資料２　開所式講演録（桑島京子団長）

Address by Kyoko Kuwajima at the handing-over ceremony of equipment and machinery of the Foundry Technology Development Project in 18 May 1998 in Sri Lanka

Honorable Mr. C.V. Gooneratne, Minister of Industrial Development,
His Excellency Mr. Yoji Sugiyama, Ambassador of Japan to Sri Lanka,
Distinguished guests, ladies and gentlemen,

It is indeed a great pleasure for me to extend, on behalf of Japan International Cooperation Agency (JICA), my most sincere and heartfelt congratulations on this auspicious occasion of the ceremony for the handing over of equipment and machinery of the Foundry Technology Development Project. As this title indicates, this project is designed to contribute to the upgrading of foundry technology in Sri Lanka, by way of strengthening the technical and institutional capacity of the Industrial Development Board (IDB) through daily on-the-job-training and technical advice from Japanese experts. It is our great pleasure to see that this project has been implemented according to plans and right on schedule.

The ceremony today marks a significant and special step forward for the future of the foundry industry in Sri Lanka. I would like to remind you, however, that we are only midway through the cooperation period of the project . Two and half years from now is the most crucial time for achieving the expected goals of the project because by that time the training and technical service activities of IDB should be improved and firmly established so as to prove effective in upgrading the technology of engineers and technicians in the foundry industry in response to the needs of the country. I am certain that we can do this through mutual cooperation between Japanese and Sri Lankan experts.

From the viewpoint of JICA's recent approach to technical cooperation, JICA is paying keen attention to the sustainability of a project after its completion. I would say that the success of a project depends on it. The question is whether or not the technology from the Japanese expert teams will be securely transferred to the counterpart personnel in the recipient agency within the remaining cooperation period. And whether or not this agency is able to maintain its effective function both institutionally and financially. A sufficient budget is indispensable. In addition, efforts should be made so that self-financing measures may be devised to help stabilize project operations. I trust that such project sustainability will be accomplished under the capable leadership of Mr. Jayasinghe, Chairman of IDB, and the continuous efforts of the distinguished IDB staff.

Ladies and gentlemen, I would like to draw your attention to the sophisticated machinery and equipment provided to this project by the Japanese government. Among them, the Cupola and the High Frequency Induction Furnace equip IDB foundry with an indigenous as well as an advanced melting facility which enables IDB to select technology best suited to the various needs in Sri Lanka. Therefore, IDB foundry is expected to be a model factory for local foundries by demonstrating the capacity to produce high quality cast iron products with both conventional and modem technology. IDB will also be an open laboratory putting its elaborate testing equipment to public use.

Please be reminded that trainees from private companies who attend IDB's training program will become aware of the importance of essential foundry technologies and skills for quality management. At the same time, company owners will come to recognize the necessity of capital investment to introduce new technology like that in IDB in order to raise their production quality and capacity to a competitive level.

Ladies and gentlemen, commemorative seminar will be held tomorrow by inviting two experienced foundry experts, Mr. Ohshima and Mr. Watanabe from Japan. They will give special lectures titled "Measures for Substantial Quality Improvement and Big Cost Reduction of Sri Lankan Castings" and "Future Technology for Casting Production as of today." Through such seminars, IDB provides at hand useful knowledge as well as technical information to local foundries. It is our sincere hope that

Sri Lankan industries will make full use of the benefits of the project.

Finally, let me reiterate my deepest appreciation to the Government of Sri Lanka and all people concerned, for their continued good will and sincere support of this project.

Thank you for your kind attention.

資料3　EDNA Company Ltd.見学記録

1　日時

1998年5月16日（土）13:00～15:00

2　見学目的

同工場は、キュポラ2基、低周波誘導炉数基を所有する鋳物および機械組立工場であることから、FDTプロジェクトの参考となるため。

3　工場の概要

(1) 創立　1972年

(2) 従業員数　約250名

- うち鋳物工場の従業員は約110名

（他は別の場所にある機械組立工場の従業員）

(3) 主な生産物

- ウォーターポンプ
- マンホールカバー
- 機械部品

(4) 生産能力（高）

- 225トン／月／キュポラ
- 300トン（125トン）／月／低周波誘導炉

(5) 勤務体制

- 3交替制

（誘導炉は14時間／日運転）

(6) 平均賃金

- 5,600ルピー（約12,000円）

（スリ・ランカの平均賃金より高い）

- 賃金は歩合制である。

(7) 主なクライアント

- SINGER SLI LANKA
- SLI LANKA Plantation Company
- SLI LANKA TELEPHONE
- KUBOTA ENGINE

(8) キュポラの燃料

コークスはオーストラリア産。インド産は品質が悪く使えないとのこと。

(9) 検査機器

・CE メーター

(10) 電気代

・電気代　7ルピー（約15円）/kw/h

　　　　（日本　10円/kw/h)

・生産コストに占める電気代の割合

ダクタイル鋳鉄の1 kg当たりのコスト40～45ルピーのうち10ルピー（22～25%）が電気代。

・18:00～21:00のピーク時は電気代が他の時間帯に比較して高い。

(11) 安全対策

・作業者は無安全帽、裸足である。理由は、安全帽と安全靴を着用すると仕事の能率が低下するため。

(12) その他

・同社の技術員がIDBの木型研修コースに参加している。

資料４　分光分析機の設置およびUNDP所有試験検査機器の使用に関する問題

１　問題点

（１）「分光分析機の当初予定していた設置場所が使用不可能となり、同機器の設置が出来ない状態となっている。」

実施協議等（注１）で双方合意していたFDSI（注２）が現在使用中の場所について、FDSIは現在設置されている故障中の分光分析機（注３）を撤去する事も、JICAから供与された分光分析機を設置する事も拒否している。

（注１）

事前調査	1994.2.28～3.11	（別添１）
長期調査	1995.2.26～3.12	
実施協議	1995.9.24～10.5	（別添２）

（注２）FDSI（The Foundry Development & Services Institute）

鋳物産業及びその消費者からの賛助会費により構成された民間団体、目的は業界よりの試験検査依頼に対するサービス提供及び関連情報の提供、UNDPは拠出金US$ 688,000-をもってFDSI/UNDPプロジェクトを1991年12月から３年間の協力を実施、その後期間を延長して現在に至っている。IDBはFDSIに対し、事務室、実験検査棟、TEL回線、及び若干の機器の提供を無償で行っている。現在は主任が１人と秘書１人の計２名がほとんど活動のないと思われる事務所に時々勤務している。

（注３）UNDP所有の分光分析機

UNDPは工業開発省（旧観光地方工業開発省）とのAgreementに記載のある原子吸光分析機の供与は実施せず、替りに中古のエミッション分光分析機を供与した。設置時から既に故障しており英国から技師が来て修理を行ったがなおせず、結局一度も使用することなく設置時のまま放置されている。

（２）「実施協議等で合意しているFDSIの機械（UNIDO所有、注４）の使用は、現時点で不可能となっている。」

上記（１）同様、FDSIはIDB/JICAプロジェクトがUNDP所有機械を使用する事を拒否している。

（注４）① Micro Scope

② Hardness Tester

2　現在までの経緯

(1) 事前調査、長期調査、実施協議及び計画打合せ調査時において、IDB側は一貫した説明として、FDSIの機械（UNDP所有）が使用可能な事、スペクトロメーターの設置場所の使用についても問題はないとしており、機械リスト作成双方合意署名した。

(2) 昨年末、Chief Adriser より IDB Chairman に対して分光分析機の設置場所の確認及びFDSI機械の使用見通しについて、UNDPより公式承認を得る様要請した。

(3) それを受けて、IDBは工業開発省に対しUNDPと協議をもつよう依頼。
1996年12月3日　FDSI/UNDPプロジェクトの終結の為の三者協議（工業開発省、FDSI、UNDP）をUNDPが主催。（別添3）

(4) 本会議でFDSIは、「延長期間終了後UNDPからの補助が停止されれば、FDSIは継続不可能、従って政府の補助が必要」との発言。

(5) 工業開発省は上記を受け、大蔵省へ予算要求を行ったが、1997年2月25日付書簡（別添4）のとおり。
UNDP協力終了後のFDSIへの大蔵省予算は認めないとの閣議決定。

(6) 又、上記三者協議において次の点が合意されている。
FDSI/UNDPプロジェクト拠出金残金US$ 26,500を専門家の派遣及び分光分析機の修理に使う。この2点が終了した時点でFDSI/UNDPプロジェクトは終了する。

(7) 工業開発省よりIDBへの書簡（1997年4月11日付、別添5）
今後IDBはFDSIのラボラトリー及び機械を引き継いで産業界に対し必要なサービスをIDB独自で出来るや否や。

(8) IDBより工業開発省へ書簡（1997年5月6日付、別添6）
FDSIの業務を今後IDBが引き継ぐ事に同意する。

(9) 工業開発省よりIDBへ書簡（1997年5月20日付、別添7）
FDSIはFDSI/UNDPプロジェクトよりも、IDB/JICAプロジェクトがより効果的であるかとの問合せ。

(10) IDBより工業開発省への書簡（1997年6月2日付、別添8）

IDBは最大限努力しているので、IDB/JICAプロジェクトはより良い効果的サービスを提供可能である。

(11) 工業開発省次官からFDSIへの書簡（1997年6月16日付、別添9）

JICAからIDBへ供与された分光分析機を設置する為に、故障している分析機の撤去及び部屋の明渡しを要請。

以上が、現在までの経緯であるが、FDSIから現在までのところ何の返答もなし。
FDSIは、IDBに対し極めて非協力的である為、FDSIが使用中の場所及び機械についてのFTDプロジェクトによる使用は全く期待が出来ない状況です。
本件に関して、JICAとの合意事項の遵守という観点からIDBは十分その責任を感じており、上述のようなやりとりがなされているところです。
又、小職も実施協議時、FDSI、UNDP等の本件関係者と十分な議論をしていれば違った形でR/D合意が出来たものと、深く反省しており、責任を感じております。
ただ本件は、JICAが直接交渉のテーブルにつく事が出来ず、いら立ちを感じている所です。

3　今後の対応

(1) 分光分析機の設置

①暫定的にFoundry工場内の現在C/Pもしくはワーカーが使用している部分を必要な改装をした後設置する。

↓

FDSIの活動が終了し、実験検査棟がIDBに返還されればそこへ再度移設する。

②新たな試験検査棟を建てそこへ設置する。

上記①又は②の方向で現在IDB Chairmanと協議中です。①が現実的。
現実は、前記やりとりの後FDSIは分光分析機のみ11月に撤去した。

(2) 追加試験機器（FDSI所有と重複のもの）

Micro Scope及びHardness Testerは何とか、JICAから供与を受けたいと考えておりますのでよろしくお願いします。

以上

ලංකා කාර්මික සංවර්ධන මණ්ඩලය இலங்கை கைத்தொழில் அபிவிருத்திச் சபை

INDUSTRIAL DEVELOPMENT BOARD OF CEYLON

PHONE 605 450, 452
CHAIRMAN 60 7002
FAX 60 7002
TELEX 2265 LUMINX CE
TELEGRAM KARMANTA
CABLES KARMANTA

615, GALLE ROAD, KATUBEDDA, MORATUWA.
SRI LANKA
P.O. BOX 09

YOUR REF·
OUR REF 10/161
DATE 22 July 1997

Mr. T. Sakata
Chief Advisor
FTD Project

Dear Sir,

SUMMARY OF THE FOUNDRY DEVELOPMENT & SERVICES INSTITUTE (FDSI) AND ITS EQUIPMENT

This project was commenced on December 1991. The project period is three years and the UNDP input is $ 688,000. The government input is in kind.

A copy of the project document is annexed. The operational counterpart of the project is the FDSI. This is a private sector Company established by the foundry industry together with the consumers of castings. The Industrial Development Board (I.D.B.) is the organization under the Ministry of Tourism & Rural Industrial Development which is charged with co-ordinating the development programme of this Ministry. It has been agreed that the project will be monitored by I.D.B.

