



BRIDGE PROTECTION SYSTEMS ATTACHMENT

Annual Frequency of Collapse Computations

Baltimore, MD

DCA24MM031

(5 pages)

Annual Frequency of Collapse Computations for Pier 16

Vessel ID	Vessel Type	DWT (tons)	Speed @ Pier (fps)	Impact Force (kips)	Vessel Trips (N)		PA	PG	PC	PF		Annual Frequency of Collapse (AF)			
					Inbound	Outbound				Inbound	Outbound	Inbound	Outbound	Total	Cumulative
1	Container	4,887	14.0	7,976	4	4	0.0001	0.0202	0.0607	1.0000	1.0000	0.000000	0.000000	0.000000	0.000000
2	Bulk Carrier	7,690	13.5	9,648	36	36	0.0001	0.0156	0.0632	1.0000	1.0000	0.000004	0.000004	0.000008	0.000008
3	General Cargo	7,690	15.9	11,364	20	19	0.0001	0.0134	0.0665	1.0000	1.0000	0.000002	0.000002	0.000004	0.000012
4	Vehicles Carrier	4,887	14.5	8,261	14	14	0.0001	0.0129	0.0465	1.0000	1.0000	0.000001	0.000001	0.000002	0.000014
5	Tanker	5,775	12.8	7,928	14	13	0.0001	0.0032	0.0000	1.0000	1.0000	0.000000	0.000000	0.000000	0.000014
6	Other	1,000	17.7	4,562	3	2	0.0001	0.0317	0.0353	1.0000	1.0000	0.000000	0.000000	0.000000	0.000014
7	Other	3,000	17.7	7,901	1	0	0.0001	0.0145	0.0554	1.0000	1.0000	0.000000	0.000000	0.000000	0.000014
8	Other	5,000	17.7	10,200	5	4	0.0001	0.0275	0.0766	1.0000	1.0000	0.000001	0.000001	0.000002	0.000016
9	Other	7,690	17.7	12,650	64	63	0.0001	0.0304	0.0838	1.0000	1.0000	0.000016	0.000016	0.000032	0.000048
Total												0.000024	0.000024	0.000048	

