

Appendix 4-1 Details of Mining Plan

Silimpon Work Schedule

Road development

	Road length	Y1		Y2		Y3		Y4		Y5		Y6		Y7		Y8		Y9		Y10		Y11		Y12		Y13		Y14		Y15		Y16		Y17		Y18		Y19		Y20		Y21		Y22	
		meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS	meter	TONS
Main & Sub slope(Rock)	324m x 2 [108 d]	445	[108d]	★ Rel (reinforce rail) road																																									
Main & Sub slope(Ceal)	1410m x 2 [392 d]	450	3.4	260	2.0			260	2.0	260	2.0			260	2.0			260	2.0			260	2.0			54	0.4	206	1.6					260	1.8					260	1.8				
West 1	630m x 2 [84 d]			1260	10.2																																								
East 1	790m x 2 [110 d]			1580	13.2																																								
West 2	840m x 2 [117 d]					1680	13.7																																						
East 2	1070m x 2 [149 d]					1815	15.4	225	1.9																																				
West 3	960m x 2 [133 d]							1920	15.8																																				
East 3	1320m x 2 [183 d]							2100	17.2	1700	13.2																																		
West 4	1330m x 2 [172 d]							1330	11.4	1090	8.7																																		
East 4	1445m x 2 [174+116d]									1261	9.1	1633	12.0																																
West 5	1455m x 2 [201 d]											1440	11.8	1470	11.8																														
East 5	1530m x 2 [425 d]													1844	13.8	1056	7.3																												
West 6	1570m x 2 [438 d]																																												
East 6	1570m x 2 [422 d]																																												
West 7	1735m x 2 [482 d]																																												
East 7	1310m x 2 [364 d]																																												
West 8	1850m x 2 [514 d]																																												
East 8	1105m x 2 [306 d]																																												
West 9	1385m x 2 [385 d]																																												
East 9	910m x 2 [253 d]																																												
East 10	700m x 2 [184 d]																																												
Total	50,188m	1123	3.6	3100	15.8	3595	28.1	3345	26.7	3310	26.6	2341	17.8	3339	25.6	3416	25.6	2421	17.7	3601	26.7	2543	17.1	1800	12.9	1800	12.1	1745	10.8	1556	11.1	1800	12.2	1803	12.8	1611	8.0	2448	12.0	2631	10.8	2048	11.9	224	1.2

Working Face (East colliery)

		Y1		Y2		Y3		Y4		Y5		Y6		Y7		Y8		Y9		Y10		Y11		Y12		Y13		Y14		Y15		Y16		Y17		Y18		Y19		Total Tons
		days	tons	days	tons	days	tons	days	tons	days	tons	days	tons	days	tons	days	tons	days	tons	days	tons	days	tons	days	tons	days	tons	days	tons	days	tons	days	tons	days	tons	days	tons			
No. 1	52,067			(1440)	52,067																																	52,067		
No. 2 West	42,959			(1250)	42,959	(180)	4,167																															42,959		
No. 2 East	66,334					(1620)	66,334																															66,334		
No. 3 West	65,702					(530)	19,892	(1120)	46,410																													65,702		
No. 3 East	84,655							(1120)	44,438	(1110)	40,247																											84,655		
No. 4 West	84,823								(1320)	56,818	(910)	29,417																											84,823	
No. 4 East	56,226									(1540)	56,226																											56,226		
No. 5 West	111,820									(40)	4,456	(1560)	51,000	(530)	19,384																							111,820		
No. 5 East	41,064														(1120)	41,064																					41,064			
W/P Total	605,850				60,850		81,892		50,818		80,813		51,798		81,000		80,426																					605,850		
East Colliery Production Total		16,850		102,814		111,892		108,838		109,981		118,828		81,000		80,426																						718,310		
		Y1		Y2		Y3		Y4		Y5		Y6		Y7		Y8		Y9		Y10		Y11		Y12		Y13		Y14		Y15		Y16		Y17		Y18		Y19		

