ブラジル連邦共和国

スアッペ臨海工業開発計画

資料No. 5

BOOK IV - VOLUME 2

PART 2 - HIGHWAY SYSTEM

PART 3 - RAILROAD SYSTEM

BOOK IV - PART 2

HIGHWAY SYSTEM

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PART 2 - HIGHWAY SYSTEM

1.0 TRAFFIC STUDIES

1.1 DIMENSIONING THE INTERNAL ROADS AND THE ACCESS ROAD TO THE INDUSTRIAL COMPLEX

For dimensioning the internal roads the location of the 1st stage industries and the highway network planned to service them were taken into consideration.

The number of trips to work was based on the number of direct jobs provided by the Suape Industrial Comples in the 1st stage of implementation.

The flowchart in Figure 1-I was used to calculate the number of vehicles during rush hour.

A PASSENGER TRANSPORTATION

The home-to-work trip hourly distribution contributes so much traffic during the peak period that it would be disadvantageous for the industries to transport cargo during this period. Therefore, dimensioning the roads can be based solely on the passenger traffic, admiting for a margin of safety an volume of cargo traffic equal to 10% of the average hourly cargo transported.

It is predicted that by the end of the 1st stage the Industrial Complex will have around 22,000 employees, as listed below, of whom 80% will travel from home to work and vice-versa during rush hours.

JOB FORECAST FOR THE 1st STAGE

INDUSTRY		
Refinery	-	600
Fertilizer Plant	-	100
Aluminum	-	2,000
Cement	-	1,500
Others	-	1,000
Subtotal	-	5,200
PORT/ADMINISTRATION AND OPERATION		
ADMINISTRATION CENTER:		
Administration Headquarters	-	131
Businesses	-	335
Hotels	-	150
Restaurants	-	180
Subtotal		846
CONSTRUCTION	-	15,000
TOTAL JOBS	-	21,646

Once the forecast residential areas are constructed at Suape, 70% of the hoursing demand will be met; this 70% is therefore fixed as the percentage of employees in the area.

Since these employees will be of a relatively low economic status and since the distances to be covered are vey short, it is presumed that heavy use will be made of public transportation; it may be assumed that 90% of the residents in the area will use public buses or buses supplied by the firms for which they work.

For the remaining 30%, a division of the job categories must be made in order to characterize two distinct economic ranges:

- Those with greater economic purchasing power

Construction workers

For the first group, the percentage found in Recife (Transportation Study of Greater Recife), 50% using automobiles, was used. For the second ground, it was assumed that 90% will use public transportation and 10% will use automobiles (engineers working at the construction sites, etc.).

To convert the individual trips into a number of vehicles, it was assumed that there will be 36 passengers per bus and 1.5 passengers per car. The bus equivalence to passenger car units was assumed to be:

1 bus = 3 UCP's (passenger car units) (Coefficient for hilly ground) based on the Highway Capacity Manual - National Academy of Sciences - National Research Council - 1965.

Using this methodology, the following traffic flow, represented in the flowchart in Figure 1-I, was obtained:

Table 2

Section	Passengers
AA'	1,108 UCP
BB'	1,532 UCP
CC'	549 UCP
DD'	1,530 UCP
EE'	255 UCP

B CARGO TRANSPORTATION BY TRUCK

In order to make the criteria uniform, the same cargo transportation volumes as used for dimensioning the paving, as well as the same type of truck, were adopted.

The absence of peak periods in truck traffic shown in traffic counts made in Recife permits us to assume that the situation will be the same in Suape. For this reason, the daily truck traffic was divided uniformly by 14 daily working hours.

As stated before, truck traffic should not occur during rush hours since it would be disadvantageous for the industries to have their trucks delayed in an hour of intense passenger traffic. Therefore, only a 10%portion of the hourly truck traffic was assumed to move during rush hours.

To convert the number of trucks into UCP's the factor of 5 was adopted, in keeping with the region's geographical conditions, yielding:

CARGO TRAFFIC

Sections	Trucks/day			Trucks/hour			UCP/hour L		
	1980	1985	1995	1980	1985	1995	1980	1985	1995
AA'	481	684	847	34	49	61	170	245	303
BB'	399	513	544	29	37	39	145	185	195
CC'	375	478	490	27	34	35	135	170	175
DD'	24	34	50	2	3	4	10	15	20
EE'	71	149	263	5	11	19	25	55	95

Note: L' - Equivalence Factor - 5 UCP = 1 truck

The participation of cargo transportation during rush hours (10% of the hourly cargo flow) results in:

SECTION	1995
AA'	31 UCP
BB'	20 UCP
CC'	18 UCP
DD'	2 UCP
EE'	10 UCP

C DIMENSIONING THE ROADS

Since only a small difference in work starting times is expected to occur in the industrial zone, the peak traffic period was assumed to be one hour long.

Thus for the various sections, the following traffic flows during the rush hour were used.

SECTION	PASSENGERS	CARGO	TOTAL
AA'	1,108	31	1,139 UCP
BB'	1,532	20	1,552 UCP
CC'	549	18	567 UCP
DD'	1,530	2	1,532 UCP
EE'	255	10	265 UCP

The Suape Industrial Complex's internal traffic may be considered traffic with urban characteristics since the roads are characterized by peak period loads, close crossing distances and a large passenger movement.

The following formula was adopted for calculating the capacity of a two lane highway:

$$C = 2{,}000 \times W_L \times T_B \times T_T$$

where W_L is a parameter that varies with the highway dimensions and T_B and T_T are parameters relative to the rates for buses and trucks.

Adopting the dimensions recommended in the Highway Capacity Manual and using the equivalence factors for buses and trucks, yields:

$W_L = T_T = T_B = 1$; then

$C = 2{,}000 \times 1 \times 1 \times 1 = 2{,}000$ UCP's/hour

Since the traffic flows calculated for the various sections of the planned highway network are below the saturation level for a two land highway, a typical section of the following form was adopted:

BICYCLE ROUTE	DITCH	HIGHWAY SHOULDER	HIGHWAY LANES	BICYCLES	DITCH	HIGHWAY SHOULDER
1.60	0.5	3.00	7.20	3.00	0.5	1.60

For the points with the largest load on the roads it was concluded that the service level will be A if there is no traffic signalling installed and level D with traffic signalling.

By the end of the fist stage the highways will be operating at 75% of their saturation level, leaving a margin of 25%.

It is recommended that the shoulders receive the same surface treatment as the highway lanes in the places where bus stops will be necessary, and on hills where the heavier vehicles will greatly reduce speed.

1.2 ACCESS ROADS TO THE INDUSTRIAL COMPLEX

Section AA', cited in the preceding item, can be viewed as an extension of highway PE-60 since its cutt-off is situated at a point which will accomodate only the traffic connecting with the Industrial Complex's external area.

Considering the traffic flows set down in item C of 1.1.1 and comparing section AA's flow with the calculation of the two lane highway's capacity, it was concluded that during the first stage there would be no justification for widening the present highway PE-60. Only improvements to the present shoulders are suggested.

Since the distances to the closest cities (Cabo, Ponte dos Carvalhos, etc.) are approximately 20 km with quite hilly sections, the use of bicycles as means of commuting along the access roads to the Industrial Complex is not feasible, nor is construction of special bike routes justifiable.

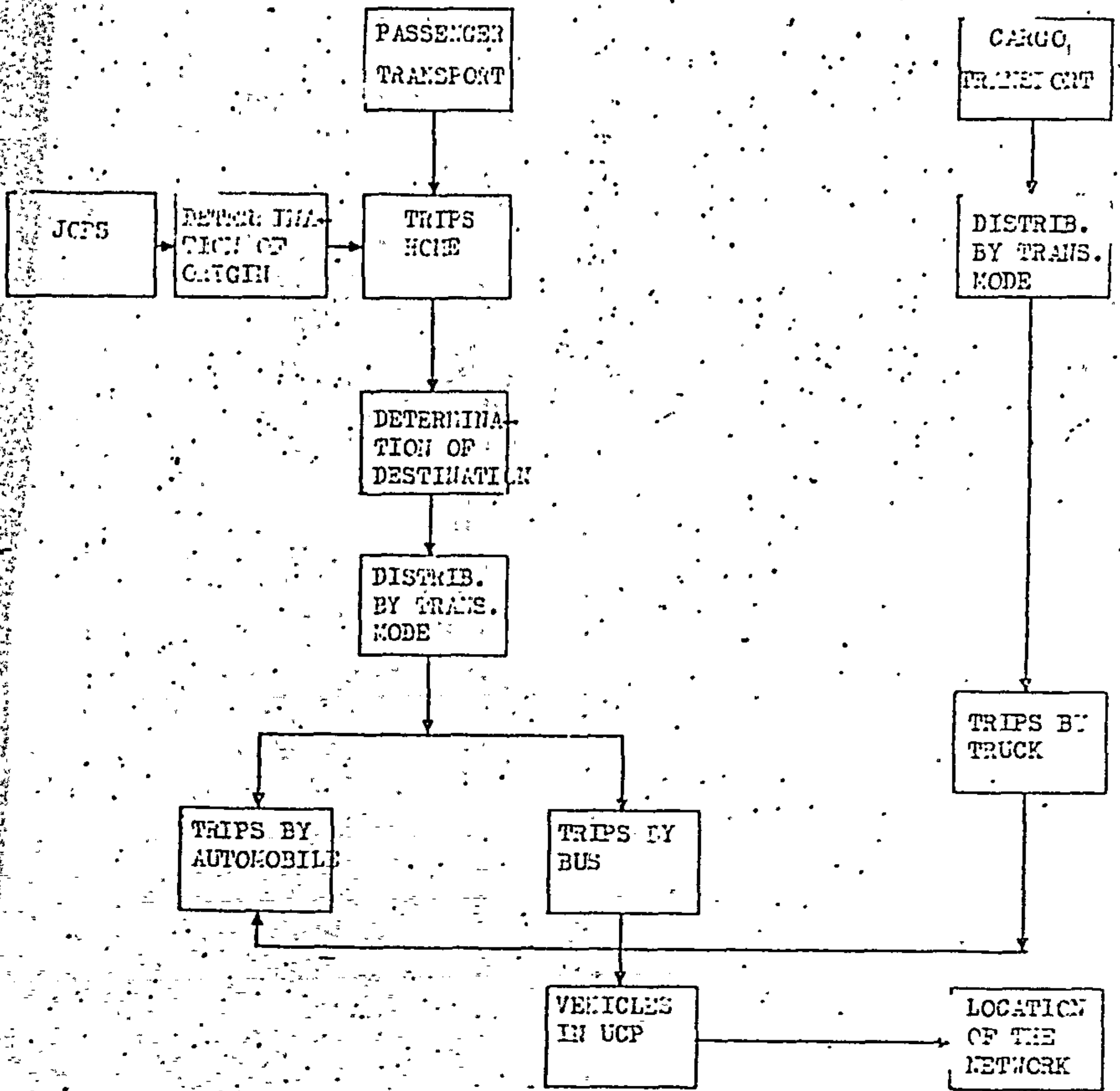

FIGURE 11

GOVERNO DO ESTADO DE PERNAMBUCO - FAAC
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL DE PERNAMBUCO
COMPLEXO INDUSTRIAL DE SUAPE

FLOWCHART OF LOCATION OF VEHICLES IN THE NETWORK

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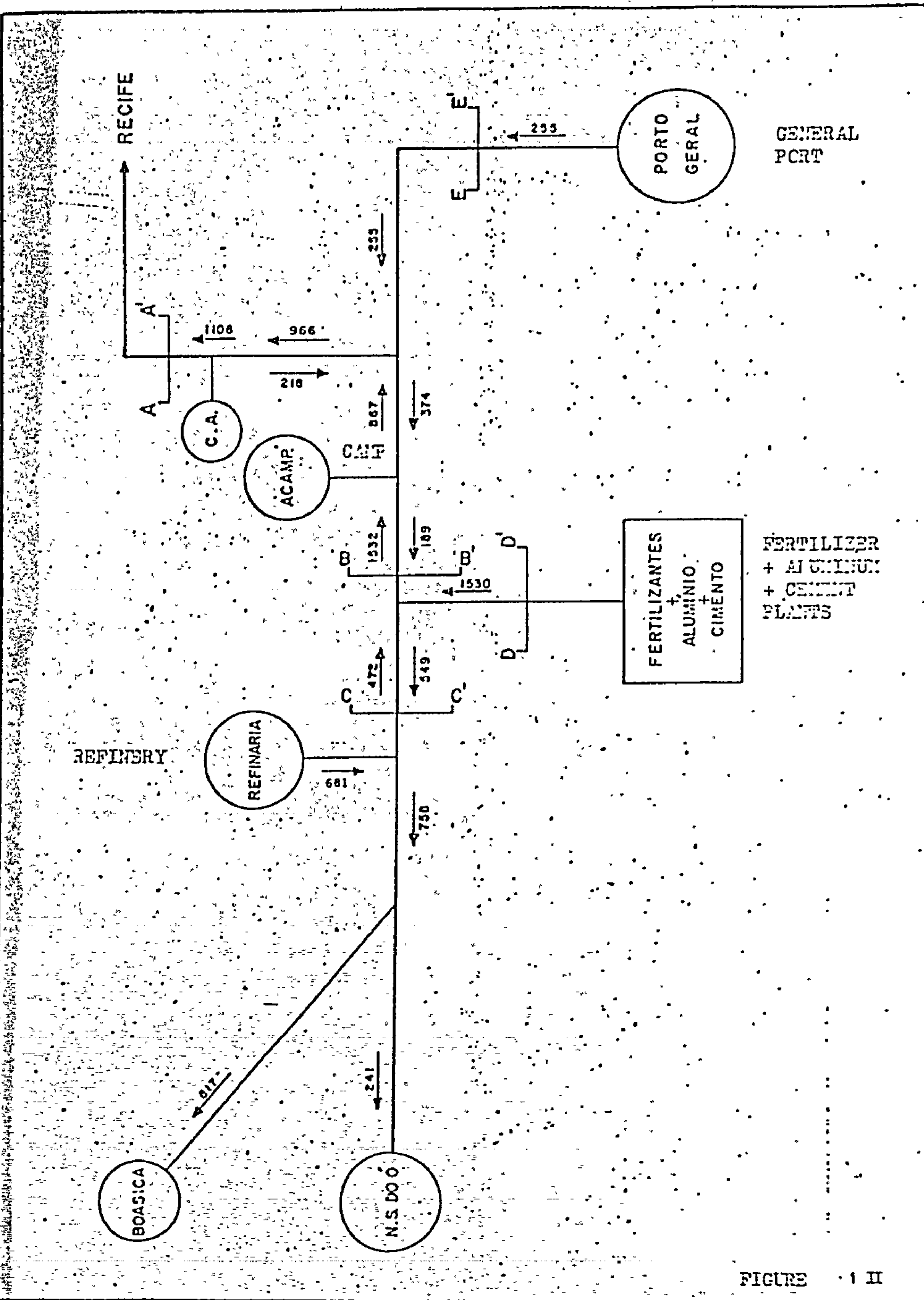

FIGURE 1 II

UNITS IN UCP

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COMPLEXO INDUSTRIAL DE SUAPE

DISTRIBUTION OF THE TRAFFIC FLOW

TOMO II
VOLUME 2
PARTE 2
2.0

2.0 BASIC GEOMETRICAL DESIGN

2.0 BASIC GEOMETRICAL DESIGN

2.1 GENERAL CONSIDERATIONS

The planned highway network aims, during the first stage, at linking the various port terminals to a main distribution trunk road for the Industrial Complex. The network itself is interconnected with the stated and federal highway system through a main access road to highway PE-60.

The routes proposed are intended to fit simultaneously the region's technical and economic conditions and the port industrial complex's operating framework without hindering the functions for which the adjacent areas are designed.

2.2 HORIZONTAL PLAN AND PROFILE

2.2.1 CHARACTERISTICS

The philosophy expressed above guided the determination of the highway characteristics to be presented below. The highway system plan (scale 1:10,000) was based on aerial photographs on a 1:30,000 scale, restitution of the aerial photographic survey on a 1:10,000 scale and local reconnaisance.

The highway traffic characteristics demand that traffic flow continuously. Therefore, for the Main Access and the Main Distribution Trunk Road, horizontal radii larger than the minimum (380 m) and a maximum slope of 2%, or a class "O" highway in a flat and hilly region, as per the classification scheme established in DNER's regulation no. 3,602.

The port access roads' characteristics permit them to be classed as class "1" roads with a minimum horizontal radius of 245 m and a maximum slope of 3%.

2.2.2 LENGTHS OF HIGHWAY TO BE CONSTRUCTED FOR THE FIRST STAGE

The highway system is presented in Topographical Plan on a 1:10,000 scale and in profile on a 1:2,000 horizontal scale and a 1:200 vertical scale in the respective Book of Drawings. The average lengths on the plan yield the following values:

HIGHWAYS	LENGTHS
Main access	1.60
Main Distribution Trunk	5.60
Port Road 1	5.30
Port Road 3	2.57
Port Road 4 (Part)	4.07

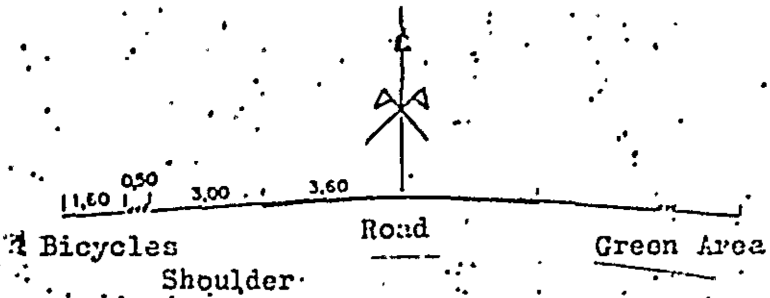
Port Road 5 (part)	2.60
Townsite access 1	3.75
Townsite circuit	3.70
Secondary access to the Refinery	1.78
N S of O access (ZR1)	1.15
Access to the Cement Plant	1.20
Road 1 (ZR2)	2.40
Road 2 (ZR2)	1.50
Road 3 (ZR2)	2.20
Road 4 (ZR2)	0.70
Road 5 (ZR2)	2.00
	42.12

2.3 TRANSVERSAL SECTIONS

Transversal sections for the highway system were designed to handle, all through the working life of the roads, the increases in heavy, medium and light traffic.

Figure 2.I shows the section to be used for the various highway sections for the first stage. For maximum utilization of the Industrial Complex, duplication of the section in the main access road and the main distribution trunk road was predicted.

PORT ROUTES AND SECONDARY DISTRIBUTION ROADS



MAIN ACCESS ROADS

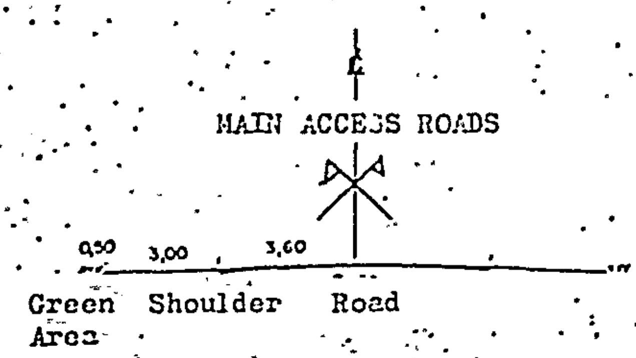


Figure - 2 XXVIII

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GOVERNO DO ESTADO DE PERNAMBUCO - FPAC
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL
DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

TYPICAL SECTIONS OF THE
HIGHWAY ROUTES

[illegible]	data	escala	desenho nº	folha
[illegible]	[illegible]	1:200	[illegible]	[illegible]

TOMO IV
VOLUME 2
PARTE 2
3.0

3.0 CONVENTIONAL CIVIL CONSTRUCTIONS

3.0 CONVENTIONAL CIVIL CONSTRUCTIONS

3.1 GENERAL CONSIDERATIONS

In order to protect the highway system infrastructure and the paved roads, drainage to capture surface and underground water was planned.

According to criteria in the following items, quantitative values for the following elements were arrived at:

- Cave and grade culverts
- Deep drains
- Gutters
- Benches
- Protection ditches
- Plant covering

3.2 ORIENTATION ADOPTED

3.2.1 CAVE BOTTOM CULVERTS

Information needed to pre-dimension cave bottom culverts was taken from aerial photographs (1:30,000 scale) and a topographic plan (1:10,000 scale). A 20 year replacement period was adopted for a projected 70mm/hour water fall rate.

The flow sections, determined by the Talbot empirical formula, were converted to pipe sections with Ø 1.00 m.

3.2.2 DEEP DRAINS

Deep drainage was indicated for all cuts with a red elevation greater than 3 meters.

3.2.3 GUTTERS

Gutters at the cut embankment bases were adopted.

3.2.4 BENCHES

Were adopted for the sides of the fills with a red elevation greater than 3 meters.

3.2.5 PROTECTION DITCHES

Were considered along all of the cuts.

3.2.5 PLANT COVERING

Grass covering of all the fill embankments was predicted. No such covering will be done on the cuts since most of them will be widened.

The area to be covered was estimated as the product of the fill extension times the mean height axonometrically projected over the embankment slopes. A one meter strip of grass covering was assumed in addition to the base of the fill embankment slopes.

3.3 QUANTITATIVE DATA

Quantitative data for each drainage element for each section of the highway system, are presented in the following tables:

-	Culverts	Table 3/1
-	Deep Drains	Table 3/2
-	Gutters	Table 3/3
-	Benches	Table 3/4
-	Protection Ditches	Table 3/5
-	Plant covering	Table 3/6
-	Summary Table	Table 3/7

TABLE 3/1

CULVERTS	
SECTION.	LENGTH IN METERS
Main Access.	66
Distribution Trunk + Port Route I	657
2nd section Port Route I + secondary access road to bulk products port	671
Townsite access road + Townsite Road 1	354
N S O Access + Port Route IV	191
Road 2	83
Road 3	177
Road 4	88
Road 5	205
Secondary access to Refinery	89
TOTAL.	2,580

TABLE 3/2

DEEP DRAINS - HIGHWAY A1	
SECTION	LENGTH (M)
Distrib. Trunk + Port Route 1	3,160
2nd section Port Route 1 + secondary access to bulk products port	2,980
	700
Port Route 3 + Port Route 4 + secondary access to Fertilizer Plant	-
Secondary access to Cement Factory Main access road	930
Port Route V + Access to N S O	-
Townsite access 1 + Townsite Road 1	1,170
Townsite circuit	1,376
Road II	708
Road III	1,580
Road III	-
Road V	1,870
Secondary access to the Refinery	1,060
TOTAL	15,540

TABLE 3/3

HIGHWAY - GUTTERS

SECTION	LENGTH
Trunk + Port Route 1	3,528
Main Access	928
Port Route 3 + Port Route 4 + secondary access to fertilizer plant	1,890
2nd section Port Route 1 + secondary access to bulk products plant	4,200
Access to N S O + Port Route V	1,500
Secondary access to Cement Factory	-
Townsite Access 1 + Townsite Road 1	2,070
Townsite circuit	2,240
Road II	710
Road III	2,660
Road IV	640
Road V	1,870
Secondary access to Refinery	1,460
TOTAL	22,170

TABLE 3/4

BENCHES	
SECTION	LENGTH - OBS
Dist. trunk + Port Route 1	6,240
Main access	920
Port Route 3 + Port Route 4 + Secondary access to fertilizer plant	11,440
1st section Port Route 1 + Secondary access to bulk products port	6,330
Access to N S O + Port Route V	-
Secondary access to Cement Factory	2,440
Townsite access + Townsite road 1	2,900
Townsite circuit	2,200
Road II	1,830
Road III	1,090
Road IV	-
Road V	1,620
Secondary access to the Refinery	1,770
TOTAL	38,800

TABLE 3/5

PROTECTION DITCHES	
SECTION	LENGTH IN METERS
.Dist. trunk + Port Route 1	3,530
.Main access	930
.Port Route 3 + Port Route 4 + Secondary access to fertilizer plant	1,8600
.1st section Port Route 1 + secondary access to bulk products port	4,200
Access to H S O + Port Route V	1,400
.Secondary access to Cement Plant	-
.Townsite access + Townsite Road I	930
.Townsite circuit	2,240
.Road II	710
.Road III	2,670
.Road IV	640
.Road V	1,870
.Secondary access to Fertilizer Plant	1,460
TOTAL	22,170

TABLE 3/6

SECTION	AREA (M^2)
Main access	11,800
Dist. trunck + Port Route 1	56,000
2nd section Port Route 1 + secondary access to bulk products port	48,600
Access to N S O	20,000
Port Route 3 + Port Route 4 + secondary access to Fertilizer Plant	79,500
Secondary access to Cement Factory	17,270
Townsite Access 1 + Townsite Road 1	40,300
Townsite circuit	19,810
Road II	13,000
Road III	7,820
Road IV	1,290
Road V	14,790
Secondary access to the Refinery	16,700
TOTAL	346,880

TABLE 3/7

QUANTITIES OF CONVENTIONAL CIVIL CONSTRUCTIONS (SUMMARY)

SERVICES	UNIT	HIGHWAY
Excavation and laying of concrete pipes ∅ 1.00 m		2,580
Deep drains		15,540
Concrete gutters		22,170
Commercial benches		38,800
Protection ditches		22,170
Plant covering		346,880

TOMO - II
PARTE 2
VOLUME 2
4.0

4.0 EARTH MOVING

4.0 EARTH MOVING

4.1 ORIENTATION ADOPTED

The basic design for earth moving took into consideration the following factors:

- Nature of the material to be excavated
- Crossing of the mangrove swamp areas
- Volumes of material to be excavated
- Volume of compacted fill
- Mean transport distance

4.2 CUTS

For purposes of calculating volumes, embankments with a 1:1 slope were adopted for the cuts. The present status of the work doesn't permit more detailed studies on the cut embankment slope stability.

Whenever the cut sub-grade material shows low support capacity, it is suggested that better quality material, with expansion less than or equal to 2%, be substituted.

4.3 BORROW MATERIAL

The results of volume calculations showed a clear predominance of fill volumes over cut volumes. Widening the cuts was indicated as the first choice for obtaining borrow material in a manner that preserves the region's natural landscape as much as possible and provides better drainage and visibility conditions.

4.4 NATURE OF THE MATERIAL

The materials to be excavated were sampled by auger drillings at points where the route showed a section of cuts.

The samples obtained were laboratory tested for:

- Size consist
- Physical limits
- Compaction and
- California Bearing Resistance (CBR)

The results are presented in Tables 4/1 and 4/2.

The nature of the materials was found to be group A2 clayey and/or silty sands and group 7 clayey silty materials, as per the HRB classification system.

For subgrade materials, a good part of the group A7 materials could be used since a low bearing resistance capacity and a higher than recommended expansion were found in only two of the drill holes. All of the group A2 material will be used.

4.5 FILLS

4.5.1 COMPOSITION

Embankment slopes for the fills constituted of cut and borrow materials were set a 3 (horizontal) : 2 (vertical) in order to determine values needed for calculation of volumes.

Use of materials with low bearing resistance (CBR less than 3) and high expansion (greater than 3%) in the fills is not recommended.

Material with expansion greater than 2% should not be used in the final layer (60 cm).

In sections where the subgrade support capacity is such that, in spite of being greater than the recommended minimum, it leads to high pavement thickness, the fill should be topped with select materials. Materials from group A2 will be suitable.

4.5.2 FILLS IN MANGROVE SWAMPS

Special attention was given to this topic. However, defining solutions for crossing mangrove swamp regions does not fit in the scope of this phase's work. It is recommended that studies be conducted at a more advanced stage for specific solutions for each fill in mangrove swamp areas. The following are suggested:

BERMS

Are lateral equilibrium benches to reduce shearing tensions that occur in the fill's soft foundation layer. An example of the method is shown on page 4-I.

VERTICAL SAND DRAINS

Are columns of sand penetrated into the soft layer on which the fill will be lain. The serve to accelerate the condensing processes to occur in that layer.

DYNAMITING UNDESIRABLE MATERIAL

Consists in the elimination of the soft material by explosions either under the fill or at the base of the fill.

Use of the above suggested processes will be determined for each fill area after the characteristics of the soft material, the thickness of the layer in which it occurs, the height of fill over this soft layer and other factors, such as economy of the project design and execution time, have been checked.

In order to make cost estimates that are as realistic as possible, 2m, the value of the pole measurements taken in this region, was added to the red elevation quantities for the fill over mangrove swamps.

4.6 PRESENTATION

Cut, borrow and fill volumes and mean transport distance are listed in Table 4/3.

The cut and fill volumes were determined from the mean of the red elevations taken from the profiles.

The value 1.3 was adopted for a coefficient of expansion. Therefore the volumes are increased by 30%.

The red elevations for fills over mangrove swamps were increased by 2 meters.

The high mean transport distances arise from the fact that borrow materials will be obtained by widening the cuts. It is not difficult to realize that, in addition to the considerations cited in item 4.3, shorter transport distances cannot be realized by performing lateral borrow operations because the fills that require the largest borrow volumes are located in low areas.

The proposed transversal sections plus two meters on each side were used as a basis for predicting quantities of deforesting, stump grubbing and clearing (Table 4/4).

4.7 QUANTITATIVE DATA

The excavation volumes and the transport distances were taken from Table 4/3. The fill volumes, without added measurements for expansion, were used for the compaction volumes. Quantities for earth moving work in the various highway system components are listed in Table 4/4.

