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FORMULATION OF THE SPEED-AVERAGING
FACTOR FOR ONE-IN-50 YEAR EXTREME
WINDS IN STORM SURGE PREDICTIONS

S. Ishiguro
1980

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FORMULATION OF THE SPEED-AVERAGING
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5 pages, 2 tables and 1 figure.

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1. Introduction

Shellard (1974) has estimated once-in-50 year extreme wind speeds over the seas around the British Isles. The result has been represented on a map with equal wind-speed lines, ranging from 30 to 40 m/s in hourly-mean wind speed. If a once-in-50 year extreme wind speed averaged over a period longer than one hour is required, this can be obtained by multiplying the hourly-mean extreme wind speed by a certain factor. Such a factor has also been given by Shellard (1975) as shown in Table 1.

Extreme wind speeds estimated by Shellard are based on various wind data observed around the seas, but the factor shown in Table 1 is based on the analysis of the wind data observed at Lerwick for 1957-70.

In order to estimate an extreme storm surge by a dynamic computation, a reliable estimation of extreme meteorological conditions is required for the input. The author has found no better material for this purpose than Shellard's work, although this was originally for the design of offshore constructions and the estimation of wind-generated wave heights.

It is convenient to express the factor shown in Table 1 by a single formula, when this is applied to a computer. This paper describes such a formula. The author has applied this formula successfully to his own computations, and as it also has many other applications he thinks that it is worthy of separate documentation.

Table 1 Ratio of maximum speeds averaged over a varying number of hours (V_t) to maximum speeds over one hour (V_1). (Shellard, 1975)

Period	t (hr)	3	6	12	18	24	36	48	72
Ratio	V_t/V_1	0.96	0.90	0.82	0.74	0.71	0.66	0.58	0.51

2. Formula

The author has found that the following formula fits the factor shown in Table 1:-

$$V_t/V_1 = 0.79 - 0.00394t + 0.25e^{-0.11t}$$

where V_1 is the hourly-mean extreme wind speed, and V_t is the extreme wind speed averaged over the period of t. The values of V_t/V_1 and $(V_t/V_1)^2$ obtained by this formula are shown in Table 2. The two types of value are also shown with Shellard's original values in Fig. 1.

Table 2 Values computed by the formula (Ishiguro).

t (hr)	v_t/v_1	$(v_t/v_1)^2$	t (hr)	v_t/v_1	$(v_t/v_1)^2$
1	1.000	1.000	41	0.631	0.398
2	0.983	0.966	42	0.627	0.393
3	0.958	0.918	43	0.623	0.388
4	0.935	0.875	44	0.619	0.383
5	0.915	0.836	45	0.614	0.378
6	0.896	0.802	46	0.610	0.373
7	0.878	0.771	47	0.606	0.368
8	0.862	0.743	48	0.602	0.363
9	0.847	0.718	49	0.598	0.358
10	0.834	0.695	50	0.594	0.353
11	0.821	0.674	51	0.590	0.348
12	0.810	0.655	52	0.586	0.343
13	0.799	0.638	53	0.582	0.339
14	0.788	0.622	54	0.578	0.334
15	0.779	0.607	55	0.574	0.329
16	0.770	0.593	56	0.570	0.325
17	0.762	0.580	57	0.566	0.320
18	0.754	0.568	58	0.562	0.316
19	0.746	0.557	59	0.558	0.311
20	0.739	0.546	60	0.554	0.307
21	0.732	0.536	61	0.550	0.302
22	0.726	0.526	62	0.546	0.298
23	0.719	0.517	63	0.542	0.294
24	0.713	0.509	64	0.538	0.290
25	0.707	0.501	65	0.534	0.285
26	0.702	0.493	66	0.530	0.281
27	0.696	0.485	67	0.526	0.277
28	0.691	0.478	68	0.522	0.273
29	0.686	0.471	69	0.518	0.269
30	0.681	0.464	70	0.514	0.265
31	0.676	0.457	71	0.510	0.260
32	0.671	0.451	72	0.506	0.256
33	0.667	0.444	73	0.502	0.252
34	0.662	0.438	74	0.499	0.249
35	0.657	0.432	75	0.495	0.245
36	0.653	0.426	76	0.491	0.241
37	0.648	0.421	77	0.487	0.237
38	0.644	0.415	78	0.483	0.233
39	0.640	0.409	79	0.479	0.229
40	0.635	0.404	80	0.475	0.225

