FOURTH INTERNATIONAL CONFERENCE
PORT DEVELOPMENT AND COASTAL ENVIRONMENT

BOOK OF ABSTRACTS

PDCE’2007 Varna Bulgaria

25th - 28th September 2007
Book of Abstracts
of 4th International Conference
Port Development and Coastal Environment - PDCE’2007
25 - 28 September 2007

Black Sea Coastal Association (BSCA)

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FOREWORD

The Black Sea Coastal Association, the Organizing Committee and the International Scientific Advisory Board of the 4th International Conference on Port Development and Coastal Environment 2007 (PDCE 2007) invite you to attend this year’s conference which will be held in Varna, Bulgaria, from September 25 through 28, 2007.

PDCE 2007 continues the successful conference series held in Varna in 1997, 2000, and 2003, as a multidisciplinary international forum on port and coastal engineering, environmental protection, and related sciences. It will bring together experts, scientists, engineers, policy makers and environmentalists concerned with ports, coasts and environmental protection.

We expect the PDCE 2007 conference to create an environment for a broad exchange of scientific information and expertise across sectors and nations. We believe that the conference will also raise participants’ awareness of current EU environmental legislation addressing marine environment. Finally, we believe that PDCE 2007 will contribute to the advancement of new strategies for port and coastal zone development that take into account environmental concerns from a long-term sustainable perspective.

We expect that the technical program at PDCE 2007 will allow conference participants from 17 countries to share their knowledge and experience, to network on an informal basis, and to create opportunities for further cooperation.

On behalf of the organisers, we welcome you to PDCE 2007 and look forward to seeing you in Varna, Bulgaria, in September 2007.

Valeri Penchev
Chair, PDCE 2007 Organising Committee

Boyan Savov
Chair, Black Sea Coastal Association
# Tentative Scientific Program

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Post Conference Tours

- Boat cruise along the Black Sea coast (1 day)
- Excursion round Bulgaria (2 1/2 days)
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NEW ITALIAN PORT MASTERPLANS FOR EAST-GOING TRAFFIC

A. Noli, MODIMAR srl, Roma, Italy
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P. De Girolamo, University of L’Aquila, Italy
G. Ievolella, Ministry of Public Works, Roma, Italy

The paper describes the new designs for updated masterplans of three important Italian ports, namely Civitavecchia (Roma), Ravenna and Ortona (Adriatic Sea), which will play a significant role in the growing maritime traffic with the countries of Eastern Europe, including Bulgaria.

The masterplans include new breakwaters and long quays for the ports extensions following modern criteria to accommodate longer and deeper vessels under safe conditions.

Advanced hydraulic and navigability studies have been performed to verify the design choices, together with traffic forecasts.

As an example the future development of Civitavecchia port is herewith shown.

Figure 1.
Waterborne infrastructure investments in the United States require economic justification demonstrated through benefit cost analysis. To identify and analyze congestion, analysts must understand the large number of vessel calls, the influences of nature (tide or current), and the complicated transit rules imposed throughout a harbor. Accurately predicting and analyzing impacts of random vessel interactions across space and time requires a detailed simulation model. HarborSym is a non-proprietary, event driven Monte Carlo simulation model developed by the Corps of Engineers (USACE) to assist in planning and economic analyses of maritime infrastructure improvements. HarborSym has been designed as a geographically portable, data-driven application, allowing the model to be applied to different ports by changing the input data.

HarborSym has been applied to Tampa Harbor as a part of the planning process for studying potential port improvements. By simulating existing harbor conditions, specific causes of congestion and problematic locations within the system are identified. This information can be used to quantify the magnitude of the problem and target formulation of alternatives to effectively minimize delays. HarborSym can be applied to evaluate impacts to the transportation network of possible improvements based on current and projected traffic patterns. HarborSym’s sophisticated visualization capabilities, shown in Figure 1, allow effective communication of USACE understanding of the congestion problems, proposed solutions, and results of economic analyses to external stakeholders. This enhanced communication can engage local experts early in the analysis to encourage feedback on simplifying assumptions, while allowing reviewers to understand the analytical components and results at the conclusion of the investigation.

The paper will discuss the benefits of and approaches to utilizing simulation models in a planning setting, as well as provide examples related to data development needs, formulation and analysis of alternatives, and methods to describe and communicate model behavior in the context of the Tampa Harbor application.

Figure 1. Example of HarborSym Animation for Tampa Harbor
WEATHER AND CLIMATE RISK FOR PORT INFRASTRUCTURE PROJECTS

M. Hannam, CARES Ltd, Coastal and Reclamation Engineering Services

Ports and their stakeholder communities sit at the heart of the integrated logistics chain for import and export of goods. Global increase in demand linked to growing population and shifting demographics of consumption is leading to increased demand for Ports Infrastructure and Sustainable Maritime Transport Networks. Given the challenges of weather, the environment and climate change and the implications for design and operation of new infrastructure this paper explores the arguments in favour of a more integrated approach which makes best use of advances in predictive techniques as the premise for environmental engineering best practise and related technical standards.

Ports are traditionally the centre of the distribution network. For centuries port engineers have striven to construct breakwaters and berths of ever higher capacity and performance. During the last 50 years unprecedented advances have been made in our ability to construct and position large prefabricated units in response to growth in demand for Port Capacity. The capability of dredging plant has also increased significantly. Engineers can now construct ports in locations and water depths and at speeds which only a generation ago would have seemed impossible.

In recent years new port infrastructure development has undergone a radical change. The nature of port operations has been subjected to modification and advances in the use of proven technology from pioneering industries such as the offshore sector. Ports must also now be considered within the wider context of integrated transport on the landward side and of increasing environmental protection and marine spatial planning constraints on the seaward side.

Although the primary function of a port is as a cargo-handling facility, its design must also ensure free access to shipping and calm conditions within it, even in poor or potentially extreme weather conditions. Accurate Site specific now-casts, detailed longer range probabilistic weather (or risk based) forecasts and climatology’s for Ports are not widely available or utilised at present. The design of ports is no longer merely a question of civil engineering, but other factors such as environmental legislation, socio-economics and containerisation of cargos are becoming increasingly important.

The ability to detect and predict long-term changes or variability in the weather patterns that we experience is crucial if we are to manage successfully any risk that such changes may pose. The analysis of historical data has been long-used as a tool to inform us about the likely conditions that we might expect to encounter on average, or to identify significant trends that have occurred. However, such information does not embrace a predictive capability. For example, will a recently observed trend in a particular weather variable continue? We may rely upon climate change models to provide us with this information but must also seek to deal with the degree of uncertainty associated with their output. Additionally, the key to success lies in our interpretation of the results in a practical sense. Do we need to modify traditional thinking on the basis of the information that we are presented with? In particular, reference to environmental extremes such as sea level rise, extreme wave inundation, flooding associated with increased storminess, and structures fatigue of assets associated with extremes of temperature or wind speed are key criteria. These critical variables are explored in the context of impacts upon port community infrastructure and operations. This paper takes a brief look at a representative selection of new port development
projects from both the UK and overseas having regard to both historical information and the output from predictive models. It asks how this might impact on our approach to the design and operation of new infrastructure exposed to marine environment in a rapidly changing climate.

A traditional approach to the design of marine structures involves the estimation of extreme values of environmental parameters relevant to the structure in question over desired return periods. If we say that a given value for a critical weather/environment variable has a return period of 100 years, this signifies that over a period of time we might, on average, expect to encounter such an event once every hundred years. In the expectation of a particular structure being in use for a long period of time, it clearly makes sense for it to be designed to withstand the forces associated with such events. The estimates are calculated through the analysis of sets of historical or modelled data and the application of extreme value theory. This technique does not recognise any changes to the environmental conditions that may take place in the future - a potential flaw if one accepts the possible impacts of climate change. In the context of increased storminess and environmental extremes, an intensity of environmentally limiting conditions may be considered of most interest if we wish to factor a predictive element into our design criteria and if we wish to focus our interests upon extreme values.

Improvements in Cost-Benefit Analysis (CBA) are also affecting port related infrastructure design. It has for instance become apparent that the cost of constructing wave defences permitting uninterrupted cargo transfer up to 1-in-10 year storms far outweighs the cost of interruptions to port operations necessitated by structures scaled to give 10-in-1 year storm protection.

Construction costs are of paramount importance, in that the cost of developing a new site must be lower than the cost of moving cargo to the closest existing port, or modifying an existing port to accommodate additional cargo. In other words, any project must be truly competitive; Asset Management investment strategies and planned maintenance should include an integrated consideration of weather climate and environmental risk criteria to enable due diligence.

