir = 138.75m

Total length of fly over = 1100m

Total width of flyover
Carriage way width of flyover = 1100m(2lanes)

Length of service roads on either side of the flyover = 4lanes(2 x 7.5m)

Flyover

Total number of piers = Number of retaining walls
 $= 18(p_1, p_2 \dots p_n)$

Approach lengths = $2(A_2 \& A_3)$

- A1 = 254.50m
- A2 = 138.75m

Spans

Normal span = 36.5m

Obligatory span = 40m

Gradient maintained = 1:20 to 1:25

Intersections

1st intersection @ p2-p3, R18

2nd intersection @ p10, p11, p12 starting from ch. 654.500 to 770.783

3rd intersection @ p17 & p18 ch. 952.00 to 996.00

1.4 Necessity

The main purpose for the construction of this flyover is the amount of traffic control required at some of the busy junctions in the city of Visakhapatnam. For this very reason GVMC have conducted a detailed survey on the traffic problems at those junctions and have finally proposed a grade separator for the junctions to ease the traffic control and movement simultaneously.

1.4.1 Grade Separation

It is the method of aligning a junction of two or more surface transport axes at different heights (grades) so that they will not disrupt the traffic flow on other transit routes when they cross each other.

The composition of such transport axes does not have to be uniform; it can consist of a mixture of roads, footpaths, railways, canals, or airport runways. Bridges, tunnels, or a combination of both can be built at a junction to achieve the needed grade separation.

1.5 Objectives Of Study

The main objectives of the project submitted are

- To understand the general steps involved in the construction of a civil engineering structure.
- To know the methods available to conduct Traffic studies.
- To know about the various site conditions that will affect the stability of the structure.
- To know in detail about lying of pile foundations and factors affecting them.
- To know about the mix design procedure.

2. REVIEW OF LITERATURE

An overpass or flyover is called a bridge, road, railway or similar structure that crosses over another road or railway. An overpass and underpass form a grade separation. Stack interchanges are made up of many overpasses.

2.1 History of Bridges

In North America, a flyover is a high-level overpass, built above main overpass lanes, or a bridge built over what had been an at-grade intersection. Traffic engineers usually refer to the latter as a grade separation. A flyover may also be an extra ramp added to an existing interchange, either replacing an existing cloverleaf loop (or being built in place of one) with a higher, faster ramp that bears left. Such a ramp may be built as a right or left exit. A cover leaf or partial cover leaf contains some 270 degree loops, slowing traffic and such loops are difficult to construct with more than multiple lanes. where all such turns are replaced with flyovers (perhaps with some underpasses) only 90 degree turns are needed, and there may be four or more distinct levels of traffic. Depending upon design, traffic may flow in all directions at or near open road speeds (when not congested). For more examples see freeway interchange. Railway overpasses are used in North America to replace at-grade crossing as a safer alternative. Using overpasses allows for unobstructed rail traffic flow from mixing with vehicular and pedestrian traffic.

The world's first rail road flyover was constructed in 1843 by the London and Croydon railway at Norwood junction railway station to carry its atmospheric Railway vehicles over the Brighton main line.

2.2 Types of Bridges

- Arch Bridge
- Beam Bridge
- Cable-stayed Bridge
- Cantilever Bridge
- Draw Bridge
- Suspension Bridge
- Truss Bridge

3. TRAFFIC DETAILS

3.1 Introduction

As Visakhapatnam is one of the fastest developing port cities in India, considerable economic activities are observed due to existing port, good networking of national high ways, steel plant and upcoming gangavaram port are leading to increase in traffic within the city limits. Development works for road widening are in progress. Many junctions are on verge of reaching capacity limits.

So in order to bear the traffic in the city limits some of the traffic improvement options were chosen in order to reduce the traffic flow. The traffic improvement options chosen are as follows.

- RE-ROUTING BUS MOVEMENT
- ONE WAY CIRCULATION MOVEMENT
- GRADE SEPERATORS

Finally after conducting a survey in the city regarding the traffic movements the GVMC has come to conclusion of constructing a flyover for feasibility of traffic moments in city from Asilmetta to station road Which is major junction which is connecting all the major areas in the city.

