

CHAPTER – X METHOD OF WORK

10.1 METHOD OF DEVELOPMENT

The property of Churi Underground mine has been developed in stages and their present status are as follows:

CHURI BLOCK:

* **Churi Old (Manual Section) :** Developed fully by Conventional B&P with drilling, blasting and manual loading into tubs with rope haulage transport in both the seams. Presently workings are isolated except few headings for return airway.

* **Churi Old (Sealed Off):** In this part of the property only Lower Bachra seam is worked which is developed and depillared in distant past by Conventional Bord & Pillar method and presently sealed off. It falls beyond the proposed mining area for Churi-Benti UG Project (greater than 150m from proposed boundary). The presence of water / fire cannot be ruled out.

• **Churi Re-Organization(CRO) Section :** Mechanized development of Lower Bachra seam by LHD with LDCC/MDCC and Gate Belt Conveyor transport system whereas Upper Bachra seam is developed manually. Development of LBS in CRO section is almost complete except in patches, which requires conformity of thickness by putting extra exploration boreholes. Upper Bachra Seam is partly developed and partly virgin which has to be developed by the Conventional Bord & Pillar method of mining. Depillaring of seams in CRO and Churi Old has not been done in any of the seams due to non-availability of land.

BENTI BLOCK:

Benti Section: Presently development with LHD is in progress in the Bottom lower Bachra seam/section after crossing the Damodar River through W-6 panel in CRO.

10.2 PRESENT MINING METHOD & MINE DEVELOPMENT

The status of the seams being worked is as under:

- | | | |
|-------|---------------------------|---|
| (i) | Upper Bachra (UBS) | -B & P Development in progress. |
| (ii) | Lower Bachra (LBS) | -Almost fully developed by B&P. |
| (iii) | Bottom Lower Bachra (BLB) | -B & P Dev. is in progress in Benti block |

In Churi Block, both the seams, namely Lower Bachra & Upper Bachra are almost fully developed by Bord & Pillar method of mining. Lower Bachra seam has been fully developed with LHD in CRO & manually in Churi old section of Churi block. Upper Bachra seam is being developed manually in CRO.

Upper Bachra seam has also been developed manually by B & P method in Churi old mine. Part of the property of Upper Bachra seam in CRO, is still to be developed, which is in progress.

The Churi UG project is developed along the floor of the seam in both the seams. The average size of pillar is 25x25m centre-to-centre and size of gallery 4.2x2.4m (in LBS) & 4.2x1.5-2.0m. Depth of working for UBS and LBS varies from 18-91m & 37-93m respectively. The dip of the coal bearing strata generally varies from 1 in 20 to 1 in 40 (2^0 - 3^0), generally towards northwest.

In Benti block, major part of the property is virgin. Development of Bottom Lower Bachra seam/section is in progress by LHD along the floor of the seam. The size of pillar is 25x25m centre-to-centre and size of gallery 4.2x2.4m (in Bottom Lower Bachra seam).

10.2.1 Trunk Road Development

At present Churi Old and CRO have separate set of trunk roadways in each section along the mine entries. The trunk roadways (in each section) comprises of 4-6 headings. Trunk roadways have been driven up to the adjusted boundary between CRO and Ray-Bachra underground mine in Lower Bachra Seam.

Trunk headings development in Churi old mine has been done up to 47th level. The present length along the trunk roadway up to extreme point in CRO is more than 2.5km whereas in Churi Old mine is about one km. The method of trunk roadway development in CRO is mechanized Bord & Pillar with LHD whereas in Churi old mine it is manual Bord and Pillar. At present drivage of trunk roadway is complete in both the seams (CRO & Churi old). Benti block has been approached through W-6 panel in CRO with 3 headings by crossing below Damodar river. Trunk heading development is in progress with LHD in Bottom Lower Bachra seam/section.

10.2.2 Panel Development and Extraction

The panel layout in CRO and Churi Old consists of 5-6 headings, except few, in both the seams/sections. The panels have gallery size of 4.2x2.4m & size of pillar is 25x25m center-to-center. In few cases, the size of pillar may be of lesser dimension. The seam thickness of Upper Bachra Seam varies from 1.2m to 4.0m whereas the seam thickness of Lower Bachra seam varies up to 11.24m (visual thickness) as in NNKC-48. The panels in Churi block are generally developed up to the boundary of the mine but in some cases it has not been developed up to the boundary due to thickness problem or practical operational difficulties at that time. The panels are developed generally with 1.5-2.4m height of extraction leaving 0.5-0.6m solid coal in roof against immediate shaly roof.

10.2.3 Existing Transport

Presently the mode of transport of coal from face to surface is as follows :

- (a) SDL/LHD feeds coal to face conveyor/medium duty chain conveyor and then to Gate Belt Conveyor and brought to surface by trunk belt conveyor and then fed to CHP at Ray Siding.
- (b) Material transport from surface to underground is through incline No.6 by direct rope haulage and endless haulages.
- (c) Coal from manual district is directly loaded manually onto face conveyors which feeds to the gate belt conveyor and finally to trunk belt conveyor for transport up to surface.

10.2.4 Existing Ventilation

The mine is categorized as Degree-I in gassiness. The ventilation system comprises of Incline 6 & 7 as intake and air -shaft and Incline 1A as the return for the Upper Bachra, Lower Bachra and Bottom Lower Bachra seam/section. One PV-200 type Fan is presently installed to serve the ventilation requirement of the mine.

10.2.5 Existing Support System

The existing practices of roof support in the workings of Churi & Benti blocks are roof bolts with W-strap as per approved SSR from DGMS. It is also supplemented with conventional support as and when required.

10.2.6 Existing Production:

The present production from Churi UG is from Upper Bachra in CRO and from Bottom Lower Bachra in Benti block. The mine is presently producing around 0.16MTY with mechanized as well as manual districts.

10.3 PROPOSED METHOD OF WORK

The suggested method of extraction for the Churi-Benti project comprises of:

- ❖ Bord & Pillar development & depillaring with Continuous Miner
- ❖ Bord & Pillar development & depillaring with low height LHD
- ❖ Heightening of existing galleries with remote controlled LHD.

10.4 B&P DEVELOPMENT & DEPILLARING WITH CONTINUOUS MINER

The Continuous Miner will be deployed for development and depillaring of virgin reserves in Benti block (Panel B-5 to B-9 & T-3). Subsequently, it will be shifted in Churi Block for depillaring of panels W-1 to W-15 in the western section of CRO and panel E12 & E13 of eastern section of CRO. The virgin patches within the panel are also proposed to be developed and depillared by Continuous Miner.

A. Geo-mining Parameters: The geo-mining parameters of the area proposed for deployment of Continuous Miner is briefly stated below:

Table 10.1 : Geo-mining Characteristics of mining area under Churi block

Sl. No.	Parameters	Upper Bachra Seam (UBS)	Lower Bachra seam (LBS)
1	Area within mine boundary	5.89 sq. km	
2	Mining area considered for CM deployment	2.03 sq. km	
3	No. of borehole intersections within mine boundary	56	
4	Boreholes density (BHs/sq.km)	9.5	
5	General Thickness range (m)	0.13-4.84	1.71-11.24
6	Depth range (m)	26.21 - 91.00	21.59 - 93.65
7	Parting (m)	0.47-20.27	
8	Grade of Coal (inband)	C – E	B – E
9	Present declared grade	Grade 'B' Long Flame	
10	Immediate roof	Grey shale, sandy shale, conglomerate, medium to coarse grained sand stone	Carb. Shale / grey shale / fine to medium grained sandstone
11	Immediate floor	Carbonaceous shale, grey shale	Grey shale, intercalations of shale & sandstone, carb. shale, sandy shale
12	R.M.R	47.3	41.72-61.0

10.2: Geo-mining Characteristics of mining area under Benti block

Sl. No.	Parameters	Upper section of Top Lower Bachra (UTLB) / Combined Top Lower Bachra (CTLB)	Bottom Lower Bachra seam (BLB)
1	Area within proposed mine boundary Existing area Additional area	2.1sq. km 1.79sq. km 0.31sq. km	
2	Mining area considered for CM deployment	0.41 sq. km	
3	No. of borehole intersections within proposed mine boundary	23	
4	Boreholes density (BHs /sq. km)	12.7	
5	General Thickness range (m)	0.45 – 4.15 (UTLB) 1.10 – 5.10 (CTLB)	0.24 - 4.25
6	Depth range (m)	73.10 – 109.19 (UTLB) 74.06 – 106.75 (CTLB)	76.27 – 121.68
7	Parting (m)	0.30 – 5.17 (parting between BLB & CTLB/LTLB)	
8	Grade of Coal (inband)	C – F (UTLB) D – F (CTLB)	A – E
9	Present declared grade	Grade 'B' Long Flame (BLB)	
10	Immediate roof	Medium to coarse grained sandstone, carbonaceous shale grey shale & conglomerate	Coarse to very coarse grained sandstone carb. shale, grey shale & sandy shale
11	Immediate floor	Carbonaceous shale, sandy shale, grey shale, grey wacks, medium to coarse grained sandstone & alternate band of shale & sandstone	Sandy shale, alternate bands of shale & sandstone, carb. shale, grey wacks, coarse to very coarse grained sanstone
12	Present Status of mining	Virgin	Initial B&P development by LHD being done

