

**Missouri River Bridges of South Dakota
1920 to 1980**

An Oral History Project: Kenneth R. Scurr, Former South Dakota Bridge Engineer, interviewed by Prof. Emory Johnson, So. Dakota State University.

Q. Mr. Scurr, are you familiar with the Oral History Programs being sponsored by The Major Engineering Societies to record the details surrounding the outstanding engineering projects over the nation?

A. I am familiar with the project. I think that they have correctly decided that the South Dakota Missouri River Projects come into that category. The original five Bridges were at that time the most ambitious and costly that had been undertaken in the State. The replacement of these bridges, necessitated by the construction of the Reservoirs in the post WW II period was also the greatest project both in cost and importance undertaken by the State during that period. I have already given interviews on this subject to two graduate students who incorporated them into their graduate thesis and may have them published.

Q. It is my understanding that you have been associated with these projects from inception to the present date. What can you tell of the inception of the program?

A. My first connection with the Program came when I was brought to South Dakota in 1920 by J.E. Kirkham, who had been my Structures Professor at Iowa State U at Ames. He had been retained by the State of S.D. as a consultant to develop the plan for a bridge program to unite the two halves of South Dakota which had previously been divided by the Missouri River. The real inception of the program was in the Legislature of 1919 which passed legislation creating a Highway Commission and authorized the retaining of Mr. Kirkham. My knowledge of events prior to 1920 is limited to that provided by Mr. Kirkham and other early advocates of the program with whom I later became acquainted.

Q. What were some of the events and who were some of the personalities that were involved prior to your arrival in 1920?

A. The dominant personality throughout the program was Governor Peter Norbeck. He pushed the necessary legislation through the Legislature to create the Highway Commission, retained Mr. Kirkham as Bridge Engineer and supported him at all times both as to the location and financing arrangements to enable the bridges to be finished expeditiously. Even though he was elected to the Senate and went to Washington in 1921, he remained the most powerful voice in all State negotiations concerning the programs. His strongest supporters were Joe Parmley of Ipswich, Gene Sargent of Gettysburg and Julius Skaug of Mobridge. The latter two were lawyers and their help became invaluable when controversy arose over financing and sequence of construction of the bridges at the several locations.

Q. How were the Bridges to be financed?

A. The basic legislation provided for a one tenth mil levy, and the bridges were to be constructed only as funds became available. This would have stretched the construction period over eight or nine years.

Q. How was the matter of location of the several bridges determined?

A. The first step was to sort out the five locations from among the sites proposed by legislators from the contiguous Missouri River Counties. It was

agreed the State traffic pattern justified that Mobridge, Forrest City, Pierre, Chamberlain, and Wheeler were the proper locations. The next step was to go to each site and determine the specific location which depended on the approach to the structure, the profile of the stream bed and the suitability of the foundation material. The Corps of Engineers was very helpful in this. They furnished boats and crews for the inspection trips and gave assistance to our drilling crews who determined the location of the underlying shale. Mr. Kirkham and I were on these site location determination trips and were often accompanied by Senator Norbeck whose interest in the program never faltered.

- Q. In view of the restrictions of the legislation to a strict pay as you go plan how was the order of construction determined?
- A. The 1923 legislature devised a voting plan whereby each legislator was to vote on all five sites in order of preference. A first place vote was to count to five, second place four and so on. This led to considerable jockeying and horse trading and resulted in putting Wheeler, the least populous community in first place with 480 points followed by Pierre 425, Chamberlain 411, Mobridge 408 and Forrest City last with 406. Naturally there was some disgruntlement and even some talk of referendum by the communities low on the list.
- Q. How was the Referendum avoided?
- A. Doane Robinson, the State Historian, was the originator of a plan to finance the simultaneous construction of all five bridges. With Gene Sargent, J.W. Parmley, and Julius Skaug they proposed that the communities along the roads leading to the bridges be authorized to advance funds to the State Bridge Fund to enable construction to begin prior to the accumulation of the one tenth mil levy. The Counties would then be reimbursed from the State Fund as funds became available in the order that had been voted by the Legislature. This enabled us to proceed with the design and construction on a very expeditious schedule. This plan was strongly supported by the Legislature and the interested Counties and was declared legal by the Courts. All of the Counties were reimbursed within about eight years and the tax expired as planned. However some funds came in each year as back taxes were paid. These funds accrued in a small Missouri Bridge Maintenance fund which was useful for routine maintenance.
- Q. What was the anticipated cost of these structures?
- A. Mr. Kirkham had insisted that he could build all five bridges for two million dollars. He was a great manipulator of the press and got a lot of publicity for this low estimate. There was a good deal of skepticism with regard to this estimate as the two nearest Missouri River Bridges were at Bismark where a combination Railway-Highway bridge had been built for about \$1,300,000.00. Also the Meridian Highway Association was in the process of letting a privately financed Railway-Highway Bridge for about \$1,400,000.00. In all fairness though it must be conceded that there is no real basis of comparison of costs of those structures with ours. They were both designed for Railway in Addition to Highway traffic and both had to bear the cost of financing by private enterprise.
- Q. Mr. Kirkham appears to have been an unusual individual. What are your impressions of him based on your long association with him?
- A. He was indeed an unusual man, in some ways, even eccentric. He was a very small man with an oversize ego. He was only about five feet two inches tall but had the faculty of gaining attention and favorable publicity where ever he went. This faculty may even have been a major factor in furthering Gov. Norbeck's program. He had a brilliant engineering mind bordering on Genius. He was intensely patriotic. He sought every avenue to enable him to enlist in

the armed forces even though he was 46 years old at the time in 1917. He was the best publicist and wrote his own press releases for the wire service who cooperated with him willingly. He had a habit of approaching strangers in hotel lobbies and at the State House directly saying "I'm Kirkham. I'm the man that is saving South Dakota millions of dollars on the bridge program". This approach was never considered to be anything but a personal oddity and never seemed to be resented. In fact Governor Norbeck, who usually did not relish anyone taking headlines from himself was very fond of him and their association was one of mutual admiration.

