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GUIDELINES ON WET MIX PLANT

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GUIDELINES ON WET MIX PLANT

1. INTRODUCTION

Use of Wet Mix Macadam (WMM) over the conventional Water Bound Macadam (WBM) as a pavement layer has proved to be quite effective in the sense that it ensures superior gradation of aggregates, faster rate of construction, higher standard of compaction that can be achieved, lower consumption of water and stricter standards of quality achievable. Specifications for Wet Mix Macadam are given in IRC:109-2015.

This document "Guidelines on Wet Mix Plant" caters to the mechanisation aspect of preparation of Wet Mix Macadam in a central mixing plant so that the laid down requirements of end result specifications in respect of sizes and grading of aggregates, optimum moisture content, proper mixing etc. are achieved.

The initial draft document "Guidelines on Wet Mix Plant" was prepared by Shri Anand Patel. Necessary inputs obtained from the Representatives of Industry and Shri Ananyabrata Maulikwere incorporated in the document. The Mechanization and Instrumentation Committee (G-4) deliberated on the draft document in a series of meetings and finally approved the draft document in its meeting held on 12th June, 2017. The document was approved by the General Standards and Specifications Committee in its meeting held on 24th June 2017 and thereafter by IRC Council in its 212th meeting held at Udaipur (Rajasthan) on 14th to 15th July, 2017.

The Composition of Mechanization and Instrumentation Committee (G-4) is as given below:

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2. SCOPE

This document covers advantages and major assemblies of a Wet Mix Plant, typical average power requirement of various parts of the plant, pug mill performance, plant maintenance and safety.

This document is intended for use by highway engineers, field personnel within road construction agencies and contractors entrusted with the task of road construction and maintenance.

Emission and noise limits for a diesel genset used in a Wet Mix Plant have been provided in **Appendix-I**.

Sample calculation for output analysis of a Wet Mix Plant has also been included in **Appendix-V**

3. PURPOSE

Wet Mix Macadam (WMM) is a base or sub base pavement layer below the bituminous layer, wherein clean, crushed, graded aggregates and granular materials, like graded course sand are mixed with water and other additives like lime, cement etc. in desired proportion in a mixing plant and rolled to a dense mass on a prepared surface.

A central mixing plant used for producing the wet mix macadam is called a wet mix plant. It has provision for:

- Controlled feeding of aggregates of different sizes in the required proportion.
- Addition of specified quantity of water.
- Addition of specified quantity of other ingredients like lime or cement.
- Forced/positive mixing of all the ingredients to produce a consistent homogeneous mix.

A wet mix plant can be used with slight modification and other optional devices for:

- Production of cold bituminous mix – addition of emulsion
- Certain type of soil stabilisation – addition of cement or lime
- Blending of material for GSB

4. ADVANTAGES OF WET MIX PLANT

Use of a central mixing plant provides the following advantages:

- Higher production
- Proper quality control
- Lower unit production cost

- Proper blending and proportioning of aggregates for uniform gradation
- Uniform control of additives
- Uniform and homogeneous mixing
- No segregation

5. MAJOR ASSEMBLIES OF WET MIX PLANT

A Wet Mix Macadam Plant shall consist of the following assemblies/sub assemblies:

- Aggregate Feeder
- Gathering Conveyor
- Oversize Removal Screen
- Charging Conveyor
- Pug Mill Unit
- Water Tank and Metering Unit
- Filler Fines Feeding System
- Gob Hopper
- Storage Silo (optional)
- Control Cabin (housing the control panel)

5.1 Aggregate Feeder

Efficient wet mix plant operation starts with the cold aggregate feeder. The functions of the feeder system are to provide an even flow of accurately metered aggregates (meeting the gradation requirements) and provide surge storage capacity between the feeders and aggregate stockpiles. Surge capacity, as determined by bin size, keeps a 'material head' over the feeders for constant metering and determines how frequently the front end loader must cycle between the stockpiles and the cold aggregate feeder.

The feeder system consists of four or more bins, with separators between them, to avoid inter mixing of aggregates being loaded in different bins. Bins are welded modular units made with mild steel, duly reinforced and stiffened and mounted on a rigid frame of such dimensions that there is no distortion of the bins under fully loaded conditions. Bin walls and bin gates are so designed as to prevent sagging and ensure smooth flow of aggregates to feeders.

Only graded aggregates are to be fed to the feeder system. Otherwise, grizzly screens are to be put over the bins.

Each bin should have provision for the adjustment of total and proportional feed and should be capable of being locked in any setting. Bin gates should have a graded scale to control the gate opening. Variable speed drive provided below each bin to control speed of auxiliary conveyor belt also helps in controlling aggregate flow. Therefore, aggregate flow may be regulated by adjustment of either or both gate opening and conveyor belt speed.

The capacity of the bins should be sufficient to run the plant for minimum 10 minutes. The bin containing fines is provided with a bin vibrator to avoid sticking of fines with the bin wall.

5.2 Gathering Conveyor (Fig. 1)

Gathering conveyor collects aggregates of different sizes from the auxiliary conveyors fitted under each bin and discharges it into the slinger conveyor. The essential components of the gathering conveyor are the continuous belt, idler, driving unit, and pulley and take up unit to maintain the tension in the belt and supporting structure.

Gathering conveyor shall have belt of required width, reputed make and drive of adequate capacity through speed reducer or direct geared motor.

