# AC 2009-1038: BRIDGE DESIGN ON THE RESERVATION: A STUDY OF CURRICULUM IMPLEMENTATION WITH AMERICAN INDIAN YOUTH

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Dr. Gillian Roehrig is an Associate Professor of Science Education. Gill is a former high school chemistry teacher with a strong interest in engaging students in inquiry-based activities and integrating technology into science classrooms. Technology Enhanced Communities (TEC) funded by the Minnesota Office of Higher Education is an online learning community developed in collaboration with graduate students David Groos and Joel Donna for middle school science teachers in Minneapolis Public Schools working to integrate technology into their classrooms. TEC will be extended to include teachers on the White Earth Reservation.

# Bridge Design on the Reservation: A Study of Curriculum Implementation with American Indian Youth


## Abstract

To promote engineering education with American Indian students in grades 5-8, a civil engineering focused curriculum was designed through collaboration among educators, researchers, and engineers. The curriculum was created to introduce American Indian youth to career opportunities in civil engineering, various civil engineering concepts, and the role of civil engineers in the technology driven 21$^{st}$ century. The emphasis of the curriculum is placed on structural engineering, which is a branch of civil engineering concerned with the design and structure of buildings, bridges, and roads. The curricular activities focused on one particular structure - bridges. Through the activities the students engaged in engineering, as well as science, mathematics, and technology.


## *Introduction*

Researchers have addressed various issues regarding the education for American Indian students[1,2,3]. School problems such as low enrollment and graduation rates, large percentage of absenteeism, suspension and expulsion, low achievement scores on math, science, and reading, and the high drop out rates are commonly associated with American Indian students' education[4]. Several researchers have addressed the ways to improve the education of American Indian such as implementing culturally relevant curriculum[3], applying Native American pedagogy[5], and training teachers to meet the particular needs of American Indian students[1]. In addition to these, it has been addressed that parental involvement is a necessary factor for American Indian students' achievement[4]. Thus, parents of American Indian students are highly encouraged to be involved in the education of their children.

American Indian students have different learning styles[3]. Their learning is environment dependent, and they think in more relational styles rather than in analytic styles[3]. In addition, they could not easily see the connection between the whole and its subcategories. As visual learners, American Indian students learn best by observing their parents or elders[6]. Preston suggests that using experiential learning and cooperative learning activities can improve these students' problem solving abilities and can reduce their mathematics and science anxiety[3]. Furthermore, Preston points out that workshops, after school, and weekend or summer school opportunities that emphasize hands-on activities and applications to real life situations can improve American Indian students' attitudes toward mathematics and science[3]. It is well documented that American Indian students demonstrate high interest and success as they participated in activity-based science programs[7].

In this light, the innovative "Reach for the Sky (RFTS)" program at [removed for review] was developed as a summer and after school program to serve a specific group of American Indian youth – Anishinabe – who live on the White Earth Indian Reservation in Minnesota. The goal of the RFTS project is to make STEM (Science, Technology, Engineering, and Mathematics) disciplines more culturally relevant to the Anishinabe youth. More information about the program can be found at [URL removed for review]. The program is a three year collaborative project funded by the National Science Foundation. The curriculum that is presented in this paper was implemented in the second year of the RFTS program. The curriculum was delivered to approximately 70 American Indian students in the after school program of the RFTS project and was implemented in a two month long period in fall 2008.

***Curriculum Design***

The curriculum was created to introduce American Indian youth to career opportunities in civil engineering, various civil engineering concepts, and the role of civil engineers in the technology driven 21st century. The curriculum emphasizes structural engineering, a branch of civil engineering concerned with the design and structure of buildings, bridges, and roads. The curricular activities focused on one particular structure - bridges. The context of this curriculum was chosen due to the social relevance to the students to the 35W bridge collapse over the Mississippi River in Minnesota on August 01, 2007. This devastating tragedy impacted many families in Minneapolis, and it brought attention to the nation's other bridges. The media has presented massive information regarding the 35W bridge collapse and structural deficiencies of many other bridges. In order to help students understand this tragedy, the role engineers play in society, and to increase their interest in civil engineering, this particular curriculum was developed.