Appendix 4-2 Basis of Cost Estimate

Cost Estimation at Silimpoon

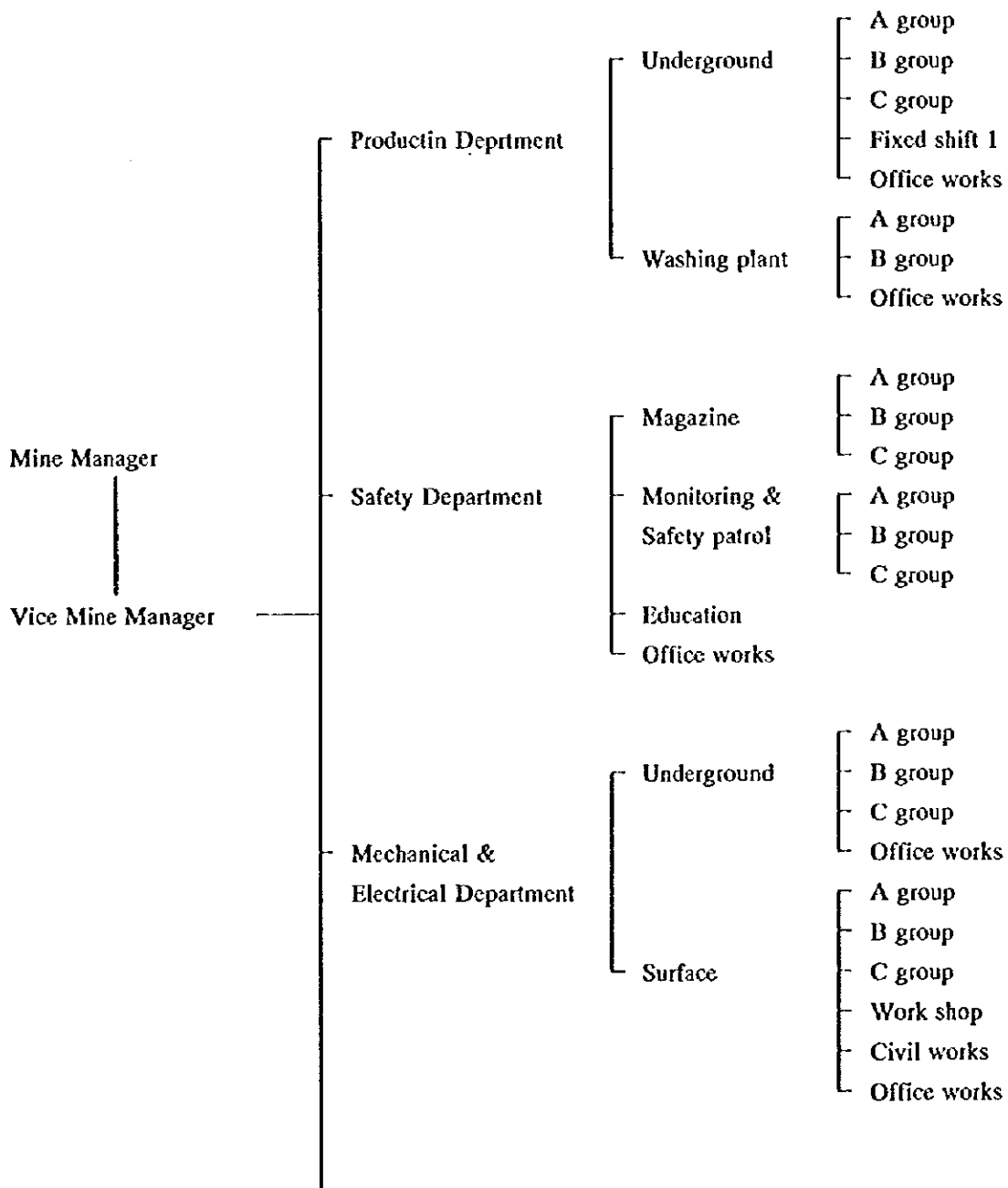
1. Working days and operating shift

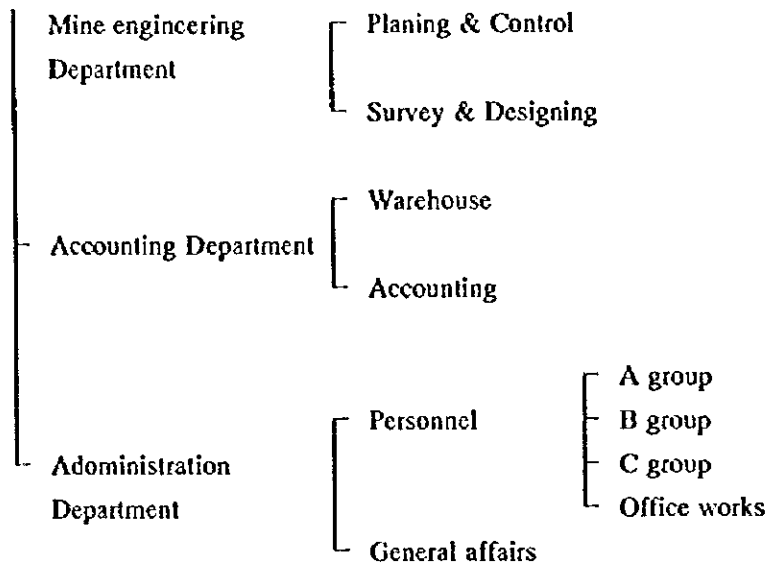
Working days per week is 5 days .

$$\begin{aligned} \text{Annual working days} &= [52 \text{ weeks / year}] \times [5 \text{ days / week}] - \text{public holidays} \\ &= 52 \times 5 - 10 = \underline{250 \text{ days / year}} \end{aligned}$$

One working day is divided 3 shifts . One shift is 8 operating hours .

2. Organization at mine site





2. Numbers of Personnel

2-1. Production department

(1) Underground

Coal production mainly consists of 1 face of long wall mining , 2 faces of road development and its operation is done by 3 shifts (A , B , C group).

Average attendance ratio of these direct produvtnon group is estimated 85 % through 3 shifts .

① workers at long wall mining (required & registered) per shift

	required	registered
Making holls & blasting works	4	
Expanding rink bars & standing hydraulic props	4	
Shoveling & moving chain conveyor	4	
Removing hydraulic props at 3rd row	6	
Making stable room and other works	4	
Checker for rik bars & hydraulic props	1	
Subtotal	23	27

② One driving face needs 5 workers . In this study there are regularly 2 driving faces . Therefore 10 workers are required per shift and 12 registered workers are necessary per shift .

③ To maintain roads , to prepare and do various works , for these purpose 8 workers are required per shift . Average attendance ratio of these workers is estimated

90 % per shift . Therefore 9 registered workers are necessary per shift .

- ④ To transport coal , rock , materials and so on , battery locomotives & mine cars are introduced at horizontal rail roads . Basically one battery locomotive at upper level road and two battery locomotives at lower level road are used . One battery locomotive is run by operator and conductor . Therefore 6 workers are required per shift . Then 2 conductors are required at slope transportation . So for horizontal and slope transportation 8 workers are required per shift at underground works . Additionally at surface one battery locomotive is used for various works and one operator , one conductor and one helper are necessary per shift . Total transportation workers are 11 . Average attendance ratio of these workers is estimated 90 % per shift . So 12 registered workers are necessary per shift .

	required	registered
U/G horizontal rail road	6	
Slope conductors	2	
Surface	3	
Subtotal	11	12

- ⑤ Fixed shift 1 group is necessary to do important works using skilled worker .

(2) Washing plant

At least a baum jig and hand picking system is introduced . When input capacity of the jig is 60 tons/hour and input capacity of hand piking is 15 tons/hour , total input capacity per day is a next equation . $(60 + 15) \text{ tons/hour} \times 6 \text{ hours/shift} \times 2 \text{ shifts/day} = 900 \text{ tons/day}$. Therefore 2 shifts/day operation has enough capacity . 12 workers for handpicking and 6 workers for various operators are required per shift . Therefore 18 workers are necessary per shift . Average attendance ratio of these workers is estimated 90 % per shift . So 20 registered workers are necessary per shift .

Number of workers for Production department

		required workers				registered workers			
		shift 1	shift 2	shift 3	subtotal	shift 1	shift 2	shift 3	subtotal
U/G	L/W , B&P	23	23	23	69	27	27	27	81
	Headings	10	10	10	30	12	12	12	36
	Maintenance	8	8	8	24	9	9	9	27
	Transportation	11	11	11	33	12	12	12	36
	Fixed shift 1	8			8	9			9
	Office works	2			2	2			2
	Subtotal	62	52	52	166	71	60	60	191
W/P	Hand picking	12	12		24	13	13		26
	Operaters	6	6		12	7	7		14
	Subtotal	18	18		36	20	20		40
Production Dcp total		80	70	52	202	91	80	60	231

Number of staff for Production department (registered)

		shift 1	shift 2	shift 3	subtotal	
Depatment head		1			1	
U/G	Superintended	1			1	
	Section chief	1			1	
	Group chief	1	1	1	3	
	General staff	L/W	3	3	3	9
		Heading	2	2	2	6
		Maintenance	2	2	2	6
		Transportation	2	2	2	6
		Fixed shift 1	1			1
U/G subtotal		13	10	10	33	
W/P	Superintended	1			1	
	Group chief	1	1		2	
	General staff	2	2		4	
	W/P subtotal	4	3		7	
Production department total		18	13	10	41	

Number of registered personnel for Production department

	shift 1	shift 2	shift 3	subtotal
Workers	91	80	60	231
Staff	18	13	10	41
Production department total	109	93	70	272

2-2. Safety department (number of resistered personnel)

		shift 1	shift 2	shift 3	subtotal	
Staff	Department head	1			1	
	Superintended	1			1	
	Group chief	1	1	1	3	
	General staff	Magazine	2	2	2	6
		Monitor & patrol	1	1	1	3
		Education	2			2
	Subtotal		8	4	4	16
Workers	Patrol	2	2	2	6	
	Office work	1			1	
	Subtotal		3	2	2	7
Safety department total		11	6	6	23	

2-3. Mechanical & electrical department (number of registered personnel)

		shift 1	shift 2	shift 3	subtotal		
Department head		1			1		
U/G	Staff	Superintended	1			1	
		Section chief	1			1	
		Group chief	1	1	1	3	
		General staff	Mechanical	1	1	1	3
			Electrical	1	1	1	3
		Staff subtotal		5	3	3	11
	Workers	Mechanical (including winding operator)		6	6	6	18
		Electrical		2	2	2	6
		Fixed shift 1 (Mechanical & Electrical)		3			3
		Office works		1			1
workers subtotal		12	8	8	28		
U/G subtotal		17	11	11	39		
Sur-face	Staff	Superintended	1			1	
		Section chief	1			1	
		Group chief	1	1	1	3	
		General staff	3 shifts	1	1	1	3
			Work shop	2			2
			Civit works	1			1
	Staff subtotal		7	2	2	11	
	Workers	3 shift		3	3	3	9
Workshop		6			6		

