8.1. INFRASTRUCTURE--CAPITAL COSTS

8.1.1. ACCESS ROADS

8.1.1.1. CLEARING

The total cost per kilometer is the sum of two separate cost curves (labor and equipment operation) having a roadway width (X), in meters. The curves are valid for widths between 3 and 30 m, operating one shift per day. This cost is multiplied by the total kilometers to obtain the capital cost. Each curve includes all of the daily operating and maintenance costs associated with clearing for access roads. Supplies have not been considered in the clearing costs because it is assumed that cleared brush or timber would be buried under the excavation waste; thus, supplies of fuel oil for burning the clearing slash are not required.

BASE CURVE

The curves are based on estimated costs for clearing medium growth on terrain with a side slope of 25%. Medium growth varies from heavy brush to one tree, 0.33 m in diameter, per 40 m^2.

(L) Labor Operating Cost $(Y_L) = 1{,}135.467(X)^{0.711}$

The operating labor costs are distributed as follows:

Direct labor.....	86%
Maintenance labor.....	14%

The direct labor costs consist of the following typical range of personnel:

		Av salary per hour (base rate)
Dozer operator.....	12%	$16.33
Wheel-loader operator.....	12%	16.33
Flatbed-truck driver.....	12%	15.89
General laborer.....	64%	13.86

The average wage for labor is $14.63 per worker-hour (including burden and average shift differential).

(E) Equipment Operating Cost $(Y_E) = 467.945(X)^{0.711}$

The equipment operating cost consists of 35% for repair parts, 53% for fuel and lubrication, and 12% for tires.

The equipment operating cost consists of

Dozer crawler.....	31%
Wheel loader.....	47%
Flatbed truck.....	12%
Pickup truck.....	9%
Chainsaws.....	1%

The equipment operating cost distribution is

	Repair parts	Fuel and lube	Tires
Dozer crawler.....	52%	48%	-
Wheel loader.....	36%	43%	21%
Flatbed truck.....	9%	80%	11%
Pickup truck.....	8%	90%	2%
Chainsaws.....	39%	61%	-

ADJUSTMENT FACTORS

Brush Factor For light clearing conditions where the growth consists mainly of brush and small trees, multiply the curves by the following factors:

Brush factor $(F_{B\ LIGHT}) = 0.25$

For heavy clearing conditions, defined as when clearing a dense growth of trees (diameter of the trees commonly exceeding 0.33 m), multiply the curves by the following factor:

Brush factor $(F_{B\ DENSE}) = 1.75$

Side Slope Factor For clearing on terrain with side slopes other than 20% to 30% multiply the curves by the following factors:

For clearing on terrain with side slopes of 0% to 20%,

Side slope factor $(F_{S\ 0\%-20\%}) = 0.8$

For clearing on terrain with side slopes of 30% to 50%,

Side slope factor $(F_{S\ 30\%-50\%}) = 1.8$

For clearing on terrain with side slopes of 50% to 100%,

Side slope factor $(F_{S\ 50\%-100\%}) = 2.5$

Burning Equation If fuel oil (for burning slash) or other supplies, such as cables and chokers, are used, add the following supply cost equation to the total cost per kilometer. The total cost per kilometer for supplies is for a roadway of width (X), in meters, varying in width from 3 to 30 m.

(S) Supply Operating Cost $(Y_{S\ BURNING}) = 269.796[0.100(X)]^{-0.0303}$

This cost is multiplied by the total kilometers, valid for values between 3.33 to 3,333.33 km, to obtain the capital cost.

For clearing operations from 1 to 500 ha (roadway width in meters multiplied by roadway length in meters multiplied by 0.0001), the supplies consist of 78% for fuel oil and 22% for tools, cables, and chokers. For clearing operations of 500 to 1,000 ha, supplies consist of 83% for fuel oil (for burning wood and scrub) and 17% for tools, cables, and chokers.

