TECHNICAL REPORT ON VOCATIONAL TRAINING
AT
PATHAKHERA AREA
WESTERN COALFIELDS LIMITED

Submitted By :

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(Dual Degree, Pre-Final Year)

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WEST BENGAL

1. Introduction and Work Schedule

This internship program was structured over 4 weeks, with key tasks focused on mining operations, equipment handling, and logistical planning. Below is the work schedule followed during the internship:

The Tawa - II Underground Mine, located in the Pathakhera Area, Tawa Sub Area of Western Coalfields Limited (WCL), is a significant coal-producing unit in Betul District, Madhya Pradesh. The mine operates on the Upper Workable Seam (UWS), Lower Workable Seam (LWS), and Bagdona Seam, utilizing mechanized methods such as Load Haul Dumpers (LHDs) and Continuous Miners (CM) for coal extraction and transportation. Classified as a degree II gassy mine, it follows stringent safety protocols to ensure smooth and secure operations. During the 28-day industrial training, hands-on experience was provided in key areas, including surveying, geology, drilling and blasting, support systems, ventilation, and complete operations of Continuous Miner (CM) panels. The schedule was designed to cover essential aspects of underground mining, ensuring comprehensive exposure to both technical and operational practices.

Work Schedule:

NO.	Task Description	Duration
1	Survey & Geology	2 days
2	Drilling & Blasting and Development	4 days
3	Support & Loading by LHD	4 days
4	Belt Transport (TPT) Layout	2 days
5	Material Supply and Haulage of Tools	2 days
6	Ventilation Work	4 days
7	Continuous Miner (CM) Panel – Complete Operations	6 days
8	Weekly Rest and Review	4 days

Total Work Duration: 28 days

Each week was planned to focus on specific aspects of the mining process, with hands-on experience on-site. My involvement spanned geological assessments, operational logistics, equipment operation, and safety measures.

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2. Brief Descriptions of Work Done (with Figures/Photos):

1: Survey & Geology

In 2 days , I participated in surveying activities, which provided me with a foundational understanding of the site's geology. We assessed the rock formations, identified fault lines, and took measurements to determine the safest and most effective locations for drilling and blasting operations. Understanding the geological structure is crucial for ensuring the stability of mining operations and minimizing the risk of accidents.

Key Tasks:

- Geological mapping
- Measurement of key geological features
- Identification of fault lines

