APPENDIX-IV

EXPERIMENTAL DATA OF CFT WITH TWO NOZZLES

Head = 3m, Front wall - Circular arc, Rear wall - Spiral vortex, $\delta_1 = 60°$ $\delta_2 = 36°$ in the following cases. Other details of the runner and nozzle are listed in Table 7.1

(1) Q' = 0.0614, Q_f = 1.0, P_{in} = 882.9 W

Sl. No.	Speed N, rpm	Torque T, Nm	Output Power P_o, W	Efficiency, %	Speed Ratio Nr
1	322.85	0	0	0	0.661
2	274.01	6.12	163.87	18.56	0.561
3	270.10	7.81	212.96	24.12	0.553
4	254.96	9.59	251.45	28.48	0.522
5	234.14	11.39	292.24	33.10	0.506
6	226.14	13.22	312.37	35.39	0.463
7	204.16	15.16	321.91	36.46	0.418
8	197.81	18.63	390.42	44.22	0.405
9	187.07	21.46	405.60	45.94	0.383
10	175.83	22.80	416.46	47.17	0.360
11	166.06	23.44	404.37	45.80	0.340
12	156.30	22.41	387.36	43.79	0.321

(2) Q' = 0.0614, Q_f = 0.66, P_{in} = 882.9 W

Sl. No.	Speed N, rpm	Torque T, Nm	Output Power P_o, W	Efficiency ,%	Speed Ratio Nr
1	275.47	0	0	0	0.564
2	248.61	3.61	92.26	10.45	0.509
3	228.58	7.22	168.63	19.11	0.468
4	213.93	9.02	197.24	22.34	0.438
5	198.79	12.16	254.01	28.77	0.407
6	182.67	15.62	298.16	33.77	0.374
7	167.53	20.39	362.25	41.03	0.343
8	149.46	22.22	346.01	39.19	0.306
9	114.78	26.44	317.49	35.96	0.235

(3) Q' = 0.0614, Q_f = 0.40, P_{in} = 882.9 W

Sl. No.	Speed N, rpm	Torque T, Nm	Output Power P_o, W	Efficiency ,%	Speed Ratio Nr
1	250.07	0	0	0	0.512
2	227.12	3.62	84.41	9.56	0.465
3	208.56	5.99	133.32	15.11	0.427
4	185.60	9.65	181.88	20.62	0.380
5	176.81	12.63	232.20	26.33	0.362
6	156.78	16.23	270.17	30.63	0.321
7	148.48	18.64	291.00	32.96	0.304
8	125.04	21.23	279.06	31.65	0.256
9	117.71	22.20	271.05	30.69	0.241

(4) Q' = 0.0614, Q_f = 0.25, P_{in} = 882.9 W

Sl. No.	Speed N, rpm	Torque T, Nm	Output Power P_o, W	Efficiency ,%	Speed Ratio Nr
1	333.11	0	0	0	0.682
2	315.03	3.63	126.96	14.38	0.645
3	297.94	7.19	223.37	25.30	0.610
4	263.75	11.95	331.18	37.51	0.542
5	229.56	17.42	425.02	48.15	0.471
6	195.37	23.44	477.56	54.09	0.405
7	196.58	25.19	487.89	55.36	0.382
8	191.21	25.24	478.53	54.32	0.371
9	176.81	25.80	472.00	53.46	0.362

(5) Q' = 0.0614, Q_f = 0.15, P_{in} = 882.9 W

Sl. No.	Speed N, rpm	Torque T, Nm	Output Power P_o, W	Efficiency ,%	Speed Ratio Nr
1	350.69	0	0	0	0.728
2	333.11	3.05	114.34	12.95	0.682
3	313.08	9.01	287.74	32.59	0.641
4	295.50	14.42	442.33	50.15	0.605
5	274.01	19.25	551.85	62.47	0.561
6	263.00	22.79	610.70	69.17	0.518
7	234.93	26.44	656.20	74.33	0.481
8	225.65	28.82	674.36	76.38	0.462
9	215.88	29.40	662.62	75.05	0.442

(6) Q' = 0.0614, Q_f = 0.0, P_{in} = 882.9 W

Sl. No.	Speed N, rpm	Torque T, Nm	Output Power P_o, W	Efficiency ,%	Speed Ratio Nr
1	382.44	0	0	0	0.783
2	346.79	3.58	136.85	15.52	0.710
3	339.94	5.40	201.12	22.78	0.696
4	330.17	7.19	239.35	27.11	0.676
5	321.87	9.56	317.49	35.96	0.659
6	314.00	10.17	339.12	38.41	0.643
7	307.22	12.21	377.79	42.79	0.629
8	298.92	12.63	391.48	44.34	0.612
9	286.22	14.42	427.32	48.40	0.586
10	275.96	17.44	508.99	57.65	0.565
11	244.21	22.22	562.41	63.72	0.502
12	195.37	30.62	621.56	70.44	0.401
13	170.95	33.40	591.54	67.19	0.354

(7) Q' = 0.0718, Q_f = 1.0, P_{in} = 1030.0 W

Sl. No.	Speed N, rpm	Torque T, Nm	Output Power P_o, W	Efficiency ,%	Speed Ratio Nr
1	356.55	0	0	0	0.732
2	302.82	7.79	238.96	23.22	0.623
3	288.17	9.61	282.01	27.38	0.583
4	253.98	13.22	347.93	33.78	0.519
5	239.33	18.63	473.39	45.96	0.491
6	234.42	21.04	509.85	49.50	0.483
7	210.03	24.13	533.34	51.78	0.433
8	195.37	26.40	535.60	52.07	0.410
9	195.60	33.63	653.23	63.42	0.385
10	170.95	36.07	644.57	62.58	0.350
11	122.12	38.45	488.94	44.46	0.252

