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Low flow hydraulics in rivers for environmental applications in South Africa

Jordanova, Angelina Alekseevna

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Test 1

Slope = 0.001136

Discharge = 0.005 m^3/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 m^3/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)	Vx (cm/s)	Vy (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

Longitudinal chainage (m)	Transverse distance (m)	Vx (cm/s)	Vy (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

Longitudinal chainage (m)	Transverse distance (m)	Vx (cm/s)	Vy (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

Longitudinal chainage (m)	Transverse distance (m)	Vx (cm/s)	Vy (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 m^3/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
	0.03	20.03	0.69	20.04	0.200
	0.01	24.27	-0.73	24.28	0.243
4.0	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

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

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

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

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

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 m^3/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
	0.03	18.97	-0.61	18.98	0.190
	0.01	22.03	-0.24	22.03	0.220
4.0	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

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

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

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

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

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 m^3/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)	Vx (cm/s)	Vy (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

Longitudinal chainage (m)	Transverse distance (m)	Vx (cm/s)	Vy (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

Longitudinal chainage (m)	Transverse distance (m)	Vx (cm/s)	Vy (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

Longitudinal chainage (m)	Transverse distance (m)	Vx (cm/s)	Vy (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
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

Longitudinal chainage (m)	Transverse distance (m)	Vx (cm/s)	Vy (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	0.434
	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	0.231
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

Longitudinal chainage (m)	Transverse distance (m)	Vx (cm/s)	Vy (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 m^3/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

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

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

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 m^3/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
	0.01	30.93	-0.60	30.94	0.309
4.0	0.19	36.63	-0.15	36.63	0.366
	0.17	35.48	-0.22	35.48	0.355

