

Appendix F

Test 1

Slope = 0.001136

Discharge = 0.005 m³/s

Uniform depth = 0.035 m

Condition: Empty flume

Table F-1 Test 1 velocity measurements

Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
0.19	39.13	-0.11	39.13	0.391
0.17	41.06	-0.49	41.06	0.411
0.15	40.69	-0.16	40.69	0.407
0.13	41.32	-0.05	41.32	0.413
0.11	39.64	-0.21	39.64	0.396
0.09	37.76	0.07	37.76	0.378
0.07	38.16	-0.77	38.17	0.382
0.05	36.37	-0.52	36.37	0.364
0.03	31.25	-0.14	31.25	0.313
0.01	30.36	-0.14	30.36	0.304

Test 2

Slope = 0.001136

Discharge = 0.005 m³/s

Condition: One hemisphere at chainage 4.5 m



Figure F-1 Experimental set up of Test 2

Table F-2 Test 2 velocity measurements

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
3.5	0.19	31.54	0.58	31.55	0.315
	0.17	33.20	0.04	33.20	0.332
	0.15	32.50	-0.37	32.50	0.325
	0.13	34.38	-1.08	34.40	0.344
	0.11	25.05	1.51	25.10	0.251
	0.09	30.71	-0.10	30.71	0.307
	0.07	31.78	-0.80	31.79	0.318
	0.05	30.08	-0.88	30.09	0.301
	0.03	30.12	-1.56	30.16	0.302
	0.01	25.59	-0.34	25.59	0.256
3.75	0.19	30.40	0.77	30.41	0.304
	0.17	29.64	0.46	29.64	0.296

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Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.15	29.18	0.54	29.18	0.292
	0.13	28.55	0.89	28.56	0.286
	0.11	37.76	-2.50	37.84	0.378
	0.09	32.71	-0.52	32.71	0.327
	0.07	27.85	-0.37	27.85	0.279
	0.05	24.68	-1.22	24.71	0.247
	0.03	22.64	-0.99	22.66	0.227
	0.01	24.35	-0.01	24.35	0.244
4.0	0.19	31.70	0.44	31.70	0.317
	0.17	31.06	0.42	31.06	0.311
	0.15	33.97	-0.79	33.98	0.340
	0.13	27.99	0.87	28.00	0.280
	0.11	32.67	-0.28	32.67	0.327
	0.09	32.84	-1.08	32.86	0.329
	0.07	34.12	-1.64	34.16	0.342
	0.05	26.36	-0.46	26.36	0.264
	0.03	26.53	-0.14	26.53	0.265
	0.01	24.61	-0.19	24.61	0.246
4.1	0.19	28.64	1.03	28.66	0.287
	0.17	32.14	0.23	32.14	0.321
	0.15	31.56	-0.08	31.56	0.316
	0.13	32.89	-1.00	32.91	0.329
	0.11	31.12	-0.26	31.12	0.311
	0.09	30.67	-0.52	30.67	0.307
	0.07	31.19	-0.29	31.19	0.312
	0.05	28.52	-0.27	28.52	0.285
	0.03	27.51	-1.29	27.54	0.275
	0.01	24.45	-0.22	24.45	0.245
4.2	0.19	33.44	-0.33	33.44	0.334
	0.17	31.69	0.17	31.69	0.317
	0.15	30.91	-0.12	30.91	0.309
	0.13	30.63	-0.66	30.64	0.306
	0.11	33.77	-1.20	33.79	0.338
	0.09	32.16	-0.81	32.17	0.322
	0.07	29.32	-0.85	29.33	0.293
	0.05	27.09	-1.13	27.11	0.271
	0.03	25.71	-1.21	25.74	0.257

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Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.01	24.46	-0.27	24.46	0.245
4.3	0.19	30.22	0.20	30.22	0.302
	0.17	31.42	-0.14	31.42	0.314
	0.15	30.31	-0.71	30.32	0.303
	0.13	32.97	-1.79	33.02	0.330
	0.11	31.23	-1.23	31.25	0.313
	0.09	30.11	-1.13	30.13	0.301
	0.07	29.90	-1.50	29.94	0.299
	0.05	29.40	-0.99	29.42	0.294
	0.03	22.97	-0.67	22.98	0.230
	0.01	25.72	-0.47	25.72	0.257
4.4	0.19	21.86	1.23	21.89	0.219
	0.17	25.80	-1.70	25.86	0.259
	0.15	27.86	-3.14	28.04	0.280
	0.13	29.90	-4.74	30.27	0.303
	0.11	37.58	-7.02	38.23	0.382
	0.09	32.94	-4.76	33.28	0.333
	0.07	31.75	-4.46	32.06	0.321
	0.05	32.41	-3.01	32.55	0.325
	0.03	27.67	-2.40	27.77	0.278
	0.01	12.12	3.67	12.66	0.127
4.5	0.05	45.84	-5.70	46.19	0.462
	0.03	42.99	-3.04	43.10	0.431
5.0	0.15	30.19	2.34	30.28	0.303
	0.13	38.59	2.25	38.66	0.387
	0.11	44.14	2.75	44.23	0.442
	0.09	47.23	1.02	47.24	0.472
	0.07	41.41	-0.16	41.41	0.414
	0.05	40.93	-0.02	40.93	0.409
	0.03	40.20	-1.60	40.23	0.402
	0.01	36.22	-3.22	36.36	0.364
5.2	0.19	30.34	-0.09	30.34	0.303
	0.17	30.62	-0.07	30.62	0.306
	0.15	34.94	0.07	34.94	0.349
	0.13	40.62	-0.64	40.63	0.406
	0.11	41.76	0.07	41.76	0.418
	0.09	38.97	-1.09	38.99	0.390

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Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.07	37.77	-0.62	37.78	0.378
	0.05	39.05	-0.04	39.05	0.391
	0.03	33.12	-1.94	33.18	0.332
5.5	0.19	36.27	0.13	36.27	0.363
	0.17	36.62	0.19	36.62	0.366
	0.15	37.46	0.25	37.46	0.375
	0.13	39.40	-0.48	39.40	0.394
	0.11	39.95	0.16	39.95	0.400
	0.09	40.64	0.10	40.64	0.406
	0.07	41.70	0.26	41.70	0.417
	0.05	37.40	-1.69	37.44	0.374
	0.03	34.60	-1.23	34.62	0.346
	0.01	29.34	-0.32	29.34	0.293
6.0	0.19	36.96	0.23	36.96	0.370
	0.17	38.62	0.61	38.62	0.386
	0.15	38.81	-0.15	38.81	0.388
	0.13	38.04	-0.05	38.04	0.380
	0.11	36.87	-0.25	36.87	0.369
	0.09	40.14	-0.89	40.15	0.401
	0.07	40.87	-0.08	40.87	0.409
	0.05	37.32	-0.94	37.33	0.373
	0.03	34.46	-1.70	34.50	0.345
	0.01	30.86	-0.14	30.86	0.309
6.5	0.19	35.68	1.51	35.71	0.357
	0.17	40.06	0.46	40.06	0.401
	0.15	39.90	0.25	39.90	0.399
	0.13	37.44	0.42	37.44	0.374
	0.11	39.13	0.03	39.13	0.391
	0.09	37.71	0.43	37.71	0.377
	0.07	39.61	0.03	39.61	0.396
	0.05	36.71	-0.88	36.72	0.367
	0.03	37.80	-0.09	37.80	0.378
	0.01	34.59	-0.21	34.59	0.346

Test 3

Slope = 0.001136

Discharge = 0.005 m³/s

Condition: One hemisphere at chainage 4.5 m and other at 5.5 m



Figure F-2 Experimental set up of Test 3

Table F-3 Test 3 velocity measurements

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
3.5	0.19	29.69	-0.97	29.71	0.297
	0.17	30.31	-0.70	30.32	0.303
	0.15	29.23	-0.67	29.24	0.292
	0.13	29.19	-1.70	29.24	0.292
	0.11	29.67	-0.81	29.68	0.297
	0.09	30.43	-1.39	30.46	0.305
	0.07	27.06	-0.94	27.08	0.271
	0.05	25.58	-1.07	25.60	0.256
4.0	0.03	20.03	0.69	20.04	0.200
	0.01	24.27	-0.73	24.28	0.243
	0.19	29.36	0.26	29.36	0.294
	0.17	28.45	-0.52	28.45	0.285
	0.15	28.49	-0.63	28.50	0.285

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Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.13	27.62	-0.99	27.64	0.276
	0.11	29.13	-0.41	29.13	0.291
	0.09	30.50	-1.77	30.55	0.306
	0.07	29.49	0.94	29.50	0.295
	0.05	26.31	-0.62	26.32	0.263
	0.03	22.79	-0.22	22.79	0.228
	0.01	23.65	-0.58	23.66	0.237
4.2	0.19	30.14	-0.80	30.15	0.302
	0.17	28.56	-0.32	28.56	0.286
	0.15	27.60	-0.77	27.61	0.276
	0.13	26.68	-1.22	26.71	0.267
	0.11	26.63	-1.39	26.67	0.267
	0.09	29.33	-2.09	29.40	0.294
	0.07	28.33	-1.45	28.37	0.284
	0.05	27.73	-1.83	27.79	0.278
	0.03	23.32	-0.81	23.33	0.233
	0.01	21.86	-0.28	21.86	0.219
4.4	0.19	21.89	1.00	21.91	0.219
	0.17	23.95	-2.00	24.03	0.240
	0.15	25.46	-3.43	25.69	0.257
	0.13	27.70	-5.18	28.18	0.282
	0.11	27.98	-5.11	28.44	0.284
	0.09	27.66	-4.99	28.11	0.281
	0.07	29.11	-3.80	29.36	0.294
	0.05	29.15	-3.62	29.37	0.294
	0.03	24.70	-2.33	24.81	0.248
4.5	0.05	42.06	-6.27	42.52	0.425
	0.03	39.81	-4.61	40.08	0.401
4.6	0.09	48.04	3.49	48.17	0.482
	0.07	46.88	1.92	46.92	0.469
	0.05	49.16	-0.30	49.16	0.492
	0.03	41.16	-0.70	41.17	0.412
4.7	0.09	33.78	4.59	34.09	0.341
	0.07	38.31	3.94	38.51	0.385
	0.05	41.12	2.36	41.19	0.412
	0.03	41.43	0.93	41.44	0.414
4.8	0.19	17.45	-1.89	17.55	0.176
	0.17	18.04	0.41	18.04	0.180