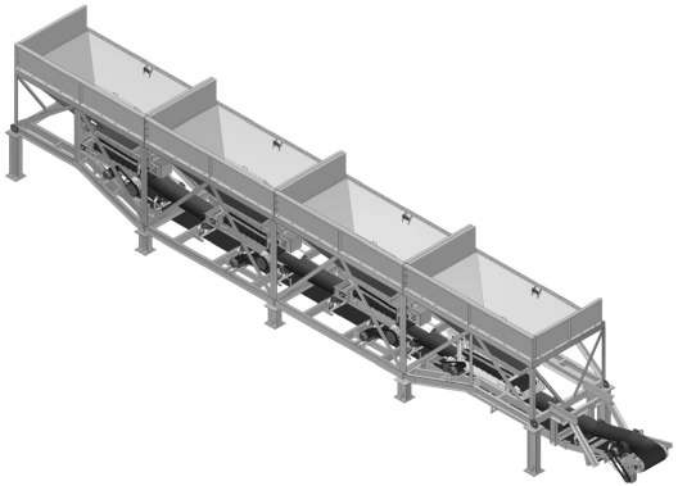

Fig. 1 Gathering Conveyor

5.3 Oversize Removal Screen (Fig. 2)

A single deck vibrating screen of adequate screening area and suitable vibratory mechanism is provided at the discharge end of the gathering conveyor for rejecting any over sized aggregate before being fed to the slinger conveyor. The screen shall be robust, easily replaceable and heavy duty framed sieve (usually with square opening). The purpose of oversize rejection is to protect the pug mill from damage.

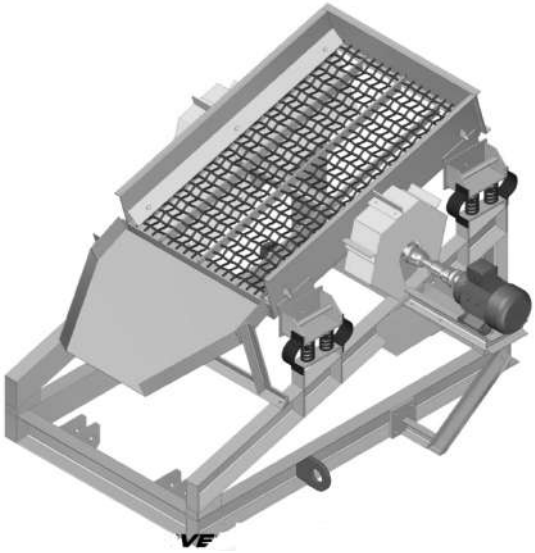

Fig. 2 Oversize Removal Screen

5.4 Charging Conveyor (Fig. 3)

Charging conveyor (also known as slinger conveyor) is an inclined conveyor provided for transferring the aggregates received from the vibrating screen after removing the over sized aggregates into the pug mill. The angle of inclination of the conveyor should not be more than 18º in case of plain belt. However, with use of V cleated belt the angle of inclination can go up to 30-40º.

A continuous electronic weighing arrangement with load cell is mounted on the slinger conveyor to continuously monitor the total weight of aggregates being fed into the pug mill and synchronize it with the feed of water and other filler additives.

The aggregate metering system should be calibrated before commencement of work and thereafter at regular intervals as recommended by manufacturer.

Charging conveyor consists of head and tail pulleys, carrying idlers, return roller and tensioned device. It shall have belt of required width, reputed make and drive of adequate capacity through speed reducer or direct geared motor.

Fig. 3 Charging Conveyor

5.5 Pug Mill (Fig. 4)

The charging conveyor feeds aggregates into pug mill. Inter-lock is provided between pug mill and conveyor drive to start and stop simultaneously.

A twin-shaft Pug Mill performs the following functions:

- Receive materials to be blended (aggregates from charging conveyor and requisite, precise amount of water from water system and filler additives from filler fines feeding system) at one end.
- Continuous, uniform, homogeneous mixing as the materials are pushed towards the pug mill's discharge end.
- Discharge the mix to gob hopper/load out conveyor.

Mounted on a sturdy chassis, the pug mill is fabricated from heavy duty Mild Steel plate and has a twin shaft of carbon steel mounted on heavy duty anti friction bearings in Cast Iron pedestals. Each shaft is equipped with high abrasion resistant, easily replaceable sets of paddle arms and tips to facilitate forced action-mixing of aggregates and water (**Fig. 5**). The pug mill is so designed as to ensure continuous outflow of homogenous mix at discharge end. The mix material shall not accumulate in pug mill at any point.

The pug mill should have replaceable inner liner plates. It should be fully covered and must have safety mechanism to prevent accidental powering on of the pug mill while being accessed during inspection or maintenance or cleaning.

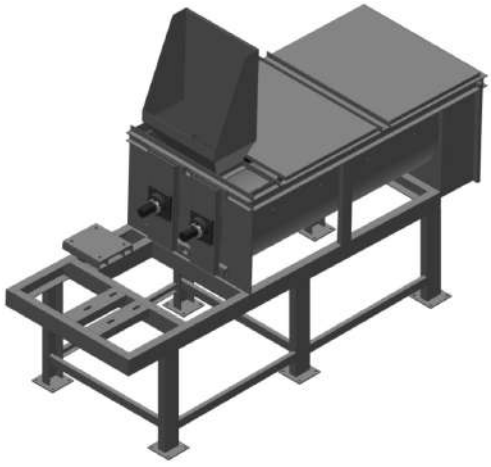

Fig. 4 Pug Mill

Fig. 5 Typical Paddle Arms in a Pug Mill

5.6 Water Tank and Metering Unit

It consists of a water storage tank, pump, pump drive motor, water pipelines, flow meter and spray bar. Addition of controlled amount of water in the pug mill (meeting the design moisture content requirement) is facilitated by the spray bar with the help of a variable speed centrifugal pump or electronically operated hydraulic control valve and electronic flow meter (for accurate metering). The water tank shall have adequate surge capacity. In case of fabrication from Mild Steel, the water tank should be painted with corrosion proof paint inside and outside.

The spray bar should be installed transverse to the direction of aggregate flow in the pug mill for uniform mixing with water.

The metering system should be calibrated before commencement of work and thereafter at regular intervals as recommended by the manufacturer. A mechanically operated totalizer should be installed in the water pipeline after the delivery valve, to record the cumulative flow, and is to be used to calibrate the electronic flow meter.

5.7 Filler Fines Feeding System (Fig. 6)

It consists of a filler silo of adequate capacity with a bucket elevator arrangement or a pneumatic conveyor for transfer of bagged or bulk filler like lime or cement into the silo.

Dozing arrangement consists of a rotary metering valve coupled with a precision screw conveyor or a continuous weighing system (for cases where very precise control is needed) to deliver the specified quantity of fines to the pug mill.

