The Impact of Agribusiness on South Dakota’s Local Roads – Successes and Failures

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Submission date July 29, 2008

Word count = 4,090 text + 1,500 for 5 figures and 1 photo = 5,590
Abstract

Local roads are being destroyed by rapid growth in agribusiness. This paper will showcase successes and failures of local roads impacted by the construction of new agriculture related businesses. The paper will also illustrate how local agencies are handling the new wave of heavy trucks traveling over local roads at a rate that had never been experienced in the past. Some of these roads have been serving local traffic for over 40 years without major breakdown. But since the construction of new agriculture related plants and businesses these roads deteriorate at an alarming rate. The problem is compounded by lack of any improvement strategy by either the local government that owns the road or the owner of the new plant. Two success stories and one failure will be discussed in the body of this paper. The success is attributed to the foresight of the local officials who knew the magnitude of the new generated traffic and took the necessary steps to strengthen the road structure. The one failure was the result of lack of planning and funds needed to meet the new challenge. Local agencies should be very cautious in accepting a new agribusiness before exploring the negative consequences that will definitely impact the integrity of the local road system.

Word count = 210
INTRODUCTION

All states, including South Dakota, are experiencing dramatic growth in value-added agricultural processing plants, rural subdivisions, commercial dairies, large cattle feed lots, and large scale hog or poultry confinement operations. Many of these plants are located on roads and streets managed by local agencies with limited funds. Local politicians are quick to accept new agribusiness because it brings new jobs and improves the local economy. However, they often underestimate the amount of damage these new businesses will do to the local road network. The transportation funds available to local agencies are hardly enough to maintain the existing local road network. Attracting new industries or agribusiness such as ethanol plants, feed lots, dairy farms, etc. will definitely compound the maintenance and rehabilitation problems faced by all local agencies. Just like any new challenge, proper planning and development of an effective strategy for road improvement can result in a credible solution, and the opposite will definitely result in an inferior and costly one. This paper will briefly showcase three projects, two of which are considered successes and one which is considered a failure.

CASE STUDY #1 – ETHANOL PLANT AT LOOMIS, SD

This project is located in Davison County near Mitchell South Dakota. It involved the construction of a new ethanol plant. Part of the criteria for site selection was easy access to a railroad line. The site selected was located on a Burlington Northern rail line and could be accessed only by county roads from all four directions. The nearest state highway was four miles away from the plant. That highway (SD state hwy 37) had been recently reconstructed with good design for carrying heavy truck traffic. The surface is dowel-jointed portland concrete pavement (JPCP). However, the local highways leading to the plant were either asphalt surface treatments (very thin) on approximately six inches of aggregate base, or thin pavement (2 ½ inches) over aggregate base.

The final permitting process was completed by the county and appropriate state agencies and site construction began in 2005. Davison County recognized that at least one primary access route would have to be designated to serve the plant and structural improvement would be needed. The route selected for this is a four mile section of a local collector connecting state highway 37 and the plant. The existing surface was an aging asphalt surface treatment with multiple chip seals on approximately six inches of base aggregate. The average daily traffic prior to the plant opening was approximately 320 vehicles per day with a low percentage of trucks. The ethanol plant management projected that up to 100 heavy trucks (80,000 lb tractor/trailer) per day would be necessary to keep the plant profitable.
The county recognized the need to improve the four-mile road, and applied for an Agribusiness Access Grant from the SD Department of Transportation (SDDOT) late in 2005. The SDDOT approved a grant for road improvement for $500,000 with a 1:1 matching requirement from local sources. Davison county officials raised strong objection to the match requirement maintaining they could not divert funds already allocated for other needs to match the state grant. State officials agreed to significantly reduce the match and asked the county to submit a plan for road improvement. The county determined that four inches of hot-mix overlay will be adequate to carry the new loads. The SDDOT objected and cited concern over foundation strength of underlying soil and existing aggregate base (2, 5, 6). No agreement was reached. County officials felt the road would perform for at least a year while disagreement over improvement could be worked out.

Unfortunately, the plant opened in December of 2006 without any improvements to any roads leading to it. Due to deep frost in the roadbed, there were no road problems through the winter. But, in March of 2007, during spring thaw, many sections of the road failed in less than three weeks. The road even had to be closed for a period of time for temporary repair. Davison County officials had to react quickly at this point. The services of a professional engineering firm were contracted. Plans for significant improvement to the overall structure of the road were fast-tracked.

