Feasibility Studies of New Ghat Road Project Chainage 50+050 to Chainage 55+290 in the State of Maharashtra.

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ABSTRACT-

Feasibility studies are carried out to validate expenditure on infrastructure projects. In spite the importance of the studies in supporting decisions related to public expenditure on infrastructure projects, there are no attempts to assess such studies after construction. Ghat Roads are approach routes into the mountainous region like Western and Eastern Ghats. They generally served to connect to sea side regions with the upper region Deccan plateau of the Indian Subcontinent. An analysis of a feasibility study for a state highway ghat road construction project is presented in this paper with an emphasis on the estimates, and forecasts presented in that study to weigh expected benefits from the project against expected costs.

The Ghat road will improve connectivity between two tahsils, reducing the travel distance by 40.00 KMS. The Proposed road aims to reduce the Distance and travel time between two districts. This would facilitate trade, and commerce between two districts and reduce the traffic pressure on present roads passing through the existing ghats which are used to travel in kokan presently.

Objective of the project is to Study and Annalise the approved alignment, Carry out Detail Project Report using relevant IRC Codes, Carry out Tunnel feasibly report, Cost comparison between Tunnel and Design Ghat Alignment. Methodology for this project will be collecting data, Design of alignment, preparing Design drawings for via duct/Bridge/ Flyover, Carrying out tunnel feasibility report, preparing detail estimate, cost comparison of tunnel and approved alignment. The cost of tunnel construction is double the cost of construction of road including cost of 1100 m long flyover proposed.With due consideration to the budgetary cost estimate, it can be seen that tunnel construction in not economically viable. It would thus be prudent to construct road as per design ghat road alignment.

Keywords: Construction value, Infrastructure projects, Economic feasibility, Feasibility validation.

1. INTRODUCTION

Examples of infrastructure projects include tunnels, bridges, highways and power generation plant. Infrastructure projects can be arranged in classes or categories as large construction project that utilize extensive amount of assets concerning money, materials, labour, equipment and time. Huge expenditures on infrastructure projects need to be compared against the anticipated benefits resulting from these projects to the public and the national economy. Therefore, feasibility study needs to be conducted in advance, before the construction of infrastructure project. Highway construction and expansion in India has crossed 10,000 KMS. During the year 2018-19, which translated to 30 KMS. Road construction per day during the budgetary year which is more than doubled of 12 KMS per day during the year 2014-15.

The economic feasibility study of a project is an approximate cost of the probable profitability of that project, or a study that computes the expected outcomes from a project relative to its cost. Owners, decision makers and banking institutions build their resolution to go ahead with and/or finance any project based on the results of the feasibility study of that project. Ensuring the validity of economic feasibility studies of infrastructure projects is a vital step in ascertaining that decisions related to the construction of infrastructure facilities is based on consistent and standard procedures that avoid the use of confusing or insufficient data.

The area is one of the world's ten "hottest biodiversity hotspots" and has over 7,402 species of flowering plants, 1,814 species of non-flowering plants, 139 mammal species, 508 bird species, 179 amphibian species, 6,000 insect's species and 290 freshwater fish species; it is likely that many undiscovered species live in the Western Ghats. At

least 325 globally threatened species occur in the Western Ghats.

The government of Maharashtra, has decided to construct a Ghat road connecting Two State Highways. The proposed two-lane state highway connects various places in Kokan with the places which lie in Western Ghats. The Ghat road will improve connectivity between two tahsils, reducing the travel distance by 40.00 Kms. The Proposed road aims to reduce the Distance and travelling time between two districts. This would facilitate trade, and commerce between two districts and reduce the traffic pressure on present roads passing through the existing ghats which are used to travel in kokan presently.

2.0 Problem Statement

The proposal for construction of a two-lane road connecting two state highways in two districts of Maharashtra. The Ghat road will improve connectivity between two tahsils, reducing the travel distance by 40.00 Kms. The project involves total 25.76ha. Of forest land in both the district. The Proposed road aims to reduce the Distance and travelling time between two districts. This would facilitate trade, and commerce between two districts and reduce the traffic pressure on present roads passing through the existing Ghats which are used to travel in kokan presently, which also bisects the wildlife sanctuary. There will be wild life mitigation measures taken into consideration during pre and post tendering stage provision of animal over/under passages, guide walls, noise barriers on bridges, etc. for proper movement of wild animals.

3.0 Literature Study –

To work on Objectives, we did the literature survey and from survey, we found following important references to relate the objectives.