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Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.15	19.28	1.45	19.33	0.193
	0.13	23.34	1.41	23.38	0.234
	0.11	28.84	1.06	28.86	0.289
	0.09	35.26	1.57	35.29	0.353
	0.07	34.70	1.00	34.71	0.347
	0.05	38.04	1.48	38.07	0.381
	0.03	36.76	1.10	36.78	0.368
	0.01	24.19	-1.87	24.26	0.243
4.9	0.19	22.54	-0.93	22.56	0.226
	0.17	21.90	-0.90	21.92	0.219
	0.15	23.25	0.03	23.25	0.233
	0.13	26.07	-0.34	26.07	0.261
	0.11	30.07	0.52	30.07	0.301
	0.09	34.67	0.88	34.68	0.347
	0.07	35.39	0.61	35.40	0.354
	0.05	36.57	0.56	36.57	0.366
	0.03	36.39	0.97	36.40	0.364
	0.01	23.60	-1.38	23.64	0.236
5.0	0.19	24.22	-0.42	24.22	0.242
	0.17	23.78	0.22	23.78	0.238
	0.15	24.84	-0.12	24.84	0.248
	0.13	26.39	-1.55	26.44	0.264
	0.11	29.26	0.37	29.26	0.293
	0.09	32.79	0.07	32.79	0.328
	0.07	35.76	0.70	35.77	0.358
	0.05	34.35	0.41	34.35	0.344
	0.03	33.74	0.50	33.74	0.337
	0.01	21.18	-1.44	21.23	0.212
5.2	0.19	25.83	-1.78	25.89	0.259
	0.17	26.09	-0.65	26.10	0.261
	0.15	27.2	-0.38	27.20	0.272
	0.13	29.06	-0.17	29.06	0.291
	0.11	29.55	-0.64	29.56	0.296
	0.09	31.22	-0.34	31.22	0.312
	0.07	33.51	0.90	33.52	0.335
	0.05	31.13	0.34	31.13	0.311
	0.03	25.90	-0.64	25.91	0.259
	0.01	20.74	0.03	20.74	0.207

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Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
5.4	0.17	22.37	-2.72	22.53	0.225
	0.15	25.11	-4.61	25.53	0.255
	0.13	28.78	-6.95	29.61	0.296
	0.11	30.64	-7.56	31.56	0.316
	0.09	33.12	-7.17	33.89	0.339
	0.07	34.56	-6.80	35.22	0.352
	0.05	35.16	-5.18	35.54	0.355
	0.03	30.82	-3.71	31.04	0.310
5.5	0.05	44.40	-4.12	44.59	0.446
	0.03	44.41	-3.04	44.51	0.445
5.6	0.07	45.45	6.25	45.88	0.459
	0.05	56.42	5.01	56.64	0.566
	0.03	59.31	3.63	59.42	0.594
5.65	0.07	37.47	4.10	37.69	0.377
	0.05	45.02	4.17	45.21	0.452
	0.03	40.08	2.13	40.14	0.401
5.75	0.19	26.24	-2.78	26.39	0.264
	0.17	27.65	1.90	27.72	0.277
	0.15	44.01	4.25	44.21	0.442
	0.13	47.72	6.89	48.21	0.482
	0.09	32.13	-3.04	32.27	0.323
	0.07	35.40	-3.21	35.55	0.355
5.85	0.17	37.50	0.00	37.50	0.375
	0.15	32.52	1.03	32.54	0.325
	0.13	40.47	0.52	40.47	0.405
	0.05	41.81	-1.40	41.83	0.418
5.95	0.19	35.41	-1.29	35.43	0.354
	0.17	38.01	-1.60	38.04	0.380
	0.15	38.49	-0.47	38.49	0.385
	0.11	38.12	-0.66	38.13	0.381
	0.09	41.59	-1.50	41.62	0.416
	0.07	44.49	0.30	44.49	0.445
	0.05	41.32	-1.25	41.34	0.413
6.1	0.19	35.93	-1.08	35.95	0.359
	0.17	37.19	-0.84	37.20	0.372
	0.15	37.54	-0.61	37.54	0.375
	0.13	39.75	-0.71	39.76	0.398
	0.11	41.48	-0.37	41.48	0.415

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Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.09	40.92	-0.97	40.93	0.409
	0.07	44.01	-0.32	44.01	0.440
	0.05	30.74	-0.78	30.75	0.307
	0.03	36.93	-3.00	37.05	0.371
6.25	0.19	37.52	-0.75	37.53	0.375
	0.17	38.49	-0.65	38.50	0.385
	0.15	39.07	-0.23	39.07	0.391
	0.13	41.21	-1.07	41.22	0.412
	0.11	41.91	-1.62	41.94	0.419
	0.09	41.03	-1.66	41.06	0.411
	0.07	43.15	-0.38	43.15	0.432
	0.05	40.88	-1.89	40.92	0.409
	0.03	33.69	-1.83	33.74	0.337
	0.01	19.95	0.82	19.97	0.200
6.5	0.19	38.42	-0.51	38.42	0.384
	0.17	40.21	-0.72	40.22	0.402
	0.15	39.94	-0.79	39.95	0.399
	0.13	39.10	-1.04	39.11	0.391
	0.11	37.65	-0.46	37.65	0.377
	0.09	39.64	-1.75	39.68	0.397
	0.07	38.33	-1.52	38.36	0.384
	0.05	35.25	-2.19	35.32	0.353
	0.03	32.44	-1.44	32.47	0.325
	0.01	29.06	-0.32	29.06	0.291
7	0.19	38.79	0.02	38.79	0.388
	0.17	41.37	-0.01	41.37	0.414
	0.15	38.60	-0.17	38.60	0.386
	0.13	40.17	-0.30	40.17	0.402
	0.11	39.54	-0.38	39.54	0.395
	0.09	39.67	-1.09	39.68	0.397
	0.07	37.98	-1.22	38.00	0.380
	0.05	37.88	-0.56	37.88	0.379
	0.03	32.67	-1.04	32.69	0.327
	0.01	28.57	0.03	28.57	0.286
8.0	0.19	40.58	0.17	40.58	0.406
	0.17	40.58	-0.16	40.58	0.406
	0.15	40.33	-0.17	40.33	0.403
	0.13	42.06	-1.27	42.08	0.421

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Longitudinal chainage (m)	Transverse distance (m)	V_x (cm/s)	V_y (cm/s)	V (cm/s)	V (m/s)
	0.11	41.67	-1.10	41.68	0.417
	0.09	40.39	-0.83	40.40	0.404
	0.07	36.27	-0.79	36.28	0.363
	0.05	36.65	-1.23	36.67	0.367
	0.03	34.39	-0.77	34.40	0.344
	0.01	34.67	-0.17	34.67	0.347

Test 4

Slope = 0.001136

Discharge = 0.005 m³/s

Condition: Three hemispheres at chainages 4.5, 5.5 and at 6.5 m



Figure F-3 Experimental set up of Test 4

Table F-4 Test 4 velocity measurements

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
3.5	0.19	28.76	0.06	28.76	0.288
	0.17	28.33	0.06	28.33	0.283
	0.15	27.81	-0.10	27.81	0.278
	0.13	24.60	-0.25	24.60	0.246
	0.11	25.89	-0.01	25.89	0.259
	0.09	33.02	-3.07	33.16	0.332
	0.07	26.33	-0.33	26.33	0.263
	0.05	27.16	-0.15	27.16	0.272
4.0	0.03	18.97	-0.61	18.98	0.190
	0.01	22.03	-0.24	22.03	0.220
	0.19	32.14	0.86	32.15	0.322
	0.17	27.42	-0.91	27.44	0.274
	0.15	27.39	-1.18	27.42	0.274

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Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.13	30.46	-2.55	30.57	0.306
	0.11	32.00	-2.46	32.09	0.321
	0.09	25.17	-2.84	25.33	0.253
	0.07	28.00	-0.78	28.01	0.280
	0.05	24.32	-0.85	24.33	0.243
	0.03	23.56	-0.32	23.56	0.236
	0.01	21.72	-0.43	21.72	0.217
4.2	0.19	27.17	-0.31	27.17	0.272
	0.17	27.07	-0.35	27.07	0.271
	0.15	25.50	-0.51	25.51	0.255
	0.13	22.17	-0.14	22.17	0.222
	0.11	22.59	-1.31	22.63	0.226
	0.09	26.39	-1.75	26.45	0.264
	0.07	28.23	-1.17	28.25	0.283
	0.05	23.32	-1.14	23.35	0.233
	0.03	23.02	-0.03	23.02	0.230
	0.01	20.19	-0.11	20.19	0.202
4.4	0.19	21.55	-0.48	21.56	0.216
	0.17	21.32	-2.31	21.44	0.214
	0.15	23.47	-3.48	23.73	0.237
	0.13	24.87	-5.12	25.39	0.254
	0.11	30.28	-6.90	31.06	0.311
	0.09	28.76	-4.86	29.17	0.292
	0.07	28.04	-4.41	28.38	0.284
	0.05	28.09	-3.08	28.26	0.283
	0.03	23.18	-2.34	23.30	0.233
4.5	0.05	37.74	-4.36	37.99	0.380
	0.03	35.65	3.74	35.85	0.358
4.6	0.11	38.20	4.21	38.43	0.384
	0.09	45.84	2.89	45.93	0.459
	0.07	42.77	1.75	42.81	0.428
	0.05	43.34	0.07	43.34	0.433
	0.03	40.72	-0.74	40.73	0.407
4.8	0.19	16.02	0.39	16.02	0.160
	0.17	17.68	0.08	17.68	0.177
	0.15	19.39	1.82	19.48	0.195
	0.13	23.68	1.33	23.72	0.237
	0.11	22.04	1.09	22.07	0.221

