イラン国

カスピ海沿岸地域農業開発計画
モデルインフラ整備事業実施設計調査

(カスピ海沿岸地域農業開発プロジェクト・パイロット実施センター)

報　告　書

平成３年１月

国際協力事業団

イラン国

カスピ海沿岸地域農業開発計画
モデルインフラ整備事業実施設計調査

（カスピ海沿岸地域農業開発プロジェクト・パイロット実施センター）

報　告　書

平成３年１月

国際協力事業団

序　　文

本プロジェクトは『イ』国最大の農産物生産地であるカスピ海沿岸地域の農業開発並びに農業振興に資するため、カスピ海沿岸地域農業開発プロジェクト・パイロット実施センター(CAPIC)を拠点として、潅漑排水、圃場整備の計画、設計施工技術及び栽培、機械化営農技術等の確立を図り技術者、普及員の養成・訓練を行うことを目的として、平成2年4月1日から5か年間の協力を実施しています。

しかし、本計画実施の中心となるCAPICについては、用地造成まで終了していますが、主要施設及び実証圃場については、未着手の状況であり、これら施設の早期建設が不可欠です。そこで、これら施設のうち実証圃場の実施計画を行うため、1990年9月2日から同年10月31日まで、プロジェクト基盤整備に係る実施設計調査団を派遣しました。

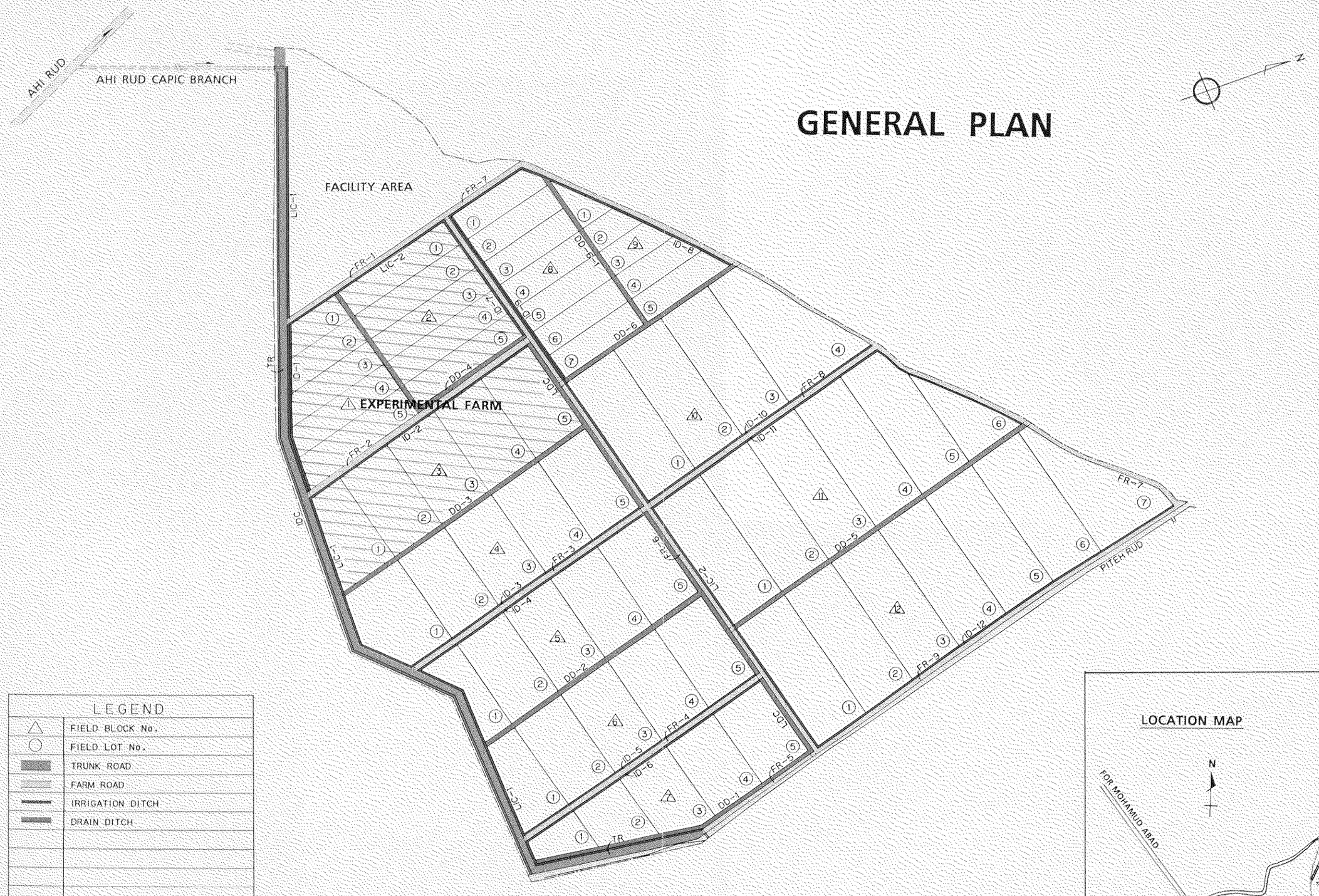
本報告書は、現地調査と国内作業の結果をとりまとめたものであり、これらの施設の整備を実施するうえで活用される予定です。

最後に、本調査実施に当たり御協力いただいた関係者各位に深甚なる謝意を表する次第です。

1991年1月

国際協力事業団
農業開発協力部
崎　野　信　義

GENERAL PLAN



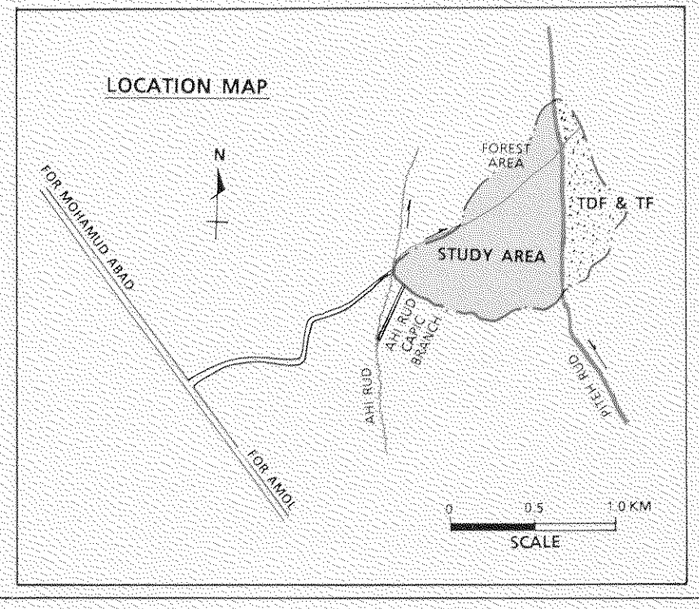
LEGEND

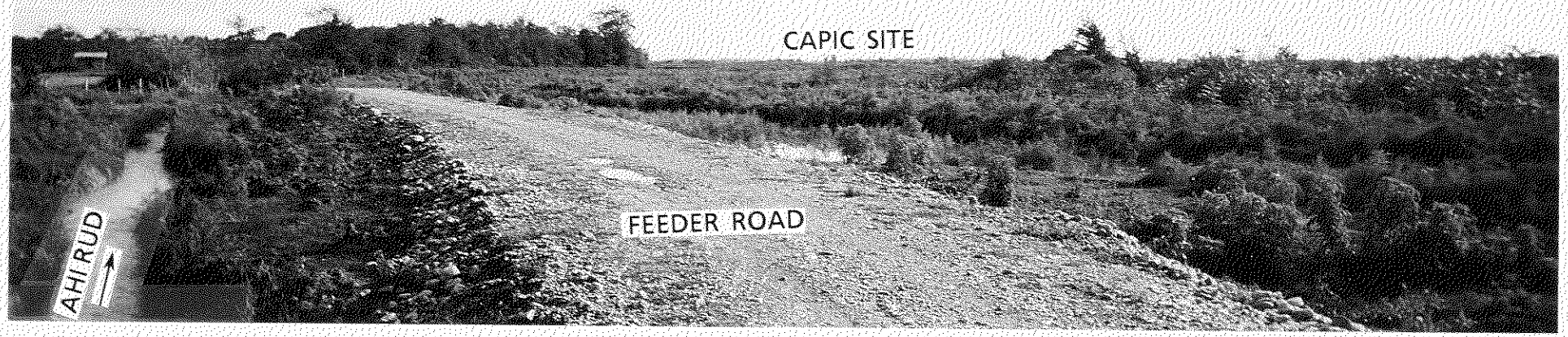
△	FIELD BLOCK No.
○	FIELD LOT No.
	TRUNK ROAD
	FARM ROAD
	IRRIGATION DITCH
	DRAIN DITCH

0 50 100 200 300 m

SCALE

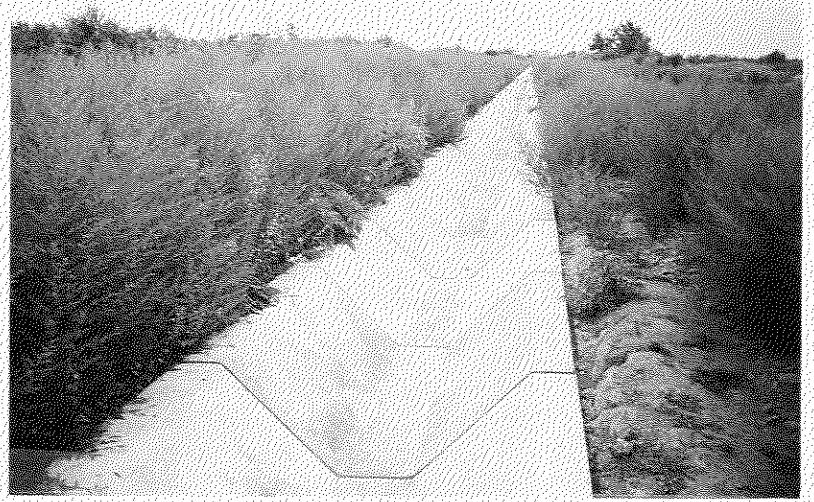
LOCATION MAP





CAPIC SITE

FEEDER ROAD FROM THE NATIONAL ROAD TO THE CAPIC SITE
(Constructed by MOA)



AHI RUD CAPIC BRANCH CANAL
(Constructed by MOA in 1990)

ABANDONED AREA
(Storage of irrigation water)

LOCAL VARIETY OF PADDY
(Growing and Harvested)

THRESHER FOR PADDY
(at a field)

HARVESTED PADDY TRANSPORTED BY POWER TILLER

目　次

序　文

計画一般図

写　真

頁

第１章　まえがき 1

第２章　計画地域の現況 3

2.1. 位置、面積及び地勢 3

2.2. 土壌及び地下水 3

2.3. 気象･水文 4

2.4. 潅漑状況 4

2.5. 排水状況 4

2.6. 道路状況 4

2.7. 農業の機械化状況 5

2.8. 農地の状況 5

2.9. 水準点 5

第３章　圃場整備工の設計

3.1. 総　論 8

3.2 農地の設計 9

3.2.1. 耕区の設計 9

3.2.2. 整地土量計算法 12

3.2.3 運土計画 13

3.3 潅漑施設計画 28

3.3.1 潅漑計画 28

3.3.2 用水系統模式図 32

3.3.3 潅漑施設の設計 32

3.3.4. 附帯構造物の設計 35

3.4. 排水施設計画 52

3.4.1. 排水計画 52

3.4.2. 排水系統模式図 53

3.4.3. 排水施設の設計 53
3.4.4. 附帯工の設計 54
3.5. 農道計画 62
3.5.1. 一 般 62
3.5.2. 規 模 62
3.5.3. 横断面の計画 63
3.5.4. 道路配置と延長 64
3.5.5. 附帯工の設計 65

第4章 工事数量 67
4.1. 圃場の造成 67
4.1.1. 造成面積 67
4.1.2. 整地土量と運土距離 67
4.1.3. 畦畔工 67
4.1.4. 法面仕上工 67
4.2. 用水路工 68
4.2.1. 水路工 68
4.2.2. 附帯工 68
4.3. 排水路工 68
4.3.1. 排水路工 68
4.3.2. 附帯工 68
4.4. 農道工 68
4.4.1. 道路工 68
4.4.2. 附帯工 68
4.5. 実験農場 69

第5章 建設計画 98
5.1. 建設形態 98
5.2. 建設計画 98
5.2.1. 圃場造成工事 98
5.2.2. 灌漑施設工事 98
5.2.3. 排水路工事 98
5.2.4. 農道工事 99
5.3. 必要な建設機械 99
5.3.1. 必要な建設機械の選定 99
5.3.2. 作業能力の算定 100

5.3.3. 機械の月平均稼働日数 100
5.3.4. 建設機械の必要台数 101
5.4. 建設スケジュール 101
5.5 工事仕様書 101

第6章 工 事 費 147
6.1. 基本条件 147
6.1.1. 積算項目 147
6.1.2. 単価 147
6.2. 工事費 147

設計図集

第1章　まえがき

第1章　まえがき

ハラーズ川流域はイランにおける最も豊かな農業地域の一つである。南部をエルブレス山脈に、北部をカスピ海に囲まれたこの地域は、豊富な水源、肥沃な土壌、緩やかな傾斜を持つ沖積平野である。農業に適した気象の地域はこの国の主要な米の生産地域として開発された。

しかしながら、将来の繁栄を期するには、いまだに多くの制約が存在すると言える。人的資源の最大限の活用と恵まれた自然条件の活用を通して、この地域は効果的に再活性化されるだろう。

この地域の生活水準を向上させ、農業生産の増大を目的として、この地域の中心に農業省は、1988年に140haの用地を持つカスピ海沿岸地域農業開発プロジェクト・パイロット実施センター(CAPIC)を設立した。

その結果、CAPICはこの地域に適する圃場整備や進歩的な営農法の展示から、ハラーズ川流域のみならず同じ様な状況にある隣接地域をも含めた地域を対象に、訓練や普及までの幅広い職務を課せられた。この様な広い範囲の職務を遂行するために、CAPICの職員は最終段階には85名まで増員される予定である。

日本政府は1990年4月に「ハラーズ川流域農業開発プロジェクト」と呼称されるプロジェクト方式技術協力を開始した。この協力の一環として、国際協力事業団(JICA)は、CAPIC実証農場の農地開拓の詳細設計を行う目的で、実施設計調査団を1990年9月2日から10月31日までの2ヵ月間現地に派遣した。設計作業はこのプロジェクトの実施計画書(TIS)の作成に引き続き、9月中旬から始められた。

この詳細設計は未墾地の開拓43ha(39haの水田と4haの施設用地)を対象とする。この作業には用水路や排水路、農道や農地開拓に関する附帯施設が含まれる。設計基本図として準備された縮尺1/1000の地形図や土壌、地下水、水資源や余剰水をプロジェクト地域から排除する排水路等の数多くの測量・調査が実施され、設計に用いられた。この設計期間中に数回の全体会議や度重なる個別技術会議が持たれた。

次に述べる様なプロジェクトに与えられた課題を考慮して、この設計を実施した。

- 数種の灌漑・排水システム/実証を可能にする。
- 正確な適期水管理を容易にする。
- 圃場内における容易な運搬と全ての圃場への進入を可能にする。
- 圃場サイズの弾力性を保持する。
- 裏作導入を可能にする。
- 耕地面積を最大にし、施設用地は可能な限り最小にする。

設計に際して、建設される施設の耐久性、営農に必要な安全方策に対する経済的考慮が払われた。

CAPIC事業が完成の暁には、初期の目的を十二分に発揮することは疑いない。

この設計作業の終了に関し、政府レベルからプロジェクトを常に支援して頂いたハラル・ラソウロフ農業省次官に感謝の意を最初に表したい。次いで、実際に作業スケジュールを調整し、全ての必要なサービスを与えていただいたプロジェクト・マネージャーである、アリザデ氏に感謝したい。そして、ナバビ氏を初めとするプロジェクトのアドバイザリー・グループ・メンバーや技術職員による優れた技術的な助言に対しこれを記録に止めたい。最後に、このプロジェクトのスタッフの多大な協力と援助によって、この報告書が取りまとめられた事を記しておきたい。

第２章　計画地域の現況

第２章　計画地域の現況

2.1. 位置、面積及び地勢

計画地域はマザンダラン州アモール市の北約10kmに位置し、約2km離れた地点には国道が走っている。この国道と計画地域は農業省が建設した砂利舗装道路で結ばれている。

前章で述べた如く、CAPIC用地として配分された約140haの内の78.04haに対して、農業省により縮尺1/1000の地形図が作成されている。この78.04 haは以下に述べる４つの地区、即ち実証農場(MF)、建物用地(FA)、旧来農法展示圃場と実験農場(TDF&TF)、森林･道水路等のその他からなる。この土地利用面積を以下に要約する。

項　　目	総　面　積	(実　面　積)	備　　考
	(ha)	(ha)	
実証農場	39.03	(35.09)	
建物用地	3.75	(3.37)	
TDF&TF	22.87		
その他	12.93		森林･ピテ･ルード用地を含む
計	78.04		

詳細設計対象地区は上記の中の実証農場と建物用地で、総面積は併せて42.78haである。この地区は、南部をCAPICの境界線で、東部をピテ･ルードで、北西部をアヒ･ルードで囲われている。しかし、建物用地は整地計画のみが設計に含まれている。

詳細設計対象地区は南から北に、またピテ･ルード方向に勾配約1/150から1/200で傾斜している。地盤標高は国家地図製作局水準点では-5mから0.0m(仮水準点標高では約95から100m)の範囲にある。南部地域が高位部で、北部地域が低位部で、地区内は緩やかに褶曲している。

2.2. 土壌及び地下水

実証農場の土壌は現地調査結果によればシルト質壌土から壌質粘土である。実証農場の南部の一部には地表面から40~80cmに砂質土壌が観察される。他の地域にも砂質土壌が見られるが、地表面から1.5m以上の深い所にある。農業省の土壌試験場の土壌分析資料によれば、上記砂質土壌以外に圃場整備工事に対する阻害要因は見当たらない。

この地域が潅漑されず降雨もないため、調査期間中の地下水位は低くかった。しかし、農業省の観測した過去の資料によれば、最高地下水位は地表から約1.0m以内になる。

2.3. 気象･水文

バブル･サール観測所の資料によれば、この地域の気象概況は年間降雨量は約800mm、平均気温は16.3℃、平均相対湿度は83%、年間平均降水日数は106日である。以下にその概要を示す。

項　目	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月	平均
気　温	7.4	7.2	9.6	14.0	19.2	23.4	25.1	25.7	22.9	18.3	13.2	9.3	16.3
湿　度	84	84	85	82	81	78	80	82	83	83	84	85	83
降雨量	82	73	66	46	26	28	30	47	77	112	95	111	793
降雨日数	11	9	13	10	6	5	6	7	10	9	10	10	106
蒸発量	31	40	62	93	136	165	164	146	105	74	42	28	1,086

注) 蒸発散量は修正ペンマン法にて算定。上記の全ての数字はマスター･プラン報告書より引用。

計画地区は現在は耕作されず、アヒ･ルードが潅漑用水源で、ピテ･ルードが排水河川である。両水路共に土水路である。蛇行していたピテ･ルードは1989年に農業省の手によって直線水路に改修され、ピテ･ルードの流下能力は1990年に建設された橋梁地点で毎秒4.0m^{3}である。

9月初めや収穫期の予期せぬ降雨により、米の収量や品質の低下を招いている。このような環境の下では、手作業による収穫は低い品質にならざるを得ない。この期間の雇用労賃は通常の1.5~2倍になっている。この様な高い雇用労賃は、米からの農家所得を減少させている。

2.4. 潅漑状況

計画地区内には水田はないが、地区周辺の水田では稲作栽培に対する潅漑用水は十分でなく、潅漑余剰水や環元水を10~20haの低湿地に貯留し、耕作用にかんがい水として再利用している。CAPIC沿いのアヒ･ルードは両岸から1.0から1.5mの深さであるため、隣接耕地には直接潅漑できない。1990年、農業省によってCAPIC地区上流約370mに建設されたアヒ･ルードCAPIC導水路からは、CAPIC地域に潅漑水を容易に導水できる。

2.5. 排水状況

現在、計画地区内には排水路はなく、ピテ･ルードが排水河川である。集中豪雨が発生した時には、実証農場内の低地に1~2日間、最高0.5mの湛水を発生させる。しかし、実証農場の大部分は地盤標高が高いのために排水問題はない。

2.6. 道路状況

ハラーズ川流域内には、国道や州道等の主要幹線道路はアスファルト舗装されているが、農道は幅員1.5~2.0mの砂利舗装道であり、狭い幅員は農業機械の通行を困難にしている。

実証農場や建物用地内はサラ地のために道路はないが、前述の様に国道からCAPIC地域への進入道路は既に建設されている。

2.7. 農業の機械化状況

ハラーズ川流域内の農地には耕耘機やトラクターが稼働しているが、耕耘機が主体である。米の収穫時期には麦用の大型刈取･脱穀機が道路沿いに見られるが、米の脱穀にのみ使用されている。現在の道路状態が貧弱なために田植や収穫は手作業に頼らざるを得ない状況である。

2.8. 農地の状況

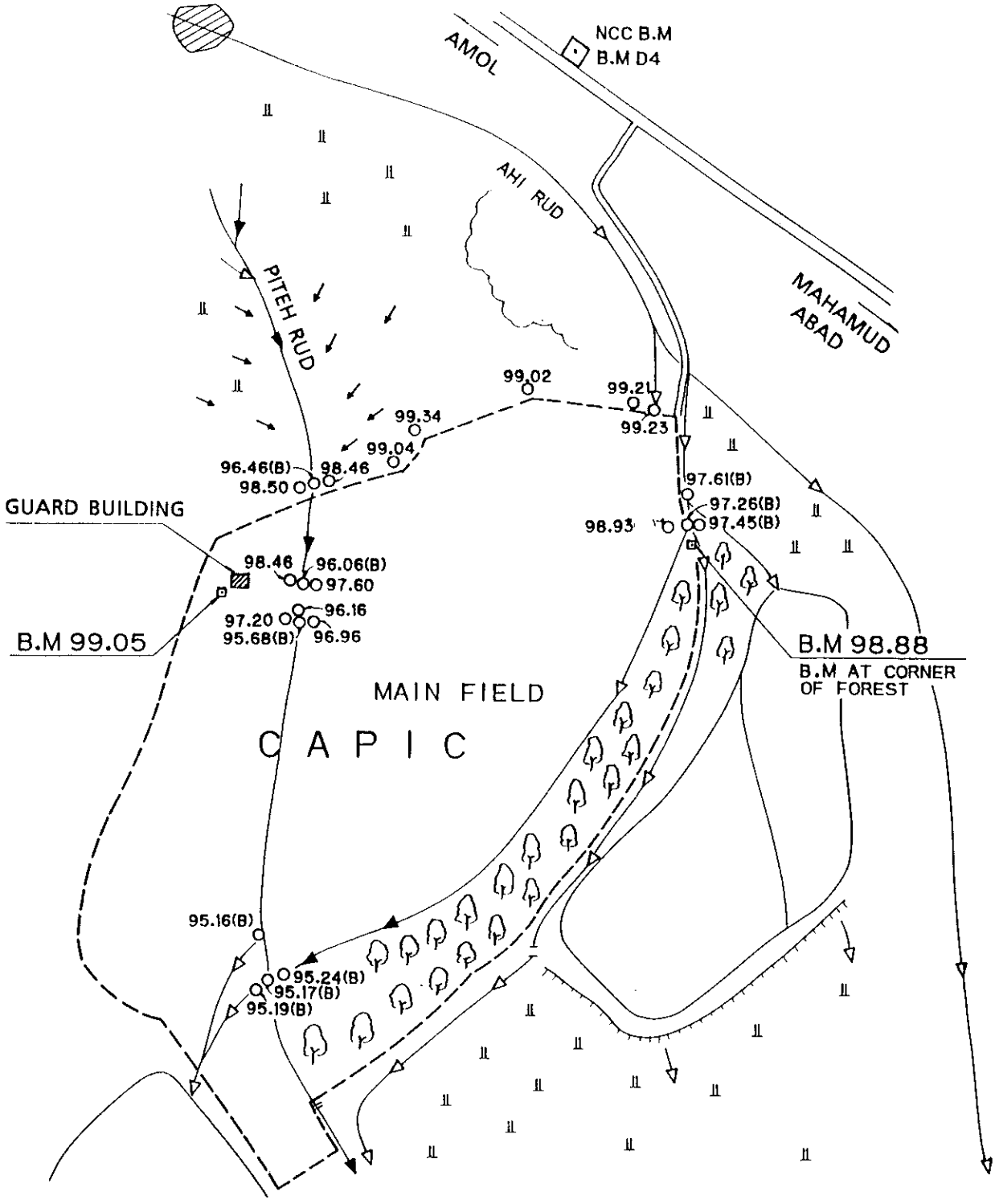
CAPIC地区は開墾地のため耕作されていない。CAPIC地域の周囲の農地は冬期の低温のために水稲の年一作栽培が行われている。。しかし、冬期の裏作に畑作物を栽培している農地も1部には見られるが、その面積は低温と貧弱な排水状況のために限られている。収穫末期には家畜の飼料を積んだトラックが見られる。

2.9. 水準点

この地域の地形図やその他の測量成果には仮水準点が使用されている。国家地図製作局の水準点(+4.991m)はマハマ･アバッドとアモールとを結ぶ国道沿いの郵便局の脇にある。旧来農法展示圃場と実験農場(TDF&TF)用地の南部地域に位置する仮水準点は国家地図製作局の水準点と結ばれている。国家地図製作局の水準点標高による同水準点の真標高は、釘の頭で-0.974m、コンクリート杭の頭では-0.969mである。仮水準点の標高は99.05mであるので、国家水準点との差は100.024m (＝99.05＋0.974) となる。(図2-9-1参照)

1990年にはもう一つの仮水準点がCAPIC地区内の森林地域の南部に設置され、その標高は仮水準点を基準にすると98.88mである。(図2-9-2参照)

農業省が測量した縮尺1/1000の地形図に表示されている標高は、全て上記の旧来農法展示圃場と実験農場(TDF&TF)用地の南部地域に位置する既設見張り小屋脇の仮水準点を基準にしてある。この設計は全て同水準点を基にしている。



Note: All elevation indicated in this figure are based on the temporary Bench Mark.
(B) Bottom elevation

図 2-9-1　仮水準点と実測測量標高

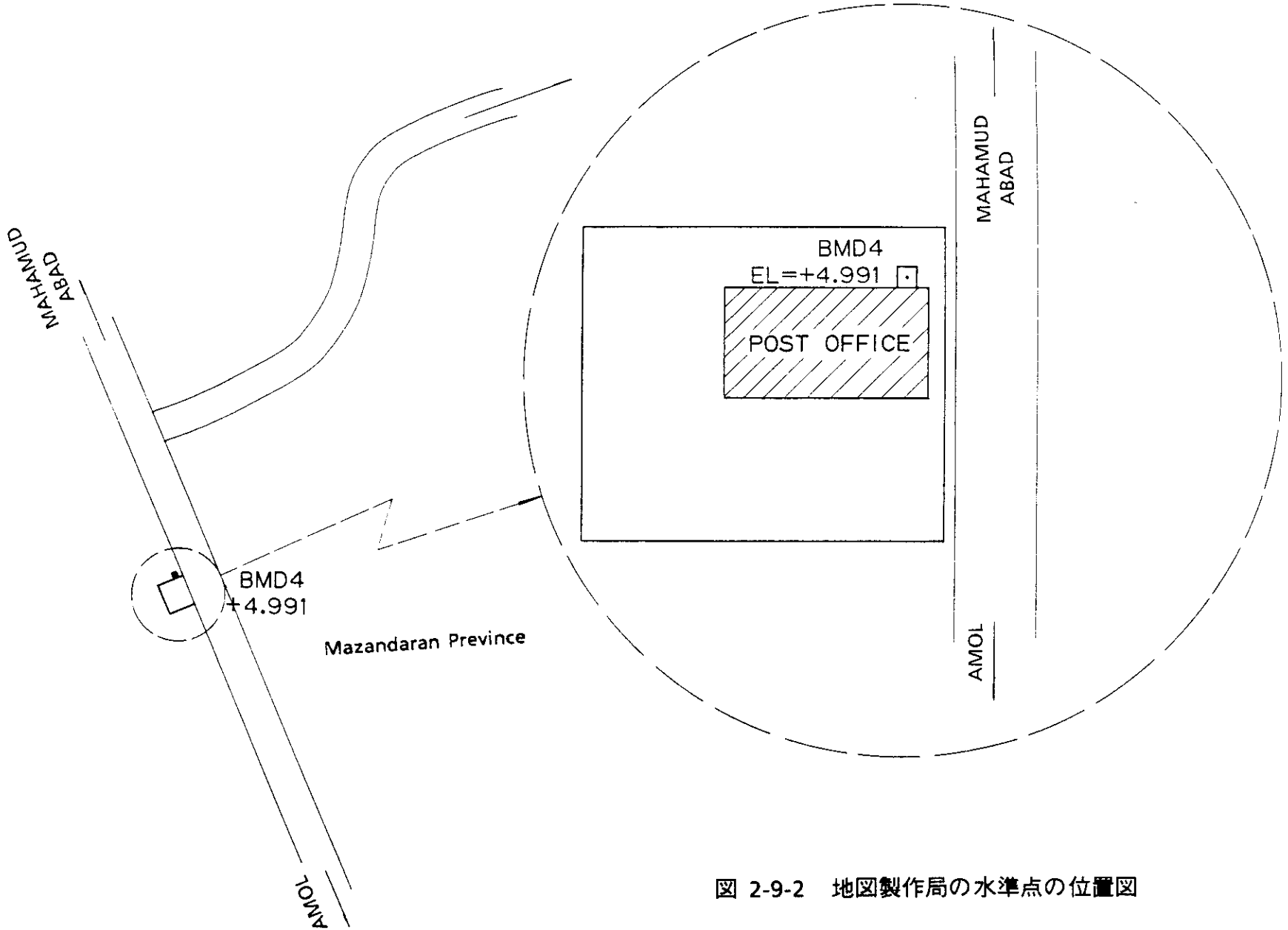


図 2-9-2　地図製作局の水準点の位置図

第３章　圃場整備工の設計

第３章　圃場整備工の設計

3.1. 総　論

CAPIC実証農場は、ハラーズ川流域内の全ての地域を対象にして、圃場整備の展示と同時に稲作技術の実証、米作の機械化、ポスト・ハーベストや畜産に重要な役割を果たす。この様な役割を考慮し、本調査作業の目的は、機械化営農や水監理方法を、ハラーズ川流域内の農民に展示するために必要な施設の設計をすることである。この作業は、CAPIC地区内の建物用地の整地計画を含む実証農場の農地造成の詳細設計を行うことにある。この目的を達成するためにこの調査地区内に多くの施設を計画した。施設用地を含む実証農場用地は、アヒ・ルードやピテ・ルードに囲まれ、また、南をCAPIC地区の南側の境界で囲まれている。(計画一般図参照)

建物用地の脇に計画された約6haの実験農場には、多岐の農業分野、農業機械化分野や普及の分野の活動に必要な施設、小用水路、小排水路、小農道も設計に含まれている。

計画地区の潅漑用水は、1990年に農業省によって建設されたアヒ・ルード水路から供給される。この調査での計画用水路は、この水路に接続させ、圃場整備を行った開拓農地、TDFとTFに潅漑用水を運ぶ。この潅漑用水路は開拓農地のみならず、TDFとTFにも用水を導水できるに十分な能力を与える。

実証農場内に計画する農道は、CAPIC地域と国道を結ぶ既設の砂利舗装された連絡道とを結ぶ。又、計画農道は、実証農場とTDF & TF地区とを結ぶ既設の橋梁とも結ぶ。

CAPIC地区の幹線排水路はピテ・ルードである。しかし、この調査には、水稲栽培期間中の用水不足を考慮して、用水の再利用可能な構想も含まれている。

計画施設は耕地の建設、用水路、排水路と農道であり、次章以降に各施設計画の詳細を述べる。

3.2 農地の設計

3.2.1. 耕区の設計

(1) 耕区の形状と大きさ

圃場整備される耕区の形状と大きさは、地形勾配、潅漑・排水、水管理、農家の経営規模や導入する農業機械の稼働率等の条件を考慮して決定する。

a) 耕区の配置

耕区の長辺は、整地費を押さえるためにできる限り等高線に沿って計画する。従って耕区の短辺は等高線に直角となる。(図3-2-1 参照)

b) 耕区の形状

農業機械の作業効率や圃場整備後における耕作未利用地を減少させるために、原則として、計画耕区は長方形とする。農業機械の利用が困難となるので、できるだけ耕区内に鋭角の隅ができるのを避けるべきである。しかし、直角の隅が不可能な場合には、鈍角の隅で計画する。(図3-2-1 参照)

c) 大きさ

次の条件を考慮して耕区の大きさを決定する。

- 地形条件
  - 上・下流の水田の標高差は、両耕区間を農業機械が運行可能なように、50 cm 以内にする。(図 3-2-2 参照)
  - 農道、用水路や排水路の潰地
  - 工事費
  - 営農技術と水管理

一般に、整地土量が ha 当たり 3,000 m^3 以上の場合には、耕区の大きさを変えるか、又は再区画割を考える。CAPIC の実証農場は地形勾配が 1/150 から 1/200 と緩やかであるので、整地土量がこの数字を越えることはない。

実証農場の南部地域には砂質土壌の層が地表から 40 から 80 cm の所に現れる。表土扱いを実施すれば、耕区の大きさの制限要因とはならない。しかし、この様なケースの場合には、表土扱い作業のため事業費は高くなる。表土扱いを実施しない場合には、砂質土壌の上に 20 から 30 cm の耕土を確保する。耕区の短辺は最大で 20 から 40 m に制限される。

表土扱いは一般に事業費が高くなるので、表土扱いの扱い土層深は作物の根の長さを考慮して 15 cm とする。従って、表土扱いの扱い土量は、ha当たり1,500 m^3となる。表土の運搬距離は、耕区の大きさや表土扱いの方法によって変化する。事業費を押さえるためには、表土扱い面積をできる限り押さえることが望ましい。

- 農業機械の作業効率

農業機械が直線に運転される限りにおいては、原則的に耕区の長辺の長さを決定する要因にはならない。しかし、農業機械の作業効率は、実際には肥料や農薬の容器の容量の様な制限要素によって影響をうける。現時点では最大の耕区の長辺長は、概ね250 m程度である。動力噴霧機は無風状態では、農薬を100 m程度しか散布できない。農業機械の改良や発展が更になされればこの制限要因は変化する。

ロータリ耕耘作業における農業機械の作業効率の試験データによれば、次の耕区の大きさが約70％以上の作業効率を示す。

小型耕耘機0.05 ha以上
中型トラクター(15～20 ps) 0.15 ha以上
大型トラクター(30 ps) 0.30 ha以上

この試験データは、更に、耕区の長辺と短辺に比率のよる作業効率の違いを示している。この結果によれば、長辺と短辺の比率が1:10と1:1では大きな差異はないが、ロータリー耕耘の場合には0.2 ha以下の耕区では作業効率が落ちる。そして、ロータリー耕耘作業においてはこの比率が4以上、プラウによる耕耘の場合は6以上の比率の時が、農業機械の作業効率が良くなる。

この結果によれば、短辺が20 m以上で、耕区の面積が0.3 ha以上の場合が、作業効率が高い。従って、農業機械の観点からは、耕区面積が0.3 ha以上で短辺が20 m以上、長辺は100 m～150 mが望ましい。

- 潅漑、排水と水管理

水管理の観点からは、耕区の長辺は150 mまでが望ましい。150 m以上の長辺を持つ区画では適期の水管理がより困難となる。

農業機械の高い作業効率を得、また節水を行うためには、ある一つの耕区の潅漑作業を数時間以内に終ることが望まれる。この様な場合には、耕区の大きさは約0.5 haに制限される。農業機械のより高い作業効率や、一本の小用水路の潅漑区で水管理を実施するには、圃区の大きさも5～6 haが望ましい。

農業機械の作業効率を増大させるには地下水位は少なくとも50 cm以下が必要であろう。収穫期の潅漑を終了する時点には、地下水位は地表から20～30 cm以下にあることが、農業機械のよりよいオペレーションに要求される。このことは耕区の大きさを制限する要因であるが、土性により変化する。もし、暗渠排水施設が導入されれば、この制限要因は耕区の大きさの決定要因とはならなくなる。

- 農家の経営規模

  計画地域の農家の経営規模も耕区の大きさを決定する制限要因の一つである。上記のような平均的な耕区の大きさは個別経営農家には推奨できないが、共同経営農業を行うにはより大きな耕区が要求されるだろう。

- CAPICの実証農場に適用する耕区の大きさ

  CAPICの実証農場には、水管理や農業の機械化を実証したり、展示したりするために様々な大きさの区画を計画する。例えば、0.2haの耕区は、小型耕耘機を用いる農業の機械化のために計画する。

以上のような様々な条件や制限要素を考慮して、耕区の長辺や短辺は次のように決定する。

耕区の長辺　100～150m

耕区の短辺　最大60m

(2)　圃区の大きさ

圃区は幾つかの耕区からなり、用排分離システムにおける水管理の単位となる。圃区の大きさは導水路等の施設用地による潰地に影響する。より大きな導水路等の間隔は、低い導水路密度では潰地を減少させるが、あまりに広い導水路間隔は営農にとって有利にはならない。図3-2-3には農地における潰地の率を表している。この結果によれば、上記の耕区の大きさを考慮して、圃場整備にはⅢとⅣ型が適当である。(図3-2-3参照)

(3)　実証農場における耕区の大きさと方向

圃場整備事業においては、耕区の長辺を等高線に平行にすることが整地工事費を最小にすることは良く知られている。CAPIC地区においては、等高線は二方向に向いていることが、農業省の製作した1/1,000地形図から明らかである。等高線の主方向は東から西に走っており、南部の一部の地域で等高線は南から北方向に走っている。導水路の骨格を決めるにはこの地形条件を考慮しなければならない。ここでは、5ケースの比較を行った。(図3-2-4参照)

ケースAとDは、実証農場の上流地区に位置し、等高線方向が主方向と異なった地域である。ケースAは、耕区の長辺方向が等高線と直角に交わり、ケースDは等高線と同じ方向である。長辺の長さを100mにし、短辺の長さをA1とD1ケースは30m、A2とD2ケースは60m、A3とD3ケースは90mとした。

(図3-2-5～-9参照)

ケースB、CとEは実証農場の下流地区にあり、長辺の長さは150mとした。ケースBとCの方向は、上述のケースAと同じ方向とし、ケースEは、上述のケースDと同じ方向

である。ケースBとCの違いは、排水路の位置の違いである。ケースCでは、排水路は実証農場地域の低い所に配置してある。上流地区と同じく、短辺の長さはB1、C1とE1は30m、B2、C2とE2は60m、B3、C3とE3は90mである。

この土量と運土距離の計算には、理論式を用いた。この式は耕区の長辺と短辺の長さ、最大切土高と、等高線と長辺とのなす角が必要である。

(図3-2-10と-11参照)

この比較の結果、耕区の短辺の長さが長くなれば土量が増える。短辺長60mのケースB2とC2は長辺と等高線の方向がほぼ一致しているため最小の土量を示している。一般に、短い短辺の耕区は土量が小さいし、短辺長30mと60mの区画の間の差異は、90mに比べて大きくはない。(表3-2-1参照)

ケースAとDとの間に運土距離の大きな差がみられるが、下流地区のケース間にはあまり大きな差はない。ケースDが最も小さい運土距離を示している。(表3-2-1参照)

整地工の工事費は、土量のみならず運土距離にも関係する。建設機械のha当たりの稼働時間の解析では、他のケースに比較して、ケースDが最も小さな値を示したが、下流地区では各々のケース間での差は僅かであった。結果として上流地区では、ケースDを、下流地区ではケースEを採用する。(表3-2-1参照)

3.2.2. 整地土量計算法

(1) 計算法

圃場整備の整地土量を計算するためには、次の様な計算法が用いられる。これらの計算には運土距離の計算が重要である。

- 従来法　この方法は最も精度が高い計算法であるが、運土距離の計算が複雑で、多くのデータ処理作業が必要となる。

- 理論式　他の方法に比べて、データ処理時間が最も短いが、地形が複雑な場合には精度が落ちる。しかし、土量と運土距離が理論式によって計算できる。この計算に必要なデータは前述してある。

- メッシュ法　計算過程の違いで、各種の名称がある。この計算は現況の区画の面積に代わりに、一耕区内に面積一定の幾つかのメッシュを用いるもので、メッシュのXとY軸上の座標とメッシュの標高を必要とする。切土と盛土の重心位置の座標を基にして、運土距離を計算する。メッシュの大きさを変更する事によって、計算精度と計算時間は変化する。

大区画圃場整備の整地工事費は運土量のみならず運土距離によっても変わる。土量計算法を用いるときには、この点を考慮しなければならない。土量計算には多くの方法があり、上記の計算法による特徴を考慮して、本設計にはメッシュ法を用いて土量計算を行う。

(2) 土量計算

土量計算には次のデータと計算手順でもって計算をおこなう。

(表 3-2-2 と図 3-2-12 参照)

入力データ ： メッシュの大きさ、標高 (EL)、座標及び耕区の面積
計画標高 (ELprop) = メッシュ標高の合計÷耕区内の有効メッシュの数
平均メッシュ面積 (AMA) = 計画耕区面積÷耕区内の有効メッシュの数
切土高 = (EL - ELprop) の正の値
盛土高 = (EL - ELprop) の負の値
整地土量 = 切土高 × AMA
X 軸上の切土の重心位置 (Xhc) = (切土高 × 切土の X 座標)の総計÷切土高総計
Y 軸上の切土の重心位置 (Yhc) = (切土高 × 切土の Y 座標)の総計÷切土高総計
X 軸上の盛土の重心位置 (Xhe) = (盛土高 × 盛土の X 座標)の総計÷盛土高総計
Y 軸上の盛土の重心位置 (Yhe) = (盛土高 × 盛土の Y 座標)の総計÷盛土高総計

$$運土距離 = \sqrt{((Xhc - Xhe)^2 + (Yhc - Yhe)^2)}$$

3.2.3 運土計画

計画田面標高は、道路、灌漑用水路、畦畔に必要な土量や排水路な残土を考慮して最終的な標高を決定する。

整地工における主な修正点は以下の通りである。

- CAPIC 地区の南側境界に沿った地域は、他の地域よりも標高が高く、TDF 及び TF へ導水するために支線用水路第1号 (LIC-1) の導水勾配は、緩やかな設計とした。
- 支線用水路第 2 号(LIC - 2) から分岐する小用水路第 7, 8, 9 号で灌漑される高位部耕区は灌漑できないので、仮水準点の標高で 99.00 m 以下に計画標高を修正する。
- 第 11 圃区の高位部から余剰土量を運土し、第 4 から 6 耕区の標高を修正する。第 6 耕区の標高は上流の標高より高いために、20 cm 低くする。
- 更に上記の修正に、各筆の田面高を修正し、前述の様に実証農場内に計画する道路、用水路、畦畔用土を考慮して各筆の田面高を修正し、最終田面標高を決定する。(第 4 章の表 4-4-1 と -2 及び図 4-1-1参照)

上記の土量計算の結果は下記のように要約できる。

項　　目	工事量	運土距離	必要な建設機械
耕区内移動	27,600 m^3	57.0 m	ブルドーザー
耕区外移動	6,240 m^3	82.2 m	ブルドーザー
計	33,840 m^3	61.6m	

注) 詳細は第4章4-1節参照

整地運土のベクトル図は添付設計図No.3に編集してある。

(2) 表土扱

実証農場における表土扱い面積は、切・盛高さと砂質土の深さにより、3.43 haとする。運土距離は、表土を耕区の両側に一次仮置きする表土扱方法を適用し、22.7 mとする。基盤整地後、同じ量の表土を田面に戻す。実証農場内の表土扱い地域は1,8及び9圃区である。(第4章の表4-1-3と図4-1-1参照)

(3) 畦畔工

耕区間の畦畔は水稲生育に必要な用水を貯留するために計画する。畦畔は上流耕区の所有となる。法勾配は1:1、畦畔高30 cm、天端巾30 cmで計画する。道路と水路施設が30 cmの高さを持つのでこの施設側には畦畔を計画しない。

(4) 法面仕上工

耕区間の田差が10 cm以上の法面に、法面崩壊から法面を守るために法面仕上げを計画する。

表3-2-1　区画の大きさによる整地土量の比較

Case	Field Lot Size (m)	Total Area (sq.m)	Earth Work Volume			Hauling Distance		Working Time		
			Volume (cu.m)	Per ha (cu.m/ha)	Rate (%)	Distance (m)	Rate (%)	Workablt'y (cu.m/ha)	Time (hr)	Rate (%)
(Upper Portion of the Main Field)										
A1	100 × 30	121,086	7,482	618	100	64.0	100	34.2	18.1	100
A2	100 × 60	121,086	8,053	665	108	64.2	100	34.1	19.5	108
A3	100 × 90	121,086	9,196	759	123	65.6	103	33.4	22.7	125
D1	100 × 30	109,801	5,901	537	100	48.0	100	45.4	11.8	100
D2	100 × 60	109,801	7,350	669	125	47.2	98	46.2	14.5	123
D3	100 × 90	109,801	10,150	924	172	56.7	118	38.5	24.0	203
(Lower Portion of the Main Field)										
B1	150 × 30	108,412	8,009	739	100	82.4	100	26.6	27.7	100
B2	150 × 60	108,412	7,530	695	94	81.0	98	27.1	25.6	92
B3	150 × 90	108,412	12,139	1,120	152	83.3	101	26.3	42.6	154
C1	150 × 30	107,774	9,291	862	100	73.0	100	30.0	28.7	100
C2	150 × 60	107,774	8,791	816	95	76.6	105	28.6	28.5	99
C3	150 × 90	107,774	11,678	1,084	126	79.7	109	27.5	39.4	137
E1	150 × 30	122,062	9,279	760	100	75.8	100	28.9	26.3	100
E2	150 × 60	122,062	11,152	913	120	69.4	92	31.6	28.9	110
E3	150 × 90	122,062	11,851	971	128	78.0	103	28.1	34.6	132

Note: Workability $Q = 60 \times q \times f \times E / (0.034 \times D + 0.025)$: q = hauling volume of swamp bulldozer (16 ton class) per one cycle = 2.09 cu.m/cm
f = Soil conversion factor = 1.00 : E = Workability = 0.60 : D = Hauling distance (m)
Therefore, $Q = 60 \times 2.09 \times 1.00 \times 0.6 / (0.034 \times D + 0.025)$

表 3-2-2 土 量 計 算 サ ン プ ル

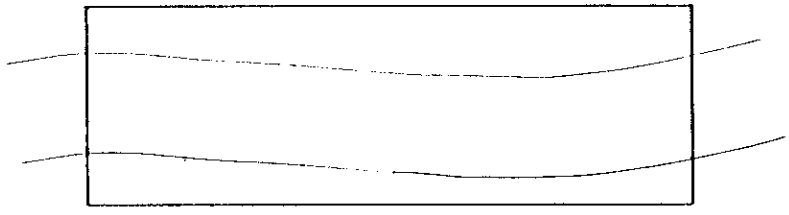
No.	X	Y	EL	Height (cm)		Cut		Fill		
				Cut (Hc)	Fill (He)	H·Hc	Y·Hc	X·He	Y·He	
1-1	5	5	99.11		39			195	195	
1-2	15	5	99.22		28			420	140	
1-3	25	5	99.38		12			300	60	
1-4	35	5	99.40		10			350	50	
1-5	45	5	99.46		4			180	20	
1-6	55	5	99.47		3			165	15	
1-7	65	5	99.53		7			455	35	
....								...	...	
....								...	...	
....								...	...	
3-6	55	25	99.59	9		...	...			
3-7	65	25	99.63	13		1,375	225			
3-8	75	25	99.67	17		845	325			
3-9	85	25	99.69	19		1,275	425			
3-10	95	25	99.71	21		1,615	475			
Average			99.50			85.1	22.9	24.5	5.3	
Total				214	232	18,204	4,908	5,684	1,230	

Earth Moving Volume : $V = \Sigma Hc \times 100 =$ 100×2.14 m = 214 m^3

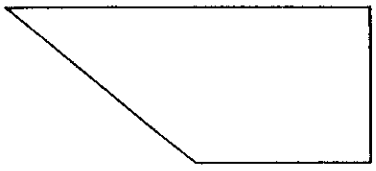
Hauling Distance = : $\sqrt{\{(\Sigma X \cdot Hc - \Sigma X \cdot He)^2 + (\Sigma Y \cdot Hc - \Sigma Y \cdot He)^2\}} =$ 63.1 m

No. of Effective Mesh :n = 30

Average Mesh Area : = Field lot area / n = 100 m^2



ALIGNMENT OF FIELD LOT



FIELD LOT WITH
ACUT ANGLE CORNER

FIELD LOT WITH
OBTUSE ANGEL CORNER

図 3-2-1　耕区の形状

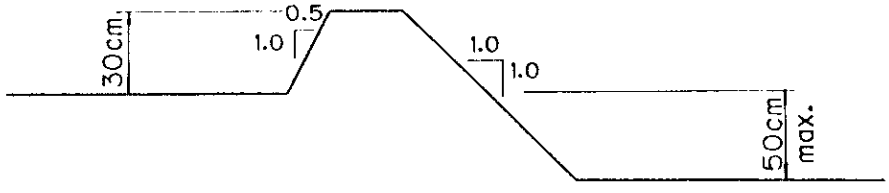
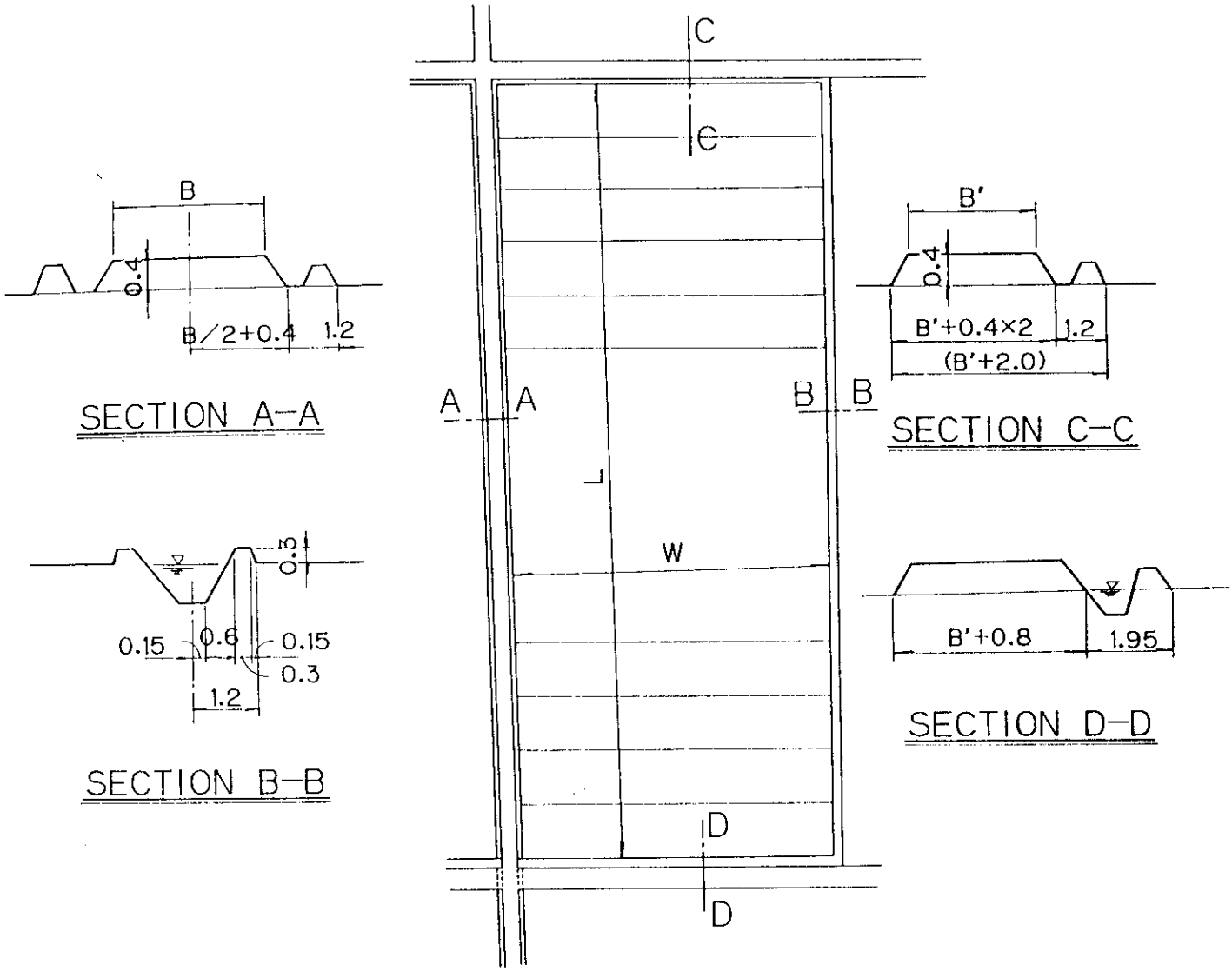


図 3-2-2　最大田差

図 3-2-3　計画施設による潰地の算定



Type	L	W	B	B'	Area of Field Block	Land for facilities	Rate
	m	m	(2.5)		ha	(1803) m²	(6.0) %
I	300	100	3.5	3.5	3.0	1953	6.5
II	600	100	(2.5) 3.5	3.5	6.0	(3018) 3318	(5.0) 5.5
III	300	150	(2.5) 3.5	3.5	4.5	(2096) 2246	(4.7) 5.0
IV	600	150	(2.5) 3.5	3.5	9.0	(3311) 3611	(3.7) 4.0
V	600	200	(2.5) 3.5	3.5	12.0	(3605) 3905	(3.0) 3.3

Note : ( ) In case of a road width of 2.5 m

図 3-2-4　整地土量比較計算のサンプル位置図

図 3-2-5　代替案ケースＡの区画割図

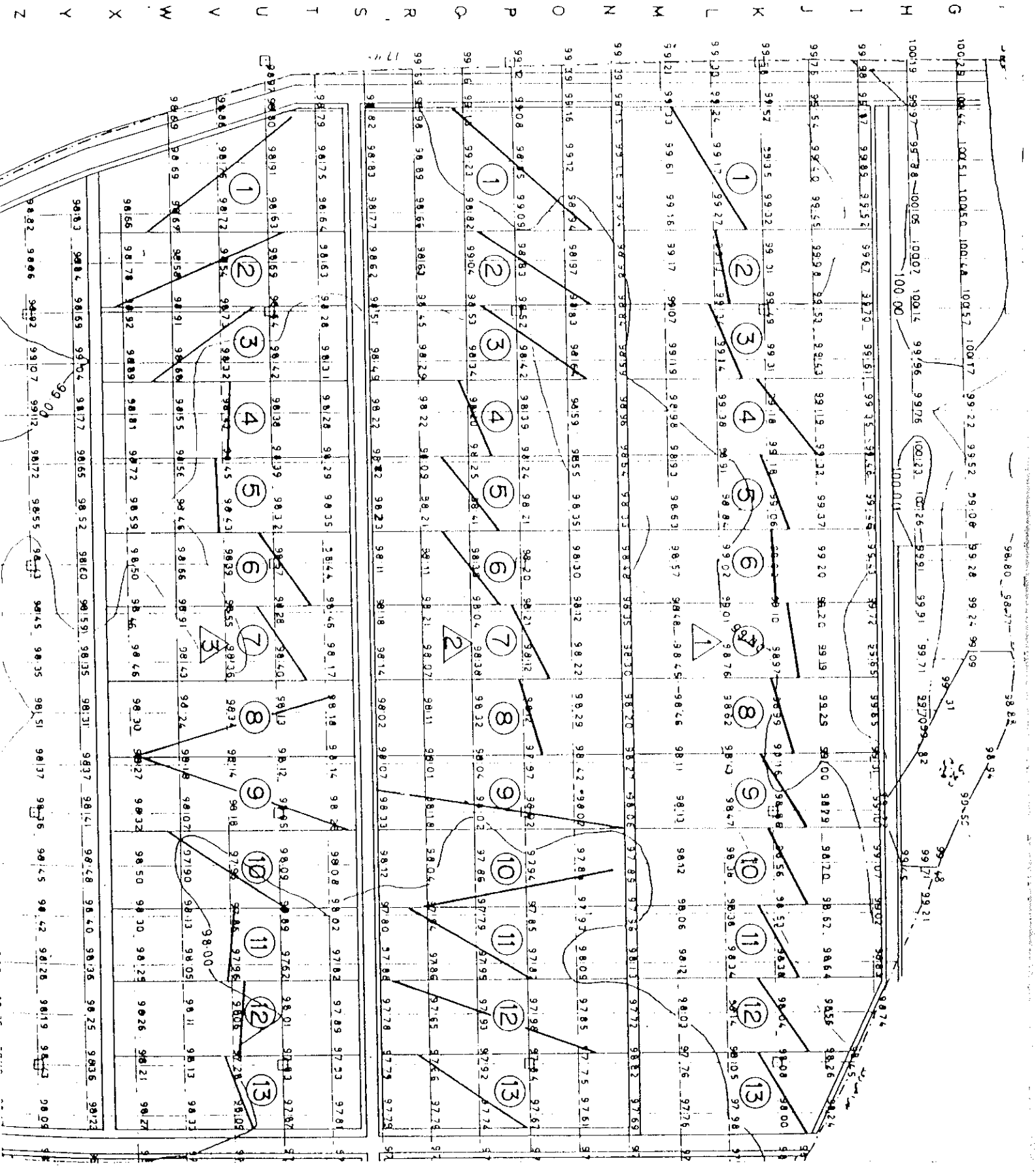


図 3-2-6　代替案ケースＢの区画割図

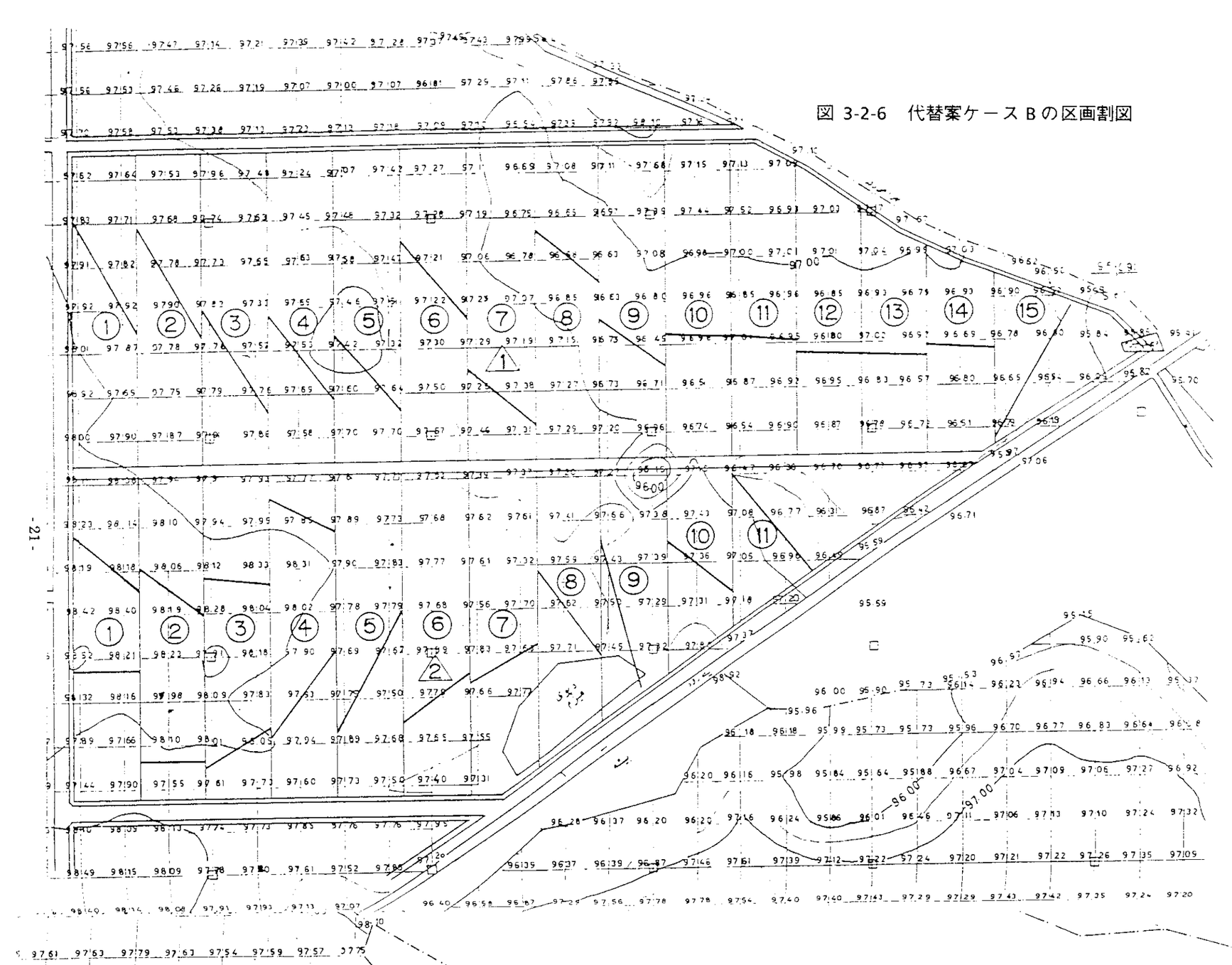


図 3-2-7　代替案ケースＣの区画割図

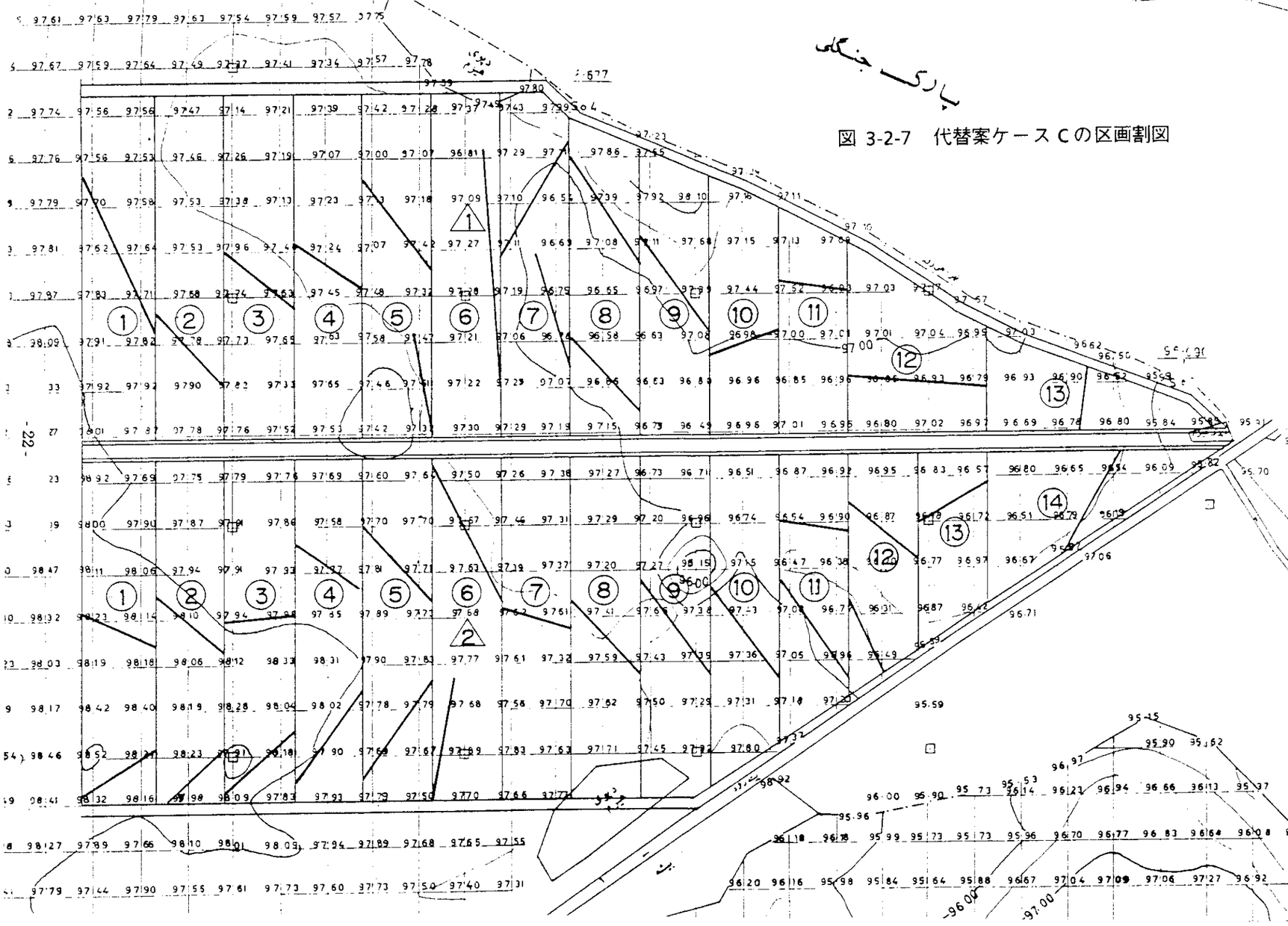


図 3-2-8　代替案ケースＤの区画割図

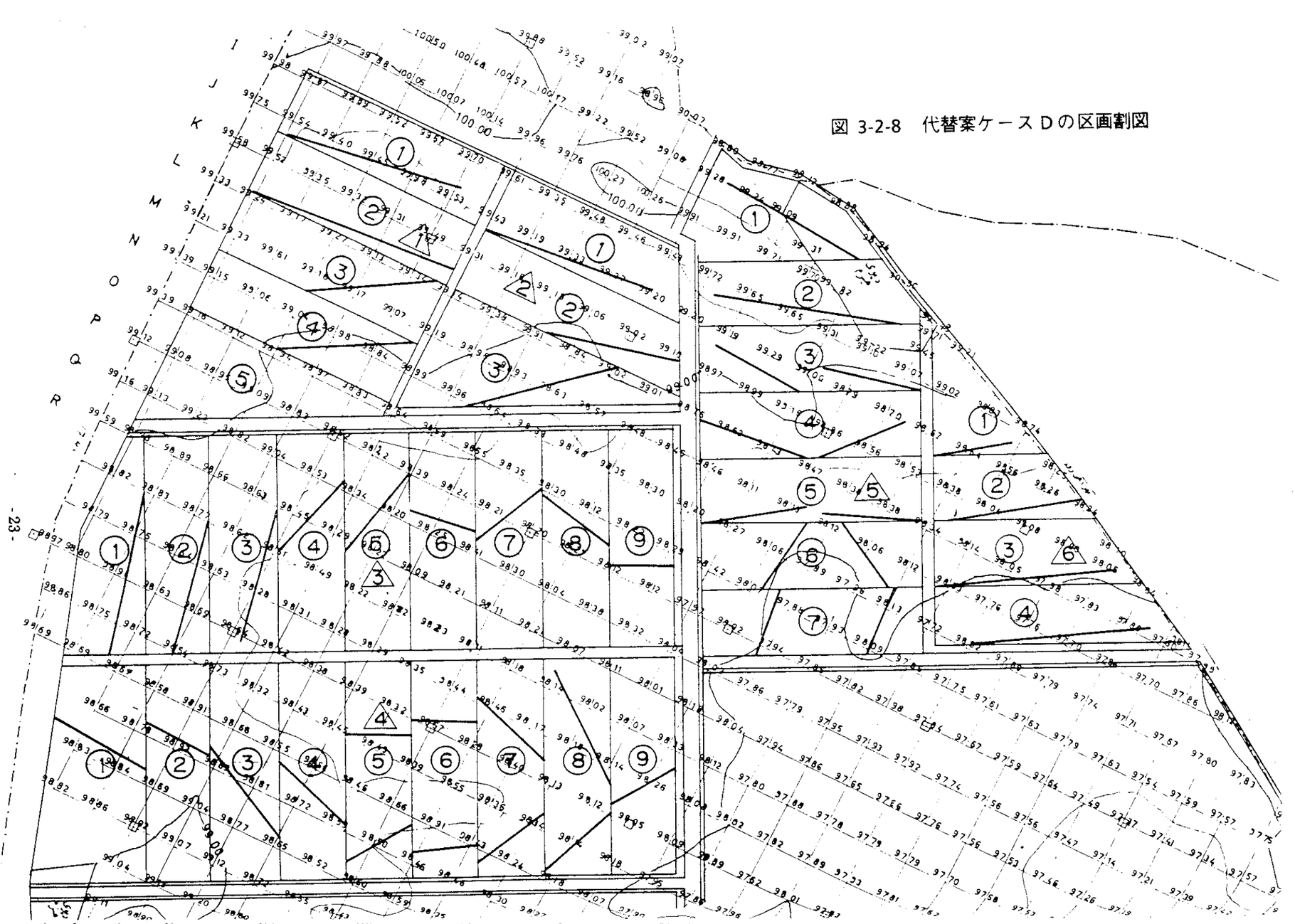


図 3-2-9　代替案ケースＥの区画割図

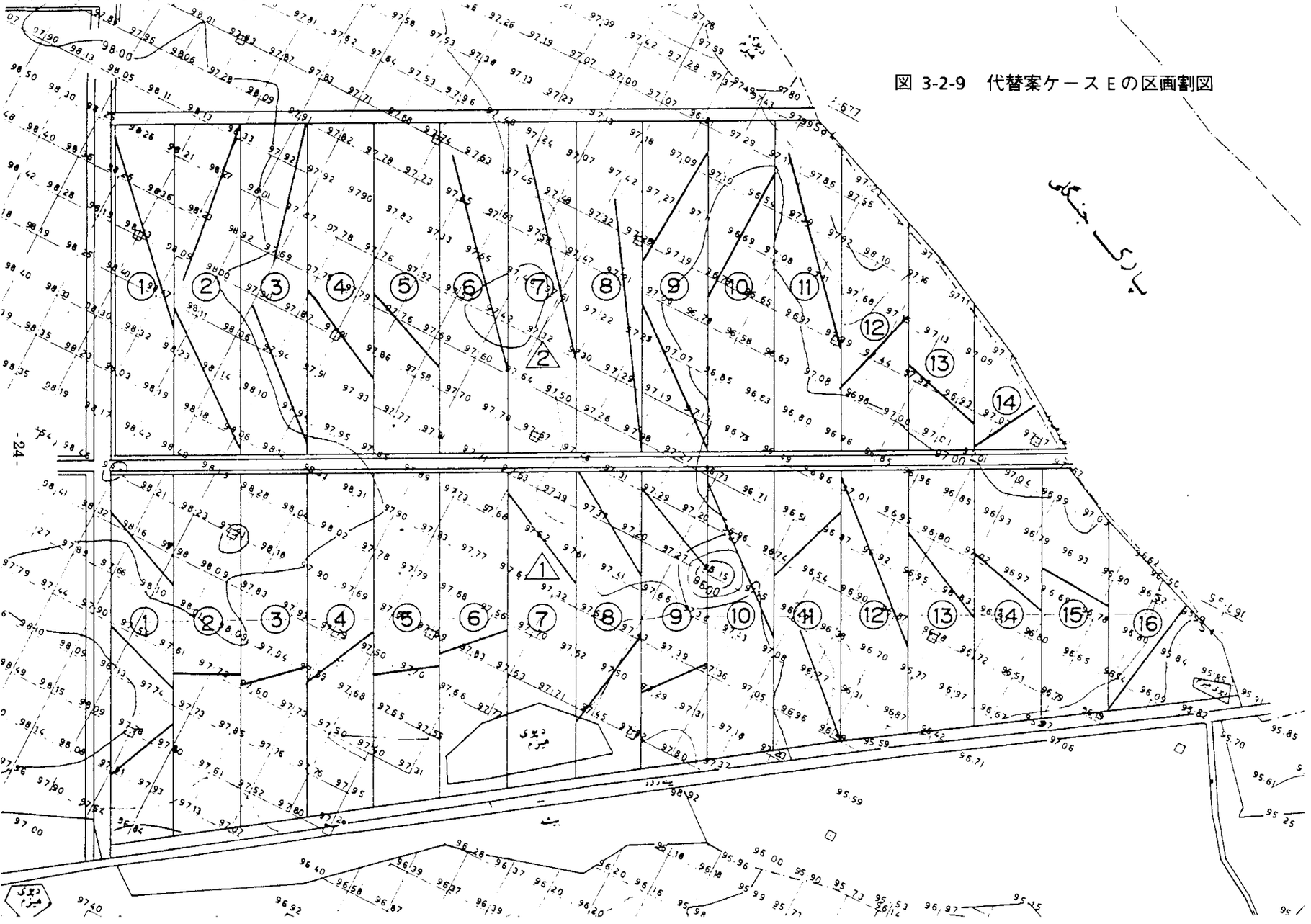
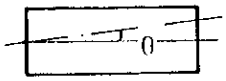
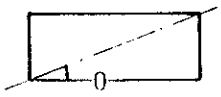
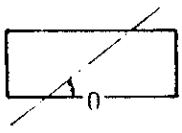
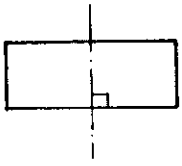


図 3-2-10 整地土量計算理論式

Case No.	Figure	Range	Equation to be Applied	
			Volume (cu.m)	Hauling Distance (m)
I		θ=0°	$\frac{L\times B\times hmax}{4}$	$\frac{2\times B}{3}$
II		0°〈θ〈T-ANG	(I×k×B3×(k×SIN2+3×COS2)) ÷(24×COS)	(2×B×COS×k1) ÷(k2×SIN2+3×COS2)
III		θ=T-ANG	$\frac{L\times B\times hmax}{6}$	$\frac{\sqrt{(B2+L2)}}{2}$
IV		T-ANG〈θ〈90°	I×B3(3×K2×SIN2+COS2)÷(24×SIN)	(2×k×B×SIN×k1)÷(3×k2×SIN2+COS2)
V		θ=90°	$\frac{L\times B\times hmax}{4}$	$\frac{2\times L}{3}$

Note: k = L/B, T-ANG=tan-1 (1/k), B3 = B^3, I = tan i = 2×hmax÷(B×COS+L×SIN)
COS=cos θ, COS2=$\cos^2\theta$, k2=k^2, k4=k^4, SIN=sin θ, SIN2=$\sin^2\theta$,L2=L^2,
i=Ground slope, k1=√(k4×SIN2+COS2), hmax=the max. cutting depth within a field lot

図 3-2-11 理論式による整地土量計算様式

(CASE-)

(SHEET NO. OF)

FBN	FLN	AREA (sq.m)	B (m)	L (m)	ELEVATION (m)		h (m)	θ (°)	θo (°)	EA	V (cu.m)	D (m)
					Max.	Min.						

