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LAYER HOUSING

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SITE SELECTION

Regardless of the type of commercial poultry production being considered, a relatively large building site is a key requirement. Future expansion should always be considered.

The proposed building site should be reasonably level to accommodate manure handling, feed handling, and for load out. Having all farm buildings on the same elevation will make it easier to tie the systems together later on. Good drainage away from the buildings is also required.

Depending on the number of barns and the desired layout, space must be provided in the poultry yard for manure storage and between the barns for proper ventilation, fire safety and snow and wind control. A distance of 15 to 30 m (50 to 100 ft.) is usually adequate and still practical.

Site selection must also take into account various Municipal and Provincial By-Laws and Regulations that may impact on such things as distance to neighbors, type and timing of manure disposal, environmental concerns, etc.

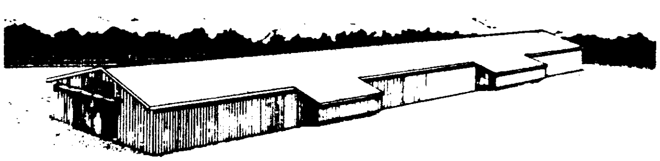


FIGURE 1 SINGLE STOREY CAGED LAYER BARN

A good water source that has both adequate quantity and quality is another critical factor to consider in selecting a building site. A well should have a capacity of 1 to 1 1/2 gallons per minute per 10,000 birds and have total dissolved solids of less than 2500 ppm. Nitrate/nitrites should be less than 100 ppm and alkalinity should be less than 1000 ppm. Dugout capacities should be based on about 800 gallons per day per 10,000 birds. Algae and turbidity in dugouts needs to be controlled to prevent fouling of water lines and drinkers.

BARN CONSTRUCTION

Pole-frame or stud-wall buildings are most commonly used for laying barns. These are either single storey (Figure 1) or double storey (Figure 2) structures that utilize the lower half of the building for manure storage. Recent trends in cage designs with manure belts is reducing the need for these "deep pit" laying barns.

Small barns for floor operation are typically laid out as shown in Figure 3. Individual or community nests may be used.

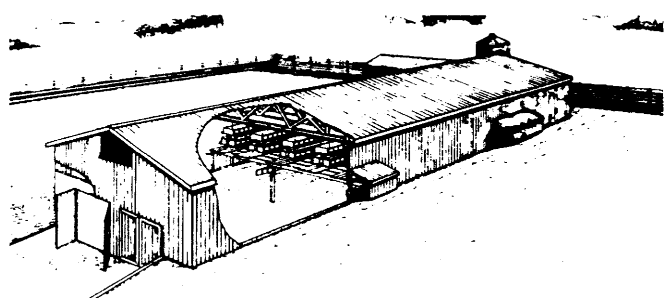


FIGURE 2 DEEP PIT CAGED LAYER BARN

1 - Alberta Agriculture; Barrhead, Alberta
2 - Ontario Ministry of Agriculture, Food and Rural Affairs; Stratford, Ontario

COMPLETE INSTRUCTIONS

The Canada Plan Service, a Canadian federal/provincial organization, promotes the transfer of technology through factsheets, design aids and construction drawings that show how to plan and build modem farm structures and equipment for Canadian agriculture.
For more information, contact your local provincial agricultural engineer or extension advisor.

