ATTACHMENT
Workshop Materials and Product for the Pilot Projects

ATTACHMENT 1
Workshop Materials and Product
for the Pilot Metalwork Cluster, Waru - Sidoarjo

WORKSHOP MATERIALS AND PRODUCT
for Metalwork Cluster, Waru-Sidoarjo

Record of Workshop, Material, and Products

1) Workshop and Seminar

Program Name	Workshop / Seminar Title	Materials and Working Paper
1. Guidance	- Discussion for formation of the Working Group - Discussion for the Direction of the Pilot Project	- Guideline - Handout
2. Development of the Core Products 1) Initial Planning	- Discussions for selecting the Core Products	- Guideline - Feasibility Study Sheet *
2) Designing	- Workshops on Drawing	- Text *
3) Experimental Product	- Workshops on Propulsion System of the Fishing Boat - Workshops on Cooking Gas Stove - Workshops on Oil Filter	- Reference from the Web - Text - Comparative product - Reference from the Web
4) Business Plan	- Workshop on Business Plan	- Text
3. Factory Management 1) 5S	- Workshops on 5S - Consultation Services on 5S	- Text
2) Inventory Control	- Workshops on Inventory Control - Consultation Services on Inventory Control	- Text
3) Production Control	- Workshops on 5S - Consultation Services on 5S	- Text*
4) Quality Control	- Workshops on 5S - Consultation Services on 5S	- Text - Inspection Manual
5) Customized Consultation	- Consultation Services at the factories	- None
6) Meeting with the Potential Buyers	- Discussion with the buyers	- None

*Attached documents

2) Product

Program Name	Reports / Products
1. Guidance	- None
2. Development of the Core Products 1) Initial Planning	- Feasibility study (propulsion system, cooking gas stove, and oil filter)
2) Designing	- Designing (propulsion system, cooking gas stove, and oil filter)
3) Experimental Product	- Experimental products (propeller and cooking gas stove)

4) Business Plan	- Cost analysis (cooking gas stove and oil filter)
3. Factory Management	
1) 5S	- Report
2) Inventory Control	- Report
3) Production Control	- Report
4) Quality Control	- Report
5) Customized Consultation	- Report
6) Meeting with the Buyers	- Report

3) Attached Samples of Materials and Product

Attachment	Title	Prepared by
1	- Cluster Development Strategy prepared in October 2002	JICA Study team with the cluster stakeholders
2	- Text for the Drawing Workshop	Institute of Technology Surabaya (ITS)
3	- Text for the Production Control Workshop	JICA Study team
4	- Format for the Initial Feasibility Study of the Product Development	JICA Study team

Pilot Metalwork Cluster, Waru-Sidoarjo

Attachment 1-1 : Cluster Development Strategy Prepared in October 2002 (English)

CLUSTER DEVELOPMENT STARATEGY
METAL AND MACHINERY COMPONENT CLUSTER, SIDOARJO

(prepared in October 2002)

1. Goals: Long-term Target (10 years)

(1) To shift from informal to formal business

Table A.1 shows the number of formal and informal SMEs in Waru district. The informal SMEs should be transformed into formal in the mid to long-term perspective so that they are eligible for receiving public and private sector assistance and avail its services toward society. Informality has been a common issue pertaining to the SMEs in Indonesia. The transformation implies the establishment of basic and essential business infrastructure in bringing the cluster dynamism.

Table A.1 Formal and Informal Industry in Sidoarjo and Waru district

	Formal Industry (Year 2000)		Informal Industry (Year 1999)	
	Units	Workers	Units	Workers
Sidoarjo District	1,737	42,233	11,500 (87%)	46,195 (50%)
Waru Subdistrict	327	9,849	1,603 (83%)	8,359 (46%)

Source: Sidoarjo District in Figures 2000 and Econit Report

(2) To break through a vicious cycle

Majority of cluster SMEs are caught in a vicious cycle, characterized by a small business scale, a small lot production, a small profit, non-eligibility for bank loan, and inability of facility renovation. Up to date, only a few firms in Waru have established a vendor status against assemblers. It is a good contrast to SMEs in other ASEAN nations such as Malaysia and Thailand where they have developed a qualified vender status applicable to international standard through public and private sector collaboration.

In Waru, Industry and Handicraft Cooperative Waru (IHCW) has been consistently taking efforts in spinning out from the vicious cycle with various activities including technical assistance, financing, insurance, and sales promotion. Despite these efforts, still the cluster cannot find the way to get out of the vicious cycle. All the possible counter measures to break the first cutting edge should be discussed and put into practice. Spinning out from the vicious cycle would be an ignition to stride a first step toward bringing dynamism in the cluster.

(3) To establish a supporting industry status

The current business standards of the cluster SMEs are far behind from the ones applicable to a supporting industry. They are not entitled to enter a diagram of assemblers and vendors even as a third layer vendor. Upon application of development scenarios, certain numbers of cluster SMEs should be developed to be a supporting industry status to help machinery and an electric industry sub-sector. A potential may exist in sub-sectors such as auto parts, spare parts for food processing machinery, furniture making machinery, and agricultural machinery by digging out a market from mid to large-scale industries locating in and around Surabaya. Attaining the supporting industry status by certain number of firms with the estimated turnover of approximately 50 million/annum/worker or above will positively affect the increase in employment and income in the cluster. Actually, the employment and income should be aimed to be doubled in the forthcoming 10 years.

(4) To create dynamism of the industrial clustering

Taking off from the current survival status to a dynamic cluster is the last but not least goal. Based on the development scenarios, a good mixture of the conceivable resources amongst the cluster SMEs should be mobilized.

2. Scenario

The following figure indicates the pass in which the Waru-Sidoarjo cluster develops into a dynamic one in ten years. Scenarios have been designed to strengthen the capacity of the cluster as well as fostering several leading SMEs. Fostering leading SMEs is the most efficient methodology in generating horizontal and vertical linkage. Strengthening their capacity is pre-requisite to ignite business growth for the entire cluster.

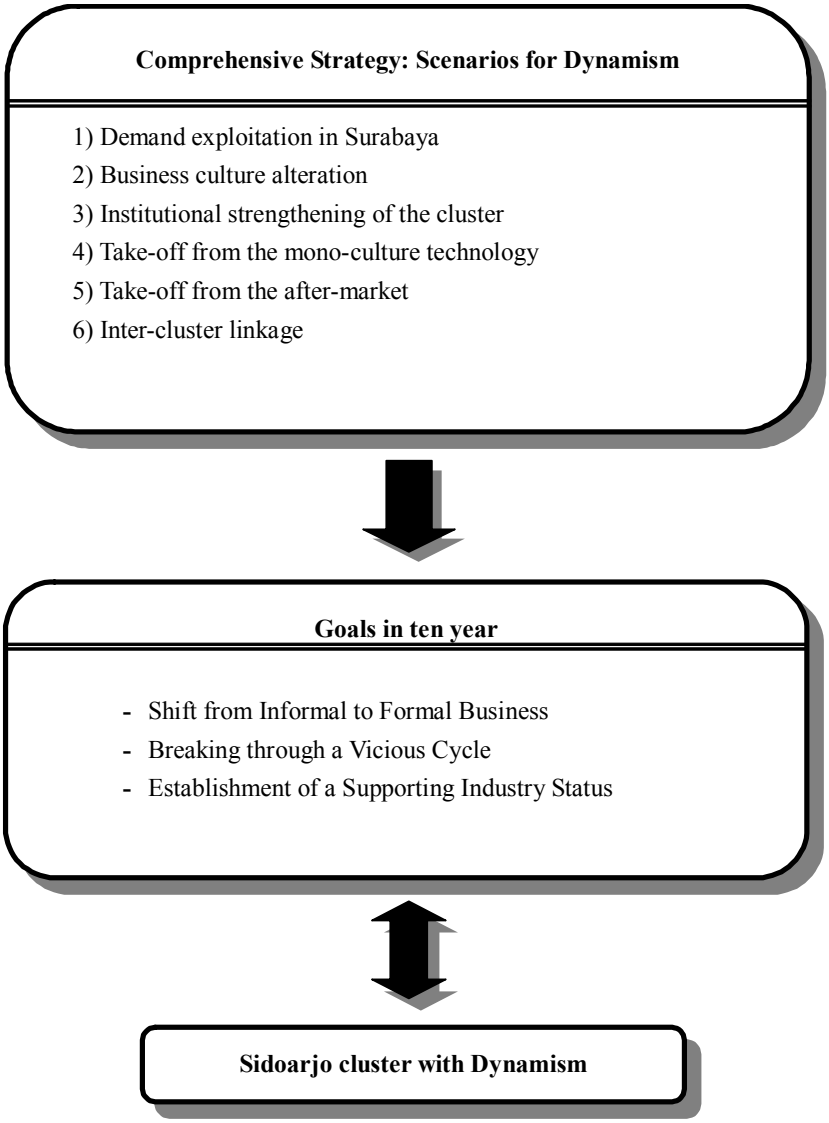


Figure A.1 Development Scenario of Waru-Sidoarjo Cluster

(1) Short-term perspective

1) Demand Exploitation in Surabaya

Waru-Sidoarjo cluster is adjacent to Surabaya, the second most industrialized city in Indonesia following Jakarta. There is a substantial accumulation of various industries such as food processing (e.g. coffee, tea, cocoa, etc.), garments, paper, shoe making, furniture, plastic, agricultural machinery, equipment (e.g. pump, tractor, shovel, plough, etc), and auto parts (e.g. spring, castings for engine parts, etc). According to the Indonesian Exporters Association East Java, total export value from East Java, excluding petroleum, accounts for 15~20 % of the total export in Indonesia. The major export items include paper, plastic, furniture, shoes, garments, coffee, tea,

cocoa, rubber, and horticulture. Quite obviously, there must be abundant business opportunities to supply metal and machinery components in these potential markets. It is a questionable whether the cluster SMEs have ever made an extensive effort to develop a business connection with these industries.

A specialization in producing relevant components and/or intermediate products marketable toward industries in Surabaya should be a powerful scenario for inviting dynamism in the cluster in the mid to long term. Candidate products could be metal and machinery parts and components for coffee and tea-processing machine, a furniture-making machine, and agricultural machinery. In developing a new product, an interface is essential with scenario (e) and (f). The scenario implies fulfilling the demand of an adjacent market, which is considered market-driven. A detailed market survey under close collaboration with KADIN and the establishment of a venue for a business talk should be launched. It should be simultaneously followed by the identification of potential new products.

2) Business culture alteration

Cluster SMEs should become aware of changing global economy stimulated by AFTA and massive penetration of made-in-China products into the Indonesian market place. The adverse influences and a threat of business opportunities in the domestic market should be also informed.

Moreover, the current business culture based on informal, household, inherited, and micro-scale industry should be altered to be a registered, corporate culture. The alteration of the current business culture is the first step for Sidoarjo cluster to break through the vicious cycle. Not only the action plan for the first year, but also continuous application of mid-term projection to alter the current business culture should be adopted.

3) Institutional strengthening of the cluster

IHCW has extended a variety of services for the sake of its members including common procurement, common facility, strengthening of horizontal and vertical linkage, and financial assistance. A consolidation of secretariat function at IHCW in terms of technical standard of staff members, documentation, management skills, planning, and dissemination of business information is essential in order to become the central intelligence institution. Then, the magnitude of assistance should be maximized in order to bring about dynamism toward the entire part of the cluster.

A cooperative enterprise would be a possible stakeholder comprising divisions of marketing, procurement, stock management, sales, accounting, and administration. A cooperative enterprise takes the form of corporation having vertical linkage with member enterprises (subcontracting).

The Japanese style of "keiretsu" would be another way of cluster transformation. Keiretsu requires a mid-scale manufacturer managing the business transactions with outside firms outside and subcontractors inside.

4) Take-off from the mono-culture technology

The majority of cluster SMEs depend upon a mono-culture technology, stamping and/or pressing for a lengthy of time. These technologies are categorized as one of the simplest production technology in the sector. The cluster should face and take off from a seabed of mono-culture technology and adapt more sophisticated machining technologies such as casting, heat treatment, surface plating, welding, and machining.

In the long-term development scenario, it is essential to install a furnace in the cluster, hopefully a common cupola in order to supply quality raw materials and cut down raw material costs. Accordingly, these processes enable the cluster to produce much more value-added products which lead the cluster to be a status of potential group of vendors, or in other words, a supporting industry toward the market in Surabaya.

The acquisition of the sophisticated production technology should be based on mid to long-term perspective, i.e., launching from the first year action plan through mainly lectures, and should be followed by on-the-job training to acquire the technology.

(2) Mid-term perspective

1) Taking-off from the after market

The auto parts sector, especially, those for motorcycles, generates considerable volume of industrial outputs in the cluster. However, the majority of auto parts have been sold at an after-market in and around Sidoarjo. The quality of the products is low and uneven, hence, hardly any automobile manufacturers in Indonesia intend to procure such products. Accordingly, those products are desperately bargained in an after-market, and the manufacturers can enjoy only a small profit.

Taking off from after-market syndrome and entering into the regular market implies upgrading product quality, upgrading technology, and strengthening competitiveness

of the enterprises. Astra Foundation provides assistance in improving the product quality produced by after market producers. The assitance has been appreciated by many producers and quite effective in bringing up the product standards amongst after market producers. Further collaboration with Astra Foundation has to be sought.

2) Inter-cluster linkage

Clusters with other products should fully coordinate in exchanging technical and market information, intensify a vertical linkage, and thus sub-contract a certain product each other whenever such demand arises amongst the clusters. A furniture cluster, for example, can make an order for a furniture-making machine to the metalwork cluster. Another conceivable case is a group of popular Toraja coffee producers in Sulawesi and Java coffee supply coffee processing machines over the Internet. An up-to-date naming for such inter-cluster coordination should be attached such as "*e*-cluster-club" to raise much wider concerns in Indonesia.

(3) Long-term perspective: Becoming the dynamic cluster

Figure A.2 shows an image in which the cluster is attained dynamism upon application of the discussed scenarios. It is intended that the orders from numbers of outside large SMEs and the numbers of sub-contracts shall be increased. Horizontal and vertical linkages are firmly established including those with outside institutions.

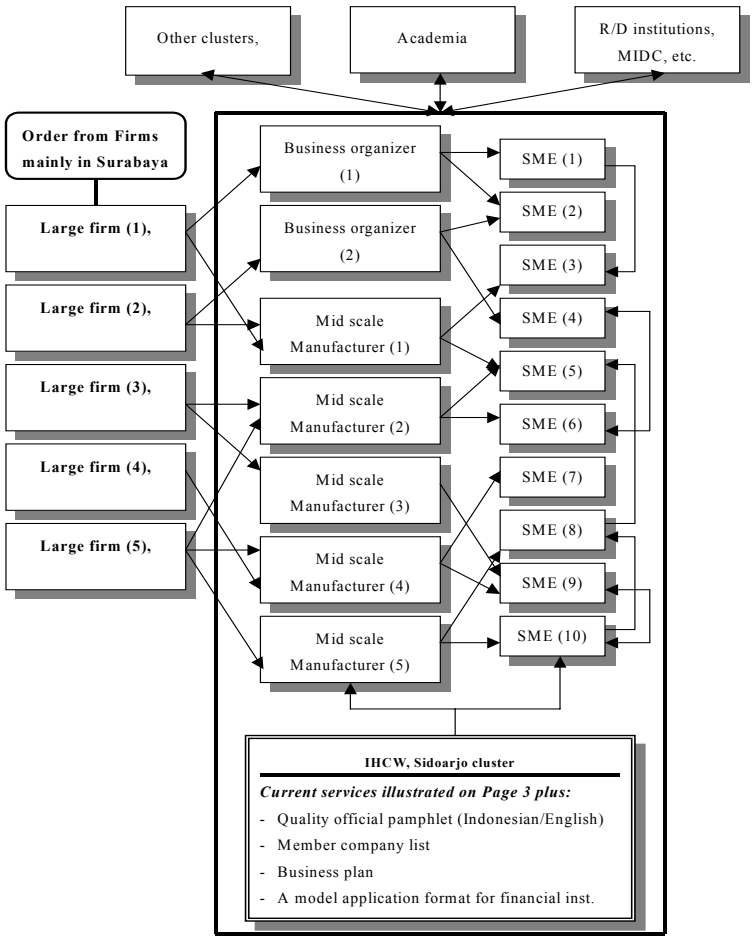


Figure A.2 Image of the Dynamic Cluster

3. One-Year Action Programs

The One-year Action Programs aim at intensively improving technological and managerial capacity in the cluster in an effort to lead the cluster to the path towards a sustainable growth. The action programs also envisage ignition-effects on the business activities, which are expected be continued by the cluster SMEs and their stakeholders.

Beneficiaries of the One-year Action Program are IHCW and metalwork SMEs located in Waru.

PROGRAM 1: GUIDANCE FOR CLUSTER BUSINESS DEVELOPMENT

(1) Background/Purpose

The history of the cluster is traced back to a few blacksmiths producing agricultural tools almost 70 years ago. 300 enterprises and more than 3,000 workers are estimated to be engaged in metalwork and machinery components in Waru. There exists a cooperative, IHCW, under which 135 enterprises are the members.

Technology in the cluster is dominated by stamping. Higher technology such as machining and molding is seldom observed except in a few SMEs. The characteristics of the cluster are summarized as follows:

- Business transactions dominated by traders
- Little linkage with final market
- Miscellaneous parts and components more than 3,000 kinds
- Low level of knowledge for quality and process control
- Lack of 5S concept
- Lack of consciousness towards innovation

In order to break through the present constraints, guidance for business development should be presented initially. The primal purpose of the guidance is to make cluster enterprises aware of the necessity for business development in the following aspects:

- Enlightenment of entrepreneurship
- Identification of the major products linked to final markets
- Necessity of cluster transformation

(2) Content

1) Enlightenment of Entrepreneurship

- Discussion on necessity of innovation
- Discussion on creating competitiveness of the metalwork and machinery component sector
- Training on the following business management practices
  - business planning
  - financial / budget management

Implementation

Targets: SME owners or representatives recommended by IHCW
Provider: JICA Study Team together with BDS provider

Place: IHCW's meeting room
Period: One week

Presentation papers for the lecture are to be prepared by the JICA Study Team. Training for business management practice would be provided by a BDS provider.

2) Discussion on Core Products

The lack of core products virtually hampers the division of labor among cluster SMEs. The present condition in which many enterprises produce different products independently is a constraint to creating cluster dynamism. An expert firstly demonstrates the reason why core products are necessary for the further development of the cluster. The discussion would be a kick-off to make SMEs aware of the significance of core products for cluster dynamism.

Implementation

Targets: SME owners or representatives recommended by IHCW
Provider: JICA Study Team, Final makers (assembler, machinery) in Surabaya
Place: IHCW's meeting room
Period: within two days

Outside stakeholders are expected be mobilized to participate in discussion.

3) Preparatory Works for Subsequent Programs

- Preparation of specification for market survey
  A provisional conclusion of the discussion on the core products is to be reflected into the specifications for the coming market survey.

- Guidance for subsequent programs
  The rough schedule of the subsequent program on technical improvement and market survey will be guided by the JICA Study Team. Prior to implementation of these programs, the co-operative is requested to organize special groups to receive the programs.

(3) Expected Output / Outcome

- Enhanced understanding of business management skill and practice
- Consensus on core product sought by the cluster
- Discussion result of program 1

PROGRAM 2: MARKET SURVEY AND FORMULATION OF MARKETING STRATEGY

(1) Purpose

- To survey and identify potential market and middle or large-scale industries in Surabaya area, to which Sidoarjo cluster might expand the sales or production of metal and machinery components by utilizing its business network with stakeholders and sub-contracting network among cluster
- To understand the whole picture of industrial activities in Surabaya area
- To draft a marketing strategy, and propose some immediate actions related to exploitation of market

(2) Content

1) Market survey for the core product

The following steps will be taken to undertake the market survey;

- The sample survey of present products through an interview with cluster SMEs (around 50 SMEs)
- Identification and confirmation of the core product
- Interview survey for the existing and potential core clients in Surabaya area
- Data collection for demand / supply trend for the proposed core product
- Analysis of the future market prospective and the cluster's constraints hampering market development for the core product
- Preparation of the survey report

Implementation

Execution: IHCW and member cluster SMEs (sub-group for marketing strategy)
Guidance: BDS provider (assisted by JICA Study Team)
Place: IHCW's meeting room
Period: Within one or two months

2) Action Plan for the Immediate Sales Promotion

Based on the market survey, marketing strategy and action plans for the immediate sales promotion will be prepared.

- Preparation of the short-term marketing strategy (for the core product)
- Preparation of marketing actions for the immediate sales promotion (not limited to the core product)

- Implementation plan of the proposed marketing actions for the immediate sales promotion

Target products (existing) for marketing include spare parts for automobile, construction machinery, electric parts, food (coffee and tea) processing machine, furniture making machine, agricultural machinery (pump, hand tractor).

Implementation

Targets: SME owners or representatives recommended by IHCW
Provider: BDS provider (assisted by JICA Study Team)
Place: IHCW's meeting room
Period: Within three weeks

(3) Expected Output / Outcome

- Market survey result for the proposed core product
- Marketing strategy including proposed actions with staffing and budgetary plan
- Realization of the proposed actions in the marketing strategy

PROGRAM 3: MANAGEMENT IMPROVEMENT

(1) Purpose

- To identify production management skill and quality control technology
- To improve production management skill and provide know-how on quality control, leading to productivity enhancement through training workshop, and on-the-job-training at the selected cluster SMEs

(2) Content

1) Promotion of 5S

It was commonly observed that inspected factories are generally untidy and that scraps and semi-finished products are disorderly placed. This situation necessitates the so-called 5S. The implementation of 5S will be applied to SMEs willing to implement. Pictures are to be taken before and after 5S so that the effect of 5S can be visually assessed.

Implementation

Targets:	Cluster SMEs (sub-group for 5S promotion)
Provider:	JICA Study Team together with IHCW
Place:	IHCW's meeting room (for the initial guidance / follow-up session)
	Each SME's workshop (for the on-the-job training)
Period:	within five weeks (intermittent practice)

2) Quality Improvement

Most of metal products are manufactured by the orders of traders without specific design. Accordingly SMEs are not familiar with gauging or measurement. The most serious thing is that they do not have any knowledge on design. Workers or technicians selected are to be given an intensive training of how to use instruments of measurement for drawing of design.

JICA Study Team is scheduled to train managers and engineers the basic skills of quality control for the purpose of inspection of products. Training focuses on statistical analysis of defective goods and inspection method of products.

Implementation

Targets:	Cluster SMEs (sub-group for production technology)

Provider: JICA Study Team together with IHCW
Place: IHCW's meeting room (for the initial guidance / follow-up session)
Each SMEs' workshop (for the on-the-job training)
Period: within five weeks (intermittent practice)

3) Work Process Control

One of the reasons why most cluster enterprises are not able to become subcontractors is the delay in delivery of products. This can be ascribed to improper practice of process control. The best method would be the Gantt Chart clarifying the difference between planned and actual work process.

Implementation

Targets: Cluster SMEs (sub-group for production technology)
Provider: JICA Study Team together with IHCW
Place: IHCW's meeting room (for the initial guidance / follow-up session)
Each SMEs' workshop (for the on-the-job training)
Period: within five weeks (intermittent practice)

(3) Expected Output / Outcome

- Clear understanding of the contents of the seminar and training program
- The extent to which trained practices are applied at the later stage in the selected SMEs (checked at follow-up visits)
- Diagnosis report on the present level of production management skill and quality control technology of the trained cluster SMEs

PROGRAM 4: EXPERIMENTAL PRODUCTION OF CORE PRODUCT

(1) Purpose

This program is intended to offer cluster SMEs the valuable opportunity of manufacturing core products which could be a kick-off to the initial step of cluster transformation. The term "experimental" means that the cluster can step up or take collective actions towards the same objective. This program is not the top-down approach but market-oriented so that the Sidoarjo cluster must take orders from core industries around Surabaya.

(2) Content

1) Actions to Take Orders of Core Products

This sub-program is a consecutive program of Program 2. One of the possible actions is supposed to be establishment of the sales promotion unit in IHCW. The unit is responsible for continuous sales promotion actions (such as preparation of an official pamphlet, cluster firm list with products, and advertisement) and market information collection activity.

IHCW is requested to appoint competent members or cluster SMEs to establish the sales promotion unit, and take orders for the core product from the outside clients through the sales promotion unit.

Implementation

Execution: IHCW (sales promotion unit) and its appointed cluster SMEs
Guidance: BDS provider (assisted by JICA Study Team)
Period: After program 2, until the end of pilot phase

2) Productions of Core Products

Immediately after taking orders for the core product, IHCW is again requested to nominate viable SMEs to be engaged in the production of the product ordered. The actions are supposed to be:

a) Design
Upon the receipt of technical specifications, SMEs selected will immediately proceed to design. They are to be assisted by a professional designer.

b) Division of labor

Depending on the kind of technology used, the division of labor among enterprises is the desired. This is the experimental step towards the future cluster transformation. Nominated SMEs are to be assisted by professional technicians or the R&D (e.g. Surabaya Institute of Technology).

c) Product review

Product review will be made primarily on the compliance with clients' demands in the following aspects:

- Design
- Production skill
- Product quality
- Delivery

Implementation

Execution: Cluster SMEs nominated by IHCW
Guidance: JICA Study Team together with IHCW and R&D institute
Place: Nominated SMEs' workshop
Period: After taking the order, until the end of pilot phase

(3) Expected Output/Outcome

- Establishment of sales promotion unit
- Client's order for the core product
- Actual production activity for core product ordered
- Realization of immediate sales promotion actions

PROGRAM 5: PREPARATION OF BUSINESS DEVELOPMENT PLAN

(1) Purpose

The preceding Programs (1 to 4) will be the basic inputs to Program 5. The cooperative assisted by a BDS provider will be requested to prepare the business development plan.

(2) Content

1) Workshops on Cluster Transformation

The participants, who have already gained the experience and knowledge through the preceding Programs, are expected to discuss a comprehensive approach to cluster transformation. It is strongly recommended that other similar clusters be invited to disseminate the results of this workshop to them.

Implementation

Targets:	IHCW and member cluster SMEs
Provider:	BDS provider together with JICA Study Team
Place:	IHCW's meeting room
Period:	Within one or two days

2) Business Plan for New Co-operative Organization

A realistic and feasible business plan in view of strengthening the role and function of the existing co-operative will be formulated, consisting of the following particulars:

- Outline of the new organization (including Co-operative Enterprise)
- Charter of the organization
- Mission and tasks for the organization
- Member of the board (and managers and opening staff)
- Internal organization setup and sections with each function and responsibility
- Line-up of products to be further promoted
- Services and activities which is newly initiated and transferred
- Requirements of external assistance including BDS
- Initial funding and mid-term operating plan
- Projection of financial statements

A business planning is basically entrusted to the BDS provider, but a few key SME members will be nominated to participate in preparation of the plan.

Implementation

Targets: IHCW and member cluster SMEs
Provider: BDS provider (assisted by JICA Study Team)
Place: IHCW's meeting room
Period: Within one or two months

After the planning, then IHCW and member SMEs will step toward the initial execution stage, comprising of the following activities;

- Invitation of cluster SMEs willing to be the share-holder of the new organization
- Actual fund-raising and financial arrangement for the preparation of opening-capital
- Required registration procedure
- Business operation in accordance with mid-term operating plan

(3) Expected Output / Outcome

- Business plan for new co-operative organization
- Progress of the business plan

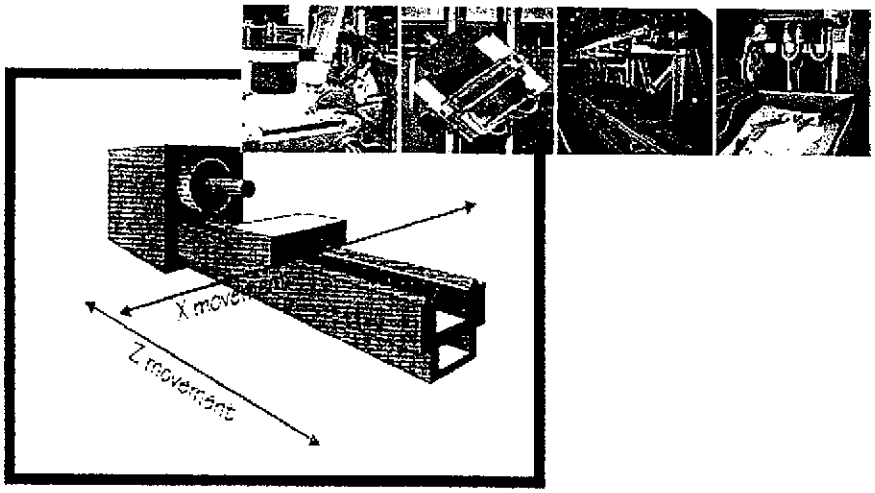
Pilot Metalwork Cluster, Waru-Sidoarjo

Attachment 1-2 : Text for the Drawing Workshop (Indonesian)

bekerja sama dengan

Jurusan Teknik Industri
Institut Teknologi Sepuluh Nopember (ITS) Surabaya

DRAWING WORKSHOP



PELATIHAN MENGGAMBAR TEKNIK

Penyusun :
Yudha Prasetyawan

Trainer :
Yudha Prasetyawan
Arief Rahman

SIDOARJO, JAWA TIMUR
2003

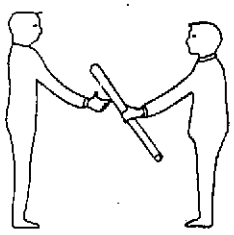
1 PENGANTAR : PERLUNYA MENGGAMBAR TEKNIK

Gambar sebagai Bahasa Teknik

- Gambar dan Bahasa ditujukan untuk meneruskan informasi.
- Bahasa diwujudkan melalui serangkaian kalimat yang harus dapat menyampaikan maksud si penulis kepada pembaca, hal tersebut sangat tergantung pada penyampaian dan pemahaman.
- Gambar mewakili sebuah ungkapan bahasa yang sangat kaya dan dapat dipakai untuk menyampaikan suatu informasi yang akurat, dan relatif tidak memerlukan kemampuan pemahaman yang tinggi dikarenakan sudah ada standar yang dipakai (persepsi yang sama).
- Gambar teknik lebih ditujukan untuk meneruskan gambar yang dilengkapi berbagai keterangan secara tepat dan obyektif. Keterangan tidak perlu dengan bahasa, tetapi cukup dengan lambang-lambang.

Tabel 1.1 Bahasa dan Gambar.

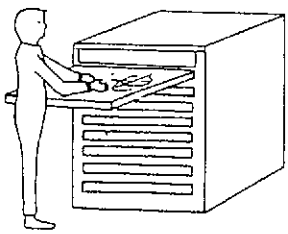
	Lisan	Kalimat	Gambar
Indra	Akustik	Visual	Visual
Ekspresi	Suara	Kalimat	Gambar
Aturan	Tata bahasa		Standar gambar



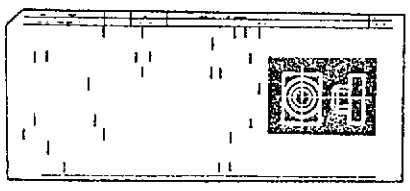
Gb. 1.1 Penyampaian informasi.

Fungsi Gambar

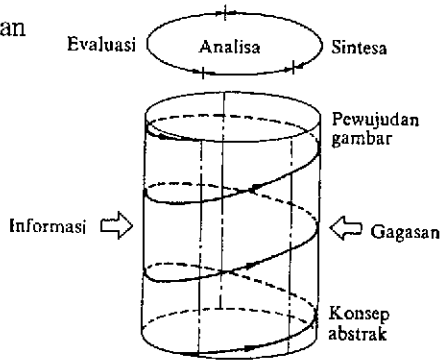
- Penyampaian informasi, meneruskan maksud perancang dengan tepat kepada orang-orang yang dituju (bagian produksi ataupun para pelanggan)
- Penyimpanan dan penggunaan, informasi yang dapat disimpan dan dapat digunakan sewaktu-waktu. Misalnya untuk pengembangan produk baru dengan inspirasi dari produk lama
- Sarana proses pemikiran dari sebuah perencanaan



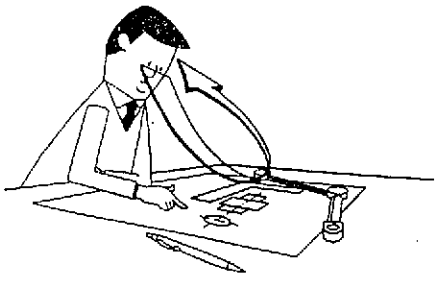
Gb. 1.2 Pengawetan, penyimpanan dan penggunaan informasi.



Gb. 1.3 Kartu berlubang dengan gambar film mikro.



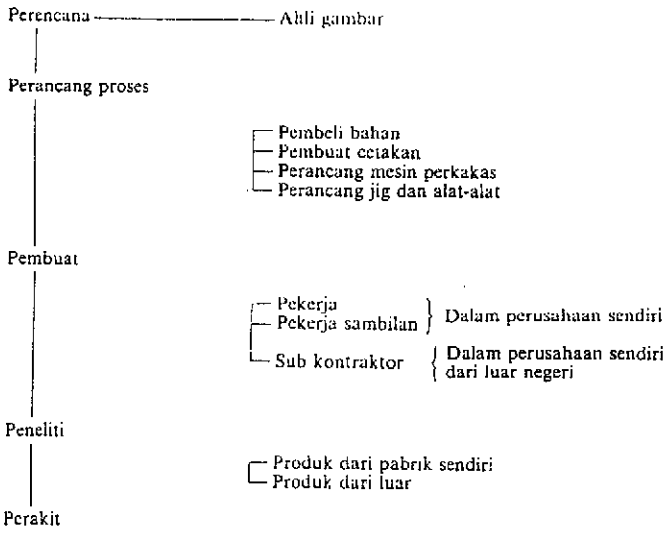
Gb. 1.4 Proses pemikiran dari perencanaan dan gambar.



Gb. 1.5 Gambar sebagai cara untuk direnungkan.