Appendix F

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.09	31.66	2.42	31.75	0.318
	0.07	32.85	1.97	32.91	0.329
	0.05	33.96	1.27	33.98	0.340
	0.03	29.54	-0.17	29.54	0.295
	0.01	31.86	0.00	31.86	0.319
5.0	0.19	24.85	-0.38	24.85	0.249
	0.17	22.46	0.43	22.46	0.225
	0.15	24.17	0.29	24.17	0.242
	0.13	26.68	-0.06	26.68	0.267
	0.11	30.44	0.87	30.45	0.305
	0.09	30.98	0.34	30.98	0.310
	0.07	30.03	1.43	30.06	0.301
	0.05	28.99	0.81	29.00	0.290
	0.03	29.17	0.44	29.17	0.292
	0.01	20.60	-0.77	20.61	0.206
5.2	0.19	37.99	-0.50	37.99	0.380
	0.17	38.63	-0.80	38.64	0.386
	0.15	39.32	-0.94	39.33	0.393
	0.13	39.67	-1.16	39.69	0.397
	0.11	40.99	-1.44	41.02	0.410
	0.09	43.56	-2.36	43.62	0.436
	0.07	40.54	-2.20	40.60	0.406
	0.05	39.49	-2.66	39.58	0.396
	0.03	35.08	-2.38	35.16	0.352
5.4	0.17	19.45	-2.28	19.58	0.196
	0.15	23.19	-4.39	23.60	0.236
	0.13	25.99	-5.57	26.58	0.266
	0.11	29.03	-7.10	29.89	0.299
	0.09	31.49	-6.53	32.16	0.322
	0.07	31.47	-4.52	31.79	0.318
	0.05	31.15	-4.75	31.51	0.315
	0.03	30.34	-3.02	30.49	0.305
5.5	0.05	41.68	-4.21	41.89	0.419
	0.03	37.70	-3.51	37.86	0.379
5.6	0.13	28.65	9.05	30.05	0.300
	0.11	38.70	8.04	39.53	0.395
	0.09	43.38	4.10	43.57	0.436
	0.07	41.67	2.05	41.72	0.417

Appendix F

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.05	42.94	0.83	42.95	0.429
	0.03	40.92	-0.91	40.93	0.409
5.8	0.19	26.93	-0.14	26.93	0.269
	0.17	25.98	-1.33	26.01	0.260
	0.15	28.72	0.48	28.72	0.287
	0.13	29.73	0.53	29.73	0.297
	0.11	34.70	0.94	34.71	0.347
	0.09	31.76	0.60	31.77	0.318
	0.07	33.12	1.17	33.14	0.331
	0.05	35.90	0.49	35.90	0.359
	0.03	33.07	0.05	33.07	0.331
6.0	0.19	28.17	-0.38	28.17	0.282
	0.17	27.93	-0.95	27.95	0.279
	0.15	29.70	-0.02	29.70	0.297
	0.13	31.56	-0.99	31.58	0.316
	0.11	31.83	-0.91	31.84	0.318
	0.09	31.49	-1.00	31.51	0.315
	0.07	32.26	0.09	32.26	0.323
	0.05	34.18	-0.33	34.18	0.342
	0.03	31.91	-0.50	31.91	0.319
6.2	0.19	28.10	-0.54	28.11	0.281
	0.17	29.48	-0.53	29.48	0.295
	0.15	28.46	-1.23	28.49	0.285
	0.13	30.51	-1.79	30.56	0.306
	0.11	30.94	-0.79	30.95	0.310
	0.09	31.51	-1.66	31.55	0.316
	0.07	33.3	-0.43	33.30	0.333
	0.05	32.65	-1.75	32.70	0.327
	0.03	27.72	-0.76	27.73	0.277
6.4	0.19	22.39	3.74	22.70	0.227
	0.17	23.24	0.94	23.26	0.233
	0.15	22.93	-2.19	23.03	0.230
	0.13	29.89	-4.96	30.30	0.303
	0.11	30.64	-5.24	31.08	0.311
	0.09	31.55	-5.84	32.09	0.321
	0.07	34.81	-3.19	34.96	0.350
	0.05	33.98	-3.82	34.19	0.342
	0.03	30.1	-2.98	30.25	0.302

Appendix F

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
6.5	0.05	44.76	-4.96	45.03	0.450
	0.03	44.50	-4.15	44.69	0.447
6.6	0.07	53.26	7.82	53.83	0.538
	0.05	60.16	5.74	60.43	0.604
	0.03	58.33	2.91	58.40	0.584
6.85	0.19	50.59	-1.40	50.61	0.506
	0.17	54.30	0.20	54.30	0.543
	0.15	50.79	0.04	50.79	0.508
	0.09	48.38	-3.50	48.51	0.485
7.0	0.19	43.04	-1.61	43.07	0.431
	0.17	42.79	-0.15	42.79	0.428
	0.15	45.07	0.14	45.07	0.451
	0.13	45.66	0.11	45.66	0.457
	0.11	47.11	-0.02	47.11	0.471
	0.09	48.08	-1.21	48.10	0.481
	0.07	46.42	-2.12	46.47	0.465
	0.05	40.51	-2.36	40.58	0.406
	0.03	33.11	-2.32	33.19	0.332
7.1	0.19	38.48	-1.79	38.52	0.385
	0.13	43.12	-3.10	43.23	0.432
	0.11	46.45	-3.70	46.60	0.466
	0.09	45.09	-2.87	45.18	0.452
	0.07	41.36	-1.94	41.41	0.414
7.75	0.19	37.99	-0.50	37.99	0.380
	0.17	38.83	-0.80	38.84	0.388
	0.15	39.32	-0.94	39.33	0.393
	0.13	39.67	-1.16	39.69	0.397
	0.11	42.99	-1.44	43.01	0.430
	0.09	43.56	-2.36	43.62	0.436
	0.07	40.54	-2.20	40.60	0.406
	0.05	39.49	-2.66	39.58	0.396
	0.03	35.08	-2.38	35.16	0.352
8.5	0.19	36.79	-0.54	36.79	0.368
	0.17	38.51	-0.53	38.51	0.385
	0.15	38.70	-0.79	38.71	0.387
	0.13	40.75	-1.53	40.78	0.408
	0.11	42.05	-1.61	42.08	0.421
	0.09	40.65	-1.91	40.69	0.407

Appendix F

Longitudinal chainage (m)	Transverse distance (m)	V_x (cm/s)	V_y (cm/s)	V (cm/s)	V (m/s)
	0.07	37.82	-1.61	37.85	0.379
	0.05	37.56	-2.20	37.62	0.376
	0.03	34.13	-2.12	34.20	0.342
	0.01	27.63	0.27	27.63	0.276

Test 5

Slope = 0.001136

Discharge = 0.005 m³/s

Condition: Four hemispheres at chainages 4.5, 5.5, 6.5 and at 7.5 m



Figure F-4 Experimental set up of Test 5

Table F-5 Test 5 velocity measurements

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
3.5	0.19	28.07	0.59	28.08	0.281
	0.17	28.29	0.67	28.30	0.283
	0.15	27.49	0.69	27.50	0.275
	0.13	31.37	-0.38	31.37	0.314
	0.11	27.54	0.13	27.54	0.275
	0.09	27.87	-0.57	27.88	0.279
	0.07	26.12	-0.09	26.12	0.261
	0.05	26.55	-0.19	26.55	0.266
	0.03	22.44	0.28	22.44	0.224
	0.01	22.27	0.21	22.27	0.223
4.0	0.19	26.53	-0.88	26.54	0.265
	0.17	27.28	-0.96	27.30	0.273

Appendix F

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.15	28.44	-0.84	28.45	0.285
	0.13	28.95	-0.97	28.97	0.290
	0.11	25.59	-0.97	25.61	0.256
	0.09	27.75	-1.88	27.81	0.278
	0.07	23.87	0.98	23.89	0.239
	0.05	22.48	-0.99	22.50	0.225
	0.03	20.56	-0.86	20.58	0.206
	0.01	21.77	-0.50	21.78	0.218
4.2	0.19	24.11	-0.29	24.11	0.241
	0.17	27.25	-0.49	27.25	0.273
	0.15	26.54	-1.30	26.57	0.266
	0.13	27.99	-1.27	28.02	0.280
	0.11	38.36	-1.84	38.40	0.384
	0.09	27.27	-1.76	27.33	0.273
	0.07	27.84	-0.84	27.85	0.279
	0.05	25.54	-1.89	25.61	0.256
	0.03	19.25	-1.74	19.33	0.193
	0.01	20.10	-0.58	20.11	0.201
4.4	0.19	23.23	-0.12	23.23	0.232
	0.17	22.98	-2.44	23.11	0.231
	0.15	23.97	-3.38	24.21	0.242
	0.13	26.34	-4.89	26.79	0.268
	0.11	29.83	-4.45	30.16	0.302
	0.09	27.38	-5.44	27.92	0.279
	0.07	28.31	-4.06	28.60	0.286
	0.05	25.79	-3.45	26.02	0.260
	0.03	22.25	-0.51	22.26	0.223
4.5	0.05	35.73	-5.35	36.13	0.361
4.6	0.11	33.42	0.95	33.43	0.334
	0.09	43.43	1.46	43.45	0.435
	0.07	43.52	0.72	43.53	0.435
	0.05	41.56	-0.95	41.57	0.416
	0.03	38.57	-1.75	38.61	0.386
4.8	0.19	17.31	1.20	17.35	0.174
	0.17	16.92	-0.24	16.92	0.169
	0.15	19.68	1.28	19.72	0.197
	0.13	25.15	1.50	25.19	0.252

Appendix F

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.11	23.79	0.61	23.80	0.238
	0.09	30.66	0.71	30.67	0.307
	0.07	32.43	1.01	32.45	0.324
	0.05	31.81	0.47	31.81	0.318
	0.03	29.77	-0.27	29.77	0.298
	0.01	32.17	-0.55	32.17	0.322
5.0	0.19	23.16	0.51	23.17	0.232
	0.17	22.31	0.25	22.31	0.223
	0.15	23.83	-0.56	23.84	0.238
	0.13	26.58	0.54	26.59	0.266
	0.11	32.76	0.88	32.77	0.328
	0.09	29.87	-0.79	29.88	0.299
	0.07	30.73	0.10	30.73	0.307
	0.05	25.66	1.19	25.69	0.257
	0.03	25.19	-0.28	25.19	0.252
	0.01	28.17	-0.19	28.17	0.282
5.2	0.19	24.49	-0.25	24.49	0.245
	0.17	24.33	-1.14	24.36	0.244
	0.15	24.87	-1.36	24.91	0.249
	0.13	28.52	-1.21	28.55	0.285
	0.11	26.37	-1.95	26.44	0.264
	0.09	29.04	-2.35	29.13	0.291
	0.07	24.00	1.22	24.03	0.240
	0.05	24.44	0.97	24.46	0.245
	0.03	18.87	-0.28	18.87	0.189
	0.01	24.73	-0.33	24.73	0.247
5.4	0.19	18.33	-1.63	18.40	0.184
	0.17	21.82	-2.90	22.01	0.220
	0.15	23.22	-5.17	23.79	0.238
	0.13	29.29	-5.34	29.77	0.298
	0.11	28.52	-6.05	29.15	0.292
	0.09	31.09	-7.37	31.95	0.320
	0.07	32.56	-4.20	32.83	0.328
	0.05	31.55	-3.28	31.72	0.317
	0.03	25.59	-1.70	25.65	0.256
5.5	0.05	39.01	-5.54	39.40	0.394
	0.03	38.52	-2.89	38.63	0.386

