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# Construction of Rigid Pavement for National Highway 163

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**Abstract:**
The above project is basically the four lining of the road from yadigiri to Warangal. It is a stretch of about 99.103kilometers .major portion of road is basically a Rigid pavement (concrete) based project and only a selected part of it Flexible pavement(Asphalt)based. this makes the project one of the first of its kind in nation with such a large stretches of rigid pavement .the basic shift in the construction ideology is based on the fact that unlike the previous road projects consisting of asphalt pavement whose construction cost is less but overwhelming maintenance and repair cost and in the beginning, it should minimize the maintenance and repair cost and also increase the life span of the pavement. Coming to the project, it consist of both main carriage way (MCW)NH :163 and a new carriage way(NCW)NH:202,The client of the project is "NATIONAL HIGHWAYS AUTHORITY OF INDIA(NHIA)" and L&T is playing a role of EPC(Engineering Procurement and construction)

The project is divided into two zone's based on the distance covered

- Zone A- from 54kms-103kms(ALER)
- Zone B- from 103kms-150.103(MADIKONDA)

Quality is the key component which propels performance and defines leadership traits. At L&T construction, quality standards have been internalized and documented in quality Assurance manuals.

L&T construction recognizes the crucial significance of the human element in ensuring quality .structured training program ensure that every L&T employee is conscious of his/her role and responsibility in extending L&T construction's tradition of leadership through quality .

- Whole project is divided into following stages
- Designing
- Planninng
- Execution
- Controlling

## I. PROJECT BASIC DETAILS

The above picture shows you the alignment of the road project mainly with four bypass wangapally, Alair, Jangaon, Warangal. Out of which Warangal bypass is the lengthiest bypass with a typical cross section (TCS:9)

Kilometers covered by bypass

- Wangapally-5.5kms(TCS- )
- Alair-2.5kms(TCS- )
- Jangaon-8.9kms(TCS- )
- Warangal-29kms (TCS-9)

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NATIONAL HIGHWAYS AUTHORITY OF INDIA

FOUR LANING OF YADGIRI - WARANGAL SECTION OF NH-163 (NEW NH-202) FROM KM 54.000 TO KM 150.000 (DESIGN LENGTH 99.103 KM) UNDER NHDP PHASE-IV TO BE EXECUTED UNDER EPC MODE IN THE STATE OF TELANGANA.

## DLC LABORATORY TRAIL MIX DESIGN

Firstly proportion of different sizes of aggregates shall be decided based upon their individual gradations to arrive at a blend with gradation meeting the requirement of combined gradation as per table 600-1 of Morth specification

- The mix shall be proportioned with a maximum aggregate cementitious material ratio of 15:1
- MDD and OMC of the mix shall be determined using six no's of cubes with varying moisture content
- For each trail 6 cubes shall be prepared (compacted to 100%of MDD)for determination of compressive strength at 7days.
- The sample shall be cured at control temperature for 7days
- The sample shall be tested for compressive strength at 7days
- The required target strength is 10mpa at 7days(1mpa=1N/M^2)

## II. LONGITUDINAL AND TRANSVERSE JOINT TRANSVERSE JOINT:

- At the end of each days run a transverse construction joint shall be formed by a stop end or by cutting back into the compacted material to form a true transverse vertical face
- The joint shall be cut vertically on the concrete by any suitable means
- All the loose/debris generated after cutting shall be removed from that particular.

## LONGITUDINALJOINT:

- Joint shall be cut to a vertical face. The line shall be marked along the alignment of concrete before the sagging portion and cutting shall be made along with the straight line
- If continuous adjacent paving is planned in a days work then, longitudinal joint cutting is not required .when there is a continuous adjacent paving planned. Then the edge of first laid lane shall not be compacted after at least 100 to 150 mm and while compacting the adjacent lane edge roller shall be in center position of both the joints and both the joints shall be compacted

## III. PAVEMENT QUALITY CONCRETE (PQC)

The work shall consist of construction pavement in accordance with MORTH specification, IRC 15-2000.

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The construction shall also be in conformity with lines, grades and cross –sections shown in the drawings and / or as directed by the Engineer.

