

2016

Parameterisation of intra array effects around Wind Turbine Monopiles

Needham, M.

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The Plymouth Student Scientist, 9(2), p. 160-194.

<http://hdl.handle.net/10026.1/14132>

The Plymouth Student Scientist
University of Plymouth

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Appendices & CD Annex

Appendix

1.0 Gantt Chart

- Proposed start of Project II Gantt Chart (Oct 2015)
- Achieved Gantt Chart (Jan 2016)

2.0 Autocad Coastal Basin layout

3.0 Autocad Sensor positions layout

4.0 %EI of TKE at various traverse positions in Bed and Free stream positions

- #### 5.0 Bed Shear lab results
- Directly observed and scaled
 - Inferred from TKE and scaled

6.0 Lab Risk Assessment form

7.0 Free stream left and right transect TKE plots

CD Annex (available only by contacting project advisor)

Raw results

Wave Readings

ADV Readings

Post processed results

Matlab scripts

Excel Document "Preliminary Results"

Gantt chart

Delivered Gantt chart (Jan 2016)

Proposed Gantt Chart (Oct 2015)

Lab information

Lab set up photographs

Traverse diagrams

Data collection points

Lab Booking forms

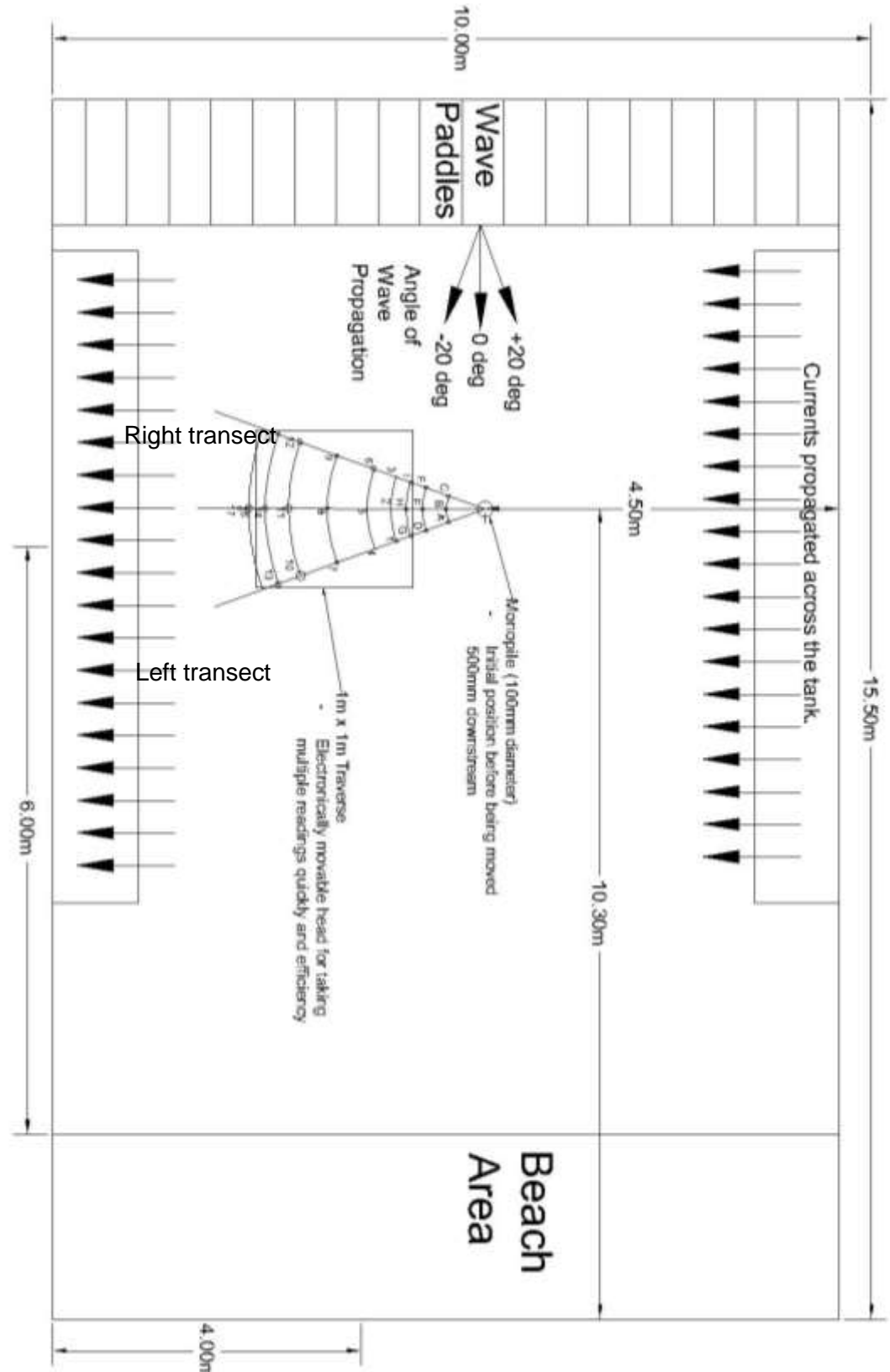
Project I (for reference)

