

## 分析対象ケース

価格	出資金／長期借入金比率	長期借入金利率	ケースNo.
a) 固定価格	a) 30 : 70	a) 10%	1)
		b) 15%	2)
		c) 20%	3)
	b) 35 : 65	a) 10%	4)
		b) 15%	5)
		c) 20%	6)
b) 名目価格	a) 30 : 70	a) 10%	7)
		b) 15%	8)
		c) 20%	9)
	b) 35 : 65	a) 10%	10)
		b) 15%	11)
		c) 20%	12)

### 5) 短期借入金に関する前提

キャッシュ・フロー分析では、運用資金の合計に対して調達資金が不足する場合、その不足分を短期借入金で補充するものとする。建設期間中利息は、短期借入金で調達されると設定した。短期借入金の元本返済と利息返済は、借り入れの翌年に行われる。短期借入金の利率は、上記の設定ケースに対して適用される長期借入金利率と同じ利率を設定した。

### 15.5.3 財務分析結果

表15.5は、資金調達案各ケースに対する分析結果を要約したものである。

#### a) 固定価格ベース

出資金／長期借入金比率が、30%:70%のケースでは、著しい資金不足を示す。資金不足は短期借入金の調達を招き、このための利息の支払が、翌期以降の資金不足を次々と引き起こしていく。僅かに、利率10%の場合においてのみ、財務の健全性が保たれる。

出資金／長期借入金比率が、35%:65%のケースでは、利率20%の場合は厳しい資金繰りとなる。出資金／長期借入金比率が35%:65%、および利率15%の場合、損益計算書上の累積黒字転換年は、2017年であり、計画有料道路開業後23年目に相当する。

#### b) 名目価格ベース

他方、名目価格ベースにおけるキャッシュ・フロー分析は概ね良好な結果を示した。これは、高水準の料金収入が寄与している。出資金／長期借入金比率が、30%:70%のケースと出資金／長期借入金比率が、35%:65%のケースとでは、計算結果に大きな差異は認められない。

表 1 5. 5 Summary of Financial Analysis Results

Equity Interest /Loan Ratio	FIRR (ROI)	NPV (Million Rp.)	FIRR (ROE)	NPV	First Year of Surplus			Annual Surplus in Cash Flow (Year)	Maximum Annual Short-term Loan Amount (Million Rp.) (Year)	Year of Maximum Short-term Loan
					(No.)	(%)	(Year)			
1. (Constant Price) 30%:70%	12.87	-44,752	14.33	-8,622	2001	2006	2010	107,655	2005	
(a) Toll Rate: 3% up / year	15%	-44,752	11.68	-48,791	2012	*	*	578,353	2011	
(b) Cost: Constant	20%	-44,752	9.62	-88,962	*	*	*	-	-	
10%	12.87	-44,752	14.19	-10,891	2001	2005	2009	83,054	2003	
15%	12.87	-44,752	11.81	-48,191	2009	2017	2018	420,425	2010	
20%	12.87	-44,752	9.90	-85,490	*	*	*	-	-	
2. (Current Price) 30%:70%	21.95	361,845	26.87	421,608	2000	2001	2003	70,037	1999	
(a) Toll Rate: 40% up / 3year	15%	361,845	24.37	371,507	2002	2006	2007	220,707	2002	
(b) Cost: 8% up / year	20%	361,845	22.37	321,405	2006	2011	2012	769,245	2005	
10%	21.95	361,845	26.35	418,779	1999	2001	2002	55,281	1999	
15%	21.95	361,845	24.17	372,255	2001	2005	2007	178,714	2001	
20%	21.95	361,845	22.37	325,732	2006	2010	2011	620,749	2005	

Note: \*) ..... Nil first year of surplus within the project life.

出資金／長期借入金比率が35%:65%、および利率15%の場合、損益計算書上の累積黒字転換年は、2005年であり、これは計画有料道路開業後10年目に相当する。また、利率20%の場合は、損益計算書上の累積黒字転換年は、2010年であり、計画有料道路開業後15年目に相当する。

計算結果例として、出資金／長期借入金比率が35%:65%、および利率15%の場合（固定価格および名目価格）を表示する。Appendix A—15.5 からA—15.8 は、各々、固定価格の場合の長期借入金返済計画、損益計算書、資金繰表および財務内部収益率（ROE）を示す。Appendix A—15.9 からA—15.12 は、名目価格の場合の上記と同様の各表を示す。

#### 15.5.4 感度分析

##### 1) コストと料金収入に対する感度分析

###### a) 感度分析ケース

名目価格ベースで出資金／長期借入金比率が35%:65%、そして利率が15%および20%の場合に対して、コストと料金収入を変えて、感度分析を行った。

- ケース1: コストの10%増
- ケース2: 料金収入の10%減
- ケース3: 上記ケース1とケース2の組み合わせ

###### b) 分析結果

感度分析の結果を、表15.6に示す。

##### 2) 長期借入金利率に対する感度分析

###### a) 感度分析ケース

名目価格ベースで出資金／長期借入金比率が35%:65%の場合において、長期借入金利率を22.5%および25.0%に変えて、感度分析を行った。

###### b) 分析結果

感度分析の結果を表15.6に示す。

長期借入金利率を22.5%に変化させた場合、損益計算書上の累積黒字転換年および資金繰表上の黒字転換年は、共に2014年（開業後19年目）となる。

他方、同様の条件下で長期借入金利率を25.0%に変化させた場合、損益計算書上の単年度黒字転換年は、2015年となるが、損益計算書上の累積赤字および資金繰表上の赤字は、プロジェクト・ライフの計算期間内では、共に黒字に転換しない。

表 1 5. 6 Summary of Sensitivity Analysis Results

For Case of Equity/Loan Ratio = 35%.65% in Current Price Basis

Interest Rate	FIRR (ROI)		FIRR (ROE)		NPV	NPV	First Year of Surplus			Annual Surplus in Cash Flow (Year)	Maximum Annual Short-term Loan Amount (Million Rp.) (Year)	Year of Maximum Short-term Loan (Year)
	(%)	(Million Rp.)	(%)	(Million Rp.)			Annual Surplus in Profit & Loss (Year)	Accum. Surplus in Profit & Loss (Year)	Annual Surplus in Profit & Loss (Year)			
1. (Sensitivity to Cost and Revenue)												
15.0%	21.95	361,845	24.17	372,255	2001	2005	2007	2007	2007	178,714	2001	
1) Cost +10%	20.99	329,582	22.92	341,034	2002	2006	2007	2007	2007	244,861	2002	
2) Revenue -10%	20.89	293,398	22.79	303,808	2003	2006	2008	2008	2008	228,856	2002	
3) Combination of 1) and 2)	19.96	261,135	21.59	272,587	2003	2007	2009	2009	2009	323,306	2005	
1-b. (Base Case)												
20.0%	21.95	361,845	22.37	325,732	2006	2010	2011	2011	2011	620,749	2005	
1) Cost +10%	20.99	329,582	21.18	289,858	2006	2012	2012	2012	2012	846,960	2005	
2) Revenue -10%	20.89	293,398	21.06	257,285	2006	2012	2013	2013	2013	787,655	2005	
3) Combination of 1) and 2)	19.96	261,135	19.91	221,411	2009	2014	2015	2015	2015	1,140,933	2008	
2. (Sensitivity to Interest Rate)												
22.5%	21.95	361,845	21.58	302,471	2009	2014	2014	2014	2014	1,213,963	2008	
2) Interest Rate: 25.0%	21.95	361,845	20.86	279,209	2015	*)	*)	*)	*)	4,024,560	2015	

Note: \*) ..... Nil first year of surplus within the project life.

## 15.6 財務分析の結論

名目価格ベースでのFIRRの値は、ROIが約22%およびROEが約22~27%（長期借入金の利率条件によって巾がある）である。これらの値は、インドネシアでの商業銀行における現在の一般的な預金金利の水準23~28%（インドネシアでの金融引き締め政策の結果として昨年から大幅に上昇した）と比較すると、同等のあるいは低いレベルである。

上記の比較によると、現在の金利水準が今後も続くものとした場合は、財務分析の結果は楽観的なものではない。

他方、長期借入金利率に対する感度分析の結果は、財務の健全性を保持する上では、22%の利率が本プロジェクトに適用されるべき利率として最高のものであることを示唆している（この場合の累積黒字転換年は開業後19年目の2014年となる）。

それ故、財務的フィージビリティを高めるためには、可能なかぎり低利の長期借入金の導入を図る努力が求められる。

さらに、金利に関する方策のほかに、有料道路利用料金水準の増大の可能性（そのような可能性は15.3.1節で示唆されている）を検討することも、財務的フィージビリティ性を高めるためのもうひとつの財務上の対策である。



## 第16章 結論と提言





## 第16章 結論と提言

### 16.1 結論

#### 16.1.1 プロジェクトの必要性

本プロジェクト（それは、スラバヤから延びる主要な交通と開発のコリドーにおける3本の放射有料道路のひとつとして、南西方向への有料道路を建設するものである）は、スラバヤ大都市圏の発展にとって極めて重要であり、また下記の重要な役割を果たすものとして期待される：

- ・ 最近の交通量の急激な増加および急速な地域開発の進行に対処するため、スラバヤ大都市圏の道路網を改善し、強化する。
- ・ 近い将来大問題になる可能性のある、スラバヤーモジョクルト間の南西コリドーにおける国道／州道上の交通混雑を解消する。
- ・ ジャワ縦貫有料道路計画の進展に寄与する。（計画有料道路はジャワ縦貫有料道路の東端を構成するものである）。

#### 16.1.2 将来交通量

モジョクルトとスラバヤ間の国道／州道上における現在の交通量は、道路がスラバヤ市に近づくにつれて増加する。すなわち、交通量は、モジョクルト近辺では、18,400台／日であるが、スラバヤ近辺では43,700台／日となる。

社会・経済フレームワークに関する分析結果によると、スラバヤーモジョクルトのコリドー沿いの直接影響圏（スラバヤ市、グレシック県、シドアルジョ県、モジョクルト県およびモジョクルト市を含む）においては、2005年人口および2015年人口は1990年人口の、各々1.38倍および1.64倍となる。そして、2005年および2015年の地域総生産は、1990年地域総生産の各々2.54倍および4.64倍となる。これらに対応して、将来交通需要量は増加し、2005年および2015年の自動車総交通需要量は、1990年のそれぞれの各々2.6倍および4.9倍になるものと推定される。

そのような状況のもと、計画有料道路が存在しない状態での現存の国道／州道では、1990年時点の交通需要を効率的に処理することはできず、まして2005年および2015年の交通需要を満たすことは不可能となる。

計画有料道路上の将来交通需要量は、平均区間交通量で、1995年では12,100台／日、2005年では39,900台／日および2015年では75,600台／日と予測されている。

#### 16.1.3 技術的側面

##### (1) 最適路線

最初代替路線を6案選定し、これらを概算将来交通需要予測と経済分析結果にもとづき、3案（代替路線案B1、D1、およびD2）にしぼり込んだ。更に比較検討の結果、代替路線B1が環境への影響、交通、経済の見地から他案に優れていることがわかり、最適路線案として採用した。

モジョクルト市の南東、モジョクルト・バイパス上の始点（モジョクルトIC）から路線は北東方に進み、現存の鉄道と交差し次いでボロン河を渡る。路線はさらに5km程水田地帯を同方向に進み、ここから向きを北に変え、スラバヤ河架橋地点に至る。架橋地点を境とし、路線は向きを東に転ずるため大きな曲線を描くが、やがてスラバヤ河段丘の裾の部分をクリアン市の北方約3.5kmにあるクリアンICまで東進する。クリアンICを過ぎ、路線はスラバヤ河沿いの平地を北東方に向きを変えて進み、やがて計画中のドリオレジョ・ニュータウン南部に抜がるゆるやかな丘陵地を過ぎ、ラカルサントリ地区に至る。ラカルサントリ地区に計画有料道路の料金所を選定した。また、この地区で計画中の内郭環状道路と路線が交差するためインターチェンジを計画した。また、ラカルサントリの軍用地を避けて路線を設定した。計画有料道路のスラバヤ側終点区間（延長約1.5km）には県道、マス河、スラバヤーグムボル有料道路がある。さらに、マス河の兩岸地域は密集した市街地となっている。密集市街地における用地取得、環境への影響を考慮し、当区間では全面的に高架橋を採用することとした。1:5,000縮尺地形図を用いた概略設計の結果得た最適路線の延長は38.32kmである。

## (2) 計画有料道路の設計概要

- 1) 設計速度は、計画有料道路東側部分を除き、平坦地の都市間有料道路として位置づけ、120km/hrを採用した。計画有料道路東側部分（内部環状道路以東）においては、都市有料道路を想定し、設計速度100km/hrとした。
- 2) 交通量予測結果にもとづき、計画有料道路は、第1期工事で4車線を建設し、第2期工事で6車線に拡幅する段階施工を採用することができる。車道幅員は1車線当たり3.6m、路肩の幅員は、外側で3.0m、内側で1.5mとした。また中央分離帯の幅員は、内側路肩を含め5.5mとし（6車線最終段階）、縁石により舗装面より高くする。
- 3) 段階施工の概要は、第1期工事で全土工を完了し、外側の各2車線を舗装、第2期工事の追加舗装を内側車線でおこなう。第2期工事が必要となるのは2010年頃と想定される。橋梁と高架橋の場合、第1期工事で、6車線分をすべて工事する。
- 4) 下記インターチェンジの中、モジョクルトIC、クリアンIC、スラバヤJCは第1期工事で施工する。

第1期工事では、モジョクルトICとクリアンICで料金所が必要な他、ラカルサントリICに本線ゲートを準備しなければならない。

- 5) 橋梁と高架橋の総延長は4.06kmで、計画有料道路総延長の10.6%を占める。ボロン河とスラバヤ河では、3径間連続PCボックス・ガーダー橋を採用したが他の橋梁と高架橋の場合は、経済性と施工の容易さを考え、PC-I桁上部工とすることができる。
- 6) 土工部では盛土区間が大部分を占めている。スラバヤ河橋梁付近と計画有料道路の東部には軟弱地盤地域があり、1.0m厚サンドマットと40cm径のサンド・ドレーンを計画した。客土による総盛土量は約4,800,000m<sup>3</sup>と見積られており、この中約4,200,000m<sup>3</sup>が、遠くモジョサリの南東地域から材料を運搬し施工しなければならない土量である。
- 7) 舗装はアスファルト・コンクリートで計画した。セメント・コンクリートの場合に比較し、初期投資額の削減、軟弱地盤への対応、走行性の面で優れている。上・下層路盤とバインダー・表層を含む舗装の総厚は47～67cmである。

#### 16.1.4 環境影響の側面

最適代替路線の選定では、環境影響時に住民立ち退きと農地補償に伴うマイナス影響を最小にするよう配慮した。

本計画の実施母体による環境影響評価書作成に必要な資料を提供するため、事前環境影響調査を実施した。事前環境影響調査は、予測されるマイナス影響とその緩和対策の検討に主眼をおいた。

計画地での人間をとりまく社会、人為的、自然等の諸環境を見直し、工事前、工事中、工事後で予測されるマイナス影響をEIAガイドラインに従って検討の結果、もし適切な緩和対策を確実に実施する場合、その殆どが、實際上軽減可能であることがわかった。

予測される重要な環境影響は、工事前段階における住民立ち退きと農地補償の問題、工事中における交通量増加から派生する現道改良等の問題、そして工事後の騒音、振動、大気汚染の問題である。

- 1) 立ち退き住民に対しては、適切な補償を行なうか、代替地への転住が必要である。また、農地を用地として取得した場合には、適切な補償を行なわねばならない。
- 2) 盛土・舗装材料の運搬路（州・県道）は工事開始前に車道拡幅、舗装強化を含む改良をおこない、工事期間中適切な維持・修善をつづける必要がある。
- 3) 工事後の騒音、振動、大気汚染による影響が予測されるが、この中、相当な部分は、適切な有料道路施設の設計（防音壁、緩衝帯設置等）により、緩和することができる。しかし、基礎的な観測体制とモニタリング・システムの確立が肝要である。

計画有料道路の実施母体は、調査団がおこなった事前環境調査の後をひきつぎ、環境影響に関する詳細な研究調査と計画地の環境現況調査をおこない、環境影響評価書の作成を早期に実施する必要がある。

#### 16.1.5 事業費

本計画の初期投資額は、1991年価格において391,757百万ルピアで、その内訳は下記の通りである。

##### 初期投資額の概要

	(Million Rp.)
Construction cost	263,194
Purchase of maintenance equipment	1,141
Land acquisition and compensation	75,433
Utility relocation	3,215
Engineering	13,160
Sub-Total	356,143
Contingency	35,614
Total	391,757

### 16.1.6 経済評価の結果

経済分析は、標準的な手法である割引キャッシュ・フロー法に従って、経済内部収益率、純現在価値および費用便益比を算定するものである。定量的経済便益は、車両走行費用と車両時間価値の節減便益とした。分析結果は、本プロジェクトが経済的観点から見てフィージブルであることを示す。

経済内部収益率 (EIRR)	=	27.88%
純現在価値 (NPV)	=	4,575億4,100万ルピア (1991年価格)
費用便益比 (B/C)	=	2.68

感度分析では、便益の30%減そして費用の30%増という厳しいケースにおいても、なお約19%の経済内部収益率を示す。

### 16.1.7 財務評価の結果

財務分析は、標準的な手法である割引キャッシュ・フロー法に従って、財務内部収益率および純現在価値を算出するものである。そして、損益計算書およびキャッシュ・フロー表（資金繰表）を作成し、単年度黒字転換年および累積黒字転換年を吟味する。収入推定に際しての料金水準は、スラバヤーンポール有料道路の現在の料金体系に基づいている。

名目価格ベース（有料道路料率については、3年間で40%上昇（年間平均約12%上昇）、また費用に関しては年間8%増加を設定）において、FIRR（財務内部収益率）は、ROIで22.0%、そしてROEで22.4%（長期借入金利率20%の場合）を示す。長期借入金利率20%の場合、損益計算書上の単年度黒字転換年および累積黒字転換年は、各々2001年および2005年である。FIRRの値は、インドネシアでの商業銀行における現在の一般的な預金金利の水準23~28%（インドネシアでの金融引き締め政策の結果として昨年から大幅に上昇した）と比較すると、同等あるいは低いレベルである。上記の比較によると、現在の金利水準が今後も続くものとした場合は、財務分析の結果は楽観的なものではない。

感度分析の結果は、財務の健全性を保持する上では、22%の利率が本プロジェクトに適用されるべき利率として最高のものであることを示唆している（この場合の累積黒字転換年は開業後19年目の2014年となる）。

それ故、財務的フィージビリティを高めるためには、可能なかぎり低利の長期借入金の導入を図る努力が求められる。

## 16.2 提言

### 16.2.1 プロジェクトの実施

本調査の結果は、本プロジェクトが技術的観点から見て妥当なものであり（建設上の大きな技術的問題はない）、国民経済的観点からもフィージビリティは高いことを示している。直接便益以外にも、関連地域の開発に対する莫大な間接便益が期待でき、本プロジェクトは可能なかぎり早期に実施されてよう提言する。

しかしながら、算定されたFIRRの値とインドネシアでの商業銀行における現在の一般的な預金金利水準とを比較する場合、本プロジェクトの財務的妥当性は必ずしも楽観的なものではない。財務的フィービリティを改善するためには、下記の方策が採られる必要がある：

- ・ 可能なかぎり低利の長期借入金の導入を図る。一案として、建設費が割高な区間（例えば、スラバヤ・ジャンクションを含む長大な橋梁部・高架部をもつ内郭環状道路の東側区間）については、Jasa Marga単独事業とし、ソフト・ローン調達による建設が挙げられる。
- ・ 有料道路料金水準引き上げの可能性を検討する。
- ・ 詳細設計段階において、建設費の低減化を図る。（例えば、盛土高を低くするために、交差道路の統・廃合について関連地方自治体と協議を行なう）。
- ・ 計画有料道路の民間事業者に対して、税制上の優遇措置適用を考慮する。

#### 16.2.2 環境影響調査

EIA ガイドラインにおける規定に対応した環境影響調査が、早期に実施される必要がある。特に、住民移転や用地取得の問題を含む社会的環境に対する影響を明らかにするために、現地調査実施による詳細なデータの収集が急務である。

#### 16.2.3 その他の留意事項

##### (1) 環状道路の整備計画

計画有料道路の有効利用を図るためには、現在計画中の内郭環状道路および中郭環状道路との連結が重要である。計画有料道路と相俟ってスラバヤ地域の包括的な道路ネットワーク整備を実現するため、これら環状道路を早期に完成させることが望ましい。

##### (2) 計画有料道路の西方への延伸

計画有料道路の西方への延伸（ジャワ縦貫有料道路）のためのルートは、モジョクルト県およびモジョクルト市において既に大綱が決定している。延伸道路の用地取得を容易にするため、ルート上の土地開発凍結が望ましい。