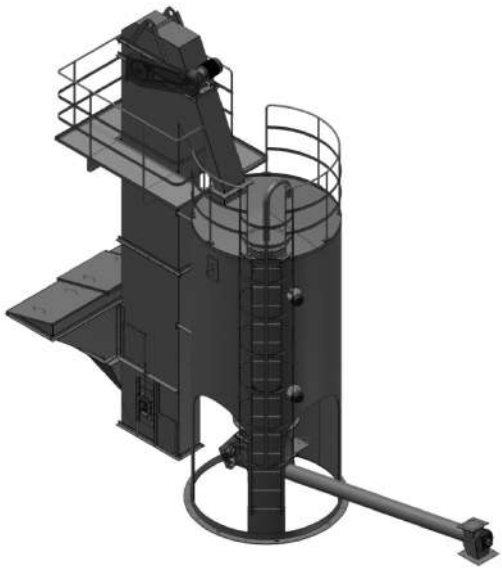

Fig. 6 Filler Fines Feeding System

5.8 Gob Hopper (Fig. 7)

It is made of heavy duty wear resistant steel plate and is fitted into the discharge end of pug mill (or at the end of load-out conveyor). The gob hopper arrangement allows the discharge of mix into tipper truck without any settle-down/slippage. Gob Hopper shall be of adequate capacity having clamshell gates hydraulically operated for quick opening and closing without causing segregation of mix.

The angle of inclination of the load-out conveyor should not be more than 24º in case of plain belt. However, with use of V cleated belt the angle of inclination can go up to 30º-40º.

In case the pug mill has an integrated gob hopper arrangement, its elevation level with respect to the ground should be approximately 2700 mm. A trench is generally made in the ground to allow the tipper truck to pass through.

Fig. 7 Gob Hopper

5.9 Storage Silo (optional)

It is advantageous to have a storage silo (**Fig. 8**) as it ensures continuous production of mix even when no tipper truck is readily available for loading. This also leads to saving in the number of trucks required. It is recommended to use a silo for plant having capacity in excess of 100TPH.

Fig. 8 Storage Silo

Mix is carried from the pug mill to the silo by the load-out conveyor. The silo should be rigid, easy to erect and transfer. It is equipped with fast operating hydraulic/pneumatic operated clamshell gates to facilitate quick discharge of mix into the tipper trucks without segregation.

The load-out conveyor shall have belt of required width, reputed make and drive of adequate capacity through speed reducer or direct geared motor.

5.10 Centralized Control Cabin and Panel (Fig. 9)

A centralized control cabin houses the control system for centralized plant operation. It should be designed and erected to enable full view of the plant from inside. Alternatively, CCTV system may be used to provide real time view of the entire plant. The control cabin should have air conditioning, proper illumination and furnishing. It should have a public address system for addressing/warning people outside. In addition, the control cabin should have the following features:

a) The cabin should be vermin proof. The controls should be integral with the cabin to provide clear working area and accessibility to the panels for connection and testing. There should be adequate illumination near the panel for operation and maintenance without glare or reflection. The floor of the cabin should be covered with rubberized material.

b) All important switches in the control panel should be properly labelled/should be accompanied by the corresponding indications. The instruments and switches should preferably be at eye level. The controls should not be placed in such position that they can be inadvertently operated by unauthorized personnel.

c) The following provisions should be made in the cabin:
   i) Main control for complete plant including safety switches.
   ii) Facility to enter mix recipe and control plant operation as per recipe and plant load.
   iii) Calibration of aggregate feeders, water pump/ valve and filler addition rotary valve.
   iv) Recording of production data as per format decided by the user in consultation with system supplier.

d) The power supply to the plant shall be through matching capacity heavy duty cable connected with matching capacity thimbles and main switches.

e) The following parameters should be displayed on the control panel in the control cabin:
   i) Recipe Percentage (Each aggregate type, filler, water)
   ii) Aggregate Quantity (TPH)
   iii) Filler Quantity (TPH)
   iv) Water Quantity (TPH)
   v) Conveyor Speed
   vi) Gob Hopper and Bin Vibrator Timer

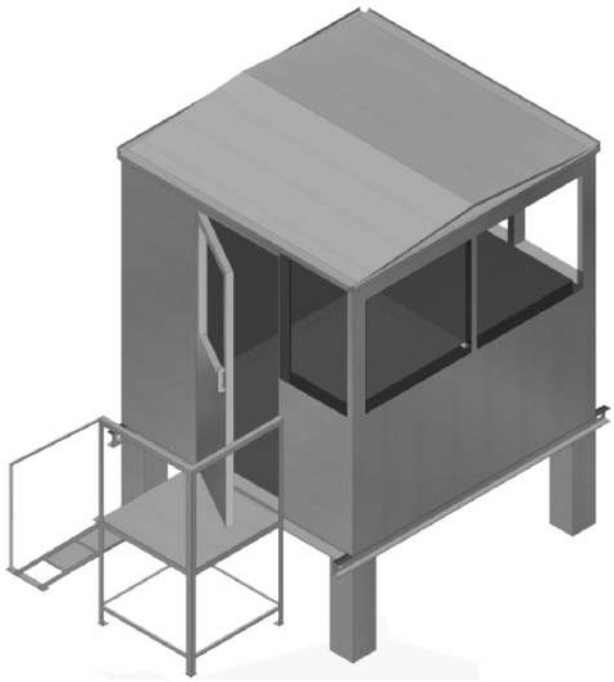

Fig. 9 Control Panel

6. POWER REQUIREMENT

A wet mix plant is fitted with electric motors for operation of different units. All electric motors shall be as per relevant BIS specsifications.

Wet mix plants with capacities ranging from 60TPH to 300TPH are being used in India and, accordingly, the average power requirement of such plants is brought out in **Table 1**. The values given in the Table are indicative. The manufacturers may have their own selection as per design.

