平成元年度

帰国研修員フォローアップチーム報告書

ー溶接技術集団研修コースー

平成２年４月

国際協力事業団
名古屋国際研修センター

序　　　　　文

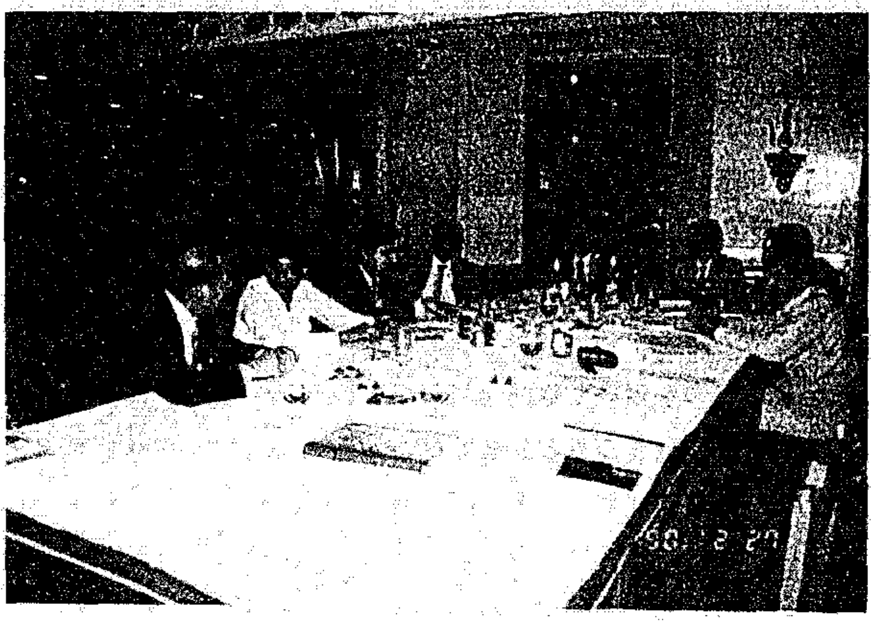
国際協力事業団は、集団研修コースの帰国研修員に対するアフターケアの一環としてフォローアップ調査団を派遣している。本報告書は、名古屋国際研修センターが(社)日本溶接協会の協力を得て実施している溶接技術集団研修コースのフォローアップ調査団が平成２年２月２４日から同年３月１５日までインド、スリランカ、及びタイを訪問、調査した結果をとりまとめたものである。

本調査にあたりご協力を頂いた帰国研修員、研修員所属先、各国政府機関、在外公館及びＪＩＣＡ事務所に感謝の意を表するとともに、本報告書が広く研修関係者に利用され、今後の研修コースの改善に役立てば幸いである。

平成２年４月

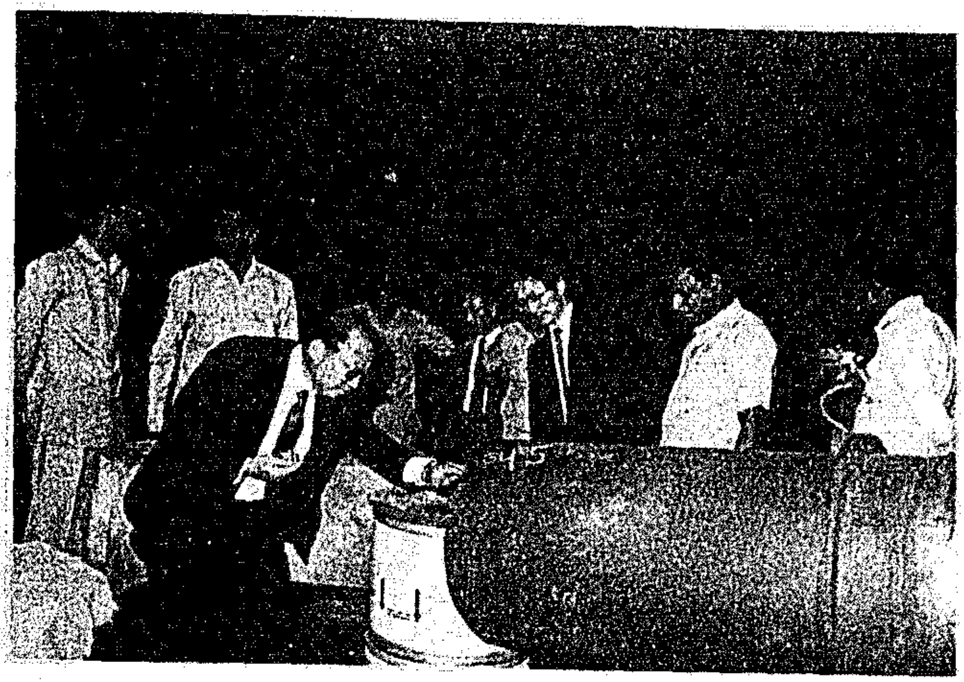
国際協力事業団
名古屋国際研修センター
所長　寺神戸　曠

(1) インド



ニューデリーにおけるセミナー風景

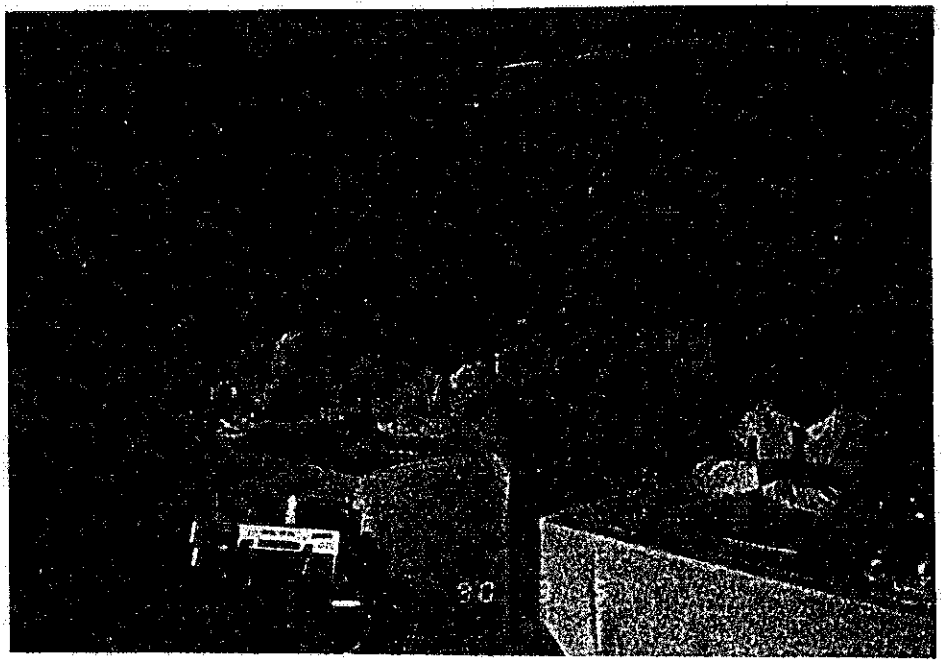
セミナー終了後の懇親会（ニューデリー）



インド国立溶接研究所にて（ティルチラパリ市）
（後列左から２人目が所長のMr. V. G. Jagannath）

(2) スリランカ

コロンボにおけるセミナー風景
（左から２人目が在スリランカ日本国大使館　神埼二等書記官）



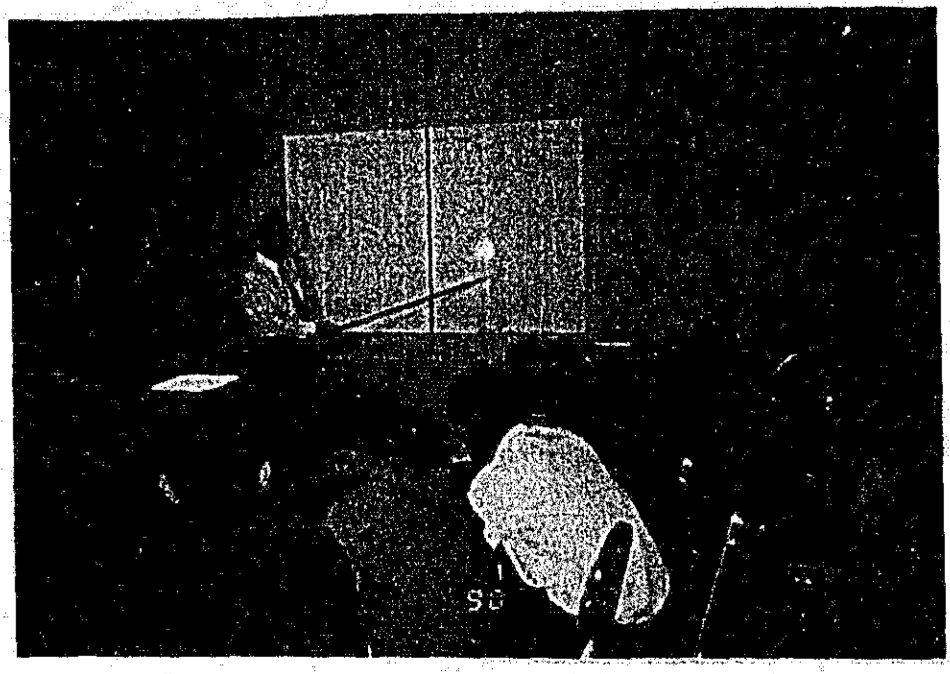
コロンボにおけるセミナー風景

セミナー終了後の懇親会（コロンボ）

セイロン製鋼所にて（アスルギリア）
（ろう付き保修工場での帰国研修員とのディスカッション）

(3) タ イ

バンコクにおけるセミナー風景
（帰国研修員に挨拶をする益本団長）



バンコクにおけるセミナー風景

(「最近の日本の溶接技術の概要とアーク溶接電源の発展」と題して講義をする益本団長)

タイ国鉄マカサン工場にて

(左から保母、益本団長、帰国研修員：Mr. Kongsak Pramlek<客車部長>、荻野)

目　次

Ⅰ．派遣チームの概要

1．派 遣 目 的

溶接技術集団研修コースは過去１６回実施され、参加した研修員の人数は１７１名にのぼっている。今回、これまでの割当国の中から技術レベルの異なると思われる三ケ国を訪問し、当該国の技術的問題点及びニーズを把握するとともに、帰国研修員に対し現地での技術指導を行い、わが国で実施した本コースの研修成果を測定し、今後の研修内容及びフォローアップ事業の向上、改善に資することを目的とする。

具体的調査方法は以下の通りである。

(1) 帰国研修員に対し面談及びアンケート調査を行い、帰国後の動向、研修内容の評価・有効度、帰国後の技術的問題点、ＪＩＣＡに対する要望等の調査・分析を行う。

(2) 帰国研修員所属先に対し、アンケート記入及び聞き取りを行い、研修員の選考、帰国研修員の貢献度、今後の要望等の調査を行う。

(3) 各国援助窓口を訪問するとともに、アンケート調査を行い、研修員の選考方法、ＪＩＣＡに対する要望等の調査、分析を行う。

(4) 各国の帰国研修員所属先及び、溶接関連機関を訪問し、溶接技術の現状及び直面している問題、今後の計画等を調査、把握する。

(5) 帰国研修員及びその関係者に対して技術セミナーを実施し、帰国研修員に対する技術的フォローアップ及び当該国における技術水準向上のための技術指導を行う。

以上をとりまとめ、各国に本調査団所見（現地レポート）を提出する。

2．団 員 構 成

氏名	担当業務	所属先
益本　功	団長、技術指導	名古屋大学名誉教授　岐阜職業訓練短期大学校　校長
保母金朗	技術指導	通商産業省　中部通商産業局　公益事業部　発電課長
荻野清彦	業務調査	国際協力サービス・センター　研修監理部　研修監理員

3．日　程

平成２年２月２４日から同年３月１５日まで（２０日間）

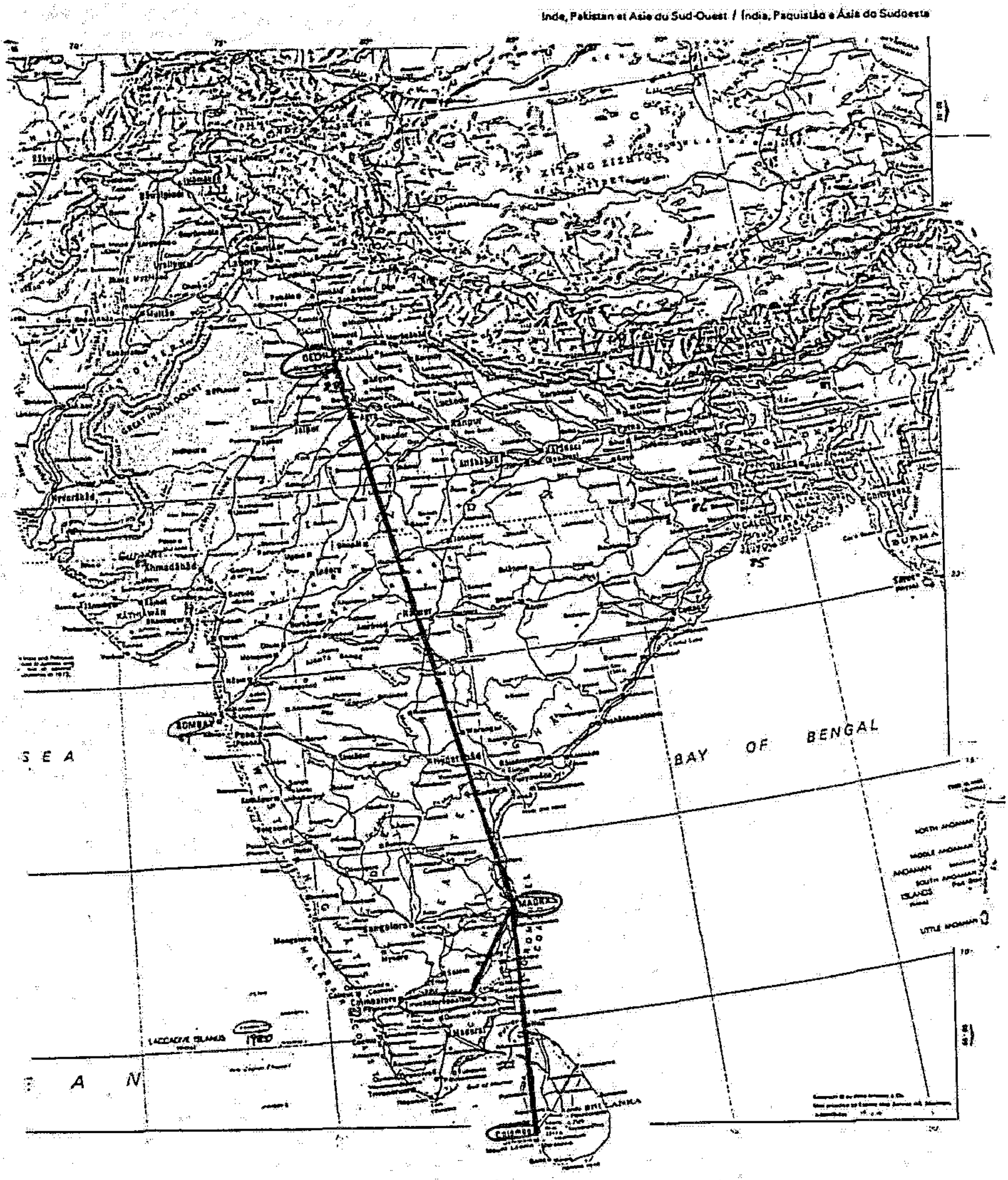
月	日	曜	行　程	交通手段	宿泊地	調査内容 A.M.	調査内容 P.M.
2	24	土	名古屋発10:05 香港着13:30 香港発16:15　デリー着21:55	JL705 AI331	デリー		
	25	日	デリー市内	自動車	デリー	セミナー準備	セミナー準備
	26	月	デリー市内	自動車	デリー	ＪＩＣＡ・大使館打ち合わせ、大蔵省訪問	工業省訪問
	27	火	デリー市内	自動車	デリー	マルチ機械会社訪問	セミナー開催、帰国研修員面談、関係者との懇親会
	28	水	デリー市内、デリー発19:40 ﾏﾄﾞﾗｽ着22:10	IC540	マドラス	インド工科大学訪問	★
3	1	木	マドラス→ﾃｨﾙﾁﾗﾊﾟﾘ	IC501	ﾃｨﾙﾁﾗﾊﾟﾘ	★溶接研究所訪問	Bharat Heavy Electricals Limited　訪問
	2	金	ﾃｨﾙﾁﾗﾊﾟﾘ →マドラス	IC501	マドラス	★資料整理	報告書作成、提出
	3	土	マドラス発10:30 コロンボ着11:40	IC573	コロンボ	★	★
	4	日	コロンボ市内	自動車	コロンボ	資料整理	資料整理
	5	月	コロンボ市内	自動車	コロンボ	ＪＩＣＡ・大使館打ち合わせ	援助窓口機関訪問（大蔵省対外援助局）、 セミナー開催、帰国研修員面談、関係者との懇親会
	6	火	コロンボ市内	自動車	コロンボ	ＣＩＳＩＲ訪問	コロナワ国営工場訪問
	7	水	コロンボ市内	自動車	コロンボ	セイロン製鋼所訪問	報告書作成、提出
	8	木	コロンボ発08:45 バンコク着13:35	UL422	バンコク	★	ＪＩＣＡ・大使館打ち合わせ
	9	金	バンコク市内	自動車	バンコク	援助窓口機関訪問(DTEC)、金属加工・機械工業開発研究所(MIDI)訪問	ラジャマンガラ工科大学訪問
	10	土	バンコク市内	自動車	バンコク	資料整理	資料整理
	11	日	バンコク市内	自動車	バンコク	資料整理	資料整理
	12	月	バンコク市内	自動車	バンコク	セミナー開催、帰国研修員面談	帰国研修員面談、関係者との懇親会
	13	火	バンコク市内	自動車	バンコク	国鉄マカサン工場訪問	キングモンクット工科大学訪問
	14	水	バンコク市内、バンコク発22:40	JL718	機中泊	報告書作成、提出	★
	15	木	成田着06:05 成田発09:25 名古屋着10:25	NH375		★	

★：移動

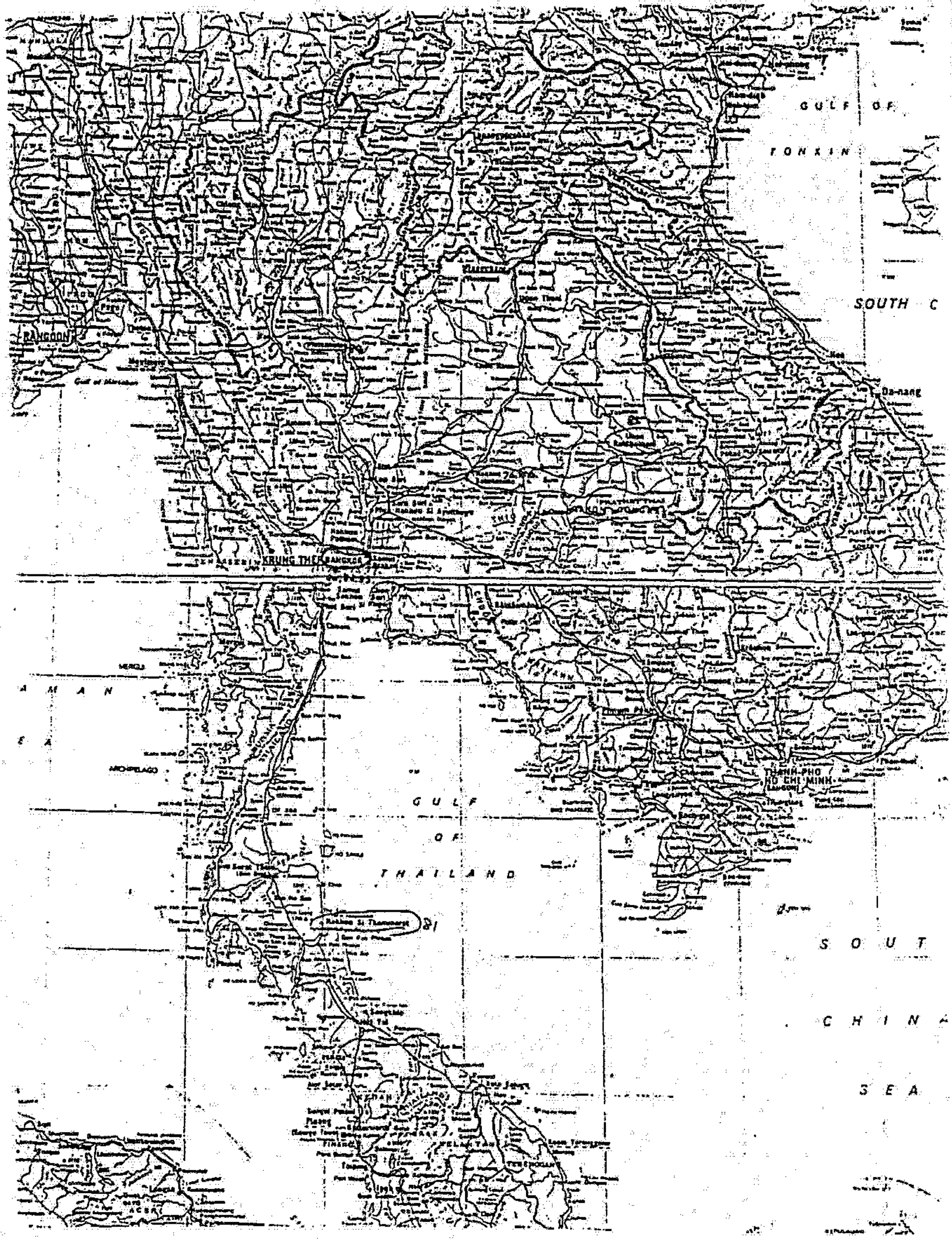
・インド　　　（２／２４～３／２　：７日間）
・スリランカ　（３／３　～３／７　：５日間）
・タ　イ　　　（３／８　～３／１４：７日間）

4. 踏　査　図

(1) インド・スリランカ



(2) タ イ


GULF OF
TONKIN
SOUTH C
RANGOON
Gulf of Martaban
Da-nang
KRUNG THEP (BANGKOK)
MERGUI
ARCHIPELAGO
GULF
OF
THAILAND
THANH-PHO
HO CHI MINH
(SAIGON)
Nakhon Si Thammarat
SOUT
CHINA
SEA

5．主 要 面 会 者

(1) インド

大蔵省経済事業部　次長

(Deputy Secretary, Department of Economic Affairs)

Mr. Rajiv Sharma

〃　　　　課長

(Under Secretary, Department of Economic Affairs)

Mr. Harsh Singh

〃　　　　係長

(Section Officer, Department of Economic Affairs)

Mr. Balwant Singh

工業省工業開発部　部長

(Joint Secretary, Department of Industrial Development)

Mr. L. Mansingh

マルチ機械会社　アドバイザー（鈴木自動車より出向）

和久田　和利

インド工科大学　機械工学部　部長・教授

(Professor, Department of Mechanical Engineering)

Dr. R. S. Parmar

〃　　　主任設計技師

(Chief Design Engineer)

Mr. S. Swaminathan

Dr. D. T. Shahani

インド工科大学　C.P.W.D.主任技師

(Chief Engineer, C.P.W.D.)

Mr. P. B. Vijay

インド国立溶接研究所　理事長

(Senior Manager)

Dr. G. Venkataraman

〃　　　所長

(General Manager)

Mr. V. G. Jagannath

〃　　　副所長

(Deputy General Manager)

Mr. Ramanattan

〃　　　部長

(Manager)

Mr. A. M. Mohanthy

バラト重電気会社　取締役

(General Manager)

Mr. Fthiraj

〃　　　産業用エネルギー担当　取締役

(General Manager in charge of Industrial Energy Production)

Mr. Mallian

（帰国研修員）

第9回参加(1982)　グジャラート州灌漑局副技師長

(Deputy Executive Mechanical Engineer, Irrigation Department, the Government of Gujarat)

Mr. P. C. Vasvada

第１０回参加(1983)　機器製造会社　主任技師
(Senior Engineer, Instrumentation Limited)
Mr. T. Ponniah

第１２回参加(1985)　アンドリューユール社　生産技師
(Production Engineer, Andrew Yule & Co., Ltd.)
Mr. Debabrata Chakrabarty

第１４回参加(1986)　テレコム製作所　次長
(Deputy General Manager, Telecom Factory)
Mr. Abdul Majid

第１５回参加(1988)　マルチ機械会社　車体技術部　溶接技師
(Engineer <Welding Engineering>, Body Engineering Dept., Maruti Udyog Limited)
Mr. Sunil Pahilajani

第１６回参加(1989)　ヒンドスタン石油会社　次長
(Deputy Manager, Hindustan Petroleum Corporation Ltd.)
Mr. Patel Mahesh Mohan

橋梁工学集団研修コース(1974)、ガス圧接個別研修コース(1985)に参加
インド工科大学　Ｃ.Ｐ.Ｗ.Ｄ.　主任技師
(Chief Engineer, C.P.W.D., Indian Institute of Technology)
Mr. P. B. Vijay

在インド日本国大使館	一等書記官	佐伯　義文
		西郷　正道
在マドラス日本国総領事館	総領事	田中　祥策
ＪＩＣＡインド事務所	所　長	倉林　太郎

(2) スリランカ

財政・計画省対外援助局　次長

(Asst. Director, Department of External Resources)

Mr. B. H. Passaperuma

セイロン科学・工業研究所　所長

(Director, Ceylon Institute of Scientific & Industrial Research)

Dr. E. R. Jansz

国営工場（コロナワ）　工場長

(Director, Government Factory, Kolonnawa)

Mr. G. S. Fernando

セイロン製鋼所　会長

(Chairman, Ceylon Steel Corporation)

Mr. Michael Pereira

〃　　次長

(Asst. General Manager, Ceylon Steel Corporation)

Mr. S. Yogaratnam

Mr. R. N. Wijewardena

Mr. S. I. Jayakuru

〃　　鋳造部　技師補

(Asst. Engineer, Foundry Dept. Ceylon Steel Corporation)

Mr. Nimal Yaba

〃　　機械技術課副主任　機械技師

(Deputy Chief Mechanical Engineer, Mechanical Engineering Div. Ceylon steel Corpration)

Mr. S. Ranabahu

セイロン製鋼所　研究所　金属技師

(Metallurgist, Laboratory, Ceylon steel Corporation)

Mr. D. K. Sarathkumara

〃　　　　　　　保全部　機械技師

(Mechanical Engineer, Maintenance Dept.)