Note;FBN = Field Block, FLN = Field Number, B = Length of Shorter Side of the Field Lot, L = Length of Longer Side of the Field Lot, h = ELmax-Elmin, θ = Angle between Counter Line and Longer Side of the Field Lot, θo = θ in Tan θ = B/L, EA = Eqation applied, V = Cutting Volume, D = Hauling Distance

図 3-2-12　メッシュの割り方

In Case of Regular Size of Filed Lot with 100 × 30 m

3 (25m)	99.43	99.46	99.51	99.54	99.55	99.59	99.63	99.67	99.69	99.71
2 (15m)	99.29	99.31	99.41	99.43	99.48	99.49	99.54	99.58	99.61	99.64
1 (Y=5m) (0 m)	99.11	99.22	99.38	99.40	99.46	99.47	99.53	99.55	99.59	99.61
(0m) 1 (X=5m)	2 (15)	3 (25)	4 (35)	5 (45)	6 (55)	7 (65)	8 (75)	9 (85)	10 (95)	

Note :

·	The center of a mesh
99.11	Representative EL of the mesh
1, 2	No. of mesh on X or Y axis
X=5m	Distance in m from the original point to the center of the mesh on X-axis
Y=5m	Distance in m from the original point to the center of the mesh on Y-axis

In Case of Irregular Size of Field Lot

3 (25m)	99.43	99.46	99.51	99.54	99.55	*	*	*	*	*
2 (15m)	99.29	99.31	99.41	99.43	99.48	99.49	*	*	*	*
1 (Y=5m) (0 m)	99.11	99.22	99.38	99.40	99.46	99.47	99.53	*	*	*
(0m) 1 (X=5m)	2 (15)	3 (25)	4 (35)	5 (45)	6 (55)	7 (65)	8	9	10	

Note :

·	The center of effective meshes
*	Non-effective meshes
99.11	Representative El of the mesh
1, 2	No. of mesh on X or Y axis
X=5m	Distance in m from the original point to the center of the mesh on X-axis
Y=5m	Distance in m from the original point to the center of the mesh on Y-axis

3.3 灌漑施設計画

3.3.1 灌漑計画

(1) 灌漑面積

CAPIC地区の灌漑地域は、1/1,000の地形図によって面積算定をした。純灌漑面積は用・排水路道路の施設用地を除いた面積である。TDFとTFの純灌漑面積は、減歩率を5%と仮定し算定した。計画灌漑面積は下記に示す。

地　区	総面積	純灌漑面積	非灌漑面積
実証農場	39.03 ha	35.09 ha	3.94 ha
TDF	10.00 ha	9.05 ha	0.50 ha
TF	12.87 ha	12.23 ha	0.64 ha
計	61.90 ha	56.82 ha	5.08 ha

注) TDF- Traditional Demonstration Field
TF - Trial Field

(2) CAPIC地区の水利権

CAPIC地区に対する水利権は、マザンダラン州の地方水利局(Mazandaran Reginal Water Board)によって承認されている。灌漑期間中の灌漑用水は年間946,080 m^3、又は、30 lit/sec/haである。

(3) CAPIC地区の灌漑水源

CAPIC地区の灌漑水は1990年に農業省が建設したアヒ・ルードCAPIC導水路より取水する。CAPIC地区の近傍に掘削した深井戸は用水試験の結果、CAPIC地区の水利権水量より小さいため(モーター回転毎分950回転で6.25 lit/sec)、計画に用いなかった。

アヒ・ルードCAPIC導水路は、コンクリート舗装、導水勾配1/1,000、計画通水量183 lit/sec/secであり、水路末端のインバート標高は仮水準点を基に、99.23 mである。

(図3-3-3参照)

(4) 水管理の実施

次の様な試験や展示が実証農場内の圃場整備が行われた後で、実施可能となる。

a) 灌漑システム
　用・排分離灌漑システム
　用排兼用灌漑システム
　田越灌漑システム

b) 排水システム
　自然排水システム
　水位調節排水システム

c) 潅水方法
中干し
輪番潅漑システム

(5) CAPIC地区の潅漑の基本諸元

a) 代掻き期間 (Nd又は nd)

- 全CAPIC地域
Nd = 16日 (CAPIC内の農業活動の状況から計画)

- 一筆の耕区内
nd = 2日
第1日 - 代掻用水の施用
第2日 - 代掻及び田植

b) 1日当たりの代掻面積 (Ao又は ao)

Ao = A / Nd (ha/日)

もし、田越潅漑システムを行う水田が潅漑期間前に代掻を行った場合には、次の式を使用する。

ao = (A - Ap) / Nd 又は、 As / Nd (ha/日)
ここに; A = 全潅漑面積 (ha)
As = 用排分離システムの潅漑面積 (ha)
Ap = 田越潅漑システムの潅漑面積 (ha)

c) 潅漑効率 (E)

E = Ea × Ef = 0.85 × 0.95 = 0.765
ここに; Ea = 圃場配水効率 = 0.85
Ef = 小用水路の搬送効率 = 0.95
(この数字はマスター・プランより引用)

d) 作物用水量

- 田植後の圃場
ETcrop = ETo × Kc = 4.4 mm/日 × 1.1 = 4.84 mm/日

ここに; ETo = 対象作物の蒸発散量(5月に 4.4 mm/日)
Kc = 作物係数 = 1.1 (田植後の耕区からの蒸発散量 係数)

- 代掻後の圃場

ETcrop = ETo × Kc = 4.4 mm/日 × 1.0 = 4.4 mm/日
ここに; Kc = 1.0 (自由水面からの蒸発係数)

e) 代掻用水量 (h1)

h1 = (212 × As + 189 × Ap) / A
用排分離潅漑システムの場合: h1 = 161.8 mm/E = 212 mm
田越潅漑システムの場合 : h1 = 144.8 mm/E = 189 mm

代掻用水は以下によって算定。

項　　目	用排分離潅漑システム	田越潅漑システム
30 cm の土層の飽和用水量	75 mm	75 mm
田面湛水深	50 mm	50 mm
代掻期間の浸透量(2日間)	28(14×2)mm	11(5.5×2)mm
水面蒸発量(2日間)	8.8(4.4×2)	8.8(4.4×2)mm
計	161.8 mm	144.8 mm

f)　浸透量 (P)

(生育段階と圃場のタイプによって異なる)

潅漑システムのタイプ	代掻段階	生育段階
用排分離潅漑システム	14.0mm/日	7.0 mm/日
田越潅漑システム	5.5 mm/日	3.0 mm/日
計	14.0×As+5.5×Ap / A	7.0×As+3.0×Ap / A

注) 浸透量は排水改良を考慮して仮定した。

g)　田植後の消費水深 (h2)

$$h2 = (15.5 \times As + 10.2 \times Ap) / A$$

(単位: mm/日)

潅漑システムのタイプ	面積(ha)	ETcrop	浸透量	計	消費水深
用排分離潅漑システム	As	4.84	7.0	11.84	15.5
田越潅漑システム	Ap	4.84	3.0	7.84	10.2
計 / 平均	A				h2

(6)　ピーク用水量

用水量は次の3つのケースで計算した。

a)　ケース 1

全潅漑地域を16日間で代掻し、実証農場の35.06 haは用排分離システム、TDF と TF の21.73 ha は田越潅漑システムの場合。

$$Q1 = 10 (ao \times h1 + ao (Nd - 1) \times h2) / 86{,}400$$
$$= 10 \times (3.55 \times 203 + 3.55 \times (16 - 1) \times 13.5) / 86{,}400$$
$$= 167 \text{ lit / sec}$$

ここに: ao = A / Nd = 56.82 ÷ 16 = 3.55 ha/日
h1 = (212 × As + 189 × Ap) / A = 203 mm
h2 = (15.5 × 35.09 + 10.2 × 21.73) / 56.82 = 13.5 mm / 日
A = 56.82 ha
As = 35.09
Ap = 21.73 ha

b) ケース 2

潅漑期間前に田越潅漑システムで地域の代掻を行う場合。(面積と潅漑システムは前と同じ)

$$Q2 = 10(ao \times h1 + (Ap + ao(Nd-1)) \times h2)/86{,}400$$
$$= 10 \times (3.55 \times 212 + (21.73 + 2.19 \times (16-1) \times 13.5)/86{,}400$$
$$= 139 \text{ lit/sec}$$

ここに: ao = A / Nd = 56.82 ÷ 16 = 3.55 ha
h1 = 212 mm
h2 = 13.5 mm / 日
A = 56.82 ha
As = 35.09
Ap = 21.73 ha

c) ケース 3

全潅漑地域が用排分離システムの場合。

$$Q1 = 10(ao \times h1 + ao(Nd-1) \times h2)/86{,}400$$
$$= 10 \times (3.55 \times 212 + 3.55 \times (16-1) \times 15.5)/86{,}400$$
$$= 183 \text{ lit/sec}$$

ここに: ao = A / Nd = 56.82 ÷ 16 = 3.55 ha/日
h1 = (212 × As + 189 × Ap) / A = 212 mm
h2 = 15.5 mm / 日
A = 56.82 ha
As = 35.09
Ap = 0 ha

ケース3が最大用水量を示すので、CAPIC の計画用水量は 183 lit/sec とする。

(7) 期別用水量の算定

ピーク用水量の 183 lit/sec は、代掻最終日に現れる。(図 3-3-1 参照)

a) 常時最大用水量

2.05 lit/sec/ha × 56.82 = 115 lit/sec (7月下旬)

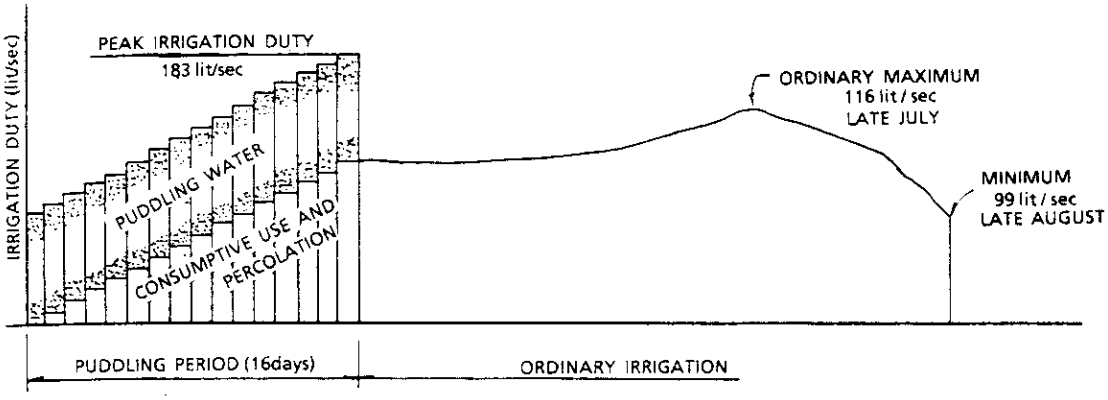
ここに:			
	作物用水量	ETo × Kc / 2 = 164 × 1.2 / 2	= 98.4 mm
	浸透量	P × 15 日 = 7 × 15	= 105.0 mm
	純用水量 (In)		= 203.4 mm
	粗用水量 (Ir)	In / E = 203.4 / 0.765	= 265 mm/15 日
			= 17.7 mm/ 日
			= 2.05 lit/sec/ha

b) 常時最小用水量

1.75 lit/sec/ha × 56.82 = 99 lit/sec (8月下旬)

ここに:			
	作物用水量	ETo × Kc / 2 = 146 × 0.95 / 2	= 69.4 mm
	浸透量	P × 15 日 = 7 × 15	= 105.0 mm
	純用水量 (In)		= 174 mm
	粗用水量 (Ir)	In / E = 174 / 0.765	= 227 mm/15 日
		(又は	= 15.1 mm/ 日)
		(又は	= 1.75 lit/sec/ha)

図 3-3-1　期別組用水量



(8)　生育期間の総用水量

用排分離システムと自然排水が全潅漑地域に実施された時には、生育期間の全用水量は、1,055千m^3になる。これはCAPICに与えられた水利権水量(946千m^3)をやや上回る。従って、排水路内の水位を調節して地下水位を上げ、浸透量を押さえる排水路内にチェックを設け、用水を節約する必要がある。

総用水量 = 総期別粗用水量 × 潅漑面積 = 1,857 × 56.82 ha
= 1,055,000m^3

総期別粗用水量 = 1,857mm (詳細は表3-3-5参照)

3.3.2　用水系統模式図

水路ごとの潅漑面積と単位用水量に基づいて計算した用水系統模式図を図3-3-4と表3-3-1から-3に示す。

3.3.3　潅漑施設の設計

実証農場で計画した支線用水路は、CAPIC地区の南側境界でのアヒ・ルード導水路から潅漑用水を受け、圃場に潅漑用水を配水する小用水路に送る。

(1)　水路配置

- 用排分離の場合
  実証農場に計画した小用水路は、維持管理が容易となるように農道沿いに配置した。各々の耕区は、農道の両側に配置した小用水路から直接潅漑する。(図3-3-5と3-3-6参照)
- 用排兼用の場合
  実証農場では、排水路の上流端に位置する排水路放水工を開き、同時に排水路内のチェックを操作することによって用排兼用潅漑システムを農民に展示することができる。この場合、チェック上流の水田に排水路から潅漑用水を供給し、下流の水田

は同じ排水路に余剰水を排水できる。しかながら、チェック間の水田では、排水路の水位を効果的に調節する水管理のため、できる限り同じ品種の同じ生育時期の水稲を作付ける。排水路の水位は水田の田面より高く保たねばならない。(図 3-3-5 と 3-3-6 参照)

- 田越潅漑の場合

  圃区を潅漑するために、小用水路の最上流端の分水口を開き、潅漑期間中その下流のチェックや他の分水口を閉じる。潅漑用水は上流水田から下流水田に流れる。(図 3-3-5 及び 3-3-6 参照)

(2) 用水路

CAPICの用水路は 2 本の支線用水路 (LIC) と 12 本の小用水路 (ID) からなる。

a) 支線用水路 (LIC)

支線用水路第 1 号 (LIC-1)	総延長	1,120 m (コンクリート・ブロック造)
支線用水路第 2 号 (LIC-2)	総延長	893 m (コンクリート・ブロック造及び農業省規格コンクリート二次製品水路)
計		2,013 m

図 3-3-7 に示す様に、TDFと TF に潅漑水を搬送するために、支線用水路第 1 号の (1) 断面区間は導水勾配が 1/5,000 、(2) および (3) 断面区間は導水勾配が 1/3,000と緩い。支線用水路第 1 号は仮水準標高 99.07 m で、標高 88.80 m までの TDF と TF に潅漑用水を引継ぐ。一方、図 3-3-7 に示す様に、地形勾配によって、支線用水路第 2 号の (1) 断面区間は導水勾配が 1/2,000 、(2) 断面区間は導水勾配が 1/500、(3) 断面区間は導水勾配が 1/600 と急な導水勾配で設計する。(2) および (3) 断面区間は、農業省規格コンクリート二次製品水路 A-3 型を適用する。支線用水路第 1 号 (LIC-1) の水理計算は表 3-3-6 に、支線用水路第 2 号 (LIC-2)の水理計算は表 3-3-7 にそれぞれ表してある。

b) 小用水路

実証農場には、12 本の小用水路を計画し、その詳細を次節で述べてある。

(3) 用水路の標準断面

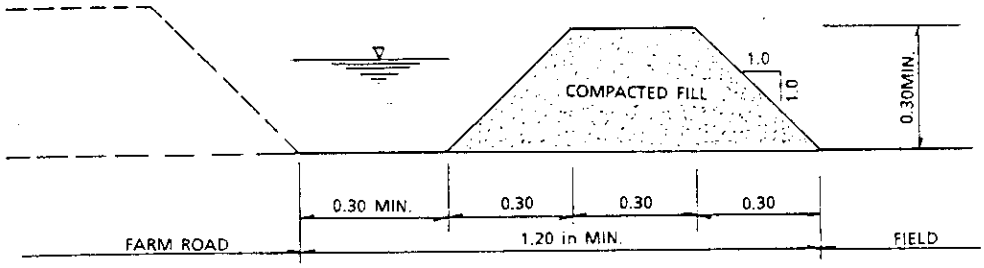
a) 支線用水路 (LIC)

支線用水路は、図 3-3-8 に示す様に二つのタイプ、即ち、コンクリート・ブロック型と農業省規格コンクリート二次製品に分けられる。両タイプとも鉄筋の入手が市場で困難なため、鉄筋を使用していない。薄いコンクリート・ライニング水路は代替タイプとして検討したが、水路用地が多くなるので採用しなかった。

b) 小用水路

維持管理の容易性と施工性を考慮して、1:1の側法勾配、天端巾30 cm、水路深さ最小30 cmの小用水路を計画した。支線用水路は舗装してあるが、小用水路は工事費の節減のために、水路からの漏水が考えられる高盛土区間や砂質土壌地域を除き、土水路とした。(図3-3-2参照)

図3-3-2　小用水路標準断面図



(4) 用水路の設計基準

- 適用公式

灌漑に必要な用水を通水する断面を決定するために、マニング公式を適用する。粗度係数は、コンクリート水路で0.015、土水路で0.030を用いた。

マニング公式　　$V = S^{1/2} \cdot R^{2/3} / n$

$Q = A \times V$

ここに：
v＝流速(m/sec)
S＝導水勾配(1/　　)
R＝径深(m)＝A/P
n ＝粗度係数
Q＝流量(m^3/sec)
A＝通水断面積(m^2)
P＝潤辺(m)

- 最大許容流速

最大流速はコンクリート舗装水路で1.5 m/sec、土水路で0.8 m/secとするが、代掻用水のような一時的な用水には、この1.5倍まで許容する。

- 最小許容流速

農業技術ハンドブックの水路(No.1)の設計基準によると次の様な最小許容流速が決められている。

a) 堆砂を起こさない流速

シルト以上の粒径の流砂を含む水の場合。

v = 0.45 ~ 0.90 m/sec

b) 草を生やさない流速

v = 0.70 m/sec以上

支線用水路第1号は98.8 mのTDFやTF地区を灌漑するために緩やかな勾配となっているので、特に、CAPIC地域にこの流速を適用することは困難である。そ

れ故、この設計では最小流速を 0.3 m/sec とする。堆砂や草の生えることは避け難いので、水路の堆砂や草取り等の維持作業が必要となる。CAPIC 地区のアヒ・ルード導水路の流砂はシルトからなるので、堆砂を取り除く沈砂池の建設は必要ないであろう。

- フリーボード

効率的な維持管理を行うために適切なフリーボードが必要である。十分なフリーボードがない用水路は、維持管理ミスによる越水によって堤塘が容易に破壊される。しかしながら、過大なフリーボードは用水路建設工事費の増大を招く。支線用水路と小用水路のフリーボードを次のように決定する。

フリーボード = 0.05 × d + hv + (0.05~ 0.15) (m)

ここに : d = 水深 (m)
hv = 速度水頭 (m)

これに基づき、フリーボードは以下のように定める。

支線水路 : コンクリート・ブロック水路 = 13 cm
農業省規格コンクリート二次製品水路 = 7 cm

小用水路 : 5 cm 、しかし、代掻時では 3 cm

(5) 用水路の諸元

以上の基本諸元に基づいて、各小用水路の計画諸元を表 3-3-4 のように決定した。

3.3.4. 附帯構造物の設計

(1) チェック

実証農場内に、水路の水位を調節する目的で 7 ヶ所のチェックを計画する。添付設計図「支線用水路第 1 号と第 2 号の縦断図」にその計画位置を示した。支線用水路第 2 号は急勾配のため 5 ヶ所のチェックを計画する。

(2) 分水工

小用水路に潅漑用水を分水するために、12 ヶ所の分水工を小用水路の始点に計画する。分水工は 40 cm 巾を持ち、維持管理を容易にするために5cm の分水ヘッドで計画する。

(3) 排水路放水工

用排兼用システムが実証農場で行う場合、潅漑用水を排水路に分水するために排水路放水工を計画する。支線用水路第 1 号と第 2 号及び小用水路第 8 号に、それぞれ、3 ヶ所、3ヶ所及び1 ヶ所計画した。

(4) パーシャル・フリューム

用水路の通水量を計測するために、2ヶ所の1.5ft型パーシャル・フリュームを、支線用水路第1号と第2号が分岐する地点に計画する。1.5ft型パーシャル・フリュームは支線用水路において常に完全越流状態で操作できる事を考慮し、損失水頭を少なくするために選定した。1.5ft型パーシャル.フリュームの流量計算式は以下の通りである。

$$Q = 1.056\,Ha^{1.538}$$

ここに； Q = 流量 (m^3/sec)
Ha= 収縮断面の水深 (m)

(5) 余水吐

潅漑システムの安全のために、2ヶ所の余水吐を計画した。その1つ(余水吐1-1)は支線用水路第1号の始点に、他の1つは支線用水路第1号の測点No.9+43地点、ピテ・ルードの横断構造物の約180m上流に、余剰水を排除するために計画した。計画流量の計算式を以下に示す。

$$Q=\{2\sqrt{(2g)}\}/3.\ \gamma.L\{(h1+h2)/2\}^{1.5}$$

ここに：Q = 越流量(m^3/sec)
L = 越流提の長さ(m)
γ = 流量係数
h1 = 上流水深 (m)
h2 = 下流水深 (m)

余水吐1-1の場合

Q=0.279 m^3/sec

(アヒ・ルード導水路の満水量0.462 m^3/sec - 支線用水路第1号の計画通水量 0.183 m^3/sec = 0.279 m^3/s)

h1 = 0.20 m (EL 99.78 - 99.65)
h2 = 0.0 m
故に L= 4.64 m (約 5.0 m)

余水吐1-2の場合

Q=0.144 m^3/sec
h1 = 0.13 m (フリーボード)
h2 = 0.0 m
故に L= 5.15 m (約 5.0 m)

(6) ピテ・ルードサイフォン

ピテ・ルードサイフォンは潅漑用水をピテ・ルードを越してTDFとTFに搬送するために、コンクリートパイプ径400mmで計画する。

(7) 分水口

計画耕区には分水水頭最低20cmで、30m間隔で様々な分水口が計画できる。本計画では現況水路に使用されているような最も簡単な構造の分水口を計画する。小用水路の分水口

地点で、各々の農民自身によって、十分な水管理を行うことは難かしい。良い水管理の実施を考慮すると、農民を教育し、水利組合の設立をすべきである。この水管理に関する普及がなされた後に、費用の掛かる分水口を導入する。図3-3-9には分水口の例を添付してある。

表 3-3-1 用水路の通水量(代掻期最大)

NAME OF CANAL	OPERATED UNDER IRRIGATION EXCLUSIVELY		OPERATED UNDER IRRIGATION-CUM-DRAINAGE	
	AREA (ha)	DISCHARGE (lit/sec)	AREA (ha)	DISCHARGE (lit/sec)
Ahi Rud				
Capic Branch	56.82	183	56.82	183
LIC-1 (1)	56.82	183	56.82	183
(2)	36.89	147	35.30	144
(3)	35.30	144	35.30	144
(4)	32.42	139	35.30	144
(5)	26.71	128	29.37	133
	21.73	119	23.90	123
LIC-2 (1)	19.93	116	21.52	119
	17.98	113	17.98	113
(2)	14.74	107	14.74	107
(3)	6.03	91	10.93	100
ID-1	1.59	39	-	-
ID-2	2.88	71	-	-
ID-3	3.05	75	-	-
ID-4	2.66	65	-	-
ID-5	2.81	69	-	-
ID-6	2.17	53	-	-
ID-7	1.95	48	-	-
ID-8	1.16	28	3.24	79
ID-9	2.08	51	-	-
ID-10	3.81	87	-	-
ID-11	4.90	89	-	-
ID-12	6.03	91	-	-

Note) This table is derived by the equation below.

Q = A1 * 24.5 lit/sec/ha (lit/sec)
Q = 86.9 lit/sec + (A2 - 3.55) * 1.734 lit/sec/ha (lit/sec)

A1 : Irrigation area less than 3.55 ha

A2 : Irrigation area more than 3.55 ha

212 mm * 10,000 / 86,400 = 24.5 lit/sec/ha

15.5 mm * 10,000 / 86,400 = 1.794 lit/sec/ha 1.734

1.794

表 3-3-2 用水路の通水量(常時最大)

NAME OF CANAL		OPERATED UNDER IRRIGATION EXCLUSIVELY		OPERATED UNDER IRRIGATION-CUM-DRAINAGE	
		AREA (ha)	DISCHARGE (lit/sec)	AREA (ha)	DISCHARGE (lit/sec)
Ahi Rud Capic Branch		56.82	116	56.82	116
LIC-1	(1)	56.82	116	56.82	116
	(2)	36.89	76	35.30	72
	(3)	35.30	72	35.30	72
	(4)	32.42	66	35.30	72
	(5)	26.71	55	29.37	60
		21.73	45	23.90	49
LIC-2	(1)	19.93	41	21.52	44
		17.98	37	17.98	37
	(2)	14.74	30	14.74	30
	(3)	6.03	12	10.93	22
ID-1		1.59	3.3	-	-
ID-2		2.88	5.9	-	-
ID-3		3.05	6.3	-	-
ID-4		2.66	5.5	-	-
ID-5		2.81	5.8	-	-
ID-6		2.17	4.4	-	-
ID-7		1.95	4.0	-	-
ID-8		1.16	2.4	3.24	6.6
ID-9		2.08	4.3	-	-
ID-10		3.81	7.8	-	-
ID-11		4.90	10	-	-
ID-12		6.03	12	-	-

Note) The ordinary maximum discharge appears in later half of July,
Discharge of ordinary maximum can be computed as follows :

$Q = 2.05 * A$

Q : Ordinary maximum discharge of canal (lit/sec)
A : Irrigation area of canal (ha),
2.05 : Unit water requirement at ordinary maximum (lit/sec/ha)

表 3-3-3 用水路の通水量(常時最小)

NAME OF CANAL	OPERATED UNDER IRRIGATION EXCLUSIVELY		OPERATED UNDER IRRIGATION-CUM-DRAINAGE	
	AREA (ha)	DISCHARGE (lit/sec)	AREA (ha)	DISCHARGE (lit/sec)
Ahi Rud Capic Branch	56.82	99	56.82	99
LIC-1 (1)	56.82	99	56.82	99
(2)	36.89	65	35.30	62
(3)	35.30	62	35.30	62
(4)	32.42	57	35.30	62
(5)	26.71	47	29.37	51
	21.73	38	23.90	42
LIC-2 (1)	19.93	35	21.52	38
	17.98	31	17.98	31
(2)	14.74	26	14.74	26
(3)	6.03	11	10.93	19
ID-1	1.59	2.8	-	-
ID-2	2.88	5.0	-	-
ID-3	3.05	3.2	-	-
ID-4	2.66	1.4	-	-
ID-5	2.81	4.9	-	-
ID-6	2.17	6.8	-	-
ID-7	1.95	3.4	-	-
ID-8	1.16	2.0	3.24	5.7
ID-9	2.08	3.6	-	-
ID-10	3.81	6.7	-	-
ID-11	4.90	8.6	-	-
ID-12	6.03	11	-	-

Note) The ordinary minimum discharge appears in later half of August just begore harvesting. Discharge of the ordinary minimum can be computed as follows :

$Q = 1.75 * A$

Q : Ordinary minimum discharge of canal (lit/sec)

A : Irrigation area of canal (ha),

1.75 : Unit water requirement at ordinary maximum (lit/sec/ha)

表 3-3-4 小用水路

Name of Irri. Ditch	Irri. Area (ha)	Design Discharge (lit/sec)	Length (m)	Hydraulic Gradient (1/)	Roughness Coefficient	Size of Irrigation Ditch			Design Velocity (m/sec)
						Bottom (B, cm)	Flow Depth (FD, cm)	Canal Depth (H, cm)	
ID-1	1.59	31.1 / 3.3	173	1/250	0.030	30	16	30	0.44
ID-2	2.88	56.4 / 5.9	271	1/300	〃	30	22	30	0.48
ID-3	3.05	59.7 / 6.3	286	1/350	〃	30	24	30	0.46
ID-4	2.66	52.1 / 5.5	282	1/450	〃	30	24	30	0.41
ID-5	2.81	55.0 / 5.8	291	1/400	〃	30	24	30	0.43
ID-6	2.17	42.5 / 4.4	293	1/350	〃	30	20	30	0.42
ID-7	1.95	38.2 / 4.0	149	1/450	〃	30	20	30	0.38
ID-8	1.16	63.4 22.7 / 2.4	340	1/900 1/150	〃	40 30 30	29 18 11	40 30 30	0.54 0.25 0.49
ID-9	2.08	40.7 / 4.3	208	1/750 1/100	〃	30 30	24 14	30 30	0.32 0.66
ID-10	3.81	70.077.8	286	1/500	〃	30	28	35	0.42
ID-11	4.90	71.9 / 10.2	459	1/500	〃	30	29	35	0.42
ID-12	6.03	74.0 / 12.4	447	1/400	〃	30	28	35	0.46
Total	35.09		3,485						

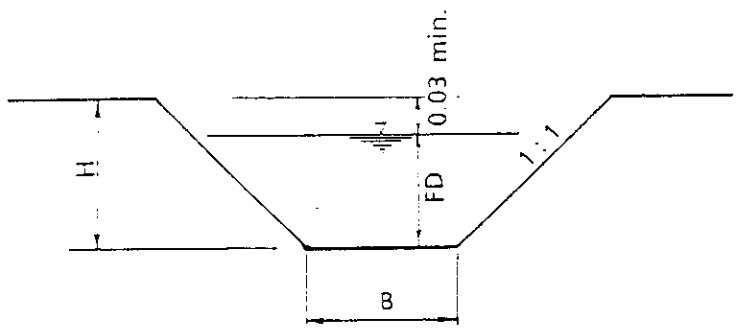


表 3-3-5　CAPICの用水量

Month			Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Reference Crop Evapo.(ETo mm/mon)			62	93	136	165	164	146	105	
Cropping Pattern				Nursery	Land preparation & Transplanting			End of Irrigation	Harvesting	
Water Requirement	Crop Coefficient (kc)			Nursery		1.1	1.2	0.95		
	Period (days)				15	30	15 16	15 16		
	Nursery	(mm)		14	5					19
	Land Preparation	(mm)			162					162
	Crop Water Requirement	(mm)			75	182	189	157		603
	Percolation	(mm)			105	210	217	217		749
Total	○	(mm)		14	347	392	406	374		1,533
Rainfall (50 % Prob.)	r	(mm)	63	44	25	28	30	46	75	
	re	(mm)	47	33	19	21	23	35	56	
Net Irrigation Requirement	In	(mm)		0	328	371	383	339		1,421
Irrigation Requirement	Ir	(mm)		0	429	485	500	443		1,857

Note)
1. Cropped period is selected as in the Middle Land taking location of CAPIC into consideration
2. Requirement of nursery refers to the Master Plan.
3. Land preparation water refers to Pudding water in case of separate irrigation system.
4. Percolation is dapreding on 7 mm/day in case of separate irrigation system.
5. Rainfall refers to 50 % probability in the Master Plan.
6. In = Wr - re, Ir = In/E = In / 0.765

0.765.

表 3-3-6 支線用水路第 1 号水理計算

Station	Distance (m)	Incremental Distance	Structure	Q (cu.m/s)	Canal Slope	V (m/s)	Head loss (m)	Water Level (m)	Depth (m)	Canal Bed (m)
			Air Rud Branch	0.183	1/1,000	0.73		99.58	0.35	99.23
No.0	(Note)	Designed to check up by 0.07m						99.65	0.42	99.23
		286.25	LIC - 1 (1)	0.183	1/5,000	0.37	0.06			
No.2 + 86.25	286.25							99.59	0.45	99.14
		5.027	LIC - 1 (2)	0.144	1/5,000	-	0			
		(Note)	Same Section as LIC - 1 (1)							
No.2 + 91.307	291.307							99.59	0.45	99.14
		2.943	1.5 ft Parshall Flume	0.144	-	-	0.10			
No.2 + 294.25	294.25							99.49	0.42	99.07
		653.75	LIC - 1 (2)	0.144	1/3,000	0.42	0.22			
No.9 + 48	948.00							99.27	0.42	98.85
		1.00	Check Gate 1-2	0.119	-	-	0			
No.9 + 49	949.00							99.27	0.37	98.90
		156.00	LIC - 1 (3)	0.119	1/3,000	0.40	0.05			
No.11 + 5 (IP8)	1,105.00							99.22	0.37	98.85
		15.00	Syphon (ø400)	0.119	-	0.95	0.10			
No.12 + 20	1,120.00							99.12	0.37	98.75
		160.00	LIC -1 (3)	0.119	1/3,000	0.40	0.05			
No.12 + 80	1,280.00							99.07	0.37	98.70

Note)

1. Head loss of 1.5 ft Parshall Flume. (refer to "Water Measurement Manual", USBR)

$Q = 1.056\ ha^{1.538}$

Where :

Q : discharge (cu.m/sec) = 0.144 cu.m/sec

ha : depth at gaging point in the converging section (m)

$ha = (Q/1.056)^{1/1.538} = 0.274$ m

$h_{loss} = 0.3 * ha$

h_{loss} = required minimum head loss for free flow(m)

$h_{loss} = 0.3 * 0.274 * 0.082 = 0.10$ m

2. Head loss of syphon

1) Friction loss

$$hf = L * i = L * 10.57 * C^{-1.85} * D^{-4.87} * Q^{1.85}$$
$$= 14.25 * 10.57 * 130^{-1.85} * 0.40^{-4.87} * 0.119^{1.85}$$
$$= 14.25 * 0.0022 + 0.032\ m \cdots\cdots \text{Hazen-Williams}$$

i : hydraulic gradient

L : length of pipe (m)

C : coefficient of concrete pipe

Q : discharge (cu.m/sec)

2) Head loss of entrance

$hen = fen * hv = 0.5 * 0.046 = 0.023$ m

fen : coefficient of entrance loss

fv : velocity head (m)

$fv = v^2/2g = (Q/A)2/2g = 90.119/(\pi * 0.5^2 * 0.25))^2/19.6$

3) Head loss of exit

$hex = fex * hv = 1.0 * 0.046 = 0.046$ m

hex : coefficient of exit loss

4) Total head loss

$h = hf + hen + hex = 0.032 + 0.023 + 0.046 = 0.101$
$= 0.10$ m

表 3-3-7　支線用水路第２号水理計算

Station	Distance (m)	Incremental Distance	Structure	Q (cu.m/s)	Canal Slope	V (m/s)	Head loss (m)	Water level (m)	Depth (m)	Canal Bed (m)
No.0	0							99.59	0.45	99.14
		3.657	B 1.1, H 0.60	0.119	1/2,000	-	0.00			
No.0 + 3.657	3.657							99.59	0.45	99.14
		2.594	1.5 ft Parshall Flume	0.119	-	-	0.11			
No.0 + 6.60	6.60							99.48	0.36	99.12
		193.40	LIC - 2 (1)	0.119	1/2,000	0.47	0.10			
No.2	200.00							99.38	0.36	99.02
		0	Transition	0.107	1/2,000	-	-			
No.2	200.00							99.38	0.25	99.13
		368.50	LIC - 2 (2)	0.107	1/500	0.82	0.74			
No.5 + 68.5	568.50							98.64	0.25	98.39
		324.50	LIC - 2 (3)	0.100	1/600	0.76	0.54			
No.8 + 93.0	893.00							98.10	0.25	97.85

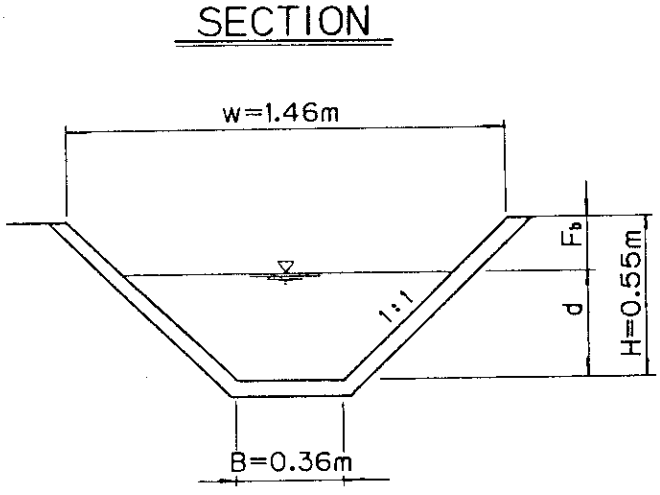
Note)　Head loss of 1.5 ft Parshall Flume

$ha = (Q / 1.056)^{1/1.538} = 0.242$ m

$h_{loss} = 0.3 * ha = 0.3 * 0.242 = 0.073 = 0.11$ m

h_{loss} is set at 0.11 m taking minimum discharge measurement into consideration

図 3-3-3　CAPICのアヒ・ルード導水路の通水量



Hydraulie Elements
Slope of Canal : i = 1/1000
Roughness coefficent
: n = 0.014

$v = \sqrt{i}\,/\,n\,R^{2/3}$, $Q = v \cdot A$ ····· (Manning Eguation)
v = mean velocty (m/sec)
Q = discharge (m^3/sec)
R = hydraulic mean depth (m)
R = A/P
A = flow area (m^3)
P = wetted perimeter (m)

d	$\sqrt{i}/n$	A (m^2)	P (m)	R (m)	v (m/s)	Q (m/s)	Fb (m)	Remarks
0.20	2.259	0.112	0.926	0.121	0.553	0.062	0.35	
0.25	〃	0.153	1.067	0.143	0.617	0.094	0.30	
0.30	〃	0.198	1.209	0.164	0.676	0.134	0.25	
0.35	〃	0.249	0.350	0.184	0.731	0.183	0.20	Original design
0.36	〃	0.259	1.378	0.188	0.742	0.192	0.20	in case reducing Fb
0.37	〃	0.270	1.407	0.192	0.752	0.203	0.19	
0.38	〃	0.281	0.435	0.196	0.762	0.214	0.18	
0.40	〃	0.304	0.491	0.204	0.782	0.238	0.15	

Free board (Fd) is seccomended as follows ;
Fb = 0.05d + hv + (0.05~0.15)for lined or non-lined canal.
Fb = 0.05 × 0.35 + 0.02 + (0.05~0.15) = 0.02 + 0.02 + (0.05~0.15)
= 0.09~0.19 (m)

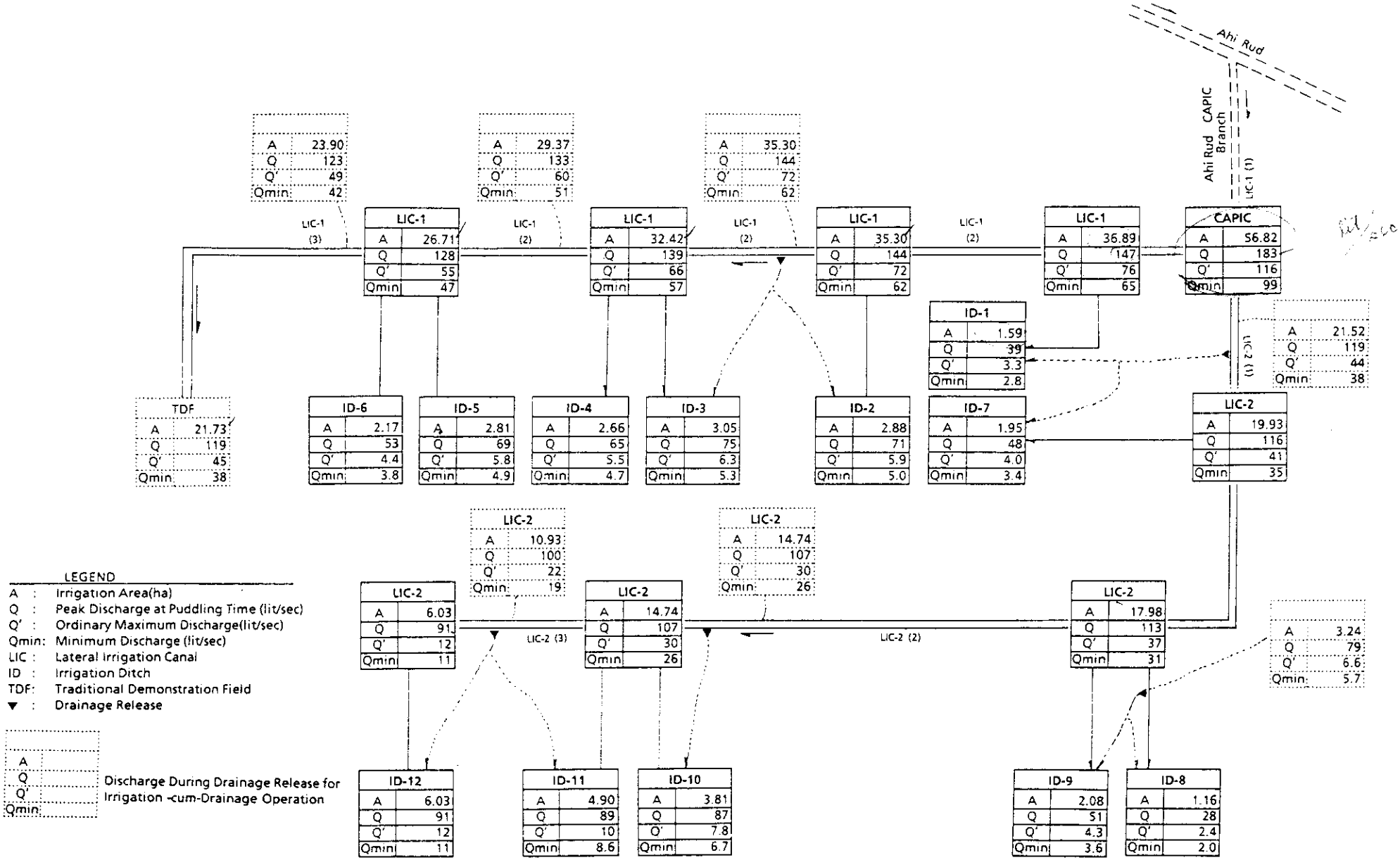
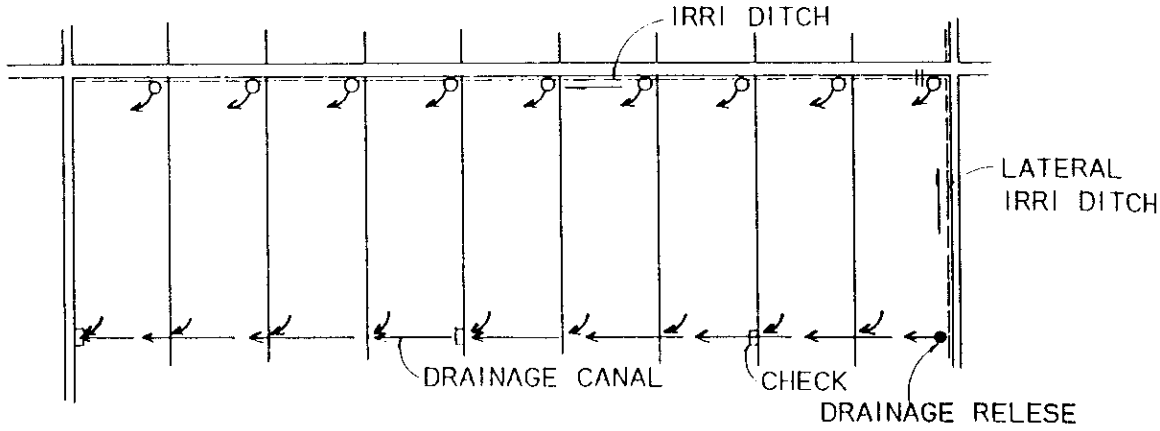
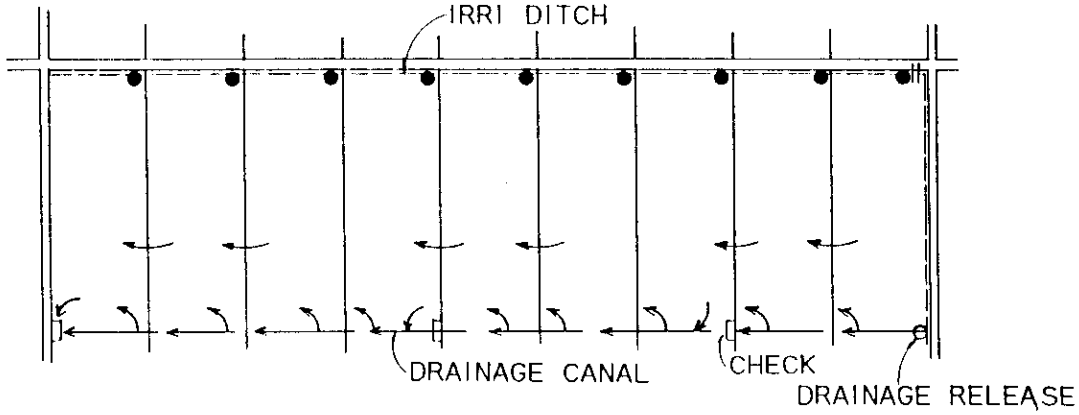


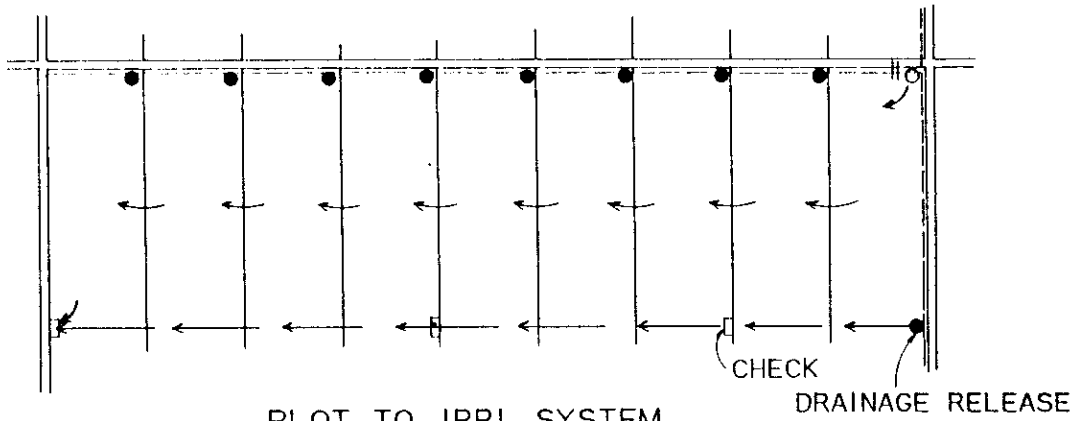
図 3-3-4　計画用水系統模式図



SEPARATE IRRI. and DRAINAGE SYSTEM



DUAL PURPOSE CANAL IRRI. SYSTEM



PLOT TO IRRI. SYSTEM

Note:

O OPEN

● CLOSE

図 3-3-5　CAPICで実施される潅漑システム

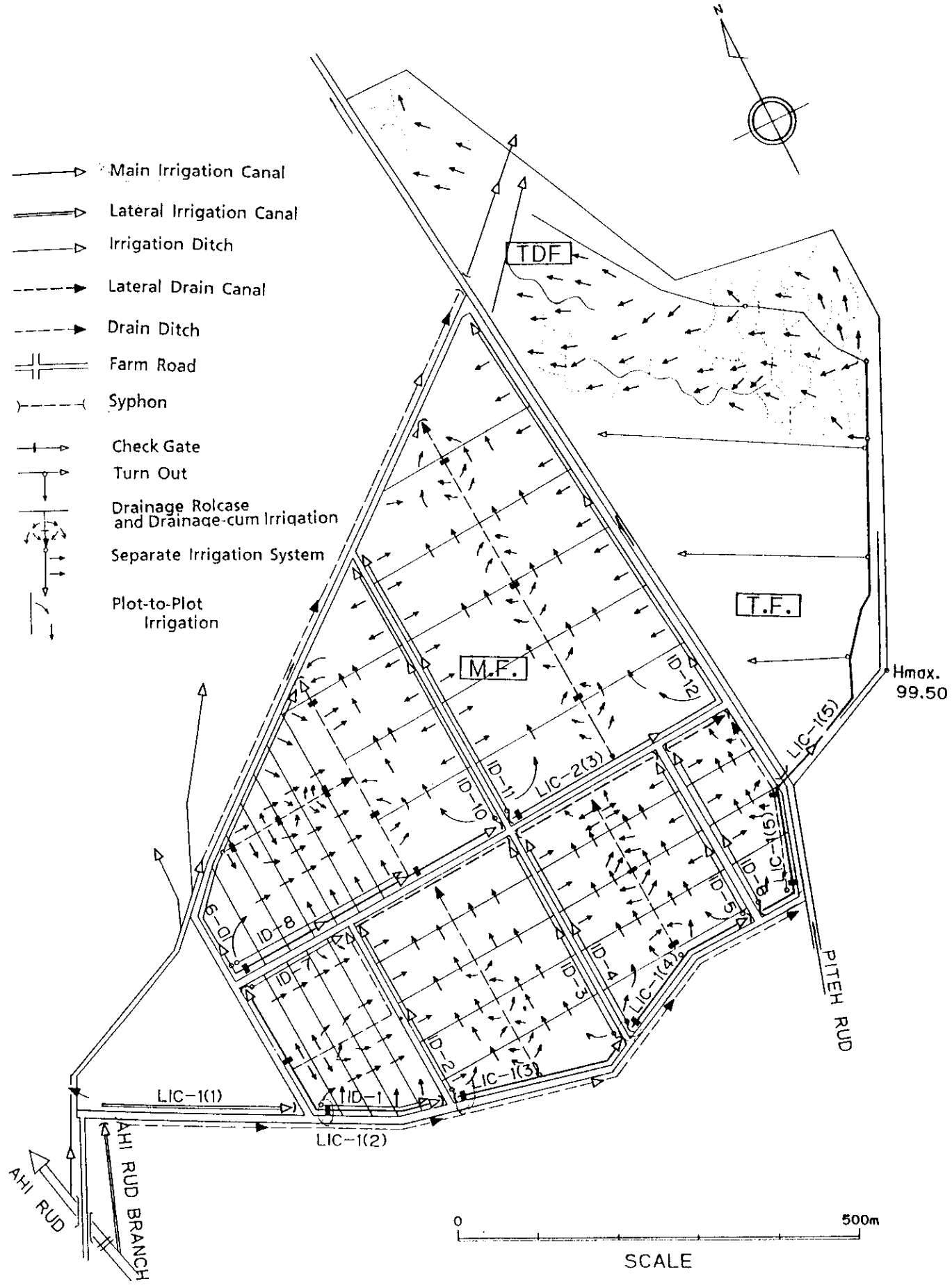
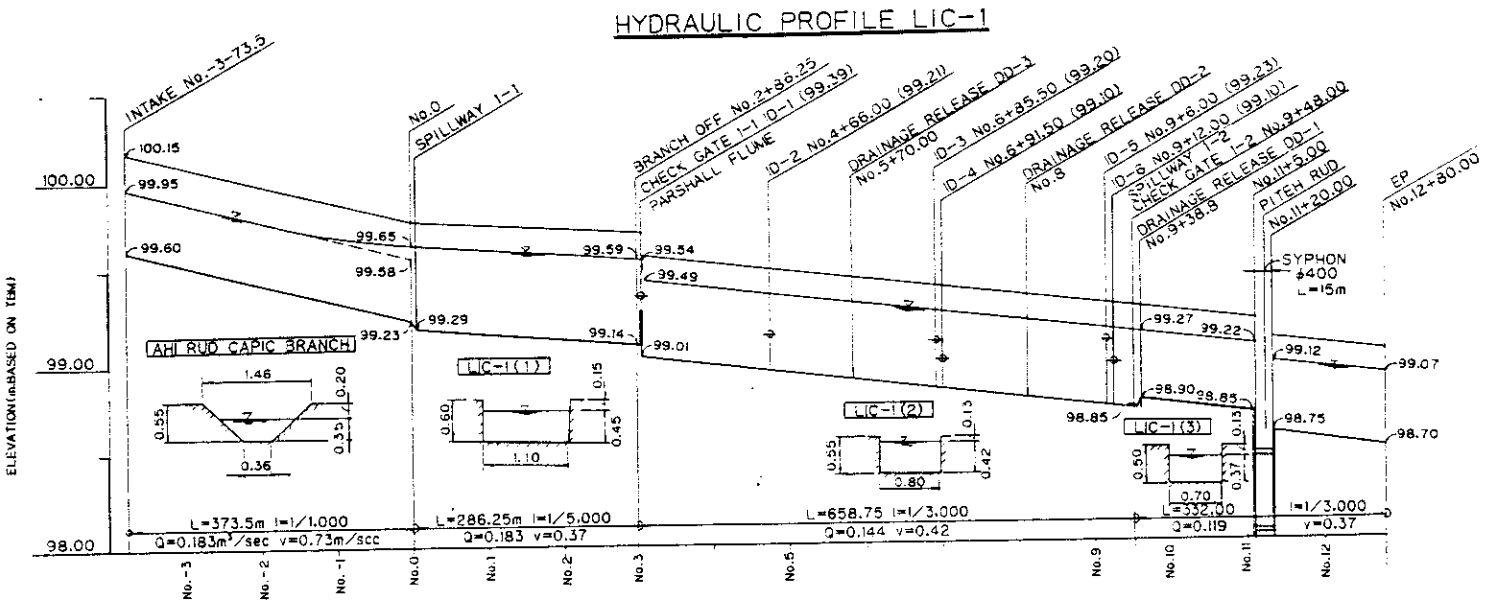
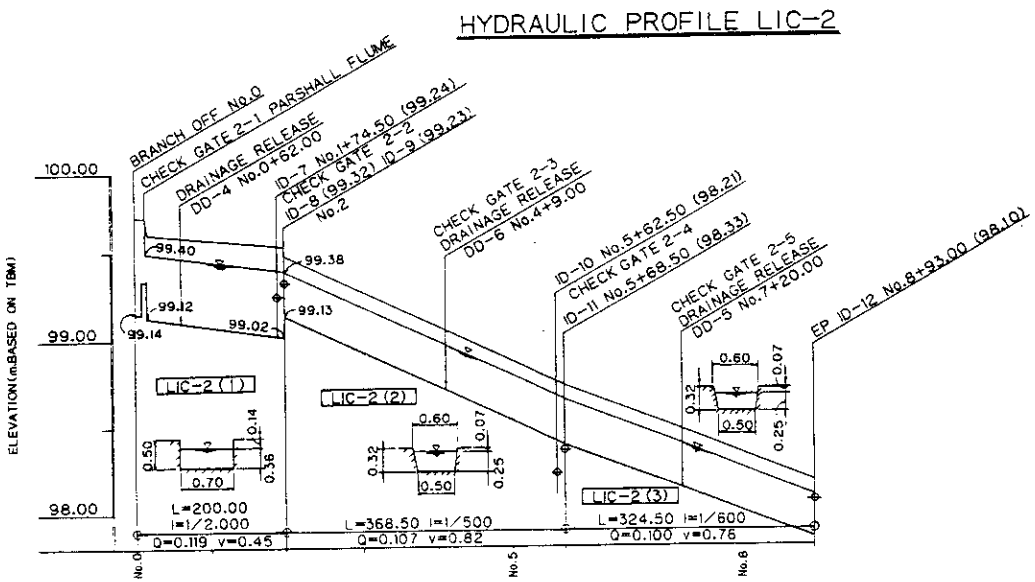
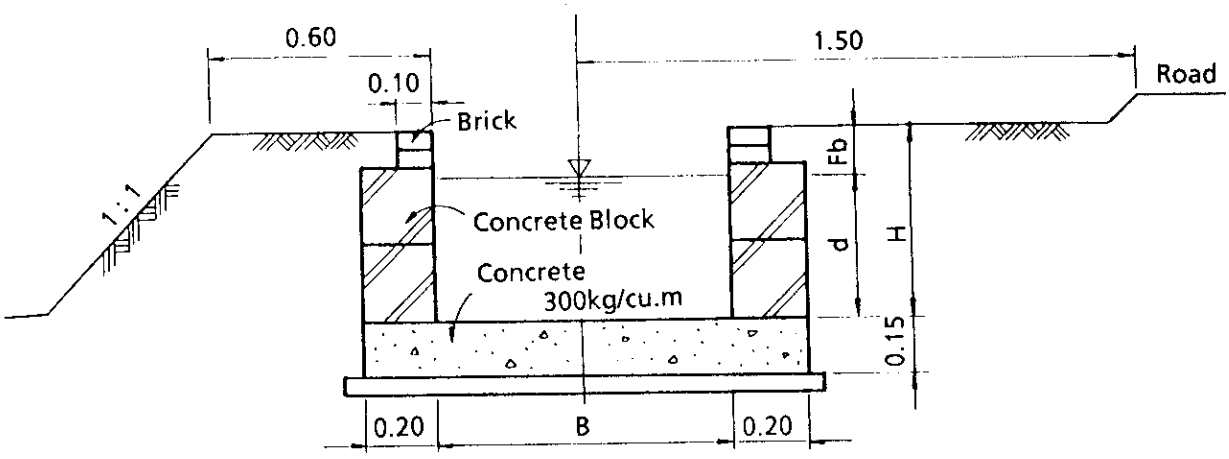


図 3-3-6　計画灌漑システム

図3-3-7　支線用水路第１及び２号水理縦断

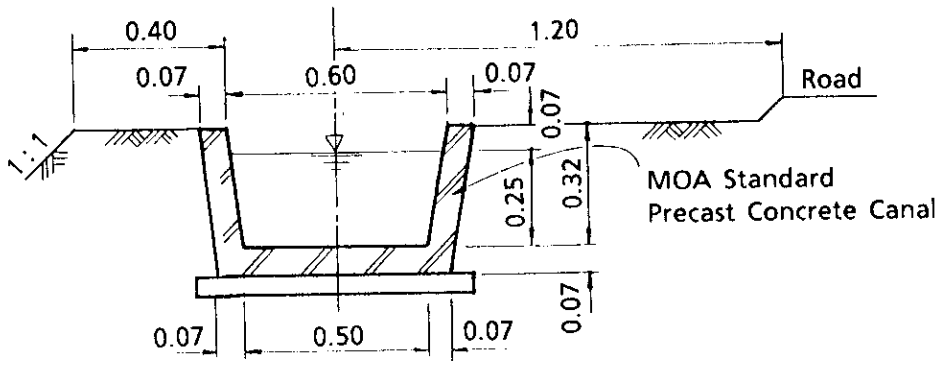






LIC	Q	i	B(m)	H(m)	d(m)	Fb(m)	v
LIC-1(1)	0.183	1/5000	1.10	0.60	0.45	0.15	0.37
LIC-1(2)	0.144	1/3000	0.80	0.55	0.42	0.13	0.42
LIC-1(3)	0.119	1/3000	0.70	0.50	0.37	0.13	0.37
LIC-2(1)	0.119	1/2000	0.70	0.50	0.36	0.14	0.45

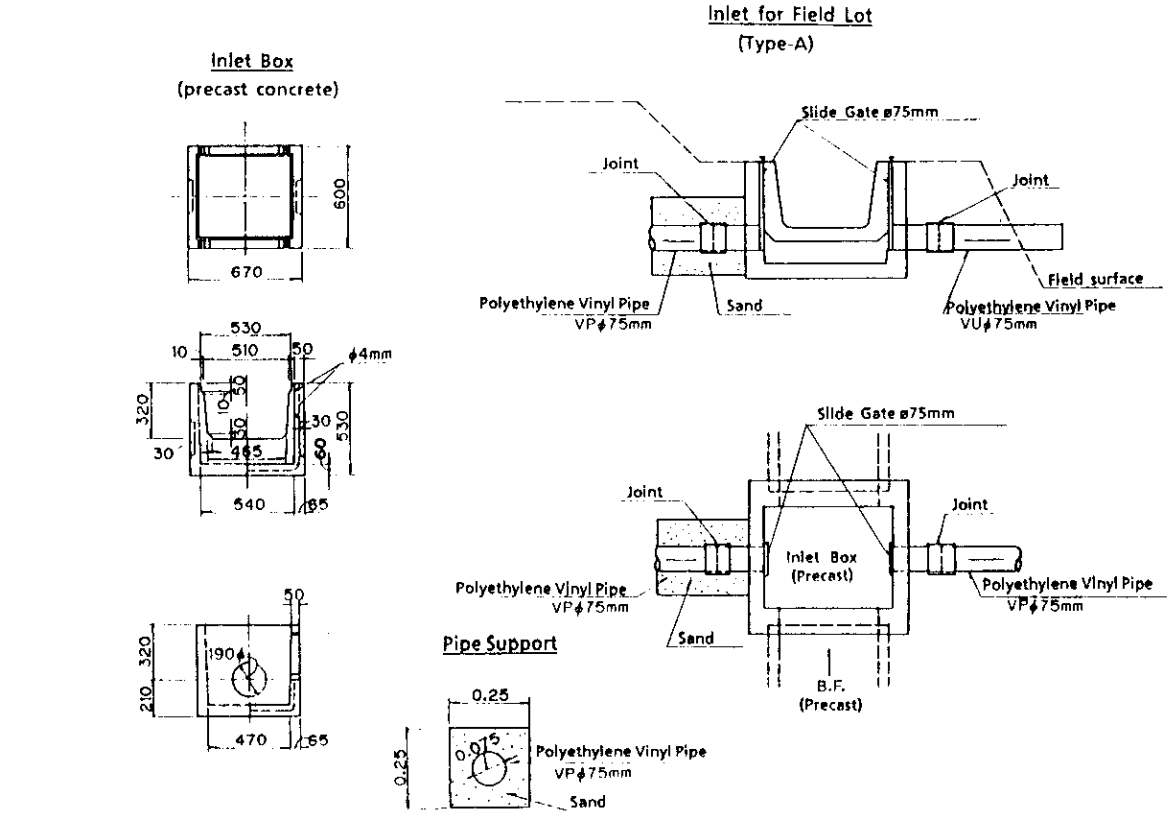
Note ; Q = m^3/sec, v = m/sec



LIC	Q	i	v
LIC-2(2)	0.107	1/500	0.82
LIC-2(3)	0.100	1/600	0.76

Note ; Q = m^3/sec, v = m/sec

図 3-3-8　支線用水路の標準断面



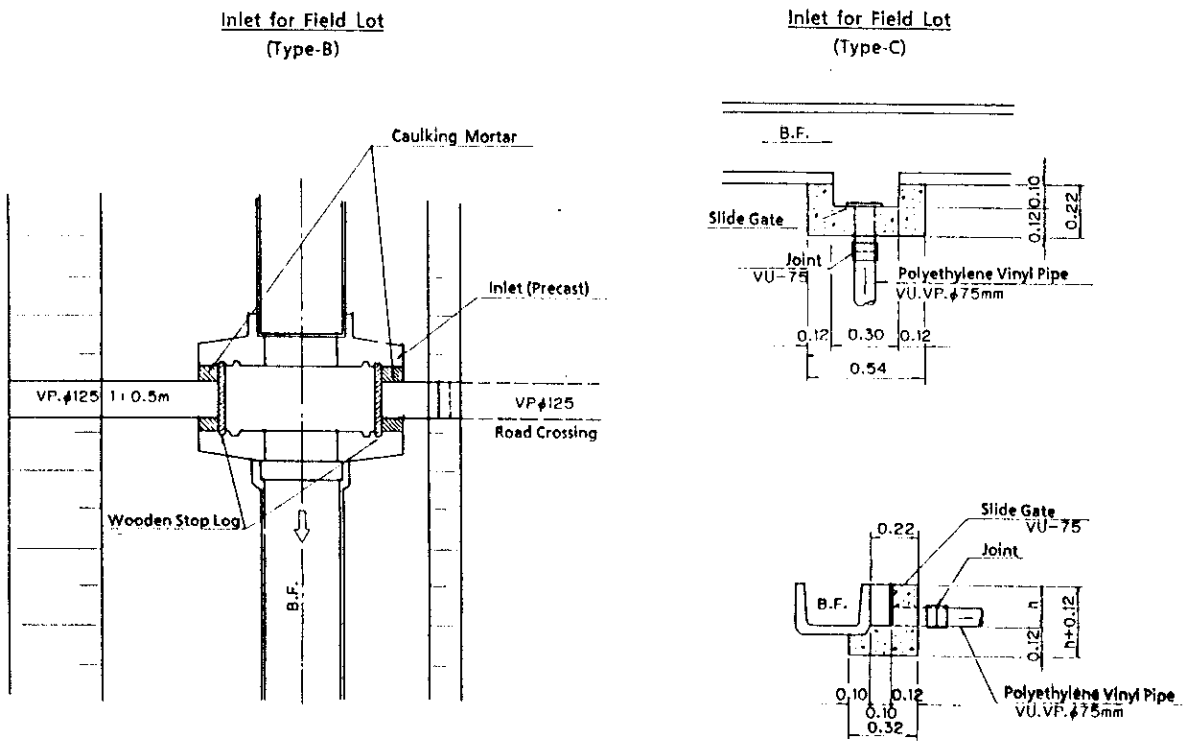


図3-3-9　将来の分水口の標準図

3.4. 排水施設計画

3.4.1. 排水計画

計画地区内では多くの降雨は主に9月から翌年3月の冬の期間に降る。マスタープランではベルシームが裏作として計画されているので、排水計画はこれらの条件を考慮した。水稲の生育期間には強い降雨は観測されないので、冬作物を考慮して排水計画を樹てた。

(1) 許容湛水期間

9月から翌年3月の冬作のベルシームの耐湛水性を考慮して単位排水量を決定する。農業省マザンダラン農業総局種子植物改良部(Seed Plant Improvement, Mazandaran General Department of Agriculture, MOA)の資料によると次のような生育状態が試験されている。

湛水期間	状　　態
2から3日間	8月中旬から10月中旬の発芽期間では被害がない
5から6日間	9月から3月の生育期間においては10 cmから15 cmの湛水では被害がない

(2) 計画降雨

2日降雨2日間排除と、5日降雨5日間排除の二つの降雨を排水計画の基礎諸元として検討し、排水の経済性を考慮して、次の確率1/5の降雨を適用した。

項　　目	計画降雨量	備　　考
2日雨量 5日雨量	118 mm/2-日(平均降雨強度118/2＝59mm/日) 167 mm/5-日(平均降雨強度167/5＝33mm/日)	採用

降雨による被害を少なくする事によって作物の生育の安全性を増すために、上記の平均降雨強度、59 mm/日を実証農場の排水施設の設計に採用する。

(3) 流出率

実証農場内の排水路については流出率0.8を、またピテ・ルード流域には流出率0.6を適用する。

(4) 単位排水量

計画降雨と流出率から次の単位排水量を適用する。

実証農場内の排水路 = 5.4 lit/sec/ha
ピテ・ルード = 4.1 lit/sec/ha (0.41m^3/sec/km^2)

(5) 計画排水量

a) ピテ・ルード

ピテ・ルードの流域面積は、CAPICの境界地点で8.3 km^2である。その結果、ピテ・ルードの計画洪水量は上記単位排水量と流域面積から3.4 m^3/secとなる。(図3-4-1参照)

$$Q = 0.41\ m^3/sec/km^2 \times 8.3\ km^2 = 3.4\ m^3/sec$$

b) 実証農場

建物用地を含む実証農場の総排水量は以下の通りである。

$$Q = 5.4\ lit/sec/ha \times 42.78\ ha = 231\ lit/sec$$

c) TDFとTF

$$Q = 5.4\ lit/sec/ha \times 22.87\ ha = 123\ lit/sec$$

(6) 地下水排水

3.14×10^{-3}から3.18×10^{-3}の高い透水係数を考慮すると、暗渠排水は必要がなく、90 cm深さの排水路を実証農場に計画する。

(表3-4-1と図3-4-2参照)

3.4.2. 排水系統模式図

前節3.4.1で述べたごとく、実証農場の排水路は二つの機能を持つ。潅漑期間、即ち水稲栽培期間では、余剰水や管理ロスの水を、CAPIC地区下流の農地で再利用するために、アヒ・ルードに排水する。裏作栽培のために冬の期間は実証農場の余剰水はできる限り早くピテ・ルードに排水する。

(図3-4-3参照)

3.4.3. 排水施設の設計

実証農場の排水組織の管理のために、排水施設として支線排水路や小排水路の水路と、排水暗渠や排水チェック構造物の様な附帯構造物を計画する。実証農場のある区域で行われる用排兼用システムで潅漑用に排水路の水位を調節するために、チェック構造物は重要となる。

(1) 排水路の配置

排水路による潰地を少なくするために、排水路は圃区と圃区の間に配置する。

(2) 排水路の形と規模

地区内の土性がシルトからシルト質ロームであるので、実証農場の排水路は全て土水路で、法勾配 1:1 の梯形水路で計画する。

(3) 排水路断面決定のための適用公式

支線排水路と小排水路の通水量を設計するためにマニング公式を用いる。

(4) 最大及び最小許容流速

水路の通水能力を決定するには最大許容流速を0.9 m/sec、最小許容流速を 0.3 m/sec を適用する。

(5) 最小の水路規模

前節 3.4.1 で述べたように地下水排除を考慮して、排水路は最小の底巾 0.3 m、最小深さ 0.9 mで計画する。

3.4.4. 附帯工の設計

(1) 排水暗渠

排水路と農道が交差する地点には排水暗渠工を計画する。この構造物は側法と水路底の防護工と最小口径 600 mm のパイプからなる。(表 3-4-2 参照)

(2) 排水チェック構造物

圃場整備後の用排分離システムは、時々、土性によって多大の潅漑用水を必要とする場合がある。この様な場合には、構造物の堰板チェックゲートの開閉によって地下水位を調節し、用水を節水する。この構造物は水稲栽培期間中に必要な調査を行ってから施工するものとする。しかし、構造物の堰板によるチェックゲートは雨期、すなわち冬期間は開けておかなければならない。構造物の上・下流は石張りで舗装し、チェックはコンクリート構造とする。(表 3-4-3 参照)

鋼製ゲートの例を図 3-4-5 に掲げ、チェック構造物の安定計算を次の頁に添付する。

表 3-4-1　CAPICの現場透水係数

Hole No	Hole Depth (cm)	Ground Water Depth From Ground Surface (cm)	Hydraulic conductivity (K) cm/sec	
1	-	-	-	Like No 13
2	163.0	100.0	$K=1.52\times10^{-2}$	
3	196.0	138.0	$K=1.84\times10^{-2}$	
4	204.0	148.0	$K=2.86\times10^{-2}$	
5	-	-	-	Like No 13
6	147.0	77.0	$K=1.22\times10^{-2}$	
7	142.0	46.0	$K=1.09\times10^{-2}$	
8	158.0	95.0	$K=3.18\times10^{-2}$	
9	190.0	149.0	$K=1.15\times10^{-2}$	
10	240.0	169.0	$K=1.29\times10^{-2}$	
11	176.0	68.0	$K=3.14\times10^{-3}$	
12	250.0	166.0	$K=8.87\times10^{-3}$	
13	-	-	-	There were hard material in the Hole It was not possible to continue.
14				
15	195.0	125.0	$K=1.78\times10^{-2}$	
16	184.0	116.0	$K=1.62\times10^{-2}$	
average max min	196.0 250.0 142.0	116.0	1.56×10^{-2} 3.18×10^{-2} 3.14×10^{-3}	

表 3-4-2　排水暗渠 B 型の安定計算

1) Calculation of Load equivalent to Soil Thickness(t)

Applied live load =T-10 ton load

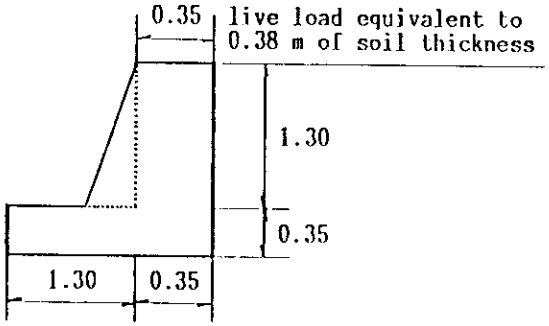
Load equivalent to soil thickness

Vehicle space B=2.75m. L=7.00m

Live load =10 ton/(2.75×7.00) ×(1+0.3) = 0.68ton/sq.m

Equivalent soil thickness(t)=0.68/1.8ton/cu.m=0.38m

2) Section of Inlet



3) Design of Wall

M (Moment by load)=1/2×K×H^2×1/3×H×γ

=1/2×0.3×$(1.3+0.38)^2$×1/3×(1.30+0.38)×1.8

=0.427t.m=42,700 kg.cm

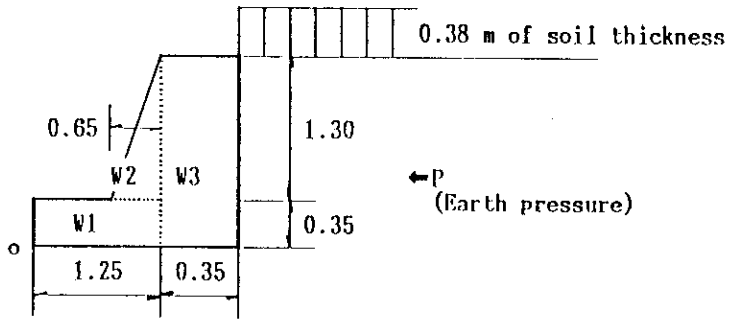
Allowable bending stress of concrete (σ_{cs})=2.5kg/sq.cm

Required section modulus(Zr)=M/σ_{cs}=42,700/2.5=17,080cm^3

Section modulus of the wall (z)

Z=bh^2/6=100×35^2/6=20,400cm^3 > Zr　OK

4) External Loads



5) Calculation of Moment

Equation	V	H	x	y	Vx	Hy
W1 1.25×0.35×2.3	1.01		0.63		0.64	
W2 0.65×1.3×1/2×2.3	0.97		1.03		1.00	
W3 0.35×1.65×2.3	1.33		1.43		1.90	
P 1/2×0.3×1.8×$(1.65+0.38)^2$		1.11		0.68		0.75
Total (Vo)	3.31	1.11			3.54	0.75

6) Safety against overturning

e=(Vx-Hy) / Vo - L / 2= (3.54-0.75) / 3.11 - 1.60 / 2=0.04

L / 6=0.27> e,　OK.