Table 1 Average Power Requirement for a Wet Mix Plant

S. No.	Details of Unit	Power Requirement (in HP)				
Plant Output Capacity		**60TPH**	**100/120TPH**	**160TPH**	**200TPH**	**250TPH**
1	**Four Bin Feeder**					
1.1	Auxiliary Conveyors (4 nos.)	6	8	12	12	12
1.2	Gathering Conveyor	5	5	5-7.5	5-7.5	7.5
1.3	Bin Vibrator		1	1	1	1
2	**Charging Conveyor**	5	7.5	7.5	7.5	10
3	**Vibrating Screen**	0.5	3	3	3	3
4	**Pug Mill**	15	25	30-50	40-60	50-60
5	**Water Pump**	2	2-3	3-5	3-5	3-7.5
6	**Load-Out Conveyor with Gob Hopper**					
6.1	Drive Motor	-	7.5	7.5	7.5	7.5
6.2	Hydraulic Power Pack	3	5	5	5	5
7	**Load-out Conveyor with Storage Silo**					
7.1	Drive Motor	-	10	15	15	15
7.2	Hydraulic Power Pack	-	5	5	5	5
8	**Filler Silo**	-	-	6	6	6
9	**Recommended Genset Capacity**	37.5KVA	82.5KVA	125KVA	125KVA	150KVA

7. PUG MILL PERFORMANCE

A pug mill's ability to achieve a homogeneous, thoroughly coated mix in a given number of seconds is influenced by many design variables:

7.1 Pug Mill's Shape, Proportions and Volume

i) The shape should be designed for continuous material flow without any unnecessary restriction.

ii) The width should be adequate to accommodate the paddle arms and tips. Sufficient clearance is to be provided to avoid premature wearing out of outer body and should be less than the maximum aggregate size so that the aggregates are pushed forward while mixing. The length of the pug mill is governed by the optimum time required for proper mixing.

7.2 Paddle Tip Number, Size and Peripheral Speed

i) In order to have a consistent output capacity, a minimum of 230 sq. cm face area is suggested for tip size. However, this may vary from manufacturer to manufacturer.

ii) The number of tips provided should be sufficient to ensure consistency of homogeneous mixing. Based on data available for various reputed manufacturers, the thumb rule of 1 paddle tip for every 4.6 TPH of plant output capacity may be considered to work out the requirement of paddle tips. This is given in **Table 2**.

Table 2 Requirement of Paddle Tips for various Plant Output Capacities

Plant Output Capacity (TPH)	Minimum No. of Paddle Tips
100	22
200	44
300	66

7.3 Paddle Arm and Tip Shape

Paddle arm should be strong and sturdy. The tips should be rounded in the corner for smooth operation. Tips should be made of material having high wear resistance.

7.4 Paddle Arrangement

Paddles should be arranged for smooth operation and proper mixing.

7.5 Power Input

Sufficient power should be provided for achieving the required output capacity.

8. PLANT MAINTENANCE

Proper maintenance of the plant is necessary to ensure trouble free operation and reduce plant downtime. The success of an effective maintenance strategy lies in properly timing the replacement and overhaul of individual components, keeping in view factors like number of hours of operation, load factor, site conditions, age of plant, intuition and experience with the plant, environmental factors etc. Accordingly, the requisite maintenance interval for the plant and its components is worked out using suitable parameters for calculation/measurement like service hours or calendar time, whichever occurs first.

8.1 Plant Maintenance Schedule

8.1.1 *Daily Maintenance Schedule (or Every 10 Service Hours)*

i) Lubricate all parts as given in daily lubrication chart.
ii) Inspect conveyor belts for alignment and excessive wear.
iii) Inspect tension on all belts.
iv) Inspect all guards to assure they are in place.
v) Inspect all gates and valves.
vi) Check the gear box oil level at least one hour after shut down of plant, when the oil will settle down and indicate the correct level. If necessary, top them up.
vii) Top up all drip feed lubricators.
viii) Tighten all bolts after completing day's operation.
ix) During plant operation, check the bearings and ensure that overheating does not occur.
x) Be alert for undue noise, which may be on account of loose bolts.

8.1.2 *Weekly Maintenance Schedule (or Every 50 Service Hours)*

i) Clean and lubricate all parts as given in weekly lubrication chart.
ii) Check all belts and drives and make necessary adjustments accordingly. Ensure that there is no slackness.
iii) Inspect feeder and conveyor belts for wear and tear and broken fasteners. In case of holes and cuts, repair them immediately by lacing or vulcanizing.
iv) Check the belt scrapers on feed unit and in gob hopper. Ensure they are in good working condition and effective. If necessary, replace them.
v) Remove build-up, if any, from plant structure.

8.1.3 *Monthly Maintenance Schedule (or Every 250 Service Hours)*

i) Check all electrical wiring and cables for loss of insulation or corrosion and replace, if required.
ii) Check the screen mesh and repair/replace, if required.
iii) Check the load cell and replace, if required.
iv) Check operation of storage bins level indicators, light bars and pinch valve systems.
v) Adjust/replace skirt boards and conveyor seals as required.
vi) Inspect belt scale accuracy.
vii) Inspect water meter accuracy.
viii) Inspect filler addition rotary valve accuracy.

8.1.4 *Quarterly Maintenance Schedule (or Every 800 Service Hours)*

i) Drain the oil of gear boxes, flush them and refill to correct level with recommended gear oil.

ii) Inspect the interior of pug mill and repair/replace components as needed.

iii) Clean electric contact and relays in control panel.

8.2. Maintenance of Electric Motors

i) Isolate the mains supply to prevent unauthorized starting.

ii) Cover all the exposed motor starter panels and controls, with tarpaulin or plastic sheet to prevent damage during rainfall.

iii) Always place the proper size of fuse while replacing it. Never use a substitute of different size.

iv) Ensure earthing of entire electric supply line is done properly.

v) Always keep the motors and contacts clean from dust.

vi) Test check no-volt coils and overload protection devices for their proper function.

vii) All wiring should be placed under insulated cabling and properly covered trench.