## ***Appendices***



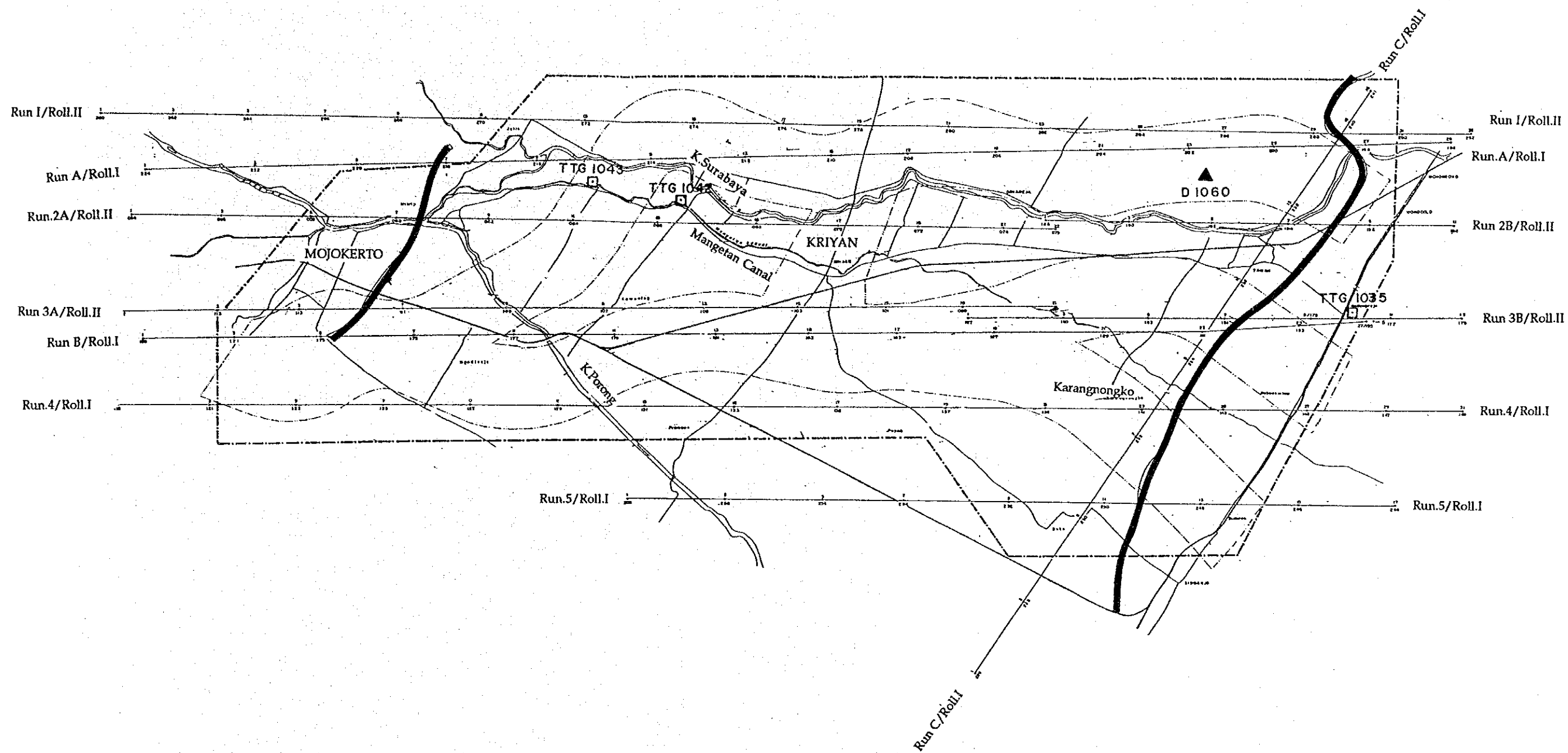


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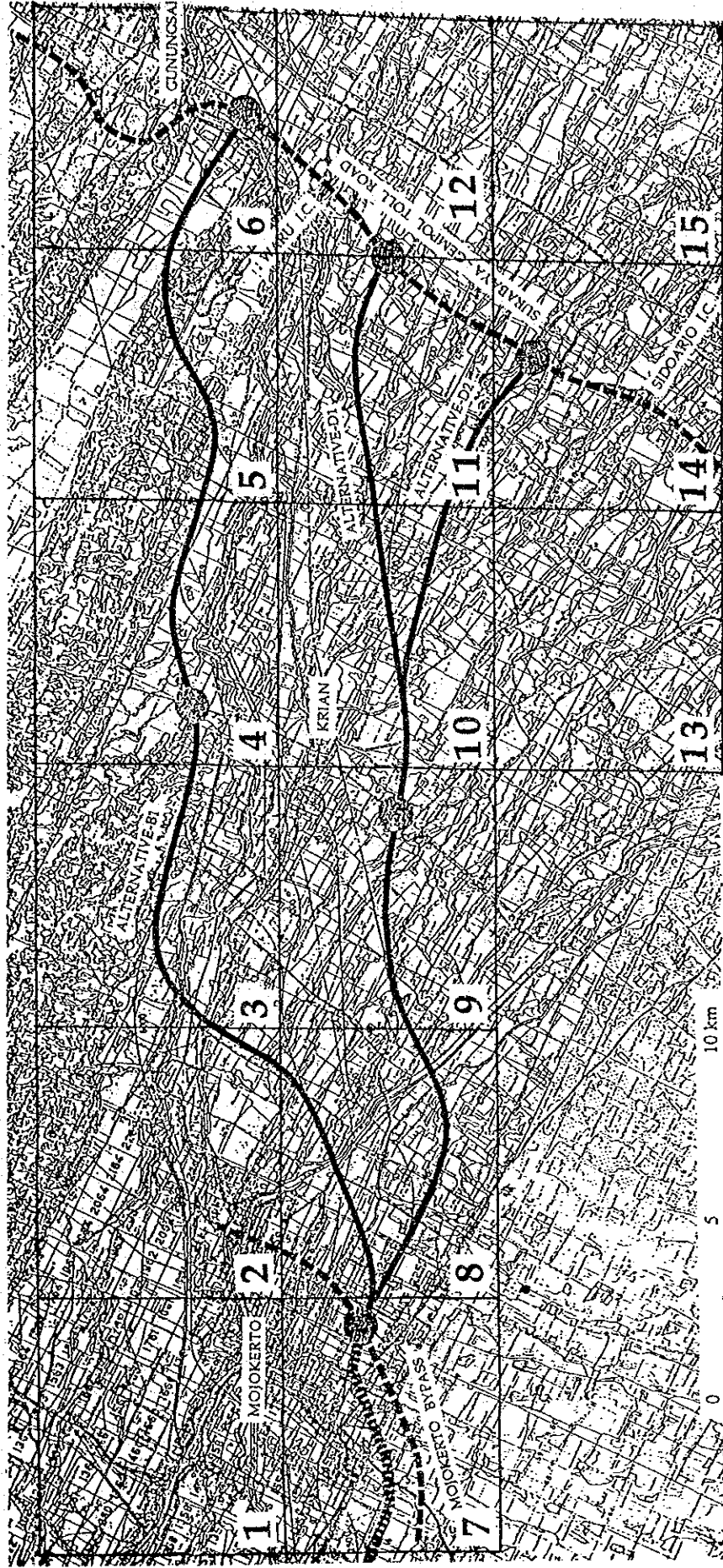
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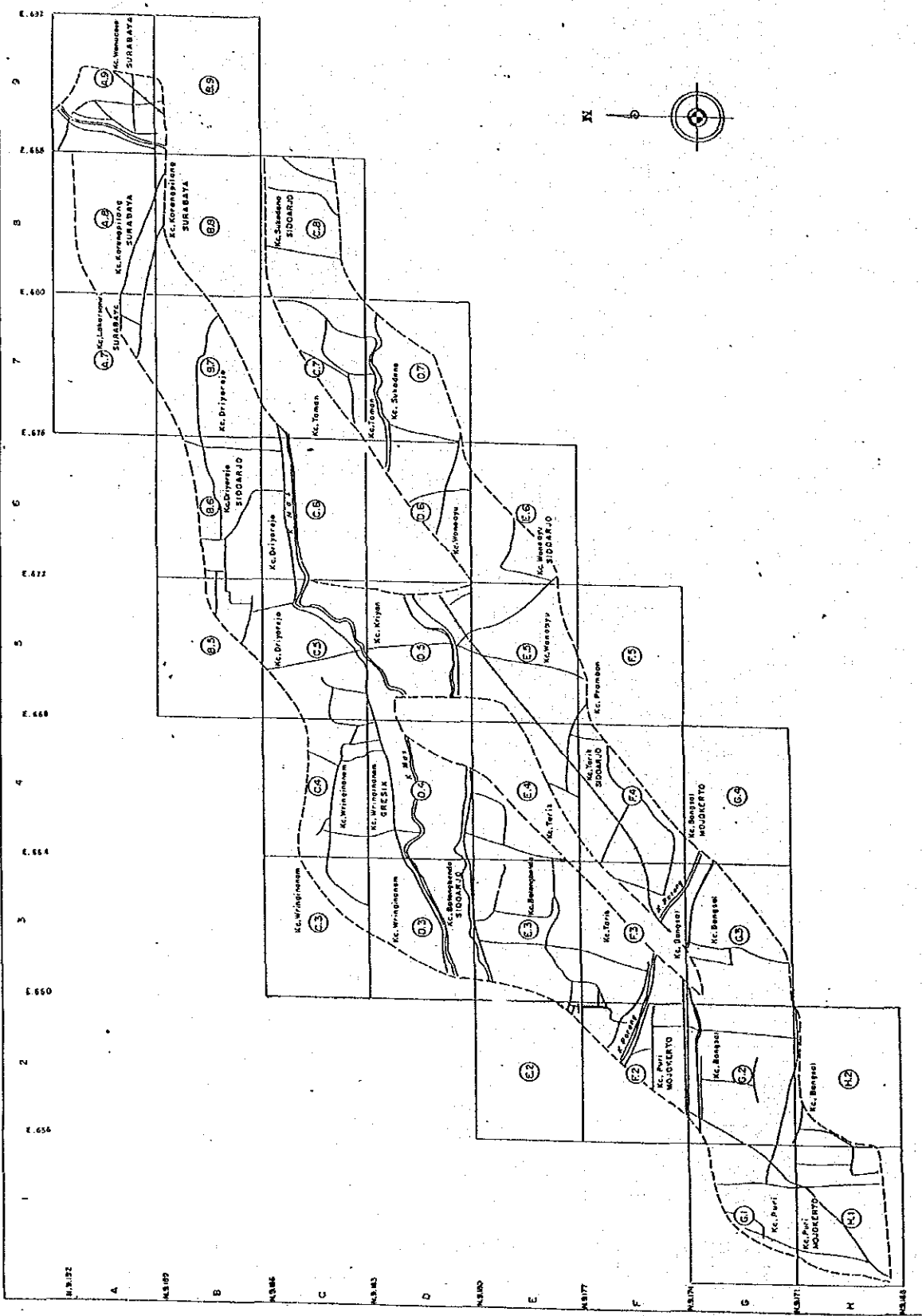


- Aerial Photography Boundary
- Mapping Boundary
- → → Flight Course
- Existing Toll Road
- ▲ Datum point
- T.T.G. Bench Marks





SCALE



SURABAYA - MOJOKERTO TOLL ROAD PROJECT

Appendix A-6.3 Sheet Index Chart of Topographic Map

BORING LOG

PROJECT SURABAYA-MOJOKERTO TOLL ROAD GROUND ELEVATION +18.10 DATE 21<sup>st</sup> DEC 1990 - 22<sup>nd</sup> DEC 1990  
 HOLE NO. MB.90.01 GROUND WATER LEVEL 94.2-94.0 SURVEYED BY S. TAKADA OHEN/HODII

SCALE	ELEVATION m	DEPTH m	PROXIMITY OF STRATA m	SOIL			STANDARD PENETRATION TESTS				N VALUE	NO OF DEPTH SAMPLE		
				SUBSTRATUM SYMBOL	VISUAL CLASSIFICATION	COLOR	DESCRIPTION	DEPTH m	NO OF BLOWS AT EACH 10cm DEPTH	NO OF BLOWS AT EACH 30cm DEPTH			NO OF BLOWS AT EACH 60cm DEPTH	
1	17.70	0.40	0.40	CLAY	CLAY	BROWN YELLOWISH BROWN	SOFT SANDY CLAY	1.55						
2	16.90	1.20	0.80	SAND	SAND	YELLOWISH BROWN	SOFT SILTY FINE SAND	2.00	9/30	3	4	5	SP.1	
3							SOFT TO MEDIUM SANDY CLAY COHESION-HIGH W/ HIGH TO MEDIUM	3.55	5/30	2	2	3		SP.2
4							MEDIUM CLAY	4.00	7/30	2	3	4		SP.3
5						GREY	CLAY WITH SOME GRAVEL	5.55						
6						VIOLETISH GREY	SANDY CLAY	6.00						
7	10.50	7.60	6.40	CLAY	CLAY	GREY	COHESION-HIGH INCLUDING GRAVEL	7.55	11/30	3	4	7		SP.4
8	9.70	8.40	0.80	CLAY	CLAY	WHITISH GREY	CLAYEY FINE SAND	8.00						
9						YELLOWISH BROWN	CLAYEY FINE TO MEDIUM SAND	9.55	45/30	15	24	21		SP.5
10						YELLOWISH BROWN	CLAYEY FINE SAND SOLID STATUS	10.00						
11	6.60	11.50	3.10	SAND	SAND	YELLOWISH BROWN BLACKISH BROWN	CLAYEY FINE SAND WITH GRAVEL	11.55	30/30	14	14	16		SP.6
12	5.90	12.60	1.10	SAND	SAND	YELLOW TO BLACKISH BROWN	CLAYEY FINE SAND SOLID STATUS	12.00	62/30	20	30	32		SP.7
13						GREY TO YELLOWISH BROWN	FINE TO MEDIUM SAND SOLID STATUS	13.55	60/15	40	60			SP.8
14						GREY TO BLACKISH BROWN	SILTY MEDIUM SAND	14.00						
15						BROWN	SILTY MEDIUM SAND	15.70						
16	1.60	16.50	3.90	SAND	SAND	YELLOWISH BROWN	SANDY SILT	16.00	24/30	5	9	15		SP.9
17							HARD SANDY SILT	18.00						
18	-0.80	18.90	2.40	SAND	SAND	YELLOWISH BROWN	SANDY SILT	18.45	39/30	17	24	15		SP.10
19						GREY TO BROWN	SANDY SILT	19.55						
20	-2.60	20.70	1.80	SAND	SAND	GREY TO BROWN	SANDY SILT	20.00	21/30	8	9	12		SP.11
21	-2.90	21.00	0.30	SAND	SAND	BROWN	SANDY SILT	21.55	35/30	7	13	22		SP.12
22						GREYISH BROWN BLACKISH GREY	SANDY SILT	22.00						
23						YELLOWISH BROWN	HARD SANDY SILT	23.55						
24	-6.50	24.60	3.60	SILT	SILT	YELLOWISH BROWN	SANDY SILT	24.00	24/30	2	11	13		SP.13
25						BROWNISH BLACK	SANDY SILT	25.55						
26	-8.30	26.40	1.80	SAND	SAND	BROWNISH BLACK	SANDY SILT	26.00						
27						LIGHT BROWN	SANDY CLAY WITH BRECCA	27.55						
28	-9.80	27.90	1.50	CLAY	CLAY	BROWN	SANDY CLAY WITH BRECCA	28.00	31/30	10	15	16		SP.14
29	-10.80	28.90	1.00	SAND	SAND	BROWN	SANDY SILT	29.55	25/30	5	9	16		SP.15
30						BROWNISH GREY	CLAY WITH SOME SAND	30.00						
31						GREYISH BROWN	SANDY CLAY	31.70	75/24	15	20	55		SP.16
32	-13.60	31.80	3.00	CLAY	CLAY	YELLOWISH GREY	SANDY CLAY WITH BRECCA	32.09						
33	-14.60	32.70	0.80	SAND	SAND	YELLOWISH GREY	SANDY CLAY							
34	-15.15	33.25	0.55	CLAY	CLAY	BROWN	SANDY CLAY							
35	-16.60	34.70	1.45	SAND	SAND	DARK BROWN	CLAYEY FINE SAND	34.00	55/5	25	55			SP.17
36	-17.70	35.80	1.10	CLAY	CLAY	LIGHT BROWN	SANDY CLAY	34.20	50/10	15	50	10		SP.18
37								35.55						
								35.80						

BORING LOG

PROJECT SURABAYA-MOJOKERTO TOLL ROAD GROUND ELEVATION +14.50 m DATE 23<sup>rd</sup> DEC 1990 - 25<sup>th</sup> DEC 1990  
 HOLE NO. MB. 90.02 SURVEYED BY S. TAKADA OHEH / HODID  
 GROUND WATER LEVEL GL = 2.10 m

SCALE	ELEVATION m	ELEVATION m	THICKNESS OF STRATA m	SYMBOL	VISUAL CLASSIFICATION	COLOR	DESCRIPTION	STANDARD PENETRATION TESTS				NO OF DEPTHS SAMPLE	SOIL SAMPLE
								DEPTH m	NO OF BLOWS AT EACH 10cm	N VALUE	NO OF DEPTHS SAMPLE		
1	13.95	0.55	0.55		CLAY	BROWN	VERY SOFT	1.55	4/30	2	2	2	SP.1
2	2.00						SOFT TO MEDIUM SANDY CLAY COHESION: MEDIUM Wn: MEDIUM	2.00	4/30	2	2		
3	3.00							3.00					
4	3.60					GREENISH BROWN		3.60					
5	4.05						MEDIUM SANDY CLAY	4.05	10/30	3	4	6	UD-1 SP.2
6	5.55	6.00	5.45		CLAY	GREY		5.55	8/30	2	4	4	SP.3
7	7.55	7.50	0.60		CLAY	LIGHT BROWN	SILTY CLAY WITH SOME SAND	7.55	7/30	2	3	4	SP.4
8	8.00							8.00					
9	9.00	9.00	2.40		CLAY	GREY	MEDIUM CLAY COHESION: HIGH Wn: MEDIUM	9.00					
10	9.60	10.30	1.30		CLAY	DARK BROWN	STIFF SANDY CLAY COHESION: HIGH	9.60	10/30	3	5	5	UD-2 SP.5
11	10.05							10.05					
12	11.55	12.00	1.70		CLAY	GREENISH GREY	SANDY CLAY COHESION: HIGH Wn: MEDIUM TO HIGH	11.55	5/30	1	2	3	SP.6
13	12.00							12.00					
14	14.00	14.45	2.45		CLAY	BROWNISH TO GREENISH GREY	MEDIUM SILTY CLAY COHESION: HIGH Wn: HIGH	14.00	6/30	1	3	3	SP.7
15	14.45							14.45					
16	15.00	15.60	1.15		CLAY	GREENISH BROWN	MEDIUM CLAY	15.00					
17	15.60							15.60	5/30	1	2	3	SP.8
18	16.05							16.05					
19	17.55						CLAYEY FINE SAND	17.55	6/30	2	3	3	SP.9
20	18.00	18.50	2.90		SAND	BLACKISH TO GREYISH BROWN		18.00					
21	19.55							19.55					
22	20.00							20.00	11/30	3	5	6	SP.10
23	21.55							21.55					
24	22.00	21.90	3.40		CLAY	BROWNISH GREY	STIFF CLAY COHESION: HIGH Wn: MEDIUM	22.00	11/30	3	5	6	SP.11
25	23.55							23.55					
26	24.00							24.00	16/30	4	7	9	SP.12
27	25.55							25.55					
28	26.00							26.00	15/30	4	6	9	SP.13
29	27.55							27.55					
30	28.00							28.00	15/30	4	6	9	SP.14
31	29.55							29.55					
32	30.00	30.90	6.15		CLAY	DARK BROWN	STIFF SANDY CLAY COHESION: HIGH Wn: LOW	30.00	14/30	4	6	8	SP.15
33	31.55							31.55					
34	32.00							32.00	13/30	3	6	7	SP.16
35	34.00							34.00					
36	34.37							34.37	5/22	6	21	30	SP.17
37	35.10							35.10	75/16	65	10		SP.18
38	35.26							35.26					



BORING LOG

PROJECT SURABAYA - MOJOKERTO TOLL ROAD GROUND ELEVATION 11.80 DATE 19<sup>th</sup> DEC 1990

HOLE NO. MB.90.03 GROUND WATER LEVEL GL - 2.50 SURVEYED BY S. TAKADA OHN/HODID

SCALE	ELEVATION	DEPTH	THICKNESS OF STRATA	SOIL			STANDARD PENETRATION TESTS					SOIL SAMPLES			
				SYMBOL	VISUAL CLASSIFICATION	COLOR	DESCRIPTION	DEPTH OF PENETRATION	NO OF BLOWS AT EACH 10cm	N	VALUE	NO OF SAMPLE	DEPTH OF SAMPLER		
1	10.90	0.90	0.90		CLAY	YELLOWISH BROWN	WITH A LITTLE SAND COHESION: HIGH	1.55	2	3	4			SP.1	1.55
2	9.80	2.00	1.10		CLAY	GREYISH BROWN	WITH HUMUS SOIL COHESION: HIGH	2.00	2	3	4				2.00
3	9.20	2.60	0.60		CLAY	GREYISH BROWN	SILTY CLAY WITH SAND	3.55	2	3	5				3.55
4							MEDIUM CLAY COHESION: HIGH W <sub>n</sub> : MEDIUM	4.00	2	3	5				4.00
5								5.55	2	3	5				5.55
6	5.30	6.50	3.90		CLAY	GREYISH BROWN		6.00	2	3	5				6.00
7						YELLOWISH TO GREYISH BROWN		7.55	2	3	5				7.55
8	3.70	8.10	1.60		CLAY	GREYISH BROWN	WITH A LITTLE SAND COHESION: HIGH	8.00	2	3	5				8.00
9	2.80	9.00	0.90		CLAY	GREENISH BROWN	ORGANIC SILTY CLAY COHESION: HIGH	9.55	3	4	5				9.55
10	1.80	10.00	1.00		CLAY	BROWNISH GREY	SILTY CLAY WITH A LITTLE SAND COHESION: HIGH W <sub>n</sub> : MEDIUM	10.00	3	4	5				10.00
11															
12															
13															
14															
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30															

