January 11, 2017 Meeting

The January, 2017 Waterloo Technical Society (WTS) meeting was called to order by President Gary Dorhout at 7:10 pm. President Dorhout noted that this was the fourth meeting of the 103rd year of the Society.

A total of 36 were in attendance.

Treasurer's Report. Ken Friend submitted his report after the meeting to be included in the minutes. The treasury had a beginning balance of $1,152.17 with $60 income from dues and expenses of November's speaker's dinner of $18 leaving a balance of $1,194.17. A total of 8 honorary and 47 paid members gave a membership roster of 55 members.

Old Business. The speakers for the remainder of the fiscal year have not all been identified. Suggestions are still being accepted from the membership. President Dorhout presented this lineup:

Speakers for the 2016-2017 Meeting Year (Year 103)

- 14 Sep 2016 - Dr. Donald Gurnett from U of I. Voyager Spacecraft
- 12 Oct 2016 – Dr. Tim Nagel – Sign Technology
- 9 Nov 2016 – Mr. Steve Crouse – Facilities Changes at PEC
- 14 Dec 2016 – No Meeting
- 11 Jan 2017 - Brian Keierleber – County Engineer, Independence – Ultra High Performance Concrete used in Bridge Building
- 08 Feb 2017 – FIRST Robotics – Team Presentation
- 08 Mar 2017 -- Mr. Gomes – Waverly-Using Ultralights for Crop inspections-Tim
- 12 Apr 2017 – UNI Solar Boat Team
- 10 May 2017 – Open

Speakers for the 2017-2018 Meeting Year (Year 104)

- 13 Sep 2017 – Cody Wilkinson – John Deere Small Grains, Air Seeding Equipment
- 11 Oct 2017 – Mr. Gomes – Using Ultra-lights for Crop Inspections
- 8 Nov 2017 – Robert Levis -- WCF&N Railroad by Gene Van Gorder, 319-233-4235
- 13 Dec 2017 – No meeting

Officers for 2016-2017

President:	Gary Dorhout
Co-Vice Presidents:	Jerry Mohling & James Stevenson
Treasurer:	Kenneth Friend & Paul Anderson
Dinner Reservations:	Derek Eagles & Steve Lang
Secretary:	James Stevenson
Publicity/Recognition:	Open
Auditing:	Bill Mitchell & Jim Garrett
Nominating Committee:	Open
Web Site:	Tim Schoenfelder
Membership	Todd Whiting

Gifts to FIRST Robotics and UNI SolarBoat. Derek Eagles moved and Phil Berger seconded that WTS give $250 to each of these organizations. Motion carried unanimously.

New Business. No new business was discussed.

Guest Speaker: Brian Keierleber has been the County Engineer in Buchanan County Iowa since 1993. He oversees the maintenance and construction of 963 miles of county roads and 259 county bridges. Past engineering experience includes working as the Palo Alto County Engineer in Emmetsburg Iowa, project engineer for the City of Bartlesville, Oklahoma, and the Oklahoma Department of Transportation. He was commissioned in the US Army as a Civil Engineering Officer and served for 14 years as a Combat Engineer Platoon Leader, Training Officer, Infantry Company Commander, Field Artillery Battery Commander, Engineer Group Civil Engineer Officer and Battalion Civil Engineer Officer.

He is a 1981 Graduate of South Dakota State University with a Bachelors of Science in Civil Engineering. Brian is a member of the VFW, American Legion, and Knights of Columbus. He is married with 5 children and 4 grandchildren. His topic is Ultra High Performance Concrete (UHPC) in bridge building.

Overview: Buchanan County, Iowa has 259 bridges longer than 20 feet, 27 of these are rail car bridges, 3 are made of UHPC and 3 are glue laminated wooden bridges. Some of these bridges were first built in 1871 and are still in daily use. Traffic has changed in weight due to farming practice and equipment changes. Manure is moved in liquid form in cylinders holding 12,000 gallons and weighing 200,000 pounds. Iowa has 24,800 bridges compared to states like Kansas with 25,200 that need continual inspection and repair.

Material: UHPC is a cementitious composite material composed of an optimized gradation of granular constituents, a water-to-cementitious materials ratio less than 0.25, and a high percentage of discontinuous internal fiber reinforcement. The mechanical properties of UHPC include compressive strength greater than 21.7 ksi (150 MPa) and sustained postcracking tensile strength greater than 0.72 ksi (5 MPa). Ultra-high performance concrete has a discontinuous pore structure that reduces liquid ingress, significantly enhancing durability as compared to conventional and high-performance concretes

Ultra High Performance Concrete is structurally more comparable to steel than traditional concrete. As a result, far less material (-70%) is needed to achieve the same structural requirements. This leads to much lower weight, less substructure when used as a facade as well as lower shipping and installation costs. In addition, because UHPC does not contain the capillary pores of traditional precast or glass-reinforced concrete, it does not absorb water and degrade in demanding freeze/thaw or marine conditions.



Figure 1 This Wapello County, Iowa, structure was the first UHPC bridge constructed in the United States. The bridge includes three UHPC prestressed I-girders spanning a creek in rural Iowa.



Figure 2 Longitudinal connections are cast between deck-bulb-tee girders on the Route 31 Bridge in Lyons, NY. Field-cast UHPC can simplify connection details and ease constructability. This photo shows the casting of fluid ultra-high performance concrete (UHPC) from a wheelbarrow into the void space between the top flanges of two deck-bulb-tee prestressed concrete girders. The rebar can be seen extending from the girders into the void. The UHPC is self-consolidating. Source: New York State Department of Transportation.

Bridge Design: Bridges fail in transverse flexure. To provide a design with strength against this failure mode, the bridge sections are PI shaped as illustrated in Figure 3.