The I.D.B. will make an "in kind" contribution to this project in the form of a loan of premises and available equipment and could occupy a seat on the Board or the governing committee of the FDSI.

The expected I.D.B. inputs to the project

- Office and laboratory space, equipped to receive air conditioning and specific equipment where specified.
- Available laboratory and other equipment
- Access to services of telephone and fax.
- An exclusive telephone line for outgoing calls.

I.D.B. has provided the above facility to the F.D.S.I. However, during the process of the project the F.D.S.I. or the UNIDO has changed some of the agreed equipment and they may have replaced with other items.

The original agreement is to have a atomic absorption spectrometer but they have obtained an emission spectrometer from a British Company. This appears to be a second hand used spectrometer. We observed that this machine was not functioning from the date of installation even though IDB provided the infrastructure facility and humidity control unit. The I.D.B. spent nearly Rs.500,000 for this facility.

We understand that the readings are varying to the standard samples and also it varies without any connection to the samples. The Company which exported this machine 'SCI-TEK INSTRUMENTS' tried to repair it on few ocassions. At last they took a part of it to England for repairing.

However, we understand that this machine was not repaired and also no one comes to repair it.

At the time of signing the JICA - I.D.B - FTD Project or earlier we anticipated the services of the Emission Spectrometer which belongs to FDSI, but later we came to know that it is not functioning. Therefore, a new spectrometer was requested from JICA.

The UNDP invited for a meeting on 03.12.1996 at 2.p.m. in the Secretary's Room of the Ministry of Industrial Development for a terminal tripatite review.

At this meeting F.D.S.I. brought the issue of not having funds to operate after the termination and they requested whether ministry could provide the operational funds or to provide the balance money available to the FDSI by UNDP for their operational work.

The UNDP was not agreeable to their request but the Ministry agreed to prepare a Cabinet paper for funding the F.D.S.I. from Treasury.

The decision to transfer equipment was not taken at this meeting even though we mentioned that we could operate the laboratory with our trained staff with the assistance of JICA.

The project period of the FDSI ~~will be~~ ended by 31.12.1996.)

The Ministry by their letter 25.02.1997 informed the Chairman-FDSI that the Cabinet has not approved the funds from the Treasury to meet the expenditure of their organisation.

Subsequently, the ministry inquired from I.D.B. by their letter dated 11.04.1997, whether we are agreeable to take over the FDSI Laboratory and equipment and provide the necessary services to the metal industry.

We informed the Ministry by our letter dated 06.05.1997 that we are agreeable to take over the equipment which are in working order and provide the services to the Metal Industry along with the equipment donated by JICA.

Then again the Ministry inquired by their letter dated 20.05.97, that FDSI-Chairman wants to have an assurance that IDB/JICA project will be more effective than the FDSI/UNIDO Project.

We again replied by our letter dated 02.06.1997 that we are taking a great effort to service the metal industry by the IDB/JICA Project and we could provide a better effective service.

Lastly, the Secretary of the Ministry of Industrial Development wrote a letter on 16.06.1997 to Chairman-FDSI, requesting the room to locate the JICA Spectrometer.

We are still awaiting for a proper solution.

Yours faithfully,

H.F. Nanayakkara

H.F. NANAYAKKARA
DY. CHIEF ENGINEER/FOUNDRY MANGER

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கைத்தொழில் அபிவிருத்தி அமைச்சு
MINISTRY OF INDUSTRIAL DEVELOPMENT

P. O. BOX 570,
73/1, Galle Road,
Colombo 3.

My No. 113/01/09

Your No.

Date /6 June 1997

(2)

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ලැබුණා
18-6-1997
[illegible]
(c)

Mr. T N Jinasena
Chairman
Foundry Development and Services Institute.

Dear [illegible],

LOCATION OF THE EMISSION SPECTROMETER DONATED BY "JICA"

The Emission Spectrometer donated by 'JICA' for the Foundry Technology Development Project funded by them has been received by the Industrial Development Board on 06/06/96. and it has to be installed within one month from the date of arrival, according to the agreement.

This instrument needs to be installed in a humidified room. Since the Spectrometer of the FDSI is not functioning and the IDB has spent its funds for the humidity control unit used by the FDSI, the IDB has proposed o install the Spectrometer in the room where the Spectrometer belonging to the FDSI is presently located.

The FDSI building can be arranged to locate the new Spectrometer in a manner that it would be isolated from the main laboratory of the FDSI. You will agree that constructing a new building and installing a humidity control unit to house this new Spectrometer is a waste of meagre resources. As such I would be pleased if you would kindly agree to this request for installing the new Spectrometer in the room contructed for this purpose so that test operations and training of counterparts could commence early.

Yours sincerely

K AUSTIN PERERA
SECRETARY

Copy to : Chairman IDB - Reference your letters No. 10/61 dated 10.06.1997 and 12.06.1997.

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கைத்தொழில் அபிவிருத்தி அமைச்சு
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තැ. පෙ. 570,
73/1, ගාලු පාර,
කොළඹ 3.

அ. பெ. 570,
73/1, காலி வீதி,
கொழும்பு 3.

P. O. BOX 570,
73/1, Galle Road,
Colombo 3.

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මගේ අංකය / எனது எண் / My No. } 113/01/050
ඔබේ අංකය / உமது இல. / Your No. }
දිනය / திகதி / Date } 20 .05.1997

Mr. H.M.W. Jayasinghe
Chairman
Industrial Development Board

FUNDS TO MAINTAIN THE FOUNDRY DEVELOPMENT & SERVICES INSTITUTE

Please refer to my letter on above dated 25.02.1997 addressed to Mr. Nihal Jinasena Chairman, Foundry Development and Services Institute (FDSI), with copy to you informing the decision of Cabinet in not granting approval to the proposal for obtaining funds from the Treasury to meet expenditure of the 'F.D.S.I' during 1997.

In response to this letter Mr. Jinasena Chairman 'F.D.S.I' has written to me stating that the local Foundry Industry has been in decline for the past forty years mainly due to the lack of skills development and introduction of new technology. He also outlines the importance of operating the 'F.D.S.I' laboratory until the Foundry Industry in Sri Lanka becomes vibrant enough for the 'F.D.S.I' to be self financing .

Your letter dated 06.05.1997 mentions that the I.D.B is in agreement to take over the Laboratory Equipment of 'F.D.S.I' which are in working order and use them along with the Laboratory Equipment gifted by the 'JICA' to provide services to the Metal Industries Sector utilising your trained staff and the JICA Experts.

Taking into consideration the concern expressed by Mr. Jinasena regarding the adverse effect the termination of the services of the 'F.D.S.I' would have on the 'Foundry Industry' please let me know whether an assurance could be given by the 'I.D.B' that a combination of the UNDP/UNIDO Project and the 'JICA' Project would provide a more effective and un-interrupted service to the Foundry Industry.

Mrs. K.P.M. Speldewinde
Additional Secretary
for Secretary

Copy to: Mr. T N Jinasena
Chairman
F.D.S.I

කර්මාන්ත සංවර්ධන අමාත්‍යාංශය
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මගේ අංකය / எனது இல. / My No. 113/01/050
ඔබේ අංකය / உமது இல. / Your No.
දිනය / திகதி / Date 11 .04.1997

ලැබුණා
02-5-1997
[illegible]
කා.සං.ම.

Mr. Vasantha Jayasinghe
Chairman
Industrial Development Board

TAKING OVER FROM THE 'F.D.S.I' AND OPERATION OF THE LABORATORY GIFTED BY UNDP/UNIDO.

Annexed herewith is a copy of a letter addressed to me by Mr. T.N. Jinasena Chairman Foundry Development and Services Institute on the above matter.

Please let me know whether the 'I.D.B' is in agreement to take over this Laboratory and Equipment from the Foundry Development and Services Institute and provide the necessary services to the Metal Industries sector.

In this regard your attention is drawn to the concluding 'para' of the report of the Terminal Tripartite Review Meeting, a copy of which has been sent by the Resident Representative U.N.D.P to Mr. S.L.P. Stembo, by letter SRL/89/014 dated 7th January 1997.

An early reply on this matter would be appreciated.

Mrs. K P M Speldewinde
Additional Secretary
for Secretary

United Nations Development Programme
Sustainable human development

SRL/89/014

7 January, 1996.

Dear Ms. Speldewinde,

SRL/89/014 - Reactivation of the Foundry Industry

Please find enclosed herewith the draft report of the tripartite review meeting of the above project held on 3 December, 1996. We would appreciate receiving any comments you may have on the report.

By copy of this letter, we are forwarding a copy of the report to the undermentioned officials.

Yours sincerely,

Ownding

fr Arve Ofstad
Resident Representative

Ms. K.P.M. Speldewinde,
Additional Secretary,
Ministry of Industrial Development,
73/1, Galle Road,
Colombo 3

cc: Mr. T.N. Jinasena, Chairman, Foundry Development & Services Institute
Mr. Ranjan Rodrigo, National Project Director
Mr. S.L.P. Stambo, Industrial Development Board
Mr. A. Buckle

REPORT OF THE TERMINAL TRIPARTITE REVIEW MEETING

PROJECT NO:	SRL/89/014
PROJECT TITLE:	Reactivation of the Foundry Industry
DATE:	3 December, 1996 - 2.00 p.m.
VENUE:	Ministry of Industrial Development

NAMES OF PARTICIPANTS

Ministry of Industrial Development

(1) Mr. W. Jayamaha, Acting Secretary
(2) Mrs. K.P.M. Speldewinde, Additional Secretary Ministry Industrial Development
(3) Mr. W.C. Dheerasekera, Director
(4) Mr K.R.L. Perera, Additional Director

Foundry Development & Services Institute (FDSI)

(1) Mr. T.N. Jinasena, Chairman
(2) Mr. Ranjan Rodrigo, NPD

Industrial Development Board (IDB)

(1) Mr. S.L.P. Stambo
(2) Mr. H.F. Nanayakkara

UNIDO
(1) Mr. A. Buckle
(2) Mr. Jacek Wojcik, Consultant

UNDP
(1) Mr. Richard Conroy, Deputy Resident Representative (Programme)
(2) Mr. Tilak Gunawardana, Asst. Resident Representative (Programme)

Follow-up:

This item was not taken up as a separate agenda as subjects for follow-up were taken up under other agenda items.

Project Concept & Design:

The meeting commenced with introductory comments made by Mrs. K.P.M. Speldewinde, Additional Secretary, Ministry of Industrial Development and Mr. T.N. Jinasena, Chairman Foundry Development and Services Institute. Mrs. Speldewinde stated that the project though a good project was affected by delays owing to various reasons. The institutional arrangements with the IDB, the problems of the spectrometer and the general situation of the foundry industry which resulted in reduced demand for FDSI's services were the main nstraints faced by the project. The FDSI is now faced with the problem of being unable to meet its operational expenses after the termination of the project. In this connection, the FDSI has had discussions with the Secretary of Ministry of Industrial Development and the Hon. Minister of Industrial Development. Although the Ministry understand the requirements of the FDSI, funds for this purpose have not been provided in the Ministry's estimates for 1977. Hence a special request should be made to the Ministry of Finance and Planning for which the Ministry intends to seek the approval of the Cabinet of Ministers.

Mr. T.N. Jinasena, Chairman, FDSI, circulated a paper outlining the status of the Foundry Industry at present. He stated that the foundry industry was a vibrant part of the economy earlier, but is going through a difficult period due mainly to the competition from imports as a result of the liberalisation of the economy.

Mr. Jinasena informed the meeting that without Government assistance, the FDSI will not be able to operate the laboratory. A minimum of Rs.35,000/-per month is required to cover the salaries and operational expenses of the laboratory.

