The Adaptation of an Ore Feeder to Replace a Chute

Donald M. Forsman

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The Adoption of an Ore Feeder to Replace a Chute

Term Paper
Submitted to
Professor K. S. Stout
Assistant Mining Professor
Mining Department

In Partial Fulfillment of the
Requirements of Mining 61

by
Donald M. Forsman

Butte, Montana
April 20, 1957
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420 Maple Street  
Anaconda, Montana  
April 20, 1957

Mr. K. S. Stout  
Assistant Mining Professor  
Montana State School of Mines  
Butte, Montana

Dear Mr. Stout:

I herewith submit this report on The Adaptation of an ore Feeder to Replace a Chute. If this system would work in practice it seems that a salvageable chute would be obtained. Most of the calculations are based upon production figures from the Denver Equipment Handbook, and most of the stresses involved come from actual practice.

Sincerely,

[Signature]

Donald M. Forsman
Introduction

For years in mining, gravity has been used to advantage in ore transportation, and until recently chutes were about the only method of loading cars for mine level haulage. During recent years slushers have been used to advantage in loading ore cars and in a few cases mucking machines.

Each of these methods of car loading have advantages and disadvantages. Chutes are hard work and have considerable lost time through spillage. Slushers require a larger working force of men and are extremely expensive in initial outlay.

From J. D. Riggleman's report, "Design of a Steel Chute-Mouth," he estimates approximately two to three per cent of the total mining cost per ton of ore is involved in loading cars. If this figure could be appreciably decreased, either a lower grade of ore could be mined or a greater profit could be realized.

I believe that by installing apron ore feeders in place of chutes, spillages, manual labor, and loading time could be reduced, and greater safety and the average car factor could be increased. Although an apron feeder would be a considerable investment, maintainence should be very low and the feeder would be re-usable many times.
Factors for a Satisfactory Chute Gate

Because our proposed pan feeder chute would be adaptable for direct replacement of chute gates, it seems that one should review the criteria of a satisfactory chute gate.

"Chute gates, at bottoms of chute, raises, etc., control the flow of ore in loading into cars. Their design and details vary widely. Following general points are important:

(a) The cheapest chute-gate that will do the work without undue maintenance cost and delays due to clogging is the best. First cost should be considered in connection with the total tonnage passed, elaborate designs are warranted only by large tonnages. (b) Gates must be suited to the size of the ore. Simple board gates serve for fine ore, other forms are necessary for handling large lumps. (c) For rapid loading, mechanically operated gates are sometimes required. (d) Strength is essential as wear is heavy and gates must often withstand blasting of boulders in or above them. (e) Clearances must be ample, to provide room for barring, to allow for settlement of supporting timbers, and to prevent men from being injured by getting pinched between chutes and cars."

It can be seen that a relatively expensive chute gate would not pay in some installations. Assume a 50 ft. stope with a 100 ft. lift and 6 ft. of ore would only produce about 2,500 tons. Using two per cent of mining costs as $0.20 a ton, the chute cost would be $500.00 and it would take at least ten hours of continuous operation to pull that amount of ore. It would cost about $150.00 to install and remove any type of chute gate. This leaves only $320.00 to pay interest and initial costs for a chute gate. It becomes quite apparent that in a small stope an apron ore feeder would be a very marginal investment, and probably a conventional chute gate of a non re-usable type would be cheaper.

On the other hand assume a stope 100 ft. long with a 200 ft. lift and 20 ft. wide. This stope would produce about 33,400 tons and the amount chargeable to a chute would be about $6,660. Considering the cost of installation, removal of the chute, and the labor of one man to pull the chute; there is still $6,000.00 chargeable to the chute. If an apron feeder could cut the chute cost in half then it would be very profitable to make the installation.

Another considerable item which Peele mentions indirectly is safety. In my experience I've noticed, if a chute cannot be stopped, a worker is liable to try almost anything to stop
it which could result in a very serious accident, subsequently adding to the already high accident insurance and poor safety record of mining. If a safer type of chute could be installed with no direct saving; possibly an over-all saving would be effected in the mine due to decreased accidents.

"A satisfactory chute gate must be suited to the size of the ore." The ore apron feeder has been proven successful in long use in mineral dressing operations, the ore apron feeder works very well. With coarse ore or very large lumps, it seems as good a method of control as can be maintained with a conventional chute. With large lumps they are best handled on grizzlies, or not allowed to form. An extra hole or two drilled, will generally decrease, if not eliminate large lumps. If large lumps get into a chute they generally cause considerable damage or delay in loading cars. With the ore pan feeder the flow of muck could be stopped, eliminating many of the spills caused by boulders caught in the chute gate. Any type of chute will get hung up several floors high, this is generally due to the character and size of the ore and it doesn't seem that a modification of chute design will remedy this.

