Decongesting NH-57 via Nayagarh Town by Bypass, Odisha

ABSTRACT:

The Nayagarh Township is one of the developing areas in the state of Odisha nowadays. The population growth rate in the decade 2011-2021 is 14 %. It involves various famous temples, government offices, and interconnecting districts Khordha and Boudh. Due to the population growth and to avoid road congestion the new By-pass is introduced with the help of different structures involved in it. The objectives are to find the data required, various appurtenant structures with their pros and cons, locational appropriateness choice for the correct positioning, and benefits received from their housing. The construction of a bypass from Nayagarh from the left fringe of the town to the left edge avoiding intermediate hills has been approved by MoRT&H considering the continuous traffic congestion in heart of the town. The By-pass of the length of about 17km is proposed of two lanes with paved shoulders only involving a built-up area over the agricultural area. The bypass shall decongest the present traffic jam on the main road of Nayagarh town during the peak traffic period.

Keywords: By-pass, Paved shoulder, Traffic congestion, Two-lane, Urban roads

1. INTRODUCTION

Nayagarh district (Lat. 19^0 54' to 20^0 32' N., and 84^0 29' to 85^0 27' E. Long.) was a sub-division under the jurisdiction of Puri district before 1993. On 1st April 1993 the Nayagarh, Khordha, and Puri were separated into three districts. Nayagarh was a princely state during the British period. The district (20.1654° N, 85.0233° E) is of Area: 3890 km², and a fraction of the Puri Loka Sabha constituency. Housed within hillocks in the West and North East, the district forms fertile valleys (between Rukhi and Balaram Hillocks) transected by many streamlets.

National Highway-57 is previously known as NH-224 in Odisha connecting Balangir and Khordha in the state of Odisha. Nayagarh town is located at a distance of 85 km from Bhubaneswar, the state capital of Odisha, and connected that serves as an important transportation mode connecting Khorda, Nayagarh, Daspalla, Boudh, Sonepur, Balangir, etc. Nayagarh Township comprises a municipality and 40villages. As per the 2011 census, the population in Nayagarh Township was 60036 which have been projected to population of 76846 in 2022. The district headquarters of Nayagarh is mainly communicated to the state capital

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Bhubaneswar and in the last five years, the township is connected by Rail, 2017 [1].~~(P&C Dept, 2022[1]).~~

The Government of Odisha is planning to upgrade & rehabilitate the connectivity of roads between various important places in Odisha. PWD has been entrusted with the preparation of DPR for M/s CADD Consulting Engineers Pvt. Ltd, Bhubaneswar for the development of the NH network. MoRT&H has decided to take up the development of various National Highway stretches in the state of Odisha under Public Works Department (PWD) – National Highway Division considering a myriad of alternatives.

Public Works Department (PWD) – National Highway Division, Odisha has been entrusted with the assignment of "Consultancy Services for Feasibility Study and preparation of Detailed Project Report for proposed Bypass at Nayagarh on NH-57 in the State of Odisha" has been awarded to **M/s CADD Consulting Engineers Pvt. Ltd, Bhubaneswar.** *The Project stretch comprises the following for a total length of 17.024Km in the state of Odisha*. The administrative approval of bypass to Nayagarh town, in Odisha, a loop road to NH-57 concurred with MoRTH (Ministry of Road Transport & Highways), GOI. By Hon. Nitin Gad Kari, on 19th Jan, 2022.

1.1 Nayagarh Bypass

The executive summary intends to present the findings of the feasibility study report in a summarized manner. The project location of the Nayagarh Bypass is shown in Figure~~:~~ 1.