First literature - Advanced Road Safety for Ghat Roads at Amboli

In this study for provision of solution they categorized this ghat into 3 stages, based on risk factor and vision factor. The risk zones are divided on the basis of various factors such as physical road conditions, intensity of curve i.e. sharp curve or smooth curve, critical points in ghat sections like waterfall, sunset point etc. By modification in the ghat road they can make Amboli ghat safe for traveling. Also, from data collection they came to know that accidents occur in Amboli are mostly because of carelessness of driver having no information about the road, drink and drive cases. For that awaking the people and also providing check post at suitable location is best solution. As Amboli receives max rainfall so that the wear and tear of road is happened for that it is necessary to periodic maintenance of road, use standard quality material so that road can provide service for longer time. In this study they tried to provide best solutions so that accidents can be reduce with economy and people feel safe while using the road.

Second literature - Evaluation of Accidents on Curves in Ghats Sections

In this study they have explained that the latest emerging technologies for road safety focuses on finding ways to avoid or minimize road accidents to road users with special concern by reducing the causes of road accidents. Research in this paper includes important issues like road accident and their impacts, causes of this accident, effect of accident, prevention and control that we can improve this situation. Percentage of accident in ghat area is increasing day by day. This paper includes some solutions and ideas to improve safety in ghat areas. Road accident is increasing every day and it is dangerous to all people, in this case all people must realize and give more attention to decrease the rate of road accident So Road safety education is therefore the need of hour. As a conclusion, there is lot of causes of road accidents. So, there is a clearly need of road safety education and it should be directly given to the road users who are frequently involved and injured in road accident.

Third literature - Study and Application in Renovation of Hill Transport

This study and analyse is about the existing pavements by means of using several methods. Generally, it is an idea to renovate the pavement when there are some possibilities. This study is concerned to predict the existing road in hill station. The work initially starts from survey on existing pavement and their condition i.e.., it may include culvert, pavement dimensions, road width etc., and after the process of surveying we use L.S and C.S method to find the road level. It may help to make the horizontal alignment upon the road. Finally, the designing process is carried out. At pavement design, they consider number of conditions over the project. This study mainly notifies whether any possibility to renovate the existing roads and also, we used some software to analyse the data regarding the pavement. The application of this project is 1. Minimum distant 2. Easily accessible 3. Time consideration. Apart from that we have referred several journals to gain some ideas in renovation and also gave possible advantages over renovation of pavement. The key to a successful project is in the

planning. Creating a project plan is the first thing we have done before undertaken this project. Initially they consider two aspects site survey and traffic survey. The former involves analysis of road width, transition curves, soil type, hairpin bends and damaged culvert. Whereas for the latter they had an already existing hill road as of 25% and designed the pavement, hairpin bend, retaining wall. Having followed all the steps mentioned above we have made a study in hill transport renovation.

Fourth literature- Investigation of the mass movement in varandha region, western ghat of Maharashtra using geospatial technique

In this study they have explained that Mass movements are not an uncommon phenomenon in Western Ghat area. Especially, during the rainy season, along the Bhor-Mahad State highway faces number of unusual mass movement incidents such as rock fall, landslides and creep movements through which big blocks, rubbles, soil mixed boulders slides and spread along the road, affected the road traffic jam problems, causes large scale damages road constructions and human lives. The highway has deep cut along its rout with mostly untreated, unsafe slopes and presence extreme climatic conditions. For the prevention of such mass movements, there is need of ground improvement techniques for the stability of slopes. The controlled measures are to be considered while construction of new ghat. Unless otherwise the evaluation is properly made on stability factors, the vulnerability is going to be high in future due to increase in traffic and developments. Therefore, by keeping all these views in the mind, there is need of implementation of above-suggested measures and further, detail investigations to stabilize the mass movements in this area.

Fifth literature-Advance Road Safety for Ghat Road's at Hairpin Bend

In this study, we got to know about the accident which occurs on the road at Ghat section. We understand the causes and effect of accidents and then founded out a solution introducing a new technique to avoid such accident. The new technique consists of two CCTV cameras and two LCD screen which displays the live scene captured from the CCTV. This help in reducing the accidents and to enjoy the safer ride. Life is important than any other thing, once gone cannot be regained. So, to save this valuable life, this method has important role. It can help Road users at Ghats from being killed in a serious injury.