Project II (Digital Copy)

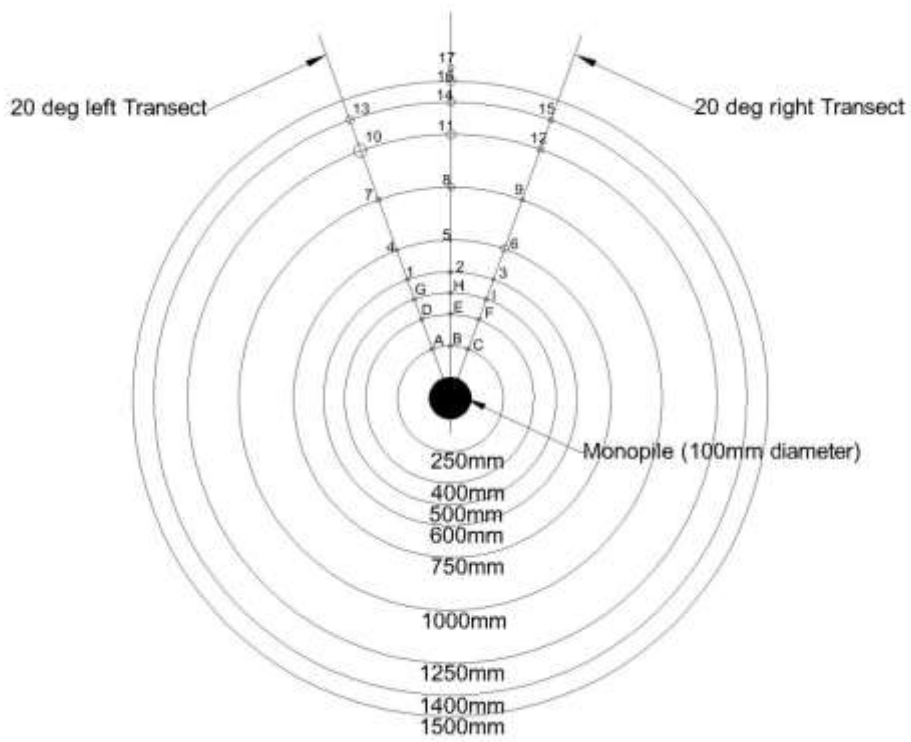
1.0 Gantt Chart

Not provided. Contact Project Advisor.