	Civil work (including road maintenance)	6			6
	Office works	1			1
	Worker subtotal	16	3	3	22
	Surface subtotal	22	5	5	32
Mechanic & electrical department	Staff	13	5	5	23
	Workers	28	11	11	50
	total	40	16	16	73

2-4. Mine engineering department (number of personnel)

Staff	Department head		1
	Planing & control	Section chief	1
		General staff	2
		Subtotal	3
	Survey & designing	Section chief	1
		General staff	2
		Subtotal	3
Staff subtotal		7	
Workers	Survey & designing	6	
Mine engineering department total		13	

2-5. Accounting department

Staff	Department head		1
	Superintendent		1
	Warehouse	Section chief	1
		General staff	1
	Accounting	Section chief	1
		General staff	4
	Staff subtotal		9
Workers	Warehouse		4
	Accounting		8
	Workers subtotal		12
Accounting department total		21	

2-6. Adomistration department

		shift 1	shift 2	shift 3	subtotal	
Staff	Department head	1			1	
	Superintendent	1			1	
	Personnel	Section chief	1			1
		General staff (3 shift)	1	1	1	3
		General staff	2			2
		Policlinic	1	1	1	3
	Personnel subtotal		5	2	2	9
	General affairs	Section chief	1			1
		General staff	2			2
		General affairs subtotal		3		
Staff subtotal		8	2	2	12	
Workers	Personnel	Driver & helper	6	6	6	18
		Security guard	4	4	4	12
		Policlinic , other	2	2	2	6
		Office works	2			2
	Personnel subtotal		14	12	12	38
	General affairs		2			2
Workers subtotal		16	12	12	40	
Adomistration total		24	14	14	52	

2-7. Classified personnel

	Manager	Production	Safety	Mec/Ele	Mn/Eng	Account	Adomini	Subtotal
Manager/Vice	2							2
Department head		1	1	1	1	1	1	6
Superintended		2	1	2		1	1	7
Section chief		1		2	2	2	2	9
Group chief		5	3	6				14
General staff		32	11	12	4	5	8	72
Staff subtotal	2	41	16	23	7	9	12	110
Workers		231	7	50	6	12	40	346
	2	272	23	73	13	21	52	456

2-8. Labor cost

This is referred to Mamut Copper Mining .

Overtime , welfare and other cost is calculated as 20 % of basic salary .

	Salary scale/month/peson	Number	1000US\$/year
Manager & Vice	Supervisory G15 A&B (1355+1195)/2/3.8=336\$	2	9,676
Department head	Supervisory G13 A&B (1245+1045)/2/3.8=301\$	6	26,006
Superintendent	Supervisory G11 A&B (1140+1000)/2/3.8=282\$	7	28,426
Section chief	Supervisory G9 A&B (1040+910)/2/3.8=257\$	9	33,307
Group chief	Supervisory G7 A&B (950+830)/2/3.8=234\$	14	47,174
General staff	Supervisory G5 A&B (865+755)/2/3.8=213\$	72	220,838
Worker	Production G5 I II III (630+495+400)/3/3.8=134\$	346	667,642
Total			1,033,069

3. Work shedule

3-1. Basic rule for work schedule

(1) Road development

In order to simplify a work shedule , total length of inseam-road at mining panel is included length of working face , then it is devided tow . This number is length of upper and lower road respectively .

Connection roads , winzs and other are made by a fixed shift-1 team and maintenance teams . And coal production of these roads is not count to simplify the study .

From 1st to 5th year number of teams of road development is 2 teams/shift .

From 6th to middle of 11th year number of teams of road development is 1 ~ 2 teams/shift

From middle of 11th to the final year number of team of road development is 1 team/shift

① Main and Submain slope in rock \Rightarrow 1 m/shift/slope , 3 m/day/slope

② Main and Submain slope in coal \Rightarrow 1.2 m/shift/slope , 3.6 m/day/slope

③ Inseam road \Rightarrow 2.4 m/shift/road , 7.2 m/day/road

(2) L/W

Coal production from L/W using hydraulic props and rink bars depends on number of hydraulic props which are removed . One team can remove 50 hydraulic props/shift . In this study there are 2 teams , so 100 hydraulic props/shift are removed . This means that 60 m/shif can be mined and 180 m/day , because

distance between hydraulic plops is 0.6 m.

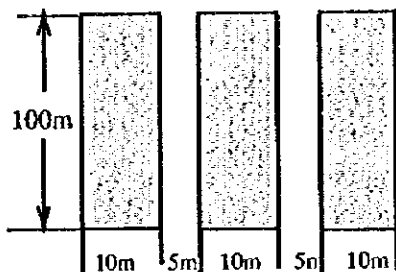
Advancing meters of L/W is showned the next .

$$180 \text{ m/day} \div 100 \text{ m/cycle} = 1.8 \text{ cycle/day} , 1.8 \text{ cycle/day} \times 1.2 \text{ m/cycle} = \underline{2.16 \text{ m/day}} .$$

★ From 11th to 22th year at other mining panel , L/W is operated 1shift/day and it advances 0.72 m/day .

★ After road development finishes , from 22th year additional mining operation is 2 shift/day and it advances 1.44 m/day .

(3) Board & Pillar



At mining panel 10 m wide safety pillar is remained and 5 m width is mined , so mining ratio is 1/3 .

A L/W team devides into 4 teams/shift and each team works at 4 faces .

One face advances 3.6 m/shift and 10.8 m/day , 4 faces advance 43.2 m/day [regular teams] .

[Additional teams]

In 6th and 9th year 1 team/shift (3 teams/day) is moved from road development to Board & Pillar to avarage annual production . In this cace advancing ratio is 10.8 m/day .

From 11th to 22th year 4 teams/day is adopted . In this cace advancing ratio is 3.6m \times 4shift/day = 14.4 m/day .

(4) Production shedule (\times 1000 tons)

Year	1	2	3	4	5	6	7	8
Production	3.6	107.2	163.4	162.1	160.5	165.5	166.1	152.1

Year	9	10	11	12	13	14	15	16
Production	152.6	156.7	169.4	162.7	176.0	155.1	161.7	171.7

Year	17	18	19	20	21	22	23	24
Prodtion	172.0	155.9	156.4	160.8	159.4	173.6	164.2	130.3

4. Investment

4-1. Parmanent facilities and others at surface (US\$)

	Facility and equipment	Number	Unit price	Total	Memo
1	Access road and preparation work			300,000	
2	Office , shower roon and so on	1	300\$/m ²	300,000	1000 m ² , 1/3 of Japan
3	Warehouse	1	300\$/m ²	150,000	500 m ² , 1/3 of Japan
4	Explosives magazine	1	300\$/m ²	60,000	200 m ² , 1/3 of Japan
5	Workshop	1		400,000	including implements
6	Air compressor	1	250,000	500,000	300HP × 2
7	Washing plant	one set		600,000	Jig , conveyor , pumps
8	Main fan	1	150,000	150,000	200HP
9	Main winding machine	1	600,000	600,000	300 ~ 400HP
10	Submain main winding machine	1	100,000	100,000	50 ~ 100HP
11	Clean water plant	one set		100,000	
	Subtotal			3,260,000	
12	Others			652,000	20 % of Subtotal
	Total			3,912,000	

4-2. Transportation and other equipment at surface (US\$)

