TECHNICAL NOTE NO: 17

Sub: **Coarse Aggregates in Road Construction - Water Absorption test- Importance-**Reg.

Ref : 1) Cir Memo No. 711/Circulars/CEQC/DCE/DEE/AEE/2014 Dt 02.11.2018 of the CE(R&B) Quality Control Vijayawada.

2) MORD Specification for Rural Roads 2014.

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The water absorption of coarse aggregates in road construction is an important factor to consider for several reasons: Here are some key reasons why water absorption is important.

1. **Durability**: Excessive water absorption in coarse aggregates can lead to reduced durability of the road construction materials. When aggregates absorb too much water, they become more susceptible to freeze-thaw cycles, which can cause them to crack and deteriorate over time. This can result in the need for frequent maintenance and repairs.
2. **Workability**: The water absorption characteristics of coarse aggregates can affect the workability of the concrete or asphalt mix used in road construction. Aggregates that absorb too much water can lead to a mix that is difficult to work with, making it challenging to achieve the desired compaction and finish.
3. **Gradation Control**: The absorption of water by coarse aggregates can affect the gradation of the mix. Water-absorbing aggregates may cause the fine particles in the mix to be washed away, altering the mix's overall gradation. This can result in poor performance and decreased strength of the road surface.
4. **Weight and Volume**: Water absorption in aggregates affects their weight and volume. This, in turn, can impact the overall density and strength of the road construction material. High water-absorption aggregates can lead to a reduction in the material's strength, making it less capable of withstanding traffic loads and environmental stresses.

5. **Cost**: Excessive water absorption can lead to higher material costs due to the need for more cement or asphalt to compensate for the moisture absorption. Additionally, it can result in increased maintenance and repair costs over the lifespan of the road.
6. **Quality Control**: Proper quality control is crucial in road construction to ensure that the resulting infrastructure is durable and safe. Monitoring the water absorption characteristics of coarse aggregates helps in selecting the right materials and maintaining consistency in the construction process.

The coarse aggregates used in the Subbase, Base, Wearing Courses and Cement Concrete in road construction shall satisfy the certain requirements as per MORD . Apart from Gradation, AIV, Water Absorption also plays an important role in the acceptance criteria of the coarse aggregate used in the Road construction.

The maximum allowable Water absorption values of Coarse Aggregate used in the pavement for different components of the crust is shown below as per MORD 2014.

Sl.No	Component	Max Water Absorption Value	MORD 2014 Clause/Table
1	WBM Sub base/Base/Surfacing	**2% (If it is greater than 2% the soundness test shall be carried out as per IS: 2386 (Part 5)**	Clause 405.2.1
2	WMM	**2% (If it is greater than 2% the soundness test shall be carried out as per IS: 2386 (Part 5)**	Clause 406.2.1 & Table 400.11
3	BM	**2%**	Table 500.3
4	Surface Dressing	**1%**	Clause 505.2.1
5	OGPC	**1%**	Clause 506.1.2.2
6	SDBC	**2%**	Table 500.13
7	MSS	**1%**	Clause 507.2.2
8	Seal Coat	**1%**	Clause 508.2.2

9	CC Pavement	**5% (Where the water absorption is more than 3 percent, the aggregate shall be tested for soundness in accordance with IS:2386(Part 5).**	Clause 1501.2.4.1