In the summer of 2007, reconstruction was done with methods that are not traditional in SD, or anywhere in the country. Traditional design in SD would be recycling of the existing surface and salvage of material if suitable, followed by roadway widening and placing six to eight inches of aggregate base. Surfacing would be four to six inches of hot-mixed asphalt pavement (2, 5, 6). Concrete pavement is seldom used on local roads in SD.

The new design called for roadway widening, salvaging of the existing asphalt surface and base for use outside the traveled way. Aggressive reworking of the upper one to two feet of the subgrade was done next to improve density and stability to the satisfaction of the engineer. This consisted of ripping and mixing with motorgraders, adding water and applying compaction. A woven geotextile fabric was then placed over the entire section as a separator between subgrade soil and aggregate base. Deep aggregate base (twelve inches) was placed over the fabric. The intent was to obtain necessary structural strength in the roadway to carry anticipated loads without including a pavement layer (1).

Finally, asphalt surfacing was done by applying a prime coat of cutback liquid asphalt (MC-70) followed by a conventional chip seal. This design was determined to be adequate for three to five years. It also must be emphasized that three inches of hot-mixed asphalt pavement was placed in three locations on this project: at both plant entrances and at the intersection of the county road and state highway 37. The reason for this is the anticipated shearing of the thin surfacing in those areas where aggressive braking and turning movements would occur. However, the paved portion of this road is less than 1% of the entire surface. The total cost of this project was approximately $790,000.

This is certainly not the traditional design for agribusiness access in SD, or in any part of the USA where significant truck traffic is expected. But, similar design has been used for many years in other nations, particularly, New Zealand, Australia and South...
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Africa. Considering the dramatic rise in the cost of pavements in recent years, no doubt road engineers in the USA will have to look at similar methods of construction. It is worth noting that construction like this was done in SD in the 1950s and 60s and was called “blotter surfacing” and some of those surfaces performed remarkably well for over 40 years (5). The difference in the project just completed in Davison County road is a woven geotextile was used on the entire section and much thicker aggregate base was used compared to the old blotter construction.

In the summer of 2008, the authors made close follow-up observation of this road. After one year of performance, the road was found to be very sound. Three small areas of minimal distress where the base aggregate weakened appeared after the spring thaw. In the opinion of the authors this is attributed to a small quantity of substandard base material being placed in those areas. While they were easily repaired, there is an important lesson to be learned. The control of quality in the base aggregate can never be stressed enough. There is no structural strength in the prime and chip sealed surface (1). Consequently, all structural strength must be built in the subgrade and base. Quantity and quality cannot be compromised! A second chip seal was placed in early July, 2008 to make the surface more durable. There is no measurable wheel rutting.

To assess the structural integrity of the new surface structure, a Dynamic Cone Penetrometer (DCP) was used to make a random test of base and subgrade strength on the new section which is labeled as site B in Figure 1. Another random test was made on an original section of the road beyond the plant and is labeled site A in the same Figure. The DCP readings showed a dramatic strength gain in the reconstructed section as shown in Figure 2. Once again, it should be noted that four inches of hot-mixed asphalt pavement is scheduled to be placed in the next two to four years. While this project was born out of disaster, it has become a real success story in SD.

Figure 2 clearly illustrates the significant improvement that the 4-mile section of 247th Street, between State Highway 37 and the plant, has received. Site A represents the entire road before the construction of the plant while site B represents the road after improvements. The DCP values reveal that it took three times the number of blows to reach the same penetration of approximately 45 centimeters (18 inches).

CASE STUDY #2 – ETHANOL PLANT AT ROSHOLT, SD

This project also deals with an ethanol plant located just outside the city of Rosholt in Roberts County, SD. A site near a railroad line had to be selected which dictated the location of this plant. Primary access to the plant is approximately one mile of road from SD State Highway 127 to the plant. Approximately 0.60 mile was an aging asphalt pavement on a county road running through the town of Rosholt. The last 0.40 mile was an existing township road with very low traffic and a thin gravel layer. Local officials understood the magnitude of the problem they would face with added heavy truck traffic and how it would impact the structural capacity of the existing road.

The application for Agribusiness Access Road grant money from the SDDOT was discussed but this was not considered feasible for this project. There were two potential problems if SDDOT grant money were to be used. The portion of the road within the town of Rosholt has several intersections and other features typical of urban sections. Use of state funds could have required some change to the cross section to meet state
standards (5). This was also the case on the rural section outside of town. The second problem was a stipulation in using state grant money which does not allow a business to be sold within four years of a project being built. This eliminates speculation in land and business development using state money.

