www.ijiarec.com

ISSN:2348-2079

Volume-8 Issue-3

International Journal of Intellectual Advancements and Research in Engineering Computations

# Studying the failures and increasing the life span in highway projects (SH78)

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## ABSTRACT

In the hills roadwork sector, asset quality plays a key role in the successful completion of a project. During the project failure occurs and life span of project is reduced in hilly roads. This paper is about studying the failures and increasing the life span in hills roads and designing some structure for reduction of road failures

## INTRODUCTION

Roads are the nerves of the nation. They contribute to the economic, industrial, social and cultural development of the country. Efficient transportation system brings about national integration and better understanding of the people living in different parts of the country and of the world of all the three transportation systems, transportation by road is the only mode of the transportation that would provide door to door service for the people. The road network alone could serve the remotest of the vest closely linked to the rate at which the transport sector grows. In India's case, it has been found that while the economy grows at a certain rate, say r% per annum, road transport has grown at 2r% [1-5].

Hence the project includes widening roads, constructing retaining wall in steep areas, culverts to divert the flow of water in roads. Breast wall constructing in land sliding areas.

## AIM AND OBJECTIVES

The main objectives of this project are the following.

- To understand and analyze the traffic problems of the study area.
- To find short, easy and safe alignment.
- To collect rainfall data and design the drainage structure.
- To estimate the cost.
- To analyses the quality of materials
- To identify failures of structures.
- To find the reduction of life period.

## METHODOLOGY

The research methodology, which is a combination of both standard and quantitative approaches, was adopted in this study. This research has the advantage of finding solid research formats and achieving legitimate and reliable findings. The study initially collected items such as book reviews [6-8].

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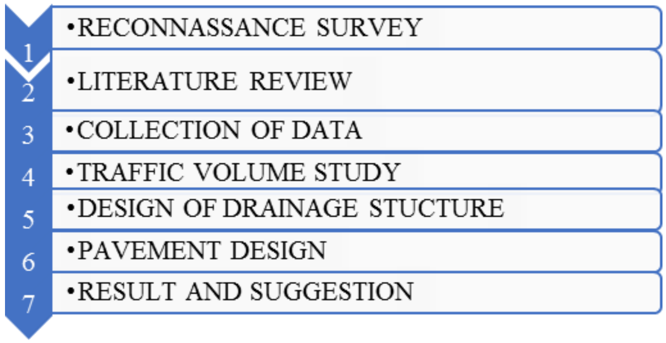


**Figure 1 Step by step process of methodology**

## DATA COLLECTION

Contact the authorities concerned and collect details regarding the project. It includes map study to get the rough alignment of the proposed project. It is possible to have an idea of several alternatives route so that further details of these may be studied later at the site [9, 10].

- Visited highway department at pollachi.
- Collected relevant information about the valparai.
- Collected the details of profile leveling from highways department.
- Collected details regarding the site from valparai

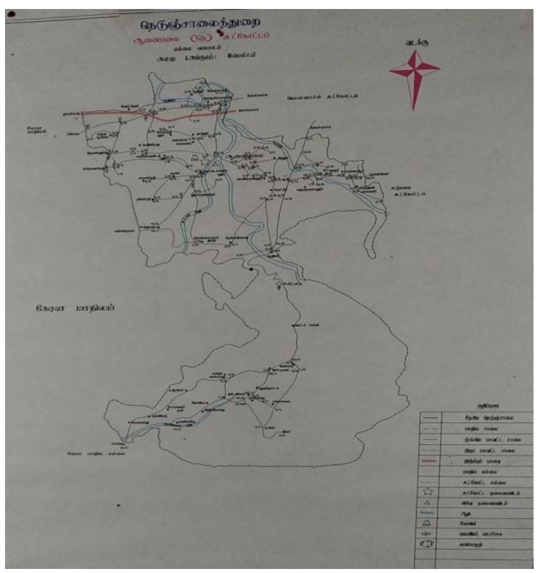

**Figure 2 Road map of SH78**

## TRAFFIC VOLUME STUDY

Traffic studies were carried out to analyse the traffic characteristics. Traffic volume study is the number of vehicles crossing a section of road per unit time at any selected period. Traffic volume is used as quantity measure of flow; the commonly used units are vehicles per day and vehicles per hour.

Daily traffic volumes very considerably in a week and there are variations with season. It is a common practice to consider the passenger car as the standard vehicle unit to convert the other classes and this unit is called Passenger Car Unit (PCU). Thus mixed traffic flow, the traffic volume and capacity are generally expressed as PCU/hour or PCU /lane/hour and the traffic density as PCU/kilometre length of lane.