Appendix F

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
5.6	0.15	14.51	6.54	15.92	0.159
	0.13	16.05	4.63	16.70	0.167
	0.11	36.68	5.54	37.10	0.371
	0.09	42.12	1.93	42.16	0.422
	0.07	41.23	0.93	41.24	0.412
	0.05	38.35	0.06	38.35	0.384
	0.03	36.64	-0.69	36.65	0.366
	0.01	36.64	-0.69	36.65	0.366
5.8	0.19	20.33	0.29	20.33	0.203
	0.17	20.36	0.03	20.36	0.204
	0.15	24.24	0.58	24.25	0.242
	0.13	28.64	1.22	28.67	0.287
	0.11	28.33	0.26	28.33	0.283
	0.09	36.18	1.78	36.22	0.362
	0.07	35.17	1.05	35.19	0.352
	0.05	36.01	0.85	36.02	0.360
	0.03	21.81	2.75	21.98	0.220
	0.01	24.30	0.72	24.31	0.243
6.0	0.19	24.24	0.35	24.24	0.242
	0.17	23.85	-0.32	23.85	0.239
	0.15	26.33	-0.75	26.34	0.263
	0.13	29.79	-0.71	29.80	0.298
	0.11	26.84	-3.76	27.10	0.271
	0.09	34.05	-1.30	34.07	0.341
	0.07	36.52	-0.51	36.52	0.365
	0.05	33.02	0.33	33.02	0.330
	0.03	25.83	-0.90	25.85	0.258
	0.01	27.42	-0.03	27.42	0.274
6.2	0.19	25.75	-0.20	25.75	0.258
	0.17	26.13	-0.99	26.15	0.261
	0.15	27.03	-0.69	27.04	0.270
	0.13	31.85	-0.57	31.86	0.319
	0.11	25.72	-3.25	25.92	0.259
	0.09	32.53	-1.31	32.56	0.326
	0.07	31.84	-1.00	31.86	0.319
	0.05	32.22	-0.66	32.23	0.322
	0.03	26.73	-1.51	26.77	0.268
	0.01	22.28	0.12	22.28	0.223

Appendix F

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
6.4	0.19	22.27	0.44	22.27	0.223
	0.17	23.25	-1.11	23.28	0.233
	0.15	25.45	-3.43	25.68	0.257
	0.13	28.05	-4.59	28.42	0.284
	0.11	29.12	-5.58	29.65	0.296
	0.09	33.42	-5.37	33.85	0.338
	0.07	31.36	-4.91	31.74	0.317
	0.05	32.35	-3.54	32.54	0.325
	0.03	33.11	-2.75	33.22	0.332
	6.5	0.05	42.95	-5.98	43.36
	0.03	40.79	-3.95	40.98	0.410
6.6	0.09	46.31	2.24	46.36	0.464
	0.07	44.85	-0.11	44.85	0.449
	0.05	44.46	-0.01	44.46	0.445
	0.03	42.87	-0.18	42.87	0.429
6.8	0.09	34.40	-0.76	34.41	0.344
	0.07	36.59	0.77	36.60	0.366
	0.05	37.14	0.26	37.14	0.371
	0.03	34.08	0.57	34.08	0.341
7.0	0.19	23.53	-1.22	23.56	0.236
	0.17	25.31	-1.01	25.33	0.253
	0.15	27.56	-1.00	27.58	0.276
	0.13	30.45	-0.89	30.46	0.305
	0.11	25.93	-1.17	25.96	0.260
	0.09	33.55	-1.20	33.57	0.336
	0.07	34.07	0.10	34.07	0.341
	0.05	33.82	-0.24	33.82	0.338
	0.03	31.38	-0.52	31.38	0.314
		0.01	23.10	-0.24	23.10
7.2	0.19	30.77	-1.52	30.81	0.308
	0.17	27.39	-1.56	27.43	0.274
	0.15	30.36	0.43	30.36	0.304
	0.13	32.44	-0.67	32.45	0.324
	0.11	26.81	-2.33	26.91	0.269
	0.09	35.13	-1.70	35.17	0.352
	0.07	35.56	-0.21	35.56	0.356
	0.05	34.09	-0.73	34.10	0.341

Appendix F

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.03	30.61	-1.06	30.63	0.306
	0.01	23.32	0.12	23.32	0.233
7.4	0.17	21.43	-1.57	21.49	0.215
	0.15	23.32	-4.20	23.70	0.237
	0.13	30.26	-6.17	30.88	0.309
	0.11	28.64	-7.45	29.59	0.296
	0.09	36.27	-6.17	36.79	0.368
	0.07	34.35	-5.93	34.86	0.349
	0.05	35.37	-5.51	35.80	0.358
	0.03	29.45	-2.89	29.59	0.296
7.5	0.05	33.11	-9.75	34.52	0.345
7.6	0.07	39.23	4.99	39.55	0.395
	0.05	59.59	7.00	60.00	0.600
	0.03	60.88	5.07	61.09	0.611
8.5	0.19	37.80	-0.18	37.80	0.378
	0.17	38.97	-0.29	38.97	0.390
	0.15	39.50	-0.58	39.50	0.395
	0.13	40.55	-1.17	40.57	0.406
	0.11	43.97	-2.59	44.05	0.440
	0.09	43.13	-1.63	43.16	0.432
	0.07	39.40	-2.31	39.47	0.395
	0.05	36.79	-2.53	36.88	0.369
	0.01	20.54	0.82	20.56	0.206
9.0	0.19	40.67	-0.71	40.68	0.407
	0.17	40.49	-0.41	40.49	0.405
	0.13	41.10	-2.06	41.15	0.412
	0.11	41.92	-1.26	41.94	0.419
	0.09	40.53	-1.35	40.55	0.406
	0.07	38.72	-1.05	38.73	0.387
	0.05	31.00	-0.85	31.01	0.310
	0.01	28.32	-0.06	28.32	0.283

Test 6

Slope = 0.001136

Discharge = 0.005 m³/s

Condition: Two hemispheres at chainages 4.5 and at 8.5 m



Figure F-5 Experimental set up of Test 6

Table F-6 Test 6 velocity measurements

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
3.5	0.19	28.52	0.64	28.53	0.285
	0.17	29.14	0.05	29.14	0.291
	0.15	25.95	0.67	25.96	0.260
	0.13	22.93	1.84	23.00	0.230
	0.11	36.47	-3.02	36.59	0.366
	0.09	25.27	-1.51	25.32	0.253
	0.07	25.90	1.03	25.92	0.259
	0.05	18.86	-0.78	18.88	0.189
	0.03	28.25	-0.78	28.26	0.283
	0.01	25.59	-0.34	25.59	0.256
3.75	0.19	25.70	0.36	25.70	0.257
	0.17	28.70	-0.37	28.70	0.287

Appendix F

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.15	27.28	-0.11	27.28	0.273
	0.13	30.92	-4.15	31.20	0.312
	0.11	33.35	-0.45	33.35	0.334
	0.09	25.52	0.31	25.52	0.255
	0.07	29.77	1.95	29.83	0.298
	0.05	24.87	-0.82	24.88	0.249
	0.03	17.53	1.22	17.57	0.176
	0.01	19.37	1.28	19.41	0.194
4	0.19	27.60	0.59	27.61	0.276
	0.17	27.17	0.39	27.17	0.272
	0.15	37.57	-3.11	37.70	0.377
	0.13	29.66	-1.92	29.72	0.297
	0.11	20.33	-0.98	20.35	0.204
	0.09	27.39	-0.68	27.40	0.274
	0.07	23.39	-1.94	23.47	0.235
	0.05	24.30	1.49	24.35	0.243
	0.03	26.26	0.32	26.26	0.263
	0.01	19.80	-1.01	19.83	0.198
4.4	0.19	17.59	-0.98	17.62	0.176
	0.17	19.77	-2.87	19.98	0.200
	0.15	18.11	-3.88	18.52	0.185
	0.13	23.13	-6.32	23.98	0.240
	0.11	24.28	-8.47	25.71	0.257
	0.09	27.61	-6.02	28.26	0.283
	0.07	26.65	-3.87	26.93	0.269
	0.05	28.07	-4.33	28.40	0.284
	0.03	23.06	-1.98	23.14	0.231
4.5	0.05	38.93	-5.68	39.34	0.393
	0.03	30.69	-3.24	30.86	0.309
4.6	0.13	24.04	4.50	24.46	0.245
	0.11	46.68	3.96	46.85	0.468
	0.09	49.48	3.54	49.61	0.496
	0.07	42.46	1.55	42.49	0.425
	0.05	45.26	0.16	45.26	0.453
	0.03	29.65	1.44	29.68	0.297
4.8	0.19	16.98	-0.68	16.99	0.170
	0.17	18.85	1.12	18.88	0.189

Appendix F

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.15	20.34	1.39	20.39	0.204
	0.13	28.07	2.49	28.18	0.282
	0.11	29.99	4.21	30.28	0.303
	0.09	36.25	4.24	36.50	0.365
	0.07	36.32	3.41	36.48	0.365
	0.05	33.26	1.62	33.30	0.333
	0.03	42.32	-0.74	42.33	0.423
	0.01	25.42	-0.92	25.44	0.254
5	0.19	21.60	-0.26	21.60	0.216
	0.17	22.37	0.85	22.39	0.224
	0.15	23.55	0.91	23.57	0.236
	0.13	28.41	0.61	28.42	0.284
	0.11	31.81	0.17	31.81	0.318
	0.09	33.90	-0.31	33.90	0.339
	0.07	33.04	-0.25	33.04	0.330
	0.05	29.31	2.31	29.40	0.294
	0.03	36.20	2.20	36.27	0.363
	0.01	26.58	0.33	26.58	0.266
5.25	0.19	25.34	-2.58	25.47	0.255
	0.17	26.94	0.21	26.94	0.269
	0.15	25.56	2.14	25.65	0.256
	0.13	30.32	0.58	30.33	0.303
	0.11	30.94	0.57	30.95	0.309
	0.09	34.71	-0.47	34.71	0.347
	0.07	34.06	0.46	34.06	0.341
	0.05	22.40	2.06	22.49	0.225
	0.03	25.92	-0.30	25.92	0.259
	0.01	21.44	-0.44	21.44	0.214
6	0.19	28.48	0.23	28.48	0.285
	0.17	32.12	0.09	32.12	0.321
	0.15	30.61	0.39	30.61	0.306
	0.13	32.26	-0.45	32.26	0.323
	0.11	36.02	-1.75	36.06	0.361
	0.09	30.31	-0.14	30.31	0.303
	0.07	27.10	0.35	27.10	0.271
	0.05	23.69	0.70	23.70	0.237
	0.03	26.08	-0.44	26.08	0.261