Sixth literature- Review on Study the Investigation of mass Movement along Malshej Ghat

After studying various parameter and investigation the site they measurably found that anthropogenic and natural phenomenon are the reason for landslide in malshej ghat. Heavy rainfall in July to August 2017 is a main reason of landslide in malshej ghat. There is need to provide various landslide control and prevent measures like netting, bolting and short creating etc.

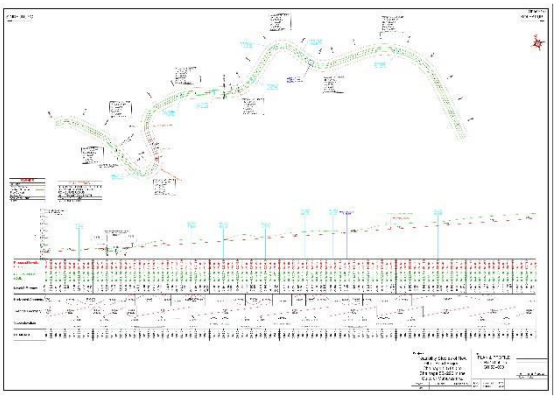
4. METHODOLOGY TO BE OPTED-

1. Collection of Site Ground Data and documentary data.
2. Study and Annalise, the approved alignment.
3. Horizontal and Vertical Design of Approved Alignment using auto CAD software.
4. Preparing Detail Estimates using estimate software.
5. Tunnel feasibly report for the ghat site for conservation of wild life in the forest area.
6. Results and analysis. (Cost comparison between Tunnel and Design Ghat Alignment).
7. IRC Codes used IRC SP 73-2015, IRC 36-1970, IRC 38-1998, IRC SP 23-1993, IRC 037-2012, IRC 52-2001, IRC SP 48-1998, IRC 67-2012, IRC 35-1997.

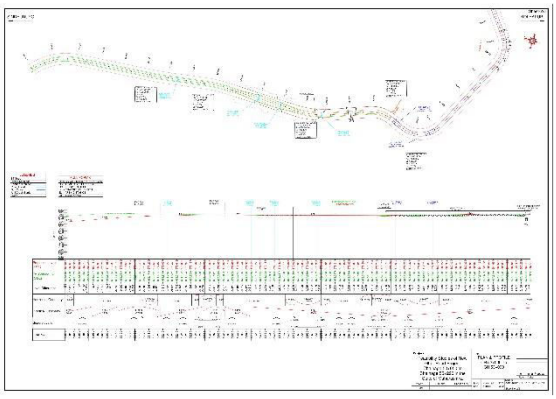
5. RESULTS AND ANALYSIS

a. Design Drawings:

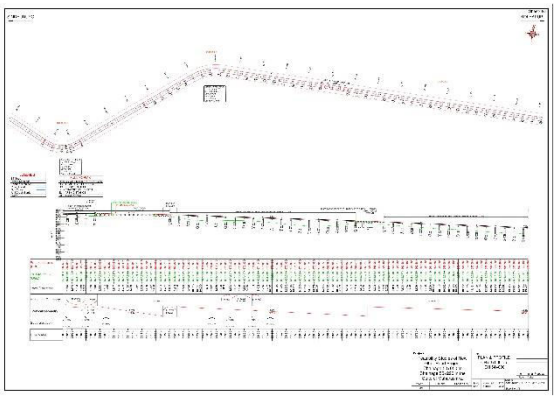
1. Plan and profile for CH 51+050 to CH 52+000



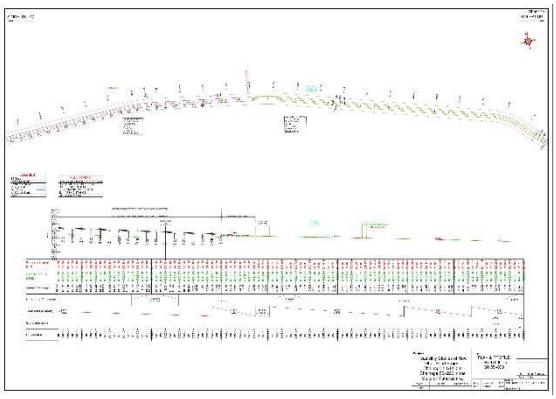
2. Plan and profile for CH 52+000 to CH 53+000



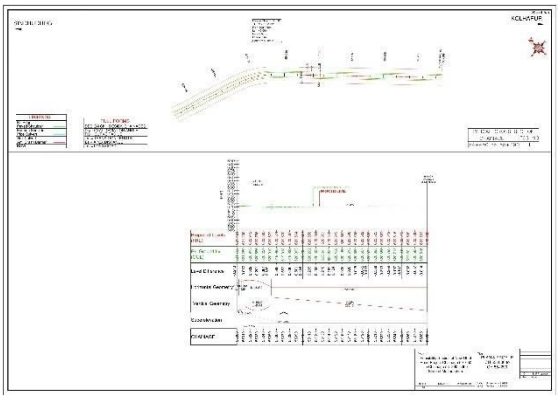
3. Plan and profile for CH 53+000 to CH 54+000



4. Plan and profile for CH 54+000 to CH 55+000



5. Plan and profile for CH 55+000 to CH 55+290



b. Detail estimate Recapitulation sheet.

