Validation 5. Periodic Flow in a Wavy Channel

5.1 Purpose

The purpose of this test is to compare the predictions of FLUENT's standard k-ε and RNG k-ε turbulence models against the experimental results of Kuzan [1] for the u velocity profiles.

5.2 Problem Description

The wavy bottom wall has a sinusoidal shape whose amplitude and wave length are 0.1 m and 1.0 m, respectively. Since the flow is periodic, the computational domain can be chosen to cover only one period of the wavy channel, as shown in Figure 5.2.1. The length of the periodic domain is 1 m.

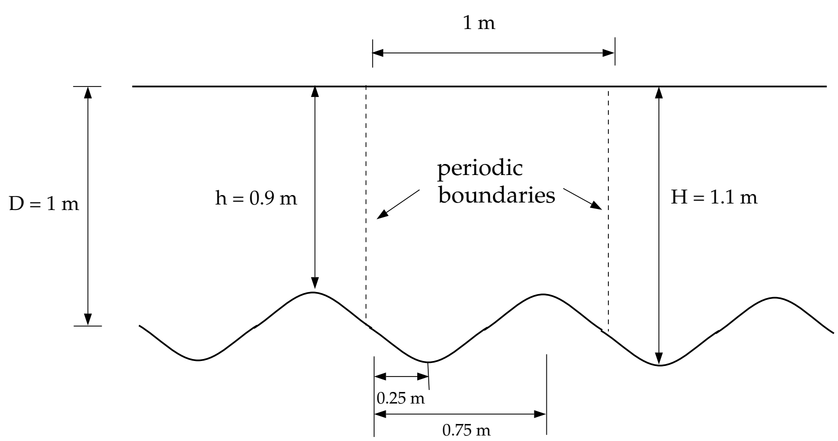

Figure 5.2.1: Problem Description

5.3 References

1. Kuzan, J.D., *Velocity Measurements for Turbulent Separated and Near-Separated Flows Over Solid Waves*, Ph.D. thesis, Dept. Chem. Eng., Univ. Illinois, Urbana, IL, 1986.

5.4 Results

Figures 5.4.1 - 5.4.4 compare the u velocity profiles at the wave crest and at the wave trough with Kuzan's [1] experimental results for both the standard k-ε and the RNG k-ε models. The u velocity is normalized by the average fluid velocity at the mean channel height, $U = 0.816$ m/s.

The velocity profiles at the wave trough confirm that the flow reversal occurs in the wave hollow, thus creating a recirculation zone. Near the top straight wall, velocity profiles remain attached to the wall. The predictions are in very close agreement with the experimental data.

5.4.1 Validation-Specific Information

Solver:	FLUENT 2d
Version:	6.3.11
Solution Files:	1. `std.cas`, `std.dat`
	2. `rng.cas`, `rng.dat`

These solution files are available from the Fluent Inc. User Services Center as described in the Introduction.