TABLE 4/1

REGISTER NO.			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
DRILL HOLE NO.			1	2	3	6	7	7	8	8	9	
POSITION												
DEPTH		FROM	0	0	0	0	0	150	0	200	0	
-cm-		TO	220	400	400	400	150	400	200	400	200	
SIZE CONSIST	SCREENING - % PASSING	2"										
		1"								100		
		3/8"		100		100	100			95		
		NO. 4	100	98		99	99	100		95	100	
		NO. 10	98	95	100	99	88	99	100	98	99	
		NO. 40	74	84	94	96	88	93	88	85	72	
		NO 200	51	76	87	89	52	56	55	52	24	
AASHO RANGE			E/F	E/F	E/F	E/F	E/F	E/F	E/F	E/F	E/F	
LIQUIDITY LIMIT			55	75	86	83	61	57	45	46	25	
POROSITY INDEX			34	48	39	36	34	29	21	21	9	
ATOMIC STRUCTURE												
GRANULATION INDEX			13	20	20	20	15	14	10	[illegible]	3	
HRB CLASSIFICATION			A7-5	A7-5	A7-5	A7-5	A7-6	A-7-6	A7-6	A7-6	A-2-4	
NORMAL AASHO 12 BLOWS		MAX DENSITY	1732	1450	1352	1402	1570	1527	1545	[illegible]	[illegible]	
		MOISTURE	172	222	244	232	192	196	200	[illegible]	123	
		CBR	6	3	9	9	1	2	4	2	8	
		EXPANSION	2,3	3,0	0,3	1,9	0,7	3,4	1,5	1,3	0,1	
INTER. AASHO 26 BLOWS		MAX DENSITY										
		MOISTURE										
		CBR										
		EXPANSION										
MODIF. AASHO 56 BLOWS		MAX DENSITY										
		MOISTURE										
		CBR										
		EXPANSION										
FIELD		NAT MOISTURE										
USEABLE YES(Y) NO(N)												
OBSERVATIONS												

NOTES:

HIGHWAY | SECTION [illegible] | SUBSECTION

TESTS - SUBGRADE AND NATURAL LAND

TRANSCON S/A

TABLE 4/2

REGISTER NO.		1.828	1.829	1.83[illegible]
DRILL HOLE NO.		1	4	5
DEPTH -cm-	FROM	220	0	0
	TO	400	400	400
SIZE CONSIST SCREENING - % PASSING	2"			
	1"			100
	3/8"		100	99
	NO. 4	100	99	95
	NO. 10	97	98	94
	NO. 40	56	67	49
	NO 200	35	43	33
AASHO RANGE		E/E	E/E	E/E
LIQUIDITY LIMIT		32	53	49
POROSITY INDEX		NP	27	21
ATOMIC STRUCTURE		1		
GRANULATION INDEX		0	7	3
HRB CLASSIFICATION		A2-4	A7-6	A27
NORMAL AASHO 12 BLOWS	MAX DENSITY			
	MOISTURE			
	CBR			
	EXPANSION			
INTER. AASHO 26 BLOWS	MAX DENSITY	1915	1820	1820
	MOISTURE	12.0	12.8	12.5
	CBR	5	11	6
	EXPANSION	0.4	1.4	0.3
MODIF. AASHO 56 BLOWS	MAX DENSITY			
	MOISTURE			
	CBR			
	EXPANSION			
FIELD	NAT MOISTURE			
USEABLE YES(Y) NO(N)				
OBSERVATIONS				

NOTES:

HIGHWAY	SECTION Suaqie	SUBSECTION
SAND/GRAVEL No.	NAME	LOCATION
	TEST - SAND/GRAVEL	
	TRANSCON S/A	

TABLE 4/3

HIGHWAYS	FILL	CUT	BORROW	MEAN TRANSPORT DISTANCE		
				TO 0.4 km	0.4-0.8Km	0.8-1.5km
Main Access	69,000	41,000	28,000	-	69,000	-
Dist. trunk + Port Route 1	363,000	226,000	137,000	114,000	74,000	175,000
Port Route 3 + Port Route 4 + Secondary Access to Fertilizer Plant	617,000	35,000	582,000	13,000	57,000	647,000
Secondary access to Cement Plant	108,000	-	108,000	-	-	108,000
Second section Port Routell + Secondary access to bulk products port	385,000	228,000	157,000	125,000	260,000	
Port Route 5 + Access to NSO	122,000	2,000	120,000	-	-	180,000
Townsite access 1 + Townsite Road I	186,000	62,000	124,000	35,000	57,000	94,000
Townsite Circuit	102,000	49,000	53,000	47,000	55,000	-
Road II	78,000	80,000	-	80,000	-	-
Road III	44,000	86,000	-	86,000	-	-
Road IV	5,000	7,000	-	7,000	-	-
Road V	107,000	108,000	-	108,000	-	-
Secondary Access (Refinery)	96,000	36,000	60,000	32,000	64,000	-

TABLE 4/4

DEFORESTING, STUMP GRUBBING AND CLEARING	
SECTION	AREA (m^2)
Main Access	38,000
Dist. trunk + Port Route 1	149,000
2nd section Port Route 1 + secondary access to bulk products port	164,000
Port Route 3 + Port Route 4 + secondary access to Fertilizer Plant	180,000
Secondary access to Cement Factory	32,000
Townsite Access 1 + Road I	138,000
Townsite Circuit	77,000
Road II	39,000
Road III	50,000
Road IV	11,000
Road V	50,000
Secondary access to the Refinery	54,000
Port Route V	161,000
	1,107,000

TABLE 4/5

SERVICES	UNIT	QUANTITIES HIGHWAYS
- Cut and borrowing excavation of 1st category material with transport distance up to 0.4 km	m^3	647,000
- Cut and borrowing excavation of 1st category material with transport distance from 0.4 to 0.8 km.	m^3	636,000
- Cut and borrowing excavation of 1st category material with transport distance from 0.8 to 1.5 km.	m^3	1,104,000
- Cut and borrowing excavation of 2nd category materials with transport distance up to 0.2 km.	m^3	960,000
- Cut and borrowing excavation of 3rd category material with transport distance up to 0.2 km.	m^3	48,000
- Deforesting, stump grubbing and clearing	m^2	1,107,000
- Compaction	m^3	1,694,000

BERMS

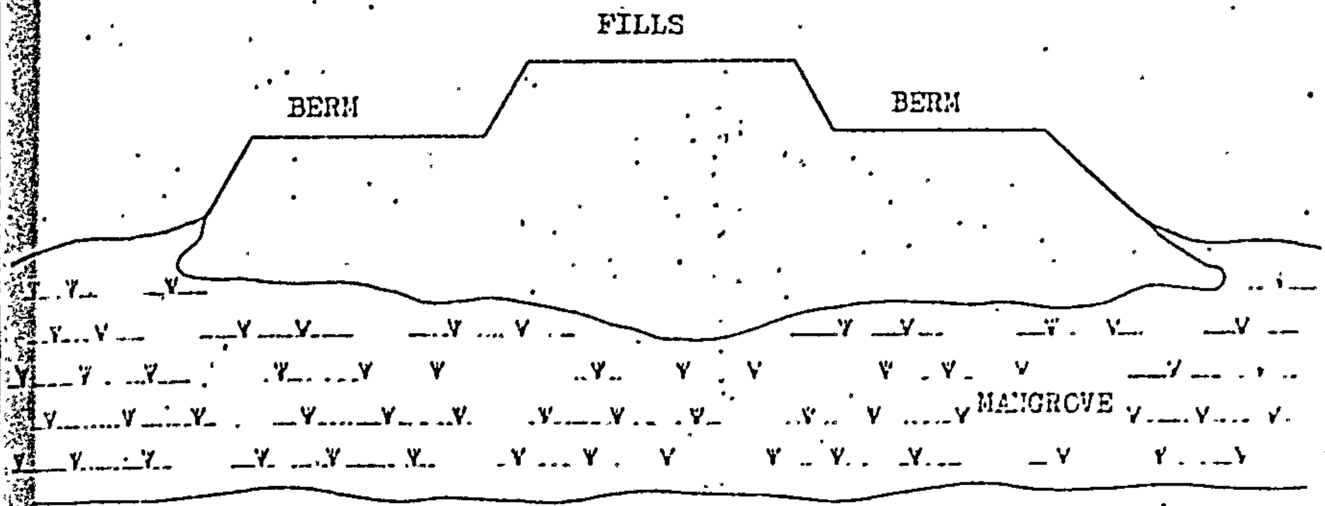


FIGURE .-4 I

dipor

TRANSCON S.A

[illegible]

COMPLEXO INDUSTRIAL DE SUAPE

BERMS – SUGGESTED SOLUTION FOR FILL OVER MANGROVE SWAMPS

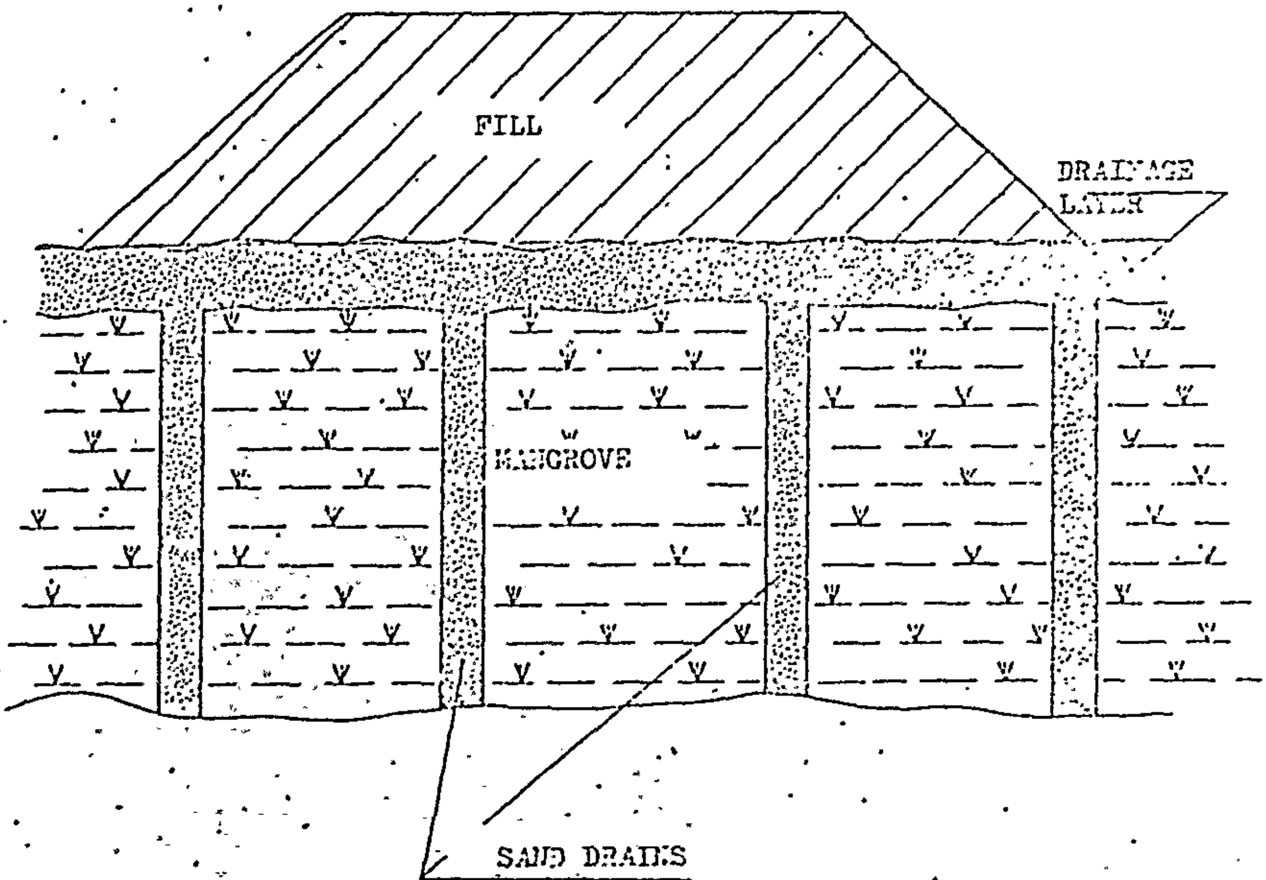
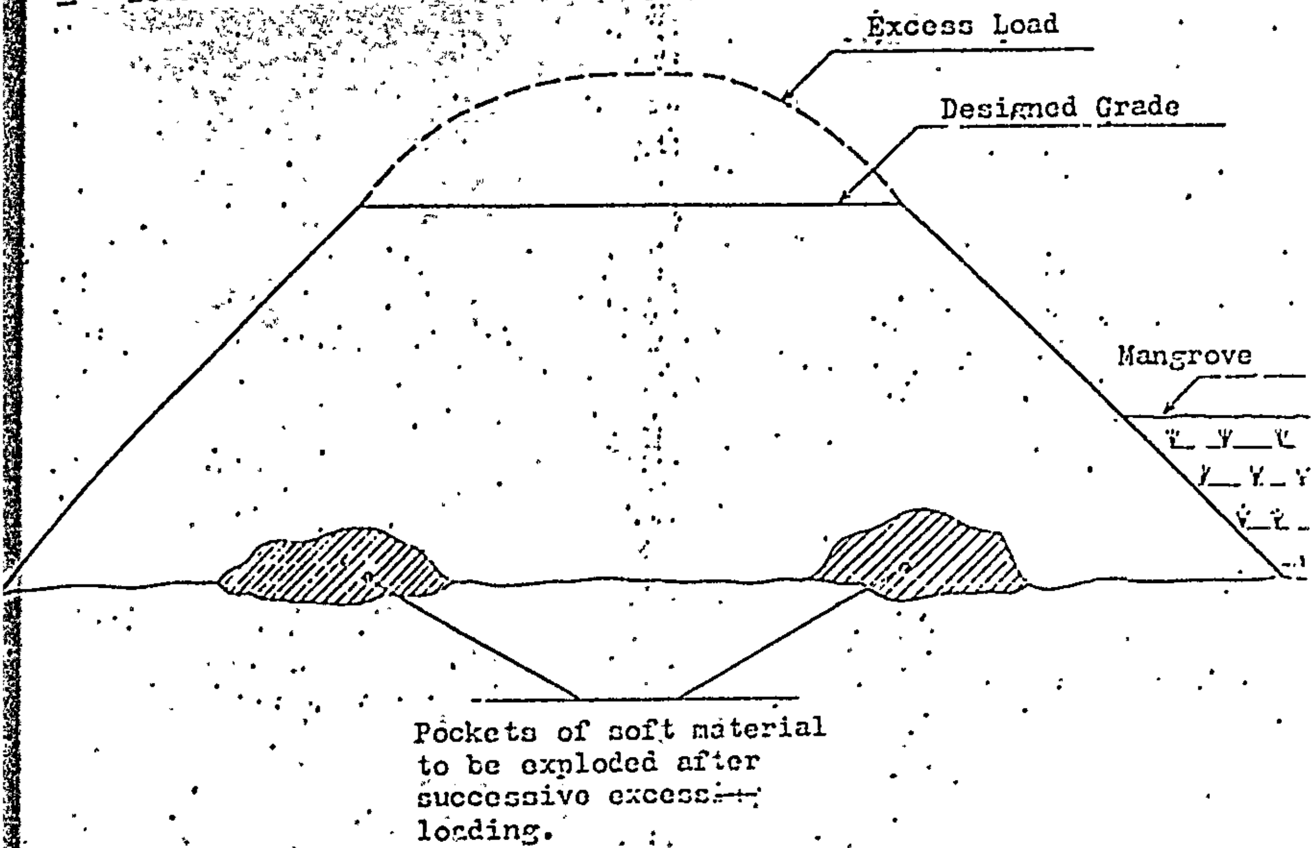


FIGURE -4 II

dipor	COMPLEXO INDUSTRIAL DE SUAPE
TRANSCON SA	VERTICAL SAND DRAINS

LOCALIZED EXPLOSIONS



EXPLOSIONS UNDER THE FILL

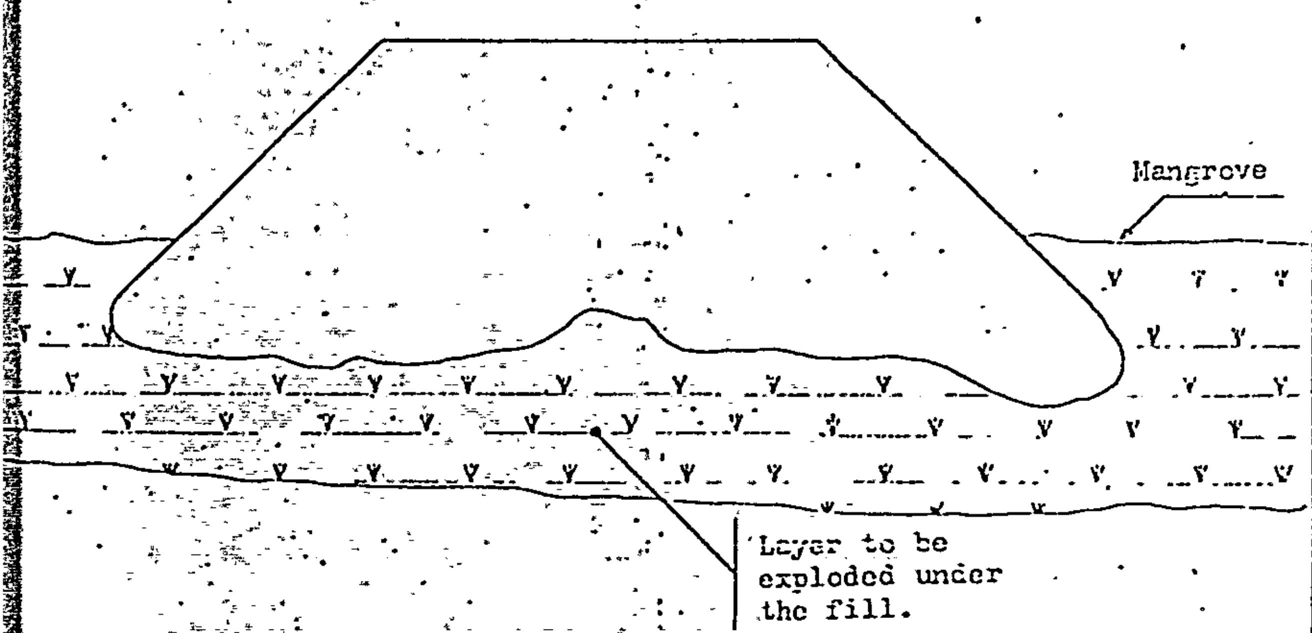


FIGURE - 4 III

dipor

TRANSCON S.A

COMPLEXO INDUSTRIAL

LOCALIZED EXPLOSIONS

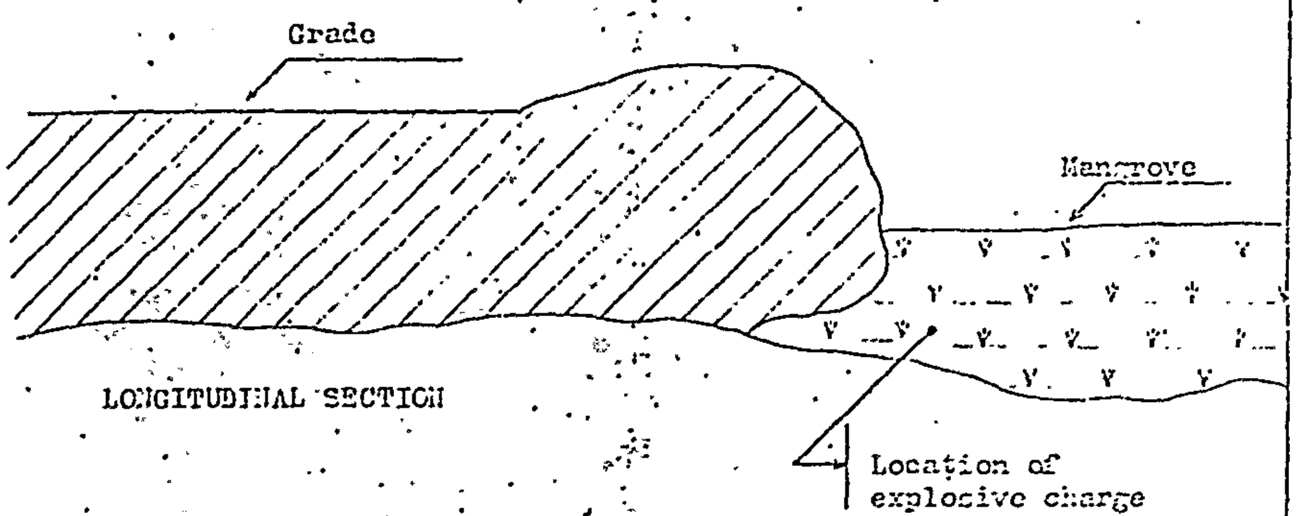


FIGURE 4

dipor

TRANSCON SA

EXPLOSION AT THE BASE
OF THE FILL

TOMO IV
PARTE 2
VOLUME 2
5.0

5.0 PAVING

5.0 PAVING

5.1 CALCULATION OF NUMBER N

The number N, used to predimension paving was calculated for a projected period of 20 years (1975-1995 - 1st stage), based on the results of the dimensioning of the highway network: undivided two lane highways.

Murilo Lopes de Souza's Method for Design of Flexible Paving (Método de Projeto de Pavimentos Flexíveis) was used. This method gives the following expressed for the number N:

$$N = VT \times FE \times FC \times FR$$ where:

VT is the volume of one way traffic during the projected period

FE is the axle factor

FC is the load factor

FR is the regional factor

5.1.1 TRAFFIC VOLUME (VT)

The traffic considered for the 1st stage is composed of cargo vehicles for transport of products originating in or destined for the port complex, and passenger vehicles (buses and automobiles) for transport of construction workers and industrial employees.

A CARGO FLOW

The economic studies conducted led to the cargo flow conclusions shown in Tables 5/1 through 5/4. Figure 5-I shows the cargo distribution according to origin, destination and type of cargo. Using information from these tables, the values of the cargos to be transported throughout the first stage on sections A, B, C, D and E were calculated in 1,000 tons.

SECTIONS	CARGO (1,000 TONS)	
	ORIGIN - SUAPE	DESTINATION - SUAPE
A	83,019	26,268
B	79,377	-
C	72,394	-
D	6,963	-
E	3,642	26,266

Cargo transportation by two types of trucks was assumed: one with a 25 ton capacity to transport 70% of the cargo, and the other with a 12.5 ton capacity to transport the remaining 30% of the cargo. These vehicles are sketched schematically in Figure 5-II. Using the figures for the cargo tonnages to be transported and the determination of the types of trucks to carry the cargo the cargo traffic composition in a total number of trucks for the 1st stage was developed. See Table 5/5.

B PASSENGER TRAFFIC FLOW

The flow distribution shown in Figure 5-III was derived from the dimensioning of the highway network.

The values indicated are for buses and automobiles (always a larger number) per day, in one direction. They will be used in dimensioning the paving under the assumption that the flow will occur more than once a day, i.e., in the opposite direction. In order to arrive at a total number of passenger vehicles during the 1st stage, it was assumed that the distribution dhown in Figure 5-III, corresponding to the end of the stage, 1995, will remain constant starting in 1980 because the production increases in the factories in operation will not imply any great increase in the number of employees. The excess number of passenger vehicles resulting from the assumption of a traffic level equal to that forecast for 1995 will be compensated for by the construction traffic which is impossible to forecast correctly. Therefore the paving will not be overdimensioned.

It was assumed that the increase in passenger traffic in the years 1975 (zero) through 1980 will increase linearly (values in Figure 5-III), and from then on to the end of the first stage the increases will also be linear. The resulting total numbers of buses and automobiles for passenger traffic is shown in Table 5/6.

C CALCULATION OF TRAFFIC VOLUME (VT)

The sum of the cargo traffic volumes from Table 5/5 and the passenger traffic volumes from Table 5/6 yield the total traffic volume for the projected period (VT) shown in Table 5/7.

5.1.2. AXLE FACTOR (F,E)

The axle factors for the various sections were calculated using Table 5/7.

Example for section A:

Vehicles with 3 axles:	3,060,596
Vehicles with 2 axles:	8,263,530
Total:	11,324,126

3 axles: 27%
2 axles: 73%

F.E. = 0.27 x 3 + 0.73 x 2 = 2.27

The axle factors are shown below for all the highway sections:

SECTION	F.E.
Section A	2.27
Section B	2.20
Section C	2.28
Section D	2.03
Section E	2.31
Refinery Access	2.00
N S. do O Access	2.00
Townsite Access 1	2.00
Townsite Circuit	2.00
Road I	2.00
Road II	2.00
Road III	2.00
Road IV	2.00

5.1.3 CARGO FACTOR (F.C)

Calculation of the cargo factor for each section may be found in Table 5/8. The loads per single axle and tandem vehicles were selected according to the types of vehicles and their equivalence factors. The percentage composition of the types of axle traffic and the operating equivalence (% x F.EQ.) were calculated, taking into consideration the frequency for vehicles with the single or tandem axles.

FC was found to be = $\frac{\Sigma \% \times F.EQ}{100}$

5.1.4 REGIONAL FACTOR

The value 1.8 was assumed for the regional factor since the region has a mean annual rainfall of over 1,500 mm.

5.1.5 NUMBER "N"

A summary of the calculation of the number N for all the highway sections is found in Table 5/9.

5.2 DEFINITION OF PAVING

5.2.1 ORIENTATION ADOPTED

Use of materials existing in the region for construction of the paving layers, within technologically recommendable conditions, was attempted.

Therefore a brief survey of materials was made, compatible with the study phase's requirements.

Once data on the existing materials were obtained, solutions were proposed for the paving phases.

5.2.2 SUBGRADE

The location of the 9 drill holes executed in the area led to the indication of the following values for the subgrade CBR:

- Port Access (Bulk Products Port) – CBR 3
- Other Highway Sections – CBR 6

For the sections where the subgrade capacity is low but still higher than the minimum recommended support capacity, a layer of select material for capping the fills and substituting for the cuts' upper layers was adopted. The paving for the port access (bulk products port) will have a subgrade reinforcement layer made up of material from Group A2 detected in some of the drill holes and abundant in the source areas surveyed by DER (referred to in the following item).

The CBR values for the Group A2 materials found in the drill holes permit the adoption of a CBR value equal to 8 for subgrade reinforcement.

The results of tests run on samples obtained from the drill holes are listed in Tables 5/10 and 5/11.

The drill holes are located approximately at the following coordenates:

DRILL HOLE No.	COORDENATES N	E
ST1	9,079,450	279,500
ST2	9,081,250	279,350
ST3	9,082,750	279,250
ST4	9,075,880	279,200
ST5	9,074,900	278,230
ST6	9,071,750	278,430
ST7	9,075,700	282,450
ST8	9,076,500	281,450
ST9	9,073,050	261,300

They are sketched in Figure 5-IV.

5.2.3 MATERIALS SURVEY

DER (PE) furnished the results of studies done on ten source areas located along the line of access to Suape projected by them and represented schematically in Figure 5-V.

The results of the DER studies are presented in Tables 5/12 through 5/42 and in Figure 5-VI. In general, the majority of the materials fall into Group A2, with low expansion, CBR greater than 20, with little or no plasticity.

Observation of the results shown in Tables 5/10, 5/11, and 5/12 through 5/43 indicated the difficulty in finding materials with grosser size consists. A more intense search for more materials is beyond the scope of this study.

Samples were taken from three areas where rocky materials appeared:

- Cape of Santo Agostinho (P2)
- Algodoais (P3)
- Ponte dos Carvalhos (P1)

The location of these areas is indicated schematically in Figure 5-VI. Abrasion tests were run on the samples with the Los Angeles testing machine and the results, Tables 5/44 through 5/46, proved that the wear percentage permits use of the materials found in these three areas.

Since the Cape of Santo Agostinho quarry is located in an area which is being historically and ecologically preserved, its use is not recommended.

The choice of the Algodoais, Ponte dos Carvalhos or other areas detected during a more intense search for materials will depend on the various tests to be run in the future.

To estimatethe transport distance, the Ponte dos Carvalhos quarry, which would give the worst transport distance situation, was used for the present phase.

5.2.4 PRIMARY PAVING SOLUTIONS

The use of concrete for the short run is not recommended because during the first years of the road system implementation settling of the fills will definitely occur over mangrove swamp and water-logged areas.

It was therefore proposed to use flexible paving at first and to use concrete at a later phase when the fill stability is consolidated and the traffic intensity so justifies.

The following sections deal with discussions of possible solutions for each paving component phase.

A REINFORCEMENT OF SUB-SOIL

Will be used on sections with the subgrade's low support capacity demands. Normally this will be done with Group A2 material presumed to be available near the routes.

B SUB-BASE

As per the section on Materials Survey, the construction of a sub-base stabilized by size consist with Group A2 materials present along the Suape access line (Project DER-PE - PE-028). It is presumed that sub-base materials will be found in other areas, since drillings showed Group A2 materials in the subgrade; however, the source areas lying along the project PE-28 line were taken as the basic source. Their use will mean the worst transport distance situation.

C BASE

The brief materials survey did not encounter materials that would naturally lend themselves to a base stabilized by size consist without blending. At a later date a more intense search could come up with a definitive decision on the use of this type of base.

Since there is abundant soil A2-4 present, two mixtures using this material were projected for the base:

CEMENT SOIL

The Brazilian Portland Cement Association recommends a percentage increase of from 5% to 9% for cement soil bases using A2-4 material. Therefore for basic design purposes a A2-4 soil base with 7% cement by weight was indicated.

Crushed Rock Soil

The soil A2-4 encountered has neither the support capacity nor the size consist composition to meet the requirements for materials to make up a base that is stabilized by size consist. The addition of crushed rock would correct such deficiencies and could lead to the adoption of this type of base.

A common size consist range was taken from the sub-base source areas and a mixture with crushed rock that would place the mixture within one of the ranges required for the base (see Figure 5-VII) was designed.

In general, the designed mixture is made up of 70% soil and 30% crushed rock, by weight.

QUARRIES	BASE (RANGE)	SOIL A2-4	CRUSHED ROCK
1"	100		100
3/8"	60 - 100		0 - 15
4	50 - 85	100	0 - 5
10	40 - 70	98	
40	25 - 45	60	
200	5 - 20	20	

The numbers above are the percentages passing through the indicated screens.

D. COVERING

Progressive covering to be done in accordance with traffic increases was indicated for the highway system during the 1st stage. Covering suggestions included the double surface treatment with asphalt emulsion for the construction phase and the initial traffic generated during installation of the industries. When the traffic justifies, the pavement would be increased with a layer of bituminous concrete. This would all occur during the 1st stage, in accordance with the values found for the number N.

5.3 PREDIMENSIONING THE PAVEMENT

The Murilo Lopes de Souza method was used to predimension the pavement, in accordance with the values of N for each sections and the subgrade CBR considerations described in Item 5.2.2.

The coefficients proposed in the method are:

- Subgrade reinforcement K - 0.71
- Sub-base K - 0.77
- Base stabilized by size consist K - 1.00
- Soil cement base K - 1.4
- Surface treatment K - 1.2
- Bituminous concrete K - 2.0

Table 5/47 contains a summary of the pavement layers for each section.

5.4 QUANTITATIVE DATA

Table 5/48 contains the quantitative estimates for the paving work, calculated based on the transversal sections proposed for the first stage, the thicknesses of the layers composing the pavement, and the mean transport distances of 3.0 km, 10.0 km, and 20 km, for reinforcement, sub-base and base, respectively.