Pengembangan Gambar dan Keadaan Teknik

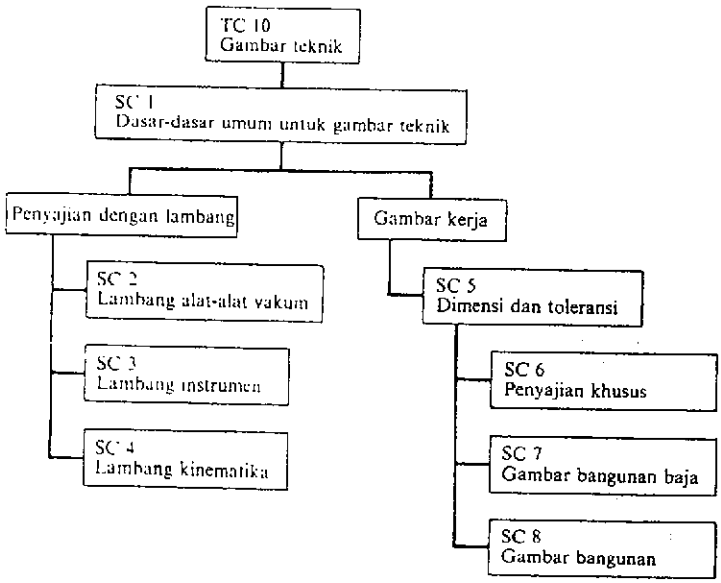
- Pada permulaan industri, perencana dan pembuat merupakan orang yang sama, tetapi perkembangan menunjukkan bahwa hal tesebut sudah merupakan perpaduan fungsi lintas bagian/departemen maupun lintas perusahaan
- Standar gambar akan disesuaikan dengan kebutuhan misalnya untuk cara penggambaran manual / terkomputerisasi, cara reproduksi, penyimpanan dan sebagainya



Gb. 1.6 Pemakai gambar.

Tujuan Mempelajari dan Menerapkan Gambar

- Internasionalisasi gambar, untuk memudahkan komunikasi hasil gambar dalam dunia tanpa batas (borderless world) perlu adanya suatu keseragaman, dan hal tersebut sudah dituangkan dalam kerangka standar gambar teknik ISO/TC10 yang dirumuskan tahun 1978



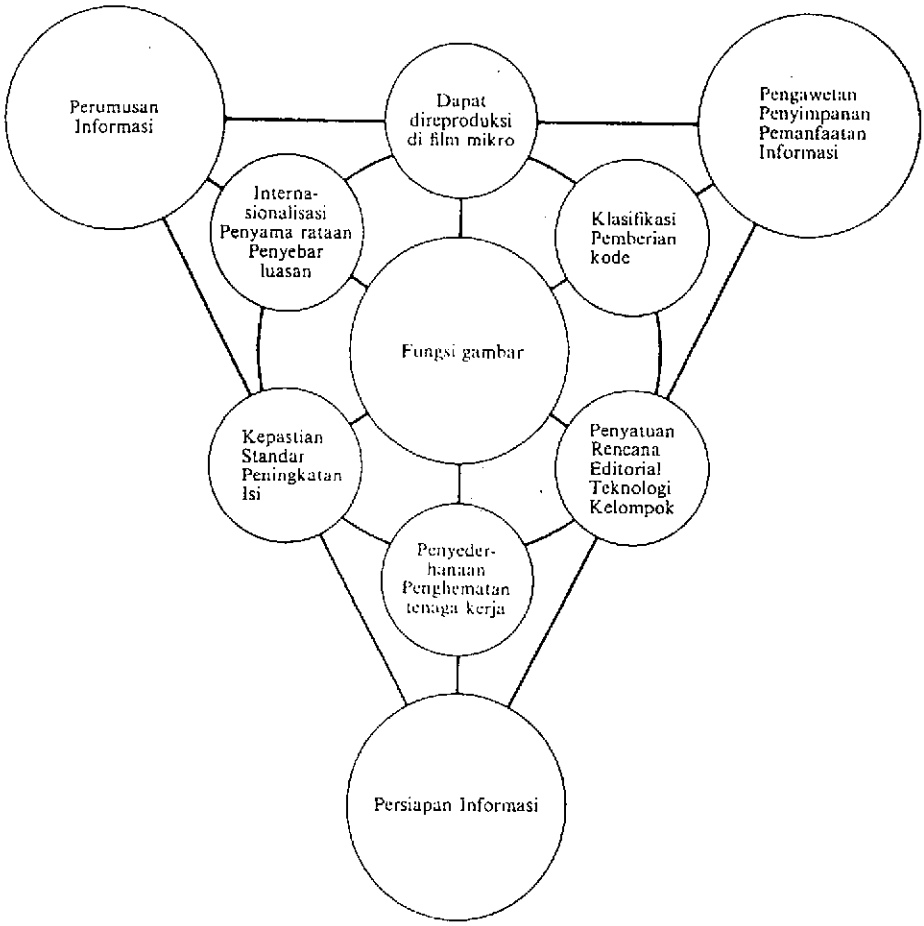
Gb. 1.7 Kerangka dan ISO/TC 10.

Tabel 1.2 Rangka dari ISO/TC 10.

SC	WG	Judul	Sekretariat	Sub laporan
SC 1		Dasar-dasar umum	NNI	
SC 2		Lambang-lambang untuk teknologi vakum	AFNOR	
SC 3		Lambang-lambang untuk instrumentasi	ANSI	
SC 4		Lambang-lambang untuk kinematik	GOST	
	WG 3	Lambang-lambang untuk instrumentasi penghitung, pengukur, pencatat dan otomatis	ANSI	
SC 5		Memberi ukuran dan toleransi	SNV	
	WG 1	Revisi dari rekomendasi ISO R 1101-1969	SNV	
	WG 2	Toleransi posisi, dasar dan sistim-sistim dasar.	SNV	
	WG 3	Prinsip bahan maksimum dan hal-hal yang berhubungan	ANSI	
	WG 4	Revisi dari rekomendasi ISO R 129-1959 (bekerja sama dengan ISO/TC 10/SC 8)	ANSI	
	WG 5	Penafsiran limit ukuran dan hubungannya dengan toleransi bentuk dan posisi dan kekasaran permukaan.	ANSI	
	WG 6	Dasar-dasar pengukaran dan hal-hal yang berhubungan (bekerja sama dengan ISO/TC 3/SC 3)	SIS	
	WG 7	Istilah	ANSI	
SC 6		Penyajian ukuran pada gambar teknik	DIN	
	WG 1	Penunjukan pada gambar: Bagian-bagian yang dihasilkan oleh proses pembentukan.	DIN	
	WG 2	Penyederhanaan gambar instalasi pipa.	NNI	
	WG 3	Penyederhanaan gambar bantalan gelinding	DIN	
	WG 4	Penyederhanaan gambar perapat (seal)	DIN	
	WG 5	Penunjukan elemen, sistim dan instrumen optik pada gambar	—	
	WG 6	Penyajian pengikat	—	
SC 7		Pekerjaan struktur logam	UNI	
SC 8		Gambar bangunan	SIS	
	WG 3	Gambar struktur kerangka komponen prefab (termasuk masalah perakitannya)	GOST	
	WG 4	Pipa-memipa (Plumbing), pemanasan (Heating), ventilasi dan salurannya (Ducting).	SIS	
	WG 5	Perencanaan kota	—	
	WG 8	Lambang untuk gambar penyelidikan lapangan yang menyangkut mekanika tanah.	NSF	
	WG 9	Instalasi pipa luar	—	
	WG 10	Istilah	—	

- Mempopulerkan gambar, pada lingkungan teknologi yang berkembang, jumlah orang yang harus membaca dan menggunakan meningkat jumlahnya.
- Perumusan gambar, diperlukan untuk gambar yang melibatkan lintas bidang, misalnya arsitektur, perkapalan, teknik sipil dan sebagainya
- Sistematika gambar, diperlukan untuk memudahkan penyajian gambar
- Penyederhanaan gambar, penghematan waktu dan peningkatan mutu perencanaan.
- Modernisasi gambar, cara baru telah dikembangkan seperti misalnya : film mikro, Computer Aided Design (CAD) dan sebagainya.

Dengan demikian, untuk mendapatkan fungsi gambar teknik sebagai sarana informasi harus ditunjang oleh sifat-sifat kepastian standar, dapat direproduksi dan lain-lain. Selengkapnya dapat dilihat pada gambar berikut ini.



Gb. 1.8 Fungsi dari sifat gambar.

2 PENGUNAAN ALAT GAMBAR

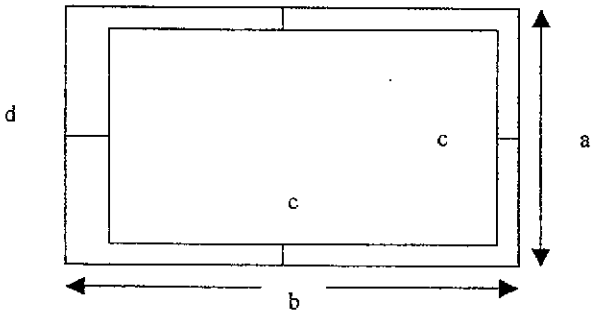
Alat-alat gambar sangat berguna untuk mewujudkan gambar teknik dalam sajian yang tepat dan mudah dipahami. Beberapa alat gambar antara lain : kertas gambar, pensil (potlot) gambar, jangka, penggaris T, penggaris segitiga, mal lengkungan, mal bentuk, penggaris skala, busur derajat, penghaspus, pita gambar, mesin gambar dan gambar.

Bila menggambar teknik menggunakan bantuan komputer, misalnya CAD, maka keberadaan alat tersebut hanya dipergunakan saat membuat sketsa (gambar kasar) dan saat mencetak hasil di atas kertas gambar.

Kertas Gambar dan Ukurannya

Berbagai macam kertas gambar (kertas putih, kalkir, film, dsb) dipakai sesuai dengan tujuan gambar

- Pembuatan sketsa cukup dilakukan pada kertas putih biasa ataupun kertas milimeter yang mudah dihapus
- Pembuatan gambar asli, digambar di atas kertas kalkir karena cetak biru dapat langsung dibuat dari kertas tersebut. Gambar dengan pensil dilakukan di kertas kalkir kasar, sedangkan dengan tinta di kertas kalkir mengkilap
- Pembuatan film gambar, dibuat dari polyester, karena dipergunakan untuk gambar yang sangat teliti di mana sifat tahan lama gambar sangat diperlukan (tidak boleh memuai maupun menyusut.
- Ukuran kertas gambar yang mudah diperoleh adalah dengan standar sebagai berikut.



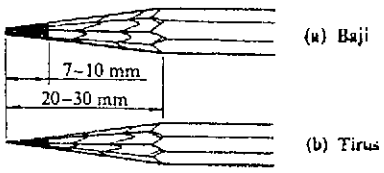
Tabel 2.1 Lambang dan ukuran kertas gambar.

Lambang		A0	A1	A2	A3	A4
$a \times b$		841 × 1189	594 × 841	420 × 594	297 × 420	210 × 297
c min.		20	20	10	10	10
d min	Tanpa tepi jepit	20	20	10	10	10
	Dengan tepi jepit	25	25	25	25	25

Pensil Gambar

Pensil gambar dibedakan menurut cara pemakaiannya.

- Pensil biasa, pensil gambar dibagi menurut kekerasannya, berturut-turut H (Hard), F (Firm) atau HB (Half Black) dan B (Black). Tiap golongan dibagi lagi dalam 6 tingkat kekerasan yang dinyatakan dengan angka. Golongan keras dari 9H sampai dengan 4H; golongan sedang dari 3H sampai B; dan golongan lunak dari 2B sampai dengan 7B. Untuk mendapatkan garis "tebal" maka pensil harus ditajamkan dan diputar pelan-pelan saat pemakaian (bentuk baji).



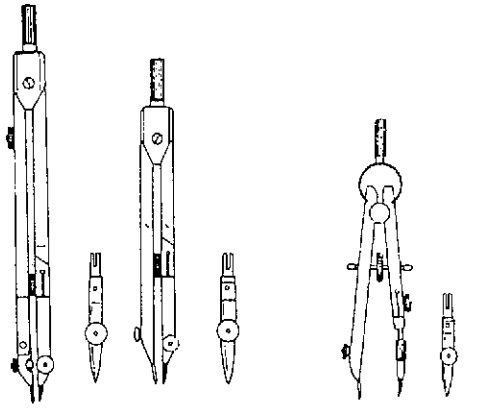
Gb. 2.1 Bentuk ujung potlot.

- Pensil mekanik, pensil ini dapat diisi kembali. Pensil jenis ini memberikan keuntungan dengan waktu meraut pensil yang menjadi berkurang. Ukuran isinya sesuai dengan pensil biasa dan tersedia berbagai ketebalan 0,3; 0,5; 0,7 dan 0,9. Karena ukurannya yang kecil maka penggunaannya harus hati-hati agar tidak mudah patah.

Perlengkapan Jangka

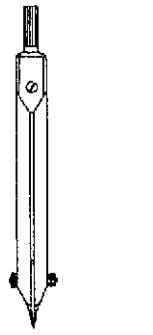
Perlengkapan ini penting artinya dan berharga dalam pembuatan gambar. Ujung jangka hendaknya dapat dipertukarkan antara tinta dengan pensil.

- Jangka, jangka menjadi 3 bagian, jangka besar untuk menggambar diameter 100–200 mm, jangka menengah untuk lingkaran 20-100 mm,dan jangka kecil untuk lingkaran 5-30 mm. Di samping itu terdapat jangka pegas untuk membuat bundaran-bundaran kecil.
- Jangka pembagi, alat ini digunakan untuk memindahkan ukuran, atau membagi garis lurus menjadi beberapa bagian yang sama, atau membuat tanda-tanda jarak yang sama.

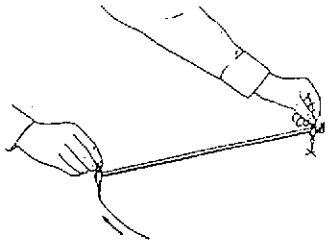


(a) Jangka besar (b) Jangka sedang (c) Jangka pegas

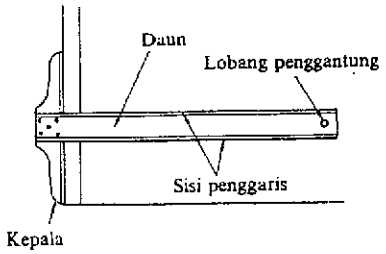
Gb. 2.2 Macam-macam jangka.



Gb: 2.3 Jangka pembagi.



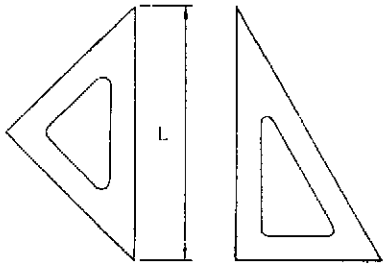
Gb. 2.4 Jangka batang.



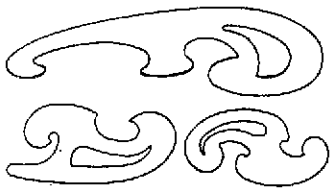
Gb. 2.5 Penggaris-T.

Penggaris

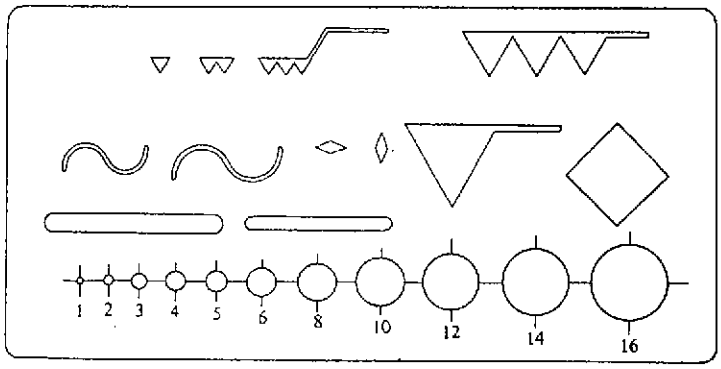
- Penggaris-T, terdiri atas bagian kepala dan daun. Garis-garis horisontal dapat dibuat dengan penggaris ini dengan menekankan bagian kepala di tepi kiri meja gambar, dan digeser ke atas atau ke bawah.
- Segitiga, diperlukan sepasang yang terdiri dari segitiga siku-siku sama kaki, dan sebuah segitiga sama sisi 60°. Ukuran segitiga adalah L dan besarnya 100-300 mm.
- Mal lengkungan, untuk menggambar garis lengkung yang tidak dapat dibuat oleh jangka.
- Mal bentuk, untuk membuat gambar secara cepat untuk bentuk yang tersedia (misalnya untuk simbol)



Gb. 2.6 Segi-tiga.



Gb. 2.7 Mal lengkungan.

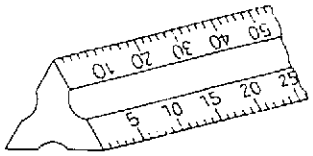


Gb. 2.8 Sablon bentuk.

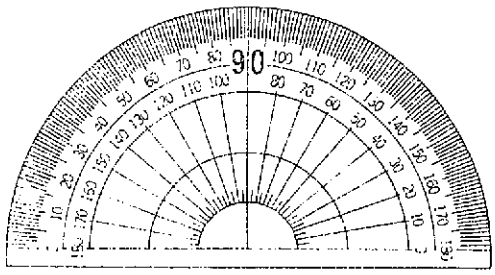
Alat-alat Lain

Berbagai macam alat lain yang umumnya diperguanakan adalah :

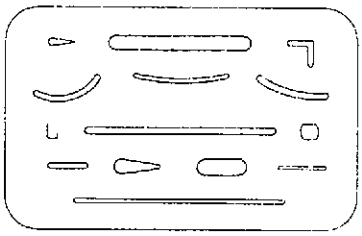
- Mistar skala, biasanya terbuat dari kayu ataupun plastik dengan panjang umumnya 300 mm
- Busur derajat, biasanya terbuat dari aluminium ataupun plastik. Busur derajat ini mempunyai garis pembagi dari 0° sampai dengan 180°. Alat ini dipakai untuk mengukur sudut ataupun membagi sudut.
- Penghapus, dipergunakan untuk membuang garis salah (menghilangkan gambar tanpa merusak kertas).
- Pelindung penghapus, dipakai untuk membantu saat menghilangkan garis yang berdekatan.



Gb. 2.9 Mistar skala.

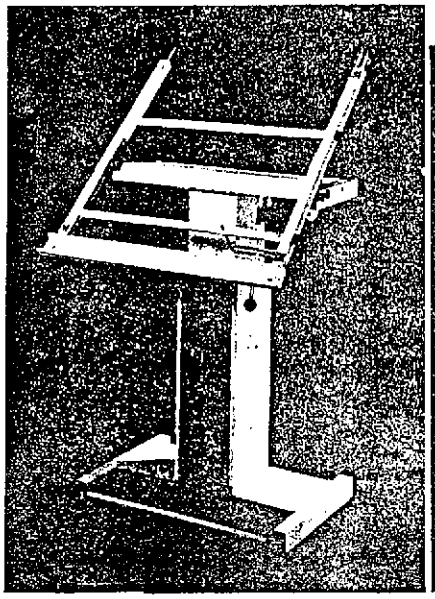


Gb. 2.10 Busur derajat.

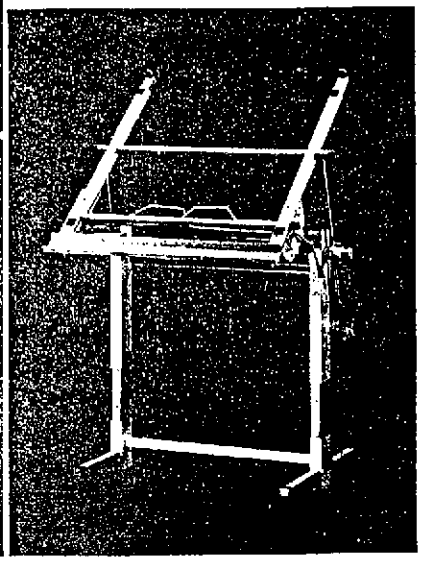


Gb. 2.11 Pelindung penghapus.

- Pita gambar, untuk menempelkan kertas pada papan gambar
- Alas kertas gambar, jika langsung pada papan maka akan terdapat bekas-bekas tusukan jangka, maka perlu alas plastik yang lunak.
- Papan gambar dan meja gambar, harus mempunyai permukaan yang rata dan tepi yang lurus dimana penggaris-T digeser, ukuran yang ada disesuaikan dengan kertas gambar.



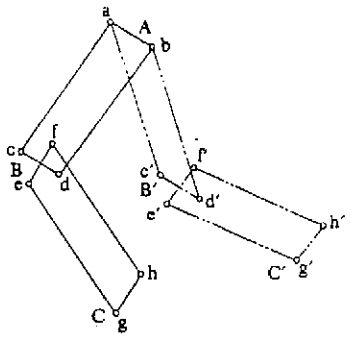
Gb. 2.12 Meja gambar sederhana.



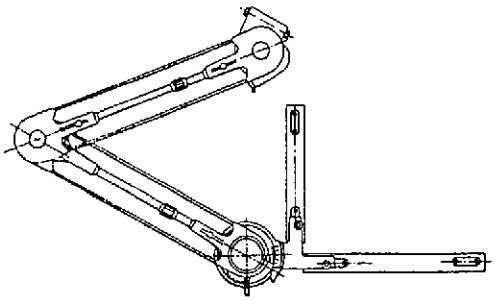
Gb. 2.13 Meja gambar.

Mesin Gambar

Mesin gambar merupakan alat yang dapat menggantikan alat-alat seperti busur derajat, penggaris-T, segitiga dan ukuran, serta dapat dipakai untuk mekanisme gerak sejajar.



Gb. 2.14 Mekanisme batang dari sebuah mesin gambar.

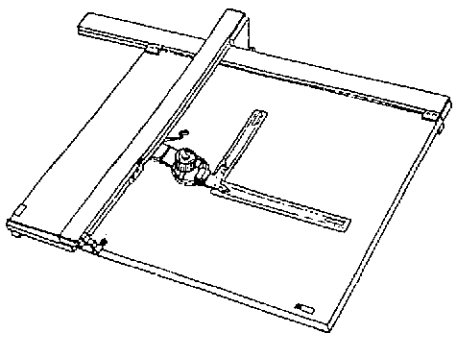


Gb. 2.15 Mesin gambar pita.

Tabel 2.2 Jenis-jenis Mesin Gambar.

Jenis	Lambang	Daerah kerja (mm)	Kombinasi skala	
			P (Jenis-Pita)	L (Jenis-Batang)
Jenis A0–L	A0–L	A0 1000	400L–250L	500L–300L
Jenis A1–L	A1–L	A1 800	400L–250L	400L–250L
Jenis A1–S	A1–S	A1 710	300S–200S	300S–200S

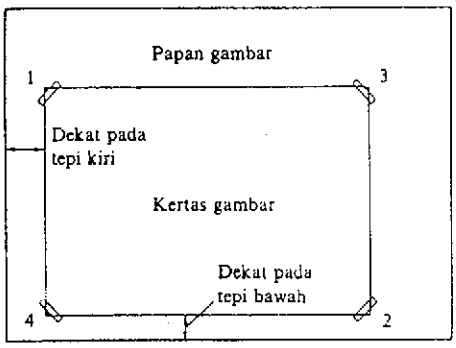
Catatan: (1) Lambang A0 dan A1 masing-masing dipergunakan pada papan gambar jenis A0 dan A1.
(2) Lambang L dan S masing-masing menunjukkan jenis besar dan kecil.
Tiap jenis mempunyai peralatannya sendiri.



Gb. 2.16 Mesin gambar kereta.

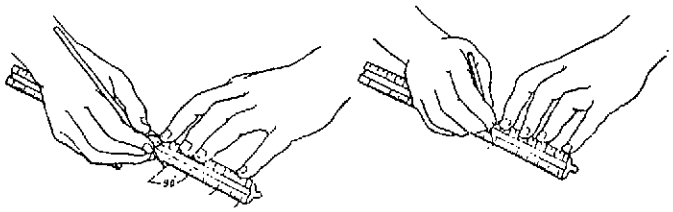
Penggunaan Alat-alat Gambar

- Menempatkan kertas gambar, kertas putih biasa diletakkan dengan muka yang halus menghadap ke atas. Ukuran kertas harus disesuaikan dengan benda yang akan digambar.



Gb. 2.17 Penempatan kertas gambar.

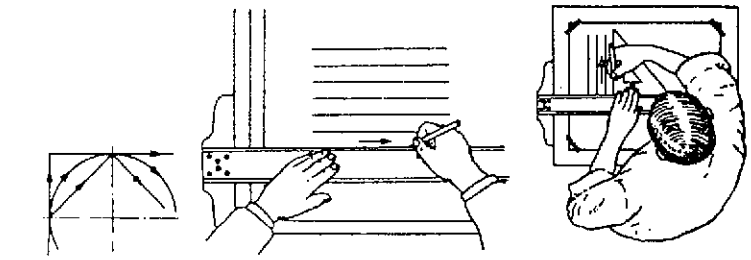
- Memindahkan Ukuran, mistar diletakkan sejajar mungkin dengan garis dimana ukuran akan diletakkan. Dianjurkan untuk tidak memindahkan ukuran langsung dari mistar ukur ke jangka pembagi.



(a) (b)

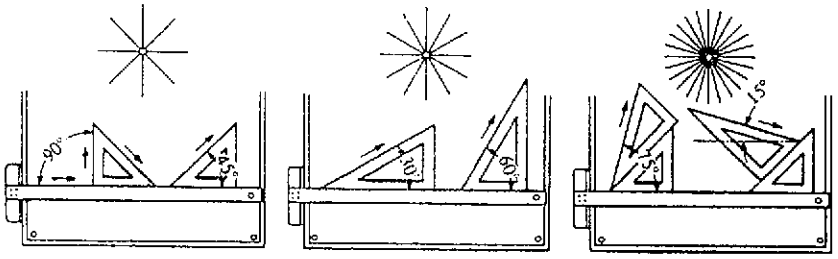
Gb. 2.18 Cara memindahkan ukuran.

- Menggambar garis lurus, garis lurus mendatar ditarik dari kiri ke kanan, sedangkan garis vertikal dari atas ke bawah. Garis sembarang ditarik dari kiri ke kanan. Pembuatan garis dapat dilakukan dengan bantuan penggaris-T ataupun segitiga, termasuk untuk membuat kemiringan tertentu.

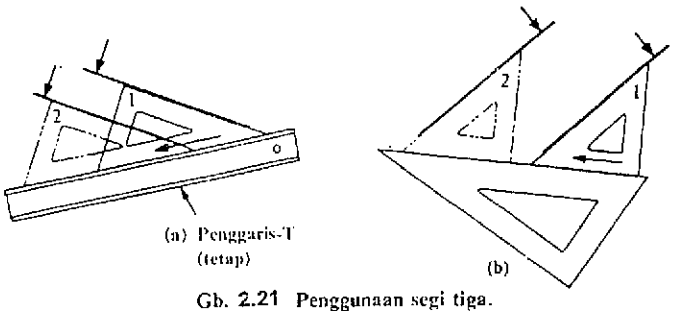


(a) Arah menarik garis (b) Garis horizontal (c) Garis vertikal

Gb. 2.19 Menggambar garis lurus.

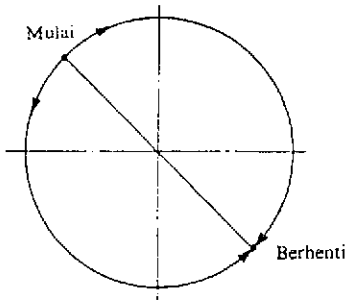


Gb. 2.20 Penggunaan segi tiga.

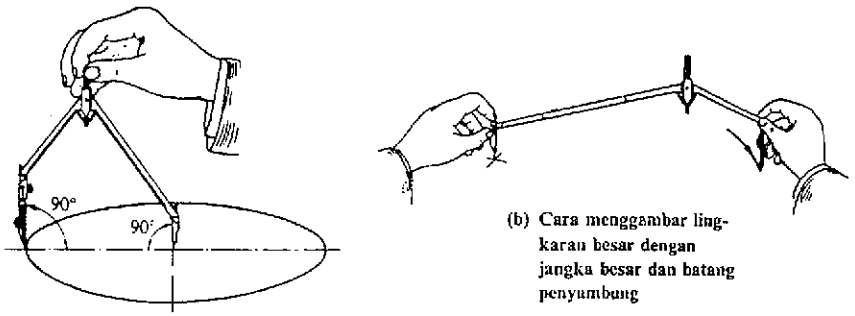


Gb. 2.21 Penggunaan segi tiga.

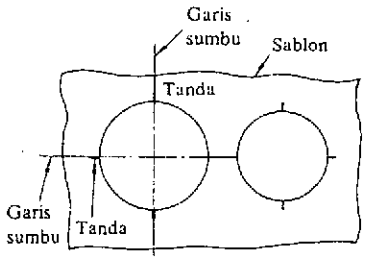
- Menggambar lingkaran, lingkaran kecil dapat digambar sekaligus dengan jangka kecil. Jangka dipergunakan dalam posisi kedua kakinya tegak lurus pada kertas gambar dan ditekan secara konstan untuk mendapat tebal garis yang sama. Garis lengkung dapat dibuat dengan menggunakan mal, dan umumnya tidak dapat diselesaikan dalam satu tarikan sekaligus.



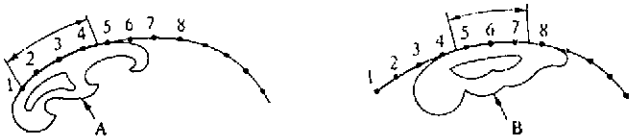
Gb. 2.22 Arah penggambaran sebuah lingkaran besar.



Gb. 2.23 Cara menggambar lingkaran.



Gb. 3.26 Sablon lingkaran. Tanda-tanda harus berimpit dengan garis sumbu.



Gb. 2.24 Penggunaan mal.

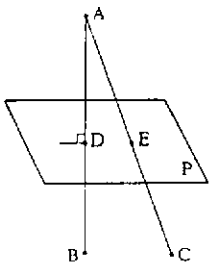
3 PROYEKSI DAN POTONGAN (IRISAN)

PROYEKSI

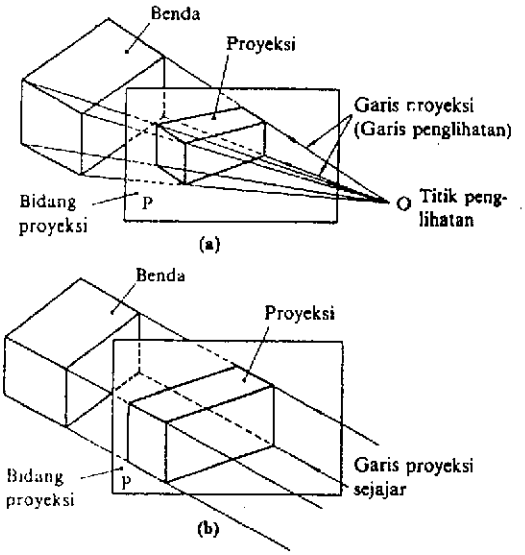
Proyeksi merupakan cara untuk menyajikan benda 3 dimensi dalam sebuah bidang gambar dua dimensi.

- Ortogonal, proyeksi sejajar dengan garis-garis proyeksi dan tegak lurus pada bidang proyeksi
- Miring, garis proyeksi dibuat membentuk sudut dengan bidang proyeksi

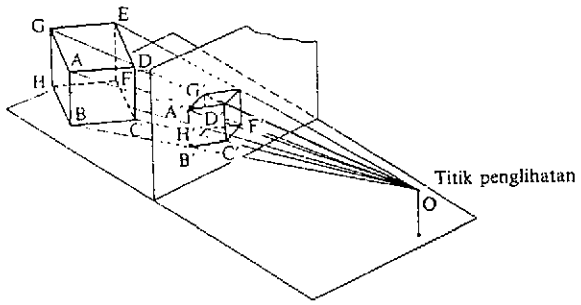
Pada umumnya digunakan proyeksi ortogonal



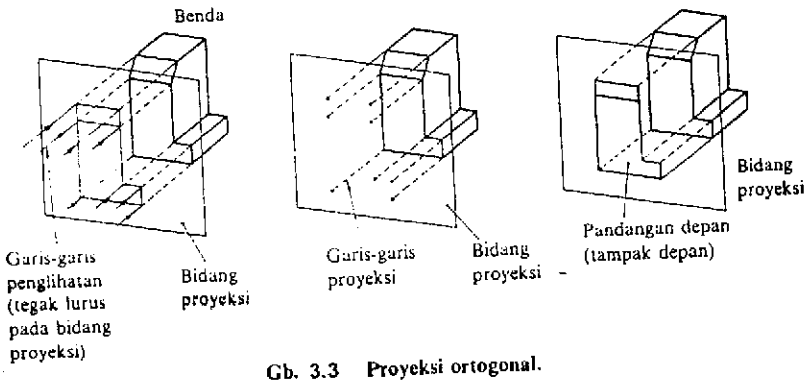
Gb. 5.1 Proyeksi.



Gb. 3.1 **Proyeksi dari sebuah benda.**

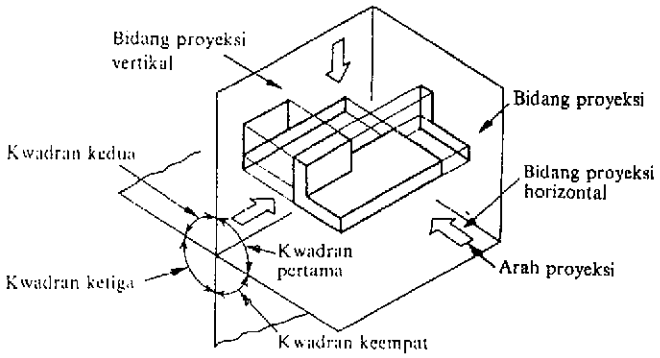


Gb. 3.2 Proyeksi perspektif.



Gb. 3.3 **Proyeksi ortogonal.**

- Bidang-bidang proyeksi yang paling banyak digunakan adalah bidang horizontal dan vertikal. Bidang utama ini membagi seluruh ruang menjadi 4 kuadran.
- Jika benda yang akan digambar diletakkan pada kuadran pertama, dan diproyeksikan pada bidang-bidang proyeksi, maka cara proyeksi ini disebut "proyeksi kuadran pertama" atau " cara proyeksi sudut pertama", demikian juga untuk kuadran ke dua, tiga dan empat.
- Gambar-gambar pandangan pada umumnya digambar menurut cara proyeksi sudut pertama atau sudut ke tiga.



