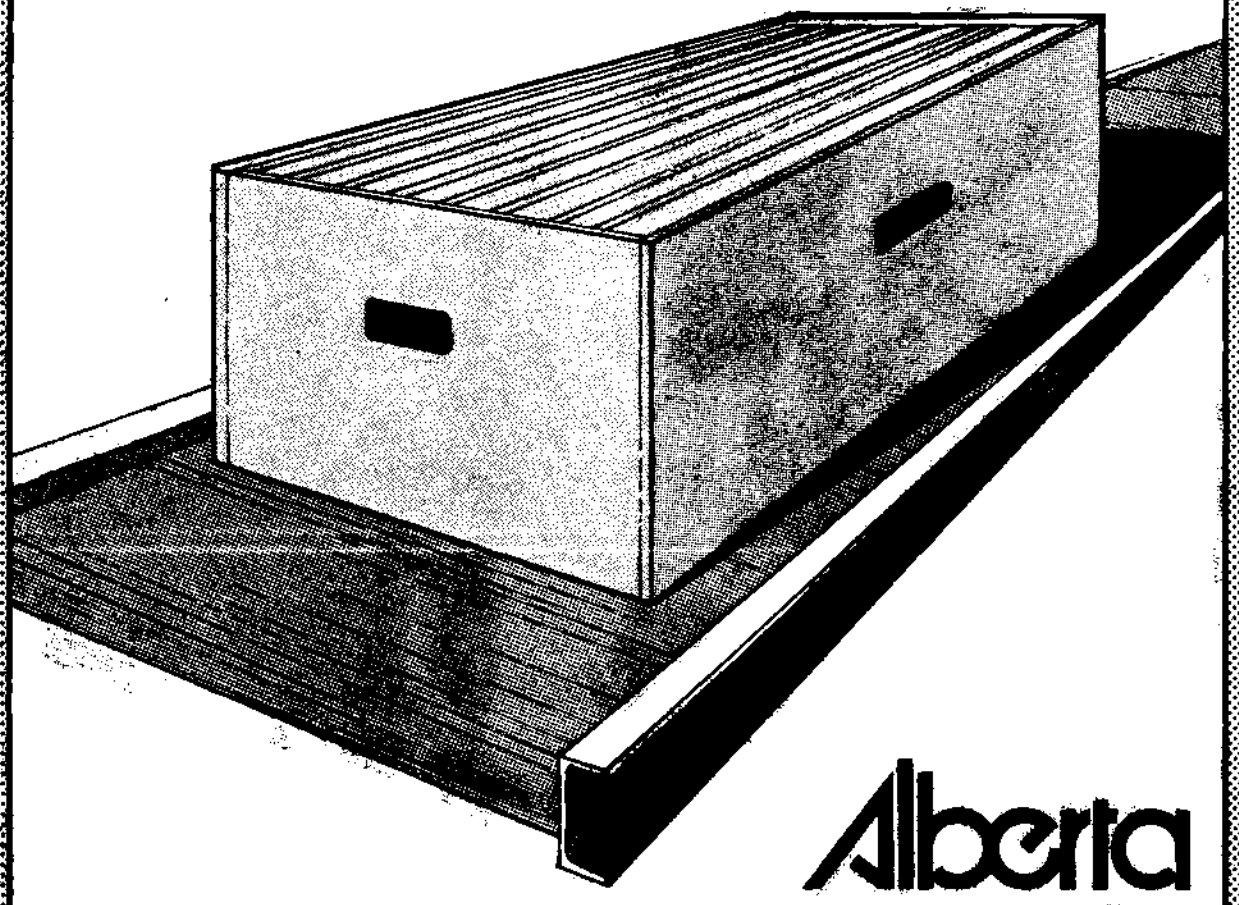
Don Mecson

HONEY HOUSE AND EQUIPMENT LAYOUTS



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INTRODUCTION

A lack of basic technical information on honey-house design has limited the performance of extraction systems in Alberta. In the past, the mechanical aspects of beekeeping were treated lightly because they were secondary to the cultural aspects. In Alberta, the high production of honey, condensed season, and recent tight economic conditions have made these issues significant enough to stimulate the improvement of the technology to deal with them. The improvement in technology is first required in the areas of equipment and building layouts. Further development of the technology should follow in the areas of specific equipment and new concepts for handling and extraction.

This publication presents a set of principles on which to base arrangements for a honey house. Information is included on aspects of equipment and buildings that support these principles. The paper begins with details for the selection of a site for the honey house. Principles for equipment layout are then given, followed by principles and details for the building layout.

SITE SELECTION

A well located honey house will minimize many problems associated with, the site, the use of the building, its compatibility with people in the area, its compatibility with other uses of the area, and its esthetics. The site for the honeyhouse is determined mainly by:

- Its general location in relation to nectar supplies.
- Its access to all-weather roads.
- Physical characteristics of the site.
- Water supply
- Electricity
- Its relationship to dwellings.
- Its relation to sources of contamination.

Nectar Supplies - Nectar supplies will determine the general location for the honey house. Maximum distances travelled to nectar supplies ususally range from 30 to 60 km, with one known case of 120 km. Greater travel distances would have to be justified by such things as assurance of nectar supplies.

Access - The honey house should be located near enough to all-weather roads to permit easy access during wet weather and winter travel for the shipping of honey.

Physical Characteristics of the Site - The area for the building and associated traffic should be high enough so the ground can be sloped away at a rate of at least 2 cm per meter. It should also be located far enough away from wind breaks to avoid heavy accumulations of snow.

Water Supply - A supply of 23 L/min (5 gpm) of potable water from a public main or well is a minimum required in the honey house for cleaning, preparing sugar syrups, and for the washrooms. If the water supply is inadequate, a cistern or large pressure tank can be used to avoid temporary shortages. For fire fighting, the water supply must be installed so the required flow can be maintained under fire conditions. A 2 hour supply at 45 L/min (10 gpm) is a minimum required for fighting the initial stages of a fire. A public main, large cistern, very high producing well or a lake or dugout is required for general fire fighting.

Electricity - Honey houses are not normally heavy users of electricity so rural power supplies will generally be quite adequate. A minimum of a 10 kVA transformer is required for most average commercial honey houses. If a home is to be included on the same supply a 12 or 15 kVA transformer will be required.

Relationship to Dwellings - There are two general arrangements for the relation of the honey house to the home. The first is to have the honey house near the home for the convenience and for use of common utilities. The second arrangement is required if a member of the family is allergic to bees. In this arrangement the honey house is located at a distance from the home so as to avoid any bee problem. In many such cases the home is located in a nearby town. This has the added advantage of keeping the honey operation separate from the home. The nuisance of bees in public areas however must be minimized. This means locating the honey house downwind and at some distance from these areas.

Relationship to Sources of Contamination - The honey house should be located at least than 1 km from waste disposal areas to avoid having bees that enter these areas return to contaminate the honey. It should also be located away from strong odors and sources of dust.

EQUIPMENT LAYOUT

A good equipment layout should be developed before doing the building layout to avoid problems associated with the equipment not fitting the building. This will permit the systematic development of the honey house.

Handling hive parts requires the greatest effort and most space of all operations in the honey house. Orderly movement of these parts from one operation to the next is therefore essential to avoid needless handling, confusion and wasted space. The system of handling hive parts also affects safety and sanitation. The location of equipment to handle the hive parts must be established first. Equipment for the handling of honey and wax should then be arranged around this equipment. This is because the handling of honey and wax can be done with pumps and through pipelines and is therefore more flexible than the handling of the hive parts.

The "U" Flow

The most efficient layout for the equipment and associated batch storage space is based on the U flow. In the U flow, the hive parts travel in a "U" shaped path. Changes in direction of movement of the hive parts can, in most cases, be best accomplished where they go from one operation to another. Figures 1, 2, 3, 4 and 5 are examples of basic layouts for various types of operations. The sump, wax separator and other associated equipment have been omitted because their location is of secondary importance. In these arrangements supers are positioned just inside the extraction room. The frames are then removed from the hive bodies. These frames are routed through the uncapper and accumulated near or in the extractor. In the meantime the hive bodies are moved to, accumulated, and positioned near the extractor to accept the emptied frames. The frames are put into the boxes. These supers are then moved and assembled next to the incoming supers thus completing the U flow.

Manual and Mechanized Tasks

In the extraction of honey many very repetitive operations are required. Small amounts of time associated with doing any segment of the operation are therefore very significant. For example, the task of removing a frame from a super may take 3 seconds. In doing 500 supers with an average of 8 fames each, 500 x 8 x 3 = 12000 sec or 200 min. are required. If this operation could be reduced by 1 sec it would result in a saving of 1/3 x 200 = 66 min. This small saving combined with others can make the difference between an efficient and inefficient operation.

