6. CONCLUSIONS

As discussed in the above chapters, the relationship of Echo height against Flexural strength relationship can be utilized to measure the existing Flexural strength of the GRP structure without destructing the structure and the durability of the GRP boat can be ensured comparing designed ultimate Flexural strength.

The Glass fiber Reinforced Plastic Inshore Petrol Crafts, built in Sri Lanka Navy are designed by an outside organisation and unwilling to disclose raw design data to Sri Lanka Navy boat yard according to the construction agreement, hence the designed Flexural strength not available at this movement to predict expected life of the IPCs. The communication has started on this regard and hope get favourable result in due course. However due to this unavoidable situation of comparison of the designed Flexural strength detail with the Flexural strength measured through this technique to predict the expected life time as proposed in this study is not being able to achieve as expected.

In order to overcome this difficulty, it is recommended to measure and record the proposed flexural strength during routine underwater maintenance for next five years and generate an average reduction of flexural strength per boat per year. This result can be used to predict the life of the particular class of IPC.

Further it is proposed to continue this study on different types of GRP boat hull with different GRP thickness to develop standard relationship on flexural strength over ultrasonic signal height, in order to generalise and make standard method for the assessment of GRP boat hull.

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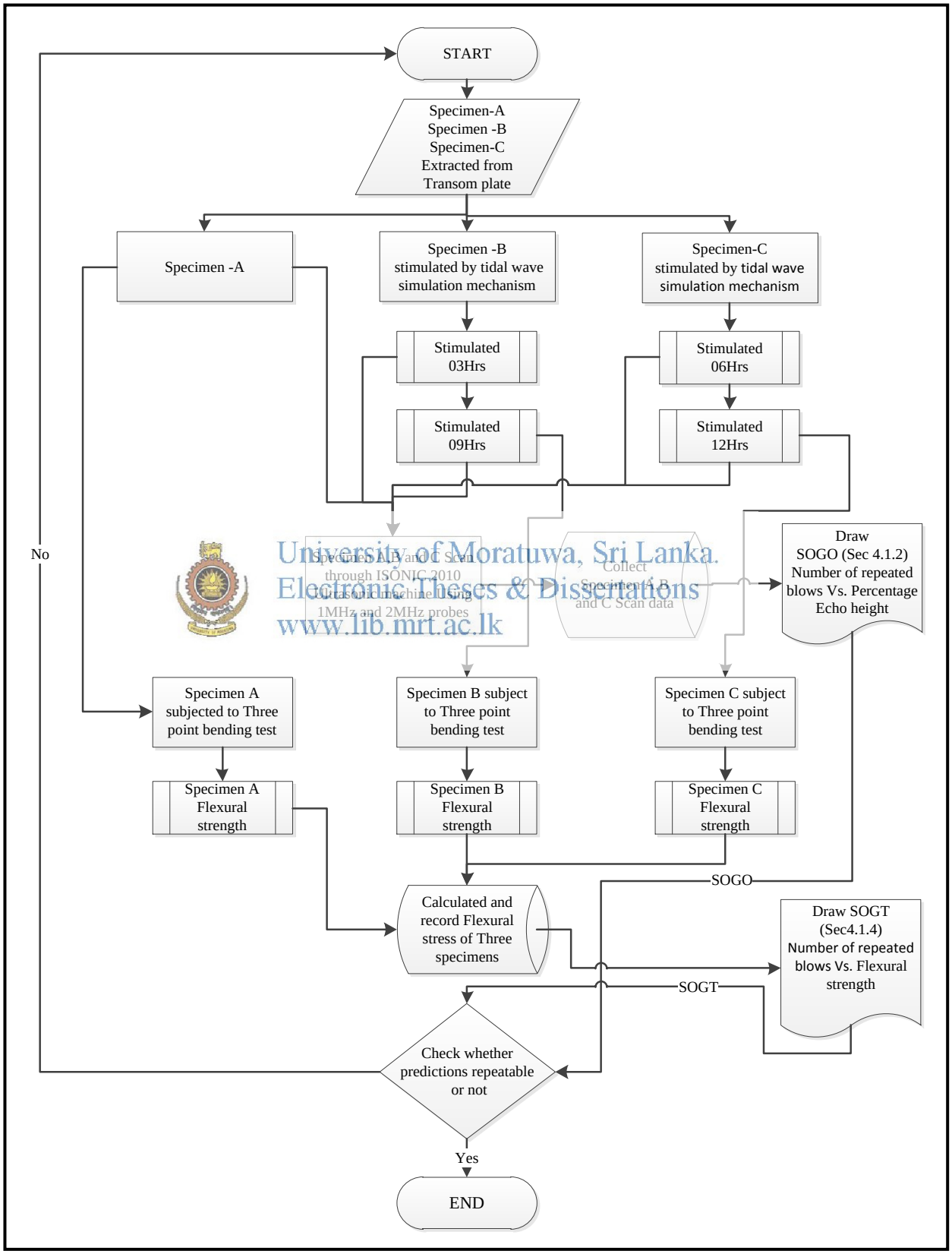
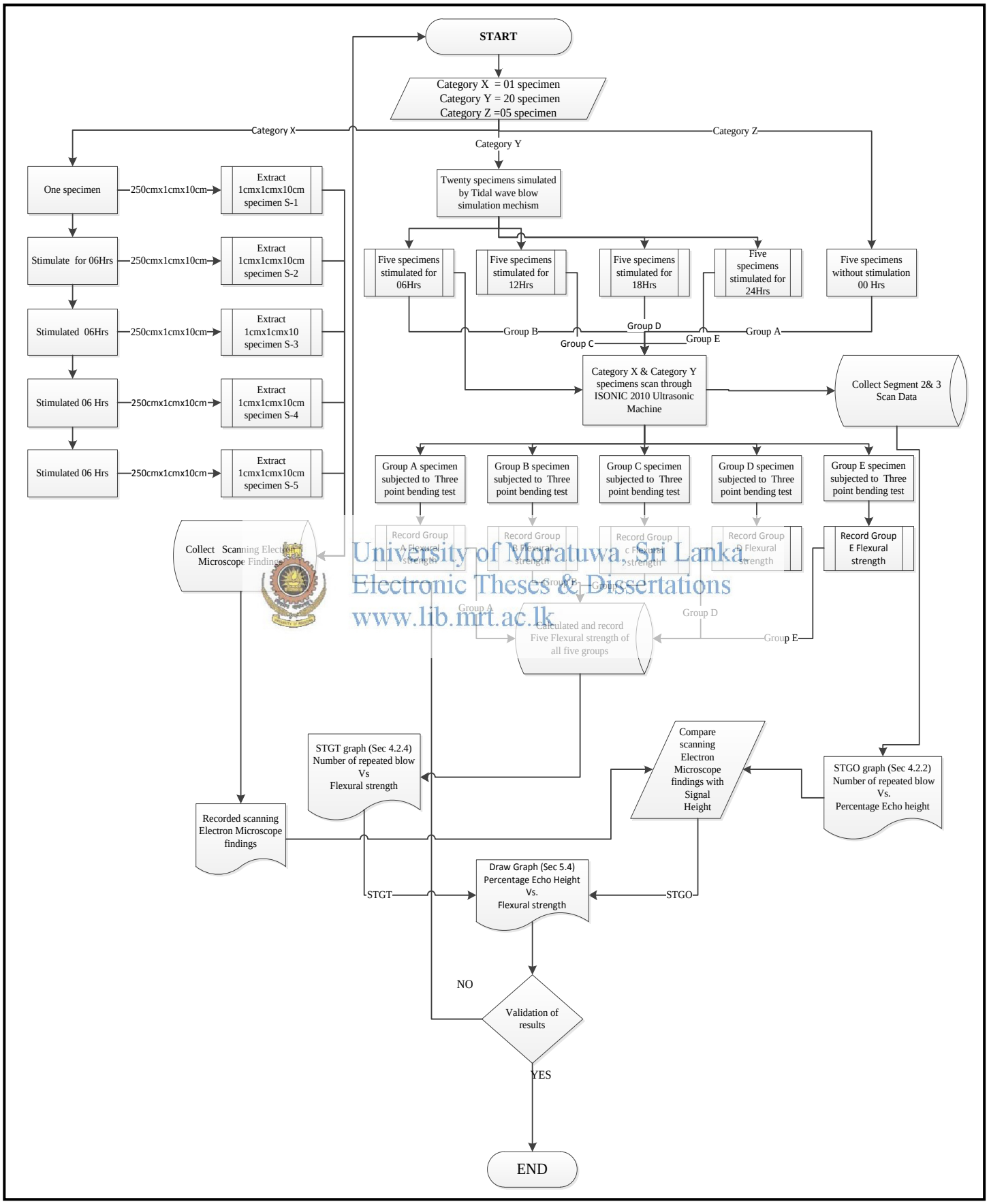
Appendix A - Flow Chart Stage One



