Feasibility Study for Concrete Swine Buildings and Manure Storage Facilities in Western Canada

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Summary

A feasibility study has been completed to evaluate the potential of concrete swine buildings and manure storage facilities in the Prairie region. Three building concepts combined with four manure storage options have been studied. A building with concrete walls and wood truss roof would increase concrete usage by 25% compared to a conventional wood frame building. The

A pig barn with concrete walls and manure tanks promises the best longevity and reduced costs.

various combinations of building and manure storage concepts were evaluated for their effect on annualized building costs.

The result of this evaluation either decreased annualized building cost by 16% or increased it by up to 34%. A swine facility design with concrete walls and concrete manure tanks is the most promising option for enhancing the life cycle and reducing the annualized cost of production facilities. Supplemental information should be gathered about the design and cost of swine buildings with concrete walls considering construction techniques and local availability and pricing of concrete in the Prairies.

Introduction

Swine production is expanding in many areas of Canada, especially in the Prairies. Independent and corporate producers are interested in investing and developing this industry so their needs in terms of production systems and facilities can vary. Most of the building construction that occurs in the Prairies presently is done with traditional wood framing structures and earthen manure storage (EMS) facilities. Other types of livestock facility design with concrete wall panels have been constructed, mainly in Ontario (Figure 1), over the last 20 years. Concrete walls have been chosen as a way to increase building life cycle and also to improve rodent control.

Similar alternatives for buildings and manure storage facilities have not been extensively explored yet for the Prairie conditions. Limited information has been gathered. As a result, there is a knowledge gap that prevents swine producers from considering different building and manure storage alternatives within their decision-making process.

Meanwhile, the Cement Association of Canada (CAC) is interested in expanding the market of its member companies and wanted to explore the potential of new building and manure storage facility designs for the swine industry. In 2001, CAC mandated PSC to complete a preliminary feasibility study on alternative buildings and manure storage facilities for Prairie swine operations.

Depending on the combinations of materials used, building costs decrease by 16% or increase by 34%

Study Procedures

Three building concepts and four manure storage options have been evaluated. The reference building and manure storage concepts (building concept 1 and manure storage concept A) were based on the Prairie Swine Centre Elstow Research Farm, a 600-sow farrow-to-finish operation of standard wood construct with an EMS. The three building concepts included:

1. a conventional design incorporating wood frame walls and wood truss roof;
2. a building with concrete walls and wood truss roof; and
3. a building with concrete walls and an insulated concrete slab for roofing.

The studied manure storage concepts were:
A) a regular EMS;

B) an EMS with a synthetic liner;

C) a concrete manure tank; and

D) a deep pit concrete storage underneath the barn.

Results and Discussion

Building concepts 2 and 3 would respectively increase concrete usage by 25 and 107% compared to a conventional wood frame

Figure 1: *Fan arrangement and manure pit design along the sidewall of the concrete barn built by FRED GROENESTEGE CONSTRUCTION LIMITED (Sebringville, ON).*

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building (Table 1). The concrete volume required by manure storage concepts C and D would exceed that required by concept A by 60 and 183%. If building concept 3 is combined with manure storage concept D, the total concrete usage would be practically three times that used with a typical farm construction (concepts 1 and A).

More information needs to be gathered on design safety, construction techniques and local availability of concrete.

The various combinations of building and manure storage concepts either decreased the annualized building cost by 16% or increased it by up to 34%. Considering the concrete usage, the cost analysis and the pros and cons of each combination, building concept 2 combined with manure storage concept C is considered to be the most feasible options that would provide Prairie swine producers with more durable facilities at a lower cost.

A deep pit barn design (concept D) could offer some benefits and would greatly increase the concrete demand. However, considering potential safety risks associated with possible H_2S accumulation in the barn and corrosion problems, as reported in other jurisdictions. More research needs to be completed before heavily promoting this barn concept.

Implications

A swine facility with concrete walls and concrete manure tanks constitutes the most promising option for enhancing the life cycle and decreasing the annualized cost of production facilities. Supplemental information should be gathered about the design and cost of swine buildings with concrete walls considering construction techniques and local availability of concrete in the Prairies and life cycle maintenance requirements.

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Table 1. Volume of concrete used for different building and manure storage concept combinations

Building concept	Total volume of concrete (m^3/site) [Increase compared to concepts 1 and A; %]			
	Manure storage concept			
	A	B	C	D
1	1,757 [0]	1,757 [0]	2,804 [60]	4,975 [183]
2	2,201 [25]	2,201 [24]	3,248 [85]	5,419 [208]
3	3,645 [107]	3,645 [107]	4,692 [167]	6,863 [291]

Table 2. Annual cost for different building and manure storage concept combinations

Building concept	Annual cost ($/year) [Increase compared to concepts 1 and A; %]			
	Manure storage concept			
	A	B	C	D
1	267,488 [0]	271,729 [2]	281,886 [5]	357,780 [34]
2	225,544 [-16]	229,785 [-14]	239,941 [-10]	315,835 [18]
3	266,949 [0]	271,190 [1]	281,346 [5]	357,240 [34]