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पत्रांक 1585/02 आ.वि.प्र.प. 114

देहरादून, दिनांक 01 दिसम्बर, 2014

सेवा में,

समस्त क्षेत्रीय मुख्य अभियन्ता,
लोक निर्माण विभाग,
देहरादून/पौड़ी/अल्मोड़ा/हल्द्वानी।

विषय :- कोल्ड मिक्स टेक्नोलॉजी के प्रयोग के सम्बन्ध में।

महोदय,

जैसा कि आप अवगत है कि उत्तराखण्ड राज्य की भौगोलिक स्थिति एवं मौसम को देखते हुए बिटुमिनस के कार्य कराये जाने हेतु मात्र 4-5 माह ही मौसम अनुकूल रहता है। अतः बिटुमिनस का कार्य एवं नवीनीकरण का कार्य पैच मरम्मत के कार्यों में आशानुकूल प्रगति प्राप्त नहीं हो पाती है तथा जनता को आवागमन में कठिनाई का सामना करना पड़ता है तथा शिकायतें प्राप्त होती हैं।

अतः यह आवश्यक है कि उत्तराखण्ड राज्य की भौगोलिक परिस्थिति को देखते हुए प्रदेश में कोल्ड मिक्स टेक्नोलॉजी के प्रयोग को पूरी तरह से लागू किया जाय। जिससे कि वर्षभर बिटुमिनस का कार्य कराकर समय से पूर्ण हो सकें। इस सम्बन्ध में MORD, MORTH Specification के नये Edition एवं IRC 14, IRC 100 द्वारा भी PC कार्य तथा Surface dressing को Emulsion द्वारा किये जाने की विशिष्टियां दी गयी हैं। अतः निर्दिष्ट किया जाता है कि शीत काल में भी Emulsion द्वारा नवीनीकरण के छोटे हुए कार्य एवं पैच मरम्मत का कार्य अनवरत रूप से कराया जाय। फील्ड स्तर से यह दलील कदापि न दी जाय कि अभी मौसम अनुकूल नहीं है अथवा मार्ग की सरफेस में नमी है। आप सहमत होंगे कि अक्सर छोटे-छोटे पैच अथवा पोट होल्स अधिकतर शीत ऋतु एवं वर्षा ऋतु में उत्पन्न होते हैं, यदि इनको तत्काल रूप से मरम्मत कर दिये जाय तो मार्ग की दशा ठीक रहेगी साथ-साथ पैच रिपेयर में भी व्यय भार कम होगा। जबकि यदि इनको बरसात/शीतकाल के बाद किया जाता है तो यही पोट होल्स बड़े आकार लेकर पूरे मार्ग में फैल जाते हैं। जिससे जनता एवं आवागमन को कठिनाई के साथ-साथ मरम्मत करने में व्यय भार भी अधिक आता है।

अतः आपसे अपेक्षा की जाती है कि इस सम्बन्ध में अधीनस्थों को Emulsion का अधिक से अधिक प्रयोग मार्गों पर करने हेतु निर्देशित किया जाय ताकि सर्व ऋतु में Emulsion का प्रयोग कर यातायात हेतु मार्ग सुलभ रहे। यह भी अवगत कराना है कि रुद्रप्रयाग जनपद में लोक

निर्माण विभाग द्वारा कोल्ड मिक्स टैक्नोलोजी/Emulsion का प्रयोग अपने मार्गों पर किया गया। मयाली गुप्तकाशी मोटर मार्ग पर कोल्ड इमल्शन की ट्रायल रिपोर्ट संलग्न है। जिसकी उपयोगिता/गुणवत्ता ठीक पायी गयी। अतः इस सम्बन्ध में स्वयं अपने स्तर से अनुश्रवण कर Renewal एवं पैंच रिपेयर हेतु अनुपालन कराया जाना सुनिश्चित किया जाय।