The design of the curriculum is theoretically aligned with *constructivism.* Curriculum design from a constructivist perspective focuses on the social construction of learning and enables students to learn through collaboration[8]. The bridge building activities allowed students actively engaged in their knowledge construction as they learned the concepts through hands-on activities. Demonstrations, computer simulations, and videos were employed to increase students' engagement. In addition, all students were asked to keep journals, written as *blogs,* to reflect on their learning. The designers of the curriculum created a restricted online social network with content management capabilities (*Ning* – http://www.ning.com/) to deliver the curriculum and allow students to have interactive experiences with technology. Only the students, teachers, and the designers of the curriculum had access to the RFTS Ning site. The website enabled students and teachers to share curricular artifacts and their experiences with the curriculum.

The curriculum includes five main parts: exploring civil engineering, bridge construction, different types of bridges, designing the least expensive bridge, and bridge Model Eliciting Activity (MEA)[9]. In the first part of the curriculum, students explored civil engineering and gained an understanding of the engineering design process –ask, imagine, plan, create, test, improve (adapted from Boston Museum of Science). First, the students watched short video clips that explored civil engineering as a career. Then, they discussed different types of civil engineering projects found in their community and how to become a civil engineer. There were two purposes in this: (1) to help the students connect the content of the curriculum to their everyday lives, and (2) to encourage the students to consider engineering as a career. Following these introductory activities, students engaged in deep discussions about the 35W bridge collapse. This context connects activities in the Summer 2008 program and to the curriculum in the after-school program in Fall 2008. During the summer program, the students visited the new 35W bridge construction site to observe the new bridge construction. Civil engineers of the new

35W bridge gave presentations about the structure of the old and new bridge. Through analyzing the 35W bridge collapse and the design of the new bridge, students increased their knowledge about the different bridge structures and also engaged in the curriculum activities. When the first part of the curriculum was finished, students wrote short essays describing a career in civil engineering. They posted their essays on RFTS Ning site.

Figure 1: Students building paper bridge

In the second part of the curriculum, students built model bridges following engineering processes. Through building paper bridges students experienced bridge structure as they learned about science concepts such as balance and forces (e.g. tension, compression, torsion, shear, and flexure). They discussed how different forces act when the length of a beam and shape (e.g., round, square, etc.) of columns changed. Students then built beams and columns from copy paper with the goal of creating the strongest bridges (Figure 1), and they participated in a small competition where they put weights on their bridges to find the bridge formation that is most structurally stable. After the competition, teachers provided enough time for students to redesign their bridges to make them stronger.

The third part of the curriculum focused on different types of bridges (beam, truss, arch, suspension, and cable-stayed) and how different types of forces act on each type of bridge.

Figure 2: Students are testing their K’NEX bridge

Groups of three-four students built all five types of bridges from K’NEX™. They tested their bridges (Figure 2) by putting weights on them to find how strong they were and what forces were acting on them. When they built all five types of bridges they discussed the similarities and differences among different types of bridges. During that time, teachers showed pictures of different types of well-known bridges and asked questions such as “what factors might engineers consider while designing these bridges? What were these bridges designed for? What are the main structural differences among these bridges?”

In the fourth part of the curriculum, students used the West Point Bridge Design (WPBD) Software 2007. It is free software and can be downloaded from http://bridgecontest.usma.edu/. The software allows students to build various types of truss bridges (e.g. through truss and deck truss) and test their designs. Figure 3 shows a screen shot of a truss bridge design in WPBD. Students engaged in the engineering design process through this bridge building software that has a real life estimator for cost analysis and structural analysis.

