OMB No. 1024-0018

United States Department of the Interior
National Park Service

National Register of Historic Places
Multiple Property Documentation Form

This form is for use in documenting multiple property groups relating to one or several historic contexts. See instructions in Guidelines for Completing National Register Forms (National Register Bulletin 16). Complete each item by marking "x" in the appropriate box or by entering the requested information. For additional space use continuation sheets (Form 10-900a). Type all entries.

__X__ New Submission ___ Amended Submission

A. Name of Multiple Property Listing

Common Farm Barns of South Dakota, 1857-1958

B. Associated Historic Contexts

(Name each associated historic context, identifying them, geographical area, and chronological period for each.)

Common Farm Barns of South Dakota, 1857-1958

C. Form Prepared by

name/title Robert C. Vogel, Senior Historian

organization Pathfinder CRM, LLC date ~~September 2007~~

street & number 168 W. Main Street telephone 507-498-3810

city or town Spring Grove state Minnesota zip code 55974

D. Certification

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this documentation form meets the National Register documentation standards and sets forth requirements for the listing of related properties consistent with the National Register criteria. This submission meets the procedural and professional requirements set forth in 36 CFR Part 60 and the Secretary of the Interior's Standards for Planning and Evaluation.

__See continuation sheet

Signature of certifying official Date

State or Federal agency and bureau

I, hereby, certify that this multiple property documentation form has been approved by the National Register as a basis for evaluating related properties for listing in the National Register.

Signature of the Keeper of the National Register Date

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Provide the following information on continuation sheets. Cite the letter and the title before each section of the narrative. Assign page numbers according to the instructions for continuation sheets in How to Complete the Multiple Property Documentation Form (National Register Bulletin 16B). Fill in page numbers for each section in the space below.

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E. STATEMENT OF HISTORIC CONTEXTS

Introduction

The South Dakota State Historic Preservation Office has delineated two broad, statewide historic contexts that encompass the heritage preservation value of farm barns: *Permanent Farm and Ranch Settlement, 1858-1893* and *Changing Rural Patterns and the Impact of New Farm Technologies, 1893-1929*. A statewide thematic study unit, *Homesteading and Agricultural Development*, has also been developed to describe the important trends and patterns in South Dakota agricultural history from the 1860s through the 1940s. Each of these contextual studies identified barns as an important resource type associated with farming and ranching. The present study develops a new statewide thematic context, *Common Farm Barns of South Dakota, 1857-1958*, that elaborates, modifies, and refines earlier historic context statements relating to farm barns.

For the purposes of the present study, a *common farm barn* is defined as the largest freestanding agricultural outbuilding on a farmstead or ranch, the primary historic function of which was to provide shelter for animals, fodder, farming implements, and various related agricultural tasks under one roof. Common barns are ordinary farm buildings of the kind frequently encountered in a given place and time period. Architecturally, a common barn reflects vernacular building themes, even if its form and structure are derived from prototypes designed by professionally trained architects or engineers. The primary historical significance of common farm barns is the product of their association with the broad patterns of agricultural development and the changing rural landscape; secondarily, individual properties may be significant for their design, construction, or information value. To be considered historic, a common farm barn must be at least fifty years old.

1. Overview of South Dakota Agricultural History

It would be difficult to understate the importance of agriculture in South Dakota history. Despite the sharp reduction in the number of family farms and ranches and shifts in other sectors of the economy since the late 1950s, agriculture remains a dominant industry in the state as well as its most extensive land use. The ongoing transformation of its rural built environment is reflected in the heritage of South Dakota farm barns.

In broad, general terms, the history of South Dakota agriculture during the settlement period, which ended about 1917, was chiefly the story of the westward movement of the farming frontier from the older settled parts of the Midwest onto the northern plains, the continuous opening of new land for speculation and production, the modification of traditional farming practices by the introduction of improved machinery, and recurring cycles of economic boom and bust. Secondary themes include the emphasis on wheat farming, the rise and decline of open range livestock ranching, and the attempts to cultivate large areas of semi-arid land using dry-land farming techniques. During the post-settlement period, South Dakota agriculture entered an entirely new phase, characterized by radically different patterns of land use and production. The four decades after 1917 were marked by the steady industrialization of agriculture, as manifested by increased mechanization, the expanding role of government in agriculture, and overproduction of staple crops and livestock. Other outstanding factors in the changing face of rural South Dakota have been the rise in the standard of living, marked shifts in the number and size of family farms, and the increasing economic and functional obsolescence of traditional agricultural buildings. The year 1958 was selected as the terminal date for the historic context because it generally corresponds to the beginning of the post-industrial or “agri-business” era in South Dakota agricultural history.

Euro-Americans had been prodding and probing what is now South Dakota for nearly a hundred years before the first pioneer farms were established near present-day Sioux Falls in 1857-58. After Congress authorized the organization of Dakota Territory in 1861, the rectangular survey began to prepare the way for opening the interior to settlement and various schemes were advanced to promote immigration. The region’s reputation as part of the

"Great American Desert" retarded agricultural development and Dakota remained a scantily populated borderland until the late 1860s. The first significant wave of immigrants began moving into the territory after the Civil War, and the influx of settlers soon reached boom proportions. Free land under the Homestead Act of 1862 was a strong inducement to take up quarter-sections of prairie land along the Big Sioux, Vermilion, and James rivers, and the territory's attractions were widely proclaimed in a torrent of guide books, pamphlets, newspaper articles, and magazine features. Several successive years of good crop growing conditions and the approach of railroads then being constructed across Iowa and Minnesota also helped encourage agricultural development. However, neither cash grain farming nor stock raising were practical on a commercial scale due to the lack of transportation facilities and markets.

The First Dakota Boom of 1868-73 was an illusion for most of the territory's agriculturists. The Panic of 1873 hit the region especially hard and was followed by several years of depressed prices for farm products. The financial depression would have held up agricultural development in any event, but to the economic crisis was added a succession of natural disasters in the form of droughts and grasshopper plagues. Most of the homesteaders were left impoverished and many farms were abandoned. The cycle of boom-and-bust repeated itself during the Great Dakota Boom of 1878-87, which was marked by a tremendous increase in immigration and agricultural expansion. During the years 1875-86, abundant rainfall occurred over the Great Plains, a phenomenon which received an immense amount of attention in government reports and the popular press. Attracted by the prospects of grain farming, the East River country[1] became dotted with prairie homesteads and there was wild speculation on the progress of the territory, which was believed to be on the verge of being admitted to statehood. The rapid influx of settlers afforded a ready market for grain, beef, and other farm products, but it was the railroads that were the primary motive force behind late-nineteenth century agricultural expansion. Until the first train rolled into Sioux Falls in 1878, the Missouri River and a primitive network of overland trails were the territory's only routes of immigration and commerce. Two major Midwestern railways, the Chicago & Northwestern and the Chicago, Milwaukee & St. Paul, penetrated Dakota in the late 1870s and quickly caught up with the leading edge of settlement. By 1881, both railroads had pushed their main lines as far west as the Missouri River and were busy constructing a skeleton network of branch lines.

Homesteaders found the Dakota prairies relatively easy to cultivate. Steel plows, mechanical reapers, threshing machines, and mowers had all been invented before the Civil War and new models were available that were specially adapted to western prairie farming. Farms were taken up in 160-acre tracts that could be "proved up" in five years or commuted for cash. Many homesteaders stayed in one place only long enough to prove up or commute their claims, then sell or rent the land to an actual settler. The conventional wisdom was that a prairie farmer could acquire all the land he wanted, grow wheat, and become prosperous in the span of three or four years. The reality was much more stark. Homesteading in Dakota was no bonanza for the average settler. Environmental hazards included hot winds, extremes of high and low temperature, blizzards, hail, frost, floods, noxious weeds, prairie fires, and insect infestations. The greatest and most persistent threat to agriculture, however, was drought.

Handicapped by climate and inaccessibility, agricultural development in the West River country was slow, and a kind of hollow frontier developed during the 1870s, when the leading edge of settlement leapfrogged the Missouri Plateau. The search for precious metals played a major role in the exploration and initial settlement of the Black Hills, where the discovery of gold in 1874 was followed by the establishment of subsistence farming and livestock herding. Between the eastern fringe of the farming frontier and the mining settlements of the Black Hills stretched a vast territory of grassland that was widely regarded as unfit for any kind of agricultural use until it was

[1] It is customary for South Dakotans to apply the terms "East River" and "West River" to the eastern and western sections of the state, with the Missouri River forming the line of demarcation; see Edward Patrick Hogan and Erin Hogan Fouberg, *The Geography of South Dakota* (Sioux Falls, 2001), 157-161.

discovered that the longhorn cattle of Texas not only could survive the harsh climate of the northern plains unsheltered but flourished on the natural forage provided by the short-grass prairie. The slaughter of the great northern buffalo herd and the reduction of the Sioux nation cleared the way for the expansion of the "cattle kingdom" into western Dakota, and by 1885 a number of large cattle outfits had moved in and were in control of large holdings. Except for the mining camps and Indian reservations, the whole region was one vast, unbroken stretch of grazing territory where cattle could be turned out to forage on the free grass of the public domain—stockmen rarely owned more than small portions of the land, which they obtained for little or nothing, over which their herds ranged. After the annual roundup the steers were trailed eastward to the railheads, where they were loaded on railcars for shipment direct to the packers, while the bulls, cows, and calves were kept for breeding stock or sold to newcomers who were streaming onto the northern plains looking to cash in on the "beef bonanza". Sheep also became a profitable form of livestock ranching enterprise on the high plains, beginning with flocks of Mexican sheep that were driven up from Nebraska. Contrary to popular folklore, cattle and sheep ranching coexisted to a considerable extent on the open range. Homesteaders and barbed-wire fences nibbled at the edges of the range, although very little land was actually placed under cultivation before the late 1890s.

Severe blizzards and drought in 1886-87, and a devastating drop in beef prices caused by overproduction, signaled the close of the great open range cattle boom. Inflated values were wiped out and many of the large cattle companies failed. Meanwhile, the return of droughts and crop failures turned the East River homesteader boom to bust and the wild optimism of the mid-1880s quickly gave way to despair as thousands of settlers were bankrupted. Even more striking than the sharp reduction in crop and livestock production was the precipitous decline in population, with some counties losing more than half their population in a matter of months, one of the factors which delayed South Dakota statehood until 1889. A large proportion of the homesteaders never "proved up" or obtained their patent through commutation and moved away, and thousands of farmsteads were either abandoned or sold. Droughts and crop failures persisted through the early 1890s and the national depression brought on by the Panic of 1893 further retarded agricultural development.

Agriculture during the settlement period was labor intensive and production was distributed over large areas with tens of thousands of small, fairly diversified farms where the bulk of the state's population lived. Farmers not only employed most of the work force, they owned several hundred thousand work animals (e.g., 720,060 horses in 1925) and were near-continuously engaged in building construction activities of one kind or another. Farm production emphasized a few important commodities: spring wheat, barley, flax, corn, and beef cattle. Undoubtedly the most striking feature in the early agricultural history of the state was the predominance of wheat as the main field crop. (By 1909, South Dakota ranked third in the nation in wheat production.) Land was so easily acquired that it perpetuated old-fashioned and wasteful farming practices—when his land wore out from growing wheat year after year, the prairie homesteader usually found it cheaper to take up new land than to care for the old. Even more harmful to agriculture was the mania for speculation in land as a commodity, which made farming less efficient and encouraged settlers to take up claims in areas which were totally unsuited to general farming on 160-acre homesteads. Most homesteaders literally scratched out a livelihood under near-subsistence conditions, constrained by the underdeveloped rural infrastructure and harried by droughts, prairie fires, blizzards, and locusts. Nevertheless, there were many careful, progressive farmers and ranchers whose enterprises became increasingly efficient and specialized. Overall, the development of grain farming and livestock ranching depended largely upon markets and transportation, and because of the mature railroad system and the expanding domestic market for foodstuffs, at the turn of the century South Dakota was on the verge of developing a sustainable agricultural economy based on the production of cereal and meat.

Agricultural historians sometimes refer to the years from 1896 to 1920 as the Age of Prosperity. In South Dakota, this period was marked by another surge of immigration and amazingly rapid settlement of large areas hitherto undeveloped. By 1917 practically all of the arable land in the state had been claimed and occupied, thanks to the government's liberal land policies and the mania for dry-land farming. South Dakota agriculture boomed as never

before during the First World War when the market prices of farm products reached record levels; and while the war in Europe triggered a great increase in demand for American agricultural exports, the biggest market expansion was in the United States, created by the explosive growth of the non-farm population between 1890 and 1920. East River farmers especially saw substantial improvement in income and quality of life and the rising tide of rural prosperity triggered a great building boom, perhaps the biggest in the state's history. As agriculture become more commercially oriented, subsistence farming gradually disappeared and farmers began to start thinking of themselves as businessmen.

The final chapter in South Dakota's homestead era took place between 1902 and 1917, when the last of the great Indian reservations were opened up to settlers. Convinced by dry-land farming propagandists that "rain follows the plow," settlers fanned out across the West River country to take up enlarged homesteads on sub-marginal land where they tried to make a living growing wheat on land that was physically unsuited for cultivation. After the onset of a severe drought in 1915, much of the topsoil that had been exposed by dry farming was deflated by wind erosion; huge dust storms, precursors of the 1930s "Dust Bowl," swept over the high plains, destroying crops and livestock. Most of the West River homesteaders lost their farms and were forced to migrate elsewhere. For a generation, the trend in agriculture throughout most of the West River country was backward.

Notwithstanding a postwar recession and several years of bad crops, trends which were operative before the turn of the century continued to modify farming during the 1920s. Great advances were made in farm mechanization, highlighted by a 162% increase between 1920 and 1930 in the number of South Dakota farm families owning at least one tractor. The same period saw automobile ownership more than double, with 86% of farm families owning a car at the time of the 1930 census. In the southeast, farmers embraced the Corn Belt farming system, with its emphasis on corn and other feed crops and livestock. Increasing numbers of farmers turned to dairying in order to increase their profit margins, although many small herds were liquidated during the 1930s and 1950s because of drought and a major drop in the price of milk. Wheat and other small grains continued to dominate farm output, especially in the northern and central parts of the state.

The farm crisis of the early 1920s and the Great Depression of 1929-35 wiped out much of the farm wealth that had accumulated during the era of prosperity. Chief among South Dakota farmers' problems, aside from the near-collapse of the general economy and depressed commodity prices, was the persistence of drought. Outbreaks of wheat rust and grasshopper infestations further reduced crop yields and forced many farmers to leave the land. The average value of an acre of South Dakota farmland fell from over $200 in 1920 to less than $50 in 1940, while the market prices for wheat, corn, and beef did not return to 1919 levels again until after the Second World War. Nevertheless, the number of farms and agricultural production actually increased during the 1930s, despite tremendous population shifts. The adversity of the Great Depression was followed by a spectacular expansion of farming brought on by the Second World War which greatly improved the financial condition of most farm and ranch families. The postwar years saw the trend toward farm enlargement resume and accelerate, although much of the increase was offset by the increasing number of family farms that passed out of existence. New kinds of farm machinery, electric power, and improved highways helped lighten the work and improve the quality of life on thousands of farms and farms.

By the middle of the twentieth century three distinct type-of-farming regions had developed within the state's borders. The Corn Belt system of mixed feed crops, grain, and livestock farming predominated in the east and east-central areas, where corn was the major field crop. Because corn cropping draws heavily on soil fertility, farmers grew oats, wheat, soybeans, and hay as the transitional crops in a three- or four-year rotation. A large proportion of the crops raised were used to fatten beef cattle and hogs, although there were also many large farms where corn, oats, and soybeans were cultivated as cash crops. The practice of fattening beef cattle on grain in farm feedlots, which had been evolving in eastern South Dakota since the 1880s, became more widespread after 1935, although the region was regarded as under-stocked with feeder cattle throughout most of

the 1950s due to the persistence of drought conditions. Because of its cooler climate and less productive soils, the counties in northeast South Dakota historically had a higher proportion of dairy farmers and a considerable amount of dairy farming continued to be carried on in the southeast corner of the state as well because of its close proximity to major markets for fluid milk. Farming in the north-central counties was dominated by spring wheat and small grains, as it had been since the days of the homesteaders, and increased mechanization significantly enlarged the acreage that could be farmed by a single family. Barley and flax were also grown on a commercial scale and most grain farmers also raised some cattle as well as small acreages of corn and hay. The western half of the state was part of the range livestock region where beef cattle and sheep were the most important enterprises. Three-fourths of all land west of the Missouri River was used for grazing, although less than half of it was privately owned. By the late 1950s, the trend away from raising steers on grass was well underway and most of the cattle raised on the western range were being shipped as calves or yearlings to farms and feedlots in the Corn Belt to be fattened on grain before they were sold for slaughter. Drought and shortages of range feed made the 1950s a difficult decade for cattlemen, however.

As with other sectors of the South Dakota economy, the transformation of agriculture and rural life between 1857 and 1958 was driven by long-term economic shifts, as well as periods of economic and environmental crisis. Among the most influential trends were technological development, the rise of consumer influence in agricultural production, and the increasing integration of South Dakota farming and ranching into national and global markets. Technological developments in agriculture were particularly influential in driving change on the farm and the pace of change, already rapid during the late-nineteenth century, became extraordinarily rapid during the post-settlement phase in the state's history. Advances in farm mechanization and transportation led to ever-increasing economies of scale that spurred rapid and far-reaching shifts in farm size, accompanied by an equally rapid decline in the number of farms and in the farm population. From near complete reliance on animal power in 1900, South Dakota farmers rapidly embraced mechanical power: threshers, combines, tractors, and trucks became routine adjuncts to farming by 1940. Advances in plant and animal breeding increased yields and quality and helped generate unprecedented growth in agricultural productivity. At the same time, the structure of farms and the built environment also underwent tremendous transformation.

2. Architectural History

South Dakota's common farm barns are best understood and appreciated as examples of vernacular architecture. Vernacular architecture encompasses many types of buildings which were constructed for everyday use by ordinary people, often using locally available materials, and reflecting regional variations in the built environment. Unlike the academic or period styles, architectural fashion did not dictate farm barn design to any great extent—there is no such thing as a "Victorian" or a "Craftsman" barn. In most cases, if a farmer wanted to make his barn appear more stylish, he embellished it with some minor form of detailing, such as exposed rafter tails along the eaves of the roof or some stickwork applied to the gable wall. The typical South Dakota farm barn built between the 1850s and the 1950s was a large, wood-framed, general purpose outbuilding that provided shelter for crops, animals, tools, and manure under one roof. Although somewhat plain if not altogether homely in appearance, it was usually built strong, capacious, and well proportioned. Drainage, exposure to sunlight, and access to water were the chief practical considerations in selecting the building site, and as agriculture expanded and farms became more specialized farmers sometimes added a lean-to or wing to the old barn or erected a second barn to meet the requirements of new crops and livestock.

Under ordinary circumstances, farmers and ranchers built the kinds of barns they were used to working with. Oftentimes they simply followed the lead of their neighbors, which explains why the predominant barn types in South Dakota are conventional Midwestern barns that reflect the broad patterns of farm barn development in the north-central states. Like generations of American agriculturists before them, whenever they encountered novel situations, Dakotans attempted to reconcile the new environment to their preconceived notions of what a good

farm barn should be. Thus, barn builders have historically tended to be conservative, preferring to design and construct their farm barns along traditional lines, though they were usually amenable to variations suggested by other farmers. The profession of the agricultural engineer did not emerge until the early 1900s, but many important innovations in barn planning trickled down to farmers, either by personal contact or through books, magazines, agricultural bulletins, and newspapers. In newly settled areas under frontier conditions, homesteaders had little choice but to build for expediency, guided by common sense and convenience, using whatever materials were at hand. In long-settled agricultural districts, however, a few common barn configurations came to be preferred over others, and in most cases the choice of design and materials for new farm barns seems to have been influenced most by their similarity to the barns forms prevailing in neighboring communities. Over time, specific combinations of roof shapes, floor plans, structural systems, and materials became fixed solutions to the requirements of individual farmers and ranchers for new barns. Some of these common barn modes persisted in South Dakota for over a century.

The Origin and Diffusion of Common Barn Forms

The basic pattern of rural settlement and agricultural development in South Dakota was derived chiefly from the Midwest. It is not surprising, then, that the common farm barns of South Dakota are not very different from contemporaneous farm barns built in Minnesota, Iowa, North Dakota, and Nebraska. Working under the assumption that farm barn building concepts were shaped primarily by regional and ethnic influences, barn historians have generally looked to the New England and Middle Atlantic culture hearths, as well as Old World folk architecture, for the pre-industrial origins of Midwestern barn-building traditions. The prototype for the conventional, two-level, gable-roofed general purpose farm barn, for example, is most often identified in the literature as the English three-bay threshing barn that evolved in New England during the seventeenth and eighteenth centuries. German and Swiss emigrants are credited with the introduction of the bank barn, widely known as the Pennsylvania Barn, and large, multi-level farm barns with masonry basements are sometimes referred to simply as “German” barns, regardless of location or the cultural affiliations of their builders. Much of the current thinking on barn type origins and diffusion tends to emphasize the “Americanization” of traditional Colonial and Old World folk barn forms through regional innovations and adaptations.