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5.4.2 Plot Data

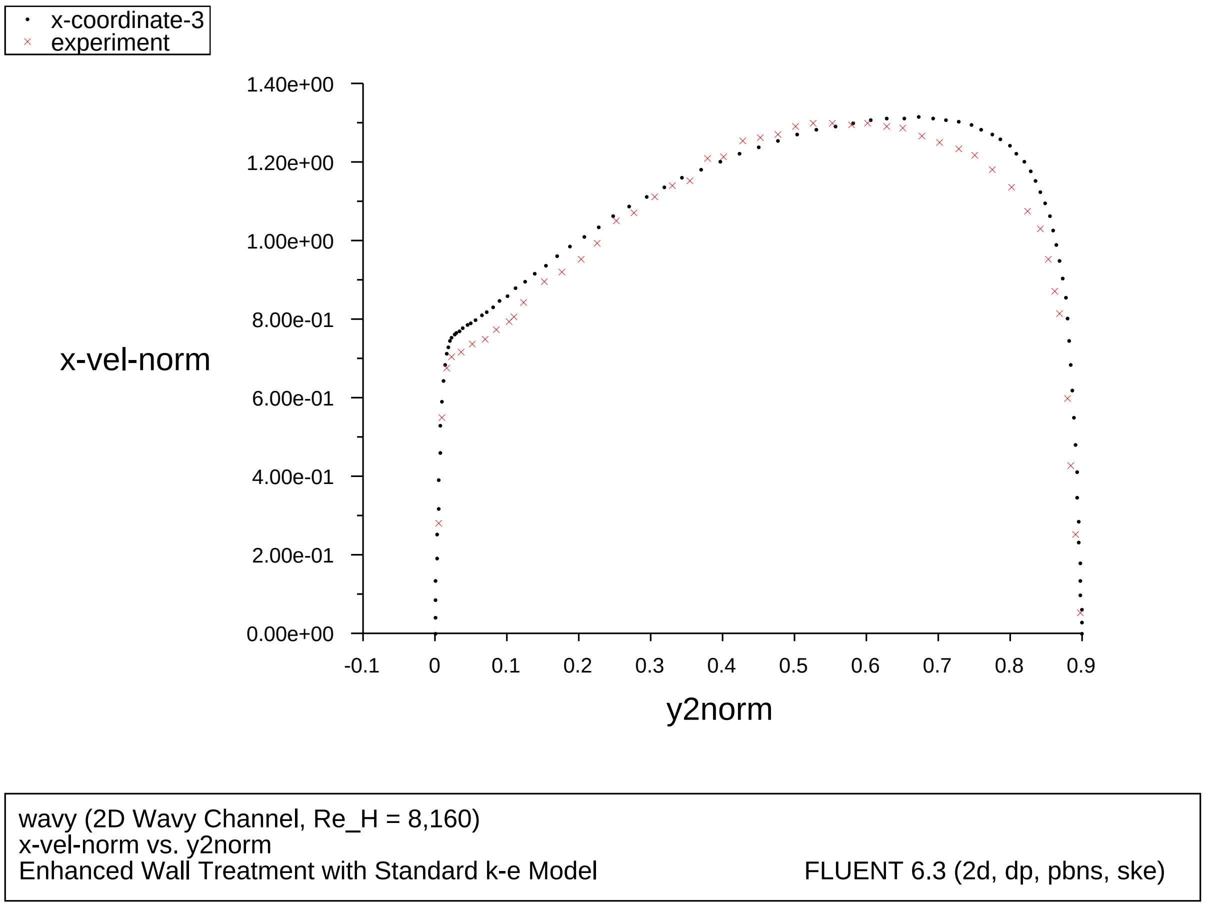

Figure 5.4.1: Normalized u Velocity at the Wave Crest (Standard k-ε Model)

