VISVESVARAYA TECHNOLOGICAL UNIVERSITY

BELAGAVI – 590 018

INTERNSHIP REPORT

on

"CONSTRUCTION OF BOX CULVERT AND ROAD REPAIRING

Submitted in partial fulfillment of
the Requirement for the Award of

BACHELOR OF ENGINEERING

in

CIVIL ENGINEERING

Submitted By

G SAI VENKATESH

(1SJ18CV032)

Internship carried out at:

MESPC INFRA PROJECTS PRIVATE LIMITED

UNDER THE GUIDANCE OF

INTERNAL GUIDE:
Mr. SHATISH Y A
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Junior Engineer
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DEPARTMENT OF CIVIL ENGINEERING

S J C INSTITUTE OF TECHNOLOGY

CHICKBALLAPUR – 562 101

2021-22

S J C INSTITUTE OF TECHNOLOGY

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CHICKBALLAPUR - 562 101, KARNATAKA

DEPARTMENT OF CIVIL ENGINEERING

CERTIFICATE

This is to certify that the Internship Work entitled **"CONSTRUCTION OF BOX CULVERT AND ROAD REPAIRING"** is a bonafide work carried out by **G SAI VENKATESH (1SJ18CV032)** is bonafide student of S J C Institute of Technology in partial fulfillment for the award of Bachelor of Engineering in Civil Engineering in Visvesvaraya Technological University, Belagavi during the academic year 2021-22. It is certified that they have completed the Internship satisfactorily.

Signature of Guide	Signature of Coordinator	Signature of HOD
Mr. SATHISH Y A	**Mr. KAMATH G M**	**Dr. G NARAYANA**
Assistant Professor	Assistant Professor	Professor and HOD
Dept. of Civil Engineering, SJCIT	Dept. of Civil Engineering, SJCIT	Dept. of Civil Engineering, SJCIT

30/6/22

30/6/2022

EXTERNAL VIVA

Name of the Examiners: **Signature of the Examiners:**

1.

2.

ACKNOWLEDGMENT

With great pride I would like to express my gratitude to S J C Institute of Technology. The teof learning for providing us the required platform for the fulfillment of the internship.

Remembering with reverence, I offer my pranamas at the lotus feet of Byravaikya Padmabhushana Paramapoojya Jagadguru Sri Sri Sri Dr. Balagangadharanatha Mahaswamiji. Submitting devout pranamas and seeking the blessings of his holiness Paramapoojya Jagadguru Sri Sri Sri Dr. Nirmalanandanatha Mahaswamiji and poojya Sri Sri Mangalanatha Swamiji.

I express my sincere thanks to **Dr. G T Raju, Principal of SJCIT**, Chickballapur for providing us with excellent infrastructure to complete the internship.

I express wholehearted gratitude to **Dr. G Narayana** who is the respectable HOD, Civil Engineering Department. We wish to acknowledge the support for making our task easy by providing us with all valuable help and encouragement.

I thank my Internship Coordinator **Mr. Kamath G M, Assistant Professor,** for his guidance, encouragement and valuable suggestion.

It is my privilege to thank my Guide **Mr. Sathish Y A, Assistant Professor,** for his guidance, encouragement, support and valuable suggestion for completion of my internship.

And last but not the least, I would be very pleased to express my heartfelt thanks to **MESPC INFRA PROJECTS PRIVATE LIMITED, BENGALURU** for their guidance and support provided to complete the internship.

I also thank all those who extended their support and co-operation while bringing out this internship.

Finally, I would like to thank our family members and friends for their kind co-operation and motivation to proceed in my internship work.

G SAI VENKATESH
(1SJ18CV032)

ABSTRACT

Box Culvert is the arrangement made to cross an obstacle in the form of a stream, a river or a road to pass without closing the way beneath. A Culvert is defined as sta. Box Culverts are generally found in three locations, the first is at the bottom of depressions where no natural water course exist, second is where natural stream intersect the roadway and third is at locations required for passing surface water carried in the ditches beneath roadways and driveways to adjacent property. There are many general problems occur with box culvert such as serviceability and strength, abrasion and deterioration of concrete. For masonry culverts there will be major cause due to sedimentation and blockage by debris. Standard specifications as any structure whether made up of single and multiple cell construction.

The basic characteristics of box culverts the first on is hydraulic in which the culvert is design for highest flood level or peak value with a submerged inlet to improve hydraulic efficiency. Second is structural culverts are used take all the Dead load, live load, load due to pressure, Impact load and braking forces that are safely to be resist by structure and soil.

The road network of any city is its lifeline and the evaluation of their performance is very necessary for future traffic planning, design, operation and maintenance, etc. Traffic flow in most cities of India is a mixed traffic characteristic and also traffic congestion is the common problem in most major cities. The objective is to improve the performance operation of the urban road network by proposing the proper alternatives to enhance the traffic capacity.

MESPC
INFRA PROJECTS PRIVATE LIMITED

Mob : 9964440879
9844874999
GSTIN : 29AALCM5727C1ZB

MESPC INFRA PROJECTS PRIVATE LIMITED

Ref. No. :

Date :.....

INTERNSHIP COMPLETION LETTER

To Whom So Ever Is Concern

We are glad to inform you that **Mr. G SAIVENKATESH(1SJ18CV032)** from S J C Institute of technology, chikkaballapura, has successfully completed his internship, on construction execution of box culvert and road works, from 06\04\2022 to 06\05\2022. During his internship, he was present from start, till the end of the training and was exposed to various activities in construction

His association with us was very fruitful and wishes him all the best in future endeavors

Thanking You,

MESPC INFRA PROJECT PVT LTD.

For MESPC Infra Projects Pvt. Ltd.,

Director

1/10, Muneshwara Temple Road, Ananthpura Village, Singanayakanahalli Post, Yelahanka, Bangalore - 560 064.

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CHAPTER 1

ABOUT THE COMPANY

INTRODUCTION

Mespc Infra Projects Private Limited is an unlisted private company incorporated on 18 January, 2018. The Main Activity of the Company "MESPC INFRA PROJECTS PRIVATE LIMITED" is, Other building installation [Includes industrial process piping work, installation of illumination and signaling systems for roads, railways, airports, harbors etc. and installation of certain plants such as electric power and transformer plants, telecommunication plants and radar plants etc.], It Comes Under Division Construction and this come under section Construction . Private limited company and is located in Bangalore, Karnataka

VISION AND MISSION OF MESPC
VISION

Build World-Class, Mega Organization which makes significant contribution to the Society. And have a positive effect on the economic and social life of our state.

MISSION

- Based on innovative products and services that make a difference and excellence of its business operations.
- By providing the best quality and vast range ofprofessional services with minimal cost and on- time completion.
- Continual improvement in quality and cost through innovative technology and effective utilization of resources.
- By exceeding customer satisfaction.
- Work with the communities, other Government Department and the private sector to get the best result.

CHAPTER 2

ABOUT THE PROJECT

INTRODUCTION OF BOXCULVERT

Box Culvert is the arrangement made to cross an obstacle in the form of a stream, a river or a road to pass without closing the way beneath. A Culvert is defined as standard specifications as any structure whether made up of single and multiple cell construction with a clear span of 6m. Box Culvert which has got its name due to its shape & orientation and looks like a hollow rectangular box with two slab & two vertical walls which connects monolithically. Box culverts are easy to design and easy to construct economically. It is designed to carry all the loads comes from topslab and transferred with help of vertical walls to bottom slab which rest generally where the bearing capacity of soil is low. Box Culverts are economical due to their rigidity and monolithic action no separate foundation is required when bottom slab is rest on hard soil. The structure is designed such as rigid frame adopting moment distribution method for obtaining final distributed moments on the basis of the vertical walls and slabs. Box Culverts are generally found in three locations, the first is at the bottom of depressions where no natural water course exist, second is where natural stream intersect the roadway and third is at locations required for passing surface water carried in the ditches beneath roadways and driveways to adjacent property. There are many general problems occur with box culvert such as serviceability and strength, abrasion and deterioration of concrete. For masonry culverts there will be major cause due to sedimentation and blockage by debris.