While culture is not necessary rooted in ethnicity or nationality, the folk building traditions of some ethnic groups have been shown to be durable and persistent with respect to farm barn architecture in South Dakota. Folk architecture is characterized by its conservatism, drawing upon a limited range of building prototypes and allowing few individual variations. Immigrants carried their folk barn designs and methods of construction in their collective consciousness, thus eliminating the need for any kind of plans. These traditional approaches to building seem to have been very much alive and well in certain parts of South Dakota during the early settlement period. Few, if any, folk barns appear to have been built in the state after 1940, however.

South Dakota’s ethnic tapestry has always been a complex mosaic and the folk architecture contributions of immigrant communities were varied. By and large, foreign-born settlers seem to have largely discarded their traditional barn forms when they arrived in South Dakota and were content to build farm barns which resembled those of their American neighbors. This is not surprising, as a pervasive national culture had already developed by the mid-nineteenth century, particularly in the Midwest, and the impulse for immigrants to conform to the dominant cultural forms of their new homeland must have been strong. However, in certain places where dense concentrations of a particular ethnic group occurred, cultural historians have sometimes been able to discern examples of their distinctive folk architecture in barns, though the reasons for their perseverance is not always clear. For example, German-Russian immigrants in southeast South Dakota made greater use of their traditional house-barns, in which humans and animals were quartered together under the same roof. Farm barns which reflect elements of ethnic folk architecture are notably present in eastern South Dakota, where a handful of surviving specimens of Czech, Norwegian, Danish, and Finnish folk barns have been documented.

Although they were the dominant culture group in South Dakota, American immigrants whose ancestors had resided in North America for multiple generations, the so-called "old-stock Americans," also subscribed to a number of folk building traditions. South Dakota's native-born settlers hailed from diverse regions but were predominantly Midwesterners whose forbears had been part of the great westward migration into the Old Northwest and the Upper Mississippi Valley and they appear to have been fairly evenly distributed along the homesteader frontier that swept over the region between 1857 and 1915. The culture hearth of the "cattle kingdom" in the West River country, on the other hand, was Texas and the Old Southwest, where the predominant architectural and land use patterns were an amalgam of Tidewater, Appalachian, and Spanish Borderland traditions. With respect to barn building, the Midwesterners generally adhered to the "big barn" pattern that had developed in New England and Pennsylvania, with its emphasis on large, wooden grain and livestock barns. In contrast, West River livestock ranchers as a group were not heavily dependent upon buildings other than dwellings, and when they built barns they seem to have been less bound by tradition and were more inclined to adopt new, functional forms.

Several distinct but related folk barn building traditions converged during the westward movement of American agriculture across the Appalachian barrier that began in the late-eighteenth century. In what is now western Pennsylvania and Ohio, the exigencies of pioneer life forced settlers to adapt their farming practices and buildings to changing conditions, and as settlers from various regions and ethnic backgrounds were thrown together under similar environmental conditions there gradually developed a composite form of vernacular barn architecture that was unique to the Midwest. Even during the very early stages of agricultural settlement in the Old Northwest, several innovations in farm barn form and structure were in evidence by the 1820s. Several major farm barn types eventually evolved in Ohio, Indiana, and Illinois, the core of the Midwest, where the English Three-Bay, Raised Three-Bay, Pennsylvania Bank Barn, and Sweitzer types predominated. With small modifications, these were the types of conventional farm barns that were built in Michigan, Wisconsin, Iowa, and Minnesota during the early settlement period. These regional vernacular adaptations of folk barn prototypes were not significantly modified by agricultural science and engineering until near the end of the nineteenth century.

In South Dakota, most common farm barns were an amalgam of pre-industrial and contemporary vernacular building forms. The term *contemporary vernacular* refers to the popular architecture that emerged from the Industrial Revolution. The factory system in North America dates from the early 1800s and the rising tide of industrialization had an immediate and transformational impact on agriculture, especially in the areas of mechanized cultivation and transportation. In the area of farm building, new technologies and products also effected revolutionary changes in the form, structure, and fabric of farm barns, but the pace of change was slower. First and foremost, the mass production and marketing of machine-sawn lumber stimulated the development of balloon-framing, which allowed barn builders to substitute light-weight milled boards for the traditional heavy timber frames, while at the same time saving farmers' considerable labor and expense. Of course, without the invention and manufacture of railroad transportation equipment, commercial lumbering would have been well-nigh impossible on the western plains. By the time South Dakota was opened to settlement, barn builders had come to rely more and more on factory-made building tools and materials, including machine-cut nails, door and window hardware, galvanized sheet metal, window glass, saws, and hammers. The invention of new farming implements and machinery also effected important changes in the form and function of farm barns. Like agriculture itself, the pattern of barn type diffusion was east-to-west and at the local level was tied to the proximity of railroads. The progress of barn design was likewise influenced by the state of regional agricultural development, with the most rapid development occurring wherever farming operations were most intensive and there was capital available for investment in new buildings.

The relationship between folk and contemporary vernacular architecture was never stable with respect to farm barns. Although contemporary vernacular architecture strove for efficiency through the application of science and

technology, farmers were by nature conservative in their approach to building and pressure to confirm with "general consent" was an important, though under-recognized, characteristic of farm management during the era of traditional farming. In South Dakota generally, cultural traditions continued to inform the design and construction of farm barns well into the twentieth century. Even barns designed by academically trained agricultural engineers often incorporated traditional barn forms, such as the gambrel roof shape or board-and-batten siding, in deference to long established tastes and conventional wisdom. The forms, plans, and images of contemporary vernacular farm barns were transmitted and entered the collective consciousness of farmers experientially, through observation and personal communication, or through the media of agricultural journalism, education, and commercial product marketing. Thus, contemporary vernacular architecture was popular architecture in the truest sense, in that it allowed individual farmers and builders to self-consciously select the basic barn plan that best met their particular needs and then modify it according to their notions of usefulness and propriety.

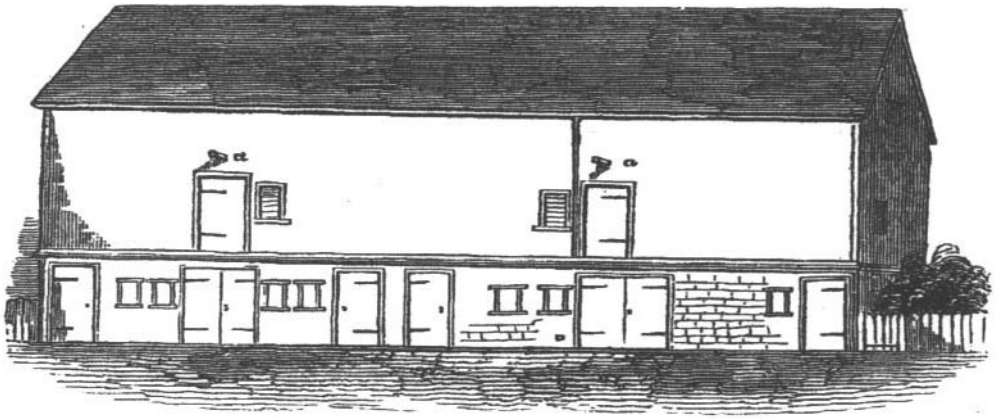
The Influence of Agricultural Science and Engineering

In the eastern United States the work of John Pitkin Norton, Orange Judd, Jesse Buel, and others demonstrated to Americans the practical benefits of scientific farming before the Civil War. Relatively little interest was shown in barn improvements, however, outside of a small circle of wealthy gentleman farmers and amateur architects. Early efforts aimed at improving the quality of rural architecture through books such as Asher Benjamin's *American Builder's Companion* and Minard Lafever's *Modern Builder's Guide*, both published in the 1830s, probably had little influence on western farm building because of their limited distribution. However, a distinguishing feature of nineteenth-century book publishing in the United States was the architectural pattern book containing written descriptions, plans, and elevations for every conceivable kind of building. The first mass-market pattern books aimed at general readers appeared during the late 1830s and the genre remained popular until the early 1900s. Andrew Jackson Downing and Alexander Jackson Davis were nineteenth-century America's most original and prolific architects and while their main focus was on picturesquely styled cottages and villas, their appreciation for the role of architecture as a civilizing force in rural life was expressed in numerous plans for farm barns. Davis introduced balloon framing to a mass audience in his pattern book *Rural Residences* (1837), while Downing's *Cottage Residences* (1842) and *The Architecture of Country Houses* (1850) became national best-sellers and were frequently reprinted for generations after the author's untimely death in a steamboat accident in 1852. Although they are widely credited with launching the Victorian aesthetic in American domestic architecture, the extent to which the early pattern book architects directly influenced common barn building is difficult to gauge.

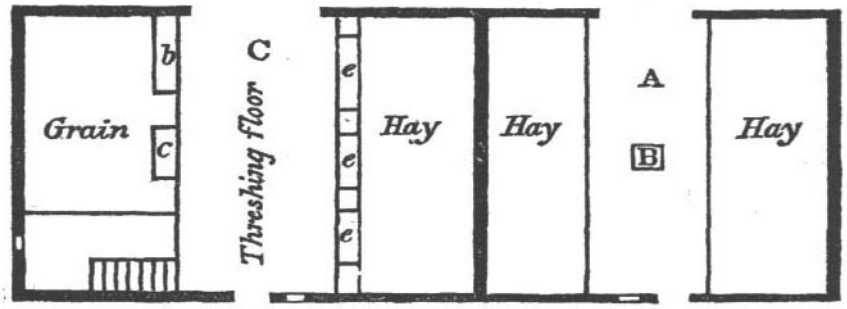
The federal government's involvement in agriculture dates from 1839, when Congress appropriated funds for the use of the Patent Office in collecting agricultural statistics. The first annual report on agriculture in the United States appeared in 1854 and in 1862 responsibility for the promotion of agriculture was transferred to a the newly created bureau headed by the Commissioner of Agriculture. The bureau's 1867 report devoted a section to barns, illustrated with engraved views, and offered the following commentary on the need for a new kind of general purpose barn:

> A modern American barn upon a farm where a general mixed husbandry is practiced ought to include under one roof, or at least in one building, including wings, all the accommodations furnished by the collection of buildings which usually form so nondescript a group around any old farm homestead . . . One good building takes the place of a score of others of all ages and as diverse in character as ingeniously inconvenient.[2]

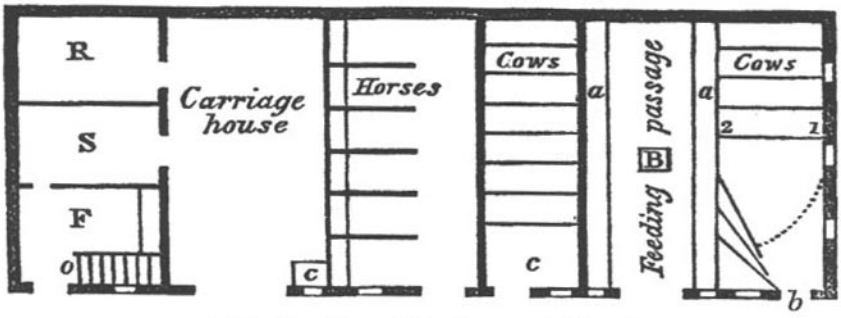
[2] "Model Farm Buildings," *Annual Report of the Commissioner of Agriculture, 1867* (Washington, 1868), 284.



[Fig. 95. Elevation of a Basement Barn.]



[Fig. 96. Plan of the Main Floor.]



[Fig. 97. Plan of the Basement Floor.]

Elevation and plans of a “basement barn” for A. J. Downing, *The Architecture of Country Houses* (1852).

Grassroots interest in agricultural improvements found an outlet in agricultural societies, which sprang up all over the country during the nineteenth century to spread information about improved farming methods through agricultural fairs and publications. There were over nine hundred agricultural societies in the United States by 1858 and the institution migrated west into Dakota, where a territorial agricultural society was formed in the late 1870s. County agricultural societies were also formed and several put on fairs prior to the first territorial fair held at Sioux Falls in 1885.

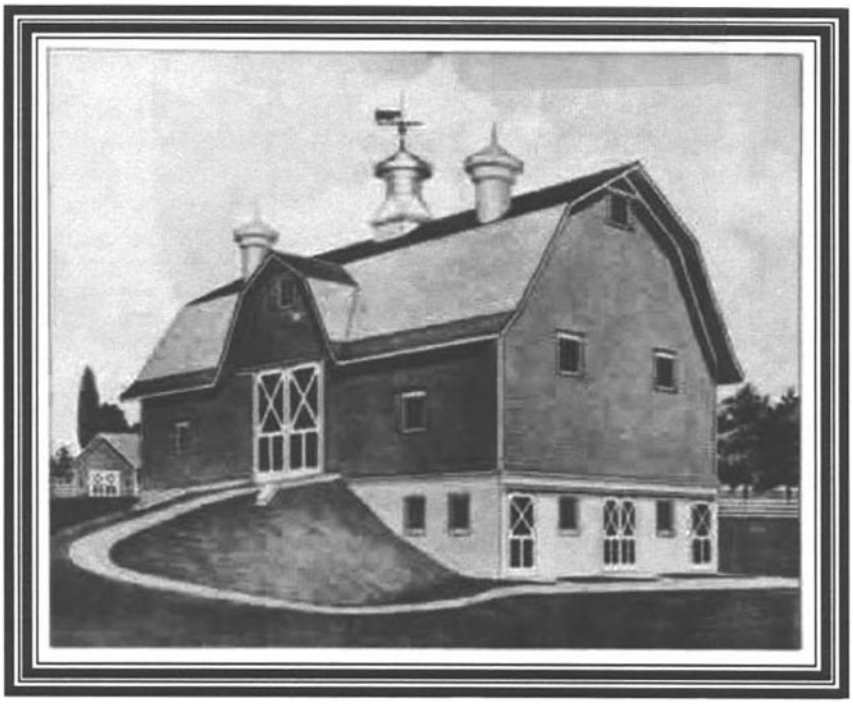
Agricultural journalism evolved in tandem with the agricultural societies. The beginnings of the "farm press" can be traced to *The American Farmer* (1819-33), *The Cultivator* (1834-53), and the *American Agriculturist* (1842-79). There were at least thirty agricultural periodicals in circulation by the 1840s, with more than one hundred thousand subscribers. Chicago emerged as the hub of agricultural publishing, with over fifty farm periodicals published there. Probably the most influential Midwestern farm journal was *The Prairie Farmer*, founded in 1840 as the *Union Agriculturist and Western Prairie Farmer* by the forerunner of the Illinois State Agricultural Society; starting with a subscription base of about 500, the weekly newspaper was mailed to more than 12,000 in 1859 and circulation peaked at 370,000 in 1950. The first mass distribution farm newspaper to be published in Dakota Territory was the *Dakota Farmer*, founded in Aberdeen in 1881, followed by the *Northwestern Farmer and Breeder* which started publication in Fargo in 1883. Both papers were subsequently acquired by Fargo businessman Edward A. Webb, who merged them to form the *Northwestern Farmer*. In 1890 Webb moved the company to the Twin Cities, where the paper, renamed *The Farmer* in 1898, formed the basis of the Webb Publishing Company, which continued to print a separate South Dakota edition until 1979. Other widely read late-nineteenth century farm periodicals with a penchant for farm barns included the Chicago-based *Breeder's Gazette* (1881-1931), a weekly illustrated livestock and crop reporting journal founded by J. H. Sanders, who also published numerous books of barn plans. Much of the success of these farmer periodicals stemmed from their practice of soliciting information from individual farmers. An opinion survey of farmers conducted for the U.S. Department of Agriculture revealed that the farm press was one of the dominating influences in American agriculture, ahead of the agricultural colleges and cooperative extension services.

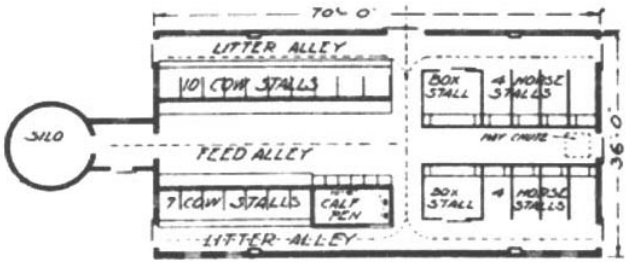
While many of the early published barn plans illustrated the inventiveness and ingenuity of their creators, many were not practical for use by ordinary farmers. Lewis F. Allen, author of one of the earliest architectural pattern books aimed at rural builders, cautioned against eccentricity in barn design:

> It may not be out of place here, to remark that many *designers* of barns, sheds and other out-buildings for the accommodation of farm stock, have indulged in fanciful arrangements for the convenience and comfort of animals, which are so complicated that when constructed, as they sometimes are, the practical, common-sense farmer will not use them; and, in the *learning* required in their use, are altogether unfit for the use and treatment they usually get from those who have the daily care of the stock which they are intended for, and for the rough usage they receive from the animals themselves. A very pretty, and a very plausible arrangement of stabling, and feeding, and all the etceteras of a barn establishment, may be thus got up by an ingenious theorist at the fireside, which will work to a charm, as he dilates upon its good qualities, untried; but, when subjected to experiment will be utterly worthless for practical use.[3]

Notwithstanding the obvious need for better educational facilities, agricultural education in the United States got off to a slow start. Professorships in natural history, chemistry, and agriculture were established at Columbia, Yale, and other eastern colleges at a fairly early date, but there was no institution of higher learning dedicated principally to the agricultural sciences until the 1850s, when Michigan, Maryland, and Pennsylvania created the

[3] *Rural Architecture* (New York, 1852), 288.





Description

This barn is 36 ft. wide by 70 ft. long.

The basement wall extends 10 ft. above the ground and the frame sidewalls are 14 ft. high.

The lower story is 9½ ft. high, the hay mow is 29 ft. high from floor to hay carrier-track, the vertical sidewalls in the hay mow are 13 ft. high, and the ridge of roof is 43 ft. above the ground.

The basement wall is of concrete construction, and the entire floor of the lower story is of concrete construction.

Mow capacity, 100 tons loose hay.

The barn above the basement is of plank-frame construction and has a clear hay mow without posts.

Louden Barn Plan Design Number 2566B Louden Machinery Company catalog.

first state-supported agricultural colleges. The great impetus to agricultural education came with the passage of the Morrill Act in 1862, which provided for a grant of land to each state for the purpose of endowing colleges of agriculture and the mechanic arts. Land grant colleges were soon established in all of the states and territories, including Dakota, where the Dakota Agricultural College at Brookings (modern-day South Dakota State University) opened its doors in 1885. The Hatch Act of 1886 provided funds for agricultural experiment stations in the various state colleges with the mission of research in all branches of agriculture which were considered useful to farmers. The territorial legislature was quick to establish stations at Fargo and Brookings. The value of agricultural extension work was recognized by Congress in 1914 with the passage of the Smith-Lever Act, which appropriated funds for a wide range of farmer education and technical assistance programs, including the extension agent program. A year later, the South Dakota legislature approved funds for a new agricultural extension facility on 320 acres northwest of the recently re-named South Dakota College of Agriculture and Mechanic Arts at Brookings. In addition to teaching and research, the mission of the agricultural colleges and experiment stations included the dissemination of information to farmers. The South Dakota Agricultural Experiment Station began printing extension bulletins in 1887 and had fifteen titles in its catalog by the time of statehood.

The period from roughly 1870 to 1940 witnessed revolutionary changes in the design and construction of farm barns. By that time the Industrial Revolution had progressed sufficiently so that many kinds of buildings could be planned on solid engineering principles and built from standardized, mass-produced materials. In large parts of the country, folk barn architecture gave way to contemporary forms. This trend toward designed farm barns encouraged architects, engineers, farm managers, and building materials manufacturers to concentrate more on the development of new kinds of farm barns. At the same time, improved building tools, materials, and marketing made it easier for farmers to learn about, acquire, and build better farm buildings.

No factor has been more significant in the evolution of farm barn design than the advent of agricultural engineering. The formative years of the profession took place during the late eighteenth and early nineteenth centuries, but until the 1870s agricultural science placed more emphasis on improved farm machinery, soil chemistry, plant science, and animal husbandry than on farm planning or structural engineering. Opportunities for professional practice in designing barns were few and far between until near the turn of the century. Much of the early work in farm barn engineering was carried on by amateurs, mostly individual farmers, carpenters, and mechanics. For example, neither John L. Shawver or Joseph E. Wing, who were responsible for some of the earliest breakthroughs in the application of balloon framing and self-supporting rafter systems to farm barn design, was a trained architect or engineer—Shawver, of Bellefontaine, Ohio, was a former schoolteacher, while Wing was a gentleman farmer from upstate New York.

