THE MOBILE STACKING CONVEYOR

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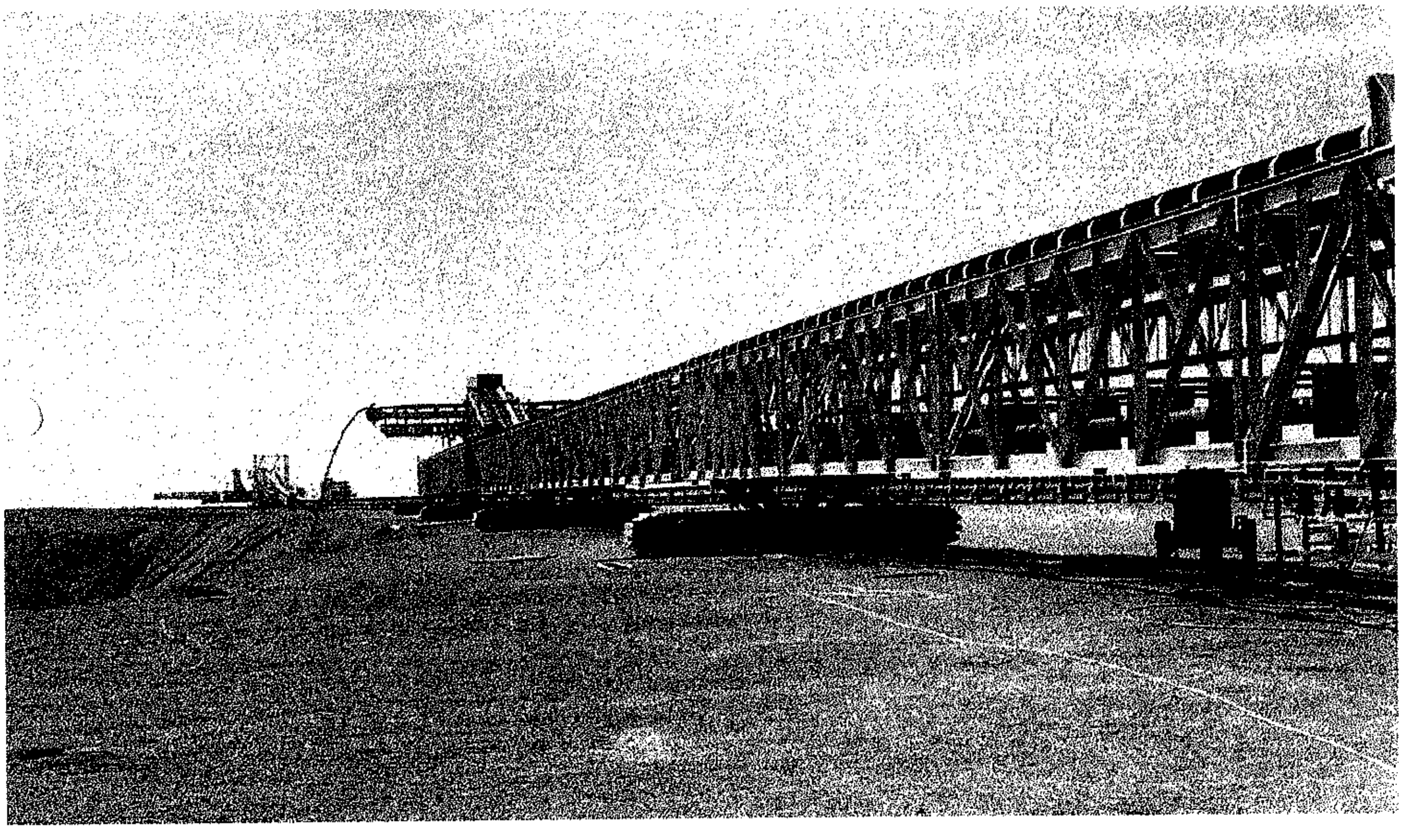


OVERVIEW

There is no better example today of the mining industry moving into the 21st century than the development of the Mobile Stacking Conveyor to form waste dumps in an ecologically sensitive country.

The use of the MSC has allowed the construction of larger volume waste dumps with high moisture content tailing aimed at eventually eliminating slime dames and thus high water usage.

Systems such as these are difficult to justify when one looks at the initial capital costs only. Luckily, however, some progressive organisations are prepared to use management tools such as simulation, financial modelling and life cycle costing to allow them to justify initial high capital costs knowing that during the life of the mine, the rewards will be extensive.

This dissertation shows a typical system where considerable savings will be realised in the development of such an installation.

THE MOBILE STACKING CONVEYOR

INTRODUCTION

South Africa and South America has become the largest users of dumps for stockpiling mine waste, tailings, overburden and the development of heap leach systems.

