Abstract

Title: Bridges instrumentation against local erosion in pillars. A case application (Besós river)
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The document was written as a master thesis for the Geological Engineering Degree. Its origin lies in RENFE worries about bridge safety. About 50% of bridge failures connected with water courses is due to river basin erosion.

The research has two parts. The first one mentions the theoretical basis of basin erosion and has a bibliographic review of the instrumentation methods in bridge pillars around the world. The second one introduces an instrumentation proposal, using the experiences got in the forward sections and studying the specific characteristics of the location, with the aim of being a pattern for the instrumentation of similar bridges.

There are five main measurements are derived:

**Sounding rod:** It consists of a vertical bar, fixed by a structure, which can vertically go down. By measuring that drop can be obtained the erosion produced in the support point of the bar with the river bed.

**Magnetic sliding collar devices:** It consists of a ground stuck vertical bar, which guides a group of magnetic rings, that will lie on the river bed bottom. Inside the bar, some sensors which are able to determinate the ring position are installed in an equidistant. The erosion level will be fixed after knowing their position.

**Sonic fathometer:** It is based on the acoustic wave emission against the river bed and in the time measurement until the echo is received. By knowing the wave propagation speed in the water, the distance until the river bed can be calculated. That distance will grow when the erosion increases.
**Piezoelectric film sensors:** These kinds of sensors are sensitive to the vibrations caused by the water wave. If they are installed on a vertical bar situated in front of the pillar river and if it is possible to detect which sensors are shaken by the wave, the magnitude of the erosion will be known.

**Buried emitters or sensors:** They consist of identified sensors, which are buried in front of the bridge pillar. When the erosion begins, they are diged up and then they start to emit a signal, which can be detected by a data office.

Each measure system has advantages and drawbacks, which are described in detail in every section. Their importance’s is useful to choose which instruments to install in each case.

The knowledge and experience level reached when the research was taken was one of the reasons to choose between the magnetic collar and the sonar is, in the instrumentation described in the second part of the document. Regarding to the rest of the instruments, either they were not convenient for the area or they are still under research, which is not advisable to be installed in a testing field.

The instrumentation suggested for a testing field is based on an hybrid system, which consists of magnetic sliding collar and sonic fathometer. It has been checked that they complement each other very well. The measurement is done in a different way, although the results should be similar. If not, this complementation would allow try to obtain the reason for this difference.

The document suggests that the instruments should be installed inside a concrete frame ready to stand any avenue. Moreover, a PVC box will hold the electronic systems and will protect them against humidity.