Characterization of Tank Hydrodynamics and Mixing

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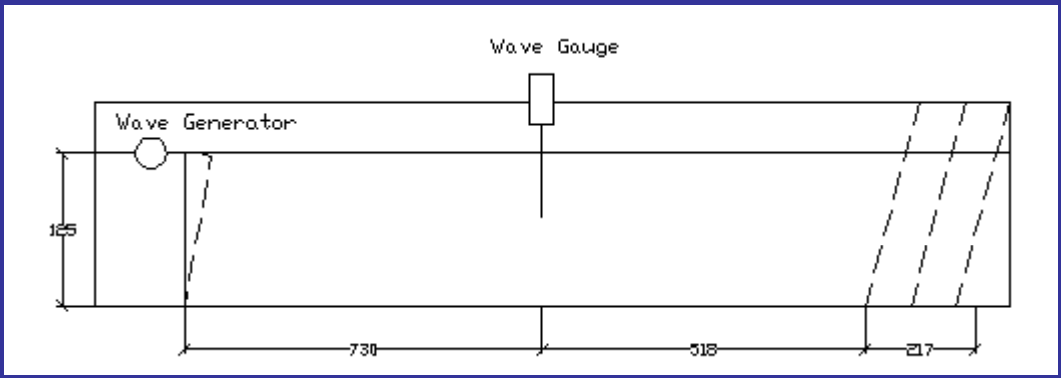
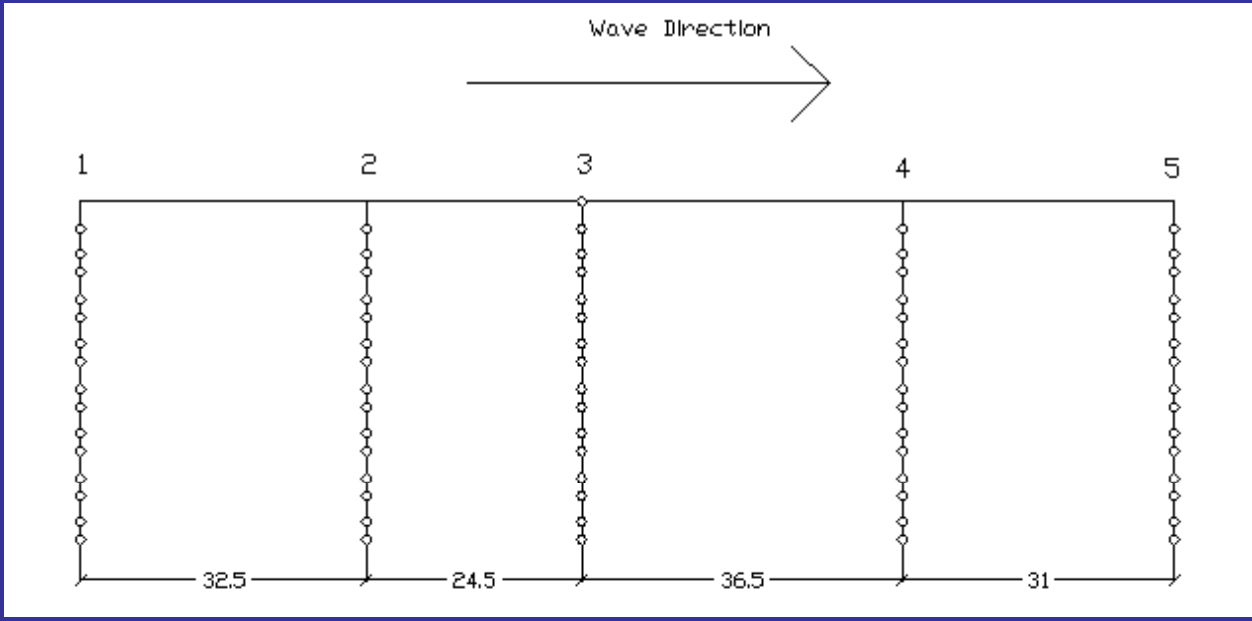
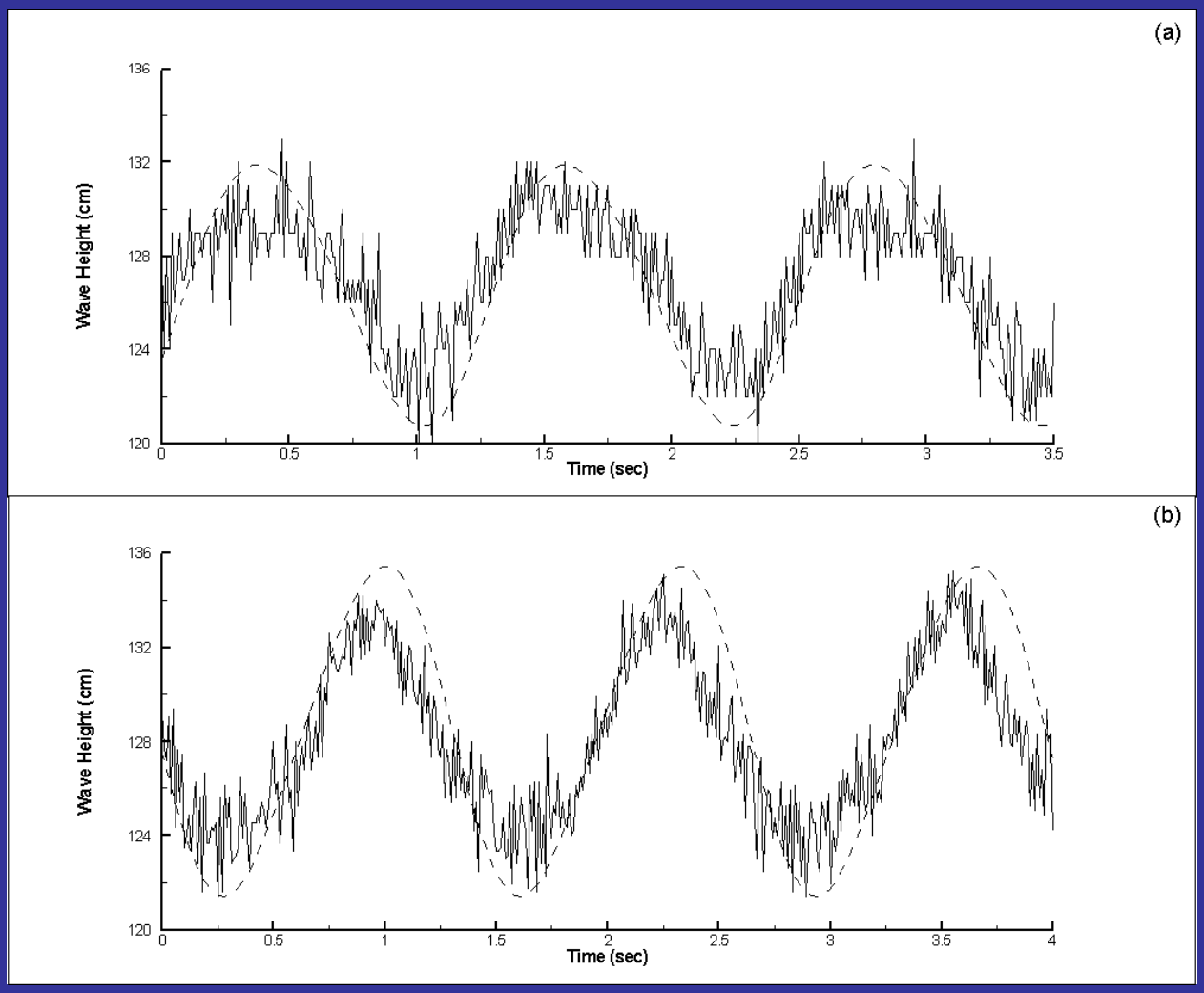
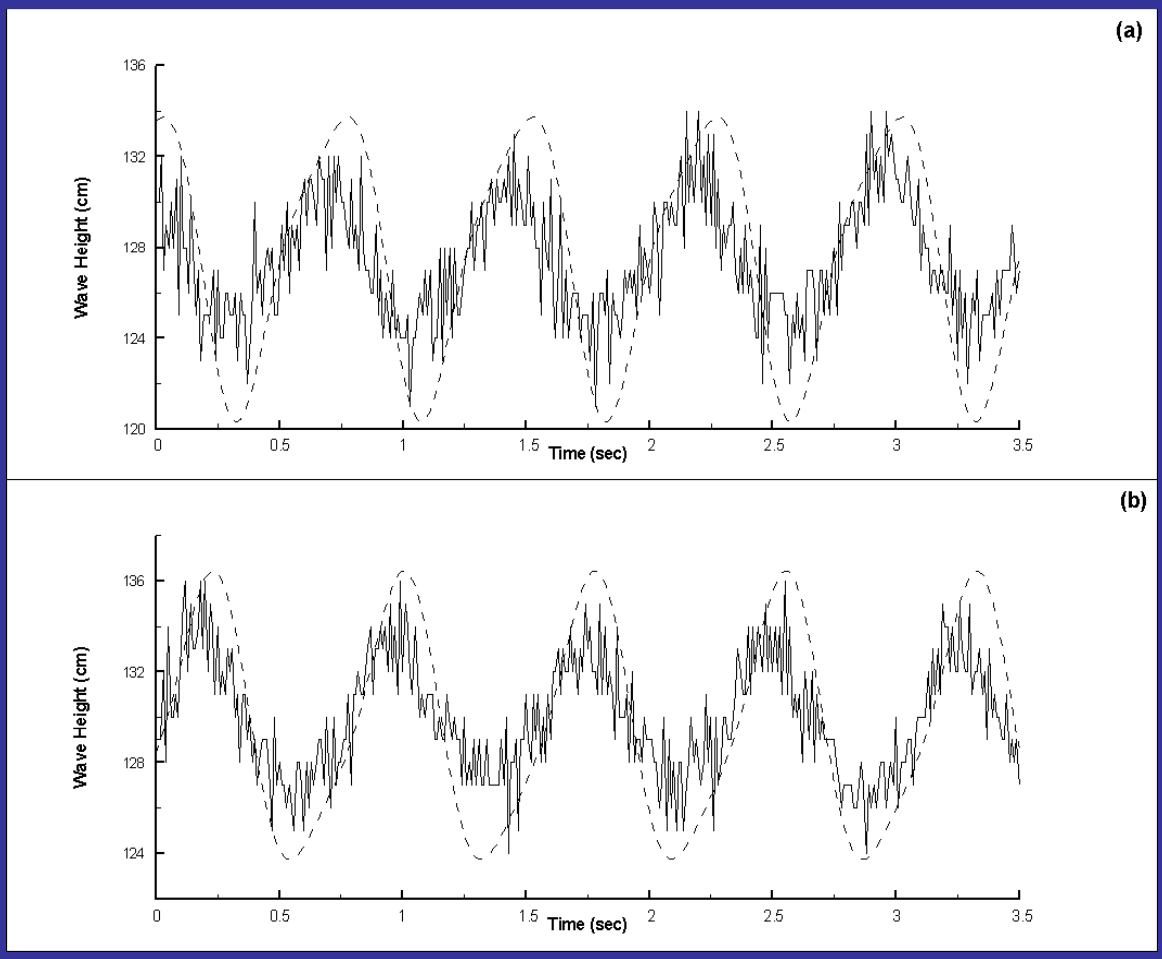