3.2 Existing Traffic Details

Existing daily traffic at:

Asilmetta junction	:	1,17,400PCU
RTC junction	:	1,27,141PCU
Sangam sarat junction:		1,01,688PCU
Ambedkar junction	:	1,01,390PCU
Rednam junction	:	86,999PCU
Ramatakies junction	:	1,00,199PCU
Madillapalem junction:		1,24,101PCU
Jagadamba junction	:	1,34,073PCU
Siripuram junction	:	1,23,647PCU

- Every year traffic is likely to increase at an average growth rate of 5.5%
- Common peak traffic 8050PCU/Hr at 17:45-18:45

3.3 Existing Traffic Scenario

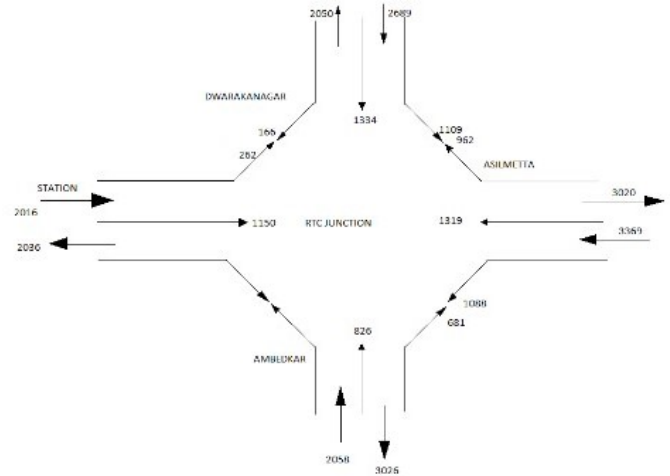


Figure 3.1 Traffic movements at RTC junction

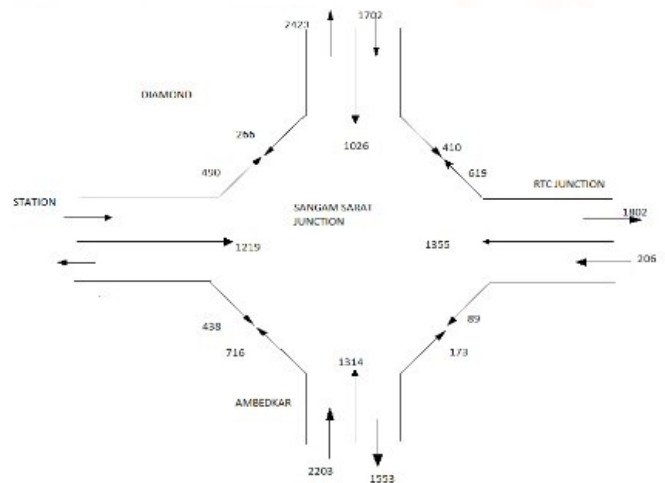


Figure 3.2 Traffic Movements at sangam sarat junction

- Two wheelers, Auto - 79%
- Car, LCV - 13%
- Bus, Mini bus - 6%

4. SOIL INVESTIGATION

4.1 Introduction

In This project the soil for which the substructure to be designed is collected from NOVAS site located GANGAVARAM PORT road. This is a 10 storied

building with a provision of stilt plus one basement floor and eight upper floors. The stilt floor is meant for car and other vehicular parking, suiting the park arrangement, the column's spacing in one direction can be large and this can be between 6 and 10 meters in other directions column's spacing can be 4 to 5 meters.

The Maximum load on central columns can be about 400 to 500 tones and on the edge columns, maximum load can be assumed as about to 200 to 250 tones. It can be reasonably assumed that on the plan area of the building, the maximum uniformly distributed load can be between 10 to 11t/m². This area is in earth quake zone-2 and combining the earth quake loads and wind loads and live loads the maximum vertical load intensity can be taken as about 12 to 12.5t/m².

4.2 Field Operations

Bore hole drilling operations have been carried out at 8 locations along the proposed underpass alignment.

The locations are:

- Bore Hole No.1 CH-060.000m
- Bore Hole No.2 CH-130.000m
- Bore Hole No.3 CH-196.000m
- Bore Hole No.4 CH-280.000m
- Bore Hole No.5 CH-318.000m
- Bore Hole No.6 CH-350.500m
- Bore Hole No.7 CH-402.500m
- Bore Hole No.8 CH-454.000m

Table 4.1 Unconfined Compressive Strength Of The Rock Samples

Bore Hole No.	Depth Of The Sample (m)	Unconfined Compressive Strength (t/m ²)	Safe Bearing Capacity (t/m ²) Safety Factor – 8
BH-1	Btn. 3m	2290	286
BH-1	Btn. 4m &	2810	351
BH-1	Btn. 5m &	3910	489
BH-2	Btn. 4m &	1585	198
BH-2	Btn. 5m &	2850	346
BH-2	Btn. 6m &	6545	818
BH-3	Btn. 4m &	1690	211
BH-3	Btn. 5m &	3415	427
BH-3	Btn. 6m &	1590	488