Where the tidal range for a given Port is increasing, the need for dredging becomes significant, both to keep channels free and to provide pockets of sufficient depth alongside quays. Dredging is expensive, as is the alternative of providing locked basins. The cost of providing and maintaining a deep dredged channel generally far outweighs the commercial benefits of uninterrupted operation in the short term. With suitable vessel traffic control and communications systems, ships can generally be scheduled to arrive and depart during the tidal window, without undue costs to owners. The environmental assessment of dredging options will also require closer attention to weather and climate factors in the future.

Similarly, the berthing structures in commercial ports are designed to support the mechanical handling equipment employed and to provide roads and rail tracks for vehicles to move loads to and from the port. As the mechanical handling aids have become larger and heavier, the structures that support them have had to become more robust. Unfortunately the location of most ports is historical and determined by the existing road and rail links, rather than by geophysical considerations. On many projects the consolidation and reinforcement of foundations for dockside equipment, storage and marshalling yards is therefore a major capital expenditure. Risk of increased exposure to structural failures may be significantly influenced by extreme weather and climate change.

The author advocates an integrated approach as being required to ensure sustainable development of new port infrastructure in response to the challenges from weather and climate and the environmental consequences. A risk management approach is essential to ensure design and operating criteria are subject to rigorous, risk-based, environmental sensitivity analysis. A clear analysis of the implication of future climate change and related uncertainty is also essential. Reliance upon re-analysis of past environmental information may significantly underestimate or ignore future scenarios that in the event of rapid climate change are becoming more likely.
UNCERTAINTIES IN THE DESIGN OF BED PROTECTIONS NEAR QUAY WALLS

H. J. Verhagen, Delft University of Technology
A. Roubos, Rotterdam Public Works Department

During the design of bed protection near a quay wall a one has to deal with several uncertainties. Therefore practical experience and insight in the consequences of the choice of the input variables in the present design formulas is a condition to guaranty an optimal design. To enlarge this insight several bed protections in the port of Rotterdam have been investigated. Because one of the bed protections did not satisfy the demands of stability required to guarantee a stable bed protection, this bottom protection is studied with soundings. Using these soundings the actual level of stability can be compared with the present design formulas.

The loads on this bed protection differ, because of diversity in shipping and tidal motion. Therefore a better comparison can be made by resembling the results of the soundings with a probabilistic approach. The probabilistic model is calibrated by the sounding results and by registrations of mooring and unmooring vessels. From these probabilistic approaches insight in the influence of each input variable can be derived.

By using a combination of probabilistic results and a fault-tree the probability of a scour hole near a quay wall can be calculated. With these results it is still not possible to choose one strategy for designing bed protections. The impact of a scour hole on the environment of a quay wall needs to be investigated. Therefore a study to the interaction between a scour hole and the quay wall is enclosed. With these results a risk based analysis is made to evaluate the different strategies and their consequences.

A possibility to combine the application of the probabilistic model with a targeted implementation of bottom depth soundings can lead to solving the uncertainties in the design formulas and to an optimisation of the total number of soundings. On the one hand it is possible to reduce the costs by reducing the number of soundings. On the other hand it is possible to reduce undesirable impact of the scaling-up in shipping. In fact this means, shortening the time period between a sounding and the occurrence of a scour hole. So the safety demands for the quay wall remain guaranteed. During the first time of the required life time no soundings have to be done. In the second part of the life cycle relative more soundings are necessary due to scaling-up.
FIELD MEASUREMENTS FOR THE DETERMINATION OF SHIP-INDUCED LOADS IN A TIDAL RIVER PORT

A. Matheja, L. Schweter
B. Franzius-Institut, Leibniz University of Hannover

In the port of Stade-Bützfleth at the tidal river Elbe water level measurements were accomplished over a period of approx. 6 weeks. Motivation for these measurements was the observation that due to the ship-sizes and –speeds in recent past an increase of the wave attack and thus an increase of loads up to failures of the mooring system of large ships moored in the port of Stade-Bützfleth was observed.

To determinate the ship-induced loads and their origin, wave measurements were linked with the corresponding ship passage data (ship name, length, width, draught, position, passing distance and speed over ground).

Evaluations showed that highest loads are caused by Post-Panmax ships at subcritical speed during the evening and night hours and in the early morning respectively (see Figure 1).

![Figure 1: Ship-induced waves measured in the port of Stade-Bützfleth](image-url)
II. DREDGING AND ENVIRONMENT
(PRESENTED BY CEDA)
PLENARY PAPER: IMPACT OF EUROPEAN UNION ENVIRONMENTAL LAW ON DREDGING

F. J. Mink  
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W. Dirks  
Van Oord NV, Netherlands  
G. H. van Raalte  
Royal Boskalis / Hydronamic, Netherlands  
H. de Vlieger  
DEME/DEC, Belgium  
M. Russell  
British Marine Aggregate Producers Association (BMAPA), UK

The European Dredging Contractors established the European Dredging Association (EuDA) back in 1994 as a trade association for contacts with the European institutions; this includes the influencing and follow-up of EU law that might impact the dredging sector.

Amongst the areas where EU legislation affects the industry, the environmental law has taken a prominent role.

The EuDA Environment Committee has recently prepared a comprehensive review of European environmental rules and their impact on the practice of dredging and dredged material disposal. This paper presents a summary of the findings.

The paper discusses the various types of legal instruments the EU can use, the hierarchy of legislation, plus the different directives that apply to the dredging industry.
USE AND DISPOSAL OF DREDGED MATERIAL IN THE NETHERLANDS

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Frequent dredging is essential in the Netherlands to keep seaports, rivers en canals accessible for navigation, other purposes are drainage, flood protection and remediation of contaminated sites. We have to deal with large volumes of dredged material (about 30 million cubic meter each year). Clean or lightly contaminated dredged material (90 %) is mainly relocated into the aquatic system and placed on banks of waterways, minor amounts are used for nature development, and as a building material. About 10 % is heavily contaminated and is disposed of in large-scale sub-aquatic Confined Disposal Facilities (CDF’s).

Regulatory criteria (Chemical Toxicity Test) for relocation at sea have recently been evaluated. New legislation, to encourage the use of dredged material and soils from floodplains, will enable relocation on banks of rivers and canals, filling of existing sand and gravel pits and use as a building material. Minimizing risks for humans and the environment and protection of surface- and groundwater is important when choosing a destination for dredged material.

A small part of the contaminated sediment that is transported to CDF’s can be processed to building material by sand separation and clay ripening. A new sub-aquatic CDF is now under construction.

In the rivers Rhine and Maas large volumes of sediment are removed for flood protection and nature development. The sand en gravel yield partly finances these projects. The remaining sand and gravel pits are used for storage of lightly contaminated dredged material.

State of the art on use and disposal in the Netherlands will be addressed, taking into account upcoming national legislation and guidelines from Europe on water and sediment.
LEGAL PROCEEDINGS IN A LONG-TERMED PROJECT FOR LAND-BASED DEPOSITION OF SILT TO IMPROVE AGRICULTURAL CONDITIONS

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In Germany there is still no national policy on dredged material management. Regulations can be derived from a variety of acts, including the Water Act, the Waterways Act, the Soil Protection Act, the Waste Act and the Nature Conservation Act, all of which are increasingly being influenced by the process of legal harmonisation across the European Union.

The legislation requirements are highly complex, meaning that in practice multiple regulations will apply, each of which relates to a specific way of dredged-material handling and special areas of competence.

Subject of this paper:
In August 2003 some farmers from a region near to the river Ems offered approximately 530 hectares of pasture/farmland to the German Federal Waterways and Shipping Administration (WSV) for disposal of non-polluted silt from maintenance dredging in the Ems-river. They wanted to improve conditions of that low lying, wet marshland and to obtain better profit. To the WSV this means an enormous economic chance to get rid of huge amounts of silt from dredging for passing big, new build cruise-liners from a shipyard down the Ems-river to the North Sea twice a year. However for that project the suitable legal requirements had to be found out and afterwards had to be solved.

This paper informs about the steps necessary and tries to give an idea of experience in obtaining all those necessary permits permissions within the administrative machinery.
SEDIMENT MANAGEMENT - AN ESSENTIAL PART OF RIVER BASIN MANAGEMENT PLANS

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Sediment is an essential, integral and dynamic part of our river basins. Where human activities interfere with sediment quantity or quality, sediment management becomes necessary. One of SedNet’s main recommendations is to integrate sustainable sediment management into the European Water Framework Directive related policy, legislation, and implementation process. This is to achieve good ecological status, or potential, and at the same time to support the well being of the European economy.