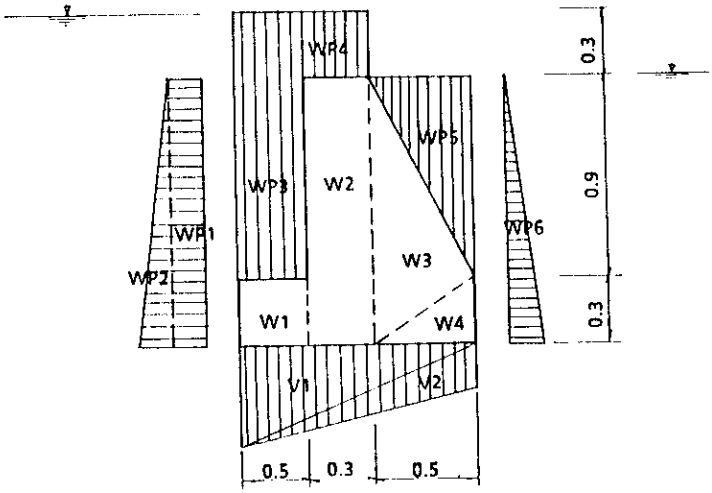
f = 3.54 × 0.75 = 4.7 > 1.2,　OK.

7) Safety against sliding

f = 3.31 × 0.7 / 1.11 = 2.1 > 1.2,　OK.

表 3-4-3　排水チェック構造物の安定計算

1)　Design Section



2)　Calculation of External Force

		Force		Arm length		Moment	
No.	Equation	V	H	x	y	Vx	Hy
W1	0.3×0.5×2.3	0.35	-	0.25	-	0.09	-
W2	0.3×1.2×2.3	0.83	-	0.65	-	0.54	-
W3	1.2×0.5×1.2×2.3	0.69	-	0.97	-	0.67	-
W4	0.3×0.5×1/2×2.3	0.17	-	1.13	-	0.19	-
WP1	0.3×1.2×1.0	-	0.36	-	0.60	-	0.22
WP2	1.2×1.2×1/2×1.0	-	0.72	-	0.40	-	0.29
WP3	0.5×1.2×1.0	0.60	-	0.25	-	0.15	-
WP4	0.3×0.3×1.0	0.09	-	0.65	-	0.06	-
WP5	0.9×0.5×1/2×1.0	0.23	-	1.13	-	0.26	-
WP6	1.2×1.2×1/2×1.0	-	-0.72	-	0.40	-	-0.29
U1	1.5×1.3×1/2×1.0	-0.98	-	0.43	-	-0.42	-
U2	1.2×1.3×1/2×1.0	-	-0.78	-	0.87	-	-0.68
	Total	1.98	-0.42			1.54	-0.46

3)　Safety against overturning

$e = |\Sigma M / \Sigma V - L/2| = |(1.54 - 0.46)/1.98 - 1.3/2| = 0.11$

$L/6 = 1.3/6 = 0.22$

Therefore;　$L/6 = 0.22 > e = 0.11$　OK.

4)　Safety against sliding

$|\Sigma H| = 0.42$, $\alpha \Sigma V = 0.7 \times 1.98 = 1.39$

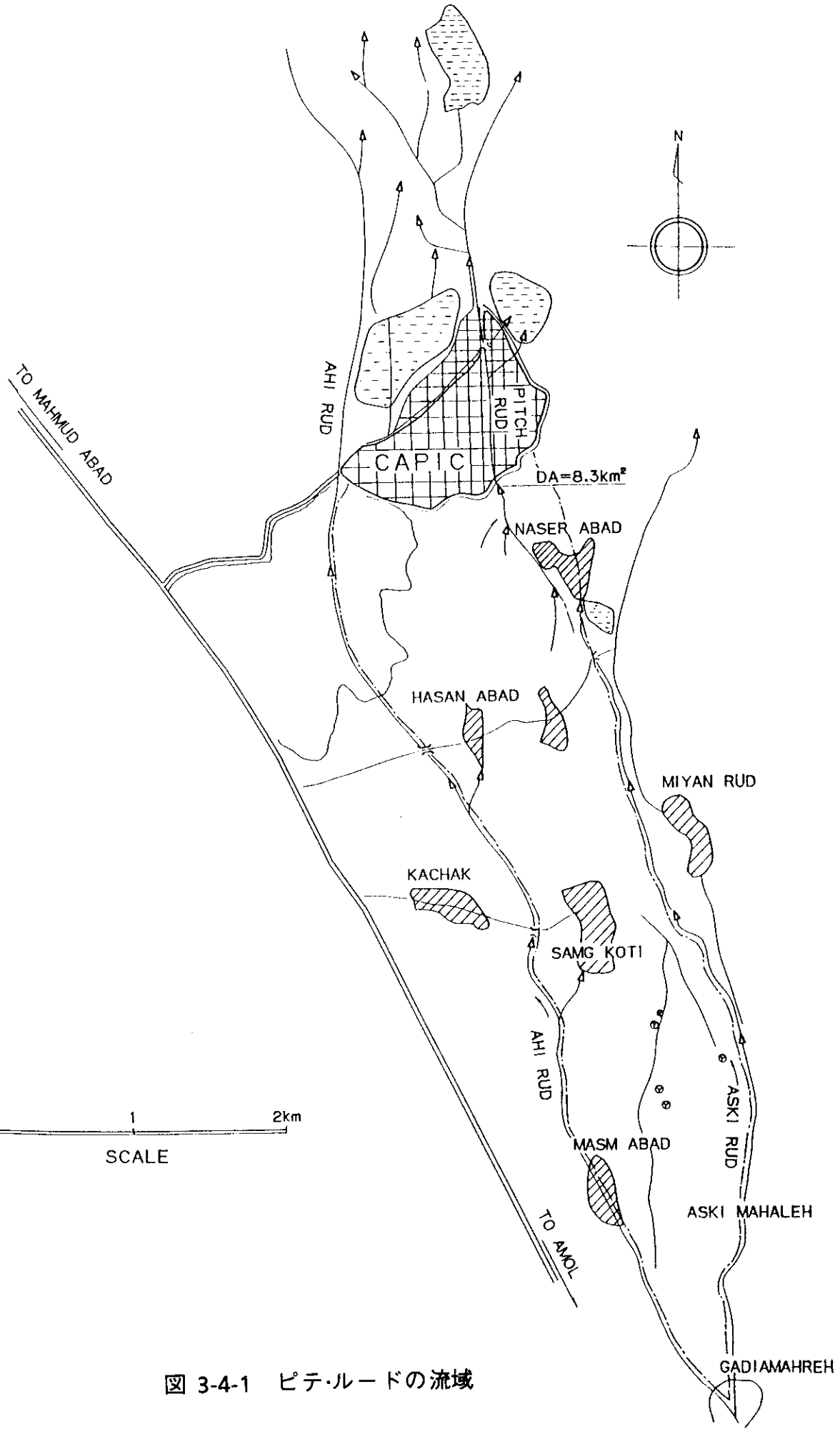


図 3-4-1　ピテ･ルードの流域

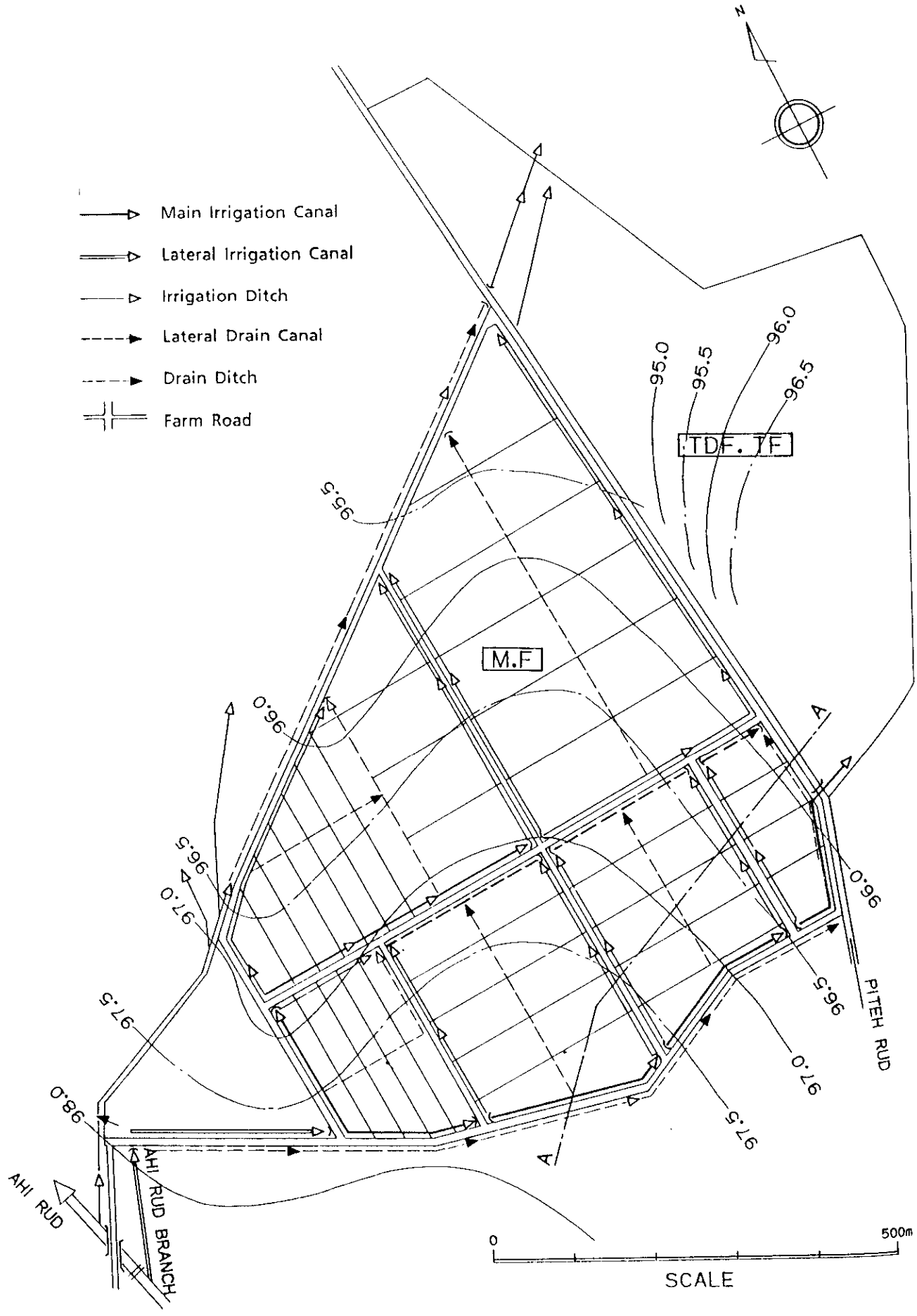
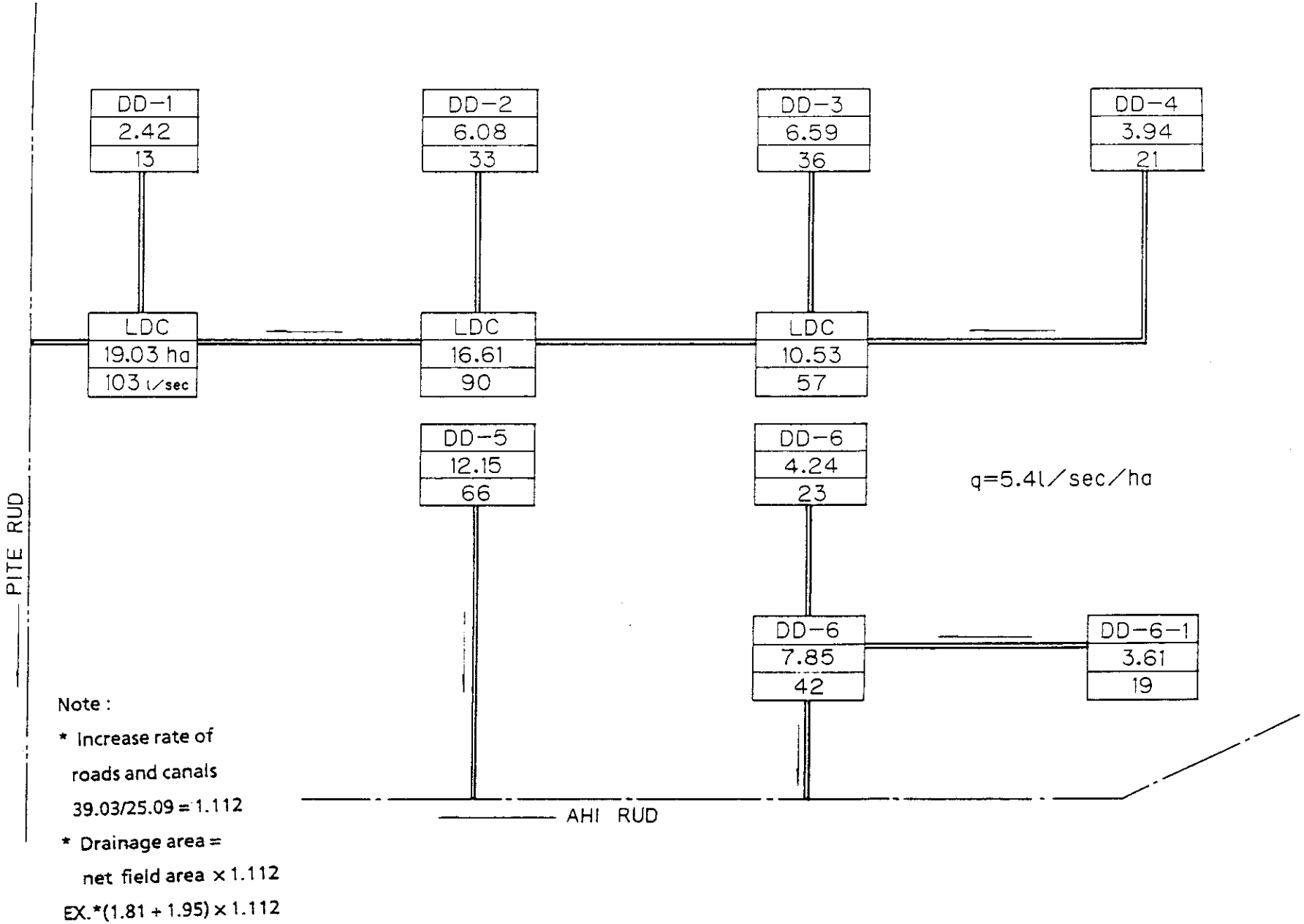
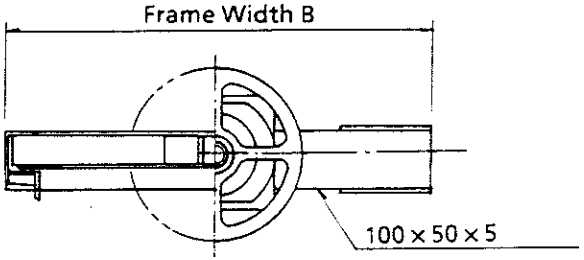


図 3-4-2　CAPICの地下水コンター図

図 3-4-3　計画排水系統図

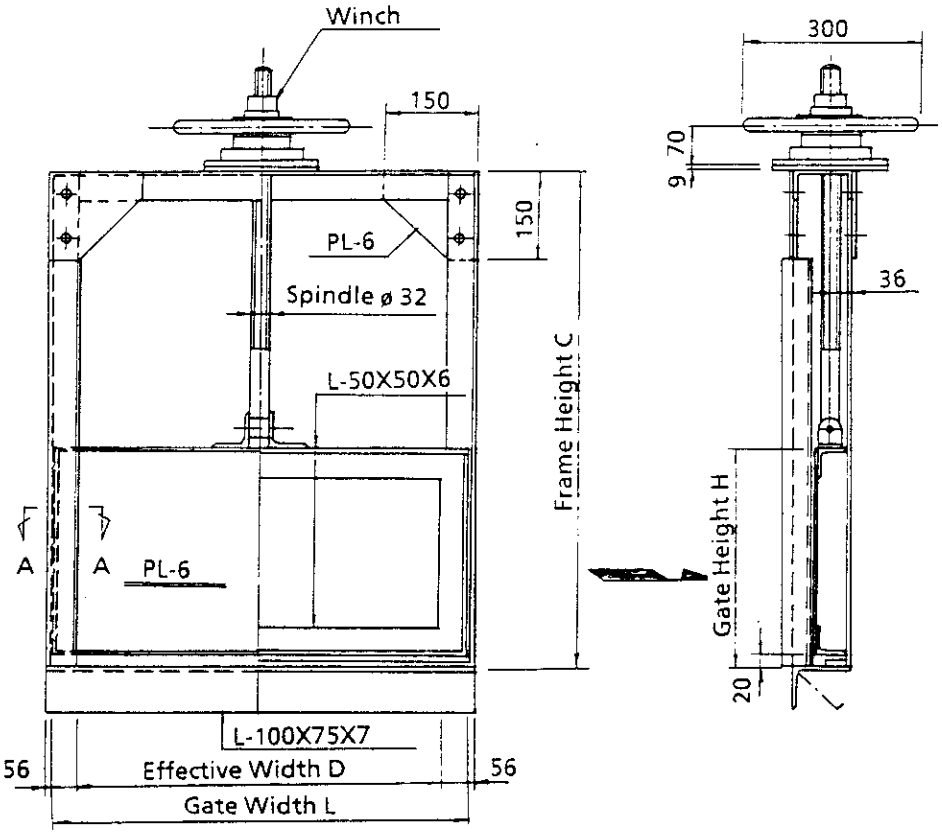


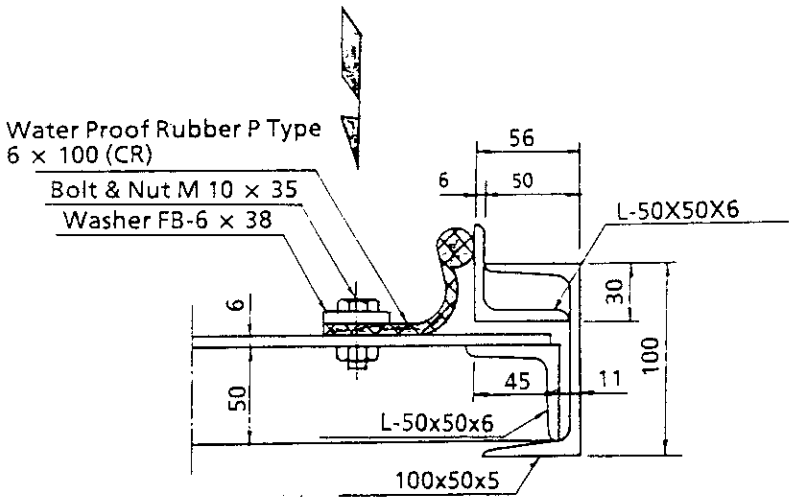


Dimension

D	L	H	B	C	Weight (kg)
500	590	320	612	740	71.45
550	640	355	662	810	81.65
600	690	380	712	860	86.45
650	740	415	762	930	92.65
700	790	440	812	980	97.65
800	890	450	912	1,000	103.75
900	990	500	1,012	1,100	130.85
1,000	1,090	550	1,112	1,200	149.55

(Unit: mm)





SECTION A - A

図 3-4-4　鋼製ゲートの標準図

3.5. 農道計画

3.5.1. 一　般

農地から、又は農地への農業生産資材の搬入や農産物の搬出は農道を通じて行われるという、農道は営農にとって重要な役割を果たす。圃場整備計画における道路網は国道や州道等や農区の大きさによって決められる。しかし、道路による潰地を小さくするために、農道の構造や規模は、特に導入される農業機械の規模や農作業に基づいて決定する。

この章では、幹線道路や農道の構造や規模、角切、進入路等の附帯施設について述べる。

3.5.2. 規　模

CAPICの実証農場の農道は、3タイプ、即ち、幹線農道、農道A型と農道B型を計画する。

(1) 幹線道路

一般に、幹線道路の幅員はハラーズ川流域に導入される農業機械を考慮して決定される。道路上で二台の車両が停車することなしにすれ違いが可能な道路幅員が必要である。CAPICの実証農場の幹線道路は、二つの農作業を考慮して決定する。稲作栽培期間に二台のトラクター(30PS級)が道路上ですれ違いが可能な幅員と、収穫期にコンバインと他の車両がすれ違いが可能な幅員である。その結果、道路の車道幅員は4.5mとし、路肩は0.25m、車道部幅は5.0mで計画する。(図3-5-1参照)

稲作栽培期		収穫期	
項　目	幅	項　目	幅
外側余裕	0.3m	外側余裕	0.3m
車幅(トラクター 30PS級)	1.7	車幅(コンバイン 20PS級)	2.3
すれ違い余裕幅	0.3	すれ違い余裕幅	0.3
車幅(トラクター 30PS級)	1.7	車幅(トラクター 20PS級)	1.1
外側余裕	0.3	外側余裕	0.3
計(車道幅員)	4.3	計(車道幅員)	4.3
	(4.5)		(4.5)
2路肩	0.5	2路肩	0.5
合計(車道部幅)	5.0	合計(車道部幅)	5.0

(2) 農道(A)

農道(A)は農業生産投入資材や農業生産物を運搬する機能を持つ。車道幅員は日常の営農活動と収穫期を考慮して決定する。日常の農作業期間は二台の25PS級のトラクターがすれ違い可能な幅員で、約3.0mの車道幅員が必要である。収穫期には30PS級のコンバイン

が通行可能な 2.9 m (約 3.0 m) の車道幅員が必要である。路肩幅は 25 cm とすると、車道部幅は 3.5 m となる。(図 3-5-1 参照)

農作業期		収穫期	
項目	幅	項目	幅
外側余裕	0.3 m	外側余裕	0.3 m
車幅(トラクター 25PS級)	1.1	車幅(コンバイン 30PS級)	2.3
すれ違い余裕幅	0.3	すれ違い余裕幅	0.3
車幅(トラクター 25PS級)	1.1	計(車道幅員)	2.9
外側余裕	0.3		(3.0)
計(車道幅員)	3.1	路肩 (両側 0.25×2)	0.5
	(3.0)	合計(車道部幅)	3.5
路肩 (両側 0.25×2)	0.5		
合計(車道部幅)	3.5		

(2) 農道 (B)

農道 (B) は、道路による潰地を少なくする事を展示する目的で計画する。この道路の機能は前述の農道 (A) と同様であるが、一台のトラクターのみが通行可能とする。車道幅員と車道部幅は、それぞれ 2.0 m と 2.5 m である。(図 3-5-1 参照)

項目	幅
外側余裕	0.3 m
車幅(トラクター 25PS級)	1.1
すれ違い余裕幅	0.3
計(車道幅員)	1.7
	(2.0)
路肩 (両側 0.25×2)	0.5
合計(車道部幅)	2.5

3.5.3. 横断面の計画

(1) 道路高

計画道路高さは、耕地への農業機械の出入りを考慮して決定する。農業機械、特にトラクターが、補助器具なしに上ることができるのは、道路高が 50 cm を限度である。又、道路路面は常に乾燥状態でなければならない。以上を考慮して、CAPIC の実証農場の道路高を次のように決定する。

道路	道路高
幹線道路	50 cm
他の農道	40 cm

(2) 舗　装

建設費を押さえるために、農道は砂利舗装で、道路盛土は地区内流用土で計画する。舗装厚は以下のとおりである。

道　路	道路高
幹線道路	15 cm
農道(A)	15 cm
農道(B)	10 cm

(3) 側法勾配

地区内流用土の盛土材料がシルトからシルティ・ロームであるので、道路法面を崩壊から守るため側法勾配を1:1とする。(図 3-5-1 参照)

(4) 横断勾配

特に冬の、降雨による余剰水は早く路面から排除するため、横断勾配は5%で計画する。余剰水は道路中央から路肩に向かって排水する。(図 3-5-1 参照)

3.5.4. 道路配置と延長

(1) 道路の配置

幹線道路はCAPIC地区の南側境界沿いに配置し、農道(A)は全ての耕区に出入りできるように配置し、農道(B)は実証農場の南東部に計画する。農道(A)は又、アヒ・ルードやピテ・ルード沿いにも配置し、重機が通行可能な維持管理用道路として計画する。

(2) 計画道路延長

CAPICの実証農場の総計画延長は、1/1,000地形図上で4,631 mである。次表に道路別・タイプ別延長を示す。

道路名	延長	タイプ	道路名	延長	タイプ
幹線道路	1,140 m	-	農道第 5 号	138.0 m	A
農道第 1 号	194.0 m	A	農道第 6 号	684.0 m	A
農道第 2 号	276.5 m	A	農道第 7 号	869.0 m	A
農道第 3 号	290.0 m	A	農道第 8 号	290.5 m	A
農道第 4 号	297.0 m	B	農道第 9 号	452.0 m	A

幹線道路	1,140.0 m	(29.2 m/ha)
農道タイプ-A	3,194 0 m	(81.8 m/ha)
農道タイプ-B	297 0 m	(7.6 m/ha)
計	4,361.0 m	(118.7.m/ha)

3.5.5. 附帯工の設計

(1) 角切工

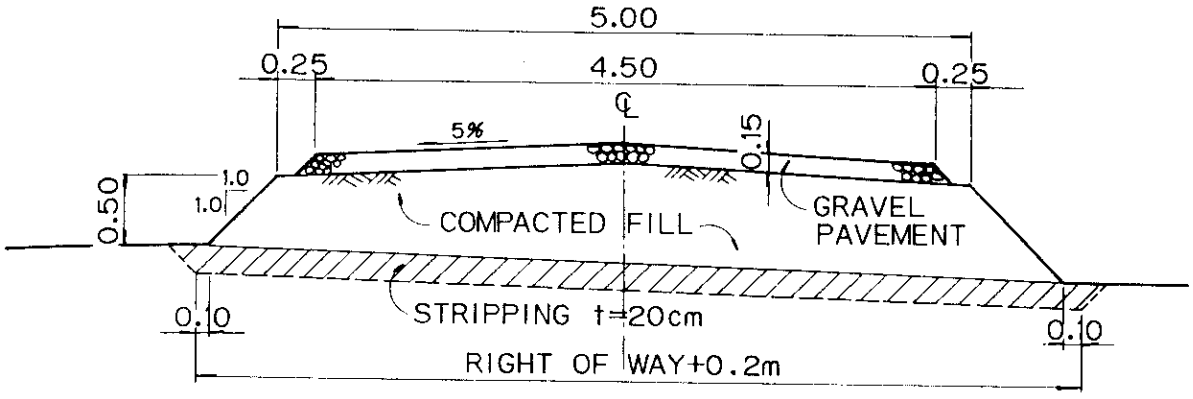
道路の交差点には、車両がスムーズに転回できる十分の長さをもった角切工を計画する。角切工の長さは道路の幅員によって決定する。設計基準は次のとおりである。

道路幅員 (A)	交差道路の幅員 (B)		
	3 m	4 m	5 m
3 m	L=2.0 m	1.5	1.0
4 m	1.5	1.0	1.0
5 m	1.0	0.5	0

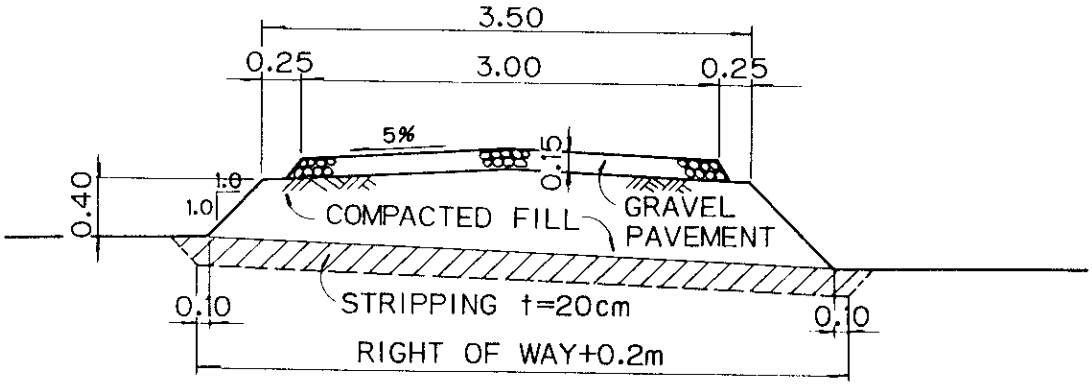
5 m 以上の幅員の道路の交差点には角切工を設けない。鋭角の交差点の角切工の長さは上記の表の 1.5 倍の長さで計画する。(添付設計図 No. 21 参照)

(2) 進入路工

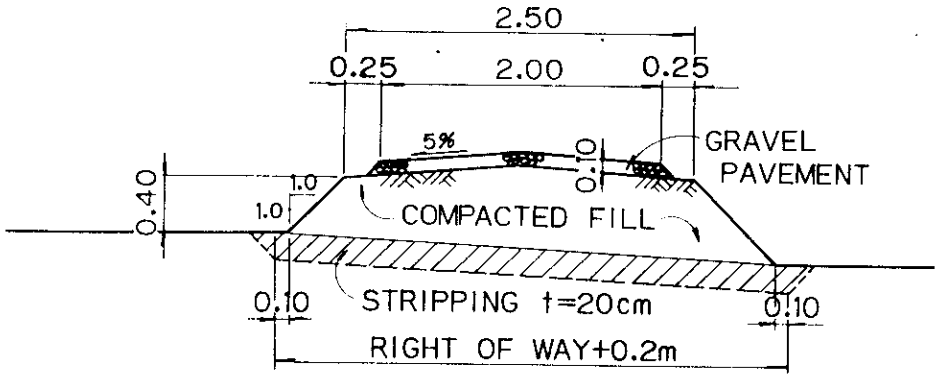
耕地面と道路路面との差が 50 cm 以上の場合は、農業機械のスムーズな進入を行うために、進入路工を計画する。進入路工の幅は、コンバインやトラクターの回転を考慮して 3.0 m とする。縦断勾配は最大 32.5 % とする。50 cm 以下の標高差の場合の小用水路の横断には、木製や鋼製の仮渡しを使用する計画である。



TRUNK ROAD



FARM ROAD(A)



FARM ROAD(B)

図 3-5-1　農道の標準断面図

第4章　工事数量

第4章 工事数量

4.1. 圃場の造成

4.1.1. 造成面積

項　　目	実証農場 (ha)	建物用地 (ha)	総　計 (ha)
総 面 積	39.03	3.75	42.78
実 面 積	35.09	3.37	38.46
そ の 他	3.94	0.38	4.32

(詳細は表4-1-1参照)

4.1.2. 整地土量と運土距離

項　　目	単　位	土　量	運土距離	土　量	運土距離
表土剥ぎ	m^3	-	-	5,149	22.7
基盤切盛	m^3	33,840	61.6	-	-
基盤整地	ha	35.09	-	-	-
表土戻し	m^3	-	-	5.149	22.7
表土整地	ha	-	-	3.43	-

注) * 表土扱い地域の運土量は基盤整地土量に含まれている。
** 建物敷地の土量(V=5,531m^3、D=73.0m)を含む。

詳細は表 4-4-1 から -3 と図 4-4-1と -2 参照

4.1.3. 畦畔工

全畦畔延長は5,921mであり、表4-1-1に詳細は示す。

4.1.4. 法面仕上工

総法面仕上げ工面積は1,357m^2で、詳細を表4-1-4に示す。

4.2. 用水路工

4.2.1. 水路工

実証農場内の支線用水路(LIC)、小用水路(ID)の総延長は5,948mで、用水路密度はha当たり140.7mである。表4-2-1及び図4-2-1に詳細は示す。用水路の延長は表4-2-2に纏めてある。

4.2.2. 附帯工

用水路附帯工には道路横断暗渠工、分水工、サイフォン工、余水吐工、パーシャル.フリューム、チェック、排水路分水工(支線用水路と小用水路ID-8)を計画する。(表4-2-3及び-4参照)

4.3. 排水路工

4.3.1 排水路工

承排水路、支線排水路及び小排水路から成る計画排水路の総延長は3,447mである。表4-3-1に各々の排水路延長を示す。排水路の水路密度は88.3mである。表4-3-2排水路工の数量計算書である。(表4-3-1と4-3-2及び図4-3-1参照)

4.3.2. 附帯工

排水路暗渠工、チェックで構成される附帯工は表4-3-3から4-3-6に数量を示す。

4.4. 農道工

4.4.1 道路工

道路総延長は4,631mで、道路密度は132.0mとなる。表4-4-1及び図4-4-1にその詳細を示し、農道建設数量は表4-4-2に示す。

4.4.2 附帯工

農道附帯工として、角切工と圃場進入路工を計画する。表4-4-3から4-4-7にその数量を示す。(表4-4-3から-7と図4-4-2参照)

4.5. 実験農場

実験農場として、次の圃区番号及び耕区番号に該当する面積6.42haを計画する。

圃区番号	工区番号	面　積 (m^2)	畦畔延長 (m)	圃区番号	工区番号	面　積 (m^2)	畦畔延長 (m)
1	1	2,040	78	3	1	4,825	100
	2	2,630	97		2	6,000	100
	3	3,200	116		3	6,000	100
	4	3,672	128		4	6,000	100
	5	4,381	-		5	6,000	-
小計		15,923	519	小計		28,825	400
2	1	3,900	130	計		64,248	1,439
	2	3,900	130				
	3	3,900	130				
	4	3,900	130				
	5	3,900	-				
小計		19,500	520				

圃場の整地、農道や潅漑排水路の建設は前節4.1から4.4で述べた通りである。実験農場に必要な追加施設の数量は表4-5-1から4-5-8に示してある。(詳細は添付設計図参照)

表 4-1-1　耕区面積と畦畔長調書

Field Block No.	Field Lot No.	Acreage (sq. m)	Length of plot dike (m)	Field Block No.	Field Lot No.	Acreage (sq. m)	Length of plot dike(m)
1	1	2,040	78	5	1	2,589	100
	2	2,630	97		2	6,000	100
	3	3,200	116		3	6,000	100
	4	3,672	128		4	6,000	100
	5	4,381	-		5	6,000	-
ST		15,923	519	ST		26,589	400
2	1	3,900	130	6	1	4,100	100
	2	3,900	130		2	6,000	100
	3	3,900	130		3	6,000	100
	4	3,900	130		4	6,000	100
	5	3,900	-		5	6,000	-
ST		19,500	520	ST		28,100	400
3	1	4,825	100	7	1	2,180	48
	2	6,000	100		2	3,585	72
	3	6,000	100		3	4,981	92
	4	6,000	100		4	5,511	92
	5	6,000	-		5	5,475	-
ST		28,825	400	ST		21,732	304
4	1	6,446	100				
	2	6,000	100				
	3	6,000	100				
	4	6,000	100				
	5	6,000	-				
ST		30,446	400				

Note; ST- Sub-Total

Field Block No.	Field Lot No.	Acreage (sq. m)	Length of plot dike (m)	Field Block No.	Field Lot No.	Acreage (sq. m)	Length of plot dike(m)
8	1	2,820	100	11	1	9,000	150
	2	3,000	100		2	9,000	150
	3	3,000	100		3	9,000	150
	4	3,000	100		4	9,000	150
	5	3,000	100		5	8,739	119
	6	3,000	100		6	4,248	-
	7	3,000	-	ST		48,987	719
ST		20,820	600				
				12	1	8,654	149
9	1	1,912	47		2	8,886	148
	2	1,665	65		3	8,753	147
	3	2,198	82		4	8,793	147
	4	2,693	98		5	8,745	148
	5	3,158	-		6	8,955	149
ST		11,626	321		7	7,511	-
				ST		60,297	888
10	1	9,000	150				
	2	9,000	150				
	3	9,000	150				
	4	11,078	-				
ST		38,078	450	Total		350,923	5,921
				Facility Area		33,700	-
				Grand Total		384,623	5,921

Note; ST- Sub-Total

表 4-1-2 整地土量

				Earth Work Volume and Hauling Distance					
		Area	EL	w/in Field Lot		w/in Field Block		Out of Field Block	
FBN	FLN	(sq.m)	(m)	V (cu.m)	D (m)	V (cu.m)	D (m)	V (cu.m)	D (m)
1	1	2,040	98.99	55	23.9	-	-	-	-
	2	2,630	98.87	106	39.4	-	-	-	-
	3	3,200	98.71	168	47.3	-	-	-	-
	4	3,672	98.60	245	81.0	-	-	-	-
	5	4,381	98.51	338	76.6	-	-	-	-
ST		15,923		912	64.9	-	-	-	-
2	1	3,900	98.94	2	71.4	+ 637	-	-	-
	2	3,900	98.94	91	30.3	- 193	46.4	-	-
	3	3,900	98.65	82	30.2	- 444	67.6	-	-
	4	3,900	98.27	107	27.8	-	-	-	-
	5	3,900	98.20	130	29.9	-	-	-	-
ST		19,500		412	29.7	637	61.2	-	-
3	1	4,825	98.84	244	66.2	-	-	-	-
	2	6,000	98.81	392	46.0	-	-	-	-
	3	6,000	98.47	308	56.0	-	-	-	-
	4	6,000	98.38	369	50.2	-	-	-	-
	5	6,000	98.14	192	27.2	-	-	-	-
ST		28,825		1,505	50.0	-	-	-	-
4	1	6,446	98.93	244	42.5	-	-	-	-
	2	6,000	98.77	381	41.5	-	-	-	-
	3	6,000	98.45	175	34.9	-	-	-	-
	4	6,000	98.36	273	54.6	-	-	-	-
	5	6,000	98.19	451	48.9	-	-	-	-
ST		30,446		1,534	45.1	-	-	-	-
5	1	2,589	98.77	56	38.9	-	-	-	-
	2	6,000	98.74	190	27.5	-	-	-	-
	3	6,000	98.59	170	35.0	-	-	-	-
	4	6,000	98.49	229	37.8	-	-	-	-
	5	6,000	98.28	231	24.1	-	-	-	-
ST		26,589		876	31.5	-	-	-	-

Earth Work Volume and Hauling Distance

FBN	FLN	Area (sq.m)	EL (m)	w/in Field Lot V (cu.m)	w/in Field Lot D (m)	w/in Field Block V (cu.m)	w/in Field Block D (m)	Out of Field Block V (cu.m)	Out of Field Block D (m)
6	1	4,100	98.92	199	26.4	-	-	-	-
	2	6,000	98.84	373	36.9	-	-	-	-
	3	6,000	98.64	371	37.3	-	-	-	-
	4	6,000	98.36	473	53.8	-	-	-	-
	5	6,000	98.14	773	53.2	-	-	-	-
ST		28,100		2,189	45.4	-	-	-	-
7	1	2,180	98.82	282	18.9	-	-	-	-
	2	3,585	98.31	726	40.6	-	-	-	-
	3	4,981	98.95	1,221	44.3	-	-	-	-
	4	5,511	97.93	1,083	54.6	-	-	-	-
	5	5,475	97.74	636	44.7	-	-	-	-
ST		21,732		3,948	44.7	-	-	-	-
8	1	2,820	98.96	26	26.4	+1,273	-	-	-
	2	3,000	98.94	-	-	+1,197	-	-	-
	3	3,000	98.93	221	34.3	-	-	-	-
	4	3,000	98.86	3	25.4	-1,118	90.5	-	-
	5	3,000	98.56	-	-	- 139	120.1	-	-
						- 899	93.8		
	6	3,000	98.11	52	34.9	- 298	124.1	-	-
	7	3,000	97.98	98	29.0	-	-	-	-
ST		20,820		400	32.5	2,454	97.5	-	-
9	1	1,912	98.94	44	27.4	+ 477	-	-	-
	2	1,665	98.88	-	-	- 353	54.7	-	-
	3	2,198	98.37	70	18.7	- 124	94.2	-	-
	4	2,693	98.05	75	34.8	-	-	-	-
	5	3,158	97.83	102	24.7	-	-	-	-
ST		11,626		291	26.3	477	65.0	-	-
10	1	9,000	97.94	522	67.8	-	-	-	-
	2	9,000	97.77	381	43.6	-	-	-	-
	3	9,000	97.54	570	79.3	-	-	-	-
	4	11,078	97.54	1,180	68.6	-	-	-	-
ST		38,078		2,653	67.2	-	-	-	-

Earth Work Volume and Hauling Distance

FBN	FLN	Area (sq. m)	EL (m)	w/in Field Lot V (cu. m)	w/in Field Lot D (m)	w/in Field Block V (cu. m)	w/in Field Block D (m)	Out of Field Block V (cu. m)	Out of Field Block D (m)
11	1	9,000	98.07	618	39.0	-	-	-	-
	2	9,000	97.80	396	43.4	-	-	-	-
	3	9,000	97.47	155	31.9	+ 708	-	-	-
	4	9,000	97.22	385	31.9	- 262	86.4	-	-
	5	8,739	97.22	734	58.6	- 446	122.1	-	-
						- 960	53.9	-	-
	6	4,248	97.17	136	49.0	+ 960	-	-	-
ST		48,987		2,424	44.6	1,668	77.2	-	-
12	1	8,654	97.83	772	91.1	-	-	-	-
	2	8,886	97.69	651	95.7	-	-	-	-
	3	8,753	97.53	503	43.2	-	-	-	-
	4	8,793	97.19	1,032	51.6	-	-	-	-
	5	8,745	96.78	515	23.4	- 497	85.9	-	-
	6	8,955	96.73	371	81.3	+ 945	-	-	-
	7	7,511	96.73	1,081	86.5	- 537	60.0	-	-
ST		60,297		4,925	69.7	945	79.3	-	-
Total		50,923		22,069	53.0	6,240	82.2	-	-
Facility Area		33,700		5,531	73.0	-	-	-	-
G. Total		384,623		27,600	57.0	6,240	82.2	-	-

Note; FBN-Field Block No. : FL- Field Lot No. : EL- Field Surface Elevation
V-Earth Work Volume : D-Hauling Distance : w/in-within
"+" - Surplus of earth on a field lot, "-" deficit of earth on a field

表 4-1-3　表土扱い工調書

FBN	FLN	Area (sq.m)	Thickness (cm)	Volume (cu.m)	Hauling Distance (m)
1	1	2,040	15	306	17.0
	2	2,630	15	395	21.9
	3	3,200	15	480	26.7
8	1	2,820	15	423	23.5
	2	3,000	15	450	25.0
	3	3,000	15	450	25.0
	4	3,000	15	450	25.0
	5	3,000	15	450	25.0
9	1	1,912	15	287	15.9
	2	1,665	15	250	13.9
	3	2,198	15	330	18.3
	4	2,693	15	404	22.4
	5	3,158	15	474	26.3
Total		34,316		5,149	22.7

Earth moving method : Temporary stockpiled method

Note: Hauling Distance = length of longer side/4
FBN: Filed Block No.
FLn: Field Lot No.

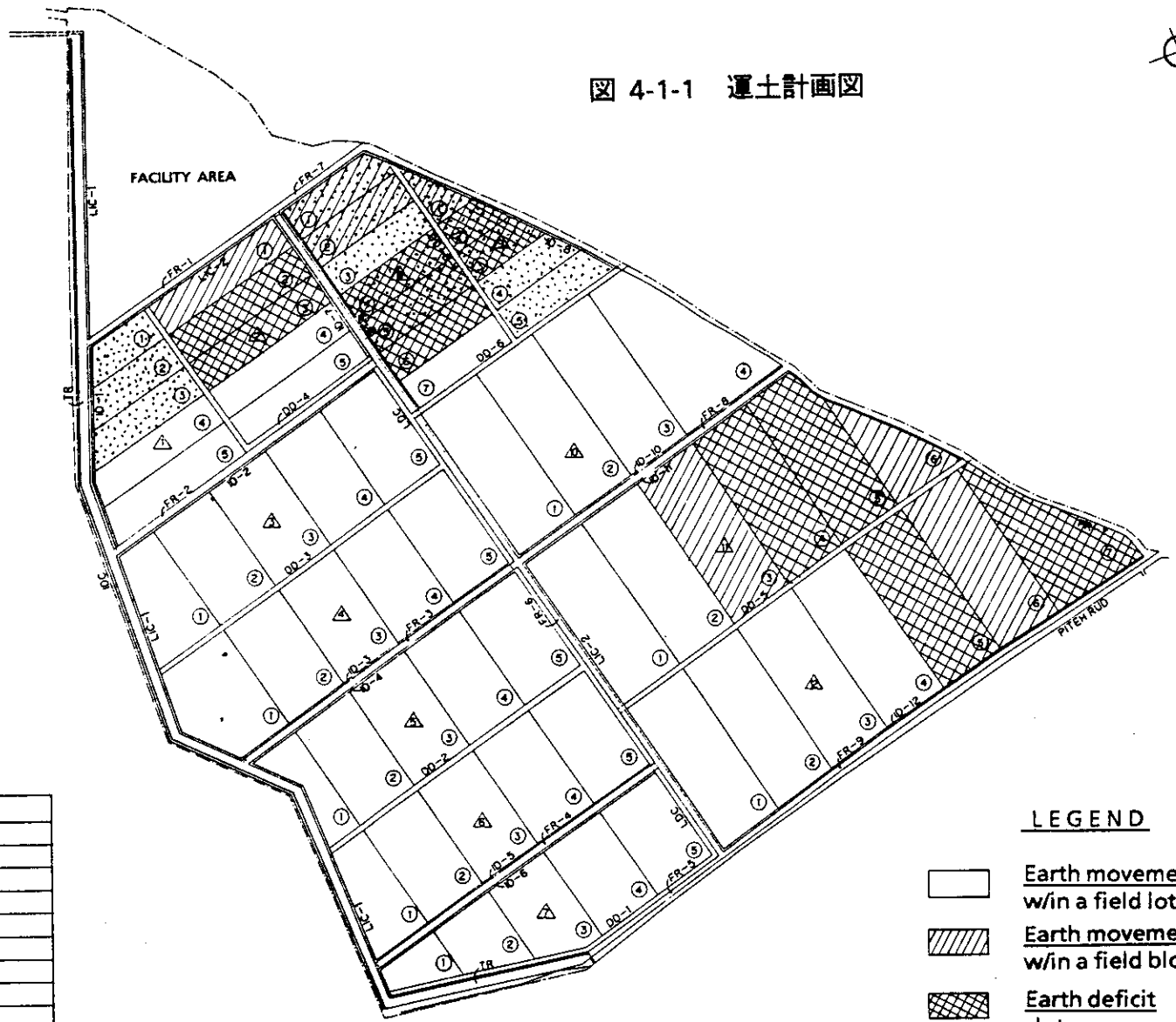
表 4-1-4　法面仕上げ面積調書

FBN	FLN	EL_1 ① (m)	EL_2 ② (m)	h (m) ①−②	L (m)	Slope Area (sq. m)
1	1	98.99	98.97	0.02	-	-
	2	98.97	98.71	0.26	97	36
	3	98.71	98.60	0.11	116	18
	4	98.60	98.51	0.09	-	-
Sub-Total						54
2	1	98.94	98.94	0.0	-	-
	2	98.94	98.65	0.29	130	53
	3	98.65	98.27	0.38	130	70
	4	98.27	98.20	0.07	-	-
Sub-Total						123
3	1	98.84	98.81	0.03	-	-
	2	98.81	98.47	0.34	100	48
	3	98.47	98.38	0.09	-	-
	4	98.38	98.14	0.24	100	34
Sub-Total						82
4	1	98.93	98.77	0.16	100	23
	2	98.77	98.45	0.32	100	45
	3	98.45	98.36	0.09	-	-
	4	98.36	98.19	0.17	100	24
Sub-Total						92
5	1	98.77	98.74	0.03	-	-
	2	98.74	98.59	0.15	100	21
	3	98.59	98.49	0.10	100	14
	4	98.49	98.28	0.21	100	30
Sub-Total						65
6	1	98.92	98.84	0.08	-	-
	2	98.84	98.64	0.20	100	28
	3	98.64	98.36	0.28	100	40
	4	98.36	98.14	0.22	100	31
Sub-Total						99
7	1	98.82	98.31	0.51	48	35
	2	98.31	97.95	0.36	72	37
	3	97.95	97.93	0.02	-	-
	4	97.93	97.74	0.19	92	25
Sub-Total						97
8	1	98.96	98.94	0.0	-	-
	2	98.94	98.93	0.01	-	-
	3	98.93	98.86	0.07	-	-
	4	98.86	98.56	0.30	100	42
	5	98.56	98.11	0.45	100	64
	6	98.11	97.98	0.13	100	18
Sub-Total						124
9	1	98.94	98.88	0.06	-	-
	2	98.88	98.37	0.51	65	47
	3	98.37	98.05	0.32	82	24
	4	98.05	97.83	0.22	98	30
Sub-Total						101
10	1	97.94	97.77	0.17	150	36
	2	97.77	97.54	0.23	150	49
	3	97.54	97.54	0.0	-	-
Sub-Total						85

FBN	FLN	EL_1 ① (m)	EL_2 ② (m)	h (m) ①−②	L (m)	Slope Area (sq.m)
11	1	98.07	97.80	0.27	150	57
	2	97.80	97.47	0.33	150	70
	3	97.47	97.22	0.25	150	53
	4	97.22	97.22	0.0	-	-
	5	97.22	97.17	0.05	-	-
Sub-Total						180
12	1	97.83	97.69	0.14	149	30
	2	97.69	97.53	0.16	148	33
	3	97.53	97.19	0.34	147	71
	4	97.19	96.78	0.41	147	85
	5	96.78	96.78	0.0	-	-
	6	96.78	96.61	0.17	149	36
Sub-Total						255
Total						1,357

Note; Slope (sq.m) = $\sqrt{2} \times h \times L$
Where h is less than 10 cm, this work is not performed.

図 4-1-1　運土計画図



LEGEND	
△	FIELD BLOCK No.
○	FIELD LOT No.
	TRUNK ROAD
	FARM ROAD
	IRRIGATION DITCH
	DRAIN DITCH

LEGEND

- Earth movement w/in a field lot
- Earth movement w/in a field block
- Earth deficit lot
- Top soil treatment lot

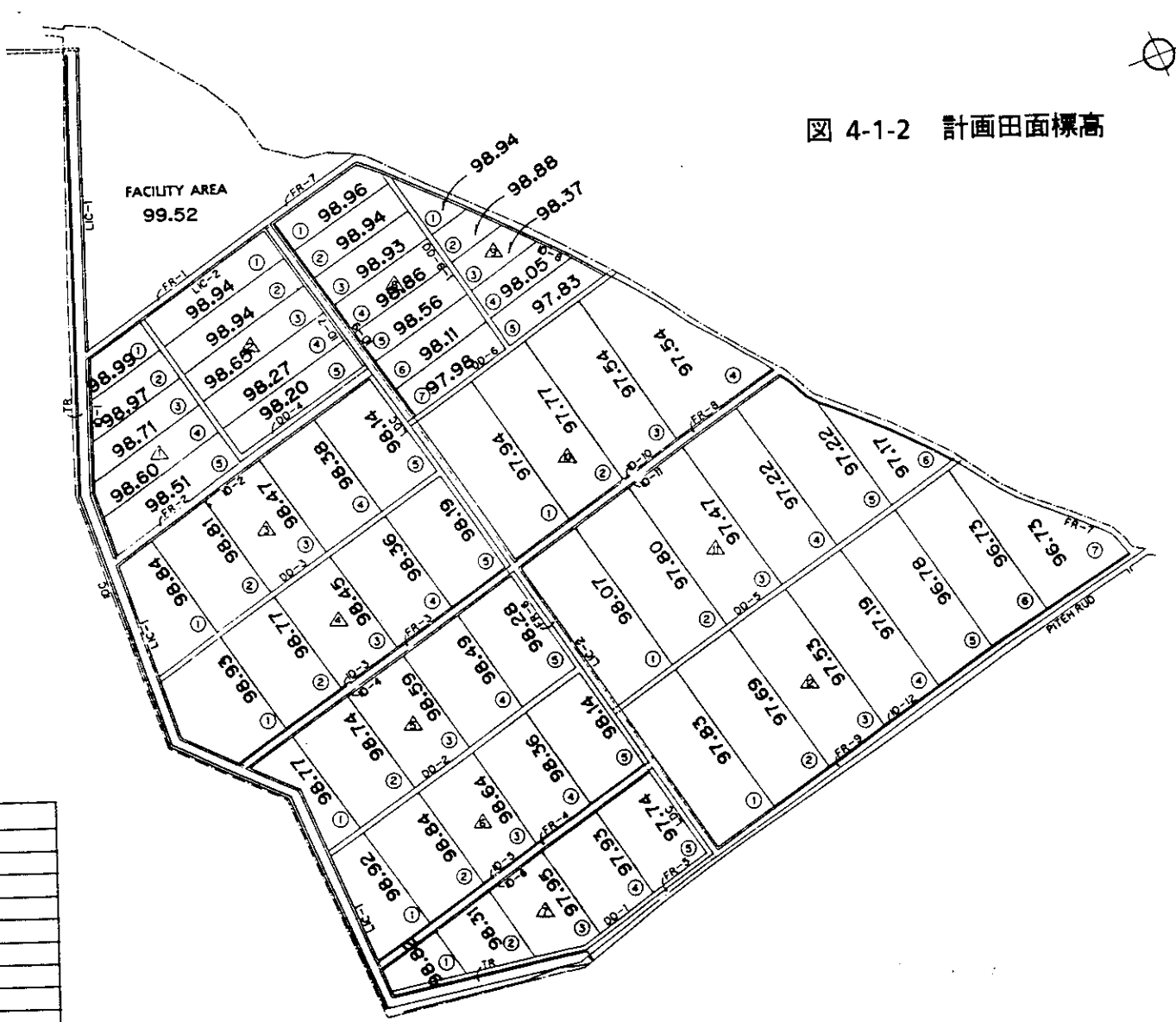
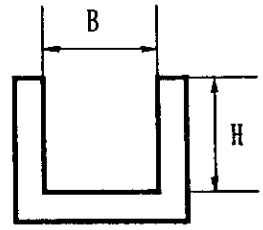

FACILITY AREA
99.52
98.94
98.88
98.37
98.96
98.94
98.93
98.86
98.56
98.11
97.98
98.05
97.83
98.99
98.97
98.71
98.60
98.51
98.94
98.94
98.65
98.27
98.20
97.54
97.54
97.54
97.77
97.94
97.22
97.22
97.17
97.47
98.14
98.38
98.47
98.19
98.36
98.81
98.84
98.45
98.77
98.93
98.28
98.49
98.59
98.74
98.77
98.14
98.36
98.64
98.84
98.92
98.31
98.95
97.74
97.53
97.69
97.83
97.19
96.78
96.73
96.73
98.07
97.80
PITCH ROAD
LEGEND
FIELD BLOCK No.
FIELD LOT No.
TRUNK ROAD
FARM ROAD
IRRIGATION DITCH
DRAIN DITCH
SCALE

図 4-1-2　計画田面標高

表 4-2-1　用水路調書

Name of Canal	Type	Gross Length (m)	Net Length (m)	--- Size --- B	H
LIC-1	1	288.5	270.6	1.10m	0.60m
"	2	660.5	629.8	0.80	0.55
"	3	171.0	156.0	0.80	0.50
Sub-total		1,120.0	1,056.4		
LIC-2	1		2.4	1.10m	0.60m
	1	199.4	187.0	0.70	0.50
"	2	369.6	357.9	MOA A-3 Type	
"	3	324.0	278.0	MOA A-3 Type	
Sub-total		893.0	825.3		
Total		2,013.0	1,881.7		
ID-1		173.0	173.0	0.30	0.30
ID-2		271.0	271.0	0.30	0.30
ID-3		286.0	286.0	0.30	0.30
ID-4		282.0	282.0	0.30	0.30
ID-5		291.0	291.0	0.30	0.30
ID-6		293.0	293.0	0.30	0.30
ID-7		149.0	149.0	0.30	0.30
ID-8	1	101.0	101.0	0.40	0.35
"	2	136.0	136.0	0.30	0.30
"	3	103.0	103.0	0.30	0.30
ID-9		208.0	208.0	0.30	0.30
ID-10		286.0	286.0	0.30	0.35
ID-11		459.0	459.0	0.30	0.35
ID-12		447.0	447.0	0.30	0.35
Total		3,485.0	3,485.0		



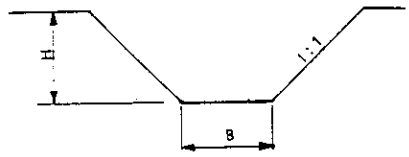


表 4-2-2　用水路工の数量調書

a) Lateral Irrigation Canal

Name of Canal	Net Length (m)	Concrete (150kg/cu.m) @	Concrete (150kg/cu.m) V	Concrete (300kg/cu.m) @	Concrete (300kg/cu.m) V	Form @	Form V	Concrete Block lining @	Concrete Block lining V
LIC-1	270.6	0.100	27.1	0.298	80.6	0.30	81.2	0.80	216.5
"	629.8	0.065	40.9	0.253	159.3	0.30	188.9	0.80	503.8
"	156.0	0.065	10.1	0.253	39.5	0.30	46.8	0.80	124.8
Sub-total	1,056.4		78.1		279.4		316.9		845.1
LIC-2	2.4	0.100	0.2	0.298	0.7	0.30	0.7	0.80	216.5
	187.0	0.060	11.2	0.238	44.5	0.30	56.1	0.80	503.8
"	357.9	0.036	12.9	-	-	-	-	-	-
"	278.0	0.036	10.0	-	-	-	-	-	-
Sub-total	825.3		34.3		45.2		56.8		720.3
Total	1,881.7		112.4		324.6		373.7		1,565.4

Name of Canal	Net Length (m)	Brick lining (150kg/cu.m) @	Brick lining (150kg/cu.m) V	Precast Canal MOA A-3 Type @	Precast Canal MOA A-3 Type V	Stripping (cu.m)	Compacted Fill (cu.m)
LIC-1	270.6	0.40	108.2	-	-	160	332
"	629.8	0.30	188.9	-	-	344	1,192
"	156.0	0.20	31.2	-	-	84	890
Sub-total	1,056.4		328.3	-	-	588	2,414
LIC-2	2.4	0.40	1.0	-	-	-	-
	187.0	0.20	37.4	-	-	98	268
"	357.9	-	-	2	716	147	672
"	278.0	-	-	2	556	130	384
Sub-total	825.3		38.4		1,272	375	1,324
Total	1,881.7		366.7		1,272	963	3,738

Name of Canal	Net Length (m)	Slope Tamping (sq.m)	Excavation (cu.m)	Backfill (cu.m)	Sand (cu.m)	Mortar @	Mortar V
LIC-1	270.6	117	286	103	-	0.026	7.04
"	629.8	488	662	218	-	0.024	15.12
"	156.0	355	172	97	-	0.022	3.43
Sub-total	1,056.4	960	1,120	418	-	-	25.59
LIC-2	2.4	-	-	-	-	0.026	0.06
	187.0	104	200	30	-	0.022	4.11
"	357.9	389	199	-	88	-	-
"	278.0	188	175	-	78	-	-
Sub-total	825.3	681	574	30	166		4.17
Total	1,881.7	1,641	1,694	448	166		29.76

b) Irrigation Ditch

Canal Name	Net Length (m)	Compacted Fill @	Compacted Fill V	Excavation (manual) @	Excavation (manual) V	Excavation (manual) @	Excavation (manual) V
ID-1	173.0	0.48	83	0.18	31	1.45	251
ID-2	271.0	0.36	98	0.18	49	1.25	339
ID-3	286.0	0.36	103	0.18	51	1.25	358
ID-4	282.0	0.36	102	0.18	51	1.25	353
ID-5	291.0	0.36	105	0.18	52	1.25	364
ID-6	293.0	0.36	105	0.18	53	1.25	366
ID-7	149.0	0.36	54	0.18	27	1.25	186
ID-8	101.0	0.64	65	0.26	26	1.50	152
"	136.0	0.36	49	0.18	24	1.25	170
"	103.0	0.46	47	0.18	19	1.45	149
ID-9	208.0	0.36	75	0.18	37	1.25	260
ID-10	286.0	0.43	123	0.23	66	1.50	429
ID-11	459.0	0.43	197	0.23	106	1.50	689
ID-12	447.0	0.39	174	0.18	80	1.40	626
	3,485.0		1,380		672		4,692

表 4-2-3 用水路附帯工調書

	Name of structure	Location
a)	LIC-1	
1.	Spillway 1-1	No.0
2.	Road crossing (TR)	No.0+5.5
3.	Road crossing (FR-1)	No.2+79.75
4.	Turn-out with branch off (ID-1)	No.2+85.45
5.	Parshall flume(w=1.5ft)	No.2+91.31
6.	Road crossing (FR-2)	No.4+59.50
7.	Turn-out (ID-2)	No.4+65.50
8.	Drainage release(DD-3)	No.5+69.50
9.	Turn-out (ID-3)	No.6+85.00
10.	Road crossing (FR-3)	No.6+86.00
11.	Turn-out (ID-4)	No.6+91.00
12.	Drainage release	No.7+99.50
13.	Turn-out (ID-5)	No.9+ 5.50
14.	Road crossing (FR-4)	No.9+ 6.50
15.	Turn-out (ID-6)	No.9+11.50
16.	Drainage release	No.9+38.30
17.	Spillway 1-2	No.9+43.00
18.	Check gate 1-2	No.9+48.00
19.	Siphon	No.11+5.00

	Name of structure	Location
b)	LIC-2	
1.	Check gate 2-1 with branch-off	No.0
2.	Parshall flume	No.0+3.66
3.	Drainage release	
4.	Turn-out (ID-7)	No.1+93.55
5.	Road crossing(FR-6)	No.1+94.55
6.	Drainage release DD-6 w/ check gate 2-3	No.4+ 8.50
7.	Turn-out ID-10	No.5+62.00
8.	Road crossing(FR-8)	No.5+63.00
9.	Turn-out ID-11 w/ check gate 2-4	No.5+68.00
10.	Drainage release DD-6 w/ check gate 2-3	No.4+ 8.50
c)	Irrigation Ditch (ID)	
1.	Drainage release DD-6 on ID-8	

表 4-2-4 用水路附帯工数量調書

a) Road crossing (n= 7)

Item	unit	FR-1	FR-2	FR-3	FR-4
Excavation	cu.m	-	26	23	23
Backfill	cu.m	-	18	16	16
Concrete (300kg/cu.m)	cu.m	3.48	2.97	2.48	2.48
Concrete (150kg/cu.m)	cu.m	0.43	0.36	0.30	0.30
Form	sq.m	23.10	25.38	21.48	21.48
Reinforced bar (D10)	m	433.4	287.5	239.6	239.6
Reinforced bar (D14)	m	59.8	68.6	57.2	57.2

	unit	FR-6	FR-8	TR	Total
Excavation	cu.m	-	17	-	89
Backfill	cu.m	-	13	-	63
Concrete (300kg/cu.m)	cu.m	2.19	1.83	4.88	20.31
Concrete (150kg/cu.m)	cu.m	0.27	0.25	0.49	2.40
Form	sq.m	18.67	15.44	29.16	154.71
Reinforced bar (D10)	m	265.7	186.3	357.6	2,009.7
Reinforced bar (D14)	m	22.1	44.7	94.2	403.8

b) Turnout (n=10)

Item	unit	Type-A		Type-B		Type-C	
		@	V	@	V	@	V
n	Place	5	-	1	-	1	-
Excavation	cu.m	included in road crossing construction work					
Backfill	cu.m	included in road crossing construction work					
Dry masonry (t=15cm)	sq.m	-	-	-	-	-	-
Concrete (300kg/cu.m)	cu.m	0.44	2.20	0.30	0.30	0.37	0.37
Concrete (150kg/cu.m)	cu.m	0.07	0.36	0.06	0.06	0.07	0.07
Form	sq.m	3.56	17.80	2.13	2.13	2.46	2.46
Reinforced bar(ϕ 4)	m	-	-	-	-	-	-
Reinforced bar (D10)	m	33.4	167.0	24.8	24.8	29.7	29.7
Reinforced bar (D14)	m	14.9	74.5	10.5	10.5	12.5	12.5
Steel plate(t=9mm)	kg	-	-	-	-	-	-

Item	unit	ID-1*1	ID-7	ID-8,9*2	Total
n	Place	1	1	1	10
Excavation	cu.m	included in road crossing construction work			
Backfill	cu.m	included in road crossing construction work			
Dry masonry (t=15cm)	sq.m	3.0	2.9	6.7	12.6
Concrete (300kg/cu.m)	cu.m	2.62	0.47	1.62	7.58
Concrete (150kg/cu.m)	cu.m	0.33	0.07	0.29	1.18
Form	sq.m	11.85	3.38	8.85	46.47
Reinforced bar(ϕ 4)	m	-	5.0	-	5.0
Reinforced bar (D10)	m	209.7	41.6	156.1	628.9
Reinforced bar (D14)	m	-	-	-	97.5
Steel plate (t=9mm)	kg	153	57	199	409
Iron gate 1100x600mm	pc	1	-	-	1
Iron gate 400x600mm	pc	1	-	-	1
Iron gate 400x550mm	pc	-	1	2	3
Iron gate 700x500mm	pc	-	-	1	1

Note: *1 with a branch off structure
*2 with a check gate 2-2 structure

c) Siphon (n=1)

Item	unit	Volume
Excavation	cu.m	141
Backfill	cu.m	48
Compacted fill	cu.m	208
Concrete(300kg/cu.m)	cu.m	13.9

Concrete(150kg/cu.m)	cu.m	0.7	
Form	sq.m	101.0	
Reinforced bar (D10)	m	490.9	
Reinforced bar (D14)	m	760.6	
Reinforced bar (D16)	m	73.3	
Wet masonry (t=30cm)	sq.m	4.0	
Brick wall	sq.m	0.4	
Darwell bar (D16)	m	12	
Mortar	cu.m	0.034	(=0.002+0.012+0.02)
RC pipe ϕ400mm@3.5	pc	5	

d) Spillway (n=2)

Item	unit	1-1	1-2	Total
n	Place	1	1	2
Excavation	cu.m	included in road crossing construction work		
Backfill	cu.m	included in road crossing construction work		
Wet masonry (t=15cm)	sq.m	14	17	31
Dry masonry (t=30cm)	sq.m	-	11	11
Concrete (300kg/cu.m)	cu.m	3.64	-	3.64
Concrete (150kg/cu.m)	cu.m	0.43	-	0.43
Form	sq.m	14.27	-	14.27
Reinforced bar (D10)	m	128.3	-	128.3

e) Parshall flume (n=2)

Item	unit	LIC-1	LIC-2	Total
n	Place	1	1	2
Excavation	cu.m	included in road crossing construction work		
Backfill	cu.m	included in road crossing construction work		
Concrete (300kg/cu.m)	cu.m	0.83	0.83	1.66
Concrete (150kg/cu.m)	cu.m	0.21	0.21	0.42
Form	sq.m	8.01	8.01	16.02
RC pipe ϕ400mm@2.5m	pc	1	1	2

f) Drainage release(n=6)

Item	unit	Type-1		Type-2		Type-3		Total
		@	V	@	V	@	V	
n	Place	3	-	1	-	2	-	6
Excavation	cu.m	included in road crossing construction work						-
Backfill	cu.m	included in road crossing construction work						-
Wet masonry (t=15cm)	sq.m	10	30	10	10	10	30	70
Concrete (300kg/cu.m)	cu.m	0.33	0.99	0.31	0.31	0.30	0.60	1.90
Concrete (150kg/cu.m)	cu.m	0.07	0.21	0.07	0.07	0.06	0.12	0.40
Form	sq.m	2.11	6.33	1.96	1.96	2.21	4.42	12.71
Reinforced bar(ϕ4)	m	5.0	15.0	5.0	5.0	5.0	10.0	30.0
Reinforced bar (D10)	m	33.6	100.8	32.0	32.0	3.8	7.6	111.6
Steel plate (t=9mm)	sq.m	64	192	57	57	64	192	441
Iron gate 400x550mm	pc	1	3	1	1	-	-	4
Stop log	cu.m	-	-	-	-	0.016	0.032	0.032

g) Check Gate (n=2)

Item	unit	1-2	2-1	Total
n	Place	1	1	2
Excavation	cu.m	included in road crossing construction work		
Backfill	cu.m	included in road crossing construction work		
Concrete (300kg/cu.m)	cu.m	0.61	-	0.61
Concrete (150kg/cu.m)	cu.m	0.08	-	0.08
Form	sq.m	3.90	-	3.90
Reinforced bar (D10)	m	51.6	-	51.6
Steel plate (t=9mm)	kg	39	-	39
Iron gate 800x550mm	pc	1	-	1
Iron gate 1100x600mm	pc	-	1	1

i) Drainage release on ID-8 (n=1)

Item	unit	Quantity
n	Place	1
Excavation	cu.m	-*1
Backfill	cu.m	-*1
Wet masonry	sq.m	10
Concrete (300kg/cu.m)	cu.m	0.302
Concrete (150kg/cu.m)	cu.m	0.055
Form	sq.m	2.21
Reinforced bar (φ4mm)	m	5.0
Reinforced bar (D10)	m	3.8
Stop log (wood)	cu.m	0.016

Note: *1 Earth work volume is inculuded in the canal construction work.