Annual Frequency of Collapse Computations for Pier 17

Vessel ID	Vessel Type	Single Vessel Capacity DWT (tonnes)	Speed @ Pier (fps)	Impact Force (kips)	Vessel Trips (N)		PA	PG	PC	PF		Annual Frequency of Collapse (AF)			
					Inbound	Outbound				Inbound	Outbound	Inbound	Outbound	Total	Cumulative
1	Container	5,000	14.0	8,068	4	4	0.0001	0.0722	0.0270	0.7708	0.8287	0.000001	0.000001	0.000002	0.000002
2	Container	15,000	14.0	13,974	353	353	0.0001	0.0814	0.0634	0.7144	0.7859	0.000130	0.000143	0.000273	0.000275
3	Container	25,000	14.0	18,041	36	35	0.0001	0.0735	0.0740	0.7525	0.8147	0.000015	0.000016	0.000031	0.000306
4	Container	35,000	14.0	21,346	28	27	0.0001	0.0714	0.0798	0.7490	0.8121	0.000012	0.000012	0.000024	0.000330
5	Container	45,000	14.0	24,204	26	26	0.0001	0.0744	0.0835	0.7467	0.8103	0.000012	0.000013	0.000025	0.000355
6	Container	55,000	14.0	26,759	16	16	0.0001	0.0749	0.0864	0.7146	0.7861	0.000007	0.000008	0.000015	0.000370
7	Container	65,000	14.0	29,090	17	17	0.0001	0.0732	0.0883	0.7409	0.8059	0.000008	0.000009	0.000017	0.000387
8	Container	75,000	14.0	31,248	5	4	0.0001	0.0741	0.0899	0.7271	0.7956	0.000002	0.000002	0.000004	0.000391
9	Container	85,000	14.0	33,266	19	19	0.0001	0.0745	0.0912	0.7236	0.7928	0.000009	0.000010	0.000019	0.000410
10	Container	95,000	14.0	35,168	11	10	0.0001	0.0696	0.0924	0.7216	0.7913	0.000005	0.000005	0.000010	0.000420
11	Container	105,000	14.0	36,973	3	3	0.0001	0.0666	0.0934	0.7183	0.7890	0.000001	0.000001	0.000002	0.000422
12	Bulk Carrier	5,000	13.5	7,780	42	41	0.0001	0.0759	0.0226	0.7767	0.8329	0.000006	0.000006	0.000012	0.000434
13	Bulk Carrier	15,000	13.5	13,475	297	296	0.0001	0.0809	0.0616	0.7181	0.7887	0.000106	0.000116	0.000222	0.000656
14	Bulk Carrier	25,000	13.5	17,396	18	18	0.0001	0.0755	0.0705	0.7882	0.8417	0.000008	0.000008	0.000016	0.000672
15	Bulk Carrier	35,000	13.5	20,584	14	13	0.0001	0.0782	0.0781	0.7530	0.8152	0.000006	0.000006	0.000012	0.000684
16	Bulk Carrier	45,000	13.5	23,340	11	10	0.0001	0.0744	0.0825	0.7467	0.8103	0.000005	0.000005	0.000010	0.000694
17	Bulk Carrier	55,000	13.5	25,803	15	15	0.0001	0.0749	0.0855	0.7146	0.7861	0.000007	0.000008	0.000015	0.000709
18	Bulk Carrier	65,000	13.5	28,051	11	10	0.0001	0.0732	0.0874	0.7409	0.8059	0.000005	0.000005	0.000010	0.000719
19	Bulk Carrier	75,000	13.5	30,132	8	7	0.0001	0.0741	0.0891	0.7271	0.7956	0.000004	0.000004	0.000008	0.000727
20	Bulk Carrier	85,000	13.5	32,078	10	10	0.0001	0.0745	0.0905	0.7236	0.7928	0.000005	0.000005	0.000010	0.000737
21	Bulk Carrier	95,000	13.5	33,912	14	13	0.0001	0.0666	0.0918	0.7183	0.7890	0.000006	0.000006	0.000012	0.000749
22	General Cargo	5,000	15.9	9,163	43	42	0.0001	0.0778	0.0358	0.7637	0.8233	0.000009	0.000010	0.000019	0.000768
