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REQUIREMENTS FOR MANUFACTURE OF RAW SUGAR

TECHNICAL AIDS BRANCH

INTERNATIONAL COOPERATION ADMINISTRATION

Washington, D. C.

A.I.D.
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FOREWORD

This manual is a revision of an earlier report of the same type issued in 1955. This revised version includes current costs of labor, machinery, equipment and supplies, as well as additional information relative to engineering, training, safety, markets, sales, financial and economic factors.

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This manual is designed to provide a general picture of the factors which must be considered in establishing and operating a small-scale factory of this type. It should prove useful in creating interest in the subject, and serve to give enough understanding of the related considerations to help government officials, other leaders and businessmen to determine whether the potential deserves more-detailed attention.

However, it is important to note that in most cases plans for the actual development and installation of a plant will require expert engineering and financial advice in order to meet specific local situations. For further information and assistance, readers should contact their local Productivity Center, Industrial Institute, Servicio, or United States Operations Mission.

Mention of the name of any firm, product, or process in this manual is not to be considered a recommendation or endorsement by the International Cooperation Administration, but merely a citation that is typical in its field.

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The original report was prepared by the Methods Engineering Council, Pittsburgh, Pennsylvania.

Technical information, as well as review, was provided by Technical Enterprises, Inc., 31 South Street, New York 4, New York.

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PLANT REQUIREMENTS FOR MANUFACTURE OF RAW SUGAR

INTRODUCTION

The sugar plant described in this manual is intended to manufacture raw sugar from sugar cane.

Production of cane varies with many conditions such as soil, temperature, water, and climate; and yield amounts to from 40 to 75 tons per acre. The plant herein described requires an input of 600 tons of cane per day for its economical operation and the harvesting campaign usually lasts about five months. It is therefore assumed that it will draw its raw materials from an area about 2,000 acres under cultivation.

The output of this plant will amount to approximately 60 tons of raw sugar per day. Raw sugar is produced near the cane growing areas by mills usually called "centrals." The raw sugar from several centrals is then shipped, often long distances and usually overseas, to great refineries at the seaports of more densely populated areas where the consumption is high.

GENERAL ASSUMPTIONS

In order to make realistic estimates in this manual, certain assumptions are made. These are:

1. The costs of the building and general facilities are based on United States prices.

2. Material costs are based on sizes and specifications of materials used in the United States.

3. Labor costs are based on the average for the industry as recently published by the United States Bureau of Labor.

4. Adequate power and water are available at the plant site.

5. Adequate transportation facilities are available at the plant site.

6. The plant operates 24 hours a day, seven days a week, for a period of five months each year.

7. No special provision is made for the training of new personnel. It is assumed that learner's rates are paid in such cases.

8. The following items cannot be estimated realistically:

   A. Land value;
   B. Distribution and selling costs;
   C. In-freight and out-freight;
   D. Taxes.

   While general estimates will be made of each of these items except taxes, for the purpose of completing cost estimates, adjustment should be made in accordance with actual local costs.

   In fact, all cost estimates contained in this manual should be adjusted to conform to local conditions.

9. Columns are provided in the tables included in this manual to facilitate the conversion of cost figures to conform with local costs.

PRODUCT SPECIFICATIONS

The plant described in this manual produces raw sugar. It is packaged in bags for shipment to centers for refining.

By-products of the production of sugar are molasses (blackstrap) which is usually sold to the fermentation industries, and bagasse or megasse (wood fibre) used as fuel or sold for the manufacture of insulating or wall board.

PRODUCTION PROCESS

Cane sugar is produced from a plant which is a member of the grass family, Graminacae. The cultivation of sugar cane requires tropical or semi-tropical temperatures and a great deal of rain. This limits its successful growth to those regions within, or adjacent to, the isotherms of 68°F.

There are many varieties of sugar cane. Each is grown in the region which is most favorable because of climatic and soil conditions, or resistance to the diseases of cane prevalent in that area. It grows from five feet in height to a height of 25 to 30 feet, but commonly ranges from 10 feet to 15 feet. The stems are from one to three inches in diameter.

Sugar cane is propagated from cuttings from the stalk rather than from seed. Sections of the stalk, each containing two or three buds

which are located at a node or joint, are planted in the ground with a shallow covering of earth. Growth arises from the bud as several shoots known collectively as a stool.

A decreasing yield results from subsequent cuttings so it is not feasible to harvest cane for many years from one plant. The first crop after planting is known as plant cane; subsequent crops from the same planting are known as ratoons.

Harvesting is usually started just before the crop is fully matured in order that the entire crop may be disposed of before it has passed the optimum state of maturity. The stalks are cut off just above, at, or a little below the ground. The tops, because of their lower yield, are chopped off, and the leaves stripped. Burning the leaves off may be advantageous when there is objectionable weed growth, but cane from burned fields is subject to spoilage during wet weather because the action of microorganisms is favored. The sooner cane is hauled to the mill, the higher the yield of sucrose will be.

There are several variations to the process of making sugar. Following is a general outline of the process.

Crushing

When the cane reaches the mill it is subjected to a process of slicing, shredding, or chipping, which reduces the cane to pieces of small size. This operation is not primarily to obtain juice, but to facilitate extraction in the crushing process which follows. Crushers consist of three grooved or toothed rolls through which the shredded cane is passed.

There are generally three or more sets of these three-roller mills employed in pressing out (extracting) the juice from the cane. By the time the cane has gone through the shredder and the first mill about 60 percent of the juice has been extracted. The succeeding mills express additional quantities of juice -- water or dilute juice usually being added to facilitate the removal of as much as possible at the final regrinding and milling. The woody fibre left as a result is known as bagasse.