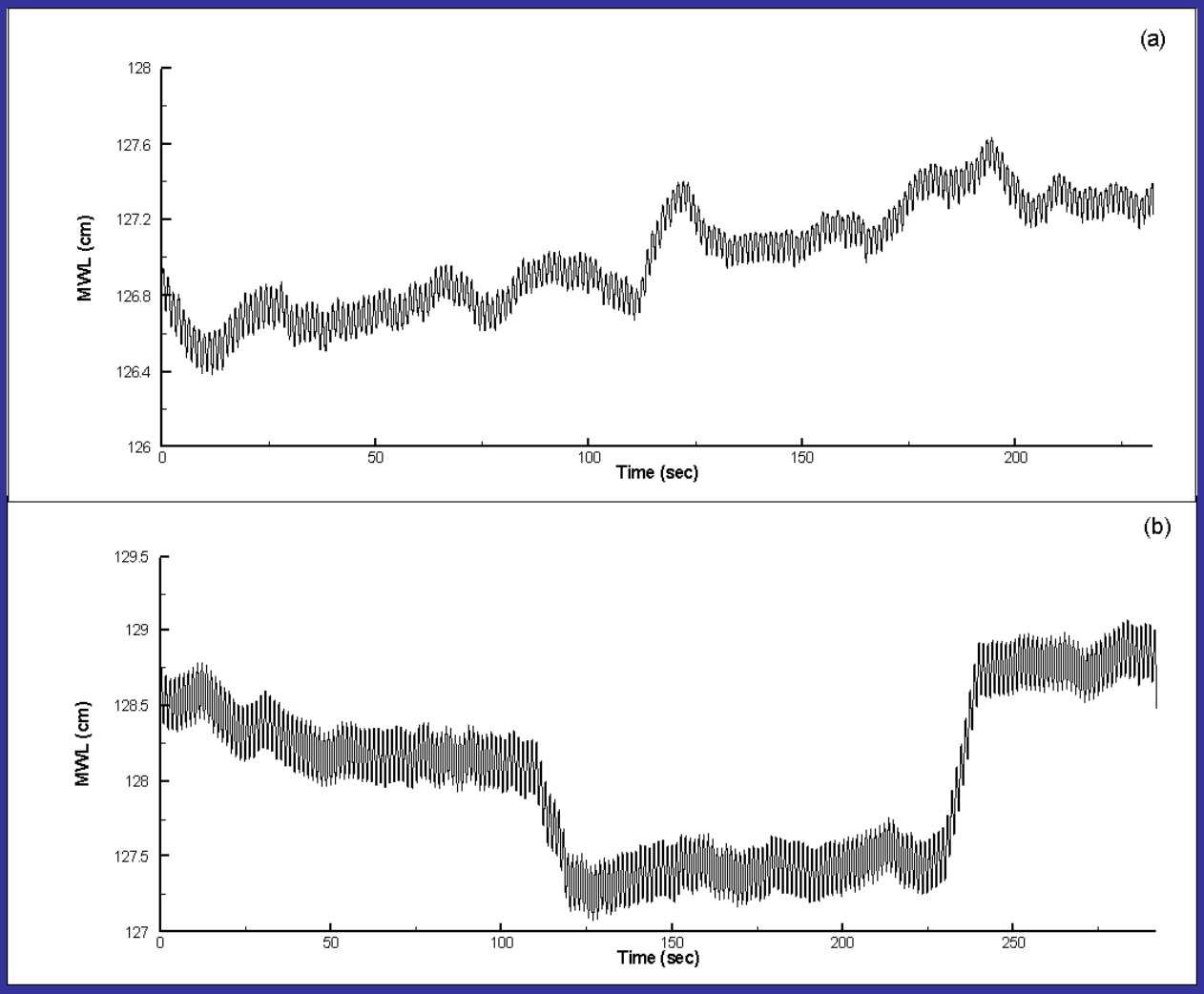
Locations at which the ADV was placed for measuring velocity. The wave gauge was at location 3. Position 1 is at 673 cm from the wavemaker.