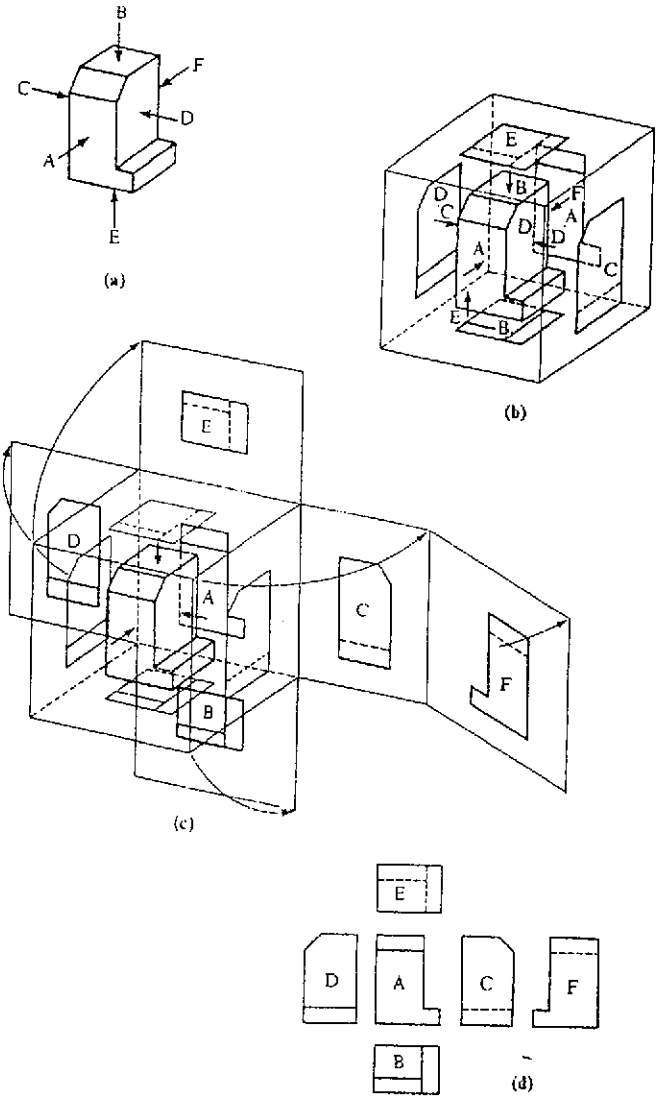
Gb. 3.4 **Bidang koordinat utama dan kwadran-kwadran.**

Cara Proyeksi Sudut Pertama

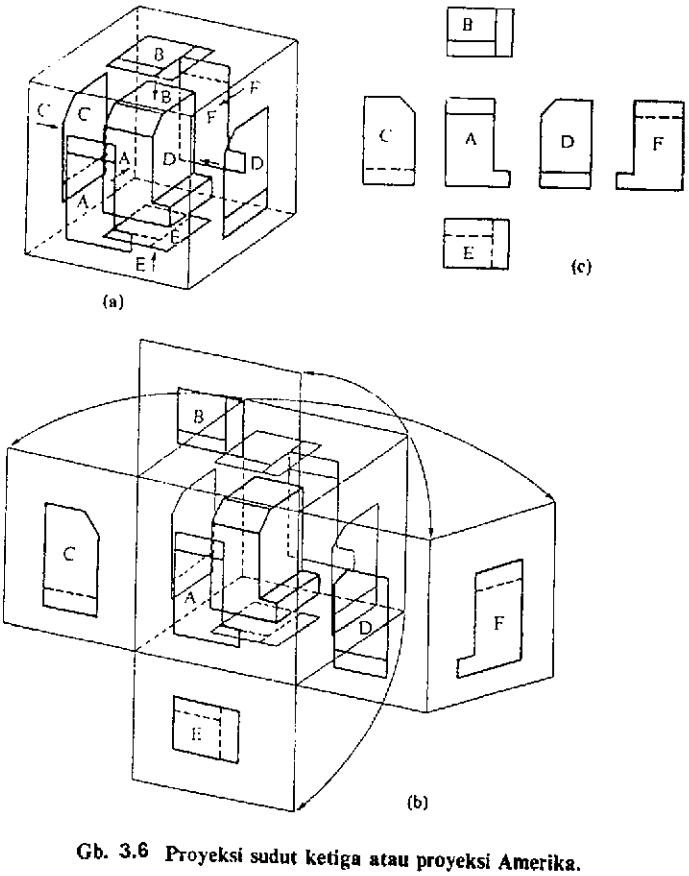
- Benda sebagaimana tampak pada bagian (a) diletakkan di depan bidang-bidang proyeksi (b).
- Benda diproyeksikan pada bidang belakang menurut garis penglihatan A, dan gambarnya adalah gambar pandangan depan [didorong].
- Jika proyeksi (b) telah dibuat semuanya, hasilnya kurang berguna (masih 3 dimensi), dimisalkan peti proyeksi dibuka dan dapat diletakkan pada satu bidang vertikal yang sama (c).
- Susunan gambar proyeksi harus diatur sedemikian rupa sehingga pandangan depan A dipakai sebagai patokan, pandangan kiri C di kanan, pandangan kanan D di kiri, pandangan bawah E di atas, sedangkan pandangan belakang F boleh ditempatkan di kiri ataupun kanan.
- Gambar tersebut disebut gambar proyeksi sudut pertama atau Cara "E", karena banyak dipergunakan di negara-negara Eropa, seperti : Jerman, Swiss, Perancis dan Rusia.

Cara Proyeksi Sudut Ketiga

- Benda yang akan digambar diletakkan dalam peti dengan sisi-sisi tembus pandang sebagai bidang-bidang proyeksi (a)
- Tiap bidang proyeksi akan tampak gambar pandangan dari benda menurut arah penglihatan, yang ditentukan oleh arah anak panah [ditarik]
- Pandangan depan dalam arah A dipilih sebagai pandangan depan, pandangan lainnya juga diproyeksikan menurut arah masing-masing anak panah (a).
- Sisi-sisi peti dibuka menjadi satu bidang proyeksi depan menurut arah anak panah (b).
- Hasil lengkap (c) dapat dilihat, padangan depan A sebagai patokan, pandangan atas B diletakkan di atas, pandangan kiri C diletakkan di kiri, pandangan kanan D diletakkan di kanan, pandangan bawah E diletakkan di bawah, dan pandangan belakang dapat diletakkan di kiri ataupun kanan.
- Susunan proyeksi yang demikian disebut gambar proyeksi sudut ke tiga, dan disebut juga cara "A" karena telah dipakai di Amerika, demikian pula Jepang, Australia, dan Kanada.



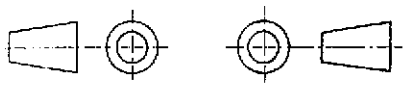
Gb. 3.5 Proyeksi sudut pertama atau proyeksi Eropah.



Gb. 3.6 Proyeksi sudut ketiga atau proyeksi Amerika.

Pengenalan Cara-cara Proyeksi dan Lambangnya

- Jika kedua cara proyeksi tersebut diperbandingkan, maka tampaklah bahwa gambar yang satu merupakan kebalikan dari yang lain.
- Standar ISO (ISO/DIS 128) ditetapkan bahwa kedua cara tersebut boleh dipergunakan
- Jika pada gambar telah ditentukan cara proyeksi yang dipakai, maka cara yang dipakai harus dituliskan dengan lambang.

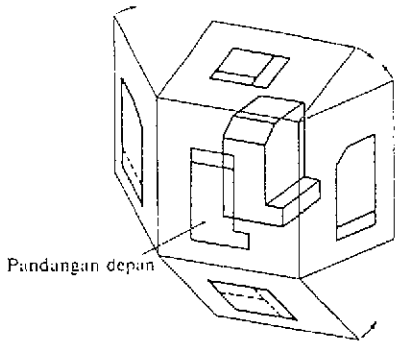


(a) Proyeksi sudut pertama. (b) Proyeksi sudut ketiga.

Gb. 3.7 Lambang cara proyeksi.

Kelebihan dari Proyeksi Sudut Ketiga

- Dari gambar, benda langsung dapat dibayangkan.
- Gambarnya mudah dibaca, karena hubungan antar gambar dekat (depan dengan kiri, dan sebagainya)
- Pandangan yang berhubungan diletakkan berdekatan, sehingga dengan demikian mudah untuk membaca ukuran-ukurannya.

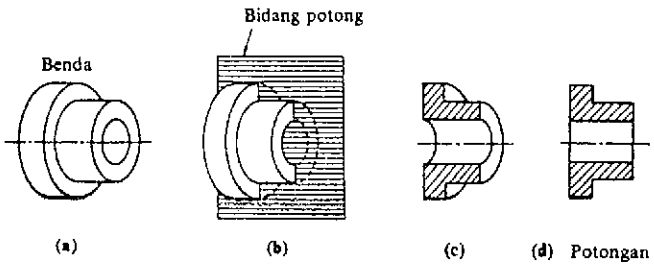


Dengan referensi pandangan depan, pandangan-pandangan yang lain dilipat tegak lurus, maka diperoleh bentuk benda sebenarnya

Gb. 3.8 Keuntungan cara proyeksi sudut ketiga.

POTONGAN

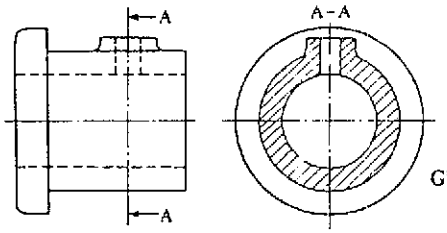
- Alasan utama adalah bahwa tidak jarang suatu benda memiliki rongga-rongga di dalamnya
- Bagian tersembunyi harus digambar dengan garis gores, jika banyak sekali bagiannya maka gambar tersebut tentu akan rumit sekali
- Gambar berikut ini adalah gambaran suatu benda dengan bagian yang tidak kelihatan, maka untuk memperlihatkan bentuk benda secara mudah dalam proyeksi, dilakukanlah pemotongan (perwujudan gambar potongan)



Gb. 3.9 Penjelasan mengenai potongan.

Penyajian Potongan

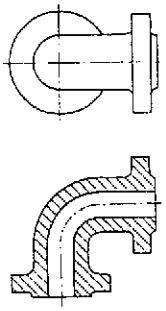
- Umumnya bidang potong dibuat melalui sumbu dasar dan potongannya disebut potongan utama.
- Bila perlu bisa dibuat di luar sumbu dasar, akan tetapi harus diberi tanda
- Aturan umum untuk gambar proyeksi berlaku juga untuk potongan



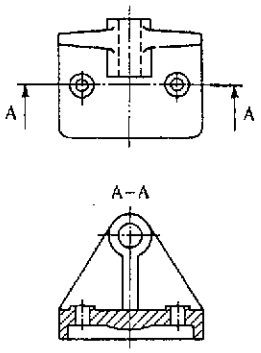
Gb.3.10 **Potongan tidak melalui garis sumbu dasar.**

Letak Potongan dan Garis Potong

- Jika letak bidang potong sudah jelas (umumnya melalui sumbu dasar), tidak perlu penjelasan tambahan
- Jika letak bidang potong tidak jelas, bidang tesebut harus dinyatakan oleh sebuah garis sumbu dan ujung-ujungnya dipertebal dan pada tempat garis tersebut berubah arah. Ujung garis potong diberi tanda huruf (kapital/besar), dan diberi anak panah yang menunjukkan arah penglihatan.



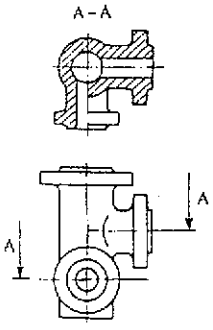
Gb.3.11 **Potongan melalui garis sumbu dasar.**



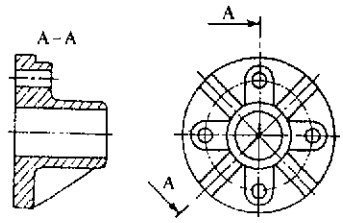
Gb 3.12 **Potongan dengan garis bidang potong**

Potongan oleh Lebih dari Satu Bidang

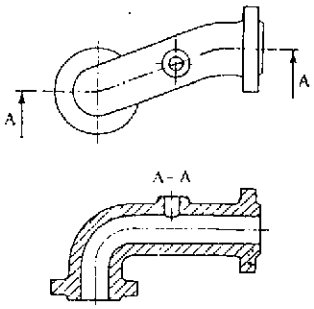
- Potongan meloncat, potongan-potongan dalam beberapa bidang sejajar dapat disatukan untuk penyederhanaan dan penghematan waktu.
- Potongan oleh dua bidang berpotongan, bagian-bagian simetrik dapat digambar pada dua bidang potong yang saling berpotongan (menyudut). Satu bidang potongan merupakan potongan utama, sedangkan bidang yang lain menyudut dengan bidang pertama diproyeksikan diputar hingga berhimpit pada bidang proyeksi pertama.
- Potongan pada bidang berdampingan, potongan pipa pada gambar berikut dapat dibuat dengan bidang-bidang yang berdampingan melalui garis sumbunya.



Gb.3.13 **Potongan meloncat.**



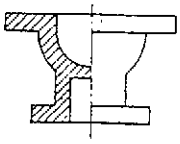
Gb. 3.14 Potongan dengan dua bidang menyudut.



Gb. 3.15 Potongan dengan bidang-bidang berdampingan.

Potongan Separuh

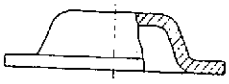
- Benda simetris dapat digambar separuh berupa potongan, separuh merupakan gambar pandangan
- Garis tersembunyi tidak perlu digambar dengan garis gores, karena sudah jelas pada gambar potongan



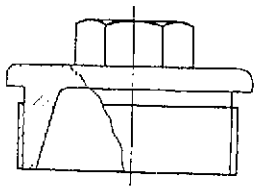
Gb. 3.16 Potongan setengah.

Potongan Setempat

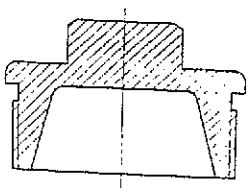
- Keperluan gambaran bagian kecil saja dari suatu benda
- Juga menunjukkan bagian benda yang tidak boleh dipotong



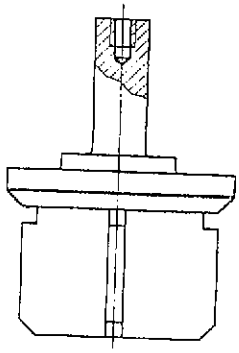
Gb. 3.17 (a) Potogan setempat.



(b) Potongan setempat.



(c) Potongan penuh.



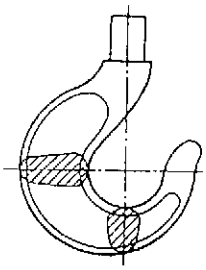
(d) Potongan setempat.

Potongan yang diputar di tempat atau dipindahkan

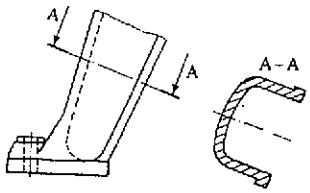
- Bagian tertentu dari benda seperti ruji roda, tuas, peleg, rusuk penguat dan sebagainya, penampangnya dapat digambar setempat
- atau setelah potongannya diputar, dipindahkan ke tempat lain.
- ada sedikit perbedaan, penampang digambar setempat dengan garis tipis, gambar penampang dipindahkan dengan garis tebal.

Susunan Potongan Berurutan

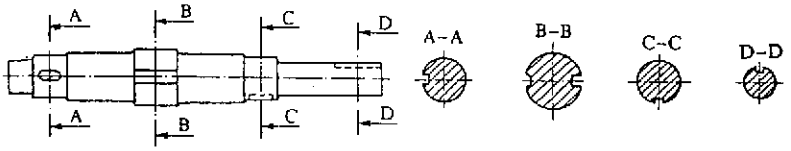
- Potongan dapat diletakkan di samping ataupun bawah untuk keperluan kemudahan menempatkan ukuran



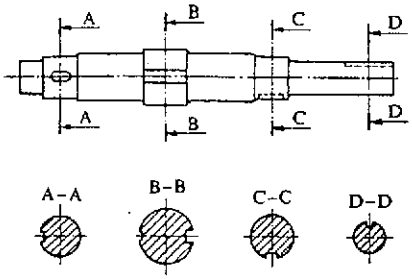
Gb.3.18 **Potongan diputar di tempat.**



Gb. 3.19 **Potongan diputar dan dipindahkan.**



Gb. 3.20 **Potongan berurutan.**



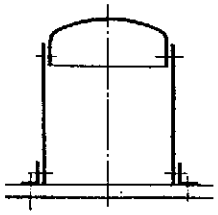
Gb. 3.21 **Potongan berurutan.**

Penampang-penampang Tipis

- Plat, baja ataupun profil dapat dibuat dengan garis tebal atau seluruh bagiannya dihitamkan
- Jika berdekatan, bagian perbatasan dibiarkan putih

Gb. 3.22 **Potongan benda tipis.**

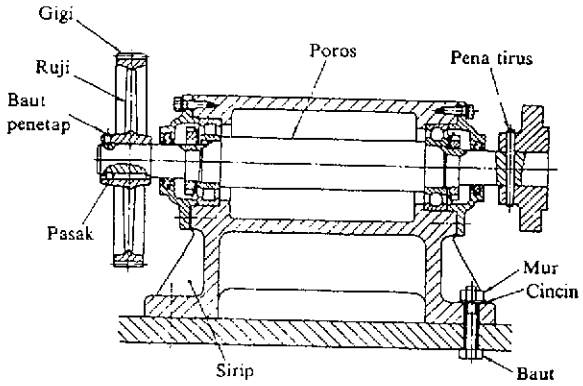
Gb. 3.23 **Potongan benda tipis dengan ruang kosong di antaranya.**



Gb. 3.24 **Potongan benda tipis digambar dengan garis tebal.**

Bagian Benda / Benda Yang Tidak Boleh Dipotong

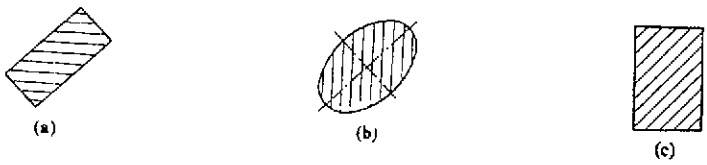
- Bagian benda seperti rusuk penguat, baut, paku keling, pasak, poros tidak boleh dipotong memanjang



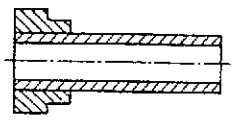
Gb. 3.25 Bagian-bagian yang tak dapat diperlihatkan oleh potongan.

Arsir

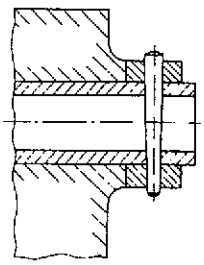
- Arsir berupa garis-garis tipis miring dipergunakan untuk membedakan gambar potongan dengan gambar pandangan
- Kemiringan arsir 45o terhadap garis sumbu, atau terhadap garis gambar.
- Jarak antar garis arsir disesuaikan dengan besarnya bagian yang diarsir
- Bagian potongan yang terpisah diarsir dengan sudut yang sama
- Arsiran dari bagian yang berdekatan harus dibedakan sudutnya agar jelas.
- Penampang yang luas dapat diarsir secara terbatas, yakni pada bagian kelilingnya saja.
- Potongan-potongan sejajar dari benda yang sama, yang terdapat pada potongan meloncat diarsir serupa, tetapi dapat juga digeser bila perlu
- Garis-garis arsir dapat dihilangkan untuk menuliskan huruf / angka, jika tidak dapat dilakukan di luar daerah arsir



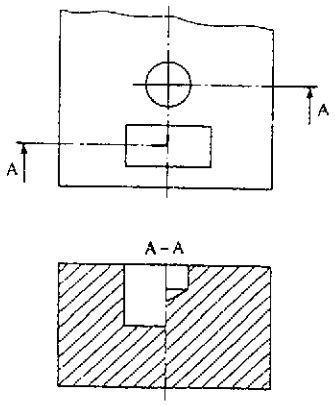
Gb. 3.26 Arsir.



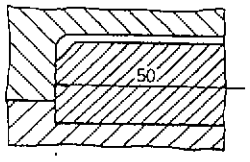
Gb. 3.27 Arsir dari bagian-bagian yang berdampingan.



Gb. 3.28 Arsir bidang yang luas.



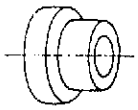
Gb. 3.29 Arsir pada potongan sejajar (meloncat).



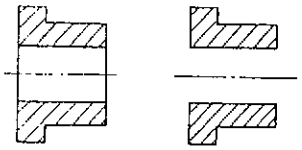
Gb. 3.30 Arsir dan angka.

Catatan Tentang Potongan

- Potongan dapat dipergunakan jika bentuk dalam dapat diperjelas dengan memotong bendanya
- Elemen mesin yang tidak boleh dipotong dalam arah memanjang, dapat digambar dengan potongan setempat.
- Gambar potongan tidak boleh hanya menunjukkan bagian yang dipotong saja



(a) Benda



(b) Benar (c) Salah

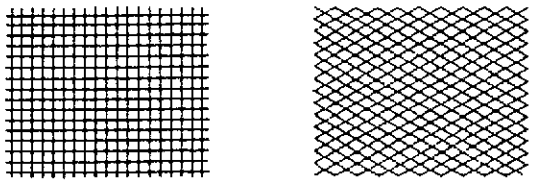
Gb. 3.27 Contoh potongan yang salah.

4 PEDOMAN-PEDOMAN DASAR

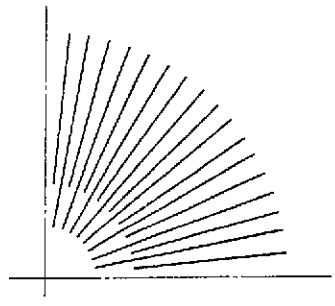
Pembuatan gambar teknik memakai pedoman-pedoman dasar, tidak hanya bertujuan untuk standarisasi, tetapi terlebih untuk menyelaraskan pemahaman antara pengguna dan pembuat. Pedoman dasar yang dimaksud meliputi penggunaan garis, penggunaan huruf dan pemberian ukuran.

Garis

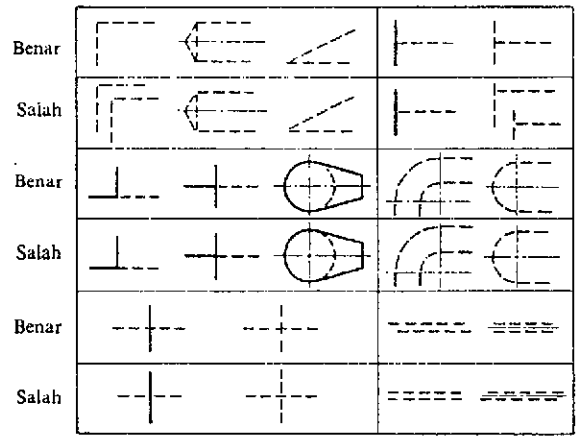
- Beberapa garis yang dipergunakan memiliki arti tersendiri
- Jenis garis dibedakan menjadi tebal dan tipis dengan perbandingan 1:0,5, sedangkan ukuran yang biasa dipakai adalah 0,18; 0,25; 0,35; 0,5; 0,7; 1; 1,4 dan 2 mm. Umumnya garis tebal adalah 0,5 atau 0,7 mm.
- Jarak antar garis diharapkan minimal 0,7 mm. Khusus garis sejajar berpotongan, diharapkan jaraknya paling sedikit 4 kali tebal garis
- Garis gores dan garis bertitik yang berpotongan atau bertemu, harus diperlihatkan secara jelas titik perpotongan/pertemuannya.



Gb. 4.1 Garis-garis sejajar yang saling berpotongan.



Gb. 4.2 Garis-garis yang memotong pada sebuah titik.



Gb. 4.3 Gambar garis gores dan garis bertitik.

- Penggunaan garis dalam bentuk dan tebal, dapat dilihat pada tabel di halaman selanjutnya.
- Bila dua garis atau lebih yang berbeda-beda jenisnya berhimpit, maka penampakkannya dalam gambar harus mengikuti prioritas sebagai berikut :
    1. Garis gambar (garis tebal kontinu, jenis A)
    2. Garis tidak tampak (garis gores tipis, jenis E)
    3. Garis potong (garis bergores, yang dipertebal pada ujung-ujungnya dan tempat-tempat perubahan arah, jenis H)
    4. Garis sumbu (garis bergores, jenis G)
    5. Garis Bantu, garis ukur, dan garis arsir (garis tipis kontinu, jenis B)

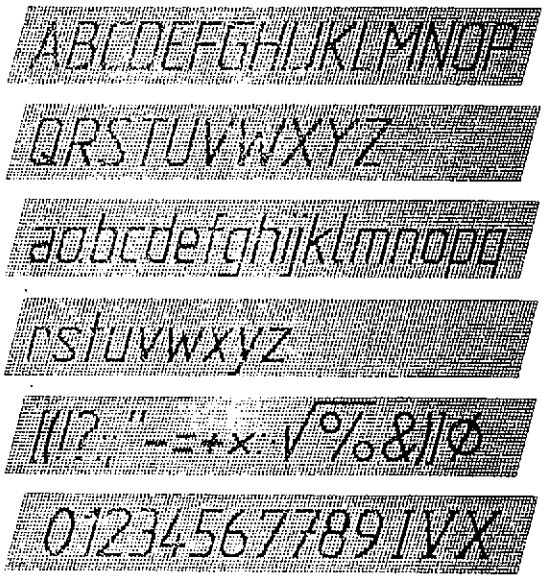
Tabel 4.1 Macam-macam garis dan penggunaannya.
(ISO. R 128)

Jenis garis	Keterangan	Penggunaan
A ———	Tebal kontinu.	A1. Garis-garis nyata (gambar). A2. Garis-garis tepi.
B ———	Tipis kontinu. (lurus atau lengkung)	B1. Garis-garis berpotongan khayal (imaginer). B2. Garis-garis ukur. B3. Garis-garis proyeksi/bantu. B4. Garis-garis penunjuk. B5. Garis-garis arsir. B6. Garis-garis nyata dari penampang yang diputar ditempat. B7. Garis sumbu penuck.
C ~~~	Tipis kontinu bebas.	C1. Garis-garis batas dari potongan sebagian atau bagian yang dipotong, bila batas-nya bukan garis bergores tipis.
D [1] ——/\/\/\——	Tipis kontinu dengan sig-sig.	D1. Sama dengan C1.
E – – – – –	Garis gores tebal [2].	E1. Garis nyata terhalang. E2. Garis tepi terhalang.
F – – – – –	Garis gores tipis.	F1. Garis nyata terhalang. F2. Garis tepi terhalang.
G ——— · ——— · ———	Garis bergores tipis.	G1. Garis sumbu. G2. Garis simetri. G3. Lintasan.
H	Garis bergores tipis, yang dipertebal pada ujung-ujungnya dan pada perobahan arah.	H1. Garis (bidang) potong.
J ——— · ——— · ———	Garis bergores tebal.	J1. Penunjukan permukaan yang harus mendapat penangan khusus.
K ——— ·· ——— ·· ———	Garis bergores ganda tipis.	K1. Bagian yang berdampingan. K2. Batas-batas kedudukan benda yang bergerak. K3. Garis sistem (pada baja profil). K4. Bentuk semula sebelum dibentuk. K5. Bagian benda yang berada di depan bidang potong.

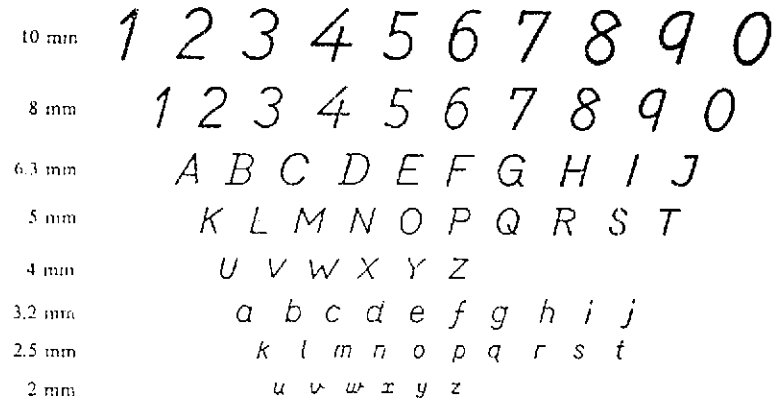
1) Garis ini cocok untuk gambar yang diproduksi dengan mesin.
2) Walaupun terdapat dua macam garis, tiap lembar memakai hanya satu macam saja (jangan dicampur!).

Huruf dan Angka

- Harus memiliki bentuk/ciri-ciri yang jelas, seragam, dapat dibuat microfilm / direproduksi
- Bentuk huruf dan angka harus mudah ditulis dan dibaca
- Standar ukuran dan angka dapat dilihat pada tabel berikut.

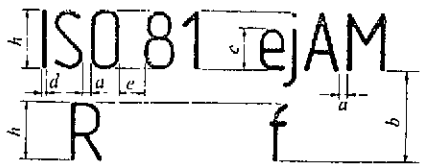


Gb. 4.4 Bentuk huruf-huruf (miring)-ISO.



Gb. 4.5 Bentuk huruf-huruf JIS.

Tabel 4.2 Perbandingan huruf yang dianjurkan.



Huruf A ($d = h/14$)

Sifat		Perbandingan	Ukuran						
Tinggi huruf Tinggi huruf besar	h	(14/14) h	2,5	3,5	5	7	10	14	20
Tinggi huruf kecil (Tanpa tangkai dan kaki)	c	(10/14) h	—	2,5	3,5	5	7	10	14
Jarak antara huruf	a	(2/14) h	0,35	0,5	0,7	1	1,4	2	2,8
Jarak minimum antara garis	b	(20/14) h	3,5	5	7	10	14	20	28
Jarak minimum antara perkataan	e	(6/14) h	1,05	1,5	2,1	3	4,2	6	8,4
Tebal huruf	d	(1/14) h	0,18	0,25	0,35	0,5	0,7	1	1,4

Catatan: Jarak antara dua huruf a boleh dikurangi setengahnya, bila mana ini memberi efek visual yang lebih baik; seperti misalnya LA, TV dsb., *d. h. i. a.* sama dengan tebal huruf d.

Huruf B ($d = h/10$)

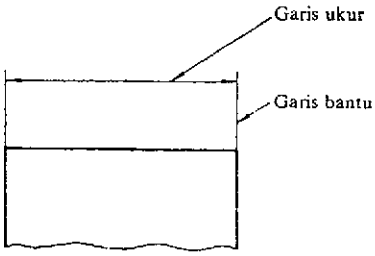
Sifat		Perbandingan	Ukuran						
Tinggi huruf Tinggi huruf besar	h	(10/10) h	2,5	3,5	5	7	10	14	20
Tinggi huruf kecil (Tanpa tangkai dan kaki)	c	(7/10) h	—	2,5	3,5	5	7	10	14
Jarak antara huruf	a	(2/10) h	0,5	0,7	1	1,4	2	2,8	4
Jarak minimum antara garis	b	(14/10) h	3,5	5	7	10	14	20	28
Jarak minimum antara perkataan	e	(6/10) h	1,5	2,1	3	4,2	6	8,4	1,2
Tebal huruf	d	(1/10) h	0,25	0,35	0,5	0,7	1	1,4	2

Catatan: Jarak antara dua huruf a boleh dikurangi setengahnya, bila mana ini memberi efek visual yang lebih baik; seperti misalnya LA, TV dsb., *d. h. i. a.* sama dengan tebal huruf d.

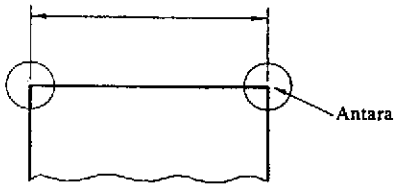
Ukuran

Aturan-aturan dasar untuk memberi ukuran

- Pada dasarnya ukuran-ukuran linier harus dilengkapi dengan garis bantu, garis ukur, dan angka ukur.

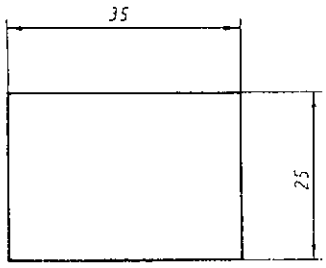


Gb. 4.6 **Garis ukur dan garis bantu.**

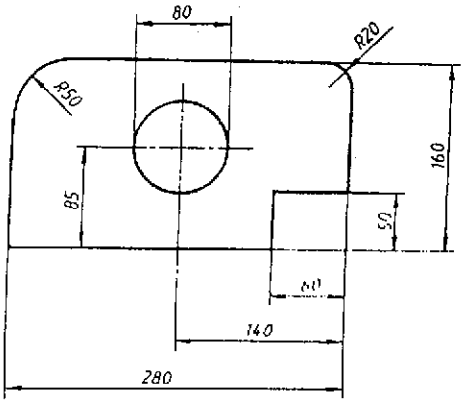


Gb. 4.7 **Garis bantu dan antara yang tampak.**

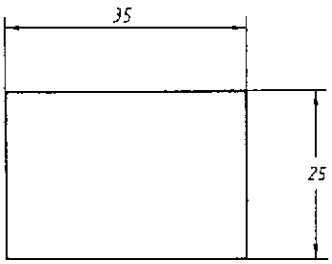
- Jika ruang antar garis bantu terlalu sempit untuk menempatkan anak panah, maka anak panahnya dapat diganti dengan titik.



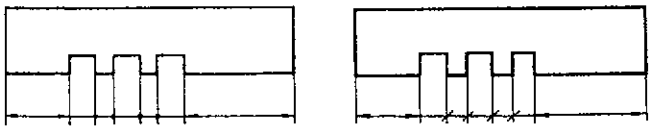
Gb. 4.8 **Ukuran-ukuran normal.**



Gb. 4.9 **Contoh memberi ukuran.**

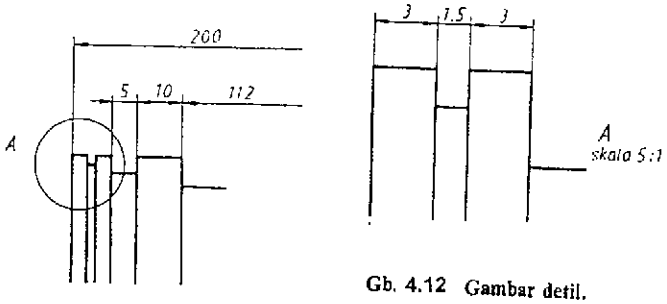


Gb. 4.10 **Ukuran-ukuran searah.**

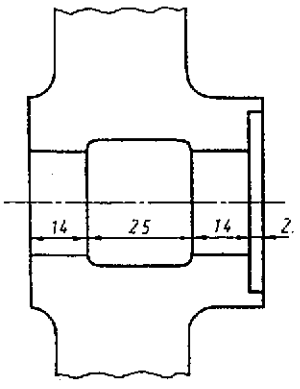


Gb. 4.11 **Ruang ukur yang sempit.**

- Garis ukur dapat ditarik langsung dari garis gambar, tanpa garis bantu.
- Garis gambar atau garis sumbu dapat dipergunakan sebagai garis bantu, tetapi tidak boleh dipakai sebagai garis ukur.

