MARINA DESTRUCTION EVALUATION TOPOGRAPHIC LEVELING, NUMERICAL MODELING, AND DIGITAL VIDEO

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Abstract. On the 18th of April 2012, deficiency of the central breakwater and the lateral docks of the marina inPatras (Greece) resulted in one ship sinking and in several other damages due to fierce storm. The amplitude ofthe surge and the reason of this malfunction caused intense conflict among engineers; as such surge amplitudehad never been predicted. A factor intensifying the confusion is that the tide gauge of the marina was out offunction during the storm. Thereafter, there is important lack of crucial data concerning the tide amplitude. Thisstudy is focused on shedding some light on the causes of this event and also on defining the real wave height ofthe surge. A complex approach was followed, for the purpose of this study, in order to avoid biased estimates.This approach included step by step leveling based on flood fingerprint analysis, digital video analysis andnumericalsimulation.Resultsshowthatearlierestimate sandalsotechnicaldesignqualityindicatorsunderestimate dinundationrisk.Consequently,inefficientoperationofthe marinastructureisapresentquestion. At the same time, the surge wave amplitude estimate (>1.20m) adds important information to theinundation risk reassessmenteffortsin the eastern Mediterranean.

Keywords: Surge,Marinadamage,Numericalsimulation, Leveling,Digitalvideoanalysis.

INTRODUCTION

The study of natural disaster causes, demands a rather complex analytical procedure which often becomes a matter of controversy among researchers [1,2]. Analysis of such phenomena should be thoroughly painstaking, especially when they are enhanced by regionally localized topographical parameters [3,4]. In many cases, troubleshooting of marina deficiency events during storms has come to dead end, with difficulty in multiparametrical characterization of a phenomenon being the main cause, usually focused on several non-linear hydrodynamic factors of simultaneous effect [5,6].

The present project is focused on the significant structural fault of a typical marina located in the region of Patras, Greece. On the 18th of April, 2012, one sailing boat was submerged, while others were severely damaged along with related infrastructure of the marina, during a fierce storm.

Nevertheless, the recorded weather conditions during the hours of the storm could never justify such a disastrous outcome. On the same time, lack of sea level records for the same time period, due to the marina's tide gauge malfunction, further obfuscates any research. The conflict which followed came as a natural consequence, involving the vessel owners and the marina management.

Despite the lack of sea level records, sea condition representation is made possible through digital video analysis stemming from video material recorded by amateurs as well as reporters. This visual material depicts the storm period in the marina in detail and was brought to public some days later. In addition, water's muddy composition during flood left essential marks of the sea level on the steady platforms.

The aforementioned sources of valuable information were synthesized with meteorological observations in order that a reliable representation of the phenomenon to be succeeded. Such a simulation could only add to our capability of evaluating the causes of the structural fault and assist on the assessment of the basic surge characteristics.

PATRASMARINA

Patras marina is located on the western side of Central Greece (Latitude 38° 15' 45", Longitude 21° 44' 28"), with its front adopting a western direction, while its 596 meter main breakwater extends on a North to South axon. The central breakwater is constructed out of irregularly shaped rocks forming a fluctuating height from 2.30 to 3.10 m, relatively to the mean sea surface. Figure 1 illustrates marina's main structure. On the northern side, it borders on a smaller adjoining marina belonging to the sailing association, the entrance of which faces the North. All points marked on figure 1 refer to the southern section (depths ranging from 5 to 7m), where faults were observed. Depths of the northern section are gradually decreased down to the scale of 2m. Next to the 55 meter wide southern entrance, which adopts a southwestern direction, one can notice the entrance to Patras main port after a distance of 192m. Therefore, the whole structure (see fig.1) creates an unprotected area which is vulnerable to winds the direction of which ranges between 90°-95°, and therefore, waving following this direction can be enhanced resulting in dangerous sea level elevation.

Topographic characteristics of the area make this

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scenario quite possible. The marina of Patras lies to the southeast of the Gulf of Patras. On the east, the gulf is bounded by the Gulf of Corinth. On the west, it is bounded by the Ionian Sea through a 12km wide channel, the deepest spot of which reaching 70m. The gulf surface covers an area of 350 to 400 km². Its length ranges between 40 and 50 km, while its width between 10 and 20km. The deepest spot of 132m is observed on the center of the gulf, however most depths do not exceed 80m. On the North side, the gulf is closed by a massif consisting of two mountains (Palaiovouna and Varasova reaching 1013 and 874m high, respectively) which form an intermediate 5,4 km long gorge. This topographic anomaly creates a range of special phenomena which affect the regional climate (cloud concentration, wind direction e.t.c.) [7]. The most important effect is the regional speed and direction alterations of the Northern and Northwestern winds inside the gulf area, due to the so called Bernoulli's law [8]. Finally, the gulf is also characterized by intense surface streams [9] of West to East direction.

Figure 1.Patras marina map, indicating the spots for which video recordings are available (a,b,c,). (The map is oriented to the North.) Figure also shows the southern entrance of the marina, as well as the entrance to Patras main port and the unprotected area between them.