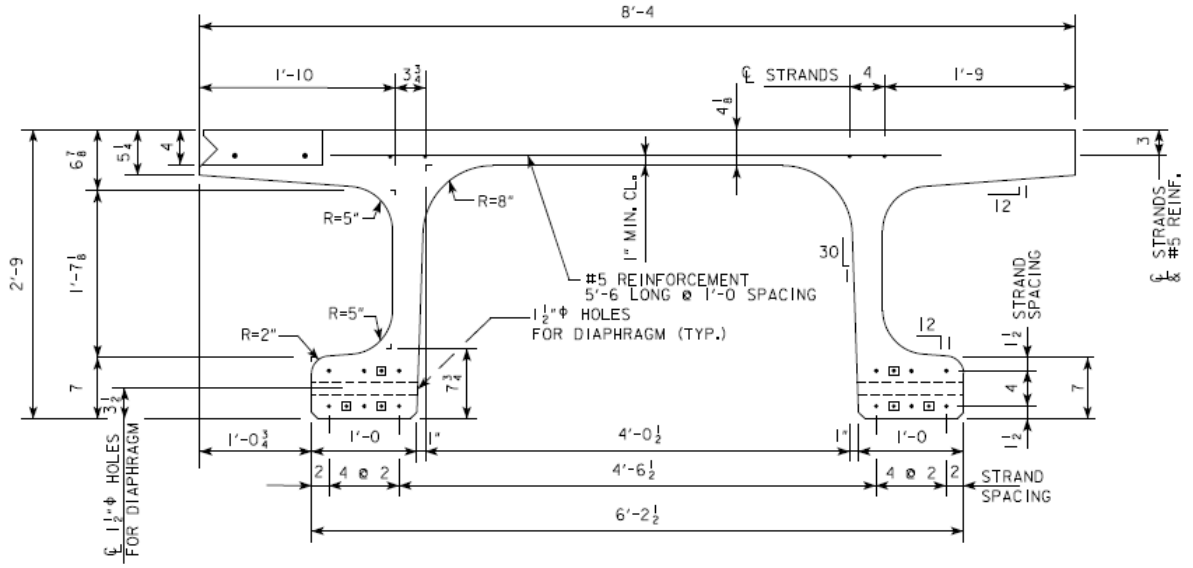


Figure 3 PI Section.

By placing three PI section girders side-by-side a full width bridge can be constructed as shown in Figure 4.

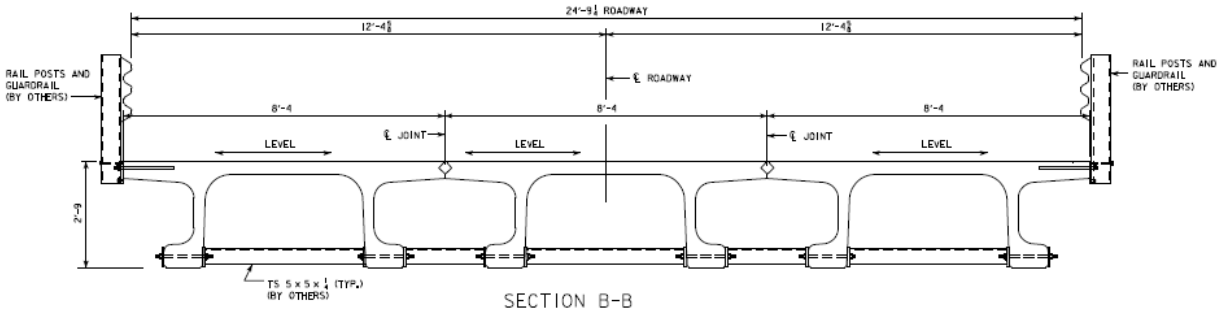


Figure 4. Bridge cross section with three PI girders.

Benefits of using UHPC: Bridges made from ultra-high performance concrete have these advantages:

Self consolidating	High strength	Dense, low permeability
Low creep, post cure	High durability	High post-cracking strength

If a crack does develop, small, ¾ inch long by 4 mil diameter, fibers arrest the crack giving the bridge high strength compared to conventional material.

In order to fabricate bridge sections, Buchanan County had to develop a mixing process on the site. The laboratory mixing by the Korean developer of the mix did not work when scaled up to a real bridge dimension. With moist sand and cement in the mixer, small balls of compound would develop. To solve this problem, a grain elevator with spiral auger was used to put 40 pound bags in a ready-mix truck. The Korean premix and

Portland cement were mixed prior to adding sand. Then the steel fibers were added using large vibrators to incorporate them in the slurry. The PI sections were poured then steam cured at 195 degrees Fahrenheit.

Once the 52 feet long by 5 feet wide beams were poured, cables were fed through pipes located in the feet of the PI section and stretched to 300,000 pounds of tension. Strain gauges monitored the cables to provide the proper strength. UHPC has a compressive strength of 21,000 psi versus 3,500 psi for conventional concrete. The 27 bridges in Buchanan County which are made from de-commissioned railroad flat cars can hold 253,000 pounds.

Final properties:

• Modulus of elasticity at release	5,800 ksi
• Modulus of elasticity final	7,800 ksi
• Design compressive strength at release	12,500 psi
• Design compressive strength final	21,500 psi
• Tensile strength	1,200 psi
• Allowable compressive release stresses 0.6 (12,500 psi)	7,500 psi
• Allowable compressive stress at service 0.6 (21,500 psi)	12,900 psi
• Allowable tensile stress at service 0.7 (1200 psi)	840 psi

Further information may be obtained at https://www.researchgate.net/publication/265289939.

Next Meeting. Our February 8, 2017 meeting features FIRST Robotics Team presentation.

Meeting adjourned at 8:35 pm.

Respectfully submitted,

James R. Stevenson, Vice President and Secretary