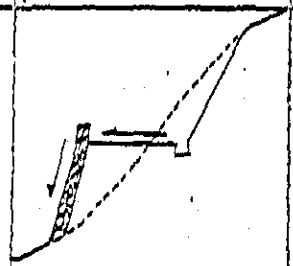
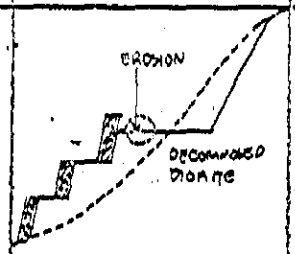
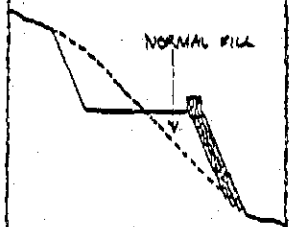
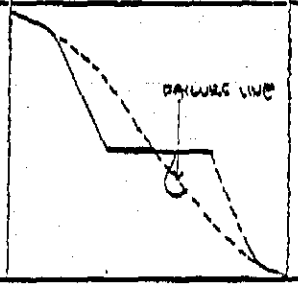
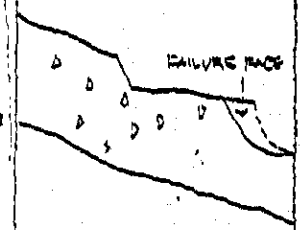
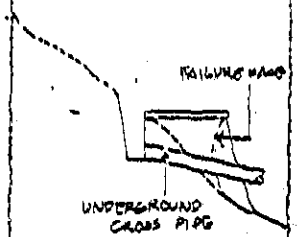
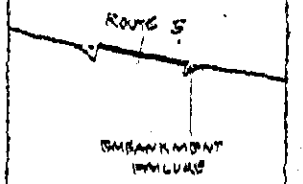
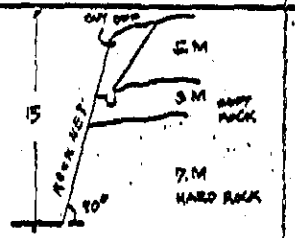
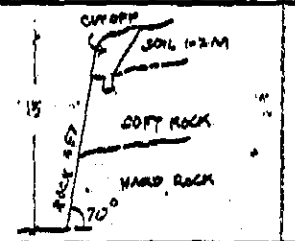
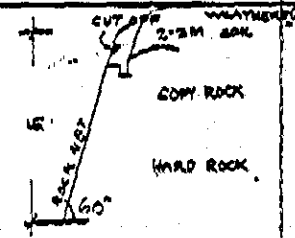
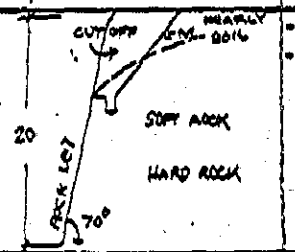
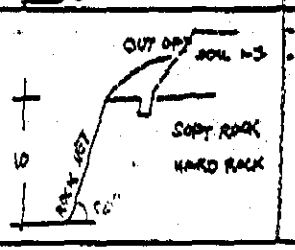
EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	KM.	LAND FORM FEATURE	CONDITION OF EMBANKMENT FEATURE	CONDITION OF PAVEMENT FEATURE	PRESENT LAND FORM	EMBANKMENT TREATMENT	NOTE
65	215.300	cutting and embankment	normal	normal		gutter repair	
66	215.600	cutting and embankment	road shoulder is eroded by running water	gully		gutter and shoulder repair overlay	
67	215.900	cutting and embankment	normal	cracks and settlements		gutter repair	
68	216.800	cutting and embankment	Foot of Embankment is weosws by Sta. Fe river	cracks and settlements		revetment	

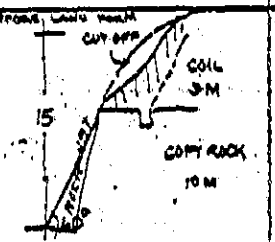
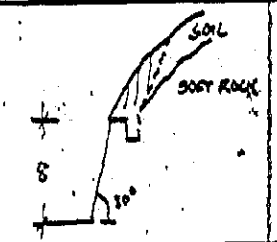
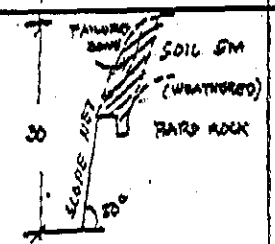
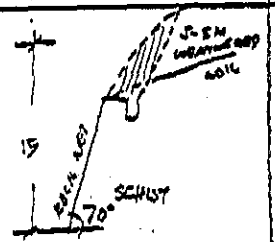
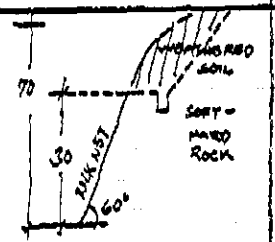
EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	KM.	LAND FORM FEATURE	CONDITION OF EMBANKMENT FEATURE	CONDITION OF PAVEMENT FEATURE	PRESENT LAND FORM	EMBANKMENT TREATMENT	NOTE
69	223.700	cutting and embankment	slope failure is occurs at the toe of hill	cracks on the pavements		failure zone repair by masonry	
70	225.100	half cut and fill	Foot of Embankment is eroded by Sta. Fe river running water from pipe	normal		revetment vertical drain	
71	225.400	plain	erosion by stream	normal		Box culvert	

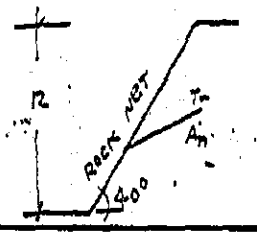
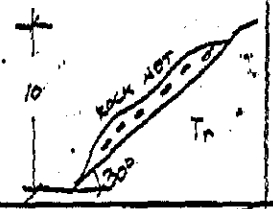
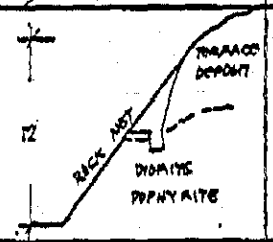
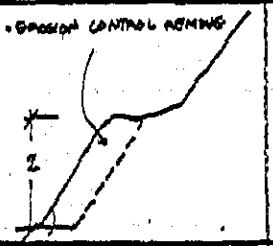
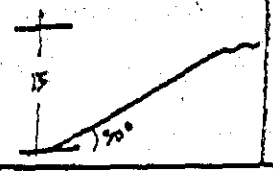
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
1	167.000	*Diorite -upper half consists of strongly weathered soil -slope surface leaves open cracks *Covered soil depth 2-3m	*weathered zone surface failure *hard rock, rock fall		*soil, soft rock zone remove 1 : 1 *hard rock rock net protection *need drainage on top of the slope.	*failure surface erosion of stream *rock fall occur by exfoliation *land slide type (2)
2	167.300	*Diorite -occurs hard rock -cracks present *Covered soil very thin about 2-3m *Gully pregent along the slope	*soft rock zone surface exfoliate along open joint *failures occur due to surface stream erosion.		*drainage establish *unstable zone remove and rock net protection (soft rock and hard rock)	*failures occur due to surface erosion of water stream *rock fall *land slide type (3)
3	169.500	*Diorite -very hard -cracks present *Covered soil -weathered soil 3-5m	*rock fall exfoliate along the crack. there are many crack in the diorite bed.		*drainage establish unstable zone remove and rock net protection	*failure in small scale *rock fall often occured *land slide type (3)
4	167.600	*Andesite -strongly weathered -presence of many brecciated gullies -rocks *Covered soil -very thick	*failures occur due to surface stream erosion and exfoliation from joint		*drainage establish *unstable zone remove and rock net protection	*failure occur along joint (exfoliate) and large scale *land slide type (3)
5	167.800	*Shale -joint bedding abundant which exfoliated soft rock *Andesite -strongly weathered *Covered soil -thin	*failure occur on the slope consist of soil and slope of andesite that exfoliate along joints *all soft rock		*drainage establish *unstable zone remove and rock net protection	*failure in small scale *land slide type (3)

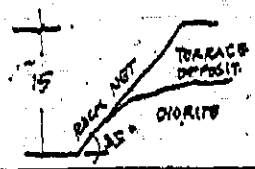
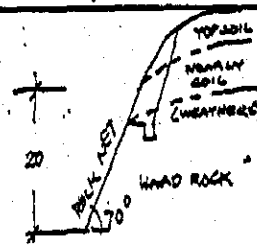
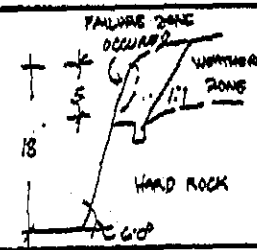
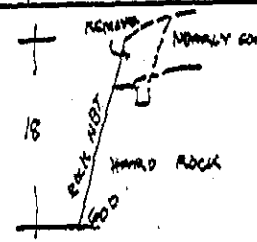
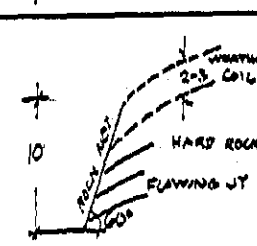
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
6	167.900	*Andesite -Brecciated -exfoliated, also strongly weathered (nearly soil) *Covered soil -very thick about 5 10m	*bed rock strongly weathered because many gullies exist. failure occurs.		*drainage establish *unstable zone remove *rock not protection	*failure occured mainly due to water surface stream action *land slide type (3)
7	169.200	*Andesite -strongly weathered (nearly soil) -agglomerate occurs *Covered soil -very thick	*weathered zone exfoliation and swamp stream action		*drainage establish *swamp treatment	*mainly needs swamp treatment *land slide type (3)
8	170.700	*Sand stone shale many joint bedding exist, easy to exfoliate *Covered soil thickness about 5m	*exfoliation occur from schisty joint *failure occures due to surface water action and to intense weathering.		*unstable zone remove *hard rock zone Rock not protection	*failure on the middle scale *land slide type (A)
9	171.000	*Schist -cracks very abundant (bedding joint) -upper half is andesite *Lower schist *Covered soil about 5-8m thick	*there are many gullies on the slope surface. *failure happens in all of the upper portion of the weathered zone.		*unstable zone remove *drainage establish *rock not protection	*failure occured in small scale due to surface water action *land slide type (A)
10	171.100	*Schist -strongly weathered (nearly soil) *Covered soil very thick (5 - 15m)	*failure occurs due to surface water erosion and underground water action (erosion) *failure exfoliates on the schisty rocks		*drainage establish *weathered soil remove and hard rock not protection	*many gully exists *failure often occured *land slide type (A)

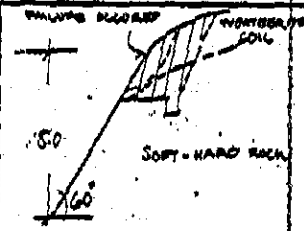
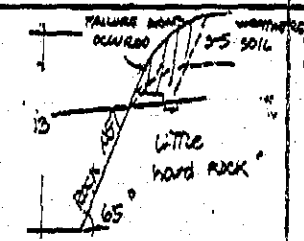
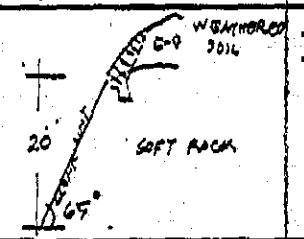
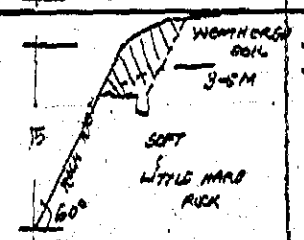
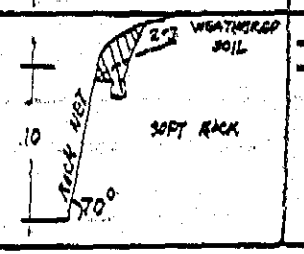
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
11	173.500	*Terrace deposits (upper) and andesite (lower) *Covered soil very thin (without terrace deposits)	*failure occurs by surface exfoliation *water spring and the boundary terrace deposits compounded with andesite are the causes of failure.		*drainage establish *weathered soil (unstable zone) removed	*there are underground water on the slope *land slide type (A)
12	173.900	*Terrace deposits -debris present along the slope	*failure occurs with gully on surface slope *failure is due to underground water action.		*drainage establish *unstable zone remove	*there are underground water on the slope *land slide type (A)
13	174.000	*Terrace deposits there are many unstable Breccia.	*failure occurs with gullies on surface slope.		*drainage establish *unstable zone remove	*there are underground water on the slope *land slide type (A)
14	182.100	*Talus deposits sand (granitic)	*failure occurs by surface water erosion.		*drainage establish *unstable zone remove	*there are underground water on the slope *land slide type (A)
15	183.500	*Talus deposits and terrace deposits	*failure occures by surface water erosion.		*drainage establish *unstable zone remove	*land slide type (A)

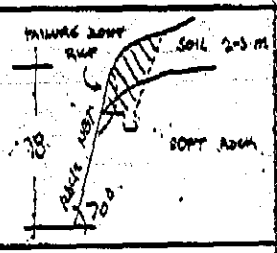
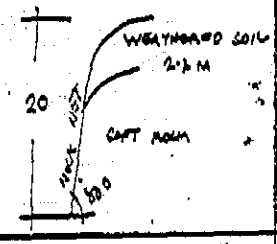
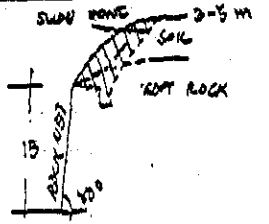
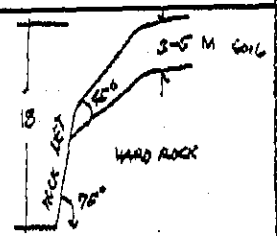
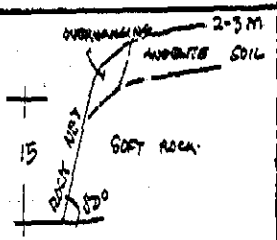
CUTTING SLOPE AT VALLEY CHECK DAM-1

NO-	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
16	185.600	*Diorite and terrace deposits	*failure occurs by surface water erosion.		*drainage establish *rock net protection	*there are underground water on the slope *land slide type
17	185.900	*Andesite slightly weathered *Top soil few meters thick	*failure occured by exfoliate joint on the weathered block *there are many gullies on the slope (strongly weathered)		*drainage establish *rock net protection	*there are many gullies on the slope *land slide type (3)
18	186.100	*Andesite, diorite predominantly diorite) weathered to a depth of about 5m (nearly soil) *Top soil (weathered soil) about 5.0m	*failure occurs on the top of slope (weathered soil) failure is due to underground water action, and surface water action.		*drainage establish *unstable zone remove	*there are many gullies on the slope *land slide type (.)
19	186.200	*Diorite -upper slope very -weathered (nearly to soil) -and lower parts slightly weathered *Covered soil depth about 5m	*failure occurs by exfoliation.		*Loose block should be cut off *drainage establish	*failure is exfoliated from joint because large failure does not occur *land slide (C)
20	186.400	*Diorite fault present on the lower slope, because diorite is sheared. *Covered soil few meters thick	*failure occurs by sliding along flowing joint and exfoliation along joint.		*unstable zone remove *rock net protection	*failure exfoliates from joints. (small scale) *land slide type (C)

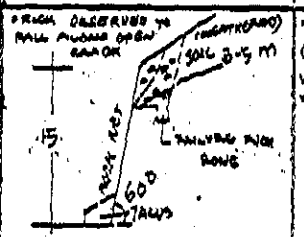
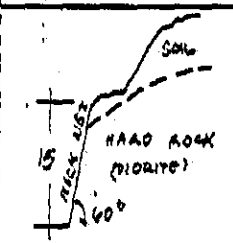
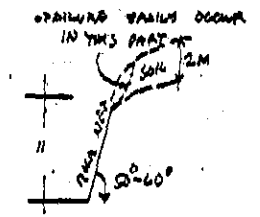
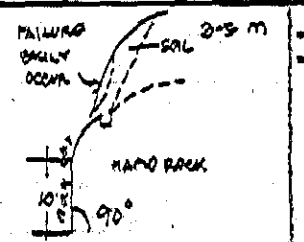
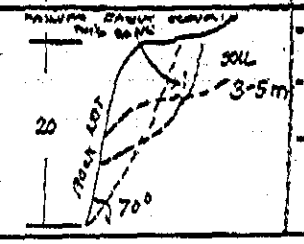
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
21	186.800	*Diorite weathered zone is 3-5m (upper slope)	*failure occurs on weathered zone due to surface and underground water actions. *there are many gullies on the slope.		*unstable zone remove *drainage establish (there are many gullies on the slope)	*there is water spring on the lower slope *land slide type (B)
22	187.100	*Diorite -weathered nearly to soil; 3-5m thick	*failure occurs on surface (weathered soil) *there are many gullies on the slope due to water surface action.		*unstable zone remove *drainage establish	*there are many gullies on the slope *land slide type (B)
23	187.200	*Andesite and scholstein are weathered soil. faults present on the slope because basement rock is sheared.	*failure occurs due to surface water erosion. (gullies present along the slope).		*unstable zone remove *drainage establish (there are many gullies on the slope)	*there is fault because rock is sheared *large scale failure. *land slide type (B)
24	187.300	*Diabase, diorite almost weathered to soil -there is fault on the slope. *Covered soil 3-5m thick	*failure occurs on the weathered zone. *failure is due to water action on the surface of slope.		*unstable zone remove *drainage establish	*failure occured on small scale *land slide type (C)
25	187.500	*Diorite, andesite -generally hard -cracks are abundant *Covered soil very thin	*failure occurs on surface *failure is due to water action on the surface of slope.		*unstable zone remove *drainage establish	*small scale failure. *there are gullies *land slide type (B)

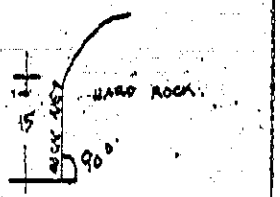
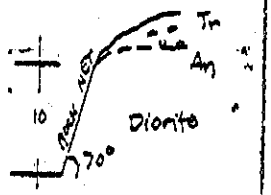
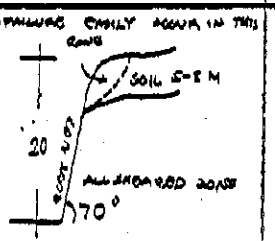
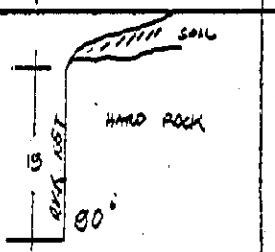
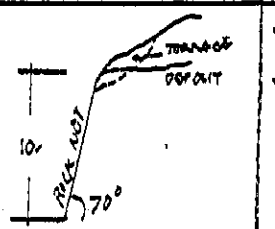
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
26	187.700	*Andesite upper half of cutting slope is intensely weathered	*weathered zone failure (exfoliate)		*unstable zone remove *drainage establish	*failure occured on small scale *land slide type (3)
27	187.800	*Andesite weathered zone is 5-8 meters thick *Covered soil very thin	*failure occure on the top of the slope. failure is due to surface water action.		*unstable zone remove *drainage establish	*failure occured on small scale *land slide type (3)
28	187.900	*Andesite generally hard. weathered zone is 3-5 meters *Covered soil very thin	*failure occure by exfoliation on weathered andesite (flowing joint)		*unstable zone remove *drainage establish	*unstable zone overhung *many gullies *land slide type (C)
29	188.100	*Micro-diorite is very hard at lower part. But top of slope is strongly weathered.	*rock falls exfoliated from flowing joint *failure occure by erosion of top soil.		*unstable weathered zone remove	*there are many gullies on the slope. *land slide type (3)
30	188.200	*Andesite strongly weathered *Upper half slope strongly weathered (nearly soil)	*rock fall occure by exfoliation *failure occure due to surface water action (there are many gullies)		*rock net should be use	*there are many gullies *land slide type (3)

