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No. RW/RMP-16(3)/84

Dated the 18th March, 1988

To:

1. All Chief Engineers of the States and Union Territories dealing with National Highways
2. The Director General Border Roads.
3. The Director General, Works, CPWD.

Subject : Use of Secondary Gradation Control Unit in Hot Mix Plants.

Ref: Ministry's letter No. RW/RMP-16(3)/84 dated 1st January, 1985.

Kindly refer to the Ministry's letter mentioned above (copy enclosed for ready reference) *vide* which the Technical specifications and component arrangements for the Hot Mix Plants to be used on NH Works were laid down.

2. In para 2 of the letter, it was also requested that these should form a part of the contract document and the work should not be allowed to be executed with the plants which do not fulfill these minimum requirements whether the plants belong to the contractors or State PWDs or to the Ministry.
3. However, it has been observed that some of the plants of the Ministry, State PWD and the contracts which are being utilised on NH Works do not conform to these technical specifications of the Hot Mix Plant. One of the major deficiency noticed is that the Secondary Gradation Control Unit has been removed or not fitted with the Hot Mix Plant. This is affecting the quality of the mix and thereby the works executed.
4. The Ministry had constituted a Group of Officers to study the problems being faced in using the gradation control unit and suggest improvement/modifications, if any, in the existing system. The Group of Officers after detailed deliberations and study of the problems, recommended that use of secondary gradation control unit is a MUST for achieving proper quality mix for NH Works. A copy of the report is enclosed herewith.
5. It would be seen that the Group of Officers has also emphasised that the steps should be taken to produce the aggregates of required sizes and grading. The group has also highlighted the difficulties being experienced and solutions suggested thereto.
6. It is requested that suitable instructions may kindly be issued to concerned so that the Hot Mix Plants of technical specifications and component arrangements as specified in the Ministry's letter dated 1/1/85 mentioned above are used for execution of NH Works whether these Hot Mix Plants belong to the Ministry, State PWD or the Contractor.
7. It is also suggested that this should form part of the contract document and technical specifications of the Hot Mix Plant should be specified in the NITs.

Please acknowledge the receipt of this letter and the Ministry may be informed of the action taken in the matter.

Enclosure to letter No. RW/RMP-16(3)/84 dated the 18th March, 1988

No. RW/RMP-16(3)/84

Dated the 1st January, 1985

To

1. All Chief Engineers of the States and Union Territories, dealing with National Highways.
2. The Director General, Works, CPWD, New Delhi.
3. The Director General, Border Roads, New Delhi.

Subject : Use of Hot Mix Plant on National Highway works.

It has been observed that sometimes Hot Mix Plants used on National Highway works are not properly equipped with arrangements for gradation control of aggregate, measuring of bitumen and mineral filler feed system which are essential to obtain mix of desired specifications and ensure quality of asphaltic road works.

2. It has, therefore, been decided that while inviting tenders and allotting work to Contractors, it may be specified that Hot Mix Plants should conform to component arrangements as per Annexure attached. This should also form part of the contract documents. The work should not be allowed to be executed by Contractors, with the plant which do not fulfil these minimum requirements.
3. Similarly, departmental Hot Mix Plants which already have the essential features should be used on works as such, without putting in disuse or removing any of the components.

**MINISTRY OF SURFACE TRANSPORT
(ROADS WING)**

Enclosure to Letter No. RW/RMP-16(3)/84 dated the 1st Jan., 1985

TECHNICAL REQUIREMENT OF HOT MIX PLANT TO BE USED ON NATIONAL HIGHWAY WORKS

Composition of Plant

The Hot Mix Plant shall conform generally to I.S. Specifications No. IS-3066/1965 as amended from time to time and shall be equipped with the following arrangements.

1. **Cold Aggregate Feeder:** The cold aggregate feeder shall have minimum three independent bins or compartment, each provided with accurate mechanical means for feeding the aggregate at a uniform and predetermined rate to the cold elevator or to some intermediate conveyor or directly into the dryer. The feeder shall provide for the adjustment of total and proportional feed and shall be capable of being locked in any setting.