Purification of the juice

The purpose of purification, also called clarification or defecation, is to remove the largest possible amount of impurities from the juice at the start. Clarification is effected by the use of sulfur dioxide (SO_2), lime and heat. For a picture of a clarifier, see page 25. The amount of SO_2 and lime used, the way in which they are added, and the temperature to which the juice is heated are variable factors depending upon the region and conditions. The more common way of adding lime is that of mixing a definite amount in the form of milk of lime ($Ca(OH)_2$) with a weighted quantity of the cold juice. The exact amount of lime to be used, until recently, was determined by

various methods employing different indicators and titrating. It is now common to adjust the juice to the desired hydrogen ion concentration by means of pH determining apparatus. Best results are obtained when the pH of the cold juice is brought up to 8 or 8.5. Some of the factors which must be considered in regulating the pH of the juice are: inversion of sucrose, destruction of sucrose, destruction of glucose, clearness of the juice, increase in purity, and the volume of the settling.

The temperature is generally raised to boiling after liming. A flocculent precipitate containing calcium phosphates and other insoluble salts carries down finely divided material in the juice, including coagulated albumen, fat, gum, and wax. The juice is then permitted to settle and the clear liquid decanted. The mud, slops, or sludge which remains is pressed in a filter and the juice extracted by the filters is mixed with the purified juice. The combined clarified juice is evaporated in multiple-effect vacuum evaporators to a syrup containing about 35 to 45 percent of water.

Crystallization

The concentrated juice, or syrup, is further evaporated in vacuum pans until it is saturated with sugar. When the syrup becomes saturated, crystals of sugar separate out. As water evaporates, more syrup is added to the pan and sugar is deposited on the crystals already formed. The mass of syrup and sugar crystals finally obtained is designated by the sugar manufacturers as massecuite, magma, or melada.

Centrifuging

The massecuite is placed in centrifugals with perforated metal baskets which have a lining of wire cloth and perforated bronze sheets. Crystals of sugar remain in the basket while the liquor; or molasses, is thrown out through the perforations by centrifugal force. The crystals of sugar are brown and some syrup still adheres. This sugar, known as raw sugar, may be further prepared for consumption by refining. The molasses still contains crystallizable sucrose and is therefore mixed with syrup and returned to the vacuum pans. The new massecuite is centrifuged and molasses again returned to the vacuum pan to be treated as before. After the centrifugal treatment has been repeated three times, the higher quality A and B sugars are ready to be bagged and the C sugars, of lower grade, are returned to the vacuum pans as seed for more A and B sugars. Molasses of such low sucrose concentration that removal of sucrose is uneconomical is called blackstrap and is largely used in the fermentation industries.

To produce a higher quality white sugar, a further refining process may dissolve the crystals in hot water, passing the liquid through an activated carbon filter. The water is then evaporated in a vacuum and the sugar passed through a centrifugal which throws off most of the remaining molasses.

DIRECT MATERIALS

Sugar cane is the only direct material used. This is used at the rate of 600 metric tons per day for 150 days or 90,000 tons per year.

Based on an estimated cost of $5.00 per ton delivered at the plant to total annual cost would amount to $450,000.

PRODUCTION CAPACITY

Raw sugar is produced at the rate of 66-2/3 metric tons per day.

PROVISION FOR EXPANSION

The sugar mill is designed as a complete unit and all the important parts are in use all the time that the mill is running. There is no provision for expanding without the construction of a complete new line of equipment including the rolls and the power plant. The operation as planned is continuous 24 hours per day, seven days per week. There is no possibility of increasing production by increasing working time. However, production can be increased by improvement in the cane grown, by its harvesting, its prompt transportation and by the care with which the extraction processes and subsequent steps are carried out.

PLANT SITE

A plant site of 100,000 square feet is required for the manufacturing of raw sugar.

The estimated cost of this site is $1,000. This includes any necessary preparation of the site for the proposed use.

This estimate does not include the farm land on which the cane is grown.

BUILDINGS

Thebuildings should be of steel construction, with corrugated siding and roofing, ventilating-sash windows, steel doors and concrete floor. The floor area should be 25,000 square feet. The shape of the building would be rectangular.

It is estimated that such a building will cost $200,000.

POWER

Electric power required for this plant will be generated by the equipment purchased and erected as part of the plant equipment. No power will be purchased.

FUEL

Begasse will be used for fuel. Accordingly no expenditure for fuel is necessary.

WATER

Water is needed for drinking and for the usual sanitary purposes, boiler feed water and fire protection. Water is also needed in large quantities for extracting the sucrose and other processes. Only potable water should be used. It is estimated that it will cost about $5,000.

DIRECT LABOR

The following personnel are seasonal, employed only during the period of cane harvesting of five months each year.

Description	Number Required	Hourly Rate	Estimated Annual Cost	Actual Cost
Seasonal workers	100	$ 1.50	$ 180,000	_____

INDIRECT LABOR

The following personnel are full time employees.

Description	Number Required	Hourly Rate	Estimated Annual Cost	Actual Cost
Manager	1		$ 12,000	_____
Superintendents	4		32,000	_____
Chemists	3		24,000	_____
Bookkeeper	1		5,000	_____
Clerk	1		3,800	_____
Secretary	1		3,600	_____
Maintenance	3	$ 2.00	12,000	_____
Boiler room	3	2.00	12,000	_____
Engineers	3	2.00	12,000	_____
Pipe fitters	3	2.00	12,000	_____
Skilled leaders	15	2.00	60,000	_____
Truck driver	1	1.50	3,000	_____
Total	39		$ 191,400	_____