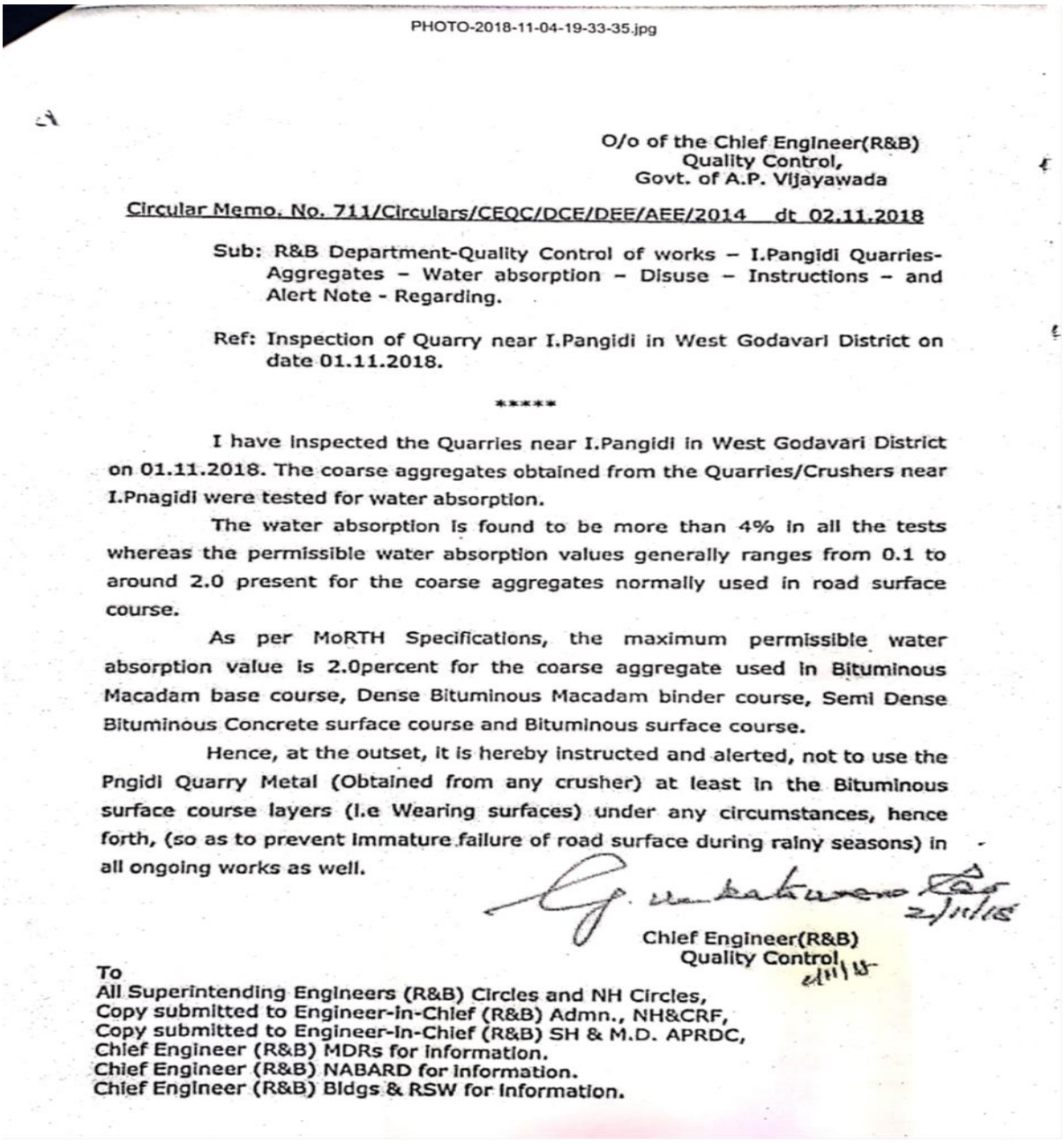
As seen from the above table the water absorption values are ranging from 1 to 3 percent and the field engineers are not concentrating on this parameter which results into premature failure of BT surfaces during rainy season as shown below since the water absorption values are beyond the limits.

In our State also some quarries are yielding coarse aggregate with more than the allowable water absorption value and the same being used in road construction without testing.

Through ref 1st cited The Chief Engineer (R&B) QC Vijayawada has reported that the Coarse aggregate obtained from the Pangidi quarry in West Godavari Dist exhibits the water absorption value is more than 4% which is unfit for use in the Road construction whereas the permissible values are generally in the ranges from 1% to 2% only for flexible pavements.

As per MORD specifications the max limit of Water absorption for Sub Base, Base courses and Wearing Courses are **2% and 1%** respectively as mentioned in the above Table.

Accordingly R&B department through ref 1st cited (attached below) has alerted their Engineers, not to use **Pangidi quarry** metal (obtained from any crusher) at least in the Bituminous surface course layers so as to prevent immature failure of road surface during rainy season.



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O/o of the Chief Engineer(R&B)
Quality Control,
Govt. of A.P. Vijayawada

Circular Memo. No. 711/Circulars/CEQC/DCE/DEE/AEE/2014 dt 02.11.2018

Sub: R&B Department-Quality Control of works – I.Pangidi Quarries-Aggregates – Water absorption – Disuse – Instructions – and Alert Note - Regarding.