	Facility and equipment	Number	Unit price	Total	Memo
1	Commuter bus	2	100,000	200,000	Life time 8 years
2	Service truck	2	30,000	60,000	Life time 8 years
3	Patrol car	1	40,000	40,000	Life time 8 years
4	Bulldozer (D-85)	1	350,000	350,000	Life time 10 years
5	Frontend loader (WA-350)	1	200,000	200,000	Life time 10 years
6	Grader	1	150,000	150,000	Life time 10 years
	Total			1,000,000	

4-3. Safety equipment in U/G (US\$)

	Facility and equipment	Number	Unit price	Total	Memo
1	Safety lamp (YL2000)	300	500	150,000	Life time 5 years
	Lamp charger (YL-5240-40)	8	12,000	96,000	
2	CO Mask	300	115	34,500	Life time 3 years
3	Dust Mask	300	30	9,000	Life time 3 years
4	Methan detector (Toka)	70	1,360	95,200	
	Methan detector (Toka 100 %)	6	1,360	8,160	
5	Oxygen measure (GO-25KS)	6	2,100	12,600	
6	CO detector	6	1,400	8,400	
7	Oxygen breathing apparatus	30	12,000	360,000	Rescure team
8	Radio communicatin system	one set		70,000	

9	U/G telephone system	one set		50,000	
	Total			893,860	

4-4. U/G main transportation (US\$)

	Facility and equipment	Number	Unit price	Total	Memo
1	Mine car (2 m ³)	200	5,000	100,000	
2	Flat car	10	5,000	50,000	
3	Menride slope train	one set		200,000	
4	Battery locomotive	4	200,000	800,000	
				1,150,000	

4-5. U/G road development and Board & Pillar

	Facility and equipment	Number	Unit price	Total	Memo
1	Side-dumping loader (ME632)	3	250,000	750,000	Life time 10 years
2	Side-dumping loader (ME612)	6	150,000	900,000	Life time 10 years
3	Chain conveyor	8	50,000	400,000	Life time 10 years
4	Hydraulic prop (internal pump)	1,250	700	875,000	Life time 10 years
5	Electric winch (30 HP)	4	40,000	160,000	
6	Local fan	10	25,000	250,000	
7	Air Auger	12	2,000	24,000	Life time 2 years
8	Rock hammer	6	3,000	18,000	Life time 2 years
9	Coal pick	12	1,000	12,000	Life time 2 years
10	Small pump	20	2,000	40,000	Life time 2 years
	Total			3,429,000	

4-6. U/G Long wall (US\$)

	Facility and equipment	Number	Unit price	Total	Memo
1	Hydraulic prop	1,000	500	500,000	Life time 5 years
2	Rink bar	1,000	100	100,000	Life time 5 years
3	High-pressure pump	2	50,000	100,000	Life time 10 years
4	Face conveyor	2	70,000	140,000	Life time 10 years
5	Chain conveyor	2	50,000	100,000	Life time 10 years
6	Air auger	8	2,000	16,000	Life time 2 years
7	Coal pick	8	1,000	8,000	Life time 2 years
	Total			964,000	

4-7. U/G Others

	Facility and equipment	Number	Unit price	Total	Memo
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1	Fixed drainage pump	2	30,000	60,000	Life time 10 years
2	Small back-hoe (for maintenance)	3	50,000	150,000	Life time 10 years
3	Survey Implement	one set		50,000	
				260,000	

4-8. First investment

1	Parmanent facilities and others at surface	3,912,000
2	Transportation and other equipment at surface	1,000,000
3	Safety equipment	893,000
4	U/G main transportation	1,150,000
5	U/G road development and Board & Pillar	3,429,000
6	U/G Long wall	964,000
7	U/G others	260,000
		11,608,000

5. Consumables

5-1. Electricity (Industrial Class 2)

Installed capacity is 1500kw and its working ratio is supposed 60 % .

① At working days : $250 \times 24 \times 900\text{kw} \times 0.23 \text{ RM} \div 3.8\text{RM}/\$ = 326,842 \text{ US\$/year}$

② At holidays : $150 \times 24 \times 300\text{kw} \times 0.32 \text{ RM} \div 3.8\text{RM}/\$ = 65,368 \text{ US\$/year}$

392,210 US\$/year

5-2. Materials for road development US\$ / meter

	Number	Unit price	total	Memo
Steel support	one set		150	3 pieces (beam \times 1 , leg \times 2)
Bracing wood	10	0.8	8.0	6" \times 6" 3.5 RM/Ft divided 4 pieces
Wood plate	18	0.5	9.0	6" \times 6" 3.5 RM/Ft divided 6 pieces
Tention bar	10	0.2	2.0	
Detonator cap	40 / 30	1.5	60 / 45	Rock / Coal
Explosive	80 / 50	1.0	80 / 50	Rock / Coal
Slipper wood	2	8.9	17.8	
Rail		20.0	20.0	22.7 kg/m
Air pipe	1	7.9	7.9	excluding valves
Water pipe	1	3.3	3.3	excluding valves
Drainage pipe	1	3.3	3.3	
Power cable	1	80	80	
Others			10	hoses , tamping materials , etc
			451.3 / 406.3	Rock / Coal

From 6th year material cost of in seam road is 50 % and 20 % of above mentioned table excluding exclusives and wood materials. Because these materials can be recoverable .

$$406.3 - (150 + 20 + 7.7 + 3.3 + 3.3) \times 0.5 + 80 \times 0.8 = \underline{250.2 \text{ US\$ / meter}}$$

5-3. Materials for Board & Pillar US\$ / meter

	Number	Unit price	total	Memo
Wood plate	10	0.5	5.0	
Detonator cap	20	1.5	30.0	
Explosive	20	1.0	20.0	
Others			5.0	Air hose , water hose ,etc
Total			60.0	

