HOW TO COMBINE ANALOGOUS SEISMOTECTONIC ENVIRONMENT AND THEORETICAL MODELS ?

Case of soft sites:

Views of geotechnical engineers

- **Poor reliability of "attenuation laws for soft sites", because site specific motions are narrow banded and because of the non linear behaviour of soft soils under strong input motions (*see the tremendous differences in amplification factors on soft soils between the main shock and the aftershocks of the Kobe earthquake*).**
- **A more screening criteria of similarity between two site should be used.**
- **Finally responses of different sites would be computed to identify similarities.**

Which combination ?

- **Try to identify a boundary between the soft profile(it can be also a 2D model) and a hard enough surrounding area,**
- **Use the analogous seismotectonic environment for the surrounding area,**
- **Use a theoretical model of the soft profile for computing the site effect.**

HOW TO REDUCE EPISTEMIC UNCERTAINTY ?

- **Probabilistic approach (attenuation relationships for soft site)**

  By introducing a better screening criteria for the similarity of sites

  ***Shear wave velocity* + *depth* + …**

- **Deterministic approach**

  By introducing the statistical dispersion of the profile characteristics

  Stochastic finite elements ? not appropriate for non linear analyses.
  Monte Carlo simulations …

HOW TO IMPROVE THE DESCRIPTION OF SEISMIC INPUT MOTIONS FOR ENGINEERING PURPOSE ?

As a first step

The seismologist community should

- **propose a credible indicator of the damaging capacity of a seismic input motion**
  The damage is measured by a global scale, such as MSK scale.

The engineering community should

- **specify to the community of seismologists what are the key parameters of a seismic input motion that governs its damaging capacity.**
  The damage is measured by engineering criteria, such as cracks width.

as a second step,

Seismologists and engineers should

- **concur on the choice of an appropriate format for the description of seismic input motions adequate for engineering purpose**
  Displacement ? Velocity ? Arias Intensity ? Other ? ...
  Which spectral representation ?

THIS IS THE MATTER FOR COMMON WORKSHOPS OF BOTH COMMUNITIES IN THE COMING YEARS

HOW TO IMPROVE THE USE OF THE SEISMIC INPUT MOTION ?

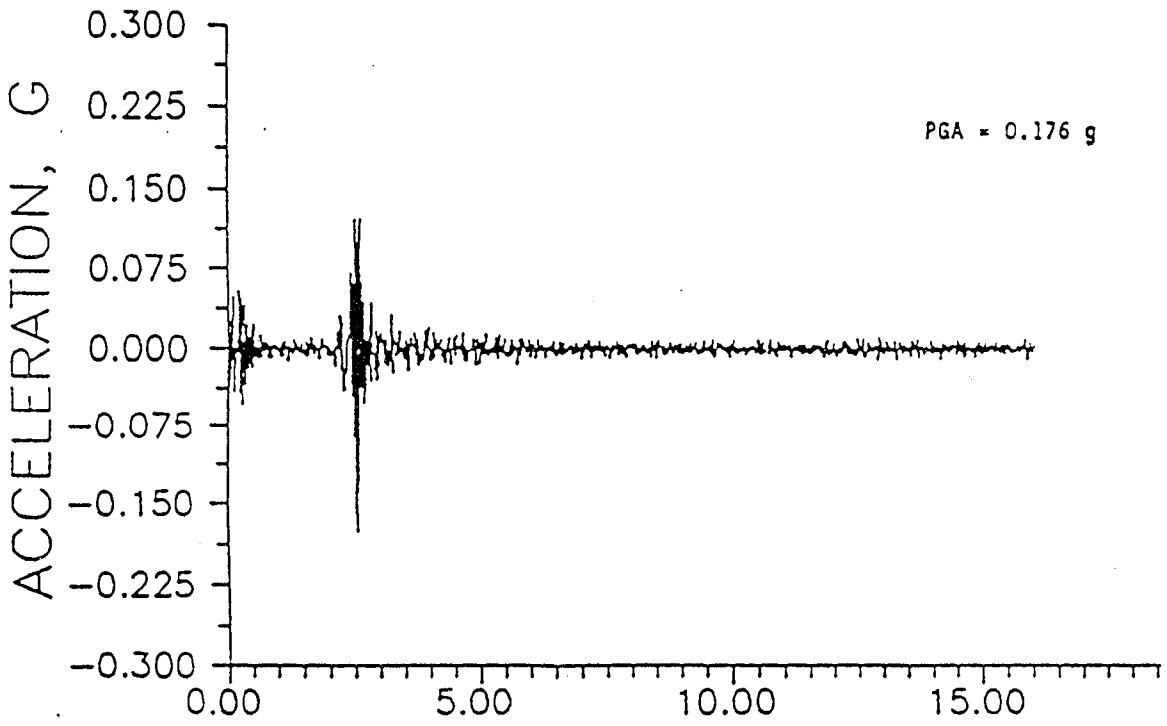
The engineering community should

- **revise the engineering practices so as to set up rules that account realistically of the damaging capacity of the seismic input.**

  Realistic modelling of the effects of a seismic input on a structure are available; unfortunately this type of sophisticated modelling is not appropriate for design purpose. (see the example of the Camus experiment)
  However it should be used as a basis for an evolution of the engineering approach.