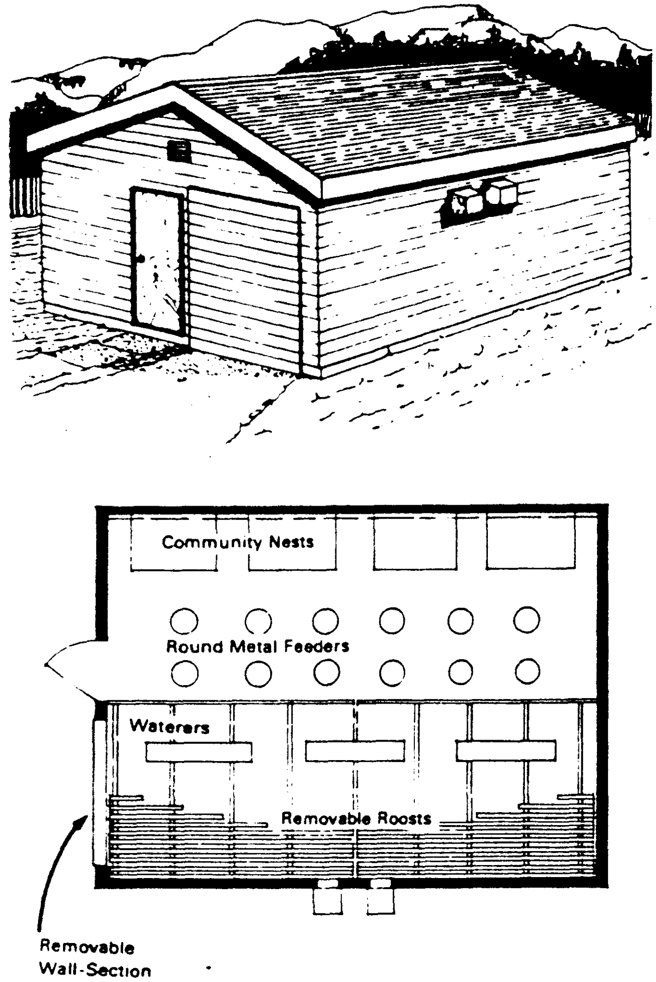


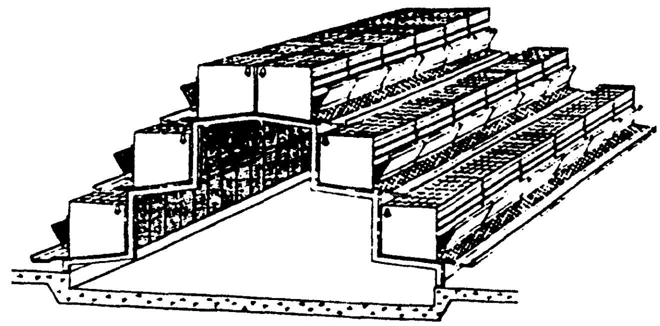
FIGURE 3 SMALL POULTRY BARN FOR FLOOR OPERATIONS (CPS PLAN Q-5255)

Cage laying barns are usually built wide enough to accommodate two to six rows of cages. This is dependent on the size of the flock, the style of the cage used, whether hand feeding and egg collection are used, and whether the barn is to be sectioned off into several rooms to accommodate continuous egg supply rather than an all-in all-out type of operation.

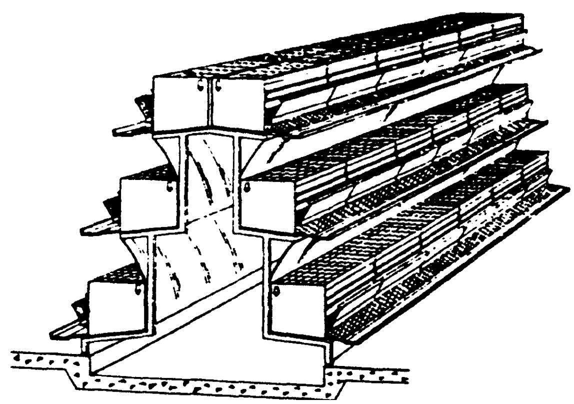
A major consideration before finalizing building width, length, and height is to decide on the style of cage row to be used. Figure 4 indicates some of the various cage styles. The height of the cages, width of the cages, number of cage rows required and number and width of alleys, need to be determined before a building can be selected. Stronger walls and trussed rafters are also required if ceiling suspended cages are to be used.

Table 1 outlines the floor, feed and water space requirements needed for laying flocks.