There are two types of culverts which are rigid culvert for example concrete and flexible culvert for example steel. Rigid culverts are made to bear the bending moments where the flexible culverts are not. The structural and hydraulic design of box culvert is different from the bridge design for construction, maintenance, replacement and repair procedure. The basic characteristics of box culverts the first on is hydraulic in which the culvert is design for highest flood level or peak value with a submerged inlet to improve hydraulic efficiency. Second is structural culverts are used take all the Dead load, live load, load due to pressure, Impact load and braking forces that are safely to be resist by structure and soil. The third one is maintenance there is a problem with the blockage by debris and sediment, especially when the culvert are subjected to seasonal flow. The fourth one is the construction in which culvert are made to take the vehicle load by combined strength of box and surrounding embankment. The last fifth one is Durability of materials are major problem in box

culverts and other drainage structure. In counteractive environment can cause corrosion and abrasion of the available materials. The culvert is divided into categories first is according to type of materials used in which first is concrete materials which the culvert is made either precast or cast in situ. The selection is depending on the size, type, flexibility etc. Precast concrete is easy to handle and installed.

1. ADVANTAGES OF BOXCULVERT

- The box culvert is a rigid frame structure and simple in construction.
- It is Suitable for non-perennial streams where scrub depth is not significant but the soil is weak. The bottom slab of the box culvert reduces pressure on the soil.
- Box culverts are economical due to their rigidity and monolithic action and separate foundations are not required.

2. DISADVANTAGES OF BOXCULVERT

- Challenging part to construct is that dry surface is needed to construct.
- Heavy vehicles are not allowed to pass over it.

CHAPTER 5

PROJECT DETAILS

1. BOX CULVERT

A box culvert is a structure designed to allow passing of water through it. Its hydraulic design will be based on the hydraulic data obtained of that particular area. Even the dimensions of the box culvert were obtained from the hydraulic data collected.

Fig. 3.1: Box culvert

2. PROJECTADDRESS

Bagepalli- Gudibande Road

Devireddipalli village

Paragodu panchayath

Chickballapur district

CHAPTER 4

PLAN OF BOX CULVERT

1. STRUCTURAL DESIGN OF BOX CULVERT

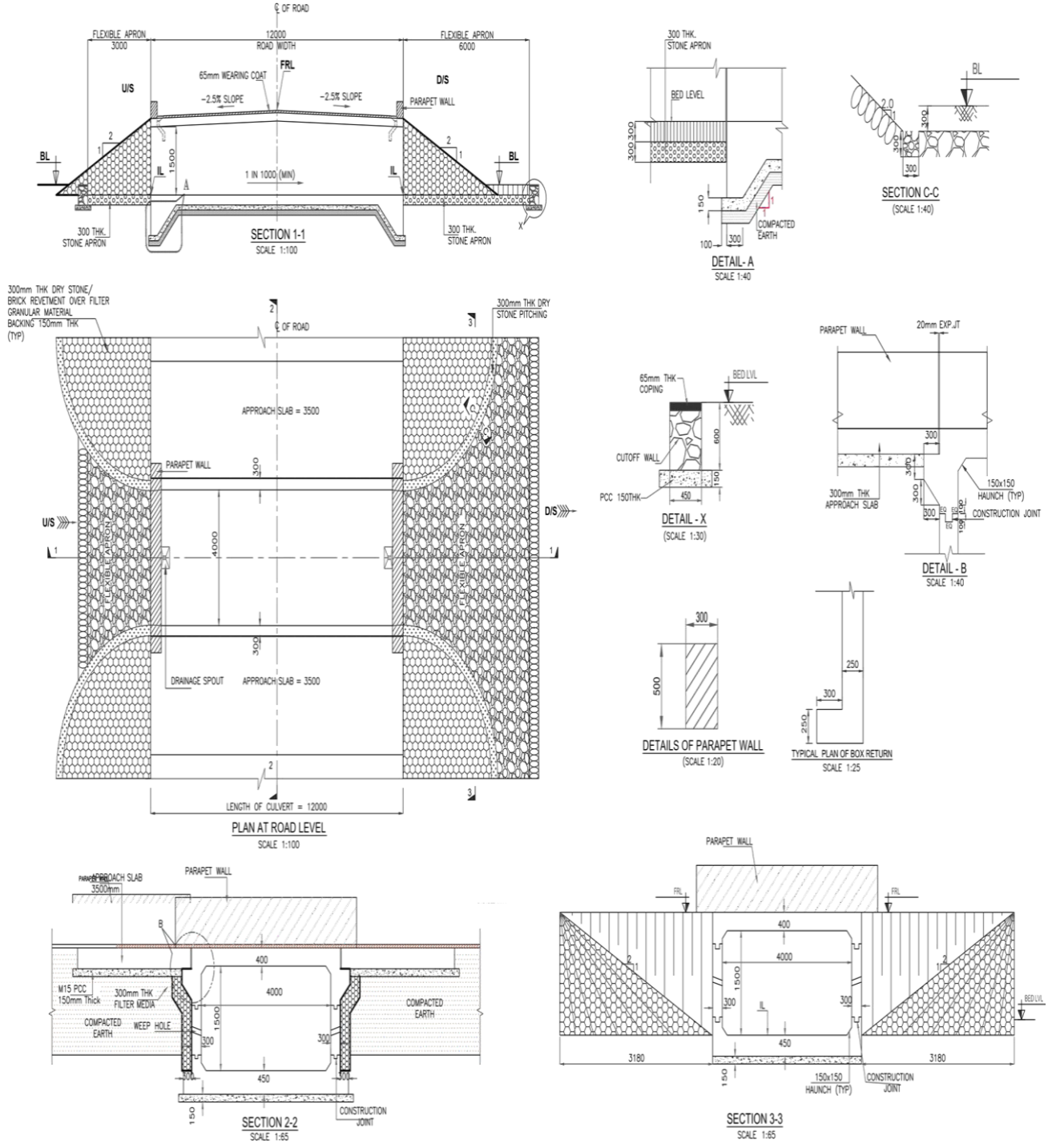
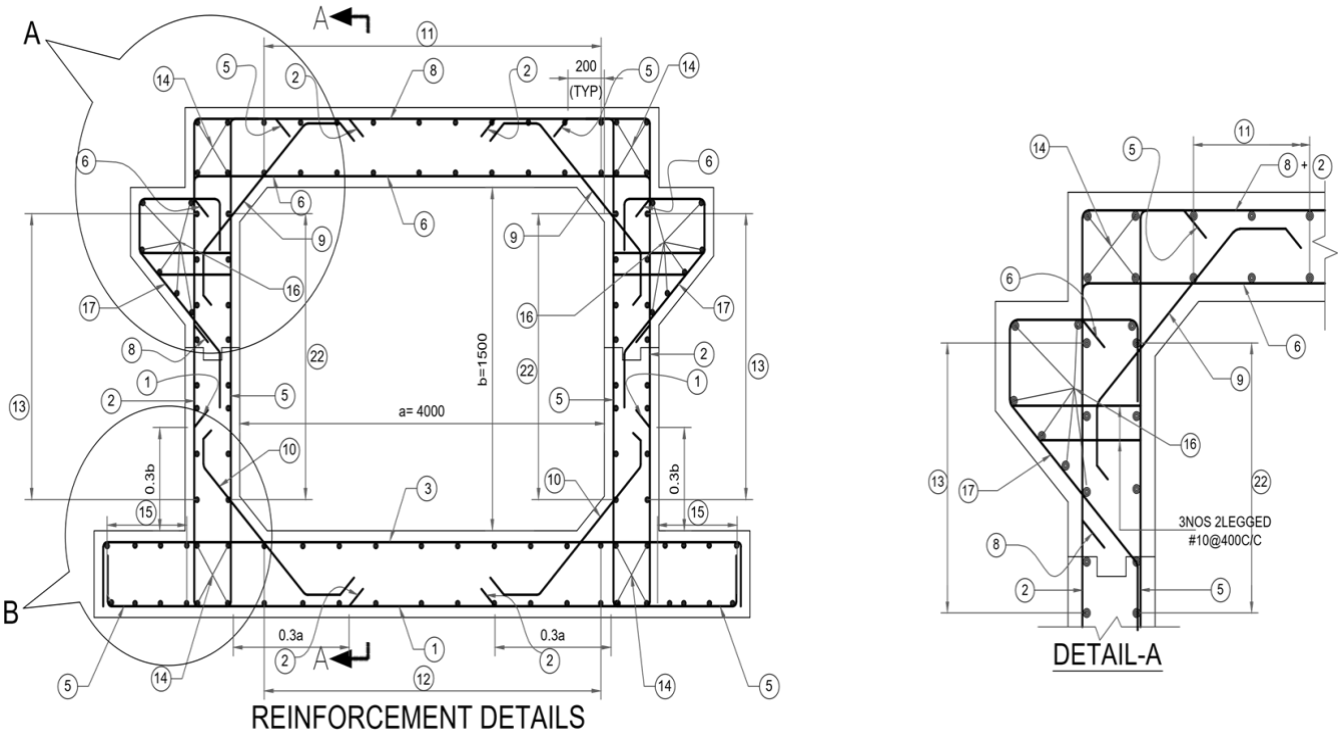
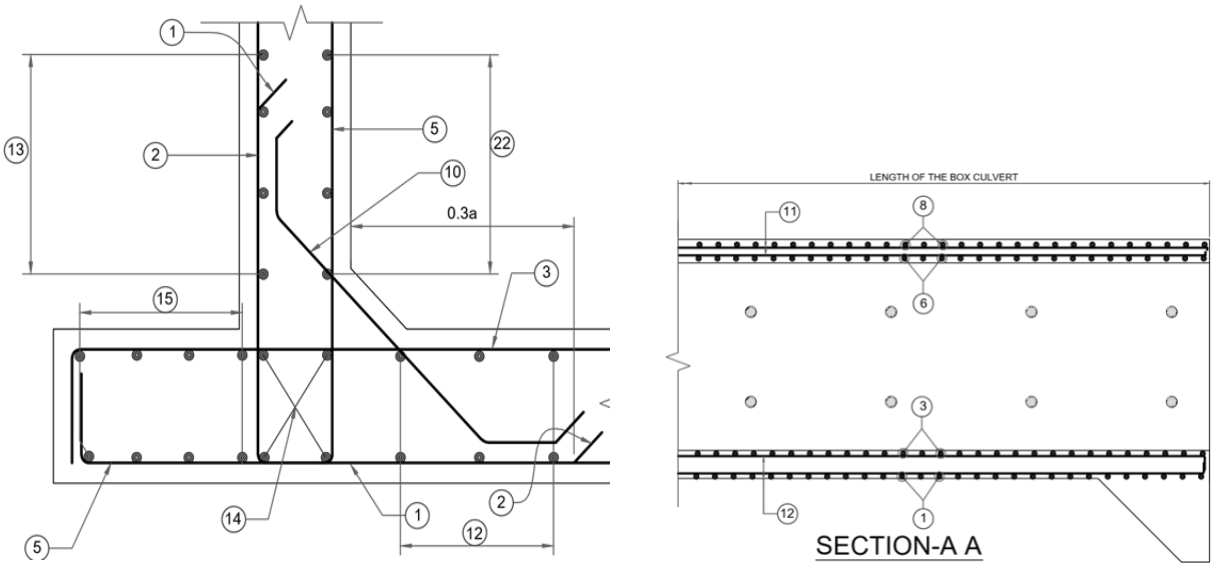