2. **Dryer**

The dryer shall be capable of continuously agitating the aggregates while heating to desired temperature. At the discharge end of the dryer or any other suitable locations, means shall be provided for ascertaining the temperature of the heated aggregate.

3. **Screening Unit and Gradation Control**

The dried aggregate shall be screened into not less than three sizes. The plant shall include means for accurately proportioning each bin size of aggregate either by weight or by volumetric measurement. When the gradation control is by volume, the unit shall include a feeder mounted under the compartment bins. Each bin shall have an accurately controlled, individual gate to form an office for proportioning the material drawn from each respective bin compartment. The office shall have positive mechanical adjustment and provided with a lock. Indicators shall be provided and on each gate to show the gate opening in centimeters.

4. **Mixer Unit**

The plant shall included a mixer of an approved twin shaft pugmill type capable of producing a uniform mix. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of fines.

5. **Mineral Filler Supply Unit**

There shall be an independent arrangement to feed mineral filler directly into the pugmill. The hopper to bin for mineral filler shall provide for the adjustment proportion the feed with the aggregate and bitumen feeds and shall be capable of being locked in any setting.

6. **Bitumen Heating**

A heating system for bitumen always with effective and positive control of temperature shall be provided, to maintain proper temperature and for allowing continuous circulation between storage tank and proportioning units during the entire operating period. Suitable arrangements shall be provided for recording the temperature at the tanks and in the circulating system.

7. **Synchoronisation**

For synchronization of Aggregate bitumen and filler feeds satisfactory means shall be provided to afford positive inter-locking control between the flow of aggregate from the bins or compartment, flow of bitumen from the tank and flow of mineral filler.

REPORT OF GROUP OF OFFICERS ON USE OF GRADATION CONTROL UNIT IN HOT MIX PLANTS

1. INTRODUCTION

1.1 Ministry vide their Memorandum No. RM-16(3)/84 dated 8th September, 1987 constituted a group of officers' study the use of gradation control unit in Hot Mix Plants. It was required by the Ministry that the report should be submitted within 4 months.

1.2 Terms of Reference

The terms of reference of the group of officers were as under :

- (a) To study the problems faced in using Gradation Control Unit in Hot Mix Plants.
- (b) To suggest improvements/modifications, if any, in the existing system.
- (c) The effect on the quality of mix of the Gradation Control Unit is not used.

1.3 Composition

The composition of the group of officers is as at Annexure-I.

1.4 Methodology Adopted and Meeting Held

An introductory paper containing information regarding necessity for the constitution of the group, requirement as per specifications, the requirement for producing uniform quality mix, primary gradation control, secondary gradation control etc. was circulated to all the members. They were requested to send write-up based on the experience to the Convenor. These were circulated to other members for their study and offering comments/suggestions.

The meeting of the group was held on 24/11/87. Detailed discussions were held covering various aspects of the problems.

2. REVIEW OF REQUIREMENTS

2.1 In the developing country like India, with the rapid increase in the intensity of traffic and introduction of heavier vehicles, the road pavements of better specifications and quality are very necessary. This would also result in comfort and safety to the motorists.

2.2 Specifications prescribed by the Ministry for BM, DBM, SDC, BC(AC) stipulate permissible variations for various size of aggregates. In order to adhere these variation and to achieve stability of the laid down mix, all the members were of unanimous opinion that it is better to have control at every stage of the construction including various stages in the hot mix plants.

2.3 In bituminous mixes, the aggregates constitute 90-95% of the overall mass. The stability of these mixes is mainly due to the mechanical interlocking of the aggregates. The function of the binder is to keep the aggregates together. Larger variations in aggregates gradation affects the stability of mix considerably. Hence, gradation control is of utmost importance.

2.4 In hot mix plant, 3 components namely the cold aggregates feeder unit, hot aggregate screening unit and aggregates proportioning unit are mainly responsible for the gradation control.

3. DIFFICULTIES AND SOLUTIONS SUGGESTED

3. The difficulties being experienced in the use of secondary gradation control unit were discussed and appropriate solutions were also suggested. These are as under :

3.1 The height of the gradation control unit specially hot elevator makes the maintenance/operation very difficult.

The ladder and working platform should be properly provided with guards so that operator/mechanic can easily reach the spot and carry out maintenance work safely.