Equipment should be used to effectively do the repetitive, simple, heavy, and time-consuming operations. For example, equipment may be used to:

- lift a pallet of full supers to the proper working height
- convey and assemble charges of uncapped frames for the extractor
- move, accumulate and position empty hive bodies next to the extractor for direct filling with empty frames.
- convey and accumulate the empty supers next to the pallet for outgoing supers

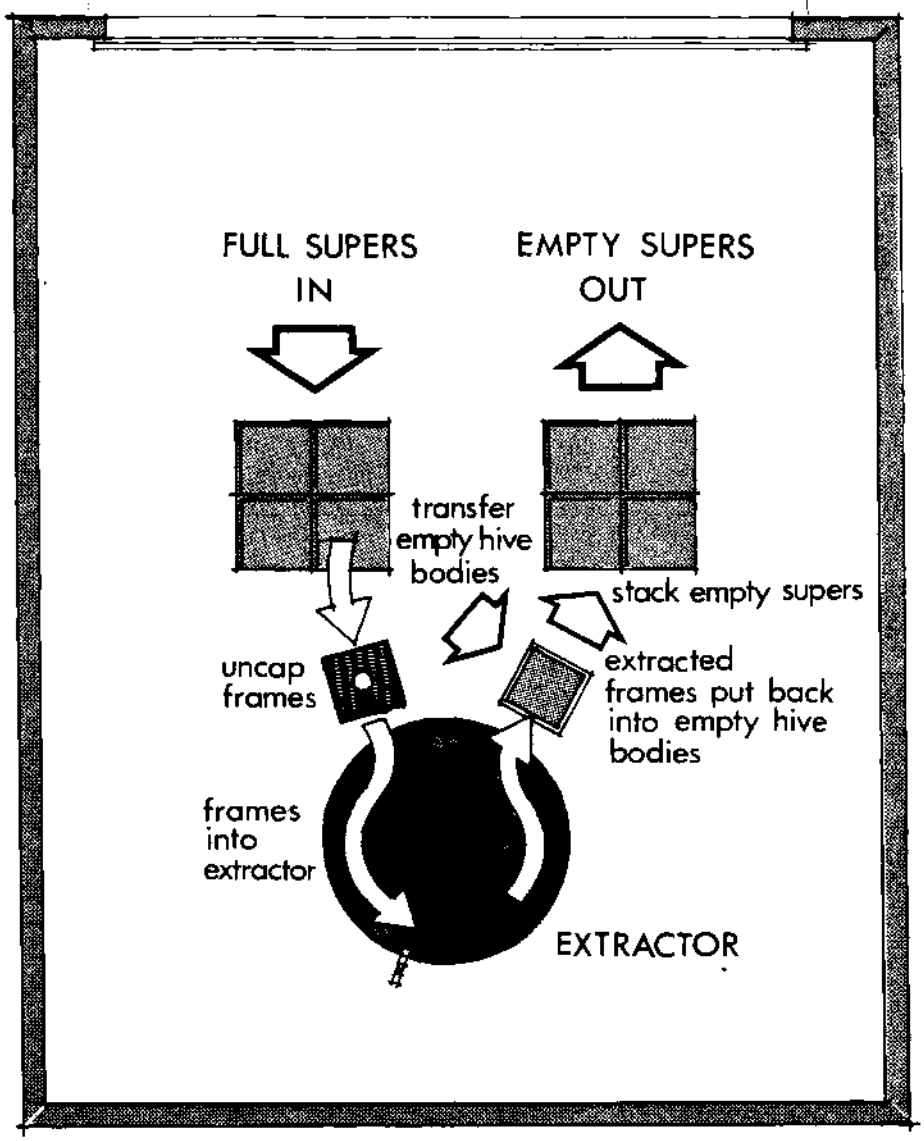


FIGURE 1: U-FLOW FOR HIVE PARTS IN A GARAGE TYPE OPERATION

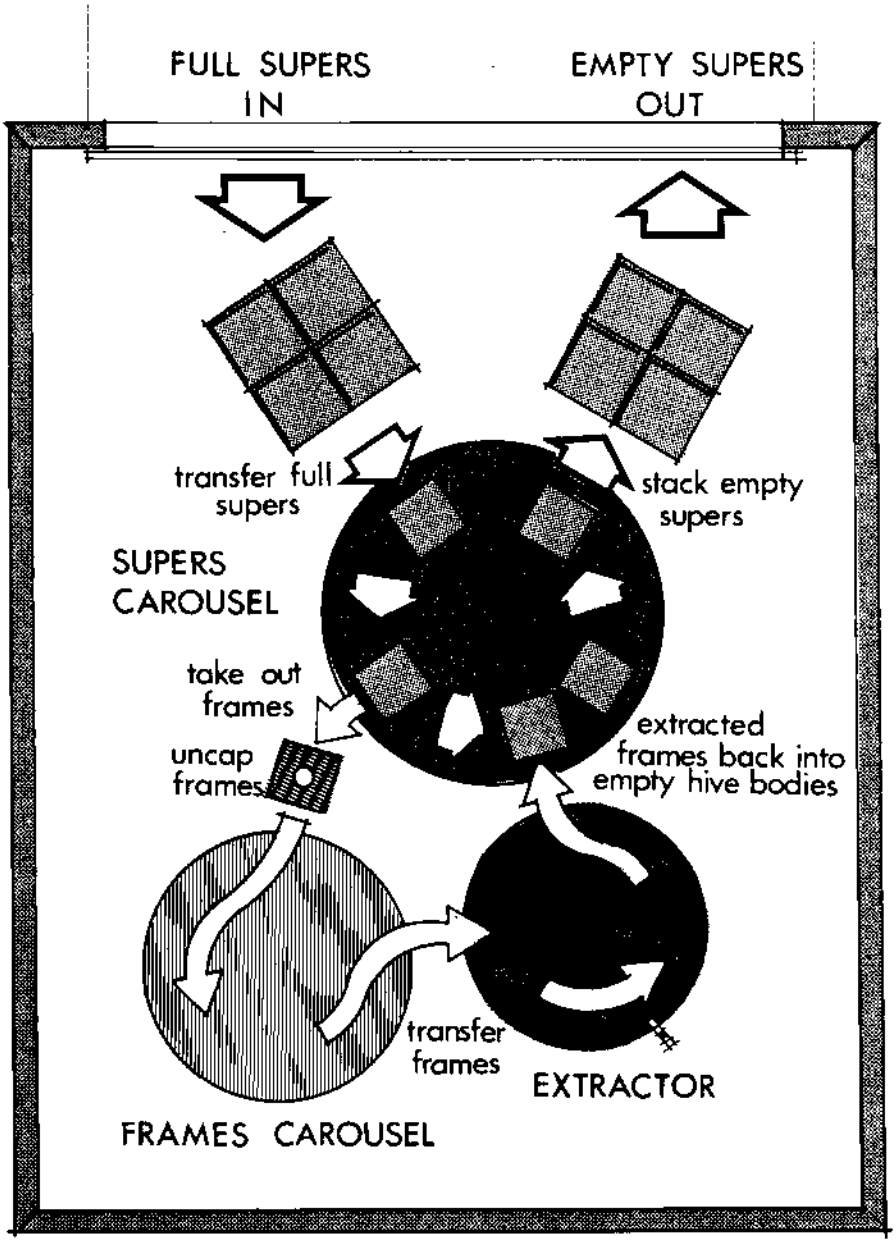


FIGURE 2: U-FLOW USING CAROUSELS IN A GARAGE TYPE OPERATION

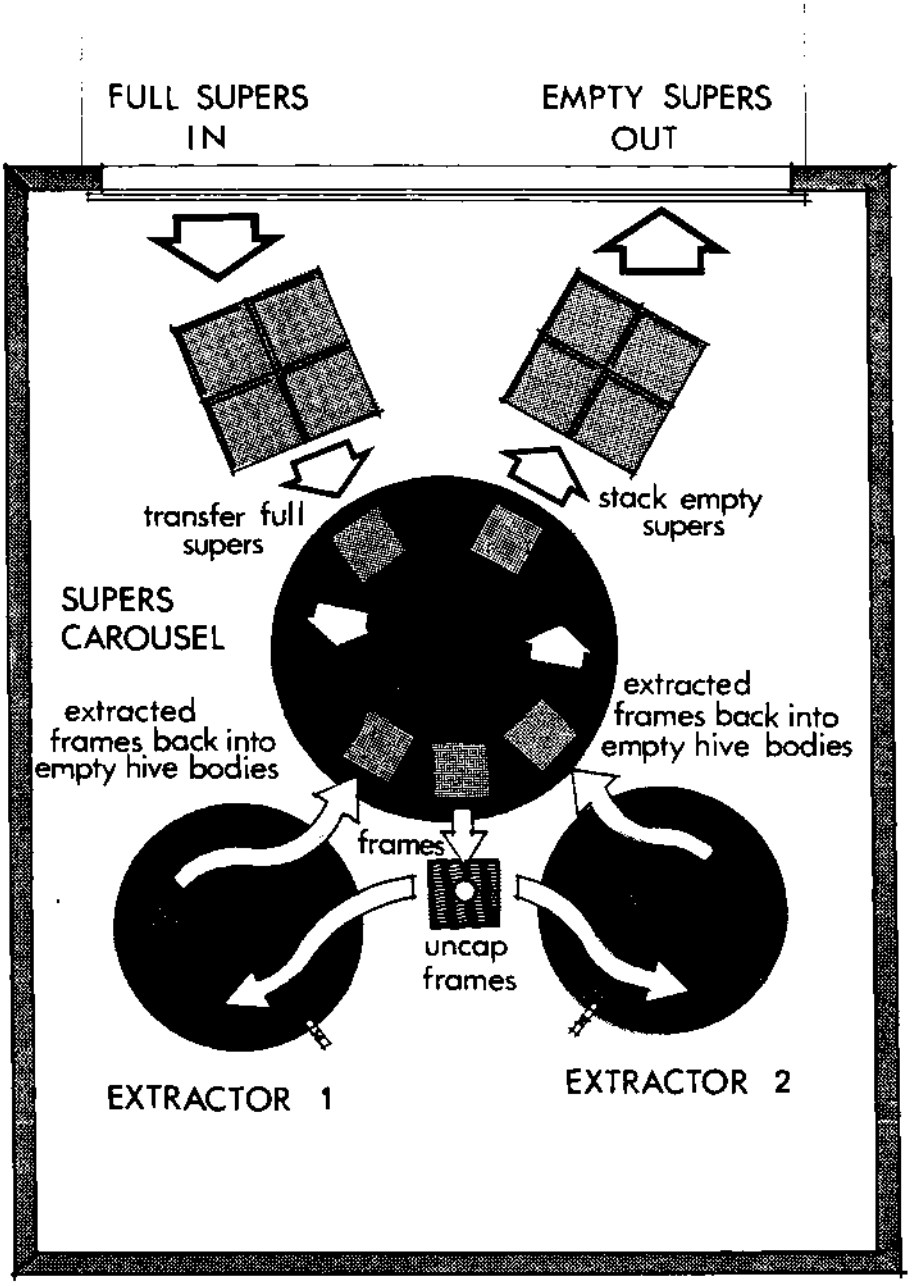


FIGURE 3: U-FLOW USING TWO EXTRATORS IN A GARAGE TYPE OPERATION

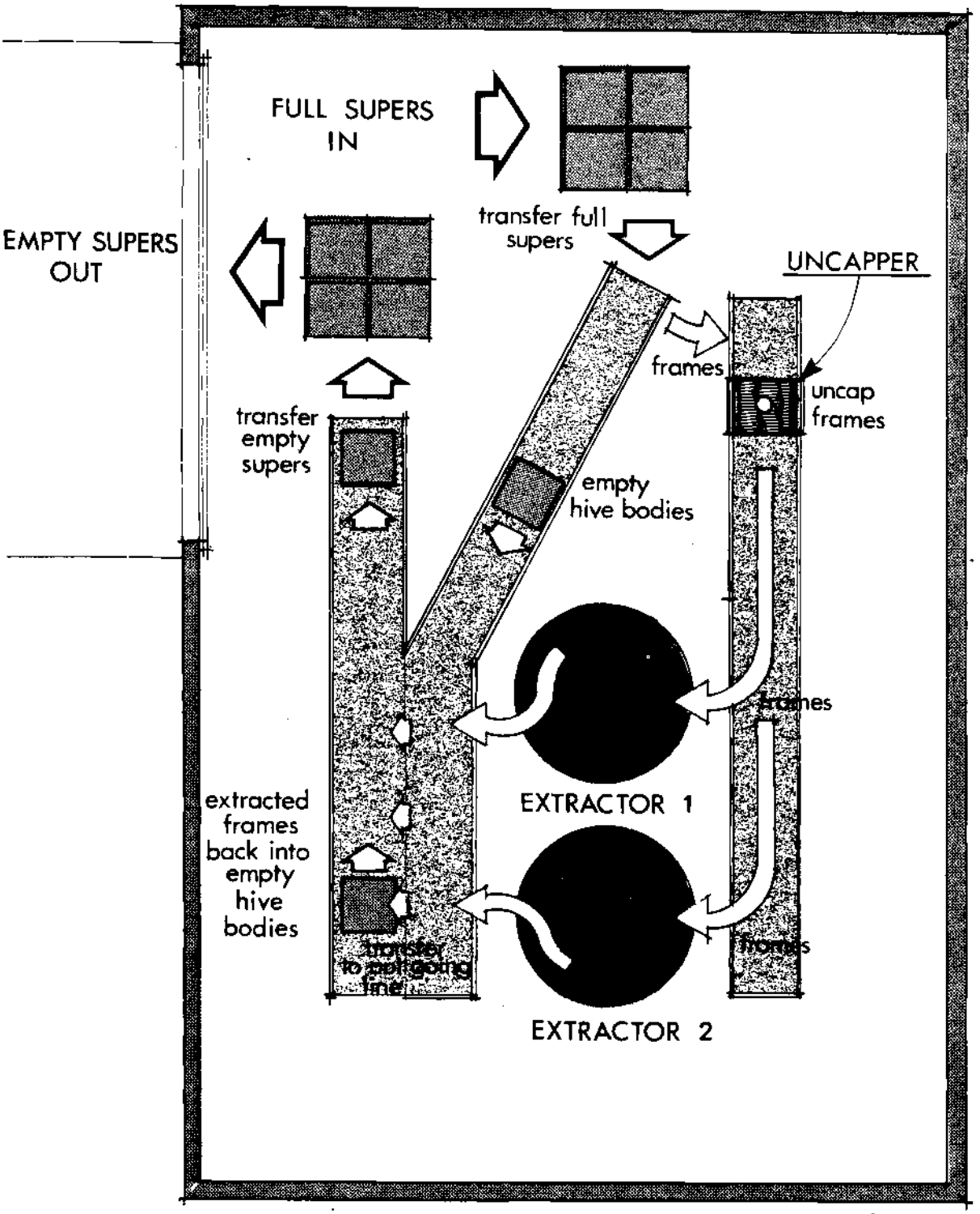


FIGURE 4: U-FLOW FOR VERTICAL AXIS EXTRACTOR USING CONVEYORS

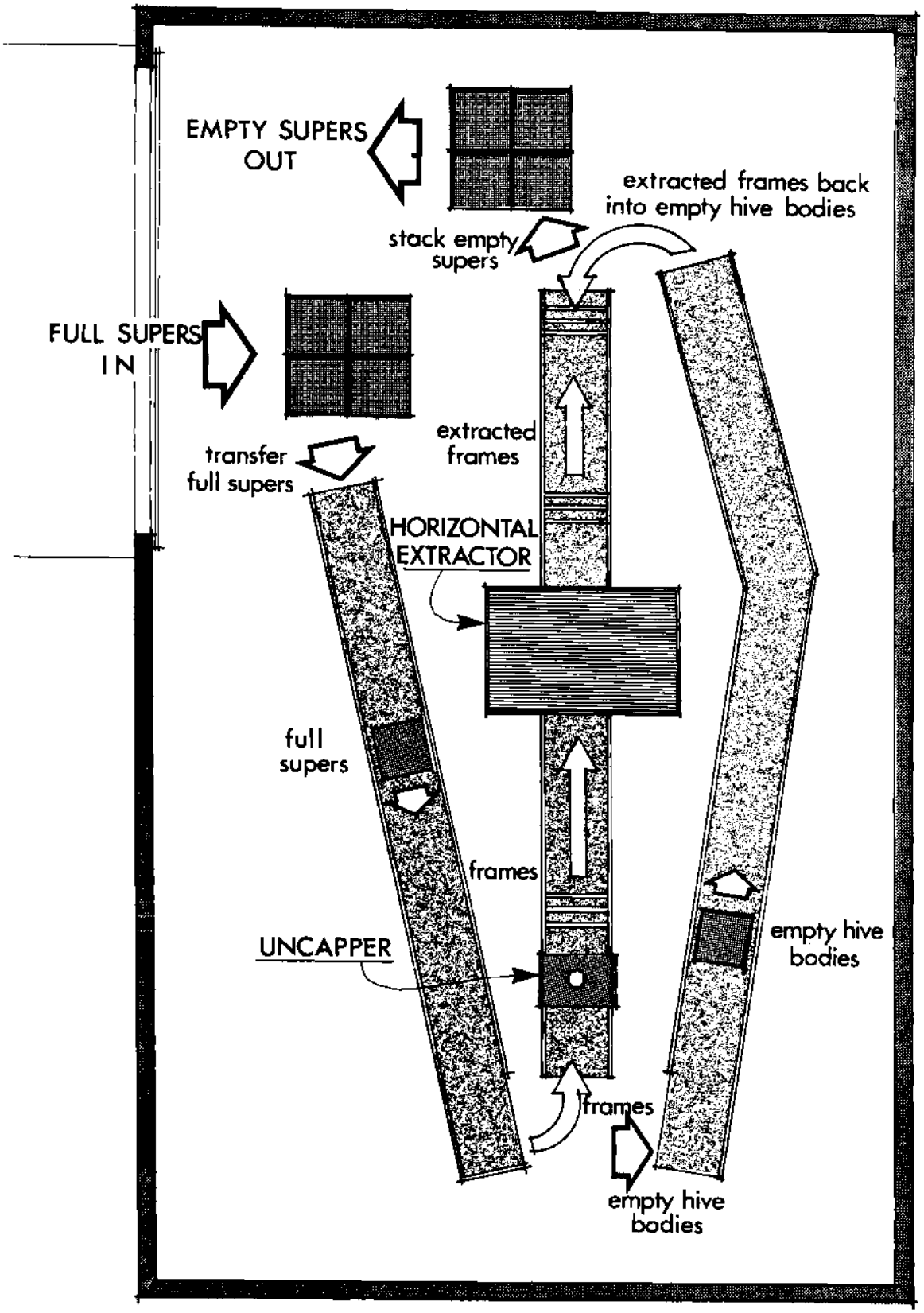


FIGURE 5: U-FLOW FOR HORIZONTAL EXTRACTOR USING CONVEYORS

The equipment that handles hive parts should take them from the position at which they were last worked on and move them into position for the next operation. Because of the nature of the batch type process used in the extraction of honey, hive parts move in surges. This requires that the batches be temporarily stored between operations. The equipment, for example, that is used to move the uncapped frames from the uncapper to the extractor can also double as an accumulator for the frames. The equipment must therefore be large enough to hold at least one batch. Hive bodies and empty supers should be treated in a similar manner. Equipment should be used to move and accumulate the empty hive bodies, as well as position them for recieving the extracted frames. Another conveyor should be used to return the empty supers to a position next to where they entered the extraction room. By using equipment in this way, an orderly flow of the hive parts can be maintained in the extraction room.

The extraction process can be further enhanced by making the manual operations as efficient as possible. To do this the equipment should be arranged so that a minimum of movement is required. Equipment may be required to assist with or totally do operations that cause the operator fatigue. To accomplish tasks most effectively, the operator should use movements such as: reaching, moving, grasping, positioning, disengaging, releasing, examining, and