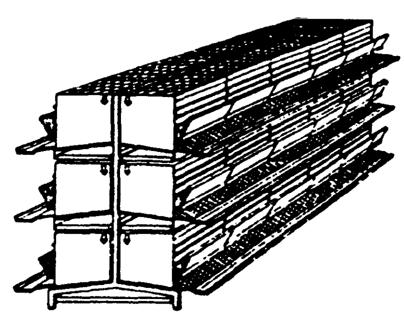
Adequate insulation and correct insulation placement are of primary concern in poultry buildings. Insulation is required for the foundation, walls and ceiling to minimize building heat loss. This insulation must be properly placed between studs and joists to eliminate cold spots and consequent wet spots on the inside of the building. Barns should be built to accommodate RSI 1.4 (R8) foundation insulation, RSI 3.5 (R20) wall insulation, and RSI 3.5 to 5.3 (R20 to R30) ceiling insulation.



STAIR STEP



OFFSET CAGES



STACKED CAGES

FIGURE 4 CAGE STYLES

Table 1 Floor, Feed and Water Requirements For Layering Flocks

FLOOR HOUSING

	Floor System		
	Deep Litter Floor Dropping Pits Under Roosts	Combination ½-2/3 Wire or Slat Floor ½-2/3 Deep Litter Floor	Complete Wire or Slat Floor
Floor Area per Hen:			
Egg-strain Breeds	0.186 m2 (2 ft2)	0.093 m2 (1 ft2)	0.046 m2 (.5 ft2)
Heavy Breeds (over 2.7 kg)	0.279 m2 (3 ft2)	0.140 m2 (1.5 ft2)	0.093 m2 (1 ft2)
Feeding Space per 100 Hens:	If hand fed 6000 mm of double-sided troughs or 4 round hanging feeders (pan diameter 400 mm). For automatic feeding reduce feeding space 50%		
Watering Spaces per 100 Hens:	2 watering cups, two 22 litre fountains of 1500 linear mm of drinking troughs.		
Nesting Space per 100 Hens:	20 nests, 250 x 300 x 300 mm or 300 x 200 mm for light and heavy breeds respectively or 2 community nests 600 mm x 1200 mm.		

CAGE HOUSING	Cage Space (per bird)	Feed Space (per bird)	Water Space (per bird)
1.75 kg Bird	0.044 m2 (68 in 2)	100 mm (4')	1 water cup per cage or 1 per 2 cages
2.0 kg Bird	0.046 m2 (72 in 2)	100 mm (4°)	depending on cage design

The types of insulation most commonly used in barn construction are the rigid polystyrene boards for the foundations, fibreglass batts for the walls, and either fibreglass batts or cellulose fibre blown-in insulation for the ceiling. Rodent damage to the building can be minimized if care is taken in sealing any wall openings, especially those at the foundation-wall connections and in the building corners.

The insulated structure must be carefully and totally lined with a polyethylene vapor barrier on the warm side of the wall. This will prevent moisture penetration into the insulation as well as excess air leakage. The interior can then be sheathed with either plywood or metal for a durable inside finish.

MANURE SYSTEMS

In floor operations, the litter area can be cleaned frequently, or more straw or shavings can be added until the litter depth is 300 mm (12 in.). As long as the litter remains dry, clean out of the barn is not required. The manure area under the slatted portion of a floor laying operation need only be cleaned out once or twice per flock.

Cage laying operations typically have two manure handling options. In single storey barns, there are concrete trenches 225 mm to 300 mm (9 to 12 in.) deep under the cage rows. Manure is scraped in these with either automatic gutter cleaners or by a small tractor scraper. (Tractor scraped gutters require a suspended cage system). The manure is moved to one end of the barn where it is either stored as a liquid in a large concrete manure tank or transferred to a lagoon. In some cases, it is handled as a semi-solid and immediately elevated outside to a manure spreader where it is spread on the land. The liquid system (concrete tank or lagoon) has to be agitated and handled through a liquid manure spreader tank. Water is usually added to the manure gutters 24 hours before clean-out to facilitate scraping. More water is added in a liquid manure system than in the manure spreader system. Owing to its sticky consistency, a large power unit is required to handle the manure if no water is added to it.