B. Mining Parameters for CM Panel

No. of Headings	-	4-8
Gallery width	-	4.8m
Development height	-	2.4m (Already developed)
	-	4.6m (where heightening proposed)
Pillar Extraction height	-	2.7m – 4.6m
Av. Pillar size	-	25 x 25m center to center in UBS & LBS. (Size varies within the panels)
Panel width	-	79.2m – 179.2m (In Churi Block) 125m – 150m (In Benti Block)
Panel length	-	Up to 1000m in both blocks
Cut out distance for CM (assumed)	-	15m in split 10m in Slices
Cutting width	-	3.3m

C. Panel Development

CHURI BLOCK

Most of the panels in Churi block are almost developed. Panel formation has been done by considering existing panel barriers, which shows panels of 4 to 8 headings. The av. pillar size is 25m x 25m centre to centre with a gallery width of 4.2m. The virgin patches falling within the panels are proposed to be developed and depillared by CM itself.

BENTI BLOCK

Major part of the Benti block is virgin. Five headings panel has been proposed for development and depillaring. The proposed pillar size is 25m x 25m centre to centre with a gallery width of 4.2m or 4.8 m. The proposed development height for Low Height LHD panels is 2.4m or actual seam thickness after leaving 0.3m to 0.50m coal in roof and 4.6m for CM development district. Proposed width of galleries for CM development panels are 4.8m.

Development height and Horizon - The existing average height of development in Upper Bachra, Lower Bachra, Bottom Lower Bachra and Upper Section of Top Lower Bachra seam/section proposed to 2.4m or seam thickness leaving 0.3 to 0.5m coal in the roof to provide additional support to the immediate shaly roof. The seam has been proposed to develop along the floor of the seam.

LOW HEIGHT LHD PANEL

Pillar Size	: 25m x 25m (center to center)
Gallery Size	: 4.2m
Development Ht.	: 2.4m or actual seam thickness after leaving 0.3m to 0.5m coal in roof
Depillaring Ht.	: Actual seam thickness

CONTINUOUS MINER PANEL

Pillar Size	: 25m x 25m (center to center)
Gallery Size	: 4.8m
Development Ht	: 4.6 m or actual seam thickness after leaving 0.3m to 0.5m coal in roof
Depillaring Ht	: 4.6m or Actual seam thickness

D. Method of Pillar Extraction

Method of extraction would be depillaring with caving. There are many methods of pillar extraction by continuous miner like:

- ❖ NAVID METHOD
- ❖ CHRISTMAS TREE METHOD
- ❖ POCKET AND FENDER METHOD and
- ❖ Other methods

The sketches of the above methods are enclosed in this chapter. However the method of work will be finalized after scientific study for the project .Out of the above-mentioned methods POCKET AND FENDER METHOD has been successfully tried in some other mines of CIL .The brief description of the above method is as under.

The method of extraction of pillars comprises of the following:

- Splitting and Slicing of the pillar.
- Line of extraction.
- Extraction height and horizon.
- Manner of extraction.
- Sequence of operation in Pillar extraction.

Splitting and Slicing: The existing developed pillar shall be splitted into two parts by driving a roadway of 6.6m width parallel to pre developed rises and perpendicular to the face line at the centre of pillar. The height of the splitted gallery may be 4.6m. The existing size of pillar is 25m x 25m in which two slices in each fender may be possible. The width of one slice may be 6.6m and the width of other slice may be 3.3m. The height of extraction in slices may be 4.6m.

As the method suggested for depillaring is totally new for CCL, so the width and height of split and slices may change depending upon the method of extraction. The above width & height of splits and slices are proposed as per the method being practiced in SECL.

Line of Extraction: The pillars in a depillaring panel will be extracted while retreating from boundary, maintaining a straight line of extraction. The straight-line method with fully mechanized equipment has several advantages over the diagonal line of extraction as it reduces both the tramming distance and cable length.

Extraction Height and Horizon: The extraction height in pillar shall be up to 4.6m and it shall be worked along the floor of the seam.

Manner of Extraction: It is proposed to introduce one fully mechanized Bord & Pillar district using Continuous Miner and Ancillary equipments in Churi - Benti project for development and depillaring of Lower Bachra and Bottom Lower Bachra seam/section. The Continuous Miner will develop virgin property in Benti block (Thickness >3m) with pillar size 25mx25m and gallery size 4.8mx4.6m. The developed pillars of the Churi-Benti Project will be depillared by the CM up to 4.6m height or actual seam thickness.

The manner of extraction would be splitting and slicing, which is common in the mines of CIL. The mine management and the work force are familiar with the method and the subsequent strata behaviour. The pillars in a depillaring panel will be extracted while retreating from boundary, maintaining a straight line of extraction. There may be several methods/layout for depillaring in a panel. A tentative layout for depillaring by C.M. is indicated in sketches 1 to 4. Keeping in view the extraction system/layout being followed in other mines of CIL with CM, one of the suggested method may be "Pocket and Fender Method". In this method, the sequence of extraction may be as under:

A split roadway of suitable width is to be developed parallel to pre-developed rises and perpendicular to the face line at the center of the pillar. It will form two fenders and the fenders so formed shall be extracted by making inclined pockets into that fender at an angle of 60° to the horizontal. These inclined pockets are made at a particular distance from the side of the pillar to form a snook that will provide temporary stability to the workings and later on it will get crushed and helps in regular caving of the roof. While making fenders, the roadway shall be supported with bolts in a manner specified in the approved systematic support plan.

The coal cut by the Continuous Miner shall be collected by the gathering arm of the machine and discharged into shuttle Cars. The shuttle car feeds the coal by a chain conveyor installed in its body, to a self-propelled feeder breaker. Coal is then discharged to the surface through a series of gate & trunk belt conveyors.

Before going for development/depillaring of panels with CM in Churi-Benti Project, prior permission under Reg. 100 of CMR, 1957 have to be obtained. Similarly, various public works like road, high tension line etc. passes over the lease hold property of Churi Block. So before going for depillaring, the permission under regulation 105 of CMR, 1957 would also have to be obtained and should be complied effectively.

It is proposed to shift the surface features like villages, roads, power trestles, private/company quarters, sub-station etc.

Sequence of Operation : The sequence of operation of Continuous Miner for "Pocket and Fender Method" has been shown in Sketch-2. The details of sequence of operation of the seams shall be as below :

- Cut 1 is driven in a split up to a maximum distance of 15m or as permitted by DGMS.
- The Continuous Miner is trammed to Cut-2 in second split of a pillar and commences cutting while the Roof Bolter Machine supports Cut-1.
- Once the CM completes Cut-2 and Roof bolting is completed in Cut-1, CM commences Cut-3 (in first split) operation.
- When Cut-3 in 1st split shall be in progress, the roof bolter shall support the Cut-2.
- As the Cut-3 is completed and roof bolter supports Cut-2, CM will again be trammed to 2nd split for Cut.4.
- When Cut-4 in 2nd split shall be in progress, the roof bolter shall support the Cut-3.
- When Cut-4 is complete and Cut-3 is supported by the roof bolter, then CM shall be trammed to first split to take the slice-5 in the fender and Cut-4 shall be supported by the roof bolter.
- This process shall be repeated as shown in sketch.

In addition to above, other method of extraction like Navid method, Christmas tree method are also available. Final method of extraction may be finalized after detailed scientific study for deployment of CM.

E. Support System

Support system shall be of roof bolting supplemented by conventional support as and when required.

Support System during panel development : At the time of panel development, the roadways are proposed to be supported with roof bolts. The roof bolting may be quick setting resin roof bolt or fixed column-grouted bolt using cement, sand mortar. Development galleries will be supported by 2-3 rows of roof bolts 1.8m in length. The distance between two adjacent rows of bolt and between two adjacent bolts in a row should be around 1.2m. The above specification may change depending upon the results of the scientific study. In addition to above, the provisions of Reg. 108 of CMR, 1957 together with related circulars are to be complied. The support system for the development galleries shall be as per the approved Systemic Support Rules.

