

Comparison between Asphalt Batch Mix Plant and Asphalt Drum Mix Plant

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Abstract- This study has attempted to raise the issue of soft considerations in the selection of equipment for building construction projects: to increase awareness to their nature, variety, and richness; to their significant role and potential impact on the outcome of decision making; and to the inherent difficulty of evaluating them and integrating them within a comprehensive selection process. Selecting the “right” equipment is usually crucial for the success of the project; hence the great importance of profound understanding and appreciation of the issue of soft considerations and the essentiality of their structured integration within the equipment selection process.

Keywords- Construction equipment; Construction management; Decision making.

I. INTRODUCTION

Modern highway construction projects are complex in nature and success of a project depends greatly on proper and scientific planning. Before starting any project its planning is done with great care, as the efficiency of the whole project largely depends upon its planning. While planning each and every detail should be worked out in anticipation and should be considered carefully. Planning of a construction project involves deciding about the extent of mechanization, equipment planning, and execution planning etc. while planning a highway project equipment manager should be carefully decided the extent of mechanization so as to minimize the cost of project.

Most of the construction projects involve laborious work which is to be handled by men and the equipment designed for doing the work undersigned. It is difficult for workers to accomplish all things in a project and so there comes the need for machines particularly the construction machinery that is widely used nowadays almost everywhere in the world. The factors affecting performance of equipment on a particular job can be divided in to two categories –

- 1) Job factors
- 2) Management factors

Job factors refer to those items, which are particular to a job, because of physical conditions, etc. Management factors refer to those items, which arise due to arrangements of plants at site, and for managing the same in an effective manner.

1) Job Factors:-

It can be understood that the physical factors of the job will affect the performance of equipment e.g., the type of material would determine how much load can be carried in a scraper bowl. Similarly, the rolling resistance of the haul road will determine the operating speed. Such factors are listed below, with possible range of variation so that these can be used in estimating the realistic production of equipment on any job

1. Swell and shrinkage factor for materials
2. Rolling resistance of haul road, which may vary from 20 - 40 kg per ton
3. Gradients, which can be favorable or unfavorable, for loading and for travel
4. Reduction of horse power of engine due to altitude. This will be at rate of 3 per cent loss in horse power per 300 meters, above 1,000 meters.
5. In case of power shovel or draglines the angle of swing, and depth of cut.
6. Climatic and terrain conditions.
7. Moisture content in earth and stone metal. Such factors can be assessed at each job, and the estimator can make an intelligent guess, as to how they will affect the production of equipment.

2) Management Factors

1. Proper matching of equipment, sizes and numbers, so that the most important production equipment is not kept waiting or idle. Time required for on-the-job servicing and maintenance.
2. Unavoidable delays in combined operation of all equipments. For this purpose, sometimes a 50minute hour is used in the calculation of the production of earth moving equipment.

3. Operator's efficiency depending upon the training and experience of the operator.
4. Availability of well-equipped workshops, maintenance facilities, spares part stock, etc.
5. Good management worker relationship.

II. PLANNING AND SELECTION OF ASPHALT BATCH MIX PLANT AND ASPHALT DRUM MIX PLANT

(i) PLANNING OF ASPHALT BATCH MIX PLANT

Asphalt Batch Mix Plant of Desai Group, Plot No.265/1, Om Sadanika, Panvel Uran Road, (Uran Naka), Panvel, Raigad- 410206. Maharashtra – India.

Plant Type: - (100-120 tph).

Actual works account for 8 hrs...2-3 hours were required initially for heating.

In 8 hr. the total quantity of bitumen mix output was 600 metric ton.

I.e. $600/2 = 300$ cu.m.

Single tipper/ load contain 16 Cu.m.

Hence number of load in a day
 $= 300/16$
 $= 18.75$
 $= 19$

Planning was did for 5 km. length of road construction i.e. semi dense bituminous road.

The thickness of road was 0.030 meter.

