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CATERPILLAR INC.
FLEET PRODUCTION AND COST ANALYSIS

Zonia Mine Arimetco 22-JUN-93

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CATERPILLAR INC.
FLEET PRODUCTION AND COST ANALYSIS

Cost Summary -- Grand Total
Zonia Mine 7,500,000 TONS

Equipment	Qty	Model	Cost per Hour (each unit)	Operating Hours	$ Total	$ per TON
Loaders	2	992	85.00	8,568	728,280	0.097
Loader Total:	2			8,568	728,280	0.097
Haulers	6	777	60.00	24,276	1,456,560	0.097
Hauler Total:	6			24,276	1,456,560	0.194
Support Total:	0			0	0	0.000
Grand Total:	8			32,844	2,184,840	0.291

Overall Production and Cost Summary FPC-2a1
Zonia Mine

Fleet Name	Course Name	Material Qty TONS	TONS per Sched Hr	Sched Hrs Required	$ Total	$ per TON
A-1	TOTALS ..	7,500,000	1,576	4,760	2,184,611	0.291
GRAND TOTAL..		7,500,000	1,576	4,760	2,184,611	0.291

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Haulers	6-777	60.00	24,276	1,456,560	0.194
			0	0	0.000
Total	6		24,276	1,456,560	0.194
Support # 1			0	0	0.000
2			0	0	0.000
3			0	0	0.000
4			0	0	0.000
5			0	0	0.000
6			0	0	0.000
Total	0		0	0	0.000
Fleet Total	8		32,844	2,184,840	0.291

Cost Summary -- A-1 - H-1
Zonia Mine 7,500,000 TONS

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			0	0	0.000
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Support # 1			0	0	0.000
2			0	0	0.000
3			0	0	0.000
4			0	0	0.000
5			0	0	0.000
6			0	0	0.000
Total	0		0	0	0.000
Fleet Total	8		32,844	2,184,840	0.291

CATERPILLAR INC.
FLEET PRODUCTION AND COST ANALYSIS

Productivity and Cost -- A-1 -H-1 FPC-1c2

Loader	Hauler1	Hauler2
Qty & Model 2-992	6-777	
Loader Fill Factor..... 95.0%		%
TONS /Pass (3,375 Lbs/LCY).. 21.64		
System Passes per Hauler..... 4.00		
Hauler - Payload, TONS..... 86.57		
- % of Rated Payload.. 119.9%		%
Loader Cycle Time, Minutes... 0.65		
First Bucket Dump, Minutes... 0.10		
Hauler Exchange Time, Minutes 0.70		
Hauler Cycle Time		
Load with Exchange..... 2.75		
Haul..... 5.29		
Dump and Maneuver..... 1.00		
Return..... 2.02		
Potential Cycle Time.. 11.06		
Wait on Slow Hauler.....		
Wait to Load..... 1.04		
Total Cycle Time..... 12.10		

Potential Production

	TONS /Hour	Avg MPH
992	3,778	
777	2,817	12.3

Operating Schedule

Operating Efficiency	80%
Scheduled Hrs/Year	6,240

Fleet Estimates

Fleet Availability	76.5%
TONS /Sched Hr	1,576
Total TONS	7,500,000
Sched Hrs Reqd	4,760
Total $	2,184,611
$ per TON	0.291
TONS /Year	9,832,965
Years Required	0.76

HAUL - Travel Time & Speeds
Zonia Mine

Course Name	Course Desc	Material Qty TONS	Density Lbs per LCY	Density Lbs per BCY	Initial Speed --MPH--	HAULER
H-1		7,500,000	3,375	4,320	0.00	Model 777 ID T-1

HAUL Segment	Distance FEET	Rolling Resist%	Grade %	MPH Limit	Potential Speed	--Segment Speed-- Max	at End	Cumulative Minutes
	1,000	3.00	8.00	37.00	7.73	7.73	7.73	1.51
	2,000	3.00	6.00	37.00	10.13	10.13	10.13	3.78
	1,500	3.00	0.00	37.00	26.28	25.08	25.08	4.63
	1,500	3.00	0.00	37.00	26.28	25.98	25.98	5.29

CATERPILLAR INC.
FLEET PRODUCTION AND COST ANALYSIS

RETURN - Travel Time & Speeds
Zonia Mine

Course Name	Course Desc	Material Qty TONS	Density Lbs per LCY	BCY	Initial Speed --MPH--	HAULER Model 777 ID T-1
H-1		7,500,000	3,375	4,320	0.00	