Mr. I. Dayaratna

（帰国研修員）

第１回参加(1974)　モラツア大学研修科　主任

(Head, Training Div., University of Moratuwa)

Mr. V. P. Amara Jayawardane

第２回参加(1975)　ナワルッカ工業所　工場長

(Factory Manager, Nawalcka Industries)

Mr. P. M. Nimalasiri

第３回参加(1976)　スリランカ運輸省　機械技師

(Mechanical Engineer, Sri Lanka Transport Board)

Mr. M. H. M. Farouk

第３回参加(1976)　国営工場（コロナワ）　副工場長

(Deputy Factory Engineer, Government Factory, Kolonnawa)

Mr. J. Timothy N. De Saram

第１０回参加(1983)　国営工場（コロナワ）　工場次長

(Asst. Works Manager, Government Factory Kolonnawa)

Mr. K. Sivananthan

第１１回参加(1984)　ｽﾘﾗﾝｶｴﾝｼﾞﾆｱﾘﾝｸﾞ研究開発ｾﾝﾀｰ　機械技師

(Mechanical Engineer, National Engineering Research
& Development Center of Sri Lanka)

Mr. T. A. Wickramasinghe

第１３回参加(1986)　ｽﾘﾗﾝｶｴﾝｼﾞﾆｱﾘﾝｸﾞ研究開発ｾﾝﾀｰ　機械技師
(Mechanical Engineer, National Endineering Research
& Development Center of Sri Lanka)
Mr. D. C. Jayaratne

第１４回参加(1987)　クリヤピチヤ工科大学　主任講師
(Senior Instructor, Technical College, Kuliyapitiya)
Mr. B. A. V. Jayawardene

第１５回参加(1988)　セイロン製鋼所　主任機械技師
(Senior Mechanical Engineer, Ceylon Steel Corporation)
Mr. K. S. W. Sirisena (Sanath)

第１６回参加(1989)　セイロン製鋼所　機械技師
(Mechanical Engineer, Ceylon Steel Corporation)
Mr. S. E. Sumanasiri

在スリランカ日本国大使館　特命全権大使　新田　勇
二等書記官　神崎　義雄

ＪＩＣＡスリランカ事務所　副参事　新納　宏

(3) タ　イ

総理府技術経済協力局　日本係長代行

(Acting Director, Japan Sub-Division, Department of Technical and Economic Cooperation)

Mr. Sutin Susila

〃　　　　　　技術援助課

(Officer, Technical Services Division, Department of Technical and Economic Cooperation)

Mr. Tirath Viputtikulvart

金属加工機械工業開発研究所　ﾘｰﾀﾞｰ(JICA専門家) 和泉　武
業務調整　　西脇　英隆

ラジャマンガラ工科大学　工学部長

(Dean, Faculty of Engineering Technology, Rajamangala Institute of Technology)

Dr. Chanchai Siriwat

タイ国鉄マカサン工場　副技師長

(Deputy Chief Mechanical Engineer, Makkasan Workshop, State Railway of Thailand)

Mr. Nikom Tagapanij

キングモンクット工科大学(北ﾊﾞﾝｺｸ) 産業工学短期大学部　学部長

(Director, Industrial Technology College, King Mongkut's Institute of Technology, North Bangkok)

Asst. Prof. Samreang Rasmevisva

〃　　　　　〃　　　講師

(Instructor, Industrial Technology College, King Mongkut's Institute of Technology, North Bangkok)

Mr. Nakorn Sang-on

Mr. Chairoj Patimaporntep

（帰国研修員）

第１回参加(1974)　ﾗｼﾞｬﾏﾝｶﾞﾗ工科大学評議員(兼)生産工学部　主任

(Asst. Dean for Academic Affairs, Department of Industrial Engineering, Faculty of Engineering Technology, Rajamangala Institute of Technology)

Mr. Adisak Vannaval

第３回参加(1976)　ﾗｼﾞｬﾏﾝｶﾞﾗ工科大学　講師

(Lecturer, Korat Campus, Rajamangala Institute of Technology)

Mr. Taweechai Sajjariyarat

第４回参加(1977)　タイ国鉄マカサン工場機械部　客車課長

(Chief, Passenger Car Division, Mechanical Department, Makkasan Works, State Railway of Thailand)

Mr. Kongsak Pramlek

第６回参加(1979)　タイ海軍造船所品質管理部　分析課長

(Chief, Engineering Analysis Division, Quality Control Department, Royal Thai Naval Dockyard)

Mr. Jakchai Chuenyarin

第８回参加(1981)　ナコーン　シ　タマラジ工科大学　講師

(Lecturer, Nakorn Si Thamaraj Technical College)

Mr. Nugool Keoprachu

第９回参加(1982)　ﾗｼﾞｬﾏﾝｶﾞﾗ工科大学生産工学部　溶接研究室長

(Head, Welding Section, Department of Industrial Engineering, Rajamangala Institute of Technology)

Mr. Kasemchai Boonpen

第１０回参加(1983)　キングモンクット工科大学（北ﾊﾞﾝｺｸ）　助教授

(Assit Professor, King Mongkut's Institute of Technology, North Bangkok)

Mr. Yukol Julupai

第１１回参加(1984)　ピツァネロク工科大学　講師

(Lecturer, Pitsaneloke Technical College)

Mr. Dumrongkate Thongsin

第１２回参加(1985)　ウボルラジチャタニ工科大学　講師

(Lecturer, Ubolrajchathani Technical College)

Mr. Charoen Chummuel

第１３回参加(1986)　ラジャマンガラ工科大学　講師

(Lecturer, Korat Campus, Rajamangala Institute of Technology)

Mr. Preecha Kueklang

ＪＩＣＡタイ事務所　副参事　　原　智佐

岩本　隆

II. 調 査 内 容

1．各国における溶接の現状と課題

(1) インド

ア．国の概要

人口　7億8,137万人　(87年)

面積　328.8万km²（日本の約8.8倍）

首都　ニューデリー

国民総生産	2134億4000万ドル (86年)
1人当たり国民総生産	270ドル (86年)
主 な 産 業	織物、鉄鋼、食品加工、セメント、機械、化学、肥料、取付け工具等
主 な 資 源	クロム、石灰、鉄、マンガン、ボーキサイト、石油、生ゴム、材木、米、穀物、コーヒー、サトウキビ、香辛料、紅茶、綿、コプラ等
労働力人口	2億4460.5万人 (81年)
産業別労働比率	農業 70%、工業・商業 19%
発 電 量	1,700億kWh (86年)
粗鋼生産量	1180万h　(86年)
自動車台数	乗用車 150万台、商用車 95.2万台 (85年)

イ．マルチ機械会社　―　ハリアナ州　―

1980年国営自動車会社として発足。1982年に鈴木自動車(株)と合併契約を締結。1983年に1号車を完成させ、市場に出す。現在の出資比率はインド政府60%、鈴木自動車(株)40%である。敷地面積120万m²、従業員数 3,724人。2交替勤務体制。主に、軽自動車、ワンボックスカー、ジープタイプカーを生産している。日本と同じような生産工程、経営方法を採用しているが、日本と比べ自動化率は低く、労働集約型生産である。原材料の鋼板は主に日本、ドイツから輸入している。
本調査団は概要説明を受けた後、工場見学の機会を得たが、溶接に関しては次のような所見を持った。

1．溶接の前、后工程が十分注意されていない。

2．ビード長が均一ではない。

3．ブローホールの問題がある。

生産性、品質の向上のためには、資格を有した溶接技術者の養成と、統一されたスペックの導入が今後必要であると考える。

ウ、インド工科大学　—　デリー　—

全学生数 5,000人。溶接部門は機械工学部の中にあり、機器設計開発センターと協力して研究、教育を実施している。

機械工学部の主な研究は次のような内容である。

1．水中溶接

2．アーク溶接現象および電源

3．パルスＭＩＧによるアルミニウム合金の溶接

4．高張力鋼用サブマージアーク溶接ワイヤとフラックス

5．溶接ロボット

6．溶接現象の数学モデル

上記機器設計開発センターでは、鉄筋のガス圧接とシリーズ抵抗溶接の実用化に積極的であった。

尚、セミナーにも参加してくれたガス圧接部門の Mr. Vijay は本コースの帰国研修員ではないが、橋梁技術およびガス圧接の研修のために、ＪＩＣＡ研修員として二度来日している。

エ、溶接研究所・バラト重電気会社　— ティルチラパリ —

溶接研究所はインド国政府とバラト重電気会社の共同出資により設立された。設備についてはＵＮＩＤＯから２回に渡り多くの援助を受けている。研究員数は40名。溶接技術のあらゆる分野での実用的研究を行い、多くの成果をあげている。また、溶接研究所では、溶接技術者、管理者、非破壊検査員、溶接作業者等、種々の溶接関係者の教育訓練を行い、産業界への技術移転を行っている。　特に、ＵＮＩＤＯおよび、国際溶接学会（ＩＩＷ）の協力を得て、開発途上国に対する溶接技術教育のセンター的な役割も積極的に果たそうとしている。現在の運営は、50% が溶接研究所自身の収入、残り50%が国からの援助でまかなわれている。

バラト重電気会社は、圧力溶接工場、パイプ工場、バルブ工場を持つ。これらの工場はインド最大であり、日本の住友金属(株)、東洋バルブ(株)との協力が密に行われている。多くの材料は新日鉄(株)、神戸製鋼(株)から輸入されている。本調査団のために、溶接研究所研究員より最近の代表的研究等４件が報告され、討論が行われた。

1．溶接技術研究所における教育活動の概況

2．新しい顕微鏡観察法による溶接部の研究

3．破壊力学による圧力容器残存寿命の予測

4．セラミックと金属、および異種金属間の接合

本調査団からは益本団長が本調査団の目的、最近の日本における溶接技術の特徴を説明し、暖い歓迎に対して感謝の意を述べた。

(2) スリランカ

ア．国の概要

人口　1,636万人　(87年)

面積　　6.6万km² (九州の約1.8倍)

首都　スリジャヤワルダナプラ

国民総生産	64億6000万ドル (86年)
1人当たり国民総生産	400ドル (86年)
主 な 産 業	合板、製紙、製粉、化学、織物
主 な 資 源	黒鉛、石灰石、宝石、リン鉱石、森林、生ゴム、紅茶、ココナッツ、米等
労働力人口	597.2万人 (85年)
産業別労働比率	農業 46%、工業・商業 27%、サービス業 26%
発　電　量	32億kWh (86年)

イ．セイロン科学・工業研究所　—　コロンボ　—

スタッフの人数は55名。うち女性が65%を占めている。生化学的研究が中心で、食品加工、薬品、ゴム、香水等に関わる研究、機器分析を行っている。更に中小企業への技術指導、大卒者を対象とした研修も実施されている。ＵＮＩＤＯ、日本政府から機材供与を受けている。現在当研究所が抱えている主な問題点としては、予算の不足、女性スタッフが多いことによる研究の時間的制限、人材の民間企業への流出等が所長より述べられた。

ウ．国営工場　—　コロナワ　—

従業員数 1200名。溶接工の人数は20名。鋳造、鍛造、板金、塑性加工、溶接、木工、ゴム成形等種々の作業が行われ、病院用調度類、溶接造管、スタンプ、パンチ等小物が多種多用製造されている。しかし、工場で使用されている機械類は溶接電源を含めて古すぎる程古く、精度が要求されるものの製造は不可能と思われる。設計も従来の伝習で古い。溶接機としては、50年以上は経っていると思われるアーク溶接機数台と、1ケ月前に導入されたと言う炭酸ガスアーク溶接機が1台見られた。日本から溶接機を供与できれば、溶接技術は発展し、帰国研修員の力量ももっと発揮できるであろう。

エ．セイロン製鋼所　—　アスルギリア　—

従業員数は1500人。そのうち技術者は75人（機械、金属、電気等）。製鋼、鋳造、圧延、溶接棒製造等の設備を持っている。但し、電気炉はコストが高いため現在は運転されておらず、主な製品は圧延による鉄筋棒鋼（月産4,000トンすべて国内市場向け）である。尚、当製鋼所で働いている帰国研修員の人数は、本コースも含めて20名。

工場見学後、本調査団は出席したスタッフとディスカッションの場を持ち、いくつかの技術的問題が討議された。スリランカには溶接棒の国内規格が未だなく、日本における規格化の手順・方法に関する質問も出された。

スリランカの溶接技術は日本のそれと比べて明らかに大きな相違があり、スリランカの一般的な溶接方法はガス溶接と古い溶接電源を用いた被覆アーク溶接である。更に熟練溶接工の不足、炭酸ガス溶接等の導入の困難さも指摘される。

これらの問題解決のためには、帰国研修員も含めた同国の溶接技術者が協力してこれらの問題を分析し、具体的かつ効果的な方策を立てることが肝要であると考えられる。その過程の中で、必要に応じてＪＩＣＡの援助を求めることもできるであろう。そうしたスリランカの技術者自身の努力、協力体制を育てるためにも、スリランカにおける溶接技術者協会あるいは溶接学会のような組織の設立が強く要望される。

また、スリランカには技術以前の社会的、経済的問題が山積し、本研修コースの目的が直ちに十分実現されているとは言い難いかもしれないが、帰国研修員は、日本での研修成果を現在の職務に確実に生かし、前進しているので、本研修コースは今後もスリランカにとって重要な援助の一つであると考える。

(3) タ イ

ア．国の概要

人口　5,360万人　(87年)

面積　51.4万km² (日本の約1.4倍)

首都　バンコク

国民総生産	424億4000万ドル (86年)
1人当たり国民総生産	810ドル (86年)
主な産業	織物、鉱業、木工製品
主な資源	アンチモン、錫、タングステン、鉄、ガス、森林、生ゴム、米、コーン、タピオカ等
労働力人口	2674.2万人
産業別労働比率	農業 59%、工業・商業 26%、サービス業 10%
発電量	240億kWh (86年)

イ．金属加工機械工業開発研究所（ＭＩＤＩ）　―　バンコク　―

金属加工技術の教育訓練、中小企業工場への助言及び指導、適正な生産技術の開発と試作及び受託試験、技術情報の普及等を目的としてＪＩＣＡの技術援助プロジェクトの1つとして2年前に設立された。

鋳造設備、熱処理設備、鍛造設備、材料試験、検査設備、溶接設備、電気メッキ設備、精密測定器，ＮＣ旋盤、金属組織検査室の他、視聴覚講義室を有する。それらの諸設備の中には最新のものが多く、タイの中小企業との結びつきを強くして、今后の活用が期待されている。

ウ．ラジャマンガラ工科大学（ＲＩＴ）　―　バンコク　―

４年制の大学で、総学生数は8,000人。工学部の教官数は約100名。工学部には土木工学、電気工学、電子工学、機械工学、生産工学（製品設計、機械工具、溶接生産）の各学科がある。工学部以外は、他のキャンパスにあるものも含めて、農学部、農業工学、経営学部、美術学部、家政学部、工芸学部、音楽部がある。

工学部長 Dr. Chanchai Siriwat と評議員兼生産工学部主任 Adisak Vannanval（帰国研修員）、溶接研究室長 Kasemchai Boonpen（帰国研修員）の出迎えと案内により関係学生実験室と研究室を見学した。設備は可成り古いが、学生のコンピュータープログラミング演習用の端末も用意され、溶接の自動化、コンピューター導入の方向への研究も計画されていた。

エ．タイ国鉄マカサン工場　―　バンコク　―

従業員約2,400人のタイ最大の国鉄工場。技術者の人数は30人。

機関車、客車、貨車の補修、改造、部品生産を行い、溶接工場、機械工場、鋳造工場、鍛造工場を持つ。アーク溶接機は60台、その内7台がＭＩＧおよび炭酸ガス。溶接工の技能は必ずしも劣っているとは見えなかったが、溶接、切断そのものは品質以前であり、切断面は粗く、開先準備についての配慮も殆んど無いに等しい。

技師長 Mr. Nikom Tagapanij に挨拶の後、帰国研修員 Mr. Kongsak Pramlek の案内によって工場を見学した。Kongsak 氏から見学の感想を求められたので品質改善の必要を指摘した。

オ．キングモンクット工科大学（北バンコク）　―　バンコク　―

同大学産業工学短期大学部の学部長 Samreang Rasmevisva 助教授と、副学部長 Yukol Julupai 助教授（帰国研修員）の歓迎を受け、Mr. Yukol の詳細な大学の歴史、現況、各学部学科の構成の説明の後、産業工学短期大学部と工学部の見学を行った。

学生数 5,403 名。教官の人数は 846 名。８の学部と 45 の学科を有する。学部および部は次の通り。

1．産業工学短期大学部（２年生で学生数は 200 名）
2．工学教育および科学部
3．工学教育開発研究所
4．タイ・ドイツ教育支援センター
5．工学部
6．大学院
7．産業用工学開発研究所
8．応用科学部
9．学長事務部

溶接は主として２年生の産業工学短期大学部で行われている。タイの工科大学は３年間の技術職業教育の後入学するので、合計５年間の教育期間の中で 1/3 は溶接技術（溶接方法、溶接冶金、検査）の教育を受け、卒業生には資格 Diploma が与えられている。現在の資格はテクニシャン・エンジニアに相当するものであるが、将来は４年制にして溶接技術者の教育を行いたいとのことであった。学科としては、機械、電気、土木、社会科学の４つがある。

工学部教官にはドイツ留学の人が何人かあり、ハノーバ工科大学のエルドマン・イエッニッツアー教授は年二回訪ねて指導を行っているとのことであり、溶接機類もドイツの援助によるものが多く見受けられた。

2．帰国研修員に対するアンケートの分析

1．アンケート回収数

	インド	スリランカ	タイ
帰国研修員数	9	14	12
面談者数	6	10	10
アンケート回収数	7	10	10

アンケート回収数のうち、インド分には、面談者以外からの郵送分１名が含まれている。

2．帰国研修員の現在の職性

	インド				スリランカ				タイ			
%	85	75	50	25	85	75	50	25	85	75	50	25
研究開発		1	1	1	1		1	3			1	7
教育指導	1	1	1	1	2		2	3	4	1	3	2
製造	1			3	1	1	1	2			3	6
管理	1			2			4	5		1	5	2
その他	1	1	2	1	1		2					3

帰国研修員のうち、大学・研究所等に勤務する者が、インド　０人、スリランカ　４人、タイ　８人となっている。

3．ＪＩＣＡ研修以後、仕事上で個人的向上はありましたか？

		インド	スリランカ	タイ
はい		7	10	10
	大いに	(4)	(4)	(4)
	ある程度	(2)	(6)	(4)
いいえ				

注）（　）は内数

どのような点が向上しましたか？

	インド	スリランカ	タイ
労働条件	3	3	6
責任	6	7	7
将来性	5	1	4
給与	1		1
より適した仕事	3	2	2
仕事の内容	4	3	5
専門家意識	7	4	4
国際性	5	1	3

4．現在、仕事をする上で一番大きな問題は何ですか？

インド
・新技術、新材料を導入できる立場でない。
・最新の機材を導入する資金がない。
・最新の技術を導入するための技術者が不足している。
・若いスタッフに技術的教育訓練が必要である。

スリランカ
・工業に適用できる技術開発が遅れている。
・熟練工が不足している。
・ロシア製の圧延機が老朽化し、その部品調達が困難である。

タイ
・研修用機器が不足している。
・X線、レーザー溶接設備がない。
・上級大学への進学が許可されない。
・ＱＣ部門における技術者が不足している。
・テキストが不足している。

5．溶接技術研修コースをどのように評価しますか？

	インド	スリランカ	タイ
大変良い	2	7	3
良い	5	3	6
普通			
良くない			

なお、帰国研修員のコメントは、次の通りである。

インド・講義・実習で学んだことは大いに役立っている。
・工場見学によって最新の日本の技術が学べた。
・支給された文献・教材等は、大いに有用である。

スリランカ・十分に検討された有益なプログラムである。
・自己の能力が向上出来た。自信を持って仕事に向かえる。
・最新技術を習得できた。
・職場の人を指導できるようになった。
・コースの運営がスムースであった。

タイ・研修員のレベルに合った内容で合った。
・個別実習が良かった。
・帰国後、仕事に応用できた。
・研究開発に応用出来た。

6．日本における研修の有用性

		インド			スリランカ			タイ		
		A	B	C	A	B	C	A	B	C
講義	溶接冶金	3	4		4	6		4	6	
	溶接方法	4	3		6	4		6	4	
	溶接継手の強度・力学	4	2	1	6	4		1	9	
	溶接施工	3	4		5	4		4	6	
	非破壊試験	4	3		5	4	1	5	5	
	溶接技術の応用	3	4		4	5		9	1	
実習		2	5		4	4		6	4	
工場見学		5	2		7	2		6	4	
個別実習		5	1		5	3		8	2	

注）　A：大変有用　　B：有用　　C：無用

インドにおいて、「溶接継手の強度・力学」に１件の無用が在るが、その理由は、講義時間が短すぎるとしている。また、スリランカの「非破壊試験」の無用１件は、同国では非破壊試験が適用出来ないことを、理由としている。

7．ＪＩＣＡ研修で修得した知識経験は、仕事にどの程度活用できますか？

	インド	スリランカ	タイ
活用度が８５％			６
７５％	３	２	３
５０％	３	５	１
２５％	１	２	

その知識経験をどのように活用していますか？

インド
・船体の修理に応用している。
・スペックの確立、設計管理制度の確立に役立てている。
・鋳造の代わりに溶接技術を応用している。
・バルブの肉盛り溶接に活用している。
・品質向上のための適切な溶接施工ができるようになった。
・半自動溶接を導入できた。
・溶接による熱変形の問題を解決できた。
・溶接機器の選定の時に役立った。

スリランカ
・CO_2溶接が導入できた。
・溶接割れ、変形の防止に役立った。
・溶接棒の選択に利用できた。
・溶接方法、溶接棒の管理方法について指導できた。

タイ
・大学のカリキュラムの改善ができた。
・教育用実験室が設置できた。
・溶接工の指導が可能となった。
・非破壊検査が有益であった。

８．修得した知識経験は広く普及できましたか？

	インド	スリランカ	タイ
普及度が85％	1		4
75％	2	3	3
50％	3	3	2
25％	1	2	

「普及度25%には、インド1、スリランカ2であるが、その理由として研修内容と実用溶接技術とのギャップ、資金の制約等をあげている。」

どのようにして普及しましたか？

インド・討論、文献資料の回覧を通じて普及した。
・溶接施工法を確立出来た。
・手溶接、溶接欠陥、溶接継手、低水素系溶接棒、ＭＡＧ、　　溶接等について普及できた。
・溶接棒、溶接ワイヤーの製造業者に対し普及できた。
・日々の仕事を通じて普及出来た。

スリランカ・日々の仕事を通じて普及出来た。
・アーク溶接、ガス溶接、プラズマ切断、溶射、溶接施工法、溶接方法顕微鏡組織、溶接冶金、非破壊検査等について普及できた。

タイ・同僚、学生へ普及できた。
・溶接施工法を改善できた。
・アルミ溶接、肉盛り溶接に適用できた。

・ＴＩＧ、ＭＡＧ、破壊検査、非破壊検査について普及できた。

9．本コース改善のための意見はありませんか？

インド
・本コースの研修員が大学で学士、修士を取得できるような制度と結び付けてほしい。
・講義、見学が終わった段階でテスト等を行えばより理解が深まる。
・個別実習はテーマを明確にした方がよい。
・溶接継手の設計に関する研修を増やして欲しい。
・講義を中心とした国際レベルにマッチした内容にコースを改善することには賛成であるが、実習も大切である。
・帰国研修員の Advanced course を設けて欲しい。

スリランカ
・帰国研修員が国際資格を得るための知識を教えて欲しい。このための再教育の機会が欲しい。
・新カリキュラムでの指導を帰国研修員にもお願いしたい。
・実習は減らさないで欲しい。

タイ
・新カリキュラムでの指導を帰国研修員にもお願いしたい。
・研修期間を長くして欲しい。
・溶接検査技師、監督者の認定をして欲しい。
・短期コース及び特別講義を設置して欲しい。