5-4. Materials for Longwall US\$ / ton

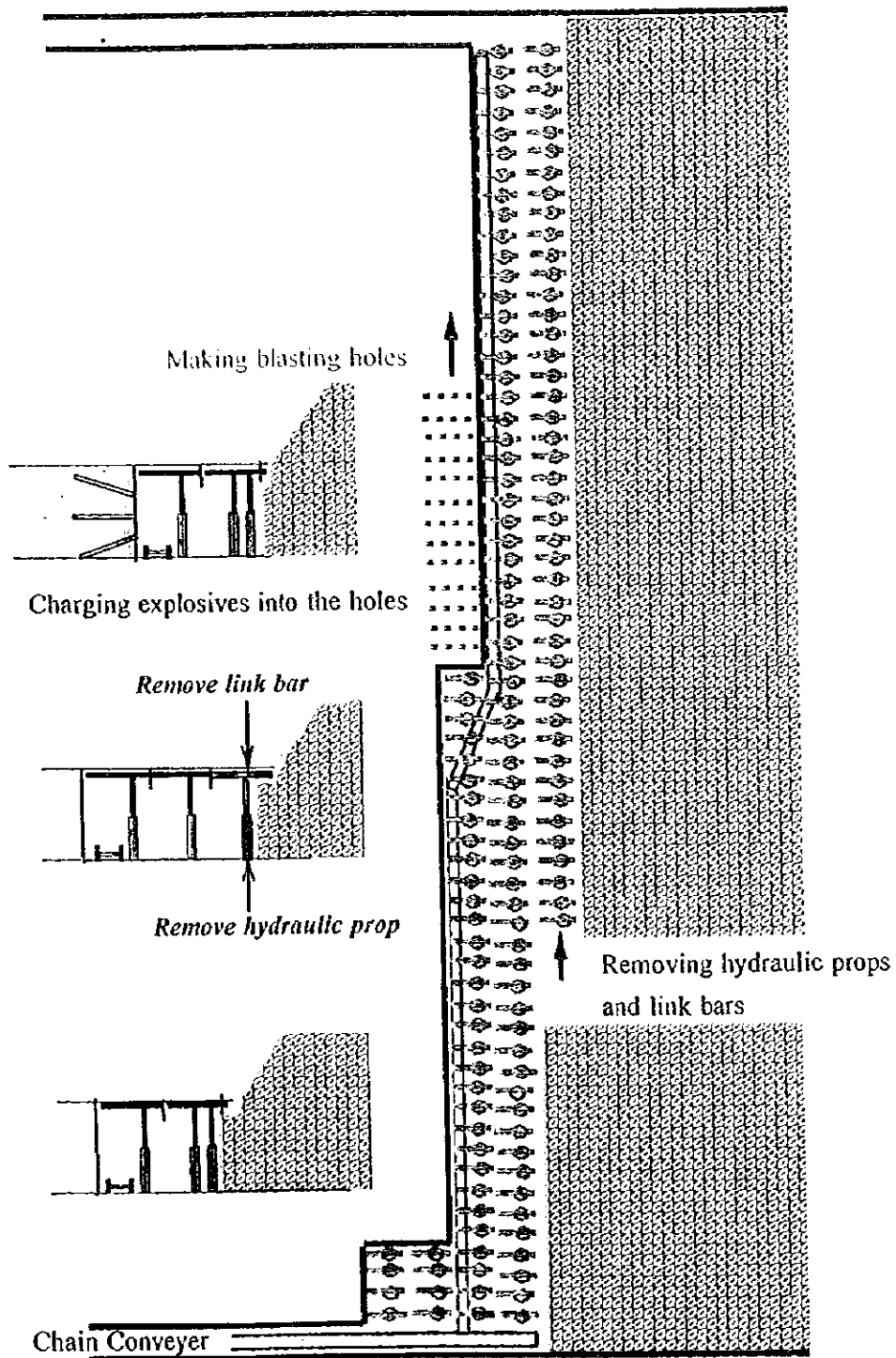
	Number	Unit price	total	Memo
Wood plate	1	0.5	0.5	
Bamboo net	1	0.5	0.5	
Detonator cap	1	1.5	1.5	
Explosive	1	1.0	1.0	
Others		0.5	0.5	Air hose , water hose ,etc
Total			4.0	

Appendix 4-3 Illustration of Mining Method

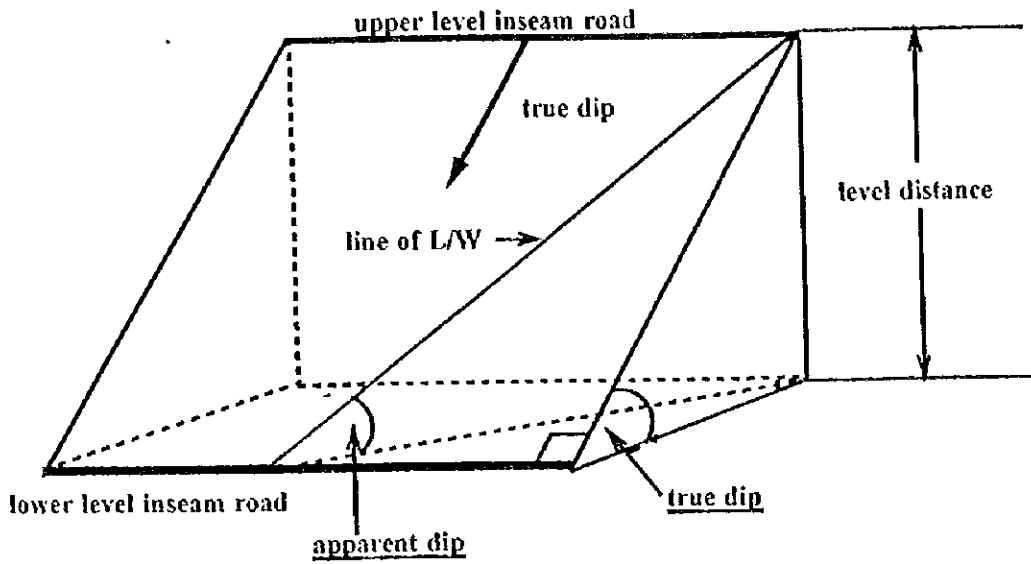
Working Sequence of L/W using Hydraulic props and Blasting

1. Before Blasting

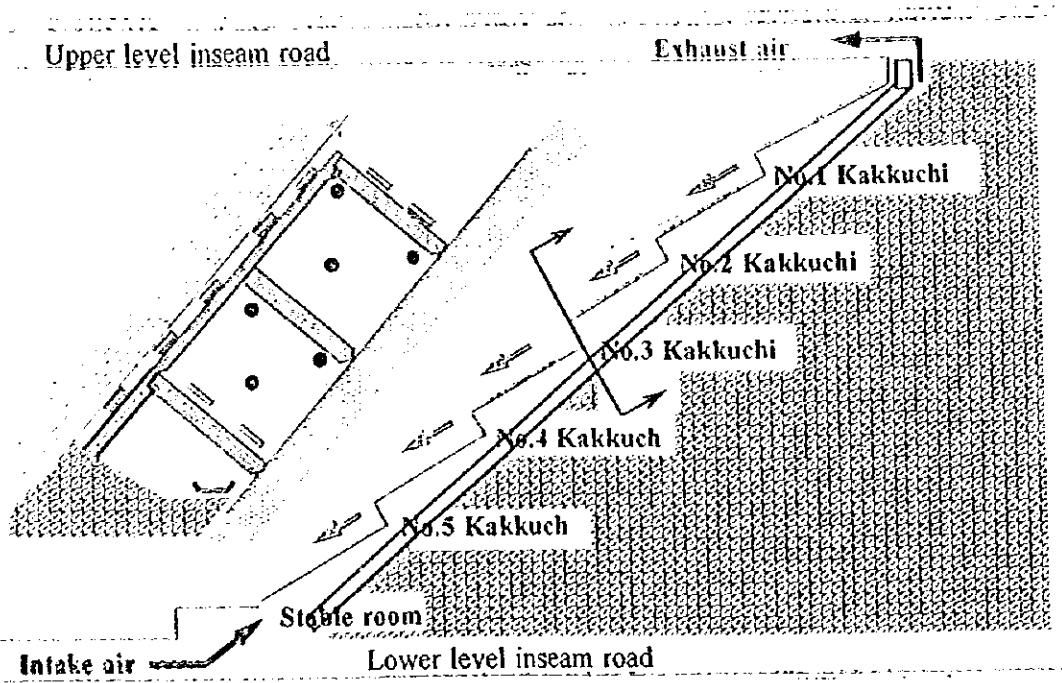
Blasting holes are made and explosives are charged into the holes.