THIS IS THE MATTER FOR WORKSHOPS OF THE ENGINEERING COMMUNITY IN THE COMING YEARS

Small magnitude shallow focus earthquakes



Event

Leroy, Ohio, 31/01/86
Magnitude : 4,8.

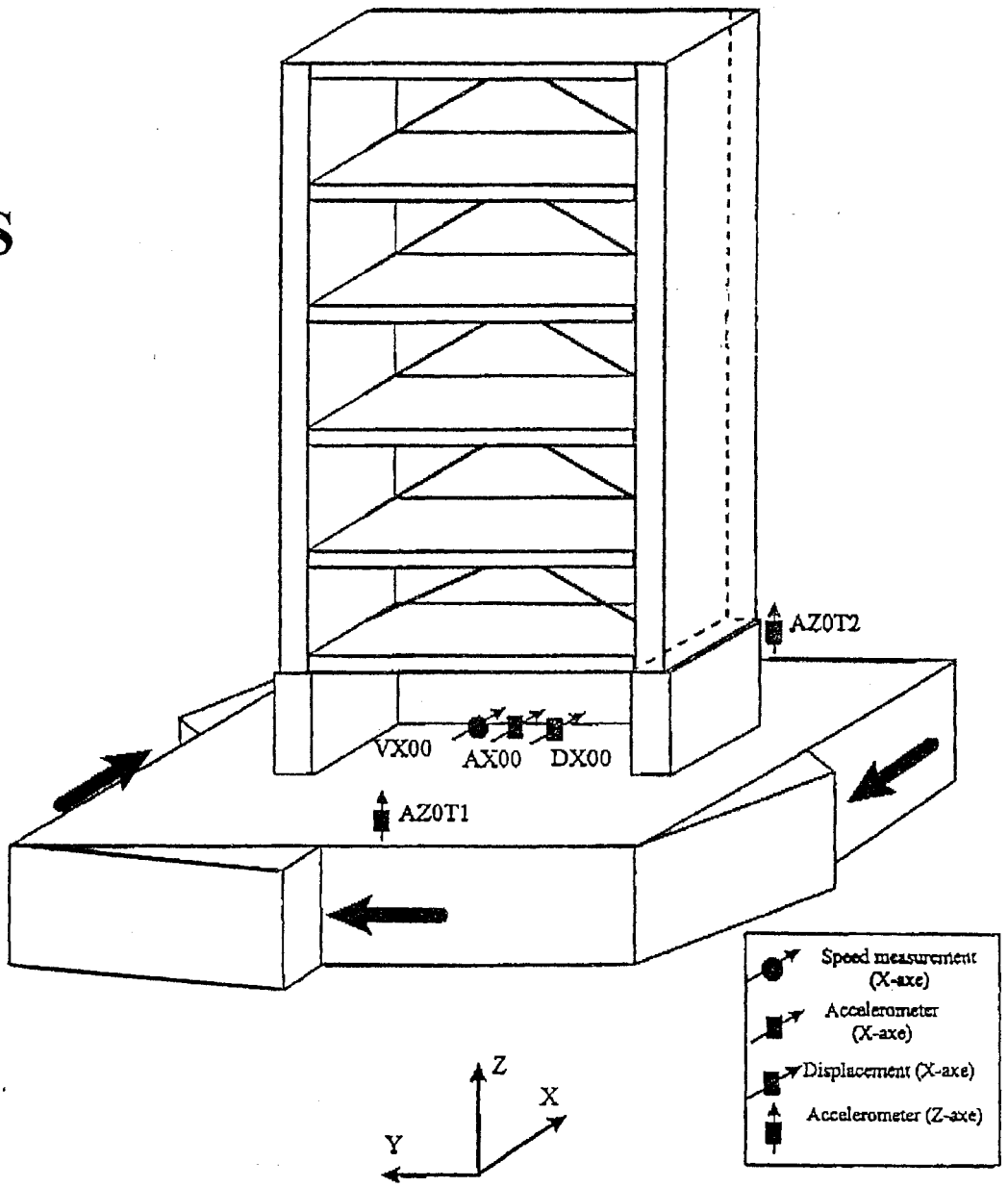
Site

Distance : 10 km
Intensity V
a_{max} : 0.18 g

Perry NPP
SSE : 0.15g

Feedback : No structural damage
Several spurious alarms

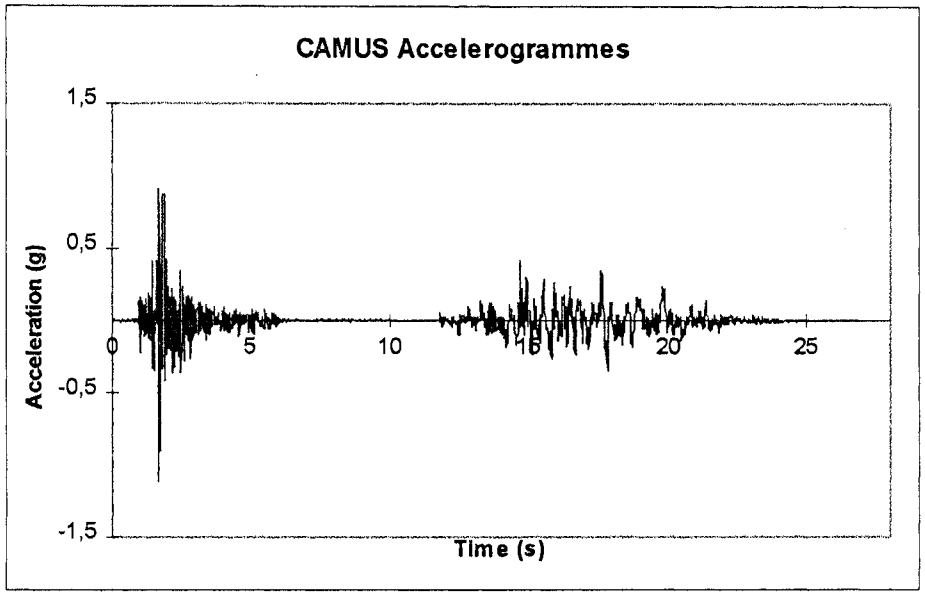
Essais CAMUS

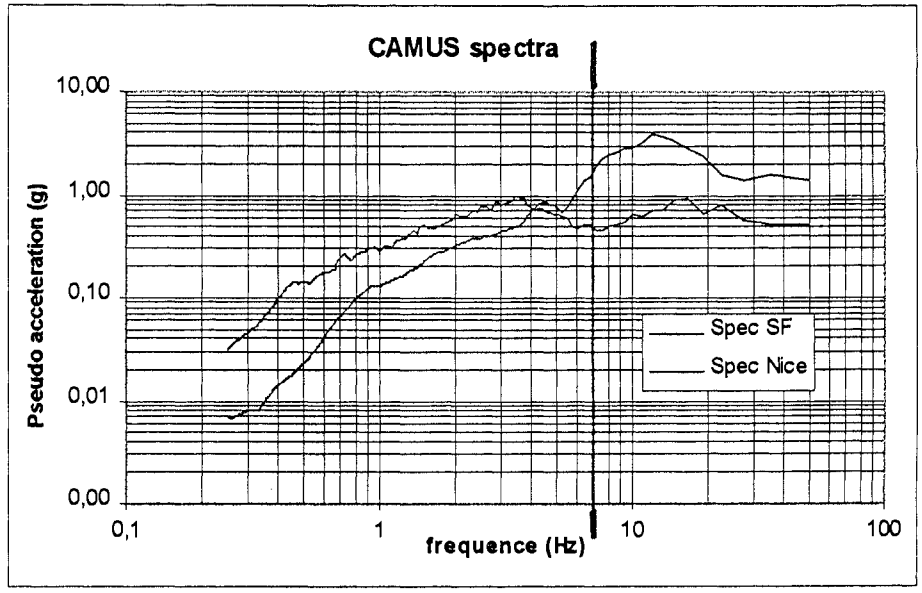


The Camus mock-up was tested on the Azalée shaking table of the French CEA, in Saclay

SMIRT 16 Conference *Washington, DC, USA, August 12-19, 2001*

San Francisco 1.11g - Nice 0.4g





As opposed to the "prediction" of the current engineering practice (based on the description of the input motion by response spectra and on the eigen frequency of the building, here 7 Hz) , it appeared that the Nice input motion (0.4g) was more damaging than the San Francisco input motion (1.1g). This result is well predicted by more sophisticated models that account for a realistic description of the damage in concrete.