図 4-2-1　計画用水路配置図

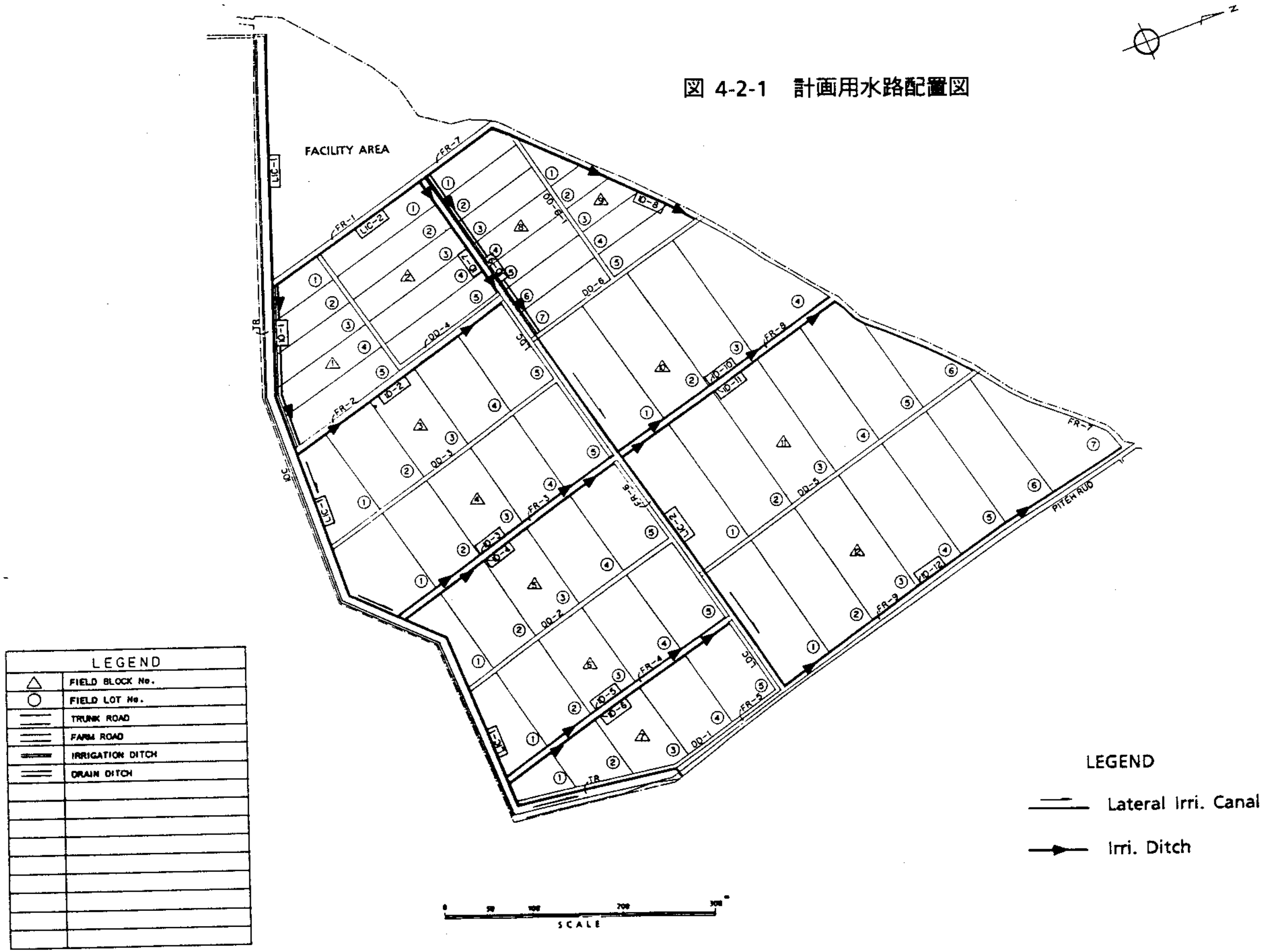


表 4-3-1　排水路調書

Name of Canal	Length and Size: Length (m)	Bottom Width (m)	Average Depth (m)	Remarks
IDC	936.5	0.30	1.28	Interception Drainage Canal (IDC)
LDC	524.0	0.30	1.07	Lateral Drainage Canal (LDC)
DD-1	312.0	0.30	0.98	Drain Ditch (DD)
DD-2	270.0	0.30	0.91	
DD-3	300.0	0.30	0.89	
DD-4	284.5	0.30	0.94	
DD-5	382.0	0.30	0.96	
DD-6	232.0	0.30	0.78	
DD-6-1	206.0	0.30	1.03	
Total	3,447.0			

表 4-3-2　排水路工の数量調書

Name of Canal	Length (m)	Excavation @	Excavation V	Compacted Fill @	Compacted Fill V	Slope Tamping @	Slope Tamping V
IDC	936.5	2.022	1,894	-	-	3.620	3,390
LDC	524.0	1.466	768	0.18	94	3.875	2,030
DD-1	312.0	1.254	391	0.18	56	3.620	1,129
DD-2	270.0	1.235	333	0.36	97	4.426	1,195
DD-3	300.0	1.111	333	0.36	108	4.271	1,281
DD-4	133.0	1.331	177	0.18	24	4.271	568
"	151.5	1.331	202	0.36	55	4.271	647
DD-5	382.0	1.530	584	0.36	138	4.808	1,837
DD-6	232.0	1.015	235	0.36	84	4.172	968
DD-6-1	206.0	1.463	301	0.36	74	4,709	970
Total	3,447.0		5,218		730		14,015

表 4-3-3 排水暗渠調書

Canal Name	Location and Type: Road Name	Type	Gate	Remarks
IDC	-	-		
LDC	FR-2	A		
"	FR-3	A		
"	FR-4	A		
"	FR-5	B		to Piteh Rud
DD-1	-	-		
DD-2	-	-		
DD-3	-	-		
DD-4	-	-		
DD-5	FR-7	B		to Ahi Rud
DD-6	FR-7	B		to Ahi Rud
DD-6-1	-	-		
Total	6 places	(Type-A : 3 places)		
		(Type-B : 3 Places)		

表 4-3-4 排水暗渠数量調書

		Work volume: Type-A (n=3) @	Type-A (n=3) V	Type-B (n=3) @	Type-B (n=3) V	Total
Excavation	:	included in canal excavation works				-
back fill	:	- do -				-
Concrete (200 kg/cu.m)	: cu.m :	1.49	4.47	3.66	10.98	15.45
Concrete (150 kg/cu.m)	: cu.m :	0.16	0.48	-	-	0.48
Form	: sq.m :	8.51	25.53	18.70	56.10	81.63
Wet masonry	: sq.m :	9.06	27.18	9.87	29.61	56.79
Backfill Gravel	cu.m :	2.72	8.16	2.96	8.88	17.04
Dry masonry	: sq.m :	30.37	91.11	40.52	121.56	212.67
RC pipe @3.5m (600 mm in dia.)	: pcs :	1	3	1	3	6
" @2.0m (600 mm in dia.)		1	3	1	3	6
Vynil pipe (40 mm in dia.)	: m :	1.6	4.8	1.6	4.8	9.6

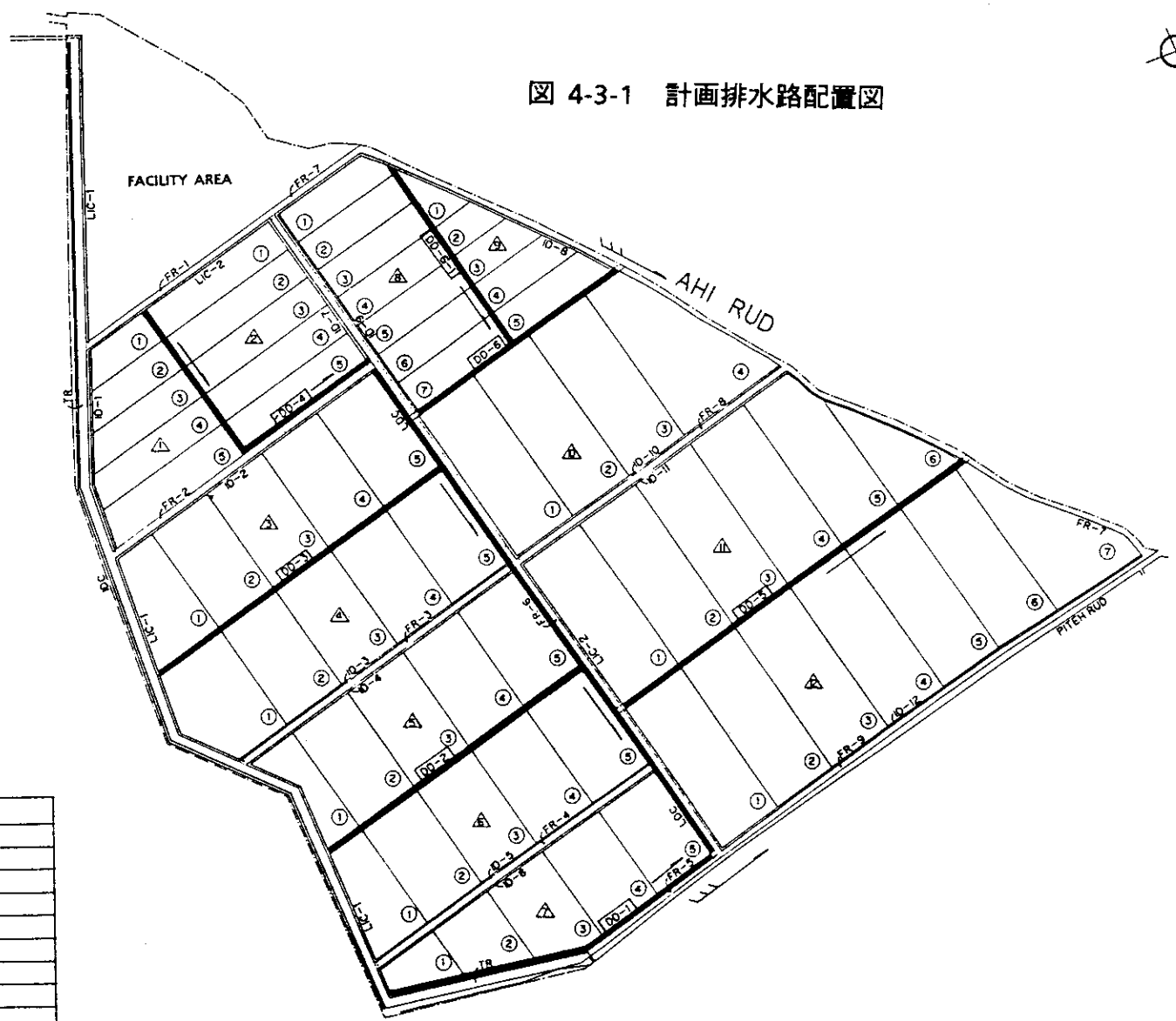
表 4-3-5　排水チェック数量調書

Canal Name	No. of Check	Remarks
IDC	-	Interception Drainage Canal
LDC	2	Lateral Drainage Canal
DD-1	3	Drain Ditch
DD-2	3	
DD-3	3	
DD-4	3	
DD-5	4	
DD-6	2	
DD-6-1	3	
Total	23	

表 4-3-6　排水チェック工の数量調書

		Check (n= 23)	
	Unit	@	V
Concrete (200 kg/cu.m)	cu.m	2.44	56.1
Form	sq.m	12.96	298.1
Dry Masonry	sq.m	36.62	842.3
Wooden Stop log	cu.m	0.036	0.83

図 4-3-1　計画排水路配置図



LEGEND	
△	FIELD BLOCK No.
○	FIELD LOT No.
	TRUNK ROAD
	FARM ROAD
	IRRIGATION DITCH
	DRAIN DITCH

表 4-4-1 農道調書

Name of Canal	Length (m)	Total Road Width (m)	Paved Width (m)	Paved Area (sq.m)	Type
TR	1,140.0	5.00	4.50	5,130	TR
FR-1	194.0	3.50	3.00	582	A
FR-2	276.5	3.50	3.00	829.5	A
FR-3	290.0	3.50	3.00	870	A
FR-4	297.0	2.50	2.00	594*	B
FR-5	138.0	3.50	3.00	414	A
FR-6	684.0	3.50	3.00	2,052	A
FR-7	869.0	3.50	3.00	2,607	A
FR-8	290.5	3.50	3.00	871.5	A
FR-9	452.0	3.50	3.00	1,356	A
Total	4,631.0			15,306.0	
(TR	1,140.0m)			14,712 (more than W = 3.0m)	
(Type-A	3,194.0m)			594 (less than W = 3.0m)	
(Type-B	297.0m)				

表 4-4-2 農道工数量調書

Road Name	Length (m)	Stripping @	Stripping V	Compacted Fill @	Compacted Fill V	Slope Tamping @	Slope Tamping V	Gravel Pavement @	Gravel Pavement V
TR	1,140.0	1.248	1,423	5.045	5,751	1.754	2,000	0.675	769.5
FR-1	194.0	0.980	190	3.976	771	1.414	274	0.450	87.3
FR-2	132.5	0.886	117	2.868	380	1.315	174	0.450	59.6
FR-2	144.0	0.890	128	2.907	419	1.344	194	0.450	64.8
FR-3	290.0	0.926	269	3.360	974	1.598	463	0.450	130.5
FR-4	297.0	0.746	222	2.265	673	1.739	516	0.450	59.4
FR-5	138.0	1.040	144	4.672	645	2.404	332	0.450	62.1
FR-6	684.0	0.962	658	3.837	2,625	1.853	1,267	0.450	307.9
FR-7	869.0	0.872	758	2.253	1,958	1.216	1,057	0.450	391.1
FR-8	290.5	0.922	268	3.305	960	1.570	456	0.450	130.7
FR-9	452.0	0.944	427	3.577	1,616	1.725	780	0.450	203.4
Total	4,631.0		4,604		16,772		7,513		2,266.3

Excavation: FR-1 194.0m x 2.687cu.m/m = 15cu.m (Excavation of Side ditch)

表 4-4-3　角切工調書

Road Name	Itrsct. Road	No. of Corner Cutting by Type										
		Total	A-1	A-2	A-3	A-4	A-5	B-1	B-2	B-3	B-4	B-5
TR	-	-	-	-	-	-	-	-	-	-	-	-
FR-1	TR	2	1	-	-	-	-	1	-	-	-	-
"	FR-6	1	1	-	-	-	-	-	-	-	-	-
FR-2	TR	2	-	1	-	-	-	1	-	-	-	-
"	FR-6	2	2	-	-	-	-	-	-	-	-	-
FR-3	TR	2	1	-	-	-	-	-	1	-	-	-
"	FR-6	2	2	-	-	-	-	-	-	-	-	-
FR-4	TR	2	2	-	-	-	-	-	-	-	-	-
"	FR-6	2	1	1	-	-	-	-	-	-	-	-
FR-5	FR-6	1	-	1	-	-	-	-	-	-	-	-
FR-6	-	-	-	-	-	-	-	-	-	-	-	-
FR-7	FR-6	1	1	-	-	-	-	-	-	-	-	-
FR-8	FR-6	2	2	-	-	-	-	-	-	-	-	-
"	FR-7	2	1	-	-	-	-	1	-	-	-	-
FR-9	FR-6	1	1	-	-	-	-	-	-	-	-	-
"	FR-7	1	1	-	-	-	-	-	-	-	-	-
Total		23	16	3	-	-	-	3	1	-	-	-

Note; Itrsct. = Intersection,　FR = Farm Road

表 4-4-4　角切工の数量調書

Type	Places	Compacted fill		Slope tamping	
		@	V	@	V
A-1	16	1.000	16	2.000	32
A-2	3	1.300	4	2.600	8
B-1	3	1.949	6	2.121	13
B-2	1	2.533	3	2.757	8
Total	23		29		51

表 4-4-5　進入路工調書

Road Name	Itrsct. Road	Type Total	1	2	S1	S2	S3	S4	Location FBN	FLN
TR	ID-1	5	2	3	-	-	-	-	1	1, 2, 3, 4, 5
"	LIC-1	5	-	-	-	-	2	3	1	1, 2, 3, 4, 5
FR-1	-	-	-	-	-	-	-	-		
FR-2	ID-2	-	-	-	-	-	-	-		
FR-3	ID-3	-	-	-	-	-	-	-		
"	ID-4	-	-	-	-	-	-	-		
FR-4	ID-5	-	-	-	-	-	-	-		
"	ID-6	3	1	2	-	-	-	-	7	2, 3, 5
FR-5	-	-	-	-	-	-	-	-		
FR-6	ID-9	4	2	2	-	-	-	-	8	4, 5, 6, 7
"	LIC-2	4	-	-	2	2	2	3	8	4, 5, 6, 7
"	ID-7	3	1	2	-	-	-	-	2	3, 4, 5
FR-7	ID-8	2	-	2	-	-	-	-	9	3, 4
FR-8	ID-10	-	-	-	-	-	-	-		
"	ID-11	3	3	-	-	-	-	-	11	3, 4, 5
FR-9	ID-12	-	-	-	-	-	-	-		
Total		24	9	11	2	2	2	3		

Note; Itrsct. = Intersection,　FR = Farm Road

表 4-4-6　進入路工の数量調書

Type	Places	Compacted Fill @	Compacted Fill V	RC pipe 400mm (pcs)	RC pipe 500mm (pcs)	RC pipe 600mm (pcs)	Concrete (cu.m)	Form (sq.m)
1	9	3.319	30	9	-	-	8.3	30.2
2	11	7.521	83	22	-	-	20.2	67.8
S1	2	3.319	6	-	6	-	3.7	8.6
S2	2	7.521	15	-	30	-	5.2	16.2
S3	2	3.319	6	-	-	6		
S4	3	7.521	15	-	-	30		
Total	24		155	31	36	36	37.4	122.8

表 4-4-7　ピテ・ルードの練石積工の数量調書

Item	Unit	Quantity
Wet masonry (t=30cm)	sq.m	645.6
Concrete (200kg/cu.m)	cu.m	29.49
Form	sq.m	112.56

図 4-4-1　計画道路配置図

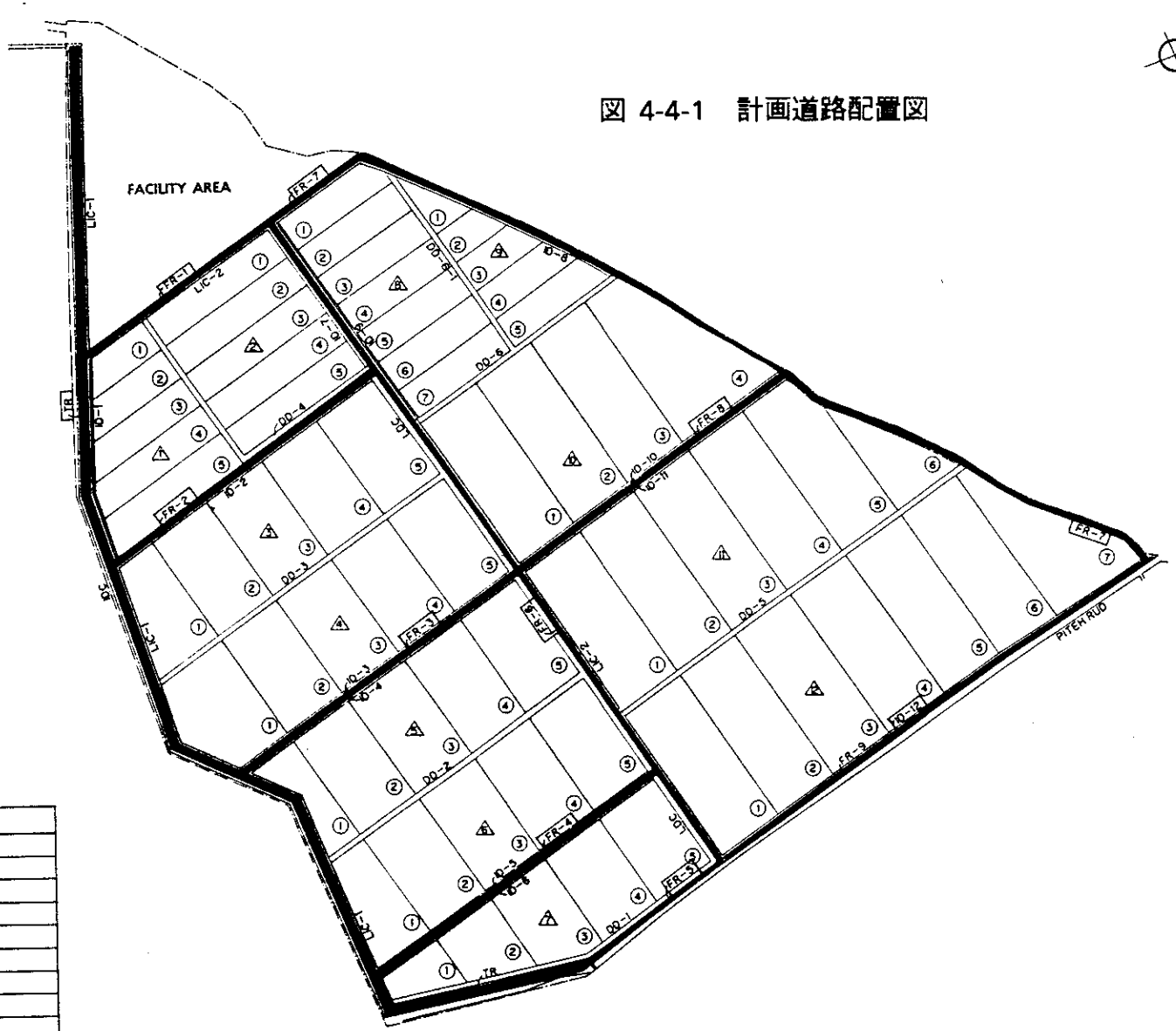


図 4-4-2　計画進入路配置図

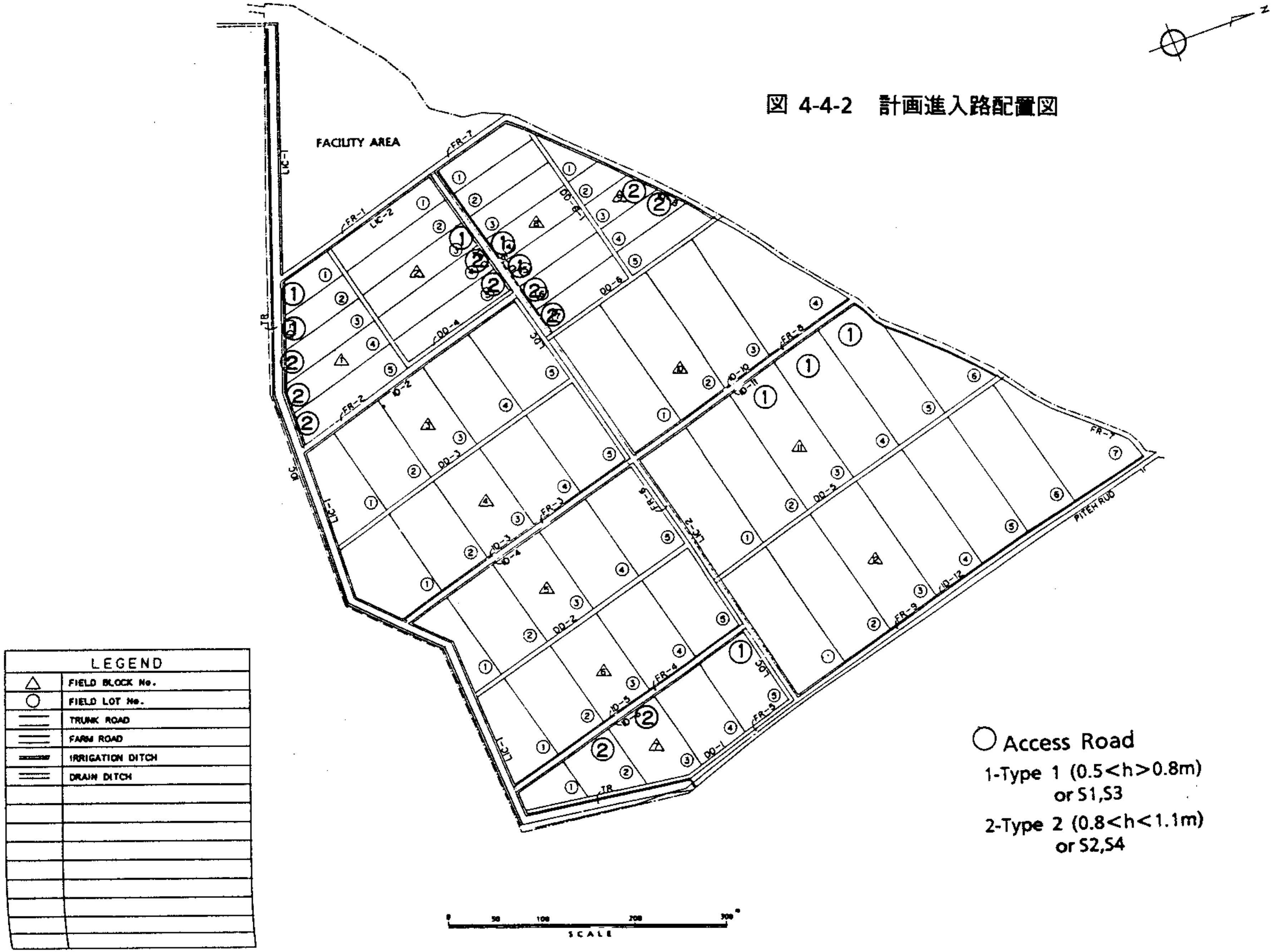


表 4-5-1　実験農場の農道調書

Name of Road	Total Length	Net Length	Total Road Width	Type
FRD-1	111.0m	111.0m	2.50m	2
FRD-2	111.0	111.0	2.50	2
FRD-3	111.0	111.0	2.50	2
FRD-4	111.0	111.0	2.50	2
FRD-5	151.0	151.0	1.50	1
FRD-6	151.0	141.0	1.50	1
FRD-7	151.0	141.0	1.50	1
FRD-8	82.0	82.0	3.50	3
FRD-9	120.0	120.0	3.50	3
FRD-10	120.0	116.5	1.50	1
FRD-11	61.0	61.0	1.50	1
FRD-12	101.0	101.0	3.50	3
FRD-13	101.0	101.0	3.50	3
Total	1,482.0	1,458.5		
(Type-1	634.0m	610.5m)		
(Type-2	444.0m	444.0m)		
(Type-3	404.0m	404.0m)		

表 4-5-2　実験農場の農道工数量調書

Name of Road	Net Length (m)	Type	Compacted Fill @	Compacted Fill V	Slope Tamping @	Slope Tamping V
FRD-1	111.0	2	0.915	102	0.849	94
FRD-2	111.0	2	0.915	102	0.849	94
FRD-3	111.0	2	0.915	102	0.849	94
FRD-4	111.0	2	0.915	102	0.849	94
FRD-5	151.0	1	0.570	86	0.849	128
FRD-6	141.0	1	0.570	80	0.849	120
FRD-7	141.0	1	0.570	80	0.849	120
FRD-8	82.0	3	1.293	106	0.849	70
FRD-9	120.0	3	1.293	155	0.849	102
FRD-10	116.5	1	0.570	66	0.849	99
FRD-11	61.0	1	0.570	35	0.849	52
FRD-12	101.0	3	1.293	131	0.849	86
FRD-13	101.0	3	1.293	131	0.849	86
Total	1,458.5			1,278		1,239

表 4-5-3　実験農場の小用水路工数量調書

Name of F.Ditch	Length (m)	Type	Cmpctd' Fill (cu.m)	Slope Tamping (sq.m)	Name of F.Ditch	Length (m)	Type	Cmpctd' Fill (cu.m)	Slope Tamping (sq.m)
FD-1	150	1	30	128	FD-4-6	29	1	6	25
FD-2	112	1	22	95	FD-5	112	1	22	95
FD-2-1	29	1	6	25	FD-5-1	29	1	6	25
FD-2-2	29	1	6	25	FD-5-2	29	1	6	25
FD-2-3	29	1	6	25	FD-5-3	29	1	6	25
FD-2-4	29	1	6	25	FD-5-4	29	1	6	25
FD-2-5	29	1	6	25	FD-5-5	29	1	6	25
FD-2-6	29	1	6	25	FD-5-6	29	1	6	25

表 4-5-3 実験農場の小用水路工数量調書(統)

Name of F.Ditch	Length (m)	Type	Cmpctd. Fill (cu.m)	Slope Tamping (sq.m)	Name of F.Ditch	Length (m)	Type	Cmpctd. Fill (cu.m)	Slope Tamping (sq.m)
FD-3	112	1	22	95	FD-6	112	1	22	95
FD-3-1	29	1	6	25	FD-6-1	29	1	6	25
FD-3-2	29	1	6	25	FD-6-2	29	1	6	25
FD-3-3	29	1	6	25	FD-6-3	29	1	6	25
FD-3-4	29	1	6	25	FD-6-4	29	1	6	25
FD-3-5	29	1	6	25	FD-6-5	29	1	6	25
FD-3-6	29	1	6	25	FD-6-6	29	1	6	25
FD-4	112	1	22	95	FD-7	76	1	15	65
FD-4-1	29	1	6	25	FD-8	80	1	16	68
FD-4-2	29	1	6	25	FD-9	114	1	23	97
FD-4-3	29	1	6	25	FD-10	118	1	24	100
FD-4-4	29	1	6	25	FD-11	137	1	27	116
FD-4-5	29	1	6	25	Total	2,105		425	1,799

Note:
Compacted Fill: (0.3+0.9)x 0.3 x 1/2 /0.9 = 0.2 cu.m/m
(note; 0.9 is soil conversion factor from compacted condition to natural one)
Slope Tamping : $\sqrt{2}$ x 0.3 x 2 = 0.85 sq.m/m

表 4-5-4 実験農場の小農道調書

Name of F.Ditch	Crossed Farm road	Type	Name of F.Ditch	Crossed Farm road	Type
FD-1	-	-	FD-8	FRD-10	1
FD-2	FRD-5	1	FD-9	FRD-10	1
"	FRD-6	1	FD-10	FRD-10	1
"	FRD-7	1	"	FRD-11	1
FD-3	FRD-5	1	FD-11	FRD-10	1
"	FRD-6	1	"	FRD-11	1
"	FRD-7	1	ID-2	FRD-12	3
FD-4	FRD-5	1	"	FRD-13	3
"	FRD-6	1	LIC-2	FRD-5	4
"	FRD-7	1	"	FRD-6	4
FD-5	FRD-5	1	"	FRD-7	4
"	FRD-6	1	Total		26
"	FRD-7	1	Type-1	21 places	
FD-6	FRD-5	1	Type-2	0 "	
"	FRD-6	1	Type-3	2 "	
"	FRD-7	1	Type-4	3 "	
FD-7	-	-			

表 4-5-5 実験農場の小農道工数量調書

Item	unit	Type 1	Type 3	Type 4	Total	
n		21	2	3	26	
Concrete						
300kg/cu.m		-	-	0.8	0.8	
200kg/cu.m		13.5	2.7	1.0	17.2	
150kg/cu.m		-	-	0.4	0.4	
Form	㎡	52.8	10.1	17.4	80.3	
RC Pipe ϕ400mm	pc	21	4	-	25	(L=2.5m)
Reinforced bar	kg	-	-	30	30	

表 4-5-6 実験農場の小排水路工数量調書

Name of F.Drain	Length (m)	Cmpctd. Fill (cu.m)	Slope Tamping (sq.m)	Name of F.Drain	Length (m)	Cmpctd. Fill (cu.m)	Slope Tamping (sq.m)
FDR-1	148.5	59	378	FDR-5	75.0	30	191
FDR-2	75.0	30	191	FDR-5-1	26.0	10	25
FDR-2-1	26.0	10	25	FDR-5-2	26.0	10	25
FDR-2-2	26.0	10	25	FDR-5-3	26.0	10	25
FDR-2-3	26.0	10	25	FDR-6	75.0	30	191
FDR-3	75.0	30	191	FDR-6-1	26.0	10	25
FDR-3-1	26.0	10	25	FDR-6-2	26.0	10	25
FDR-3-2	26.0	10	25	FDR-6-3	26.0	10	25
FDR-3-3	26.0	10	25	FDR-7	58.0	23	148
FDR-4	75.0	30	191	FDR-8	98.0	39	250
FDR-4-1	26.0	10	25	FDR-9	127.5	51	325
FDR-4-2	26.0	10	25	Total	1,197.0	472	2,431
FDR-4-3	26.0	10	25				

Note;
B/Q per m
Compacted fill
(0.9 + 0.3) x 0.3 x 1/2 x 2 / 0.9 = 0.4 cu.m/m
Slope tamping area per m
$\sqrt{2}$ x (0.3 + 0.6) x 2 = 2.546 sq.m/m

表 4-5-7 実験農場の小用水路道路暗渠工調書

Name of F.Ditch	Crossed Farm road	Type	Canal Protection Work	Name of F.Ditch	Crossed Farm road	Type	Canal Protection Work
FDR-1	FRD-1	2	-	FDR-5	FRD-6	1	-
"	FRD-2	2	1	"	FRD-7	1	-
"	FRD-3	2	1	FDR-6	FRD-6	1	-
"	FRD-4	2	-	"	FRD-7	1	-
FDR-2	FRD-6	1	-	FDR-7	-	-	-
"	FRD-7	1	-	FDR-8	FRD-10	1	-
FDR-3	FRD-6	1	-	FDR-9	FRD-10	1	-
"	FRD-7	1	-	"	FRD-11	1	-
FDR-4	FRD-6	1	-	Total	(places)	17	2
"	FRD-7	1	-	(Type-1	13 places)		
				(Type-2	4 places)		

表 4-5-8 実験農場の小用水路道路暗渠工及び水路保護工数量調書

Item	unit	FDR Road Crossing ----- TYPE -------- 1	2	Canal Protection Work	Total
n	Places	13	4	2	17 (2)
Concrete					
200 kg/cu.m		11.7	5.1	-	16.8
Form	㎡	43.1	18.1	-	61.2
Pipe (φ400mm)					
L=2.5m	pc	-	8	-	8
L=3.5m	pc	13	-	-	13
Dry Masonry	㎥	-	-	5.7	5.7

Note; ( ) Canal protection work

第5章　建設計画

第5章　建設計画

5.1.　建設形態

この工事は圃場造成、潅漑・排水路や農道の建設から成り立っている。圃場造成工事の主要工種は表土扱い工、基盤切盛工、整地工と畦畔築立工等から成る。

技術的な観点と工種やその数量を考慮すると、CAPIC事務所による直営工事が望ましい。

5.2.　建設計画

5.2.1.　圃場造成工事

工事開始に当たっては、木、草、茎、石等の圃場造成工事に対する全ての障害物を取り除かねばならない。その後、表土剥取り、基盤切盛り、基盤整地、表土戻し、表土整地の順に工事を行うものとする。これらの作業は主に湿地タイプの16tonブルドーザーにて行なわれる。盛土に際しては、工事終了後の圧密沈下を考慮して、転圧や余盛りに十分注意を払って行なわねばならない。基盤面整地はブルドーザーの3回掛けとし、表土整地はブルドーザー4回掛けとする。表土は表土扱い作業の後、基盤面上で15cm以上を確保せねばならない。

5.2.2.　潅漑施設工事

支線用水路は農道沿いに配置されているので、この建設作業は建設機械による損壊を避けるために、プロジェクトの建設スケジュールの終わり頃に行う。埋戻土の転圧は人力にて行う事が望ましい。

一方、小用水路は土水路であるため、盛土材料を圃場より確保する。それ故、整地工や道路工の施工時に盛土材料を水路用地に確保しておかなければならない。そして、盛土転圧作業は道路転圧と同時に行ない、転圧方法も同じ方法とする。転圧終了後、必要な矩形断面に掘削し、法面整形を行なわねばならない。

道路横断暗渠、分水工等の附帯工は、農道の盛土作業が終了後に建設すべきである。

この建設工事は上流から下流に向かって実施すべきである。

5.2.3.　排水路工事

この水路工事はこの章で述べる他の関連工事に先だって実施されねばならない。排水路は建設期間中、特に冬期の、降雨による過剰水や地下水の排除に有効である。排水路の建設

工事は下流から上流に向かって実施されなければならない。道路との交差点には仮設コンクリート・パイプを据え付けなければならない。

排水路は土水路で計画し、0.3~0.4m^{3}容量の矩形バケットを持つバックホウで掘削作業を行い、ブルドーザーで盛土転圧作業を行う。掘削残土は基盤整地にて処理する。法面仕上げは工事終了直前に行われなければならない。

5.2.4. 農道工事

道路敷巾内の20 cmの表土は道路盛土前に取り除かなくてはならない。盛土材料は周辺の圃場からまかなう。盛土材料の撒出し厚は30 cm以内とし、ブルドーザーにて施工する。盛土転圧もブルドーザー転圧とする。

舗装材料の砂利は地区外から搬入し、工事終了直前に施工する。

5.3. 必要な建設機械

5.3.1. 必要な建設機械の選定

必要な施設の建設には、次の様な建設機械が必要である。ここに述べる建設機械は土の湿潤度や地耐力により変更される。プロジェクト・サイトの土地条件や気象・水文状況から判定して次の様な建設機械が必要になるだろう。しかし、これらの状況が気象などによって変化すれば、この建設機械はもっと効率の良いものに置き換えられる。

- 表土剥作業 : 16ton級 湿地ブルドーザー
- 基盤切盛作業 : 16ton級 湿地ブルドーザー
- 整地作業 : 16ton級 湿地ブルドーザー
- 表土戻作業 : 16ton級 湿地ブルドーザー
- 掘削作業 : 0.3~0.4m^{3}級 バックホウ
- 転圧作業 : 21ton級 標準ブルドーザー
- 撒出し作業 : 21ton級 標準ブルドーザー又は 3.7m級 モーターグレーダー
- 材料運搬 : 11ton級 ダンプトラック
- 積込み.積卸し : 1.4m^{3}級 ドーザーショベル
- コンクリート混合 : 0.5m^{3}級 コンクリートミキサー
- 夜間照明や仮設ポンプの動力 : 20 KVA発電機

5.3.2. 作業能力の算定

建設機械の作業能力は、現地には信頼できる正確な資料がないため、1989年の農林水産省の「土地改良事業積算基準、積算シリーズ No.1」により算定する。必要機械の作業能力は以下の通りである。

(表5-3-1 及び 5-3-9 参照)

作業項目	使用機械	作業能力
1. 基盤切盛作業		
運土距離D=61.6m	16ton 湿地ブルドーザー	21.44 m^3/hr
運土距離D=22.7m	16ton 湿地ブルドーザー	73.76 m^3/hr
2. 整地作業		
基盤切盛地区	16ton 湿地ブルドーザー	0.130 ha/hr
表土扱地区	16ton 湿地ブルドーザー	0.084 ha/hr
3. 表土剥作業	16ton 湿地ブルドーザー	127.5 m^3/hr
4. 道路盛土材料撒出		
転圧合成作業	21ton 標準ブルドーザー	62.09 m^3/hr
5. 道路盛土材料転圧作業	21ton 標準ブルドーザー	141.75 m^3/hr
6. 道路盛土材料撒出作業	21ton 標準ブルドーザー	110.40 m^3/hr
7. 道路舗装材料撒出作業 *1	3 ton 標準ブルドーザー	230 m^2/hr
8. 小形水路掘削作業 *2	矩形0.35m^3容量バックホウ	13.99 m^3/hr

注) *1 撒き出し巾3.0m以上で、同厚さ10 cm以上
*2 掘削断面積1.5m2程度

5.3.3. 機械の月平均稼働日数

月平均稼働日数は11月から3月までの建設期間の降雨と休日(金曜日)とを考慮して算定する。降雨資料は1975年から1985年のバブル・サール観測所を用いた。

圃場整備工における稼働日数の算定には、現地におけるこの種の基準がないため、農林水産省の1989年の農林水産省の「土地改良事業積算基準、積算シリーズ No.3」により算定する。

降雨量	降雨による作業不能日数
0 ~ 4.9 mm	0
5.0 ~ 9.9 mm	降雨日1日に付き0.5日
10.0 ~ 29.9 mm	降雨日1日に付き1.5日
30.0 ~ 49.9 mm	降雨日1日に付き2.5日
50.0 mm 以上	降雨日1日に付き3.5日

以上に加えて宗教上の安息日である金曜日は全ての作業を行わないものとする。以上の計算により月の平均稼働日数は21日となった。残りの9日は降雨や金曜日による作業不能日となる。

5.3.4. 建設機械の必要台数

前述の作業能力、月平均作業日数や建設期間等に基づいて、建設機械の必要台数を求めると表5-3-1 -から5-3-9のようになる。

5.4. 建設スケジュール

建設スケジュールを建設機械の作業能力、作業日数、作業順序と建設期間を考慮して、図5-4-1に示す。

5.5 工事仕様書

次に掲げる工事仕様書は「直営工事」を想定したものである。建設工事の施工管理基準もこの仕様書に掲げてある。この仕様書は、仮設工事、建設機械の動員、土工、コンクリート工事、パイプ工事、石積工事や農道工事等からなる。

CAPIC 実証農場の工事仕様書

1991 年 1 月

国 際 協 力 事 業 団

(JICA)

CONTENTS

SECTION 1. TEMPORARY WORKS AND MOBILIZATION OF CONSTRUCTION EQUIPMENT

101 Temporary Works
102 Mobilization of Equipment

SECTION 2. EARTHWORKS

201 Scope
202 Clearing and Grubbing at Site
203 Stripping, Removal of Top Soil
204 Cutting and Filling for Farmland
205 Land Leveling Work
206 Excavation for Canal
207 Excavation for Structures
208 Embankment and Backfill

SECTION 3. CONCRETE WORKS

301 Scope
302 Cement
303 Water
304 Fine Aggregate
305 Coarse Aggregate
306 Proportion for Concrete Mixes
307 Batching and Mixing
308 Conveying
309 Laying
310 Forms
311 Curing and Protection
312 Reinforcing Steel Bars
313 Tolerance for Concrete Construction
314 Concrete Construction
315 Precast Concrete Construction

SECTION 4. PIPE WORKS

401 Scope
402 Fabrication of R.C. Pipes
403 Construction Method

SECTION 5. STONE WORKS

501 Scope
502 Materials
503 Excavation
504 Dry Masonry
505 Wet Masonry
506 Tolerance

SECTION 6. FARM ROAD WORKS

601 Scope
602 Clearing and Grubbing
603 Stripping of Top soil
604 Excavation for Road Bed
605 Embankment
606 Compaction
607 Testing of Fill
608 Gravel Pavement

SECTION 1. TEMPORARY WORKS AND MOBILIZATION OF CONSTRUCTION EQUIPMENT

101 Temporary Works

The temporary works consist of the following :

(1) Access roads and temporary detours in any places required at the construction.

(2) Temporary drainage canal to drain the site and road crossing infrastructure.

(3) Temporary power and water supplies at the construction site.

102 Mobilization of Equipment

All the necessary construction equipment required for the construction works shall be mobilized and moved into the Project site in time for the respective works programmed prior to construction. Construction Equipment, once moved into the Project area shall not be permitted, prior to the completion of the Contract works, to be moved out or transferred to another project site without the written approval of the Project Engineer.

SECTION 2. EARTHWORKS

201 Scope

This scope covers stripping, excavation of a farmland, land leveling, fill and backfill for structures, surface of soil handling and disposal of excavated materials.

202 Cleaning and Grubbing at Site

(1) Cleaning the right-of-way, borrow, quarry, farmland and stockpiled area will be cleared before construction begins. Such clearing consists of the removal and disposal, in a manner approved by the Engineer, of all trees, stumps, stems, brush, roots, vegetation and other objectionable matters within the work area.

All materials to be burned shall be piled neatly and in a suitable condition shall be burned completely. Special precautions shall be taken at all times to prevent fire from spreading. Necessary and suitable equipment and supplies should be prepared for fire fighting should the need arise.

(2) Grubbing shall consist of the removal of tree stumps, roots, brush, and rubbish from the work area to be occupied by the embankment and permanent structures and from the surface of excavation, and elsewhere as directed by the Engineer. It shall include scraping of the natural ground surface at an adequate depth by all effective means to remove vegetation and other objectionable materials.

The holes resulting from the grubbing up shall be filled with materials approved by the Engineer and then well compacted.

203 Stripping, Removal of Top Soil

The stripped top soil shall be transported and temporarily stored at a place for soil reuse. Before commencing the works, the place for at a storage of the top soil shall be decided upon by the

Engineer. Thickness of stripping of the top soil is 15 centimeters(cm) in depth, unless otherwise shown on the Drawings or directed by the Engineer. The works include stripping, collecting, Loading, hauling, unloading, and stockpiling at a location directed by the Engineer.

204 Cutting and Filling for Farmland

(1) After stripping and removal of the top soil, the subgrade of farmland shall be made as level as possible by cutting and filling. The cutting portion of the subgrade desirable shall be slightly lower than the filling portions The proposed elevation, of subgrade for the lower rice field shall not exceed that of the upper neighboring rice fields.

(2) The leveling of subgrade for farmland shall be regulated within a tolerance approximately 7.5 cm.

(3) Until sufficient the bearing capacity and impermeability for subgrade is obtained, it should be compacted in order to avoid differential settlement and extreme seepage after execution of cutting and filling by the use of a compactor or other appropriate equipment as directed by the Engineer.

205 Land Leveling work

After compaction of cutting and filling works, the stored soil described in Item 203 shall be hauled and refilled at the original place, The leveling of refilled surface shall be performed to avoid uneven land through means approved by the Engineer so as to make the surface of each lot confirm to a tolerance of approximately five(5) cm at five(5) points on each farm lot.

206 Excavation for Canal

Excavation shall be performed in a workmanlike manner and in accordance with the lines, grades and dimensions shown in the Drawings or as directed by the Engineer. Excavation operations shall be such that all materials suitable for embankment shall be separated from objectionable materials that are to be disposed of. All excavated

surfaces shall be trimmed to the required slopes and grades within the following tolerances:

Item	Tolerances
Profile of invert of channel and ditches	3 cm
Profile of operation road and access roads	9 cm
Side slope above minimum elevation of operation roads	30 cm

The extreme of these tolerances should not be continuous beyond a distance of 40 m measured at any place, in any direction, parallel to the excavated surface.

Precautions shall be taken to preserve, in an undisturbed condition, materials beyond the designated lines of excavation and materials loosened beyond the excavation limits resulting from excavation operations. They should be considered defective work and be compacted or removed and replaced with compacted embankment as directed by the Engineer.

207 Excavation for Structures

Excavation generally means the excavation of earth material such as soil, sand and gravel other than rock. Unless otherwise approved, no excavation shall be permitted under water. The site shall be kept well drained and free from inundation caused by rainfall or groundwater during construction.

(1) Excavation of drainage canals and foundation of structures shall be carried out in accordance with the lines, grades, slopes and dimensions as shown the Drawings or as directed by the supervisor or the Engineer.

(2) In case of over excavation which is not approved or directed by the supervisor or the Engineer, the filling and compaction works shall be composed of the same material.

(3) If the required bearing capacity for the structures is not obtained by the excavation shown in the Drawings, the excavation shall continue until the allowed bearing capacity is obtained.

(4) Prior consent is quite essential for carrying out spoil dumping at any place where excavated materials deemed unsuitable as fill material and to be removed to.

(5) Existing concrete and/or brick structures, such as culverts, brick walls, etc., should be demolished and disposed of accordingly.

208 Embankment and Backfill

These items cover the specifications for embankment and backfill works as shown in the Drawings or otherwise as directed by the Engineer. The earth for drainage canal embankment and related structures shall be furnished and positioned. The slope of the embankment shall be made according to the shaping of slope indicated in the Drawings. The backfill, as referred to herein, will be defined as refill works.

(1) The earth for the backfill works should be made free from roots, stones of more than one (1) cm in diameter, and other objectionable matter. Backfill materials shall be placed in layers, with each layer being not more than fifteen (15)cm thick before compaction, and then thoroughly compacted by power compactor(s) or bulldozer(s).

(2) No backfill materials should be placed on concrete structures before a period of fourteen (14) days has elapsed after positioning the concrete.

(3) The embankment works should be carried out in conformity with the lines, grades, and dimensions indicated on the Drawings, unless otherwise directed by the Engineer. The Engineer may instruct the changing of a slope of the embankment works in respect of soil conditions at the site. Such a change will be made according to the quantities of materials available.

(4) Any embankment materials which are rendered unsuitable after being positioned at the site, will be replaced. Such objectionable fill materials shall be re-excavated and removed

for disposed in the spoil area. The excavated area shall be refilled with suitable materials.

(5) Backfill for the construction of the pipeworks shall be carried out after laying the pipes. The backfill up to 60 cm above the top of the pipe shall be made soon after completion of the joints. The heavy equipment, including trucks, should not be used for spreading and rolling compaction of the above-mentioned backfill works.

(6) When sufficient materials for embankment and backfill are unavailable from the ditch materials or earth moving works, additional materials should be obtained from sources directed by the Engineer. The materials should be adequate in quality for such a purpose.

(7) Embankment shall be constructed in horizontal layers which extend the full width of the embankment. The thickness of the layers should not exceed 15 cm after compaction. When a layer of material is dissimilar from the preceding layer, the materials shall be blended by disking, mixing, scarifying, or a combination of these methods. Compacted embankment shall be compacted to not less than 90% compaction when testes in accordance with laboratory compaction test for soils, American Standard for Testing Materials (ASTM) 698-427.

SECTION 3. CONCRETE WORKS

301 Scope

This Section deals with all the concrete construction to be carried out as shown in the Drawings or otherwise directed by the Engineer. This includes the necessary work to :

(1) Furnish all materials, and mix, transport, place, finish, protect and cure concrete.

(2) Furnish, construct, erect and remove forms.

(3) Construct expansion and contraction joints, and furnish and place for water stop, joint fillers and sealing compound.

(4) Furnish, store, cut, bend and properly place the reinforcement steel bars required for the work.

Concrete shall be composed of portland cement, fine and coarse aggregates, water, and if necessary, admixtures or agents approve by the Engineer. The design of concrete mixtures and consistency shall be as specified in this section.

All the applicable provisions of the ASTM or equivalent shall be as specified in this Section.

302 Cement

(1) General : The cement for mortar and concrete works shall be of a quality which conforms to the requirements of the Standard Specification of Portland Cement. Special Cement may be used subject to the approval of the Engineer provided it meets the requirement of Portland Cement with respect to strength, soundness, and setting time.

(2) Storage : The cement, in unbreakable sealed bags shall be stored in a dry, weathertight and properly ventilated warehouse with adequate provisions for the prevention of absorption of moisture. All storage facilities should be to permit easy access for inspection and identification. Sacked cement shall not be stocked higher than 14 sacks for storage for a period of not longer than 30 days and not higher than seven(7) sacks for a

longer period. Any cement stored at the Project site over two (2) months shall not be used unless retest proves that it is satisfactory.

303 Water

The water used in concrete, mortar and grout shall be free from objectional quantities of silt, organic matter, alkali, salts, and other impurities.

304 Fine Aggregate

(1) General : The fine aggregate is used to designate aggregates in which the maximum size of particles is five(5) millimeters(mm) and shall consist of natural sand, manufactured sand, or a combination of both. The shape of particles shall be generally spherical or cubical and reasonably free from flat or elongated particles.

(2) Quality : The sand shall be clean, hard, dense, durable uncoated rock fragments and shall be free from injurious amounts of dirt, organic mater, and other deleterious substances and be well-graded from fine to coarse. The fine aggregates as delivered to the mixer shall have a fineness modulus of not less than 2.30 or more than 3.00. The sum of the percentages of all deleterious substance shall not exceed 5% by weight. Fine aggregates having a specific gravity of less than 2.60 may be rejected.

(3) Storage : Fine aggregates shall be stored in such a manner as to avoid the inclusion of any foreign materials in the concrete. The storage or stock piles shall be constructed so as to prevent segregation. All fine aggregates shall remain in free drainage storage for at least 72 hours prior to use. Sufficient live storage shall be maintained at all times to permit continuous placement of concrete.

305 Coarse Aggregate

(1) General : The coarse aggregate used should be the designated aggregates and of such sizes as to fall within the range of five(5) to 50 mm or any size or range within such limits. It shall consist of natural gravel, crushed rock, or mixture of both. The crushed coarse aggregate shall be generally spherical or cubical and reasonably free from flat or elongates particles.

(2) Quality : The coarse aggregates shall be clean, hard, dense, durable, uncoated rock fragments and shall be free from injurious amounts of dirt, organic matter, and other deleterious substances and be well graded from fine to coarse within the nominal size ranges hereinafter specified in the classes of concrete. Coarse aggregates shall contain not more than 1.5% of materials passing the No.200 sieve by meshing, nor more than 5% of soft fragments. It shall have an abrasion loss of not more than 45% at 500 revolutions. Coarse aggregates having a specific gravity of less than 2.60 may be rejected.

(3) Maximum size : Unless otherwise directed, the maximum sizes of aggregates to be used in concrete for the various parts of the work shall be in accordance with the following:

General Use	Maximum Aggregate Diameter
A. Reinforced Concrete	25 mm
B. Plain Concrete	
For less 7.5 cm in thickness	25 mm
For over 7.5 cm in thickness	40 mm
C. Level Concrete	50 mm

306 Proportion for Concrete Mixes

The proportion for mixtures for all classes of concrete shall be designed to obtain compressive strength within 28 days as directed by the Engineer. The amount of water to be used in the concrete shall be regulated as required to secure concrete of the proper consistency. The slump of concrete at the time of placing shall not exceed 7.5 cm for concrete elsewhere. Mix proportions can be estimated by means of specific examples or available data but should be tested to meet the required strength. In cases where a quantity of concrete is small and

structures are simple, a mix proportion by volume may be permitted by the Engineer as guided below:

Class	Min. 28 days Compressive Strength	Min. Use of Cement	Mix proportions by volume Cement : fine aggregate : Coarse aggregate
A. (reinforced concrete)	210 kg/sq.cm	300 kg/cu.m	cf. 1 : 2 : 4
B. (plain concrete)	180 kg/sq.cm	200 kg/cu.m	cf. 1 : 3 : 6
C. (leveling concrete)	135 kg/sq.cm	150 kg/cu.m	cf. 1 : 4 : 8

Other proportions for mixed design may be directed by the Engineer at the site.

307 Batching and Mixing

(1) Concrete shall be machined-mixed. Hand mixing shall be allowed only in cases of emergency when there is a machine breakdown or malfunction, and in the construction of small structures where the total volume of concrete is less than two(2) cubic meters(cu.m).

(2) Measuring devices shall be suitably designed and constructed for the purpose and shall be weighing separately the cement, fine and coarse aggregates. The accuracy of all weighing devices shall be such that successive quantities can be measured to within 1.0% of the desired weights. Cement in standard bags need not be weighted. The water measuring instruments shall be of such a type as to be readily controlled to obtain an accuracy of 1.5% of the desired quantity of water.

(3) The aggregate shall be dampened by watering if it is drier than the condition known as saturated surface dry.

(4) Cement paste for the first batch shall contain sufficient cement mortar to coat the inside of the drum to avoid the reduction of the required mortar content of the mix.

(5) The mixing time of concrete shall be more than two (2) minutes but less than five (5) minutes. Overmixing, requiring the introduction of additional water to preserve the required consistency, will not be permitted. The mixer shall be

completely emptied before receiving the materials for the succeeding batch and shall be kept clean and washed after stopping work at the end of each shift.

(6) The temperature of the concrete when it is being placed shall be not more than 32°C and not less than 4°C in moderate weather, or 10°C when the mean daily temperature drops below 4°C.

(7) Truck mixer will be permitted only when the mixers and their operation are such that the concrete throughout the mixed batch and from batch to batch is uniform with respect to consistency and grading. Any concrete retained in truck mixers long enough to require additional water to permit satisfactory placing shall be discarded.

308 Conveying

The concrete shall be conveyed from mixer to forms, as rapidly as practicable, by methods which prevent segregation or loss of ingredients. The method and equipment used for transporting concrete, and the time that elapses during transportation, shall be such as to cause no appreciable segregation of coarse aggregate or slump loss in excess of 2.5 cm in the concrete as it is delivered to the work site. Retempering of concrete will not be permitted. There shall be no vertical drop greater than 1.5 meters(m) except where suitable equipment is provided to prevent segregation.

309 Laying

(1) Concrete shall be laid only in the presence of the Engineer or his duly authorized representatives.

(2) All concrete for earth foundations shall be laid upon clean, damp surfaces free from standing or running water. Prior to laying concrete, the earth foundation shall be satisfactorily compacted in accordance with approved methods by the Engineer.

(3) The surface of construction joints shall be clean, rough, and surface dry when covered with fresh concrete or mortar. Cleaning should consist of the removal of all laitance, loose,

or defective concrete, coatings, sand, sealing compound if used, and other foreign materials.

(4) Formed concrete shall be placed in continuous approximately horizontal layers, the depth of which shall generally not exceed 50cm, unless otherwise specified.

(5) The permissible depth of concrete in one lift will be as shown in the detailed Drawings or as directed for each structure by the Engineer. Unless otherwise authorized or shown, lift of mass concrete shall not exceed 1.5 m in height and the minimum of 72 hours should elapse between the placing of each successive lift.

(6) Concrete shall be vibrated until it has been consolidated to the maximum practicable density, is free from rock pockets of coarse aggregate, and fits snugly against all surface of forms and embedded materials by use of mechanical vibrators, sticks, or wooden hammers.

(7) The manipulation of concrete adjacent to the surface of the lift in connection with completing lift placement shall be the minimum necessary to produce not only the degree of consolidation desired in the surface layer of concrete but also a surface with the desired degree of roughness for bonding with the next lift.

(8) Exposed unformed surface of concrete shall be brought to uniform surfaces and worked with suitable tools to a reasonably smooth wood-float or steel-trowel finish as directed.

(9) In laying concrete through reinforcement, care should be taken that no segregation of the coarse aggregate occurs. On the bottom of beams and slabs, where the congestion of steel near the forms makes positioning difficult, a layer of mortar of the same cement-sand ratio as used in the concrete shall be first deposited in order to cover the surface.

310 Forms

(1) Forms shall be used to shape the concrete in the required lines with sufficient strength to withstand the pressure resulting from placement and vibration of the concrete, and shall be maintained rigidly in correct position. Forms shall be sufficiently tight to prevent mortar loss from the concrete.

(2) Chamfer strips shall be placed in the corners of forms for exposed exterior corner so as to produce beveled edges.

(3) At the time concrete is placed in the forms, their surface should be free from any objectionable materials and oiled to prevent sticking.

(4) Form bolts or clamps should be used to fasten forms. The use of ties consisting of spacer and wire instead of clamps will be permitted but spacers must be completely removed before or during the placement of concrete. Bolts or clamps shall be positive in action and shall be sufficient in strength and number to prevent displacement of the forms. They shall be of a type which can be entirely remove or cut back two (2) cm or more below the finished surface of the concrete surface.

(5) Forms shall be removes as soon as possible to enable the earliest practicable repair of surface imperfections, but in no case shall they be removed before approval of the Engineer.

(6) Any necessary repair or treatment shall be performed at once. All porous and fractured concrete shall be removed by chipping openings into the concrete with dimensions as directed, and the chipped openings shall be filled with dry-pack, mortar, or concrete, as directed.

311 Curing and Protection

(1) All concrete shall be kept continuously moist for a period of not less than seven (7) consecutive days after being sprayed by sprinkling, spraying or by other approved method or combination methods applicable to local conditions.

(2) If concrete is cured by membrane curing, it should be sprayed uniformly with sealing compound. The sealing compound shall conform to AASHO Designation : M - 148 Type II.

312 Reinforcing Steel Bars

(1) All steel reinforcing materials for concrete works as indicated on the Drawings shall be furnished. All reinforcement shall be prepared, cleaned, cut, bent and placed, as shown in the detailed Drawings or directed by the Engineer. All chains, supports and ties should be furnished, Reinforcement shall be reasonably free from loose, flaky rust and scale, and free from oil, grease, and other costing which might destroy or reduce its bonding with the concrete.

(2) All steel reinforcement bars shall conform to the requirement of ASTM : A-615 or equivalent standard. All bars shall be of the deformed type unless otherwise specified on the Drawings and shall be Grade 40.

(3) The distance from the center of the main reinforcement to the concrete surface shall be five (5) cm apart from those portions shown in the Drawings. The concrete covering the stirrups, spacing bars, and similar secondary reinforcement may be reduced by the diameter of such bars, unless otherwise indicated by the Engineer.

(4) The splicing length in reinforcement bars shall be at least thirty (30) times the diameter of the bar and should be bound by steel wire.

(5) The reinforcements shall be secured in position by use of metal or concrete supports, spaces, or tie. Such supports shall be of sufficient strength to maintain the reinforcement in place throughout the concreting operation. The supports shall be used in such a manner as to not be exposed or contribute in any way to the discoloration or deterioration of the concrete.

313 Tolerance for Concrete Construction

Variations in alignment, grade and dimensions of the structures from the established alignment, grade and dimensions shown in the Drawings shall be within the tolerances specified in the following tables. Concrete works that exceeds the tolerance limits specified herein may be required to be remedied, or removed and replaced by the Engineer.

(1)	Variation from vertical : In the line & surface of column, piers, and walls.	Exposed in 3 m ..... Backfilled in 3 m	12 mm 20 mm
(2)	Variation from the level or from the grades indicated in the Drawings : - In floors, inverts, ceilings and beam soffits	In 3 m ..... In 12 m more	12 mm 20 mm
(3)	Variation of linear structure lines from established positions in plan and related position of walls :	In any bay or 6 m max . In 12 m more	12 mm 25 mm
(4)	Variation in locations of sleeves and sizes and locations of floor openings and wall openings :	.....	6 mm
(5)	Variation in cross-sectional dimensions of columns, beams, and in the thickness of slabs and walls :	Minus ..... Plus	6 mm 12 mm

314 Concrete construction

All concrete construction shall conform to the provision of the above section and to detailed requirements of the following paragraphs.

(1) All structures shall be built to the specified lines, grades, and dimensions. The location of all construction joints shall be as shown in the Drawings or as instructed by the Engineer. All timber, metal or other accessories necessary for its completion as shown in the Drawings shall be placed and attached to each structure.

(2) The dimensions of each structure shown in the Drawings will be subject to those changes as may be found necessary by the Engineer to adapt the structures to the actual field conditions.

315 Precast Concrete Construction

(1) Precasting of concrete may be resorted to as an alternative to cast-in-situ concrete for certain structures such as small size of canal and other small structures. Reinforced concrete pipes are excluded from this paragraph.

(2) In transporting and placing the precast concrete, extreme care shall be observed in handling, storage, movement and erection to avoid crashing, twisting, or other distortions that will result in cracking or damage to the precast concrete. Precast concrete members shall be handled, transported, and erected in an upright position and the points of support and direction of the reactions with respect to the member shall be approximately the same as when the member is in final position.

(3) Individual components under precast concrete shall conform to the corresponding provision of this section 3 and will be subject to the usual testing for concrete.

SECTION 4. PIPE WORKS

401 Scope

This Section covers fabrication and installation of all pipes, fittings and other incidental appurtenances for turnouts, culverts, canal crossings, drainage crossings, and other structures shown in the Drawings including hauling, laying, installing, jointing and all other works necessary to produce a completed facility.

402 Fabrication of R.C. Pipes

(1) The pipes shall meet the requirements of the Standard Specifications for Reinforced Concrete Culvert Pipes ASTM : C361-571 or the latest revision. Concrete for pipes shall have a minimum compressive strength of 210 kg/sq.cm in 28 days. The maximum size of aggregates shall be 20 mm. Reinforcing bars shall be plain, grade SD 30. Lapping of ends of the ring bars shall not be less than 48 bar diameter.

(2) The quality of all materials, the process of fabrication, and the finished pipes shall be subject to inspection and approved by the Engineer. Such inspection may be made at the place of manufacture, or at the work site after delivery, or at both places, and the pipe shall be subject to rejection at any time on account of failure to meet any of the specification requirements.

403 Construction Method

(1) Care shall be taken during loading, transporting, and unloading to prevent the pipes, fittings, or coatings from damage. Under no circumstance shall pipes or fittings be dropped or rolled against one another. All pipes or fittings shall be examined and no piece shall be installed which is found to be defective.

(2) If any defective pipe or fittings is discovered after it has been installed, it shall be removed and replaced with a sound pipe or fitting in a satisfactory manner.

(3) All pipes and fittings shall be thoroughly clean before installation. Particular care shall be taken not to overstress threaded connections at joints.

(4) Excavation for pipe installation shall be in conformity with Section 2. The bottom of the trench shall be finished accurately according to grade and prepared in such a way to provide a firm and uniform beating throughout the entire pipeline length. In cases where the foundation is composed of a gravel layer, the foundation shall be replaced by suitable soil materials of more than ten (10) cm in thickness. It should be compacted sufficiently under the instruction of the Engineer.

(5) The pipes shall be laid carefully, ends fully and closely jointed, and true to the lines and grades as shown in the Drawings. Each pipe section shall be securely attached to the adjoining section unless otherwise specified and should be filled with stiff mortar.

(6) The mortar shall be placed so as to form a durable watertight joint. After each section of pipe is laid and before the succeeding section is laid, the lower portion of the hub shall be plastered thoroughly on the inside with mortar to such depth as to bring the inner surfaces of the abutting pipes flush and even. After the section is laid, the remainder of the joint shall then be wiped and finished smoothly. After the mortar of the joint sets, the construction of the reinforced concrete collar shall be performed as in the Drawings.

(7) Any pipe which is not in accurate alignment or which shows any undue settlement after being laid, or is damaged, shall be removed and relaid or replaced with a new one.

(8) Cuttings of the pipe shall be kept to the minimum. When the cuts are necessary, they shall be perpendicular to the axis of the pipe and smooth. The cuts should be made with tools in conformity with the pipe manufacture's recommendations or under the instruction of the Engineer.

(9) After the pipes have been installed and the mortar joints and reinforced concrete have sufficiently set, selected materials from excavation or borrow shall be placed alongside the pipes in layers not exceeding 15 cm in thickness and compacted thoroughly, layer upon layer. The backfilling for pipes shall be done simultaneously at both sides and shall conform to the provisions prescribed in Section 2.

SECTION 5. STONE WORKS

501 Scope

The works under this Section shall consist of furnishing and placing appropriate size of stones or spalls for dry masonry and wet masonry with cement mortar, in accordance with the Drawings and this specification or as directed by the Engineer.

502 Materials

(1) The stones consist of round natural stones and shall be sound, tough, durable, dense, resistant to the action of air and water, and suitable in all respects for the purpose intended. Other stones shall not be used unless otherwise specified.

(2) Unless other sizes are shown in the Drawings, stones shall have a thickness of not less than 150 mm, and widths of not less than one and one half(1.5) times their respective thickness, and length of not less than one and one half(1.5) times their respective thickness but not exceeding 300 mm.