Areas such as ash dumps, tailings disposal, rehabilitation sites and minerals extraction have all lent themselves to the formation of extensive dumping sites, usually being formed with the use of one of the following systems:

- trucks and dozers
- grasshopper conveyors and spreaders
- shiftable conveyors and spreaders.

With the differentiation between the grasshopper and shiftable system usually being a function of capacity and capital outlay.

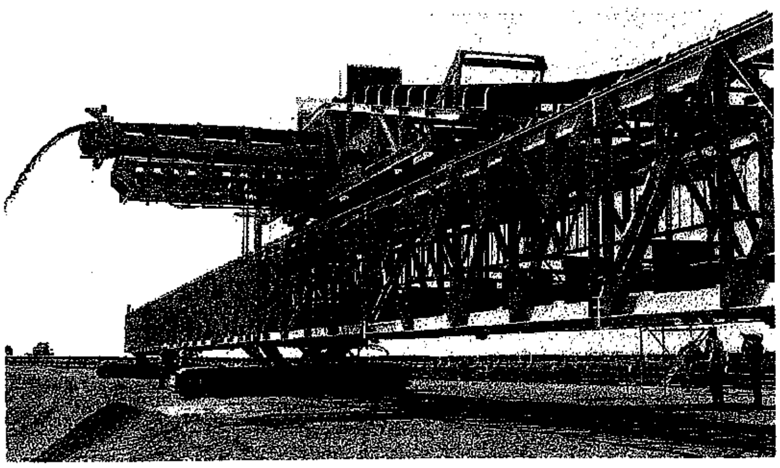
With the development of high capacity heap leach pads for the extraction of minerals such as gold and copper an alternative dumping procedure had to be found which allowed for improved control of the dump site allowing for high speed operations on rapidly developed pads resulting in low ground bearing pressures, which can be negotiated by the crawler system capable of travelling over such terrain, with the ability to quickly develop the dump/pad.

To meet these requirements, the Mobile Stacking Conveyor (MSC) was developed and has proven itself very cost effective in this field. Since its inception in the early 1980's the MSC has had outstanding success in heap leach pad development, resulting in new opportunities for utilisation on similar stockpiling systems.

To this end the waste dump formation and dump rehabilitation have been investigated as areas of interest for the MSC.

Prior to delving into the application of the MSC, we would like to highlight the components that make up the unit.

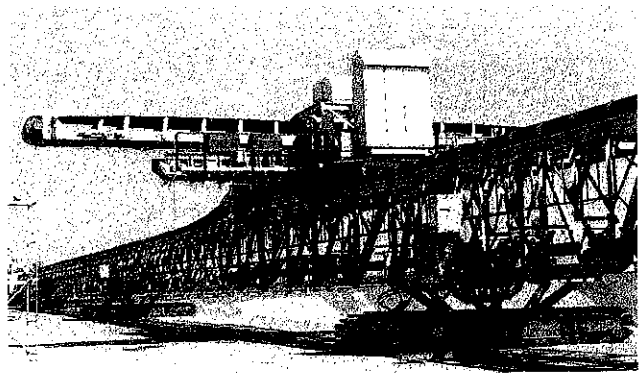
Figure 1



This picture shows a typical installation 200m long with crawlers mounted every 50m.

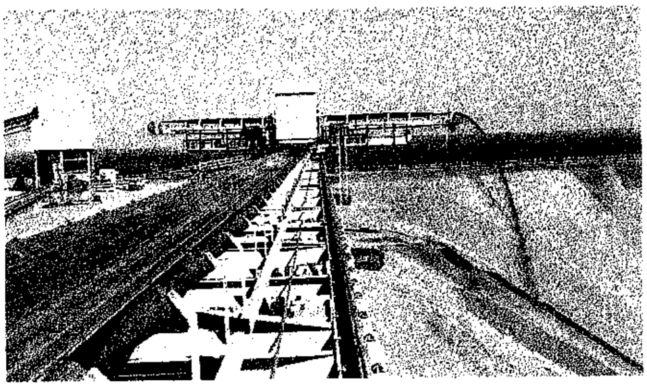
Note the closeness of the crawlers to the dump edge, allowing accurate placement of tailings resulting in a very smooth dump surface suitable to allow the crawlers to negotiate the pad without extensive dump surface preparation.