संलग्न-यथोपरि।

(एच0के0 उप्रेती)
प्रमुख अभियन्ता

प्रतिलिपि निम्नलिखित को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित :-

1. सचिव, लोक निर्माण विभाग, उत्तराखण्ड शासन।
2. समस्त अधीक्षण अभियन्ता, लोक निर्माण विभाग, उत्तराखण्ड।
3. समस्त अधिशासी अभियन्ता, लोक निर्माण विभाग, उत्तराखण्ड।
4. समस्त तकनीकी अधिकारी, विभागाध्यक्ष कार्यालय।
5. गार्ड फाईल।

प्रमुख अभियन्ता,
लोक निर्माण विभाग।
1.1.14

Cold Mix Trial Report

Introduction – Cold Mix Technology

Hot mixes are conventionally used for construction of road in India. The hot mixes are prepared by mixing aggregates and bitumen at elevated temperature of 155 deg Celsius, and consequently degrade the environment and consume higher energy due to emission of hydrocarbon and suspended particulate matters. Hon' able Supreme Court of India had to take stringent decision to minimize the pollution by issuing the directives to close down hot mix plants in and around Delhi which are supposed to be the source of environment degradation. It is the need of hour to use green technology to protect the environment and to conserve the energy. The use of emulsion based cold mixes provides green technology for road construction as it eliminates heating. The cold mixes are prepared by mixing aggregates and bitumen emulsion at ambient temperature. Bitumen emulsion based cold mix offer certain advantages over hot bituminous road mixtures in terms of potential cost savings, protection of environment, energy savings, decrease in carbon footprint, use of damp aggregates and increase in construction period 10-11 months during the year as construction with cold mix is feasible in cold climate and rainy season with damp aggregates.

The construction of road with hot mix in Uttarakhand is not feasible and some time not desirable during July to February due to rains, cold climates. The fire wood is used for preparation of hot mix resulting in deforestation leading to change in ecology. The use of mechanized method to prepare hot mix by using Mix Sol consumes 200-250 litre of diesel per day to construct 150-200m road length with width 3.30m.

Background

In order to initiate the implementation of Cold Mix Technology in Uttarakhand state, a meeting was organised with Engineer - in - Chief, UK PWD on 06th March, 2014 in the presence of SE, Rudraprayag Circle, Xen – Rudraprayag Division and Xen – Ukhimath division. During the meeting, various aspects of Cold Mix technology were discussed and it was decided to conduct the trial on Mayali – Guptkashi Road leading to Kedarnath.

A field visit to trial section was made by our Technical Advisor – Dr. NKS Pundhir and Asst. Manager – Mr. Naveen Kumar to finalize the exact location of trial stretch in the presence of Department JE Mr. Gaurav. Trial stretch on Mayali – Guptkashi Road (Chainage km 2.1 km – km 3.1) was finalized during the field visit.

A proposal vide letter no. HIN/Cold Mix/UK/01 dated was submitted to SE, Rudraprayag Circle for executing Cold Mix Trial on Mayali – Guptkashi Road with following terms and conditions :-

- 1) Bitumen Emulsion will be supplied by Hindustan Colas Limited. Aggregates and other raw materials required during the laying will be provided by the department/ contractor.
- 2) All labour, machinery required for laying will be provided by the department/ contractor.
- 3) Technical supervision and assistance during the entire laying process will be in the scope of Hindustan Colas Limited. Department will also depute its representative for observance of laying work during the entire process.
- 4) After successful completion of entire stretch, its performance will be observed by the department for 3 (three) months from the date of completion of work. Department will provide the performance certificate after completion of three months, depending on the condition of stretch.
- 5) Invoice of the emulsion will be submitted after completion of three months observation period. Payment for Bitumen Emulsion will be released within 15 days from the invoice date, provided the stretch is in good condition.

