COST Action TU1402

"Quantifying the Value of Structural Health Monitoring"

1st Workshop - Technical University of Denmark - 4th and 5th May 2015

Task 4: Case Studies Portfolio

Healh monitoring of earthen embankments (dikes and levees)

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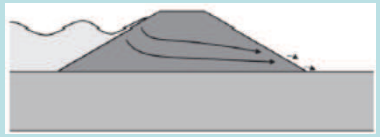
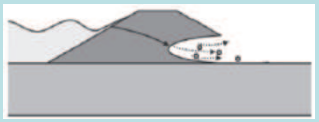
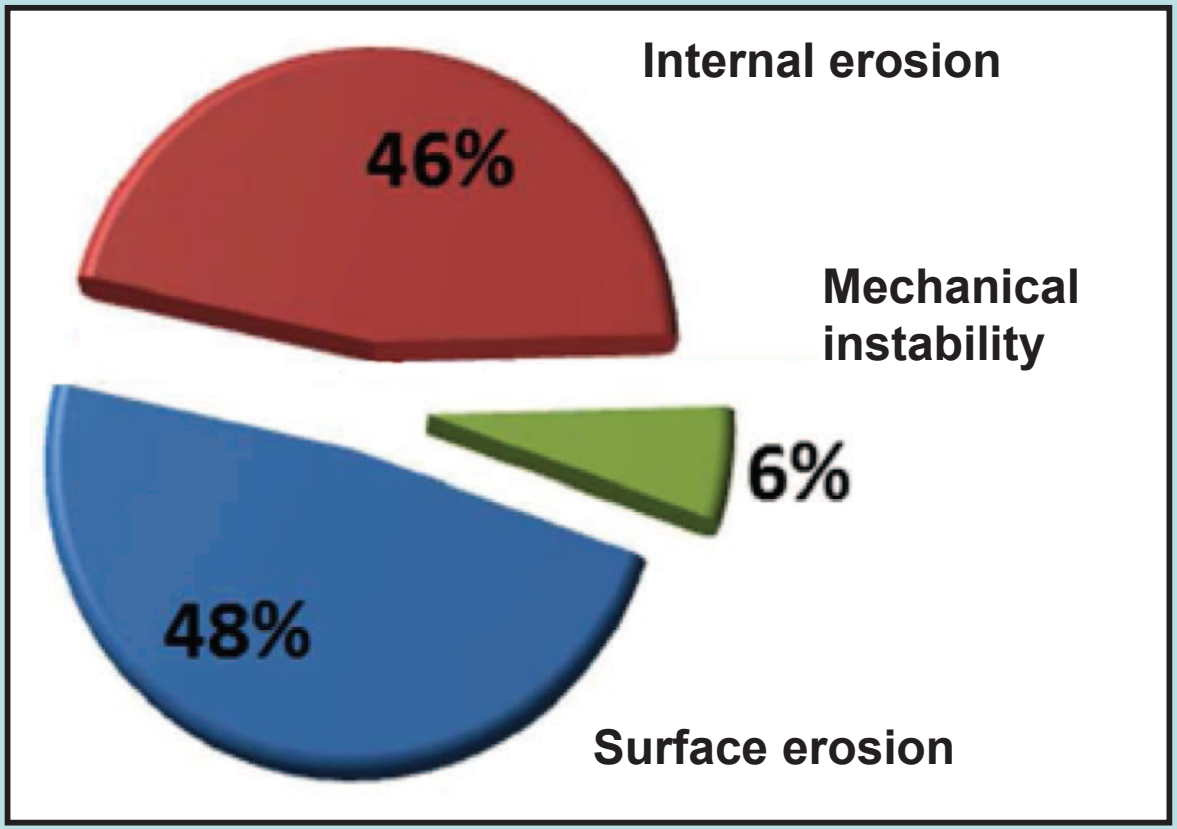
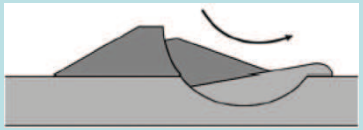
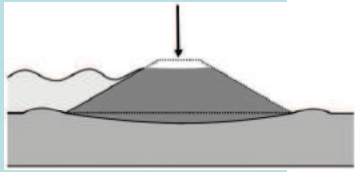
Erosion is the main cause of rupture of dikes and levees