PRODUCTION TOOLS AND EQUIPMENT

Production equipment

		Estimated Cost	Actual Cost
1.	Rotary cane hoist, electric drive, 60' boom, capacity 10 tons, all steel construction mounted on a track	$ 60,000	_____
2.	Cane feeder table, all steel construction, driven by a 5 hp. motor	40,000	_____
3.	One auxiliary cane carrier, 6 feet wide, 80 feet long, all steel construction, with roller chains and steel slats, driven by a 25 hp. motor	40,000	_____
4.	One main carrier, 42 inches wide, 100 feet long, all steel construction, with steel chain, sprockets, shafts, and driven by one 25 hp. electric motor	60,000	_____
5.	One rotary cane leveler mounted on shaft and driven by one 15 hp. motor	30,000	_____
6.	Two sets of cane knives mounted on rotating shafts, each set driven by one 100 hp. electric motor	100,000	_____
7.	One magnetic separator	30,000	_____
8.	Five heavy duty, three-roll cane mills, 25 inches by 42 inches. Each mill driven by one 150 hp. motor, complete with all accessories	500,000	_____
9.	All such items as tanks, pumps, conveyors, air compressors	300,000	_____
10.	Two 600 square foot horizontal juice heaters	50,000	_____
11.	One clarifier, approximately 20 feet in diameter	95,000	_____
	Carried forward	$ 1,305,000	_____

Production tools and equipment - continued

Production equipment - continued

	Estimated Cost	Actual Cost
Brought forward	$ 1,305,000	
12. One multiple-effect evaporator of approximately 10,000 square feet heating surface, complete with accessories	25,000	
13. Three vacuum pans about 8 feet diameter, complete with all accessories and condensers	60,000	
14. Four electrically driven centrifugal with frame and accessories	20,000	
15. One complete station for putting the sugar in bags or barrels	30,000	
16. Miscellaneous traps, steam chests, vacuum pans and pipe accessories, foundations, construction and erecting	60,000	
Total	$ 1,500,000	

Boiler room

Three 500 hp. water tube boilers complete with foundation and erection costs, dutch oven furnace, stokers, boiler feed, water pumps, pipes, gauges and other accessories	$ 240,000	

Engine room

1. Two 750 kw. turbo generators	$ 80,000	
2. One 250 kw. diesel generator	50,000	
3. All the necessary switchboards, switches, meters and other engine room equipment	70,000	
Total	$ 200,000	

SUMMARY PRODUCTION TOOLS AND EQUIPMENT

	Estimated Cost	Actual Cost
Production equipment	$ 1,500,000	_____
Boiler room	240,000	_____
Engine room	200,000	_____
Total production tools and equipment	$ 1,940,000	_____

OTHER TOOLS AND EQUIPMENT

Description	Estimated Cost	Actual Cost
Maintenance tools	$ 500	_____
Maintenance equipment	5,000	_____
Welding equipment	400	_____
Compressor	800	_____
Lift truck	600	_____
Skids	400	_____
Benches and tables	1,000	_____
Laboratory equipment	1,500	_____
Wheel barrows	400	_____
Drill press	1,200	_____
Soldering outfit	1,000	_____
Chemical laboratory equipment	3,200	_____
Benches and tables	400	_____
Lathe engine	1,800	_____
Milling machine	2,500	_____
Power hacksaw	400	_____
Sheet metal equipment	3,900	_____
Total	$25,000	_____

TRUCKS

Trucks and tractors including one general purpose five-ton truck costing $6,000 will be required. The total cost of trucks and tractors will be $50,000.

FURNITURE AND FIXTURES

Description	Number Required	Estimated Unit Cost	Estimated Total Cost	Actual Cost
Desks and chairs	4	$225	$1,000	_____
Filing cabinets	6	70	420	_____
Typewriters	6	150	900	_____
Adding machines	4	140	560	_____
Other business machines			1,400	_____
Chairs	12	60	720	_____
Total			$5,000	_____

SUPPLIES

Item	Estimated Cost	Actual Cost
Maintenance materials and parts	$35,000	_____
Chemicals, including sulfur and lime	36,500	_____
Tools	2,000	_____
Lubrication	500	_____
Office supplies	500	_____
Truck gas, oil and repairs	500	_____
Total	$75,000	_____

DEPRECIATION

Item	Estimated Cost	Years Life	Estimated Cost	Actual Per Year
Buildings	$ 200,000	20	$ 10,000	_____
Production tools and equipment	1,940,000	10	194,000	_____
Other tools and equipment	25,000	10	2,500	_____
Furniture and fixtures	5,000	10	500	_____
Trucks, tractors	50,000	4	12,500	_____
Total			$ 219,500	_____

MANUFACTURING OVERHEAD

Item	Estimated Cost	Actual Cost
Depreciation	$ 219,500	_____
Power	---	_____
Water	5,000	_____
Fuel	---	_____
Supplies	75,000	_____
Indirect labor	191,400	_____
Total	$ 490,900	_____

MANUFACTURING COSTS

Direct materials	$ 450,000	_____
Direct labor	180,000	_____
Manufacturing overhead	490,900	_____
Total	$ 1,120,900	_____

FIXED ASSETS

Item	Estimated Cost	Actual Cost
Land	$ 1,000	_____
Buildings	200,000	_____
Production tools and equipment	1,940,000	_____
Other tools and equipment	25,000	_____
Furniture and fixtures	5,000	_____
Trucks, tractors	50,000	_____
Total	$ 2,221,000	_____

WORKING CAPITAL

Item		Estimated Cost	Actual Cost
Direct materials	- 30 days	$ 37,500	_____
Direct labor	- 30 days	15,500	_____
Manufacturing overhead	- 30 days	40,900	_____
Reserve for sales collections	- 30 days	137,500	_____
Total		$ 231,400	_____

CAPITAL REQUIREMENTS

Item	Estimated Cost	Actual Cost
Fixed assets	$ 2,221,000	_____
Working capital	231,400	_____
Total	$ 2,452,400	_____

SALES REVENUE

The yield of raw sugar is estimated at 10,000 tons per year. If sold to a refinery at $7.50 per 100 pounds or $165 per ton this will produce a revenue of $1,650,000.