Conception of Kakkuchi mining



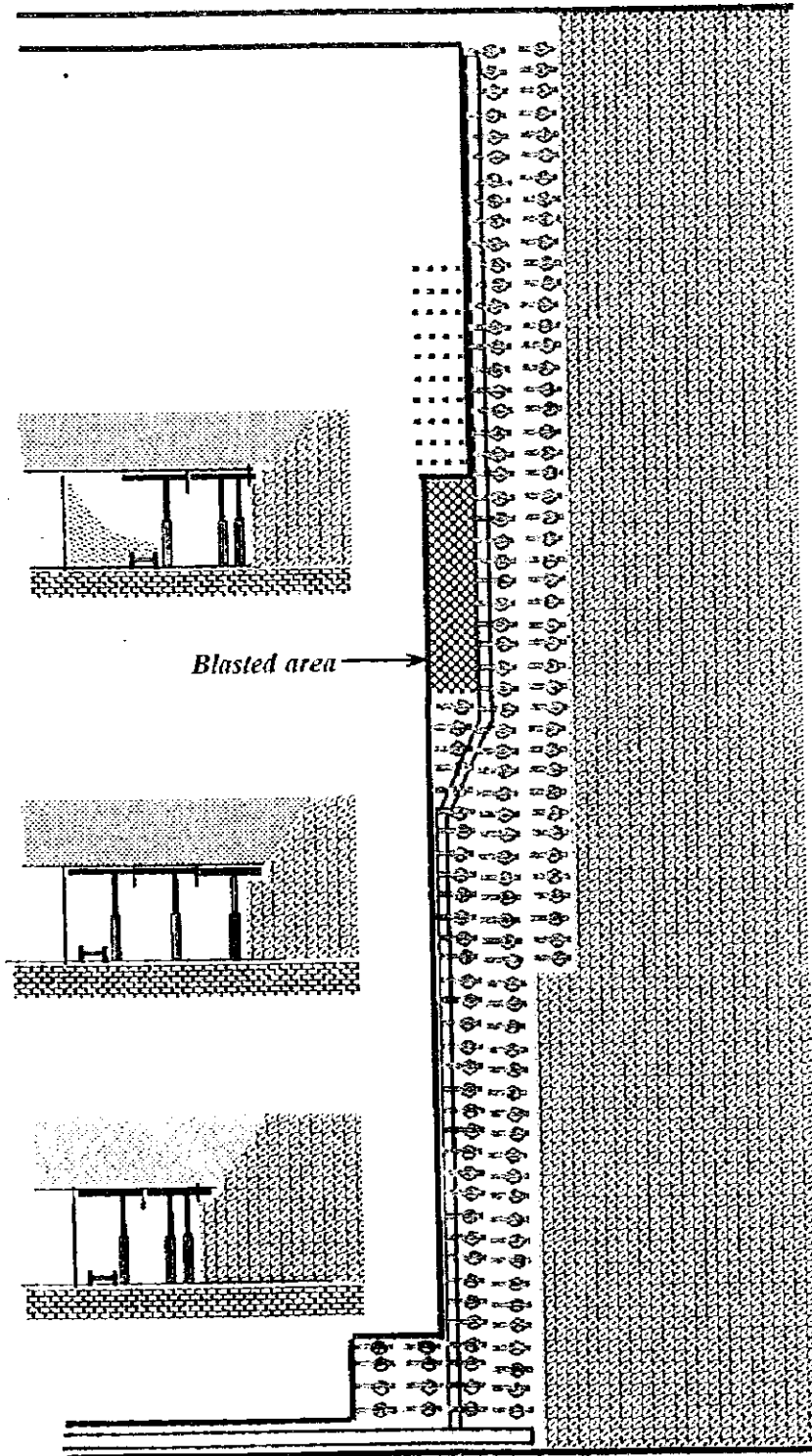
General layout of Kakkuchi L/W



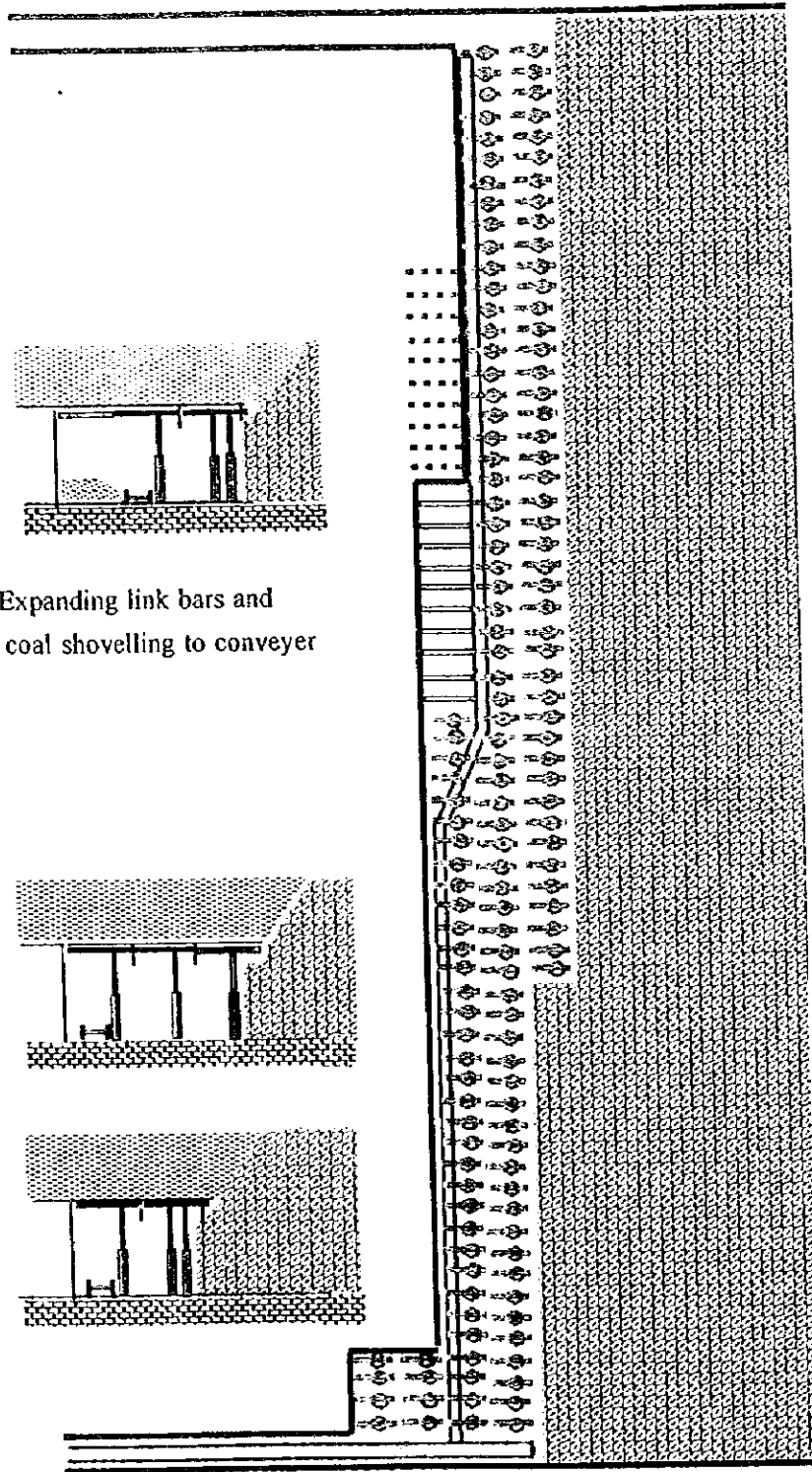
○ : Blasting hole ——— : Plastic (or steel) trough

2. Blasting

After checking safety , blasting is done .

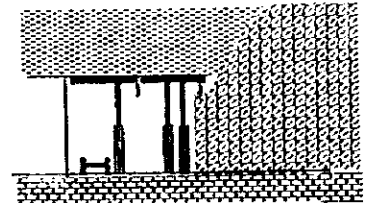
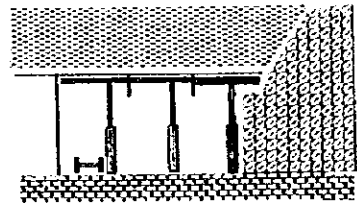
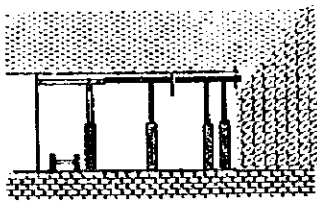


3. Link bars are expanded immediately after blasting to prevent roof falling .
Cutout coal is loaded into the chain conveyer .