Progress:

Mr. Jinasena, Chairman, FDSI, outlining the progress stated that some very useful results by way of technology transfer and certain spin-offs have been produced by the project. One important spin-off is the close cooperation that exists amongs foundries now. FDSI can serve as a strong united force for the foundry sector. The project also supported some very useful technology transfer activites, the technology of the divided blast cupola, training in pattern-making and training in foundry technology in India. The project also demonstrated that a positive contribution can be made for the upliftment of the ornamental foundry sector.

The negative aspects were the delays caused by various reasons and the non-availability of a working spectrometer. These factors retarded the development of the project. He thanked the Ministry of Industrial Development for the offer of cooperation.

Progress (cont'd.):

Mr. Alan Buckle emphasised the following in his analysis of the situation:

1. The casting industry is an important and a basic operation for any economy.
2. There is a requirement to provide common services when industrial enterprises cannot provide on their own. This is the role of technical institutions. The relationship between a technical institution and the industry is a subjective relationship.
3. The present project was proposed as the industry needed awareness of opportunities and new ways of carrying out foundry operations.
4. The expectation was to build up local capacity and provide training to the industry. The persons trained by the project should be available for training in the industry.
5. A spectrometer was not included in the original project document. It was a mistake to purchase a used piece of equipment.
6. Coordination of the activities between FDSI and IDB is extremely important. FDSI can work with the IDB on the requirements of the industry. Existence of FDSI is extremely important to the industry and for the IDB it provides a vehicle to reach the industry.
7. Consider the services of the non-ferrous castings expert important in assisting the small ornamental castings sector. UNIDO expects to arrange the mission in January.
8. Opportunities are available in the export market which could be exploited by the foundry sector in Sri Lanka. A market survey would be useful even in respect of exploiting the potential in the local market.
9. In concluding, Mr. Buckle stated that the project has achieved some useful results. However, he felt that more could have been achieved if not for the constraints.

Mr. Conroy stated that the project was an ambitious one which was expected to have an impact on a vital sector of the economy but a declining one. The decline was not halted during the life of the project due to macro-economic policies and structural changes. Under such a situation development of a self-supporting service centre is an extremely difficult task.

With the decline of traditional buyers, the industry did not make a concerted effort to look for new products and buyers. This needed forward-looking industry, one that is sharing information and not guarding it.

Progress (cont'd.):

The positive side of the project should not be minimised. The project made some useful contributions in terms of training and transfer of technology to the foundry industry. FDSI as an association of foundry pesonnel can look after the interests of the industry.

In respect of the future, Mr. Conroy saw very little of a future role for the UNDP in the project. He looked forward to discuss proposals on the use of remaining project funds. UNDP has constantly reiterated that UNDP assistance will terminate at the end of 1996. However, we have to admit that in the short term and in the medium term, an organisation cannot be self-supporting.

In respect of the spectrometer, he mentioned that the spectrometer would have been a useful item but it could not have generated the fonding required by the FDSI.

Commenting on the options available, Mr. Conroy stated that it is for the Ministry of Industrial Development to decide on the nature and extent of assistance it could provide to the FDSI. UNDP welcomes the Ministry's assistance to FDSI to enable it to continue its services to the foundry industry. The Ministry also has an important role to play in forging and fostering a relationship between IDB and FDSI.

Commenting on the role of the UNDP, he stated that what can be done by the UNDP in the future is very limited. UNDP is not in a position to extend its contribution to some of the recurrent costs of the institute. Further, only a limited amount of funds is available in the project budget.

Mr. Jinasena in responding stated that experience has shown that FDSI cannot be sustained from the income derived from its services, both technical and commercial Services. Further, he stated that for FDSI to enter into commercial activities, it should have commercially-oriented staff with expertise in procurement, marketing and banking. Mr. Ranjan Rodrigo informed of the difficulties FDSI is experiencing in obtaining Commissions or some of the marketing activities it has undertaken in the past.

Operational Issues:

1. Mr. Buckle outlined that the amount of funds expected to be available when the present commitments are met will be in the region of US $26,500, of which US $13,000 is ear-marked for the mission of the non-ferrous castings expert and a further US $7,000 for repairs to the spectrometer. UNDP and UNIDO representatives informed that the balance funds could be used for technical assistance activities such as undertaking a market survey or for the procurement of equipment or chemicals.

Operational Issues (cont'd.)

2. Mr. Jack Wojcik, Consultant, raised the issue of environment factors affecting the foundry industry. In this connection, Mr. Buckle suggested that Mr. Wojeck interact with industry personnel to impart whatever knowledge that can be transferred during the short period of his mission. UNDP informed of the cleaner production audit programme operational with the assistance of the UNDP/CEA/UNIDO project Industrial Pollution Reduction Programme.

3. Mr. Jinasena stated that FDSI will continue to function as a forum of foundry industry personnel. However, the functioning of the laboratory is in question. Unless assistance from the Ministry to meet the operational costs of the laboratory is forthcoming (estimated to cost a minimum of Rs.35,000/- per month), FDSI will not be in a position to continue with the operations of the laboratory.

4. It was agreed to hold the decision to transfer the equipment until the institutional arrangements are decided.

Workplan:

Reporting on vehicle usage:

One of the project vehicles is in the custody of the UNDP and the other is being used for project activities.

Decisions & Recommendations:

1. The Ministry of Industrial Development will pursue the possibilities of providing financial assistance to the FDSI to enable it to meet its operational expenses of the laboratory.

2. The remaining project funds amounting to US $26,500 (approximately) will be utilised for arranging a mission by a non-ferrous castings expert (US $13,000), for repairs to the spectrometer and balance funds for technical assistance activities required by the FDSI. ✓

3. The project will be operationally closed except for the activities listed under 2. ✓

4. FDSI will continue to function as a forum for foundry industry personnel. The operation of the laboratory by the FDSI will depend on the decision of the Ministry of Industrial Development to extend financial assistance to FDSI to meet the operational expenses of the laboratory. A decision as to the future of the laboratory will be made when the decision of the Ministry is known.

5. The decision to transfer the equipment will be made after the institutional arrangements for the laboratory are decided.

Need for Evaluation:

This subject was not discussed as the project budget is less than one million dollars and as an external evaluation of the project is not considered necessary.

Any other matters:

TG/jv
6 January 1997

Any

DP/SRL/89/014 REACTIVATION OF THE FOUNDRY INDUSTRY
TERMINAL TRIPARTITE REVIEW MEETING

Foundry Development & Services Institute (FDSI)

FDSI commenced work from December 1991 and the estimated grant from UNIDO was US$688,000.

We have provided the office accommodation and the Metallurgical Laboratory premises to FDSI. The laboratory was refurbished and a dehumidifier was installed, The cost incurred by IDB was about Rs.750,000/-.

In addition to the above capital cost an operational cost is continuously incurred by IDB for electricity, telephone, use of Fax machine and postage. However, this expenditure is not reimbursed to IDB nor there was any gainful service to IDB, but they may have serviced the private sector.

We understand that FDSI had acquired few testing equipment from UNIDO and the vital and most expensive items are not in working order.

The Ministry inquired from us by their letter 113/01/05 dated 22nd August 1996, whether we could take over the FDSI and provide the same services. We replied to this letter on 19th September that we are agreeable to take over the metallurgical laboratory equipment and provide a similar or better service with the trained staff assisted by JICA Experts.

However, there was no further response to the above letter.

Further, we submitted an alternative draft agreement to FDSI to corporate with their service by making payments to IDB.

We wish to mention that the Testing Equipment and the Emission Spectrometer to be given by JICA is a property of IDB and it has to be operated by IDB staff trained by JICA.

At any time we could provide the service or test reports to FDSI by using these equipment on a agreed payment basis.

Above position was informed by the Chief Engineer and the Dy. Chief Engineer to the Hon. Minister at a meeting with FDSI Council Member held on 15.11.1996 at the Hon. Minister's Office.

United Nations Development Programme
Sustainable human development

undp

18 November, 1996.

(17)
Mr [illegible]
Pl study the rpt
and discuss
22/11/96

[illegible]
22-XI-1996
(7) [illegible]

Dear Mr.Perera,

DP/SRL/89/014 - Reactivation of the Foundry Industry
Terminal tripartite Review Meeting.

In continuation of our letter of 18 November we are pleased to send herewith the Draft Terminal Report (prepared by the Foundry Development and Services Institute) and a Draft Agenda for the Review meeting of the project to be held on 3rd December 1996.

By copy of this letter we are sending a copy of the Draft Terminal Report and the Agenda to the undermentioned as well.

With kind regards,

Yours sincerely,

Conroy
fr Richard Conroy
Resident Representative a.i.

Mr.K.Austin Perera
Secretary
Ministry of Industrial Development
73/1, Galle Road
Colombo 3

copy:
Mrs.K.P.M.Speldewinde, Addl.Secretary, Ministry of Industrial Development
Miss.Nalini Madanayake, Director Dept of Ext.Resources
✓ Mr.Wasantha Jayasinghe, Chairman IDB
Mr.Nihal Jinasena, Chairman FDSI
Mr.Ranjan Rodrigo, NPD FDSI
Mr.Alan Buckle, Head, Metallurgical Ind.Branch, UNIDO.

DP/SRL/89/014 - Reactivation of the Foundry Industry

Draft Agenda for the Terminal Tripartite Review
meeting to be held on
Tuesday 03 December 1996 at 2:00 p.m at
Conference Room of the
Ministry of Industrial Development.

1. Introductory Remarks -
Mr.K.Austin Perera, Secretary, Ministry of Industrial Development and by Mr.Nihal Jinasena, Chairman FDSI.

2. Project Concept and Design -
Introduction by Mr.Alan Buckle, UNIDO.

3. Progress - Production of project outputs and progress towards the achievement of project objectives -

<u>Immediate Objective 1:</u>

An operating, self supporting Foundry Development and Services Institute.

<u>Output 1.1</u>	The plan of implementation of the project and of the operation of the FDSI.
<u>Output 1.2</u>	The FDSI Installed and Operational.

<u>Immediate Objective 2:</u>

To improve, through the activities of the FDSI the production, quality and market share of the Foundry sub-sector.

<u>Output 2.1</u>	Programmes for individual participating plants.
<u>Output 2.2</u>	Operational consulting services offering to foundries and consumers of metal parts and spares.

4. Operational Issues -
   1. Transfer of project equipment.
5. Implementation of the remaining project activities -
6. Conclusions and future direction based on experiences gained.
7. Any other business.

資料５　「開所式記念セミナー講演要旨」（渡邊紀夫短期専門家）

— Future technology for casting production as of today —

1) Introduction

Progress of casting technology among 30 years is very big. This is by the development of casting, using material for casting production and system change for automation of the process.

But development of the new technology for casting process is very few, only CO_2 process, shell mold, V process, fluid self hardening process, E.P. process are applied for casting production.

These modern casting process, material, automatic machinery are introduced to past foundries and now various complex designs.

Sound casting are produced in low level inferior rate, high productivity and lowest production cost in shortest delivery time. But all these item are not satisfied perfectly.

2) Future casting technology and engineers

Casting technology is the production technology of castings having high dimension accuracy, in aimed composition, soundness, aspect in accordance with customers' demands.

So it is necessary to link together the man power, materials and machine systematically under each surrounding condition.

Checking the recent conditions, machining tools are automated remarkably and utilization of the computer, industrial robot are spread gradually.

But application and control of these technology are not kept in high level at many foundries.

The causes of these facts are depending on the dissatisfactory improvement of engineers' productivity, countermeasures for inferior product and cost reduction.

Also effectiveness of the training for technician is not perfect.

It is important to investigate the bringing up process which type of engineer is necessary, specialist engineers who know special item or all mighty engineers who know all item shallow and widely.

3) Demand for castings

Demands from the customers became more severe, high level quality and less machining allowance closed to zero, namely near net shape in short delivery time.