Equipment Factor Where it is necessary to purchase equipment, or have a subcontractor perform the work, multiply the equipment operation value by the following applicable factor in order to obtain the total value of equipment ex- pense for ownership and operation:

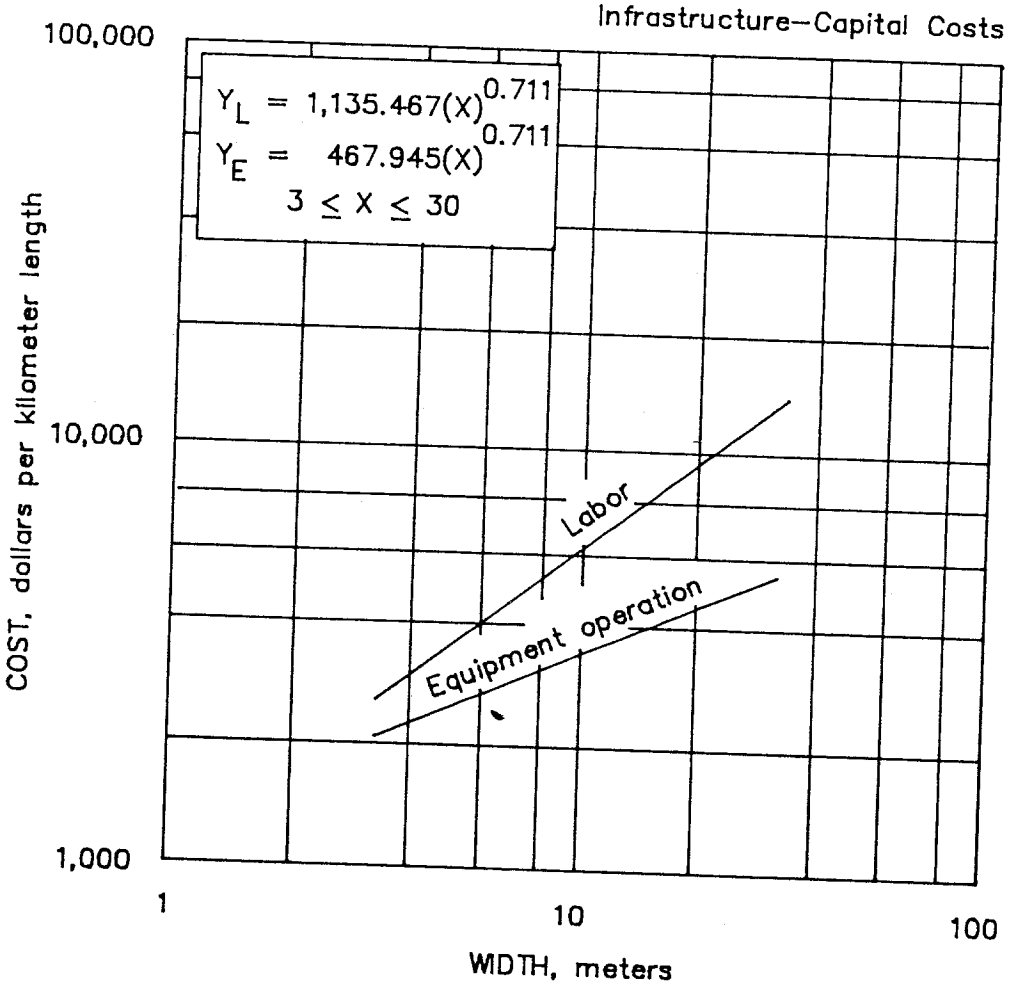
Shifts per day.....	1	2	3
Factor.....	1.91	1.68	1.61

Subcontractor Factor If a subcontractor is used, to compensate for the subcontractor's markup, multiply the costs obtained from the curve by the following factors:

Labor factor $(F_L) = 1.5$

Supply factor $(F_S) = 1.2$

Equipment operation factor $(F_E) = 1.2$



8.1.1.1. Access road
CLEARING

8.1. INFRASTRUCTURE--CAPITAL COSTS

8.1.1. ACCESS ROADS

8.1.1.2. DRILL AND BLAST

The total cost per kilometer is the sum of three separate cost curves (labor, supplies, and equipment operation) for a roadway width (X), in meters. The curves are valid for widths between 3 and 30 m, operating one shift per day. This cost is multiplied by the total kilometers to obtain the capital cost. Each curve includes all of the daily operating and maintenance costs associated with drilling and blasting for access roads.

BASE CURVE

The curves are based on estimated costs for drilling and blasting a cut with a single ditch. The terrain has a side slope of 25%, and the cut contains 50% rock.