It was determined in this case to do joint access road improvement with local funds and with funds provided by the ethanol plant. While there was some small reduction in standards, it is the judgment of the authors that there was no significant compromise to safety, even on the rural section which now has a roadway width of 28 ft. (4, 5). This meets SDDOT’s standards as set its in their Secondary Road plan. It must be emphasized that sound engineering and construction principles were used on this project. In addition, the county has a good track record in managing the maintenance and rehabilitation of their road system. More importantly, the Highway Superintendent studied and evaluated many options for adding durability to the pavement because of the increase in heavy truck traffic. His conclusion to use the process described hereafter was based on cost-benefit in addition to minimal disruption to traffic flow.

The work was managed by the Roberts County Highway Superintendent. Unfortunately, the plant opened before road improvement could be planned and completed. The township road was maintained for a period of time with added gravel and frequent blade maintenance. The county road surface, which was already 30 years old, began to show significant distress. County officials observed that the problems on the county road were surface distress only. There was little evidence of base related problems. Roberts County had a policy of using deep aggregate base in road construction back to the 1960s. Borings have shown eight to ten inches was commonly used in an era when six inches was generally considered adequate. This proved to be far sighted and the base performed well, even under the increased loadings from the ethanol plant traffic in the new millennium.

Improvement to the county road began by milling off all of the existing asphalt surfacing down to the base. The millings were hauled to the township road section to be used for building improved base for pavement there. The ethanol plant paid for all work done by the milling contractor and for hauling the material to the township road. The millings were placed and compacted on the township road resulting in added thickness of approximately six inches over the existing gravel to provide a total of ten inches of base. Figure 3 shows a general layout of the plant and the local roads serving it.

The next phase was to place a one-inch leveling course on the entire section. This provided a relatively smooth, tight surface on which to install a fabric. Prior to placing the fabric, a tack coat of CSS-1H was applied to the road surface. Then, a paving grade fabric (PetroMat®) was placed on the tack oil. Final surfacing was three inches of hot-mixed asphalt (HMA) using PG 58-28 binder and SDDOT class D aggregate (well graded natural aggregate). This work was completed in 2005 and Roberts County spent only $50,740 for their share of the project. Accurate figures from the ethanol plant’s share of the project were not available, but are estimated to be no more than the county share – more likely less.

This road has been serving the plant for the last three years with no significant defects and remarkable performance. There is no measurable rutting and very little cracking in the pavement. The ethanol plant, as well as the community, is very happy with this road. However, in early summer of 2008, two small areas of distress were
Selim, Skorseth, and Mahgoub noted. They were located on either side of the railroad track. After observing this and checking with the County Highway Superintendent the reason was clear. The railroad had advised that they would be making improvement to the road crossing and did not allow the county to reconstruct that section. Consequently, no work was done within the railroad right-of-way except asphalt overlay without fixing the underlying pavement layers. Most importantly, no paving fabric was placed there. It is very interesting to note that the failure appeared only where the subgrade was not improved and fabric was not used. See Figure 4.

CASE STUDY #3 – DAIRY PLANT NEAR BRANDT, SD
This study involved the construction of a new commercial dairy in Blom Township located near Brandt, SD. Final permitting was completed and construction was set to begin in the summer of 2006. The dairy was not large for a commercial operation. Operation would begin with approximately 750 cows and potential increase to 1500. The selected site was 1.25 miles away from SD State Highway 15. The only access to the site is a very low volume, gravel surfaced road maintained by the township. While no records are available, ADT on this road was likely less than 20 prior to the dairy being built. One indication of the low traffic of level on this road was the fact it was not even opened in the winter. However, it must be noted that this road had performed well for 40+ years carrying local traffic consisting of a mix of light vehicles and some truck traffic during harvest. There was no serious distress prior to the dairy being built.

The township recognized that significant problems would arise once the dairy was built. The township board contacted the SD Local Transportation Assistance Program (LTAP) early in 2006 for advice. The LTAP field services manager inspected the road and recommended application for an Agribusiness Access Grant from SDDOT. The rationale for the recommendation was simple: the township had such limited funds and expertise; there was no way for them to make the road improvement needed to handle year round traffic (2, 5). A particularly difficult issue would be providing access for a few heavily loaded milk and feed trucks during spring thaw. Truck traffic previously was primarily only during harvest when the road had reasonably good stability. The advice from LTAP was ignored. No road improvements were made.

Construction was delayed and the dairy did not begin milking cows until late November of 2007. Since there was already frost in the subgrade at that time, no problems occurred until the spring of 2008. At this point, the road failed. It had to be closed for a short period of time and another road was used to get milk out to the state highway. But, the alternate route began to fail as well. A hasty agreement was made for improvement. The county commission agreed to help with some local funds. Since a portion of the access road is under the jurisdiction of another township, they also agreed to help. The dairy owners agreed to provide funding as well. A loose agreement was reached where each party would provide approximately $10,000 dollars for improvement - $40,000 in total.