Frequency of design change of the castings increases and delivery time is cut down.

According to these condition, we are obliged to produce the castings under unstable castings design.

On the other hand, engineers having experience in casting production are decreased and inexperienced engineers increased.

The skill of the solidification analysis and metal flow in the mold, are developed widely and be utilized among engineers, but sometimes they cannot get sound castings, furthermore they do not know how to train the technician for producing good quality castings, only draw on the performance of the machine but level up of the productivity and countermeasure against inferior product.

Recently development of the dimension accuracy for castings is becoming more important.

For the fish born chart referring to dimension dispersion of the product under as cast condition, King of Sand, mold properties especially strength, contractiblity and molding mechanism affect the dimensions.

Also for the grey iron castings, factors refer to the graphic formation by carbon and silicon, for ductile iron noduralilty of the graphite, pearlite percentage in the microstructure affect the dimension of the castings, furthermore the shake out temperature also affect accuracy of the castings.

These facts are not able to be acquired from the literature buy only the experiences for the production of the castings.

In recent years various demands for material strength and rigidity are applied for the automobile iron castings with light weight and severe quality assurance.

Dissatisfaction of the client for castings are (1) Cost (2) Weight (3) Quality characteristics.

So we must produce castings at low production cost, high level dimension, namely near net shape as possible in short delivery time, especially decreasing the finishing time of the casting surface.

4) Future direction of the molding process

At present time, many kind of the casting process applied for casting production.

According to the demands for castings and condition of the environment, various casting process were developed and applied in past fifty years.

I would like to pick up the problem for these casting process, after that, consider the future direction of the casting technology.

(1) Green sand molding process

1. Green sand molding process is applied for casting production as most economical process, generally applied for small machine parts under 100 kgs especially 50 kgs.

   Automatic molding machine are developed for high speed molding, now it become most important process in this field. These automatic machine are superior in the molding speed, but transcription of the pattern dimension and control range of the molten metal composition, molding sand are becoming narrow.

   Now we are able to produce the castings in high level dimension and low price at mass production.

   According to the shortage of fund and insufficient technology, small scale foundries in Asian country reply on the customary molding process (hand molding or jolt machine). In future small and medium sized enterprises developed and intend to take general green sand molding process (namely, jolt squeeze, blow squeeze, air impact air flow-press (sei-atsu)).

   I would like to compare the existing green sand molding process.

2. General green sand molding process (especially blow squeeze, air impact - air flow pressing plus squeeze (sei-atsu) etc.) are by adding energy from the back surface of the mold and copy the model shape to the mold.

   But this process have the defect that it is impossible to transfer the energy from the back surface to the pattern plane and the strength surrounding the flask is small.

   Movement of the mold wall is big by the swelling at pouring and expansion at solidification.

   In jolt squeeze molding process also the energy of jolting is impossible to transfer on the pattern plane, especially mold strength at the neighborhood or corner of the flask. So it is easy to generate the swelling.

3. Mold strength be affected by the properties of using sand to improve the strength, it is difficult to control the sand properties.

4. According to adding the energy from the back surface of the mold, it is necessary to serve big energy, so existing model cannot apply.

5. It is impossible to get enough strength at the pattern plane. So we must attach R at the edge of the pattern. By this countermeasure generation of the burr occur and it is necessary to take much finishing cost.

(2) Technical feature of the double squeeze molding process

1. By double squeeze molding, squeeze from upper and lower surface, it is possible to get high quality castings compared with general molding process (jolt squeeze, blow squeeze, air impact, air flow press-squeeze (sei-atsu) etc.).
2. By squeezing from the pattern plane, molding be performed directly at product plane, and also at the neighbor portion of the flask. By the friction of the inside plane of the flask and sand, transfer of the sand grain are prevented, so the filling density become high.

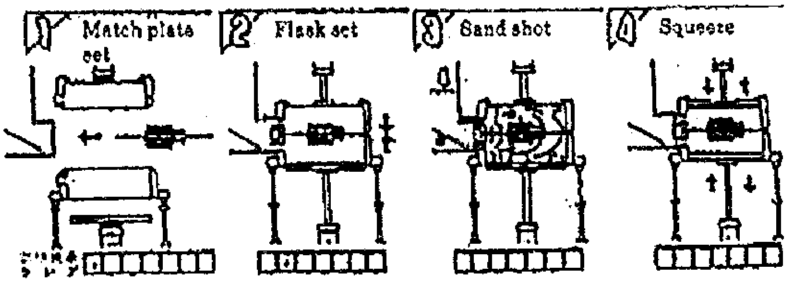
   By these action, the strength of mold become uniform and minimize the movement of the mold wall, so we are able to get castings with accurate dimension.
3. Differ from past molding process transferring energy, this process are molding from the pattern plane and back surface of the mold mechanically.

   So it is possible to use the sand in wide range, namely it is possible to apply existing sand treatment facilities and not necessary to control the range of the sand property narrow.
4. We are able to set the squeeze pressure variable (4 - 7 kg/cm^2) so it is possible to use existing pattern and as the pattern plane is squeezed, if the plane pressure is small, it is effective for molding. So no problem by wood pattern using.
5. By squeezing from the pattern plane, it is possible to shape the sharp edge and pattern draw process is different from existing process. It is possible to take accurate pattern draw system utilizing the pattern squeeze mechanism inversely and possible to decrease the burr.

(3) Economical superiority of the double squeeze molding machine

1) By the less movement of the mold wall, the product weight become lighter.
2) Dimension accuracy is high, so possible to decrease the machining stock.
3) By putting the model at the neighborhood of the flask, product weight per one flask possible to increase.
4) Inferior rate of the castings is possible to decrease by preventing running out of the molten metal.
5) Lead time is shorten by decreasing finishing time of the burr generated.
6) New investment for the pattern is not necessary by utilizing existing pattern.
7) New investment for sand preparation system are not necessary, because of utilizing existing facilities.
8) As not using big energy for molding, environment as big noise and vibration are improved and durability of the machine become good.

1. Feature of various molding process



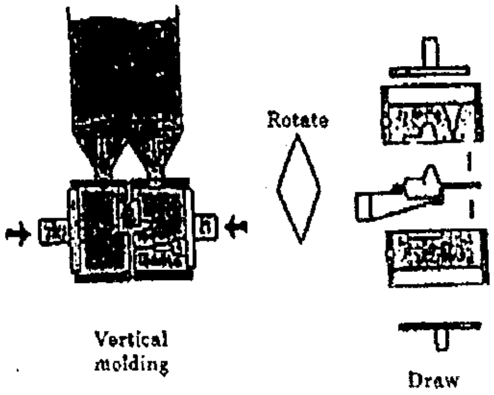
Side blow

Match Plate

Filling defect in the shadow of the pattern is big
↓
applied for simple shape

Complete the mold by squeeze

sand control is difficult



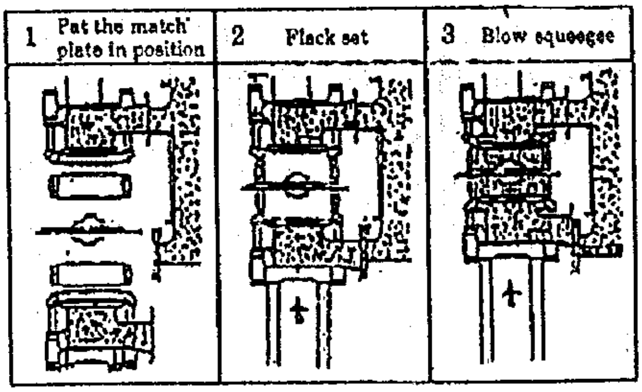
Side blow from upper side

Match Plate

Slightly Improve the filling for the defect of shadow portion when blowing

Complete the mold by squeeze

Sand control is difficult



Top under blow

Match Plate

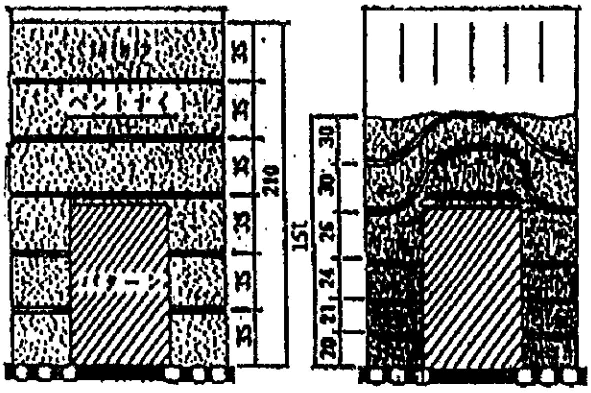
One method for preventing shadow when blowing

Wearing of the pattern is big

Difference occur in the mold hardness of cope and drug

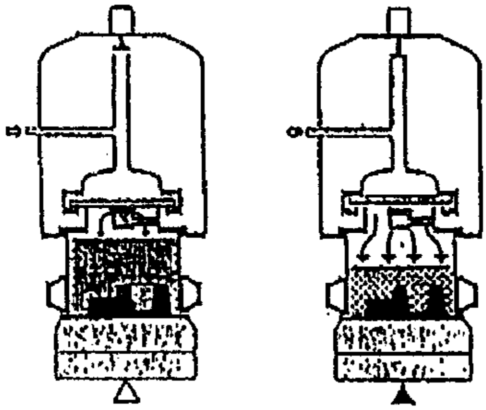
Complete the mold by squeeze

Sand control is difficult

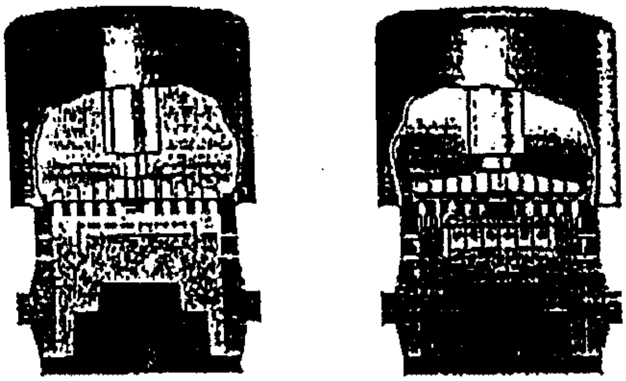


Before Seiutsu After Seiutsu

Air flow press (Seiutsu)



Explosion (impact plus) or compressed air



Explosion (Vario impulse) or compressed air

- Air flow press

attach the vent hole on the pattern plate, after putting sand in the flask, add the pressure by airflow.

As this process utilize the going straight property of the air, strength of the side planes is weak.

Some times be used as squeeze machine because of pattern cost and sand control problem.

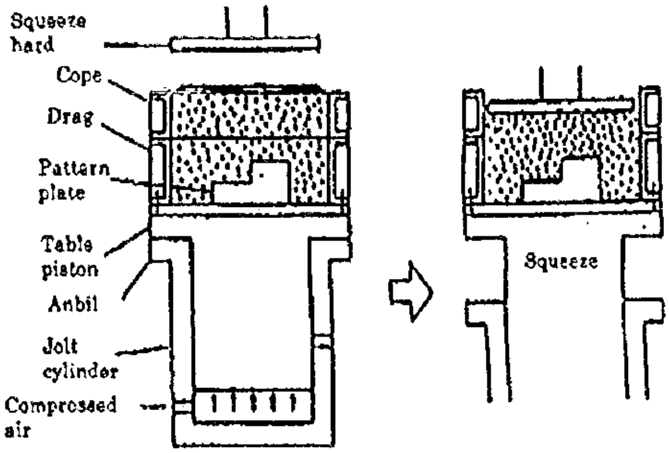
- Molding by impact wave

transmit the energy to the parting plane by the sand as media.

Left figure shows 2 step explosion system for level up the strength near the flask surface.

- Molding by impact wave

Left figure shows the process provide different pressure on the out side and inside portion for keeping the strength hard near the flask.