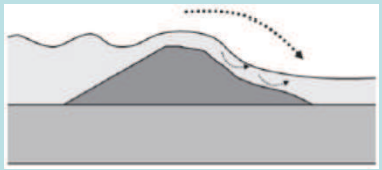












Healh monitoring of earthen embankments (dikes and levees)

Dikes and levees: very long structures (up to several tens of kilometers)

Needs: i) information on long-term behaviour of the structure
↳ preventive maintenance
ii) early warnings in case of extreme loads
↳ real-time safety evaluation

Modern approach: high tech monitoring systems + mechanical models of data interpretation
cost-effective and modular

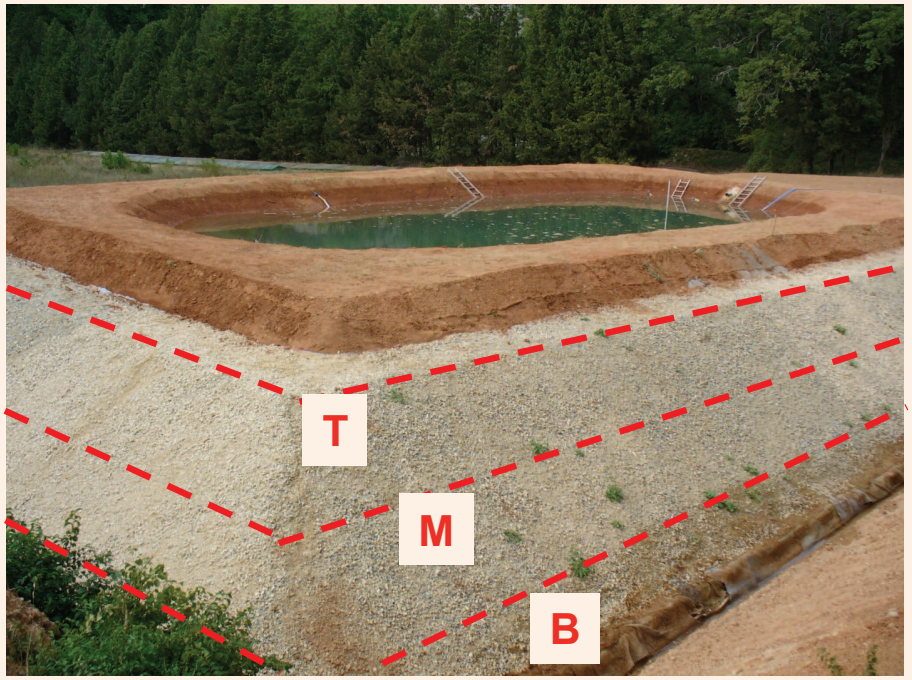
We present here an example of such an approach combining punctual measurements and distributed measurements with fiber optic, providing with time remote measurement every meter.

The link between SHM and structural performance assessment should be discussed in two directions :

