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Six Laning of Vijayawada bypass from China Autupalli (Design Ch. 0.000) to Gollapudi (Design Ch. 30.000) in Vijayawada - Gundugolanu section of NH-16

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ABSTRACT

Highway is a main road, especially one connecting major towns and cities. It is any public and private road or other public way on land. It is used for major roads, but also includes other public roads and public tracks. In INDIA highways are made by NHAI (National Highway Authority of India). In highway, mainly two type of highways construction we use flexible and rigid pavement. In flexible pavement it have some important layer. The layers are: Embankment, Subgrade, Granular sub base, Cement Treated Base, Wet Mix Macadam, Dense mix Bitumen Macadam, Bitumen Concrete mix. Embankment and Subgrade is natural soil layer under the pavement structure, in any case, it is a lowest layer of the pavement. Granular-Sub-base is often the main load- bearing layer of the pavement. Its role is to spread the load evenly over the subgrade. WMM (Wet Mix Macadam) modern technology- are base course layers for Pavement/Road design. DBM (Dense Bituminous Macadam) & BC (Bituminous Concrete) are the top most layers of a Bituminous Top Roads, whose thickness is determined my MSA & CBR. CBR ranges from 3% to 15 % for Flexible pavement as per IRC:37–2012.

Keywords: Highway, NHAI, Wet Mix Macadam, Dense mix Bitumen Macadam, Bitumen Concrete, IRC

INTRODUCTION

The Government of India has taken up a massive program of up-gradation and development of National Highways. As a part of this program, the National Highways Authority of India (NHAI) has been entrusted with the project stretch (Package III) which aims in serving as a bypass for Vijayawada city starts near Chinna Avutapalli village (Km 0.000) on NH-16 and ends near Gollapudi village (Km 30.000), Krishna District in the State of Andhra Pradesh to 6-lane with paved shoulder configuration. Krishna district is an administrative district in the Coastal Andhra region of the Indian state of Andhra Pradesh. Machilipatnam is the administrative headquarters and Vijayawada is the most populated city in the district. It has an area of 8,727 km2 (3,370 sqm) and had a population of 45, 29,009 as per2011 census of India. It is bordered on the east by the West Godavari, on the south by the Bay of Bengal, on the west by Guntur, and on the east by the state of Telangana. "Independent Engineer Services for Supervision of Six Laning of Vijayawada Bypass from China Autupalli (Design Ch.0.000) to Gollapudi (Design Ch.30.000) in Vijayawada – Gundugolanu section of NH-16 in the State of Andhra Pradesh under Bharatmala Pariyojana on Hybrid Annuity Mode" is the title of the project (Package-3) From [Design Ch.0.00] to [Design Ch.30.000], the project spans 30.000 km (6 Lane Length).

Flexible Pavements

Flexible pavement is defined as a mixture of asphaltic or bituminous material and aggregates laid in layers over the subgrade over a bed of compacted granular material of appropriate quality. Flexible pavements include water-bound macadam roads and stabilized soil roads with or without asphaltic overlays. The design of flexible pavement is founded on the idea that as a load is transmitted downwards from the surface by virtue of spreading over an ever greater area and transporting it deep enough into the ground through successive layers of granular material, the intensity of the load reduces.

Embankment

Embankment refers to the earthen material that is laid and compacted to raise the grade line of a proposed roadway or railway above the original ground level of the existing ground. The road's grade line may be increased for a variety of reasons, including the following:
1. Maintaining the subgrade above the groundwater table (GWT)
2. avoiding surface and capillary water damage to the pavement
3.Maintaining the road's intended vertical alignment.

Filling height, material used, settlement issues, and stability analysis are all factors to consider while designing an embankment. Ground improvement is required to control foundation soil settlement in the case of grater fill height and weak foundation soil. The embankment may settle after construction due to consolidation, fill height settling, or both.

Material Properties:

1. **MDD:** 1.52 T/Cum for embankment up to 3.0m height, 1.60 T/Cum for embankment more than 3.0m height. For fly ash, separate density requirement as per contract shall be applicable.
2 .**CBR:** Minimum CBR requirement NIL
3 .**Coarse material:** Size not more than 75mm
4. **Free swell index:** Not exceeding 50% (to be used only below 500mm of top of the embankment)
5. **Liquid Limit:** Not exceeding 70
6. **Plasticity Index:** Not exceeding 45

METHODOLOGY

1. Excavation is required to finish the roadway construction according to the Technical Specifications.
2. Loosening and compaction of the original ground/subgrade, as instructed by the Engineer, to the requisite depths.
3.Completion of the subgrade layer, including all leads and lifts, with the help of approved borrow area material.
4. Completion of the road subgrade using acceptable authorized material from the roadway excavation or any other excavation.
5. Build the subgrade with acceptable material that has a wet CBR of at least 8% and is completed according to MORTH.