doing. The operator should not use such movements as; changing direction, prepositioning, searching, selecting, planing, holding, or having a delay because of having to balance something or for any other reason. These movements are generally an indication of, a poorly defined flow for the materials, lack of suitable equipment, inappropriate equipment or poorly arranged equipment.

By using equipment such as, conveyors, rotary tables, and slides as well as the extraction equipment to move and accumulate the hive parts, the repetitious and redundant manual handling of the hive parts can be avoided. This will also eliminate the clutter of stacks of hive parts awaiting attention. By eliminating the storing and handling of hive parts in the extraction room, sanitation and safety can be greatly improved. The training of operating staff is also simplified because the required movement of hive parts is pre-determined by the equipment.

Packaging Equipment Layouts

Equipment layouts for packaging systems should also be designed around the U flow concept. The layout of equipment for handling of the containers must be done first followed by the layout of equipment for the handling of the honey. Storage of both filled and empty containers must be done outside the packing room. This avoids congestion and allows orderly movement of the containers.

PLANNING THE HONEY HOUSE

This section describes a method for developing a plan for a honey house that can be expanded in stages. Included is a systematic approach to the development of an operation to suit the needs of a growing apiary. Figures 6a through 6f are a series of plans illustrating this approach. With this design, efficient materials handling can be maintained thoughout the staged development of the honey house. This system can apply to any operations that have outgrown the garage type hobby system. It should be noted that it is important to have the equipment layout before planning the honey house. Planning a honey house can be done in three basic steps:

- Selecting the type of building
- Developing the building layout
- Defining the details for construction

Selecting The Type Of Building

Having an idea of the type of building to be used will permit the development of an appropriate building layout. The following points should be considered in selecting the type of building to be used.

