OVERBURDEN REMOVAL—BULLDOZERS

Operating Cost Equations: These equations provide the cost of excavating and relocating overburden using bulldozers. Costs are reported in dollars per loose cubic yard of overburden handled. The equations are applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by bulldozer.

The base equations assume the following:

1. No ripping.
2. Cutting distance, 50 ft.
3. Efficiency, 50 min/h.
4. Dozing distance, 300 ft.
5. Average operator ability.
6. Nearly level gradient.

Base Equations:

Equipment operating cost. . . $Y_E = 0.993(X)^{-0.430}$
Labor operating cost . . . . $Y_L = 14.01(X)^{-0.945}$

Equipment operating costs average 47% parts and 53% fuel and lubrication. Labor operating costs average 86% operator labor and 14% repair labor.

Distance Factor: If the average dozing distance is other than 300 ft, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_D = 0.00581(\text{distance})^{0.904}$.

Gradient Factor: If the average gradient is other than level, the factor obtained from the following equation must be appled to the total cost per loose cubic yard:

$F_G = 1.041e^{[0.015(\text{percent gradient})]}$.

Ripping Factor: If ripping is required, total operating cost must be multiplied by the following factor. This will account for the reduced productivity associated with ripping:

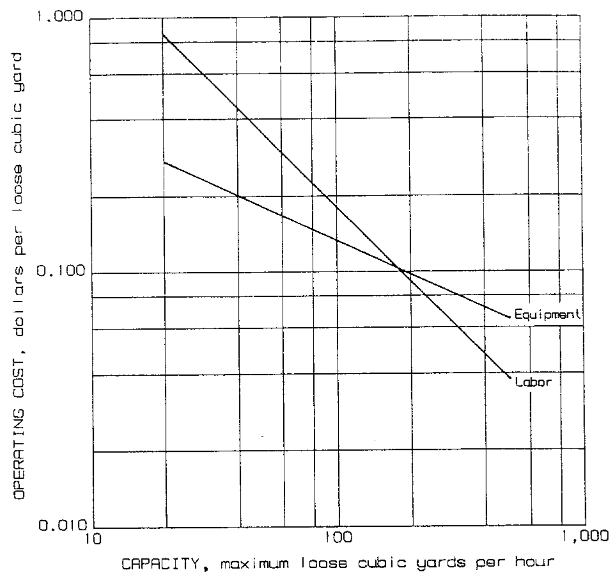
$F_R = 1.595$.

Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by the factors obtained from the following equations:

Equipment factor . . . . $U_e = 1.206(X)^{-0.013}$
Labor factor . . . . $U_l = 0.967(X)^{0.015}$

Digging Difficulty Factor: Parameters given in the discussion on site adjustment factors in section 1 should be used to determine if a digging difficulty factor is required. If so, one of the following should be applied to total cost per loose cubic yard:

F_H, easy digging .	0.830	F_H, medium-hard digging	1.250
F_H, medium digging	1.000	F_H, hard digging .	1.670



Overburden removal operating costs - Bulldozers

Total Cost: Cost per loose cubic yard of overburden is determined by

$$[Y_E(U_e) + Y_L(U_l)] \times F_D \times F_G \times F_H \times F_R.$$

The total cost per loose cubic yard must then be multiplied by the total yearly amount of *overburden* handled by bulldozer. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.

OVERBURDEN REMOVAL—DRAGLINES

Operating Cost Equations: These equations provide the cost of excavating overburden using draglines. Costs are reported in dollars per loose cubic yard of overburden handled. The equations are applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by dragline.

The base curves assume the following:

1. Bucket efficiency, 0.90.
2. Full hoist.
3. Swing angle, 90°.
4. Average operator ability.

Base Equations:

Equipment operating cost . . . $Y_E = 1.984(X)^{-0.390}$

Labor operating cost . . . . $Y_L = 12.19(X)^{-0.888}$

Equipment operating costs consist of 67% parts and 33% fuel and lubrication. Labor operating costs consist of 78% operator labor and 22% repair labor.

Swing Angle Factor: If average swing angle is other than 90°, the factor obtained from the following equation must be applied to the total cost per loose cubic yard:

$F_S = 0.304(\text{swing angle})^{0.269}$.

Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by the factors obtained from the following equations:

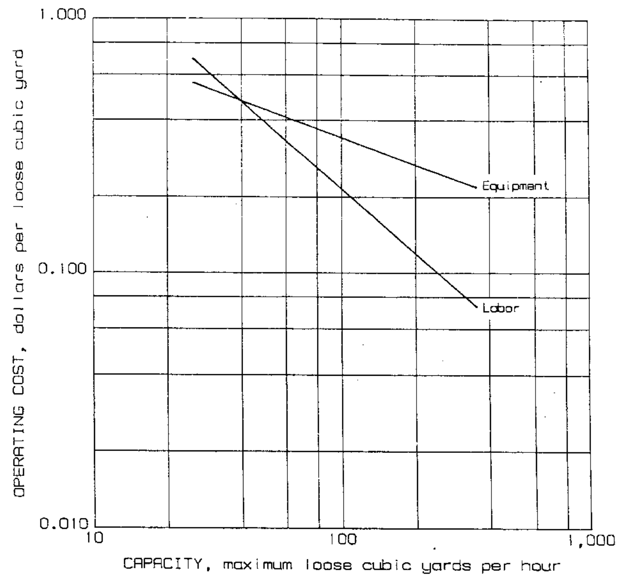
Equipment factor . . . . $U_e = 1.162(X)^{-0.017}$

Labor factor . . . . $U_l = 0.989(X)^{0.006}$

Total Cost: Cost per loose cubic yard of overburden is determined by

$$[Y_E(U_e) + Y_L(U_l)] \times F_S.$$

The total cost per loose cubic yard must then be multiplied by the total yearly amount of *overburden* handled by dragline. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Overburden removal operating costs - Draglines

OVERBURDEN REMOVAL—FRONT-END LOADERS

Operating Cost Equations: These equations provide the cost of relocating overburden using wheel-type front-end loaders. Costs are reported in dollars per loose cubic yard of overburden handled. The equations are applied to the following variable:

X=Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by front-end loader.

The base equations assume the following:

1. Haul distance, 500 ft.
2. Rolling resistance, 2%, nearly level gradient.
3. Inconsistent operation.
4. Wheel-type loader

Base Equations:

Equipment operating cost . . . $Y_E=0.407(X)^{-0.225}$
Labor operating cost . . . . $Y_L=13.07(X)^{-0.936}$

Equipment operating costs average 22% parts, 46% fuel and lubrication, and 32% tires. Labor operating costs average 90% operator labor and 10% repair labor.

Distance Factor: If average haul distance is other than 500 ft, the factor obtained from the following equation must be applied to the total cost per loose cubic yard:

$F_D=0.023(\text{distance})^{0.616}$.

Gradient Factor: If total gradient (gradient plus rolling resistance) is other than 2%, the factor obtained from the following equation must be applied to the total cost per loose cubic yard:

$F_G=0.877e^{[0.046(\text{percent gradient})]}$.

Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by the factors obtained from the following equations:

Equipment factor . . . . $U_e = 1.162(X)^{-0.017}$
Labor factor . . . . $U_l = 0.989(X)^{0.006}$

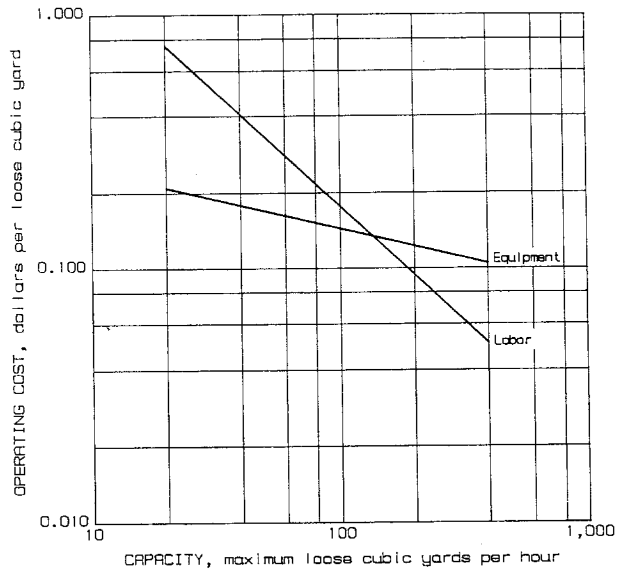
Track-Type Loader Factor: If track-type loaders are used, the following factors must be applied to the total cost obtained from the base equations:

Equipment factor . . . . $T_e=1.378$
Labor factor . . . . $T_l=1.073$

Total Cost: Cost per loose cubic yard of overburden is determined by

$$[Y_E(U_e)(T_e) + Y_L(U_l)(T_l)] \times F_D \times F_G.$$

The total cost per loose cubic yard must then be multiplied by the total yearly amount of *overburden* handled by dragline. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Overburden removal operating costs - Front-end loaders

OVERBURDEN REMOVAL—REAR-DUMP TRUCKS

Operating Cost Equations: These equations provide the cost of hauling overburden using rear-dump trucks. Costs are reported in dollars per loose cubic yard of overburden handled. The equations are applied to the following variable:

X=Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by rear dump truck.

The base equations assume the following:

1. Haul distance, 2,500 ft.
2. Loader cycles to fill, 4.
3. Efficiency, 50 min/h.
4. Average operator ability.
5. Nearly level gradient.

Base Equations:

Equipment operating cost . . . $Y_E=0.602(X)^{-0.296}$
Labor operating cost . . . . $Y_L=11.34(X)^{-0.891}$

Equipment operating costs consist of 28% parts, 58% fuel and lubrication, and 14% tires. Labor operating costs consist of 82% operator labor and 18% repair labor.