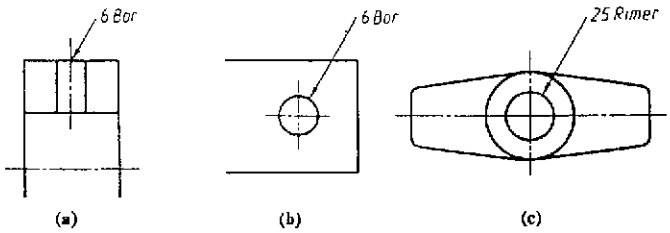


Gb. 4.12 **Gambar detil.**

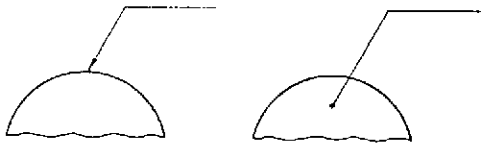


Gb. 4.13 **Garis gambar sebagai garis bantu.**

- Bagian-bagian seperti misalnya lubang yang dibor diberi ukuran dengan garis penunjuk, beserta ukurannya. Garis ukur diakhiri dengan titik bila dalam bidang gambar (bukan garis)

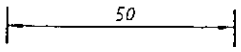


Gb. 4.14 Memberi ukuran lubang.

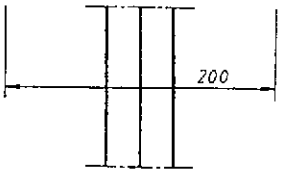


Gb. 4.15 Garis penunjuk.

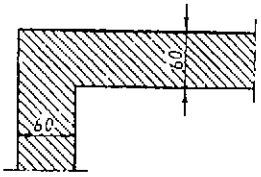
- Angka-angka ukur
  1. Diletakkan kira-kira di tengah dan sedikit di atas
  2. Jika berada dalam bagian arsir, arsiran di daerah angka ukur harus dihilangkan
  3. Dapat diletakkan dekat anak panah untuk mencegah sulitnya membaca karena menumpuk
  4. Pada bagian sempit dapat ditempatkan di luar garis ukur



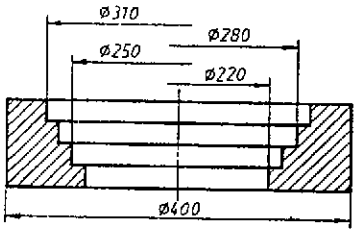
Gb. 4.16 Garis ukur dan angka.



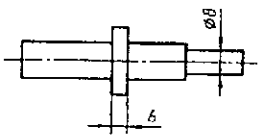
Gb. 4.18 Angka diletakkan di pinggir.



Gb. 4.20 Angka dan arsiran.

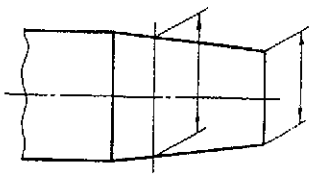


Gb. 4.17 Garis ukur sebagian.

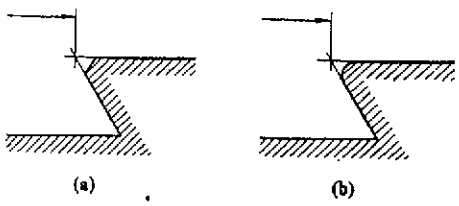


Gb. 4.19 Angka di atas perpanjangan garis ukur.

- Pada benda atau bagian benda yang agak miring, garis bantu juga disesuaikan
- Jika dua bidang miring berpotongan dan bagian lancip ini kemudian dibulatkan atau dipotong, maka ukuran harus diberikan dengan garis bantu khusus.

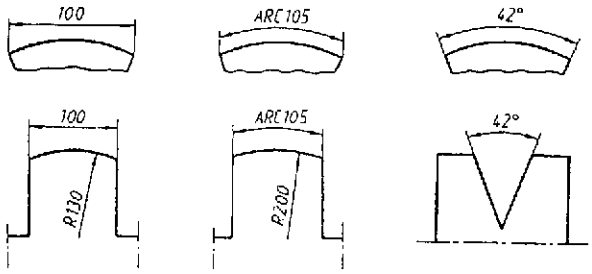


Gb. 4.21 Garis bantu miring.



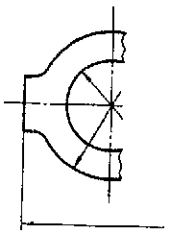
Gb. 4.22 Garis bantu khusus.

- Memberi ukuran pada tali busur, busur dan sudut.



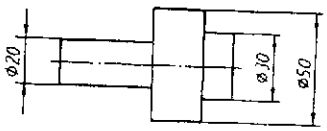
Gb. 4.23 Memberi ukuran tali busur, busur dan sudut.

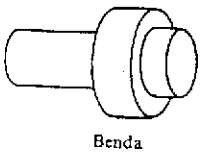
- Gambar sebagian dari benda simetris dapat dibuat garis ukur yang sedikit melebihi garis sumbu benda.



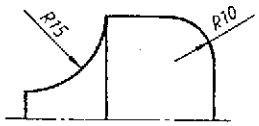
Gb. 4.24 Memberi ukuran benda simetris.

- Huruf dan lambang tambahan pada angka ukur (diameter, jari-jari, bujursangkar, bola, kemiringan, dan tebal)

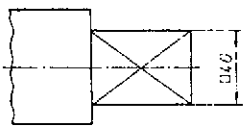


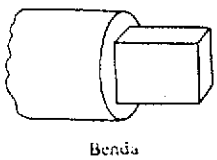


Gb. 4.25 Lambang diameter "ϕ".

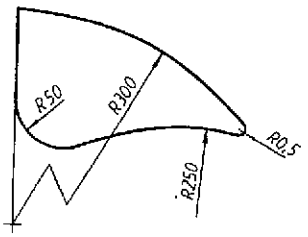


Gb. 4.26 Lambang jari-jari "R".

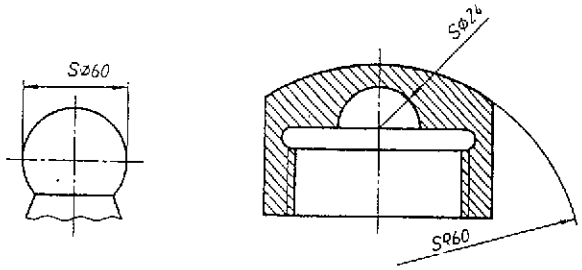




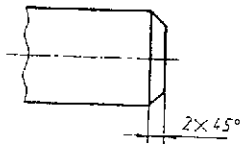
Gb. 4.27 Lambang bujur sangkar "□".



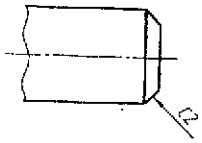
Gb. 4.28 Lambang jari-jari "R".



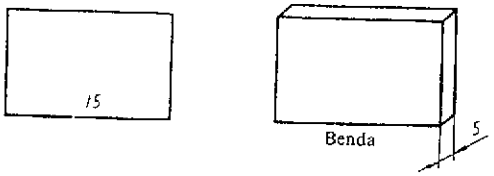
Gb. 4.29 Lambang bola.



Gb. 4.30 Kemiringan.

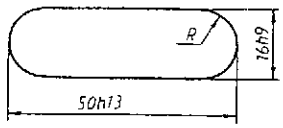


Gb. 4.31 Lambang kemiringan "C".

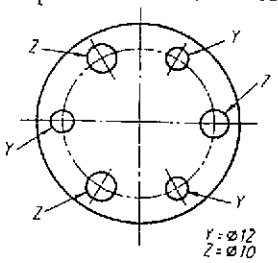


Gb. 4.32 Lambang tebal "t".

- Lambang jari-jari dapat diberikan tanpa ukuran, bila ukuran lengkungan tersebut sudah diberikan oleh patokan lain
- Bila perlu, untuk menghindari perulangan dapat dipakai huruf-huruf referensi

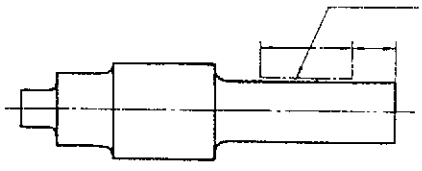


Gb. 4.33 "R" tanpa ukuran.



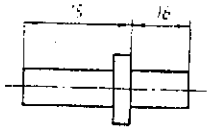
Gb. 4.34 Memberi ukuran dengan huruf-huruf referensi.

- Bagian yang perlu mendapat pengerjaan khusus misalnya dipoles dapat diberi tambahan garis sumbu tebal
- Angka ukur harus dibuat sesuai dengan gambar (rasional)



Gb. 4.35 Penunjukan khusus dengan ukuran-ukuran.

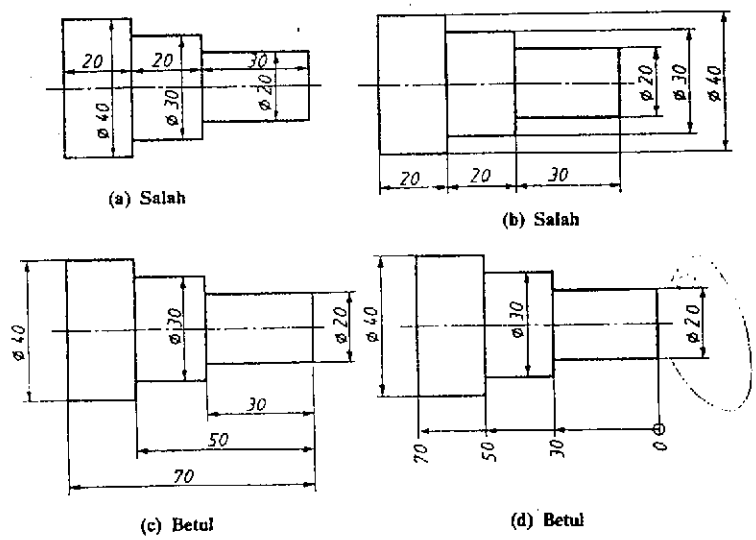
Gb. 4.36 Penunjukan khusus tanpa ukuran.



Gb. 4.37 Ukuran tidak sesuai gambar.

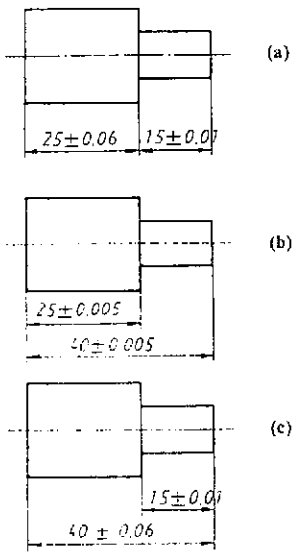
Dasar-dasar umum untuk memberi ukuran

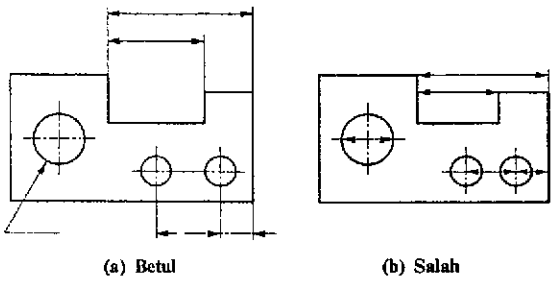
- Ukuran-ukuran harus ditempatkan pada pandangan atau potongan yang memberikan bentuk kerja yang paling jelas.



Gb. 4.38 Memberi ukuran bagian-bagian berbentuk silinder.

- Semua ukuran memiliki toleransi, meskipun tidak selalu dinyatakan

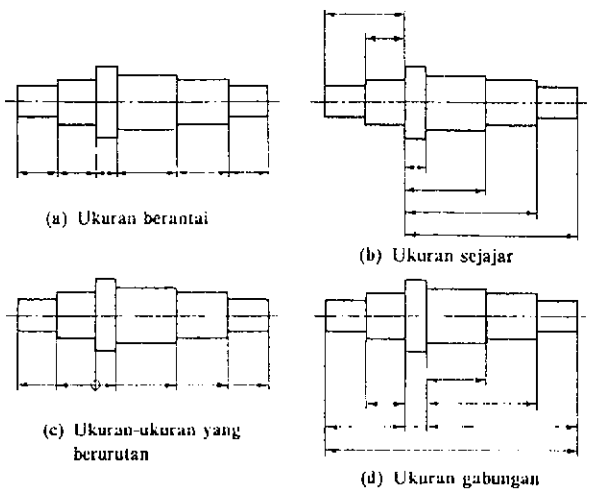




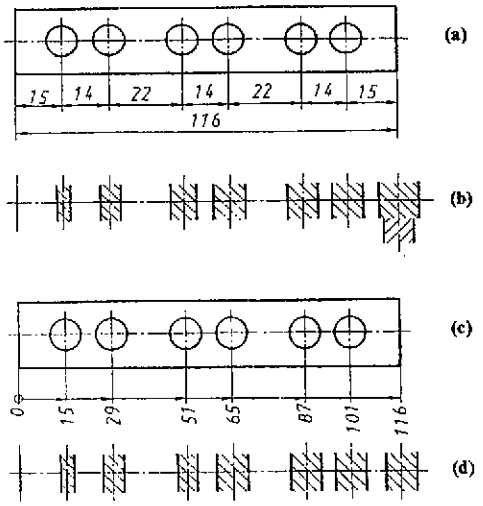
Gb. 4.39 Garis-garis ukur dan garis-garis bantu.

Gb. 4.40 Macam-macam ukuran dan toleransinya.

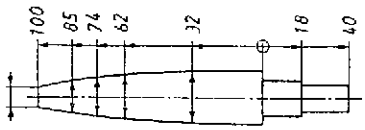
- Beberapa tentang pemberian susunan ukuran
  1. Ukuran berantai
  2. Ukuran sejajar
  3. Ukuran berhimpit
  4. Ukuran gabungan
  5. Ukuran dengan koordinat



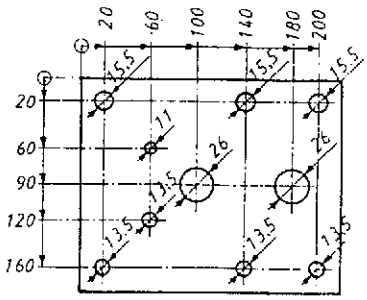
Gb. 4.41 Macam-macam cara pemberian ukuran.



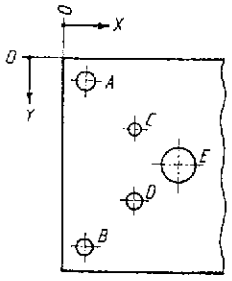
Gb. 4.42 Ukuran-ukuran dan diagram toleransinya.



Gb. 4.43 Ukuran-ukuran yang berurutan.



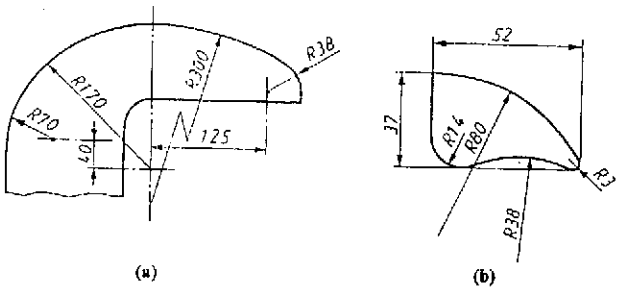
Gb. 4.44 Memberi ukuran dengan koordinat-koordinat.



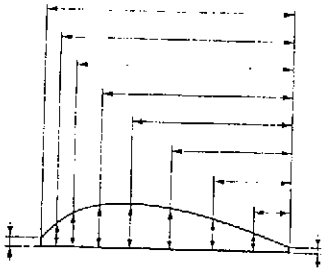
	A	B	C	D	E
X	20	20	60	60	100
Y	20	160	60	120	90
ø	15,5	13,5	11	13,5	26

Gb. 4.45 Memberi ukuran dengan koordinat-koordinat.

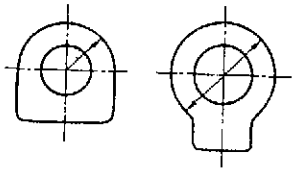
- Memberi ukuran dengan bentuk-bentuk tertentu
  1. Profil
  2. Jari-jari atau diameter
  3. Ukuran lubang an dengan garis penunjuk
  4. Ukuran sudut
  5. Ukuran bagian yang sama
  6. Ukuran lubang dengan alur pasak
  7. Ukuran lubang



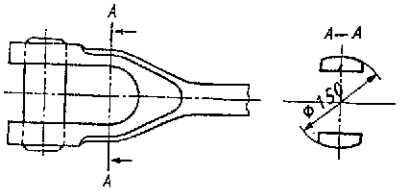
Gb. 4.46 Memberi ukuran dengan jari-jari.



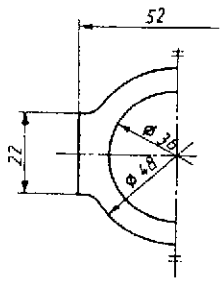
Gb. 4.47 Memberi ukuran dengan ordinat.



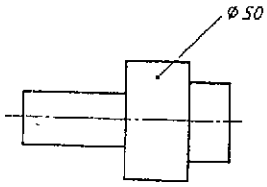
Gb. 4.48 Jari-jari atau diameter.



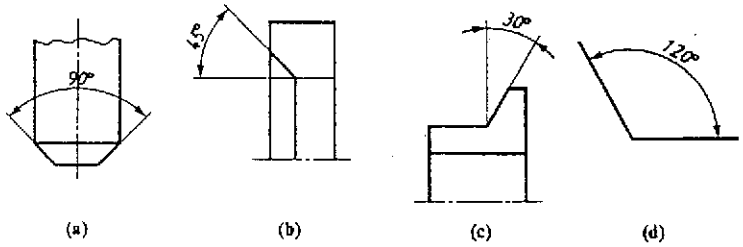
Gb. 4.49 Diameter diperlukan untuk proses pengerjaan.



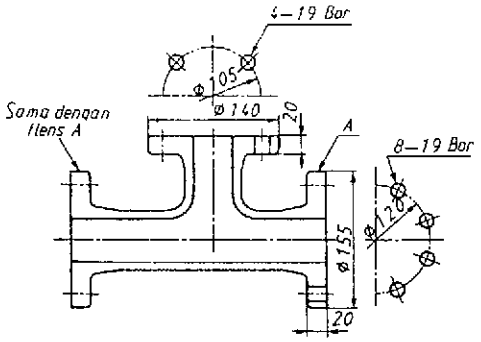
Gb. 4.50 Diameter pada separoh dari bagian simetris.



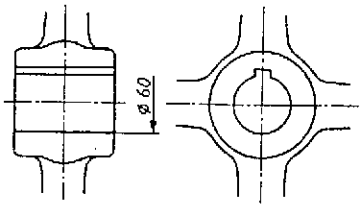
Gb. 4.51 Ukuran diameter dengan garis penunjuk.



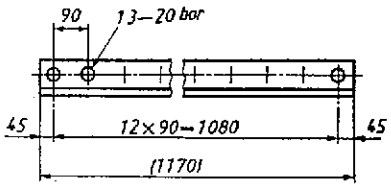
Gb. 4.52 Pemberian ukuran sudut.



Gb. 4.53 Ukuran-ukuran dari bagian-bagian yang sama.

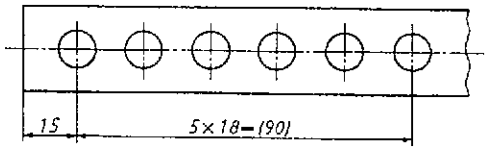


Gb. 4.54 Diameter dalam dengan alur pasak.

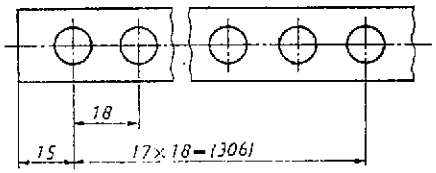


Gb. 4.55 Ukuran lubang.

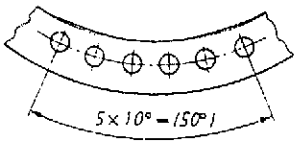
- Elemen-elemen yang berjarak sama



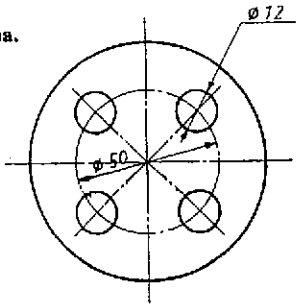
Gb. 4.56 Memberi ukuran bagian-bagian yang berjarak sama.



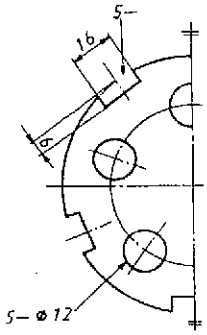
Gb. 4.57 Memberi ukuran bagian-bagian yang berjarak sama.



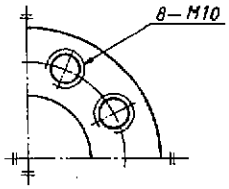
Gb. 4.58 Memberi ukuran bagian-bagian yang berjarak sama.



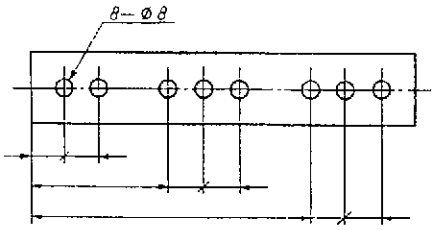
Gb. 4.59 Memberi ukuran lubang.



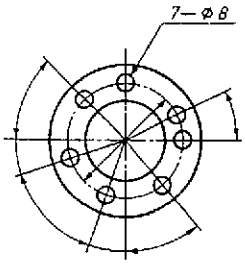
Gb. 4.60 **Memberi ukuran bagian-bagian yang berjarak sama pada lingkaran.**



Gb. 4.61 **Memberi ukuran bagian-bagian yang berjarak sama pada lingkaran.**

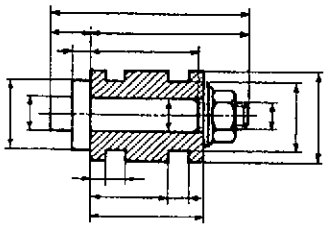


Gb. 4.62 **Memberi ukuran letak lubang terhadap bidang referensi.**



Gb. 4.63 **Memberi ukuran lubang.**

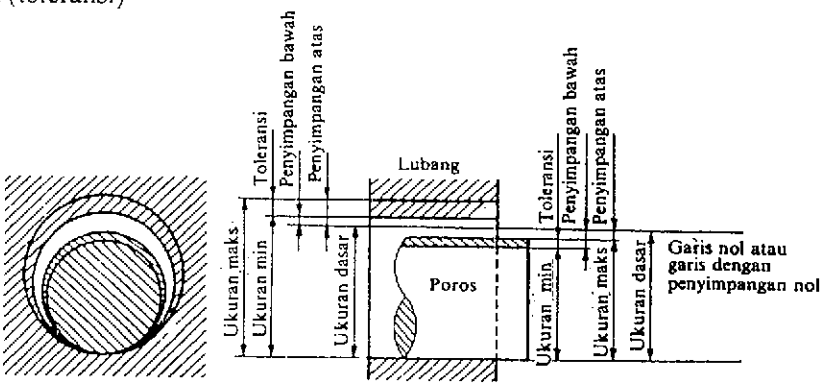
- Cara memberikan ukuran bagian dalam gambar susunan, ukuran-ukuran dari tiap bagian sedapatnya harus dipisahkan.



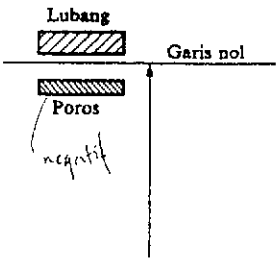
Gb. 4.64 **Memberi ukuran bagian-bagian yang disusun.**

5 TOLERANSI

Proses pembuatan dengan menggunakan alat tentunya akan sangat sulit jika diminta ketelitian yang sangat tinggi, untuk itu perlu adanya kelonggaran ukuran boleh berada dua batas ukuran yang diijinkan (toleransi)



Gb. 5.1 Definisi istilah mengenai toleransi.



Gb. 5.2 Bagan diagram daerah toleransi.

Standar Toleransi Internasional (IT)

- Perbedaan simpangan atas dan bawah harus dipilih sesuai dengan persyaratan fungsionalnya
- Nilai toleransi standar telah ditentukan oleh ISO/R286 (ISO System of Limits and Fits)
- Tingkatan diameter nominal, telah dihitung nilai kisaran di mana nilai toleransinya dapat dianggap sama (tidak mencapai ekstrim), misalnya untuk tingkat sampai dengan 3 mm dapat dipakai nilai toleransinya untuk seluruh ukuran antara 1-3 mm. Dalam kondisi normal dipakai tingkat utama
- Kualitas toleransi dibagi menjadi 18 bagian yaitu IT 01, IT 0, IT 1 sampai dengan IT 16.
- Pekerjaan sangat teliti seperti alat ukur, instrumen optik menggunakan IT 01 s.d IT 04
- Bidang permesinan umum untuk sifat mampu tukar menggunakan IT 5 s.d IT 11
- Pekerjaan kasar menggunakan IT 12 s.d IT 16

IT 5 s.d 16

$$i = 0{,}45\sqrt[3]{D} + 0{,}001\,D$$

D harga rata-rata geometrik dari kelompok ukuran nominal (mm)

- Hasil perhitungan numerik untuk toleransi standar dapat dilihat pada tabel.

Tabel 5.1 Nilai toleransi standar untuk kwalitas 5 s/d 16.

	IT 5	IT 6	IT 7	IT 8	IT 9	IT 10	IT 11	IT 12	IT 13	IT 14	IT 15	IT 16
Nilai	7 *i*	10 *i*	16 *i*	25 *i*	40 *i*	64 *i*	100 *i*	160 *i*	250 *i*	400 *i*	640 *i*	1000 *i*

Tabel 5.2 Nilai toleransi standar untuk kwalitas 0,1, 0 dan 1.

	IT 01	IT 0	IT 1
Nilai dlm. mikron utk. *D* dlm. mm	0,3 + 0,008 *D*	0,5 + 0,012 *D*	0,8 + 0,020 *D*

Tabel 5.3 Tingkat Diameter Nominal.

Tingkat diameter nominal			
Tingkat utama		Tingkat antara	
Milimeter		Milimeter	
di atas	s/d	di atas	s/d
—	3		
3	6		
6	10		
10	18	10 14	14 18
18	30	18 24	24 30
30	50	30 40	40 50
50	80	50 65	65 80
80	120	80 100	100 120
120	180	120 140 160	140 160 180
180	250	180 200 225	200 225 250
250	315	250 280	280 315
315	400	315 355	355 400
400	500	400 450	450 500

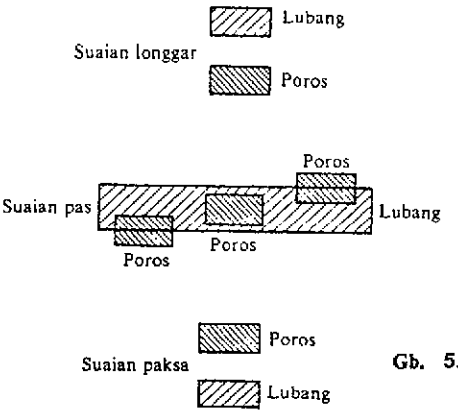
Tabel 5.4 Nilai numerik untuk toleransi standar (Metrik).

Kwalitas			01	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14*	15*	16*
Toleransi standar dalam mikron ($1\mu = 0{,}001$ mm)	untuk tingkat diameter dalam mm	<	0,3	0,5	0,8	1,2	2	3	4	6	10	14	25	40	60	100	140	250	400	600
		>3 to 6	0,4	0,6	1	1,5	2,5	4	5	8	12	18	30	48	75	120	180	300	480	750
		>6 to 10	0,4	0,6	1	1,5	2,5	4	6	9	15	22	36	58	90	150	220	360	580	900
		>10 to 18	0,5	0,8	1,2	2	3	5	8	11	18	27	43	70	110	180	270	430	700	1100
		>18 to 30	0,6	1	1,5	2,5	4	6	9	13	21	33	52	84	130	210	330	520	840	1300
		>30 to 50	0,6	1	1,5	2,5	4	7	11	16	25	39	62	100	160	250	390	620	1000	1600
		>50 to 80	0,8	1,2	2	3	5	8	13	19	30	46	74	120	190	300	460	740	1200	1900
		>80 to 120	1	1,5	2,5	4	6	10	15	22	35	54	87	140	220	350	540	870	1400	2200
		>120 to 180	1,2	2	3,5	5	8	12	18	25	40	63	100	160	250	400	630	1000	1600	2500
		>180 to 250	2	3	4,5	7	10	14	20	29	46	72	115	185	290	460	720	1150	1850	2900
		>250 to 315	2,5	4	6	8	12	16	23	32	52	81	130	210	320	520	810	1300	2100	3200
		>315 to 400	3	5	7	9	13	18	25	36	57	89	140	230	360	570	890	1400	2300	3600
		>400 to 500	4	6	8	10	15	20	27	40	63	97	155	250	400	630	970	1550	2500	4000

*s/d 1 mm, kwalitas 14 s/d 16 tidak diberikan.

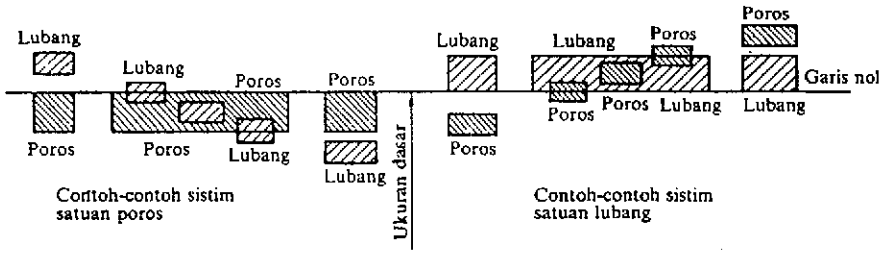
Suaian

- Perbedaan ukuran yang diijinkan untuk suatu pemakaian tertentu bagi pasangan lubang dan poros
  1. Suaian longgar (clearance fit)
  2. Suaian pas (transition fit)
  3. Suaian paksa (interference fit)
- Tiap suaian harus dipilih sesuai dengan persyaratan fungsional dari pasangan yang bersangkutan



Gb. 5.3 Bagan diagram daerah toleransi pada macam-macam suaian.

- Sistem Satuan Lubang dan Satuan Poros
  - Garis nol = garis dengan penyimpangan nol
  - Pada sistem satuan lubang, penyimpangan bawah dari lubang diambil sama dengan 0
  - Pada sistem satuan poros, penyimpangan atas diambil sama dengan 0
  - Biasanya dipakai sistem poros dasar

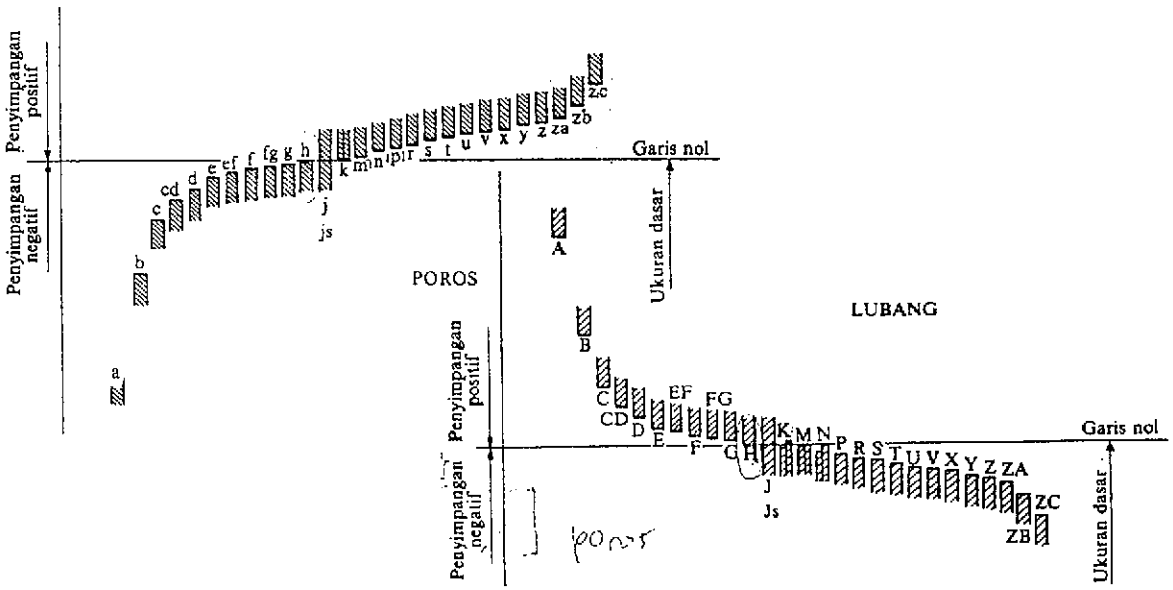


Gb. 5.4 Sistim satuan poros dan sistim satuan lubang.

- Lambang Untuk Toleransi, Penyimpangan dan Suaian
  - Kedudukan daerah toleransi terhadap garis nol, dinyatakan dengan lambang huruf (huruf besar untuk lubang, huruf kecil untuk poros)
  - Lambang H mewakili lubang dasar dan h mewakili poros dasar
  - Toleransinya dinyatakan dengan angka yang sesuai dengan angka kualitas

    $45H7/g7$ atau $45H8\text{-}g7$ atau $45\frac{H8}{g7}$

    diameter poros 45mm, suaian longgar dalam sistem lubang dasar dengan nilai toleransi dari tingkat IT 7
  - Lubang H – poros g : suaian longgar dalam sistem lubang dasar
  - Lubang H – poros m : suaian pas dalam sistem lubang dasar
  - Lubang R – poros h : suaian paksa dalam sistem poros dasar



Gb. 5.5 Masing-masing kedudukan dari macam-macam daerah toleransi untuk suatu diameter poros/lubang tertentu.

Tabel 5.5 Suaian untuk tujuan-tujuan umum.

Sistim lubang dasar

Lubang dasar	Lambang dan kwalitas untuk poros																
	Suaian longgar						Suaian pas				Suaian paksa						
	b	c	d	e	f	g	h	js	k	m	n	p	r	s	t	u	x
H 5						4	4	4	4	4							
H 6						5	5	5	5	5							
					6	6	6	6	6	6	6	6					
H 7				(6)	6	6	6	6	6	6	6	6	6	6	6	6	6
				7	7	(7)	7	7	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)
H 8					7		7										
				8	8		8										
				9													
H 9				8			8										
		9	9	9			9										
H 10	9	9	9														

Sistim poros dasar

Poros dasar	Lambang dan kwalitas untuk lubang																
	Suaian longgar						Suaian pas				Suaian paksa						
	B	C	D	E	F	G	H	Js	K	M	N	P	R	S	T	U	X
h 4							5	5	5	5							
h 5							6	6	6	6	6	6					
h 6					6	6	6	6	6	6	6	6					
				(7)	7	7	7	7	7	7	7	7	7	7	7	7	7
h 7				7	7	(7)	7	(7)	(7)	(7)	(7)	(7)	(7)	(7)			
					8		8										
h 8			8	8	8		8										
			9	9			9										
h 9			8	8			8										
		9	9	9			9										
	10	10	10														

Tabel 5.6 (a) Nilai penyimpangan lubang untuk tujuan umum.