(3) Mortar for wet masonry shall consist of one (1) part cement to three (3) parts fine aggregate by volume with sufficient water to produce a thick and creamy mixture conforming to the provisions of Section 3.

503 Excavation

(1) The beds for masonry shall be excavated to the required depths and slope and then trimmed and compacted as shown in the Drawings. All foreign materials such as lumps of earth, wooden pegs and stumps, roots, other debris and water shall be thoroughly removed.

(2) The masonry shall be founded in a toe trench dug in conformity with the Drawings or as instructed by the Engineer. The trench

shall be filled with stone of the same class as that specified for the masonry works unless otherwise specified.

504 Dry Masonry

(1) Stones shall be placed by hand or individually by machines. They shall be laid with close joints and shall be firmly bedded into the slope and against the adjoining stones. Each stone shall be laid with its longest axis perpendicular to the slope in close contact with each adjacent stone.

(2) The stones shall be thoroughly rammed into place and the finished surface shall be presented as even. Interstices between stones shall be filled with small broken fragments firmly wedged into place.

(3) Stones shall be well-arranged in such a manner that they can resist appreciable disturbance. Where big spaces occur between stone and bed surface, the said spaces shall be filled with spalls or appropriate sized stones.

505 Wet Masonry

(1) The wet masonry shall consist of hand placed stones presenting an even exposed surface. Stones shall be placed to form a layer of masonry works with a thickness of 300 mm, perpendicular to the slope, unless otherwise shown in the Drawings.

(2) The interstices and joints shall be filled with mortar consisting of one(1) part cement to three(3) parts fine aggregates or as directed by the Engineer. The materials for mortar are to be mixed shall be accurately measured by volume. The water contents and consistency shall be suitable for workability.

(3) Forty(40) mm weep holes shall be formed in the mortared face at two(2) m spacing vertically and horizontally, unless otherwise shown on the Drawings. The minimum of two(2) weep holes shall be placed in each section of wet masonry.

(4) Within 24 hours of construction, the joints on all exposed faces shall be raked clean of loose mortar and pointed with the specified mortar.

(5) Wet masonry shall be protected from the sun and kept moist for at least the specified time. It shall be protected from freezing during the winter season appropriate measures approved or directed by the Engineer.

(6) All masonry which is damaged shall be removed and replaced.

506 Tolerance

The allowable to tolerances for finished surface shall be :

(1) Protrusions or depressions are not to exceed ten (10) mm above or below the average plane level in any one (1) square meter of surface.

(2) The thickness of masonry works are not to be less than the stated dimensions in the Drawings or under these specifications.

SECTION 6. FARM ROAD WORKS

601 Scope

(1) The farm road works include setting out of alignment, cleaning and grubbing, stripping, excavation, embankment, and gravel pavement.

(2) The location, type, longitudinal profiles, transversal sections and other details of the works shall be in conformity with the Drawings.

602 Cleaning and Grubbing

This work shall be carried out in conformity with the provision of Section 2, "Earth Works".

603 Stripping of Top soil

This works shall be carried out in conformity with the provision of Section 2, "Earth Works".

604 Excavation for Road Bed

Road bed shall be excavated to the elevation as shown in the Drawings or as directed by the Engineer. The excavated materials shall be transported and deposited in the storage pile designated by the Engineer.

605 Embankment

The embankment shall be constructed of suitable materials in accordance with this specification and in conformity with the lines, grade, and dimensions shown in the Drawings or as established by the Engineer.

(1) The area of excavated foundations shall be compacted sufficiently by compactor or by means directed by the Engineer.

(2) Before positioning the first fill on such compacted foundation areas, the surface must be scarified to a depth of not less than 50 mm, in order to roughen the surface and provide good bonding for the fill placed upon it.

(3) The fill shall be placed and spread in continuous layers parallel to the major axis of the farm road.

(4) The spread of each layer shall not exceed 25 cm in thickness.

(5) where the surface has dried too much for proper bonding, it should be uniformly sprinkled with water, scarified, harrowed and mixed until the moisture content of the in-place materials is within the required limits. If the moisture content of the in-place material is higher than the limit required, such fill shall be controlled until its moisture content is within the required limit or it should be removed from the site if directed by the Engineer.

606 Compaction

Each layer of the fill material shall be compacted by an appropriate compactor so that the fill material forms a single homogeneous mass. When so directed by the Engineer, hand-operated heavy duty tampers and/or smooth-faced vibrating rollers shall be used for the compaction of fill material placed in area inaccessible to the compaction equipment selected for normal use. These tampers or rollers shall be air, gasoline, or diesel powered. They shall be easily manoeuvrable and of sufficient capacity to obtain the specified density.

The dry density of the fill shall be not less than the required degree of compaction of 90%.

Note : Degree of compaction

$$= \frac{\text{Dry density of fill in-situ}}{\text{Max. dry density of standard compaction}} \times 100\ (\%)$$

607 Testing of Fill

Compaction or a density test shall be performed every 200 m length of farm roads. Method of testing shall be in accordance with the standard laboratory compaction test in soil, (ASTM : 698-427). The density of fills in place will be determined by using the sand cone method.

608 Gravel Pavement

(1) Aggregates for gravel pavement shall consist of hard, durable particles or fragments of crushed stone, crushed slag, or crushed or natural gravel, and fuller of natural or crushed sand or other finely divided mineral matter. The composite material shall be well distributed in terms of size of particles, and be free from vegetable matter and lumps or balls of clay, and be of such nature that it can be compacted readily to form a firm and stable subgrade.

(2) The aggregates shall be placed as a uniform mixture on a prepared subgrade in a quantity which will provide the required compacted thickness.

(3) Where the required thickness is 150 mm or less, the material may be spread and compacted in one layer. Where the required thickness is more than 150 mm, the aggregate shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of any one layer shall not exceed 150 mm.

(4) The aggregates shall be spread with equipment that will provide a uniform layer which compacted surface elevation will conform to designed level and traverse slopes as shown in the Drawings. The allowable to tolerance shall be as specified hereunder:

Permitted variation from design thickness of layer	± 20 mm
Permitted variation from design level of surface	+ 10 mm - 20 mm
Permitted surface irregularity measured by 3-m straight-edge	± 20 mm

表 5-3-1　ブルドーザーの作業能力の算定(基盤切盛)

1. Working Item : Cutting and filing of earth and top soil treatment works

2. Applied Equipment : Swamp type bulldozer (16 ton class)

3. Equation

$$Q = \frac{60 \cdot q \cdot f \cdot E}{Cm}$$

Where: Q - Workability per hr (cu.m/hr)
q - Capacity per cycle (cu.m)
Bulldozer (Swamp, 16 ton class) 2.09 cu.m
f - Soil conversion factor = 1.00

	Condition of soil			
	Natural	Loose	Compacted	
Sand	1.00	1.20	0.95	
Sandy soil	1.00	1.25	0.90	
Clayey soil	1.00	1.35	0.90	(applied)

E - Work efficiency
Conditions : refer to note
Cm - Necessary time for operation per cycle (min)
Cm = 0.034 · L + 0.25 L - hauling distance (m)
In case of L=61.6m for cutting and filling, Cm=2.34 min
In case of L=22.7m for top soil removal, Cm=1.02 min
In case of L=22.7m for top soil replace, Cm=1.02 min

4. Workability per hr
In case of cutting and filling, Q= 60 x 2.09 x 1.00 x 0.4 / 2.34 = 21.44 cu.m/hr
In case of top soil removal, Q= 60 x 2.09 x 1.00 x 0.6 / 1.02 = 73.76 cu.m/hr
In case of top soil replace, Q= 60 x 2.09 x 1.00 x 0.55 / 1.02 = 67.62 cu.m/hr

5. Necessary working hours and days
5.1 Net working hour (NWH)
1) Cut and fill works : Working volume = 33,840 cu.m
NWH = 33,840 cu.m / 21.44 cu.m/hr = 1,578.4 hr
2) Top soil treatment : Working volume = 5,149 cu.m
NWH = 5,149 cu.m / 73.76 cu.m/hr = 61.5 hr
NMH = 5,149 cu.m / 67.62 cu.m/hr = 76.1 hr

5.2 Working hour per day = 6.1 hr

5.3 Net working day (NWD)
1) Cut and Fill works NWD = 1,578.4 hr / 6.1 hr/day = 258.8 days
2) Top soil removal NWD = 61.5 hr / 6.1 hr/day = 10.1 days
3) Top soil replace NWD = 76.1 hr / 6.1 hr/day = 12.5 days

5.4 Gross working days
1) Cut and Fill works = 258.8 days x 30/21 = 369.7 days
2) Top soil treatment Top soil removal 10.1 days x 30/21 = 14.4 days
Top soil replace 12.5 days x 30/21 = 17.9 days
Note; In a month, the number of rainy days and Friday would calculate at 11 days during the construction period from November to March. The net workable day, therefore, is 21 days a month.

5.5 Necessary number of bulldozer
1) Cut and Fill works
In case of 80 days' construction period, 369.7 / 80 = 4.6 bulldozers
2) Top soil treatment
In case of 30 days' construction period
Top soil removal 14.4 / 30 = 0.5 bulldozer
Top soil replace 17.9 / 30 = 0.6 bulldozer

Note:

1. Work efficiency (E) of Bulldozer for Land Consolidation

Work Item	Work Conditions Good	Fair	Poor	Remarks
1) Top soil removal				
Sandy soil	0.85~0.75	0.75~0.65	0.65~0.55	
Clayey soil	0.75~0.65	0.65~0.55	0.55~0.45	applied
2) Earth moving				
Sandy soil	0.60~0.55	0.55~0.45	0.45~0.40	
Clayey soil	0.50~0.45	0.45~0.35	0.35~0.30	applied
Soil with gravel	0.55~0.50	0.50~0.40	0.40~0.35	
3) Top soil replace				
Sandy soil	0.80~0.70	0.70~0.60	0.60~0.50	
Clayey soil	0.70~0.60	0.60~0.50	0.50~0.40	applied

Remarks:

1. Under the conditions of wide working place, good foundation, high speed working and enough thickness (about 20 cm) of earth volume, the highest E value should be applied.
2. Under the opposite conditions of the above, the lowest E value should be applied.
3. In case that the working condition is ranged between the above, the middle E value would be applied.
4. For the Ultra Swampy Type Bulldozer, the lowest E value would be applied

2. Soil classification:

Categories	Classified soil(s)
Sand	sand
Sandy soil	sandy loam, loam, silty loam
Clayey soil	clay, clay loam
Soil with gravel	gravel, sand with gravel and/or gravel with sand,
Rock	crashed rock

Source:
Cost Estimate Series No.1, Cost Estimate Standard on Land Improvement Project, Ministry of Agriculture, Forestry and Fishery (MAFF), 1989

表 5-3-2 ブルドーザーの作業能力の算定(整地工)

1. Work Item : Land leveling

2. Applied Equipment : Swamp bulldozer (16 ton class)

3. Equation

$$S = So \cdot E$$

Where: S - Workability per hr (ha/hr)
So - Standard workability per hr (0.186 ha/hr)
E - Work efficiency (= 0.7 for cut and fill area)
(= 0.45 for top soil treatment area)

4. Workability per hr
In case of a cut and fill area
S = 0.186 x 0.7 = 0.130 ha/hr
In case of a top soil treatment area
S = 0.186 x 0.45 = 0.084 ha/hr

5. Necessary working hours and days

5.1 Net working hour
- Cut and fill area
Working volume = 35.09 ha
35.09 / 0.13 = 269.9 hr
- Top soil treatment area
Working volume = 3.43 ha
3.43 / 0.084 = 40.8 hr

5.2 Working hour per day = 6.1 hr

5.3 Net working day
Cut and fill area = 269.9 hr / 6.1 hr = 44.2 days
Top soil treatment area = 40.8 hr / 6.1 hr = 6.7 days

5.4 Gross working days
Cut and fill area = 44.2 x 30 / 21 = 63.1 days
Top soil treatment area = 6.7 x 30 / 21 = 9.6 days
In a month, the number rainy days will assume at 9 days during the construction period. The net workable day is 21 days per month.

5.5 Necessary number of bulldozer
Cut and fill area
In case of 30-days working period
63.1 / 30 = 2.1 bulldozers
Top soil treatment area
In case of 10-days working period
9.6 / 10 = 1.0 bulldozers

Note:

1. Standard workability per hour (So)

Equipment	Class	So		
Bulldozer	11 ton	0.177	(ha/hr)	
"	15 "	0.187	"	
Swamp bulldozer	13 "	0.167	"	
"	16 "	0.186	"	(applied)
Ultra S. bulldozer	13 "	0.175	"	
"	18 "	0.214	"	

2. Work efficiency (E)

Work Item	Work Conditions Good	Fair	Poor	
1) Land Leveling				
Back and Fill area	0.90	0.70	0.50	(applied)
Top soil treatment area	0.60	0.45	0.30	(applied)

Remarks:
- Good work condition
  Under the conditions of good foundation, soil with suitable moisture, easy land leveling work, etc.
- Poor work condition
  Under the opposite conditions of the above
- Fair work condition
  Under the conditions between above two conditions
- Working times of land leveling work by above condition are as follows:

Work Item	Work Conditions Good	Fair	Poor
Land Leveling			
Back and Fill area	LSD 2 times	LSD 3~2 times	LSD 4 times
	SSD 1 time	SSD 2 time	SSD 1~2 times
Top soil treatment area	LSD 3~4 times	LSD 4 times	LSD 5 times
	SSD 2 time	SSD 2~3 time	SSD 3~4 times

Remarks: LSD - The bulldozer should move to the direction of the long side of a filed lot.
SSD - The bulldozer should move to the direction of the short side of a filed lot.

表 5-3-3　ブルドーザーの作業能力の算定(表土剥)

1. Work Item : Stripping works

2. Applied equipment : Swamp bulldozer (16 ton class)

3. Equation

$$Q = \frac{60 \cdot q \cdot f \cdot E}{Cm}$$

Where: Q - Workability per hr (cu.m/hr)
q - Capacity per cycle (cu.m)
Bulldozer (Swamp, 16 ton class) 2.09 (applied)
f - Soil conversion factor = 1.00
E - Work efficiency (E= 0.6)
Cm - Necessary time for operation per cycle (min)
Cm = 0.034 . L + 0.25 L - hauling distance (= 10m)
In case of L=10, Cm= 0.59 min

4. Workability per hr
Q= 60 x 2.09 x 1.00 x 0.6 / 0.59 = 127.5 cu.m/hr

5. Necessary working hours and days

5.1 Net working hour
Working volume = 4,604 cu.m (refer to Table 4-4-1)
4,604 / 127.5 = 36.1 hr

5.2 Working hour per day = 6.1 hr

5.3 Net working day = 36.1 hr / 6.1 hr = 5.9 days

5.4 Gross working days = 5.9 x 30 / 21 = 8.4 days
In a month, the number rainy days will assume at 9 days during the construction period. The net workable day is 21 days per month.

5.5 Necessary number of bulldozer
In case of 10-days working period
8.4 / 10 = 0.8 bulldozer

Note:

1. Work efficiency (E)

Work Item	Work Conditions			
	Good	Fair	Poor	
1) Top soil removal				
Sandy soil	0.85~0.75	0.75~0.65	0.65~0.55	
Clayey soil	0.75~0.65	0.65~0.55	0.55~0.45	(applied)
2) Earth movement				
Sandy soil	0.60~0.55	0.55~0.45	0.45~0.40	
Clayey soil	0.50~0.45	0.45~0.35	0.35~0.30	
Soil with gravel	0.55~0.50	0.50~0.40	0.40~0.35	
3) Top soil replace				
Sandy soil	0.80~0.70	0.70~0.60	0.60~0.50	
Clayey soil	0.70~0.60	0.60~0.50	0.50~0.40	

Remarks:

1. Under the conditions of wide working place, good foundation, high speed working and enough thickness (about 20 cm) of earth volume, the highest E value should be applied.
2. Under the opposite conditions of the above, the lowest E value should be applied.
3. In case that the working condition is ranged between the above, the middle E value would be applied.
4. For the Ultra Swampy Type Bulldozer, the lowest E value would be applied

Soil classification:

Categories	Classified soil(s)
Sand	sand
Sandy soil	sandy loam, loam, silty loam
Clayey soil	clay, clay loam
Soil with gravel	gravel, sand with gravel and/or gravel with sand,
Rock	crashed rock

Source:

Cost Estimate Series No.1, Cost Estimate Standard on Land Improvement Project, Ministry of Agriculture, Forestry and Fishery (MAFF), 1988

表 5-3-4 ブルドーザーの作業能力の算定(撒出し･転圧合成作業)

1. Working Item : Combination works of spreading and compaction of embankment materials for road construction

2. Applied Equipment : Standard type bulldozer 21 tons class

3. Equation

$$Q = Qs \times Qc / (Qs + Qc)$$

Where: Q - Workability per hr of combination work (cu.m/hr)
Qs- Workability of spreading (110.4 cu.m/hr)
Qc- Workability of compaction (141.75 cu.m/hr)

4. Workability per hr of Combination Works (Q)

$$Q = 110.40 \times 141.75 / (110.40 + 141.75)$$
$$= 62.09 \text{ cu.m/hr}$$

5. Necessary working hours and days

5.1 Net working hour (NWH)
Working volume = 16,772 cu.m (refer to Table 4-4-2)
NWH = 16,772 cu.m / 62.09 cu.m/hr = 270.12 hr

5.2 Working hour per day = 5.9 hr

5.3 Net working day (NWD)
NWD = 270.12 hr / 5.9 hr/day = 45.8 days

5.4 Gross working days (GWD)
GWD = 45.8 days x 30/21 = 65.4 days

Note; In a month, the number of rainy days and Friday would calculate at 11 days during the construction period from November to March. The net workable day, therefore, is 21 days a month.

5.5 Necessary number of bulldozer
In case of 50 days' construction period, 65.4/50 = 1.3 bulldozers

表 5-3-5 ブルドーザーの作業能力の算定(道路用盛土転圧)

1. Working Item : Compaction of embankment materials for road construction

2. Applied Equipment : Standard type bulldozer 21 tons class

3. Equation

$$Q = \frac{V \cdot W \cdot D \cdot E}{N}$$

Where: Q - Workability per hr (cu.m/hr)
V - Compacting speed (m/hr)
Bulldozer (Standard, 21 ton class) (= 3,500 m/hr)
W - Effective compaction width per operation (= 0.9m)
D - Compacted thickness (= 0.30m)
E - Work efficiency (= 0.6)
N - Necessary number of operation on required compaction (= 4)

2. Workability per hr
3500 x 0.9 x 0.3 x 0.60 / 4 = 141.75 cu.m/hr

Note:

1) Effective compaction width and compacting speed by equipment

Equipment	Class	E. C. Width	C. Speed	
Bulldozer	11 ton	0.7 m	3,500 m/hr	
- do -	15 ton	0.8	"	
- do -	21 ton	0.9	"	(applied)
Vibrating roller	2.5~2.8 ton	0.7	1,000 m/hr	
	3~5 ton	0.8	"	
Tire roller	8~20 ton	1.8	3,500 m/hr	
Swamp Bulldozer	13 ton	1.3 m	3,500 m/hr	
	16 ton	1.5 m	"	

2) Work efficiency

	----- Work Conditions ---			
Equipment Name	Good	Fair	Poor	Remark
Bulldozer	0.80	0.60	0.40	(0.6 is applied.)
Vibrating roller	0.40	0.40	0.40	
Tire roller	0.60	0.40	0.20	
Swamp bulldozer	0.80	0.60	0.40	

Remarks:
(1) Good condition:
In case of good balance between supply of material and workability, good materials for embankment and compaction, no rolling of working place and no obstruction
(2) Fair condition:
condition between good and poor conditions
(3) Poor condition:
In case of bad balance between supply of material and workability, much waiting time, poor materials with much moisture ratio, complicated geographic conditions and much work loss

3) Necessary number of operation on required compaction

Item	Equipment	Class	C.thickness	N.N.of operation	
Road embankment	Bulldozer	15 ton	0.30 m	5 times	
"	"	21 "	0.30 "	4 "	(applied)
Subgrade	"	15 "	0.20 "	7 "	
"	"	21 "	0.20 "	6 "	

表 5-3-6　ブルドーザーの作業能力の算定（道路用盛土撤出し）

1. Working Item : Spreading of embankment materials for road construction

2. Applied Equipment : Standard type bulldozer 21 tons class

3. Equation

$$Q = 10 \cdot E (A \cdot D + B)$$

Where: Q - Workability per hr (cu.m/hr)
E - Work efficiency (= 0.6)
A - Coefficient of Spreading
Bulldozer, Standard, 21 ton class (= 18)
D - Spreading thickness (= 0.30m)
B - Coefficient of Spreading
Bulldozer, Standard, 21 ton class (= 13)

2. Workability per hr (Q)

$$Q = 10 \times 0.6 \times (18 \times 0.3 + 13) = 110.4 \text{ cu.m/hr}$$

Note:

1) Work efficiency

----- Work Conditions ---			
Good	Fair	Poor	Remark
0.80	0.60	0.40	(0.6 is applied.)

Remarks:
(1) Good condition:
In case of good balance between supply of material and workability, good materials for embankment and compaction, no rolling of working place and no obstruction
(2) Fair condition:
condition between good and poor conditions
(3) Poor condition:
In case of bad balance between supply of material and workability, much waiting time, poor materials with much moisture ratio, complicated geographic conditions and much work loss

2) Coefficient of spreading

Equipment	Class	C. of Spreading A	C. of Spreading B	
Bulldozer	3 ton	4	3	
(Standard)	6 "	7	5	
"	9 "	9	7	
"	11 "	11	8	
"	15 "	13	9	
"	21 "	18	13	(applied)
" (swamp)	13 "	10	8	
"	16 "	13	9	

表 5-3-7　ブルドーザーの作業能力の算定(道路舗装材の撤出し)

1. Working Item : Spreading of gravel materials for road pavement
2. Applied Equipment : Standard type bulldozer 3 tons class
3. Applied Condition : The spreading width of a road is more than 3 m. The thickness of materials is more than 10 cm.
4. Workability per hr = 230 sq.m/hr
5. Labor for assistance of spreading works = 0.34 person/100 sq.m
6. Necessary working hours and days

6.1 Net Working Hour (NWH)

- Calculation of Working Volume

Name of Road	Length (m)	Paved Width (m)	Paved Area (sq.m)	By Machine (sq.m)	By Man-Power (sq.m)
TR	1,140.0	4.50	5,130.0	5,130.0	0
FR-1	194.0	3.00	582.0	582.0	0
FR-2	276.5	3.00	829.5	829.5	0
FR-3	290.0	3.00	870.0	870.0	0
FR-4	297.0	2.00	594.0	-	594
FR-5	138.0	3.00	414.0	414.0	0
FR-6	684.0	3.00	2.052.0	2,052.0	0
FR-7	869.0	3.00	2,607.0	2,606.0	0
FR-8	290.5	3.00	871.5	871.5	0
FR-9	452.0	3.00	1.356.0	1,356.0	0
Total	4,631.0		15,306.0	14,712.0	594

Net working hours = 14,712/230 = 64.0 hr

Required man-power = 594 × 0.34/100 = 2.02 man·day

6.2 Working Hour per Day = 5.9 hr (bulldozer)

6.3 Net Working Day (NWD)

NWD = 64.0 hr/5.9 hr/day = 10.8 days by machine

6.4 Cross Working Days (GWD)

GWD = 10.8 days × 30/21 = 15.4 days (by machine)

GWD = 2.02 days × 30/21 = 2.88 man day (by man power)

Note: In a month, the number of rainy days and Friday would calculate at 11 days during the construction period from November to March. The net workable day, therefore, is 21 days a month.

6.5 Necessary Number of Bulldozer

In case of 20 days' construction period, 15.4/20 = 0.77 bulldozer

2.88/20 = 0.1 men

表 5-3-8 バックホウの作業能力の算定(小水路の掘削)

1. Applied Work : Excavation of small scale canal by trapezoid shaped bucket

2. Applied equipment : 0.35 cu.m class backhoe of bucket capacity on trapezoid shape

3. Applied condition : less than 2.5 sq.m of cross sectional area to be excavated

4. Equation

$$V = Vo \cdot E$$
$$E = E1 \cdot E2$$

Where : V = Workability per hr (m/hr)
Vo = Based on the following equation
$Vo = 129.6 \cdot qo \cdot \alpha / A$
qo : Rated capacity (0.35 cu.m)
A : Cross sectional area to be excavated (= 1.5sq.m/m)
α : Coefficient by rotated angle of boom (= 0.89)
E1 = Coefficient by size of cross sectional area to be excavated = $0.23 \cdot A + 0.68 = 0.23 \times 1.5 + 0.68 = 1.03$
E2 = Coefficient by soil and work conditions (= 0.50)

5. Workability per hr
$E = E1 \cdot E2 = 1.03 \times 0.50 = 0.52$ (= 0.515)
$Vo = 129.6 \cdot qo \cdot \alpha / A = 129.6 \times 0.35 \times 0.89 / 1.5 = 26.9$ m/hr
$V = Vo \cdot E = 26.9 \times 0.52 = 13.99$ m/hr

6. Necessary working hours and days

6.1 Net working hour
Working volume = 3,447 m
3,447 / 13.99 = 246.4 hr

6.2 Working hour per day = 6.1 hr

6.3 Net working day = 246.4 hr / 6.1 hr = 40.4 days

6.4 Gross working days = 40.4 days x 30 / 21 = 57.7 days
In a month, the number rainy days will assume at 9 days during the construction period. The net workable day is 21 days per month.

6.5 Necessary number of bulldozer
In case of 45-days working period ·
57.7 / 45 = 1.3 backhoes

Note:

1. Coefficient by rotated angle of boom

Rotated angle(°)	45	90	135	180	
Coefficient(α)	1.00	0.89	0.83	0.76	(applied)

2. Coefficient by soil and work conditions

Soil	Work conditions: Good	Fair	Poor	
Sandy soil	0.75	0.60	0.45	
Clayey soil	0.65	0.50	0.35	(applied)
Soil w/ gravel	0.60	0.45	0.30	

Remarks;

Work conditions in good : in case of loose materials, easy excavation, no obstruction on work and continuous work is available

in poor : in case of stiff materials to be excavated, many obstructions on works and continuous work is difficult.

in fair : In case between goon and poor conditions

表 5-3-9 バックホウの作業能力の算定(掘削)

1. Applied Work : Excavation

2. Applied equipment : 0.35 cu.m class backhoe

3. Applied condition : 1~4m depth to be excavated

4. Equation

$$Q = \frac{3,600 \cdot q \cdot f \cdot E}{Cm}$$

Where : Q = Workability per hr (cu.m/hr)
q = Excavation volume per cycle (cu.m/cycle)
q = qo x K = 0.35 x 0.8 = 0.28
qo : Rated capacity (0.35 cu.m)
K : Coefficient of loading = 0.8

f = Soil conversion factor (f=1,0)
E = Work efficiency (E=0.60)

5. Workability per hr
Q = 3,600 x 0.28 x 1.0 x 0.60 / 30
= 20.16 cu.m/hr

6. Necessary working hours and days

6.1 Net working hour
Working volume = 140.9 cu.m
140.9 / 20.16 = 7.0 hr

6.2 Working hour per day = 6.1 hr

6.3 Net working day = 7.0 hr / 6.1 hr = 1.1 days

6.4 Gross working days = 1.1 days x 30 / 21 = 1.6 days
In a month, the number rainy days will assume at 9 days during the construction period. The net workable day is 21 days per month.

6.5 Necessary number of bulldozer
In case of 2-days working period
1.6 / 2 = 0.8 backhoes

Note:

1. Relation between rotated angle of a boom and circle time

Rotated angle(°)	45	90	135	180
Circle time (sec)	28	30	32	35 (applied)

2. Work efficiency

	Work conditions						
	Natural ground			Loose conditions			
Soil	Good	Fair	Poor	Good	Fair	Poor	
Sandy soil	0.80	0.65	0.50	0.85	0.70	0.55	
Clayey soil	0.75	0.60	0.45	0.80	0.65	0.50	(applied)
Crashed rock	-	-	-	0.65	0.50	0.35	

Remarks;

Work conditions in good : in case of loose ground, 1~4m excavated depth, and no obstruction things, continuous works are available.

in poor : in case of stiff ground to be excavated, obstruction things and continuous work is difficult.

in fair : In case between goon and poor conditions

表 5-3-10 稼働日数の算定(2の1)

Rainfall	1975/76 Nov	Dec	Jan	Feb	Mar	Total
0 to 5mm	25	24	29	20	27	126
5 to 10	1	5	1	4	3	13
10 to 30	2	2	1	5	1	11
30 to 50	2	-	-	-	-	2
MT 50 mm	-	-	-	-	-	-

Rainfall	1976/77 Nov	Dec	Jan	Feb	Mar	Total
0 to 5mm	27	26	20	26	30	129
5 to 10	1	-	4	1	-	6
10 to 30	2	4	5	1	1	13
30 to 50	-	1	2	-	-	3
MT 50 mm	-	-	-	-	-	-

Rainfall	1977/78 Nov	Dec	Jan	Feb	Mar	Total
0 to 5mm	28	23	28	23	28	130
5 to 10	-	6	1	2	-	9
10 to 30	-	1	2	3	3	9
30 to 50	2	1	-	-	-	3
MT 50 mm	-	-	-	-	-	0

Rainfall	1978/79 Nov	Dec	Jan	Feb	Mar	Total
0 to 5mm	21	27	27	21	28	124
5 to 10	2	1	2	4	1	10
10 to 30	4	3	2	3	2	14
30 to 50	1	-	-	-	-	1
MT 50 mm	2	-	-	-	-	2

Rainfall	1979/80 Nov	Dec	Jan	Feb	Mar	Total
0 to 5mm	27	25	25	21	28	126
5 to 10	1	2	1	3	2	9
10 to 30	1	2	5	4	1	13
30 to 50	1	1	-	-	-	2
MT 50 mm	-	1	-	-	-	1

Rainfall	1980/81 Nov	Dec	Jan	Feb	Mar	Total
0 to 5mm	26	24	28	24	26	128
5 to 10	-	-	-	1	2	3
10 to 30	3	7	1	4	3	18
30 to 50	1	-	2	-	-	3
MT 50 mm	-	-	-	-	-	0

Rainfall	1981/82 Nov	Dec	Jan	Feb	Mar	Total
0 to 5mm	27	31	29	20	25	132
5 to 10	-	-	1	3	5	9
10 to 30	2	-	1	5	1	9
30 to 50	1	-	-	-	-	1
MT 50 mm	-	-	-	-	-	0

Rainfall	1982/83 Nov	Dec	Jan	Feb	Mar	Total
0 to 5mm	19	29	24	27	25	124
5 to 10	4	2	3	1	2	12
10 to 30	4	-	3	-	4	11
30 to 50	2	-	1	-	-	3
MT 50 mm	1	-	-	-	-	1

Rainfall	1983/84 Nov	Dec	Jan	Feb	Mar	Total
0 to 5mm	26	26	27	22	30	131
5 to 10	1	1	1	6	-	9
10 to 30	3	3	3	1	1	11
30 to 50	-	-	-	-	-	0
MT 50 mm	-	1	-	-	-	1

Rainfall	1984/85 Nov	Dec	Jan	Feb	Mar	Total
0 to 5mm	19	25	28	20	27	119
5 to 10	6	2	2	4	2	16
10 to 30	4	2	1	4	2	13
30 to 50	1	2	-	-	-	3
MT 50 mm	-	-	-	-	-	0

Note; MT - more than

	Total Rainy Day 0 to 5mm	5 to 10	10 to 30	30 to 50	MT 50mm
1975/76	126	13	11	2	0
1976/77	129	6	13	3	0
1977/78	130	9	9	3	0
1978/79	124	10	14	1	2
1979/80	126	9	13	2	1
1980/81	128	3	18	3	0
1981/82	132	9	9	1	0
1982/83	124	12	11	3	1
1983/84	131	9	11	0	1
1984/85	119	16	13	3	0
Total	1269	96	122	21	5
Average	126.9	9.6	12.2	2.1	0.5
No Work-able Days	0	4.8	18.3	5.3	1.8

Workable days including Friday 126.9 + 9.6 + 12.2 + 2.1 + 0.5 - 4.8 - 18.3 - 5.3 - 1.8 = 121.1

表 5-3-10 稼働日数の算定(2の2)

Rainfall	1975/76 Nov	Dec	Jan	Feb	Mar	Total	1976/77 Nov	Dec	Jan	Feb	Mar	Total
0 to 5mm	3	3	4	3	4	17	4	3	1	3	4	15
5 to 10	-	1	1	1	-	3	-	-	1	-	-	1
10 to 30	1	-	-	-	-	1	-	1	2	1	-	4
30 to 50	-	-	-	-	-	-	-	1	-	-	-	1
MT 50 mm	-	-	-	-	-	-	-	-	-	-	-	-

Rainfall	1977/78 Nov	Dec	Jan	Feb	Mar	Total	1978/79 Nov	Dec	Jan	Feb	Mar	Total
0 to 5mm	4	4	4	4	4	20	4	5	3	4	5	21
5 to 10	-	1	-	-	-	1	-	-	1	-	-	1
10 to 30	-	-	-	-	-	-	-	-	-	-	-	-
30 to 50	-	-	-	-	-	-	-	-	-	-	-	-
MT 50 mm	-	-	-	-	-	-	-	-	-	-	-	-

Rainfall	1979/80 Nov	Dec	Jan	Feb	Mar	Total	1980/81 Nov	Dec	Jan	Feb	Mar	Total
0 to 5mm	4	2	4	4	3	17	4	1	5	3	4	17
5 to 10	1	1	-	-	1	2	-	-	-	-	-	-
10 to 30	-	-	-	-	-	-	-	3	-	1	-	4
30 to 50	-	1	-	-	-	1	-	-	-	-	-	-
MT 50 mm	-	-	-	-	-	-	-	-	-	-	-	-

Rainfall	1981/82 Nov	Dec	Jan	Feb	Mar	Total	1982/83 Nov	Dec	Jan	Feb	Mar	Total
0 to 5mm	4	4	4	3	2	17	2	5	4	4	4	19
5 to 10	-	-	-	-	2	2	2	-	-	-	-	2
10 to 30	-	-	1	1	-	2	-	-	-	-	-	-
30 to 50	-	-	-	-	-	-	-	-	-	-	-	-
MT 50 mm	-	-	-	-	-	-	-	-	-	-	-	-

Rainfall	1983/84 Nov	Dec	Jan	Feb	Mar	Total	1984/85 Nov	Dec	Jan	Feb	Mar	Total
0 to 5mm	2	4	4	3	4	17	4	2	4	3	4	17
5 to 10	-	-	-	-	-	-	-	-	-	-	-	-
10 to 30	2	1	-	1	1	5	1	2	-	1	1	5
30 to 50	-	-	-	-	-	-	-	-	-	-	-	-
MT 50 mm	-	-	-	-	-	-	-	-	-	-	-	-

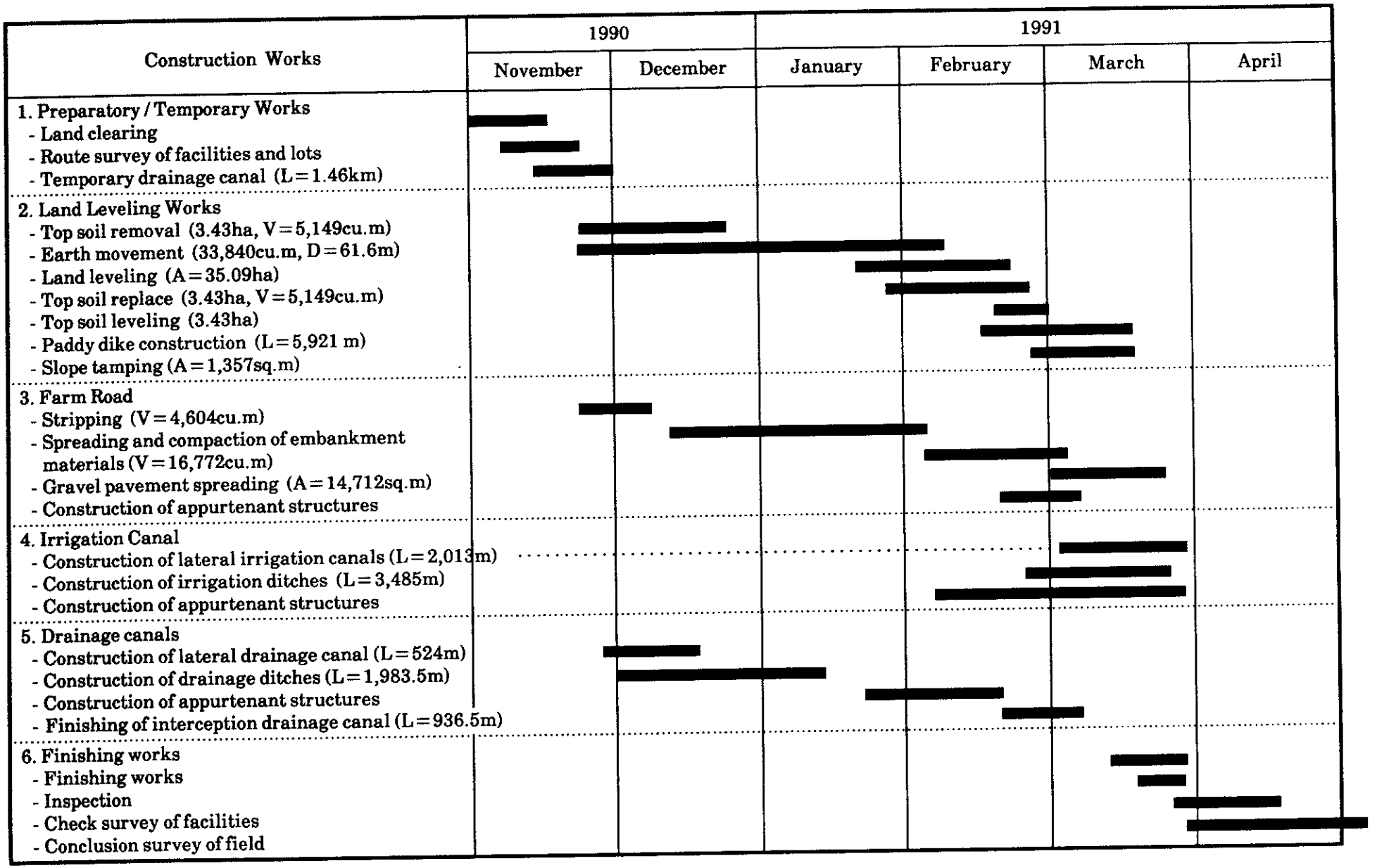
Note: MT - more than

	Total Rainy Day on Friday 0 to 5mm	5 to 10	10 to 30	30 to 50	MT 50mm
1975/76	17	3	1	0	0
1976/77	15	1	4	1	0
1977/78	20	1	0	0	0
1978/79	21	1	0	0	0
1979/80	17	2	0	1	0
1980/81	17	0	4	0	0
1981/82	17	2	2	0	0
1982/83	19	2	0	0	0
1983/84	17	0	5	0	0
1984/85	17	0	5	0	0
Total	177	12	21	2	0
Average	17.7	1.2	2.1	0.2	0.0
No Workable Days	0	0.6	3.2	0.5	0.0

Workable days including Friday 121.1 - 17.7 - 1.2 - 2.1 - 0.5 + 0.6 + 3.2 + 0.5
= 104.2

Average workable days per month = 104.2 / 5 = 20.8 days
say 21 days

図 5-4-1　工事工程表(案)


Construction Works
1990
1991
November
December
January
February
March
April
1. Preparatory / Temporary Works
- Land clearing
- Route survey of facilities and lots
- Temporary drainage canal (L=1.46km)
2. Land Leveling Works
- Top soil removal (3.43ha, V=5,149cu.m)
- Earth movement (33,840cu.m, D=61.6m)
- Land leveling (A=35.09ha)
- Top soil replace (3.43ha, V=5,149cu.m)
- Top soil leveling (3.43ha)
- Paddy dike construction (L=5,921 m)
- Slope tamping (A=1,357sq.m)
3. Farm Road
- Stripping (V=4,604cu.m)
- Spreading and compaction of embankment materials (V=16,772cu.m)
- Gravel pavement spreading (A=14,712sq.m)
- Construction of appurtenant structures
4. Irrigation Canal
- Construction of lateral irrigation canals (L=2,013m)
- Construction of irrigation ditches (L=3,485m)
- Construction of appurtenant structures
5. Drainage canals
- Construction of lateral drainage canal (L=524m)
- Construction of drainage ditches (L=1,983.5m)
- Construction of appurtenant structures
- Finishing of interception drainage canal (L=936.5m)
6. Finishing works
- Finishing works
- Inspection
- Check survey of facilities
- Conclusion survey of field

第6章　工事費

第6章　工事費

6.1.　基本条件

工事費は以下に述べる条件に基づいて積算する。

6.1.1.　積算項目

積算項目は、前章で述べたCAPICの実証農場を建設するに必要な土木工事であり、用地買収、補償、測量、事務費や施工監理費を含まない。

6.1.2.　単価

単価は材料費、労務費と建設機械借上費からなり、1990年10月時点のアモールやその周辺の建設業者や機械ディーラーから収集した。全ての機械借上費用には機械償却費、機械修理費、運転手経費や燃料が含まれている。(図6-1-1から-3参照)

6.2.　工事費

この施設の建設に必要な工事費を表6-2-1と-2に掲げる。

表 6-1-1　単価一覧表

Description	Specifications	Unit	Price (rials)	Remarks
1. Hiring of Machinery				
Bulldozer	15 tons	hr	5,500	
"	21 tons	"	7,500	
Hydraulic	0.3 cu.m	"	6,000	Wheel type
excavator	0.6 cu.m	"	8,000	Crawler type
Loader	1.5 cu.m	"	10,000	Wheel type
Dump truck	4 tons	"	3,500	
"	8 "	"	4,000	
"	11 "	"	5,500	
Cargo truck	1 "	day	15,000	
"	6 "	"	40,000	
"	4 "	hr	3,000	
"	8 "	"	4,000	
"	11 "	"	5,000	
Mini bus		day	20,000	
Water lorry	6 cu.m	hr	5,000	
Truck crane	15 tons	"	10,000	
"	20 "	"	12,000	
Road roller	6-8 "	"	6,000	
Tire roller	9-15 "	"	8,000	
Tamper	60-80 kg	mo	800,000	
Concrete Vibrator	D28 mm	hr	1,300	
Motor Grader	2200 mm	"	12,000	
Submergible pump	D 50, 0.4 kw		380,000	Price robin w/o hose
2. Materials (Iron/Steel)				
Reinforcing bar	#2 mm	kg	1,200	
"	#4 mm	"	1,000	
"	#6 mm	"	780	
"	#8 mm	"	760	
Deformed bar	D10 mm(0.616 kg/m)	m	500	R.6000/12m
"	D12 mm(0.888 kg/m)	"	750	R.9000/12m
"	D14 mm(1.209 kg/m)	"	960	R.11500/12m
"	D20 mm(2.466 kg/m)	"	1,330	R.16000/12m
Steel pipe	dia 2"	m	6,200	R.37000/6m
"	dia 4"	"	9,200	R.55000/6m
Steel plate	t = 9mm	kg	700	
"	t =12mm	"	700	
Equal angle iron	6 x 50 x 50 mm	"	700	
"	7 x 100 x 100 mm	"	1,000	
Nails		"	1,100	
High strength bolts		"	800	
Iron wire		"	1,200	

3. Materials (Concrete/Asphalt)

Portland cement		ton	60,000	(G)
Concrete	200 kg/cu.m	cu.m	9,000	(G) cement only
"	300 kg/cu.m	cu.m	12,000	(G) cement only
Form	Wooden	sq.m	1,500	
RC pipe	Rashid(Guilan)			
dia. 400 mm	t=50 mm, L=3.5 m	pc	95,000	
dia. 500 mm	t=56 mm, L=3.5 m	"	98,000	
dia. 600 mm	t=68 mm, L=3.5 m	"	102,000	
dia.1000 mm	t=95 mm, L=3.5 m	"	127,000	
dia.1250 mm	t=110mm, L=3.5 m	"	148,000	
	Ahwaz(Khuzestan)			Mater.+Trans.
dia. 500 mm	t=65 mm, L=2.5 m	"	37,000	20+17=37,000
dia. 600 mm	t=75 mm, L=2.5 m	"	49,000	26+23=49,000
dia.1000 mm	T=110mm, L=2.5 m	"	114,000	59+55=114,000
Asphalt		ton	40,000	compound

4. Materials (Wood)

Timber	for beams	ton	70,000	domestic
"	for others	cu.m	540,000	imported

5. Materials (Stone/Brick)

Fine aggregate	less than 5mm dia.	cu.m	7,000	for concrete
Broken Stone	20 mm dia.	cu.m	4,000	for concrete
Stone		cu.m	3,000	
Brick		pc	18	

6. Oil/Gas

Gasoline	lit	30	(G)
Kerosene	"	4	(G)
Engine oil	"	250	

7. Glass

Glass	t=4.6mm	sq.m	8,000	domestic
	t= 6 mm	"	25,000	imported

8. Paint

Rust prevention		sq.m	1,000	
Oil paint		kg	3,000	2500/kg
Emulsion	for mortar	sq.m	500	

9. Compound Price

Brick-laying	sq.m	5,000	
Concrete blocks laying	sq.m	4,500	

表 6-1-2 代価一覧表

No.	Work Item	Specification	Unit	Cost (rials)
1	Cut and fill of earth moving	Bulldozer SW-16ton	cu.m	257
2	Cutting and filling of top soil removal	Bulldozer SW-16ton	cu.m	75
3	Cutting and filling of top soil replacement	Bulldozer SW-16ton	cu.m	81
4	Land leveling of earth moving area	Bulldozer SW-16ton	ha	63,308
5	Land leveling of top soil area	Bulldozer SW-16ton	ha	98,726
6	Stripping	Bulldozer SW-16ton	cu.m	43
7	Combination of spreading and compaction works of embankment materials	Bulldozer ST-21ton	cu.m	121
8	Compaction of embankment materials	Bulldozer ST-21ton	cu.m	53
9	Spreading of embankment materials	Bulldozer ST-21 ton	cu.m	68
10-1	Spreading of paving materials (gravel)	Bulldozer ST-3 ton	sq.m	24
10-2	Spreading of paving material (gravel) by manual	manual	sq.m	42
11	Excavation of small canal	Back hoe (0.35cu.m)	m	429
12	Construction of plot dike	machine+manual	m	124
13	Slope tamping	manual	sq.m	133
14-1	Excavation	manual	cu.m	1,050
14-2	Excavation	Backhoe(0.35cu.m)	cu.m	298
15	Backfill	manual	cu.m	249
16-1	Pipe placement	ϕ 400 mm x 3.5m excluding materials	pc	7,297
16-2	Pipe placement	ϕ 500 mm x 3.5m excluding materials	pc	7,297
16-3	Pipe placement	ϕ 600 mm x 3.5m excluding materials	pc	8,097

16-4	Pipe placement	∮ 400 mm x 2.5m excluding materials	pc	3,682
16-5	Pipe placement	∮ 500 mm x 2.5m excluding materials	pc	4,106
16-6	Pipe placement	∮ 600 mm x 2.5m excluding materials	pc	4,429
17-1	Wet masonry	t=30cm including materials	sq.m	6,094
17-2	Wet masonry	t=15cm including materials	sq.m	3,861
18-1	Dry masonry	t=30cm including materials	sq.m	2,110
18-2	Dry masonry	t=15cm including materials	sq.m	1,458
19-1	Mortar	1,100 kg/cu.m	cu.m	75,100
19-2	Mortar	720 kg/cu.m	cu.m	53,350
19-3	Mortar	530 kg/cu.m	cu.m	42,650
20	MOA A-3 Precast concrete canal	50cm (B)x 32cm (H) x 50cm(L)	pc	2,874

表 6-1-3 代価の算定

1. Cut and fill of earth moving
   Equipment : Swampy type Bulldozer (16 ton)
   Workability : 21.44 cu.m/hr (Hauling distance D= 61.6m)
   refer to Table 5-3-1
   Hired charge : 5,500 rials/hr (The cost of 15 ton bulldozer is applied)
   Unit Cost : 5,500 / 21.44 = 257 rials/cu.m

2. Cut and fill of top soil removal
   Equipment : Swampy type Bulldozer (16 ton)
   Workability : 73.76 cu.m/hr (Hauling distance D= 27.2m)
   refer to Table 5-3-1
   Hired charge : 5,500 rials/hr (The cost of 15 ton bulldozer is applied.)
   Unit Cost : 5,500 / 73.76 = 75 rials/cu.m

3. Cut and fill of top soil replacement
   Equipment : Swampy type Bulldozer (16 ton)
   Workability : 67.62 cu.m/hr (Hauling distance D= 27.2m)
   refer to Table 5-3-1
   Hired charge : 5,500 rials/hr (The cost of 15 ton bulldozer is applied.)
   Unit Cost : 5,500 / 67.62 = 81 rials/cu.m

4. Land leveling of earth moving area
   Equipment : Swampy type Bulldozer (16 ton)
   Workability : 0.130 ha/hr (refer to Table 5-3-2)
   Hired charge : 5,500 rials/hr (The cost of 15 ton bulldozer is applied.)
   ①Machine cost : 5,500 / 0.130 = 42,308 rials/ha
   ②Labor Cost : 3,500 rials/day / 6 men/ha = 21,000 rials/ha
   Total(Unit Cost= ① +②) 63,308 rials/ha

5. Land leveling of top soil area
   Equipment : Swampy type Bulldozer (16 ton)
   Workability : 0.084 ha/hr (refer to Table 5-3-2)
   Hired charge : 5,500 rials/hr (The cost of 15 ton bulldozer is applied.)
   ①Machine cost : 5,500 / 0.084 = 65,476 rials/ha
   ②Labor Cost : 3,500 rials/day / 9.5 men/ha = 33,250 rials/ha
   Total(Unit Cost= ① +②) 98,726 rials/ha

6. Stripping works
   Equipment : Swampy type Bulldozer (16 ton)
   Workability : 127.5 cu.m/hr (refer to Table 5-3-3)
   Hired charge : 5,500 rials/hr (The cost of 15 ton bulldozer is applied.)
   Unit Cost : 5,500 / 127.5 = 43 rials/cu.m

7. Combination of spreading and compaction works of embankment materials
   Equipment : Standard type Bulldozer (21 ton)
   Workability : 62.09 cu.m/hr (refer to Table 5-3-4)
   Hired charge : 7,500 rials/hr
   Unit Cost : 7,500 / 62.09 = 121 rials/cu.m

8. Compaction of embankment materials
   Equipment : Standard type Bulldozer (21 ton)
   Workability : 141.75 cu.m/hr (refer to Table 5-3-5)
   Hired charge : 7,500 rials/hr
   Unit Cost : 7,500 / 141.75 = 53 rials/cu.m

9. Spreading of embankment materials
Equipment : Standard type Bulldozer (21 ton)
Workability : 110.4 cu.m/hr (refer to Table 5-3-6)
Hired charge : 7,500 rials/hr
Unit Cost : 7,500 / 110.4 = 68 rials/cu.m

10-1. Spreading of paving materials (gravel) by bulldozer
Equipment : Standard type Bulldozer (3 ton)
Workability : 230 sq.m/hr (refer to Table 5-3-7)
Hired charge : 2,750 rials/hr (50% of the cost of 15 ton bulldozer is assumed)
①Machine cost : 2,750 / 230 = 12 rials/sq.m
②Labor Cost : 3,500 rials/day x 0.34 men/100sq.m = 12 rials/sq.m
Total(Unit Cost= ① +②) 24 rials/sq.m

10-2. Spreading of paving materials (gravel) by manual
Workability 1.2. men/100 sq.m (thickness is more or equal to 10 cm)
Labor cost 3,500 rials/man.day
Unit cost = 3,500 x 1.2/100 sq.m = 42 rials/sq.m

11. Excavation of small canal
Equipment : 0.35 cu.m Backhoe with a trapezoid shaped bucket
Workability : 13.99 m/hr (refer to Table 5-3-8)
Hired charge : 6,000 rials/hr
Unit Cost : 6,000 / 13.99 = 429 rials/m

12. Construction of plot dike
Embankment volume per m (0.3 x 0.9) x 0.3 x 1/2 / 0.9 = 0.2 cu.m/m
Slope tamping volume $\sqrt{2}$ x 0.3 x 2 = 0.85 sq.m/m
①Compaction by Bulldozer 0.2 x 53 rials/cu.m = 11 rials/m
②Slope tamping work by manual =0.85 x 133 rials/sq.m= 113 rials/m
Total(Unit Cost= ① +②) 124 rials/m

13. Slope tamping work by manual
Workability 0.38 men/10 sq.m
Labor cost 3,500 rials/man.day
Unit cost = 3,500 x 0.38/10 sq.m = 133 rials/sq.m

14-1. Excavation by manual
Workability 3.0 men/10 cu.m
Labor cost 3,500 rials/man.day
Unit cost = 3,500 x 3.0/10 cu.m = 1,050 rials/cu.m

14-2. Excavation by machine
Equipment : 0.35 cu.m Backhoe
Workability : 20.16 m/hr (refer to Table 5-3-9)
Hired charge : 6,000 rials/hr
Unit Cost : 6,000 / 20.16 = 298 rials/cu.m

15. Backfill by manual
Workability 0.71 men/10 cu.m
Labor cost 3,500 rials/man.day
Unit cost = 3,500 x 0.71/10 cu.m = 249 rials/cu.m

16-1 to -3. Pipe placement (φ400~600mm L=3.5m)

	Price	Unit	φ400~500mm @	φ400~500mm Cost	φ600mm @	φ600mm Cost
Workability (pcs/day)			12.3	-	11.3	-
Scaffolding man	7,000*1	men	-	-	1.0	7,000
Skilled labor	5,250*2	men	2.0	10,500	1.0	5,250
Common labor	3,500	men	3.5	12,250	3.5	12,250
Truck crane (15ton)	10,000	hr	6.7	67,000	6.7	67,000
Total				89,750		91,500
Unit cost per piece		rials/pc		7,297		8,097

Note; *1 - Assumed price = common labor 3,500 x 2 = 7,000 rials/day
*2 - Assumed price = common labor 3,500 x 1.5 = 5,250 rials/day

16-4 to -6. Pipe placement (φ400~600mm L=2.5m)

	Price	Unit	φ400mm @	φ400mm Cost	500mm @	500mm Cost	φ600mm @	φ600mm Cost
Workability (pcs/day)			14.8	-	13.7	-	12.7	-
Skilled labor	5,250*1	men	2.0	10,500	2.0	10,500	2.0	10,500
Common labor	3,500	men	3.0	10,500	3.5	12,250	3.5	12,250
Truck crane (5ton)	5,000*2	hr	6.7	33,500	6.7	33,500	6.7	33,500
Total				54,500		56,250		56,250
Unit cost per piece		rials/pc		3,682		4,106		4,429

Note; *1 - Assumed price = common labor 3,500 x 1.5 = 5,250 rials/day
*2 - Assumed price = half price of 15 ton truck crane

17-1. Wet masonry (including materials) per sq.m (t=30cm)

Item	Specification	Quant'y	Unit	Price	Cost
-Materials-					
Boulder	φ25 cm ±	0.30	cu.m	3,000	900
Packed concrete	150 kg/cu.m	0.119	cu.m	8,000	952
Backfill gravel	φ5~15 cm	0.339*1	cu.m	3,000	1,017
Packed materials*2		0.068	cu.m	3,000	204
Vinyl pipe*3	φ40mm	0.16	m	5,000	800
Others		0.20	%		775
-Labor-					
Mason		0.063	men	7,000*5	441
Skilled labor		0.018	men	5,250*6	95
Common labor		0.260*4	men	3,500	910
Total					6,094

Note; *1 t=0.30m x 1.0 sq.m x 1.13 = 0.339 cu.m (loss 13%)
*2 20% of backfill gravel = 0.339 x 0.2 = 0.068 cu.m
*3 0.50 m/pc / 3 sq.m = 0.16m/sq.m (1 piece per 3 sq.m)
*4 mason works 0.122 men/sq.m + Packed concrete 0.036 men/sq.m + Backfill gravel 0.34 x 3.0/10cu.m = 0.260 men/sq.m
*5 Assumed price = common labor 3,500 x 2 = 7,000 rials/day
*6 Assumed price = common labor 3,500 x 1.5 = 5,250 rials/day

17-2. Wet masonry (including materials) per sq.m (t=15cm)

Item	Specification	Quant'y	Unit	Price	Cost
-Materials-					
Boulder	φ15 cm ±	0.15	cu.m	3,000	450
Packed concrete	150 kg/cu.m	0.050*1	cu.m	8,000	400
Backfill gravel	φ5~15 cm	0.170*2	cu.m	3,000	510
Packed materials		0.034*3	cu.m	3,000	102
Vinyl pipe	φ40mm	0.16*4	m	5,000	800
Others		0.20			452
-Labor-					
Mason		0.057	men	7,000*6	399

17-2. (continued)

Skilled labor	0.015	men	5,250*7	79
Common labor	0.191*5	men	3,500	669
Total				3,861

Note; *1 t=0.15m x 1.0 sq.m x 1/3 = 0.05 cu.m
Note; *2 t=0.15m x 1.0 sq.m x 1.13 = 0.170 cu.m (loss 13%)
*3 20% of backfill gravel = 0.170 x 0.2 = 0.034 cu.m
*4 0.50 m/pc / 3 sq.m = 0.16m/sq.m (1 piece per 3 sq.m)
*5 mason works 0.110 men/sq.m + Packed concrete 0.030 men/sq.m + Backfill gravel 0.17 x 3.0/10cu.m = 0.191 men/sq.m
*6 Assumed price = common labor 3,500 x 2 = 7,000 rials/day
*7 Assumed price = common labor 3,500 x 1.5 = 5,250 rials/day

18-1. Dry masonry (including Materials) per sq.m (t=0.30m)

Item	Specification	Quant'y	Unit	Price	Cost
-Materials-					
Boulder	ϕ 25 cm ±	0.30	cu.m	3,000	900
Packed gravel	ϕ 5 cm ±	0.118	cu.m	3,000	354
-Labor-					
Mason		0.0147	men	7,000*2	103
Common labor		0.215	men	3,500	753
Total					2,110

Note; *1 t=0.20m x 1.0 sq.m x 1.13 = 0.226 cu.m (loss 13%)
*2 Assumed price = common labor 3,500 x 2 = 7,000 rials/day

18-2. Dry masonry (including Materials) per sq.m (t=0.15m)

Item	Specification	Quant'y	Unit	Price	Cost
-Materials-					
Boulder	ϕ 15 cm ±	0.15	cu.m	3,000	450
Packed gravel	ϕ 5 cm ±	0.05*1	cu.m	3,000	150
-Labor-					
Mason		0.057	men	7,000*2	399
Common labor		0.131	men	3,500	459
Total					1,458

Note; *1 t=0.15m x 1.0 sq.m x 1/3 = 0.05 cu.m
*2 Assumed price = common labor 3,500 x 2 = 7,000 rials/day

19. Mortar per cu.m by manual operation

			Ratio 1:1		Ratio 1:2		Ratio 1:3	
	Price	Unit	@	Cost	@	Cost	@	Cost
Cement	60,000	ton	1.1	66,000	0.72	43,200	0.53	31,800
Sand	7,000	cu.m	0.75	5,250	0.95	6,650	1.05	7,350
Common labor	3,500	men	1.1	3,850	1.0	3,500	1.0	3,500
Total				75,100		53,350		42,650

20. MOA A-3 (Precast Concrete Canal)

Item	Specification	Quant'y	Unit	Price	Cost
-Materials-					
Concrete	300kg/cu.m	0.047	cu.m	12,000	564
Form		0.90	sq.m	1,500	1,350
Mortar 1:2		0.0009*3	cu.m	53,350	48
-Labor-					
Common labor		0.107*1	men	3,500	374
Placement (Common labor)		0.11*2	men	3,500	385
Unloading (Skilled labor)		0.002*3	men	5,250*5	11
" (Common labor)		0.002*4	men	3,500	7
Truck crane (5ton)		0.027*6	hr	5,000*7	135
Total					2,874

Note:

*1 for form composition and dismantling, cleaning, and oil coating
0.90 sq.m x 1.12men/10sq.m = 0.101 men
for curing of concrete
0.31 (0.62 x 0.50) sq.m x 0.2 men/10sq.m = 0.006 men
Total = 0.107 men

*2 21men/100m x 0.5 = 0.11men/m

*3 Caulking mortar 0.0009 cu.m/place

*4 Unloading
Skilled labor 0.0147men/cu.m x 0.74 x 0.39 x 0.5 = 0.002men/pc
Common labor 0.0162men/cu.m x 0.74 x 0.39 x 0.5 = 0.002men/pc

*5 Assumed price = common labor 3,500 x 1.5 = 5,250 rials/day

*6 Hauling of Canals : Truck crane 3.91ton/hr D=500m
2.8ton/time/(0.047x2.3ton) = 25.9 pcs (say = 26 pcs)
3.91/2.8 = 1.4, 26 x 1.4 = 36.4 pcs/hr(= 1/36.4 = 0.027hr/pc)

*7 Assumed price = half price of 15 ton truck crane

表 6-2-1　事業費総括表

(Unit : rials)

Item	Quantity	Unit	Project Cost	Remarks
A. Field Construction	42.78	ha	12,971,751	
B. Irrigation Canals			28,691,743	
C. Drainage Canals	3,447	m	8,649,958	
D. Farm Roads	3,447	m	11,464,946	
E. Experimental Farm	6.42	ha	4,233,996	
F. Preparatory and Temporary Works	42.78	ha	10,067,791	
Sub-total			76,080,185	
G. Physical Contingency (within 10% of above total)		LS	7,607,815	
Total			83,688,000	

表 6-2-2 事業費明細書

Item	Quantities	unit	Unit Cost (rials)	Cost (rials)	Unit price No.
A. Filed construction					
A.1 Earth works					
- Top soil removal	5,149	cu.m	75	386,175	2
- Cutting and filling	33,840	cu.m	257	8,696,880	1
- Land leveling	35.04	ha	63,308	2,218,312	4
- Top soil replacement	5,149	cu.m	81	417,069	3
- Land leveling of top soil treatment area	3.43	ha	98,726	338,630	5
Sub-total				12,057,066	
A.2. Plot dike construction	5,921	m	124	734,204	12
Sub-total				734,204	
A.3. Plot slope tamping work	1,357	sq.m	133	180,481	13
Sub-total				180,481	
Total				12,971,751	
B. Irrigation Canals					
B.1. Irrigation canal construction					
a) Lateral Irrigation Canal (LIC)					
- Concrete (150kg/cu.m)	112.4	cu.m	6,750*1	758,700	T 6-1-1
- Concrete (300kg/cu.m)	324.6	cu.m	12,000	3,895,200	T 6-1-1
- Form	373.7	sq.m	1,500	560,550	T 6-1-1
- Concrete block lining	1,565.4	sq.m	4,500	7,044,300	T 6-1-1
- Brick lining	328.3	sq.m	5,000	1,641,500	T 6-1-1
- Mortar lining (1:2)	29.76	cu.m	53,350	1,587,696	19-2
- Precast C. Canal MOA A-3	588	pcs	2,874	1,689,912	20
- Stripping	2,414	cu.m	43	103,802	6
- Compacted fill	3,738	cu.m	121	452,298	7
- Slope tamping	1,641	sq.m	133	218,253	13
- Excavation	1,649	cu.m	1,050	1,731,450	14-1
- Backfill	448	cu.m	249	111,552	15
- Sand	166	cu.m	3,000	498,000	T 6-1-1
Sub-total				20,293,213	
Note; *1 assumed price = Concrete 200kg/cu.m (9000rials/cu.m) x 75%					
b) Irrigation Ditch (ID)					
- Compacted fill	1,380	cu.m	121	166,980	7
- Excavation (manual)	672	cu.m	1,050	705,600	14-1
- Slope tamping	4,692	sq.m	133	624,036	13
Sub-total				1,496,616	
Total				21,789,829	

B.2. Appurtenant structures

a) Road crossing (n= 7)

- Excavation	89	cu.m	1,050	93,450	14-1
- Backfill	63	cu.m	249	15,687	15
- Concrete(150kg/cu.m)	2.4	cu.m	6,750*1	16,200	
- Concrete(300kg/cu.m)	20.3	cu.m	12,000	243,600	T 6-1-1
- Form	154.7	sq.m	1,500	232,050	T 6-1-1
- Reinforced bar (D10)	2,009.7	m	500	1,004,850	T 6-1-1
- Reinforced bar (D14)	403.8	m	960	387,648	T 6-1-1
Sub-total				1,993,485	

Note; *1 assumed price = Concrete 200kg/cu.m (9000rials/cu.m) x 75%

b) Turn-out (n=10)

- Dry masonry (t=15cm)	12.6	cu.m	1,458	18,371	18-2
- Concrete (300kg/cu.m)	7.6	cu.m	12,000	91,200	T 6-1-1
- Concrete (150kg/cu.m)	1.2	cu.m	6,750*1	8,100	
- Reinforced bar(ϕ 4mm)	0.5	kg	1,000	500	T 6-1-1
- Reinforced bar(D10)	628.9	m	500	314,450	T 6-1-1
- Reinforced bar(D14)	97.5	m	960	93,600	T 6-1-1
- Form	11.9	sq.m	1,500	17,850	T 6-1-1
- Steel plate (t=9mm)	409	kg	700	286,300	T 6-1-1
- Iron gate (1100x600mmx1pc)	103.75	kg	1,000	103,750	T 6-1-1
- Iron gate (400x600mmx1pc)	71.45	kg	1,000	71,450	T 6-1-1
- Iron gate (400x550mmx1pc)	214.35	kg	1,000	214,350	T 6-1-1
- Iron gate (700x500mmx1pc)	97.65	kg	1,000	97,650	T 6-1-1
Sub-total				1,317,571	

Note; *1 assumed price = Concrete 200kg/cu.m (9000rials/cu.m) x 75%

c) Siphon (n=1)

- Excavation(machine)	141	cu.m	298	42,018	14-2
- Backfill	48	cu.m	249	11,952	15
- Compacted fill	208	cu.m	121	25,168	7
- Dry masonry (t=15cm)	12.6	sq.m	1,458	18,371	18-2
- Concrete (300kg/cu.m)	13.9	cu.m	12,000	166,800	T 6-1-1
- Concrete (150kg/cu.m)	0.7	cu.m	6,750*1	4,725	
- Reinforced bar(ϕ 4mm)	0.5	kg	1,000	500	T 6-1-1
- Reinforced bar(D10)	490.9	m	500	245,450	T 6-1-1
- Reinforced bar(D14)	760.6	m	960	730,176	T 6-1-1
- Reinforced bar(D16)	73.3	m	1,145*2	83,929	
- Wet masonry (t=30cm)	4.0	sq.m	6,094	24,376	17-1
- Brick lying	0.4	sq.m	5,000	2,000	T 6-1-1
- Darwell bar (D16)	12	m	1,145*2	13,740	
- Mortar (1:1)	0.034	cu.m	75,100	2,553	19-1
- RC pipe (ϕ 400mm@3.5m)	5	pc	95,000	475,000	T 6-1-1
- Pipe placement (ϕ 400mm@3.5m)	5	pc	7,297	36,485	16-1
Sub-total				1,883,243	

Note; *1 assumed price = Concrete 200kg/cu.m (9000rials/cu.m) x 75%
*2 assumed price = (960rials/m(D14) + 1330(D20))/2 = 1,145 rials/m

d) Spillway (n=2)

- Wet masonry (t=15cm)	31	cu.m	3,861	119,691	17-2
- Dry masonry (t=30cm)	11	cu.m	2,110	23,210	18-1
- Concrete (150kg/cu.m)	0.4	cu.m	6,750*1	2,700	
- Concrete (300kg/cu.m)	3.6	cu.m	12,000	43,200	T 6-1-1
- Form	14.3	sq.m	1,500	21,450	T 6-1-1
- Reinforced bar (D10)	128.3	m	500	64,150	T 6-1-1
Sub-total				274,401	

Note; *1 assumed price = Concrete 200kg/cu.m (9000rials/cu.m) x 75%

e) Parshall flume (n=2)					
- Concrete (150kg/cu.m)	0.4	cu.m	6,750*1	2,700	
- Concrete (300kg/cu.m)	1.7	cu.m	12,000	20,400	T 6-1-1
- Form	16.0	sq.m	1,500	24,000	T 6-1-1
- RC pipe ϕ 400mm@2.5m	2	pc	37,000*2	74,000	T 6-1-1
- Pipe placement	2	pc	3,682	7,364	16-4
Sub-total				128,464	
Note; *1 assumed price = Concrete 200kg/cu.m (9000rials/cu.m) x 75%					
*2 applied the price of 500mm in dia., due to no data					
f) Drainage release (n=6)					
- Wet masonry (t=15cm)	70	sq.m	3,861	270,270	17-1
- Concrete (150kg/cu.m)	0.4	cu.m	6,750*1	2,700	
- Concrete (300kg/cu.m)	1.9	cu.m	12,000	22,800	T 6-1-1
- Form	12.7	sq.m	1,500	19,050	T 6-1-1
- Reinforced bar (ϕ 4mm)	3.0	kg	1,000	3,000	T 6-1-1
- Reinforced bar (D10)	111.6	m	500	55,800	T 6-1-1
- Steel plate(t=9mm)	441	kg	700	308,700	T 6-1-1
- Iron gate (400x550mm)	285.8	kg	1,000	285,800	T 6-1-1
- Stop log (wooden)	0.032	cu.m	540,000	17,280	T 6-1-1
Sub-total				985,400	
Note; *1 assumed price = Concrete 200kg/cu.m (9000rials/cu.m) x 75%					
g) Check gate (n=2)					
- Concrete (150kg/cu.m)	0.1	cu.m	6,750*1	675	
- Concrete (300kg/cu.m)	0.6	cu.m	12,000	7,200	T 6-1-1
- Form	3.9	sq.m	1,500	5,850	T 6-1-1
- Reinforced bar (D10)	51.6	m	500	25,800	T 6-1-1
- Steel plate(t=9mm)	39	kg	700	27,300	T 6-1-1
- Iron gate (800x550mm)	97.65	kg	1,000	97,650	T 6-1-1
- Iron gate (1100x600mm)	97.65	kg	1,000	97,650	T 6-1-1
Sub-total				262,125	
Note; *1 assumed price = Concrete 200kg/cu.m (9000rials/cu.m) x 75%					
i) Drainage release (n=1, ID-8)					
- Wet masonry (t=15cm)	10	sq.m	3,861	38,610	17-2
- Concrete (150kg/cu.m)	0.1	cu.m	6,750*1	675	
- Concrete (300kg/cu.m)	0.3	cu.m	12,000	3,600	T 6-1-1
- Form	2.2	sq.m	1,500	3,300	T 6-1-1
- Reinforced bar (ϕ 4mm)	0.5	kg	1,000	500	T 6-1-1
- Reinforced bar (D10)	3.8	m	500	1,900	T 6-1-1
- Stop log (t=5cm)	0.016	cu.m	540,000	8,640	T 6-1-1
Sub-total				57,225	
Note; *1 assumed price = Concrete 200kg/cu.m (9000rials/cu.m) x 75%					
Total				6,901,914	
G.Total				28,691,743	
C. Drainage canals					
C.1. Drainage canal construction					
- Excavation	3,447	m	429	1,478,763	11
- Compacted fill	730	cu.m	121	88,330	8
- Slope tamping	14,015	sq.m	133	1,863,995	13
Total				3,431,088	

