Improved farming methods have required better buildings, for increased output. Developments have been pointed toward the need for structures which are low in cost when measured against production.

22. Trends in Farm Structures

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BUILDINGS, THE SILENT PARTNER IN FARM OPERATION, have played an important and ever increasing role in the development of Iowa agriculture. From bare shelters almost primitive in nature, they have increased in importance and extent until at the present time Iowa farmers maintain an investment greater than do the farmers in any other state, and one which represents nearly one-twelfth of the national total. As agriculture has grown from a bare subsistence level to that of a modern food and feed factory there have also been marked structural changes in modern houses, animal shelters, and crop storages, all effective shelters and production tools in the great agricultural industry.

Early settlements in Iowa were made near the principal streams, because such land could be farmed without tile drainage, and because the wooded area there furnished building material and fuel. Poor transportation and few cash markets required that practically all necessities be produced on the farm. There were few buildings except the farm house because livestock was usually allowed to roam at will.

Some of the more progressive farmers framed their houses and barns from hand-hewn timbers, largely of native oak, as they had done in the East. The year 1856 marked the approximate beginning of a great lumber industry which mined out the white pine forests along the upper tributaries of the Mississippi River. Logs floated down the Mississippi to lumber mills in the river towns and were sawed into huge timber, planks, and boards, making possible the expansion of building on the farm. The period 1856–1900 was marked by the construction of many full frame barns of mortise and tenon construction, which used a large amount of material. White pine, the principal lumber, did not possess great strength and was used in large timbers. A great deal of labor was required to fabricate and large crews to erect. It was a proud carpenter whose barn frame, completely pre-cut, would fit together at a neighborhood raising without extra cutting. The large amount of material required was little handicap as long as there was plenty of timber in Wisconsin and Minnesota.

Depletion of these forests about 1900, however, with remote timber more expensive, brought structural economies. Plank frames using largely materials no thicker than two inches became rather common. Other factors also contributed to this general trend. Douglas fir from the West and yellow pine from the South both possessed structural properties superior to white pine. The lighter plank frames could be erected by smaller crews. Development of the self-supporting gambrel roof eliminated troublesome braces which cluttered the haymow when full-frame construction was used.

About 1920, A. W. Clyde, then extension engineer for Iowa State College, developed another truss. It provided structural stability with additional saving in materials and labor. Gas pipe was used for shear pins at the ends of the trusses to make a joint comparable in strength to the remainder of the structure.

During the latter part of the Nineteenth Century, another type of construction appeared which promised to be the most popular of all. This is the curved or so-called "Gothic roof." The self-supporting arch was used in masonry construction for centuries and before the days of reinforced concrete, large openings could be spanned only by the use of this principle. It offered advantages also in the use of wood. The first ones to appear were formed by cutting one edge of relatively wide and short boards to an arc of a circle. These were then laminated, using a total thickness of three or four, staggering splices to give a continuous rafter of the desired length. The popularity in Iowa has been less than in the Northwest due to the wastage of lumber and the large amount of labor necessary in the fabrication. The strength has been satisfactory when such rafters were spaced on two-foot centers. The urge to cheapen the cost, however, resulted in spacing the sawed rafters eight feet apart. This was unsatisfactory primarily because the sawed rafter was not strong enough when spaced so far apart, and also because the savings were not as great as anticipated. The trend turned gradually but surely toward the bent rafter. The exact date of the first application of this method in Iowa is not known. However, the Hershey Creamery, a unique barn and operations structure near Muscatine, was built in 1878 of hip Gothic construction on a very substantial level. Being 72 feet by 120 feet, it required more substantial construction than would be required in our more common barn widths. It is said that each rafter required a keg of nails.

Popularity of this type of construction has been slow due to the fact that many roofs have sagged out of shape, as the result of improper construction methods which can be readily overcome. Modern glues, cheap and effective, have provided a satisfactory solution to the problem of fastening, and promise to revolutionize construction methods. Glued laminated construction becomes increasingly popular because members can readily be formed to the correct structural shape. It makes possible bending the wood, avoiding cross grain and staggering splices so that members of any desired size can be obtained without weak joints.