REMARKS:

BORING MACHINE YSO-1

SYMBOLS OF SAMPLER  
 ● DENISON - TYPE SAMPLER  
 ⊕ THINWALL SAMPLER  
 ○ SPLIT - SPOON SAMPLER  
 X OTHER SAMPLER

BORING LOG

PROJECT SURABAYA - MOJOKERTO TOLL ROAD. GROUND ELEVATION +12.5 m. DATE 16<sup>th</sup> DEC 1990 - 18<sup>th</sup> DEC 1990  
 HOLE NO. MB 90.04 GROUND WATER LEVEL 6.730 m. SURVEYED BY S. TAKADA CHEN

SCALE	ELEVATION m	DEPTH m	THICKNESS OF STRATA m	SYMBOL	VISUAL CLASSIFICATION	COLOR	DESCRIPTION	STANDARD PENETRATION TESTS				N VALUE	NO OF SAMPLES	NO OF DEPTH SYMBOL OF SAMPLER	
								DEPTH cm	NO OF BLOWS AT EACH 10cm	10 cm	20 cm				30 cm
1	11.00	1.50			CLAY	YELLOWISH BROWN	SOFT TO MEDIUM CLAY WITH HUMUS SOIL	1.55	9/30	4	4	5		SP.1	1.55
2								2.00							2.00
3	9.00	3.50	2.00		CLAY	YELLOWISH BROWN	MEDIUM CLAY COHESION: HIGH Wn: MEDIUM	3.60	7/30	2	3	4		SP.2	3.60
4						GREENISH TO YELLOWISH BROWN	MEDIUM CLAY COHESION: HIGH Wn: MEDIUM TO LOW	4.05							4.05
5	7.70	4.80	1.30		CLAY			5.55	8/30	2	3	5		SP.3	5.55
6								6.00							6.00
7								7.55	8/30	2	3	5		SP.4	7.55
8								8.00							8.00
9								9.55	11/30	3	4	7		SP.5	9.55
10								10.00							10.00
11								11.55	14/30	5	6	8		SP.6	11.55
12								12.00							12.00
13								13.55	15/30	5	6	9		SP.7	13.55
14								14.00							14.00
15						GREEN		15.55	19/30	4	9	10		SP.8	15.55
16								16.00							16.00
17								17.55	18/30	4	9	9		SP.9	17.55
18								18.00							18.00
19								19.55	16/30	4	8	8		SP.10	19.55
20						GREENISH GREY		20.00							20.00
21						TO		21.55	17/30	5	8	9		SP.11	21.55
22						GREEN		22.00							22.00
23								23.55	16/30	6	7	9		SP.12	23.55
24					CLAY			24.00							24.00

REMARKS:

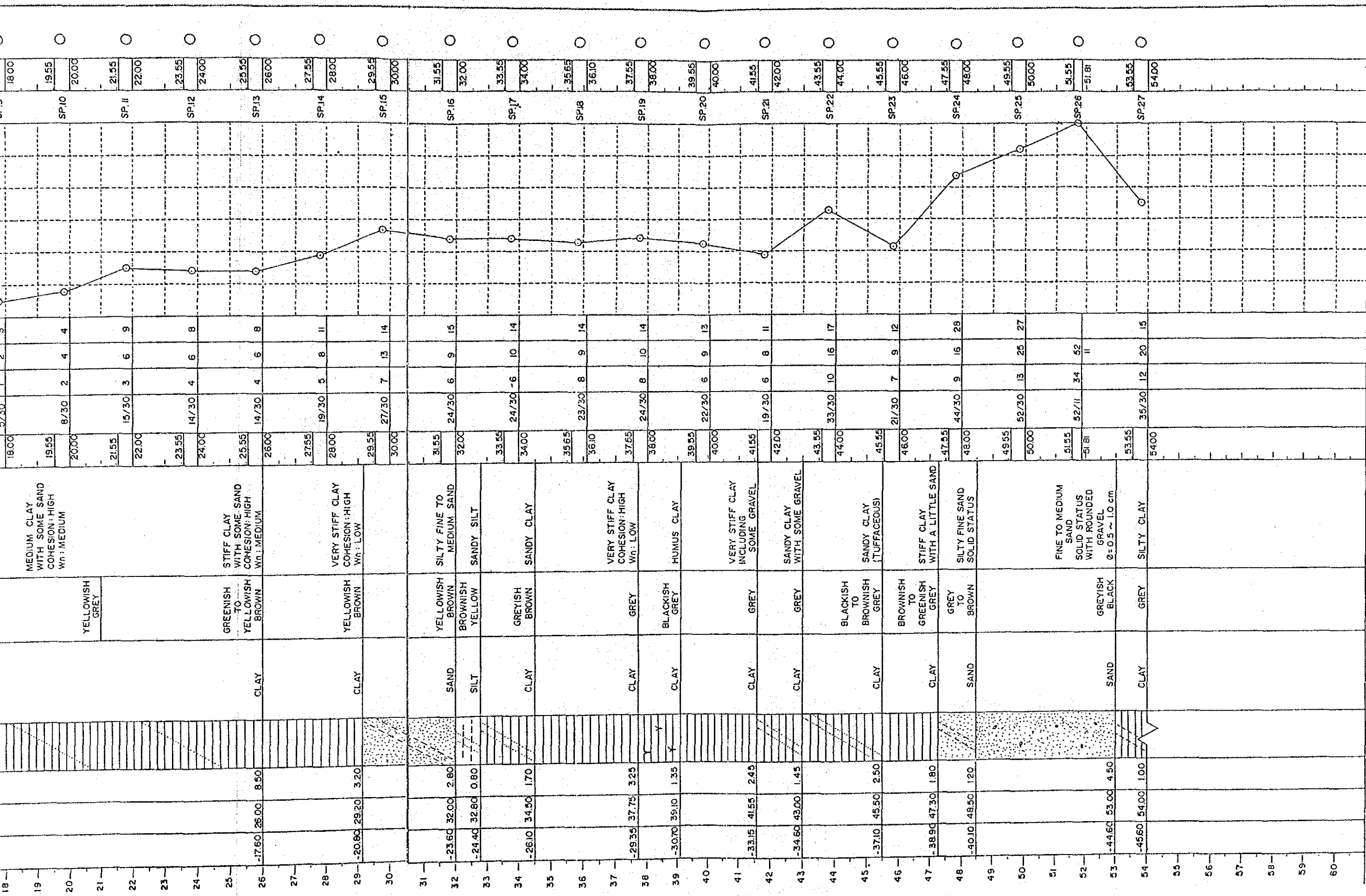
BORING MACHINE YSO-1

SYMBOLS OF SAMPLER  
 ● DENISON-TYPE SAMPLER  
 ⊕ THINWALL SAMPLER  
 ○ SPLIT-SPOON SAMPLER  
 ⊗ FOIL SAMPLER  
 ⊙ OTHER SAMPLER

**BORING LOG**

PROJECT SURABAYA-MOJOKERTO TOLL ROAD. GROUND ELEVATION + 8.40 DATE 10<sup>th</sup> DEC. 1990 - 15<sup>th</sup> DEC. 1990  
 HOLE NO. MB. 90.05 GROUND WATER LEVEL GL - 2.25 SURVEYED BY S. TAKADA OHEN/HODIO

SCALE	ELEVATION m	ELEVATION m	THICKNESS OF STRATA m	SYMBOL	SOIL		STANDARD PENETRATION TESTS					N VALUE	NO OF SAMPLE	DEPTH SYMBOL OF SAMPLER m	SOIL SAMPLES
					VISUAL CLASSIFICATION	COLOR	DESCRIPTION	DEPTH m	NO OF BLOWS AT EACH 10cm SECTION	10 cm	20 cm				
1	8.00	0.40	0.40	SILT	BLACK	SANDY SILT	2/30	1	1	1	1	1	1	1.55	SP.1
2	6.40	2.00	1.60	CLAY	BLACKISH GREY	VERY SOFT SANDY CLAY	2/30	1	1	1	1	1	1	2.00	UD-1
3	5.90	2.50	0.50	SILT	YELLOWISH GREY	SANDY SILT	2/30	1	1	1	1	1	1	2.50	UD-1
3	4.90	3.50	1.00	SAND	BLACKISH GREY	SILTY SAND WITH GRAVEL	8/30	2	4	4	4	4	4	3.55	SP.2
5	5.55	6.00	0.45			FINE TO MEDIUM SAND PARTIALLY SOLID STATUS WITH FINE GRAVEL	53/30	10	20	33	33	33	33	5.55	SP.3
7	7.55	8.00	0.45				55/30	9	21	34	34	34	34	7.55	SP.4
9	9.55	10.00	0.45				5/30	2	3	2	2	2	2	9.55	SP.5
10	11.55	12.00	0.45				3/30	2	2	1	1	1	1	11.55	SP.6
12	13.55	14.00	0.45				3/30	1	1	2	2	2	2	13.55	SP.7
14	15.00	15.60	0.60				5/30	1	2	3	3	3	3	15.00	UD-2
15	17.55	18.00	0.45				5/30	1	2	3	3	3	3	17.55	SP.8
17	19.55	20.00	0.45				5/30	1	2	3	3	3	3	19.55	SP.9
19	21.55	22.00	0.45				8/30	2	4	4	4	4	4	21.55	SP.10
21	23.55	24.00	0.45				15/30	3	6	9	9	9	9	23.55	SP.11
23	25.55	26.00	0.45				14/30	4	6	8	8	8	8	25.55	SP.12
25	27.55	28.00	0.45				19/30	5	6	11	11	11	11	27.55	SP.13
27	29.55	30.00	0.45				27/30	7	13	14	14	14	14	29.55	SP.14
29	31.55	32.00	0.45				24/30	6	9	15	15	15	15	31.55	SP.15
31	33.55	34.00	0.45				24/30	6	10	14	14	14	14	33.55	SP.16
33	35.65	36.10	0.45				23/30	8	9	14	14	14	14	35.65	SP.17
35	37.55	38.00	0.45				23/30	8	9	14	14	14	14	37.55	SP.18



REMARKS : BORING MACHINE YSO-1

SYMBOLS OF SAMPLER  
 ● DENISON-TYPE SAMPLER  
 ⊕ THINWALL SAMPLER  
 ⊖ SPLIT-SPOON SAMPLER  
 ⊗ OTHER SAMPLER

SURABAYA - MOJOKERTO TOLL ROAD PROJECT Appendix A-6.4 (5) Boring Log (B-5)



**Appendix A-6.5 Mean Monthly Rainfall**

No.	Station Name	Month												Total
		1	2	3	4	5	6	7	8	9	10	11	12	
2	Lengkong	272.4	318.2	260.8	170.1	94.6	40.0	18.8	4.0	24.8	24.6	118.2	203.6	1,550
5	Terusan Mojokerto	314.9	307.5	287.5	174.0	106.7	36.2	21.8	7.0	29.2	32.0	134.3	226.7	1,677
7	Sambiroto	371.0	329.1	285.1	180.1	106.2	46.5	26.1	12.9	33.9	32.1	145.5	229.8	1,798
25	Bakalan	352.3	362.7	326.1	191.1	138.3	59.0	20.3	9.2	30.8	58.7	142.5	290.9	1,982
27	Krikilan	368.6	329.1	261.5	187.5	135.1	78.3	30.3	10.9	27.3	42.6	136.3	315.7	1,923
28	Botokan	328.9	330.6	283.7	153.6	160.3	71.8	27.7	8.4	25.8	27.7	120.5	267.4	1,806
34	Krian	359.2	363.9	296.5	170.1	150.2	67.9	27.8	9.5	31.7	47.9	142.1	280.2	1,947
36	Cepicles	359.4	372.5	302.5	187.3	114.2	48.5	22.1	5.6	18.0	29.5	141.9	265.7	1,867
37	Prambon	346.4	331.3	285.4	179.1	115.9	45.0	17.6	4.2	8.8	28.3	125.3	225.6	1,713
38	Sruti	364.8	315.4	270.9	180.7	136.7	51.5	19.9	12.8	20.9	69.5	182.0	252.4	1,702
53	Gunungsari	335.2	235.7	255.5	173.8	131.7	66.7	25.0	10.6	31.1	46.3	142.4	266.3	1,707

**Appendix A-6.6 Average Number of Monthly Rainy Days**

No.	Station Name	Month												Total
		1	2	3	4	5	6	7	8	9	10	11	12	
2	Lengkong	18.3	17.4	17.0	9.6	5.7	3.5	1.4	0.5	1.7	3.1	8.1	13.1	99.2
5	Terusan Mojokerto	17.5	17.1	15.5	10.2	6.2	2.5	1.2	0.6	1.3	2.4	8.3	12.6	95.1
7	Sambiroto	18.5	17.2	15.6	9.2	6.0	3.6	1.7	1.1	2.1	2.9	8.5	13.3	99.7
25	Bakalan	15.4	14.2	12.3	8.0	5.9	2.9	1.0	0.5	1.3	2.1	6.8	11.4	81.5
27	Krikilan	18.3	17.2	16.1	10.0	8.6	4.8	1.7	0.6	1.5	2.5	7.9	13.6	102.5
28	Botokan	16.8	17.0	15.4	9.4	7.9	4.9	1.6	0.7	1.3	1.9	7.1	13.1	96.9
34	Krian	19.1	18.1	17.8	10.4	8.1	4.2	1.9	0.9	1.5	3.0	8.7	14.4	107.9
36	Cepicles	16.3	15.5	12.9	8.7	5.0	2.7	1.1	0.5	1.1	1.6	6.7	11.3	83.1
37	Prambon	18.2	16.9	15.5	9.6	6.9	3.8	1.3	0.4	0.8	2.0	7.1	13.4	95.5
38	Sruti	15.1	14.4	12.0	8.7	7.0	3.6	1.5	0.5	0.8	1.4	5.4	10.9	81.0
53	Gunungsari	15.9	13.2	14.2	10.2	7.8	4.9	1.7	0.9	1.6	2.4	7.2	12.4	92.1

Appendix A-6.7 Maximum Daily Rainfall at 11 Stations

(Unit : mm/day)

No.	Station Name	Year																			
		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	Lengkong	135	115	80	110	63	51	46	62	110	88	60	86	95	103	91	94	86	55	60	45
5	Terusan	60	94	92	100	70	94	134	51	105	65	66	97	110	80	83	90	82	82	85	64
7	Mojokerto	104	95	72	120	105	67	67	101	161	73	63	90	83	93	96	130	82	85	145	72
25	Bakalan	116	121	98	95	98	94	98	70	115	67	110	68	207	65	89	85	132	65	82	121
27	Krikilan	60	64	60	65	85	100	59	69	100	125	120	83	83	94	95	106	106	58	68	62
28	Botokan	81	99	81	91	80	110	90	107	105	108	90	102	90	106	106	109	112	96	68	95
34	Krian	98	70	73	122	98	125	79	103	106	110	135	93	97	121	95	131	103	69	95	114
36	Cepiples	76	110	58	76	98	93	86	67	104	78	87	84	85	96	98	74	133	59	93	89
37	Prambon	121	87	187	138	67	100	82	75	70	51	74	79	65	88	158	97	96	79	113	150
38	Sruni	68	75	70	98	71	70	89	94	85	83	95	82	90	90	108	83	130	87	124	87
53	Gunungsari	94	85	85	95	62	75	60	70	175	61	81	92	90	98	171	126	109	86	93	120

## **Appendix A-9.1 Basic Strength and Allowable Stress of Materials**

### **A.1 Materials and Basic Strengths**

#### 1) Concrete

The use of each class of concrete and required strengths are as shown in Table-A1 and Table-A2, respectively.

#### 2) Reinforcing Steel

Type, designation and yield strength of reinforcing steel for concrete structures are specified in Table-A3.

#### 3) Prestressing Steel

Nominal diameter and yield and breaking strengths of prestressing steel are shown in Table-A4.

### **A.2 Allowable Stresses**

#### 1) Concrete

The allowable stresses of each class are as shown in Table-A5 and Table-A6.

#### 2) Reinforcement

The allowable stress for each type and designation of reinforcing steel is as shown in Table-A7.

#### 3) Prestressing Steel

The allowable stresses for each type of prestressing steel are as shown in Table-A8.



**Table-A1 Concrete Class and Use**

Class of Concrete	Use of Each Class of Concrete
A - 1	Prestressed concrete box girders
A - 2	Prestresses concrete hollow slabs
A - 3	Precast prestressed concrete I-girders
A - 4	Precast prestressed concrete hollow core slab units
A - 5	Precast prestressed concrete T-girders
B - 1	Reinforced concrete slabs and cross beams of prestressed concrete I-girder bridge
B - 2	Cast in place reinforced concrete piles
B - 3	Pipe culverts
B - 4	Reinforced concrete for bridge deck slab
B - 5	Reinforced concrete for pier columns and cantilevered pier heads except for pedestrian bridge
C - 1	Stairs of pedestrian bridge
C - 2	Reinforced curbs
C - 3	Piers for pedestrian bridge
C - 4	Abutment, piers except for columns, approach slabs, retaining walls, foundation of street lighting poles
C - 5	Box culverts including wing walls
D	Gravity type retaining walls, non-reinforced curbs
E	Levelling concrete, backfill concrete in masonry structure
AA	Prestressed concrete piles

**Table-A2 Concrete Class Strength**

Class of Concrete	Minimum Compressive Strength at 28 days	
	By Cube Test	By Cylinder Test
A-1 to a-5	400	346
B-1 to B-5	350	290
C-1 to C-5	250	210
D	150	130
E	100	80
AA	600	500

**Table-A3 Type, Designation and Yield Strength of Reinforcing Steel**

Type	JIS G 3112		ASTM A 615		Indonesian Standard
	Designation	Yield Strength	Designation	Yield Strength	
Round Bar	SR 24	24	Grade 40	28	As applicable
Deformed Bar	SD30	30	Grade 60	42	As applicable

**Table-A4 Notation, Nominal Diameter and Strength of Prestressing Steel**

Notation	Nominal Diameter	Yield Strength	Breaking Strength	Applicable Standard	
	(mm)	(kg/mm <sup>2</sup> )	(kg/mm)	JIS	ASTM
PC Wire SWPR 1	7	135	155	G3536	
PC Wire SWPR 1	8	130	150	G3536	A421
PC 7-Wire Strand SWPR 7A	T12.4	150	175	G3536	A416
PC 7-Wire Strand SWPR 7B	T12.7	160	190	G3536	A416
PC 9-Wire Strand SWPR 19	T19.3	162	189	G3536	A416
PC 9-Wire Strand SWPR 19	T21.8	161	187	G3536	A416
PC Bar SBPR 80/95	23	80	95	G3109	A422

**Table-A5 Allowable Stress of Concrete for Prestressed Concrete Structure**

(kg/cm<sup>2</sup>)

Designation	Class of Concrete					
	AA	A-1 A-2	A-3	A-4	A-5	B-1
Allowable Compressive Stress due to Bending						
- Temporary Stress before Losses due to Creep and Shrinkage	210	152	152	162	152	143
- Stress at Service Load after Losses have occurred	170	119	119	129	119	117
Allowable Axial Compressive Stress						
- Temporary Stress before Losses due to Creep and Shrinkage	160	121	121	121	121	107
- Stress at Service Load after Losses have occurred	135	93	93	93	93	83
Allowable Tensile Stress due to Bending						
- Temporary Stress before Losses due to Creep and Shrinkage	-	12.9	12.9	12.9	12.9	11.7
- Due to Dead Load and Superimposed Load	-	0	0	0	0	0
- Due to Dead Load, Superimposed and Live Load	-	12.9	12.9	12.9	12.9	11.7
Allowable Shearing Stress						
- Stress at Service Load	-	4.8	4.8	4.8	4.8	4.4
- Stress at Ultimate Load due to Shear Force or Torsional Moment	-	44	44	44	44	39
- Stress at Ultimate Load due to Shear Force and Torsional Moment	-	52	52	52	52	47
Allowable Diagonal Tension Stress						
- Stress at Service Load due to Shear Force or Torsional Moment	-	8.6	8.6	8.6	8.6	8.4
- Stress at Service Load due to Shear Force and Torsional Moment	-	11.6	11.6	11.6	11.6	11.0

**Table-A6 Allowable Stress for Reinforced and Plain Concrete Structure**

(kg/cm<sup>2</sup>)

Designation	Class of Concrete			
	B-2	B-3,-5	C-1,-5	D
Allowable Compressive Stress due to Bending	77	97	70	31
Allowable Axial Compressive Stress	63	82	55	31
Allowable Shearing Stress	3.8	4.4	3.6	-

**Table-A7 Allowable Stress of Reinforcement**

(kg/cm<sup>2</sup>)

Designation	SR 24	SD 30
Allowable Tensile Stress		
- General Use	1400	1800
- Under Water	1400	1600
Allowable Compressive Stress	1400	1800

**Table-AS Allowable Stress of Prestressing Steel****(kg/mm<sup>2</sup>)**

Designation	PC Wire SWPR 1 7 mm	PC Wire SWPR 1 8 mm	PC Wire SWPR 7A T12.4 mm	PC Wire SWPR 7B T12.7mm
Initial Prestressing Work	122	117	135	145
Immediately after Prestressing Work	108	105	123	133
Stress at Service Load after Losses have occurred	93	90	105	114