Ref: Inspection of Quarry near I.Pangidi in West Godavari District on date 01.11.2018.

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I have inspected the Quarries near I.Pangidi in West Godavari District on 01.11.2018. The coarse aggregates obtained from the Quarries/Crushers near I.Pnagidi were tested for water absorption.

The water absorption is found to be more than 4% in all the tests whereas the permissible water absorption values generally ranges from 0.1 to around 2.0 present for the coarse aggregates normally used in road surface course.

As per MoRTH Specifications, the maximum permissible water absorption value is 2.0percent for the coarse aggregate used in Bituminous Macadam base course, Dense Bituminous Macadam binder course, Semi Dense Bituminous Concrete surface course and Bituminous surface course.

Hence, at the outset, it is hereby instructed and alerted, not to use the Pngidi Quarry Metal (Obtained from any crusher) at least in the Bituminous surface course layers (I.e Wearing surfaces) under any circumstances, hence forth, (so as to prevent immature failure of road surface during rainy seasons) in all ongoing works as well.

Chief Engineer(R&B)
Quality Control

To
All Superintending Engineers (R&B) Circles and NH Circles,
Copy submitted to Engineer-in-Chief (R&B) Admn., NH&CRF,
Copy submitted to Engineer-In-Chief (R&B) SH & M.D. APRDC,
Chief Engineer (R&B) MDRs for information.
Chief Engineer (R&B) NABARD for information.
Chief Engineer (R&B) Bldgs & RSW for information.

To mitigate the adverse effects of water absorption in coarse aggregates, engineers and construction professionals often conduct tests to assess the moisture content and absorption properties of the aggregates. Based on the test results, appropriate adjustments can be made to the mix design and construction methods to optimize the durability and performance of the road construction materials. Choosing aggregates with low water absorption can also be an effective strategy for improving the quality and longevity of road infrastructure. Otherwise, water repelling agents may be added to the BT surface course mixes during construction to prevent immature failure of roads.

Test Procedure for Water Absorption:

1. Aggregate larger than 10 mm:

1.1 Apparatus required -

Fig. 1: Wire Mesh Bucket

Wire basket of not more than 6.3mm mesh or a perforated container of convenient size with thin wire hangers for suspending it from the balance.

Fig. 2: Setup of Water Absorption Test

1.2 Sample: A sample of not less than 2000 g of the aggregate shall be tested.

1.3 Test Procedure:

The sample shall be thoroughly washed to remove finer particles and dust, drained and then placed in the wire basket and immersed in distilled water at a temperature between 22 to 32 degree Celsius with a cover of at least 50 mm of water above the top of the basket.

1.3.1 Immediately after immersion the entrapped air is removed from the sample by lifting the basket containing it 25 mm above the base of the tank and allowing it to drop 25 times at the rate of about one drop per second. The basket and the aggregate should remain completely immersed in water for a period of 24+/- 0.5 hours afterwards.

1.3.2 The basket and the sample shall then be jolted and weighed in water at a temperature of 22 to 32 degree Celsius.

1.3.3 The basket and the aggregate are then removed from water and allowed to drain for a few minutes. After which the aggregates are transferred to one of the dry absorbent clothes.

1.3.4 The aggregates placed on the absorbent clothes are surface dried till no further moisture could be removed by this cloth. The aggregates are transferred to the second dry cloth spread in a single layer.

1.3.5 Covered and allowed to dry for at least 10 minutes until the aggregates are completely surface dry. 10 to 60 minutes drying may be needed. A gentle current of unheated air may be used during the first ten minutes to accelerate the drying of aggregate surface. The aggregate shall then be weighed **(Weight B).**

1.3.6 The aggregate shall then be placed in the oven in the shallow tray, at a temperature of 100 to 110 degree Celsius and maintained at temperature for 24+/- 1 /2 hours as shown below.

It shall then be removed from the oven, cooled in the airtight container, and weighed **(Weight C)** as shown below**.**

1.3.7 Calculations: Water Absorption shall be calculated as follows.

Water Absorption (percent of dry weight) = 100(B-C)/C

Where

B= the weight in g of the saturated surface-dry aggregate in air, and

C= the weight in g of oven-dried aggregate in air.

1.3.8 Reporting of Results: The individual and mean results shall be reported. The size of the aggregate tested shall be stated, and whether it has been artificially heated.

Project Advisor
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