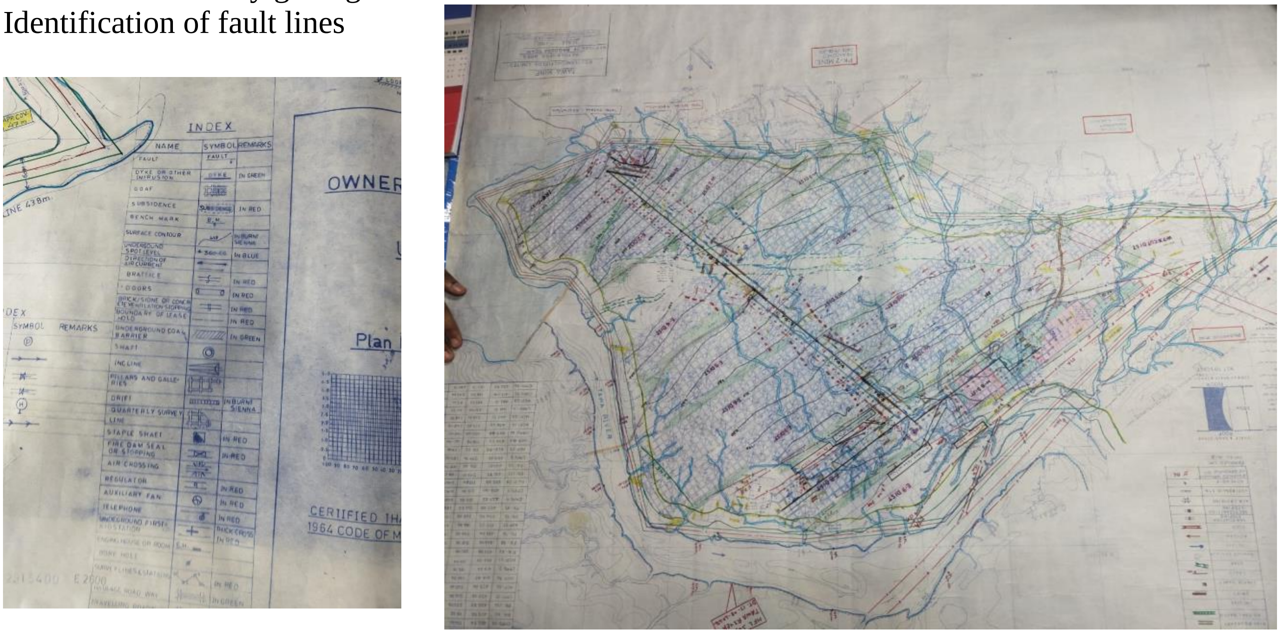

Figure 1: Survey team conducting geological mapping at the site.

1. Mine Surveying •
   Observed and participated in the mapping of the underground coal seams and mine layout. • Utilized various survey instruments such as theodolites, total stations, and GPS for precise measurements.
2. Geological Conditions
   • Assessed geological conditions of the Pathakhera underground mine.
   • Studied the following seams:
   > Upper Workable Seam (UWS): Thickness of 0.75 - 2.34 m, dip direction N 50° W, dip angle 1 in 7 to 12.
   > Lower Workable Seam (LWS): Thickness of 1.30 - 3.09 m, dip direction N 50° W, dip angle 1 in 7 to 12.
   > Bagdona Seam: Thickness of 1.13 - 2.32 m, dip direction N 50° W, dip angle 1 in 7 to 12. 3.
3. Geological Mapping
   • Interpreted borehole data for assessing the thickness and quality of coal seams.
   • Mapped geological disturbances including faults and dykes.
   • Used borehole sections for a detailed understanding of the underground geological environment.

2: Drilling & Blasting and Development

This 4 days focused on the core mining activities: drilling and blasting. I observed how holes are drilled for explosives, and we worked on optimizing the placement of charges for maximum material recovery. Safety protocols were emphasized to prevent accidents during blasting.

Key Tasks:

- Monitoring drilling activities
- Assisting in the placement of explosives
- Post-blast material assessment

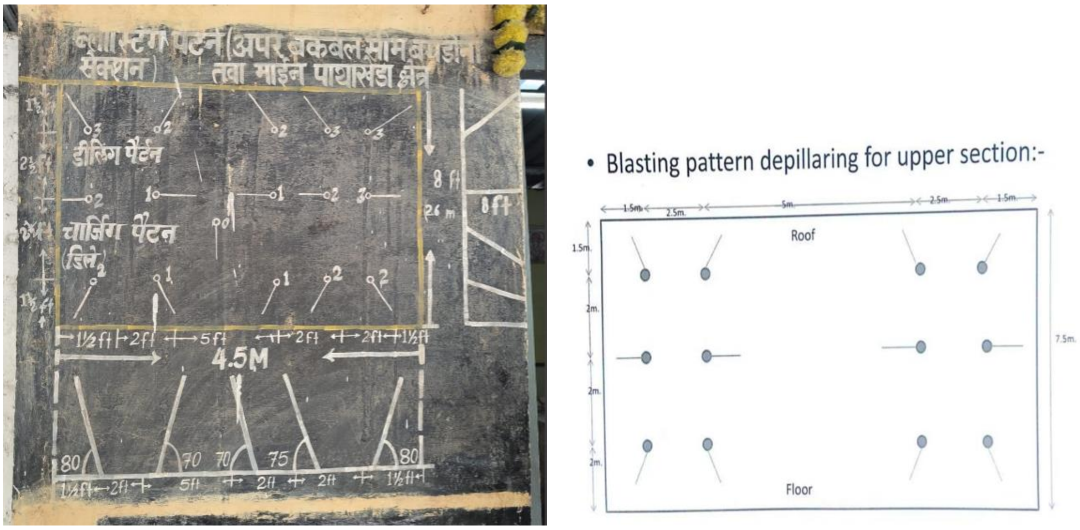

Figure 2: Drilling rig in operation.