Fig. 4.1: Structural plan of Box culvert

2. REINFORCMENT DETAILS



SINGLE CELL BOX CULVERT



PARAPET WALL

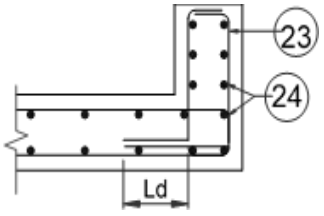


Fig. 4.2: Reinforcement details

3. BAR BENDING SCHEDULE

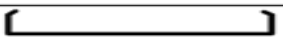
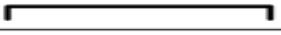
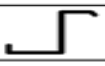
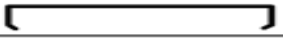
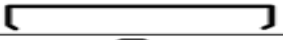
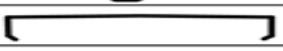
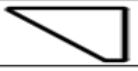
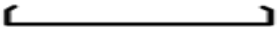
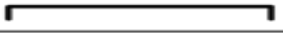
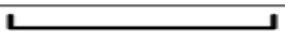
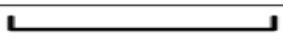
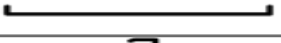
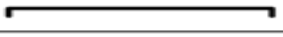
BAR TYPE	DIA MM	LENGTH OF BARS	SPACING MM	BAR SHAPE	NO OF BARS	TOTAL LENGTH IN M	TOTAL WEIGHT
1	10	5.540	150		81	448.740	277.000
2	10	5.090	150		81	824.580	509.000
3	12	5.240	150		81	424.440	377.280
4	NOT IN USE				0	0	0
5	12	2.890	150		81	468.180	416.160
6	12	4.470	150		81	362.070	321.840
7	NOT IN USE				0	0	0
8	10	6.040	150		81	489.240	302.00
9	10	0.981	150		81	158.863	98.063
10	10	0.981	150		81	158.863	98.063
11	10	12.410	250		15	372.300	229.815
12	10	12.510	250		15	375.300	231.667
13	10	12.210	250		5	122.100	75.370
14	10	12.0	16 Nos.		16	192.00	118.519
15	10	12.510	175		3	75.060	46.332
16	12	12.0	12 Nos.		12	144.0	128.00
17	12	1.664	175		70	232.997	207.108
18	NOT IN USE				0	0	0
19	NOT IN USE				0	0	0
20	10	3.625	175		28	202.973	125.292
21	10	4.600	12Nos.		12	55.200	34.074
22	10	12.210	175		8	190.360	120.593
TOTAL STEEL REQUIRED FOR CULVERT = 3716.178 KG							
23	12	1.5	150		9	27	24
24	12	1.4	150		4	11.20	9.956
TOTAL STEEL REQUIRED FOR PARAPET WALL= 33.956 KG							
25	12	3.8	150		79	300.20	266.844
26	12	3.8	150		79	300.20	266.844
27	12	11.9	150		23	273.70	243.289
28	12	11.9	150		23	273.70	243.289
TOTAL STEEL REQUIRED FOR APPROACH SLAB = 1020.267KG							
29	12	1.950	250		3	23.400	20.800
30	12	1.070	250		7	29.960	26.631
31	12	1.950	250		3	23.400	20.800
32	12	1.070	250		7	29.960	26.631
TOTAL STEEL REQUIRED FOR BOX RETURN =94.862KG							
TOTAL WEIGHT (KG) 4865.262							

Fig. 4.3: details of bar bending schedule

CHAPTER 5

DETAILS OF BOX CULVERT COMPONENTS

1. DIMENSIONS OF BOX CULVERT COMPONENTS

- ❖ Length of Culvert: 12m
- ❖ Box culvert dimensions: 3m*1.5m
- ❖ Approach slab width: 3.5m
- ❖ Flexible apron:
- Width: 0.3m
- Height: 0.6m
- Slope: 1:2
- ❖ Stone pitching: 0.3m
- ❖ Parapet wall width: 300mm

1. COMPONENTS OF BOXCULVERT

I. **Bottom slab:** The bottom slab is loaded at its edge by the weight of the digester wall. In the case of a spherical shell, the weight of the earth load also acts on it. The bottom slab distributes the weight over the ground of the site. The larger the foundation area, the less settlement will be experienced.

II. **Deck slab:** A slab of concrete used to make the base for the roadway, railway, pedestrian walkaway, etc. on the bridge.

III. **Haunch:** An extension, knee like protrusion of the foundation wall that a concrete porch or patio will rest upon for support.

IV. **Wing wall:** wing wall is a smaller wall attached or next to a larger wall or structure.

V. **Return wall:** a wall that makes a decided angle with and is approximately the same height as an outer wall of a building and that is distinguished from a partition or a low wall carrying a partition.

VI. **Drop wall:** This type of wall doesn't support floor or roof loads above them which means it won't carry any of the weight of the structure above it. Non-Load bearing walls are also called as Drop wall or Filling wall.

VII. **Curtain wall:** The primary purpose of a curtain wall system is to protect the building interior against the exterior natural phenomena such as sun exposure, temperature changes, earthquake, rain, and wind. This protection can be separated into two major categories, namely structural safety and interior environmental control.

CHAPTER 6

TASKS PERFORMED IN CULVERT CONSTRUCTION

COMPLETE METHOD STATEMENT FOR BOX CULVERT CONSTRUCTION

The construction sequence of box culvert mainly consists of following activities:

1) Raft construction (foundation)
2) Wall construction (substructure)
3) Deck construction (Superstructure)

1. CONSTRUCTION OF CONCRETE CULVERT RAFT (stage-1):

a) SURVEY AND SETTING OUT

- Survey points shall be marked on either direction of alignment by the total station from control points.
- A benchmark shall also be established at nearby site location where no disturbance will occur throughout the execution phase.
- The benchmark shall be checked at the frequent interval as and when required.
- The foundation shall be marked on the ground with the clearance of formwork space required.
- All the Survey instruments used shall be calibrated periodically as per the Calibrationplan. Survey check reports/other relevant data shall be maintained in relevant inspection formats.

b) DEWATRERING

The open foundations are provided mainly for the cross-drainage structures, hence required advance planning for dewatering before excavation to commence as per conditions. If required water shall be diverted through other channels, or otherwise dewatering shall be done if required. Pumped out water shall be released at the farthest point to the maximum possible.