Distance Factor: If average haul distance is other than 2,500 ft, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_D=0.093(\text{distance})^{0.311}$.

Gradient Factor: If total gradient (gradient plus rolling resistance) is other than 2%, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_G=0.907e^{[0.049(\text{percent gradient})]}$.

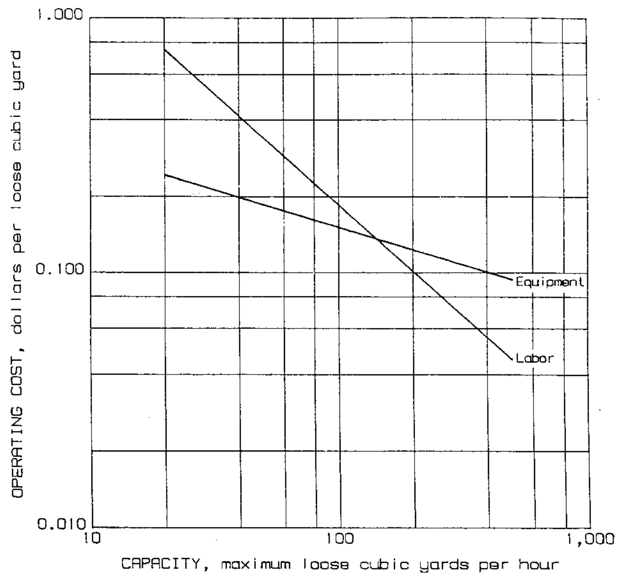
Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by the factors obtained from the following equations:

Equipment factor . . . . $U_e=0.984(X)^{-0.016}$
Labor factor . . . . $U_l=0.943(X)^{0.021}$

Total Cost: Cost per loose cubic yard of overburden is determined by

$$[Y_E(U_e+Y_L(U_l)] \times F_D \times F_G.$$

The total cost per loose cubic yard must then be multiplied by the total yearly amount of *overburden* handled by truck. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Overburden removal operating costs - Rear-dump trucks

OPERATING COSTS

OVERBURDEN REMOVAL—SCRAPERS

Operating Cost Equations: These equations provide the cost of excavating and hauling overburden using scrapers. Costs are reported in dollars per loose cubic yard of overburden handled. The equations are applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by scraper.

The base curves assume the following:

1. Standard scrapers.
2. Rolling resistance, 6%, nearly level gradient.
3. Efficiency, 50 min/h.
4. Haul distance, 1,000 ft.
5. Average operator ability.

Base Equations:

Equipment operating cost . . . $Y_E=0.325(X)^{-0.210}$
Labor operating cost . . . . $Y_L=12.01(X)^{-0.930}$

Equipment operating costs consist of 48% fuel and lubrication, 34% tires, and 18% parts. Labor operating costs consist of 88% operator labor and 12% repair labor.

Distance Factor: If average haul distance is other than 1,000 ft, the factor obtained from the following equation must be applied to the total cost per loose cubic yard:
$F_D=0.01947(\text{distance})^{0.577}$.

Gradient Factor: If total gradient (gradient plus rolling resistance) is other than 6%, the factor obtained from the following equation must be applied to the total cost per loose cubic yard:
$F_G=0.776e^{[0.047(\text{percent gradient})]}$.

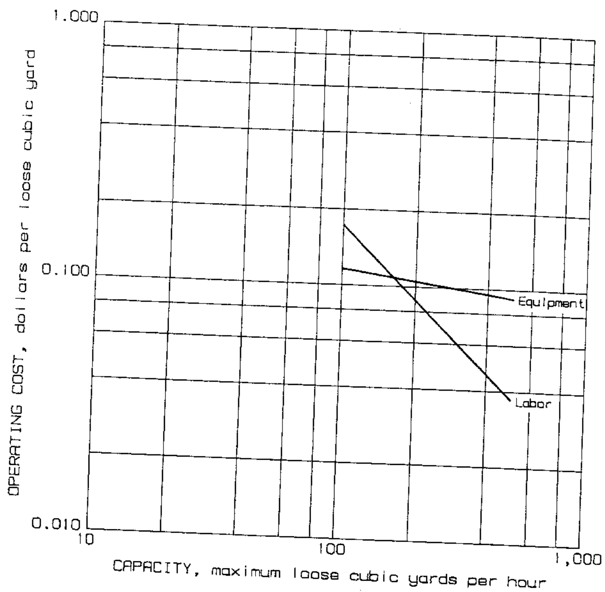
Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by the factors obtained from the following equations:

Equipment factor . . . . $U_e=1.096(X)^{-0.006}$
Labor factor . . . . $U_l=0.845(X)^{0.034}$

Total Cost: Cost per loose cubic yard of overburden is determined by

$$[Y_E(U_e) + Y_L(U_l)] \times F_D \times F_G.$$

The total cost per loose cubic yard must then be multiplied by the total yearly amount of *overburden* handled by scraper. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Overburden removal operating costs - Scrapers

MINING—BACKHOES

Operating Cost Equations: These equations provide the cost of excavating pay gravel using backhoes. Costs are reported in dollars per loose cubic yard of pay gravel handled. The equations are applied to the following variable:

X=Maximum loose cubic yards of pay gravel moved hourly by backhoe.

The base equations assume the following:

1. Easy digging difficulty.
2. Swing angle, 60° to 90°.
3. Up to 50% of maximum digging depth.
4. Average operator ability.
5. No obstructions (boulders, tree roots, etc.).

Base Equations:

95–200 LCY/h:

Equipment operating cost . . . $Y_E=8.360(X)^{-1.019}$
Labor operating cost . . . . $Y_L=17.53(X)^{-1.009}$

175–275 LCY/h:

Equipment operating cost . . . $Y_E=11.44(X)^{-1.021}$
Labor operating cost . . . . $Y_L=17.25(X)^{-1.000}$

250–375 LCY/h:

Equipment operating cost . . . $Y_E=15.17(X)^{-1.003}$
Labor operating cost . . . . $Y_L=19.97(X)^{-1.017}$

350–475 LCY/h:

Equipment operating cost . . . $Y_E=22.59(X)^{-0.995}$
Labor operating cost . . . . $Y_L=16.55(X)^{-0.977}$

Equipment operating costs consist of 38% parts and 62% fuel and lubrication. Labor operating costs consist of 88% operator labor and 12% repair labor.

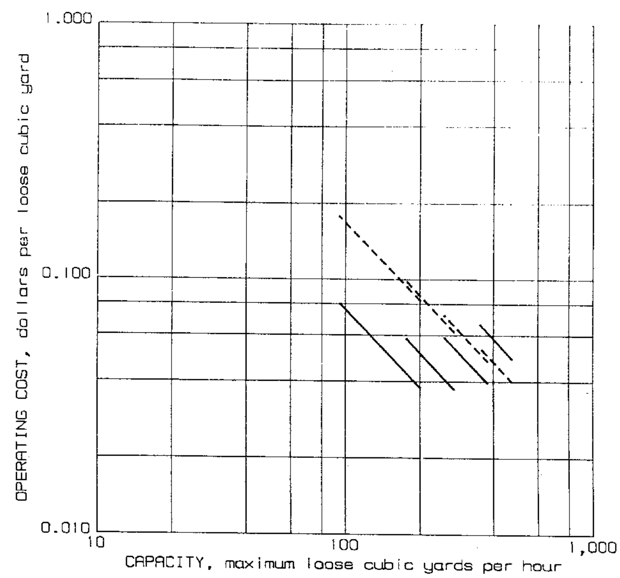
Digging Depth Factor: If average digging depth is other than 50% of maximum, the factor obtained from the following equation must be applied to the total cost per loose cubic yard of pay gravel:

$F_D=0.09194(\text{percent of maximum digging depth})^{0.608}$.

Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by the factors obtained from the following equations:

Equipment factor . . . . $U_e=1.078(X)^{-0.003}$
Labor factor . . . . $U_l=0.918(X)^{0.021}$

Digging Difficulty Factor: Parameters given in the discussion on site adjustment factors in section 1 should be used to determine if a digging difficulty factor is required.



Mining operating costs - Backhoes

If so, one of the following should be applied to total cost per loose cubic yard of pay gravel:

F_H, easy digging . . . 1.000
F_H, medium digging 1.250
F_H, medium-hard digging 1.500
F_H, hard digging 1.886

Total Cost: Cost per loose cubic yard of pay gravel is determined by

$$[Y_e(U_e) + Y_L(U_l)] \times F_D \times F_H.$$

The total cost per loose cubic yard must then be multiplied by the total yearly amount of *pay gravel* handled by backhoe. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.

MINING—BULLDOZERS

Operating Cost Equations: These equations provide the cost of excavating and relocating pay gravel using bulldozers. Costs are reported in dollars per loose cubic yard of pay gravel handled. The equations are applied to the following variable:

X=Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by bulldozer.

The base equations assume the following:

1. No ripping.
2. Cutting distance, 50 ft.
3. Efficiency, 50 min/h.
4. Dozing distance, 300 ft.
5. Average operator ability.
6. Nearly level gradient.

Base Equations:

Equipment operating cost . . . $Y_E=0.993(X)^{-0.430}$
Labor operating cost . . . . $Y_L=14.01(X)^{-0.945}$

Equipment operating costs average 47% parts and 53% fuel and lubrication. Labor operating costs average 86% operator labor and 14% repair labor.

Distance Factor: If average dozing distance is other than 300 ft, the factor obtained from the following equation must be applied to the total cost per loose cubic yard:

$F_D=0.00581(\text{distance})^{0.904}$.

Gradient Factor: If average gradient is other than level, the factor obtained from the following equation must be applied to the total cost per loose cubic yard:

$F_G=1.041e^{[0.015(\text{percent gradient})]}$.