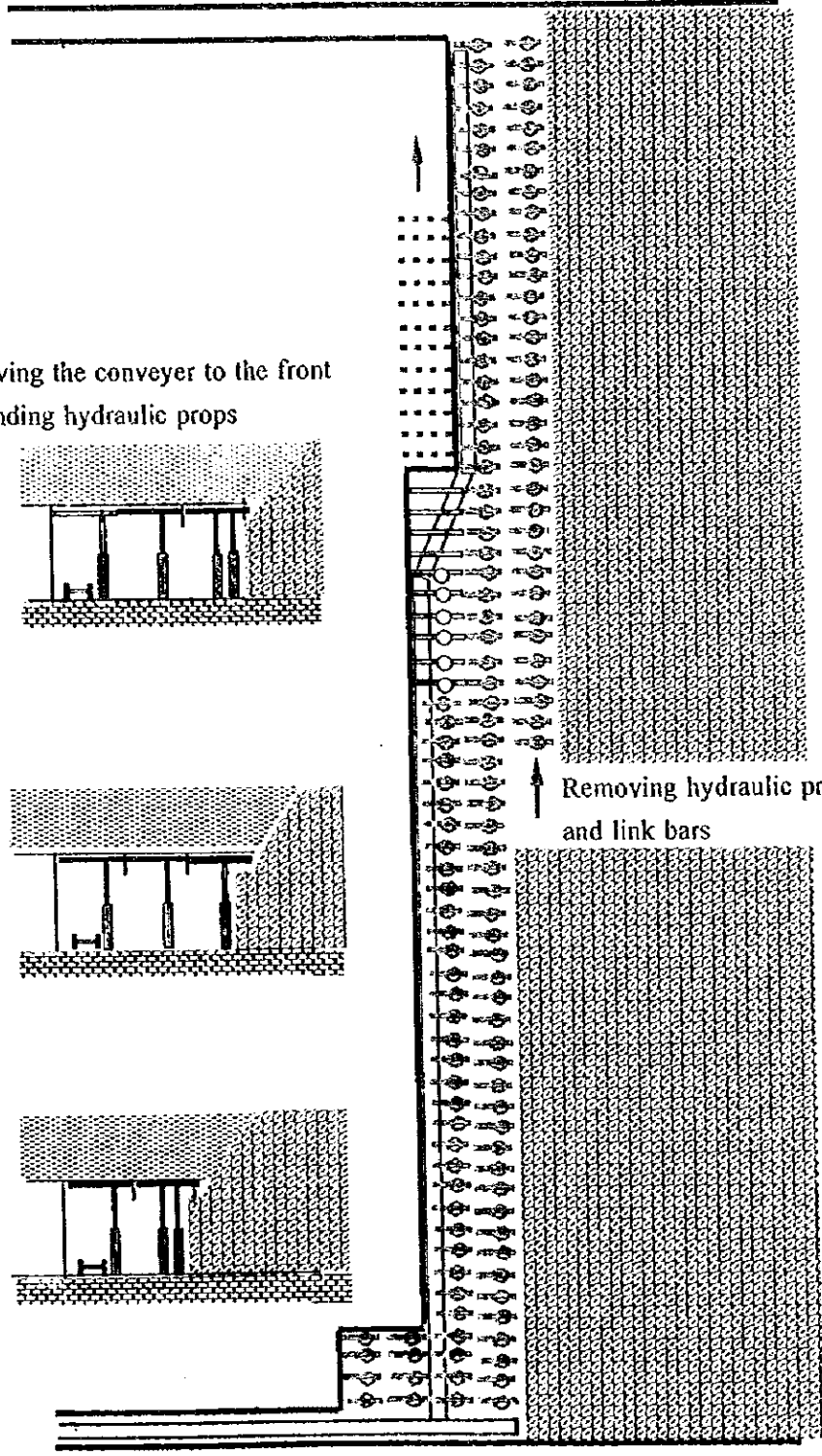


Expanding link bars and
coal shovelling to conveyer

Moving the conveyer to the front
Standing hydraulic props



Removing hydraulic props
and link bars



Appendix 5

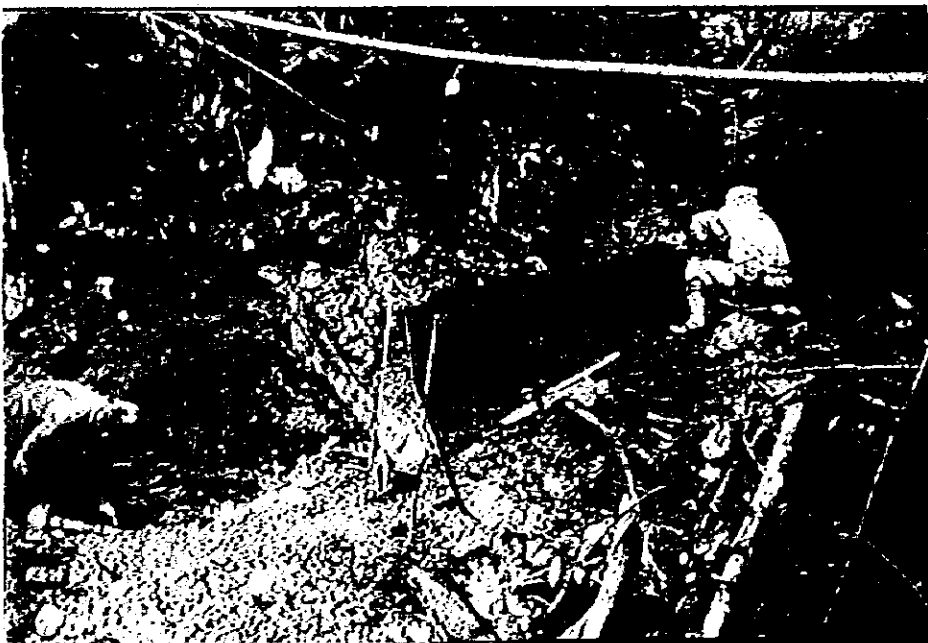
Photographs



Geological mapping



Coal outcrop (YK001
1.16m on BD route in
Sesui West Area)



Observing and logging
of coal outcrop (NK141
3.05m in Malibau Area)