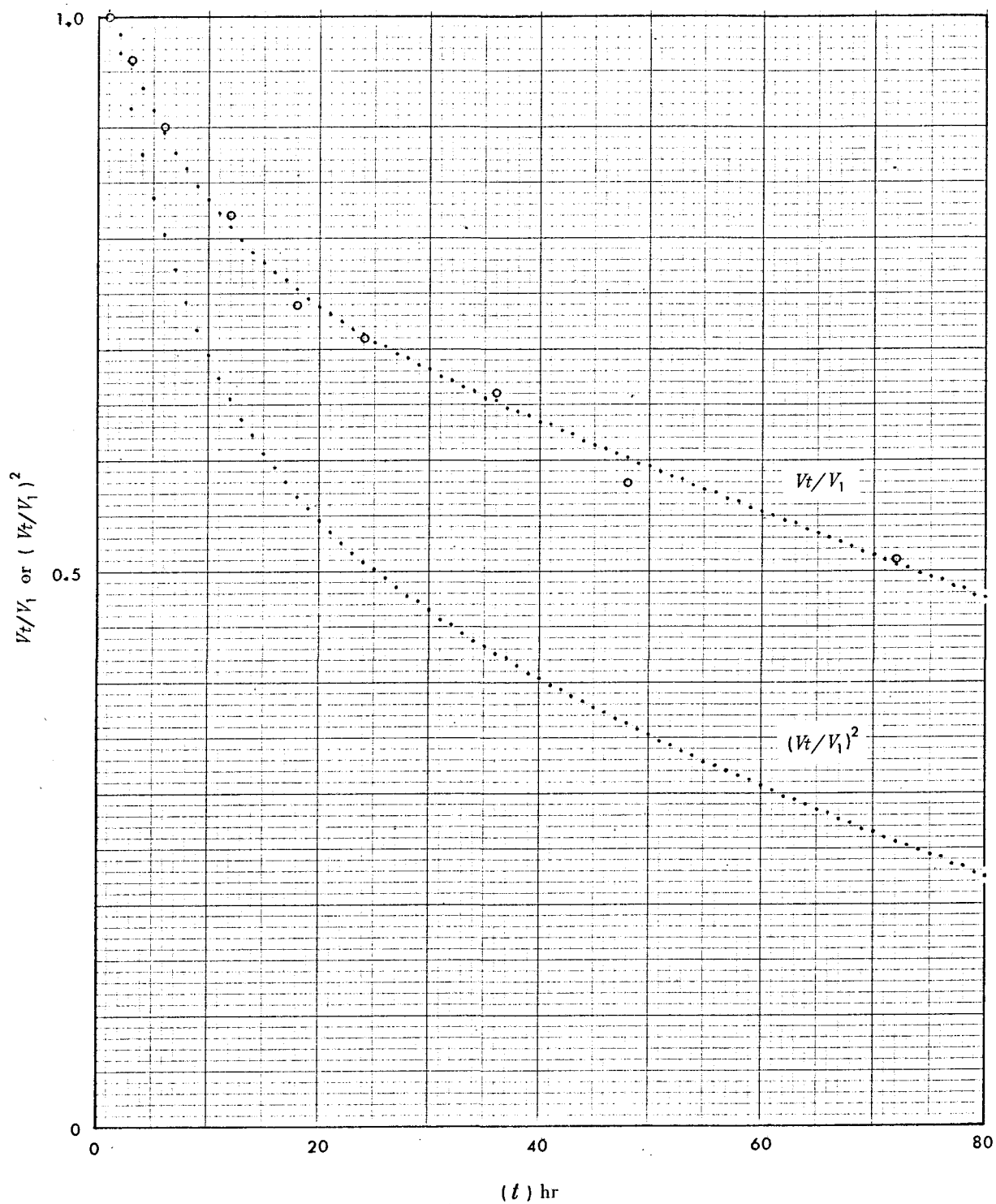


Fig. 1 Values computed by the formula (dots) and the original values (circles).

References

- (1) London, Department of Energy (1977)
Guidance on the design and construction of offshore installations, Fig. 2.4,
London, HMSO.
- (2) Shellard, H.C. (1975)
Lerwick anemograph records 1957-70 and the offshore industry,
Meteorological Magazine, London, 104, pp. 189-208.

Note Shellard has made three more sets of data which are similar to Table 1. See page 201 of reference (2).