10．溶接技術者又は監督者のための資格認定制度がありますか？

	インド	スリランカ	タイ
あります	3		1
ありません	3	10	9

どのような団体がどのような方法で認定を行っていますか？

インド・インド溶接学会

タイ・大学

１１．溶接士のための資格認定制度がありますか？

	イ ン ド	スリランカ	タ イ
あ り ま す	3	7	4
あ り ま せ ん	3	3	6

どのような団体がどのような方法で認定を行っていますか？

イ ン ド・インドボイラー監督局

スリランカ・統一したものはない。

タ イ・内務省技能開発センター
・大学

１２．溶接検査技士（非破壊試験を含む）のための資格認定制度がありますか？

	イ ン ド	スリランカ	タ イ
あ り ま す	1		4
あ り ま せ ん	4	9	5

どのような団体がどのような方法で認定を行っていますか？

イ ン ド　・インド非破壊検査協会

タ イ　・タイ非破壊検査協会

・ＵＴ，ＲＴについては原子力エネルギー協会

・大学

１３．溶接技術分野における貴国の問題点は何ですか？

インド	・半自動、全自動溶接の普及度は低く、機材の品質も悪い。 ・CO_2溶接ワイヤー及びCO_2ガスの品質が良くない。 ・フラックス入りワイヤーが導入できない。
スリランカ	・溶接工、溶接技術者、監督者の深刻な不足。 ・溶接技術者養成のための適切な教育機関がない。 ・新しい設備を持った研究機関の不足。 ・溶接棒、溶接材料等の統一された規格がない。 ・資金不足のため、半自動の新しい溶接方法が導入できない。 ・非破壊試験のための機器の不足。
タ　イ	・溶接技術者、監督者、検査技師の不足。 ・大学に溶接技術者養成のための適切なカリキュラムがない。 ・最新機器の不足。 ・総合的な研究、教育を行う機関がない。

１４．アフターケアについて

インド
・技術情報、文献を送って欲しい。
・「ＫＥＮＳＨＵ－ＩＮ」を送って欲しい。
・帰国研修員に対し、日本の大学で修士を得るための指導をして欲しい。
・機材供与による、インド溶接技術センターへの援助を望む。

スリランカ
・帰国研修員を対象とした短期上級コースの設置。
・技術情報、文献を送って欲しい。
・フォローアップチームの派遣。
・溶接に関するビデオテープを送って欲しい。

タイ
・ビデオ等の教育用機器の援助が欲しい。
・帰国研修員に対する上級研修コースを希望。
・技術情報、出版物、日本の溶接規格に関する書物、溶接機器のカタログを送って欲しい。
・専門家の派遣を望む。

３．技協窓口調査結果

(1) インド

日本から送られてきたＧＩは、ＪＩＣＡインド事務所を通じ、大蔵省経済事業部へ送られる。更に当事業部からコースの内容・分野によって関係省庁へ渡り、そこを通じて諸機関、企業へ人選依頼が行く。溶接コースの場合は工業省が窓口となっている。各省での人選を経て、大蔵省経済事業部に設置された人選委員会にて最終選考がなされる。

以上の過程には約２ケ月を要する。また、最終人選に際してはＧＩに記されている応募条件を基準として選考が行われる。

研修員受入通知後、各候補者は約２週間で出国のための諸手続きを完了し、準備をする。

日本での研修を終了して帰国した研修員は、経済事業部へのレポート提出を義務づけられている。

本調査団が大蔵省経済事業部を訪問した際、次のような要望が出された。

ア．インドからの研修員の増加

イ．更なる機材供与、専門家の派遣。

(2) スリランカ

ＧＩはＪＩＣＡスリランカ事務所から、大蔵省対外援助局を通じて各省庁へ送られる。候補者の人選は各省庁で行われ、最終選考が同局でなされ、かつ首相の認可を必要とする。その後、Ａ２３フォームがＪＩＣＡへ送られる。大蔵省対外援助局での最終人選はＧＩに記載されている応募条件に基づいて実施される。

ＪＩＣＡの受入回答受理後、出発までの手続きには、約２週間要する。

従来、日本での研修終了者に対しては、帰国後レポート等の報告義務はなかったが、昨年よりレポート提出を義務化している。

スリランカにおいては、溶接技術者、熟練溶接工が大変不足しており、国内にある教育機関の数も限られている。本コースに対する今後への期待には大変強いものがある。

(3) タ イ

ＪＩＣＡタイ事務所から総理府技術経済協力局を経て各関係省庁へＧＩが送られる。各省庁での候補者の人選を経て、同局で最終選考を行う。その結果、Ａ２３フォームがＪＩＣＡタイ事務所へ送られてくる。全体で約２ケ月を要する。

技術経済協力局での最終人選では、ＧＩに載っている応募条件による選考の他に、同局独自の選考基準による審査及び英語の語学試験が実施されている。

ＪＩＣＡの受入れ回答後、出発までの手続きに必要な期間は約２週間。

日本での研修を終えた研修員に対しては、技術経済協力局へのレポート義務がある。

タイ技術経済協力局から1987年以後本コースの研修員参加がないので、今後の採用についての要請があった。調査団はこれに答える立場にはないが、タイ国政府側の希望順位として溶接技術コースが低いためではないかと答えた。しかし、帰国研修員との面談やアンケートの回答によると、タイ産業における溶接技術者の不足が切実な問題として提言されている。

（タイＪＩＣＡ事務所ではＪＩＣＡプロジェクトは300もあり、数年来溶接技術に対する希望順位が低いので、割当国にはなっていないとのことであった。）

III. 技術セミナーの概要

1. 実施状況

国名	日時	場所	参加者
インド	2月27日 15時~17時30分	デリー市 シェラトンホテル　マユラの間	帰国研修員9名中6名 他コース帰国研修員1名
スリランカ	3月5日 15時~18時30分	コロンボ市 ヒルトンホテル　アマシストの間	帰国研修員14名中10名 帰国研修員の上司・同僚10名 海外青年協力隊員2名 在スリランカ日本大使館員1名 JICAスリランカ事務所職員1名
タイ	3月12日 9時~12時	バンコク市 JICAタイ事務所会議室	帰国研修員12名中10名

2. セミナーの内容

セミナーは、フォローアップチームの訪問目的の説明と団員の自己紹介の後、出席した帰国研修員の自己紹介と一人一人による帰国後の活動状況、研修効果の評価及び当該国における溶接技術に関する問題点等の報告が行なわれ、これに対し調査団との質疑応答を行なう形で進められた。

この帰国研修員の個別報告及び総括の後、ビデオ「Welding Technology - Today and Future (IHI 提供)」を上映し、益本団長が「最近の日本の溶接技術の概要とアーク溶接電源の発展」を紹介した。

帰国研修員からの報告等の概要は次の通りである。

(1) インド

- 帰国研修員のための上級研修コースの設置を要望
- プラズマ切断機等の新しい機材の供与によるJICAのインド溶接協会への支援を望む
- 日本の技術情報の定期的提供を望む
- 本コースの新しいカリキュラムに対する賛同・意見
- 炭酸ガスアーク溶接による突合わせ溶接(板厚は2.5mm)のためのパラメーター
- 高張力低合金鋼に対する腐食防止のための肉盛り溶接
- シャルピー衝撃試験片のスペック(ノッチの方向)

(2) スリランカ

- 熟練溶接工の育成の必要性
- 新しい溶接方法の導入(炭酸ガス溶接等)の困難さ
- スリランカ溶接技術者協会あるいは溶接学会の設立の必要性
- 溶接変形の問題
- 異種金属の溶接における割れの問題

(3) タイ

- 溶接技術者と熟練溶接工の不足
- 上記育成のための教育機関の不足と溶接設備の古さ(例えば、金属組織観察や非破壊試験装置は全く無いに等しい)
- タイ溶接協会の基礎造り、溶接技術者、研究者の経験交流の必要性
- 日本からの援助と技術情報の提供を望む
- 帰国研修員のための上級研修コースの設置を要望
- 各国の帰国研修員が参加できる国際セミナーの東南アジアでの定期的開催を要望

IV. 添付資料

1. 現地報告書

(1) インド

SUMMARY REPORT OF THE TECHNICAL FOLLOW-UP TEAM
FOR JICA EX-PARTICIPANTS OF THE GROUP TRAINING COURSE
IN WELDING TECHNOLOGY

1. Introduction

Being dispatched by the Japan International Cooperation Agency (JICA) as part of its technical follow-up programme for the ex-participants of the Group Training Course in Welding Technology, the team headed by Dr. Isao MASUMOTO, Professor Emeritus of Nagoya University as mentioned below, arrived at Delhi on February 24, 1990 and conducted its follow-up activities for a period of 5 days. The team has the pleasure to submit a summary report on the results of its study so that it would be referred to by the authorities concerned of the Government of India.

2. Team Members

(1)	Leader Technical Advisor	Dr. Isao MASUMOTO Professor Emeritus, Nagoya University Head, Gifu Technical Training College
(2)	Technical Adviser	Mr. Kaneaki HOBO Director, Power Generation Div. Public Utilities Dept. Chubu Bureau of International Trade and Industry Ministry of International Trade and Industry
(3)	Coordinator	Mr. Kiyohiko OGINO Training Coordinator, Nagoya Branch International Cooperation Service Center

3. Objectives

The follow-up team primarily aims at knowing how and to what extent the ex-participants of Welding Technology Course are making use of the knowledge as welding engineers acquired in Japan, together with understanding the needs in this field in order to improve future training programmes.

Secondly, it aims at providing ex-participants with the latest information in this field in Japan.

4. Summary of the Follow-Up Activities and General Impression

We conducted:

- interview with the officials in the Ministry of Finance and Ministry of Industry

- interview with the manager of ex-participant's organization.

- interview with ex-participants

- technical discussion

Out of the above mentioned activities, we have grasped the present situation in the field of welding technology in India and confirmed the effects of the training programme of JICA. Please refer to the attached papers for details.

We would like to express sincere appreciation and gratitude to the support extended by the Government of India, the organizations concerned with the people involved, and also the contribution of the Embassy of Japan, Consulate-General of Japan in Madras and JICA Office in India.

March 2, 1990

Isao MASUMOTO
Leader of the Follow-Up Team for JICA Ex-participants of the Group Training Course in Welding Technology

(Appendix I)

I. LIST OF EX-PARTICIPANTS

	1. Mr. K. Alimanikfan (1980)	Asst. Engineer Administrastion of Union Territory of Lakshwadweep
	2. Mr. Progoti Bora (1981)	Executive Engineer Diphu Mechanical Div. Irrigation Dept. the Government of Assam
*	3. Mr. P. C. Vasvada (1982)	Deputy Executive Mechanical Engineer Monitoring & Inventory Control Cell Irrigation Dept. the Government of Gujarat
*	4. Mr. T. Ponniah (1983)	Senior Engineer Instrumentation Limited
*	5. Mr. Debabrata Chakrabarty (1985)	Production Engineer Andrew Yule & Co., Ltd.
	6. Mr. A. K. Bandyopadhya (1986)	Asst. Manager (Welding) Burn Standard Co., Ltd.
*	7. Mr. A. Majid (1987)	Deputy General Manager Telecom Factory
*	8. Mr. Sunil Pahilajani (1988)	Engineer (Weld Engineering) Body Engineering Dept. Maruti Udyog Limited
*	9. Mr. Patel Mahesh Mohan (1989)	Deputy Manager Hindustan Petroleum Corporation Ltd.

* : Ex-participants who attended the seminar

Mr. P. B. Vijay — Chief Engineer, C.P.W.D.

Mr. P. B. Vijay who was a JICA participant of the Group Training Course in Bridge Engineering (1974) and Individual Course in Gas Pressure Welding of Reinforced Bars (1985) also could attend the seminar.

II. LIST OF INTERVIEWEES

1. Ministry of Finance	
- Mr. Rajiv Sharma	Deputy Secretary Dept. of Economic Affairs
- Mr. Harsh Singh	Under Secretary Dept. of Economic Affairs
- Mr. Balwant Singh	Section Officer Dept. of Economic Affairs
2. Ministry of Industry	
- Mr. L. Mansingh	Joint Secretary Dept. of Industrial Development
3. Maruti Udyog Ltd.	
- Mr. Kazutoshi Wakuda (Japanese)	Advisor from Suzuki Motor Corp.
- Mr. Sunil Pahilajani (Ex-participant)	Engineer
4. Indian Institute of Technology	
- Dr. R. S. Parmar	Professor Dept. of Mechanical Engineering
- Mr. S. Swaminathan	Chief Design Engineer
- Dr. D. T. Shahani	Chief Design Engineer
- Mr. P. B. Vijay	Chief Engineer C.P.W.D.
5. Welding Reseach Institute	
- Dr. G. Venkataraman	Senior Manager
- Mr. V. G. Jagannath	General Manager
- Mr. Ramanattan	Deputy General Manager
- Mr. A. M. Mohanthy	Manager
6. Bharat Heavy Electricals Limited	
- Mr. Fthiraj	General Manager
- Mr. Mallian	General Manager (in charge of Industrial Energy Production)
7. Embassy of Japan	
- Mr. Yoshifumi Saeki	First Secretary
- Mr. Masamichi Saigo	First Secretary
8. JICA Office	
- Mr. Taro Kurabayashi	Resident Representative

III. SUMMARY OF SEMINAR

The Group Training Course in Welding Technology has been conducted by JICA during the the past sixteen years. Nine Indian engineers participated in this course. Six out of nine ex-participants could assemble and attend the seminar held on February 27, 1990 in Delhi, India. Some of them came to Delhi by taking nineteen hours by train or by taking four hours by air from the distance of more than 2,000 kilometers. One ex-participant has written to us to tell the impossibility of attendance at the seminar because the receiving of information was too late. We had no answer from two ex-participants. JICA has sent questionnaires to all the ex-participants in advance and received answers from seven of them.

We, the members of follow-up team, were warmly received by the ex-participants. We could be convinced that the Group Training Course in Welding Technology could have been conducted very effectively and successfully to the ex-participants in India.

The summary of the seminar is as follows:

1. Requests to JICA from the ex-participants

   (1) Advanced Training Course in Welding Technology for the ex-participants.

   (2) Support to Indian Welding Institute in the form of the provision of newly developed equipments, i.e., plasma cutting machines, controllable arc welding power sources, and so on.

   (3) Periodical technical information of Japan

2. New Curriculum

   JICA and JWES (Japan Welding Engineering Society), to which JICA entrusts the implementation of the Welding Course, have an intention to elevate the course to the level of internationally qualified welding engineers by introducing the new curriculum. This idea was supported by the ex-participants with some comments and suggestions.

3. Technical Problems Discussed

   (1) Parameters of CO_2 arc welding for the butt joint of thin sheet (2.5 mm in thickness).

   (2) Anti-erosion surfacing to high strength and low alloy steel.

   (3) Specification of Charpy impact specimens (notch direction).

At the end of the seminar two technical reports on the latest welding technology in Japan were introduced to the attendants by using a video tape (by courtesy of Ishikawajima-Harima Heavy Industries, Ltd.). We presented this video tape to Welding Research Institute in Tiruchirapalli when we visited it.

IV. VISIT TO WELDING RESEARCH INSTITUTE (WRI) & BHARAT HEAVY ELECTRICALS LIMITED (BHEL)

WRI was established under the joint auspices of the Government of India and BHEL, and was assisted by UNDP/UNIDO through phase I and phase II in the form of the provision of equipments. WRI has conducted R & D in various practical facets and contributed to the development of welding technology in India. The institute has also provided engineers, supervisors, technicians and welders with training and education for the purpose of the technical transfer to industries. The institute is highly expected to play a role of leader for the dissemination of welding technology through training and education to developing countries in collaboration with UNIDO and IIW.

We, the members of follow-up team, were warmly welcomed by Mr. V. G. Jagannath, general manager, and all the staff members. In the morning we could have a chance to observe both laboratories of WRI and three workshops of BHEL; pressure vessels, pipes and valves. The workshop of pressure vessels is largest in scale in India (300m x 300m). BHEL is closely related with some Japanese enterprises, such as, Sumitomo Metal Co., Toyo Valve Co. and so on. Nippon Steel Corp. and Kobe Steel Corp. are the main suppliers of steel plates and welding consumables.

In the afternoon some of the latest projects conducted by WRI were presented:

1. Outline of training and education programme of WRI in 1990.

2. Observation of weld by the new method of microscopic examination (color etched metallography).

3. Estimation of residual life of pressure vessels by fracture mechanism.

4. Joining of ceramics and metals or joining of dissimilar metals.

After the presentation by research staffs of WRI, Dr. Masumoto, the leader of follow-up team, explained the objectives of the visit to India and presented some latest topics of welding technology in Japan. Finally the future possibility of cooperation between WRI and Japan was proposed and discussed in order to expedite the training and education of welding technology in developing countries. We were also invited to dinner party and could have a time to talk with general managers and other executives.

Last but not least, we would like to express our sincere appreciation to the warm and heartful hospitality extended by all the staffs of WRI and BHEL.

(2) スリランカ

SUMMARY REPORT OF THE TECHNICAL FOLLOW-UP TEAM
FOR JICA EX-PARTICIPANTS OF THE GROUP TRAINING COURSE
IN WELDING TECHNOLOGY

1. Introduction

Being dispatched by the Japan International Cooperation Agency (J I C A) as part of its technical follow-up programme for the ex-participants of the group training course in Welding Technology, the team headed by Dr.Isao MASUMOTO ,Professor Emeritus of Nagoya University as mentioned below, arrived at Colombo on Mar.3, 1990 and conducted its follow-up activities for a period of 3 days. The team has the pleasure to submit a summary report on the results of its study so that it would be referred to by the authorities concerned of the Government of Sri Lanka.

2. Team Members

(1)Leader Technical Advisor	:Dr.Isao MASUMOTO Professor Emeritus, Nagoya University Head, Gifu Technical Training College
(2)Technical Advisor	:Mr.Kaneaki HOBO Director, Power Generation Div. Public Utilities Dept. Chubu Bureau of International Trade and Industry Ministry of International Trade and Industry
(3)Coordinator	:Mr.Kiyohiko OGINO Training Coordinator, Nagoya Branch International Cooperation Service Center

3. Objectives

The follow-up team primarily aims at knowing how and to what extent the ex-participants of Welding Technology Course are making use of the knowledge as welding engineers acquired in Japan, together with understanding the needs in this field in order to improve future training programmes.

Secondly, it aims at providing ex-participants with the latest information in this field in Japan.

4. Summary of the follow-Up Activities & General Impression

We conducted:

-interview with the officials in Ministry of Finance and Planning

-interview with the managers of ex-participants' organizations

-interview with ex-participants

-technical discussion

Out of the above mentioned activities, we have grasped the present situation in the field of welding technology in Sri Lanka and confirmed the effects of the training programme of JICA. Please refer to the attached papers for details.

We would like to express sincere appreciation and gratitude to the support ecxtended by the Government of Sri Lanka, the organizations concerned with the people involved, and also the contribution of the Embassy of Japan and JICA office in Sri Lanka.

March 7, 1990

I. Masumoto

Isao MASUMOTO
Leader of the Follow-Up Team for
JICA Ex-Participants of the Group
Training Course in Welding Technology

I. LIST OF EX-PARTICIPANTS

*	1. Mr. V. P. Amara Jayawardane (1974)	Head Training Div. University of Moratuwa
*	2. Mr. P. M. Nimalasiri (1975)	Factory Manager Nawalcka Industries
*	3. Mr. M. H. M. Farouk (1976)	Mechanical Engineer Sri Lanka Transport Board
*	4. Mr. J. Timothy N. De Saram (1976)	Deputy Factory Engineer Government Factory (Kolonnawa)
	5. Mr. L. W. S. De Silva (1977)	(He has gone to Australia.)
	6. Mr. Sivakumaran Wignarajah (1978)	Researcher Laser Technology Center (Japan)
	7. Mr. J. Saththianathan (1979)	(He has gone to Australia.)
	8. Mr. W. A. Peter (1980)	(He stays in India for training.)
*	9. Mr. K. Sivananthan (1983)	Asst. Works Manager Government Factory (Kolonnawa)
*	10. Mr. T. A. Wickramasinghe (1984)	Mechanical Engineer National Engineering Research & Development Center of Sri Lanka
*	11. Mr. D. C. Jayaratne (1986)	Mechanical Engineer National Engineering Research & Development Center of Sri Lanka
*	12. Mr. B. A. V. Jayawardene (1987)	Senior Instructor Technical College (Kuliyapitiya)
*	13. Mr. K. S. W. Sirisena (Sanath) (1988)	Senior Mechanical Engineer Ceylon Steel Corporation
*	14. Mr. S. E. Sumanasiri (1989)	Mechanical Engineer Ceylon Steel Corporation

* : Ex-participants who attended the seminar

II. LIST OF INTERVIEWEES

1. Department of External Resources	
- Mr. B. H. Passaperuma	Asst. Director
2. Ceylon Institute of Scientific & Industrial Research (CISIR)	
- Dr. E. R. Jansz	Director
3. Government Factory (Kolonnawa)	
- Mr. G. S. Fernando	Director
- Mr. J. Timothy N. De Saram (Ex-participant)	Deputy Factory Engineer
4. Ceylon Steel Corporation	
- Mr. Michael Pereira	Chairman
- Mr. S. Yogaratnam	Asst. General Manager
- Mr. R. N. Wijewardena	Asst. General Manager
- Mr. S. I. Jayakuru	Asst. General Manager
- Mr. Nimal Yaba	Asst. Engineer Foundry Dept.
- Mr. K. S. W. Sirisena (Sanath) (Ex-participant)	Senior Mechanical Engineer
- Mr. S. Ranabahu	Deputy Chief Mechanical Engineer Mechanical Engineering Div.
- Mr. D. K. Sarathkumara	Metallurgist Laboratory
- Mr. I. Dayaratna	Mechanical Engineer Maintenance Dept.
- Mr. S. E. Sumanasiri (Ex-participant)	Mechanical Engineer
5. Embassy of Japan	
- Mr. Isamu Nitta	Ambassador
- Mr. Yoshio Kanzaki	Second Secretary
6. JICA Office	
- Mr. Hiroshi Niino	Assistant Resident Representative

III. SUMMARY OF SEMINAR

The Group Training Course in Welding Technology has been conducted by JICA during the the past sixteen years. Totally fourteen engineers participated in this course from Sri Lanka. Ten ex-participants out of fourteen could assemble and attend the seminar held on March 5, 1990 in Colombo, Sri Lanka. Besides the ex-participants, some of their fellow workers or superiors, officials of Embassy of Japan and JICA Sri Lanka Office, and two members of JOCV also could attend the seminar. Four ex-participants could not attend it. Two of them have gone to Australia. One is now working for Laser Technology Center in Tokyo, Japan as a researcher. One ex-participant stays now in India for further study. JICA has sent questionnaires in advance and received answers from all the ex-participants who attended the seminar.

We, the members of follow-up team, were heartily welcomed by the ex-participants. We could be convinced that the Group Training Course in Welding Technology could have been conducted very effectively and successfully to the ex-participants in Sri Lanka.

At first every ex-participant had an opportunity to give a presentation in turn by referring to his job at present and the effect of the Group Training Course in Welding Technology to his present and future jobs. After the presentation two reports on latest welding technology in Japan were introduced to the attendants by using a video tape (by courtesy of Ishikawajima-Harima Heavy Industries, Ltd). And Dr. Masumoto, the leader of follow-up team, gave a short lecture on the status quo of welding technology in Japan.

At the end of the seminar some problems were discussed for imporving the welding technology in Sri Lanka:

1. How to increase the number of skillful welders.
2. How to introduce the advanced welding processes, especially CO_2 welding.

Establishment of Welding Engineering Society or Association was highly expected in order to analyse and solve the preblems mentioned above.

Some technical preblems were also presented:

1. welding deformation.
2. weld cracks caused by the welding of dissimilar metals, such as, Cu and Al-alloy.

We, however, had no sufficient time to discuss them. Dr. Masumoto has promised to help solve those problems later.

After the seminar a reception party was held by inviting not only the ex-participants but some distinguished guests.

IV. COMMENTS

1. In Sri Lanka the welding processes most commonly applied are Gas Welding and SMAW (Shielded Metal Arc Welding). They have some difficulties in introducing CO_2 Arc Welding Process and in increasing the number of skillful welders. All the welding engineers in Sri Lanka (including the ex-participants) are highly requested to collaborate with each other to cope with those problems successfully by establishing Welding Engineering Society or Association.

2. What the ex-participants acquired in Japan by participating in the Group Training Course in Welding Technology could have been effectively applied to their jobs. We believe that the implementation of the Group Training Course in Welding Technology has been and will be one of the most important technical assistance by JICA to Sri Lanka.

(3) タ イ

SUMMARY REPORT OF THE TECHNICAL FOLLOW-UP TEAM FOR JICA EX-PARTICIPANTS OF THE GROUP TRAINING COURSE IN WELDING TECHNOLOGY

1. Introduction

Being dispatched by the Japan International Cooperation Agency (J I C A) as part of its technical follow-up programme for the ex-participants of the group training course in Welding Technology, the team headed by Dr.Isao MASUMOTO, Professor Emeritus of Nagoya University as mentioned below, arrived at BANGKOK on Mar 8, 1990 and conducted its follow-up activities for a period of 5 days. The team has pleasure to submit a summary report on the results of its study so that it would be referred to by the authorities concerned of the Government of Thailand.