TABLE 5/1 – 5/2

SUAPE PORT INDUSTRIAL COMPLEX – PROJECTION OF LAND (HIGHWAY) TRANSPORTATION

A. – ORIGIN SUAPE

IN 1,000 TONS

PRODUCT/DESTINATION	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
WHEAT	97	111	125	139	153	171	189	207	225	243	263	279	297
– Olinda	55	55	55	55	55	55	55	55	55	55	55	55	55
– Interior of Pernambuco	42	56	70	84	98	116	134	152	170	188	208	224	242
FERTILIZERS	115	115	115	115	215	215	215	355	359	362	365	320	324
– Interior of Pernambuco	40	40	40	40	75	75	75	124	125	126	127	112	113
– Interior of Alagoas	40	40	40	40	75	75	75	124	125	126	127	112	113
– Paraíba and Rio Grande do Norte	35	35	35	35	65	65	65	107	109	110	111	96	98
ALUMINUM	150	150	150	150	150	150	150	150	150	150	150	150	150
PETROLEUM DERIVATIVES	3,426	3,502	3,676	3,835	4,154	4,365	4,580	4,813	4,380	4,615	4,803	4,336	3,836
– Pernambuco	2,159	2,139	2,266	2,331	2,603	2,715	2,860	2,933	3,156	3,344	3,485	3,677	3,836
– Alagoas	376	423	423	470	470	517	564	564	612	612	659		–
– R. G. do Norte	421	423	470	470	517	517	517	612	612	659	659	659	–
– Paraíba	470	517	517	564	564	612	639	659	–	–	–	–	–
TOTAL	3,723	3,878	4,066	4,229	4,672	4,901	5,134	5,545	5,114	5,370	5,576	5,085	4,607

PRODUCT/DESTINATION	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
WHEAT	315	333	351	359	367	375	383	391	399	407	415	423	432
– Olinda	55	55	55	55	55	55	55	55	55	55	55	55	55
– Interior of Pernambuco	260	270	296	304	312	320	328	336	344	352	360	368	377
FERTILIZERS	328	331	336	336	336	336	336	336	336	335	335	335	335
– Interior of Pernambuco	114	115	117	117	117	117	117	117	117	117	117	117	117
– Interior of Alagoas	114	115	117	117	117	117	117	117	117	117	117	117	117
– Paraíba and Rio Grande do Norte	100	101	102	102	102	102	102	102	102	102	102	102	102
ALUMINUM	150	150	150			–	–	–	–	–	–	–	–
PETROLEUM DERIVATIVES	4,041	4,236	4,473	4,805	5,121	5,437	5,838	6,202	6,639	7,035	7,495	7,951	8,519
– Pernambuco	4,041	4,236	4,473	4,805	5,121	5,437	5,838	6,202	6,639	7,035	7,495	7,951	8,519
– Alagoas	–	–	–	–	–	–	–	–	–	–	–	–	–
– R. G. do Norte	–	–	–	–	–	–	–	–	–	–	–	–	–
– Paraíba	–	–	–	–	–	–	–	–	–	–	–	–	–
TOTAL	4,834	5,050	5,315	5,500	5,824	6,148	6,557	6,929	7,374	7,750	8,245	8,720	9,286

TABLE 5/3 - 5/4

SUAPE PORT INDUSTRIAL COMPLES - PROJECTION OF LAND (HIGHWAY) TRANSPORTATION

B. - DESTINATION SUAPE

IN 1,000 TONS

PRODUCT/ORIGIN	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
ALCOHOL	111	111	113	113	113	152	152	152	152	152	151	152	152
- Interior of Pernambuco	111	111	113	113	113	152	152	152	152	152	152	152	152
MOLASSES	103	177	265	313	381	450	487	520	567	606	645	685	723
- Interior of Pernambuco, Alagoas, R.G. do Norte and Paraíba	103	177	265	313	381	450	487	520	567	600	645	685	723
VEGETABLE OILS	32	34	42	46	52	60	62	62	63	64	65	49	49
- Interior of Pernambuco	32	34	42	46	52	60	62	62	53	64	65	49	49
SUGAR	422	462	492	545	622	730	820	817	919	927	1044	1057	1199
- Interior of Pernambuco	492	462	492	545	622	730	820	817	919	927	1044	1066	1199
- Paraíba and R.G. do Norte													
TOTAL	652	792	832	1016	1162	1392	1522	1550	1700	1757	1927	1952	2122

PRODUCT/ORIGIN	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
ALCOHOL	152	152	182	182	182	181	182	181	181	181	181	181	181
- Interior of Pernambuco	152	152	182	182	182	181	181	181	181	181	181	182	182
MOLASSES	762	801	842	850	853	865	874	882	890	893	905	914	925
- Interior of Pernambuco, Alagoas, R.G. do Norte and Paraíba	762	801	842	850	856	866	874	882	890	893	906	914	925
VEGETABLE OILS	49	49	49	49	49	49	49	49	49	49	49	49	49
- Interior of Pernambuco	49	49	49	49	49	49	49	49	49	49	49	49	49
SUGAR	1238	1287	1340	1349	1359	1368	1377	1385	1395	1405	1415	1425	1435
- Interior of Pernambuco	1238	1287	1340	1349	1359	1368	1377	1386	1396	1405	1415	1425	1435
- Paraíba and R.G. do Norte													
TOTAL	2220	2298	2412	2422	2447	2464	2481	2498	2516	2532	2551	2559	2590

TABLE 5/5 - COMPOSITION OF CARGO TRAFFIC

SECTIONS	CAP. 25 ton.		CAP. 12.5 ton.	
	LOADED	UNLOADED	LOADED	UNLOADED
SECTION A	2,324,532	736,064	1,992,456	630,912
SECTION B	2,222,556	-	1,905,048	-
SECTION C	2,027,032	-	1,737,456	-
SECTION D	195,524	-	167,592	-
SECTION E	736,064	101,976	630,912	87,408

TABLE 5/6 - COMPOSITION OF PASSENGER TRAFFIC

SECTION	VEHICLES PER DAY (ONE WAY)		VEHICLES DURING 1st STAGE	
	BUS	AUTO	BUS	AUTO
SECTION A	111	772	709,012	4,931,150
SECTION B	207	915	1,322,212	5,844,562
SECTION C	153	409	977,287	2,612,487
SECTION D	225	856	1,437,187	5,467,700
SECTION E	37	143	236,337	913,412
ACCESS TO REFINERY	100	381	638,750	2,433,637
ACCESS TO N S DO O (1)	49	131	312,987	836,762
MAIN ROAD (2)	104	278	664,300	1,775,725
TOWNSITE CIRCUIT	52	139	332,150	887,862
ROAD 2	26	70	166,075	447,125
ROAD 3	26	70	166,075	447,125
ROAD 4	26	70	166,075	447,125
ROAD 5	26	70	166,075	447,125

(1) - Port Route V + Access to N S do O

(2) - Townsite Access 1 + Road 1

TABLE 5/7 – COMPOSITION OF TOTAL TRAFFIC FLOW – CARGO AND PASSENGERS

SECTION	CARGO TRAFFIC				PASSENGER TRAFFIC		TOTAL (VT)
	25 TON TRUCKS		12.5 TON TRUCKS				
	LOADED	UNLOADED	LOADED	UNLOADED	BUSES	AUTOMOBILES	
SECTION A	2,324,532	736,064	1,992,456	630,912	709,012	4,931,150	11,324,126
SECTION B	2,222,556	-	1,905,048	-	1,322,212	5,844,562	11,294,378
SECTION C	2,027,032	-	1,737,456	-	977,287	2,612,487	7,354,262
SECTION D	195,524	-	167,592	-	1,437,187	5,467,700	7,268,003
SECTION E	736,064	101,976	630,912	87,408	236,337	913,412	2,706,109
ACCESS TO REFINERY	-	-	-	-	638,750	2,433,637	3,072,367
ACCESS NS DO O (1)	-	-	-	-	312,987	836,762	1,149,749
MAIN HIGHWAY (2)	-	-	-	-	664,300	1,775,725	2,440,025
TOWNSITE CIRCUIT	-	-	-	-	332,150	887,862	1,220,012
ROAD 2	-	-	-	-	166,075	447,125	613,200
ROAD 3	-	-	-	-	166,075	447,125	613,200
ROAD 4	-	-	-	-	166,075	447,125	613,200
ROAD 5	-	-	-	-	166,075	447,125	613,200

(1) Port Route V + Access to N S do O

(2) Townsite Access 1 + Road 1

TABLE 5/8 – CARGO FACTOR

SECTION	SINGLE AXLES < 5 ton FREQ.	%	5 ton – F.EQ. = 0.1 FREQ.	%	Eq.F.EQ.	9 ton – F.EQ. = 2 FREQ.	%	Eq.F.EQ.	12 ton – F.EQ. = 4 FREQ.	%	Eq.F.EQ.	TANDEM AXLES < 13 ton FREQ.	%	17.5 ton – F.EQ. = 10 FREQ.	%	Eq.F.EQ.	25 ton F.EQ. = 70 FREQ.	%	Eq.F.EQ.	Σ Eq.F.EQ. 100
SECTION A	10,371,312	41	6,420,928	25	2.5	789,022	3	6	2,324,532	9	36	1,266,976	5	1,292,456	8	80	2,324,532	9	630	7,59
SECTION B	13,011,336	52	4,137,604	17	1.7	1,322,212	5	10	2,222,556	9	36	-	-	1,935,048	8	80	2,222,556	9	630	7,58
SECTION C	9,302,261	38	5,744,488	22	2,2	977,287	6	12	2,627,032	12	48	-	-	2,737,456	10	100	2,627,032	12	840	10,02
SECTION D	12,272,537	86	253,216	2	0.2	1,437,187	10	20	255,524	1,5	6	-	-	167,592	1	10	255,524	1,5	105	1,41
SECTION E	2,053,461	33	1,658,326	26	2,6	236,317	4	8	736,044	12	48	189,284	3	630,912	10	100	736,044	12	840	10,02
ACCESS REF.	5,324,024	93	-	-	-	636,750	10	20	-	-	-	-	-	-	-	-	-	-	-	0,20
ACCESS MS do O(1)	1,795,511	86	-	-	-	312,987	14	28	-	-	-	-	-	-	-	-	-	-	-	0,28
MAIN HIGHWAY	4,215,750	86	-	-	-	666,300	14	28	-	-	-	-	-	-	-	-	-	-	-	0,28
TOWN CIRCUIT	2,107,874	86	-	-	-	332,150	14	28	-	-	-	-	-	-	-	-	-	-	-	0,28
ROAD 2	1,240,335	85	-	-	-	166,075	14	28	-	-	-	-	-	-	-	-	-	-	-	0,28
ROAD 3	1,660,335	85	-	-	-	166,075	14	28	-	-	-	-	-	-	-	-	-	-	-	0,28
ROAD 4	1,660,325	86	-	-	-	166,075	14	28	-	-	-	-	-	-	-	-	-	-	-	0,28
ROAD 5	1,660,325	86	-	-	-	166,075	14	28	-	-	-	-	-	-	-	-	-	-	-	0,28

(1) - Port Route V + Access MS do0

(2) - Townsite Access 1 + Road 1

TABLE 5/9 - NUMBER "N"

SECTION	V T	F.E.	F.C.	F.R.	N.
SECTION A	11,324,126	2.27	7.59	1.8	3.5×10^8
SECTION B	11,294,378	2.20	7.58	1.8	3.4×10^8
SECTION C	7,354,252	2.28	10.02	1.8	3.0×10^8
SECTION D	7,268,003	2.03	1.41	1.8	3.7×10^7
SECTION E	2,706,109	2.31	10.02	1.8	1.1×10^8
ACCESS TO REFINERY	3,072,387	2.00	0.20	1.8	2.2×10^6
ACCESS TO N S do O (1)	1,149,749	2.00	0.28	1.8	1.1×10^6
MAIN ROAD (2)	2,440,025	2.00	0.28	1.8	2.4×10^6
TOWNSITE CIRCUIT	1,220,012	2.00	0.28	1.8	1.2×10^6
ROAD 2	613,200	2.00	0.28	1.8	6.0×10^5
ROAD 3	613,200	2.00	0.28	1.8	6.0×10^5
ROAD 4	613,200	2.00	0.28	1.8	6.0×10^5
ROAD 5	613,200	2.00	0.28	1.8	6.0×10^5

(1) Port Route V + Access to N S do O

(2) Townsite access 1 + Road 1

REGISTER NO.			S-825	S-827	S-830	S-831	S-832	S-833	S-834	S-835	S-83[illegible]
DRILL HOLE NO.			1	2	3	[illegible]	7	7	8	8	9
POSITION											
DEPTH -cm-	FROM		0	0	0	0	0	150	0	250	0
	TO		220	400	400	400	150	400	250	400	200
SIZE CONSIST	SCREENING - % PASSING	2"									
		1"								100	
		3/8"		100		100	100			98	
		NO. 4	100	96		99	99	100		98	100
		NO. 10	98	95	100	99	98	99	100	98	99
		NO. 40	74	84	94	96	83	94	86	85	72
		NO. 200	51	76	87	89	62	56	55	58	34
AASHO RANGE			F/F	F/F	F/F	F/F	F/F	F/F	F/F	F/F	F/F
LIQUIDITY LIMIT			58	95	86	83	61	57	45	46	26
PLASTICITY INDEX			34	48	39	36	34	29	21	21	9
EQUIVALENCE (SAND)											
GRANULATION INDEX			13	20	20	20	12	14	10	10	2
HRB CLASSIFICATION			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NORMAL AASHO 12 BLOWS	MAX DENSITY		1732	1450	1352	1469	1570	1627	1545	1767	1821
	MOISTURE		173	292	344	233	193	136	200	138	126
	CBR		6	3	9	9	1	2	4	2	8
	EXPANSION		0,3	3,0	0,3	1.9	0,7	3.4	1.5	1.3	0,1
INTER. AASHO 26 BLOWS	MAX DENSITY										
	MOISTURE										
	CBR										
	EXPANSION										
MODIF. AASHO 56 BLOWS	MAX DENSITY										
	MOISTURE										
	CBR										
	EXPANSION										
FIELD	NAT MOISTURE										
USEABLE YES (Y) NO (N)											
OBSERVATIONS											

NOTES:

HIGHWAY: | SECTION: Snape | SUBSECTION:

TESTS - SUBGRADE AND NATURAL LAND

TRANSCON S.A. | QD 5/10

REGISTER NO.	5.825	5.829	5.834							
DRILL HOLE NO.	1	4	5							
DEPTH -cm- FROM	320	0	0							
DEPTH -cm- TO	400	400	400							
SIZE CONSIST – SCREENING – % PASSING 2"										
SIZE CONSIST – SCREENING – % PASSING 1"			100							
SIZE CONSIST – SCREENING – % PASSING 3/8"		100	99							
SIZE CONSIST – SCREENING – % PASSING NO. 4	100	99	98							
SIZE CONSIST – SCREENING – % PASSING NO. 10	97	98	94							
SIZE CONSIST – SCREENING – % PASSING NO. 40	55	67	49							
SIZE CONSIST – SCREENING – % PASSING NO. 200	35	43	33							
AASHO RANGE	E/F	E/F	E/F							
LIQUIDITY LIMIT	32	53	49							
PLASTICITY INDEX	NP	27	21							
EQUIVALENCE (SAND)										
GRANULATION INDEX	0	7	3							
HRB CLASSIFICATION	[illegible]	[illegible]	[illegible]							
NORMAL AASHO 12 BLOWS MAX DENSITY										
NORMAL AASHO 12 BLOWS MOISTURE										
NORMAL AASHO 12 BLOWS CBR										
NORMAL AASHO 12 BLOWS EXPANSION										
INTER. AASHO 26 BLOWS MAX DENSITY	1915	1880	1880							
INTER. AASHO 26 BLOWS MOISTURE	12.0	13.8	12.5							
INTER. AASHO 26 BLOWS CBR	5	11	6							
INTER. AASHO 26 BLOWS EXPANSION	0.14	1.14	0.3							
MODIF. AASHO 56 BLOWS MAX DENSITY										
MODIF. AASHO 56 BLOWS MOISTURE										
MODIF. AASHO 56 BLOWS CBR										
MODIF. AASHO 56 BLOWS EXPANSION										
FIELD NAT MOISTURE										
USEABLE YES (Y) NO (N)										

OBSERVATIONS

NOTES:

HIGHWAY | SECTION: [illegible] | SUBSECTION:

SAND/GRAVEL NO. | NAME: | LOCATION:

TEST – SAND/GRAVEL

TRANSCON S.A. | CD 5/11

TABLE - 5/12

TEST RESULTS

AREA No. 1

TRANSCON S.A.

HIGHWAY: [illegible]   LOCATION: EST. 194+18 LE

SECTION: [illegible]

REGISTER NO			3034	3.035	3.036	3.037	3.038	3039	3.040	3.041	3.042	3.043
DRILL HOLE			1	2	3	4	5	6	7	8	9	10
DEPTH			10-60	10-50	10-25	10-65	10-55	10-60	10-50	10-25	10-45	10-40
SIZE CONSIST	SCREENING - % PASSING	2"										
		1"										
		3/8"	100	93	100	100	100	99	100	100	100	100
		NO 4	100	90	100	100	99	99	100	99	100	100
		NO 10	98	86	100	99	97	93	99	97	100	100
		NO 40	71	52	28	75	70	67	70	65	78	77
		NO 200	18	20	15	16	17	14	16	10	25	45
AASHO RANGE			E-F	E	E/F	E/F	F	E	E	E	F/E	F/E
LIQUIDITY LIMIT			NL	NL	NL	NL	NL	NL	NL	NL	21	[illegible]
PLASTICITY INDEX			NP	NP	NP	NP	NP	NP	NP	NP	5	8
EQUIVALENCE (SAND)												
GRANULATION INDEX												
CLASSIFICATION	HRB		A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-3	A-2-4	A-4
	SUCS											
TEXTURE CLASSIFICATION												
BLOWS ENERGY	Mold. Comp.	D_{max}	1770		1745						1955	
		Hot.	9.5		9.4						10.1	
		CBR	31		14						25	
		Exp.										
USEABLE												

NOTES:

TRANSCON S.A.

TABLE - 5/13

TEST RESULTS

AREA No. 1

HIGHWAY: PE-28 M[illegible] LOCATION: EST. 124+12 LC

SECTION: [illegible]

REGISTER No			3.043	3.044	3.045	3.046	3.047	3.048	3.049	3.050	3.051	3.052
DRILL HOLE			11	12	13	14	15	16	17	18	19	20
DEPTH			10-15	10-80	10-[illegible]	10-80	10-55	10-5[illegible]	10-110	10-20	10-15	10-15
SIZE CONSIST	SCREENING - % PASSING	2"										
		1"										
		3/8"	100	100	100	100	100	100	100	100	100	100
		NO 4	100	100	99	100	100	100	100	100	100	100
		NO 10	100	99	98	99	99	99	98	98	100	100
		NO 40	77	75	76	74	63	72	73	68	71	71
		NO 200	25	15	15	19	14	24	17	21	16	16
AASHO RANGE			[illegible]	F/F	F/F	F/F	F	F/F	F/F	F	FF	FF
LIQUIDITY LIMIT			19	NL	NL	NL	NL	NL	NL	NL	NL	NL
PLASTICITY INDEX			NP	NP	NP	NP	NP	NP	NP	[illegible]	NP	NP
EQUIVALENCE (SAND)												
GRANULATION INDEX												
CLASSIFICATION	HRB		A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4
	SUCS											
TEXTURE CLASSIFICATION												
BLOWS / ENERGY	Mold. Comp.	D max			1235		1242		1500		1260	
		Hot.			105		106		96		92	
		CBR			33		40		31		34	
		Exp.										
USEABLE												

NOTES:

TABLE - 5/14

TEST RESULTS

AREA No. 1

TRANSCON S.A.

HIGHWAY: [illegible] LOCATION: EST. 194+12 L.E.

SECTION: Secc 4.

			21	22	23	24	25	26	27	28	29	30
REGISTER NO			2.053	2.054	2.055	2.056	2.057	2.058	2.059	2.060	2.061	2.062
DRILL HOLE			21	22	23	24	25	26	27	28	29	30
DEPTH			10-80	10-100	10-110	10-55	10-13[illegible]	10-90	10-60	10-60	10-[illegible]	10-100
SIZE CONSIST	SCREENING - & PASSING	2"										
		1"										
		3/8"	100	100	100	100	100	100	100	100	100	100
		NO 4	100	100	100	100	100	100	100	100	100	100
		NO 10	100	100	99	99	99	97	99	92	95	92
		NO 40	32	39	32	34	35	33	35	34	68	37
		NO 200	24	34	14	23	15	17	15	21	14	19
AASHO RANGE			F/F	F/F	F/F	F/F	F/F	F/F	F/F	F/F	F	F/F
LIQUIDITY LIMIT			21	NL	NL	NL	NL	NL	NL	NL	NL	NL
PLASTICITY INDEX			6	NP	NP	NP	NP	NP	NP	NP	NP	NP
EQUIVALENCE (SAND)												
GRANULATION INDEX												
CLASSIFICATION	HRB		A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4
	SUCS											
TEXTURE CLASSIFICATION												
BLOWS / ENERGY	Mold. Comp.	D_{max}		1.25[illegible]								
		Hot.		11								
		CBR		31								
		Exp.										
USEABLE												

NOTES:

TABLE - 5/15

TEST RESULTS

AREA No. 1

TRANSCON S.A.

HIGHWAY: PE-22 S/Guan   LOCATION: EST. 194+18 L.E.

SECTION: Sinop

REGISTER NO	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072
DRILL HOLE	31	32	33	34	35	36	37	38	39	40
DEPTH	10-120	10-15	10-25	10-100	10-75	10-100	10-50	10-65	10-70	10-70
SIZE CONSIST – SCREENING – % PASSING 2"										
1"										
3/8"	100	100	100	99	100	100	100	100	100	100
NO. 4	100	100	100	99	100	100	100	100	100	100
NO. 10	100	100	99	99	99	99	99	99	99	99
NO. 40	62	59	79	73	74	71	74	62	71	72
NO. 200	17	10	32	23	24	22	23	13	23	12
AASHO RANGE	F	F	F/F	F/F	F/F	F	F/F	F	F/F	F/F
LIQUIDITY LIMIT	NL	NL	NL	NL	NL	NL	NL	NL	NL	[illegible]
~~POROSITY~~ PLASTICITY INDEX	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
PLASTICITY INDEX										
EQUIVALENCE (SAND)										
CLASSIFICATION HRB	A-2-4	A-2	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4
CLASSIFICATION SUCS										
TEXTURE CLASSIFICATION										
BLOWS ENERGY Mold. Comp. D_{max}			1755		1710		1735		1725	
Hot.			10.5		11.0		9.9		10.4	
CBR			25		27		32		24	
Exp.										
USEABLE										

NOTES:

TABLE - 5/16

TEST RESULTS

AREA No. 1

TRANSCON S.A.

HIGHWAY: DE-[illegible] [illegible]   LOCATION: EST. 194+18 L.E.

SECTION: Sieca fil

REGISTER NO			3073	3074	3075	3076	3077	3078	3079	3080	3081	3082
DRILL HOLE			41	42	43	44	45	46	47	48	49	50
DEPTH			10-90	10-80	10-20	10-60	10-60	10-65	10-95	10-55	10-70	10-[illegible]
SIZE CONSIST	SCREENING - % PASSING	2"										
		1"										
		3/8"				100				100		
		NO 4	100	100	100	99	100	100	100	99	100	100
		NO 10	100	99	99	98	92	97	100	98	100	92
		NO 40	21	75	74	72	76	74	33	35	33	33
		NO 200	12	45	14	20	16	12	20	27	19	31
AASHO RANGE			F/F	F/F	F/F	F/F	F/F	F/F	F/F	F/F	F/F	F/F
LIQUIDITY LIMIT			NL	NL	NL	NL	NL	NL	NL	NL	NL	NL
PLASTICITY INDEX			NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
EQUIVALENCE (SAND)												
GRANULATION INDEX												
CLASSIFICATION	HRB		A-2-4	A-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4
	SUCS											
TEXTURE CLASSIFICATION												
BLOWS / ENERGY	Mold. Comp.	D max								1.22[illegible]		1.22
		Hot.								9.9		9.6
		CBR								25		45
		Exp.										
USEABLE												

NOTES:

TABLE - 5/17

TEST RESULTS

AREA No. 1

TRANSCON S.A.

HIGHWAY: PE-28

SECTION: Sucos

LOCATION: EST. 195 LE.

REGISTER NO		2089	2090	2091	2092						
DRILL HOLE		51	52	53	54						
DEPTH		10-100	10-100	10-100	10-100						
SIZE CONSIST SCREENING - % PASSING	2"										
	1"										
	3/8"										
	NO 4	100	100	100	100						
	NO 10	99	98	99	99						
	NO 40	71	71	69	69						
	NO 200	19	13	14	11						
AASHO RANGE		F	F	F	F						
LIQUIDITY LIMIT		NL	NL	NL	NL						
PLASTICITY INDEX		NP	NP	NP	NP						
EQUIVALENCE (SAND)											
GRANULATION INDEX											
CLASSIFI-CATION	HRB	A-2-4	A-2-4	A-3-4	A-2-4						
	SUCS										
TEXTURE CLASSIFICATION											
BLOWS ENERGY Mold. Comp.	D_{max}										
	Hot.										
	CBR										
	Exp.										
USEABLE											

NOTES:

TABLE - 5/18

TEST RESULTS

AREA No. 2

TRANSCON S.A.

HIGHWAY: [illegible]

SECTION: [illegible]

LOCATION: 140 x 230 m. LE

REGISTER NO			3088	3089	3090	3091	3092	3093	3094	3095	3096	3097
DRILL HOLE			1	2	3	4	5	6	7	8	9	10
DEPTH			10-80	10-100	10-80	10-100	10-130	10-140	10-130	10-170	10-90	10-100
SIZE CONSIST	SCREENING - % PASSING	2"										
		1"	100	100		100	100					
		3/8"	98	96	100	99	99					
		NO 4	97	95	100	96	97	100	99	99	99	100
		NO 10	94	92	99	89	92	98	97	97	96	98
		NO 40	49	45	69	55	54	69	62	60	61	64
		NO 200	13	13	25	13	20	13	13	15	16	14
AASHO RANGE			E	E	F	E	F	F	F	F	F	F
LIQUIDITY LIMIT			NL	18	21	19	18	19	21	20	NL	NL
PLASTICITY INDEX			NP	NP	5	NP	NP	NP	NP	4	NP	NP
EQUIVALENCE (SAND)												
GRANULATION INDEX			0	0	0	0	0	0	0	0	0	0
CLASSIFICATION	HRB		A-1-B	A-1-B	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4
	SUCS											
TEXTURE CLASSIFICATION												
BLOWS / ENERGY	Mold. Comp.	D_{max}	1900		1890						1955	
		Hot.	9.6		10.4						9.5	
		CBR	61		24						69	
		Exp.										
USEABLE												

NOTES:

TABLE - 5/19

TEST RESULTS

AREA No. 2

TRANSCON S.A.

HIGHWAY: Camino R. 93

LOCATION: Est. 140 a 280 m. lz

SECTION: Suave

REGISTER NO		3098	3099	3100	3101	3102	3103	3104	3105	3106	3107
DRILL HOLE		11	12	13	14	15	16	17	18	19	20
DEPTH		10-120	10-145	10-150	10-25	10-80	10-140	10-150	10-50	10-60	10-90
SIZE CONSIST — SCREENING - % PASSING	2"										
	1"		100								
	3/8"	100	96				100			100	
	NO 4	99	95	100	100	100	100	100	100	99	100
	NO 10	96	95	99	98	97	99	99	99	99	99
	NO 40	65	66	65	61	58	56	61	74	57	66
	NO 200	15	20	21	21	17	17	24	27	23	11
AASHO RANGE		F	F	F	F	F	F	F	MF	F	F
LIQUIDITY LIMIT		28	19	21	17	NL	NL	22	26	25	NL
PLASTICITY INDEX		NP	NP	9	NP	NP	NP	5	4	6	NP
EQUIVALENCE (SAND)											
GRANULATION INDEX		0	0	0	0	0	0	0	0	0	0
CLASSIFICATION	HRB	A24	A24	A24	A24	A24	A24	A24	A24	A24	A1B
	SUCS										
TEXTURE CLASSIFICATION											
ENERGY BLOWS — Mold. Comp.	D_{max}	1940		1910						1880	
	Hot.	9.9		10.8						10.6	
	CBR	45		27						31	
	Exp.										
USEABLE											

NOTES:

TABLE - 5/20

TEST RESULTS

AREA No. 2

TRANSCON S.A.

HIGHWAY: [illegible]

LOCATION: Est. [illegible]

SECTION: [illegible]

REGISTER NO		3108	3109	3110	3111	3112	3113	3114	3115		
DRILL HOLE		21	22	23	24	25	26	27	28		
DEPTH		10-110	10-110	10-80	10-70	10-40	10-40	10-70	10-45		
SIZE CONSIST - SCREENING % PASSING	2"										
	1"					100					
	3/8"	100				98					
	NO 4	100	100	100	100	97	100		100		
	NO 10	99	100	99	99	96	99	100	99		
	NO 40	63	74	61	62	57	56	62	50		
	NO 200	16	52	20	23	21	13	16	15		
AASHO RANGE		F/E	F/E	F	F	F	E	F	F		
LIQUIDITY LIMIT		19	33	19	22	25	NL	19	NL		
PLASTICITY INDEX		NP	6	NP	7	6	NP	NP	NP		
EQUIVALENCE (SAND)											
GRANULATION INDEX		0	0	0	0	0	0	0	0		
CLASSIFICATION	HRB	A-2-4	A-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4		
	SUCS										
TEXTURE CLASSIFICATION											
BLOWS / ENERGY — Mold. Comp.	D_{max}	1820						1820			
	Hot.	10.3						9.3			
	CBR	46						51			
	Exp.										
USEABLE											

NOTES:

TABLE - 5/21

TEST RESULTS

AREA No. 3

TRANSCON S.A.

HIGHWAY: [illegible] LOCATION: [illegible]

SECTION: [illegible]

REGISTER NO			1018	1019	1020	1021	1022	1023	1024	1025	1026	1027
DRILL HOLE			1	2	3	4	5	6	7	8	9	10
DEPTH			10-45	10-60	10-80	10-90	10-50	10-40	10-40	10-55	10-75	10-80
SIZE CONSIST	SCREENING - % PASSING	2"										
		1"						100		100		
		3/8"			100		100	97		97		
		NO 4	100	100	100	100	97	95	100	97	100	100
		NO 10	98	99	99	99	90	93	98	95	99	97
		NO 40	59	59	56	59	49	64	55	55	45	55
		NO 200	18	19	14	17	18	29	13	16	9	17
AASHO RANGE			E	E	E	F	F	E/F	E	F	F	F
LIQUIDITY LIMIT			NL	NL	NL	NL	23	22	NL	NL	NL	19
PLASTICITY INDEX			NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
EQUIVALENCE (SAND)												
GRANULATION INDEX												
CLASSIFICATION *	HRB											
	SUCS											
TEXTURE CLASSIFICATION												
BLOWS / ENERGY	Mold.Comp.	D_{max}	2070		1970		2045					
		Hot.	8.7		7.3		8.8					
		CBR	76		51		44					
		Exp.										
USEABLE												

NOTES:

TABLE - 5/22

TRANSCON S.A.

TEST RESULTS

AREA No. 3

HIGHWAY: *Pe-28*

SECTION: *Pe-60- Suabe*

LOCATION: *Est 138 60*

REGISTER NO		1028	1029	1030	1031	1032	1033	1034	1035	1036	1037
DRILL HOLE		11	12	13	14	15	16	17	18	19	20
DEPTH		10-55	10-50	10-50	10-100	10-40	10-50	10-50	10-65	10-60	10-60
SIZE CONSIST SCREENING - % PASSING	2"										
	1"										
	3/8"	100									100
	NO 4	100	100	100	100		100	100	100	100	100
	NO 10	98	98	99	99	100	99	99	98	99	95
	NO 40	57	45	57	46	63	57	56	62	61	55
	NO 200	21	12	19	11	24	16	16	24	20	21
AASHO RANGE		F	F	F	F	F	F	F	F	F	F
LIQUIDITY LIMIT		22	NL	19	NL	26	18	16	22	19	19
PLASTICITY INDEX		NP	NP	NP	NP	7	NP	NP	2	NP	NP
EQUIVALENCE (SAND)											
GRANULATION INDEX											
CLASSIFICATION	HRB										
	SUCS										
TEXTURE CLASSIFICATION											
BLOWS / ENERGY Mold. Comp.	D_{max}	2035		2035		2010					
	Hot.	9.4		8.7		10.7					
	CBR	61		80		43					
	Exp.										
USEABLE											

NOTES:

TABLE - 5/23

TEST RESULTS

AREA No. 3

TRANSCON S.A.

HIGHWAY: Pc 23 LOCATION: Est. 138 ...

SECTION: pr. 60 - Suatz

REGISTER NO		1038	1039	1040	1041	1042	1043				
DRILL HOLE		21	22	23	24	25	26				
DEPTH		10.55	10.90	10.30	10.40	10.70	10.60				
SIZE CONSIST – SCREENING & PASSING	2"										
	1"										
	3/8"			100	100						
	NO 4	100	100	100	99	100	100				
	NO 10	99	99	99	97	99	99				
	NO 40	56	56	65	63	68	58				
	NO 200	15	15	29	26	27	16				
AASHO RANGE		F	F	E/F	E/F	E/F	F				
LIQUIDITY LIMIT		NL	21	22	26	27	NL				
PLASTICITY INDEX		NP	NP	NP	8	8	NP				
EQUIVALENCE (SAND)											
GRANULATION INDEX											
CLASSIFICATION	HRB										
	SUCS										
TEXTURE CLASSIFICATION											
BLOWS / ENERGY – Mold. Comp.	D_{max}					2.000					
	Hot.					10.1					
	CBR					49					
	Exp.										
USEABLE											

NOTES:

TABLE – 5/24

TEST RESULTS

AREA No. 4

TRANSCON S.A.

HIGHWAY: PE-28 LOCATION: EST-221-LE

SECTION: PE-60-SUAPE

REGISTER NO			1045	1046	1047	1048	1049	1050	1051	1052	1053	1054
DRILL HOLE			1	2	3	4	5	6	7	8	9	10
DEPTH			10-45	10-46	10-90	10-150	10-50	10-40	10-200	10-145	10-95	10-60
SIZE CONSIST	SCREENING – % PASSING	2"										
		1"			100		100					100
		3/8"	100	100	99		99	100	100			99
		NO 4	99	99	99	100	98	99	99	100	100	99
		NO 10	97	97	97	98	94	97	97	98	97	97
		NO 40	58	57	62	59	61	54	59	63	51	65
		NO 200	12	13	16	15	17	12	16	15	13	21
AASHO RANGE			F	F	F	F	F	F	F	F	F	F
LIQUIDITY LIMIT			NL	NL	20	NL	20	NL	19	NL	19	21
PLASTICITY INDEX			NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
EQUIVALENCE (SAND)												
GRANULATION INDEX												
CLASSIFICATION	HRB											
	SUCS											
TEXTURE CLASSIFICATION												
BLOWS / ENERGY	Mold. Comp.	D_{max}	2005				2030	1985			2010	
		Hot.	9.0				9.2	9.4			9.0	
		CBR	49				66	63			38	
		Exp.										
USEABLE												

NOTES:

TABLE - 5/25

TEST RESULTS

AREA No. 4

TRANSCON S.A.

HIGHWAY: PE-28 LOCATION: EST-281-LE

SECTION: PE-60-SUAPE

REGISTER NO			1055	1056	1057	1058	1059	1060	1061	1062	1063	1064
DRILL HOLE			11	12	13	14	15	16	17	18	19	20
DEPTH			10-90	10-90	10-55	10-115	10-110	10-150	10-110	10-110	10-60	10-60
SIZE CONSIST	SCREENING - % PASSING	2"										
		1"							100		100	
		3/8"							99	100	97	100
		NO 4	100	100	100	100	100	100	99	99	96	99
		NO 10	99	96	98	99	99	98	98	96	94	98
		NO 40	62	59	57	62	70	66	55	54	68	70
		NO 200	21	10	15	16	27	18	19	13	19	12
AASHO RANGE			F	F	F	F	F/F	F	F	F	F	F
LIQUIDITY LIMIT			23	NL	20	NL	26	19	23	NL	18	NL
PLASTICITY INDEX			NP	NP	NP	NP	9	NP	NP	NP	NP	NP
EQUIVALENCE (SAND)												
GRANULATION INDEX												
CLASSIFICATION	HRB											
	SUCS											
TEXTURE CLASSIFICATION												
BLOWS / ENERGY	Mold. Comp.	D_{max}		1960		2010				2031		
		Hot.		92		94				92		
		CBR		53		50				53		
		Exp.										
USEABLE												

NOTES:

TABLE 5/26

TEST RESULTS

AREA No. 4

TRANSCON S.A.