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

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

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

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 m^3/s

Condition: One hemisphere at chainage 4.5 m

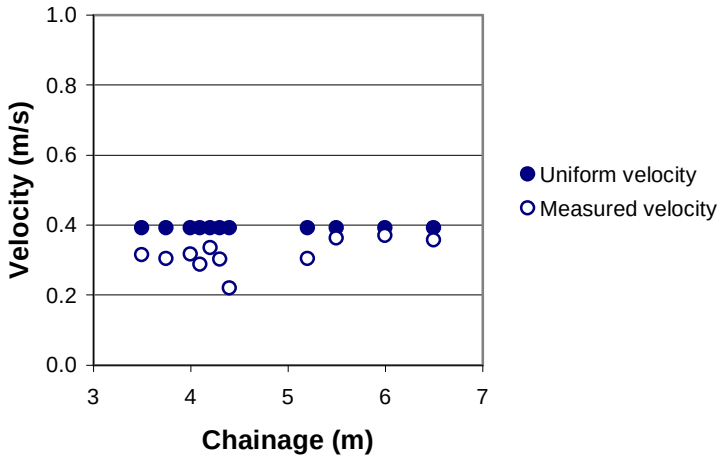


Figure F-7 Velocity measurements at 0.19 m from left side of the flume

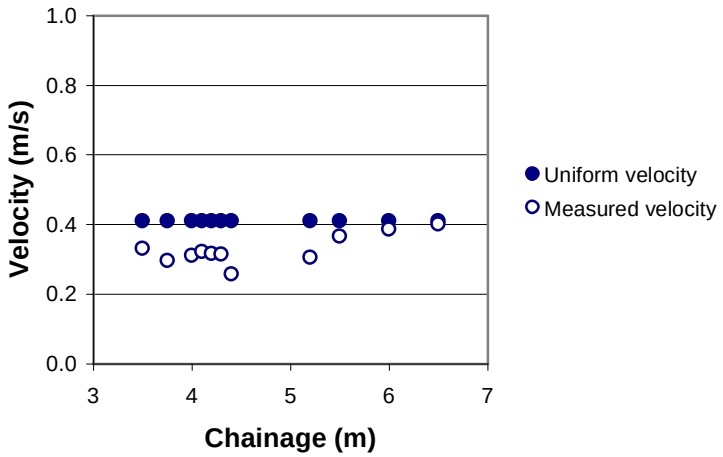


Figure F-8 Velocity measurements at 0.17 m from left side of the flume

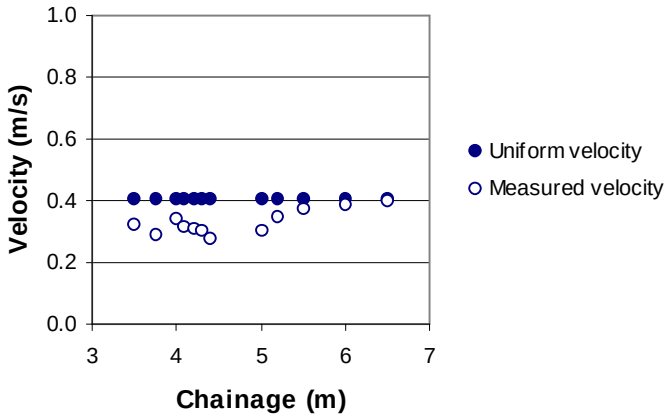