Appendix F

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.01	28.48	0.49	28.48	0.285
7	0.19	27.04	-0.05	27.04	0.270
	0.17	27.81	0.24	27.81	0.278
	0.15	28.15	0.48	28.15	0.282
	0.13	27.13	0.32	27.13	0.271
	0.11	28.02	0.45	28.02	0.280
	0.09	32.84	-0.34	32.84	0.328
	0.07	29.71	0.29	29.71	0.297
	0.05	31.80	-0.06	31.80	0.318
	0.03	25.44	1.08	25.46	0.255
	0.01	29.04	0.94	29.06	0.291
8	0.19	26.82	-0.08	26.82	0.268
	0.17	27.41	0.09	27.41	0.274
	0.15	28.61	0.47	28.61	0.286
	0.13	30.92	-0.70	30.93	0.309
	0.11	23.23	1.04	23.25	0.233
	0.09	22.65	0.69	22.66	0.227
	0.07	26.50	-0.28	26.50	0.265
	0.05	23.82	0.45	23.82	0.238
	0.03	30.34	0.40	30.34	0.303
	0.01	26.90	1.39	26.94	0.269
8.4	0.19	19.06	1.12	19.09	0.191
	0.17	20.44	-0.38	20.44	0.204
	0.15	23.03	-4.71	23.51	0.235
	0.13	28.96	-5.45	29.47	0.295
	0.11	29.30	-6.06	29.92	0.299
	0.09	30.05	-5.48	30.55	0.305
	0.07	29.47	-3.71	29.70	0.297
	0.05	29.07	-3.43	29.27	0.293
	0.03	32.70	-2.27	32.78	0.328
	0.01	29.66	0.13	29.66	0.297
8.5	0.05	44.18	-4.36	44.39	0.444
	0.03	43.12	-3.32	43.25	0.432

Test 7

Slope = 0.001136

Discharge = 0.005 m³/s

Condition: One cylinder at chainage 4.5 m



Figure F-6 Experimental set up of Test 7

Table F-7 Test 7 velocity measurements

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
3.5	0.19	35.92	-0.06	35.92	0.359
	0.17	37.14	-0.15	37.14	0.371
	0.15	36.06	-0.02	36.06	0.361
	0.13	36.92	-0.44	36.92	0.369
	0.11	38.72	-1.14	38.74	0.387
	0.09	36.22	-0.57	36.22	0.362
	0.07	34.82	-0.41	34.82	0.348
	0.05	34.38	-0.34	34.38	0.344
	0.03	32.18	-0.79	32.19	0.322
4.0	0.01	30.93	-0.60	30.94	0.309
	0.19	36.63	-0.15	36.63	0.366
	0.17	35.48	-0.22	35.48	0.355

Appendix F

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.15	36.48	-0.28	36.48	0.365
	0.13	36.57	-0.55	36.57	0.366
	0.11	36.06	-0.78	36.07	0.361
	0.09	32.98	-0.38	32.98	0.330
	0.07	35.20	-0.68	35.21	0.352
	0.05	34.66	-0.56	34.66	0.347
	0.03	31.61	-0.70	31.62	0.316
	0.01	29.70	-0.35	29.70	0.297
4.25	0.19	34.92	0.28	34.92	0.349
	0.17	35.99	-0.27	35.99	0.360
	0.15	35.78	-0.34	35.78	0.358
	0.13	37.05	-0.85	37.06	0.371
	0.11	35.81	-0.67	35.82	0.358
	0.09	35.13	-0.55	35.13	0.351
	0.07	34.72	-0.77	34.73	0.347
	0.05	33.47	-0.33	33.47	0.335
	0.03	29.85	-0.32	29.85	0.299
	0.01	28.53	-0.49	28.53	0.285
4.46	0.19	27.93	0.68	27.94	0.279
	0.17	30.46	-1.98	30.52	0.305
	0.15	31.44	-2.92	31.58	0.316
	0.13	34.13	-3.69	34.33	0.343
	0.11	36.34	-3.79	36.54	0.365
	0.09	36.85	-3.69	37.03	0.370
	0.07	35.60	-2.86	35.71	0.357
	0.05	36.41	-2.67	36.51	0.365
	0.03	35.04	-2.14	35.11	0.351
	0.01	32.63	-1.32	32.66	0.327
4.5	0.17	48.27	7.31	48.82	0.488
	0.15	46.67	6.54	47.13	0.471
	0.09	41.10	-5.73	41.50	0.415
	0.07	39.73	-4.55	39.99	0.400
	0.05	40.85	-3.48	41.00	0.410
	0.03	38.99	-2.65	39.08	0.391
	0.01	35.87	-1.06	35.89	0.359
4.56	0.19	0.00	0.00	0.00	0.000
	0.17	0.00	0.00	0.00	0.000

Appendix F

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.15	52.18	0.31	52.18	0.522
	0.13	51.26	0.72	51.27	0.513
	0.11	50.15	0.96	50.16	0.502
	0.09	45.88	0.03	45.88	0.459
	0.07	45.62	-0.92	45.63	0.456
	0.05	44.05	-0.92	44.06	0.441
	0.03	42.14	-0.98	42.15	0.422
	0.01	39.01	-0.60	39.01	0.390
4.6	0.19	0.00	0.00	0.00	0.000
	0.17	12.66	3.93	13.26	0.133
	0.15	48.56	4.37	48.76	0.488
	0.13	47.69	2.36	47.75	0.477
	0.11	46.70	1.74	46.73	0.467
	0.09	43.91	1.20	43.93	0.439
	0.07	43.09	0.62	43.09	0.431
	0.05	43.51	0.28	43.51	0.435
	0.03	39.81	0.37	39.81	0.398
	0.01	40.73	-0.31	40.73	0.407
4.65	0.19	9.78	1.25	9.86	0.099
	0.17	23.81	3.70	24.10	0.241
	0.15	41.68	5.40	42.03	0.420
	0.13	44.31	4.13	44.50	0.445
	0.11	45.01	2.60	45.09	0.451
	0.09	40.95	1.98	41.00	0.410
	0.07	41.48	0.78	41.49	0.415
	0.05	41.81	0.01	41.81	0.418
	0.03	41.28	-0.37	41.28	0.413
	0.01	39.12	-0.31	39.12	0.391
4.7	0.19	14.86	0.47	14.87	0.149
	0.17	27.40	3.45	27.62	0.276
	0.15	39.90	4.68	40.17	0.402
	0.13	42.74	3.04	42.85	0.428
	0.11	42.27	2.15	42.32	0.423
	0.09	40.34	1.13	40.36	0.404
	0.07	42.03	1.13	42.05	0.420
	0.05	41.43	0.41	41.43	0.414
	0.03	40.73	-0.33	40.73	0.407

Appendix F

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.01	38.63	-0.53	38.63	0.386
4.75	0.19	22.39	-0.07	22.39	0.224
	0.17	28.61	2.48	28.72	0.287
	0.15	39.03	3.75	39.21	0.392
	0.13	42.71	2.94	42.81	0.428
	0.11	41.31	1.94	41.36	0.414
	0.09	39.71	1.08	39.72	0.397
	0.07	39.94	0.76	39.95	0.399
	0.05	39.90	-0.04	39.90	0.399
	0.03	34.97	0.42	34.97	0.350
	0.01	37.28	-0.35	37.28	0.373
4.8	0.19	25.14	0.85	25.15	0.252
	0.17	30.53	2.55	30.64	0.306
	0.15	38.03	2.49	38.11	0.381
	0.13	40.84	2.38	40.91	0.409
	0.11	41.72	1.54	41.75	0.417
	0.09	40.94	0.72	40.95	0.409
	0.07	40.79	-0.12	40.79	0.408
	0.05	41.21	0.22	41.21	0.412
	0.03	37.60	0.01	37.60	0.376
	0.01	36.79	-0.39	36.79	0.368
4.9	0.19	28.28	0.57	28.29	0.283
	0.17	32.12	1.17	32.14	0.321
	0.15	37.19	2.09	37.25	0.372
	0.13	40.29	1.95	40.34	0.403
	0.11	40.41	1.27	40.43	0.404
	0.09	40.30	0.07	40.30	0.403
	0.07	40.53	-0.17	40.53	0.405
	0.05	40.03	-0.18	40.03	0.400
	0.03	35.42	-0.77	35.43	0.354
	0.01	35.52	-0.33	35.52	0.355
5.0	0.19	30.71	0.31	30.71	0.307
	0.17	32.00	0.86	32.01	0.320
	0.15	34.60	1.16	34.62	0.346
	0.13	38.84	0.83	38.85	0.388
	0.11	40.06	0.74	40.07	0.401
	0.09	39.83	0.43	39.83	0.398

Appendix F

Longitudinal chainage (m)	Transverse distance (m)	V _x (cm/s)	V _y (cm/s)	V (cm/s)	V (m/s)
	0.07	39.83	-0.43	39.83	0.398
	0.05	37.03	-0.25	37.03	0.370
	0.03	36.88	-0.75	36.89	0.369
	0.01	35.12	-0.78	35.13	0.351
5.5	0.19	34.63	-0.48	34.63	0.346
	0.17	34.72	-0.09	34.72	0.347
	0.15	36.57	0.30	36.57	0.366
	0.13	36.02	0.64	36.03	0.360
	0.11	38.32	0.31	38.32	0.383
	0.09	39.09	0.23	39.09	0.391
	0.07	39.03	-0.25	39.03	0.390
	0.05	37.82	-0.83	37.83	0.378
	0.03	36.08	-0.35	36.08	0.361
	0.01	34.74	-0.68	34.75	0.347
6.5	0.19	36.39	-1.39	36.42	0.364
	0.17	37.49	-1.13	37.51	0.375
	0.15	38.34	-0.87	38.35	0.383
	0.13	38.13	-1.29	38.15	0.382
	0.11	41.15	-1.34	41.17	0.412
	0.09	35.55	-0.56	35.55	0.356
	0.07	38.18	-0.46	38.18	0.382
	0.05	39.21	-1.32	39.23	0.392
	0.03	36.85	-1.13	36.87	0.369
	0.01	35.34	-1.22	35.36	0.354
7.0	0.19	36.31	-0.99	36.32	0.363
	0.17	36.92	-0.99	36.93	0.369
	0.15	38.10	-1.17	38.12	0.381
	0.13	37.77	-1.19	37.79	0.378
	0.11	40.20	-1.87	40.24	0.402
	0.09	37.87	-1.46	37.90	0.379
	0.07	37.81	-1.45	37.84	0.378
	0.05	38.86	-1.19	38.88	0.389
	0.03	41.56	-1.85	41.60	0.416
	0.01	34.69	-1.16	34.71	0.347