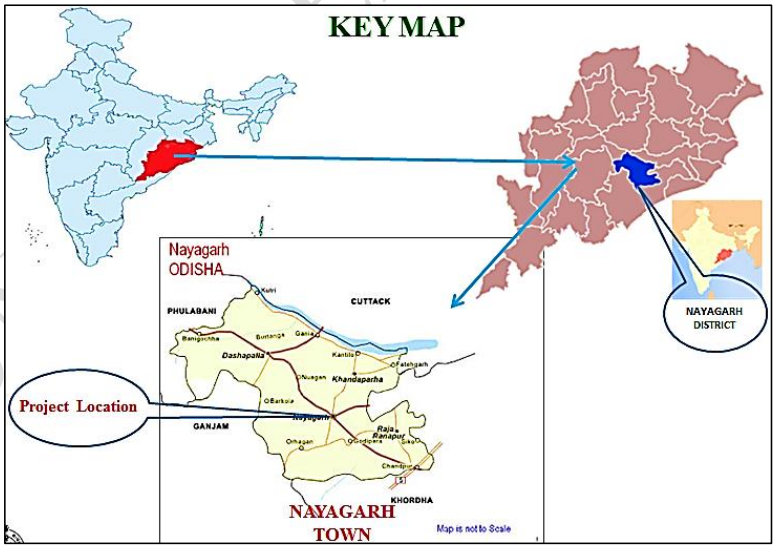

Fig.~~ure~~ 1.~~:~~ Key Map of Nayagarh Bypass (Source: Govt of Odisha)

The present study envisages the necessity of the future societal benefits of the proposed bypass, traffic survey and data analysis, and details of the design, upgrading, and rehabilitation of the

existing road. New provisions of structures are to be incorporated at various places as per necessity (Fig 1).

2. REVIEW OF LITERATURE

The Nayagarh state in past was established by Suryamani Baghela from Rewa while on pilgrimage to Puri. The Baghua Nayagarh fort symbolizing the tiger as the icon was ruled by Bagel Singh from 1480 to 1510. Later the state was subdivided as Nayagarh, Khandapada, and Dassapalla. in 1595. The Present NH-57 was the only road joining Puri with Boudh and Balangir via Nayagarh from the 14th century passing through the mountains Rukhi and Balaram, https://nayagarh.nic.in/history.

Traffic overcrowding has become an insistent problem in the growing townships and urbanization in recent years globally [2, 3, 4, 5, 6].~~, Suresh et al., 1990[2], Zhao et al., 2015[3]; Loo et al., 2022[4], Bagh et al, 2022[5]. Serok, et al., 2022[6].~~ Upsurge in owning of vehicles, on-road traffic traumas, and problems like accidents, congestion, queueing, and delay in travel time have persistent occurrences at present by misbehavior and violation of the rules, mostly during peak hours [7, 8].~~, Binu et al, 2022[7], Patro et al, 2022[8].~~ The drastic drop in traffic volume, and traumas during the pandemic in 2019 has significantly reduced road traffic collisions (RTCs) not only in India but also throughout the globe [9, 10, 11, 12].~~(Solanki et al., 2016[9], Dhillon et al., 2020[10], Yasin et al., 2021[11], Mishra et al., 2022[12]).~~ The ring road bypasses, vehicle underpasses VUP's, over bridges, *etc.*, can be thought of as alternatives for urban traffic agglomeration [13, 14, 15].~~, Nugmanova, et al, 2019[13], Panda et al., 2022[14], Behera et al., 2022[15].~~ Adaptive-Cruise Control (ACC), Musical roads, and WEB GIS application during plying can reduce traffic Jams and reduce traffic collisions [16, 17].~~(Kesting et al, 2007[16], Jena et al., 2022[17]).~~