23	General Cargo	15,000	15.9	15,871	203	203	0.0001	0.0788	0.0685	0.7313	0.7987	0.000080	0.000088	0.000168	0.000936
24	General Cargo	25,000	15.9	20,489	35	34	0.0001	0.0711	0.0765	0.7990	0.8498	0.000015	0.000016	0.000031	0.000967
25	General Cargo	35,000	15.9	24,243	4	3	0.0001	0.0740	0.0818	0.7900	0.8430	0.000002	0.000002	0.000004	0.000971
26	General Cargo	45,000	15.9	27,489	2	2	0.0001	0.0731	0.0854	0.7864	0.8402	0.000001	0.000001	0.000002	0.000973
27	General Cargo	55,000	15.9	30,390	2	1	0.0001	0.0747	0.0878	0.7787	0.8344	0.000001	0.000001	0.000002	0.000975
28	General Cargo	65,000	15.9	33,038	1	0	0.0001	0.0783	0.0897	0.7787	0.8344	0.000001	0.000000	0.000001	0.000976
29	Vehicles Carrier	5,000	14.5	8,356	16	15	0.0001	0.0747	0.0266	0.7818	0.8368	0.000002	0.000002	0.000004	0.000980
30	Vehicles Carrier	15,000	14.5	14,473	358	358	0.0001	0.0793	0.0644	0.7273	0.7956	0.000133	0.000145	0.000278	0.001258
31	Vehicles Carrier	25,000	14.5	18,685	57	56	0.0001	0.0758	0.0737	0.7759	0.8324	0.000025	0.000026	0.000051	0.001309
32	Vehicles Carrier	35,000	14.5	22,109	11	11	0.0001	0.0758	0.0799	0.7787	0.8344	0.000005	0.000006	0.000011	0.001320
33	Vehicles Carrier	45,000	14.5	25,069	5	4	0.0001	0.0691	0.0840	0.7772	0.8334	0.000002	0.000002	0.000004	0.001324
34	Tanker	5,000	12.8	7,377	17	17	0.0001	0.0744	0.0141	0.7831	0.8378	0.000001	0.000001	0.000002	0.001326
35	Tanker	15,000	12.8	12,777	67	67	0.0001	0.0816	0.0585	0.7308	0.7985	0.000023	0.000026	0.000049	0.001375
36	Tanker	25,000	12.8	16,494	6	5	0.0001	0.0838	0.0674	0.7538	0.8158	0.000003	0.000002	0.000005	0.001380
37	Tanker	35,000	12.8	19,516	3	2	0.0001	0.0779	0.0745	0.7815	0.8365	0.000001	0.000001	0.000002	0.001382
38	Tanker	45,000	12.8	22,130	1	1	0.0001	0.0751	0.0796	0.7764	0.8329	0.000000	0.000000	0.000000	0.001382
39	Tanker	75,000	12.8	28,569	1	0	0.0001	0.0721	0.0871	0.7787	0.8344	0.000000	0.000000	0.000000	0.001382
40	Other	1,000	17.7	4,562	3	2	0.0001	0.0814	0.0000	0.7136	0.7854	0.000000	0.000000	0.000000	0.001382
41	Other	3,000	17.7	7,901	1	0	0.0001	0.0658	0.0000	0.8093	0.8577	0.000000	0.000000	0.000000	0.001382
42	Other	5,000	17.7	10,200	5	4	0.0001	0.0774	0.0207	0.7321	0.7995	0.000001	0.000001	0.000002	0.001384
43	Other	7,000	17.7	12,069	64	63	0.0001	0.0784	0.0349	0.7221	0.7918	0.000013	0.000014	0.000027	0.001411
44	Other	9,000	17.7	13,685	37	36	0.0001	0.0779	0.0438	0.7223	0.7920	0.000009	0.000010	0.000019	0.001430
45	Other	11,000	17.7	15,130	1	0	0.0001	0.0814	0.0502	0.7136	0.7854	0.000000	0.000000	0.000000	0.001430
46	Other	13,000	17.7	16,448	1	0	0.0001	0.0814	0.0551	0.7136	0.7854	0.000000	0.000000	0.000000	0.001430
											Total	0.000687	0.000743	0.001430	