Some of the changes come so gradually that one must look to the past to appreciate how extensive they have been. Improvements have been made not only in the farm structure, but also in the equipment within. Iowa people have been leaders in this development. In 1866 William Louden received the first patent issued on a hay stacker. The next year in 1867, he received the first patent ever issued on a hay carrier. This invention made possible the two-story barn, since previously all hay had to be pitched by hand. He set up a factory six miles southeast of Fairfield in 1868. In 1895, Louden invented the first flexible barn door hanger, the forerunner of practically every barn door hanger used today. He brought out a manure or litter carrier and exhibited the first practical all-steel cow stall in 1907 at the National Dairy Show. In 1912, he introduced the first individual sanitary water bowl for cows.

The modern house is not only different from the log cabin of the settlers of a century ago in appearance, but also in the methods employed in erection. The early pioneer lived almost entirely upon a subsistence basis with few goods to purchase and little surplus to store. From log cabins with roofs of poles thatched with straw, grass or sod, to hand hewn timbers, to milled shapes, to almost complete prefabrication—this represents the progress witnessed since Iowa became a state. Prefabrication is not new and really is only a matter of degree. Years ago, sash and door factories started making windows, doors, and moldings. Each year brought progress until windows are now completely fitted in frames ready to place in the wall to give superior performance. Precutting and sectional construction will doubtless advance to the benefit of the ultimate user because the product can be made better and will be better designed.

But improvement in construction methods represents only a small portion of the progress in providing better places for people to live. Fireplaces were notorious wasters of heat, most of which traveled up the large chimney. Even the old stove which displaced the fireplace has been discarded. Modern stoves are streamlined, more efficient, more sightly and less dirty. Yet many Iowa farmers today insist upon modern heating systems which are almost completely automatic, not simply in regulating temperature within rather narrow limits but also in humidifying the atmosphere and filtering out dust particles, for better health.

Modern sanitary systems made possible by automatic water systems are becoming increasingly common on Iowa farms. More than half the Iowa farms are now supplied with electric power. Thanks to electricity, the farmer can have adequate refrigeration, radios, electric irons, and many other conveniences.

Timber resources have always been relatively small in Iowa. The broad prairies covered for centuries by a heavy sod of native grass have made Iowa a leading agricultural state, but also have meant that Iowans must, to a large extent, look elsewhere for building materials. Portland cement, practically unknown a century ago, has become an indispensable material in the construction of foundations, walks, feeding floors, and pavements, and frequently of buildings themselves. The development of methods of reinforcing concrete with steel has brought to the farmer a versatile, durable product. Iowa has a plentiful supply of clay, limestone, and gypsum so that we now have several plants making high-class building material. Local manufacture is an important factor in the cost and consequent use of heavy building materials.

CLAY PRODUCTS

The general suitability of many Iowa clays for burned clay masonry has led to valuable developments originated by Iowans. The clay products industry in Iowa had its origin almost one hundred years ago in the many small "backyard" plants which were sometimes opened to supply brick for the construction of a single building or only a few buildings in the immediate vicinity. Not much is known about these plants, but there are many old buildings constructed of these bricks that are still serving the purpose for which they were built. A number of the buildings at Iowa State College were constructed from brick made on the campus.

As the pioneers settled in Iowa, the demand for brick grew. Lack of adequate transportation again stimulated small community brick plants. As farming practices improved, the need for farm drain tile added another product to these small plants. There were eventually over two hundred such small brick and tile plants scattered over Iowa, most of which survived until World War I. Today only twenty such plants exist. Modern transportation and newer methods of manufacture enable the remaining plants to supply the demand.

The brick manufactured by these early plants were handmolded, dried in the sun, and burned in "scove" kilns, the earliest type of brick kiln. A scove kiln was merely a pile of dried brick set with parallel cross tunnels spaced about four feet apart at the bottom. Fires were built in these tunnels and the heat passed up through the mass of brick, thus "burning" them. The sides of the pile of brick were plastered with a mixture of clay, sand, and water to help retain the heat. The top of the pile would be left unplastered to provide a draft. This crust or "scove" applied to the outside gave the kiln its name.

In 1871, soon after the coming of the Milwaukee Railroad to a north Iowa trading post now called Mason City, N. M. Nelson and Henry Brickson established a brickyard near there. This was the first "commercial" plant built in Iowa. The clay was a surface formation known as boulder clay.

In 1894, Robert Goodwin and Frank Dale established a small drain tile and brick plant at Grand Junction, and also the first press brick plant in the state at Goodwin, on the site of a coal mine owned by Goodwin. W. J. Goodwin and Dan Goodwin, sons of Robert, built the Goodwin Tile and Brick Company in Des Moines in 1902. This plant is still in operation, now owned by Dan Goodwin, and is near the site of the old press brick plant operated by his father. Robert Goodwin and a Mr. McBroom also founded the Redfield plant in 1896. This plant is still in the hands of the Goodwin family.