Subgrade Construction Equipment:

For the projected progress of road subgrade construction work, the following sets of equipment are required.
1. Excavator
2. Pavement Breaker/Jack Hammer & Air Compressor
3. Dumpers/Tippers
4. Automobile Graders
5. Vibratory Compactor
6. Tractors Dozer with Disc Harrows/Spreading Blade/Ploughs
7. Water bowser with sprinklers and other features
8. Crawler Dozers

Crawler Dozers for Road subgrade construction

1. The grader will initially spread the heap of earth dumped over a stretch maintaining an approximate line and level.
2. At this stage, the material should have an Optimum Moisture Content(OMC), ranging from +1% to –2%. The following mixing or drying process should be adopted if it is not found within the permissible limit.
3. **The material at the site is too Dry:** Additional water shall be added to increase the moisture content up to the permitted limit. After sprinkling water with the browser, the material shall be thoroughly mixed with the help of grader to obtain a homogenous mix. After that, the grader shall carry out the final precise grading.
4. **The material at the site is too Wet:** If the material at the site is too wet, it shall be dried by aeration and exposure to the sun until the moisture content is acceptable.

When a combination of grader and dozer is used, the dozer shall carry out the initial spreading of borrowed material to the approximate line and level. After that, the grader shall carry out the final precise grading.
The in-situ moisture content shall be checked with the help of rapid moisture meter.
Compaction of fill shall start immediately after achieving the required moisture content. Compaction shall be done with the help of vibratory compactor. The compaction pattern, which includes the number of passes required, shall be finalized after full-scale trials at the site to achieve the required degree of compaction as per technical specification. The general pattern shall be as follows.
1. Initial rolling, two static passes with a vibratory roller.
2. Subsequent rolling, four vibratory passes(One pass includes both forward and reverse movement of the roller).

Sub Base

It acts as a drainage layer for the pavement to avoid excessive wetting and weakening of subgrade.

Permeability requirements of Granular Sub-base (GSB) is 300m/day as per IRC 37:2012 Flexible Pavement

Strength wise GSB is more superior as compared to the subgrade.

Material Requirement for Granular Sub-base (GSB)

1. River/Natural sand
2. Crushed Gravel
3. Crushed Stone
4.Blast Furnace slag metal
5.Brick metal, kankar and crushed concrete is permitted in lower sub-base.
6.Granular Sub-base (GSB) materials shall be free from organic or other deleterious constituents.

CEMENT TREATED BASE

Cement-Treated Base (CTB) is a type of Soil-Cement that describes an intimate mixture of native soils and/or manufactured aggregates with measured amounts of portland cement and water that hardens after compaction and curing to form a strong, durable, frost-resistant paving material after compaction and curing. CTB is adaptable since it can be blended in place and compacted afterward, or it can be blended at a central facility and brought to the placement area, where it is spread on a prepared subgrade or subbase and compacted. To finish the pavement structure, a bituminous or portland cement concrete wearing course is laid on top of the cured CTB. Highways, roads, streets, parking lots, airports, and materials handling and storage spaces all employ CTB as a pavement basis.

The goal of cement-treated foundation construction is to get a thorough mixing of aggregate/granular material, the correct amount of portland cement, and enough water to allow maximum compaction. The completed CTB must be properly cured in order for the cement to hydrate and the cement-aggregate mixture to solidify. The following are the primary quality control factors for CTB:

1. The right amount of cement is used.
2. The right amount of moisture is used.
3. Thorough mixing
4. Proper compaction
5. Adequate curing

Plants, Equipment and Machinery for Wet Mix Macadam:

The following sets of plant and equipment are necessary for Wet Mix Macadam works.

WMM plant – 01 No

Loader – 1 No

WMM Paver (Sensor) – 01 No.

Motor Grader – 01 No

Vibratory Rollers, capacity 80-100KN static wt – 2 Nos.

