

The World Through My Mathematical Lens

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The Steepest Ride A Mathematical View from Stoos

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When I have some free time, I love hiking in the Swiss mountains. One of my recent adventures with friends took us to Stoos, where we hiked all the way up to the stunning Fronalpstock. The views were breathtaking, and the hike itself was unforgettable.

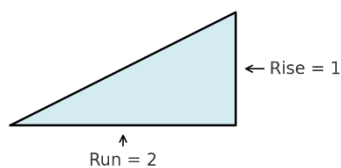
From there, we hiked down the Fronalp Trail, a 4.5 km path that shares the story of Stoos's alpine herdsman. Along nine themed stations, we explored their traditions and rituals. A wooden ball became our playful companion, rolling through balancing games, ball tracks, and resting spots cleverly built into the landscape.

But before all that, what really caught my attention was the first cable car, the Stoosbahn, known as the **steepest funicular** in the world. They say it has a **gradient of 110%**, which corresponds to an angle of 47.73° . But what does that actually mean? How can something be more than 100% steep? That's what I will try to explain in the next section – through a mathematical lens.

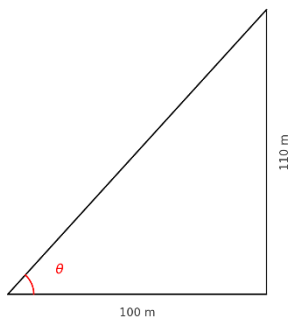
Gradient (slope)

In mathematics, the gradient is a way to describe how steep a slope is. It is defined as the ratio of the vertical *rise* to the horizontal *run*.

For example, if a path goes up 1 meter for every 2 meters forward, its gradient is $1 \div 2 = 0.5$, or expressed as a percentage 50%. A gradient of 100% means the rise and run are equal. Anything above 100% means it's even steeper than that!



How can we picture a **110% slope**? Since it's more than 100%, the **rise is greater than the run**. Imagine a slope where you go **more up than forward**. That's what a **110% gradient** means. For example, for every **100 meters** you move horizontally, you climb **110 meters** vertically.



Only at the steepest section of the Stoosbahn a gradient of 110% is measured, and it isn't that steep for the entire journey up.



Technical details

Steepest Section:

110%, 47.73 degrees

Length:

1740 m

Height difference:

744 m



Passenger Capacity:

1500 passengers per hour.

Speed:

10 meters per second (36 km/h).

Journey Time:

4 minutes

Vehicles:

2, with four rotating cylinders each

The funicular features a level compensation system, ensuring that the cabins remain horizontal even on the steepest slopes.

The angle

Now we can understand what a **110% gradient** really means. But how does this connect to the **47.73° slope**?

Let's imagine the slope as a right-angled triangle: the elevation is **110 m** and the horizontal distance (the run) is **100 m**. Using trigonometry, we can calculate the angle of elevation. Since we know the **opposite side** (110 m) and the **adjacent side** (100 m), we use the tangent function:

$$\tan \theta = \text{opposite} / \text{adjacent} = 110 / 100 = 1.1$$

Now, taking the inverse tangent (or arctangent) gives us:

$$\theta = \tan^{-1} 1.1 \approx 47.7^\circ$$

That's where the 47.7° angle comes from.

As a comparison, if the elevation and the run were the same (say 100 m up and 100 m across), then the slope would form a perfect 45° angle.