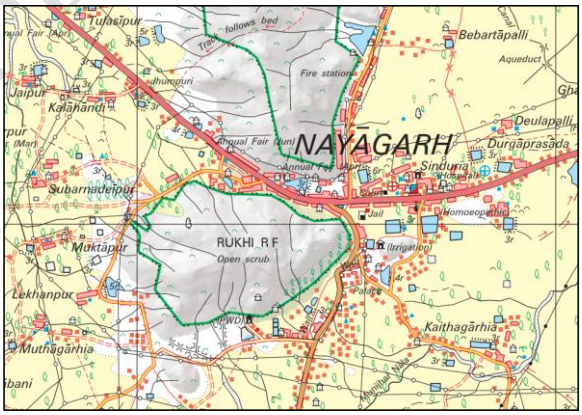

Fig. 2.~~:~~ The SOI index map of Nayagarh township in 1986-1987

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The population of urban areas in India has augmented from 17% to 31.16% in 60years (1951-2011)[9]. ~~Solanki et al., 2016[9].~~ Odisha, in India, is the 11th largest populous state comprising 3.47% of the country, occupying a total landmass (4.7%), of which > 83% are rural domiciles as per Census 2011 as Census 2021 with no census due to pandemic COVID-19 [18, 19].~~(Hoda et al., 2021[18], Mishra 2021[19]).~~ The district has an area of 3890Km^2 housed in an area of 2.5% of the state and accommodating population of 962789 (502636, male and female 460153) as per the 2011 census, and population in 2022 is 950,924 in 12 Tehsils, and 227927 houses, (aadhar uidai.gov.in Dec 2020) (Fig. 2).

2.1 The governance, Nayagarh Township

The habitat of Nayagarh was 500years old which was ruled by Baghua kings and later by Gadajat administration.. After independence the subdivision headquarters "the Nayagarh Township" was constituted as Notified area Council (NAC) on 13.5.1953. The NAC was upgraded covering an area of 1600km, as a Municipality (Govt. in H&UD Dept. No. 3109/dt. 11th Feb 2019). It is headed by the executive Officer and under the jurisdiction of Collector and DM, Nayagarh. Nayagarh receives Class-IV town status according to Census 2001 and the district headquarters.

2.2 The connectivity Nayagarh Town

Nayagarh town strategically conjoins the N.H .224, and MDR No. 68. The NH 224 passes through Khordha-Nayagarh- Boudh- Sonapur-Balangir is of 298 kms and then to Vijayawada - Ranchi corridor. Nayagarh is 87km from Bhubaneswar the capital of Odisha. The MDR – 68 connects Aska, Berhampur, Odagaon, Sarankul, Kantilo, Khandapara etc. which carries an important transportation mode in Odisha. By 2021, the district has 802.180km in total out of which State Highway (S.H): 114.759km, Major District Road (M..D.R.) 80.433km, Other Dist. Road (O.D.R), 606.988, and the NH 57.

2.3 The Physiography~~:~~

Physio-graphically, the Nayagarh housed under alluvial plain, lies at elevation of 420' above MSL. The area is not flood prone and covered by two hills RUKHI and Balaram that bifurcate the area into fertile valleys intersected by hill streams i.e. Dahuka and Lunijhar. The valley of Nayagarh has red and loamy soil of laterite origin. The climate of Nayagarh is hot summer and cooler winter and fed by average annual rainfall of 1340.70 mm. The SW monsoon (June to Sept) contribute rainfall 74.44% of the total and NE (Jan-Feb) monsoon amounts 10.13%. The max^m ,and min^m temperature of the municipality is 42º c, and 15ºc respectively

2.4 The Transport infrastructure Nayagarh~~:~~

The district Nayagarh houses 98.93 Km of NH, 92.62km SH, 40.33km MDR, 555.74km of ODR, and 2596.92 km of intra-village roads through forests connecting villages in 2018-19. Apart from these roads, there exist forest roads of 370.11km and village roads as 648.71km in 2018-19. The construction of new roads has been suspended due to the Biological disaster, pandemic-2019. As last km connectivity, a new bus stand is under construction at the new bus stand and in progress as the old stand at the centre of the township could not accommodate the number of passenger vehicles. The Nayagarh is connected by rail to Khordha from 20 June 2017 and the only nearby aerodrome is at Bhubaneswar which is about 90km away.

3. PROJECT ROADS

Nayagarh bypass road under the present consultancy services contract needs to be constructed to 2-lane with Paved shoulder standard. The chainage (km stone) of starting & end points of these roads have been taken as per discussions with the client (Table 1 and Table 2). The alignment plan of the Nayagarh Bypass is shown in Fig.-3 and Ffig. 4.