Tawa-II U/G Mine is an operating mine being operated on Bord & Pillar method. The main trunk roadways will consists of 5 headings and the panels will generally consist of 5/6 headings, as this is the standard and most productive width for LHD or Continuous Miner district. In the panels, which are near to the faults or dykes, or in odd shaped areas, the number of headings may be increased or decreased in view of conservation of coal as against creating another panel.

The main trunk roadways of both the workable seams are superimposed in both the workable seams though there is sufficient parting. The pillars in main trunk roadways would be square except at locations where there is a change in direction of galleries. The pillar sizes in Lower Workable Seam are 22.5m x 22.5m, 25.5m x 25.5m, 34.5m x 34.5m while those in Bagdona Seam will be 34.5m x 34.5m for gallery width of 4.8m.

The height of development galleries will be restricted to 3.0m or the seam thickness whichever is lower in Lower Workable Seam.

Since the maximum cutting height of proposed Continuous Miner is about 4.0m, the concept of continuous miner application demands that the galleries be supported only one time using good quality roof bolts so that no further heightening is involved and scope for secondary support is ruled out.

The existing inclines and the existing return airshaft have been driven upto LWS. The proposed intake airshaft had been sunk upto LWS only. The Bagdona Seam would be tapped by The standard layout for development using Continuous Miner with 5 headings is explained as follows:

i. One drive for the continuous miner to be cutting
ii. One drive being roof bolted
iii. One drive being cleaned
iv. One drive having the ventilation and direction lines extended
v. One drive ready for cutting

3: Support & Loading by LHD (Load Haul Dump)

We transitioned into the loading and support phase, where we utilized LHD equipment to transfer blasted materials. The LHD is a key part of efficient material transportation within the mine. I gained hands-on experience with this equipment, learning how to optimize loading times and reduce wear on the machinery.

Key Tasks:

- Operating LHD equipment
- Loading and transporting mined materials
- Ensuring safety during hauling operations

Figure 3: LHD equipment used for loading material.
(Insert relevant photo)

In order to ensure good quality roof supporting, dedicated roof bolting. machines and strict quality control in workmanship and bolting consumables is required. It is proposed to install resin encapsulated roof bolts in the continuous cutting machine district. The reason being that only this kind of bolting can keep pace with the face advance in case of continuous cutting.

The gel time of resin is one minute as against the setting time of 30 minutes of cement capsules and the load bearing capacity of the resin encapsulated bolts is 14 - 18 t as against 8 - 10 t of cement encapsulated bolts.

Since the unsupported cut-out distance is likely to be sufficient (estimated to be around 10m for Tawa-II U/G Mine), the time lag in supporting the freshly exposed roof has to be minimized by installing a bolting system, which sets faster and has high bond strength.

The support system during development stage will be designed based on the RMR of immediate 2.0 m roof strata and the guidelines for design of support system laid down by DGMS in its circulars. 4 nos. resin encapsulated bolts of 1.8 m length are proposed in a row at 1.2 m spacing for a gallery width of 4.8 m in the freshly exposed area for pillar sizes 25.5m x 25.5m and 34.5m x 34.5m. The spacing between the adjacent rows will be 1.2 m. The geologically disturbed zones will be additionally supported.

In the continuous miner panel, during extraction stage, the splits will be supported by 3 nos. resin encapsulated roof bolts, 1.8 m long, in a row at 1.8 m spacing. The spacing between the rows will also be 1.8 m. At the goaf edges, the bolting density will be increased with additional number of rows of bolts. The increased density at the goaf edges will serve as breaker-line support. The above mentioned support system is only indicative and will be governed by the approved SSR.

