

Planning and Designing Suburban-Urban Poultry Housing in Kentucky

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Interest in suburban-urban poultry keeping continues to increase. The main reasons for keeping poultry are for eggs and meat, and to address food sustainability or security issues. Poultry are also enjoyed as pets, for ornamental purposes, and providing enjoyment. Poultry can contribute to pest control and provide nutrient-rich manure for gardening. However, there are also challenges to keeping poultry in a suburban-urban setting.

If it is allowed, backyard poultry-keeping in a city or on its fringes has many challenges. At the top of the list are:

- Noise and odor nuisance ordinances and issues
- Manure management and sanitation
- Predator control
- Injury and disease minimization
- Soil and vegetation management

Poultry need a well-built, well-located house to remain healthy and productive. A house does not have to be expensive, but it does not pay to buy or build a poorly designed house. An understanding of functional planning and design from an architectural and engineering perspective provides the knowledge needed to address the challenges of suburban-urban poultry housing. This publication discusses design parameters for the environmental needs of poultry and improved labor efficiency.

The need to create a complete backyard plan cannot be overemphasized. The plan should include everything in the yard, including future project areas and room for expansion. Safety, security, and fire prevention should be considered. Ideally, backyard poultry housing should be movable. Portability allows the caretaker to adjust the structure or move it if the property is sold. If odors become a problem, the dwelling could be moved downwind from the offended building. If better natural ventilation is needed, the building could be rotated to

take full advantage of prevailing winds. However, in many cases, the option to move or rotate a house is not possible and therefore must be chosen carefully. After carefully evaluating alternatives, the best design and placement compromises can be logically chosen.

Housing Requirements

General housing requirements for birds are protection from precipitation, access to indirect sunlight, warmth in winter, shade and cool breezes in summer, cleanliness—clean and able to be cleaned efficiently—and a durable floor. Housing must also consider the caretaker and the ease of accomplishing tasks. Therefore, the functional planning requirements for suburban-urban poultry flocks are choosing the proper location for the coop and/or run; providing an environment suitable for the health and productivity of poultry; maximizing the efficiency of the caretaker; and providing sanitary conditions.

Location and Siting

Poultry health and production are affected by temperature, humidity, air movement, ventilation rates, and lighting. Protection from the elements must be provided to control moisture, temperature, and wind. A structure for housing poultry that has optimum environmental conditions is clean, well ventilated, dry, and comfortable. However, the ability to provide optimum environmental conditions depends on the selection of a suitable building site. It cannot be stressed enough that the location of poultry housing is extremely important, as it affects the functional efficiency of the structure.

The orientation of the house and the relative location of windows, doors, and openings affect weather protection. However, even though the orientation may be correct, considering sun, wind, and

precipitation patterns, the site-specific location may block or be shadowed by structures, trees, and or topography.

There are four major compass points for orienting a house. The orientation will affect the amount of sunlight and precipitation, which may enter a house. Allowing free sunlight to enter the coop has several beneficial effects that include facilitating egg production. More importantly, sunlight provides drying and disinfecting of bedding and surfaces, and provides warmth in winter. A north-facing housing will provide indirect light and protection from the sun. However, intense storms originate from this direction. Storms originating from the northeast (Nor'easter) are rare but can be severe. Facing the housing to the west exposes the birds to higher afternoon temperatures with intense sunlight. There are many prevailing wind patterns for Kentucky that originate from the south and southwest. To provide the best air movement and light, chose a site with southern or southeastern exposure. Southeastern exposure is preferred because fewer weather patterns originate from this quadrant and because air temperatures are typically lower in the mornings. Installing a cantilevered roof can provide the birds with shade and cool breezes in the summer and warmth in winter.

The housing location should be on high ground utilizing natural water drainage and creating roof lines to move drainage away from the foundation. Any building site that receives upland drainage that passes through or near entrances can damage the structure, stress the birds, and reduce labor efficiency. In some cases, it may be necessary to install a type of foundation drain.

It is necessary to have good air flow through the housing unit. Air movement and sunlight can be obstructed by topographical features. Obstacles such as fences, shrubs, trees, houses, and other structures can and will interfere with air movement and light penetration. A house should not be placed in an air pocket where frost occurs early and fog collects often. Choose a location that will not

compromise air movement and sunlight and consider the benefits to blocking sunlight from the west and weather patterns from the north and northeast.