C. 2. Appurtenant structures

a) Drainage road crossing (n=6)					
- Concrete (200 kg/cu. m)	15.5	cu. m	9,000	139,500	T 6-1-1
- Concrete (150 kg/cu. m)	0.5	cu. m	6,750*1	3,375	9000 x 75%
- Form	81.6	sq. m	1,500	122,400	T 6-1-1
- Wet masonry	56.8	sq. m	6,094	346,139	17-1
- Dry masonry	212.7	sq. m	2,110	448,797	18-1
- RC pipe ϕ 600mm @3.5m	6	pcs	102,000	612,000	T 6-1-1
- RC pipe ϕ 600mm @2.5m	6	pcs	49,000	294,000	T 6-1-1
- Pipe placement ϕ 600mm @3.5m	6	pcs	8,097	48,582	16-3
- Pipe placement ϕ 600mm @2.5m	6	pcs	4,429	26,574	16-6
Sub-total				2,041,367	

Note; *1 assumed price = Concrete 200kg/cu. m (9000rials/cu. m) x 75%

b) Drainage check structure					
- Concrete (200 kg/cu. m)	56.1	cu. m	9,000	504,900	T 6-1-1
- Form	298.1	sq. m	1,500	447,150	T 6-1-1
- Dry masonry	842.3	sq. m	2,110	1,777,253	18-1
- Wooden stop log	0.83	cu. m	540,000	448,200	T 6-1-1
Sub-total				3,177,503	
Total				5,218,870	
G. Total				8,649,958	

D. Farm Roads

D. 1. Farm road construction

- Stripping	4,604	cu. m	43	197,972	6
- Compacted fill	16,772	cu. m	121	2,029,421	7
- Slope tamping	7,513	sq. m	133	999,229	13
- Gravel	2,266.3	cu. m	3,000	6,798,900	T 6-1-1
- Gravel paving (machine)	14,712	sq. m	24	353,088	10-1
- Gravel paving (manual)	594	sq. m	42	24,948	10-2
Total				10,403,558	

D. 2. Appurtenant Structures

a) Corner cutting (n=23)					
- Compacted fill	29	cu. m	121	3,509	7
- Slope tamping	51	sq. m	133	6,783	13
Sub-total				10,292	

b) Access road to field (n=24)					
- Compacted fill	155	cu. m	121	18,755	8
- RC pipe ϕ 400 mm @=3.5m	31	pc	95,000	2,945,000	T 6-1-1
- RC pipe ϕ 500 mm @=3.5m	36	pc	98,000	3,528,000	T 6-1-1
- RC pipe ϕ 600 mm @=3.5m	36	pc	102,000	3,672,000	T 6-1-1
- Pipe placement ϕ 400 mm @=3.5m	31	pc	7,297	226,207	16-1
- Pipe placement ϕ 500 mm @=3.5m	36	pc	7,297	262,692	16-2
- Pipe placement ϕ 600 mm @=3.5m	36	pc	8,097	291,492	16-3
- Concrete (200kg/cu. m)	37.4	cu. m	9,000	336,600	T 6-1-1
- Form	122.8	sq. m	1,500	184,200	T 6-1-1
Sub-total				11,464,946	

c) Wet masonry of Piteh Rud (L=165m)					
- Wet masonry (t=30cm)	645.6	sq.m	6,094	3,934,286	17-1
- Concrete(200kg/cu.m)	29.5	cu.m	9,000	265,500	T 6-1-1
- Form	112.6	sq.m	1,500	168,900	T 6-1-1
Sub-total				4,368,686	
Total				15,843,924	
G.Total				26,247,482	

E. Experimental Farm

E.1 Farm Road (L=1,482m)

- Compacted fill	1,278	cu.m	121	154,638	7
- Slope tamping	1,239	sq.m	133	164,787	13
Total				319,425	

E.2 Farm Ditches (L=2,105m)

(1) Canal					
- Compacted fill	425	cu.m	121	51,425	7
- Slope tamping	1,799	sq.m	133	239,267	13
Sub-total				290,692	
(2) FD Road Crossing (n=26 places)					
- Concrete 150kg/cu.m	0.4	cu.m	6,750*1	2,700	
- Concrete 200kg/cu.m	17.2	cu.m	9,000	154,800	T 6-1-1
- Concrete 300 kg/cu.m	0.8	cu.m	12,000	9,600	T 6-1-1
- Form	80.3	sq.m	1,500	120,450	T 6-1-1
- RC pipe ϕ400mm@2.5m	25	pc	37,000	925,000	T 6-1-1
- Pipe placement ϕ400mm@2.5m	25	pc	3,682	92,050	16-4
- Reinforced bar (D10)	57	m	500	28,500	T 6-1-1
Sub-total				1,333,100	
Note; *1 - Assumed cost =concrete 200kg/cu.m (9,000) x 75%					
Total				1,623,792	

E.3 Farm Drain (L=1,197m)

(1) Canal					
- Compacted fill	472	cu.m	121	57,112	7
- Slope tamping	2,431	sq.m	133	323,323	13
Sub-total				380,435	
(2) FD Road Crossing (n=17)					
- Concrete 200kg/cu.m	16.8	cu.m	9,000	151,200	T 6-1-1
- Form	61.2	sq.m	1,500	91,800	T 6-1-1
- RC pipe ϕ400mm@2.5m	8	pc	37,000	296,000	T 6-1-1
- RC pipe ϕ400mm@3.5m	13	pc	95,000	1,235,000	T 6-1-1
- Pipe placement ϕ400mm@2.5m	8	pc	3,682	29,456	16-4
- Pipe placement ϕ400mm@3.5m	13	pc	7,297	94,861	16-1
- Dry masonry (t=30cm)	5.7	sq.m	2,110	12,027	18
Sub-total				1,910,344	
Total				2,290,779	
G.Total				4,233,996	

F. Preparatory and Temporary Works

F.1 Preparatory work

- Land clearing				
427800/900	475	men	4,500	2,137,500
Total				2,137,500

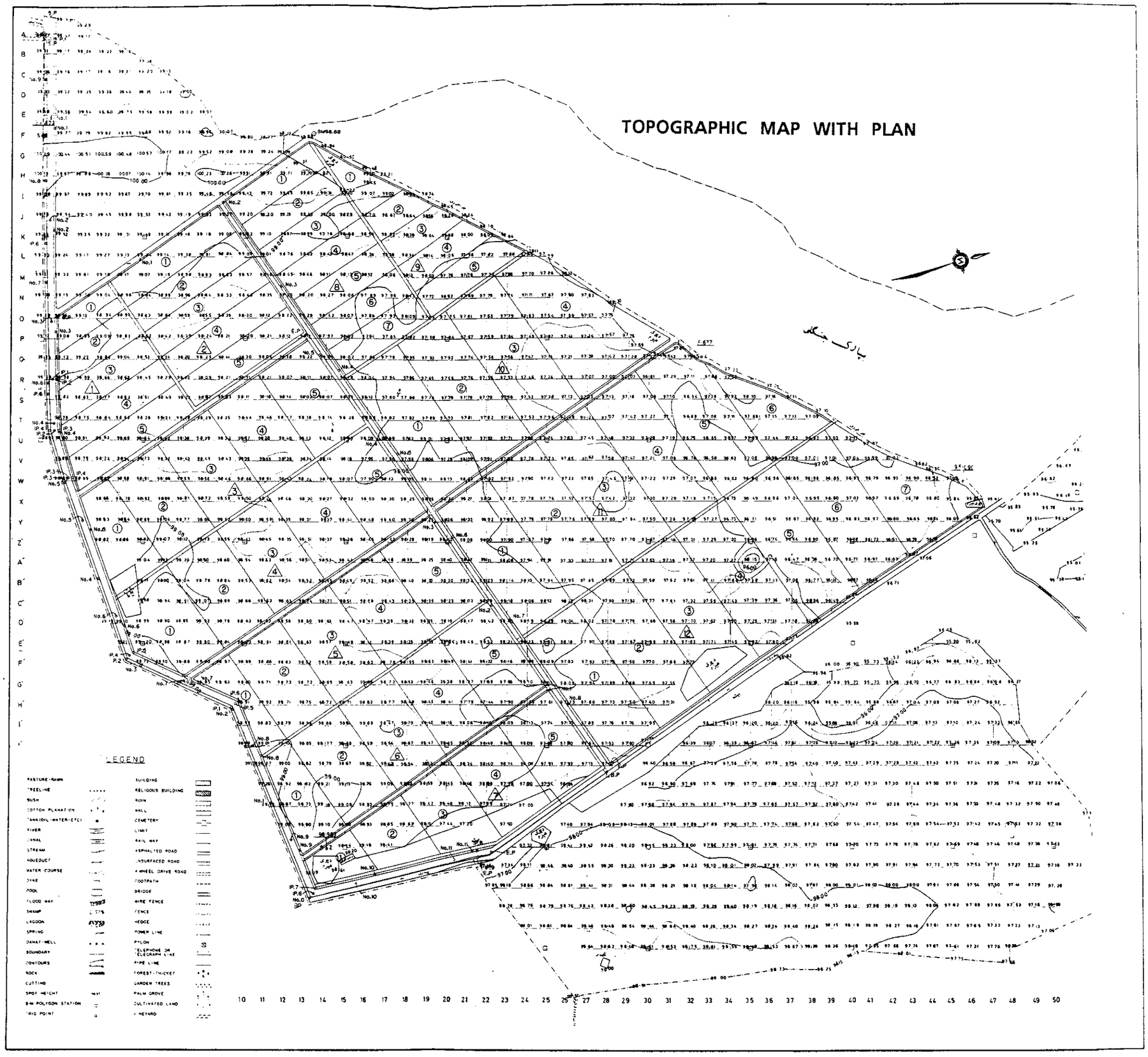
F.2 Temporary work					
- Submergible pump					
81places x 5days/place / 21 days/month	20		month	380,000	7,600,000
- Temporary pipe for Piteh Rud Wet Masonry Work					
dia. 600mm RC pipe@3.5	3		pc	102,000	306,000
Pipe placement dia.600mm@3.5	3		pc	8,097	24,291
Total					7,930,291
G.Total					10,067,791

設　計　図　集

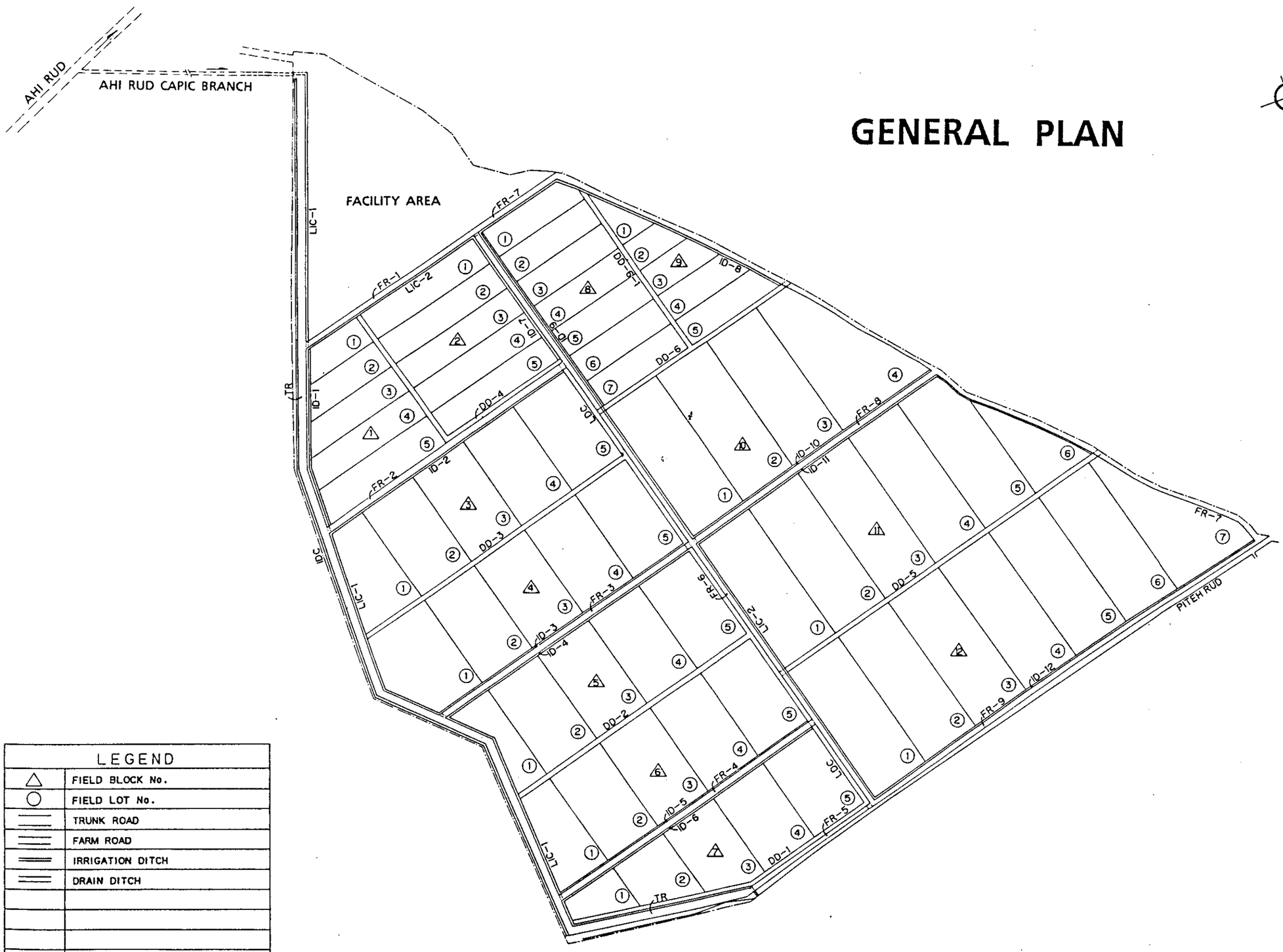
設 計 図 の 目 次

DWG No.	Name
1	Topographic Map with Plan
2	General Plan
3	Vector of Earth Moving
4	Longitudinal Profile LIC-1
5	Longitudinal Profile LIC-2
6	Road Crossing (FR-1), Branch Off, Check Gate (1-1, 2-1), Parshall Flume and Turn-out (ID-1)
7	Road Crossing (FR-2, 3, 4, 8), Check Gate (2-4) and Turn-out (ID-2, 3, 4, 5, 6, 10 and 11)
8	Road Crossing (FR-6), Check Gate (2-2) and Turn-out (ID-7, 8, 9)
9	Spillway and Trunk Road crossing (LIC-1)
10	Lateral Irrigation Canals Spillway 1-2 and Check 1-2
11	Drainage Release and Check Gate (2-3, 2-4, ID-8)
12	Longitudinal Profile of Irrigation Ditches
13	Piteh Rud Siphon (1/2)
14	Piteh Rud Siphon (2/2)
15	Longitudinal Profile of Interception Drainage Canal
16	Longitudinal Profile of LDC-1 and DD-1
17	Longitudinal Profile of DD-2, -3 and -4
18	Longitudinal Profile of DD-5, -6 and -6-1
19	Typical Cross Section of Drainage Canal and Road crossing (Type-A)
20	Road Crossing (Type-B) and Drainage Check Structure
21	Typical Cross Section of Farm Road and Its Appurtenant Structure, and Typical Layout of Field Block
22	longitudinal Profile TR
23	Longitudinal Profile Farm Road -1, -2, and -3
24	Longitudinal Profile Farm Road -4, -5, and -6
25	Longitudinal Profile Farm Road -7
26	Longitudinal Profile Farm Road -8, and -9
27	Layout and Drawings of Experimental Farm and Necessary Facilities

TOPOGRAPHIC MAP WITH PLAN



GENERAL PLAN



LEGEND	
△	FIELD BLOCK No.
○	FIELD LOT No.
═══	TRUNK ROAD
═══	FARM ROAD
═══	IRRIGATION DITCH
═══	DRAIN DITCH

LEGEND	
△	FIELD BLOCK No.
○	FIELD LOT No.
═══	TRUNK ROAD
═══	FARM ROAD
═══	IRRIGATION DITCH
═══	DRAIN DITCH
•	CUT POINT (WEIGHTED AVERAGE)
▲	FILL POINT (#)
294 →	EARTH MOVING and VOLUME

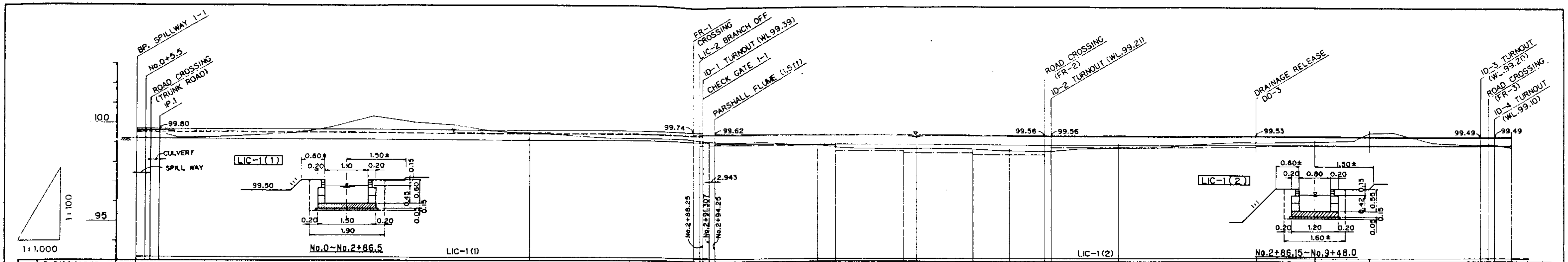
0 50 100 200 300 m
SCALE

MINISTRY OF AGRICULTURE
HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT

VECTOR OF EARTH MOVING

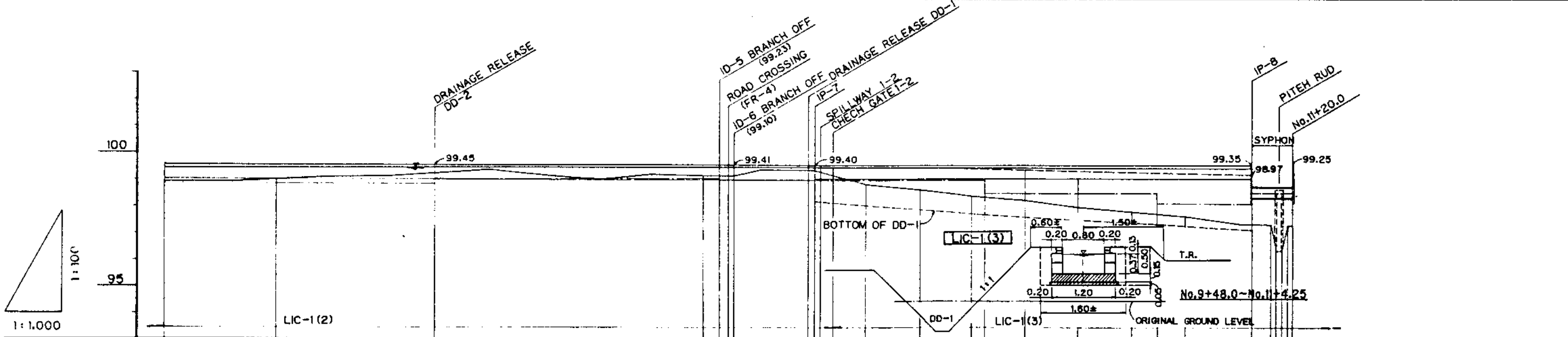
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No.	3	APPROVED	

JAPAN INTERNATIONAL COOPERATION AGENCY



D. DISCHARGE (Lit/sec) / Bed Slope: Q=183 lit/sec, I=1:5,000; Q=144 lit/sec, I=1:3,000; Q=144 lit/sec; Q=139 lit/sec, I=1:3,000

STATION	DISTANCE (m)	CUMULATIVE DISTANCE (m)	ELEVATION (m)	PROPOSED ELEVATION Left (m)	PROPOSED ELEVATION Right (m)	PROPOSED CANAL BOTTOM (m)	PROPOSED WATER LEVEL (m)	CURVE
No.0 +5.5 +8.0 IP.1	0.0 5.5 2.5 4.0	0.0 5.5 8.0 12.0	99.47 99.47		99.50	99.23 99.20 99.20 99.20	99.65 99.65 99.65 99.65	
+20	8.0	20.0	99.24			99.20	99.65	
+40	20.0	40.0	99.26			99.19	99.64	
+60	20.0	60.0	99.33			99.19	99.64	
+80	20.0	80.0	99.50			99.19	99.64	
No.1	20.0	100.0	99.82			99.18	99.63	
+20	20.0	120.0	100.37			99.18	99.63	
+40	20.0	140.0	100.08			99.17	99.62	
+60	20.0	160.0	99.93			99.17	99.62	
+80	20.0	180.0	99.65			99.17	99.62	
No.2	20.0	200.0	99.55			99.16	99.61	
+20	6.5	220.0	99.38			99.16	99.61	
+40	20.0	240.0	99.27			99.15	99.60	
+60	20.0	260.0	99.27			99.15	99.60	
+80 +83 +86.25 +91.307 +94.25	20.0 3.0 3.25 5.057 2.943	280.0 283.0 286.25 291.307 294.25	99.27 99.16 99.16		99.50 98.99	99.14 99.14 99.07	99.59 99.59 99.49	
No.3	5.75	300.0	99.10			99.07	99.49	
+20	20.0	320.0	99.13		98.99 98.87	99.06	99.48	
+40	20.0	340.0	99.00			99.05	99.47	
IP.2	7.0	347.0	99.00			99.05	99.47	
+60	13.0	360.0	98.82		98.87 98.71	99.05	99.47	
+80	20.0	380.0	98.79			99.04	99.46	
IP.3 No.4	17.5 2.5	397.5 400.0	98.80 98.80		98.71 98.60	99.03	99.45	
+20	20.0	420.0	98.81		98.60 98.51	99.03	99.45	
+40 IP.4	20.0 5.0	440.0 445.0	98.69 98.69			99.02 99.02	99.44 99.44	
+60 +63 +66.0	15.0 3.0 3.0	460.0 463.0 466.0	98.69 98.69 98.69		98.51 98.84	99.01 99.01 99.01	99.43 99.43 99.43	
+80	14.0	480.0	98.75			99.01	99.43	
No.5	20.0	500.0	98.83			99.00	99.42	
+20	20.0	520.0	98.82			98.99	99.41	
+40	20.0	540.0	99.00			98.99	99.41	
+60	20.0	560.0	99.10			98.98	99.40	
+70		570.0			98.84 98.93	98.98	99.40	
+80	20.0	580.0	99.05			98.97	99.39	
No.6	20.0	600.0	99.10			98.97	99.39	
+20	20.0	620.0	99.20			98.46	99.38	
IP.5	8.0	628.0	99.60			98.96	99.38	
+40	12.0	640.0	99.60			98.95	99.37	
+60	20.0	660.0	99.10			98.95	99.37	
+80 +85.5 +88.5 +91.5	20.0 5.5 3.0 3.0	680.0 685.5 688.5 691.5	99.00 99.00 99.00 99.00		98.93 98.77	98.94 98.94 98.94	99.36 99.36 99.36	
No.7	8.5	700.0	98.85		98.77	98.93	99.35	



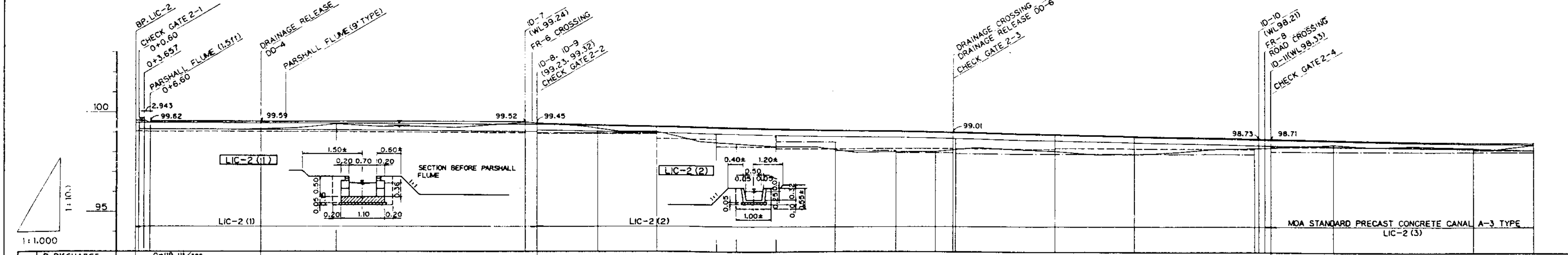
D. DISCHARGE (Lit/sec) / Bed Slope: Q=133 lit/sec; Q=128 lit/sec, I=1:3,000; Q=1230 lit/sec; Q=119 lit/sec

STATION	DISTANCE (m)	CUMULATIVE DISTANCE (m)	ELEVATION (m)	PROPOSED ELEVATION Left (m)	PROPOSED ELEVATION Right (m)	PROPOSED CANAL BOTTOM (m)	PROPOSED WATER LEVEL (m)	CURVE
No.7	8.5	700.0	98.85		98.77	98.93	99.35	
+20	20.0	720.0	98.83			98.93	99.35	
+40 IP.6	20.0 1.5	740.0 741.5	98.91 98.91			98.92	99.34	
+60	18.5	760.0	98.99			98.91	99.33	
+80	20.0	780.0	99.01			98.90	99.32	
No.8	20.0	800.0	99.14		98.77 98.92	98.90	99.32	
+20	20.0	820.0	99.26			98.89	99.31	
+40	20.0	840.0	99.05			98.89	99.31	
+60	20.0	860.0	98.87			98.88	99.30	
+80	20.0	880.0	99.09			98.87	99.29	
No.9	20.0	900.0	99.00		98.92	98.87	99.29	
+6 +9 +12	6.0 3.0 3.0	906.0 909.0 912.0	99.00 99.00 99.00		98.82	98.86	99.28	
+20	8.0	920.0	99.19			98.86	99.28	
+38.8 +40 IP.7 +43 +48	38.8 1.2 2.0 5.0	940.0 941.0 943.0 948.0	99.19 99.19 99.00			98.85 98.85 98.90	99.27 99.27	
+60	12.0	960.0	98.61			98.89	99.26	
+80	20.0	980.0	98.40			98.89	99.26	
No.10	20.0	1000.0	98.20		98.82 98.31	98.88	99.25	
+20	20.0	1020.0	98.00			98.87	99.24	
+40	20.0	1040.0	97.80			98.87	99.24	
+60	20.0	1060.0	97.60		98.31 97.95	98.86	99.23	
+80	20.0	1080.0	97.40			98.85	99.22	
No.11 IP.8 +11 +14 +16 IP.9 +20	20.0 5.0 7.0 2.0 2.0 2.0 2.0	1100.0 1105.0 1112.0 1114.0 1116.0 1118.0 1120.0	97.20 97.20 97.20 96.16 96.15 97.15	98.97 98.97	97.95	98.85 98.85 98.75	99.22 99.22 99.12	

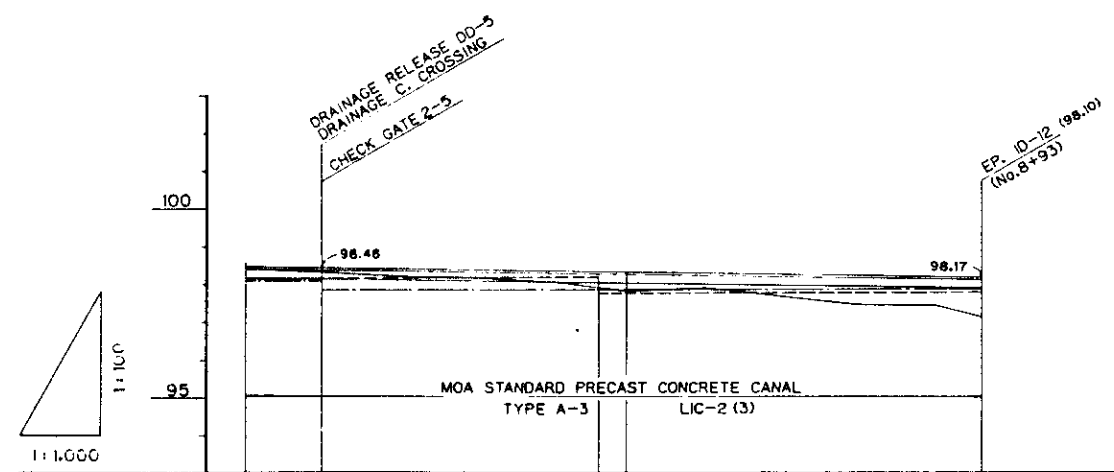
NOTE: 1. ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

2. ϕ—DR/SEC—ϕ SHOWING DISCHARGE ON IRRI.-CUM-DRAINAGE SYSTEM.

MINISTRY OF AGRICULTURE HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT			
LONGITUDINAL PROFILE LIC-1			
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No. 4		APPROVED	
JAPAN INTERNATIONAL COOPERATION AGENCY			



STATION	D. DISCHARGE (Lit/sec) / Bed Slope	WATER LEVEL (m)	CANAL BOTTOM (m)	ELEVATION Right (m)	ELEVATION Left (m)	ELEVATION (m)	CUMULATIVE DISTANCE (m)	DISTANCE (m)	CURVE
No.0	Q=119 lit/sec; Q=116 lit/sec, I=1:2,000	99.59	99.14	98.99	99.50	99.16	0.0	0.0	
+3.657		99.59	99.14				3.657	3.657	
+6.60		99.48	99.12				6.600	2.943	
+20		99.47	99.11			99.10	20.0	13.40	
+40		99.46	99.10			99.05	40.0	20.0	
+60		99.45	99.09	98.99		99.10	60.0	20.0	
+62		99.45	99.09	98.94			62.0		
+80		99.44	99.08			99.17	80.0	20.0	
No.1		99.43	99.07			99.34	100.0	20.0	
+20		99.42	99.06			99.24	120.0	20.0	
+40		99.41	99.05			99.25	140.0	20.0	
+60		99.40	99.04			99.18	160.0	20.0	
+80		99.39	99.03			99.33	180.0	20.0	
+94.05		99.38	99.02 / 99.02	98.94	99.50	99.43	194.05	14.05	
No.2	Q=107 lit/sec, I=1:500	99.38	99.13	98.94	98.96	99.42	200.0	20.0	
+20		99.34	99.09			99.29	220.0	20.0	
+40		99.30	99.05		98.96 / 98.94	99.02	240.0	20.0	
+60		99.26	99.01	98.94 / 98.65	98.94 / 98.93	99.01	260.0	20.0	
+80		99.22	98.97	98.65 / 98.27	98.93 / 98.86	98.48	280.0	20.0	
No.3		99.18	98.93			98.38	300.0	20.0	
+20		99.14	98.89	98.27 / 98.20	98.86 / 98.56	98.28	320.0	20.0	
+40		99.10	98.85			98.29	340.0	20.0	
+50				98.20 / 98.14	98.56 / 98.11		350.0	10.0	
+60		99.06	98.81			98.00	360.0	10.0	
+80		99.02	98.77		98.11	98.04	380.0	20.0	
No.4		98.98	98.73			98.06	400.0	20.0	
+ 9		98.96	98.71		97.98 / 97.94	98.18	409.0	9.0	
+20		98.94	98.69			98.25	420.0	11.0	
+40		98.90	98.65			98.12	440.0	20.0	
+60		98.86	98.61	98.14 / 98.19		98.06	460.0	20.0	
+80		98.82	98.57			97.89	480.0	20.0	
No.5		98.78	98.53			97.92	500.0	20.0	
+20		98.74	98.49			98.00	520.0	20.0	
+40		98.70	98.45			98.19	540.0	20.0	
+60		98.66	98.41	98.19	97.94	98.26	560.0	20.0	
+62.5		98.65	98.41			98.26	562.5	2.5	
+65.5		98.65	98.40			98.26	565.5	3.0	
+68.5	Q=100 lit/sec; Q=91 lit/sec, I=1:600	98.64	98.39	98.28	98.07	98.26	568.5	3.0	
+80		98.62	98.37			98.36	580.0	11.5	
No.6		98.59	98.34			98.40	600.0	20.0	
+20		98.55	98.30			98.28	620.0	20.0	
+40		98.52	98.27			98.35	640.0	20.0	
+60		98.49	98.24			98.23	660.0	20.0	
+80		98.45	98.20	98.28 / 98.14		98.18	680.0	20.0	
No.7		98.42	98.17	98.14	98.09	98.40	700.0	20.0	



STATION	D. DISCHARGE (Lit/sec) / Bed Slope	WATER LEVEL (m)	CANAL BOTTOM (m)	ELEVATION Right (m)	ELEVATION Left (m)	ELEVATION (m)	CUMULATIVE DISTANCE (m)	DISTANCE (m)	CURVE
No.7	Q=100 lit/sec	98.42	98.17	98.14		98.40	700.0	20.0	
+20	Q=91 lit/sec, I=1:600	98.39	98.14		98.07 / 97.83	98.23	720.0	20.0	
+40		98.35	98.10			98.16	740.0	20.0	
+60		98.32	98.07			98.09	760.0	20.0	
+80		98.29	98.04			98.00	780.0	20.0	
No.8		98.25	98.00	98.14 / 97.74		97.73	800.0	20.0	
+20		98.22	97.97			97.85	820.0	20.0	
+40		98.19	97.94			97.61	840.0	20.0	
+60		98.15	97.90			97.40	860.0	20.0	
+80		98.12	97.87			97.40	880.0	20.0	
EP (No.8+93)		98.10	97.85	97.74	97.83	97.07	893.0	13.0	

NOTE: 1. ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

2. ϕ—ϕ SHOWING DISCHARGE ON IRRI.-CUM-DRAINAGE SYSTEM.

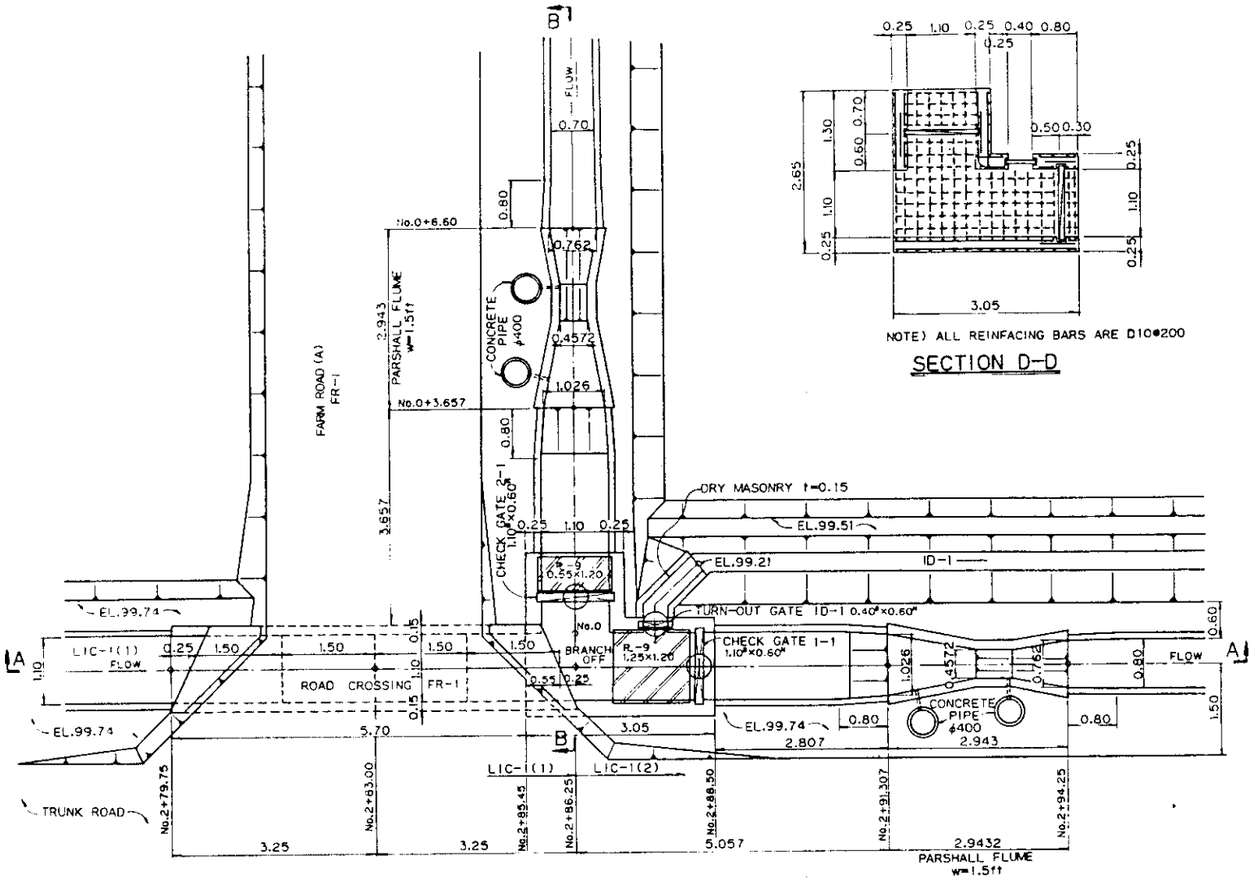
MINISTRY OF AGRICULTURE

HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT

LONGITUDINAL PROFILE LIC-2

SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No.	5	APPROVED	

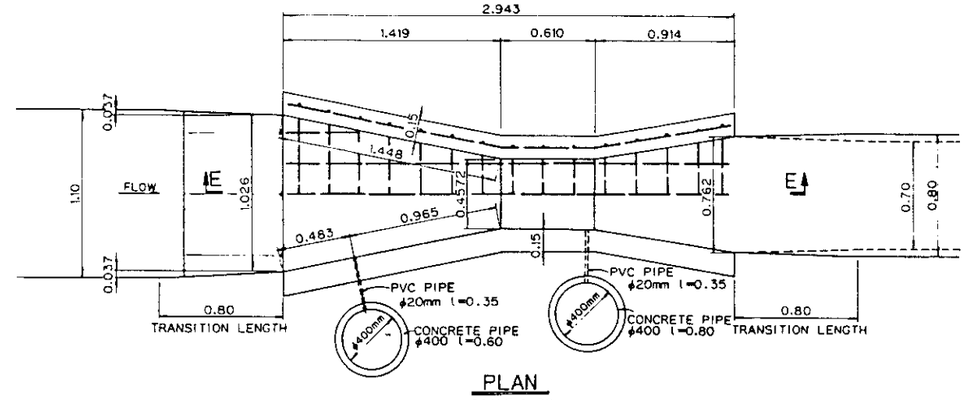
JAPAN INTERNATIONAL COOPERATION AGENCY



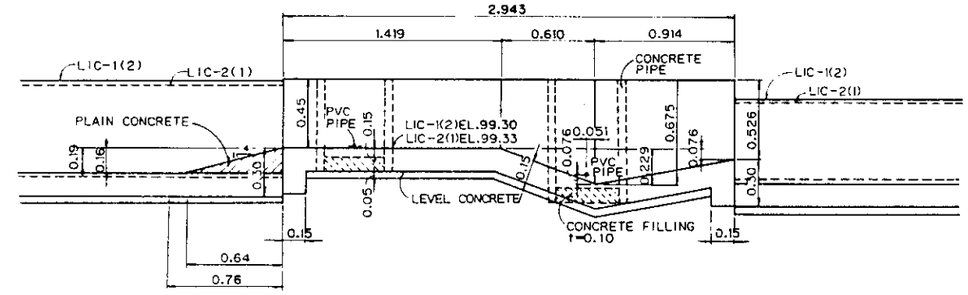
PLAN
SCALE 1:50

NOTE) ALL REINFACING BARS ARE D10@200

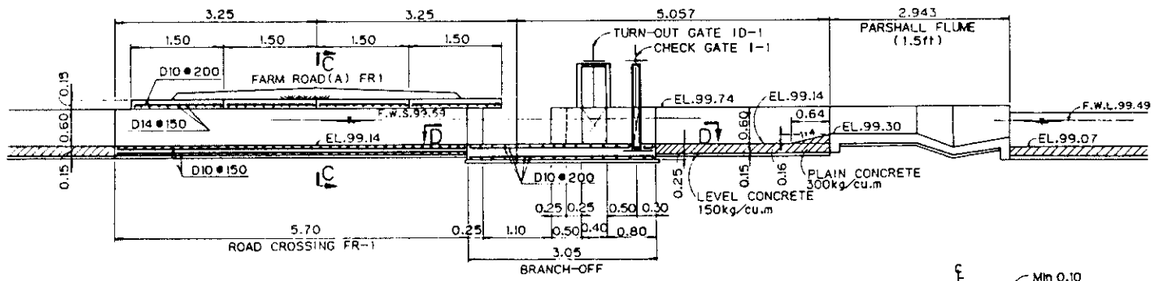
SECTION D-D



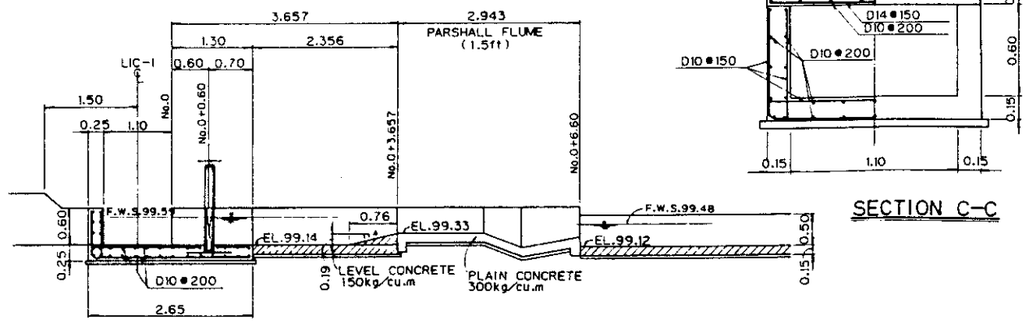
PLAN
SCALE 1:20



SECTION
SCALE 1:20

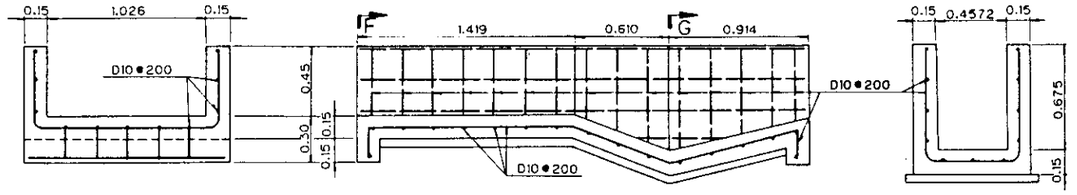


SECTION A-A
SCALE 1:50



SECTION B-B
SCALE 1:50

SECTION C-C



SECTION F-F
SCALE 1:20

SECTION E-E
SCALE 1:20

SECTION G-G
SCALE 1:20

PARSHALL FLUME

NOTE : ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

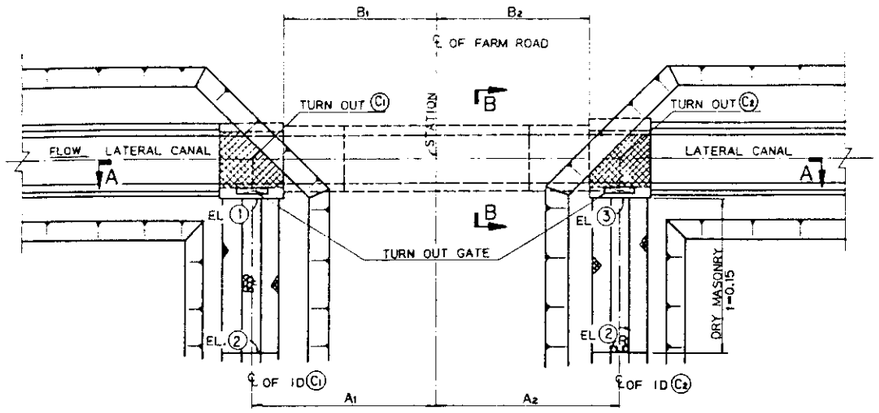
MINISTRY OF AGRICULTURE

HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT

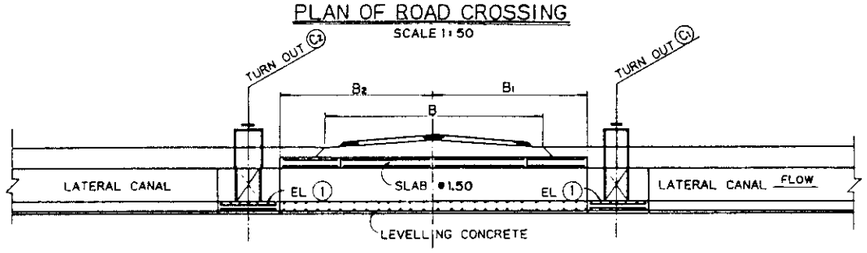
ROAD CROSSING (FR-1).
BRANCH OFF, CHECK GATE (1-1, 2-1)
PARSHALL FLUME AND TURN-OUT (ID-1)

SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No.	6	APPROVED	

JAPAN INTERNATIONAL COOPERATION AGENCY

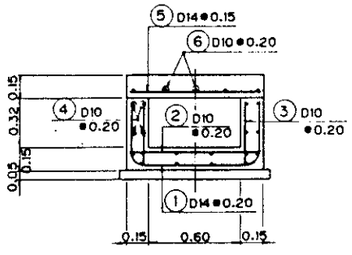


PLAN OF ROAD CROSSING
SCALE 1:50



SECTION A-A
SCALE 1:50

SECTION B-B(TYPE A)
SCALE 1:20

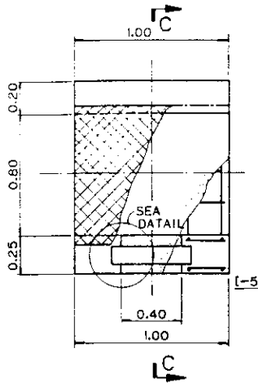


SECTION B-B(TYPE B)
SCALE 1:20

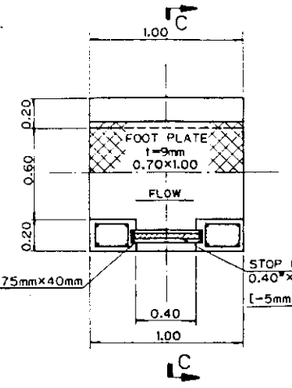
DIMENSION TABLE

ROAD NAME	FR 2	FR 3	FR 4	FR 8
STATION	No.4+63.0	No.6+88.5	No.9+9.0	No.5+65.5
ROAD CROSSING	TYPE A	TYPE A	TYPE A	TYPE B
LATERAL CANAL	LIC-1(2)	LIC-1(2)	LIC-1(2)	LIC-2(3)
TURN OUT C1	—	ID-3 TYPE A	ID-5 TYPE A	ID-10 TYPE B
C2	ID-2 TYPE A	ID-4 TYPE A	ID-6 TYPE A	ID-11 TYPE C
ELEVATION EL1	99.01	98.94	98.86	(R) 98.41 (L) 98.39
EL2	—	98.93	98.96	97.89
EL3	99.96	98.83	98.87	98.01
DIMENSION A1	—	3.00	3.00	3.00
A2	3.00	3.00	3.00	3.00
B1	3.50	2.50	2.50	2.50
B2	2.50	2.50	2.50	2.50
B	3.50	3.50	2.50	3.50
CHECK GATE	—	—	—	2-4

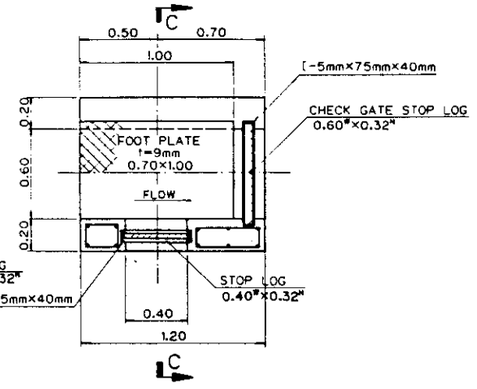
ROAD CROSSING



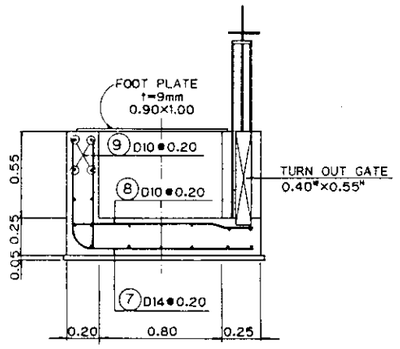
TYPE A PLAN
SCALE 1:20



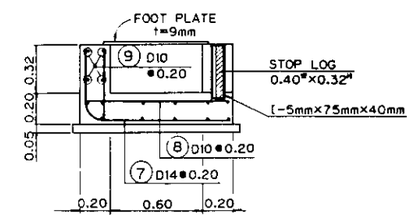
TYPE B PLAN
SCALE 1:20



TYPE C PLAN
SCALE 1:20



SECTION C-C(TYPE A)
SCALE 1:20



SECTION C-C(TYPE B&C)
SCALE 1:20

TURN OUT

NOTE : ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

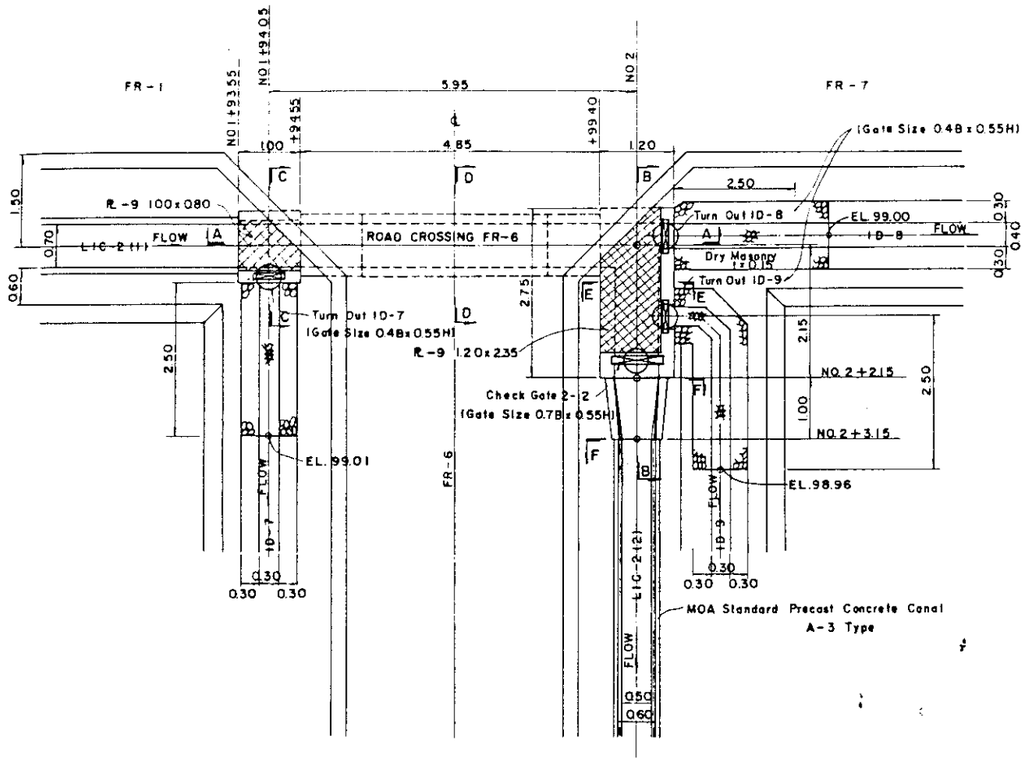
MINISTRY OF AGRICULTURE

HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT

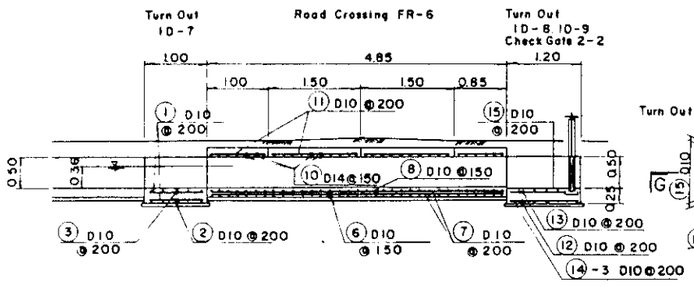
ROAD CROSSING (FR-2, 3, 4, 8), CHECK GATE (2-4) AND TURN-OUT (ID-2, 3, 4, 5, 6, 10 AND 11)

SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No.	7	APPROVED	

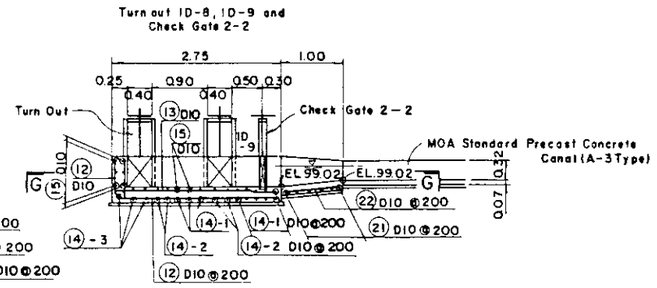
JAPAN INTERNATIONAL COOPERATION AGENCY



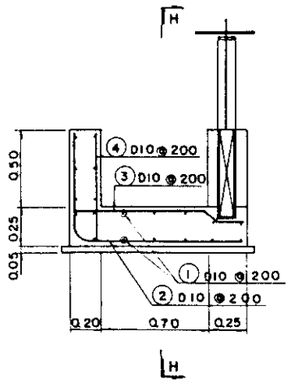
PLAN
SCALE 1:50



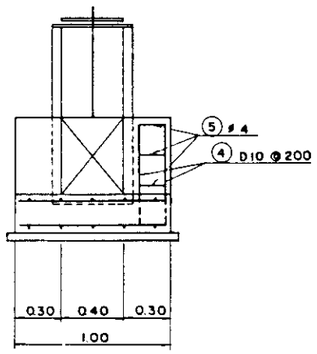
SECTION A-A
SCALE 1:50



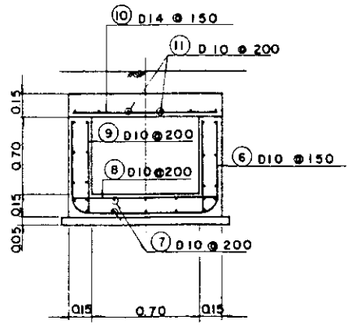
SECTION B-B
SCALE 1:50



SECTION C-C



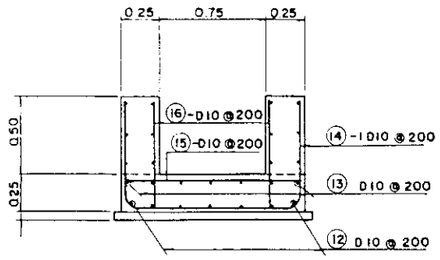
SECTION H-H



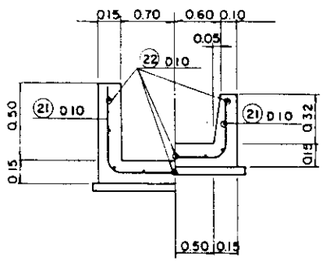
SECTION D-D

TURN-OUT ID-7
SCALE 1:20

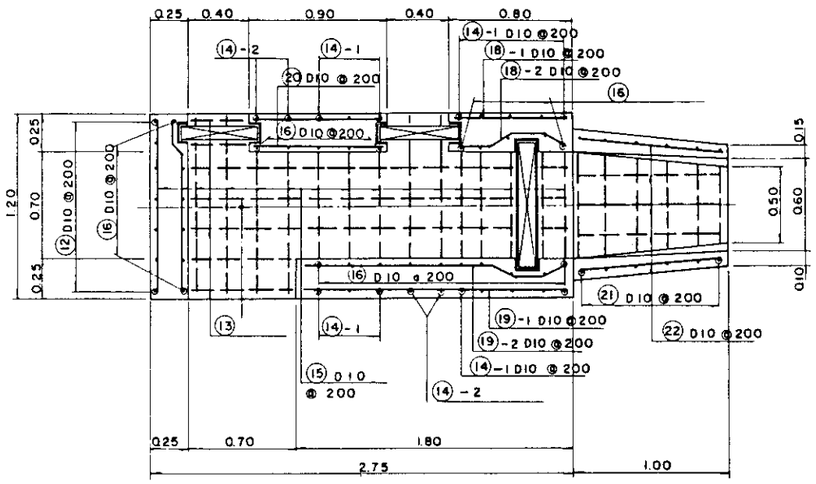
ROAD CROSSING FR-6
SCALE 1:20



SECTION E-E
SCALE 1:20



SECTION F-F
SCALE 1:20

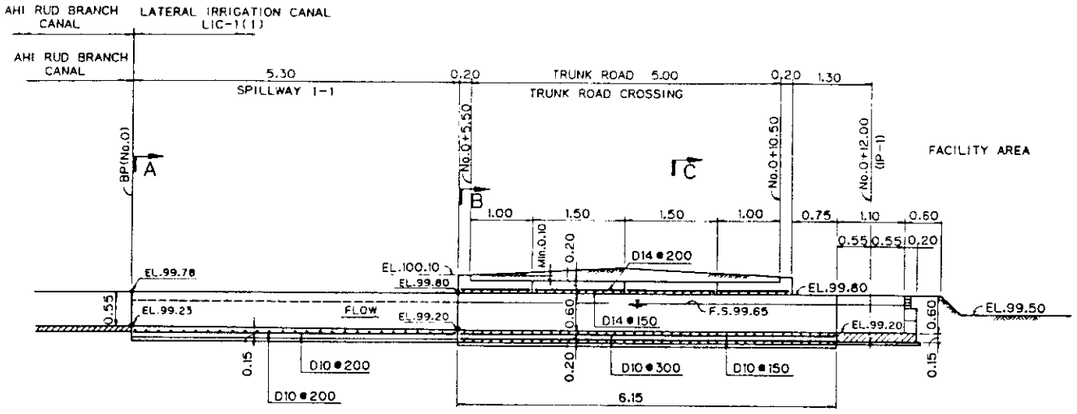


SECTION G-G
SCALE 1:20

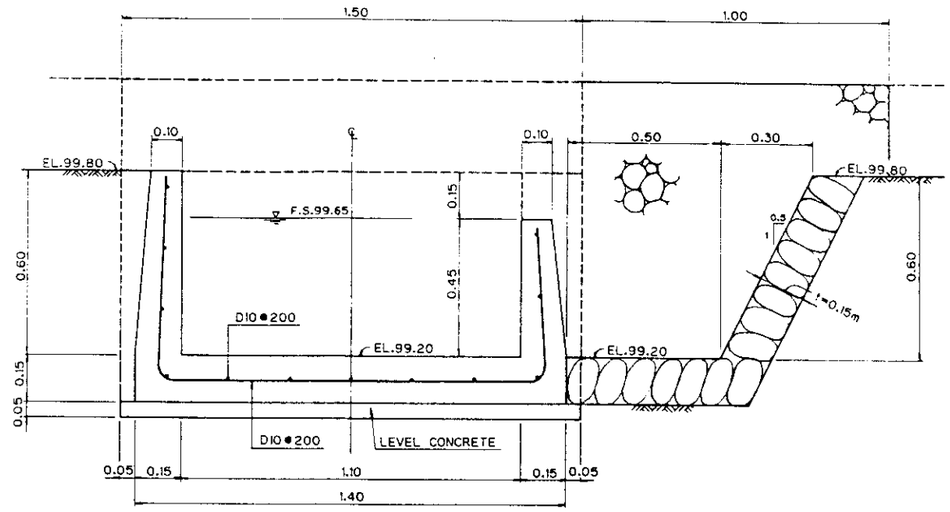
TURN-OUT ID-8, ID-9 and CHECK GATE 2-2

NOTE : ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

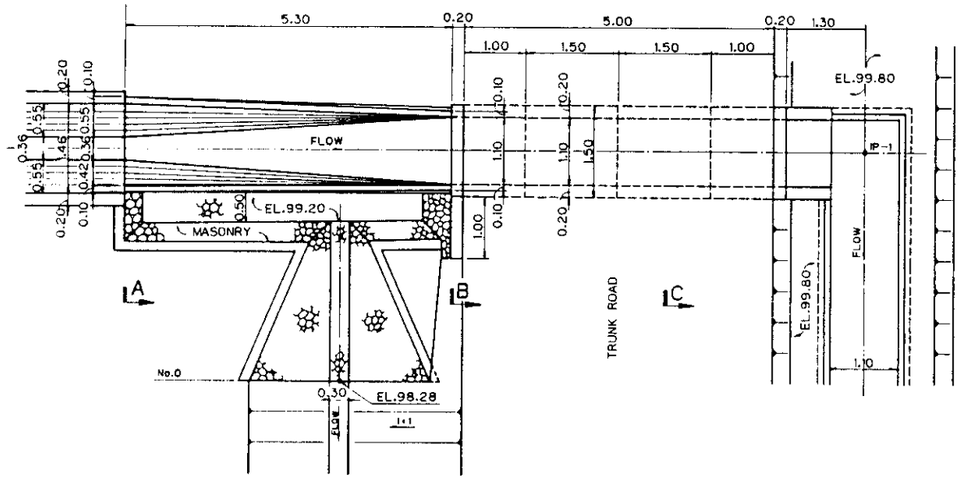
MINISTRY OF AGRICULTURE			
HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT			
ROAD CROSSING (FR-6), CHECK GATE (2-2) and TURN-OUT (ID-7, 8, 9)			
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No.	8	APPROVED	
JAPAN INTERNATIONAL COOPERATION AGENCY			



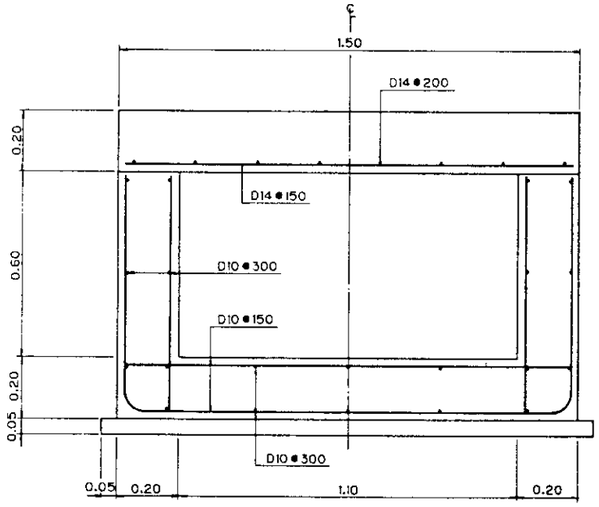
PLOFILE
SCALE 1 : 50



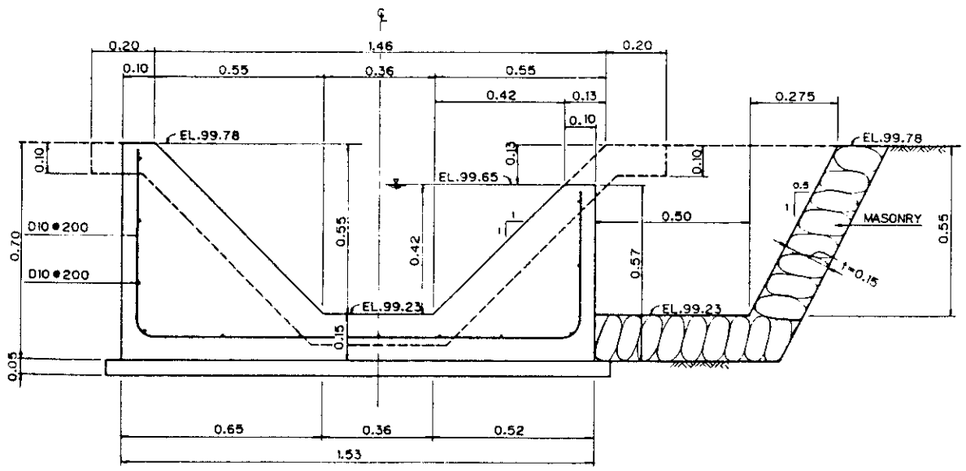
SECTION B-B
SCALE 1 : 10



PLAN
SCALE 1 : 50



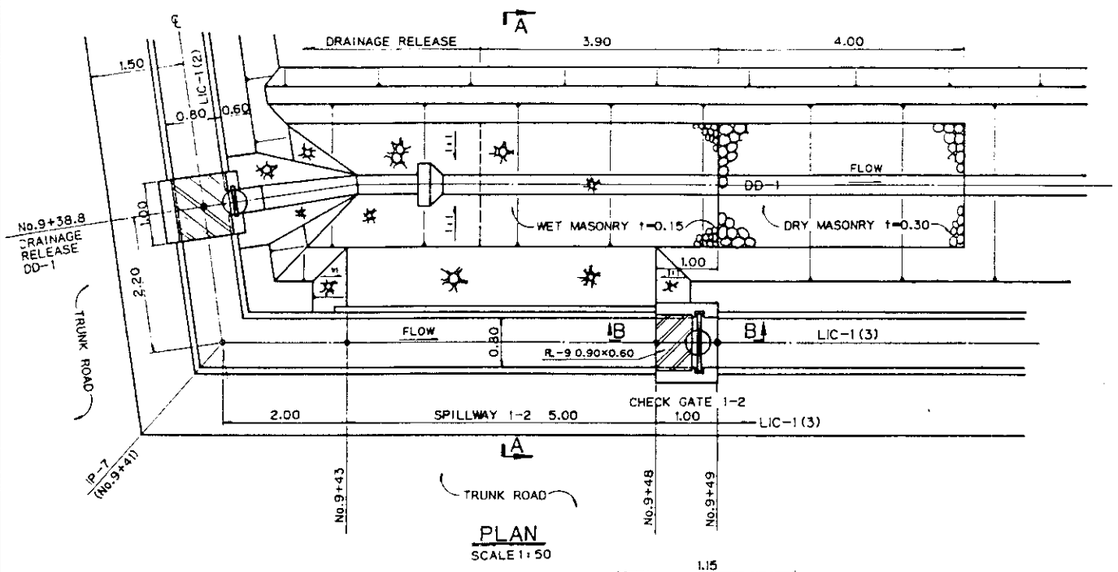
SECTION C-C
SCALE 1 : 10



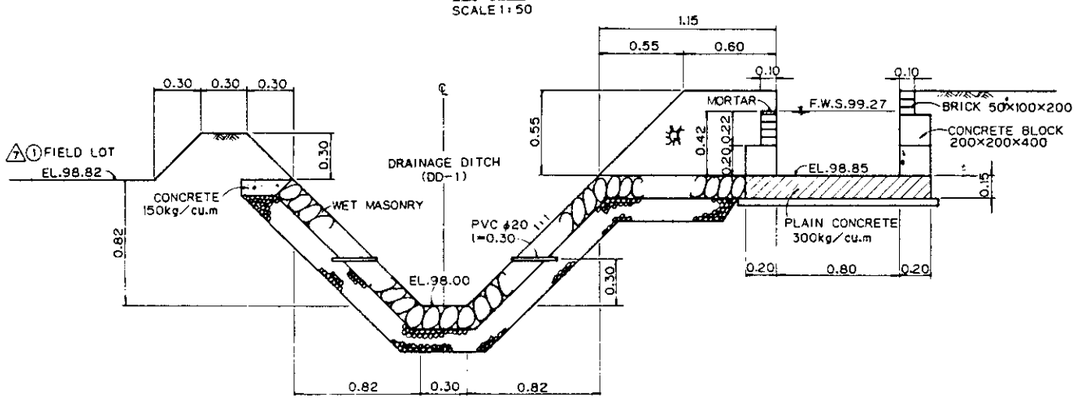
SECTION A-A
SCALE 1 : 10

NOTE : ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

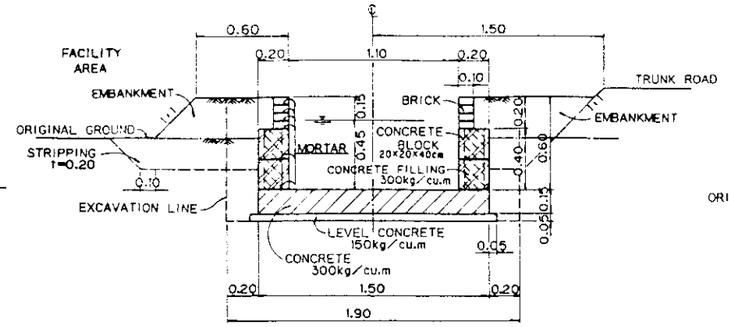
MINISTRY OF AGRICULTURE			
HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT			
SPILLWAY 1-1 AND TRUNK ROAD CROSSING (LIC-1)			
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No.	9	APPROVED	
JAPAN INTERNATIONAL COOPERATION AGENCY			