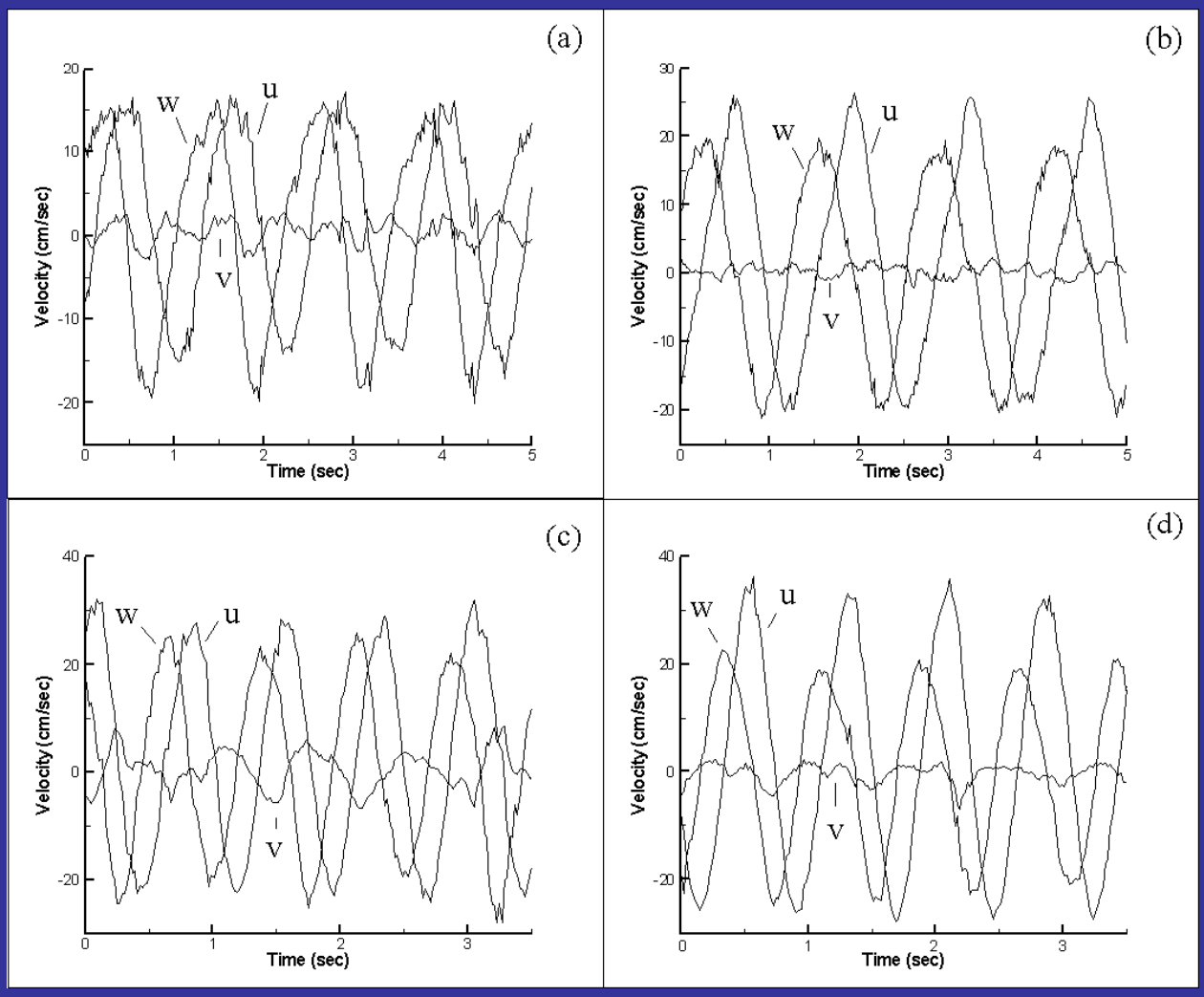
Low frequency wave profiles for (a) 5cm (b) 10 cm stroke.
Secondary effects cause deviation from the linear theory.



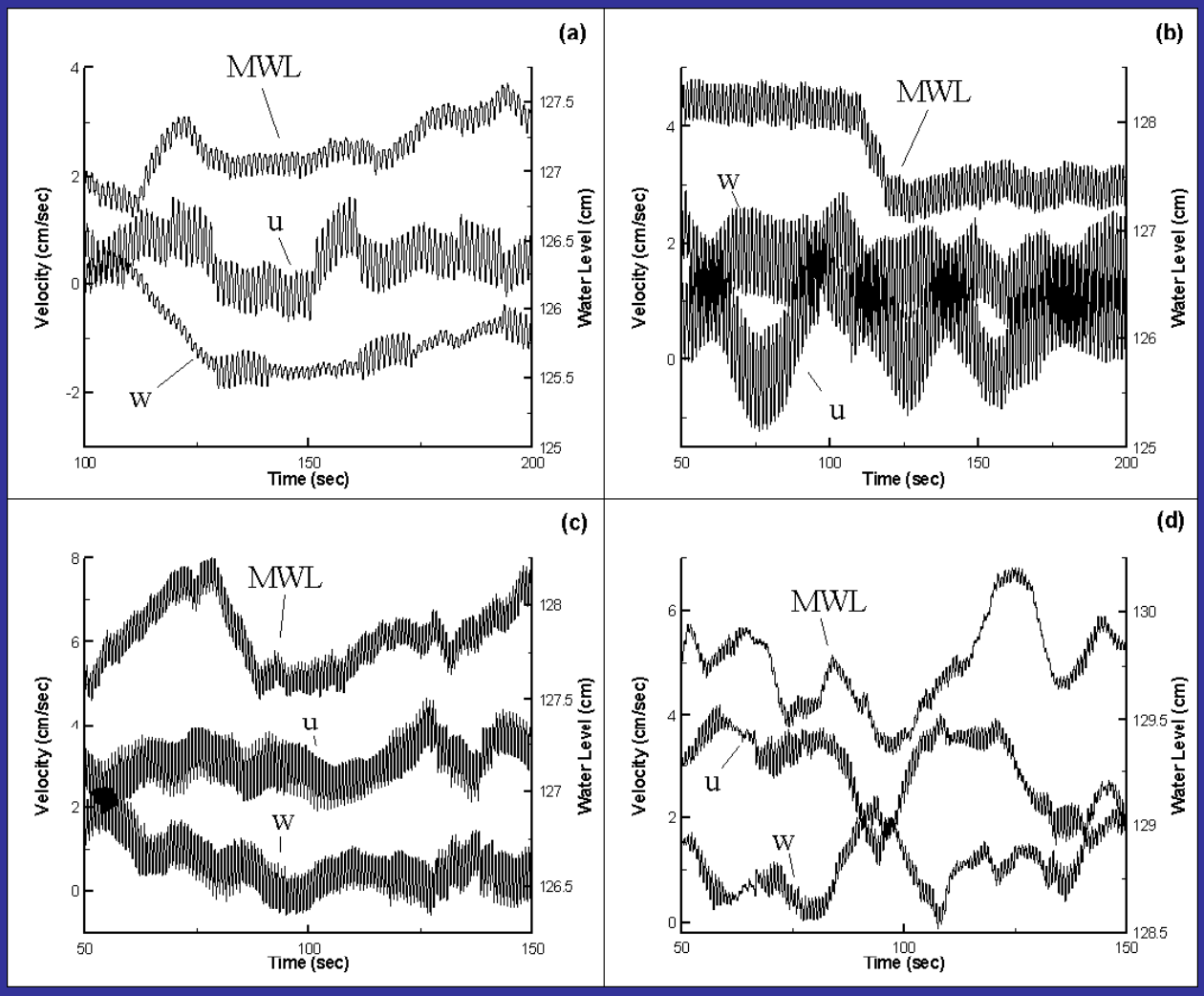
High frequency wave profiles for (a) 5cm (b) 10 cm stroke.
The wave gauge was not fully capable of capturing the crest and the trough.



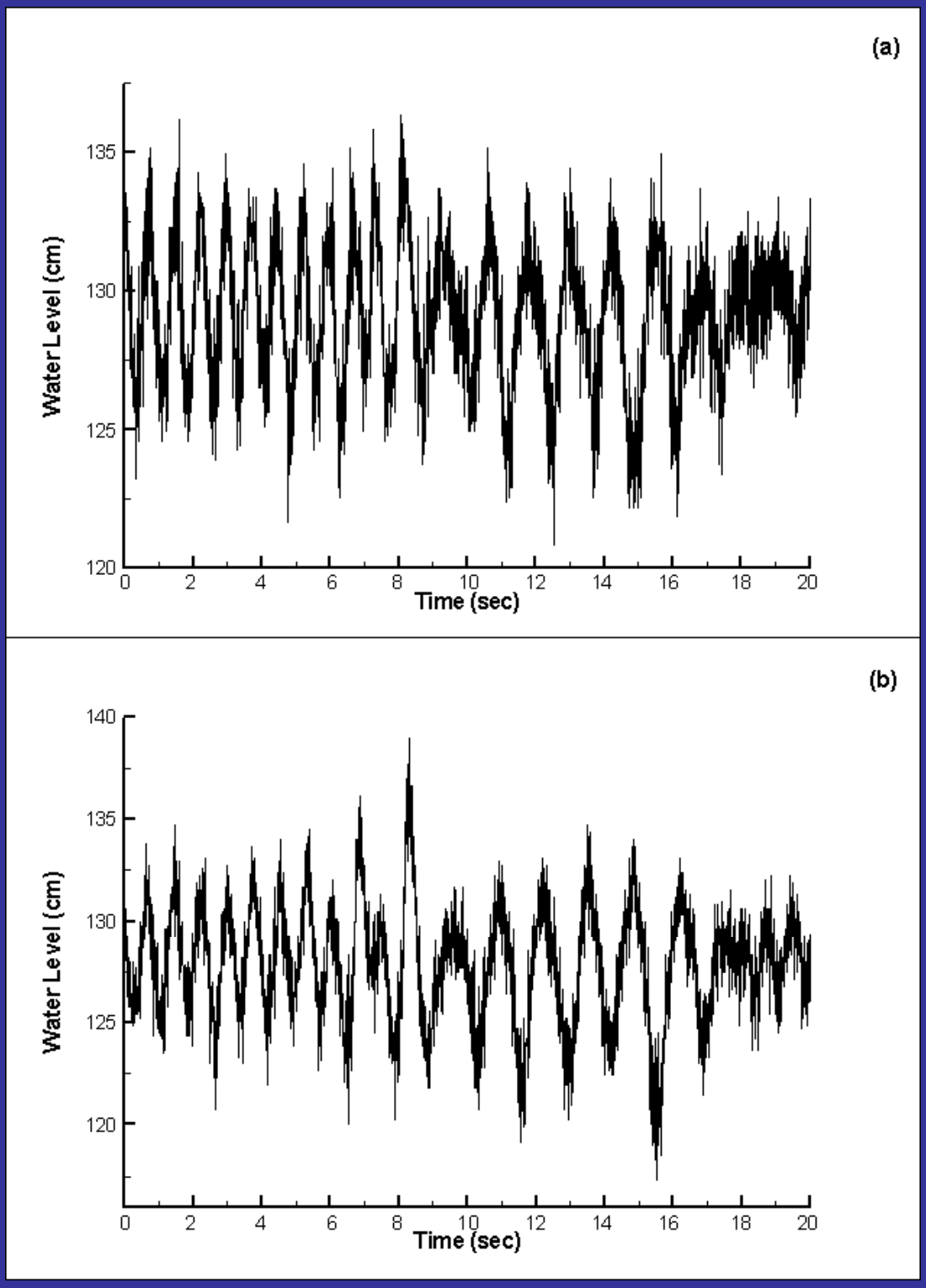
Mean water level (MWL) for the Low Frequency (LF) waves for the (a) 5-cm and (b) 10-cm stroke.



