

Planning, Scheduling, Cost Analysis and Risk Management of Industrial Machine Foundation

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Abstract— The Industrial Machine foundations used to encounter such dynamic forces/vibrations caused by machines used is known as machine foundations. The dynamic forces are transmitted to the foundation supporting the machine. Generally, the moving, shaking components of the machines are balanced, yet there is always some unbalanced condition in actual practice which results the eccentricity of rotating parts. While Construction these types of foundation accuracy should be at higher side because the machine's leg or foot should be at right place as per the machine drawing this become a challenging job, various type of risk is involved and their mitigation technique are mention.

Key Words: *Planning, Scheduling, Risk Management of Industrial Machine Foundation, Use of Thermocol for pocket formwork*

I. INTRODUCTION

Machine Foundation is a structure used to receive and transfer to the ground the static load from a machine and the dynamic loads imposed during the operation of the machine as a result of imbalances in the moving parts.

1.1 Problem Statement

- Risk Involvement is more
- Rate of Accuracy is Less
- Due to Accuracy is Less, Cost is Increases
- Time of construction More, goes beyond Deadline

1.2 Objectives

- Planning & Scheduling of Foundation
- To Achieve More Accuracy by using Thermocol Formwork
- Risk Management and Mitigation Technique.
- Cost Analysis

II. METHODOLOGY

Step 1: - Excavation

Marking of excavation is done by adding 600mm on both-sides of original dismission of excavation.

1) Excavation is done in: -

- Soil or Murrum
- Soft Rock
- Hard Rock
- Exist Concrete Flooring

2) Equipment Used

- JCB (Back How Front Bucket Machine)
- Pork Clan Excavation Machine

Note: - If Hard Strata is not available than “Plump Concrete” is done for 1Ft

Step 2: - Disposal of Excavated Material

1) Equipment Used

- JCB (Back How Front Bucket Machine)
- Tractor or Dumper (to dumper the excavated material in specific place)

Step 3: - Ground Water Management

If Ground water is present it is removed by using dewatering system.

1) Equipment Used

- Electrical Dewatering Pumps

Step 4: - P.C.C

P.C.C Bed is provided of M10 concrete at Thickness of 4” (100mm) or 6” (150mm).

Step 5: - Water-proofing

By Shahabad Tiles

By Brunt Bricks

Step 6: - Marking of Foundation

Raft Reinforcement is marked for Installing of Formwork

Marking of Pockets are done.

Step 7: - Preparing of Raft

1) Raft are construct to transfer load evenly. Raft are two types

- Single Raft
- Double Raft (Box Raft)

2) Placing of Formwork for foundation reinforcement

3) Preparation of Pockets

This is the most popular method employed. Over-size holes are formed in the foundation concrete at the time of casting which have enough cross-section to permit a degree of lateral movement during the final positioning of bolts. When the bolts are positioned, the hole or pocket is filled with non-shrink engineering grout to ensure that the bolt is bonded to the foundation concrete thoroughly and reliably. The main advantages of pre-forming pockets are that less critical positioning tolerances are necessary compared with cast-in bolts and there is a choice of pocket size, shape and method of forming.

Types of Pockets

- Woods
- Bricks
- Thermocole

Step 8: - Filling of Raft/ Side Pardi

This Pardi is fill in levels e.g. If Pardi is 3m Depth it is filled in 1m intervals.

Advantage in fill the pardi in levels are

- Load on formwork is less.
- Tamping can be done easily and efficiently.
- Benefit for further Shuttering work.

Step 9: - Water-Proofing for Side Pardi

Water -Proofing is provided by Brick-work and Shahabad Tiles are place over it.

Step 10: - Providing Curving Angles

Curving Angles are provided to above edge of foundation to protects form Breaking.

Step11: - Cleaning of Pockets

Removal of Thermocol present in pockets by spraying petrol.

Step12: - Miscellaneous Work

Finalized the work, Final Touched ups.

III. CASE STUDY

3.1. Location: - Bharat Forge Limited, Pune Cantonment, Mundhwa at 5000 Ton Shop.

3.2 Name of Machine: - Roller Conveyor Shot Blast Machine.

Construction Blaster Type X roller conveyors differentiate themselves from the Type G and Type HD roller conveyors by the shot blast wheels being installed at an angle to the direction of movement through the machine. The angled positioning of the shot blast wheels ensures that the blasting operation is perfect, especially on parts such as welded constructions, flame cut parts or other complex formed prefabricated parts with base ends.

3.3 Application of Machine: - Cleaning, Corrosion Removal, Cosmetic Finishing, Deburring, Deflating, Internal Cleaning, Paint Stripping, Preparation for Painting, Bonding and Plating, Rust and Heat Scale Removal, Shot Peening, Surface Texturing

3.4 Foundation Type for this Machine: - R.C.C Wall Type Machine Foundation. This type of machine foundation consists of a pair of walls with a slab resting on top. This type of foundation is constructed of homogeneous materials. It is used for small machines and the machine is rested on the top slab.