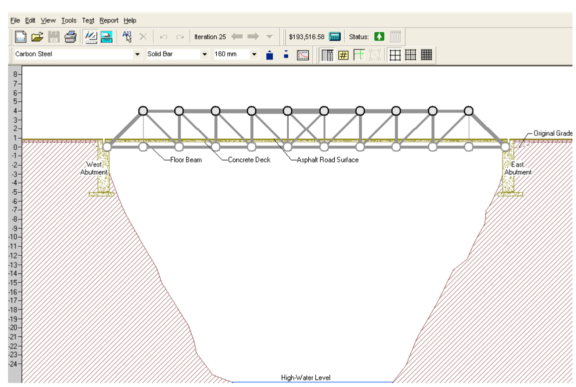


Figure 3: Truss bridge design

Groups of two students made a team and designed their truss bridges.

The final part of the curriculum had students engaged in a Model Eliciting Activity (MEA)[9] which is a problem-based design activity focusing on solving real world problems. Students worked in groups of 3 to 4 to create a procedure to choose the type of bridge to replace a bridge, which is structurally similar to the 35W bridge and has structural deficiencies. Students made construction decisions, developed skills in critical thinking and teamwork, and experienced the engineering design cycle (see appendix for more information about the bridge MEA).

### *Teacher Training*

The teachers of the after school program were trained on how to deliver the curricular unit by the curriculum designers-authors of this paper. The curriculum was implemented in three school sites with two teachers collaboratively teaching at each site. Six teachers participated in the training. During the two four-hour long trainings, teachers as students experienced all the curricular activities. In addition, during the training teachers learned how to use the RFTS *Ning* site. Teachers learned to design their own blogs, create discussion boards, and upload pictures.

### *Evaluation of the Curriculum*

To investigate the effectiveness of the curriculum on enhancing students' interest and understanding of civil engineering concepts, a research study was designed. A mixed-method research methodology was employed in the study[10]. Various data collection instruments were used: students' pre- and post-tests, bridge designs, blogs, and MEA procedures, and teachers' reflection journals. Clements[11] *Curriculum Research Framework* (CRF) was used to structure this curriculum study development. Clements defines curriculum as "a specific set of instructional materials that order content in order to support pK-12 classroom instruction" (p. 36). Using Clements' framework, the research followed a three-phase process: (1) use existing research that allow the curriculum development team to apply what is already known to the curricular modules, (2) revise curricular modules in accordance with models of children's thinking and learning within the specific content domain, and (3) conduct formative and summative evaluations in classroom settings. Stages 1 and 2 were completed prior to the implementation of the curriculum reported in this paper. The project team used prior research and pilot testing as our means to complete these stages. The evaluation of the curriculum is the focus of the research here. Stage 3 is comprised of formative research and summative research. This paper aims to report the formative research of stage 3. Future research will report on the summative research on this curriculum.

The qualitative data is reported in the form of excerpts of student classroom artifacts and teacher responses to reflection questions. This data is being used in the formative stages of the research to allow the project staff to revise the curriculum. The quantitative research is a paired t-test[12] to determine if the students' pre- and post-test data differs significantly. Here, a $p = 0.01$ cutoff level of significance was used to determine statistical significance.

The data analysis demonstrates that the curriculum has positive impacts on students. From 64 students, 27 of them completed both pre- and post-tests. 30 students completed only pre-test and

7 students completed only post test. The pre- and post-test was developed based on the content being taught in the curriculum. The pre- and post-test covered structural engineering content included structural similarities and differences in five different types of bridges (bean, arch, trust, suspension, and cable) and strengths and weaknesses of these different bridge structures. In addition, the test was designed to capture students' understanding of science and mathematics concepts related to structural engineering. The science concepts in the test included the forces that act on a bridge and the mathematics concepts focused on geometrical shapes of columns and the effect of bridge pier shape on the stability of bridges. The pre- and post-test were equivalent and included same number of true false questions, matching questions, fill in the blank questions, and open ended questions. The pre- and post- test scores of the students were graded based upon percentage of correct answer. Figure 4 shows all the pre and post test scores. Mean score for the pre-test is 27 and mean score for the post-test is 51 out of a total of 100.

