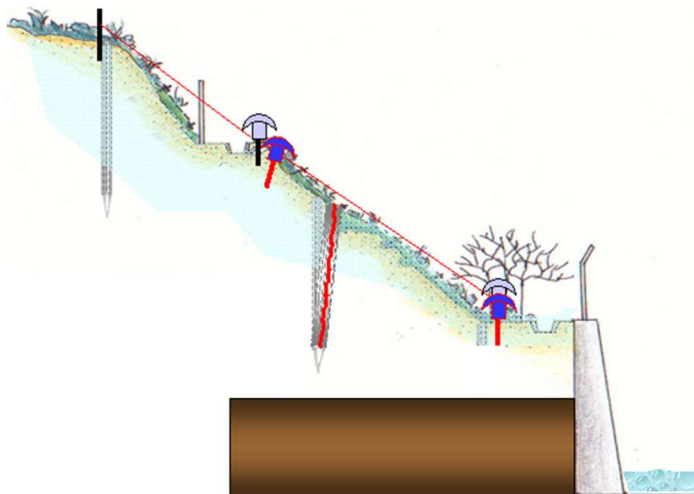
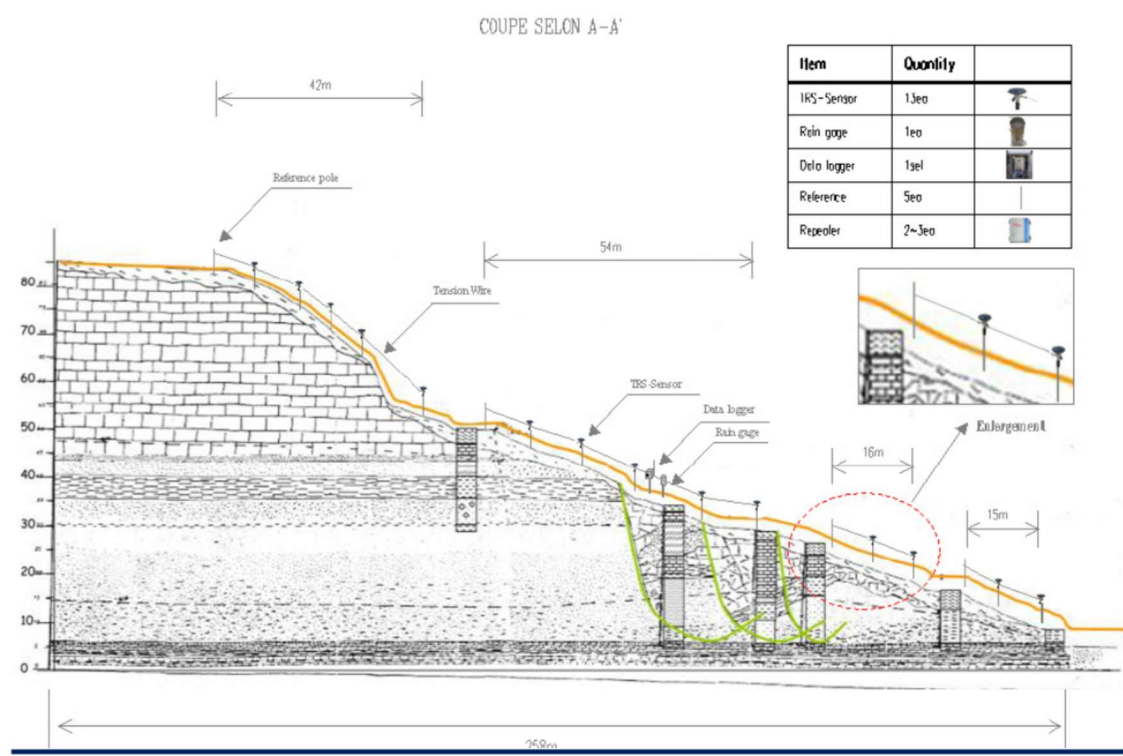


Geotechnical beacons

Basically, geotechnical measurements are the tools used to monitor natural sites and civilian engineering structures. Measurements are performed, for engineering structure, before building on and in the soil to ensure healthy life of the bridge, dam and so on. Then on natural sites they are used to control the evolution of underground layer and on structures to monitor their health.

Several sensors can be used and combined to provide the information of interest.

Displacement is, probably, one of the first parameter one want to measure, displacement may lead to weakening.



For instance, settlement on underground layers may create weakness zones and load applied upstream will induce possible slope collapsing.