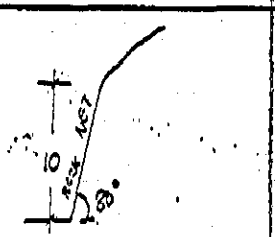
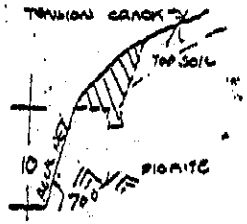
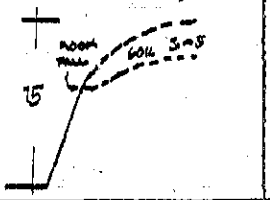
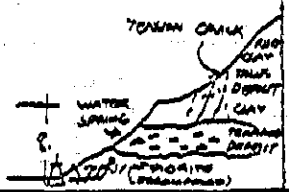
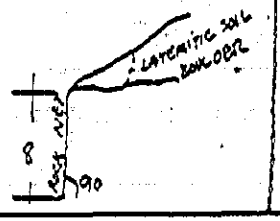
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
31	189.100	*Micro Diorite slightly weathered *Covered soil 3-5m thick	*rock fall rock fall observed along open crack *failure observed on weathered zone		*unstable zone remove (failure observed on weathered zone) *drainage establish	*there are many gullies on the slope *land slide type (B)
32	190.000	*Micro diorite numerous cracks (open crack) are present *debris *few meter *depth	*failure occur on the middle of the slope and land slide occurs on surface slope.		*unstable zone remove *rock net protection	*there are gullies on the slope *land slide type (B)
33	190.200	*Micro diorite little hard rock (moderately weathered)	*failure occure on weathered zone (cause by water action) *rock falls all exfoliated.		*unstable zone remove *rock net protection	*there are many gullies *land slide type (A)
34	190.300	*Diorite hard rock (moderately weathered)	*failure occurs on upper slope due to water action. *rock fall occurs exfoliate on lower part of slope.		*unstable zone remove *rock net protection	*large scale failure occured. *many gullies on slope *land slide type (B)
35	191.100	*Micro Diorite little hard rock *Covered soil from 3 5m thick	*failure exfoliated from open flowing joint due to water action (underground surface)		*failure occured at top of cut slope *treatment of water (drainage) *rock net protection	*there are many gullies on the slope *land slide type (A)

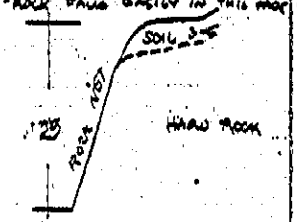
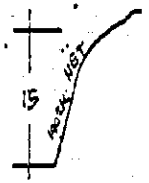
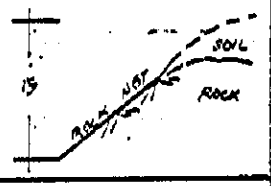
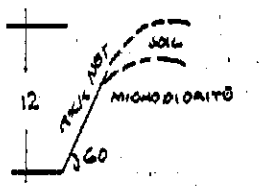
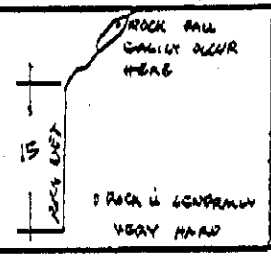
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
36	192.000	*Schist hard rock (slightly weathered)	*rock fall exfoliate from open joint.		*rock net protection *unstable zone remove	*only rock fall *land slide type (C)
37	192.200	*Diorite, andesite hard rock (slightly weathered) *Covered soil terrace deposit (3-5m)	*failure occurs on terrace deposit *rock fall exfoliate breccia		*unstable zone should be remove *rock net protection	*breccia fall (exfoliate) *land slide type (B)
38	192.900	*Schist, schalstein there is fault on the slope because basement rock is sheared.	*failure occurs easily in weathered soil (exfoliate due to schisty joint)		*unstable zone should be remove *drainage establish *rock net protection	*there are water spring on the upper slope. *land slide type (A)
39	193.000	*Diorite, schalstein hard rock (slightly weathered) *Covered soil about one meter	*weathered zone failure (by water action), there are many gullies on the slope.		*unstable zone should be remove *rock net protection	*present slope is dry *failure occured in small scale *land slide type (B)
40	193.150	*Diorite strongly weathered (soft rock) *Covered soil on terrace deposits about 3-5m	*failure occurs on terrace deposits *rock fall exfoliate from joint.		*unstable zone should be remove *drainage establish	*terrace deposits failure (small scale) *land slide type (A)

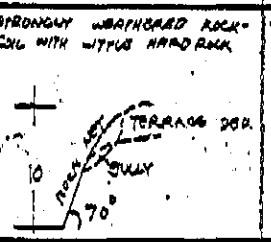
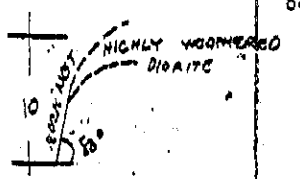
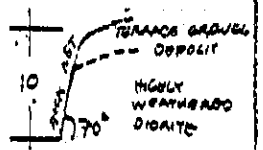
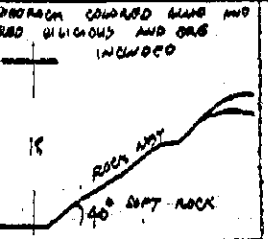
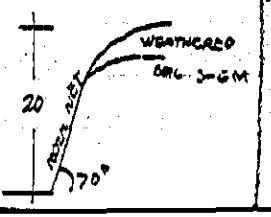
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
41	194.200	*Diorite, andesite hard rock (slightly weathered) *Covered soil (minimal)	*exfoliation failure, rock falls do not occur on the slope.		*unstable zone should be removed and rock net protection should be used.	*no problem *land slide type (C)
42	195.300	*Diorite slightly weathered hard rock (partly soft rock) *Covered soil 3-5 meter	*failure occurs on top of slope (soil failure) *rock fall exfoliate from joint.		*unstable zone should be removed *drainage establish *rock net protection	*there is tension crack on the natural slope. *failure occurs easily when it rains
43	195.850	*Micro joint hard rock *Covered soil 3-5m	*failure occurs on top of slope (weathered soil) many gullies present.		*unstable zone should be remove *rock net protection	*there are many gullies on the slope *land slide type (B)
44	196.100	*Terrace deposit and diorite (decomposed) all nearly weathered soil	*failure occurs due to underground water action and under groundwater stream, through upper diorite.		*unstable zone should be remove *drainage establish *mound up (mason) establish (if failure occurs, debris will not reachon road surface)	*very rich underground water *land slide type (D)
45	196.200	*Micro diorite little hard rock (slightly weathered) weathering zone depth 3-5m (nearly, soil)	*failure occurs due to surface water action (weathered soil) and slide		*unstable zone remove *rock net protection	*failure occurs easily *land slide type (B)

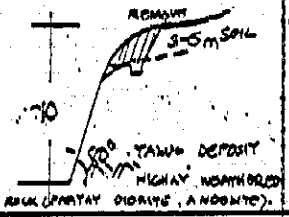
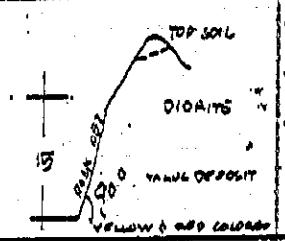
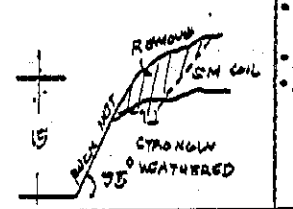
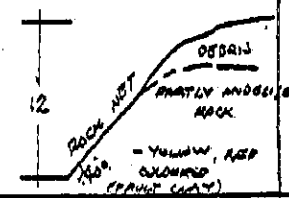
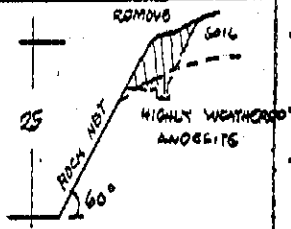
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
46	196.450	*Micro diorite (Hornfels) there are many cracks but rock place very hard *Covered soil depth 3-5m	*rock fall *exfoliation along joint		*unstable zone should be remove *rock net protection	*there is water spring on the lower slope. *land slide type (C)
47	196.500	*Micro diorite hard rock there is a small fault on the slope	*rock fall *exfoliated along open crack		*unstable zone should be remove *rock net protection	*there is water spring on the slope *land slide type (C)
48	196.750	*Diorite slightly weathered *Covered soil depth 3-5m	*failure *exfoliate on top of slope due to water action *rock fall *exfoliate along joint		*unstable zone on top of slope should be remove *rock net protection	*land slide type (A)
49	197.000	*Diorite strongly weathered (nearly soil) *Covered soil 2m thick	*failure occured on top of slope *rock fall exfoliate		*unstable zone on top of slope should be remove *rock net protection	*sheared zone *land slide type (C)
50	197.300	*Micro diorite fresh (hard) *Covered soil little	*rock fall exfoliate from flowing joint		*rock net protection	*no problem *land slide type (C)

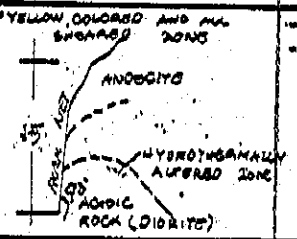
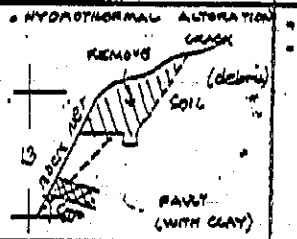
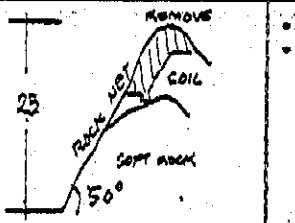
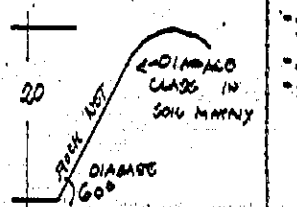
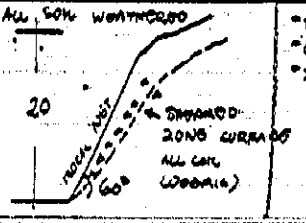
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (In cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
51	201.300	*Diorite strongly weathered *Covered soil 2-5m thick Terrace deposit	*failure occured on the weathered zone (exfoliate)		*rock net protection	*there are gullies at terrace deposit *land slide type (C)
52	201.600	*Diorite strongly weathered (soil, little hard rock) *Covered soil 3-5 meter depth (weathered soil)	*failure occure at weathered soil along the surface slope. (by surface water action)		*unstable zone should be remove.	* there is no problem *land slide type (B)
53	202.200	*Diorite strongly weathered (little hard rock) *Covered soil depth 1.5m	*failure occure due to surface stream action on the slope (there are many gullies.)		*unstable zone should be remove *drainage establish /	*land slide type (C)
54	202.950	*Diorite, Quartz porphyrite Hydrothermally altered zone (bed rock breccia) soft rock b *Covered soil thin	*failure occure along joints (rock fall)		*rock net protection *unstable zone should be remove	*all soft rock * large scale failure occurs. *land slide type (B)
55	203.200	*Hydrothermally altered zone *Diorite strongly weathered *Covered soil depth 3-5m	*weathered zone failure surface observed to exfoliate		*unstable zone remove *rock net protection	*sheared zone *land slide type (A)

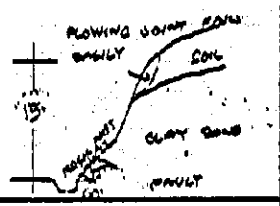
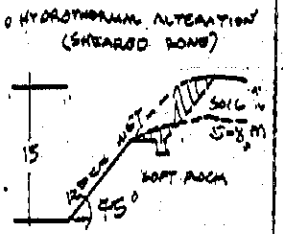
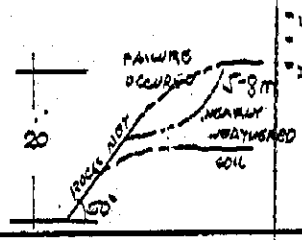
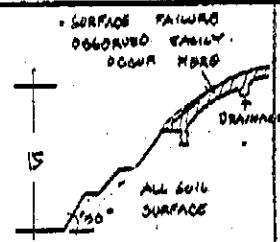
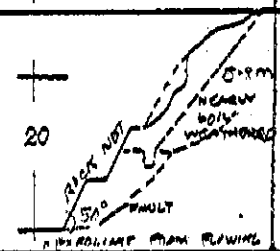
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
56	203.200	"Andesite strongly weathered (sheared zone) "Covered soil thin	"failure occur due to surface water action (gullies) and and exfoliation along joints.		"unstable zone remove "rock net protection	"hydrothermally altered zone "there are gullies "land slide type (B)
57	203.300	"Diorite strongly weathered sheared zone (hydrothermally altered zone) hard rock	"exfoliation occure from open cracks erode surface water action.		"loose block should be remove "rock net used as protection "drainage established	"there are many gullies on the slope "land slide type (B)
58	203.500	"Diorite soft rock sheared zone (Breccia rock) strongly weathered	"exfoliate cause by surface water "slope surface exfoliated "all sheared zone "cut-off of surface protection		"loose and unstable zone remove "rock net protection "drainage establish	"there are many gullies on the slope and many fault "land slide type (B)
59	203.700	"Sheared zone diorite, andesite porphyry (all soil, breccia)	"failure occure at surface		"drainage establish (there are many water spring points) "loose and unstable zone remove	"there are many gullies on the slope, and water spring "land slide type (B)
60	203.800	"Andesite strongly weathered (hydrothermally altered) moderately hard	"top of slope observed to have failed due to exfoliation along surface.		"drainage establish (there are water spring on the slope) "loose and unstable zone remove "rock net protection	"there are many water spring at the slope "land slide type (B)

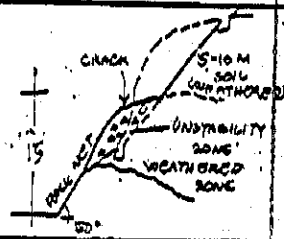
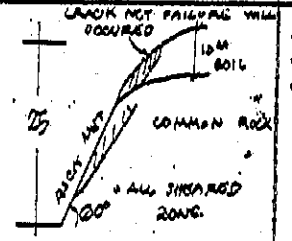
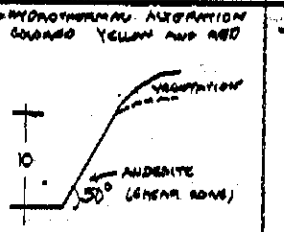
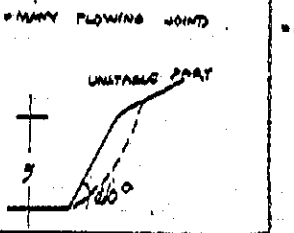
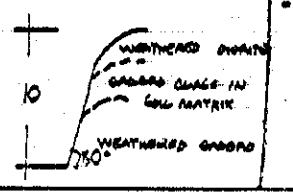
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
61	204.000	*Andesite strongly weathered *Frequently fractured loose	* exfoliation *unstable zone should be remove and rock net protection should be used.		*unstable zone remove *rock net protection	*failure in small scale *land slide type (3)
62	204.100	*Diorite sheared fracture zone * Top soil 5-10m (debris)	*weathered soil failure and debris fall occure due to underground surface water action.		*unstable zone remove *rock net protection	*there are many fault because basement rock breccia *land slide type (2) (A)
63	204.300	*Diabase nearly weathered soil	*failure cause by water action (gullies) *exfoliation (intense)		*unstable zone remove *there are many gullies on the slope.	*there are many gullies on the slope *land slide type (A) (3)
64	204.500	*Diabase strongly weathered	* slide (slump) weathered zone		*unstable zone should be remove *drainage establish *rock net protection	*there are many gullies on the slope *land slide type (B)
65	204.700	*Diabase/porphyry *Frequently fractured weathered breccia	*surface exfoliate *there are many gullies on slope surface, failure occured on the surface.		*unstable zone remove *drainage establish *rock net protection	*there are many gullies on the slope and water spring *land slide type (3)

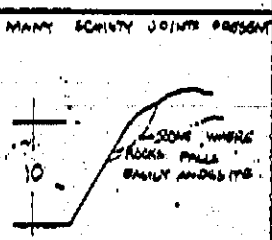
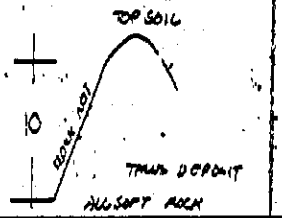
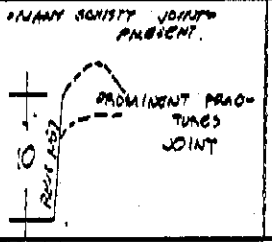
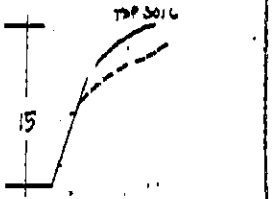
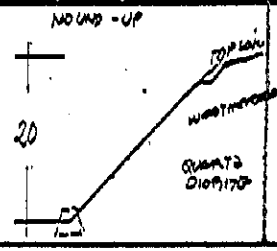
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
66	205.000	*Quartz porphyry (Qp) (clay) *frequently crack loose (nearly soil alternation)	*surface is observed to exfoliate. *failure occurs along joint (inside) with clay and block.		*unstable zone remove *drainage establish *rock net protection	*there is water spring. *hydrothermal alteration rock are all nearly soil *land slide type (B)
67	206.000	*Diabase nearly soil *Frequently (crack) *nearly soil weathered	*failure occurs at slope surface due to surface water action.		*unstable zone remove *drainage establish *rock net protection	*there are many gullies on the slope *land slide type (B)
68	206.300	*Diabase/porphyrite nearly soil *Frequently crack nearly soil	*surface failure is due to water action *there are many gullies in the slope due to surface water.		*unstable zone remove *drainage establish *rock net protection	*there are many gullies on the slope *land slide type (A) (B)
69	206.900	*Diabase/ Porphyrite *Frequently, very loose	*surface exfoliate by many gully (surface water stream) *Sheared zone, failure occured at surface of slope. (exfoliate)		*unstable zone remove *drainage establish *rock net protection	*there are many gullies on the slope *rocks have many crack *land slide type(B)
70	207.100	*Diorite/porphyrite nearly soil (sheered zone) *Frequently, very loose	*Failure observed on the slope surface (exfoliate from flowing joint)		*unstable zone remove *drainage establish *rock net protection	*there are many gullies and water spring on the slope. *all sheared zone *land slide type (B)

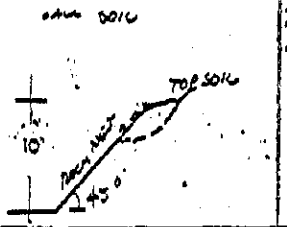
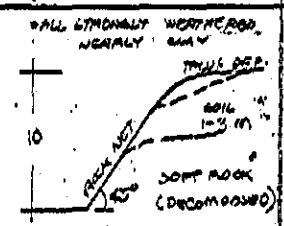
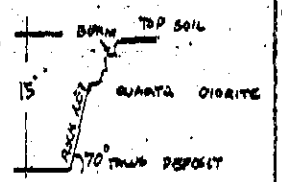
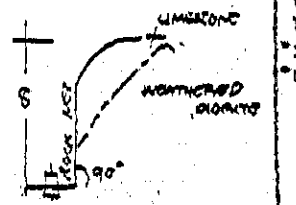
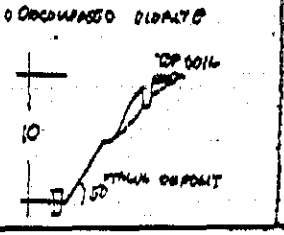
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (In cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
71	207.700	*Andesite, dioritic porphyrite *Sheared zone nearly soil *Frequently crack	*failure occure due to under ground water, and surface water action. *Rock is exfoliated		*unstable zone remove *drainage establish *rock net protection	*there is water spring at the slope. *land slide type (B)
72	207.900	*Andesite strongly weathered *Frequently crack zone	*surface failure is obabrved to exfoliate. *failure occure on weathered soil due to water action.		*unstable zone remove *drainage establish *rock net protection	*there are many water spring quantity and gullies. *land slide type (B)
73	208.600	*Andesite strongly weathered to soil	*exfoliate from joint of surface (in small scale)		*unstable zone remove	*no problem *land slide zone type(A)
74	208.800	*Diorite *Sheared zone *Frequently crack very loose	*observed to exfoliate from flowing joint.		*unstable zone remove	*no problem *land slide type (A).
75	209.000	*Gabbro, diorite strongly weathered	*weathered zone failure (top of slope) exfoliates.		*unstable zone remove	*no problem *land slide type (C)