Figure F-9 Velocity measurements at 0.15 m from left side of the flume

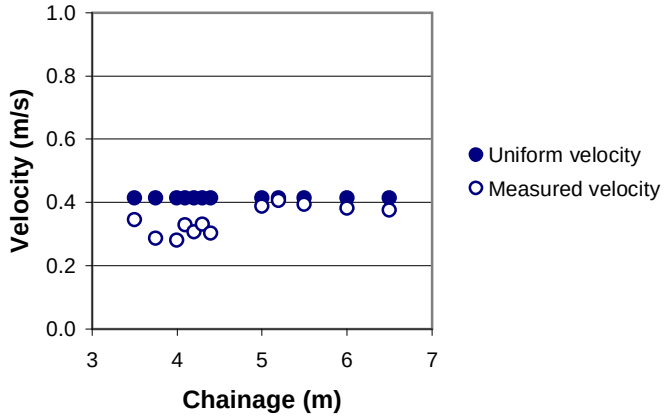


Figure F-10 Velocity measurements at 0.13 m from left side of the flume

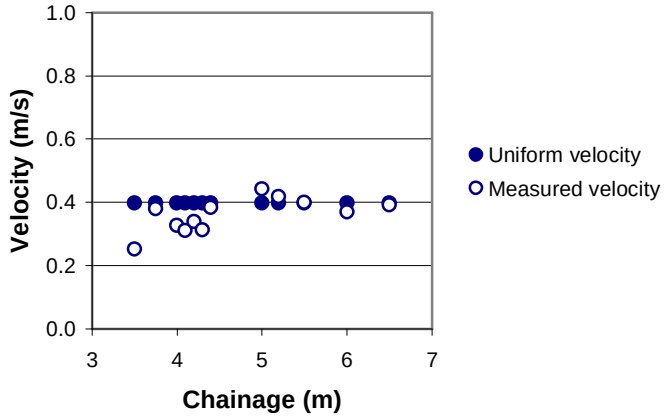


Figure F-11 Velocity measurements at 0.11 m from left side of the flume

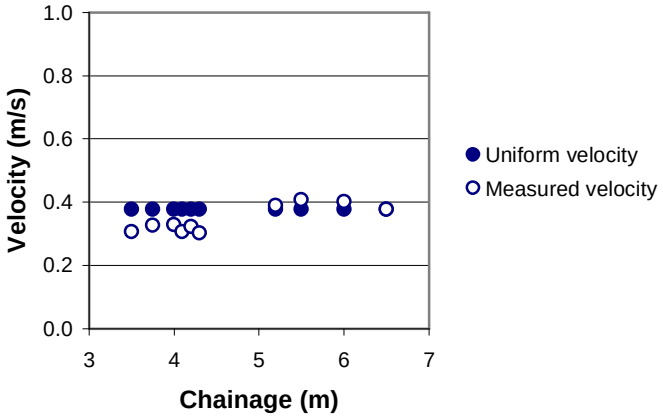


Figure F-12 Velocity measurements at 0.09 m from left side of the flume

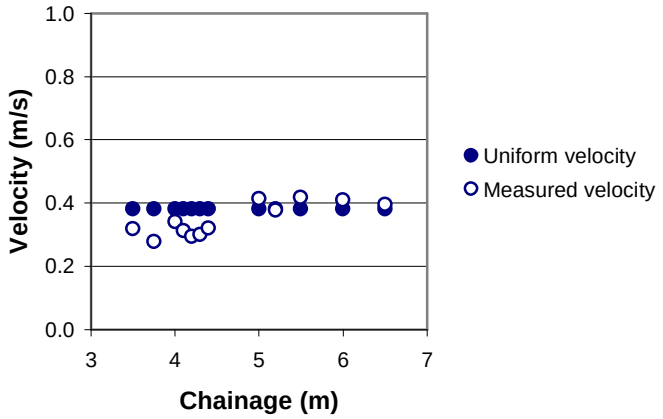


Figure F-13 Velocity measurements at 0.07 m from left side of the flume

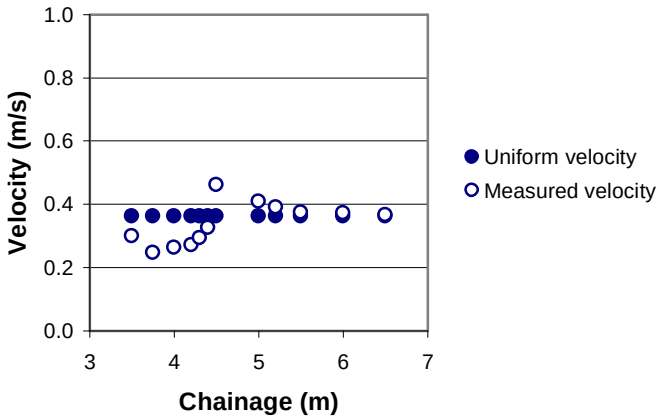


