

## The Steel Bridge Project: Virginia Tech's Team Crafts Steel, Goes for Gold

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Imagine the expertise and planning involved in constructing a bridge. Now, imagine the pressure involved in executing such a project in under 30 minutes: this is the challenge that lies ahead of the Virginia Tech chapter of the American Institute of Steel Construction/American Society of Civil Engineers (AISC/ASCE) Steel Bridge Project. The annual project is a regional competition involving 13 Mid-Atlantic schools. Teams plan and design their bridges for months in advance, meticulously building each component in their respective labs. The individual parts of each bridge must be transported to the competition site and assembled quickly and under strict standards during the competition.

Each team must construct a steel bridge that meets the needs of a scenario created each year by the ASCE. The scenario determines the dimensional restrictions, the weight of the bridge, and the external obstacles, such as natural features and man-made structures around which the bridge must be built. This year's bridge must support a 2,500-lb. weight, and measure in at 1/10th the size of a hypothetical 200 ft. bridge—so a 20-ft. model. Each year the bridge must cross some hypothetical obstacle; this year that obstacle will be a river. The bridge can't be too high, too long, or too low as the judges will precisely measure every dimension. Even the individual pieces must strictly adhere to certain guidelines, and they cannot be larger than 3 ft. x 4 in. x 6 in.

Engineers on each team have 30 minutes to successfully assemble their bridge, with up to 15 minutes of additional time that would incur major penalties. Not only must the engineering, design, and timing be flawless, but team members may not drop a

piece of the structure or pick up more than one piece at a time without penalty. The team with the fastest time, lightest bridge, fewest penalties, and lowest deflection (which is how much the bridge moves or slopes in response to the applied weight) receives the fewest points and wins the competition.

I sat down with Virginia Tech's team captains—Laura Wild, Cody Furrow, and Joseph Spaziani, all of whom are civil engineering students—and had them walk me through their process. They were hard at work preparing for their fast-approaching regional competition from March 30 through April 1, 2017. They thoroughly explained the process and goals of their team, which includes about 25 Virginia Tech students.

The first step in the development process is anticipating trouble. “Based on dimensions or the physical layout they give us, we have to identify what our challenges might be,” says co-captain Spaziani. To begin, the engineers start designing on paper what would eventually become a large and complex structure. Then, the team uses a structural analysis program—RISA 3D—to plot coordinates, plan dimensions, and “connect the dots” for several different hypothetical designs. The team specifies the exact dimensions for individual parts and plots so that when the steel is delivered they can start cutting and welding pieces right away. All welding and construction is completed in the machine shop at the Virginia Tech Ware Lab. The team was also able to practice construction in the basement of Christiansburg's Fieldstone United Methodist Church thanks to the organizational efforts of Kara Lattimer, one of the team's advisors out of the civil engineering department.

In last year's competition at George Washington University, Virginia Tech's team came in a frustrating fourth place—only the top three teams move on to Nationals. With funding from Virginia Tech's Ware Lab, as well as the American Institute of Steel

Construction (AISC), Skanska, and STV Group Inc., this year's team hoped to top last year's performance.

When asked what aspects the team wanted to improve upon and execute differently this year, the captains were in resounding agreement: construction method, not design, had been their downfall. The plotting and number crunching leading up to the competition was nearly flawless, but when the time came to assemble the pieces, the team couldn't execute the method they had practiced. This year, however, the team planned to learn from the mistakes of years past and dominate the competition. Spaziani summed up their strategy when he said, "You need to design something you can actually build."

Come competition time, the VT engineering students did, in fact, design and build a wonderful bridge. The team came in Second Place, thus securing a place in Nationals. Before their turn on the day of the competition, the captains had the opportunity to meet with judges to ask any final questions and discuss weight placement. Their first step upon entering the strictly designated building area was to organize their tools and set out their pieces. After a simple "3, 2, 1, go!" from the judges, the team set to work. There were 4 dropped nuts, which added 1 minute to their final time, as well as 4 loose bolt penalties and a boundary infraction. Despite these minor violations, the team completed construction in 20 minutes, 28 seconds (25 minutes, 28 seconds after penalties), which won them First Place in the timing category.

The captains are very pleased with the outcome, stating that everything they practiced came together perfectly during the competition. Of course, none of this would be possible without their faculty advisors and lab managers: Dr. Paolo Scardina, Dr. Matthew Hebdon, and Dewey Spangler to whom they expressed gratitude.

Nationals are next for this team, which will take place at Oregon State University on May 26 and 27, 2017 including 45 teams from across the country. Teams have the option to completely redesign their bridges, but VT's engineers are happy with what they've built. They will only be making a few small changes to their design such as connection types and size of the spindling members.

These civil engineering students are ready to set off across the country to make their school proud. "We're going to Nationals and representing Virginia Tech against all the other schools, I think that's pretty exciting!" says co-captain Laura Wild. The team knows that Nationals will pose a greater challenge, but they hope to cross that bridge with ease.