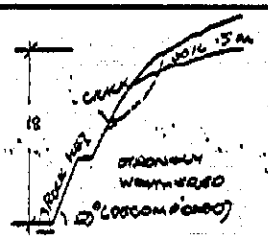
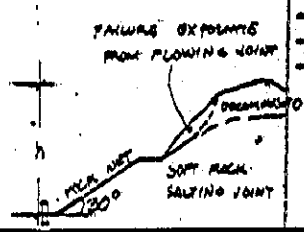
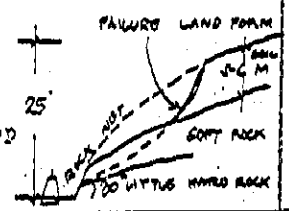
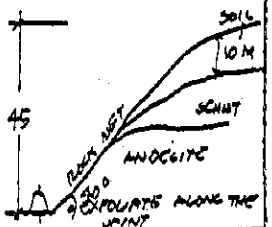
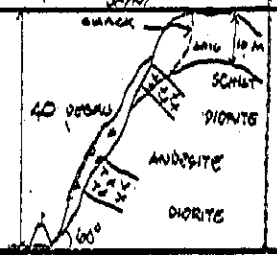
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
76	209.100	*Andesite slightly weathered *Frequently rock piece is very hard	*exfoliate from joint		*rock net protection *unstable zone remove	*land slide type (C)
77	209.600	*Andesite strongly weathered *All soft rock.	*weathered soil zone failure by water action.		*unstable zone remove *there are gullies on the slope because drainage needs treatment.	*there are many hollow on the slope *land slide type (B)
78	209.900	* Pophyritic andesite fresh	*exfoliation occure along joint (rock fall)		*rock net protection	*land slide type (C)
79	211.400	*Andesite strongly weathered	*exfoliation		*there is a plain space side of road because	*land slide type (C)
80	213.400	*Quartz Diorite strongly weathered (decompose diorite like mesa)	*surface exfoliation from joint and surface erosion		*there are many gullies on the slope (surface water) treatment surface water is needed. *mound up (small)	*there is a little problem in drainage *land slide type (B)

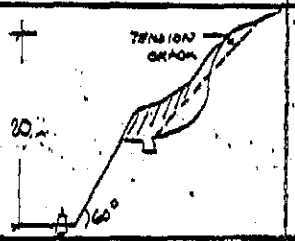
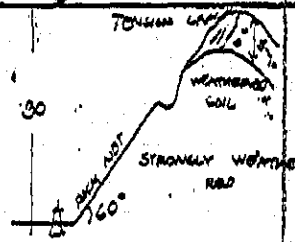
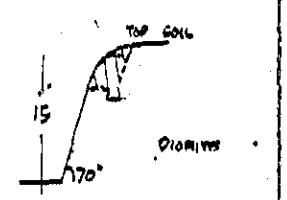
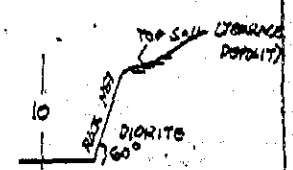
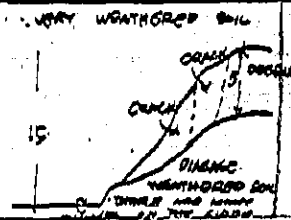
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
81	213.800	*Debris (Limestone) strongly weathered (all soil) *limestone bed rock	*clay and boulder sudm by ground surface water action		*unstable zone remove *needs treatment of drainage	*there is water spring on the slope *land slide type (B)
82	213.900	*Limestone - Quartz diorite strongly weathered very loose	*slump failure is due to water action.		*loose soil slump type slide *needs drainage at the slope	*soil is calicius, and have high water content *land slide type (C)
83	215.600	*Quartz Diorite strongly weathered *Frequently crack loose	*erosion due to stream action * There are many gullies present on the cutting slope		*drainage establish *mound up establish	*surface eroded out due to water action (small scale) *land slide type (B)
84	216.000	*Limestone above quartz diorite strongly weathered little soft rock	*rock fall observed. limestone boulders		*unstable zone should be remove *rock net protection *mound up establish	*Rock falls only *land slide type (A)
85	216.100	*Quartz Diorite strongly weathered (decomposed)	*surface exfoliate (erosion by surface water) there are many gullies.		*drainage establish (water spring) *mound up establish	*surface exfolirte (small scale) *land slide type (B)

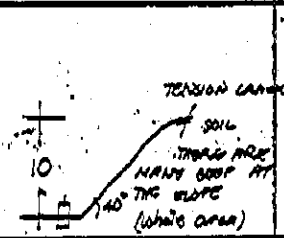
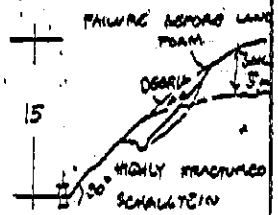
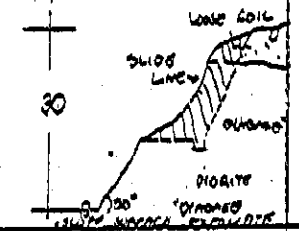
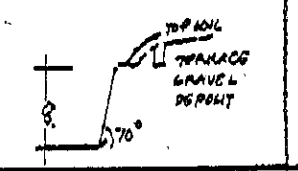
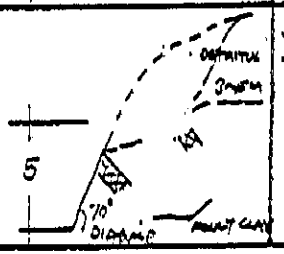
CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
86	216.700	* Granditorite strongly weathered (decomposed)	*exfoliation is observed along joints and gullies *failure occurs at the top of the slope.		*mound up *drainage establish *rock net protection *unstable zone remove	*surface exfoliate *land slide type (B)
87	216.800	*Diorite strongly weathered (decomposed)	*exfoliate from joints (exfoliat		*mound up *drainage establish *unstable zone remove	*this exfoliate from joint surface *land slide type (B)
88	217.100	*Schalstein/andesite nearly soil (weathered) *Frequently, loose	*surface failure *exfoliate from joint (open) *highly weathered schalstein failure is observed due to ground water activities which occure on top of the natural slope.		*mound up (concrete wall) *drainage establish	*surface failure will occured easily at the slope *land slide type (A)
89	217.600	*Schalstein/Andesite nearly soil strongly weathered	*failure occure on top of the slope by exfoliation from joint and surface water action (there are many gullies on the slope).		*unstable zone remove *drainage establish *mound up (or concrete wall)	*surface failure will occur easily at the slope *land slide type (A)
90	219.220	*Schalstein/Andesite Diorite *Frequently crack very loose	*failure on weathered soil is observed. *natural slope have gully relief, slope surface		*unstable zone remove *drainage establish *mound up (or concrete wall)	*there are tension crack on the natural slope *land slide type (A)

CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
91	219.350	*Schalstein nearly soil upper part of slope lower parts have little hard rock	*top soil failure is due to underground water stream action *bed rock exfoliate from joint		*unstable zone remove *drainage establish *mound up (concrete wall) *rock net establish	*surface failure easily occur due to water action *land slide type (A)
92	219.900	*Schalstein/Andesite strongly weathered nearly to soil	*failure is observed on top of weathered soil along the slope by surface and ground water action. *rock fall occur by exfoliation of flowing joint.		*unstable zone remove *drainage establish *mound up (concrete wall) *rock net establish	*there are many gullies on the slope *land slide type (A)
93	220.000	*Schalstein moderately hard rock slightly weathered	*erosion by surface water		*unstable zone remove *drainage establish *rock net establish	*little problem *land slide type (3)
94	220.300	*Diorite strongly weathered (decomposed)	*surface exfoliated terrace deposit		*unstable zone remove *drainage establish	*little problem *land slide type (3)
95	220.900	*Diabase nearly soil (weathered)	*failure occurs on the surface of slope by ground water activities		*unstable zone remove *drainage establish *mound up	*large scale failure *land slide type (A)

CUTTING SLOPE STABILITY CHECK TABLE

NO.	KM	GEOLOGICAL FEATURE	CAUSE OF FAILURE (in cutting slope)	PRESENT LAND FORM	CUTTING SLOPE TREATMENT	REMARKS
96	221.200	*Soil (schalstein) nearly soil (sheared zone)	*surface exfoliate *there are many tension cracks on the upper portion of the slope.		*unstable zone remove *drainage establish *mound up	*bed rock do not withstand mainly sheared clay *land slide clay (A)
97	223.150	*Schalstein strongly weathered (nearly soil)	*failure occurs along natural water way surface of slope *rock fall along cracks of bed rock		*unstable zone remove *drainage establish *mound up (concrete wall)	*there are many gullies on the slope *land slide type (A)
98	223.850	*Diabase strongly weathered *cracks are observed, very loose.	*slope surface is observed to peel off. *heavy rain led to the exfoliation of slope surface.		*unstable zone remove *drainage establish *mound up (concrete wall)	*there are many gullies on the slope *land slide type (A)
99	224.000	*Terrace depocit gravel (boulder cobble and sand)	*failure occurs due to under ground water flowing out and exfoliation from surface of slope.		*unstable zone remove *drainage establish	*there are many gullies on the slope *land slide type (B)
100	224.160	*Diabase (fault exist) nearly soil *Covered soil detritus (gravel...)	*failure occurs as a result of underground water flowing out and surface water stream action.		*unstable zone remove *drainage establish.	*detritus have many under ground water *land slide type (A)

APPENDIX C

QUANTITATIVE ANALYSIS OF SELECTED ALTERNATIVE ROUTES

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/. Summary of Length (Alternative Route)

ITEM \ ROUTE				II	II'	II"	V	II & V
Total Lenght (m)				10,160.0	10,130.0	10,060.0	10,882.5	10,850.0
ITEMS	NEW CONSTRUCTION SECTION			8,240.0	8,210.0	8,140.0	6,462.5	6,430.0
	Details	Earth Work SECTION		5,610.0	5,340.0	4,965.0	3,352.5	3,570.0
			Cut (m)	1,992.0	1,879.0	1,912.0	1,552.0	1,647.0
			Fill (m)	1,797.5	2,090.0	1,750.0	1,122.5	1,090.0
			Half Cut & Half Fill	1,820.5	1,371.0	1,303.0	678.0	833.0
		Structure Section		2,630.0	2,870.0	3,175.0	3,110.0	2,860.0
			Bridge (m)	760.0	760.0	795.0	1,270.0	990.0
			Tunnel (m)	1,870.0	2,110.0	2,380.0	1,840.0	1,870.0
TO-BE-IMPROVEMENT SECTION				1,920.0	1,920.0	1,920.0	4,420.0	4,420.0

KM 202 218 + 000

I - 3

1-1 List of Items

Route II

	STA.	NEW CONSTRUCTION					IMPROVEMENT
		Cut	Fill	C & F	Bridge	Tunnel	
II_1	202 + 00						
	+ 500						500.00
	+ 950		450.0				
	203 + 170				220.0 II-1		
	+ 300		130.0				
	+ 600	300					
	+ 647.5		47.5				
	+ 747.5				100.0 II-2		
	+ 800.0		52.5				
	204 + 000			200.0			
	+ 135.0	135.0					
	+ 225.0				90.0 II-3		
	+ 450.0	225.0					
	205 + 000			550.0			
	Sub total	660.0	680.0	750.0	410.0		500.00
II_2	205 + 000						
	205 + 37.5			37.5			
	+ 152.5				115.0 II-4		
	+ 200		47.5				
	+ 350	150.0					
	+ 600			250.0			
	+ 830			230.0			
	207 + 700					1,870.0	
	Sub total	150.0	47.5	517.5	115.0	1,870.0	
II_3	207 + 700						
	+ 850	150.0					
	+ 872.5		22.5				
	+ 932.5				60.0 II-5		
	208 + 000		67.5				
	+ 350.0			350.0			
	+ 450.0	100.0					
	+ 600.0		150.0				
	209 + 532.0	932.0					
	+ 567.0				35.0 II-6		

Route II

STA.	NEW CONSTRUCTION					IMPROVEMENT
	Cut	Fill	C & F	Bridge	Tunnel	
202 + 00						
+ 500						
+ 950		450.0				500.00
203 + 170				220.0 II-1		
+ 300		130.0				
+ 600	300					
+ 647.5		47.5				
+ 747.5				100.0 II-2		
+ 800.0		52.5				
204 + 000			550.0			
+ 135.0	135.0					
+ 225.0				90.0 II-3		
+ 450.0	225.0					
205 + 000			550.0			
Sub total	660.0	680.0	750.0	410.0		500.00

II'

STA.	CUT	FILL	C/F	BRIDGE	TUNNEL	IMPROVEMENT
205+000						
+035	35.0					
+110				75 B'-1		
+450		340.0				
+518			68.0			
+558				40 B'-2		
+560	2.0					
207+670					2110.0	
SUB TOTAL	37.0	340.0	68.0	115.0	2110.0	
TOTAL		2090.0		760.0	2110.0	
II"						
205+000						
+035	35.0					
+185				150.0 X'-1		
+220	35.0					
207+600					2380.0	
SUB TOTAL	70.0			150.0	2380.0	
TOTAL		1750.0		795.0	2380.0	

ROUTE X

	STA.	NEW CONSTRUCTION					IMPROVEMENT
		CUT	FILL	C|F	BRIDGE	TUNNEL	
X	205+000						
	~205+110	110.0					
	~205+680				570.0		
	~205+710			30.0			
	~205+770				60.0		
	~205+865			95.0			
	~205+940				75.0		
	~206+030	90.0					
	~206+080				50.0		
	~206+155	75.0					
	~206+335				180.0		
	~206+430	95.0					
	~206+482.5		52.5				
	~206+582.5				100.0		
		370.0	52.5	125.0	1035.0		
				@ 20.0M	TUNNEL		
					L = 1840 M		
X+Y	205+000	110.0					
	~205+110						
	~205+680				570.0		
	~205+710			30.0			
	~205+770				60.0		
	~205+870	100.0					
	~205+995				125.0		
	~206+100	105.0					
	~206+120		20.0				
	~206+280			150.0			
	~206+300	50.0					
	~206+400			100.0			
	~206+500	100.0					
		465.0	20.0	280.0	755.0		

2 Earth Works.....

2-1

Route 11

1) Total of Cut$_3$ $540.095.^{0m^3}$

Total F: 11$_3$ $245,035^{0m^3}$

Common $540,095.^{0} \times 30\% \times 0.9 = 145,825^{0}$

Soft Rock $540,095.^{0} \times 30\% \times 1.1 = 178,331^{0}$

Hard Rock $540,095.^{0} \times 40\% \times 1.3 = \underline{280,849^{0}}$

$604,905^{0m3}$

2) Tunnel

$1870^{n} \times 77.5^{m^2/n} = 144,925.^{0}$

Common $144,925.^{0} \times 20\% \times 1.0 = 28,985^{0}$

Soft Rock $144,925.^{0} \times 30\% \times 1.3 = 56,520^{0}$

Hard Rock $144,925.^{0} \times 40\% \times 1.5 = \underline{86,955^{0}}$

$172,460.^{0m^3}$

D + 2) = $777,365.^{0}$

3) Excavation of Surplus Material

$777,365^{0} - 245,035^{0} = 532,330^{m3}$

4) Formation of Embankment From Roadway Excavation

$245,035.^{0}$

STA.	LENGTH	CUT			FILL			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE.AREA	VOLUME	
202 + 500					0			
+ 950	450				45.0	22.5	10,125.0	
203 + 170	11-1 Br.							
203 + 300	130					176.0	22,880.0	
+ 600	300		100.0	30,000.0				
+ 647.5	47.5					20.0	95.0	
+ 747.5	11-2 Br.							
+ 800.0	52.5					20.0	1,050.0	
204 + 000	200.0		100.0	20,000.0		20.0	4,000.0	
+ 135.0	135.0		144.0	19,440.0				
+ 225.0	11-3 Br.							
+ 450.0	225.0		184	41,400				
205 + 000.	550.0		20.0	11,000		200.0	110,000	
	Sub-Total			121,840			149,005	

STA.	LENGTH	CUT			FILL			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE.AREA	VOLUME	
205 + 000								
205 + 325	37.5		170.0	6,375.0		10.0	375.0	
+ 152.5	11-4 Br.							
+ 200	47.5					18.0	855.0	
+ 350	150.0		136.0	20,400.0				
+ 600	250.0		20.0	5,000		10.0	2,500.0	
+ 830	230.0		80.0	18,400		10.0	2,300.0	
207 + 700	TUNNEL		$1870^{m} \times 77.5^{m^2/n}$	144,925.0				
				50,175			6,030.	
				144,925.0				
		Sub-Total		195,100.0				

STA.	LENGTH	CUT			FILL			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
207 + 700								
+ 850	150.0		500.0	75,000				
+ 872.5	22.5					20.0	450	
+ 932.5	11-5 Br.							
208 + 000	67.5					20.0	1,350	
+ 350	350.0		120.0	42,000		20.0	7,000	
+ 450	100.0		186.0	18,600				
+ 600.0	150.0					40.0	6,000	
209 + 532.0	932.0			200,000				
+ 567.0	11-6 Br.							
+ 770	203.0		160	32,480				
+ 790	11-7 Br.							
210 + 090	300.0					180.0	54,000	
+ 180	11-8 Br.							

STA.	LENGTH	CUT			FILL			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE.AREA	VOLUME	
210 + 180								
+ 410	230					40	9,200	
+ 440	11-9							
+ 740	300					40	12,000	
				368,080			90,000	
				540,095.0			245,035.0	
			Tunnel	144,925.0				

2-2 Route 11'

1) Total of Cut

499,270.0 m^3

Fill

275.725.0 m^3

Common 499,270.0 x 30% x 0.9 = 134,803.0

Soft Rock 499,270.0 x 30% x 1.1 = 164,759.0

Hard Rock 499,270.0 x 40% x 1.3 = 259,620.0

559.182.0 m^3

2) Tunnel

2110 m x 77.5 m^2/n = 163,525.0 m^3

Common 163,525.0 x 20% x 1.0 = 32,705.0

Soft Rock 163,525.0 x 30% x 1.3 = 63,774.0

Hard Rock 163,525.0 x 40% x 1.5 = 98,115.0

194,594.0

1) + 2) = 753,776

3) Excavation of Surplus Material

753,776 - 275,725.0 = 478,051 m^3

4) Formation of Embankment From Broadway Excavation

275,725.0 m^3

11'

STA.	LENGTH	CUT			FILL			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE.AREA	VOLUME	
205 + 000								
+ 035	35.0		170.0	5,950				
+ 110	11'-1							
+ 540	340					100	34,000	
+ 518	680		50.0	3,400		40.0	2,720	
+ 558	11'-2							
+ 560	2.0		0					
207 + 670	TUNNEL		2110^{m}x77.5^{m2}	163,525.0				
				9,350			36,720	
				163,825				
			Sub-Total	172,875				
	Total		Tunnel	163,525.0 499,270.0			275,725.0	

2-3 Route 11"

1) Total of Cut

Fill

496,570.0 m^3

239,005.0 m^3

Common 496,570.0 x 30% x 0.9 = 134,073.0

Soft Rock 496,570.0 x 30% x 1.1 = 163,868.0

Hard Rock 496,570.0 x 40% x 1.3 = 258,216.0

556,157.0 m^3

2) Tunnel

2380 m x 77.5m^3/m = 184,450.0 m^3

Common 184,450.0 x 20% x 1.0 = 36,890.0

Soft Rock 184,450.0 x 30% x 1.3 = 71,935.0

Hard Rock 184,450.0 x 40% x 1.5 = 110,670.0

219,495.0 m^3

1) + 2) = 775,652.0 m^3

3) Excavation of Surplus Material

775,652.0-239,005.0 = 536,647.0 m^3

4) Formation of Embarkment From Roadway Excavation

= 239,005.0 m^3

11"

STA.	LENGTH	CUT			FILL			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE.AREA	VOLUME	
205 + 000								
+ 035	35.0		170.0	5,950				
+ 185	11"-1							
+ 220	35.0		20.0	700				
207 + 600	TUNNEL	2380 m x 77.5 m^2		184,450.0				
				6,650				
				184,450				
			Sub-Total	191,100				
Total				496,570.0			239,005.0	
			Tunnel	184,450.0				