Before the 1880s it was difficult to obtain comprehensive, professional training in agricultural engineering and much of the early academic work in the field was carried on by men who had been trained in other disciplines such as agronomy, chemistry, economics, or civil engineering. The multidisciplinary character of the profession is personified in the career of Franklin Hiram King of Wisconsin, who taught agricultural physics, invented a widely used barn ventilation system, was chief soil agent of the U.S. Bureau of Soils, and conducted the first agricultural engineering extension work in the 1890s. A great deal of important work on farm barns was carried at an early date at the various Midwestern agricultural colleges and experiment stations. The first undergraduate degree programs in agricultural engineering were established at the Iowa State College and the University of Wisconsin in 1904, and the colleges of agriculture and engineering at Minnesota, Illinois, Michigan, and North Dakota also offered undergraduate training in the field and eventually established agricultural engineering degree programs. In 1907 agricultural engineers from around the country gathered at the University of Wisconsin in Madison to character the American Society of Agricultural Engineers (now known as the American Society of Agricultural and Biological Engineers).

According to the annual reports of the Agricultural Experiment Station at Brookings, instruction in agricultural engineering was included in the course of study at the Dakota Agricultural College during the late 1880s. In the 1890s a Department of Architecture and Agricultural Engineering was established, although agricultural engineering did not attain the dignity of a separate department until 1925. The barns constructed on the Brookings campus and at the Eureka, Highmore, Cottonwood, and Vivian sub-stations were showplaces and laboratories for the new building methods. South Dakota's agricultural engineers made important contributions in diverse areas, including development of one of the first forced-air barn ventilation systems (see Kelley 1921). Ralph L. Patty, who was appointed extension specialist in agricultural engineering in 1916, carried out important work in the areas of farm drainage and dairy barn sanitation and garnered national attention for his experiments with rammed earth construction in the 1930s.

Prospective farm barn builders in South Dakota did not lack for farm barn plans and specifications that were inexpensive and readily available from a variety of sources. This included practical information on the design, construction, and maintenance of farm buildings disseminated by the various agricultural colleges and experiment stations, which were published in bulletins and circulars that were distributed gratis to any farmer who asked to have his names placed on a station's mailing list. Agricultural engineering research and farm building education was also carried on by the U.S. Department of Agriculture, where the bureau of agricultural engineering began collecting data relating to farm buildings in the early 1890s. Over the years a wealth of information about farm barns found an outlet in the department's numerous publications programs, especially the *Farmer's Bulletin* pamphlet series, with more than two thousand titles, which were distributed to farmers free of charge from 1889 until 1984.

Architectural pattern books enjoyed a renewal of popularity after the Civil War and continued to include farm barn plans, often accompanied by detailed specifications and step-by-step instructions for their erection. An entirely new genre of barn plans emerged near the end of the nineteenth century when commercial barn planning services began to produce and distribute catalogs of barn plans, often as an adjunct to other agricultural product lines. The most successful of these was the Louden Machinery Company of Fairfield, Iowa. Founded in 1867 by William Louden, the company started out as a manufacturer of hay fork carriers and other farm equipment invented by Louden himself. The company entered the architectural business in the 1890s and eventually marked a wide range of houses, garages, and other buildings. Louden's free barn planning service was started in 1906 and relied on colorfully illustrated catalogs to market its ever-growing portfolio of general purpose and specialty barns. Louden advertised widely in the farm press and offered its customers coupons redeemable for free, customized barn plans. Between 1907 and 1939, the Louden design team in Fairfield reportedly drew up plans and specifications for more than 30,000 farm barns for clients all over the world.. A competitor, the James Manufacturing Company of Fort Atkinson, Wisconsin, also garnered a share of the Midwestern barn planning business through its *Jamesway Barn Book* farm building magazine. There were hundreds, perhaps more than one thousand different farm barn plans in circulation by the late 1920s.

A raft of trade books aimed at encouraging farmers to construct better farm buildings appeared during the first two decades of the twentieth century, with titles like *Barn Plans and Outbuildings*, *Modern Farm Buildings*, *The Farmer His Own Builder*, *The Farmstead: The Making of the Rural Home and the Lay-Out of the Farm*, and *Modern Farmyard Buildings*. Many of these works were frequently reprinted, indicating a strong and persistent demand. Barn plans also made up chapters in general guides to farming and the popular encyclopedia *Farm Knowledge*, which was prepared for Sears, Roebuck and Company. William A. Radford, an architectural pattern book impresario based in Chicago who was best known for his house plan books, also published several volumes of barn plans as well a manual on framing, all under the auspices of the Radford Architectural Company. Radford, who also stumped for barns on the road and held free barn planning seminars for farmers, claimed it cost thousands of dollars to compile each book, which retailed for one or two dollars. Few agricultural publishers devoted as much ink to barn plans as James H. Sanders and his son Alvin, publishers of the *Breeder's Gazette*.

In the 1890s Sanders and his son created their own publishing house to produce volumes of farm building plans contributed by *Gazette* subscribers and leading experts from around the country. Many of the barn plans were contributed by farmers and were illustrated with renderings prepared by the staff at Sanders Publishing. The company's philosophy on barns and the need for barn books was summed up by Alvin Sanders:

> In barn building as in the planning of the farm house, nearly every individual has his own peculiar ideas and tastes. It is rarely that one is entirely satisfied with what a neighbor has done in such matters. At the same time it is clear that many general propositions may be gleaned from a study of what successful farmers in different parts of the country have already carried out.[4]

A number of respected academics also produced textbooks for courses in farm management and agricultural engineering that influenced the broad pattern of farm barn design and construction beyond the classroom walls. Of these the most popular and widely used were probably *Agricultural Engineering*, a general textbook by J. Brownlee Davidson of Iowa State College, published in 1913 and widely adapted by others; and *Farm Buildings*, co-authored by Deane G. Carter and W. A. Foster of the Iowa State Agricultural Experiment Station, first printed in 1922, with a fourth edition issued in 1954. Karl J. T. Ekblaw of the University of Illinois contributed a general textbook on rural building, *Farm Structures* (1914), and the first comprehensive work on the uses of concrete in farm construction (1917) that were standard reference works for years to come. By the 1920s, agricultural engineers had largely displaced architects in farm building—the prevailing opinion among the engineering profession being that architects were not equipped to design proper farm barns because they "did not care for this class of work because of the low fees for services and lack of transportation facilities."[5] Farm buildings figured prominently in the agricultural engineering literature of the 1920s and 1930s, which saw a steady stream of important contributions on barn design, sanitation, construction methods, planning, and maintenance.

Interest in factory-fabricated, mass-distributed farm buildings developed toward the end of the nineteenth century. The first mail-order catalog barn "kits" may have appeared as early as the 1860s but apparently did not gain wide acceptance until after the turn of the century. Sears, Roebuck and Company was not the first to offer barns for sale through its mail-order catalog, but its *Book of Barns* may have been the number-one source of kit barns in the country between 1911 and 1929. In addition to the illustrated catalogs, kit barns were also widely advertised in newspapers and magazines. To obtain a mail-order barn, a farmer simply selected a model from one of several catalogs that were in wide circulation and submitted the order with a down-payment. Barns were available for as little as $800, delivered. Barn lumber, hardware, and fixtures were manufactured at mills scattered around the country—Gordon-Van Tine Company, which fabricated most of the Sears barns and also marketed its own brand of barns, had mills in Davenport, Iowa, Chehalis, Washington, and St. Louis, Missouri. Once the parts had been manufactured they were shipped to the various company building yards, where they were marked, assembled, and shipped to the railroad station nearest the purchaser.

The focus of agricultural engineering eventually began to shift away from farm buildings toward an emphasis on farm machinery, drainage, and irrigation, although barn plans continued to be developed and distributed. The Midwest Plan Service, a consortium of agricultural engineering departments formed to develop and distribute state-of-the-art farm building plans, was formed in 1933 with the South Dakota State Agricultural Extension Service as a charter member. The trend toward mass-produced farm buildings was directed by the growing class of professionally trained agricultural and industrial engineers who were employed by private companies that had begun moving to capitalize on the new building technologies. Like their colleagues at the agricultural colleges and experiment stations, private sector engineers also conducted research and experiments in new farm barn design and construction and published the results of their work in professional journals, monographs, and trade

[4] *Farm Buildings* (Chicago, 1905), Publisher's Note.
[5] W. A. Foster, "Agricultural Engineering in Farm Buildings," *Agricultural Engineering* 1 (1920), 27.

magazines. An important marketing tool for the new generation of farm barns was found in the promotional materials which were widely distributed by extension personnel and given away free at state and county fairs.

3. Construction Methods and Materials

Wood

Although expert opinion advised farmers to put up good barns as soon as possible, most Dakota homesteaders were subsistence farmers who sheltered their draft animals and grain in small, temporary, and crudely built structures. Building with logs was a traditional American craft and generations of pioneers had been accustomed to felling, peeling, and notching logs for use in building houses, barns, stockades, and bridges. Conditions were favorable for log construction in southeast South Dakota, where the mingled groves of upland hardwoods and dense floodplain forests provided suitable trees; and in the pine forests of the Black Hills. The horizontal corner-notched log construction technique was a Scandinavian import that apparently entered North America with the Forest Finns who settled on the lower Delaware River in the 1630s. The lineal ancestor of most South Dakota log barns was probably the Appalachian crib folk barn, of which preserved specimens exist in the older settled parts of the Midwest but not in South Dakota.

To construct a log barn, the builder needed to fell trees of uniform size, cut them to uniform length, notch the ends, and stack them so that the notched corners interlocked, forming a rectangular crib that required neither bracing or nails. The better-built log barns would have used logs that were hewn flat on two sides and the corners notched so that the inner and outer walls were flush; however, round logs were probably used more often in the building of small barns on subsistence homesteads because they were easier to handle. Saddle notching, whereby the end of the upper log is grooved to fit with its neighbor, was probably the most common form of notching and worked well with both round and split logs. Square notching was also a traditional method and a competent woodsman could make a very tight crib using half-dovetail or dovetail notching. Most often it was the high cost of milled lumber before the railroads came which dictated using indigenous materials. Among the species available for use in log building construction were white oak, bur oak, basswood, quaking aspen, cottonwood, and Ponderosa pine. Some black walnut, silver maple, and western red cedar logs also probably found their way into pioneer log barns, and whole round or partially hewn logs with the bark left on also occasionally turn up as substitutes for timber posts or joists in framed barns. Small pioneer barns would have been sided or roofed with split-logs if lumber was scarce or unavailable. Although the log barn was by no means the poorest type of farm barn, sooner or later, the pioneer log barns were dismantled, abandoned, or replaced with frame structures.

Theoretically, just about any species of tree could be sawed into lumber for use in farm building construction, so the first frame barns in any district were more often than not built from whatever wood was readily available. The floodplain forest bordering the Missouri, Sioux, James, and Vermillion rivers produced many kinds of large trees that could be harvested and milled into boards for use in building construction. Early immigrant guide books called attention to the native timber resources of the new territory and county histories often record steam sawmills established at an early date, which suggests that lumbering, rather than farming, may have been the first commercial activity of the Dakota pioneers. On the open prairie, homesteaders scouted out the local trees and chopped down the biggest for use in construction. Oak, the preferred hardwood for timber framing, was limited to scattered groves of bur and white oak in the extreme eastern and southeastern parts of the state; therefore, it is likely that much of the oak found in South Dakota barns was imported from neighboring Minnesota and Iowa.

Cottonwood was probably the native species most often used for barn framing and quite a bit was also sawed into lumber for siding and shingles. An early twentieth-century U.S. Forest Service study noted that it was widely used for construction lumber, including barn framing, in the Mississippi Valley. The eastern cottonwood is a common

bottomland hardwood tree in eastern South Dakota and also grows in pure stands along watercourses in the western parts of the state. Cottonwood is one of the softer hardwoods, but hardens when dried and therefore works well for rough building construction, though without paint or any other kind of preservative cottonwood boards provide only a few years of service before they become warped and cracked. An early immigrant guide reported the mills in Union, Clay, Yankton, and Bon Homme counties were producing cottonwood lumber for between $15 and $25 a thousand board feet in the late 1860s; but the same source also mentions that the railroads were bringing in "plenty of pine lumber" from Minnesota and Iowa. South Dakota sawmills also cut basswood, maple, ash, and willow for rough framing and boards for farm buildings. The American elm was traditionally sawed into boards for barn framing in the east, but it is not known to what extent this practice extended west of the Mississippi River.

The oldest technique used in barn building was heavy timber frame construction, sometimes referred to as "post-and-beam" construction, which was the common framing system employed throughout North America from Colonial times. Timber framing utilized large wooden posts and beams up to a foot thick that were fitted together with interlocking joinery and fastened with tapered wooden pegs or dowels. This kind of structural system required a large number of heavy pieces of wood, preferably hardwood, which had to be cut by the scribe rule and shaped with cross-cut saws, broadaxes, and adzes before they could be carefully fitted together to form a rigid, self-supporting framework. Construction of farm barns using heavy timber framing was limited geographically to southeast South Dakota and the Black Hills, where there was abundant native timber. The type of timber used for framing determined to a great extent the size of the timber sticks, oak being much stronger than cottonwood, for example. If oak was not available, and the builder had access to another hardwood such as maple or cottonwood, he used them. If suitable timber sticks for framing could not be obtained locally, the builder had to either purchase hardwood timber produced elsewhere or use pine. When whole sticks of timber in the required lengths were not available, sills and plates needed to be spliced together at the bents or the width of the barn had to be reduced. Because of the large timbers and special skills needed to assemble them, heavy timber frame barns were expensive to build. Oak timbers of sufficient length and thickness for heavy framing became increasingly hard to come by after 1890.

Because much of South Dakota is naturally treeless prairie and hundreds of miles distant from the nearest sources of native hardwood timber, relatively few barns were framed entirely with heavy timbers. The predominant structural system was plank framing, a modification of the balloon framing system, which utilized dimensional lumber with nailed joints for the bearing walls, joists, and rafters. Balloon framing may have been invented in 1832 by George Snow in Chicago and was the standard in home and commercial building construction by the 1850s. Because it called for identical pieces of two-inch milled lumber that were joined with nails instead of wooden pegs, plank frame construction was cheaper, faster, and required much less skill than traditional timber framing. The largest pieces of lumber used were usually 2X12 boards, which could be obtained from just about any lumber yard. Another significant advantage of plank framing was that it allowed for taller, wider barns with self-supporting roofs, which greatly increased the space available in the loft for storing hay and other fodder.

John L. Shawver, inventor of the celebrated "Shawver Truss," described plank framing in an address before the Wisconsin Farmers' Institute in 1896:

> In the old-style barns we were accustomed to using square timbers, and the rule was to put a great many timbers horizontally in the barn. Now, you can take a piece of square timber, and unless it is thoroughly braced and supported in all places, it will bend and give way. Now, if you take a piece of timber, thin but wide, you have only two-thirds as much material in this piece as in the other . . . If you put it on edgewise it is impossible to bend it to the same extent that you do the other. Another thing, in the old style frames we usually put up our frames with short braces having a run of three or four feet. The result was that they

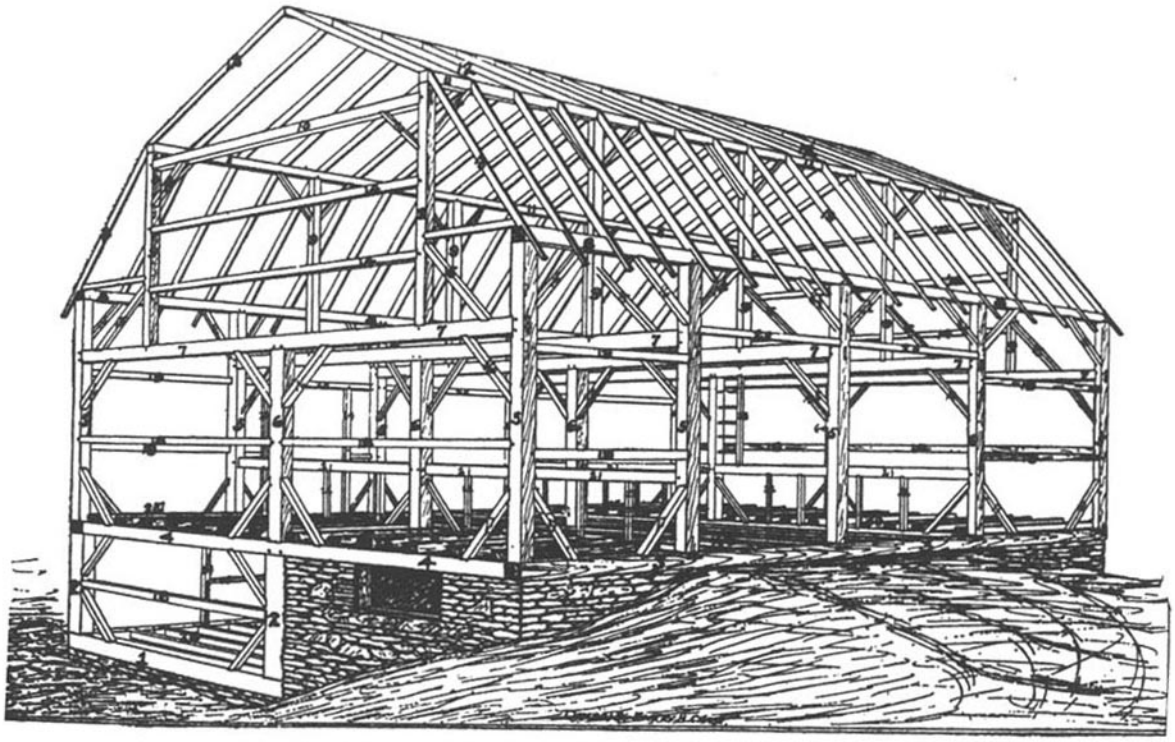


Fig. 120. General Framing Plan for a Heavy Timber Barn.

Heavy timber frome barn, from William A. Radford, *Framin*g (1907).

> would not have enough purchase. The long braces will have a great deal more purchase than the short ones; if you put in a brace sixteen feet long you will have sixteen times as much resisting power as one only four feet in length. With a short brace there will be a tendency for that barn to go one way or the other, but as soon as you put in your long brace, forming two triangles, it becomes firmly established, and there is no possible chance for it to give way. Geometry teaches us that the strongest possible figure that we can secure is the triangle, and here we have it. You will notice that this bent is made up entirely of triangles, and we have secured great strength.[6]

Farm barn construction in South Dakota during the great rural building boom of 1896-1929 was spurred by the availability of cheap mass-produced building materials, especially softwood lumber. The overwhelming majority of the barns that survive to the present day were built of yard lumber that was freighted in on railcars from the big mills in Minnesota, Wisconsin, Iowa, Texas, Louisiana, Washington, and Oregon. Lumber yards, a vital adjunct to the development of commercial farming, were located in every town and village in South Dakota with a railroad siding. Eastern white pine was the most important timber species logged in the Great Lakes region, the center of large-scale lumbering during the second half of the nineteenth century. The first decades of the twentieth century saw the growth of the great Southern and Western timberlands, which provided most of the construction lumber used in the twentieth century. From the late 1870s through the 1920s, the Black Hills was also an important source of construction lumber, chiefly Ponderosa pine. Because of its high bending and compression strength, Douglas-fir from the Rocky Mountains and Pacific Northwest was regarded as an ideal wood for barn framing, while eastern white pine and southern yellow pine made excellent dimension lumber for structural work. Occasionally, a South Dakota farm barn was shingled with bald cypress imported from the Gulf Coast.

There was general agreement among barn experts that a journeyman carpenter with a crew of four men could raise a forty-by-sixty-foot plank-framed barn in about one week, with another week for finishing work. James Harvey Sanders, publisher of *The Breeder's Gazette* and an ardent proponent of farm barn planning, described the erection of a plank-framed barn:

> Get one carpenter to superintend the job; three or four men can find employment and the more men the shorter the job. Pike up joists six or eight high and square; mark and cut off with a small crosscut saw; pile each sort out by itself so you can get hold of it quickly and surely. Never make splices without breaking joints and use a block 2' long at the splice. Spike together well as splices and everywhere. Use spikes 6" long and drive in a plenty; they are cheap. Put bents together on the ground, though you may finish spiking them together after raising, as spikes should be driven from each side. Raise the bents and brace up temporarily until you have two standing, then put on a box plate, plumb very carefully, then put in long side braces and one or two pieces of nail girts. That will make the frame very rigid. You can now continue to raise the bents one at a time and continue putting on plates and braces as fast as they are raised.[7]

By the late 1880s much of the lumber available to South Dakota barn builders was being milled to uniform sizes, though there was wide variation in the dimension standards used by mills located in different parts of the country. It was not until the 1930s that the various regional lumber manufacturers agreed to a uniform standard for each class of common stock. Most of the building lumber used in South Dakota farm barns was produced far from where it was used; indeed, some of it was shipped great distances. Local mills also produced boards and timbers to non-standard specifications, although by the early 1900s construction lumber was no longer milled locally outside of the Black Hills. Therefore, many of the boards would have had to be ripped or planed on the farm and

[6] "Barn Building," *Wisconsin Farmers' Institute: A Hand-Book of Agriculture* (Milwaukee, 1896), 140-141.
[7] *Farm Buildings*, 18.