BH-4	Btn. 7m &	2130	266
BH-4	Btn. 8m &	3300	412
BH-4	Btn. 9m &	3650	456
BH-5	Btn. 4m &	1500	187
BH-5	Btn. 5m &	2665	333
BH-5	Btn. 6m &	3610	461
BH-6	Btn. 3m &	1585	198
BH-6	Btn. 4.5m &	2300	287
BH-6	Btn. 5.5m &	3110	389
BH-7	Btn. 7m &	2015	252
BH-7	Btn. 8m &	3385	423
BH-7	Btn. 9m &	3900	488
BH-8	Btn. 4.5m &	2930	356
BH-8	Btn. 5.5m &	3910	489
BH-8	Btn. 6.5m &	5575	697

5. FOUNDATIONS

5.1 Introduction

The Foundation type depends On the sub soil nature and condition of the location Generally the type of foundations proposed for the construction of flyover between Vemanamandiram and DRM's office are the pile foundations. There are 18 piers and 2 Abutments. The pile depth generally varies between 6m to 18m until the hard rock strata comes into contact. The foundations take the shapes of square and hexagonal as per design. Square foundations (free piers) consist to 6 piles and hexagonal foundation (fixed piers) consists of 8 piles. The hexagonal foundations are laid at obligatory points. The span distances between square to square foundations are 36.5m and the span distances between hexagonal and square are 40m.

5.2 Pile Foundations

Critical areas where foundation strata are very deep and excavation would be difficult for open foundations pile foundations shall be adopted.

5.3 Use of Piles

Pile is relatively small diameter shaft usually of 1 to 2m diameter, which are driven or installed into the ground by suitable means. The piles are usually driven in groups called pile groups to provide foundation for structure. The pile groups may be subjected to vertical loads, horizontal loads or a combination of both loads. Piles are useful in

transferring loads through poor soils or water to a suitable bearing stratum by means of end bearing. Such piles are called End Bearing Piles or Point Bearing Piles. when the piles are installed in soft soils such the load is transferred through friction along the length of piles, they are called Friction Piles. Piles are also used to resist horizontal loads as in the case of foundation for retaining walls (abutments). As the horizontal loads act perpendicular to the pile axis, these piles are termed as Laterally Loaded Piles. In the case of large lateral loads, piles are driven at an angle and hence termed as Batter Piles. these have been found to serve better than vertical piles.

Short piles are sometimes used for compacting loose sand deposits which get densified by the vibrations setup on driving. such piles are known as compaction piles. Piles may be required to increase the stability of tall structures, where the foundations are subjected to large eccentric loads and moments. They are also used to avoid damage due to positive scouring soil immediately below the foundation. While driving piles a soft layer of bentonite clay is applied on the outer layer of driller to ease the process of driving pile. It loosens the hard compacted soil to soft layer of soil, which helps the machine to drive the pile easily into the hole.

5.4 Pile Groups

In the foundations plan they used 2 different types. they are

- 6pile group
- 8pile group

5.5 Six Pile Group

- Each pile is of 1m diameter and distance between each pile in vertical direction is 1.3m and in horizontal direction is 2m.
- According to six pile foundation design it has 20no's of 20mm diameter bars in 92cm diameter and with 4cms cover on each side.
- M35 grade concrete is used every pile, pier cap concreting and M15 grade is used for P.C.C. Layer of 100mm thick.

5.6 Eight Pile Group

- Each pile in 8 group is of 1m diameter and consists of 23 no's of 32 diameter bars

- They carry the more load than 6 pile group.
- It is in shape of octagon with dimensions as shown below.
- Grade of concrete for pile, pier cap is M45 and for P.C.C is M15.

6. RESULTS & MIX DESIGN

6.1 Introduction

The process of selecting suitable ingredients of concrete and determining their relative amounts with the objective of producing a concrete of the required, strength, durability, and workability as economically as possible, is termed the concrete mix design. The proportioning of ingredient of concrete is governed by the required performance of concrete in 2 states, namely the plastic and the hardened states. if the plastic concrete is not workable, it cannot be properly placed and compacted. The property of workability, therefore, becomes of vital importance. The compressive strength of hardened concrete which is generally considered to be an index of its other properties, depends upon many factors, e.g. quantity of cement, water and aggregates; batching and mixing; placing, compaction and curing. The cost of concrete is made up of the cost of materials, plant and labour. The variations in the cost of materials arise from the fact that the cement is several times costly than the aggregate, thus the aim is to produce as lean a mix as possible. From technical point of view the rich mixes may lead to high shrinkage and cracking in the structural concrete which may cause cracking. The actual cost of concrete is related to the cost of materials required for producing a minimum mean strength called characteristic strength that is specified by the designer of the structure. This depends non the quality control measures, but there is no doubt that the quality control adds to the cost of concrete.the extent of quality of control is often an economic compromise, and depends on the size and type of job. The cost of labour depends on the workability of mix. E.g., a concrete mix of inadequate workability may result in a high cost of labour to obtain a degree of compaction with available equipment.