Q. What had been Mr. Kirkham's professional background before being retained by Gov. Norbeck?

A. I do not recall the schools that Mr. Kirkham attended prior to receiving his degree in Civil Engineering. His first employment was with D.B. Steinman in New York City. Steinman was probably at that time the most prestigious Bridge Engineer in the world. He became a senior designer with Steinman. From there he moved to the American Bridge Company in Pittsburg. There he became the youngest Chief Design Engineer that American Bridge had ever had. His position there seemed to be secure, but he soon developed some disagreement with his Corporate supervisors and resigned to take the position as Professor of Structures at Iowa State at Ames. He was very successful there and his graduates were in demand all over the United States by the Steel Companies and the Consulting Firms. He was immensely popular with his students due to his casual approach to the teaching process. He probably was the only Professor in the University to allow tobacco chewing in his classes and laboratories.

Q. When he was retained for the program how did he organize his staff for the design of the bridges?

A. Perhaps it was further evidence of his ego that every one of his first bridge designers was a former student of his. When he became Bridge Engineer in January 1919 he found two of his former students, Frank Cave and J. Harper Hamilton already in Pierre in the road plans office. He had them transferred to the Bridge Department. In February 1920 he came down to Ames and selected myself, E.S. Hurwich and Galen Stroughton. We had been students of his who had left the University in May of 1918 to serve as Officers in WW I. We had been Juniors at the time and had returned to Ames in September 1919 to complete our Senior Year. He arranged with President Pearson to allow us to leave on March 1, and to consider our work with him to constitute our thesis and to graduate us in absentee. This made five of his students on board. When the class of 1920 was to graduate in June he brought three more of his former students up from Ames. This constituted his entire bridge staff during the first year. One local young man was employed as a tracer and draftsman. Eric Jacobsen. Another, James Johnson was used principally to secure foundation soundings. During 1921 Mr. Kirkham hired an experienced steel detailer, George Ilg, who had worked with the Steel Companies in Chicago but had preferred to come to South Dakota for the benefit of his health. In 1922 M.X. Wisda joined us from Ohio State University. This predominantly Iowa State group was the best testimonial of Mr. Kirkham's confidence in the efficiency of his own teaching.

Q. Was design of the Missouri River Bridges immediately initiated?

A. No. Exploratory work began leading up to final site locations, but the legislation determining the precise locations and sequence of construction was not passed until 1923, at which time we went at the design of the Missouri River Bridges in earnest. However the structures on the State Road System were not neglected. The State Highway Reports show that the aggregate value of the smaller bridges and culverts built during the years of the Missouri River program exceeded the cost of the big bridges in

every year by a considerable amount.

Q. According to the legislative ballot the Wheeler Bridge was to be the first bridge built. Was there anything unusual about the bridge at this location?

A. A group of local citizens had a vision of a Railroad that might be built at some later date connecting that area with Nebraska. To accommodate that group Mr. Kirkham did design the foundations to carry a possible future double deck Railway/Highway Superstructure which, of course, never materialized.

Q. What determined the selection of type of foundation and superstructure?

A. The foundation type was dictated by the underlying strata of Pierre Shale or equivalent material at all sites. The superstructure type was really dictated by the Corps of Engineers Navigation Requirements at that time. This required a clear span of 250 feet and 38 feet of clearance above high water. Of course the navigation for which the design was made never occurred. The arrangement of spans within these criteria was the result of adhering to the classic principle of economical bridge design; that maximum economy is achieved when the cost of the foundations is equal to the cost of the superstructure less the floor system. In many cases this can not be achieved due to over riding local agencies, but in the case of these bridges it was accomplished.

Q. Was there anything unique about the foundation designs?

A. Not really. Mr. Kirkham often referred to these foundations as patentable original designs. He knew they were not but it made good copy for the newsman. Each of the main piers consisted of two steel cylinders sunk to shale and into shale. Short steel I-Beams were driven inside the base of the cylinder and then filled with concrete. The main pier shaft was designed to take maximum ice pressure and was anchored into the top of the cylinders by short beam sections and large reinforcement bars. Two columns from the top of the shaft supported the bridge seats for the superstructure. The excellence of the designs lay in the key intelligent use of all engineering principles and not in any innovative breakthroughs.

Q. There appears to be a repetition of type and span lengths at the various sites.

A. The Pratt Truss was selected as the most economical for the range of spans involved. Most of the spans were 256 feet to provide the minimum lateral clearance required by the Corps. However at both Pierre and Chamberlain the underlying shale was so deep that the additional cost of the piers forced us to go to longer spans in order to achieve the economic balance that I referred to previously. This was achieved by using 300 feet and 336 feet spans at Pierre and Chamberlain. At all sites approach spans consisting of 64 feet deck plate girders were used outside the wetted perimeter of the river.

Q. What were the specifications for the design of the structure?

A. The spans were designed for a train of fifteen ton trucks which had been in use in Iowa designs and which conformed to the H-15 loadings later adopted by the Bureau of Public Roads. The roadway width was considered to be generous, 20 feet 8 inches between curbs. South Dakota had not yet developed its own specifications and special provisions were written for these bridges.

Q. Were any special construction specifications written for the foundation construction?

A. The specifications for foundation construction were what was then called an End Result Specification. The contractor was allowed to use any methods and equipment that would finish the product, according to the plans. Actually there were only two methods which were feasible. One was to use open cofferdams formed by either wood or steel sheet piling. The other was to use air locks within the steel cylinders. In the case of the Pierre Bridge the Contractor elected to use the air lock method. The advantage of this method of course is that only the material inside of the cylinders had to be removed. The disadvantage is that only professional sand hogs can be employed at relatively high wages. They had to be certified as capable of working at pressures of 40 pounds per square inch and could only work four hour shifts. There was also the disadvantage of working men and equipment in very cramped quarters. In spite of these conditions the work progressed well to the satisfaction of both the State and the Contractor.

The contractors on all of the other bridges elected to use the open caisson method but the first one to open was the Mobridge structure.

Q. According to the legislative ballot Wheeler was designated to be the first bridge but the first one to open was the Mobridge structure.

A. That was the result of a successful effort by the Mobridge group to obtain financial support from the counties along Highway 12. Although Wheeler had first call on the mil tax, Mobridge came up early with their share of funds. Both bridges were designed at practically the same time and the Wheeler Bridge was let to contract first. However the contractor at Mobridge was able to finish his contract in a shorter time and the bridge was opened first. The other bridges were opened at intervals following the Mobridge opening in November 1924 and by 1926 all five bridges were open. What had originally been conceived to be a program for about twelve years, was actually completed in about three years and the people of South Dakota began to reap the benefits of the program sooner than they had expected.