Figure 2



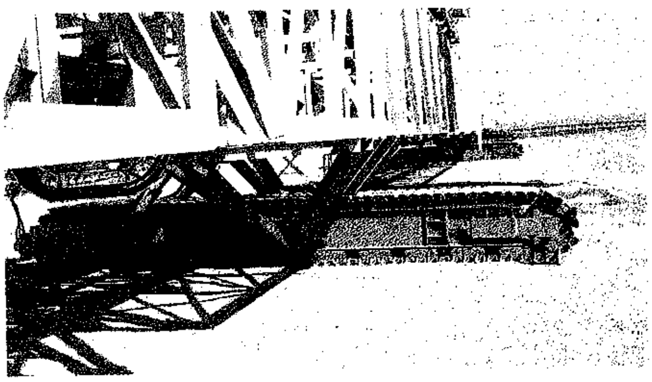
Here we see the tripper with its translating boom. The tripper itself can traverse the full length of the MSC, being driven through an onboard drive, sheeve and rope configuration. The travel drive is variable speed allowing controlled placement of tailings even with variable feed rates.

Figure 3



Another feature of the tripper translating boom is its ability to back stack and possibly top soil as it advances. The translating boom propels itself forward, being able to reach 12m from the MSC centre-line, thus improving ground drying time prior to travelling.

Figure 4



The heart of any machine of this type is the crawler. Here we have to cater for low ground bearing pressures by designing a special crawler.

Commercially available crawlers are not practical nor economical for such a machine, therefore we must custom design the unit to meet the specifications.
The actual design incorporates the principles of scraper chain design in the link construction, making the unit economically viable, yet well proven in the mining environment.

Figure 5

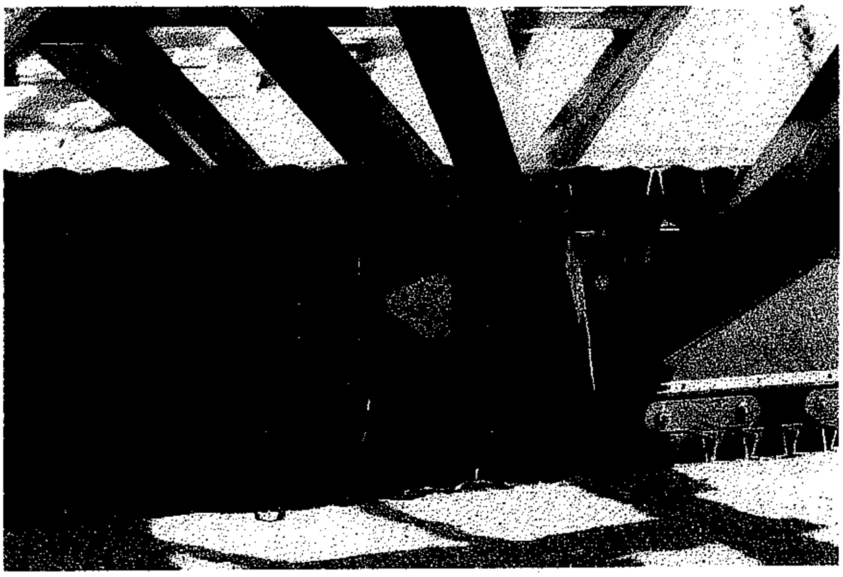


Figure 5 above and Figure 6 below give a closer view of the crawler levelling and driving mechanism. The drive is a conventional hydraulic unit, giving proportional speed and thus accurate alignment control of the total system.