3.5 Planning and Scheduling of Roller Conveyor Shot Blast Machine Foundation

TABLE I. Planning and Scheduling of Roller Conveyor Shot Blast Machine Foundation

Task Name	Duration	Start	Finish	Predecessors
Shot Blasting Foundation	50 days	Tue 20-06-17	Wed 16-08-17	
Excavation	9 days	Tue 20-06-17	Thu 29-06-17	
Excavation in Concrete (300 mm)	1 day	Tue 20-06-17	Tue 20-06-17	
Excavation in Soft Rock 830 mm	1 day	Wed 21-06-17	Wed 21-06-17	3
Dewatering Process	1 day	Thu 22-06-17	Thu 22-06-17	4
Excavation in Hard Rock (1645 mm)	2 days	Fri 23-06-17	Sat 24-06-17	4,5
Disposal of Excavated Material	4 days	Fri 23-06-17	Tue 27-06-17	6,5,3,4
Bar Bending	6 days	Wed 28-06-17	Tue 04-07-17	7
P.C.C. & Water-Proofing	4 days	Tue 04-07-17	Fri 07-07-17	10
Plum Concrete M10	1 day	Tue 04-07-17	Tue 04-07-17	10
Box type Water-Proofing by Shahabad Tiles	2 days	Wed 05-07-17	Thu 06-07-17	12
Marking & Checking	1 day	Fri 07-07-17	Sat 08-07-17	13,11
Preparing of Raft, Column, Pardi	3 days	Mon 10-07-17	Wed 12-07-17	14
Raft Shuttering	4 days	Thu 13-07-17	Mon 17-07-17	15
Raft 1	1 day	Thu 13-07-17	Thu 13-07-17	
Raft 2	1 day	Thu 13-07-17	Thu 13-07-17	17SS
Concreting of 1 Raft (Evening)	1 day	Fri 14-07-17	Fri 14-07-17	18,17
Finishing 2 Raft Shuttering	1 day	Fri 14-07-17	Fri 14-07-17	19FF,18SS
Concreting of 2 Raft	1 day	Sat 15-07-17	Sat 15-07-17	20
Level 1	11 days	Mon 17-07-17	Sat 29-07-17	16
Reinforcements of Pardi Including Side Pardi Formwork Up to 1200 mm	3 days	Mon 17-07-17	Thu 20-07-17	
Concreting Level 1	1 day	Thu 20-07-17	Fri 21-07-17	23
Removal of Out-side Formwork for Water-Proofing	1 day	Fri 21-07-17	Sat 22-07-17	24
Shahabad Box Type Water-Proofing (up to 1200mm)	4 days	Fri 21-07-17	Wed 26-07-17	25SS
Murrum Filling (up to 1200mm) & Compacting	2 days	Wed 26-07-17	Fri 28-07-17	26
Level 2	6 days	Fri 28-07-17	Fri 04-08-17	27
Reinforcements of Pardi Including Side Pardi Formwork Up to 1200 mm	1 day	Fri 28-07-17	Sat 29-07-17	
Concreting Level 2	1 day	Sat 29-07-17	Mon 31-07-17	29
Removal of Out-side Formwork for Water-Proofing	1 day	Mon 31-07-17	Tue 01-08-17	30
Shahabad Box Type Water-Proofing (up to 1200mm)	2 days	Mon 31-07-17	Wed 02-08-17	31SS
Murrum Filling (up to 1200mm) & Compacting	2 days	Wed 02-08-17	Fri 04-08-17	32
Preparing of Column & Final Level (up to 300mm)	4 days	Fri 04-08-17	Wed 09-08-17	33
Installing Thermocol Pockets	1 day	Fri 04-08-17	Sat 05-08-17	
Welding Plates	2 days	Sat 05-08-17	Tue 08-08-17	35
Concreting Columns & Final Level	1 day	Tue 08-08-17	Wed 09-08-17	36
Preparing Staircase	4 days	Wed 09-08-17	Mon 14-08-17	37
Miscellaneous Work & Hand-Over Foundation	2 days	Fri 11-08-17	Mon 14-08-17	38FF

3.6 Risk Management for Roller Conveyor Shot Blast Machine Foundation

1. Scaffolding was very difficult to install for water-proofing to pardi.

Sol: - Foundation Pardi was built in level of 1m brick work is done and after that the Shahabad tiles were placed.