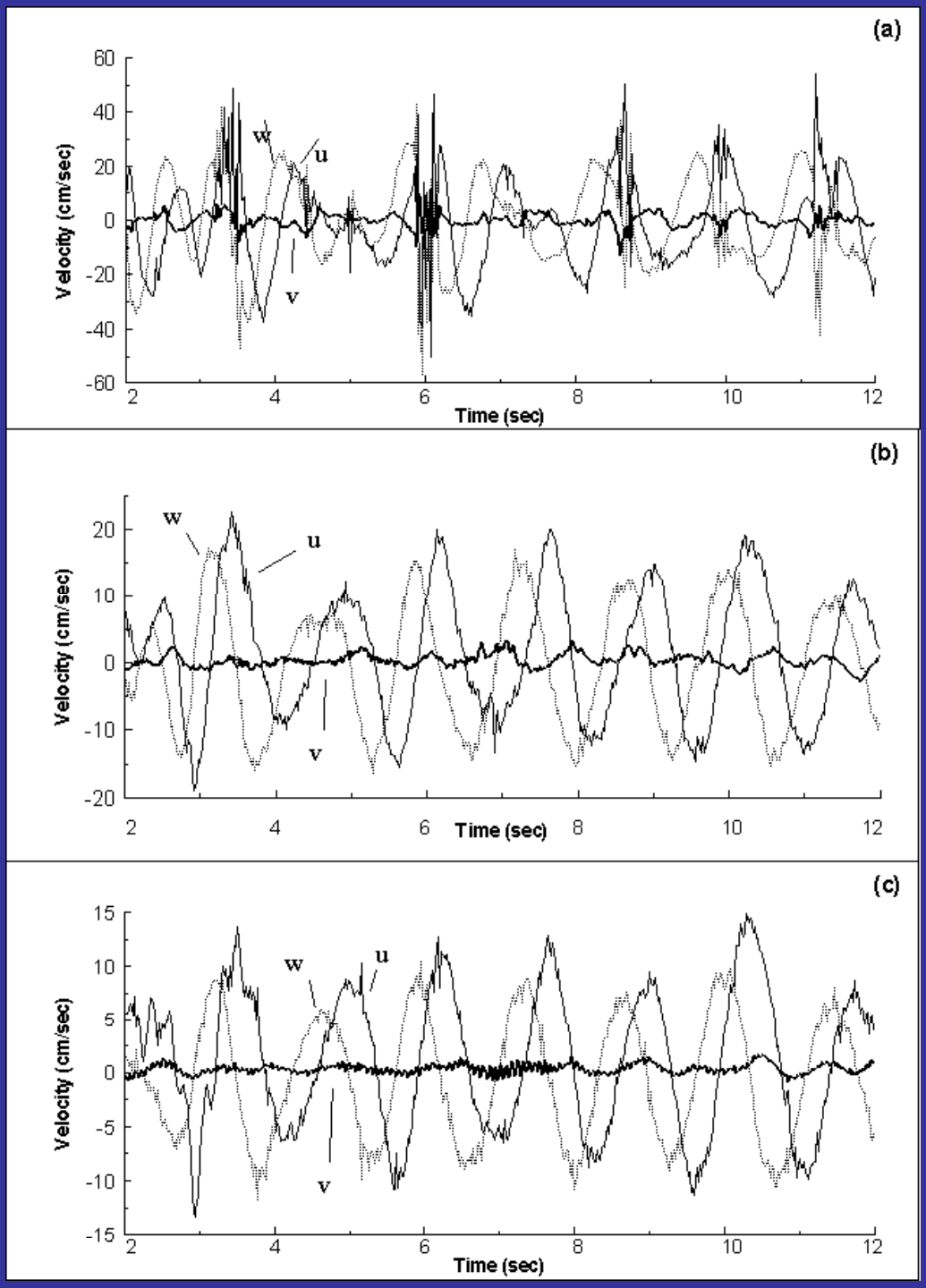
Time series of the longitudinal (*u*), lateral (*v*), and vertical (*w*) velocities for the Low Frequency (LF) waves at 6-cm depth for the stroke of (a) 5-cm and (b) 10-cm. Panels (c) and (d) are for the High Frequency (HF) waves for the strokes of 5-cm and 10-cm, respectively. Note that the magnitude of *v* is much smaller than *u* and *w*, indicating that the generated waves were predominantly unidirectional.



Comparison of moving averages of (a) LF, 5 cm stroke, (b) LF, 10 cm stroke at 6 cm depth and (c) HF, 5 cm stroke and (d) HF, 10 cm stroke at 3 cm depth. Moving averages were taken over 1000 and 500 points for water level and velocity, respectively.
The averages of u and w seem unrelated to the MWL.
They are most likely due to currents in the tank.