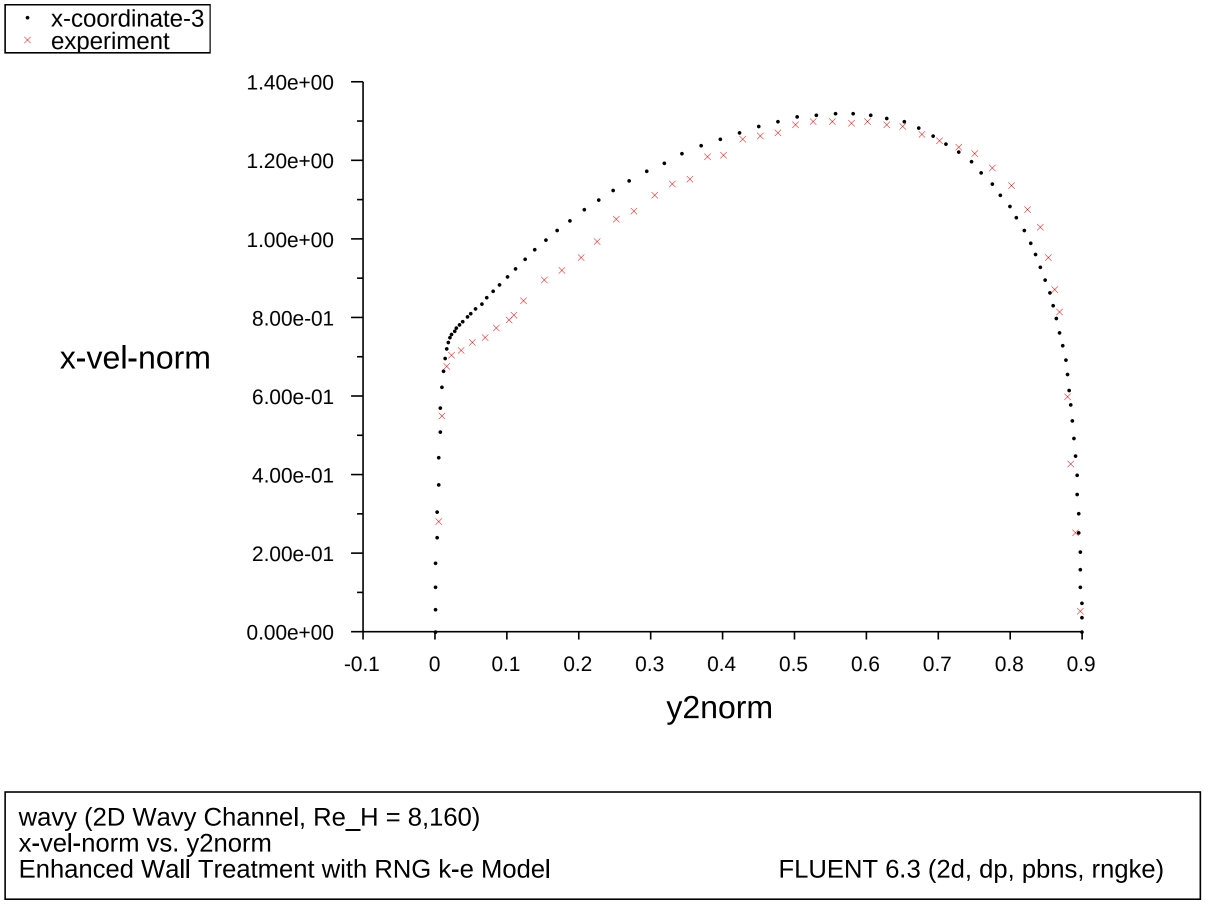

Figure 5.4.2: Normalized u Velocity at the Wave Crest (RNG k-ε Model)

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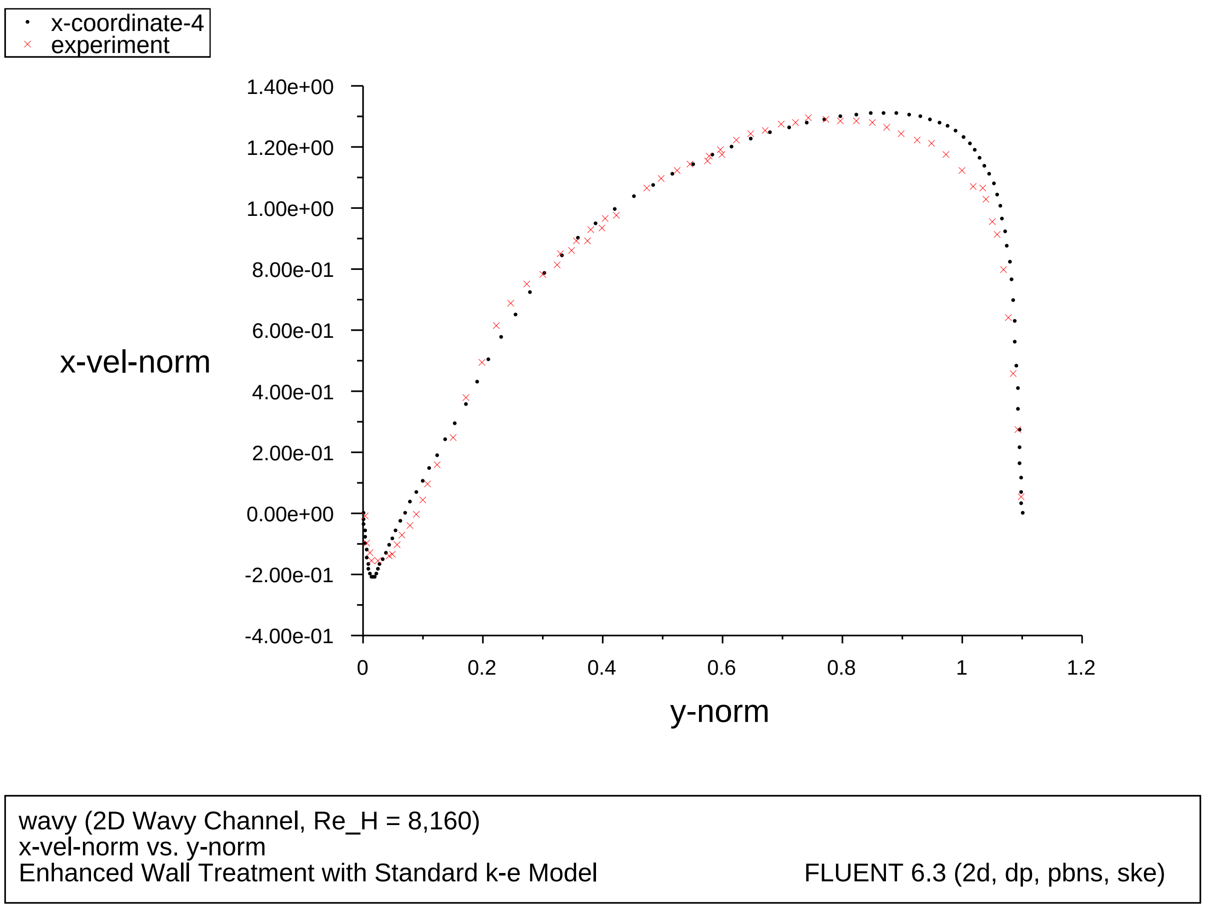