Ripping Factor: If ripping is required, total operating cost must be multiplied by the following factor. This will account for reduced productivity associated with ripping:

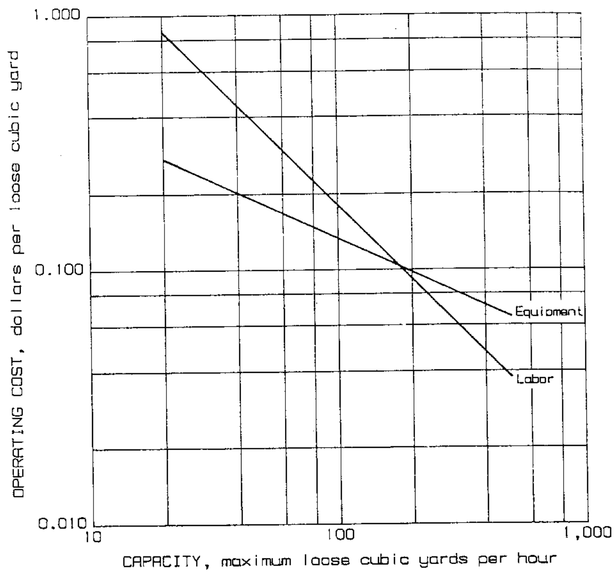
$F_R=1.595$.

Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by the factors obtained from the following equations:

Equipment factor . . . . $U_e=1.206(X)^{-0.013}$
Labor factor . . . . $U_l=0.967(X)^{0.015}$

Digging Difficulty Factor: Parameters given in the discussion on site adjustment factors in section 1 should be used to determine if a digging difficulty factor is required If so, one of the following should be applied to total cost per loose cubic yard.

F_H, easy digging . . . 0.830
F_H, medium digging 1.000
F_H, medium-hard digging 1.250
F_H, hard digging 1.670



Mining operating costs - Bulldozers

Total Cost: Cost per loose cubic yard of pay gravel is determined by

$$[Y_E(U_e)+Y_L(U_l)]\times F_D\times F_G\times F_H\times F_R.$$

The total cost per loose cubic yard must then be multiplied by total yearly amount of *pay gravel* handled by bulldozer. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.

MINING—DRAGLINES

Operating Cost Equations: These equations provide the cost of excavating pay gravel using draglines. Costs are reported in dollars per loose cubic yard of pay gravel handled. The equations are applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by dragline.

The base curves assume the following:

1. Bucket efficiency, 0.90.
2. Full hoist
3. Swing angle, 90°.
4. Average operator ability.

Base Equations:

Equipment operating cost... $Y_E=1.984(X)^{-0.390}$
Labor operating cost .... $Y_L=12.19(X)^{-0.888}$

Equipment operating costs consist of 67% parts and 33% fuel and lubrication. Labor operating costs consist of 78% operator labor and 22% repair labor.

Swing Angle Factor: If the average swing angle is other than 90°, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_S=0.304(\text{swing angle})^{0.269}$.

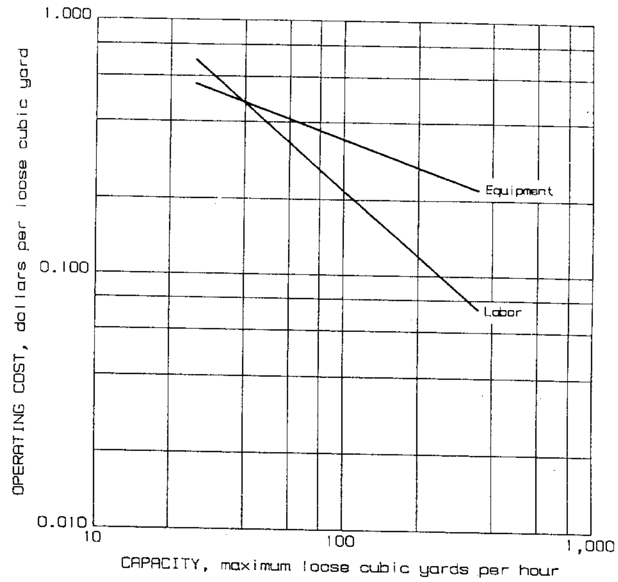
Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by the factors obtained from the following equations:

Equipment factor .... $U_e=1.162(X)^{-0.017}$
Labor factor .... $U_l=0.989(X)^{0.006}$

Total Cost: Cost per loose cubic yard of pay gravel is determined by

$$[Y_E(U_e)+Y_L(U_l)]\times F_S.$$

The total cost per loose cubic yard must then be multiplied by the total yearly amount of *pay gravel* handled by dragline. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Mining operating costs - Draglines

MINING—FRONT-END LOADERS

Operating Cost Equations: These equations provide the cost of hauling pay gravel using wheel-type front-end loaders. Costs are reported in dollars per loose cubic yards of pay gravel handled. The equations are applied to the following variable:

X=Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by front-end loaders.

The base equations assume the following:

1. Haul distance, 500 ft.
2. Rolling resistance, 2%, nearly level gradient.
3. Inconsistent operation.
4. Wheel-type loader.

Base Equations:

Equipment operating costs . . $Y_E = 0.407(X)^{-0.225}$

Labor operating costs . . . . . . $Y_L = 13.07(X)^{-0.936}$

Equipment operating costs average 22% parts, 46% fuel and lubrication, and 32% tires. Labor operating costs average 90% operator labor and 10% repair labor.

Distance Factor: If the average haul distance is other than 500 ft, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_D = 0.023(\text{distance})^{0.616}$.

Gradient Factor: If total gradient (gradient plus rolling resistance) is other than 2%, the factor obtained from the following equation must be applied to the total cost per loose cubic yard:

$F_G = 0.877e^{[0.046(\text{percent gradient})]}$.

Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by factors obtained from the following equations:

Equipment factor . . . . $U_e = 1.162(X)^{-0.017}$
Labor factor . . . . $U_l = 0.989(X)^{0.006}$

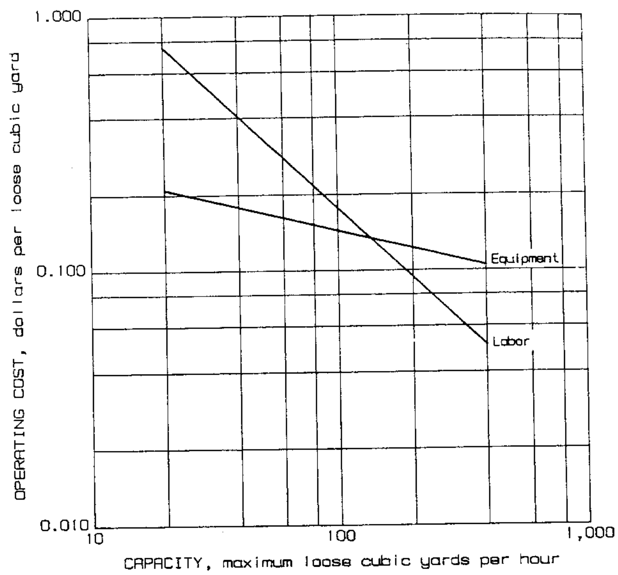
Track-Type Loader Factor: If track-type loaders are used, the following factors must be applied to total cost obtained from the base equations:

Equipment factor . . . . $T_e = 1.378$
Labor factor . . . . $T_l = 1.073$

Total Cost: Cost per loose cubic yard of pay gravel is determined by

$$[Y_E(U_e)(T_e) + Y_L(U_l)(T_l)] \times F_D \times F_G.$$

The total cost per loose cubic yard must then be multiplied by total yearly amount of *pay gravel* handled by front-end loader. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Mining operating costs - Front-end loaders

MINING—REAR-DUMP TRUCKS

Operating Cost Equations: These equations provide the cost of hauling pay gravel using rear-dump trucks. Costs are reported in dollars per loose cubic yard of pay gravel. The equations are applied to the following variable:

X=Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by rear dump truck.

The base equations assume the following:

1. Haul distance, 2,500 ft.
2. Loader cycles to fill, 4.
3. Efficiency, 50 min/h.
4. Average operator ability.
5. Rolling resistance, 2%, nearly level gradient.

Base Equations:

Equipment operating cost... $Y_E=0.602(X)^{-0.296}$
Labor operating cost .... $Y_L=11.34(X)^{-0.891}$

Equipment operating costs consist of 28% parts, 58% fuel and lubrication, and 14% tires. Labor operating costs consist of 82% operator labor and 18% repair labor.

Distance Factor: If average haul distance is other than 2,500 ft, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_D=0.093(\text{distance})^{0.311}$.

Gradient Factor: If total gradient (gradient plus rolling resistance) is other than 2%, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_G=0.907e^{[0.049(\text{percent gradient})]}$.

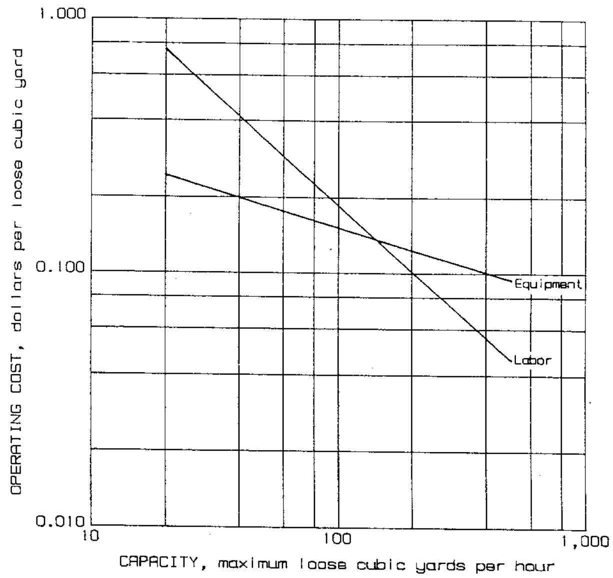
Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by factors obtained from the following equations:

Equipment factor.......... $U_e=0.984(X)^{-0.016}$
Labor factor .... $U_l=0.943(X)^{0.021}$

Total Cost: Cost per loose cubic yard of pay gravel is determined by

$$[Y_E(U_e)+Y_L(U_l)]\times F_D\times F_G.$$

The total cost per loose cubic yard must then be multiplied by the total yearly amount of *pay gravel* handled by rear-dump truck. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Mining operating costs - Rear-dump trucks

MINING—SCRAPERS

Operating Cost Equations: These equations provide the cost of excavating and hauling pay gravel using scrapers. Costs are reported in dollars per loose cubic yard of pay gravel handled. The equations are applied to the following variables:

X = Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by scraper.