The Kalo Brick and Tile Company of Fort Dodge was founded in 1889 by Luke and S. C. Johnson, brothers.

The Straight family, which first produced clay products in Scotland, established their first Iowa plant in Fonda in 1894. Their other plants at Spencer and Auburn were built in 1904 and 1907, respectively, and the Adel Clay Products Company at Adel also in 1907. This plant was moved to Redfield in 1927 and is now operated by M. T. and H. R. Straight, sons of Lee Straight, one of the founders.

Other pioneer plants which are still in operation are the Johnston Clay Works, Inc., established in 1898 at Fort Dodge; the Sheffield Brick and Tile Company organized at Sheffield in 1907; the Rockford Brick and Tile Company, first formed in 1910 at Rockford; and the

Vincent Clay Products Company, organized in 1911 by the Vincent family of Fort Dodge and still in their hands.

With the exception of the Vincent Clay Products Company, all modern Iowa clay products plants now use the round "beehive" periodic downdraft kilns in burning their ware. The Vincent company uses a continuous chamber kiln.

These Iowans developed new units to meet the ever-changing demands of modern construction, improved methods of manufacture and distribution, and a better conception of the industry's responsibilities to the economy of the state and nation.

Since Iowa's greatest industry is agriculture, much of the development in clay products here has pointed toward better farm buildings. The "Iowa Type" clay tile silo, for example, was originated at Iowa State College in 1907–08 by Professor J. B. Davidson and Matt King. The first such silo, built with curved hollow clay blocks and reinforced with steel, was built on a farm near Rockford in 1908. This silo is still used on the Howell farm.

The clay products industry of Iowa also developed the clay crib tile which has been used extensively for the past twenty-five years for permanent corn cribs and granaries on many an Iowa farm. The textured facing tile which is used in the construction of many of Iowa's farm buildings, as well as in commercial, industrial, and residential structures, is another contribution of Iowa producers. Previously hollow tile was used almost exclusively as a "back-up" material, or where appearance was not important. The application of a texture to the face of the tile, plus better control of manufacturing, raised hollow tile to the ranks of the finer building materials and its use has spread throughout the United States.

The "universal" closure or corner-jamb unit is another product originated by the clay products industry in Iowa which has been adopted generally by the industry. This versatile unit can be used to close the corners and at the window and door jambs in clay tile construction as well as in the construction of pilasters and load-bearing piers.

The use of finely-ground or pulverized clay in place of lime in cement-lime mortars was first introduced by the clay products industry in Iowa.

One of the most recent contributions of the clay products industry in Iowa was the development of a system of precast tile joist floor construction. Co-operation in research between Iowa State College and the building industry resulted in eliminating expensive formwork, and made possible the use of a low-cost, permanent, and fire-resistant floor construction in all types of buildings.

The industry in this state also has contributed nationally in the perfection of the "de-airing." By means of a vacuum chamber attached to the auger machine, the clay is made more workable, denser, and much stronger, resulting in a finer and more uniform brick or tile. H. R. Straight, of the Adel Clay Products Company, was largely responsible for the perfection of this de-airing process.

The Iowa members of this important industry are considered among the most progressive and "researchminded" groups in the entire industry by those who manufacture clay building products in other areas. While the research and development of new products and better production methods by the Iowa clay products industry have been carried on largely with the thought of improving the construction of farm buildings, their contributions have had application to all types of construction.

FENCING

Early reports of the State Agricultural Society reveal how serious the fencing problem was. Some of the writers predicted that as the population increased, Iowa would follow the European pattern of small, fenceless farms. Iowa lacked the stone for the New England type of fencing and the timber for rail fences used in Ohio and Indiana.

Early farmers kept only a minimum of livestock and had constant difficulty in controlling what they had. Livestock losses constantly plagued the owner, and damage to his neighbors' crops, if the loss to his own were not enough trouble, led to frequent feuds and lawsuits. Lawmakers, worried over means of settling the controveries, provided for suitable damage and for the recovery of stray animals.

During the late sixties and early seventies the planting of willow slips and osage orange seeds for hedge fences was at a fever heat in the Midwest. Osage orange seed was shipped from Texas to Illinois where it was sold for five dollars per pound. Eloquent essays were written pro and con. Growing conditions were not as favorable in Iowa as in its native habitat. Dying hedge plants left gaps in the fence. Even a properly trimmed hedge taxed the moisture and plant food of the soil, and trimming was expensive. The hedge fence was gradually replaced by wire.