(L) Labor Operating Cost $(Y_L) = 9{,}633.822(X)^{0.496}$
The operating labor costs are distributed as follows:

Direct labor.....	79%
Maintenance labor.....	21%

The direct labor costs consist of the following typical range of personnel:

		Av salary per hour (base rate)
Air-track driller.....	33%	$16.78
Compressor operator.....	17%	17.23
Chuck tender.....	27%	13.86
Powderman.....	≈ 8%	16.33
Powderman helper.....	7%	14.56
Flatbed-truck driver.....	8%	15.89

The average wage for labor is $15.68 per worker-hour (including burden and average shift differential).

(S) Supply Operating Cost $(Y_S) = 7{,}247.524(X)^{0.644}$
The supply cost consists of 79% blasting supplies and 21% drilling supplies. Drilling supplies consist of percussion drill bits, rods, striking bars, and couplings; blasting supplies consist of dynamite, ANFO, electric blasting caps, and connecting wire.

(E) Equipment Operating Cost $(Y_E) = 4{,}109.384(X)^{0.496}$
The equipment operating cost consists of 51% for repair parts, 48% for fuel and lubrication, and 1% for tires.

The equipment operation curve consists of

Air-track drills.....	33%
Portable compressors.....	55%
Flatbed truck.....	7%
Pickup truck.....	5%

The equipment operating cost distribution is:

	Repair parts	Fuel and lube	Tires
Air-track drills.....	93%	7%	-
Portable compressors.....	34%	65%	1%
Flatbed truck.....	9%	80%	11%
Pickup truck.....	8%	90%	2%

ADJUSTMENT FACTORS

Rock Factor For drilling and blasting cuts that contain other than 50% rock, multiply the curves by the following factors:

For drilling and blasting cuts containing 25% rock,

Rock factor $(F_{R\ 25\%}) = 0.6$

For drilling and blasting cuts containing 100% rock,

Rock factor $(F_{R\ 100\%}) = 1.4$

Side Slope Factor For terrain with side slopes of 0% to 20% that require drilling and blasting for two ditches and for providing material for a minimum fill, the base curve costs should be used without any adjustments. For terrain with side slopes other than 0% to 20% multiply the cost obtained from the curves by the following factors:

For clearing on terrain with side slopes of 20% to 50%,

Side slope factor $(F_{S\ 20\%-50\%}) = 1.5$

On terrain with side slopes in the range of 50% to 100%,

Side slope factor $(F_{S\ 50\%-100\%}) = 3.0$

Equipment Factor Where it is necessary to purchase equipment, or have a subcontractor perform the work, multiply the equipment operation value by the following applicable factor in order to obtain the total value of equipment expense for ownership and operation:

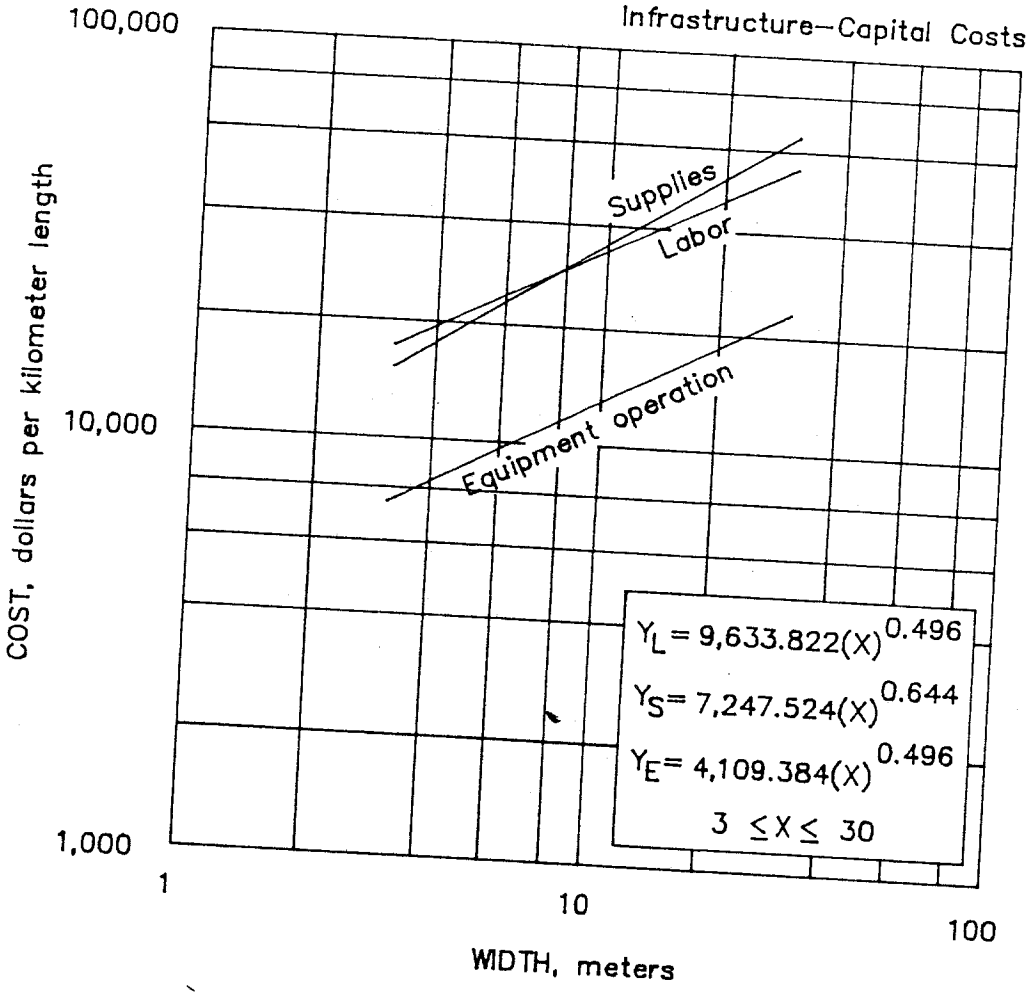
Shifts per day.....	1	2	3
Factor.....	2.12	1.84	1.75