Uttarakhand PWD accepted our proposal vide letter no. 626 /M. GVG/14 dated 10.03.2014 for executing the trial meeting the above conditions. Detailed proposal for the work was submitted by HINCOL vide ref: HINCOL/VA/CMT/ 002 dated 18.03.2014 and permission was granted to start the work on the 3rd km of Mayali – Guptkashi section by Executive Engineer, PD, PWD Rudraprayag vide letter no. 1108/2C dated 30/03/2014.

HINCOL provided Bitumen Emulsion in the second week of April' 2014 and technical team was deputed in the site on 21.04.2014.

OBJECTIVES AND SCOPE

The objective and scope of this trial are given under:

- Formulation for bitumen emulsion suitable for different type of aggregates available in Uttarakhand for premix carpet with cold mix.
- To construct hilly road by laying premix carpet with bitumen emulsion using concrete mixer to generate confidence in construction agencies to use emulsion based cold mix as environment friendly and energy efficient technology.
- Development of guidelines for design, construction and quality control of premix carpet using cold mix.
- PWD, Border Roads Organisation and other road building agencies provide surface courses such as Dense Bituminous Concrete (DBC), Semi Dense Bituminous Concrete (SDBC), Mix seal surfacing (MSS) and Premix Carpet (PC). In view of economic consideration the Premix carpet (PC) has been most significant specification for rural roads, hill roads and other low volume roads.

SPECIFICATIONS ADOPTED FOR TEST TRACK

A quality emulsion and application specifications are important factors to adopt the cold mix Technology. The prevailing construction specifications in India are as below:

- IRC: 14- 2004 Specification for Premix Carpet Using Cationic Bitumen Emulsion.
- IRC: 100-2014 Specification for Cold Mix Technology
- IRC: 110-2005 Standard Specification and Code of Practice for Design and Construction of Surface Dressing.
- MORTH-2012 Specification of Tack Coat for Roads
- MORTH-2012 Open Graded Premix Surfacing Using Cationic Bitumen Emulsion (Section 510.2, page 202 of Orange Book)
- MORTH-2012 Surface Dressing Using Cationic Bitumen Emulsion (Section 509.1, page 194 of Orange Book)

TRIAL SECTION AND PRE-CONSTRUCTION ROAD CONDITION

The Mayali-Guptkashi Road in Uttarakhand passes through the hilly terrain. The hills are mostly unstable due to presence of soil and prone to landslide. The existing road surface had developed distress in the form of cracking and potholes. The black top was somewhere covered with soil and stone due to landslides. The location of trial section was selected from Km. 2.300 to km. 3.300 on the Road.