Annual Frequency of Collapse Computations for Pier 18

Vessel ID	Vessel Type	Single Vessel Capacity DWT (tonnes)	Speed @ Pier (fps)	Impact Force (kips)	Vessel Trips (N)		PA	PG	PC	PF		Annual Frequency of Collapse (AF)			
					Inbound	Outbound				Inbound	Outbound	Inbound	Outbound	Total	Cumulative
1	Container	5,000	14.0	8,068	4	4	0.0001	0.0722	0.0278	0.7708	0.8287	0.000001	0.000001	0.000002	0.000002
2	Container	15,000	14.0	13,974	353	353	0.0001	0.0814	0.0638	0.7144	0.7859	0.000131	0.000144	0.000275	0.000277
3	Container	25,000	14.0	18,041	36	35	0.0001	0.0735	0.0743	0.7525	0.8147	0.000015	0.000016	0.000031	0.000308
4	Container	35,000	14.0	21,346	28	27	0.0001	0.0714	0.0801	0.7490	0.8121	0.000012	0.000013	0.000025	0.000333
5	Container	45,000	14.0	24,204	26	26	0.0001	0.0744	0.0837	0.7467	0.8103	0.000012	0.000013	0.000025	0.000358
6	Container	55,000	14.0	26,759	16	16	0.0001	0.0749	0.0867	0.7146	0.7861	0.000007	0.000008	0.000015	0.000373
7	Container	65,000	14.0	29,090	17	17	0.0001	0.0732	0.0885	0.7409	0.8059	0.000008	0.000009	0.000017	0.000390
8	Container	75,000	14.0	31,248	5	4	0.0001	0.0741	0.0901	0.7271	0.7956	0.000002	0.000002	0.000004	0.000394
9	Container	85,000	14.0	33,266	19	19	0.0001	0.0745	0.0914	0.7236	0.7928	0.000009	0.000010	0.000019	0.000413
10	Container	95,000	14.0	35,168	11	10	0.0001	0.0696	0.0926	0.7216	0.7913	0.000005	0.000005	0.000010	0.000423
11	Container	105,000	14.0	36,973	3	3	0.0001	0.0666	0.0935	0.7183	0.7890	0.000001	0.000001	0.000002	0.000425
12	Bulk Carrier	5,000	13.5	7,780	42	41	0.0001	0.0759	0.0234	0.7767	0.8329	0.000006	0.000006	0.000012	0.000437
13	Bulk Carrier	15,000	13.5	13,475	297	296	0.0001	0.0809	0.0620	0.7181	0.7887	0.000107	0.000117	0.000224	0.000661
14	Bulk Carrier	25,000	13.5	17,396	18	18	0.0001	0.0755	0.0709	0.7882	0.8417	0.000008	0.000008	0.000016	0.000677
15	Bulk Carrier	35,000	13.5	20,584	14	13	0.0001	0.0782	0.0784	0.7530	0.8152	0.000006	0.000006	0.000012	0.000689
16	Bulk Carrier	45,000	13.5	23,340	11	10	0.0001	0.0744	0.0827	0.7467	0.8103	0.000005	0.000005	0.000010	0.000699
17	Bulk Carrier	55,000	13.5	25,803	15	15	0.0001	0.0749	0.0858	0.7146	0.7861	0.000007	0.000008	0.000015	0.000714
18	Bulk Carrier	65,000	13.5	28,051	11	10	0.0001	0.0732	0.0876	0.7409	0.8059	0.000005	0.000005	0.000010	0.000724
19	Bulk Carrier	75,000	13.5	30,132	8	7	0.0001	0.0741	0.0893	0.7271	0.7956	0.000004	0.000004	0.000008	0.000732
20	Bulk Carrier	85,000	13.5	32,078	10	10	0.0001	0.0745	0.0907	0.7236	0.7928	0.000005	0.000005	0.000010	0.000742
21	Bulk Carrier	95,000	13.5	33,912	14	13	0.0001	0.0666	0.0919	0.7183	0.7890	0.000006	0.000006	0.000012	0.000754
22	General Cargo	5,000	15.9	9,163	43	42	0.0001	0.0778	0.0365	0.7637	0.8233	0.000009	0.000010	0.000019	0.000773
23	General Cargo	15,000	15.9	15,871	203	203	0.0001	0.0788	0.0689	0.7313	0.7987	0.000081	0.000088	0.000169	0.000942
24	General Cargo	25,000	15.9	20,489	35	34	0.0001	0.0711	0.0768	0.7990	0.8498	0.000015	0.000016	0.000031	0.000973
25	General Cargo	35,000	15.9	24,243	4	3	0.0001	0.0740	0.0821	0.7900	0.8430	0.000002	0.000002	0.000004	0.000977