Siting will also affect the efficiency of caring for the chickens as they must be checked every day. The location of a chicken coop should provide convenient access for the owner in order to accomplish tasks such as feeding, watering, gathering eggs, and monitoring the condition of the birds. The location is also important from an accessibility standpoint, as distance affects convenience and the amount of time needed to check and care for the birds. The path to and from the housing should have well-drained soils and be passable throughout the year. **Last, avoid placing the house near the property boundary to avoid potential conflicts with neighbors.**

Four Basic Environmental Factors

There are four basic environmental factors that affect the health and productivity of poultry:

- The surfaces on which they stand.
- The air they breathe.
- The space provided to move, eat, and drink.
- The means by which they are confined.

The Surfaces on Which Poultry Stand Foundation and Flooring

The floor design of permanent poultry housing is probably the most neglected technical aspects of housing. As with any building, the foundation should be elevated a minimum of six inches above the existing grade (Figure 1). This is true for the coop but also for an attached run or scratching shed, if it is provided. A flooring system is required to provide separation of the birds from their manure, proper drainage, predator control, and rodent infestation. In general, a flooring system will either be pervious or impervious.

A slatted flooring system can be provided in the form of slats, wire, or by providing a well-drained surface such as gravel or sand (medium size). Figure 2 is an example of an elevated pervious floor, which separates the birds from their manure. This type of flooring system has the added benefit of being an excellent manure management system. It separates the birds from their manure, it allows drying of the manure, and by being under an elevated house, allows the manure to be removed without entering the house. All that is left is the beneficial reuse of the ma-

nure and bedding. Having a slatted floor system allows poultry manure, which is approximately 70-80 percent moisture, the opportunity to dry and not create wet or anaerobic conditions, which create odors and harbor pathogens. Wet manure is also conducive to the reproduction of flies and other insects, which are known to carry poultry diseases.

Impervious surfaces are also used as a flooring system. Concrete is the typical material used in agriculture to create an impervious surface. Wood flooring has been used as a flooring system. However, wood materials rot easily. Any impervious surface used to house poultry must be sealed to protect it and make it waterproof.

When an impervious surface is used for housing, it must be bedded to provide thermal and physical comfort for the birds and improve manure handling and sanitation. A successful bedding system that has been used in poultry housing for generations is the deep litter system. The concept of deep bedding is to begin with 2-4 inches of a dry bedding material and then add bedding, as needed, to create a deeper bed of litter. Ultimately, the area will build up to approximately 6-8 inches of bedding or deeper. The maintenance for this type of system is the periodic

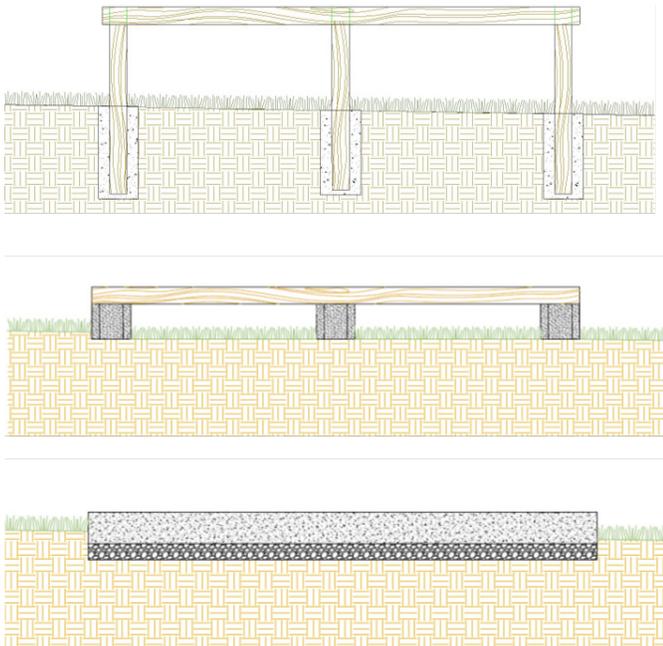


Figure 1. Types of foundations used for poultry housing. A post and block foundation is used to elevate the house versus a slab, which is elevated above the surround grade.