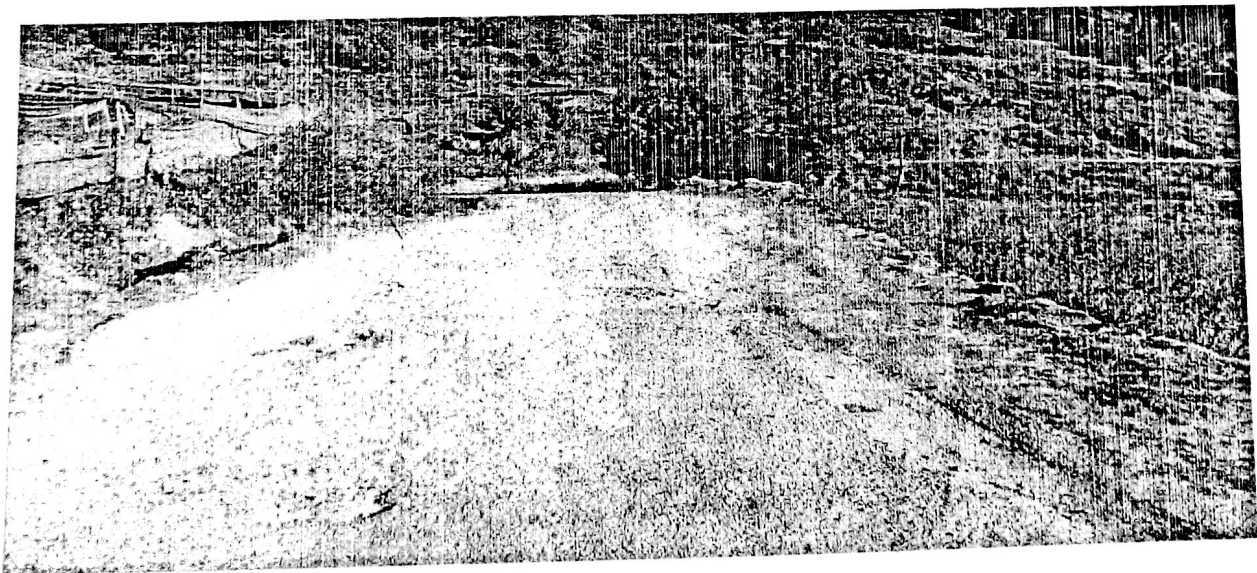


Photo 1: Condition of Road before construction

Bitumen Emulsion and Aggregate used

Bitumen Emulsion: - Bitumen Emulsion RS 1 was used for tack coat application and SS 2 was used for premix carpet and seal coat application. The recommended use of different grade of emulsion is given:

Type	Recommended uses
RS-1	A quick setting emulsion used for tack coating
RS-2	A quick setting emulsion used for Surface dressing, Penetration macadam , Penetration Grouting
MS	A medium setting emulsion used for plant or road mixes with coarse aggregate for premix carpet, Patching mixes with no dust and fine materials
SS-1	A slow setting emulsion used for priming of Granular Sub- Base
SS-2	A slow setting emulsion used for plant / road mixes with fine aggregates such as - SDBC, MSS, BM, DBM, BC. This emulsion is also used for slurry seal treatment and tack coating
PMB Emulsion	This emulsion is used for micro surfacing for maintenance of road

Aggregates

Important properties of aggregate from the standpoint of highway pavement construction are Mineralogical composition, Hardness and abrasion resistance, Density, porosity, and absorption, durability, particle shape and surface texture, gradation and surface chemistry.

13.2mm and 11.2mm aggregates are required for premix carpet. The quantity of material for Open graded Premix Carpet Cold Mix for 10 m² is given below:

Sl. No.	Item	Quantity per 10m ² of road surface
(a)	Coarse aggregates – Nominal stone size 13.2 mm (passing IS 22.4 mm square mesh sieve, retained on IS 11.2 mm square mesh sieve)	0.18 m ³
(b)	Coarse aggregates – Nominal stone size 11.2mm size (passing IS 13.2 mm square mesh IS sieve, retained on IS 5.6 mm square mesh IS sieve)	0.09 m ³
(c)	Total Quantity of Aggregate	0.27 m ³
	Bitumen emulsion MS grade	20-23 kg.
	• SS-2 grade in case of aggregates with dust	

Laying of PC with Bitumen emulsion:

1) Preparation of Road Surface

The pavement surface was thoroughly cleaned of all dirt, dust and other loose materials by compressor upto 400m and after this chainage, the manual method was used to clean the road. All the cracks were cleaned and filled with bitumen emulsion of slow setting (SS-2) grade by spraying the material @ 5 kg per 10m² area. The aggregate passing 2.8mm and retained on 180µm were spread over the tack coated area and compacted with 8-10 tonne road roller for cracks of 3mm wide. The pot hole was carried out by cold mix and grouting macadam. Proper cleaning was carried out before applying tack coat. In dry road condition, wetting (damping) of surface with water was also done.