ℓ - 4 Route V

1) Total of Cut

429,255.0 m^3

Common 429,255.0 x 30% x 0.9 = 115,899.0

Soft - Rock x 30% x 1.1 = 141,654.0

Hard - Rock x 40% x 1.3 = 223,213.0

480,766.0 m^3

Total Fill

92,370.0 m^3

2) Tunnel

1,840m x 77.5 m^3/n = 142,600.0

Common 142,600 x 20% x 1.0 = 28,520.0

Soft - Rock x 30% x 1.3 = 55,614.0

Hard - Rock x 40% x 1.5 = 85,560.0

169,694.0 m^3

1) + 2) = 650,460.0 m^3

3) Excavation of Surplus Material

650,460.0 - 92,370.0 = 558,090.0 m^3

4) Formation of Embankment from Roadway Excavation

92,370.0

STA.	LENGTH	CUT			FILL			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE.AREA	VOLUME	
205 + 000								
+ 110	110.		50.0	5,500.0				
+ 680	Br							
+ 720	30.0		20.0	600.0		7.5	225.0	
+ 770	Br							
+ 865	95.0		35.0	3,325.0		6.0	570.0	
+ 940	Br							
206 + 030	90.0		200.0	18,000.0				
+ 080	Br							
+ 155	75.0		70.0	5,250				
+ 335	Br							
+ 430	95.0		300.0	28,500				
+ 482.5	52.5					30.0	1,575.0	
+ 582.5	Br		Sub Total	61,175.0			2,370.0	
				429,255.0				
	Total	Tunnel 184.0 m x 77.5		142,600.0			92,370.0	

2 - 5 Route II & V

(1) Total of Cut

430,080.0 m^3

Total Fill

140,000 m^3

Comzon 430,080.0 x 30% x 0.9 = 116,122.0

S - Rock x 30% x 1.1 = 141,926.0

H - Rock x 40% x 1.3 = 223,642.0

481,690.0 m^3

(2) Tunnel

144,925

Common = 28,985.0

Soft - Rock = 56,520.0

Hard - Rock = 86,955.0

172,460.0

1) + 2) = 653,150.0

(3) Excavation of Surplus Material

653,150.0 - 140,000 = 513,150 m^3

(4) Formation of Embankment from Roadway Excavation

140,000 m^3

STA.	LENGTH	CUT			FILL			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE.AREA	VOLUME	
206 + 000 206 + 100	100.0		400.0	40,000				
206 + 300	200		20.0	4,000		250	50,000	
206 + 500	200		90.0	18,000				
				62,000			50,000	
			II'3	368,080			90,000	
				430,080.0			140,000	
			Tunnel	144,925.0				

3 Slope protection

Slope protection No. I For Embankment (Placing Topsoil)

Route II

	STA	Length	Left		Right	
			m	m^2	m	m^2
II_1	202 + 500					
	+ 950	450	5.0	2250.0	5.0	2250.0
	203 + 170					
	+ 300	130	5.0	650.0	12.0	1560.0
	203 + 600					
	+ 647.5	47.5	5.0	237.5	5.0	237.5
	+ 747.5					
	+ 800	52.5	5.0	262.5	5.0	262.5
	204 + 000	200.0	-		5.0	1000.0
	204 + 450					
	205 + 000	550.0	-		24.0	13000.0
				3,400.0		18,510.0
	Sub total			Left + Right =	21,910.0 m^2	
II_2	205 + 000					
	+ 37.5	37.5	-		-	
	+ 152.5					
	+ 200	47.5	-		8.0	380.0
	+ 350					
	+ 600	250.0	-		3.0	750.0
	+ 600					
	+ 830	230.0	-		3.0	690.0
						1,820.0
	Sub Total			L + R =	18,200 m^2	
II_3	207 + 850					
	+ 872.5	22.5	5.0	112.5	5.0	112.5
	+ 932.5					
	208 + 000	67.5	5.0	337.5	5.0	337.5
	+ 350	350.0	-		-	
	+ 450					
	+ 600	150.0	12.0	1,800.0	-	
	209 + 790					
	210 + 090	300.0	24.0	7,200.0	3.0	900.0
	+ 180					
	+ 410	230.0			24.0	5,520.0
	Sub Total			9,450.0		6,870.0
				L+R=16,320.0 m^2		

Slope protection For Embankment (Placing Topsoil)

Route II '

	STA	Length	Left		Right	
			m	m^2	m	m^2
II'	202 + 110					
	+ 450	340.0	-		24.0	8,160.0
	+ 518	68.0	-		18.0	1,224.0
						9,384.0
V				L + R =9,384.0 m^2		
V	206 + 430					
	206 + 482.5	52.5	5.0	262.5	5.0	262.5
				L + R =525.0 m^2		
II&V	206 + 100					
	+ 300	200.0			20.0	4,000.0

Slope protection No. I For Cut Section (Planting Work)

Length of Cut x 2m/m

	STA	Length		Unit	Length of Planting Work
		Left	Right		
II_1	203 + 300 203 + 600	300.0	300.0	2m/m	1,200 m
	204 + 450 205 + 000	500.0	-	2m/m	1,000 m
					2,200 m
II_2	205 + 000 205 + 37.5	37.5	-	2m/m	75 m
	205 + 350 205 + 600	250.0	-	2m/m	500 m
	205 + 600 205 + 830	230.0	-	2m/m	460 m
II_3	207 + 700 + 850	150.0	150.0	2m/m	600 m
	208 + 350 + 450	100.0	100.0	2m/m	400 m
	208 + 600 209 + 532.0	932.0		7m/m	6,524 m
					7,524 m
II'	205 + 000 + 035	35.0		4	140 m
	+ 450 + 518	68.0		2	136 m
					276 m
II"	205 + 000 + 035	35.0		4	140 m
V	205 + 000 205 + 110		110	2	220
	205 + 710		30.0	2	60
	205 + 770 205 + 865		95.0	2	190
	205 + 940 206 + 030		90.0	5	450
	205 + 080 206 + 155		75.0	2	150
					1070 m

Slope protection No. 3 For Cut Section (Concrete spraying)

Route II

	STA	Length	Left		Right	
			m	m	m	m
II_1	203 + 800					
	204 + 000	200.0	10.0	2000.0	-	
	+ 135.0	135.0	7.0	945.0	19.0	2565.0
	+ 225					
	+ 450.0	225.0	20.0	4500.0	-	
	205 + 00	50.0	20.0	1000.0		
				8,445.0		2,565.0
	Sub total		L + R =	11,010.0m^2		
II_2	205 + 200					
	+ 350	150.0	15.0	2,250.0		
	Sub total			2,250.0m^2		
II_3	208 + 000					
	+ 350	350.0	-		15.0	5,250.0
	209 + 567					
	+ 770	203.0			15.0	3,045.0
	Sub Total		L			8,295.0m
V	206 + 335					
	206 + 430	95.0	-		20.0	1,900.0

Slope protection No. 4 (Precast Concrete Frame)

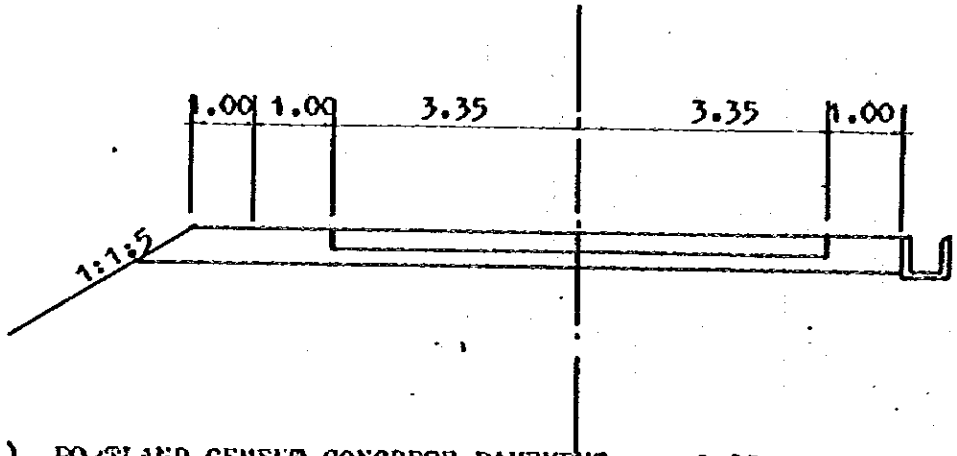
II_3 STA. 207 + 600 H=10m x 200m = 2,000m^2

4 MINOR STRUCTURES

Retaining Wall For Embankment

Section	J.P.A.	STONE MASONRY		RETAINING WALL			
		H=3m	H=5m	H=5m	H=7m	H=8m	H=10m
II_1	203 + 170 + 300		130.0m				
	204 + 150 204 + 500						50.0m
	204 + 500 205 + 000	500.0					
	Sub Total	500.0m	130.0m				50.0m
II_2	[illegible] + 152.5 205 + 200			47.5			
				47.5			
	Sub Total			95.0m			
II_3	208 + 000 208 + 100				100.0		
	208 + 200 208 + 800				100.0		
	209 + 180 209 + 200						20.0
	209 + 450 209 + 532					82.0	
	209 + 567.0 209 + 650						83.0
	210 + 310 210 + 410						100.0
	210 + 440 210 + 600				160.0		
	Sub Total				360.0m	82.0m	203.0m
V	205 + 630 205 + 710			30.0			

5. PAVEMENT



1) PORTLAND CEMENT CONCRETE PAVEMENT 0.23 m

1m x 6.70m = 6.70 m^2/m

2) CRUSHED GRAVEL BASE COURSE 0.20 m

1m x 6.70m x 0.20 m = 1.34 m^3/m

1m x 1.00m x 0.43 m = 0.43 m^3/m

1m x (2.00 + 2.645)m x 0.43m ÷ 2= 1.00 m^3/m

2.77 m^3/m

3) Prime Coat

1m x 7.16 m

No.	Unit Cost	Quantity	P/m Cost	Cost 000 P/Km.
1	161.38 P	6.70 m^2	1,081 P/m	
2	115.43	2.77 m^3	318 P/m	
3	4.03	7.16 m^2	29 P/m	
			1,428 P/m	1,428 P/m

6.Safety facility

1) Traffic Road Sign

STA.	202 + 500	intersection	2 set	
	203 + 150	Steep Grade	2	
		Tunnel	2	
		Steep Grade	2	
	210 + 740	intersection	2	Santa Fe
			10	

2) Guard Rail

Lined on length of Embankment

7. Drainage

Cross Drains per Km:

1) Pipe Culvert

Rain faced Concrete Pipe Culvert = 1.22 m

(P.C.) = 8

L = 13m

2) Reinforced Concrete Box Culvert.

(B.C.) 2.40 x 2.40 = 3

L=15m

3) Inlet and Outlet Headwall and Wingwall.

8 + 3 = 11 set

No.	Unit Cost	Quantity	P/m Cost	Cost 000 P/Km.
1	1,312.44	8		10.5 000 P/Km.
2	5,397.64	3		16.2
3	27,074.0	11		297.8

4) Side Ditch

Used on length of Cut Section

5) Sub Drainage

Used on length of Cut Section

8. TUNNEL ('000 ₱)

ITEM \ ROUTE	II (L=7870 m)	II' (L=2110 m)	II" (2380 m)	V (1840 m)	II + V (L=1870 m)	REMARKS
Length of Tunnel	1,870 m	2,110 m	2,380	1,840	1,870	
Total Cost	233,000	266,000	291,000	230,000	233,000	
1. Main Work	134,000	152,000	171,000	133,000	134,000	
1) Excavation, Lining and Drain	133,000	151,000	170,000	132,000	133,000	
2) Portal	1,000	1,000	1,000	1,000	1,000	
2. Traffic Safety and Control Facilities	88,000	103,000	109,000	86,000	88,000	
1) Lighting Facility	3,500	3,700	4,000	3,300	3,500	
2) Power Receiving Distribution	5,200	5,900	6,000	5,500	5,200	
3) Stand-by Generator Facility	1,100	1,100	1,100	1,000	1,100	
4) Communication Facilities	5,100	5,100	5,100	5,100	5,100	
5) Fire-Preventing Facilities	3,900	4,300	4,900	3,800	3,900	
6) Measuring Control Facility	5,200	5,400	5,700	5,100	5,200	
7) Ventilation Facilities	63,500	77,500	82,200	62,200	63,500	
Vertical Shaft	12,000	18,000	20,100	12,000	12,000	
Horizontal Shaft	11,300	19,800	21,500	10,000	11,300	
Ventilating Station	14,500	15,000	14,900	14,500	14,500	
Fan	25,700	25,700	25,700	25,700	25,700	
3. High Tension Line	11,000	11,000	11,000	11,000	11,000	

Section	STA.	NAME	CONSTRUCTION COST	LENGTH
	8 Bridge Route II			
II_1	202 + 950 203 + 170	II - 1	'000 P 7,283.0	L = 220m
	203 + 647.5 203 + 747.5	II - 2	2,474.0	100m
	204 + 135 204 + 225	II - 3	2,434.0	90m
			12,191.0	
II_2	205 + 32.5 205 + 152.5	II - 4	2,737.0	115m
II_3	207 + 872.5 207 + 932.5	II - 5	1,698.0	60m
	209 + 532.0 209 + 567.0	II - 6	1,182.0	(S) 35m
	209 + 770 209 + 790	II - 7	843.0	(S) 20m
	210 + 90 210 + 180	II - 8	2,597.0	90m
	210 + 410 210 + 440	II - 9	706.0	(S) 30m
			2,026.0	
		Total	21,954.0	

Bridges

Section	STA	NAME	CONSTRUCTION COST	LENGTH
			'000 P	
II'	205 + 035 205 + 110	II' - 1	1,629.0	75m
	205 + 518 205 + 558	II' - 2	1,251.0	40m
			2,880.0	
		Total	22,097.0	
II"	205 + 035 205 + 185	II" - 1	3,808.0	150m
		Total	23,025.0	
II&V	205 + 870 205 + 995	II + V - 1	3,814.0	125m
V	205 + 110 205 + 680	V - 1	29,984.0	570m
	205 + 710 205 + 770	V - 2	2,205.0	60m
	205 + 865 205 + 940	V - 3	2,704.0	75m
	206 + 030 206 + 080	V - 4	1,769.0	50m
	206 + 155 206 + 335	V - 5	6,498.0	180m
	206 + 482.5 206 + 382.5	V - 6	2,824.0	100m
			45,984.0	
		Total	53,010.0	

10 Sabo

Approximate Cost Estimation of Erosion/Sediment Control Works

1) On the southern side of Dalton Pass

Four Sabo dams shall be delineated at the proper sites in the extreme upper reaches of Digdig River for the following reasons:

a) To support the foundation of the newly planned road, especially for the parcel of land where the land slide is feared to occur (KM 204 205)

b) To support the foundation of existing road, especially at the site where a fierce land slide and gully erosion is prevailing (KM 206 207)

c) To treat the muck of Tunnel Construction properly at the site adjacent to the Tunnel Entrance.

d) To maintain the natural environment of the rivers and mountain slopes or its vegetation that might be deteriorated totally by the construction works of the Project.

The main purpose for each dam is as follows:

CAPINTALAN No. 1: To control the sediment,
No. 2: To control the sediment and the erosion
No. 3: To check the further erosion
4: To check the further erosion.

No. 1 - dam H = 20^m (From foundation to Spillway crest)
L = 101^m (Total crest length)
Vc = 12.500^{m3} (concrete volume)
Ve = 7.000^{m3} (Excavation volume)

$12,500 \times 20,000 + 7,000 \times 7,000 = 250 \times 10^6 + 49 \times 10^6$
$= 299 \times 10^6$
$= (\ 10 \times 10^6)$

Assuming alternative site ---------- 7×10^6

No. 2 - dam H = 13^m (From foundation to Spillway crest)
L = 40^m (Total crest length)
Vc = 2.400^{m3} (Concrete volume)
Ve = 900^{m3} (Excavation volume)

$2,400 \times 20,000 + 900 \times 7,000 = 48 \times 10^6 + 6.3 \times 10^6$
$= 54.3 \times 10^6$
$= (\ 1.8 \times 10^6\ )$

No. 3 - dam H = 9^m (From foundation toSpillway crest)
L = 47^m (Total crest length)
Vc = 1.800^{m3} (Concrete volume)
Ve = 1.000^{m3} (Excavation voluze)

$1,800 \times 20,000 + 1,000 \times 7,000 = 36 \times 10^6 + 7 \times 10^6$
$= 43 \times 10^6$
$= (\ 1.4 \times 10^6\ )$

No. 4

Assume the same with No. 3
$= 43 \times 10^6$
$= (\ 1.4 \times 10^6\ )$

2) On the northern side of Dalton Pass

One Sabo dam, three consolidation works, and three ground sills shall be delineated in the rivercourse adjacent to the Santa Fe Bridge. The length of channel works which is related to the above mentioned works is to extend one thousand meters. The purpose of these works consists in the following matters.

a) To support and stabilize the parcel of land where the newly planned road is passing by.

b) To protect the existing Santa Fe Bridge from the sediment flow.

c) To lend support to the treatment of muck of Tunnel Construction.

d) To maintain the natural environment of the center of Municipality Santa Fe.

Sabo dam H = 8^{m} (From foundation to Spillway crest)
L = 75^{m} (Total crest length)
Vc = $2{,}200^{m3}$ (Concrete volume)
Ve = $1{,}500^{m3}$ (Excavation volume)

$2{,}200 \times 20{,}000 + 1{,}500 \times 7{,}000 = 44 \times 10^{6} + 10.5 \times 10^{6}$
$= 54.5 \times 10^{6}$
$= (\quad 1.8 \times 10^{6})$

Consolidations Vc = $330^{m3} = 1{,}000^{m3}$)
Ground Sills Vc = $100 \times 3 = 300^{m3}$)

$(1{,}300 \times 20{,}000) \times 1.5 = 39 \times 10^{6}$
Rivetment Works $2 \times 1000 \times 66{,}000 = 132 \times 10^{6}$
$= 171 \times 10^{6}$
$= (\quad 5.7 \times 10^{6})$

Total Construction Cost for Sabo

$$
\begin{array}{r}
7 \times 10^6 \\
1.8 \times 10^6 \\
1.4 \times 10^6 \\
1.4 \times 10^6 \\
1.8 \times 10^6 \\
5.7 \times 10^6 \\
\hline
19.1 \times 10^6 = 20 \times 10^6
\end{array}
$$

// IMPROVEMENT

1) For Route II, II' & II"

Section (a) + Section (c)

507.0 + 869.0 = 1,376.0 '000 P

2) For Route V

Section (a) + (b) + (c)

507.0 + 12,608.0 + 869.0 = 13,984.0 '000 P

IMPROVEMENT

(a) KM. 202 + 000 To KM. 202 + 500

L = 500m

	'000 P
(1) OVER LAY m P 750.0	
500m X 750.0	(375.0)
(2) Drainage	(132.0)
Concrete side Ditch L = 300m	
300m x 433.18 P	130.0
Clean and repair Existing Culvert	
3 Boxes x 13.0m x 62.38 P	2.0
(3) Total	507

'000 P

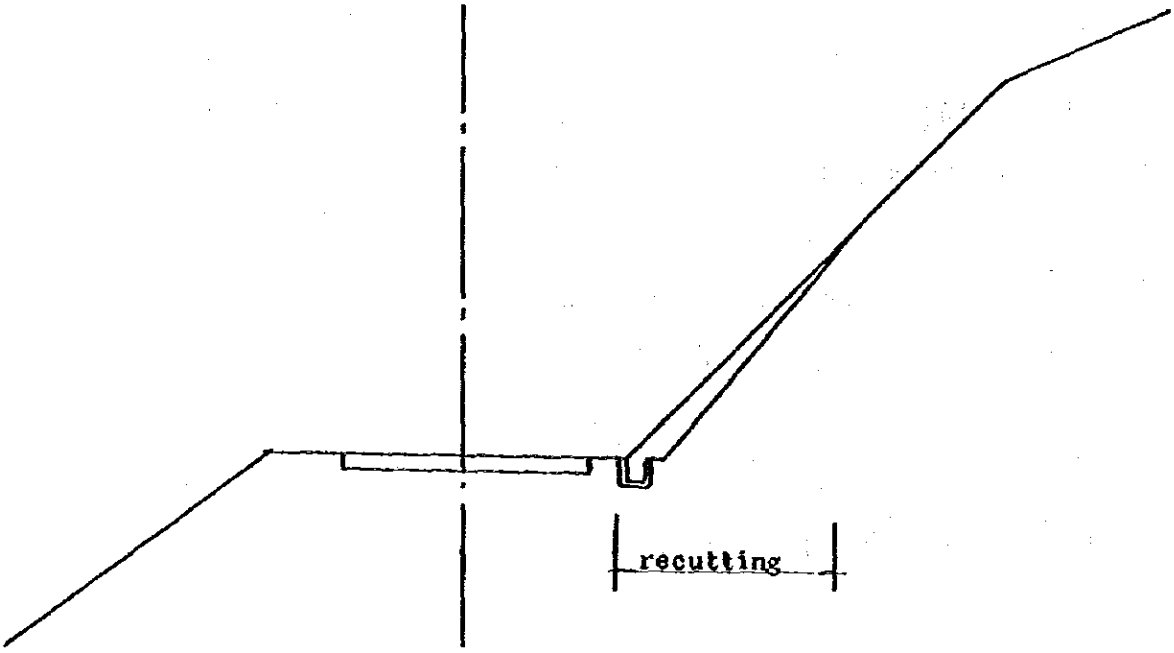
507.0

(b) KM 202 + 500 To KM. 205 + 000 L = 2,500m

	' 000P
(1) OVER LAY	
2,500m x 750.0 P	(1,875.0)
(2) Drainage	(924.0)
Side ditch: 2,100m x 433.18 P	910.0
Clean Out Existing Side Ditch	
1,100m x 4.21 P	5.0
Clean and repair Existing Culvert	
11 pipes x 13.0m x 62.38P	9.0