Sampling after trenching
at SW37



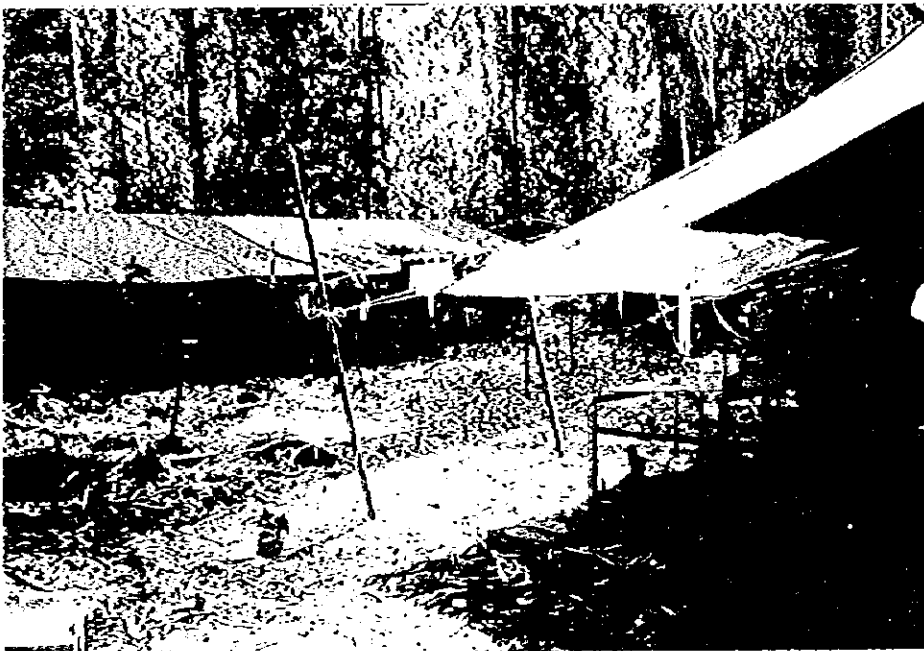
Trenching NK137



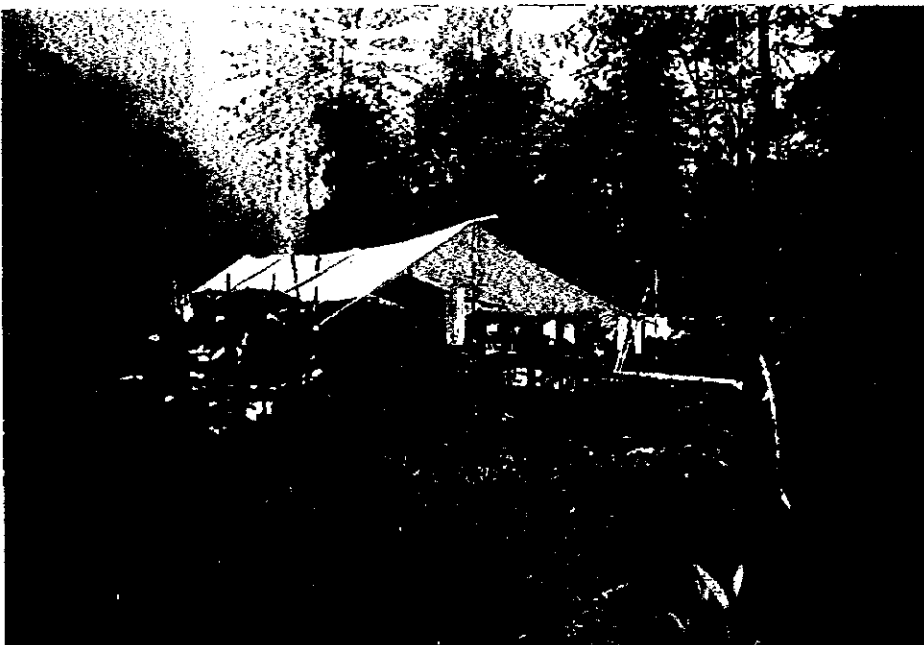
GPS survey
in S.W. Malibau



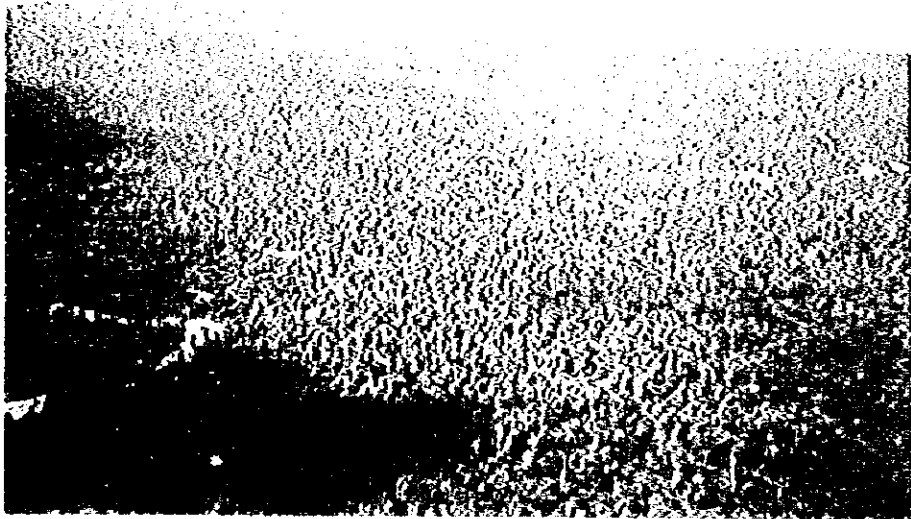
ISUZU INVADERS,
donated by JICA, on
slippery timber road
after rain



Base camp



Temporary camp for
survey of remote place

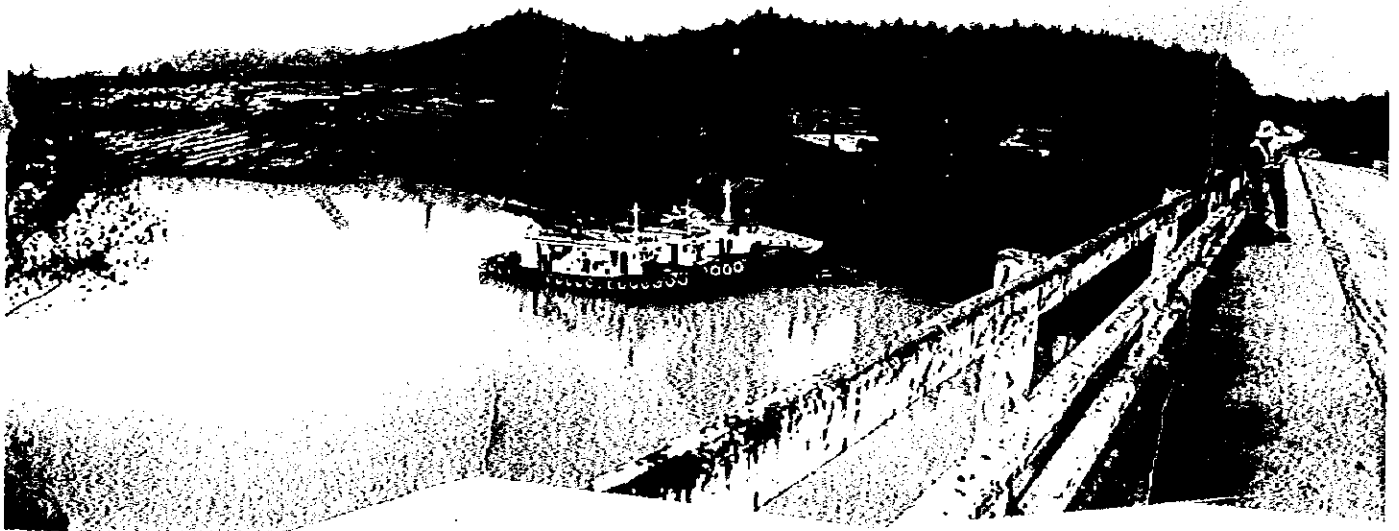


Aerial view of Silimpopon Area



Timber road

Kalabakan town on the Kalabakan river
Timber are transported by barge from this point.





The abandoned No. 1
incline of old Silimpon
Colliery.



Old facilities of the
Silimpon Colliery.



Reporting at
GSD Headquarter,
Kuala Lumpur





JICA