Figure F-14 Velocity measurements at 0.05 m from left side of the flume

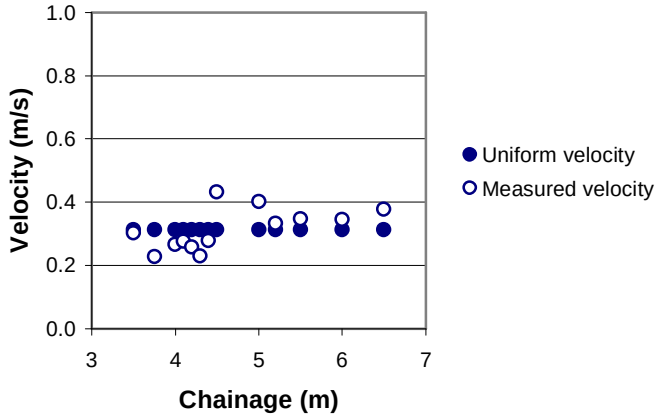


Figure F-15 Velocity measurements at 0.03 m from left side of the flume

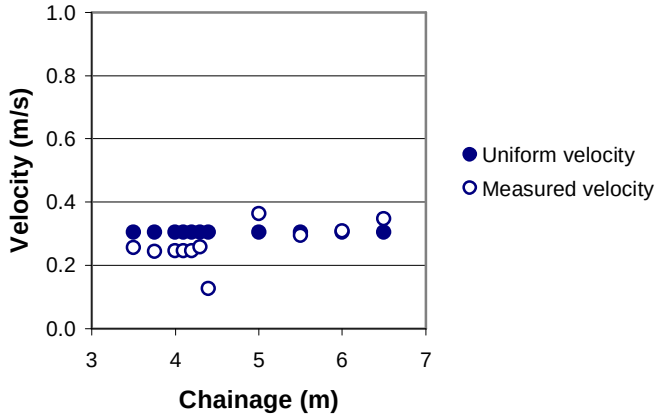


Figure F-16 Velocity measurements at 0.01 m from left side of the flume

Test 3

Slope = 0.0011

Discharge = 0.005 m^3/s

Condition: Two hemispheres at chainage 4.5 m and 5.5

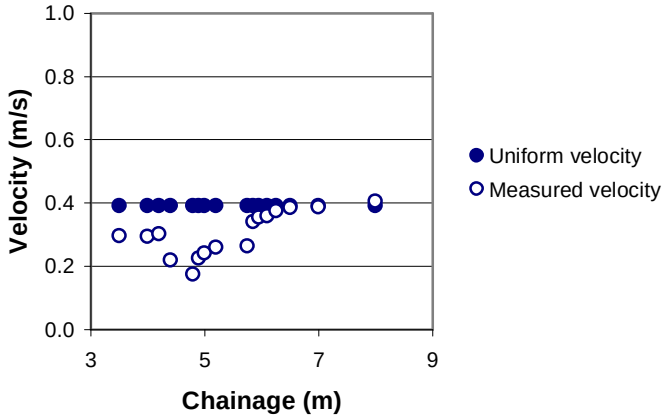


Figure F-17 Velocity measurements at 0.19 m from left side of the flume

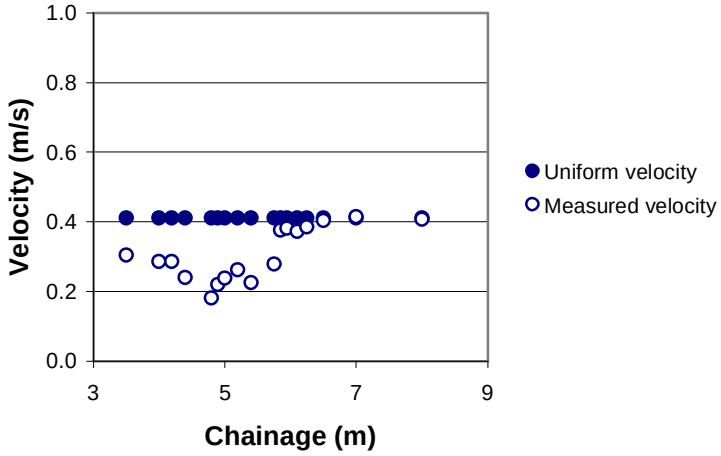