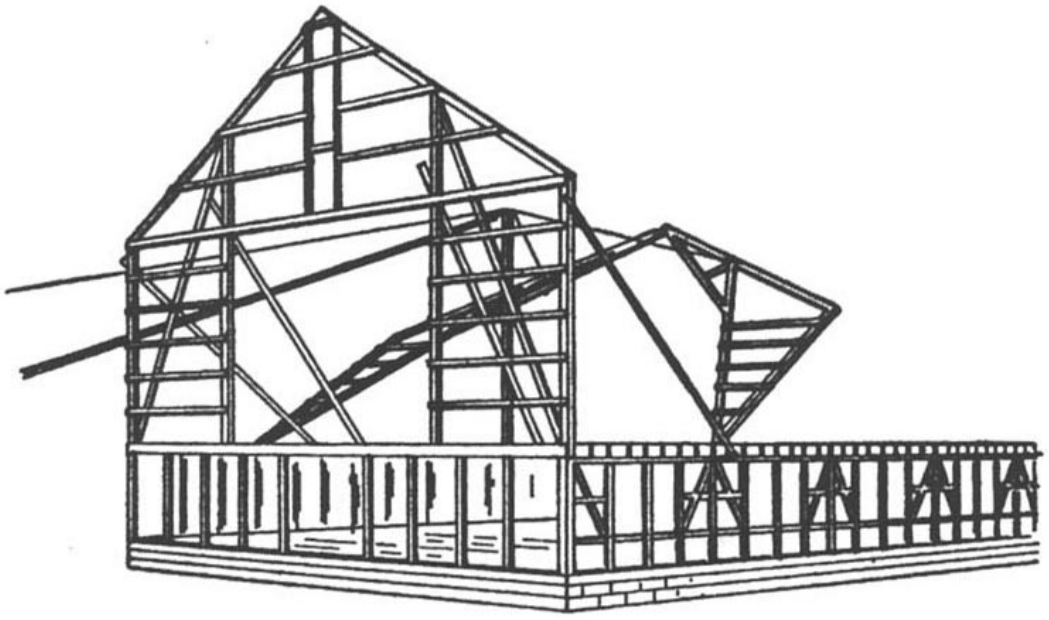


Fig. 134. How the Bents are Raised.

Raising the bents in a plank frame barn, from William A. Radford, *Framing* (1907).

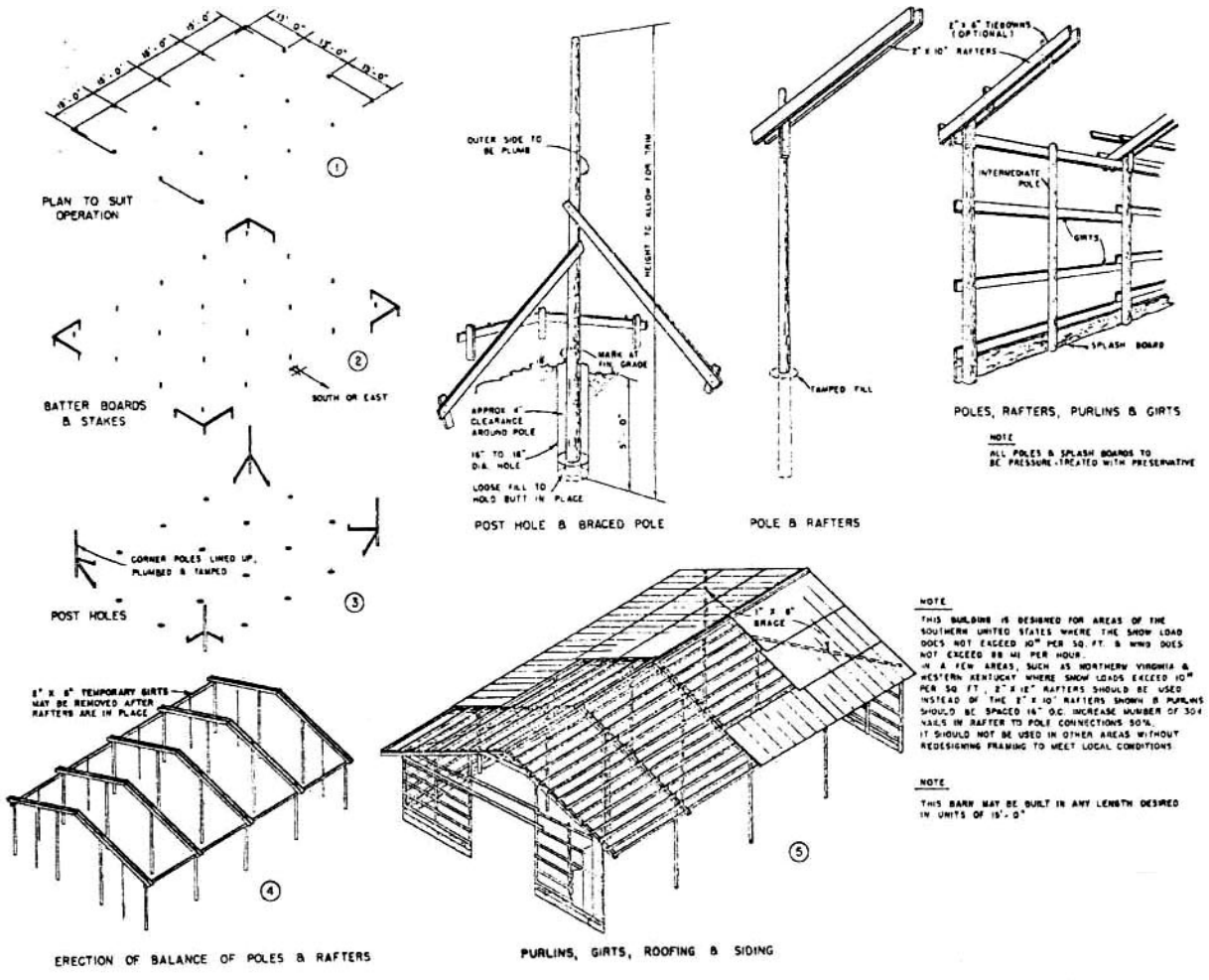
fitted into place. Consequently, it is not at all uncommon to find a barn built with lumber that is of non-standard thickness, width, or length. Similar discrepancies existed in other construction materials.

The laminated trusses used in some Gothic arch roofs were made of wood sections that were glued together. Glue had been used in cabinetmaking for a very long time but was not used in building construction until about 1905. Truss manufacturers first used vegetable or starch glues, but the results were less than satisfactory because they did not withstand exposure to dampness well. The same soybean glues used in the manufacturing of plywood were widely used in laminated trusses until the invention of synthetic resins in the 1930s.

Because it is a biological material, wood is subject to gross deterioration from dampness, insects, and microorganisms. Builders' guides and engineering texts emphasized the need for using only well-seasoned lumber in farm barn construction. Insufficiently dried lumber quickly shrank and became warped out of shape, especially under semi-arid conditions. Boards milled from Ponderosa pine and Black Hills spruce were often preferred over other woods for barn siding in the West River country because they were naturally resistant to warping and did not require as much drying as yellow pine or fir. Even in well built farm barns, however, rot and dry rot often attacks the joists, beams, studs, and posts. In timber frame barns, the old mortise and tenon connections also have a tendency to split when they dry out, especially if the wood used is not seasoned oak. Although paint slows down the weathering of barn siding, it does not prevent decay from the action of fungi on damp wood, which nearly always starts on the unpainted interior side. Decay in barn wood is forestalled chiefly by regular maintenance, good ventilation, and proper site drainage. The use of wood preservatives to increase the serviceable life of frames and boards began in the late nineteenth century with cold-soaking seasoned timbers in coal tar creosote, zinc chloride, various mixtures of compounds of arsenic, chromium, or copper. Pressure treated wood was developed in the twentieth century using steam or hot-and-cold bath methods but was not widely used for framing in farm buildings until after the Second World War.

Post frame or "pole barn" construction has a long history in North America, although it is a rather recent arrival in the Upper Midwest. Post frame construction uses a simple system of vertical wooden posts on which hang a framework of girts, bracing, and sheathing, all of which is secured to the posts with heavy steel bolts. The common name is derived from the primary load-bearing members, which were originally treated round poles. 6-inch square timber posts eventually replaced round poles as the primary structural supports. H. Howard Doane and B. G. Perkins have been credited with "inventing" the pole barn in 1930. Seeking to construct a low-cost, multi-purpose farm building, they used creosote-treated telephone poles, standard dimension lumber, and corrugated metal roofing to erect the prototype on a farm near St. Joseph, Missouri. Doane, founder of Doane Agricultural Services and one of the leading lights in the emerging field of farm management, had for some time argued that conventional farm barns were obsolete because they were poorly suited to the requirements of twentieth-century beef cattle and dairy operations.

Like so many farm building innovations, the pole barn concept went nowhere until the Second World War, when the federal government imposed a limit of $1500 on the cost of new farm building construction to conserve materials for use in the war effort. Because it used less than one-third of the lumber required to build a conventional barn, the pole barn system was enthusiastically promoted by agricultural experts and quickly adopted by farmers. Although Doane's company received a patent for the "pole building design concept" in 1953, they chose to make their building plans available free of charge, which no doubt contributed to its acceptance by farmers. The location of the original pole barn erected by Perkins and Doane has been recognized as a national landmark of engineering heritage by the American Society of Agricultural and Biological Engineers.



Plans for a pole barn (post frame construction), adapted from the U.S.D.A. Midwest Plan Service plan number 5780.

Sod

As agriculture spread westward onto the treeless prairies there was increasing use of sod as a building material. The raw materials were slabs of sod that were turned with a plow or a special sod-cutter, and then cut into bricks which were dried in the sun. The thickest sod best suited for building purposes would have been cut along streams, but short-grass and even bunch grass prairie could also be cut for making bricks. The common sod brick was roughly 18 inches wide, 24 inches long, and 8 inches thick, and weighed about fifty pounds. Freshly cut sod bricks were laid roots-up (the grass roots held the bricks in place) and stacked in alternating courses two bricks thick to form walls. Some sod buildings had green, living sod roofs, but most that are pictured in old photographs appear to have roofs made of boards or brush.

Earth

Outside of a handful of ethnic enclaves, earth was used to construct farm barns only under frontier conditions and, like log barns, they were usually temporary structures with short life-spans. It is noteworthy that farm barns with walls made of batsa brick or “puddle clay” are found only in the areas dominated by German-Russian immigrants who brought the abode-like building technique with them to Dakota in the 1870s and adapted it to balloon-frame construction in their house-barns. Only one farm barn built entirely of adobe has been recorded in the state and it dates from 1917. Barns with walls built of earth represent a small subset of South Dakota’s rural architectural heritage and the technology was never used in common farm barn construction. During the early 1930s, Ralph L. Patty and Henry H. De Long of South Dakota State College conducted experiments with the rammed earth wall-building technique, and constructed a demonstration garden wall at Brookings which was later listed in the National Register. Rammed earth construction never caught on with South Dakota farmers, however.

Stone

Because they carried heavy loads, barn foundation and basement walls were built thick, using fieldstone, rubble, or rough-dressed quarry-stone mortared with natural lime cement. Quarrying foundation stone, excavating basements, leveling ground, and hauling the stone to the building site were laborious, time-consuming, and often expensive tasks. Before any construction could begin, the barn’s footprint had to be marked off, usually with wooden stakes and string. To provide enough room for working on footings and foundation walls, it was necessary to excavate a slightly larger hole than the masonry actually would occupy. The depth of the excavation had to extend below the frost-line for the proper placement of footings, but if the basement was dug too deep it could result in a chronically damp stable. Farm building experts often advised farmers to hire skilled masons, assuming that the expertise required to build a thick masonry wall for a large barn would most likely be found only among journeymen stonemasons.

South Dakota is well endowed with native building stone. Although relatively few stone barns were erected in the state, stone was quarried in every county for use in farm barn foundations and basement walls. Walls of dressed stone or rubble, mortared with a mixture of lime and sand, are most common. Limestone was the preferred stone for heavy construction and it is an excellent building material because of its density and durability. Niobrara Chalk, a soft, fine-grained, white organic limestone commonly known as “chalk rock” (the same material traditionally used to make blackboard chalk) was used to construct farm barns in Bonne Homme and Charles Mix counties. In the southeastern part of the state, where the Sioux Quartzite was commercially quarried at an early date, the pink-colored crystalline metamorphic rock turns up in the basement walls and foundations of farm barns. In northeast South Dakota, barn foundations were also built out of rounded granite boulders and cobbles originally deposited by the glaciers.

Clay

Some farm communities had access to appropriate clay deposits for brick-making, though only a handful of brick barns have been reported, notably in Norway Township, Clay County. Because good, hard-burned brick will not absorb moisture to an extent greater than about five percent of its weight, many more barns have brick paving on their ramps, driveways, or stable floors, often laid in basket weave or herringbone patterns. Although there were numerous brickyards in the state, much of the common brick used in farm construction was probably imported. Hollow clay block, also known as vitrified clay tile, was popular with rural builders in the twentieth century because it was lighter than common brick and therefore cost less to transport. Clay block experiments by M. L. King and J. B. Davidson at Iowa State College in 1907-19 focused on its applications in building silos and corn cribs, but clay tile was also recommended for use in dairy barns because it was fireproof and easily cleaned.

Cement and Concrete

Portland cement was first manufactured in the United States in 1874 and was available to South Dakota barn builders at an early date. Because of their interest in sanitation, dairymen quickly took to using cement to waterproof their barn walls and install washable stable floors. Building with structural concrete made with Portland cement, sand, and aggregate became increasingly popular during the 1890s and was widely promoted by farm building experts. Despite some early prejudice against it, concrete proved to be the only material that met the modern farmer's requirements of sanitation, durability, and economy, and it was fire-proof. The Yankton Cement Works, a large state-owned concrete plant, was opened in the 1890s to meet the increasing demand for Portland cement in all forms of construction. As early as 1911, the Universal Portland Cement Company and others were printing up plans and specifications for concrete farm buildings, including farm barns. Reinforced concrete was used experimentally for large barns but because monolithic concrete walls tend to trap condensation, building hollow walls enjoyed broader acceptance.

Concrete block, a farm building material that was virtually unknown in 1900, was widely available by 1905, thanks to Harmon S. Palmer's invention of the first practical machine for making concrete block. Machine-made hollow concrete blocks and cinder blocks were frequently used in barn construction and in most cases the blocks were poured at the job site. Rusticated concrete block, commonly referred to as rock-faced block, was popular with barn builders because it resembled ashlar and came in a wide variety of shapes and textures. Rusticated concrete block was in vogue during the 1910s and 1920s, but its popularity sagged in the 1930s.

The biggest changes in barn construction practices resulted from the widespread adoption of concrete after about 1900. In fact, the invention of the powered cement mixer probably revolutionized farm building as much as any other technological advance. Contractors soon perfected the art of poured concrete construction, which allowed them to replace stone foundations with poured concrete footings that better distributed the weight of the barn from the foundation walls to the soil. Concrete eventually replaced cut stone walls altogether and by about 1920 modular concrete blocks were the most common structural system used in barn basement walls. In the 1920s, Iowa State College agricultural engineers conducted tests using an experimental concrete ribbed arch barn constructed at the experiment station in 1915.

Metal

Because of their high cost, architectural metals were used sparingly on farm barns built before the 1920s. Cast iron was occasionally used for supporting the floors in large barns. Experiments with barns framing using steel columns and beams began in the late nineteenth century and a few steel-framed barns were built as experiments in the 1920s. Much of the piping in dairy barns was cast iron or steel. Galvanized and enameled iron was used for barn fixtures and milk handling equipment in dairy barns before the invention of stainless steel in 1916.

Strips of corrugated sheet iron, popularly known as "galvanized iron," had been used to roof commercial buildings since the 1850s and two agricultural engineering studies of the use of galvanized roofing observed that it had been used on barns "for many, many years" by the 1930s.[8] While there were those who thought it made a good barn roof, many barn planners found the early versions of galvanized iron and steel roofing less than satisfactory. "Perhaps no form of roofing has caused more disappointment and vexation than metal, which rusts rapidly and requires frequent paintings," complained the publishers of the *Breeder's Gazette* in a commentary on the modern barn.[9]

Hot-rolled steel framing for barns was first produced commercially in 1914 and was occasionally used in constructing arch roof barns in other parts of the Midwest. A 1936 agricultural engineering textbook produced for use at the University of Missouri states flatly that steel posts and girders were being used in many barns because they took up less space and allowed more headroom. However, a 1938 paper by a prominent steel company engineer noted the "potentialities for steel barn construction have been far from exploited."

The application of rigid frame construction to building construction began in the late nineteenth century and the first all-steel automobile garages appeared before 1910. Storage sheds made of galvanized steel were used as farm buildings at an early date. Butler Manufacturing Company of Kansas City introduced its first cylindrical galvanized steel grain bin in 1907 and in 1939 won the government contract to provide more than twenty thousand steel bins to the U.S. Department of Agriculture for storing surplus grain. This accomplishment led the way for the company to develop designs for pre-engineered all-metal farm buildings using a framework of rigid frame of steel girders. The first line of prefabricated, all-steel Butler farm buildings was introduced in 1940.

Experiments with prefabricated metal barns were ongoing throughout the first half of the twentieth century but it was not until the Second World War that all-metal, rigid-frame construction attracted the attention of engineers employed by the military. The prototype of the "Steel Arch Rib Building" was created in 1941 by the George A. Fuller Construction Company for erection at the U.S. Navy's Construction Battalion Center at Quonset Point, Rhode Island. An estimated 170,000 Quonset Huts were manufactured during the war and an unknown number of these were subsequently purchased as government surplus by private citizens. After the war, agricultural engineers quickly adapted the Quonset Hut form for use as a farm utility building and several companies, including the original manufacturer, the Stran-Steel Division of Great Lakes Steel Corporation, continued to manufacture them for many years.

Workmanship

A farmer had to be a jack-of-all-trades when it came to farm building construction. Skilled artisans and craftsmen also filled an important niche in agricultural communities, though detailed information on individual builders and contractors is scanty.

Barn construction, like farming, was a seasonal operation and the slack times between fall harvest and spring planting were often used for construction work. Springtime had its advantages for barn raising, particularly if the labor was done by the farmer himself and his hired hands, but generally fall and winter were the months devoted to building—because farm hands were employed mainly during the growing season, they had to seek other work during the remainder of the year, which made farm construction projects attractive as winter work. The extent to

[8] Earl D. Anderson, "New Barns for New Conditions," *Agricultural Engineering* 19 (1938), 117; and G. C. Bartells and K. J. T. Ekblaw, "The Production and Use of Galvanized Roofing Sheets," *Agricultural Engineering* 13 (1932), 47.
[9] *Farm Buildings*, 17.

which communal barn building was carried on within a given area is difficult to determine. The term "barn raising" may have been coined in Pennsylvania during the late eighteenth century, when big timber-framed barns were becoming the norm in newly settled districts and where farmers considered the buildings essential for mixed farming. Such barn raisings were traditionally a mix of rural ceremony and ritual. The practice migrated across the Midwest and Great Plains, more or less unchanged, and probably persisted into the early twentieth century. Generally, the construction work at a barn raising was performed by the owner with the help of able-bodied family members and neighbors, who were not paid, although it was common for a prosperous farmer to hire joiners, stonemasons, and other artisans for highly specialized tasks, or to employ a master carpenter to oversee the most critical jobs, such as assembling and raising the frames.

Poor workmanship and faulty design plagued farm barn construction. "Poor proportions result in a poor appearance, and weakened construction, in the case of the gambrel roof," noted Foster and Carter. "The common faults found in existing barns are that the two pitches are made nearly equal; the upper part is made too flat; the lower pair of rafters are too long; or the angles of both sets of rafters are not correct"."[10] Many large and valuable farm barns were wrecked before they could grow old when important structural members failed. A University of Minnesota study of barns damaged caused by a massive windstorm that demolished over six hundred barns in South Dakota, Minnesota, and Wisconsin in 1941, determined that most of the structural damage was the result of weak construction. As with most large buildings, shedding water was the biggest challenge to the builders, and farm barns were often wrecked because of poor site drainage caused by ground water seepage or runoff. The problems with barn foundation walls stemming from the employment of untrained or incompetent workers was a frequent topic addressed in barn construction manuals and advice books.

4. The Morphology of Common Farm Barns

Placement and Relation to Other Farm Buildings

Although some divergent opinions circulated, careful attention to site selection was recommended by all of the experts, although there was nothing like consensus among farmers as regards the ideal situation for a proper farm barn. Because exposure to moisture causes wood to rot and makes stables unhealthy for animals, common sense dictated that farmers position their barns on rising ground whenever possible, avoiding sites near running streams or wetlands. A site on a low hill or rise with a good southern exposure was optimal.