Total quantity of bitumen mix required for 5 km. road
 $= \text{Length} \times \text{Width} \times \text{Thickness}$
 $= 5000 \text{ m} \times 7 \text{ m} \times 0.030 \text{ m}$
 $= 1050 \text{ cu.m}$

Total number of loads required for road construction of a length 5 km.
 $= 1050/16$
 $= 65.625$

Number of days required to complete road construction of semi dense bituminous concrete
 $= 65.625/19$
 $= 3.453$
 $= 4 \text{ days}$

(ii) PLANNING OF DRUM MIX PLANT

Owner of plant: - Desai Group

Location: - Plot No.265/1, Om Sadanika, Panvel Uran Road, (Uran Naka), Panvel, Raigad- 410206. Maharashtra – India

Capacity: - 40-60 tph

Actual works account for 8 hrs. 2-3 hours were required initially for heating.

In 8 hr. the total quantity of bitumen mix output was 350 metric ton.

I.e. $350/2 = 175$ cu.m.

Single Tipper/ Load contain 16 cu.m.

Hence number of loads in a day
 $= 175/16$
 $= 10.937$
 $= 11$

Planning was did for 5 km. length of road construction i.e. semi dense bituminous road.

The thickness of road was 0.030 meter.

Total quantity of bitumen mix required for 5 km. road
 $= \text{Length} \times \text{Width} \times \text{Thickness}$
 $= 0.030 \text{ m} \times 7 \text{ m} \times 5000 \text{ m}$
 $= 1050 \text{ cu.m}$

Total number of loads required for road construction of a length 5 km.
 $= 1050/16$
 $= 65.625$

Number of days required to complete road construction of semi dense bituminous concrete
 $= 65.625/11$
 $= 5.96 \text{ days}$
 $= 6 \text{ days}$

III. ASPHALT BATCH HOT MIX PLANT

These Asphalt Batch Hot-Mix Plants consists of the following:

1. The cold aggregate feeding bins to feed the aggregate to the drier drum

2. The drier, a revolving cylindrical drum where the aggregates are heated. The drum is also provided with a burner. A dust collector is also usually provided.
3. The screens, which are provided in deck form, separate the aggregate into the required sizes, throwing out the oversized stones.
4. Aggregate weighing system, weighs various sizes of aggregates and allow them for mixing in a desired proportion. In some hot-mix plants, aggregate proportioning is done by volume.
5. Bitumen storage tanks, have heating system with a thermostat to keep the bitumen at a constant temperature. These tanks are provided with the heat insulators.

The mixing unit, which consists of a box with 2 horizontal shafts rotating in opposite directions. These shafts are fitted with removable mixing paddles. These mixing boxes have an opening gate at the bottom at a sufficient height to discharge into the waiting dump trucks.

Asphalt Batch Mix Plant of Desai Group, Plot No.265/1, Om Sadanika, Panvel Uran Road, (Uran Naka), Panvel, Raigad-410206. Maharashtra – India

Plant Type: - (100-120 tph).

Truck past of Semi dense Bound Concrete 25 mm thick (MH 11 AL 4158)- 16 ton

6. Aggregate (4 types size used)
7. 5.6 to 0.09 mm (on site called dust) – (0-8 mm)
8. 5.6 mm to 11 mm (on site called 10 mm) (8-16 mm) as per IS
9. 20 mm (16 – 25 mm)
10. 40 mm (25 – 38 mm)
11. Bitumen
12. Furnace Oil
13. Electricity / Generator

Truck (MH-11-AL-4158) of 16 ton mix contain of SDBC

14. Bitumen (4 %) – 640 kg
15. 5.6 to 0.09 mm (31 %) – 4960 kg
16. 11 to 56 mm (65 %) – 10,400 kg

Expenditure for 1 truck of mix

17. 5.6 to 0.09 mm (4960 kg) = 0.992 by $4960/5000=0.992$ brass

Rate of 1 brass: 1800

$$\therefore 0.992 \times 1800 = \text{Rs. } 1785.6/-$$

----- (a)

18. Bitumen

640 kg i.e. 4 %

Rs. 48 per kg. Since rate Rs.48000 per MT

$$\therefore 48 \times 640 = \text{Rs. } 30,720/-$$

----- (b)