The base equations assume the following:

1. Standard scrapers.
2. Rolling resistance, 6%, nearly level gradient.
3. Efficiency, 50 min/h.
4. Haul distance, 1,000 ft.
5. Average operator ability.

Base Equations:

Equipment operating cost . . . $Y_E = 0.325(X)^{-0.210}$

Labor operating cost . . . . $Y_L = 12.01(X)^{-0.930}$

Equipment operating costs consist of 48% fuel and lubrication, 34% tires, and 18% parts. Labor operating costs consist of 88% operator labor and 12% repair labor.

Distance Factor: If average haul distance is other than 1,000 ft, the factor obtained from the following equation must be applied to the total cost per loose cubic yard:

$F_D = 0.01947(\text{distance})^{0.577}$.

Gradient Factor: If total gradient (gradient plus rolling resistance) is other than 6%, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_G = 0.776e^{[0.047(\text{percent gradient})]}$.

Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by factors obtained from the following equations:

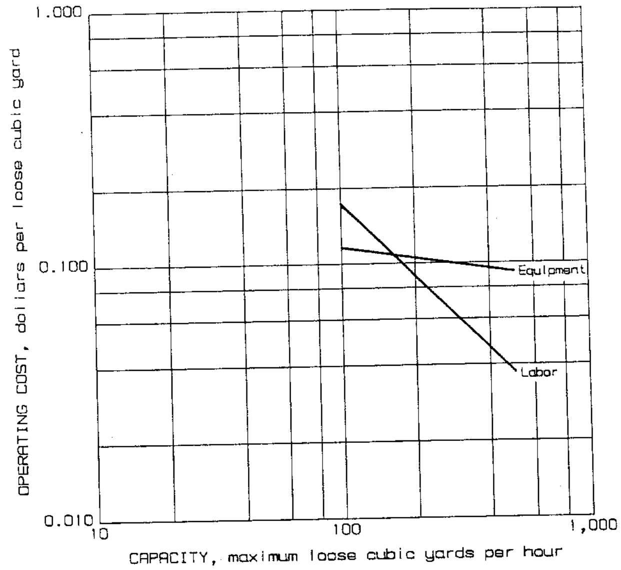
Equipment factor . . . . $U_e = 1.096(X)^{-0.006}$

Labor factor . . . . $U_l = 0.845(X)^{0.034}$

Total Cost: Cost per loose cubic yard of pay gravel is determined by

$$[Y_E(U_e) + Y_L(U_l)] \times F_D \times F_G.$$

The total cost per loose cubic yard must then be multiplied by the total yearly amount of *pay gravel* handled by scraper. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Mining operating costs - Scrapers

PROCESSING—CONVEYORS

Operating Cost Equations: These equations provide the cost of moving gravel using conveyors. Costs are reported in dollars per cubic yard of gravel handled and include the operating cost of the conveyor along with the drive. The equations are applied to the following variable:

X = Maximum cubic yards of material moved hourly by conveyor.

The base equations assume the following:

1. Conveyors, 40 ft long.
2. Feed, 3,120 lb/yd³.
3. Nearly level setup.

Base Equations:

Equipment operating cost . . . $Y_E = 0.218(X)^{-0.561}$
Labor operating cost . . . . $Y_L = 0.250(X)^{-0.702}$

Equipment operating costs average 72% parts, 24% electricity, and 4% lubrication. Labor operating costs consist entirely of repair labor.

Conveyor Length Factor: If conveyor length is other than 40 ft, factors obtained from the following equations must be applied to respective portions of the operating costs. These factors are valid for conveyors 10 to 100 ft long:

Equipment factor . . . . $L_e = 0.209(\text{length})^{0.431}$
Labor factor . . . . $L_l = 0.245(\text{length})^{0.390}$

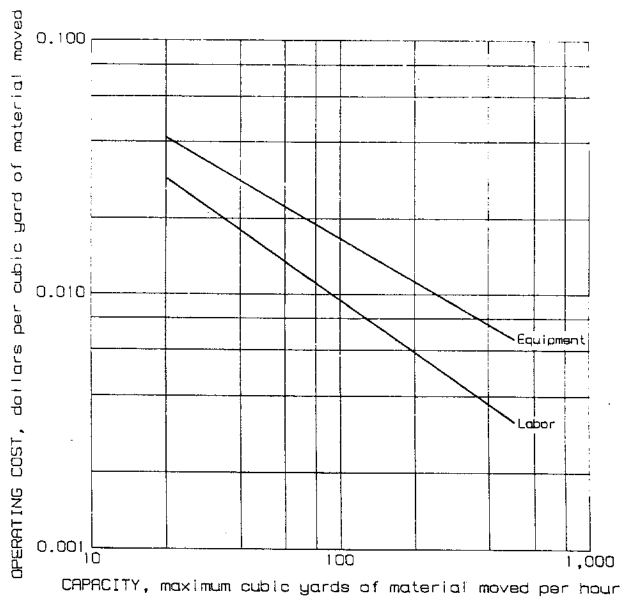
Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of base operating costs must be multiplied by the following factors:

Equipment factor . . . . $U_e = 1.155$
Labor factor . . . . $U_l = 1.250$

Total Cost: Cost per cubic yard of gravel is determined by

$$[Y_E(L_e)(U_e) + Y_L(L_l)(U_l)].$$

The total cost per cubic yard must then be multiplied by the total yearly amount of *feed* handled by conveyor. (A separate operating and total yearly cost must be calculated for each conveyor in the circuit.) This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Processing operating costs - Conveyors

OPERATING COSTS

PROCESSING—FEED HOPPERS

Operating Cost Equations: These equations provide cost of material transfer using vibrating feeders. Costs are reported in dollars per cubic yard of feed and include the operating cost of the hopper, feeder, and drive motor. The equations are applied to the following variable:

X = Maximum cubic yards of feed handled hourly by feed hopper.

The base equations assume the following:

1. Unsized feed.
2. Feed solids, 2,300 lb/yd^3.

Base Equations:

Equipment operating cost . . . $Y_E = 0.033(X)^{-0.344}$
Labor operating cost . . . . $Y_L = 0.017(X)^{-0.295}$

Equipment operating costs consist of 88% parts, 6% electricity, and 6% lubrication. Labor operating costs consist entirely of repair labor.

Hopper Factor: In many installations, a vibrating feeder is not used, and pay gravel feeds directly from the hopper. If this is the case, no operating cost for feeders is required.

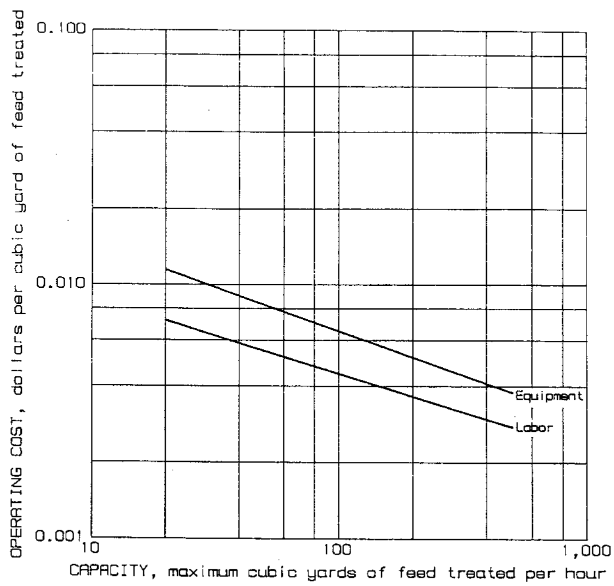
Used Equipment Factor: If a feeder with over 10,000 h of previous service life is to be used, the following factors must be applied to respective operating costs to account for increased maintenance and repair requirements:

Equipment factor . . . . $U_e = 1.176$
Labor factor . . . . $U_l = 1.233$

Total Cost: Cost per cubic yard of feed is determined by

$$[Y_E(U_e) + Y_L(U_l)].$$

The total cost per cubic yard must then be multiplied by total yearly amount of *feed* handled by feed hopper. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Processing operating costs - Feed hoppers

PROCESSING—JIG CONCENTRATORS

Operating Cost Equations: These equations provide the cost of gravity separation using jig concentrators. Costs are reported in dollars per cubic yard and include the operating cost of the jigs and associated drive motors. The equations are applied to the following variable:

X = Maximum cubic yards of feed handled hourly by jig concentrators.

The base equations assume the following:

1. Cleaner service.
2. Hourly capacity, 0.617 yd^3/ft^2.
3. Feed solids, 3,400 lb/yd^3.
4. Slurry density, 40% solids.
5. Gravity feed.

Base Equations:

Equipment operating cost . . . $Y_E = 0.113(X)^{-0.328}$
Supply operating cost . . . . . . $Y_S = 0.002(X)^{-0.184}$
Labor operating cost . . . . $Y_L = 3.508(X)^{-1.268}$

Equipment operating costs consist of 40% parts, 34% electricity, and 26% lubrication. Supply operating costs consist entirely of lead shot for bedding material. Labor operating costs consist of 66% operator labor and 34% repair labor.