Settlement along with displacement and angle will give deformation of the ground.

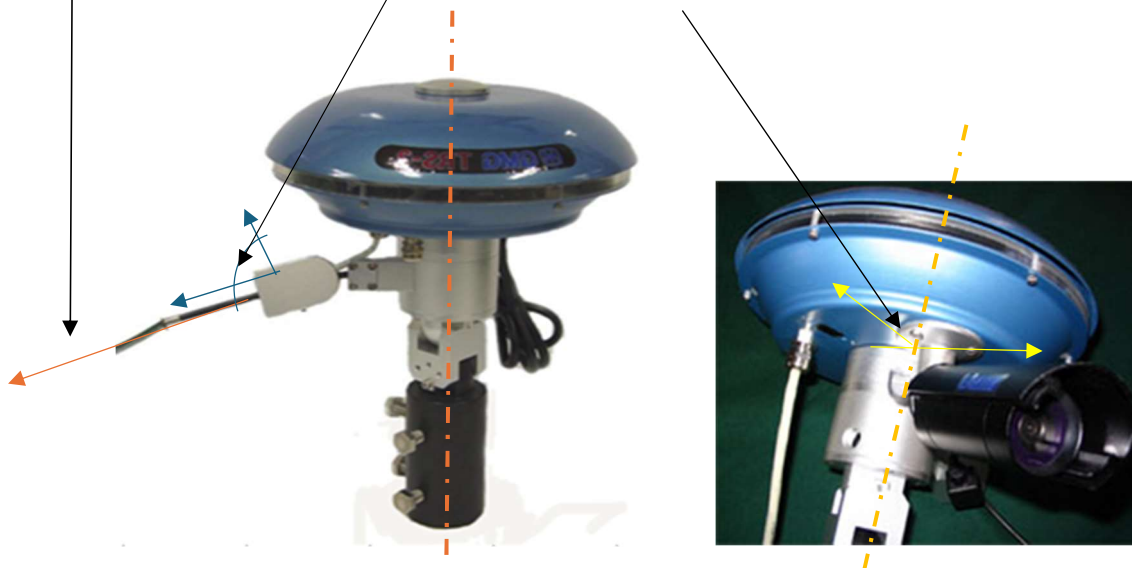
Fracturing lines may be determined by geologists and measurements smartly implemented will provide data to help preventing disaster.

Above illustration shows a cascade of beacons implemented on a slope.

These beacons measurements, along with meteorological data will facilitate collapsing point prediction.

Beacon

As an example, following beacon measures displacement using a potentiometric instrument. A wire spooled around the axis of the potentiometer will be attached to a cable providing accurate **linear displacement** measurement. Angle of this displacement will help measuring settlement. The out of vertical positioning is determined by two **inclinometers**.



Initial position of the beacon will be determined by a reference pole upstream. There is a possibility to add a GPS in the head of the beacon.



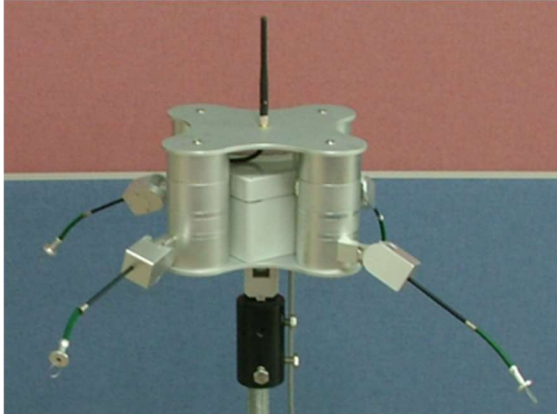
Moving antenna



Stand-alone beacon

The problem, if the beacon takes an angle, will be to keep GPS positioning accuracy. In such case, the flat disk supporting GPS antenna can be kept perpendicular to the ground using inclinometers and a mechanism.

This idea generated the concept of a stand alone beacon using only inclinometers and GPS.