Figure F-18 Velocity measurements at 0.17 m from left side of the flume

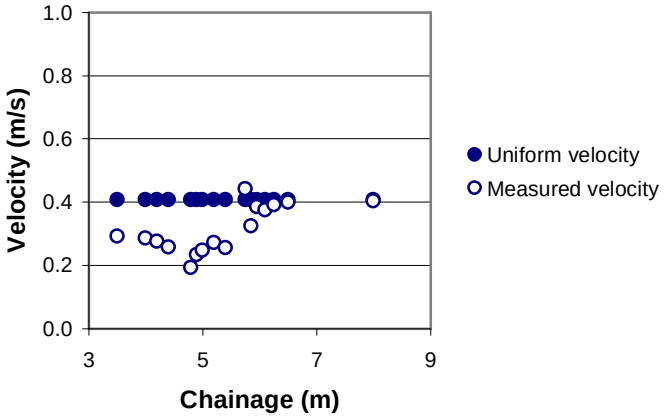


Figure F-19 Velocity measurements at 0.15 m from left side of the flume

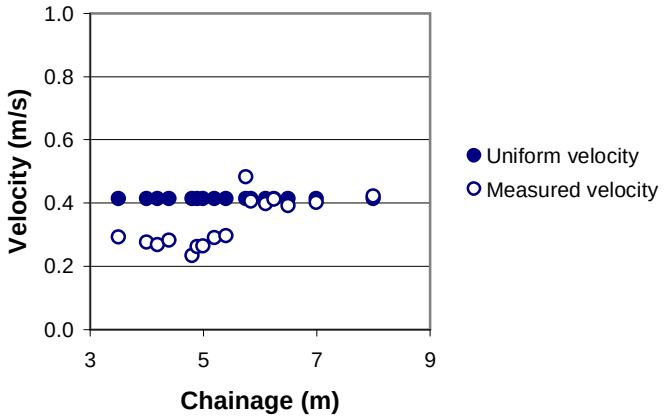


Figure F-20 Velocity measurements at 0.13 m from left side of the flume

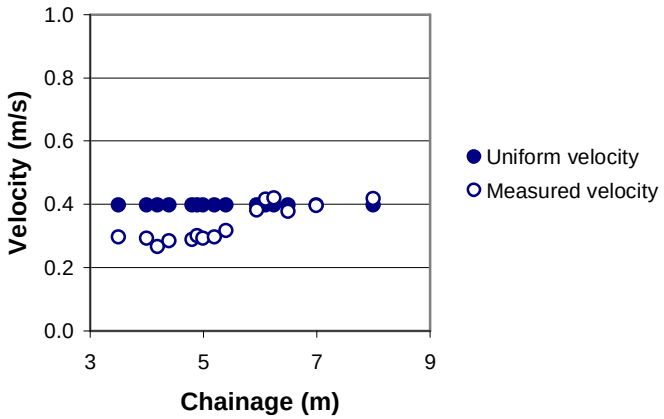


Figure F-21 Velocity measurements at 0.11 m from left side of the flume

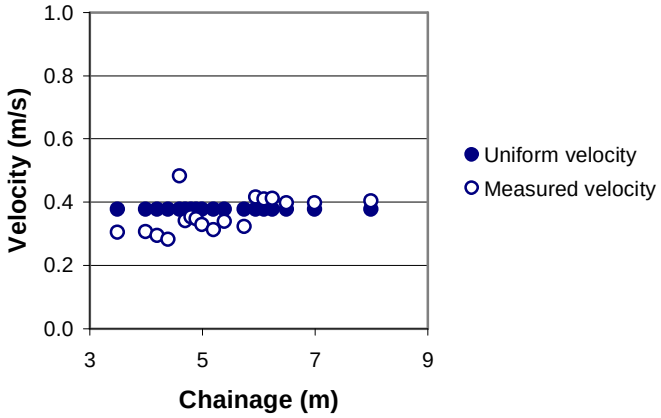


Figure F-22 Velocity measurements at 0.09 m from left side of the flume

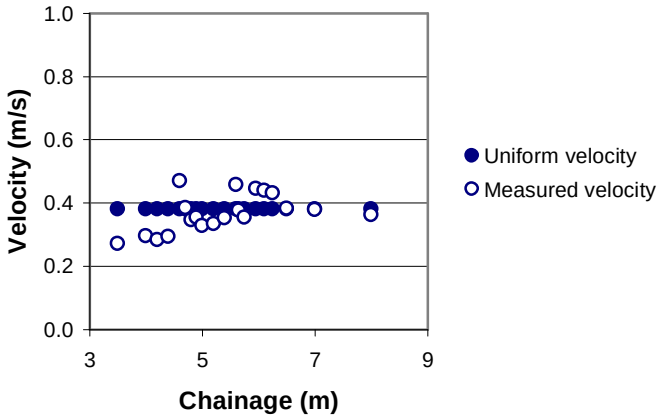