C) EARTH WORK AND EXCAVATION FOR RAFT

The excavation shall be done with safe side slopes as per ground conditions and with sufficient margin for working on structural concrete. Excavation shall be carried out either by JCB or

excavator, and excavated materials shall be disposed of by using tractor trolleys or dumpers as directed. The pit level reached up to PCC bottom, shall be properly levelled and compacted before laying plain cement concrete.

c) LEVELLING COURSE (PCC) FOR CROSS DRAINAGE STRUCTURE

The excavated pit shall be manually dressed with sufficient working space around the raft to be constructed. Fix forms like ISMC or wooden plank sat the edge as formwork P.C.C Shall be supplied from the batching plant through transit mixers. It shall be manually spread and compacted in a uniform layer of levelling course thickness. After initial the initial set, the concrete shall be sprinkled with water to save it from cracking. Curing shall be done by keeping it moist with Hessian cloth or by a continuous spray of water. After allowing it to gain strength over 24 hours, it shall be released for raft activities.

d) REINFORCEMENT BINDING FOR CULVERT RAFT

As per the approved construction drawings and bar bending schedule reinforcement of raft is prestraightened/cut/bend in the rebar yard. Rebar shall be tied as per approved drawings and bae bending schedule. To hold the top rebar mesh of raft rebar chairs shall be provided at appropriate places to avoid the sagging of top mesh. After completion of top reinforcement, erect the wall vertical bars with binders/spacers. Necessary pipe support with an inclined member shall be provided to the vertical bars temporarily from the sides to avoid tilting of rods.

e) FORM WORK FIXING FOR CULVERT RAFT

Concrete cover blocks of the same grade that of foundation concrete shall be tied to there in for cement before fixing formwork. Steel formwork plates applied with de-moldings oil is fixed in position with the help of props and ties/spacers against each other to line and level as per formwork and staging drawing. The formwork shall be properly jointed with bolts and washer. To keep the frame work joints leak proof, forms or masking tape shall be used in joints.

f) BOXCULVERT RAFT CONCRETING

Concrete shall be supplied from batching plant through transit mixers. Concrete shall be poured into the foundation using direct concrete pump as per accessibility. Chutes shall be made using M.S.

sheets/CGI sheets supported by structural steel members. Chutes shall be placed with an appropriate

slope so that concrete free flows.

Concrete shall be laid in 300 mm to 450 mm thick layers and vibrated with diesel or electrically operated 60 mm needle vibrators. The exposed top surface of the concrete shall be smooth finish using mason's trowel. The wall portion shall be made with Shear leys, as shown in the drawing. Cut piece reinforcement rods of diameter higher than 25 mm shall be embedded along the center line of the base raft support inclined props to be used in 2nd stage formwork of wall before final setting of concrete. After the initial set, protect the concrete surface with a moist hessian cloth. After final set mortar bunds shall be made for ponding of water, the sand layer is laid in bunds to retain water, the sand layer is laid in bunds to retain water for the proper curing. Within 24 hours, concrete will gain sufficient strength, and de-shuttering shall be done carefully.

g) BOXCULVERT RAFT FORMWORK REMOVAL

The concrete shall be allowed to gain strength over 12 to 24 hours. Then forms shall be removed without damage to concrete. The forms, side supports and shoring, shall be safely removed, cleaned and stacked properly for future use. The exposed concrete side surfaces shall be inspected for blemishes. Top of the raft shall be provided with cement sand mortar bund and kept inundated with water for curing till curing period is over.

2. BOXCULVERT WALL CONSTRUCTION (STAGE-2):

The construction joint between wall and deck shall be provided as per the following guidelines:

- **For Box Culvert without Cushion**- Construction Joint shall be 300mm below the end of corbel level.
- **For box culvert with Cushion**- Construction Joint shall be 300mm below the deck slab bottom level.
- Maximum wall lift height in a single pour shall be restricted to 2.35m. Incase wall lift height is greater than above, and the intermediate lift shall be planned accordingly.

i. BOXCULVERT WALL REINFORCEMENT

Against the dowels left through the raft, balance reinforcement shall be tied for the predetermined lift to be concreted. Vertical rods shall be provided with required overlaps as per construction drawings. Efforts shall be made to minimize overlaps. Horizontal shall be tied position.Concrete cover blocks tied with reinforcement as required.

ii. BOX CULVERT WALL FORMWORK

After completion of reinforcement work, Steel forms in panels shall be erected, aligned and fixed in positions as required against the already tied reinforcement. The line and level shall be achieved as per approved drawings and then cleared the wall for concreting.

iii. BOXCULVERTWALLCONCRETING

The concrete mixed from centralized batching plant shall be delivered through transit mixers. It shall be placed manually or through cranes + bucket/concrete pumps as site condition. Concrete shall be laid in 350-400mm layer and vibrated with needle vibrators.

iv. FORMWORK REMOVAL, INSPECTION AND CURING

After gaining strength over about one day, the side from panels shall be safely removed, cleaned and stacked for future use/lifted up and fixed for the next lift. The de-molded concrete surface shall be inspected for blemishes if noticed shall be mended immediately as per approved methodology. The exposed concrete surfaces shall be covered with moist hessian cloth and shall be maintained moist over the curing period.

3. BOX CULVERT DECK WITH WALL 2nd LIFT AND CORBEL CONSTRUCTION (STAGE-3)

The general construction methodology shall be comprised of following:

1. Fabrication of shutter and reinforcement
2. Staging
3. Formwork and reinforcement
4. concrete

(i) FABRICATION OF SHUTTER AND REINFORCEMENT

- Standard shutters shall be used, or required size shutters shall be fabricated at centralized fabrication yard as per drawing for G.A of Formwork & Staging. The shutters shall be transported to site by truck/trailer.
- Reinforcement shall be fabricated at the centralized yard as per BBS made in accordance with

the latest "Good for Construction" Drawing and approved by Engineer and it shall be transported to site by truck/trailer.

- Store the fabricated reinforcements on wooden/concrete sleepers to avoid any contamination from soil/groundwater.

(ii) DECK SLAB STAGING

- After completion of the wall up to required height, staging or deck will start.
- Erect, vertical member in the form of props / H-Frame /MS Pipe/ Cup-lock pipe above the base slab of RCC Box in between the walls as per staging drawing. Brace the vertical members in both directions and diagonally.
- Erect the longitudinal girder and cross girders as per staging drawing.

(iii) DECK SLAB FORMWORK AND REINFORCEMENT

- Parallel with girder erection fix the balance wall inner side shutter and align by taking support from the staging erected as per staging and formwork drawing. Apply shuttering oil to the formwork before fixing.
- Fix soffit shuttering over cross girder. Check the soffit shuttering level and introduce necessary wooden packing below the shuttering joints for having provision for de shuttering and levelling.
- Apply shuttering oil over the soffit shuttering and start reinforcement work as per the GFC drawings.
- Fix the prefabricated reinforcement bars for deck as well as for balance wall portion of the wall as per GFC drawings. Reinforcement cover shall be maintained as per GFC Drawing by means of cover blocks placed at suitable intervals. The cover Block shall be of the same grade of concrete of deck.
- Fix the reinforcement bars for the crash barrier reinforcement as per GFC Drawing.
- Fix the side/end shutter of wall and deck after applying shuttering releasing agent.
- To keep the shutter joints leak-proof, forms or masking tape shall be used in joints.
- Support the side/end shutters by inclined support members, as shown in the formwork/staging drawing.

(iv) BOXCULVERT DECK SLAB CONCRETING

- After checking of staging, formwork and reinforcement, cast the wall and deck. Concrete shall be placed in a single continuous pour in such a sequence, which will avoid the formation of cold joints.
- Concrete shall be produced in the controlled batching plant as per approved Mix Design and shall be transported to site by Transit Mixer. The slump and temperature of concrete shall be checked at the site before pouring, and it should be as per the requirement of inspection and test plan of the casting of RCC Box/specification of the contract. Concrete shall be poured in the formwork by Static concrete Pump/placer boom without any disruption to avoid cold joints. Separate arrangement for concreting shall be kept ready for any major mechanical fault of concreting equipment.
- Needle vibrator is to be operated vertically in combination with the shutter vibrator. No vibrator to be run for more than 2 minutes at one place to prevent segregation. Do not allow any pocket formation or honey-comb in the concrete. Feel the flow of concrete by hammering the shutters by a wooden mallet.
- Deck concrete top-level shall be finished smoothly.
- Removetheendandsideshutterafter24hrsofconcreting.
- Start curing of deck and wall by using wet Hessian cloth or by continuous water sprinkling arrangement to keep the girder wet up to 14 days.
- The soffit and staging shall be removed depending on the span length as per guide lines of relevant IS Code.