The sod fence also appeared in the prairie states where wood and stone were scarce and hedge fences were still a rarity. C. A. Martin describes it as follows:

A sod fence, besides its other value, is a double barrier against the prairie fires which are so sweeping and destructive . . . for a wide strip is cleared of sods, the fence standing in the middle of it. The sod is first cut, then with a breaking plow one furrow is turned directly in the line of the fence, completely inverting the sod. The team is turned to the right, and a second or back furrow is inverted on top of the first. Additional furrows are cut, diminishing in width to five or six inches on the outer side. . . After the two inner sods are turned, the rest are carried by hand, wheelbarrow, or a truck and laid on the sod wall, care being used to "break joints" and to taper gradually to the top.

Development of the wire fence was gradual and many people contributed. The earliest effort was a smooth iron wire, sometimes flat, coated with a film of zinc. Iron wire was inexpensive, easily transported, and simple to erect, and it guarded property well. It was popular in the fast-growing regions of the South and West where timber was scarce. Because it often sagged in hot weather or tightened up to a point of snapping in cold weather, there were many who never were quite satisfied with it. It did not completely restrain cattle. The catalog of an early barbed wire manufacturer graphically stated the case against smooth wire as follows:

The animals pressed up to the boundaries of the pasture and, sticking their heads between the wires, calmly lunched off the adjacent crop. Growing more resolute, they broke bounds altogether, or contentedly sawed their itching necks on the smooth wire until the fence gave way.

The advantages of wire fence were sufficient to attract numerous inventors who attempted to overcome its shortcomings.

Following the general idea of attaching to the wire a sharp point or barb to keep livestock from rubbing against it, more than four hundred designs were developed. Perhaps the earliest attempt to apply barbs to wire consisted of driving nails through a wooden rod and attaching this rod to the smooth fence wire. High cost prevented widespread use of this method, even though it was effective.

These inventors were widely scattered. In 1859, Samuel Freeman built a fence of smooth wire in Scott County, Iowa. Two years later his son, Pembroke, perhaps tiring of the continual repair, attached wire barbs to this fence, making it highly effective as compared with smooth wire. If he were the inventor of barbed wire, he made no attempt to patent his idea and produced no wire commercially.

Three patents were issued in 1867 to Alonzo Dabb, Lucien B. Smith, and William D. Hunt, respectively. Numerous others followed shortly thereafter.

Three pioneers, Joseph Glidden, Isaac Ellwood, and Jacob Haish, residents of the same community in Illinois, were working independently during this period attempting to develop a barbed wire for farm fences. When Haish had developed a satisfactory design, he transformed the second story of his carpentry shop into a barbed wire factory. A twisting device was placed at one end of the shop, the spool at the other end, and a worktable in the center where the barbs were spaced and firmly attached by a tap of the hammer. A special machine was devised to cut and shape the "S" barbs. According to Haish, similar devices are used today in the manufacture of barbed wire.

The Glidden-Ellwood firm formed their barbs in such a manner that they had to be slipped over the end of one wire before twisting. This was accomplished by carrying the end of the wire to the top of a windmill tower from which elevation the barbs slid down the wire to the workmen who pinched them tightly in place at the proper spacing as the wire was twisted. Protection against rusting was first furnished by dipping the wire in linseed oil alone, but this proved unsatisfactory.

During the period of the suits regarding the patents on the barbed wire, farmers and stockmen became antagonistic to the use of barbed wire, calling it "inhuman, barbarous, and cruel to animals." State legislatures were asked to pass laws prohibiting its use. Cattle soon learned to stay away from this new fence, however, and these charges were forgotten.

The development of an inexpensive, effective fence changed the entire picture of agriculture in Iowa from a wheat and range to a cattle state. Well-fenced pastures and fields encouraged the production of corn, hogs, and dairy cattle.

Woven wire fence was first produced in 1883 in a wagon shop on a farm in Michigan. The original process was crude, but the principle of continuous vertical wires is still used in making wire fences today. In recent years one wire charged with electric current has attained great popularity, especially for temporary fences.

BUILDING PROBLEMS

The development of livestock raising to an extent not equaled by any other state has brought with it demand for more and better buildings. Breeding and selection has emphasized certain beneficial characteristics with consequent loss of some others. Most farm animals, although able to withstand the rigors of an Iowa winter, are not profitable to their owners without adequate housing.