Figure F-23 Velocity measurements at 0.07 m from left side of the flume

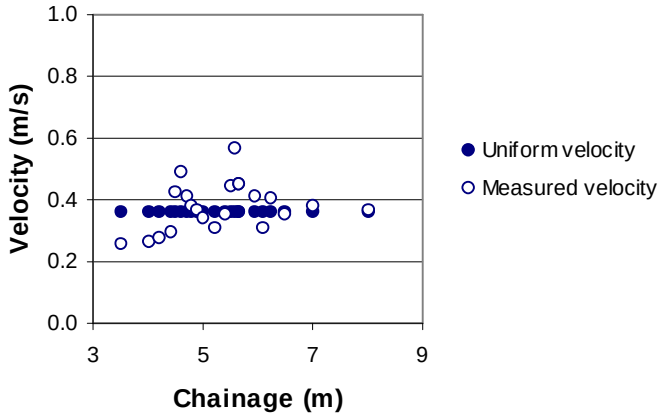


Figure F-24 Velocity measurements at 0.05 m from left side of the flume

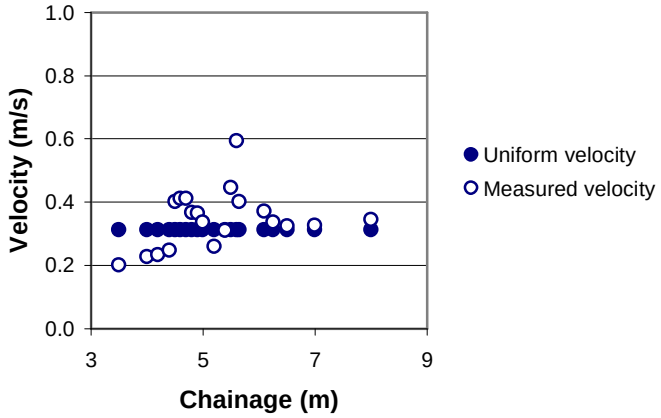


Figure F-25 Velocity measurements at 0.03 m from left side of the flume

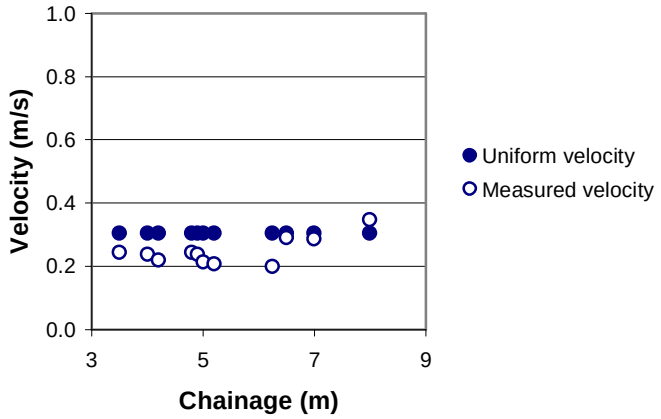


Figure F-26 Velocity measurements at 0.01 m from left side of the flume

Test 6

Slope = 0.0011

Discharge = 0.005 m^3/s

Condition: Two hemispheres at chainage 4.5 and 6.5 m

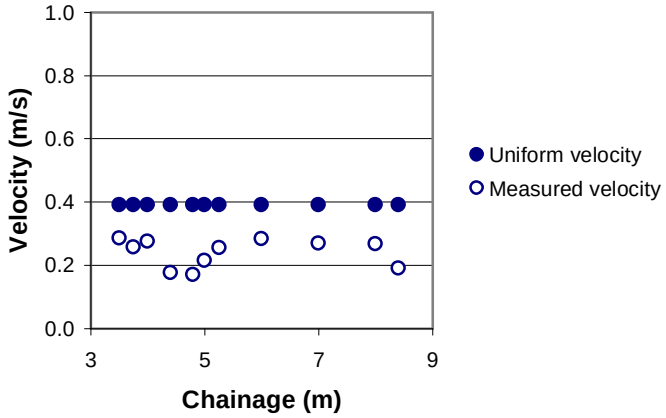