Rougher-Coarse Factor: If jigs are to be used for rougher service or a coarse feed, higher productivity will be realized. To compensate for this situation, the following factor must be applied to total operating cost:

$F_R = 0.344.$

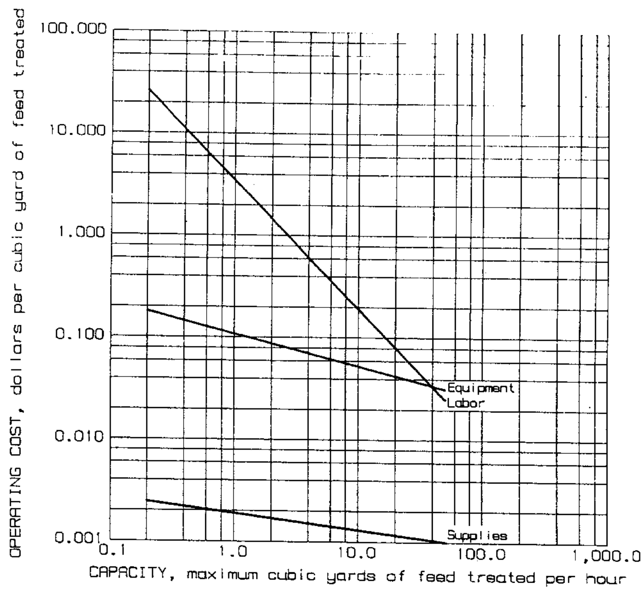
Used Equipment Factor: If jig concentrators with over 10,000 h of service life are to be used, the following factors must be applied to respective operating costs to account for increased maintenance and repair requirements:

Equipment factor . . . . $U_e = 1.096$
Labor factor . . . . $U_l = 1.087$

Total Cost: Cost per cubic yard of feed is determined by

$$[Y_E(U_e) + Y_S + Y_L(U_l)] \times F_R.$$

The total cost per cubic yard must then be multiplied by the total yearly amount of *feed* handled by jig concentrators. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Processing operating costs - Jig concentrators

PROCESSING—SLUICES

Operating Cost Equations: These equations provide the cost of gravity separation using sluices. Costs are reported in dollars per cubic yard of feed and consist entirely of the expense of periodic concentrate cleanup. The equation is applied to the following variable:

X = Maximum cubic yards feed handled hourly by sluice.

The base equations assume the following:

1. Steel plate construction.
2. Angle iron riffles.
3. Feed solids, 3,400 lb/yd^3.
4. Length-to-width ratio, 4:1.
5. Gravity feed.

Base Equation:

Labor operating cost . . . $Y_L = 0.337(X)^{-0.636}$

Labor operating costs consist entirely of feed adjustment and cleanup labor. Costs of maintenance labor and parts are negligible.

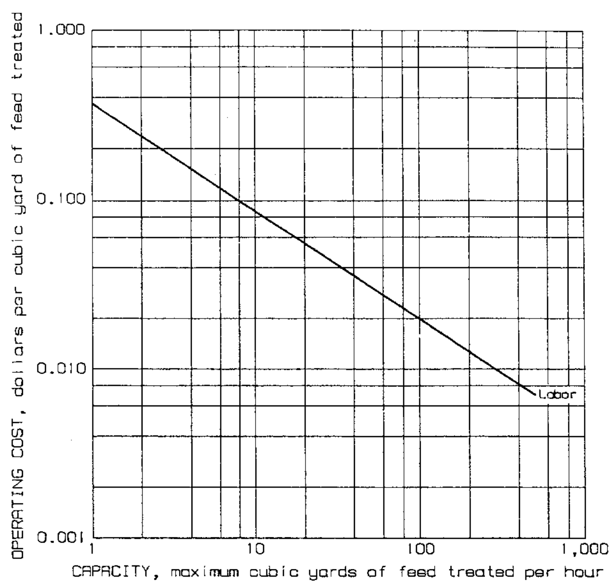
Wood Sluice Factor: If wood sluices are to be used, an allowance must be made for periodic sluice replacement. To account for this, an equipment cost must be added to total cost, and labor cost must be multiplied by the following factor:

Equipment cost . . . . $Y_E = 0.00035(X)^{0.383}$
Labor factor . . . . $W_l = 1.141$

Total Cost: Cost per cubic yard of feed is determined by

$$[Y_L(W_l) + Y_E].$$

The total cost per cubic yard must then be multiplied by total yearly amount of *feed* handled by sluices. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Processing operating costs - Sluices

PROCESSING—SPIRAL CONCENTRATORS

Operating Cost Equations: These equations provide the cost of gravity separation using spiral concentrators. Costs are reported in dollars per cubic yard of feed and include the operating cost of the spirals and slurry splitters only. The equations are applied to the following variable:

X = Maximum cubic yards of feed handled hourly by spiral concentrators.

The base equations assume the following:

1. Rougher service.
2. Solids per start, 1.75 st/h.
3. Feed solids, 3,400 lb/yd³.
4. Slurry density, 10% solids.
5. Gravity feed.

Base Equations:

Equipment operating cost... $Y_E = \$0.0007/yd^3$
Labor operating cost .... $Y_L = 0.755(X)^{-0.614}$

Equipment operating costs consist entirely of parts. Labor operating costs consist entirely of operator labor, with the operator performing functions such as lining replacement.

Cleaner-Scavenger Factor: If spirals are to be used for cleaning or scavenging, throughput is reduced. The following factors must be applied to respective operating costs:

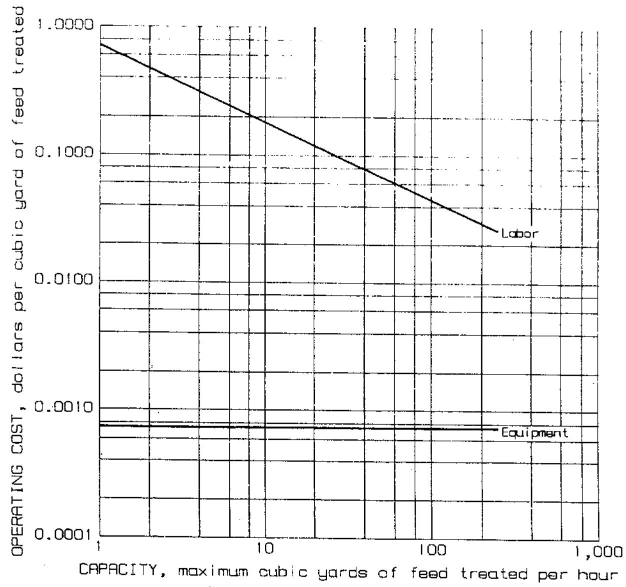
Equipment factor.......... $C_e = 2.429$
Labor factor .... $C_l = 1.796$

Used Equipment Factor: Because spiral concentrators have no moving parts, they enjoy a long service life. Generally, only the liners require periodic replacement. For this reason, the operating costs asscociated with spirals are typically constant throughout the life of the machine.

Total Cost: Cost per cubic yard of feed is determined by

$$[0.0007(C_e) + Y_L(C_l)].$$

The total cost per cubic yard must then be multiplied by the total yearly amount of *feed* handled by spiral concentrators. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Processing operating costs - Spiral concentrators

OPERATING COSTS

PROCESSING—TABLE CONCENTRATORS

Operating Cost Equations: These equations provide the cost of gravity separation using table concentrators. Costs are reported in dollars per cubic yard of feed and include the operating cost of the tables and associated drive motors. The equations are applied to the following variable:

X = Maximum cubic yards of feed handled hourly by table concentrators.

The base equations assume the following:

1. Cleaner service.
2. Feed solids, 3,400 lb/yd^3.
3. Slurry density, 25% solids.
4. Gravity feed.

Base Equations:

Equipment operating cost . . . $Y_E = 1.326(X)^{-0.443}$
Labor operating cost . . . . $Y_L = 1.399(X)^{-0.783}$

Equipment operating costs consist of 87% parts, 7% electricity, and 6% lubrication. Labor operating costs consist of 67% operator labor and 33% repair labor.

Rougher-Coarse Factor: If the tables are to be used for rougher service or a coarse feed, higher productivity will be realized. To compensate for this situation, the following factors must be applied to both equipment and labor operating costs:

Equipment factor . . . . $R_e = 0.415$
Labor factor . . . . $R_l = 0.415$

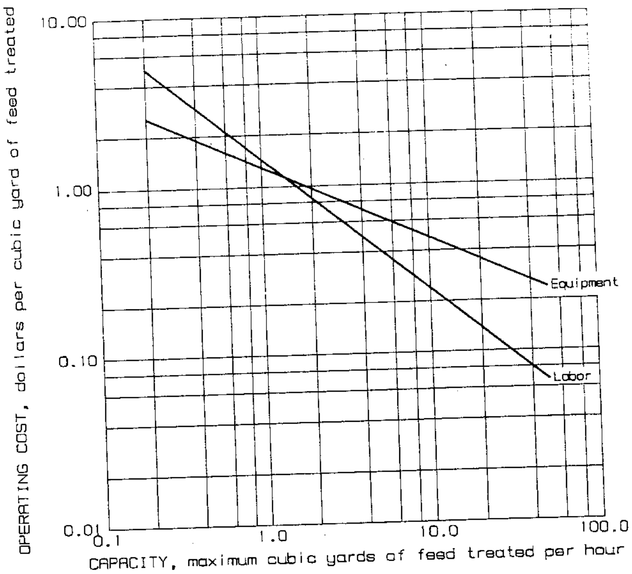
Used Equipment Factor: If table concentrators with over 10,000 h of service life are to be used, the following factors must be applied to the respective operating costs to account for increased maintenance and repair requirements:

Equipment factor . . . . $U_e = 1.217(X)^{-0.002}$
Labor factor . . . . $U_l = 1.121(X)^{-0.026}$

Total Cost: Cost per cubic yard of feed is determined by

$$[Y_E(R_e)(U_e)+Y_L(R_l)(U_l)].$$

The total cost per cubic yard must then be multiplied by the total yearly amount of *feed* handled by table concentrators. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Processing operating costs - Table concentrators

PROCESSING—TAILINGS REMOVAL—BULLDOZERS

Operating Cost Equations: These equations provide the cost of removing and relocating tailings using bulldozers. Costs are reported in dollars per cubic yard of tailings moved. The equations are applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by bulldozer.