19. 11 to 56 mm (i.e. 10 mm)

2500 per brass

$$10400 / 5000 = 2.08 \text{ brass}$$

$$\therefore 2.08 \times 2500 = \text{Rs. } 5200$$

----- (c)

20. Transportation Charges

$$16 \text{ km} + 16 \text{ km} = 32 \text{ km}$$

In one liter the truck covers 2 km (averagely)

\therefore 16 liter of Diesel required for one truck to transport and return to plant

$$\therefore 16 \times 55 = \text{Rs. } 880/-$$

----- (d)

21. Driver Payment

Monthly payment is Rs. 12,000/- per month.

As per day trip of truck are 4

For one trip payment is Rs. 100/-

----- (e)

$$(100 \times 4 = 400; 400 \times 30 \text{ days} = 12,000/-)$$

22. Oil and other maintenance of vehicle i.e. Truck = Rs. 200/- ----- (f)

23. Overall plant maintenance : Rs. 2000 per day ----- (g)

24. Operator payment = Rs. 500 per day

$$\therefore \text{Rs. } 125/- \text{ for 1 truck}$$

----- (h)

- ix) Generators fuel consumption

5 lit for 1 load

$$\therefore 5 \times 55 = 275$$

----- (i)

Total Expenditure for 1 Truck

$$= (a) + (b) + (c) + (d) + (e) + (f) + (g) + (h) + (i)$$

$$= 1785.6 + 30720 + 5200 + 880 + 100 + 200 + 2000 + 125 + 275$$

$$= \text{Rs. } 41046.9$$

Considering 10 % Profit per load/truck was said by J.E (PWD), Here cost for 1 load to Contractor is calculated by DSR as per Particular region (lead, trip)

Now money returns from one truck to Owner of plant from Since its totals cost Rs. 46000 per load or truck

Total profit of from one truck

$$= \text{Rs. } 46000 - 41016.9$$

$$= 4983.1 \text{ per truck}$$

$$\text{For 1 tone} = 4983.1 / 16$$

= Rs. 311.44 per tone

As per Demands on site requirement, truck was filled.

As per Desai Group in a month 5000 ton Asphalt mix require again as per experience of a operator 19 trucks per day filled of mix (Asphalt)

∴ 19 truck x 16 tone = 304 ton per day (minimum)
 $5000 / 304 = 16.44$ days
 = 16.44 day in a month.

In a year the plant go for 8 month (excluding the end of May, June, July, August, September closed in a year).

Out of 8 month only following days working of a plant:
 = 16.44 avg. Day x 8 months
 = 131.52 ~ 132 days

Total tone of asphalt mix in a year
 = 304 x 132 days
 = 40128 ton in a year

Profit from asphalt batch plant in a year
 = 40128 x 311.44
 = Rs. 12497464.32
 = Rs.1.249 Cr.

Considering 15% contingencies and other expenses

Total Profit from Asphalt batch Plant in a year
 = 12497464.32 × 0.85
 = 10622844.67

Percentage profit from Asphalt batch Plant in a year
 = 1, 06, 22,844.67 ÷ 2, 70, 00,000
 = 39.34 %

This huge profit is possible to plant owner because of the favorable condition given below and some of the assumptions are considered here.

- The plant owner himself was a contractor who has taken a contract of States & National highways.
- Plant owner has its own trucks, other accessories for the running of plant as well as transportation.
- Here no. of trucks i.e. demand of Asphalt is more since the contractor has a huge amount of work demand in the work of surrounding area.
- The case is considered particular SDBC and considered for a year.
- Ideally not possible of this profit but as per site condition what I had studied it is calculated.

- Average distance is considered for a year calculation although it is 16 km is here.

IV. ASPHALT DRUM MIX PLANT

Owner of plant – Desai Group

Location –Plot No.265/1, Om Sadanika, Panvel Uran Road, (Uran Naka), Panvel, Raigad- 410206. Maharashtra – India

A) Material used for semi dense B.C.