Test 2

Slope = 0.0011

Discharge = 0.005 m³/s

Condition: One hemisphere at chainage 4.5 m

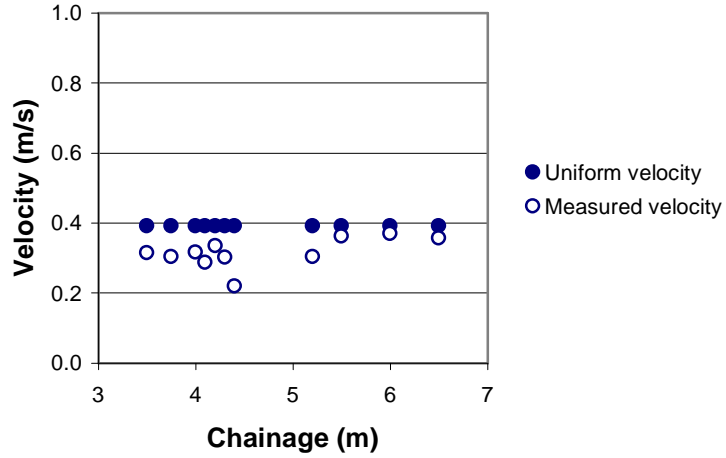


Figure F-7 Velocity measurements at 0.19 m from left side of the flume

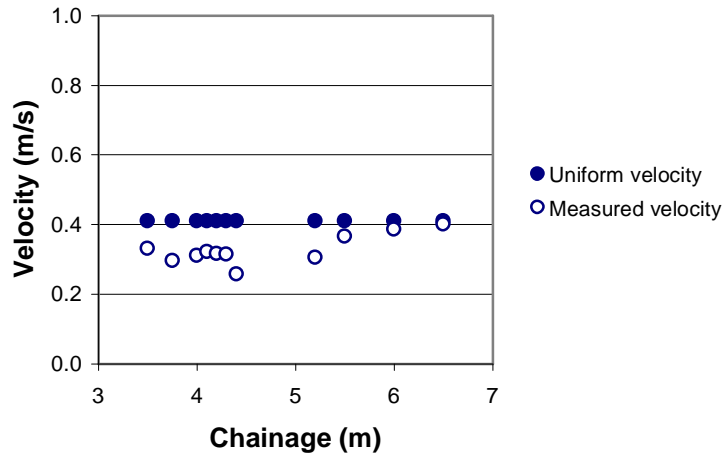


Figure F-8 Velocity measurements at 0.17 m from left side of the flume

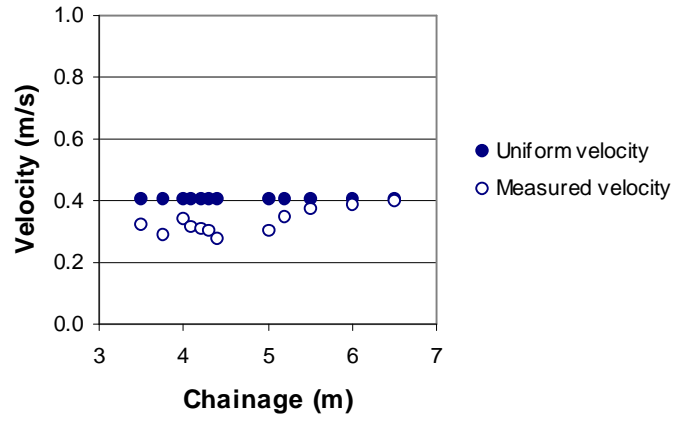


Figure F-9 Velocity measurements at 0.15 m from left side of the flume

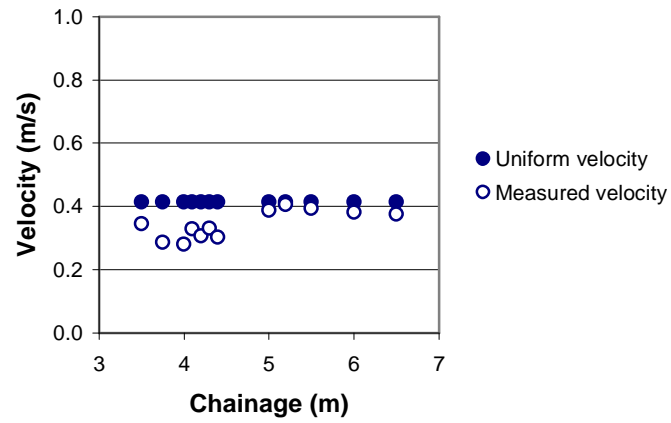


Figure F-10 Velocity measurements at 0.13 m from left side of the flume

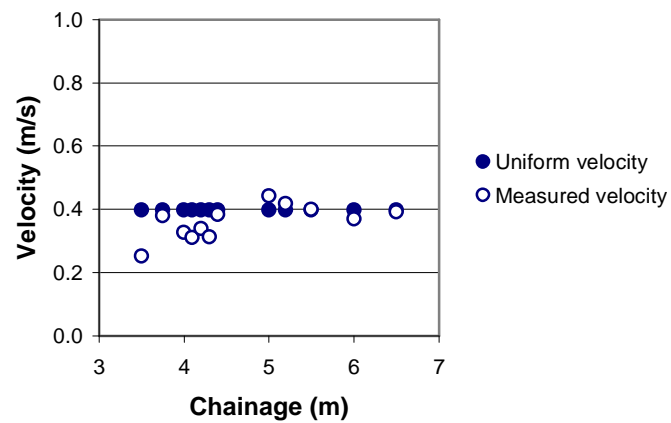


Figure F-11 Velocity measurements at 0.11 m from left side of the flume

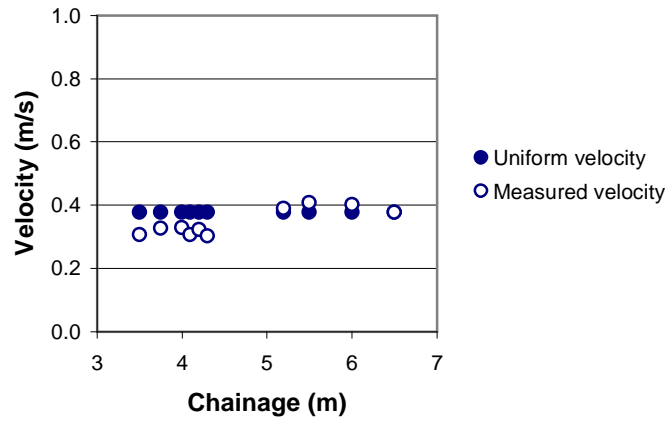


Figure F-12 Velocity measurements at 0.09 m from left side of the flume

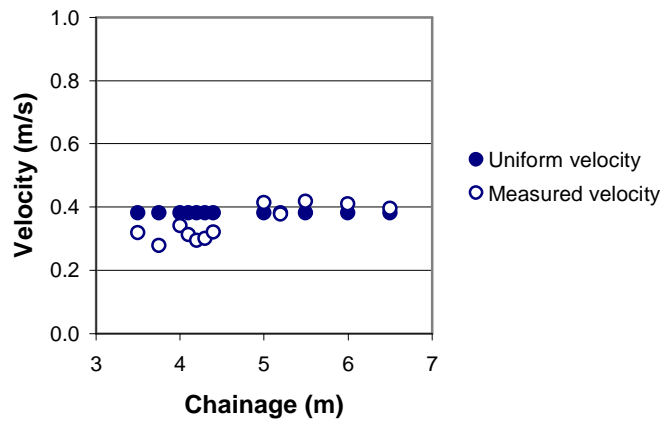


Figure F-13 Velocity measurements at 0.07 m from left side of the flume

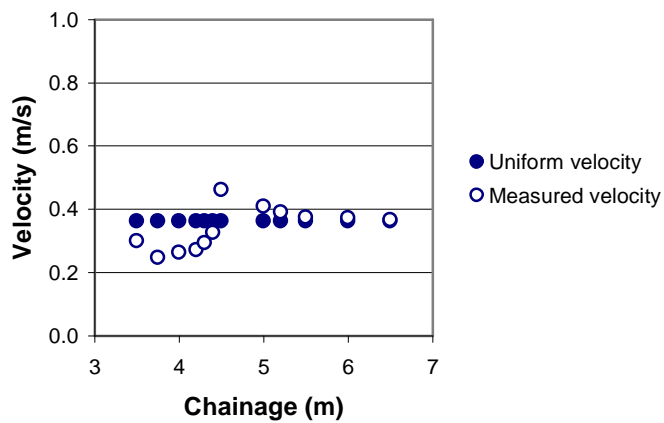


Figure F-14 Velocity measurements at 0.05 m from left side of the flume

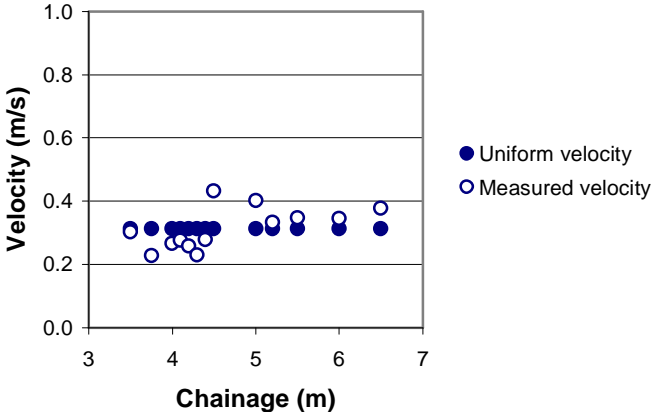


Figure F-15 Velocity measurements at 0.03 m from left side of the flume

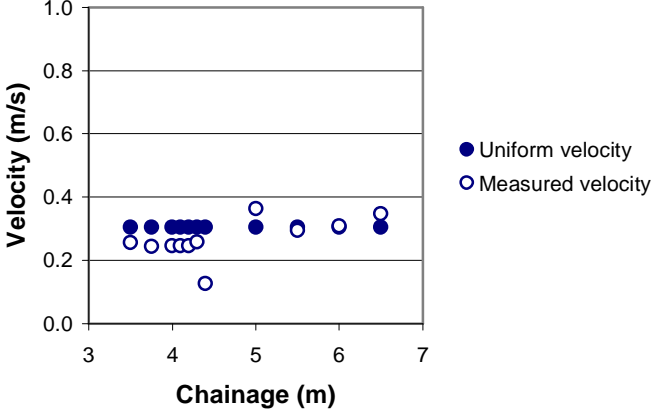


Figure F-16 Velocity measurements at 0.01 m from left side of the flume

Test 3