Topographical considerations aside, the spatial relationships between the barn and other components of the farmstead was largely a matter of personal taste and convenience. "The importance of location and arrangement with reference to the fields and pastures is a point often overlooked, and much valuable time is wasted in driving stock to and from the barn that might be with a very little foresight be saved," advised J. H. Sanders.[11] In the Midwest generally, custom dictated that the farm barn be placed in the middle of the farmstead, though there has always been considerable variation in the arrangement of farm buildings from one region to another. Isaac Phillips Roberts, a Yankee carpenter who had been superintendent of the model farm at the Iowa Agricultural Experiment Station before moving back east to a professorship in agriculture at Cornell University, advised farmers to place the barn "far enough from the house to prevent the aromas of the stables and kitchen from mingling," about one hundred feet.[12] Viewsheds also played a role in building placement. South Dakota farmers showed little inclination toward the Eastern habit of trying to make their farm barns inconspicuous and preferred to lay out their farmsteads so that the barn could be seen from the public road; more often than not, the barns

[10] *Farm Buildings* (New York, 1922), 76-77.
[11] *Practical Hints About Barn Building* (Chicago, 1893), 10.
[12] *The Farmstead* (New York, 1900), 257.

themselves are oriented so that they present an agreeable aspect from the front or back porch of the farm dwelling.

Sometimes, the placement of a farm barn was completely arbitrary, if not altogether accidental:

> It is safe to say that a large proportion of American farm building groups are the result of accident or force of circumstances imposed by thoughtless ancestors rather than a studied plan based on economic and climatic conditions: when one looks at some groups he is almost forced to believe that the buildings were located in a particular place because the farmer, driving in with a load of lumber, had got stuck in the mud and built where he was forced to unload.[13]

When all is said and done, each farmstead has its own peculiar make-up and no two are exactly alike in their plans and arrangement.

Ground Plans

Ground plans for common farm barns range from simple rectangles to squares, with compound plans being on the whole rather rare. Most published plans for conventional plank-framed general purpose barns indicate dimensions of 32 to 42 feet wide, which was dictated by the limits of the extant rafter-truss systems; there was no limit to the length, although few farm barns exceeded 100 feet. L- and T-shaped barns are usually the result of a wing or ell added perpendicular to the axis of the original barn in order to create a sheltered yard at the angle of intersection; the addition was usually built to function as a feeder barn and, because it does not have a hayloft its roof is usually lower than that of the main barn. U-shaped or courtyard barns are most often associated with large livestock operations and are quite rare.

Many farm barns have been enlarged with additions and all of the conventional, multi-level barn forms were intended to accommodate the addition of sheds, lean-to's, and other accessory structures. Probably the most common form of barn attachment is a transverse shed built onto the side of the main barn to provide a shelter for livestock or storage space for farm equipment. Wagon sheds, workshops, and various multipurpose appendages have been commonly attached to the sides of barns and covered with single-slope roofs. During the twentieth century, many of the old wagon sheds were used to shelter tractors, trucks, harvesters, and other farm machinery.

Walls

As discussed above, the walls of most common farm barns were balloon-framed out of two-inch planking. A wall framed in this manner will have wooden sills laid on top of the foundation walls, onto which the vertical framing members, 2X6 or 2X4 studs, are toe-nailed on 12- or 16-inch centers. The barn siding is nailed to the outside of the studs. It is rare to find barn walls with sheeting underneath the siding, as in house construction. Molded concrete block or hollow clay tile was often used for raised basement walls, often laid in double courses and covered on the inside with a coat of cement for waterproofing.

The wall height of a farm barn, sometimes expressed in stories, is not always easy to visualize. Bank barns, for example, offer a much lower profile on the uphill side than on the downhill side. Floor height also varies within multi-level barns, which balance stable area below against hay storage capacity on their upper levels. The conventional frame barn with an upper-level hayloft is one and one-half stories in height. The old-fashioned bank barn is usually considered a two-story building unless it has a large hayloft. Most often, the changes in exterior

[13] F. W. Ives, "Some New Ideas on the Group Planning of Farm Buildings," *Agricultural Engineering* 4 (1923), 35.

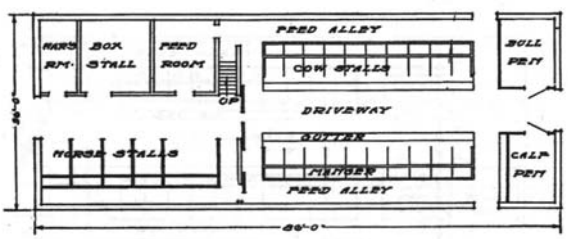


FIG. 34.—Floor plan of a typical general farm barn.

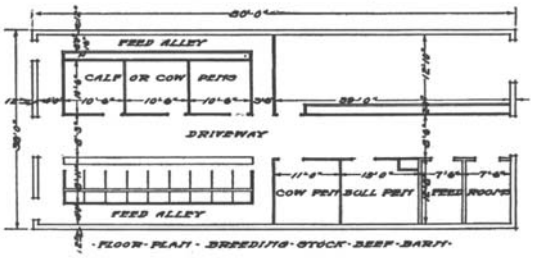


FIG. 26.—Floor plan of a beef cattle feeding barn.

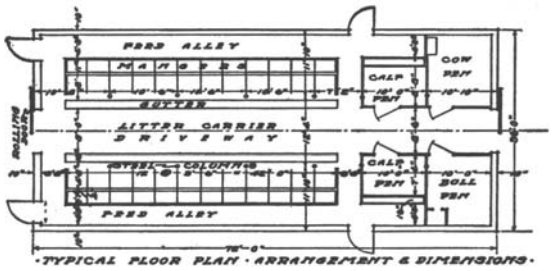


FIG. 10.—A floor plan of a dairy barn giving usual dimensions.

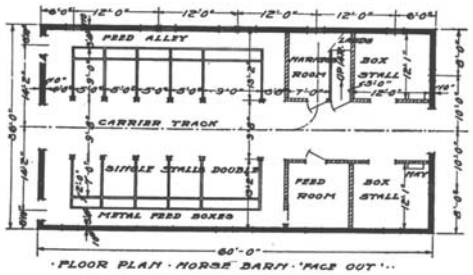


FIG. 14.—A floor plan of a typical horse barn.

Common barn floor plans, from W. A. Foster and Deane G. Carter, *Farm Buildings* (1922).

wall finishes on multi-level barns indicate the position of the different floors. For example, in a typical bank barn, the basement walls are masonry, the main floor walls are covered with vertical board siding, and the eave line of the gable or gambrel roof defines the haymow level. Side walls range from 6 to 18 feet from the top of the foundation or basement wall to the lower roof rafters. A one-story barn without a loft will usually have a much taller sidewall than a conventional one and one-half story barn, where the lower sidewall is usually 8 to 10 feet and the hayloft sidewall is 2 to 6 feet. Three-story farm barns occur in other parts of the Midwest were are not common in South Dakota.

Bents

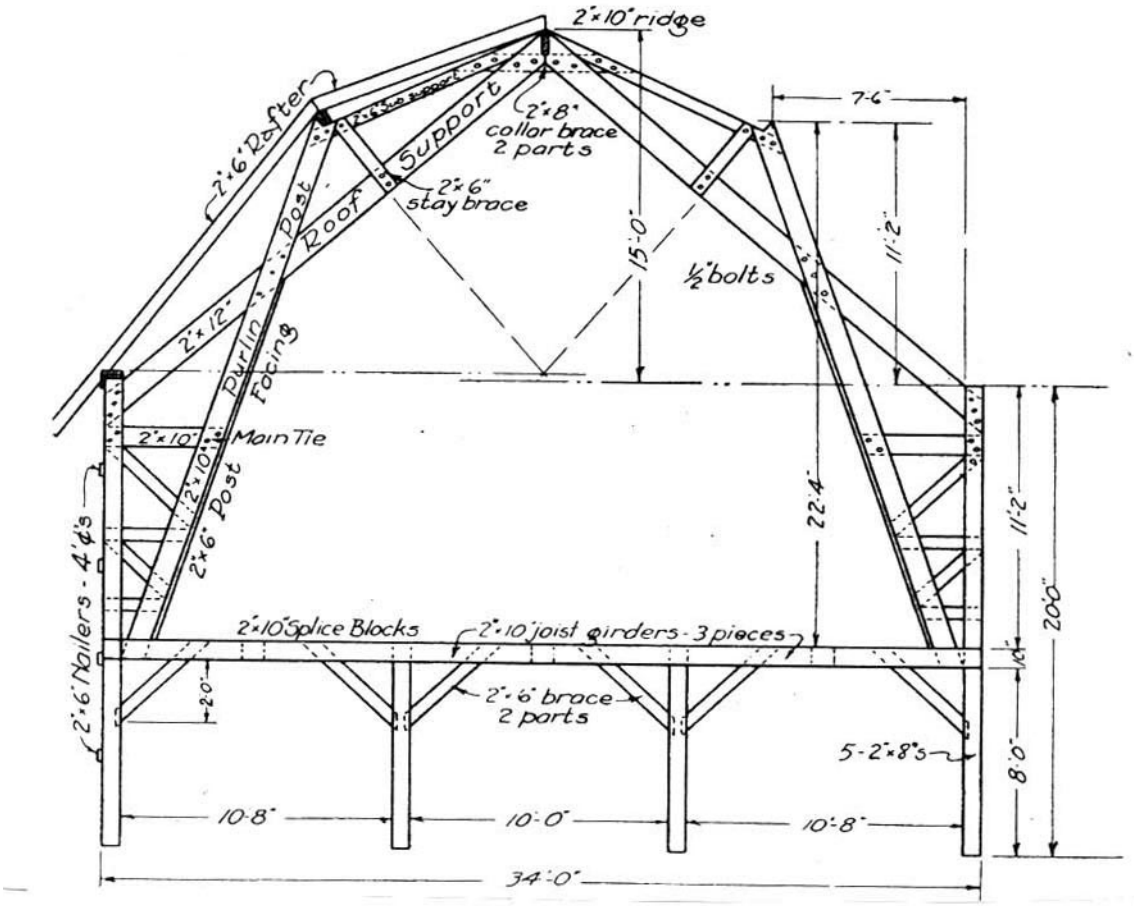
The core volume of a farm barn may be expressed either in gross dimensions, square footage, or the number of bays or bents enclosed by its four walls. In traditional barn construction, the term *bent* is used two ways: first, to describe the grouping of posts, beams, rafters, struts, and knee braces which form the principal structural unit; and second, to describe the space between two such framing units. The bents in a plank-framed barn are usually 8 to 16 feet apart and the end bents are framed with more lumber than the interior bents to give the end walls greater strength and rigidity.

Roofs

Rooflines dominate the visual character of old barns more than any other design feature. The geometry of roof designs changed a great deal over the course of time, but the most enduring forms are the straight gable, gambrel, and Gothic arch forms. The oldest type of barn roof was the simple straight gable roof with two slopes that meet at the ridge, forming a triangle in the gable-ends, and it is probably the most common roof shape found on historic farm barns throughout South Dakota. A functional attribute of gable-roofed barns is related to the pitch of the roof: the steeper the pitch, the smaller the haymow and the narrower the main floor. Lower-pitched gable roofs predominate among farm barns built after 1920.

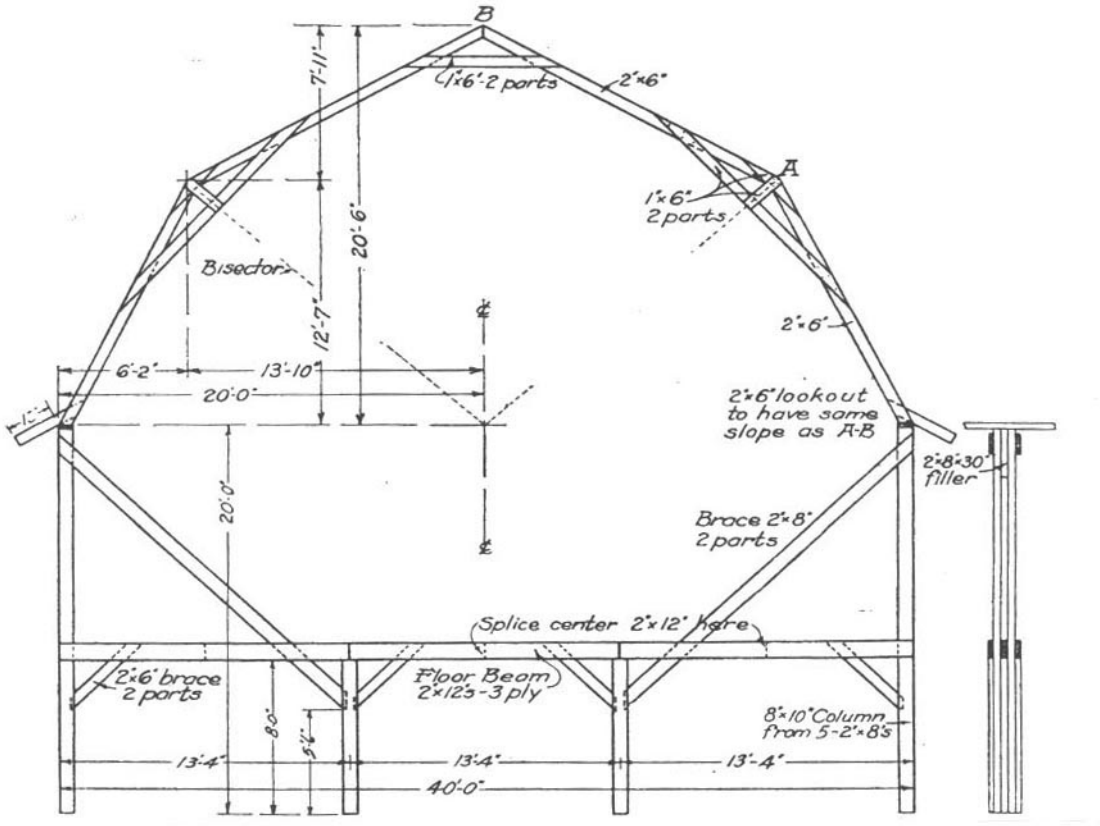
The gambrel roof shape (named for the crooked shape of a horse's hind leg) is a curb roof with two differently pitched surfaces on each elevation, with the lower roof usually steeper than the upper. The gambrel roof first appeared in American domestic architecture during the seventeenth century but it was not adapted to farm barns until after balloon framing was perfected in the nineteenth century. The use of plank-framed trusses enabled farmers to erect barns with gambrel roofs that eliminated the need for timber posts, tie-beams, and purlins and thus allowed for much larger haymows. By the early 1900s the gambrel roof had come to epitomize the "big red barn" image of the barn as the farmer's factory.

Barns with vaulted or Gothic arch roofs began to appear in the Midwest around 1905 and were widely promoted by the farm press, agricultural engineers, and barn planning services. The first Gothic arch rafters bent to curve instead of sawed appeared in plans published in 1916, though a combination of built-up and bent rafter construction made a stronger barn in the opinion of many. Laminated truss systems were common by the 1920s. More than any other shape, the arch roof emphasizes the vertical aspect of the barn, giving the appearance of a building that rises skyward from the corners toward the center. These picturesque barns won immediate praise from farmers for their attractiveness and their ability to withstand extreme winds. Farm building outlets like the Louden Machinery Company designed and patented various truss-less roof systems to simplify construction and allow for the use of lower priced lumber. All of the arch roof shapes relied upon self-supporting rafter systems made from stock lumber that was readily available from lumberyards or sawmills. The only serious downside of the Gothic arch roof was its complexity and frequent failures of bolts, nails, and glued joints posed a persistent problem for engineers and builders. A range of alternative vaulted roof shapes evolved between the 1920s and 1940s, including semi-circular roofs.



Shawver Truss (Plank Frame) Bent

Cross-section of a Shawver Truss bent in a plank frame barn, from J. Brownie Davidson, *Agricultural Engineering* (1913).



Wing Joist Frame (Plank Frame) Bent

Cross-section of a Wing joist Frame Bent in a plank frame barn, from J. Brownie Davidson, *Agricultural Engineering* (1913).

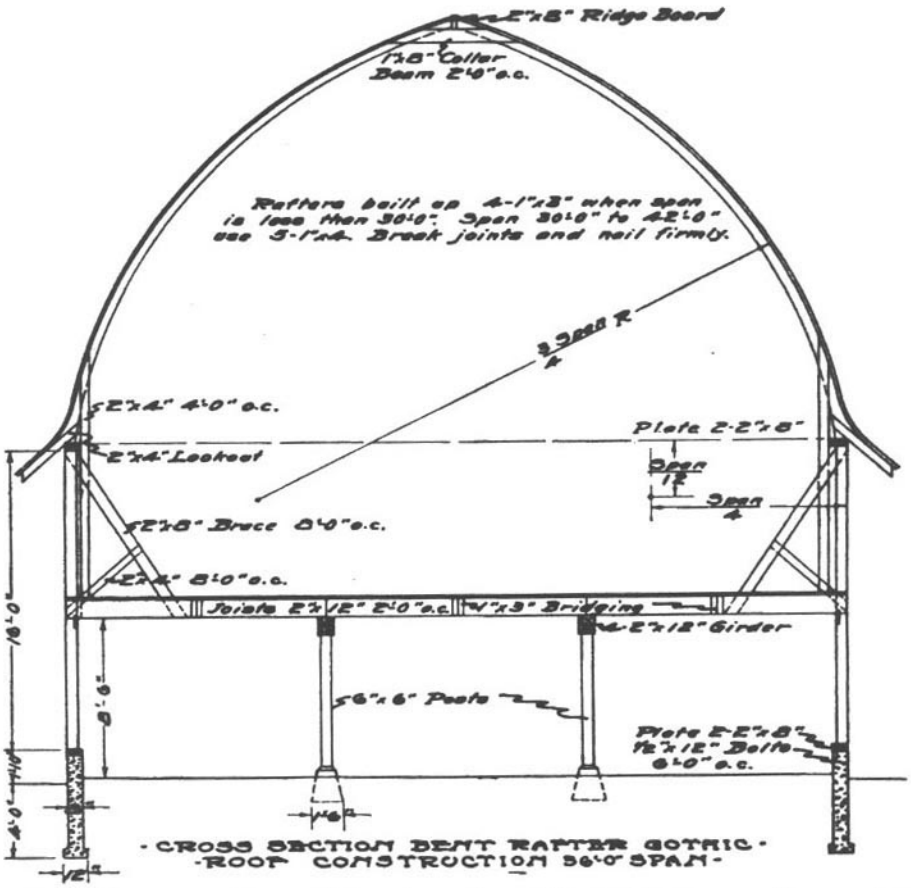


FIG. 80.—Cross-section of bent rafter (Gothic) type of construction.

Cross-section of a Gothic Arch bent rafter system, from W. A. Foster and Deane G. Carter, *Farm Buildings* (1922).

Single-slope roofs, usually low-pitched, are found on the shed or lean-to structures attached to the sides of barns. The shed roof shape is more commonly found on special-purpose structures, such as machinery sheds or hog houses. It is also common for gable-roofed barns to have lean-to sheds attached to their sides. In most cases, the shed roofs start below the eaves of the main roof, but sometimes they follow the same pitch, creating a "broken gable" profile. One and-one-half story gable-roofed barns with low, steeply-pitched shed roofs on their long sides are sometimes mistaken for monitor-type barns. The true monitor roof, which is seldom seen in South Dakota, is found on large transverse aisle barns where the side sheds are integral to the barn plan and the gable-roofed core takes the form of a clerestory.

It is safe to say that most of the roofs on South Dakota barns built prior to 1930 were originally covered with wood shingles machine-cut from cedar or pine. Some builders dipped the wood shingles in creosote to increase their durability. Nationally, wood shingles were "still going strong" as barn roofing as late as the 1930s, despite concerns over their flammability. Paper saturated with petroleum, commonly known as tarpaper, was invented by William Griscom in 1892 and was frequently used by sodbusters for sheathing their shanties. Tarpaper was also the forerunner of the asphalt shingle, made from rectangular pieces of felt coated with a mix of tar and gravel. Asphalt and asbestos shingles both made their appearance around the turn of the century. Tar saturated roll roofing was widely promoted as barn roofing in the 1930s and 1940s. In South Dakota, covering barn roofs with "tin" or "tinned iron"--more precisely, *terne*, made from soft steel panels hot-dipped in a mixture of lead and tin—does not seem to have been common until after 1940. Relatively few farm barns seem to have been fitted with metal gutters and downspouts to carry water off their roofs.

Foundations

Although some pioneer era farm barns were built directly on the ground, most common farm barns have continuous masonry foundations. Since the foundation walls must sustain nearly all of the weight of the entire barn, they usually rest on broad, flat footings up to twice as thick as the walls. If the footings are properly laid, the barn will not settle. Barn foundation walls were usually built of native limestone or boulders up until the time when concrete became the material of choice for masonry construction. Some of the most interesting foundation walls are those constructed of roughly shaped, hand-dressed, rectangular pieces of limestone laid in level beds. It is rare to see a farm barn in South Dakota with burnt brick foundation walls, although good brick clay is fairly abundant over much of the state. Foundation wall thickness varies from barn to barn, and even within a barn, but they are usually about eighteen inches thick. The joints in the older stone foundations are filled with soft mortar made from sand and lime. However, since the 1890s it has been customary to add Portland cement to the mortar to make the walls less susceptible to weathering. Some barn foundations have been water-proofed by the application of a cement scratch-coat and many stone foundations have been partially reconstructed with poured concrete or concrete block.