## MATERIALS:

- All the materials required in the construction will be form the source approved by the supervision consultant/ engineer and according to the relevant clauses of MORTH specification mentioned in the contract.

Aggregate gradation given as per IS 383 Table 1 shall be adopted after blending the coarse &fine aggregates.

| IS SIEVE DESIGNATION | AS PER IS 383 TABLE -5 %OF PASSING | DESIGN GRADATION % OF PASSING |
|---|---|---|
| 40mm | 100 | 100 |
| 20mm | 95-100 | 98.0 |
| 4.75mm | 30-50 | 41.4 |
| 600.00micron | 10-35 | 17.2 |
| 150 micron | 0-6 | 0.8 |

## MIX PROPORTIONS:

The concrete mix proportions for PQC are stated below for 1cum of concrete.

| | |
|---|---|
| Cement | 422kg |
| Sand | 740kg |
| 20mm | 680kg |
| 10mm | 435 kg |
| Water | 160lit |
| Admixture | 4.22kg |

## EQUIPTMENTS:

- The following plants & equipment will be developed for the construction of PQC.
- Batching plant (capacity 30cumec/hr) with all the required accessories and storage facilities
- Tippers / Transit Millers
- Sensor paver with inbuilt vibrator
- Ordinary sprayer for curing compound
- Back hoe
- Water tanker.
- Appropriate equipment for laboratory and survey.
- Cutting machine for joint cutting.

## IV. MEASUREMENT OF DENSITY OF SOIL IN PLACE BY NUCLEAR DENSITY GAUGE PURPOSE

This is a quick method of determining the in-situ density of soil which is based on the radiation.

## EQUIPMENT

For this test special equipment which measures in place density using gamma radiation is used. Gauge usually contains a small gamma source (about 10 mCi) such as Cesium – 137 on the end of the retractable rod.

**Fig.: NUCLEAR DENSITY GAUGE – used for in situ density measurement of soil**

## PROCEDURE

- Make the surface even by using a guide plate or any other suitable equipment.
- Make a hole by pounding a steel rod with a similar diameter to that of gauges retractable rod. The hole should be at least 50mm deeper than the intended depth of measurement.
- Nuclear Density Gauges normally operate in two modes.
- Direct Transmission
- Back Scatter
- For measuring the density of soil, set the equipment to ‘Direct Transmission Mode’.
- Lower the source rod into the hole. Set the handle to the depth position required.
- Read the detector count on the panel. Use the calibration chart provided by the manufacturer to obtain density of material.
- It may be noted that the detector count is inversely proportional to the density of the surrounding material.

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## V. REINFORCED EARTH PANELS

Reinforced Earth or Mechanically stabilized earth (MSE) is soil constructed with artificial reinforcing. It can be used for retaining walls, bridge abutments, dams, seawalls, and dikes. Although the basic principles of MSE have been used throughout history, MSE was developed in its current form in the 1960s. The reinforcing elements used can vary but include steel and geosynthetics. The reinforcement materials of MSE can vary. Originally, long steel strips 50 to 120 mm (2 to 5 in) wide were used as reinforcement. These strips are sometimes ribbed, although not always, to provide added resistance. Sometimes steel grids or meshes are also used as reinforcement. Several types of geosynthetics can be used including geogrids and geotextiles. The reinforcing geosynthetics can be made out of high density polyethylene, polyester, and polypropylene. These materials may also be ribbed and come in varying sizes and strengths.

### Design of Reinforced Earth Structures

Reinforced Soil Structure consists of facing panels and compacted fill incorporating reinforcing elements (e.g. strips or grids). The reinforced soil block consists of the compact fill and reinforcing elements.

### Design Requirements

#### 1. Wall Facings

Wall facing panels shall be of incremental height, precast reinforced concrete, manufactured in accordance with Division 3 “Concrete”. The minimum concrete grade shall be S32. Steel reinforcement shall be a minimum of 450 mm2 per meter in each of two directions at right angles to each other and located at mid depth of the panel thickness. Wall facing panels shall be designed to prevent relative displacement.