(8) Q' = 0.0718, Q_f = 0.857, P_{in} = 1030.0 W

Sl. No.	Speed N, rpm	Torque T, Nm	Output Power P_o, W	Efficiency ,%	Speed Ratio Nr
1	312.10	0	0	0	0.639
2	299.89	2.58	80.58	7.86	0.614
3	274.99	8.41	245.76	23.86	0.563
4	250.04	13.19	342.58	33.26	0.512
5	225.16	19.78	464.84	45.13	0.461
6	170.95	30.61	544.97	52.91	0.352
7	146.53	32.40	495.02	48.07	0.302

(9) Q' = 0.0718, Q_f = 0.714, P_{in} = 1030.0 W

Sl. No.	Speed N, rpm	Torque T, Nm	Output Power P_o, W	Efficiency ,%	Speed Ratio Nr
1	266.42	0	0	0	0.535
2	257.89	5.38	152.65	14.82	0.528
3	232.98	9.57	229.69	22.30	0.477
4	210.02	13.23	289.84	28.14	0.431
5	183.16	18.64	360.09	34.96	0.375
6	180.23	19.22	366.78	35.61	0.369
7	166.55	22.80	400.26	38.86	0.341
8	156.78	24.63	408.19	39.63	0.321
9	136.76	26.98	386.87	57.56	0.281
10	117.23	30.25	369.15	35.84	0.243

(10) Q' = 0.0718, Q_f = 0.50, P_{in} = 1030.0 W

Sl. No.	Speed N, rpm	Torque T, Nm	Output Power P_o, W	Efficiency ,%	Speed Ratio Nr
1	255.93	0	0	0	0.524
2	234.93	5.43	139.08	13.50	0.481
3	207.09	9.61	204.15	19.82	0.424
4	175.83	13.19	242.98	23.59	0.360
5	146.04	18.65	287.99	27.96	0.299
6	92.00	26.45	256.78	24.93	0.191

(11) Q' = 0.0718, Q_f = 0.286, P_{in} = 1030.0 W

Sl. No.	Speed N, rpm	Torque T, Nm	Output Power P_o, W	Efficiency ,%	Speed Ratio Nr
1	332.13	0	0	0	0.681
2	307.22	5.44	181.59	17.63	0.623
3	291.10	9.61	286.96	27.86	0.596
4	258.86	13.20	360.29	34.98	0.531
5	239.82	18.59	473.18	45.94	0.491
6	212.95	22.78	504.18	48.95	0.436
7	192.93	25.76	514.12	50.05	0.395
8	186.09	27.61	539.81	52.41	0.381
9	173.88	30.05	548.99	53.30	0.356
10	165.09	31.83	553.11	53.71	0.338
11	154.83	34.33	550.12	53.42	0.317

(12) Q' = 0.0718, Q_f = 0.143, P_{in} = 1030.0 W

Sl. No.	Speed N, rpm	Torque T, Nm	Output Power P_o, W	Efficiency ,%	Speed Ratio Nr
1	366.81	0	0	0	0.751
2	335.06	5.40	198.17	19.24	0.686
3	325.78	9.63	321.15	31.18	0.667
4	311.13	14.99	490.59	47.63	0.637
5	298.92	18.58	589.57	57.24	0.612
6	277.91	22.17	653.02	63.40	0.565
7	255.93	26.42	705.55	68.51	0.524
8	244.19	30.01	772.91	75.04	0.502
9	234.93	31.82	787.74	76.48	0.481
10	220.77	36.59	827.91	80.38	0.452
11	210.51	36.67	803.40	78.10	0.431

(13) Q' = 0.0718, Q_f = 0.0, P_{in} = 1030.0 W

Sl. No.	Speed N, rpm	Torque T, Nm	Output Power P_o, W	Efficiency ,%	Speed Ratio Nr
1	401.97	0	0	0	0.823
2	358.99	3.59	141.73	13.76	0.735
3	337.09	7.78	265.74	25.80	0.691
4	320.89	13.15	443.00	43.01	0.657
5	292.08	15.15	460.82	44.74	0.598
6	271.08	21.20	588.03	57.09	0.555
7	255.93	26.42	706.89	68.63	0.524
8	239.82	28.19	709.98	68.93	0.491
9	225.60	30.06	710.08	68.94	0.462
10	204.65	35.69	768.28	74.59	0.419
11	181.21	39.10	744.28	72.26	0.371
12	157.75	43.23	715.13	69.42	0.323

List of Technical papers published pertaining to the Thesis

1. *"Performance Analysis of a Cross Flow Turbine with Double Nozzles"* , by J.Kumar and PR.Thiyagarajan, Proceedings of the 22nd FMFP Conference, IIT, Madras, Dec.1995, pp.64-70.

2. *"Experimental Investigations of an Impulse type CFT with double nozzles"*, by J.Kumar and PR.Thiyagarajan, Proceedings of 2nd National Conference on Fluid Machinery, PSG College of Technology, Coimbatore, June 1996, pp.200-212

3. *"Effect of flow fraction on performance of CFT with two nozzles"*, by J. Kumar and Dr. PR. Thiyagarajan, International Conference on Small Hydro power development in Himalayas, April 20-22, 1998, pp 470-479, Shimla, India

4. *"Effect of spiral vortex shaped nozzle on cross flow turbine performance"*, by J.Kumar and PR. Thiyagarajan, 1st International Conference on FMFP, Dec.15-17, 1998, pp 386-395, IIT, New Delhi.

5. *"Finite Element Analysis of flow through 1st stage flow passage of Cross Flow Turbine Runner"*, by J.Kumar and PR.Thiyagarajan 3rd National Conference on Fluid Machinery 12th and 13th September,1998, Pune