

MEASUREMENTS OF FREAK WAVES IN NORWAY AND RELATED SHIP ACCIDENTS.

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BASIS FOR DESIGN :

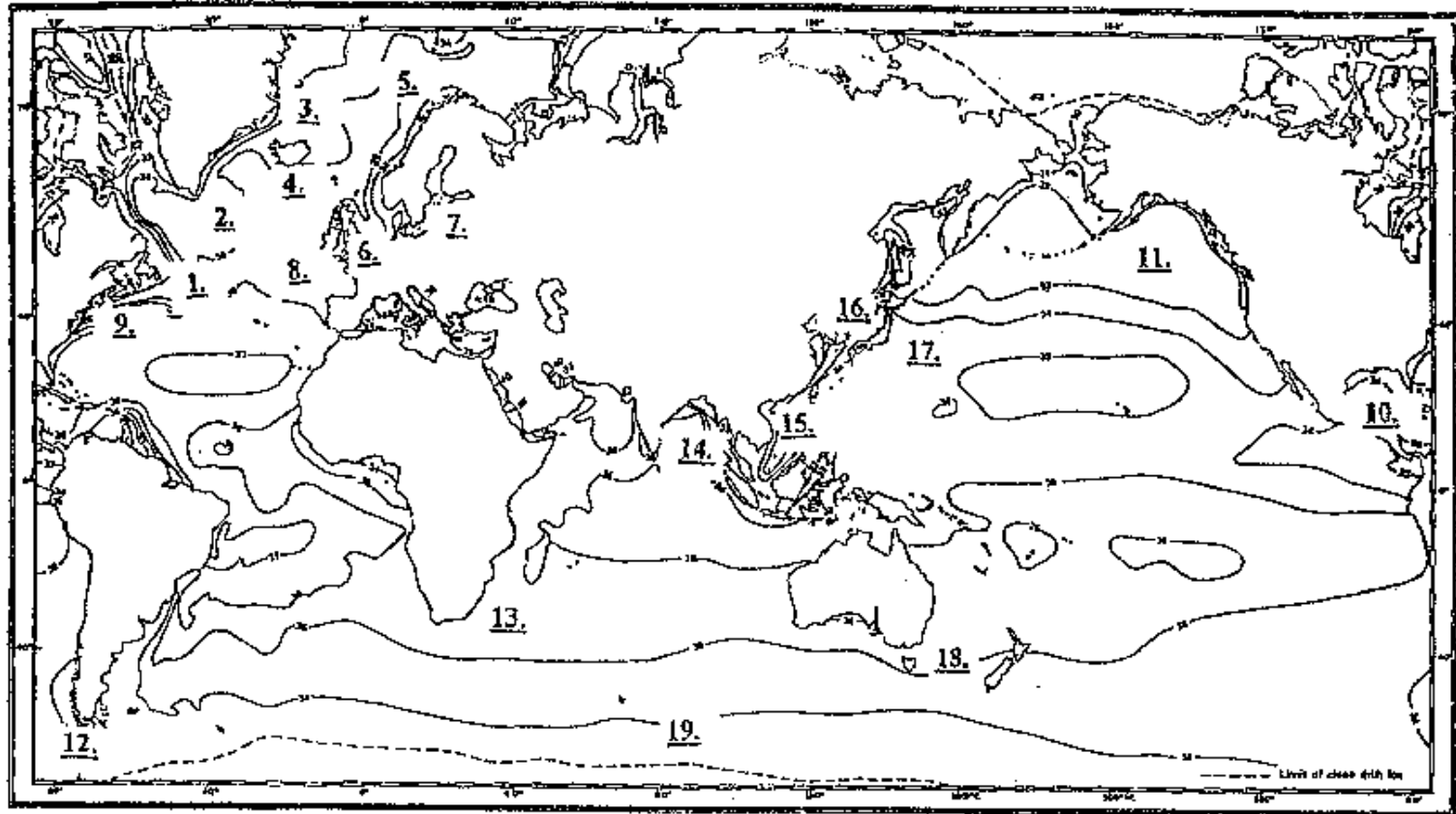
- The accident with the semisubmersible platform **OCEAN RANGER** , started this investigation.
- A World Data Bank with ship and offshore installation accidents caused by extreme waves is established.