3) Slope protection (Concrete Spraying)

		'000 P
Cut Section	L = 2,100m	(9,809.0)



Recutting (Soft - Rock)

1.0m x 6.0m x ½ = $3m^2$

		'000 P
$3m^2$ x 2,100m x 41.40 P	=	216.0

Concrete Spraying

H	L	
20m	x 280m	= 5,600.0m^2
30	x 300	= 9,000.0
20	x 150	= 3,000.0
10	x 200	= 2,000.0
20	x 200	= 4,000.0
50	x 150	= 7,500.0
30	x 100	= 3,000.0
		34,100.0m^2

		'000P
34,100.0m^2 x 280.0P	=	9,548.0
4) Total	=	12,608.0 '000 P

(C) KM 216 + 580 To KM. 218 + 000 L = 1,420m

1) Drainage (285.0 '000₱)

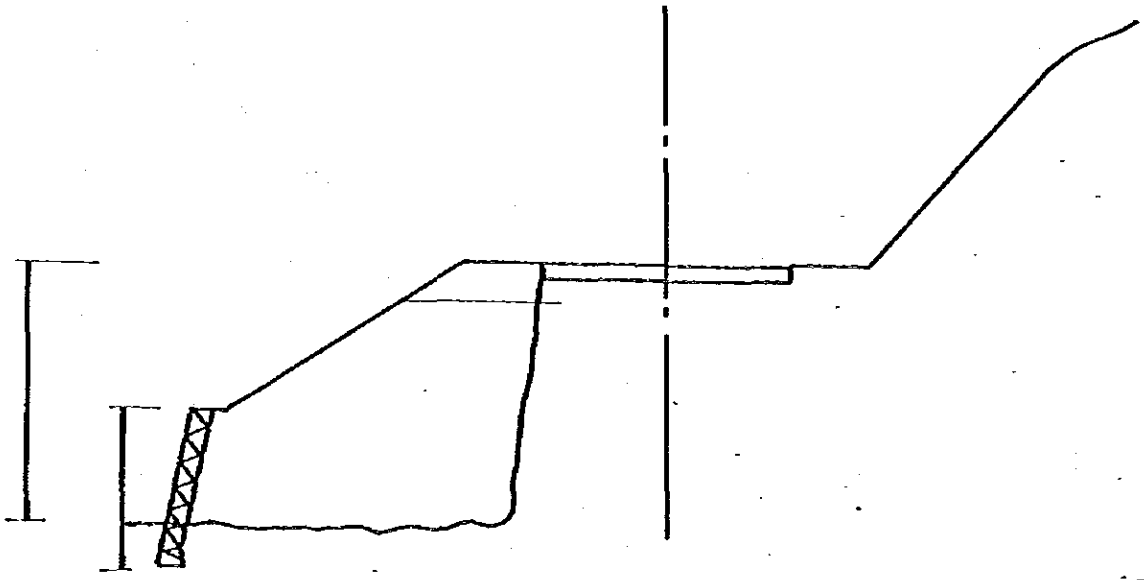
Side Ditch 650m x 433.18₱ 282.0 '000₱

Clean and repair Existing Culvert

4 pipes x 13.0m x 62.38₱ 3.0

2) KM. 216 + 800 Shoulder Scorded (475.0)

L = 160 m



		'000₱
Earth Work	36 m^2/m x 160 m x 34.1₱	196.0
Crushed Gravel Base Course	3 m^2/m x 160 m x 115.43₱	55.0
Stone Masonry H = 4 m	160 m x 14000₱	224.0

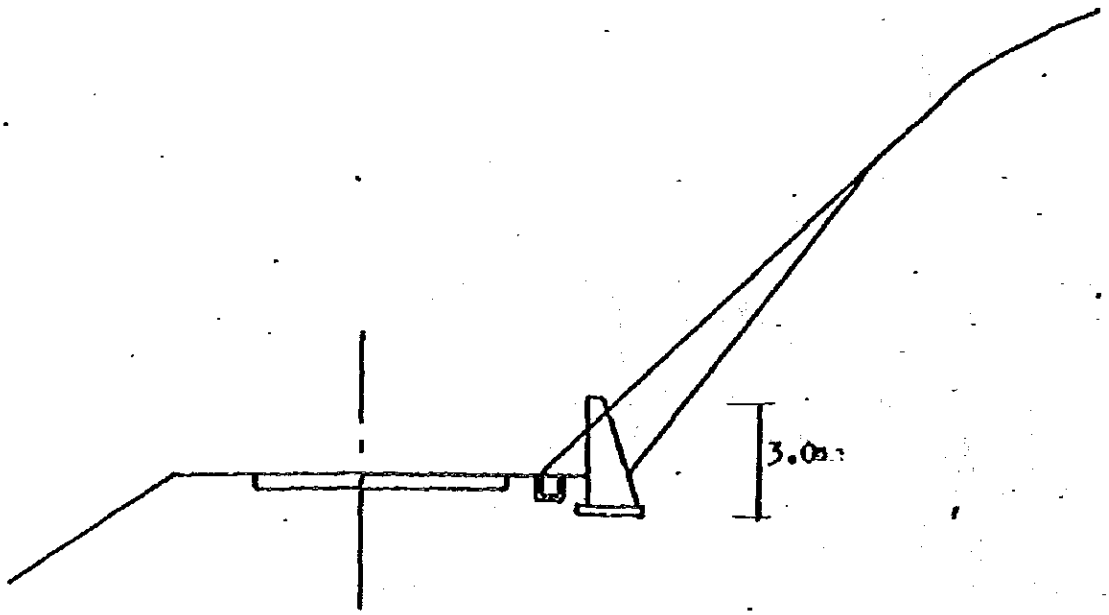
3) KH 217 + 250 Land slided L = 70m (1090) '000P

Recutting 70m x $70m^2$ = 4,900 ∴ (common)

$49,000m^2$ x 0.5 x 13.05^P = 320 '000P

Retaining Wall H = 3m

70m x 1100^P = 77.0



4) Total 869.0 '000P

/2 Right-of-Way W=40.0 m

as January 1981 P

Section	Kilo-Post	Length	Land				Buildings	Total
					Forest	Crops	Nipa	
			2.5 P/m²	6 P/m²	7.5 P/m²	13P/hill	44 P/m²	
II	202 + 600 203 + 000	400.0		96,000.0			1(44.0P)	
	203 + 100 203 + 700	600.0		144,000			1(44.0P)	
	203 + 750 + 800	50.0		12,000				
	204 + 000	200.0		48,000			1(44.0)	
	204 + 500	500.0	4,000.0		10,000			
	205 + 000	500.0		10,000				
			4,000.0	300,000.0	10,000		132.0	314.'000P
II_2	205 + 000 205 + 800	800.0		240,000				
								240'000P
II_3	207 + 600 210 + 100	2,500.0	200,000					200'000P
II'	205 + 000 205 + 560	560.0			168,000			168'000P
II"	205 + 000 205 + 220	220.0			66,000			66
V	205 + 100 V"205+800	700.0			210,000			
	206 + 400 206 + 400	600.0			180,000			
	206 + 500 206 + 500	100.0		24,000				
	206 + 600	100.0	8,000					
			8,000	24,000	390,000			427.0
II+								

ROAD RIGHT -OF- WAY
1978 Price Level

RURAL	TYPE	UNIT	COST
Land	a) Uncultivated	P/hectare	P20,000.00
	b) Cultivated	P/hectare	P50,000.00
	c) Forest	P/hectare	P60,000.00
	d) Crops and improvement	P/hectare	P30/tree - coconut P10/hill - banana P60/grove - bamboo P30/tree - mango P10/tree - atar apple
Buildings	a) Residential	P/m^2	P35/sq. m/ - Nipa/mix mat P1,000-P1,500 - conc. P500-700 - semi-conc.

APPENDIX D

QUANTITIES AND COST ESTIMATES OF THE MOST LIKELY ROUTE

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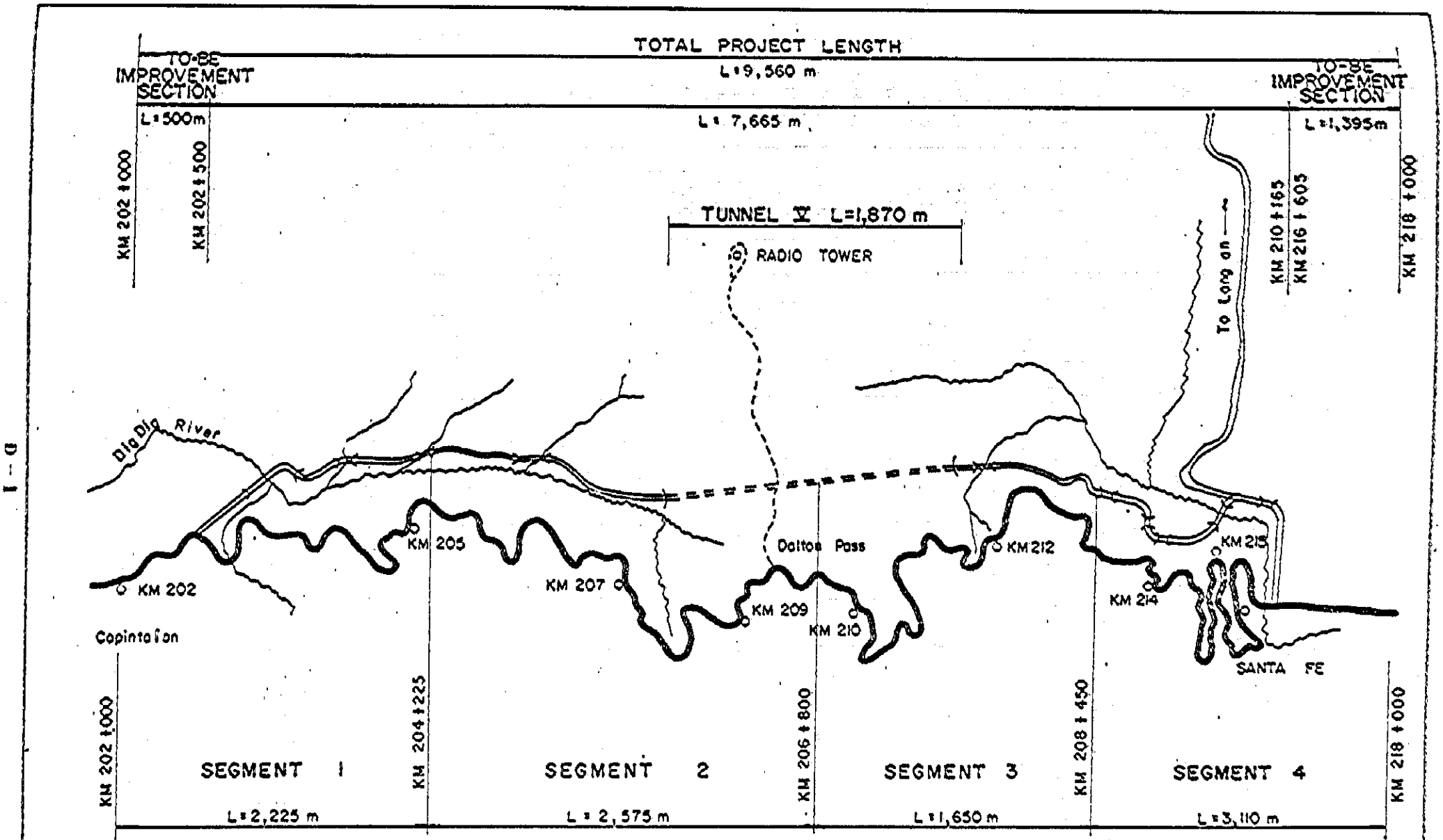


FIG. SEGMENTATION

I. SUMMARY OF LENGTH

ITEM	SECTION 1 Km 202 + 000 - Km 204 + 225	2 - Km 206 + 800	3 - Km 208 + 450	4 - Km 218 + 000	(m) TOTAL
TOTAL LENGTH	2,225.0	2,575.0	1,650.0	3,110.0	9,560.0
NEW CONSTRUCTION SECTION	1,725.0	2,575.0	1,650.0	1,715.0	7,665.0
EARTH WORK	1,325.0	1,470.0	705.0	1,387.0	4,887.0
Cut Left Side	660.0	1,412.5	250.0	425.0	2,747.5
Right Side	605.0	332.5	567.5	667.0	2,172.0
Average	632.5	872.5	408.75	546.0	2,459.75
Fill Left Side	665.0	77.5	455.0	742.0	2,139.50
Right Side	720.0	1,157.5	137.5	200.0	2,215.0
Average	692.5	617.5	296.25	821.0	2,427.25
STRUCTURES	400.0	1,035.0	945.0	378.0	2,808.0
Tunnel	0	870.0	800.0	0	1,870.0
Bridge L< = 50	0	0	45.0 (1)	108.0 (3)	153.0 (4)
L> = 50	400.0 (3)	115.0 (1)	0	270.0 (3)	785.0 (7)
To - Be - Improvement Section	500.0	0	0	1,375.0	1,875.0

* Including Santa Fe Bridge (L = 30m)

※ : Cut & Fill

	Station Kilo.-Post	Left		Right		Bridge or Tunnel
		Cut	Fill	Cut	Fill	
	Km. 202+000					
	202+500	To Be Improvement Section (L=500m)				
	202+950		450.0		450.0	
	203+170					Br No.1 220.0
	203+300		130.0		130.0	
※	+330	30.0			30.0	
	+600	270.0		270.0		
※	+625	25.0			25.0	
	+657.5		32.5		32.5	
	+747.5					Br No.2 90.0
	+800		52.5		52.5	
REG I	204+135	335.0		335.0		
	+225					Br No.3 90.0
	sub total	660.0	665.0	605.0	720.0	400.0
REG II	204+370	145.0		145.0		
※	+450	80.0			80.0	
	+460		10.0		10.0	
※	+880	420.0			420.0	
	+900		20.0		20.0	
※	205+000	100.0			100.0	
	+037.5	37.5		37.5		
	+152.5					Br No.4 115.0
	+200.0		47.5		47.5	

	Station Kilo.-Post	Left		Right		Bridge or Tunnel
		Cut	Fill	Cut	Fill	
	205 + 200.0					
	+350.0	150.0		150.0		
SEG 2	205+830	480.0			480.0	
※	206+800	/				TUNNEL 970M
	Sub Total	1412.5	77.5	332.5	1152.5	Br 115.0 T 97
	207+700					TUNNEL 900
SEG 3	+830	130.0		130.0		
	+877.5		47.5		47.5	
	+922.5					Br. NO 5 45.0
※	208+050		127.5	127.5		
	+170	120.0		120.0		
※	+200		30.0	30.0		
※	+260		60.0	60.0		
	+300		40.0		40.0	
※	+400		100.0	100.0		
SEG 3	+450		50.0		50.0	
	sub Total	250.0	455.0	367.5	137.5	Br 45.0 Tun 970
	+498					Br NO 6 48.0
SEG 4 ※	+630		132.0	132.0		
	+680	50.0		50.0		
※	+845		165.0	165.0		
	+900					Br NO 7 55.0
※	209+070		170.0	170.0		
	+130	60.0		60.0		

Station Kilo.-Post	Left		Right		Bridge or Tunnel
	Cut	Fill	Cut	Fill	
209+130					
+190					Br No 8 60.0
+240		50.0		50.0	
+300	60.0		60.0		
X +330		30.0	30.0		
209+481		151.0		151.0	
+636					Br No.9 155.0
+815		179.0		179.0	
+845					Br No 10 30.0
X +950	105.0			105.0	
X 210+100	150.0			150.0	
+165		65.0		65.0	
216+605					
218+000	To - Be - Improvement			(L=1395)	
Sub Total	425.0	942.0	667.0	700	Br 348.0

II CONSTRUCTION COST ESTIMATE

CONSTRUCTION COST

NO.1 SEG 1 AS JANUARY : 1981 '000 P

DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	REMARKS
I. EARTHWORKS				1,237.0	
Clearing & Grubbing	SqM	0.85	10,770.0	9.2	
Stripping	CuM	20.83	1,077.0	22.4	
Excavation of Common Surplus Material	CuM	23.6	4,444.8	104.9	
Excavation of Common Soft-Rock Material	CuM				
Excavation of Common Hard-Rock Material	CuM				
Formation of Embankment From Roadway Excavation In Common Material	CuM	34.1	32,272.5	1,100.5	
Formation of Embankment From Roadway Excavation In Soft Material	CuM				
Formation of Embankment From Roadway Excavation In Hard Material	CuM				
Formation of Embankment From Borrow Excavation In Common Material	CuM	23.39	—		
Compaction of Existing Ground	SqM	2.83	—		
Compaction of Cut Section	SqM	2.25	0		
I-1 Slope Protection				2,058.6	
Gabions	each	455.85	—		
Molted Gabions	each	533.51	—		
Clearing of Boulder Stone	SqM	2.60	—		
Placing Top Soil	SqM	6.18	4,316.5	26.7	
Seeding	SqM	0.97	4,316.5	4.2	
Planting Work	L.M.	180.30	1,083.0	195.3	
Fencing For Droped Stone	L.M.		—		

CONSTRUCTION COST

NO.2 SEG 1

DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	REMARKS
Netting for Slope Protection	SqM	20.0	6,108.0	122.2	
Concrete Spraying	SqM	280.0	6,108.0	1,710.2	
Precost Concrete Frame	SqM	220.0	0	0	
II MINOR STRUCTURE				0	
Retaining Wall H=4m	M	4230.0	0		
Retaining Wall H=7m	M	9000.0	0		
Retaining Wall H=8m	M	10000.0	0		
Stone Masonry H=2m	M	800.0	0		
" H=3m	M	1100.0	0		
" H=4m	M	1250.0	0		
Stone Masonry H=5m	M	1750.0	0		
" H=7m	M	2500.0	0		
" H=7x2m	M	5000.0	0		
III PAVEMENT	M	1,428.0	1325.0	1,892.1	
Subbase Course	CuM				
Crushed Gravel Base Course	CuM				
Prime Coat	SqM				
Tack Coat	SqM				
Portland Cement Concrete Pavement 0.23m	SqM				
Side Walk	L.M		0		
III-1 Safety Facilities		—		—	
Pavement Marking					
White W=0.15m	M				
Yellow W=0.15m	M				
Traffic Road Sign	each				
Kilometer Post	each				
Pavement Stud	each				
Delineator	each				

CONSTRUCTION COST

NO.3 SEG 1

DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	REMARKS
Metal Beam Type Guard Rail	M				
Guard Rail End Place	each				
Concrete Post for Guard Rail	each				
IV OVERLAY	M	750.0		—	
V DRAINAGE				917.1	
Grouted Side Ditch	L.M.	171.76	—		
Concrete Side Ditch w=0.5m.	L.M.	433.18	1,265.0	548.0	
Sub-Drainage	L.M.	170.85	1,265.0	216.1	
Reinforced Concrete Pipe Culvert Ø 1.2Cm.	L.M.	1330.0	54.0	71.8	
Reinforced Concrete Box Culvert 1.50 X 1.50	L.M.		—		
2.00 X 2.00	L.M.	55000.0	—		
2-3.00 X 3.00	L.M.		—		
Clean and Repair Existing Culvert	L.M.		—		
Clean Out Existing Ditches	L.M.		—		
Inlet and Outlet Headwall and Wingwall	set	27,074.0	3	81.2	
VI TUNNEL	M				
VII BRIDGE					
VII-1 Sobou					
VIII DIRECT COST					Total I to VII
IX MISCELLANEOUS MINOR WORKS					VIII X 0.15
X SUB-TOTAL ECONOMIC COST					VIII + IX

CONSTRUCTION COST

NO.1 SEG 2 AS JANUARY : 1981

DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	REMARKS
I. EARTHWORKS				4,661.3	
Clearing & Grubbing	SqM	0.85	25,893.8	22.0	
Stripping	CuM	20.83	2,589.4	53.9	
Excavation of Common Surplus Material	CuM	23.6	110,943.1	2,618.3	
Excavation of Common Soft-Rock Material	CuM				
Excavation of Common Hard-Rock Material	CuM				
Formation of Embankment From Roadway Excavation In Common Material	CuM	34.1	56,625.6	1,930.7	
Formation of Embankment From Roadway Excavation In Soft Material	CuM				
Formation of Embankment From Roadway Excavation In Hard Material	CuM				
Formation of Embankment From Borrow Excavation In Common Material	CuM	23.39	—		
Compaction of Existing Ground	SqM	2.83	—		
Compaction of Cut Section	SqM	2.25	16,103.5	36.2	
I-1 Slope Protection				2,975.4	
Gabions	each	455.85	—		
Matted Gabions	each	533.51	—		
Clearing of Boulder Stone	SqM	2.60	—		
Placing Top Soil	SqM	6.18	9,603.3	59.3	
Seeding	SqM	0.97	9,603.3	9.3	
Planting Work	L.M.	180.30	5,042.0	909.1	
Fencing For Droped Stone	L.M.		—		

CONSTRUCTION COST

NO.2 SEG 2.

DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	REMARKS
Netting for Slope Protection	SqM	20.0	4,965.0	99.3	
Concrete Spraying	SqM	280.0	4,965.0	1,390.2	
Precast Concrete Frame	SqM	220.0	2,310.0	508.2	
II MINOR STRUCTURE				1,100.4	
Retaining Wall H=4m	M	4230.0	45.0	190.4	
Retaining Wall H=7m	M	9000.0	0	0	
Retaining Wall H=8m	M	10000.0	60.0	600.0	
Stone Masonry H=2m	M	800.0	0	0	
" H=3m	M	1100.0	100.0	110.0	
" H=4m	M	1250.0	160.0	200.0	
Stone Masonry H=5m	M	1750.0	0	0	
" H=7m	M	2500.0	0	0	
" H=7+2m	M	5000.0	0	0	
III PAVEMENT	M	1,428.0	2,460.0	3,512.9	
Subbase Course	CuM				
Crushed Gravel Base Course	CuM				
Prime Coat	SqM				
Tack Coat	SqM				
Portland Cement Concrete Pavement 0.23m	SqM				
III-1 Safety Facilities		—		—	
Pavement Marking					
White W=0.15m	M				
Yellow W=0.15m	M				
Traffic Road Sign	each				
Kilometer Post	each				
Pavement Stud	each				
Delineator	each				

CONSTRUCTION COST

NO.3 SEG 2

DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	REMARKS
Metal Beam Type Guard Rail	M				
Guard Rail End Piece	each				
Concrete Post for Guard Rail	each				
V OVERLAY	M	750.0		—	
V DRAINAGE				1345.0	
Grouted Side Ditch	L.M.	171.76	—		
Concrete Side Ditch w=0.5m.	L.M.	433.18	1745.0	755.9	
Sub-Drainage	L.M.	170.85	1745.0	298.1	
Reinforced Concrete Pipe Culvert Ø 1.2Cm.	L.M.	1330.0	117.0	155.6	
Reinforced Concrete Box Culvert			—		
1.50 X 1.50	L.M.				
2.00 X 2.00	L.M.	55000.0	—		
2-3.00 X 3.00	L.M.		—		
Clean and Repair Existing Culvert	L.M.		—		
Clean Out Existing Ditches	L.M.		—		
Inlet and Outlet Headwall and Wingwall	set	27074.0	5	135.4	
VI TUNNEL	M				
VII BRIDGE					
VIII Sabou					
VIII DIRECT COST					Total I to VII
IX MISCELLANEOUS MINOR WORKS					VIII X 0.15
X SUB-TOTAL ECONOMIC COST					VIII + IX

CONSTRUCTION COST

NO.1 SEG3 AS JANUARY : 1981

DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	REMARKS
I. EARTHWORKS				6,055.4	
Clearing & Grubbing	SqM	0.85	24,662.5	21.0	
Stripping	CuM	20.83	2,466.3	51.4	
Excavation of Common Surplus Material	CuM	23.6	196,065.4	4,627.7	
Excavation of Common Soft-Rock Material	CuM				
Excavation of Common Hard-Rock Material	CuM				
Formation of Embankment From Roadway Excavation In Common Material	CuM	34.1	39,087.5	1,332.9	
Formation of Embankment From Roadway Excavation In Soft Material	CuM				
Formation of Embankment From Roadway Excavation In Hard Material	CuM				
Formation of Embankment From Borrow Excavation In Common Material	CuM	23.39	—		
Compaction of Existing Ground	SqM	2.83	—		
Compaction of Cut Section	SqM	2.25	10,221.2	23.0	
I-1 Slope Protection				2,454.5	
Gabions	each	455.85	—		
Molled Gabions	each	533.51	—		
Clearing of Boulder Stone	SqM	2.60	—		
Placing Top Soil	SqM	6.18	5,900.8	36.5	
Seeding	SqM	0.97	5,900.8	5.7	
Planting Work	L.M.	180.30	1,243.0	224.1	
Fencing For Droped Stone	L.M.				

CONSTRUCTION COST

NO.2 SEG3

DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	REMARKS
Netting for Slope Protection	SqM	20.0	6216.9	124.3	
Concrete Spraying	SqM	280.0	6,216.0	1,740.5	
Precast Concrete Frame	SqM	220.0	1,470.0	323.4	
II MINOR STRUCTURE				1080.2	
Retaining Wall H=4m	M	4230.0	0.	0	
Retaining Wall H=7m	M	9000.0	0	0	
Retaining Wall H=8m	M	10000.0	0	0	
Stone Masonry H=2m	M	800.0	350.0	280.0	
" H=3m	M	1100.0	0	0	
" H=4m	M	1250.0	80.0	100.0	
Stone Masonry H=5m	M	1750.0	0	0	
" H=7m	M	2500.0	280.0	700.0	
" H=7+2m	M	5000.0	0	0	
II PAVEMENT	M	1,428.0	1,605.0	2,291.9	
Subbase Course	CuM				
Crushed Gravel Base Course	CuM				
Prime Coat	SqM				
Tack Coat	SqM				
Portland Cement Concrete Pavement 0.23m	SqM				
II-1 Safety Facilities		—		—	
Pavement Marking					
White W=0.15m	M				
Yellow W=0.15m	M				
Traffic Road Sign	each				
Kilometer Post	each				
Pavement Stud	each				
Delineator	each				

CONSTRUCTION COST

NO.3 SEG3

DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	REMARKS
Metal Beam Type Guard Rail	M				
Guard Rail End Piece	each				
Concrete Post for Guard Rail	each				
IV OVERLAY	M	750.0		—	
V DRAINAGE				704.0	
Grouted Side Ditch	L.M.	171.76	—		
Concrete Side Ditch w=0.5m.	L.M.	433.18	817.5	354.1	
Sub-Drainage	L.M.	170.85	817.5	139.7	
Reinforced Concrete Pipe Culvert Ø 1.2Cm.	L.M.	1330.0	97.0	129.0	
Reinforced Concrete Box Culvert			—		
1.50 X 1.50	L.M.				
2.00 X 2.00	L.M.	55000.0	—		
2-3.00 X 3.00	L.M.		—		
Clean and Repair Existing Culvert	L.M.		—		
Clean Out Existing Ditches	L.M.		—		
Inlet and Outlet Headwall and Wingwall	set	27074.0	3	81.2	
VI TUNNEL	M				
VII BRIDGE					
VII-1 Sobou					
VIII DIRECT COST					Total I to VII
IX MISCELLANEOUS MINOR WORKS					VIII X 0.15
X SUB-TOTAL ECONOMIC COST					VIII + IX

CONSTRUCTION COST

NO.1 SEG 4 AS JANUARY : 1981

DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	REMARKS
I. EARTHWORKS				4,385.6	
Clearing & Grubbing	SqM	0.85	32,405.5	27.5	
Stripping	CuM	20.83	3,240.6	67.5	
Excavation of Common Surplus Material	CuM	23.6	110,930.4	2,618.0	
Excavation of Common Soft-Rock Material	CuM				
Excavation of Common Hard-Rock Material	CuM				
Formation of Embankment From Roadway Excavation In Common Material	CuM	34.1	49,050.7	1,672.6	
Formation of Embankment From Roadway Excavation In Soft Material	CuM				
Formation of Embankment From Roadway Excavation In Hard Material	CuM				
Formation of Embankment From Borrow Excavation In Common Material	CuM	23.39	—		
Compaction of Existing Ground	SqM	2.83	—		
Compaction of Cut Section	SqM	2.25	0	0	
I:1 Slope Protection				1,418.8	
Gabions	each	455.85	—		
Molted Gabions	each	533.51	—		
Clearing of Boulder Stone	SqM	2.60	—		
Placing Top Soil	SqM	6.18	9,077.5	56.1	
Seeding	SqM	0.97	9,077.5	8.8	
Planting Work	L.M.	180.30	7,130.0	1,285.5	
Fencing For Droped Stone	L.M.				

CONSTRUCTION COST

NO.2 SEG 4

DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	REMARKS
Netting for Slope Protection	SqM	20.0	228.0	4.6	
Concrete Spraying	SqM	280.0	228.0	63.8	
Precost Concrete Frame	SqM	220.0	0	0	
II MINOR STRUCTURE				4,345.1	
Retaining Wall H=4m	M	4230.0	0	0	
Retaining Wall H=7m	M	9000.0	245.0	2,205.0	
Retaining Wall H=8m	M	10000.0	70.0	700.0	
Stone Masonry H=2m	M	800.0	0	0	
" H=3m	M	1100.0	300.0	330.0	
" H=4m	M	1250.0	265.0	331.3	
Stone Masonry H=5m	M	1750.0	45.0	78.8	
" H=7m	M	2500.0	0	0	
" H=7+2m	M	5000.0	140.0	700.0	
III PAVEMENT				2,016.7	
	M	1,428.0	1,367.0	1,952.1	
Subbase Course	CuM				
Crushed Gravel Base Course	CuM				
Prime Coat	SqM				
Tack Coat	SqM				
Portland Cement Concrete Pavement 0.23m	SqM				
Side Walk	L.M	169.9	380.0	64.6	
III-1 Safety Facilities		—		—	
Pavement Marking					
White W=0.15m	M				
Yellow W=0.15m	M				
Traffic Road Sign	each				
Kilometer Post	each				
Pavement Stud	each				
Delineater	each				

CONSTRUCTION COST

NO.3 SEG 4

DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	REMARKS
Metal Beam Type Guard Rail	M				
Guard Rail End Place	each				
Concrete Post for Guard Rail	each				
V OVERLAY	M	750.0		—	
VI DRAINAGE				3,031.8	
Grouted Side Ditch	L.M.	171.76	—	—	
Concrete Side Ditch w=0.5m.	L.M.	433.18	1,092.0	473.0	
Sub-Drainage	L.M.	170.85	1,092.0	186.6	
Reinforced Concrete Pipe Culvert Ø 1.2Cm.	L.M.	1330.0	69.0	91.8	
Reinforced Concrete Box Culvert			—		
1.50 X 1.50	L.M.				
2.00 X 2.00	L.M.	55000.0	39.0	2,145.0	
2-3.00 X 3.00	L.M.		—		
Clean and Repair Existing Culvert	L.M.		—		
Clean Out Existing Ditches	L.M.		—		
Inlet and Outlet Headwall and Wingwall	set	27,074.0	5	135.4	
VII TUNNEL	M				
VII BRIDGE					
VIII Sabou					
IX DIRECT COST					Total I to VII
X MISCELLANEOUS MINOR WORKS					VIII X 0.15
XI SUB-TOTAL ECONOMIC COST					VIII + IX

III. QUANTITIES

1. EARTHWORKS

1) Clearing & Grubbing, Stripping (0.1 m)

STA	LENGTH	SIDE	AVG. SIDE	AREA
203 + 510		0		
+ 400	90.0	26.0		1,170.0
+ 540	140.0	0		1,820.0
+ 580	40.0	48.0		960.0
+ 610	30.0	0		720.0
203 + 790		0		
+ 800	10.0	13.0		65.0
+ 900	100.0	0		650.0
+ 950	50.0	27.0		675.0
204 + 000	50.0	16.0		1,075.0
+ 100	100.0	42.0		2,900.0
+ 135	35.0	0		735.0
				10,770.0 m^2
			SEG. 1	1,077.0 m^3
+ 225		0		
+ 300	75.0	43.0		1,612.5
+ 400	100.0	18.0		3,050.0
+ 450	50.0	0		450.0
+ 450		0		
+ 500	40.0	13.0		260.0
+ 600	100.0	0		650.0
+ 700	100.0	13.0		650.0
+ 750	50.0	4.0		425.0
+ 850	100.0	13.0		850.0
+ 900	50.0	0		325.0
205 + 00	100.0	51.0		2,550.0
+ 37.5	37.5	0		956.3

STA.	LENGTH	WIDE	AVE. WIDE	AREA
205 + 200				
+ 230	30.0	0		
+ 300	70.0	41.0		1,435.0
+ 350	50.0	0		1,025.0
+ 400	50.0	20.0		500.0
+ 500	100.0	11.0		1,550.0
+ 600	100.0	20.0		2,000.0
+ 700	100.0	30.0		2,950.0
+ 800	100.0	34.0		3,200.0
+ 840	30.0	63.0		1,455.0
			Seg. 2	
			Total	25,893.8a^2
			x 0.1	2,589.4a^3
207 + 6[illegible]0		56.0		
+ 750	60.0	110.0		4,980.0
+ 800	50.0	110.0		5,500.0
+ 830	30.0	50.0		2,400.0
+ 877.5	47.5	0		1,187.5
+ [illegible]22.5		0		
+ [illegible]50	27.5	36.0		495.0
208 + 000	50.0	36.0		1,800.0
+ 100	100.0	55.0		4,550.0
+ 200	100.0	0		2,750.0
+ 300	100.0	0		
+ 350	50.0	20.0		500.0
+ 400	50.0	0		500.0
			Seg. 3	24,662.5a^2
				2,466.3a^3

STA.	LENGTH	WIDE	AVE. WIDE	AREA
208 + 4?8		0		
+ 550	52.0	40.0		1,040.0
+ 600	50.0	80.0		3,000.0
+ 650	50.0	75.0		8,750.0
+ 750	100.0	30.0		6,250.0
+ 845	95.0	0		1,425.0
+ 8??		0		
+ 950	51.0	75.0		1,912.5
209 + 000	50.0	23.0		2,450.0
+ 100	100.0	35.0		2,900.0
+ 130	30.0	0		525.0
+ 240		0		
+ 270	30.0	65.0		975.0
+ 310	40.0	0		1,300.0
20? + 636		0		
+ 700	64.0	4.0		128.0
+ 750	50.0	0		100.0
+ ?00		0		
210 + 000	100.0	20.0		1,000.0
+ 165	65.0	0		650.0
			Seg. 4	32,405.5a^2
			Total	3,240.6a^3
			Total	93,731.8a^2
				9,373.2a^3

2) Cut and Embankment Volume

SEGMENT	CUT	FILL	TUNNEL	SURPLUS MATERIAL OF EXCAVATION	EMBANKMENT
1	+ 36,717.3	- 32,272.5	0	4,444.8	32,272.5
2	+ 78,10 .8	- 56,625.0	+89,458.3	110,943.1	56,625.0
3	152,150.4	- 39,087.5	83,002.5	196,065.4	39,087.5
4	159,280.4	- 49,050.0	0	110,930.4	49,050.0
Total	426,257.1	-177,035.0	172,460.8	422,383.7	177,035.0

SEGMENT	CUT					TUNNEL					Fill	Others For (Deposit Area)	Remarks
	VOLUME	Common x40%x0.9	Soft-Rock x30%x1.1	Hard-Rock x30%x1.3	Total	VOLUME	Common x20%x1.0	Soft-Rock x30%x1.3	Hard-Rock x40%x1.5	Total			
1	33,997.5	12,239.1	11,219.2	13,259.0	36,717.3	-	-	-	-	-	32,272.5		
2	72,323.8	26,036.6	23,866.9	28,206.3	78,109.8	75,175.0	15,035.0	29,318.3	45,105.0	89,458.3	56,625.0	277,855.0	No. 1 to No. 5 SABO DAM
3	140,880.0	50,716.8	46,490.4	54,943.2	152,150.4	69,750.0	13,950.0	27,202.5	41,850.0	83,002.5	39,087.5		
4	148,130.0	53,326.8	48,882.9	57,770.7	159,980.4	-	-	-	-	-	49,050.0	237,225.0	
Total	395,331.3	142,319.3	130,459.4	154,179.2	426,957.9	144,925.0	28,985.0	56,520.8	86,955.0	172,460.0	177,035.0		

SEGMENT 1

STA.	LENGTH	CUT			FILL			REMARKS
		AREA	AVG. AREA	VOLUME	AREA	AVG. AREA	VOLUME	
PM 202+500					0			
+800	300.0				2.0		300.0	
+900	100.0				18.0		1000.0	
+950	50.0				20.0		950.0	
			Br No 1 L=220.0					
203+170					176.0			
+250	80.0				176.0		14080.0	
+310	60.0	0			0		5,280.0	
+400	90.0	100.0		4500.0				
+540	140.0	0		7000.0				
+580	40.0	140.0		2800.0				
+610	30.0	0		2100.0	0			
+657.5	47.5				20.0		475	
			Br No. 2 L=90.0					
				16,400.0			30,635.0	

STA.	LENGTH	CUT			FILL			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
KM. 203 +747.5					30.0			
+790	42.5	0			8.0		807.5	
+800	10.0	17.0		85.0	8.0		80.0	
+900	100.0	0		850.0	0		400.0	
+950	50.0	55.0	C.S	1375.0	7.0		175.0	
204 +000	50.0	55.0		2,750.0	0		175.0	
+100	100.0	145.0		10,000.0				
+135	35.0	0		2.537.5				
			Bm No 3 L=		90.0 m			
+225		0						
+300	75.0	1840	C.S	6,900.0				
+400	100 0	15.0		7.950.0				
+450	50.0	0		375.0	0			
+460	10.0				300.0		1,500.0	
				34,822.5			3,137.5	

SEG 1 ↑ ↓ SEG 2

SEGMENT 1

STA.	LENGTH	CUT			FILL			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
KM 204+460		0			300.0			
+500	40.0	14.0		280.0	30.0		6,600.0	
+600	100.0	0		700.0	40.0		3,500.0	
+700	100.0	18.0		900.0	50.0		4,500.0	
+750	50.0	2.0		500.0	138.0		4,700.0	
+850	100.0	14.0		800.0	200.0		16,900.0	
+900	50.0	0		350.0	144.0		8,600.0	
205+000	100.0	165.0		8,250.0	0		7,200.0	
+037.5	37.5	0		3,093.8				
			B. NO. 4	L. 115.0 m				
+152.5					18.0			
+200	47.5				18.0		855.0	
+230	30.0	0			0		270.0	
+300	70.0	140.0	CS	2,730.0				
				19,773.8			53,125.0	

STA.	LENGTH	CUT			FILL			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
205+300		140.0	c.s		20.0			
+350	50.0	0		3500.0	20.0		1000.0	
+400	50.0	45.0		1125.0	0		500.0	
+500	100.0	15.0		3000.0	5.0		250.0	
+600	100.0	53.0		3,400.0	0		250.0	
+700	100.0	76.0		6,450.0				
+800	100.0	110.0		9,300.0				
+230	30.0	460.0		8.550.0				
				35,325.0			2.000.0	
			TOTAL	106,321.3			88.897.5	
206+800	77.5	x 970 =	75,175.0 m³					
	(TUNNEL		77.5 m² x 1870 = 144,925 m³)					
	171	x 900 =	69,750.0					