Appendix B - Flow Chart Stage Two



Appendix C - Raw Data

(1) Echo Height Reading -Stage One & Stage Two

Table 1.1: Stage One-Echo height readings utilizing 1MHz and 2MHz probes

Specimen	Number of repeated blow	Percentage Echo height 1 MHz probe	Percentage Echo height 2 MHz probe
A	0	77	82
B	36000	57	71
C	72000	49	62
D	108000	46	54
E	216000	41	48

Table 1.2: Stage Two-Echo height readingsutilizing1MHz probe

Specimen		Percentage Echo height (H)						Number of repeated blow (L)
		reading Y_i	$\bar{Y}$	deviation $d_i = Y_i - \bar{Y}$		$H = \bar{Y} \pm \sigma_y$		
A	A_1	79	79	0	0	79	79	0
	A_2	79		0				
	A_3	79		0				
	A_4	79		0				
	A_5	79		0				
B	B_1	68	68.6	-0.6	0.49	69.09	68.11	138600
	B_2	69		0.4				
	B_3	68		-0.6				
	B_4	69		0.4				
	B_5	69		0.4				
C	C_1	64	63.6	0.4	0.49	64.09	63.11	277200
	C_2	63		-0.6				
	C_3	64		0.4				
	C_4	64		0.4				
	C_5	63		-0.6				
D	D_1	39	38.4	0.6	0.49	38.89	37.91	415800
	D_2	39		0.6				
	D_3	38		-0.4				
	D_4	38		-0.4				
	D_5	38		-0.4				
E	E_1	34	33.6	-0.4	0.49	34.09	33.11	554400
	E_2	33		0.6				
	E_3	34		-0.4				
	E_4	34		-0.4				
	E_5	33		0.6				

Table 1.3: Stage Two- Echo height readings utilizing 2MHz probe

Specimen		Percentage Echo height (H)						Number of repeated blow (L)
		reading Y_i	$\bar{Y}$	deviation $d_i = Y_i - \bar{Y}$	σ_y	$H = \bar{Y} \pm \sigma_y$		
A	A_1	85	85	0	0	85	85	0
	A_2	85		0				
	A_3	85		0				
	A_4	85		0				
	A_5	85		0				
B	B_1	76	76.6	-0.6	0.49	77.09	76.11	138600
	B_2	77		0.4				
	B_3	77		0.4				
	B_4	76		-0.6				
	B_5	77		0.4				
C	C_1	68	68.2	-0.2	0.40	68.6	67.8	277200
	C_2	68		-0.2				
	C_3	69		0.8				
	C_4	68		-0.2				
	C_5	68		-0.2				
D	D_1	56	56	0	0.63	56.63	55.37	415800
	D_2	56		0				
	D_3	55		-1				
	D_4	57		1				
	D_5	56		0				
E	E_1	48	47.2	0.8	0.65	47.85	46.55	554400
	E_2	46		-1.2				
	E_3	47		-0.2				
	E_4	48		0.8				
	E_5	47		-0.2				

(2) Flexural Strength reading- Stage One & Stage Two

Table 2.1: Stage one-Flexural Strength through Three Point Bend Test

Specimen	Number of repeated blow	Span L (mm)	Width b (mm)	Depth d (mm)	Load P (N)	Flexural Strength (MPa)
A	0	250	58	10	2850	184.26
B	72000	250	58	10	2250	145.47
C	324000	250	58	10	1225	79.20

Table 2.2: Stage Two-Flexural Strength through Three Point Bend test

Specimen	Number of repeated blow	Span L (mm)	Width b (mm)	Depth d (mm)	Load P (N)	Flexural Strength (MPa)
A	0	250	58	20	6350	102.64
B	138600	250	58	20	5650	91.33
C	277200	250	58	20	5250	84.86
D	415800	250	58	20	5100	82.44
E	554400	250	58	20	4650	75.16