26	General Cargo	45,000	15.9	27,489	2	2	0.0001	0.0731	0.0857	0.7864	0.8402	0.000001	0.000001	0.000002	0.000979
27	General Cargo	55,000	15.9	30,390	2	1	0.0001	0.0747	0.0880	0.7787	0.8344	0.000001	0.000001	0.000002	0.000981
28	General Cargo	65,000	15.9	33,038	1	0	0.0001	0.0783	0.0899	0.7787	0.8344	0.000001	0.000000	0.000001	0.000982
29	Vehicles Carrier	5,000	14.5	8,356	16	15	0.0001	0.0747	0.0273	0.7818	0.8368	0.000003	0.000003	0.000006	0.000988
30	Vehicles Carrier	15,000	14.5	14,473	358	358	0.0001	0.0793	0.0648	0.7273	0.7956	0.000134	0.000146	0.000280	0.001268
31	Vehicles Carrier	25,000	14.5	18,685	57	56	0.0001	0.0758	0.0740	0.7759	0.8324	0.000025	0.000026	0.000051	0.001319
32	Vehicles Carrier	35,000	14.5	22,109	11	11	0.0001	0.0758	0.0802	0.7787	0.8344	0.000005	0.000006	0.000011	0.001330
33	Vehicles Carrier	45,000	14.5	25,069	5	4	0.0001	0.0691	0.0843	0.7772	0.8334	0.000002	0.000002	0.000004	0.001334
34	Tanker	5,000	12.8	7,377	17	17	0.0001	0.0744	0.0149	0.7831	0.8378	0.000001	0.000002	0.000003	0.001337
35	Tanker	15,000	12.8	12,777	67	67	0.0001	0.0816	0.0590	0.7308	0.7985	0.000024	0.000026	0.000050	0.001387
36	Tanker	25,000	12.8	16,494	6	5	0.0001	0.0838	0.0678	0.7538	0.8158	0.000003	0.000002	0.000005	0.001392
37	Tanker	35,000	12.8	19,516	3	2	0.0001	0.0779	0.0748	0.7815	0.8365	0.000001	0.000001	0.000002	0.001394
38	Tanker	45,000	12.8	22,130	1	1	0.0001	0.0751	0.0799	0.7764	0.8329	0.000000	0.000000	0.000000	0.001394
39	Tanker	75,000	12.8	28,569	1	0	0.0001	0.0721	0.0873	0.7787	0.8344	0.000000	0.000000	0.000000	0.001394
40	Other	1,000	17.7	4,562	3	2	0.0001	0.0814	0.0000	0.7136	0.7854	0.000000	0.000000	0.000000	0.001394
41	Other	3,000	17.7	7,901	1	0	0.0001	0.0658	0.0000	0.8093	0.8577	0.000000	0.000000	0.000000	0.001394
42	Other	5,000	17.7	10,200	5	4	0.0001	0.0774	0.0215	0.7321	0.7995	0.000001	0.000001	0.000002	0.001396
43	Other	7,000	17.7	12,069	64	63	0.0001	0.0784	0.0356	0.7221	0.7918	0.000013	0.000014	0.000027	0.001423
44	Other	9,000	17.7	13,685	37	36	0.0001	0.0779	0.0444	0.7223	0.7920	0.000009	0.000010	0.000019	0.001442
45	Other	11,000	17.7	15,130	1	0	0.0001	0.0814	0.0508	0.7136	0.7854	0.000000	0.000000	0.000000	0.001442
46	Other	13,000	17.7	16,448	1	0	0.0001	0.0814	0.0556	0.7136	0.7854	0.000000	0.000000	0.000000	0.001442
											Total	0.000693	0.000749	0.001442	

Annual Frequency of Collapse Computations for Pier 19

Vessel ID	Vessel Type	Single Vessel Capacity DWT (tonnes)	Speed @ Pier (fps)	Impact Force (kips)	Vessel Trips (N)		PA	PG	PC	PF		Annual Frequency of Collapse (AF)			
					Inbound	Outbound				Inbound	Outbound	Inbound	Outbound	Total	Cumulative
1	Bulk Carrier	1,935	13.5	4,840	3	2	0.0001	0.0121	0.0019	1.0000	1.0000	0.000000	0.000000	0.000000	0.000000
2	General Cargo	1,935	15.9	5,700	3	2	0.0001	0.0134	0.0218	1.0000	1.0000	0.000000	0.000000	0.000000	0.000000
3	Other	1,935	17.7	6,346	3	2	0.0001	0.0317	0.0562	1.0000	1.0000	0.000001	0.000000	0.000001	0.000001
											Total	0.000001	0.000000	0.000001	