Central to the EU Water Framework Directive (WFD) are River Basin Management Plans, which have to be produced and published by 2009. Until now sediment related issues have played a minor role in the Common Implementation Strategy (CIS) process.

On the basis of this background, SedNet organised a Round Table Discussion with the objective to derive generic and specific recommendations for sediment management based on experiences in selected river basins. The discussion brought together delegates from European river commissions, user groups, and scientists. The river basins represented were the Danube, Douro, Elbe, Humber and Rhine. Some of the uses discussed were aggregate dredging for the construction industry; agricultural use of grassland in floodplains; dredging for navigation purposes; drinking water supply; hydropower generation; etc.

The participants concluded that sediment management is an issue in all 5 river basins. Each river basin has specific natural characteristics, uses, histories, challenges. It also became evident that until now the WFD thinking is very ‘fluvial’. Sediment quantity and quality issues are closely interrelated and can not be separated. Sediment management in terms of quality and quantity should receive due attention in River Basin Management Plans. To develop such a plan can be challenging taking into consideration the requirements of different European and national legislation. Also EU Policies may create conflicting ambitions.

An adaptive management approach is required; there is not a one-size-fits-all solution. Estuaries are different from rivers and require adequate attention. It is important to make use of experience from other river basins and to develop common basic approaches.

Also future research will be necessary. There is a need to collate available data to identify knowledge gaps and enhance understanding, linking sediment management to environmental and climate change issues.

The Round Table concluded that achieving good ecological status requires a proper attention to sediment issues, with an awareness of natural variation and differences between river basins.
ECOLOGICAL CONSEQUENCES OF DREDGED MATERIAL DISPOSAL IN THE MARINE ENVIRONMENT: A HOLISTIC ASSESSMENT OF ACTIVITIES AROUND THE ENGLAND AND WALES COASTLINE

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Around England and Wales, there are over 150 sites designated for the disposal of dredged material at sea, not all of which are used in any one year. In total, approximately 40 million wet tonnes are disposed of annually, therefore, in terms of quantity, maintenance dredged material far outweighs all other materials disposed of to the marine environment. Quantities deposited at individual sites may range from a few hundred to several million tonnes. The nature of the material may vary from soft silts to boulders or even crushed rock according to origin, although the majority consists of finer material. Studies of the impacts of dredged material disposal around England and Wales have previously described impacts at individual disposal sites; combining data from a variety of studies, however, allows their simultaneous comparison, making the detection of any general trends possible. The formulation of a general trend in the ecological effects of dredged material disposal in the coastal environment could lead to the development of a conceptual model upon which a decision-framework could be based.

This study provides a holistic perspective on the ecological effects of dredged material disposal. The analyses revealed that ecological effects associated with dredged material disposal were dependent on the numerical techniques used, and that impacts were disposal-site specific. Disposal-site communities were generally faunistically impoverished to varying degrees, and impacts following intertidal placement were comparable to those of subtidal placement. We conclude that any assessment of the consequences of dredged material disposal to the coastal environment must take account of site-specific variation in prevailing hydrographic regimes and in ecological status, along with information on the disposal activity itself (mode, timing, quantity, frequency and type of material). As would be expected, variability in the latter presents a significant challenge in attempts to generalise about environmental and ecological impacts.
CONTAMINATED DREDGED MATERIAL: MONITORING RESULTS FROM THE FIRST CAPPING TRIAL IN THE UK

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Maintenance dredging operations are conducted to remove sediments in order to maintain harbour berths, marinas and approach channels. The amount of dredging and disposal undertaken around the world varies enormously, with the magnitude of dredging operations in the UK being relatively large. Around 25-40 million tonnes of dredged material are disposed of annually to designated sites in UK waters. The activity is controlled under national legislation and licensing authorities have also to take account of the requirements of various international conventions on marine disposal to aim at maintaining any adverse environmental consequences.

This study is located off the north east coast of the UK, where the local port authority (The Port of Tyne) needed to dispose of 500,000 tonnes of dredged material to sea from 9 sites within the estuary of the River Tyne. Initial contaminant analyses of the material showed that ~224,000 tonnes were highly contaminated with the anti-fouling agent tributyltin (TBT) and the concentration of some heavy metals exceeded the permitted limit for sea disposal. Following consultation on the application and taking into account socio-economic issues, a trial capping project to dispose of approximately 60,000 m$^3$ of contaminated dredged material (CDM) was conducted. An active disposal site, known as Souter Point, located 4 miles off the coast in approximately 48m of water was used for this exercise. The location and conditions at the disposal site dictated that level bottom capping utilising the natural shape of the sea bed to form a mound was the best choice for the trial. It was predicted that the CDM would form a layer 1.5 m thick across the 200 m by 200 m target site for the trial. The cap design was for a 1m layer of silt and a 0.5 m layer of sand cap to ensure isolation of CDM from potential impacts, i.e., bioturbation (minimum 0.3 m), erosion by severe storm or a number of small storms, and human activities, for example trawling.

‘Check monitoring’ with a combination of acoustic and ground-truthing techniques (e.g., grabs, SPI camera) was conducted on behalf of the regulator to provide an independent assessment of the quality and validity of scientific findings of consultants acting on behalf of the licensee. The data also allowed an assessment of long-term maintenance of the integrity and efficacy of the cap and status of the physical and biological resources in the area. Results from the monitoring are presented in this work.
III. ENVIRONMENTAL ISSUES
METHODOLOGICAL PROCEDURE FOR ESTIMATING THE CONSEQUENCES OF CONTAMNANT EMISSION FOR PORT WATER BODIES' QUALITY

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The Water Framework Directive (2000/60/EC) (henceforth, WFD) establishes a framework to protect inland surface waters, transitional waters, coastal waters, and groundwater. This recent legislation aimed specifically at protecting aquatic environment has had a direct impact on port water bodies’ environmental management.

For this reason, the Spanish National Ports Administration considered it essential and urgent to have available some scientifically and technically robust tools to contribute to port water management. A methodology, based on WFD’s principles, has been developed under the name of “ROM 5.1. Quality of coastal waters in seaport areas”, within the framework of the well-known Spanish standardisation programme in the field of ports (ROM Programme).

One of the most important items established in this methodology is the environmental risk assessment and management of port water bodies. The principal objectives are to identify environmental hazards, to estimate the risk that each hazard has on the receptor, and to make decisions on an appropriate course of action to manage these risks in a cost-effective manner. Environmental risk estimation, in ROM 5.1, is based on the combination of three terms: probability that some (dangerous) event will occur, consequences of the event if it actually occurs, and vulnerability of the receptor. In seaport areas, the major environmental hazards are related to contaminant emissions and water bodies affected by these contaminant emissions are the receptor.

To estimate consequences of contaminant emissions a standard methodological procedure has been established. This methodological procedure is based on two simple steps: calculation of the affected area by each contaminant substance by means of numerical models and superposition of all affected areas by means of a Geographical Information System (GIS). In this article the possible sources of uncertainty in the application of this methodological procedure and some aspects related to the practical implementation of the proposed method are analysed and discussed.
NEW TOOL FOR THE MANAGEMENT OF THE QUALITY OF SEAPORT AQUATIC SYSTEMS. “ROM 5.1. QUALITY OF COASTAL WATERS IN PORT AREAS”

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In order to “establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater”, in the year 2000 the European Parliament published Directive 2000/60/EC (henceforth Water Framework Directive or WFD). The management policies established by the WFD define a unique performance framework for watersheds. Furthermore, in this new framework of management, it is possible to identify singular elements, such as ports, whose peculiarities justify the development of control and monitoring programmes specific and adequate to their characteristics (operational monitoring programmes in WFD terms).

For this reason, the management policies of ports are nowadays undergoing a process of modification towards models that conjugate social, economic, legal, technical and environmental imperatives and that meet the requirements of the WFD. With these main objectives, the paper introduces a first methodological and technical tool for integral management of seaport water quality, with direct incidence in design, evaluation and environmental monitoring of infrastructure works, activities and port operations. This tool, included in the Spanish standardisation programme of ports (ROM PROGRAMME) under the denomination of “ROM 5.1. Quality of coastal waters in port areas”, is structured in four large working areas (Figure 1):

- The programme of delimitation of uses and characterization of water bodies, to identify the physical singularities of ports aquatic systems.
- The programme of assessment and management of environmental risks, to identify and assess the effects of activities with potential to interfere with the quality of water bodies.
- The programme of environmental monitoring, to evaluate the quality of water bodies.
- And, finally, the programme of management of contaminant episodes, to reduce the consequences of possible accidental contamination episodes.
Figure 1: Diagram for application of the ROM .5.1.
USER PERCEPTION OF SHIP-WASTE RECEPTION FACILITIES AND RELEVANT CHARGES. THE THESSALONIKI PORT CASE STUDY

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European Directive 2000/59/EC [1] has set up the same aim as the 73/78 Marpol Convention [2] on the prevention of pollution by ships and targets all ships calling at all member state ports. According to the Directive a waste reception and handling plan should be drawn and applied by each port, while a cost recovery system to encourage the delivery of waste on land and discourage dumping at sea should be established by 28/12/2002.