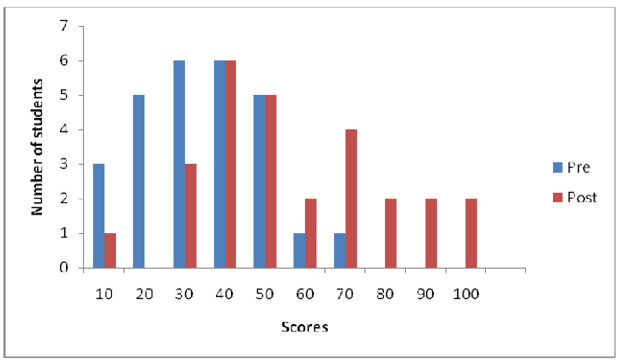

Figure 4: Pre- and post-test scores of all students

The hypothesis test is as follows:

$H_0$: The means of the pre- and post-tests are equivalent.

$H_a$: The mean post-test is greater than the mean of the pre-test.

Rejection of the null hypothesis comes when the differences between the means are statistically significant ($p < 0.01$). This is a one-tail test of significance. The scores of the 27 students who completed the pre- and post-test were compared. Their post-test scores show a higher degree of students' understanding of the civil engineering concepts than the pre-test. The null hypothesis was rejected ($p<0.000001$) in favor of the alternative hypothesis showing a significant difference between pre- and post-test scores.

The students' blog entries provided information on their level of engagement in activities. Most students indicated that they enjoyed building bridges. Before receiving the curriculum, almost all students could not explain the job requirements of civil engineers, but at the end of curriculum implementation, each student could provide a reasonable explanation of the roles and duties of civil engineers in society. Some sample responses are: "civil engineers design buildings, bridges, and roads", "They build bridges, roads, tunnels, and subways." The following quotes demonstrate student interest in becoming engineers: "I liked looking at pictures and watching videos of civil engineers and bridges, I think engineering is about building cool stuff", "I want to be an engineer."

The analysis of MEA responses shows that students' increased their knowledge about bridge structures. The examination of MEA responses provided information about how well the students understand the concepts that were presented through the curriculum. Students' responses demonstrate that students thought critically, collaborated, analyzed and synthesized given information, and used that information to solve the real engineering problem. In their responses, students specifically explained what particular type of bridge they would choose to replace the bridge that is given in the MEA. An example of student answer is below.

> "I think an arch bridge would work because it lasts a long time and it is built for long distances. The arch would be better because the bridge is made out of stone and a lot of stone is found around Minnesota. But the problem is that the arch is hard to build and cost a lot. They look fun to build."

Teacher's reflection papers provide valuable information regarding the effectiveness of the curriculum. Some teacher reflections on the curriculum are:

> "Getting our students to think about engineering as a career is great. The understanding that engineers are problem solvers is a wonderful lesson all by itself. They enjoyed exploring what civil engineers do too."
>
> "All of the students were interested in the topic of bridges. All of the students gained from the curriculum…They all enjoyed the time on the computers and the time building with the K'NEX. The objectives of the bridge building activities were all met but at very different levels for different student."
>
> "It's a great curriculum. It gives kids a lot of great knowledge and experiences. It is a great introduction to engineering."

***Challenges Faced during the Implementation***

Originally, the curriculum was designed to implement in a two week long period. In the after school program students met four days a week for one and a half hours. The curriculum could not be completed in the planned time period mainly because of the time constraints put on teachers for other unrelated parts of the after school program and because of computer related issues that teachers experienced. Curriculum activities required regular computer use; however, the access to the computer labs in schools was challenging. Because it is an after school program, little technological help was available to teachers to overcome computer-related problems. For example, the WPBD software works only on PC. Two of the schools have only Macs so cross-platform software programs needed to be downloaded to these computers. While teachers made the extra effort to be able use the software program in the program, one school was not able to get the WPBD software to work.