Figure 2. A pervious chicken floor made from a plastic material, which is nonporous and should not harbor bacteria or rot.

stirring of the litter, the addition of fresh bedding, and periodic cleanout. Complete cleanout is a management practice used to control diseases, especially after depopulation.

Chicken Runs or Scratching Sheds

A portion of suburban-urban poultry housing may include an attached chicken run. As a rule, floors for poultry run should be warm and dry, constructed from material which is smooth, durable, and easy to clean. A surface that is typically used in a chicken run is an unimproved earthen surface. This is not a recommended practice due to Kentucky's climate and the low bearing capacity of soil. Kentucky receives approximately 50 inches of precipitation per year. This volume of rain combined with low temperatures and very slow evaporation in winter creates muddy conditions. Chicken runs should be covered as a best management practice to keep them dry but also provide the added benefit of additional protection from predators and wild birds, which may be carrying diseases. Even if a chicken run has a roof, they are typically narrow with a width dimension of less than 8 feet, making it easy for precipitation to enter. Sidewall curtains can be provided, as needed, to prevent precipitation from blowing into the structure.

Flooring should provide dry and comfortable conditions, separate birds from the manure, and help with sanitation. Some Kentucky soils have a high clay content and may initially be well drained. However, after continued foot traffic, the vegetation becomes denuded, the soil becomes compacted, and moisture will not infiltrate freely. The result is a surface that will provide unacceptable living conditions for birds. Placing a run or scratching shed on an unimproved lawn results in those areas having long-term issues with managing mud, soil, vegetation, and sanitation. There can also be issues with wood rot and decay when wooden building materials are in contact with wet

soil and manure. An earthen floor is an unsuitable flooring material for controlling moisture, sanitation, and any number of parasitic poultry diseases. Many disinfectants are ineffective on earthen floors due to the amount of soil present which neutralizes them. In addition, an earthen floor has very little bearing capacity and its strength weakens when it is wet. This may result in the birds doing a significant amount of damage through scratching, dusting, and foot traffic. If earthen floors are used, the soil should be removed after a year or two and replaced.

Concrete is the only material that best meets all requirements for permanent runs. The agricultural industry has not come up with a cheaper, more durable, and easily cleaned surface than concrete. Including concrete in the design of a run, or coop, eliminates the need to bury fence along the perimeter of the run to exclude predators. The permanence of the pad, for foot traffic only, can be improved with a thickness of two inches of concrete over several inches of gravel. An insulation/vapor barrier layer under the concrete can provide thermal benefits, while the surface can be sloped to provide drainage. Bedding should be applied and removed as needed to provide comfort and sanitation.

Other surfaces may be suitable for a run. Heavy traffic pads constructed from geotextile fabric and gravel are a type of surface that can provide drainage, control mud, provide reinforcement, and separate gravel from soil. They are less expensive to install than concrete but have a shorter lifespan. Incorporating a plastic "traffic" grid in the design and into the matrix can extend the lifespan of the surface and make cleaning easier. Last, a **soil cement** pad is another option that can be used to successfully manage a chicken run. Soil cement is a mixture of soil and Type I Portland cement that is used to stabilize surfaces while increasing the bearing capacity of the soil. The process also makes the soil waterproof.

The Air a Bird Breathes

The air that a bird breathes is affected by temperature, humidity, wind, type and concentration of contaminants, air pressure, and light.

Ventilation

The need for adequate ventilation cannot be over emphasized. Birds release heat, water vapor, and gases when they breathe. In addition, their manure creates gases and high concentrations of moisture. An exchange of air is needed to remove moisture, carbon dioxide, ammonia, methane, as well other gases and contaminants, while providing the birds with fresh air. It is important to have the proper amount of air changes without having too little or too much. The optimum thermoneutral temperature zone for chickens is between 68-95°F. However, for maximum feed efficiency the ideal is a temperature between 70-75°F. The goal is to stay within an operating range where heat is removed in summer but retained in winter. Permanent ventilation is not recommended. An adjustable ventilation system is recommended to provide the required ventilation in winter without drafts and high ventilation rates in summer. In order to make sure there is an adequate amount of ventilation, a minimum size of the inlet should be 6 square inches of inlet area per 25 square feet of floor area. However, ventilation is so important in the summertime, that dual doors should be installed on the house. An ideal design feature is the implementation of removable windows or ones that can slide out of the way to increase ventilation rates during the hottest summer days and provide maximum ventilation (Figure 3). These features could be included into removable door panels with or without windows.