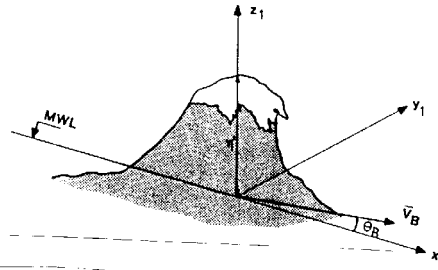
AREAS WITH FREAK WAVES

1	New Foundland Banks
2	The Sea south of Greenland
3	Coastal areas near Iceland
4	Coastal areas near Faero Islands
5	Coastal area on the Norwegian coast
6	The North sea
7	The Baltic Sea

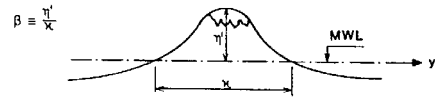
8	The Biscay Bay
9	Gulf Stream on the east coast of USA.
10	The Mexican Gulf
11	The Sea west of British Columbia.
12	The Sea near Cap Horn
13	Aghulhas current east of South Africa
14	The Bengal Sea

15	The South China Sea
16	The Japan Sea
17	The Pacific Sea east of Japan
18	Coastal areas near Australia
19	Areas south of 40 degr. South
20	Mediterranean Sea
21	Great Lakes



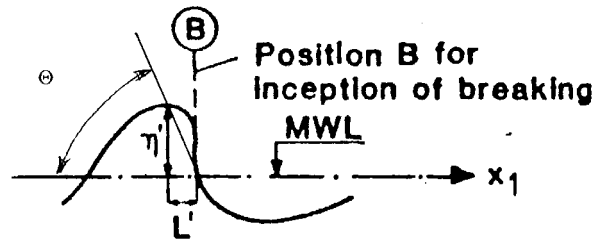


DEFINITION OF CREST LENGTH λ AND 3-D CREST SHAPE FACTOR β IN SYNOPTIC DOMAIN :

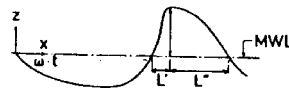


DEFINITION OF CREST FRONT STEEPNESS ϵ_x IN SYNOPTIC DOMAIN :

$\epsilon_{x,B} = \frac{\eta'}{L}$



VERTICAL ASYMMETRY FACTOR
 $\lambda = \frac{x}{\omega} = \frac{L'}{L''}$



HORIZONTAL ASYMMETRY FACTOR
 $\mu = \frac{\eta'}{H}$

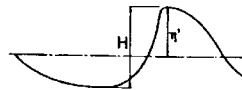
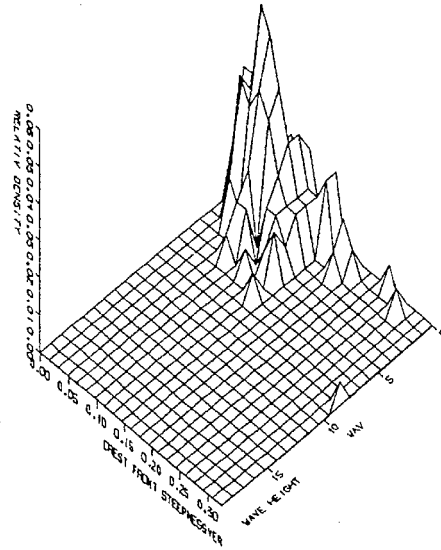
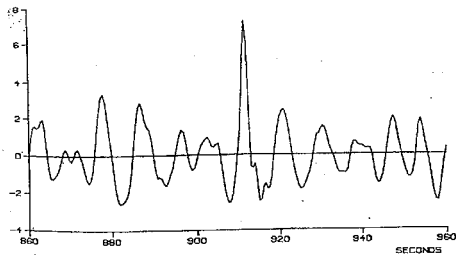
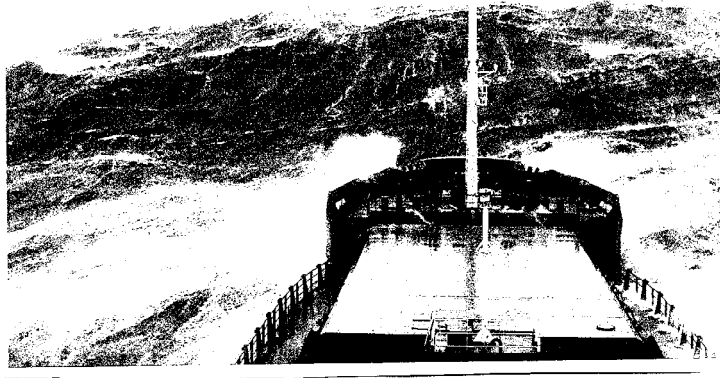


FIG 1.