RECAPITULATION OF COSTS, SALES AND PROFITS

Item	Estimated Cost		Actual Cost
Direct materials	$ 450,000		_____
Direct labor	180,000		_____
Manufacturing overhead	490,900		_____
Total manufacturing costs		$ 1,120,900	_____
Interest on loans	$ 3,000		_____
Insurance	4,000		_____
Legal	5,000		_____
Auditing	8,000		_____
Unforeseen expense	50,100		_____
Total unforeseen and administrative costs		70,100	_____
Sales costs, such as commissions, bad debts, discounts, allowances, travel, and freight out		50,000	_____
Shipping bags		39,000	_____
Profit before taxes		370,000	_____
Total annual gross sales		$ 1,650,000	_____

BUDGET CONTROL

A requisition form designed to provide accurate records of procurement and indicate the purpose of procurement with the least amount of time and effort is shown on the following page.

This form has an account number for each type of the various expenditures which the manager will review in detail, monthly or oftener, in order to control his expenses. Some items, such as power and water, are usually under contract and are easily checked by reference to monthly bills. For simplification, items (marked with an asterisk below) are omitted from the purchase requisition. Variations in the labor costs are easily reviewed by examination of the payroll vouchers. The simplified type of control thus provided makes certain that the manager can control expenditures promptly.

Following the requisition form, a sample voucher check is shown. Voucher checks should be used for the payment of all expenditures and the appropriate book account number placed on each voucher.

At the end of each month the manager will receive a statement of all expenditures broken down by budget accounts. If the expenditures exceed the budgeted monthly allowances of any of the accounts, the bookkeeper will furnish the manager with a break-down of all expenditures relative to the budgeted accounts exceeded. All these supporting data can be secured by reference to the purchase requisitions and the check vouchers. This reference will enable the manager to determine what caused the over-expenditure and take corrective action.

If at any time during each month it becomes apparent that expenditures will exceed any of the budget accounts, the bookkeeper will bring this to the attention of the manager for his information and action.

BUDGET CONTROL ACCOUNTS

Account Number		Monthly Expense	Monthly Budget	Annual Budget	Actual
10	Administrative	$_____	$ 1,667	$ 20,000	$_____
20	Sales	_____	7,416	89,000	_____
30	Direct Materials	_____	37,500	450,000	_____
40	Supplies	_____	6,250	75,000	_____
51	Power*	_____	0	0	_____
52	Water*	_____	416	5,000	_____
53	Fuel	_____	0	0	_____
60	Unforeseen Expense (Reserve Account)	_____	4,170	50,100	_____
71	Direct Labor*	_____	15,000	180,000	_____
72	Indirect Labor*	_____	16,000	191,400	_____
80	Depreciation (Reserve Account)	_____	---	219,500	_____

Note: Administrative includes interest on loans, insurance, legal and auditing.

PURCHASE REQUISITION	COMPANY NAME	DATE

- ☐ 10 ADMINISTRATION
- ☐ 20 SALES
- ☐ 30 MATERIALS
- ☐ 40 SUPPLIES
- ☐ 50 UTILITIES
- ☐ 60 UNFORESEEN EXPENSE

INDICATE BELOW THE USE OF MATERIALS

- ☐ DIRECT MATERIALS
- ☐ MAINTENANCE MATERIALS
- ☐ MAINTENANCE SERVICES
- ☐ OPERATING SUPPLIES

	PLEASE ORDER THESE MATERIALS OR SERVICES	DELIVERY WANTED	
QUANTITY	DESCRIPTION	UNIT	TOTAL

QUOTES FROM		REQUISITIONED BY	
QUOTES FROM		APPROVED BY	
QUOTES FROM		ORDER NO.	ORDER DATE

R. W. MITCHELL MANUFACTURING COMPANY

1422 BOSWORTH STREET, S. E.

65-22
514

ANYWHERE, U. S. A._____19____ No. 10000

PAY _____ DOLLARS $ _____

TO THE ORDER OF

R. W. MITCHELL MANUFACTURING COMPANY

TO FIRST NATIONAL BANK
ANYWHERE, U. S. A.

BY SAMPLE CHECK

VICE PRESIDENT

ACCOUNT NUMBER

Sample voucher check to be used for the payment of all expenditures in connection with Budget Control.

R. W. MITCHELL MANUFACTURING COMPANY

ENGINEERS

The services of professional engineers are desirable in the design of this plant, even though the proposed plant is small.

A correct design is one which provides the greatest economy in the investment of funds and establishes the basis of operation that will be most profitable in the beginning and will also be capable of expansion without expensive alteration.

The addresses of professional engineers who specialize in industrial design, some of whom may be willing to undertake such work on low cost projects overseas, can be secured by reference to the published cards in various engineering magazines. They may also be reached through their national organizations, one of which is the

National Society of Professional Engineers
2029 K Street, Northwest,
Washington 6, D. C.

Manufacturers of industrial equipment employ engineers familiar with the design and installation of their specialized products. These manufacturers are usually willing to give prospective customers the benefit of technical advice by those engineers in determining the suitability of their equipment in any proposed project.

The equipment manufacturers also know, and can recommend, professional engineers in private practice, who are willing and able to provide appropriate consulting services.

TRAINING

Manufacturing an inferior quality of product during the training period could create sales resistance that might be difficult to cope with later. To avoid such possibilities, the quality of the product should be maintained at all times, including the training period.

In some areas skilled operators may be available locally. In other areas all the operators may have to be trained.

If skilled operators are not available, adequate training would be assured by using one or more of the following methods:

A. If the plant is designed and installed by a competent engineering firm, the contract should be negotiated, if possible, on a turn-key basis. On this basis the contractor agrees to operate the plant and produce the quality and quantity of the product stated in the contract for an agreed period of time. Such a contract would assure adequate personnel training, since full quantity and quality could not be produced with an untrained organization.

