MEASUREMENTS OF FREAK WAVES IN NORWAY AND RELATED SHIP ACCIDENTS.

Søren Peter Kjeldsen
Trondheim Maritime Academy
Norway.
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
FIG 1.

DEFINITION OF CREST LENGTH $\lambda$ AND 3-D CREST SHAPE FACTOR $\beta$ IN SYNOPTIC DOMAIN:

$$\beta = \frac{\lambda}{L}$$

DEFINITION OF CREST FRONT STEEPNESS $\varepsilon_x$ IN SYNOPTIC DOMAIN:

$$\varepsilon_{x,B} = \frac{\eta}{L}$$

Position B for Inception of breaking MWL

VERTICAL ASYMMETRY FACTOR

$$\lambda = L = \frac{\lambda}{L}$$

HORIZONTAL ASYMMETRY FACTOR

$$\mu = \frac{\lambda}{H}$$
BREAKING CRITERIA

- A Breaking Criteria for extreme irregular waves is based on:
- **CREST FRONT STEPNESS**
Breaking Freak Wave
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:
- $0.32 \leq \text{steepness} \leq 0.78$ 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 Froude’s Law for scaling of experiments.
Info: Peter.kjeldsen@c2i.net

Books
Video-Films
and CD-roms
are available.