Figure 3. A dual door for the house consists of a screen and a removable glass door.

Wire Mesh

Wire mesh is typically used as a siding and flooring material. One characteristic of this material is that it ventilates holding areas, which can be an asset or a liability. There are multiple types, thicknesses, strengths, sizes, and patterns of wire siding and flooring material. Bird comfort and predation are the two most important requirements to satisfy. Contrary to its name, the recommended type of wire used on poultry housing, to exclude predators, is not “chicken wire” or chicken netting. These materials have the ability to contain the birds. However, the wire gauge and the construction, consisting of a twisted wire, does not provide the mechanical strength needed to deter predators. It may hold up briefly, but a caretaker should never underestimate the persistence of a predator. One of the most likely predators an urban chicken is likely to encounter is the family dog, which can easily penetrate “chicken wire.” In addition, the openings are large enough, for some predators, to reach through the openings. The recommended wire type is a hardware cloth, welded wire mesh or fence, which provides the needed strength, with a sufficient spacing (e.g. ½ inch) to deter predators.

Roof Lines

The size and shape of the house will largely determine the kind of roofline that will be used. There are six roof lines used for poultry houses (Figure 4). Of these, four are commonly used. The type of roof chosen is largely a matter of personal preference. However, the type of roof will influence the cost of construction to quite an extent. Ventilation is also greatly controlled by roof lines. In addition, the orientation of the roof line relative to compass points and prevailing wind can greatly affect temperature and ventilation of the house. Roof lines and the relative location of access points can also affect caretaker efficiency when conducting routine tasks. In particular, the caretaker should have adequate head room to care for the birds.

A. Shed. The shed roof is the most common roof chosen (Figure 4). It is easier to fabricate for an inexperienced carpenter. When a single rafter can span the width of the building fewer rafters need to be

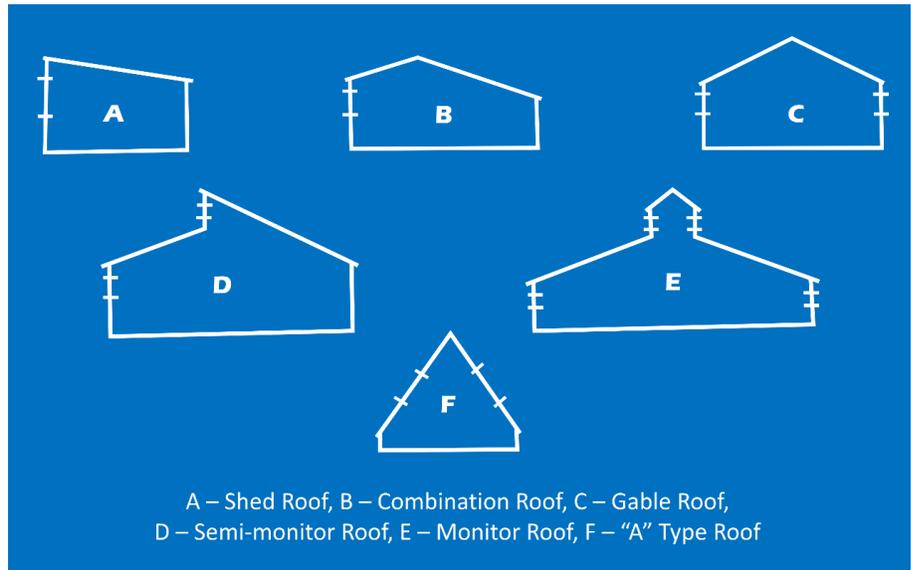


Figure 4. The different types of roofs used on poultry houses. (Donnie Stamper)

cut. It can provide rapid ventilation when provided with openings, in the front and back, and allows more sunlight to enter. A shed roof also has the advantage of diverting all the water in one direction - north of the structure—leaving the south or front, dry and warm. However, the aesthetics of the side profile of a shed roof does not provide a good appearance.

