

# REVAMPING OF VIBRATING WIRE INSTRUMENTS OF THE EXISTING DAM

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## ABSTRACT

*This paper deals with the revival of non-working Vibrating Wire instruments which are meant for measurement of various structural parameters. The Central Water & Power Research Station (CWPRS), Pune, India has taken a pivotal role in revival work of these instruments. At the Dam site of Ukai Dam, Gujarat, India, the Data Collection has been stopped since 1995, due to failure of the Read Out Unit(transmitter), which is of Valve Version, an outdated instrument for acquiring the Data of the embedded instruments. The revival work includes total revamping of the Data of Inaccessible instruments installed during 70's. The data thus obtained are verified and analysed. This can be used for the Health Monitoring Purpose of the Structure.*

## 1. INTRODUCTION

The instrumentation installed in dam is used for evaluating the performance of the dam structure during construction as well as during the operational stage. It is an important integral component for monitoring the health of a Dam Structure. The basic purpose of instrumentation is to provide input data, analyze these data (usually include pore pressure, seepage, dynamic loads, stress and strain, uplift pressure, temperature, displacements in all directions, water level etc.) by an expert and to predict any hazard if any, so that timely remedial measures can be taken.

Ukai Dam is a multipurpose scheme, constructed across the Tapi River during 1964 -1972, in Surat district and is one of the largest reservoirs in Gujarat. The earth-cum-masonry dam is constructed for irrigation, power generation and flood control purpose. Its embankment wall is 4,927 m long. Its earth dam is 80.77 meters high, whereas the masonry dam is 68.68 meters high. The dam's left bank canal feeds water to an area of 1,522 km<sup>2</sup> and its right canal provides water to 2,275 km<sup>2</sup> of land. There is one mini hydal project (2 x 2.5 MW) at the left bank and a hydroelectric project (4 x 150MW).

For newly constructed dams, modern instrumentation can be applied right from the design stage, but for the existing old Dams, accessing the data of embedded existing instruments to advance digitizing standards becomes very challenging task. This was attempted at Ukai Dam located near Surat, Gujarat and became successful in accessing the data with the newly developed Solid State Read-out unit.

A new read out unit with the solid state device has been developed over a period of 18 months and the data are verified in the site. The verification was possible only due to the availability of old records of Data with the project authorities.

Since the output is in digital form, this can be stored, transmitted, analyzed and interpreted. This is a new beginning in the field of rehabilitation, for revamping of Vibrating Wire sensors.



Figure 1 : Ukai Dam at upstream

## **2. COMPONENTS AND METHODOLOGY**

The read out unit, which is of valve version, has stopped working from 1995 and since then the Instrumentation Data were not accessed. The efforts were made to rectify the read out unit but in vein, due to non availability of the components and supporting technical service documents. The valve version is obsolete as of today.

A new circuit has to be designed and developed on the basis of various catalogues pertaining to the Original Equipment Manufacturer(OEM) and also from different companies.

The embedded sensors are sealed ones however, the connecting wires are of different IR materials like rubber, PVC, etc., which have aging effect and hence the variation in the line resistance. This would result in improper signal handling of both transmission and reception of the signals. The attenuation and the fear of harmonics has to be taken care, which varies from sensor to sensor. This would result in multiple frequencies at the reception and in such cases the scanning process need to be incorporated for excitation. The OEM, M/s.Maihak is not reachable and hence technical support is not available.

Since no spare sensor was available for the R&D work, quite frequent visits were made to the site with the Oscilloscopes, Functional Generator, Amplifiers and PLL circuits to access the correct output data of the instrument.

Utmost care has to be taken while testing the sensor through excitation voltage and signal. Higher frequencies would damage the sensor. Sometimes, at low frequencies, the vibrating wire would produce the 1<sup>st</sup> harmonics which would result in wrong result. The testing was carried out in the lab for many number of occasions with similar sensors. After damaging around six equivalent sensors, we could arrive at the right fabricated similar sensor. This process took nearly 18 months.

## **3. CONCLUSIONS**

With the development of solid state read out unit to access the data of the vibrating wire instruments of 70s technology, many dams which have been instrumented can be revived. This revival has been successful for the instruments of M/s. Maihak Instruments of German make. The confidence level has been increased to take up revival work of accessing Data for any vibrating wire instruments of different bands installed in the structure by other companies also.

Some of the dams which have been instrumented with Maihak made Instruments, the Data can be accessed with the newly developed read out unit. In India, many structures would have been instrumented with this type of Vibrating Wire instruments during 70s. We need to identify with various organisations and the dam owners to revamp. This revival of the existing embedded instruments of the structure, is an achievement in the field of instrumentation towards Safety Evaluation of the Existing Dams.

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## **REFERENCES**

- Von Hans Altmann. 1961; Freiberg research booklet of Maihak Instruments, A 212, Berlin, Mai.,  
Porfirio V. Guerrero, Vicente H. K. M. and Agustín de Gortari . 2016 ; Comparison of Excitement Methods of Vibrant Wire Sensors, African Journal of Physics, ISSN: 9821-5213 Vol. 3 (4), pp. 078-080.