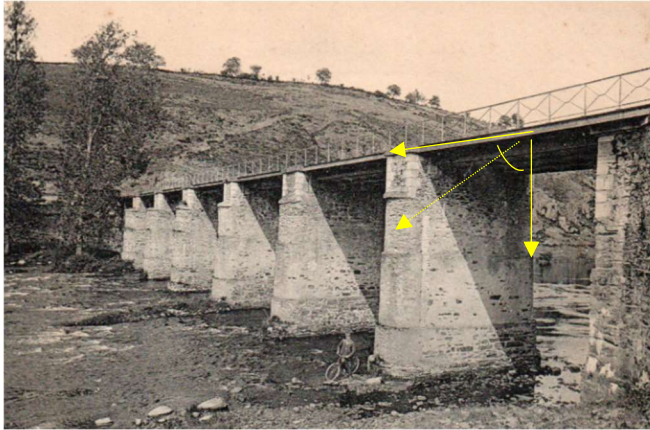
For rock falls, the idea of the beacon is to sense in different directions, like a spider. Then, the instrument will use simultaneously several displacement sensors along with associated tilt of the displacement and one single vertical positioning.

Each displacement sensor will be attached to part of a net covering rocks pile up.

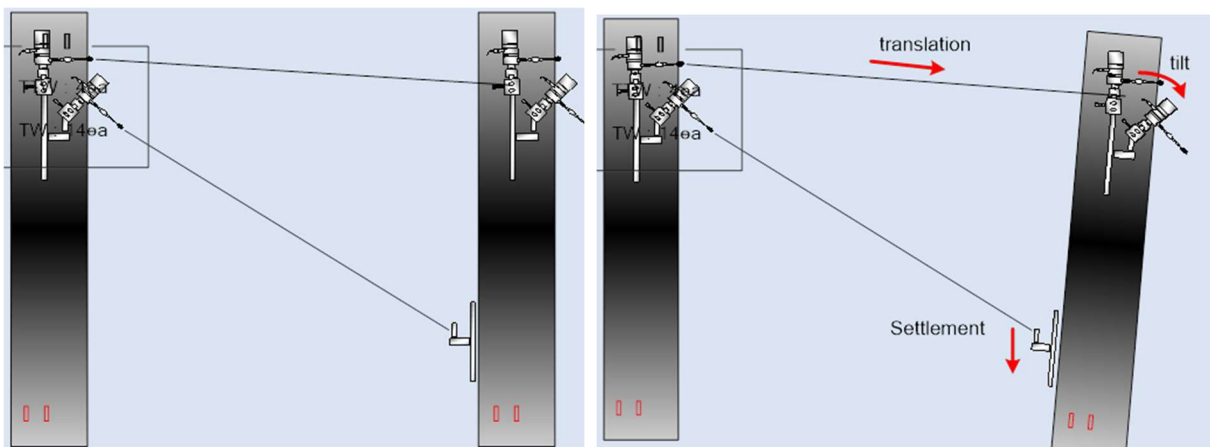


In all cases, video camera can be added and radio transmission can fit each beacon of a cascade or stand-alone units.

If beacons can be used for natural sites, it may, as well applies to engineering structures as bridges.



Bridges piers can be monitored the same way.



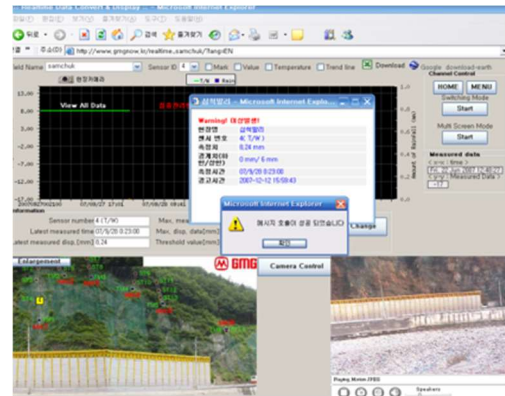
Data acquisition network

Connecting sensors separately or one to another physically with cables can be risky. Cable damages would generate expensive technical operations. The choice of radio transmission is therefore a smart option. Each beacon can be connected in a network to nodes, then transmitted to data acquisition system.



Data acquisition device may be installed in a control room or just be autonomous near by the site. In such case a communication link must be established in between site and distant control location.

This opens the door to Real Time Monitoring. Data transmitted through internet may be used in a control room where ever in the country but also shared with selected people as expert or emergency teams.



The usual problem with the use of internet is the suppliers are usually trying to provide their own proprietary cloud system.

Most of the users do not want any third party getting an access to their data.

This is why it is always interesting to use a remote control software as Splashtop, Teamviewer or Anydesk. Then the measurement system can be monitored easily with any usual processing software.

In addition, access to part of the data can be allowed under condition of security key and decisions can be controlled directly as well by selected operators.



In addition to geotechnical data, meteorological station and camera networks can feed the user data base. After computing, on determination of thresholds some decisions can, be made.



Automatic or manual reaction can be started : horn, lights, safety gates, calling operators or rescue teams ...