No engineering advice or services were sought. Base improvement was made with spoil material left from an interstate highway rehabilitation job done several years earlier. This material consisted of broken, salvaged concrete with top size up to ten inches. It was donated, but it had not been processed to meet any base or subbase...
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specification. It also appeared to be contaminated with a large amount of dirt and re-bars. A contractor was hired to place this on the existing surface of the failed road and compact it into the subgrade to strengthen it. The surface of the subgrade was finished with inadequate crown for an unpaved road (3). Culverts were also replaced during this phase of the work.

Thereafter, a new surface layer of gravel was placed at a depth of four inches in thickness. Unfortunately, the gravel was not tested to ensure that it meets SD’s gravel surfacing specification. While it appears to be good quality material, there is no verification of that. The bigger problem is the road is not adequate to carry heavy trucks over a subgrade that is still shows signs of being weak. This will continue to be a problem, especially during spring thaw (2, 5). Figure 5 shows a general layout of the plant and roads that lead to it.

In July 2008, SDLTAP personnel inspected the road and conducted a DCP test and the results were very bad indeed as shown in Figure 6. While the traffic volume on this road is still extremely low, the local officials fail to recognize the impact of adding just one, or a few, loaded trucks daily and what will happen in prolonged wet periods or during the spring thaw. The money spent was significant for very small agencies, but was for the most part wasted. The township perceived the paper work and some of the standards required for using SDDOT Agribusiness Access Grant money were excessive. However, those standards, such as requiring all material to meet state specifications and placing eight inches of gravel, would have resulted in a road that would provide all-weather service for legal loads.
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CONCLUSIONS
While engineers and road managers recognize the problem, elected officials often underestimate the impact of added heavy truck traffic on existing streets and highways. Most of these roads still carry an overall low volume of traffic. Consequently, there are no capacity issues. The real problem is structural strength of the roadways. This problem is compounded by the fact that access issues are not addressed during the permitting process. In all three cases presented in this paper, the agribusinesses went into production before road improvement was done. This makes it harder to do reconstruction while maintaining traffic and ultimately adds to the overall cost. If detour routes are designated, those roads deteriorate rapidly reducing the overall condition rating of the road system.

Two of the three cases studied in this paper show remarkable good performance by using novel design. This not only included geotextiles, but in Davison County the deep base and thin surfacing concept is performing very well. Conventional design with much thicker pavement surfacing would have increased the cost of the project by an estimated 40%. Good engineering services are essential to plan these projects. Of equal importance is control of quality of both work and material during the construction process.

Local officials are quick to promote the development of agribusiness in their counties, cities, towns and townships. It is assumed that significant economic gain will come as a result. In reality, the great cost of improving roads and streets to provide access may well offset any economic gain. At the least, it will take years to realize overall economic gain since much money needs to be spent up front to improve access. In the meantime, routine maintenance and rehabilitation on the rest of the road system must be deferred. The overall condition of the road system can deteriorate significantly because of this. It is debatable whether local government will realize economic gain.

RECOMMENDATIONS
Although this study was unfunded by any agency the SDLTAP through their contacts with their clientele felt obligated to address this issue. Unfortunately the analysis of these three agribusiness access roads has had to be quite limited. But, there are still some strong recommendations to be made.

1. Access improvement must be considered during the permitting process before agribusinesses are allowed to begin building. The funding for necessary improvement needs to be addressed at the same time.

2. Engineers and managers must look at new ways of building adequate structural strength in roads and streets and avoid the traditional concept of thick pavement surfacing which is rapidly becoming unaffordable for local agencies.

3. More emphasis must be placed on control of work and material quality while the subgrade and aggregate base construction or rehabilitation is done.

4. New means of funding needs to be explored. Traditional use of property taxes, motor fuels taxes and vehicle license and registration fees are not adequate to cover costs of access road improvement.
5. Cooperation and buy-in from the agribusinesses must be sought for access issues. In two of the three cases presented in this study, the agribusinesses provided funding. This gives a sense of ownership and interest in road improvement and maintaining it after construction.

REFERENCES


2. SD Department of Transportation, “Rural Road Design, Maintenance, and Rehabilitation Guide”, Publication No. SD95-16-G2, September, Pierre, SD, 1995


5. SD Department of Transportation, “Secondary Road Plan”, SDDOT, Pierre, SD, 1997

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