HIGHWAY: PE-28 LOCATION: EST-281-LE

SECTION: PE-60-SUAPE

REGISTER NO		1065	1066	1067	1068	1069	1070				
DRILL HOLE		21	22	23	24	25	26				
DEPTH		10-100	10-55	10-140	10-110	10-150	10-60				
SIZE CONSIST – SCREENING % PASSING	2"										
	1"	100									
	3/8"	99									
	NO 4	99	100	100	100	100	100				
	NO 10	96	99	98	92	99	98				
	NO 40	65	61	63	68	66	63				
	NO 200	20	13	16	22	13	21				
AASHO RANGE		F	F	F	F	F	F				
LIQUIDITY LIMIT		20	NL	NL	21	NL	21				
PLASTICITY INDEX		NP	NP	NP	NP	NP	NP				
EQUIVALENCE (SAND)											
GRANULATION INDEX											
CLASSIFICATION	HRB										
	SUCS										
TEXTURE CLASSIFICATION											
BLOWS / ENERGY – Mold. Comp.	D_{max}	2070				1965					
	Hot.	9.6				8.6					
	CBR	91				52					
	Exp.										
USEABLE											

NOTES:

TABLE - 5/21

TEST RESULTS

AREA No. 5

TRANSCON S.A.

HIGHWAY: PE-28 LOCATION: EST-291-LD

SECTION: PE-60-SUAPE

REGISTER NO			1071	1072	1073	1074	1075	1076	1077	1078	1080	1081
DRILL HOLE			1	2	3	4	5	6	7	8	10	11
DEPTH			10-80	10-55	10-140	10-140	10-90	10-120	10-130	10-75	10-80	10-110
SIZE CONSIST	SCREENING - % PASSING	2"										
		1"					100					100
		3/8"					99					98
		NO 4	100	100	100	100	99	100	100	100	100	98
		NO 10	98	99	99	99	98	98	98	99	98	97
		NO 40	64	62	65	58	58	60	60	56	54	57
		NO 200	18	11	13	11	12	13	15	15	14	17
AASHO RANGE			F	F	F	F	F	F	F	F	F	F
LIQUIDITY LIMIT			21	NL	NL	NL	NL	NL	NL	NL	NL	27
PLASTICITY INDEX			NP	NP	NP	NP	NP	NP	NP	NP	NP	9
EQUIVALENCE (SAND)												
GRANULATION INDEX												
CLASSIFICATION	HRB											
	SUCS											
TEXTURE CLASSIFICATION												
BLOWS / ENERGY	Mold. Comp.	D_{max}		1925		1980		1990		1970		
		Hot.		9.4		8.4		9.2		9.9		
		CBR		57		51		68		62		
		Exp.										
USEABLE												

NOTES:

TRANSCON S.A.

TABLE - 5/28

TEST RESULTS

AREA No. 5

HIGHWAY: PE-28 LOCATION: EST-291-LD

SECTION: PE-60-SUAPE

REGISTER NO			1082	1083	1084	1085	1086	1087	1088	1089	1090	1091
DRILL HOLE			12	13	14	15	16	17	18	19	20	21
DEPTH			10-70	10-100	10-60	10-100	10-65	10-130	10-120	10-100	10-60	10-40
SIZE CONSIST	SCREENING - % PASSING	2"										
		1"										100
		3/8"										99
		NO. 4	100			100	100	100		100	100	99
		NO 10	98	100	100	99	98	99	100	98	99	97
		NO 40	55	63	65	63	57	61	39	59	63	60
		NO 200	13	12	10	18	12	12	14	15	12	15
AASHO RANGE			F	F	F	F	F	F	F	F	F	F
LIQUIDITY LIMIT			NL	NL	NL	21	NL	NL	NL	NL	NL	NL
PLASTICITY INDEX			NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
EQUIVALENCE (SAND)												
GRANULATION INDEX												
CLASSIFICATION		HRB										
		SUCS										
TEXTURE CLASSIFICATION												
BLOWS / ENERGY	Mold. Comp.	D_{max}				1.994		1.942				
		Hot.				10.2		9.9				
		CBR				37		63				
		Exp.										
USEABLE												

NOTES:

TABLE - 5/29

TEST RESULTS

AREA No. 5

TRANSCON S.A.

HIGHWAY: PE-28 LOCATION: EST-0291-LD

SECTION: PE-60-SUAPE

REGISTER NO		1092	1093								
DRILL HOLE		22	23								
DEPTH		1.15	0.70								
SIZE CONSIST - SCREENING % PASSING	2"										
	1"										
	3/8"										
	NO 4	100	100								
	NO 10	99	99								
	NO 40	62	61								
	NO 200	14	11								
AASHO RANGE		F	F								
LIQUIDITY LIMIT		NL	NL								
PLASTICITY INDEX		NP	NP								
EQUIVALENCE (SAND)											
GRANULATION INDEX											
CLASSIFICATION	HRB										
	SUCS										
TEXTURE CLASSIFICATION											
BLOWS / ENERGY - Mold. Comp.	D_{max}	1645									
	Hot.	9.4									
	CBR	71									
	Exp.										
USEABLE											

NOTES:

TABLE – 5/30

TEST RESULTS

AREA No. 06

TRANSCON S.A.

HIGHWAY: RS-29 LOCATION SA. 196 LE

SECTION: [illegible]

REGISTER NO		5186	5187	5188	5189	5190	5191	5192	5193	5194	5195
DRILL HOLE		01	02	03	04	05	06	07	08	09	10
DEPTH		0-75	0-90	0-85	0-177	0-160	0-200	0-150	0-150	0-200	0-180
SIZE CONSIST – SCREENING % PASSING	2"										
	1"			100		100				100	
	3/8"			94		99			100	94	100
	NO 4	100	100	98	100	99	100	100	99	98	99
	NO 10	98	99	97	99	97	98	99	95	96	98
	NO 40	67	65	60	67	68	64	61	57	64	64
	NO 200	07	17	08	12	20	14	11	14	14	10
AASHO RANGE		F	F	F	F	F	F	F	F	F	F
LIQUIDITY LIMIT		NL	17	NL	NL	10	NL	NL	NL	NL	19
PLASTICITY INDEX		NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
EQUIVALENCE (SAND)											
GRANULATION INDEX		0	0	0	0	0	0	0	0	0	0
CLASSIFICATION	HRB	A-3	A-2-4	A-3	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-3
	SUCS										
TEXTURE CLASSIFICATION											
BLOWS / ENERGY – Mold. Comp.	D_{max}	1.93					1.95		1.90		
	Hot.	7.5					9.5		9.5		
	CBR	15					32		50		
	Exp.										
USEABLE											

NOTES:

TABLE - 5/31

TRANSCON S.A.

TEST RESULTS

AREA No. 06

HIGHWAY: YE-28

LOCATION: BH 146-LE.

SECTION: Suda 8

REGISTER NO		5196	5197	5198	5199	5200	5201	5202	5203	5204	5205
DRILL HOLE		11	12	13	14	15	16	17	18	19	20
DEPTH		0-150	0-70	0-110	0-150	0-190	0-150	0-50	0-140	0-110	0-60
SIZE CONSIST — SCREENING - % PASSING	2"										
	1"	100			100	100	100				
	3/8"	99			99	98	99	100			
	NO 4	98	100	100	99	98	98	99	100	100	100
	NO 10	97	94	94	97	96	97	97	97	99	94
	NO 40	63	72	59	61	74	62	63	67	65	63
	NO 200	13	32	21	13	13	12	12	30	30	12
AASHO RANGE		F	F/F	F	F	F	F	F	F	F	F
LIQUIDITY LIMIT		NL	22	18	NL	NL	NL	NL	18	17	NL
PLASTICITY INDEX		NP	05	04	NP	NP	NP	NP	NP	NP	NP
EQUIVALENCE (SAND)											
GRANULATION INDEX		0	0	0	0	0	0	0	0	0	0
CLASSIFICATION	HRB	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4
	SUCS										
TEXTURE CLASSIFICATION											
BLOWS / ENERGY — Mold. Comp.	D_{max}				1835		1850		1833		
	Hot.				9.1		9.7		10.7		
	CBR				30		37		24		
	Exp.										
USEABLE											

NOTES:

TABLE - 5/32

TEST RESULTS

AREA No. 07

TRANSCON S.A:

HIGHWAY: XE-28. LOCATION: OH. 205-LE

SECTION: Sanhe

REGISTER NO		3112	3113	3114	3115	3116	3117	3118	3119	3120	3121
DRILL HOLE		01	02	03	04	05	06	07	08	09	10
DEPTH		10-180	10-50	10-100	10-80	10-60	10-60	10-150	10-180	10-60	10-80
SCREENING - % PASSING	2"										
	1"						100	100			
	3/8"		100	100			99	98			100
	NO 4	100	99	99		100	98	97	100	100	99
	NO 10	99	99	98	100	98	97	96	99	94	97
	NO 40	70	75	71	75	66	76	69	71	75	74
	NO 200	17	30	18	30	16	31	11	20	26	22
AASHO RANGE		F	F/F	F/F	F/F	F	F/F	F	F/F	F/F	F/F
LIQUIDITY LIMIT		NL	27	17	22	24	25	NL	18	21	24
PLASTICITY INDEX		NP	08	NP	06	08	06	NP	03	06	08
EQUIVALENCE (SAND)											
GRANULATION INDEX		0	0	0	0	0	0	0	0	0	0
CLASSIFICATION	HRB	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4
	SUCS										
TEXTURE CLASSIFICATION											
BLOWS ENERGY Mold. Comp.	D_{max}	1995				1835		1830			
	Hot.	4.3				10.3		9.5			
	CBR	30				70		59			
	Exp.										
USEABLE											

NOTES:

TABLE – 5/33

TRANSCON S.A.

TEST RESULTS

AREA No. 07

HIGHWAY: YE-29 LOCATION: Ch. 205 - LE

SECTION: Sudhe

REGISTER NO		3122	3123	3124	3125	3126	3127	3128	3190	3150
DRILL HOLE		11	12	13	14	15	16	17	18	19
DEPTH		0-110	0-190	0-80	0-190	0-24	0-130	0-90	0-20	0-60
SIZE CONST. – SCREENING % PASSING	2"									
	1"									
	3/8"						100	100		
	NO 4		100			100	99	99	100	100
	NO 10	100	99	100	100	99	99	99	94	99
	NO 40	76	70	74	75	67	77	75	70	73
	NO 200	20	18	20	23	16	24	20	22	26
AASHO RANGE		F/F	F	F/F	F/F	F	F/F	F/F	F	F/F
LIQUIDITY LIMIT		20	18	15	19	12	18	19	24	22
PLASTICITY INDEX		04	04	NP	05	NP	NP	05	10	08
EQUIVALENCE (SAND)										
GRANULATION INDEX		0	0	0	0	0	0	0	0	0
CLASSIFICATION	HRB	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4
	SUCS									
TEXTURE CLASSIFICATION										
ENERGY Mold. Comp.	D_{max}		1895				1890	1900		
	Hot.		94				99	91		
	CBR		57				52	40		
	Exp.									
USEABLE										

NOTES:

TABLE - 5/34

TEST RESULTS

AREA No. 08

TRANSCON S.A.

HIGHWAY: [illegible]

LOCATION: Estaca 319 - L E.

SECTION: Suape

REGISTER NO		3251	3252	3253	3254	3255	3256	3257	3258	3259	3260
DRILL HOLE		01	02	03.	04	05	06.	07	08	09	10
DEPTH		10-120	10.130	10-160	10.140	10-170	10.200	10.140	10.150	10.110	10.160
SIZE CONSIST SCREENING - % PASSING	2"										
	1"								100.		
	3/8"							100.	99		
	NO 4	100	100.	100.	100.	100	100	100.	97	100	100
	NO 10	99.	99	99	99	99	99	99	93	99	99
	NO 40	61	63	68	58	65	63	70	36	68	66
	NO 200	13.	14	13.	19	15.	9.	25	7	23	15
AASHO RANGE		F	F	F	F.	F.	F	F	E	F	F
LIQUIDITY LIMIT		NL	NL	NL	22	NL	NL	NL	NL	22	19
PLASTICITY INDEX		NP	NP	NP	5	NP	NP	NP	NP	5	NP
EQUIVALENCE (SAND)											
GRANULATION INDEX		0	0	0	0	0	0	0	0	0	0
CLASSIFICATION	HRB	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-1-B	A-2-4	A-2-4
	SUCS										
TEXTURE CLASSIFICATION											
BLOWS / ENERGY Mold. Comp.	D_{max}	2110		1870					2140		1870
	Hot.	9.7		9.3					11.2		9.5
	CBR	48.		53.					34		35
	Exp.										
USEABLE											

NOTES:

TABLE - 5/35

TRANSCON S.A.

TEST RESULTS

AREA No. 08

HIGHWAY: PE-28

SECTION: Guaíba

LOCATION: Estaca 319- L.E.

REGISTER NO			3261	3262	3263	3264	3265	3266	3267	3268	3269	3270
DRILL HOLE			11	12	13	14	15	16	17	18	19	20
DEPTH			10-110	10-120	10-110	10-130	10-140	10-160	10-130	10-150	10-130	10-170
SIZE CONSIST	SCREENING - % PASSING	2"										
		1"										
		3/8"	100									
		NO 4	99	100	100	100	100	100	100	100	100	100
		NO 10	97	99	97	99	97	99	99	93	[illegible]	93
		NO 40	68	76	66	64	72	64	65	68	69	[illegible]
		NO 200	18	22	17	18	20	17	23	29	19	12
AASHO RANGE			F	F/F	F	F	F/F	F	F	F/F	F	F
LIQUIDITY LIMIT			21	21	19	NL	19	17	NL	25	19	NL
PLASTICITY INDEX			NP	NP	NP	NP	NP	NP	NP	7	NP	NP
EQUIVALENCE (SAND)												
GRANULATION INDEX			0	0	0	0	0	0	0	0	0	0
CLASSIFICATION	HRB		A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4
	SUCS											
TEXTURE CLASSIFICATION												
BLOWS / ENERGY	Mold. Comp.	D_{max}				1870		1890				
		Hot.				9.5		8.8				
		CBR				48		68				
		Exp.										
USEABLE												

NOTES:

TABLE - 5/36

TEST RESULTS

AREA No.

TRANSCON S.A.

HIGHWAY: PE-28 LOCATION: Estaca 319- L.E.

SECTION: Sul de [illegible]

REGISTER NO			3271	3272	3273	3274	3275	3276	3277	3278	3279	328[illegible]
DRILL HOLE			21	22	23	24	25	26	27	28	29	30
DEPTH			10-150	10-70	10-90	10-110	10-140	10-140	10-60	10-70	10-80	10-15[illegible]
SIZE CONSIST	SCREENING - % PASSING	2"										
		1"										
		3/8"				100					100	
		NO 4	100	100	100	99	100	100	100	100	99	100
		NO 10	99	98	99	98	99	98	99	99	90	99
		NO 40	63	70	68	65	69	67	65	71	62	55
		NO 200	11	13	20	13	16	19	15	21	7	12
AASHO RANGE			F	F	F	F	F	F	F	F	F	F
LIQUIDITY LIMIT			NL	20	20	NL	NL	NL	21	22	NL	NL
PLASTICITY INDEX			NP	NP	NP	NP	NP	NP	NP	5	NP	NP
EQUIVALENCE (SAND)												
GRANULATION INDEX			0	0	0	0	0	0	0	0	0	0
CLASSIFICATION	HRB		A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4
	SUCS											
TEXTURE CLASSIFICATION												
BLOWS ENERGY	Mold. Comp.	D_{max}	1960			1805						
		Hot.	8.7			9.5						
		CBR	41			51						
		Exp.										
USEABLE												

NOTES:

TABLE 5/37

TEST RESULTS

AREA No. 08

HIGHWAY: PE-28				LOCATION: Estaca 319.L.E								TRANSCON S.A.	
SECTION: Suape													
REGISTER NO				3281	3282	3283	3284	3285	3286	3287	3288	3289	3290
DRILL HOLE				31	32	33	34	35	36	37	38	39	40
DEPTH				10.150	10-160	10.120	10.90	10.120	10-160	10-140	10-140	10.140	10-120
SIZE CONSIST	SCREENING - % PASSING	2"											
		1"					100						
		3/8"					96	100					
		NO 4		100	100	100	96	99	100	100	100	100	100
		NO 10		99	99	98	92	98	99	99	99	98	98
		NO 40		65	62	69	61	64	57	69	59	67	67
		NO 200		12	8	14	15	14	11	19	19	13	19
AASHO RANGE				F	F	F	F	F	F	F	F	F	F
LIQUIDITY LIMIT				NL	NL	NL	20	21	NL	20	16	NL	13
PLASTICITY INDEX				NP	NP	NP	NP	NP	NP	5	NP	NP	NP
EQUIVALENCE (SAND)													
GRANULATION INDEX				0	0	0	0	0	0	0	0	0	0
CLASSIFICATION	HRB			A2-4	A2-4	A2-4	A2-4	A2-4	A2-4	A2-4	A2-4	A2-4	A2-4
	SUCS												
TEXTURE CLASSIFICATION													
BLOWS / ENERGY	Mold. Comp.	D_{max}			1715		1825		1810				
		Hot.			9.5		10.4		9.4				
		CBR			21		37		32				
		Exp.											
USEABLE													

NOTES:

TABLE - 5/38

TRANSCON S.A.

TEST RESULTS

AREA No. 08

HIGHWAY: DE-28

SECTION: Suape

LOCATION: Estaca 319-L.E

REGISTER NO		3291	3292	3293	3294	3295	3296	3297	3298	3299	3300
DRILL HOLE		41	42	43	44	45	46	47	48	49	50
DEPTH		10-60	10-80	10-140	10-150	10-130	10-120	10-110	10-80	10-80	10-150
SIZE CONSIST - SCREENING % PASSING	2"										
	1"					100					
	3/8"					99	100				
	NO 4	100	100	100	100	99	99	100	100	100	100
	NO 10	99	98	99	98	93	98	99	99	93	99
	NO 40	64	58	64	69	68	43	41	63	40	70
	NO 200	16	14	13	15	17	20	19	17	5	13
AASHO RANGE		F	F	F	F	F	F	F	F	E	F
LIQUIDITY LIMIT		NL	NL	NL	NL	NL	18	18	NL	NL	NL
PLASTICITY INDEX		NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
EQUIVALENCE (SAND)											
GRANULATION INDEX		0	0	0	0	0	0	0	0	0	0
CLASSIFICATION	HRB	A2-4	A2-4	A2-4	A2-4	A2-4	A-2-4	A2-4	A2-4	A2-3	A2-4
	SUCS										
TEXTURE CLASSIFICATION											
BLOWS / ENERGY - Mold. Comp.	D_{max}				1935		1915		1890		1875
	Hot.				8.6		9.2		10.4		9.6
	CBR				44		61		33		50
	Exp.										
USEABLE											

NOTES:

TABLE – 5/39

TEST RESULTS

AREA No. 9

TRANSCON S.A.

HIGHWAY: PE. 28

LOCATION: EST. 267 + 16 (L.D.)

SECTION: SUAPE

REGISTER NO		1363	1364	1365	1366	1367	1368				
DRILL HOLE		11	12	13	14	15	16				
DEPTH		10-200	10-130	10-130	10-140		10-90				
SIZE CONSIST – SCREENING – % PASSING	2"										
	1"	100		100	100						
	3/8"	93	100	98	99	100					
	NO 4	93	100	91	98	100	100				
	NO 10	92	99	95	97	100	98				
	NO 40	61	68	64	62	59	67				
	NO 200	16	17	22	12	15	29				
AASHO RANGE		F	F	F	F	F	F/E				
LIQUIDITY LIMIT		NL	NL	NL	NL	NL	25				
PLASTICITY INDEX		NP	NP	NP	NP	NP	9				
EQUIVALENCE (SAND)											
GRANULATION INDEX											
CLASSIFICATION	HRB										
	SUCS										
TEXTURE CLASSIFICATION											
BLOWS / ENERGY – Mold. Comp.	D_{max}	1950		2095	2030						
	Hot.	9.0		8.1	9.5						
	CBR	63		61	76						
	Exp.										
USEABLE											

NOTES:

TABLE - 5/40

TRANSCON S.A.

TEST RESULTS

AREA No. 9

HIGHWAY: PE-28

LOCATION: EST. 917+16 (L.D)

SECTION: SURBE

REGISTER NO			1353	1354	1355	1356	1357	1358	1359	1360	1361	1362
DRILL HOLE			1	2	3	4	5	6	7	8	9	10
DEPTH			10-20	10-40	10-60	10-90	10-140	10-210	10-80	10-80	10-110	10-120
SIZE CONSIST	SCREENING - % PASSING	2"										
		1"						100		100		
		3/8"				100	100	98		99		
		NO 4	100	100	100	99	99	96	100	99		100
		NO 10	99	99	99	98	98	95	93	92	100	99
		NO 40	63	31	68	65	63	60	63	64	62	60
		NO 200	26	23	24	16	23	18	18	12	23	18
AASHO RANGE			E/F	E/F	F	F	F	F	F	F	F	F
LIQUIDITY LIMIT			NL	NL	22	NL	NL	NL	NL	NL	24	NL
PLASTICITY INDEX			NP	NP	NP	NP	NP	NP	NP	NP	9	NP
EQUIVALENCE (SAND)												
GRANULATION INDEX												
CLASSIFICATION	HRB											
	SUCS											
TEXTURE CLASSIFICATION												
BLOWS / ENERGY	Mold. Comp.	D_{max}		2015		1925			2010		2050	
		Hot.		9.5		7.0			8.5		9.1	
		CBR		84		54			23		54	
		Exp.										
USEABLE												

NOTES:

TABLE - 5/41

TEST RESULTS

AREA NO. 10

TRANSCON S.A.

HIGHWAY: PE-98   LOCATION: EST-302 L.D

SECTION: PE-60 SUAPE

			1	2	3	4	5	6	7	8	9	10
REGISTER NO			1	2	3	4	5	6	7	8	9	10
DRILL HOLE			1	2	3	4	5	6	7	8	9	10
DEPTH			10-60	10-60	10-60	10-40	10-20	10-20	10-60	10-20	10-20	10-100
SIZE CONSIST	SCREENING - % PASSING	2"										
		1"										
		3/8"							100			
		NO 4	100	100	100	100	100	100	99	100	100	100
		NO 10	99	99	100	100	100	100	98	100	99	99
		NO 40	64	73	71	71	28	75	74	67	22	21
		NO 200	14	12	19	13	35	22	25	17	25	20
AASHO RANGE			F	C/F	C/F	F/F	F/F	F/F	C/F	F	F/F	F/F
LIQUIDITY LIMIT			NL	NL	25	NL	20	22	21	18	21	19
PLASTICITY INDEX				NP	6	NP	NP	8	6	NP	5	5
EQUIVALENCE (SAND)												
GRANULATION INDEX			0	0	0	0	0	0	0	0	0	0
CLASSIFICATION	HRB		a2-4	a2-4	a2-4	a2-4	a2-4	a2-4	a2-4	a2-4	a2-4	a2-4
	SUCS											
TEXTURE CLASSIFICATION												
BLOWS ENERGY	Mold. Comp.	D_{max}	1913								1875	
		Hot.	94								99	
		CBR	44								49	
		Exp.										
USEABLE												

NOTES:

TABLE - 5/42 TEST RESULTS AREA No. 10													TRANSCON S.A.

HIGHWAY:

SECTION:

LOCATION: EST-302 L.D

REGISTER NO			11	12	13	14	15	16	17	18	19	20
DRILL HOLE			11	12	13	14	15	16	17	18	19	20
DEPTH			10-220	10-90	10-20	10-40	10-100	10-90	10-200	10-150	10-90	10-10
SIZE CONSIST	SCREENING - % PASSING	2"										
		1"										
		3/8"										
		NO 4	100	100	100	100	100	100	100	100	100	100
		NO 10	90	99	99	98	100	99	99	99	100	100
		NO 40	13	78	77	64	78	67	20	72	32	13
		NO 200	15	20	25	11	20	15	20	14	32	20
AASHO RANGE			F	F/E	F/E	F	F/E	F/E	F/E	F/E	F/E	F/E
LIQUIDITY LIMIT			18	17	17	NL	17	NL	18	17	20	19
PLASTICITY INDEX			NP	NP	NP	NP	NP	NP	NP	NP	4	NP
EQUIVALENCE (SAND)												
GRANULATION INDEX			0	0	0	0	0	0	0	0	0	0
CLASSIFICATION	HRB		A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4	A-2-4
	SUCS											
TEXTURE CLASSIFICATION												
BLOWS ENERGY	Mold. Comp.	D_{max}	1925				1815			1940		1965
		Hot.	8.6				9.0			9.7		9.8
		CBR	45				25			51		29
		Exp.										
USEABLE												

NOTES:

TABLE – 5/43

TRANSCON S.A.

TEST RESULTS

AREA No. 10

HIGHWAY: PE-28 LOCATION: EST-302

SECTION: PE-60

REGISTER NO			21	22
DRILL HOLE			21	22
DEPTH			10-40	10-12
SIZE CONSIST	SCREENING – % PASSING	2"		
		1"		
		3/8"		
		NO 4	100	100
		NO 10	99	99
		NO 40	10	21
		NO 200	24	19
AASHO RANGE			F	F/F
LIQUIDITY LIMIT			19	12
PLASTICITY INDEX			NP	NP
EQUIVALENCE (SAND)				
GRANULATION INDEX			0	0
CLASSIFICATION	HRB		A2-4	A2-4
	SUCS			
TEXTURE CLASSIFICATION				
BLOWS ENERGY	Mold. Comp.	D_{max}		1570
		Hot.		9.9
		CBR		59
		Exp.		
USEABLE				

NOTES:

LOS ANGELES ABRASION TEST

ABRASÃO "LOS ANGELES"

PENEIRAS (POL.) SCREENS (")		PÊSO EM GRAMAS WEIGHT IN GRAMS				RESULTADO RESULT	
PASSANDO PASSING	RETIDO RETAINED	A	B	C	D		
1½"	1"	1.250				PÊSO INICIAL: 5000 g.	INITIAL WEIGHT
1"	3/4"	1.250				PÊSO RETIDO NA PEN. Nº 12: 3802 g.	WEIGHT RETAINED IN SCREEN 12
3/4"	1/2"	1.250	2.500			PÊSO PASS. NA PEN. Nº 12: 1198 g.	WEIGHT PASSING SCREEN 12
1/2"	3/8"	1.250	2.500			ABRASÃO "LOS ANGELES": 24 %	LA ABRASION
3/8"	1/4"			2.500		FAIXA: "A"	RANGE
1/4"	Nº 4			2.500		OBSERVAÇÕES: NOTES	
Nº 4	Nº 8				5.000		
NÚMERO DE ESFERAS NUMBER OF SPHERES		12	11	8	6		
PÊSO DAS ESFERAS — g WEIGHT OF SPHERES		5000 ± 25	4.584 ± 25	3330 ± 20	2500 ± 15		
NÚMERO DE REVOLUÇÕES NUMBER OF REVOLUTIONS		500	500	500	500		

ADESIVIDADE — MÉTODO R.R.L. ADHESIVENESS — RRL METHOD

LIGANTE TIPO	BOND TYPE				
DOPE TIPO	DOPE TYPE				
DOPE — %					
OCORRÊNCIA	FREQUENCY				
RESULTADO	RESULT				

ADESIVIDADE — MÉTODO "RIEDEL-WEBER" ADHESIVENESS — RIEDEL-WEBER METHOD

DOPE TIPO	DOPE TYPE				
DOPE — %					
DESLOCAMENTO BDL. INICIAL Nº BDL. FINAL Nº	DISPLACEMENT BDL. INITIAL No. BDL. FINAL No.				
RESULTADO	RESULT				

RODOVIA: HIGHWAY	TRECHO: SECTION	SUBTRECHO: SUBSECTION

PROCEDÊNCIA: SOURCE	LOCALIZAÇÃO: LOCATION	NATUREZA: NATURE	AMOSTRA Nº SAMPLE NO/ REGISTRO Nº REGISTER NO.
LABORATÓRIO: LABORATORY	OPERADOR: TECHNICIAN	DATA: DATE	CALCULISTA: CALCULATOR / VISTO: APPROVAL

LOS ANGELES — ADESIVIDADE LOS ANGELES ABRASION TEST

TRANSCON S.A. | QD 5/44

JV-2/5.55

LOS ANGELES ABRASION TEST

ABRASÃO "LOS ANGELES"

PENEIRAS (POL.) SCREENS (")		PÊSO EM GRAMAS WEIGHT IN GRAMS			
PASSANDO PASSING	RETIDO RETAINED	A	B	C	D
1½"	1"	1.250			
1"	3/4"	1.250			
3/4"	1/2"	1.250	2.500		
1/2"	3/8"	1.250	2.500		
3/8"	1/4"			2.500	
1/4"	Nº 4			2.500	
Nº 4	Nº 8				5.000
NÚMERO DE ESFERAS NUMBER OF SPHERES		12	11	8	6
PÊSO DAS ESFERAS — g SPHERE WEIGHT — G		5000 ± 25	4584 ± 25	3330 ± 20	2.500 ± 15
NÚMERO DE REVOLUÇÕES NUMBER OF REVOLUTIONS		500	500	500	500

RESULTADO RESULT

PÊSO INICIAL: INITIAL WEIGHT 5.000 g.

PÊSO RETIDO NA PEN. Nº 12 WEIGHT RET. IN SCREEN 12: 4.119 g.

PÊSO PASS. NA PEN. Nº 12 WEIGHT PASSING SCREEN 12: 881 g.