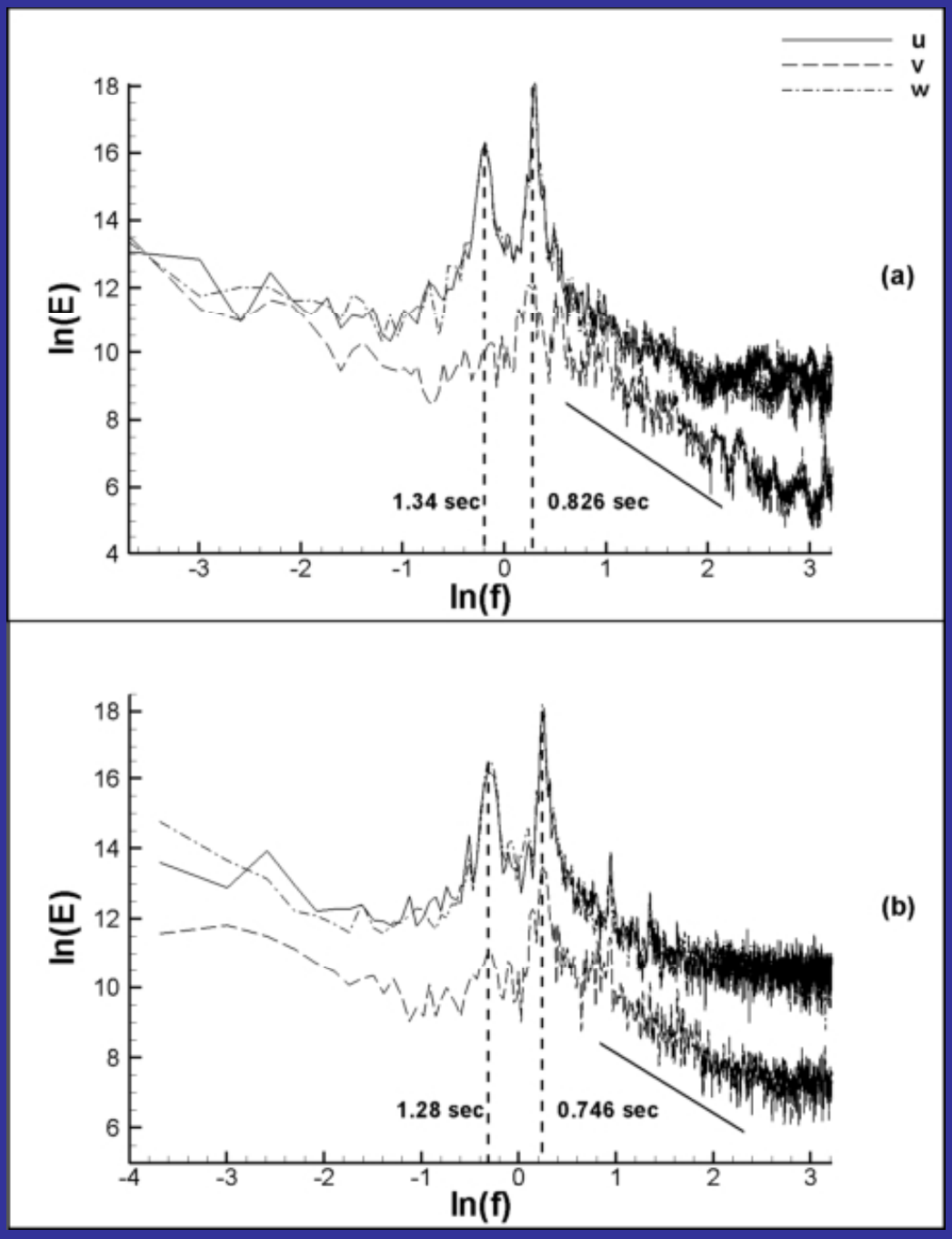


Breaking wave profile for (a) 5-cm stroke and (b) 10-cm stroke.

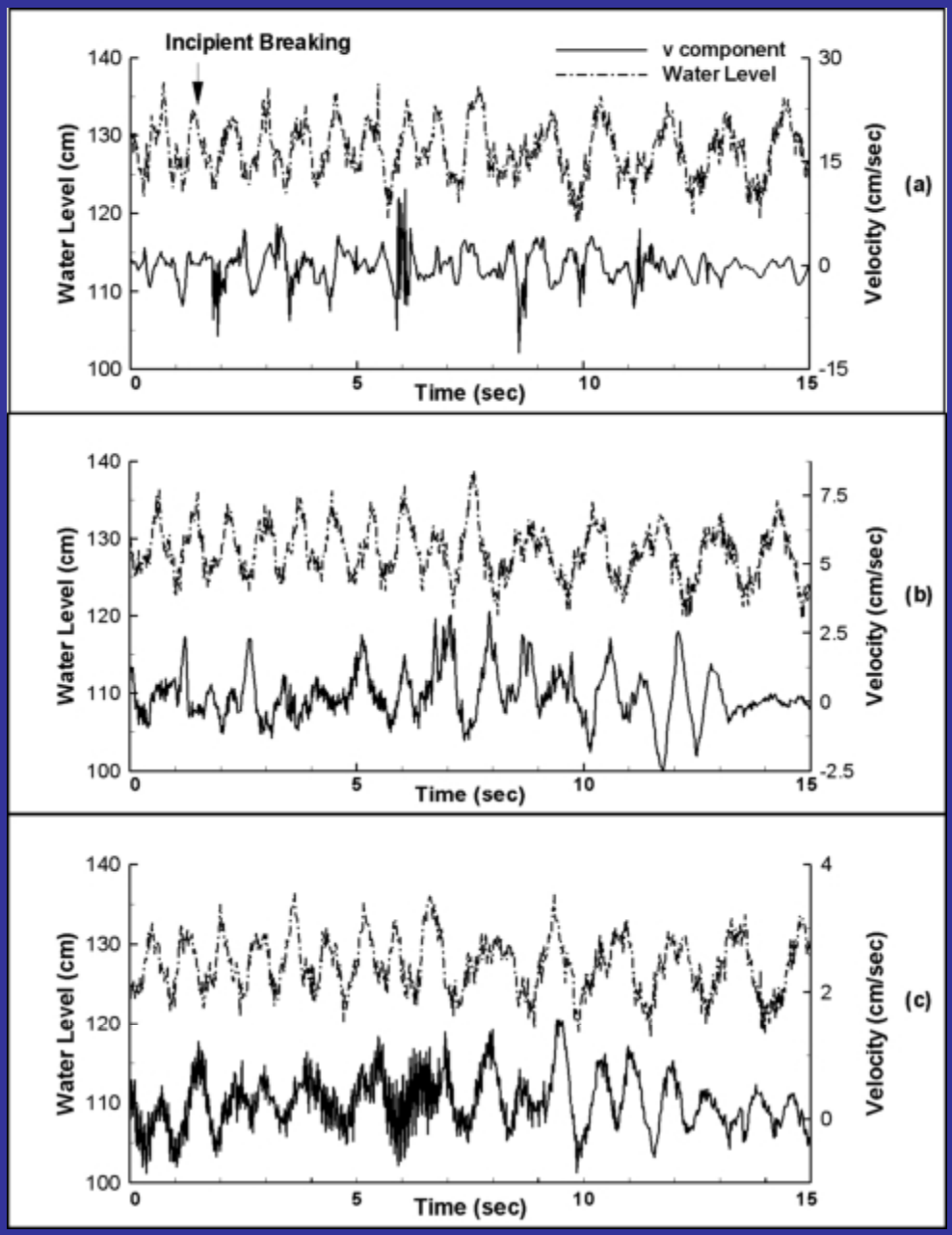


Time series of the longitudinal (*u*), lateral (*v*), and vertical (*w*) velocities in the ten seconds surrounding the breaker for the 10-cm stroke. Panels (a), (b), and (c) correspond to the depths 6 cm, 21.2 cm, and 41.5 cm, respectively. While the breaker affects *u* and *w* at all depths, it affects *v* only near the surface.