B. Combination. The combination roof is a modification of the shed roof and offers a more appealing side elevation view (Figure 4). However, it requires twice as many rafter cuts as the shed roof.

C. Gable. A gable roof typically matches the other roof lines on the property (Figure 4). Gable roofs can provide more air space and head space for the caretaker, if the peak is at the front of the house. They are easy to ventilate with a gable or ridge vent (Figure 5). However, the openings needed to ventilate in summer would need to be restricted in winter. Otherwise, the house will be too cold in winter. An adjustable vent opening system is a good feature to install.



Figure 5. A continuous ridge vent, which ventilates both sides of the house.

D. Semi or Half Monitor. The semi monitor roofline is a design that has been applied to poultry houses (Figure 4). It is a popular design in trade magazines. However, it is expensive to build and hard to ventilate. The design is more contemporary and may not blend well with surrounding buildings.

E. Monitor. The monitor roof provides a large volume of air, which can be an advantage in summer of ventilating the house (Figure 4). However, it can be too cold in winter. Variations on this design can include a cupola or ridge vent. The standard for ridge vents is to provide a 3-inch ridge opening for every 10 feet of width. A ridge vent would provide even more ventilation advantages, if the cupola/ridge vent included a damper (figures 6 and 7). Figure 6 shows a damper, which is open to provide ventilation on warmer days. The same damper can be slid closed but has openings to provide the minimum calculated amount of circulation needed for the birds.

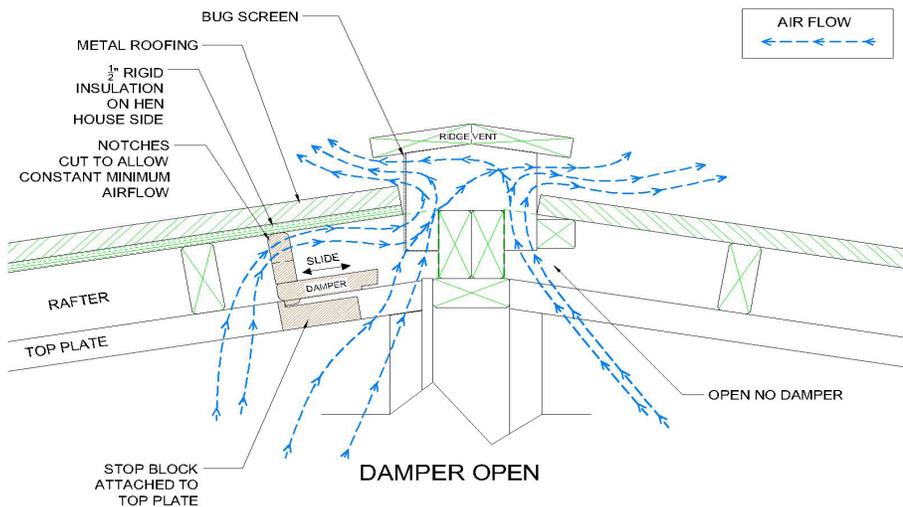


Figure 6. Illustration of damper fully open. The opposite side is fully open year-round.