1. Estimated Cost for 1100m vai duct and 80m flyover: - **Rs.57, 33, 67,765.00/-**

RECAPITULATION-SHEET

Sr No	Sub-Estimate Title			Amount (Rs.)
1	Major Bridge (Flyover)			57,33,67,765.00
2	Q.C.Charges & Royalty			38,34,683.00
			Sub Total	**57,72,02,448.00**
	Add work contingency	@ 4.00 %		2,30,88,098.00
	Add Insurance towards Labour	@ 0.50 %		28,86,012.00
	Add G.S.T. on Roads & Bridges	@ 12.00 %	of Rs. 573367764.71	6,88,04,132.00
	Add Computer charges	@ 2.00 %		1,15,44,049.00
	Add Maintenance for 5 years	@ 2.50 %		1,44,30,061.00
			Total	69,79,54,800.00
	Deduct For hard Rock Recovery as per attached Statement			-1,74,960.00
			Say Rs.	**69,77,79,840.00**

2. Estimated Cost for road portion in ghat and 40m flyover: - **Rs. 51, 58, 17,041.00/-**

RECAPITULATION-SHEET

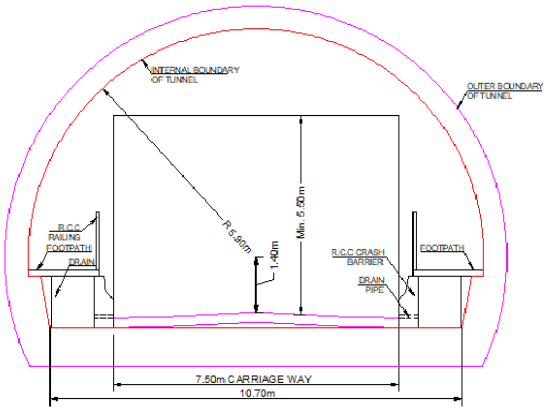
Sr No	Sub-Estimate Title			Amount (Rs.)
1	Major Bridge (Flyover)			16,59,80,233.00
2	Road			32,74,64,251.00
3	Minor Bridge (@ CH - 51/695 , 52/710 & 52/790)			1,43,09,761.00
4	C.D.Work			80,62,796.00
5	Q.C.Charges & Royalty			14,90,207.00
			Sub Total	**51,73,07,248.00**
	Add work contingency	@ 4.00 %		2,06,92,290.00
	Add Insurance towards Labour	@ 0.50 %		25,86,536.00
	Add G.S.T. on Roads & Bridges	@ 12.00 %	of Rs. 515817040.71	6,18,98,045.00
	Add Computer charges	@ 2.00 %		1,03,46,145.00
	Add Maintenance for 5 years	@ 2.50 %		1,29,32,681.00
			Total	62,57,62,945.00
	Deduct For hard Rock Recovery as per attached Statement			-89,16,921.00
			Say Rs.	**61,68,46,024.00**

c. Tunnel feasibility report.

Dimensions of Tunnel

The proposed road alignment is for two lane standard state highway. The internal dimensions

of tunnel for two lane state highway along with provisions for footpath, stream, crash barrier etc., are shown in figure below. The inside cross-sectional area of tunnel is 75 Sqm.