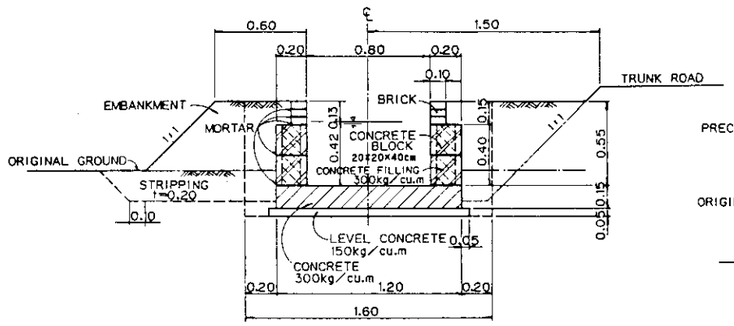
PLAN
SCALE 1:50



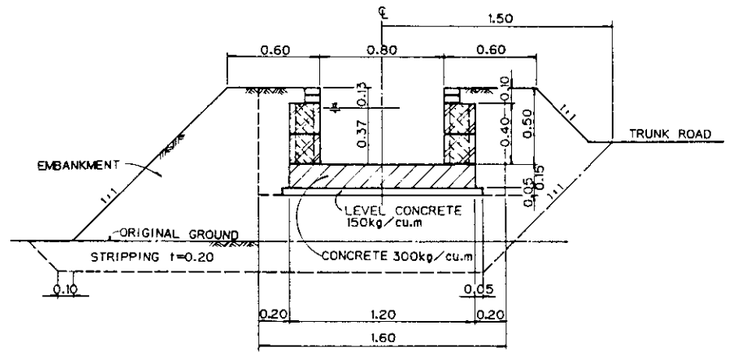
SECTION A-A
SCALE 1:20



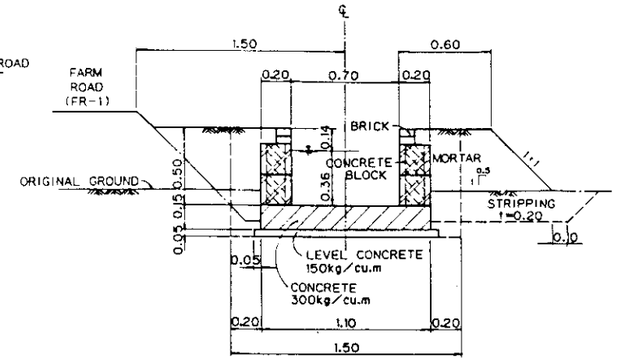
LIC-1(1)
SCALE 1:20



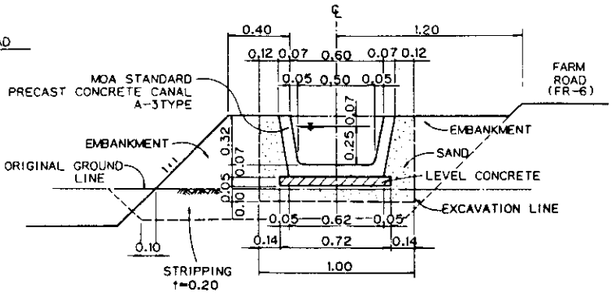
LIC-1(2)
SCALE 1:20



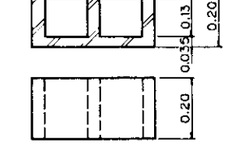
LIC-1(3)
SCALE 1:20



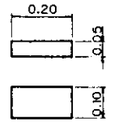
LIC-2(1)
SCALE 1:20



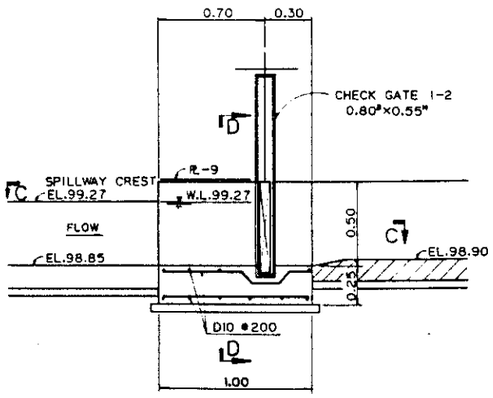
LIC-2(2) and LIC-2(3)
SCALE 1:20



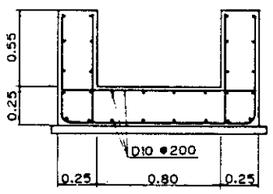
CONCRETE BLOCK
SCALE 1:10



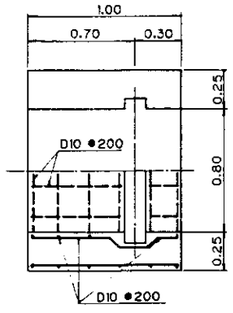
BRICK
SCALE 1:10



SECTION B-B
SCALE 1:20



SECTION D-D
SCALE 1:20



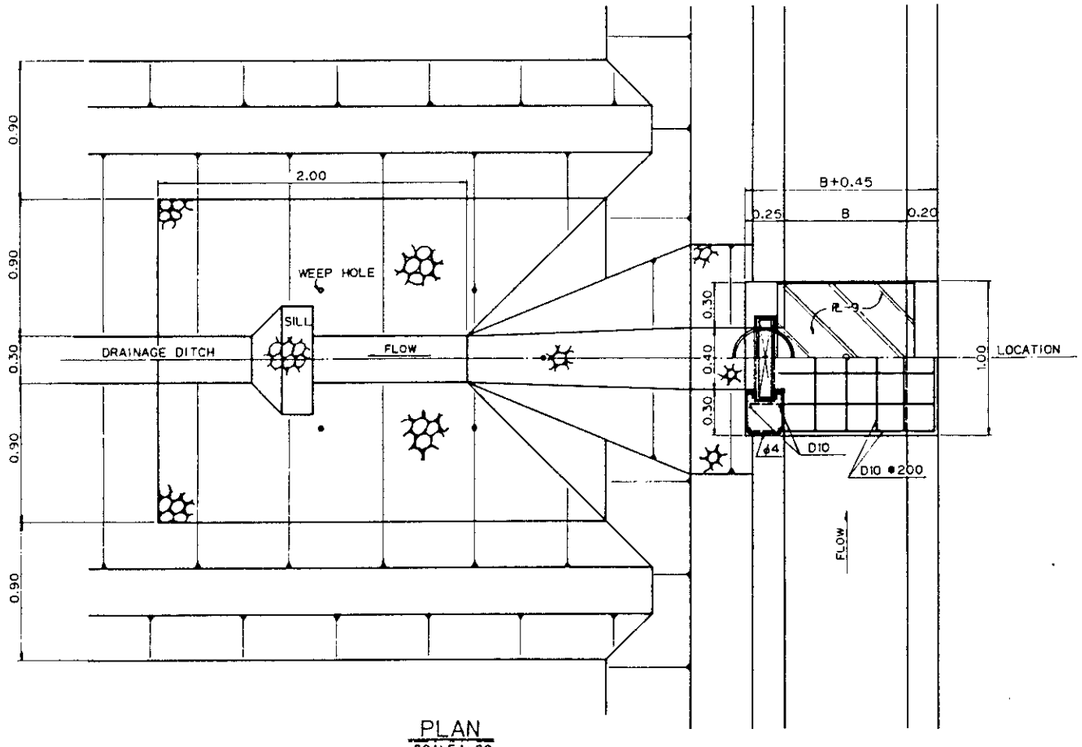
SECTION C-C
SCALE 1:20

SPILLWAY 1-2 & CHECK GATE 1-2

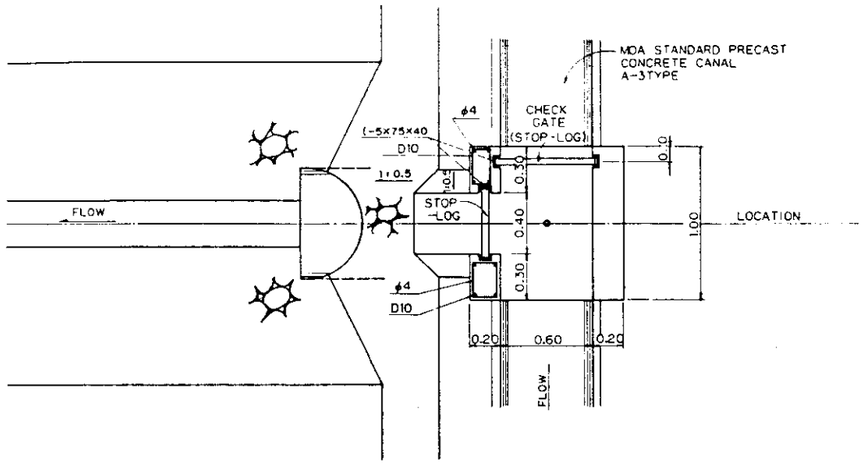
LATERAL IRRIGATION CANALS

NOTE : ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

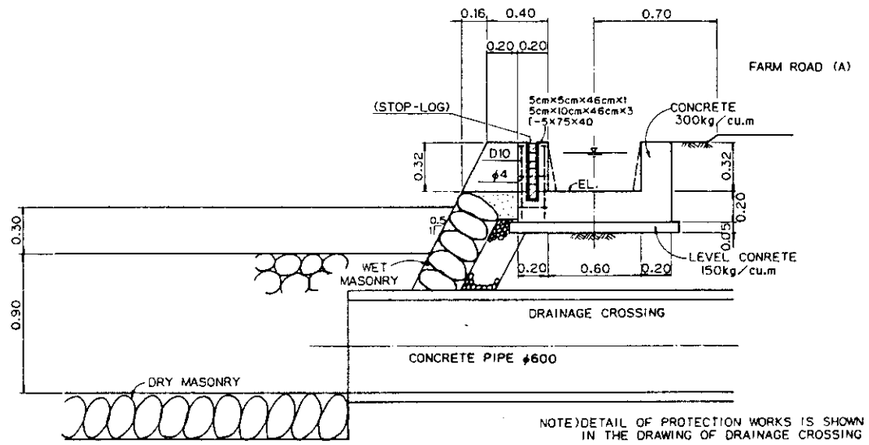
MINISTRY OF AGRICULTURE			
HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT			
LATERAL IRRIGATION CANALS SPILLWAY 1-2 AND CHECK GATE 1-2			
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No.	10	APPROVED	
JAPAN INTERNATIONAL COOPERATION AGENCY			



PLAN
SCALE 1:20



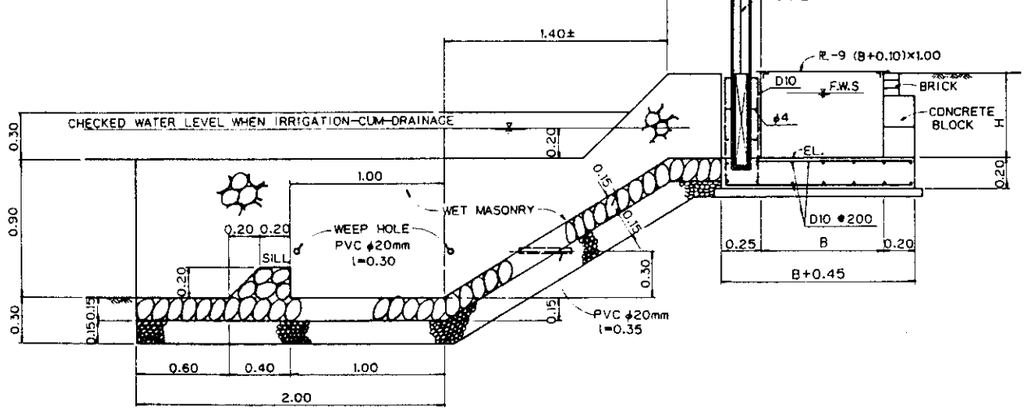
PLAN
SCALE 1:20



SECTION
SCALE 1:20

SILL TYPE PROTECTION

DRAINAGE RELEASE	CHECK GATE	CANAL	LOCATION	EL	CANAL SIZE B	CANAL SIZE H	REMARK
DD-5	2-5	LIC-2 (3)	No.7+20	98.14	0.60	0.32	WITH DRAINAGE CROSSING
DD-6	2-3	LIC-2 (2)	No.4+9	98.71	〃	〃	〃
DD-6-1	ID-8	ID-8	103.5m	98.89	ID TYPE B=0.40, H=0.35		WITHOUT DRAINAGE CROSSING SILL TYPE PROTECTION TO BE APPLIED



SECTION
SCALE 1:20

SILL TYPE PROTECTION

DRAINAGE RELEASE	CANAL	LOCATION	CANAL SIZE B	CANAL SIZE H	EL	GATE SIZE B	GATE SIZE H	PLATE SIZE
DD-1	LIC-1 (2)	No.9+38	0.80	0.55	98.85	0.40	0.55	0.90×1.00
DD-2	〃	No.8+0	〃	〃	98.90	〃	〃	〃
DD-3	〃	No.5+70	〃	〃	98.98	〃	〃	〃
DD-4	LIC-2 (1)	No.0+62	0.70	0.50	99.09	0.40	0.50	0.80×1.00

NOTE : ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

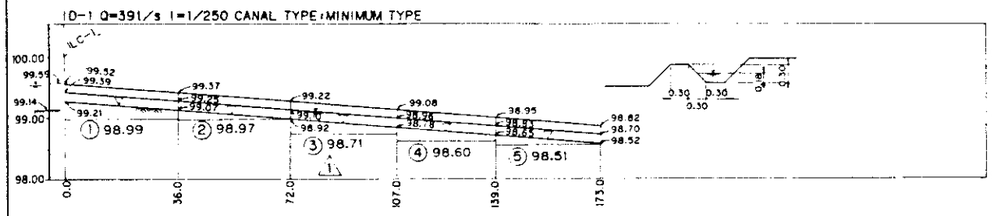
MINISTRY OF AGRICULTURE

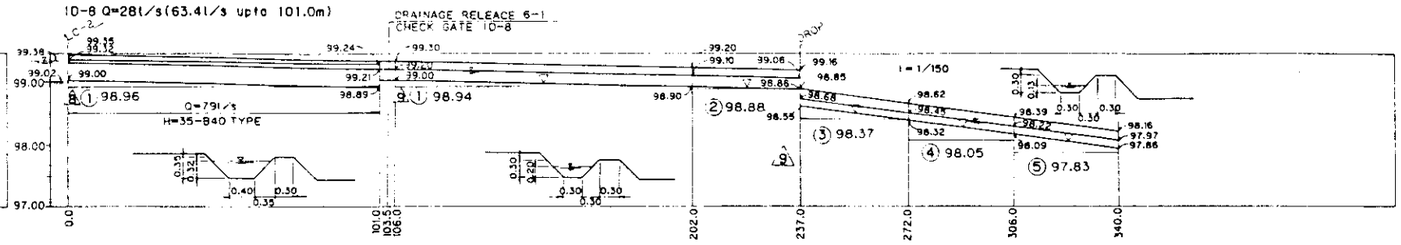
HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT

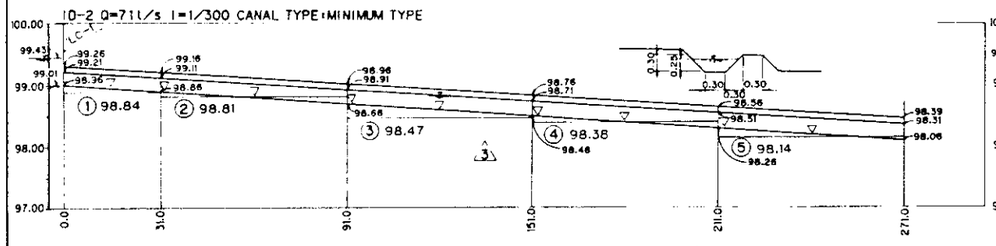
DRAINAGE RELEASE AND CHECK GATE (2-3, 2-4, ID-8)

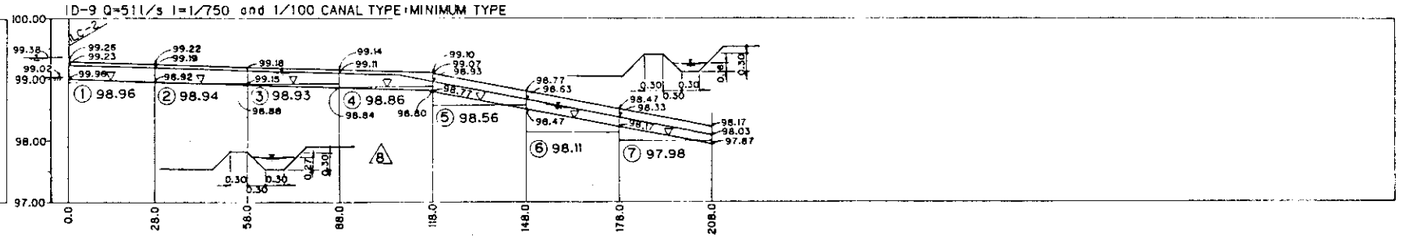
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No. 11	APPROVED		

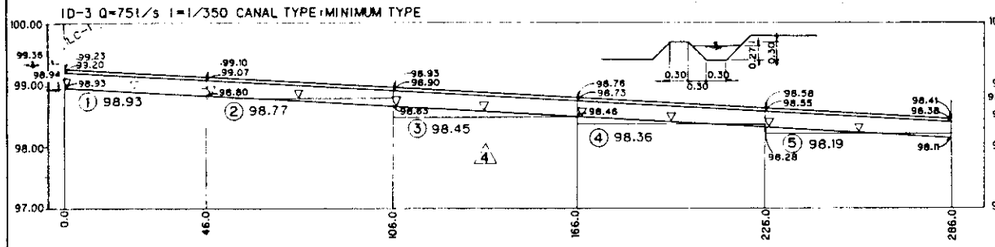
JAPAN INTERNATIONAL COOPERATION AGENCY

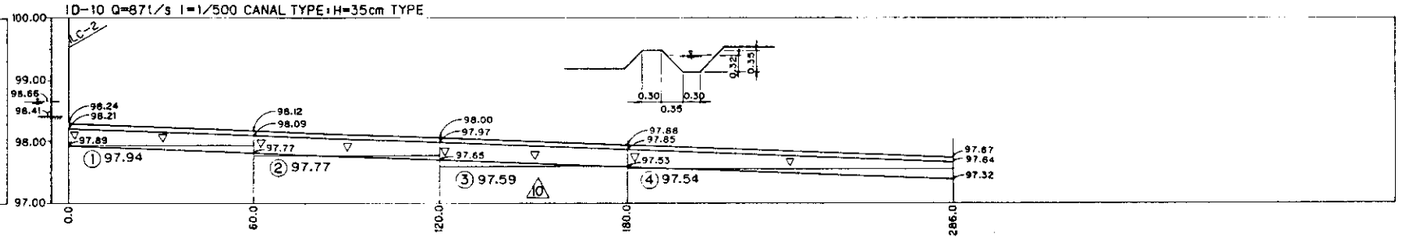


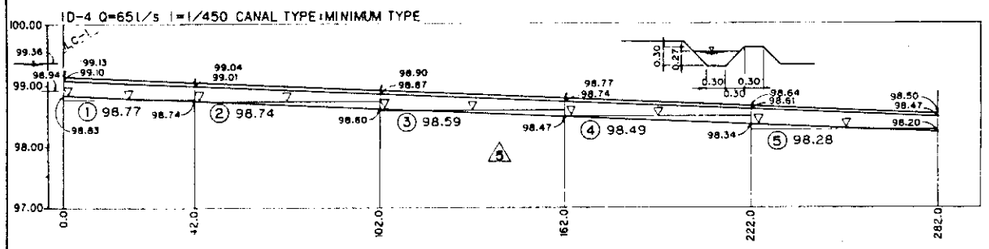


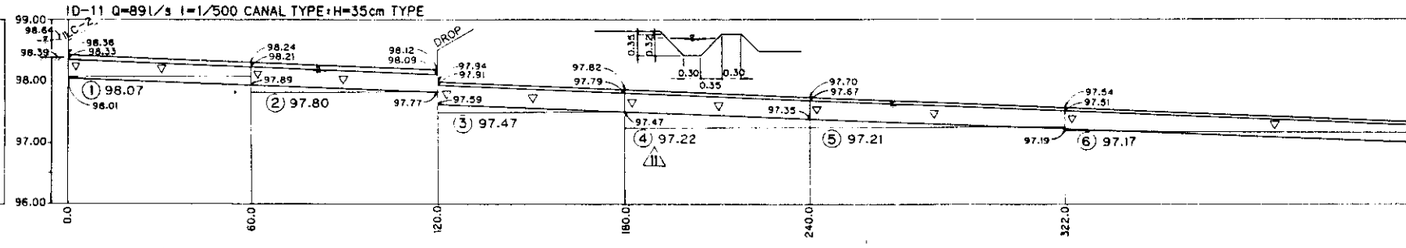


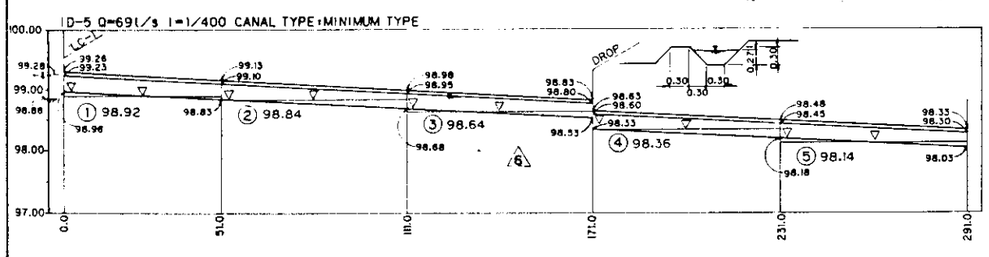


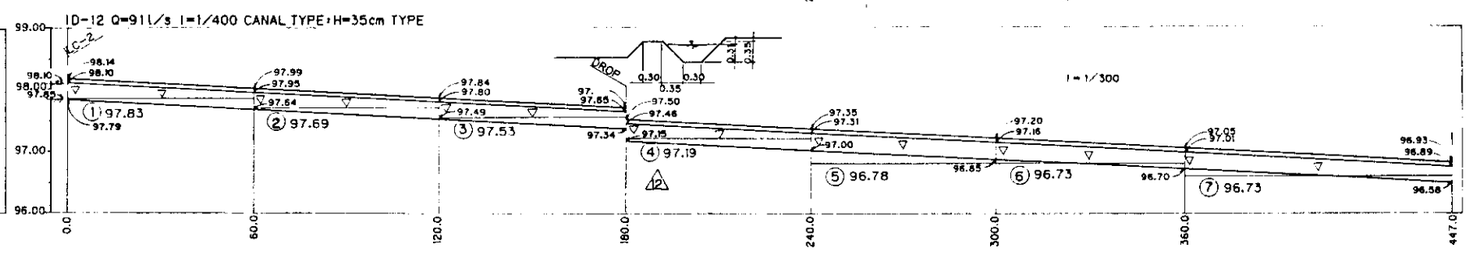


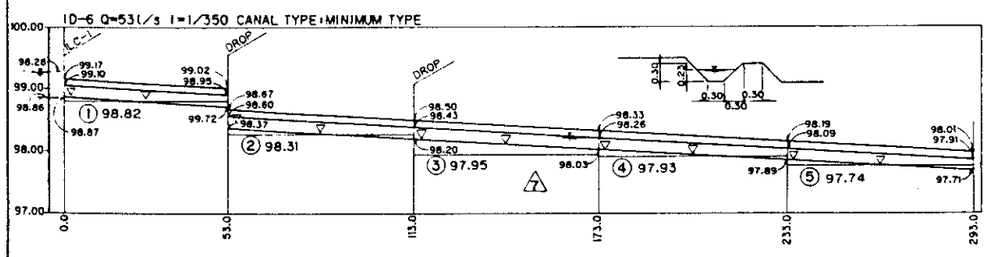


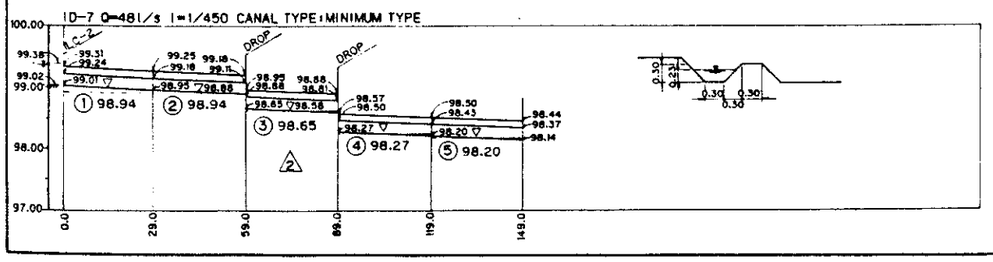


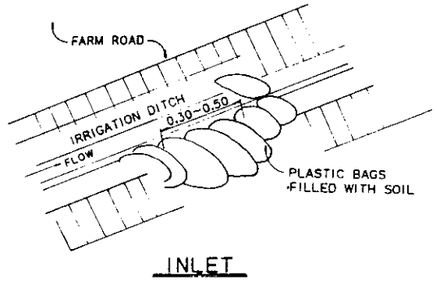












INLET

NOTE
1. ALL FIGURES SHOWN IN THIS DRAWING ARE IN METER. UNLESS OTHERWISE SPECIFIED.
2. △ NUMBER OF FIELD BLOCK.
   ○ NUMBER OF FIELD LOT.
3. INLET (DETAILED ARE SHOWN IN DWG No.)

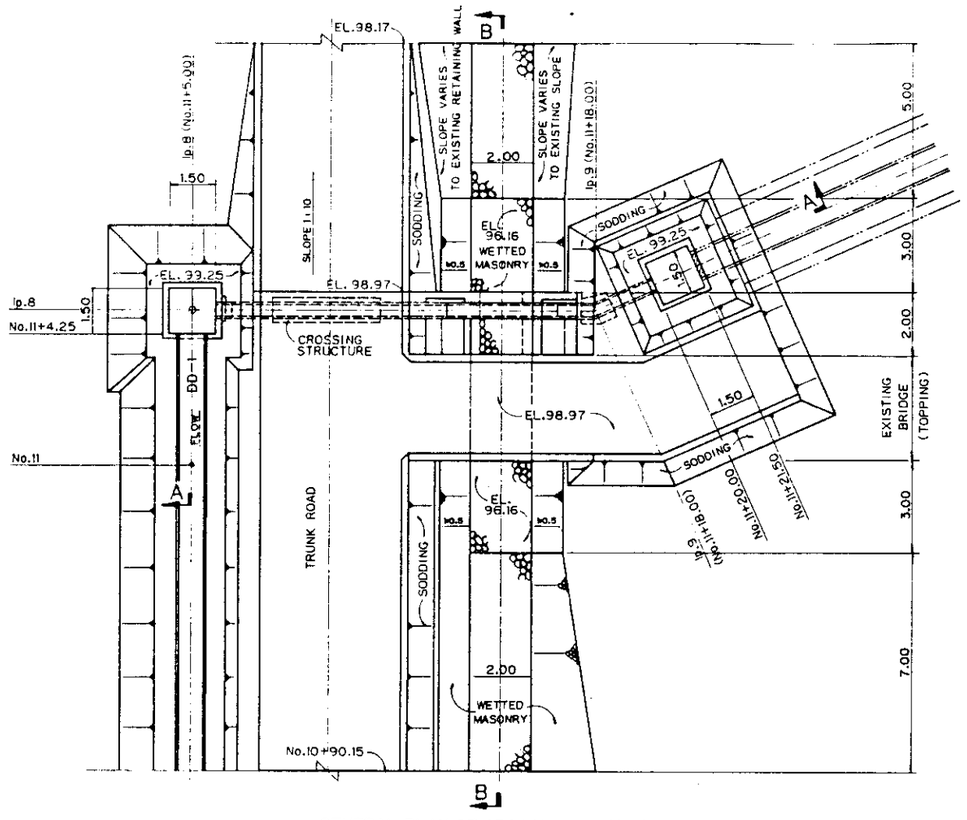
MINISTRY OF AGRICULTURE

HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT

LONGITUDINAL PROFILE OF IRRIGATION DITCHES

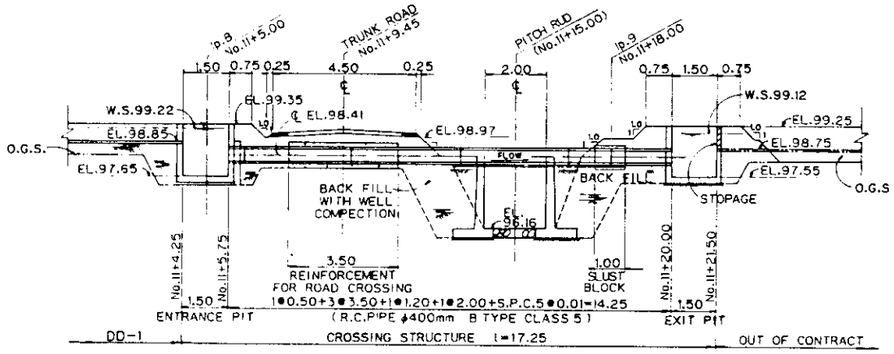
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No. 12	APPROVED		

JAPAN INTERNATIONAL COOPERATION AGENCY



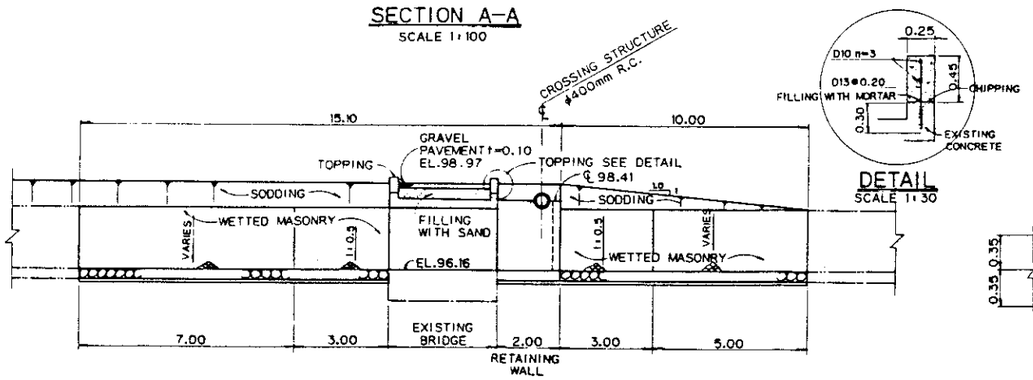
GENERAL PLAN OF CROSSING STRUCTURE

SCALE 1:100



SECTION A-A

SCALE 1:100

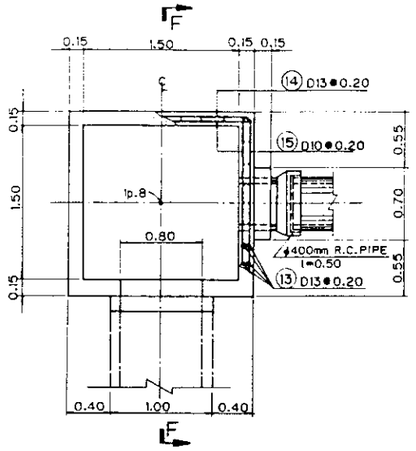


SECTION B-B

SCALE 1:100

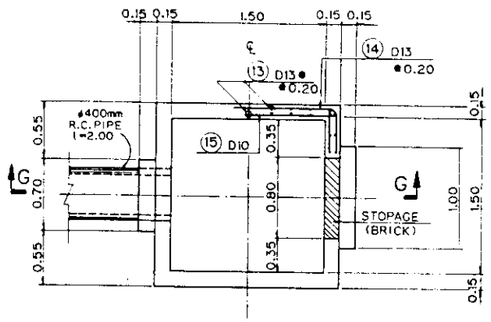
DETAIL

SCALE 1:30



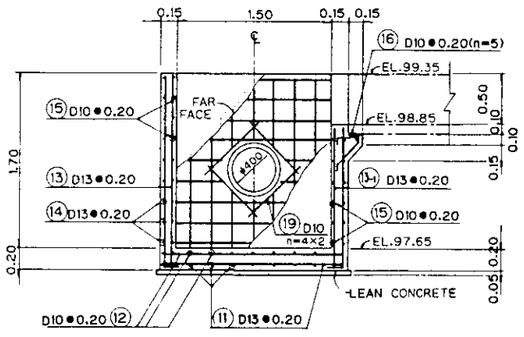
PLAN OF ENTRANCE PIT

SCALE 1:30



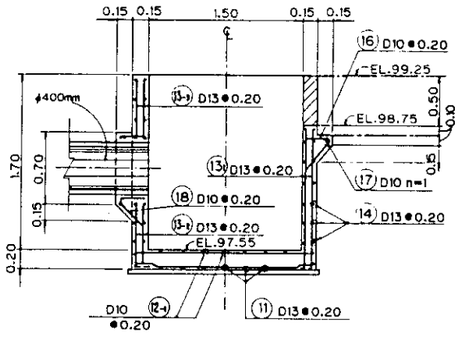
PLAN OF EXIT PIT

SCALE 1:30



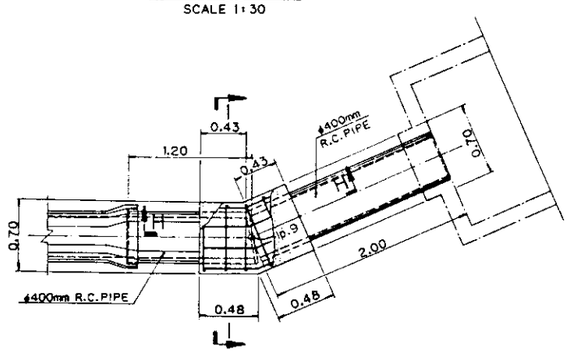
SECTION F-F

SCALE 1:30



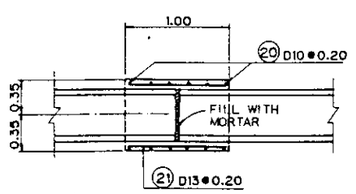
SECTION G-G

SCALE 1:30



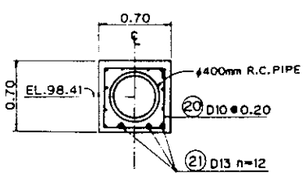
SLUST BLOCK

SCALE 1:30



SECTION H-H

SCALE 1:30



SECTION I-I

NOTE : ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

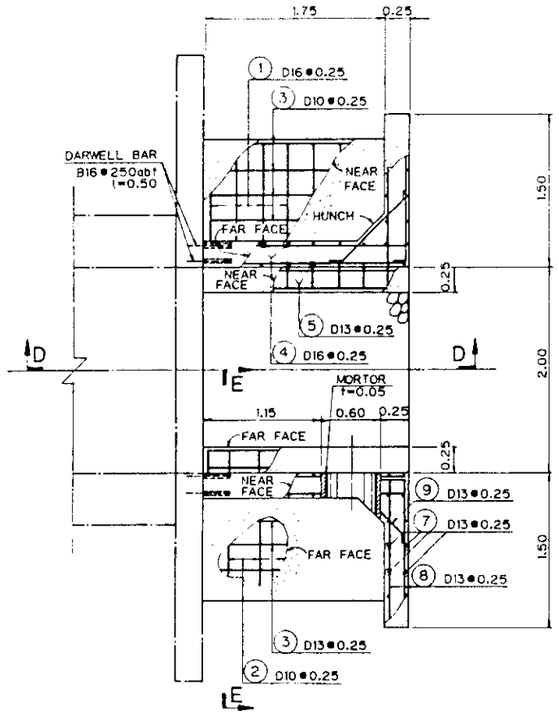
MINISTRY OF AGRICULTURE

HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT

PITEH RUD SIPHON (1/2)

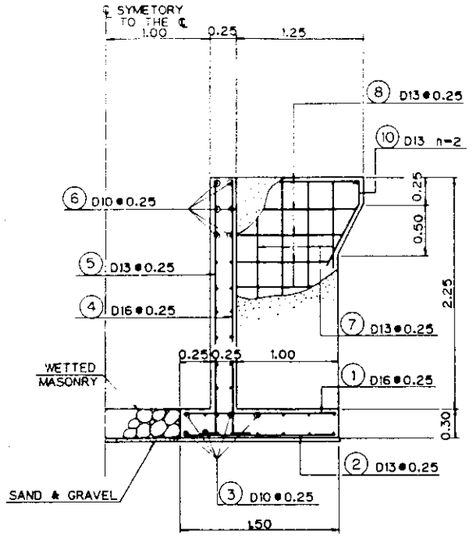
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No.	13	APPROVED	

JAPAN INTERNATIONAL COOPERATION AGENCY



PLAN OF RETAINING WALL

SCALE 1 : 30

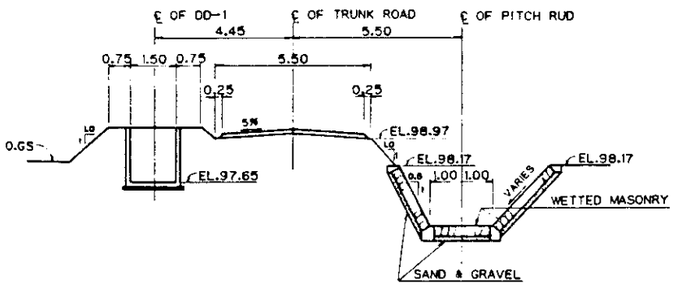


SECTION E-E

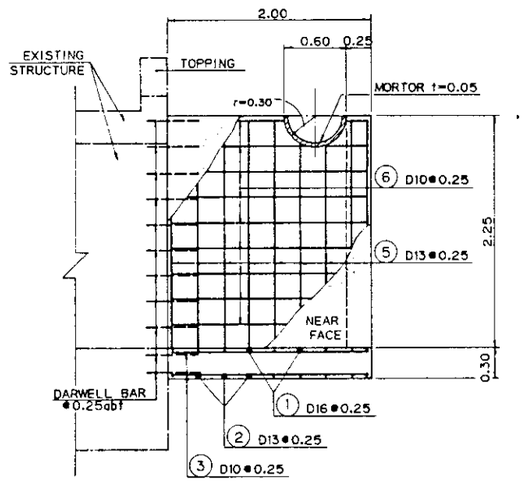
SCALE 1 : 30

SECTION C-C

SCALE 1 : 100



SECTION C'-C'

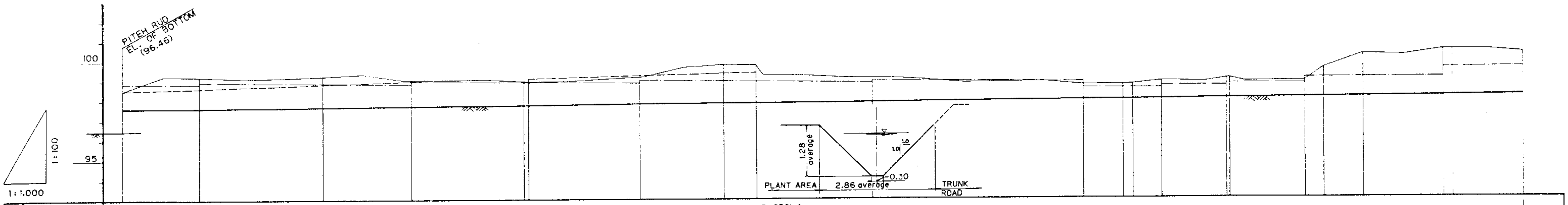


SECTION D-D

SCALE 1 : 30

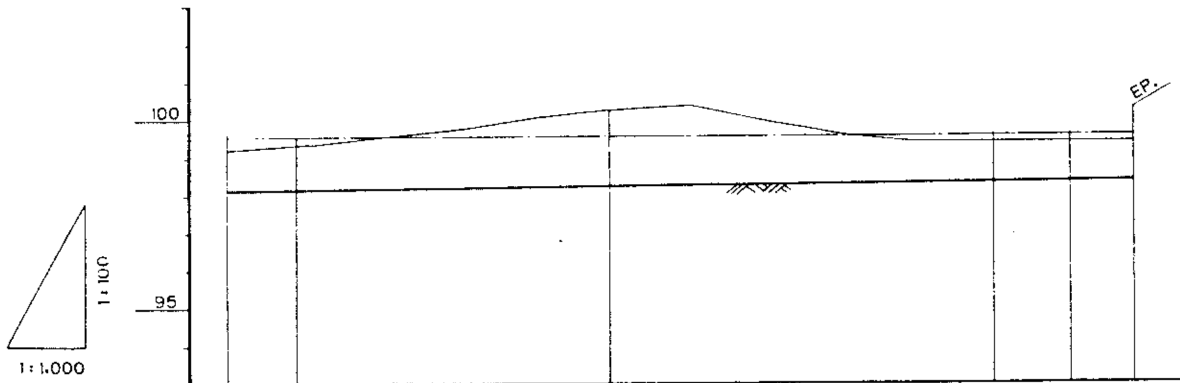
NOTE : ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

MINISTRY OF AGRICULTURE			
HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT			
PITEH RUD SIPHON (2/2)			
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No.	14	APPROVED	
JAPAN INTERNATIONAL COOPERATION AGENCY			



D. DISCHARGE (Lit/sec): Q=279l/sec
Bed Slope: I=1/1300

STATION	PROPOSED WATER LEVEL (m)	PROPOSED CANAL BOTTOM (m)	PROPOSED ELEVATION Right (m)	PROPOSED ELEVATION Left (m)	ELEVATION (m)	CUMULATIVE DISTANCE (m)	DISTANCE (m)	CURVE
No.0	98.46	97.56	98.46	98.82	(96.46) 98.46	0.0	0.0	
+20					99.19	20.0	20.0	
+40				98.82 98.92	99.19	40.0	20.0	
+60					99.09	60.0	20.0	
+80					99.09	80.0	20.0	
No.1					99.16	100.0	20.0	
+20					99.26	120.0	20.0	
+40				98.92 98.77	98.99	140.0	20.0	
+60					98.99	160.0	20.0	
+80					98.99	180.0	20.0	
No.2 IP.1			99.04		98.91 98.91	200.0 202.0	20.0 2.0	
+20					98.90	220.0	18.0	
+40					99.00	240.0	20.0	
+60		97.76		98.77 98.93	99.10	260.0	20.0	
+80					99.60	280.0	20.0	
No.3					99.72	300.0	20.0	
IP.2 +20			99.34		99.72 99.21	316.0 320.0	16.0 4.0	
+40					99.21	340.0	20.0	
+60					99.10	360.0	20.0	
+80				98.93 98.84	99.10	380.0	20.0	
No.4					99.00	400.0	20.0	
+20					98.82	420.0	20.0	
+40					98.82	440.0	20.0	
+60					98.83	460.0	20.0	
+80		97.93		98.84 98.51	98.66	480.0	20.0	
No.5 IP.3					98.69 98.69	500.0 504.5	20.0 4.5	
+20				98.51 98.60	98.86	520.0	15.5	
+40					98.80	540.0	20.0	
IP.4				98.60 98.71	98.97	553.0	13.0	
+60					98.79	560.0	7.0	
+80					98.82	580.0	20.0	
IP.5		98.01		98.71 98.97	98.82	589.5	9.5	
No.6					99.59	600.0	10.5	
+20				98.97 98.99	99.16	620.0	20.0	
+40					99.12	640.0	20.0	
+60		98.07		98.99 99.50	99.39	660.0	20.0	
+80					99.39	680.0	20.0	
No.7	99.00	98.10			99.21	700.0	20.0	



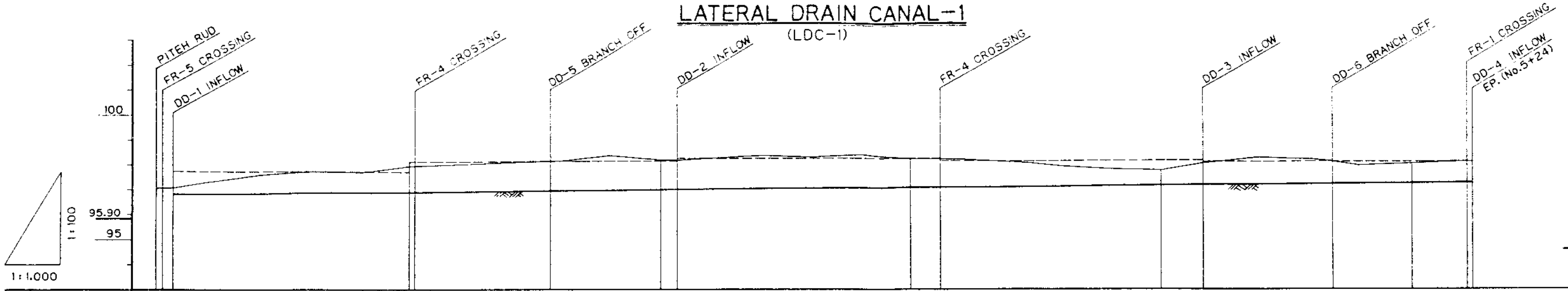
D. DISCHARGE (Lit/sec): Q=279l/sec
Bed Slope: I=1/1300

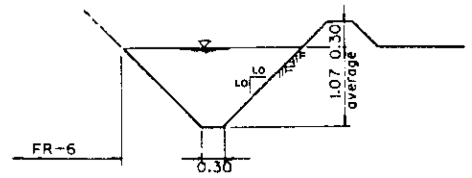
STATION	PROPOSED WATER LEVEL (m)	PROPOSED CANAL BOTTOM (m)	PROPOSED ELEVATION Right (m)	PROPOSED ELEVATION Left (m)	ELEVATION (m)	CUMULATIVE DISTANCE (m)	DISTANCE (m)	CURVE
No.7	99.00	98.10		99.50	99.21	700.0	20.0	
IP.6 +20					99.58 99.33	718.0 720.0	18.0 2.0	
+40					99.58	740.0	20.0	
+60					99.75	760.0	20.0	
+80					99.98	780.0	20.0	
No.8					100.19	800.0	20.0	
+20					100.29	820.0	20.0	
+40					99.81	840.0	20.0	
+60					99.48	860.0	20.0	
+80					99.33	880.0	20.0	
No.9					99.36	900.0	20.0	
+20					99.31	920.0	20.0	
EP	99.18	98.28	99.21	99.50	99.31	936.5	16.5	

NOTE: ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

MINISTRY OF AGRICULTURE			
HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT			
INTERCEPTION DRAINAGE CANAL			
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No. 15		APPROVED	
JAPAN INTERNATIONAL COOPERATION AGENCY			

LATERAL DRAIN CANAL-1
(LDC-1)

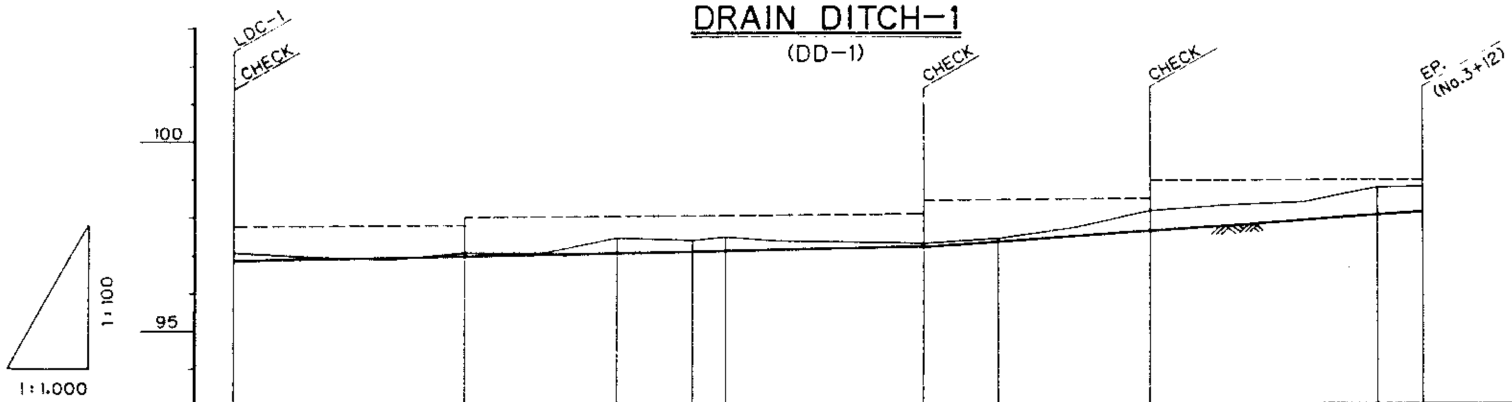


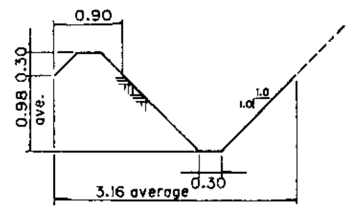


PROPOSED – D. DISCHARGE (Lit/sec) / Bed Slope: Q=103l/sec, I=1/1300; Q=90l/sec, I=1/1300; Q=57l/sec, I=1/1300; Q=21l/sec, I=1/1300

STATION	DISTANCE (m)	CUMULATIVE DISTANCE (m)	ELEVATION (m)	ELEVATION Right (m)	ELEVATION Left (m)	CANAL BOTTOM (m)	WATER LEVEL (m)	CURVE
No.0	0.0	0.0	97.07			96.03	96.93	
+2	2.0	2.0	97.07					
+6	4.0	6.0	97.07	97.74		96.84	97.74	
+20	14.0	20.0	97.33					
+40	20.0	40.0	97.61					
+60	20.0	60.0	97.73					
+80	20.0	80.0	97.73					
No.1	20.0	100.0	98.01	97.74 / 98.14				
+2	2.0	102.0	98.01					
+20	18.0	120.0	98.05					
+40	20.0	140.0	98.11					
+56.5	16.5	156.5	98.22					
+60	3.5	160.0	98.22					
+80	20.0	180.0	98.40					
No.2	20.0	200.0	98.19					
+6.5	6.5	206.5	98.19	98.14 / 98.28		97.00	97.90	
+20	13.5	220.0	98.27					
+40	20.0	240.0	98.40					
+60	20.0	260.0	98.35					
+80	20.0	280.0	98.43					
No.3	20.0	300.0	98.25					
+12	12.0	312.0	98.25	98.28 / 98.19				
+20	8.0	320.0	98.26					
+40	20.0	340.0	98.15					
+60	20.0	360.0	98.00					
+80	20.0	380.0	97.86					
No.4	20.0	400.0	97.89					
+17.5	17.5	417.5	98.08	98.19 / 98.14		97.16	98.06	
+20	2.5	420.0	98.08					
+40	20.0	440.0	98.30					
+60	20.0	460.0	98.26					
+68.5	8.5	468.5	98.18					
+80	11.5	480.0	98.01					
No.5	20.0	500.0	98.04					
+20	20.0	520.0	98.12	98.14				
+22	2.0	522.0	98.12					
EP (No.5+24)	2.0	524.0	98.12			97.24	98.14	

DRAIN DITCH-1
(DD-1)





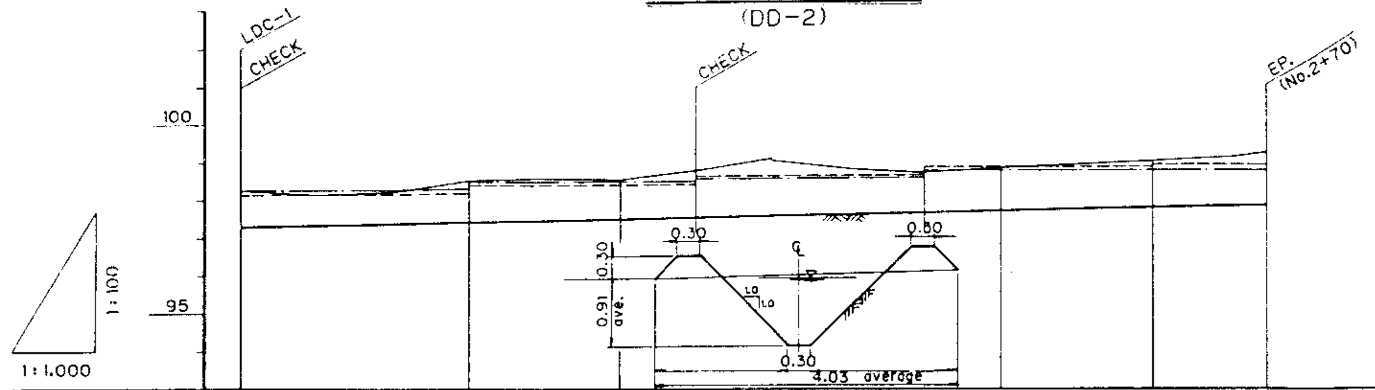
PROPOSED – D. DISCHARGE (Lit/sec) / Bed Slope: Q=13l/sec, I=1/700; Q=13l/sec, I=1/160

STATION	DISTANCE (m)	CUMULATIVE DISTANCE (m)	ELEVATION (m)	ELEVATION Right (m)	ELEVATION Left (m)	CANAL BOTTOM (m)	WATER LEVEL (m)	CURVE
No.0	0.0	0.0	97.07	97.74		96.84	97.74	
+20	20.0	20.0	96.90					
+40	20.0	40.0	96.84					
+60	20.0	60.0	97.00	97.74 / 97.93				
+80	20.0	80.0	97.00					
No.1	20.0	100.0	97.40					
+20	20.0	120.0	97.30	97.93 / 97.95				
IP.1	9.0	129.0	97.40					
+40	11.0	140.0	97.30					
+60	20.0	160.0	97.20					
+80	20.0	180.0	97.20	97.95 / 98.31		97.10	98.00	
No.2	20.0	200.0	97.30					
+20	20.0	220.0	97.60					
+40	20.0	240.0	98.00	98.31 / 98.82				
+60	20.0	260.0	98.10					
+80	20.0	280.0	98.20					
No.3	20.0	300.0	98.61					
EP (No.3+12)	12.0	312.0	98.61	98.82		97.92	88.82	

NOTE: ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

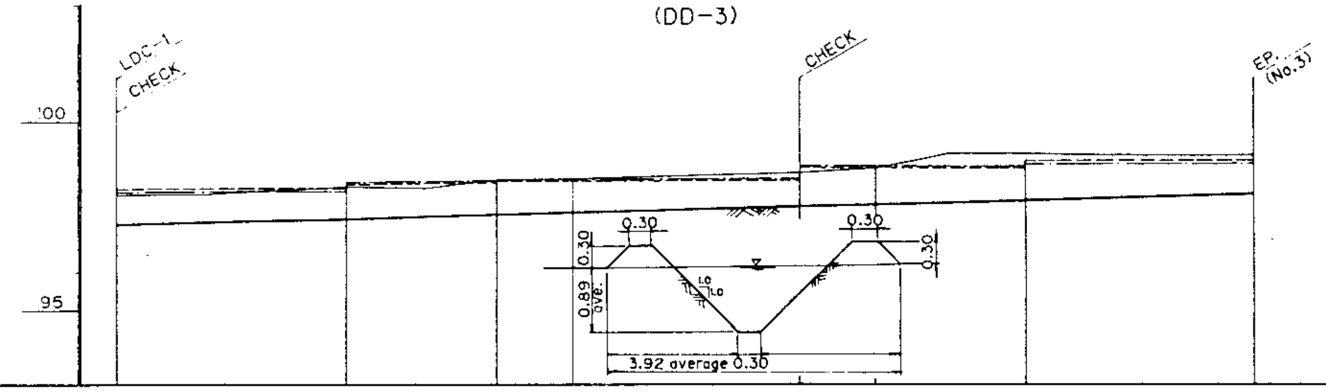
MINISTRY OF AGRICULTURE HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT	
LONGITUDINAL PROFILE LDC-1, and DD-1	
SURVEYED	CHECKED
DESIGNED	SUBMITTED
DWG No. 16	APPROVED
JAPAN INTERNATIONAL COOPERATION AGENCY	

DRAIN DITCH-2
(DD-2)



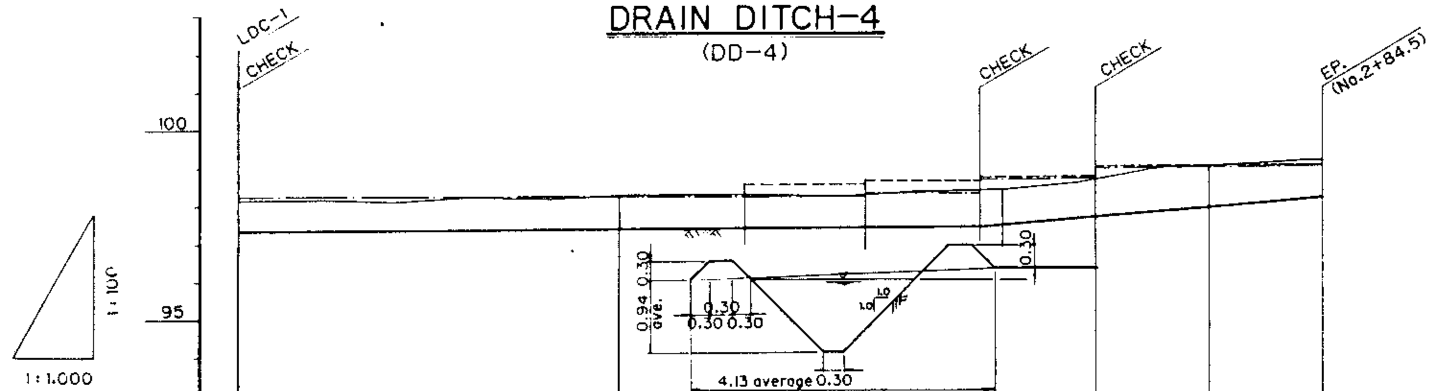
	No.0	+20	+40	+60	+80	No.1	+20	+40	+60	+80	No.2	+20	+40	+60	EP (No.2+70)
D. DISCHARGE (Lit/sec) / Bed Slope	Q=33l/sec I=1/400														
PROPOSED WATER LEVEL (m)	98.14														98.74
PROPOSED CANAL BOTTOM (m)	97.24														97.84
PROPOSED ELEVATION Right (m)	98.14			98.14 98.36			98.36 98.64			98.64 98.84			98.84 98.92		98.92
PROPOSED ELEVATION Left (m)	98.28			98.28 98.49			98.49 98.59			98.59 98.74			98.74 98.77		98.77
ELEVATION (m)	98.19	98.10	98.18	98.45	98.55	98.50	98.75	99.09	98.81	98.71	98.79	98.99	99.00	99.10	99.27
CUMULATIVE DISTANCE (m)	0.0	20.0	40.0	60.0	80.0	100.0	120.0	140.0	160.0	180.0	200.0	220.0	240.0	260.0	270.0
DISTANCE (m)	0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	10.0
CURVE															

DRAIN DITCH-3
(DD-3)



	No.0	+20	+40	+60	+80	No.1	+20	+40	+60	+80	No.2	+20	+40	+60	+80	EP (No.3)
D. DISCHARGE (Lit/sec) / Bed Slope	Q=36l/sec I=1/400															
PROPOSED WATER LEVEL (m)	98.14															98.89
PROPOSED CANAL BOTTOM (m)	97.24															97.99
PROPOSED ELEVATION Right (m)	98.19			98.19 98.36			98.36 98.45			98.45 98.77			98.77 98.93			98.93
PROPOSED ELEVATION Left (m)	98.14			98.14 98.38			98.38 98.47			98.47 98.81			98.81 98.84			98.84
ELEVATION (m)	98.08	98.05	98.13	98.24	98.29	98.43	98.46	98.50	98.56	98.61	98.72	99.16	99.13	99.11	99.11	99.11
CUMULATIVE DISTANCE (m)	0.0	20.0	40.0	60.0	80.0	100.0	120.0	140.0	160.0	180.0	200.0	220.0	240.0	260.0	280.0	300.0
DISTANCE (m)	0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
CURVE																

DRAIN DITCH-4
(DD-4)

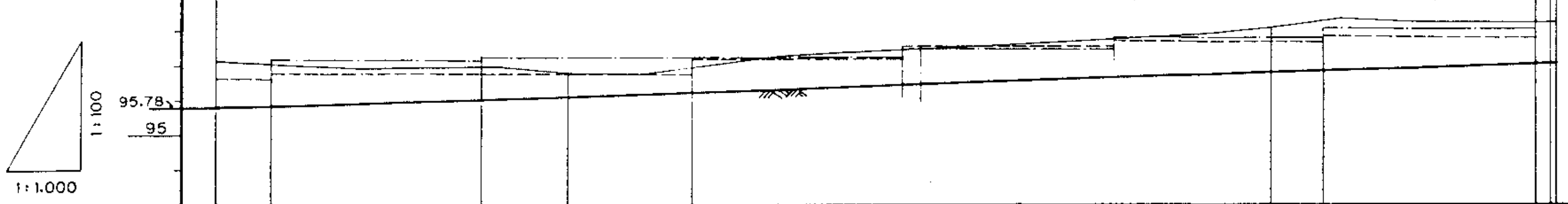


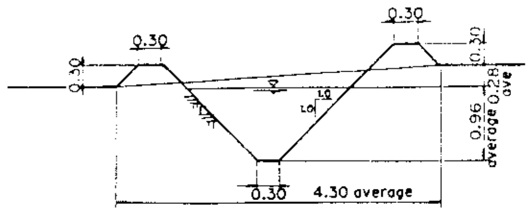
	No.0	+20	+40	+60	+80	No.1	+20	IP.1	+40	+60	+80	+94.5	No.2	+20	+40	+60	+80	EP (No.2+84.5)
D. DISCHARGE (Lit/sec) / Bed Slope	Q=21l/sec I=1/2700											Q=21l/sec I=1/120						
PROPOSED WATER LEVEL (m)	98.20											98.27						99.02
PROPOSED CANAL BOTTOM (m)	97.30											97.37						98.12
PROPOSED ELEVATION Right (m)	98.14			98.14 98.38			98.38 98.47	98.47 98.51		98.51 98.60		98.60 98.71		98.71 98.97		98.97 98.99		98.99
PROPOSED ELEVATION Left (m)	98.20									98.20 98.27		98.27 98.65		98.65 98.94				98.94
ELEVATION (m)	98.12	98.12	98.04	98.17	98.11	98.23	98.22	98.25	98.22	98.22	98.32		98.34	98.52	98.90	98.98	99.10	99.10
CUMULATIVE DISTANCE (m)	0.0	20.0	40.0	60.0	80.0	100.0	120.0	133.0	140.0	160.0	180.0	194.5	200.0	220.0	240.0	260.0	280.0	284.5
DISTANCE (m)	0.0	20.0	20.0	20.0	20.0	20.0	20.0	13.0	7.0	20.0	20.0	14.5	5.0	20.0	20.0	20.0	20.0	4.5
CURVE																		

NOTE: ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

MINISTRY OF AGRICULTURE			
HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT			
LONGITUDINAL PROFILE DD-2, -3 and -4			
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No. 17	APPROVED		
JAPAN INTERNATIONAL COOPERATION AGENCY			

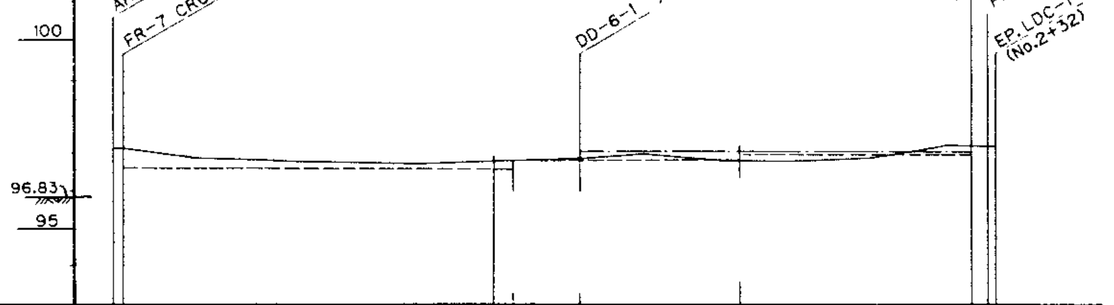
DRAIN DITCH-5
(DD-5)

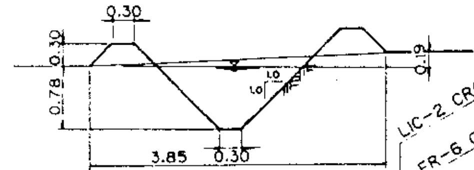




D. DISCHARGE (Lit/sec) Bed Slope	Q=66l/sec I=1/180																			
PROPOSED WATER LEVEL (m)	96.70										97.27									97.89
PROPOSED CANAL BOTTOM (m)	95.80										96.37									96.89
PROPOSED ELEVATION Right (m)	96.61	96.61 96.78						96.78 97.19			97.19 97.53			97.53 97.69			97.69 97.83			97.83
PROPOSED ELEVATION Left (m)		97.17			97.17 97.22						97.22 97.47			97.47 97.80			97.80 98.07			98.07
ELEVATION (m)	97.10 97.10	97.00	96.93	97.00	96.98	96.80	96.73	97.00	97.25	97.38	97.46	97.57	97.71	97.79	97.89	98.10	98.33	98.28	98.24	98.23 98.23 98.23
CUMULATIVE DISTANCE (m)	0.0 2.0	15.5 20.0	40.0	60.0	80.0	100.0	120.0	140.0	160.0	180.0	200.0	220.0	240.0	260.0	280.0	300.0	320.0	340.0	360.0	376.0 380.0 382.0
DISTANCE (m)	0.0 2.0	13.5 4.5	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	16.0 4.0 2.0
STATION	No.0 + 2	+15.5 +20	+40	+60	+80	No.1	+20	+40	+60	+80	No.2	+20	+40	+60	+80	No.3	+20	+40	+60	+76 +80 EP (No.3+82)
CURVE																				

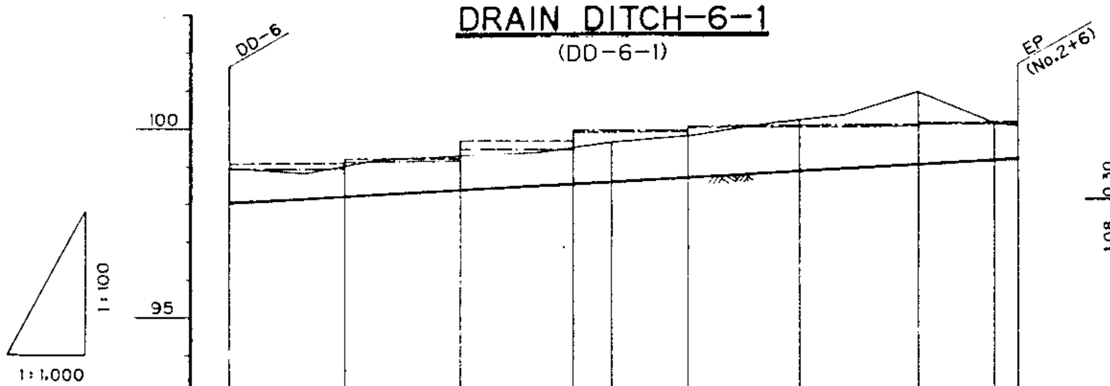
DRAIN DITCH-6
(DD-6)

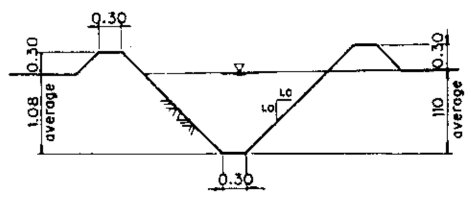




D. DISCHARGE (Lit/sec) Bed Slope	Q=42l/sec I=1/1200						Q=23l/sec I=1/1200					
PROPOSED WATER LEVEL (m)												
PROPOSED CANAL BOTTOM (m)	96.85						96.95					92.04
PROPOSED ELEVATION Right (m)	97.54					97.54 97.77			97.77 97.94			97.94
PROPOSED ELEVATION Left (m)	97.83						97.83 97.98					97.98
ELEVATION (m)	98.11 98.11	97.88	97.78	97.75	97.69	97.78	97.85 97.85	97.94	97.82	97.82	97.86	98.18 98.18 98.18 98.18
CUMULATIVE DISTANCE (m)	0.0 2.5	20.0	40.0	60.0	80.0	100.0	120.0 125.5	140.0	160.0	180.0	200.0	220.0 226.0 230.0 232.0
DISTANCE (m)	0.0 2.5	17.5	20.0	20.0	20.0	20.0	20.0 2.5	17.5	20.0	20.0	20.0	20.0 6.0 4.0 2.0
STATION	No.0 + 2.5	+20	+40	+60	+80	No.1	+20 +22.5	+40	+60	+80	No.2	+20 +26 +30 EP (No.2+32)
CURVE												

DRAIN DITCH-6-1
(DD-6-1)

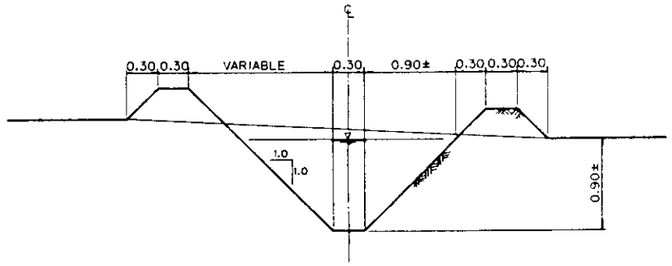




D. DISCHARGE (Lit/sec) Bed Slope	Q=19l/sec I=1/180													
PROPOSED WATER LEVEL (m)	97.25													97.09
PROPOSED CANAL BOTTOM (m)	96.95													98.09
PROPOSED ELEVATION Right (m)	97.98		97.98 98.11		98.11 98.56		98.56 98.86		98.86 98.93		98.93 98.94		98.94 98.96	98.96
PROPOSED ELEVATION Left (m)	97.83		97.83 98.05		98.05 98.37		98.37 98.88		98.88 98.94					98.94
ELEVATION (m)	97.85	97.72		98.12	98.23	98.28		98.56	98.70	99.00		99.22	99.82	98.94 98.88
CUMULATIVE DISTANCE (m)	0.0	20.0		40.0	60.0	80.0		100.0	120.0	140.0		160.0	180.0	200.0 206.0
DISTANCE (m)	0.0	20.0		20.0	20.0	20.0		20.0	20.0	20.0		20.0	20.0	20.0 6.0
STATION	No.0	+20		+40	+60	+80		No.1	+20	+40		+60	+80	No.2 EP (No.2+6)
CURVE														

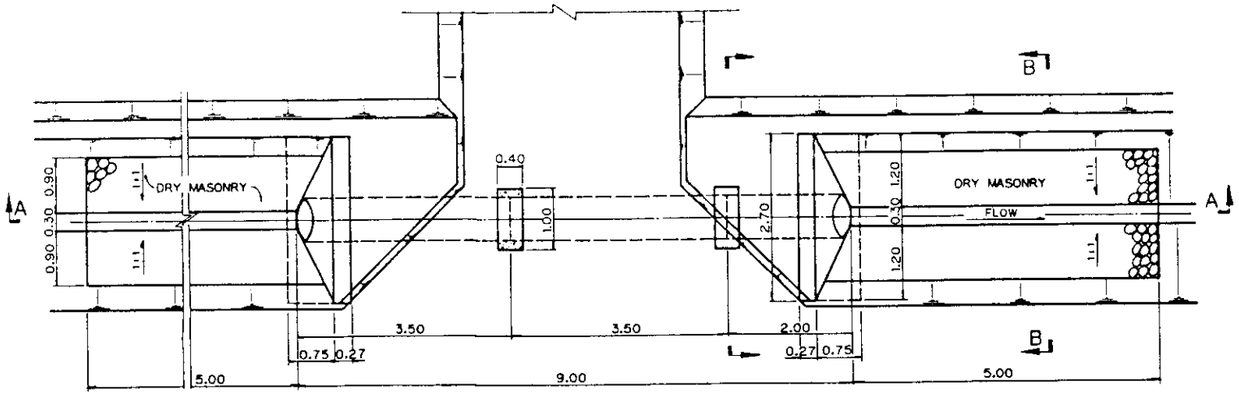
NOTE: ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

MINISTRY OF AGRICULTURE			
HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT			
LONGITUDINAL PROFILE DD-5, -6 and -6-1			
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No. 18	APPROVED		
JAPAN INTERNATIONAL COOPERATION AGENCY			