## GEOMETRIC DESIGN

Geometric design is an aspect of highway design dealing with the visible dimensions of the road way. It is dictated within economic limitations by the requirements of the traffic and includes and design of horizontal and vertical alignment, sight distances, cross section components, lateral and vertical clearances, intersection treatment, control of access etc. "C" class materials are aggregate and brick. Road classification and Design speed in kmph for various terrains.

**Table 1 Design speed on hills road**

| S,No | Road classification | Mountainous Terrain | | Steep Terrain | |
|---|---|---|---|---|---|
| | | Ruling | Minimum | Ruling | minimum |
| 1 | NH and SH | 50 | 40 | 40 | 30 |
| 2 | MDR | 40 | 30 | 30 | 20 |
| 3 | ORD | 30 | 25 | 25 | 20 |
| 4 | VR | 25 | 20 | 25 | 20 |

**Table 2 design criteria for hair-pin bends**

| | | |
|---|---|---|
| i. | Minimum design speed | 20km/h |
| ii. | Minimum roadways width at | 11.5m for double-lane |
| | Apex | 9.0m for single-lane |
| | NH and SH | |
| | MDR and ODR | 7.5m |
| | VR | 6.5m |
| iii. | Minimum radius for the inner curve | 14 m |
| iv. | Minimum length of transition | 15 m |
| v. | Gradient | |
| | Maximum | 1 in 40 (2.5%) |
| | Minimum | 1 in 200 (0.5%) |
| vi. | Super-elevation | 1 in 10(%) |

## DESIGN OF DRAINAGE STUCTURE

### Road drainage design

**Table 3 Flood recurrence interval (years) in relation to design life and probability of failure.**

| Design Life (years) | Chance of Failure (%) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 10 | 20 | 30 | 40 | 50 | 60 | 70 |
| | recurrence interval (years) | | | | | | |
| 5 | 48 | 23 | 15 | 10 | 8 | 6 | 5 |
| 10 | 95 | 45 | 29 | 20 | 15 | 11 | 9 |
| 15 | 100+ | 68 | 43 | 30 | 22 | 17 | 13 |
| 20 | 100+ | 90 | 57 | 40 | 229 | 22 | 17 |
| 25 | 200+ | 100+ | 71 | 49 | 37 | 28 | 21 |
| 30 | 200+ | 100+ | 85 | 59 | 44 | 33 | 25 |
| 40 | 300+ | 100+ | 100+ | 79 | 58 | 44 | 34 |
| 50 | 400+ | 200+ | 100+ | 98 | 73 | 55 | 42 |

## Culverts

Culverts are by far the most commonly used channel crossing structure used on forest roads. Culvert types normally used, and the conditions under which they are used, are as follows:

- CM pipe-arch Low fills limited head room
- Multi-plate Large sizes (greater than 1.8 meters)

## Surface sloping

Reducing the erosive power of water can be achieved by reducing its velocity. If, for practical reasons, water velocity cannot be reduced, surfaces must be hardened or protected as much as possible to minimize erosion from high velocity flows.

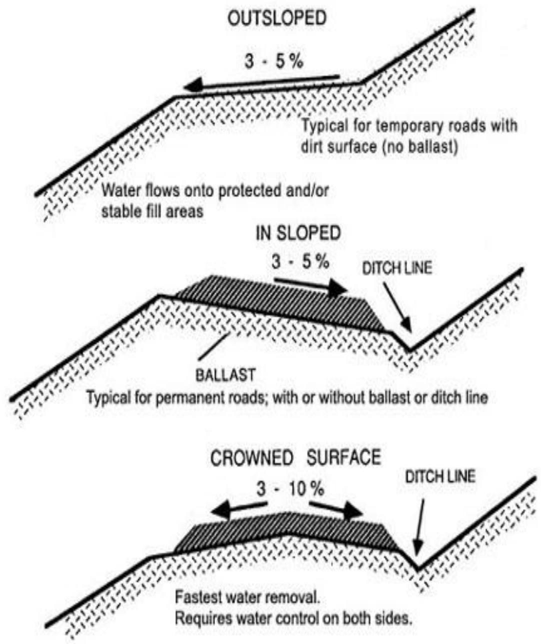


**Figure 2. Earth curvature**

**Table.4 Effect of in-sloping on sediment yield of a graveled, heavily used road segment with a 10 % down grade for different cross slopes**

| Transverse grade | Sediment Delivery tonnes/ha/year |
|---|---|
| conventional 0 - 2 % | 970 |
| 5 % | 400 |
| 9 % | 300 |
| 12 % | 260 |

