PSD applications in Civil Engineering

Recent tragic events have brought into focus the instability of the earth-crust we live on. Designing and building earthquake-resistant structures is one important way of creating safer environment.

The SiTek PSD can be a helpful tool for this kind of civil engineering. PSD technology is well suited for instrumentation that can remotely and contactless perform static and dynamic displacement measurements of building structures.

A pioneer in this field is Robert Jenzer, who twenty years ago developed a measurement method of testing in civil engineering. The result was the OCULUS system sold by Jenzer AG in the late 70's.
This instrument was intended for remote measurement (up to 300m) of two-dimensional displacement.

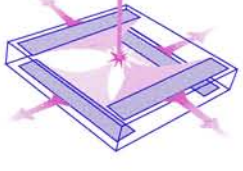
That this instrument was developed in Switzerland is no coincidence. This country is for the most part a mountainous country. Approximately 50% of the land is covered by the Alps and lies more than 1000m above sea level. It is therefore not surprising that many tunnels and bridges are necessary in the building of Switzerland's roads and railways. The corresponding Swiss standard specifies that loading tests are to be performed on all bridges having a span greater than 20m. The OCULUS was designed to facilitate these measurements by remotely probing load-induced displacements of reinforced and prestressed concrete structures.

The OCULUS system

The OCULUS system consists of
- a laser emitter
- a reception camera with a SiTek PSD
- an electronic signal processing unit.

The laser source serves as the measuring basis for the point to be measured. The laser beam is aimed at the PSD receiver and any minute movement of he receiver module relative to the stationary laser beam will be recorded.

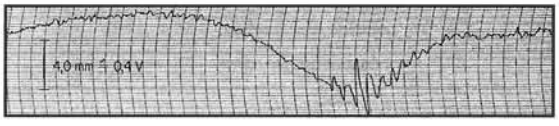
Measurements are taken at a rate of 8000 Hz and the measuring resolution is 0,2% of the measuring range. Since the laser system generates its own measurement basis optically, it can be installed practically independently of the topographical conditions. In many cases it affords the only opportunity to measure the dynamic diplacement at the characteristic point of a structure.



Some typical applications

Bridge flexure measurement

In the summer of 1979 the Swiss Federal Laboratory for Materials Testing and Research conducted static and dynamic load tests on the Niederhofen Reuss Bridge (national highway N2). The JENZER OCULUS proved in this case to be a valuable aid for quick, uncomplicated measurements at different locations.

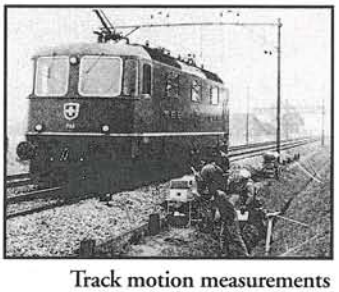


The bridge flexure resulting from a 16 tons truck

During the building of the Ganter Bridge over the Simplon pass the fundamental frequencies and damping of the free-standing support piers needed to be determined. Using conventional methods for these measurements would have been impossible and instead the OCULUS was used.

Vibration measurements of bridge supports

Here the system was set up to measure the frequency and damping of a 148 m high free-standing pier with cantilevered beams on both sides of the pier but before connecting them with the corresponding cantilever on the adjacent pier. The receiver was mounted at the pier head and transmitter was positioned 220 meters away on the opposite slope along the old Simplon road. The pier and its cantilevers was pulled from its neutral position by means of jacks and wire cables which deflected the support 40 mm. The free oscillatory process was initiated by cutting the cables. The test record showed that the fundamental frequency was 0.14 Hz with a damping of 4 minutes.



Track motion measurements

Another popular application suitable for the OCULUS is ***measurement of railway track motion*** under load. Such measurements were for example conducted during reconstruction of the Bilten-Reichenburg railway line in Switzerland. Test measurements concentrated on horizontal and vertical motion as well as the vibration frequency. A Re4/4 II locomotive (mass 80 tonnes) travelling over the instrumentation point at speeds up to 140km/h was used for the load test.