ABRASÃO "LOS ANGELES" LA ABRASION: 17 %

FAIXA: RANGE "A"

OBSERVAÇÕES: NOTES

ADESIVIDADE — MÉTODO R.R.L. ADHESIVENESS — RRL METHOD

LIGANTE TIPO	BOND TYPE			
DOPE TIPO	DOPE TYPE			
DOPE — %				
OCORRÊNCIA	FREQUENCY			
RESULTADO	RESULT			

ADESIVIDADE — MÉTODO "RIEDEL-WEBER" ADHESIVENESS — RIEDEL-WEBER METHOD

DOPE TIPO	DOPE TYPE			
DOPE — %				
DESLOCAMENTO / Nº INICIAL / Nº FINAL	DISPLACEMENT / INITIAL BDL No. / FINAL BDL No.			
RESULTADO	RESULT			

RODOVIA: HIGHWAY	TRECHO: SECTION	SUBTRECHO: SUBSECTION
PROCEDÊNCIA: SOURCE	LOCALIZAÇÃO: LOCATION	NATUREZA: NATURE / AMOST. Nº SAMPLE NO. / REGISTRO Nº REGISTER NO.
LABORATÓRIO: LABORATORY	OPERADOR: TECHNICIAN	DATA: DATE / CALCULISTA: CALCULATOR / VISTO: APPROVED

LOS ANGELES — ADESIVIDADE LOS ANGELES — ADHESIVENESS TEST

TRANSCON S.A. QD 5/45

LOS ANGELES ABRASION TEST

ABRASÃO "LOS ANGELES"

PENEIRAS (POL.) SCREENS (")		PÊSO EM GRAMAS WEIGHT IN GRAMS			
PASSANDO PASSING	RETIDO RETAINED	A	B	C	D
1½"	1"	1.250			
1"	3/4"	1.250			
3/4"	1/2"	1.250	2.500		
1/2"	3/8"	1.250	2.500		
3/8"	1/4"			2.500	
1/4"	Nº 4			2.500	
Nº 4	Nº 8				5.000
NÚMERO DE ESFERAS NUMBER OF SPHERES		12	11	8	6
PÊSO DAS ESFERAS – g SPHERE WEIGHT		5000 ± 25	4584 ± 25	3.330 ± 20	2.500 ± 15
NÚMERO DE REVOLUÇÕES NUMBER OF REVOLUTIONS		500	500	500	500

RESULTADO — RESULT

- PÊSO INICIAL: INITIAL WEIGHT — 5000 g.
- PÊSO RETIDO NA PEN. Nº 12: WEIGHT RETAIN IN SCREEN 12 — 4.034 g.
- PÊSO PASS. NA PEN. Nº 12: WEIGHT PASSING SCREEN 12 — 966 g.
- ABRASÃO "LOS ANGELES": LA ABRASION — 19 %
- FAIXA: RANGE — "A"
- OBSERVAÇÕES: NOTES

ADESIVIDADE – MÉTODO B.R.L.
ADHESIVENESS – BRL METHOD

LIGANTE TIPO	BOND TYPE				
DOPE TIPO	DOPE TYPE				
DOPE – %					
OCORRÊNCIA	FREQUENCY				
RESULTADO	RESULT				

ADESIVIDADE – MÉTODO "RIEDEL-WEBER"
ADHESIVENESS – RIEDEL-WEBER METHOD

DOPE TIPO	DOPE TYPE				
DOPE – %					
DESLOCAMENTO SOL. INICIAL SOL. FINAL	DISPLACEMENT INITIAL BDL No. FINAL BDL No.				
RESULTADO	RESULT				

RODOVIA: HIGHWAY	TRECHO: SECTION	SUBTRECHO: SUBSECTION
PROCEDÊNCIA: [illegible]	LOCALIZAÇÃO: LOCATION	NATUREZA: NATURE — AMOSTRA Nº: SAMPLE NO. — REGISTRO Nº: REGISTER NO.
LABORATÓRIO: LABORATORY	OPERADOR: TECHNICIAN — DATA: DATE	CALCULISTA: CALCULATOR — VISTO: APPROVED

"LOS ANGELES" – ADESIVIDADE
LOS ANGELES ADHESIVENESS TEST

TRANSCON S.A. — QD 5/46

IV-2/5.57

TABLE 5/47 - DIMENSIONING THE PAVEMENT

SECTION	N.	THICK-NESS EQUIV. cm	REF/ cm	SUB-BASE cm	BASE cm	SURF-ACING cm	CONCRETE cm
MAIN ACCESS	3.5×10^8	70	-	35	20	2.5	10
DIST. TRUNK (1)	3.2×10^8	70	-	35	20	2.5	10
ACCESS FERTILIZER PLANT (2)	3.7×10^7	63	-	40	20	2.5	5
ACCESS BULK PRODUCTS PORT (3)	1.1×10^8	96	50	25	20	2.5	10
MAIN HIGHWAY (4)	2.4×10^6	54	-	40	20	2.5	-
ACCESS - REFINERY	2.2×10^6	54	-	40	20	2.5	-
ACCESS - N S do O (5)	1.1×10^6	53	-	40	20	2.5	-
TOWNSITE CIRCUIT	1.2×10^6	53	-	40	20	2.5	-
ROAD 2	0.6×10^6	52	-	40	20	2.5	-
ROAD 3	0.6×10^6	52	-	40	20	2.5	-
ROAD 4	0.6×10^6	52	-	40	20	2.5	-
ROAD 5	0.6×10^6	52	-	40	20	2.5	-

(1) - Dist. Trunk + Port Route 1 + Access to bulk products port
(2) - Port Route 3 + Section of Port Route 4 + Second. Access - Fertilizers
(3) - Section of Port Route 1 + Secondary Access to bulk products port
(4) - Townsite Access 1 + Road 1
(5) - Section Port Route 5 + Access N S do O

TABLE 5/48 - PAVING QUANTITATIVE DATA (SUMMARY)

SERVICES	UNIT	MAIN ACCESS	DISTRIBUTION TRUNK LINE (1)	ACCESS (2) FERTILIZERS	ACCESS (3) BULK PORT	ACCESS (4) N S do O	MAIN HIGHWAY (5)	CIRCUIT	ROAD 2	ROAD 3	ROAD 4	ROAD 5	ACCESS REF.	TOTAL	UNIT COST	COST
SUBGRADE REGULARIZATION	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SUBGRADE REINFORCEMENT	[illegible]	-	-	-	[illegible]	-	-	-	-	-	-	-	-	[illegible]	[illegible]	[illegible]
SUB-BASE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
BASE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PRIMING	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DOUBLE SURFACE TREATMENT	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
BITUMINOUS CONCRETE 5 cm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	-	-	[illegible]	[illegible]	[illegible]
10 cm														[illegible]	[illegible]	[illegible]
TRANSPORTATION	[illegible]	-	-	-	[illegible]	-	-	-	-	-	-	-	-	[illegible]	[illegible]	[illegible]
REINFORCING MATERIAL (DIST-3km)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SUB-BASE MATERIAL (DIST-10km)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
BASE MATERIAL (DIST-20km)																
														TOTAL	-	[illegible]

(1) - Dist. Trunk + Port Rto 1 + Second. Acc. Bulk Prod. Port

(2) - Port Rto 3 + Section Port Rto 4+ Sec. Acc. Fertilizer Plant

(3) - Section Port Rto 1 + Second. Access Bulk Prod. Port

(4) - Section Port Rto 5 + Access to N S do O

(5) - Townsite Access 1 + Road 1

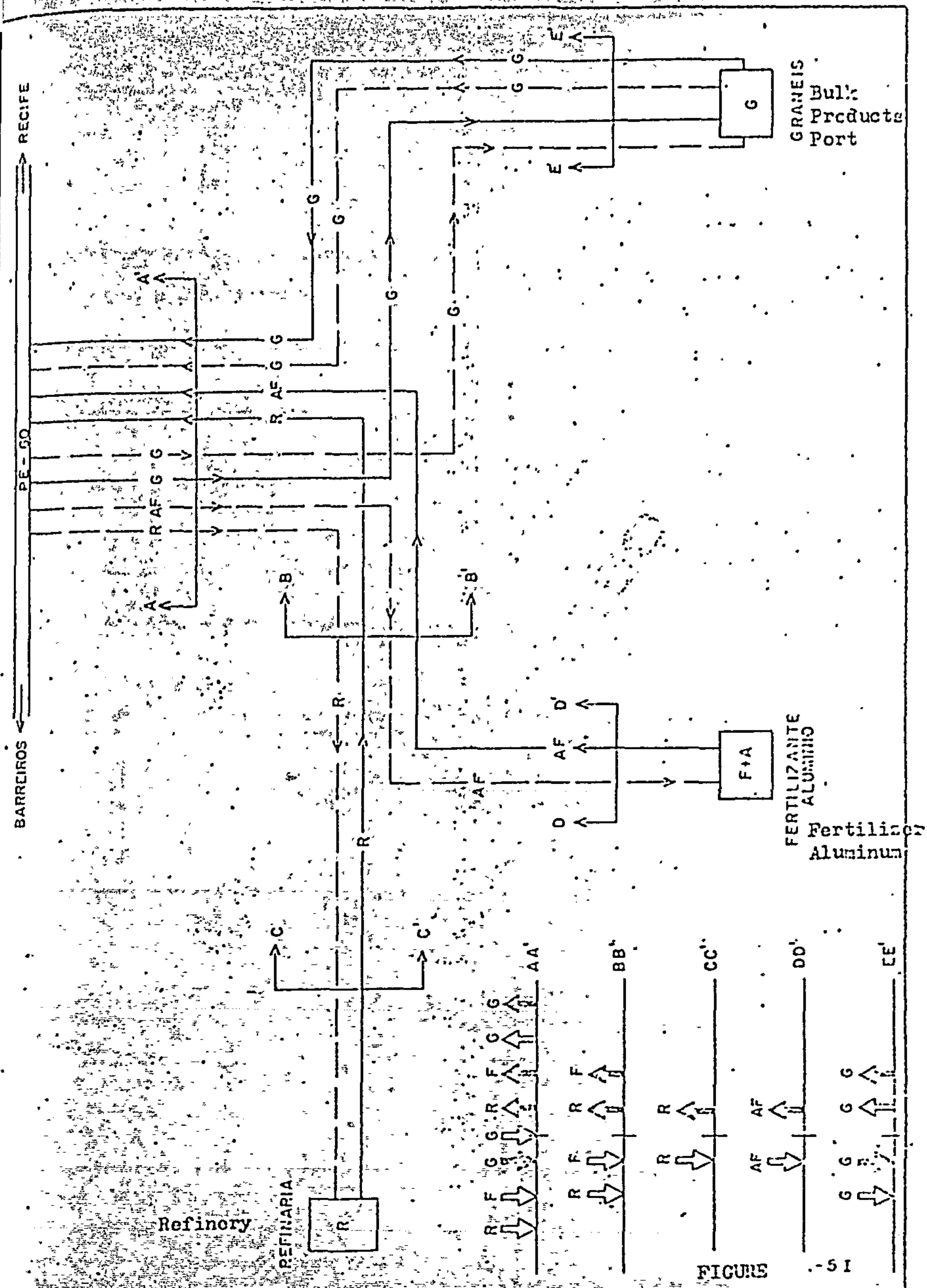


FIGURE .- 5 I

LOADED

UNLOADED

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TRANSCON S.A.

COMPLEXO INDUSTRIAL DE SUAPE

DISTRIBUTION OF CARGO TRAFFIC FLOW

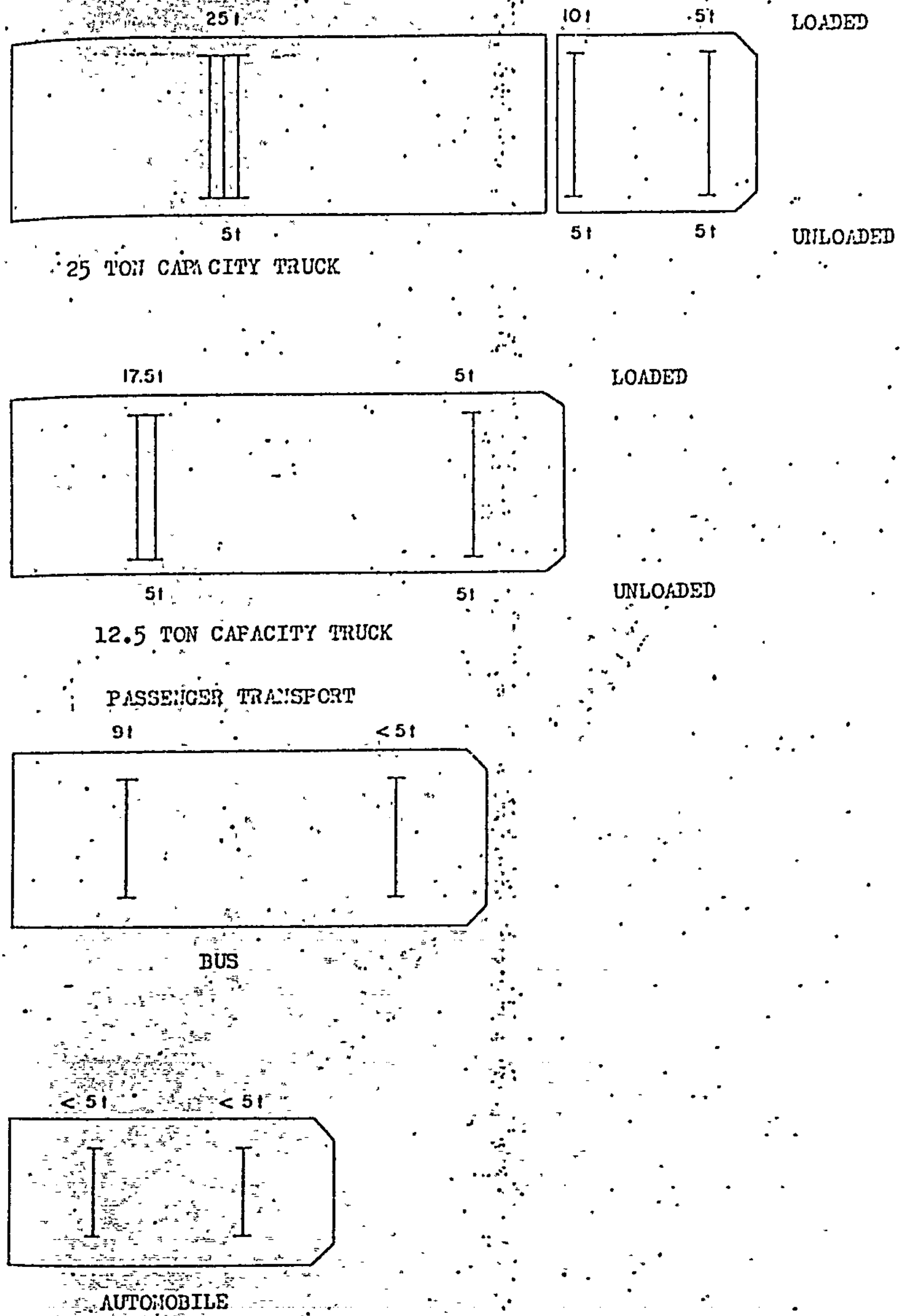


FIGURE 5 II

dipor

COMPLEXO INDUSTRIAL DE SUAPE

CARGO TRANSPORTATION

TRANSCON S.A.

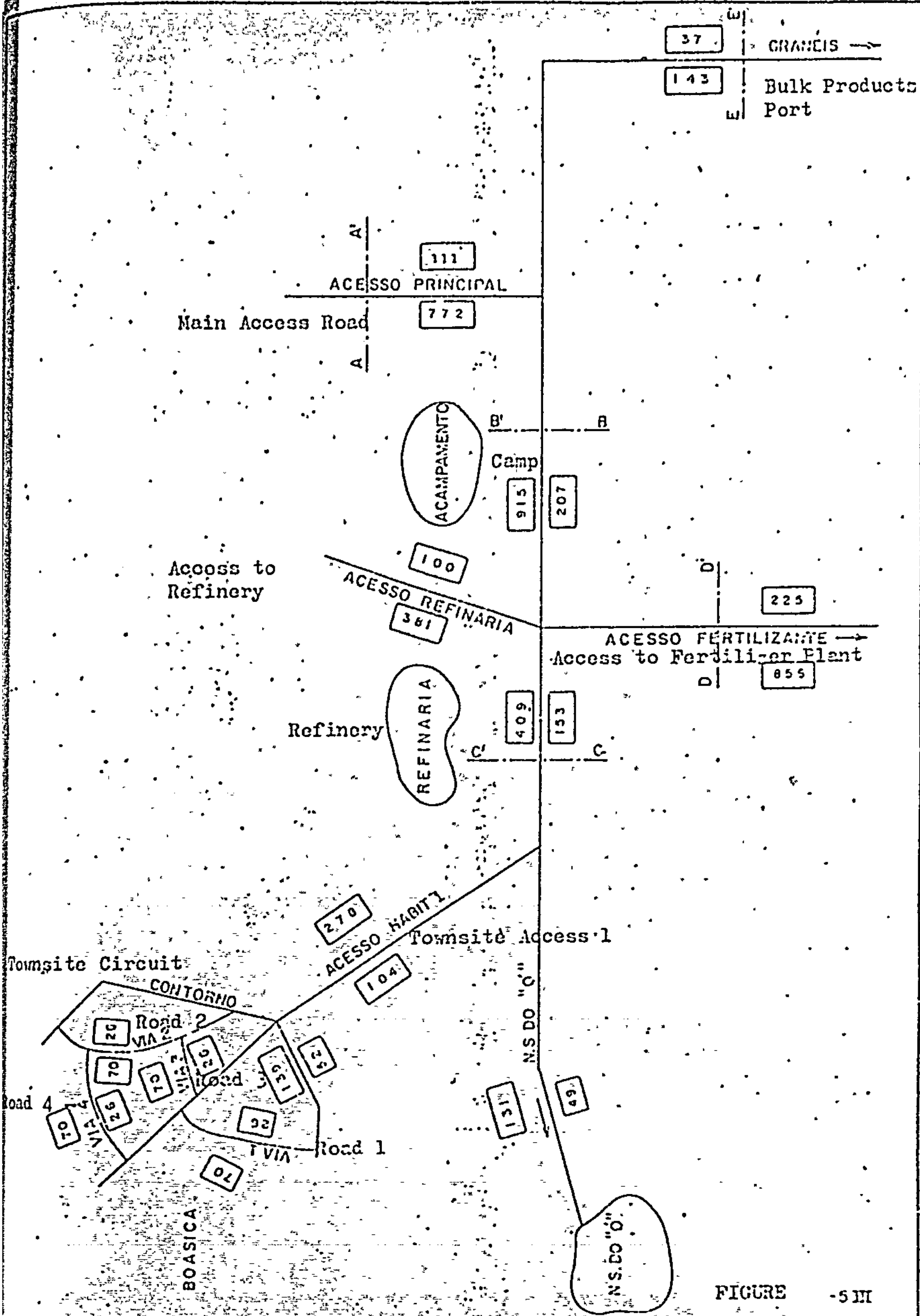


FIGURE -5 III

dipe r

ONE WAY FLOW OF BUSES AND CARS? PER DAY

TRANSCON S.A.

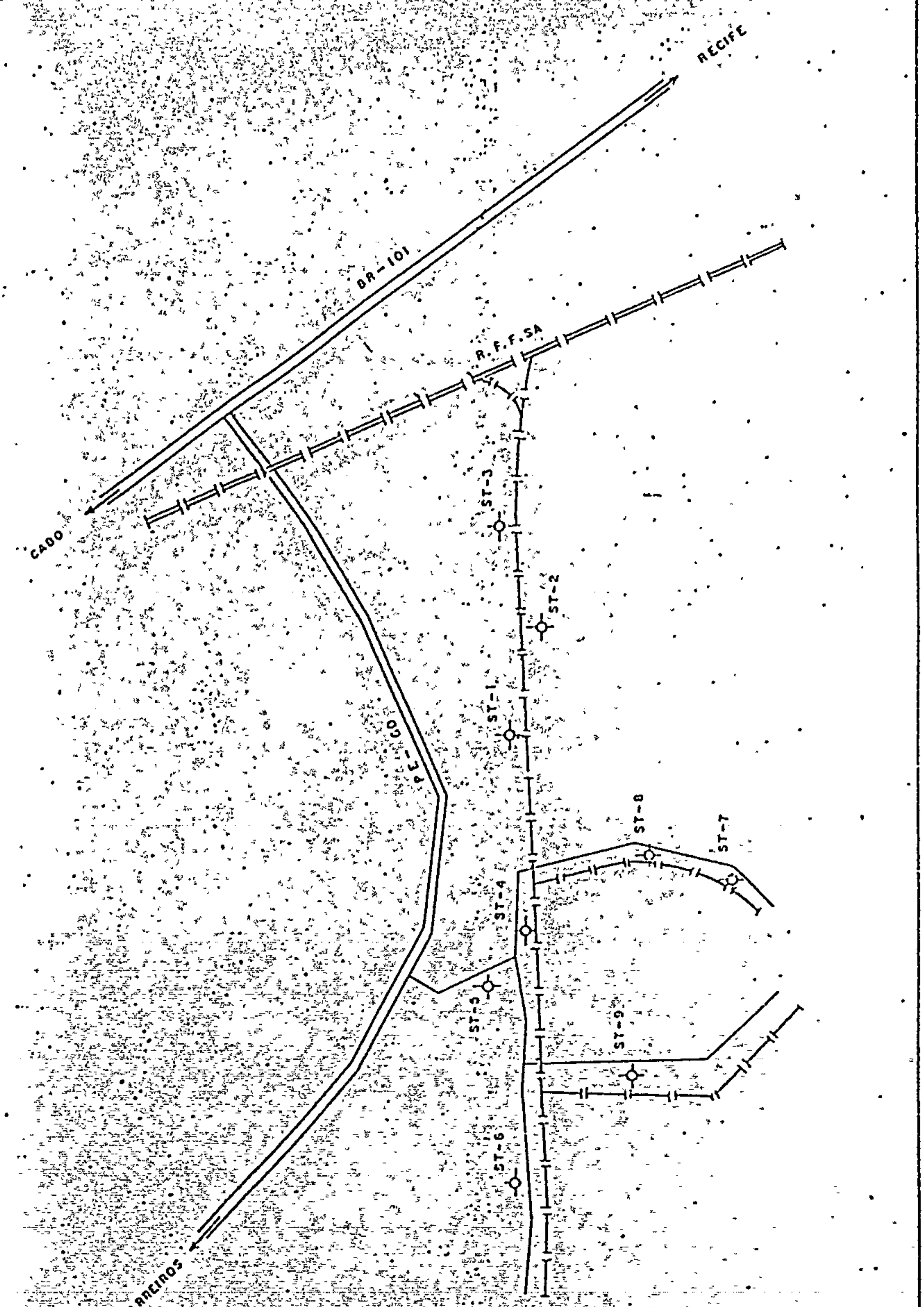


FIGURE 5-IX

KEY		
PLANNED HIGHWAY	ciper	COMPLEXO INDUSTRIAL DE SUAPE
PLANNED RAILROAD	FRANCON S.A.	LOCATION OF DEPOSITS
EXISTING HIGHWAY		
EXISTING RAILROAD		
AUGER DRILLING		

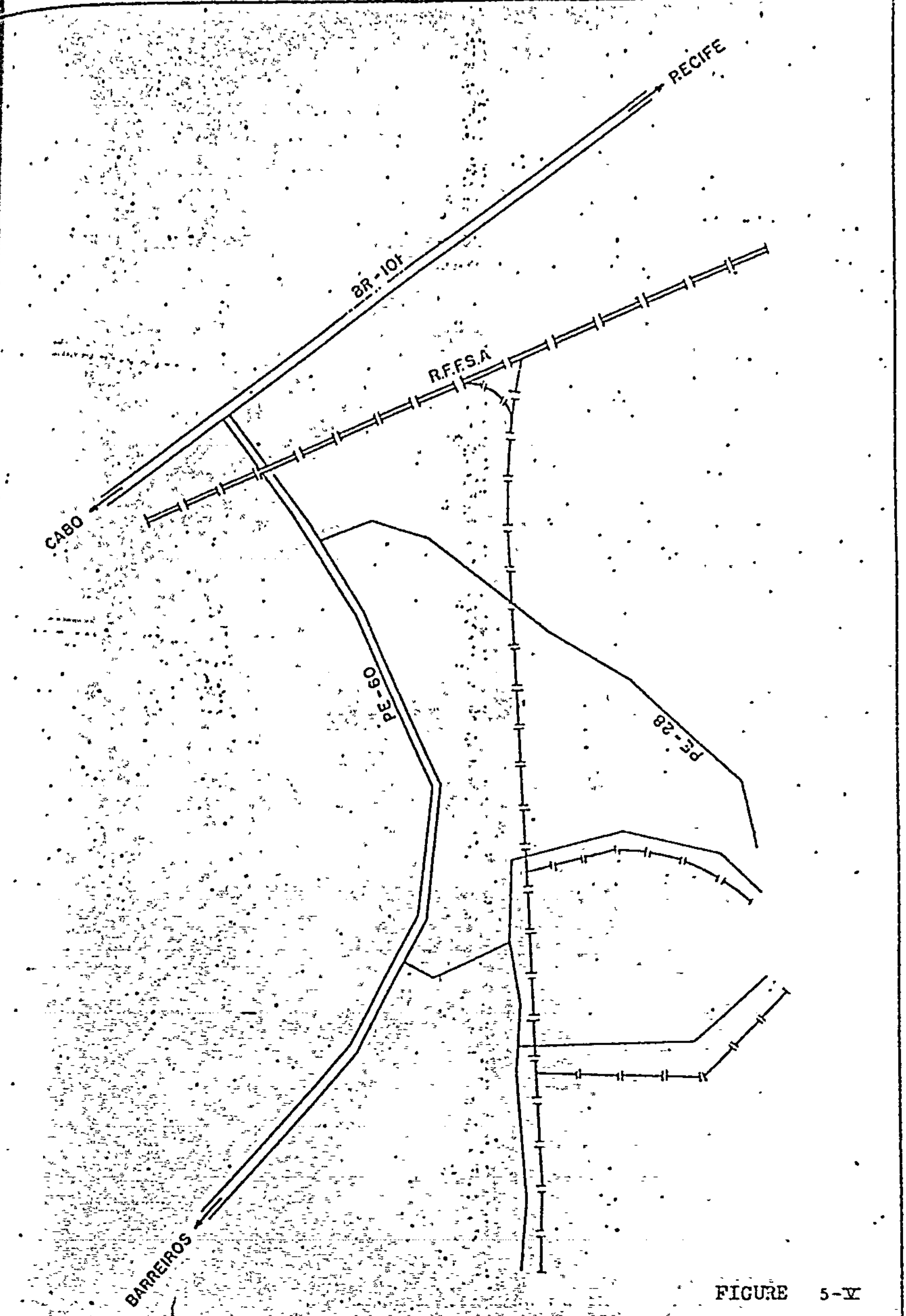


FIGURE 5-V

dipor

TRAMACON SA

COMPLEXO INDUSTRIAL DE SUAPE

SKETCH OF HIGHWAY/RAILROAD SYSTEM TO THE PORT

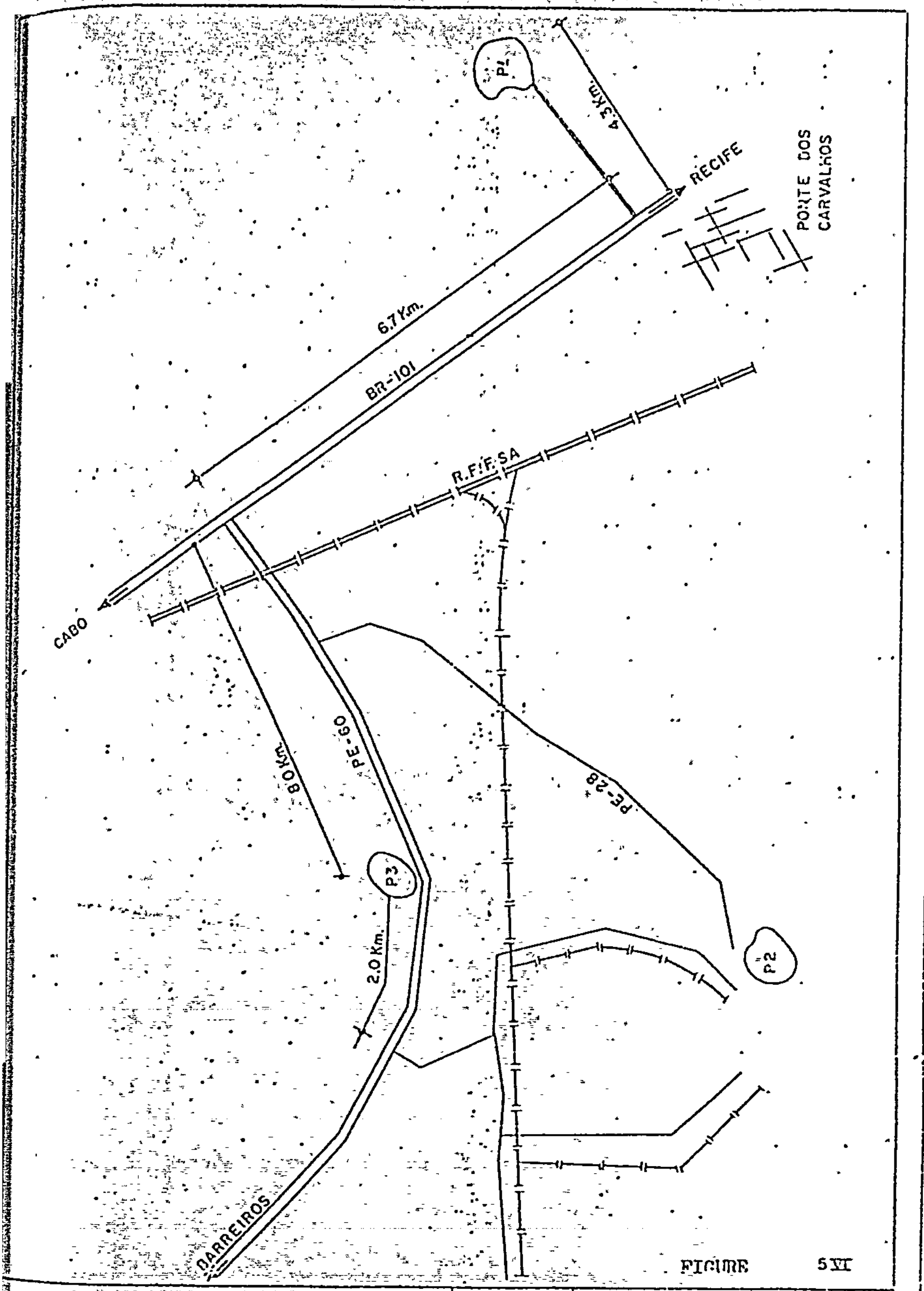


FIGURE 5 VI

diper

TRANSCON SA

LOCATION OF QUARRIES

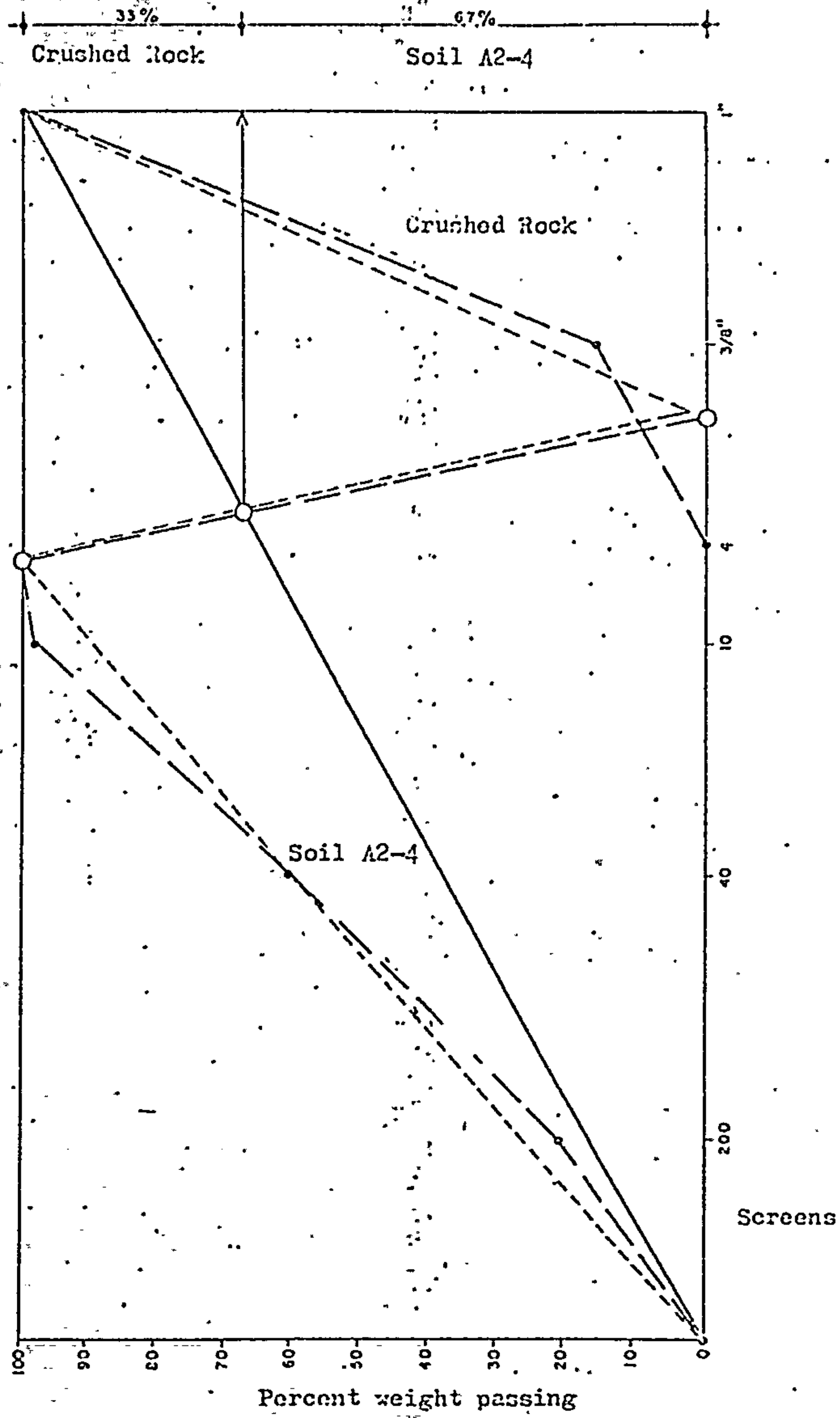


FIGURE 5-XII

GOVERNO DO ESTADO DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

diper

TRANSCON S.A

SOIL-ROCK MIXTURE
SOIL A2-4 WITH CRUSHED ROCK

RANGE OF THE MIXTURE: RANGE "D" (BASE)

TOMO IV
PARTE 2
VOLUME 2
6.0

6.0 SPECIAL CIVIL CONSTRUCTIONS

TOMO

6.0 SPECIAL CIVIL CONSTRUCTIONS

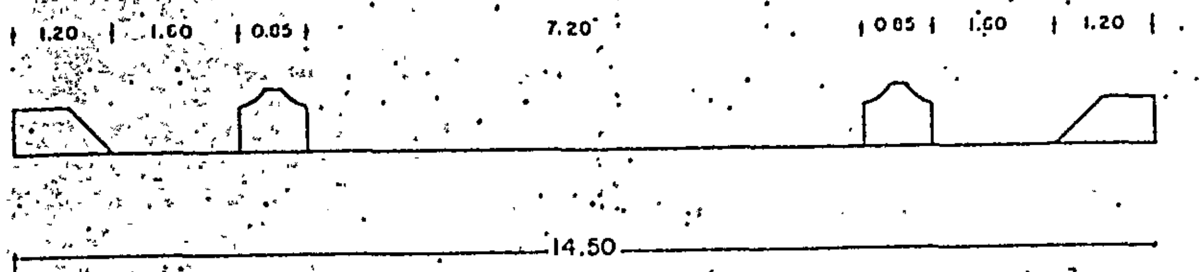
6.1 DESCRIPTIONS

The following bridges were planned to overcome the water courses that will continue to cross the roadbeds even after hydrological work has been done:

Highway Section	Water Course	Span (m)	Width (m)
Port Route 1	Algodoais Canal	52	14.50
Distribution Trunk	Ipojuca Canal	24	13.00
Main Access Road	Tabatinga River	40	13.00
Townsite Access 1	Ipojuca River	100	14.50
Distribution Trunk	Jasmin River	9	13.00
Distribution Trunk	Tabatinga River	40	13.00

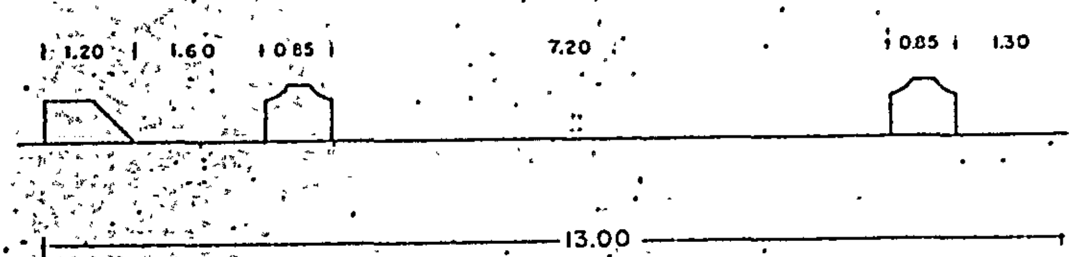
The typical transversal section adopted allows for passage of pedestrians and bicycle riders, appropriately protected from the vehicle traffic. For the sections where the heaviest traffic will occur, and where a future doubling the number of lines is expected in the future, the tranversal section is 13 m wide, and could be doubled with loss of only one shoulder.