8.3. Requirement of Tools, Equipment and Spares for Maintenance

Wet mix plants are often located in remote area, where repair facilities are not available. It is advisable to make available the following tools, equipment and spares in the workshop at site to ensure effective repair, maintenance and upkeep of the plant and allied machinery. This would reduce the plant downtime:

i) Diesel welding set.

ii) Small electrical tools for drilling, grinding etc.

iii) Pillar drill machine of 25 mm capacity.

iv) Gas welding set.

v) Chain pulley block of 3 ton capacity.

vi) Hydraulic jack of adequate capacity for erection of plant.

vii) 25 mm Manila rope of length 50 m, 100 mm wire rope of length 70 m, wire rope clamps, packing timber like railway sleepers.

viii) One set of hand tools such as spanner, screw drivers, hammers, chain spanners, screw spanner, chain and pipe wrench.

ix) Grease guns, oil cans and trays.

x) General items of store like bolts, nuts, washers, pins, fasteners, bearings, load cells, belts, motor reducers, electrical components, rubber items, cotton waste and other fast moving items (as per manufacturer's recommendations).

xi) Lubricants as per manufacturer's recommendations.

Bulk purchase of spares and lubricants should be avoided as it leads to additional space requirement, blockage of investment, chances of pilferage and fire hazard. The aim is to work out an optimum requirement of spares and lubricants keeping in view various factors like lead time between placement of purchase order for supply of items, cost of procurement and vitality of the item to plant operation, fast moving/slow moving spare etc.

9. PLANT SAFETY

It is very important to ensure safety of equipment as well as operating and maintenance staff at site. Efforts should be made to make the plant site an accident free zone. In this connection, following precautions should be strictly followed.

9.1 Work Site

i) Create awareness regarding safety among staff.

ii) There should be no slip-shot and short cuts.

iii) Provide proper training to staff on safety requirements.

iv) Always employ a skilled and trained worker for the job.

v) Every worker should be medically fit for the job assigned.

vi) Keep fire fighting equipments in operational condition.

vii) Ensure that workers wear proper Personal Protection Equipment (PPE) such as helmets, safety vests, safety belts, goggles, gloves and other items as necessary.

viii) Use proper tools and tackles.

ix) Ensure proper and clean platform/pathways for the work men to pass through.

x) Provide adequate illumination.

xi) Provide guards and railings wherever necessary.

xii) Blow siren before start of plant every time.

xiii) There should be an emergency switch located at a short distance from the plant, which will stop all plant operations in the event of an emergency.

xiv) A First Aid Box should always be available, in the control room.

xv) Smoking should be prohibited near fuel storage tanks.

9.2 Plant and Equipment

i) Keep the equipment in good running condition.

ii) Never operate unsafe equipment.

iii) Be familiar with all controls, gauges, instruments.

iv) Look around before starting the plant and equipment.

v) Never leave the equipment unattended with its engine running.

vi) Keep operator's platform clean and free from oil and grease.

vii) Operate the equipment only from operator's seat/platform.

viii) Never carry out servicing, adjustment and repairs, when the equipment is running.

ix) Never permit any unauthorized person to handle the equipment.

x) The operator must have maximum unrestricted view of the operating area.

xi) Avoid loose connections in electrical system.

xii) Ensure that engine is switched off and immobilized against unauthorized use.

xiii) Don't leave the control, when the equipment is working.

xiv) Be careful in removing the radiator cap, after engine has been running.

xv) Store fuel and lubricants away from plant.

xvi) Inspect all cables of plant periodically.

xvii) Shut down procedure :

1. Put all the controls in neutral.
2. Shut off the engine after allowing it to idle and gradually cool down.

xviii) No open fire should be allowed around fuel storage tank.

9.3 Loading and Transportation of Plant and Equipment

i) Load and unload the plant and equipment on a level ground.

ii) Use the indicated lifting points, while lifting the plant and equipment with a crane.

iii) Ensure correct loading and unloading procedure for different types of equipment.

iv) Use ramp of adequate strength.

v) Block transport vehicle, so that it cannot move.

vi) Tie and block the equipment securely for transport.

9.4 Maintenance of Plant and Equipment

i) Carry out repair and servicing in accordance with manufacturers' recommendations.

ii) Before working on hydraulic system, make sure that hydraulic pressure is released.

iii) While installing the electrical system, the supply battery must be disconnected.

iv) Protect the eyes with safety glasses, while striking the metal parts and during welding.

v) Wear gloves, while handling parts with sharp edges and during welding.

APPENDIX-I

Emission and Noise Limits for a Diesel Genset used in Wet Mix Plant

A. Emission Limits

The emission limits for new diesel engines (up to 800KW) for generator sets were notified by the Environment (Protection) (Third Amendment) Rules vide GSR 771(E) dated 11.12.2013 at Sl. No. 95 and its amendments GSR 232(E) dated 31.03.2014, GSR 789(E) dated 11.11.2014, GSR 105(E) dated 17.02.2015, GSR 54(E) dated 23.01.2015, under the Environment (Protection) Act 1986.

Table 3 lists out the emission limits for new diesel engines up to 800KW for genset applications.

Table 3 Emission Limits for Diesel Gensetsupto 800KW

Power Category	Emission Limits (g/k W-hr)			Smoke Limit (Light Absorption Coefficient, m^{-1})
	NO_x + HC	CO	PM	
Upto 19 KW	≤ 7.5	≤ 3.5	≤ 0.3	≤ 0.7
More than 19 KW upto 75 KW	≤ 4.7	≤ 3.5	≤ 0.3	≤ 0.7
More than 19 KW upto 800 KW	≤ 4.0	≤ 3.5	≤ 0.2	≤ 0.7

B. Noise Limits

Noise limits for generator sets run with diesel were notified by Environment (Protection) Second Amendment Rules vide GSR 371(E) dated 17.05.2002 at Sl. No. 94 and its amendments vide GSR 520(E) dated 01.07.2003, GSR 448(E) dated 12.07.2004, GSR 315(E) dated 16.05.2005, GSR 464(E) dated 07.08.2006, GSR 566(E) dated 29.08.2007 and GSR 752(E) dated 24.10.2008; GSR 215(E) dated 15.03.2011 under the Environment (Protection) Act 1986.