- Aggregate
 - 5.6 to 0.09 mm (0-8 mm) Dust 10 %
 - 11 to 5.6 mm (10 mm) 85 %
- Bitumen 5 %
- Furnace Oil – 60 lit / truck or loan
- Electricity / Generator – 4 liter for 1 truck or load

Averagely 700 load for a year as per suggested by 22 year experienced operator.

B) Expenditure on Plant

- Bitumen 5 % → 800 kg = Rs. 48 per kg
 ∴ 800 x 48 = 38400/
 ----- (a)
- Dust (0-8 mm) i.e. 5.6 to 0.09 mm 0 % = 1600 kg
 $16000/5000 = 0.32$ brass
 Rate of 1 brass = 18000
 $0.32 \times 1800 = \text{Rs. } 576/-$
 ----- (b)
- 11 to 5.6 mm (10 mm)– 85 % → $0.85 \times 16000 = 13,600$ kg
 2500 per brass
 $13600 / 5000 = 2.72$ brass
 ∴ $2500 \times 2.72 = \text{Rs. } 6800$
 ----- (c)
- Furnace oil 3.75 lit / ton from
 60 lit per truck or load
 I.e. Rs. 50 x 3.75 lit for one truck
 = Rs. 187.5
 ----- (d)
- Generator
 For 1 load or truck 4 liter of Diesel is used
 Therefore $4 \times 55 = \text{Rs. } 220$
 ----- (e)
- Transportation charges
 $19\text{km} + 19\text{ km} = 38\text{ km}$ (Avg. distance taken)
 The truck takes 1 liter of diesel to cover 2 km averagely
 ∴ 19 liter of Diesel required for one truck to transport and return to plant

$$\therefore 19 \times 55 = \text{Rs. } 1045/-$$

----- (f)

vii) Driver Payment

Monthly payment is Rs. 12,000/- per month.

As per day trip of truck are 4

For one trip payment is Rs. 100/-

----- (g)

viii) Oil and other maintenance of vehicle i.e. Truck = Rs. 200/- ----- (h)

ix) Overall plant maintenance: Rs. 700 per day ----- (i)

x) Operator payment

----- (j)

= Rs. 500 per day

\therefore Rs. 125/- for 1 truck

----- (k)

Total Expenditure for 1 Truck or load

$$= (a) + (b) + (c) + (d) + (e) + (f) + (g) + (h) + (i) + (j) + (k)$$

$$= 38400 + 576 + 6800 + 187.5 + 220 + 1045 + 100 + 200 + 700 + 125$$

$$= \text{Rs. } 48353.5$$

Considering minimum 10 % Profit per load/truck was said by J.E (PWD), here cost for 1 load to Contractor is calculated by DSR as per Particular region. (Lead, trip)

Now money returns from one truck to Owner of plant from Contractor

Since its totals cost Rs. 53500 per load or truck.

$$\text{Profit of from one truck or load} = \text{Rs. } 53500 - 48353.5 = 5146.5$$

As per 22 experience of operator per year the 700 load or truck are loaded.

$$\therefore \text{Profit from Plant in a year} = 5146.5 \times 700 = \text{Rs. } 36,02,550$$

But here some of deductions are there like

i) Supervisor Payment = $20000 \times 12 = 240000$

ii) Engineer Payment if any and other staff = $35000 \times 12 = 420000$

$$\text{So Profit from a plant} = 3602550 - 660000 = 29,42,000$$

Considering 15 %

$$\text{Total profit from a plant} = 29,42,000 \times .85 = \text{Rs. } 2500700$$

% Profit from plant in a year

$$= 2500700 \div 8000000$$

$$= 31.25\%$$

Whereas Rs. 80,00,000 is an initial cost of Drum Mix plant.

V. CONCLUSION

In the project, detailed literature provided explains the concepts of planning and selection of construction equipments. These concepts have been used to analyze the case study. It has been inferred that –

Using asphalt batch mix plant a road 5 km. length of semi dense bituminous concrete required 4 days to construct whereas a drum mix plant required 6 days to construct of same length of road of 5 km.

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