Subcontractor Factor If a subcontractor is used, to compensate for the subcontractor's markup, multiply the costs by the following factors:

Labor factor $(F_L) = 1.5$

Supply factor $(F_S) = 1.2$

Equipment operation factor $(F_E) = 1.2$



8.1.1.2. Access roads
DRILL AND BLAST

8.1. INFRASTRUCTURE--CAPITAL COSTS

8.1.1. ACCESS ROADS

8.1.1.3. EXCAVATION

The total cost per kilometer is the sum of two separate cost curves (labor and equipment operation) having a roadway width (X), in meters. The curves are valid for widths between 3 and 30 m, operating one shift per day. This cost is multiplied by the total kilometers to obtain the capital cost. Each curve includes all of the daily operating and maintenance costs associated with excavation for access roads.

BASE CURVES

The curves are based on a dozer excavation operation that is working on terrain with a side slope of 25%, side-casting from cuts or ditches to a 30-cm fill or to waste. The material to be excavated is either blasted rock or a common conglomerate that presents some difficulty in cutting and drifting.

(L) Labor Operating Cost $(Y_L) = 29.843(X)^{1.870}$

The operating labor costs are distributed as follows:

Direct labor.....	60%
Maintenance labor.....	40%

The direct labor costs consist of the following typical range of personnel:

		Av salary per hour (base rate)
Dozer operator.....	60%	$16.33
Grader operator.....	20%	16.33
Water-truck driver.....	20%	15.89

The average wage for labor is $16.24 per worker-hour (including burden and average shift differential).

(E) Equipment Operating Cost $(Y_E) = 27.128(X)^{1.870}$

The equipment operating cost consists of 46% for repair parts, 50% for fuel and lubrication, and 4% for tires.

The equipment operation curve consists of

Dozer crawlers.....	47%
Dozer-ripper crawler.....	25%
Motor grader.....	15%
Water truck.....	9%
Pickup truck.....	4%

The equipment operating cost distribution is

	Repair parts	Fuel and lube	Tires
Dozer crawlers	51%	49%	-
Dozer ripper crawler	53%	47%	-
Motor grader	45%	41%	14%
Water truck	29%	55%	16%
Pickup truck	8%	90%	2%

ADJUSTMENT FACTORS

Side Slope Factor On terrain with a side slope other than 20% to 30%, multiply the costs obtained from the curves by the following factors:

For clearing on terrain with side slopes of 0% to 20%,

Side slope factor $(F_{S\ 0\%-20\%}) = [0.8(S)]^{0.600}(W)^{0.756}$
where S = side slope [defined as 1 + (percent slope/100)],
and W = roadway width, in meters.