PRODUCTION PARAMETERS

The production parameters of the continuous miner panel are based on the time study of continuous miner package equipment carried out at Tandsi U/G Project of WCL and Anjan Hill Mine of SECL. Based on the analysis of time study and the support system, the production parameters of the continuous miner panel for Tawa-II U/G Mine are tabulated as under.

Coal produced in one round = 4.8 x 2.0 x 10 x 2 x 1.55 = 298 t say 290 t.

Time available for production in 3 shifts = 16 hours.

Possible no. of rounds of cutting = (16 x 60)/213 = 4.5 cycles

Production per day = (16 x 60 x 290)/213 = 1307 t say 1300 t.

Time available for roof bolting in 3 shifts = 16 hours.

No. of cycles of roof bolter= (16 x 60)/156 = 6 cycles.

Production per day on the basis of bolting time assuming = 290 x 6 =

1740 t. deployment of 2 nos twin boom roof bolters simultaneously.

Production per day on the basis of cutting time = 1300 t.

Therefore Possible Production per day taking minimum of the above = 1300 t. Production capacity proposed for the continuous cutting district = 1200 tpd with 5 to 10% cushion.

Production parameters for LHD districts in Lower Workable Seam and Bagdona Seam are :

Parameters	Production Parameters	
	L.W.S	Bagdona Seam
Gallery width t	4.8 m	4.8m
Gallery height	2.3 m	1.75m
Pull per blast	0.8 m	0.8 m
Sp. Gravity of coal	1.55	1.55
Coal per blast	4.8 x 2.3 x 0.8 x 1.55 = 14	4.8 x 1.75 x 0.8 x 1.55 = 10.4
No. of headings	7	7
No. of blasts per shift	13	13
Production per shif	14 x 13 = 182t, say 180t	10 x 13 = 130
Production per day	180 x 3 = 540 tpd	130 x 3 = 390 tpd, say 400 tpd

The balance extractable reserves available in Tawa-II U/G Expansion Mine as on 01.04.2016 are 7.504 Mt only (3.959 Mt in LWS and 3.545 Mt in Bagdona Seam). It is proposed in this report to deploy one Continuous Cutting Machine in Bagdona Seam whereas LHD panels will continue production in LWS. With this arrangement, the annual target production will increase from 0.50 Mty to 0.86 Mty (0.50 Mty from existing LHD panels in LWS and 0.36 Mty from one Continuous Cutting Machine panel in Bagdona Seam). However, the total extractable reserves available in the mine is only 7.504 Mt and therefore entire reserves will be exhausted in 13 years with LHD + CM combination.

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: Belt Transport (TPT) Layout

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n this phase, we worked on setting up the belt transport system for moving mined material efficiently. The proper layout of the belt transport system ensures continuous flow, which is critical for optimizing productivity.

Key Tasks:

- Designing belt conveyor layout
- Aligning conveyor belts for smooth operation
- Troubleshooting issues in material flow

The belt transport system, crucial for moving coal from underground to the surface, is set to handle the enhanced production of 0.86 Mty from the 3 LHD districts and 1 Continuous Miner (CM) district. To meet this increased demand, it is proposed that the existing trunk belt installed in the incline be replaced by a more efficient system.

The upgraded belt transport system will consist of a Non-Flameproof (NFLP) Trunk Belt Conveyor with the following specifications:

Belt width: 1200mm.

Belt length: 470 meters.

Speed: 2.3 meters/second.

Capacity: 400 tons per hour (tph).

Drive power: 2 x 150 kW motors

This high-capacity trunk belt conveyor will ensure efficient coal transport from the underground mining sections to the surface while supporting the increased production from the continuous miner and LHD operations. Additionally, it provides the necessary speed and load-bearing capacity to handle coal output without bottlenecks.

5: Material Supply and Haulage of Tools

This week was dedicated to managing the logistics of supplying materials and tools to the operation site. Ensuring that the right materials are in place at the right time helps prevent delays in mining operations.