Basements

The lowest story of a common farm barn is typically referred to as the basement if it has masonry walls and its headroom is lower than that of the story above it. Bank barns, where the lower level is built into the side of a hill and the walls are partly below ground level, are sometimes referred to as basement barns. A raised basement is built on grade, i.e., with the walls beginning at ground level, to enclose space for handling livestock and manure. Farm barns with raised basements are more likely to date from the early twentieth century and their basement walls are usually hallow clay tile or concrete blocks, built on poured concrete footings. Only a few barns built prior to 1940 have basement walls made of monolithic concrete, as modular block walls were cheaper, quicker, and easier to build. Concrete blocks manufactured during the early part of the twentieth century were often quite

large, measuring up to 30X8X10 inches, compared with the modern standard common hollow-core unit, which is just under 8X8X16 inches and weights approximately forty pounds.

Stables

The major agricultural production processing and storage component of a farm barn is the stable, which is usually located in the lowest level of the barn. In a bank barn, the stable is partly below ground level, underneath the main floor. The basic requirements of a good barn stable were that it be strongly built, durable, and keep animals, their fodder, and farm implements dry. These basic requirements were not always met by the builders, however, and some of the old barn stables are little more than crude cellars.

The floor plans of barn stables varied considerably. Log and sod barns, for example, were often little more than a single room with the livestock on one side and fodder against the opposite wall. In contrast, a large livestock barn provided two or more rows of stalls separated by feeding passages, with specialized rooms for processing and storage, a concrete floor, and an attached silo. Dairy farmers as a group probably paid the most attention to stable layout, materials, and fixtures, and the stables in dairy barns built after 1900 are fundamentally different from those in older barns because of their emphasis on sanitation and ventilation. Dairy barns have washable concrete floors, often grooved to provide better traction for the cows, with gutters located behind the stalls to carry off the manure and urine. By the end of the nineteenth century, it was common to stable cattle and horses in box stalls, usually on opposing sides of the barn, and in a well appointed dairy barn the cows were usually held in stalls with wood or iron stanchions, with space also provided for the care of calves or colts, for maternity care, and for storing cream cans. Most older general purpose barns have only one aisle or feeding alley, running down the center of the stable, while large livestock and feeder barns have two or three aisles as well as cross alleys, anywhere from four to eight feet wide. Although the interior walls of the stables in most general purpose barns were left unfinished, stables for horses or sheep were sometimes rendered snug and warm by a double thickness of boards, with diagonal sheathing or boxing on the inside wall, creating a dead air space between the interior and exterior walls that could be packed with straw for insulation. The ceilings in dairy cow and horse stables are also sometimes tightly paneled with a double thickness of beaded boards, with paper in between. The stables in dairy barns are usually finished with concrete or cement plaster. Face brick and glazed tile block were also used where a washable surface was required.

Nineteenth-century barns were notorious for their poorly ventilated stables, many of which were veritable dungeons. “A whole volume might be written upon the bad effects of illy-ventilated and badly-lighted stables for horses,” fumed *Breeder’s Gazette* publisher James H. Sanders.[14] Loose-fitting windows and doors and cracks in the siding allowed in a certain amount of fresh air, but in cold or windy weather many stables were damp and foul-smelling. With the recognition that damp stables were dangerous to the health of livestock came the development of a variety of barn ventilating systems (see below). Before rural electrification, South Dakota farmers illuminated their stables by hanging kerosene lanterns from the overhead beams. Because tipped lanterns were a leading cause of barn fires, sometimes the lanterns were sometimes hung from adjustable cords passed through pulleys so that they could be easily moved but would not be tipped over during farm chores. During the early settlement period, it was sometimes necessary to provide rooms in the barn for farm laborers. This practice was becoming increasingly rare by the early 1900s, but South Dakota farm lore is filled with references to men who slept, at least temporarily, in the barn. While pioneer era farm barns tended to be small, dark, and cramped, with low headroom and poor ventilation, the part of the barn that would have offered the most comfortable quarters, with its straw-filled mangers and box stalls, was the stable.

[14] *Practical Hints*, 113.

Lofts and Haymows

Multi-level farm barns usually have sturdy wooden floors built over the stable area, often built of quarter-sawed oak or hard pine boards, which forms a loft over part or all of the stable area. In barns with basements, the loft is the third level, corresponding to the attic in a dwelling. Because very few farms could afford a separate outbuilding for hay storage, the loft usually contained the haymow. Hay was placed in the mow through the hay door, located near the top of the gable-end wall. Overhead tracks and carriers for moving hay and straw were installed in barns constructed after about 1900 and most older barns were eventually retrofitted with hay bale moving equipment. The ridge of the barn roof is often extended to create a hay hood that extends over the hay-loading door to provides some protection for the pulley mechanism used to hoist the hay into the loft. When fodder is needed in the stable area, the bales or loose hay are thrown down chutes leading to the feed room. Most farm barns have some kind of stairway or ladder for to facilitate passage between the main floor and the loft.

Haymow size and placement play an important role in barn design. The earliest haylofts were little more than wooden scaffolds for loose hay—the term *haymow* referred to the mass of hay laid up in a barn and not the structure itself. Traditionally, both fodder and grain were stored in raised lofts where they could be easily passed down to livestock in the stable. Haymaking became more important whenever farmers kept more livestock, and new labor-saving devices like the mechanical pick-up hay baler made large haymows more practical. South Dakota farmers eventually built barns with haymows where fifty or even one hundred tons of roughage could be safely stored. The need for more haymow space also led directly to the adoption of the gambrel roof form and framing systems that eliminated the need for interior posts.

The primary objective in hay-making is to dry the green plants (which may be alfalfa, clover, prairie grass, or oat hay) sufficiently so that the hay can be stored safely without heating or becoming moldy. Nineteenth-century homesteaders often cut, cocked, and stacked their hay by hand with sickles and scythes, although horse-drawn mowers, rakes, loaders, and stackers were available by the 1870s. The labor-saving hay fork and hay carrier were in wide use throughout the north-central states by the early 1900s. Although green hay cures rapidly in the swath, it was usually raked into windrows or stacked in large conical hay cocks to cure. After the hay cured, it was gathered up and loaded into specially-built wagons, called *hay ricks*, for transport to the barn. If it was not stacked in the field, hay was hauled from the windrow using a buck rake, generally regarded as the most efficient method of handling hay until the introduction of the pick-up hay baler in the 1940s. Fully automatic, one-man hay balers were not widely seen in South Dakota until after the Second World War, when some farmers also began using field choppers, which allowed them to produce large amounts of loose hay that was more convenient to feed to livestock and took up less space than baled hay. The traditional small rectangular hay bale was bound with sisal twine and weighed about seventy pounds.

Before the modern farming era, the transfer from hay rick to haymow was usually made inside the barn, where the loose hay was lifted up into the haymow using a hay sling or grapple fork. Baled hay became common in the late nineteenth century with the adoption of the stationary hay baler or hay press, and several models of horse-powered hay forks and hay stackers were available for loading and unloading baled hay. South Dakota farm barns built after 1880 were usually equipped with some form of the bale spear, pulley, and track system that hoisted baled hay into the barn loft through a large door in the gable-end. Once the hay had been placed in the mow, it caused more worry, anxiety, and disappointment than any other crop. No matter what method is used in handling and storing the hay, the farmer needs to carefully judge how to arrange the mow so that the various kinds and qualities of hay are available when needed. For example, late-cut hay, which is put in the barn last, is usually of a poorer quality than early-cut hay. Hay is also very sensitive to weather conditions at the time of harvest: hay that is too dry has lower nutritional value, but if it is stored too wet it can quickly become rotten or moldy. The most serious hazard associated with hay storage is fire caused by spontaneous combustion in the haymow. If the moisture content of the hay is too high when it is put in the mow, rapid fermentation can occur in

which a large amount of heat is produced within the mass. If the mass of hay becomes hot enough, if will smolder or burst into flames, often with catastrophic results. Various steps are taken to prevent haymow fires. To allow better air-flow in the pile of hay bales, farmers will usually stack the bales on-edge in crisscross fashion in order to leave small spaces between the layers of bales. In the nineteenth century, farm advice books recommended building barns with over-sized haymow doors or leaving small gaps between the boards in the gable-wall siding to provide air flow.

Another widely used approach to ventilating large haymows was to construct one or more dormer windows along the upper surface of the roof, where they provided natural light to the loft as well as ventilation. Dormers were most often built on large barns with Gothic arch or gambrel roofs, where they added visual interest to the barn by breaking up the monotony of the large expanse of roof surface. The most common dormer shapes are those with low side walls and hip or shed roofs. Barns with segmental or eyebrow dormers, with and without side walls, are rare but not unheard of. Most dormer windows are fitted with casement sash, though some large dormers have double-hung windows.

Siding

Most of the common barns constructed in South Dakota before 1958 are wooden buildings with plain walls and modest ornamentation. With respect to decoration, the gable end wall usually receives more attention than the side walls. Even without any decorative detailing, the gable-end wall often makes a strong design statement in its own right, depending on its geometry and finishes. Only a handful of the barns recorded in the statewide inventory have been embellished with verge board moldings or stick work on their gable-end walls. Religious symbols and icons such as hex marks are also rarely seen on South Dakota barns. Occasionally a farmer paints the farm name and date over the main door or under the gable.

Barn siding came in a wide range of sizes and shapes, rough or dressed, with considerable variation in thickness and width. Planed, matched, inch-and-a-quarter pine boards were the standard barn siding material. Two basic types of wall cladding were generally preferred by South Dakota barn builders. The most common was to nail the boards to the outside of the framing in horizontal strips, with the upper board overlapping the one below it, making the surface weather-tight. To keep the boards from looking uneven, the siding was sometimes built using beveled or tapered boards called clapboards. In vertical siding, the boards were placed side-by-side but did not overlap, and to keep out the weather, the joint formed where the two sides met was covered by a narrow strip of wood, called a batten—hence the common name, *board-and-batten* siding. Farm barns were sometimes sheathed in rough boards nailed flush to the studs, without any overlap, but as the wood weathers the boards often crack or become loose. Twentieth-century barn siding often has boards that were tongued-and-grooved along the edges, which made the wall more durable and weather-tight, as well as more pleasing to the eye. Old barn siding varies in width from just under three inches to over twelve inches and the boards are typically about one-inch thick and planed on both sides. The old barn builder's axiom that siding made of "good stuff" will last as long as the barn does is generally found to be true.

The physical characteristics of barn lumber can sometimes be a useful indicator of a given structure's age. The oldest barns have timber posts and beams that were hewn out of whole pieces of heartwood, but most of the barns constructed after 1880 have sawed timber frames or structural members built up from dimension lumber. Upon close inspection, floor joists, rafters, and other framing members sometimes exhibit the distinctive vertical cut marks indicative of lumber that was ripped with a mechanical sash saw, the type commonly used at water-powered sawmills, rather than the arced saw marks associated with circular saw blades. Circular saws were invented during the early nineteenth century but were not widely used in Midwestern lumber mills before the 1880s. Lumber manufactured with band saws, which leave their own distinctive marks, will usually post-date 1880. Hand-hewn lumber, of course, is distinguished by the marks made by axes and adzes. Nails can also

provide clues as to the general age of a structure. The oldest barn will have mortise and tenon joints and the siding will be secured with Type B cut nails, the most common type of iron nail used during the latter part of the nineteenth century. Steel wire nails were mass-produced from the late 1880s on and galvanized wire nails are a telltale sign of twentieth-century carpentry.

Paint Color

During the settlement period, barn walls were often left unpainted and assumed a dark gray color. Unpainted farm buildings were by no means unusual and it is likely that some of the very oldest farm barns in South Dakota have never been painted. Barns were painted to improve their appearance to the preserve the wood siding. The traditional color scheme for Midwestern farm barns is red with white trim, which appears to have been popular since the early nineteenth century. Barn paint was originally a mixture of milk, vermillion or ferric oxide pigment, and lime that was cut with turpentine and strained through cheesecloth. Whitewash made of quicklime slaked with water was used for the trim. By the late nineteenth century, however, barn red paint was made of ground ferric oxide mixed with boiled linseed oil. Commercially manufactured barn paint was introduced in the 1860s but it was not until 1880 that pre-mixed house and barn paint was available in zinc-coated metal cans. Various explanations have been put forward to explain the preference for red barns, most of them apocryphal.

White lead house paint, although it was less durable than the old red barn paint, started to become popular with farmers in the early 1900's because it produced a smoother surface when used boards made out of the heavier softwoods, such as southern yellow pine or Douglas-fir. It was believed by many that painting barns white with black trim signaled that farming had become a business. White had also been the traditional farmhouse paint color since Colonial times and generations of farm folk had sought to enhance the appearance of their dwellings with a coat of whitewash or white paint. Occasionally, a modern-day farmer will paint his old barn light gray, light yellow, or tan by adding colored pigment to white lead paint, although "barn red" remains popular even for steel-walled buildings.

Doors and Windows

Barn doors and windows are visual focal points on what are otherwise mostly plain, undecorated walls. The walls of the main floor usually have large openings to allow the passage of wagons and farm machinery, with smaller doors in the corners for ease of access. On most general purpose barns, the main doors are located in the gable end. The earliest barns would have had double doors attached to the frames with strap hinges that opened outwards, but the sliding barn door, which was probably invented in the 1840s, has long been the norm on the western prairies. The overhead garage door, invented in 1921, has also been adapted to farm barns. By the late nineteenth century it would have been common to see hinged or sliding hayloft doors installed in the peaks of the gable ends.

Because light was important both for the health of the stock and convenience of farm work, most barns were oriented to provide maximum solar exposure. As a rule, twentieth-century barns tend to have more windows than nineteenth-century barns. Sometimes, the only windows in an old barn are the small windows at the peaks of the gables to bring sunlight and ventilation to the haymow. Bank barns were usually built with fixed basement windows called "cellar sash" placed just below the ceiling to increase natural lighting in the stable area. Barns constructed after 1900 were equipped with factory-made casement, fixed, or double-hung windows to obviate the necessity for artificial light in the stable. Dairy barns differed from general purpose barns in that the stable area required much more natural light and ventilation, so the number and size of windows was dramatically increased in comparison with general purpose barns. The rule of thumb circa 1900 was four square feet of window area to each one thousand pounds live weight of cows kept in the stable. General purpose barns usually have more

windows on the south, east, and west elevations than on the north. Before the invention of metal screens, lath frames covered with brown paper or old gunny sacks were used to keep out flies.

There was considerable debate among barn experts with respect to the appropriate number, size, and placement of windows in a farm barn. One architect, albeit one whose specialty was Eastern estate barns, thought the windows in barns "should be less large and numerous as possible," and preferred casement windows over double-hung sash, except in dairy barns where the sash needed to be movable to provide adequate ventilation. "Barn windows should have small panes of glass, as the cross bars of the windows serve not only to hold the glass but as fenders also," stated Isaac Phillips Roberts, ever the thrifty barn planner: "Since the glass in barn windows is likely to be broken, the cost of repairs is reduced to a minimum if the panes are small". "Large windows, possibly in groups of two or three, are better than small windows," suggested Foster and Carter.[15]

Cupolas

The traditional solution to the problem of barn stable ventilation was to set a cupola on top of the roof to help increase air movement naturally. The older type of barn cupola is made of wood and is between four and ten feet tall, resembling a belfry or belvedere, except that its principal function is to provide ventilation and light, rather than a lookout. The cupola functions as a kind of chimney, drawing warm air upwards from the stable through flues or holes cut in the haymow floor, then venting it through the roof. "A cupola, if it is large and well proportioned, may add beauty to the barn and serve to ventilate the mows, thereby making them cooler for the workmen than they otherwise would be," advised architect H. Armstrong Roberts, who pointed out that cupolas also provided sunlight to the haymow, "thereby avoiding the necessity of windows at the side of the mows, where they are likely to be broken and where they are covered as soon as the barn is partially filled."[16] Wooden barn cupolas were historically built in a variety of shapes and sizes, with louvered walls and gabled, cross-gabled, or gambrel roofs, the roof shape of the cupola not always matching that of the main barn roof. They are often decorated with fancy stickwork and topped off with weathervanes.

More prevalent than the wooden cupola is the metal ventilating cupola, which is actually the housing for the ventilating system outtake flue or exhaust vent. Like the old-fashioned wooden cupola, the metal cupola's primary function is to carry warm, moist air from the lower level of the barn, up through the haymow, and out through the roof. The intakes for the system consist of openings in the lower barn walls, usually placed at ceiling-height, which allow cooler outside air to enter the barn. The outtake flues are located in the walls of the stable and extended upwards through the loft to the roof. Barn ventilating systems were not mechanical, in that they relied upon the suction produced by the flow of air across the flue and the thermal buoyancy of the warm air from the barn stable to ventilate the interior spaces. Rotary fans were usually added after farms were electrified, but only about one in twenty South Dakota farms were on the grid before 1940. Cylindrical sheet metal barn cupolas first appeared in the 1890s, largely as a result of the pioneering work of F. H. King of Wisconsin, whose King Ventilating System was eventually installed in thousands of barns across the country. Large dairy and livestock barns often have as many as four cupolas for ventilating the stable and haymow, with two being the norm for barns between 35 and 75 feet long. The basic design utilizes a square wooden box framed with two-by-fours, which is attached to the roof ridge and forms the housing for the outtake flue. The drum of the cupola, which is made out of galvanized iron or steel, protects the opening of the flue from the elements, prevents back-drafts, and keeps out birds. A rotating metal finial on top of the cupola keeps the flue opening facing down-wind. Because the metal cupola conducts electricity, it is usually fitted with a lightning rod. Metal weathervanes (traditionally called "wind vanes") are common. Many of the ventilator systems were patented and the different styles of metal cupolas were

[15] Alfred Hopkins, *Modern Farm Buildings* (New York, 1913), 75; Roberts, *The Farmstead*, 295; *Farm Buildings* (1922 edition), 49.
[16] *The Farmer His Own Builder* (Philadelphia, 1905), 295.

marketed by barn planning agencies and mail-order catalog houses; the manufacturer and model names can sometimes be found stamped or painted on the side of the metal drum or on the finial.

Lightning Rods

Because wood-framed barns filled with hay were especially vulnerable to fire caused by lightning strikes, farmers eagerly installed various lightning rod systems, the earliest of which appeared around 1840. The typical lightning rod system consists of air terminals or points, the ground rods or terminals, the main conducting cables between the points, and the down conductor cables that leads to the ground rods. The distinctive glass balls on the lightning rods are purely decorative: typically blue or white, they were sold by traveling salesmen from the 1870s until the last manufacturer went out of business during the Great Depression.

Milk houses

The vernacular pattern language of farm barns includes a variety of specialized, small-scale structures which are sometimes found attached directly to the exterior of the barn. The milk house is a dairy barn accessory, usually consisting of a small, single-story building, typically measuring 10 to 12 feet on a side and square or nearly square in plan. The exterior walls may be either masonry or wood, with cinder block and hollow clay tile being much more common than weatherboard. The interior surfaces are always concrete so that they can be kept meticulously clean. The milk house is sometimes a freestanding building but more often it is found attached directly to the outer wall of the dairy barn.

The earliest milk houses were spring houses, small buildings placed over natural bedrock seeps or on running streams, with stone-lined catchments for fresh water that was used to cool cream and cheese over the summer. Early dairy farmers sometimes harvested lake or river ice and preserved it in sawdust for use in cooling cream and other dairy products. The form of the common milk house, which dates from the 1890s, is largely the result of government regulations for milk handling that mandated washable equipment so that every surface touched by the milk could be kept in sanitary condition. Its primary function is to keep milk cold and clean. Traditionally, milk was hand-carried or piped into the milk house, where it was placed in metal cans which were stored in tanks filled with fresh, cool water to await transport to the creamery. Until the 1930s most South Dakota farmers marketed cream, which they separated from the milk in the milk house using a continuous centrifugal cream separator based on the machine invented by Dr. Gustav De Laval in 1878. Tank trucks for transporting milk appeared around the time of the First World War, although refrigerated bulk tanks did not replace the old-fashioned milk cans until the 1950s.

Silos

The earliest silos on South Dakota farms were probably pit silos in which green fodder was packed and covered with earth. Round tower silos constructed of concrete staves, concrete block, or glazed hollow clay tile are often found near farm barns; and sometimes they are attached to the walls of large, special-purpose livestock barns so that the silage can be delivered directly to the feed room or one of the feed alleys inside the barn. They range in height from 18 to 60 feet and usually have domed metal roofs. The oldest concrete silos tend to have very thick walls and concrete caps, but clay tile and concrete stave silos have much thinner walls, usually no more than three to six inches thick.

The first masonry silo in the United States was erected in Michigan in 1875 and their development was very rapid. It is not known when the structure made its South Dakota debut but it may have been before 1900. Silage was routinely fed to dairy cattle but was not widely used for feeding dairy or beef cattle in South Dakota before the

1920s. The fiberglass-lined, air tight, bottom-unloading silo was invented by the O. A. Smith Company and entered production in 1939—it is not known when the first proprietary Harvestore was built in South Dakota.