The base equations assume the following:

1. Efficiency, 50 min/h.
2. Dozing distance, 300 ft.
3. Average operator ability.
4. Nearly level gradient.

Base Equations:

Equipment operating cost... $Y_E = 0.993(X)^{-0.430}$
Labor operating cost .... $Y_L = 14.01(X)^{-0.945}$

Equipment operating costs average 47% parts, and 53% fuel and lubrication. Labor operating costs average 86% operator labor and 14% repair labor.

Distance Factor: If average dozing distance is other than 300 ft, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_D=0.00581(\text{distance})^{0.904}$.

Gradient Factor: If average gradient is other than level, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_G=1.041e^{[0.015(\text{percent gradient})]}$.

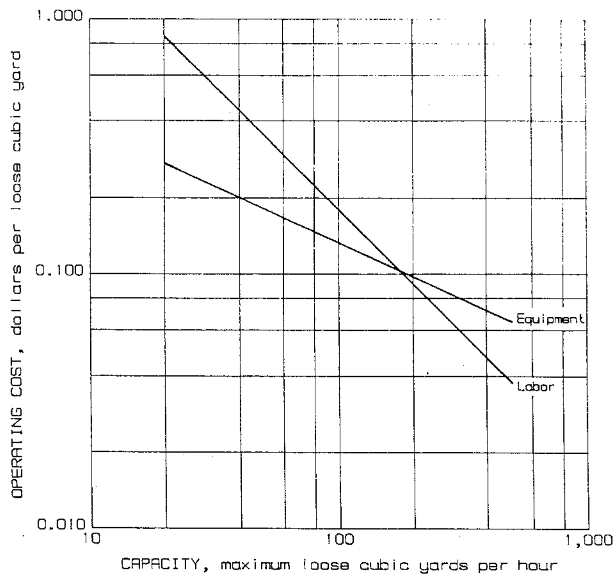
Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by factors obtained from the following equations:

Equipment factor .... $U_e=1.206(X)^{-0.013}$
Labor factor .... $U_l=0.967(X)^{0.015}$

Total Cost: Cost per cubic yard of tailings is determined by

$$[Y_E(U_e) + Y_L(U_l)] \times F_D \times F_G.$$

The total cost per cubic yard must then be multiplied by the total yearly amount of *tailings* moved by bulldozer. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Processing operating costs - Tailings removal - Bulldozers

PROCESSING—TAILINGS REMOVAL—DRAGLINES

Operating Cost Equations: These equations provide the cost of removing and relocating tailings using draglines. Costs are reported in dollars per cubic yard of tailings moved. The equations are applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by dragline.

The base equations assume the following:

1. Bucket efficiency, 0.90.
2. Full hoist.
3. Swing angle, 90°.
4. Average operator ability.

Base Equations:

Equipment operating cost . . . $Y_E = 1.984(X)^{-0.390}$
Labor operating cost . . . . $Y_L = 12.19(X)^{-0.888}$

Equipment operating costs consist of 67% parts, 33% fuel and lubrication. Labor operating costs consist of 78% operator labor and 22% repair labor.

Swing Angle Factor: If average swing angle is other than 90°, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_S = 0.304(\text{swing angle})^{0.269}$.

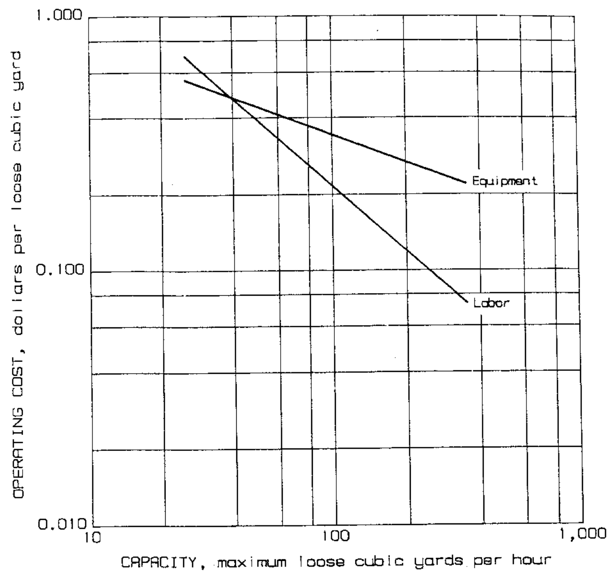
Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by factors obtained from the following equations:

Equipment factor . . . . $U_e = 1.162(X)^{-0.017}$
Labor factor . . . . $U_l = 0.989(X)^{0.006}$

Total Cost: Cost per cubic yard of feed is determined by

$$[Y_E(U_e) + Y_L(U_l)] \times F_S.$$

The total cost per cubic yard must then be multiplied by the total yearly amount of *tailings* moved by dragline. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Processing operating costs - Tailings removal - Draglines

PROCESSING—TAILINGS REMOVAL—FRONT-END LOADERS

Operating Cost Equations: These equations provide the cost of removing and relocating tailings using wheel-type front-end loaders. Costs are reported in dollars per cubic yard of tailings moved. The equations are applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by front-end loader.

The base equations assume the following:

1. Haul distance, 500 ft.
2. Rolling resistance, 2%, nearly level gradient.
3. Inconsistent operation.
4. Wheel-type loader.

Base Equations:

Equipment operating cost . . . $Y_E = 0.407(X)^{-0.225}$
Labor operating cost . . . . $Y_L = 13.07(X)^{-0.936}$

Equipment operating costs average 22% parts, 46% fuel and lubrication, and 32% tires. Labor operating costs average 90% operator labor and 10% repair labor.

Distance Factor: If average haul distance is other than 500 ft, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_D = 0.023(\text{distance})^{0.616}$.

Gradient Factor: If total gradient (gradient plus rolling resistance) is other than 2%, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_G = 0.877e^{[0.046(\text{percent gradient})]}$.

Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by factors obtained from the following equations:

Equipment factor . . . . $U_e = 1.162(X)^{-0.017}$
Labor factor . . . . $U_l = 0.989(X)^{0.006}$

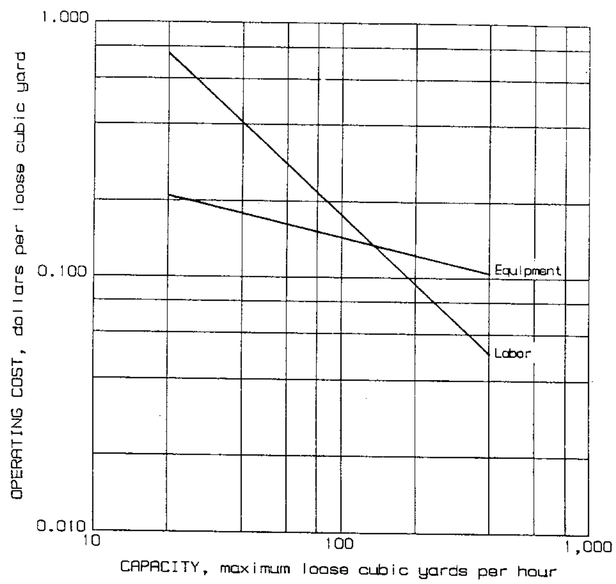
Track-Type Loader Factor: If track-type loaders are used, the following factors must be applied to total cost obtained from the base equations:

Equipment factor . . . . $T_e = 1.378$
Labor factor . . . . $T_l = 1.073$

Total Cost: Cost per cubic yard of tailings is determined by

$$[Y_E(U_e)(T_e) + Y_L(U_l)(T_l)] \times F_D \times F_G.$$

The total cost per cubic yard must then be multiplied by the total yearly amount of *tailings* moved by front-end loader. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Processing operating costs - tailings removal - Front-end loaders

PROCESSING—TAILINGS REMOVAL—REAR-DUMP TRUCKS

Operating Cost Equations: These equations provide the cost of removing and relocating tailings using rear-dump trucks. Costs are reported in dollars per cubic yard of tailings moved. The equations are applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by rear-dump truck.

The base equations assume the following:

1. Haul distance, 2,500 ft.
2. Loader cycles to fill, 4.
3. Efficiency, 50 min/h.
4. Average operator ability.
5. Rolling resistance, 2%, nearly level gradient.

Base Equations:

Equipment operating cost . . . $Y_E = 0.602(X)^{-0.296}$
Labor operating cost . . . . $Y_L = 11.34(X)^{-0.891}$

Equipment operating costs consist of 28% parts, 58% fuel and lubrication, and 14% tires. Labor operating costs consist of 82% operator labor and 18% repair labor.

Distance Factor: If average haul distance is other than 2,500 ft, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_D = 0.093(\text{distance})^{0.311}$.

Gradient Factor: If total gradient (gradient plus rolling resistance) is other than 2%, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_G = 0.907e^{[0.049(\text{percent gradient})]}$.

