

R&D Technical Summary FD1901

Development of Predictive Tools and Design Guidance for Mixed Beaches

Background to R&D project

Coarse grained beaches are an important feature of the UK coastline. They form barrier beaches in front of low lying marsh lands, toe protection along eroding cliffs and wide, prograding nesses where local hydrodynamic conditions encourage deposition. These beaches are occasionally formed predominantly of steeply inclined gravel or cobbles, but more often they comprise a less steep upper beach of mixed sand and gravel fronted by a wide lower foreshore of sand or a rock platform. Although found in many other areas of the world, mixed beaches are of particular interest to UK shoreline managers where their coast defence characteristics help to protect substantial urban areas and high value agricultural, recreational and environmental assets.

The understanding of mixed sand/gravel beaches is relevant to the management of over one third of the shoreline of England and Wales, and almost all of the heavily populated south-east coast of England. However, despite their importance, the majority of the existing research into coastal processes and morphology change in the last fifty years has been concerned with sandy beaches. Some research has been devoted to gravel beaches and but almost none to mixed beaches, with some key issues having not been tackled at all (Mason and Coates, 2001).

The overall aim of the research was to facilitate the development of Coastal Strategy Plans and Beach Management Plans by:

- Improving understanding of processes and responses for beaches with widely graded sediments including sand and gravel,
- Developing predictive tools for beach responses, and
- Disseminating information and guidance to UK shoreline managers.

The objectives of this programme were to:

- Consolidate MAFF funded work on surf zone hydrodynamic over porous beaches (OTTP – ANEMONE and Shingle Beach Research Programmes),
- Continue to monitor and review existing data, published research, laboratory studies and numerical model developments both in the UK and internationally,
- Undertake process studies of the important factors controlling transport (threshold of motion, flows through porous sediment) using physical models,
- Develop a conceptual model of cross-shore transport into a numerical study, and
- Disseminate guidance to the UK and EU coastal community.

Results of R&D project

The aims of the mixed beach project were successfully concluded and have been communicated through papers and reports as well as conference and workshop presentations. The research has yielded a significant step forward in understanding the key cross-shore processes involved and this has identified further research to improve UK beach management methods. Full details of the research are published in the Final Report. The following summarises the conclusions:

- Typical mixed beaches in the UK have a bimodal composition, with approximately 20-30% in the sand fraction. The composition of these beaches is very variable spatially (alongshore, across-shore and with depth) as well as temporally (daily and seasonally).
- Previously available empirical predictive tools, when applied to mixed sediment beaches, produced broadly the right results but should only be used as qualitative tools together with the conceptual model of beach processes presented in this research and with the new formulations proposed for crest and step elevations.

- The HRW numerical cross-shore model with permeability and morphological predictive capability (OTTP 1D) has been found suitable for predicting wave processes, velocities, overtopping of the beach crest and flow over an impermeable beach core. Validation results for the morphological model of gravel beaches are encouraging. However, due to the complexity of the behaviour of mixed beaches, the development of a mixed beaches cross-shore modelling capability will require further research effort beyond the present project.
- From the analysis of the experimental and field data, the understanding of the processes that prevail in coarse-grained beaches and their inter-relationship has been broadened, but a number of areas of important further research were identified.

R&D Outputs and their Use

The final report presents technical information and research findings from the project, it draws extensively on the HR Wallingford sponsored PhD thesis submitted by Lopez de San Roman Blanco (2003) that provides a full and detailed account of most of the research associated with this project, the literature review (chapters 2 and 3) is presented as an annex to the Final Report. Other details of the work completed may be found in HR Wallingford document TR130 accessed using the following website address (<http://www.hrwallingford.co.uk/publications/coastal.html>).

The following work has been completed:

- Field experiments at Seaford and Slapton Sands,
- Completion of permeameter, threshold, swash zone velocity and boundary layer experiments using small scale laboratory facilities,
- Successful completion of the EU-TMR full scale wave flume research using the GWK facility in Hannover, working with a project team from UK and European Universities,
- Compilation of all GWK experimental data for use by other researchers within Report TR130 and within a database held at HR Wallingford for distribution on CD ROM, and
- Further development and validation of the OTTP cross-shore beach model.

In addition, the project has provided training and research opportunities for a number of young scientists, and has fostered collaborations between HR Wallingford and UK, French, Italian and German Universities. These collaborations realised a very high return through access to academic research, field measurement programmes, laboratory facilities and, most importantly, the opportunity to undertake unique prototype scale experiments within the EU funded GWK facility in Hannover.

 This R&D technical summary refers to R&D Project FD1901 and the following R&D outputs:

- **R&D Final report - Development of Predictive Tools and Design Guidance for Mixed Beaches.** Dated May 2003.
- **R&D Final report appendix A - Dynamics of gravel and mixed, sand and gravel, beaches (Chapters 2 and 3).** Published May 2003.

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The above outputs are available to download in pdf format from the Defra/EA Flood and Coastal Erosion Risk Management R&D Programme website: www.defra.gov.uk/environ/fcd/research.

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