Barnyards

Most farmsteads have some kind of barnyard, either open or enclosed, which is as much part of the barn as the stable or hayloft. Until quite recently, it was common to see several farming structures arranged within the barnyard, if not attached directly to the barn itself; most, including wagon sheds, ice houses, woodsheds, butchering sheds, and root cellars, have literally disappeared from the twenty-first century farm. On farms where livestock are raised the barnyard most often takes the form of a paddock, corral, or feedlot, depending on the type of operation. On a modern dairy farm, the open feedlot next to the loafing barn is sometimes sloped and paved for easy cleaning. Cattle loading ramps, pens, gates, and breeding chutes are still barnyard fixtures, and stacks of baled hay or straw may be seen stored in the yard alongside the barn under an open shed or covered with plastic. Because livestock require plenty of water, pumping windmills are also sometimes found next to the farm barn. Barn cisterns and elevated water tanks, formerly quite common, are very nearly extinct.

F. ASSOCIATED PROPERTY TYPES

For planning purposes, the property type *common farm barn* is herein defined as a large agricultural outbuilding that was built between 1857 and 1958 to shelter harvested crops *and* livestock. Specialized farm outbuildings, regardless of size, are more properly classified as granaries, stables, corn cribs, hog houses, cattle sheds, carriage houses, or machine sheds. Livery stables, carriage houses, and other urban forms are not considered farm barns. Common farm barns are usually examples of vernacular architecture, including individual builders' interpretations of barn designs created by trained architects and engineers. The kinds of farm barns that are not addressed by the present study are one-of-a-kind barns created as showplaces, institutional barns designed as public works, exhibition livestock pavilions, estate farm barns with unique architectural features, and folk barn forms with limited distribution in the state. National Register multiple-property studies have already been developed for evaluating and registering South Dakota's round and polygonal barns as well as German-Russian, Czech, and Finnish folk architecture.

1. Description

The architectural classification of common farm barns can be an exacting task. "One of the hottest arguments I ever witnessed took place between two geographers, both knowledgeable in the ways of the land, who were looking at the same structure and debating whether it should be called a barn or a shed," writes a noted cultural geographer:

> The one whose roots lay deep in the hills of the Appalachian South was appalled that anyone could be so dismally ignorant as to fail to understand that such a large and imposing structure was a barn. The one who was born and raised in one of the rich corn counties in Iowa had nothing but scorn for anyone who could be so stupid as to suggest that such a "dinky" little old building was anything but a shed.[17]

Myriad terms have been used to describe the various historic barn forms recorded in South Dakota and there is no consensus on type names or descriptors. Indeed, a conspicuous feature of the regional barn literature is the absence of a shared typology. Consequently, the barn type labels used in the most frequently-cited studies are often ambiguous, misleading, or contradictory. With few exceptions, architectural historians have generally neglected the evolution of common farm barn forms that reflect the influences of industrialization and agricultural engineering.

Log Barn

The log barn consists of a rectangular cribwork of horizontally laid logs between five and ten feet high, over which was placed a single-pitch or gable roof made of split logs, poles, rough boards, or brush. They could be constructed of any available species of wood and were often built entirely by hand with only a few simple tools. The basic log building module is usually a crib or pen 16 to 18 feet square, although log structures with walls 24 feet long were not unusual. The walls may be built either of round, split, or hewn logs. The saddle notch appears to have been the most commonly used corner notching system, followed by square and half-dovetail notching. It is unlikely that the walls of log barns would have been chinked, except when the structure was occupied as a combination dwelling and barn.

Although they represented a successful vernacular solution to the need for shelter in a frontier environment, log barns were not long-lived farm buildings and most were probably either torn down, burned down, or abandoned

[17] *The Look of the Land* (Englewood Cliffs, NJ), 123.

not long after they were built. A few may have been converted into hog houses or sheds and therefore remained in service. According to one study, "hundreds" of log buildings were erected in South Dakota, primarily in the Black Hills and on West River homesteads, between 1900 and 1940. Very few log barns appear to have survived as standing structures, although hewn-log farm barns have been reported from the Black Hills area.

Sod Barn

The sod barns built by homesteaders on the Great Plains were mostly small, low profile structures similar in size and shape to sod houses. Surviving specimens have inclined walls made of sod bricks about two feet thick, with cottonwood or cedar poles and rafters supporting the single-pitched roof, which was traditionally made of sod, willow brush matting, or lumber. Unlike sod houses, where the exterior walls were often plastered with mud or lime, the walls of sod barns were left untreated. The south wall was often left open, much like a modern loafing barn. The floors are simply tamped earth. Used primarily for stabling draft animals and storing grain, some sod barns may have also temporarily sheltered humans, in which case evidence may survive in the form of sod or wood partition walls, stovepipe holes, or window frames.

The era of the sod barn in South Dakota came to an end around 1918. As might be expected, few examples are preserved intact. The "soddie" was in many ways a short-lived structure, with an average life-span of six or seven years according to some authorities. Some sod barns were converted to other uses but most have been allowed to return to the earth.

Multi-Level Barn with Gable Roof

The one-and-one-half story, wood-framed, gable-roofed general purpose barn is the oldest and most widespread farm barn type. It is rectangular or square in plan, timber or plank framed, and the wooden superstructure is raised one to four feet above grade on a continuous masonry foundation. The primary diagnostic element is the straight gable roof with a slope of between 30 and 45 degrees. Most are ground stables, i.e., the stable is on the main floor, which is at ground level. The roof is always oriented to the barn's long axis. Siding is either horizontal boards or board-and-batten. One or both gable peaks is sometimes inclined backward to form a "clipped" or jerkin-head gable.

Specimens built in the nineteenth century sometimes resemble the Yankee or Connecticut three-bay folk barn prototype, but mechanical threshing made the threshing floor functionally obsolete before Dakota Territory was opened to settlement. The location of the doors may indicate the type of farming for which the barn was built, as barns with side doors were most closely associated with grain farming, while barns with end doors were better suited to mixed farming. Most examples recorded by survey, however, seem to have their main doors in the gable-end. In the oldest specimens, hay was stored loose in one of the bays on the main floor. The conventional stable plan is separate box stalls for dairy cows and horses, arranged on opposite sides of a center aisle, with rooms for feed, grain, and farming implements. Gable-roofed barns were sometimes extended with additions.

The traditional bank barn is also a common form of the multi-level, gable-roofed family of general purpose farm barns, but because of its unique historical associations it is treated as separate type (see below).

Multi-Level Barn with Gambrel Roof

This type of farm barn is distinguished by its distinctive, some might say iconic, roof shape. The gambrel roof has four surfaces with two different pitches. The upper surfaces slope approximately 30 degrees, while the slopes of the lower roofs may be as steep as 60 degrees. Sometimes the lower slope is much lower-pitched, and these broad, often very large roofs are sometimes identified as examples of the "English" gambrel. Gambrel roofs with

a steeper pitch and flared eaves, which resemble the shape of a bell at the lower roof edge, are commonly referred to as "Dutch" gambrels. Gambrel roofs are self-supporting and the cantilevered trusses are built entirely of two-inch dimensional lumber. Considerable storage space is provided above the main floor: because the roof is entirely supported by the exterior wall framing, the haymows in gambrel roof barns may be 30 feet high from the floor to the hay carrier-track and are unobstructed by posts. In ground plan and structure these barns are very similar to multi-level barns with gable roofs—some would argue that the cantilevered roof and plank frame construction are merely adaptations of the traditional three-bay folk barn form. Dimensions vary greatly, but they are almost always longer than they are wide. Most examples from South Dakota are built entirely with dimensional lumber and feature plank framing built up from 2X6, 2X10, and 2X12 lumber. Wall cladding is weatherboard siding, often tongue-and-groove pine or fir boards. Smaller barns are more likely to be sided with board-and-batten siding. Window dormers and cupolas are common.

The multi-level, plank-framed general purpose barn with a gambrel roof was ideally suited to the kinds of mixed farming practiced by most East River farmers from the 1890s through the 1950s. The elimination of the interior bracing in the loft allowed for a significant increase in haymow capacity over similar-sized gable-roofed barns, enabling farmers to put up more fodder for winter-feeding their livestock. It may be the most numerous type of historic farm barn that is preserved in the state and occurs in all farming areas as well as on livestock ranches.

Multi-Level Barn with Arch Roof

The two-level, arch-roofed farm barn is defined by its fornicate or vaulted roof which usually takes the shape of a "Gothic" or parabolic arch formed by bent rafters. One-and-one-half stories in height, it is balloon framed and rests upon a concrete foundation. Barns with pointed, round, or semi-circular arch roofs have somewhat different rafter truss systems than Gothic arch roof barns but share the same basic engineering concepts. The radius of the arch is usually three-fourths of the width of the barn. Other prominent characteristics include raised masonry basement walls, horizontal weatherboard siding, and metal roof ventilator cupolas. In rare examples the superstructure is built entirely out of masonry, usually glazed hollow clay tile or rusticated concrete block. Older specimens exhibit both sawed and bent rafters made of 1X8 or 1X10 planks that are bolted and nailed together; barns built after 1930 are more likely to have glued laminated rafters. Large arch-roofed barns were built with lamella, bent-rafter, or laminated rafters which could be adapted to barns of any width and required no internal bracing. The arched roof allows for a cavernous haymow that is free of interior bracing.

Barns with curved roofs probably appeared in South Dakota around 1910. During the 1920s, the South Dakota editions of *The Farmer* and other agricultural periodicals frequently carried advertisements for standard-plan barns with arch roofs "ready-framed" with "all the framework cut to fit". Wood-framed farm barns with semi-circular roofs, sometimes referred to as "round" or "rainbow" roof barns, represent a modification of the Gothic arch design that appeared in the 1920s. As late as 1974, the Midwest Plan Service updated the plans and specifications for a 40-stall "Gothic Arch Roof" barn in its catalog. Farm barns with arched roofs were most often constructed as special purpose barns to house dairy cattle or other livestock. Most examples are found in the eastern part of the state.

Bank Barn

While the barn was often referred to as the farmer's bank (i.e., his place of deposit), the bank barn type derives its name from its physical placement on sloping terrain. The lowest level of the barn is banked so that the foundation walls extend into the side slope of the hill, thus providing a natural ramped wagon drive into the upper level as well as a "walk-out" basement-level stable on the downhill side. If no hill was available, an earthen ramp was sometimes constructed to provide access to the door on the upper level. Bank barns have rectilinear plans and gable or gambrel roofs. Bank barns constructed with heavy timber framing occur only in the southeast corner of

the state and are very rare. They are typically sited on a south-facing hillside, with the top of the north basement wall at or slightly above the ground surface, in order to provide a broad southern exposure that admits sunshine to the stable and protects it from the coldest winter blasts. Farmers usually stabled their milk cows in the sunniest, warmest corner of the stable. Most of the bank barns that have been identified by survey are plank-framed.

Bank barns are widely distributed throughout the East River country and are historically associated with mixed grain and livestock farming. Nineteenth century commentators generally regarded it as the ideal barn for general farming in the Midwest, where farmers required shelter for their surplus grain and fodder as well as their valuable livestock. The bank barn was also well suited to small-scale dairying and was promoted by barn planning services through the 1920s. In the absence of chemical fertilizers, careful farmers made good use of the bank barn as a repository of barn manure.

Raised Basement Barn

The most important variant of the traditional bank barn is the raised basement barn, which features a conventional gable, gambrel, or arch-roofed superstructure raised on top of a full masonry basement, which encloses the stable on the main floor. Unlike the bank barn, it is built on level ground and it is always plank-framed. Some examples have a ramp or high drive leading up to the upper level but usually the main doors are in the gable-end at ground level. The basement walls are 8 to 10 feet high, constructed either of hollow clay tile, concrete block, or poured in place concrete, and the stable is usually configured with one or two center aisles. The entire area between the stable and the roof peak is often available for use as a haymow. Raised basement barns with gambrel roofs were extremely popular with livestock and dairy farmers, and in other parts of the Midwest, these barns have been referred to as “foundation barns”. The “Wisconsin” type dairy barn is a raised basement barn (see below).

Wisconsin Dairy Barn

The Wisconsin type dairy barn is a raised basement barn, one-and-one-half stories in height, tall and long, surmounted by a broadly projecting Gothic arch or gambrel roof. The basement walls are smooth concrete block or glazed hollow clay tile, occasionally stucco, and the wooden side walls are usually finished narrow-reveal clapboards or drop siding. Fenestration is balanced and the side walls are pierced for long rows of small casement or double-hung windows that provide light and air to the stable. The main entry doors are in the gable-end but there are numerous small service doors to allow easy access and movement of livestock. The standard floor plan features an elongated stable with two continuous, lengthwise rows of stalls where the cows were fed, bedded, and milked, three service alleys, one or two feed rooms, a milk room, and three or four confinement pens are usually found at the ends of the barn. The stable has washable cement floors and walls. Before the advent of modern flush systems, dairy barns were usually equipped with alley scrapers and other types of mechanical barn cleaners that moved manure from the alleys and gutters into a collection channel, located either in the center of the barn or at the ends of the service alleys. The upper level contains a cavernous haymow which is sometimes lighted by dormer windows. Other historic character defining features include attached or detached milk houses and cylindrical silos, triangular hay hoods, and rooftop metal cupolas. The Wisconsin type dairy barn is 34 feet wide and most were built to standard lengths of 36 and 66 feet.

The earliest Wisconsin type dairy barns were quite small by later standards small and housed about eighteen milk cows in stanchions or tie-stalls. The cows were usually kept in the barn during the winter except for an hour or two of daily exercise in good weather. During the spring and summer they were put out to pasture and brought into the barn at milking time. Swinging stanchions eventually replaced the old-fashioned rigid stanchions. Cows were milked by hand on many farms up to the 1940s. The first vacuum-type milking machine was patented in 1865 but the De Laval Milker, introduced around 1918, was probably the first widely used milking machine before

rural electrification in the 1950s. There was originally no milking parlor: cows were milked one after the other, either by hand or with a milking machine that was transported on a cart—hand milking persisted well after the Second World War on farms with small herds. The barn stable area was designed to be kept as clean as the farm wife's kitchen. The abundance of windows reflected the emerging science of bacteriology, as the increased sunlight reduced bacterial growth in addition to making barn chores easier.

As the name suggests, this type of barn was developed for dairy farmers in the northern dairy region and it incorporates many design features perfected by agricultural engineers and dairy specialists at the Wisconsin Agricultural Experiment Station in Madison. The design reflects not only the state of the art in structural engineering but the influence of government regulation of the dairy industry through compulsory tuberculin testing and pasteurization. The first common farm barn designed from the ground up by professionally trained engineers, it incorporated a number of recent scientific improvements and had a profound impact on barn building throughout the Midwest. The design probably also marks the first time in agricultural engineering where the comfort of the animals housed in the stable was a priority. Evidence of its evolving plan and character can be seen in the University of Wisconsin Dairy Barn, built in 1897 with additions in 1909 and 1916. Several University of Wisconsin faculty and staff played pivotal roles in the development of the Wisconsin type dairy barn, including Franklin H. King and Frank White. It was widely promoted as the ideal dairy barn for the north-central states by engineers, agricultural experiment stations, government bureaus, barn planning services, industry groups—and by farmers.

While most of the cows milked in South Dakota were part of small herds that were housed in general purpose farm barns, the Wisconsin type barn was designed for dairying on a commercial scale. The South Dakota College of Agriculture and Mechanic Arts was an early leader in the dairy field. The first milking parlor in the state was installed at the dairy barn in Brookings in 1941. The state adopted minimum market standards for clean milk in the 1890s and eventually promulgated rigorous standards for dairy barn equipment and herd management. The standard Wisconsin plan dairy barn exceeded all of these requirements for nearly half a century. After about 1940 the number of dairy farms decreased very rapidly and many of the old Wisconsin type barns were adapted for other kinds of farming enterprises. Many became general purpose barns, hay barns, or were reconstructed and modernized for housing beef cattle or hogs. Quite a few are still used today for dairying. The Wisconsin type dairy barn occurs only in northeast, east central, and southeast South Dakota where dairying was important during the first half of the twentieth century.

Western Feeder Barn

The Western Feeder type farm barn, also commonly known as the "three portal" or "transverse frame" barn, consists of a rectilinear, plank-framed core one and one-half stories high with a broad, low-pitched gable roof and short sidewalls. The principal roof is most often a straight gable, but sometimes it is extended by shed roofs having a different pitch, slightly lower pitch than that of the principal roof; the resulting profile is referred to as an "extended" or "broken" gable when viewed end-on. Occasionally, a third shed with an identically-sloped roof is placed on the back side of the barn as well. The typical feeder barn has a central storage space for hay and feed that is usually about 24 feet wide; with the side feeding sheds, the barn is usually between 48 and 60 feet wide. The foremost authority on Iowa farm barns has identified three distinct sub-types of "beef cattle feeder barns" in that state: an early, broad, gable-roofed form; a three-bay "extended gable" variant dating from the 1890s; and a monitor gable roof form that was popular between 1900 and 1920. The latter, while not a true monitor barn, is often identified as a "monitor" in field surveys; a recent study of farm barns in northern Utah classifies this as a type of "intermountain barn". The characteristic three portals are the openings to the three broad feeding alleys that extend through the barn, parallel to the axis of the roof. A large hay hood projects from under the peak of the gable to protect the hayfork track, which is used to load the central hay barn. The main floor is sometimes

partitioned off with separate rooms for storing grain, farm machinery space, horse stalls, cattle pens, feed rooms, and wagon sheds.

The Western feeder barn was built to "finish" beef cattle or sheep on hay, grain, and other rations after they had grown to maturity—in some parts of the state, especially in the West River region, it also functioned as a dairy barn. Until the early twentieth century, West River livestock ranchers fattened their beef cattle and sheep on grass and sold them directly to the packers, so they had little need for cattle barns. Feeder barns were built primarily in the East River counties where large numbers of western livestock were "finished" before slaughter. The feeder barn was also well adapted to the West River country, where a number were built in the 1920s and 1930s when some of the large cattle outfits began to feed out their breeding stock over the winter months and desired shelter for valuable saddle and draft horses.

Barn writers have argued with authority that German-Americans created the traditional, multi-level, wood-framed American farm barn, so it is perhaps not surprising that they also credit the Western feeder barn to Teutonic folk architecture, along with the inevitable blending of Dutch and English elements. In its South Dakota context, the Western feeder barn is an architectural carry-over from the Corn Belt, where large numbers were built; the same basic form is built throughout the Great Plains and the Intermountain West. The plans for beef cattle barns illustrated in nineteenth-century plan books do not appear substantially different in form and structure from conventional farm barns. The Western feeder barn form was widely promoted by agricultural extension in the early twentieth century. Farmers generally liked its strong lines broad expanse of roof. Its chief advantage over other common barn forms was its commodious stable and large hayloft, which provided handling room and feed for a larger number of animals than could be accommodated in any of the standard general purpose barns. Balloon-framed with stock lumber, it was also comparatively cheap and easy to build. Carter and Foster state flatly that it was the most common type of beef cattle feeder barn in the Midwest.

Specialized Barns for Horses, Sheep, and Hogs

In South Dakota the term "barn" is frequently applied to several types of special purpose farm buildings used exclusively to particular kinds of livestock. A horse barn, for example, is any farm building that is used for handling work stock or saddle horses, regardless of its architectural form. Specialty barns constructed purposefully to stable horses are usually one and one-half story, rectilinear, wood-framed buildings with gable, gambrel, or arch roofs. Because horses require more space than cattle, the stables in horse barns are usually quite large, with box stalls, transverse service aisles, a central driveway, and multiple specialized rooms for feeding, grooming, and veterinary care. The ceilings of horse barns often provide more than eight feet of clearance and the floors may be either wooden planking or cement, or a combination of materials. Horses also require plenty of exercise, in addition to fresh air and sunlight, so there are numerous windows, rooftop cupolas, and dormer windows. The horse barn is typically found near the center of the farmstead with its long axis oriented north-and-south. The horse barn at South Dakota State University, designed by Ralph L. Patty and constructed in 1925, was not intended to represent any kind of common barn, but some of its features, such as the Shawver truss rafters and the custom ventilating system, were probably intended to illustrate progressive farm barn design. Most of the working horses on South Dakota farms were stabled in general purpose barns along with the cattle and other stock.