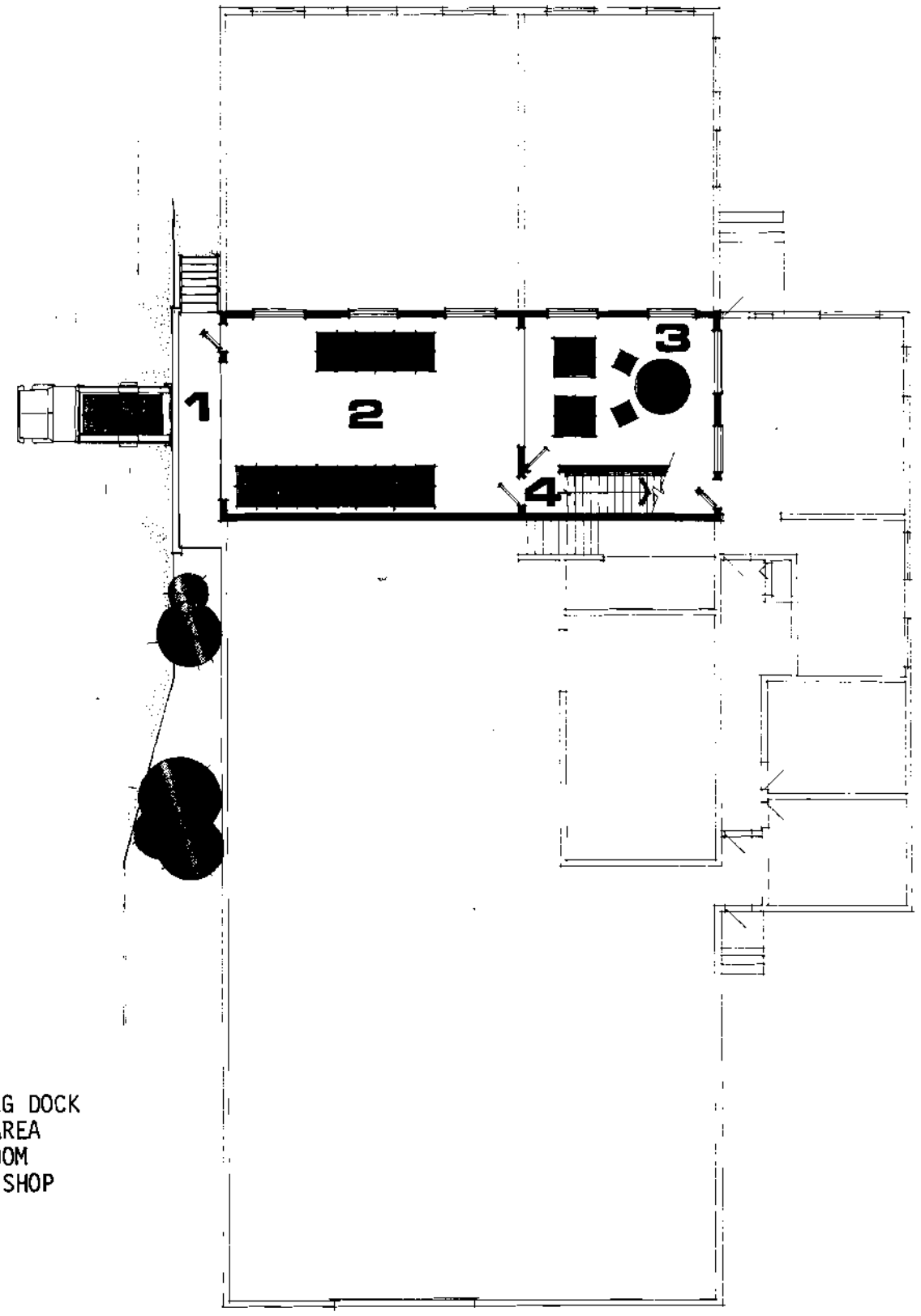
- Consider type of construction suitable for high walls 4 to 6m (12 to 18 ft).
- Straight walls are better for storage and utilization of space.
- Consider ease of construction and total cost of the building.
- Consider suitability for expansion.
- Is it to be self or contractor built?
- If it is to be a self built structure, more emphasis on conventional wood construction.
- If it is to be contractor built which contractor will provide the best deal.

Building Layout

An effective general layout of a honey house can be defined by using the two following principles outlined below and described in the subsequent sections: First, establish a central maneuvering area. Second, use the right angle rule for the handling of supers, to systematically arrange the areas of the honey house arround the maneuvering area. It is necessary to include the "U" flow layout in extraction room to make the best use of these two principles.

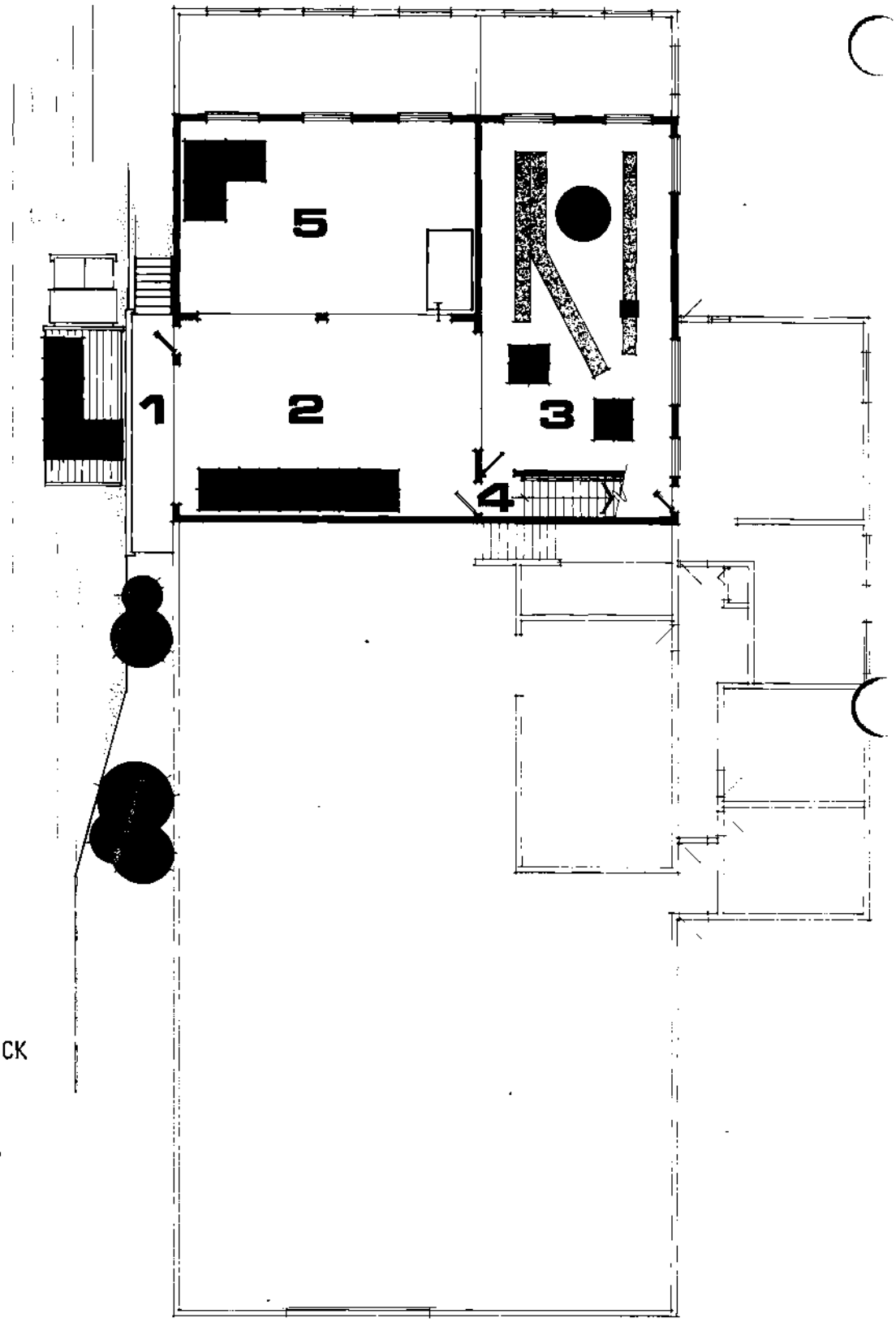
The principle of the central maneuvering area

The handling of boxes and frames is the major task done in the honey house. The building must therefore be designed to accommodate the efficient flow of these parts. To permit this, a central maneuvering area is required. The central maneuvering area must provide efficient access to all areas of the honey house. This makes the maneuvering area the key part of the honey house.