OTHER ROADS



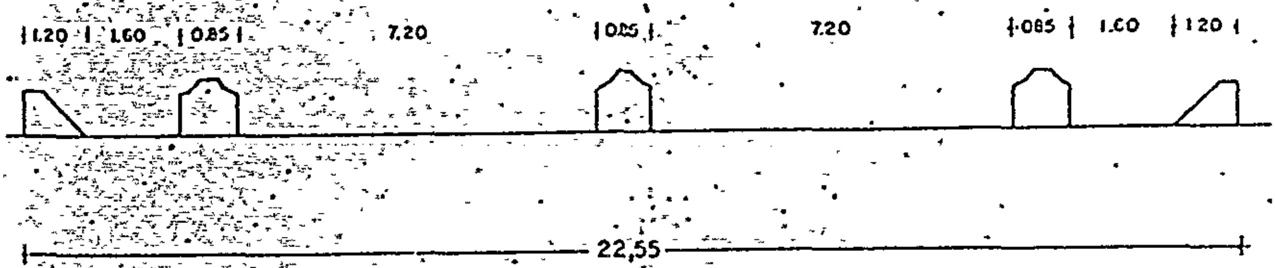
Scale 1:100

MAIN ACCESS ROAD AND DISTRIBUTION TRUCK



Scale 1:100

DUPLICATION



Scale 1:125

diper

TRANSCON S.A.

GOVERNO DO ESTADO DE PERNAMBUCO [illegible]
[illegible]
DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

TYPICAL SECTIONS

[illegible]

TOMO IV
PARTE 2
VOLUME 2
7.0

7.0 OVERALL BUDGET

7.0 OVERALL BUDGET - HIGHWAY SYSTEM

Description	Cr$
Conventional Civil Constructions	58,139.60
Special Civil Constructions	4,362,792
Earth Moving	19,389,910
Paving	32,384,355
SUBTOTAL	61,951,037
Engineering and Inspection	6,195,103
TOTAL	68,146,140

CONVENTIONAL CIVIL CONSTRUCTIONS BUDGET

	Culverts		Deep Drains		Gutters		Benches		Protection Ditches		Plant Covering	
	Unit. Cr$563,50		Unit. Cr$50,00		Unit. Cr$30,00		Unit. Cr$50,00		Unit. Cr$5,00		Unit. Cr$2,50	
	Ext. m	Total Cr$	Ext. m	Total Cr$	Ext. m	Total Cr$	Ext. m	Total Cr$	Ext. m	Total Cr$	Area m²	Total Cr$
Main Access	66	37,191	930	46,500	920	27,600	920	46,000	930	4,650	11,800	29,500
Dist. Trunk + Section Port Route 1	657	370,219	3,160	158,000	3,528	105,840	6,240	312,000	3,530	17,650	56,000	140,000
2nd Section Port Rte 1 + Sec. Access - Bulk Products Port	672	378,160	2,980	149,000	4,200	55,300	6,330	316,500	4,200	21,000	48,600	121,500
Townsite Access 1 + Townsite Road 1	354	199,477	1,170	58,500	2,070	62,100	2,900	145,000	930	4,650	61,300	153,250
Access N S do O + Port Route V	-	-	-	-	1,500	45,000	-	-	1,400	7,000	22,000	55,000
Townsite Circuit	191	107,620	1,376	68,800	2,240	67,200	2,200	110,000	2,240	11,200	19,810	49,525
Road 2	83	46,770	708	35,400	710	21,300	1,830	91,500	710	3,550	13,000	32,500
Road 3	177	99,739	1,580	79,000	2,660	79,800	1,090	54,500	2,670	13,350	7,820	19,550
Road 4	88	49,587	-	-	640	19,200	-	-	640	3,200	1,290	3,225
Road 5	205	115,517	1,870	93,500	1,870	56,100	1,620	81,000	1,670	8,350	14,790	36,975
Sec. Access to Refinery	89	50,151	1,060	53,000	1,460	43,800	1,770	88,500	1,460	7,300	16,700	41,750
Port Rte 3 + Rte 4 + Sec. Access Fertilizers	-	-	700	35,000	1,860	55,800	11,440	572,000	1,860	9,300	78,300	195,750
Sec. Access to Cement Factory					-		2,440		-	-	17,270	
Total Drainage Cost (Cr$ 5,813,980.00)	2,580	1,453,839	15,540	777,000	22,170	665,100	38,800	1,940,000	22,170	110,850	346,880	867,200

EARTH MOVING BUDGET

Services	Unit	Quantity	Unit.Cr$	Subtotal (
Cut and fill excavation of 1st category material with transport distance up to 0.4 km	m^3	647,000	4.33	2,801,51(
Cut and fill excavation of 1st category material with transport distance between 0.4 and 0.8 km	m^3	636,000	6.10	3,879,60(
Cut and fill excavation of 1st category material with transport distance between 0.8 and 1.5 km	m^3	1104,000	8.50	9,384,00(
Cut excavation of 2nd category material with transport distance up to 0.2 km	m^3	96,000	12.00	384,000
Cut excavation of 3rd category material with transport distance up to 0.2 km	m^3	48,000	25.00	1,200,000
Deforesting, stump grubbing and clearing	m^2	1107,000	0.18	199,260
Compaction	m^3	1694,000	0.91	1,541,540
TOTAL				19,389,910

PAVING BUDGET

Services	Unit	Main Access	Dist. Trunk + Port Route 1	P Rte 3 + Sect P Rte 4 + Sec. Access Fertilizer Plant	Secondary Access to Bulk Products Port	Section Port Rte 5 + Access to N S do O	Townsite Access 1 + Road 1	Townsite Circuit	Road II	Road III	Road IV	Road V	Secondary Access to Refinery	Total	Unit Cost	Total Cost
Subgrade Regularization	m²	22,166	81,673	39,450	64,393	55,500	94,350	52,350	20,550	32,250	8,100	25,200	34,860	622,574	6.95	375,320.55
Subgrade Reinforcement	m³	-	-	-	49,315	-	-	-	-	-	-	-	-	40,315	11.56	478,235.22
Sub-base	m³	7,308	23,527	33,128	18,659	21,312	36,230	20,102	7,831	12,384	3,120	9,927	13,363	215,486	11.25	2,563,523.25
Base	m³	4,212	14,059	17,101	14,229	9,333	16,810	9,423	3,692	5,605	1,458	4,644	6,264	109,450	50.31	5,506,333.52
Priming	m³	20,332	72,600	87,316	69,344	48,840	83,028	46,063	18,684	28,380	7,128	22,706	30,476	535,225	2.99	1,600,332.72
Double Surface Treatment	m³	26,332	72,603	87,316	69,344	48,840	83,028	46,063	18,684	20,380	7,128	22,766	30,476	535,228	6.00	4,222,324.23
10 cm Bit. Concrete	m²	11,212	33,600	-	137,944	-	-	-	-	-	-	-	-	83,776	32.15	2,763,372.43
5 cm Bit. Concrete	[illegible]	-		47,736										47,736	16.25	775,336.42
Transportation																
Reinforcement Material (3 km)	m³xkm	-	-	-	120,945	-	-	-	-	-	-	-	-	120,945	3.55	429,354.75
Sub-base Material (10 km)	m³xkm	78,640	273,270	381,880	183,330	213,120	362,300	261,020	78,910	133,840	31,109	99,093	133,630	2,154,912	3.13	6,775,156.35
Base Material (20 km)	m³xkm	64,240	227,000	338,020	284,580	199,300	339,660	183,460	73,980	116,100	27,360	92,226	125,329	2,139,160	3.03	6,633,254.63
TOTAL																22,384,226.77

SPECIAL CIVIL CONSTRUCTIONS - BUDGET

Bridge	Length	Unit	Total
Port Route 1 over the Algodoais Channel	52	14,973.97	778,646.20
Distribution Trunk over Ipojuca Channel	24	15,456.85	370,964.35
Main Access Road over Tabatinga River	49	13,584.76	665,653.39
Townsite Access Road 1 over Ipojuca River	100	16,188.41	1,618,840.57
Distribution Trunk over Jasmin River	9	27,736.57	249,629.17
Distribution Trunk over Tabatinga River	40	16,976.45	679,058.12
TOTAL			4,362,791.80

BOOK IV - PART 3

RAILROAD SYSTEM

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1.0

1.0 TRAFFIC

PART 3 - RAILROAD SYSTEM

1.0 TRAFFIC

1.1 TRAFFIC FORECAST

Analagously to the highway system, the railroad system consists of a Distribution Trunk Line starting at a main yard connected with the 3rd RFFSA division's south line, three branch lines to the port and one branch line to the petroleum refinery.

The Railroad Distribution Trunk Line starting from the main yard will run approximately parallel to the Highway Distribution Trunk Line and will branch off from there with one branch line running to the Collective Port, one branch line between Highway Port Routes II and III to Z-1 and Z-2 central, and another branch line approximately parallel to the Highway Port Route V for the coastal industrial zone.

The Railroad Distribution Trunk Line will be single tracked to the ZR-2 townsite since the possibility of extending passenger traffic from there to Recife has been forecast. The line would pass through a railroad station built next to the administration area, as described in the highway system section.

In the first stage the main yard module adequate to meet forecast demand, the Railroad Distribution Trunk Line, the branch lines to the collective port and to the aluminum and fertilizer plants will be installed.

Based on the forecast presented in Table 1/1 of Railroad Transport with origin or destination at Suape, the following annual and dialy railroad car cargos for 1980, 1985, 1995 and 2005 were obtained.

YEAR 1980

PRODUCT	ANNUAL TONNAGE (1,000 t)	RR CAR CAPACITY, in tons	No. of RR CARS/ YEAR	RR CARS/DAY (YEAR 330 d)
A_1 - Destination Bulk Products Port	250	42	5,953	18
Subtotal A	250		5,953	18
B_1 - Destination - Fertilizer Plant				
LIQUID AMMONIA	7	30	234	1
UREA	38	42	905	3
Subtotal B	45		1,139	4
B_2-ORIGIN- Fertilizer Plant	100	42	2,381	8
Subtotal	100		2,381	8
SUBTOTAL	145		3,520	12
C_2-ORIGIN-Petroleum Refinery				
Liquid Petroleum Derivatives	380	30	12,667	39
Subtotal C	380		12,667	39
T O T A L	775		22,140	69

YEAR 1985

PRODUCT	ANNUAL TONNAGE (1,000 t)	RR CAR CAPACITY in tons	No. of RR CARS/ YEAR	RR CARS/DAY (YEAR 330 d)
A_1- Destination Bulk Products Port	700	42	16,667	51
Subtotal A	700		16,667	51
B_1- Destination - Fertilizer Plant				
LIQUID AMMONIA	17	30	567	2
UREA	103	42	2,453	8
Subtotal B	120		3,020	10
B_2-Origin- Fertilizer Plant	200	42	4,762	15
Subtotal	200		4,762	15
SUBTOTAL	320		7,782	25
C_2-Origin-Petroleum Refinery				
. Liquid Petroleum Derivatives	480	30	16,000	49
Subtotal C	480		16,000	49
T O T A L	1,500		40,349	125

YEAR 1995

PRODUCT	ANNUAL TONNAGE (1,000 t)	RR CAR CAPACITY in tons	No. of RR CARS/ YEAR	RR CARS/DAY (YEAR 330 d)
A_1- Destination Bulk Products	1,200	42	28,572	87
Port Subtotal A	1,200		28,572	87
B_1- Destination - Fertilizer Plant				
LIQUID AMMONIA	49	30	1,634	5
UREA	181	42	4,310	13
Subtotal	230		5,944	18
B_2-Origin- Fertilizer Plant				
Subtotal	250	42	5,953	18
SUBTOTAL B	250		5,953	18
	480		11,897	36
C_2-Origin-Petroleum Refinery				
Liquid Petroleum Derivatives	790	30	26,334	80
Subtotal C	790		26,334	80
T O T A L	2,470		66,803	203

YEAR 2005

PRODUCT	ANNUAL TONNAGE (1,000 t)	RR CAR CAP. CITY in tons	No. of RR CARS/ YEAR	RR CARS/DAY (YEAR 330 d)
A_1- Destination Bulk Products Port	1,300	42	30,953	94
Subtotal A	1,300		30,953	94
B_1- Destination - Fertilizer Plant				
LIQUID AMMONIA	49	30	1,634	5
UREA	181	42	4,310	13
Subtotal	230		5,944	18
B_2-Origin- Fertilizer Plant				
Subtotal	250	42	5,953	18
SUBTOTAL B	250		5,953	18
	480		11.897	36
C_2-Origin-Petroleum Refinery				
Liquid Petroleum Derivatives	1,500	30	50,000	152
Subtotal C	1,500		50,000	152
T O T A L	3,200		92,850	282

TABLE 1/1

PROJECTED LAND TRANSPORT (HIGHWAY)

A – ORIGIN SUAPE

PRODUCT/DESTINATION	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
FERTILIZERS	100	100	100	100	200	200	200	200	200	200	200	250	250	250	250	250	250	250	250	250	250	250	250	250	[illegible]	250
– Interior of Pernambuco	50	50	50	50	100	100	100	100	100	100	100	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
– Alagoas	50	50	50	50	100	100	100	100	100	100	100	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
PETROLEUM DERIVATIVES (!)	283	295	415	435	455	480	500	530	560	585	610	650	680	710	750	790	840	900	960	1.030	1.092	1.170	1.250	1.330	1.400	1.500
– Interior of Pernambuco	313	303	435	435	455	480	500	530	550	525	610	650	680	710	750	790	840	900	960	1.030	1.050	1.170	1.250	1.330	1.400	1.500
TOTAL	333	331	435	435	455	480	500	530	560	585	610	650	680	710	750	790	840	900	1.210	1.260	1.340	1.420	1.490	[illegible]	[illegible]	1.750

B – DESTINATION SUAPE

PRODUCT/ORIGIN	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
SUGAR	250	300	460	500	600	700	700	800	800	900	900	1.000	1.030	1.100	1.100	1.200	1.200	1.300	1.300	1.300	1.300	1.300	1.350	[illegible]	[illegible]	[illegible]
																			1.300	1.300	1.300	1.300	[illegible]	[illegible]	[illegible]	[illegible]
– Interior of Pernambuco, Paraíba and R. G. do Norte	250	300	460	500	600	700	700	800	800	900	900	1.000	1.030	1.100	1.100	1.200	1.200	1.300	1.300	1.300	1.300	1.300	1.350	1.300	1.300	1.350
AMMONIA	7	7	7	7	17	17	17	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
– Camaçari	7	7	7	7	17	17	17	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
UREA	38	33	33	38	103	103	103	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131
– Camaçari	38	33	36	36	103	103	103	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131
TOTAL	325	345	465	545	720	[illegible]	820	1.030	1.030	1.130	1.130	[illegible]	1.230	1.330	1.330	1.430	1.530	1.530	1.530	1.530	1.530	1.530	1.530	1.530	1.530	1.530

(!) Assumed creation of a proving base in Salgueiro and/or Petrolina to supply the Pernambucan Sertão.

1.2 TRAIN MOVEMENT

1.2.1 RUNNING TIMES

Even though the basic design's technical conditions are excellent, the velocity assumed for train traffic on the Suape line will be low. The distances between the releasing stations and between the switches for branch lines are so short that the mean velocity can be considered equal to 20 km/hour.

Therefore we have the following values for running times.

1) From the main yard to releasing station 1 -
   Distance = 5.79 km; $t = \frac{5.79}{20} \simeq 18$ minutes

2) From releasing station 1 to releasing station 2 -
   Distance = 4.96 km; $t = \frac{4.96}{20} \simeq 15$ minutes

3) From releasing station2 to the Refinery -
   Distance = 2.57 km; $t = \frac{2.57}{20} \simeq 8$ minutes

4) From releasing station 1 to the Bulk Products Port
   Distance = 5.00 km; $t = \frac{5.00}{20} \simeq 15$ minutes

5) From releasing station 2 to the Fertilizer Plant -
   Distance = 5.61 km; $t = \frac{5.61}{20} \simeq 17$ minutes

1.2.2 TRAINS

A YEAR - 1980 - SCHEMATIC 1 (FIGURE 1-I)

In this year, in accordance with the daily cargo flows and railroad cars to be handled, the following trains should run on the Suape line.

a 18 railroad cars carrying sugar should arrive daily at the bulk products port for unloading.

These 18 cars will make up just 1 train.

b 8 railroad cars to be loaded with fertilizers and 4 carrying ammonia and urea to be unloaded should arrive daily at the fertilizer plant.

These 12 cars will make up just 1 train.

c 39 railroad cars should arrive daily at the petroleum refinery to be loaded with petroleum derivatives.

These 39 cars will make up 2 trains of 19 to 20 cars each.

The graph for 1980 in Figure 1-II diagrams the movement of the trains, 24 Hours a day.

B YEAR - 1985 - SCHEMATIC 2 (FIGURE 1-III)

In this year, in accordance with the daily cargo flows and railroad cars to be handled, the following trains should run on the Suape line.

a_1 51 railroad cars carrying sugar should arrive daily at the bulk products port for unloading.

These 51 cars will make up 2 trains of 25 to 26 cars each.

b_1 15 railroad cars to be loaded with fertilizers and 10 carrying ammonia and urea to be unloaded should arrive daily at the fertilizer plant.

These 25 cars will make up just 1 train.

c_1 49 railroad cars should arrive daily at the petroleum refinery to be loaded with petroleum derivatives.

These 49 cars will make up 2 trains of 24 to 25 cars each.

The graph for 1985 in Figure 1-II diagrams the movement of the trains, 24 hours a day.

C YEAR - 1995 - SCHEMATIC 3 (FIGURE 1-IV)

In this year, in accordance with the daily cargo flows and railroad cars to be handled, the following trains should run on the Suape line.

a_2 87 railroad cars carrying sugar should arrive daily at the bulk products port for unloading.

These 87 cars will make up 4 trains of 21 to 22 cars each.

b_2 18 railroad cars to be loaded with fertilizers and 18 carrying ammonia and urea to be unloaded should arrive daily at the fertilizer plant.

These 36 cars will make up 2 trains of 18 cars each.

c_2 80 railroad cars to be loaded with petroleum derivatives should arrive daily at the petroleum refinery.

These cars will make up 3 trains of 26 to 27 cars each.

The graph for 1995 in Figure 1-V diagrams the movement of the trains, 24 hours a day.

D YEAR - 2005 - SCHEMATIC 4

In this year, in accordance with the daily cargo flows and railroad cars to be moved, the following trains should run on the Suape line.

a_3 94 railroad cars carrying sugar should arrive daily at the bulk products port for unloading.

These 94 cars will make up 4 trains of 23 to 24 cars each.

b_3 18 railroad cars to be loaded with fertilizers and 18 carrying ammonia and urea to be unloaded should arrive daily at the fertilizer plant.

These 36 cars will make up 2 trains of 18 cars each.

c_3 152 railroad cars should arrive daily at the petroleum refinery to be loaded with petroleum derivatives.

These 152 cars will make up 5 trains of 30 to 31 cars each.

The graph for 2005 in Figure 1-VII diagrams the movement of the trains, 24 hours a day.

The bulk products terminals, the fertilizer plant and the petroleum refinery should all have sidings for the switching needed to position the cars for loading and/or unloading and for returning the locomotive to the head of the train.

As can be seen from the diagrams showing the train schedules, their length of time in the terminals appears to be sufficient for loading and/or unloading the cars. In the event that the terminal facilities don't have the necessary capacity for loading the cars in the projected lengths of time, supplementary sidings will be indispensable for accomodating the train that is arriving as well as the one which remains loading or unloading. They will also permit the mandatory maneuvers of removing one train and placing the other at the loading and/or unloading sites.

The railroad cars that enter and leave Suape will be weighed by an automatic electronic scale located near releasing station no. 1, before the first branching.

1.2.3. COMMUNICATIONS

Operation of trains on the line demands a communication system linking the terminals, the releasing stations and the main yard.

Based on the basic design level graph made of the trains, consultants recommend that a selective call telephone system be installed. The system could eventually be connected to the system already existing for the RFFS/A's third Northeast division, at whose southern line the Suape railroad yard and line originate. It is also indispensible that the locomotives, releasing stations and yard control tower be equipped with hand talk radios capable of covering the Complex's entire area. This device will make possible direct communication between the control tower and interested parties and will permit more speed and safety in operating and switching trains.

1.2.4 RELEASING OF TRAINS

Even though it might be possible to use the selective call telephone system to release the trains between the Suape yard and the various terminals, for safety reasons the consultants recommend that a staff electric releasing system be installed. This equipment would be installed at the railroad yard and releasing stations 1 and 2 (See schematics 1, 2, 3 and 4), (Figures 1-I/III/IV/VI).

As can be inferred from the train graphs there is no need for a more sophisticated releasing system unless there is a desire to economize on labor.

Each releasing station will have to be manned 24 hours a days by one operator, just like the station at the main yard.

Switchmen would not be needed on the line. They would be replaced by the releasing station operators or by the train crew switchmen who would, in any event, have to perform switching at the terminals.

Thus the two stations would need nine persons (four employees for each stations plus one as a cover for holidays and leaves). No train would leave a terminal without first having been authorized to do so by the operator of the respective releasing stations through the selective call telephone system. This will assure better control and traffic safety.

1.2.5 SIGNALLING

Light signals, working on local batteries and operated by the releasing station operators, could be used to indicate to the locomotive engineer how close the train is to the switching devices in front of which the train has to stop or slow down in order to receive the releasing signal.

In general two consecutive signals would be installed in each direction. The first would be the approach or warning signal and the second would be the full stop or proceed at slow speed signal. The signal characteristics would comply with the Brazilian railroad signalling standards.

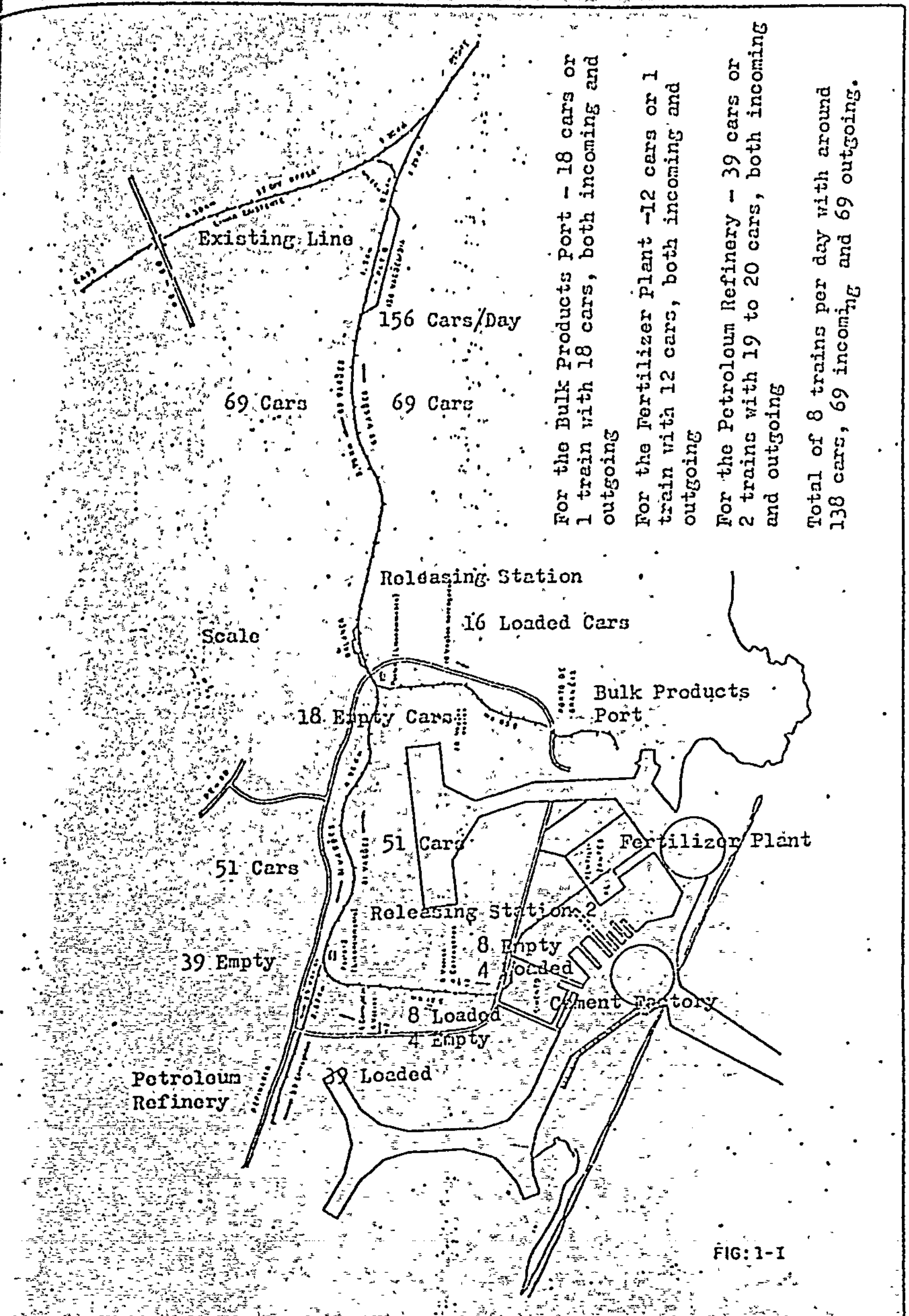


FIG: 1-I

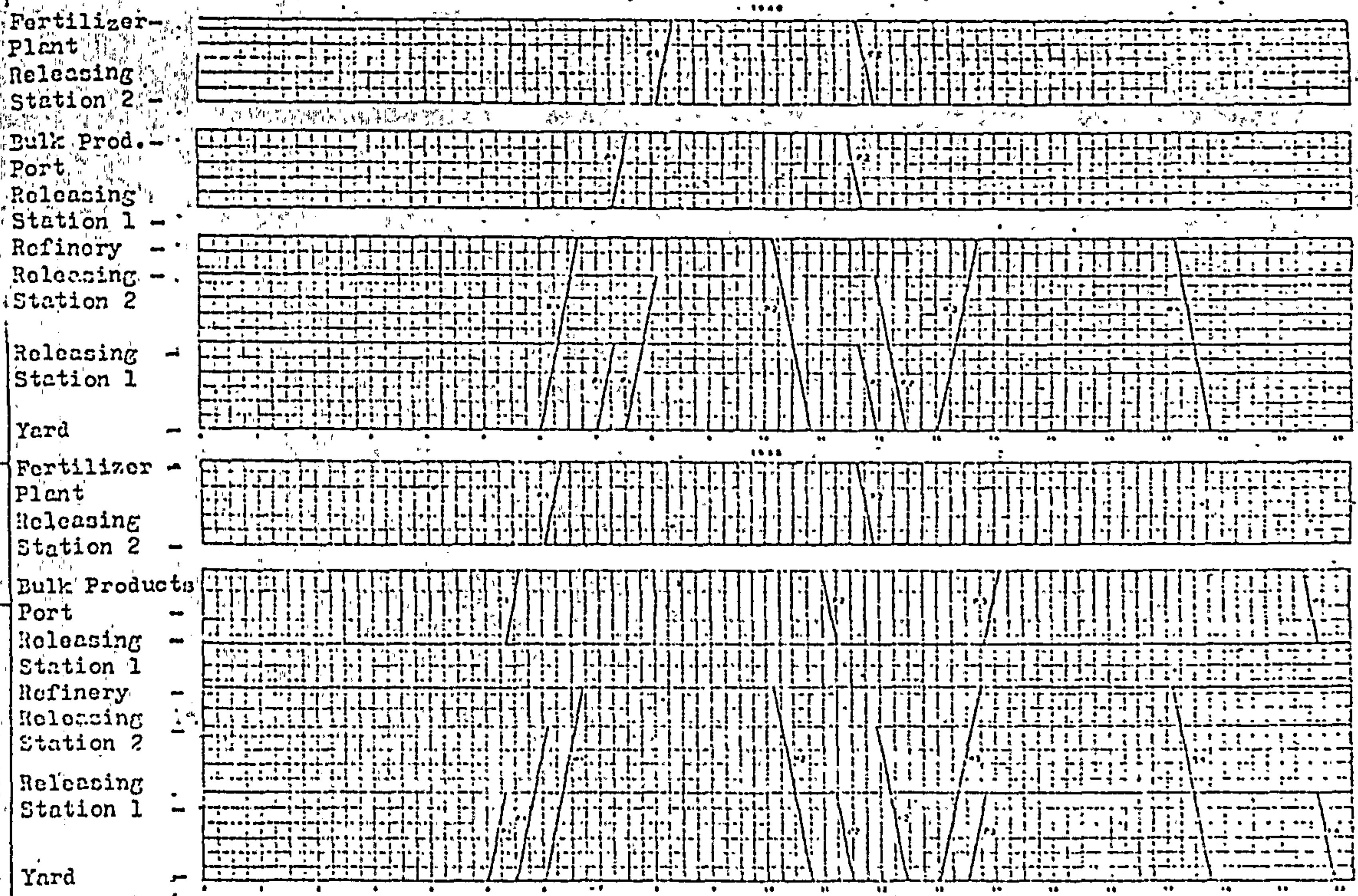
dipor

TRANSCON S.A.