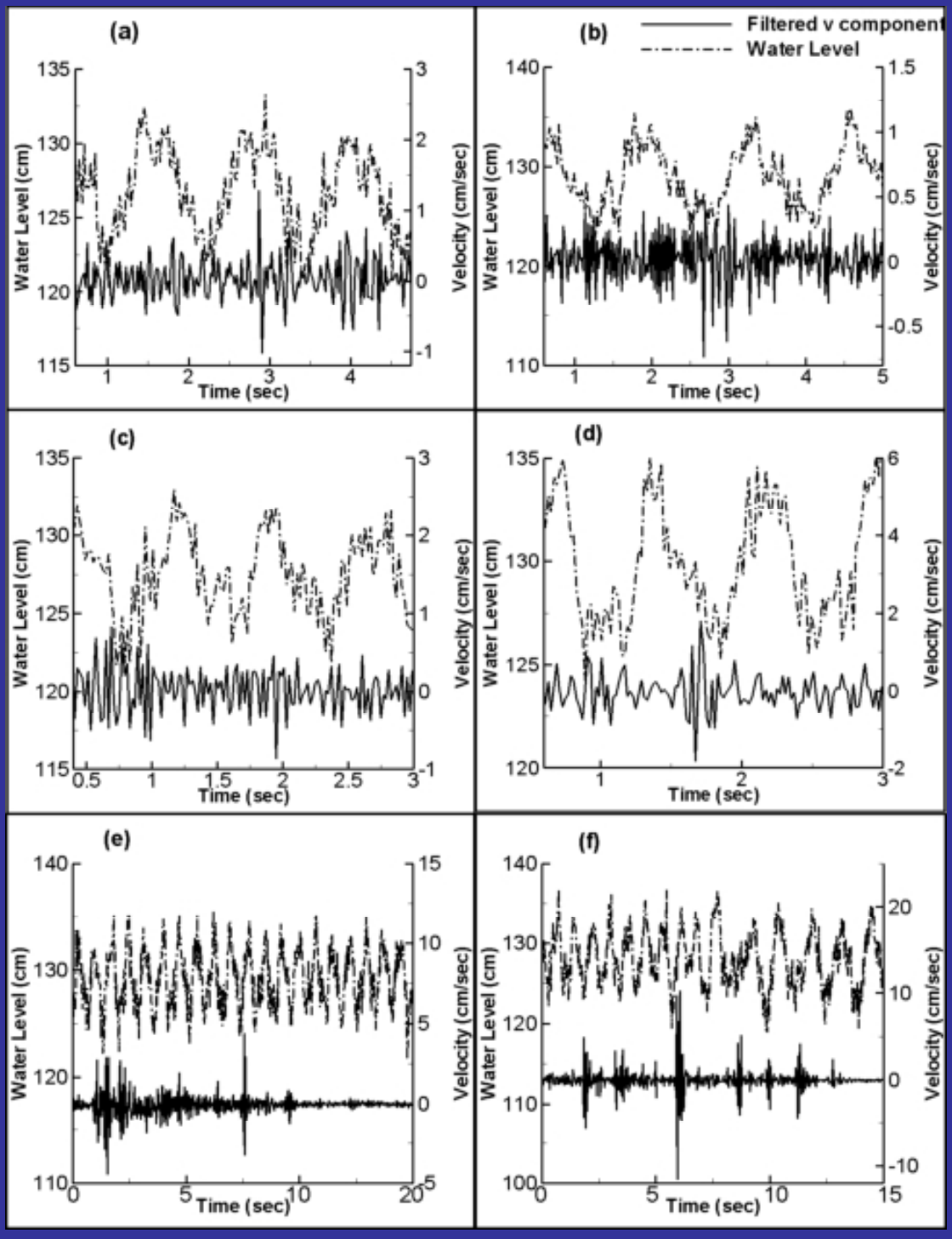
Energy Dissipation and Mixing



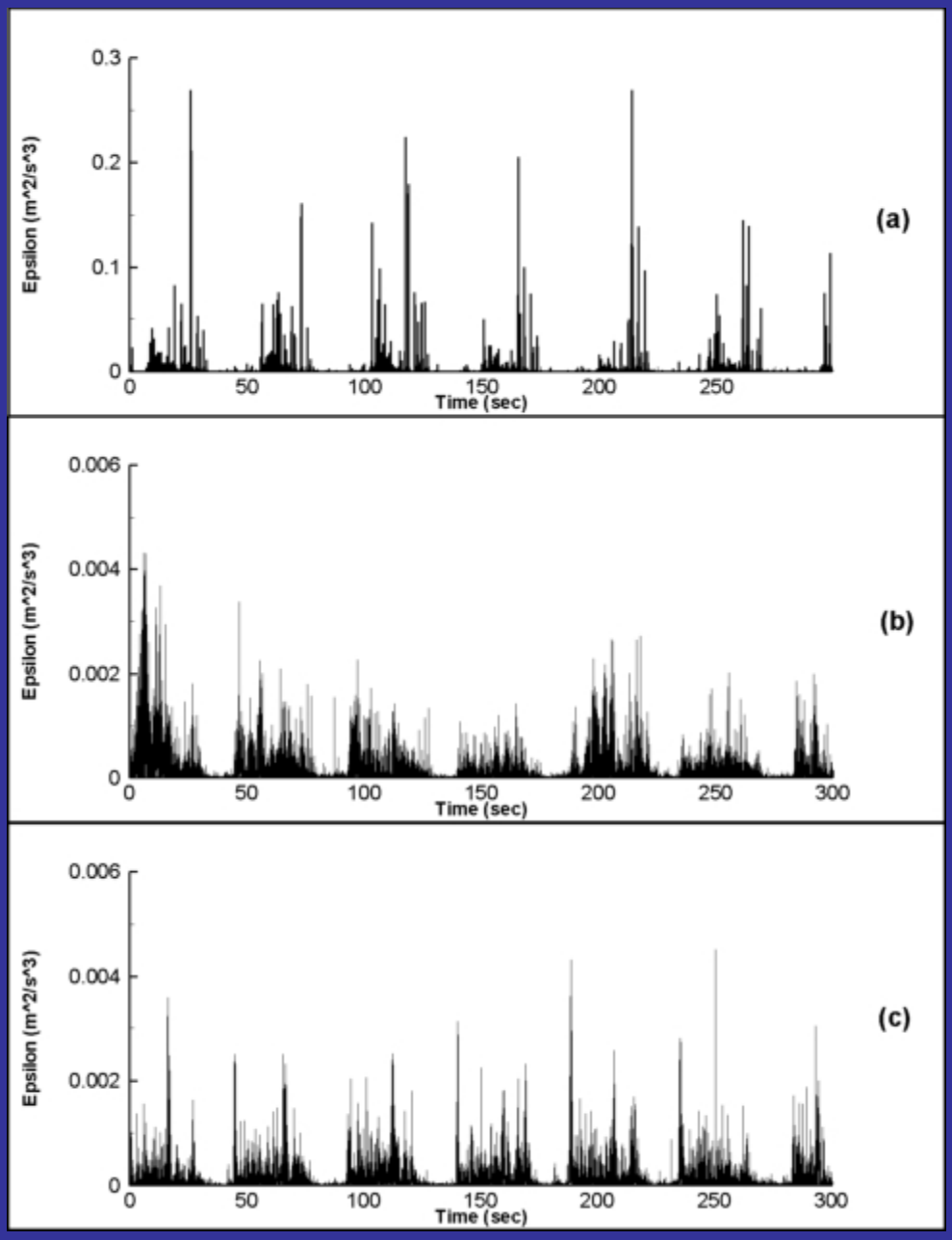
Three component velocity spectra for (a) 5 cm and (b) 10 cm stroke breaking waves. The dominant frequencies are displayed.



Velocity series for component *v* of breaking waves generated with a 10 cm stroke at depths of (a) 6 cm, (b) 21.21 cm and (c) 41.49 cm. The water level for each series is shown.

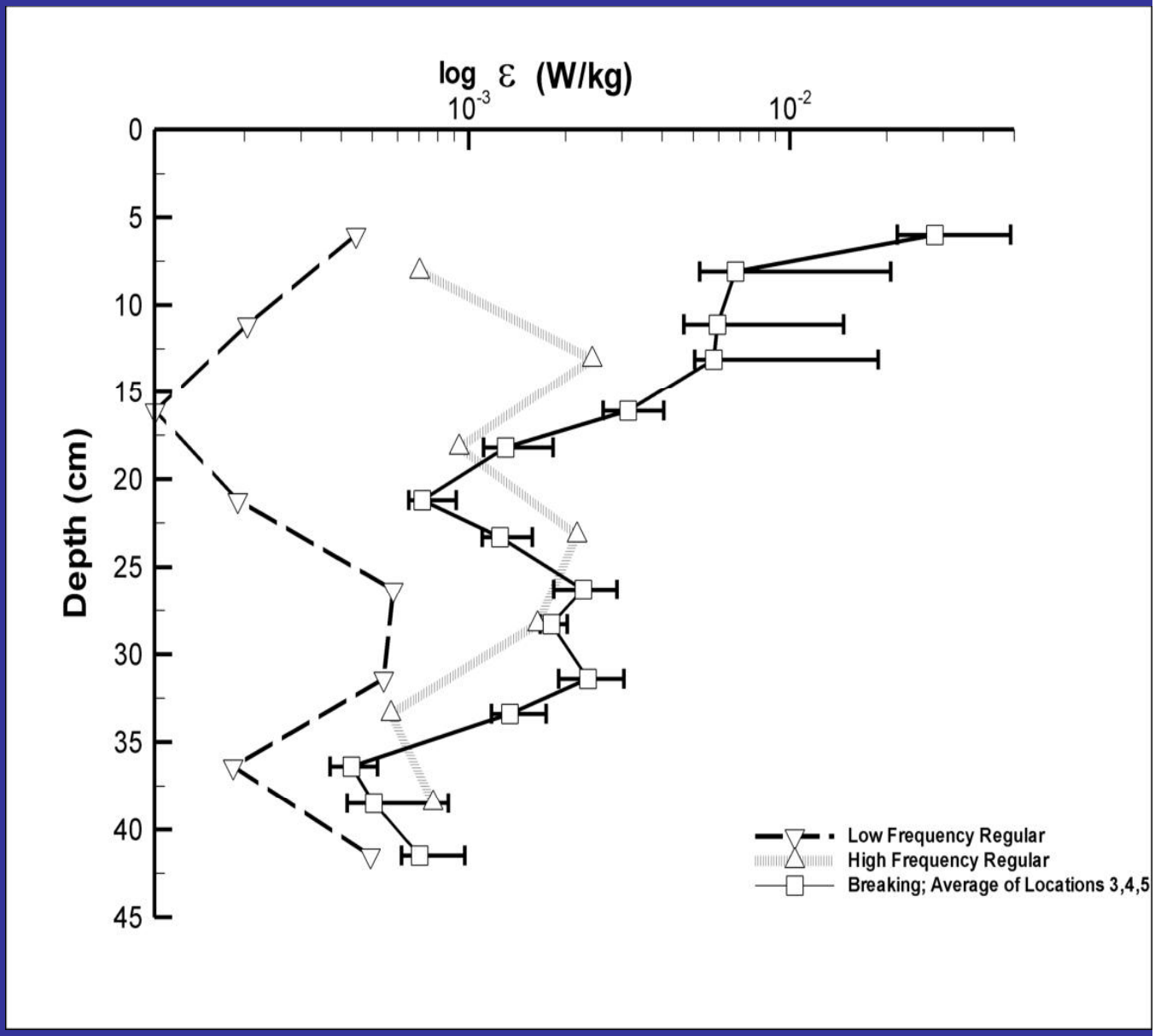


Series for filtered across tank velocity v for (a) LF 5 cm stroke, (b) LF 10 cm stroke, (c) HF 5 cm stroke and (d) HF 10 cm stroke. The series for filtered across tank velocity *v* at location 4 for is shown for (e) 5 cm stroke and (f) 10 cm stroke breaking waves.