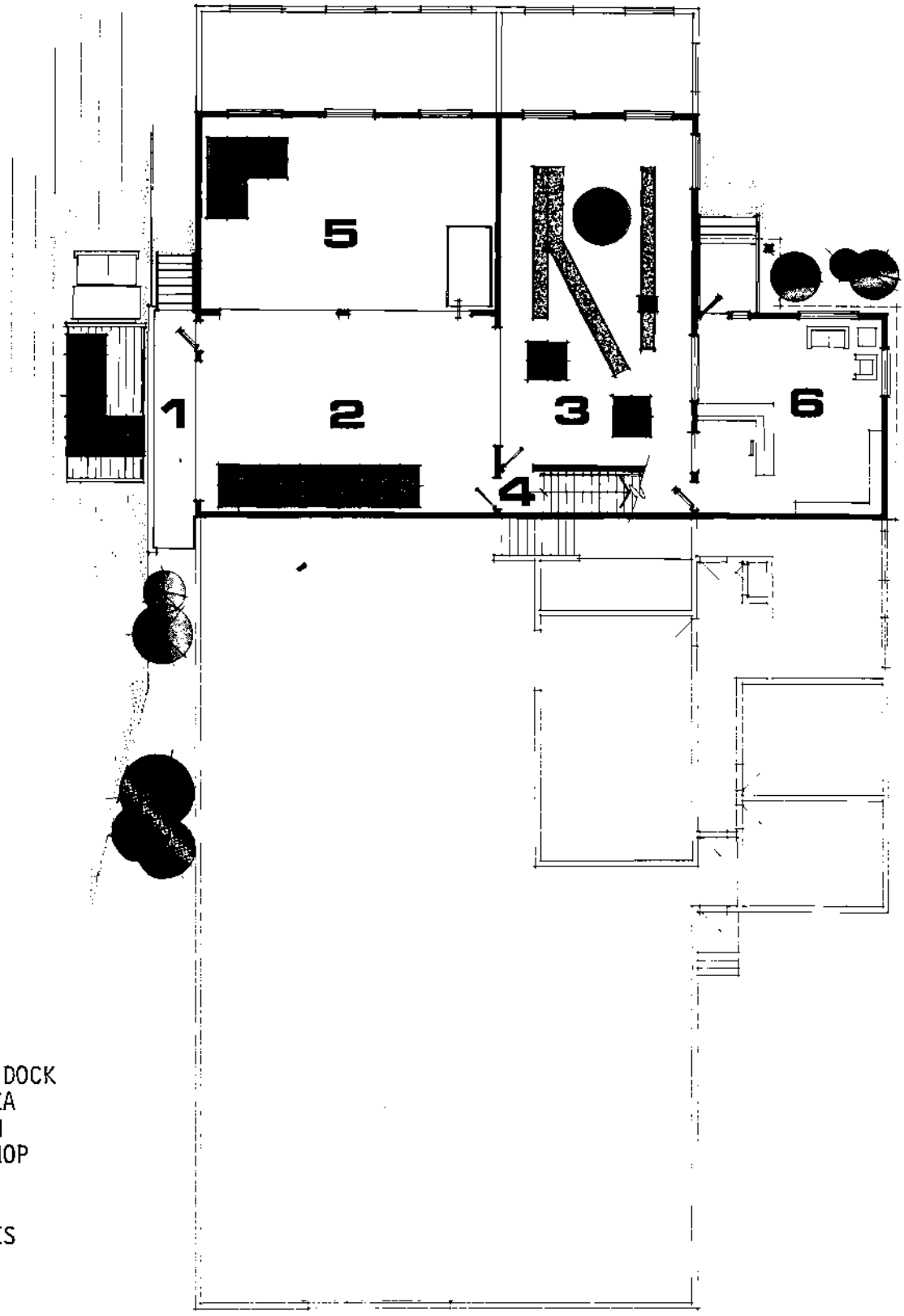
1. RAISED LOADING DOCK
2. MANEUVERING AREA
3. EXTRACTION ROOM
4. WOOD WORKING SHOP
   UP STAIRS

FIGURE 6a: MODULAR HONEY HOUSE STAGE I



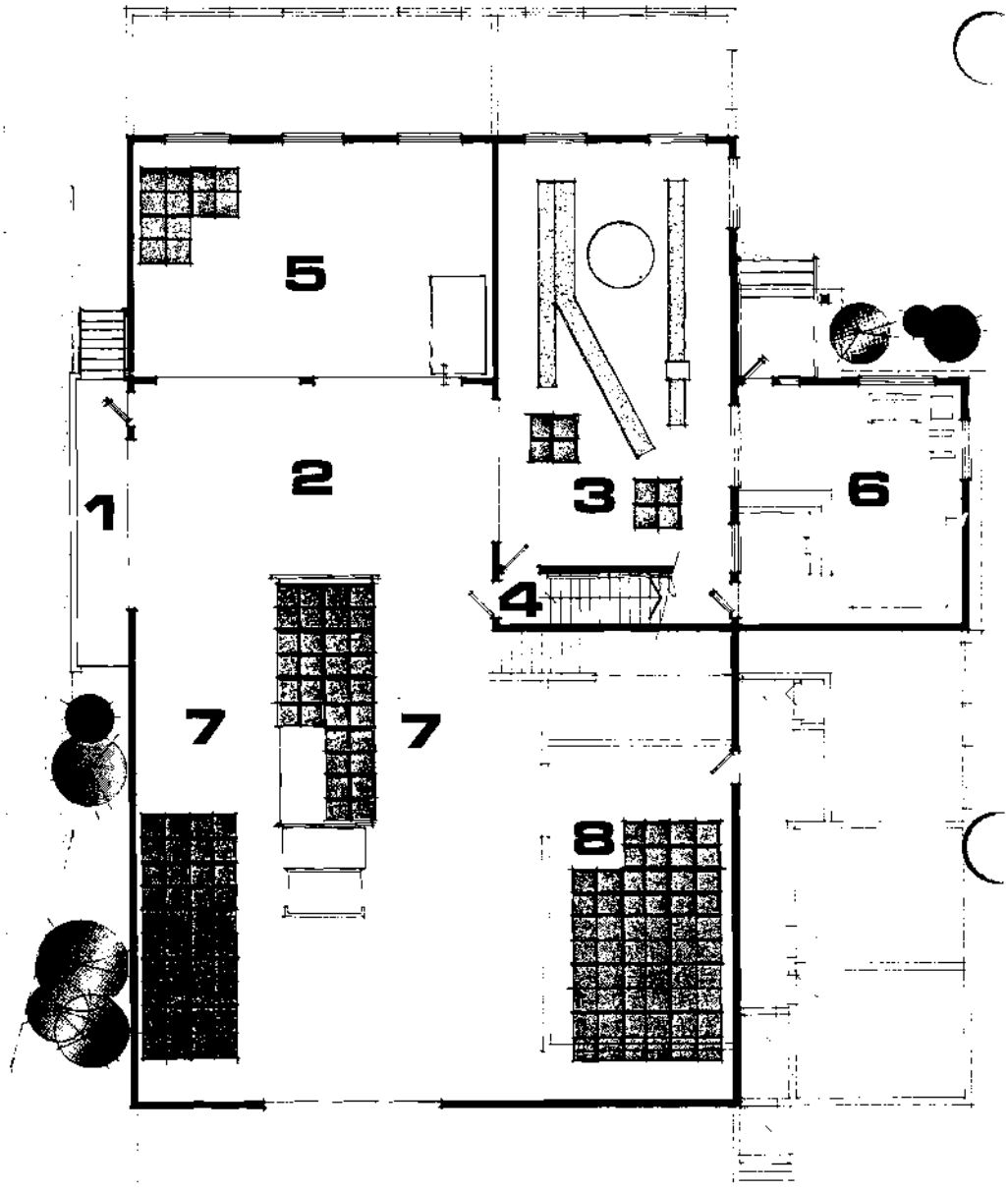
1. RAISED LOADING DOCK
2. MANEUVERING AREA
3. EXTRACTION ROOM
   (1st EXPANSION)
4. WOOD WORKING SHOP
   UP STAIRS
   (1st EXPANSION)
5. HOT ROOM

FIGURE 6b: MODULAR HONEY HOUSE STAGE II



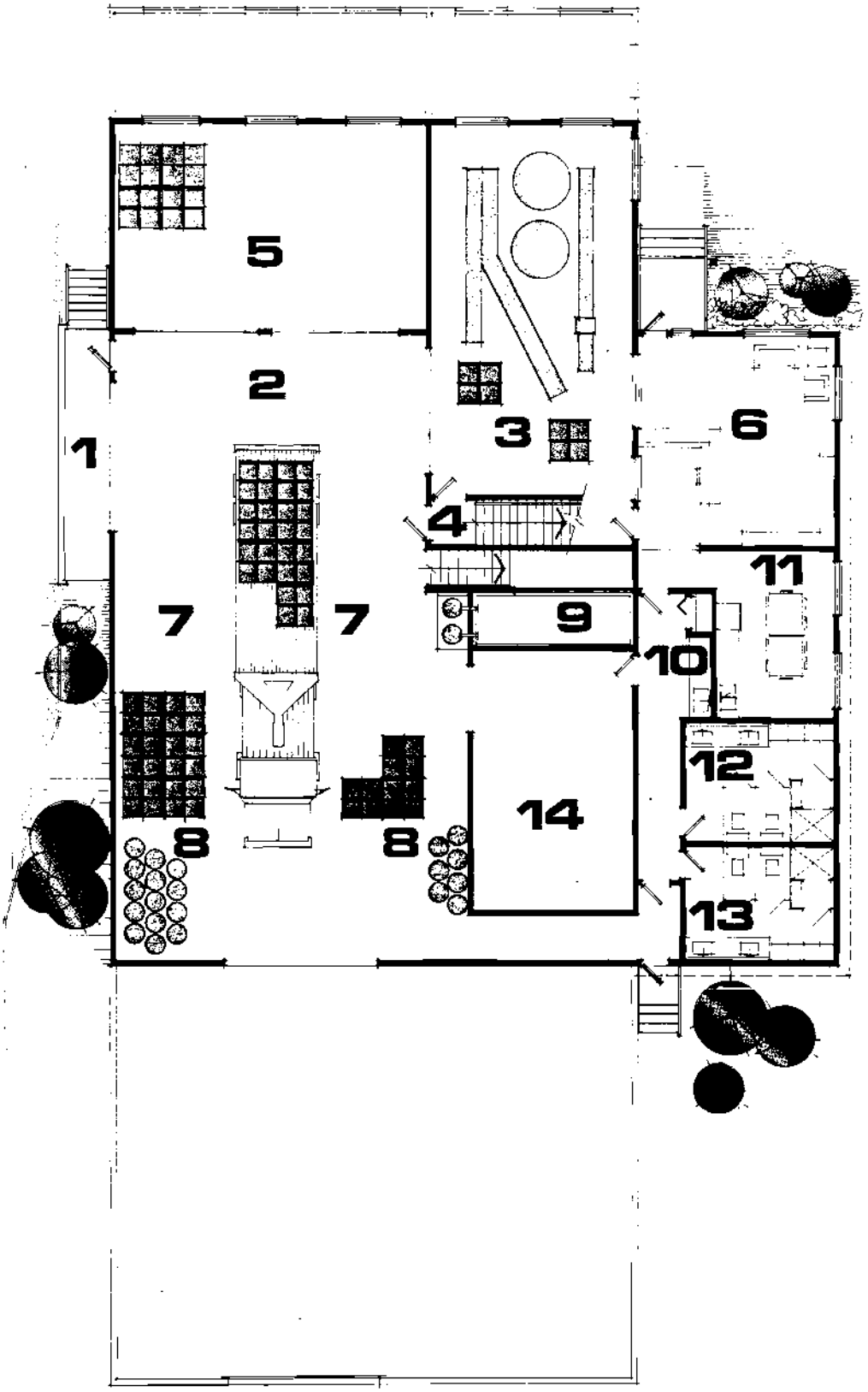
1. RAISED LOADING DOCK
2. MANEUVERING AREA
3. EXTRACTION ROOM
4. WOOD WORKING SHOP
   UP STAIRS
5. HOT ROOM
6. OFFICE AND SALES
   AREA