Satuan μm

Tingkat diameter (mm)		B	C		D			E			F			G		H					
>	to	B 10	C 9	C 10	D 8	D 9	D 10	E 7	E 8	E 9	F 6	F 7	F 8	G 6	G 7	H 5	H 6	H 7	H 8	H 9	H 10
—	3	+180 +140	+85	+100 +60	+34	+45 +20	+60	+24	+28 +14	+39	+12	+16 +6	+20	+8	+12 +10	+4	+6	+10 0	+14	+25	+40
3	6	+188 +140	+100	+118 +70	+48	+60 +30	+78	+32	+38 +20	+50	+18	+22 +10	+28	+12	+16 +4	+5	+8	+12 0	+18	+30	+48
6	10	+203 +150	+116	+138 +80	+62	+76 +40	+98	+40	+47 +25	+61	+22	+28 +13	+35	+14	+20 +5	+6	+9	+15 0	+22	+36	+58
10	14	+220 +150	+138	+165 +95	+77	+93 +50	+120	+50	+59 +32	+75	+27	+34 +16	+43	+17	+24 +6	+8	+11	+18 0	+27	+43	+70
14	18																				
18	24	+244 +160	+162	+194 +110	+98	+117 +65	+149	+61	+73 +40	+92	+33	+41 +20	+53	+20	+28 +7	+9	+13	+21 0	+33	+52	+84
24	30																				
30	40	+270 +170	+182	+220 +120	+119	+142 +80	+180	+75	+89 +50	+112	+41	+50 +25	+64	+25 +9	+34	+11	+16	+25 0	+39	+62	+100
40	50	+280 +180	+192	+230 +130																	
50	65	+310 +190	+214	+260 +140	+146	+174 +100	+220	+90	+106 +60	+134	+49	+60 +30	+76	+29 +10	+40	+13	+19	+30 0	+46	+74	+120
65	80	+320 +200	+224	+270 +150																	
80	100	+360 +220	+257	+310 +170	+174	+207 +120	+260	+107	+126 +72	+159	+58	+71 +36	+90	+34 +12	+47	+15	+22	+35 0	+54	+87	+140
100	120	+380 +240	+267	+320 +180																	
120	140	+420 +260	+300	+360 +200	+208	+245 +145	+305	+125	+148 +85	+185	+68	+83 +43	+106	+39 +14	+54	+18	+25	+40 0	+63	+100	+160
140	160	+440 +280	+310	+370 +210																	
160	180	+470 +310	+330	+390 +230																	
180	200	+525 +340	+355	+425 +240	+242	+285 +170	+355	+146	+172 +100	+215	+79	+96 +50	+122	+44 +15	+61	+20	+29	+46 0	+72	+115	+185
200	225	+565 +380	+375	+445 +260																	
225	250	+605 +420	+395	+465 +280																	
250	280	+690 +480	+430	+510 +300	+271	+320 +190	+400	+162	+191 +110	+240	+88	+108 +56	+137	+49 +17	+69	+23	+32	+52 0	+81	+130	+210
280	315	+750 +540	+460	+540 +330																	
315	355	+830 +600	+500	+590 +360	299	+350 +210	+440	+182	+214 +125	+265	+98	+119 +62	+151	+54 +18	+75	+25	+36	+57 0	+89	+140	+230
355	400	+910 +680	+540	+630 +400																	
400	450	+1010 +760	+595	+690 +440	+327	+385 +230	+480	+198	+232 +135	+290	+108	+131 +68	+165	+60 +20	+83	+27	+40	+63 0	+97	+155	+250
450	500	+1090 +840	+635	+730 +480																	

Catatan: Nilai atas menunjukkan penyimpangan atas, dan nilai bawah penyimpangan bawah.

Tabel 3.3 (b) Nilai penyimpangan lubang untuk tujuan umum.

Satuan μm

Tingkat diameter (mm)		Js			K			M			N		P		R	S	T	U	X
>	to	Js 5	Js 6	Js 7	K 5	K 6	K 7	M 5	M 6	M 7	N 6	N 7	P 6	P 7	R 7	S 7	T 7	U 7	X 7
—	3	±2	±3	±5	0 −4	0 −6	0 −10	−2 −6	−2 −8	−2 −12	−4 −10	−4 −14	−6 −12	−6 −16	−10 −20	−14 −24	—	−18 −28	−20 −30
3	6	±2,5	±4	±6	0 −5	+2 −6	+3 −9	−3 −8	−1 −9	0 −12	−5 −13	−4 −16	−9 −17	−8 −20	−11 −23	−15 −27	—	−19 −31	−24 −36
6	10	±3	±4,5	±7,5	+1 −5	+2 −7	+5 −10	−4 −10	−3 −12	0 −15	−7 −16	−4 −19	−12 −21	−9 −24	−13 −28	−17 −32	—	−22 −37	−28 −43
10	14	±4	±5,5	±9	+2 −6	+2 −9	+6 −12	−4 −12	−4 −15	0 −18	−9 −20	−5 −23	−15 −26	−11 −29	−16 −34	−21 −39	—	−26 −44	−33 −51 −38 −56
14	18																		
18	24	±4,5	±6,5	±10,5	+1 −8	+2 −11	+6 −15	−5 −14	−4 −17	0 −21	−11 −24	−7 −28	−18 −31	−14 −35	−20 −41	−27 −48	−33 −54	−33 −54 −40 −61	−46 −67 −56 −77
24	30																		
30	40	±5,5	±8	±12,5	+2 −9	+3 −13	+7 −18	−5 −16	−4 −20	0 −25	−12 −28	−8 −33	−21 −37	−17 −42	−25 −50	−34 −59	−39 −64 −45 −70	−51 −76 −61 −86	—
40	50																		
50	65	±6,5	±9,5	±15	+3 −10	+4 −15	+9 −21	−6 −19	−5 −24	0 −30	−14 −33	−9 −39	−26 −45	−21 −51	−30 −60 −32 −62	−42 −72 −48 −78	−55 −85 −64 −94	−76 −106 −91 −121	—
65	80																		
80	100	±7,5	±11	±17,5	+2 −13	+4 −18	+10 −25	−8 −23	−6 −28	0 −35	−16 −38	−10 −45	−30 −52	−24 −59	−38 −73 −41 −76	−58 −93 −66 −101	−78 −113 −91 −126	−111 −146 −131 −166	—
100	120																		
120	140	±9	±12,5	±20	+3 −15	+4 −21	+12 −28	−9 −27	−8 −33	0 −40	−20 −45	−12 −52	−36 −61	−28 −68	−48 −88 −50 −90 −53 −93	−77 −117 −85 −125 −93 −133	−107 −147 −119 −159 −131 −171	—	—
140	160																		
160	180																		
180	200	±10	±14,5	±23	+2 −18	+5 −24	+13 −33	−11 −31	−8 −37	0 −46	−22 −51	−14 −60	−41 −70	−33 −79	−60 −106 −63 −109 −67 −113	−105 −151 −113 −159 −123 −169	—	—	—
200	225																		
225	250																		
250	280	±11,5	±16	±26	+3 −20	+5 −27	+16 −36	−13 −36	−9 −41	0 −52	−25 −57	−14 −66	−47 −79	−36 −88	−74 −126 −78 −130	—	—	—	—
280	315																		
315	355	±12,5	±18	±28,5	+3 −22	+7 −29	+17 −40	−14 −39	−10 −46	0 −57	−26 −62	−16 −73	−51 −87	−41 −98	−87 −144 −93 −150	—	—	—	—
355	400																		
400	450	±13,5	±20	±31,5	+2 −25	+8 −32	+18 −45	−16 −43	−10 −50	0 −63	−27 −67	−17 −80	−55 −95	−45 −108	−103 −166 −109 −172	—	—	—	—
450	500																		

Catatan: Nilai atas menunjukkan penyimpangan atas, dan nilai bawah penyimpangan bawah.

Tabel 5.7 (a) Nilai penyimpangan poros untuk tujuan umum.

Satuan μm

Tingkat diameter (mm)		b	c	d		e			f			g			h					
>	to	b 9	c 9	d 8	d 9	e 7	e 8	e 9	f 6	f 7	f 8	g 4	g 5	g 6	h 4	h 5	h 6	h 7	h 8	h 9
—	3	−140 −165	−60 −85	−20 −34	−45	−14 −24	−28	−39	−6 −12	−16	−20	−2 −5	−6	−8	0 −3	−4	−6	−10	−14	−25
3	6	−140 −170	−70 −100	−30 −48	−60	−20 −32	−38	−50	−10 −18	−22	−28	−4 −8	−9	−12	0 −4	−5	−8	−12	−18	−30
6	10	−150 −186	−80 −116	−40 −62	−76	−25 −40	−47	−61	−13 −22	−28	−35	−5 −9	−11	−14	0 −4	−6	−9	−15	−22	−36
10	14	−150	−95	−50		−32			−16			−6			0					
14	18	−193	−138	−77	−93	−50	−59	−75	−27	−34	−43	−11	−14	−17	−5	−8	−11	−18	−27	−43
18	24	−160	−110	−65		−40			−20			−7			0					
24	30	−212	−162	−98	−117	−61	−73	−92	−33	−41	−53	−13	−16	−20	−6	−9	−13	−21	−33	−52
30	40	−170 −232	−120 −182	−80		−50			−25			−9			0					
40	50	−180 −242	−130 −192	−119	−142	−75	−89	−112	−41	−50	−64	−16	−20	−25	−7	−11	−16	−25	−39	−62
50	65	−190 −261	−140 −214	−100		−60			−30			−10			0					
65	80	−200 −274	−150 −224	−146	−174	−90	−106	−134	−49	−60	−76	−18	−23	−29	−8	−13	−19	−30	−46	−74
80	100	−220 −307	−170 −257	−120		−72			−36			−12			0					
100	120	−240 −327	−180 −267	−174	−207	−107	−126	−159	−58	−71	−90	−22	−27	−34	−10	−15	−22	−35	−54	−87
120	140	−260 −360	−200 −300																	
140	160	−280 −380	−210 −310	−145 −208	−245	−85 −125	−148	−185	−43 −68	−83	−106	−14 −26	−32	−39	0 −12	−18	−25	−40	−63	−100
160	180	−310 −410	−230 −330																	
180	200	−340 −455	−240 −355																	
200	225	−380 −495	−260 −375	−170 −242	−285	−100 −146	−172	−215	−50 −79	−96	−122	−15 −29	−35	−44	0 −14	−20	−29	−46	−72	−115
225	250	−420 −535	−280 −395																	
250	280	−480 −610	−300 −430	−190		−110			−56			−17			0					
280	315	−540 −670	−330 −460	−271	−320	−162	−191	−240	−88	−108	−137	−33	−40	−49	−16	−23	−32	−52	−81	−130
315	355	−600 −740	−360 −500	−210		−125			−62			−18			0					
355	400	−680 −820	−400 −540	−299	−350	−182	−214	−265	−98	−119	−151	−36	−43	−54	−18	−25	−36	−57	−89	−140
400	450	−760 −915	−440 −595	−230		−135			−68			−20			0					
450	500	−840 −995	−480 −635	−327	−385	−198	−232	−290	−108	−131	−165	−40	−47	−60	−20	−27	−40	−63	−97	−155

Catatan: Nilai atas menunjukkan penyimpangan atas dan nilai bawah penyimpangan bawah

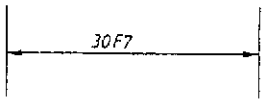
Tabel [redacted] (b) Nilai penyimpangan poros untuk tujuan umum.

Satuan μm

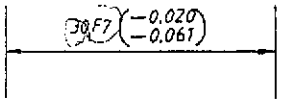
Tingkat diameter (mm)		js				k			m			n	p	r	s	t	u	x
>	to	js 4	js 5	js 6	js 7	k 4	k 5	k 6	m 4	m 5	m 6	n 6	p 6	r 6	s 6	t 6	u 6	x 6
—	3	±1,5	±2	±3	±5	+3	+4 0	+6	+5	+6 +2	+8	+10 +4	+12 +6	+16 +10	+20 +14	—	+24 +18	+26 +20
3	6	±2	±2,5	±4	±6	+5	+6 +1	+9	+8	+9 +4	+12	+16 +8	+20 +12	+23 +15	+27 +19	—	+31 +23	+36 +28
6	10	±2	±3	±4,5	±7,5	+5	+7 +1	+10	+10	+12 +6	+15	+19 +10	+24 +15	+28 +19	+32 +23	—	+37 +28	+43 +34
10	14	±2,5	±4	±5,5	±9	+6	+9	+12	+12	+15	+18	+23	+29	+34	+39	—	+44	+51 +40
14	18						+1			+7		+12	+18	+23	+28		+33	+56 +45
18	24	±3	±4,5	±6,5	±10,5	+8	+11	+15	+14	+17	+21	+28	+35	+41	+48	—	+54 +41	+67 +54
24	30						+2			+8		+15	+22	+28	+35	+54 +41	+61 +48	+77 +64
30	40	±3,5	±5,5	±8	±12,5	+9	+13	+18	+16	+20	+25	+33	+42	+50	+59	+64 +48	+76 +60	—
40	50						+2			+9		+17	+26	+34	+43	+70 +54	+86 +70	
50	65	±4	±6,5	±9,5	±15	+10	+15	+21	+19	+24	+30	+39	+51	+60 +41	+72 +53	+85 +66	+106 +87	—
65	80						+2			+11		+20	+32	+62 +43	+78 +59	+94 +75	+121 +102	
80	100	±5	±7,5	±11	±17,5	+13	+18	+25	+23	+28	+35	+45	+59	+73 +51	+93 +71	+113 +91	+146 +124	—
100	120						+3			+13		+23	+37	+73 +54	+101 +75	+126 +104	+166 +144	
120	140	±6	±9	±12,5	±20	+15	+21	+28	+27	+33	+40	+52	+68	+88 +3	+117 +92	+147 +122	—	—
140	160						+3			+15		+27	+43	+90 +65	+125 +100	+159 +134		
160	180													+93 +68	+133 +108	+171 +146		
180	200	±7	±10	±14,5	±23	+18	+24	+33	+31	+37	+46	+60	+79	+106 +77	+151 +122	—	—	—
200	225						+4			+17		+31	+50	+109 +80	+159 +130			
225	250													+113 +84	+169 +140			
250	280	±8	±11,5	±16	±26	+20	+27	+36	+36	+43	+52	+66	+88	+126 +94	—	—	—	—
280	315						+4			+20		+34	+56	+130 +98				
315	355	±9	±12,5	±18	±28,5	+22	+29	+40	+39	+46	+57	+73	+98	+144 +108	—	—	—	—
355	400						+4			+21		+37	+62	+150 +114				
400	450	±10	±13,5	±20	±31,5	+25	+32	+45	+43	+50	+63	+80	+108	+166 +126	—	—	—	—
450	500						+5			+23		+40	+68	+172 +132				

Catatan: Nilai atas menunjukkan penyimpangan atas dan nilai bawah penyimpangan bawah.

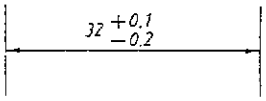
- Penulisan Toleransi Linier dan Sudut
  - Toleransi suaian dengan lambang ISO
  - Toleransi dengan angka
  - Toleransi simetris
  - Ukuran-ukuran batas
  - Ukuran-ukuran batas dalam satu arah



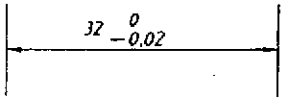
Gb. 5.6 **Toleransi suaian dinyatakan dengan lambang ISO.**



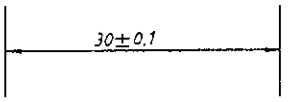
Gb. 5.7 **Toleransi suaian dinyatakan oleh lambang dan nilai penyimpangan.**



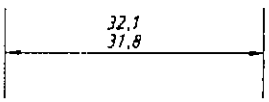
Gb. 5.8 **Toleransi dinyatakan oleh nilai penyimpangan.**



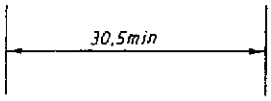
Gb. 5.9 **Toleransi dinyatakan oleh nilai penyimpangan.**



Gb. 5.10 Toleransi simetris.

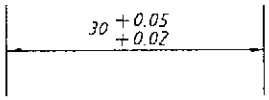


Gb. 5.11 Batas-batas ukuran.

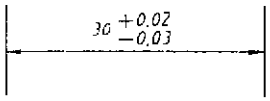


Gb. 5.12 **Batas ukuran dalam satu arah.**

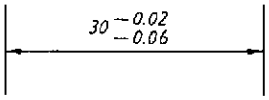
- Urutan penulisan penyimpangan, penyimpangan atas harus ditulis pada kedudukan atas dan penyimpangan bawah harus ditulis pada kedudukan bawah



Gb. 5.13 **Urutan penulisan.**

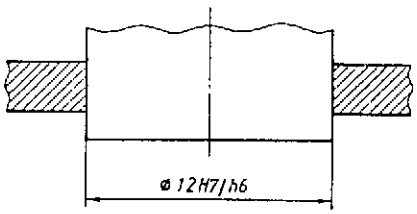


Gb. 5.14 **Urutan penulisan.**

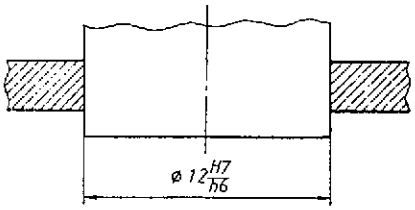


Gb. 5.15 **Urutan penulisan.**

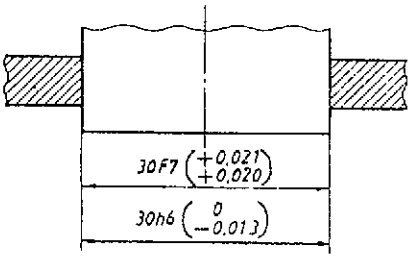
- Satuan, penyimpangan harus dinyatakan dalam satuan yang sama dengan satuan ukuran nominal dan jumlah desimal yang sama, kecuali salah satunya nol
- Toleransi pada gambar susunan dan sudut (sama dengan aturan untuk ukuran linier)



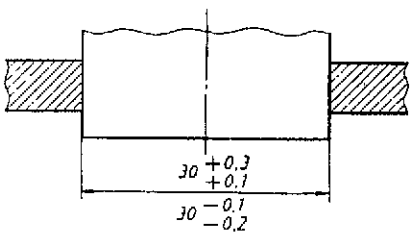
Gb. 5.16 **Toleransi pada gambar susunan.**



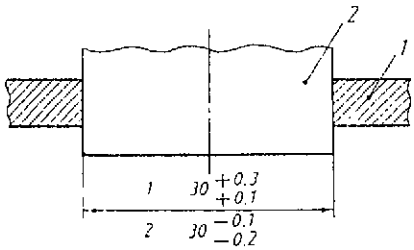
Gb. 5.17 **Toleransi pada gambar susunan.**



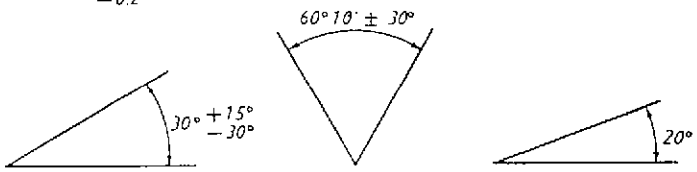
Gb. 5.18 Toleransi pada gambar susunan.



Gb. 5.19 **Toleransi pada gambar susunan.**



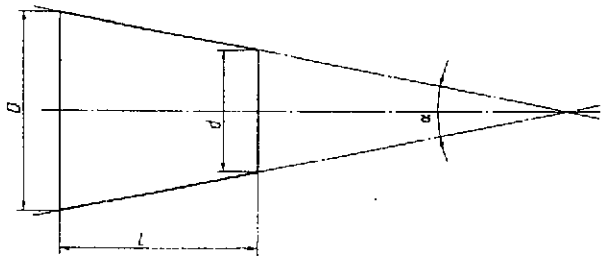
Gb. 5.20 **Toleransi pada gambar susunan.**



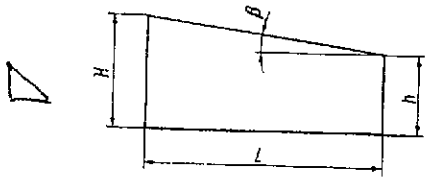
Gb. 5.21 **Toleransi pada ukuran sudut.**

- Memberi ukuran dan toleransi pada kerucut
  - Bila perlu dapat dipakai lambang untuk menunjukkan arah pendakian
  - Ketirusan diperinci sebagai sudut apit atau sebagai perbandingan, misalnya : 0.3 rad, 35°, 1:5, 0.2:1, 20%
  - Diameter pada ujung yang besar dan yang kecil
  - Diameter dari suatu penampang tertentu, di dalam atau di luar kerucut
  - Ukuran yang menentukan letak potongan, di mana diameter diperinci
  - Panjang kerucut

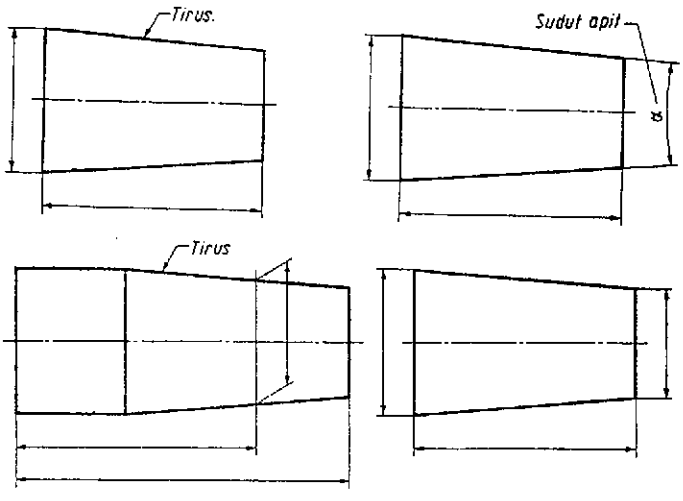
$$C = \frac{D - d}{L} = 2 \tan \frac{\alpha}{2} \quad \text{(Gb. 13.23)}$$



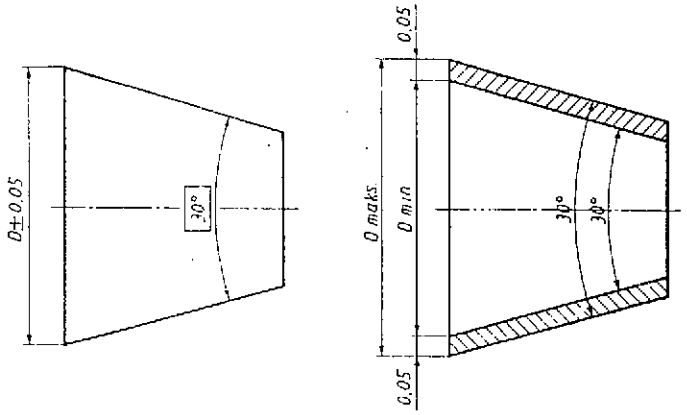
Gb. 5.22 **Tirus.**



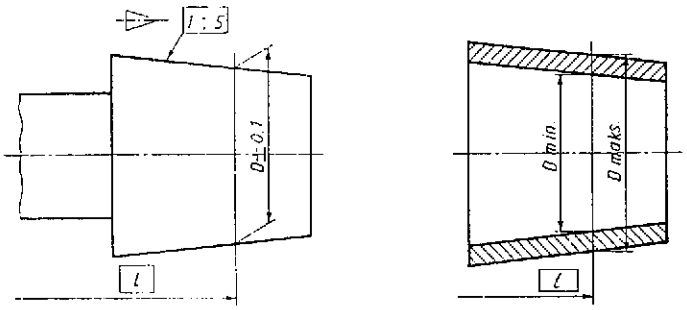
Gb. 5.23 **Pendakian.**



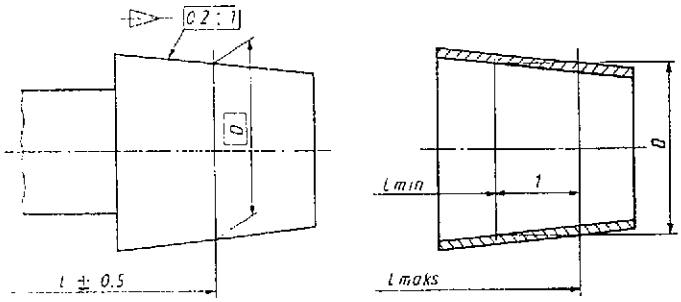
Gb. 5.24 **Ukuran-ukuran kerucut.**



Gb. 5.25 Sistim dasar ketirusan (I).

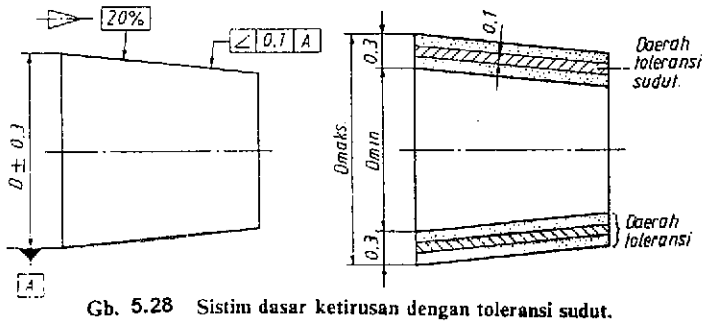


Gb. 5.26 Sistim dasar ketirusan (II).

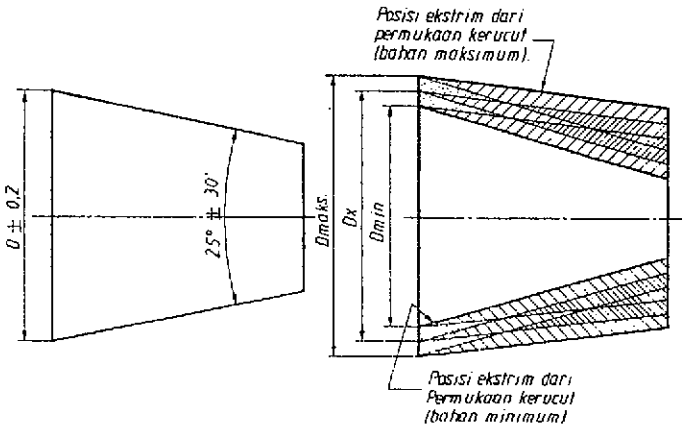


Gb. 5.27 Sistim dasar ketirusan (III).

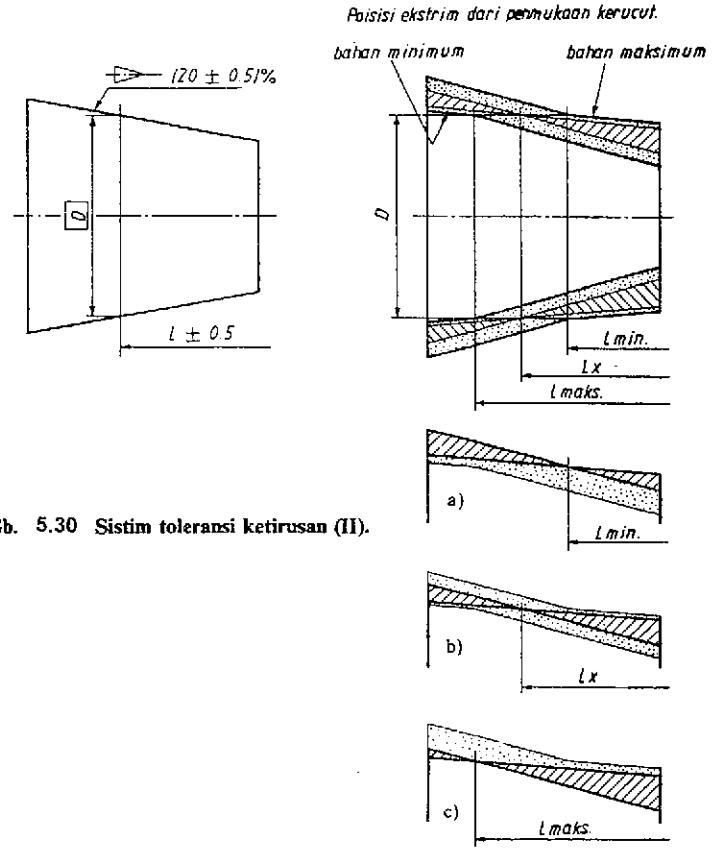
- Toleransi kerucut



Gb. 5.28 Sistim dasar ketirusan dengan toleransi sudut.

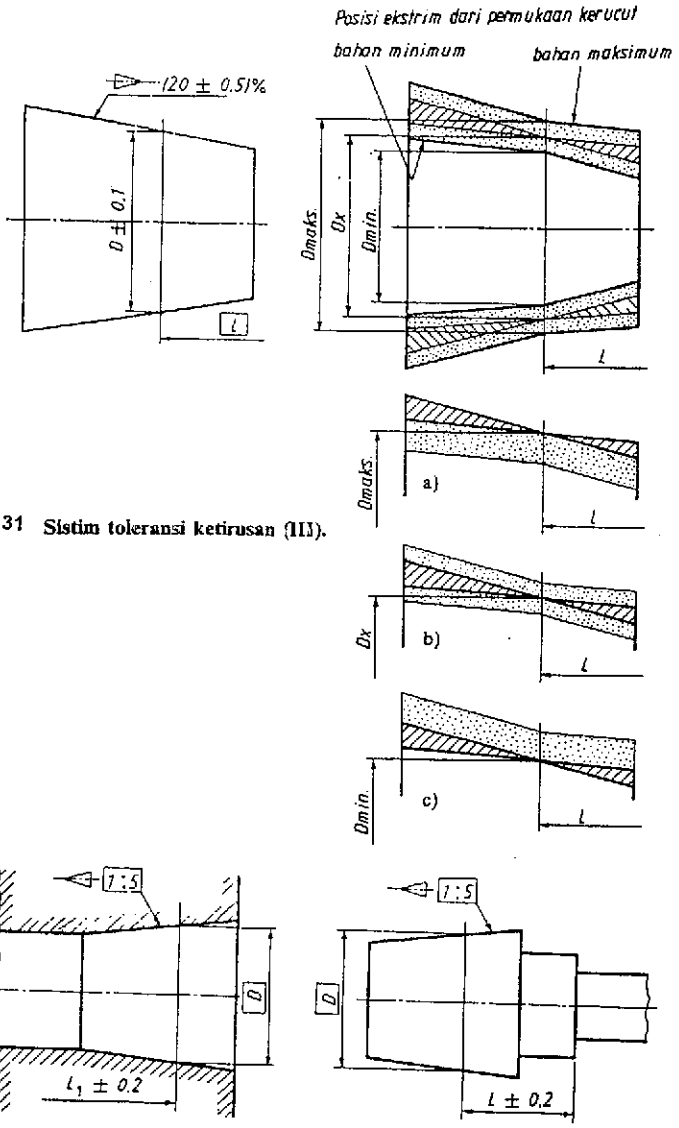


Gb. 5.29 Sistim toleransi ketirusan (I).



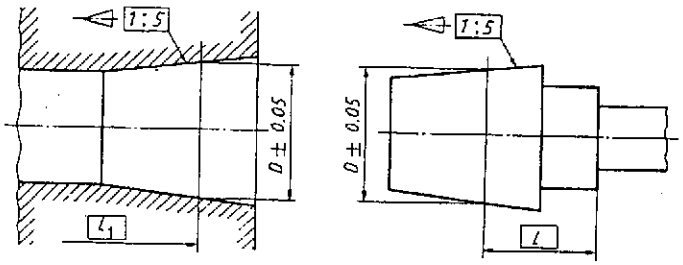
Gb. 5.30 Sistim toleransi ketirusan (II).

- Bila suaian pada bagian berpasangan diperlukan, maka perlu diperinci :
  - Ketirusan nominal yang sama
  - Sebuah ukuran dalam kotak untuk diameter atau untuk posisi yang berhubungan dengan bidang ukur yang sama untuk kedua bagian ukur yang dirakit

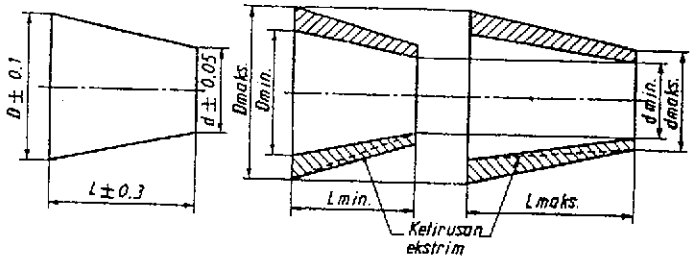


Gb. 5.31 Sistim toleransi ketirusan (III).

Gb. 5.32 Ukuran dua buah kerucut yang berpasangan (I).



Gb. 5.33 Ukuran dua buah kerucut yang berpasangan (II).



Gb. 5.34 Contoh yang jelek dari ukuran kerucut.

Tabel 5.8 Ringkasan Toleransi Geometrik.

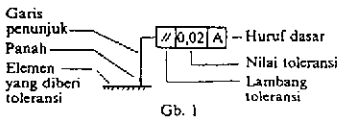
Toleransi bentuk membatasi penyimpangan-penyimpangan orientasi dan/atau lokasi bersama dari dua elemen atau lebih. Untuk alasan-alasan fungsional sebuah elemen atau lebih dapat dinyatakan sebagai dasar. Bila mana diperlukan, sebuah toleransi geometrik harus diperinci terhadap elemen dasar untuk menjamin bahwa dasar tersebut cukup tepat untuk maksudnya.

Toleransi geometrik berlaku untuk seluruh jangkauan dari elemen yang diberi toleransi, kecuali bila mana ditentukan lain, umpamanya 0,02/50 menyatakan bahwa toleransi sebesar 0,02 diizinkan untuk jangkauan seluas 50 pada tiap titik pada elemen yang diberi toleransi.

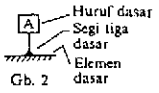
Bila sebuah toleransi geometrik berlaku untuk sebuah poros atau bidang tengah, maka panah dari garis penunjuk berakhir pada garis ukur (Gb. 4).

Bila sebuah toleransi geometrik berlaku untuk sebuah garis atau permukaan, maka garis penunjuk beserta panahnya harus jelas terpisah dari garis ukur (Gb. 5).

Cara penunjukan di atas berlaku juga untuk segi tiga dasar.



