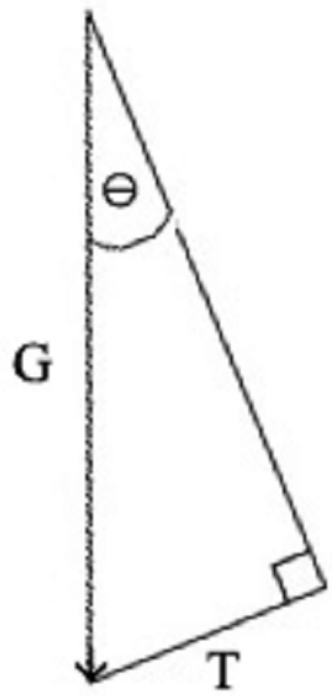
Geo Tech Note:

Acceleration Effects on Tilt Measurements

A tilt sensor at rest experiences a constant gravitational acceleration G. When the sensor is tilted (rotated) by an angle θ from its starting position, it senses this tilt as the acceleration component T, where $T = G\sin\theta$ (see diagram below). For small angles measured in radians, $\sin\theta = \theta$ and we can write $T = G\theta$

If the sensor receives a horizontal acceleration of magnitude T instead of a tilt, it responds the same way that it responds to an actual tilt. An acceleration T of one milliG (10-3 x 980 cm/sec2) is equivalent to a tilt T of one milliradian (10-3 radian = 0.0573 degree). Within the passband of the tilt sensor, both signals will be measured with the same amplitude.



For small angles, tilt and horizontal acceleration are directly proportional: Tilt in radians = horizontal acceleration in G's. At 0.25 radian (14.32 degrees) the error grows to about 1 percent. At larger angles the accurate proportionality is $T = G\sin\theta$

The following methods can be used to differentiate tilts from horizontal accelerations when both are present:

1. Accelerations at higher frequencies than the tilt signals of interest are easily removed by low-pass filtering.*

2. Perform an analysis to determine if acceleration amplitudes are significantly lower than tilt amplitudes in your application. If so, you may be able to safely ignore the former, even if both occur at the same frequencies.

Because of their small size, excellent performance and low cost, Jewell Instruments tiltmeters and clinometers provide cost-effective solutions in many applications where accelerations are present.

* Our analog Geo tiltmeters are all supplied with an RC or 2-pole Butterworth low-pass filter. In addition, our 900-Series analog inclinometers are available with viscously damped sensors that remove high frequencies. Digital low-pass filtering is included with our digital Geo tiltmeters.

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