AGGREGATE COURSES

SECTION 301 – AGGREGATE COURSES

Note: *If local conditions indicate that aggregate production will be subcontracted, and that aggregate producers will likely pay Davis-Bacon wage rates, no reduction for labor should be made to the basic rock cost. Also, not all contracts require Davis Bacon rates in basic rock and hauling costs. Check with your Contracting Officer.*

The costs shown herein are applicable only for situations closely fitting the stated assumptions. However, the procedure and work items should be considered and estimated for all projects where that type of work is involved. On larger base and surfacing projects of 25,000 cy or more (19,000 m^3), consideration should be made for additional economies due to the large quantities. Total in place cost for these large jobs will average about *10% less.* On the other hand, for small projects of 5,000 cy or less (3,800 m^3), costs will be at least *20% higher.*

Aggregate costs are estimated in the following three categories:

A. Basic Rock Cost
B. Load and Apply
C. Haul

A. BASIC ROCK COST (Labor: 45 percent)

The following costs assume a production rate of l50 TPH (136 metric tons per hour). Material weighs 2,800 to 3,000 lbs/cy (1,660 to 1,880 kg/m^3) loose. Costs shown are in tons and loose cubic yards. Material Grading C, 1-1/2 inch minus (38 mm).

1. Move-in/move-out costs (approximate). Includes cost to set up and take down equipment. Does not include movement of equipment commonly used on other parts of job. Make cost allowance per instructions under Section 151 (Mobilization).

Screened	Crushed Pit Rock	Crushed Quarry Rock
$4,000	$9,000	$15,000

For platform scale add $2,000 to $2,500 (includes move-in, set-up, ramps, and certification). If belt scales will be used, make an allowance of $500-1,500 for certification.

2. Pit development, see note after Item 11 on next page.

3. Royalty charge for private pits. These are highly variable, costs range from $.50/CY ($.65/m^3) to $1.00/CY ($1.30/m^3) or higher.

	ID and MT
4. Drilling and shooting costs:	
Normal drilling and shooting:	$1.45/cy ($1.90/m^3) loose
(includes tractor for moving material)	$1.00/ton ($1.10/metric-ton)
Breaking oversize	$4.50/cy ($5.89/m^3) loose
	$3.20/ton ($3.53/metric-ton)
5. Ripping, if required:	$1.05/cy ($1.37/m^3)
	$0.70/ton ($0.78/metric-ton)

6. Crushing. For grading other than Grading C, the following multipliers should be applied to crushing costs shown in (a) and (b) below.

Table 3
US Customary (English) Units

Max Size (in)	3"	2"	l -1/2"	1"	3/4"	3"	2"	1-1/2"	1"	3/4"
Grading	A	B	C	D	E	F	G	H	J	K
Multiplier	0.9	0.95	1.00	1.10	1.25	0.80	0.9	0.95	1.05	1.20

Max Size (in)	6"	4"	3"	2"	
Grading	L	M	N	O	
Multiplier Size Ratio 1.10	0.6	0.7	0.7	0.7	

Metric Units

Max Size (mm)	63	50	50	37.5	25	37.5	25
Grading	A	B	C	D	E	F	G
Multiplier	0.93	0.95	1.00	1.05	1.10	1.20	1.25

	ID and MT
a. Crushed pit rock (drilling and shooting and/or ripping generally not required)	$3.75/cy ($4.90/m^3) loose $2.75/ton ($3.05/metric ton) or
b. Crushed quarry rock (includes loading into crusher)	$4.90/cy ($6.41/m^3) loose $3.55/ton ($3.90/metric ton)

(If size-ratio requirements are included in the grading, increase crushing costs approximately 10%. If bentonite binder is specified at 2% of aggregate quality, add $2.00 per ton ($2.20 per metric ton) to rock cost for projects over 10,000 tons (9,070 metric tons) and $3.00 per ton ($3.31 per metric ton) for smaller projects)

7. Screening only	$2.50/cy ($3.27/m^3) loose $1.90/ton ($2.13/metric ton)
8. Pit run (no crushing - includes dozer loader, and operators)	$1.70/cy ($2.22/m^3) loose $1.20/ton ($1.34/metric ton)
9. Stockpiling (use only where required by contract or job conditions)	$0.75/cy ($0.98/m^3) loose $0.55/ton ($0.62/metric ton)
10. Weighting: (Platform Scales)	$0.25/ton ($0.28/metric ton)

11. Contractor Quality Control: (If required by contract, add the cost of contract or sampling and testing. See Section 153.)