RETURN Segment	Distance FEET	Rolling Resist%	Grade %	MPH Limit	Potential Speed	--Segment Speed-- Max	at End	Cumulative Minutes
	1,500	3.00	0.00	37.00	37.29	36.97	36.97	0.64
	1,500	3.00	0.00	37.00	37.29	37.00	37.00	1.10
	2,000	3.00	-6.00	37.00	38.68	37.00	37.00	1.72
	1,000	3.00	-8.00	37.00	38.68	37.00	37.00	2.02

Number of Haulers Analysis--> A-1 -H-1 FPC-1d2

From 1 to 8 777
Total TONS of Material 7,500,000
Operating Efficiency 80% Scheduled Hrs/Year 6,240

Loader.... 2-992
1st Hauler 6-777
2nd Hauler

Qty 777	TONS per Sched Hr	Sched Hrs Required	$ per TON	$ Total	TONS per Year	Years Required
1	287	26,101	0.71	5,324,625	1,793,028	4.18
2	575	13,051	0.44	3,327,890	3,586,056	2.09
3	862	8,700	0.35	2,662,312	5,379,083	1.39
4	1,122	6,686	0.32	2,386,807	6,999,981	1.07
5	1,349	5,559	0.30	2,268,211	8,418,266	0.89
6	1,576	4,760	0.29	2,184,611	9,832,965	0.76
7	1,780	4,213	0.29	2,148,759	11,107,807	0.68
8	1,961	3,825	0.29	2,145,767	12,235,622	0.61

CATERPILLAR INC.
FLEET PRODUCTION AND COST ANALYSIS

Number of Haulers Analysis--> A-1 -H-1 FPC-1d2

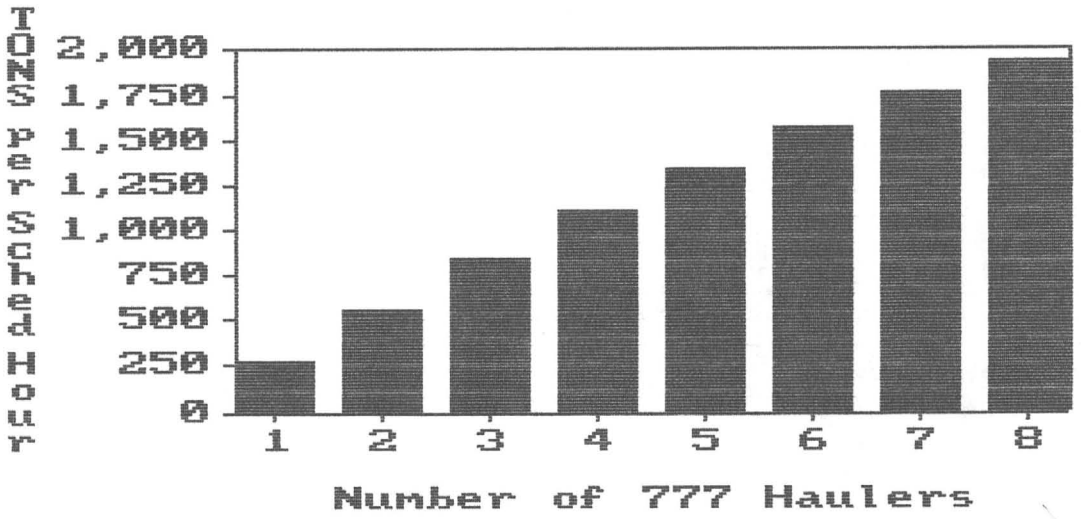
From 1 to 8 777
Total TONS of Material 7,500,000
Operating Efficiency 80% Scheduled Hrs/Year 6,240