Thessaloniki port authority s.a. was one of the first ports in Greece that fully complied with the Directive’s requirements, addressing in detail the legal, financial and practical responsibilities of the different operators involved in the delivery of waste and residues in port. The plan was studied and drawn up by the SU-PORT Thematic Network of the Aristotle University of Thessaloniki. In 2006, an extensive questionnaire survey, among the port users, has taken place, assessing the users overall opinion on port’s ship-waste management plan.

This paper considers ways of ensuring adequate provision of reception facilities and presents the approach taken by SU-PORT network to establish and evaluate the charging system for the use of port reception facilities. Results, experiences and incentives to the use of Thessaloniki’s port waste reception facilities to date are considered and presented. Conclusions are drawn and suggestions are made about the improvement of the provisions and use of waste facilities and the need of a more appropriate awareness campaign to port-users.


ASSESSMENT OF IMPACTS ON RAME HEAD DISPOSAL SITE OF DREDGE MATERIAL, S.W. ENGLAND

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The Rame Head disposal site near Plymouth, in England, has been used for over 70 years for the disposal of material dredged from within the Port of Plymouth (5.5 million tonnes in 20 years). Public concern surrounding litter, water clarity, the health of marine animals and sediment contaminants led to fears of impacts on Whitsand Bay and popular dive sites nearby from the disposal activity. Cefas have undertaken multi-disciplinary surveys over the disposal site and the wider area, to assess the quality of the local environment, with a view to the acceptability of the continued use of the site. The available evidence indicates that the physical, chemical and biological impacts are generally consistent with those accepted as related to dredged material disposal and are localised within and close to the boundaries of the disposal site. The main exception is the concentration of Polycyclic Aromatic Hydrocarbons (PAH). Elevated levels of PAHs found (5500 µg kg⁻¹ dry weight) are comparable to concentrations at other UK disposal sites, but their actual source and relative contribution from the variety of possible sources are unknown. Individual disposal events were identified by acoustic techniques, which showed no long-term accumulation of dredged material within the disposal site or near by. Some large items of litter were observed, some of which are likely to have originated from the naval dockyard, but their age and timing of disposal has not been determined.

The assessment is constrained by the physically dynamic, heterogeneous nature of the seabed and limited biological information. The available evidence indicates that the environmental effects of deposited dredge material are largely confined to the immediate vicinity of the licensed area. This supports a view that future disposal of dredged material to the Rame Head disposal site, subject to continued monitoring and assessment is an acceptable one.
IV. NUMERICAL MODELLING (WAVES, CURRENTS, SEDIMENTS)
BLACK SEA WIND WAVES MODELLING USING ARTIFICIAL NEURAL NETWORKS

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The paper is focused on engineering application of artificial intelligence technologies in wind wave modeling and in perspective for on-line forecasting.

The available experimental data from Black sea storms monitoring were used to make an attempt at showing that neural networks provide practical solutions in modeling of the basic wind wave characteristics: height, period and length.

The results obtained can be estimated as preliminary for wind wave modeling and forecasting with neural networks.

REFERENCES


СНиП 2.06.04-82, 1983. Нагрузки и воздействия на гидротехнические сооружения (волновые, ледовые и от судов). Москва, Стройиздат.
POSSIBILITIES OF MINIMIZING SEDIMENTATION IN HARBORS IN A BRACKISH TIDAL ENVIRONMENT

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Sedimentation in harbour entrances at tidal and brackish rivers cannot be avoided due to tidal currents and turbulent mixing processes. But reduction in sedimentation can significantly decrease maintenance dredging costs. Transport, erosion, settling, sedimentation and deposition of sediments in a tidal environment depend on factors like sediment size, settling velocity, tides, salinity changes and is controlled by unsteady 3D currents, turbulent mixing processes and stochastic sediment input from the upper and lower tidal part of the river.

Different mechanisms of sediment movement into a harbour in a tidal and brackish environment are evaluated in a regional numerical 3D-model of the Weser Estuary. Complex multidimensional boundary conditions were extracted from this regional model to run, as a second step, several detailed numerical 3D-models with different geometries, tidal conditions and salinity in a parametric study (Fig. 1). The influence of these parameters on sedimentation in harbours was determined. The results of this parametric study were used to develop solutions to reduce sedimentation in harbours in a brackish tidal environment.

Figure 1: Detailed model area and boundary conditions of a parametric study

REFERENCES

THE USE OF PROBABILITY DENSITY FUNCTIONS FOR ESTIMATING WAVE SPECTRAS AT LOW CRESTED BREAKWATERS

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Low crested breakwaters (LCS), submerged or slightly emerged, are shore parallel barriers constructed to match the requiring of low cost and small intrusion in the landscape. They function by allowing a given amount of wave energy to be transferred in the shadow zone to reduce the hydraulic loading and maintain, at the same time, the equilibrium of the protected environment. Although they are frequently employed in shore protection projects, and with a wide spectrum of geometrical variants, the response of the beach to their placement still remains quite uncertain. Seiji, Uda and Tanaka (1987) in a survey of 1552 breakwaters built in Japan, found that 60 percent of the structures produced accretionary developments and 35 percent did not; Dean Chen and Browder (1997) documented the dramatic sand loss subsequent to the positioning of a prefabricated underwater barrier at Palm Beach, Florida. Obviously, the purpose of improving the predictability of the functional response has to be pursuit by deepening the knowledge on the effects of wave-structure interaction, that allows the engineers to properly foresee the most relevant characteristics of the shadow zone hydrodynamics. Till now, most of the attention has been addressed to the prediction of the so called “transmission coefficient (K_t)” that is to say the amount of the potential energy of the transmitted wave field. Despite several researches proved $K_t$ to be a leading parameter for the long term evolution of the protected beach, many other aspects of the hydraulic response must be considered. Among them the Power Spectral Density (PSD) function is of course of significance for sediment transport problems as it represents the distribution of the wave energy in the domain of the different oscillation frequencies. Moreover, as already stressed by van der Meer et al.(2000), PSD contains information on wave period, that is a very important parameter for sediment transport as well as for many coastal engineering issues, such as overtopping, hydraulic stability of breakwaters etc.

At the authors knowledge, the sole available method for estimating PSD past low crested structures is that proposed by van der Meer et al. (2000). This simplified method assumes the transmitted PSD curve to be similar to the incident one for frequencies lower than 1.5 times the peak one, whereas a fixed percentage (40%) of the transmitted power is thought to uniformly spread in the range included between 1.5 and 3.5 times the peak frequency.

Moving from the analysis of hydraulic model tests conducted at a quasi-prototype scale in the Grosser WellenKanal of Hannover, Germany, this paper proposes an alternative approach for estimating PSD, that would seem to give a quite realistic description of the transmitted spectrum.

BASIS OF NEW METHOD

In developing the new prediction method for PSD the following approach has been dealt with; as a first step we found empirical formulae for the prediction of some “characteristic features” of the transmitted PSD (e.g. spectral periods $T_{01}, T_{02}, T_{-10}$, main peak, etc.); then we
assumed the \( PSD \) function to be approximated by a parametric curve (basically a probability density function) the expression of which has been fixed a priori (e.g. a Weibull function). Finally we estimated parameters of the curve, by imposing the “characteristic features” of the spectrum to coincide with those coming from the aforementioned formulae. Figure 1 shows an example of spectral estimate, obtained by combining two Weibull functions. Performances of different pdf such as Weibull, Erlang and Beta distribution have been compared.

\[ S(f) \text{ [m}^2 \text{s]} \]

\[ 0 \quad 0.002 \quad 0.004 \quad 0.006 \]

\[ 0 \quad 0.5 \quad 1 \quad 1.5 \quad f \text{ [Hz]} \]

\[ \text{Weibull} \]

\[ \text{Measured Spectrum} \]

**Figure 1: Predicted vs. measured PSD**

REFERENCES


PRACTICABILITY OF WIND WAVES SIMULATIONS IN THE BLACK SEA DEEP AND SHALLOW WATERS

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Sea state is an essential element of the closely coupled atmosphere – ocean system. Wind waves are one of the phenomena that determine it and represent the surface splitting these two most important subsystems regulating the climate dynamics. Moreover, they affect many human activities such as navigation, design of hydro-technical constructions, production and transport of oil and gas, marine tourism, and are one of the main factors for environmental security in the coastal zone and shore areas. Therefore, wind waves gain strategic geophysical significance and their observation and forecasting are relatively well-developed.