FIGURE 6c: MODULAR HONEY HOUSE STAGE III



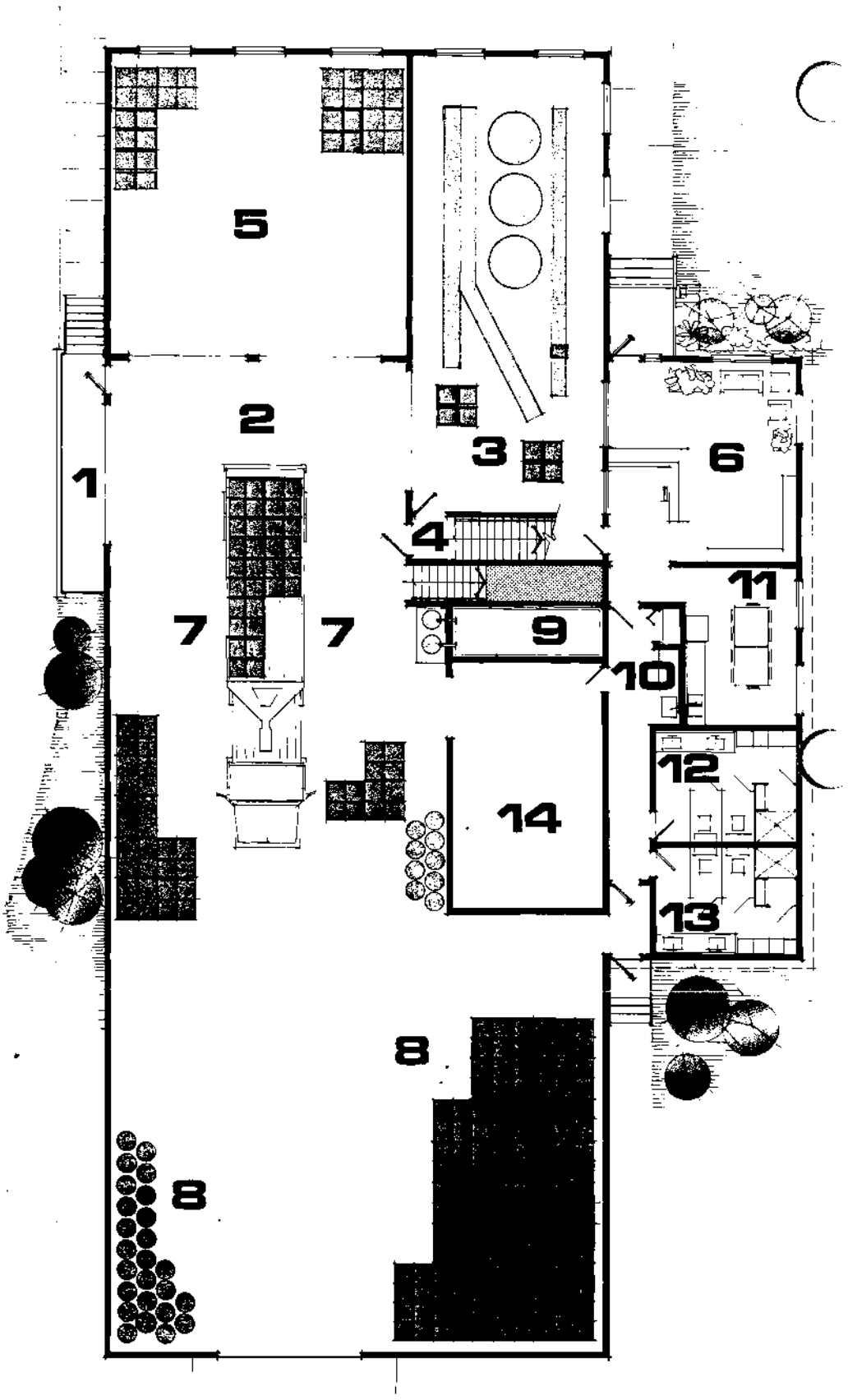
1. RAISED LOADING DOCK
2. MANEUVERING AREA
3. EXTRACTION ROOM
4. WOOD WORKING SHOP UP STAIRS
5. HOT ROOM
6. OFFICE AND SALES AREA
7. INSIDE LOADING AREA
8. STORAGE AREA

FIGURE 6d: MODULAR HONEY HOUSE STAGE IV



1. RAISED LOADING DOCK
2. MANEUVERING AREA
3. EXTRACTION ROOM
4. WOOD WORKING SHOP UP STAIRS
5. HOT ROOM
6. OFFICE AND SALES AREA
7. INSIDE LOADING AREA
8. STORAGE AREA
9. TANK ROOM
10. UTILITY AREA AND CLOSET
11. COFFEE ROOM
12. WASH ROOM
13. WASH ROOM
14. PACKING ROOM

FIGURE 6e: MODULAR HONEY HOUSE STAGE V



1. RAISED LOADING DOCK
2. MANEUVERING AREA
3. EXTRACTION ROOM (2nd EXPANSION)
4. WOOD WORKING SHOP UP STAIRS (2nd EXPANSION)
5. HOT ROOM (EXPANDED)
6. OFFICES AND SALES AREA
7. INSIDE LOADING AREA
8. STORAGE AREA (EXPANDED)
9. TANK ROOM
10. UTILITY AREA AND CLOSET
11. COFFEE ROOM
12. WASH ROOM
13. WASH ROOM
14. PACKING ROOM

FIGURE 6f: MODULAR HONEY HOUSE STAGE VI

The maneuvering area must be arranged to provide direct access to; the loading dock or loading area, the hot room, the extraction room, the barrel filling station, a packaging area and a storage area. The maneuvering area must also be large enough to permit easy maneuvering of the associated equipment. A portion of the storage area adjacent to the maneuvering area can serve as temporary storage for extracted supers awaiting return to the yards.

The right angle principle

The right angle principle should be used to systematically arrange the rooms arround the maneuvering area. The right angle principle states that: An ideal motion for a mobile materials handling machine is to unload at right angles to the loading position. Figure 7 is an illustration of the principle.

Loading docks

The loading dock will determine the position of the truck for loading and unloading. This in turn will determine the arrangement of the other main areas of the honey house, as will be explained later.

There are three basic arrangements for loading docks. They can be located either inside or outside of the honey house:

- Raised docks for rear loading and unloading
- Raised docks for side loading and unloading.
- Floor level docks for loading and unloading generally from both sides.

Outside loading docks are most appropriate for operations ranging in size from the smallest hobby operation to the larger part time operations where stray bees are not a problem. Inside loading docks are generally more appropriate for the larger operations where the area of the loading dock is not a major portion of the honey house.

Although more expensive, an inside loading dock is in many cases preferable to an outside one. A load of honey supers if located outside can, in a very short time, attract an intolerable number of stray bees. The same load if located inside will not attract bees from the surrounding areas, and most of the bees associated with the load can be expelled through bee escapes in the building. The moderated temperature of the inside loading dock also makes loading and unloading supers much more pleasant. An inside loading dock area can also serve as a garage for an associated vehicle/s.

Raised loading docks are commonly used with hand carts and pallet jacks. This generally includes the types of operations between those that manhandle the individual supers and those that use a fork lift and pallets.

Truck level loading areas are most appropriate for the hobby and large operations; i.e. those that manhandle the individual supers and those that use fork lifts and pallets.