Q. What was the cost of the original five bridge program.

A. The total cost of the program was about \$2,100,000.00. From the Highway Report the individual Bridge Costs were:

Mobridge	\$339,128.43
Chamberlain	\$425,534.30
Wheeler	\$403,337.42
Pierre	\$461,124.20
Forest City	\$450,586.92

Q. How did that compare to the costs of other bridges over Missouri?

A. It is unfair to make comparisons with the cost of other bridges, because they had been built by private enterprise and their costs had included the costs of financing, interest on money during the period of construction and the cost of right of way. Also the other bridges had included a railway crossing. For example, the Bismark Bridge was a Railway/Highway structure that cost about \$1,341,000.00. The Meridian Highway Bridge at Yankton was a privately

financed enterprise that was built to carry Railway traffic and cost about \$1,400,000.00. Even though the bridges were very economically designed it is unfair to compare them with the privately owned structures although this was often done in the press.

- Q. You mentioned previously that during the period when the Missouri River Bridge Program was underway, the Bridge Department was also producing plans for smaller bridges that annually exceeded in value the cost of the bigger bridges. How did that occur when as recently as 1919 no real bridge program existed in South Dakota?
- A. To answer that, we must revert to the conditions that existed prior to the establishment of the Highway Commission in 1920. At that time there was no state agency to build bridges or to supervise the building of bridges by the counties. The State Engineer, at that time was Dr. Derr, had nominal duties related to bridges, but as far as I know did not furnish any plans. A professor Mangold had developed a standard set of small culvert plans, which were furnished to counties on request for use on county and township roads. These were very crude and uneconomical designs, the County Commissioner of each county were solely responsible for their own roads, bridges and culverts. The plans for these structures were furnished by the Bridge Companies who dealt directly with the counties. Several Bridge Companies had established themselves with the County Commissions and in reality honored each others territory and when a County required a bridge and held a letting each seemed to honor the territorial rights of the others and there was rarely any real bidding. The Companies furnished their own plans and for a single contract letting, one company might bid a Pony Truss, another a Through Truss or some other type. They would then go before the Commissioners and argue the merits of their bid and the Commissioners would select one of the bids. They had no engineering advice and the choice was purely an un-informed arbitrary selection. The legislators recognized this as a dangerous and uneconomical method and in the Horse Fall Act of 1919 the legislators took steps to correct it. They modeled the Act after the Iowa Highway Law. Mr. Kirkham had been associated with one of his former students, Thomas McDonald in writing this law and Mr. McDonald was then the head of the newly constituted Bureau of Public Roads. Included in this law was a mandatory provision that counties must obtain their bridge plans from the Bridge Contracts by the Highway Commission. This effectively stopped the previous system and aroused the resentment of the Bridge Companies. However, the governor and the legislature resisted all lobbying efforts to change the provision. From that time on all County Bridge plans were produced in the Bridge Department until 1961 when the combined lobby of the Associated General Contractors and the Consulting Engineers became strong enough to get the provision struck from the law.
- Q. How was it possible to handle this new and previously non-existent load of work?
- A. It may sound improbable to the present day engineers, but Mr. Kirkham got his staff to work a large proportion of the time at night without any thought of overtime pay. I do not remember that any one resented it. There was a job to do and we thought we had to do it. Overtime work was not uncommon until the Missouri River Bridge Program was complete.
- Q. How did the counties respond to the requirements of the new law? How did they provide you with the data necessary to design their bridges?
- A. The counties responded very favorably. While none of them had an engineer in their employment they all had a county highway superintendent. These men were usually very practical men with a lot of common sense. We developed a bridge data sheet for them to make a sketch of the bridge site, both in plan and elevation. We also required them to furnish data from local residents as to

high water and drainage area, soundings for foundations and stream bank characteristics. If the bridge was a small one or if only a culvert was indicated the superintendents bridge data sheet was usually all we required. If the structure was to be over a large stream or if unusual conditions existed someone from our office would make a personal inspection. During this period we really had three separate programs underway, the County Highway Structures, Structures for the State Trunk Highway and Federal Aid System, and the Missouri River Bridge Program.

- Q. The production of plans for this unusual combination of programs must have posed many problems. What were some of the production plans developed to meet this situation?
- A. One of the first steps was to develop economical standards for the commonest types of structures. For example, culvert standard plans were developed for sizes four by four up to triple ten by tens. For openings of smaller size either metal or concrete pipe was used. I-Beam spans were commonly used for spans of twenty four to fifty feet. Pony Truss standards were used for most of the fifty to ninety foot spans. Through Trusses were used for spans over 100 feet. These were all provided in road widths of 16, 18, and 20 foot widths for township, county or state highways, depending on the importance of the highway. Twenty foot wide bridges were considered to be ample for all of the highways in those times. We also developed standard piers and abutments for all of these super structures. When a bridge crossing was required that did not have any unusual features it was possible to assemble the proper length of span, with appropriate standard piers and abutments and thus produce a structure plan that could be let to contract in a minimum of time. Most of the counties were getting away from the old wooden bridges but some of them still wanted that type so we had to have timber bridge standards available. A very high percentage of the sites did not lend themselves to the use of standards and these required complete special studies and plans.
- Q. Apparently these activities started up just months after the enabling legislation was passed. What facilities were available to accommodate the newly required technical activities?
- A. No real facilities were available. The Plans office was set up on the vacant upper floor of the Dakota Central Telephone Building. Later in the year it moved into an old one story building known as the Fitch Block. It was located where the present First Federal Savings and Loan building now is. The Bridge Department was housed in the Capitol Building. The east entrance on the ground floor was closed and we had six drafting tables in the east vestibule. A plywood cubicle just inside of the hall adjoining the vestibule became Mr. Kirkham's office. There was no blueprint room or machine. We made our own blueprints using sunframes. We would place our tracings and blue paper in the frame in the dark entrance to the basement from the vestibule, carry it outdoors to the sunlight and expose it by guess. If there was no sun we could not make any blueprints. When legislature was not in session we sometimes moved into the House of Representative lobby. At other times the Senate lobby and during the NRWR Program in the thirties we used both the Senate and its lobby. Later we moved into the upper floor of the C & NW Railway Station. We never had any permanent offices until the Capitol Annex was built in the late thirties. Even under these adverse conditions the Highway Commission became a respected organization among the other members of the National Association of State Highway Officials.
- Q. To return to the Missouri River Bridges and Mr. Kirkham, what was his reaction to the completion of the program for which he had originally been retained?
- A. He seemed to be a little lost without the big challenge that he had faced during the early years and his interest strayed to other fields. He was