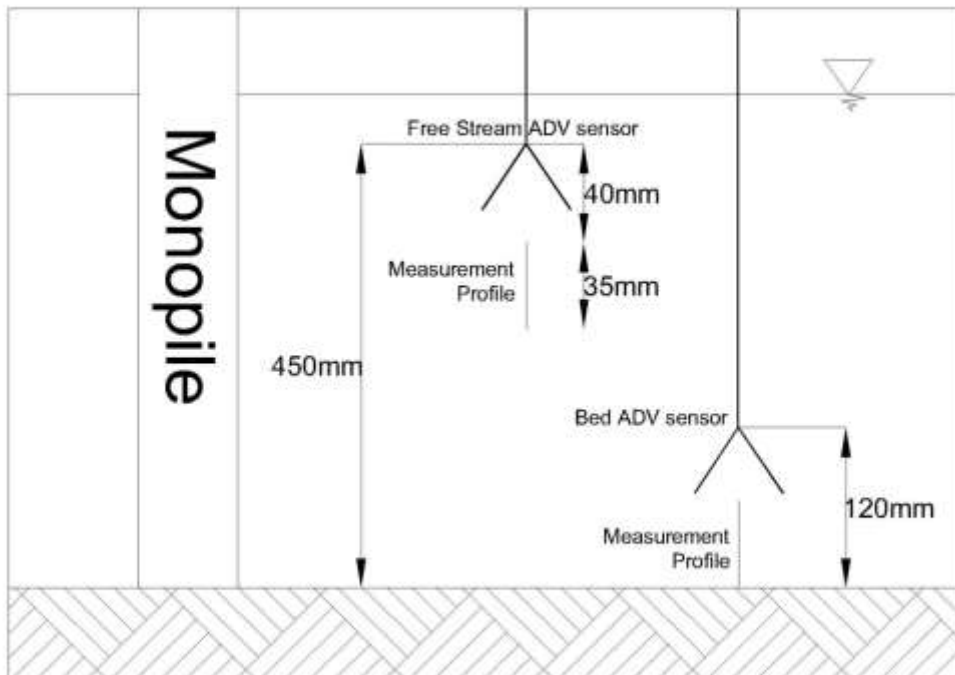
2.0 Autocad Coastal Basin Layout



3.0 Autocad sensor position layout



ADV Reading Locations



4.0 %EI of TKE at various traverse positions in Bed and Free stream positions

Sensor in Bed position % EI on original Current & No Waves condition			
Sensor Number	20deg	0deg	- 20deg
A	-3.57	107.14	32.14
B	-7.27	-21.82	-4.55
C	116.00	-36.00	80.00
D	27.30	-25.75	101.56
E	5.45	18.18	38.18
F	3.70	25.30	-7.71
G	73.12	317.52	93.48
H	205.56	155.56	166.67
I	292.56	33.86	56.67
1	-66.10	N/A	-39.70
2	183.33	91.67	0.00
3	-49.68	-42.89	-41.49
4	-62.24	284.28	-46.76
5	40.20	-73.40	-22.05
6	-42.83	-24.02	-49.88
7	-58.79	-37.54	-52.66
8	-28.09	-4.30	-18.62
9	-42.65	-36.67	-46.68
10	-62.15	-41.21	-51.29
11	-20.68	-18.37	-35.92
12	-59.66	-44.22	-57.43
14	-41.57	-30.11	-32.30
16	-32.33	-26.27	-16.21

Sensor in Free Stream position % EI on original Current & No Waves condition			
Sensor Number	20deg	0deg	- 20deg
A	92.00	N/A	54.67
B	31.18	47.31	8.60
C	149.09	183.64	123.64
D	158.49	137.74	167.92
E	69.70	109.09	125.76
F	107.14	151.79	117.86
G	96.83	68.25	76.19
H	92.19	75.00	160.94
I	120.37	109.26	87.04
1	N/A	318.75	587.50
2	37.50	28.41	40.91
3	90.91	118.18	221.21
4	566.67	246.67	573.33
5	78.79	233.33	263.64
6	129.17	133.33	333.33
7	410.00	350.00	380.00
8	41.43	18.57	18.57
9	680.00	260.00	580.00
10	327.27	300.00	872.73
11	88.37	55.81	111.63
12	257.14	250.00	628.57
14	131.25	184.38	128.13
16	278.26	195.65	347.83

%EI of TKE at various traverse positions in Bed and Free stream positions comparing TKE under current only condition to TKE under Current and various angles of wave propagation. (Red denotes Smaller environmental impacts, Green denotes bigger environmental impacts)

