Students calculate Wallenda's highwire math. Answer: more questions

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Nik Wallenda walks a tightrope across the Chicago River from Marina City to the Leo Burnett Building in Chicago, Nov. 2, 2014. Photo: Brian Cassella/ Chicago Tribune/ TNS

CHICAGO — Millions watched on television last Sunday as Nik Wallenda set the world record for highest incline tightrope walk in Chicago. He walked across a wire strung between Marina City's west tower and the Leo Burnett Building, about 50 stories above the ground. Not only that, the wire sloped upward at a 19-degree angle.

Then a class of 10th- and 11th-grade math students at Hinsdale South High School in Darien, Illinois, took a closer look. The numbers didn't seem to add up.

Show Your Work

The mystery began Monday when math teacher Linda Korbus gave the class what she considered to be a fun assignment — figuring out how the Wallenda team had calculated the incline of the tightrope.

The students used dimensions supplied by the Discovery Channel, which sponsored Wallenda's walk. They pulled out their protractors, compasses and rulers and got to work on the trigonometry to try to figure out how steep Wallenda's wire was.

They reduced the problem to the kind of question you might see on the SAT. If Discovery's height of Marina City was 588 feet, the height of the Leo Burnett Building was 671 feet, and Wallenda walked a total of 454 feet, what was the incline?

The answer: 10.5 degrees, not 19 degrees.

"I was expecting the grand reveal of 19 degrees, since professional engineers had worked on this. When it came out lower, I couldn't believe it," said Korbus, who immediately pulled out her own pencil to do the math. "Using the numbers they gave us, it just couldn't be true," she added, referring to the official estimate.

The Numbers Were Puzzling

The students and the teacher were puzzled. Perhaps Wallenda had landed on an elevated platform on top of the roof, the students guessed, or maybe the buildings' dimensions or the length of the walk were reported incorrectly by the Discovery Channel.

As it turned out, no one was wrong. There was one thing that Korbus' math class did not consider: tightropes are not straight. Thanks to gravity, they dip in the middle. This means that the steepness of the wire varied as Wallenda made his way across, the wire became steeper on the second half of his walk.

Another factor the students didn't consider was that stabilizer wires were attached to the wire to hold it in place. On Wallenda's tightrope, there were 18 pairs of stabilizer wires running from the tightrope to concrete barriers on the ground. These smaller wires kept the high wire from swinging wildly as Wallenda made his trek across. They also pulled the center down, making the second half of the walk steeper.

"We don't have it simply suspended between two points," explained Mike Troffer, Wallenda's uncle and chief engineer. "The stabilizers pull down on the rope, and the bend becomes steeper," he added.

Final Adjustments Swayed The Incline

While the city of Chicago gave Wallenda and his team the freedom to rig the wire as they saw fit, there were restrictions put in place by the owners of Marina City and the Leo Burnett Building, the two buildings that Wallenda walked between.

On Marina City, the wire was tied to existing steel bolts that used to anchor television towers. On the other side, the wire was tied to a steel beam that already was in place on the Leo Burnett Building.

When designing the tightrope, Troffer said he figured out how tight he could make the wire without breaking the anchors. When Wallenda inspected the tightrope hours before his walk, however, he wanted it to be tighter.

To tighten the main wire, they tightened the stabilizers, pulling the center of the wire downward and increasing the steepness of the second half. What originally would be a 16-degree incline thus became a 19-degree incline, Troffer said.

"Nik got out there to check and he was not pleased with how tight some of the stabilizers were," Troffer said. "He corrected it, but the consequence was that it pulled harder on the rope and it bent more and more."

This last-minute adjustment made the wire even more curved, adding to the complication of calculating its steepness. The angle of the wire changed depending on where on the wire you looked. The estimate that Korbus' students determined — 10.5 degrees — was based on the assumption that the wire was a straight line.

A representative from Guinness World Records was on the roof as Wallenda took the walk, but no one from the record-keeping group could be reached for a comment on the incline. In addition to setting a world record for the highest incline tightrope walk, Wallenda also set a world record for the highest blindfolded tightrope walk.

Korbus said her students will go back to the drawing board and delve further into the math.