Table 1.- Detail of Project Roads – as per Alignment Approval

Sl. No.	Name of the road	Project Location		Length (km)
		Start	End	
1	Nayagarh Bypass	Km 235.530 of NH-57 near Mankapalli Village	Km 198.280 of NH-57 near Barapandusara village	16.733

Table 2.- Detail of Project Roads – as per Design

Sl. No.	Name of the road	As per Design Km		Design Length (km)
		Start Km	End Km	
1	Nayagarh Bypass	Km 235.469 (Existing Km. 235.469 of NH-57) near Mankapalli Village	Km 252.493(Existing Km. 247.001of NH-57) near Badapandusara village	17.024

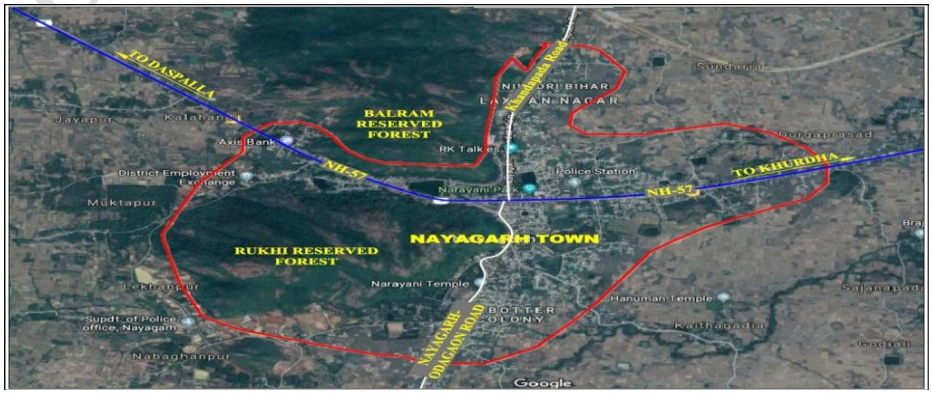

Fig. 3.: Road Map at Nayagarh Town

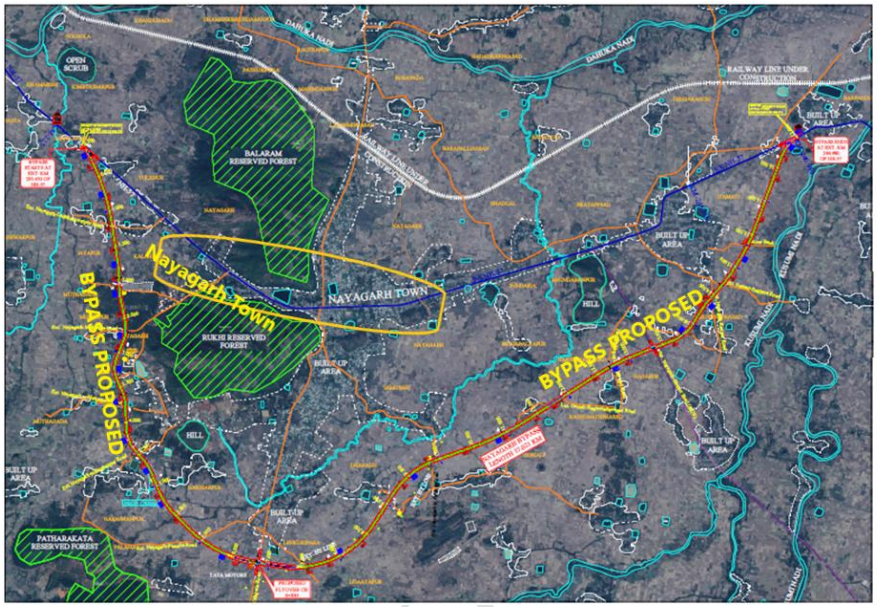

Fig. 4 .: Alignment Plan on Satellite Image, the new bypass from NH-57 to Nayagarh (Km 235.469 to Km 252.493) (Village from Mankapalli to Badapandusara)

4. APPROACH AND METHODOLOGY

The primary objectives of the study are to evaluate the existing road and traffic conditions, and the growth potential of the influence area, and to suggest appropriate improvement schemes for the Project Roads. The improvement schemes so suggested based on the study would relieve traffic congestion along the route and bring about savings in vehicle operating and total transportation costs. The bypass for Nayagarh town would promote user comfort, safety, and environmental standards.