## PAVEMENT DESIGN

The following define the general pavement layers in a flexible pavement system. Some of these are most important layers. The definitions are presented "top-down" through the pavement structure with the stronger layers on top of the weaker layers. The concept of stronger layers on top of weaker layers, as load stresses are spread out and down through the pavement, is further supported by the horizontal extension of weaker layers beyond stronger layers in a pyramidal effect (See Figure 2.1).Standard Department practice is to extend the base 4-in beyond the edge of the structural course. This is very important when dealing with granular materials. Without this support, vehicle loads would cause failure along the pavement edge. The pavement structure or system as it is sometimes referred to is the pavement layers designed to support traffic loads and distribute them to the roadbed soil or select embankment material.

### Friction course

The friction course is the uppermost pavement layer and is designed to provide a skid resistant surface. The following friction courses are used by the department:

- Friction Course FC-12.5 is a dense graded mix and is typically placed 1½-in thick.
- Friction Course FC-9.5 is a dense graded mix and is typically placed 1.0-in thick.
- Friction Course FC-5 is an open graded mix and is typically placed 3/4-in thick.

### Old mixes

Types S-I, S-II, S-III, FC-1, FC-2, FC-3, FC-4, FC-6, Type I, II and III Asphaltic Concrete, Binder, and Asphaltic Concrete base mixes will occasionally be encountered on rehabilitation projects but are no longer designed by the department.

### 90% MR Method

Resilient modulus values using AASHTO T 307 at 11 psi bulk stress are sorted into descending order. For each value, the percentage of values, which are equal to or greater than that value, is calculated. These percentages are plotted versus the $M_R$ values. Thus, 90% of the individual tests results are equal to or greater than the design value.

The following illustrates the mechanics of calculating the Resilient Modulus ($M_R$) obtained from a set of LBR data.

## DATA

The following field data has been provided

**Table 5. Illustrates the mechanics of calculating the Resilient Modulus**

| Sample Number | LBR Values In Ascending Order |
|---|---|
| 1 | 22 |
| 2 | 22 |
| 3 | 23 |
| 4 | 24 |
| 5 | 24 |
| 6 | 24 |
| 7 | 25 |
| 8 | 25 |
| 9 | 25 |
| 10 | 26 |
| 11 | 26 |
| 12 | 27 |
| 13 | 27 |
| 14 | 40 |

Sample No. 14 is considered an outlier by inspection and should be eliminated. It is satisfactory to drop a high number as in this example, but care should be taken before dropping a low number, because it may indicate a localized weak spot, that may require special treatment.

- This results in 13 good samples. 13x
- 90% = 11.7 (Use 12)
- Count back 12 samples starting with Sample Number 13 to Sample Number 1
- 90% meet or exceed the Design LBR = 22
- The following are some Limerock Bearing Ratio (LBR) input values were input into the equations to obtain Resilient Modulus ($M_R$) values.

## RESULTS AND DISCUSSION

### The following comparisons are provided

The pavement description in the plans with a design speed of 55 mph should read. In this paper the study of failure in hilly road and also discussed about the drainage designs and pavement design are researched. The factor of affecting the hilly road

1. Sudden climatic changes
2. Low number of culverts
3. Loss soil land slide has occurred
4. Low quality of work has done
5. Pavement thickness has reduced
6. No drains have provided

| **For a Design Speed of 55 mph: Layer/Material** | **Coefficient** | **Thickness** | **$SN_C$** |
|---|---|---|---|
| Friction Course, FC-5 | 0.00 | x3/4" | =0.00 |
| Structural Course | 0.44 | x3.0" | =1.32 |
| Optional Base Group 9 | | | =1.80 |
| Type B Stabilization (LBR 40) | 0.08 | x12.0" | =0.96 |
| | | 3.75" | 4.08 |
| **For a Design Speed of 45 mph:** | | | |
| **Layer/Material** | **Coefficient** | **Thickness** | **$SN_C$** |
| Friction Course, FC-12.5 | 0.44 | x1-1/2" | =0.66 |
| Structural Course | 0.44 | x1-1/2" | =0.66 |
| Optional Base Group 9 | | | =1.80 |
| Type B Stabilization (LBR 40) | 0.08 | x12.0" | =+0.96 |
| | | 3.0" | 4.08 |

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