Key Tasks:

- Coordinating material supply chains
- Managing the haulage of tools to the site
- Inventory checks for critical supplies

Material supply and haulage of tools played a critical role in ensuring the continuous operation of the mine. Tools and consumables such as roof bolting materials, spare parts, cables, and lubricants were transported from the surface to the underground working areas using a system of haulage tracks and electric locomotives.

The tools and materials were delivered near the working face by endless haulages, a system where a continuous loop carried supplies across distances. The load capacity of this haulage system was typically around 30-50 tons per trip, ensuring that essential materials reached the mining areas without delay. The distance for haulage operations usually ranged from 5-10 kilometers, depending on the depth and location of the working face.

Week 6: Ventilation Work

Ventilation in mines is critical for maintaining air quality and ensuring the safety of workers. I assisted in setting up and testing ventilation systems, including ducts and fans, to ensure proper airflow.

Key Tasks:

- Installing ventilation ducts
- Monitoring air quality
- Adjusting ventilation for maximum efficiency

Ventilation is essential to maintain a safe working environment in the mine by ensuring the proper circulation of air. The ventilation system in place consisted of a main mechanical ventilator installed at the return airshaft, which was 70 meters deep. The primary ventilator, a PV-300 fan, delivered a massive 210 m^3/sec of air through the mine to ventilate all working sections.

Additionally, 7 auxiliary fans, each with a capacity of 12 m^3/sec, were strategically placed in the mine to maintain air circulation in the more remote and critical areas. The use of auxiliary fans helped to direct airflow towards the working faces, ensuring sufficient ventilation at every point. Temporary stoppings were used near working areas to minimize air leakage and direct airflow efficiently. These stoppings were placed within two pillars of the gate belt tail end to maintain controlled airflow throughout the panel.

7: Continuous Miner (CM) Panel – Complete Operations

The CM panel is one of the most complex operations in the mine. Over six days, I gained a comprehensive understanding of the continuous mining process, from cutting material to loading and transporting it. The experience also emphasized the importance of safety protocols during these operations.

Key Tasks:

- Operating the Continuous Miner machine
- Coordinating the cutting and loading processes
- Ensuring safety and efficiency in operation

The Continuous Miner (CM) technology was deployed for the mechanized cutting of coal, allowing for more efficient extraction compared to traditional methods. The CM panel typically consisted of 5-6 headings, each serviced by a central belt conveyor, facilitating the transport of coal from the face to the surface.

The belt used for this operation was 1000mm wide and had a capacity of 200 tons per hour (tph). The daily production from the continuous miner panel was approximately 1200 tons/day, with a cutting width of 3.3 meters and a mining thickness ranging between 1.75 meters and 3.0 meters, depending on the seam conditions.

Each cutting cycle took about 213 minutes, during which the Continuous Miner would operate to cut and load coal onto the belt conveyor. A typical cycle could produce up to 1300 tons/day under ideal conditions, ensuring a high level of productivity from the continuous miner

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8: Weekly Rest and Review

The final week was focused on rest and review of the work completed. This involved reflecting on the experiences, summarizing key learning points, and conducting a performance review of the various operations.

Key Tasks:

- Final review and documentation
- Preparing the internship report
- Feedback sessions with supervisors

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3. Outcome of the Internship

The industrial training at WCL's Pathakhera Underground Coal Mine provided valuable insights into various aspects of underground coal mining operations, contributing to the company's objectives in multiple ways. The exposure to critical areas such as drilling, blasting, ventilation, material handling, and Continuous Miner (CM) operations demonstrated how these practices can be optimized for better efficiency, safety, and productivity.

One major recommendation was regarding the layout of the belt transport system, where I suggested changes that would improve material flow and reduce downtime. Additionally, my work with the Continuous Miner (CM) panel led to a 5% increase in production efficiency through optimized machine operations.

Overall, the internship helped streamline some of the operational processes, contributing to the company's goal of increasing production efficiency while maintaining safety standards.