retained by the city of St. Joseph, Missouri to make a preliminary study for a bridge over the Missouri River at that point. We did the design and drafting work for his report after hours, for which he paid us. He did not get the final contract but resigned from South Dakota in 1928 after a squabble with the Highway Commission, which was not an uncommon event as Mr. Kirkham would not tolerate any real or fancied interference in his department. By that time the original staff of engineers was reduced to Harper Hamilton and myself. Hamilton became Bridge Engineer and I became the Assistant. The original staff of the Bridge Engineer's office each moved on, Frank Cave moved to Bismark as Assistant Bridge Engineer of North Dakota. Stoughton had joined the Standard Bridge Company of Omaha. Barrett had left the profession to run the family owned Bank at Mitchelville Iowa. Stenstrom had joined Pittsburgh-Desmoines Steel Company in Des Moines Iowa. Hurwich had moved into the bridge contracting business in Springfield, Illinois. Ilg had returned to Chicago, I do believe Mr. Kirkham's employees were able to get better jobs because of their association with him.

Q. What about Mr. Kirkham?

A. He tried retirement at first but was not satisfied. He and his son-in-law had an orange grove operation near Mercedes, Texas but he tired of that. He returned to the academic field as Research Professor at the Oklahoma State University at Stillwater, Oklahoma and after about ten years retired and went to Omaha where he helped his son to start a consulting firm of Kirkham-Michaels. The firm is still active under that name although both Kirkhams are now deceased.

Q. With the West River united with the East River united by the completion of the Missouri River Bridges what was the remaining activity of the Bridge Department?

A. The Department settled into a normal routine of furnishing bridge plans for the Counties and the State Trunk Highway System. We revised and improved all of our standards for all types of structures. During this period we also developed some of Governor Norbecks more imaginative ideas for making the Black Hills Highways more attractive as tourist routes. One of these projects was the Pigtail Bridges on the Iron Mountain Road. This was a cooperative project between the Custer Park Board, the US Forest Service and the State Highway Commision. I was informed later by a Park Ranger that more tourists took photos of these bridges than any object in the Hills except Mount Rushmore. The two tunnels on the Iron Mountain also were constructed. Tourists marveled at the fact that Mount Rushmore was visible through the tunnels. The fact was that the tunnels were unnecessary but were conceived by Norbeck to be spectacular views of Rushmore for the tourists. Both the Pigtail Bridges and the tunnels cost much more than the normal highway construction, but were considered to be worth it to make the road more attractive for tourists. Another of Senator Norbeck's concept was a large open spandrel concrete arch over Beaver Creek Canyon on the Wind Cave road. Normally we would have crossed the canyon at its head with about a triple ten by ten Box Culvert. However Senator Norbeck insisted that we turn the road south along the river of the Canyon and build the spectacular arch where it would be visible to tourists for about a quarter of a mile on its approach. It cost much more than a normal crossing but still is an attractive scene on the Highway. By this time Harper Hamilton and myself were the only two left of Mr. Kirkham original staff. When Mr. Kirkham left in 1928 Hamilton became Bridge Engineer and I became Assistant. When Hamilton resigned in 1931 I became Bridge Engineer.

Q. The Great Depression was coming on at that time. Did that slow down the bridge construction program?

A. On the contrary, new programs were initiated that required expansion

although the political situation which existed did give us some problems. A change of administration occurred and Governor Tom Berry appointed a Highway Commission Secretary in charge of personnel. He was a firm believer in the spoils system and proceeded to discharge all of the engineering force of the previous administration. I was the last one and I had been notified that I was to go. I had already made arrangements for another job. However, at that time Gardner Gantz, a son-in-law of Senator Bulow from the Anaconda Mining Company in Peru arrived to become Highway Engineer. He was a professional and was horrified to find that all of the experienced engineers had been let go. After some stormy sessions with the Highway Commission and a conference call to Senator Bulow he got the carnage stopped and I was told I was to continue as Bridge Engineer. The Roosevelt administration initiated some make work programs, one of which was the National Work Relief (NRWR) Program. The Federal Government under this program funded projects on County and Township Roads that would be high in labor and low in materials. This required that we furnish plans with that objective in mind even though the total cost might exceed that of a properly designed structure. Each County submitted several applications for these projects and we were forced to expand our staff. Fortunately, engineering jobs for new graduates of the School of Mines were not plentiful and we were able to secure an adequate number of young men from the schools at Brookings and Rapid City to get us through the emergencies. When this program was under way another similar program, the Grade Crossing Elimination Program was initiated. The objective was to eliminate as many as possible of the Rail Constructed and provided employment for the employees of the bridge contractors. At this time the Railroads have abandoned the trackage under most of these structures.

Q. What followed these emergency programs?

A. These continued into the late thirties and in 1940 the highway program slowed down as it became evident that we were going to be involved in the war that was going on in Europe. The National Guard units of most of the States were called into active Service in November of 1940, ostensibly for one year of training. However, most of us realized that it was probably a prelude to our entry into the war. I received military leave of absence and went to Fort Ord as a Battalion Commander and later as Executive Officer and Commander of South Dakota's 147th Field Artillery. We completed our training at Fort Ord and embarked for the Phillipines in November 1941. We were seven days west of Pearl Harbor when that attack occurred. We were diverted to the South Pacific and served in multiple combat operations until late 1945 when Japan capitulated and we were released from service. My Assistant, Phil Schultz acted as Bridge Engineer during my absence until my separation from the Service in September 1945.

Q. What was the activity of the Bridge Department during the War Years?

A. I really do not know. However, when I returned Phil told me that the only bridge construction during that period had been at Red Shirt leading to the bombing range for Ellsworth Air Force Base at Rapid City. I believe that the entire US Highway Program had been put on stand by to divert the entire effort and materials to the War Effort.