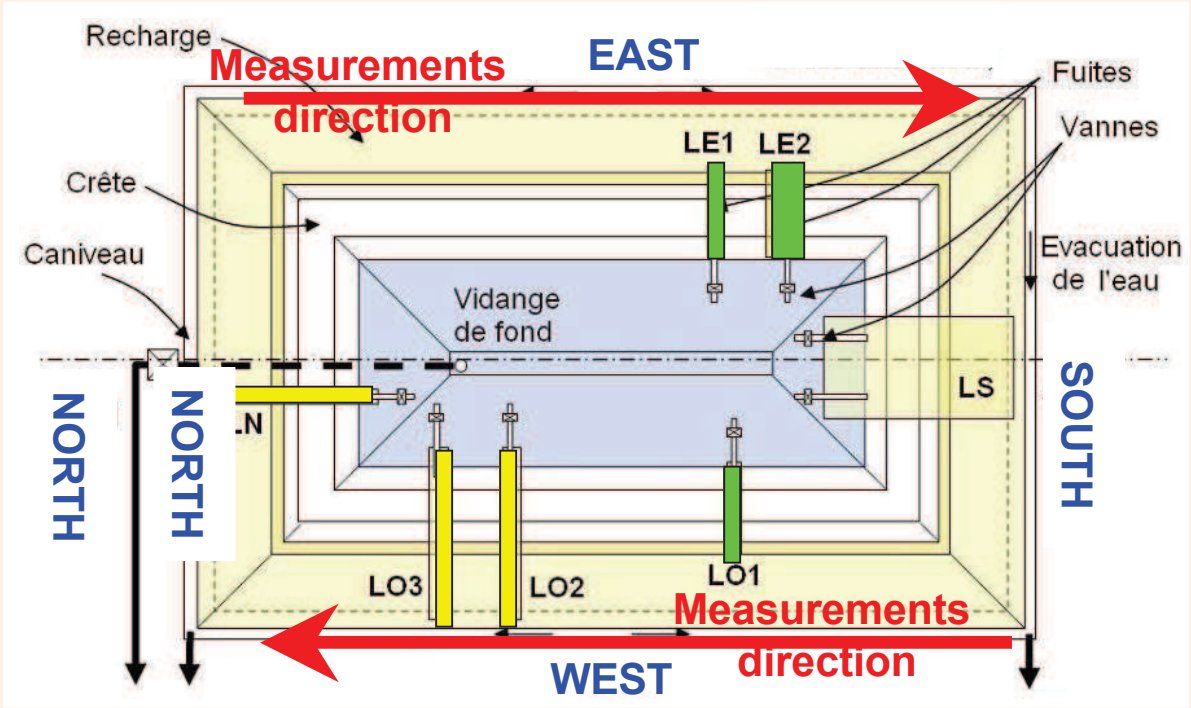
i) thresholds and triggering alarms
ii) long-term behaviour of the structure

We are currently working on two case studies (fluvial dikes)
We will design and install two other systems in 2016 (flood-defence structures)

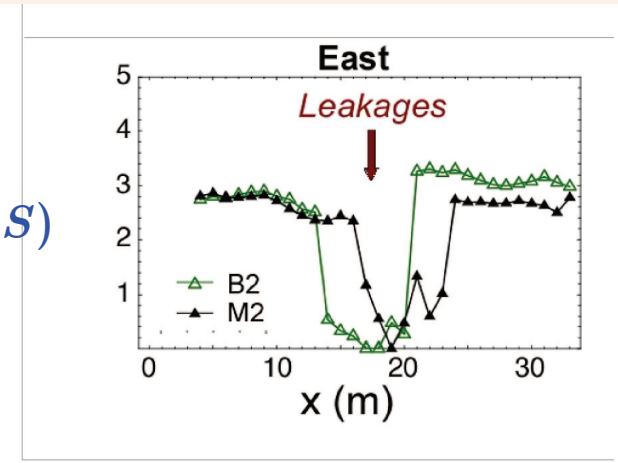
Leaks can be detected by means of horizontal temperature measurement



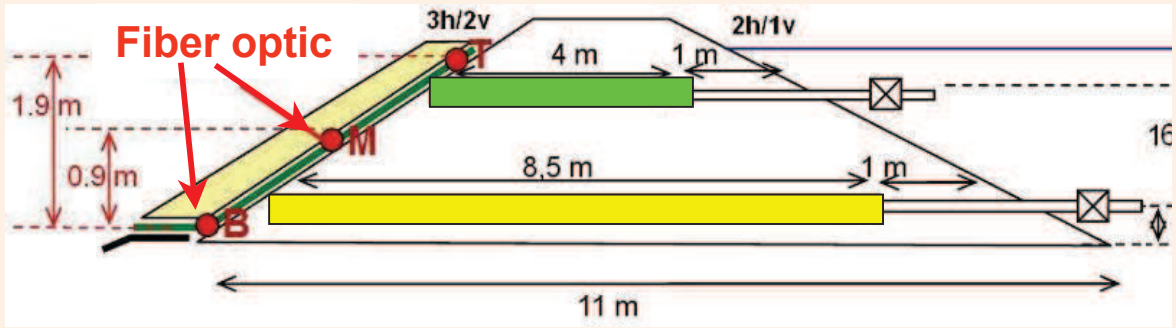
Experimental basin (2003-2008)