NOTE: Please refer to Appendix 3.0 for a sensor position layout

5.0 Bed Shear lab results

Directly measured and scaled results

Prototype Bed Shear Readings along CL of Monopile (N/m ²)					
Sensor number	Distance downstream of Monopile CL (m)	Monopile & No waves	Monopile & Waves		
			+ 20 deg	0 deg	- 20 deg
2	30	0.2081	0.1921		0.2785
5	37.5	0.3920	0.4381	0.4993	0.3380
8	50	0.3175	0.5511	0.4500	0.2509
11	62.5	0.5249	0.5780	0.3175	0.3485
14	70	0.4263	0.5780	0.6337	0.6919
16	75	0.3380	0.6771	0.5917	0.4867

Min Bed Shear (N/m²) 0.1921

Max Bed Shear (N/m²) 0.6919

Inferred from TKE using University of Illinois guidance and scaled

Prototype Bed Shear along downstream CL of Monopile (N/m ²)					
Sensor number	Distance from Monopile (m)	No wave condition	+ 20 deg	0 deg	- 20 deg
B	12.5	104.5000	96.9000	81.7000	99.7500
E	20	52.2500	55.1000	61.7500	72.2000
H	25	17.1000	52.2500	43.7000	45.6000
2	30	11.4000	32.3000	21.8500	11.4000
5	37.5	9.4864	13.3000	2.5232	7.3945
8	50	7.2266	5.1964	6.9157	5.8811
11	62.5	6.6399	5.2671	5.4200	4.2547
14	70	6.5341	3.8180	4.5668	4.4233
16	75	5.6080	3.7950	4.1351	4.6990

Min Bed Shear (N/m²) 2.5232

Max Bed Shear (N/m²) 104.5000

General Risk Assessment Form: The School of Marine Science and Engineering

Maxwell Needham

Coastal Basin, marine building.

Date: 06/10/2015

Assessed by:

Activity/Location



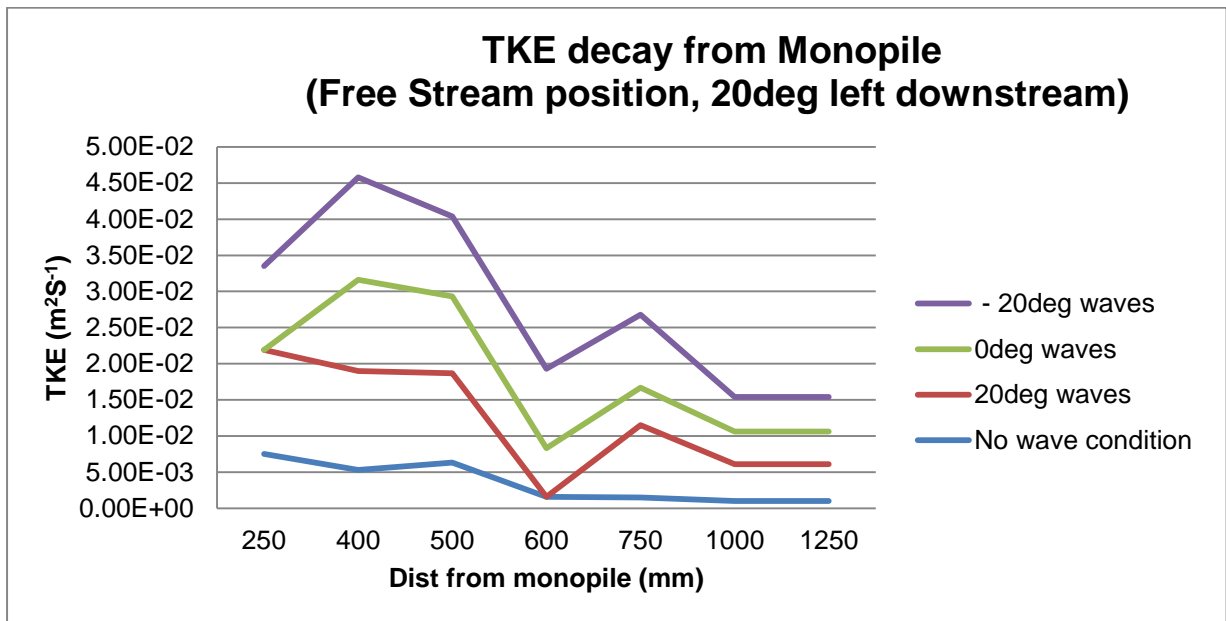
Work Activities	Hazards	No. at risk	Controls in place at present	Risk Level			Assessed risk			Comment
				L (1 - 2)	M (3 - 4)	H (6 - 9)	Low	Med	High	
Constructing pile model and assembling traverse	Manual handling	2	Suitable equipment to be used and follow lifting techniques		3			✓		Don't lift more than capable
	Drops from height	2	Suitable footwear to be worn and not to over lift	1			✓			Lifters to be aware of the weight being lifted
All	Slip, trips and falls	All	Signs warning of wet floor, suitable footwear to be worn, no distractions whilst working	2			✓			
	Electrocution	1	All wires checked for damage and PAT tested, any unnecessary wires kept away from the flume and equipment only on when needed		3			✓		All equipment will be checked before use
Running model	Working near water	1	Access to the flume difficult, flume is set at height so can't fall in	2			✓			Entering the tank whilst full will be kept to a minimum. No unattended working
	Working at height	2	Awareness when climbing in and out of tank, suitable footwear offering grip, equipment to be kept secure	2			✓			
	Skin irritation from chlorinated water	1	Hand washing facilities available if skin comes into contact	1			✓			