Photo 2:- Cleaning of Road by compressor

2) Preparation of Cold Mix

The aggregates of 13.2mm (oversize) and 11.2 mm was used and blended aggregates of 150kg weight were charged into concrete mixer driven with diesel engine. Optimum water content as determined in the laboratory (2%) was added and mixed to damp the aggregate surface. The quantity of water varies with the condition of aggregates, whether dry/wet due to summer or rains. The required quantity of bitumen emulsion (6% by weight of aggregates) of SS - 2 grade was then added into damp aggregate at ambient temperature and mixed for two minutes to prepare cold mix . The additional time of mixing was avoided as it causes decoating of binder from aggregates.

5) Spreading the Cold Mix

In half of road width, the cold mix was laid over the tacky surface and spread uniformly in required thickness of about 28 mm loose mix by manual method. The cold mix turns black from brown colour after some time when water of emulsion exudes after breaking of emulsion. The cold mix can be laid by paver to get higher work target. The cold mix was aerated for about one hour and then rolled by paver to get higher work target. The rolling was done with the outside drive wheel covering equal parts of the pavement and shoulder. The wheels were kept wet with water during compaction. The rolling was also repeated after 2 hours and next day.

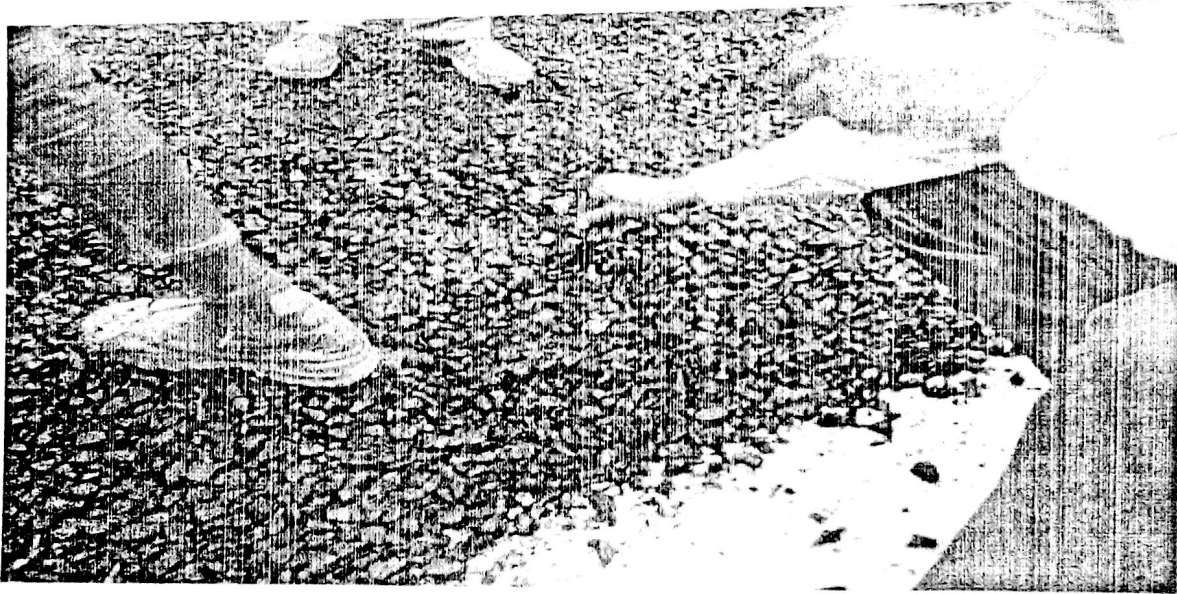


Photo 7: Spreading of Cold Mix

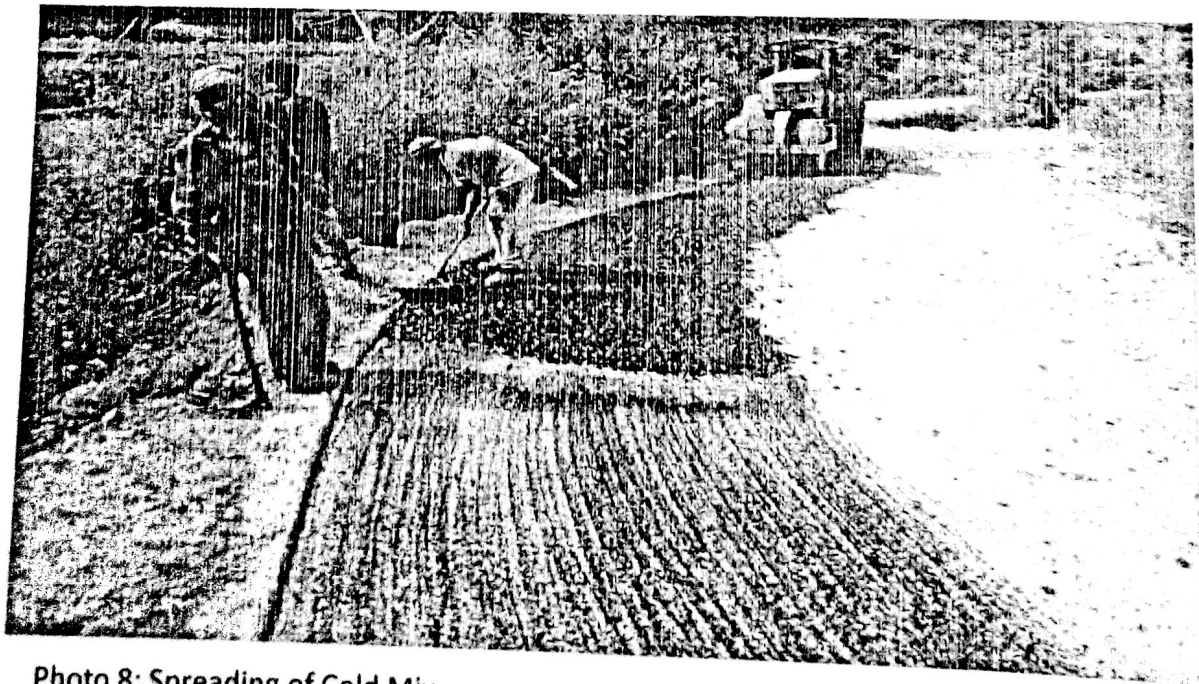


Photo 8: Spreading of Cold Mix



Photo 9: View of Premix Carpet

6) Traffic Control

The traffic was regulated and test section was left to open for traffic after 2 - 3 hours. The traffic at some test sections could not be controlled after completion of laying and hence, it was allowed at slow speed as per IRC guideline.

7) Liquid Seal Coat on Premix Carpet

The liquid seal coat was provided on PC by first tack coating the premix carpet with bitumen emulsion (SS-2) @12-13 kg. per 10m^2 area and then 6.3mm passing aggregate (0.09 cubic meter per 10 sq. meter area) was spread over it. The aggregate layer was then compacted with 8-10 ton road roller.