Creating a sustainable community in the RFTS Ning site was also a challenge that the curriculum designers faced. At the beginning of the curriculum implementation, the quality of students' blog entries was below expectations. Instead of using Ning to give responses to the content related questions or participating in the content focused discussions, students used Ning to socialize with their classmates. Thus, teachers strongly encouraged students to be reflective in their learning process and to participate in online discussions. Students gradually became more interested in forums and discussions. It was also found that some students had hard time to engage in the forums or discussions since they have under-developed writing and reading skills.

Attendance was another challenge that teachers faced while implementing the curriculum. Approximately one fifth of the students attended the program for the full duration of the curriculum implementation. The rest of the students came to the program at various times.

A final challenge revolved around the location of the researchers and the schools. Since the school sites and the university are far away from each other, the university educators could not make as many observations or provide as much on-site help as they would have liked. However, teacher training, detailed lesson plans, and continuous communications between teachers and the curriculum designers allowed teachers to successfully implement the curriculum.

***Conclusions***

Given the growing emphasis on engineering education, this curriculum provides valuable information for university educators, researchers, and K-12 educators interested in the best practices in engineering education. The curriculum sheds new light on the effective design and implementation of integrated science, technology, engineering, and mathematics education curricula. To enhance engineering education in K-12 in diverse settings, a strong emphasis should be given to integrating engineering with other STEM disciplines in a contextual manner. As evidenced by the data, through engaging with the curriculum activities, students learned how to apply mathematics, science, and technology to engineering problems. The curriculum activities greatly increased students' knowledge and level of interest in engineering as shown in students' pre- and pos-test results and blog entries. Further, it was found that hands-on, inquiry-based activities enhanced students' motivation. Thus, to increase the knowledge and skills of American Indian students in STEM disciplines teachers should apply student-centered instruction. It is important to note that even though the curriculum was particularly designed for an after school program, with modifications it can be easily implemented in a regular school program. As a next step, the designers of the curriculum plan to formalize the curriculum and implement it in an engineering education focused inner city school.

## References


1. Bradley, C. (1984). Issues in mathematics education for Native Americans and directions for research. *Journal for Research in Mathematics Education, 15*(2, Minorities and Mathematics), 96-106.
2. Nelson, K., Simonsen L., & Swanson E. (2003) *Research issues for mathematics education in rural communities: Focus on Native Americans*. Athens, Ohio: Ohio University Press.
3. Preston, V. (1991). Mathematics and science curricula in elementary and secondary education for American Indian and Alaska Native students. Available at: http://www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/23/f5/4a.pdf
4. National Center for Educational Statistics, US Department of Education (2008). Status and trends in the Education of American Indian and Alaska Natives: 2008. Available at http://nces.ed.gov/pubs2008/2008084.pdf
5. Hankes, J. E. (1998). *Native American pedagogy and cognitive-based mathematics instruction. Native Americans: Interdisciplinary perspectives*. Garland Publishing, KY.
6. Pewewardy, C. (2002). Learning styles of American Indian/Alaska Native students: A review of the literature and implications for practice. *Journal of American Indian Education, 41*(3), 22-56.

7. Zwick, T. & Mille, K. (1996). A comparison of integrated outdoor education activities and traditional science learning with American Indian students. *Journal of American Indian Education, 35*(2), 1-10.
8. Hand, B. & Treagust, D. F. (1991). Student achievement and science curriculum development using constructive framework. *School Science and Mathematics, 91*(4), 172-176.
9. Diefes-Dux, H. A., Moore, T., Follan, D., Imbrie, P. K., & Zawojewski, J. (2005). Model-Eliciting Activities: A framework for posing open-ended engineering problems (interactive session). ASEE National Conference, Portland.
10. Creswell, J. & Clark, V. (2007). *Designing and conducting mixed methods research*. CA: Sage Publications.
11. Clements, D. H. (2007). Curriculum research: Toward a framework for "research-based curricula." *Journal for Research in Mathematics Education, 38*(1), 35-70.
12. Muijs, D. (2004). Doing quantitative research in education with SPSS. CA: Sage Publication.