Designation	PC Wire SWPR 19 T19.3 mm	PC Wire SWPR 19 T21.8 mm	PC Bar SBPR 80/95 23 mm
Initial Prestressing Work	146	145	72
Immediately after Prestressing Work	132	131	66.5
Stress at Service Load after Losses have occurred	113	112	57

## Appendix A-9.2

## Crossing Roads and Railway Lines

NO.	Sta.	ROAD CLASS	SURFACE CONDITION	WIDTH (m)	PLANNED STRUCTURE
1	0 + 000	Mojokerto Bypass	Asphalt Paved	11.8(6.8)	Mojokerto IC Rampway Bridge
2	0 + 105	Farmers Path	Earth	5.7	Relocate and connect with Mojokerto Bypass
3	0 + 724	Desa Road	Earth	4.8	Box Culvert 6 x 3.5, Sta. 0 + 724
4	0 + 975	Farmers Path	Earth	7.0	Box Culvert 3 x 3, Sta. 0 + 975
5	1 + 400	Desa Road	Earth	5.0	Overbridge, Sta. 1 + 450
6	1 + 660	Desa Road	Earth	5.8	Overbridge, Sta. 1 + 450
7	1 + 780	Desa Road	Earth	5.8	Relocate Parallel with the Toll Road
8	3 + 050	Farmers Path	Earth	4.0	Toll Road Bridge (Sadar River Bridge)
9	3 + 300	Desa Road	Earth	4.0	Box Culvert 6 x 3.5, Sta. 3 + 300
10	3 + 695	PJKA Railway Line		4.4	Toll Road Bridge (Railway Bridge)
11	4 + 000	Farmers Path	Earth	3.0	Box Culvert 3 x 3, Sta. 4 + 020
12	4 + 865	Kabupaten Road	Asphalt Paved	5.0(4.0)	Toll Road Bridge (Porong River Bridge)
13	4 + 944	Desa Road	Gravel	6.0(4.0)	Toll Road Bridge (Porong River Bridge)
14	5 + 080	Inspection Road (K. Porong)	Earth	4.2	Toll Road Bridge (Porong River Bridge)
15	5 + 285	Inspection Road (K. Porong)	Earth	4.2	Toll Road Bridge (Porong River Bridge)
16	5 + 335	Inspection Road (Porong Canal)	Earth	5.0	Toll Road Bridge (Porong River Bridge)
17	5 + 475	Desa Road	Earth	5.4	Box Culvert 6 x 3.5, Sta. 5 + 475
18	5 + 730	Desa Road	Earth	7.0	Overbridge, Sta. 5 + 975
19	5 + 940	Desa Road	Asphalt Paved	7.0(3.7)	Overbridge, Sta. 5 + 975
20	6 + 865	Desa Road	Earth	3.0	Overbridge, Sta. 6 + 865
21	7 + 485	Desa Road/Sugarcane Railway	Gravel	9.0(4.0)	Relocate and Connect with Desa Road at Sta. 7+730
22	7 + 730	Desa Road/Sugarcane Railway	Earth	6.7	Toll Road Bridge (Balong Bendo Bridge)
23	8 + 150	Farmers Path	Earth	3.0	Box Culvert 3 x 3, Sta. 8+150
24	8 + 690	Inspection Road (Ploso Canal)	Earth	8.1	Toll Road Bridge (Ploso Canal Bridge)
25	8 + 805	Desa Road	Earth	5.8	Box Culvert 6 x 3.5, Sta. 8 + 805
26	9 + 054	Sugarcane Railway		2.0	Box Culvert 6 x 3.5, Sta. 9 + 020
27	10 + 195	Farmers Path	Earth	3.0	Box Culvert 3 x 3, Sta. 10+195

Appendix A-9.2 Crossing Roads and Railway Lines

NO.	Sta.	ROAD CLASS	SURFACE CONDITION	WIDTH (m)	PLANNED STRUCTURE
28	10 + 575	National Highway	Asphalt Paved	16.3(7.3)	Toll Road Bridge (Mangetan Viaduct)
29	10 + 663	Inspection Road (Mangetan Canal)	Earth	7.6	Toll Road Bridge (Mangetan Canal Bridge)
30	10 + 855	Desa Road	Earth	5.1	Toll Road Bridge (Balong Bendo Viaduct)
31	11 + 185	Desa Road	Earth	5.6	Toll Road Bridge (Balong Bendo Viaduct)
32	11 + 490	Desa Road	Earth	5.5	Toll Road Bridge (Surabaya River Bridge)
33	11 + 594	Provincial Road	Asphalt Paved	7.5(4.5)	Toll Road Bridge (Surabaya River Bridge)
34	11 + 735	Desa Road	Earth	5.3	Toll Road Bridge (Wringinanom Viaduct)
35	11 + 864	Desa Road	Earth	5.0	Toll Road Bridge (Wringinanom Viaduct)
36	12 + 833	Farmers Path	Earth	3.0	Box Culvert 3 x 3, Sta. 12 + 833
37	13 + 045	Farmers Path	Earth	3.0	Box Culvert 3 x 3, Sta. 13 + 045
38	13 + 615	Desa Road	Gravel	10.0(4.0)	Box Culvert 6x3.5, Sta. 13+570
39	13 + 680	Desa Road	Earth	5.0	Relocate to Box Culvert, Sta. 13 + 570
40	14 + 213	Farmers Path	Earth	3.0	Relocate to Overbridge, Sta. 14 + 535
41	14 + 370	Farmers Path	Earth	3.0	Relocate to Overbridge, Sta. 14 + 535
42	14 + 422	Farmers Path	Earth	3.0	Relocate to Overbridge, Sta. 14 + 535
43	14 + 625	Farmers Path	Earth	3.0	Relocate to Overbridge, Sta. 14 + 535
44	14 + 735	Farmers Path	Earth	3.0	Relocate to Overbridge, Sta. 14 + 535
45	15 + 324	Desa Road	Earth	4.8	Overbridge, Sta. 15 + 324
46	15 + 983	Farmers Path	Earth	3.0	Box Culvert 3 x 3, Sta. 15 + 983
47	16 + 430	Farmers Path	Earth	3.0	Box Culvert 3 x 3, Sta. 16 + 430
48	16 + 739	Farmers Path	Earth	3.0	Connect with Box Culvert, Sta. 16 + 860
49	16 + 860	Farmers Path	Earth	3.0	Box Culvert 3 x 3, Sta. 16 + 860
50	17 + 300	Farmers Path	Earth	3.0	Box Culvert 3 x 3, Sta. 17 + 300
51	17 + 515	Desa Road	Earth	6.0	Relocate to Box Culvert 6 x 3.5, Sta. 17 + 450
52	17 + 565	Desa Road	Earth	6.0	Relocated with Parallel to the Toll Road
53	17 + 660	Desa Road	Earth	6.0	Relocate to Box Culvert 6 x 3.5, Sta. 17 + 795
54	17 + 733	Desa Road	Earth	6.0	Relocate to Box Culvert 6 x 3.5, Sta. 17 + 795

NO.	Sta.	ROAD CLASS	SURFACE CONDITION	WIDTH (m)	PLANNED STRUCTURE
55	17 + 945	Desa Road	Earth	6.0	Relocate to Box Culvert 6 x 3.5, Sta. 18 + 065
56	18 + 105	Desa Road	Earth	6.0	Relocate to Box Culvert 6 x 3.5, Sta. 18 + 065
57	18 + 300	Desa Road	Earth	6.0	Relocate to Box Culvert 6 x 3.5, Sta. 18 + 065
58	18 + 380	Desa Road	Earth	6.0	Relocate to Box Culvert 6 x 3.5, Sta. 18 + 515
59	18 + 723	Farmers Path	Earth	3.0	Box Culvert 3 x 3, Sta. 18 + 723
60	19 + 175	Farmers Path	Earth	3.0	Box Culvert 3 x 3, Sta. 19 + 325
61	19 + 665	Desa Road	Earth	6.7	Relocate to Box Culvert 6 x 3.5, Sta. 19 + 500
62	19 + 940	Farmers Path	Earth	3.0	Relocate Parallel with the Toll Road
63	20 + 255	Farmers Path	Earth	4.4	Box Culvert 3 x 3, Sta. 20 + 255
64	20 + 490	Farmers Path	Earth	3.0	Box Culvert 3 x 3, Sta. 20 + 490
65	20 + 755	Kabupaten Road	Asphalt Paved	6.7(4.0)	Overbridge, Sta. 20 + 755
66	21 + 285	Farmers Path	Earth	3.0	Relocate to Toll Road Bridge (Larongan River Bridge)
67	21 + 870	Farmers Path	Earth	3.0	Box Culvert 3 x 3, Sta. 21 + 870
68	22 + 243	Farmers Path	Earth	3.0	Box Culvert 3 x 3, Sta. 22 + 243
69	22 + 740	Desa Road	Earth	7.5	Overbridge, Sta. 22 + 740
70	23 + 155	Desa Road	Earth	6.0	Overbridge, Sta. 23 + 155
71	23 + 235	Farmers Path	Earth	3.0	Relocate Parallel with the Toll Road
72	23 + 567	Farmers Path	Earth	3.0	Relocate to Box Culvert 3 x 3, Sta. 23 + 775
73	23 + 953	Farmers Path	Earth	3.0	Relocate to Box Culvert 3 x 3, Sta. 23 + 775
74	24 + 220	Farmers Path	Earth	3.0	Box Culvert 3 x 3, Sta. 24 + 220
75	24 + 865	Desa Road	Earth	8.7	Box Culvert 6x3.5
76	25 + 623	Farmers Path	Earth	3.0	Relocate to Overbridge, Sta. 25 + 950
77	25 + 870	Kabupaten Road	Asphalt Paved	8.5(5.5)	Relocate to Overbridge, Sta. 25 + 950
78	26 + 180	Farmers Path	Earth	3.0	Box Culvert 3 x 3.5
79	26 + 443	Desa Road	Earth	6.1	Box Culvert 6 x 3.5
80	26 + 830	Farmers Path	Earth	3.0	Box Culvert 3 x 3, Sta. 26 + 830
81	27 + 250	Farmers Path	Earth	3.0	Relocate to Box Culvert 3 x 3, Sta. 27 + 510



**Appendix A-9.2 Crossing Roads and Railway Lines**

NO.	Sta.	ROAD CLASS	SURFACE CONDITION	WIDTH (m)	PLANNED STRUCTURE
82	27 + 335	Farmers Path	Earth	5.0	Relocate to Box Culvert 3 x 3, Sta. 27 + 510
83	27 + 607	Farmers Path	Earth	5.0	Relocate to Box Culvert 3 x 3, Sta. 27 + 510
84	27 + 765	Desa Road	Asphalt Paved	8.5(5.5)	Box Culvert 6 x 3.5
85	27 + 985	Farmers Path	Earth	3.0	Relocate to Overbridge, Sta. 28 + 035
86	28 + 117	Farmers Path	Earth	3.0	Relocate to Box Culvert 3 x 3, Sta. 28 + 300
87	28 + 505	Farmers Path	Earth	3.0	Relocate to Box Culvert 3 x 3, Sta. 28 + 300
88	29 + 275	Desa Road	Earth	6.0	Relocate to Box Culvert 3 x 3, Sta. 29 + 090
89	29 + 325	Desa Road	Earth	6.0	Relocate Parallel with the Toll Road
90	29 + 880	Desa Road	Earth	7.1	Relocate to Box Culvert 6 x 3.5, Sta. 30 + 115
91	30 + 030	Desa Road	Earth	5.3	Relocate to Box Culvert 6 x 3.5, Sta. 30 + 115
92	30 + 287	Desa Road	Earth	7.4	Relocate to Box Culvert 6 x 3.5, Sta. 30 + 115
93	30 + 390	Farmers Path	Earth	3.0	Relocate to Overbridge, Sta. 30 + 550
94	30 + 443	Farmers Path	Earth	3.0	Relocate to Overbridge, Sta. 30 + 550
95	31 + 455	Farmers Path	Earth	3.0	Relocate to Overbridge, Sta. 30 + 550
96	32 + 090	Farmers Path	Earth	3.0	Relocate to Box Culvert 3 x 3, Sta. 32 + 150
97	32 + 325	Farmers Path	Earth	3.0	Relocate to Box Culvert 3 x 3, Sta. 32 + 150
98	32 + 415	Farmers Path	Earth	3.0	Relocate to Box Culvert 3 x 3, Sta. 32 + 150
99	32 + 545	Farmers Path	Earth	3.0	Relocate to Box Culvert 3 x 3, Sta. 32 + 150
100	32 + 760	Farmers Path	Earth	3.0	Relocate to Toll Road Bridge (Lakarsantri Viaduct)
101	33 + 017	Planned Inner Ring Road			Toll Road Bridge (Lakarsantri Viaduct)
102	33 + 127	Desa Road (to be widened to 20 m)	Asphalt Paved	5.4(3.0)	Toll Road Bridge (Lakarsantri Viaduct)
103	33 + 470	Farmers Path	Earth	3.0	Relocate to Box Culvert 3 x 3, Sta. 33 + 400
104	33 + 520	Farmers Path	Earth	3.0	Relocate to Box Culvert 3 x 3, Sta. 33 + 400
105	33 + 640	Desa Road	Earth	5.0	Relocate to Overbridge, Sta. 33 + 780
106	33 + 747	Desa Road	Earth	5.0	Relocate to Overbridge, Sta. 33 + 780
107	33 + 800	Desa Road (to be widened to 20 m)	Asphalt Paved	11.1(4.5)	Overbridge, Sta. 33 + 780
108	34 + 345	Farmers Path	Earth	3.0	Relocate to Box Culvert 3 x 3, Sta. 34 + 485

Appendix A-9.2 Crossing Roads and Railway Lines

NO.	Sta.	ROAD CLASS	SURFACE CONDITION	WIDTH (m)	PLANNED STRUCTURE
109	34 + 540	Farmers Path	Earth	3.0	Relocate to Box Culvert 3 x 3, Sta. 34 + 485
110	34 + 945	Desa Road	Gravel	5.0(3.0)	Portal Culvert 8 x 5.5, Sta. 34 + 945
111	35 + 490	Road in Housing Complex	Gravel	4.0(3.0)	Relocate to Box Culvert 6 x 3.5, Sta. 36 + 415
112	36 + 415	Road in Housing Complex	Asphalt Paved	4.7(4.7)	Box Culvert 6 x 3.5, Sta. 36 + 415
113	37 + 303	Desa Road	Gravel Road	3.0(1.5)	Toll Road Bridge (Karangpilang Viaduct)
114	37 + 500	Desa Road	Asphalt Paved	3.5(2.5)	Toll Road Bridge (Karangpilang Viaduct)
115	37 + 580	Provincial Road	Asphalt Paved	21.9(12.6)	Toll Road Bridge (Karangpilang Viaduct)
116	37 + 780	Jl. Kebon Sari	Asphalt Paved	9.4(5.0)	Toll Road Bridge (Wonokromo Viaduct)
117	38 + 025	Jl. Kebon Agung	Asphalt Paved	6.1(4.0)	Toll Road Bridge (Wonokromo Viaduct)
118	38 + 320	Surabaya - Gempol Toll Road	Asphalt Paved	22.5(15.0)	Toll Road Bridge (Wonokromo Viaduct)
		Toll Road		1 location	
		National Road		2 locations	
		Planned Inner Ring Road		1 location	
		Provincial Road		2 locations	
		Kabupaten Road		4 locations	
		Desa/Local Road		99 locations	
		Inspection Road		5 locations	
		PJKA Railway Line		1 location	
		Sugarcane Railway		3 locations	
		Total		118 locations	

NO.	STA.	KIND OF WATERWAY	WIDTH AND DEPTH (m)	PLANNED STRUCTURE
1	0 + 010	Side Ditch	1.5(1.0) x 0.3	Pipe Culvert $\phi$ 1.0 (Mojokerto IC Ramp)
2	0 + 100	Side Ditch	1.0(0.5) x 0.3	Pipe Culvert $\phi$ 1.0 (Mojokerto IC Ramp)
3	0 + 110	Side Ditch	1.0(0.5) x 0.3	Pipe Culvert $\phi$ 1.0 (Mojokerto IC Ramp)
4	0 + 307	Drainage Canal	3.0(2.5) x 0.3	Pipe Culvert 2 - $\phi$ 1.0 (Mojokerto IC Ramp)
5	0 + 570	Irrigation Canal	8.0(6.5) x 1.5	Box Culvert 2-3 x 3, Sta. 0 + 570
6	0 + 620	Drainage Canal	3.5(2.5) x 1.0	Box Culvert 3 x 2, Sta. 0 + 620
7	0 + 722	Side Ditch	0.6x 0.6	Pipe Culvert $\phi$ 1.0, Sta. 0 + 722
8	0 + 727	Side Ditch	0.6x 0.6	Pipe Culvert $\phi$ 1.0, Sta. 0 + 727
9	0 + 780	Drainage Canal	2.5(1.5) x 0.8	Box Culvert 2 x 1.5, Sta. 0 + 780
10	0 + 965	Irrigation Canal	2.0(1.0) x 0.5	Pipe Culvert 2 - $\phi$ 1.0, Sta. 0 + 965
11	1 + 070	Drainage Canal	3.0(2.5) x 1.3	Box Culvert 3 x 2, Sta. 1 + 070
12	1 + 100	Drainage Canal	0.9(0.5) x 0.4	Relocation in parallel with the Toll Road
13	1 + 465	Irrigation Canal	3.0(2.5) x 1.0	Relocation in parallel with the Toll Road
14	1 + 525	Irrigation Canal	3.0(2.5) x 1.0	Box Culvert 3 x 2, Sta. 1 + 525
15	1 + 657	Side Ditch	0.2 x 0.2	Relocation in parallel with the Toll Road
16	1 + 673	Side Ditch	0.2 x 0.2	Relocation in parallel with the Toll Road
17	1 + 745	Drainage Canal	8.0(5.0) x 3.0	Box Culvert 2-3 x 3, Sta 1 + 745
18	1 + 810	Irrigation Canal	6.0(4.0) x 1.0	Box Culvert 4.5 x 2.5, Sta. 1 + 810
19	2 + 375	Drainage Canal	4.0(1.5) x 1.2	Box Culvert 4.5 x 2.5, Sta. 2 + 375
20	3 + 070	Sadar River	20.5(17.5) x 2.5	Sadar River Bridge
21	3 + 296	Side Ditch	1.5(1.0) x 0.3	Relocation in parallel with the Toll Road
22	3 + 305	Side Ditch	1.5(1.0) x 0.3	Relocation in parallel with the Toll Road
23	3 + 685	Side Ditch	1.6(0.8) x 0.3	Railway Bridge
24	3 + 710	Side Ditch	2.5(1.3) x 0.5	Railway Bridge
25	4 + 915	Irrigation Canal	10.0(8.0) x 1.6	Porong River Bridge
26	4 + 933	Irrigation Canal	15.0(12.0) x 2.0	Porong River Bridge

Appendix A-9.3 Crossing Rivers and Waterways

NO.	STA.	KIND OF WATERWAY	WIDTH AND DEPTH (m)	PLANNED STRUCTURE
27	4 + 985	Drainage Canal	6.5(2.5) x 2.7	Porong River Bridge
28	5 + 215	Porong River	182.0(105.0) x 9.5	Porong River Bridge
29	5 + 315	Porong Canal	35.0(10.0) x 4.0	Porong River Bridge
30	5 + 580	Irrigation Canal	3.0(1.0) x 1.2	Box Culvert 3 x 2, Sta. 5 + 580
31	5 + 730	Irrigation Canal	0.8 x 0.4	Pipe Culvert ø 1.0, Sta. 5 + 730
32	5 + 735	Side Ditch	0.6(0.5) x 0.5	Pipe Culvert ø 1.0, Sta. 5 + 735
33	5 + 943	Irrigation Canal	1.5(0.8) x 0.6	Pipe Culvert 2 - ø 1.0, Sta. 5 + 925
34	6 + 605	Irrigation Canal	0.6(0.3) x 0.3	Pipe Culvert ø 0.6, Sta. 6 + 605
35	6 + 875	Irrigation Canal	1.0(0.6) x 0.6	Pipe Culvert ø 1.0, Sta. 6 + 890
36	7 + 130	Irrigation Canal	0.6(0.3) x 0.6	Pipe Culvert ø 1.0, Sta. 7 + 130
37	7 + 717	Irrigation Canal	2.0(0.6) x 0.6	Tarik Bridge
38	7 + 720	Irrigation Canal	2.0(1.0) x 1.0	Tarik Bridge
39	7 + 735	Irrigation Canal	0.8(0.4) x 0.4	Tarik Bridge
40	7 + 736	Irrigation Canal	0.8(0.4) x 0.4	Tarik Bridge
41	7 + 833	Drainage Canal	1.3(0.8) x 0.5	Pipe Culvert ø 1.0, Sta. 7 + 833
42	8 + 150	Drainage Canal	3.0(1.0) x 1.5	Box Culvert 3 x 2, Sta. 8 + 150
43	8 + 700	Irrigation Canal (Kedung Ploso)	7.8(3.0) x 1.5	Ploso Canal Bridge
44	9 + 707	Drainage Canal (Kedung Oling)	8.0(2.0) x 3.0	Box Culvert 2-3 x 3, Sta. 9 + 707
45	10 + 200	Drainage Canal	0.7(0.3) x 0.4	Pipe Culvert ø 1.0, Sta. 10 + 200
46	10 + 285	Irrigation Canal	1.5(0.7) x 0.7	Mangetan Viaduct
47	10 + 455	Irrigation Canal	1.5(0.7) x 0.7	Mangetan Viaduct
48	10 + 640	Mangetan Canal	38.2(26.0) x 4.0	Mangetan Canal Bridge
49	10 + 850	Side Ditch	1.0(0.5) x 0.5	Balong Bendo Viaduct
50	11 + 190	Irrigation Canal	5.0(3.6) x 0.9	Balong Bendo Viaduct
51	11 + 350	Irrigation Canal	2.0(1.0) x 0.8	Balong Bendo Viaduct
52	11 + 550	Surabaya River	74.0(37.5) x 4.4	Surabaya River Bridge