Gb. 1



Gb. 2

Gb. 3

Gb. 4

Gb. 5

Gb. 6 Ⓜ Kondisi bahan maksimum (KBM)

Gb. 7 Ⓟ Daerah toleransi yang diproyeksikan

Gb. 8 $\frac{\phi 1,5}{A1}$ Susunan dasar (ISO 5459)

Lambang dan sifat yang diberi toleransi				Contoh dari penunjukan dan pengertian		
				Penunjukan	Daerah toleransi	Pengertian
Toleransi bentuk	Elemen-elemen tunggal	—	Kelurusan garis atau sumbu.	⌀0,03	⌀t	Sumbu poros yang sebenarnya harus terletak dalam silinder berdiameter $t = 0{,}03$.
		▱	Kedataran permukaan.	0,05	t	Bidang yang sebenarnya harus terletak antara dua bidang sejajar berjarak $t = 0{,}05$.
		○	Kebulatan. (Kebulatan) sebuah cakra, silinder, kerucut dsb.	0,02	t	Keliling yang sebenarnya tiap potongan melintang harus terletak antara dua lingkaran konsentris berjarak $t = 0{,}02$.
		⌭	Kesilindersan.	0,05	t	Bidang yang sebenarnya harus terletak antara dua silinder koaksial berjarak radial $t = 0{,}05$.
	Elemen tunggal berhubungan	⌒	Profil garis	0,06	⌀t	Garis yang sebenarnya dari tiap potongan memanjang harus terletak antara dua garis yang menyinggung lingkaran-lingkaran berdiameter 0,08, yang titik-titik pusatnya terletak pada garis teoritis tepat.
		⌓	Profil permukaan	0,03	⌀t	Bidang yang sebenarnya harus terletak antara dua bidang sejajar, yang menyinggung bola-bola berdiameter 0,03, yang titik-titik pusatnya terletak pada bidang teoritis tepat. Daerah toleransi demikian terletak simetris pada bidang teoritis tepat.
Elemen-elemen yang berhubungan	Toleransi orientasi	//	Kesejajaran garis (sumbu) atau permukaan terhadap garis atau bidang dasar.	// 0,1 A	⌀t	Sumbu atas yang sebenarnya harus terletak dalam silinder berdiameter $t = 0{,}1$, sejajar dengan sumbu bawah (garis dasar).
		⊥	Ketegak lurusan garis (sumbu) atau permukaan terhadap garis atau bidang dasar.	⊥ 0,05	t	Sumbu silinder yang sebenarnya harus terletak antara dua bidang datar sejajar berjarak $t = 0{,}05$, tegak lurus pada bidang dasar.
		∠	Kemiringan garis (sumbu) atau permukaan garis atau bidang dasar.	∠ 0,1 A 60°	t a	Sumbu lubang miring yang sebenarnya harus terletak antara dua bidang datar sejajar berjarak $t = 0{,}1$, yang membuat sudut 60° dengan bidang (bidang dasar).
	Toleransi lokasi	⌖	Posisi garis, sumbu atau permukaan terhadap masing-masing atau terhadap sebuah elemen dasar atau lebih.	⌖ ⌀0,05 B 10(E)	⌀t	Sumbu lubang yang sebenarnya harus terletak dalam silinder berdiameter $t = 0{,}05$. Sumbu silinder terletak pada posisi teoritis tepat.
		◎	Konsentrisan sumbu atau titik terhadap sumbu dasar (titik dasar).	◎ ⌀0,01 A	⌀t	Sumbu silinder yang sebenarnya harus terletak dalam silinder berdiameter $t = 0{,}01$, yang koaksial dengan sumbu dasar A.
		=	Kesimetrisan bidang tengah atau garis (sumbu) terhadap garis atau permukaan dasar.	= 0,08 A	t	Bidang tengah dari lekukan harus terletak antara dua bidang datar sejajar berjarak $t = 0{,}08$, dan terletak simetris terhadap bidang tengah dari elemen dasar A.
	Toleransi putar	↗	Toleransi putar dari sebuah elemen terhadap sumbu putar.	↗ 0,02 A-B	t	Pada tiap putaran terhadap sumbu dasar AB, toleransi putar tiap titik pada tiap potongan tidak boleh melebihi $t = 0{,}02$. Ini berlaku untuk tiap letak pengukuran (bidang pengukuran).
		⌰	Toleransi putar total dari sebuah elemen terhadap sumbu putar.	⌰ 0,1	t	Pada beberapa kali putaran terhadap sumbu dasar AB toleransi putar total tiap titik pada permukaan yang telah ditentukan, tidak boleh melebihi $t = 0{,}1$. Di samping ini, titik pengukuran tidak boleh menggeser dalam arah aksial antara dua bidang sejajar berjarak $t = 0{,}1$.

Pilot Metalwork Cluster, Waru-Sidoarjo

Attachment 1-3 : Text for the Workshop on the Production Control (English)

Text for the Production Control

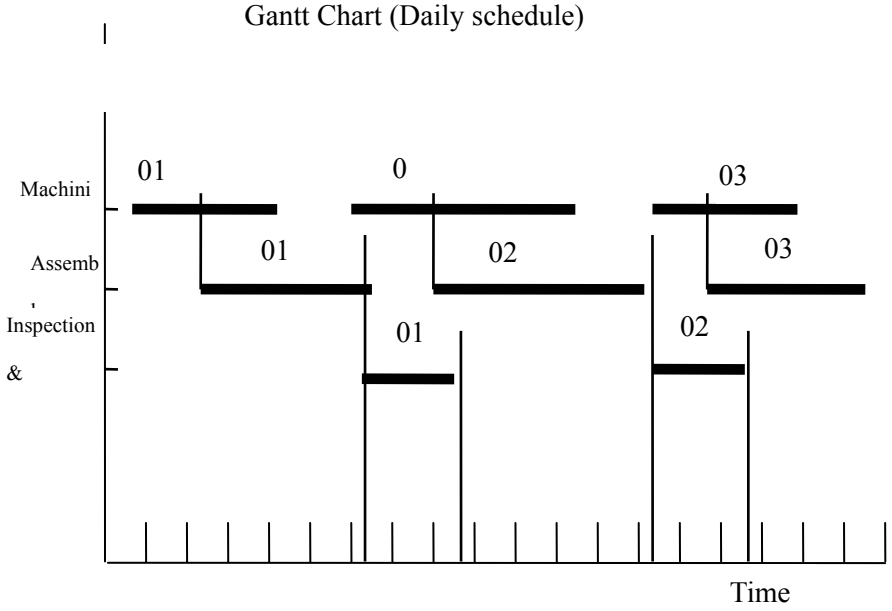
1. Gantt Chart

The various aspects of production should be controlled, but the most important factor is to maintain punctual delivery of the products. For this purpose, production is scheduled and checked during the processing. If any problems may cause delay of the delivery, quick and effective measures to prevent or to minimize the delay should be taken. In an advanced factory, the production process is fully scheduled and every process is closely watched. If any delays in the process can be avoided, major confusion will be avoided.

In a modern production system, the assembler can suffer major losses due to delays in delivery of any parts delivery. Suppliers are therefore requested to adhere to strictly punctual delivery. If any sub-contractor is not punctual, they may be rejected from the production system. Sometimes assemblers would also maintain excessive stocks of some parts in order to prevent delays in processing, particularly delays in parts supply in developing countries. However, maintaining extra stock requires more working capital and consequently higher interest payments. Under these conditions, assemblers cannot be as competitive in the international market.

The Gantt chart is a method to schedule production. Developed by an American engineer, Mr. H. L. Gantt, this method is very popular in advanced countries. However, it is less popular in developing countries due to the limited available of descriptions available in texts. Nonetheless, some production control men use it as a standard approach. The method is simple: time is defined as the horizontal axis and a line on the chart indicates each process. An example is given in the following diagram.

Gantt Chart (Daily schedule)



Usually the chart is provided to the customer, who then knows how and when his ordered product is being processed. Progress of the process should be checked daily and if any delays occur, recovery should be planned by introducing overtime. If problems such as machinery failure occur, these should be reported to the control center and measures taken such as assigning other machines or transferring the process to another factory. If delays in delivery are unavoidable, even after introducing countermeasures, the customer should be immediately informed of a revised production schedule. The customer can then take his own measures to minimize losses. The normal method of scheduling is divided into two steps. The first step involves preparing a schedule for each order. The second, based largely on the schedule from the first step, involves preparing a more detailed schedule of each process. An example is presented below.

Schedule

2002/August PT Mitra Jaya

Work No.	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1

Schedule Name: _____ Qty. _____

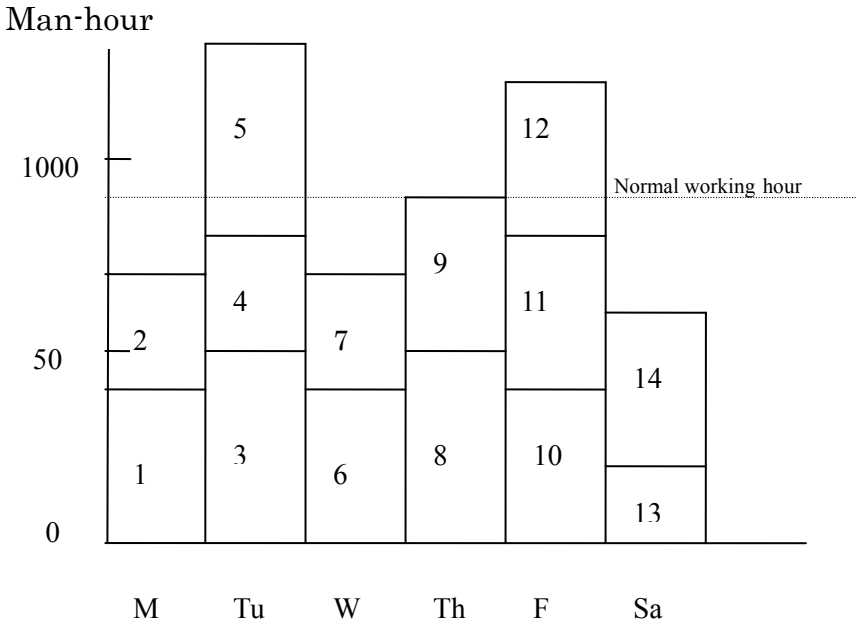
2002/Aug/

	1		2		3		4		5		6		7	
Blanking														
Stamping														
Drilling														
Welding														
Painting														
Inspection														
Packing														

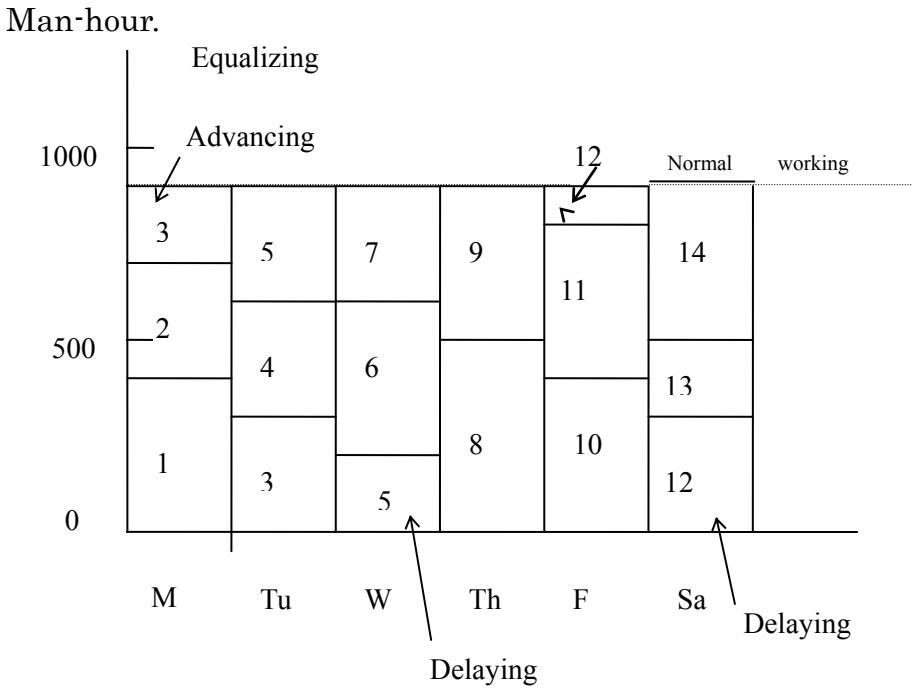
2. Loading plan (Yamazumi-hyo)

When loading to each machine or equipment is checked on the Gantt chart, the production controller knows in the future whether the machine will be occupied or idle. He can then inform the sales department of what type of job is desirable to realize full operation of the factory.

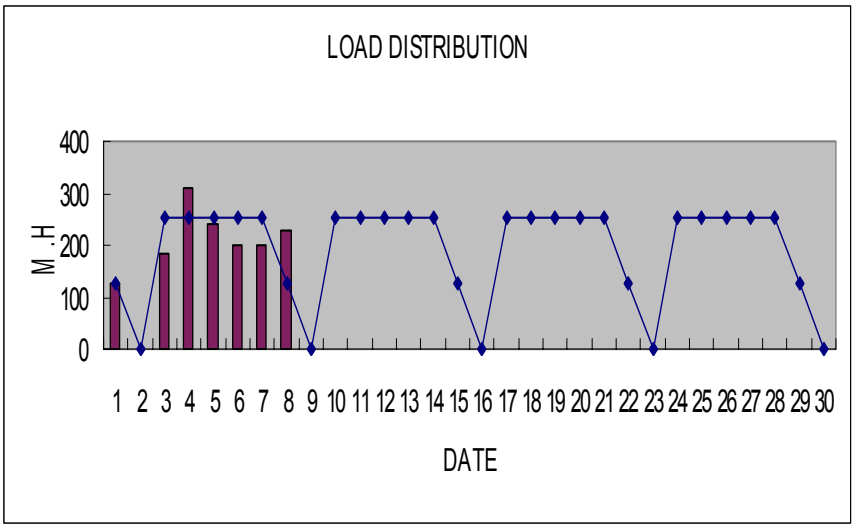
However, this method is a little complicated and not easily understood by sections other than production control. Therefore, a loading plan is also prepared to demonstrate a factory's work loading conditions.



Based on the chart, the factory's loading conditions are indicated. This method is used commonly by a construction company where the load for each construction site always has a peak. The chart is referred to as Yamazumi, meaning mountain-like. Factory loads can be adjusted by advancing or delaying jobs between days (referred to as job adjustment), as shown in the following chart.



In the case of a delaying adjustment, the customer's permission should be obtained regarding the delaying quantity. The following is an example of a prepared loading chart in Excel.



The loading chart should be hand over to the sales department to provide the full loading job for the factory. When factory jobs are loaded steadily, productivity will increase effectively.

3. Dispatching (Sasitate)

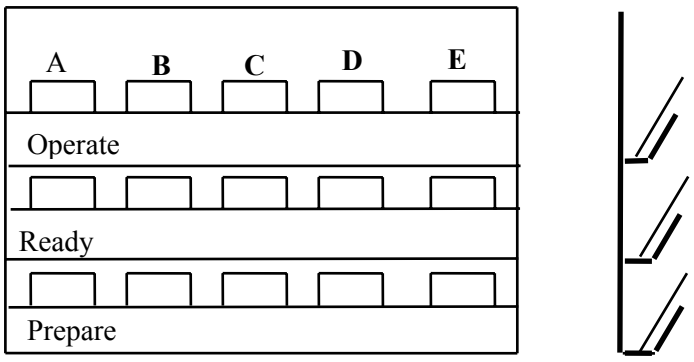
The production controller gives instruction to workers in accordance with a production schedule. This procedure is referred to as dispatching. For dispatching, three types of cards are used, namely a job card, semi-product card (moving card) and material/parts card. Examples are given below.

JOB CARD				No.
Issued 2002/ /		Issued by		
To be completed by 2002/ / / Result of completion at 2002/ / /		Section	Worker	
Standard man-hour	Actual man-hour	Qty. inspected	Qty. passed	
Drawing No.	Work No.		Quantity	
Parts No.	Name of product			

SEMI-PRODUCT CARD (MOVING CARD)				No.
Issued 2002/ / /				Issued by
Drawing No.	Work No.			Qty.
Parts No.	Name of Product			
No.	Process	Section	Received	Remarks
1				
2				
3				
4				
5				
6				
7				
8				

Request of Material and Parts				No.
Issued 2002/ / / Material delivered 2002/ / /		Issued by		Issued Section
Work No.				
Code No.	Name	Qty.	Unit Cost	Total Cost

A job card indicates what work should be undertaken by the worker. A moving card is attached to the container of a semi-product after which it is moved to the next process. This card is an identification card to prevent a semi-product from being misplaced. A request of material and parts card is used when commencing the first procedure. The report recorded on these cards is used for cost calculation and future revision of standard man-hours for each job.

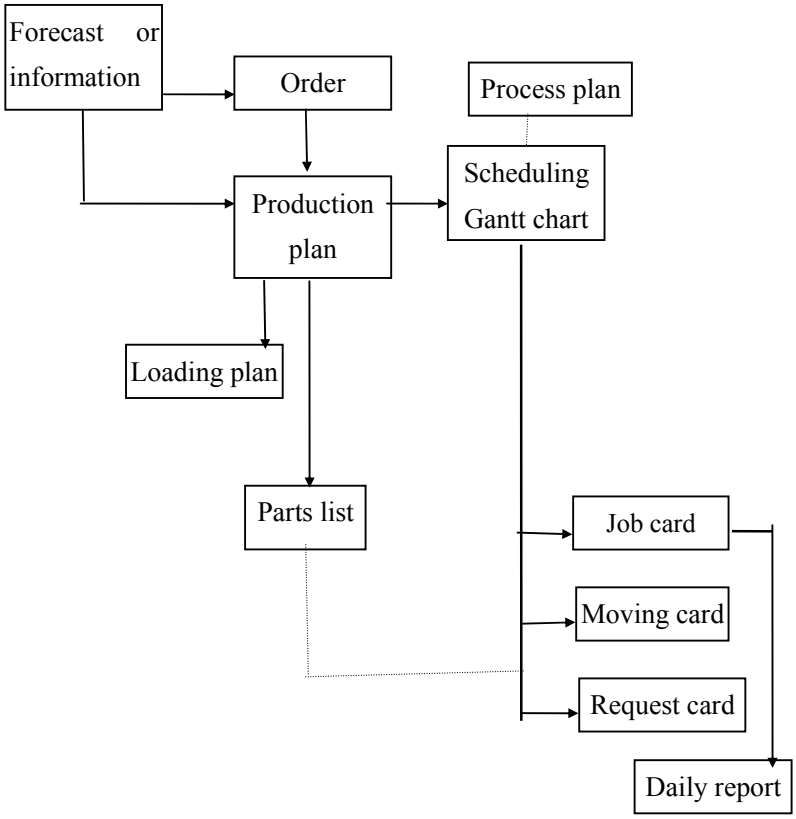


These cards are inserted on the board shown above. The name of each worker is indicated on the upper board, and cards are inserted for jobs now operating at the upper stage. Cards for work already prepared are inserted in the middle stage and for work under preparation at the low stage, as shown in the illustration. Workers therefore know what job comes next as well as what he should then do. When a job is completed, the worker returns the card to its original position. He then removes cards in the next box and places it in the upper box. A foreman or supervisor can determine who has completed what job. The cards are then collected and the foreman is able to prepare his report.

Cards are inserted in the box on the dispatching board, hence the Japanese refer to this procedure as Sasitate meaning to insert.

4. Conventional system of production control

Based on forecasts of the sales department or information from assemblers or traders, production plans for a month or year should be prepared. A loading plan should be prepared based on the production plan. The sales plan should be adjusted based on the loading plan. Therefore, when an order is received, based on the production process and loading plan, daily or weekly production schedules (Gantt charts) should be prepared by the production control center. Dispatching should also be carried out by the production control center and the results of job performance reported in the form of a daily report by the foreman.



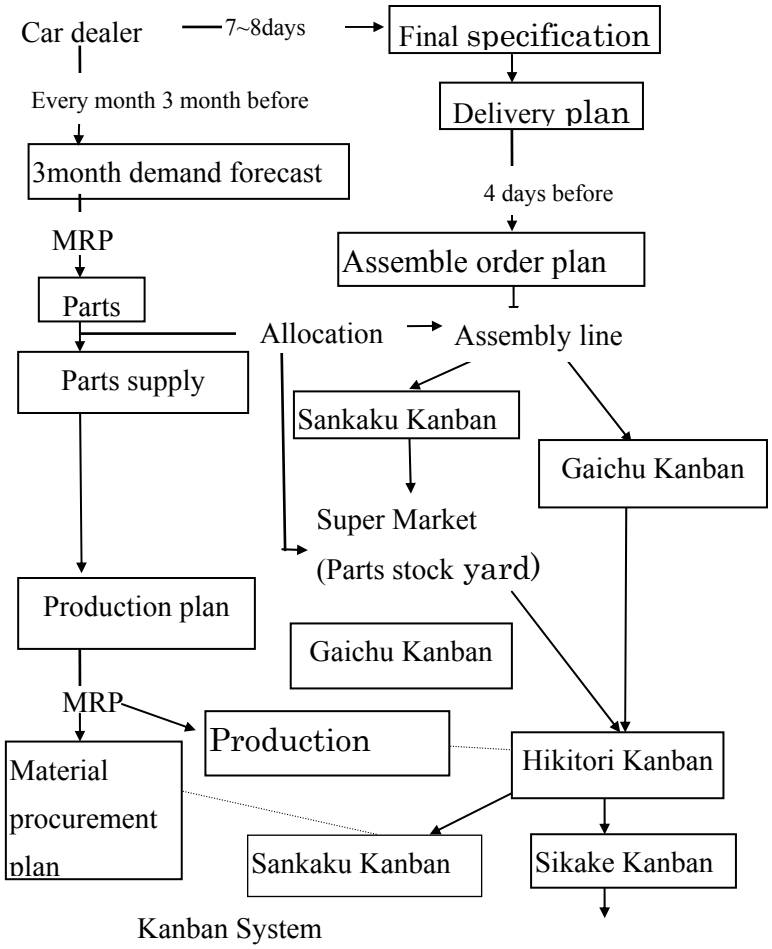
5. Out line of Kanban system (Just in time)

In order to reduce stock in the factory, automobile industries adopt the JIT (Just-In-Time) system. Typical of a very successful JIT system is the Toyota Kanban system. A Kanban system has many advantages, but also some weaknesses. When road conditions are poor, periodic collection of parts can be prevented due to serious traffic jams. The Kanban system has no function of load equalizing, as performed by a loading plan in the conventional method. Automobile assemblers undertake this function as part of the assembly order plan. Loads should be equalized and stable in this type of system, otherwise processes may become idle during production. The system also has a weakness when unexpected problems occur related to accidents, for example fire in a sub-contractor's factory. A JIT system minimizes the stock on hand, hence an assembler can be caught with almost no stock if an unexpected accident occurs.

It is not fully recommended that a Kanban system be adopted in developing countries. Nonetheless, most industries attempt to adopt the Toyota system when implementing JIT, even under severe international competition. Therefore factory managers should have some background knowledge on this system.

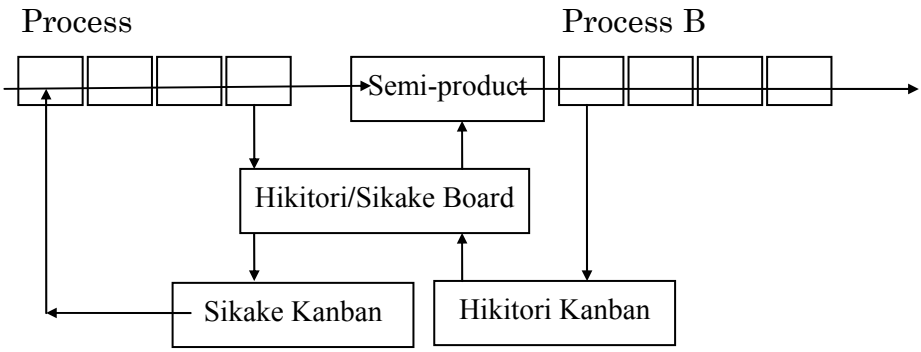
In the Kanban system instructions for production are not issued by the controller. They are issued by the assembly shop and follow the process in a backward direction. When a process lacks material or a semi-product to continue working, the process orders it to the upstream process, thus maintaining minimum stock between the processes. The automobile industry is very much dependant on parts suppliers. Hence, ordinarily large numbers of parts should be kept in stock. The Kanban system, however, attempts to reduce the intermediate stock levels to something approaching zero.

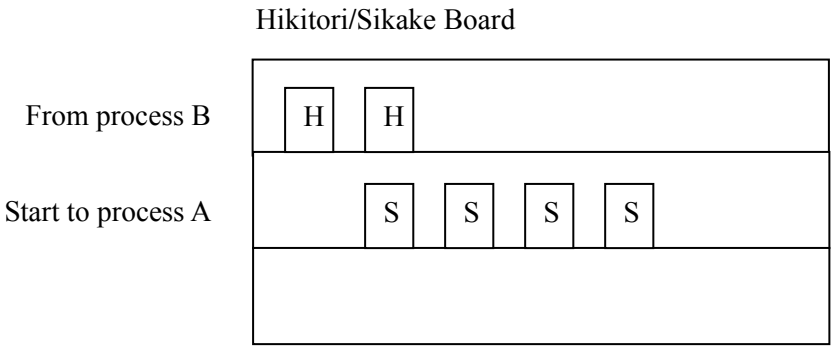
As shown in the following chart, details on car sales including required specifications, are informed by dealers approximately 7 to 8 days before required delivery. Based on this information, the assembler determines the delivery plan for cars. Four days prior to delivery, an assembly order plan is developed by the assembler and the assembly line commences operations to assemble the automobiles. Sankaku kanban requests materials and Gaichu Kanban orders parts to the sub-contractor. Limited amounts of stock assembly parts are maintained in a Super Market. and the available stock is adjusted according to the allocation plan. Parts are collected by trucks, which periodically circulate to every sub-contractor. The assembler therefore requests the punctual completion of parts by the sub-contractor in accordance with the instruction given by Gaichu Kanban.



Kanban System

In the factory, the Kanban system is applied as shown in the following chart. Production moves from process A to process B. When process B requires semi-products made by process A, process B sends the Hikitori Kanban to process A by placing the Kanban on the Hikitori/Sikake Board. Process A then commences production of the semi-product. When this is completed the Sikake Kanban is sent back to process B together with the semi-products. When process A receives the Hikitori Kanban, it removes the Sikake Kanban, which is then circulated in each sub-process of process A.

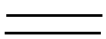

Process
Process B
Semi-product
Hikitori/Sikake Board
Sikake Kanban
Hikitori Kanban


Hikitori/Sikake Board
From process B
Start to process A
H
H
S
S
S
S

6. Process Diagram

A process diagram is a very convenient tool when preparing the production schedule and inspection planning. It is particularly useful when analyzing improvements in the production process. The process diagram uses the following symbols:

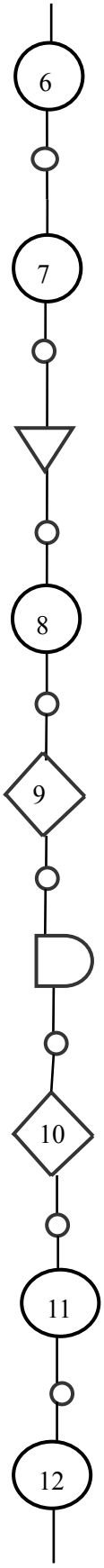
Name	Symbol
Process	
Transport	
Stock	
Pile of semi-product	
Quantity inspection	
Quality inspection	

Name	Symbol
Flow	
Boarder of section	
Abbreviation	

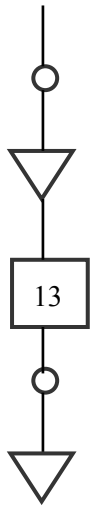
Name	Combined symbol
Quality and quantity inspection	
Quantity and Quality inspection	
Quantity inspection in process	

An example of the process diagram is shown in the following pages:

Time (min.)			Transportation distance (m)
		Material store	
0.85		**Fork lift**	**15**
125.00		**On pallet**	
0.05		**Manual put on machine**	**1**
1.00	1	**Milling end**	
0.20		**Conveyor**	**3**
1.00	2	**Lathe 1 shaft diameter**	
0.20		**Conveyor**	**3**
62.50		**Pallet**	
0.05		**Manual**	
1.50	3	**Lathe 2 shaft diameter finish**	
0.20		**Conveyor**	**3**
0.50	4	**Automatic inspection shaft diameter**	
0.05		**Manual to machine**	**1**
0.25	5	**End gear cutting**	
0.35		**Conveyor**	**5**



0.25	**Cleaning**	
0.35	**Conveyor**	**5**
0.75	**Heat treatment**	
0.10	**Manual on pallet**	**2**
62.50	**On pallet**	
0.10	**Manual to machine**	**2**
1.50	**Grind shaft**	
0.15	**Manual to inspection desk**	**3**
0.35	**Inspection shaft diameter**	
0.15	**Manual to pallet**	**3**
30.00	**On pallet**	
0.15	**Manual to inspection machine**	**3**
0.50	**Shaft surface inspection**	
0.15	**Manual to machine**	**3**
1.00	**Automatic lathe flange making**	
0.15	**Manual to machine**	**3**
0.50	**Drill**	



0.15	**Manual to pallet**	**3**
125.00	**On pallet**	
0.15	**Quantity inspection**	
0.75	**Fork lift to product store**	**7**
	Product store	

Firstly, the process diagram is to be prepared without time descriptions. The operating time of each process is then measure by a stopwatch. If time measurement is not possible, the data can be assumed based on information from an operator. The transportation distance must also be measured in order to improve efficiency. Moreover, the store of semi-product and stock has to be reduced.

Pilot Metalwork Cluster, Waru-Sidoarjo

Attachment 1-4 : Format for the Initial Feasibility Study of the Product Development (English)

Format for the Initial Feasibility Study of the Product Development

(*to be written by the enterprises*)

1. Market

Market A	1) Name of the Potential Customers (sales route)
	2) Area
	3) Expectations/Specifications of the Criteria to Purchase the Product by the Customer
	3) Name of the Competitors
	4) Unit Price of the Competitor's Product
	5) The Competitor's Estimated Sales Volume per Year
	6) Targeted Competency Against the Competitors' Products Explain how the products in Sidoarjo can sell despite the existence of competitors.

Market B	1) Name of the Potential Customers (sales route)
	2) Area
	3) Expectations/Specifications of the Criteria to Purchase the Product by the Customer
	3) Name of the Competitors
	4) Unit Price of the Competitor's Product
	5) The Competitor's Estimated Sales Volume per Year
	6) Targeted Competency Against the Competitors' Products Explain how the products in Sidoarjo can sell despite the existence of competitors.

2. Production Process

Identify the Production Process with the Names of the Companies

3. Technological Capability

Identify any difficulties in production that require information, engineers, and infrastructure.

4. Financial capability

Identify the items and costs in production that cannot be absorbed by the accumulated capital of the SMEs.

5. Rough Estimation of the Cost per Unit

Material	
Labor	
Transport	
Marketing	
Investment / Production Units per Year / Lifetime of Investment	

ATTACHMENT 2
Workshop Materials and Product
for the Pilot Wooden Furniture Cluster, Serenan - Klaten

WORKSHOP MATERIALS AND PRODUCT
for Pilot Wooden Furniture Cluster, Serenan-Klaten

Record of Workshop, Material and Products

1) Workshop and seminar

Program name	Workshop / seminar title	Materials and working paper
1. Institutional Strengthening of the Cluster	- Discussion workshop for formation of the unit - Discussion workshop for networking with outside institutions (furniture association)	- None - None
2.Seminar on European Classic Furniture	- Seminar on European Classic Furniture	- Handout of the topic
3. Cluster Analysis	- Workshop for marketing / sales promotion action planning	- None
4. Technical Training and Business Planning	- Workshop for accounting - Workshop for entrepreneurship and business planning - Workshop for finance (financial analysis and financial access)	- Handout of the topic - Handout of the topic - None
5. Training on Wood Use Management and Pretreatment with Production Management	- Workshop for production and wood use management - Consulting by visiting individual SMEs, JICA & local experts and BDS provider	- Text for production and wood use management - None
6. Technical Training on Jig-making and Machinery Use	- Workshop for practical learning of Jig and machinery (at factory)	- Text for machinery use
7. Study on Joint-use of Kiln and Machines	- Workshop for improvement of kilns - Consulting by visiting individual SMEs, JICA & local experts and BDS provider	- Text for kiln use - None
8. Marketing/Product-tracing Study and Exhibition Planning	- Workshop for exhibition preparation - Workshop for exhibition reporting	- Manual for Exhibition Preparation

2) Products

Program name	Products
1. Institutional Strengthening of the Cluster	- Cluster development strategy (reviewed)
2.Seminar on European Classic Furniture	- Activity Review for European Classic Furniture Seminar
3. Cluster Analysis	- Report by JICA expert (contributed as inputs of the text for following training)
4. Technical Training and Business Planning	- Business plan of group work
5. Training on Wood Use Management and Pretreatment with Production Management	- Modified materials for production management (photograph)
6. Technical Training on Jig-making and Machinery Use	- None
7. Study on Joint-use of Kiln and Machines	- Official letter for the Provincial Government
8. Marketing/Product-tracing Study and Exhibition Planning	- Product Brochure of the Collaboration Unit

3) Attached Samples of Material and Products

Attachment	Title	Prepared by
1	- Cluster Development Strategy prepared in October 2002	JICA Study team with Cluster SMEs
2	- Activity Review for European Classic Furniture Seminar	Indonesia Design Centre
3	- Extract of “Produksi Reproduksi Mebel Antik di Serenan” (Text for Production and Wood Use Management)	JICA Study team
4	- Mebel Serenan Untuk Masa Depan: Persiapan untuk perhiasan di PPE (Manual for Exhibition Preparation)	JICA Study team
5	- Product Brochure of the Collaboration Unit	Collaboration Unit

Pilot Wooden Furniture Cluster, Klaten

Attachment 2-1 : Cluster Development Strategy Prepared in October 2002

CLUSTER DEVELOPMENT STRATEGY

Wooden Furniture Cluster, Serenan-Klaten

(1) Goals : Long-term Target (10 years)

A long –term target of the Serenan cluster is summarized as below.