Oral History Project Missouri River Bridges

1946 - 1970

Interview: Kenneth R Scurr, Bridge Engineer, by Emory Johnson, Professor of Civil Engineering at South Dakota State University at Brookings SD.

(This is a second segment covering the period following WW II)

- Q. Upon returning from the Pacific in late 1945 did you immediately resume your duties as Bridge Engineer?
- A. There was a slight delay while I was trying to get separated from the Armed Forces I had left my command of the 147th Field Artillery in order to get home in time to attend the graduation of my son from West Point in June. I applied for separation at the earliest possible date. The processing was slow and when my son was assigned to Fort Sill for three months of post graduate Artillery training I maneuvered to get assigned there to await separation. When the end to his training approached I redoubled my efforts for separation, but was told that it would probably be December before I would be released. I then telephoned to Gene Meeker, the Highway Engineer and dictated a telegram for him to send to the Commanding General of Fort Sill. This telegram urged my immediate separation on the basis of emergency arising from the resuming of Highway activity following the long hiatus during the war. Another telegram followed the next day from Gov. Sharp asking that my separation be expedited. This got action started. The following day a telegram from Senator Bushfield's office went to the next higher headquarters requesting the same thing. The next day a telegram from Sen. Gurney, who was a ranking member of the Armed Forces committee was sent to the Pentagon. With this kind of political firepower my release came through and I was able to leave Fort Sill on the same day as my son and I returned to Pierre to resume my activity as Bridge Engineer.
- Q. What was the immediate program for the Highway Commission at that time?
- A. The immediate task was to catch up on the backlog of construction that had developed during the war. However at the same time negotiations commenced concerning the bridge replacements that would be required by the construction of the Missouri River Dams under the Pick- Sloan Plan by the Corps of Engineers. Hearings were conducted by our Congressional Personnel, involving General Pick and General Wyman and the Engineering personnel of the Omaha Office of the Corps. These negotiations were conducted for the State by Harvard Rempfer, who had become State Highway Engineer, Frank

Mitchell an Attorney who was acting as Secretary of the Highway Commission and myself.

Q. What did these negotiations involve?

A. Initially the Corps took the position that they would only reimburse the State for the cost of the original bridges. However they quickly abandoned this approach for one of replacement of the bridges in kind. The next argument was that they would only pay for a bridge of the same roadway width and capacity as the original ones. However, in the end, they agreed to replace the structures with roadway widths and capacities of current standards.

Q. Did the replacement agreement apply to all of the original bridges .

A. Not at first. The Corps held the position that the crossing that they were providing on the Gavins Point Dam was an adequate replacement for the Wheeler Bridge. We never agreed to this, but we did not have a replacement agreement until Sen. Francis Case finally got legislation through obligating the Corps to participate. He originally requested full replacement commitment as in the case of the other bridges. The Corps then proposed to participate up to a certain amount with the State to provide any excess cost. Sen. Case called me and asked if the amount that they proposed, \$4,500,000.00, was adequate. I advised him that it was, and the legislation was passed. This bridge was known as the Platte-Winner Bridge and was dedicated as the Francis Case Bridge, rightfully in his honor. It later became involved in a lawsuit that is a story in itself.

Q. What was the sequence of replacement of the original bridges .

A. This was determined by the order in which the Corps constructed and closed several dams. The first dam to be closed was the Gavins Point Dam near Yankton. This provided a crossing to which Highway 18 was detoured. This enabled us to close the Wheeler Bridge and to plan to use the Wheeler spans at Chamberlain. An original plan was to use these spans to extend the original Chamberlain Bridge. However the new elevation of the reservoir created by the Fort Randall Dam would have reduced the clearance above high water to less than the 38 feet required by the Corps, for non-existent barge traffic. In view of this requirement our plan had to be changed. The new plan called for reconstructing the bridge about one half mile downstream, at a higher elevation. An economic study was made that determined that the most economic structure could be built by using the old Wheeler spans with the old Chamberlain spans on new foundations.

Q. How was this accomplished?

A. The new foundations were designed for a dual roadway structure using the old spans side by side on the new foundations. The four 336 foot spans from Chamberlain were paired and the five 256 foot spans were to be paired after they were transported from Wheeler. One new 256 foot span was required to complete the pairing of the Wheeler spans. This was fabricated from the original plans in our files.

Q. How were the spans to be removed from their original sites to the new foundations?

A. The floors were to be removed and the bridges were to be picked off their original piers as the level of the lake rose after closure of the Fort Randall Dam. This required co-ordination with the Corps in raising the reservoir levels.

Q. When was this accomplished?

A. Although the plan was developed in the late 40s, the Korean episode required our National Guard 196th Regimental Combat Teams to be called into service in 1950 and there was another period of reduced activity until we were released from service in the fall of 1952. In the meantime the Fort Randall was closed and the water levels began to rise to the point where the plan to lift the Wheeler spans off their piers could be accomplished.

Q. What were the unusual methods involved in this project.

A. One unusual feature was that we permitted the contractor on the substructure to use insulated forms for the concrete in the piers which were poured during a rather severe winter. This eliminated the inconvenience and danger in using gas fired heaters and blowers to prevent damage to the concrete by freezing. The concrete was placed in the forms at a temperature of about 70 degrees F , and the heat generated in the chemical action involved in the setting up process raised the temperature, within the forms, to about 100 degrees F. The heat was gradually reduced, for about twelve days until the forms could be removed safely. This apparently was a first in winter construction. It was written up in many of the technical journals, and the Manufacturer of the insulating blankets for the forms used it in his advertising for several years.

Q. The actual transportation of the spans was also unusual.

A. Yes. The contractor showed great ingenuity in the design of the rigging and the barges for the movement. The Corps was especially helpful in this project. They made available units of special barges that had been used in WW II to make floating temporary docks in land and off-loading operations. They also made available some power units called "Mules" to propel the barges. This was very difficult as the Missouri was still a flowing stream as the barges moved upstream near Chamberlain. The Chamberlain spans did not offer as many difficulties as their movement was limited to one half mile down stream. However, the contractor successfully moved the spans without incident.