Wall facing panels shall incorporate anti graffiti measures and aesthetics in the design. A footing shall be designed to accommodate the wall facing panels.

#### 2. Joint Fillers

Joint fillers between wall facing panels shall be composed of durable inert material resistant to attack from the soil material and the atmosphere. Joint fillers shall be provided to allow for joint rotation without spalling of concrete edges and to prevent loss of fines from the backfill material and staining of the panel faces.

#### 3. Soil Reinforcing

Reinforcing strips or grids and their connections shall be fabricated from approved reinforcing products.

Such products shall be sufficiently strong, stiff, stable and durable to satisfy the performance and design requirements of major reinforced soil structures and this Specification with a minimum of 10 years data from laboratory and site applications in representative conditions. Steel reinforcing shall comply with AS 3679, with a minimum base metal thickness of 5mm and hot dip galvanised after fabrication in accordance with AS 4680 with a minimum average coating thickness equivalent to 600 grams per square metre.

Steel mesh shall comply with AS 4671 and hot dip galvanised after fabrication with zinc to AS4680 with a minimum average coating thickness equivalent to 600 grams per square metre. Synthetic material shall comply with a British Board of Agreement Certificate and demonstrated by testing in a NATA accredited laboratory to satisfy the performance and design requirements of this Specification.

#### 4. Backfill

- Select backfill shall comply with the requirements of the designer and have a particle size distribution, shear strength and coefficient of friction value to ensure the design parameters are achieved.
- If the backfill is in contact with galvanized steel components, it shall comply with the properties specified in Clause 420.8 “Verification Requirements”.
- Pulverised fuel ash (PFA) shall not be used as select backfill.
- Reinforced earth is a composite material formed by the friction between the earth and the reinforcement. By means of friction the soil

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transfers to the reinforcement the forces built up in the earth mass. The reinforcement thus develops tension and the earth behaves as if it has cohesion.

## VI. COMPONENTS OF REINFORCED EARTH

- SOIL
- SKIN
- REINFORCEMENT

### SOIL FOR REINFORCED EARTH

- Development of sufficient friction between earth and reinforcement.
- No interstitial pore water pressure develops within the reinforced earth structures
- The placing and compaction of the earth fill layers can be accomplished easily
- The soil must conform to certain electro-chemical conditions to avoid corrosion

### REINFORCEMENT FOR REINFORCED EARTH

- Reinforced members are composed of thin wide strips also called ties.
- Should be flexible to ease placement.
- Should have adequate tensile strengths.
- Should have adequate service life taking in to account corrosion and weathering.

### FACING ELEMENTS

- Should retain the back fill between the layers of reinforcements.
- Made of either metal units or pre-cast concrete panels.
- Should be able to deform without distortion.

## VII. PRODUCTIVITY OF EARTH MOVING EQUIPTMENT

### 1. EXCAVATOR:

Bucket capacity – 1.5cum
Fill factor – 80%
Cyclic time - 30sec /hour
Production rate = 3600sec*1.5*80%*50 / 30sec*60
=120cum /hour

### 2. BACKHOE

Loader capacity -3cum
Material in one hour – 114 cum
Hoe capacity -0.6cum

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Backhoe comprises a bucket on the end of an articulated boom, set on a pneumatic tyred or crawler tractor unit. The boom, bucket arm and bucket are usually controlled by hydraulic rams. Back-acters operate by digging towards the machine in an arc from a small distance above the surface on which the machine stands to a position vertically below the outer edge of the machine. The maximum depth of excavation is related to the length of the boom and machines with depth capacities between 2.6 and 6 m are in common use.