For clearing on terrain with side slopes of 30% to 100%,

Side slope factor $(F_{S\ 30-100\%}) = [0.8(S)]^{3.958}(W)^{0.087}$
where S = side slope [defined as 1 + (percent slope/100)],
and W = roadway width, in meters.

Material Factor For excavation of materials that are easy to cut and drift, multiply the costs obtained from the curves by the following factors:

Material factor $(F_{M\ EASY}) = 0.75$

For excavation of extremely wet and sticky material, multiply the curves by the following factors:

Material factor $(F_{M\ DIFFICULT}) = 1.33$

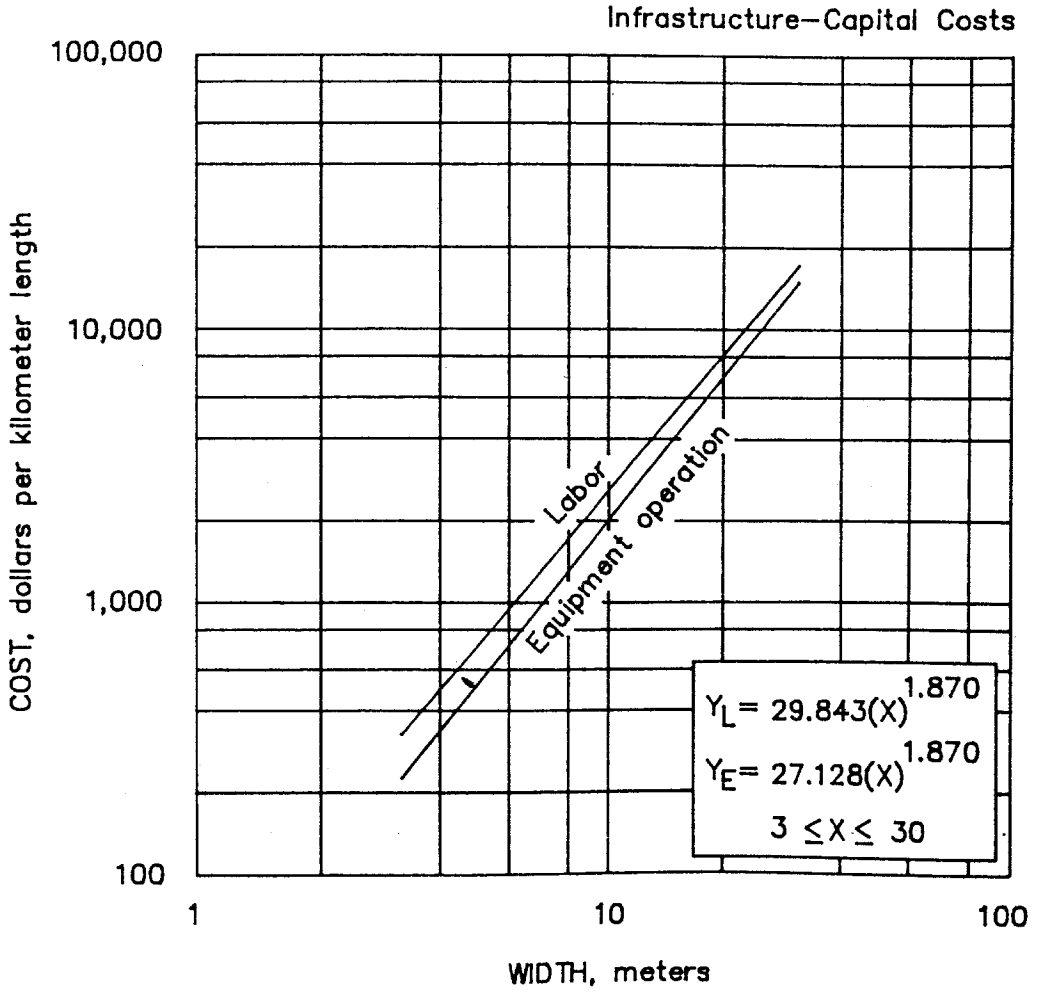
Equipment Factor Where it is necessary to purchase equipment, or have a subcontractor perform the work, multiply the equipment operation cost obtained from the curve by the following applicable factor in order to obtain the total value of equipment expense for ownership and operation:

Shifts per day.....	1	2	3
Factor.....	1.94	1.71	1.63

Subcontractor Factor If a subcontractor is used, to compensate for the subcontractor's markup, multiply the costs obtained from the curves by the following factors:

Labor factor $(F_L) = 1.5$

Equipment operation factor $(F_E) = 1.2$



8.1.1.3. Access roads
EXCAVATION

8.1. INFRASTRUCTURE--CAPITAL COSTS

8.1.1. ACCESS ROADS

8.1.1.4. GRAVEL SURFACING

The total cost per kilometer is the sum of three separate cost curves (labor, supplies, and equipment operation) for a roadway width (X), in meters. The curves are valid for widths between 3 and 30 m, operating one shift per day. This cost is multiplied by the total kilometers to obtain the capital cost. Each curve includes all of the daily operating and maintenance costs associated with gravel surfacing of access roads.

BASE CURVE

The curves are based on costs for preparing a road subbase, spreading surfacing material on the roadway, and compacting the surfacing material to a depth of 0.20 m. The surfacing material is delivered to the jobsite in suppliers' trucks.

(L) Labor Operating Cost $(Y_L) = 293.304(X)^{0.667}$

The operating labor costs are distributed as follows:

Direct labor.....	83%
Maintenance labor.....	17%

The direct labor costs consist of the following typical range of personnel:

		Av salary per hour (base rate)
Grader operator.....	21%	$16.33
Roller operator.....	21%	16.33
Dumpman.....	18%	13.86
Grade checker.....	20%	15.89
Water-truck driver.....	20%	15.89

The average wage for labor is $15.66 per worker-hour (including burden and average shift differential).

(S) Supply Operating Cost $(Y_S) = 6{,}880.012(X)^{1.006}$

The supply cost consists of 100% minus 1.9-cm road-surfacing gravel. The gravel, delivered and dumped on the roadbed by suppliers' trucks, costs $13.76/mt.

(E) Equipment Operating Cost $(Y_E) = 135.032(X)^{0.667}$

The equipment operating cost consists of 37% for repair parts, 51% for fuel and lubrication, and 12% for tires.

The equipment operation curve consists of

Motor grader	42%
Rubber-tired, self-propelled roller	19%
Water truck	26%
Pickup truck	13%

The equipment operating cost distribution is

	Repair parts	Fuel and lube	Tires
Motor grader	45%	41%	14%
Rubber-tired, self-propelled roller	49%	40%	11%
Water truck	29%	55%	16%
Pickup truck	8%	90%	2%

ADJUSTMENT FACTORS

Equipment Factor Where it is necessary to purchase equipment, or have a subcontractor perform the work, multiply the equipment operation cost obtained from the curve by the following applicable factor in order to obtain the total value of equipment expense for ownership and operation:

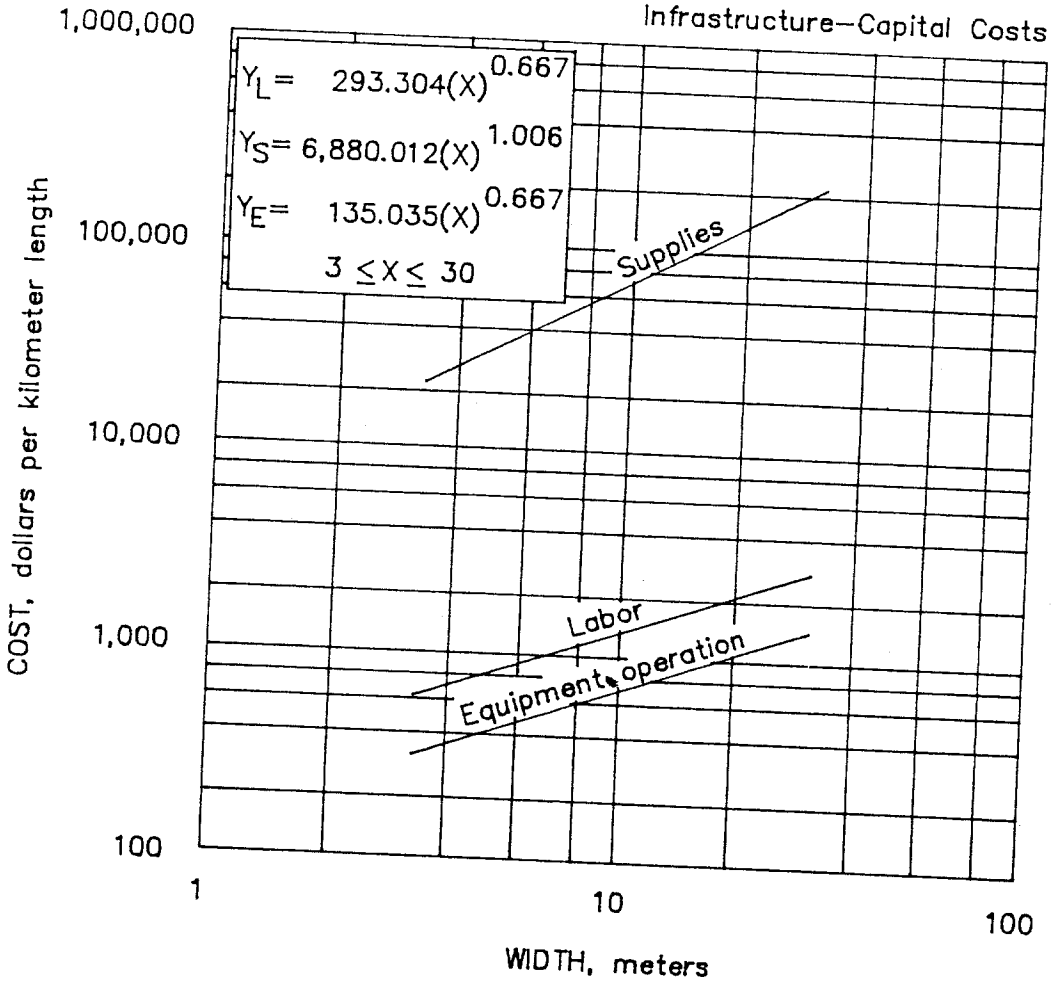
Shifts per day	1	2	3
Factor	2.05	1.79	1.70

Subcontractor Factor If a subcontractor is used, to compensate for the subcontractor's markup, multiply the costs obtained from the curves by the following factors:

Labor factor (F_L) = 1.5

Supply factor (F_S) = 1.2

Equipment operation factor (F_E) = 1.2



8.1.1.4. Access roads
GRAVEL SURFACING

8.1. INFRASTRUCTURE--CAPITAL COSTS

8.1.1. ACCESS ROADS

8.1.1.5. PAVING

The total cost per kilometer is the sum of three separate cost curves (labor, supplies, and equipment operation) for a roadway width (X), in meters. The curves are valid for widths between 3 and 30 m, operating one shift per day. This cost is multiplied by the total kilometers to obtain the capital cost. Each curve includes all of the daily operating and maintenance costs associated with paving of access roads.

BASE CURVE

The curves are based on a paving operation for laying and compacting hot-mix asphalt concrete (purchased locally from a hot-mix plant) to a depth of 5.1 cm. Costs to produce an appropriate paving road base are covered in section 8.1.1.4., gravel surfacing.

(L) Labor Operating Cost $(Y_L) = 117.710(X)^{1.005}$
The operating labor costs are distributed as follows:

Direct labor.....	80%
Maintenance labor.....	20%

The direct labor costs consist of the following typical range of personnel:

		Av salary per hour (base rate)
Paver operator.....	13%	$16.33
Roller operator.....	26%	16.33
General laborer.....	22%	13.86
Rear-dump truck driver.....	39%	15.89

The average wage for labor is $15.55 per worker-hour (including burden and average shift differential).

(S) Supply Operating Cost $(Y_S) = 2{,}661.382(X)^{1.005}$
The supply cost consists of 100% asphalt concrete (minus 1.9-cm hot mix). The asphalt concrete, supplied by a local hot-mix plant, costs $26.37/mt.

(E) Equipment Operating Cost $(Y_E) = 68.436(X)^{1.005}$
The equipment operating cost consists of 32% for repair parts, 58% for fuel and lubrication, and 10% for tires.

The equipment operation curve consists of

Asphalt paver.....	20%
Rubber-tired, self-propelled roller.....	5%
Steel-wheeled, tandem roller.....	5%
Rear-dump trucks.....	64%
Pickup truck.....	6%

The equipment operating cost distribution is

	Repair parts	Fuel and lube	Tires
Asphalt paver.....	68%	32%	-
Rubber-tired, self-propelled roller.....	43%	51%	6%
Steel-wheeled, tandem roller.....	50%	50%	-
Rear-dump trucks	22%	63%	15%
Pickup truck.....	8%	90%	2%

ADJUSTMENT FACTORS

Supply Factor The supplies cost should be adjusted for changes in the base asphalt-concrete price.