Advantage: -

- Scaffolding is not needed i.e. Cost Effective.
- Extra excavation for installing scaffolding is eliminated.
- Only inner side the Formwork were used, by using only at one side formwork cost as well as time is saved
- By concreting in levels load on formwork is sustainable.
- After completing this level murrum is filled and that level is finished the job is 10% completed.

2. Making Pockets.

Pockets is an important aspect for this foundation because the machine's legs will be rest on these pockets. The challenge was to keep the demission of these pockets undisturbed.

Sol: - Thermocole Box are used i.e. Thermocole box are made as per the accurate Dimension and that box are placed in the place of these pockets.

Advantage of using Thermocole

- Dimension remains undisturbed.
- Removal of thermocole is easy after the concrete is set.
- While removing of thermocole the accurate demission is maintained.
- Thermocole and concrete does not have any type of bond in between them, so thermocole plays the role of separator.



Fig 1. Use of Thermocole box as pockets formwork

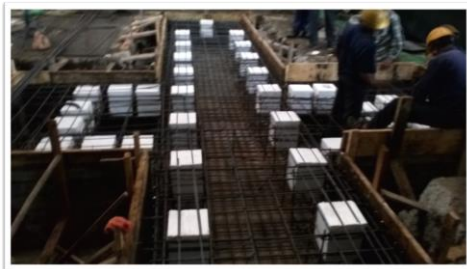


Fig 2. Thermocole box are aligned as per pockets of Machine

3.7 Cost Analysis for Roller Conveyor Shot Blast Machine Foundation

Sr. No.	DESCRIPTION OF ITEMS	QTY	UT.	RATE	AMOUNT	SAC
1	Excavation in Concrete J.C.B Breaker	12.88	M ³	1250.00	16100.00	995433
2	Excavation in Soft Rock	6.22	M ³	450.00	2799.00	995433
3	Disposal of Excavation Material	28.65	M ³	250.00	7162.50	995433
4	Murrum Filling Around Foundation	51.42	M ³	250.00	12855.00	995433
5	P/L Plum Ready Mix Concrete M10	4.61	M ³	3450.00	15904.50	995454
6	P/L Ready Mix Concrete M60	4.80	M ³	9250.00	44400.00	995454
7	P/L Ready Mix Concrete M25	25.16	M ³	6550.00	164798.00	995454
8	P/C B.B Masonry	5.56	M ³	6125.00	34055.00	995456
9	P/F Waterproofing Box Type Shahabad Tiles	21.83	M ²	800.00	17464.00	995428
10	P/L Shuttering	53.60	M ²	352.00	18867.20	995452
11	P/F Pockets (0.20 x 0.30 x 0.35)	16.00	Nos	450.00	7200.00	995428
12	P/F Pockets (0.32 x 0.42 x 0.35)	8.00	Nos	500.00	4000.00	995428
13	P/F Pockets (0.35 x 0.40 x 0.35)	8.00	Nos	550.00	4400.00	995428
14	P/L GP2 Concrete	1.05	M ³	45000.00	47250.00	995454
15	P/A Plastering	4.78	M ²	338.00	1615.64	995472
16	Misc. Work	1.00	Nos	6500.00	6500.00	995433
17	Charges for Reinforcements of Steel	452.65	Kgs.	8.00	3621.20	995428
				Rate of Taxes	Sub Total	408992.04
Amount In Words				CGST 9%		36809.28
				SGST 9%		36809.28
Four Lakh Eight-Two Thousand Six Hundred Ten & Paise Sixty-One Only.				Total Amt.		482610.61

Table II. Cost Analysis for Roller Conveyor Shot Blast Machine Foundation

IV CONCLUSIONS

4.1 Achieve More Accuracy: -

Accuracy is achieved by using Thermocole Box as pocket formwork. The accurate demission is maintained.

4.2 Risk Management: -

Foundation Pardi was built in level of 1m brick work is done and after that the Shahabad tiles were placed. Pockets is an important aspect for this foundation because the machine's legs will be rest on these pockets. The challenge was to keep the demission of these pockets undisturbed.

4.3 Cost Effective: -

Foundation Pardi was built in level of 1m brick work is done and after that the Shahabad tiles were placed. That Scaffolding is not needed, cost of Scaffolding is eliminated. Hence it Cost Effective.

4.4 Outcomes: -

The project details literature provided explains concept of Machine Foundation is a structure used to receive and transfer to the ground the static load from a machine and the dynamic loads imposed during the operation of the machine as a result of imbalances in the moving parts.

To Sustain these type of load, foundation is designed, While Execution many Risk are involved to mitigate these Risk is challenging job. While mitigating these Risk the cost should be in economy side.

4.5 Recommendation: -

- While Excavation extra dimension should be considering i.e. by adding 600mm on both-sides of original dismission of excavation.
- Thermocole should be use Mandatory in these types of structure to achieve accuracy

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