$\eta_a(Pe,S)$



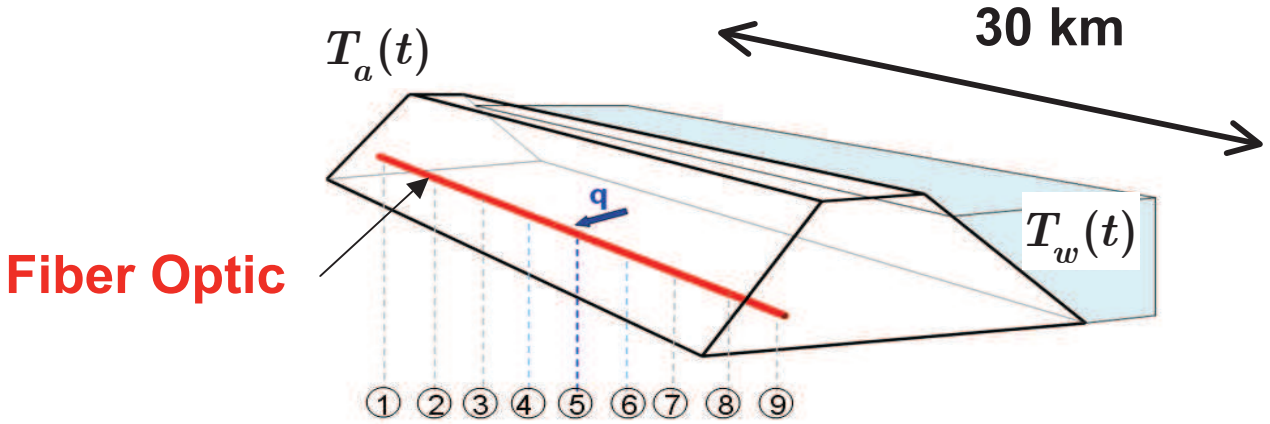
Diffusion time (days)
air effect of the soil temperature



The leakage is detected by the reduction of the air temperature diffusion time

Leaks can be detected by means of horizontal temperature measurement

Horizontal temperature measurements can be obtained on a long distance every meter by means of fiber optic cable (up to tens of km)



Temperature measurement every meter along 20 Miles

Models of interpretation: diffusion/convection equations, impulse response function analysis, Green's function, Finite Element Method

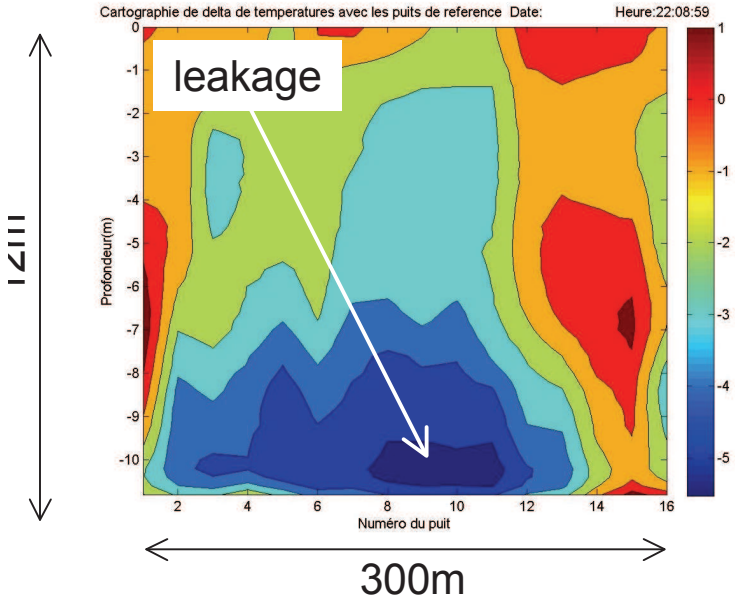
$$T(t,x) = T_0(x) + \underbrace{h_a\left(t,\alpha_a(x),\eta_a(x)\right) * T_a(t)}_{\text{air temperature effect}} + \underbrace{h_w\left(t,\alpha_w(x),\eta_w(x)\right) * T_w(t)}_{\text{water temperature effect}}$$

Seepage velocity can be esimated by means of vertical temperature measurement

Vertical temperature measurements can be obtained localy by means of punctual measurements (probes) or by means of fiber optic cable

Remote monitoring system, real time monitoring

Standalone system with photovoltaic cells



Real time monitoring of the leakage