



## THE USE OF STEEL BUILDING PANELS FOR ANIMAL CONFINEMENT

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### BACKGROUND

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This Technical Bulletin is intended to assist users in the design and maintenance of metal animal confinement buildings with respect to obtaining a longer building life. Secondly, it contains recommendations for materials selection decisions.

GALVALUME<sup>®1</sup> Coated Sheet Steel has outstanding corrosion resistance in a wide variety of environments, including rural, industrial and marine regions. Atmospheric exposure for more than twenty five years has clearly demonstrated that it is at least two to four times more durable in these environments than G90 galvanized sheet. GALVALUME<sup>®</sup> Coated Sheet Steel easily meets its twenty five-year warranty requirements, even in regions of acid rain.

In certain applications, however, the relative corrosion rates of materials change. One of these applications is animal confinement buildings for hogs, cattle, and poultry. In these environments, the corrosion of GALVALUME<sup>®</sup> is more rapid than hot-dip galvanized. For this reason, **U. S. Steel neither recommends nor warrants the use of GALVALUME<sup>®</sup> Coated Sheet Steel in animal confinement applications.**

Various types of livestock, including cattle, hogs, and poultry, live all or most of their lives in confinement buildings. Animal waste and waste decomposition by-products generated in these buildings create corrosion problems for metal building materials. Longer confinement times make the environment more corrosive.

The business of raising livestock is very competitive. Building cost effective housing is an important aspect of this competition. Careful design and proper maintenance is a very important part of keeping the overall cost of metal animal confinement buildings as low as possible.

### CORROSION PROBLEMS WITH ANIMAL CONFINEMENT BUILDINGS

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Animal confinement buildings are highly corrosive environments. The waste products generated contain sulfides, ureas, amines and other corrosive agents. They are rich in bacteria that oxidize the waste materials to organic acids that readily attack aluminum, iron, and zinc. Dust typically carries bacteria to all interior areas of the building. The constant high humidity from the animals, the waste and the cleaning water adds to the corrosivity of the environment.

Direct contact of the building panels with animal wastes will quickly corrode and perforate the steel. The moisture will carry the corrosive ingredients through any paint film, corroding painted steel.

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Building panels that do not come in direct contact with animal wastes are still subject to extremely corrosive conditions. Waste gases and gases from waste decomposition, when combined with water, form a very corrosive solution. Water condenses on cool areas, absorbing these corrosive gases and bacteria laden dust from the air. The resulting solution severely attacks the metal coating, even through paint.

The most severe attack comes on the underside of the roof, in crevices, at the bottom of sidewalls, near exhaust ports on the sidewalls and roof, or between insulation and an exterior wall. These areas dry slowly because of poor air circulation or severe condensation.

Exterior areas near ventilation ports are exposed to much the same corrosive atmosphere as interior areas with only the natural washing effects of rain to cleanse them.

## **BUILDING DESIGN**

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Building design factors that affect the corrosivity of these environments include insulation, ventilation practices, and interior cleanliness. Corrosion in confinement buildings can occur on both the exterior and interior of roofing and sidewall panels. Ventilation exposes some areas on the exterior of the roof or sidewalls to these corrosive fumes. The dominant factor in determining the building's corrosion resistance is the building design. The steel material used is not the key factor in the building's life.

## **INSULATION AND VAPOR BARRIER**

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Rigid or batt insulation, combined with a vapor barrier, protects the inside of the panels from corrosive gases and keeps the building comfortable for the animals. Well-sealed joints and vapor barriers maintain moisture tightness such that corrosive vapors do not penetrate between the boards or batts and condense on the inside of the roofing panels.

The top and bottom sidewall and roof edges, as well as any cut edges, need a good vapor barrier because of the close proximity to fasteners. Condensation between the insulation and roofing is exceptionally aggressive because of the long drying time associated with small gaps. A designed gap between the insulation and wall allows easier drying, should moisture penetrate the system.

Because some minor leaking of the barrier always occurs, the use of blown-in insulation should be avoided. This material holds moisture well and dries exceptionally slowly when wet. Additionally, it settles and creates uninsulated pockets at the top of walls and sloped roofs.

In an environmentally controlled building, the use of a good insulation and vapor barrier system also helps reduce energy costs.

## **VENTILATION**

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Any and all efforts to ventilate the corrosive fumes generated within an animal confinement building will reduce the severity of corrosion from these gases. The decreased concentration of the corrosive gases would make any leaks in the vapor barrier less of a problem. The dew point decreases with any decrease in humidity, causing less condensation.

The odor of a building is a rough indication of the ventilation's effectiveness because the corrosive gases are very aromatic.

The use of stacks of discharge tubes to release the gases away from the building greatly reduces the corrosive effects on the building exterior because the fumes discharged with either power or natural ventilation could cause a corrosive attack on the exteriors in close proximity to the discharge.

Eave venting requires special attention to areas near the openings, such as the drip edge or cut edges. The underside of a vented overhang requires protection, such as an extension of the insulation and vapor barrier from inside the building.