Photo 10: View of Liquid Seal Coating



Photo 11: Compaction of Liquid Seal on Premix Carpet

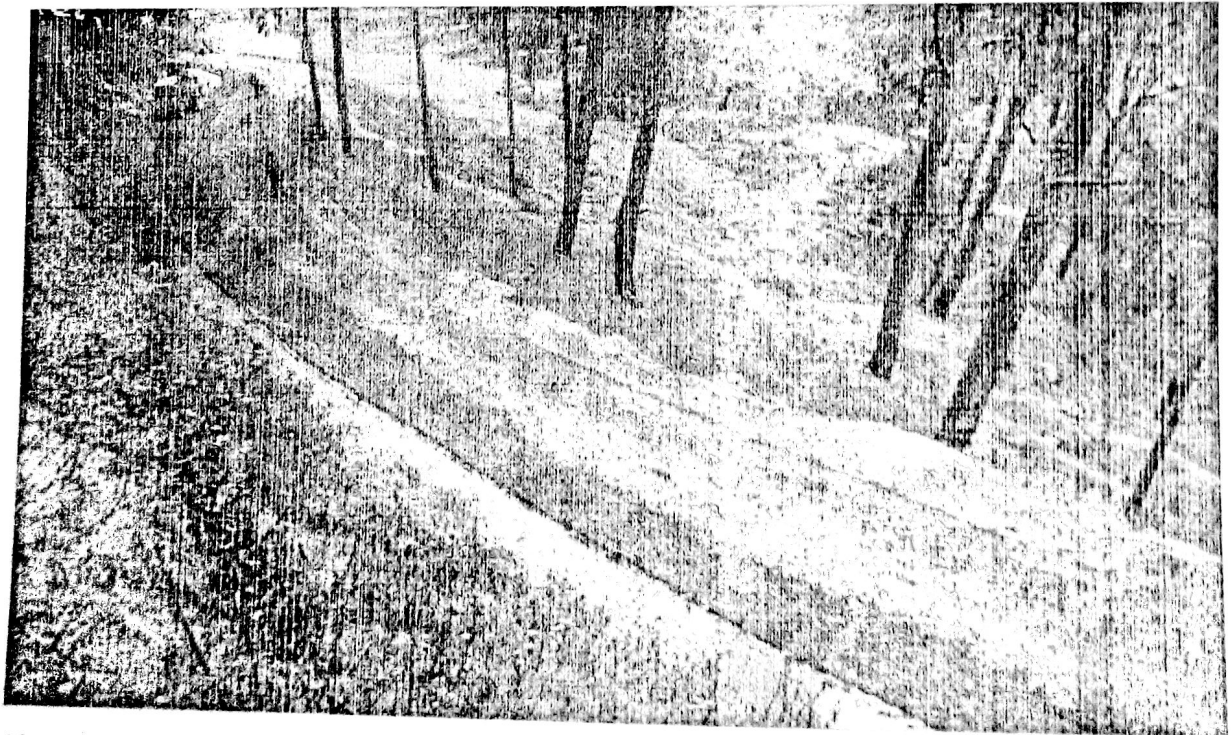


Photo 12: Finished Premix Carpet

8) Laying of Control Sections

The control section of 20mm PC with bitumen was also laid as per IRC 14: 2004, using Mix Sol or steel plate on bhatti with fire wood from km 1.3 to km 2.3 and km 3.3 to km 4.3 on Mayali-Guptkashi Road.