### 3. GRADER

Passes are made -6 nos for 1km / 5kmph
2 hours to complete the task of grading 1km with min of 6 passes

Blade length – 3.17 -3.6 m

Balde angle 30 degrees
Efficiency – 60%
Productivity = 5*3.17*1000*0.6 /6
=1585 m^2 /hour (for 6 passes)

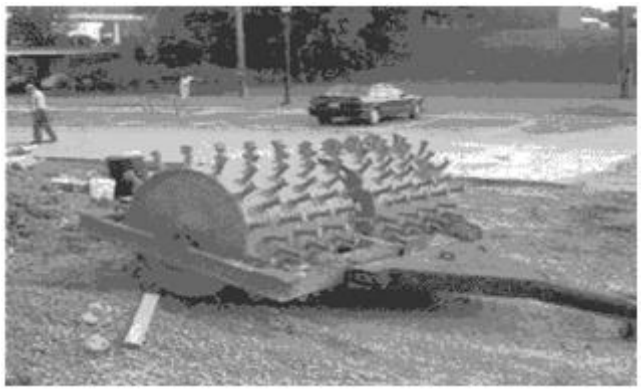
**The following types of road rollers are generally used.**

### 1. CYLINDRICAL ROLLER

- This is a light roller of iron, concrete or stone; drawn by hand or bullocks. The size varies, but it is generally about 1 meter in dia. and about 1.5 meter long.
- This ground pressure generated by this type of roller is about **7 kg/cm2**.

### 2. SHEEP FOOT ROLLER

- As the name indicates, this type of roller consists of a drum having many round or rectangular shaped protrusions or "**feet**" on it. These rollers are also called **tamping rollers**.



- Various types are available having different diameters and widths of drum and different lengths and shapes of feet. The most common type is the one having two drums 1.22 meters wide and 1.06 either as taper-foot or club-foot rollers according to the shape of the feet.
- Area of each protrusion can vary from **30 to 80 cm2**.
- The **coverage** area is about **8 to 12%.**
- The **thickness of compacting layer is kept about 5 cm more than the length of each foot**.
- This type of roller mostly used for compaction of cohesive soils such as heavy clays and silty clays. Not effective with sandy soils.
- The weight of the drum can be increased by filling the drum with water or damp sand.
- The factors that governs the amount of compaction of soil are as follow:
- Gross weight of the roller
- Area of each feet
- No of feet or lugs in contact with ground
- Total no of feet per drum
- Maximum pressure is exerted on soil when a foot is vertical.

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- The soil is supposed to be consolidated when the impression by the projecting teeth is not more than 12 mm deep or when the surface has been rolled **16 to 20 times**.
- **10 to 20 passes** are generally required to give complete coverage.
- The density of the consolidated soil should be about 1.48 kg/cm3. The top layer has to be finished with a smooth wheel roller.
- Pressure on the feet may be increased by filling the drum with wet sand or some other material, which may be 4 to 7kg/cm2 for light rollers and upto 25 to 70 kg/cm2 for giant rollers.

## 3. PNEUMATIC TYRED ROLLERS

This type of roller consists of a heavily loaded wagon with several rows of four to six closely spaced tyres. This is also called rubber tyred roller.

- It provided uniform pressure throughout the width.
- 2 factors governing the amount of compaction are as follow
- Tyre pressure
- Area of contact
- Tyre pressure may be upto about **7 kg/cm2**
- The **coverage** area is about **80%**.
- The gross weight of the roller is about 6 to 10 tonnes which can be increased to 25 tonnes by ballasting with steel section or other means.
- The maximum density can be achieved by **8 passes** of the roller. The optimum speed of roller is between **6 to 24 km/h**.
- Used for compacting cold laid bituminous pavements, soft base course materials or layers of loose soil. These rollers are also suitable for compacting closely graded sands, and fine-grained cohesive soils at moisture content approaching their plastic limits, though the compaction is not as high as that with the smooth wheel roller.
- They are particularly efficient when used to finish off the embankment compacted by sheep foot roller or on loose sandy soils.

## 4. SMOOTH WHEELED ROLLER

- This type of roller consists of a large steel drum in front and one or two wheels or drum on the rear end.
- Depending upon the number of wheels on the rear, it can be of following two types:
- Tandem rollers (having one wheel at rear and one wheel in front)
- Three wheeled rollers (having two wheel at rear and one in front)
- The **weight of tandem roller** varies from **2 to 8 tonnes** and that of **two wheeled roller** varies from **8 to 10 tonnes.**