Numerical modelling is one of the most useful tools for simulation and understanding of the wave evolution. Indispensable requirement for reliable diagnostic and forecasting entails the use of the third generation wave models. On the other hand, availability of realistic input information on wind spatial and temporal distribution affects significantly accuracy of wave model output. Number of studies, based on comparison of measurements and model computations, has arrived to the conclusion that the wind fields derived from global models either in operational mode or by means of reanalysis of all available information underestimate the real ones. This is especially relevant both for storm events and for regions where wind measurements are irregular or scarce. Therefore, the aim of the present study is to explore the applicability of different sources of wind forcing data for the Black Sea region where long-term observations in deep water areas are extremely rare. This implies selection of proper regional model capable of interpolating and eventually increasing the quality of the input driving fields. The major reanalysis of ECMWF and NCEP/NCAR with 2.5 degree resolution are used as such. Higher resolution data originated from standard synoptic maps are considered to resolve the extreme storm events as well.

Three of wave models widely used in the world practice – WAM cycle 4, Tolman’s WAVEWATCH – III and Davidan’s new spectral-parametric model (SPM) – are adopted to resolve the wave field in deep water with 0.5 degree resolution. It is found that more realistic wave fields are simulated using the atmospheric pressure field reanalysis rather than the reanalysis of surface wind. The results obtained for different areas are compared with buoy measurements. The use of SPM as source of boundary conditions for calculation of waves in shallow water is substantiated. Further, transformation of waves in shallow water is simulated with the SWAN model. It is implemented and verified for the Western Black Sea shelf and coastal zone in a 2 min grid.
V. NUMERICAL MODELLING  
(WAVE-STRUCTURE INTERACTION)
This paper presents some studies on application of existing numerical models for simulation of wind-waves propagation in shallow water (SWAN, MIKE21 SW) and in protected harbour areas (MIKE21 BW) as per the condition of Bulgarian Black Sea coast. Some examples for Port of Varna, Port of Bourgas, and Balchik Marina are presented and discussed.

Wave’s transformation and shoaling effects have been studied using various numerical approaches and techniques, including various spectra applied, different options to include also ‘obstacle’ properties, varying grid and spatial resolution.

Diffraction and reflection phenomena have been simulated primarily using the numerical model MIKE21 BW (Boussinesq waves). MIKE 21 BW is capable of reproducing the combined effects of all important wave phenomena of interest in port, harbour and coastal engineering. These include: shoaling, refraction, diffraction, wave breaking, bottom friction, moving shoreline, partial reflection and transmission, non-linear wave-wave interaction, frequency spreading, directional spreading. Harbour resonance and seiching can be also modelled using BW, however this was not the purpose of this paper.

As a replica, the latest version of SWAN 40.51 that includes also effects of diffraction and reflection was also tested on application for simulation of wave pattern in a harbour area.

There are no comprehensive data from field measurements of waves in harbours at the Bulgarian Black Sea coast that allows verification of the numerical approach, however computational results have been compared to some physical model data, as well as to some very desultorily field observations.

Results encourage authors for further research in this area and application of the above models for numerical simulation of propagation of waves in harbour areas.
NUMERICAL MODELS ON OVERTOPPING OF BREAKWATERS BY WAVES

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The stability and functionality of breakwaters depends highly on overtopping by waves. Modeling of this phenomenon is a demanding task, taking into account the complex processes involved such as wave breaking, reflection, and turbulence. Numerous researchers have developed numerical models to study wave overtopping, mainly based on the Non-Linear Shallow Water Equations (NSWE). Numerical techniques based on finite-volume, shock-capturing schemes combined with approximate Riemann solvers were used quite recently to solve these equations (Hu et al., 2000). On the other hand, Reynolds Averaged Navier-Stokes equations (RANS) combined with the Volume of Fluid (VOF) method present an alternative approach with promising results. Liu et al. (1999) studied the overtopping of a caisson breakwater, protected by armour using the RANS-VOF model developed by Lin and Liu (1998). Soliman (2003) applied the same model to simulate irregular wave overtopping tests. More recently, Shao et al. (2006) compared an incompressible Smooth Particle Hydrodynamics (SPH) model with experimental data and the numerical results of Hu et al. (2000) and Soliman (2003).

In this work, numerical simulations of the tests conducted by Stansby and Feng (2004) are presented using both a RANS-VOF model (Lin and Liu, 1998) and a SPH model (Shao et al., 2006). These tests modeled overtopping of an impermeable obstacle by regular waves inside a flume. The comparison of the RANS-VOF model results with the experimental data in terms of wave height evolution and velocity vectors is reasonably good; however, overtopping rate is moderately overpredicted. Furthermore, the SPH model reproduces effectively the wave breaking and overtopping processes. Good description of the plunging front and of the splashes that appear over the structure is also provided.

REFERENCES
NUMERICAL MODELLING OF HYDRODINAMIC RESPONSE INDUCED BY SUBMERGED BREAKWATERS AT TORRE DEL GRECO, ITALY

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In Italy in the last few years due to an increasing environmental awareness the designers of coastal structures are more frequently using submerged breakwaters as beach protection systems. Many uncertainties on the breakwaters behaviour in the breaking zone still exist mainly due to the difficulties in determining hydrodynamic response induced by the barriers either theoretically or experimentally.

This paper analyses the hydraulic performance induced by a system of submerged structures located at Torre del Greco (Italy), with particular interest in the rip current patterns that frequently develop at gaps and roundheads. The first numerical model consists of a parabolic wave model (Berkoff, 1972) MIKE 21 PMS developed by DHI Software for calculating integral wave parameters and radiation stresses, while the flow computations are carried out with a depth averaged flow model (Abbot, 1979) MIKE 21 HD. The second numerical model consists of a parabolic wave model REFDIF (Kirby and Dalrymple, 1983) and quasi-3d circulation model SHORECIRC (Putrevu and Svendsen, 1999) developed by University of Delaware and modified previously by some of the Authors (Budillon et al., 2006; Giordano et al., 2006). The main purpose of the paper is to show which are the main differences between the two codes in order to get information that may be very useful for structure designers.

Figure 1: Circulation pattern around submerged barriers at Torre del Greco, Italy

REFERENCES:


WAVE-INDUCED CURRENTS BEHIND A REEF BREAKWATER

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A study on numerical simulation of wave-induced currents behind a reef breakwater is presented in this paper.

The primary purpose of reef breakwaters is to enhance wave breaking, and this way to reduce the hydraulic loading to a required level that maintains the dynamic equilibrium of the shoreline. However, wave breaking (and associated turbulence and bottom boundary layers problems), are not understood well - research performed so far on mechanism of breaking of waves passing submerged obstacles is uncompleted, numerical models are crude.

The first step was to study wind waves propagation in shallow water. Spectral wave models (SWAN and MIKE21 SW) have been applied to simulate waves transformation and shoaling effects. This included various spectra applied, varying grid and spatial resolution (Figure 1).

![Figure 1: 3D numerical reef bathymetry](image1)
![Figure 2: Numerical simulation of wave-induced currents (FM)](image2)

2D waves in the vicinity of coastal structures have been simulated using Boussinesq Wave (BW) module of MIKE21. Radiation stresses calculated by the wave models have been used as input to MIKE 21 FLOW model to simulate wave induced currents around reef structures.

Numerical results have been compared versus results from physical model tests of transmission of waves behind reef breakwaters (Penchev et al., 2007). Good correspondence has been concluded, that encourages author for further research in this area.

REFERENCES:

Penchev V., Scheffermann J., S. Shukrieva, Zimmermann C., EVALUATION OF REEF BREAKWATER EFFICIENCY BY PHYSICAL AND NUMERICAL SIMULATIONS, Annual Book Franzius Institut, January 2007
VI. NUMERICAL MODELLING
(HYDRODYNAMICS)
HIGH RESOLUTION HYDRO-ECOLOGICAL MODELLING IN THE COASTAL ZONE

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About 60% of the world population are living in a stretch less than 60 km from the shoreline; most of the world’s largest cities are located at the sea. This area produces food and livelihood for a high percentage of the world’s population; thus, these areas are exposed to severe pollution and environmental degradation.