Photo 13:- Hot Mix Site

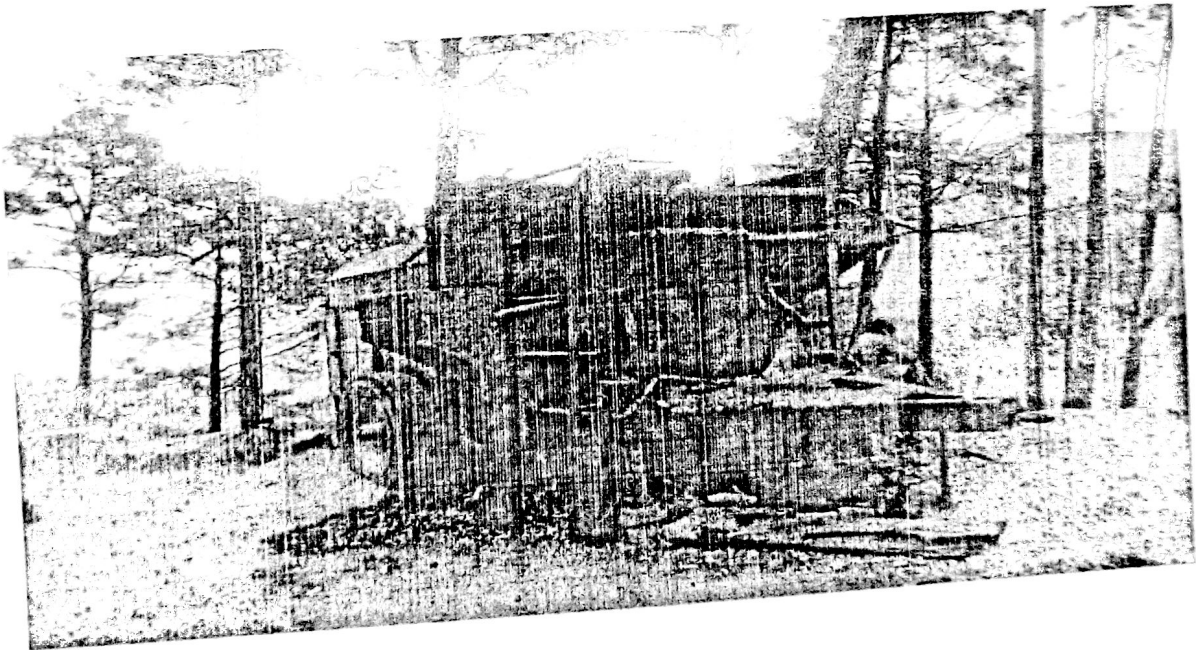


Photo 15:- Mix Sol

COST OF CONSTRUCTION WITH PREMIX CARPET

General Cost : The cost of construction for cold mix and hot mix have been calculated base on actual data. The figures were taken from contractor. The calculation of cost is given below:

Road length = 1000m , Road width = 3.3m , Area = $1000 \times 3.3 = 3300\text{m}^2$

1, Cost of Aggregates:

- Aggregates required $330 \times .27 = 89.1 = 90\text{m}^3$
- Aggregates required for seal coat $330 \times .06 = 20\text{m}^3$
- Total Aggregates = $90 + 20 = 110\text{m}^3$
- Cost of Aggregates Rs 10500/- per 5m^3
- Total cost of aggregates for 1km stretch = 2,31,000/- A

2. Labour Cost

- Labour cost 1 km with hot mix = 1,85,000/- B- hot mix
- Labour cost 1 km with cold mix = 1,00,000/- B – cold mix

3. Binder Cost for 1km road

- Hot mix 75 drum bitumen with 165kg = 7,87,500/- C –hot mix
- Cold mix 70 drum with 200lit = 7,35,500 C – cold mix

4. Compaction Cost on Road Roller

- Hot mix for 20 days @ 1000/- = 20000/-
- 200 diesel cost = 12000/-
- Tractor for ferry hot mix = 40000/-
- Total cost = 72000/- D- hot mix
- Cold mix for 8 days @ 1000/- = 8000/-
- 200 diesel for roller = 12000/-
- Cost on diesel for preparation of Cold Mix by concrete mixer = 5000/-
- Total = 25000/- D-cold mix

COST OF COMPARISON

Sr. No.	Item	Hot mix	Cold Mix
1	Aggregate	2,31,000	2,31,000
2	Labour	1,85,000	1,00,000
3	Binder	7,87,500	7,35,000
4	Roller / Machineries	72000	25,000
	Total	12,75,500	10,91,000

- Construction with cold mix is cheaper by 15-20 % in comparison with hot mix
- Figures were taken from contractor and labour contractor

BENEFITS OF COLD MIX TECHNOLOGY

The cold mix technology is having following benefits:

- Green technology for road construction
- Cold application technology , which eliminates heating
- It protects environment and conserve the energy
- It decreases carbon footprints and thus country can earn carbon credit
- Coats damp aggregates and thus suitable in rainy season
- Construction is feasibility in all weathers
- It enhances construction period during the year to 10-11 months
- Minimise water damages due to presence of anti- stripping agent in Emulsion
- Less manpower and machinery are required with cold mix
- Construction with cold mix is 15-20 % cheaper than hot mix
- Suitable for rural roads, hilly roads, low to medium traffic volume roads