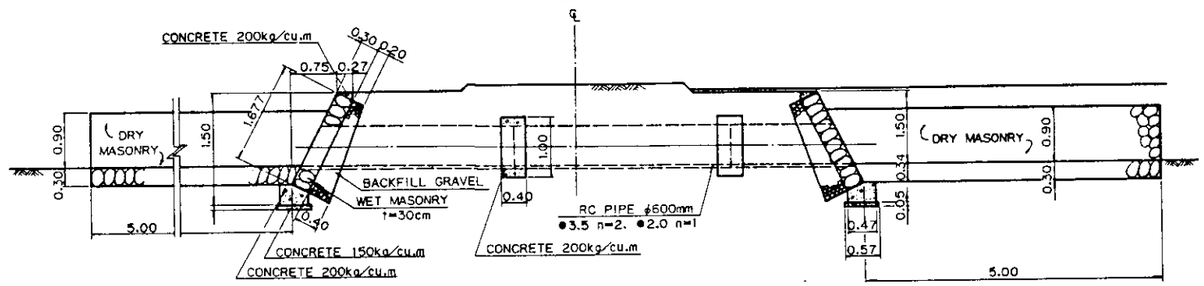
TYPICAL CROSS SECTION OF DRAIN DITCH

SCALE 1:30



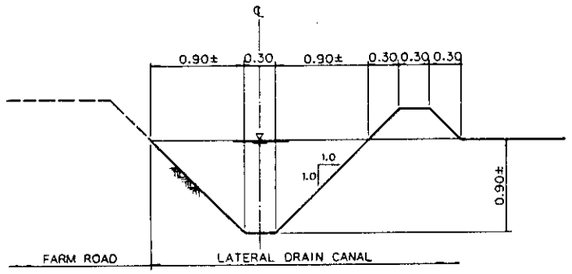
PLAN

SCALE 1:50



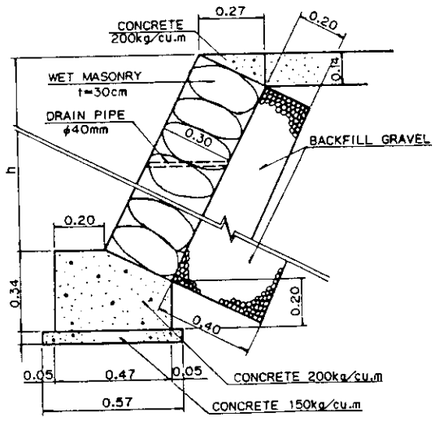
SECTION A-A

SCALE 1:50

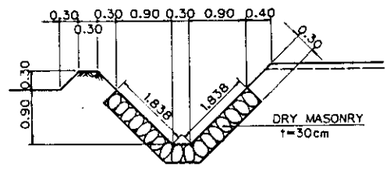


TYPICAL CROSS SECTION OF LATERAL DRAIN CANAL

SCALE 1:30



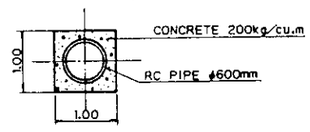
DETAIL OF WET MASONRY



SECTION B-B

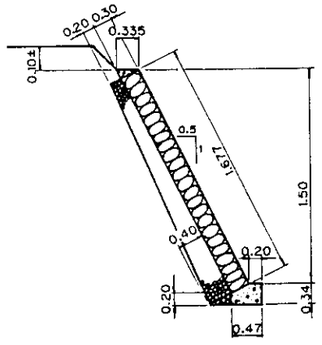
SCALE 1:50

DRAINAGE ROAD CROSSING
(TYPE-A)



SECTION C-C

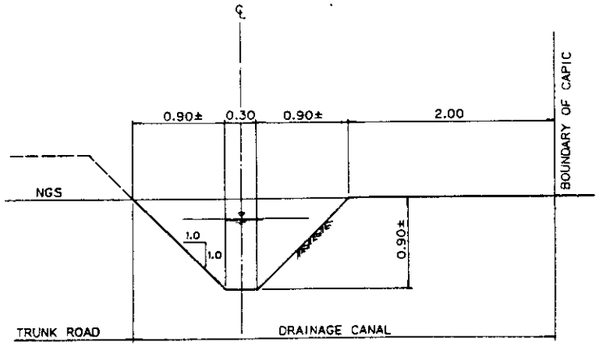
SCALE 1:50



WET MASONRY

NO SCALE

(REFER TO DETAIL OF WET MASONRY)



TYPICAL CROSS SECTION OF INTERCEPTION DRAINAGE CANAL

SCALE 1:30

NOTE : ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

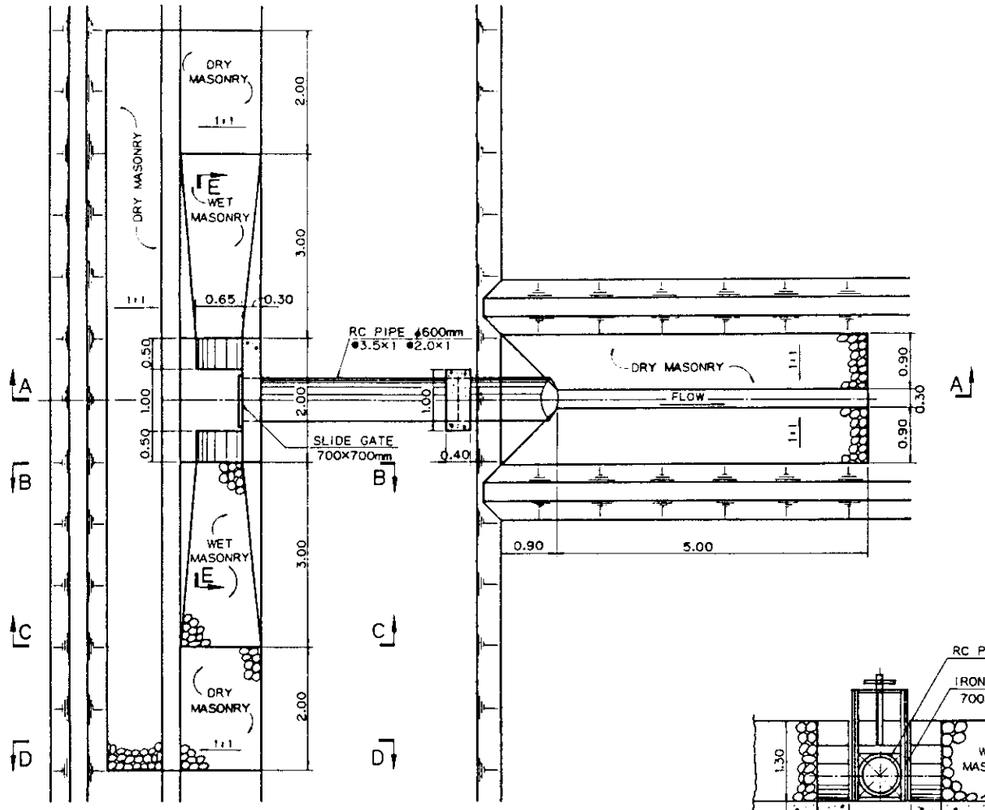
MINISTRY OF AGRICULTURE

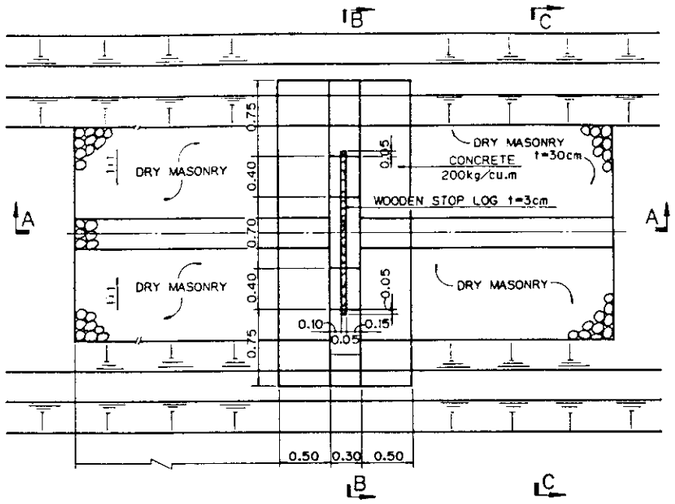
HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT

TYPICAL CROSS SECTION OF DRAINAGE CANAL AND ROAD CROSSING (TYPE-A)

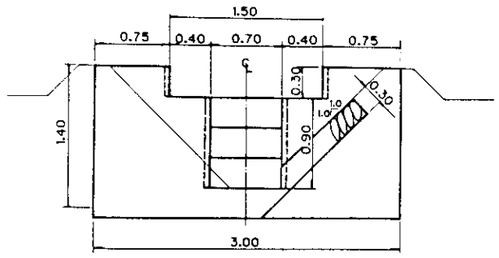
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No. 19	APPROVED		

JAPAN INTERNATIONAL COOPERATION AGENCY

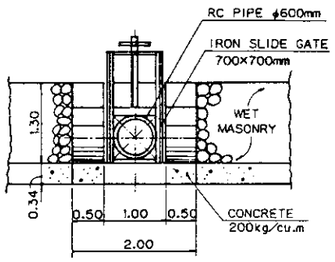




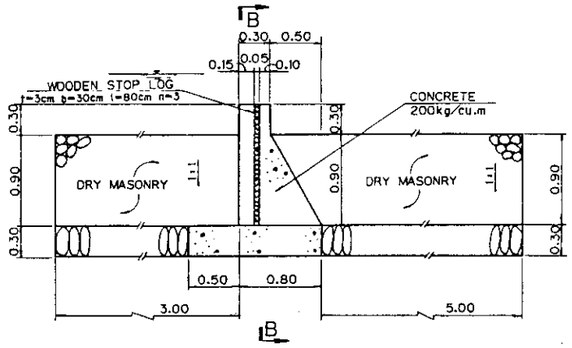
PLAN



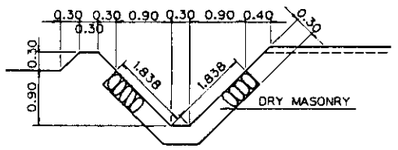
SECTION B-B



SECTION E-E

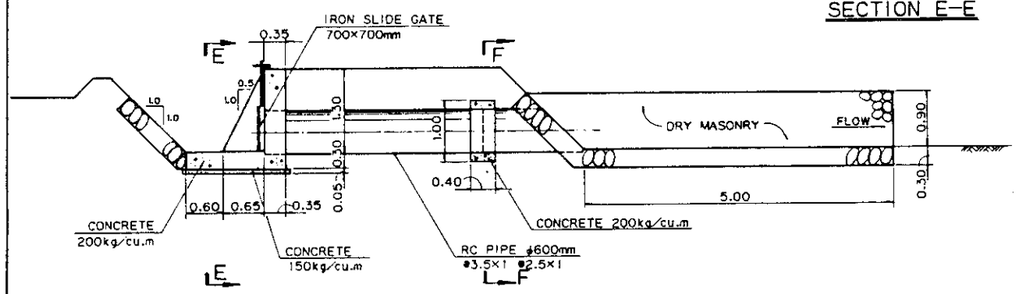


SECTION A-A

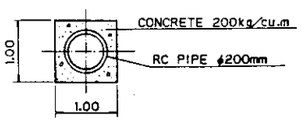


SECTION C-C

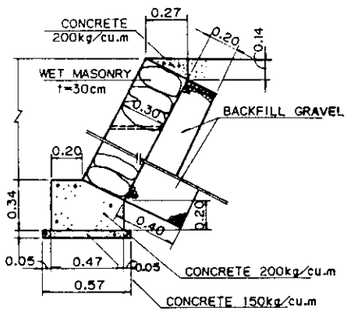
DRAINAGE CHECK STRUCTURE

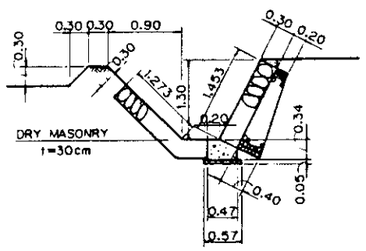


SECTION A-A

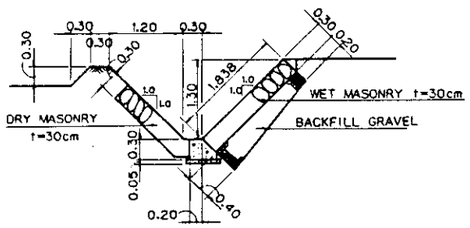


SECTION F-F
SCALE 1:50

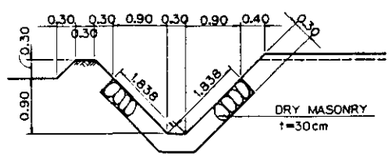




SECTION B-B



SECTION C-C



SECTION D-D

DRAINAGE ROAD CROSSING (TYPE-B)

NOTE : ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

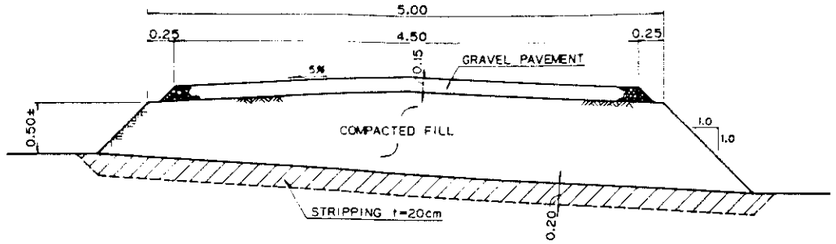
MINISTRY OF AGRICULTURE

HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT

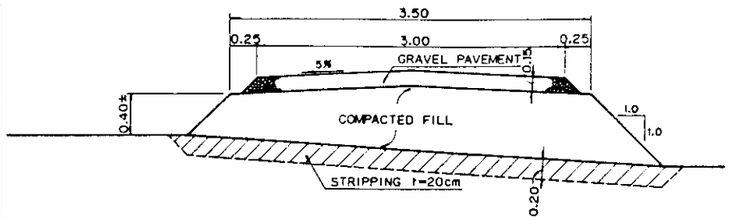
ROAD CROSSING (TYPE-B) AND DRAINAGE CHECK STRUCTURE

SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No	20	APPROVED	

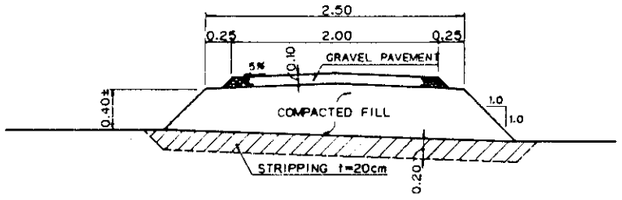
JAPAN INTERNATIONAL COOPERATION AGENCY



TRUNK ROAD(TR)



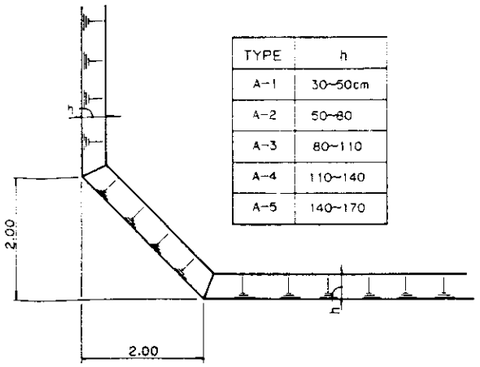
FARM ROAD-A(FR)



FARM ROAD-B(FR)

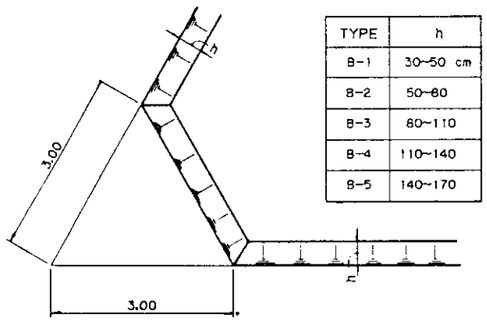
TYPICAL CROSS SECTION OF FARM ROAD

SCALE 1:30



TYPE	h
A-1	30~50cm
A-2	50~80
A-3	80~110
A-4	110~140
A-5	140~170

TYPE-A

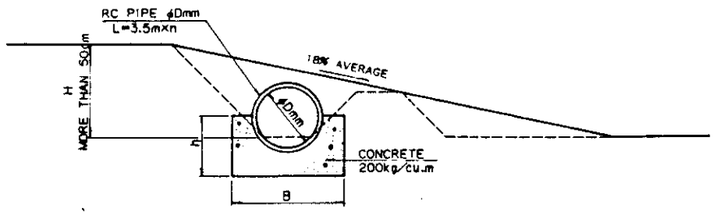


TYPE	h
B-1	30~50 cm
B-2	50~80
B-3	80~110
B-4	110~140
B-5	140~170

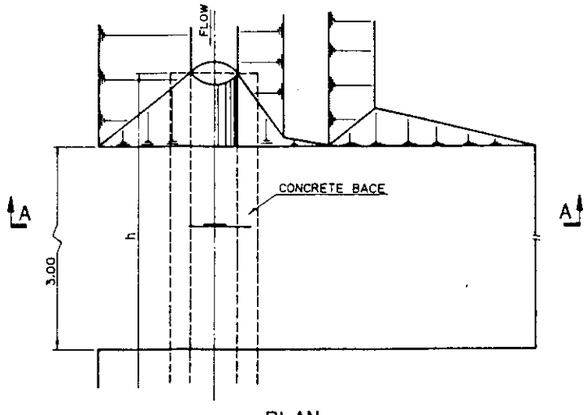
TYPE-B

CORNER CUTTING

SCALE 1:50



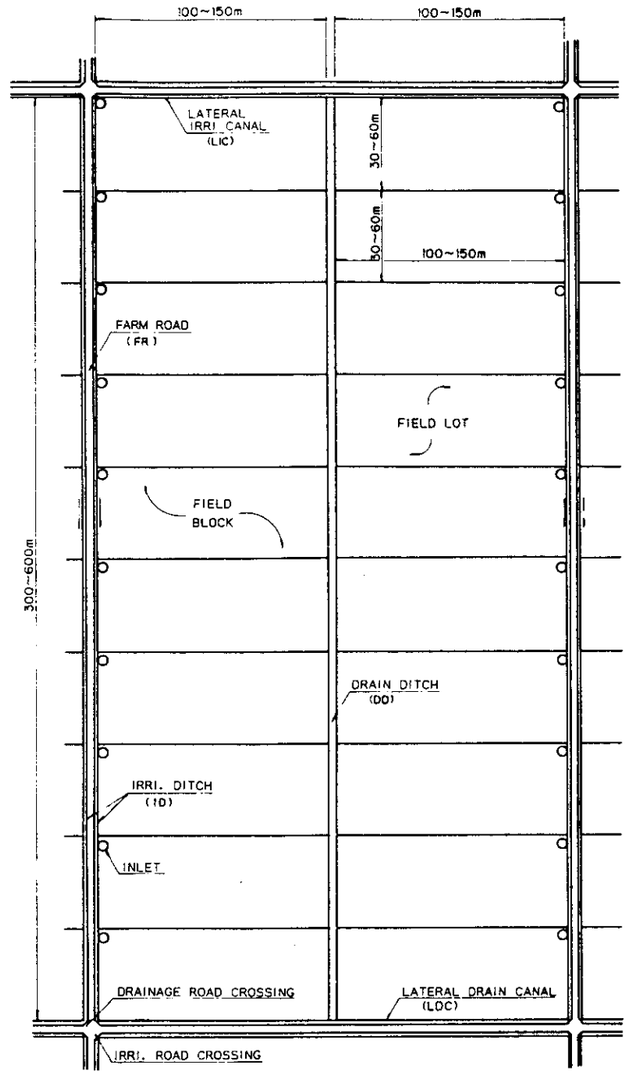
SECTION A-A



PLAN

ACCESS ROAD TO FIELD

NO SCALE



TYPICAL LAYOUT PROPOSED FACILITIES

NO SCALE

DIMENSION

TYEP	h	D	n	L
1	40cm	400mm	1pc	3.5m
2	40	400	2	7.0
S1	45	500	1	3.5
S2	45	500	2	7.0
S3	50	600	1	3.5
S4	50	600	2	7.0

NOTE : ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

MINISTRY OF AGRICULTURE

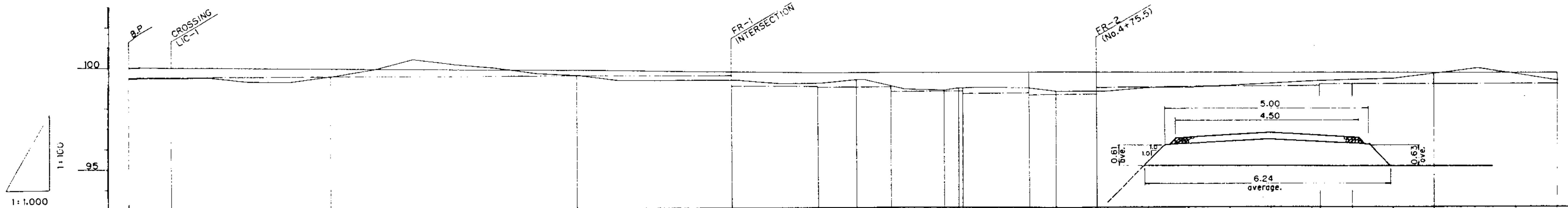
HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT

TYPICAL CROSS SECTION OF FARM ROAD and ITS APPURTENANT STRUCTURE, and TYPICAL LAYOUT OF FIELD BLOCK

SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No.	21	APPROVED	

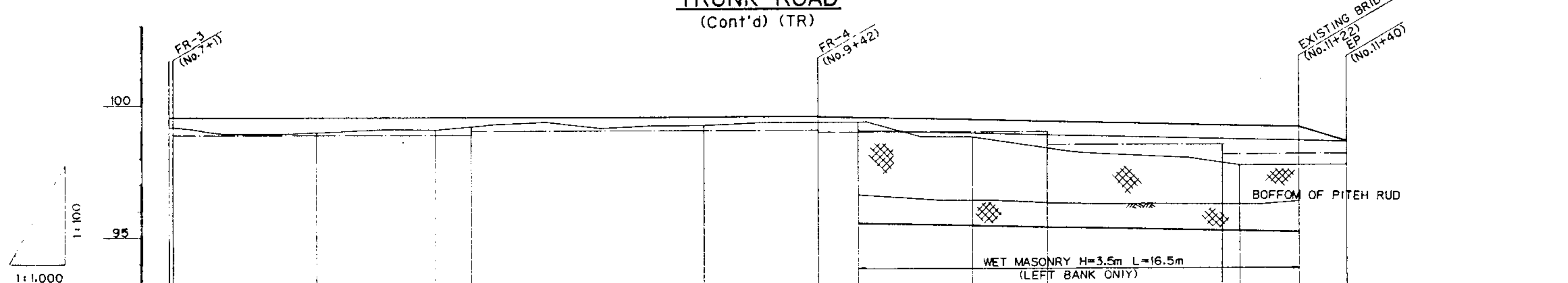
JAPAN INTERNATIONAL COOPERATION AGENCY

TRUNK ROAD
(TR)

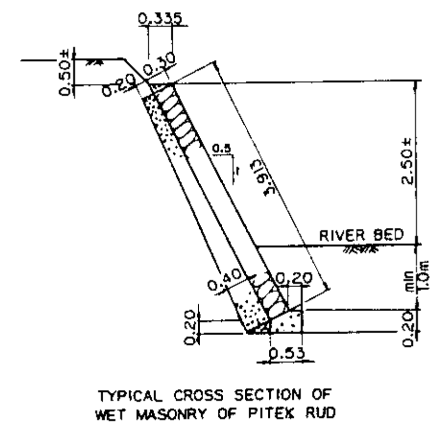


STATION	BERM EL. of ID	PROPOSED ROAD SURFACE ELEVATION	PROPOSED ELEVATION Right (m)	PROPOSED ELEVATION Left (m)	ELEVATION (m)	CUMULATIVE DISTANCE (m)	DISTANCE (m)	CURVE
No.0	99.80	100.00		99.50	99.43	0.0	0.0	
+20	99.80	100.00			99.47	20.0	20.0	
+40		99.98			99.24	40.0	20.0	
+60		99.96			99.26	60.0	20.0	
+80		99.95			99.32	80.0	20.0	
No.1		99.93			99.52	100.0	20.0	
+20		99.91			99.82	120.0	20.0	
+40		99.89			100.36	140.0	20.0	
+60		99.87			100.08	160.0	20.0	
+80		99.86			99.93	180.0	20.0	
No.2		99.84			99.65	200.0	20.0	
+20		99.82			99.55	220.0	20.0	
+40		99.80			99.28	240.0	20.0	
+60		99.78			99.27	260.0	20.0	
+80		99.76			99.27	280.0	20.0	
+96 / No.3	99.74	99.75		99.50 / 98.99	99.28 / 99.27	296.0 / 300.0	16.0 / 4.0	
+20		99.73			99.10	320.0	20.0	
+40		99.71		98.99 / 98.97	99.15	340.0	20.0	
IP.1 / +60		99.70 / 99.70			99.29 / 99.29	357.0 / 360.0	17.0 / 3.0	
+80		99.68		98.97 / 98.71	98.82	380.0	20.0	
No.4		99.66		98.71 / 98.60	98.79	400.0	20.0	
IP.2		99.65			98.89	408.0	8.0	
+20		99.65			98.89	420.0	12.0	
+40		99.63		98.60 / 98.51	98.86	440.0	20.0	
IP.3 / +60		99.62 / 99.61			98.69 / 98.69	455.0 / 460.0	15.0 / 5.0	
+75.5 / +80	99.56	99.60 / 99.60		98.51 / 98.84	98.66 / 98.66	475.5 / 480.0	15.5 / 4.5	
No.5		99.59			98.83	500.0	20.0	
+20		99.58			98.82	520.0	20.0	
+40		99.57			98.90	540.0	20.0	
+60		99.56			99.00	560.0	20.0	
+80		99.56 / 99.55		98.84 / 98.93	99.10	580.0	20.0	
No.6		99.55			99.15	600.0	20.0	
+20		99.54			99.20	620.0	20.0	
+40 / IP.4		99.53			99.47 / 99.47	640.0 / 641.0	20.0 / 1.0	
+60		99.52			99.72	660.0	19.0	
+80		99.51			99.40	680.0	20.0	
No.7	99.49	99.50		98.93	99.10	700.0	20.0	

TRUNK ROAD
(Cont'd) (TR)



STATION	BERM EL. of ID	PROPOSED ROAD SURFACE ELEVATION	PROPOSED ELEVATION Right (m)	PROPOSED ELEVATION Left (m)	ELEVATION (m)	CUMULATIVE DISTANCE (m)	DISTANCE (m)	CURVE
No.7 / +1	99.49	99.50		98.93 / 98.77	99.10 / 99.10	700.0 / 701.0	20.0 / 1.0	
+20		99.50			98.85	720.0	19.0	
+40		99.49			98.83	740.0	20.0	
IP.5 / +60		99.49			98.91 / 98.91	755.5 / 760.0	15.5 / 4.5	
+80		99.48			98.99	780.0	20.0	
No.8		99.48			98.99	800.0	20.0	
+20		99.48 / 99.48		98.77 / 98.92	99.18	820.0	20.0	
+40		99.47			99.26	840.0	20.0	
+60		99.47			99.02	860.0	20.0	
+80		99.46			99.09	880.0	20.0	
No.9		99.46			99.09	900.0	20.0	
+20		99.45			99.19	920.0	20.0	
+40	99.41	99.45		98.92 / 98.82	99.19	940.0	20.0	
IP.6 / +60		99.40			99.19 / 99.19	955.0 / 960.0	15.0 / 5.0	
+80		99.34			98.61	980.0	20.0	
No.10		99.29			98.61	1000.0	20.0	
+20		99.24 / 99.22		98.82 / 98.31	98.18	1020.0	20.0	
+40		99.18			98.00	1040.0	20.0	
+60		99.13			97.90	1060.0	20.0	
+80		99.08			97.80	1080.0	20.0	
No.11		99.02		98.31 / 97.95	97.50	1100.0	20.0	
+20 / +22	99.35	98.97			97.50 / 97.50	1120.0 / 1122.0	20.0 / 2.0	
EP		98.46		97.95	97.50	1140.0	18.0	

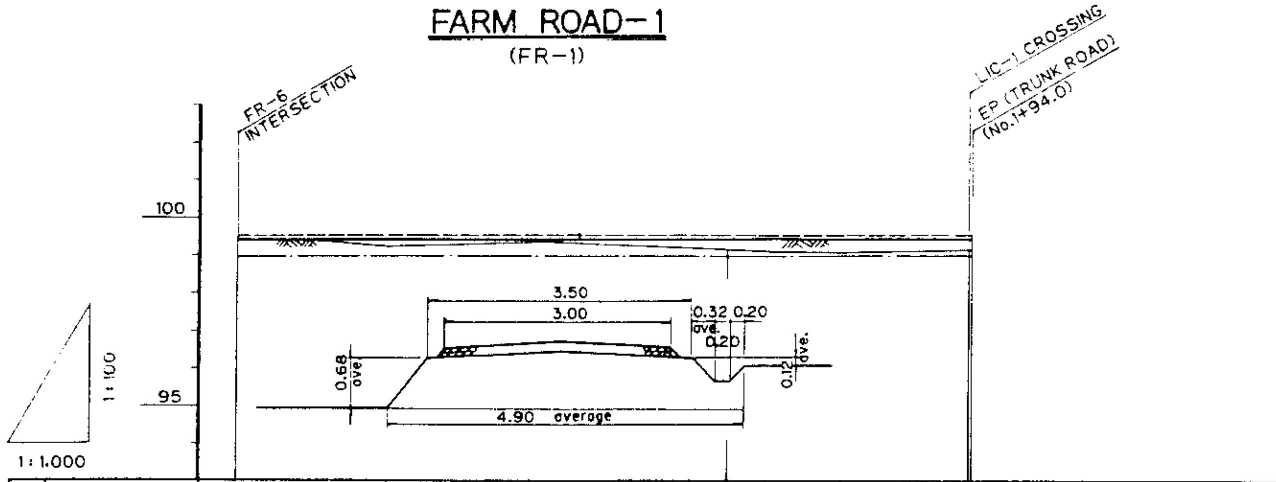


TYPICAL CROSS SECTION OF WET MASONRY OF PITEK RUD

NOTE: ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

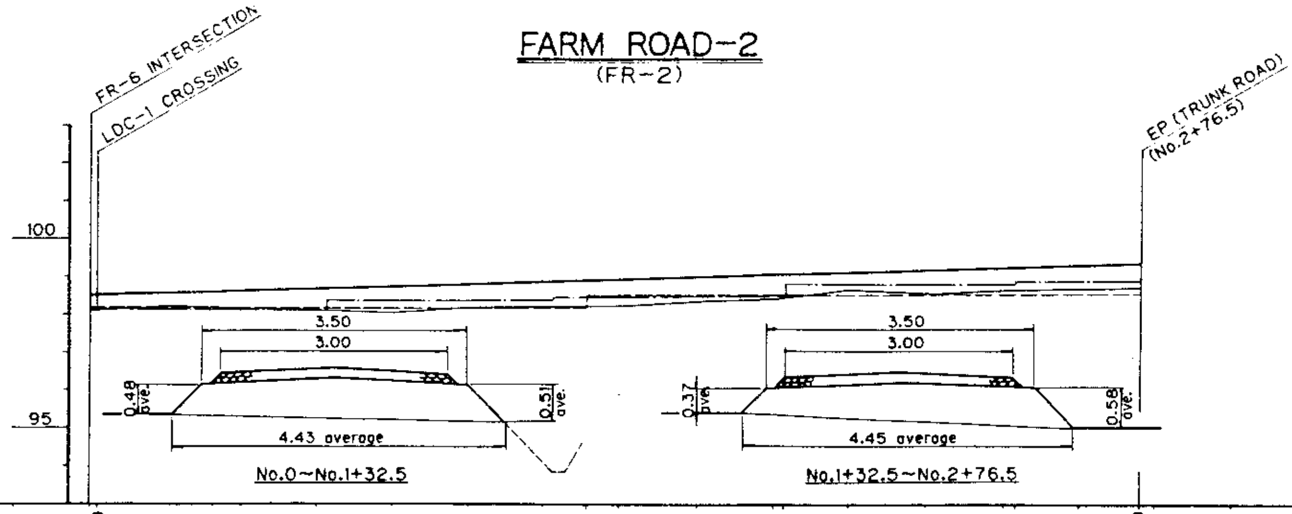
MINISTRY OF AGRICULTURE			
HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT			
LONGITUDINAL PROFILE TR			
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No. 22	APPROVED		
JAPAN INTERNATIONAL COOPERATION AGENCY			

FARM ROAD-1
(FR-1)



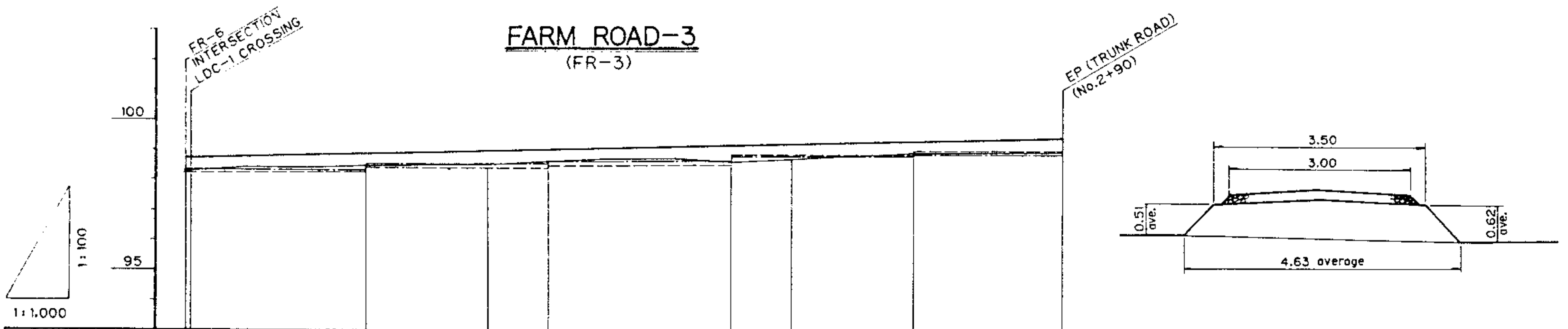
		No.0	+20	+40	+60	+80	No.1	+20		+40	+60	+80	+93 EP (No.1+94)
PROPOSED	BERM EL. of ID	99.52											99.73
PROPOSED	ROAD SURFACE ELEVATION	99.55							99.68				99.75
PROPOSED	ELEVATION Right (m)	99.52											99.52
PROPOSED	ELEVATION Left (m)	98.94							98.94 98.99				98.99
ELEVATION (m)		99.41	99.33	99.18	99.25	99.32	99.24	99.16		99.10	99.06	99.15	99.16 99.16
CUMULATIVE DISTANCE (m)		0.0	20.0	40.0	60.0	80.0	100.0	120.0		140.0	160.0	180.0	193.0 194.0
DISTANCE (m)		0.0	20.0	20.0	20.0	20.0	20.0	20.0		20.0	20.0	20.0	13.0 1.0
STATION		No.0	+20	+40	+60	+80	No.1	+20		+40	+60	+80	+93 EP (No.1+94)
CURVE													

FARM ROAD-2
(FR-2)



		No.0 +1.5	+20	+40	+60	+80	No.1	+20	+32.5	+40	+60	+80	No.2	+20	+40	+60	EP (No.2+76.5)
PROPOSED	BERM EL. of ID	98.39															99.29
PROPOSED	ROAD SURFACE ELEVATION	99.28 98.50			98.67			98.85	98.88			99.02			99.19		99.30 99.60
PROPOSED	ELEVATION Right (m)	98.20							98.20 98.51								98.51
PROPOSED	ELEVATION Left (m)	98.14			98.14 98.38			98.38 98.47				98.47 98.81			98.81 98.84		98.84
ELEVATION (m)		98.12 98.12	98.22	98.21	98.13	98.11	98.23	98.22	98.28	98.28	98.34	98.42	98.58	98.54	98.67	98.69	98.69
CUMULATIVE DISTANCE (m)		0.0 1.5	20.0	40.0	60.0	80.0	100.0	120.0	132.5	140.0	160.0	180.0	200.0	220.0	240.0	260.0	276.5
DISTANCE (m)		0.0 1.5	18.5	20.0	20.0	20.0	20.0	20.0	12.5	7.5	20.0	20.0	20.0	20.0	20.0	20.0	16.5
STATION		No.0 +1.5	+20	+40	+60	+80	No.1	+20	+32.5	+40	+60	+80	No.2	+20	+40	+60	EP (No.2+76.5)
CURVE																	

FARM ROAD-3
(FR-3)



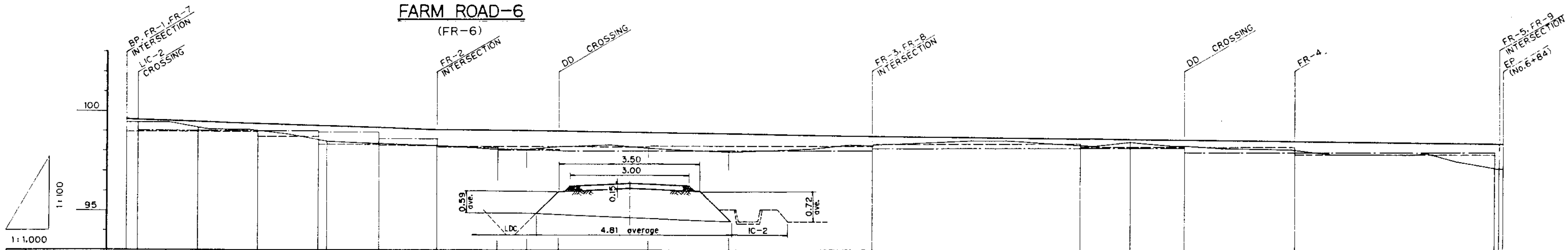
		No.0 +1.5	+20	+40	+60	+80	No.1	+20	+40	+60	+80	No.2	+20	+40	+60	+80	EP (No.2+90)
PROPOSED	BERM EL. of ID	98.53															99.26
PROPOSED	ROAD SURFACE ELEVATION	98.75 98.68			98.81			98.95			99.08			99.22			99.50
PROPOSED	ELEVATION Right (m)	98.19			98.19 98.36			98.36 98.45			98.45 98.77			98.77 98.93			98.93
PROPOSED	ELEVATION Left (m)	98.28			98.28 98.49			98.49 98.59			98.59 98.74			98.74 98.77			98.77
ELEVATION (m)		98.25 98.25	98.36	98.35	98.40	98.46	98.45	98.55	98.63	98.68	98.56	98.63	98.73	98.85	98.88	98.87	98.90
CUMULATIVE DISTANCE (m)		0.0 1.5	20.0	40.0	60.0	80.0	100.0	120.0	140.0	160.0	180.0	200.0	220.0	240.0	260.0	280.0	290.0
DISTANCE (m)		0.0 1.5	18.5	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	10.0
STATION		No.0 +1.5	+20	+40	+60	+80	No.1	+20	+40	+60	+80	No.2	+20	+40	+60	+80	EP (No.2+90)
CURVE																	

NOTE: ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

MINISTRY OF AGRICULTURE			
HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT			
LONGITUDINAL · PROFILE FARM ROAD-1, -2 and-3			
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No. 23	APPROVED		
JAPAN INTERNATIONAL COOPERATION AGENCY			

FARM ROAD-6

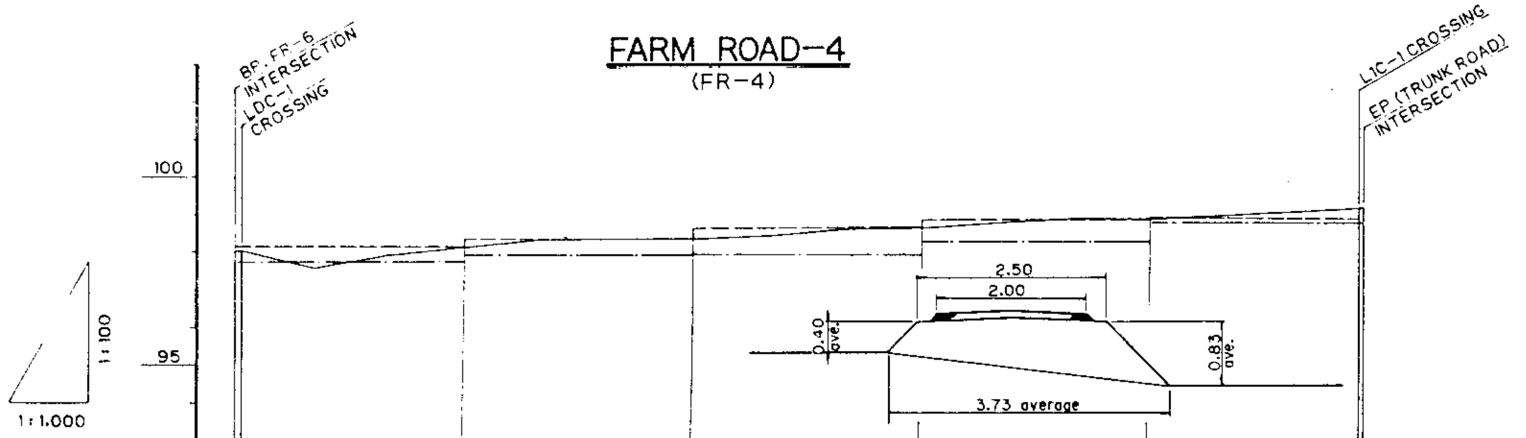
(FR-6)



STATION	DISTANCE (m)	CUMULATIVE DISTANCE (m)	ELEVATION (m)	PROPOSED ELEVATION Left (m)	PROPOSED ELEVATION Right (m)	PROPOSED ROAD SURFACE ELEVATION	PROPOSED BERM EL. of ID	CURVE
No.0 / +5.5	0.0 / 5.5	0.0 / 5.5	99.40 / 99.40	98.96	98.94	99.55	99.52	
+20	14.5	20.0	99.37					
+40	20.0	40.0	99.02	98.96 / 98.94		99.48		
+60	20.0	60.0	99.02	98.94 / 98.93	98.94 / 98.65	99.36		
+80	20.0	80.0	98.75					
No.1	20.0	100.0	98.39	98.93 / 98.86	98.65 / 98.27	99.41		
+20	20.0	120.0	98.30	98.86 / 98.56	98.27 / 98.20	99.35		
+40	20.0	140.0	98.26					
+60	20.0	160.0	98.12	98.56 / 98.11	98.20 / 98.14	99.28		
+80	20.0	180.0	98.00	98.11 / 97.98		99.21		
No.2	20.0	200.0	98.03					
+16 / +20	16.0 / 4.0	216.0 / 220.0	98.18 / 98.20	97.98 / 97.94		99.05	99.03	
+40	20.0	240.0	98.23					
+60	20.0	260.0	98.08		98.14 / 98.19			
+80	20.0	280.0	98.00					
No.3	20.0	300.0	97.88					
+20	20.0	320.0	98.00			98.86		
+40	20.0	340.0	98.05					
+60	20.0	360.0	98.26					
+72 / +80	12.0 / 8.0	372.0 / 380.0	98.25 / 98.30	97.94 / 98.07	98.19 / 98.28	98.75	98.72	
No.4	20.0	400.0	98.40					
+20	20.0	420.0	98.45					
+40	20.0	440.0	98.47					
+60	20.0	460.0	98.28					
+80	20.0	480.0	98.19		98.28 / 98.14	98.60		
No.5	20.0	500.0	98.40					
+20 / +27	20.0 / 7.0	520.0 / 527.0	98.21 / 98.22	98.07 / 97.83				
+40	13.0	540.0	98.11					
+60	20.0	560.0	98.04					
+80 / +83.5	20.0 / 3.5	580.0 / 583.5	98.01		98.14 / 98.74	98.44		
No.6	16.5	600.0	97.73					
+20	20.0	620.0	97.73					
+40	20.0	640.0	97.73					
+60	20.0	660.0	97.40					
+80 / +82 / EP (No.6+84)	20.0 / 2.0 / 2.0	680.0 / 682.0 / 684.0	97.07 / 97.07 / 97.07	97.83	97.74	98.30	98.17	

FARM ROAD-4

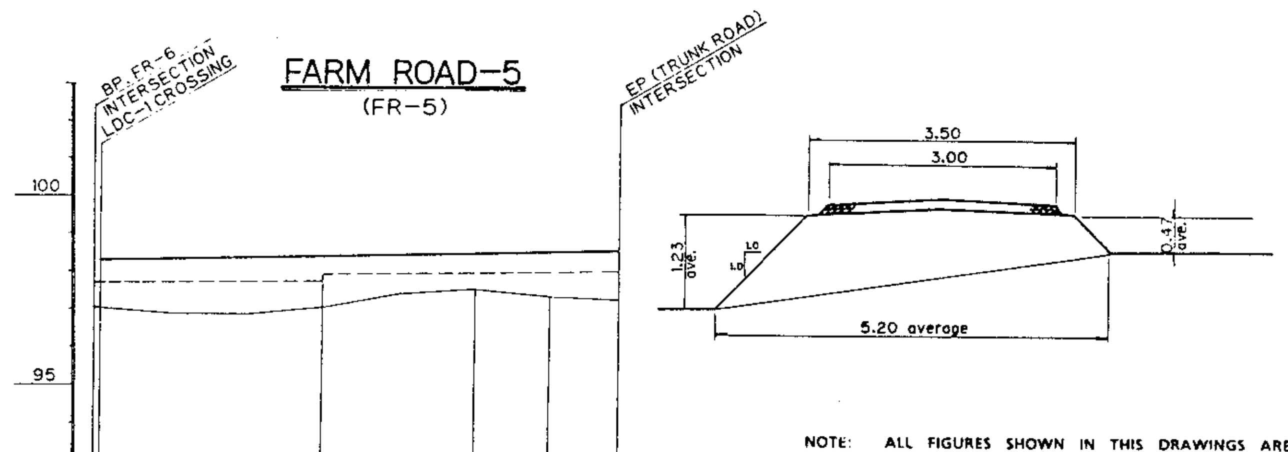
(FR-4)



STATION	DISTANCE (m)	CUMULATIVE DISTANCE (m)	ELEVATION (m)	PROPOSED ELEVATION Left (m)	PROPOSED ELEVATION Right (m)	PROPOSED ROAD SURFACE ELEVATION	PROPOSED BERM EL. of ID	CURVE
No.0 / +1.5	0.0 / 1.5	0.0 / 1.5	98.00 / 98.00	97.74	98.14	98.44	99.31	
+20	18.5	20.0	97.55					
+40	20.0	40.0	97.90					
+60	20.0	60.0	98.29	97.74 / 97.33	98.14 / 98.36	98.67		
+80	20.0	80.0	98.30					
No.1	20.0	100.0	98.32					
+20	20.0	120.0	98.34	97.93 / 97.95	98.36 / 98.64	98.92	98.86	
+40	20.0	140.0	98.45			99.04		
+60	20.0	160.0	98.61					
+80	20.0	180.0	98.63	97.95 / 98.31	98.64 / 98.84	99.14		
No.2	20.0	200.0	98.75			99.24		
+20	20.0	220.0	98.88					
+40	20.0	240.0	98.83	98.31 / 98.82	98.84 / 98.92	99.26		
+60	20.0	260.0	98.98					
+80	20.0	280.0	99.10					
+96 / EP	16.0 / 1.0	296.0 / 297.0	99.19 / 99.19	98.82	98.92	99.45	99.31	

FARM ROAD-5

(FR-5)

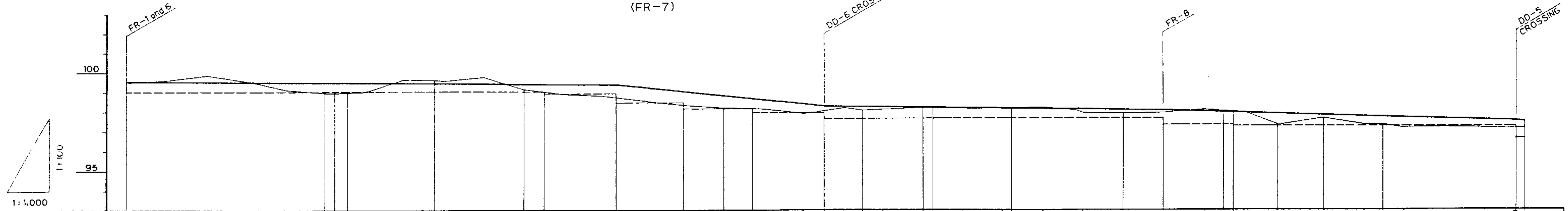


STATION	DISTANCE (m)	CUMULATIVE DISTANCE (m)	ELEVATION (m)	PROPOSED ELEVATION Left (m)	PROPOSED ELEVATION Right (m)	PROPOSED ROAD SURFACE ELEVATION	PROPOSED BERM EL. of ID	CURVE
No.0 / +1.5	0.0 / 1.5	0.0 / 1.5	97.07 / 97.07		97.74	98.30		
+20	18.5	20.0	96.90					
+40	20.0	40.0	96.84					
+60	20.0	60.0	97.00		97.74 / 97.93	98.23		
+80	20.0	80.0	97.40					
No.1	20.0	100.0	97.50					
+20	20.0	120.0	97.30		97.93 / 97.95	98.44		
EP (No.1 +38)	18.0	138.0	97.20		97.95	98.46		

NOTE: ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

MINISTRY OF AGRICULTURE			
HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT			
LONGITUDINAL・PROFILE FARM ROAD-4, -5 and-6			
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No. 24	APPROVED		
JAPAN INTERNATIONAL COOPERATION AGENCY			

FARM ROAD-7
(FR-7)

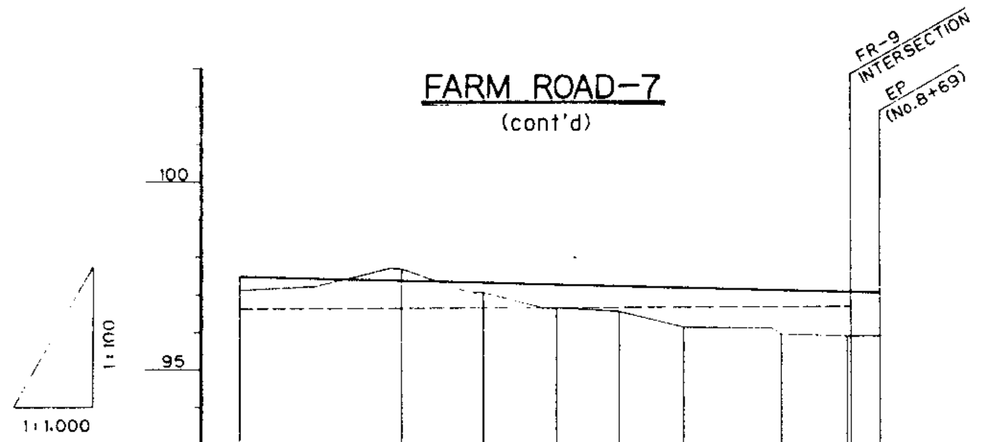


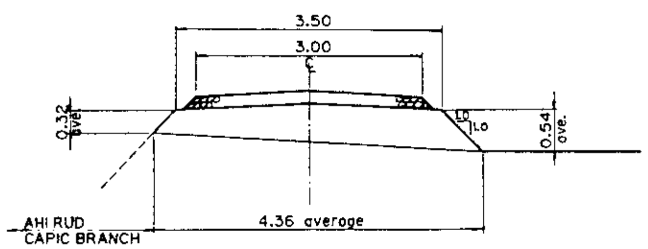
PROPOSED BERM EL. of ID	99.32																
PROPOSED ROAD SURFACE ELEVATION	99.55							99.40							99.31		
PROPOSED ELEVATION Right (m)	98.96							98.96 / 98.94							98.94 / 98.88		
PROPOSED ELEVATION Left (m)																	
ELEVATION (m)	99.46	99.55	99.80	99.50	99.09	98.88	98.88	98.88	98.94	99.55	99.55	99.50	99.71	99.10		98.83	98.74
CUMULATIVE DISTANCE (m)	0.0	20.0	40.0	60.0	80.0	100.0	104.5	111.0	120.0	140.0	155.0	160.0	180.0	200.0		220.0	240.0
DISTANCE (m)	0.0	20.0	20.0	20.0	20.0	20.0	4.5	6.5	9.0	20.0	15.0	5.0	20.0	20.0		20.0	20.0
STATION	No.0	+20	+40	+60	+80	No.1	IP.1	IP.2	+20	+40	IP.3	+60	+80	No.2		+20	+40
CURVE																	

PROPOSED BERM EL. of ID	99.18 / 98.87							98.18									
PROPOSED ROAD SURFACE ELEVATION	99.28		98.93		98.56			98.18					98.10			98.04	
PROPOSED ELEVATION Right (m)	98.88 / 98.37		98.37 / 98.05		98.05 / 97.83			97.83 / 97.54									
PROPOSED ELEVATION Left (m)																	
ELEVATION (m)		98.45	98.24	98.10		98.04	97.80		98.11	97.99	98.05	98.12	98.12	98.05	98.05	98.10	98.10
CUMULATIVE DISTANCE (m)		260.0	280.0	300.0		320.0	340.0		360.0	369.5	380.0	400.0	405.0	420.0	440.0	444.5	460.0
DISTANCE (m)		20.0	20.0	20.0		20.0	20.0		20.0	9.5	10.5	20.0	5.0	15.0	20.0	4.5	15.5
STATION		+60	+80	No.3		+20	+40		+60	IP.5	+80	No.4	IP.6	+20	+40	IP.7	+60
CURVE																	

PROPOSED BERM EL. of ID			97.71 (97.65)													97.29	
PROPOSED ROAD SURFACE ELEVATION			97.94			97.85										97.47	
PROPOSED ELEVATION Right (m)			97.54 / 97.22			97.22 / 97.17										97.17 / 96.61	
PROPOSED ELEVATION Left (m)																	
ELEVATION (m)	97.80	97.80	97.80	97.99	97.99		97.86	97.23	97.23	97.55	97.24	97.24	97.11	97.11	97.10	97.10	97.10
CUMULATIVE DISTANCE (m)	480.0	500.0	520.0	540.0	549.5		560.0	577.5	580.0	600.0	620.0	630.0	640.0	660.0	680.0	696.0	700.0
DISTANCE (m)	20.0	20.0	20.0	20.0	9.5		10.5	17.5	2.5	20.0	20.0	10.0	10.0	20.0	20.0	16.0	4.0
STATION	+80	No.5	+20 (IP.8)	+40	IP.9		+60 (IP.10)	+77.5 (IP.11)	+80	No.6	+20	IP.12	+40	+60	+80 (IP.13)	+96	No.7
CURVE																	

FARM ROAD-7
(cont'd)





PROPOSED BERM EL. of ID																
PROPOSED ROAD SURFACE ELEVATION	97.46			97.35											97.00	
PROPOSED ELEVATION Right (m)	96.61														96.61	
PROPOSED ELEVATION Left (m)																
ELEVATION (m)	97.10	97.17	97.67	97.67	97.03	97.03	96.62	96.62	96.50	96.10	96.10	96.09	95.90	95.85	95.85	95.85
CUMULATIVE DISTANCE (m)	700.0	720.0	740.0	743.0	760.0	764.5	780.0	783.5	800.0	817.0	820.0	840.0	842.5	860.0	861.0	869.0
DISTANCE (m)	4.0	20.0	20.0	3.0	17.0	4.5	15.5	3.5	16.5	17.0	3.0	20.0	2.5	17.5	1.0	8.0
STATION	No.7	+20	+40	IP.13	+60	IP.14	+80	IP.15	No.8	IP.16	+20	+40	IP.17	+60	+61	EP (No.8+69)
CURVE																

NOTE: ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

MINISTRY OF AGRICULTURE

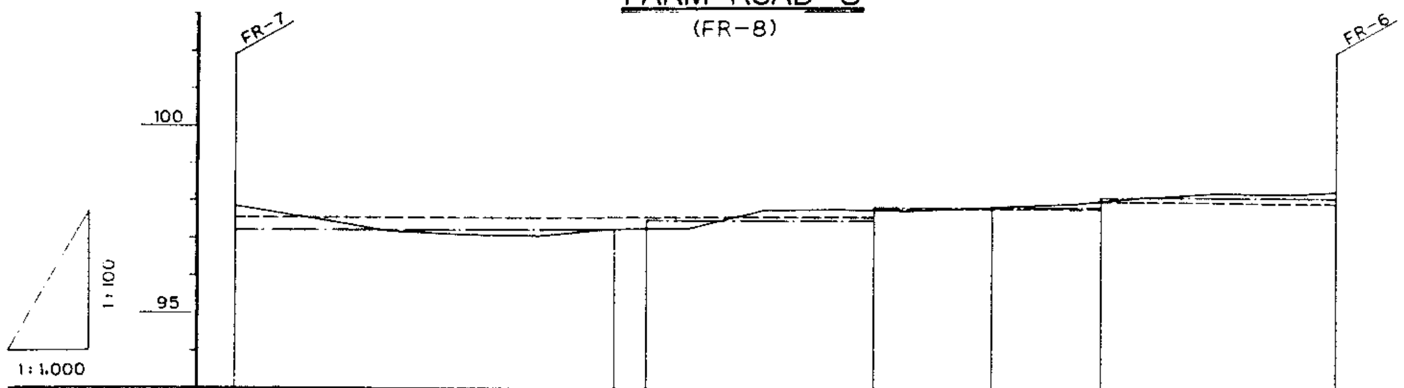
HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT

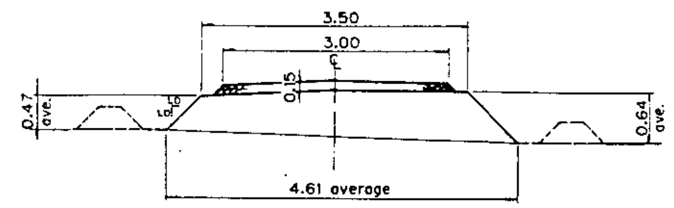
LONGITUDINAL·PROFILE
FARM ROAD-7

SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No. 25		APPROVED	

JAPAN INTERNATIONAL COOPERATION AGENCY

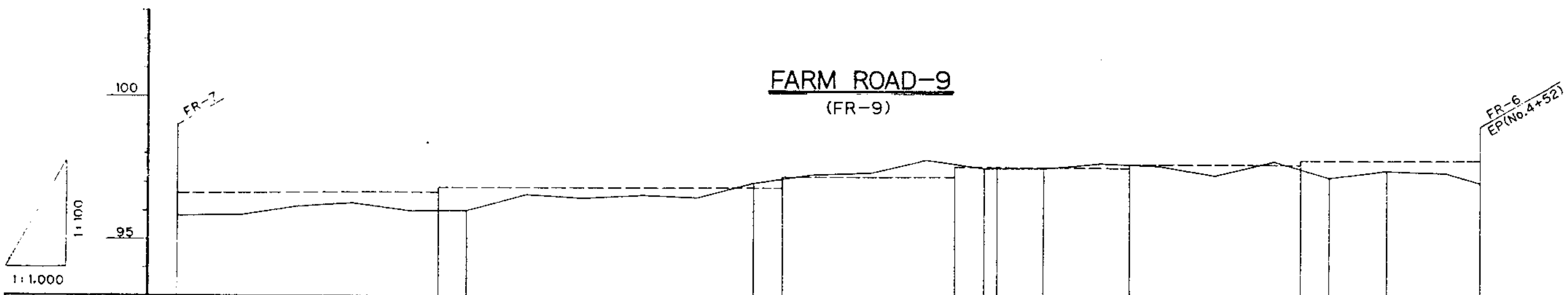
FARM ROAD-8
(FR-8)

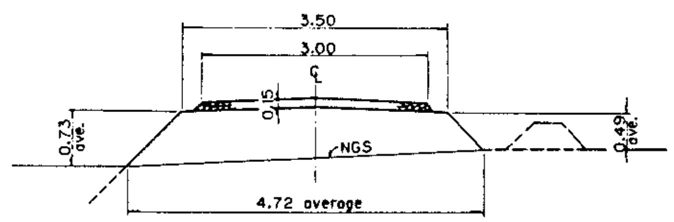




		No.0	+20	+40	+60	+80	No.1	+20	+40	+60	+80	No.2	+20	+40	+60	+80	EP (No.2+ 90.5)
PROPOSED	BERM EL. of ID	97.71					97.96			98.10			98.24				98.39
PROPOSED	ROAD SURFACE ELEVATION	97.94					98.04			98.10			98.38			98.68	98.75
PROPOSED	ELEVATION Right (m)	97.54								97.54 97.77			97.77 97.94				97.94
PROPOSED	ELEVATION Left (m)	97.22					97.22 97.47			97.47 97.80			97.80 98.07				98.07
ELEVATION (m)		97.80	97.49	97.13	97.07	97.07	97.23	97.36	97.72	97.74	97.73	97.82	97.91	98.13	98.24	98.21	98.23
CUMULATIVE DISTANCE (m)		0.0	20.0	40.0	60.0	80.0	100.0	120.0	140.0	160.0	180.0	200.0	220.0	240.0	260.0	280.0	290.5
DISTANCE (m)		0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	10.5
STATION		No.0	+20	+40	+60	+80	No.1	+20	+40	+60	+80	No.2	+20	+40	+60	+80	EP (No.2+ 90.5)
CURVE																	

FARM ROAD-9
(FR-9)

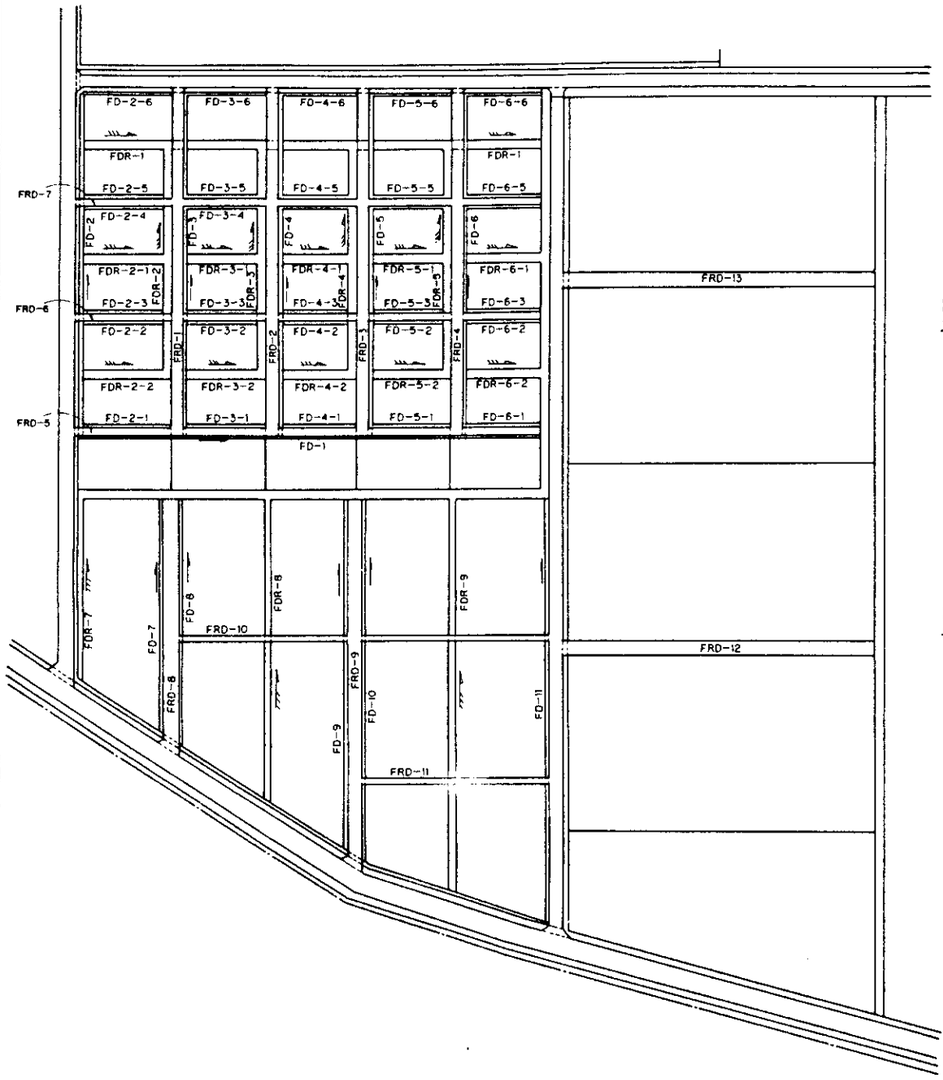


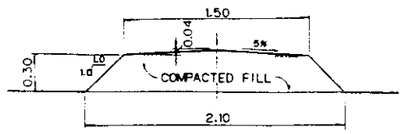


		No.0	+20	+40	+60	+80	No.1	+20	+40	+60	+80	No.2	+20	+40	+60	+80 IP.1	No.3	+20	+40	+60	+80	No.4	+20	+40	EP (No.4+ 52)
PROPOSED	BERM EL. of ID	96.86					97.12						97.47			97.64		97.82				97.99			98.17
PROPOSED	ROAD SURFACE ELEVATION	97.00					97.26						97.60			97.78		97.95				98.12			98.30
PROPOSED	ELEVATION Right (m)	96.61					96.61 96.78						96.78 97.19			97.19 97.53		97.53 97.69				97.69 97.83			97.83
PROPOSED	ELEVATION Left (m)																								
ELEVATION (m)		95.83	95.82	96.09	96.19	95.97	96.00	96.55	96.42	96.59	96.49	97.00	97.29	97.37	97.80	97.50 97.50	97.50	97.70	97.60	97.30	97.80	97.26	97.50	97.40	97.07
CUMULATIVE DISTANCE (m)		0.0	20.0	40.0	60.0	80.0	100.0	120.0	140.0	160.0	180.0	200.0	220.0	240.0	260.0	280.0 284.5	300.0	320.0	340.0	360.0	380.0	400.0	420.0	440.0	452.0
DISTANCE (m)		0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0 4.5	15.5	20.0	20.0	20.0	20.0	20.0	20.0	20.0	12.0
STATION		No.0	+20	+40	+60	+80	No.1	+20	+40	+60	+80	No.2	+20	+40	+60	+80 IP.1	No.3	+20	+40	+60	+80	No.4	+20	+40	EP (No.4+ 52)
CURVE																									

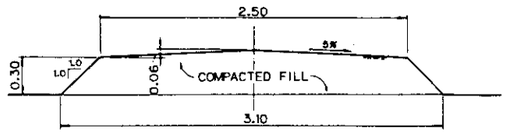
NOTE: ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

MINISTRY OF AGRICULTURE			
HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT			
LONGITUDINAL・PROFILE FARM ROAD-8 and-9			
SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No. 26	APPROVED		
JAPAN INTERNATIONAL COOPERATION AGENCY			

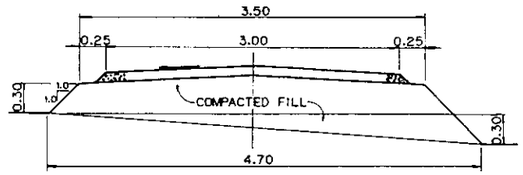




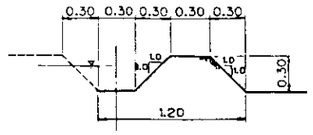
FARM ROAD(FRD)(TYPE 1)



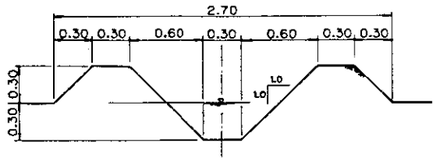
FARM ROAD(FRD)(TYPE 2)



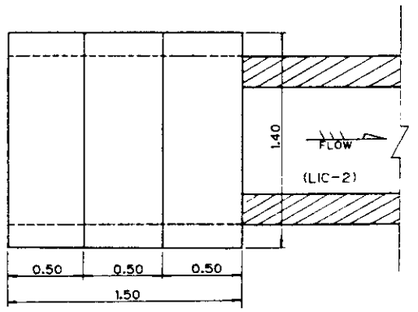
FARM ROAD(FRD)(TYPE 3)



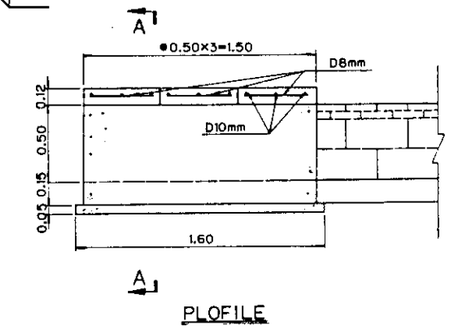
FARM DITCH(FD)



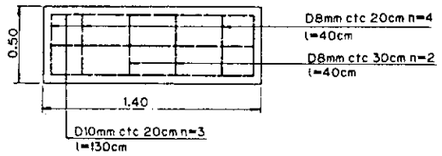
FARM DRAIN(FDR)



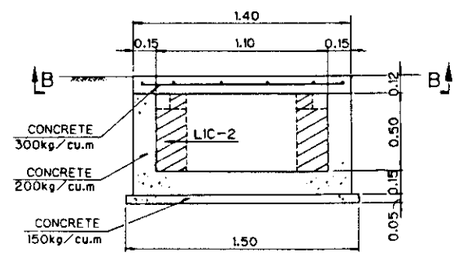
PLAN



PLOFILE



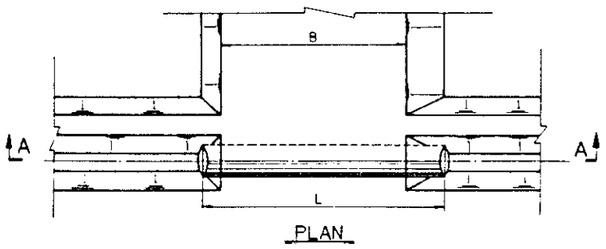
SECTION B-B



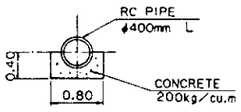
SECTION A-A

FD ROAD CROSSING(TYPE-4)

SCALE 1:50

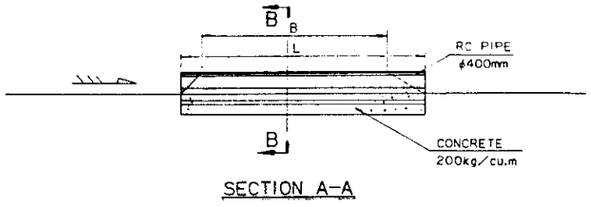


PLAN



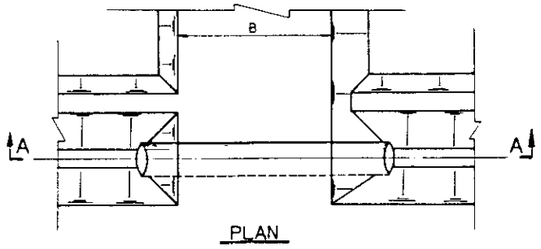
SECTION B-B

DIMENSION			
TYPE	B	L	REMARKS
1	1.5m	2.5m	
2	2.5	3.5	
3	3.5	5.0	

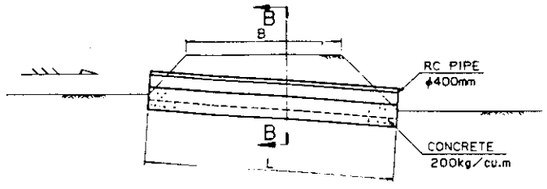


SECTION A-A

FD ROAD CROSSING



PLAN



SECTION A-A

DIMENSION			
TYPE	B	L	REMARKS
1	1.5m	3.5m	
2	2.5	5.0m	
3	3.5	5.0	

FDR ROAD CROSSING

NOTE : ALL FIGURES SHOWN IN THIS DRAWINGS ARE IN METER, UNLESS OTHERWISE SPECIFIED. THE FIGURES OF DISTANCE AND ELEVATION IN THIS DRAWING ARE BASED ON THE TOPOGRAPHIC MAP WITH A SCALE OF 1 : 1,000 SURVEYED BY MINISTRY OF AGRICULTURE

MINISTRY OF AGRICULTURE

HARAZ RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT

LAYOUT and DRAWINGS OF EXPERIMENTAL FARM and NECESSARY FACILITIES

SURVEYED		CHECKED	
DESIGNED		SUBMITTED	
DWG No 27	APPROVED		

JAPAN INTERNATIONAL COOPERATION AGENCY