Figure 6

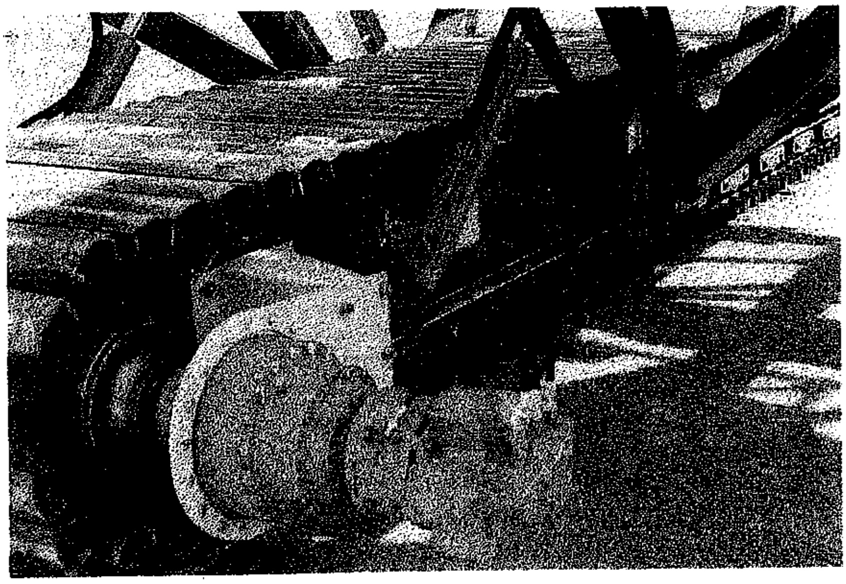
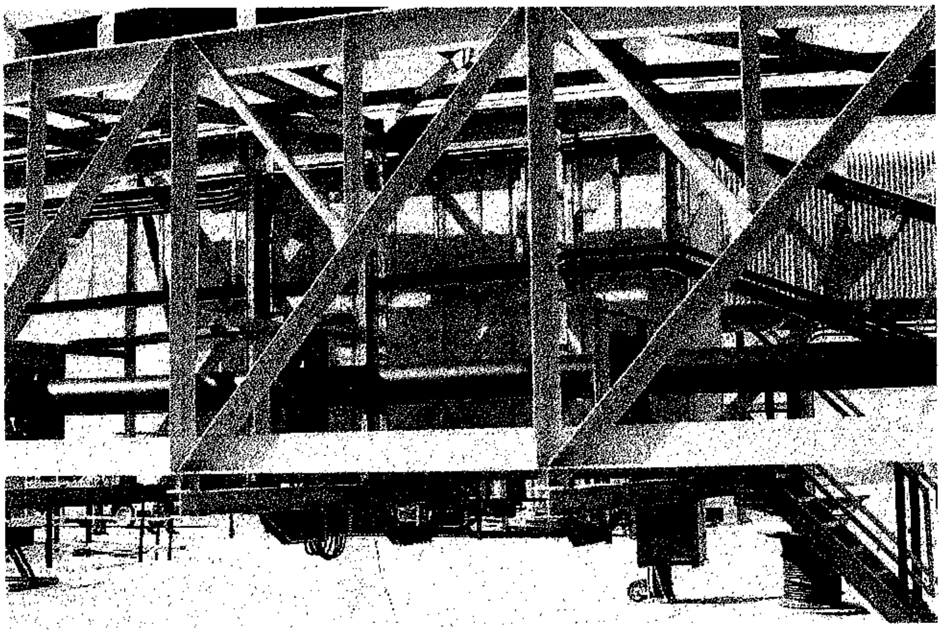


Figure 7



Another unique feature of the MSC is the return belt, which has been formed into a pipe.

The main reason for this is to eliminate spillage on the return belt strand allowing protection of the crawlers and power packs.

MODE OF OPERATION

The MSC is flexible in that it can move linearly, radially, up or down a slope without having to follow a horizontal line.

For horizontal movement, each MSC bridge is equipped with crawlers to maintain alignment, hydraulic cylinders to maintain level, (thus assisting the passage of the travelling tripper over the bridge connections). These alignment functions are controlled via a set of sophisticated field instruments coupled to a computerised control system.

To further assist the stacking of material, the tripper itself is equipped with a translating boom which allows for accurate placement of the ground in front or behind the MSC. The translating boom is programmed to detect the face of the dump via a laser probe and is able to layer the material accurately along this face. On completion of a stacked layer, the boom extends and the process is repeated until the translating boom extends the full length.

At this point, the total system is advanced forward on the previously laid ground, it is able to negotiate the small ridges in the dump surface. Therefore, it is not normally necessary to level the ground prior to movement, however, good practise is to ensure no excessive piles lie in front of the tracks and improved operation will be obtained by running a grader in front of the MSC prior to movement.

Control of movement, as stated previously is achieved via instrumentation and PLC control. The crawlers are advanced together using limits to ensure alignment between bridges. After relocation the total bridge is accurately aligned and levelled again automatically to an accuracy of ±5mm in both planes.

The moving mode is achieved by the use of what could be called a controlled shuffling action of the crawlers. Advancing one of the terminal point crawlers is immediately detected as an out of alignment between the bridge sections which is identified by the linear transducer at that junction. (Refer to Figure 8.) When this alignment exceeds a pre-defined value (miliamp signal) the next crawler in line sets off to catch the first unit. Through the use of proportional control, the drive detects a worsening or improvement of the alignment conditions and reacts by slowing or accelerating the crawler drive accordingly.

Should the condition of misalignment worsen to a further pre-defined limit, the system is shut down to prevent damage to the structure and connections.

Assuming correct operation, the first terminal crawler is advanced in this manner until it reaches its required position with all remaining crawlers following suit.

Each crawler is then shut down in the correct position and finally the total bridge is hydraulically levelled again from a pre-defined base level using two hydraulic cylinders. (Refer Figure 9.)