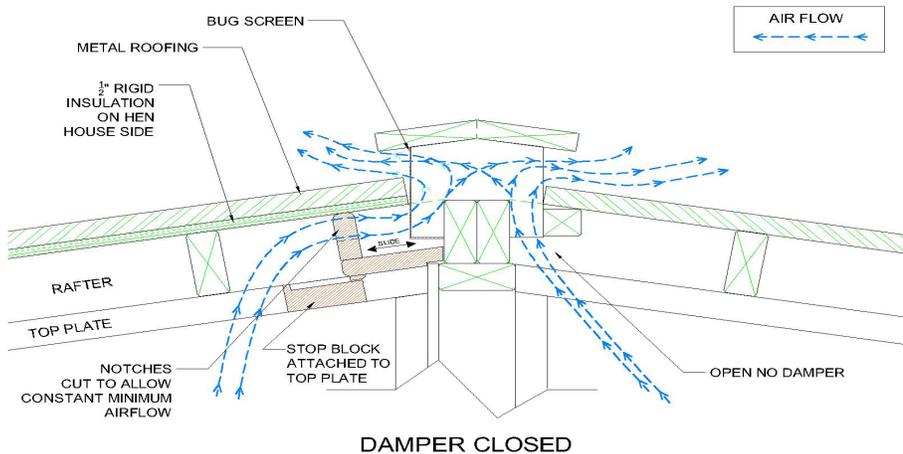


Figure 7. Illustration of the damper closed that provides minimum winter air circulation.

F. A Frame. A-frame roofs are a time-honored favorite because they efficiently use materials (Figure 4). However, the disadvantages are a lack of headroom and difficult to clean. This type of roof is commonly used mostly on very small houses. An advantage is this roof design is very light. Structures of this type are typically designed to be portable. A perfect example is a “chicken tractor,” which is more of a “tool” rather than the type of housing being discussed in this publication.

Insulation

Housing for poultry needs to be constructed to eliminate drafts. The structure must also possess insulative properties to provide thermal comfort for the birds in summer and winter. How much insulation is required depends on

the location of the house in relation to latitude and microclimate. In addition, insulation will also be dependent upon the type of flooring system used, the type of bedding used, and the management of the flooring system.

Engineers and scientists have mapped weather patterns to determine the insulation needed for all types of buildings. Kentucky lies on the border of two climate zones. A wall sheathing of 3/4-inch would provide the amount needed. A small amount of roof insulation is needed as the roof area represents the greatest amount of heat load on the structure. Roof insulation can also be obtained and is readily available through local building supply vendors. Ideally, the roof should be white to reduce summer heat loads on the birds. A shingled roof with sheathing should provide adequate insulation.

Humidity

When caretakers think of bird comfort, they may think of temperature first. However, the relative humidity has an enormous impact on bird comfort. Caretakers should consider the Temperature-Humidity Index (THI) or heat index as a guide for determining bird comfort. In general, the relative humidity should be maintained between 50 to 70 percent RH. Operating in this range will maintain a deep litter system at a moisture concentration of 20 to 30 percent. Any drier than this will lead to high concentrations of dust. Conversely, higher relative humidity can lead to high ammonia concentration, coccidiosis, and other diseases.

Supplemental Heating and Lighting

Most poultry are well adapted to cold weather. If the house is constructed properly, there should be no need for supplemental heat for the birds. However, this depends on the size of the house, the breed and size of the birds, their nutrition, the design of the coop, how the flooring/bedding system is managed, and the amount of draft entering the house.

Keeping the birds' water from freezing can be a challenge. Some caretakers may opt for a heated waterer. Others may choose to bring the water inside at night and return it to the coop the following morning. However, this can create drudgery. The important points to know are providing electricity to heat the house or keep the bird's water from freezing has the potential to create a fire. Although a housing design can easily include a heating device suitable for outdoor/poultry uses. Manufactured heated roosts and panels can be purchased to provide warmth for the birds. Just be aware that heat lamps, faulty extension cords, and overloaded systems are a few of the devices that have caused house fires. Nevertheless, when electricity is used for heating or lighting purposes it should be installed to code and with the highest safety and care.

Adding electrical components to a housing system increases the upfront and maintenance cost. Conversely, sunlight is free and abundant and should be used to disinfect, warm the facility in winter, and stimulate hens to lay. Windows and transparent roof panels are features for providing free sunlight. The advantage

Table 1. Minimum Space Requirements.

Type of Bird	Floor		Feeder (inches/bird)	Perch (inches/bird)	Water* (inches/bird)	Chicken Run (sqft/bird)
	Wire Mesh (sqft/bird)	Deep Litter (sqft/bird)				
Bantam	1	2	4	6-8	1	4
Layer	1.5	3	6	8-10	1	8
Large Breed	2	4	8	10-12	1	10
1-4 Weeks Old	0.5		1		0.5	
4-10 Weeks Old	1		2-3		0.5	
10-20 Weeks Old	1.5		3-4		0.5	

of windows is that they allow sunlight to enter and can protect birds from stormy weather and cold winds. Scientific studies conducted on the lighting of poultry buildings recommends the optimum window area be calculated based on climatic zone and using a ratio of floor area. The climatic zone for Kentucky suggests the optimum window area would be approximately 18 percent of the floor area. Recommendations also specify that 75 percent of the window area should be on the southern side wall of the building.