The methodology adopted by the Consultants for the preliminary design has been based on a sound professional practice widely followed for similar upgrading/rehabilitation proposals. The existing standards and practices in the country in respect of design, construction, and maintenance of roads and the resource availability constraints have been duly kept in view while formulating the proposals. The general guidelines given in the relevant Indian Roads Congress (IRC) Publication have been adopted as the Design Standards for the Study. Suitable modifications/ additions have been incorporated to suit local conditions and study requirements.

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The objective of the exercise has been adapted to have an optimal utilization of funds without sacrificing technical requirements.

4.1 Data Requirement For The Structures

4.1.1 Design Standards And Specifications

Guidelines for geometric standards for various types of roads in India are contained in IRC: 73-2015. However, suitable modifications/additions have been incorporated to suit local conditions and study requirements.

- General principles of a typical cross-section and its application are described below:

The provision of the bypass with 2-lane configurations has broadly been decided based on the following parameters:

1. The unsuitability of the existing carriageway to receive overlay;
2. Non-availability of ROW and possibility of acquisition of additional land if required;
3. Land use type along the existing alignment i.e. built-up;
4. Position of roadside plantation i.e. giant tree on one side or both sides
5. Geometric improvement requirements

Guidelines for structure standards for various types of structures in India are contained in IRC: 5 [20], IRC:6 [21], and IRC:112 [22]. General principles for designing a structure are described below:

a) Span arrangement by the hydrology calculation data;

b) Scouring depth calculation for calculation of foundation;

c) Soil testing report for the foundation recommendation;

d) Load calculation to design dimension;

e) Design detailing.

4.2 Traffic Ceapacity

Indian roads congress (IRC) has recommended capacity values for various lane configurations in IRC: 64-1990[23]: Later the traffic capacity has been revised in clause 2.17 of manual & specifications IRC SP: 73-2018 [24]. The Design Service Volume adopted as per IRC SP: 73-2018 for capacity analysis is given below:

For Two lane road	
Plain Terrain	-10000 PCU's/day
Rolling Terrain	-8500 PCU's/day
Mountainous and Steep	-6000 PCU's/day

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These values of Design Service Volume have been kept in view while considering proposals for the project road.

4.3 Traffic Surveys aAnd Data Analysis

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Classified Traffic Volume Count (CVC) was carried out for seven days for each traffic homogenous section in October 2018. The summary of traffic volume counts is presented in **Error! Reference source not found.**~~Table 3~~. Total AADT (the av. daily volume of traffic at a given setting over 365 days/annually**)** at this survey location was recorded as **10638 & 10973 in** terms of number and **8646 & 9046** in terms of PCU.

Pavement Design: The new flexible pavement is designed as per the guidelines of IRC: 37-2018"Guidelines for the Design of Flexible Pavements ("Fourth Revision")"[25~~,~~24].

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Type of Structures: All new bridges have to construct newly as there are no existing bridges. The total section of the Bypass is completely new construction.

The project considered various types of structures like Major bridges, Minor bridges, culverts, VUP (vehicle underpass), LVUP (Low vehicle underpass), Fly-over, Tunnel, Road over the bridge (ROB), Road under the bridge (RUB), etc. based on their location, requirements, workability, easily construction, availability of materials, *etc.*

Apart from the above, the By-pass is completed with structures like Major Bridges, Minor Bridges, Culverts (Box and Hume Pipe), Fly-over, VUP, and LVUP.

List 1 .: The summary of the proposals for structures is presented below: -

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SL NO	TYPE OF STRUCTURE	PROVISION	NOS.
01	Minor Bridge	New Construction	02
02	Fly-over	New Construction	01
03	Box Culvert	New Construction	30
04	Vehicular Under Pass (VUP)	New Construction	01
05	Light Vehicular Under Pass (LVUP)	New Construction	02

Location choosing for the Structures: The consideration of different types of structures are to be constructed depending upon their suitability location like Seepage area, Water logged area, Hilly area, Plane area, Urban area, Rural area, River, Stream, Railway crossing, Road crossing, Forest area, etc.