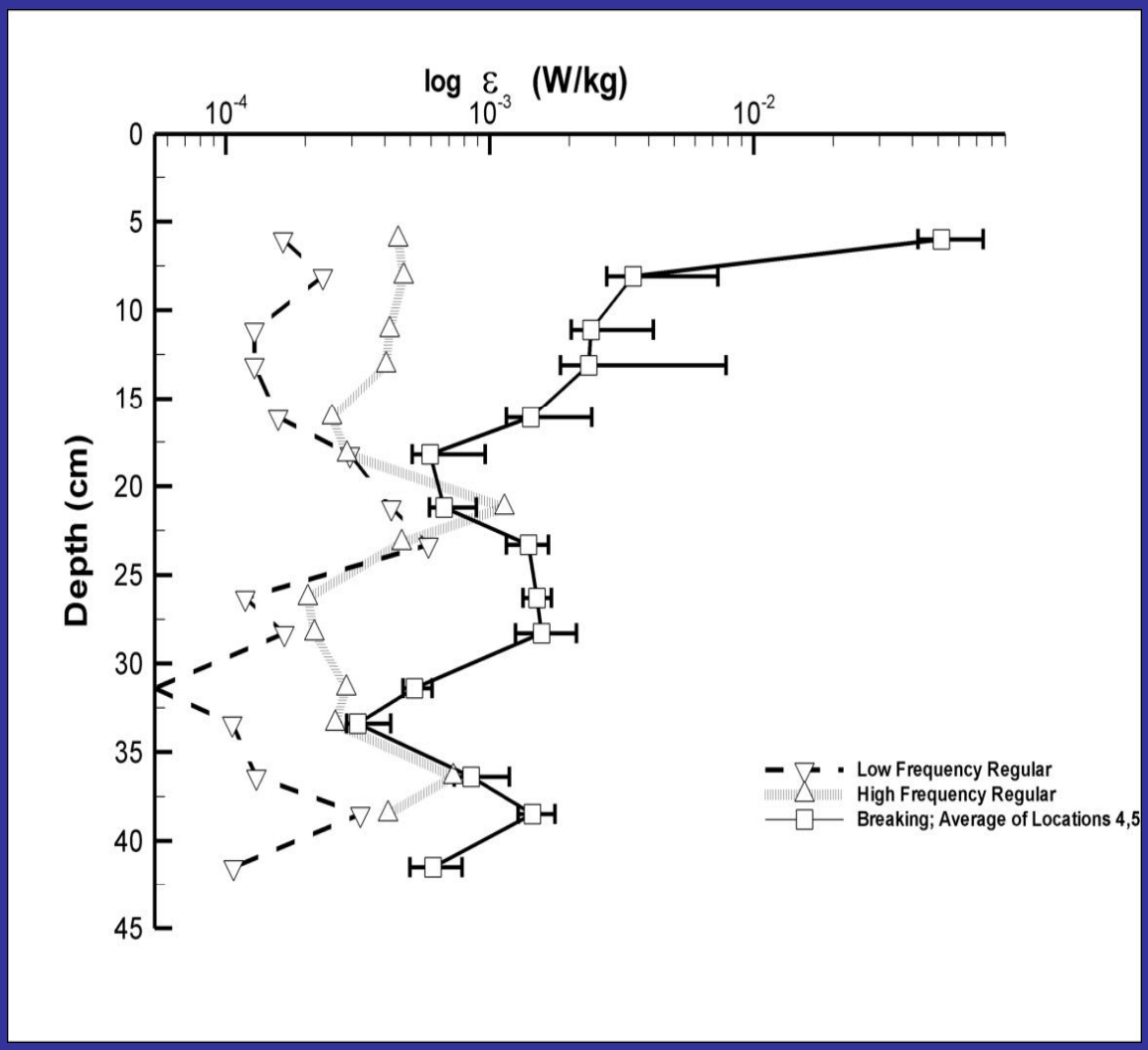


Energy dissipation rates calculated over the breaking wave, 10 cm stroke data set for depth of (a) 6 cm, (b) 21.21 cm and (c) 41.49 cm.

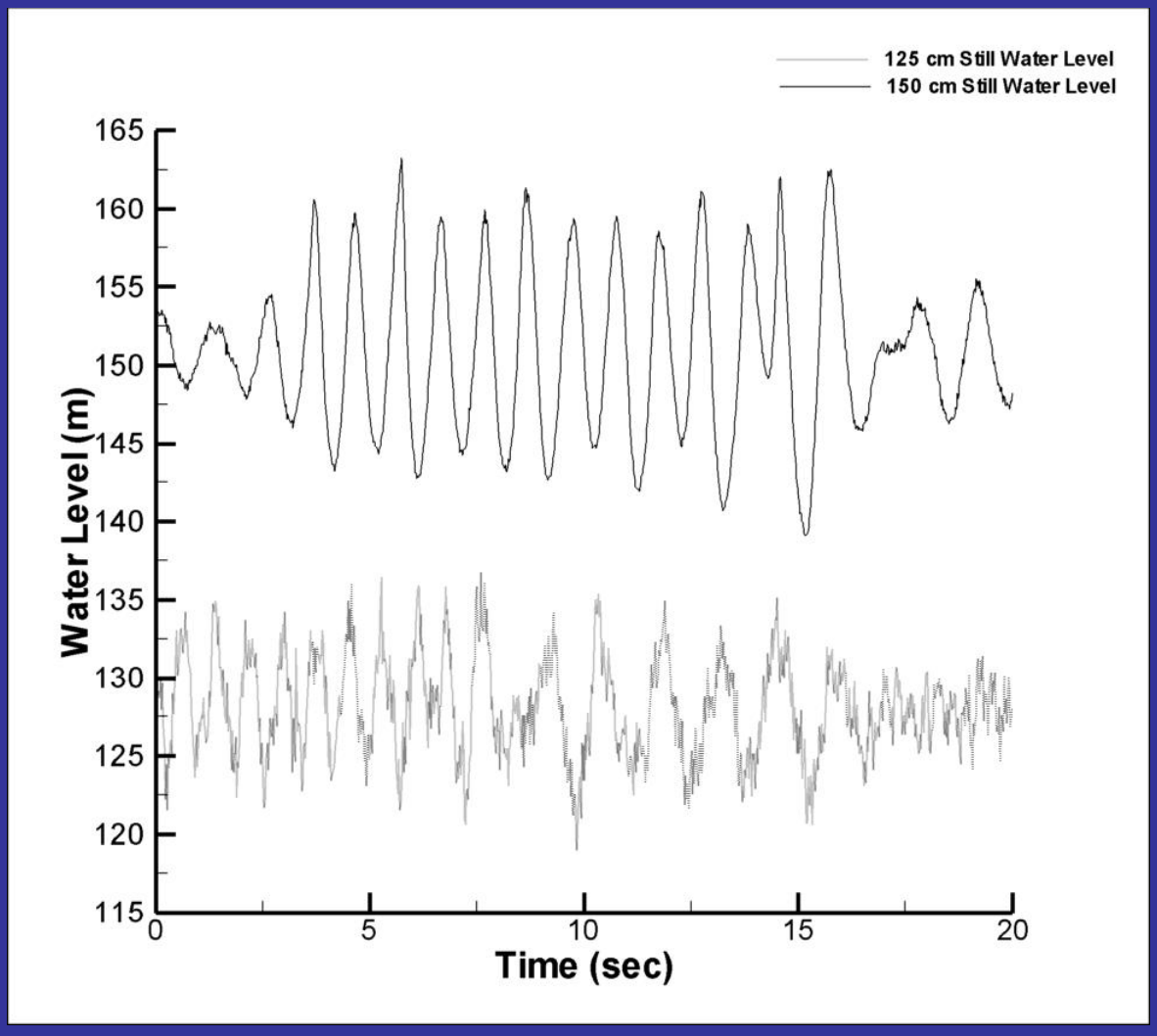
5-cm stroke


log ε (W/kg)
10^-3
10^-2
Depth (cm)
0
5
10
15
20
25
30
35
40
45
Low Frequency Regular
High Frequency Regular
Breaking; Average of Locations 3,4,5