Figure 5.4.3: Normalized u Velocity at the Wave Trough (Standard k-ε Model)

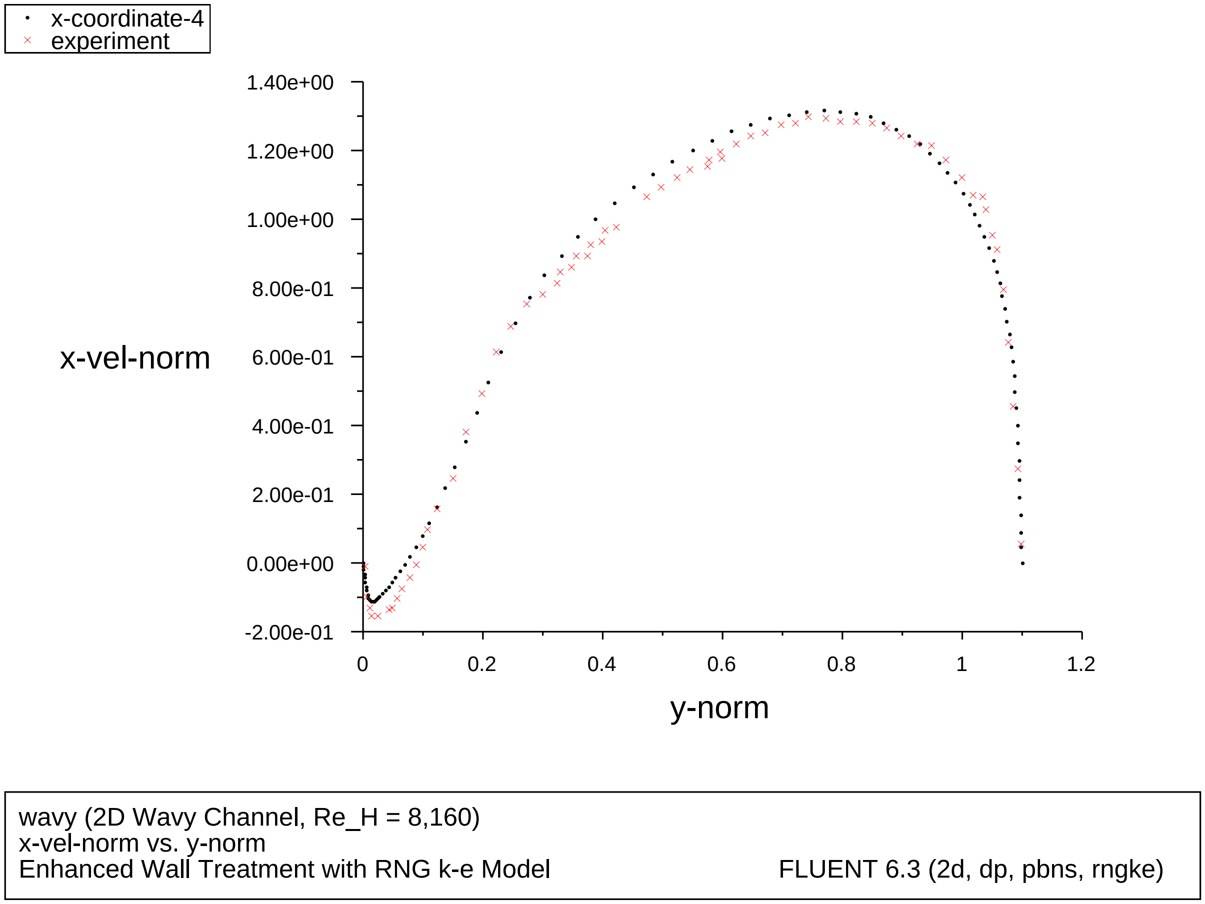

Figure 5.4.4: Normalized u Velocity at the Wave Trough (RNG k-ε Model)

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