METHODOLOGY

Digital video analysis for the estimation of natural motion basic parameters is a relatively new methodology [11]. Here, we focused on the dynamic representation of the wave height, relatively to the mean sea surface during the surge. Analysis was conducted on MATLAB software and on the open source image editing code software DigitizingTools using a frame-by-frame analysis of randomly selected videos (Ty Hedrick laboratory, University of North Carolina)[12]. Finally, the numerical analysis and the statistical elaboration were conducted through originLAB.

An attempt was made to digitally reconstruct the waving in order that the wave height and the wave dynamic characteristics to be estimated and, finally, the causes of the fault to be revealed. The highest point of the surge was compared with the height induced by the prints reduction on the spots a, b and c. Especially for point c, there were three apparent floodprints, the heights of which differed very little from each other (±4cm). FFT analysis helped the estimation of the basic wave frequencies referring to each from the three spots. The analysis was conducted in order that dynamic correlation grade of the phenomena to be localized. At the same time, the direction of the waves was also evaluated for the three spots.

CONCLUSION

A simulative hydrodynamic analysis under weather conditions similar to the ones mentioned would probably require more detailed information. Such an analysis is essential, though, due to the dangers incorporated in phenomena, such the ones described. According to ship owners, similar conditions have repeatedly led to catastrophic results again in the marina. Most of these incidents refer to weather conditions quite comparable to the ones reported from the 18th of April, which, however, should not justify such an impact. A re-planning of the marina structure as well as a construction study must begin from scratch. Finally, as far as the marina entrance is concerned, immediate safety measures should be taken in order for the perils to be reduced.

REFERENCES

Fritz, H. M., Blount, C., Sokoloski, R., Singleton, J., Fuggle, A., McAdoo, B. G. and Tate, B. (2007),"HurricaneKatrinastormsurgedistributionandfieldobservationsontheMississippiBarrierIslands.Estuarine",CoastalandShelfScience,Vol.74(1),pp.12-20.

Robertson, I. N., Riggs, H. R., Yim, S. C. and Young, Y. L. (2007), "Lessons from Hurricane Katrina stormsurge on bridges and buildings", Journal of Waterway, Port, Coastal, and Ocean Engineering,Vol. 133(6),pp.463-483.

Bretschneider, C. L. (1964), "The ash Wednesday east coast storm, March 5-8, 1962: a hindcast of events,causes,and effects", Proceedingsofthe 9thConferenceofCoastalEngineering,pp. 617-658.

Jung, Y., Xue, M., Zhang, G. and Straka, J. M. (2008), "Assimilation of simulated polarimetric radar data fora convective storm using the ensemble Kalman filter. Part II: Impact of polarimetric data on storm analysis",MonthlyWeatherReview,Vol.136(6), pp.2246-2260.

Williams, M. S., Thompson, R. S. and Houlsby, G. T. (1998), "Non-linear dynamic analysis of offshore jack-up units", Computers&Structures, Vol.69(2),pp.171-180.

Boczar-Karakiewicz, B. and Davidson-Arnott, R. G. (1987), "Nearshore bar formation by non-linear waveprocesses-acomparisonofmodelresultsand field data", MarineGeology,Vol. 77(3),pp. 287-304.

Simionato,C.G.,Vera,C.S.andSiegismund,F.(2005),"Surfacewindvariability onseasonalandinterannualscalesover Riode laPlataarea", JournalofCoastalResearch,Vol. 21(4),pp.770-783.

Godfrey, A. E. (1997), "Wind erosion of Mancos Shale badland ridges by sudden drops in pressure", EarthSurfaceProcessesandLandforms,Vol. 22(4),pp.345-352.

Fourniotis, N. T. and Horsch, G. M. (2009), "Modeling Wind and Tide-Induced Currents in the EasternIonianSea:PatraikosGulf(Greece)",in"AdvancesinWaterResourcesandHydraulicEngineering",Springer, Berlin,Heidelberg,pp. 1201-1206.

Vanicek, P., Castle, R. O. and &Balazs, E. I. (1980), "Geodetic leveling and its applications. Reviews ofGeophysics", Vol.18(2),pp.505-524.

Combes, S. A., Crall, J. D. and Mukherjee, S. (2010), "Dynamics of animal movement in an ecologicalcontext: dragonfly wing damage reduces flight performance and predation success", Biology

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letters, Vol.6(3),pp.426-429.

Hedrick, T. L. (2008), "Software techniques for two- and three-dimensional kinematic measurements ofbiologicaland biomimeticsystems", Bioinspiration&Biomimetics, Vol. 3(3),034001(6pp.).

Lycourghiotis, S.A. and Stiros, C.S. (2013), "Coastal Flooding Hazard in Low-Tide and High-Tide Coasts:Evidencefromthe NorthAegeanCoast", CoastalHazards(C.Finkl,ed.),CoastalResearchLibrary,Springer,pp.231-
243.

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