Figure 8

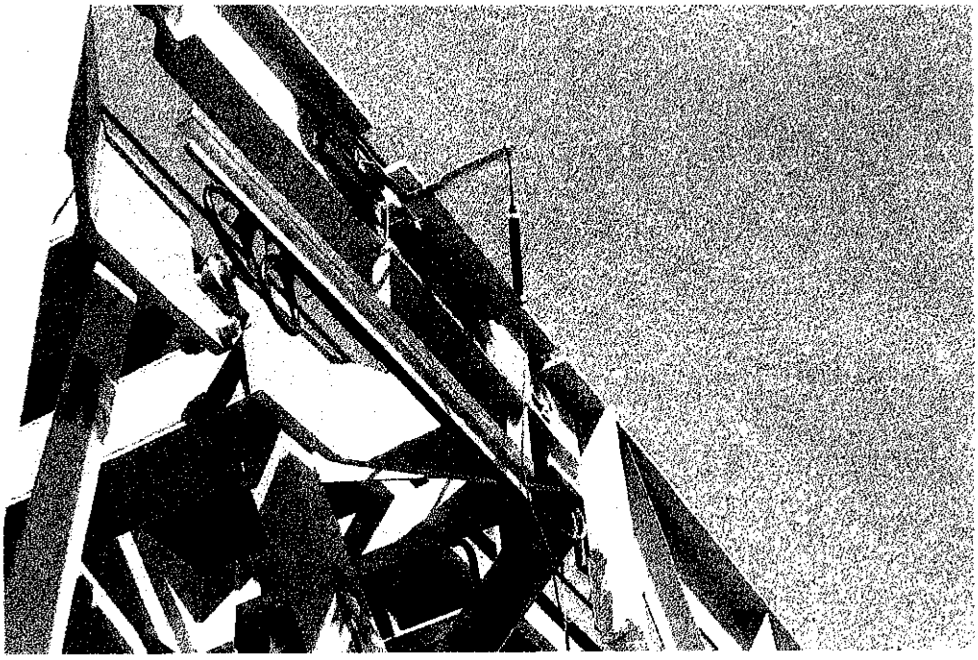
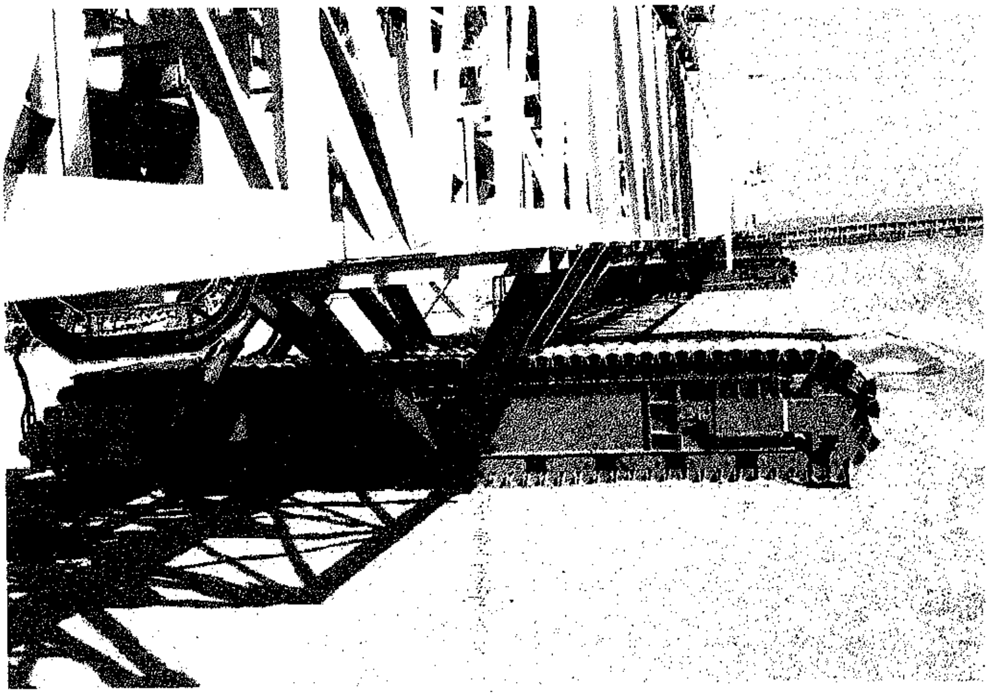


Figure 9



APPLICATIONS FOR THE MSC

The MSC is used primarily for stacking large volumes of material automatically in a pre-defined pattern. It requires little operational control and relocation time. It is ideal for materials with large moisture contents which cause problems with conventional dump stacking. Sites such as tailings dumps are ideal for the MSC in that they require long drying times to stabilise the dump prior to further stacking of materials. Therefore, because the material is laid in thin layers over large areas it is possible to travel on it sooner than with a conventional stacking system.