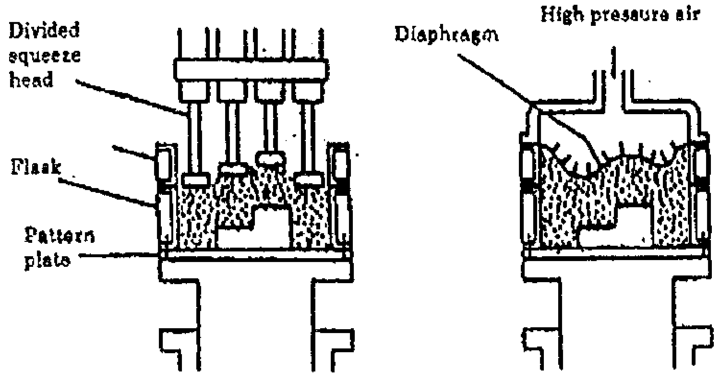
Jolt squeeze (plain head)

Pattern plate

Parting plane jolt.
opposite side squeeze.

Generate vibration or noise

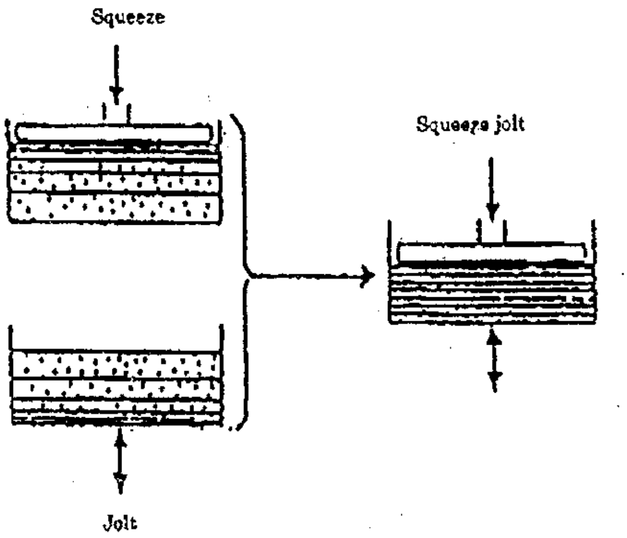
Sand control easy



Jolt squeeze (Segment head)
(diaphragm head)

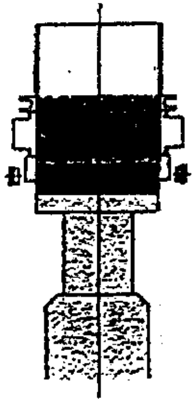
Pattern plate

By the shape of the product, Because of the sand layer, Some times squeeze force does not transfer to lower side, it is necessary to prevent this phonomona.
Diaphragm system is also same purpose as segment system.

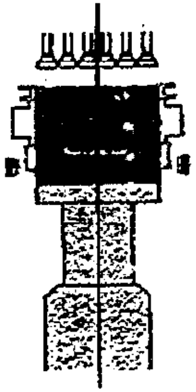


Jolt and squeeze molding

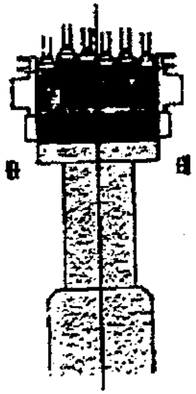
As shown in the left figure, utilize jolt for improving the filling condition of the parting plane.
When blow squeeze, blowing only intend to filling up the sand.



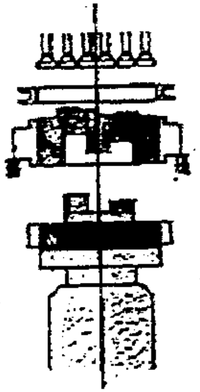
Shooting the Sand



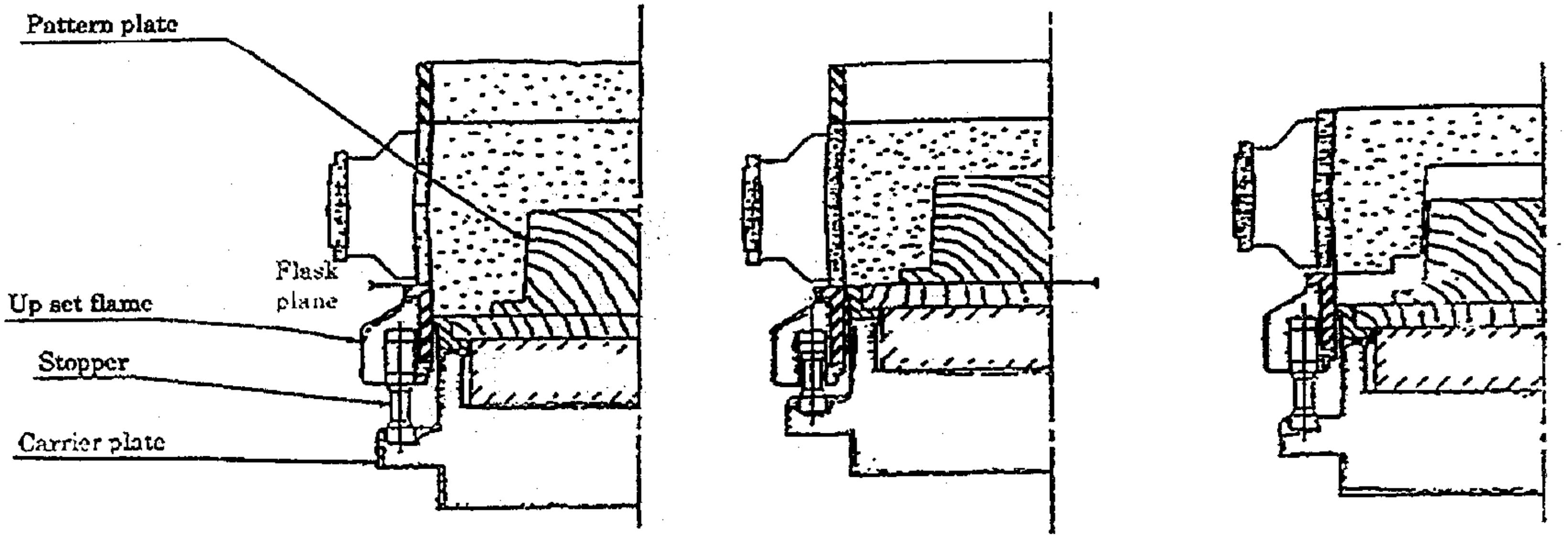
Head in



Double squeeze



Pattern draw

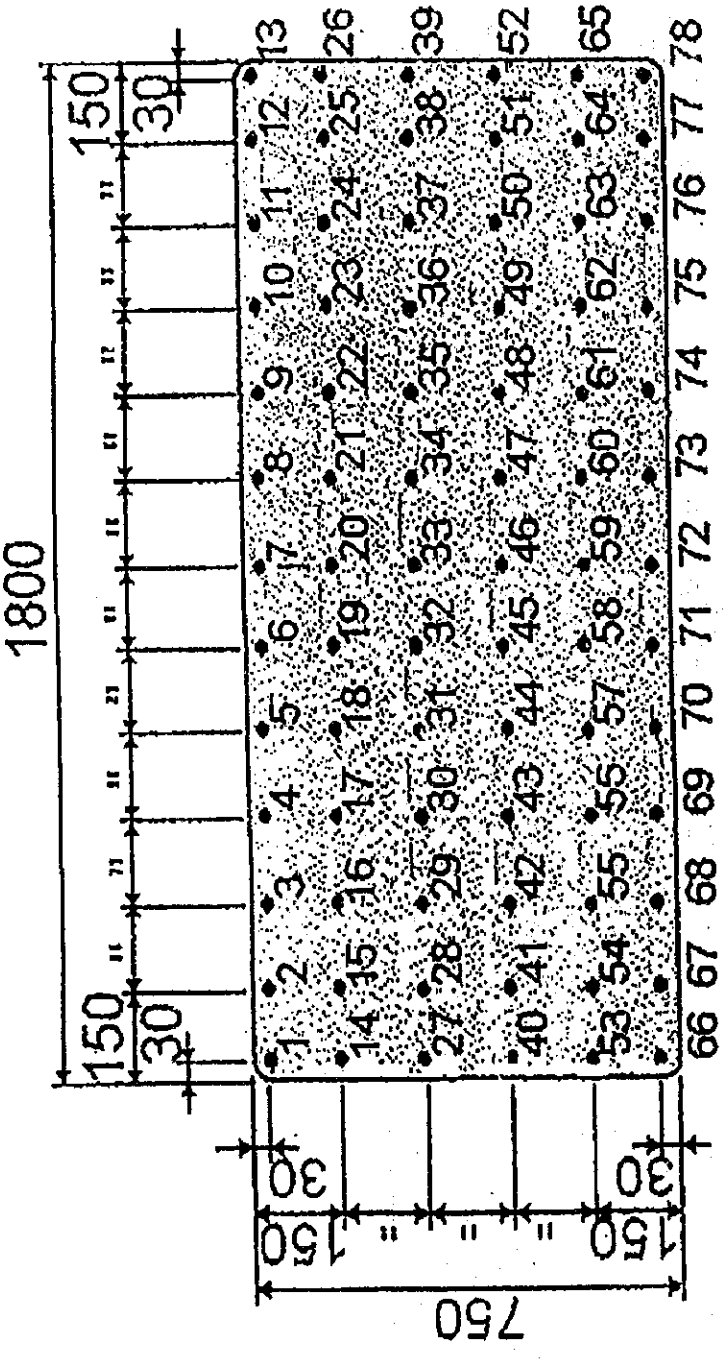


1. Sand put in (shooting)

2. molding

3. pattern draw

Double squeeze molding process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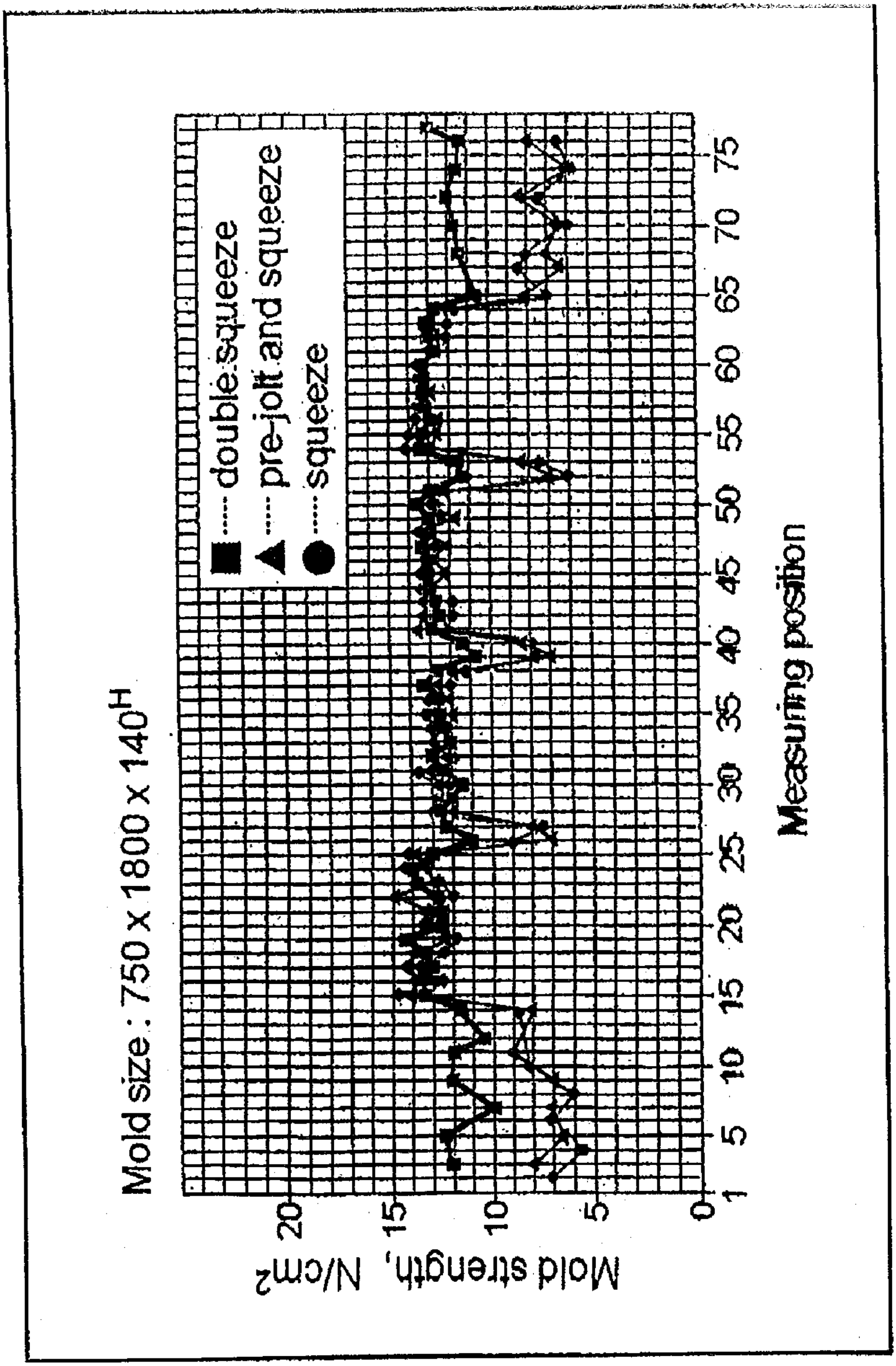
Mold size : 750 x 1800 x 140H
■ ----- double squeeze
▲ ----- pre-jolt and squeeze
● ----- squeeze
Mold strength, N/cm2
0
5
10
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Measuring position
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75