Support System in Split and Slice : The tentative support system in split galleries may be with quick setting type resin bolts at an interval of 1.2m between the rows and between bolts. Slices may not be required to be supported as it is to be extracted with remote operated Continuous Miner.

Support of Goaf Edges :

- (i) All the goaf edges shall be supported by rows of quick setting type resin bolts at 0.60-0.80m interval in between the two bolts and between two rows and 0.5m from either sides of the pillar. The length of such bolts shall not be less than 1.8m or 2.4m. Such goaf edge support shall be provided in the split/original gallery, as the case may be, at the start of the slice cut by the Continuous Miner.
- (ii) Each such goaf edge support shall have three parallel rows of bolts across the original/split gallery.
- (iii) At least two wooden props shall be installed near the goaf edge on the rib side as indicator type.

Support System at other places: The trunk roadways and other working places shall be adequately supported and secured by roof bolting system or other suitable means of support.

Support System for Geologically disturbed area : All dykes, visible slips and breaks in roof shall be supported by cogs at an interval of 2.4m on either sides of such disturbances and with cross-bars across them at an interval of not exceeding 1.2m.

Smaller geological disturbances, wherever feasible, shall be kept supported by roof bolts on both sides of the disturbances along with W-strap as suitable intervals. The length of such roof bolts shall be appropriate to the extent of the disturbances but in no case less than 1.8m. The spacing between the bolts shall be approximately chosen on the extent of the geological disturbance but in no case shall be more than 1.0m.

Additional supports shall be erected as and when required.

Monitoring of Roof Bolts : All the recommendations of DGMS Technical Circular No.3 of 1996 and other applicable regulations and circulars regarding roof bolting/floor bolting shall be effectively complied whenever applicable in this mine for safe working.

Support Material : The specifications of the support materials are as follows:

Roof Bolts : (Tor steel/MS IS:1786-1985/IS:226-1975/IS:1570)

Type : Steel/Mild steel

Length of rod - 1.8m/2.4m

Dia of rod - 20-22mm

Length of thread - 125-150mm

Bearing Plate (IS:226-1975)

Material = MS

Thickness = 6mm
Size = 150 x 150 mm²

Nut : (IS: 1363, Part-3, 1984)
Shape = Hexagonal
Height = 20mm

Cement/Resin Capsule

Length = Not exceeding 400mm
Dia = 30-32mm
Type = Quick setting (it should provide a minimum anchorage of 3 tonne after 30 min & 5tonnes after two hours of setting.

While doing the bolting operation in any roadways/workings of the mine, the provisions of CMR 1957 and various DGMS Circular (Viz Cir Tech 3/1996) shall be effectively complied for safe working of the mine.

F. Coal Evacuation From CM Panel

The Continuous Miner would cut and simultaneously load the coal by its inbuilt stage conveyor into the shuttle car directly. The loaded shuttle car would discharge coal on to feeder breaker. Crushed (-100mm size) coal will be uniformly discharged on to gate belt conveyor, which is installed in the central gallery of the panel. This gate belt conveyor will in turn discharge the coal on the trunk belt conveyor. The gate belt conveyor would be installed in the gallery so that loading distance and cable length on each side of the loading point is minimal. The panel width of the CM panel varies from 79.2m to 179.2m and length of the panel is up to 1000m. 2x200tonnes strata bunker is proposed in the Benti block in T-2 panel and 3x200tonnes strata bunker is proposed in the Churi block in the trunk heading near to W-6 panel.

G. Material Transport

The material transport in the panel is proposed to be carried out by endless and direct haulages.

H. Ventilation System in Panel

The CM panel in Churi block comprises of 4 to 8 Headings in a panel where as in Benti block 5 heading panels are proposed. In a 5 heading CM panel, three galleries on the dip side of the panel would preferably be used as intake airway while two galleries on the rise side is to be used as return airways. In case of other panels, the manager of the mine may accordingly decide the no. of galleries for intake and return airway for adequate ventilation of the panel. In no condition, the ventilation of the panel should be neglected.

The faces would be ventilated by auxiliary fan using ventilation ducting. Other measures, which may improve the ventilation of the mine, may also be adopted as and when required.

I. FACE EQUIPMENT OF CONTINUOUS MINER PANEL

It is proposed that CM panel may have the following list of equipments:

1.	Continuous Miner	-	One
	<i>(Suitable to prevailing geo-mining condition)</i>		
2.	Shuttle Car	-	Three*
3.	Roof Bolter	-	One
4.	Portable Bolter	-	One
5.	Load Haul Dumper	-	One
6.	Feeder Breaker	-	One
7.	Set of Electrical Distribution equipment	-	One
8.	Communication equipment	-	One

* The number of shuttle cars has been taken as per the agreement signed between ECL & supplier. The same has been discussed in the FDs meeting of CCL. Further, as per suggestions made by GM(Chirimiri), SECL vide letter no. SECL:BSP: DT(O):26/82 dated 28.02.07 of DT(O), SECL addressed to Dir.(T), CIL has also recommended for three shuttle cars. It has, however, recommended for higher production for the same. It is, therefore, suggested for negotiating higher guaranteed annual production with the supplier.

The details of the equipment as proposed is as below :

Continuous Miner : One suitable Continuous Miner suited to prevailing condition is proposed. The machine is equipped with radio remote control, dust scrubber and methane monitor. It cuts & loads coal in single operation.

Operational Parameters of Continuous Miner (As per CM working in SECL)

Cutting head width	-	3.3m
Cutting height	-	2.2m(Min.) to 4.6m (Max.)
Length of the machine	-	11.02m
Gallery width required	-	4.8m
Length of cut in a single pass	-	15m (development)

Actual operating specification may change depending upon method of extraction.

Shuttle Car : It transports the extracted coal from the Continuous Miner loading conveyor to a self propelled stammer Feeder Breaker. From the feeder breaker, coal is discharged to the gate belt and gate belt fed to the trunk belt conveyor. The rated load capacity of low to medium capacity shuttle car varies from 9-15 Te.

Roof Bolter : Since the development height of the panel is 2.4m, so the roof bolter which can successfully work in a gallery height of 2.2m-4.6m is proposed. The size and other specification of bolting material shall be of approved type.

Load Haul Dumper (LHD): It has the following operations to perform in the Continuous Miner district.

- (a) Cleaning the spillage coal from Shuttle Car.
- (b) Cleaning and sweeping up the heading of Continuous Miner after it has completed cutting and thereby reducing time.
- (c) Transport materials and consumable goods.
- (d) Moving switchgear and transformer and also assisting installation of main HT feeder cables.

Feeder Breaker : It receives the coal from Shuttle Cars and after crushing it to the desired size of (-) 100mm, feeds it to the conveyor at consistent controlled rate. It is mounted on tracks. The feeder breaker is having hopper sufficient to hold a complete shuttle car.

J. **Production Proposed**

The production proposed from the Continuous Miner panel is 0.50 MTY.

All the mining operations in Continuous Miner panel should be in accordance with the various regulations of CMR 1957 and various circulars issued by DGMS for safe working of the mine.

10.5 **HEIGHTENING OF EXISTING GALLERIES WITH REMOTE CONTROLLED LHD**

The gallery width required for CM is 4.8m and it can cut coal up to a height of 4.6m but the existing workings have the width and height of galleries as 4.2m and 2.4m, so heightening and widening of gallery may be required. Widening of gallery will be done as and where required.

I. **Proposal for Heightening of Galleries**

There would be separate remote controlled LHD panel for heightening of existing galleries in the western section of CRO (W-1 to W-15 panels). Other than these panels, no heightening of panels is proposed in this report. The heightening of developed galleries is proposed up to 4.6m only leaving at least 0.3-0.5m of coal in the roof.

II. **Proposal for Widening of Galleries**

Proposal for widening in those galleries is envisaged which shall be required for the movement of Continuous Miner. All the galleries of the C.M. panels may not be required for widening. The gallery through which Continuous Miner (i.e. haulage roadway) is to be driven down would be widened up to 4.8m for lowering of the machine (CM) into the panel. Widening of the galleries shall be applicable as per the requirement of CM package.

A. Layout of Panels

The mine is almost developed by Bord & Pillar method of mining in both the seams along the floor of the seam by LHD or manually in a panel form. So, the existing panel layout or layout proposed in the working plan shall be taken as the layout of the panel for heightening of galleries.