Another alternative for a dry manure system utilizes endless manure belts under the cages. The manure is conveyed to one end of the barn, dumped onto a cross conveyer, and elevated outside to the manure spreader or stockpile. Another system uses a scraper or an auger scraper. The manure is scraped off the manure boards down on to a narrow barn cleaner or into a deep pit under the cages.

In two storey or deep litter cage operations, the manure drops into the lower storey and is stored there for at least one laying flock. The ventilation fans are installed in the walls below cage level so that air flow goes down through the cages, across the top of the stored manure and out the fans. The air movement is usually adequate to create a dry manure product that can be cleaned out with a front end loader. Additional circulation can be provided by circulation fans hung below the cages. This type of manure storage requires good quality water low in salts if the droppings are to remain dry enough to stay in a manure pile. Leaking waterers also create wet manure conditions and must be corrected if the manure storage is to remain dry and at low odor levels.

HEATING SYSTEMS

Heat in the layer house comes from three different sources: from the birds themselves; from the heating system; and from lights, motors and solar heat. Layers produce a significant amount of their own heat in the form of sensible heat that is useful in helping to maintain barn temperature in cooler weather. The birds also release latent heat energy in the form of respired water vapor and moisture in the feces. Unfortunately, this is the energy that must be expelled by the ventilation system in order to keep the barn dry. As outside ambient air temperatures fall, both the ventilation heat loss and the building heat losses increase and eventually surpass the sensible heat production. This resultant heat deficit must then be made up with a supplemental heating system of some kind.

Many layer operators have been willing to accept colder barn temperatures, increased feed consumption and slightly lower egg production rather than install supplemental heating in their barns. They feel that the few extremely cold days which result in poorer barn conditions do not warrant the cost of installing a heating system. However, optimum laying conditions do require supplemental heat and if moisture levels and odor levels are to be minimized, a significant amount of supplemental heat should be added.

Forced air heating systems are probably the most practical systems in floor layer operations from a cost standpoint because of the smaller barn size and lower number of birds. These systems must be properly installed in a separate room to minimize dust and backdrafting problems.

One of the most common heating systems in a large cage laying barn is a hot water boiler and either 50 mm (2 in.) black iron pipe or finned pipe to serve as radiators. Water temperatures of 93 to 98°C (200 to 208°F) produce approximately 200 watts/m (200 BTU/ft) of black iron pipe and about 500 watts/m (500 BTU/ft) of finned pipe. The pipes are placed in front and below. the incoming fresh air inlets in negative

TABLE 2 - VENTILATION AND HEATING REQUIREMENTS FOR LAYING FLOCKS'

TYPE OF BIRD	VENTILATION RATE (US per bird)[3]			SUPPLEMENTAL HEAT (watts/bird)[4]			
	Winter	Spring/fall	Summer	-35°C	-30°C	-25°C	-20°C
Floor Housing							
Small Flock	.19	.5	3.3	12.6	10.9	9.4	7.8
Large Flock	.19	.6	3.5	4.2	3.4	2.6	1.9
Cage Housing							
Shallow Gutter2	.16	.6	3.5	1.6	1.0	.5	0
Manure Betts	.19	.6	3.5	2.8	2.1	1.5	.9
Deep Pits	.19	.6	3.5	3.2	2.5	1.8	1.2

1. Ventilation and heating requirements are calculated on the basis of maintaining barn temperatures and relative humidr6es of 16°C and 7096 RH. Barn construction is RSI 3.5 insulation in the walls and ceiling with RSI 1.4 perimeter foundation insulation. Based on dying the litter inside the barn to 35% moisture content if manure is stored for more then one week. Barn size, and number of birds per square meter effect these recommendations.
2. Manure is removed from the barn every week. Manure is dried to 50% moisture content.
3. For CFM (cubic feet per minute) multiply these rates by 2.
4. For BTU/hr/bird multiply these rates by 3.41.

pressure and naturally ventilated barns. Finned pipe radiators are usually used in conjunction with a positive pressure system mixing chamber.