Coupled atmosphere-marine 3D modelling complex FRESCO is used to simulate the hydro-ecological dynamics of the coastal sea and to study the transport of pollution under the different weather conditions.

A multidisciplinary numerical model system FRESCO with horizontal grid for atmosphere of some kilometers and for sea are less than hundred meters simulates:
- atmospheric dynamics,
- wind waves,
- marine hydrodynamics,
- marine ecosystem,
- suspended material transport.

It has been used for practical applications in coastal zones of the different seas (Baltic Sea, Mediterranean Sea). Though computational resources have quickly increased, it is still advantageous to pursue cost effective methods for atmosphere-sea modeling to reduce computational expense. This is very important for very high resolution calculations in the modeling of coastal dynamics. We examine the computational advantage feasibility of using:
- nested domains calculation
- online-offline modeling,
- splitting-up method,
- size-dependent parameterization of the biochemical reactions.

The aim of this presentation was to study the influence of the wind waves and turbulent mixing via boundary layer dynamics on the coastal hydro-ecological dynamics. Pronounced influence of the wind waves and turbulent mixing on the plankton community, nutrients and suspended material distribution is shown.
A THREE-DIMENSIONAL NUMERICAL MODELLING OF CONTAMINANT DISTRIBUTION FROM ARVAND RIVER INTO THE PERSIAN GULF

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We have employed a three-dimensional hydrodynamic model to study the contaminant dispersion in the northern part of the Persian Gulf, which is an inverse estuary of excessive evaporation.

The Persian Gulf is an important military, economic and political region owing to its oil and gas resources and is one of the busiest waterways in the world.

Countries bordering the Persian Gulf are the United Arab Emirates, Saudi Arabia, Qatar, Bahrain, Kuwait and Iraq on one side and Iran on the other side.

A contaminate has been released from Arvand River into the Persian Gulf for a year.

The findings contribute to an understanding of circulation patterns in the Gulf as an aid to ship traffic and management of oil spill events. Also the trace of the contaminant is in a very good agreement with observations.
TIDAL WAVE PROPAGATION IN THE BRANCHES OF A MULTI-CHANNEL ESTUARY: THE MEKONG DELTA CASE

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Observations in alluvial estuaries indicate that a damped tidal wave moves slower than is indicated by the classical celerity equation and the celerity of propagation is faster if the tidal wave is amplified. The Mekong Delta, Vietnam, is a multi-channel and strongly riverine estuary consisting of eight branches. The tidal wave in the Mekong Delta is damped and therefore it is expected that the tidal wave moves considerably slower than is computed by the classical equation. Based on the observations at High Water Slack and Low Water Slack moments in the dry season of 2005 in the four main paired branches of the Mekong Delta, this paper aims to:

(i) Testing the agreement among the observations, a newly developed equation describing tidal celerity of Savenije and Veling (2005) and solutions of the Mekong's hydrodynamic model in MIKE11;

(ii) Exploring the characteristics of the tidal wave propagation in the main four branches of the Mekong.

The test leads to the good agreement among the observations, the analytical equation and the model in MIKE11, confirming the expectation of slower waves. Moreover, the mathematical solutions and observations show that the wave pattern in the two sets of paired estuaries is similar; this reaffirms the assumption of “paired estuaries behave as an entity” of Nguyen and Savenije (2006).
CONTROL STRUCTURES FOR FLOOD AND RISK MANAGEMENT - CASE STUDIES OF MISSISSIPPI RIVER DELTA AND WESER RIVER ESTUARY

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Large parts of coastal hinterlands especially at tidal rivers are endangered from inundations during storm surges and floods. Coastal hinterlands are usually protected by a system of protection elements, e.g. levees and storm surge barriers.

Design loading parameters are dictated by extreme storm surge water levels and river discharges. An efficient flood and risk management might reduce risks and mitigate increasing hazards due to changes in water levels and frequencies.

At the Franzius-Institut impact studies simulating the tidal behaviour and the tidal propagation in dredged estuaries were performed using calibrated numerical models. Case studies at the Weser River estuary in Germany and the Mississippi River delta in Louisiana, US, have been done.

In these areas the coastal hinterland is below mean sea level and extreme floods and storm surges / hurricanes give risks for large scale inundation. Simulated i.a. were the effects of control structures like storm surge barriers, potential polder areas and spill-ways on water levels.

The variation of boundary conditions and control strategies indicate that optimized control strategies can reduce the tidal high water level in estuaries and deltas to a limited extent and therefore minimize the probability of failure of the coastal protection system.
VII. COASTAL STRUCTURES
EFFECT OF CLIFF SHAPE ON INTERNAL STRESSES AND ROCK SLOPE STABILITY

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The failure of coastal rock cliffs is attributed to a variety of factors such as weathering, wave action, ground water level, and rock and joint parameters. The wave induced undercutting of the vertical cliff face is hereby assumed to play a critical role (Lee & Clark, 2002). Very little attention has however been paid to the gravity induced stresses within the cliff face (La Rochelle, 1960; Savage, 1993). A numerical analysis of the stress distribution in idealised rock cliffs of varying slopes (50-90°) and in various stages of undercutting has been conducted. Investigated parameters included slope angle, cliff height, influence of a cliff base cavity, front face loading and cliff surcharge loading. The analysis showed that stresses in the cliff face geometry immediately after a failure were insignificant. With the steepening of the cliff stresses increased to reach very high values for a vertical cliff face. Additional undercutting of the cliff resulted only in a slight increase of those stress magnitudes. The steepened rock cliff can result in an unstable equilibrium condition, depending on cliff geometry and the ratio of gravity induced stresses (a function of cliff height) and material strength, which can lead to sudden cliff failure. The results of this study indicate that the most important parameter in cliff destabilization is wave induced steepening of the cliff slope.

REFERENCES


Wave run-up prediction based on field measurements performed for the Schleswig-Holstein coast protection dikes

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For the performance of a safety analysis, model and procedure has been developed for calculation of the decisive wave run-up and overtopping of coastal protection dikes.

This model considers the natural sea state characteristic as well as the complexity of the dike cross-sections in nature and are based on results from long-time flotsam level surveys, on results from extensive wave measurements on foreshore of dykes at different places at the German North Sea coast and on results from wave run-up measurements in field at dykes with different cross-sections and sea state conditions as well as from large-scale laboratory tests.

Procedures for verification and calibration of the model are discussed and compared with the EAK – 2002 recommendations.

Figure 12: Comparison of calculated wave run-up SWL + Ri with results from field measurements at the Stintec measuring section.
HYDRAULIC BEHAVIOUR OF SUBMERGED BREAKWATERS

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The conceptual design of coastal structures involves in modern times important non-technical considerations, such as the protection of the ecosystem, the aesthetic value of the nearshore landscape, etc. Thus, new forms of the conventional structures are employed, among which the submerged offshore breakwaters are becoming widespread. On the technical level, a principal measure of the protection afforded by such structures is offered by the wave transmission coefficient. This has been extensively studied in laboratory experiments and relevant formulas were produced. An aspect not thoroughly investigated so far is the effect the structure porosity has on the above coefficient. Recent studies showed that the porosity might have an appreciable effect on the wave field behind the breakwater.

On the ecological level it is known that the flow field in and around the structure plays an important role to establishing a friendly environment to seawater life. Again, for a given wave environment, porosity is the key factor in controlling the hydrodynamics inside and around such structures.

The present study contains a review of the relevant research pertaining to introducing the structure porosity into the relevant wave models; comparisons of the transmission coefficient resulting from models and formulas taking or not into account the porosity of the submerged structure; investigation of the hydrodynamic field inside the structure in the presence of either waves or simple ambient currents. The characteristics focused upon are the velocity and pressure fields. These are being regarded as being the key factors to assess the sea environment with respect to its value as habitat. In this paper a review of the results for the transmission coefficient over submerged breakwaters will be given, based on investigations taking or not the structure porosity into account. Also, some results will be given regarding the hydrodynamics inside the structure depending again on its porosity. The combination of the two points of view, i.e. technical and environmental, hinging on the same factor, the porosity of the structure, will be underlined and ways of its practical exploitation will be proposed.
A TENTATIVE FORMULA FOR LOW CRESTED BREAKWATERS RANGING FROM SUBMERGED TO EXPOSED

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In the last years a growing attention has been drawn to low crested structures (LCS) owing to their capability of meeting both the requirements of shore erosion control and landscape safeguarding. It should be emphasized that wave reflection plays a relevant role in the functional performances of LCS as it is strongly related to scour phenomena occurrence at the seaward toe of the breakwaters and because it may of course influence the amount of wave energy dissipated in the wave-structure interaction.