B. Manner of Heightening

Heightening of galleries may be done by conventional roof blasting up to 4.6m height. Blasted coal will be loaded by remote controlled LHD.

C. Manner of Widening

Manner of widening of galleries may be by side blasting with permitted explosives only and loading of blasted coal by LHD onto Chain Conveyor.

D. Face Equipment

The coal obtained due to heightening/ widening of coal shall be loaded by remote controlled LHD. Two numbers of remote controlled LHDs shall be deployed in Heightening panel.

E. Coal Evacuation from Panel

The coal shall be loaded on to chain conveyor by remote controlled LHD. Chain conveyor will feed coal to gate belt conveyor for coal evacuation from panels.

F. Ventilation of Panels

Heightening panels comprise of 4 to 8 headings, which is already developed. In five headings panel, three headings in the dip side of the panel shall act as the intake air and two headings on the rise side shall act as the return airway of the panels. In other cases, the manager of the mine may arrange the intake and return accordingly for safe working.

G. Face Ventilation

The Auxiliary fan with ducting shall do face ventilation.

H. Support System

The RMR of LBS varies between 41.7-61. It indicates that the immediate roof of LBS is of fair category.

As remote controlled LHD is envisaged for loading of coal in the panels, it is necessary that supports should be so designed that clear space is available for movement of the machineries. At present, the panel is developed up to 2.4m and is supported as per the approved SSR. Now it is to be heightened up to 4.6m. So, fresh SSR should be prepared and approved by the DGMS and should be effectively complied.

The bolt density for three types of roof classified on the basis of RMR value as recommended is as below:

Poor roof	-	1.2 to 1.5 bolts/m ²
Fair roof	-	1.0 bolt/sq.m.
Good roof	-	0.7 bolt/m ²

As per the RMR value, the roof of UBS and LBS falls in fair category of roof. So, the density of roof bolts in the Heightening panels should be 1.0 bolt/sq.m.

The bolt angle should generally be normal to the bedding plane in the roadways/galleries. This also holds good for other panels of the mine. Support materials should be as per DGMS Cir, no. 3/1996.

Support of Heightened Gallery (Within 9m of face) :

Area within 9m of the working face should be treated as the green roof. The green roof support should be done as per Reg. 108 of CMR, 1957.

Support of Heightened Gallery:

- * After heightening of galleries up to 4.6m, the roof shall be re-supported with roof bolts by roof bolter.
- * Four bolts in a row shall be installed. The spacing between the bolts in a row and between the rows shall be 1.2m.
- * Some additional roof bolts shall be installed to increase the density of roof bolts, as and when required.
- * The spacing between the sides of the pillar and the bolts in a row shall be 0.6m on the both sides of the pillar corner.
- * Bolts shall not be less than 1.8m/2.4m in length and 22mm in diameter.

Support at Junction: The bolt density should be at least 25% more than the bolt density of heightened gallery.

Support at Disturbed Places: In addition to the roof bolts, the geological disturbed area of the Heightening panel shall be supported by cross-bars, cogs W-straps and other suitable means as and when required.

Supports on Loose Floor: Props shall be set on solid floor and not on loose packing material. The support shall be kept tight against the roof. Wherever the props are to be set on sand a flat base piece not less than 5 cm thick, 25 cm wide and 75 cm long shall be used.

For legged steel cogs of 1.2m x 1.2m piece shall be set on solid floor and not on loose material. They shall be kept tight with timber sleepers against the roof to ensure maximum contact between the timber and the roof. The provisions for support on loose floor shall also hold for other working panels of the mine.

Support Material: The support material shall be as proposed in DGMS Gr Tech. 3/1996.

I. Production Proposed

The production proposed from Heightening panel is 0.15 MT i.e. 500 TPD.

Before going for heightening or widening of galleries in a panel in any of the seams or section, prior permission from DGMS should be obtained for that. All the mining operations in the Heightening panel should be in accordance with the various regulations of CMR 1957 and circulars issued by DGMS for safe working of the mine.

10.6 B & P DEVELOPMENT & DEPILLARING WITH LOW HEIGHT LHD

Bord & Pillar development & depillaring is proposed in Upper Section of Top Lower Bachra seam and Bottom Lower Bachra seam/section in Benti block. The proposed pillar size in both the seam/section is 25m x 25m, in both the seams/sections, width of gallery is 4.2m and height of gallery is 2.4m or the actual seam thickness leaving 0.3-0.5m of coal in the roof. The development is proposed in the virgin area of Upper section of Top Lower Bachra along the roof of the seam & Bottom Lower Bachra seams along the floor of the seam/section. It is proposed to leave at least 0.3-0.5m of coal in the roof, since the immediate roof of both the UTLB & BLB comprises of carb. shale, grey shale, grey wake, alternating bands of shale and sandstone. The reason to develop the UTLB along the roof is to maintain the parting thickness of 3.0m between the seams/sections for safe working.

A. Proposal for B & P Development / Depillaring panels with low height LHD

Bottom Lower Bachra Seam (BLB)

Panels B-1 to B-4, B-13 to B-15, T-1 to T-2 and B-18-B-19.

Upper Section of Top Lower Bachra Seam (UTLB)

Panels B-1 to B-4, and B-13 to B-16.

B. Layout of Panels

Since both the sections are contiguous, so layout of panels for UTLB & BLB is proposed in such a way that pillars in both the sections are vertically coincident. Generally, five headings panels for both the sections have been proposed for the development of virgin property in Benti block. Vertically coincidence of pillars should be checked by putting boreholes at the alternate junctions of the development galleries from either of the workings.

C. Method of work

Development:

Bord and Pillar method with Conventional Solid blasting. Low height LHD loading coal on to face conveyors.

Depillaring: Conventional Bord & Pillar method with caving in both the seams/sections.(simultaneous)

D. Manner of Extraction

Development: The virgin property of BLB seam would be developed along the floor of the seam leaving at least 0.3-0.5m of coal in the roof. Similarly, UTLB seam would be developed along the roof leaving at least 0.3-0.5m of coal in the roof. The details regarding the development of BLB & UTLB seams/sections are as below :

Size of Pillar	= 25m x 25m (Centre to centre)
Width of gallery	= 4.2m
Height of gallery	= 2.4m or actual seam thickness

The parting between two sections should be maintained at least 3.0m.

Depillaring: Simultaneous Bord & Pillar depillaring with Caving in UTLB & BLB has been envisaged. The developed Pillars would be extracted by splitting and slicing. Each pillar would be splitted into two equal parts by one dip split of 4.2m wide. There after level slices of 4.2m wide would be driven leaving 1.8 m (minimum) rib against the goaf so that the area of roof exposure at any one working place should not exceed 60 m² at any time. On retreat, the ribs would be reduced judiciously. Driving of a slice would commence only when the extraction in the immediate in bye slice is completed and goaf edge support as per approved SSR is erected. Only one slice in a pillar would be driven at a time and extraction of a half of a pillar shall not be commenced until extraction of the adjoining in bye half of the pillar has been completed.

Diagonal line of extraction would be maintained. The order of slicing should be strictly followed to maintain the stipulated area of exposure of 60m² (max.). In no condition, except with the permission of DGMS, the area of exposure should be more than 60m².

E. Coal Evacuation from Panel

It is proposed that the blasted coal shall be loaded by the low height LHD on to chain conveyors and chain conveyor fed it to the gate belt conveyor for transportation of coal from panel. This system will be applicable for development and depillaring panels of both UTLB & BLB. Since the working is contiguous, simultaneous working is to be done in both the seams/sections.

F. Panel Ventilation

Two or three headings in the dip side of panel (depending upon the size of panel) shall be used as intake airway and two or three headings on the rise side of the panel shall be used as the return airway of the panel. The face ventilation of the panels in both the conditions while development and depillaring shall be done with the auxiliary fans as and when required. This will be applicable for both the UTLB & BLB seams/sections.

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G. Face Equipment and Transport

Electric coal drill, Auxiliary fan, face pump may be the face equipment in UTLB & BLB workings. Blasted coal would be loaded by low height LHD on to chain conveyor and chain conveyor will feed to gate belt conveyor.

H. Support System

The immediate roof of Lower Bachra seam in the adjoining Churi block is of fair category. The RMR study for Benti has not been done, so RMR of LBS in Churi block has been taken for the support design for UTLB & BLB in Benti block. The support system for the low height LHD working comprises of :

- (a) Support for development.
- (b) Support for depillaring.