Tipper/Dumpers, Cap – 10T/20T (As per site requirement)

Plate compactor (as per site requirement)

DENSE BITUMINOUS CONCRETE

The Dense Bituminous Macadam mix shall be made in a Hot Mix Plant (HMP) according to the approved Mix Design and in accordance with MORTH Clauses 507.2 and 507.3. The HMP must have at least four cold bins, a four-deck vibratory screen, and hot bins for heated aggregate storage. Precautions must be taken to prevent moisture from entering the building.

Preparation and Transportation of Dense Bituminous Macadam (DBM) Mix:

The Dense Bituminous Macadam mix shall be made in a Hot Mix Plant (HMP) according to the approved Mix Design and in accordance with MORTH Clauses 507.2 and 507.3. The Hot Mix Plant (HMP) must have at least four cold bins, a four-deck vibrating screen, and hot bins for heated aggregate storage. Precautions must be taken to prevent moisture from entering the building.

The batch-mix mixing plant must be capable of controlling the composition of the mixture within the limits indicated in MORTH table 501.3 with respect to the authorized job mix formula.

The mixing plant's rated capacity is 200 tons per hour.

The storage Bitumen tanks must be capable of maintaining the prescribed temperature within a 5°C tolerance, and they must be fitted with a thermostat to prevent the temperature from increasing above 170°C, as well as a fixed thermometer that can be read from outside the tank. The dryer must be a spinning drum type that can heat the aggregates to the specified temperatures.

as specified in the standard In order to reduce heat losses, bitumen must be heated to the correct temperature in tanks and transported to the mixing plant via insulated pipes.

1.To obtain a proper mix, the shortest mixing period should be used. The mixing cycle periods must be between 30 and 40 seconds.
2.HMP must include automatic controls that coordinate proportioning, timing, and mixer discharge.
3.The Bitumen should be heated to a temperature of 150℃ to 165℃ so that it can be evenly spread.
4.The Aggregates must be heated to a temperature of 150℃ to 170℃ in order to be combined. The temperature differential between the binder and the aggregate should not exceed 14℃.
5.The mixing must be thorough in order to obtain a uniform mixture.
The maximum discharge temperature of the mix is 165℃.
When compacted, Asphalt Concrete (Bituminous Concrete) is a completely controlled, hot-mixed, hot-laid plant mixture of well-graded dried aggregates, filler, and paving bitumen in the best proportions as per requirements, forming a dense material layer of thickness 25-100mm on a previously prepared granular, modified granular, or Dense Bituminous Macadam (DBM) as per the specification.

Construction Materials for Asphalt Concrete:

Binder:
As a binder, an appropriate type of bituminous material that meets the applicable standard standards or is otherwise specified is typically utilized in Asphalt Concrete mixes. Bitumen from an approved supplier must be viscosity graded bitumen or polymer modified bitumen that meets IRC and MORTH specifications.
Coarse Aggregates:
Crushed rock retained on the 2.36 mm filter makes up coarse aggregates. They must be clean, hard, and cubical in shape, free of dust, soft or friable debris, organic or other harmful chemicals. Aggregate that meets all of the physical parameters for Bituminous Concrete construction listed in MORTH table 500-18.
Fine Aggregates:
Fine Aggregates are crushed stone that has passed through a 2.36 mm screen and has been retained on a 75-micron filter. They must be free of dust, soft or friable materials, organic and other harmful substances, and they must be clean, hard, durable, and dry. When tested according to IS 2720 part – 37, fine aggregates must have a sand equivalent value of not less than 50, and the Plasticity Index of the proportion passing the test must be at least 50.
When tested in line with IS 2720 part – 5, the 0.425 mm sieve must not exceed 4.
Filler:
Finely split hydrated lime or cement, as recommended by the Engineer, shall be used as filler. The filler must meet the grading requirements indicated in MORTH table 500 – 8.
Aggregate Grading and Binder Content:
When evaluated according to IS 2386 part I (Wet Grading Method), the combined grading of coarse aggregates, fine aggregates, and additional filler must meet the limit indicated in MORTH table 500 -20.
Prime Coat / Tack Coat:
It must be Bitumen Emulsion, CSS 1h, as specified by ASTM D 2397 or ASSTHO M 280 – 96.

CONCLUSION

1.By establishing the nation from chinna autupalli to gollapudi, a distance of about 30 kilometers, road users will save time and distance.
2.Reduce traffic and pollution in Vijayawada as well.
3. If we do not construct the road properly during construction, the company's maintenance costs would rise, hence only the engineer should inspect the site during construction.

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REFERENCES

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