Loader.... 2-992
1st Hauler 6-777
2nd Hauler

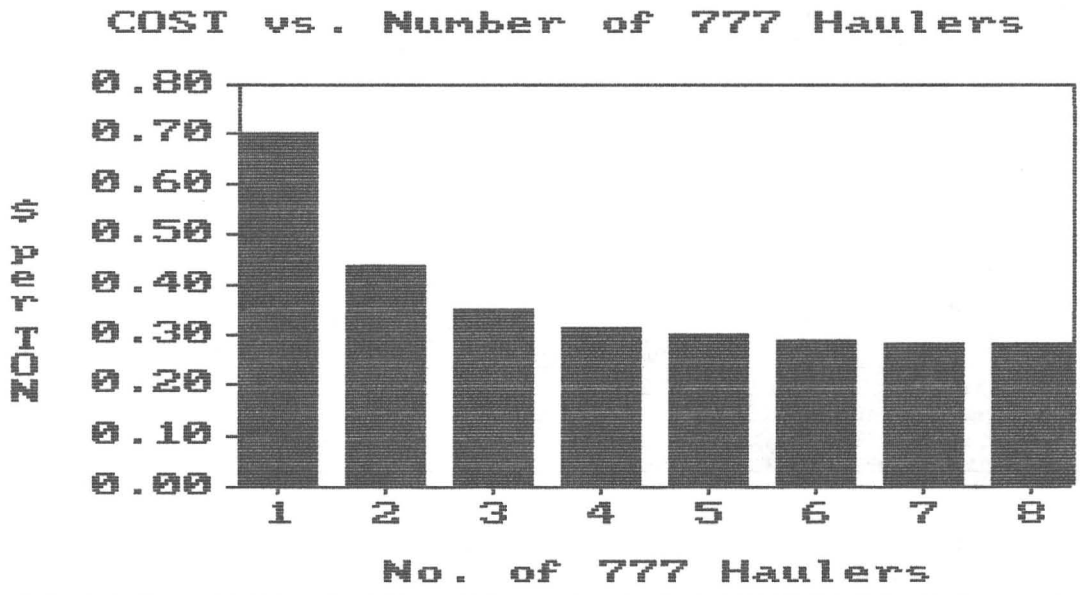
Qty 777	Fleet Match	Fleet Avail %	HAULER EFFICIENCY % Mismatch	Bunching	Combined	TONS per 60 Min Hr	TONS per Sched Hr	$ per TON
1	0.12	76.5	100.0	100.0	100.0	470	287	0.71
2	0.25	76.5	100.0	100.0	100.0	939	575	0.44
3	0.37	76.5	100.0	100.0	100.0	1,409	862	0.35
4	0.50	76.5	100.0	97.6	97.6	1,878	1,122	0.32
5	0.62	76.5	100.0	93.9	93.9	2,348	1,349	0.30
6	0.75	76.5	100.0	91.4	91.4	2,817	1,576	0.29
7	0.87	76.5	100.0	88.5	88.5	3,287	1,780	0.29
8	0.99	76.5	100.0	85.3	85.3	3,756	1,961	0.29

Fleet-Course Combination: A-1-H-1

PRODUCTION vs. Number of 777 Haulers



Fleet-Course Combination: A-1-H-1



CATERPILLAR INC.
FLEET PRODUCTION AND COST ANALYSIS

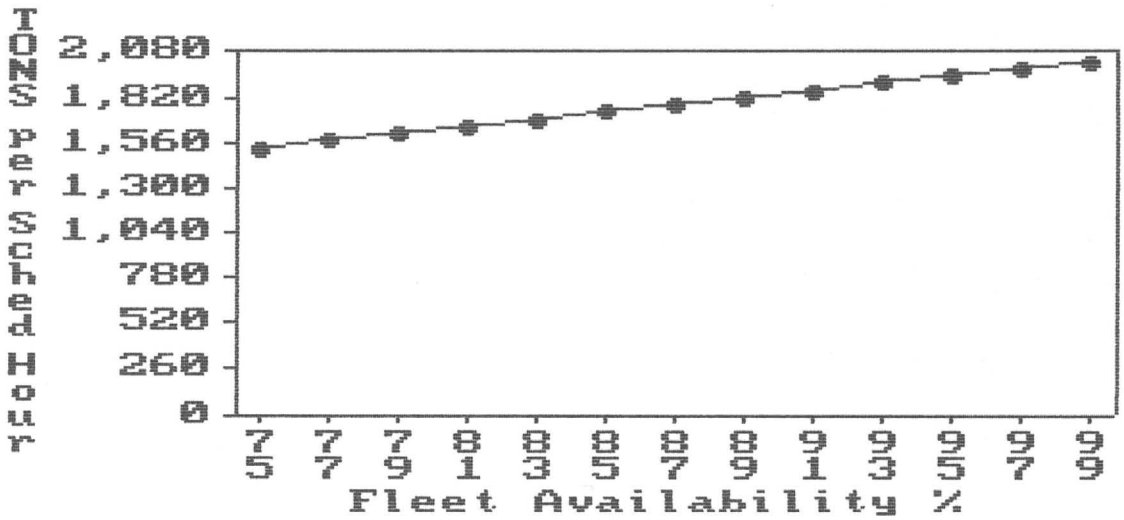
Fleet Availability Analysis--> A-1 -H-1 FPC-1e2