2. Team Members

(1)Leader Technical Advisor	:Dr. Isao MASUMOTO Professor Emeritus, Nagoya University Head, Gifu Technical Training College
(2)Technical Advisor	:Mr.Kaneaki HOBO Director, Power Generation Div. Public Utilities Dept. Chubu Bureau of International Trade and Industry Ministry of International Trade and Industry
(3)Coordinator	:Mr.Kiyohiko OGINO Training Coordinator, Nagoya Branch International Cooperation Service Center

3. Objectives

The follow-up team primarily aims at knowing how and to what extent the ex-participants of Welding Technology Course are making use of the knowledge as welding engineers acquired in Japan, together with understanding the needs in this field in order to improve future training programmes.

Secondly, it aims at providing ex-participants with the latest information in this field in Japan.

4. Summary of the follow-Up Activities & General Impression

We conducted :

-interview with the officials in DTEC and MIDI

-interview with the managers of ex-participants' organizations

-interview with ex-participants

-technical discussion

Out of the above mentioned activities, we have grasped the present situation in the field of welding technology in Thailand and confirmed the effects of the training programme of JICA. Please refer to the attached papers for details.

We would like to express sincere appreciation and gratitude to the support extended by the Government of Thailand, the organizations concerned with the people involved, and also the contribution of the Embassy of Japan and JICA office in Thailand.

March 14, 1990

I. Masumoto

Isao MASUMOTO
Leader of the follow-Up Team for
JICA Ex-Participants of the Group
Training Course in Welding Technology

(Appendix I)

I. LIST OF EX-PARTICIPANTS

* 1. Mr. Adisak Vannanval (1974)	Asst. Dean for Academic Affairs Dept. of Industrial Engineering Faculty of Engineering Technology Rajamangala Institute of Technology
2. Mr. Praphuid Dokkiang (1975)	Technical Officer Northern Industrial Promotion Center (Chiang Mai)
* 3. Mr. Taweechai Sajjariyarax (1976)	Lecturer Rajamangala Institute of Technology (Korat Campus)
* 4. Mr. Kongsak Pramlek (1977)	Chief of Planning and Controlling Sec. Passenger-car Div. Makkasan Works State Railway of Thailand
* 5. Mr. Jakchai Chuenvarin (1979)	Chief of Engineering Analysis Div. Quality Control Dept. Royal Thai Naval Dockyard
6. Mr. Chayut Wongkrajang (1980)	Planning Officer Royal Thai Naval Dockyard
* 7. Mr. Nugool Keoprachu (1981)	Lecturer Nakorn si Thammaraj Technical College
* 8. Mr. kasemchai Boonpen (1982)	Lecturer Dept. of Industrial Engineering Faculty of Engineering Technology Rajamangala Institute of Technology
* 9. Mr. Yukol Julupai (1983)	Asst. Prof. Industrial Technology College King Mongkut's Institute of Technology (North Bangkok)
* 10. Mr. Dumrongkate Thongsin (1984)	Lecturer Pitsanulok Technical College
* 11. Mr. Charoen Chummuel (1985)	Lecturer Ubolrajthani Technical College
* 12. Mr. Preecha Kucklang (1986)	Instructor Rajamangala Institute of Technology (Korat Campus)

* : Ex-participants who attended the seminar

II. LIST OF INTERVIEWEES

1. Department of Technical and Economic Cooperation (DTEC)

- Mr. Sutin Susila	Acting Director Japan Div.
- Mr. Tirath Viputtikulvart	Technical Services Div.

2. Metalworking and Machinery Industries Development Institute (MIDI)

- Mr. Takeshi Izumi	Team Leader, JICA Expert
- Mr. Hidetaka Nishiwaki	Coordinator

3. Rajamangala Institute of Technology

- Dr. Chanchai Siriwat	Dean Faculty of Engineering Technology
- Mr. Adisak Vannanval (Ex-participant)	Asst. Dean for Academic Affairs Dept. of Industrial Engineering Faculty of Engineering Technology
- Mr. kasemchai Boonpen (Ex-participant)	Lecturer Dept. of Industrial Engineering Faculty of Engineering Technology

4. State Railway of Thailand (Makkasan Works)

- Mr. Nikom Tagapanij	Deputy Chief Mechanical Engineer
- Mr. Kongsak Pramlek (Ex-participant)	Chief of Planning and Controlling Sec. Passenger-car Div.

5. King Mongkut's Institute of Technology, North Bangkok

- Asst. Prof. Samreang Rasmevisva	Director Industrial Technology College
- Asst. Prof. Yukol Julupai (Ex-participant)	Industrial Technology College
- Asst. Prof. I. Tongkam	Public Relations
- Mr. Nakorn Sang-on	Instructor
- Mr. Chairoj Patimaporntep	Instructor

6. JICA Office

- Ms. Chisa Hara	Assistant Resident Representative
- Mr. Takashi Iwamoto	

III. SUMMARY OF SEMINAR

JICA has conducted the Group Training Course in Welding Technology during the past sixteen years. Twelve is the total number of engineers who participated in this course from Thailand. Ten ex-participants out of twelve could assemble and attend the seminar held on March 12, 1990 in Bangkok, Thailand. JICA has sent questionnaires to all th ex-participants in advance and received answers from all of the attendants.

We, the members of follow-up team, were cordially received by the ex-participants. We could be convinced that the Group Training Course in Welding Technology could have been conducted very effectively and successfully to the ex-participants in Thailand after we finished the seminar.

Every ex-participant had an opportunity to give a presentation in turn by referring to his job at present, effect of the Group Training Course in Welding Technology, technical problems he has, and so on. The summary is as follows:

1. It is very useful and applicable what the ex-participants have acquired in the Group Training Course in Welding Technology conducted in Japan.

2. Every ex-participant is now playing an importrant role in his organization respectively.

3. They do not have the sufficient number of welding engineers and skillful welders in Thailand.

4. The number of welding machines and equipments, especially those for Micro-structural Testing and Non-Destructive Testing (NDT) is very small in universities, colleges or other organizations for training and education.

5. They hope to organize meetings periodically to exchange their ideas or opinions among the engineers or researchers who are the members of Thai Welding Engineering Society by receiving the assistance of JICA in the form of the provision of the latest information in welding technology in Japan.

6. They request JICA to conduct the Advanced Training Course in Welding Technology for the ex-participants in order to elevate their technical levels.

7. The follow-up team is requested to hold international seminars in future in some countries in Asia so that all the ex-participants in Asian countries can attend them easily.

At the end of the seminar two technical reports on the present welding technology in Japan were introduced to the attendants by using a video tape (by courtesy of Ishikawajima-Harima Heavy Industries, Ltd.) and a short lecture on the status quo of welding technology in Japan was given by Dr. Masumoto, the leader of follow-up team.

2．各種質問表

(1) 帰国研修員に対する質問表

FOLLOW—UP SURVEY FOR EX-PARTICIPANTS OF TRAINING PROGRAMS
at
NAGOYA INTERNATIONAL TRAINING CENTRE (NITC)
JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)

No.73,2-chome Kamenoi,Meito-ku,Nagoya 465 JAPAN

QUESTIONNAIRE

I. Personal Data:

1. Name in Full: ______________________ Age______
(Please underline family name)

2. Name of organization where currently employed: ______________

____

Address: ______________________________________
(Street and Number) (City) (State/Country)

____
(Zip code) (Cable/Telex) (Telephone)

3. Current home address: ______________________________
(Street and Number) (City)

____
(State/Country) (Zip code) (Telephone)

4. Year of your participation to JICA Welding Technology course:
19______

II. Educational data:

5. Education/Training (Degree/Non-degree) after attending training at JICA

Name of Educational/Training Institute	Location of Instituion	Years attended (from — to -)	Certificate/Diploma/ Degree & Major in

III. Employment/Work Experience:

6. Work experience: Please describe briefly what kind of work/job you have had since you returned home, including the present one.

Work/Job Position	Dates (from-to-)	Responsibilities

7. Nature of your present job: Indicate by an (x) mark in the corresponding box.

Activities	Full aprox. 85%	Major aprox. 75%	Partly aprox. 50%	Slightly aprox. 25 %
Research & Devel				
Instruction				
Production				
Administration				
Others, specify				

8. Is there any personal improvement in your job/work after JICA training?

_______ (yes) improved (___a lot) (___somewhat)
_______ (no) improvement

If, yes, please check below where applicable;

_______ work conditions
_______ responsibility
_______ for future prospects
_______ salary wise
_______ for other better jobs
_______ content of work
_______ professional recognition
_______ international contact

9. What do you consider to be the biggest problems in the performance of your present job, if any ?

Ⅳ. Training Programme:

10. How did you evaluate the Welding Technology course ?

	Excellent	Good	Fair	Not good	Poor

Please explain your answer briefly.

11. Usefulness of the training you had in Japan (in relation to your subsequent position and responsibility): Indicate by an (X) mark in the corresponding box. In case you select "not useful", please mention its reasons.

SUBJECT	very useful	useful	not useful	REASON
1) Lectures	...	...		...
a) Welding Methology				
b) Welding Processes				
c) Strength & Dynamics of Welding Joint				
d) Procedure				
e) Non-Destructive Testing				
f) Applications of Welding Technology				
2) Practice in Laboratories				
3) Observation of Industries				
4) Indivisual Practice in the Industry				

12. To what extent can you apply the knowledge/experiences acquired through JICA training to your job?

	Full aprox. 85%	Major aprox. 75%	Partly aprox. 50%	Slightly aprox. 25 %	Non 0%

- Please explain some exemple in which you have been able to use the knowledge/experiences, if you have.

13. Have you been able to pass on to anyone any of the knowledge/experiences that you acquired ?

	Full aprox. 85%	Major aprox. 75%	Partly aprox. 50%	Slightly aprox. 25 %	Non 0%

-Please explain what part of your training you could do this and how ?

-If you answered "Slightly" or "No", please explain why.

14. JICA has been conducting group training course in Welding Technology every year since 1974 and to make up the curriculum, we have put emphasis on how to show the participants the overall present situation in this field in Japan, therefore the curriculum was consisted of lectures by first-class lecturers, observations and practices in the actual industrial plants.
However, this programme has tendency not to allow the participants to fully study all the essential basis of welding technology.
On the other hand, in many industrialized countries, welding engineers who have enough knowledge and experiance in welding performance/technology are requested to assume safety and security of welded construction and we know that Europian Community has established international qualification standard of the welding engineer for the '92 unified EC specification.
In this circumstance, we would like to change the curriculum of this course to the more lecture centered one which will give systematized thorough knowledge in welding technology and encourage all the participants to get International Certificate of Welding Engineer.
As we always wish to improve this course, if you have any comments or suggestions, please state them below.

-to be continued-

V . <u>Present situation of Welding Technology in your country</u>:

15. Do you have any qualification/certificate for Welding Engineer or Welding Supervisor ?

_________ Yes _________ No

-if yes, what kind of organization is issuing this certificate and how are they qualifying this Engineer ?

16. Do you have any qualification/certificate for Welder ?

_________ Yes _________ No

-if yes, what kind of organization is issuing this certificate and how are they qualifying this Welder ?

17. Do you have any qualification/certificate for Welding Inspector, including non-destructive testing ?

_________ Yes _________ No

-if yes, what kind of organization is issuing this certificate and how are they qualifying this Inspector ?

18. Please explain in detail about problems your country faces in the field of welding technology ?

VI. <u>After-care service of JICA</u>:

19. As after-care services, JICA conducts for ex-participants the followings:
   - to dispatch follow up team for the purpose of further improvement of training courses (survey of training effects & future tecnnical needs, technical guidance and provision of up-to-date technological information)
   - to provide the ex-participants with technical information, literatures (addresses are selected by JICA)
   - to send magazine "KENSHU-IN" to ex-participants
   - to assist ex-participants to organize alumni associations.

   If you have any opinions or request concerning these servies, please explain them.

Thank you very much for your cooperation.

(2) 援助窓口に対する質問表

Questionnaire to the participants nominating organization
援助窓口に対する質問内容

(Please type or write in block letters)

1. Please tell us the processes of nominating participants after you receive the General Information (GI) of Group Training Course in Welding Technology sent from JICA office and also the time requird.
GＩ受領後の人選手順

Y o u r o f f i c e

↓GI ↑A_3Form

( )

↓ ↑

( )

↓ ↑

( )

↓ ↑

( )

-time required:
1) ___ more than 2 months
2) ___ less than 2 months

2. Are the above processes subject to change from year to year or the same over the years?
1)___ yes 2)___ no

If yes, why?

3. Do you finalize the nomination on the basis of GI (1) or on the basis of your organization's criteria(2) ?
窓口機関での最終人選
1)___ 2)___
If you answered (2) please explain the screening policies in your organization ?

4. Do you think the GI of this course clearly describes the objectives, the contents and the level of the training program?
GＩ内容の適否
1)___ yes 2)___ no
If no, what sort of additional information would you find useful ?

5. After your organization receives the notice of participant's acceptance how long does it take till he/she finishes all the procedures necessary for departure ?
受入れ回答後、出発までの手続き
1)____ more than 1 month 2)____ more than 2 weeks 3)____ less than 2 weeks

6. Does the participant report to your office after he/she finishes his/her training ?
帰国後、窓口機関での研修成果の確認
1)______ usually yes 2)_____ usually no
If usually no, how does your organization confirm the accomplishment of the training ?

7. If you have any opinion about this course in comparison with other similar courses inside or outside your country, please state below.
他機関主催の研修との比較

8. Please state your observation about the future demands in your country in the field of welding technology and their background information so that we can apply them to this training course.
同分野での将来ニーズ等の関連情報

Thank you very much.

3．参考資料

1 − (1)

Recent Advances in GMAW Processes in Japan

Hirokazu Nomura
NKK Corporation

1.Introduction

In Japan application of gas metal arc welding process has been extremely increased in the last ten years.

Fig.1(a)(Ref.1) shows the annual production rates of welding wires and covered electrodes for SMAW, and GMAW welding processes in Japan. In the last ten years the covered electrodes for SMAW have been decreased and replaced by the welding wires for GMAW, while the wires for SMAW have been remained almost even. Fig.1(b) shows the trend of the ratio in terms of deposited metal equivalent for each welding process. On the basis of deposited metal automatic and semi-automatic ratio that means GMAW plus SMAW ratio reached to approximate 80% in 1989. On the otherhand SMAW ratio which is mostly consumed in manual metal arc process decreased to 20%.

The strong demands for automation, robotization and systematization of welding due to the recent trend of shortages of labour power and skill, and requirement for higher reliability of welding in Japan have promoted further progress of the technology in power sources, welding wires, welding processes and control systems including sensor systems for GMAW. Remarkable improvement in welding power source has been mainly achieved with the aid of introduction of transistor inverter which enable to realize quick responce of welding current to control welding phenomena such as reduction of spatter generation, stabilization of arc start, uniform penetration, smooth bead appearance and so on.

Improvement in welding wires has been achieved by the development of cored wires including metal cored wire, each with 1.2 to 1.6mm in diameter. Improvement in arc welding robots has been progressed with high-grading of seam tracking function, combinated with positioner to extend application area. The robot and its system for exclusive use for fabrication of building structures and bridges, and shipbuilding has been just started. Research and development are primarily on sensor aided welding parameter control rather than just seam tracking.

In this paper some recent advances in GMAW process in Japan that were contributed to the Welding Process Committee of JWS are introduced. A few developments of welding process control systems developed by the auther are introduced as well.

2.Improvement and Development of GMAW

2.1 Power sources

In Japan progress in application of GMAW processes primarily depends upon the progress of welding power sources. Fig.2 shows the change in control devices as well as the time of the development of GMAM power sources (Ref.2). Around 1970, the thyristor was adopted to DC power source for the first time as output control device in place of electromagnetic amplifier. The function of control in power source was improved. Pulsed arc welding power source was placed on the market. Early in 1980, power transistor which enable to control welding current more quick than thyristor was appeared. Pulsed arc welding power source controlled with the secondary side chopper was developed. In 1982, transistor inverter controlled CO2 arc welding power source which enables to control welding current faster was developed.

Recently transister inverter was applied to pulsed MAG and AC CO_2/MAG power sources as well.

Fig.3 (Ref.2) shows the responce frequency for each control device of welding power source. The transister inverter enable to control welding current at very fast responce. It's function of faster control realize the following control means in GMAW process.

(1) Reducction of spatter generation by controlling welding current wave form in short-circuiting arc welding, such as intensional decrease of welding current just before the short-circuiting is broken, stabilization of short-circuiting frequency etc.
(2) Stabilization of start of ignition and extinguish of arc by improving the dynamic characteristics of power source.
(3) Stabilization of metal transfer by controlling pulse current waveform and its frequency.
(4) Realization of AC welding in GMAW by creating square waveform. Also providing penetration control by varying electrode negative/positive polarity ratio.

2.2 Welding Wires

Although problem on spatter generation especially in CO_2 arc welding has not yet solved sufficiently, research and development for the improvement of the wires have been carried out extensively in Japan.

Fig.4 (Ref.3) shows a summary of study on the effects of chemical contents in wires on spatter generation mostly when short-circuiting of the arc is broken. The wire (YGW12) adequately designed in chemical content to decrease spatter has been developed and been favorably received in automobile and electric equipment manufacturers for thin sheet welding.

Fig.5 (Ref.3) shows the chemical composition of the wire and the effect of reduction of spatter. The production of flux cored wires (FCW) in Japan has been rapidly grown by fifteen times in the last seven years. The percentage of FCW accounts for 13% of whole welding consumables. The metal cored wire with less slag former has been developed and used not only in shipbuilding, but also in fabrication of building structure and bridge component, and industrial machinary. The development of the FCW is aimed firstly at higher deposition rate and less spatter generation, and secondly at less fume emission, less hydrogen content and less porocity formation even at the welding of primer coated steel plates.

Fig.6 (Ref.3) shows that the addition of carbon in flux has more effect to reduce the fume emission rate than that in wire. Fig.7 (Ref.3) shows an example of the test in which a newly developed wire has compared to the conventional wires in the view point of porocity formation in fillet welding on a painted plate.

2.3 Arc welding robot

Fig.8 (Fig.1) shows the growth of annual production of arc welding robot in Japan. The number as well as the sales of the robot has been steadily increased. The most robots are used for GMAW. Some of the recent robots have upgraded by equiping the functions of seam tracking, presetting of welding parameters and off-line teaching. Portable robots has also developed for the use in shipbuilding, bridge and building structure fabrications.

2.4 Sensors and Sensor systems

Developments of arc welding processes and automation systems mostly for GMAW use have been promoted by the developments of sensors and sensor systems. The inventions of various sensors for arc welding in Japanese patents laid open are classified according to the principle and the purposes as shown in Fig.9 (Ref.4). In the principle, recently optical sensors and sensor utilizing arc characteristics or phenomena have increased. In the purpose although the sensors for seam tracking make up a large portion, sensors for welding parameter control have been increased recently as well. The application of seam tracking systems utilizing arc characteristics has been increased remarkably and its functions have been used mainly in commercial arc welding robots and in special welding equipments for exclusive use.

Sensors utilizing arc characteristics are classified according to type and method of oscillation, detecting parameters and purpose of control as shown in Fig.10 (Ref.5). Even now there are possibility of development for other control systems in welding. Optical sensors are classified according to detecting positions, light sources, optical devices and purposes of control as shown in Fig.11 (Ref.5). The development and use of optical sensors are just beginning in Japan. The possibility of optical sensors are being expected for control of recognition of start and stop ends of welding line, as well as groove geometry, weld pool control including penetration control and so on.

3. An example of improvement of welding process and control system.

3.1 Welding Process (High Speed Rotating Arc)

High speed rotating arc process which was originally developed by NKK has the advantage of adoption of arc sensor control as well as improvement of the bead shape (Ref.6).

Fig.12 shows the principle of the process applied for the NGW process.The welding wire is fed through a little eccentric hole at a contact tip which is rotated mechanically with a high speed. In accordance with the conventional weaving method, 4 to 5Hz is the practical limit for the weaving frequency. However, by this process, for example, 100Hz rotation can be easily obtained by a commercial DC motors. High speed rotation increases the sensitivity of the arc sensor and also improves the bead shape and the side wall fusion.

Fig.13 shows the principle of seam tracking in horizontal fillet welding. Arc voltage wave form becomes asymmetical at the center front (Cf) of the arc rotation when the torch deviates from the center axis of the groove. The deviation in transverse is detected by comparing the area of the wave forms (SL and SR) as shown in the figure. Torch height guidance is carried out by detecting average welding current. Seam tracking control by this system can be applied to each electrode individually in tandem electrode welding. This system has been mounted on the articulated arc welding robot (Ref.7) which was already put on the market.

3.2 Sensor system

One of the important subject in the automatic arc welding is to establish control system of welding parameters for controlling bead dimensions by detecting or predicting molten pool shape owing to change of groove shape.NKK and Nippon Sanso KK have jointly developed a fully automated intelligent arc welding robot that enables to use for the butt welding of SUS 304 stainless steel cylindrical pressure vessels fabrication (Ref.8).

The simultaneous control system of penetration depth and bead height despite the variation of root gap is introduced. In this system, root gap is detected by an image processing with CCD camera, then welding current and welding speed are controlled to keep constant both penetration depth and bead height. Furthermore, wire feeding rate and arc voltage are controlled so that both wire extension and arc length can be kept constant during torch height control with an automatic current control.

From the result of experiments with X-groove butt joint, both penetration depth and bead height can be simultaneously controlled to be almost constant despite the variation of root gap between 0 and 3mm. The new arc welding robot, called "Intelliarc", was successfully used for the welding of Nippon Sanso's liquefied gas storage tanks.

4. Conclusion

(1) The progress in application of GMAW in Japan is mainly depending upon the development of transister inverter type welding power sources, fine diameter flex cored wires, upgraded arc welding robots and, sensors and sensor systems.

(2) It is predicted by the auther that arc chracteristics sensors and optical sensors will become major aids, and welding parameter control system will become the most essential technology for automation in GMAW.

(3) An example of improvement of welding process and control developed by the auther is introduced.