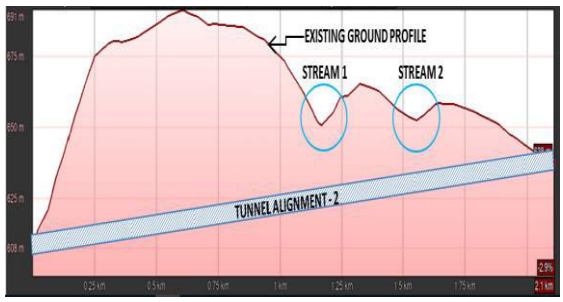


Alternative alignments fortunnel

The two alternative alignments have been identified giving due consideration to topographical features at the entry and exit points and that along the proposed alignment, gradient along the alignment, requirement of minimum cover over the crown of the tunnel etc. The two identified alternative alignments are shown in figure
TunnelAlignment– 2& 3

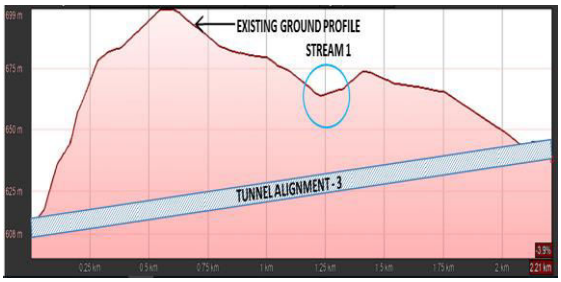
The tunnel alignment 2 & 3 is identified as an alternative to proposed road alignment majorly passing through plateau with an objective to cross the forest area without disturbing the flora and fauna.
The Tunnel Alignment – 2 & 3 extends between Ch. 51.150 km and 54.200 km of proposed road alignment. The total length of the tunnel for tunnel alignment – 2 and 3 is 2100m and 2200m respectively as against total length of road as 3050m. The tunnel alignment - 2 reduces travel distance by 960m i.e., 32% reduction in travel distance and the reduction in travel distance for tunnel alignment – 3 is 28% (Reduction in distance of 850m). The finished road level at Ch. 51.150 km and Ch. 54.200 km is 606m and 644m respectively. Thus, the average road gradient would be 1.8% and 1.7% for tunnel alignment 2 & 3 which is less than the preferred gradient of 3% for long tunnels. The longitudinal profile along the tunnel alignment – 2 & 3 is shown in figure respectively.
Ascanbeseenfromthefigure6, thetunnelalignment- 2 connectsCh.51.150kmandCh.54.200mbya straight line and thus has a shorter length as compared to tunnel alignment - 2. However, tunnel alignment -2 crosses two natural streams. Giving due considerations to the lowest bed level of naturalstreamatlocationwheretunnelalignmentcrosse snaturalstreamtheoverburdenabovethe tunnel would be just about 10m. This would pose lot of difficulties in constructing the tunnel in stretch where the alignment crosses the natural streams and would call for elaborate stabilization measures to construct the tunnel. There would also be a need to provide elaborate drainage measures to take care of theseepage.
Tunnel alignment – 3 ensures adequate overburden over the crown of the tunnel for major part of the alignment and circumnavigates natural stream 2, thus this alignment would have much lesser issues pertaining to stabilization and seepage. However, this alignment is longer than alignment – 2 by110m.Thesummaryoflengthofroadasper approved drawingandlengthoftunnelasperidentifiedalignment is tabulated in table below.

Figure – Tunnel alignment – 2



Figure– Longitudinal Profile along tunnel alignment –2

Figure– Tunnel alignment –3



Figure– Longitudinal Profile along tunnel alignment – 3

Summary of Length of road as per approved drawing and Length of tunnel as per identified alignments

Sr. No.	Description	Length of road as per alignment proposed in GAD (m)	Length of tunnel as per alternative alignment (m)
1	Alternative Alignment - 2 (Ch.51.150 - 54.200 km)	3050	2100
2	Alternative Alignment - 3 (Ch.51.150 - 54.200 km)	3050	2200

Techno-EconomicFeasibilityAnalysis

A techno economic feasibility analysis is carried out to evaluate the feasibility of tunnel along two identified alternative tunnel alignments. The pros and cons of tunnel construction along each alternative tunnel alignment are discussed hereunder:

Tunnel Alignment -2

As can be seen from figure 8a, the tunnel alignment crosses two natural streams. Giving due consideration to the fact that bed of natural stream at location where alignment crosses natural stream is just 12m above the crown of tunnel, high seepage is expected inside the tunnel. Toeffectivelymitigatetheseepage,thereshallbereq uirementofcompletelyliningthetunnelandprovidi ng water-proofing system including HDPE membrane for section of tunnel extending 25moneithersideofnaturalstreams.Withlowover burdenabovethe tunnelcrowninmajorportionof alignment beyond natural stream towards theend, the tunnel section needs to be provided with steel ribs and concrete lining. With almost 50% length of the tunnel lined with steel ribs and concrete lining the average cost of construction of tunnel would be INR. 13.24 lakh per running meter for alignment – 2. Overall cost of construction for the tunnel for alignment – 2 is thus estimated to be INR. 278coresincludingprovisionforaudits,firesafety,t unnellightingetc.