COMPLEXO INDUSTRIAL DE SUAPE

SCHEMATIC OF SUAPE BRANCH LINES - 1980

SCHEMATIC 1



- NOT TO SCALE
- DIMENSIONS IN MILLIMETERS

diper

TRANSCON SA

COMPLEXO INDUSTRIAL DE SUAPE

GRAPH OF TRAIN MOVEMENTS
1980 - 1985

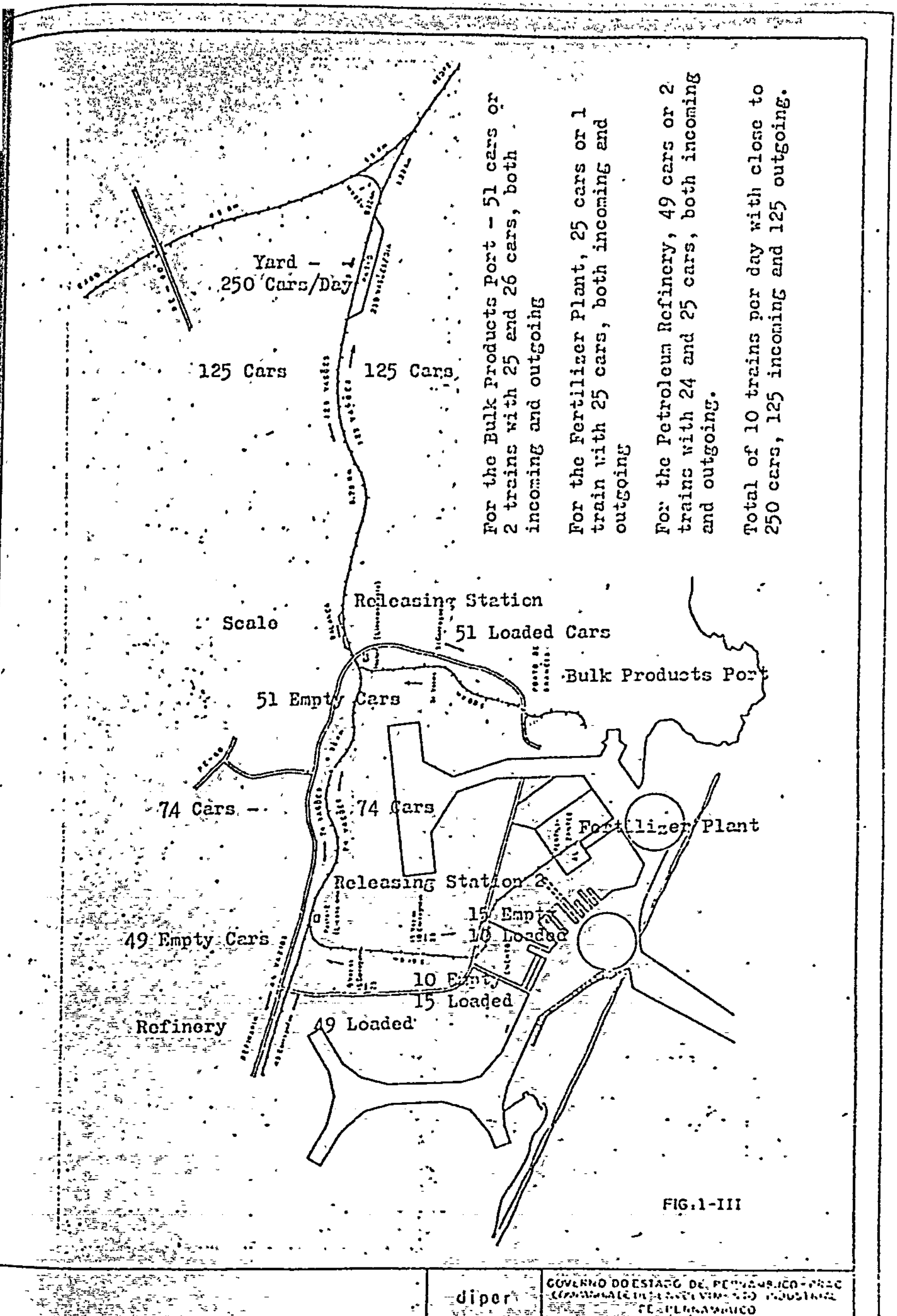


FIG.1-III

diper

TRANSCON SA

GOVERNO DO ESTADO DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

SCHEMATIC OF SUAPE BRANCH LINES - 1985
SCHEMATIC 2

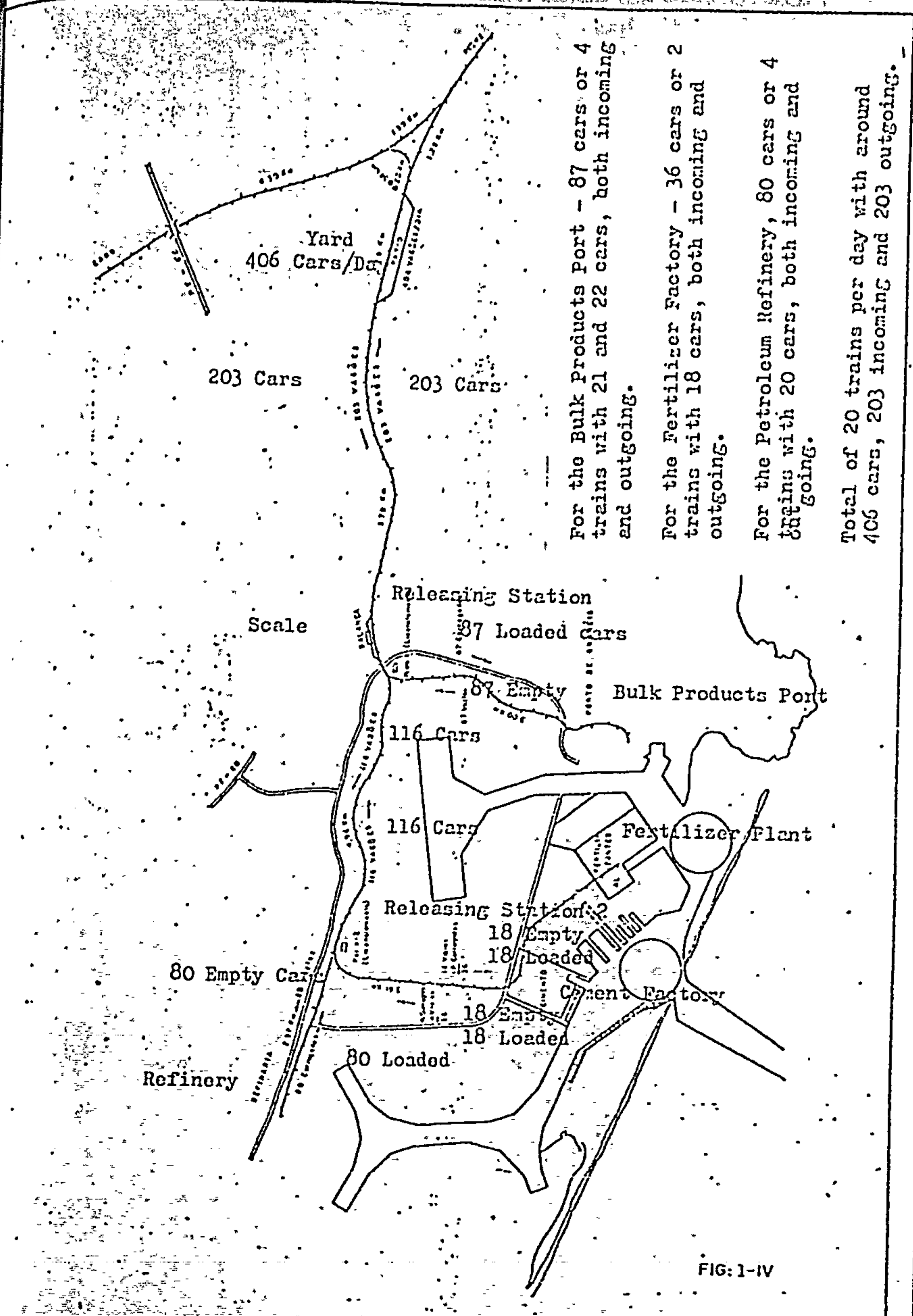


FIG: 1-IV

dipor

TRANSCON SA

GOVERNO DO ESTADO DE PERNAMBUCO - PHAC
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL DE PERNAMBUCO
COMPLEXO INDUSTRIAL DE SUAPE

SCHEMATIC OF SUAPE BRANCH LINES – 1995
SCHEMATIC 3

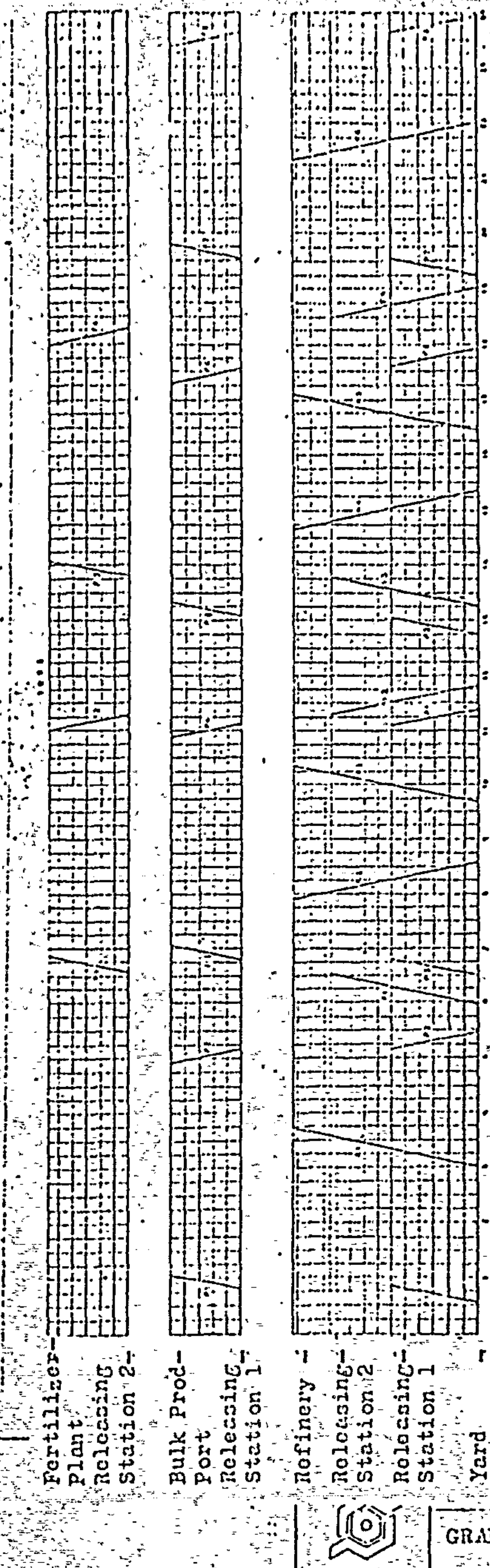


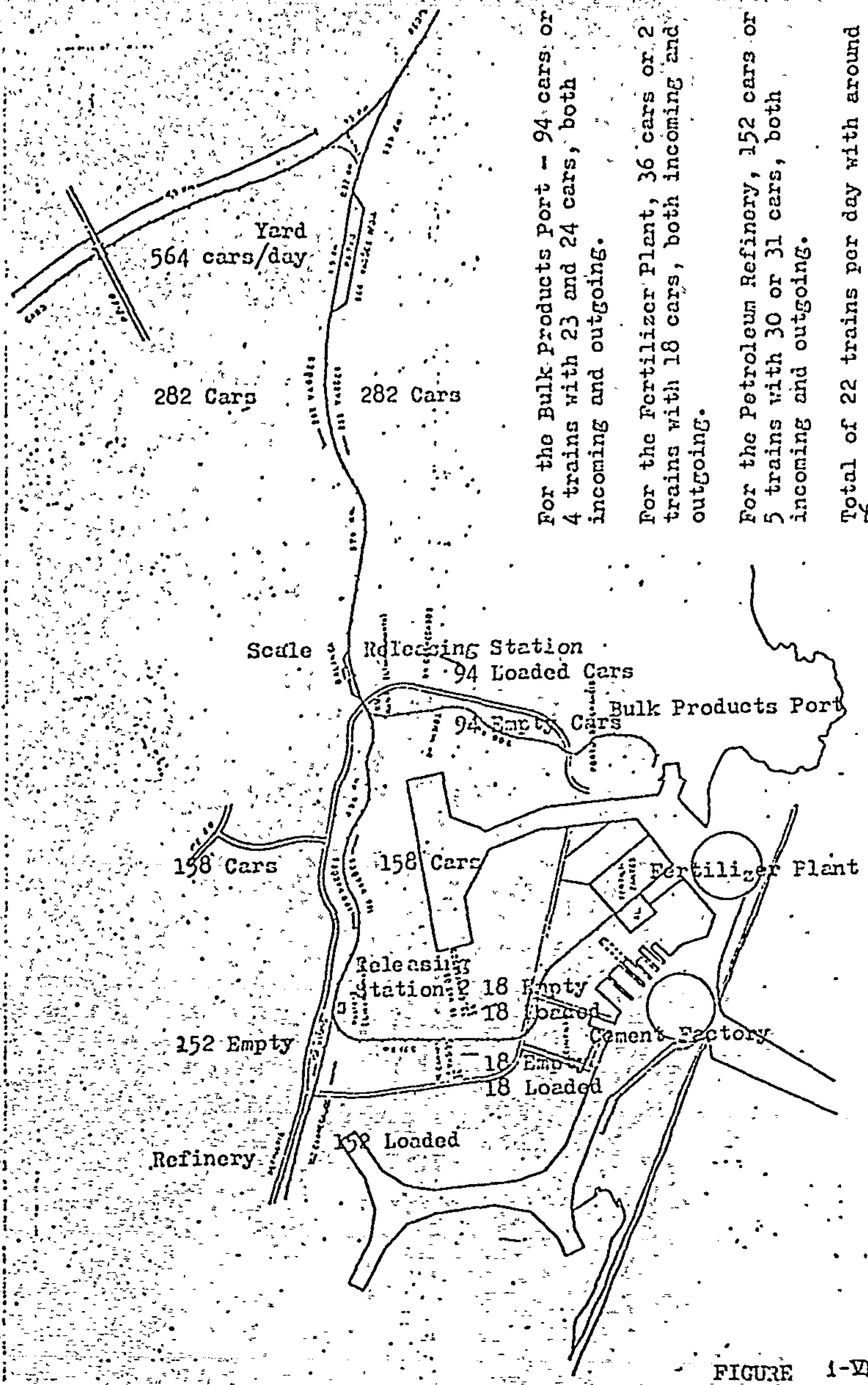
FIG: 1-V

- NOT TO SCALE
- DIMENSIONS IN MILLIMETERS

TRANSCON S.A.

O DO ESTADO DE PERNAMBUCO - ...
... DE DESENVOLVIMENTO INDUSTRIAL DE PERNAMBUCO
...PLEXO INDUSTRIAL DE SUAPE

GRAPH OF TRAIN MOVEMENTS
1995



For the Bulk Products Port - 94 cars or 4 trains with 23 and 24 cars, both incoming and outgoing.

For the Fertilizer Plant, 36 cars or 2 trains with 18 cars, both incoming and outgoing.

For the Petroleum Refinery, 152 cars or 5 trains with 30 or 31 cars, both incoming and outgoing.

Total of 22 trains per day with around 564 cars, 282 incoming and 282 out.

FIGURE 1-VI

dipor

GOVERNO DO ESTADO DE PERNAMBUCO - PRAC
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL
DE PERNAMBUCO
COMPLEXO INDUSTRIAL DE SUAPE

SCHEMATIC OF SUAPE
BRANCH LINES - 2005
SCHEMATIC 4

TRANSCON S.A.

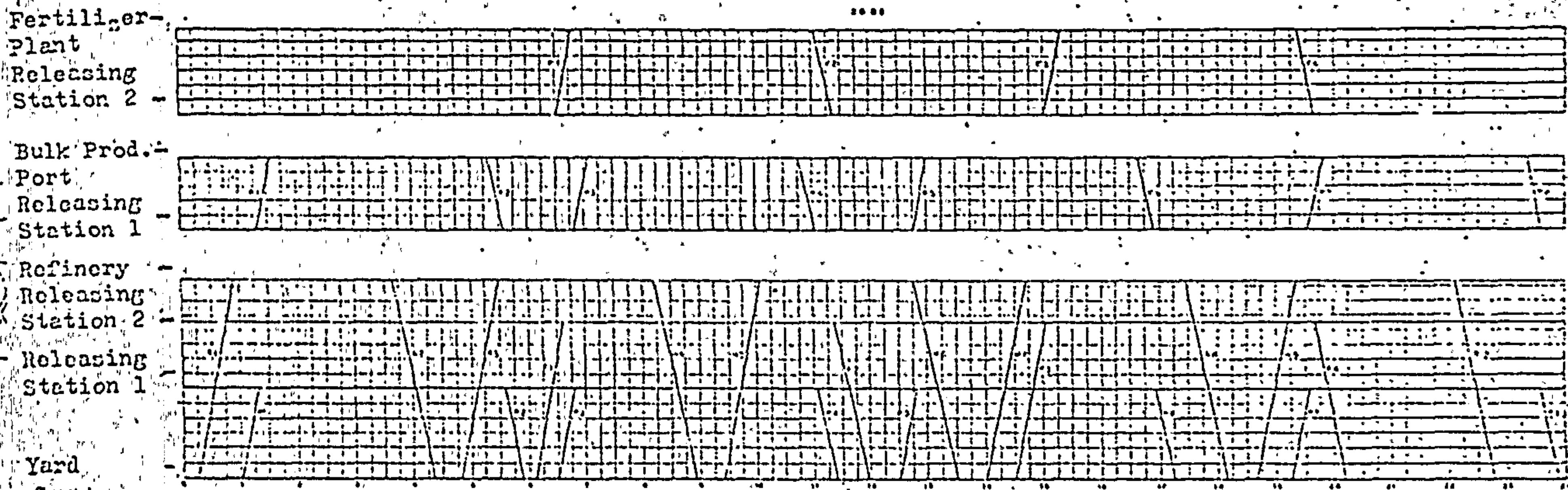


FIGURE 1-VII

TADO DE PERNAMBUCO - PHAC
SENVOLVIMENTO INDUSTRIAL
E PERNAMBUCO
INDUSTRIAL DE SUAPE

GRAPH OF TRAIN MOVEMENTS
2005

TRANSCON SA

2.0 BASIC GEOMETRICAL DESIGN

2.0 BASIC GEOMETRICAL DESIGN

2.1 CONSIDERATIONS

The railroad network links the various port branch lines to the principal line that connects with the RFFSA. Traffic in the network is directed by the operations control center located in the shunting yard. The routes proposed are intended to fit simultaneously the region's technical and economic conditions and the port industrial complex's operating framework without hindering the functions for which the adjacent areas are designed.

2.2 HORIZONTAL PLAN AND PROFILE

2.2.1 CHARACTERISTICS

The philosophy expressed above guided the determination of the railroad's characteristics.

The track system was drafted on a 1:10,000 scale based on aerial photographs on a 1:30,000 scale, restitution of this aerial photographic survey on a 1:10,000 scale, and local reconnaisance.

The Railroad Distribution Trunk Line and the main branch were designed with a minimum horizontal radius of 350 m and a maximum grade of 0.5%.

The port branch lines have a minimum horizontal radius of 245 m and a maximum grade of 0.5%.

The following additional factors were considered in the basic design horizontal plan and profile.

- Minimum height of landfill in the low areas that will assure uninterrupted traffic even in the case of floods. A geometric levelling of the floodwater marks from the 1970 flood was made and the elevation arrived at was 3.80 m at Usina Salgado.

- Elevation of the port apron = 2.70 m.

- Dredging of the main waterways crossed: Ipojuca, Pindorama, Tabatinga, Jasmim, Algodoais and Prego.

- Highway/railroad crossings.

- Railroad branch line crossings of the RFFSA.

- Railroads grades compatible with future private sidings.

2.2.2 PRESENTATION

The railroad system is presented in a topographic plan on a 1:10,000 scale and in profile on a 1:2,000 horizontal scale and a 1:200 vertical scale. See the respective volume of drawings.

The lengths measured in the plan yield the following values:

	Length (km)
Railroad Distribution Trunk Line and main branch line (Recife)	16.74
Main line (Cabo)	0.58
Port branch line 1 (Collective port)	3.17
Port branch line 2 (Fertilizer plant)	5.22
TOTAL -	75.71

2.3 TRANSVERSAL SECTIONS

For the first stage the transversal section shown in Figure 2-I was adopted.

The Main Shunting Yard's section is shown in Chapter 5.0.

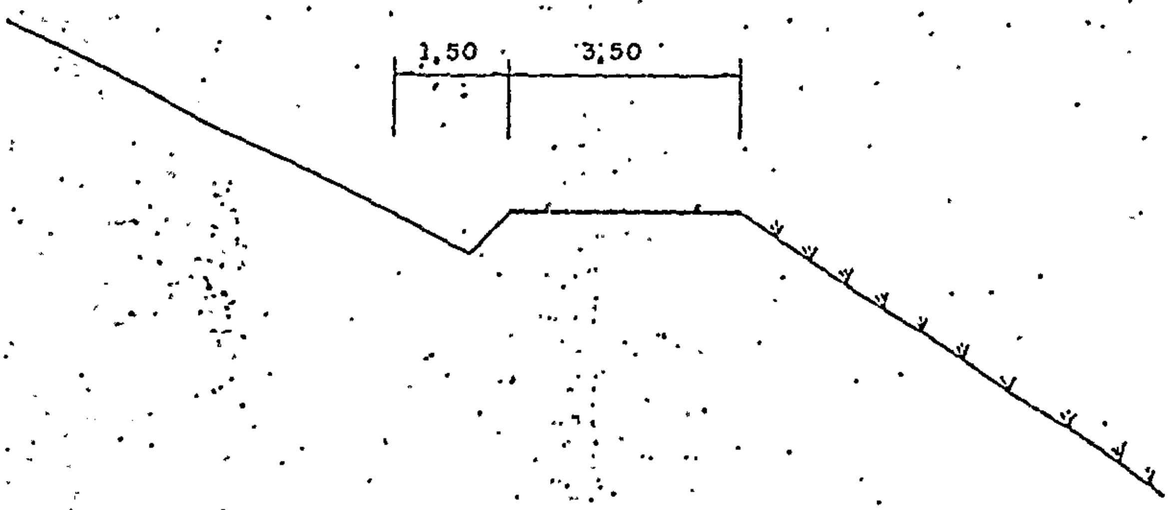


FIGURE 2-1

dipor

GOVERNO DO ESTADO DE PERNAMBUCO

DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

RAILROAD TRANSVERAL SECTION

TRANSCON SA

TOMO III
PARTE 3
VOLUME 3
3.0

3.0 EARTH MOVING

3.0 EARTH MOVING

3.1 ORIENTATION ADOPTED

The basic design for earth moving took into consideration the following factors:

- Nature of the material to be excavated
- Crossing of the mangrove swamp areas
- Volumes of material to be excavated
- Volume of compacted fill
- Mean transport distance

3.2 CUTS

For purposes of calculating volumes, embankments with a 1:1 slope were adopted for the cuts.

Whenever the cut sub-bed material shows low support capacity, it is suggested that better quality material, with expansion less than or equal to 2%, be substituted.

3.3 BORROW MATERIAL

The results of volume calculations showed a clear predominance of fill volumes over cut volumes. Widening the cuts was indicated as the first choice for obtaining borrow material in a manner that preserves the region's natural landscape as much as possible and provides better drainage and visibility conditions.

3.4 NATURE OF THE MATERIAL

The materials to be excavated were sampled by auger drillings at points where the route showed a section of cuts.

The samples obtained were laboratory tested for:

- Size consist
- Physical Limits
- Compaction and
- California Bearing Resistance (CBR)

The results are presented in Tables 3/1 and 3/2.

The nature of the materials was found to be group A2 clayey and/or silty sands and group A7 clayey silty materials, as per the HRB classification system.

For subgrade materials, a good part of the group A7 materials could be used since a low bearing resistance capacity and a higher than recommended expansion were found in only two of the drill holes. All of the group A2 material will be used.

3.5 FILLS

3.5.1 COMPOSITION

Embankment slopes for the fills constituted of cut and borrow materials were set at 3 (horizontal) : 2 (vertical) in order to determine values needed for calculation of volumes.

Use of materials with low bearing resistance (CBR less than 3) and high expansion (greater than 3%) in the fills is not recommended.

Material with expansion greater than 2% should not be used in the final layer (60 cm).

In sections where the subgrade support capacity is such that, in spite of being greater than the recommended minimum, it leads to high pavement thickness, the fill should be topped with select materials. Materials from group A2 will be suitable.

3.5.2 FILLS IN MANGROVE SWAMPS

Special attention was given to this topic. However, defining solutions for crossing mangrove swamp regions does not fit in the scope of this phase's work. It is recommended that studies be conducted at a more advanced stage for specific solutions for each fill in mangrove swamp areas. The following are suggested:

- Berms
- Vertical sand drains
- Dynamiting undesirable material

Berms

Are lateral equilibrium benches to reduce shearing tensions that occur in the fill's soft foundation layer.

Vertical sand drains

Are columns of sand penetrated into the soft layer on which the fill will be lain. They serve to accelerate the condensing processes to occur in that layer.

Dynamiting undesirable material

Consists in the elimination of the soft material by explosions either under the fill or at the base of the fill.

Use of the above suggested processes will be determined for each fill area after the characteristics of the soft material, the thickness of the layer in which it occurs, the height of fill over this soft layer and other factors, such as economy of the project design and execution time, have been checked.

In order to make cost estimates that are as realistic as possible, 2m, the value of the pole measurements taken in this region, was added to the red elevation quantities for the fill over mangrove swamps.

3.6 PRESENTATION

Cut, borrow and fill volumes and mean transport distance are listed in Table 3/3.

The cut and fill volumes were determined from the mean of the red elevations taken from the profiles.

The value 1.3 was adopted for a coefficient of expansion. Therefore the volumes are increased by 30%.

The red elevations for fills over mangrove swamps were increased by 2 meters.

The high mean transport distances arise from the fact that borrow materials will be obtained by widening the cuts. It is not difficult to realize that, in addition to the considerations cited in item 3.3, shorter transport distances cannot be realized by performing lateral borrow operations because the fills that require the largest borrow volumes are located in low areas.

The proposed transversal sections plus two meters on each side were used as a basis for predicting quantities of deforesting, stump grubbing and clearing (Table 3/4).

The excavation volumes and the transport distances were taken from Table 3/3.

The fill volumes, without added measurements for expansion, were used for the compaction volumes. Quantities for earth moving work in the various railroad system components are listed in Table 3/5.

REGISTER NO.		[illegible]	J-827	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
DRILL HOLE NO.		1	2	3	6	7	7	8	8	9	
DEPTH -cm-	FROM										
	TO	0	0	0	0	0	150	0	350	0	
SIZE CONSIST SCREENING - % PASSING	2"	220	400	400	400	150	400	250	400	200	
	1"										
	3/8"								100		
	NO. 4		100		100	100			98		
	NO. 10	100	98		99	99	100		98	100	
	NO. 40	98	95	100	99	98	99	100	98	99	
	NO. 200	74	84	94	95	83	74	86	85	72	
AASHO RANGE		51	76	87	89	53	56	55	53	34	
LIQUIDITY LIMIT		F/F	F/F	F/F	F/F	F/F	F/F	F/F	F/F	F/F	
POROSITY INDEX		33	95	86	83	61	57	45	46	26	
ATOMIC STRUCTURE		34	48	39	26	34	29	21	21	9	
GRANULATION INDEX											
HRB CLASSIFICATION		13	20	20	20	13	14	10	10	9	
NORMAL AASHO 12 BLOWS	MAX DENSITY	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	MOISTURE	1720	1450	1263	1409	1570	1627	1645	1707	1821	
	CBR	172	392	344	322	182	186	200	128	126	
	EXPANSION	6	3	9	9	1	2	4	2	8	
INTER. AASHO 26 BLOWS	MAX DENSITY	0,3	3,0	0,3	1,9	0,7	3,4	1,5	1,3	0,1	
	MOISTURE										
	CBR										
	EXPANSION										
MODIF. AASHO 56 BLOWS	MAX DENSITY										
	MOISTURE										
	CBR										
	EXPANSION										
FIELD	NAT. MOISTURE										
USEABLE YES(Y) NO(N)											
OBSERVATIONS											

NOTES:

HIGHWAY — SECTION: — SUBSECTION:

TESTS - SUBGRADE AND NATURAL LAND

TRANSCON S/A — TABLE 3/1

REGISTER NO.	S-625	S-629	S-634							
DRILL HOLE NO.	1	4	5							
POSITION	320	0	0							
DEPTH -cm- FROM	400	400	400							
DEPTH -cm- TO										
SIZE CONSIST SCREENING % PASSING 2"			100							
1"		100	99							
3/8"	100	99	98							
NO. 4	97	93	94							
NO. 10	56	67	49							
NO. 40	35	43	33							
NO 200	E/E	E/E	E/E							
AASHO RANGE	32	53	49							
LIQUIDITY LIMIT	NP	27	21							
POROSITY INDEX	1									
ATOMIC STRUCTURE	0	7	3							
GRANULATION INDEX	6.1	5.2	5.2							
HRB CLASSIFICATION										
NORMAL AASHO 12 BLOWS MAX DENSITY										
MOISTURE										
CBR										
EXPANSION	1915	1820	1880							
INTER. AASHO 26 BLOWS MAX DENSITY	120	138	125							
MOISTURE	5	11	6							
CBR	0,4	1,4	0,3							
EXPANSION										
MODIF. AASHO 56 BLOWS MAX DENSITY										
MOISTURE										
CBR										
EXPANSION										
FIELD NAT MOISTURE										
USEABLE YES (Y) NO (N)										
OBSERVATIONS										
NOTES:										

HIGHWAY: | SECTION: Sinfe | SUBSECTION:

SAND/GRAVEL NO. | NAME: | LOCATION:

TEST - SAND/GRAVEL

TRANSCON S/A | TABLE 3/2

TABLE 3/3

	FILL	CUT	BORROW	MEAN TRANSPORT DISTANCE		
				UP TO 0.4 Km	0.4 - 0.8 Km	0.8 - 1.5 Km
* Main Branch Lines and Main Distribution Trunk	819,000	252,000	567,000	74,000	124,000	621,000
Cabo Branch Lines	19,000	-	19,000	-	-	19,000
Fertilizer Plant Branch Line	269,000	5,000	264,000	-	-	269,000
Collective Port Branch Line	182,000	208,000	-	38,000	10,000	162,000

In m^3

* including marshalling yard

TABLE 3/4

DEFORESTING, STUMP GRUBBING, CLEARING

SECTION	AREA (m^2)
Main Branch Lines and Main Distribution Trunk Line	311,118
Fertilizer Plant Branch Line	116,284
Collective Port Branch Line	115,818
	543,220

TABLE 3/5

SERVICES	UNIT	QUANTITY RAILROAD	NOTE
- Excavation in cuts and borrow areas of 1st category material with transport distance up to 0.4 km	m^3	43,000	
- Excavation in cuts and borrow areas of 1st category material with transport distance between 0.4 and 0.8 km	m^3	134,000	
- Excavation in cuts and borrow areas of 1st category material with transport distance between 0.8 and 1.5 km	m^3	1,069,000	
- Excavation in cuts of 2nd category material with transport distance up to 0.2 km	m^3	46,000	10% cut volumes
- Excavation in cuts of 3rd category material with transport distance up to 0.2 km	m^3	23,000	5% cut volumes
- Deforesting, stump grubbing and clearing	m^2	543,000	
- Compaction	m^3	991,000	

TOMO IV
PARTE 3
VOLUME 2
4.0

4.0 CONVENTIONAL CIVIL CONSTRUCTIONS

4.0 CONVENTIONAL CIVIL CONSTRUCTIONS

4.1 CONSIDERATIONS

In order to protect the railroad subgrade and track structure, drainage to capture surface and underground water was planned.

According to criteria in the following item, quantitative values for the following elements were arrived at:

- Cave and grade culverts
- Deep drains
- Gutters
- Benches
- Water races
- Protection ditches
- Plant covering

4.2 ORIENTATION ADOPTED

4.2.1 CAVE BOTTOM CULVERTS

Information needed to pre-dimension cave bottom culverts was taken from aerial photographs (1:30,000 scale) and topographic plan (1:10,000 scale). A 20 year replacement period was adopted for a projected 70 mm/hour water fall rate.

The flow sections, determined by the Talbot empirical formula, were converted to pipe sectons with Ø 1.00 m.

4.2.2 DEEP DRAINS

Deep drainage was indicated for all cuts with a red elevation greater than 3 meters.

Two lines of deep drains were set for the railroad branch lines.

4.2.3 GUTTERS

Gutters at the cut embankment bases were adopted.

4.2.4 PROTECTION DITCHES

Were considered along all of the cuts.

4.2.5 PLANT COVERING

Grass covering of all the fill embankments was predicted. No such covering will be done of the cuts since most of them will be widened.

The area to be covered was estimated as the product of the fill extension times the mean height axonometrically projected over the embankment slopes.

A one meter strip of grass covering was assumed in addition to the base of the fill embankment slopes.

4.3 QUANTITATIVE DATA

Quantitative data for each indicated civil construction, for each portion of the railroad sections, are presented in Table 4.1.