Reference

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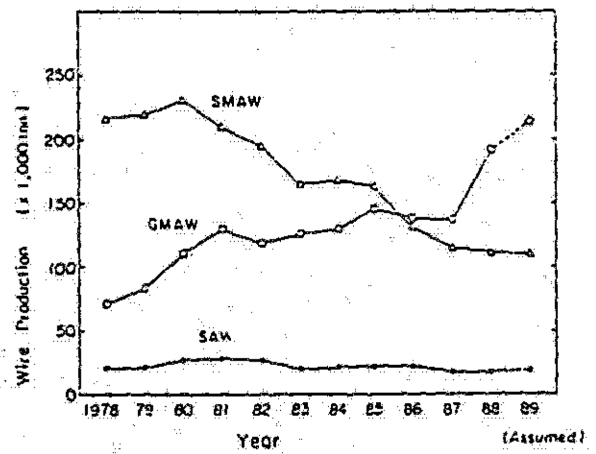


Fig.1(a) Annual Production of Welding Electrodes and Wires in Japan

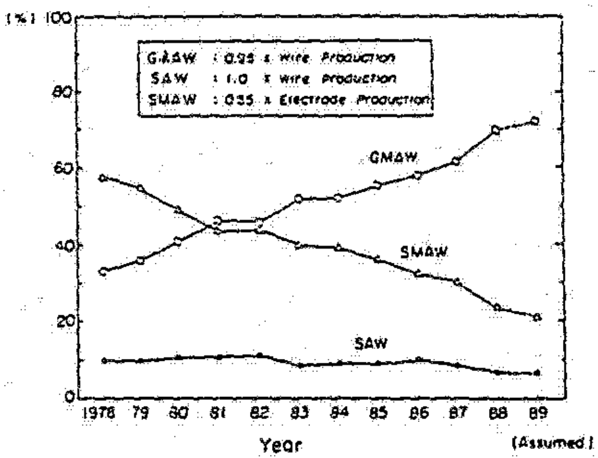


Fig.1(b) Deposited Metal Ratio for Each Welding Process

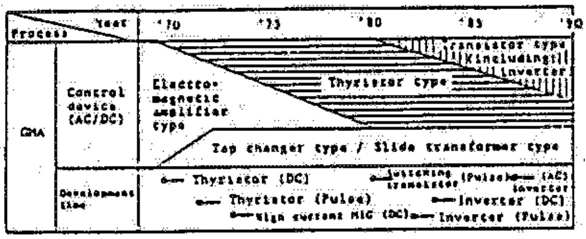


Fig.2 Change in Outout Control System of GMAW Power Source

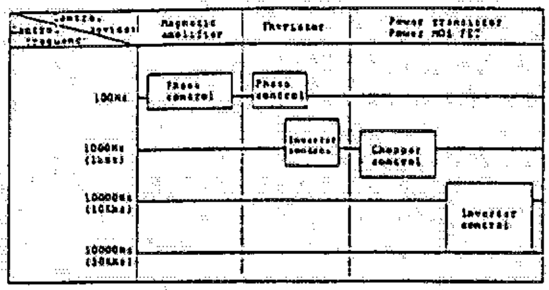


Fig.3 Control Devices and Control Frequency of Welding power Source

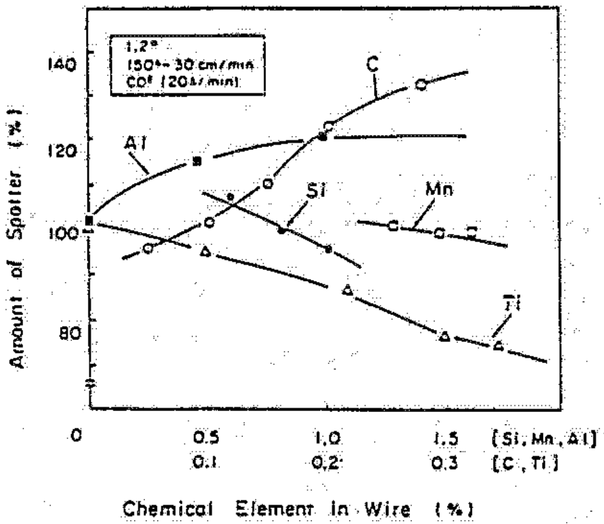


Fig.4 Effect of Chemical Content in Wire on Spatter Generation

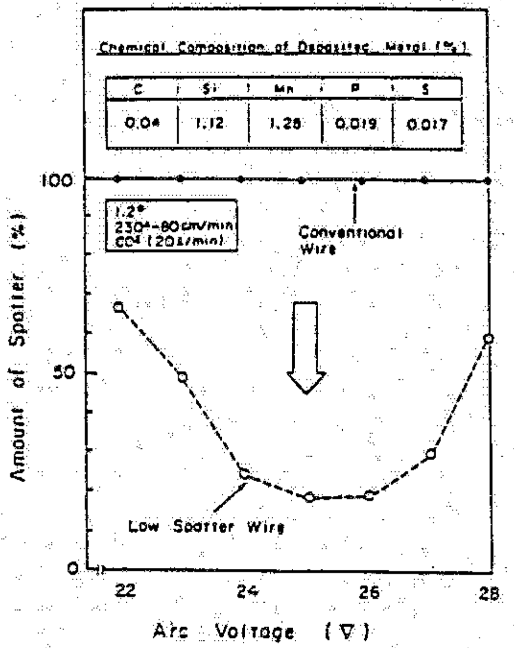


Fig.5 An Example of Low Spatter Solid Wire

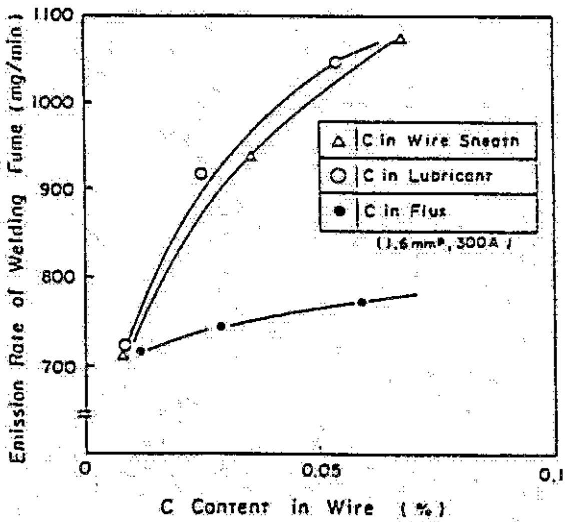


Fig.6 Effect of C Content in Wire on Fume Emittion

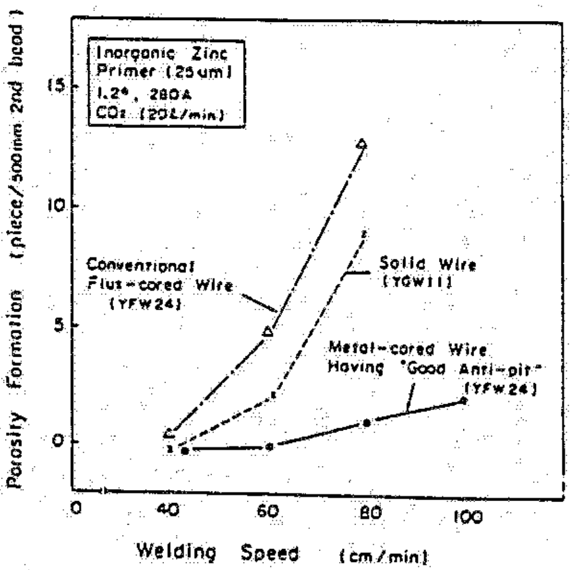


Fig.7 Effect of Wires on Porosity Formation

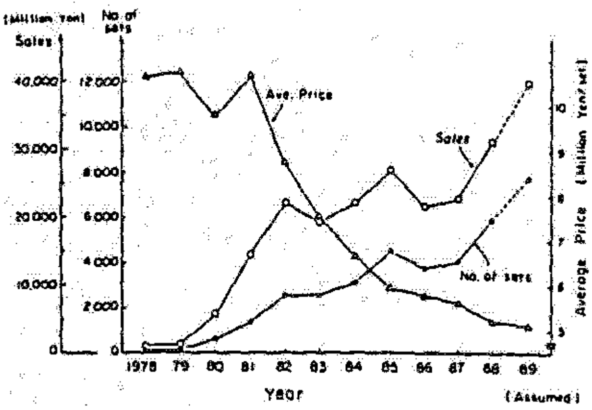


Fig.8 Annual Production and Sales of Robots for Arc Welding in Japan

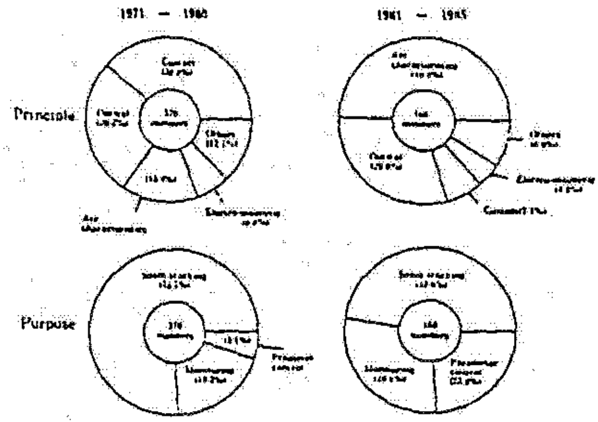


Fig.9 Inventions of Sensors for Arc Welding

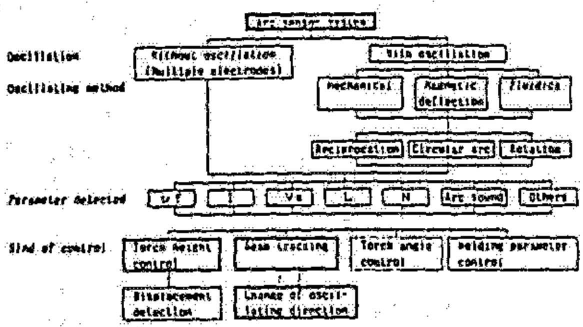


Fig10 Combination of Arc Sensor Systems

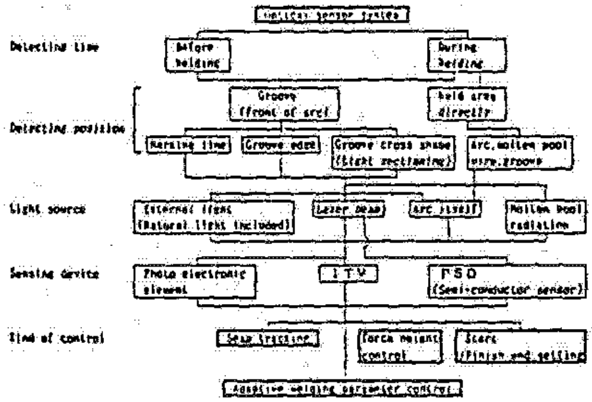


Fig.11 Classification on Optical Sensor Systems

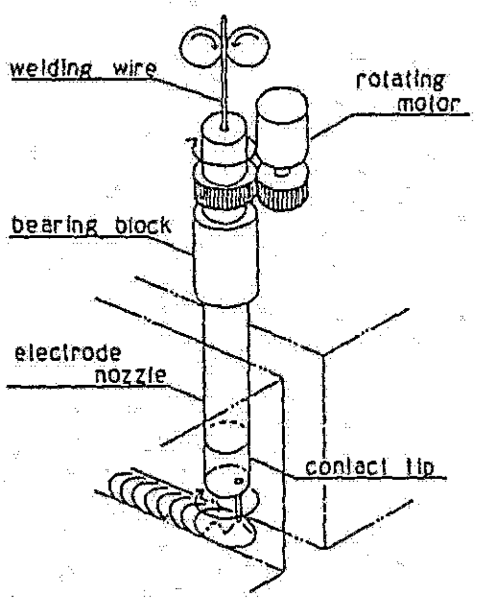


Fig.12 Principle of high speed rotating arc NGW process

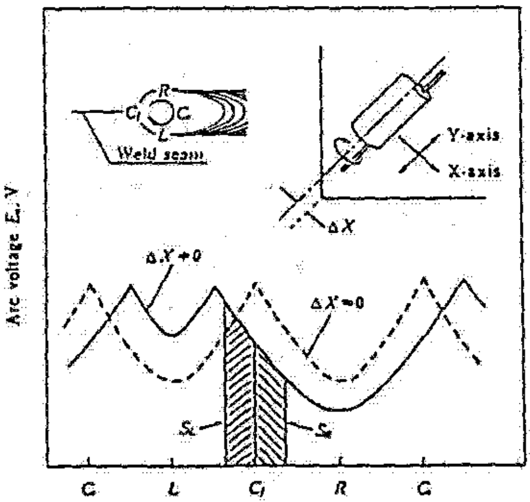
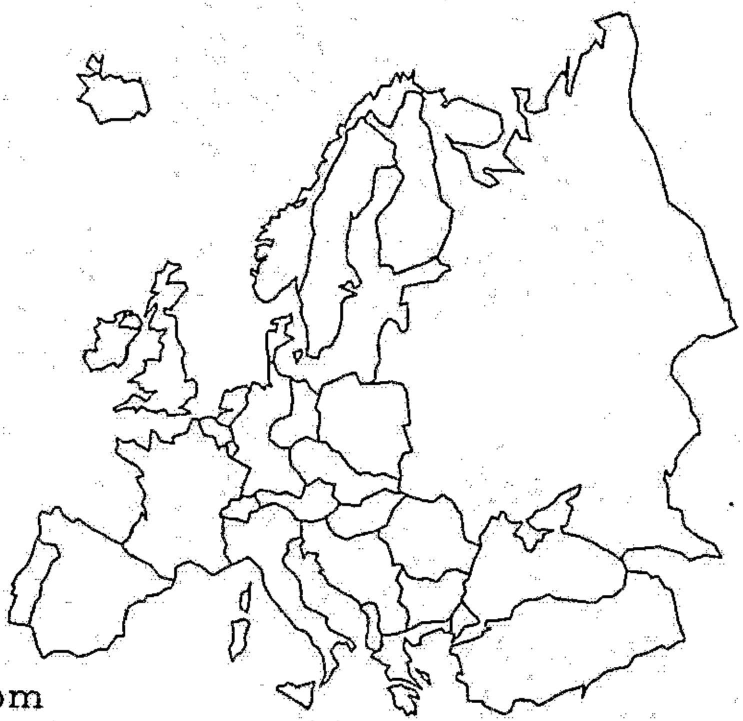


Fig.13 Principle of arc sensor in fillet welding

Minimum Requirements for the Education of Welding Engineers in the EC Countries

Guideline EWE of the
European Council for Cooperation in Welding
elaborated by the Working Group 2
in cooperation with the following countries :

Belgium
Denmark
France
Germany
Italy
Ireland
Netherlands
Portugal
Spain
United Kingdom
Sweden
Finnland



Comett Project 87/2/C/00536

Minimum Requirements for the Education of Welding Engineers in the EC-Countries

18.9.89

Guideline EWE of the European Council for Cooperation in Welding elaborated by the Working Group WG 2.2 in cooperation with the following countries: Belgium, Denmark, France, Germany, Italy, Ireland, Netherlands, Portugal, Spain, United Kingdom, and in addition with cooperation from Sweden and Finland.

Introduction

This guideline for the European education and training of Welding Engineers has been devised, evaluated and formulated by Members of the Working Group 2 of the ECCW. It covers the minimum requirements for education and training, agreed upon by all national welding societies within the Working Group 2, in terms of themes, keywords and times devoted to them. It will be revised periodically by Working Group 2 to take into account any changes which may effect the "state of the art". Students having successfully completed the course of education will be expected of being capable of applying the technology required in welding engineering as covered by this guideline.
The contents are given in the following structure:

Theoretical Education	Hours
1. Welding processes and equipment	102
2. Materials and their behavior during welding	110
3. Construction and design	64
4. Fabrication, applications engineering	110
	386
Fundamental practical skills	60
total:	446

Access to the Education

It is agreed that entry to such a programme should be on the basis of an engineer having received prior educational training to a postgraduate level. Participants should have a primary degree in an engineering discipline or its equivalent, therefore, it would be expected that participants should have at least a BSc degree.

In appendix 1 the definitions for every country are given in detail.

Theoretical Education

		Hours
1.	Welding processes and equipment	
1.1	General introduction to welding technology	4
1.2	Oxy-gas welding	5
1.3	Special oxy-gas processes	1
1.4	Electrotechnics, a review	2
1.5	The arc	4
1.6	Power sources for arc welding	4
1.7	Introduction to Gas-shielded arc welding	2
1.8	Tungsten-inert gas welding	6
1.9	MIG / MAG welding	8
1.10	Manual Metal arc welding	10
1.11	Submerged-arc welding	6
1.12	Resistance welding	8
1.13	Other welding processes	10
1.14	Cutting and other edge preparation processes	4
1.15	Surfacing	2
1.16	Fully mechanized processes and robotics	6
1.17	Brazing and soldering	4
1.18	Joining processes for plastics	4
1.19	Joining processes for advanced materials	2
1.20	Welding laboratory	10
		Hours: 102

		Hours
2.	<u>Materials and their behavior during welding</u>	
2.1	Manufacture and designation of steels	2
2.2	Testing materials and the weld joint	4
	Laboratory exercises	4
2.3	Structure and properties of metals	4
2.4	Alloys and phase diagrams	6
2.5	Iron-Carbon alloys	4
2.6	Heat treatments of base materials and welded joints	4
2.7	Structure of the welded joint	4
2.8	Plain carbon- and Carbon-manganese steels	6
2.9	Cracking phenomena in steels	4
2.10	Fine-grained steels	4
2.11	Thermomechanically treated steels	2
2.12	Application of structural and high strength steels	2
2.13	Low-alloy steels for very low temperature application	4
2.14	Low alloy creep resistant steels	4
2.15	High-alloyed (stainless) steels	8
2.16	Introduction to Corrosion	6
2.17	Introduction to Wear	2
2.18	Protective layers	4
2.19	Creep resistant and heat resistant steels	2
2.20	Cast irons and steels	4
2.21	Copper and copper alloys	4
2.22	Nickel and Nickel alloys	4
2.23	Aluminum and Aluminum alloys	6
2.24	Other metals and alloys	2
2.25	Joining dissimilar materials	4
2.26	Metallographic examinations	6
		Hours: 110

		Hours
3.	<u>Construction and design</u>	
3.1	Fundamentals of the strength of materials	4
3.2	Basics of weld design	8
3.3	Design principles of welded structures	4
3.4	Joint design	4
3.5	Fracture mechanics	8
3.6	Behavior of welded structures under different types of loadings	4
3.7	Design of Welded structures with predominantly static loading	8
3.8	Behavior of welded structures under dynamic loading	4
3.9	Design of dynamically loaded welded structures	8
3.10	Design of thermodynamically loaded welded structures	6
3.11	Design of structures of Aluminum and it's Alloys	4
3.12	Reinforcing-steel welded Joints	2
	Hours:	64
4.	<u>Fabrication, applications engineering</u>	
4.1	Introduction to quality assurance in welded constructions	6
4.2	Quality control during manufacture	8
	Practical exercises on welding procedure qualification	2
	Practical exercises on welder qualification tests	4
4.3	Welding stresses and distortion	6
4.4	Plant facilities, welding jigs and fixtures	4
4.5	Health and safety	4
4.6	Measurement, control and recording in welding	4
4.7	Non-destructive testing	20
4.8	Economics	8
4.9	Repair-welding	2
4.10	Fitness for purpose	2
4.11	Case Studies	40

The aim of this final part of the course is to assess the students knowledge in respect to the manufacture of specific welded products. The best way of doing this is a combination of experts from industry presenting special cases and project work of the students split up into groups followed by a general discussion and comments by the experts. All of the following subjects have to be dealt with, the depth to which, however, will depend on the national needs.

Subjects:

steel and lightweight structures, boilers and pressure vessels, chemical plants and pipelines, shipbuilding and offshore applications, Transportation (automobiles, railways), aerospace applications.

common items to be covered:
standards and specifications,
design,
choice of materials,
welding processes,
site welding (transport and final assembly),
consumable,
welding procedures,
tolerances on weld preparation and fit-up,
postweld heat treatment, NDT and quality control,

Hours: 110

Practical Part

This part does not aim at practical skills of the welding engineer but on gaining knowledge on the control of the different welding processes. The students shall become as familiar as possible with the difficulties and typical defects associated with incorrect use of the different welding methods. During their exercises the students are guided by skilled welding teachers.

Training for practical skill	40
oxyacetylene welding and cutting	
MMA	
TIG	
MIG/MAG	
Demonstrations on processes	20
gouging,	
brazing,	
plasma welding	
plasma cutting	
submerged-arc welding	
resistance welding	
friction welding	
electron beam welding	
laser welding	
other processes,	
	Hours: 60

The laboratory exercises contained in the foregoing subjects 1 to 4 of the theoretical part are additional and given usually at a later stage of the education.

Appendix 1

National definitions for the minimum requirements for the access to the Welding Engineer's education and examination:

Belgium:

Certificate of a university degree in engineering (ir.) or a certificate of an industrial technical university (ind.ing.). Applicants not having one of the certificates mentioned before may participate in the education but have no access to the examination and are not allowed to call themselves welding engineers.

Federal Republic of Germany:

Certificate of an engineer's degree got at universities, technical universities or medium universities. Applicants not having an engineer's degree according to the german law may participate as guests in the education, the access to the examination, however, is not permitted (see DVS-Guideline 1173).

Denmark:

Civilingeniorer (MSc.), educated at the technical University in Copenhagen, all lines are accepted.
Akademiingeniorer (BSc.), educated at the Danish engineering academy in Copenhagen or at the Aalborg university center, all lines are accepted.
Technikumingeniorer (BSc.), educated at the various engineering colleger,in, Denmark, e.g. Helsingör, Horsens, Esbjerg, Odense, Hasler, all lines are accepted.

Applicants not having an engineer's degree to at least BSc may participate as guests in the education, to the discretion of the course management. Access to the examination, however, is not permitted, and no diploma will be given.
Participants educated in other countries might enter the course and the examination, provided their background education corresponds to the danish requirements. Approval to participate

in the examination shall be given from the danish welding society (DSL). DSL has the responsibility to assure, that the rules given in this guideline are followed both with respect to the education and the examination.

Spain:

not received until now

France:

Either and preferably as far as possible a first engineer diploma recognized by the ministry of education throughout the advice of the commission of engineering title. That means nowadays Bac+five Years - or exam with a special board of examiners.

Italy:

Certificate of "Perito Industriale" or equivalent technical diploma got at a technical school (at least five years at 19 years) plus two years of documented industrial experience, or certificate of an engineer's degree (at least five years at 24 years) or a Science (Physics or Chemistry) degree (at least four years at 23 years) got at universities or technical universities.

Ireland:

The following primary degrees from irish universities and colleges are deemed to meet the entrance requirements:

B.E. (Mech. Eng.)
B.E. (Prod. Eng.)
B.E. (Manf. Tech)
B.E. (Mat. Eng.)
B.A.I. (Mech. Eng.)
B.A.I. (Manf. Tech.)

It should also be noted that the local approval board for entrance to course has the discretion to consider candidates with qualifications other than those listed above and to approve such candidates for entry to the course as the approval board considers appropriate.

Netherlands:

The access to the course is restricted to graduates of Polytechnics and Technical Universities in the fields of mechanical-, metallurgical-, civil-, ship- and aircraft engineering and, to the discretion of the course management, to persons with equivalent knowledge.

For access to the NIL examination (examination organized by the Netherlands Institute of Welding) following conditions should be fulfilled:

1. The student has to be a graduate of the above mentioned institutes in one of the mentioned fields or, to the discretion of the NIL, in an other field of study with sufficient practice in welding.
2. The student must have followed the theoretical part of the course, with sufficient results, at the applicable polytechnic.
3. The student must have followed the practical part of the course, with sufficient results, at the applicable institute.

Portugal:

The access to the education is given to the graduates of Technical Universities and Polytechnical Institutes with a minimum degree of BSc. and one year of industrial experience for the last ones.

Graduate Engineers are graduated in Technical Universities with a minimum scholar full time of five years in a recognized University.

BSc. Engineers are graduated in Polytechnical Institutes with a minimum scholar full time of three years.

The access to either Technical Universities or Polytechnical Institutes is given to students that have four years of a primary school followed by eight years in a grammar school.

The Welding Engineer Course can be attended by graduates with education in the following fields: mechanical-, materials-, metallurgical-, industrial production-, technological physics-,

shipbuilding- and aeronautics engineering and technological applied sciences.
Persons with equivalent knowledge can access the course by special permission of the course manager.

United Kingdom:
not received until now

Sweden:
Education of welding engineers should be done on a practically oriented engineering basis. It is open for engineers on a postgraduate level. The participants should have passed degree of BSc.
Swedish engineers with following basic education shall have access to the welding engineering education:

1. Civilingenjörer, Masters of Engineering (MSc)
   - Mechanical Engineering line
   - Materials Engineering line
   - or equivalent line
2. Engineers from the existing four-year engineering education at colleges of technology or from the new engineering education which is to be started at the beginning of the 1990s (corresponding to BSc.)
   - Mechanical Engineering line
   - Materials Engineering line
   - or equivalent line

Practical work within welding production, welding design and welding quality control will be particularly qualifying for the holder of the welding engineering position in future.

1－（3）

平成元年度溶接シンポジウム

各産業界における
製作技術の動向と新しい展開

会　期：平成2年2月7日（水）
会　場：日本学術会議講堂
主　催：日本学術会議溶接研究連絡委員会
共　催：大阪大学溶接工学研究所、電気学会、土木学会、
日本機械学会、日本金属学会、日本建築学会、
日本造船学会、日本非破壊検査協会、
日本溶接協会、溶接学会（五十音順）

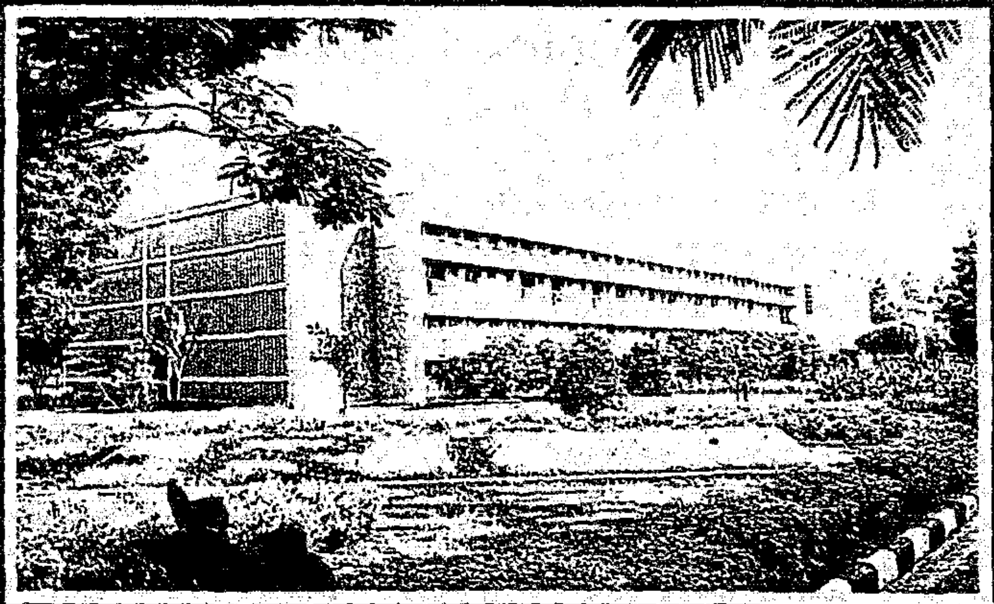
各産業界における製作技術の動向と新しい展開

目　次

2.

Objectives

- To carryout need based fundamental & applied research in the field of welding processes, technology, consumables, design, equipment and weldability of materials.
- To provide quality control, consultancy and specialised testing services to fabrication industries in India.
- To provide educational & training facilities in welding and non-destructive testing for all levels of personnel including welders, technicians, supervisors & engineers of Indian Industries.
- To keep abreast with the latest developments in welding technology elsewhere in the world and to serve as an effective centre for the dissemination of knowledge through conduct of technical conferences and seminars for the benefit of Indian industries and by rendering technical assistance to educational institutions in the country.
- To coordinate with the Indian & International standardisation institutions for the formulation of standards in welding.
- To upgrade the status of welding technology, quality & productivity to international levels in order to bridge the technological gap.



A Decade of Progress

WRI

Contents

Design, Typeset & Printed at : UMA OFFSET PRESS, *Madras - 600 006.* Phone: 868646, 860804

PROFILE

YEAR OF ESTABLISHMENT

1975 November

PARTICIPATING AGENCIES

UNDP/UNIDO, Government of India & Bharat Heavy Electricals Limited.

