Actually that is not all that Straight

Believe it or not, a possible answer to the first part of this question is: trigonometry!

The well leaks gas. We know that IF the pipe going down the hold (the 'wellbore') bangs up against the side of that hole, the cement to seal will leave a gap that allows the gas to escape, rise up into the drilling platform, and, you know the rest.

The OptiCem model's results said they need to place 21 centralizers to keep about 360 meters of pipe (the 'casing string') straight (a "1,192-foot section"). The case says "Morel had gotten 3D profile information on the well hole, which indicated that it was actually very straight: 6/10ths of a degree off of vertical." All you accountants should have immediately tried to quantify what this means. It actually means it's not as straight as it needs to be.

If you assume the beginning and end of the 360 meter section are fixed points, that means that with 21 centralizers there are a total of 23 fixed points along the run of this pipe (2 end points plus 21 centralizers) that means there are 22 spaces between all the points. That's about 16 meters each. The pipe will drop straight down for half that distance until a centralizer pulls it back to center. This means that the pipe will drop 8 meters before being corrected. So how off center will it be? That's the trig problem. If I were cruel, I would have assigned this to you as discussion… Maybe next term.

The *tangent* of 6/10ths of a degree (0.01047) times the distance (8 meters) is the answer (8.5 centimeters). So the pipe cannot be more than 8.5 centimeters off. Let's assume a 100% margin of error. Let's assume the pipe can be 17 centimeters off (8.5 times 2) before it bangs up against the side of the drill hole and creates a gas leak.

If we only put in six centralizers and assume the beginning and end points are fixed we have eight centralized points and seven spaces between them. So 360 meters / 7 equals 51.4 meters. Again, the pipe only falls straight down for half the distance before being pulled back to center with a centralizer. So that's 25.7 meters. How much off center will it be?

The tangent of 6/10ths of a degree (0.01047) times the distance (25.7 meters) is almost 26 centimeters. Did I not I say in the previous paragraph that even allowing for a 100% margin of error, this pipe could not be more than 17 centimeters off and we'll be almost 26 centimeters off.

If they did not trust the fancy new-fangled OptiCem program, how about some old-fashioned trig. Which we've understood for 1000s of years! If this was too much work to figure out, it is way easier than explaining why the project killed 11, destroyed 1000s of kilometres of coastline, destroyed thousands of peoples livelihoods and cost the company billions.

Yes, this is how I was taught Trig Functions

Sine	**Cosine**	***Tangent***
Oscar	A	Old
Has	Harry	Ass
Opposite	Adjacent	Opposite
Hypotenuse	Hypotenuse	Adjacent

A Centralizer