CHAPTER 7

QUALITY CONTROL

QUALITY CONTROL IN CONCRETE WORK

Quality control is the part of quality management that ensures products and service with requirements. It is a work method that facilitates the measurement of the quality characteristics of a unit, compares them with the established standards, and analyses the differences between the results obtained and the desired results in order to make decisions which will correct any differences. Technical specifications define the type of controls that must be carried out to ensure the construction works are carried out correctly. They include not only products material, but also the execution and completion of the work. Since concrete keeps a very important place in modern building construction works, so it is necessary to test and inspection of concrete work at Site.

Following are the quality checks made while concreting:

- Proper compacting of a poured concrete is done using vibrator so as to reduce the voids.
- Proper curing of concrete work is done for at least 7 to 10 days for gaining strength.
- Level of formwork is same throughout the building while casting walls and slabs.
- Necessary tests like slump test initial and final setting time tests are done.

1) BEFORE CONCRETING

- Ensure that the centering sheets have been cleaned and sealed with sealing tape so that there is no leakage of slurry.
- Ensure that all reinforcements are in place as per drawings. Also ensure that the chairs are not dislocated or bent.
- Ensure if all cover blocks are kept in place and are intact.
- Check if all sunken areas have been properly cleaned of dust and oily substances using high- pressure water cleaners.

2) DURING COCRETING

- Ensure a proper grade of concrete as recommended by the structural consultant is employed.
- Ensure proper expansion joints are provided as per drawing.

- Check the top surface of fresh concrete for evenness.
- Ensure sufficient compaction using appropriately sized concrete vibrator needle.

3) AFTER CONCRETING

- Curing should be carried out as per the given guidelines.
- Ensure that the columns are covered with a damp hessian jute cloth for at least 10 days (Preferable 14 days).
- For slabs, ensure that ponding is done and a water level of 25mm is maintained.
- If honeycombing is seen after de-shuttering, it has to be immediately touched with special premix concrete of approved make.

➢ Ensure the cube test results are available at the end of 7th and 28th day, after concreting. A 3rd day cube test results can also be asked for if required and recommended by the structural consultant.

CHAPTER 19

REPAIRING OF ROADS

Road widening is an act of making the surface pavement of road wider to make safer and allow greater traffic volumes.

1. INTRODUCTION OF REPAIRING OF ROADS

The high growth number of vehicles will increase the movement and use of transport infrastructure. Road widening is one of the actions that can be used as the solution. However, this solution also increases the traffic performance.

This is because people will switch to use the new widened because they believe this road can accommodate the existing traffic volume. For finding out the effects of road widening towards the increasing of traffic performance and road capacity, it is necessary to conduct a research and an analysis.

The road network of any city is its lifeline and the evaluation of their performance is very necessary for future traffic planning, design, operation and maintenance, etc. Traffic flow in most cities of India is a mixed traffic characteristic and also traffic congestion is the common problem in most major cities. The objective is to improve the performance operation of the urban road network by proposing the proper alternatives to enhance the traffic capacity.

2. SITE INTERVIEW

This project deals with the widening of road from Mallur to Kachahalli gate distance of 2 Km.

3. PROJECT DETAILS

1. Project type: Widening of road.
2. Project guide: Mr. Murali V (AEE), Mr. Swamy N (site engineer).
3. Location: Mallur to Kachahalli gate.
4. Length of road: 2 Km.

CHAPTER 9

PAVEMENT DESIGN

1) DESIGN PRINCIPLES

The philosophy of pavement design involves designing pavements for satisfactory functional and structural performance of the pavement during its intended service life period. Roughness caused by variation in surface profile, cracking of layers bound by bituminous or cementitious materials, rutting (permanent or plastic deformation) of unbound/unmodified or partially modified subgrade, granular layers and bituminous layers are the primary indicators of the functional and structural performance of pavements.

The mechanistic-empirical design approach, which was used in the second and third revisions of IRC: 37, is retained in the current revision as well for the design of flexible pavements. The theory selected for the analysis of pavements is 'linear elastic layered theory' in which the pavement is modeled as a multi-layer system. The bottom most layer (foundation or subgrade) is considered to be semi-infinite, and all the upper layers are assumed to be infinite in the horizontal extent and finite in thickness. Elastic modulus, Poisson's ratio and thickness of each layer are the pavement inputs required for calculation of stresses, strains and deflections produced by a load applied at the surface of the pavement. IITPAVE software, which is an updated version of FPAVE developed for MORTH Research Scheme R-56 "Analytical design of Flexible Pavement", has been used for the analysis of pavements.

The vertical compressive strain on top of the subgrade is considered in these guidelines to be the critical mechanistic parameter for controlling subgrade rutting. Horizontal tensile strain at the bottom of the bottom bituminous layer is taken as the causative mechanistic parameter which has to be limited to control bottom-up cracking in bituminous layers. Similarly, to ensure that the Cement Treated Bases (CTB) do not fail by fatigue cracking, tensile strain and tensile stress at the bottom of the CTB are considered to be the critical parameters to control. Rutting within bituminous layers caused by accumulated plastic (permanent) deformation in these layers due to repeated application of traffic loads is another major distress occurs in bituminous pavements. The strain values used in the fatigue and rutting performance models are computed using the elastic moduli of bituminous mixes and other layer materials. Also, the elastic modulus of the bituminous layer appears in the fatigue performance criterion. Suitable recommendations have also been made in the

Guidelines for:

(i) Fatigue cracking and moisture damage resistant mixes for the bottom (base) bituminous layer.

(ii) Rut and moisture damage resistant bituminous mixes for the intermediate (binder) bituminous layer (if provided).

(iii) Rut, moisture damage, fatigue cracking and age resistant surface course.

(iv) Drainage layer for removal of excess moisture from the interior of the pavement.

2) PERFORMANCE CRITERIA

The following performance criteria are used in these guidelines for the design of bituminous pavements.

(i) SUBGRADE RUTTING CRITERIA

An average rut depth of 20 mm or more, measured along the wheel paths, is considered in these guidelines as critical or failure rutting condition. The equivalent number of standard axle load (80kN) repetitions that can be served by the pavement, before the critical average rut depth of 20 mm or more occurs, is given by equations 2.1 and 2.2 respectively for 80 % and 90 % reliability levels.

NR = 4.1656 x 10-08 [1/εv] 4.5337(for 80 % reliability).....(2.1)

NR = 1.4100 x 10-08 [1/εv] 4.5337 (for 90 % reliability) .....(2.2)

NR = subgrade rutting life (cumulative equivalent number of 80 KN standard axle loads, that can be served by the pavement before the critical rut depth of 20 mm or more occurs) εv = vertical compressive strain at the top of the subgrade calculated using linear elastic layered theory by applying standard axle load at the surface of the selected pavement system.

NR = 4.1656 x 10-08 [1/εv] 4.5337(for 80 % reliability) εv =784.38 x 10-6 (Allowable vertical compressive strain)

IITPAVE software is used in these guidelines for the analysis of pavements. For the computation of stresses, strains and defections in the pavement, thicknesses and elastic properties (elastic modulus and Poisson's ratio) of different layers are the main inputs. For the calculation of vertical compressive strain on top of the subgrade, horizontal tensile strain at the bottom of the bottom bituminous layer and the horizontal tensile strain at the bottom of cement treated base6(CTB) layer, the analysis is done for a standard axle load of 80 kN (single axle with dual wheels).Only one set of dual wheels, each wheel carrying 20 kN load with the centre to centre spacing of 310 mm between the two wheels, applied at the pavement surface shall be considered for the analysis. The shape of the contact area of the tyre is assumed in the analysis to be circular. The uniform vertical contact stress shall be considered as 0.56 MPa. However, when fatigue damage analysis of cement treated bases (CTB) is carried the contact pressure used for analysis shall be 0.8 MPa. The layer interface condition was assumed to be fully bound for all the layers of the pavement. The materials are assumed to be isotropic.