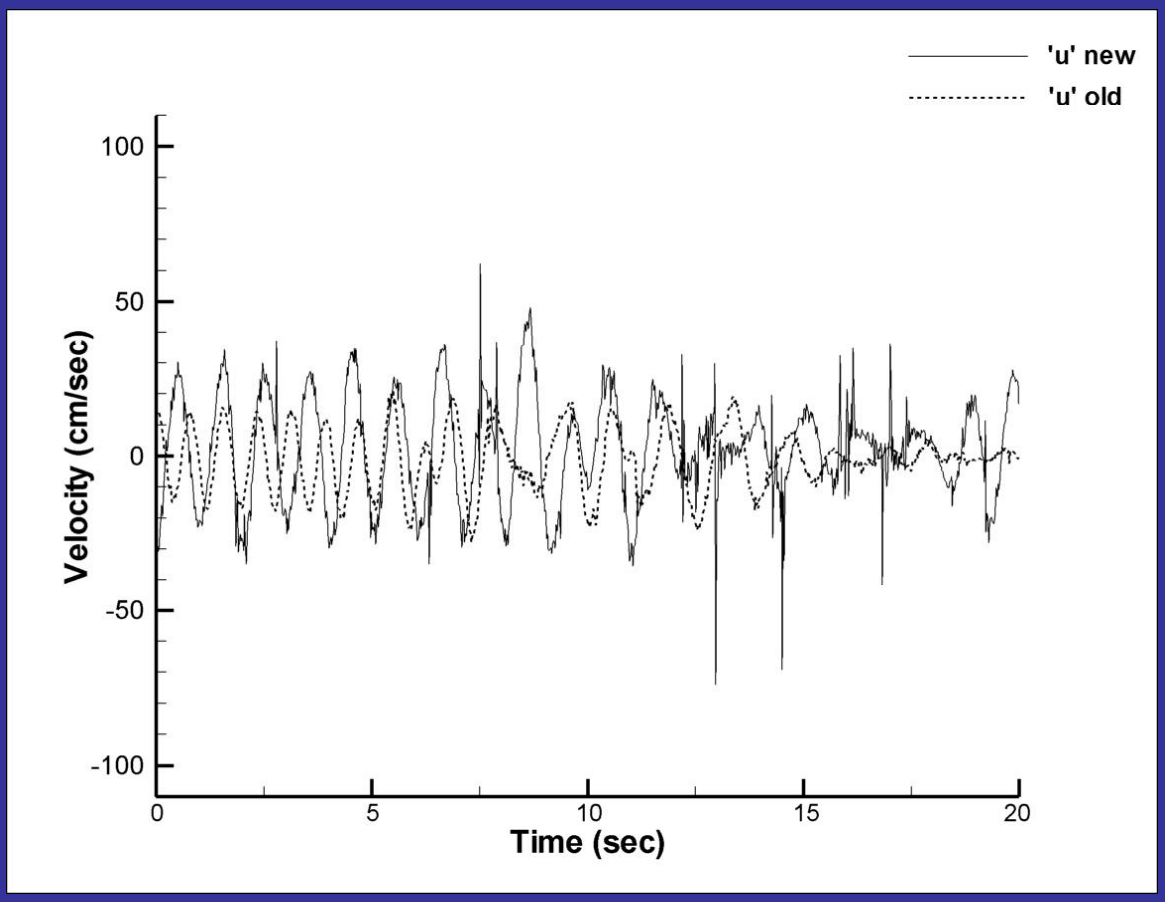
10-cm stroke


log ε (W/kg)
10^-4
10^-3
10^-2
Depth (cm)
0
5
10
15
20
25
30
35
40
45
Low Frequency Regular
High Frequency Regular
Breaking; Average of Locations 4,5

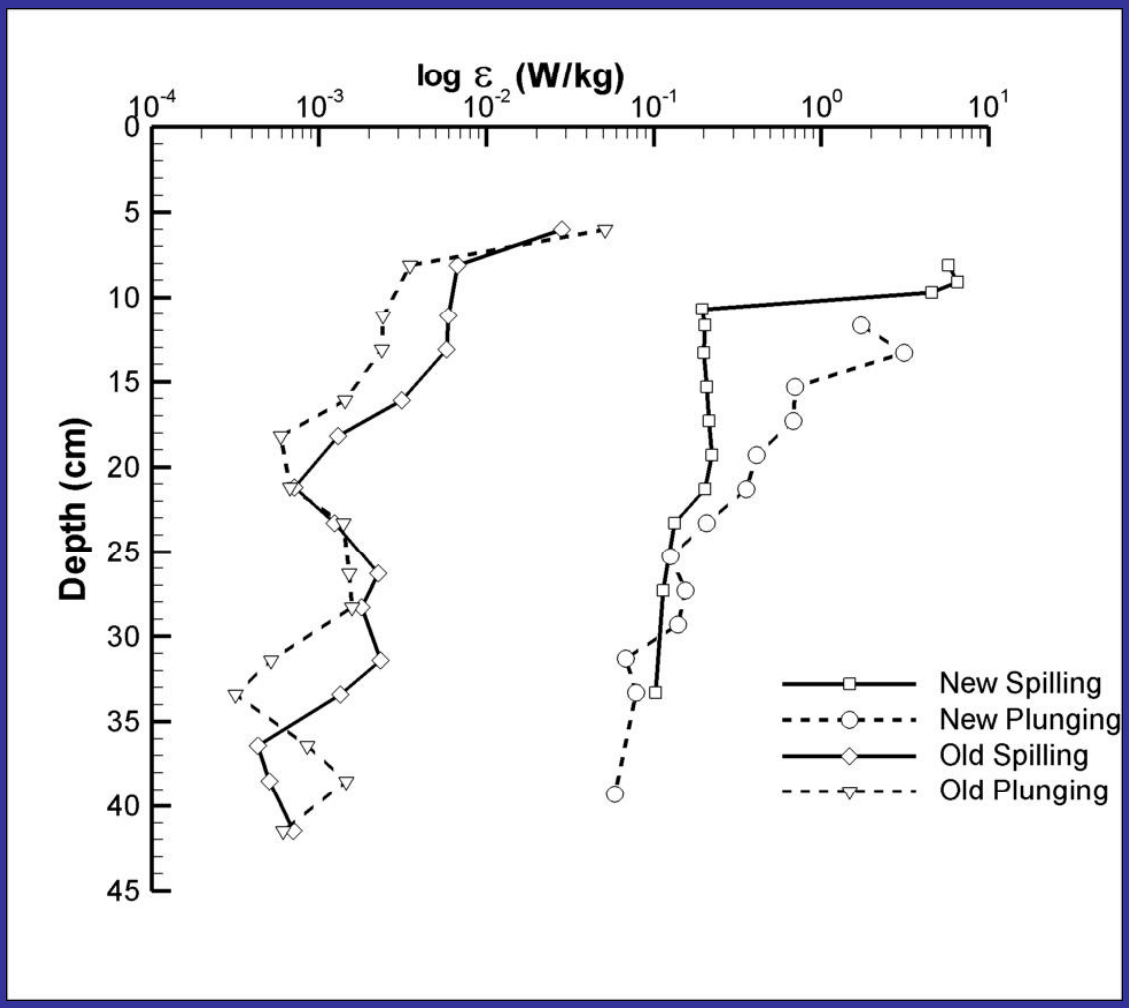
New Experiments



Turbulence Velocity Comparison



Energy Dissipation Rate



Conclusions

- Characterization of the hydraulics was conducted: Beware of currents.

- The energy dissipation rate due to regular and breaking waves was computed.

Future Work

- Correlate dispersion effectiveness to two characteristic values of hydrodynamics: Energy dissipation and burst time.