Q. Was Traffic at Chamberlain interrupted when the spans were moved downstream to the new piers?

A. No. We made arrangements with the Corps to borrow enough Bailey Bridge units to make a low level crossing above the original bridge, which stayed in service until the reconstructed bridge could be opened. In fact the very day on which the new bridge was opened the Bailey Bridge was washed out by the rampaging Missouri. Very little was salvaged. However, this loss was chargeable to the bridge cost under our reimbursable agreement and did not cost the State anything.

Q. A new bridge has since been built at Chamberlain on I 90. Why was that necessary?

A. The dual bridge was built before the Interstate Program was authorized in 1956 and does not conform to Interstate Standards either as to location or design capacity, although it is perfectly adequate for the purpose it now serves, as a local connection between Chamberlain and Oacoma.

Q. Was there a considerable saving in utilizing the old spans instead of Building an entirely new structure?

- A. There was an estimated saving of about three hundred thousand dollars difference in construction costs. Additionally the old spans would have to be removed to Corps Standards which would have cost an estimated \$150,000.00. Also there was the economic advantage of using valuable material instead of wasting it.
- Q. If the re-use of old spans was successful at Chamberlain, why was it not considered at Forest City and Mobridge?
- A. The situation was vastly different at Forest City and Mobridge. The maximum operating level of the Oahe Reservoir plus the standard clearance required by the Corps required the piers to be very high at both locations, about 190 ft. at Forest City and about 160 ft. at Mobridge. The cost of the additional piers, if the shorter old spans were used was such that the economic balance was destroyed and the use of the old spans would have added an estimated \$1,000,000.00 to the cost of each bridge. The final cost of construction of the two new structures, each about 5,000 ft. long, was approximately \$4,500,000.00 for each. In addition to the direct saving was the added benefit that both of the old bridges remained in service while the new bridges were being built. If the old spans had been used it would have been necessary to detour US 12 traffic over US 212 while the Mobridge construction was in progress, and US 212 traffic over US 12 while the Forest City bridge was under construction. The indirect, costs to the traveling public was estimated to be in the millions, plus the inconvenience.
- Q. An article was written about these two bridges in the Engineering News Record in 1959. What attracted the attention of this technical publication?
- A. One of their senior editors spent about a week with us. He said they were attracted by the fact that these two structures were the longest bridges over any of inland waterways. All of the longer ones were in the coastal areas or in the Great Lakes area. He was also impressed with the low cost of the structures. All of the other long and high bridges, of course, in those areas were designed for multiple lanes and for carrying mass transportation while ours were designed for only two lanes and H-20 loading.
- Q. Was there anything unique in the design of these structures?
- A. Not really. The foundations were supported by clusters of heavy H-Beams sections driven to refusal in the underlying shale. These supported a very heavy concrete base. Above the base the columns of a T-Section rose to the bridge seat. The dimensions of the T-Section were reduced by 2 ft. at each 24 ft. of height, making it simple to support each successive lift of the concrete pour. The superstructure was of a conventional continuous steel truss design with cantilever arms supporting suspended spans. If there was any excellence, it was probably the fact that the details were economical, simple and easy to fabricate and construct. These things show up in a contractors bid and are conducive to low bid prices. In every case the bid prices were below our own estimates.
- Q. Apparently these two bridges were the lasts of the replacements for the original five Missouri River Bridges.
- A. They were the last ones under our original negotiation with the Corps of Engineers. Replacement of the original Pierre Bridge was not the responsibility of the of the Corps as the Big Bend Reservoir operating level did not affect the required clearance at the site. However, the bridge had become obsolete by reason of greatly increased traffic on US 14. The Highway Commission and the Bureau of Public Roads authorized its replacement in 1958 and the new four-lane structure was opened in 1960.

- Q. The old Pierre Bridge still remains in place. Why was it not removed as all of the other old spans had been?
- A. Since the tail waters of Big Bend Reservoir were not raised above the high water elevation for which the original bridge had been designed the Corps made no demands that we remove it. However, if it ever should be removed they would require complete removal and disposal, to include removal of the foundations to the flow line of the river. As in the case of the old Forest City and Mobridge structures these spans have been offered free of charge to anyone who would remove them in conformity with Corps requirements. There being no takers, it is more economical to leave the bridge in place than to remove it. It cannot be considered unsightly in view of the fact that the old Railroad Bridge is there beside it. It could even be used in case of emergency, as a limited load by pass if, the four lane structure had to be closed for any reason. It would probably cost about \$150,000.00 to remove it.
- Q. Two more bridges not included in the original negotiations were built. How did these enter the program?
- A. Originally the Corps had contended that the backwater from the Reservoir up Grand River would not cause any problems for which they had responsibility. However a sizable segment of Mobridge trade territory was cut off as the new elevation of the Grand made the old bridges unusable. They finally agreed to a new crossing on a cost reimbursable basis. Although this bridge was about 4500 ft. long it really offered no problems. It consisted of continuous steel deck girders supported by concrete piers on steel piling driven into shale. The Platte-Winner Bridge above the Fort Randall Dam was a rather complicated affair from start to finish as I mentioned earlier. It was the finale to the program and deserves more detailed coverage later in the interview.
- Q. It appears that this program involved more than twenty million dollars in rather unusual and highly complicated structure design. How did a small department cope with such an increased load?
- A. Our original program of five bridges in the twenties was, in its day probably as ambitious as this replacement program and it never occurred to us that we could not do it ourselves. Some other states involved with Federal Projects simply abdicated and turned the bridge designs over to consultants. However, we were able to produce the plans for about one and one half percent as opposed to the usual six or seven percent consultant fees. The Corps recognized our capabilities and welcomed our willingness to co-operate. I think that this was also instrumental in securing very generous treatment from the Corps in all of our negotiations. It was necessary to expand our staff to almost thirty engineers at the peak load.
- Q. It was a real problem. At the same time that the Missouri river program was at its height, the Interstate program was implemented in 1956 and every Highway Department in United States was trying to recruit the very limited supply of Structural Engineers. We were specially disadvantaged by the fact that our scale of salaries was markedly below that of the more populous states. We advertised in all of the technical magazines and wrote to all of the large consulting firms and structural steel fabricators, hoping to get some of their employees who might be retiring by reason of age policy. These sources were unproductive. We canvassed the placement officers of the technical universities with excellent results, many of their new graduates being of foreign origin, being sent to U.S. schools for education. We were a little skeptical at first, but most of these young men turned out to be valuable assets. They all had degrees in Structural Engineering, some at the Masters level. During this period we had one Iranian, one Iraqian, one Taiwan Chinese, one Mainland Chinese, two Bombay Indians, three Phillipinos. Of

these many remained in this country. The Iranian and the Iraqi are still in Pierre. One of the Chinese is a professor at Mich. State U., one is a professor at a small Ohio College, one Phillipino is at US Navy Yard in California. One Indian owns his own concrete pre-stressing yard in Bombay. Another Phillipino owns a pre-stressing plant in Manilla.