Estimate pit or quarry development under Section 641, cost may be included in basic rock cost or as a separate pay item. Costs should include:

l. Clearing, grubbing, and slash cleanup
2. Access roads
3. Conserving topsoil
4. Removal of overburden
5. Ground control and traffic control
6. Restoration
7. Seeding

Production Losses
In computing aggregate costs, one should calculate the total cost of producing the final quantity of aggregate desired. To determine unit costs, the total costs of each major subdivision (basic rock cost, load and apply, and haul) should then be divided by the final desired quantity. By following this procedure, the cost of normal production losses can be included in the unit cost of the final quantity.

The following production losses should be considered:

1. Ongrade process and haul losses - essentially negligible for conscientious operator.
2. Stockpiling losses: Approximately 5 percent; use only if stockpiling required by contract, physical arrangement of pit, or work schedule imposed by contract.
3. Crushing/screening/blasting.
   a. Quarry operation approximately 5-10 percent.
   b. Gravel or rock pit - 20-30 percent

These seemingly high losses result from a high percentage of fines found in such pits. Technically, it is not "lost" material, but "reject" necessitated by gradation requirements. Actual estimate of losses should be based on field tests or experience.

Small Quantities
Increase costs for small projects as calculated above by about 20% for jobs where the quantities are less than 5,000 tons (4,536 metric tons) or 3,500 cy (2,676 m3).

Basic Rock Cost Example (US Customary - English)
Grading D, compact by hauling equipment.
Quantity required on the road - 10,000 tons
Location: Idaho (Area 2, Zone 2)
Assume hard rock quarry with stockpiling and weighing required.
Stockpiling loss - 5 percent
Crushing loss - 10 percent

To obtain 10,000 tons for the road, the contractor will have to drill, shoot, and process approximately 11,500 tons * 10,000 + 15% = 11,500 T.

Contractor will stockpile 10,000 tons + 5% = 10,500 tons.

A. BASIC ROCK COST

Move in-out (includes platform scale) $14,000 - Include under Section 151 - Mobilization.

Drill and shoot $1.00*11,500	$11,500
Crushing and screening $3.55 * 11,500 * 1.1	$44,908
Stockpiling $0.55 * 10,500	$5,775
Weighing $0.25 * 10,000	$2,500
Contractor sampling & testing (lump sum)	$3,000
Total Cost	$67,683

Unit basic rock cost = $\frac{\$67,683}{10,000 \text{ tons}} = \$6.77/\text{ton}$

Adjust for Idaho Area 2, Zone 2, 45% labor; 6.77 X 0.98 = $6.63/ton (For US Customary - English units skip to B next page)

Basic Rock Cost Example (Metric Units)

Grading D, compact by hauling equipment.
Quantity required on the road = 9,072 metric tons
Location: Idaho (Area 2, Zone 2)
Assume hard rock quarry with stockpiling and weighing required.
Stockpiling loss = 5 percent
Crushing loss = 10 percent
Contractor sampling and testing required (Public Works Project)

To obtain 9,072 metric tons for the road, the contractor will have to drill, shoot, and process approximately 10,433 metric tons; 9,072 + 15% = 10,433 metric tons.

Contractor will stockpile 9,072 metric tons + 5% = 9,526 metric tons.

A. Basic Rock Cost

Move in-out (includes platform scale) $14,000 - Include under Section 156 - Mobilization.