## **MATERIALS**

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U. S. Steel recommends painted G90 hot-dip galvanized (G90 HDG) with a zinc phosphate treatment for animal confinement applications. The design factors above are the dominant factors in determining the building's corrosion resistance. Improving building design is more cost effective than using heavier zinc coatings. Adequate ventilation, proper maintenance, good insulation and a vapor barrier provide enough protection so that interior corrosivity will not harm the steel. Painted HDG gives excellent exterior corrosion protection.

## **INTERIOR CLEANLINESS**

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The most important aspect of interior cleanliness is efficient removal of animal waste. The method and frequency of removal strongly affects the corrosivity of the atmosphere. In an environment as conducive to bacterial growth as animal confinement, keeping the building clean is easier if the bacterial growth is not allowed to progress. Frequent cleanings will require less effort than infrequent cleanings. Regular cleaning of all areas of the building keeps the corrosivity of the waste and the bacteriological by-products to a minimum. Cleanliness is not just a corrosion issue, it is a health issue for animals and workers.

## **WASTE REMOVAL**

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The most aggressive waste removal systems involve water mixtures, or slurries, often used in hog confinement to flush the wastes away from the building. The natural moisture associated with hog and cattle wastes, together with these waste removal systems, make cattle and hog confinement buildings extremely corrosive environments.

Often in poultry, broiler or breeder houses, dry wood chips or sawdust hold the animal wastes until replenishment or replacement. Many egg-laying operations keep the chickens in tiered cages from which the wastes fall to a lower level and are removed. The drier nature of poultry waste, together with improved methods for removal, make poultry houses somewhat less corrosive in nature than hog and cattle confinement buildings.

In some hog and cattle confinement buildings, a mechanical blade periodically drags the wastes to one end of the building for subsequent removal. This method increases humidity and the release of corrosive gases into the atmosphere.

Development of improved waste disposal systems will relieve some of the need for highly efficient ventilation systems. This will improve the overall cost effectiveness of the building. Bacteria decompose animal waste to amines and acids. This decomposition makes animal confinement buildings even more corrosive because these by-products can aggressively attack metal and are volatile enough to be in the air constantly.

Sites of corrosion can occur anywhere because the bacteria become air-borne and settle on surfaces from dust or mist. Any water can absorb bacteria and waste gases that will support growth of the bacteria. The most severe problems come in the less thoroughly cleaned areas, where corrosive waste and decomposition products can accumulate.

The most important steps in reducing bacteriological decomposition are an efficient waste removal system, a regular cleaning program and an easily cleaned building. Cleaning should be frequent enough that the waste does not accumulate. This depends on the rate of waste generation, the efficiency of the removal system and the efficiency of the previous cleaning.

Easily cleaned buildings will either be cleaner or make cleaning less of an effort. It involves not having water-trap areas, having good drainage capabilities, and minimal crevices. If good cleanliness is difficult to maintain, antiseptic cleaners can control bacterial growth.

## **MAINTENANCE**

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The interior vapor barrier will occasionally need to be repaired in order to maintain its original barrier properties. Frequent cleaning could cause minor rips. Sealing tape could come loose. Normal wear could also cause holes. The exterior may show early signs of corrosion if the original venting design provided inadequate protection, such as unsealed vent-stack seams.

Prompt attention to breaks in the vapor barrier are especially important in cold weather as condensation is more likely. If moisture is trapped in the insulation, interior corrosion of the roof or sidewall will occur.

Mistakes or oversights in building design can result in severe localized corrosion. Diligent observation of the building can often catch these problems while there is still time to correct the problem. Addressing these issues promptly will prolong building life.

## **SUMMARY**

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1. Insulate the building using a vapor barrier in such a manner that the corrosive gases and high humidity cannot attack the interior walls and roof. Use rigid board or batt insulation with a good vapor barrier. Seal all joints well. U. S. Steel recommends not using blown-in insulation.
2. Maintain the vapor barrier to its original high standards. Check if the original design provided adequate protection for exterior venting areas.
3. Good ventilation reduces interior corrosivity. Ventilate sufficiently to avoid localized exterior corrosion. The ventilation should release the gases far enough from the sidewalls or roof so that mixing with fresh air will serve to dilute the corrosivity sufficiently to not harm the building. Eave venting requires extra corrosion protection at the site of gaseous releases.

4. Design the building for efficient, easy cleaning, especially with regard to waste removal. Clean the interior frequently enough and thoroughly enough that the humidity, corrosive gases and bacteriological growth will not accumulate and become a corrosion issue.
5. Highly corrosion resistant fasteners, typically stainless steels, with neoprene gaskets are preferable.
6. For poultry, hog and cattle applications, painted G90 HDG combined with proper attention to building design should provide a reasonable service life. The building life will depend primarily on good design rather than on the construction material.
7. Painted, zinc phosphate-treated G90 HDG is the preferred material. It, however, requires a vapor barrier and insulation to protect it from the corrosive interior environment. U. S. Steel does not recommend using GALVALUME® Coated Sheet Steel for animal confinement applications.

#### **DISCLAIMER**

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