Another heating system that could be used is the new style of unvented, gas (or propane) fired space heaters used in conjunction with a recirculation duct system or a positive pressure duct system.

Table 2 gives some typical heating requirements for typical laying barns.

VENTILATION SYSTEMS

Ventilation is required in the winter to remove stale air containing respired water vapor, carbon dioxide, dust, manure gases, and air-borne disease organisms. This stale air is then replaced with cold, fresh air while the heating system maintains the temperature to keep the barn within the comfort zone of the birds.

Ventilation is required in the summer to remove excess heat. Sensible bird heat, equipment heat and any solar heat gains must be removed using ambient air that can also be very high in temperature. Hence, much larger volumes of air are required for summer ventilation (usually 10 to 20 times as much as winter rates). The minimum and maximum ventilation rates are given in Table 2.

NEGATIVE PRESSURE Most layer barns use negative pressure systems. That is, exhaust fans expel air from the barn, creating an interior vacuum which draws fresh air into the building. The exhaust fans must have the capacity to handle large volumes of air required in the summer, and lower rates for other seasons. Air distribution and mixing within the barn is controlled by the air inlet or baffle system. A well constructed air inlet baffle that can be adjusted to maintain a desired velocity of 4 to 5 m/sec (800 to 1000 ft/min) is required. This is achieved by providing 1.0 to 1.25 m2 of inlet area for each 5000 L/sec of fan capacity (1.0 to 1.25 ft2 per 1000 cfm). This velocity is very critical, especially in colder temperatures, to ensure good air mixing and to prevent drafts.

In two-room barns, air inlets in the middle of the barn are fairly common. Management of this type of system can be critical in that different ventilation rates from one side to the other may result in one side actually starving the other side of air. A divider board or wall in the attic may be required to prevent this short circuiting of air.

In an attempt to keep the barn as air tight as possible, the air inlet baffle is usually installed on one side of the pen only, although good results are being obtained with intermittent air inlets on both walls, especially in wide barns. During the winter when ventilation rates are low, a circulation duct under the air inlet baffle would help to carry fresh air into the pen without drafts on the birds.

It also helps to ensure good air mixing within the barn. This style of air inlet is show in Figure 5.

Such a duct can be designed using information in C.P.S. leaflet 9750 'Ventilating and Heating Small Livestock Rooms'.

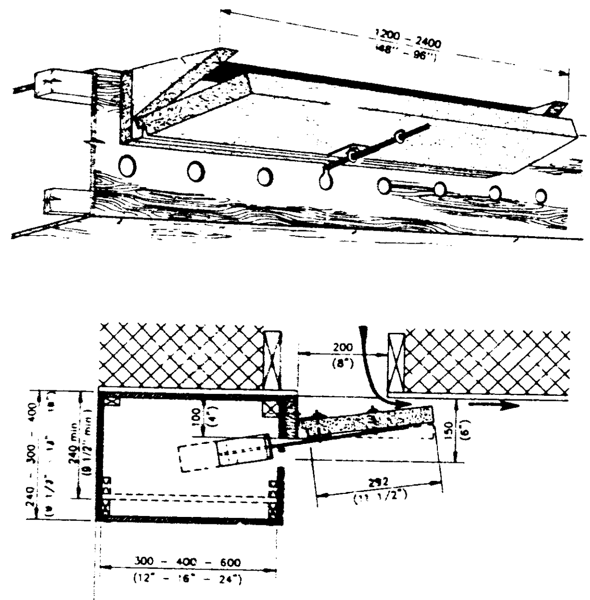


FIGURE 5 RECIRCULATION DUCT AND INTEGRATED SELF-ADJUSTING FRESH-AIR INLET

There are a number of commercially available ventilation inlet systems that do not use an air inlet baffle.

They fall in the following categories.