The amount of sunlight entering a structure depends on the orientation of the structure and the amount of shading from the roofline or shadows from nearby structures or trees. Modifying the insulative value of windows can be accomplished using a piece of shade cloth in the summer and a curtain in winter or cold nights. Double pane windows could also be included in the design to improve the insulative value. Windows and other types of building material can be obtained at a discount at Habitat Restore or similar outlets.

The Space to Move, Eat, and Drink

Adequate space is needed to prevent overcrowding, stress, and poor environmental conditions. The amount of space provided for the birds also affects the level of management needed to care for the birds. There are numerous stresses, diseases, and problems associated with lack of space. Space requirements can be broken down into floor, feeder, drinker, perch or roosting space, and nesting box requirements.

Space requirements vary between published poultry literature by more than twofold. The values and their respective ranges are listed in Table 1. These data represent the minimum space requirements and are dependent upon management and the type of flooring system. As a rule, providing more space improves the health and welfare of birds, while reducing overcrowding issues and management. Space requirements are also affected by management. For example, flooring systems that are not managed well or regularly cleaned will require additional space for the birds.

The goal of a floor space requirement is to manage the moisture produced by the birds and their manure. The data in Table 1 should be used as a guide for caretakers and do-it-yourself (DIY) builders. Floor space requirements are believed to originate from a recommendation of 400 square feet of floor space for 100 birds, weighing 4 lbs. each. This ratio provides the equivalent of 4 square feet per bird. Adjustments need to be made based on their actual weight/size of the birds housed, the type of flooring type/manure management system, amount of ventilation, etc. A remaining adjustment should include the number of birds housed, where there should be a minimum space requirement for one housed bird. Anyone considering the purchase of a manufactured house should evaluate how the measured floor space relates to the stated capacity of the house (i.e., number of birds). Many mass-produced manufactured houses greatly overestimate the number of birds the house can hold in relation to the number advertised.

Poultry Housing Sanitation

The structure should be sanitary, meaning it should be clean and able to be cleaned easily. This point cannot be overemphasized. Some of the important points to consider in the planning of housing from a sanitary standpoint are:

- The building must be on a well-drained soil.
- The building should be well-ventilated.
- The building should be well lighted.

Many of these points have already been covered to create an optimum environment for the bird. However, from the caretaker's perspective and labor efficiency, sanitation also includes the ability to clean the structure regularly and easily. Maintenance of the structure should include painting or water sealing the structure. Smooth walls facilitate cleaning and extends the lifespan of the structure. Sanitation also includes the proper disposal or beneficial reuse of poultry manure and bedding. The housing and yard, if provided, should be a part of a manure handling system, which should include the ability to easily remove manure and bedding. Sanitation also includes the ability to easily disinfect and treat the structure. Beneficial reuse of removed bedding and manure is a recommended practice. This is best conducted by composting to create a stable material before it is applied to gardens, flower beds, or lawns. A comprehensive system for managing poultry manure is a proactive way to avoid odor issues and complaints.

Summary

Suburban and urban poultry caretakers enjoy watching their chickens express their natural behaviors while free ranging in the backyard. However, housing must provide optimum conditions for the birds to thrive. Planning for housing is needed to purposefully evaluate the housing environment that the birds will live in. In addition, planning for the geographic location is essential to provide a fully functional housing system. General housing requirements for birds are proper moisture management—dryness, direct sunlight, warmth in winter, coolness in summer, cleanliness, and durable floors. Housing must also be functional, which is accomplished through effective planning to meet the requirements for suburban-urban poultry flocks. Planning starts with developing a layout of the backyard, including all infrastructure and future projects. Proper siting is needed to achieve the basic environmental requirements that affect the health and productivity of poultry. The caretaker's efficiency and ability to provide sanitary conditions should also be considered to create a functional design.

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