B. The engineering firm that designs and installs the plant can usually make training arrangements to have key personnel placed, for training purposes, in a foreign industry that produces the same type of product. This would provide training for the key personnel while the plant is being installed.

C. If neither of the above methods is possible, then qualified and experienced individuals should be employed for the key positions, either permanently or temporarily, to perform the key operations and assist in training the organization, even if they must be secured outside the country.

D. The manager should have years of successful experience in this type of business and be fully qualified in all phases of management, including the training of employees.

SAFETY

There is always danger of accident and injury in any industrial plant. Because of this, the manager should take specific action to bring to the attention of each employee the importance of safety precautions and intelligent first aid.

Practically all machines have safety appliances, and the manager should see that these are in good working condition and that the operators are making full use of them.

In addition to constant watchfulness to make sure that all practicable safety precautions are taken, first aid supplies should be readily available. One complete first aid kit should be maintained near the manager's office, and others at appropriate places throughout the plant. Some of the employees should be trained to provide first aid service.

The use of accident posters in the plant has proved to be of value in reducing accidents. It is recommended that such posters be used, and that some direct special action be taken by the manager, at least once each month, to bring to the attention of all personnel the importance of safety precautions.

A fire brigade should be established and each member trained as to his responsibility in case of fire. Fire drills should be conducted periodically.

It is recommended that the employees be encouraged to offer suggestions or recommendations relative to prevention of accidents, removal of fire hazards and maintaining general interest in all safety factors.

SUMMARY

A small plant, built and operated according to the assumptions made in this manual would be a profitable undertaking.

There are some determinations, however, that should be made before a decision is reached to build and operate such a plant. Among the necessary determinations to be made are those with respect to the following items:

MATERIALS AND SUPPLIES

1. Are all materials and supplies available locally?
2. Is the local material market competitive?
3. Is satisfactory delivery of local materials assured at reasonable prices?
4. What materials and supplies must be imported?
5. Are they available in world markets at competitive prices?
6. Would prompt delivery of imported materials and supplies be assured so that large inventories would not be required?

MARKET FACTORS

1. Is there already a demand for the product?
   A. Who are the principal consumers?
   B. Who are possible new consumers?

2. How is demand for the product now satisfied?
   A. By local production? If so, what is the volume of annual production?
   B. What percentage of consumption is filled by local production?
   C. By imports? If so, what is the volume of annual imports?
   D. What percentage of consumption is met by imports?
   E. From what areas are imports derived?

3. What is the estimated annual increase in local consumption over the next five years?
   A. How were such estimates made?
   B. By reference to official figures on population growth, family budgets, imports, etc.?
   C. By consultation with trade or industry, ministries, associations, bankers, commercial houses, wholesalers, retailers, industrial consumers, etc.?

4. If the product is already being manufactured, can the existing and estimated future local market absorb production of the new plant without price-cutting or other dislocations?

5. Would the estimated sales price and quality of the new product make it competitive with an imported equivalent?
   A. After adjusting cost to local conditions, is the estimated sales price of the product so high that tariff protection is necessary to protect it from imports?

EXPORT MARKETS

1. Could the product compete in export markets on the basis of price, quality and dependability of supply?
2. Can export markets for the product be developed?
3. If so, in what areas and in what annual volume?
4. What procedures would be necessary to develop export markets?
5. What would it cost?

MARKETING PROBLEMS

1. In calculating costs of the product, has adequate allowance been made for the expense of a sales department, advertising and promotion that might be required?

2. Do consumer prejudices against locally manufactured products exist?
   A. If so, why?
   B. Would they apply to the new product?
   C. If so, how could they be overcome and what would it cost to do so?

3. Do marketing and distribution facilities for the product exist?
   A. If not, can they be set up?
   B. What would it cost to do so?

4. Will the product be sold to:
   A. Wholesalers?
   B. Retailers?
   C. Direct to consumer?
   D. Other industries?
   E. Government?

ECONOMIC FACTORS

1. How much foreign exchange (and in what currency) is required to import machinery, equipment and supplies:
   A. How much foreign exchange (and in what currency) is required for annual interest payments and amortization of any loans contracted to import machinery and equipment, or for payment of royalties and technical services?
   B. How much foreign exchange (and in what currency) is required for annual import of raw materials and supplies?
   C. What are estimated annual foreign exchange earnings and in what currencies?
   D. Has careful consideration been given to the possibility of depreciation in the foreign exchange value of the local currency?
   E. Has careful consideration been given to the possibility of import controls, or restrictions on availabilities of foreign exchange necessary to operate the business?
   F. What benefits would the new business bring to the economy in the use of local raw materials: in employment and in technology?
   G. Do dependable facilities exist for transportation, power, fuel, water and sewage?
      (1) If not, can existing deficiencies be eliminated satisfactorily?
      (2) What would be the cost to do so?

PERSONNEL

1. Is there an adequate labor supply near the plant location?
   A. If not, how can the problem be solved?

2. Can the problem of training competent management and supervisory personnel be solved?
   A. Also, the training of skilled labor?
   B. Is technical advice available in the locality?
   C. If not, where can it be obtained and what will it cost?

LAWS AND REGULATIONS

1. Do existing labor laws, government regulations, laws and taxes favor establishment of new business?
   A. If not, can existing obstacles be removed?
   B. If so, how and when?

FINANCIAL FACTORS

1. Technical advice on selection of machinery and equipment.
   A. In selecting the machinery and equipment for the new plant, have reputable and competent engineers and technicians been consulted?
   B. Have they been asked for advice on the most suitable types of machinery and equipment for the process and locality?
   C. Have they carefully compared costs of various suppliers?
   D. Credit terms offered purchasers?

FINANCIAL REQUIREMENTS OF THE PROJECT

1. In estimating the cost of the project, has careful consideration been given to:
   A. The effect on costs of delays in construction schedules?
   B. In delivery and installation of machinery and equipment?
   C. In import of essential raw materials and supplies?