Drill and shoot $1.10* 10,433	$11,476
Crushing and screening $3.90 * 10,433 * 1.1	$44,758
Stockpiling $0.62 * 9,526	$5,906
Weighing $0.28 * 9,072	$2,540
Contractor sampling & testing (lump sum)	$2,500
Total cost	$67,180

Unit basic rock cost = $\frac{\$67,180}{9,072 \text{ metric tons}}$ = $7.41 per metric ton

Adjust for Idaho Area 2, Zone 2, 45% labor; 7.41 * 0.98 = $7.26 per metric ton

B. LOAD AND APPLY (Labor = 40 percent)

1. Loading costs are variable depending on procedures at pit. These vary depending on loading method, i.e.,

	ID and MT
a. from belt - included in basic rock cost.	$0
b. from hopper - included in basic rock cost.	$0
c. pit run - included in basic rock cost.	$0.75/cy ($0.98/m^3) loose
d. from stockpile.	$0.55/ton ($0.62/metric ton)
2. Initial Spreading (knocking down piles and rough grading if needed	$0.35/cy ($0.46/m^3 loose $0.25/ton($0.28/metric ton)
3. Grid rolling (approximate)	$0.45/cy ($0.59/m^3) loose 0.35/ton ($0.39/metric ton)
4. Grading of Aggregate base or surface course (approximate)	$0.50/cy ($0.65/m^3) loose $0.35/ton ($0.39/metric ton)

5. Compaction (approximate)
   a. With hauling equipment — $0
   b. With rollers — $0.55/cy ($0.72/m^3) loose
      $0.43/ton ($0.48/metric ton)

6. Watering: Estimate under Section 160; water should be incidental to Section 301, unless Forest has sufficient contract administration personnel for inspection of watering as separate pay item.

C. AGGREGATE HAUL (Labor = 30-50 percent)

Calculate haul according to the haul section in this costguide. These costs are based on loose cubic yards (cubic meters). Use appropriate weight conversion factor to convert to $/ton-mi. ($/metric ton-Km). If measurement for payment or credit is on another basis, appropriate adjustment factors must be made.

Haul cost = fixed cost for the truck plus variable haul costs. If Construction Induced Maintenance is needed, it should be included in aggregate haul costs.

Haul Cost Example (US Customary - English Units)

Variable costs of haul based on road characteristics and average round trip travel speed
3.0 miles, 30 mph
6.0 miles, 15 mph
2.5 miles, 10 mph (incl distance to turnaround)
Belly dump trucks (20 cy)
Density: 1.4 tons per cubic yard
Location: Idaho - Area 1 (Zone 2), Basis of payment: ton.
Haul Cost:
Haul Cost = Fixed cost + (variable haul cost) x (haul distances)
= 0.44 + (0.24 * 3.0) + (0.50 * 6.0) + (0.74 * 2.5) = $6.01/ton

Adjust for Idaho Area 1 (Zone 2) (35% Labor): $6.01 x 1.00 = $6.01/ton

Haul Cost Example (Metric Units)

Variable costs of haul based on road characteristics and average round trip travel speed.
4.8 kilometers, 48.3 kilometers per hour
9.7 kilometers, 24.1 kilometers per hour
4.0 kilometers, 10.0 kilometers per hour (include distance to turnaround)
Belly dump trucks (15m)
Density: 1.66 metric tons per cubic meter
Location: Idaho - Area 1 (Zone 2), Basis of payment: metric ton.
Haul Cost
Haul cost = Fixed cost + variable haul cost * haul distances
= $0.49 + ($0.17 * 4.8) + ($0.34 * 9.7) + (0.51 * 4.0) = $6.64 per metric ton

Adjust for Idaho Area 1 (Zone 2), 35% Labor: $6.64 * 1.00 = $6.64 per metric ton

SECTION 303 – ROAD RECONDITIONING (Labor 40-60 percent)

Normally, the majority of "reconditioning" work should be done with a grader with some minor blasting and/or tractor work for localized rock problems. More extensive work should be covered in the appropriate sections. *Good* field classification and design will usually avoid the problem of calling for use of this specification when more appropriate work items may be needed. Other examples can be traced to situations where, through years of maintenance a roadway has been widened and shifted slightly away from the original alignment. Trees that used to be outside the shoulder by 5-10 feet, were eventually cut down for safety reasons, but the *stumps remain* in what now is the shoulder. Estimator should also watch out for *subgrade boulders* which were originally well covered by native subgrade material, but the covering is now thin or absent.