Slope = 0.0011

Discharge = 0.005 m³/s

Condition: Two hemispheres at chainage 4.5 m and 5.5

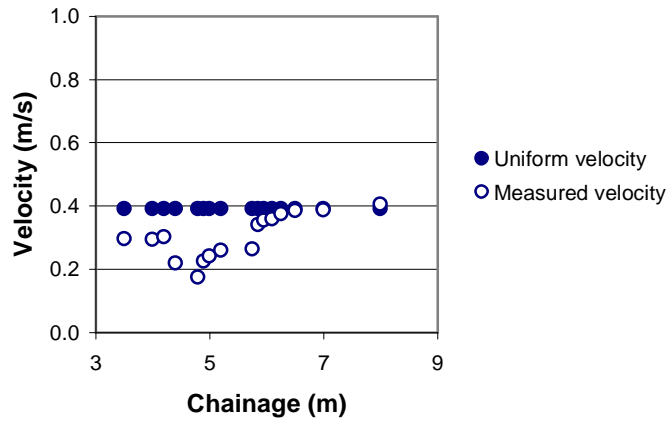


Figure F-17 Velocity measurements at 0.19 m from left side of the flume

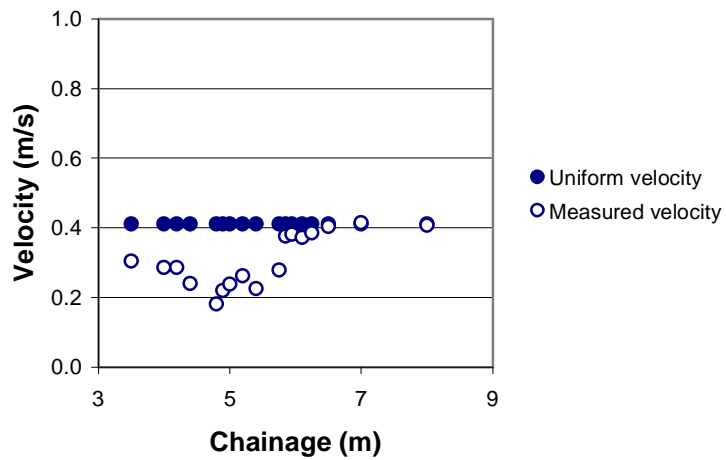


Figure F-18 Velocity measurements at 0.17 m from left side of the flume

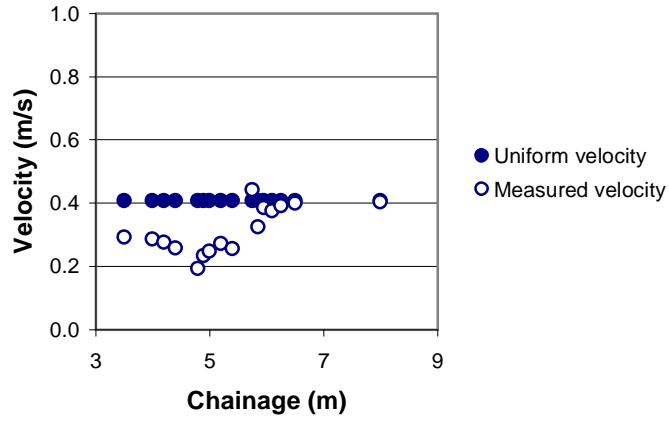


Figure F-19 Velocity measurements at 0.15 m from left side of the flume

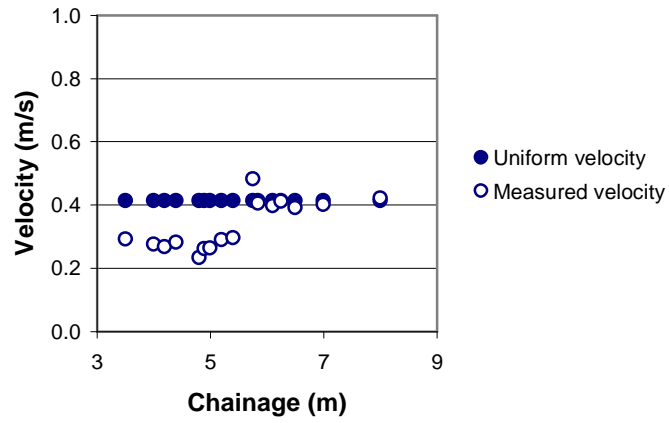


Figure F-20 Velocity measurements at 0.13 m from left side of the flume

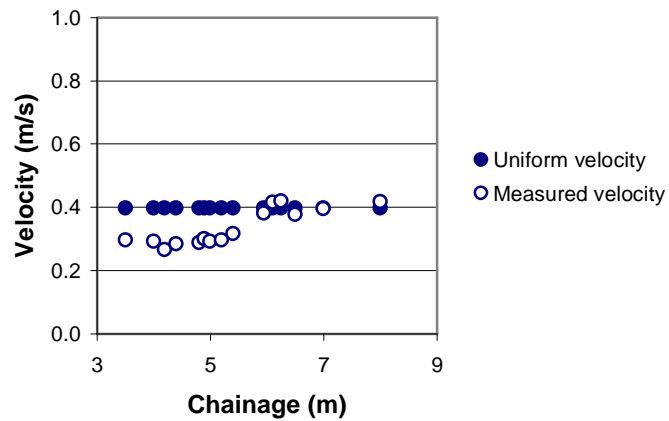


Figure F-21 Velocity measurements at 0.11 m from left side of the flume

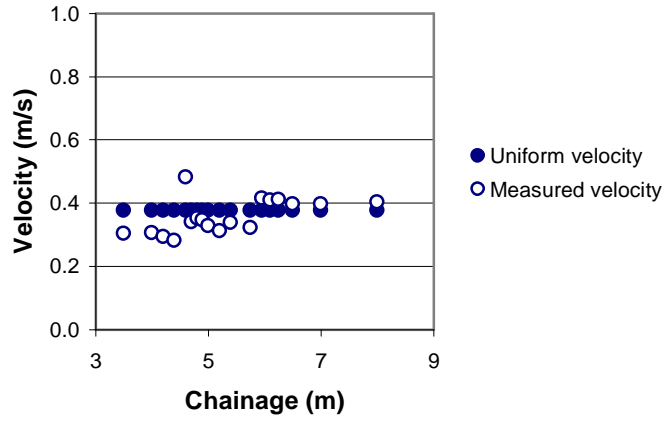


Figure F-22 Velocity measurements at 0.09 m from left side of the flume

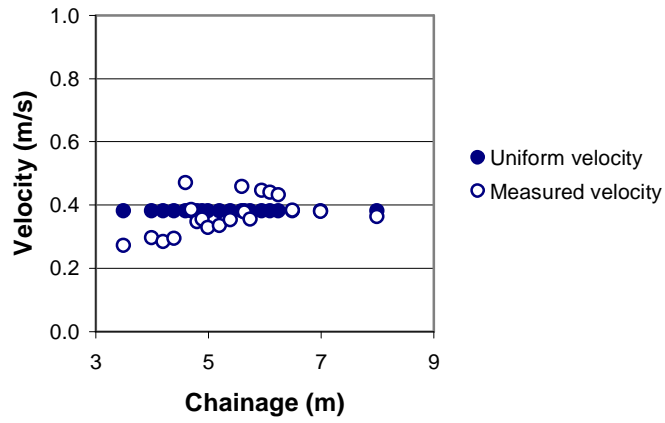


Figure F-23 Velocity measurements at 0.07 m from left side of the flume

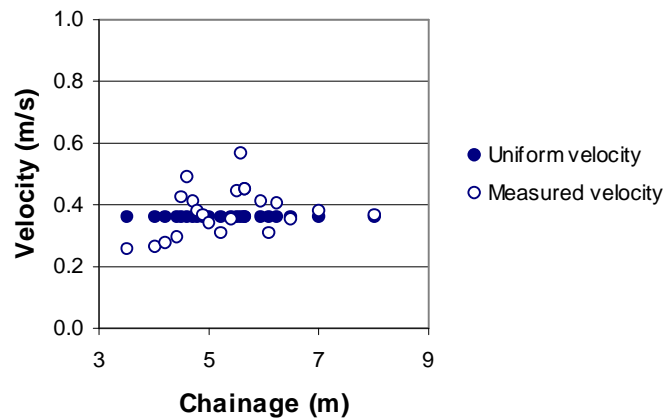


Figure F-24 Velocity measurements at 0.05 m from left side of the flume

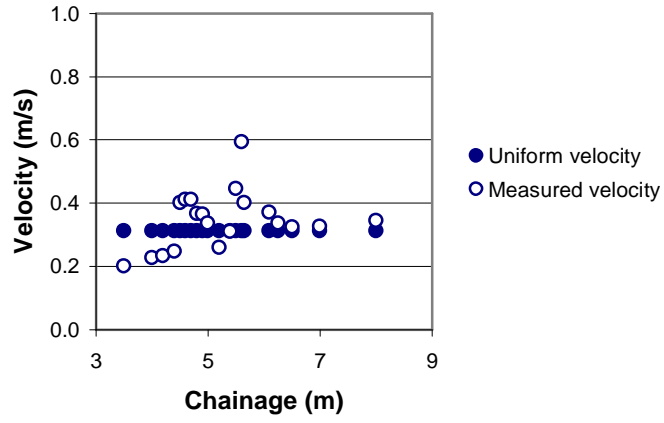


Figure F-25 Velocity measurements at 0.03 m from left side of the flume

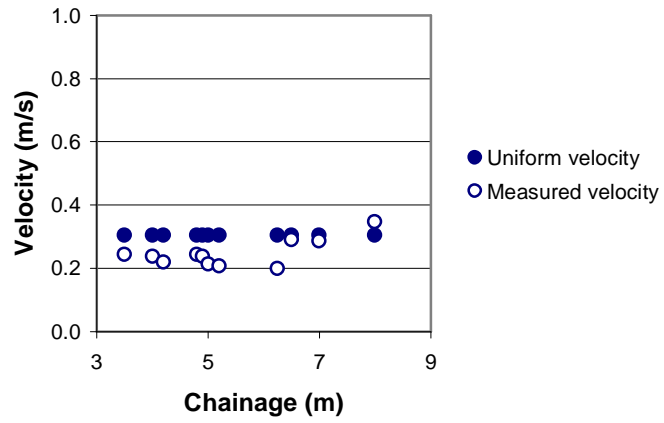


Figure F-26 Velocity measurements at 0.01 m from left side of the flume