2. In calculating cash flow and working capital requirements, has careful consideration been given to:
   A. Maintaining adequate inventories of raw materials?
   B. Supplies and spare parts?
   C. Seasonal fluctuations in the business?
   D. The time required to liquidate credit sales to customers and bad debts?
   E. The period necessary to get the plant into production?
   F. Cash required to amortize its principle loans?

3. If the economy is in a period of inflation, has full allowance been made for the influence of rising prices and wages on the cost of the project and on working capital requirements?

SHORT TERM BANK CREDITS

1. Has it been possible to make arrangements with local banks to finance short-time working capital requirements of the business?

FINANCIAL PLAN

1. Has a definite plan to finance the project been worked out?
   A. Is sufficient capital available locally?
   B. If not, what is the plan to obtain the required capital?

GLOSSARY

Raw sugar	Sugar not highly purified.
Blackstrap	Molasses.
Stool	A sugar cane stump sending out shoots.
Bagasse	Wood fibers.
Massecuite	Mixture of syrup and crystals.

ABBREVIATIONS

No.	Number
'	Foot or feet
ft.	Foot or feet
in.	Inch or inches
°F.	Degree Fahrenheit
kw.	Kilowatts
hp.	Horsepower

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Industrial Chemistry	Reinhold Publishing Corporation 330 West 42nd Street New York, New York

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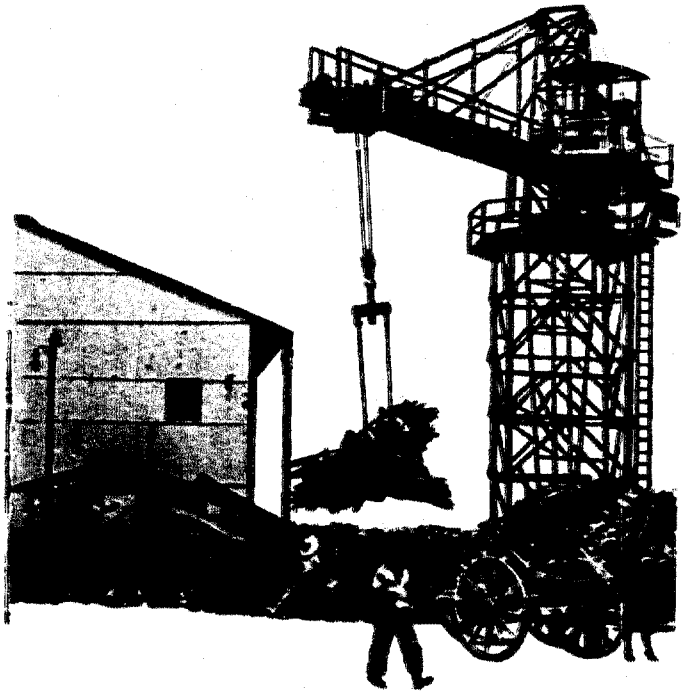
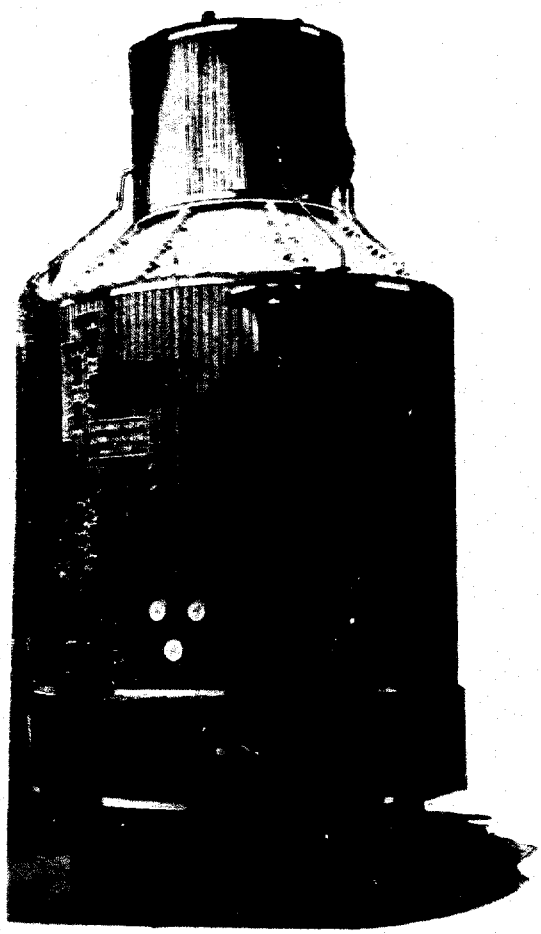
Chemical and Engineering News	McGraw-Hill Book Company 330 West 42nd Street New York 36, New York