Recently, a number of important studies are being published on this topic where empirical formulae are proposed for the prediction of the reflection-coefficient, $K_r$, which represents the reflected to incident wave height ratio. Among them two interesting expressions has been presented by Zanuttigh and Lamberti (2004) and Zanuttigh and van der Meer (2006). Nevertheless, data on LCS come from researches not directly addressed at studying wave reflection; consequently the parameters that may affect $K_r$ have been not varied enough, making the selection of main variables of the formulae not very easy. For this reason a good deal of experiments (nearly 1000 2D tests) have been designed and conducted at the University of Naples (UoN) “Federico II”, using LCS models where most of leading parameters for wave reflection, namely crest freeboard, crown width and front slope (beside wave height and period) have been varied. Only regular waves have been here used. The data base collected at the UoN has been enlarged with data coming from similar experiments conducted at the University of Bristol (Debski and Loveless, 1997) and University of Caen (Garcia Govea, 2000), obtaining nearly 2000 experiments on wave reflection at LCS.

PRELIMINARY RESULTS

Figure 1 displays the comparison between UoN data and the Zanuttigh and van der Meer formula (2006). On the whole data seem to agree at some extent with the prediction, although a relatively large scatter is evident. Of course, this scatter may be reduced, in the authors opinion, by deepening the knowledge about the wave reflection process at LCS, allowing for a more suitable choice of the governing variables in the design formulae.

![Figure 1: Comparison between UoN data and Zanuttigh and van der Meer (2006)](image-url)
REFERENCES


VIII. COASTAL MORPHOLOGY
MORPHODYNAMICS OF TIDAL INLETS IN A TROPICAL MONSOON AREA: CASE STUDY OF HUE TIDAL INLETS, VIETNAM

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Tidal inlets play an important role in water and sediment exchange between tidal basins and coastal zones. Morphological evolution of tidal inlets may lead to significant economic, social and environmental impacts. Therefore, tidal inlet dynamics has been noticed and studied extensively since the beginning of the 20th century (e.g. Lorentz, 1926; O’Brien, 1931; Escoffier, 1940; Bruun and Gerritse, 1959). But the studies mostly concentrate to the inlets with the contribution of river inflows is irrelevant. A few studies have been carried out for the tidal inlets in tropical monsoon areas where the contribution of river inflows is significant and inlet morphology has a seasonal variation (e.g., Ranasinghe R. and Pattiaratchi, 1995, 1996, 1997, 1998). Many relevant influences to tidal inlets in tropical monsoon areas such as those made by river floods or typhoons have not been studied.

This paper will present a study on morphodynamics of tidal inlets situated on the micro-tidal wave-dominated coast of Thua Thien-Hue province in central Vietnam. This is a twin inlet system connecting a large lagoon of 220 km2 to the sea. Under the tropical monsoon climatic conditions, the morphology of the inlets is highly dynamic and variable. In the NE monsoon season, the inlets are strongly influenced by river floods which may change inlet morphology dramatically and create breaches in the sand barriers. Furthermore, typhoons active in this season also may have effects to inlet and coastal morphology. In the SW monsoon season, marine processes are dominant. Wave-driven sediment transports lead to shoal the inlet channels, ebb deltas and cause the migration or closure of the inlets. Therefore, morphodynamics and morphological behaviours of the inlets are very complicated and not well understood.

The study has been carried out using a numerical modelling approach based on available survey data. To overcome data limitations, several modelling packages have been used and nested to interpolate and transform survey data available into information at the inlet areas. Firstly, a model of the continental shelf based on DELFT3D has been used to create seaward boundary conditions for the inlets. This model produced information of water level and flow field generated by tides, winds and waves in both normal and typhoon conditions. Secondly, tributary flows from the river network to the lagoon and inlets have been simulated using SOBEK-RURAL modelling package. To simulate river floods, the package has been used with the coupling of a one-dimensional module for river network and a two-dimensional
module for overland flows on the floodplain. Data from upstream gauges and results from continental shelf model have been used as model boundary conditions. Finally, a detailed model has been set up to simulate morphodynamics of the inlet using DELFT3D with boundary conditions produced from the above models. The models have been calibrated and validated with field data of hydrodynamics and bottom topography. With the help of the numerical modelling system, the understanding on tidal inlet morphodynamics has been enhanced. Some phenomena happened in the inlets such as the migration of the inlet channels, the evolution of the ebb-deltas and adjacent coasts, can be explained.
MODELLING OF CROSS SHORE PROFILE CHANGES UNDER COMBINATION OF EXTREME STORM EVENTS

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In the present work a process-based approach is used for developing of a morphodynamical model. The model of cross shore profile evolution consists of three main modules: a module of wave propagation in shallow water, a module for calculation of sediment transport and a module for bottom shape evolution. Firstly, the equation of wave vector conservation is solved numerically and secondly the wave heights are calculated by the wave energy conservation equation. Wave set-up and roller are taken into account in the hydrodynamical module. In accordance with the wave parameters a profile zonation is performed in each time step, and different formulas for sediment transport are used in the swash and surf zone. A module for sediment transport is based on the Bailard’s approach. The bottom profile evolution is calculated by the equation of sediment flux conservation.

The work of the first module is verified in the previous studies (Trifonova, 2006) as well as the model’s work is verified against the laboratory data. The present study, however, aims at the verifying of the model’s work against the morphodynamic data obtained from field experiments conducted at the Bulgarian Black Sea Coast during a storm.

Finally a short summer storm that occurred in 2006 is reconstructed and wave parameters in deep water are estimated. The model is applied to a real storm situation at the Irakli beach (in the middle part of the Bulgarian Black Sea coast), and the obtained results are accepted as satisfactory.

REFERENCES

THE INTERACTION BETWEEN THE FLOW IN THE SWASH ZONE AND THE COASTAL WATER TABLE

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Groundwater dynamics are a major part of the swash zone hydrodynamic due to potential exchanges between the subsurface aquifer and the flow above. The beach groundwater system is a highly active, shallow, unconfined aquifer in which flows are driven through sediments by tides, waves and swash oscillations. The swash wave front moving toward the onshore direction becomes steeper due to linear effects, which subsequently results in significant hydraulic gradient thus causing in/exfiltration velocities at beach face. The vertical flow exerts a force within the bed called the seepage force. Infiltration and exfiltration through the beach surface are expected to vary in some degree during runup and backwash depending on groundwater levels, the permeability of the beach material and the degree of saturation. The in/exfiltration effects on swash zone sediment transport are discussed in light of two mechanisms: effective weight modification and boundary layer thickening or thinning. Although in/exfiltration is the primary mechanisms by which groundwater flow is thought to influence sediment transport in the swash zone, the potential of beach groundwater fluctuations to cause bed failure due to instantaneous fluidization has also been considered.

This paper reviews research on beach groundwater systems and the influence of swash in/exfiltration on beach hydrodynamics and sediment transport.
A long sea outfall is proposed to dispose secondary-treated effluent from a wastewater treatment plant. Given the long design life of such a structure and hence the large future flow rates expected, the design diameter of the outfall pipe is expected to be considerably larger than required to meet the near-term demands. While the economics of the project dictate a larger diameter, the low flow rates in the years immediately following construction can lead to excessive sedimentation within the pipe.

This paper summarises the results of a case study to assess the sedimentation within the pipe, mechanisms to purge the sediment, and its impact on the coastal environment. Flow characteristics in the outfall and resulting plumes are modelled and the sedimentation loads for a range of operation conditions of treatment plant, flow rates, and pipe diameters are computed. Various options involving pipe diameter, number, slope, and jet arrangements are evaluated and recommendations are made based on the capital cost, coastal - environment impact and operational and maintenance issues.
IX. COASTAL ZONE MANAGEMENT
COASTAL ZONE MANAGEMENT AT THE NORTH SEA
ISLAND AMRUM

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Due to their exposed location, the islands of the North Sea Coast are characterized by intense morphodynamics, which may lead to sustainable changes of the coast in short terms. Against the background of the climate change in whose course the intensity and the quantity of extreme events may increase, an instrument for a sustainable Coastal Zone Management is demanded (Schuchardt & Schirmer, 2002). Three heavy storm surges within the period from November 2006 to January 2007, which caused massive erosion at the dunes of the islands, gave an impression of a possible future development. By the means of the example of the German island Amrum the risks of coastal dune erosion and flooding as well as a tool that helps to evaluate future civil works and possible erosion scenarios are described.