## Appendix A-9.3

## Crossing Rivers and Waterways

NO.	STA.	KIND OF WATERWAY	WIDTH AND DEPTH (m)	PLANNED STRUCTURE
53	11 + 605	Irrigation Canal	5.0(3.5) x 1.0	Surabaya River Bridge
54	11 + 860	Irrigation Canal	3.0(2.0) x 1.5	Wringinanom Viaduct
55	11 + 973	Irrigation Canal	1.0(0.6) x 0.6	Pipe Culvert $\phi$ 1.0, Sta. 11 + 990
56	13 + 005	Kedunganya River	15.0(7.0) x 3.0	Kedunganyar River Bridge
57	13 + 605	Side Ditch	1.0(0.6) x 0.3	Pipe Culvert $\phi$ 1.0, Sta. 13 + 605
58	13 + 630	Irrigation Canal	7.0(4.5) x 2.5	Box Culvert 2-3 x 3, St. 13 + 630
59	13 + 940	Stream	5.5(3.0) x 2.5	Box Culvert 4.5 x 2.5, Sta. 13 + 940
60	14 + 975	Stream	4.5(2.2) x 2.2	Box Culvert 4.5 x 2.5, Sta. 14 + 975
61	15 + 600	Stream	1.6(0.8) x 0.8	Pipe Culvert 2 - $\phi$ 1.0, Sta. 15 + 600
62	15 + 665	Stream	1.6(0.8) x 0.8	Pipe Culvert 2 - $\phi$ 1.0, Sta. 15 + 665
63	17 + 827	Stream	4.2(3.0) x 1.2	Box Culvert 4.5 x 2.5, Sta. 17 + 827
64	18 + 020	Stream	2.0(1.5) x 0.5	Pipe Culvert 2 - $\phi$ 1.0, Sta. 18 + 020
65	18 + 270	Stream	3.0(1.8) x 1.0	Box Culvert 3 x 2, Sta. 18 + 270
66	20 + 550	Stream	5.5(4.0) x 1.5	Box Culvert 4.5 x 2.5, Sta. 20 + 510
67	21 + 445	Larongan River	10.0(8.0) x 2.0	Larongan River Bridge
68	21 + 680	Drainage Canal	1.0(0.6) x 0.6	Pipe Culvert $\phi$ 1.0, Sta. 21 + 720
69	22 + 035	Kedondong River	17.2(6.5) x 3.0	Kedondong River Bridge
70	22 + 383	Tengah River	9.2(4.7) x 2.5	Tengah River Bridge
71	23 + 240	Irrigation Canal	2.0(1.0) x 1.0	Box Culvert 2 x 1.5, Sta. 23 + 315
72	23 + 785	Stream	2.0(1.0) x 1.0	Box Culvert 2 x 1.5, Sta. 23 + 785
73	24 + 213	Stream	2.0(1.0) x 1.0	Box Culvert 2 x 1.5, Sta. 24 + 213
74	24 + 870	Side Ditch	1.5(1.0) x 0.5	Pipe Culvert $\phi$ 1.0, Sta. 24 + 870
75	24 + 880	Side Ditch	1.5(1.0) x 0.5	Pipe Culvert $\phi$ 1.0, Sta. 24 + 880
76	24 + 965	Drainage Canal	1.5(1.0) x 1.0	Pipe Culvert $\phi$ 1.0, Sta. 24 + 965
77	25 + 450	Irrigation Canal	4.5(2.5) x 1.9	Box Culvert 4.5 x 2.5, Sta. 25 + 440
78	25 + 875	Side Ditch	1.5(0.8) x 0.3	Pipe Culvert $\phi$ 1.0, Sta. 25 + 875

## Appendix A-9.3

## Crossing Rivers and Waterways

NO.	STA.	KIND OF WATERWAY	WIDTH AND DEPTH (m)	PLANNED STRUCTURE
79	26 + 110	Drainage Canal	2.0(1.0) x 1.7	Box Culvert 2 x 1.5, Sta. 26 + 110
80	26 + 445	Side Ditch	0.9(0.4) x 0.3	Pipe Culvert $\phi$ 1.0, Sta. 26 + 450
81	27 + 318	Stream	3.0(2.0) x 0.6	Box Culvert 3 x 2, Sta. 27 + 318
82	28 + 400	Stream	2.5(1.2) x 1.2	Box Culvert 2 x 1.5, Sta. 28 + 400
83	28 + 833	Irrigation Canal	0.6(0.3) x 0.3	Pipe Culvert $\phi$ 0.6, Sta. 28 + 833
84	29 + 095	Irrigation Canal	2.5(1.3) x 1.4	Box Culvert 2 x 1.5, Sta. 29 + 095
85	30 + 293	Side Ditch	1.2(1.0) x 0.3	Pipe Culvert $\phi$ 1.0, Sta. 30 + 160
86	31 + 185	Stream	5.0(3.5) x 0.8	Box Culvert 4.5 x 2.5, Sta. 31 + 185
87	34 + 485	Irrigation Canal	3.5(2.0) x 1.3	Box Culvert 3 x 2, Sta. 34 + 485
88	34 + 785	Irrigation Canal	2.0(1.5) x 0.6	Box Culvert 2 x 1.5, Sta. 34 + 670
89	35 + 735	Drainage Canal	2.5(1.0) x 1.6	Box Culvert 2 x 1.5, Sta. 35 + 735
90	36 + 070	Drainage Canal	2.5(1.0) x 0.6	Box Culvert 2 x 1.5, Sta. 36 + 070
91	36 + 530	Drainage Canal	2.5(1.0) x 0.6	Box Culvert 2 x 1.5, Sta. 36 + 530
92	36 + 787	Drainage Canal	3.0(2.5) x 0.7	Box Culvert 3 x 2, Sta. 36 + 787
93	37 + 500	Drainage Canal	1.0(0.5) x 0.8	Karangpilang Viaduct
94	37 + 675	Mas River	77.0(50.0) x 5.0	Mas River Bridge
95	38 + 020	Side Ditch	1.3(0.3) x 0.3	Wonocolo Viaduct
96	38 + 030	Side Ditch	1.2(0.3) x 0.3	Wonocolo Viaduct
97	38 + 285	Irrigation Canal	10.0(5.0) x 1.5	Wonocolo Viaduct
		River	8 locations	
		Stream	13 locations	
		Major Irrigation Canal	3 locations	
		Minor Irrigation Canal	32 locations	
		Drainage Canal	20 locations	
		Side Ditch	21 locations	
		Total	97 locations	

**Appendix A-9.4 List of Waterway Culverts**

NO.	STATION	CROSSING ANGLE	WIDTH x HEIGHT (m)	LENGTH (m)	REMARKS
1	0 + 570	75°	2-3 x 3	135	Irrigation
2	0 + 620	85°	3 x 2	105	Drainage
3	0 + 780	80°	2 x 1.5	75	Drainage
4	1 + 070	80°	3 x 2	55	Drainage
5	1 + 300	90°	3 x 2	25	Irrigation, crosses relocated Desa Road
6	1 + 525	70°	3 x 2	135	Irrigation
7	1 + 745	65°	2-3 x 3	65	Drainage
8	1 + 810	60°	4.5 x 2.5	60	Irrigation
9	2 + 375	40°	4.5 x 2.5	90	Drainage
10	5 + 580	75°	3 x 2	36	Irrigation
11	8 + 150	85°	3 x 3	40	Drainage
12	9 + 707	90°	2-3 x 3	45	Drainage
13	13 + 630	45°	2-3 x 3	70	Irrigation
14	13 + 940	45°	4.5 x 2.5	60	Stream
15	14 + 990	30°	4.5 x 2.5	90	Stream
16	17 + 827	90°	4.5 x 2.5	60	Stream
17	18 + 260	90°	3 x 2	60	Stream
18	20 + 510	90°	4.5 x 2.5	55	Stream
19	23 + 315	75°	2 x 1.5	120	Irrigation
20	23 + 785	90°	2 x 1.5	55	Irrigation
21	24 + 213	80°	2 x 1.5	50	Stream
22	25 + 440	90°	4.5 x 2.5	45	Irrigation
23	26 + 110	85°	2 x 1.5	120	Drainage
24	27 + 318	90°	3 x 2	45	Stream
25	28 + 400	90°	2 x 1.5	45	Stream
26	29 + 095	80°	2 x 1.5	50	Irrigation
27	31 + 185	80°	4.5 x 2.5	50	Stream
28	34 + 485	45°	3 x 2	90	Irrigation
29	34 + 670	90°	2 x 1.5	55	Irrigation
30	35 + 735	90°	2 x 1.5	45	Drainage
31	36 + 070	90°	2 x 1.5	45	Drainage
32	36 + 530	90°	2 x 1.5	55	Drainage
33	36 + 787	90°	3 x 2	55	Drainage
		2-3 x 3	4 locations	315 m	
		4.5 x 2.5	8 locations	510 m	
		3 x 2	9 locations	606 m	
		3 x 3	1 location	40 m	
		2 x 1.5	11 locations	715 m	
		Total	33 locations	2186 m	

## Appendix A-9.5

## List of Roadway Culverts

NO.	STATION	CROSSING ANGLE	WIDTH x HEIGHT (m)	LENGTH (m)	REMARKS
1	0 + 724	75°	6 X 3.5	80	Desa Road
2	0 + 975	80°	3 x 3	55	Farmers Path
3	3 + 300	65°	6 x 3.5	40	Desa Road
4	4 + 020	90°	3 x 3	35	Farmers Path
5	5 + 475	65°	6 x 3.5	35	Desa Road
6	8 + 150	85°	3 x 3	35	Farmers Path
7	8 + 805	90°	6 x 3.5	35	Desa Road
8	9 + 020	90°	6 x 3.5	36	Sugarcane Railway
9	10 + 195	75°	3 x 3	36	Farmers Path
10	12 + 833	60°	3 x 3	40	Farmers Path
11	13 + 045	65°	3 x 3	40	Farmers Path
12	13 + 570	90°	6x3.5	36	Desa Road
13	15 + 983	90°	3 x 3	35	Farmers Path
14	16 + 430	85°	3 x 3	35	Farmers Path
15	16 + 860	85°	3 x 3	35	Farmers Path
16	17 + 300	80°	3 x 3	36	Farmers Path
17	17 + 450	90°	6 x 3.5	35	Desa Road
18	17 + 795	90°	6 x 3.5	35	Desa Road
19	18 + 065	90°	6 x 3.5	35	Desa Road
20	18 + 515	90°	6 x 3.5	35	Desa Road
21	18 + 723	80°	3 x 3	36	Farmers Path
22	19 + 325	90°	3 x 3	35	Farmers Path
23	19 + 500	90°	6 x 3.5	35	Desa Road
24	20 + 255	75°	3 x 3	36	Farmers Path
25	21 + 870	80°	3 x 3	35	Farmers Path
26	22 + 243	80°	3 x 3	35	Farmers Path
27	23 + 775	90°	3 x 3	35	Farmers Path
28	24 + 220	80°	3 x 3	36	Farmers Path
29	24 + 865	90°	6x3.5	36	Desa Road
30	26 + 445	90°	6x3.5	36	Desa Road
31	26 + 830	70°	3 x 3	37	Farmers Path
32	27 + 510	75°	3 x 3	36	Farmers Path
33	27 + 765	90°	6x3.5	36	Desa Road
34	28 + 300	90°	3 x 3	35	Farmers Path
35	29 + 090	80°	3 x 3	36	Farmers Path
36	30 + 115	65°	6 x 3.5	36	Desa Road
37	32 + 150	90°	3 x 3	35	Farmers Path
38	33 + 400	80°	3 x 3	36	Farmers Path
39	36 + 415	90°	6 x 3.5	35	Desa Road
		6 x 3.5	12 locations	615 m	
		3 x 3	23 locations	845 m	
		Total	35 locations	1460 m	



**Appendix A-9.6 List of Pipe Culverts**

NO.	STATION	CROSSING ANGLE	DIAMETER (m)	LENGTH (m)	REMARKS
1	Mojokerto IC	90°	1.0	40	Side Ditch
2	Mojokerto IC	70°	1.0	30	Side Ditch
3	Mojokerto IC	70°	1.0	30	Side Ditch
4	Mojokerto IC	70°	2 x 1.0	60	Drainage
5	0 + 722	75°	1.0	80	Side Ditch
6	0 + 727	75°	1.0	80	Side Ditch
7	0 + 965	80°	2 x 1.0	120	Irrigation
8	2 + 100	90°	1.0	50	Local Irrigation
9	2 + 700	90°	1.0	50	Local Irrigation
10	4 + 750	90°	1.0	55	Local Irrigation
11	5 + 730	35°	1.0	70	Irrigation
12	5 + 735	35°	1.0	95	Side Ditch
13	5 + 925	90°	2 x 1.0	250	Irrigation
14	6 + 400	90°	1.0	45	Local Irrigation
15	6 + 605	35°	0.6	90	Irrigation
16	6 + 890	90°	1.0	50	Irrigation
17	7 + 130	55°	1.0	55	Irrigation
18	7 + 833	70°	1.0	70	Drainage
19	10 + 200	80°	1.0	55	Drainage
20	11 + 973	80°	1.0	70	Irrigation
21	12 + 200	90°	1.0	50	Local Irrigation
22	12 + 700	90°	1.0	45	Local Irrigation
23	13 + 560	90°	1.0	45	Side Ditch
24	13 + 605	45°	1.0	95	Side Ditch
25	15 + 300	90°	1.0	45	Depressed Area
26	15 + 600	70°	2 x 1.0	110	Stream
27	15 + 665	55°	2 x 1.0	140	Stream
28	15 + 750	90°	1.0	60	Local Irrigation
29	16 + 250	90°	1.0	50	Depressed Area
30	17 + 100	90°	1.0	55	Depressed Area
31	17 + 400	90°	1.0	50	Depressed Area
32	18 + 020	90°	2 x 1.0	160	Stream
33	18 + 600	90°	1.0	50	Depressed Area
34	18 + 850	90°	1.0	55	Depressed Area
35	19 + 100	90°	1.0	50	Depressed Area
36	21 + 720	90°	1.0	50	Drainage
37	24 + 870	90°	1.0	75	Side Ditch
38	24 + 880	90°	1.0	45	Side Ditch
39	24 + 965	90°	1.0	45	Drainage
40	25 + 875	35°	1.0	120	Side Ditch

**Appendix A-9.6 List of Pipe Culverts**

NO.	STATION	CROSSING ANGLE	DIAMETER (m)	LENGTH (m)	REMARKS
41	26 + 390	80°	1.0	80	Side Ditch
42	26 + 450	85°	1.0	40	Depressed Area
43	28 + 250	90°	1.0	50	Depressed Area
44	28 + 833	65°	0.6	55	Irrigation
45	29 + 585	90°	1.0	45	Depressed Area
46	30 + 160	45°	1.0	100	Drainage
47	30 + 700	90°	2 x 1.0	150	Depressed Area
48	32 + 175	90°	1.0	60	Depressed Area
49	33 + 430	90°	1.0	50	Depressed Area
		2ø1.0	7 locations	990 m	
		ø1.0	42 locations	2335 m	
		ø0.6	2 locations	145 m	
		Total	49 locations	3470 m	

**A.1 Thickness Design**

This appendix describes the thickness design of flexible pavement of the Toll Road based on the AASHTO Guide for Design of Pavement Structure 1986.

The design was prepared for two design sections as follows:

Design Section	Design CBR
1 : Sta. 0+000 - Sta. 25+000 and Sta. 34+000 - Sta. 38+300	10
2 : Sta. 25+000 - Sta. 34+000	5

**A.1.1 Common Conditions for Design Section 1 and 2**

## 1) Time Constraints

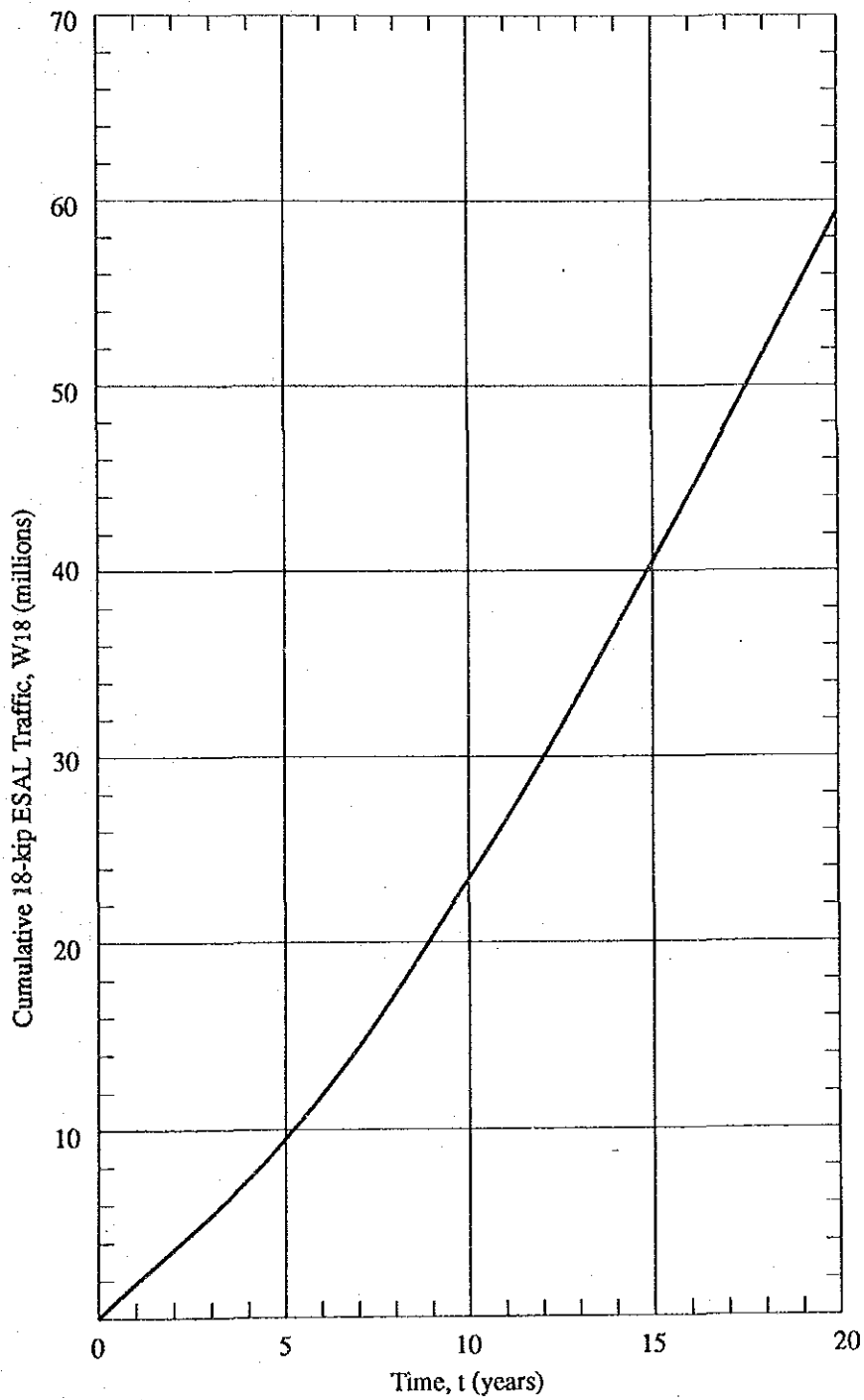
- Analysis period = 20 years
- Two-stage construction
- Performance Period of initial stage = 10 years
- Performance Period of second stage = 10 years

## 2) Traffic

- Traffic Forecast (ADT) in Representative Section

	<u>Year 1995</u>	<u>Year 2005</u>	<u>Year 2015</u>
P/C, Mini Bus, Pick-up	4,820	25,930	57,550
Large Bus	1,270	1,470	2,070
Middle Truck	3,310	7,680	12,170
Large Truck (2-axle)	1,800	4,190	6,640
Large Truck (3-axle)	720	1,680	2,660
Drawbar Trailer	90	210	330
Semi-Trailer	90	210	330
Total	12,100	41,370	81,750

- Directional distribution factor = 0.50
- Lane distribution factor = 0.90 (2-lane)  
= 0.70 (3-lane)
- 10% contingency is incorporated in estimating ESAL.
- Estimated two-way 18 kip equivalent single axle load (ESAL) applications (Refer to Table 1)
  - In 1995 =  $1.50 \times 10^6$
  - In 1995 =  $3.22 \times 10^6$
  - In 1995 =  $3.93 \times 10^6$
- Cumulative 18 kip ESAL refer to Fig.-1



**SURABAYA - MOJOKERTO  
TOLL ROAD PROJECT**

**Fig. -1 Cumulative 18-kip ESAL Traffic**

3) Reliability

- Design reliability for each stage = 95%
- Overall standard deviation = 0.45

4) Environmental Impacts

There is not enough data to differ the environmental impacts between Design Sections 1 and 2. The following average values which were estimated based on the limited data were used for the entire length of the Toll Road.