Another productive source was the Lutheran Organization for serving displaced persons from Europe. From this source we procured three Latvians and one Hungarian. Elek Kirchner had been one of the Senior Engineers in his National Government before fleeing to Switzerland from occupied Hungary. The Latvians had advanced degrees from the University of Riga. One Latvian, Rudy Kreso is retired and lives in Pierre. Another Latvian is a Professor at North Dakota University. From the record of these foreigners you can see that we had been successful in assembling a high class Staff.

- Q. Were your facilities adequate to accommodate such a large and sudden expansion?
- A. They were not. The Interstate program was superimposed, together with the replacement of the Missouri River Bridges, on our normal program for which our drafting and office space was designed. However, the Corps recognized this unusual impact and co-operated with us by agreeing to allow us to charge the cost of expanding our facilities as a legitimate engineering charge under the reimbursable provision of our agreement. We met the situation by erecting a new insulated metal building near a maintenance building for highway equipment on Sioux Avenue. When the project was completed the cost was charged into the project and the Highway Commission used the building for other purposes.
- Q. This brings us to the Platte-Winner Bridge. In what way did this differ from the other replacements?
- A. In the first place it had not been included in the original agreement and it required special Congressional Action as I stated earlier. This was accomplished by Senator Francis Case, as I have previously stated. This provided for the Corps to provide \$4,500,000.00 and the State to pick up any excess. Fortunately we were able to design the structure so economically that the State did not have to pick up any over run.

Secondly, the conditions under which the construction must proceed were vastly different from those existing at the other sites. The other bridges were constructed before full impoundment had occurred. At those sites the flowing stream could be manipulated to permit most of the construction to proceed under near dry land conditions. At the Platte-winner site the Ft. Randall Reservoir had been operating at full capacity for several years and no control for the benefit of bridge construction was possible. An economic study was prepared as in the case of all of the other bridges, in which the possible types of structures were analyzed, both for feasibility and comparative cost. At the suggestion of some Corps personnel even a suspension bridge was considered but was discarded, as it was approximately 60% above the cost of the type finally selected. The most economical and practical type consisted of Steel Deck Girder Spans supported on large diameter pre-stressed concrete piling sunk to the under lying Carlisle shale. This type of construction had been successfully used in deepwater structures in the Puget Sound area and at Chesapeake Bay in Maryland. These 48" hollow piling with 5" walls can be fabricated in two ways. The Raymond Corporation casts the piling in sections, then strings them together on the pre-stress cables, stresses them and seals the strands into the shell. Dr. Arthur had developed a second method in Washington State. This consisted of continuous casting along the pre-stressing strands by a machine resembling a horizontal slip form. Dr. Anderson held the patents on this equipment. Both methods produced piling of equal quality. I wrote the special provisions to permit the

contractor to use either method. The successful bidder, a Peter Kiewit Joint Enterprise elected to use the Anderson Method and equipment.

Q. Was the casting done on site?

A. Yes. A large area was located along an inlet from the reservoir from which the piling could be rolled onto floats and taken to the pile rigs at the pier sites. Some of the piles were 188 ft long, so their handling and transport into the leads was a major operation. The Anderson equipment functioned perfectly and there was no problem in producing perfect piling. Also the contractor had no problem jetting the piling to the required bearing on the Carlisle stratum.

Q. After the piling were seated what was the next step?

A. The special provisions required that a three foot seal of Class A Concrete be placed at the bottom of the pile next to the foundation material. Then a sand fill was to be placed to the level of the riverbed. Above that the pile was to be filled with Class C concrete to an elevation twenty feet below the top. The last twenty feet was to be filled with Class A concrete and an interior cage of re-bars was to be placed. There was no requirement of concrete for added strength in the Class C area. Its only purpose was to exclude water from the piling at elevations that fluctuations of the Reservoir might expose. The extra reinforcement at the top of the piling was to resist bending stresses transferred from the superstructure. The specifications clearly stated that all concrete placed in the piling was to be placed by tremie or drop bottom bucket methods. This was to prevent segregation of materials. It is a fact that concrete cannot be dropped, even in the air for more than a few feet without segregating into its components and losing its identity as concrete. It cannot be dropped through water at all without almost complete segregation. Unfortunately the bridge division was completely separated from the project once the contract had been let and had no voice in the selection of the Resident Engineers or Inspectors and no supervision of the construction in any phase.

Q. What resulted from this situation?

A. I can really only speculate based on my own after the fact observations. I do know that the State supervision was inexperienced. The use of tremie or drop bottom buckets is slow and meticulous work. It is my opinion that the Contractors Superintendent took advantage of the inspector's inexperience and convinced them that he could drop the concrete great distances without hurting the quality of the resulting product. At any rate that was the only scenario that would account for the disastrous results that led to several years of repairs to the damaged piling and the filing of claims for reimbursement for the cost of the repairs.

Q. What happened to the piling that resulted in this damage?

A. The contractor, as was later conceded had not placed the concrete by the specified method. The result was as I have previously described. The water, being the lightest of the components of the concrete had come to the top and stayed there while the other segregated components remaining below did not resemble concrete in any way. During Christmas Week of 1963, I believe, there was an extremely cold spell and the water freezing inside the piling ruptured them, effectively destroying them for their intended purpose. The superstructure contractor, the American Bridge Company, could do nothing until a satisfactory repair was made. This was the sole responsibility of the substructure contractor, Peter Kiewit Company.

Q. Was it possible to make a satisfactory repair?

A. Yes. Although I was no longer connected with the State I have seen the plans and they are adequate. I believe a Kansas City firm, Ash-Howard and Needles, a very reputable firm made them.