Special feature of the various kind of molding process

	Blow squeeze molding process			Air flow pressing plus squeeze molding process	Jolt - squeeze molding process
	side blow	Upper surface blow side blow	Top , under blow		
Molding	Blow squeeze molding process applied for filling the sand in cope and drag using match plate. So squeeze action be only performed from the back side of the mold.			Accompanied by the proceeding air to the vent hole, pull the sand. After that, filling sand are squeezed.	Tie up the parting plane by jolting and tie up the back surface by squeeze action.
Mold	As blow the sand with air, molding nature of the dead angle portion of the pattern is no good. In the case of top and under blow, blow nozzle are multiple, so balance of the blow nozzle is no good, also molding nature are no good.			This process utilize the straight on property of the air. So, strength of the nertical surface is weak.	Have pan application compared with other molding process.
	Mold strength around the flask and among the pattern is no good.				
	Entirely the mold strength is small, Some times can not make complete mold.	Have some advantage because of defying against the gravity. But because of side blowing, have some dead angle for the pattern.	Under blow side is no good, because of defying against the gravity. Dead angle is small.	When the effect of the air flow is small, become only squeeze molding.	Filling condition become good by jolting and possible to get dense mold.

	Blow squeeze molding process			Air flow pressing plus squeeze molding process	Jolt - squeeze molding process
	side blow	Upper surface blow side blow	Top , under blow		
Sand property	To keep good flow ability, it is necessary to decrease the compressive strength and moisture. So mold strength are low, it is difficult to use this sand for other molding process. Especially in the case of top and under blowing process, The control range of the sand property is narrow.			This process is necessary to through the air in sand. Control range of the sand property are narrow.	Control range of the sand property are wide.
Pattern	Wearing of the pattern is fast, because of the blowing the sand with air, It is recommend -ed to use metal mold.			It is easy to wear, because the movement of sand occurred by air pressing after putting the sand. Pattern cost is expensive because of the setting vent.	Wood, plastic, metal pattern are applicable.
Constructi·	As it is necessary to sealing when molding, it is difficult to control wearing of the parts is big by blowing. Spil sand is small.				
Flask	All mold with no flask.			All mold with flask.	It is applicable for no flask, with flask.

	Double squeeze molding process	Impact molding process	Impact + squeeze molding process
Mold	Mold strength, and hardness are uniform. Because of squeeze action from the pattern plane, especially in the neighborhood of the flask, possible to get high density because of the friction between inside surface of the flask and the sand. According to this fact, it is possible to get same or over mold hardness, strength as center of the flask.	Hardness peak of the mold exist upper portion of the parting plane, according to the force of repulsion by the energy of the pattern plane and also the moisture condense here. As the energy of impact is big, some times be occurred bridge phenomena. Back surface hardness is extremely low, so we must cut 20% of the mold height. And it is difficult to make forming of the pouring cup.	This molding process is air impact + squeeze. Squeeze mechanism exist near the upper air tank, effect of the impact, be declined, So we must level up the air pressure at 6kg/cm^2 or over.
Sand quality	All sand applicable. sand quality applicable in wide range compared the air using molding process. It is possible to divert existing sand preparation unit.	According to use air, controlling range of the sand quality is narrow. · It is necessary to prepare exclusive sand treatment process. · It is necessary to keep compressive strength 2.0kg/cm^2 or over. · If keep this condition, fine powder in creased and difficult to control the compact ability.	According to use air, controlling range of the sand quality is narrow. · It is necessary to prepare exclusive sand treatment process.

	Double squeeze molding process	Impact molding process	Impact + squeeze molding process
Pattern	Applicable for wood pattern. As squeeze pressure are change able gradually and the mold property are choosed voluntary. It is possible to correspond from wood to metal and apply for existing pattern.	It is necessary to prepare the pattern proofing to the transmission of big energy. Pattern must not be hollow and simplified solid shape.	Same condition as impact molding process. When use wooden pattern only squeeze applicable. But it is necessary to set vent hole on the pattern, aiming the tightening of neighborhood of the flask.
Product	Generally no fin on the product. By the squeezing action from the pattern plane, attached surface of the pattern become good result. According to keeping uniform strength, dimension accuracy of the castings are high and keep good surface.	Mold strength at the upper side of the pattern plane is high, because of the force of repulsion when energy transmission to the pattern. By this fact, attached surface of the pattern is no good and later treatment of the parting plane is necessary. By using air, it is hard to get tight mold, so some times occur the rough surface.	It is difficult to get uniform mold. So it is necessary to correspond by hard mold using high squeeze pressure. By these operation, we are not able to get good permeability. Some times affect the product. By same reason, it is difficult to get tight mold and fine surface.

	Double squeeze molding process	Impact molding process	Impact + squeeze molding process
Flask	It is possible to mold not relazting the erosion or wearing of the flask. If the wearing of the parting plane of the flask occur, because of no use of air, blow out of the sand or leak does not occour. Durable life of the flask is long.	If the parting plane of flask be eroded. The sand blow out by the air and generate the wearing of flask. - It is important to keep seal tightly. So repairment of the parting plane of flask is necessary. Average durable life of the flask is about 5 to 7 years. Maintenance cost is high.	If the parting plane of the flask be eroded. The sand blow out by the air generate the wearing of flask. It is important to keep seal tightly, so repairment of the parting plane of flask is necessary. Average durable life of the flask is about 5 to 7years. Maintenance cost is high.

資料6　「開所式記念セミナー講演要旨」（大島敏和短期専門家）
—Measures for Subtantial Quality Improvement and
Big Cost Reduction of Sri Lankan Castings

Measures for Substantial Quality Improvement and Big Cost Reduction of Sri Lankan Castings

Part Ⅰ : Introduction of Developing Iron Foundry Industry in Japan
by VIDEO

Part Ⅱ : Lecture
—Measures for Substantial Quality Improvement and
Big Cost Reduction of Sri Lankan Castings

19, May 1998

T .OSHIMA

Technical Advisor of The Materials Process Technology Centre of Japan

Lecture
-Measures for Substantial Quality Improvement and Big Cost Reduction of Sri Lankan Castings-

1. Preface

- ○ Foundry industry is very important and essential supporting industry for development of other industries, for example machinery industry etc.. Certainly development of foundry industry promotes development of other industries in Sri Lanka.
- ○ Purpose of JICA Foundry Technology Development Project in Sri Lanka

2. Measures for substantial quality improvement of Sri Lankan castings

Inadequate quality of Sri Lankan castings is due to following two factors.

a) Lack of wooden pattern making technology and technique
(The lack of this technology and technique disturbs development of foundry industry also.)

b) Insufficiency of basic foundry technology and technique, for example,
casting design preparation, melting, sand preparation, moulding and test & examination.

2.1 Wooden pattern making technology and technique

- ○ This technology and technique transfer to IDB counterpart personnel by JICA expert is in progress.
- ○ Training course on wooden pattern making by JICA project starts in May 1998 in IDB.
  This course is for out side participants.
  We wish for out side participant to acquire wooden pattern making technology and technique by participation to the course.

2.2 Foundry technology and technique

JICA experts are transferring basic foundry technology and technique to IDB counterpart personnel.

2.2.1 Casting design technology

1) Gating ratio (Ratio of sprue, runner and ingate means the ratio of their sectional areas.)
Recommendable gating ratio for grey iron castings is as follows.

In case of top gate (poured from top of the mould)
A:B:C=1:0.9:0.8

In case of bottom gate (poured from bottom of the mould)
A:B:C=1:1.2:1.2

Where : A is sectional area of sprue
B is sectional area of runner
C is total sectional area of ingates

Please refer Annex 1 in detail.

3) Design of dimensions for sprue, runner and ingate

The order for design of dimensions of sprue, runner and ingate is as follows.

① Decision of gating type
② Decision of gating ratio
③ Calculation of as cast weight
④ Decision of pouring time
⑤ Design of ingate dimension
⑥ Design of dimension of runner and ingate

After decision from ① to ③, proper pouring time is selected using Table 1.
This calculation method is shown in Annex 2.
This calculation method is complicated. So often convenient method by a lot of experiences is used.
This method is the one to decide pouring time, dimensions and number of sprue, runner and ingate directly on basis of castings weight after deciding gating ratio of 1:0.9:0.8.
This is practical and convenient. For this, applicable table is shown in Annex 3.

4) Design of risers dimension and numbers

There are some ways to design riser's dimensions.
There are the way to design from castings thickness, castings weight and ratio of volume to surface area of castings. Among them, here is mentioned about simple and practical designing method of riser dimension on basis of castings thickness.
This method is shown in Annex 4.

2.2.2 Melting technology and technique

Table 2 shows standard pouring temperature of grey cast iron. Tapping temperature of molten grey cast iron from cupola should be min.50℃ higher than the pouring temperature.

Generally tapping temperature of molten grey cast iron from cupola is too low in developing countries.
Accordingly pouring temperature is too low.
So, many kinds of defect, for example gas defects, slag inclusions, sand inclusions, cold shuts, misruns etc. occur in castings.
Moreover spheroid graphite cast iron can't be produced due to low tapping temperature of the molten metal from cupola.
The low tapping temperature is mainly due to following two causes.

a) Improper design of cupola
b) Improper cupola melting operation including charging materials

JICA supplied high frequency induction furnace, cupola and pyrometers (optical and immersion one) to IDB.
Melting operation of high frequency induction furnace is in progress, and cupola will be installed in coming June.
JICA is planning to transfer melting technology and technique to IDB counterpart personnel for improvement of above mentioned causes.

2) Pouring time

Pouring time is the basis to design the dimensions of sprue, runner and ingate. Pouring time is variable according to shapes and dimensions of castings and moulding sand. Generally this is determined by the weight (as cast weight) and wall thickness of castings. Example of standard pouring time is shown in Table 1.