1. Telescoping door air baffle.
2. Air intake door directed to a fan powered air blending and distributing unit.
3. Powered air intake, recirculation and exhaust unit with modulating dampers to control the ventilation rate.
4. Positive pressure powered air intake and recirculation unit with modulating dampers to control the air intake rate. Exhaust through dampered ports.

Generally, for some winter conditions these systems offer the opportunity to make the barn more air tight by the use of more compact openings and tighter fitting doors. In addition, they offer several choices for easy retrofit. These systems must utilize good duct distribution systems in order to provide uniform air distribution.

POSITIVE PRESSURE A positive ventilation system is one in which fans force fresh air into the barn causing a slight pressure. This pressure forces the moisture laden exhaust air out through the exhaust ports. The main advantage of the positive pressure system is that it provides excellent air distribution throughout the building. Air distribution ducts, together with the air blending features provide continuous air circulation regardless of the air exchange rate. The air exchange rate is controlled by the proportion of "Fresh" versus "Recirculated" air, while total airflow is constant. One of the disadvantages of this type of ventilation system is that unless a well sealed vapor barrier is provided, moisture can be forced into the insulation, reducing its effectiveness. Some systems also incorporate wall exhaust fans for summer conditions because the pressurizing fans will not have the capacity to meet summer ventilation requirements. A disadvantage of the combined tube and exhaust fan system is the difficulty in controlling the ventilation rate. This occurs when one system is trying to push air into the building, and the other is trying to pull it out.

Figure 6 shows the principle of a positive pressure ventilation system. Sufficient fan capacity for summer ventilation must be provided. Thus, as many as four tubes may be required to achieve this.

NATURAL VENTILATION Naturally ventilated layer barns (CPS leaflet M-9760) are becoming popular in southern Ontario. This ventilation system uses automatically adjusted side wall panels (sliding, tipping or folding) and automatically adjusted center ridge openings (continuous slot or chimneys). Tight
wall panels are required to prevent drafts on the birds. As with other types of ventilation systems, ceiling fans or recirculation ducts are required to minimize air stratification in the winter. In colder climates, wall panels may freeze at the edges, making adjustment difficult or impossible.

FEEDING AND WATERING SYSTEMS

In floor laying operations, the least expensive method of feeding is hand feeding using small
self-feeders. Water is usually supplied in automatic, troughs or fountains, or in hand filled fountains.

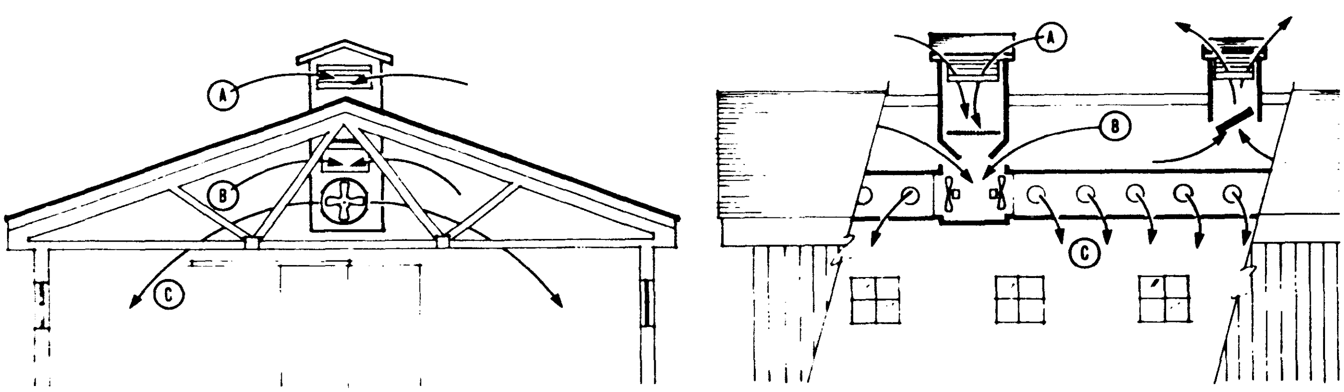
In cage operations, feeding is either by means of automatic chain feed troughs or by hand filled troughs the length of the cage row. The water system is either a continuous flowing trough or the more commonly used water cups which are under low pressure. All watering systems require a filter to prevent plugging of the float valves within the system. A pressure reducer is also required to operate most cage watering systems.