Analyzed..... From 75% to 100% Total TONS of Material 7,500,000 Scheduled Hours per Year.....6,240	Loader.... 2-992 1st Hauler 6-777 2nd Hauler	Fleet Availability 76.5%

Fleet Avail %	TONS per Sched Hr	Sched Hrs Required	$ per TON	$ Total	TONS per Year	Years Required
75.0	1,545	4,855	0.30	2,228,303	9,640,162	0.78
77.0	1,586	4,729	0.29	2,170,425	9,897,233	0.76
79.0	1,627	4,609	0.28	2,115,477	10,154,304	0.74
81.0	1,668	4,495	0.28	2,063,243	10,411,374	0.72
83.0	1,710	4,387	0.27	2,013,527	10,668,445	0.70
85.0	1,751	4,284	0.26	1,966,150	10,925,516	0.69
87.0	1,792	4,185	0.26	1,920,951	11,182,587	0.67
89.0	1,833	4,091	0.25	1,877,783	11,439,658	0.66
91.0	1,874	4,001	0.24	1,836,513	11,696,729	0.64
93.0	1,916	3,915	0.24	1,797,018	11,953,800	0.63
95.0	1,957	3,833	0.23	1,759,187	12,210,871	0.61
97.0	1,998	3,754	0.23	1,722,915	12,467,942	0.60
99.0	2,039	3,678	0.23	1,688,108	12,725,013	0.59

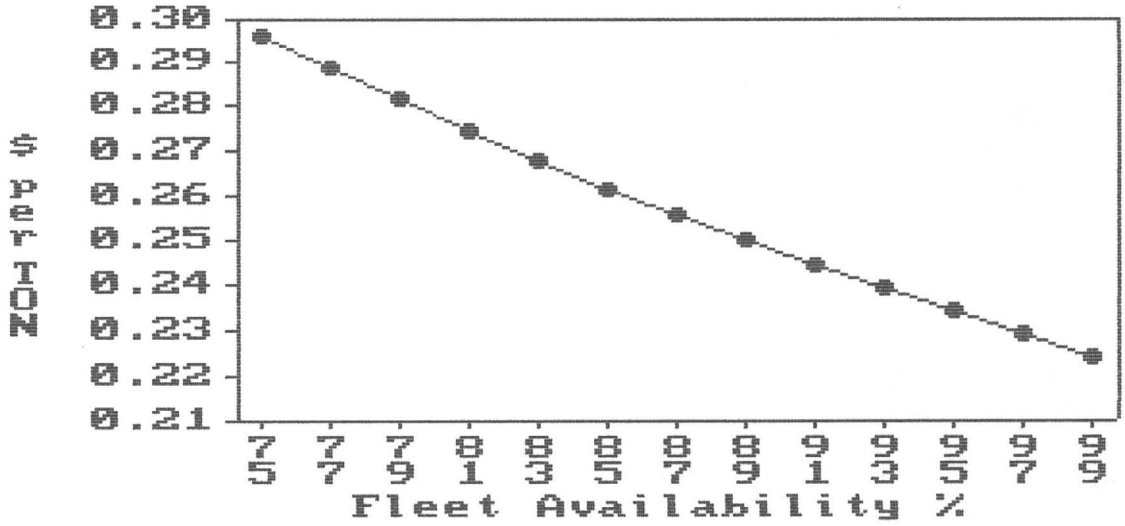
Fleet-Course Combination: A-1-H-1

PRODUCTION vs. Fleet Availability



Fleet-Course Combination: A-1-H-1

COST vs. Fleet Availability



ZONIA FLEET REQUIREMENTS

PRODUCTION REQUIREMENTS

TONS PER YEAR = 7,500,000

OF WORKING DAYS = 260

OF SHIFTS/DAY = 3

OF hours / SHIFT = 8

OF min / hr = 50 min

$$\frac{\text{TONS}}{\text{DAY}} = \frac{7{,}500{,}000}{260} = 28847 \text{ TONS/DAY}$$

$$\frac{\text{TONS}}{\text{SHIFT}} = \frac{28847}{3} = 9616 \text{ TONS/SHIFT}$$

LOADER CYCLE TIME

BASIC = 0.70 min

MATERIAL (BANK OR BROKEN) = +0.04 min

PILE = 0.00

COMMON OWNER = -0.04

CONSTANT OPER = -0.04

0.66 min

$$\frac{\text{CYCLES}}{\text{hr}} = \frac{60 \text{ min}}{0.66} = 90.91$$

$$130.43\left(\frac{50}{60}\right) = 75.76$$

76 cycles/hr

NO. PASSES TO FILL TRUCK:

FILL FACTOR = 0.95

SWELL FACTOR = -NA-

BUCKET CAPACITY: $13.5\ yd^3 \times 0.95 = 12.825\ yd^3$

TONS PER CU yd

$$168 \frac{lb}{ft^3} \left(\frac{27}{1}\right)\left(\frac{1}{2000}\right) = 2.268$$

TONS PER PASS

$$12.825 \left(\frac{2.268}{1}\right) = 29.0871 \text{ TONS.}$$

PASS TO FILL

$$95 / 29.0871 = 3.266 \approx 4$$

NOTE
NOT
VERY
ESS.

TRIPS REQ.

$$9616 / 95 = 101.2211 \text{ TRIPS} \approx 102$$

TRAVEL (TOTAL TIME) / TRIP

TRAVEL TIME = 7.9 min

SPOT TIME = 0.7 min

LOAD TIME = (0.66 · 4) = 2.64

DUMP TIME = 1.1 min

12.34 min

19 min

OF PASSES BY LOADER/SHIFT

$$8 \text{ hr} \left(\frac{50 \text{ min}}{\text{hr}}\right)\left(\frac{60 \text{ sec}}{\text{min}}\right) / \left(0.66 \times 60\right) = 606.0606$$
(39.6)

OF TRUCKS FILLED/SHIFT

$$606 / 4 = 151.5 \approx 151$$

National® Brand
42-381 50 SHEETS EYE-EASE® 5 SQUARE
42-382 100 SHEETS EYE-EASE® 5 SQUARE
42-389 200 SHEETS EYE-EASE® 5 SQUARE
42-392 100 RECYCLED WHITE 5 SQUARE
42-399 200 RECYCLED WHITE 5 SQUARE
Made in U.S.A.

OF TRIPS / TRUCK-SHIFT =

$$8\left(\frac{50}{1}\right)\left(\frac{1}{12.34}\right) = 32.41491$$

$$\boxed{32}$$

OF TRUCK REQ: $102/32 = 3.1875$ ~~4~~

OF LOADERS REQ: $4 \cdot 32/151 = 0.84$

4 TRUCKS 95 T 777

1 LOADER

42-381 50 SHEETS EYE-EASE® 5 SQUARE
42-382 100 SHEETS EYE-EASE® 5 SQUARE
42-389 200 SHEETS EYE-EASE® 5 SQUARE
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$$12.825 \left(\frac{2.268}{1}\right) = 29.0871 \text{ TONS.}$$

PASS TO FILL

$$\boxed{85} \cancel{95} / 29.0871 = 3.266 \approx 4$$
$$2.922 = \boxed{3}$$

NOTE, NOT VERY ESS.

TRIPS REQ.

$$9616 / \cancel{95}\ 85 = 101.2211 \text{ TRIPS} \approx 102$$
$$113.123 \approx 114$$

TRAVEL (TOTAL TIME) / TRIP

TRAVEL TIME = 7.9 min

SPOT TIME = 0.7 min

LOAD TIME = (0.66 · 4) = 2.64

DUMP TIME = 1.1 min

12.34 min

19 min

OF PASSES BY LOADER/SHIFT

$$8 \text{ hr} \left(\frac{50 \text{ min}}{\text{hr}}\right)\left(\frac{60 \text{ sec}}{\text{min}}\right) / (0.66 \times 60) = 606.0606$$
(39.6)

OF TRUCKS FILLED / SHIFT

$$606 / \cancel{4}\ 3 = 151.5 \approx 151$$
$$202$$

OF TRIPS / TRUCK-SHIFT =

$$8\left(\frac{50}{1}\right)\left(\frac{1}{12.34}\right) = 32.41491$$

$$\boxed{32}$$

OF TRUCK REQ:

$$102/32 = 3.1875 \rightarrow 4$$

$$114/32 = 3.56 \approx 4$$

OF LOADERS REQ:

$$3.32/\cancel{151}\ 102 = 0.634 \rightarrow 1$$

4 TRUCKS 95 T 777

1 LOADER

42-381 50 SHEETS EYE-EASE® 5 SQUARE
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