Table 1　Example of pouring time

Casting thickness Casting weight as cast	Pouring time (sec)		
	Thin thickness castings	Middle thickness castings	Heavy thickness castings
10	3 ∿ 5	-	-
20	5 ∿ 6	-	-
30	6 ∿ 7	-	-
40	7 ∿ 8	7 ∿ 8	-
50	8 ∿ 9	8 ∿ 9	-
75	9 ∿ 10	9 ∿ 10	11 ∿ 12
100	10 ∿ 11	10 ∿ 12	12 ∿ 14
150	11 ∿ 12	13 ∿ 15	16 ∿ 18
200	14 ∿ 15	16 ∿ 17	19 ∿ 20
300	17 ∿ 18	19 ∿ 20	21 ∿ 22
400	19 ∿ 21	21 ∿ 23	23 ∿ 25
500	23 ∿ 24	25 ∿ 27	28 ∿ 30
750	26 ∿ 28	29 ∿ 31	32 ∿ 34
1,000	32 ∿ 34	35 ∿ 37	39 ∿ 42
1,500	36 ∿ 38	39 ∿ 42	43 ∿ 45
2,000	-	45 ∿ 47	50 ∿ 52
3,000	-	54 ∿ 56	59 ∿ 61
4,000	-	63 ∿ 66	69 ∿ 72
5,000	-	-	80 ∿ 84
10,000	-	-	100 ∿ 110

Remark (1) Thin-thickness castings include green sand mould castings.

(2) Heavy thickness castings include top gated castings.

(3) Thickness for thin thickness castings ~~is~~ are less than 20mm.
Thickness for middle thickness castings ~~is~~ are less than 30 ∿ 35mm.
Thickness for heavy thickness castings ~~is~~ are less than 50 ∿ 60mm.

Table 2 Example of pouring temperature

Thickness Size	Thin	Medium	Heavy
Small	1380 ∿ 1450°C	1380 ∿ 1420°C	1320 ∿ 1360°C
Medium	1360 ∿ 1400°C	1340 ∿ 1380°C	1300 ∿ 1360°C
Large	1340 ∿ 1400°C	1320 ∿ 1380°C	1280 ∿ 1340°C

Note: (1) Small size castings mean its weight is less than 100 kg. Medium size's weight is 100∿200kg, large size's weight is more than 2000kg.

(2) Thin thickness castings ~~is~~ are 15∿20mm thick, medium one is 30∿35mm thick, heavy one is 50∿60mm thick.

Quality check of molten metal during of melting operation is required essentially for production of qualified castings having proper physical properties.
In Sri Lanka this check is carried out in a few foundries.
Accordingly the physical properties, for example hardness, tensile strength etc. of castings are unknown.
So, machinery and equipments composed of thus castings are unable to perform their full functions.
We will recommend to check the quality of molten grey cast iron by wedge chill test mentioned in Annex 5.

2.2.3 Moulding technology and technique

Many casting Defects, i.e.sand inclusions, gas holes, penetrations etc. are observed in Sri Lankan castings.
These defects are mainly due to improper moulding techniques.
Basic moulding technology and technique are transfering to IDB counterpart personnel By JICA expert.
Fig.1 shows proper sand moulding procedure by hand moulding.

Moulding sand is charged into moulding flask by small amount, and is rammed uniformly by using of sand rammer shown in Fig.2 each sand charging.
Hardness of mould immediately after moulding should be 60 to 80 in green hardness tester.
JICA supplied green hardness tester to IDB, so we will recommend to check your mould hardness by the hardness tester for improvement of your moulding technique.

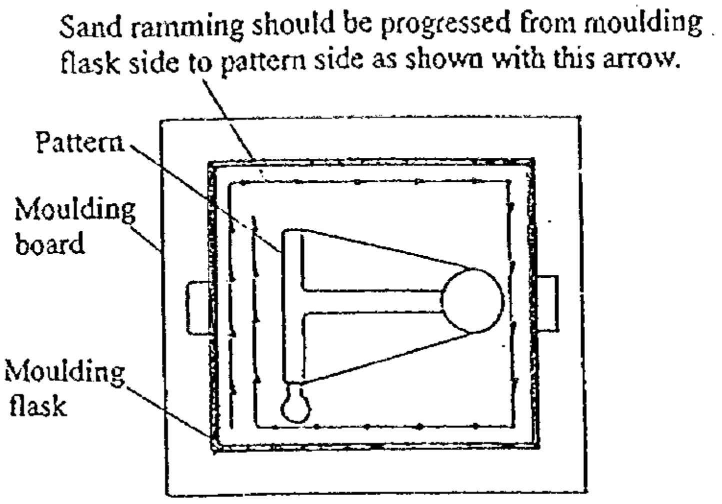

Sand ramming should be progressed from moulding flask side to pattern side as shown with this arrow.

Fig.1 Sand ramming procedure

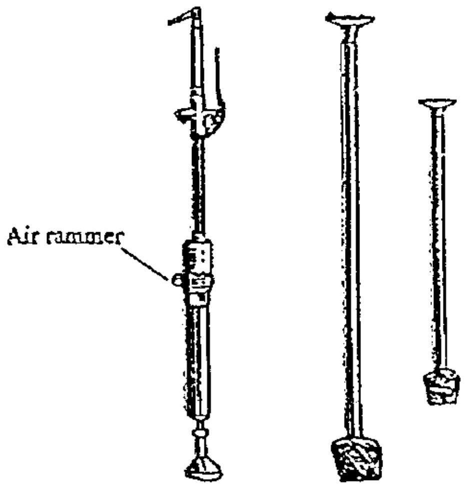


Fig .2 Sand rammers

Moulding flask are used for moulding ordinary , but in developing countries floor moulding (without moulding flask) process shown in Fig.3 is applying.

In this process, sand ramming under the pattern is difficult for hard ramming of sand, and the permeability of the mould in floor is not so high. For this reasons qualified castings are not able to be produced.

Also many moulding times are required for this process as compared with flask moulding one.

So we will recommend to change this moulding process to flask moulding one.

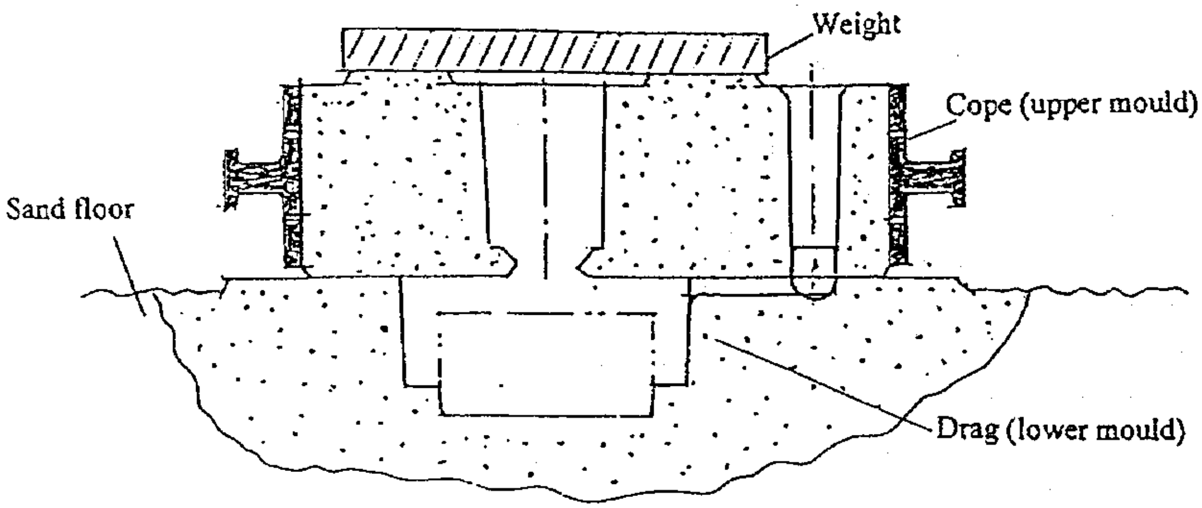


Fig.3 Floor moulding process

3.Measure for big cost reduction of Sri Lankan castings

Many measures for cost reduction of Sri Lankan castings are recommended. First of all measures is changing from floor moulding process to flask moulding one as mentioned above. There are following disadvantages in floor moulding process as compared with flask moulding one.

a) Many moulding times are required for drag(lower mould) moulding..

b)Weight setting for prevention of cope lifting by buoyancy of molten metal is required. In case of flask moulding process, clamping of moulds is of available.

c)Floor-leveling work is required after pouring.

For above mentioned reasons, flask moulding process shown in Fig.4 is recommendable. As an example, in a Taiwan foundry cooperated with us moulding productivity is increased by 80 % (100%→180%) by means of above mentioned changing according to our recommendation, and castings quality is improved materially.

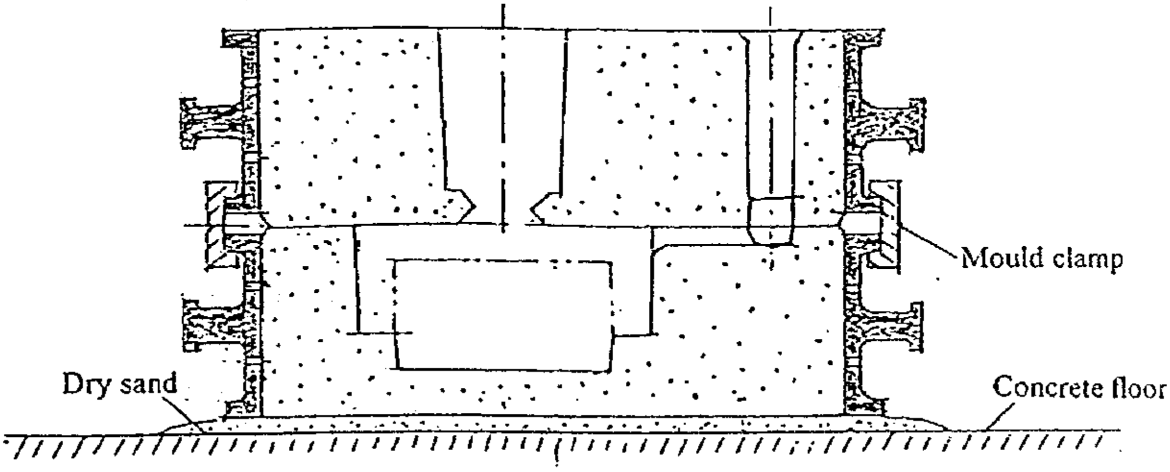


Fig.4 Flask moulding process

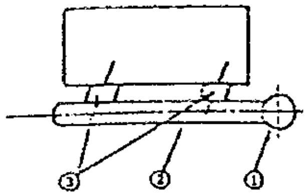
4.Conclusion

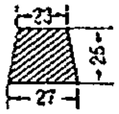
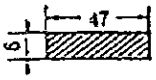
It is believed firmly that Sri Lankan foundry industry will develop in near future by acquiring of basic technology and technique in castings production. JICA would like to cooperate fully for the development.

Annex 1

Re : Calculation for gating ratio

<table>
<tr><th>Example</th><th>Calculation</th></tr>
<tr><td>
1.

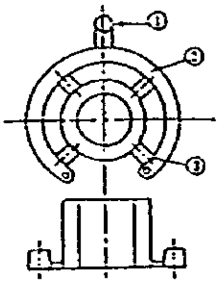


<table>
<tr><th>Mark</th><th>Part</th><th>Section</th><th>Nos.</th></tr>
<tr><td>1.</td><td>Sprue</td><td> </td><td>1</td></tr>
<tr><td>2.</td><td>Runner</td><td> </td><td>1</td></tr>
<tr><td>3.</td><td>Ingate</td><td> </td><td>2</td></tr>
</table>
</td><td>
1 Sectional area of sprue
$= \pi/4 \times 30^2 = 707\ (mm^2)$

2 Sectional area of runner
$= (23+27) \times 25 \div 2 = 625\ (mm^2)$

3 Total sectional area of Ingates $= 47 \times 6 \times 2 = 564\ (mm^2)$

Gating ratio = Sectional area of sprue: Sectional area of runner: Total sectional area of ingates
= 707:625:564 = 1:0.9:0.8
</td></tr>
<tr><td>
2.