Equipment Factor Where it is necessary to purchase equipment, or have a subcontractor perform the work, multiply the equipment operation cost obtained from the curve by the following applicable factor in order to obtain the total value of equipment expense for ownership and operation:

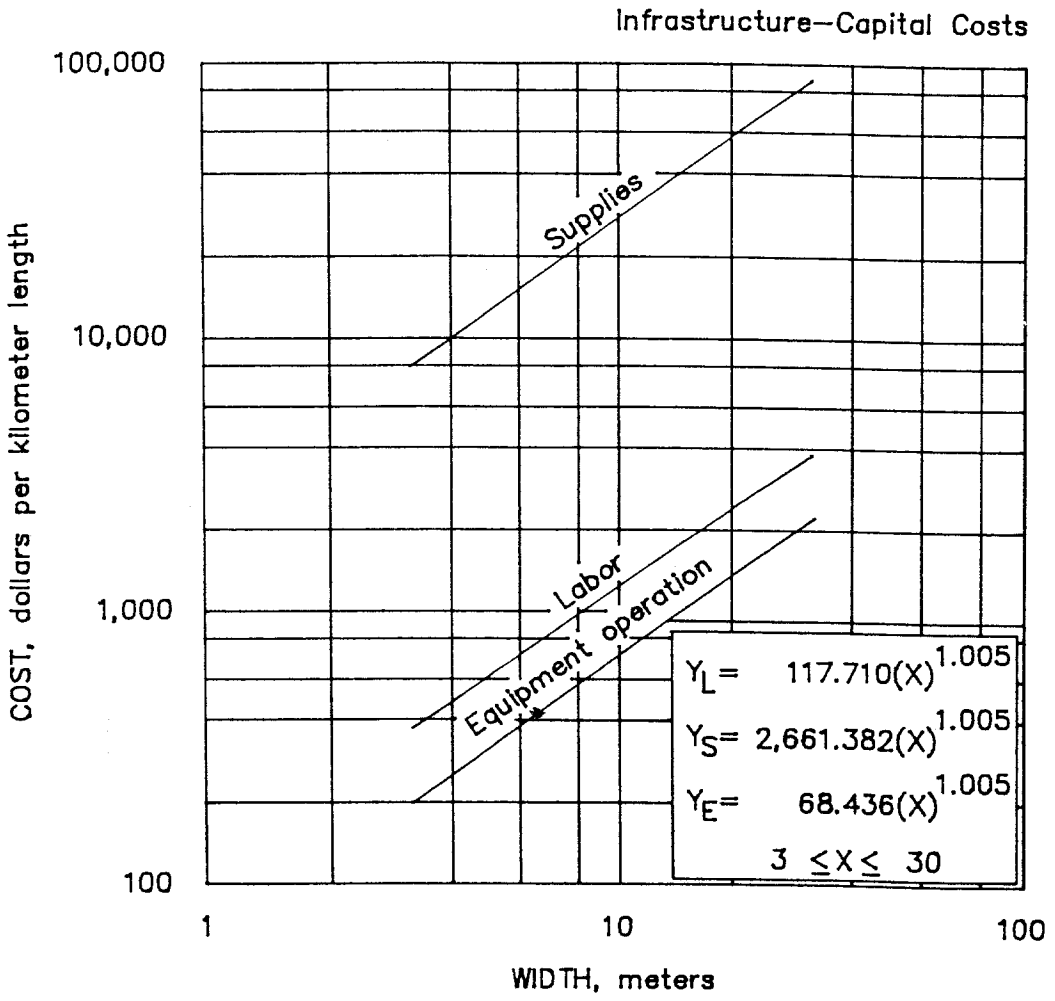
Shifts per day.....	1	2	3
Factor.....	1.44	1.33	1.29

Subcontractor Factor If a subcontractor is used, to compensate for the subcontractor's markup, multiply the costs obtained from the curves by the following factors:

Labor factor $(F_L) = 1.5$

Supply factor $(F_S) = 1.2$

Equipment operation factor $(F_E) = 1.2$



8.1.1.5. Access roads
PAVING