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AN OPTICAL TILTMETER

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Abstract. One of the most efficient methods of great earthquakes prediction is the one based on measurements of the earth surface inclination. The efficiency of this forerunner consists in the direct connection between inclination and focal mechanisms occuring previously the main shock. Tectonic plates subduction produces rocks deformation which generates very small inclinations of the earth surface.

Key words: disturbances, borehole, floor, tiltmeter

1. INTRODUCTION

The major difficulty to be solved consists in the elimination of the disturbances. This is difficult, as the disturbance period is a long one, compared to the period of inclination and the level of the inclination is very small. For this reason is quite hard to separate these two signals. The disturbances may be: the temperature, the pressure, the water level. For this reason, the first step, a very important one, is to localize the best location of the clinometer observatory (Kaariainen J. and Ruotsalainen H. [1])

2. TILTMETER TYPES

2.1 CLASSIFICATION.

1.Borehole type
2.Floor type (placed on the surface)

Borehole tiltmeters are in fact pendulum using as reference the vertical of the place so, finally, the gravitational field (the field vector) is directionally very stable.

Floor tiltmeters (“long baseline” (pipe line)) are usually used.

LONG BASELINE. This type of tiltmeter is principially composed of two vessels connected through a pipe containing a liquid (Tsumura K [2]).
Each vessel contains one sensor located inside. This type of tiltmeter is a differential one.
View its important length (even two hundred meters), it is strictly necessary to consider his bending (Allen R.V, Wood M.D, Mortensen C.E [3]).

2.2 OPTICAL TILTMETER. Being of considerable lenghth, “long baselines” are affected by thermal dilatations, and bending, is therefore necessary to imagine a different tiltmeter type, unaffected by the environment conditions.

I have imaginated an optical tiltmeter, easily handled, settle and movable. As a first iteration, this tiltmeter may be located at the Seismological Observatory “MUNTELE ROSU”, in the cave specially built for the seismometers.

This Observatory is located in the mountains, at 1360m altitude. The artifficial noise is very, very small, and inside the cave the temperature is quasi-constant. The only real problem are the winds, exceptionnally strong during the winter, but the noise produced shows a small period of oscillation, compared to the ***useful*** signal, represented by the inclination. Subsequently, the noise can be easily rejected, both mechanically and/or electronically.

Fig.1 show the Observatory

Fig. 2 show the entrance in the cave

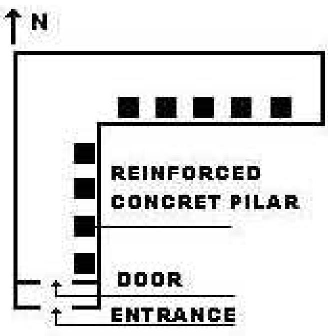

Fig.3 show the concrete pilar. On the concrete pilar are fixed the sensors.

Inside of the cave:

Fig.4 show inside of the cave on direction S-N

Fig.5 show inside of the cave on direction N-S

Fig.6 show inside of the cave on direction E-W

Fig.7 show inside of the cave on direction W-E

The scheme of the tiltmeter.

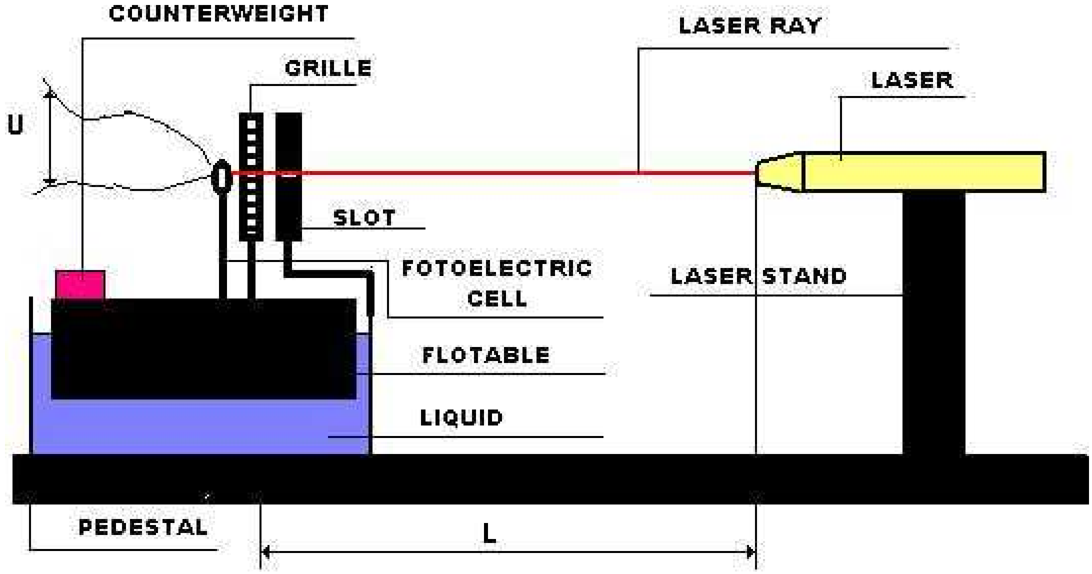

Fig.8 show the scheme of the tiltmeter.

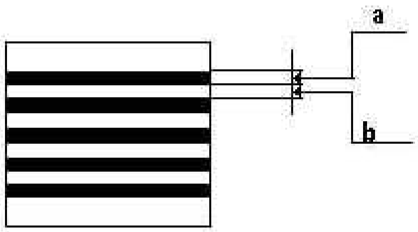

Fig. 9 show the optical array.

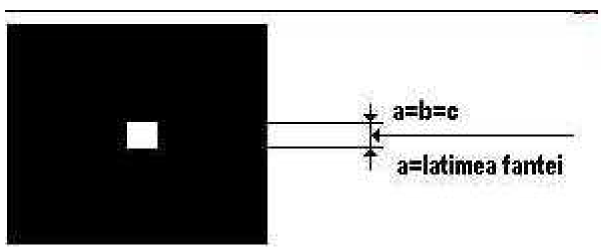

Fig.10 show the slot.

2.3 WORKING

When a tilt occurs, the flotable rests horizontal. The pedestal, the vessel containing the liquid, the slot, the laser stand and the laser set tilt. The slot position relative to the laser remains the same, therefore, the laser ray constantly hits upon the slot, even when the pedestal is tilting, but the slot and optical array relative positions are modified. The laser beam can light up either the opaque area or the transparent area of the array. Subsequently, the photoelectric cell does or does not generate an electric signal.

3. EXPERIMENTAL CONCLUSIONS

1. The resolution is a function of lines width on the array.
2. If the laser stand, the vessel, the slot stand and the array stand are made of glass or invar, so thermal dilatations are negligible.

The laser beam replaces the "long baseline" pipe.

3. The beam intensity is not important.
I have used a small and inexpensive pointer laser (red light).
As a photocell, I have used an ordinary red LED, perfectly performant. It generates 500mV, approx. This voltage level can be very easily processed.