For new DG sets with rated capacity up to 1000KVA, manufacturer on or after the 1st January, 2005, the maximum permissible sound pressure level shall be 75dB(A) at 1 m from the enclosed surface. The DG sets should be provided with integral acoustic enclosure.

APPENDIX-II

Recommended Frequency of Calibration and Permissible Tolerance in Accuracy for a Wet Mix Plant

Table 4 lists out the recommendations on frequency of calibration and maximum permissible tolerance in accuracy of measuring instrument to be followed for various components of a Wet Mix Plant to ensure optimum plant performance.

Table 4 Recommended Frequency of Calibration and Permissible Tolerance for a Wet Mix Plant

S. No.	Component	Recommended Frequency of Calibration	Maximum Permissible Tolerance in Accuracy of Measuring Instrument
1	Load Cell (Slinger Conveyor)	200 working hours	± 4 %
2	Water Metering System	200 working hours	± 2 %
3	Filler Fines Feeding System	200 working hours	± 3 %

APPENDIX-III

Air Pollution Control Measures in a Wet Mix Plant

Emission norms for DG set have already been given in **Appendix-I**. In addition, dust generation from aggregate feeding system and vehicular movement also contributes to pollution. Therefore, the wet mix plant should be set up in a suitable location in accordance with the guidelines and binding norms issued by the concerned State Pollution Control Board from time to time.

Suitable measures that can help keep the pollution within check are given below:

- Dust containment cum suppression system for the plant
- Construction of wind breaking walls as per predominant wind direction
- All roads/ vehicular movement areas within the premises to be pucca/ stabilized (stone aggregated)
- Regular cleaning and wetting of ground within the premises
- Growing and maintaining of a green belt along the periphery of the premises
- Only approved fuel and oil to be used

APPENDIX-IV

List of Do's and Dont's for a Wet Mix Plant

Do's:

- Do greasing of all bearing pedestals.
- Check oil levels in all gear boxes before starting the plant.
- Clean the plant daily.
- Check regularly idler rollers of conveyors for their smooth running. Otherwise, jammed rollers will wear at one particular space also damages the belts.
- Check for any rubbing and wear in V- belts drives of various units of the plant and replace V belts /pulley when found damaged.
- Lock the load cell frame while not operating the plant.
- Follow safety rules and precautions.
- Maintain Generator; monitor Voltage and Frequency.
- Keep the control room clean and remove all unwanted materials.
- Keep panel power off while carrying out any welding in the plant.
- Check the calibration at regular intervals.
- Tighten all the fasteners weekly.
- Check and adjust the belt scrapper and skirt rubber before starting the plant.

Dont's:

- Never attempt greasing of any moving/rotating parts of machine like driver rings roller. Otherwise, fatal accidents can result.
- Don't do welding work, when load cell is connected.
- Don't operate the plant without having proper knowledge/training.
- Don't start pug mill motor directly on load, try to remove load or give momentum to shafts before power is switched ON.
- Don't start or stop frequently higher capacity [star delta] motors on load.
- Never use wires instead of fuse links.
- Don't supply power in the panel without proper earthing.
- Don't run the plant at more than the rated capacity.
- Don't start the panel without proper power supply.
- Don't touch the panel without wearing safety shoes.
- Don't close the breaker on load without cover or arc chutes, the flash may damage eyes.
- Don't try to carry out the maintenance with power ON.
- Don't bypass safety of any equipment with power ON.
- Don't use under size cables for motors which can be fire hazardous.
- Don't smoke near fuel storage area.

APPENDIX-V

Sample Calculation for Output Analysis of a Wet Mix Plant

Given:

1 km of 2 lane (7m wide) road is to be constructed having WMM 150mm thick using a 100TPH WMM plant.

i) Quantum of work involved = 0.15 x 7 x 1000
= 1050 cum

ii) Quantity of aggregate required (assuming density 2.2 Tonnes/cum)
= 1050 x 2.2
= 2310 Tonnes

iii) Assume plant working hours per day as 7.5 hours

iv) Total tonnage produced by the 100TPH WMM plant in a day
= 100 x 7.5
= 750 Tonnes

v) Time required for producing 2310 Tonnes of WMM
= 2310 ÷ 750
= 3.08 days or say 3 days

APPENDIX-VI

Plant Calibration

The purpose of plant calibration is to ensure that the plant accurately measures and proportions the aggregates and water. The aim is to adjust the settings, if required, to ensure increased level of accuracy so that deviation between the actual and expected results in measurement is negligible.

A. Calibration of Belt Scale (Load Cell)

For calibration of load cell/belt scale attached to charging conveyor, the following steps are to be followed:

i) Prior to calibration, run the conveyor belt for about one hour to warm up the system.

ii) Ensure that the belt scale reads zero without material on the scale. In case of deviation from zero reading, follow manufacturer's guidelines to 'zero the scale".

iii) Set the cold feed gates at an opening that will allow a good material feed. Run approximately 10 tonnes of aggregate over the belt scale conveyor to ensure proper seating of the conveyor belt on the rollers and better weighing accuracy.

iv) Starting with empty belt, run the aggregate directly into a tipper truck (with known tare weight) via a bypass chute. Ensure that aggregate does not enter the pug mill.

v) Stop aggregate flow to tipper truck with an empty belt without overflowing the truck. Make sure the belt is empty before and after the test.

vi) Record the aggregate quantity loaded into the truck using metrologically certified weigh scale. It is calculated by subtracting tare weight of the truck from its final weight after loading.

vii) Record the aggregate quantity reading shown by belt scale.

viii) Compare the values obtained in steps (vi) and (vii).

ix) Adjust the belt scale based on manufacturer's guidelines and follow steps (iii) to (viii) until the values obtained in steps (vi) and (vii) are within acceptable limit.

x) Repeat the above test sequence at different production rates (low, medium, high) to make sure the belt scale is accurate even with variation in load.

B. Calibration of Feeder

Once the belt scale has been calibrated, calibration charts for the different feeders at different speeds and gate openings have to be prepared.