In raising more and more hogs and chickens in the same place year after year, the farmer faces the choice between adopting rigid sanitary measures to avoid outbreaks of disease or moving them about to keep them on ground that is not infected. The former requires good buildings that can be kept sanitary and the second, structures that can be moved.

Storage is another modern problem. Modern agriculture and modern living require carrying products from one season or year to another. A century ago, corn storage did not present a serious problem since the farmer had so little of it that he could leave it in the shock until spring if necessary, husking it out as he needed it. The increase in livestock brought with it corresponding increases in corn acreage. Several developments in corn itself and in the methods of handling it have added problems in storage. Early cribs were made by piling split rails to form a square so that spaces for ventilation were provided between the rails. Corn frequently is too wet at the time of harvest to keep through the following summer without further drying. The tendency of farmers to raise corn requiring a long growing season in an attempt to get larger yields means that many are caught with wet, immature corn. Cribs with cracks between the siding boards facilitate drying when conditions are favorable. All early cribs were low so that they could be filled by scooping from the wagon box. Many, if covered at all, were thatched with straw. High losses from rain and snow encouraged thrifty farmers to provide a roof.

Larger acreages demanded more cribs or larger cribs, with the general tendency toward the latter. The development of the elevator encouraged the farmer to make his cribs higher rather than to spread them out over a larger area. A high crib takes no more foundation or roof than a low one. But this, together with the development of a successful picker, brought on more structural problems. When corn was picked by hand and scooped by hand, the crib was filled slowly and the corn well distributed along its entire length. Some drying took place as the crib was filled. The corn was relatively clean with little husks, silks, or shelled corn. The picker plus the elevator meant rapid filling, more husks, silks, and shelled corn, and a tendency to concentrate them in one place under the elevator spout. High cribs required interior braces. Rapid filling piled the corn well above the braces before it had the chance to settle. When it did settle, as it must as it dries, the braces were broken out by the settling corn. Corn packs more densely in the bottom of high cribs, hence the farmer is faced with a ventilation problem and a loss of corn which he did not have before. Nevertheless, the modern crib, while it may still lack in perfect performance, is a great improvement over anything in use a century ago.

The trench silo is a comparatively recent development. Trenches dug in well-drained ground function satisfactorily when the owner cannot afford or justify the above-ground structures.

The growing popularity of leguminous hays has added another storage problem. Timothy had so few leaves that it appeared to make little difference if the hay were dried in the field sufficiently to keep well in storage. Small mows of open construction provided sufficient ventilation. But with legume hay, if it is dried sufficiently in the field to avoid spoilage in storage, many valuable leaves, which dry first, are dropped in the field. Hay that is completely field dried loses much of its value as feed even though no further spoilage results. Modern methods of handling include field chopping and baling. In either case, the hay stores much more compactly with less opportunity of satisfactory drying in the mow. Larger mows, like larger cribs, only add to the problem. The spontaneous ignition of leguminous hays in storage has become the principal cause of barn fires in the state. Various attempts are now being made to avoid the difficulty. One of them is the making of the hay into silage. Another provides for forcing air through the hay in the mow to dry it further.

As farming changed from a subsistence basis which required the efforts of perhaps 75 per cent of the population to a point where fewer than 20 per cent of the population can produce a surplus, buildings have done much to make the change possible. Improved farming methods require better buildings. Better buildings in turn make possible further developments in agriculture. The influence of buildings, however, is not limited to farm production. Great progress in mechanical equipment has resulted in both labor-saving and labor-easing. Improvements in buildings and building equipment have not kept pace. The result is that a farmer spends nearly half his working time in and around his buildings, often quite inefficiently. Good buildings save labor. They can also make farm living standards comparable to those of urban areas. Good buildings are not necessarily high-cost buildings and cheap buildings are not necessarily poor buildings. What is needed are buildings which are low in cost when measured against production. As the lowest priced automobiles are made possible only by efficient and well-equipped factories, so the cost of agricultural production can be lowered by means of buildings that do the job better and last longer. Structural stability is a matter of skill in design and construction and often requires no additional expense.

The problem becomes more acute because most structures are built and often planned on the farm. One can seldom go to his merchant, buy a ready-made structure, and move it out to his farm. The decision to build is only the beginning of a farmer's problem. Most farmers get so little experience that is does not carry over from one building job to the next, as is true in the case of equipment purchased at frequent intervals.