Applications of the Structures: The various benefits of the structures are given below;

1. The traffic can move from one direction to another direction easily and short duration of time without any accident.

2. 2. The reptiles/animals can cross the road safely.

3. The natural water like rivers, Stream, *etc*. can flow without any obstructions.
4. The electric/telephone/any type of cable line can pass easily.
5. The people can rest during the time of monsoon or any season.

5. Discussion

The ground network is an essential pre-requisite for rapid economic evolution, production, and distribution where the road infrastructure act a pivotal role in the development of transport, agriculture, communication, tourism or healthcare sector, etc. *Present trend of the study is the use of odd-even numbers plying over roads and Car-Zero Days and Trials that have the best sustainable impact on human health, environment, and ecosystem* [26, 2827]. ~~Glazener et al., 2022[26], Sahu et. al.,2022[28]~~

Literature on traffic congestion discusses impacts on air, environment, water, and noise effluence and the construction of improved roads ameliorating the traffic jam. The reduction in the level of pollution is to have a sustainable environment and pollution-free biome. The recurrent or non-recurrent congestion is mostly on the urban roads due to traffic flow when the travel mandate surpasses road dimensions.

Though little discussed in the present study; the traffic congestion in the present Nayagada bus stand area during peak hours, the speed, delay travel time, level of services (LOS), congestion indices, and federal approaches, need further study before and after construction of the bypass. At present there is no organized Bus Stand at Nayagarh town. This town is a four way nodal centre connecting Boudh-Kandhamal, Khandapara, Kantilo, Aska, Berhampur and Khurdha, Bhubaneswar through NH and MDR. The town is situated on the junction of two main roads. NH-224, there is tremendous economic growth which can be a galaxy of trade and commerce.

About 1000 vehicles are plying through the roads of the small congested town from diverse directions. Apart from the four, three, and two wheelers, the cycles and rickshaws play vital role for regional communication. The least organized traffic, debarred from bus stand, quality of road, the vehicles are parked on the shoulders of the main road. Paucity exchequer is deterrent towards construction of streets, main roads, updating and maintenance of current roads. Grants and taxes collected by the N.A.C. are not sufficient to meet the expenses of the categories of roads like Earthen - 15.88 kms, W.B.M - 06.81 kms, Metalled - 09.35 kms, Asphalt - 49.95 Kms, Cement Concrete - 19.21 Kms.

Under the above circumstances a proposal of a bypass (retailed outlet) and VUP between 167/074 km to 167/109 (RHS) km from NH-57 to Nayagarh town through the bus stand has been approved by MoRTH. To carter demand of the up-surging population; it is pertinent to increase

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and update the existing road infrastructure of the municipality. Since all the long route night and morning busses passing through Nayagarh town passes through the city, the town is noisy during the peak hours. The transport infrastructure also demand the construction of a by-pass to the NH-57, so that the NH based town ship can have tranquil sleep attenuated sounds in mid night and dust free. The proposed bypass is not passing through any cross drainage network; the cost/km shall not be very high.

Since NH-57 connects Bhubaneswar and Balangir and is the shortest road communication between east and western Odisha, the road is continuously applied with long-haul material transport via trucks, last-kilometer logistics, the consignment distribution, and finally policies and regulations made by both state and central government. The mixed traffic running from pedestrians to heavily loaded trucks is the main cause of traffic congestion. After construction of the bypass to divert the long-haul trucks can ameliorate the traffic jam, and save delays in transport which shall reduce the risk factor of traffic collision over the new road and its vicinity [27, 28].~~, (Pedde et al, 2017[27], Sahu et al., 2022, [28]).~~

6. CONCLUSION AND RECOMMENDATIONS

The bypass provision so suggested based on the study would relieve traffic congestion along the project road and bring about savings in vehicle operating and total transportation costs. The improved road conditions would promote user comfort, safety, and environmental standards.

It is observed from the capacity analysis that all the project roads shall be developed to 2-lane with paved shoulder standards. The discussion after the preparation of the design and drawings needs further discussion with the economical, societal, and land acquisition aspects with concerned line departments and accordingly, the provisions will be made in the next stage of submission.

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