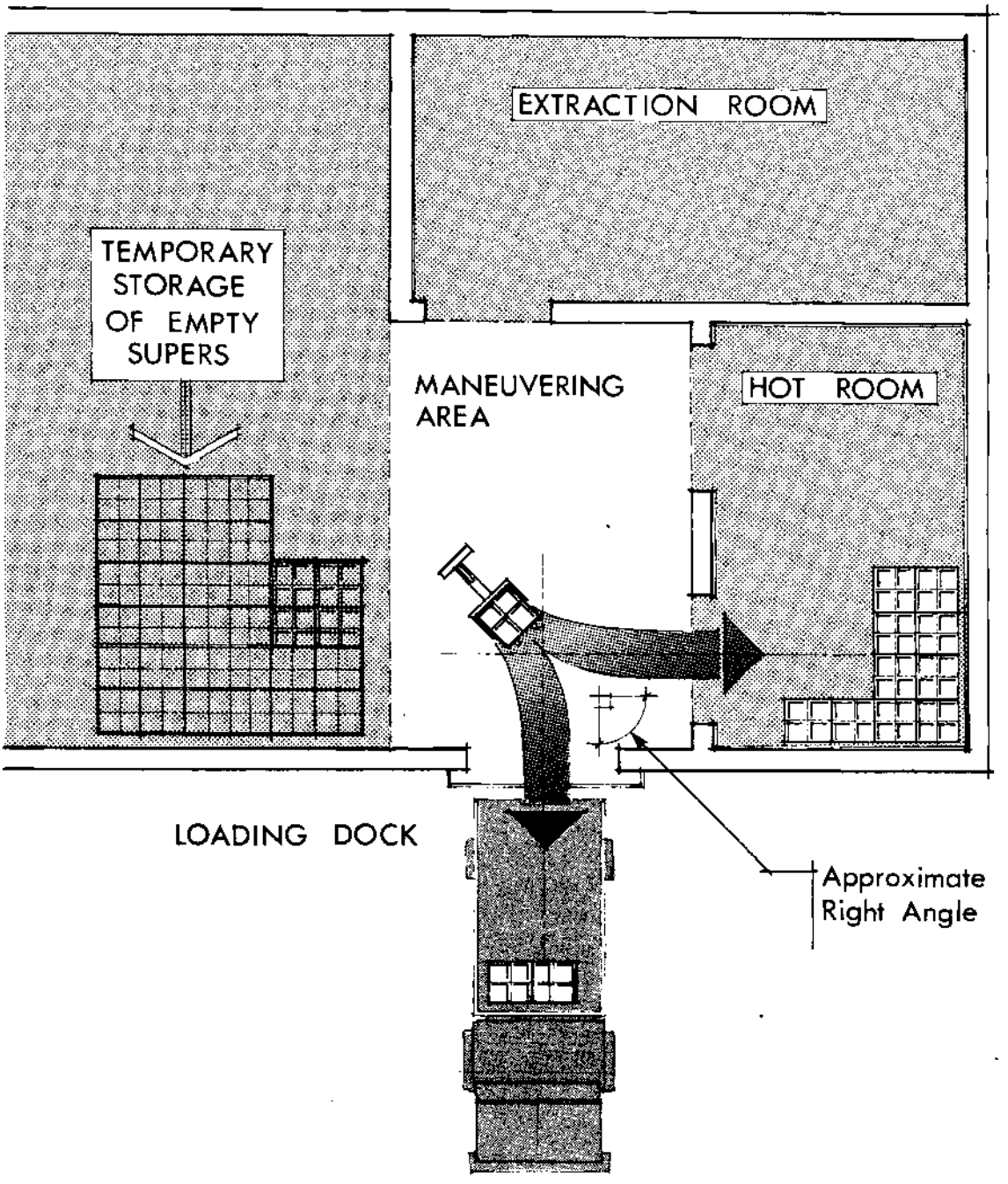


FIGURE 7: ILLUSTRATION OF THE RIGHT ANGLE PRINCIPLE

Hot rooms

The hot room must have immediate access to the maneuvering area of the loading dock. By applying the right angle principle for locating the hot room, three arrangements emerge:

- When the loading dock is level with the deck of the transporter and loading and unloading is from the rear, the hot room doors are located at right angles to the rear of the transporter on either one side or the other of the maneuvering area. Figure 6a
- When the loading dock is level with the deck of the transporter and loading and unloading is from the side, the hot room doors are located at right angles to the side of the transporter on either one side or the other of the maneuvering area. Figures 6b and 6c
- When the loading and unloading is done from the same floor level and from both sides of the transporter, the hot room doors are located to the rear of the transporter. This permits the right angle movement between the sides of the transporter and the hot room doors. Figures 6d, 6e and 6f

At least two doors are required to permit the orderly flow of supers through the hot room. These doors should open to the maneuvering area, and in the majority of cases not into the extraction room. A door for the movement of supers that opens into the extraction room means that a hand cart, pallet jack, or fork lift will be used in the extraction room. This creates safety and sanitation problems. It also results in inefficient handling of the supers because of the uncentralized and unspecified maneuvering areas. A larger extraction room is generally required as well. It is therefore best to avoid this arrangement if possible.

The size of the hot room is based first on the size of operation, then on the capacity of the extraction room, then on the management of the extraction process. Although no hard rules have been established for sizing a hot room, a minimum size would hold three days supply for the extraction line.

The depth of the hot room should be related to the size of the pallets and the size of the loads being brought in. The depth should be such that a load will completly fill a given number of rows in the hot room. This will permit an orderly sequencing of the movement of supers entering and leaving the hot room.

If the hot room is to double as a winter woodworking shop it should be located on an outside wall so windows and ventilation can be included.

Extraction room

The extraction room must be located adjacent to the maneuvering area of the loading dock to allow easy access to the storage areas for the full and empty supers. The entrance to the extraction room should be at right angles to the entrance of the hot room. See Figure 7, which illustrates the right angle principle.

Since a high portion of total manhours are spent in the extraction room, it is important to have good working conditions. This requires an ample amount of well located window area. It is therefore desirable for the extraction room to be generally located with at least one and preferably two exterior walls. The arrangement of the extraction room floor plan as described above must be based on the equipment layout and the way it is to be used.

Storage areas

An area for the temporary storage of empty supers awaiting return to the bee yards should be provided in the unheated storage area where raised loading docks are used. This area should be adjacent to the maneuvering area and at right angles to both the extraction room entrance and the loading position of the truck.

For inside floor level loading docks the temporary storage area should be located to either side of the front end of the truck when it is in the loading position. This will permit application of the right angle principle to the movement of supers from the extraction room to the temporary storage as well as the movement of supers from the temporary storage to the truck.

Tank room

The bulk honey tank may be located next to the hot room to conserve energy. If it is located in the hot room there may be a problem of humidity incompatability between the tank and hot room needs. This is because honey draws moisture from the air when the humidity is high enough which often occurs when honey is dried in the hot room. The tank should be located so the unloading gate valve with associated scales and equipment, is readily accessible from the maneuvering area of the loading dock. If packing is to be included in the honey house, the tank room may be located next to the packing room. The tank should also be located near the furnace room to use the heating equipment efficiently.

Packing room

If a significant amount of honey is to be packaged in small containers, a packing room should be established. The room layout should accomodate a predesigned packing equipment layout. Immediate access to the sales, office, and maneuvering areas is required as well. Areas outside the packing room are required for storage of empty and filled containers. The hot room may be used for the storage of the filled containers while the empty containers may be stored above the packing room.

Equipment storage

Apiculture equipment not being used should be stored in an unheated shed to minimize weathering and contamination, and to permit easy access for servicing during the winter months. In an apiary it is advantageous to have this facility as an integral part of the honey house. The storage should be readily accessable from the maneuvering area of the loading dock to permit efficient and coordinated handling of the supers, barrels etc. to and from the rest of the honey house.

Wash and utility rooms

Space for wash and change rooms should be provided in all but the most basic honey houses. If male and female personnel other than the family are to be working in the apiary, separate toilet and change rooms should be provided. Adequate space should be provided for a minimum of one sink and one toilet for every 10 people working in the apiary.

A utility room may be combined with a furnace room. Cleaning materials and equipment along with a deep wash tub are contained in this room. The room should be located near the wash rooms to minimize plumbing. The deep sink may also be located in the extraction or packing room instead of the utility room to make it more accessable to the area/s requiring it.

Workshop

Workshop areas, except temporary winter ones, must be isolated from the rest of the honey house to prevent contamination of the supers, honey and wax with sawdust, paint, fumes, etc. The space above the extraction room can be used for a shop associated with woodworking needs of the apiary. A shop to serve automotive and metalworking needs is best kept separate from the honey house.

Office

If an office and sales area are to be included they should be located at the front of the honey house and be fitted with ample window area and have reasonable access to the packing and loading dock areas. Access may be by way of a hallway. It may be desirable for promotion of sales as well as for supervision of activities to have a view of the packing and/or extraction areas from the office and sales areas.

UTILITIES

Water and Sewage

Plumbing in the honey house must be done with pipe and fittings approved for potable water. All plumbing in the honey house should be sloped and equipped with drains to allow the system to be completely drained whether or not the honey house is heated during the winter. The extra effort and expense required to slope the lines and install drains can be justified with one major freeze up. If the water system is to be used during the winter, water lines should only be installed in walls heated on both sides.

The extraction room should be equipped with at least one set of taps that combine the hot and cold water supplies. The outlet must be equipped with a fitting for a hose. If hot water is to be used for heating of the uncapping knives, or honey by way of heat exchangers, two lines will be required. The line from the hot water heater must be equipped with a circulating pump. A return line to the hot water heater should be used to conserve the water used for heating.

A hot and cold water supply should be provided for the packing area for cleaning. A hot water circulating line may also be required for heating the honey for straining prior to packaging.

The wash room/s should be equipped with at least one sink having hot and cold water for every 10 people working in the apiary. Where male and female personnel other than family are employed in the apiary, separate toilet facilities should be provided.

If a utility area is included, it should be equipped with a deep sink and hot and cold water. The utility area may simply be an area by the wall of the extraction room or packing area.

The hot room and loading dock should also have a readily available source of hot and cold water for cleaning.

Drains with traps must be provided in all areas and for all equipment serviced with a water supply.

A sump is an integral part of the honey extraction line. The floor sump will serve as a receptacle for the honey sump, associated controls and pump, as well as a floor sump for the collection of wash water. The floor sump must therefore be equipped with a drain.

The septic tank and field should be somewhat larger than that required for a home in order to dispose of the larger volumes of wash water.

Electrical

A 100 amp panel will be adequate to supply the honey house unless electric heating is to be used. Larger operations may find it necessary to have a standby plant to ensure the power supply. Standby power plants should be attached to the 120/240 V side of the power supply through a double throw switch. A minimum of a 10 kVA plant is required for a small commercial honey house by itself. If the home is also to be served by the plant a minimum of a 12 kVA plant would be required.

Power outlets in the extraction room and packing area and hot room should be kept to a minimum because of the wet conditions. Because the equipment is centrally located, power is best supplied to the equipment from the ceiling through watertight conduits and boxes. Utility plugs required in the extraction room should be equipped with ground fault interrupters and covers.

Particular attention should be given section 22 of the electrical code. In addition to the safety aspects addressed by the code, sanitation can also be improved if the required watertight wiring and electrical equipment are used.

Further information can be obtained from the Canadian Electrical Code - Part I. This code is a CSA standard adopted by the Electrical Protection Branch of General Safety Services Division of Alberta Labour.

In the extraction room, hot room, and packing area, lighting should be supplied by fluorescent tube fixtures attached to the ceiling. The light fixtures should be equipped with tight fitting diffusion lenses that permit light transmission through three sides, and that have a smooth washable outer surface. This type of lighting will provide an even light with a minimum of shadow while minimizing the problem of bees accumulating around the lights and dropping onto the workers below. The lights can also be easily cleaned.

Recommended light levels for the various areas are as follows:

Areas	illumination in footcandles	approximate watts/ft² incandescent	fluorescent
extraction room	50	8.0	3.2
packing area	50	8.0	3.2
hot room	20	3.3	1.4
hot room (if used as a winter shop)	50	8.0	3.2
loading dock area	20	3.3	1.4
office	70	11.0	4.4
wash room	30	4.9	2.0
utility areas	20	3.3	1.4
storage areas	5	0.9	0.4

Heating

Hot water heating is the most suitable for a honey house because one heater can be used to supply heat for all the separate needs. A hot water boiler, besides heating water for cleaning, can be used to heat the various areas and equipment in the building. Unit heaters and/or pipes embedded in the floor can be used in heating the hot room, extraction room, and packing room. Baseboard units can be used in the office, coffee room, and washrooms. Hot water can effectively heat the uncapping knives and the honey in the honey sump and storage tank. It can also be used to heat the honey prior to separating the wax, as well as melting the wax. For heating purposes the boiler requires a circulating pump and return lines.