LIGHTING

For floor operations, rows spaced 4 m (13 ft.) on center of 40 watt incandescent lamps, with the lamps in each row staggered and spaced 6 m (20 ft.) apart, are suggested. These should be on a dimmer and time clock for cage operations. Twenty-five watt lamps, 4 m (13 ft.) on centre down the walk aisles are suggested for flat deck or double tier cage systems and every 3 m (10 ft.) between triple or four tier cages. These should also be controlled by a dimmer and time clock. A convenience outlet should be provided every 30 m (100 ft.) around the perimeter in the floor laying operation and down each alley in a cage laying barn.

Many egg producers are interested in total light control to ensure maximum egg production. This requires tight building construction and light traps over the exhaust fans and air inlets.

The following are some general lighting programs for laying flocks. In these programs, a light intensity of 5 lux (0.5 foot candle) is equivalent to about 15 watts per



A - fresh air in **B - recircdated air** **C - stale air out**

FIGURE 6 A POSITIVE PRESSURE VENTILATION SYSTEM

18 sq m. These intensities can be achieved by the spacings noted previously. The following lighting conditions are required for houses with light control and without light control.

HOUSES WITH LIGHT CONTROL
- increase lighting at regular intervals by 15 to 20 minutes until 17 hours is reached
- at 28 to 33 weeks use about 11 lux or 1 foot candle

HOUSES WITHOUT LIGHT CONTROL
- at 20 weeks, increase the light to at least one hour over dawn and dusk light
- from 20 to 26 weeks the light should be increased to bring the day length up to the greatest total day length the flock will experience during the laying period. The flock should be continued at that day length throughout the laying cycle.

CAGES

Laying cages are available in many different styles with different feeding, watering, egg collection and manure systems. Some are shown in Figure 4. Cages must be designed for strength and durability. They can either be suspended from the ceiling or floor mounted. They must be designed so the eggs will not get caught at the back edge of the cage or in the wire mesh. Adequate feed and water space must also be considered.

EGG HANDLING

Good cage design is the first step to obtaining quality eggs. The egg conveyor belt must also carry the eggs smoothly and in single file. The egg elevator from higher tiers of cages must be well designed and adequately maintained to lower the eggs without increasing the speed. If cross conveyors are used, they must also be designed so the eggs do not bump into each other. Egg collection (either manual or mechanical) from the end of the egg conveyors, must be done with care to avoid cracking.

It is important to know that egg quality beings to decline as soon as the egg is laid. Good handling practices will slow this deterioration or at best, minimize it. Proper temperature and humidity are most important, therefore:

- Have a separate, adequately-equipped egg room close to the laying flock.
- Gather the eggs often - at least twice a day.
- Gather the eggs in baskets or containers that will allow rapid cooling.
- Cool to less than 13°C and above 7°C immediately after gathering.
- Maintain air humidity as close to 70% as possible (this slows down moisture loss for the egg).
- After chilling, pack the eggs with the small end down into fillers or flats placed in shipping cartons.
- Market the eggs as often as possible.
- Keep the egg room and transport vehicle free of off-odors.
- Do not handle eggs or their shipping containers in a rough manner. Eggs are fragile and you can break shells or internal membranes, resulting in downgrading of an otherwise top quality egg.

A typical sizing for an egg cooler room is shown in Table 3.

TABLE 3 SIZES FOR EGG COOLING ROOMS

1.67 Cases/100Hens/Week

Flock Size	3000-3600	3600-4200	4200-6000	6000-9600
Inside Size (Min.)	6 m2	8.4 m2	10 m2	13 m2
Cases (30 Doz.)	60	70	100	160
Refrigeration (kw)	1.4	1.5	2.1	3.0