Support for Development : There should be a systematic support plan for development workings duly approved by DGMS in the mine. This shall be effectively complied for all workings of Churi -Benti Project:

(i) Support of working face within 9m

All working faces shall be supported by quick setting type full column grouted bolts. The first row of support shall be at a distance of 1.8m from the face. The spacing between the rows may be 1.2m. The means of support for the working faces shall be roof bolts supplemented with conventional support as and when required.

(ii) Support of Tramming level

Where required tramming levels shall be supported by cross bars on safari clamps or in duggis at an interval of 1.2m. In general, roof bolting supplemented with conventional support as and when required shall support it. Chocks/cogs shall be set as and when required.

(iii) Support at Junction

The density of roof bolts at the junction of galleries should be 25% more than those general galleries. Cross bars, cogs, chocks or other suitable type of conventional support may also be erected as and when required.

(iv) Support of Travelling Roadway

In addition to roof bolts, traveling roadway shall be supported by rope stitching or steel girders or cross bars or vertical props or chocks/cogs at suitable intervals.

(v) Support of Airways

In addition to roof bolts, airways may be supported by rope stitching or steel girders or cross-bars or vertical props or chocks/cogs.

(vi) Support of geologically disturbed places

Geological disturbed places shall be supported by cross-bars or vertical props or steel bolts or rope stitching or with chocks/cogs in addition to roof bolts as and when required.

Support for Depillaring : While going for depillaring, the systematic support plan should be prepared for depillaring districts/panels and get approved by the DGMS. It should be complied effectively for safe working of the mine. The envisaged support for depillaring panels is as below:

(i) Support within two pillars of extraction

The support within two pillars length of extraction would be done by roof bolts at 1.2m spacing in a row and the distance between two rows of such bolts would be 1.2m. It would be supplemented with the conventional support as and when required.

(ii) Split galleries shall be supported with roof bolts at an interval of 1.2m between the rows and 1.2m between the bolts. Additional roof bolts may also be provided to increase the density of roof bolts as and when required. It shall also be supplemented with conventional support as and when required for safe working of the time.

(iii) Junction support

Junction will be supported by roof bolts with w-strap chocks/cogs may also be erected as and when required.

(iv) Slice support

Goaf side slice will be supported by cogs at 1.5m interval and rib side by roof bolts with w-strap.

(v) Goaf Edge Support

Goaf edges will be supported by cogs placed skin to skin with corner props.

Support Material

The specification of support material regarding roof bolts shall be in accordance with the Cir. Tech 3/1996 of DGMS circulars.

Regarding the conventional support, the specification support material should be as per the provisions of CMR 1957 and DGMS circulars.

Production Proposed

Production from the B & P development/depillaring with low height LHD is proposed to be 0.16MTY.

10.7 PRODUCTION PARAMETERS

The production parameters as envisaged in the Churi-Benti Project Report is as under:

CM Panel	-	0.50 MTY
Low height LHD panel	-	0.16MTY
Heightening Panel	-	0.15 MTY

TOTAL	-	0.81 MTY
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10.8 SUBSIDENCE

The Project Report for Churi-Benti Project covers area of Churi Re-organization (CRO) and Benti block. Total area under this project comes to about 7.68sq. km. For deployment of Continuous Miner, the proposed mining area is 2.44sq. km. The proposed method of depillaring with CM is by caving. Earlier, a subsidence study was carried out for the Churi UG mine. However, the part of mining area for CM under Benti block was not considered. Hence, It is proposed to undertake fresh subsidence study for assessment of damage to surface for Churi-Benti project.

10.9 EXPLOSIVES & MAGAZINE

The explosives will be used only for B&P districts with LHDs including remote controlled LHDs panel. The powder factor presently obtained is around 2.0 tonne/kg of explosive. Efforts should be made to improve powder factor to around 2.5tonne/kg. Blasting study may be undertaken for suitable blasting pattern.

An explosive magazine of 400 kg explosives and 2000 detonators already exists in the mine. The magazine would be used for the project. It should be maintained in accordance with Indian Explosive Act & rules there under. The adequate arrangement should be made for the safety of the magazine.

10.10 SCHEDULE OF EQUIPMENT PROCUREMENT

The year-wise phasing of P&M is given in appendix-A.3.

10.11 GENERAL PRECAUTION WHILE DEPILLARING

- The extraction or reduction of pillars should be conducted in such a way as to avoid extension of collapse or subsidence of the goaf over unextracted pillars.
- During the extraction of pillars, no splitting or reduction of pillars or heightening of galleries should be carried out for a distance greater than the length of two pillars ahead of the pillar under extraction. While starting of pillar extraction, it may be extended up to 2 pillars only.
- Attempts should be made to allow the roof to cave regularly so as to avoid the presence of large area uncollapsed. So that danger from air blast or weighting on pillars could be avoided. If needed, suitable means should be adopted to bring down the goaf at regular interval. Adequate number of convergence recorder / load cell should be installed to predict the roof fall.

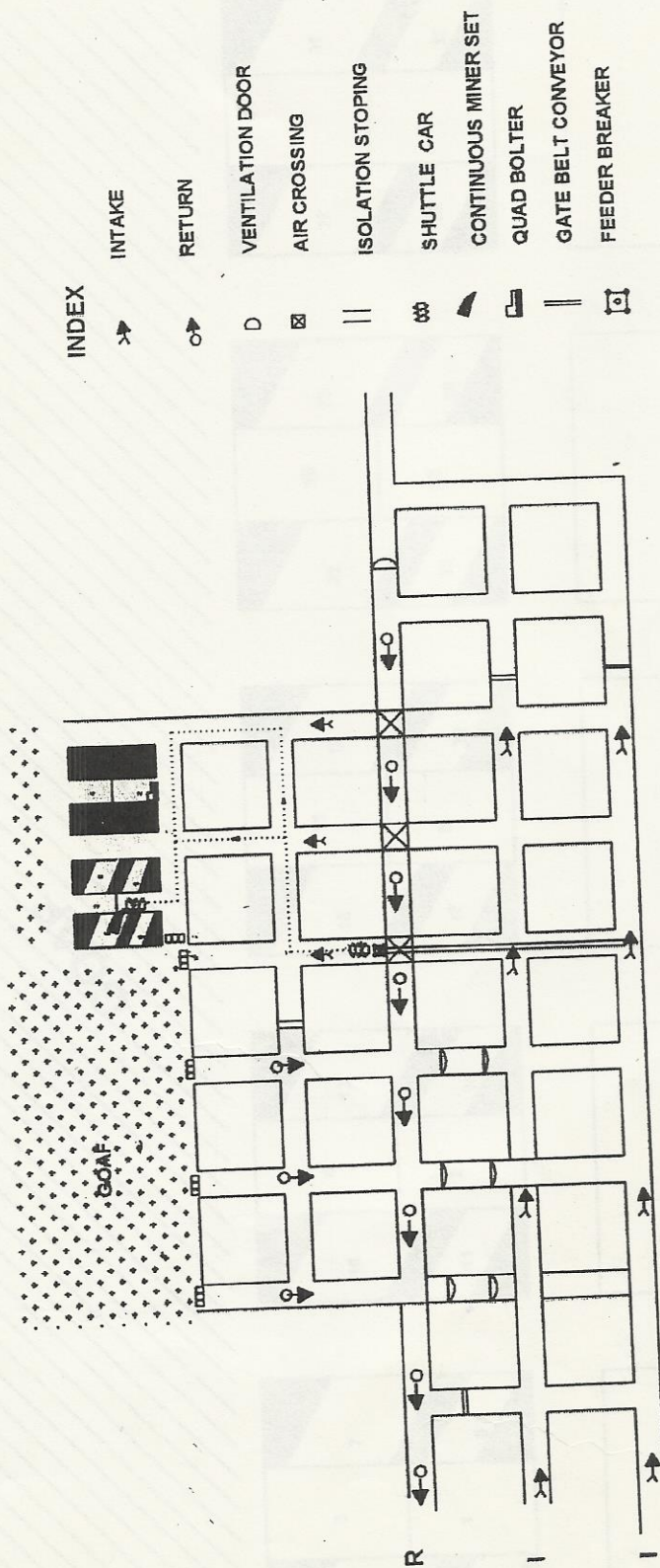
- d. Rib of not less than 1.8 m should not be left against the adjacent goaf. Some times, this may also be required in split galleries. So if needed, it must be left in split galleries also and may be judiciously reduced on retreat after setting strong breaker line of cogs or other means of artificial support adjacent to it.
- e. Adequate precautions against 'Air Blast' as per Cir. Tech.2/1988 should be taken.
- f. The area of exposure at any depillaring slice should not be more than 60m^2 at any time.
- g. In case of contiguous working, where the depillaring with caving is proposed, the extraction in both the seams or sections should be in such a manner that the line of extraction in both the seams/sections should be vertically coincident up to each other and in case of any trouble in one section, persons from both the sections should be immediately withdrawn.
- h. In case of contiguous workings, the pillars in one seam / section, should be vertically above and below the pillars in the other seam or section unless the strata are inclined at an angle of more than 30° from horizontal. The parting between two seams/sections should not be less than 3.0m at any place.
- i. While working in any of the seam/sections, use of CO detector, methanometer and other safety apparatus must be ensured for safe working of the mine. The provision for safety apparatus has been made in this report. Telemonitoring system may also be used at the mine.
- j. Water spraying arrangement to suppress the dust in continuous miner is an integral part of the machine, so availability of clean water to CM must be ensured throughout the shift.
- k. The total no. of working panels may be three, and the production envisaged is 0.81MTY. So, the ventilation of the mine should be as per statute and adequacy of ventilation in each panel should be ensured. To check the adequacy of ventilation, ventilation survey for the panels/ mine should be conducted by a scientific body. The provision for ventilation survey has been made in this report.
- l. As per the geological plan of the blocks, there are too many faults. But in actual mine operation such no. of faults has not been encountered. But some minor faults have been encountered as reported by the colliery management. So, adequate precautions should be taken while working near the fault. The presence of minor slips cannot be ruled out. So adequate precautions should be taken while working.
- m. Over the leasehold property of Churi-Benti Block, too many important surface features like nala connected to Damodar River, public road power line, power trestles, Piparwar rehabilitation site, Piparwar GM office, DVC substation, etc exists over it.