Ventilation

Ventilation in a honey house is mainly used for reducing the humidity in the extraction and hot rooms. Ventilation is also required for cooling to improve working conditions. A fan should be installed in the extraction room so that it blows air into the room. The exhaust air can then be expelled through the cold storage area. This will avoid problems that occur when exhausting air containing bees or honey aromatics through fans in the hot room or extraction room. A similar arrangment can be installed in the hot room. The fans should have external hoods to exclude the light so that the bees won't attempt to escape through the them.

Aromatics from the honey in the exhaust air will attract stray bees. It is therefore important to locate the outlets from the building away from doors and areas where bees can be a problem. Large screened and louvered vents in the gables of the storage area will allow the exhaust air to escape in the least troublesome place. In some cases it may be necessary to exhaust the air through stacks in the roof.

BUILDING COMPONENTS

Floors

Floors in the honey house are best constructed of concrete for durability and ease of cleaning. Floors in areas subject to honey spills and water require a very slightly textured surface for safety whereas dry areas should be smooth. Floors in areas requiring washing must have a slope of approximately 1% or 10mm/m (1/8 in. per foot) towards a floor drain.

Concrete for floors must provide a durable impervious surface for wear resistance and sanitation purposes. To achieve this, concrete must be high in cement content and properly surfaced and cured. Concrete with a strength of at least 30 MPa (4200 psi) will have sufficient cement to permit the development of a durable impervious surface. It is highly desirable to use an air entraining concrete to improve the resistance to surface deterioration. The concrete should contain a minimum amount of water to minimize shrinkage and surface bleed water, and to allow maximum strength and durability to be achieved.

To achieve the best results from the concrete the steps outlined in appendix A must be followed after the concrete is placed:

Concrete floors in the extraction room and packing room can be more easily kept sanitary if they are sealed. Sodium silicate (water glass), Silicofluoride, and boiled linseed oil are the most common sealers used. These sealers are thinned and applied in one to several applications to a well dried concrete surface. Other sealers are available from concrete firms. Coating materials such as the two part epoxy types perform very well if properly applied and cured.

More information on concrete is available from the Canadian Portland Cement Association in Edmonton or Calgary.

Coving

Coving must be used to seal the junction of the floor and the walls to prevent unsanitary conditions there. For concrete floors this can be effectively achieved with a high quality flexible sealant. Thorough cleaning and preparation of the area immediately arround the junction is required. An ample fillet of the flexible sealant can then be applied to the entire perimeter of the joint. Ceramic tiles can also be used but they are expensive and there is a strong chance that movement between the floor and wall would crack the seal.

Walls and Ceilings

Walls in the extraction room and hot room should be 3 to 3.6 m (10 to 12 ft) high to provide working room and space between bees that accumulate arround the lights, and the personnel working on the floor. The walls must be clad with a durable, hard, impervious material that can be easily washed. Materials such as gypsum board are not recomended because small flaws will permit water to soak the material and cause it to rapidly deteriorate. All joints should be sealed with a high quality flexible sealant.

Wall surfaces not factory sealed must be first coated with a primer-sealer, then finished with a high quality gloss or semi-gloss washable paint. A reputable paint dealer should be consulted for particular applications.

Ceilings must be clad with a hard impervious material that can be washed occasionaly. Gypsum board is durable enough for ceilings if attached at 400 mm (16 in.) intervals. Finishing requirements are the same as for the walls.

COATINGS FOR HONEY TANKS AND EQUIPMENT

Products used for specialized surface applications are referred to by industry as coating materials, where as products used mainly for aesthetic reasons are referred to as paints. Products used on the surfaces of honey tanks and equipment are called coating materials because of their special requirements to effectively protect the surface without contaminating the honey.

The two part epoxy coatings are best for protecting and sealing surfaces in contact with food. These coatings consist of a two part epoxy, pigments, and solvents. Their application and curing procedures must be strictly and skillfully adhered to, so performance requirements of the coating can be met. Coatings used to protect and seal surfaces in contact with honey must be approved by the:

- Canadian Federal Department of National Health and Welfare Food and Drug Directorate
- US Food and Drug Administration

Most of these coatings are suitable for wood, mild steel and masonry. These products along with qualified applicators can be found in the yellow pages of the telephone directories of the major cities under Coatings - Protective and Coatings - Protective - Applicatiors. Two products sold in Alberta are:

- Intergard cc25 series hb mastic group 52, sold by
  International Paints (Canada) Ltd,
  14831 118 Ave, Edmonton, Alberta
  Phone (403) 454 0751, and

° Val-Chem Hi-Build Tank Epoxy - 78 Series sold by

Cloverdale Paint N' Paper
7146 Fisher St SE
Calgary, Alberta
Phone (403) 259 4505

Cloverdale Paint N' Paper
100 Bower Plaza
Red Deer, Alberta
Phone (403) 343 2040

Cloverdale Paint N' Paper
12303 107 ave,
Edmonton, Alberta
Phone (403) 482 2362

Holloway Paint and Chemical (1975) Ltd.
7201 104 st
Edmonton, Alberta
Phone (403) 432 7427

General requirements for proper application of the two part epoxy coatings are:

° Mild steel must be sand blasted to a near white metal condition.
° Joints must be smooth.
° Protective clothing must be worn.
° Painting must be done in a well ventilated room
° Painting and curing must be done with temperatures at or slightly above 20° C.
° Runs and puddles must be avoided as they will not cure properly and may give off substances that could contaminate the honey.
° Drying times between coats as recomended by the manufacturer must be observed.
° In most cases more than one coat is required to fully protect the surface.
° AFTER THE APPLICATION OF THE COATING IS COMPLETE, THE MINIMUM TIME SPECIFIED BY THE MANUFACTURER MUST BE ALLOWED FOR IN ORDER FOR THE COATING TO CURE PRIOR TO HAVING THE HONEY COME IN CONTACT WITH IT. If this is not done the honey will become contaminated.
° For those brands that are suitable for wood, consult with the manufacturer or their representative for proper procedures.
° For application on surfaces previously painted, determine the exact identification of the existing coating and consult the manufacturer or their representative for proper procedures.

PIPING SYSTEMS FOR HONEY

Piping systems for honey must not contaminate the honey and must be easily kept sanitary. Contamination can be avoided by using the proper materials for the piping and fittings. Sanitation can be maintained if the internal surfaces are smooth and the fittings and joints are free of sharp corners such as found with threads and burrs.

Materials such as the smooth food grade stainless steel approved for dairies, or plastic pipe approved for potable water or as food grade, must be used to avoid contamination of the honey and permit the system to be kept sanitary. Manufacturers of plastic pipe produce different formulations of each of the following general types of plastic pipe. Many of the formulations have been approaved for pottable water, or for food.

PVC (polyvinyl chloride),
PE (polyethylene),
ABS (Acrylonitrile-butadiene-styrene),
CAB (cellulose acetate butyrate),
PB (polybutylene)
CPVC (Chlorinated PVC)

Copper and brass should be avoided because it is attacked by the honey. Galvanized materials should also be avoided as they have been found to be attacked somewhat by the honey.

APPENDIX A

Procedure For Surfacing Concrete Floors

- Straightedging - The concrete is leveled by pulling the straight edge straight forward with a saw like side to side motion with the top edge tilted slightly forward.
- Bullfloating - Immediately after straightedging, a darby or bull float must be used to depress all larger aggregate particles slightly and to make the surface relatively smooth. After bullfloating the concrete must be allowed to harden somewhat and permit any bleed water or water sheen to leave the surface. Any finishing operation performed while there is bleed water or water sheen on the surface can be the cause of surface defects. Bleed water is not ususal on air-entrained concrete.
- Edging and Jointing of the slab - Control joints are a means of predetermining the location of cracking and movement caused by expansion and contraction of the concrete. The joints must be to a depth of at least 1/4 the slab thickness. For 100mm (4 in) thick concrete with larger than 18mm (3/4 in) aggregate the joints should be spaced not more than 3m (10 ft.) apart. These joints should later be filled with flexible sealant.
- Floating the Surface - After the edges and joints are run, the surface is floated. Floating has three purposes;
  - to embed large aggregates just below the surface;
  - to remove slight imperfections and produce a level or plane surface, and
  - to consolidate mortar at the surface in preparation for any further finishing.
- Trowelling the Surface - Immediately after floating, the surface can be steel-trowelled. Trowelling produces a smooth, hard, dense surface. Trowelling should never be done on a surface that has not been floated previously, either by hand or power. Trowelling after bullfloating or darbying is not sufficient. For the first troweling, whether by hand or by power, the trowel blade must be held flat against the surface. If it is tilted or pitched at too great an angle, an objectionable washboard or chatter surface will result. The first flat trowelling may produce an adequate surface that is free of defects, but additional trowellings with the blade tilted may be necessary to increase smoothness and hardness. There should be a lapse of time between successive trowellings to permit the concrete to become harder. The steel-trowelled surface leaves the concrete very smooth. Such surfaces become quite slippery when wet and should be slightly roughened. For a fine swirl finish, use the trowel flat on the surface, moving it in a wide, semicircular, fan like motion.

° Curing the Concrete - Curing the concrete is one of the most important steps in concrete construction. Concrete that is too dry or cold ceases to gain strength. The important reason for curing, therefore, is to maintain favorable conditions of moisture and temperature so that hydration may take place. When done correctly, curing reduces the risk of surface scaling, crazing, dusting, and damage from freeze-thaw cycles. Three methods for curing are;

° covering the surface with wet burlap and keeping it wet.
° covering the surface with plastic.
° Wet-cure the surface by spraying a liquid membrane-forming curing compound on the finished surface. The wet-cure is highly recomended by concrete specialists. These compounds are available through concrete accessory outlets or from concrete firms..