- Swell rate constant = 0.077
- Potential vertical rise = 1.45 inch
- Swelling probability = 71%
- Environmental serviceability loss for swelling conditions considered refer to Fig.-2

5) Serviceability

- Initial serviceability = 4.6
- Terminal serviceability = 2.5
- Overall design serviceability = 2.1

6) Pavement Layer Materials Characterization

- Asphalt concrete EAC = 400,000 psi
- Granular Base EBS = 30,000 psi
- Granular Subbase ESB = 14,000 psi

7) Layer Coefficient

- Asphalt concrete  $a_1 = 0.42$
- Granular Base  $a_2 = 0.14$
- Granular Subbase  $a_3 = 0.10$

8) Drainage Coefficient

- Granular Base  $m_1 = 1.1$
- Granular Subbase  $m_2 = 1.1$

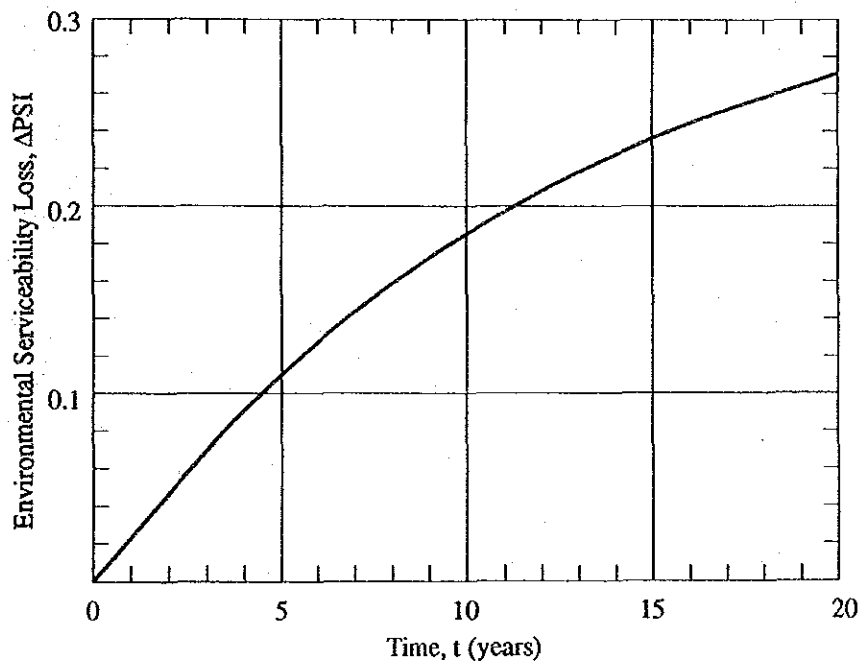
**A.1.2 Pavement thickness for Design Section 1  
(Sta. 0+000 - Sta. 25+000 and Sta. 34+000 - Sta. 38+300)**

1) Effective Roadbed Soil Resilient Modulus

- $MR = 10,000$  psi (Design CBR = 10)

2) Initial Stage Design

- Serviceability loss due to traffic = 1.91
- 18 kip ESAL =  $23.4 \times 10^6$
- Initial structural number (SN) = 5.2
- Asphalt concrete surface thickness  
=  $3.6/0.42 = 8.57$  inches (or 22 cm = 8.66 inches)  
 $SN_1 = 0.42 \times 8.66 = 3.64$
- Base course thickness  
=  $(5.2 - 3.64)/(0.14 \times 1.1) = 10.13$  inches (or 25 cm = 9.84 inches)
- No Subbase course



Environmental Serviceability Loss Versus Time For Swelling Conditions Considered

3) Overlay Design

- Serviceability loss due to traffic = 2.01
- 18 kip ESAL =  $36.0 \times 10^6$
- $PSI_{TR} = 2.1 - 0.09 = 2.01$
- $SN_y = 5.5$
- Remaining life factor ( $F_{RL}$ )  
 $R_{Lx} = 43\%$  (original SN = 5.2, Pt = 2.5)  
 $N_{fy} = 60 \times 10^6$  ( $PSI_{TR} = 2.51$ )  
 $R_{Ly} = 0.403$   
 $F_{RL} = 0.71$
- Effective SN of the original pavement at overlay ( $SN_{xeff}$ )  
 $SN_{xeff} = C_x \times SNo = 0.86 \times 5.2 = 4.47$
- $SN_{OL} = SN_y - (F_{RL} \times SN_{xeff}) = 5.5 - (0.71 \times 4.47) = 2.33$
- Asphalt concrete overlay thickness =  $2.33/0.42 = 5.55$  inches (or 14 cm)

4) Summary

Initial Stage	
Asphalt Concrete	22 cm
Granular Base	25 cm
Second Stage	
Asphalt Concrete Overlay	14 cm

**A.1.3 Pavement thickness for Design Section 2  
(Sta. 25+000 - Sta. 34+000)**

1) Effective Roadbed Soil Resilient Modulus

- MR = 7,500 psi (Design CBR = 5)

2) Initial Stage Design

- Serviceability loss due to traffic = 1.91
- 18 kip ESAL =  $23.4 \times 10^6$
- Initial structural number (SN) = 5.9
- Asphalt concrete surface thickness  
=  $3.6/0.42 = 8.57$  inches (or 22 cm = 8.66 inches)  
 $SN_1 = 0.42 \times 8.66 = 3.64$
- Base course thickness  
=  $(4.7 - 3.64)/(0.14 \times 1.1) = 6.88$  inches (or 20 cm = 7.87 inches)  
 $SN^*2 = 7.87 \times 0.14 \times 1.1 = 1.21$
- Subbase course thickness  
=  $(5.9 - (3.64 + 1.21))/(0.10 \times 1.1) = 9.55$  inches (or 25 cm = 9.84 inches)

3) Overlay Design

- Serviceability loss due to traffic = 2.01
- 18 kip ESAL =  $36.0 \times 10^6$
- $PSI_{TR} = 2.1 - 0.09 = 2.01$
- $SN_y = 6.0$
- Remaining life factor ( $F_{RL}$ )  
 $R_{Lx} = 47\%$  (original SN = 5.9, Pt = 2.5)  
 $N_{fy} = 55 \times 10^6$  ( $PSI_{TR} = 2.51$ )  
 $R_{Ly} = 0.349$   
 $F_{RL} = 0.69$

- Effective SN of the original pavement at overlay ( $SN_{xeff}$ )  
 $SN_{xeff} = C_x \times SNo = 0.88 \times 5.9 = 5.19$
- $SNOL = SN_y - (FRL \times SN_{xeff}) = 6.0 - (0.69 \times 5.19) = 2.42$
- Asphalt concrete overlay thickness =  $2.42/0.42 = 5.76$  inches (or 15 cm)

4) Summary

Initial Stage

Asphalt Concrete	22 cm
Granular Base	20 cm
Granular Subbase	25 cm

Second Stage

Asphalt Concrete Overlay	15 cm
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Appendix A-9.8 List of Relocation Roads

NO.	STATION FROM TO	LEFT OR RIGHT	WIDTH (m)	LENGTH (m)	SURFACING	REMARKS
1	4 + 800 - 4 + 890	RIGHT	8.0	125.0		Kabupaten Road
2	7 + 410 - 7 + 740	RIGHT	7.0	480.0		Desa Road
3	7 + 410 - 7 + 740	RIGHT	4.0	480.0		Sugarcane Railway
4	9 + 020 - 9 + 080	LEFT	4.0	105.0		Sugarcane Railway
5	13 + 600 - 13 + 700	LEFT	7.0	100.0		Desa Road
6	17 + 450 - 17 + 800	LEFT	7.0	350.0		Desa Road
7	17 + 670 - 17 + 800	RIGHT	7.0	130.0		Desa Road
8	17 + 910 - 18 + 100	LEFT	7.0	190.0		Desa Road
9	17 + 950 - 18 + 100	RIGHT	7.0	150.0		Desa Road
10	18 + 230 - 18 + 510	LEFT	7.0	280.0		Desa Road
11	18 + 370 - 18 + 510	RIGHT	7.0	140.0		Desa Road
12	19 + 500 - 19 + 680	LEFT	7.0	180.0		Desa Road
13	19 + 500 - 19 + 650	RIGHT	7.0	150.0		Desa Road
14	23 + 530 - 23 + 570	LEFT	7.0	40.0		Desa Road
15	29 + 230 - 29 + 350	LEFT	7.0	120.0		Desa Road
16	29 + 850 - 30 + 250	LEFT	7.0	400.0		Desa Road
17	29 + 910 - 30 + 320	RIGHT	7.0	410.0		Desa Road
18	35 + 490 - 35 + 730	RIGHT	7.0	240.0		Desa Road
Total						
				Relocation of Kabupaten Road	125 m	
				Relocation of Desa Road	3360 m	
				Relocation of Sugarcane Railway	585 m	

Appendix A-9.9 List of Relocation Waterways

NO.	STATION		LEFT OR RIGHT	WIDTH (m)	DEPTH (m)	LENGTH (m)	REMARKS
	FROM	TO					
1	1 + 060	1 + 200	R	0.9 (0.5)	0.4	140	Drainage
2	1 + 320	1 + 540	L	3.0 (2.5)	1.0	220	Irrigation
3	1 + 470	1 + 480	R	3.0 (2.5)	1.0	40	Irrigation
4	6 + 730	6 + 890	L	1.0 (0.6)	1.0	200	Irrigation
5	20 + 510	20 + 550	R	5.5 (4.0)	1.5	70	Stream
6	21 + 670	21 + 720	L	1.0 (0.6)	0.6	50	Drainage
7	23 + 200	23 + 320	L	2.0 (1.0)	1.0	120	Irrigation
8	30 + 125	30 + 240	L	1.2 (1.0)	0.3	125	Drainage

**Appendix A - 13.1 Widening and Overlay Costs**

DESCRIPTION	UNIT	UNIT PRICE (Rp.)			WIDENING IN 2010			OVERLAY IN 2005 (4-LANE)			OVERLAY IN 2015 (6-LANE)				
		TOTAL	TAX/DUTY INCLUDED	WORK QUANTITY	TOTAL	TAX/DUTY INCLUDED	WORK QUANTITY	TOTAL	TAX/DUTY INCLUDED	WORK QUANTITY	TOTAL	TAX/DUTY INCLUDED	WORK QUANTITY	TOTAL	TAX/DUTY INCLUDED
<b>1. GENERAL</b>	L.S				2,199,064	299,039		1,401,192	275,721		1,463,552	279,777			
<b>2. EARTHWORK</b>															
Common/Waste Excavation	m3	3,400	310	91,000	309,400	28,210	0	0	0	0	0	0	0	0	
Borrow Material, L=29km	m3	10,800	980	81,500	880,200	79,870	0	0	0	0	0	0	0	0	
<b>SUB-TOTAL</b>					1,189,600	108,080									
<b>3. PAVEMENT</b>															
Subgrade Preparation	m2	240	20	400,800	96,192	8,016	0	0	0	0	0	0	0	0	
Subbase	m3	25,000	2,300	96,800	2,420,000	222,640	0	0	0	0	0	0	0	0	
Granular Base	m3	34,000	3,100	74,700	2,599,800	231,570	0	0	0	0	0	0	0	0	
Prime/Tack Coat	kg	690	200	692,900	478,101	138,580	734,200	506,598	146,840	880,900	607,821	176,180			
Binder/Surface Course	ton	18,200	1,700	179,100	3,259,620	304,470	303,100	5,516,420	515,270	281,100	5,116,020	477,870			
Asphalt Cement	ton	390,000	105,000	11,700	4,563,000	1,228,500	19,700	7,689,000	2,068,500	18,900	7,137,000	1,921,500			
<b>SUB-TOTAL</b>					13,356,713	2,133,776		13,706,018	2,730,610		12,860,841	2,575,550			
<b>4. MISCELLANEOUS</b>															
Demolition of Pavement	m2	1,260	110	101,900	128,394	11,209	0	0	0	0	0	0	0	0	
Concrete Curb	m	20,700	2,800	67,900	1,405,530	196,120	0	0	0	67,900	1,405,530	190,120			
Median Drainage	m	67,000	6,400	26,000	1,742,000	166,400	0	0	0	0	0	0	0		
Guardrail	m	59,000	5,400	68,000	4,012,000	367,200	0	0	0	-0	0	0	0		
Marking	m2	11,500	1,000	13,600	156,400	13,600	26,600	305,900	26,600	32,100	369,150	32,100			
<b>SUB-TOTAL</b>					7,444,324	749,529		305,900	26,600		1,774,880	222,220			
<b>CONSTRUCTION COST</b>					24,169,701	3,289,424		15,413,110	3,032,931		16,099,073	3,077,547			

**Appendix A-13.2 Construction Cost of Additional Interchanges**

DESCRIPTION	UNIT	UNIT PRICE (Rp.)			LAKARSANTIRI INTERCHANGE			DRIYOREJO INTERCHANGE			KRIAN INTERCHANGE (2ND IC)		
		TOTAL	TAX/DUTY INCLUDED	WORK QUANTITY	TOTAL	TAX/DUTY INCLUDED	WORK QUANTITY	TOTAL	TAX/DUTY INCLUDED	WORK QUANTITY	TOTAL	TAX/DUTY INCLUDED	WORK QUANTITY
<b>1. GENERAL</b>	L/S				1,095,440	125,082		440,901	52,595		142,443	15,941	
<b>2. EARTHWORK</b>													
Clearing & Grubbing	m2	750	70	110,100	82,575	7,707	0	0	0	0	0	0	
Common/Waste Excavation	m3	3,400	310	31,900	108,460	9,889	0	0	0	0	0	0	
Borrow Material, L=29km	m3	10,800	980	0	0	0	165,200	1,784,160	161,896	49,000	529,200	48,020	
Borrow Material, L=36km	m3	12,400	1,130	332,800	4,126,720	376,064	0	0	0	0	0	0	
Sand Mat	m3	16,400	1,490	30,000	492,000	44,700	0	0	0	0	0	0	
Sand Drain Pile, D=40cm	m	8,200	750	30,600	250,920	22,950	0	0	0	0	0	0	
<b>SUB-TOTAL</b>				5,060,675	461,310			1,784,160	161,896		529,200	48,020	
<b>3. BRIDGES</b>													
Superstructure	m2	320,000	54,000	1,178	376,960	63,612	1,178	376,960	63,612	392	125,440	21,168	
PC I-Girder, Ss30m	m3	200,000	21,000	212	42,400	4,452	212	42,400	4,452	634	126,800	13,314	
Substructure	m3	320,000	32,000	828	264,960	26,496	828	264,960	26,496	0	0	0	
Abutment	m	83,000	7,600	2,899	240,617	22,032	2,899	240,617	22,032	3,960	328,680	30,096	
Pier					924,937	116,592		924,937	116,592		580,920	64,578	
Foundation													
PC Pile, D=0.6m													
<b>SUB-TOTAL</b>				4,400	35,640	3,080	4,400	35,640	3,080	2,700	21,870	1,890	
<b>4. DITCHES AND CULVERTS</b>													
Drainage													
Paved Ditch													
<b>SUB-TOTAL</b>		8,100	700							1,000	8,100	700	
<b>5. PAVEMENT</b>													
Subgrade Preparation	m2	240	20	47,500	11,400	950	19,900	4,776	398	6,900	1,656	138	
Subbase	m3	25,000	2,300	11,640	291,000	26,772	1,740	43,500	4,002	400	10,000	920	
Granular Base	m3	34,000	3,100	5,990	203,660	18,569	2,910	98,940	9,021	1,180	40,120	3,658	
Primer/Tack Coat	kg	690	200	65,200	44,988	13,040	40,900	28,221	8,180	14,700	10,143	2,940	
Binder/Surface Course	ton	18,200	1,700	11,700	212,940	19,890	7,000	127,400	11,900	2,360	46,592	4,352	
Asphalt Cement	ton	390,000	105,000	770	300,300	80,850	460	179,400	48,300	170	66,300	17,850	
Concrete Pavement, T=30cm	m2	41,000	5,300	11,360	465,760	60,208	1,770	72,570	9,381	0	0	0	
<b>SUB-TOTAL</b>				1,530,048	220,279			554,807	91,182		174,811	29,858	
<b>6. MISCELLANEOUS</b>													
Sodding	m2	480	40	47,400	22,752	1,896	38,800	16,624	1,552	10,600	5,088	424	
Concrete Block Slope Protection	m2	23,000	2,600	640	14,720	1,664	640	14,720	1,664	0	0	0	
Guardrail	m	59,000	5,400	920	54,280	4,968	1,840	108,560	9,936	440	25,960	2,376	
Delineator	m	5,100	600	2,160	11,016	1,296	1,190	6,089	714	780	3,978	468	
Marking	m2	11,500	1,000	820	9,430	820	510	5,865	510	180	2,070	180	
Guide Signs	each	14,400,000	3,050,000	14	201,600	42,700	8	115,200	24,400	2	28,800	6,100	
ROW Fence and ROW Posts	m	29,000	5,300	2,700	78,300	14,310	1,300	37,700	6,890	300	8,700	1,590	
Tollway Lighting	m	71,000	6,400	3,500	248,500	22,400	2,300	163,300	14,720	800	56,800	5,120	
Toll Booths	each	75,300,000	8,300,000	25	1,882,500	207,500	4	301,200	33,200	0	0	0	
Tollgate Office	m2	880,000	152,000	1,000	880,000	152,000	400	352,000	60,800	0	0	0	
<b>SUB-TOTAL</b>				12,049,838	1,375,897			4,849,913	578,541		1,566,870	175,355	
<b>CONSTRUCTION COST</b>													

**Appendix A-13.3 Purchase Cost of Maintenance Equipment**

DESCRIPTION	UNIT	Q'TITY	UNIT COST (RP.)		AMOUNT (1,000 RP)	
			TOTAL	TAX/DUTY INCLUDED	TOTAL	TAX/DUTY INCLUDED
1 Sedan	each	4	58,200,000	5,290,000	232,800	21,160
2 Station Wagon	each	6	27,500,000	2,500,000	165,000	15,000
3 Pick-Up	each	4	20,900,000	1,900,000	83,600	7,600
4 Ambulance	each	2	30,300,000	2,750,000	60,600	5,500
5 Dump Truck, 6 ton	each	1	108,200,000	32,500,000	108,200	32,500
6 Light Truck, 4 ton w/2.5 ton Crane	each	1	88,800,000	26,700,000	88,800	26,700
7 Water Tanker, 6000 ltr	each	2	108,800,000	32,700,000	217,600	65,400
8 Vib. Compactor, 100 kg	each	2	4,150,000	1,250,000	8,300	2,500
9 Tamper, 100 kg	each	2	4,280,000	1,280,000	8,560	2,560
10 Air Compressor, 2.5 m <sup>3</sup> /min	each	2	24,200,000	7,300,000	48,400	14,600
11 Concrete Cutter, 45 cm Blade	each	2	14,000,000	4,200,000	28,000	8,400
12 Concrete Breaker, 30 kg	each	2	1,340,000	400,000	2,680	800
13 Grass Cutter	each	5	1,130,000	340,000	5,650	1,700
14 Generator, 50 KVA	each	2	41,200,000	12,400,000	82,400	24,800
<b>TOTAL</b>					<b>1,140,590</b>	<b>229,220</b>

**Appendix A-13.5 Utility Relocation Cost**

DESCRIPTION	UNIT	Q'TITY	UNIT COST (Rp.)		AMOUNT (1,000 Rp.)	
			TOTAL	TAX/DUTY INCLUDED	TOTAL	TAX/DUTY INCLUDED
Pylon for Transmission Line	each	15	150,000,000	13,620,000	2,250,000	204,300
25 KVA Electric Cable, Aerial	m	3,700	70,000	6,350	259,000	23,495
25 KVA Electric Cable, Underground	m	2,000	250,000	22,700	500,000	45,400
Telephone Line, Aerial	m	2,200	80,000	7,300	176,000	16,060
Telephone Line, Underground	m	100	300,000	27,300	30,000	27,300
<b>TOTAL</b>					<b>3,215,000</b>	<b>291,985</b>

**Appendix A-13.4 Land Acquisition and Compensation Cost**

DESCRIPTION	UNIT RATE (RP./M2)	AREA (M2)	AMOUNT (1,000 RP.)
<b>Kab. Mojokerto</b>			
Developed Area	75,000	0	0
Village Area	56,200	25,500	1,433,100
Farmland	16,500	409,900	6,763,350
Vacant Land	6,000	10,200	61,200
<b>Kab. Sidoarjo</b>			
Developed Area	210,000	0	0
Village Area	157,500	51,700	8,142,750
Farmland	36,000	307,500	11,070,000
Vacant Land	25,000	6,300	157,500
<b>Kab. Gresik</b>			
Developed Area	75,000	0	0
Village Area	30,000	135,100	4,053,000
Farmland	8,500	1,280,400	10,883,400
Vacant Land	3,000	43,900	131,700
<b>Kod. Surabaya</b>			
Developed Area	303,000	49,800	15,089,400
Village Area	178,000	47,900	8,526,200
Farmland	32,000	236,900	7,580,800
Vacant Land	12,000	128,400	1,540,800
<b>TOTAL</b>		<b>2,733,500</b>	<b>75,433,200</b>

**Appendix A-14.1 Economic Project Cost Flows**

(Million Rp. at 1991 prices)