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Three wheeled roller

- It **ground coverage** provided by smooth wheeled roller is **100%**.
- The weight of the roller can be increased by filling the inside space of the drum with water or wet sand. This is called **ballasting**.
- The **ground pressure** exerted by tandem rollers is about **10 to 17 kg/cm2**.
- Performance of smooth wheel roller depend upon it load per cm width and diameter of the roll.
- The speed and number of passes of a smooth wheeled roller depends on the type of soil to be compacted and project requirements. The **optimum working speed has found to be 3 to 6 km/h** and about **8 passes are adequate for compacting 20 cm layer**.
- Smooth wheel rollers are most suitable for consolidating stone soling, gravel, sand, hard core, ballast and surface dressings.
- **The maximum grade a road roller can climb is 1 in 5.**

## 5. VIBRATORY ROLLERS

This type of roller is fitted with one or two smooth surfaced steel wheels 0.9 m to 1.5 m in diameter and 1.2 m to 1.8 m wide.

- Self propelled vibratory rollers are now available weighing from **4 to 6 tonnes**.
- Vibrations are generated by the rotation of an eccentric shaft inside.
- A vibratory roller is used for compacting granular base courses. It is sometimes used for asphaltic concrete work.

- They are generally towed units and can operate at speeds between **5 and 24 km/h**.
- Typical weights vary between **5 tonnesnet**and **15 tonnes ballasted**.
- Grid rollers provide **high contact pressure**but little kneading action and are suitable for compacting most coarse grained soil

## CONCLUSIONS:

### 1. MDD, OMC& NMC

**a) Assume dimension:100*14.2*0.25=355cum (674500kg)**

**MDD –** maximum dry density (1.8-1.9,2.01)
**OMC –**optimum moisture content (10,9+2%)
**NMC –** Normal moisture content (4%-5%)
**RMC=OMC-NMC**
**=9-5 =4%**
**Water content = 674500*4%**
**=26,980 liters(1 tank = 12,000 liter)**
**= (i,e2 tanks )**

**b) assume quantity of earth work** = 9,60,000cum
**percentage of OMC** = 12.5

after soil test percentage of OMC comes as per lab test=8 to 9% say (8.9%) so, OMC now= 12.5-8.9=3.6%(usually depending on the soil type, a insitu moisture content deviating 2% to 4% from the optimum moisture content as determined from the proctor test, may create impossible conditions to achieve the required compaction ) .i.e, 3.6% is ok
**QUANTITY**= 960000 *3.6%= 34560000 lit water required

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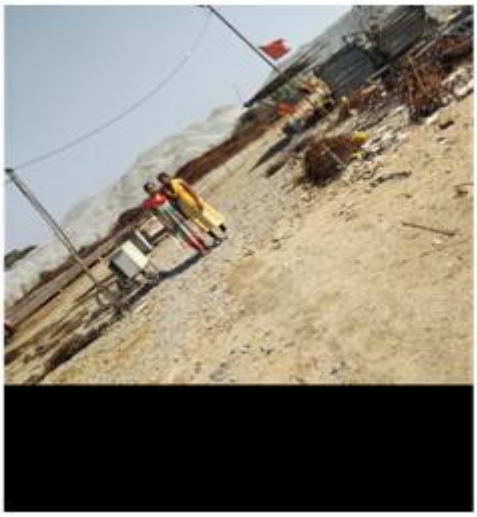
now, add evaporation losses @10% so now the exact volume of water required for compaction earth is 3,80,16,000 lit ( i.e, 3,168 tankers)

## 2. CAMBER CALCULATIONS:

Let central project line(CPL)be 142.000m
Camber slop be 2.5%(negative)
Carriage way = 7m
Median =5m
Calculate RL at a distance 9.5m
9.5*0.25=0.2375m
RL @9.5m = 142.000-0.2375
=141.7625



## VIII. CONCLUSION

It was a wonderful experience at L&T construction YWRP site of L&T project for two months in WARANGAL. We gained a lot of insight regarding almost every aspect of site. We were given exposure in almost all the departments at the site. The friendly welcome from all the employees is appreciating, sharing their experience and giving their peace of wisdom which they have gained in long journey of work. We are very much thankful for the wonderful accommodation facility from L&T. We are all hope this experience will surely help us in our future and also in shaping our career.

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