(ii)FATIGUE CRACKING CRITERIA FOR BITUMINOUS LAYER

The occurrence of fatigue cracking (appearing as inter connected cracks), whose total area in the section of the road under consideration is 20 % or more than the paved surface area of the section, is considered to be the critical or failure condition. The equivalent number of standard axle (80kN) load repetitions that can be served by the pavement, before the critical condition of the cracked surface area of 20 % or more occurs, is given by equations 2.3 and 2.4 respectively for 80 % and90 % reliability levels.

Nf = 1.6064*C*10-04 [1/εt] 3.89* [1/MRm] 0.854 (for 80 % reliability) .....(2.3)

Nf = 0.5161*C*10-04 [1/εt] 3.89* [1/MRm] 0.854 (for 90 % reliability) ..... (2.4)

Where;

C = 10M, and $MM = 4.84\ [VVVVV/\ (VVV+VVVVV) - 0.69]$

Va = per cent volume of air void in the mix used in the bottom bituminous layer.

Vbe = per cent volume of effective bitumen in the mix used in the bottom bituminous layer. Nf = fatigue life of bituminous layer (cumulative equivalent number of 80 kN standard axle loads that can be served by the pavement before the critical cracked area of 20 % or more of paved surface area occurs).

εt = maximum horizontal tensile strain at the bottom of the bottom bituminous layer (DBM) calculated using linear elastic layered theory by applying standard axle load at the surface of the selected pavement system.

MRm = resilient modulus (MPa) of the bituminous mix used in the bottom bituminous layer, selected as per the recommendations made in these guidelines.

The factor 'C' is an adjustment factor used to account for the effect of variation in the mix volumetric parameters (effective binder volume and air void content) on the fatigue life of bituminous mixes and was incorporated in the fatigue models to integrate the mix design considerations in the fatigue performance model.

A popular approach used for enhancing the fatigue life of bituminous layers is to make the bottom most bituminous mixes richer in bitumen. Larger binder volume in the mix means an increased thickness of the binder film in the mix and an increase in the proportion of bitumen over any cross section of the layer normal to the direction of tensile strain. Besides having longer fatigue lives, larger binder volumes will also be beneficial in making the mix more moisture damage resistant due to thicker binder films which also reduce the aging of the binder. Considering that the bottom bituminous layer will be subjected to significantly lower stresses and lower summer temperatures compared to the upper layers, the chance of rutting of the lower layer will be less.

Nf = 1.6064*C*10-04 [1/εt] 3.89* [1/MRm] 0.854 (for 80 % reliability) 5x106= 1.6064*1.12*10-04 [1/εt] 3.89* [1/2000]0.854 (for 80 % reliability) εt =391.77 x 10-6(Allowable maximum horizontal tensile strain).

3) RELIABILITY

These Guidelines recommend 90% reliability performance equations for subgrade rutting (equation 2.2) and fatigue cracking of bottom bituminous layer (equation 2.4) for all important roads such as Expressways, National Highways, State Highways and Urban Roads. For other categories of roads, 90 % reliability is recommended for design traffic of 20 msa or more and 80per cent reliability for design traffic less than 20 msa.

4) TRAFFIC

a) GENERAL

The design traffic is estimated in these guidelines in terms of equivalent number of cumulative standard axles (80 kN single axle with dual wheels). The following inputs are required for estimating the design traffic (in terms of cumulative standard axle load repetitions) for theselected road for a given design period.

I. Initial traffic (two-way) on the road after construction in terms of the number of commercial vehicles (having the laden weight of 3 tons or more) per day (cvpd).

II. Average traffic growth rate(s) during the design life period.

III. Design life in number of years.

IV. Spectrum of axle loads.

V. Factors for estimation of the lateral distribution of commercial traffic over the Carriageway.

- Only the commercial vehicles having gross vehicle weight of 3 tons or more are considered for the structural design of pavements.
- Estimation of the present-day average traffic should be based on the seven-day 24- hourtraffic volume count made in accordance with IRC: 9.

b) TRAFFIC GROWTH RATE

The growth rates may be estimated as per IRC: 108. Typical data required for estimation of the growth rates (r) are:

(i) Past trends of traffic growth.

(ii) Demand elasticity of traffic with respect to macroeconomic parameters like the gross domestic product and state domestic product) and the demand expected due to specific developments and land use changes likely to take place during the design life period.

- Traffic growth rates shall be established for each category of commercial vehicles. In the absence of data for estimation of the annual growth rate of commercial vehicles or when the estimated growth rate is less than 5 per cent, a minimum annual growth rate of 5 per cent should be used for commercial vehicles for estimating the design traffic.

c) DESIGN PERIOD

The design period to be adopted for pavement design is the time span considered appropriate for the road pavement to function without major rehabilitation. It is recommended that a design period of 20 years may be adopted for the structural design of pavements for National Highways, State Highways and Urban Roads. For other categories of roads, a design period of 15years is recommended. Pavements for very high-density corridors (more than 300 msa) and expressways shall preferably be designed as long-life pavements. Otherwise, for such corridors, the pavement shall be designed for a minimum period of 30 years. The commercial traffic, converted into equivalent repetitions of the standard axle, and adjusted for directional distribution, lateral distribution over the carriageway width, etc., is the design traffic.Stage construction of pavement may be adopted in projects where the growth of traffic is uncertain or future traffic volumes are expected to increase substantially due to future developments. Stage construction may also be adopted in projects for which subsequent maintenance is mandated on performance basis. For projects in which stage construction is adopted, base and sub-base layers shall be designed for the full design period. Stage construction is not allowed for pavements with cement treated bases and sub-bases. The stage-1 bituminous layer(s) of the pavement should be designed for more traffic than estimated for the initial (first) stage design period (or traffic) so that the pavement will have at least 40 % life remaining after stage-1 period (traffic). Assuming that the pavement life consumed increases linearly with traffic, the design traffic for stage-1 shall be taken as 1.67 times the design traffic estimated forstage-1 period. If designed and constructed for only the stage-1 design traffic,

the pavement, especially the bituminous layer, may not have adequate the structural condition and may develop full depth cracking and thus may not be suitable for periodical maintenance measures such as patching, crack sealing and micro- surfacing.

d) VEHICLE DAMAGE FACTOR

Vehicle Damage Factor (VDF) is a multiplier to convert the given number of commercial vehicles having different axle configurations and different axle weights into an equivalent number of standard axle load (80 KN single axle with dual wheels) repetitions. For converting one repetition of a particular type of axle carrying a specific axle load into equivalent repetitions of 80 KN single axle with dual wheel, equations below may be used.

I. Single axle with single wheel on either side = (*AAAAAAVV MMllVVll iiii kkkk*/65)4

II. Single axle with dual wheel on either side = (*AAAAAAVV MMllVVll iiii kkkk*/80)4

III.Tandem axle with dual wheel on either side = (*AAAAAAVV MMllVVll iiii kkkk*/148)4

IV.Tridem axle with dual wheel on either side = (*AAAAAAVV MMllVVll iiii kkkk*/224)4

- For small projects, in the absence of weigh pad, the axle loads of typical commercial vehicles plying on the road may be estimated approximately from the type of goods carried. Where information on the axle loads is not available and the proportion of heavy vehicles using the road is small, the indicative values of vehicle damage factor given in table below can be used.

e) LATERAL DISTRIBUTION

Lateral distribution of commercial traffic on the carriageway is required for estimating the design traffic (equivalent standard axle load applications) to be considered for the structural design of pavement. The following lateral distribution factors may be considered for roads with different types of the carriageway.

- **Single-lane roads;** Traffic tends to be more channelized on single-lane roads than on two- lane roads and to allow for this concentration of wheel load repetitions, the design should be based on the total number (sum) of commercial vehicles in both directions.

  Intermediate lane roads of width 5.50 m; the design traffic should be based on 75 per cent of the two-way commercial traffic.
- **Two-lane two-way roads;** the design should be based on 50 per cent of the total number of commercial vehicles in both the directions.
- **Four-lane single carriageway roads;** 40 per cent of the total number (sum) of commercial vehicles in both directions should be considered for design.

- **Dual carriageway roads;** the design of dual two-lane carriageway roads should be based on 75 per cent of the number of commercial vehicles in each direction. For dual three-lane carriageway and dual four-lane carriageway, the distribution factors shall be 60 per cent and 45 per cent respectively.