To highlight the layout advantages, we have included a conventional stacking system as indicated in Figure 10. To achieve the necessary filling of a dump of this type requires extensive transfers, multiple machines and highly intensive labour force. Compare this to a typical MSC layout (Figure 11) which eliminates most of the transfers, reduces the number of machines and generally streamlines the operation.

Correctly setting up a MSC dump configuration requires an initial berm to install an advancing spreader, the MSC then follows the spreader profile, being able to climb 20% slopes to the required dump height, thus the dump formation is simple to automate and control allowing extensive savings in downtime for MSC movements and therefore dramatic improvements in availability and eventually costs.

To highlight the overall savings in the use of this type of system a comparison was drawn between four systems commonly used in dump formation: -

- pumping,
- trucking & dozing,
- Mobile Stacking Conveyor,
- shiftable conveyors & spreaders.

This comparison was undertaken along the lines of a capital and O&M costing.

It can be seen that the initial capital cost of the stacker and MSC system were very similar, however, after only five years the MSC is showing extensive savings.

Trucking, which shows low initial capital costs, quickly catches up on the other systems, even at a fixed cost per ton.

Therefore, applying the philosophy of flexibility to the trucking scenario is the only way it can compete in this type of application.

CONCLUSION

In conclusion, it can be appreciated that in the mining and beneficiation processes of today to compete in the world market extensive efforts must be made to optimise operations by improving efficiencies.

The MSC system was originally developed to offer the formation of cost effective heap leaching pads which allowed a mine to be profitable even with grades of ore of less than 2gm/ton.

Figur 10

Scheme	Description	CAPITAL Capital Used / Year R'000: 0	1	2	3	4	Absorbed Power kW	Fuel Used	Water Used kLi	Labour Requirements Type 1	2	3	4	Transport Used	Dump Equipment	O&M COSTS Maintenance	Operating
1	Pumping	8976	250	1275	0	1353	115	0	167	1	3	16	6	1	2455425	656214	4664275
	Housing Allowance	1237															
2	Trucking	6570	0	1855	0	2449	120	0	5	1	2	8	24	1	2866500	270758	3999747
	Housing Allowance	1624															
3	Mobile Bridge Spreader	9650	2000	0	0	0	638	0	10	1	2	16	4	1	0	563000	1276240
	Housing Allowance	1096															
	Royalty Allowance 4%	386															
4	Crawler Mounted Stacker	12120	2000	750	0	990	828	0	10	1	1	20	4	1	837675	647000	2330365
	Housing Allowance	1219															

Annual Capacity: 3518250 ton / year
Inflation Factor: 0

OPERATING YEARS

Scheme	*Description*	0 Capital	0 Operating	1 Capital	1 Operating	2 Capital	2 Operating	3 Capital	3 Operating	4 Capital	4 Operating	5 Capital	5 Operating	Totals R'000
1	Pumping	10213.00	5320.49	250.00	5320.49	1275.00	5320.49	0.00	5320.49	1353.00	5320.49	0.00	5320.49	45014
	Per ton		1.51		1.51		1.51		1.51		1.51		1.51	
2	Trucking	8194.00	4270.51	0.00	4270.51	1855.00	4270.51	0.00	4270.51	2449.00	4270.51	0.00	4270.51	38121
	Per ton		1.21		1.21		1.21		1.21		1.21		1.21	
3	Mobile Bridge Spreader	11132.00	1839.24	2000.00	1839.24	0.00	1839.24	0.00	1839.24	0.00	1839.24	0.00	1839.24	24167
	Per ton		0.52		0.52		0.52		0.52		0.52		0.52	
4	Crawler Mounted Stacker	13339.00	2977.37	2000.00	2977.37	750.00	2977.37	0.00	2977.37	990.00	2977.37	0.00	2977.37	34943
	Per ton		0.85		0.85		0.85		0.85		0.85		0.85	

Power Costs	R	0.114	Per kW hr
Fuel Costs	R	1500	Per kLi
Water Costs	R	0,33	Per kLi
Transport	R	36000	Per Bakkie/Year
Labour			
1 Supervisor	R	50000	Per Year
2 Artisan	R	50000	Per Year
3 Labourer	R	26000	Per Year
4 Drive	R	26000	Per Year
Housing			
1 Supervisor	R	110000	Per House
2 Artisan	R	53000	Per House
3 Labourer/Driver	R	44000	Per House

NPV ANALYSIS

Year	Scheme 1	Scheme 2	Scheme 3	Scheme 4	
0	15533	12465	12971	16316	
1	5570	4271	3839	4977	
2	6595	6126	1839	3727	
3	5320	4271	1839	2977	
4	6673	6720	1839	3967	
5	5320	4271	1839	2977	
	8.0%	8.0%	8.0%	8.0%	
	39096	32906	22167	31427	*NPV*
	45014	38121	24167	34943	*PREVIOUS*

Analysis, such as that carried out in Figure 12, highlights the cost inaccuracies associated with using capital cost approach to "KIT" selection. The South Africa mining industry is benefiting from its minerals wealth by adopting extensive modelling procedures aimed at maximising efficiency to guarantee high pay-backs for capital employed.