The material flow characteristics for different sizes and types of material are different. Hence it is recommended that the calibration be done whenever there is significant change in the material size or type for any feeder bin. Each feeder belt should have a no flow switch to sense if any feeder belt is running empty.

Feeder output is regulated by gate opening only in case of constant speed drive while feeder belt speed coupled with gate opening influence feeder output in case of variable speed drive. Good practice is to achieve the right combination of belt speed and gate opening. Too close gate opening and fast belt speeds are detrimental to belt life and more prone to blockage of gate. Too large gate opening and too slow belt speed increases the weight on belt and affects motor performance at very low speeds.

B.1 Constant Speed Drive

i) Select the bin to be calibrated. Feeders of other bins are not to be operated during the calibration process.

ii) Set the gate of the selected bin at a suitable opening (preferably between 10% and 100%) and start the corresponding feeder.

iii) Calculate the aggregate feed rate at that opening using the following formula:

Feed rate (in TPH) = 0.06 x [Aggregate Weight on Belt (in kg) x Slinger Conveyor Belt Speed (in m/min)] ÷ Slinger Conveyor Belt Section Length (in m)

iv) Repeat the process for 3 more openings.

v) Plot the feed rates versus the corresponding gate openings to obtain the calibration chart of the concerned bin.

vi) Repeat the above steps to prepare calibration chart for each of the remaining bins.

Fig. 10 depicts a typical calibration chart for a wet mix plant with 4 bins.

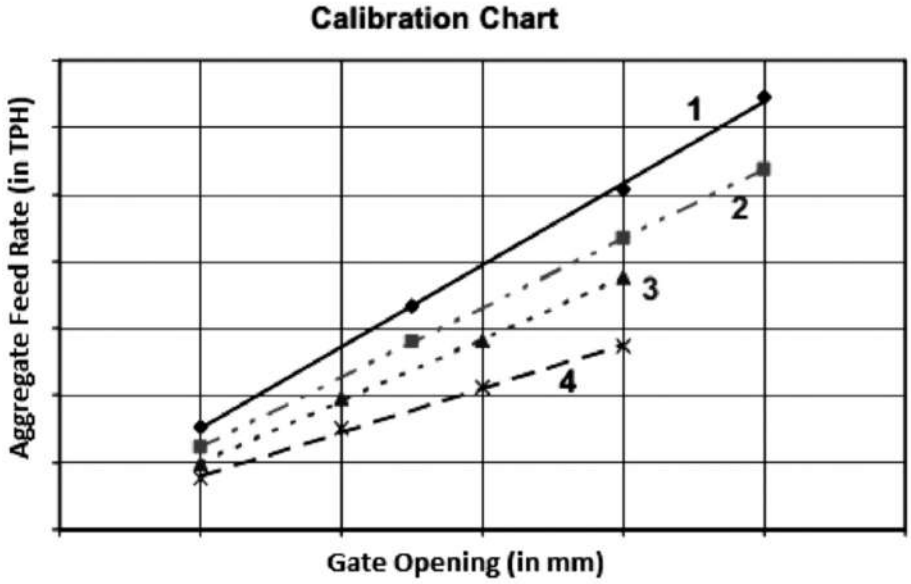

Fig. 10 Typical Calibration Chart for a 4-Bin Fixed Drive WMM Plant

vii) Aggregate proportions conforming to the mix formula and in accordance with the desired plant capacity are calculated.

Typical Example:

S. No.	Item Description	Nominal Size of Aggregate	Grading Proportion (in %) as per Mix Formula	Feed Rate Required to Achieve Desired Plant Output (Say, 90 TPH)
1	Bin 1	40 mm	43	38.7
2	Bin 2	20 mm	8	7.2
3	Bin 3	10 mm	21	18.9
4	Bin 4	Dust	28	25.2

viii) For each bin, compute the gate opening off the calibration chart, based on the required feed rate of the aggregate.

B.2 Variable Drive

i) Select the bin to be calibrated. Choose a suitable gate opening for that bin.

ii) Vary the feeder belt speed between 10% and 90% of maximum speed and record the corresponding values of aggregate feed rate. Belt speed should be measured using a tachometer or any suitable device.

iii) Plot aggregate feed rate versus percentage of feeder belt speed to obtain calibration chart for the concerned bin at the selected gate opening.

iv) Repeat the above steps to prepare calibration chart for each of the remaining bins.

Fig. 11 depicts a typical calibration chart for a wet mix plant with 4 bins, showing variation of aggregate feed rate with feeder belt speed. The chart can be used to determine the feeder belt speed settings one should use for each bin to meet the desired job mix target.