6.2 Concreting In Flyover Construction

The M35 grade cement was used and aggregates of size 20mm and 40 mm are used. The mix proportion was designed based on requirements of the structure.

All the specifications were according to IS codes and designed to bear the loads safely. A slump value to 125 to 150 mm is maintained according to the mix design. And several internal vibrators are used in order to expel the air voids and to achieve full compaction.

6.3 Mix Design For M35 Mix Proportion By weight with Ultra tech – OPC -43 Grade Cement

Table 6.1 Mix proportion Results

Water	Cement	Fine aggregate (FA)	Coarse aggregate (CA) (20+12.5)
167.2lts	440kg	634.46kg	1209.73(725.84+483.89)kg
0.38	1	1.441	2.749(60% + 40%)

Average compressive strength of concrete cubes at 28 days (By accelerated curing method boiling water method) obtained with the above proportions

- 48.14Mpa
- 47.82Mpa

Slump observed - 140mm
 Chemical added Rheobuild - 350 at dosage of 3.52 kg/m³

6.4 Mix Design For M45 Mix Proportion By weight with Ultra tech – OPC -43 Grade Cement

Table 6.2 Mix proportion Results

Water	Cement +25%G GBS	Fine aggregate	Coarse aggregate (CA) (20+12,5)
165.1lts	508kg (381 +)	581.79 kg	1211.6(726.76+484.50)kg
0.325	1.00 (0.75 +)	1.145	2.384(60% + 40%)

Average compressive strength of concrete cubes at 28 days (By accelerated curing method – boiling water method) obtained with the above proportions

At 7 days: 1) 38.96Mpa 2)39.22Mpa 3)39.22Mpa

At 28 days: 2) 59.22Mpa 2)59.14Mpa 3)59.14Mpa

- Slump observed - 145mm
- Chemical added Rheobuild – 623 at dosage of 5.68 kg/m³

Tests carried out at per IS: 10262-2000, IS: 516.2000

NOTE Actual dosage of admixture may be varied slightly from the above suggested values as per site conditions.

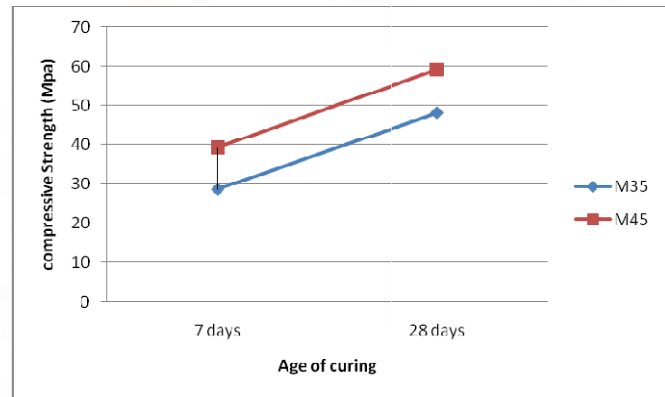


Fig : Compressive Strength of Concrete

7. CONCLUSION

The flyover in Asilmetta is the second major flyover in the city centre. It deals with the access of over traffic in Asilmetta and in sampath vinayaka temple junction. It diverts the major of traffic from railway station to complex. It is the simplest carriage way from complex to railway station. It is one of the major projects for the development of city. According to soil properties and traffic data we designed the pile and also mix design of M35 & M45 grade of concrete for the construction of pile cap and pile. with this fly over construction traffic diversion and making free movement of traffic volume reduction of collision of vehicles and reduce traffic jams and also reduce accidents with the reduction of head on collision of traffic in opposite stream.

8. REFERANCES

- M.S SETTY; CONCRETE TECHNOLOGY, S. Chand Publications
- B.C Punmia, Ashok K.jain; Limit State Design Of Reinforced Cement Concrete., laxmi publications.

- D. Johnson Victor; Essentials of Bridge Engineering, Oxford & IBH
- Highway Engineering- S. K. Khanna & C. E. G. Justo, Nemchand & Bros., 7th Edition.
- Traffic Engineering & Transportation Planning- L.K Kadiyali- Khanna Publications.
- Ministry Of Road Transport and Highways (MORTH).
- IRC:78-2000
- IRC:21-2000
- IS:2131 – 1981
- IS:6403- 1971



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