BREAKING CRITERIA

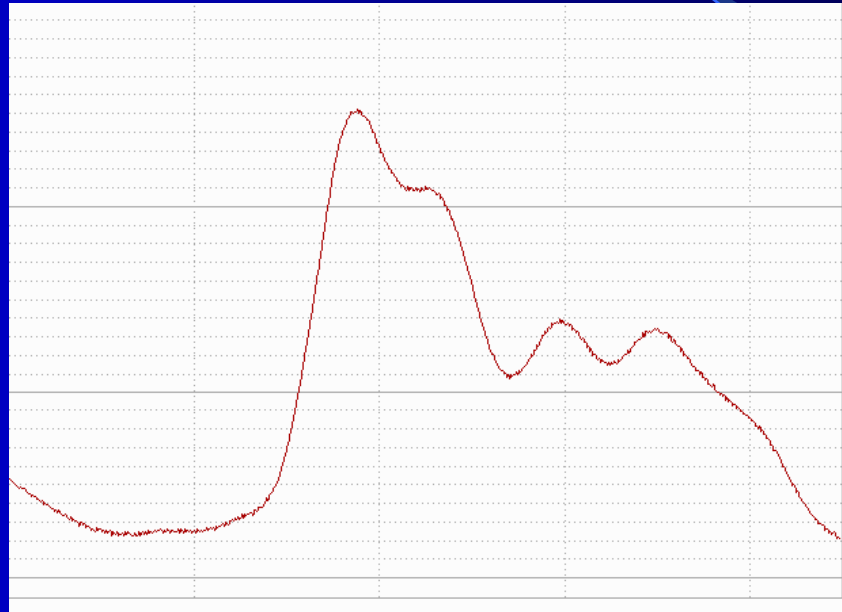
- A Breaking Criteria for extreme irregular waves is based on :
- **CREST FRONT STEPNESS**



Breaking Freak Wave

ACCIDENTS

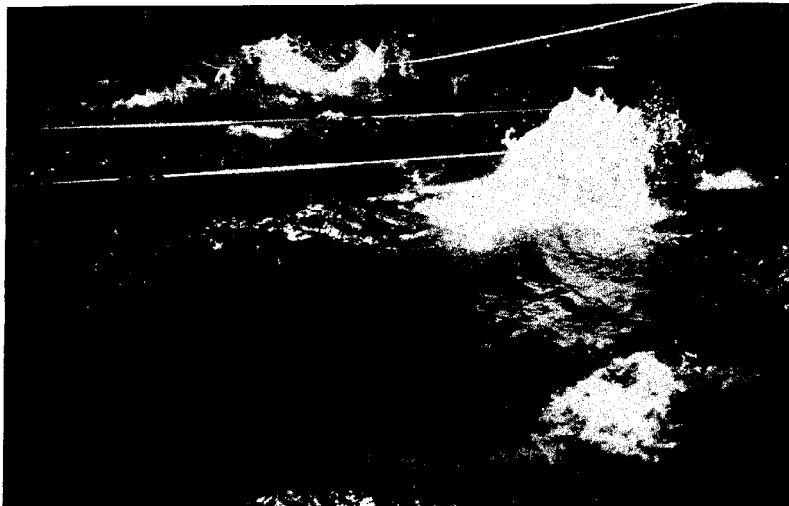
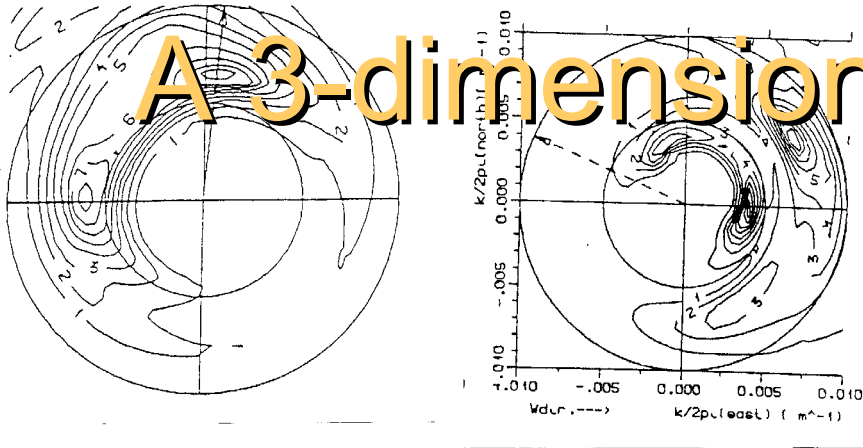
Time history of bow acceleration



Experiments with freak waves:

- ● The “Tsunami Wave Model reversed in the time domain was found to be a successful mathematical technique for modeling of a 3-dimensional freak wave.

A 3-dimensional freak wave



BASIS FOR DESIGN

FULL SCALE MEASUREMENTS OF IMPACT FORCES ON A PLATFORM.

- Drag and lift forces in extremes waves mapped from measurements in a :
Large research programme with segmented pile structure.

CONCLUSION 1:

- The basis for computation of forces caused by extreme waves
- Is an analysis in the time domain
- Of the wave crest front steepness

CONCLUSION 2:

- The experimental programs clearly shows that extreme wave load intensities are associated with transient 2- or 3-dimensional breaking waves and not with the highest waves.

BREAKING CRITERIA:

- The experiments show that irregular storm waves break when crest front steepness is in the range:
- 0.32 – 0.78 measured in the synoptic domain.

CONCLUSION 4:

- Experiments show that wave crest particle velocities can reach values as high as 2.8 times the phase velocity.
- Several mathematical models are now developed to predict crest kinematics.

SCALE EFFECTS:

- Green Water Impacts are measured on a platform at sea and stored in a data bank.
- Impact forces did not follow Froudes Law for scaling of experiments.

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Books
Video-Films
and CD-roms
are available.