BY DESIGN

How do environmental needs change through segments?

by Erin Cortus, University of Minnesota

As feeder calves turn into finishers, their environmental needs change. A few key relationships can help with building and environmental management decisions during the transition, or when raising different groups of different sizes in a common area. These relationships assume a feeder calf is 400 pounds (lb.) and a finisher is 1,200 lb. — a three-times increase in mass.

Space requirements do not grow as fast as cow mass. Space requirements also depend on the conditions afforded by the lot or pen surface (see Table 1). Physically speaking, the space needs to accommodate increasing length and width, but not height (fences are an exception!). While the animal mass may increase by three times, the space requirements approximately double.

When it comes to the thermal environment, cattle can handle a large range of temperature conditions and seasons. The upper and lower critical temperatures where performance drops off are hard to pinpoint exactly because they depend on many factors, like previous exposure, wind and humidity. The lower and upper critical temperature will both be lower for more mature cattle — meaning calves take priority for cold protection, and mature cattle take priority at high temperatures.

Table 1: Housing space requirements and comparison

Requirements	Calves 400-800 lb. (sq. ft./animal)	Finishers 800-1,200 lb. (sq. ft./animal)	Ratio of space needed for a 1,200-lb. to 400-lb. animal
Barn space without yard	20-30	30-40	2
Barn space with yard	15-20	20-30	2
Outside paved yard	40-50	50-60	1.5
Outside earth yard	200-250	250-500	2.5
Paved yard without barn	50-60	60-80	1.6
Earth yard without barn	300-600	400-800	2.6

SOURCE: This table is adapted from OMAFR, *http://www.omafra.gov.on.ca/english/livestock/beef/facts/info_housreq.htm.*

For cattle housing, ventilation requirements reflect heat production. For mild temperature conditions, a 400-lb. calf is comparable to a 1,400 British thermal unit (Btu)-per-hour heater, and a 1,200-lb. finisher is comparable to a 2,900 Btu-per-hour model. Calves require 20 cubic feet per minute (cfm) per animal in cold weather and 100 cfm per animal in hot weather.

For a three-time increase in size, heat production approximately doubles, and so should the airflow through the barn to remove heat and moisture for finishers.

Manure management is also part of environmental management. The fundamental model for manure excretion relates the dry-matter output from the cow to the amount of dry matter not digested, and assumes this dry matter is 8% of the overall feces and urine production. If we assume the dry-matter intake with respect to body weight and feed digestibility remains constant at 400 lb. vs. 1,200 lb., manure output will increase from approximately 20 lb. per head per day to 60 lb. per head per day. A three-times increase in size is closely mirrored by manure production.

These examples rely on approximations and assumptions. However, some general rules of thumb are that as cattle mass increases three times, we need to double space and ventilation, and triple manure storage capacity.

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Editor's note: "By Design" is a regular column of the *Angus Beef Bulletin* featuring facility and homestead design for cattlemen. Erin Cortus is an assistant professor and Extension specialist in the Bioproducts and Biosystems Engineering department of the University of Minnesota.