JOURNAL OF COASTAL AND HYDRAULIC STRUCTURES

Review and rebuttal of the paper

Exponentially Reduced Reflection (ERR) versus Linear Wave Theory (Airy-Laplace)

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Editor handling the paper: Hans Bihs

The reviewers remain anonymous.

Dear reviewers, dear editor,

thank you very much for your time, for your valuable comments and suggestions! In this cover letter we will answer the questions raised and explain the changes we have incorporated. First of all, the authors would like to emphasize that the manuscript is an abridged summary of part of the findings on orbital kinematics contained in Büsching (2019). The later, on the other hand, is extended by the parameter orbital acceleration, so that in the end the theory ERR can be presented for practical application. For reasons of brevity, knowledge of the author's previous results is assumed, and the author would like to encourage interested scientists to read his previous publications since 2010.

To help reviewers classify the author's previous findings on which the actual paper is based, some references to their research background are provided in the author's responses to the reviewer's comments. Please refer to the author's response to reviewer B's comment on item B3.

Reviewer B:

B1. The manuscript is quite unclear in the formulation of its premises. The reviewer fails to make any sense of the first line of the manuscript "The linear wave theory according to Airy/Laplace (1842) is widely used by engineers however violates the law of conservation of mass and considers local ground inclination $\alpha = 0$ only."

Authors´ response: The authors are grateful for addressing the first line of the manuscript´s abstract and agree with the reviewer. Therefore, the abstract has been extended by about 5 lines.

B2. Further the manuscript goes into mathematical derivations in an unclear manner with no clear definition of the eventual useful results for engineers, which seemed to be the premise of the manuscript

Author´s response: In fact, the intention of the manuscript is to explain the benefits of ERR theory to the scientific community and make it applicable to potential users. For this purpose, it might be helpful to know the author's latest findings (since 2010) on the important phenomenon of reflection. In line numbers 7 to 16, the manuscript introduces the term Exponentially Reduced Reflection (ERR), which had been initiated (a priori) by Schulejkin's work on orbital velocities above a horizontal edge streamline. In his derivation of the classical relationships for a shallow sea with a horizontal bottom, he had described elliptical trajectories. Thus, the orbital movement of waves with ground contact can be constructed from that without ground contact (deep sea). For this purpose, the ground at a depth $d < L/2$ is understood as a mirror, so that the orbital kinematics, which (after equation (4)) continues behind the mirror, is superimposed to the orbital kinematics present in front of the mirror. The result for trajectories over horizontal ground is the elliptical passes shown on the left side of Figure 5.

Schulejkin provided the equations to analytically describe elliptical orbits by superimposing only the two respective circular orbits in front of and behind the mirror. Based on his own reflection studies, the author has concluded that this effect has not yet received the attention it deserves. For Schulejkin,

"reflection" and "mirroring" probably had slightly different meanings, so that he used mirroring only in the sense of a trick to describe dynamic processes through fixed edge streamlines of a flow field. Since in his case a phase shift $\Delta\phi$ (phase jump) does not occur due to the edge streamline of a smooth flat seabed, he did not think that a phase shift (between incident and reflected waves) could play an essential role. The author, on the other hand, had made such a conjecture on the basis of the observation of two wave break processes that took place side by side (approximately synchronously) above the same slope 1:n, but on 2 different surface structures, whereby 2 different types of breakers and wave heights could be observed.

B3. The manuscript bases itself heavily on the works of just one author and makes it quite difficult for the reviewer to judge the relevance of the presented work. The context of the current state of the art, the relevance of the current manuscript and the results are simply unclear.

Author´s response: Since Schulejkin's works are little known in Western countries, the authors refer to the reviewer's formulated reservations about both Schulejkin and the manuscript. Schulejkin was 61 years old when he published his work "Theory of Ocean Waves" in 1956. It seems to be his last one of a total of 130 publications. The manuscript refers to the second edition of Schulejkin´s book in German in 1958.