Year	Construction Costs	Maintenance Equipment	Land Acq. , Compe.&Utilit.	Engineering Services	Investment Cost Total	Operation & Maintenance
1991				1,526	1,526	
1992			43,096	3,559	46,655	
1993	76,266		43,095	2,288	121,649	
1994	101,688			3,050	104,738	
1995	76,265	1,002		2,288	79,555	
1996						4,209
1997						4,209
1998						4,209
1999						4,209
2000						4,209
2001						4,209
2002						4,209
2003	11,741		5,143	352	17,236	4,209
2004						4,209
2005	13,618		0	408	14,026	4,209
2006						4,209
2007						4,209
2008	4,698		471	141	5,310	4,209
2009						4,209
2010	22,990		0	690	23,680	4,209
2011						4,630
2012						4,630
2013						4,630
2014						4,630
2015	15,856		168	476	16,500	4,630
2016						4,630
2017						4,630
2018						4,630
2019						4,630
2020						4,630
Initial Cost Total	254,219	1,002	86,191	12,711	354,123	
Overlay , Widen. & I.C.	68,903		5,782	2,067	76,752	
Grand Total	323,122	1,002	91,973	14,778	430,875	109,435

**Appendix A-14.2 Specification of Representative Vehicles**

Specifications	1) Sedan	2) Minibus (Private)	3) Minibus (Public)	4) Pick-up	5) Large Bus	6) Medium Truck	7) Large Truck
	Honda Civic Grand 1500	Toyota Corolla 1600	Toyota Kijang Minibus	Mitsubishi Colt Solar	Toyota Kijang Pick-up	Mercedes Benz OH306S	Mitsubishi Fuso FM517H
1) Length (m)	4.230	4.195	4.290	4.250	4.140	10.048	7.535
2) Width (m)	1.690	1.655	1.620	1.695	1.620	2.379	2.385
3) Height (m)	1.360	1.365	1.775	1.820	1.765	-	2.710
4) Number of wheels	4	4	4	4	4	6	6
5) Weight (Kg)	935	960	1.140	1.090	990	11,000	3,970
6) Capacity (persons)	5	5	8/10	8/10	3	53 + 1	3
7) Tyre Size	175 x 13	175 x 13	550 x 13	700 x 13	550 x 13	900 x 20	900 x 20
8) Engine Capacity (cc)	1,493	1,587	1,486	2,477	1,486	5,958	7,545
9) Number of Cylinders	4	4	4	4	4	6	6
10) Gross Horse Power	90 HP	94 HP	63 HP	80 HP	63 HP	170 HP	190 PS
11) Fuel Type	Gasoline	Gasoline	Gasoline	Diesel	Gasoline	Diesel	Diesel



### Appendix A-14.3 Tax Component of Market Sales Price of Vehicles

<1> Taxes on Sedan		Costs	Taxes
(1) CIF Price of CKD Parts		1.0000 A	
(2) Import Duty (1) x 100%		1.0000 A	1.000
(3) Assembly and Other Costs		0.7000 A	
(4) PPN Import ((1)+(2)+(3)) x 30%		0.8100 A	0.810
(5) VAT ((1)+(2)+(3)) x 10%		0.2700 A	0.270
(6) Dealer/Distributor Price Sum ((1)-(5))		3.7800 A	
(7) Dealer Commiston (6) x 10%		0.3780 A	
(8) Sales Price (6) + (7)		4.1580 A	
(9) Registration Fee (8) x 10%		0.4158 A	0.415
(10) Total Price (8) + (9)		4.5738 A	2.495
Tax Ratio	= 2.4958/4.5738	=	55%

<2> Taxes on Commercial Vehicle		Costs	Taxes
(1) CIF Price of CKD Parts		1.0000 A	
(2) Import Duty		0.0000 A	0.000
(3) Assembly and Other Costs		4.5000 A	
(4) PPN Import ((1)+(2)+(3)) x 10%		0.5500 A	0.550
(5) VAT ((1)+(2)+(3)) x 10%		0.5500 A	0.550
(6) Dealer/Distributor Price Sum ((1)-(5))		6.6000 A	
(7) Dealer Commiston (6) x 10%		0.6600 A	
(8) Sales Price (6) + (7)		7.2600 A	
(9) Registration Fee (8) x 10%		0.7260 A	0.726
(10) Total Price (8) + (9)		7.986 A	1.826
Tax Ratio	= 1.826/7.986	=	23%

## Appendix A-14.4 Equations for Vehicle Operating Costs

### A) Equations of Fuel Consumption

Sedan/Van	$Y = 0.03719 S^2 S - 4.19966 S + 175.9911$
Minibus (Public)	$Y = 0.06846 S^2 S - 8.02987 S + 340.6040$
Large Bus	$Y = 0.12292 S^2 S - 13.68742 S + 541.0279$
Medium Truck	$Y = 0.06427 S^2 S - 7.06130 S + 318.3326$
Large Truck	$Y = 0.11462 S^2 S - 12.85594 S + 503.7179$

where: Y = Fuel consumption (liter/1,000 Km)

S = Running speed (Km per hour)

Note) Sedan/Van includes Sedan/Minibus(Private)/Pick-up

### B) Equations of Engine Oil Consumption

Sedan/Van	$Y = 0.00025 S^2 S - 0.02664 S + 1.44171$
Minibus (Public)	$Y = 0.00057 S^2 S - 0.06130 S + 3.31753$
Large Bus	$Y = 0.00130 S^2 S - 0.12968 S + 7.06239$
Medium Truck	$Y = 0.00048 S^2 S - 0.05608 S + 3.07383$
Large Truck	$Y = 0.00100 S^2 S - 0.11715 S + 6.40962$

where: Y = Engine Oil consumption (liter/1,000 Km)

### C) Equations of Tyre Wear

Sedan/Van	$Y = (0.0008848 S - 0.0045333)$
Bus	$Y = (0.0012356 S - 0.0064667)$
Truck	$Y = (0.0011553 S - 0.0059333)$

where: Y = Total tyre wear of vehicle equated as wear of one tyre/1,000Km

### D) Equations of Maintenance Cost

#### (1) Maintenance Cost on Parts

Sedan/Van	$Y = (0.0000064 S + 0.0005567)$
Bus	$Y = (0.0000332 S + 0.0020891)$
Truck	$Y = (0.0000191 S + 0.0015400)$

where: Y = Maintenance parts equated as the depreciable value of vehicles/1,000Km

#### (2) Maintenance Hour of Labour

Sedan/Van	$Y = (0.00362 S + 0.36267)$
Bus	$Y = (0.02311 S + 1.97733)$
Truck	$Y = (0.01511 S + 1.21200)$

where: Y = Hours of maintenance labour /1,000 Km

E) Equations of Depreciation

Sedan/Van  $Y = 1/(2.500 S + 125)$   
 Bus  $Y = 1/(8.756 S + 350)$   
 Truck  $Y = 1/(6.129 S + 245)$

where: Y = Depreciation per 1,000 Km, equated as the depreciable value of vehicles

F) Equations of Interest

Sedan/Van  $Y = (0.15 \times 1000)/(500 S)$   
 Bus  $Y = (0.15 \times 1000)/(2571 S)$   
 Truck  $Y = (0.15 \times 1000)/(1714 S)$

where: Y = Interest per 1,000 Km, equated as one half the value of vehicles  
 (interest rate = 15% per annum)

G) Equations of Insurance

Sedan/Van  $Y = (0.035 \times 1000 \times 0.5)/(500 S)$   
 Bus  $Y = (0.040 \times 1000 \times 0.5)/(2500 S)$   
 Truck  $Y = (0.060 \times 1000 \times 0.5)/(1750 S)$

where: Y = Insurance cost per 1,000 Km, equated as one half the value of the vehicles

H) Equations of Travelling Hours for Wages

Bus  $Y = 1000/S$   
 Truck  $Y = 1000/S$

where: Y = Travelling time /1,000 Km

Average crew size per vehicle :

Minibus (Public)	= Driver :	1	Conductor: 1.7
Large Bus	= Driver :	1	Conductor: 2.0
Medium Truck	= Driver :	1	Assistant: 1.0
Large Truck	= Driver :	1	Assistant: 2.0

I) Overhead

Bus	= 10% of subtotal of A) to H) above
Truck	= 10% of subtotal of A) to H) above

Assumption on "Equations for Vehicle Operating Costs"

Parameters	Sedan/Van	Bus	Truck
Average Year-Round Speed (Km/hour)	50	40	40
Average Annual Distance Travelled (Km)	25,000	100,000	70,000
Average Service Life (years)	10	7	7
Life Time Distance Travelled (Km)	250,000	700,000	490,000

**Appendix A-14.5 1991 Unit Vehicle Operating Costs**

1991 Vehicle Operating Costs							
Financial Vehicle Operating Costs (Rp./Km)							
Speed (Km/Hour)	Sedan	Minibus (Private)	Minibus (Public)	Pick-up	Large Bus	Medium Truck	Large Truck
10	1,359	650	538	510	1,724	605	1,214
15	1,019	493	421	389	1,436	475	968
20	839	408	361	323	1,293	407	839
25	725	353	324	280	1,211	365	761
30	644	314	300	250	1,163	337	709
35	585	285	283	227	1,135	317	674
40	538	263	271	209	1,121	303	650
45	502	245	263	195	1,117	294	635
50	472	231	259	185	1,121	287	626
55	448	220	257	176	1,131	284	622
60	429	212	257	170	1,147	283	623
65	414	206	259	166	1,168	284	628
70	401	201	263	164	1,193	286	637
75	392	199	268	163	1,222	291	648
80	385	198	275	163	1,254	297	663
85	380	199	283	165	1,289	304	680
90	377	201	293	168	1,327	313	700
95	377	204	304	172	1,368	323	723
100	377	209	316	178	1,412	335	747

Economic Vehicle Operating Costs (Rp./Km)							
Speed (Km/Hour)	Sedan	Minibus (Private)	Minibus (Public)	Pick-up	Large Bus	Medium Truck	Large Truck
10	642	509	477	402	1,403	513	1,000
15	487	387	369	308	1,160	400	792
20	403	321	313	256	1,039	341	684
25	349	278	279	222	970	304	618
30	311	248	256	198	928	279	574
35	283	225	240	180	903	262	544
40	261	207	228	166	889	250	523
45	244	193	221	155	884	241	510
50	231	182	216	147	886	235	502
55	221	174	213	140	894	232	498
60	212	168	213	136	906	231	499
65	207	163	214	133	922	232	503
70	203	160	216	131	941	234	510
75	200	159	221	131	964	237	519
80	199	158	226	132	990	242	532
85	200	160	233	134	1,018	249	546
90	202	162	241	137	1,050	256	563
95	205	165	250	141	1,083	265	582
100	209	170	261	146	1,120	275	603

**Appendix A-15.1 Financial Project Cost Flows (Constant Price)**

(Million Rp. at 1991 prices)

Year	Construction Costs	Maintenance Equipment	Utility Relocation	Engineering Services	Investment Cost Total	Operation & Maintenance
1991				1,737	1,737	
1992			1,769	4,054	5,822	
1993	86,854		1,768	2,606	91,227	
1994	115,806			3,474	119,280	
1995	86,854	1,255		2,606	90,715	
1996						4,676
1997						4,676
1998						4,676
1999						4,676
2000						4,676
2001						4,676
2002						4,676
2003	13,255			398	13,653	4,676
2004						4,676
2005	16,954			509	17,463	4,676
2006						4,676
2007						4,676
2008	5,335			161	5,496	4,676
2009						4,676
2010	26,609			799	27,408	4,676
2011						5,144
2012						5,144
2013						5,144
2014						5,144
2015	19,433			582	20,015	5,144
2016						5,144
2017						5,144
2018						5,144
2019						5,144
2020						5,144
Initial Cost Total	289,513	1,255	3,537	14,476	308,781	
Overlay , Widen. & I.C.	81,586			2,449	84,035	
Grand Total	371,099	1,255	3,537	16,925	392,816	121,580

**Appendix A-15.2 Financial Project Cost Flows (Current Price)**

(Million Rp.)						
Year	Construction Costs	Maintenance Equipment	Utility Relocation	Engineering Services	Investment Cost Total	Operation & Maintenance
1991				1,737	1,737	
1992			1,910	4,378	6,288	
1993	101,306		2,062	3,040	106,408	
1994	145,882			4,376	150,258	
1995	118,164	1,708		3,545	123,416	
1996						6,871
1997						7,420
1998						8,014
1999						8,655
2000						9,347
2001						10,095
2002						10,903
2003	33,378			1,002	34,381	11,775
2004						12,717
2005	49,798			1,494	51,292	13,734
2006						14,833
2007						16,020
2008	19,740			596	20,335	17,301
2009						18,685
2010	114,836			3,448	118,285	20,180
2011						23,976
2012						25,894
2013						27,966
2014						30,203
2015	123,226			3,693	126,919	32,619
2016						35,229
2017						38,047
2018						41,091
2019						44,378
2020						47,928
<b>Initial Cost Total</b>	<b>365,352</b>	<b>1,708</b>	<b>3,972</b>	<b>17,075</b>	<b>388,107</b>	
<b>Overlay , Widen. &amp; I.C.</b>	<b>340,978</b>			<b>10,233</b>	<b>351,212</b>	
<b>Grand Total</b>	<b>706,330</b>	<b>1,708</b>	<b>3,972</b>	<b>27,309</b>	<b>739,319</b>	<b>533,881</b>

**Appendix A-15.3 FIRR (ROI) (Constant Price)**

\* FIRR = 12.87%  
 \* NPV = -44,752 (at 15% of Discount Rate)

(Unit: Million Rp.)

Year	Revenue	Construction Cost	O & M Costs	Net Cash Flow for ROI
1991		1,737		-1,737
1992		5,822		-5,822
1993		91,227		-91,227
1994		119,280		-119,280
1995		90,715		-90,715
1996	18,492		4,676	13,816
1997	23,466		4,676	18,790
1998	26,750		4,676	22,074
1999	30,033		4,676	25,357
2000	36,258		4,676	31,582
2001	39,827		4,676	35,151
2002	43,395		4,676	38,719
2003	51,719	13,653	4,676	33,390
2004	55,649		4,676	50,973
2005	59,580	17,463	4,676	37,441
2006	70,016		4,676	65,340
2007	75,323		4,676	70,647
2008	80,631	5,496	4,676	70,459
2009	93,982		4,676	89,306
2010	99,792	27,408	4,676	67,708
2011	105,601		5,144	100,457
2012	122,145		5,144	117,001
2013	128,517		5,144	123,373
2014	134,888		5,144	129,744
2015	153,995	20,015	5,144	128,836
2016	153,995		5,144	148,851
2017	153,995		5,144	148,851
2018	168,098		5,144	162,954
2019	168,098		5,144	162,954
2020	168,098	-218,060	5,144	381,014

Note: FIRR.....Financial Internal Rate of Return  
 ROI.....Return on Investment  
 NPV.....Net Present Value

**Appendix A-15.4 FIRR (ROI) (Current Price)**

\* FIRR = 21.95%  
 \* NPV = 361,845 (at 15% of Discount Rate)

(Unit: Million Rp.)

Year	Revenue	Construction Cost	O & M Costs	Net Cash Flow for ROI
1991		1,737		-1,737
1992		6,288		-6,288
1993		106,408		-106,408
1994		150,258		-150,258
1995		123,416		-123,416
1996	23,676		6,871	16,805
1997	38,698		7,420	31,278
1998	44,100		8,014	36,086
1999	49,502		8,655	40,847
2000	77,216		9,347	67,869
2001	84,814		10,095	74,719
2002	92,411		10,903	81,508
2003	140,889	34,381	11,775	94,733
2004	151,594		12,717	138,877
2005	162,299	51,292	13,734	97,273
2006	246,248		14,833	231,415
2007	264,933		16,020	248,913
2008	283,617	20,335	17,301	245,981
2009	424,929		18,685	406,244
2010	451,192	118,285	20,180	312,727
2011	477,454		23,976	453,478
2012	707,781		25,894	681,887
2013	744,686		27,966	716,720
2014	781,591		30,203	751,388
2015	1,150,591	126,919	32,619	991,053
2016	1,150,591		35,229	1,115,362
2017	1,150,591		38,047	1,112,544
2018	1,615,625		41,091	1,574,534
2019	1,615,625		44,378	1,571,247
2020	1,615,625	-469,924	47,928	2,037,621

Note: FIRR.....Financial Internal Rate of Return  
 ROI.....Return on Investment  
 NPV.....Net Present Value



**Appendix A-15.5 Debt Service of Long-term Loan (Constant price)**

(Loan Ratio = 65%)

(Unit: Million Rp.)

Year	Carried Over	Drawing	Balance after Drawing	Repayment	Ending Balance	Interest (15.00%)
1991	0	1,129	1,129	0	1,129	85
1992	1,129	3,784	4,913	0	4,913	453
1993	4,913	59,298	64,211	0	64,211	5,184
1994	64,211	77,532	141,743	0	141,743	15,447
1995	141,743	58,965	200,708	0	200,708	25,684
1996	200,708		200,708	75	200,633	30,101
1997	200,633		200,633	327	200,306	30,070
1998	200,306		200,306	4,280	196,026	29,725
1999	196,026		196,026	9,449	186,577	28,695
2000	186,577		186,577	13,380	173,197	26,983
2001	173,197		173,197	13,380	159,817	24,976
2002	159,817		159,817	13,380	146,437	22,969
2003	146,437		146,437	13,380	133,057	20,962
2004	133,057		133,057	13,380	119,677	18,955
2005	119,677		119,677	13,380	106,297	16,948
2006	106,297		106,297	13,380	92,917	14,941
2007	92,917		92,917	13,380	79,537	12,934
2008	79,537		79,537	13,380	66,157	10,927
2009	66,157		66,157	13,380	52,777	8,920
2010	52,777		52,777	13,384	39,393	6,913
2011	39,393		39,393	13,309	26,084	4,911
2012	26,084		26,084	13,056	13,028	2,933
2013	13,028		13,028	9,097	3,931	1,272
2014	3,931		3,931	3,931	0	295
2015	0		0	0	0	0
2016	0		0	0	0	0
2017	0		0	0	0	0
2018	0		0	0	0	0
2019	0		0	0	0	0
2020	0		0	0	0	0

**Appendix A-15.6 Profit and Loss Statement (Constant price)**

Year	Revenue	O&M Costs	Property Tax	Gross Profit	Interest		Profit after Interest	Depreciation	Depreciation (Interest)	Profit after Depreciation	Accum. Profit after Depre.	Corporate Tax (35%)	Profit after Tax	Profit after Tax	Accum. Profit after Tax
					(Long-term)	(Short-term)									
1991				0	0	0	0	0	0	0	(0)	0	0	0	0
1992				0	18	-13	-13			-13	(-13)	0	-13	-13	-13
1993				0	83	-83	-83			-83	(-83)	0	-83	-83	-96
1994				0	873	-873	-873			-873	(-873)	0	-873	-873	-969
1995				0	3,321	-3,321	-3,321			-3,321	(-4,290)	0	-3,321	-3,321	-4,290
1996	18,492	4,676	563	13,253	30,101	7,671	-24,519	6,176	1,874	-32,569	(-36,859)	0	-32,569	-32,569	-36,859
1997	23,466	4,676	563	18,227	30,070	11,361	-23,204	6,176	1,874	-31,254	(-68,113)	0	-31,254	-31,254	-68,113
1998	26,750	4,676	563	21,511	29,725	14,890	-23,104	6,176	1,874	-31,154	(-99,254)	0	-31,154	-31,154	-99,267
1999	30,033	4,676	563	24,794	28,695	18,998	-22,999	6,176	1,874	-30,949	(-130,120)	0	-30,949	-30,949	-130,216
2000	36,258	4,676	563	31,019	26,983	23,850	-19,814	6,176	1,874	-27,864	(-157,111)	0	-27,864	-27,864	-158,080
2001	39,827	4,676	563	34,588	24,976	28,829	-19,217	6,176	1,874	-27,267	(-181,057)	0	-27,267	-27,267	-185,347
2002	43,395	4,676	563	38,156	22,962	33,719	-18,532	6,176	1,874	-26,582	(-175,070)	0	-26,582	-26,582	-211,929
2003	51,719	4,676	563	46,480	20,962	38,505	-12,987	6,449	1,874	-21,310	(-165,126)	0	-21,310	-21,310	-233,239
2004	55,649	4,676	563	50,410	18,955	44,508	-13,053	6,449	1,874	-21,376	(-155,348)	0	-21,376	-21,376	-254,615
2005	59,580	4,676	563	54,341	16,948	48,473	-11,080	6,798	1,874	-19,752	(-144,151)	0	-19,752	-19,752	-274,367
2006	70,016	4,676	563	64,777	14,941	54,762	-4,326	6,798	1,874	-13,598	(-129,885)	0	-13,598	-13,598	-287,965
2007	75,323	4,676	563	70,084	12,934	57,508	-358	6,798	1,874	-9,030	(-111,648)	0	-9,030	-9,030	-296,995
2008	80,631	4,676	563	75,392	10,927	59,568	4,997	6,908	1,874	-3,865	(-88,951)	0	-3,865	-3,865	-300,860
2009	93,982	4,676	563	88,743	8,920	61,665	18,158	6,908	1,874	9,376	(-58,265)	0	9,376	-291,504	
2010	99,792	4,676	563	94,553	6,913	60,949	26,691	7,456	1,874	17,361	(-19,528)	0	17,361	-274,143	
2011	105,601	5,144	563	99,894	4,911	63,064	31,919	7,456	1,874	22,589	(22,813)	7,906	14,683	-259,460	
2012	122,145	5,144	563	116,438	2,933	61,458	52,047	7,456	1,874	42,717	(79,128)	14,951	27,766	-231,694	
2013	126,517	5,144	563	122,810	1,272	57,852	63,686	7,456	1,874	54,356	(142,514)	19,025	35,331	-196,363	
2014	134,888	5,144	563	129,181	295	52,518	76,368	7,456	1,874	67,038	(213,437)	23,463	43,575	-152,788	
2015	153,995	5,144	563	148,288	0	45,171	103,117	7,856	1,874	100,949	(306,824)	32,685	60,702	-92,086	
2016	153,995	5,144	563	148,288	0	37,609	110,679	7,856	1,874	112,251	(407,773)	35,332	65,617	-26,469	
2017	153,995	5,144	563	148,288	0	26,307	121,981	7,856	1,874	138,758	(520,024)	39,288	72,963	46,494	
2018	168,098	5,144	563	162,391	0	13,903	148,488	7,856	1,874	152,661	(658,782)	48,565	90,193	136,687	
2019	168,098	5,144	563	162,391	0	0	162,391	7,856	1,874	152,661	(811,443)	53,431	99,230	235,917	
2020	168,098	5,144	563	162,391	0	0	162,391	7,856	1,874	152,661	(964,101)	53,430	99,228	335,145	

Note: In the "(Accumulated Profit after Depreciation)", annual loss after depreciation is carried over for the ensuing five years.

