Geometrical and kinematic properties of breaking waves in the framework of a stationary flow approximation

Alastair D. Jenkins
DNMI Marine Forecasting Centre
Allégaten 70
5007 Bergen, Norway
Alastair.Jenkins@dnmi.no
WWW home page: http://www.dnmi.no/

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The extreme loading on structures caused by the impact of breaking waves has long been known, and has recently been brought into focus again as a result of the occurrence of unexpectedly high or steep waves around both fixed and floating offshore facilities. This has prompted work on re-analysis of wave records, and on numerical modelling of temporally and spatially extended wave fields, in order to compute more accurately the probability of occurrence of extreme waves.

In view of the potentially devastating consequences of severe wave impact, it is also necessary to make predictions of the geometry and kinematics of such a severe wave event, as well as calculating its occurrence probability. In spite of the fact that steep and breaking waves come in many different forms: spilling or plunging breakers, for example, it appears that very many of these wave forms can be related to a particular potential flow geometry which is stationary in a frame of reference moving with the wave crest. This flow field has a geometrical scale which has a fixed relation to the amount of fluid which is expelled forwards in a jet emanating from the wave crest.

Numerical simulations and laboratory experiments indicate that the relevant length and velocity scales are highly variable (the fluid acceleration is, however, scale-independent), but is may be possible to make quantitative predictions by analogy with already-established relationships between breaking wave geometry on beaches and bottom slope, for example.