SEG 2

SEG 3

SEG 2

STA.	LENGTH	CUT			FILL			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
M 207 + 690		576.0						
+ 750	60.0	870.0		43,380				
+ 800	50.0	690.0		39,000				
+ 830	30.0	150.0		12600	0			
+ 877.5	47.5	0		3562.5	20.0		475.0	
			B.	10.5	L. 45.0			
+ 922.5		0			0			
+ 950.0	27.5	70.0		762.5	150.0		2062.5	
208 + 000	50.0	115.0	C.	4625.0	0		3,750.0	
+ 100	100.0	260.0		18,750.0				
+ 200	100.0	0		13.000.0	0			
+ 300	100.0	0			304.0		15.200.0	
+ 350	50.0	100.0		2500.0	100.0		10,102.5	
+ 400	50.0	0		2,500.0	0		2500.0	
				140,550			34,037.5	

	STA.	LENGTH	CUT			FILL			REMARKS
			AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
	KM 208 + 400		0			0			
SEG 3	+ 420	20 °				200. °		2000. °	
	+ 450	30. °				0		3000 °	
				Br No 6	L = 48.0				
	+ 498		0			10. 0			
SEG 4	+ 550	52.0	148. 0		3848 °	1. 0		286. °	
	+ 600	50. 0	620. 0		19,200. °	0. 8		45 °	
	+ 650	50. 0	780. 0		35,000. °	0		20 °	
	+ 750	100. 0	48. 0		41.400 °	0. 8		40. °	
	+ 845	95. 0	0		2,280 °	10. 0		85. 5	
				Br	No. 7	L = 54 0			
	+ 899		0						
	+ 950	51. 0	770. 0		6,385. °	0			
	209 + 000	50. 0	38. 0		7.700. °	10. 0		250. °	
					116,313 °			5, 726. 5	

SEG 2

STA.	LENGTH	CUT			FILL			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
209+000		38.°			10.0			
209+100	100.°	188.9		11345.°	0		944.5	
+130	30.0	0		2833.5				
			Br No 8	L=	60.0 m			
+190					0			
+200	10.0				248.0		1,240.°	
+240	40.0	0			0		4,960.°	
+270	30.0	456.0		6,840.°				
+310	40.0	0		9,120.°	0			
+350	40.0				226.0		4,520.°	
+400	50.0				80.0		7,650.°	
+481	81.0				288.0		14,904.°	
			Br No 9	L=	155.0 m			
+636								
				30,138.5			34,218.°	

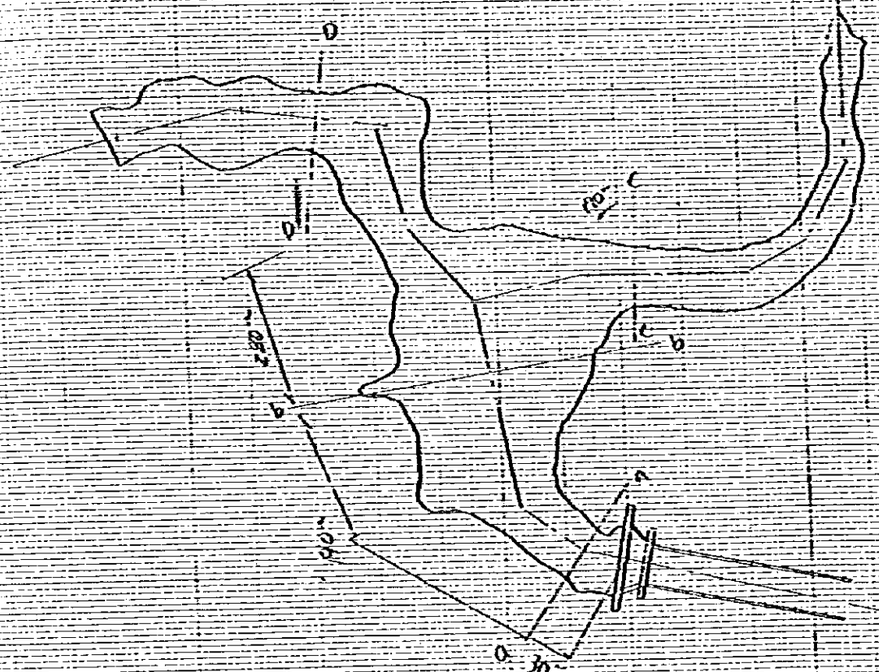
SEC 2

STA.	LENGTH	CUT			FILL			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
209+636		0			0			
+700	64.0	0.5	C5	16.0	15.0		480.0	
+750	50.0	0		12.5	72.0		2,175.0	
+800	50.0				80.0		3,800.0	
+815	15.0				80.0		1,200.0	
			BY NO. 10 L.		30.0 -			
+845					80.0			
+900	55.0	0			40.0		3,300.0	
210+000	100.0	20.0		1,000.0	10.0		2,500.0	
+165	65.0	0		650.0	10.0		650.0	
				1678.5			14105.0	
	SEGMENT =		TOTAL	287,010			58,137.5	

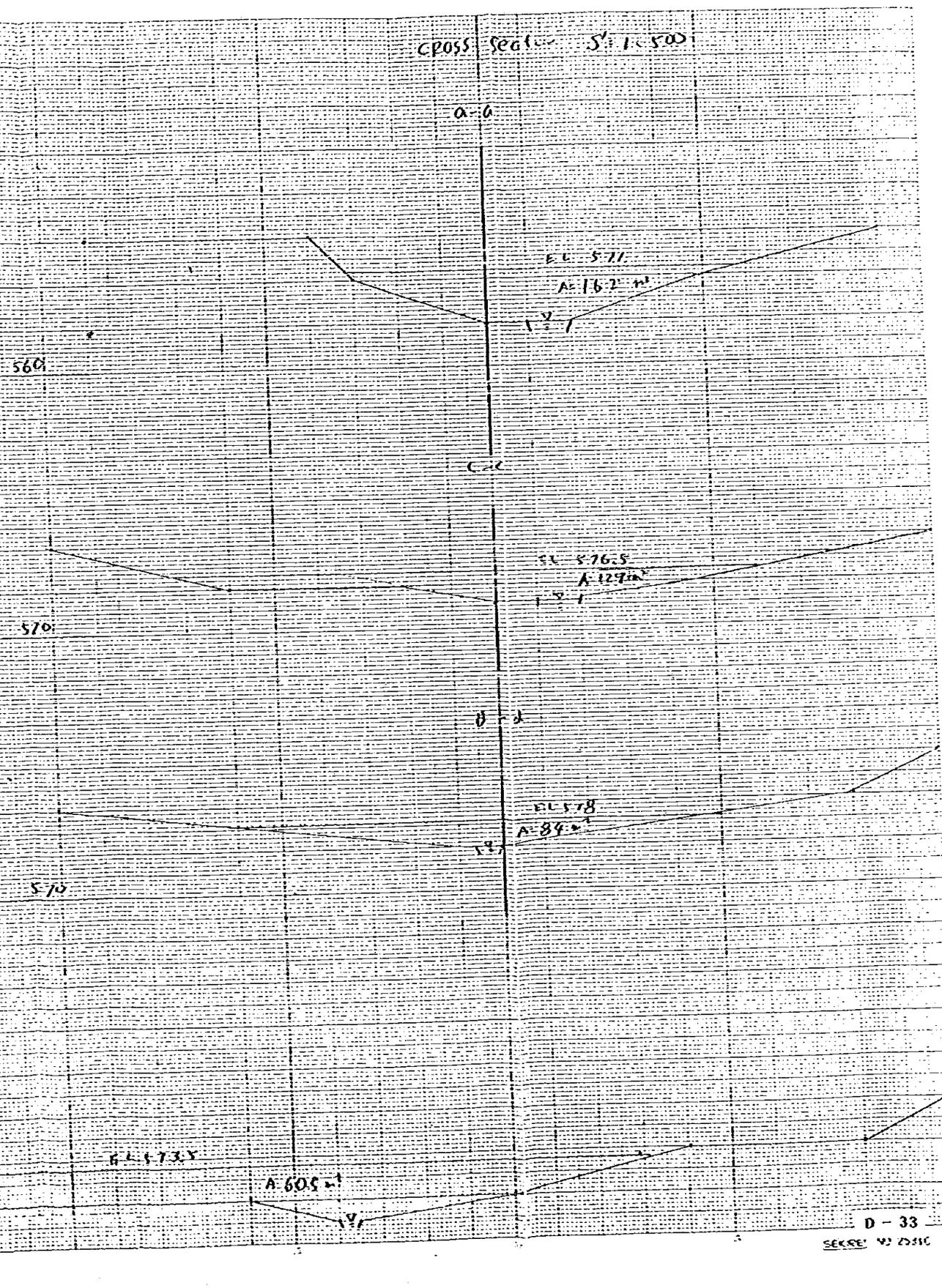
Deposition Area for Santa Fe River

A= 70000 m²

PLAN S = 1:5000



Cross Sect S = 1:500



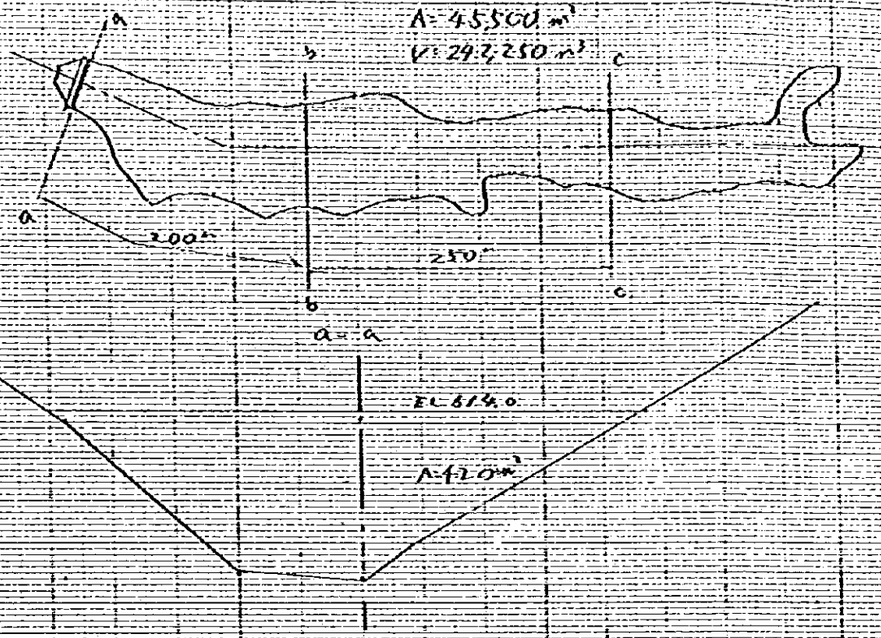
STA.	LENGTH	CUT			FILL			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
No. 1 SABO DAM 0					420.0			
+200	200.0				540.0		96000.0	
+450	250.0				350.0		111,250.0	
+650	200.0				0		35,000.0	
						Sub Total	242,250.0	
NO.2 0					270.0			
+050	50.0				110.0		9,500.0	
+190	140.0				5.0		8050.0	
+260	70.0				0		175.0	
						Sub Total	17,725.0	
NO.3	(40.0 x 240) + (100 x 240)						3360.0	
NO. 4	205	80 x ½					8,200.0	
NO 5	105	x 120 x ½					6,300.0	
						Total	277835.0	

SOUTH SIDE

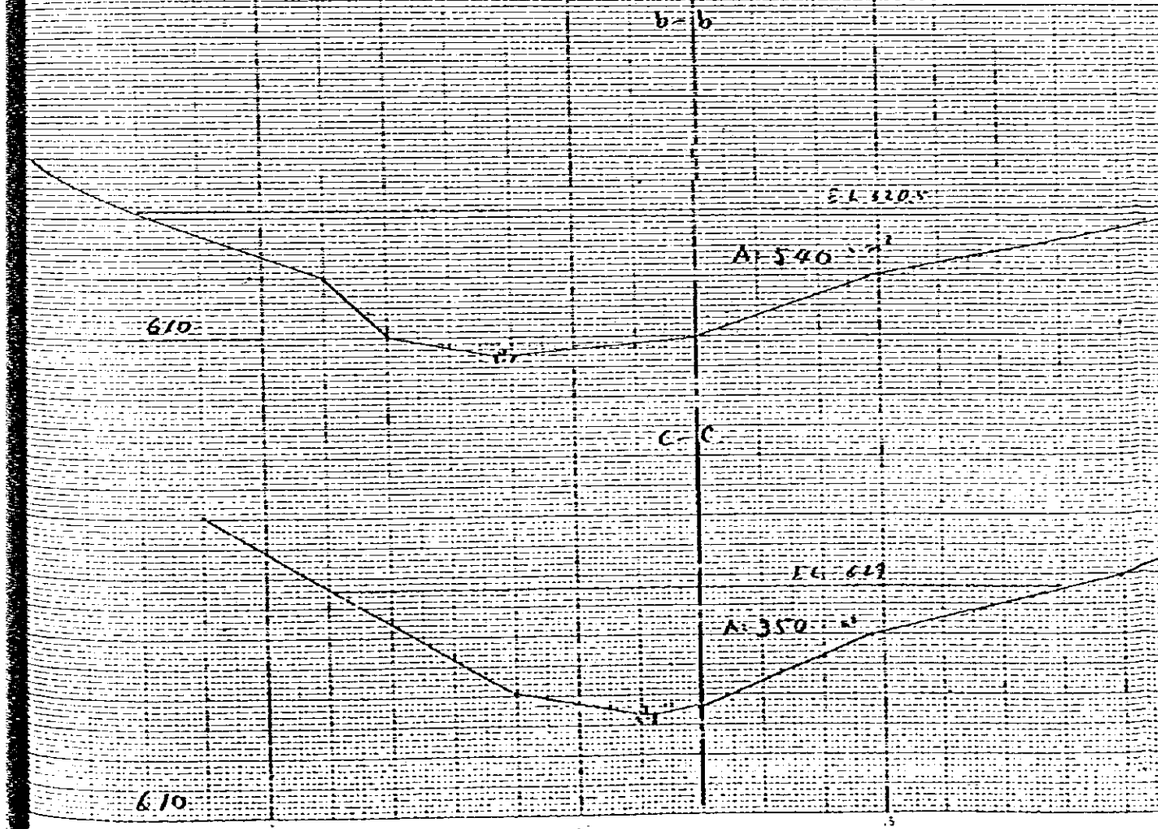
NO. 1 SABO DAM

A= 45,500 m²
V= 29,250 m³

S = 1:5,000



a-a Section
S = 1:500

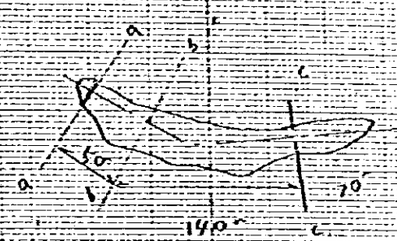


NO. 2 SABO DAM

A = 9000 m²

a-a	See Cross section	KM 205+300
b-b	See "	KM 205+700
c-c	See "	KM 205+500

V = 17725.0 m³

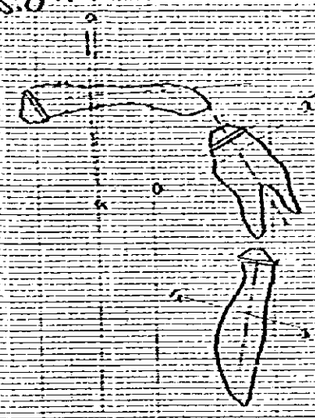


NO. 3 SABO DAM

A = 3700 m²

a-a See Cross Section KM 205+700

V = 3340.0 m³



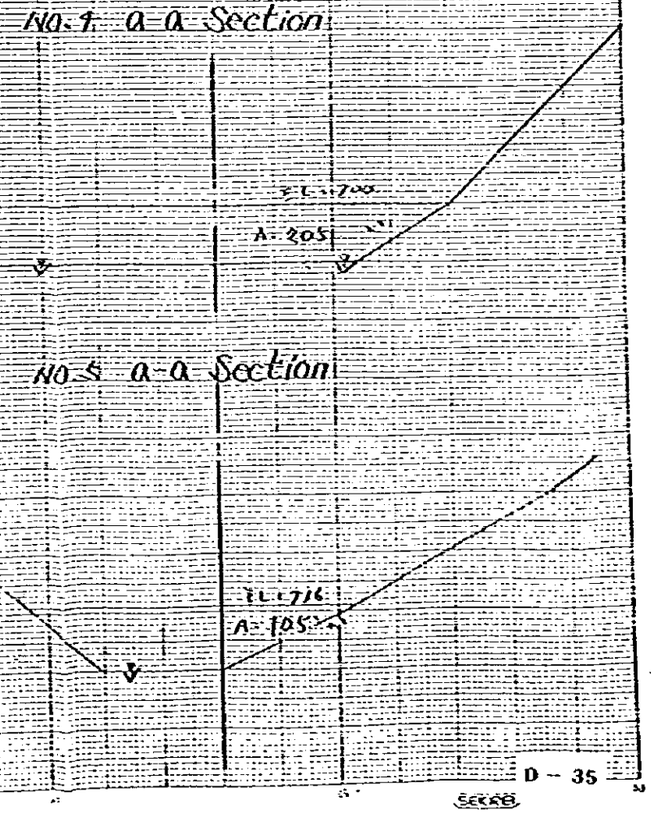
NO. 4 SABO DAM

A = 7800 m²
V = 8200 m³

NO. 5 SABO DAM

A = 6000 m²
V = 6300 m³

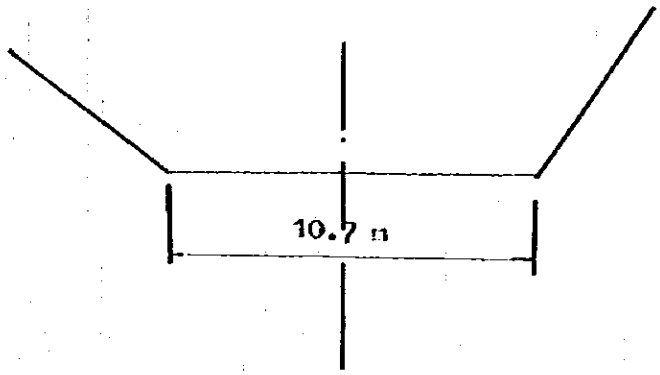
NO. 4 a-a Section



NO. 5 a-a Section

D – 35

3) Compaction of Cut Section



SEG. 2 1505.0m x 10.7m = 16,103.5m^2

3 955.25 x 10.7 = 10,221.2m^2

Total 26,324.7m^2

2. Slope Protection

ITEM \ SEGMENT	1	2	3	4	Total
For Embankment					
1) Placing Topsoil (Sq.m)	4,316.5	9,603.3	5,100.8	9,077.5	28,098.1
Seeding (Sq.m)	4,316.5	9,603.3	5,100.8	9,077.5	28,098.1
For Cut					
2) Planting Work and Vegetation (Sq.m)	3,250.0	15,125.0	3,730.0	21,389.5	43,494.5
W = 3.0m (L.M)	1,083.0	5,042.0	1,243.0	7,130.0	14,498.0
3) Concrete Spraying (Sq.m)	6,108.0	4,965.0	6,216.0	228.0	17,517.0
Netting (Sq.m)	6,108.0	4,965.0	6,216.0	228.0	17,517.0
4) Precast Concrete Frean (Sq.m)	0	2,310.0	1,470.0	0	3,780.0

.1) Slope protection for Embankment (Placing Topsoil)

SEGMENT 1

STA.	LENGTH	Left			Right			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
KM 202 + 500		0			0			
+ 800	300.°	1.0		150.°	0			
+ 900	100.°	2.5		175.°	2.5		125.°	
+ 950	50.°	2.5		125.°	2.5		125.°	
			Br No. 1 L: 220.0					
703 + 170		5.0			11.5			
+ 250	80.°	5.0		400.°°	11.5		920.°	
+ 310	60.°	0		150.°	0		345.°	
+ 610		0			0			
+ 657.5	47.5	5.0		119.°	11.5		273.°	
			Br No. 2 L: 90.0					
+ 747.5		5.0			11.5			
+ 790	42.5	5.0		213.°	11.5		489.°	