INVESTMENT

Phase I 1977-1980

UNDP Contribution: US $ 2,020,000
Indian Contribution : Rs 17,884,000

Phase II 1980-1984

UNDP Contribution: US $ 2,580,000
Indian Contribution : Rs 10,006,000

MANPOWER

Engineers & Scientists	: 44
Technical staff	: 113
Administrative staff	: 11
Total staff	: 168

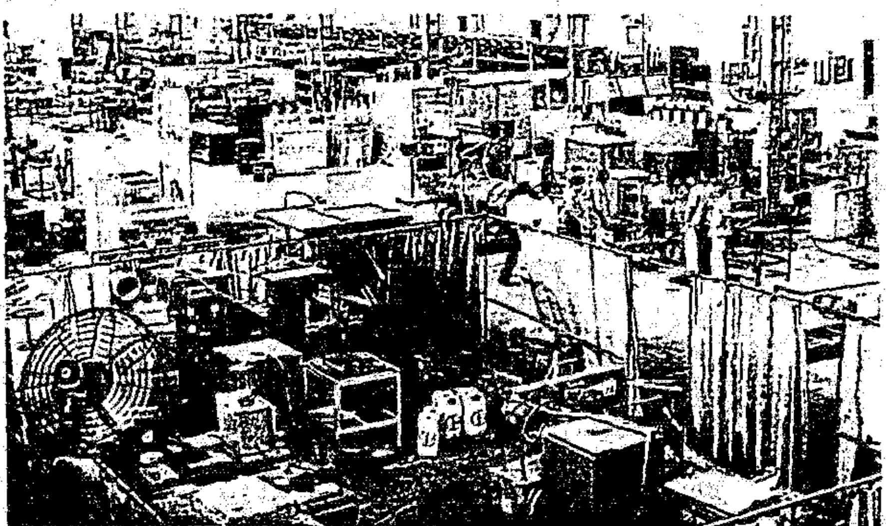
The above includes 3 doctorates, 16 postgraduates in welding & allied fields and several graduates in engineering and masters degree holders in science. About 50 Engineers have undergone training in advanced fields of welding in developed countries like Japan, CSSR, Belgium, France, UK, FRG and USA for a duration of one to three months. More than 24 experts from these countries have also visited WRI to impart training to WRI personnel.

INFRASTRUCTURAL FACILITIES

WRI has a total constructed area of 12000 square metres consisting of three buildings spread over 17.62 acres of land. The engineering building houses the main office, drawing, library & documentation sections. The laboratory building houses metallography & mechnical testing facilities. The workshop building consisting of 4 bays, houses almost all conventional & sophisticated welding, non destructive testing and machining facilities required for the conduct of research activities.

INSTITUTIONAL STATUS

The Institute is a member of the International Institute of Welding. It is an approved Centre for doctoral research by Madras University, Indian Institute of Science Bangalore and Indian Institute of Technology Madras. It is also an approved centre for testing of Manual Arc Welding electrodes as per Bureau of Indian Standards and a competent authority to test and certify welders as per Indian Boiler Regulations.



A view of WRI Workshop

HIGHLIGHTS

TOTAL NUMBER OF **MAJOR PROJECTS** COMPLETED	225
IN HOUSE **BASIC RESEARCH PROJECTS** COMPLETED	40
SPONSORED RESEARCH PROJECTS COMPLETED	185
ORGANISATIONS SERVED THROUGH CONSULTANCY	100
CONSULTANCY & TECHNICAL **SERVICES** RENDERED	1050
PRODUCTS FOR WHICH **KNOW-HOW** IS **TRANSFERRED**	4
PRODUCTS FOR WHICH **KNOW-HOW** IS **READY**	15
PATENTS SEALED	14
NATIONAL AWARDS RECEIVED	15
RESEARCH PAPERS PRESENTED & PUBLISHED	200
WELDING ***PERSONNEL TRAINED***	4500
WELDERS TRAINED & **CERTIFIED**	1050
ENGINEERS & SUPERVISORS TRAINED IN NDT	582
TOTAL NUMBER OF ***COURSES CONDUCTED***	312
BASIC **COURSES** CONDUCTED IN **WELDING**	60
BASIC **COURSES** CONDUCTED IN **NDT**	20
SHORT TERM COURSES CONDUCTED IN **WELDING**	150
SHORT TERM COURSES CONDUCTED IN **NDT**	30
PACKAGE COURSES CONDUCTED **IN WELDING & NDT**	52

FUTURE PLANS & PROPOSALS

A delegation of welding scientists from the United States visited WRI in 1987 and expressed keen interest in taking up co-operative research on several topics of mutual interest at national level mainly for the promotion and understanding of the science of welding. This programme, to be coordinated by WRI with other Indian research & educational Institutions is under consideration of the Government of India.

WRI has worked out a detailed programme of technical co-operation with the Federal Republic of Germany, under Indo-German co-operative pro-gramme and the proposal is under active consideration of Government of India.

For emerging areas of high technology such as laser, WRI in cooperation with Centre for Advanced Technology, Indore and BARC, Bombay has formulated an exchange programme of experts under the auspices of the Indo-USSR co-operative research programme. This programme on laser material processing is expected to be started in the year 1989-90 for a duration of 3 years.

Enthused by the success of WRI as a model of development, UNDP authorities have accepted in principle the funding of the Phase III programme of WRI. Currently the detailed project report presented by WRI is at an advanced stage of acceptance with the Governmnt of India and the UNDP/UNIDO

A perspective plan for WRI, "Welding Research Institute : 2001" has been prepared which charts out the plan and explores the ways and means for taking the Institute into the 21 st Century's frontier research activities. This is currently being evaluated by National Apex level organisations for implementation.

3. The Size, Structure and Functions of the Government Factory

A brochure

prepared on the occasion

of the visit of

Dr. ISAO MASUMOTO

to the Government Factory

06. 03. 1990

GOVERNMENT FACTORY

KOLONNAWA WELLAMPITIYA

The size, Structure and Functions of the Government Factory

This brochure presents the reader with a brief explanation of the Government Factory. The approximate size of the Government Factory in terms of financial turnover, worker strength and fixed assets is indicated in the first section of this brochure.

Then, the organisation structure in the workshops of the Government Factory is discussed from the bottom (worker) level up to the shop officer (foreman) level. This is followed by a discussion on the organisation structure at the top, beginning at the level of the Head of the Department (The Factory Engineer) down to the Assistant Works Managers (engineers), who are directly in charge of the workshops. Then the next two sections of this brochure, are devoted to a discussion on the limitations of the decision making authority placed on the management of the Government Factory, with regard to the selection of its employees and the forms of compensation paid to the employees. Finally, the last section of this brochure describes in brief, the main functions performed by the Government Factory.

Size

The Government Factory is an organisation which provides mechanical engineering services to other government institutions. It is a separate government department under the Ministry of Housing and Construction. The Government Factory employs around 1200 persons. The annual sales turnover of the Government Factory now records Rs. 60 million. By virtue of its moderately high financial turnover, it has been classified as a class "A" government department.

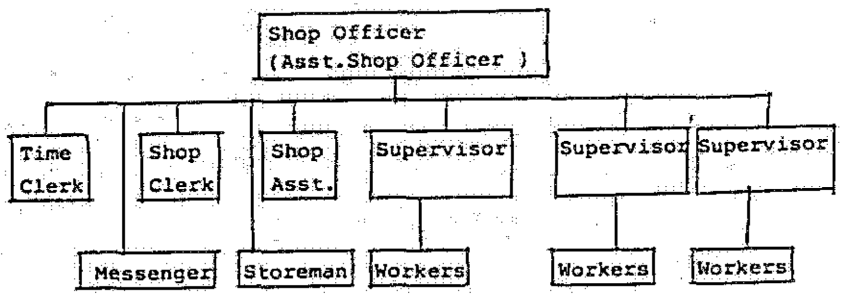
The main activities of the Government Factory are carried out by a 1000 strong workforce in 14 different workshops, situated in a 15 acre site at Kolonnawa. The workshops are equipped with plant and machinery, the present book value of which is approximately Rs. 15 million. In addition to these work shops, there are two office buildings, a stores complex and four staff quarters situated in the same site. A half a mile away from this site is the Government Factory housing scheme, which consists of 110 married quarters for some of the factory workers and their families.

Organisation Structure in the Workshops

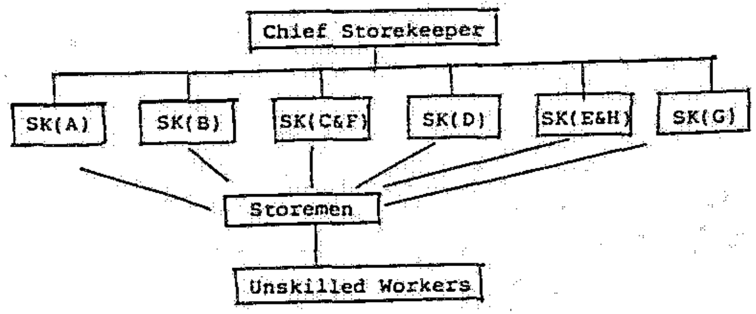
The workforce consists of workers who are categorised into three different grades according to their level of competence. The three grades are skilled, semi-skilled, and unskilled. The skilled and semi-skilled workers are further categorised into different trades according to their fields of specialisation. There are about 20 such trades at the Government Factory, ranging from machinist, welder, tinker, moulder, blacksmith, fitter to carpenter, sawyer and saw-doctor. Workers of the same trade are usually attached to the same workshop. Each workshop will have workers of one or more trades, the number of trades and the number of workers in each workshop being decided according to the workload and the type of specialised services provided by the workshop. Within a workshop, the workers are usually organized into work gangs with each work gang being in charge of a supervisor. The supervisor is a person who has been promoted from the worker ranks, due to his ability in a particular trade and due to his supervisory abilities. Each workshop could have several work gangs up to a maximum of about six or seven, with a corresponding number of supervisors.

Each such workshop is headed by a shop officer. The supervisors in a workshop report directly to the shop officer. Some large workshops have an assistant shop officer to assist the shop officer. These shop officers and assistant shop officers belong to a category of employees called foremen. These foremen are actually technical officers, who are qualified in the field of mechanical engineering to a standard equivalent to the National Diploma

(NDT/JTO) level. They are recruited as foremen and posted to the workshops as shop officer or assistant shop officer, depending on their seniority. There are 25 such foremen in all at the Government Factory. Within each workshop, is a shop office which accomodates categories of employees known as shop clerks, shop assistants, time clerks and messengers, who assist the shop officer with regard to shop clerical work, time-keeping duties and other related office work. Located within each workshop is also a shop stores which stocks the tools and *implements* required by the workers for their work. This shop stores is in charge of a storeman. A typical organisation chart for a workshop at the Government Factory is as follows.



Another important section within the workshop *premises, is the stores complex*, which is an engineering stores, maintaining stocks of raw materials and spares required by the workshops to carry out the work undertaken by the Government Factory. Unfortunately these stores are managed by generalist storekeepers who belong to a combined service under the Ministry of Publc Administraton. These storekeepers do not specialize in engineering stores and they are transferable to any government department or ministry. The most senior storekeeper is usually designated as the Chief *Storekeeper and the other* storekeepers, numbering six, report to the Chief Storekeeper. The stores complex is divided into sections A, B, C, D, E, F, G and H. The organisational chart for the stores complex is as follows.

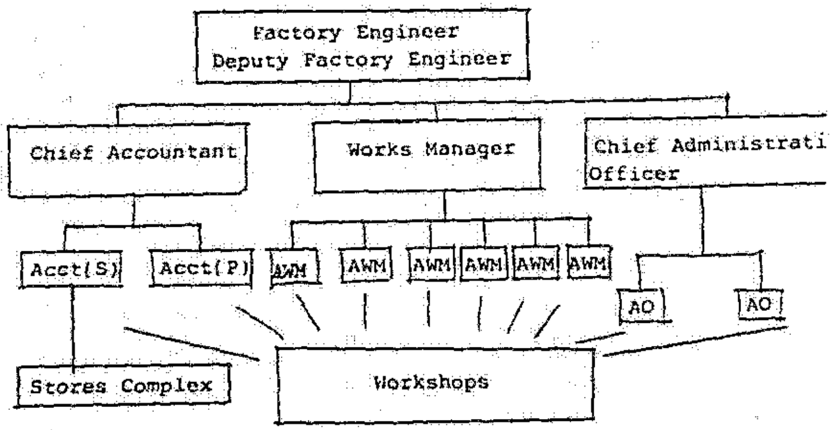


The time clerks, who work in the workshops under the shop officer, are also responsible to the Chief Time Clerk, who is stationed in a separate office. This office is also situated within the workshop premises. The coordination of the feeding of time-keeping information from the workshops to the Accounts Division, is done by the Chief Time Clerk.

The shop officers and the Chief Storekeeper could be termed as the middle level *managers* at the Government Factory. These middle level managers and the Chief Time Clerk, who usually work within the *workshop* premises, report to their respective managers in the top management of the Government Factory.

Organisation Structure at the Top

A limited organisation chart *for the top management* of the *Government* Factory is given below.



The Factory Engineer is the head of the Department and the Deputy Factory Engineer is the deputy head of *the Department*. Both the Factory Engineer and Deputy Factory Engineer are *fully qualified professional mechanical* engineers, who are also called Chartered mechanical engineers.

They are both Class 1 officers of the Sri Lanka Engineering Service (S.L.E.S.), which is a combined service, parallel to the Sri Lanka Administrative Service (S.L.A.S.). (Incidently, the Sri Lanka Engineering Service, along with the Sri Lanka Administrative Service and other parallel services, have now been absorbed *into* the All Island Service). In terms of Government Financial Regulations, the Factory Engineer, being the head of the department, is the accounting *officer*, who along with the Chief Accounting Officer (the Secretary to the Ministry *of Housing* and *Construction*), is answerable to Parliament with regard to any relevant matter concerning the Government *Factory*. For *all other purposes*, the Factory Engineer is the head of the organisation. The Factory Engineer's *post*, *being a* post of a *head of a* government department, is filled by Cabinet appointment *from* among the Class I *mechanical engineers* of the *Sri Lanka* Engineering Service. The Deputy Factory Engineer is appointed by the *Factory Engineer*, from among the mechanical engineers in the Government *Factory*. (All engineers in the Government Factory *are mechanical* engineers of the *Sri Lanka* Engineering Service).

The Department is organized into three divisions. The three divisions *are* the Accounts Division, the Administrative Division and the Works Division. The three divisional heads *report to* the Factory Engineer and the Deputy Factory Engineer. The three divisional heads *are* the Works Manager, the *Chief* Accountant and the Chief Administrative Officer.

The Chief Administrative Officer is in charge of the Administrative Division. In modern technology, he could be called the Human Resource Manager. He is an officer of the Sri Lanka Administrative Service (S.L.A.S). He has two administrative officers to assist him. They are both officers of the supra-grade of the General Clerical Service, which is also one of the combined services under the Ministry of Public Administration. The administrative division of the Government Factory handles personnel matters of all employees in the organisation, and provides typing services to the other two divisions. There are 12 clerks, 6 typists and a few minor employees working in this division. All the clerks belong to the General Clerical Service. All employees in this division belong to combined services and therefore transferable to other government departments. The administrative divison is situated in one of the office buildings outside the workshop premises.

The Chief Accountant is in charge of the Accounts Division. He is an officer of the Sri Lanka Accountants' Service. He has two other accountants to assist him and they are also officers of the Sri Lanka Accountants' Service. The main activities of the accounts division are maintaining of accounts, preparation of final accounts, job costing, stores management, payments to' employees, billing of customers, and other matters connected to the financial control of the organisation. Coordination with the Treasury and the Ministry, with regard to financial matters of the Government Factory, is also done by the accounts division. There are 25 clerks and a few minor employees working in the accounts division. These clerks also belong to the General Clerical Service. All the employees in this division too, belong to combined services under the Ministry of Public Administration and therefore they are also transferable. The chief storekeeper of the stores complex reports directly to one of the accountants (in this division), who is in charge of the stores and designated as Accountant(Stores). The accounts division is also located in one of the office buildings outside the workshop premises.

The Works Manager is the head of the works division. He is also a Chartered Mechanical Engineer and belongs to the Sri Lanka Engineering Service. The main activity of the works division is to undertake and execute work orders from clients. For this purpose, the works division has a job estimating branch, a progress branch for chasing the progress of jobs, a supplies branch for the procurement of stores required for the stores complex and the workshops, a drawing office and of course, the 14 workshops. All are located in the office buildings which are situated just outside the workshop premises.

The Works Manager is assisted by seven Assistant Works Managers, each of whom is in charge of a group of workshops or one of the branches mentioned above. The Assistant Works Managers are all mechanical engineers of the Sri Lanka Engineering Service. They are either engineering graduates or persons who have come up the ranks and reached a status equivalent to that of a graduate engineer. The shop officers (foremen) report directly to the Assistant Works Manager in charge of their respective workshops/branches.

In the offices of the works division, which are located outside the workshop premises, there are ten clerks, four draughtsmen, five foremen, four shop assistants and a few minor employees. Out of them, the clerks and the minor employees belong to combined services under the Ministry of Public Administration. All other categories of employees in these offices of the works division, belong to 'closed' services of the Government Factory.

A complete organisation chart of the Government Factory appears in Annexture 1 of this paper.

'Closed' Services versus 'Combined' Services

The above description of the organisation structure of the Government Factory, indicates the existence of two types of services for personnel; namely the 'closed' services and the 'combined' services. The closed services are those services which cater to the Government Factory only. The employees in these services are recruited by the Government Factory exclusively for employment at the Government Factory. They are not transferable to other government departments. Therefore, the employees in closed services usually remain working within the Government Factory until their retirement. The workers of all grades and trades, the supervisors, the foremen (shop officers and assistant shop officers), the shop assistants, the shop clerks, the time clerks and the storemen, all belong to closed services of the Government Factory. By virtue of the fact that eighty per cent of employees of the Government Factory are workers, it could be said that the vast majority of the employees belong to closed services. However, most employees in the top management and clerical grades belong to the so called combined services.

Combined services are those services in which the employees are recruited by the Ministry of Public Administration and posted to different government departments and ministries according to their personnel requirements. These employees are transferable from one government department to another. The Sri Lanka Engineering Service (S.L.E.S.), the Sri Lanka Administrative Service(S.L.A.S.), the Sri Lanka Accountants' Service and the General Clerical Service(G.C.S) are some such combined services. The engineers, the chief administrative officer, the accountants, the clerks, the typists, the storekeepers and the office minor employees of the Government Factory, belong to such combined services.

The management of the Government Factory therefore has no control over the selection of its employees who belong to these combined services. Vacancies, which occur from time to time, in posts at the Government Factory, which fall under the combined services categories, are filled by the Ministry of Public Administration, either by transfer from other government departments or by recruitment from outside. Large numbers of clerks are transferred in and out of the Government Factory on an annual basis. They bring with them the influences with regard to work attitudes, work norms and other forms of behaviour which exist in other government departments. Therefore it is inevitable that the officers of the Government Factory too, should exhibit the culture that exists in other government departments. It is still worse when the government decides to treat cetain important government departments on a priority basis and wants to flush out the unwanted officers from those important government departments. The Ministry of Public Administration which attaches the least importance to the Government Factory, then transfers these unwanted officers to the Government Factory office. The management of the Government Factory is then thrown into a desperate position where they are held responsible for achieving organisational goals, while they are not given the authority to select their office employees.

The situation in the workshops is very much better. Here, all employees, except the storekeepers, belong to closed services. They are recruited by the management of the Government Factory and therefore the management has a say in their selection. However, the workers are always conscious of the inequities that exist between the workshop and office conditions. The behaviour of the workers is therefore influenced by the behaviour of the office employees (mainly clerks), who exhibit the government department culture.

Compensation and Benefits

Almost all employees are paid monthly salaries and these salaries are fixed by sources outside the Government Factory. The management of the Government Factory, therefore has no authority over the amount paid as salaries. There is a salary structure attached to each category of service and the Government Factory is expected to pay each employee according to the salary structure attached to *his or her category* of service. The management of the Government Factory is, however, expected to decide on the granting of annual increments to the employees.

The Government Factory is authorised to make additional payments for any overtime work done by the employees. These overtime payments are based on the salary of each employee and therefore, even in the case of overtime payment, the amount to be paid has been pre-determined. When workers have to be sent outside the factory in order to perform their duties, the Government Factory is also authorised to pay subsistence(batta) at certain fixed rates provided certain conditions of distance from the factory and duration of job etc. are satisfied. Loans and salary advances can be paid to the employees only within the limits prescribed by the Treasury. All employees who have completed at least 10 years of service, are usually entitled to pension benefits, at the age of retirement. The age of retirement is usually 55, unless in exceptional circumstances, it is either advanced due to medical reasons or delayed due to extensions in service.

All forms of compensation usually paid to the employees are therefore not directly tied to performance. Any payment such as a financial incentive, directly tied to performance, can be given only after obtaining approval from the Ministry of Public Administration.

The other benefits enjoyed by the employees of the Government Factory include a 45 day casual and vacation leave annual entitlement, and holidays on Saturdays, Sundays and public holidays. There is also another entitlement of half pay leave, in case an employee is sick and has finished his other entitled leave. This half pay medical leave can extend up to a period equal to one-sixth of the service put in by an employee. Considering the easy accessibility to medical certificates in Sri Lanka, the half pay medical leave entitlement in public service is responsible for high rates of absenteeism in the public service. On an average, 30 per cent of the workforce is absent on any working day at the Government Factory.

Welfare facilities provided to the workers of the Government Factory include a subsidized mid-day meal or a meal allowance in lieu of it, for each worker who reports for duty on any working day. Welders are given a pint of milk a day, free of charge. Canteen facilities and a workers' mess are available for the use of the workers. Protective clothing is issued to certain categories of workers, an an annual basis. A housing scheme which provides living quarters for about one-tenth of the workforce, is situated about half a mile away from the factory. Familied workers, who apply for such quarters are selected on a point system which gives weightage to seniority in service, distance from hometown, number of children and service requirements.

<u>Functions</u>

The 14 workshops of the Government Factory are equipped to perform the following types of mechanical engineering services.

1. Machining of metal surfaces.
2. Foundry work - casting of cast iron and non-ferrous (aluminium, Brass, Copper, Gun-metal, Bell-metal and Bronze) items.
3. Smithy work - forging and heat treatment of metals.

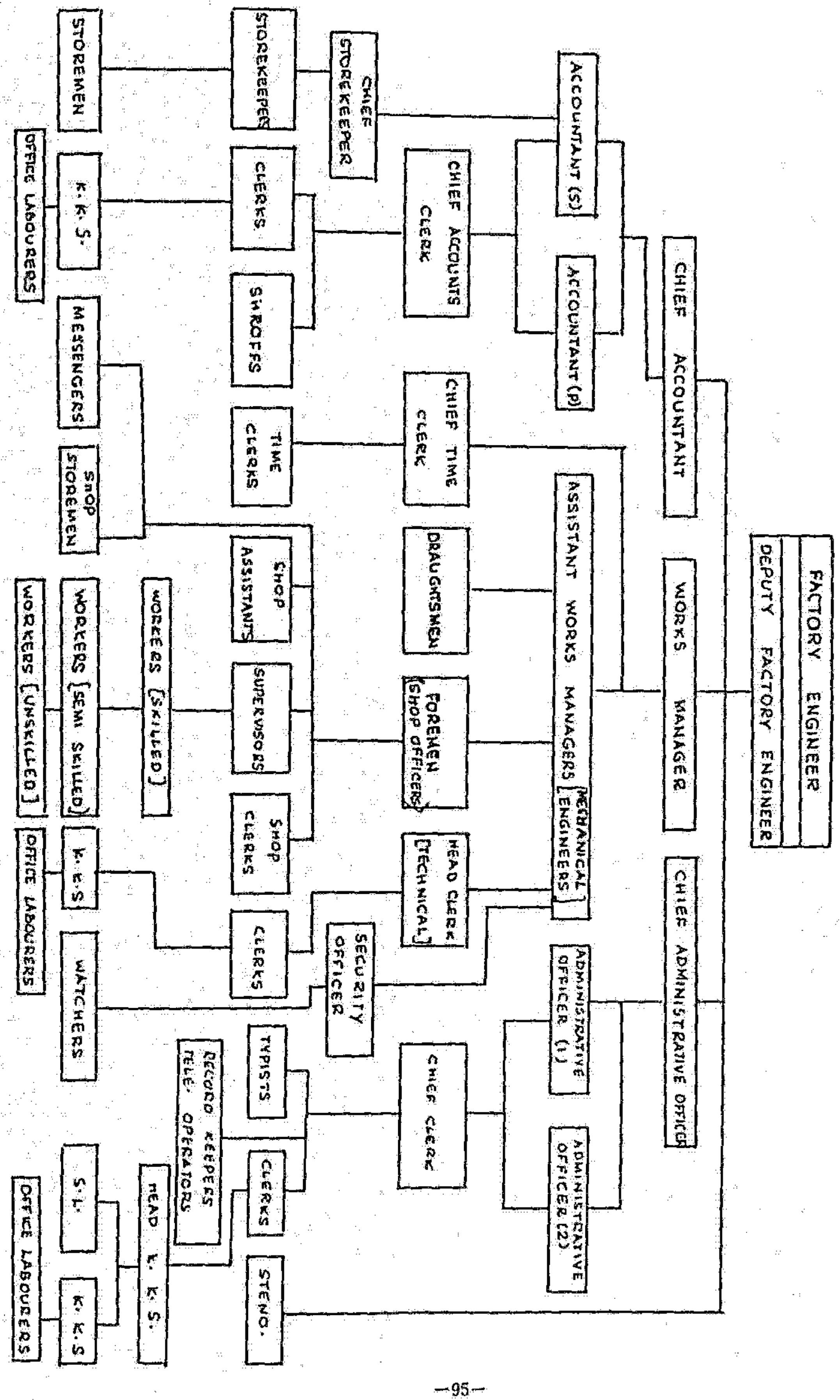
4. Heavy sheet metal fabrication.
5. Welding.
6. Tinkering - light metal sheet fabrication.
7. Metal engraving and embossing.
8. Boiler maintenance and repairs.
9. Repairs and servicing of typewriters.
10. Electro-plating.
11. Locksmith work - repairs to locks, handcuffs and iron safes.
12. Metal letter-cutting.
13. Carpentry work.
14 Saw mill work - Sawing of logs.
15. Wood-carving and pattern making.
16. General fitting - repairs to machines.