Before working below it, either it should be shifted/diverted from the proposed mining area or protective pillars of adequate size considering the angle of draw of 45° of the area to be depillared should be left against such surface features so that the line of fracture due to caving should not reach to the nala or other surface features lying over the property and may not affect the surface features which needs to be protected or may cause danger for the person employed there in. Provision of filling of seasonal nala above the HFL, shifting of trestles has been made in this report.

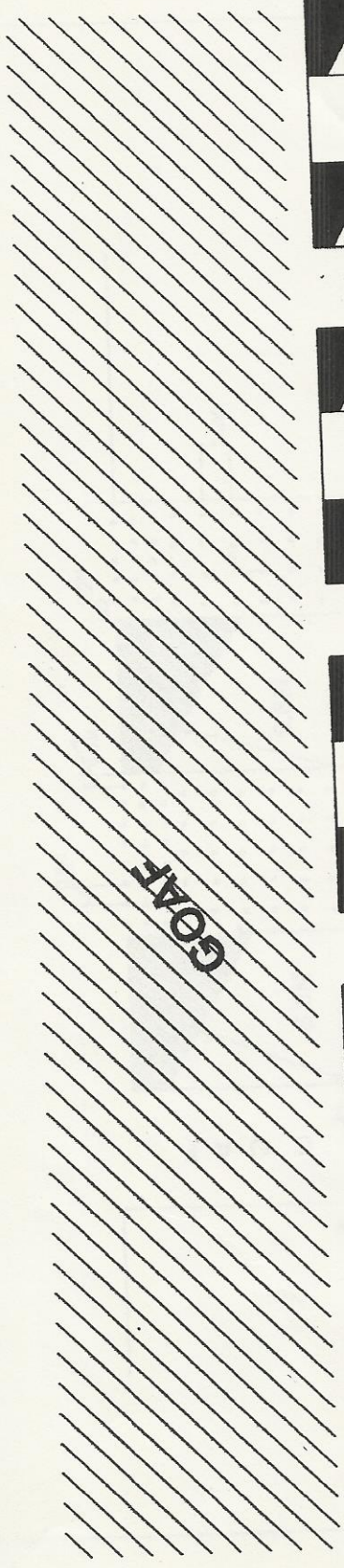
- n. No working should be conducted within 60m of HFL line without taking permission from DGMS.
- o. At present, Churi Old mine has the disused isolated working. So adequate precautions should be taken while restoring the workings in Churi old mine workings in both the seams.
- p. The mine is surrounded by Damodar river, Saphi river, workings of Ray-Bachra colliery and old abandoned working of Churi which had been worked in distant past through incline No. 2, 3, 4 & 5. So, adequate precautions should be taken while working approaches towards these old workings.
- q. While working both the sections/seams simultaneously, both the seams/sections shall be under the supervision of same overman and one experienced officer should be given for safe working of the mine. The above provisions will also be applicable for other working panels of the Churi-Benti project. Provisions for the same have been made in this report.
- r. In case of any apprehension of danger felt by the supervisor or by any other official of the mine/project, in any of the panels, the manpower should be withdrawn for the safety of the workers.
- s. Adequate precautions should be taken to avoid the danger of air blast and the provision of escape route should be made and kept maintained in the mine for safety of the mine. The persons should be trained to deal with any emergency situation, which may endanger the safety of the mine.
- t. Incubation period of coal for Churi UG is not known. It should be freshly determined so that the size of sub-panels can be decided as per the incubation period. The panel size has been envisaged in this report considering the incubation period of 9 months.
- u. As soon as the panels are exhausted it should be sealed with the approved type of isolation stoppings. The competent person to ensure any leakage from goaved out workings should conduct periodic inspection of isolation stopping as per Coal Mines Regulation, 1957. The provision of water seal should be made in these isolation stopping to prevent the accumulation of water behind the stoppings. The type of water seal should be of such type that will not allow the leakage of gases from the goaved out workings.
- v. The earlier subsidence study of Churi underground project clearly spelled out that the subsidence would reach to the surface so adequate precaution should be taken to avoid the accumulation of water over the subsided areas and any surface cracks formed due to subsidence should be effectively filled with non-combustible material.

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- w. Intrinsically safe and flameproof apparatus should be used below ground. The hydraulic fluid used by the various machines below ground should be of approved type.
 - x. Where blasting is to be done, only permitted explosives should be used and all precautions as per CMR 1957 with various DGMS Circular should be effectively complied with for the safe operation of the mine.
 - y. The working faces in each panel should be supported as per the approved SSR and if roof bolting is to be done, then full column grouting should be ensured.
 - z. Wearing of safety appliance by the workers should be ensured for the safety of the workers.
 - aa. The Incline No.1 falls within the HFL line. It is proposed to construct embankment above 3m HFL to prevent surface inrush of water.
 - bb. All the safety provisions mentioned together with statutes shall also be applicable while working in Benti Block.
 - cc. In addition to above all, such provisions of CMR 1957 and related DGMS circulars, which attracts attention while carrying out the mining operation, should be effectively complied for the safety of the mine as well as the safety of the persons employed therein.

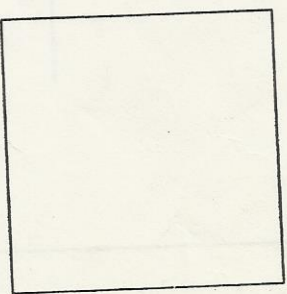
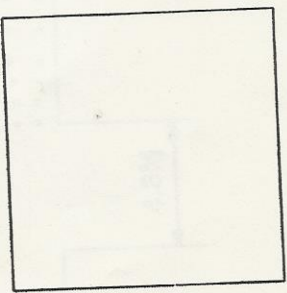
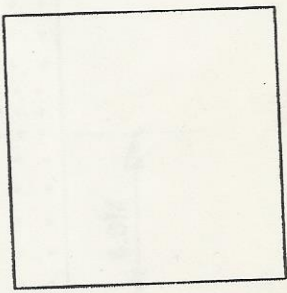
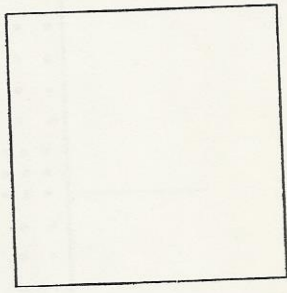
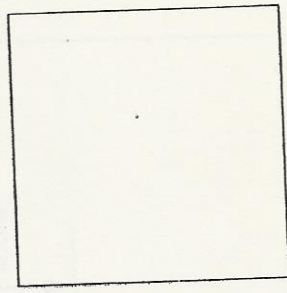
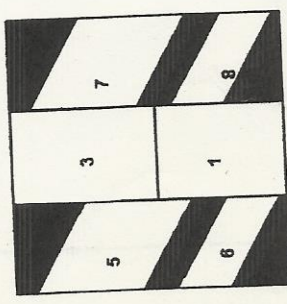
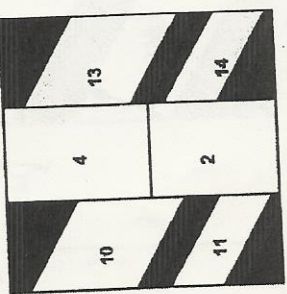
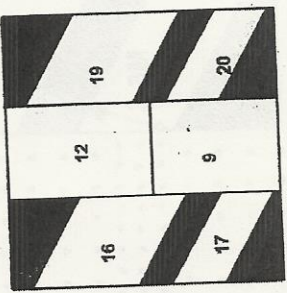
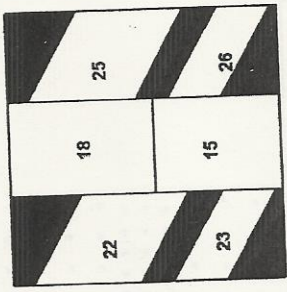
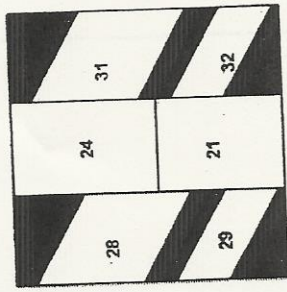
SKETCH No-1