5. PAVEMENT DESIGN PROCEDURE

Steps involved in the pavement design:

- Selecting a trial composition: In selecting the pavement composition, the designer should be guided by the expected functional requirements of the layers in a high performing pavement, such as a strong subgrade, a well-drained sub-base strong enough to withstand the construction traffic loads, a strong crack, rutting and moisture damage resistant bituminous base and a bituminous surfacing that is resistant to rutting, top-down cracking and to damages caused by exposure to environment.
- Bituminous Mix design and the mix resilient modulus: Sourcing of the material ingredients for the mix has to be decided and the physical requirements and properties of the sourced materials should be checked for their conformity with the provisions of applicable Specifications and these Guidelines. The right proportioning of the mix ingredients or the design mix should be arrived at by trials and testing. Where the resilient modulus is required to be tested in accordance with the procedures recommended in case the resilient modulus determined in this manner exceeds the limiting values specified in these Guidelines, the latter value has to be adopted. In case, it is less than the limiting value, the actual value should be adopted in the design.
- Selecting layer thickness: The selection of trial thicknesses of various layers constituting the pavement should be based on the designers' experience and subject to the minimum thicknesses recommended in these Guidelines and in other relevant specifications (when there is no specific recommendation in these guidelines) from functional and constructability considerations.
- Structural Analysis of the selected pavement structure: This is to be done by running the IITPAVE software or any other linear elastic layer programme using as inputs the layer thicknesses, the layer moduli, the layer Poisson's ratio values, the standard axle load of 80 kN distributed on four wheels (20 kN on each wheel), and a tyre pressure as 0.56MPa. For carrying out fatigue damage analysis of cement treated bases, the axle load under consideration and a contact pressure of 0.80 MPa will be considered. The program will output the stresses, strains and deflections at selected critical locations in the pavement from which the values of critical mechanistic parameters can be identified for design.
- Computing the allowable strains/stresses: The allowable strains in the bituminous layer and subgrade for the selected design traffic are to be estimated using the fatigue and rutting models given in these guidelines. The inputs to the models are the design period of pavement in terms of cumulative standard axles, the resilient modulus value of the bottom layer bituminous mix, and the

volumetric proportion of the mix. For estimating the limiting tensile strain in the CTB layer, the elastic modulus of the CTB material is an input.

- Doing the iterations: A few iterations may be required by changing the layer thicknesses until the strains computed by IITPAVE are less than the allowable strains derived from performance models.

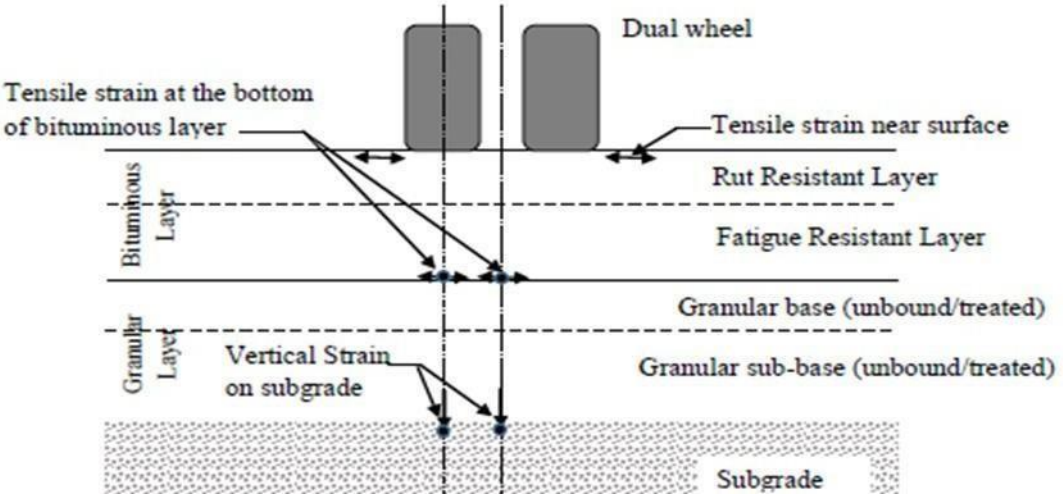


Fig. 9.1: a pavement section with bituminous layer(s), granular base and gsb showing the locations of critical strains

CHAPTER 10

COMPONENTS OF FLEXIBLE PAVEMENT

1. Prime coat
2. Tack coat
3. Surface course
4. Binder course
5. Base course
6. Sub base course
7. Compacted subgrade
8. Natural sub grade

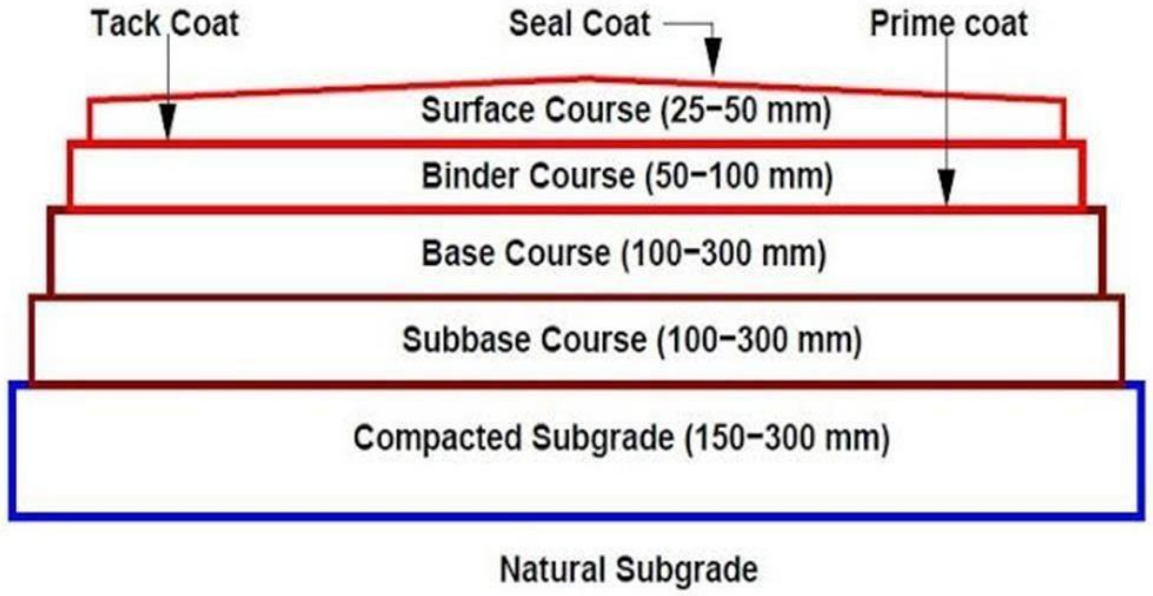


Fig. 10.1: typical cross section of flexible pavement

1. CONSTRUCTION METHODS

SETTING OUT

After the site has been cleared, the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings.

PREPARATION OF EARTH WORK

Existing ground scarified to a minimum depth of 150mm and compacted with ordinary roller.

EMBANKMENT WORK

Material from barrow pits used. Layer of earth shall be laid in not more than 25cm (loose) thick layers and compacted each layer of the soil up to 50cm below the subgrade level at OMC to meet 97% of modified proctor density.

2. CONSTRUCTION OF SUB-GRADE

The materials used in embankments, subgrades, earthen shoulders and miscellaneous backfills shall be soil, gravel, a mixture of these or any other material approved by the Engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability of the embankment/ subgrade.

Compaction by smooth wheeled roller at OMC to meet 97% of modified proctor density.

Requirement of density and compaction same as embankment.

CONSTRUCTION OPERATIONS

- Preparation of sub grade; Before laying sub base, the sub grade should be prepared by removing vegetation & extraneous matter, lightly sprinkled with water if necessary & rolled with two passes of 80 – 100KN smooth wheeler roller.
- Spreading & compacting; the sub base material should be spread on prepared sub grade with help of motor grader, its blades having controls for maintaining the required slope & grade.
- At the time of compaction, water content should be from 1% above to 2% below the optimum moisture content.
- Immediately rolling will start, if the thickness of compacted layer does not exceed 100mm, a smooth wheeled roller is used. For a compacted single layer up to 225mm, vibratory roller or heavy pneumatic tyre roller of min 200 to 300KN wt. is used.
- Rolling will start from lower edge & proceed towards upper edge longitudinally to achieve super elevation.
- The speed of roller shall not exceed 5km per hour.
- Rolling is continued till the density is achieved at least 98% of MDD for the material determined
- The surface of any layer of material on completion of compaction shall be will closed, free from movement under compaction equipment & from compaction planes, ridges, cracks or loose materials. If so, happens it should be re-compacted.

3. GRANULAR SUB BASE

The materials to be used for the work shall be natural sand, gravel, crushed stone or combination depending on grading requirement. The 40 mm down size aggregates are used to construct the sub base course. The main function of GSB is to drain out the water from earthen. Sieve analysis test is performed in GSB to determine the particle size distribution of the coarse aggregates and fine aggregates. The materials shall be free from organic or deleterious constituents.