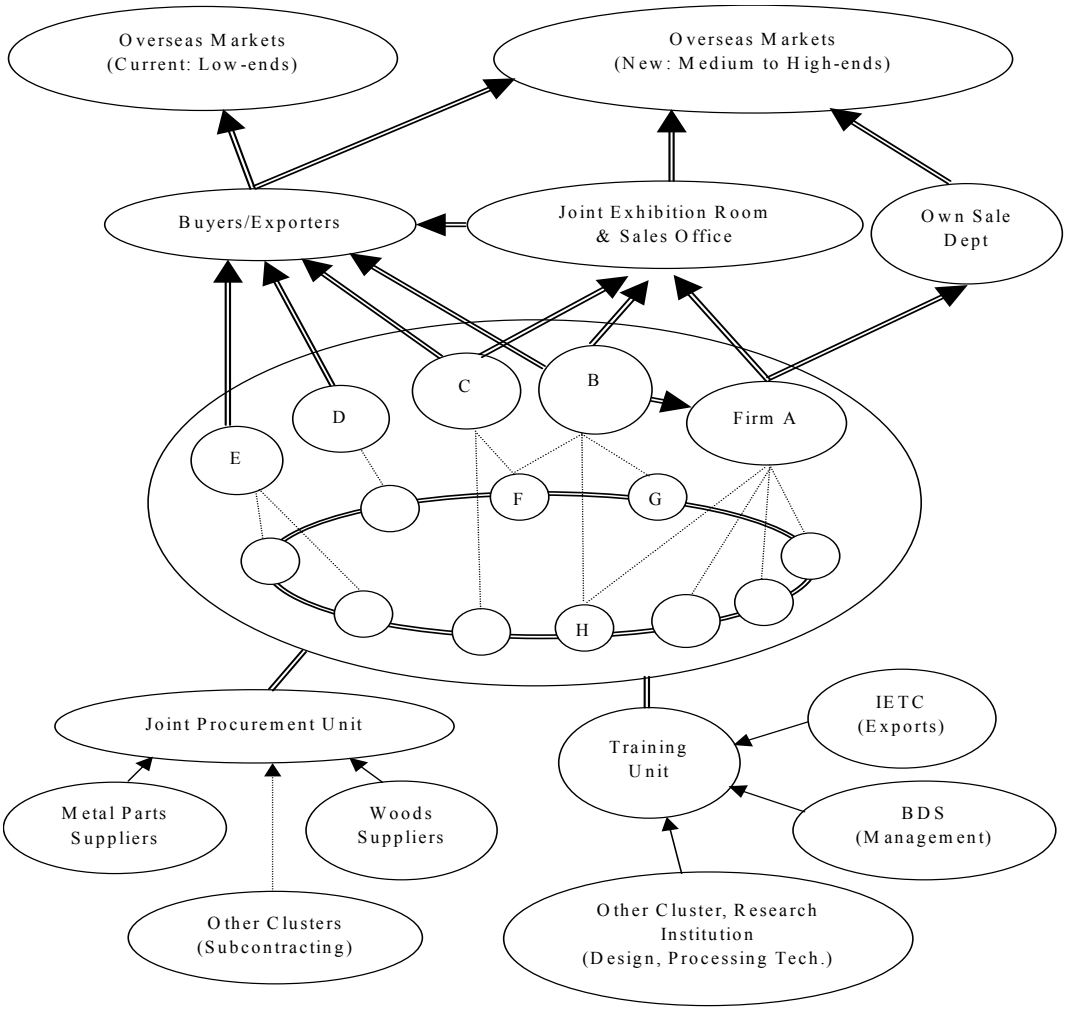
Ten (10) years goals

(a) To supply the cheapest reproduced classic European style furniture of *the lower* (try to keep key phrases consistent throughout document) *quality as in the old days, which are produced by the traditional method as in the old days,* and become one of the strongest suppliers of them
(b) To increase the supply of the finished product, growing out from the unfinished product supplier
(c) To develop and supply the cluster's own original product, of which the design is created and specification is determined by the cluster SMEs themselves, and hopefully reach the medium to high-end product market?
(d) To secure the direct business route with the buyers in the global market, either through a joint-sales office or direct contact with the overseas market
(e) To establish "Serenan Classic Furniture" brand in the global market
(f) To bring about the multiple business relation/linkage among the cluster SMEs such as division of work or sub-contracting
(g) To increase the sales amount by more than 4.5 times in ten years

By increasing the sales amount of the cluster by 20% a year in the first five years and 15% a year in the following five years, the sales amount after ten years may increase to more than 4.5 times as much as today.

By achieving the above-mentioned target, the Serenan cluster will become the combined type cluster of Hub-Spoke and Marshal type. A schematic drawing of the future situation of the Serenan cluster is shown below.

Cluster Type: Combined Type of Hub - Spoke and Marshal Type



(2) Scenario

Status quo

Serenan cluster is now suffering low profit margins by supplying mainly the unfinished products to the wholesalers or exporters' agents. There are only limited quantities that are directly exported to foreign buyers and their products' quality is inferior to those of Jepara.

On the other hand, it is said that the Jepara cluster is now facing the serious problem of quickly rising costs and some of them have already started moving to the central Java area seeking better standpoint where they can enjoy lower manufacturing costs.

If Serenan cluster will not take any counter-measure for such movement, the cluster will be forced to continue supplying the unfinished products of the cheapest reproduced European classic type furniture and continue suffering from low profit margins and it may have to become

subcontractors to the other clusters where such ex-Jepara members may take initiatives. The possible scenarios preventing such decline from occurring and pursuing their own growth shall be as follows.

Short-term perspective

1) Joint activities among the cluster members

In order to pursue the scenarios below, Serenan cluster may establish a voluntary joint activity unit, which shall be established by and among the cluster members and expected to act as the receiving body of the technical inflow and the executing body of co-working and joint procurement and sales activities. The joint activity unit shall work for:

- Acquiring the necessary skills and knowledge
- Receiving the training
- Purchasing and using the machines
- Procuring the materials at a cheaper rate,
- Engaging in joint sales activities

2) Supplier of the cheapest re-produced European classic type furniture

Although the quality of Serenan cluster products seems to be inferior to the similar products of the Jepara cluster, the exports amount of Serenan furniture has been increasing steadily in the last five years or more. The reason for this may be that the foreign buyers aim to sell the Serenan products in their home markets as cheap reproductions or imitation furniture of European classic style, which have kept the deep-rooted popularity in European communities.

Serenan may pursue the target of remaining the cheapest supplier of such kind of reproduced products.

The keywords for Serenan cluster business will be that it shall supply the *cheapest* reproduced European classic style furniture *of the lower quality as in the old days*, which are produced *by the traditional method as in the old days*. By pursuing these three keywords and strengthening the current price competitiveness further, Serenan cluster may become the one of the strongest suppliers in the field of reproduced classic European style furniture.

3) Improvement in profit margins through technical improvement

Serenan cluster is now suffering from low profit margins generated from supplying mostly the unfinished products, which are produced based on the buyers' design and specification.

Possible and adequate counter-measures shall be taken to increase the profit margins. The step they have to take for this direction may be the rationalization in processing materials and the improvement in the manufacturing method.

Short to medium-term perspective

4) Finished products supply

Serenan cluster has to grow out of the stage of the suppliers for the unfinished products to those of the finished products. The products of Serenan cluster are mostly unfinished at the moment. They sell those unfinished products to the wholesalers or exports agents, while only a few cluster members sell the finished products directly to the buyers.

The reason for this is that they lack the finishing skills and design ability. In order to become the supplier of the cheapest reproduced European classic type furniture, they need to acquire and develop various finishing skills such as sandblasting, chemical treatment and use of the specially developed paints and design ability as well.

By standardizing the manufacturing process, the processing period will be shortened and even inexperienced part-time workers will come to provide quality work, which will lead to cost reduction. The use of jigs, machinery and full-scale drawing of the products will be applied in the cluster.

Medium-term perspective

5) More variety of the products

Serenan cluster has to develop their own original products of which designs are created and the specification is determined by the cluster members. Serenan cluster may develop the ability for creating European classic furniture of their own designs, which may include neo-classic type and other styles. They also may supply Chinoiserie style furniture by using Sonokerin and rubber woods. The cluster, thus, will have a wider range of products, which will attract the attention of more markets. Hopefully in this process, they may become able to supply medium- to high-end products as well.

6) More independence in the sales activities

By introducing their own designs and specifications to their finished products, which suit the market preference, the cluster will become more independent from the wholesalers or export agents. Coupled with the firm marketing policies and direct sale efforts, the cluster may attract more attention from foreign buyers, who may prefer to have contact directly with the

manufacturers or the cluster. Serenan cluster may also diversify the sales channels, and open their own joint exhibition room and sales office inside or outside of the cluster.

Long-term perspective

7) Multiple relations among the cluster members

To supply finished products, which enjoy higher value added, the most ambitious and aggressive firms in the cluster may start direct sales to the foreign markets through their own sales department or a joint sales office of the cluster and expand to medium- to large-sized enterprises. In order to correspond the excess orders or for rationalization purposes, they may establish their own sub-contracting or work division network in the cluster, which consists of micro- to medium- sized firms.

Among those subcontractors, some may be specialized in certain skills such as handwork curving and the other may supply the unfinished products to medium or large enterprises. Small to medium sized firms may still sell the products to the exporters' agents, but the quantity will be much less. The medium sized firms, at least, will be more dependent on the joint sales office as their strategic sales outlet.

Such micro firms, as to be quality conscious and to receive multiple orders from various medium to large sized enterprises, will be ready to grow further and may become the next small to medium sized enterprises. Thus, the activities in the cluster will be activated.

Linkage to be strengthened in the scenario

a) The first linkage the cluster has to strengthen will be with the other cluster, BDS, research institute, foreign donors, or NGOs to receive training on wood use, wood pre-treatment, jig making, finishing skills, machine use and design abilities.

b) Secondary, the cluster has to seek for the collaboration with NAFED, IETC and various trading houses for acquiring market information, receiving exports training, learning marketing methods, etc. BDS will be vital in this field as well.

c) Thirdly, they may have to establish a reliable relationship with woods suppliers for stable purchasing of material woods and interactive relations with metal parts suppliers for realizing their own designed metal parts of better quality.

d) They also need to keep close contact with the MOIT, NAFED, Jakarta Design Center, etc., as they may attend exhibitions, market seminars, trade fairs, etc.

e) For improving business operations, they may need long and close linkage with various BDS for business training and management consultation.

(3) One-year Action Program

The One-year Action Program aims at intensively improving technological and managerial capacities in Serenan cluster so that it may bring the cluster a sustainable system for growth or expansion in accordance with the mid to long-term perspective mentioned above. This action program also envisages ignition-effects on the cluster's business activity, which are expected to be continuously utilized by the cluster and its stakeholders at later stages.

1) Beneficiary

Beneficiaries of the One-year Action Program will be wooden-furniture cluster SMEs located in Serenan-Klaten.

2) Lines of Action Program

Within the limited time frame of one year, special attention and focus should be intensively on the subjects including managerial, marketing, technical capacity building for the cluster SMEs who have potential in leading other SMEs in future stages.

Lines of the action program are presented as follows with the tentative contents.

Program 1: Institutional Strengthening of the Cluster (Collaboration Unit formation)

Background

It was pointed out by Serenan cluster SMEs that the linkage among the cluster SMEs are rather weak at present and the competition among them is hard because of the limited number of buyers. Under such circumstances, there must be a unified group established as a facilitating body for implementing the action program in the cluster.

Purpose

To form the Collaboration Unit (Serenan enterprise group) which serves as the main planning and executing body for the action programs for the cluster. Start with building up the core to enhance Serenan cluster to take over JICA's technical assistance, continue with playing the significant role as the incubation of business, then will expand the size of the unit in the long-term perspective. This Collaboration Unit will encourage the linkage among cluster member in not only the same industry but also various stakeholders. For the most urgent task in the pilot project, the unit will work for;

- Joint-research on the cluster analysis
- Establishment of the future business plan for the cluster
- Analysis of the necessary skills and knowledge for the cluster
- Preparation of technical training plan and arrangement of the technical training, seminar or workshop accordingly
- Arrangement for the study on a joint-use of drying kiln and processing facilities
- Planning and execution for the processing machinery introduction and joint-sales and procurement activities

Content

1) Initialization:

The Program Operation Unit recruits the members of the Collaboration Unit. BDS providers and others deemed as necessary may be invited to the Collaboration Unit for the purpose of receiving guidance and supervision.

2) Membership:

The membership may be open to some cluster members, who are willing to cooperate and ready to endeavor the effort in implementing the Collaboration Unit's objectives, and other related persons, whoever the Program Operation Unit may think appropriate, such as sub-contractors, material / metal parts suppliers or buyers.

3) Planned Activities:

a) Regular meeting

The members of the Collaboration Unit will have regular meetings to discuss the operation plans to pursue the objectives of the unit shown above, to make detailed executing plans and to evaluate the results.

b) Seminar and workshop:

The Collaboration Unit will authorize and arrange the seminar and workshop necessary for technical or marketing training. A follow-up seminar will be also arranged by the unit to monitor the efficacy of the training program and diffuse the results all the cluster members.

c) Business planning:

The Collaboration Unit will prepare and authorize its own business plan for the benefit of the cluster. The follow-up for the plan will be proceeded by the unit.

d) Future courses:

This Collaboration Unit will, in the future, become a general decision-making organization on the cluster's activities and will have a joint-procurement or training provider function under its control.

Implementation

Target : Cluster SMEs interested in the unit formation
Guidance : Local BDS provider (assisted by JICA Study Team)
Place : Meeting room in DINAS Industry at Klaten
Period : Within two days

Expected Output /Outcome

- Serenan Collaboration Unit (voluntary enterprise group)
- Documented missions, and roles and tasks of the Collaboration Unit
- Number of regular meeting held by the Collaboration Unit

Program 2 : Seminar on the European Antique Furniture

Background

Although Serenan cluster exports most of its products, either directly or indirectly, the products specification and designs are mainly supplied by the buyers. Consequently, most of the cluster members could not afford the opportunities to acquire knowledge on European antique furniture, which is their main product. In order to develop their own designs, to increase the portion of finished products, and to respond correctly to the orders placed by overseas buyers, Serenan cluster SMEs are seriously in need of acquiring basic knowledge of European antique furniture.

Purpose

To acquire basic knowledge on the history and specification (such as typical dimension, coloring) of European antique furniture

Content

A local lecturer will be invited from the Institute of Wooden Science (PIKA) in Semarang to give a lecture on European antique furniture to the members of the Serenan Cluster for two days. In this seminar, a lecturer features the brief history and various typical specifications of European antique furniture made in different areas and different centuries.

Implementation

Target : Collaboration Unit member
Provider : Lecturer from Institute of Wooden Science (PIKA) in Semarang
Place : Meeting room in DINAS Industry at Klaten
Period : Within one day

Expected Output / Outcome

- Lecture text and material
- Participants' satisfaction (through questionnaire)

Program 3 : Cluster Analysis

Background

Serenan cluster needs to identify his / her strength, weakness, opportunities and threats, and adequately understand them in order to formulate plans for strengthening capacity of the cluster.

Purpose

To acquire the clear and bias-free knowledge on the current situation of the cluster

Content

Foreign experts, who have enough knowledge on the furniture industry, shall make thorough research on the cluster's present situation and future possibility of the business development, specific technical, and managerial, and marketing constraints. An analysis report shall be disseminated to all the cluster SMEs interested, and be referred to for the purpose of preparing the technical and business plans at the next program.

Implementation

Target : The entire Serenan cluster
Provider : Collaboration Unit (under JICA Study Team guidance)
Place : The entire Serenan cluster
Period : Within two weeks

Expected Output / Outcome

- Cluster analysis report
- Dissemination of the report and discussion result

Program 4 : Technical Training and Business Planning

Background

Serenan cluster SMEs obviously lack an efficient and firm technical base. To improve the cluster's competitiveness and financial basis, technical training with adequate focus on the practical needs will have to be prepared.

Serenan cluster SMEs are mostly independent and their way of doing business differs from one to another. As the competition with other furniture clusters become harder, Serenan cluster needs to examine and share a common business direction and target. This will be true and urgent especially when some SMEs of the Jepara cluster are said to be moving into the neighboring area.

Purpose

To prepare the needs-oriented technical training plan, comprising of a series of sub-training programs

To prepare the realistic business plan envisaging the common business direction and target among the cluster SMEs, and the immediate action plan for the cluster to shift into the said common business direction and target

Content

1) Technical training planning:

Based on the findings from the "Cluster Analysis Report" prepared by a foreign expert and assisted by a local management consultant, the Collaboration Unit shall discuss and prepare his necessary technical training plan through planning session. The technical training plan needs to comprise of a series of sub-training programs, each of which is detailed by the plan of program operation, potential training provider, cost estimate and expected technical improvement.

2) Business planning:

The Collaboration Unit shall review and confirm the Cluster Development Strategy, and the long-term vision and scenario/approach employed by the Strategy. Then, assisted by a local management consultant, the Collaboration Unit shall prepare the business action plan for the Serenan cluster to realize the long-term vision through scenario/approach through planning session. The business action plan shall address the detailed plan of implementation, which

mentions the objective, organizational, financing and staffing and physical preparation plans. Action plan may be any kinds of activity ranging from the establishment of a new organization to the survey work, as long as it is realistic and feasible within the capacity of the cluster.

A dissemination workshop will be held when both plans are prepared to introduce them to other cluster SMEs interested, discuss the contents, and obtain the consensus for realization of the plans at a later stage.

Implementation

Target : Collaboration Unit
Provider : Local BDS provider (assisted by JICA Study Team)
Place : Meeting room in DINAS Industry at Klaten
Period : Within three weeks

Expected Output / Outcome

- Technical training plan with sub-training program
- Business action plan
- Dissemination of the plan and discussion result
- Actual implementation of the sub-training program and business action plan (at later stage)

Program 5: Training on Wood Use Management and Pretreatment

Background

Serenan cluster SMEs currently dry the material woods naturally, through which they can not control the water content of the material woods below around 18 %. When the water content of the material woods is higher, the engraving process becomes easier and quicker but at the same time it causes cracks, bends or warps at the single board.

Besides, the way they cut the material woods into pieces for preparing the furniture parts does not seem efficient with a lot of unused wood pieces left over, which increases the product's cost.

Purpose

To reduce the material cost and upgrade the product quality

Content

1) First Seminar:

A foreign expert shall explain the method of efficient rough mills of straight grain and flat sawn grain and the necessity of changing marking methods, and the advantage of using material woods by classification through the seminar. The expert will also give a lecture on the stacking method of the material woods and the use of dry kiln for more efficient and effective drying.

The expert then will perform the actual practices of those skills and technology introduced during the above seminar, and later work with some selected participants to transfer the skills and technology at the job-site.

2) Follow-up workshop:

The same expert will hold the follow-up workshop to confirm the result of technology transfer. Practical advice shall be given to the participants at the job-site to ensure application of skills and technology introduced.

Implementation

Target : Collaboration Unit and some selected SMEs
Provider : JICA Study Team
Place : Meeting room in DINAS Industry at Klaten (for seminar)

A factory/workshop of participant SMEs (recommended by the Collaboration Unit)

Period : Within two weeks (for the first seminar)
Within one week (for follow-up workshop)

Expected Output / Outcome

- Participant's satisfaction with and understanding of the contents of the program (through questionnaire)
- Application of skills and technology introduced among participants (through the follow-up workshop)
- Dissemination of skills and technology introduced among the entire cluster SMEs (through hearing by visiting)

Program 6: Training on Jig-making and Machinery Use

Background

In Serenan cluster, the furniture making is done manually by copying the sample without using any drawing. They use no jig but employ the traditional gauging method for processing, which causes the inefficiency in the furniture processing and non-standardization of the products. They also do not use much machines for making furniture.

Purpose

To attain standardization of the products and to improve the efficiency in processing, by giving the appropriate training on the make and use of jigs and related technique and the use of machinery

Content

1) First seminar:

A technical seminar will be provided by the foreign expert. The subjects of this seminar will be:

i) Method of achieving standardization of the product
ii) Meaning and importance of using jig to improve efficiency
iii) Method of making and using jigs
iv) Effective method of machinery use

The expert, then, will instruct and supervise the participants' work of making the sample jigs at the workshop.

2) Second seminar:

The same expert will hold the workshop to check the performance of technology transfer. Practical advice shall be given to the participants at the job-site to ensure application of skills and technology introduced. Also the expert shall hold a seminar on much higher level of skills regarding jig making and use, depending on the participant's absorption capacity.

3) Follow-up workshop:

The same expert will hold the follow-up workshop to confirm the results of technology transfer and provide the field training session at the job-site.

Implementation

Target : Collaboration Unit and some selected SMEs
Provider : JICA Study Team
Place : Meeting room in DINAS Industry at Klaten (for seminar)
A factory/workshop of participant SMEs (recommended by the Collaboration Unit)
Period : Within two weeks (for the first seminar)
Within one week (for the second seminar)
Within one week (for the follow-up workshop)

Expected Output / Outcome

- Participant's satisfaction with and understanding on the contents of program (through questionnaire)
- Application of skills and technology introduced among participants (through the follow-up workshop)
- Dissemination of skills and technology introduced among the entire cluster SMEs (through hearing by visiting)

Program 7: Study on Joint-use of Kiln and Machines

Background

In Serenan cluster, most of the processing work is done manually and the woods are dried naturally. Those practices bring about inefficiency in processing, and inferior quality of the product. On the other hand, there are not enough funds available to purchase the machinery or to afford individual kiln at each factory/workshop.

Purpose

To study and plan the scheme to proceed the joint-use of machinery or dry kiln, in order to promote machinery use and dry kiln

Content

1) First seminar:

The Collaboration Unit or some participant SMEs will be consulted by the foreign expert on the possibility and approach to scheme the joint-use of machinery or dry kiln. Then, the Collaborative Unit and some participant SMEs will study the problems and expected outcome, and learn how to implement the approach proposed by the expert. Finally, the Collaboration Unit or some participant SMEs are requested to prepare the plan on how to proceed with the joint-use of machinery or dry kiln.

2) Implementation assistance:

Based on the plan presented, the Collaboration Unit or some participant SMEs shall receive the advice on future realization of plan.

Implementation

Target	:	Collaboration Unit and some selected SMEs
Provider	:	Local BDS provider (assisted by JICA Study Team)
Place	:	Meeting room in DINAS Industry at Klaten (for seminar)
Period	:	Within three weeks (for the first seminar) Within two weeks (for the implementation assistance)

Expected Output / Outcome

- Business plan on the joint-use of machinery and dry kiln
- Dissemination of the business plan and discussion result
- Realization of the business plan on the joint-use of machinery and dry kiln

Program 8: Product-tracing Study

Background

Serenan cluster SMEs sell mostly unfinished products to some collectors in the cluster, wholesalers or export agents. Even such collectors in the cluster produce the product, according to the specification and design provided by the foreign buyers. Because of those practices, it can be hardly possible for cluster SMEs to know about the reputation of their product in the market, in which kind of market their product is sold, what else they can supply to the existing market, and what is expected from the cluster for quality improvement.

Purpose

To continuously acquire valuable market and end-user information for the purpose of preparing the marketing actions and the appropriate counter-measures for quality improvement through periodic execution of the product-tracing study

To establish a sustainable system for market information collection, utilization and distribution for the benefit of the cluster, in view of formulating and updating the joint-marketing actions and counter-measures for quality improvement

Content

An interview or listening to the wholesaler, export agent or foreign buyer on the reputation of the cluster's product and/or the market situation will be proposed at this moment. Serenan cluster SMEs can regularly meet the interview or hearing targets at Dellangu market center located near the cluster (for the initial stage).

The Collaboration Unit will first ask some cluster SMEs (collectors) to display their own product at Dellangu market center, and will prepare the implementation method and tools (including the number of target, schedule, frequency, staff in charge, and questionnaire format) of the said product-tracing study.

The study result will be disseminated among the cluster SMEs interested through the dissemination workshop (for the initial occasion) and then the report will be distributed (for the later stage) to build the unified perceptions about their product. Then, the Collaboration Unit is expected to analyze the study result and prepare the joint-marketing actions or counter-measures against the revealed findings for the benefit of the cluster.

Then a series of practices employed by the study will be systemized, for the cluster to continuously utilize the marketing information gathered for the further action-taking purpose. The Collaboration Unit, in this regard, will be in charge of continuous operation of the study.

Implementation

Target : Collaboration Unit and the cluster SMEs
Provider : Local BDS provider (assisted by JICA Study Team)
- for the study preparation
- for the planning of marketing action or quality improvement measure
Place : Meeting room in DINAS Industry at Klaten (for the study preparation)
Dellangu market center (for actual execution of the study)
Period : Within two weeks (for the study preparation)
Within one month (for each execution of the study and action planning)

Expected Output / Outcome

- Implementation methodology for the product-tracing study
- Actual execution and result of the product-tracing study
- Marketing actions or counter-measures against the findings of the study
- Repeated execution of the study
- Realization of the marketing actions or counter-measures proposed

Pilot Wooden Furniture Cluster, Klaten

Attachment 2-2 : Activity Review for European Classic Furniture Seminar (English)

Cluster Development Program

Wooden Furniture Cluster, Serenan-Klaten

Activity Review for
European Classic Furniture Seminar

Provider : Lecture from Indonesia Design Center, Mr. Prieyo Pratomo, HDII
Supporting Expert for Wood Finishing Technique, Mr. Ignatius Istiarso
Contents : Overview of European Classic Furniture
Things to consider for developing & producing classic furniture

Day1

Topic to presented :
- The Advantages of applied "design" to increase product competitive advantage in the global market.
- The Historical of European Classic Furniture, Periods & Spreading Development

Although the opening session was started behind schedule, the opening topic could trigger the participant enthusiasm and open their eyes to the fact that the cruel competition in the free trade market period should be addressed by readiness of Indonesia, in this case producer, to compete and grab the market opportunity.
It pointed out that to enter the global market, quality and innovation are crucial, otherwise nothing would be gained, as the competitor are all out in putting out their best performance.
And it will be happened if they consider to implementing "design" to their product.

In the next phase, participants were directed toward understanding of the historical of the European classic furniture, its periods, and its spread to the America and Asia region. Knowledge of names, terms, and specific characteristics of the classic furniture are expected to provide more horizons to participants in the initial introduction to the European classic style furniture.

The emphasis remained to the perfect design and high class quality aspects related to the basic characteristic of the European classic furniture originated from the furnishings of the elite class, monarch, and European aristocrat which always maintain a sophisticated standard of style.

Day2

Topic to presented : - Slide/Digital Photographic Presentation of Antique Furniture from several periods and also several area/region in Europe, Asia & America.
- Knowledge about environmentally-friendly Wood Finishing Method/Technique in compliance to ISO 14000, Green Label & Eco Label.

Following the presentation on the previous day, day tow was started by delivering knowledge and perspective by providing several photographic references on the collection of antique furniture around the world at various periods.

At this session, the participants were actually able to compare the design structure of the classical furniture and the pieces they used to produce.

The misunderstanding and misuse of the words antique, classical and ethnical upon old-style furniture were clearly and transparently discussed using the samples from the photo slides.

The next session continued with description on knowledge of process, specification, standard procedure also the benefit and detriment of various woods/furniture finishing system.

This basic knowledge was expected to be beneficial for furniture producers specifically those with export market orientation, as several countries, i.e. US and Europe required all the product entering their market to use only non-toxic materials.

Facilitator observations to the activity

The facilitator observations on the two days sessions are described in the following:

- The historical of the furniture-craft-man in Serenan were ordinary craft-man with minimal skill and quality craftsmanship. They had experienced their golden era in the 70s and early 80s when most government offices and project were directed to order furniture from them and at that time they were feel very success community.

  Currently, order from the government are low and going decrease, however the village has been established as a furniture-maker village with all psychological impact to the member of the community. Therefore they tried to diversify by producing second class local ethnic style furniture after Jepara.

  It was rather difficult & tricky to meet with such community as they thought they were successful at the management aspect, and also thought that they were technically competent provided that they have been in the business for several decades.

It should be treated by special touch and strategy to motivate them for doing some improvement specially 'cause the felted satisfied with their present achievement.

However, they are aware that they lack of furniture design knowledge, considering that they originated from the low-class furniture-maker.
They are conscious that to do compete at least with Jepara, they haven't any weapon especially from design aspect.
They used to imitate the pieces previously ordered without any understanding of the furniture design background.

Their interest to the workshop will be more intense by providing design and art knowledge and this could be the trigger to make them more creative in finding new and more innovative design structure.

- The program timing which was started in the evening created a hindrance in the choice of material selection and participant concentration.
  Participant were easily bored as they worked during the day prior to the sessions, this means the facilitator must create an active atmosphere to keep them awake.
  The timing of the presentation also resulted in a passive, one-way communication, instead of an interactive session which would be more beneficial for the participants.

  The most effective way to understand design, will be when participant could get the feel of searching and developing the design itself.
  "Learning by Doing" method of lecturing will be the good strategy to be implemented.
  The application of the above methodology required maximum interactive pattern supported with the facilitator vast knowledge and skill of the material, and full concentration and participation from the participant.

- From a quick observation, the furniture-maker in Serenan need technical training for their knowledge, in the sense of applicable techniques and not the production process techniques.

  This is related to the thought that they were experienced in production for decades and therefore material related to production were seen as unnecessary and boring for them. However they are aware of their lack of skill and knowledge in applicative technique.

Suggestion for additional material structure

Suggested topic/materials for future session:

- **Pattern, Border, Element & Component in the Classic Style furniture and application**

  The objective of the topic is to initiate the furniture-maker to learn how to apply the reference of the classical pattern, border, element and component to the development of their own new design creation.

- **Indonesian local ethnic & colonial era furniture**

  The objective of the topic is to provide knowledge in style and structure of the furniture they currently produce and call as antique, while the style was originated from local ethnic style with influence from Chinese, European, India, Egyptian and Dutch & English-colonial style.

  The ornament and element pattern in the ethnic design developed in Indonesia would also be useful as supplementary material.

- **The application of industrial view point in the SMEs production process**

  The objective of the material is to provide a clear picture of the production process application oriented towards the **"quality"** of the final product and **"customer satisfaction"** which should be delivered in a simple presentation to assure easy absorption of the content and application by the small level furniture-maker, i.e. the production of the technical design drawing, Mock-up method, guidance in material selection with the range corridor system, and determination of product measurement/dimension for safe and easy packaging also space efficient (in the container) for export delivery.

The structure and technical arrangement could be developed further and adjusted to the need arisen in the field.

The above description is compiled as the result of observation as a facilitator for the training program at the Serenan Cluster-Klaten.

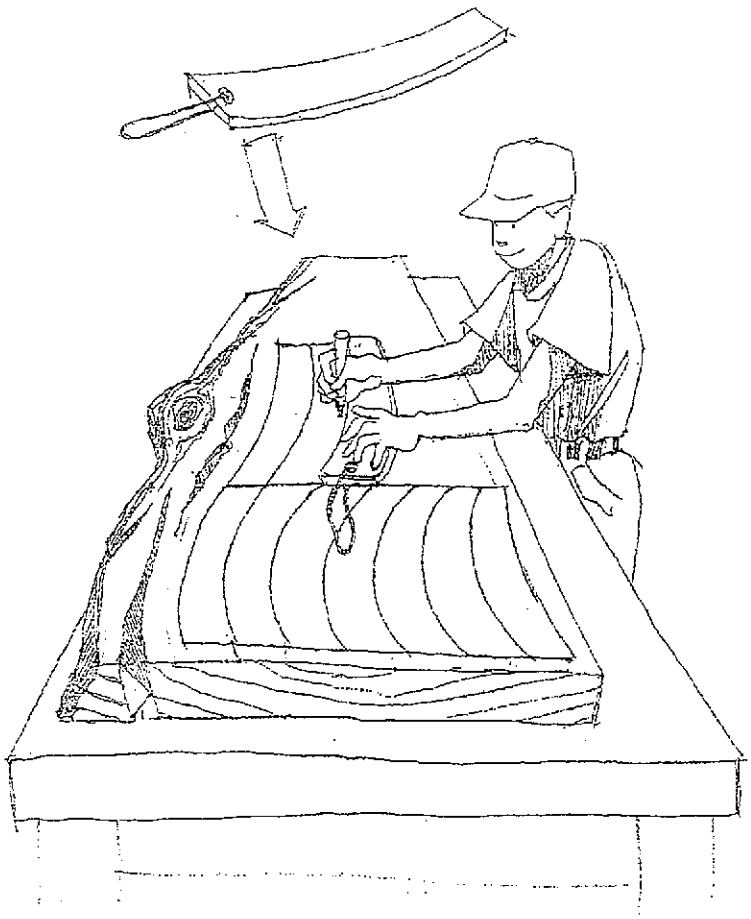
Prieyo Pratomo, HDII

Pilot Wooden Furniture Cluster, Klaten

Attachment 2-3 : Extract of the Text for Production and Wood Use Management (Indonesian)

PRODUKSI REPRODUKSI MEUBEL ANTIK

DI SERENAN



JICA STUDY TEAM

The Study on Strengthening Capacity of SME Cluster in Indonesia

2003

PRODUKSI REPRODUKSI MEUBEL ANTIK DI SERENAN

1. Pendahuluan

1.1. Produksi Reproduksi Meubel Antik

Kebanyakan produksi meubel di daerah Serenan (Jepara, Solo, Yogyakarta, dan sekitarnya) adalah produksi reproduksi meubel antik Eropa, dan produsen di daerah tersebut membuat dan mengirim barang setelah menerima pesanan dari pembeli (*buyer*) dari Italy, Spanyol, Belgia, Perancis, Jerman, dan sebagainya. Atau dari pemborong sebagai perantara di Semarang atau dari Singapura.

Jenis produk juga sudah banyak, seperti cabinet, arm chair, sofa, bingkai dining chair, dining table, console table, night table, coffee table, bingkai cermin, dan sebagainya. Kuantitas setiap pesanan juga berberda-beda, ada yang banyak pesanannya, ada juga yang jumlahya terbatas.

Kualitas (mutu) produk di Serenan belum bisa dikatakan tinggi di pasar internasional, akan tetapi mendapat pujian dan penilaian lumayan tinggi karena dibuat dengan teknik yang khas.

Pasar reproduksi meubel antik di dunia terpusat pada daerah Eropa, dan negara yang menangani dana dan kuantitas terbesar adalah Italy, dan diikuti Perancis, Jerman, Inggris, Spanyol, Belanda, dan Belgia. Amerika Serikat merupakan pasar yang besar sebagai negara pengimpor meubel dari negara-negara Eropa tersebut. Walaupun persentase di pasar internasional tidak begitu besar, di Jepang juga ada pasar meubel antik yang mewah dan harganya tinggi.

Sebagai negara produsen, Italy dan Spanyol paling besar, dan negara seperti Belgia, Perancis, Inggris, Belanda, daerah bekas Yugoslavia pun mempunyai daya produksi yang kuat. Kualitas produk yang diekspor dari Indonesia, antara lain dari Jepara, Semarang, Surabaya, dan daerah Serenan belum mendapat penilaian tinggi, tetapi jumlah produk sangat banyak karena harga terjangkau, maka pada umumnya Italy dan Spanyol memperbaiki dan mengecat ulang produk yang sudah diimpor dari Indonesia. Dengan demikian, negara-negara tersebut merebut pangsa pasar besar di pasar reproduksi meubel antik di dunia.

Ada empat hal (A-D) yang menjadi keunggulan produk Indonesia:

A) Harga yang murah,

B) Mengutamakan pengolahan tangan, dan teknik ukiran yang sangat mahir,

C) Pada umumnya menggunakan mahogani (mahoni) yang biasanya dipakai meubel antik, dan menggunakan bahan (termasuk jati) yang asli, tidak menggunakan kayu partisi atau kayu lapis,

D) Mempertahankan cara pembuatan yang sama dengan cara pembutan ratusan tahun yang lalu dengan tidak mempergunakan mesin.