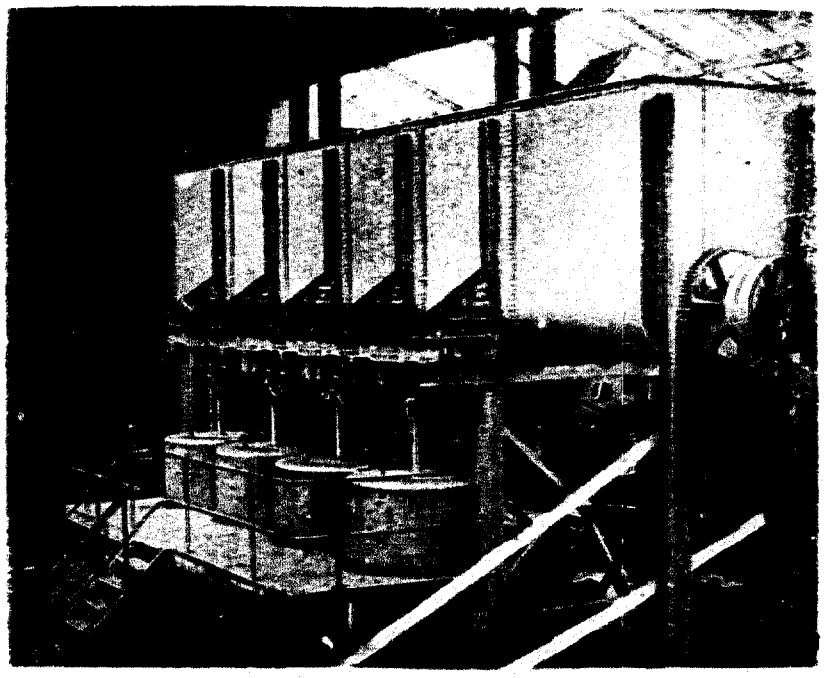
Tower crane

A clarifier

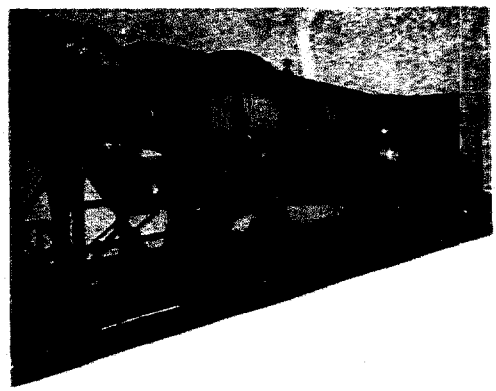
A filter



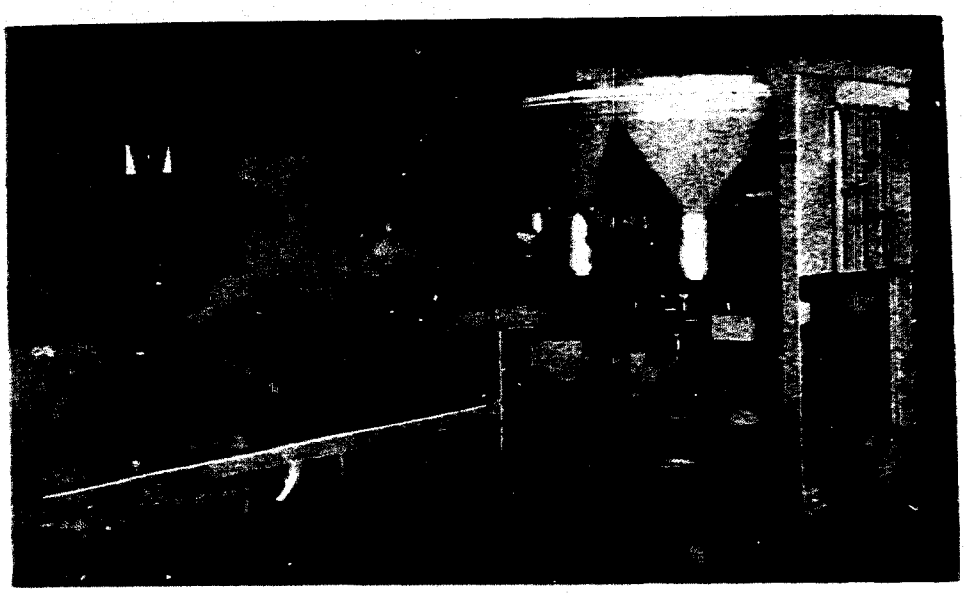
A vacuum pan



A battery of four centrifugal machines



A dryer

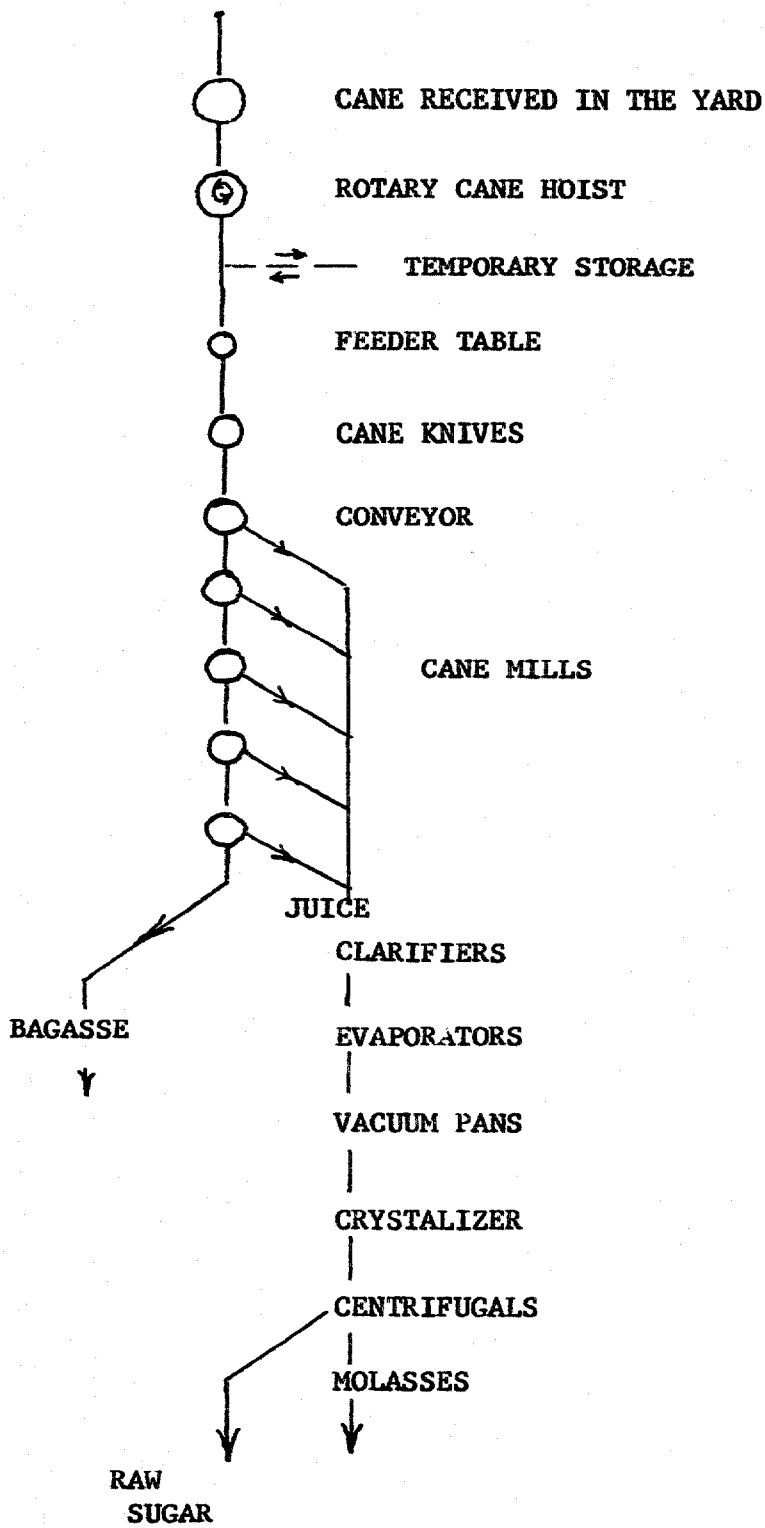