TABLE 4/1

CIVIL CONSTRUCTION QUANTITIES

CONVENTION CIVIL CONSTRUCTIONS	SECTIONS			TOTAL
	MAIN BRANCH + DISTRIBUTION TRUNK LINE	FERTILIZER PLANT BRANCH LINE	COLLECTIVE PORT BRANCH LINE	
Culverts (pipes Ø 1.00 m)	1,292 m	–	190 m	1,482 m
Deep Drains	7,660 m	120 m	4,380 m	12,160 m
Gutters	10,000 m	920 m	4,900 m	15,820 m
Protection Ditches	9,900 m	930 m	4,974 m	15,804 m
Plant Covering	135,000 m^2	44,700 m^2	79,800 m^2	259,500 m^2

TOMO II
PARTE 3
VOLUME 2
5.0

5.0 RAILROAD OPERATION

5.0 RAILROAD OPERATION

5.1 DESCRIPTION

At the start of the Suape branch line, linked to the RFFS/A Northeast Division, there should be constructed a marshalling yard. A layout of the yard is shown in Figure 5-I.

The yard will be composed of 11 lines: 4 for receiving and dispatching, 6 for classification and 1 for turn around switching. The 4 lines will have 10 m of midway between each two adjacent track centers. This large width was planned to permit inspection of long trains by a railroad vehicle running along a 6 m wide paved strip.

The vehicle would be equipped to handle small, relatively quick repairs. If more time is needed to make the repairs, the railroad car would be marked and switched to the maintenance shop.

The other 7 lines have a normal 4.25 m midway between each two adjacent track centers and 6 of them would be used for classifying the cars destined for or coming from the Port Industrial Complex's Terminals. At each end of the yard there will also be a maintenance shop for cars and a maintenance shop for locomotives. Horizontal plans and sections of the suggested layouts for the maintenance shops are shown in Figures 5-II/III. Two lines for loading and unloading containers and one line for loading and unloading incoming or outgoing cars, probably heading for or coming from industries in the vicinity of Cabo, were planned for the land available at the edges of the yard.

A road will also be needed on the western side of the yard (alongside the sea), which will give access to the container loading/unloading areas at the edges of the yard, to the maintenance shops and to the yard's administration building.

In the event of an emergency, the road could also be used to supply the locomotive shop's fuel reservoir and to provide the material consumed by both shops.

Naturally, the road will be connected with the Complex's road system.

5.2 OPERATIONS

In general, lines 1 and 2 will be used to receive trains coming from the 3rd Northeast Division's lines.

The cars brought in by these trains will have only three destinations: the bulk products port, the fertilizer plant, and the refinery.

The shunting locomotives will marshall the trains, separating them in 3 of the yard's 6 classification lines, one line for each of the three destinations.

The other 3 classification lines will be reserved for trains coming from the Industrial Complex's 3 terminals. The cars brought in by these trains will be switched to the departure lines (3 and 4) according to their destinations; in this manner the trains that will return to the 3rd Northeast Division, and on to all 1m gauge track in the nationwide railroad network, will be formed.

Line 11 will be used for turning locomotives and as an auxiliary switching line. It therefore will be occupied for only short periods of time.

The receiving lines, which will be quite long, will keep up with the nationwide trend of using long multiple traction trains, and will handle trains of up to 100 cars.

The two departure lines will also be able to form rather long trains. The shorter of the two, line 4, will have a useful length greater than 1,200 m.

For greater shunting speed and afety, all of the locomotives that run on the Suape branch line should be equipped with radios so that they can maintain contact with the control tower, other locomotives, switchmen and the releasing stations.

As can be seen from the layout, the yard only occupies one side of the central track. The other side is reserved for yard expansion which should occur when the single side becomes insufficient for marshalling operations.

Initially there will also be no need for automatic signalling or turnout rods for the switching devices. Starting in 1955 however, the number of cars to be moved could possibly demand installation of light signalling with the track circuit and turnout rods.

As shown in the suggested layout, the paved strip which will be used by vehicles for inspection and maintenance of cars on lines 1, 2, 3 and 4 will cross tracks 10 times, 5 times at each end. Therefore, for the safety of these movements, the vehicles themselves should also be equipped with radios for communication with the control tower.

Figure 5-IV shows a section of the track structure that will be used on the main brach, sub-branches and yard lines.

5.3 LOCOMOTIVES TO BE USED

5.3.1 LEVEL AND TANGENT RESISTANCE

A Empty cars

Approximate tare $\simeq$ 16 tons $V \simeq$ 20 km/hour

No. of axles = 4

$A \simeq 8\ m^2$

R = 4.4 kg/ton

$$R_n = 0.65 + \frac{13.2}{W} + 0.01394V + \frac{0.00944AV^2}{W.N} \quad \text{(Davis Formula)}$$

W = Weight/axle in tons

N = No. of axles

A = Frontal area in m^2

V = Velocity in km/hour

$$R_n = 0.65 + \frac{13.2}{4} + 0.01395 \times 20 + \frac{0.000944A.20^2}{4.4} = 4.4 \text{ km/to}$$

Loaded cars

2.1 - 42 ton load

$$R_n = 0.65 + \frac{13.2}{14.5} + 0.01395 \times 20 + \frac{0.000944 \times 8 \times 20^2}{14.5 \times 4}$$

R_n = 1.9 kg/ton

2.2 - 30 ton load

$$R_n = 0.65 + \frac{13.2}{11.5} + 0.01395 \times 20 + \frac{0.000944 \times 8 \times 20^2}{11.5 \times 4}$$

R_n = 2.1 kg/ton

2.3 - 25 ton load

$$R_n = 0.65 + \frac{13.2}{10.25} + 0.01395 \times 20 + \frac{0.000944 \times 8 \times 20^2}{10.25 \times 4}$$

R_n = 2.3 kg/ton

C [illegible] Locomotives

Weight ≃ 60 tons A ≃ 10 m^2 V ≃ 20 km/hour N = 4

$$R_n = 0.65 + \frac{13.2}{W} + 0.00931 \times V + \frac{0.00453 \times A \times V^2}{WN}$$

$$R_n = 0.65 = \frac{13.2}{15} + 0.00931 \times 20 + \frac{0.00453 \times 10 \times 20^2}{15 \times 4}$$

$$R_n = 0.65 + 0.88 + 0.1862 + 0.30 \simeq$$

$$R_n = 2.0 \text{ kg/ton}$$

5.3.2 CURVE RESISTANCE

$$R_c = \frac{500}{H}$$ H = 245 m (minimum curve radius on the section)

$$R_c = \frac{500}{245} \simeq 2.1 \text{ kg/ton}$$

5.3.3 GRADE RESISTANCE

$$R_r = 10 \times i$$ i = 0.5% (maximum slope on the section, as per the profile)

$$R_r = 10 \times 0.5 = 5 \text{ kg/ton}$$

5.3.4 NUMBER OF LOCOMOTIVES

A <u>In 1980</u>

Train P (bulk products port)

The worst alternative would be a train with 18 cars loaded with the maximum weight (42 + 16 = 58 tons)

$R_n \simeq 1.9$ kg/ton

$R_c \simeq 2.1$ kg/ton

$R_r \simeq 5.0$ kg/ton

$R_t \simeq 9.0$ kg/ton

18 cars at 58 tons = 19 x 58 = 1,044 tons

1,044 tons x 9.0 kg/ton = 9,396 kg

Assuming that the locomotive weighs 60 tons:

$R_n \simeq 2.0$
$R_c \simeq 2.1$
$R_r \simeq \underline{5.0}$
9.1 kg/ton

60 tons x 9.1 kg/ton = 545 kg

Total resistance = 9,396 kg + 546 kg = 9,942 kg

Therefore, <u>1 diesel-electric locomotive</u> with 60 tons of adherent and total weight, 12,000 kg of continuous tractive force and around 900 CV of power (models GE-U10B, GM-G8 or similar) will be sufficient to pull train P, since the total resistance will be 9,942 kg, and 12,000 kg continuous tractive force will be provided by the lighter of the two cied locomotives.

Train F (fertilizer plant)

The trains will have only 12 cars. Therefore <u>1 locomotive</u> with the characteristics of the locomotive described above will be more than sufficient.

Train R (Refinery)

Trains with a maximum of 20 cars with 30 tons of cargo and approximately 18 tons of tare.

$R_n \simeq 2.1$
$R_c \simeq 2.1$
$R_r \simeq \underline{5.0}$
9.1 kg/ton

20 cars x 48.6 = 960 tons; 960 x 9.1 kg/ton = 8,736 kg.

Since the train's total resistance is less than 9,396 kg, one locomotive equal to the one described for train P will be sufficient. Therefore a total of three locomotives will be sufficient to move the trains between the marshalling yard and the Complex's industrial and port terminals.

It is estimated that two locomotives will be needed for switching.

It is indispensable that a reserve locomotive always be on hand to substitute when one of the others has to be repaired or overhauled. Thus, the total number of locomotives will be increased to <u>six locomotives</u>, all with the above described characteristics, in 1980.

The same calculation process yields around <u>7</u> for the number of locomotives to be needed in <u>1985</u>, around <u>8</u> in <u>1995</u> and around <u>10</u> in <u>2005</u>.

KEY TO FIGURE 5-I

Porto - Port
Área Verde - Green area
Rocúo - Back up
Área P/ Containers - Area for containers
Água tratada - Treated water
Óleo diesel - Diesel fuel
Linha p/carga e descarga de containers - Containers loading and unloading track
Posto de revisão de locomotivas - Locomotive maintenance shop
Administração do patio - Yard administration building
Torre de controle - Control Tower
Estrada de Rodagem Pavimentada - Paved Road
Linha de descarga de vagões - Railroad car unloading track
Posto de revisão de vagões - Car Maintenance shop
Linha de carga e descarga - Loading and Unloading track
Linha de carga e descarga de containers - Containers loading and unloading track
Portão - Gate

SUGGESTED LAYOUT FOR THE FUTURE
SUAPE RAILROAD MARSHALLING YARD

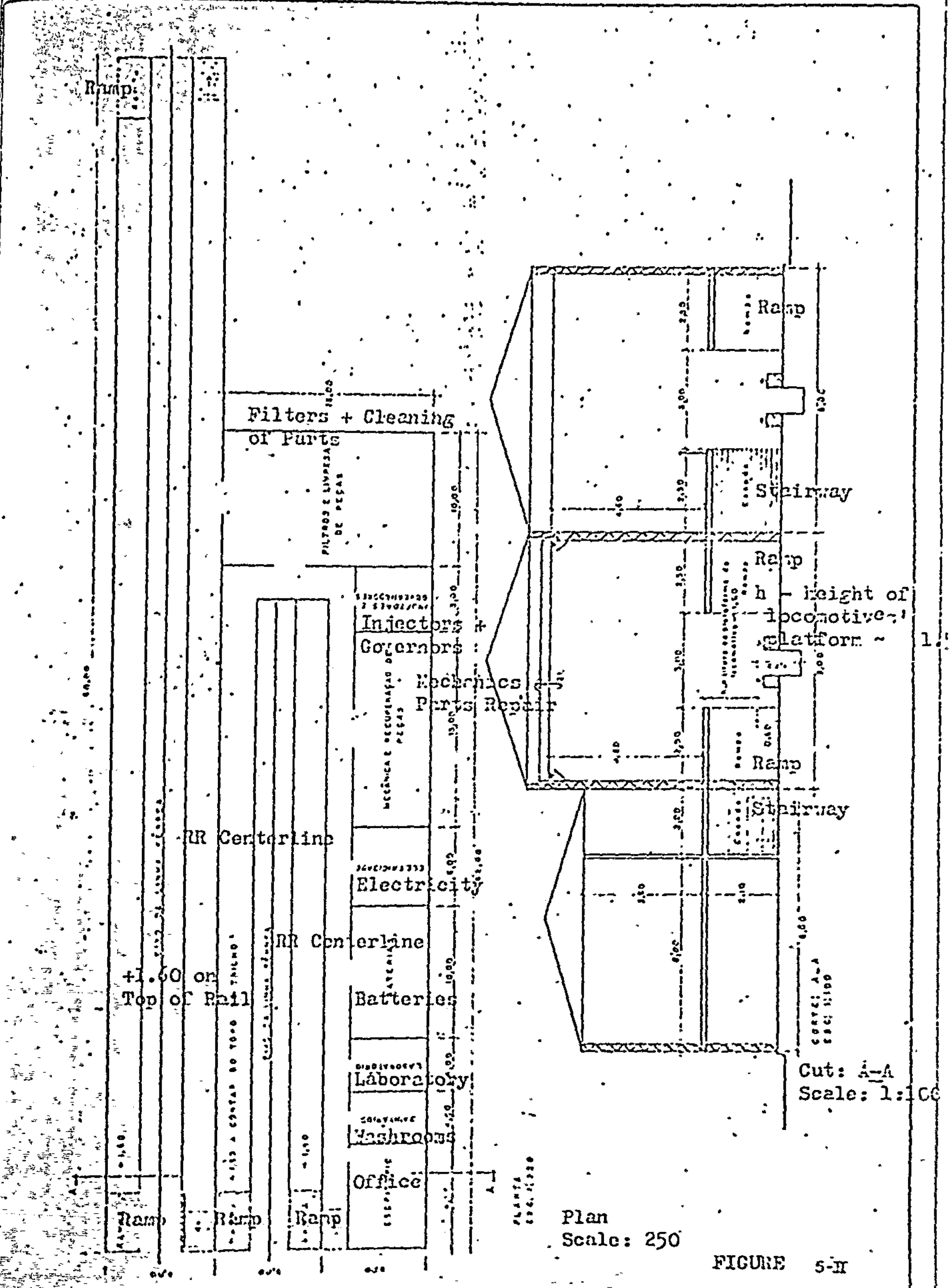


FIGURE 5-II

dipar

TRANSCON SA

COMPLEXO INDUSTRIAL DE SUAPE

SUGGESTED LAYOUT FOR THE MAINTENANCE STATION

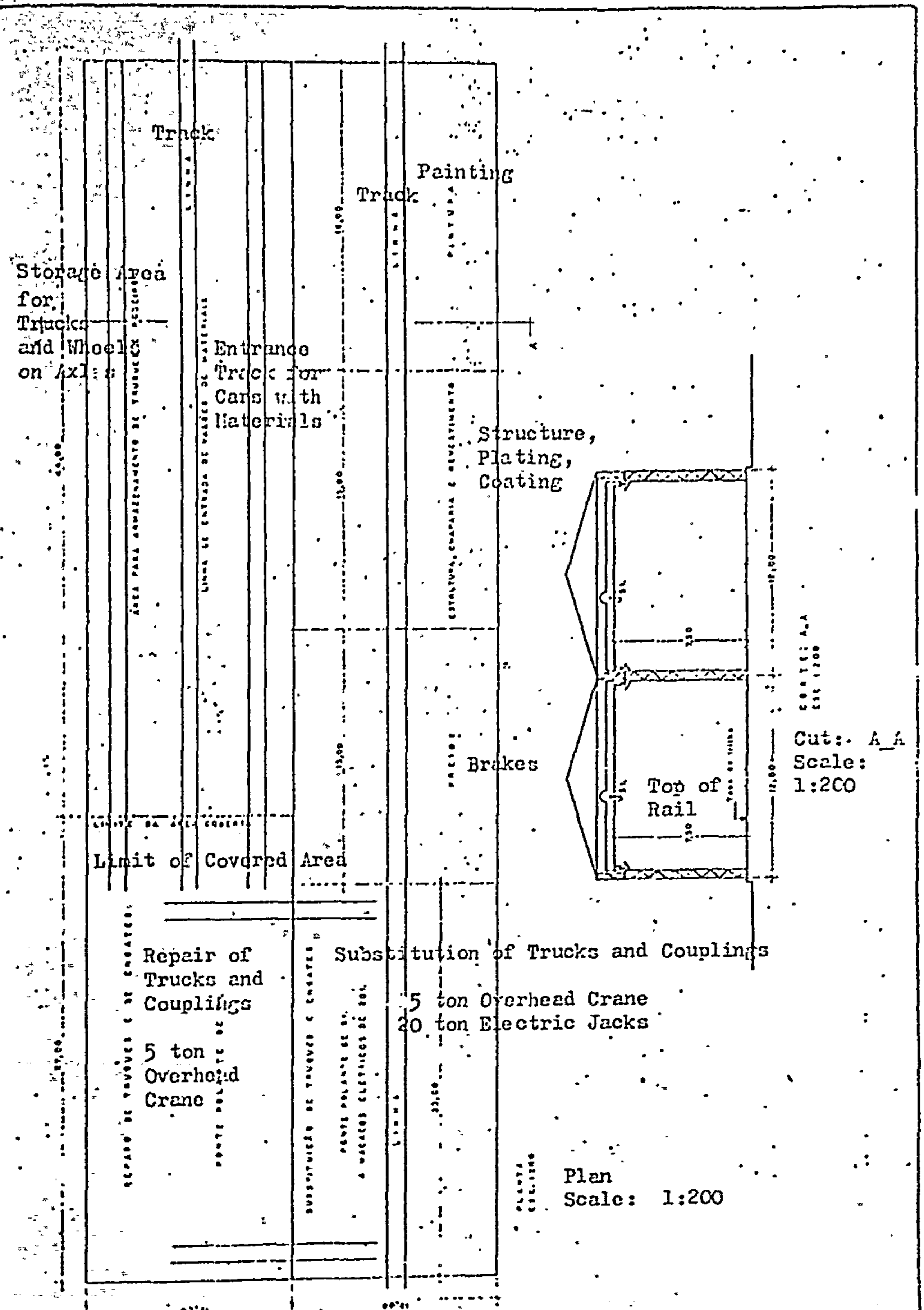


FIGURE 5-III

dipor

TRANSCON SA

GOVERNO DO ESTADO DE PERNAMBUCO

DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

VEHICLE MAINTENANCE SHOP

SUGGESTED LAYOUT

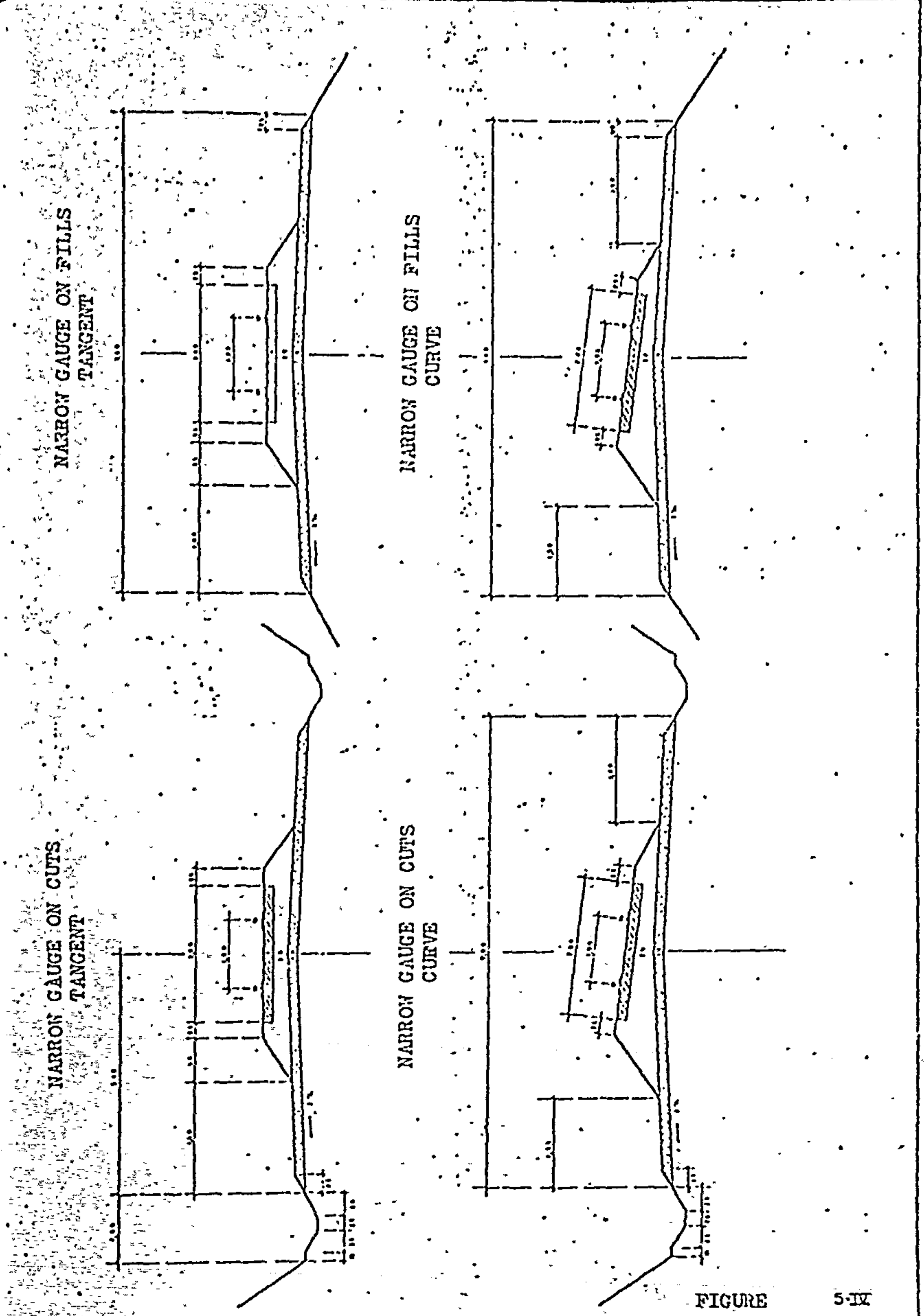


FIGURE 5-IV

diper

TRANSCON S.A.

GOVERNO DO ESTADO DE PERNAMBUCO - PRAC
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL
DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

RAILROAD TRACK STRUCTURE

TOMO IV
PARTE 3
VOLUME 2
60

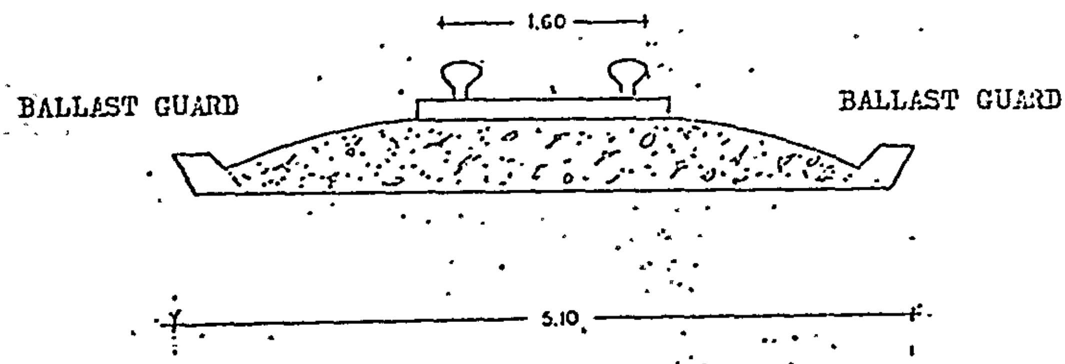
6.0 SPECIAL CIVIL CONSTRUCTIONS

6.0 SPECIAL CIVIL CONSTRUCTIONS

6.1 DESCRIPTION OF THE WORKS

The following bridges were planned to overcome the water courses that will continue to cross the railroad bed even after Hydrologic work has been done:

Railroad Section	Water Course	Span (m)	Width (m)
Main Distribution Trunk Line	Algodoais River	21	5.10
Main Distribution Trunk Line	Prego	18	5.10
Port Branch Line 1	Canal (Algodoais)	40	5.10
Main Distribution Trunk Line	Tabatinga River	40	5.10
Main Distribution Trunk Line	Jasmin River.	10	5.10



TOMO 12
PARTE 3
VOLUME 2
7.0

7.0 OVERALL BUDGET

7.0 OVERALL BUDGET

7.1 SUBGRADE

7.1.1 EARTH MOVING

A MAIN BRANCH AND DISTRIBUTION TRUNK LINE, EXCLUDING YARD

- 1st category material with average transport distance up to 0.4 km

  Qty. 36,200 m^3 x $ 4.33 = $ 156,746.00

- 1st category material with average transport distance from 0.4 to 0.8 km

  Qty. 124,000 m^3 x $ 6.10 = $ 756,400.00

- 1st category material with average transport distance from 0.8 to 1.5 km

  Qty. 151,000 m^3 x $ 8.50 = $1,283,500.00

- 2nd category material with average transport distance up to 0.4 km

  Qty. 25,200 m^3 x $ 6.72 = $ 169,344.00

- 3rd category material with average transport distance up to 0.4 km

  Qty. 12,600 m^3 x $129.07 = $ 366,282

  Subtotal = $2,732,272

B CABO BRANCH LINE

- 1st category material with average transport distance from 0.8 to 1.5 km

  Qty. 19,000 m^3 x $ 8.50 = $ 161,500.00

C FERTILIZER PLANT BRANCH LINE

- 1st category material with average transport distance from 0.8 to 1.5 km

  Qty. 269,000 m^3 x $ 8.50 = $ 2,286,500.00

D. COLLECTIVE PORT BRANCH LINE

- 1st category material with average transport distance up to 0.4 km

  Qty. 6,800 m^3 x \$ 4.33 = \$ 29,444.00

- 1st category material with average transport distance from 0.4 to 0.8 km

  Qty. 10,000 m^3 x \$ 6.10 = \$ 61,000.00

- 1st category material with average transport distance from 0.8 to 1.5 km

  Qty. 160,000 m^3 x \$ 8.50 = \$1,360,000.00

- 2nd category material with average transport distance up to 0.4 km

  Qty. 21,300 m^3 x \$ 6.21 = \$ 143,136.00

- 3rd category material with average transport distance up to 0.4 km

  Qty. 10,650 m^3 x \$29.07 = \$ 309,595.50

Subtotal = \$1,903,175.50

7.1.2 DEFORESTING, STUMP GRUBBING AND CLEARING

A. MAIN BRANCH LINE AND DISTRIBUTION TRUNK LINE, EXCLUDING YARD, BUT INCLUDING CABO BRANCH LINE

Qty. 151,118 m^2 x \$ 0.18 = \$ 27,201.20

B. FERTILIZER PLANT BRANCH LINE

Qty. 151,818 m^2 x \$ 0.18 = \$ 20,847.20

7.1.3 CONVENTION CIVIL CONSTRUCTIONS

A. CULVERTS WITH Ø 1.00 m PIPES

Main branch line and distribution trunk line excluding yard

1,292 m x $ 563.50 = $ 728,040.00

Collective Port Branch Line

190 m x $ 563.50 = $ 107,065.00

B DEEP DRAINS

Main branch line and distribution trunk line, excluding yard

7,660 m x $ 50.00 = $ 383,000.00

Fertilizer Plant Branch Line

120 m x $ 50.00 = $ 6,000.00

Collective Port Branch Line

4,380 x $ 50.00 = $ 219,000.00

C GUTTERS

Main branch line and distribution trunk line excluding yard

10,000 m x $ 30.00 = $ 300,000.00

Fertilizer Plant Branch Line

920 m x $ 30.00 = $ 27,600.00

Collective Port Branch Line

4,900 m x $ 30.00 = $ 147,000.00

D PROTECTION DITCHES

Main branch line and distribution trunk line excluding yard

9,900 m x $ 5.00 = $ 49,500.00

Fertilizer Plant Branch Line

930 m x $ 5.00 = $ 4,650.00

Collective Port Branch Line

4,974 m x \$ 5.00 = \$ 24,870.00

E PLANT COVERING

Main branch line and distribution trunk line, excluding yard

135,000 m^2 x \$ 2.50 = \$ 337,500.00

Fertilizer Plant Branch Line

79,800 m^2 x \$ 2.50 = \$ 199,500.00

Collective Port Branch Line

44,700 m^2 x \$ 2.50 = \$ 111,750.00

F COMPACTION

Main branch line and distribution trunk line, excluding yard

(368,000 ÷ 1.30) x \$ 0.91 = \$ 257,600.00

Fertilizer Plant Branch Line

(269,000 ÷ 1.30) x \$ 0.01 = \$ 188,300.00

Collective Port Branch Line

(182,000 ÷ 1.30) x \$ 0.91 = \$ 127,400.00

7.1.4 SPECIAL CIVIL CONSTRUCTIONS

Main branch line and distribution trunk line, excluding yard

128 x \$ 17,000.00 = \$ 2,176,000.00

Collective Port Branch Line

40 x \$ 17,000.00 = \$ 680,000.00

.5 SUBGRADE TOTAL

Main branch line and distribution trunk line, excluding yard

Length = 15.32 km

Cost/km = $ 466,880.87

Fertilizer Plant Branch Line

Length = 5.71 km

Cost/km = $ 478,718.23

Collective Port Branch Line

Length = 5.00 km

Cost/km = $ 664,052.00

Total = $ 13,227,203.70

7.2 TRACK STRUCTURE

7.2.1 MAIN BRANCH LINE AND DISTRIBUTION TRUNK LINE, EXCLUDING YARD

15.41 km x $ 500,000.00 = $ 7,705,000.00

7.2.2 COLLECTIVE PORT BRANCH LINE

5.00 km x $ 500,000.00 = $ 2,500,000.00

7.2.3 FERTILIZER PLANT BRANCH LINE

5.71 km x $ 500,000.00 = $ 2,855,000.00

7.2.4 TRACK STRUCTURE TOTAL

	= $ 13,060,000.00
Contingencies 10% =	1,306,000.00
	$ 14,366,000.00

or, approximately

$ 14,500,000.00

Length = 26 km Cost/km = $ 558,000

7.3 TELECOMMUNICATIONS AND SIGNALLING

7.3.1 MAIN BRANCH LINE AND DISTRIBUTION TRUNK LINE EXCLUDING YARD

15.41 km x $ 40,000.00 = $ 616,400.00

7.3.2 COLLECTIVE PORT BRANCH LINE

5.00 km x $ 40,000.00 = $ 200,000.00

7.3.3 FERTILIZER PLANT BRANCH LINE

5.61 km x $ 40,000.00 = $ 224,400.00

7.3.4 TELECOMMUNICATIONS AND SIGNALLING TOTAL

$ 1,040,800.00

Contingencies 10% = $ 104,080.00

$ 1,144,880.00

or, approximately

$ 1,200,000.00

Length = 26 km Cost/km = $46,000.00

7.4 MAIN YARD

7.4.1 SUBGRADE

A EARTH MOVING

- 1st category material with average transport distance from 0.8 to 1.5 km

  Qty. 470,000.m^3 x \$ 8.50 = \$ 3,995,000.00

B DEFORESTING, STUMP GRUBBING AND CLEARING

- Qty. 160,000 m^2 x \$ 0.18 = \$ 28,800.00

C DRAINAGE WORKS IN GENERAL

- Estimated \$ 700,000.00

D COMPACTION

- (470,000 ÷ 1.3) x \$ 0.01 = \$ 329,000.00

E SUBGRADE TOTAL = \$5,052,800.00

7.4.2 TRACK STRUCTURE

A TRACKS - Length = 13.7 km

13.7 x \$ 500,000.00 = \$6,850,000.00

B TURNOUTS = 32

32 x \$ 40,000.00 = \$1,280,000.00

TRACK STRUCTURE TOTAL

$ 8,130,000.00

COMPLEMENTARY WORKS

RAILROAD CAR MAINTENANCE SHOP:

Building: 1,128 m^2; $1,200 x 1,128	≃ $ 1,400,000.00
Facilities	≃ $ 300,000.00
Equipment	≃ $ 700,000.00
	≃ $ 2,400,000.00

LOCOMOTIVE MAINTENANCE SHOP:

Building: 1,824 m^2	
Unit cost ≃ 1,400 (due to elevated platforms)	
1,400 x 1,824	≃ $ 2,600,000.00
Facilities (including oil, water, sand supplies)	≃ $ 2,400,000.00
Equipment	≃ $ 500,000.00
	≃ $ 5,500,000.00

ADMINISTRATION BUILDING AND CONTROL TOWER

Building: 750 m^2	
Unit cost ≃ $1,100/$m^2$; $1,100 x 76	≃ $ 850,000.00
Tower: 80 m^2	
Unit cost ≃ $3,000 (due to height)	
Building ≃ $3,000 x 80	≃ $ 250,000.00
Facilities	≃ $ 200,000.00
Equipment	≃ $ 500,000.00
	≃ $ 1,800,000.00

D	LIGHTING YARD ≃ $ 800,000.00	
E	CONTAINER LOADING AND UNLOADING EQUIPMENT ≃ $ 1,400,000.00	
F	SCALE FOR WEIGHING RAILROAD CARS	≃ $ 500,000.00
G	PAVING ROADS	≃ $1,500,000.00
7.4.4	MAIN MARSHALLING YARD TOTAL:	≃ $27,082,800.00
	Contingencies 10%	≃ $ 2,708,280.00
		$29,791,080.00

5 TOTAL FOR THE RAILROAD SYSTEM DURING THE 1st STAGE

$ 58,718,283.70 or approximately <u>Cr$ 59 x 10^6</u>