Terutama A, B, dan D adalah hal-hal yang pokok yang sangat penting untuk membuat reproduksi meubel antik, maka harus dipertahankan dengan baik di Serenan sebagai ciri khas produk Serenan.

Seperti disebutkan di A, harga produk di Serenan murah. Harganya lebih murah dibandingkan produk Jepara. Hal ini ada kaitannya dengan produk Serenan yang tidak sempurna pembuatannya, tinggi persentase kandungan air, terjadi berbagai masalah di negara pengimpor. Oleh karena ada hal seperti itu, harga produk Serenan ditawar rendah.

Meubel yang tiba di negara pengimpor dengan kontainer, terjadi masalah-masalah seperti beriku: 1)pecah, 2)bagian sambungan sudah pisah, 3)berlirtir/bengkok, 4)pintu cabinet tidak tepat ukurannya, 5)laci cabinet tidak bisa digerakkan, 6)empat kaki tidak rata (maka harus diperbaiki, harus dipotong), 7) perbedaan warna kayu terlalu menyolok. Karena terjadi masalah seperti diatas, negara pengimpor sudah tahu bahwa produk dari Indonesia harus diperbaiki, diolah ulang, atau dicat ulang. Produk di daerah Jepara tujuh tahun yang lalu juga situasinya hampir sama dengan Serenan sekarang, tetapi kontrol bahan kayu sudah baik, sehingga makin meningkat penilaian dari pasar Internasional terhadap produknya. Karena produknya reproduksi meubel antik, maka bisa diolah ulang, diperbaiki, dan dicat ulang sebelum memasuki pasar, tetapi kalau produknya dijual sebagai meubel biasa, mungkin tidak ada yang lolos dari pemeriksaan. Walaupun situasinya demikian, produk Serenan mendapat penilaian yang lumayan tinggi karena harganya murah. Hal ini merupakan hal yang paling unggul bagi produk Serenan.

Seperti telah dijelaskan di B, reproduksi meubel antik menggunakan teknik penghiasan seperti mengukir bunga dan hiasan dengan cukilan timbul dan dalam, teknik yang rumit seperti pengolahan kayu dikerjakan dengan tangan (bukan mesin) seperti cara pembuatan tradisional. Selain itu, teknik-teknik pengolahan tersebut sangat mahir.

Cara pembuatannya sama dengan ratusan tahun yang lalu (D) pun menjadi keunggulan, hal ini wajar karena memproduksi reproduksi meubel antik. Di Italy dan Spanyol, dipakai kayu partisi (tipe *fingerjoint*), kayu lapis (*plywood*), pada umumnya dikerjakan dengan mesin. Dengan demikian bisa menghemat waktu dan tenaga produksi, tetapi hal ini tidak boleh digunakan sebagai produsen meubel klasik. Oleh karena itu, meubel antik Indonesia dari Serenan dan Jepara dinilai tinggi karena tetap mempertahankan cara pembuatan yang tradisional. Seperti sudah dijelaskan diatas, kita harus membuat berdasarkan cara produksi yang lama, akan tetapi bisa dikatakan mekanisasi yang tidak kelihatan di produk menjadi teknik baru yang dibutuhkan industri meubel antik di Serenan masa kini.

Ada beberapa hal yang baik dan menonjol bagi produk Serenan: 1) tidak memakai kayu lapis untuk papan belakang cabinet dan untuk papan alas laci, tetap menggunakan bahan padat, 2) menggunakan paku kayu, tidak menggunakan paku besi, 3) menggunakan balok kecil untuk bagian sambungan kursi, 4) bulatan dan lekukan diserut dengan ketam, 5) hiasan motif bunga, pita, gelombang diukir dengan tangan, 6) bahan cat yang digunakan adalah serlak spiritus yang tradisional, bukan serlak bensin.

Seperti disebut di C, bahan yang digunakannya adalah bahan yang baik dan tepat untuk membuat meubel antik dan hal ini tidak bisa dilalaikan, akan tetapi masih tinggi persentase kandungan air.

Sebelum RRT dan Afrika Utara masuk ke pasar internasional, Indonesia, terutama Jepara dan Semarang harus lebih memperkokoh kedudukannya.

1.2. Reproduksi Meubel Antik Sebagai Sarana Hidup dan Karya Seni

Di Eropa, Amerika Serikat, Jepang, dan negara lain yang membeli reproduksi meubel antik makin luas tanggapan bahwa reproduksi meubel antik adalah sarana hidup sekaligus karya seni yang kaya. Tanggapan ini sangat cocok dengan strategi komersial, yakni 'reproduksi meubel antik bisa memenuhi kebutuhan pembeli dengan mengkopi nilai seni dari meubel antik asli'. Oleh karena itu, pasar reproduksi meubel antik makin berkembang.

Seperti sudah saya ungkapkan sebelumnya, kebanyakan meubel di Serenan (Jepara, Solo, Yogyakarta, dan sekitarnya) adalah reproduksi meubel antik. Sebuah majalah interior Jerman menulis seperti berikut: "(tujuan konsumen) meubel antik adalah meubel tersebut dijadikan sejenis aksesoris dan bisa digunakan di kediaman, maka bisa dikatakan ada dua fungsi, yakni sebagai sarana hidup dan karya seni." Pasar reproduksi meubel antik diperkirakan bisa berkembang lagi. Produknya mendapat penilaian tinggi karena produk yang dibeli murah di daerah produsen sekitar US $30 diolah dan dicat ulang, sehingga menambah nilai tambah yang tinggi, bisa laku dengan harga sekitar US $200.

Produk baru yang akan naik permintaannya adalah produk yang harganya terjangkau seperti meja kecil (antara lain console, coffee lamp, pasangan nest, flower), kursi yang desainnya manis, cermin yang dihiasi berbagai ukiran. Desainnya lebih baik sederhana dan berdasarkan desain klasik, tapi ada hiasan yang menarik. Hal ini memang agak sulit, akan tetapi apakah produsen Serenan bisa memenuhi permintaan dari konsumen itu, hal ini sangat penting bagi masa depan Serenan.

1.3. Pasar Internasional dan Produsen

Reproduksi meubel antik di daerah Serenan, seperti di Jepara, makin banyak kuantitas produknya, dan makin diperhatikan di pasar internasional. Sangat dibutuhkan adanya agen perencana yang memiliki banyak informasi tentang kecenderungan pasar internasional dan pemborong yang kuat di Serenan, namun untuk membina orang seperti itu membutuhkan waktu.

Saya mendengar keluhan dari produsen setempat misalnya: "karena mutunya tidak baik ditawar murah" atau "waktu menerima pesanan sampai pengiriman barang sangat singkat, hanya dua bulan saja", tetapi hal ini tidak bisa dihindari berdasarkan keadaan saat ini. Kalau pesanan produk yang sudah biasa dibuat, jangka waktu produksi dua bulan (60 hari) sebenarnya sudah cukup, hal yang wajar.

Di Serenan, produsen mencari bahan kayu setelah menerima pesanan, akan tetapi ini tidak biasa di bidang bisnis meubel. Bahan utama yang berupa papan dan balok kering seharusnya disimpan di pabrik kayu atau di produsen meubel sebagai stok.

Kalau ada pembeli (*buyer*) atau pemborong sedaerah, bisa memprediksi adanya pesanan dan kira-kira seberapa kebutuhan bahan kayu seperti papan, balok, bahan yang bengkok, sehingga tidak terasa dikejar waktu. Selain itu, jika ada hubungan dekat dengan produsen setempat, tidak terasa tergesa-gesa pada batas waktu.

Bagaimana pun juga, apa yang saya rasakan di Serenan adalah produsen sangat sedikit yang ingin tahu tentang produk yang diproduksi oleh dirinya sendiri melewati jalur/proses seperti apa, melewati pengusaha seperti apa sebelum dijual di pasar internasional.

Saya terkejut juga, produsen tidak memiliki keinginan tahu tentang seperti apa perubahan harga produk, terjadi masalah/komplain seperti apa dan di mana. Sikap dan keadaan ini tampaknya bersangkut-paut dengan berbagai halangan yang terjadi di kedua pihak yang mengikuti bisnis.

Untuk mengatasi masalah tersebut untuk sementara, perlu memilih beberapa wali dari daerah produsen dan melaksanakan survey atau penelitian mengenai keadaan dan perpindahan kontainer, isi kegiatan managemen, perkembangan produsen di daerah lain di dalam negeri maupun di luar negeri.

Ketidakpedulian produsen terhadap jalur distribusi produk, penilaian di pasar internasional, keadaan/perkembangan saingan di daerah lain dan prediksi keadaan pasar pada masa yang akan datang dapat menimbulkan kejutan di dalam hati saya, bahkan bisa dikatakan saya merasa sedih. Mulai sekarang harus mengembangkan pasar untuk mengekspor produk dan merancang produk baru dengan cepat.

1.4. Serenan Cluster

Tujuan utama Serenan Cluster adalah meningkatkan mutu dan efisiensi produksi Serenan Cluster, dari pengeringan dan kontrol kayu yang tepat, dan standarisasi produksi. Untuk meningkatkan efek Cluster, membentuk koperasi atau kelompok, melaksanakan kegiatan promosi, membeli bahan kayu bersama-sama, merintis masa depan supaya bisa mendapat dana dari pihak pemerintah, merancang produk baru, dan sebagainya.

1.5. Masalah di Serenan

Cluster di Serenan terdiri dari _____ perusahaan (atau pabrik), dan setiap perusahaan mempunyai rata-rata 4 atau 5 tukang meubel, maka tukang meubel di daerah ini menjadi _____ orang.

Sebagai pabrik skala kecil yang pada umumnya membuat reproduksi meubel antik ala Barat di daerah pertanian, perbaikan dan perkembangan seperti apa yang dibutuhkan supaya bisa bersaing dengan produsen lain di pasar internasional? Hal itu akan saya jelaskan pada bab berikutnya.

2. Pengeringan Bahan Kayu

2.1. Keadaan Serenan dan Strategi yang Dibutuhkan

Meubel antik yang melambangkan budaya klasik dan sejarah Perancis, Inggris, dan sebagainya, dihargai tinggi oleh orang-orang di Eropa, Amerika Serikat, dan Jepang yang gaya hidupannya ala Barat, dan meubel tersebut menghiasi kehidupan dan dipakai sebagai meubel.

Lingkungan kehidupan mereka diaturkan sepanjang tahun, kondisi udara (suhu udara dan kelembaban) selalu dipertahankan stabil/sama. Oleh karena itu, sudah menjadi pengetahuan umum bahwa persentase ideal kandungan air pada produk kayu di daerah tersebut adalah rata-rata 10%.

Negara-negara Eropa, Jepang, Asia meminta persentase kandungan air ditetapkan sekitar 10%, sedangkan di Amerika Serikat meminta kurang lebih 8%, maka eksportir meubel kayu melaksanakan pengeringan kayu dengan berbagai fasilitas dan sistem. Hal ini menjadi hal yang terpenting dan mendasar untuk memproduksi meubel kayu modern.

Selain itu, pengeringan kayu selalu menjadi masalah pada waktu pemeriksaan produk ekspor. Walaupun sudah diteliti dengan baik dan memenuhi persentase standar, namun waktu membuka kontainer bisa terjadi kayu pecah karena kurang kering, melengkung, bagian sambungan merenggang, dan sebagainya. Oleh karena itu, kontrol persentase kandungan air disebut 'tema kekal abadi' bagi produsen meubel kayu.

Menurut penelitian kandungan air yang telah kami laksanakan di Serenan, mendapati angka-angka yang sangat mengejutkan dan luar kewajaran, misalnya: 18%, 22%, 28%, 35%, 40%, dan sebagainya. Kalau bahan mengandung air seperti ini, bisa dikatakan meubel tersebut dibuat dari kayu mentah.

Kami memahami keadaan ini karena mengolah kayu seperti mengukir, menyerut, dan melubang bisa dikerjakan lebih mudah kalau kayu mengandung banyak air. Akan tetapi, cara seperti ini tidak benar dan salah.

Saya menunjuk beberapa masalah, akan tetapi kebanyakan orang memberi penjelasan misalnya: "pembeli sudah puas dengan ini" atau "selama ini tidak ada komplain". Padahal komentar seperti ini sangat keliru. Pembeli sekarang mengambil kesimpulan bahwa pengolahan pengeringan dengan *dry kiln* dan kontrol persentase kandungan air di Serenan tidak sanggup dilaksanakan, maka mereka menggunakan cara lain untuk mengatasi masalah kandungan air tersebut.

Berdasarkan informasi yang diberikan oleh kawan bisnis orang Indonesia, meubel produk Indonesia yang kandungan airnya tinggi menimbulkan berbgai masalah, akan tetapi importir seperti di Italy sudah mempersiapkan pabrik khusus dan tukang meubel untuk membetulkan, mengolah ulang, mengecat ulang, mengolah dengan obat kimia di dekat pelabuhan. Dengan fasilitas tersebut, mereka menangani meubel yang bermasalah.

Produk Indonesia tidak bisa langsung memasuki pasar, maka importir dari awal "mengimpor dengan harga murah karena sudah tahu produknya harus diolah ulang" atau "sudah menghitung biaya untuk mengurus masalah-masalah".

Oleh karena itu, untuk meningkatkan mutu dan memberi harga pantas produk Serenan, sebagai langkah awal harus diwujudkan stabilitasi persentase kandungan air bahan.

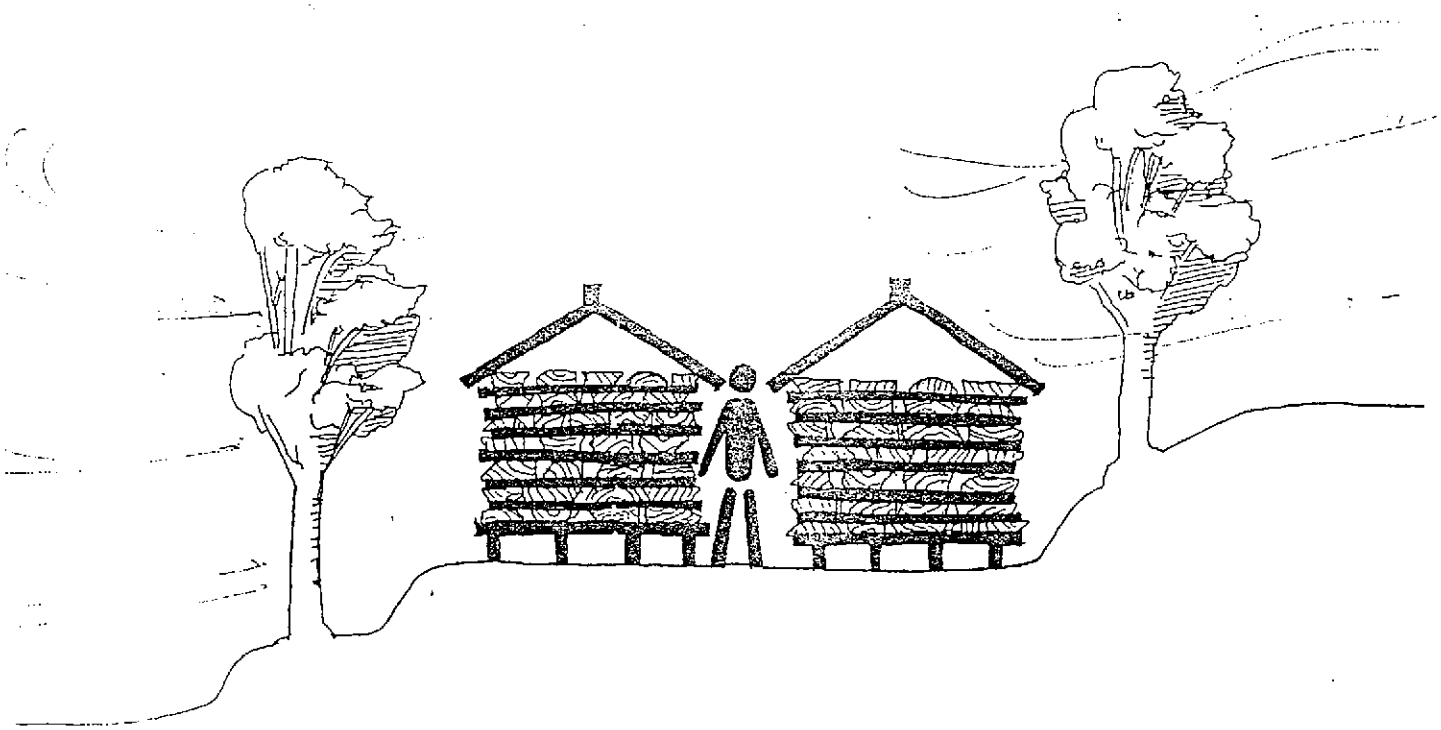
2.2. Bahan Kayu yang Dibutuhkan untuk Produk Serenan

Bahan kayu utama sekarang adalah kayu mahoni dan jati. Mahoni tumbuh banyak di Indonesia, sangat sedikit perubahannya walaupun belum kering, dan tidak mudah terjadi masalah, maka dipakai sebagai salah satu bahan pokok. Selain itu bahan ini cocok untuk meubel antik karena urat kayunya tidak begitu jelas. Di Eropa, meubel bisa dihargai tinggi asal memakai bahan mahoni, dan jarang dimakan serangga.

Berbeda dengan jati di Thailand atau Burma, bahan kayu jati (jati di Jawa) lebih tidak jelas urat kayu, sedikit perubahannya walaupun belum kering, tidak mudah pecah, tidak dimakan serangga, dan disukai orang Eropa. Berdasarkan alasan di atas ini, kayu jati menjadi bahan populer.

Bahan papan atau kayu persegi mahoni maupun jati yang dipotong dengan gergaji dari balok yang belum dikeringkan secara alamiah secukupnya, langsung diolah pada saat kandungan airnya tinggi, sekitar 25%-35%.

Biasanya kami mengeringkan kayu secara alamiah dengan cara seperti berikut: sisipkan bingkai antara bahan kayu papan dan kayu persegi yang dipotong dari balok yang digunakan untuk produksi meubel, lalu mesyusun kayu tersebut, menaruh di tempat yang tertiup angin, diatasnya dipasangi atap. Dengan cara ini persentase kandungan air bisa diturunkan sampai sekitar 25%.



Di Indonesia terdapat berbagai bahan kayu yang sangat bagus. Untuk membuat meubel klasik ala Eropa, bahan yang cocok adalah mahoni, jati, akasia, dan sebagainya. Selain itu, agathis (damar), sonokeling, pinis, padonk, nara bisa menjadi bahan yang cocok untuk memproduksi meubel antik ala Asia.

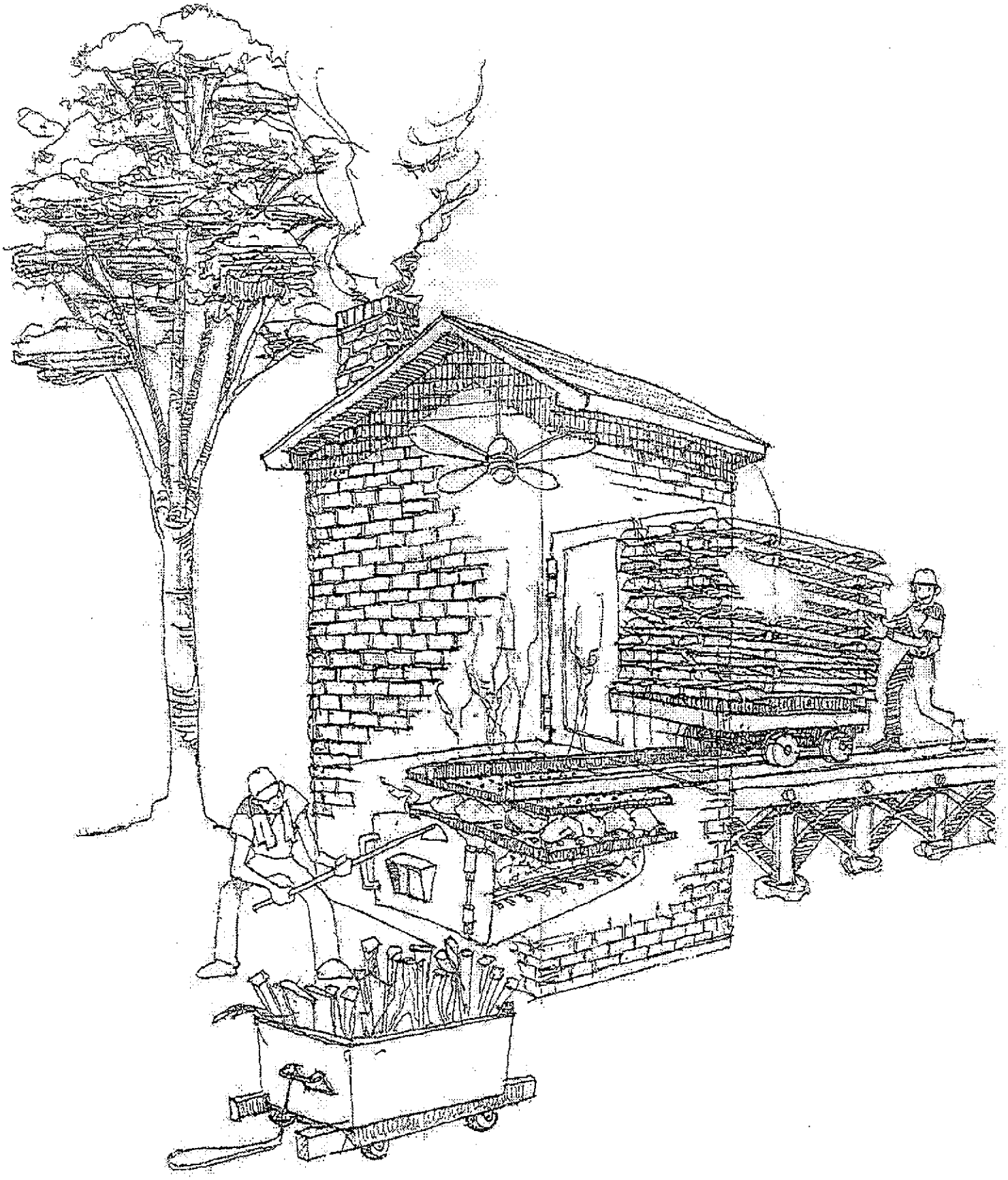
Untuk pertukangan kayu modern, serat silang, serat balik, jamur biru, noda, perbedaan warna, mata kayu (bonggol kayu), lubang bekas mata kayu, retak/pecahan kecil, kulit dalam menjadi kelemahan besar. Kami sangat khawatir karena diperkirakan menjadi masalah besar. Akan tetapi, ada satu hal yang kami ketahui dari penelitian bahwa untuk produksi meubel antik, hal-hal di atas ini tidak akan mengganggu, bahkan menjadi faktor yang dibutuhkan untuk mewarnakan meubel supaya kelihatannya meubel kuno.

2.3. Fasilitas Pengeringan Modern

Cara, teknik, dan mesin pengeringan yang disebut 'syarat mutlak' bagi industri pertukangan kayu modern mengalami inovasi besar akhir-akhir ini. Akan tetapi, fasilitas pengeringan kayu yang lengkap membutuhkan biaya besar karena harus dilaksanakan proyek besar-besaran seperti pembangunan tempat fasilitas pengeringan, penemtapan pipa di dalam bangunan, penempatan mesin yang sangat teliti, dan sebagainya. Oleh karena itu, tidak bisa dibangun jika biaya pembangunan fasilitas tersebut tidak seimbang dengan kebutuhannya. [lihat lampiran #①]

2.4. Fasilitas Pengeringan yang Cocok di Serenan –oven ikan(oven ikan bakar)-

Cara menghitung kapasitas fasilitas pengeringan adalah cukup untuk mengeringkan kayu (papan maupun balok) di sebuah pabrik yang terdiri dari rata-rata 4 atau 5 orang. Kayu yang persentase kandungan airnya sudah turun sampai 25-30% dengan pengeringan alamiah (bahan papan disusun secara bersilang) dikeringkan dengan ruang pengeringan supaya persentase kandungan air bisa turun sampai 15%. Jika bisa menggunakan serbuk hasil pengolahan kayu, sampah, tatal-tatal sebagai bahan bakar, sangat baik untuk mempertahankan kebersihan pabrik.



2.5. Usulan Percobaan Tungku Pengeringan Sederhana Gaya Serenan

2.5.1 Lokasi

Tungku pengeringan lebih baik tidak dibuat di lokasi yang dekat dengan pabrik maupun rumah hunian. (Akan tetapi, praktis untuk mengontrol api kalau dekat dengan rumah hunian.) Karena menyalakan api sepanjang hari (24 jam) selama 5 sampai 6 hari, lebih baik memilih lokasi yang mudah dilihat supaya bisa menghindari kebakaran dan api yang terlalu besar.

2.5.2 Ukuran Tungku

Umpamanya satu pabrik yang terdiri dari 4 atau 5 orang tukang meubel selama 1 minggu memakai 2 ㎥ sampai 3 ㎥ (dalam bentuk bahan papan) dan luas bagian dalam tungku pengeringan 2,5m×1,8m=4,5 ㎡, ruang pengapian di bawah lantai butuh sekitar 60cm. Berdasarkan ukuran-ukuran tersebut, ukuran tungku pengeringan termasuk dinding luar adalah P2.8m × L2,1m × T3,3m(termasuk bagian atap). [lihat lampiran #②]

2.5.3 Luas Tanah

Luas tanahnya cukup sekitar 5m×10m=50 ㎡, namun tempat pengumpulan bahan bakar dan sampah dan tempat penyimpanan bahan makin luas makin baik.

2.5.4. Bangunan

Tungku pengeringan sendiri ukurannya sekitar: 3m×2,1m×3,3m, tetapi lebih baik mempersiapkan tempat untuk lori ② yang mengangkut dan memindahkan bahan yang disusun berselang-seling sebesar: 3m×8m sebagai bagian alas. Oleh karena itu, menjadi: 3m×(2,1+8)=30,3 ㎡

Tinggi alas, pintu tungku, dan ruang pengapian butuh sekitar:

:_____cm, maka tingginya 2,5m+ _____ m=_____ m

[lihat lampiran #③]

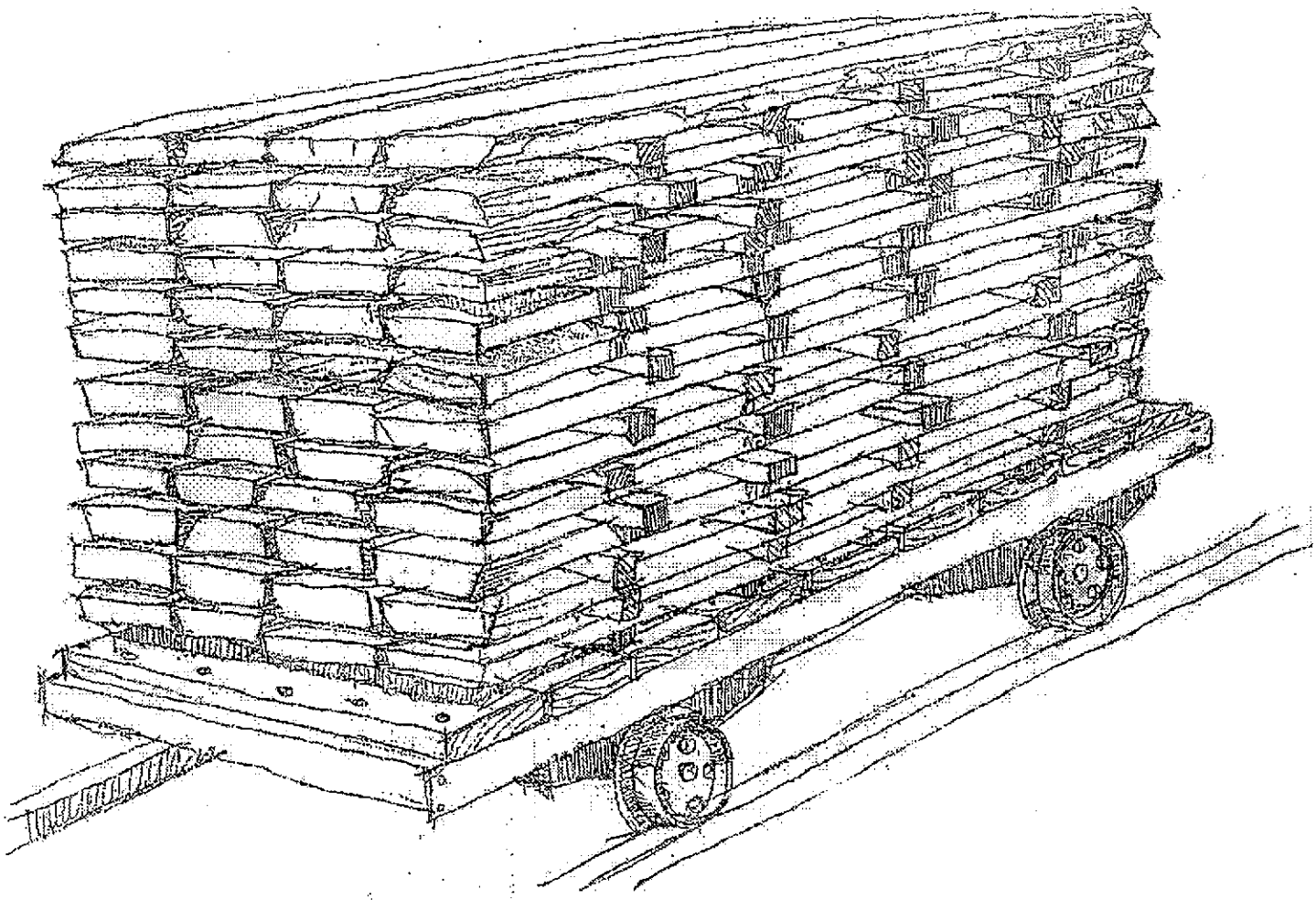
2.5.5 Ruang pengapian dibuat dengan ukuran sekitar: 1,5m×0,9m, dan lebar pintu tungku sekitar 0,5m. Oleh karena itu, luas ruang pengapian adalah sekitar 0,67 ㎡. Alas/lantai ruang pengapian lebih baik miring supaya mudah mengambil abu dengan tongkat. Selain itu, pembakarannya bisa merata dan baik jika dibuat sekat/rak di bagian dalam dari besi.

2.5.6. Lantai dan langit-langit ruang pengapian/ketel dibuat dari bahan yang tahan api, dan membuat beberapa lubang yang tepat supaya api dan panas bisa naik. (Kalau meninjau tungku Serenan sekarang, api sudah keluar dari ruang pengapian, keluar 20cm ke tungku pengering.) Supaya apinya tidak keluar dari ruang pengapian, harus ditambah jarak 20cm lagi, taruh tutup besi yang tebalnya sekitar 5 mm yang dilubangi diameter 20mm di atas batu semacam batu kali besar (sekitar 20cm-30cm) atau besi tua yang ukurannya diameter 20cm-10cm, supaya dijadikan alas ganda atau langit-langit.

Kalau menempatkan besi tua atau batu kali sebesar 20-10cm yang bisa menampung sinar inframerah, bisa meningkatkan efisiensi pengantaran /perambatan panas.

2.5.7. Terutama pada sore hari, harus diperhatikan dan mengontrol tungku dengan baik supaya meningkatkan efisiensi dan supaya api bisa menyala selama 24 jam. Oleh karena itu, bahan bakar yang cocok pada sore hari adalah sampah yang tidak terbakar habis, serbuk kayu, dan sebagainya. Kalau pintu tungku tertutup, bisa mempertahankan panas dan kelembaban. Setelah itu, jika menyalakan api pada hari berikutnya, panas dalam ruangan bisa dipertahankan. [lihat lampiran #④]

2.5.8. Lori dipakai untuk memasukkan dan mengeluarkan papan kayu dan balok yang disusun berselang-seling dan untuk mengeringkan bahan. Oleh karena itu, memasang rel besi yang menghubungkan ruang pengeringan dalam dan alas di luar. Kereta yang memuat bahan yang akan dikeringkan masuk ke ruang pengeringan, posisinya tetap di atas rel. Kalau menerapkan cara ini, lantai ruang pengeringan tidak kena beban yang berat, maka ketebalan tutup besi tidak perlu terlalu tebal.



2.5.9. Lori yang digunakan untuk pengeringan tersebut lebih baik dibuat dari logam. Kalau dibuat dari kayu, bisa terbakar (tidak tahan api), tidak dapat menahan beban berat bahan kayu (papan dan balok) yang disusun berselang-seling yang dimuatkan.

Supaya tidak terbakar, roda tidak menggunakan bearing, tetapi poros *roller bearing* yang sederhana.

Lori seperti ini seandainya disiapkan dua buah, yang satu dipakai di dalam ruang pengeringan, dan yang satu lagi memuat bahan yang akan dikeringkan yang disusun berselang-seling dan disiapkan di luar. Dengan demikian, bisa meningkatkan efisiensi kerja.

2.5.10. Untuk menyusun kayu papan dan balok, kayu sisipan yang berselang-seling harus berukuran sama supaya kayu tidak bengkok, tetap lurus. Kayu sisipan itu disisipkan sesuai dengan bahan yang dikeringkan, dan disusun dengan teliti dan celah-celahnya harus tepat, lalu masukkan ke ruang pengeringan.

2.5.11. Udara panas yang naik dari lantai disirkulasikan ke bagian bawah dengan kipas angin yang dipasang di langit-langit. Supaya mengeluarkan sebagian udara dari ruangan, dipasang kipas angin kecil di dekat lantai.

2.5.12. Bahan balok atau kayu untuk bahan kaki tidak perlu disusun berselang-seling, cukup disandarkan di dinding waktu dikeringkan. Tetapi kalau mau mencegah melengkung, lebih baik menyusun berselang-seling dengan benar dan memberi pemberat dari batu.

2.5.13. Ketika lori ① berada di ruang pengeringan, kalau bahan kayu yang dikeringkan berikutnya disusun berselang-seling di atas lori ②, bahan kayu itu bisa dikeringkan secara alami. Kalau pengeringan kayu dengan lori ① sudah selesai, lori ① dikeluarkan, menutup pintu supaya panasnya tidak turun, bahannya diturunkan dari kereta di posisi 1. Jika persentase kandungan air berkisar 15-18%, lori ① dilepaskan dari rel. Kerja semakin lancar jika ada meja putar *(turn table)*.

Sebelum panas dalam ruangan pengeringan turun, lori ② ditempatkan di atas rel, didorong, sehingga masuk ke dalam ruang pengeringan, lalu dilanjutukan proses pengeringan. Dengan demikian, bisa mempertahankan panas di dalam ruang pengeringan, maka bisa hemat untuk mengerjakan pengeringan berikutnya.