Figure F-27 Velocity measurements at 0.19 m from left side of the flume

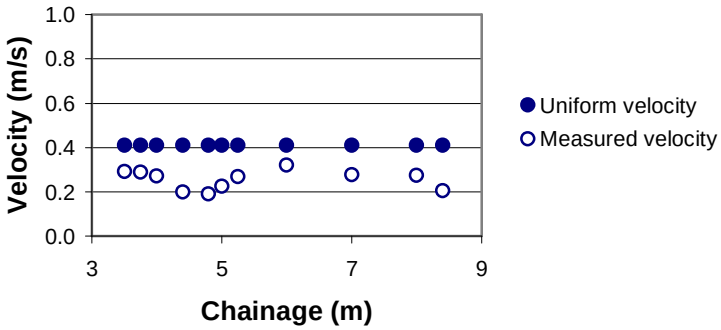


Figure F-28 Velocity measurements at 0.17 m from left side of the flume

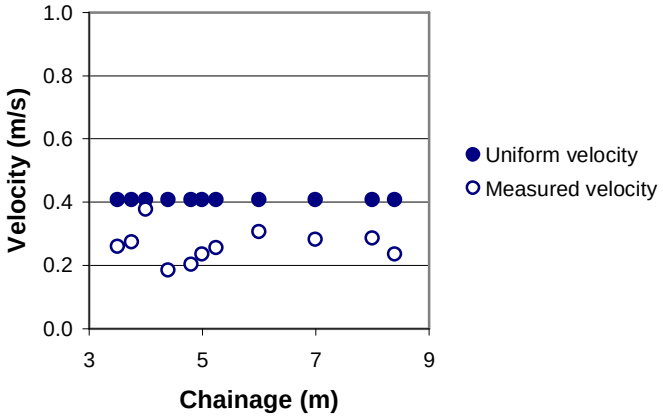


Figure F-29 Velocity measurements at 0.15 m from left side of the flume

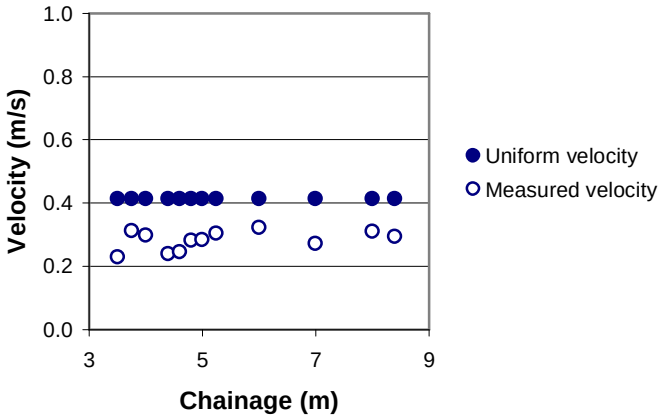


Figure F-30 Velocity measurements at 0.13 m from left side of the flume

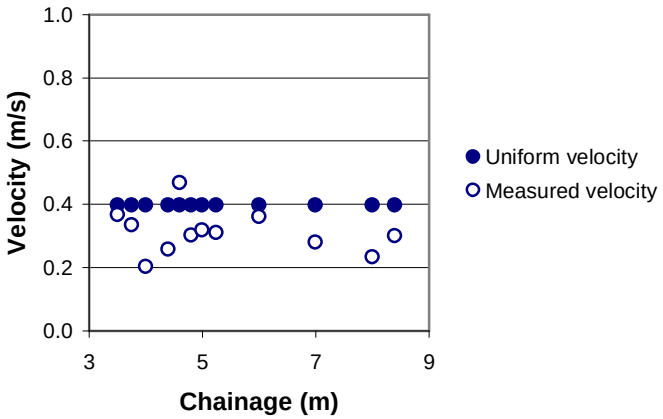


Figure F-31 Velocity measurements at 0.11 m from left side of the flume