A. Removing Slides - Use time and equipment costs. (All slides in excess of l0 cubic yards per station shall be estimated under Section 204).

B. Pull ditches with grader and clean catch basins: $225/Mile ($140/kilometer)

C. Scarifying and shaping, $/Mile ($/kilometer)Average $650-$865 ($405 -$535)

	Single Lane	**Double Lane**
Average	$650 ($405)	$865 ($535)
Heavy	$1005 ($625)	$1,350 ($840)

*For double lane, an additional 35% is allowed.

D. Finish grading with blade, $/mile ($/kilometer)

Single Lane	$250 ($155)
Double Lane	$340 ($210)

E. Compaction, $/mile ($/kilometer)

	Single Lane	**Double Lane**
(d)	-0-	-0-
(b)	$325 ($202)	$430 ($267)
(c)	$485 ($301)	$755 ($469)
(e)	$325 ($202)	$430 ($267)

F. Water - Estimate under Section 160, can be included in Section 303 if specified as incidental.

G. Constructing New Ditch - Include under Section 204

H. Erosion Control Measures - Include under Section 157

I. Clearing and Grubbing - Include under Section 20l

J. Costs for reconditioning of asphalt and aggregate surfaces should bestimated uning Sections 204, 301, 404, 414, and 430

K. Contractor Quality Control - Where applicable, make a subsidiary allowance to this pay item for contractor quality control.

SECTION 306 – DUST PALLATIVE (Contract Item)

Refer to current dust palliative manufacturer and geotechnical engineering information for detailed information on product characteristics, application rates, estimating procedure, conversion factors and calculations. If unavailable locally, recommendations and information are available from the RO Materials Engineering Center. The following is a summary of essential information.

A. Application Rates. See Application Rate Tables (Table 400-1) in this Guide. Rates for lignin sulfonate and chloride products are based on the solid contents shown under C, "*Approximate Weight-Volume Factors @ °F*", this Section. These products may be furnished with varying amounts of water and if so, adjustments based upon the weight of solids may be necessary on the application rates and payment . Rates will vary depending on the type and condition of the surface and the amount of residual dust abatement material present. For example, more dust abatement material will be required for loose pit-run gravel and less for unsurfaced roads in clay material. Due to leaching of the chloride products, it is recommended that the product be applied *slightly narrower in width* than the surfacing, particularly along *riparian areas*.

B. Unit Material Cost. The prices in the Table 400-3 are estimates for this date. Prices can be extremely variable, particularly for dust oils. Up-to-date quotes should be obtained from local suppliers for each project. The prices include estimated shipping costs for typical locations. The prices assume full truck-tanker-trailer loads of 25 or 32.5 tons or full 20,000 gallon rail cars.

C. Approximate Weight-Volume Factors @ 60°F

Material	Gallons/Ton	Pounds/Gallon
Lignin Sulfonate (50 percent solids, 1.26 S.G.)	190	10.51
Magnesium Chloride (32 percent solids, 1.317 S.G.)	182	10.98
Calcium Chloride (38 percent solids)	171	11.69

D. Shipping Costs: Shipping costs are variable and should be verified for each project. For locations other than indicated in Table 400-3, rates must be adjusted for the project location. Typical truck rates vary from $0.10 to $0.15 per ton-mile.

E. Road Preparation: Road preparation costs will depend on the existing surface condition, requirements in other sections such as 301 or 303, and the method specified. See Section 303 for grading costs and Section 160 for watering.

F. Application Cost: Typical application costs are $25 to $85 per M-Gals ($5 to $15 per ton) of liquid, depending on the type of distributor.

SECTION 321 – ROAD SURFACE STABILIZATION (Contract Item)

See R1 Forest Service Supplement for roadbed preperation and material application rate. Base road preperation costs using time and equipment and materials application costs from supplier.

End of Aggregate Courses