POST DOC OFFER

Laboratoire SIAME UPPA
Allée du parc Montaury
64600 Anglet , FRANCE

WORK TO PERFORM

TITLE:

Study of the damage mechanisms of a coastal structure: case study of the Artha breakwater

ABSTRACT: The research work developed within the framework of this post doc aims to characterize and quantify and predict the processes at the origin of the damage to a coastal structure in a generic way by relying on a particular structure: the Artha breakwater, a detached composite vertical dike protecting the bay of Saint de Luz (French Basque Country). The focus will be on the displacement of concrete armor blocs observed during some storms, the overall stability of the wall and the more local degradation of the masonry wall. The post doc will use different methodologies to achieve this goal namely data observations, empirical formulas, statistical and numerical modeling.

Key words : Breakwater, damages, machine learning, numerical modeling, observations, empirical formula.

CONDITIONS D'EXERCICE / WORKING CONDITIONS

Laboratoire : SIAME	**Site web : https://siame.univ-pau.fr/fr/index.html**
Supervisors: Prof. Stéphane Abadie **In Collaboration with : Dr D. Sous, Pr. La Borderie**	
location : Anglet Montaury	
Start: January 1st, 2021	**Duration: 2 years**
University: Université de Pau et des Pays de l'Adour (UPPA)	
Salaire mensuel brut (monthly salary before taxes): 2700€	

HOST LABORATORY PROFILE

The Wave Interactions Structures team is developing research on waves and their impacts on coastal infrastructure in a broad sense. The work is based on a strong component in numerical simulation of surface waves, taking into account fixed or mobile structures, supplemented by field measurements. The issues addressed are mainly in the field of coastal risks (submersion, impact, tsunami) with a more recent interest in energy (MRE).

MISSION - ACTIVITÉS PRINCIPALES / MISSION – PRINCIPAL ACTIVITIES

I.*Scientific Context*

This post doc offer, which concerns the damage mechanisms of coastal structures, is part of the FEDER EZPONDA project, which deals globally with the study of the mechanical and chemical

parameters responsible for the alteration of rocky cliffs on the Basque coast and defence structures. This project brings together several university teams and research centres.

In the future, coastal protection works will have to withstand ever-increasing stresses due to global warming, the gradual rise in the associated sea level and potentially more frequent or extreme storms that it is likely to produce. On the other hand, the densification of coastal populations and the multiplication of associated challenges increase overall vulnerability. To control the risk, it is therefore important to be able to have efficient tools for the management of these structures.

However, coastal facility managers currently have few means of monitoring the condition of the facility other than inspection after a storm event or more frequently at the end of winter. Real-time monitoring and the development of predictive models can thus allow better planning of interventions and their prioritization in time and space. It may also allow for emergency response in the event that the integrity of the structure is threatened. More generally, a better knowledge of the surrounding forcings and the response of the structure can generate technical improvements to the existing system or even innovations.

On the other hand, the studies that allow the design of coastal structures are always based on physical tests carried out in reduced dimensions that do not allow a perfect reproduction of the field reality given the difficulty of perfectly satisfying the laws of similarity. Thus, understanding the functioning of the structure on a real scale is also of scientific interest from this specific point of view.

In the same vein, the validation of state-of-the-art numerical models on wave/coastal structure interaction issues is never carried out on a real scale. The experimentation of the Artha breakwater thus presents a unique opportunity to test the true predictive capacity of current models, particularly with regard to their accuracy in reproducing extreme forces. This problem goes beyond the framework of coastal protection structures since all systems subject to extreme sea conditions are concerned (in particular marine energy recovery systems).

Finally, the mechanisms of movement of the armor concrete blocks are interesting for several reasons. First, and again, because they are not known on a real scale. Secondly, because they certainly share common characteristics with boulders. This boulder problem concerns primarily the EZPONDA project but more broadly the community of scientists interested in the movement of boulders under the influence of historical storms/hurricanes and tsunamis.

II. Objectives

1- Better understanding of the damage mechanisms of coastal structures,
2- Publications related to this study
3- Predictive models for stakeholders

III. Work plan

Figure 1: Photo of the ejection of a 50 T block on February 28, 2017

1- Prediction of sollicitations on the structure with machine learning algorithm

The aim of this part is to test the efficiency of machine learning algorithms, such as neural networks, random forests, etc. to predict a few variables of interest for the structure, e.g., maximum pressure over a certain time period (typically 10 min.), maximum force, etc. knowing the environmental parameters associated to waves, wind and water level which acted during the processed period. This work will be performed in collaboration with mathematician researchers specialists in this field.

2- Wall stability with empirical formulas

The wall overall stability will be studied by confronting measurements and predictions based on existing empirical formulas. A simple model, able to estimate in real time the stability safety coefficient will be proposed to the stakeholder.

3- Blocks displacement

Block displacement will be studied by focusing on the specific event illustrated in Figure 1. The aim here is to understand the physical processes that induced this observed phenomenon. We will study the hydrodynamic stresses which acted on the pile of concrete blocks and their response by numerical simulation (Boussinesq type, Navier-Stokes, DEM). This first part, related to the 2017 bevent, could also rely on measurements in wave flume. A second part will consist of tracking the blocks displacement in the recurrent images obtained through a video system deployed on site and study the predictive capacity of engineering empirical formula to predict these displacements.

4- Local damages to the facade

The post doc will also look at the mechanisms able to tear off the materials that make up the wall. Pressure in contact with the porous media that make up the wall puts excess pressure on the pores on the surface, which significantly modifies the effective stress in the material and can cause damage on a small scale. This effect will be studied by numerical simulations at the mesoscopic scale. The post doc will carry out dynamical finite element simulations (CAST3M) of a

portion of the structure to determine the conditions that favour this pull-out (protuberant element, slight fault, degradation of mechanical characteristics) under the effect of an extreme pressure field as measured by the sensor network in place.

Some part of this work could be done in association with master internships.

IV. Literature References

Larroque, B., Arnould, P., Luthon, F., Poncet, P. A., Rahali, A., & Abadie, S. (2018). In-situ measurements of wave impact pressure on a composite breakwater: preliminary results. Journal of Coastal Research, 85(sp1), 1086-1090.

Bird, P. A. D., Crawford, A. R., Hewson, P. J., & Bullock, G. N. (1998). An instrument for field measurement of wave impact pressures and seawater aeration. Coastal engineering, 35(1-2), 103-122.

REQUIRED SKILLS

Scientific knowledges related to the topic, python programming, statistics, numerical modeling of interest for the topic, image processing will be a must.

CRITÈRES D'ÉVALUATION DE LA CANDIDATURE / CRITERIA USED TO SELECT CANDIDATE

Selection process steps :
- Establishment of the selection comittee.
- Evaluation of the applicants cv's
- Interview with the selected candidates and ranking.

Criteria used in selection of the candidate:
- The candidate's motivation, scientific maturity and curiosity.
- candidate's knowledge related to the topic
- English proficiency

REQUIRED FILES,

Send an e-mail with your candidature containing:
- CV
- cover letter detailing candidate's motivations
- PhD manuscript
- Articles related to the topic
- Letters of recommendation

Deadline:	November 30, 2010

CONTACTS

E-mail: stephane.abadie@univ-pau.fr