Available historical and current data are summarized and evaluated. Therefore, the existing coastal protection system, the morphological development of the island and possible erosion scenarios are taken into consideration. Although the safety of the coastal protection at Amrum is high at present, some places demand a continuous monitoring. During past extreme events parts of the dunes in the north of the island were destroyed and the danger of a separation of the northern spit was given (Ehlers, 1988). A greater part of the eastside underlies natural erosion. The integration of the affected population into the planning of coastal protection measures is of huge importance.

The summary of the research in a web-based Decision Support System offers an instrument for the interested and affected public to get information about the coast protection of the island. Furthermore it provides a basis for communication between the decision makers in the authorities and benefits a reasonable use of the available financial funds. A risk analysis is implemented in the DSS to assess different measures in coastal protection. An access of all involved parties to the DSS is necessary and a continuous update should be carried out.

Figure 1: Destruction of dunes during a storm surge in the 1960’s

REFERENCES

EXTENSION AND OPTIMIZATION OF THE EXISTENT SHORE PROTECTION FACILITIES ON ROMANIAN SOUTHERN LITTORAL

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Due to the coastal geo/hydrodynamics changes induced by the navigation works on the Romanian Black Sea Littoral, negative changes of the coastline have been registered in the last four decades. The surveillance of the shoreline evolution shows the need of the shoreline management together with the priority for coastal protection and rehabilitation. Also, the survey of the existing shore protection facilities had revealed the structural integrity and their degree of effectiveness in erosion control. It was determined the priority actions for the vulnerable coastal areas, together with the several complementary beach protections against the threat of high waves and storm surges.

In the present work will be presented and analyzed from multiple points of view the main results of a master plan for coastal protection on Romanian littoral developed between 2005 - 2006 by Japanese and Romanian experts.
MONITORING OF HYDRODYNAMICS AND MORPHODYNAMICS IN A TIDAL FLAT AREA

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The tidal flats of the German North Sea coast are affected by intense morphodynamic processes. Especially in the estuaries changes of sedimentation and erosion occur during different time frames and challenge the decision-makers and stakeholders. To satisfy the requirements, which modern cargo ship industry demands, a concept for sediment management has to be developed to grant an economic and ecologic balanced system. To evaluate different actions and their effects, e.g. by means of numerical models, an improved knowledge of morphodynamic processes on tidal flats is required. The Institute of River and Coastal Engineering at the Hamburg University of Technology runs momentarily extensive measurements to collect hydrodynamic and morphodynamic data of tidal flats in the estuary Elbe that is the approach to the harbour of Hamburg.

Water levels, flow velocities and flow directions are recorded in high resolution as well as waves and the concentration of suspended sediments. Furthermore the bathymetry is determined in frequent intervals by a multi-beam echo sounder. To assess the long-term development of the area historical data is analysed.

The data evaluation shows a constant development of the area under investigation for longer periods under observation. Shorter time scales instead indicate a greater variability of the morphology. A main creek is responsible for the flooding and the drainage of the area under investigation. During normal tides the concentration of suspended sediments reaches the maximum time delayed to the maximum of the flow velocity. The sediment transport is, therefore, primarily related to the tide flow. A heavy storm surge did not affect the morphology directly after the event.

A model for the calculation of sediment transport in shallow water sections of tidal flats is going to be developed based on the results of the research project. Tidal flats underlie complex morphodynamics, which require the knowledge of the occurring processes. This knowledge can be achieved by high-resolution measurements whereas a certain simplification is necessary.

Figure 1: Results of multi-beam echo sounding and position of the longitudinal section

Figure 2: Longitudinal section of the main creek
A FUTURE ACTION PLAN FOR THE ELBE ESTUARY

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Apart from being an important federal waterway, large parts of the Elbe estuary have been designated as protected area in the sense of Natura 2000. This leads to a number of conflicts between the commercial obligation to maintain certain water depths and the preservation of these designated areas. Therefore the Hamburg Port Authority in close cooperation with the Federal Administration for Waterways and Navigation plan to establish a future action plan for the Elbe estuary to ensure the conservation of the invaluable estuarine system.

Man-made changes along the Elbe estuary together with evolutionary processes like sea-level rise have removed the ability of the River Elbe to dissipate tidal energy in meandering channels and varying bed forms, so that today the flood tide propagates with more energy into the estuary. These changes have resulted in an upriver transport of suspended sediment, which normally used to settle in the marshes and is now carried into the harbour of Hamburg.

Moreover the hydrodynamic of the system have changed. On the one hand side the tidal low water decrease and the tidal high water rise within the system and on the other hand there is a risk of an increase of the flood tide dominance upstream Glückstadt with the associated risk of enforcing the residual transport of sediments upriver, which is referred as “tidal pumping”. Furthermore this is associated with a gradual reduction of the flow velocities in intertidal areas and tributary channels, leading to siltation in these areas. In the long-run aspect the whole system will degenerate from the ecological point of view.

In this context the paper will describe the immediate needs and the current situation of the Elbe estuary and explains the future strategies and their frameworks. The political aspects will be analysed and the need for research followed by appropriate action will be shown. The main actions will be:

1. Dissipation of the incoming tidal energy by hydraulic engineering constructions especially within the mouth of the estuary;
2. Establishing flooding areas between Glückstadt and Geesthacht;
3. Optimising the sediment management considering the whole system.

By implementing this concept a win-win situation for economic and ecological interests can be achieved.

REFERENCES

COASTAL EROSION OF THE CONSTANTA COASTLINE - CAUSES AND SOLUTIONS

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Constanta county is situated on the west shore of the Black Sea, with a shore of more than 100 Km in length. Its coastal zone concentrates an important part of economic activities, is highly populated, and had known an aggressive development.

One of the problems of the Romanian seacoast is the intense erosion phenomenon from the last 20 years, affecting 60% of the total length, while on 40% is a trend of stabilization and land regaining. The North zone, till Constanta city, is the most affected, yearly, we lose approximately 5-6 meters of beach; while the South zone, from Constanta to Vama Veche looses 1 - 2.5 m/year.

Human activities had an important contribution at the erosion process: dams built on the Danube River and its tributaries, diminishes nearly 50% of all alluviums, that normally would reach the shore; expanding/renewal of harbors; sand beaches used as construction material; sea water pollution that caused a diminish of shellfish “stock” with approximately 50%, resulting less bio – sand (exists zones where the proportion between shells fragments and sediments is more than 50% in favour of first): the paper will present data regarding pollutants and pollution sources.

Also climate change has a role, through an increase number of highly intense storms, with consequences like the beach flood and the change of waves attack line; it is noticed a tendency of sea level rise, an average of 1,5 - 2 mm/year, determining a retread of the shore line.

The erosion trend of the Romanian seashore can be compensated through measures that will attenuate the human interventions but also will reduce the natural sea effects. The last part of the paper will present the situation of the existing jetties and what new constructions must be done and also the sectors where beach nourishment is necessary.
Bulgaria lately underwent tremendous changes that affected local people’s life in different ways. In the course of this change, it was of vital importance for the businesses and individuals to find their proper place in the changing environment. The coastal zone of Bulgaria became area of rapid development. The dominating growth of tourism goes along with urbanization not always in harmony with the environment. In order to avoid negative impacts, highest expertise in Coastal Engineering and Coastal Zone Management is a must. Learning from the EU experience one naturally comes to conclusion, that common civil engineering background traditionally regarded in Bulgaria is already rather insufficient. Today’s engineer must have gathered particular knowledge in Coastal Engineering.

Contacts with experts from EU, and particularly from the Netherlands some fifteen years ago have led to conclusion that the process of conveying knowledge and expertise in coastal engineering to Bulgaria can be boosted. The existence of a core of professionals that share this idea was considered an important precondition in this respect. The establishment of the Black Sea Coastal Association, acting as organization that efficiently could act as counterpart to facilitate knowledge transfer partnerships in coastal and port engineering and coastal zone management, was an important factor that speeded-up this process. The contacts with UNESCO-IHE, TU Delft, Franzius-Institut Hannover, and other EU institutions, the moral support and encouragement, were of great importance for building expertise in coastal engineering in Bulgaria.

The role of the scientific conferences and seminars performed on a regular basis, as well as on the training activities and the participation in European projects is emphasised also as a very important factor.

A brief review on some interesting coastal engineering projects and studies at the Bulgarian Black Sea coast is presented in the paper.

As a conclusion, permanent contacts with academic society, prestigious EU consultancies, dredging contractors and professionals is reported as a main factor in building expertise in coastal engineering in Bulgaria, and is highlighted as an integral part of the future development in this area.
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