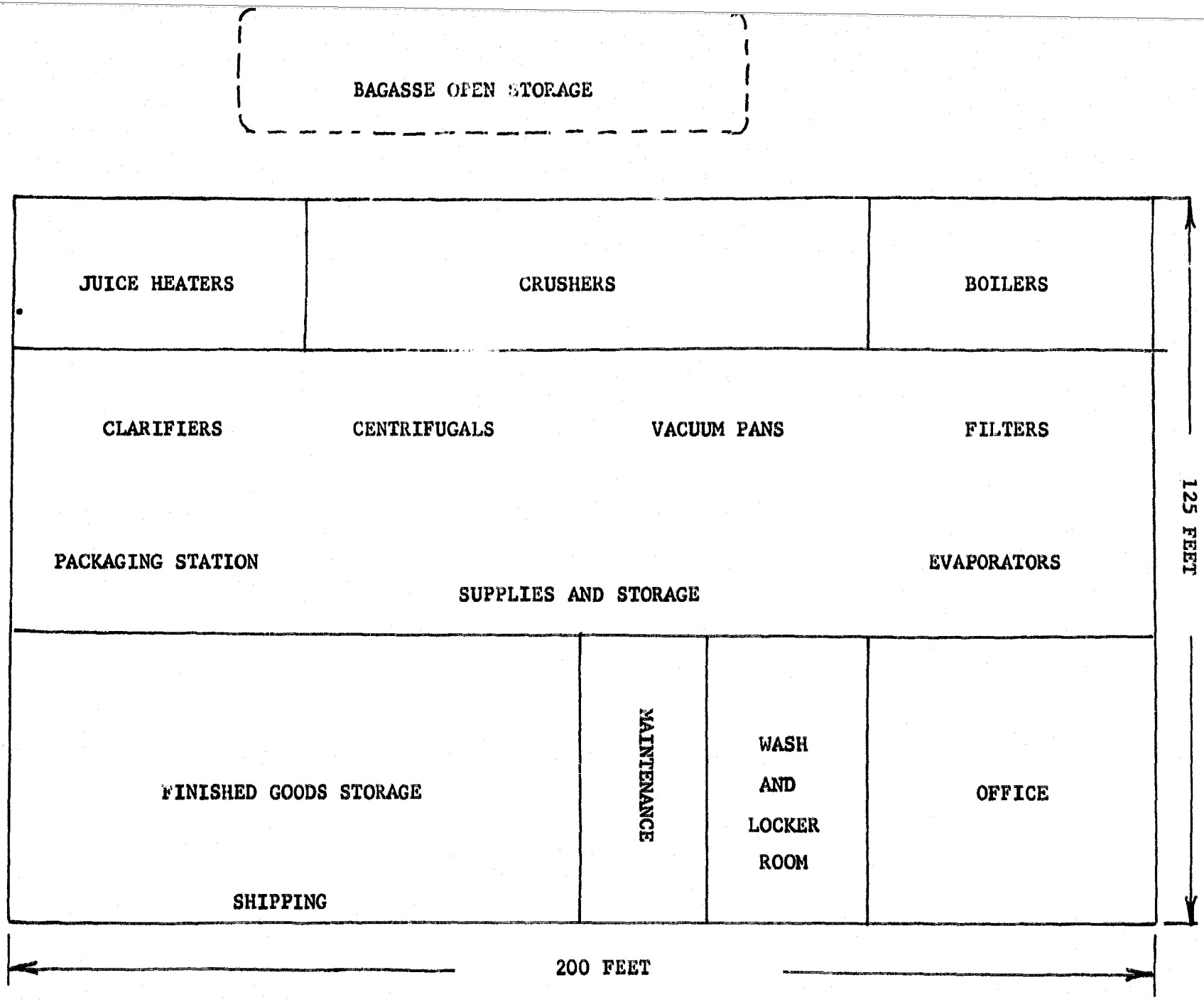
An automatic packaging station

PLANT FOR MANUFACTURE OF

RAW SUGAR

FLOW CHART





PRELIMINARY PLANT LAYOUT

INTERNATIONAL COOPERATION ADMINISTRATION

SERVICES OF THE INDUSTRIAL TECHNICAL COOPERATION PROGRAM

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