JOB NO: 3507127



GOAT



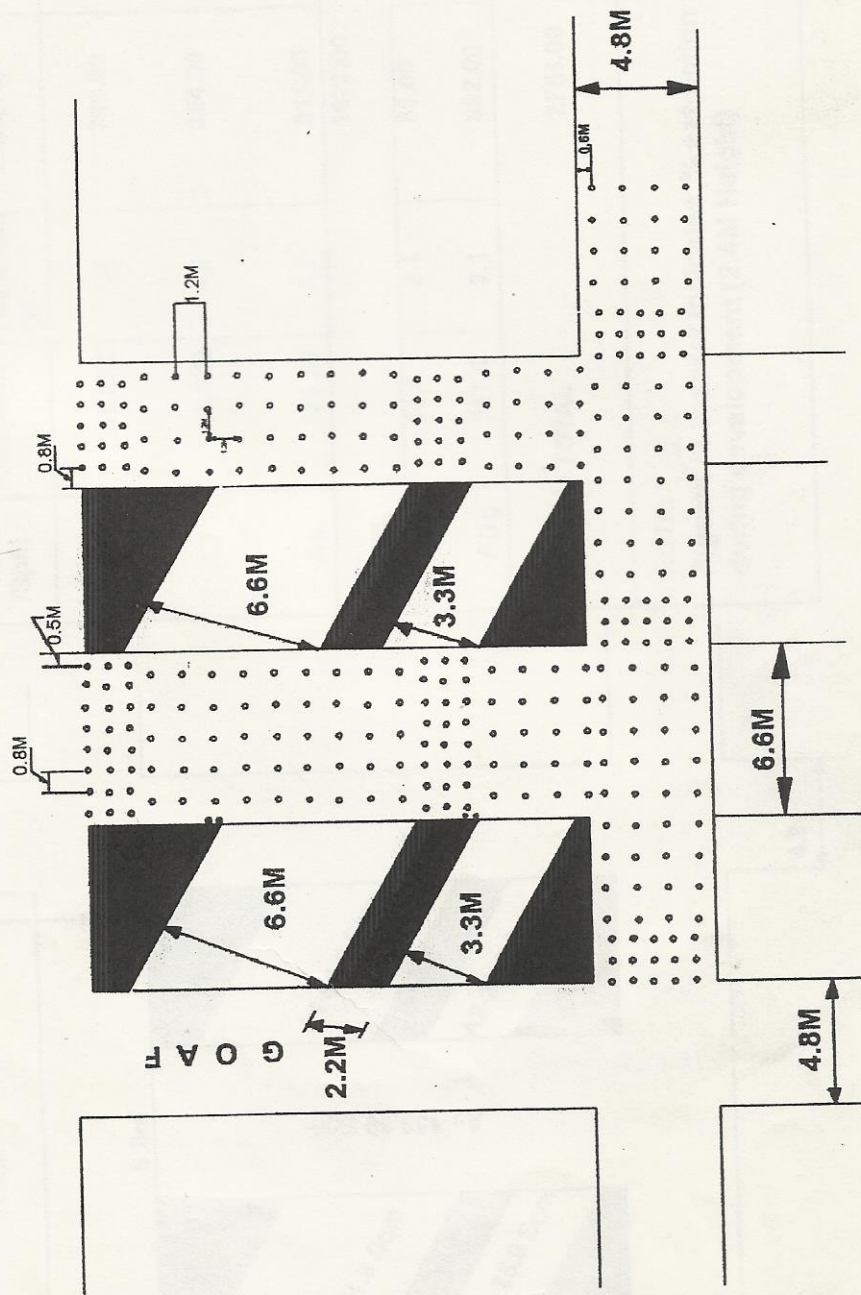
SKETCH No-2

CUTTING SEQUENCE OF PILLARS USING C.M

GOAF

GOAF

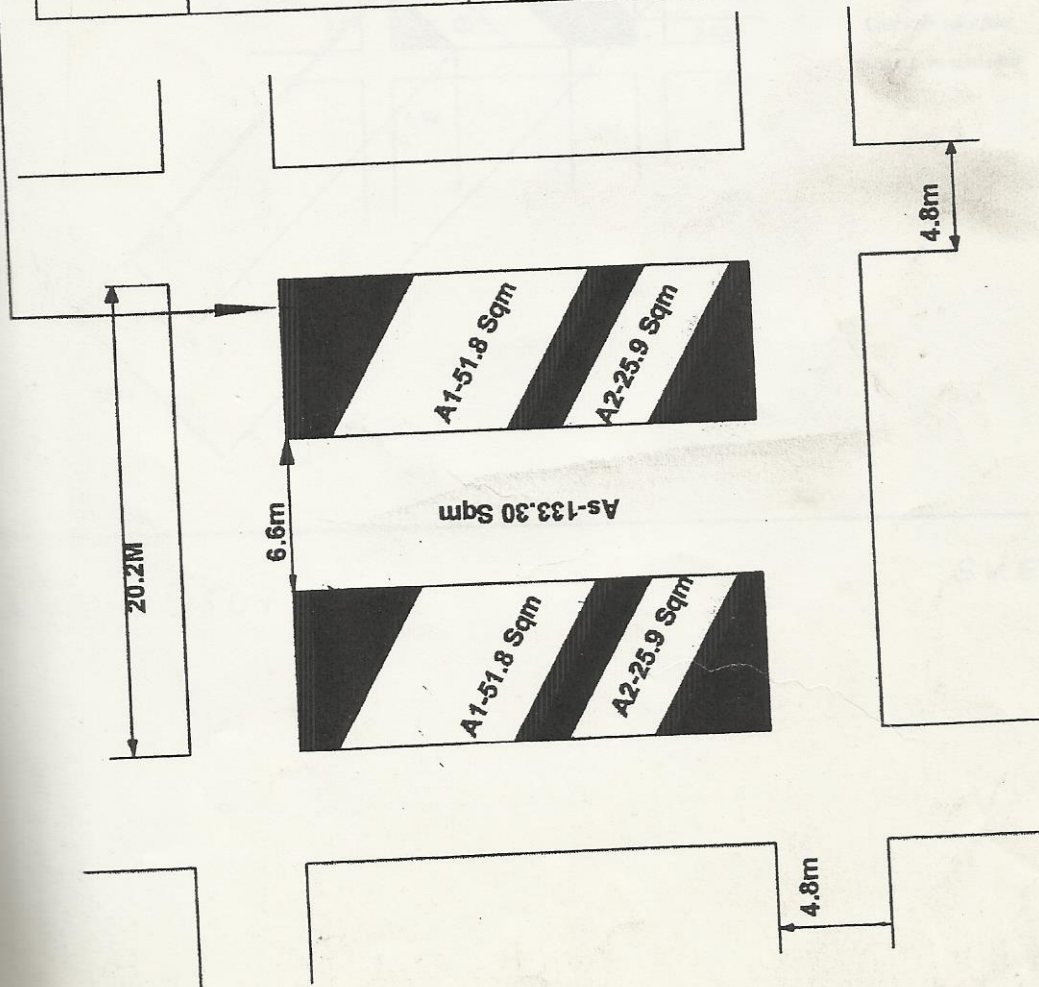
GOAF



- ROOF BOLT
- INDICATOR PROP

SYSTEMATIC SUPPORT OF A PILLAR UNDER EXTRACTION

Pillar after widening



Pocket / Split	Area(Sqm)	Thickness (M)	coal(Te)	% Extraction
A1	51.8X2	4.5	708.00	
A2	25.9X2	4.5	354.00	
As	133.30	4.5	911.00	
TOTAL			1973.00	35(47)
A(w)	24.6	2.4	89.00	
A(H)	217.0	2.1	692.00	
GRAND TOTAL			2754.00	48(61)