Tunnel Alignment –3

The length of tunnel in alignment - 3 increases by 110m as compared to length of tunnel in alignment-2.The tunnelalignment -3 crossesnaturalstream1, butthere isa sufficientcover ofalmost 35m above the crown of the tunnel. Secondly the alignment by-passes natural stream 2. However, provision of concrete lining has been considered for a distance of 200m wherein the tunnel alignment crosses natural stream 1. As mentioned in figure above, there shall be requirement of cut and cover tunnel at both the ends of tunnel. The remaining stretch of tunnel shall be lined with shotcrete and bolting. The average cost of construction of tunnel would be INR. 12.0 lakh per running meter for alignment – 3. Estimated cost of construction for the tunnel for with an overall length of 2200m along alignment– 3wouldbeINR.264coresincludingprovisionforau dits,firesafety,tunnellightingetc.

Block Estimate Tunnel Alignment –II:-**Rs. 2,781,000,000.00**

Tunnel Alignment – II

Sr. No.	Tunnel Section	Unit	Quantity	Rate (INR)	Amount (INR)
1	Cut and cover	m	200	1,200,000.00	240,000,000.00
2	Portal/ Ribs + RCC lining	m	850	1,400,000.00	1,190,000,000.00
3	Shotcrete and rock bolting	m	1050	1,000,000.00	1,050,000,000.00
4	Audits and cross passage	m	300	600,000.00	180,000,000.00
6	Ventilation shaft	m	0	300,000.00	-
7	Approach road to audits	m	1000	40,000.00	40,000,000.00
	Total (A)				2,700,000,000.00
	Add 3% for electrification, ventilation equipments, fire safety (B)				81,000,000.00
	Total cost (A+B)				2,781,000,000.00
	Total length of tunnel				2,100.00
	Cost per running meter of tunnel				**1,324,285.71**

Block Estimate Tunnel Alignment – III:-**Rs. 2,636,800,000.00/-**

Tunnel Alignment - III

Sr. No.	Tunnel Section	Unit	Quantity	Rate	Amount
1	Cut and cover	m	200	1,200,000.00	240,000,000.00
2	Portal/ Ribs + RCC lining	m	250	1,400,000.00	350,000,000.00
3	Shotcrete and rock bolting	m	1750	1,000,000.00	1,750,000,000.00
4	Audit and cross passage	m	300	600,000.00	180,000,000.00
6	Ventilation shaft	m	0	300,000.00	-
7	Approach road to audits	m	1000	40,000.00	40,000,000.00
	Total (A)				2,560,000,000.00
	Add 3% for electrification, ventilation equipments, fire safety (B)				76,800,000.00
	Total cost (A+B)				2,636,800,000.00
	Total length of tunnel				2,200.00
	Cost per running meter of tunnel				**1,198,545.45**

Cost comparison of Ghat Road Alignment and Tunnel Alignments.

Total cost of construction required to construct ghat as per table 2 & 3	Total cost of construction required to construct Tunnel Alignment - II as per table 7	Total cost of construction required to construct Tunnel Alignment - III as per table 8
57,33,67,765+ 51,58,17,041= 1,08,91,84,806	2,78,10,00,000	2,63,68,00,000

6. CONCLUSION

Conclusion –

The variations in the sanctioned alignment and the design alignment occurred due to the survey data collected during sanctioned alignment was done using local TBM (Temporary Bench Mark) and during design stage it was done using DGPS (Differential Global Positioning System)

Tunnel alternative alignment that alignment 2 and 3 for tunnel have gradient less than 3% and also help to minimize on ground construction activity in reserve forest. Cost of Alternative 3 is less than Alternative 2 due to reduction in length of tunnel section requiring support system of steel ribs and concrete lining. However, even for Alternative alignment 3 for tunnel, the cost of tunnel construction is double the cost of road construction including cost of 1100 m long flyover proposed for allowing unhindered movement of wild life across the alignment.

With due consideration to the budgetary cost estimate, it can be seen that tunnel construction in not economically viable. The project cost is getting doubled with the introduction of tunnel and there are no distinct advantages of tunnel construction in lieu of proposed road alignment including flyover, which can offset the two fold increase in project cost tangibly or intangibly. It would thus be prudent to construct road as per proposed ghat road alignment for Construction of Ghat Road.

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