SIGNATURE: DVS (Responsible Person)

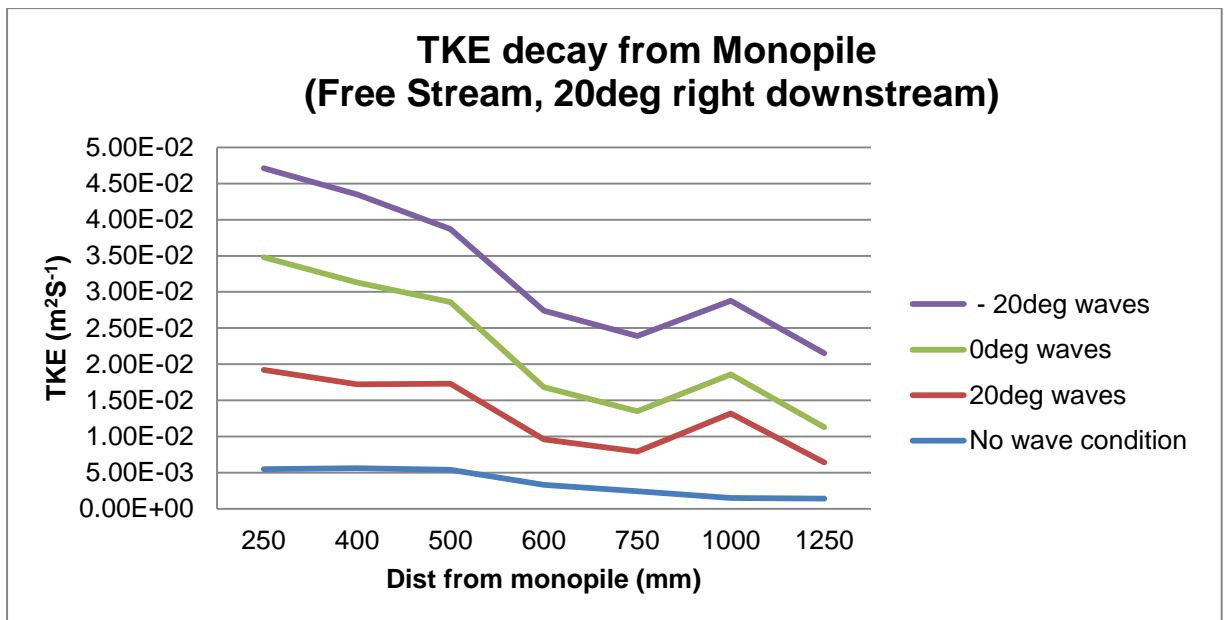
PRINT: Maxwell Needham

6.0 Lab Risk assessment form

7.0 Downstream Left and Right transect TKE plots



Free stream position TKE decay along left Transect



Free stream position TKE decay along right Transect