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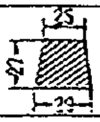
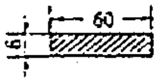
<tr><td>2.</td><td>Runner</td><td> </td><td>2</td></tr>
<tr><td>3.</td><td>Ingate</td><td> </td><td>4</td></tr>
</table>
</td><td>
1 Sectional area of sprue
$= \pi/4 \times 40^2 = 1,256\ (mm^2)$

2 Sectional area of runner
$= (25+29) \times 27 \div 2 \times 2$
$= 1,458\ (mm^2)$

3 Sectional area of ingates
$= 60 \times 6 \times 4 = 1,440\ (mm^2)$

Gating ratio = Sectional area of sprue:Sectional area of runner: Total sectional area of ingate
= 1256:1458:1440 = 1:1.2:1.2
</td></tr>
</table>

Annex 2

Re : Calculation for sectional area of sprue, runner and ingate

[Total sectional area of ingates] = $\frac{W}{v \times d \times T}$ (cm²) ....(1)

where, Casting weight as cast W=(kg)

T = Pouring time (s)

v = Velocity of molten metal at ingate (cm/s)

d = Density

= 0.0072 (kg/cm³)

V is calculated as follows.

$v = C\sqrt{2} \times g \times (H \pm 0.5h)$ ....(2)

where C = Constant

g = Acceleration of gravity

= 980 (cm/s²)

H = Height of sprue (cm)

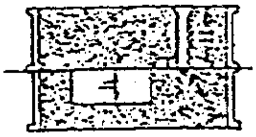
h = Height of casting (cm)

(In the formula (2), (H±0.5h), drop gate (H+0.5h), bottom gate, (H−0.5h)

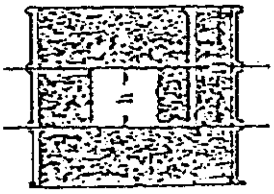
If gating ratio = 1 : 0.9 : 0.8

[Sectional area of sprue] = [Total sectional area of ingates] $\times \frac{1}{0.8}$ (cm²)

[Sectional area of runner] = [Total sectional area of ingates] $\times \frac{1}{0.9}$ (cm²)



Drop gate



Bottom gate

Annex 3

Re : Design of dimensions for sprue, runner and ingate

The section of runner is generally tapered and this is desirable. Pattern of runner with tapered section is drawn up easily from mould and makes exact mould.

To design taper from square section, upper side length is calculated reducing 2mm from side length of square and lower side length adding 2mm to side length of square, and height of it is the same side length of square.

Rectangle is better for ingate section, and this is easy for exact moulding.

Now, it is necessary to explain about relation between runner and ingate. In Fig.1, this is shown.

Runner is responsible for transferring clean molten metal with high temperature to all ingates. For this reasons, ingate should be positioned at the bottom of runner, and this height should be less than 1/4 times the height of runner.

In the case of top gate, sectional area of ingate is smaller than sectional area of runner. So, slags and impurities in molten metal are floated at upper side of runner so that they don't flow into mould cavity through lower positioned ingates.

Moreover, length of runner must be limited because runner is supposed to transfer molten metal without temperature drop and to distribute uniformly to each ingates. If length of runner is too long, molten metal will solidify by its temperature drop, and does not reach to ingates. And if distance between sprue and ingates too long, molten metal does not flow into ingates with uniform temperature. These are shown in Table 1.

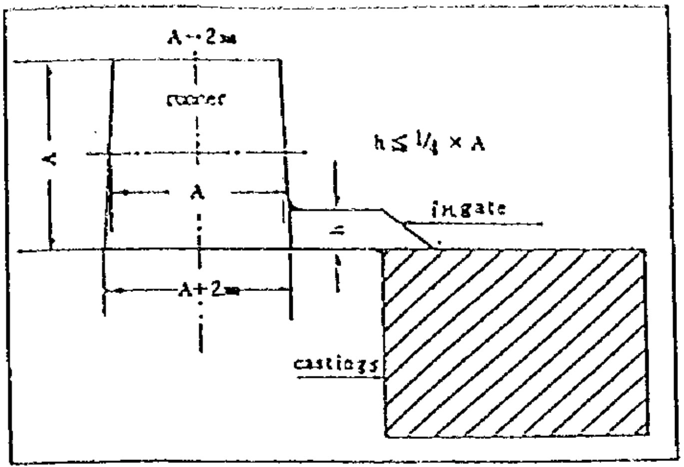


Fig. 1 Relation between runner and ingate

Table 1 Example for dimension of spure, runner and ingate

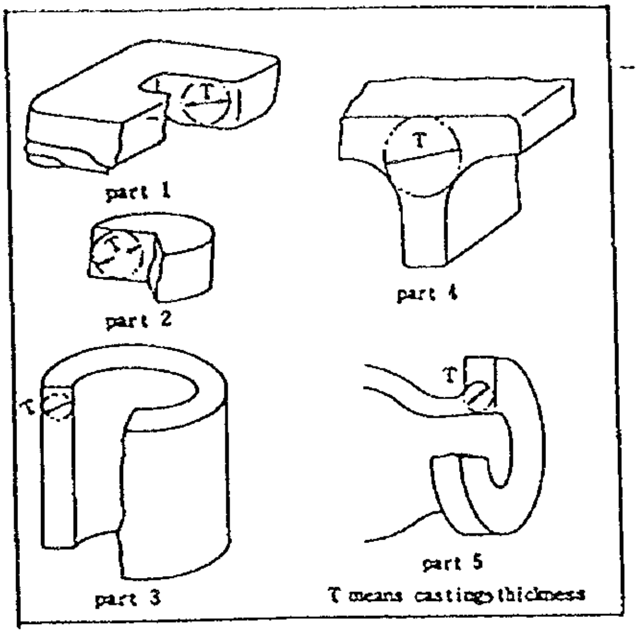
Casting wt. as cast (kg)	Pouring time (sec)	Sprue diameter (mm)	Runner (mm)		Ingate (mm)			
			One way	Both ways	2 Pieces	3 Pieces	4 Pieces	5 Pieces
20	5	26	22×22	15×15	5× 42	5×28	5×21	5×17
30	6	26	24×24	17×17	6× 44	6×22	6×22	6×17
40	7	31	26×26	18×18	6× 50	6×33	6×25	6×20
50	8	32	27×27	19×19	6× 55	6×36	6×27	6×22
75	9	37	31×31	22×22	7× 62	7×41	7×31	7×25
100	10	41	34×34	24×24	8× 65	8×44	8×33	8×26
150	11	48	40×40	28×28	10× 71	10×48	10×36	10×29
200	14	49	41×41	29×29	10× 75	10×50	10×37	10×30
300	17	54	46×46	32×32	11× 84	11×56	11×42	11×34
400	20	60	48×48	34×34	12× 87	12×58	12×44	12×35
500	23	60	51×51	36×36	12× 95	12×63	12×47	12×38
750	26	64	54×54	38×38	13×100	13×67	13×50	13×40
1000	33	66	55×55	39×39	13×105	13×70	13×53	13×42

Note: 1. This table is available for drop gate with gating ratio 1:0.9:0.8.

2. Dimensions of runner are shown as height × width, in trapezoid, length of upper side is to be (width − 2mm) lower side is to be (width +2mm).

Annex 4

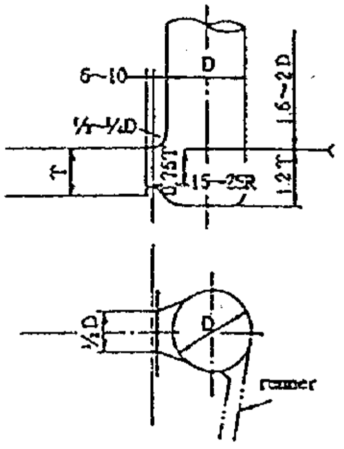
Re : Design of risers dimension and numbers



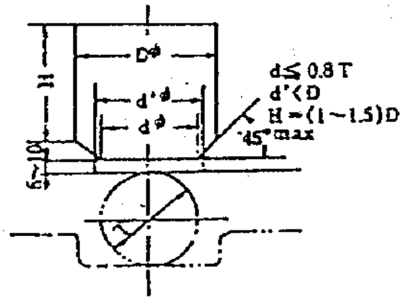
Example of determination of sectional dimension

Example for dimension and form of riser

Dia of riser / Thickness of castings (T) / Kinds of cast iron	DØ (mm)			
	10~30	31~50	51~75	76~100
JIS FC 200~ 250	T+30	T+30	T+25	T+20
〃 FC 300~ 350	T+40	T+35	T+30	T+30



Example of side riser



Example of top riser

Nos. of riser will be decided. For this, it is necessary to know feeding distance of one riser in metal feeding. Feeding distance of riser in grey cast iron, is 6 to 8 times thickness of castings in uniform wall thickness. Weight of riser is enough 10 to 30 % of castings weight in grey cast iron. This value varies due to grades of grey cast iron.

Thus, Nos. of riser are decided. And they should be decided carefully considering shape castings, gating system and condition of mould.

Annex 5

Re : Wedge chill test

From old times, quality check of molten grey cast iron is practiced by seeing break surface pattern or fluidity test of molten metal. Nowadays, chill test, measuring carbon equivalent value(= C % + 1/3 Si %) by C.E. meter, and measuring value of C.E., carbon and silicon by three E meter, are generally practiced.

There are many kinds in chill test method. Here are mentioned about wedge chill test.

In Fig. 1, dimensions of four kinds of wedge are shown, they are W-1, W-2, W-3, and W-4. Wedge test is done as follows.

Wedge mould is made of sand and its section is triangular. Generally this mould is shell mould. Molten metal is poured into this mould vertically to get triangular chill test piece. After solidification, test piece is broken by hammer at the middle. Chill structure appears on broken section of test piece. Now, quality of metal will be judged by measuring width of chill on broken section.

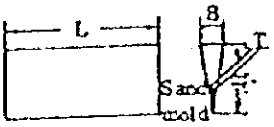
Where, dimensional allowance of test piece are 0.8mm in width and 3.2mm in length.

Example of application for chill test is shown in Table 1.

In the case of wedge chill test by N.I.K.(Japan Foundry Engineering Society), tensile strength and machinability is judged roughly by measuring width of chill. In this test W-2 type test piece is used. Chill value of 2mm is proper for grey cast iron of which tensile strength is 15kg/mm^2, and when this material is poured in the castings with 25mm thickness, its machinability is good.

And chill value of 3mm is proper for grey cast iron of which tensile strength is 20kg/mm^2 and machinability of this grey cast iron is good when it is poured to castings grey cast iron of which tensile strength is 30kg/mm^2, but if this is poured to the castings with 25mm thickness, machinability would not be good and to improve machinability, addition of calcium silicon 0.2 to 0.5 % to the molten metal is widely used.

For heavy section castings, W-3 or W-4 type of wedge is used for chill test. Judging method is the same as the one of W-2 type.



Kind of wedge	B	H	L
W-1 W-2 W-3 W-4	6 12 20 32	25 32 38 50	100 100 100 150
Allowance	0.8		3.2

(Unit: mm)

Fig. 1 Wedge type chill test piece by N.I.K.

Table 1 Example for application chill testing method

Testing method	Tensile strength kg/mm²	Test result	Machinability
Wedge chill testing method by N.I.K.	15	about 2 mm	Easy
	20	about 3 mm	Easy
	25	about 5.5mm	
	30	about 10 mm	Impossible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