MIX PROPORTIONS:

40 mm aggregates – 17%

20 mm aggregates – 18%

12 mm aggregates – 32%

Dust – 33%

COMPACTION TEST - CORE CUTTER

METHOD OBSERVATIONS:

1. Empty weight of core cutter = 960 g = w1
2. Diameter of core cutter = 10 cm = 100 mm
3. Height of core cutter = 13 cm = 130 mm
4. Volume of core cutter = 1021 cm3
5. Weight of core cutter soil = 3022 g = w2

CALCULATIONS:

Weight of soil = w2 – w1 = 2062 g

Bulk density = w2 – w1 / V = 2062/ 1021= 2.019
g/cc Moisture content = 9%
Dry density = 2.019/1+0.8 = 12.21 KN/m3

Fig. 10.2: conduction of core cutter method

GRANULAR SUB BASE GRADATION

SL NO.	IS sieve size in mm	wt.retained In mm	% of wt. retained	% of passing	gradation
1.	75	0	0	100	100
2.	53	0	0	100	80-100
3.	26.50	2697	32.80	67.2	55-90
4.	9.50	2524	30.70	36.5	35-65
5.	4.75	605	7.31	29.19	25-50
6.	2.36	468	5.69	23.5	10-20
7.	0.85	1260	15.32	8.18	2-10
8.	0.425	667	8.10	.08	0-5

Total weight = 8221 grams

Table 10.1: GSB gradation

4. BASE COURSE

Wet mix macadam (WMM) is proposed as granular base layer and dense bituminous macadam or bituminous macadam is used for bituminous base layer. This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared subgrade/sub-base/base or existing pavement as the case may be inaccordance with the requirements of these Specifications.

WET MIX MACADAM

Wet mix macadam consists of laying spreading and compacting of clean, crushed, well graded granular materials on prepared and approved sub base. The thickness of WBM shall not be less than 75 mm. The maximum thickness of single compacted layer base can be up to 250 mm.

MIX PROPORTIONS:

40 mm aggregates – 18%
20 mm aggregates – 20%
12 mm aggregates – 30%
Dust – 32%

CONSTRUCTION OPERATIONS

- Preparation of base - Before laying sub base, the sub grade should be prepared by removing vegetation & extraneous matter, lightlysprinkled with water if necessary & rolled with two passes of 80 – 100KN smooth wheeler roller.
- Provision of lateral confinement of aggregates – while constructing WMM, arrangement shall be made for lateral confinement of wet mix. This shall be done by laying in adjoining shoulders along with WMM.
- Preparation of mix – WMM is prepared in mixing plant where pug mill or pan type mixer of concrete batching plant is used. Optimum moisture for mixing is determined at the time of compaction, water in the WMM should not vary from optimum value. The mixed material should be uniformly wet & no segregation is permitted.

SPREADING OF MIX

- Immediately after mixing it is spread uniformly & evenly on prepared subgrade / subbase / base. In no case it should be dumped in heaps.
- The mix may be spread by paver finisher or motor grader.
- The motor grader is cable of spreading the material uniformly so as to achieve the specified slope & grade.
- No segregation of large & fine particles should be allowed.

COMPACTION

- After the mix has been laid to require thickness, grade & cross fall the same shall be compacted uniformly to the full depth by roller.
- If the thickness is 100mm single layer, smooth wheel roller is used. For compacted single layer up to 200mm vibratory roller is used. Same kind of rolling as in WBM is done as we discussed before.
- Along forms, Krebs, walls or other inaccessible places for rollers, mechanical tampers or plate compactor is used. Rolling should not be done when the subgrade in soft.
- If irregularities develop during rolling which exceed 12mm when tested with 3m straight edge, the surface should be loosened & premixed material added or removed.
- Rolling shall be continued till the density achieved is at least 98% of the max dry density for the material.
- After completion, the surface of any finished layer is well closed, free from movement under compaction equipment or any compaction planes, ridges, cracks & loose material.
- All loose, segregated area shall be made good to the full thickness of layer & after completion, the surface of any finished layer is well closed, free from movement under compaction equipment or any compaction planes, ridges, cracks &loose material.
- All loose, segregated area shall be made good to the full thickness of layer & re compacted.

WET MIX MACADAM GRADATION

SL NO.	IS sieve size in mm	wt. retained in mm	% of wt. retained	% of wt. passing	Gradation
1.	53	0	0	100	100
2.	45	0	0	100	80-100
3.	22.4	2240	44.93	55.07	55-90
4.	11.2	952	19.09	35.98	35-65
5.	4.75	617	12.37	23.61	25-50
6.	2.36	415	8.32	15.29	10-20
7.	0.60	385	7.92	7.57	2-10
8.	0.075	372	7.46	0.11	0-5

Total weight = 4985 grams

Table 10.2: WMM gradation

CHAPTER 11

CONSRUCTION EQUIPMENTS

The main construction equipment's used in this project are: -

1. Back Hoe
2. Static Smooth Wheeled Roller
3. Motor Grader
4. Vibratory Roller
5. Bitumen pressure sprayer
6. Paver

1. STATIC SMOOTH WHEELED ROLLER

The smooth wheeled rollers consist of one large steel drum in front and two steel drums on the rear. The gross weight of these rollers is in the range of 8- 10 tons (18000 to 22000 lbs.).

Fig. 11.1: static smooth wheeled roller

2. MOTOR GRADER

Spreading of aggregates in sub base and base course. Graders also produce inclined surfaces, to give can't or side slopes to roads.

Fig. 11.2: motor grader

3. VIBRATORY ROLLER

To compact pavement layers and sub grade to a high degree of densification. Both cohesive and non-cohesive materials can be compacted by vibratory rollers.10 to 12 tons capacity.

Fig. 11.3: vibratory roller

4. BITUMEN PRESSURE SPRAYER

Self-propelled type of bitumen pressure sprayer used. In narrow strips pressure hand sprayer used.

Fig. 11.4: bitumen pressure sprayer

5. PAVER

It lays the asphalt flat and provides minor compaction before it is compacted by a roller.

Types of Paver: These machines can be either mounted on wheels or on the tracks depending on the nature of the pavement pavers can be classified as follows:

1. Asphalt Crawler Paver
2. Asphalt Wheeled Paver
3. Concrete Pavers

Fig. 11.5: crawler paver

SITE PHOTOGRAPHS

Fig. 11.6: View of working site

Fig. 11.7: Concreting of Deck Slab

Fig. 11.8: reinforcement of culvert

Fig. 11.9: compaction of concrete

Fig. 11.10: curing of deck slab

Fig. 11.11: Road repairing work

Fig. 11.12: mechanical means of spreading of WMM layer

Fig. 11.13: manual means of spreading of granular layer

Fig. 11.14: Preparation of subbase

Fig. 11.15:Spreading of coarse aggregate

Fig. 11.16: final working day

CONCLUSION

Internship develops new skills and developed many already existing skills including innovativeness and creativity in design, working in a team-based environment, dealing with management, presentation and communication skills. It was found that they could easily be applied at college. It has been found that my ability to absorb and learn material has drastically improved, as well as my time management ability.

The main non-technical outcomes of the internship are as follows:

- **Situational awareness:** Attention to detail, Overall awareness, maintain concentration, Retain information (During shift), Anticipation of risk.
- **Conscientiousness:** Systematic and thorough approach, Checking, Positive attitude towards rules and procedures.
- **Communication:** Listening (people not stimuli), Clarity, Assertiveness, Sharing information.
- **Decision making and action:** Effective decisions, Timely decisions, Diagnosing and solving, Problems.
- **Cooperation and working with others:** Considering others' needs, supporting others, treating others with respect, dealing with conflict aggressive behavior.
- **Workload management:** multi-tasking and selective, attention, Prioritizing, Calm under pressure.
- **Self-management:** Motivation, Confidence and initiative, Maintain and develop skills and knowledge. Prepared and organized.

The main Technical Outcomes of the internship are as follows:

- For any structure it is very much important to provide quality to meet the structural requirements and also always as to plan for economical and good quality materials.
- Delay and Labour strike and also uncertainties in site like (delay in procuring materials) will increase the project cost, hence proper planning is to be done prior to the execution.
- Proper safety precautions at the working site should be adopted. Necessary workshop should be conducted.
- Preparatory meeting should be conducted on progress of work.
- Both client and contractors as to plan meting and should take necessary actions regarding the delay.

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