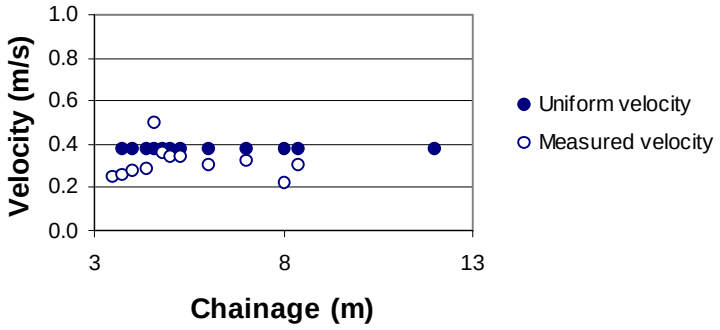


Figure F-32 Velocity measurements at 0.09 m from left side of the flume

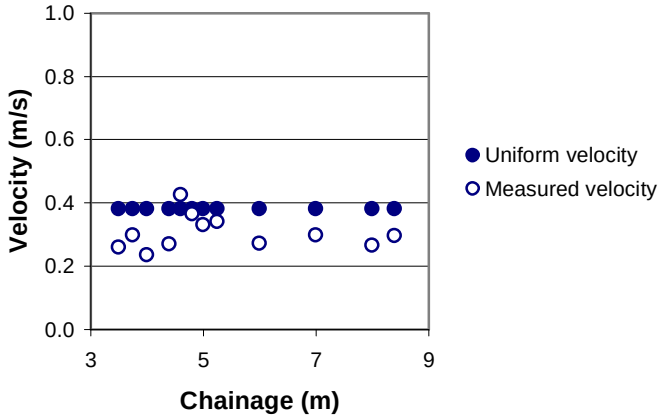


Figure F-33 Velocity measurements at 0.07 m from left side of the flume

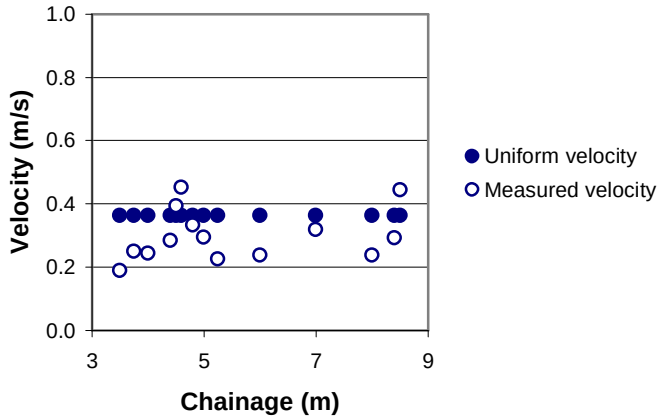


Figure F-34 Velocity measurements at 0.05 m from left side of the flume

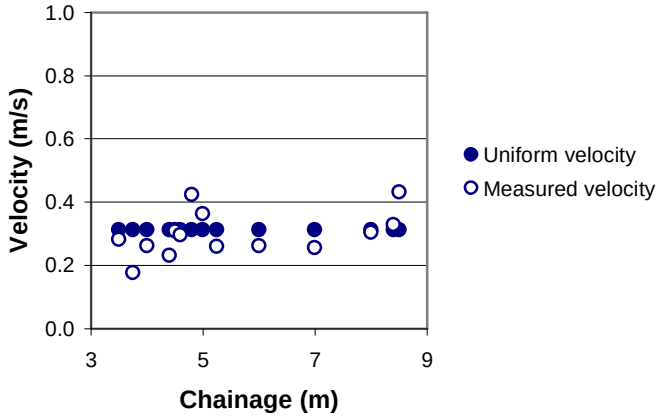


Figure F-35 Velocity measurements at 0.03 m from left side of the flume

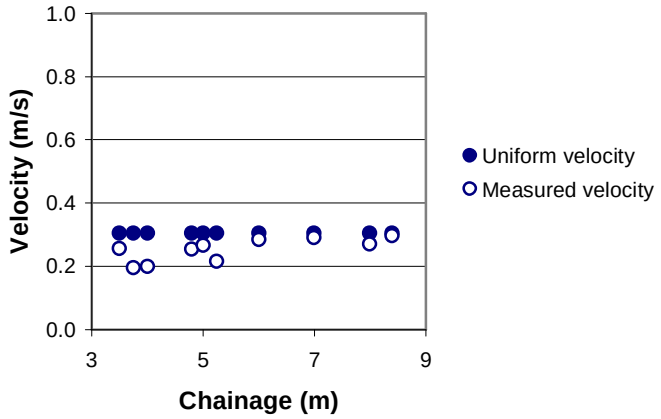


Figure F-36 Velocity measurements at 0.01 m from left side of the flume