Slope protection For Embankment (Placing Topsoil)

STA.	LENGTH	Left			Right			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
203+790		5.0			11.5			
+800	10.0	0		25.0	5.0		82.5	
+900	100.0	0			0		250.0	
+950	50.0	0			7.0		175.0	
204+000	50.0	0			0		175.0	
	Sub Total			(1357.0)			(2959.5)	4316.5 m²
+450		0			0			
+460	10.0	0			4.0		20.0	
+500	40.0	0			4.0		160.0	
+600	100.0	0			10.0		700.0	
+700	100.0	0			23.0		1,650.0	
+750	50.0	0			24.5		1,188.0	
+850	100.0				28.0		2,625.0	
+900	50.0				28.0		1,400.0	
205+000	100.0	0			0		1,400.0	

SEG 1

SEG 2

STA.	LENGTH	Left			Right			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
205 +152.5		0			0			
+200	47.5	1.0		24.0	7.0		166.3	
+230	30.0	0		15.0	0		105.0	
205 + 300								
+350	50.0							
+400	50.0	0			0			
+500	100.0	0			1.5		75.0	
+600	100.0	0			0		75.0	
			SEG 2	(39.0)			(9564.3)	9,603.3 m
207 +830		0			0			
+877.5	47.5	5.0		118.8	5.0		119.0	
			SEG 3	NO. 5				
+925		0			0			

SEG 2 ↑

↓ SEG 3

STA.	LENGTH	Left			Right			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
207 + 922.5		0			0			
+950	27.5	5.0		69.0	5.0		69.0	
208 +000	50.0	0		125.0	0		125.0	
+200		0			0			
+300	100.0	31.0		1550.0	6.0		300.0	
+350	50.0	31.0		1,550.0	6.0		300.0	
+400	50.0	0		775.0	0		150.0	
SEG 3								
+420	20.0	19.0		190.0	7.0		70.0	
+450	30.0	0		285.0	0		105.0	5,900.8 m²
			Sub Total	(4,662.8 Br No. 6)			(1,235.0)	
+498								
SEG 4								
+550	52.0	0			0			
+600	50.0	0			0			

STA.	LENGTH	Left			Right			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
208 + 600								
+650	50.0	0			0			
+750	100.0	0			0			
+845	95.0	0			0			
			Br	No. 7				
+950		0			0			
209 +000	50.0	0			0			
+100	100.0	0			0			
+190		0			0			
+200	10.0	36.0		180.0	2.0		12.0	
+240	20.0	0		360.0	0		20.0	

STA.	LENGTH	Left			Right			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
209 + 310		0			0			
+350	40.0	24.0		480.0	11.0		220.0	
+400	50.0	26.0		1,250.0	2.0		325.0	
+481	81.0	36.0		2,511.0	6.0		324.0	
209 + 636		6.0			13.0			
+700	64.0	0		192.0	16.0		928.0	
+750	50.0	0			5.0		525.0	
+800	50.0	5.0		125.0	1.0		150.0	
+815	15.0	5.0		75.0	1.0		15.0	
			Br	110.10				
+845		5.0			1.0			
+900	55.0	2.0		192.5	1.0		55.0	
210 + 000	100.0	0		100.0	12.0		650.0	
+165	65.0	0			0		390.0	

SEG 4 (5465.5)
Total 11,524.3

(3612.0)
12323 ft²

90775 ft²
= 8.849.1 m²

2) Slope protection For cut (Planting Work and Vegitation) 20 %

STA.	LENGTH	Left			Right			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
203+310		0			0			
+400	90.0	10.0		450.0	7.0		315.0	
+540	140.0	0		700.0	0		490.0	
+580	40.0	36.0		720.0	1.0		20.0	
+610	30.0	0		540.0	0		15.0	
			Total	(2,410.0)			(840.0)	3250.0 m²
204+460		0			0			
+500	40.0	10.0		200.0	0			
+600	100.0	10.0		1,000.0	0			
+700	100.0	9.0		950.0	0			
+750	50.0	2.0		275.0	0			
+850	100.0	11.0		650.0	0			
+900	50.0	0		275.0	0			
1105+000	100.0	40.0		2,000.0	0			
+315	37.5	0		750.0	0			

SEG 1

SEG 2

STA.	LENGTH	Left			Right			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
205+350		0			0			
+400	50.0	11.0		275.0	2.0		50.0	
+500	100.0	8.0		950.0	0		100.0	
+600	100.0	12.0		2,000.0	8.0		400.0	
+700	100.0	19.0		1550.0	0		400.0	
+800	100.0	20.0		1,950.0	3.0		150.0	
+830	30.0	39.0		885.0	18.0		315.0	
			SAY	(13,710.0)			(1415.0)	
								15,125.0m³

STA.	LENGTH	Left			Right			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
207+690		24.0			25.0			
+750	60.0	0		1320.0	12.0		1110.0	
+800	50.0	0			0		300.0	
+830	30.0	0			0			
+877.5	47.5	0			0			
208+300		0			0			
+350	50.0	10.0		250.0	10.0		250.0	
+400	50.0	0		250.0	0		250.0	
			Total	(1820.0)			(1810.0)	3,730.0
208+498		0			0			
+550	52.0	0			27.0		702.0	
+600	50.0	0			60.0		2,175.0	
+650	50.0	7.0		175.0	60.0		3,000.0	
+750	100.0	0		350.0	22.0		4,100.0	
+845	95.0	0			20.0		1,995.0	

SEG 3

SEG 4

STA.	LENGTH	Left			Right			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
208 + 899		0			0			
+950	51.0	0			65.0		1657.5	
209 +000	50.0	0			20.0		2125.0	
+100	100.0	9.0		450.0	8.0		1,400.0	
+130	30.0	0		135.0	0		1.200.0	
209 +240		0			0			
+270	30.0	5.0		75	50.0		750.0	
+310	40.0	0		100	0		1,000.0	
			SEG 4	(1,285.0)			(20,104.5)	21389.5 m³
			Total	19.225.0			24,269.5	43.494.5 m³

5) Slope protection For Cut (Concreat Spreying and Netting)

STA.	LENGTH	Left			Right			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
203+790		0			0			
+800	10.0	4.0		20.0	0			
+900	100.0	0		200.0	0			
+950	50.0	18.0		450.0	0			
204+000	50.0	10.0		700.0	25.0		625.0	
+100	100.0	10.0		1,000.0	25.0		2500.0	
+135	35.0	0		175.0	0		438.0	
			Total	(2,545.0)			(3,563.0)	6108.0 m²
204+225		0			0			
+300	75.0	28.0		1,050.0	2.0		75.0	
+400	100.0	8.0		1,800.0	0		100.0	
+450	50.0	0		200.0	0			

SEG 1

SEG 2

STA.	LENGTH	Left			Right			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
204+460		0	↑	↑	0	↑	↑	
+500	40.0							
+600	100.0	0			0			
+700	100.0							
+750	50.0							
+250	100.0							
+900	50.0	0			0			
205+000	100.0							
+037.5	37.5	0	↓	↓	0	↓	↓	
205+230		0			0			
+300	70.0	29.0		1015.0	0			
+350	50.0	0		725.0	0			
		SEG Z		4790.0			(-175.0)	4765.0

STA.	LENGTH	Left			Right			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
207+922.5		0			0			
+950	27.5	0			23.0		316.0	
208+000	50.0	0			23.0		1150.0	
+100	100.0	5.0		250.0	31.0		2700.0	
+200	100.0	0		250.0	0		1550.0	
+300	100.0	0			0			
+350	50.0							
+400	50.0	0			0			
			Total	(500.0)			(5.716.0)	6216.0 m³
209+636		0			0			
+700	64.0	4.0		128.0	0			
+750	50.0	0		100.0	0			
209+900		0			0			
210+000	100.0	0			0			
+145	65.0	0			0			
			Total	(228.0)			(0)	228.0 m³
			Total	8,063.0			9,454.0	17,517.0 m³

SEG-3

SEG-4

D-50

4) Precast Concreat Fremm

STA.	LENGTH	Lett			Right			REMARKS
		AREA	AVE. AREA	VOLUME	AREA	AVE. AREA	VOLUME	
205+815		20.0			3.0			
+830	15.0	39.0		442.5	18.0		157.5	
+850	20.0	39.0			18.0			
+860	10.0	39.0		1170.0	18.0		540.0	
				SEGMENT 2		Total	2310.0	m^2
207+730		24.0			25.0			
+720	10.0	24.0			25.0			
+700	20.0	24.0		720.0	25.0		750	
				SEGMENT 3.		Total	1470.0	m^2
						Total	3780.0	m^2

3. MINOR STRUCTURES

1) Retaining Wall

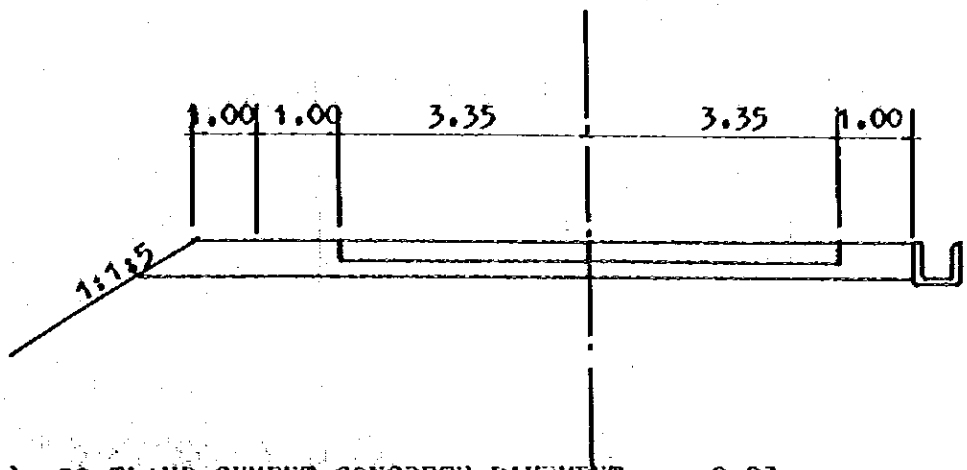
(m)

STA. \ Height	H = 4.0m	H = 7.0m	H = 8.0m	
Km 204 + 450 to Km 204 + 510			60.0	
205 + 155 to 205 + 200	45.0			
Sub Total SEGMENT 2	45.0		60.0	
Km 208 + 510 to Km 208 + 630		120.0		
208 + 685 to 208 + 710		25.0		
208 + 735 to 208 + 780		55.0		
208 + 800 to 208 + 845		45.0		
208 + 880 to 208 + 950			70.0	
Sub Total SEGMENT 4		245.0	70.0	
Total	45.0m	245.0m	130.0m	

2) STONE MASONRY

Area \ Height	H=2.0m	H=3.0m	H=4.0m	H=5.0m	H=7.0m	H=7.0m x 2
KH 202 + 990 to KH 203 + 100						
SEG. 2 KH 203 + 120 to KH 203 + 330 (240 m)		100.0 (300m³)	160.0 (640.0m³)			
204 + 510 to 204 + 590			80.0 (320 m²)			
SEG. 3 204 + 720 to 205 + 000						
205 + 450 to 205 + 500	350.0				280.0	
Sub Total SEGMENT 3 (2,580m³)	350.0 (700m³)		240.0 (960m³)		280.0 (1,960m³)	
KH 208 + 500 to KH 208 + 800		300.0				
208 + 900 to 209 + 040						140.0
209 + 461 to 209 + 481				45.0		
SEG. 4 209 + 750 to 209 + 815			65.0			
209 + 845 to 209 + 945			100.0			
209 + 950 to 210 + 050			100.0			
Sub Total SEGMENT 4 (4,145m³)		300.0 (600m³)	265.0 (1,060m³)	45.0 (225m³)		140.0 (1,960m³)
Total (8,065m³)	350.0m (700m³)	400.0m (1,200m)	505.0m (2,020m³)	45.0m (225m³)	280.0m (1,960m³)	140.0m (1,960m³)

4. PAVEMENT



1) PORTLAND CEMENT CONCRETE PAVEMENT 0.23 m

1m x 6.70m = 6.70 m^2/m

2) CRUSHED GRAVEL BASE COURSE 0.20 m

1m x 6.70m x 0.20 m = 1.34 m^3/m

1m x 1.00m x 0.43 m = 0.43 m^3/m

1m x (2.00 + 2.645)m x 0.43m ÷ 2= 1.00 m^3/m

2.77 m^3/m

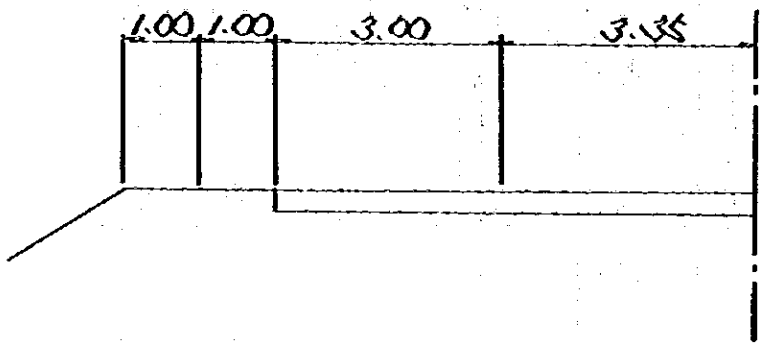
3) Prime Coat

1m x 7.16 m

No.	Unit Cost	Quantity	P/m Cost	Cost 000 P/Km.
1)	161.38 P	6.70 m^2	1,081 P/m	
2)	115.43	2.77 m^3	318 P/m	
3)	4.03	7.16 m^2	29 P/m	
			1,428 P/m	1,428 P/m

CLIMBING LANE

CLIMBING LANE



1. Earth Work Fill : $L = 100^{m} \times 8^{m^2}$ Cut $L = 100^{m} \times 8^{m^2}$

$L = 160 \times 48^{m^2}$

8180^{m^3} 800^{m^3}

193.0'000 ₱ 34.1 ₱
27.0'000 ₱

Total 220.0'000 ₱

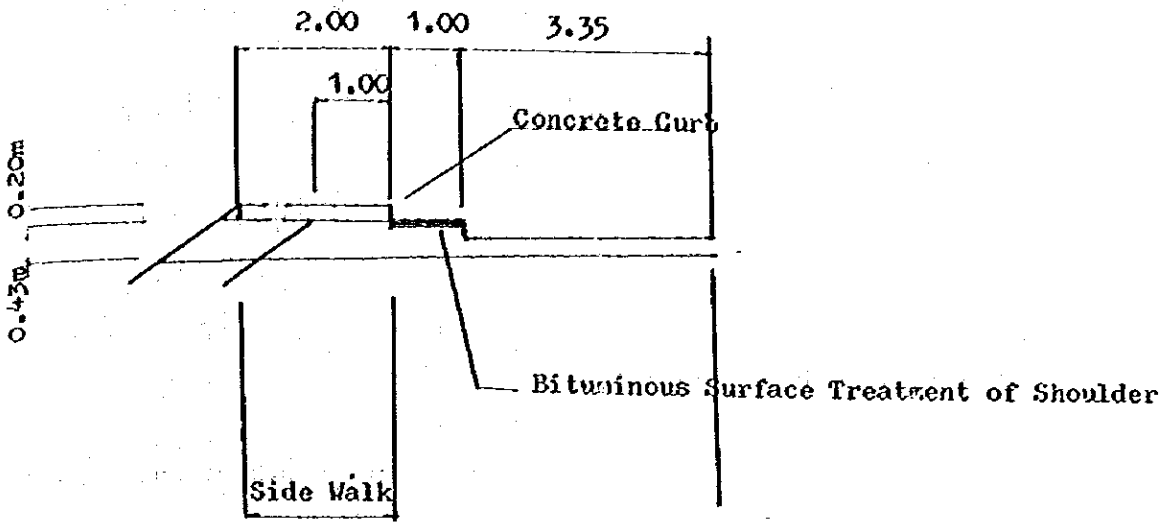
2. Pavement $L = 360^{m}$

161.38 ₱

58.0 ₱

Total 278'000 ₱

Side Walk



1) Bituminous Surface Treatment of Shoulder 1.0 x 0.1 = $0.1 m^3/m$

2) Concrete Curb $1 m/m$

3) CRUSHED GRAVEL BASE COURSE

0.20 x 2.0	0.4	
0.43 x 1.0	0.43	$0.83 m^3/m$

No.	Unit Cost	Quantity	Cost	Remarks
1	218.81 P/m^3	$0.1 m^3/m$	21.9 P/m	
2	52.18 P/m	$1 m/m$	52.2 P/m	
3	115.43 P/m^3	$0.83 m^3/m$	95.8 P/m	
			169.9 P/m	

Length of Side Walks in Santa Fe: 170.0 m

210.0 m

Total 380.0 m

5. DRAINAGE

1) Concrete Side Ditch W = 0.5m

SEGMENT 1.	660 + 605	= 1,265.0	
SEGMENT 2.	1,412.5 + 332.5	= 1,745.0	(Length of Cut Area)
SEGMENT 3.	250.0 + 567.5	= 817.5	
SEGMENT 4.	425.0 + 667.0	= 1,092.0	
	Total	= 4,919.5	(Length of Cut Area)

2) Sub - Drainage

SEGMENT 1	1,265.0
SEGMENT 2	1,745.0
SEGMENT 3	817.5
SEGMENT 4	1,092.0
Total	4,919.5

3) Reinforced Concrete Pipe Culvert

(m)

Diameter / STA.	ϕ 1.20 m	Remarks
KM 207 + 850	12.0	
203 + 200	30.0	
203 + 100	12.0	
SUB TOTAL SEGMENT 1	54.0	
204 + 460	25.0	
204 + 660	30.0	
204 + 860	33.0	
205 + 360	12.0	
205 + 550	17.0	
SUB TOTAL SEGMENT 2	117.0	
KM 207 + 150	35.0	
208 + 280	30.0	
208 + 420	32.0	
SUB TOTAL SEGMENT 3	97.0	
208 + 600	9.0	
208 + 750	10.0	
209 + 210	40.0	
210 + 120	10.0	
SUB TOTAL SEGMENT 4	169.0	
T O T A L	332.0 m	

4) Reinforced Concrete Box Culvert

Size / STA.	2.0 x 2.0	Remarks
KM. 209 + 365	39.0	
SEGMENT 4	39.0 m	
TOTAL	39.0 m	

6. TUNNEL

ITEM \ STAGE	FIRST	SECOND	LAST
Construction Cost for Tunnel	₱ 173,959,000		
Traffic Safety and Control Facilities	50,860,000		
1) Lighting facilities	3,310,000		
2) Fire Preventing facilities	6,010,000		
3) Received Power supply	(13,000,000)		
4) Distribution Line	13,140,000	1,567,000	1,960,000
5) Ventilation Facilities	15,400,000	10,213,000	69,867,000
Access Road			1,600,000
Air Shaft			40,531,000
Ventilating Station			
Fan			22,936,000
Jet Fan	11,240,000	9,636,000	
Electrical Facilities	4,160,000	577,000	4,800,000
Total Cost	224,819,000	11,780,000	71,827,000

7. BRIDGE

'000P

SEC.	STA.	NAME	TYPE	L = 50 LENGTH (m)	L = 50 DIRECT COST	LENGTH (m)	DIRECT COST
1	KM						
	202 + 560	S.D.P. No. 1	PCG			220.0	5,355.5
	203 + 702.5	No. 2	PCG			90.0	2,130.8
	204 + 180.0	No. 3	PCG			90.0	2,140.8
		Sub Total				(400.0)	(9,627.1)
2	205 + 55.0	No.4	RCDG PCG			(115.0)	(2,484.5)
3	207 + 500.0	No.5	RCDG	(45.0)	(963.2)		
4	208 + 474.0	No.6	PCG RCDG	48.0	1,035.3		
	208 + 872.0	No.7	PCG			55.0	1,655.7
	209 + 160.0	No.8	PCG			60.0	1,811.4
	209 + 553.5	No. 9	PCG			155.0	3,570.9
	209 + 830.0	No.10	RCDG	30.0	596.9		
	216 + 400.0	Santa Fe	PCG	30.0	814.8		
		Sub Total		(108.0)	(2,447.0)	(270.0)	(7,078.0)
			TOTAL	153.0	3,410.2	785.0	19,189.0