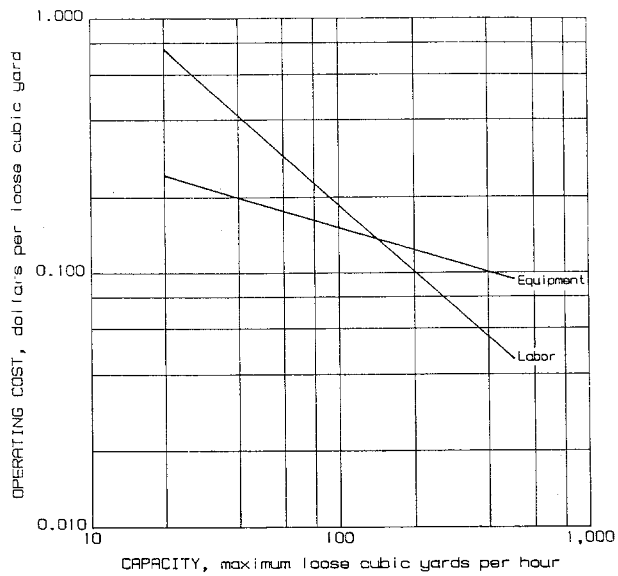
Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by factors obtained from the following equations:

Equipment factor . . . . $U_e = 0.984(X)^{0.016}$
Labor factor . . . . $U_l = 0.943(X)^{0.021}$

Total Cost: Cost per cubic yard of tailings is determined by

$$[Y_E(U_e) + Y_L(U_l)] \times F_D \times F_G.$$

The total cost per cubic yard must then be multiplied by the total yearly amount of *tailings* moved by truck. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Processing operating costs - Tailings removal - Rear-dump trucks

PROCESSING—TAILINGS REMOVAL—SCRAPERS

Operating Cost Equations: These equations provide the cost of removing and relocating tailings using scrapers. Costs are reported in dollars per cubic yard of tailings moved. The equations are applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by scraper.

The base curves assume the following:

1. Standard scrapers.
2. Rolling resistance, 6%, nearly level gradient.
3. Efficiency, 50 min/h.
4. Haul distance, 1,000 ft.
5. Average operator ability.

Base Equation:

Equipment operating cost... $Y_E = 0.325(X)^{-0.210}$
Labor operating cost .... $Y_L = 12.01(X)^{-0.930}$

Equipment operating costs consist of 48% fuel and lubrication, 34% tires, and 18% parts. Labor operating costs consist of 88% operator labor and 12% repair labor.

Distance Factor: If average haul distance is other than 1,000 ft, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_D = 0.01947(\text{distance})^{0.577}$.

Gradient Factor: If total gradient (gradient plus rolling resistance) is other than 6%, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_G = 0.776e^{[0.047(\text{percent gradient})]}$.

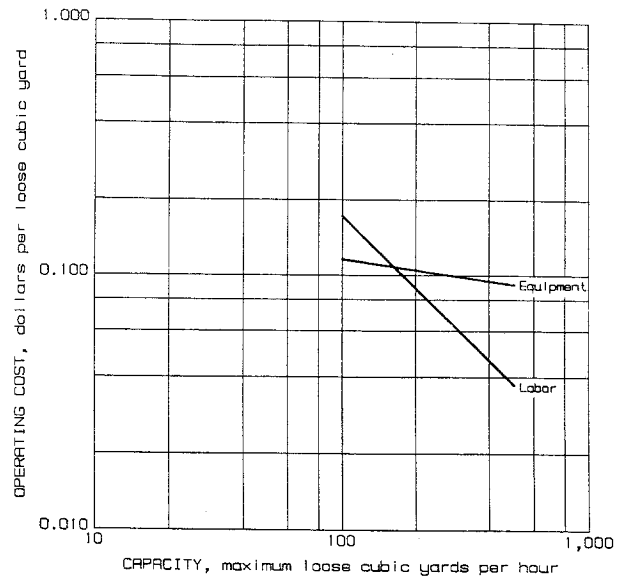
Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of base operating costs must be multiplied by factors obtained from the following equations:

Equipment factor .... $U_e = 1.096(X)^{-0.006}$
Labor factor .... $U_l = 0.845(X)^{0.034}$

Total Cost: Cost per cubic yard of tailings is determined by

$$[Y_E(U_e) + Y_L(U_l)] \times F_D \times F_G.$$

The total cost per cubic yard must then be multiplied by total yearly amount of *tailings* moved by scraper. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Processing operating costs - Tailings removal - Scrapers

PROCESSING—TROMMELS

Operating Cost Equations: These equations provide the cost of processing gravel using trommels. Costs are reported in dollars per cubic yard of gravel handled. The equations are applied to the following variable:

X = Maximum cubic yards of gravel processed hourly by trommels.

The base equations assume the following:

1. Trommels are sectioned for scrubbing and sizing.
2. Associated electric motor operating costs are included.

Base Equations:

Equipment capital cost ..... $Y_E = 0.217(X)^{-0.403}$
Labor operating cost .... $Y_L = 0.129(X)^{-0.429}$

Equipment operating costs average 63% parts, 26% electricity, and 11% lubrication. Labor operating costs consist entirely of maintenance and repair labor.

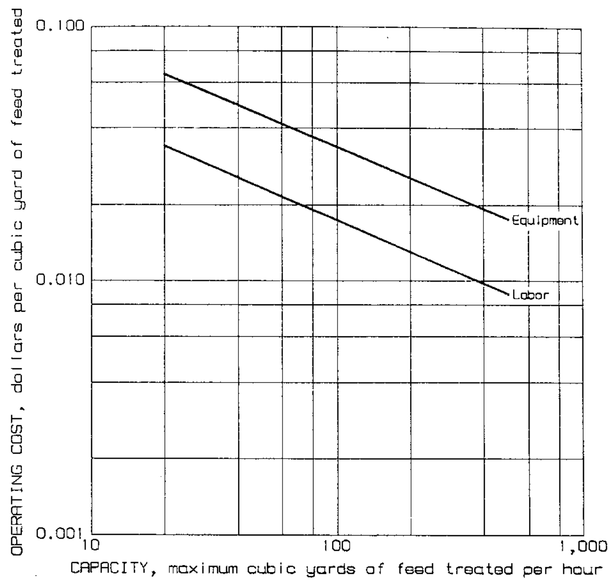
Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of base operating costs must be multiplied by the following factors:

Equipment factor .... $U_e = 1.194$
Labor factor .... $U_l = 1.310$

Total Cost: Cost per cubic yard of gravel is determined by

$$[Y_E(U_e) + Y_L(U_l)].$$

The total cost per cubic yard must then be multiplied by the total yearly amount of gravel processed by trommels. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Processing operating costs - Trommels

PROCESSING—VIBRATING SCREENS

Operating Cost Equations: These equations provide the cost of processing gravel using vibrating screens. Costs are reported in dollars per cubic yard of gravel handled. The equations are applied to the following variable:

X = Maximum cubic yards of gravel processed hourly by vibrating screen.

The base equations assume the following:

1. An average of 0.624 ft^2 of screen is required for every cubic yard of hourly capacity.
2. Associated electric motor operating costs are included.
3. Feed solids, 3,120 lb/yd^3.
4. Gravity feed.

Base Equations:

Equipment operating cost . . . $Y_E = 0.104(X)^{-0.426}$
Labor operating cost . . . . $Y_L = 0.106(X)^{-0.570}$

Equipment operating costs average 73% parts, 19% electricity, and 8% lubrication. Labor operating costs consist entirely of maintenance and repair labor.

Capacity Factor: If anticipated screen capacity is other than 0.624 ft^2/yd^3 hourly feed capacity, the respective operating costs must be multiplied by factors obtained from the following equations:

$C_e = 1.267(C)^{0.575}$,

and

$C_l = 1.207(C)^{0.458}$,

where C = anticipated capacity in square feet of screen per cubic yard of hourly feed.

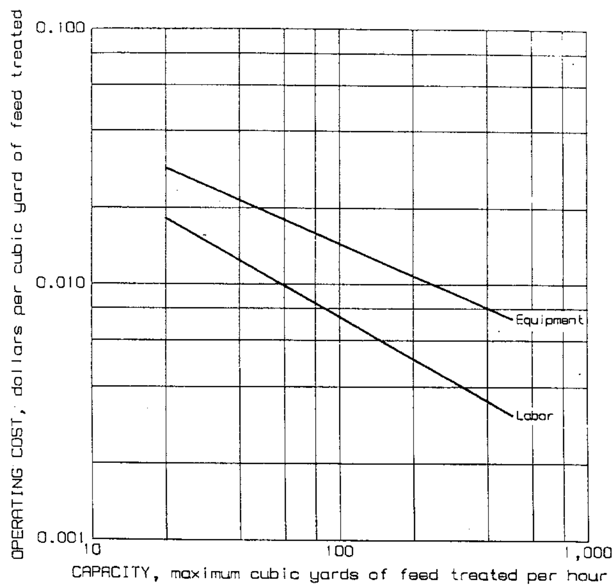
Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of base operating costs must be multiplied by the following factors:

Equipment factor . . . . $U_e = 1.197$
Labor factor . . . . $U_l = 1.131$

Total Cost: Cost per cubic yard of gravel is determined by

$$[Y_E(C_e)(U_e) + Y_L(C_l)(U_l)].$$

The total cost per cubic yard must then be multiplied by the total yearly amount of gravel processed by the vibrating screen. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Processing operating costs - Vibrating screens

SUPPLEMENTAL—EMPLOYEE HOUSING

Operating Cost Equation: This equation furnishes the operating cost associated with providing housing for workers at the minesite. Costs are reported in dollars per loose cubic yard of overburden and pay gravel. Expenses for food, supplies, water, heat, and electricity are all taken into account. The equation is applied to the following variable:

X = Average loose cubic yards of overburden and pay gravel handled hourly.