The initial capital cost approach to process layout and KIT selection has finally been exposed as a formula for destruction with companies selecting on bottom dollar rapidly falling by the wayside when international competition moves onto the scene.

The MSC is conclusively shown as a system selection adopted with the use of proven financial and simulation modelling techniques guaranteeing high productivity and low operating and maintenance costs. Therefore, the days of justifying a truck or train operation on the basis of flexibility is an excuse to justify a company's inability to forward plan.

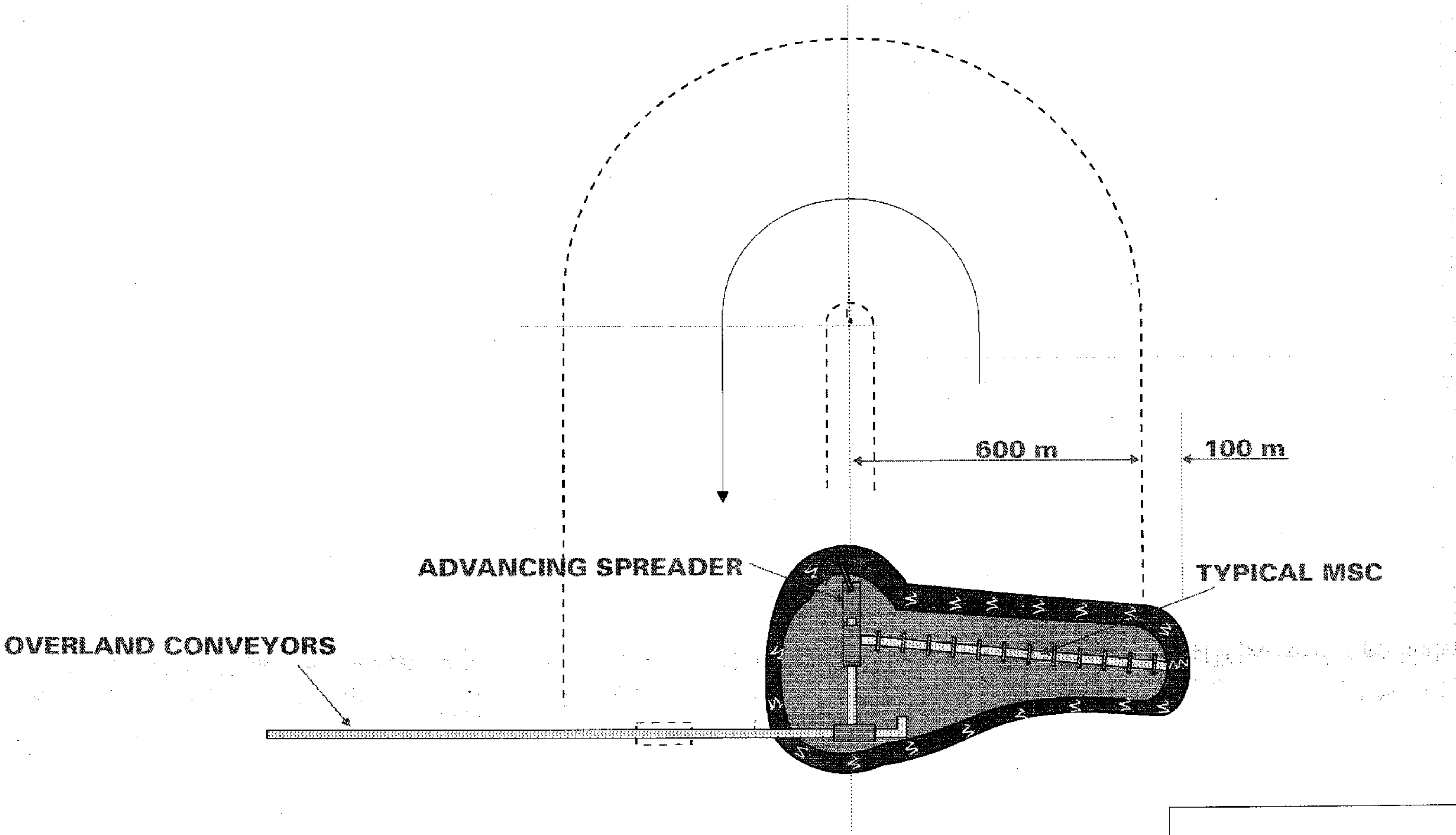

600 m
100 m
ADVANCING SPREADER
TYPICAL MSC
OVERLAND CONVEYORS

FIGURE 11

DRG No. XXX

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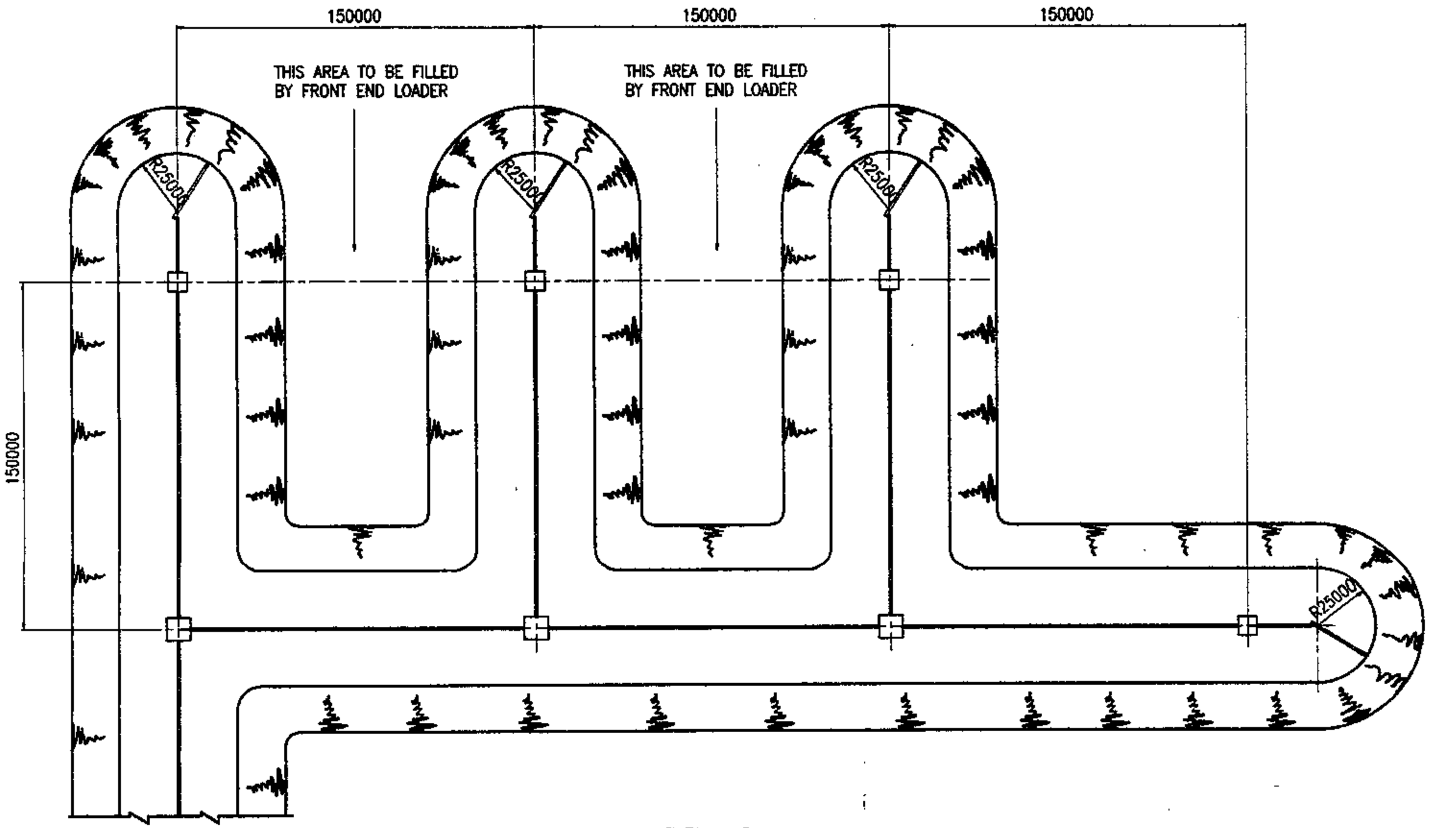

FIGURE 12

APPROVED FOR MANUFACTURE/CONSTR.

L.P.

Babcock MATERIALS HANDLING AFRICA

CONTRACT NAME AND NUMBER

CLIENT:

DESCRIPTION:

DRG.

SCALE 1:1000

SIZE A1

REV

GOOD QUALITY MEANS MEETING ALL THE REQUIREMENTS OF THIS DRAWING