Though sheep are tender animals, in comparison with cattle, they were rarely put up in special purpose farm barns. Indeed, agricultural experts cautioned stockmen against investing too heavily in unnecessary shelter for sheep. Because sheep are naturally quite well protected against the elements by their fleeces, early West River sheep ranchers ordinarily did not bother with building barns. East River farmers who raised sheep, on the other hand, sometimes provided specially constructed barns for breeding, which needed to be large enough so that the ewes, rams, and lambs could be housed separately. Most of the sheep that were shipped east to be fattened for

market were sold to general farmers who were most likely to put them up in a general purpose farm barn. When Americans lost their taste for mutton and began to place a higher value on young lamb, the market for finished sheep virtually disappeared. Beginning in the 1930s, large numbers of spring lambs were sold off the western range as feeders and sent east to be fattened on hay and grain. Most of the large sheep feeder barns date from the 1920s to the 1950s. Historic sheep barns are found in South Dakota, nevertheless, and they are usually distinguishable from other types of farm barns. A common form of sheep barn is the sheep feeder barn, which is usually one story in height, balloon-framed, with a straight gable or monitor roof. Sheep feeder barns tend to be more robust structures than those built for lambing and their interior arrangement features group housing along with smaller pens for lambing. Barns designed for breeding lambs tend to be built long and low and can be up to 40 feet wide and 100 feet long. They are more likely to have half-monitor roofs with south-facing windows and the interior layout consists of small, interconnected pens arranged along either side of a center feeding and service aisle, with each group of pens having its own door leading to the outside paddock. Because sheep require less feed than other stock, the loft space is quite small, and some barns have feed storage sheds attached to their long sides. Sheep barns were always built on sunny, well drained sites and were provided with large fenced yards.

Wood-framed buildings used for sheltering swine are commonly referred to as “hog houses,” although some of the largest occasionally meet the criteria for classification as farm barns. Barn planning books published between the 1850s and the 1920s often included plans for single story “swine barns,” usually depicted as long, narrow, balloon frame structures 20 feet wide and up to 80 feet long. The hog barn contains several pens and paddocks arranged in parallel rows alongside a central feeding alley, with feed rooms and one end. T-shaped hog barns appear to have been popular in the Midwest during the early twentieth century but the common form had a linear plan. Double-row hog farrowing houses most closely resemble ordinary one story farm barns because they often have gable or gambrel roofs. The half-monitor roof with a solid row of windows was already popular by the early 1900s and was the standard plan for colony housing by the 1930s. According to a report issued by a government animal husbandry researcher at the beginning of the twentieth century, the typical “northern” hog barn was a single-story, gable-roofed, wood-framed structure with vertical board siding, containing eight-by-eight foot farrowing pens, each pen equipped with two doors and one window.

One-Story Barn

The one-story farm barn is a freestanding, plank-framed building with a gable, gambrel, or arched roof. One-story general purpose barns are usually 12 to 18 feet wide and 28 to 36 feet long. The floor plan consists of a short feed alley along one side with box stalls or pens on the other; the smallest of them were often built with ground-floor hay and feed storage rooms in lieu of haylofts. A relatively small number of one-story barns were built as general purpose barns with stalls for cows at one end and horses at the other, with an elevated hayloft between them. One-story plank-framed hay barns usually have gable roofs and range from 32 to 48 feet in width. The barn doors on hay barns are quite large, up to 14 feet high, in order to accommodate a fully loaded hay wagon, and the barn is usually configured so that the wagon could be driven straight through it on its long axis. Special purpose barns, for dairy cattle or other livestock enterprises, are usually considerably larger. Some lack haylofts but were built with large hay and feed racks extending from the ridgepole down to the ground down the center of the barn. Those built for feeding beef cattle are little more than sheds, often very simply constructed with rough boards used for siding and their down-wind sides left open. Barn height is determined by the headroom necessary for the kind of livestock sheltered in the stable and by the storage requirements of the hayloft.

Single-story farm barns were built during the nineteenth century but did not come into their own until the early twentieth century when a movement for better farm barns swept over the country. One-story frame barns were featured prominently in the farm press and the technical literature as better barns than the traditional, multi-level farm barns, especially for the small farmer interested in building along scientific lines. Many of these small barns

were nothing more than hay or cattle sheds. On the other hand, the one-story dairy barns shown in contemporary plan books have ground-level feed storage rooms or attached hay sheds rather than overhead haylofts, which saved labor in feeding and made for better sanitation, improved stable ventilation, and reduced risk of fire. Many of the kit barns marketed by Sears and other mail-order companies were single-story barns. Because of its lower roof profile, the one-story barn was also widely touted as less prone to wind damage than traditional, multi-level barns. After about 1930 there was increasing interest in the loose housing system of handling dairy cows, which called for a one-story barn usually referred to as a "pen" barn. In the traditional stanchion system, each animal was assigned a specific stall where they were tethered by stanchions or neck chains and milked in turn, either by hand or by a mobile milking machine; but in the pen barn, the stable was replaced by a large communal pen where the cows were fed hay and other roughage and had the freedom to move about unrestrained until "milking time," when they are moved in relays to the milking parlor where the milking machinery is permanently located. The one-story "pen" or "shed" barn was well adapted to certified milk production because they were easier to keep clean than the old-fashioned stables and loose stock housing was much less labor-intensive than holding cows in stanchions or tie-stalls. The earliest one-story dairy barns included a few stalls fur use in milking—the milking parlor being a post-1940s innovation that used electrically powered milking machines.

Pole Barn

The pole barn is distinguished from other farm barns by its post-frame structural system. The basic pole barn is one story in height, with a broad, low-pitched gable roof, large end doors, and steel siding. The oldest specimens will have creosote-treated telephone poles as the primary load-bearing members—it is not known when sawn, pressure-treated timbers replaced round posts, but it probably was not until the 1960s, judging from the specifications in contemporary farm building guides. Clear-span roofs with prefabricated trusses first appeared in the 1950s. There is no overhead storage or loft space and the ceilings follow the slope of the roof. Packed earth or gravel floors are common, except when it was built for use as a flat dairy barn and a washable concrete floor was required.

Post-framed single-story farm barns probably first appeared in South Dakota during the 1940s. Many were constructed as dairy barns, commonly referred to as "flat" barns, with the milking parlor located in a separate building. The pole barn was well adapted to loose, free stall, and stanchion housing. The pole barn was also widely built as a shelter for beef cattle feedlots. These "loafing barns" are purely functional constructions: long, low, gable-roofed sheds oriented east to west with the south wall, facing the paved feed lot, left open. Although sometimes referred to as barns, these are not, strictly speaking, common farm barns and should be classified as sheds for historic preservation purposes.

The pole barn is found throughout the state and is probably the most numerous type of post-1940 farm barn. The life of a creosote-treated utility pole varies from roughly eight to twenty years, depending on the type of wood and local conditions; therefore, there may be few survivors remaining from first generation of pole barns built in the state. Although it has received little respect from preservationists and appears to be badly under-represented in South Dakota surveys, the post-frame constructed farm barn has a long history of service to farming in the north central states.

Quonset Hut Barn

The term "steel building" is commonly associated with prefabricated metal-clad farm buildings, of which the iconic Quonset Hut is probably the best known. The Quonset Hut is a prefabricated structure with a semi-cylindrical shape, constructed of corrugated steel fastened to arched steel ribs that are bolted to a concrete slab floor. In a true Quonset Hut, the walls and roof are the same seamless component, in which the curve of the roof begins at the floor. All-metal farm buildings with barrel roofs and short, vertical knee-walls are sometimes identified as

"Quonset Huts," but are properly classified as round-roofed steel buildings. The original Quonset Hut was assembled in 12-foot modules to form buildings up to 56 feet long but later agricultural versions came in various dimensions. There are usually no windows and like a tunnel, entry is only allowed at the ends. After the Second World War, the Quonset Hut was widely advertised as a machinery shed and farm storage building. Some were used as farm barns. The prefabricated farm building industry grew rapidly after the Second World War, with Butler, Lester, and other companies developing several lines of all-steel farm barns, although there was not wide acceptance of the new building technology until the late 1950s.

Mail-Order Barn

Farm barns built from kits ordered through mail-order catalogs are impossible to distinguish from conventional farm barns on the basis of form, structure, and materials. The farm barn designs marketed by Sears, Roebuck and Company, Gordon-Van Tine, Aladdin, Montgomery Ward, and the other mail-order houses share the same traits as contemporary custom-built farm barns. The only way to positively identify a mail-order barn is through intensive archival research and the visual identification of company stamps, labels, or other markings on joists, rafters, or other structural members.

2. Significance

Common farm barns are an enduring symbol of South Dakota's agricultural heritage and represent the most recognizable class of farm buildings which make up the rural built environment. The architectural characteristics of the various common barn types reflect broad patterns of settlement and agricultural development. All of the common barn forms discussed above exhibit certain adaptations to the South Dakota environment but at the same time share important traits and physical characteristics that reflect a broader regional and even national vernacular pattern language. Overall, the differences between the common farm barns of South Dakota and those of neighboring states are minor and relate primarily to the sequence of settlement. Because permanent settlement and the development of commercial agriculture in South Dakota lagged behind that of other Midwestern farming regions, its farm barns are more a reflection of contemporary vernacular rather than folk architecture themes.

South Dakota farm barns represent a set of scarce, non-renewable cultural resources that make an important contribution to the state's distinctive character and regional identity. There are presently no reliable estimates of the number of historic farm barns which remain standing in the state as a whole or in any of its subdivisions, for there has not yet been a comprehensive inventory made of barns in all of the state's sixty-six counties, and although there has been an ongoing federal census of agriculture since 1860, the census returns have not enumerated farm buildings or categorized them by age, as it has with housing since 1940. However, the agricultural census returns do take account of the number of farms and these data describe a major decline in the number of farms since 1935, when there were 83,400 farms in the state. It is reasonable, therefore, to assume that common farm barns will shortly become scarce, at least locally. In neighboring Minnesota, the state historic preservation office recently estimated that 75% of the farm barns built before 1930 had been lost by the year 2000. The prevailing view among South Dakota preservationists is that historic barns are the architectural equivalent of an endangered species.

3. Registration Requirements

Determination of the National Register eligibility of an individual farm barn under criterion A will depend heavily on the quality of the historical documentation. Many farm barns with good historic integrity will doubtless meet the National Register criteria for significance at the statewide level because they represent an important aspect of the history of South Dakota as a whole. A particular farm barn may also be locally significant because of its

importance in preserving the heritage of an individual farm that helps illustrate the rural history in a particular county, township, or community. It is critical that the evaluation is not biased in favor of old farm barns over those associated with more recent historical trends, thereby undervaluing barns associated with post-settlement period agricultural development.

Farm barns represent potentially significant architectural resources and should be carefully evaluated under National Register criterion C. The architectural and engineering significance of a particular property will most often be the product of its design and construction characteristics which make it an outstanding example of a common farm barn type. Barns which are otherwise undistinguished by their design, structure, and materials, but which retain good historic integrity, may be considered individually eligible for registration when they represent sole or rare survivors of a common farm barn type that was formerly abundant but is now rarely observed in a particular locality. Farm barns that do not rise to the level of significance required for individual registration need to be considered for their potential preservation value as contributing components in National Register-eligible sites or districts.

Significance under National Register criterion D, the potential of a farm barn to yield historically important information, is not limited to archaeological remains or ruins. Standing structures such as farm barns are complex artifacts which often yield information that is unavailable elsewhere. Historical and industrial archaeologists, for example, may determine that a particular farm barn presents a unique opportunity for studying the material culture of farming through documentation and analysis of its architectural features. Analysis of structural systems and materials can also provide answers to questions concerning the engineering concepts applied historically in common barn construction.

Assessing historic integrity in common farm barns is often problematic, particularly with respect to such intangible qualities as feeling and workmanship. While common farm barns will usually possess some if not all of the seven aspects of integrity recognized by the National Register, determining which of these are most important in evaluating the overall significance of a particular property is the critical first step. The best approach is probably to focus on determining the presence or absence of the most important farm barn diagnostic features and materials, while taking care to document the history of the property's construction, use, and alteration. Deterioration of major structural elements and character-defining features represents a major threat to the historic integrity of farm barns. Farmers' neglect of their old barns reached crisis proportions at the time of the Great Depression and postwar trends have exacerbated the problem.

For working farm barns which continue to be used in agricultural production, assessing historic integrity of materials, setting, and feeling may pose challenging questions. Contextually, farm barns were built with the expectation that they could be altered to meet the changing needs of the owner. Modifications in plan, structure, and materials that occurred during the property's period of historical significance may have acquired historic preservation value as a reflection of the property's agricultural use. While long vacant or abandoned farm barns may be somewhat more likely to retain intact a greater proportion of their original structural components and exterior finishes, working farm barns will usually exhibit evidence of recent modifications, alterations, repairs, or remodelings that were carried out in order to mitigate its functional obsolescence. In order to encourage the preservation of working farm barns, the evaluation of historic integrity must accommodate the changes that are normal, or at least necessary, for continued operation.

With respect to integrity of location, unlike granaries, poultry houses, and some other common farmstead structures, farm barns were not designed to be movable. It is possible, however, that a particular barn may have been relocated within a farmstead or ranch in response to some change in production which occurred more than fifty years ago. Under these circumstances, the move may reflect the property's physical history and would not compromise its historic integrity.

G. GEOGRAPHICAL DATA

Common farm barns more than fifty years old occur throughout South Dakota and their distribution is directly related to the physical and cultural geography of the state. Concentrations of historic farm barns occur in the East River counties, particularly in southeast South Dakota, which contains the most highly productive farmland and has historically contained the largest number of farms in the state. Historic barns occur much less frequently in the western two-thirds of the state.

Most historic farm barns have survived to the present day as outbuildings on working farmsteads. Old barns also mark the sites of abandoned farms and homesteads. The most common location is in the center of the farmstead or ranch headquarters; isolated barns are rare. The basic pattern of farm and ranch building in South Dakota appears to be on the whole consistent with that observed in neighboring states.

H. SUMMARY OF IDENTIFICATION AND EVALUATION METHODS

The purpose of the present study was to develop a statewide historic context and property types to use as a cover document for nominations of historic farm barns. To this end, an intensive, comprehensive literature search and records review was conducted in a wide range of source materials, including but not limited to popular and scholarly books, monographs, articles in scholarly and professional journals, trade publications, agricultural newspapers and other periodicals, agricultural experiment station bulletins and circulars, technical and informational publications issued by government agencies, atlases, census reports, abstracts of agricultural statistics, catalogs, bibliographies, plans, archival photographs, research papers, and unpublished records. Historic context studies, surveys, and National Register nominations already done for South Dakota farm barns were thoroughly reviewed.

Historic context research addressed the following questions:

- What important events and patterns of events in South Dakota history are best reflected by farm barns?
- What kinds of farm barns were built in South Dakota and how did they relate to the physical and economic development of individual farmsteads, agricultural regions, and the state as a whole?
- How are the different types of historic farm barns differentiated on the basis of form, structure, age, function, and other identifying characteristics?
- What factors were most important in influencing the design and construction of common farm barns?
- Why were particular barn forms, materials, and methods of construction preferred over others?
- How are different types of historic farm barns distributed within the state, how many are there, and what is their likely condition?
- What kinds of historic farm barns are underrepresented in the National Register?
- What data gaps need to be filled by future surveys and historic context research?

As the research progressed, the documentary data were assembled, examined, and critically reviewed to identify possible biases and information gaps. A historic context outline and list of sources consulted were developed at an early stage and both documents were continually revised, added to, edited, and refined. A good part of the library work was done at the South Dakota State Library in Pierre and the Hilton M. Briggs Library at South Dakota State University in Brookings. The collections of the Magrath Library at the University of Minnesota-St. Paul, the Parks Library at Iowa State University, Ames, and the Steenbock Memorial Library at the University of Wisconsin-Madison were also utilized.

Historic context research involved developing an understanding of the past through the examination and critical interpretation of documentary evidence. The primary concern was with textual materials, although maps, photographs, and other kinds of recorded data were also used. The historian's primary task was to find the information, analyze its content and biases, corroborate it with other evidence, and use the historical record to develop an interpretation of past events that links historic properties on the ground with important themes and patterns that are known to be significant in history, architecture, engineering, archaeology, or culture.

The historical record relating to common farm barns in South Dakota is huge, containing literally thousands of pieces of documentary evidence about the historical, architectural, engineering, cultural, aesthetic, and visual relationships that give them their special character and preservation value. Despite its huge size, the historical record provides barely a glimpse of individual farm barns. Most of the farm barns built in South Dakota between 1857 and 1958 have disappeared without ever being documented. Many of the information sources most likely to shed light on individual properties—farm records, family photograph albums, diaries, personal letters and papers created by their original builders and owners—have been lost or destroyed, or are so widely dispersed it would be a Herculean task just to assemble a valid, statewide sample. Much of the data on individual farm barns that has found its way into the historical record was collected and recorded by accident.

The obvious place to begin searching for primary sources that describe historic farm barns are the historic property records at the South Dakota SHPO. The SHPO has been carrying out a statewide survey of historic properties since the 1970s and maintains inventories of documentation on historic resources which have been identified by federal, state, and local government agencies, private groups, and individuals as having preservation value. In addition to the survey records, the SHPO also maintains files on properties which have been listed in or determined eligible for the National Register, including multiple-property nominations and other planning documents. Well over one thousand South Dakota farm barns have been recorded by survey and each one is documented in a survey form. In some cases a National Register form has also been prepared. Recently, computerized databases have been developed to assist researchers in collecting useful information from the paper records. These data sets are organized by county and township but are by no means comprehensive, with some counties having had very little survey work done, while others boast hundreds of recorded properties. Upon reviewing the inventory and National Register files, it is apparent that the lion's share of the effort invested in identifying, evaluating, and registering historic properties in South Dakota has gone into homes, public buildings, bridges, and commercial properties. Judging from the data and analysis they placed in the files, most preservation practitioners have been less interested in, or unknowledgeable of, farm barns as a significant preservation resource. This neglect of farm barns is especially prevalent in many of the older survey records, which are practically useless for planning purposes. The survey file documentation itself ranges from cryptic notes on handwritten survey forms to completed National Register nominations. Unfortunately, most of the historic farm barns identified by survey have been recorded as accessory buildings in relation to historic houses or as components of farmsteads, and they are not always described or evaluated separately from the "primary" historic resource. At best, the nomenclature used to identify different types of barns is confusing—the survey forms are peppered with ambiguous type designations such as "hipped platform barn," "whale-back barn," "small livestock barn," or simply "barn". Despite the uneven quality of the data contained in these records, it was possible to gain an understanding of the likely distribution and condition of the common barn types.

To its credit, the SHPO has recently sponsored surveys and historic context studies that have focused on farm barns as the primary resource. The present study also builds on several multiple property listings that have addressed various types of farm barns, including the thematic studies of round and polygonal barns, rural resources in parts of Custer, Yankton, Brown, Butte, and Meade counties, and German-Russian, Czech, and Finnish folk architecture. In addition to National Register multiple property nominations, more than two dozen National Register registration forms involving common farm barns have been completed.

The historic context statement in Section E of the present study was based to a large extent on a review of the scholarly literature related to particular topics and historical periods. Various specialized bibliographies and research guides were used to provide bibliographic control and the bibliographic references contained in the books and articles were also used to help narrow the focus of the research on specific themes, patterns, and trends. The research on the architectural history of North American barns, for example, started with the interpretations and analyses presented in the standard scholarly works that provide architectural and geographical models for studying barns and other rural buildings in a national or regional context. Using their

extensive bibliographic material, research then proceeded to more specialized topical and thematic studies of specific farm barn forms and their local variants. The main reasons for conducting such a wide-ranging review was to evaluate the elucidations of historians, architectural historians, geographers, folklorists, and others on the subject and to identify factual and interpretive information that would shed light on the ways in which South Dakota farm barns were created and used. Most of the background information for the overview of South Dakota agricultural history, on the other hand, was obtained from a few general surveys, reference works, and government documents dealing with agriculture, settlement, land use, and related subject areas.

The literature search and SHPO records review provided both the raw material and the context for the discussion of farm barn morphology in Section E, which lays the foundation for the property type and farm barn evaluation model proposed in Section F. Architectural pattern books, farm building plans, catalogs, agricultural bulletins, and agricultural engineering publications constituted the core historical record from which the study drew its findings and interpretations. A great deal of background information relating to farm barn materials and methods of construction was found in the standard engineering and farm building texts generated for instructional or reference use during the first half of the twentieth century. An unexpectedly rich vein of information about farm barn planning, design, construction, and use, much of it written from a regional perspective and presented in plain English, was found in the farmer education materials generated by the agricultural experiment stations, extension services, and government bureaus.

The present study argues that while South Dakota's common farm barns echo important folk building traditions which may have diffused across the Midwest from various Eastern culture hearths, the great majority of the buildings which survive today are best understood and appreciated as examples of contemporary or post-industrial vernacular architecture. Individually and as a group they show the history and development of modern farm buildings and represent the progression of building forms and functions in an agricultural environment that was increasingly industrialized and commercially oriented. Some of the important influences on common farm barn design and construction were a direct result of the rapid growth of American industry and engineering in the late nineteenth and twentieth century. Other critical themes include the transformation of farming through applied science, agricultural education, and government aid. Examples of folk barn forms certainly exist as rare survivors of the built environment of the frontier, along with barns that provide a physical record of the experience of particular ethnic groups who brought Old World building traditions with them to the Dakota prairies, but they are not representative of the important broad patterns of agricultural development in South Dakota which shaped the mainstream currents of settlement, land use, and cultural development. The strengths and weaknesses of this model can only be tested through more intensive surveys to identify, evaluate, and plan for the preservation of common farm barns in all parts of the state.

The multiple property study did not involve field survey or the preparation of individual National Register nominations.

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