**Appendix**

Model Eliciting Activity-Part A

Bridge Design-Individual Activity

**Read the following information and individually answer the questions that follow.**

**35W Bridge Collapse**

Background material adapted from Mn/Dot Bridge website (http://www.dot.state.mn.us/bridge/ )

The Interstate 35W Mississippi River Bridge in Minneapolis collapsed on August 1, 2007. The eight lane bridge was Minnesota's busiest, carrying 140,000 vehicles a day. This deck steel truss bridge was 1,907 feet long and had 14 spans. It was open to traffic in 1967 and expected to be reconstructed in 2020-2025. The bridge was inspected every two years until 1993; after that it was inspected every year.

Starting in 1997, deficiencies were demonstrated in inspection reports. Mn/Dot attempted to improve the condition of the bridge through bridge span rehabilitations. Furthermore, in 2001 Mn/Dot worked with civil engineers from University of Minnesota to evaluate the fatigue stress within the truss. Following the field tests, the civil engineers recommended that fatigue cracking was not expected to be a problem in the truss but reported that some critical locations of the trusses had high stress and some girders were distorted. The bridge's last inspection was completed in June 15, 2006. As a result of comprehensive analysis on fatigue and fracture structure recommended supporting the critical 52 truss members.

During the 35W bridge collapse, 13 people were killed and more than 100 injured. The investigations on the collapsed bridge continue. Mn/Dot has investigated every single detail to find what caused the bridge collapse. It has been considered that *gusset plates* in the center span and the extra weight from construction may have contributed to the tragedy. The gusset plates are steel plates that tie steel beams together on a bridge. These are a very important structural component of truss bridges. However, it should be also considered that gusset plates are not the only structural components in truss bridges; other critical parts of the bridge might have deficiencies. In addition, extra weight may not be a main factor for the bridge collapse since the bridge had less than its usual traffic at the time of the collapse. Half of the lanes were closed for the repair when the bridge failed.

**Individually**:

- Watch the video of 35 W bridge collapse from http://www.youtube.com/watch?v=osocGiofdvc
  Or go to http://reachforthesky0809.ning.com
- Generate a list of factors you believe are involved in the 35W bridge collapse.
- Generate a list of factors that you need to consider when designing a bridge.
- Once you have finished your individual response, request the memo from Mn/Dot. Read the memo individually and then let your instructor know that you are ready to proceed.

***INTERNAL MEMO***

To: Engineering Team
From: Mn/Dot
Re: Bridge Design

After the 35 W bridge collapse, Mn/Dot has focused attention on the condition of other bridges in Minnesota. Mn/Dot conducted recent inspections on bridges in the Minnesota and found that there are 1,907 bridges that are structurally deficient. As a result of recent inspections, Mn/Dot shut down another bridge in March 2008. Originally, the bridge was scheduled for replacement in 2015, but Mn/Dot inspectors found critical deficiencies during the inspection. The bridge has a similar design configuration as 35W Bridge and it is located over the Mississippi River in St Cloud.  Mn/Dot plans to replace the bridge soon. The new bridge will be located in the same place as the old one. It will carry a highway and run east-west. The length of the bridge will be approximately 900 feet. The bridge deck should have two lanes and should also have 5 ft wide sidewalks along both sides of the bridge.


Hwy. 23 bridge in St. Cloud, MN.

Starting with the St Cloud Bridge, Mn/Dot will replace many of the bridges that have been found to be structurally deficient. Because so many bridges are going to be replaced, Mn/Dot needs a procedure for comparing different type of bridges and choosing the right type of bridge to build across each span.  Mn/Dot is asking you to create this procedure. First, your team should decide on the least expensive and safest bridge to replace the St. Cloud Bridge. Pay attention to how you made this decision because we also need you to create a procedure to make the same type of decision in other locations around Minnesota. Mn/Dot will use your procedure to replace the St Cloud Bridge and then other bridges. Please find the enclosed information regarding the types of bridges that Mn/Dot plans to Build—truss Bridge, arch bridge, suspension bridge, and cable-stayed bridge. In addition to the information about the major types of bridges, Mn/Dot also has provided you two examples of four types of bridge in the U.S. You may need to use this information as a starting point to determine your procedure for selecting the new bridge design. Please respond in a letter to Mn/Dot explaining which bridge is right for the St. Cloud span and why you chose it, and provide them with a method to make the decision of which type of bridge to use to replace any bridge in Minnesota.