NOTE:
Figures in bracket indicates % extraction including coal taken during development (2.4M Height)

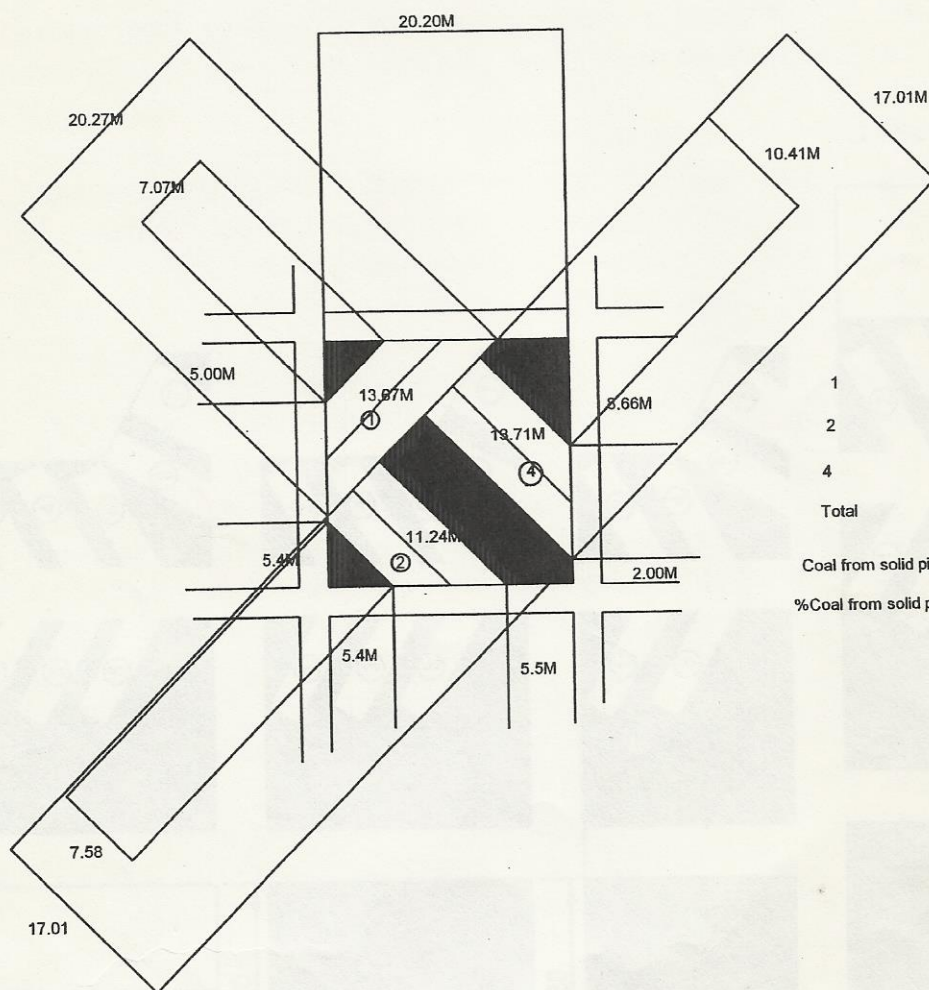
% EXTRACTION DURING DEPILLARING WITH C.M

SKETCH No-4

JOB NO: 3507127

8/28

NAVID METHOD



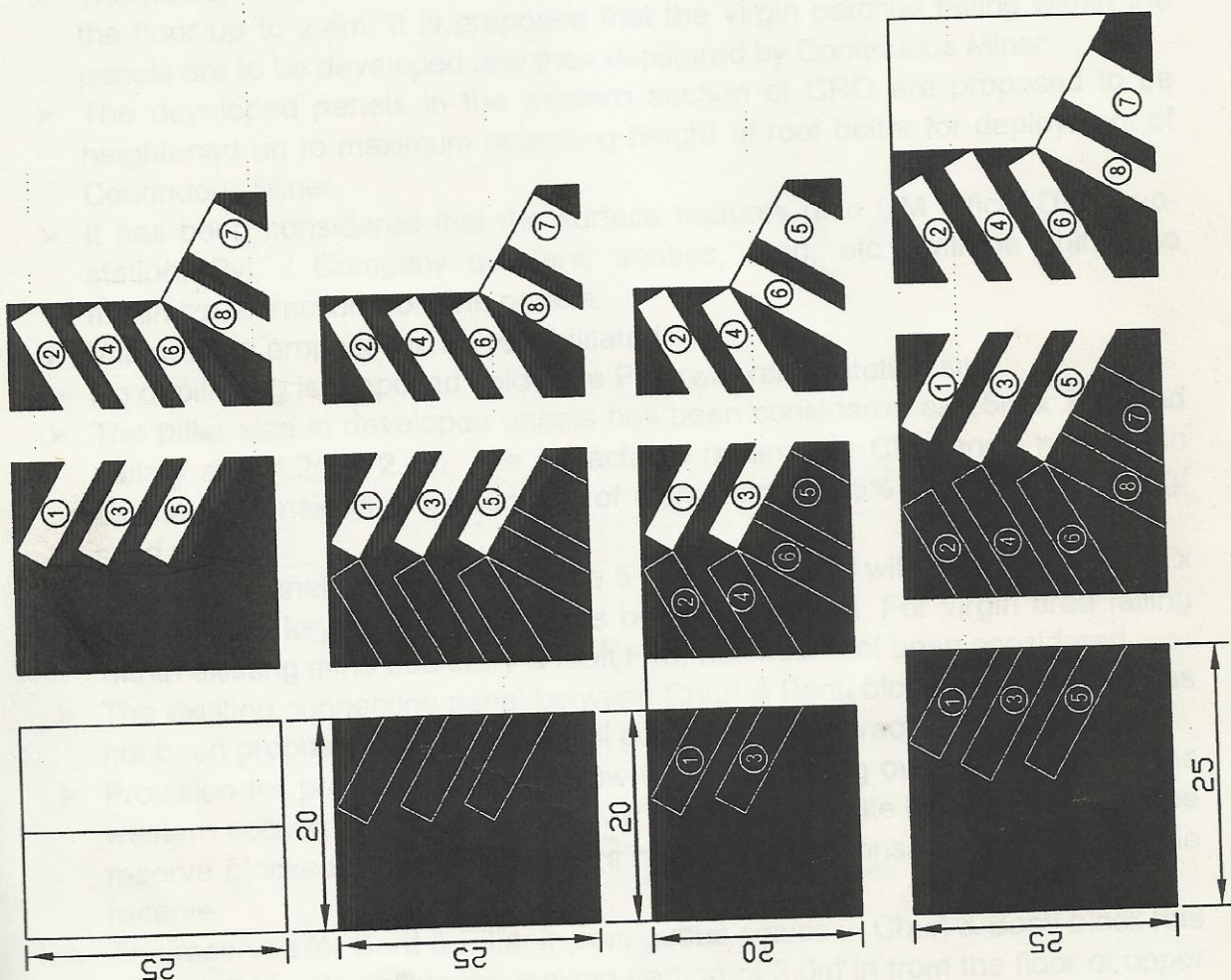
1	90.23
2	74.14
4	90.53
Total	254.9

Coal from solid pillar 408.04
 %Coal from solid pillar 62.46

JOB NO: 3507127

SKETCH NO. 5

CHRISTMAS TREE METHOD



PRODUCTION SCHEDULE

Extractable Reserves

The following points have been considered for the extractable reserves for the project:

- > In the Chud block, it has been decided to deploy Continuous Miner in the western section of CRD & panel E12 & E13, where Upper Bachra seam has unworkable thickness.
- > In Bach block, the Continuous Miner is proposed to be deployed in Bottom Lower Bachra seam/section having seam thickness > 2.0m, leaving 0.3-0.5m coal against shale roof, wherever upper seam/sections are not workable due to low thickness.

- > The western section of CRD is mostly developed in Lower Bachra seam along the floor up to 2.4m. It is proposed that the virgin coal patches in this section are to be developed and then depillared by Continuous Miner.
- > The developed panels in the western section of CRD are proposed to be depillared in to maximum seam height of 2.4m.

Continuous Miner will be deployed in the western section of CRD & panel E12 & E13, where Upper Bachra seam has unworkable thickness.

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SKETCH NO. 6

X/28

JOB NO: 3507127