Zeitschrift: Veröffentlichungen des Geobotanischen Institutes der Eidg. Tech. Hochschule, Stiftung Rübel, in Zürich

Herausgeber: Geobotanisches Institut, Stiftung Rübel (Zürich)

Band: 101 (1989)

Artikel: Mechanische Belastbarkeit natürlicher Schilfbestände durch Wellen, Wind und Treibzeug = Mechanical impacts on natural reed stands by wind, waves and drift

Autor: Binz-Reist, Hans-Rudolf

Kapitel: Summary

DOI: https://doi.org/10.5169/seals-308911

SUMMARY

(English legend of figures and tables see p. 523 - 536)

The present study deals with the impact of mechanical stress on reed stands. It consits of four sections:

I. THE COMMON REED (*Phragmites australis* Trin.), GENERAL OVERVIEW

During the last fourty years, the reed stands of most prealpine and central European lakes have been declining at an alarming rate. Causes which have been recognized thus far are direct destruction through land reclamation, and indirect destruction through environmental changes, especially water pollution by solid or liquid refuse of all kinds. The consequences of reed decline are pointed out.

II. MECHANICAL EFFECTS

With the aid of a **mathematical model,** the effect of mechanical stress factors on the reed stem, particularly wind and wave action, were simulated. All **load** ensues from the resistance of any obstacle (stem, resp. drift-wood and other floating matter) against the flow of air and water; it can thus be expressed by the equations of dynamic pressure. Some coefficients of these equations (drag coefficient, coefficient of inertia) were obtained by experiments. Experiments were undertaken in the wind tunnel at "Aerodynamisches Institut an der Eidgenössischen Technischen Hochschule Zürich (ETH)" and in the wave tank at "Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie an der ETH" (VAW). The velocity of the air particles (wind speed) is one of the initial input data of the model, whereas the water particle velocity due to the wave motion (orbital velocity) theoretically can be derived from the wave parameters (period, height, length). Two methods of wave forecasting in function of wind speed and free water surface (fetch) are presented.
The **motions of the stem and the drift** (considered as a rigid body) are expressed by differential equations. To make the numerical solution of these equations possible, the stem has to be abstracted as a concatenation of rigid bars, interconnected by elastic joints ("spiral spring"). The differential equations are integrated with a modified predictor-corrector method (initial steps with Runge-Kutta method). The computed motions and hence the deformations of the stem lead to the **stress factor** (bending moment). According to the constellation of the input parameters viz. wave height, period, mass and form of the

drift, the resulting oscillation of the stalk ist more or less irregular, in spite of the wave motion being assumed strictly periodic. The question, how the calculated stress may be compared to the measured **strength values** is therefore discussed and illustrated by some examples of reed stems being strained by wind, waves and a piece of drift-wood. A quantitative comparison between the results of the calculation and the real behaviour of the reed stem is not possible. However, it may be assumed that the **mathematical model simulates the oscillation of the stalk to the degree of accuracy normally attributed to this kind of model.** This assumption can be made on the grounds of the plausibility of the results and that they are well in agreement with qualitative field observations. The calculated examples show that the influence of drift-wood on the stress factor is strongly dependent on other input parameters. For example, at a certain wave height, which is determined by the given situation, the influence of the drift-wood almost totally disappears, i. e. the stress factor is almost the same with or without drift-wood. Above this limit, the influence of drift-wood increases steadily with increasing wave height, whereas below this level no noticeable systematic tendency is observed. It is demonstrated here in theory, that which can be observed in nature: **The destructive impact of high waves on reed is compounded by the additional mechanical stress which drifting objects represent.**

III. INVESTIGATION OF THE MECHANICAL PROPERTIES OF THE REED STEM

This section describes **laboratory and field experiments for measuring the bending stiffness and strength** of reed stalks. The **stiffness** is an important parameter of the equations of motion, whereas the **strength** serves as a relative value to be compared with the calculated loads. The aim of these measurements determined in part the procedures being used; attention was paid to test the stems in a state as "natural" as possible, although for comparison and assessment of different reed stands the specimens should be dried completely prior to testing, in order to avoid the influence of differences in water content.

IV. DISCUSSION AND CONCLUSIONS

Possible reed stand protection measures, especially those of a mechnical nature, are suggested and discussed. It is emphasized that most of these measures represent only a treatment of symptoms and may nevertheless be necessary in certain circumstances.