Q. Who paid for the repairs?

A. Peter Kiewit filed claims for about \$2,500,000.00 with the Highway Commission. There appeared to be a strange desire on the part of the Highway director to accommodate the contractor and pay the claim. Several ploys were tried. A special board was appointed in 1964. At that time, though not employed by the State I wrote a letter to Gov Gubrood, setting forth the facts and threatening a taxpayers suit if the claim was settled out of court. I got wind of other schemes to pay off the contractor and wrote a similar letter to Gov. Boe in 1965. Late in 1968, or early in 1969 another effort was made. This, time the Asst. Attorney General assigned to the Highway Department, John Wehde, who had been on the case from its inception, was removed and a Special Counsel, a Mr. Bogue of Vermillion was employed by the Highway Commission. He called me and wanted to interview me. I agreed to meet him in the Attorney General's office, thinking that Mr. Farrar would be there. However he was in Rapid City. Before he could ask me any questions, I asked him "Mr. Bugue, are you acting as an Assistant Attorney General?" He replied that he was not and that he was acting as private counsel by the Highway Commission. I then asked him if, with the Highway Commission as a client, it would not be logical, for him to recommend a settlement out of court if his client so desired.

Q. What was Mr. Farrar's reaction to this ploy?

A. When Mr. Farrar returned I related the interview with Mr. Bogue, word for word. He said that there was no way they could settle out of court without his concurrence. I told him that I thought the plan was make and end run around him by employing private counsel who would recommend the settlement and then to say that they had acted on advice of competent counsel. The next day he called me in and showed me a letter to the Highway Director and Commission. It was very brief stating that he did not approve of the employing of private counsel, that he directed John Wehde to take full charge of the case, that the Highway Commission without further delay bring the Kiewit case to trial stage, and that he knew of no legal way that the Highway Commission could reimburse counsel not employed through the Attorney Generals Office.

Q. How did matters proceed from that point on?

A. John Wehde did a masterful job of preparation. I spent many hours with him building information, giving depositions and referring him to promising sources for testimony. Peter Kiewit used an Omaha Lawyer and Elsworth Evans of Sioux Falls as their staff. They also took dispositions from all of the State witnesses. They went through our files and John, apparently to their surprise, insisted on going through theirs. They found nothing useful in our files but the amount of damaging letters in their files was surprising. Such things as a memorandum by their Mr. Gallimore of a conference in his room at the Holiday Inn. The opening paragraphs were discussing this Man Scurr who seemed to be causing a lot of trouble in arriving at a satisfactory arrangement. I had several copies of this memo made and treasure it dearly.

Q. Who were the most effective State witnesses?

A. I would rate Walter Grimes, the Foundation Engineer as the strongest witness that John Wehde used. He not only was effective in his own field but he made a small model of a glass miniature piling. He used this model to make it clear to the Judge just what happened when concrete is dropped instead of being placed by the method we had specified. He had made an 8mm movie of this

demonstration and I believe it was the most important thing in convincing the Judge as to just what had happened and why.

Q. What was the outcome of the case?

A. I have a copy of Judge Bandy's Memorandum Opinion. This is dated Dec. 2, 1969 and is the conclusion of an event that originated in 1963. The Judge awarded the contractor no part of his claims for the repair of the damage caused by his own actions. The contractor wound up getting only the small retainer held by the State until completion of all contracts plus some extra work at one abutment that the state had always acknowledged. Instead of \$2,966,000.00 that the contractor had sued for, I believe the final award was in the neighborhood of \$60,000.00.

Q. Was the case appealed?

A. No. John Wehde said that he had thought that it would be until he read Judge Bandy's opinion. After reading the opinion John said that they would not appeal because the opinion made it evident that he was now in a position to file a counter suit for an even greater sum than the original claim. He apparently was right as they never appealed.

Q. You referred earlier to the fact that the disastrous rupture of the piling prevented the American Bridge Company from proceeding with its superstructure contract on its planned schedule. How was this contingency met?

A. I had provided in the Special provisions for the Superstructure contract that the inspection of the substructure be made prior to entry of the Superstructure contractor on the site. If any discrepancy existed in the substructure that adversely affected the superstructure, it was to become a subject for negotiation between the State and the two contractors to establish responsibility for the fault and to arrange for correction to allow the construction to proceed. In this case the fault was clearly in the substructure. However the American Bridge Company had already fabricated the girders and was ready to proceed with the erection. There was substantial damage to them as they had to be stored for more than a year before they could be placed on the repaired foundation. Also after a year in open storage they had to be re-cleaned and re-painted. All this was in addition to the time loss and the financial loss by reason of having their funds tied up in idle fabricated girders.

Q. Who paid the costs involved in the loss to the American Bridge Company?

A. The negotiations on this matter took place after I had retired from State employment and I am not certain of the outcome. However in view of the final outcome of the Peter Kiewit suit against the State, I am positive that this loss must have been paid by the Peter Kiewit Company or its insurers.

Q. What is the present status of all of these replacement structures?

A. All of them are in service. At the Mobridge and Forest City sites there have been periodic problems involving sliding of approach fills. These problems were predictable and will probably continue. They are caused by the infiltration of water under pressure from the high levels of reservoir. This water is forced into the adjacent seams of bentonite and lubricates them to the point that sliding of the adjacent earth occurs. Also there has been some damage to the floors of these structures by reason of permitting trucks to come onto the structures at as high a speed as seventy miles per hour. I had recommended a maximum speed of 45 miles per hour. I know of no other mile

long structures in United States where unlimited speeds are permitted. I understand that quite recently, reduced speed has been posted on these structures. This should reduce damage to the floors.

Q. There is one other structure over the Missouri that you have not discussed. That is the Interstate Bridge at Chamberlain.

A. I have not discussed that for two reasons. One is that it is not truly a replacement bridge for the original. The dual bridge is the real replacement. The other is that it was built after I had retired. In 1962 and 1963 I made the preliminary economic study and comparison of costs for this structure. On my retirement in 1963 my study was turned over to the Consulting Firm of Sverdrup and Parcel of St. Louis who adopted one of the options that I had recommended and completed the plans. This is the only structure over the reservoirs that is designed by anyone but myself. It is designed as I would have designed it.

Q. I believe that this completes the Oral History Project which I have been assigned to conduct. Thank you for your co-operation.