3.2 The installation of secondary gradation control unit reduces the plant output.

All out efforts should be made to feed the properly graded materials, avoid oversize stones as far as possible. If this is done, the output of the plant will not be affected much.

3.3 The assessibility of hot bins poses maintenance problem.

Since the maintenance is normally done before the start of the plant or after the day's work is over, the maintenance problem normally should not be there unless and until to meet any emergency.

3.4 Due to high temperature, the chances of frequent wear and tearing of Shieves (Screens) is a common occurrence.

It was felt that extra sets of screens should be kept in stock at sites so that these can be replaced in the shortest possible time. In this way, the output of the plant will not be affected.

3.5 The overflown pipes chocked up sometimes due to the presence of large size stones.

Efforts are to be made to remove oversize/large size stones at the cold feeder belt by providing guide plate or deputing some person to remove oversize stones.

3.6. The non-uniform flow of aggregate from cold feeder sometimes leads to overloading of storage bins.

Plant operator/Supervisor is to be watchful regarding uniform flow of aggregates from various hoppers of the cold feeder arrangement.

3.7 For each mix, shieve (Screen) sizes are to change for maintaining the uniform mix.

The shieves are normally changed when the mix formula is changed. This is un-avoidable. However, this should be restricted by doing the work on longer stretches.

3.8 The component of gradation control unit due to too much vibration and dusty condition breakdown and get damage frequently.

It was suggested if proper maintenance is carried out, greasing of the various parts is done as and when required, the breakdown will automatically be reduced.

3.9 Some of the members mentioned that due to use of secondary gradation control unit, lot of dust is blown in the vicinity which is injurious to the health of the workers and results in frequent wear and tear, and break down of parts.

It was suggested that in future generation of hot mix plants, screening unit may be got enclosed to restrict the blowing dust. This practice is being followed in developed countries.

4. ALTERNATIVES CONSIDERED

4.1 One of the members suggested that screening of aggregates may be done at site before feeding into the hoppers of cold feeder.

The other members felt this may not help much as the proportions of the aggregates changes during the heating of the aggregate in the drier drum. At the same time, due to various reasons, the proportions of the aggregates is disturbed. As such, other members were of the opinion this solution will not serve the purpose.

4.2 One of the members suggested digital system for measuring of bitumens should be provided with every hot mix plant.

The other members felt the present system of interlinking metering of bitumen with help of sprocket and chain arrangement is satisfactory. However, in the future generation of the plant, the digital system may be incorporated, if found necessary.

5. DRUM MIX PLANTS

5.1 Some members expressed their anxiety that in drum mix plant — how the proportioning of aggregates will be achieved. It was explained by the Convenor that the drum mix plant of the present generation, have an electronic control sensing device for proportioning of the aggregates and spraying of correct quantity of bitumen.

6. MISCELLANEOUS POINTS

6.1 One of the members mentioned that even in advance countries where fully mechanised crushing and grading of aggregates at the quarries and fully mechanised handling various grades at hot mix plant sites have been in vogue for many years, the use of secondary (i.e) gradation for second time has been considered essential and most of the plants are being manufactured with this feature incorporated in them.

6.2 Some of the members mentioned that the management and co-ordination between the civil and mechanical wings of the PWD is of utmost importance for achieving better quality and output from the plant. As such, the management aspect must also be looked into.

6.3 Some members were of the view that all diesel engine driven hot mix plants should be converted into electrical driven plants. This is essential to overcome the problems being faced in maintenance and frequent overhauling of diesel engines.

7. FINDINGS

7. It is often observed that the aggregate proportioning done at the cold feeder end by gates opening is not enough due to various reasons as indicated below :

7.1 The fine fractions of the aggregates are blown off through chimney during the drying process which is not accounted for and sometimes proportions go out of grading limits.

7.2 Most of the quarries in India are having jaw-type of crushers and rotary screens for segregation. The availability of various size of aggregates is not uniform. Since manual removal of the aggregates is normally done from the rotary screen to stockpiles, this results inter-mixing of graded materials.

7.3 The lack of concern for proper quality and profit motive taking precedence over everything else is still seen among a large section of aggregate suppliers.