First, Fritz Büsching (1974) cited this work because Schulejkin used a method in which the law of conservation of mass is observed a priori when considering the influence of the sea floor. To the author's knowledge, there is no further research on this topic. Regarding the assessment of the relevance of the presented work:

In 1974, field data from the storm surge surf zone were first analyzed using high-precision automated systems such as the Hewlett Packard Fourier Analyzer and a Pulse Hight Analyzer. The main output in the field of spectral analysis about the present topic is summarized in Büsching (2018) https://doi.org/10.24355/dbbs.084-201805080949-0.1 The topics are: Discovery of the effect of anomalous dispersion on high-energy surf waves and Conclusion on the existence of surf zone resonances based on basin vibrations, which in turn are due to reflections. Later the effects could also be demonstrated in the wave tank. Since 1991, the author has been operating a combined flow and wave tank, which, according to his own ideas, was equipped with a spectral wave generator for the investigation of hollow body cover elements compared to a smooth revetment.

The concerning experiments were conducted with 91 wave probes which had been placed in a 10 cm array in front of the tested structures; the waves arrive simultaneously at one hollow and one smooth surface, which were located side-by-side. The signals of the wave probes were recorded nearly synchronously as energy density spectra at each measuring station, e.g. at an inclination of 1:2 with the total frequency range of $0.0326 \leq f \leq 1.3997$ Hz. Thus, it was possible to detect the lengths of partially standing waves with the associated positions of the loops and nodes from the application of the integral values of the total energy-spectra. Similarly the corresponding data for partial frequency bands could be obtained, see Figure 4 and Büsching (2010b) (doi:http://www.digibib.tu-bs.de/?docid=00047044). Since comparable evaluation methods of other authors are not known to the

authors, there is no further reference information in this regard. Another reason for the lack of reference information is the fact that in most of his results, the author found similarities with phenomena that are known facts with electromagnetic waves. This applies both to the occurrence of an anomalous dispersion effect (ADE) and to the phase shift $\Delta\phi$, which led him to define the complex reflection coefficient -even with water waves. In addition to the submitted manuscript on the ERR, the contents of the cited writings were presented and published at international conferences (Coastlab 10 and Coastlab 12). Since the author's theoretical study series has been updated until 2019, the concise revision and addition to Büsching (2019) (doi: https://doi.org/10.24355/dbbs.084-202002031131-0) including references and ERR are state of the art, as noted by reviewer C.

1 Büsching, F. (2018) Surf Zone Resonances associated with Anomalous Dispersion. 4 th International Conference in Ocean Engineering, 18-21 Feb. 2018 IIT Madras, India.

3

B4. Based on this, the reviewer fails to find the manuscript to be within the scope of the Journal of Coastal and Hydraulic Structures and recommends Reject

Author´s response: The authors believe that the content of the submitted paper is well suited for the journal. “Fluid-structure interaction” and “structural design and analysis” are clearly one of the major outcomes of this submission. Even regarding to the title of the Journal of Coastal and Hydraulic Structures, the authors believe that all three keywords contained therein are covered by the contents of the paper.

Reviewer C:

C1. The manuscript provides a new aspect and method for the topic of wave kinematics and reflection with varying bathymetry, which is a very interesting topic in the coastal and hydraulic engineering. The novel aspects, methodology, mathematical derivations, and illustrations are well presented, and the conclusions are supported by the results. The work is theoretical in nature but provides useful insights for engineering applications with an example of comparing to the well-used Morison formula.

Author´s response:

We thank the reviewer for his positive feedback.

C2. The only drawback is that the literature review is not comprehensive, mostly based on one author’s consecutive work. However, this line of theoretical study has been updated up to 2019, so the references are state-of-the-art.

Author´s response:

The disadvantage of missing references by other researchers was explained above, see response on

the comment B3 of reviewer B.We hope that we have been able to address any concerns through the responses and additions/expansions in the manuscript, and we are always happy to answer any further questions or provide clarification.

Best regards!