Test 6

Slope = 0.0011

Discharge = 0.005 m³/s

Condition: Two hemispheres at chainage 4.5 and 6.5 m

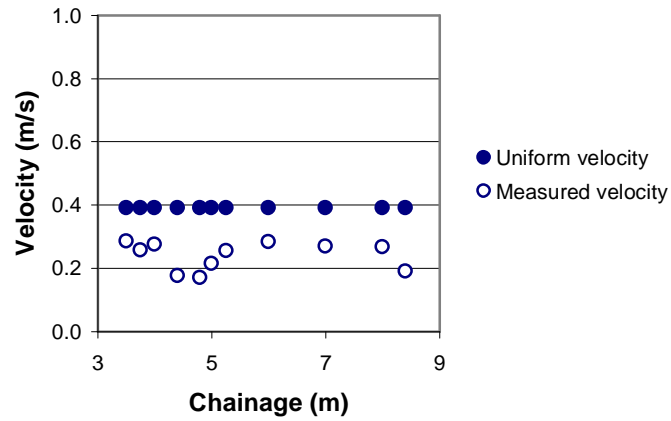


Figure F-27 Velocity measurements at 0.19 m from left side of the flume

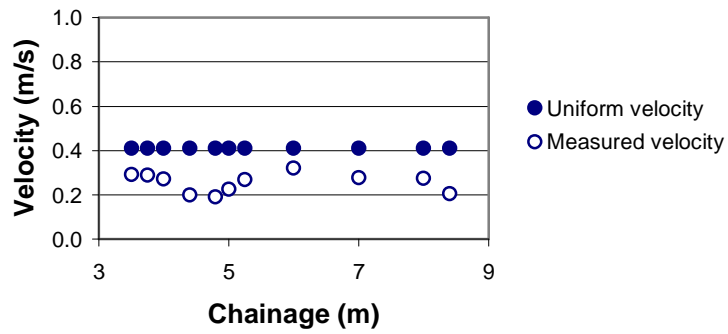


Figure F-28 Velocity measurements at 0.17 m from left side of the flume

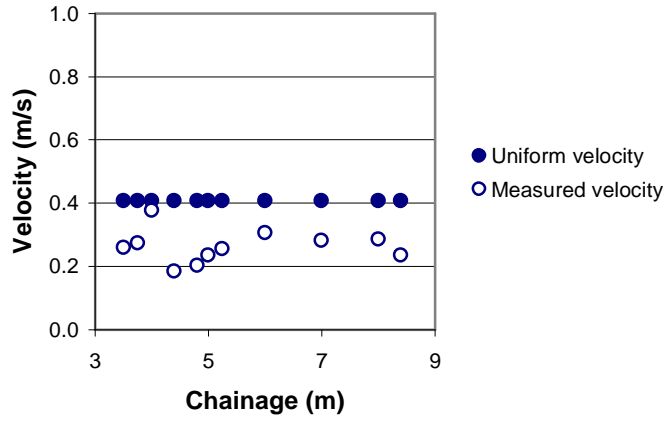


Figure F-29 Velocity measurements at 0.15 m from left side of the flume

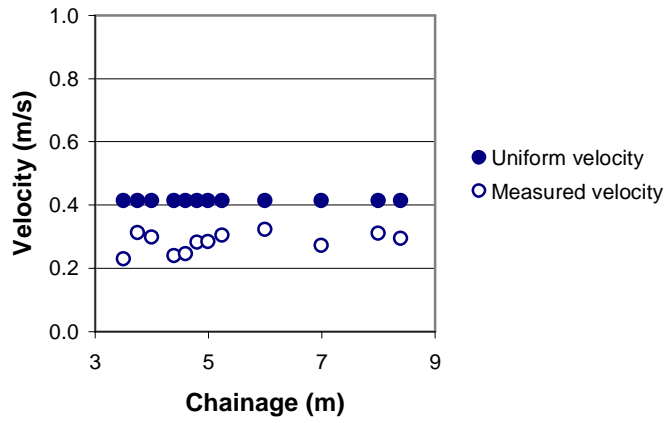


Figure F-30 Velocity measurements at 0.13 m from left side of the flume

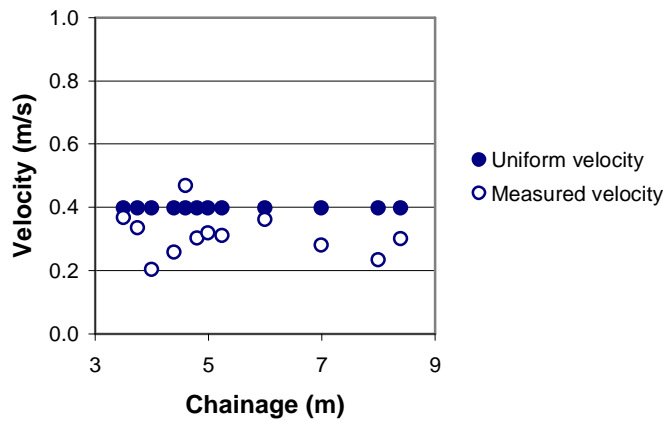


Figure F-31 Velocity measurements at 0.11 m from left side of the flume

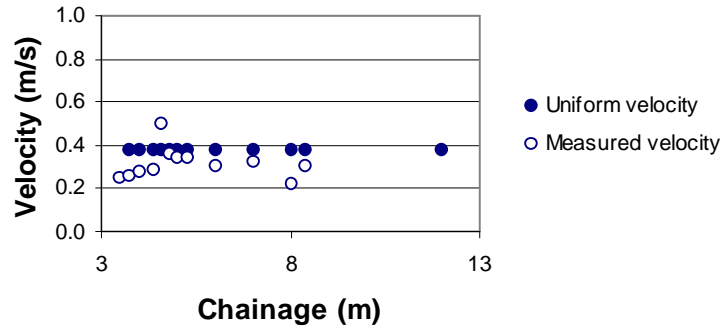


Figure F-32 Velocity measurements at 0.09 m from left side of the flume

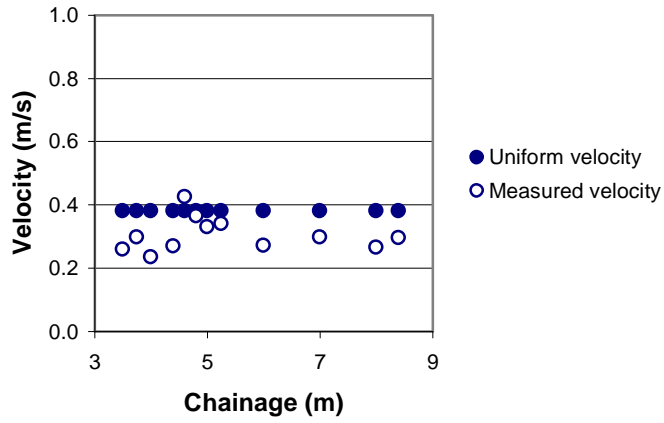


Figure F-33 Velocity measurements at 0.07 m from left side of the flume

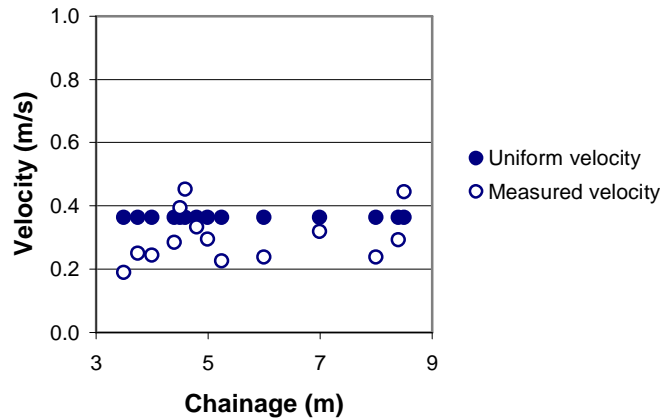


Figure F-34 Velocity measurements at 0.05 m from left side of the flume

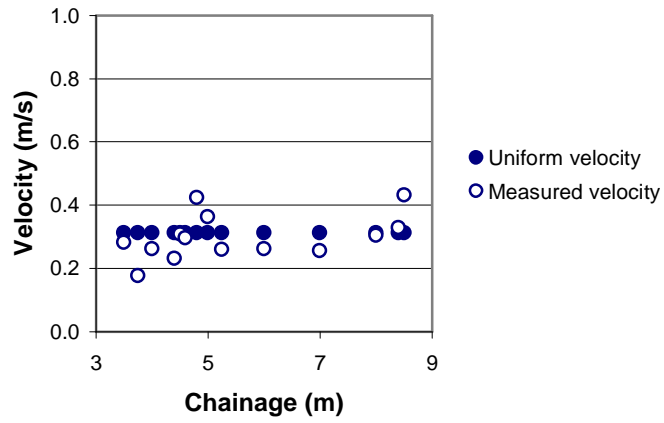


Figure F-35 Velocity measurements at 0.03 m from left side of the flume

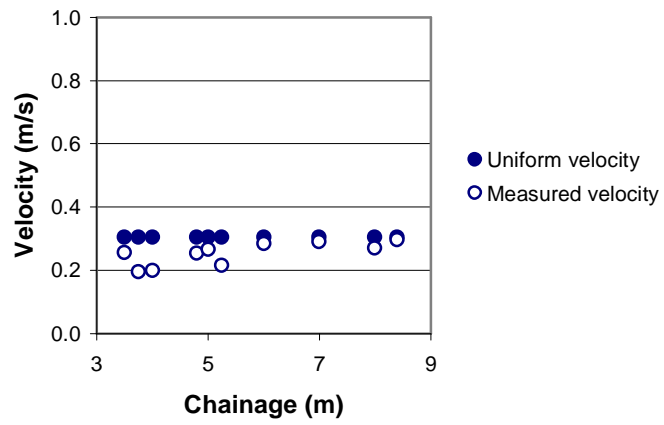


Figure F-36 Velocity measurements at 0.01 m from left side of the flume