In addition to the above services, three of the workshops are also equipped for internal maintenance work such as vehicle maintenance, building maintenance and electrical maintenance of factory-owned vehicles,buildings and machinery. All the above-mentioned mechanical engineering services, not only serve the purpose of repairing and servicing of items, but also enable the Government Factory to manufacture several items required by government institutions. Some of the standard items of manufacture are as follows.

1. Hospital equipment such as beds, trolleys and saline stands.
2. Cast iron sluice gates for irrigation projects.
3. Wooden furniture - order made for government departments, ministries, university laboratories, President's office etc.
4. Wooden ferry boats.
5. Name boards
6. Barricades
7. National Emblems.
8. Office(metal) seals for passports, driving licences, National identity cards, for post offices and for other government offices.
9. Office equipment such as paper punchers, office bells and waste paper baskets.
10. Water tanks, buckets, dustbins, motar pans, wheelbarrows, fire buckets and watch huts made of metal sheet.

ANNEXURE I

ORGANISATION CHART FOR THE GOVERNMENT FACTORY



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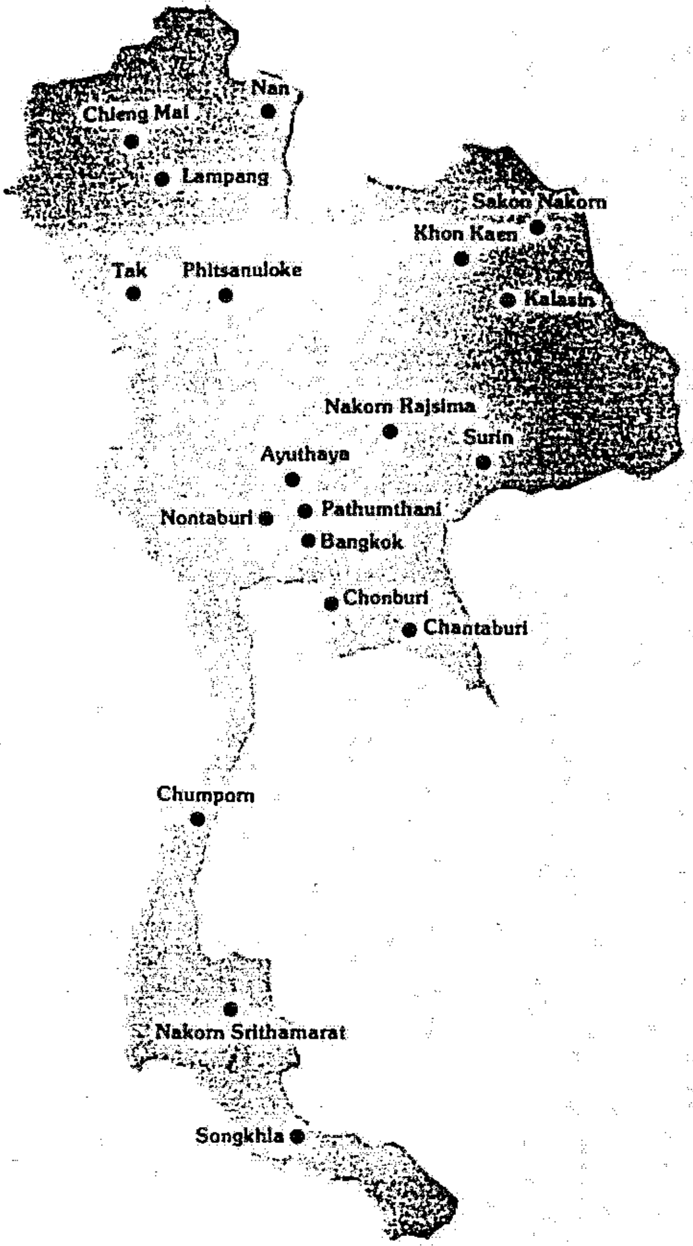
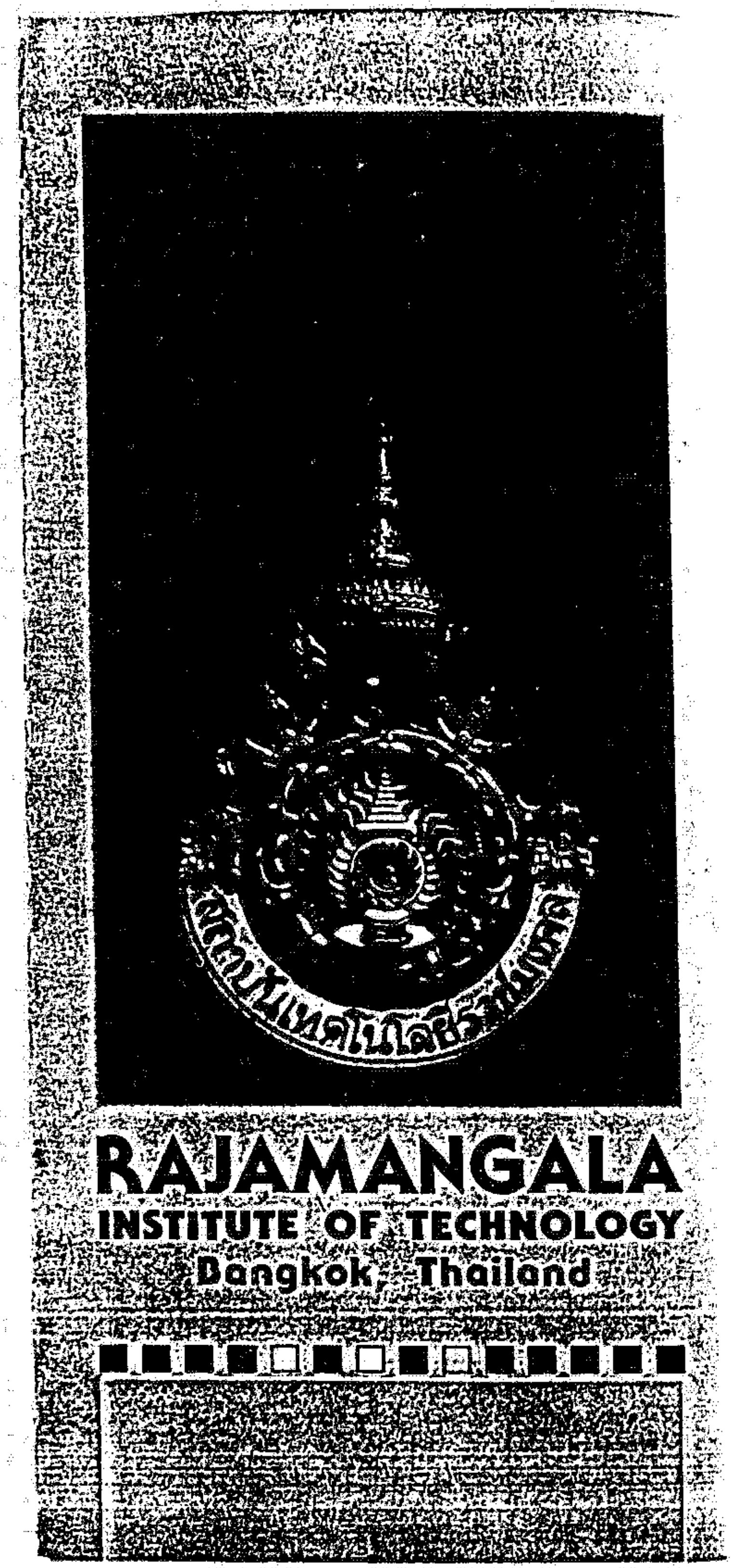
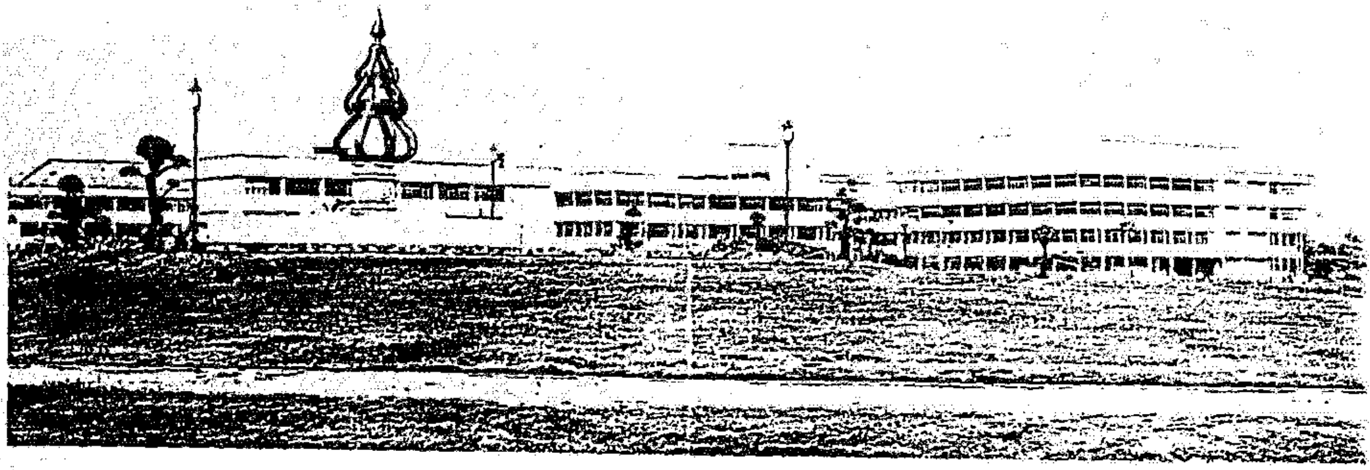


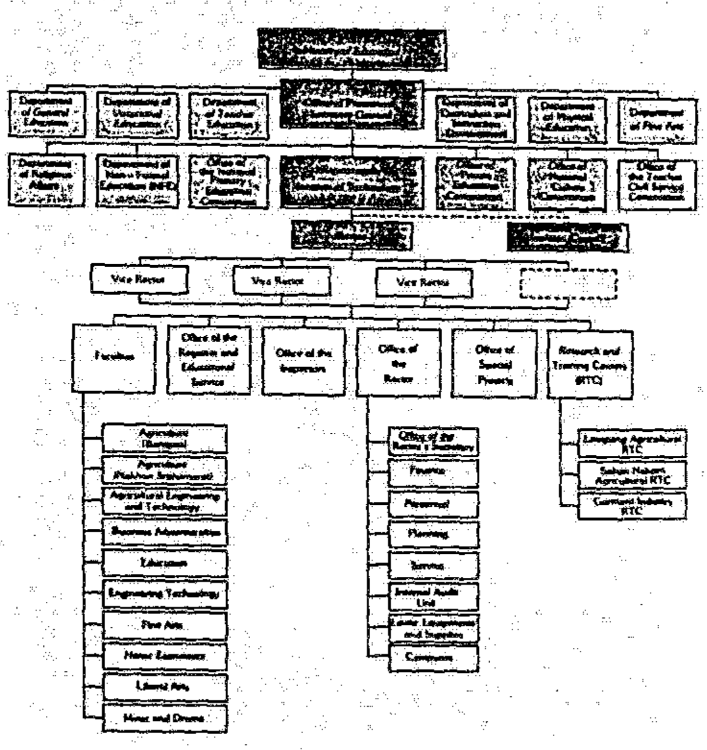
RIT Campuses and Faculties





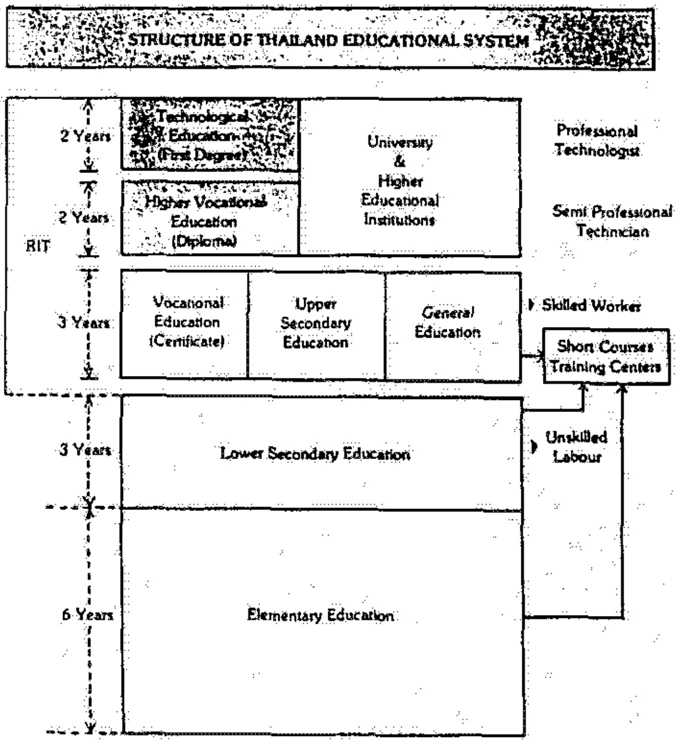
THE ORGANIZATION OF THE INSTITUTE

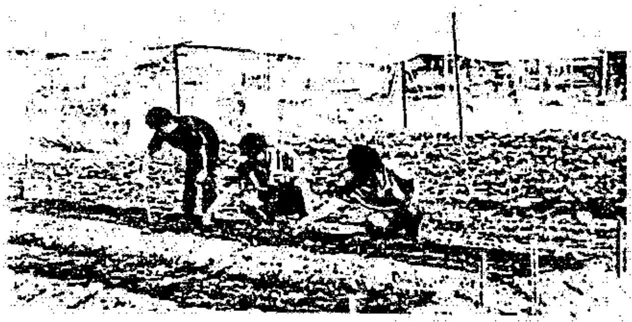
The organization of the Institute and its relationship to the Ministry of Education, is shown in the chart.



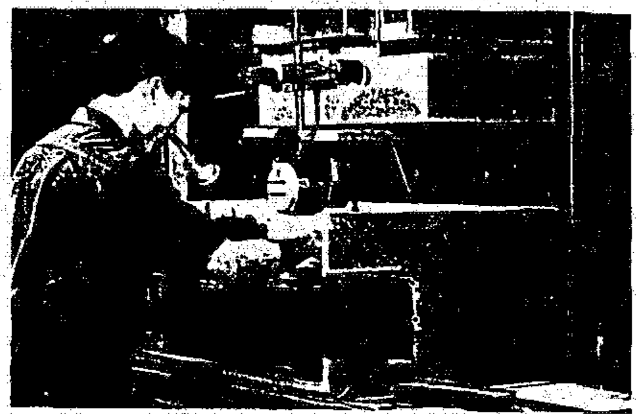
Rajamangala Institute of Technology (RIT) is an educational and research institution, having the tasks of providing vocational courses of study for students at different levels up to Bachelor's Degree, training and upgrading teachers for technical and vocational education institutions, undertaking research for the development of vocational education, as well as providing extension services.

RIT was founded in 1975 with the former name "Institute of Technology and Vocational Education". On 15 September 1988 His Majesty King Bhumibol decreed a change of name to Rajamangala Institute of Technology, with the responsibility of providing students graduated from vocational and technical colleges with an opportunity to further their education to the degree level.

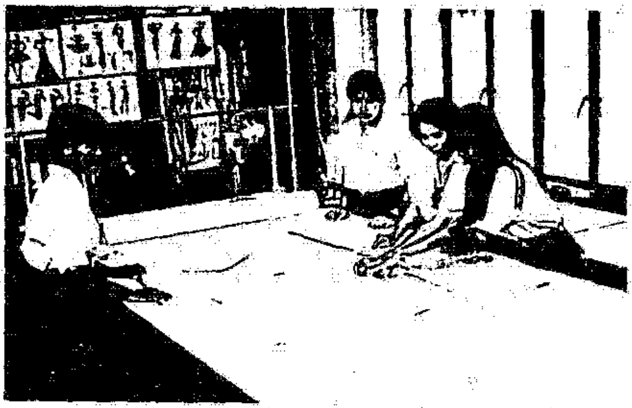


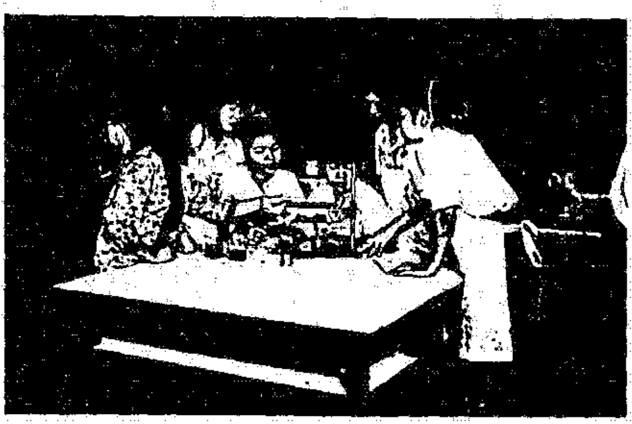


The establishment of RIT could be conceived as a recognition, on the part of the Government, of the need to promote and develop vocational and technological education in Thailand to the fullest extent.



Fields of specialization in Agriculture, Business Administration, Engineering, Fine Arts, Home Economics and Music and Drama are provided by 29 campuses at three levels :





Degree Level, Higher Vocational Diploma Level and Vocational Certificate Level. And the other 10 following faculties of RIT also offer Degree Level courses :

- **Faculty of Agriculture (Bangphra)**
- **Faculty of Agriculture (Nakhon Srithamarat)**
- **Faculty of Agricultural Engineering and Technology**
- **Faculty of Business Administration**
- **Faculty of Education**
- **Faculty of Engineering Technology**
- **Faculty of Fine Arts**
- **Faculty of Home Economics**
- **Faculty of Liberal Arts**
- **Faculty of Music and Drama**

RIT PROMINENT ACTIVITIES

— Teaching – Learning Projects
— Extension Service Projects
— Research and Development Projects

For further information, write to
399 Samsen Road
Sisao, Thewes, Bangkok 10300
THAILAND
Tel. 2800435, 2823847
FAX : 662 2800435

5.

STATE RAILWAY OF THAILAND

****

M A K K A S A N   W O R K S H O P

MECHANICAL ENGINEERING DEPARTMENT

M A K K A S A N   W O R K S H O P

1. General Description

1.1 History : Makkasan Workshop is the largest central repair, maintenance and construction installations of The State Railway of Thailand. It has been in operation since June 1910.

1.2 Site Location : The Workshop area is located in a strip of land of approximately 2,400 metre long by 290 metre wide, which is equivalent to an areaof approximately 0.67 square kilometres or 167 acres. The said area also includes 0.28 square kilometres of trackyard.

1.3 Mission and responsibility : The main function of Makkasan Workshop is to undertake maintenance, repair of all types of locomotive, passenger carriages, and goods wagons currently used in the State Railway of Thailand. It also undertakes the responsibility of bogie repair and modification of carriages and wagons as well as producing spare parts in support of its workshop and other regional workshop and units under the Mechanical Engineering Department of the State Railway of Thailand throughout the country.

2. Organization

2.1 Makkasan Workshop is organized into four main divisions, each is supervised by a Superintending Engineer. It also has seven other supporting sections, namely, secretarial, statistics, security, welfare & discipline, accounting, and machinery maintenance & testing. Deputy Chief Mechanical Engineer (Workshop) who is directly under the Chief Mechanical Engineering Department, is authorized to supervise the whole Makkasan Workshop installation.

2.2 The four main divisions mentioned above are:

2.2.1 Locomotive Repair Division : To supervise in the repair and modivication of all types of locomotives currently used as motive power in the State Railway of Thailand. The division also performs repair and installation of electrical equipment of the train as well as maintenance of Makkasan Workshop electrical facilities.

2.2.2 Freight Wagon Repair Division : To supervise in the repair of accidential wagon and modification of some type of wagons including the repair of all type of diesel railcars. To supervise in producing of some necessary spare parts need in the work of repairing and modification of wagons, passenger coaches and diesel railcars.

2.2.3 Production Division : To supervise in producing spare parts needed in repair works for locomotive, carriages and wagons as well as parts in support for rolling stock construction works, and also other units of the State Railway of Thailand.

2.2.4 Passenger Carriage Repair Division : To supervise and perform heavy and partial repair works of passenger carriages as programmed in the railway requirement targets. It also produces some relevant parts and also repair of bogies in support to other units of the Mechanical Engineering Department.

2.2.5 Other seven supporting Sections : There are other seven supporting sections which are included in the organization and are under direct control of the Deputy Chief Mechanical Engineering (Workshop). There are namely Secretarial Section, Account Section, Statistic Section, Security Section, Welfare and discipline section and Machinery maintenance & Testing Section and Workshop Stores Section.

-/2

3. Capability

The current repair and construction capability rate per month are as follows:

3.1 Repair capability

3.1.1	Diesel locomotives.	:	25-30	units
3.1.2	Passenger carriages.	:	25-30	units
3.1.3	Wagons (in term of 4-wheel).	:	70	units
3.1.4	Diesel railcar.	:	1 set	(2-car set)

3.2 Repair part Production : Production Division Produces parts for maintenance and repair works in support to verious units under machenical engineering dept. of the State Railway of Thailand in the range of approximately 110,000 per month.

4. Man Power : The man power strength of Makkasan Workshop is classified in to four main categories as follow (30th April, 1989)

4.1	Staff official.	:	429
4.2	Skilled and Semiskilled Workers.	:	2,039
4.3	Unskilled Workers.	:	204
	Total		2,672

5. Statistics showing previous record of Rolling Stock Construction Completed during October 19, 1967 (Rolling Stock Construction deactivated since, 1984).