7.4 Intermixing of various grades and mixing with sizes not required but lying at the sites or rejected materials (not timely removed) is also possible on account of non-mechanised/manual un-loading, stock-piling and lack of space on hot mix plant sites.

7.5 The size of the bins of the hot mix plants presently working, even being manufactured, are not sufficiently large. The graded materials get mixed up even during mechanised loading by loaders/tippers, which affects the initial proportions.

7.6 It is also seen that aggregates lying at hot mix plant sites is covered with dust/sands which is blown off during drying affecting proportions. Hence, there is a need for second time gradation.

7.7 Due to the above mentioned reasons, the percentage of oversize or undersize aggregate may be quite high. As such, the grading done in the cold aggregates feeder is not enough.

7.8 It is also observed that during heating of aggregates and its travel through cascading plants in the drier drum, the pregraded materials breaking and assuming a new grade is quite common. The extent of change depends on the type of stone from which the aggregate is produced. In our country, the variety of the stones available is much larger. Due to this reason also, the homogeneity of pregraded materials is bound to change between the feed-end and discharge end of the drier drum.

7.9 Due to human error in feeding the hoppers, all the bins may not be properly filled up at all the time. As a result the rate of flow of aggregate due to gravity in different bins may vary widely.

7.10 The primary gradation control unit cannot remove/segregate the oversize materials or odd size materials. As a result, some of them may pass into the mixing chamber resulting major damages to the pedal, arms/tips etc.

7.11 When stone dust/sand or smaller sizes aggregates i.e. 6 mm or lesser size are being fed from the cold feed hoppers, arching phenomenon may occur, especially when moisture content is high. The continuous rodding of the aggregates or producing vibrations with the help of mechanical vibrator is required to get rid of this problem.

No arching is experienced in 10 mm or bigger size aggregates.

7.12 As such, all members were of unanimous opinion that unless other materials is graded again just before it enters the pugmill mixture, the mix obtained may not be of proper grading and homogeneous quality.

7.13 All the members were of the opinion that keeping the above practical position in view, the secondary gradation control unit is essentially required.

8. RECOMMENDATIONS & SUGGESTIONS

8.1 For producing homogeneous and uniform mix as per the specifications and the job formula, the use of secondary gradation control unit is MUST. As such, all the hot mix plants which are belonging to the Ministry, State PWDs or the Contractor being used on National Highways should be fitted with secondary gradation control unit.

8.2 It may be impressed upon site officers to procure properly graded aggregates and stock them properly so that intermixing specially of oversize stones is reduced to the minimum possible. If this done, the output of the plant will not be affected much by the use of gradation control Unit.

8.3 It is accepted fact that the dusty atmosphere at and around hot mix plant is causing a number of problems to the human being and in the maintenance of hot mix plants. It is suggested that future generation of hot mix plants should be procured with screening and gradation control unit fully covered. Though it may be somewhat costly, the cost will be paid back due to lesser maintenance of hot mix plants and avoiding health hazards to the workers working there.

8.4 At all hot mix plants sites, additional set of screens should be kept in stock. These can be used for replacement as and when required. This is essential to keep the break down time to the minimum for the replacement of screens.

8.5 All diesel engines driven hot mix plants should be converted into electrical driven plants. This is essential to overcome the problem being faced in maintenance and frequent overhauling of the diesel engines.

GROUP OF OFFICERS

Sl. No.	Name	Designation and Address
1.	Shri D.R. Gulati	Superintending Engineer (M) & Convenor, Ministry of Surface Transport, Roads Wing, New Delhi.
2.	Shri P. Bhaskaran	Superintending Engineer, Ministry of Surface Transport, New Delhi.
3.	Shhri-S.M. Abbas Rizvi	Superintending Engineer, PWD, Lucknow.
4.	Shri P.G. Suresh	Design and Development Engineer, M/s Marshall & Sons Co. (I) Ltd., Madras.
5.	Shri R.S. Shukla	Head, Flexible Pavements Division, Central Road Research Institute, New Delhi.
6.	Shri B.K. Dutta	Superintending Engineer (M), Mechanical Circle II, PW (Roads) Directorate, Calcutta.