**Appendix A-15.7 Cash Flow (Constant price)**

Year	(Sources)		(Uses)		(Sources minus Uses)		(Uses Total)		(Repay. Loan (Long-term) / Repay. Loan (Short-term))		(Sources minus Uses)		(Unit: Million Rp.)	
	Profit after Tax	Equity	Investment Cost	Interest during Period	Total Project Costs	Repay. Loan (Long-term)	Repay. Loan (Short-term)	Total	Repay. Loan (Long-term)	Repay. Loan (Short-term)	minus Uses	Total	Net Cash Flow	Accum. Cash Flow
1991	0	608	1,737	85	(1,822)	0	0	1,822	0	85	-85	0	0	0
1992	-13	2,038	5,809	453	(6,275)	0	85	6,360	0	85	-551	0	0	0
1993	-83	31,929	59,298	5,184	(96,411)	0	551	96,962	0	551	-5,818	0	0	0
1994	-873	41,748	77,532	15,447	(134,727)	0	5,818	140,545	0	5,818	-22,138	0	0	0
1995	-3,321	31,750	58,965	25,684	(116,399)	0	22,138	138,537	0	22,138	-51,143	0	0	0
1996	-32,569	1,874	24,519	(0)	(0)	75	51,143	51,218	75	51,143	-75,737	0	0	0
1997	-31,254	1,874	-23,204	(0)	(0)	327	75,737	76,064	327	75,737	-99,268	0	0	0
1998	-31,154	1,874	-23,104	(0)	(0)	4,280	99,268	103,548	4,280	99,268	-126,652	0	0	0
1999	-30,949	1,874	-22,899	(0)	(0)	9,449	126,652	136,101	9,449	126,652	-159,000	0	0	0
2000	-27,864	1,874	-19,814	(0)	(0)	13,380	159,000	172,380	13,380	159,000	-192,194	0	0	0
2001	-27,267	1,874	-19,217	(0)	(0)	13,380	192,194	205,574	13,380	192,194	-224,791	0	0	0
2002	-26,592	1,874	-18,532	(0)	(0)	13,380	224,791	238,171	13,380	224,791	-256,703	0	0	0
2003	-21,310	1,874	-12,987	(13,653)	(0)	13,380	256,703	283,736	13,380	256,703	-296,723	0	0	0
2004	-21,376	1,874	-13,053	(0)	(0)	13,380	296,723	310,103	13,380	296,723	-323,156	0	0	0
2005	-19,752	1,874	-11,080	(17,463)	(0)	13,380	323,156	353,999	13,380	323,156	-365,079	0	0	0
2006	-13,598	1,874	-4,926	(0)	(0)	13,380	365,079	378,459	13,380	365,079	-383,385	0	0	0
2007	-9,030	1,874	-358	(0)	(0)	13,380	383,385	396,765	13,380	383,385	-397,123	0	0	0
2008	-3,885	1,874	4,897	(5,496)	(0)	13,380	397,123	415,999	13,380	397,123	-411,102	0	0	0
2009	9,376	1,874	18,158	(0)	(0)	13,380	411,102	424,482	13,380	411,102	-406,324	0	0	0
2010	17,361	1,874	26,691	(27,408)	(0)	13,384	406,324	447,116	13,384	406,324	-420,425	0	0	0
2011	14,683	1,874	24,013	(0)	(0)	13,309	420,425	439,734	13,309	420,425	-409,721	0	0	0
2012	27,766	1,874	37,096	(0)	(0)	13,056	409,721	422,777	13,056	409,721	-385,681	0	0	0
2013	35,331	1,874	44,661	(0)	(0)	9,097	385,681	394,778	9,097	385,681	-350,117	0	0	0
2014	43,575	1,874	52,905	(20,015)	(0)	3,931	350,117	354,048	3,931	350,117	-301,143	0	0	0
2015	60,702	1,874	70,432	(0)	(0)	0	301,143	321,158	0	301,143	-250,726	0	0	0
2016	85,617	1,874	75,347	(0)	(0)	0	250,726	250,726	0	250,726	-175,379	0	0	0
2017	72,963	1,874	82,923	(0)	(0)	0	175,379	175,379	0	175,379	-92,686	0	0	0
2018	90,193	1,874	99,923	(0)	(0)	0	92,686	92,686	0	92,686	7,237	0	7,237	7,237
2019	99,230	1,874	108,960	(0)	(0)	0	0	0	0	0	108,960	0	108,960	116,197
2020	99,228	1,874	108,961	(218,060)	(0)	0	-218,060	-218,060	0	0	327,021	0	327,021	443,218

**Appendix A-15.8 FIRR (ROE) (Constant price)**

(Loan Ratio = 65%) \* FIRR = 11.81%  
 (Interest Rate : 15%) \* NPV = -48,191 (at 15% of Discount Rate)

(Unit: Million Rp.)

Year	Revenue	Equity	O & M Costs	Loan Repay. (Long-term)	Loan Interest (Long-term)	Net Cash Flow for ROE
1991		608			85	-693
1992		2,038			453	-2,491
1993		31,929			5,184	-37,113
1994		41,748			15,447	-57,195
1995		31,750			25,684	-57,434
1996	18,492		4,676	75	30,101	-16,360
1997	23,466		4,676	327	30,070	-11,607
1998	26,750		4,676	4,280	29,725	-11,931
1999	30,033		4,676	9,449	28,695	-12,787
2000	36,258		4,676	13,380	26,983	-8,781
2001	39,827		4,676	13,380	24,976	-3,205
2002	43,395		4,676	13,380	22,969	2,370
2003	51,719		4,676	13,380	20,962	12,701
2004	55,649		4,676	13,380	18,955	18,638
2005	59,580		4,676	13,380	16,948	24,576
2006	70,016		4,676	13,380	14,941	37,019
2007	75,323		4,676	13,380	12,934	44,333
2008	80,631		4,676	13,380	10,927	51,648
2009	93,982		4,676	13,380	8,920	67,006
2010	99,792		4,676	13,384	6,913	74,819
2011	105,601		5,144	13,309	4,911	82,237
2012	122,145		5,144	13,056	2,933	101,012
2013	128,517		5,144	9,097	1,272	113,004
2014	134,888		5,144	3,931	295	125,518
2015	153,995		5,144	0	0	148,851
2016	153,995		5,144	0	0	148,851
2017	153,995		5,144	0	0	148,851
2018	168,098		5,144	0	0	162,954
2019	168,098		5,144	0	0	162,954
2020	168,098		5,144	0	0	162,954

Note: FIRR.....Financial Internal Rate of Return  
 ROE.....Return on Equity  
 NPV.....Net Present Value

**Appendix A-15.9 Debt Service of Long-term Loan (Current price)**

(Loan Ratio = 65%)						
(Unit: Million Rp.)						
Year	Carried Over	Drawing	Balance after Drawing	Repayment	Ending Balance	Interest (15.00%)
1991	0	1,129	1,129	0	1,129	85
1992	1,129	4,087	5,216	0	5,216	476
1993	5,216	69,165	74,381	0	74,381	5,970
1994	74,381	97,668	172,049	0	172,049	18,482
1995	172,049	80,220	252,269	0	252,269	31,824
1996	252,269		252,269	75	252,194	37,835
1997	252,194		252,194	347	251,847	37,803
1998	251,847		251,847	4,958	246,889	37,405
1999	246,889		246,889	11,469	235,420	36,173
2000	235,420		235,420	16,817	218,603	34,052
2001	218,603		218,603	16,817	201,786	31,529
2002	201,786		201,786	16,817	184,969	29,007
2003	184,969		184,969	16,817	168,152	26,484
2004	168,152		168,152	16,817	151,335	23,962
2005	151,335		151,335	16,817	134,518	21,439
2006	134,518		134,518	16,817	117,701	18,916
2007	117,701		117,701	16,817	100,884	16,394
2008	100,884		100,884	16,817	84,067	13,871
2009	84,067		84,067	16,817	67,250	11,349
2010	67,250		67,250	16,821	50,429	8,826
2011	50,429		50,429	16,749	33,680	6,308
2012	33,680		33,680	16,470	17,210	3,817
2013	17,210		17,210	11,862	5,348	1,692
2014	5,348		5,348	5,348	0	401
2015	0		0	0	0	0
2016	0		0	0	0	0
2017	0		0	0	0	0
2018	0		0	0	0	0
2019	0		0	0	0	0
2020	0		0	0	0	0

**Appendix A-15.10 Profit and Loss Statement (Current price)**

Year	Revenue	O & M Costs	Property Tax	Gross Profit	Interest (Long-term)	Interest (Short-term)	Profit after Interest	Depreciation	Depreciation (Interest)	Profit after Depreciation	(Accum. Depre.)	Corporate Tax (35%)	Profit after Tax	Profit after Tax	Accum. Profit after Tax
1991				0	0	0	0	0	0	0	(0)	0	0	0	0
1992				0	13	-13	-13			-13	(-13)	0	-13	-13	-13
1993				0	86	-86	-86			-86	(-86)	0	-86	-86	-86
1994				0	995	-995	-995			-995	(-995)	0	-995	-995	-1,094
1995				0	3,916	-3,916	-3,916			-3,916	(-3,916)	0	-3,916	-3,916	-5,010
1996	23,676	6,871	827	15,978	37,835	9,277	-31,134	7,762	2,273	-41,169	(-46,179)	0	-41,169	-46,179	-77,590
1997	38,698	7,420	893	30,385	37,803	13,958	-21,376	7,762	2,273	-31,411	(-77,590)	0	-31,411	-107,126	-134,415
1998	44,100	8,014	965	35,121	37,405	17,217	-19,576	7,762	2,273	-29,536	(-107,113)	0	-29,536	-136,952	-131,604
1999	49,502	8,655	1,042	39,805	36,173	20,886	-17,254	7,762	2,273	-27,289	(-134,316)	0	-27,289	-117,258	-75,128
2000	77,216	9,347	1,125	66,744	34,952	25,194	7,498	7,762	2,273	-2,537	(-135,856)	0	-2,537	-117,258	-117,258
2001	84,814	10,935	1,215	73,504	31,529	26,592	15,383	7,762	2,273	5,348	(-126,534)	0	5,348	-117,258	-117,258
2002	92,411	10,903	1,313	80,195	29,007	26,807	24,381	7,762	2,273	14,346	(-71,079)	0	14,346	-117,258	-117,258
2003	140,889	11,775	1,418	127,696	26,484	25,673	75,539	8,450	2,273	64,816	(25,148)	22,686	42,130	-75,128	-75,128
2004	151,594	12,717	1,531	137,346	23,962	25,424	87,960	8,450	2,273	77,237	(131,921)	27,033	50,204	-24,924	-24,924
2005	162,299	13,734	1,654	146,911	21,439	18,808	106,664	9,476	2,273	94,915	(254,125)	33,220	61,695	36,771	36,771
2006	246,248	14,893	1,786	229,629	18,916	18,008	192,705	9,476	2,273	180,956	(437,618)	63,335	117,621	154,392	154,392
2007	264,933	16,020	1,929	246,984	16,394	1,125	229,465	9,476	2,273	217,716	(655,334)	76,201	141,515	295,907	295,907
2008	283,617	17,301	2,083	264,233	13,871	0	250,382	9,883	2,273	238,206	(893,540)	83,372	154,834	450,741	450,741
2009	424,929	18,685	2,250	403,994	11,349	0	392,645	9,883	2,273	380,489	(1,274,029)	193,171	247,318	698,059	698,059
2010	451,192	20,180	2,430	428,582	8,826	0	419,756	12,249	2,273	405,234	(1,679,263)	141,832	263,402	961,461	961,461
2011	477,454	23,976	2,624	450,854	6,308	0	444,546	12,249	2,273	430,024	(2,109,287)	150,508	279,516	1,240,977	1,240,977
2012	707,781	25,894	2,834	679,053	3,817	0	675,236	12,249	2,273	660,714	(2,770,001)	231,250	429,464	1,670,441	1,670,441
2013	744,686	27,966	3,061	713,659	1,692	0	711,967	12,249	2,273	697,445	(3,467,446)	244,106	453,339	2,129,780	2,129,780
2014	781,591	30,203	3,306	748,082	401	0	747,681	12,249	2,273	733,159	(4,200,605)	256,806	476,553	2,600,333	2,600,333
2015	1,150,591	32,619	3,570	1,114,402	0	0	1,114,402	14,787	2,273	1,097,342	(5,297,947)	384,070	713,272	3,313,605	3,313,605
2016	1,150,591	35,229	3,856	1,111,506	0	0	1,111,506	14,787	2,273	1,094,446	(6,392,393)	383,056	711,390	4,024,995	4,024,995
2017	1,150,591	38,047	4,164	1,108,380	0	0	1,108,380	14,787	2,273	1,091,320	(7,488,713)	381,962	709,358	4,734,353	4,734,353
2018	1,615,625	41,091	4,497	1,570,037	0	0	1,570,037	14,787	2,273	1,552,977	(9,036,690)	543,542	1,009,435	5,743,788	5,743,788
2019	1,615,625	44,378	4,857	1,566,390	0	0	1,566,390	14,787	2,273	1,549,330	(10,586,020)	542,266	1,007,064	6,750,852	6,750,852
2020	1,615,625	47,928	5,246	1,562,451	0	0	1,562,451	14,787	2,285	1,545,379	(12,131,399)	540,883	1,004,496	7,755,348	7,755,348

Note: In the "(Accumulated Profit after Depreciation)", annual loss after depreciation is carried over for the ensuing five years.

**Appendix A-15.1.1 Cash Flow (Current price)**

Year	(Sources) Profit after Tax	Depre- ciation (Interest)	Depre- ciation	Equity	(Loan Ratio - Interest Rate -		Loan (Long- term)	(Sources Total)	(Uses) Invest- ment Cost	Interest during Const. Period	(Total Project Costs)	Repay- Loan (Long- term)	Repay- Loan (Short- term)	(Uses Total)	(Sources minus Uses)	Loan (Short- term)	(Unit: Million Rp.) Net Accum.	
					65%	15%											Cash Flow	Net Cash Flow
1991	0			608	1,129	1,737	1,737	1,737	85	(1,822)	0	0	0	1,822	-85	85	0	0
1992	-13			2,201	4,087	6,275	6,288	6,288	475	(6,764)	0	0	85	8,849	-574	574	0	0
1993	-85			37,243	89,165	106,322	106,408	106,408	5,970	(112,378)	0	574	112,952	-6,630	6,630	0	0	
1994	-995			52,590	97,668	149,263	150,258	150,258	18,482	(168,740)	0	6,630	175,370	-26,107	26,107	0	0	
1995	-3,916			43,196	80,220	119,500	123,416	123,416	31,824	(155,240)	0	26,107	181,347	-61,847	61,847	0	0	
1996	-41,169	7,762	2,273			-31,134					75	51,847	61,922	-93,056	93,056	0	0	
1997	-31,411	7,762	2,273			-21,376					347	93,056	93,403	-114,779	114,779	0	0	
1998	-29,536	7,762	2,273			-19,501					4,958	114,779	119,737	-139,238	139,238	0	0	
1999	-27,289	7,762	2,273			-17,254					11,469	139,238	150,707	-167,961	167,961	0	0	
2000	-2,537	7,762	2,273			7,498					0	16,817	184,778	-177,280	177,280	0	0	
2001	5,348	7,762	2,273			15,383					0	16,817	178,714	-178,714	178,714	0	0	
2002	14,346	7,762	2,273			24,381					0	16,817	171,150	-171,150	171,150	0	0	
2003	42,130	8,450	2,273			52,853		34,381		(34,381)	0	16,817	171,150	-171,150	171,150	0	0	
2004	50,204	8,450	2,273			60,927		34,381		(34,381)	0	16,817	159,495	-159,495	159,495	0	0	
2005	61,695	9,476	2,273			73,444		51,292		(51,292)	0	16,817	125,385	-125,385	125,385	0	0	
2006	117,621	9,476	2,273			129,370		51,292		(51,292)	0	16,817	120,050	-120,050	120,050	0	0	
2007	141,515	9,476	2,273			153,264		20,335		(20,335)	0	16,817	7,497	-7,497	7,497	0	0	
2008	154,834	9,883	2,273			166,990		20,335		(20,335)	0	16,817	0	24,314	128,950	128,950	128,950	
2009	247,318	9,883	2,273			259,474		20,335		(20,335)	0	16,817	0	37,162	129,838	129,838	258,788	
2010	263,402	12,249	2,273			277,924		118,285		(118,285)	0	16,821	0	16,817	242,657	242,657	501,445	
2011	279,516	12,249	2,273			294,038		118,285		(118,285)	0	16,749	0	135,106	142,818	142,818	644,263	
2012	429,464	12,249	2,273			443,986		118,285		(118,285)	0	16,470	0	16,749	277,289	277,289	921,552	
2013	453,339	12,249	2,273			467,861		118,285		(118,285)	0	11,862	0	11,862	455,999	455,999	1,395,067	
2014	476,553	12,249	2,273			491,075		126,319		(126,319)	0	5,348	0	5,348	485,727	485,727	2,290,794	
2015	713,272	14,787	2,273			730,332		126,319		(126,319)	0	0	0	126,319	603,413	603,413	2,894,207	
2016	711,390	14,787	2,273			728,450		126,319		(126,319)	0	0	0	0	728,450	728,450	3,622,657	
2017	709,358	14,787	2,273			726,418		126,319		(126,319)	0	0	0	0	726,418	726,418	4,349,075	
2018	1,009,435	14,787	2,273			1,026,495		1,024,124		(1,024,124)	0	0	0	0	1,026,495	1,026,495	5,375,570	
2019	1,007,064	14,787	2,273			1,024,124		1,024,124		(1,024,124)	0	0	0	0	1,024,124	1,024,124	6,399,694	
2020	1,004,496	14,787	2,285			1,021,568		1,021,568		(1,021,568)	0	0	0	-469,924	1,491,492	1,491,492	7,891,188	

**Appendix A-15.12 FIRR (ROE) (Current price)**

(Loan Ratio = 65%) \* FIRR = 24.17%  
 (Interest Rate : 15%) \* NPV = 372,255 (at 15% of Discount Rate)

(Unit: Million Rp.)

Year	Revenue	Equity	O & M Costs	Loan Repay. (Long-term)	Loan Interest (Long-term)	Net Cash Flow for ROE
1991		608			85	-693
1992		2,201			476	-2,677
1993		37,243			5,970	-43,213
1994		52,590			18,482	-71,072
1995		43,196			31,824	-75,020
1996	23,676		6,871	75	37,835	-21,105
1997	38,698		7,420	347	37,803	-6,872
1998	44,100		8,014	4,958	37,405	-6,277
1999	49,502		8,655	11,469	36,173	-6,795
2000	77,216		9,347	16,817	34,052	17,000
2001	84,814		10,095	16,817	31,529	26,373
2002	92,411		10,903	16,817	29,007	35,684
2003	140,889		11,775	16,817	26,484	85,813
2004	151,594		12,717	16,817	23,962	98,098
2005	162,299		13,734	16,817	21,439	110,309
2006	246,248		14,833	16,817	18,916	195,682
2007	264,933		16,020	16,817	16,394	215,702
2008	283,617		17,301	16,817	13,871	235,628
2009	424,929		18,685	16,817	11,349	378,078
2010	451,192		20,180	16,821	8,826	405,365
2011	477,454		23,976	16,749	6,308	430,421
2012	707,781		25,894	16,470	3,817	661,600
2013	744,686		27,966	11,862	1,692	703,166
2014	781,591		30,203	5,348	401	745,639
2015	1,150,591		32,619	0	0	1,117,972
2016	1,150,591		35,229	0	0	1,115,362
2017	1,150,591		38,047	0	0	1,112,544
2018	1,615,625		41,091	0	0	1,574,534
2019	1,615,625		44,378	0	0	1,571,247
2020	1,615,625		47,928	0	0	1,567,697

Note: FIRR.....Financial Internal Rate of Return  
 ROE.....Return on Equity  
 NPV.....Net Present Value







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