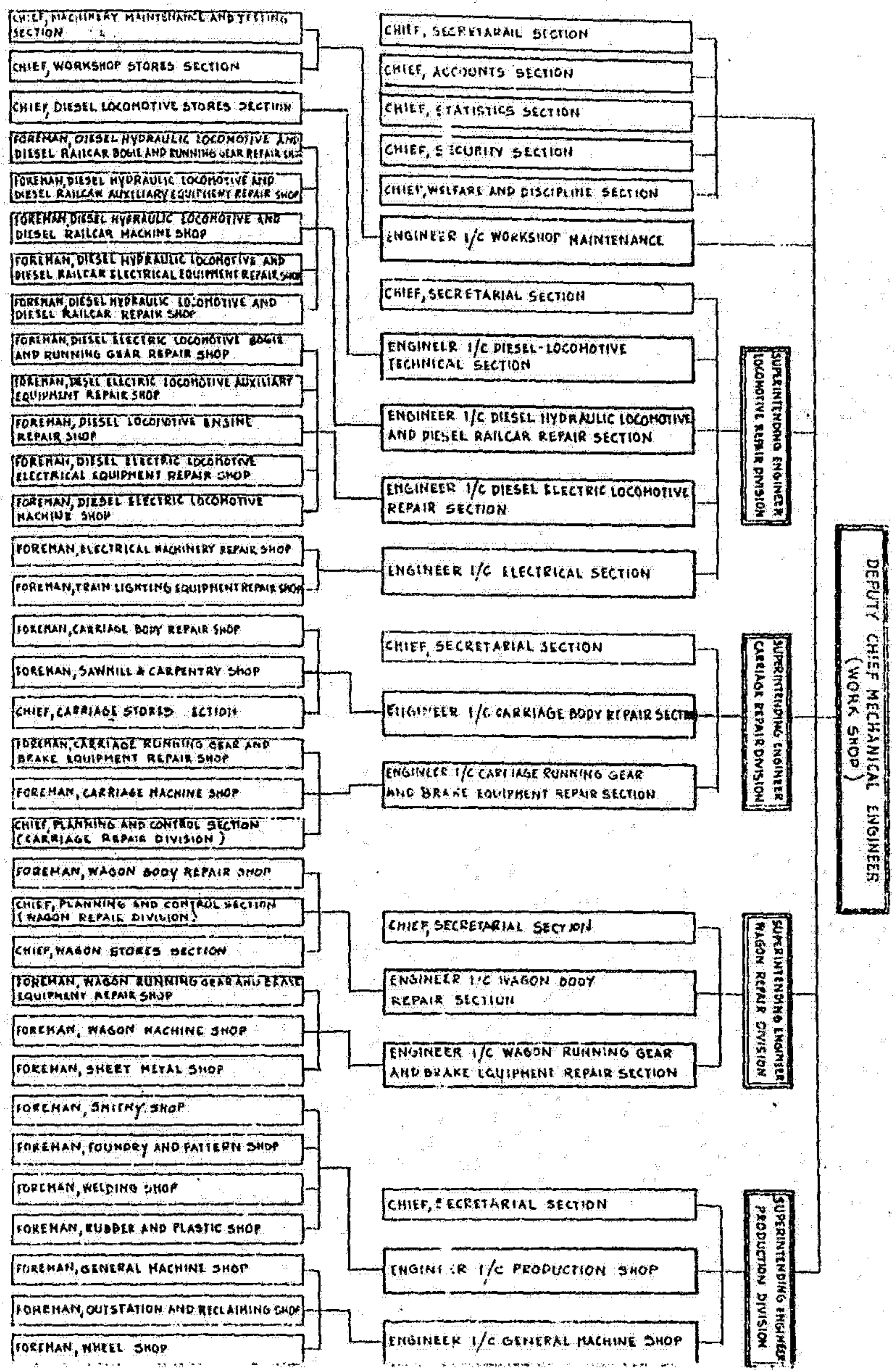
5.1 Goods Wagons

5.1.1	Bogie Oil Tank.	:	428	units	(BOT)
5.1.2	Bogie Cement Hopper Wagons Self Discharge.	:	120	units	(BCS)
5.1.3	Bogie Cement Hopper Wagon Pressure Discharge.	:	58	units	(BCP)
5.1.4	Bogie Flat Wagon.	:	199	units	(BFW)
5.1.5	Bogie Low-sided Wagon.	:	140	units	(BLS)
5.1.6	Bogie Hight-sided Wagon.	:	24	units	(BHS)
5.1.7	Bogie Covered Goods Wagon.	:	463	units	(BCG)
5.1.8	4-wheeled Brake Van.	:	70	units	(BV)
	Total		1,502	units	

5.2 Passenger Carriages

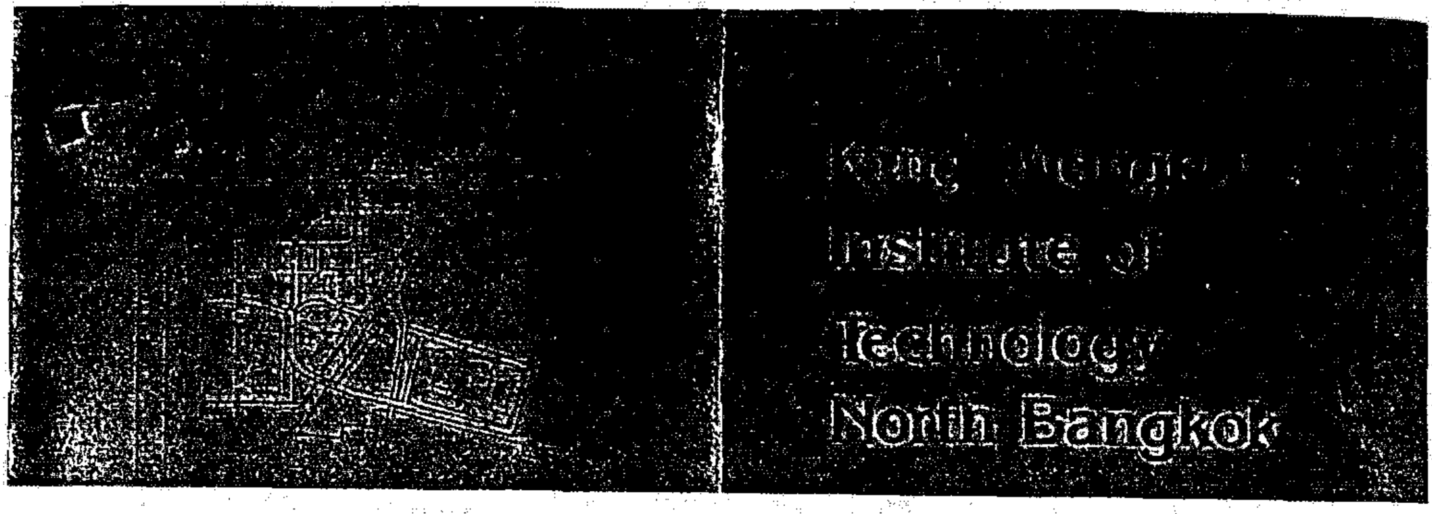
5.2.1	Bogie Third Class Carriage.	:	347	units	(BTC)
5.2.2	Bogie Full Van.	:	28	units	(BFV)
5.2.3	Bogie Bufet Third Class Carriage	:	37	units	(BBT)
5.2.4	Bogie Second & Third Class Carriage.	:	22	units	(BST)
5.2.5	Bogie Third Class & Van.	:	20	units	(BTV)
5.2.6	Bogie Second Class Day & Night Coach.	:	41	units	(BNS)
5.2.7	Air-conditioned Second Class Day & Night Coach.	:	16	units	(ANS)
	Total		511	units	

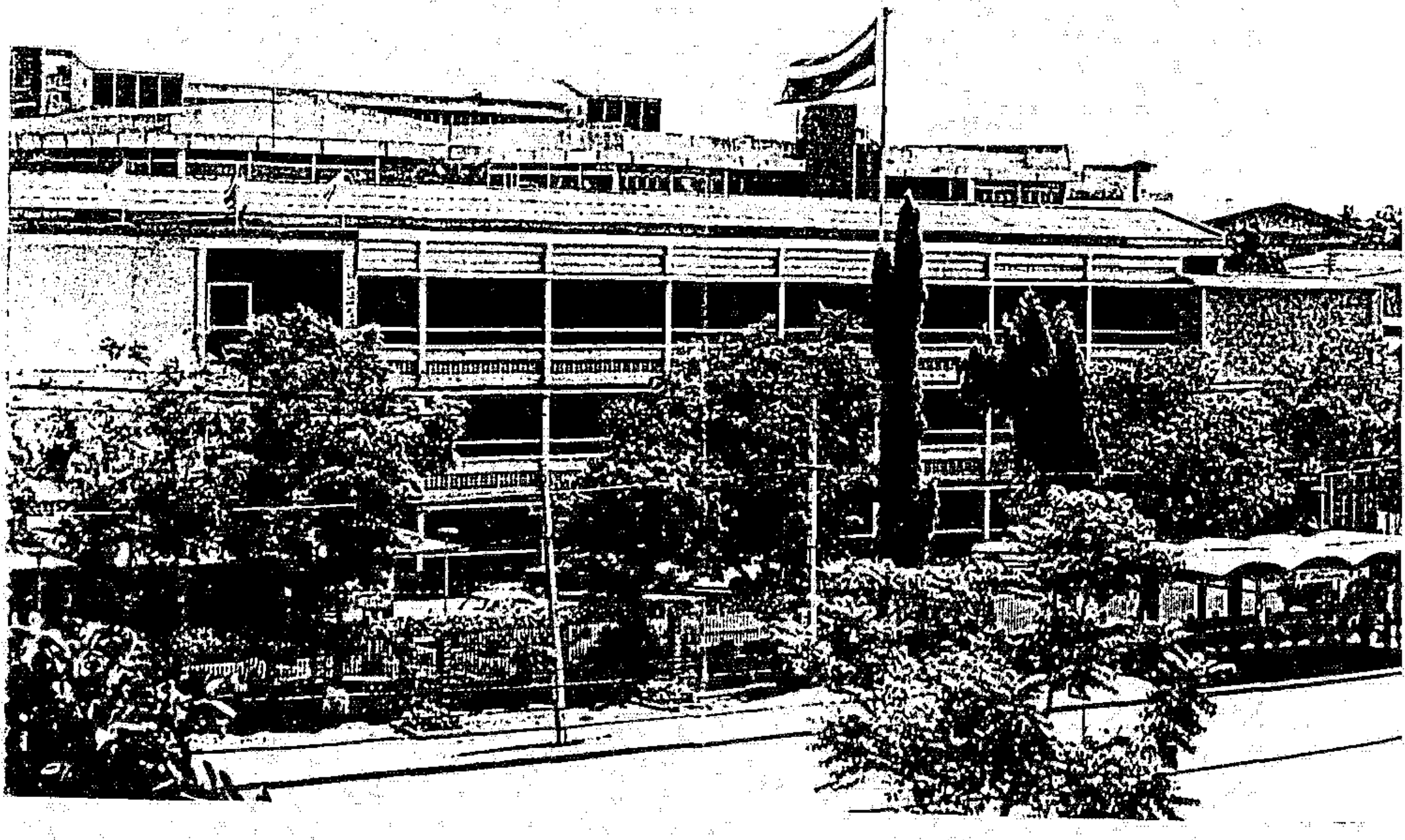
TK/Type.

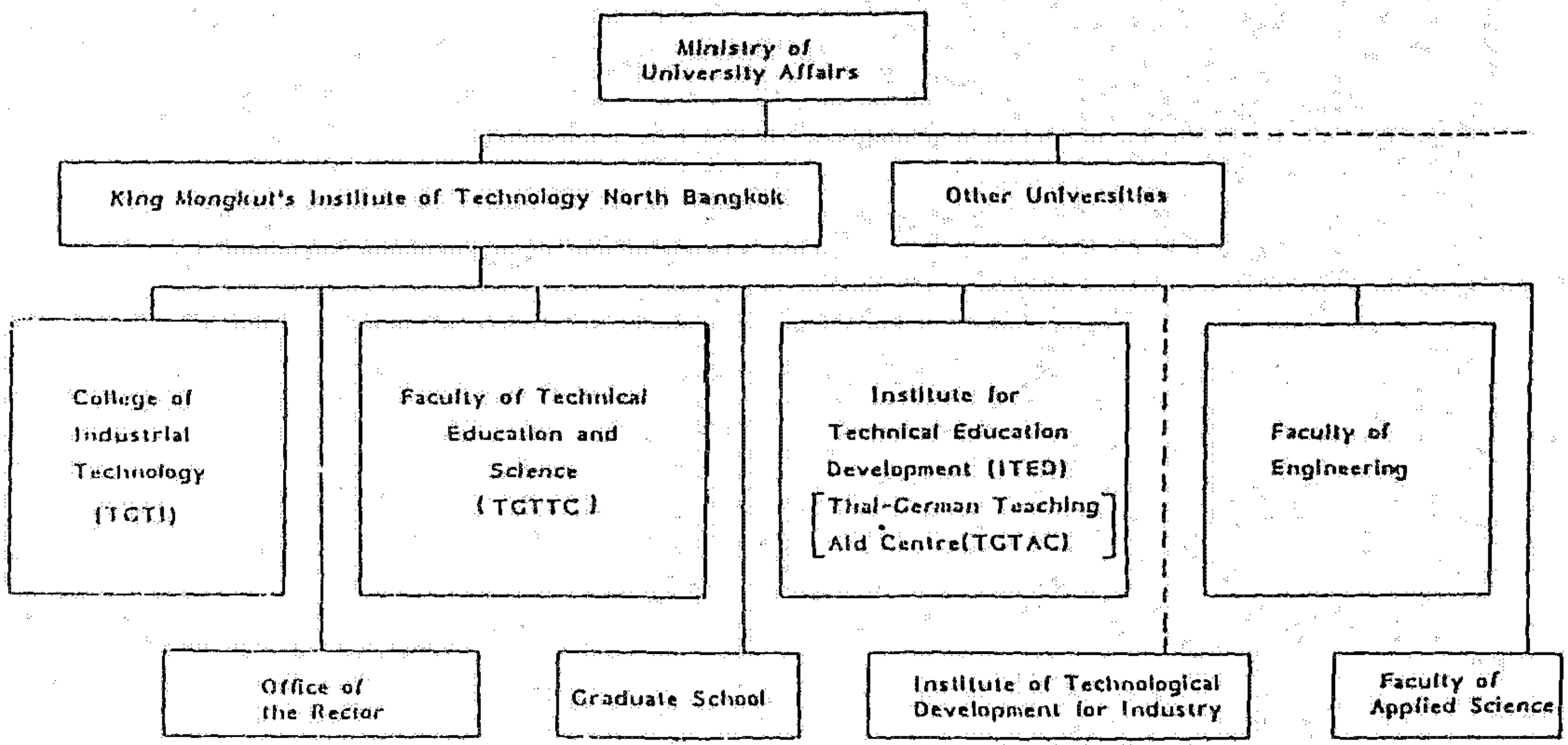


DEPUTY CHIEF MECHANICAL ENGINEERS (WORK SHOP)
SUPERINTENDING ENGINEER LOCOMOTIVE REPAIR DIVISION
SUPERINTENDING ENGINEER CARRIAGE REPAIR DIVISION
SUPERINTENDING ENGINEER WAGON REPAIR DIVISION
SUPERINTENDING ENGINEER PRODUCTION DIVISION
CHIEF, SECRETARAIL SECTION
CHIEF, ACCOUNTS SECTION
CHIEF, STATISTICS SECTION
CHIEF, SECURITY SECTION
CHIEF, WELFARE AND DISCIPLINE SECTION
ENGINEER I/C WORKSHOP MAINTENANCE
CHIEF, SECRETARIAL SECTION
ENGINEER I/C DIESEL-LOCOMOTIVE TECHNICAL SECTION
ENGINEER I/C DIESEL HYDRAULIC LOCOMOTIVE AND DIESEL RAILCAR REPAIR SECTION
ENGINEER I/C DIESEL ELECTRIC LOCOMOTIVE REPAIR SECTION
ENGINEER I/C ELECTRICAL SECTION
CHIEF, SECRETARIAL SECTION
ENGINEER I/C CARRIAGE BODY REPAIR SECTION
ENGINEER I/C CARRIAGE RUNNING GEAR AND BRAKE EQUIPMENT REPAIR SECTION
CHIEF, SECRETARIAL SECTION
ENGINEER I/C WAGON BODY REPAIR SECTION
ENGINEER I/C WAGON RUNNING GEAR AND BRAKE EQUIPMENT REPAIR SECTION
CHIEF, SECRETARIAL SECTION
ENGINEER I/C PRODUCTION SHOP
ENGINEER I/C GENERAL MACHINE SHOP
CHIEF, MACHINERY MAINTENANCE AND TESTING SECTION
CHIEF, WORKSHOP STORES SECTION
CHIEF, DIESEL LOCOMOTIVE STORES SECTION
FOREMAN, DIESEL HYDRAULIC LOCOMOTIVE AND DIESEL RAILCAR BOGIE AND RUNNING GEAR REPAIR SHOP
FOREMAN, DIESEL HYDRAULIC LOCOMOTIVE AND DIESEL RAILCAR AUXILIARY EQUIPMENT REPAIR SHOP
FOREMAN, DIESEL HYDRAULIC LOCOMOTIVE AND DIESEL RAILCAR MACHINE SHOP
FOREMAN, DIESEL HYDRAULIC LOCOMOTIVE AND DIESEL RAILCAR ELECTRICAL EQUIPMENT REPAIR SHOP
FOREMAN, DIESEL HYDRAULIC LOCOMOTIVE AND DIESEL RAILCAR REPAIR SHOP
FOREMAN, DIESEL ELECTRIC LOCOMOTIVE BOGIE AND RUNNING GEAR REPAIR SHOP
FOREMAN, DIESEL ELECTRIC LOCOMOTIVE AUXILIARY EQUIPMENT REPAIR SHOP
FOREMAN, DIESEL LOCOMOTIVE ENGINE REPAIR SHOP
FOREMAN, DIESEL ELECTRIC LOCOMOTIVE ELECTRICAL EQUIPMENT REPAIR SHOP
FOREMAN, DIESEL ELECTRIC LOCOMOTIVE MACHINE SHOP
FOREMAN, ELECTRICAL MACHINERY REPAIR SHOP
FOREMAN, TRAIN LIGHTING EQUIPMENT REPAIR SHOP
FOREMAN, CARRIAGE BODY REPAIR SHOP
FOREMAN, SAWMILL & CARPENTRY SHOP
CHIEF, CARRIAGE STORES SECTION
FOREMAN, CARRIAGE RUNNING GEAR AND BRAKE EQUIPMENT REPAIR SHOP
FOREMAN, CARRIAGE MACHINE SHOP
CHIEF, PLANNING AND CONTROL SECTION (CARRIAGE REPAIR DIVISION)
FOREMAN, WAGON BODY REPAIR SHOP
CHIEF, PLANNING AND CONTROL SECTION (WAGON REPAIR DIVISION)
CHIEF, WAGON STORES SECTION
FOREMAN, WAGON RUNNING GEAR AND BRAKE EQUIPMENT REPAIR SHOP
FOREMAN, WAGON MACHINE SHOP
FOREMAN, SHEET METAL SHOP
FOREMAN, SMITHY SHOP
FOREMAN, FOUNDRY AND PATTERN SHOP
FOREMAN, WELDING SHOP
FOREMAN, RUBBER AND PLASTIC SHOP
FOREMAN, GENERAL MACHINE SHOP
FOREMAN, OUTSTATION AND RECLAIMING SHOP
FOREMAN, WHEEL SHOP

6.






Ministry of
University Affairs
King Mongkut's Institute of Technology North Bangkok
Other Universities
College of
Industrial
Technology
(TGTI)
Faculty of Technical
Education and
Science
(TGTTC)
Institute for
Technical Education
Development (ITED)
[Thai-German Teaching
Aid Centre(TGTAC)]
Faculty of
Engineering
Office of
the Rector
Graduate School
Institute of Technological
Development for Industry
Faculty of
Applied Science

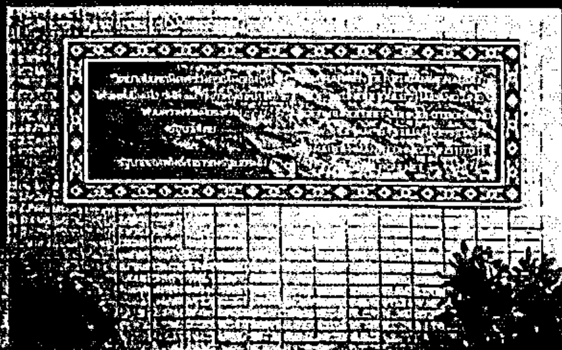
KING MONGKUT'S INSTITUTE OF TECHNOLOGY NORTH BANGKOK

Manpower has been regarded as the most important resource for the economic and social development of a country. Especially when the aim is to develop the industrial infrastructure so that the country could become more self reliant, the development of manpower in the field of science and technology is therefore vital.

The KMIT - NB deems its task in educating and training technical manpower to fulfil the needs for industrial development, especially in technology based production industries. For this reason, the educational philosophy and approach of this Institute is not only to provide technical or engineering education but the training of the young Thai in a more "practical" or production oriented manner, together with the necessary awareness during their studying years with the Institute.

The KMIT - NB is indeed a tertiary institution of learning under the supervision of the Ministry of University Affairs. The Institute enjoys the rights and priveleges as other state universities. However, due to its historical development, with its education activities ranging from the secondary "industrial trades training" programs upto the post graduate studies in engineering and technical education, the Institute possesses educational features which differ from other traditional universities.

This Institute was founded in 1959, in response to the very first economic and technical cooperation between the Government of the Federal Republic of Germany and the Government of Thailand. The Thai-German Technical School, North Bangkok aimed to produce skilled-workers in various trades.



Then in the year 1964, the Institute extended its activity to train industrial technicians. Consequently, it was upgraded to "Thai-German Technical College, North Bangkok" widely known as "Thai-German Technical Institute".

The Institute was upgraded into the King Mongkut's Institute of Technology, North Bangkok, by law promulgated in 1971 together with the Thonburi and Lardkrabang Campus, and it was transferred to be under the supervision of the Ministry of State Universities in 1974.

Due to some difficulties encountered in administration of the three campuses, in February 1986 the Institute was legally splitted up into three autonomous universities, retaining the same names.

The King Mongkut's Institute of Technology North Bangkok consists of

1. Faculty of Engineering
2. Faculty of Technical Education and Science
3. College of Industrial Technology
4. Institute for Technical Education Development

Faculty of Engineering - Main task of the Faculty is to produce graduates of Bachelor and advanced Degrees, with the capability in practical engineering to develop and control the whole process of production. In order to successfully carry out the task, the Faculty encourages strong interaction with local industries in providing R and D, testing and other consultancy services. The Faculty consists of 8 Department and one Research Center

[illegible]

• Department of [illegible] Handling
• Department of Industrial [illegible]
• Centre of [illegible] Research and [illegible]

Faculty of Technical Education and Science

Faculty of Technical Education and Science has the aim and responsibility to produce qualified technical teachers who can relate in their teaching both theory and practice in the field of Mechanics, Electricity and Civil Construction, instructors and administrators for vocational schools and other technical education institutions. The graduates will be able to use educational innovations to improve the efficiency of the teaching and learning process. Moreover it produces the applied statisticians and industrial chemists who can work efficiently.

The Faculty consists of 7 Department:
• Department of Mathematics
• Department of Science
• Department of Teacher Training in Electrical Technology
• Department of Teacher Training in Civil Technology
• Department of Teacher Training in Mechanical Technology
• Department of Languages and Social Sciences
• Department of Technology Education

• formerly known as the "Thai-German Technical Institute" has the task to produce the middle level technical manpower.

College of Industrial Technology

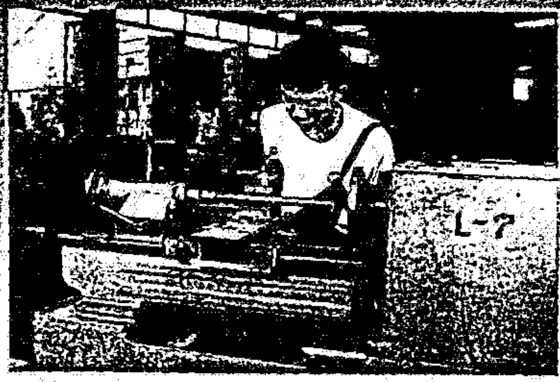
This college is actually the wellknown "Thai-German Technical Institute". The main task of this college, as it has been for the past 27 years, is to produce middle level, technical manpower in varions industrial trades.

The programs consist of 3+2 year courses, with the first 3 years course concentrates in basic trade training. Only the school leavers of grade 9 are inducted into the first course. The students are provided with basic trade theories, basic

[illegible]

The college is composed of [illegible] departments and [illegible] as follows:

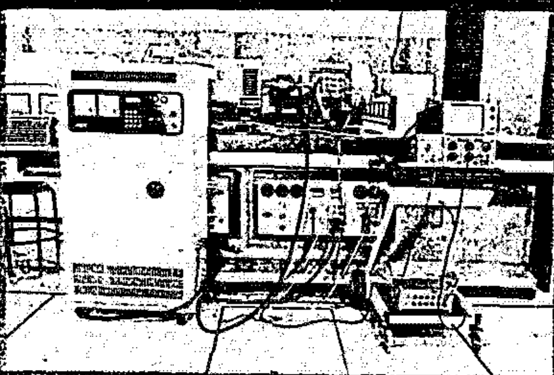
• Mechanical Department Consists of Machine Shop, Mechanical Drafting, Automotive, Industrial Plumbing and Welding Trades section.
• Electrical Department Consists of Electrical Power and Electronic sections.
• Construction Department Consists of construction, Machinery, Wood Working and Interior Decoration section.
• Applied and Social Sciences Departments.
• Centre for production training.



Institute for Technical Education Development

This is a research and development institution with status equivalent to a faculty. The aim of this institute is to become a focal point in research and development in education technology and in distribution of informations regarding vocational and technical education to vocational school system around the country. Furthermore, it aims to provide training and research services, inclusive of the Thai-German Teaching Aid centre Project, in order to upgrade the effectiveness of teaching-learning processes in vocational schools.

[illegible]



Bra tillskott

Det är ju tyvärr så att vi inte har någon industri att tala om i Thailand, säger denne teknikpedagog med ett skratt som aldrig sitter långt inne.

- Vi kan inte skicka ut studenterna på praktisk tjänstgöring. Så därför har vi inom campusområdet fått bygga upp vår egen industri. Vi har producerande enheter inom träteknik, elektroteknik, metallbearbetning *och byggelement.*

[illegible] sig för vad man skall ägna sig åt under dessa. [illegible]

[illegible] Matematik däremot [illegible] undervisar vi [illegible] som på många [illegible] Men inte går vi särskilt djupt ned i matematik som vetenskap, säger Somchob.

[illegible] det här landet behöver är producerande enheter som tillverkar saker som behövs, elektriska motorer t ex. [illegible] sådana.

Somchob vill bygga upp en fungerande basindustri. Han säger det inte direkt, men han låter påskina att regeringens industripolitik är uppe i det blå. *En massa prat och planer som det inte blir speciellt mycket av.* Plötsligt säger han:

- Regeringen vill styra, inte stimulera, industrin.

Somchob har säkert meningsfränder, inte bara i Sydostasien.

- Hans pedagogiska idé tycks vara handfast planterad i den thailändska verkligheten. Han är inte den teknikvisionär som Indonesiens Habibie (Se NT nr 13). Hans möjligheter att förverkliga sina idéer ligger naturligtvis på ett helt annat plan en Habibies, statsbyggarens.

Somchobs idéer ligger i huvudsak inom möjligheterna att utveckla institutet han har ansvaret for. Han vill ha in en kemisk linjo i undervisningen.

- Vi måste t ex lära oss att utnyttja moderna material, polymerer, t ex. Vi borde också ha en linje för industriella processer, det är också saker pojkarna bör få lära sig.

Han säger "pojkarna". Så är det, bortåt 5 000 *manliga studenter. Under rundvandringen ute bland institutionsbyggnaderna* ser jag inte en enda flicka. Jo, i kantinen.