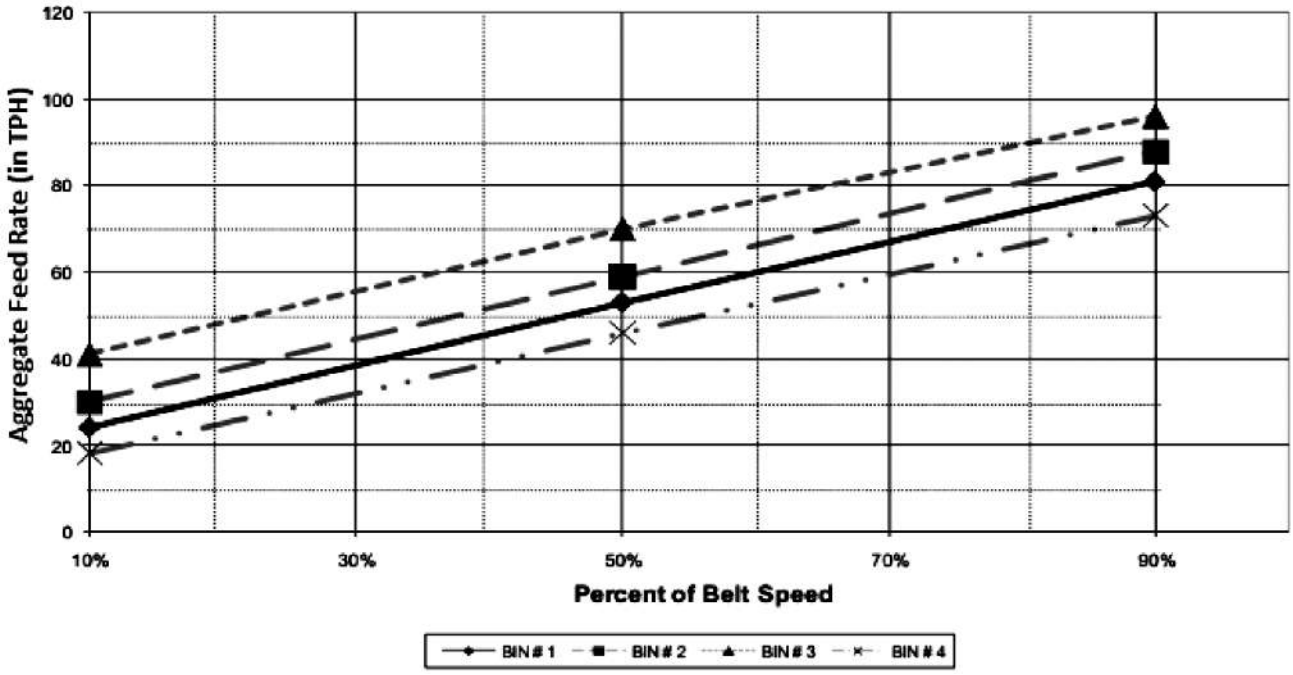

Fig. 11 Typical Calibration Chart for a 4-Bin Variable Drive WMM Plant

C. Calibration of Water Metering System

C.1 Calibration of Water Flow Meter

i) Record the water flow rate reading shown by electronic flow meter and compare it with that shown by metrologically certified instrument.

ii) Adjust the flow meter settings as per manufacturer's guidelines until the values obtained in step (i) are within acceptable limit.

C.2 Calibration of Water Pump/Valve

i) Record the quantity of water pumped by the water system at different valve openings. Plot a graph corresponding to these values.

ii) Calculate the water requirement conforming to the mix formula and in accordance with the desired plant output.

iii) Work out the valve opening corresponding to the water requirement calculated in step (ii) from the graph plotted.

APPENDIX-VII

Typical Layout of a Wet Mix Plant

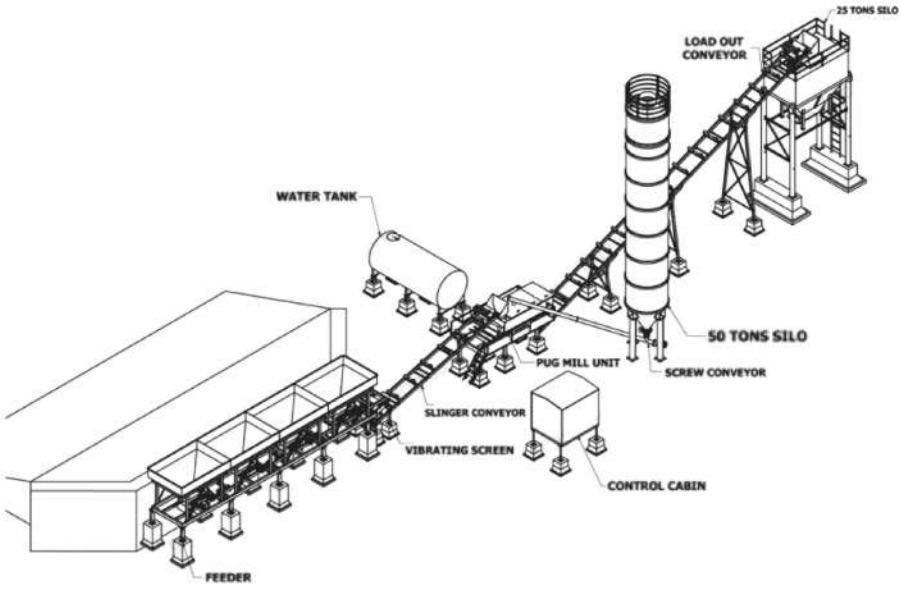

Fig. 12 Typical Layout of a 200 TPH Wet Mix Plant with Filler Silo

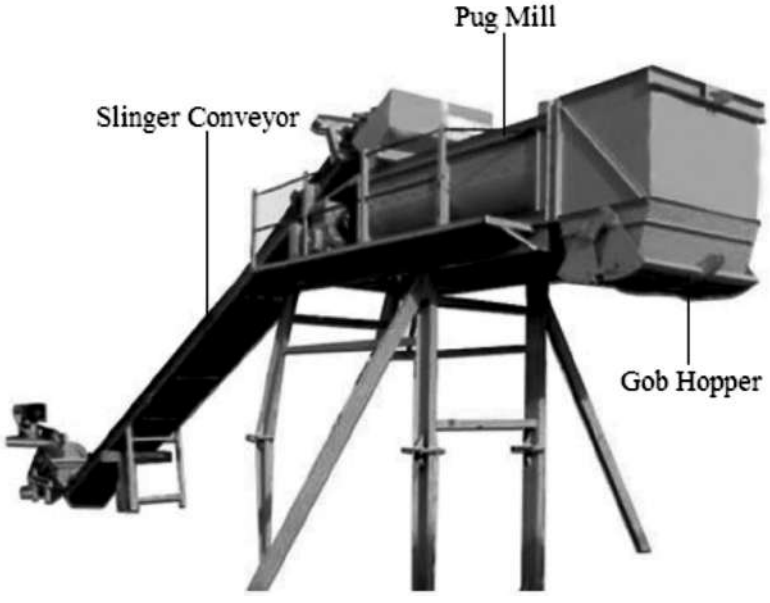

Fig. 13 Typical Layout of a Wet Mix Plant with Integrated Gob Hopper Arrangement

References

1. MoRT&H, “Specifications for Road and Bridges Works”, Fifth Revision, Ministry of Road Transport and Highways, Indian Roads Congress, New Delhi.
2. IRC:109-2015, “Guidelines for Wet Mix Macadam”, Indian Roads Congress, New Delhi.
3. Environment (Protection) Rules, 1986.