Thank you.
Peggy Abrams

Model Eliciting Activity- Part B

Bridge Design- Team Activity

- Read each team member's individual list of factors that need to be considered when designing a bridge.
- Reread the Memo as a team.
- Write the body of a memo to Peggy Abrams at Mn/Dot that includes:
    - A clear explanation of what type of bridge you decided to build in St. Cloud and why you made that decision.
    - A detailed explanation of your team's general procedure for choosing the best bridge type to build across any span and indicate how Mn/Dot can use this procedure to replace other bridges in Minnesota.

Table 1: Different Types of Bridges

| **Bridge Type** | **Advantages** | **Disadvantages** | **Span range** | **Material** | **Design Effort** |
|---|---|---|---|---|---|
| *Truss bridge* | -Strong and rigid framework<br>-Work well with most applications | -Cannot be used in curves<br>-Expensive materials needed | Short to medium | Iron, steel, concrete | Low |
| *Arch bridge* | -Aesthetic<br>-Used for longer bridges with curves<br>-Long life time<br>-Very strong | -Abutments are under compression<br>-Long span arches are most difficult to construct<br>-Relatively expensive | Short to long | Stone, cast iron, timber, steel | Medium |
| *Suspension bridge* | -Light and flexible<br>-Aesthetic | -Wind is always a concern<br>-Expensive to build | Long (up to 7,000 feet) | Steel rope and concrete | High |
| *Cable-stayed bridge* | -Fast to build<br>-Aesthetic | -Stability of cables need to be considered for long span bridges | Medium (500-2,800 feet) | Steel rope and concrete | High |

Table 2: Examples of four major types of bridges

| Bridge Name | Location | Bridge Type | Total length | Clearance below | Lanes | Constructability | Life time | Cost (Present value) |
|---|---|---|---|---|---|---|---|---|
| *Hennepin Ave Bridge* | Over Mississippi (Metro area) | Suspension bridge | 1037 feet | 37 feet | 6 | Easy | Fairly long (Built in 1990) | $100 million |
| *Golden Gate Bridge* | San Francisco, CA | Suspension bridge | 8,981 feet | 220 feet | 6 | Difficult | Fairly long (Built in 1937) | $212 million |
| *10th Ave Bridge* | Over Mississippi (Metro area) | Arch bridge | 2175 feet | 101 feet | 4 | Difficult | Long (Built in 1929) | $ 9 million |
| *Stone Arch Bridge* | Over Mississippi (Metro Area) | Arch bridge | 2100 Feet | 24.4 feet | Bike and pedestrian trials | Difficult | Long (Built in 1883) | $15 million |
| *Greenway Bridge* | Minneapolis, MN-55, Light Rail Line | Cable-stayed bridge | 2,200 feet | 20 to 27 feet | Bike and pedestrian trials | Easy | Fairly long (Built in 2007) | $5.2 million |
| *Arthur Ravenel Jr. Bridge* | South Carolina, crosses Cooper River | Cable-stayed bridge | 13,200 feet | 186 feet | 8 | Easy | Fairly long (Built in 1929) | $ 62 million |
| *John E. Mathews Bridge* | Florida, crosses St. Johns River | Truss bridge | 7736 feet | 152 feet | 4 | Difficult | Short (Built in 1953) | $ 65 million |
| *Eagle Point Bridge* | Iowa | Truss bridge | 2,000 Feet | 70 feet | 2 | Difficult | Short (Built in 1902) | $2.5 million |