The base equation assumes the following:

1. Shift, 10 h.

Base Equation:

Supply operating cost... $Y_S = 1.445(X)^{-0.583}$

Supply operating costs average 95% industrial materials and 5% fuel.

Food Allowance Factor: If workers are to pay for food and supplies out of their own pockets, the cost calculated from the above equation must be multiplied by the following factor:

$F_F = 0.048.$

Workforce Factor: The equation used to compute labor for operating cost estimation is

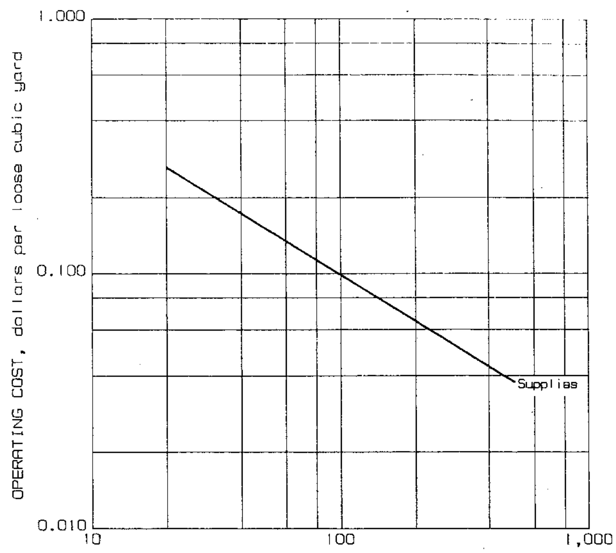
Workforce = $0.822(X)^{0.415}$.

If the workforce for the operation under evaluation is known, and is different than that calculated from the above equation, the correct cost can be obtained from the following equation:

$$Y_S = \frac{(\text{Number of workers}) \times \$17.85}{\text{Cubic yards of overburden and pay gravel handled daily}}.$$

Total Cost: Cost per loose cubic yard is determined by $Y_S \times F_F$.

The total cost per loose cubic yard must then be multiplied by the total yearly amount of *overburden* and *pay gravel* handled. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Supplemental operating costs - Employee housing

SUPPLEMENTAL—GENERATORS

Operating Cost: Operating costs of diesel generators are accounted for in the electrical portions of the other equipment operating costs. By so doing, operating costs of the generators are tied directly to size and type of equipment used.

The electrical portions of operating cost curves will also account for the expense of electricity brought in through transmission lines if diesel generators are not used. This is at best an approximation. However, costs assigned in this manner are typically more representative than costs calculated by trying to estimate the total power consumption of an operation.

SUPPLEMENTAL—LOST TIME AND GENERAL SERVICES

Operating Cost Equations: These equations account for costs not directly related to production. Costs are reported in dollars per cubic yard. Items in this section include:

1. Equipment downtime.
   a. Productivity lost by the entire crew due to breakdown of key pieces of equipment.
   b. Productivity lost by individual operators due to breakdown of single pieces of equipment.
   c. Labor charges of outside maintenance personnel.
   d. Wash plant relocation.

2. Site maintenance.
   a. Road maintenance.
   b. Stream diversion.
   c. Drainage ditch construction and maintenance.
   d. Site cleanup.
   e. Reclamation grading and recontouring.
   f. Settling pond maintenance.

3. Concentrate refinement.
   a. Time spent recovering valuable minerals from mill concentrates by panning, mechanical separation, or amalgamation.

The equations are applied to the following variable:

X = Maximum cubic yards of feed handled hourly by mill.

Base Equations:

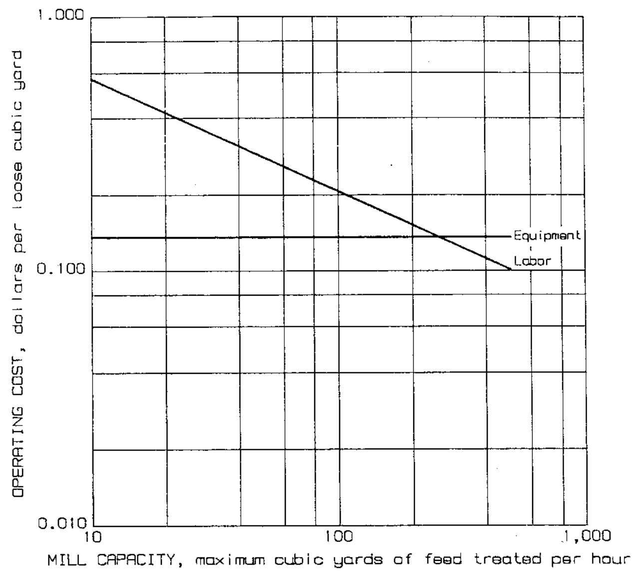
Equipment operating cost . . . $Y_E = 0.142(X)^{0.004}$
Labor operating cost . . . . $Y_L = 2.673(X)^{-0.524}$

Equipment operating costs average 53% fuel and lubrication and 47% equipment parts. Labor operating costs consist of 91% operator labor and 9% maintenance and repair labor.

Total Cost: Cost per cubic yard is determined by

$$Y_E + Y_L$$

The total cost per cubic yard must then be multiplied by the total yearly amount of *overburden, pay gravel,* and *tailings* handled. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Supplemental operating costs - Lost time and general services

SUPPLEMENTAL—PUMPS

Operating Cost Equations: These equations provide the cost of transporting and providing water using centrifugal pumps. Costs are reported in dollars per hour of pump use. If more than one pump is used in the operation, a separate cost must be calculated for each. The equations are applied to the following variable:

X = Maximum gallons of water required per minute.

The base equations assume the following:

1. Total head, 25 ft.
2. Diesel-powered pumps.
3. Abrasion-resistant steel construction.
4. Total engine-pump efficiency, 60%.

Base Equations:

Equipment operating cost... $Y_E = 0.007(X)^{0.713}$
Labor operating cost .... $Y_L = 0.004(X)^{0.867}$

Equipment operating costs average 59% fuel and lubrication, and 41% parts. Labor operating costs consist of 82% operator labor and 18% maintenance and repair labor. (Operator labor includes pipeline work.)

Head Factor: If total pumping head is other than 25 ft, factors calculated from the following equations will correct for changes in equipment and labor operating costs. The product of these factors and the original costs will provide the appropriate figures:

$H_e = 0.091(H)^{0.735}$,

and

$H_l = 0.054(H)^{0.893}$

where H = total pumping head.

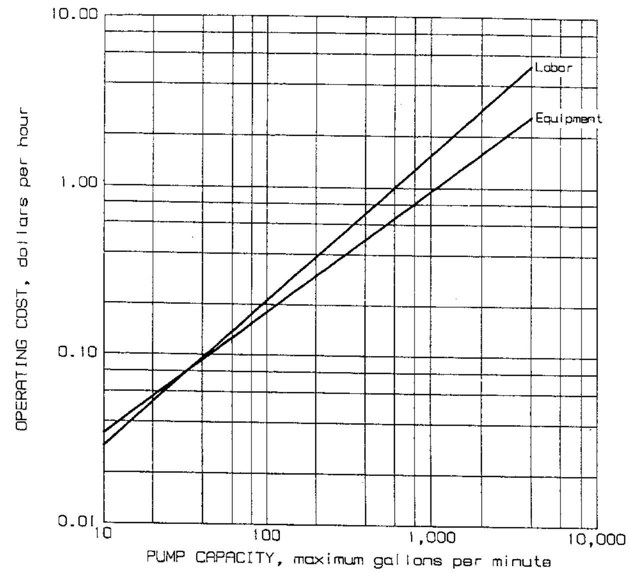
Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of base operating costs must be multiplied by the following factors:

Equipment factor .... $U_e = 1.096$
Labor factor .... $U_l = 1.067$

Total Cost: Cost per hour is determined by

$$[Y_E(H_e)(U_e)] + [Y_L(H_l)(U_l)].$$

The total cost per hour must then be multiplied by the anticipated hours per year of pump use. This product is subsequently entered in the appropriate row of the tabulation shown in figure 6 for final operating cost calculation.



Supplemental operating costs - Pumps

CAPITAL COST SUMMARY FORM

Item	Cost
Exploration:	
Method 1 cost	$
Method 2 cost	
Development:	
Access roads	
Clearing	
Preproduction overburden removal:	
Bulldozers	
Draglines	
Front-end loaders	
Rear-dump trucks	
Scrapers	
Mine equipment:	
Backhoes	
Bulldozers	
Draglines	
Front-end loaders	
Rear-dump trucks	
Scrapers	
Processing equipment:	
Conveyors	
Feed hoppers	
Jig concentrators	
Sluices	
Spiral concentrators	
Table concentrators	
Trommels	
Vibrating screens	
Supplemental:	
Buildings	
Camp	
Generators	
Pumps	
Settling ponds	
Subtotal	
Contingency (10%)	
Total	

Figure 5.—Capital cost summary form.

OPERATING COST SUMMARY FORM

Item	Annual cost
Overburden removal:	
Bulldozers	$
Draglines	
Front-end loaders	
Rear-dump trucks	
Scrapers	
Mining:	
Backhoes	
Bulldozers	
Draglines	
Front-end loaders	
Rear-dump trucks	
Scrapers	
Processing:	
Conveyors	
Feed hoppers	
Jig concentrators	
Sluices	
Spiral concentrators	
Table concentrators	
Tailings removal:	
Bulldozers	
Draglines	
Front-end loaders	
Rear-dump trucks	
Scrapers	
Trommels	
Vibrating screens	
Supplemental:	
Employee housing	
Lost time and general services	
Pumps	
Subtotal	
Contingency (10%)	
Total	

Cost per cubic yard pay gravel = total annual cost divided by pay gravel mined per year.

Final cost per cubic yard pay gravel...

Figure 6.—Operating cost summary form.

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