\(^2\) Ibid., Peele, p. 10-407.
"...The speed of loading a car can only be approximately estimated. To load ten - 5 ton cars from two chutes, requires ten minutes..."\(^3\) This means that one chute would load fifty tons in 20 minutes. A 4.2 inch ore feeder operating at 10 ft. per minute with a average depth of one ft. would give 72 tons per hour.

"...By doubling the speed to 20 ft. per minute and increasing the depth to two ft. this feeder could produce 288 tons per hour, and this would be 4.8 tons per minute."\(^4\) This chute has at least comparable capacities as to the regular chutes, plus considerable personnel safety factor.

The strength considerations of an ore feeder compared to a conventional chute are good. A feeder of comparable size on the Anaconda Smelter handles over 200 car loads of mine run ore a day with only slight and very infrequent repairs. During the time I worked around this feeder, we blasted several large boulders on it with no apparent damage.

This ore feeder would provide ample room for barring or removing large boulders. Several disadvantages encountered while building the model are: (1) To install the bin portion would be a rather difficult job, and the timber would have to be very exact to allow room for the installation; (2) If there was much lateral movement in the timber the bin may become shifted.

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\(^3\) Rood, A. D. , "Haulage," 3 - 1952.
\(^4\) Ibid.
so that the ore would not feed upon the belt.

Although there are decided disadvantages, similar problems are encountered with the conventional chute. Another factor which could be considered a possible disadvantage is that the chute and feeder would have to be removed after completion of mining. In the cases of heavy ground or a cave-in, very possibly a feeder would occasionally be lost.
Installation of a Pan Feeder Chute Gate

In general practice the chute and manway compartments are driven several floors and the pony sets are in place before the chute gate is installed. The standard practice of the mine for chute building would be followed up to the point where the chute bottom and chute gate would ordinarily be installed. From this point on the following method would be followed. The first piece to be installed would be the pan feeder; the reason for installing it first is that it is relatively heavy and there would be more room to get it into place. The pan feeder is small enough so that it could be brought into the mine completely assembled minus the motor. It would weigh about 3,200 pounds which would necessitate the use of two chain blocks to hoist it into place.

Three men would be required to install the pan feeder. The girt would have to be cut out of the set, and by fastening the chain blocks higher up the chute compartment the pan feeder could be hoisted into position. The miners could make a temporary support of the feeder by installing two stalls and the girt with supporting scabs as shown in figures one and two.
Fig. 1 Front View of Chute
Fig. 11 Side View of Chute.
The feeder would then be blocked between the caps and depending upon the exact pan feeder style which would be used, supporting U-bolts to the caps could be installed for added support. This should give the feeder sufficient support and rigidity; if calculated supports were required, a concrete foundation would be barely sufficient, but in actual practice a regular set will support a chute. The bin portion of the feeder could then be installed above the feeder by U-bolts and by bolting the bin together.

To evaluate the time required to install the motor is difficult, depending primarily on local union conditions. If an air motor was required this would add at least two or three more shifts against the chute. If an electric motor was used and an electrician required this would also add at a minimum two or three shifts. If on the other hand the miners were allowed to do their own work two days for three men should be sufficient.

To remove the pan feeder, two or three floors above the feeder would have to be empty and the chute should be bulk-headed off. The bin portion may be left in place depending upon its condition. If the bin was to be removed, the bolts could be cut off with a cutting torch and the pieces of the bin taken out. The chain blocks secured in the chute to the pan feeder, the supports cut away, and the pan feeder lowered to the sill ready for a new location.
The labor required to install the chute would be about six shifts or $150.00. The labor required to remove the chute would be about three shifts or $75.00.
The estimation of costs are taken from the Denver Equipment Company Handbook and these costs vary with local conditions but they seem for today's prices equitable.

<table>
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<tr>
<th>Item</th>
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<td>32,000</td>
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<tr>
<td>3 - 1 ft.² - 3/8 in. plate steel</td>
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Conclusion

The initial cost of the pan feeder is a very decided handicap but under proper conditions it could be a profitable investment. With greater safety, higher production, and less physical labor combined with a re-usable feature. It could possibly be made competitive with higher priced slusher methods.
Generalized View of Plate Construction

Side View

Front View

Scale 1" = 5'
Details of Chute Construction
Scale 1 in. = 3 ft
Plate II
Bibliography

