DNMI DET NORSKE METEOROLOGISKE INSTITUTT

klima

ADDITIONAL ENVIRONMENTAL DATA AT HANØYTANGEN, ASKØY NEAR BERGEN. ADDITION TO REPORT 43/92 KLIMA.

KNUT A. IDEN AND KNUT HARSTVEIT
RAPPORT NR. 26/93 KLIMA

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PREPARED BY

Knut A. Iden and Knut Harstveit

ORDERED BY

Kværner Concrete Constructions a.s
Att.: Petter Værnes
ISSUE DATE : 23/04/93

SUMMARY

Monthly extremes of wind speed are computed by a set of monthly transfer coefficients which are used together with the all-year values given in report 43/92 Klima. The coefficients are established by using empirical data from Hellisøy.
Duration statistics are prepared in a special manner to provide information about possible trend in environmental conditions during specified months. The duration statistics for April and October are prepared.

SIGNATURE

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Knut A. Iden
PROJ. RESPONSIBLE

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ADDITIONAL ENVIRONMENTAL DATA FOR HANØYTANGEN, AT ASKØY NEAR BERGEN

Contents

Introduction

Referring to the Purchase order given in Appendix 1, item 1 and item 2 are now prepared. During the preparation, modifications has been done in agreement with KCC (Petter Værnes) made on telephone.

1) DURATION STATISTICS WITH MONTHLY RESOLUTION

The duration statistics have not been performed for each month. At present statistics for April and October have been prepared. In Appendix 2 a short summary of the duration statistics are presented. The software can easily produce the tables for the other months if needed.

2) EXTREME STATISTICS WITH MONTHLY RESOLUTION

The computations of extreme values with monthly resolution are based on the extreme values presented in [2]. Following a method given in [1] a set of transfer coefficients are established. There are one set of coefficients for 10 min means and one set for 3-5 sec means.

The basis for the computations of the coefficients are empirical data from Hellisøy made available through a special treatment of the wind registrations for 10 min averages and 3-5 sec averages. The two set of coefficients come out almost the same. There is no reason to assume that the coefficients differ significant for 1 min means. In the computations for 1 min means the coefficients for 10 min are used.

1. Duration statistics with monthly resolution.

Several ways to present the duration statistics were discussed in a meeting at KCC (15.4.93). Since our standard duration statistics given as an example in [2] did not show the possible trend in conditions within a month, a simple program had to be designed.

The question that was asked was :

> Could the conditions be more rough in the beginning of the month (April) than towards the end of the month (April)?

To provide this information in an easy way , it was decided to list the data on a monthly bases after the observation was transferred to 1 / 0 if a specified criterion (<= Limit) was fulfilled/not fulfilled.

For each year a summary is also given in the form of percentages of observations fulfilling the criterions. To give a quick overview , the yearly summaries are assembled in a table. This is presented in Appendix 2 together with the detailed statistics.

As an example, the summary table for October for Flesland is presented below together with the detailed table for 1957.

BASED ON MAX 10 MIN. MEANS OF WIND SPEED OBSERVED WITHIN 6 HOURS INTERVALS

PERCENTAGES OF THE OBSERVATIONS FULLFILLING THE CRITERION

W.SPEED<=	BEAUFORT	1	2	3	4	5	6	7	8	9	10
5050 1957	10	0.0	7.3	27.4	67.7	88.7	97.6	99.2	100.0	100.0	100.0
5050 1958	10	0.8	17.7	43.5	72.6	94.4	100.0	100.0	100.0	100.0	100.0
5050 1959	10	4.0	33.9	58.9	89.5	98.4	100.0	100.0	100.0	100.0	100.0
5050 1960	10	4.8	63.7	94.4	99.2	100.0	100.0	100.0	100.0	100.0	100.0
5050 1961	10	0.0	6.5	24.2	58.1	84.7	96.0	100.0	100.0	100.0	100.0
5050 1962	10	0.0	8.9	29.0	73.4	89.5	100.0	100.0	100.0	100.0	100.0
5050 1963	10	3.2	21.8	43.5	71.8	87.9	99.2	100.0	100.0	100.0	100.0
5050 1964	10	5.6	29.0	65.3	90.3	96.0	100.0	100.0	100.0	100.0	100.0
5050 1965	10	2.4	26.6	58.1	81.5	91.9	100.0	100.0	100.0	100.0	100.0
5050 1966	10	3.2	27.4	64.5	87.9	96.8	100.0	100.0	100.0	100.0	100.0
5050 1967	10	0.0	5.6	28.2	63.7	91.1	100.0	100.0	100.0	100.0	100.0
5050 1968	10	0.0	18.5	44.4	84.7	96.8	100.0	100.0	100.0	100.0	100.0
5050 1969	10	2.4	18.5	30.6	71.8	84.7	96.0	100.0	100.0	100.0	100.0
5050 1970	10	2.4	17.7	45.2	70.2	94.4	100.0	100.0	100.0	100.0	100.0
5050 1971	10	1.6	15.3	36.3	66.1	91.1	100.0	100.0	100.0	100.0	100.0
5050 1972	10	7.3	29.8	55.6	79.8	94.4	100.0	100.0	100.0	100.0	100.0
5050 1973	10	7.3	41.1	68.5	91.9	99.2	100.0	100.0	100.0	100.0	100.0
5050 1974	10	9.7	41.1	73.4	91.9	96.0	100.0	100.0	100.0	100.0	100.0
5050 1975	10	16.1	45.2	61.3	90.3	95.2	100.0	100.0	100.0	100.0	100.0
5050 1976	10	8.9	34.7	57.3	91.9	98.4	100.0	100.0	100.0	100.0	100.0
5050 1977	10	2.4	18.5	53.2	82.3	93.5	97.6	100.0	100.0	100.0	100.0
5050 1978	10	0.8	15.3	47.6	78.2	95.2	99.2	100.0	100.0	100.0	100.0
5050 1979	10	15.3	48.4	68.5	91.1	97.6	100.0	100.0	100.0	100.0	100.0
5050 1980	10	10.5	38.7	57.3	75.8	91.9	96.8	100.0	100.0	100.0	100.0
5050 1981	10	4.8	23.4	58.9	88.7	96.0	98.4	99.2	100.0	100.0	100.0
5050 1982	10	15.3	45.2	65.3	81.5	92.7	99.2	100.0	100.0	100.0	100.0
5050 1983	10	0.0	4.8	21.8	51.6	78.2	96.8	100.0	100.0	100.0	100.0
5050 1984	10	4.0	21.0	41.9	69.4	96.8	100.0	100.0	100.0	100.0	100.0
5050 1985	10	8.9	29.0	59.7	83.9	91.9	98.4	99.2	100.0	100.0	100.0
5050 1986	10	1.6	10.5	33.9	68.5	90.3	99.2	100.0	100.0	100.0	100.0
5050 1987	10	10.5	25.8	41.1	73.4	93.5	96.0	97.6	99.2	100.0	100.0
5050 1988	10	24.2	41.1	71.0	89.5	99.2	100.0	100.0	100.0	100.0	100.0
5050 1989	10	8.1	33.1	57.3	90.3	96.8	98.4	100.0	100.0	100.0	100.0
5050 1990	10	12.1	37.1	55.6	79.0	92.7	100.0	100.0	100.0	100.0	100.0
5050 1991	10	19.4	53.2	71.0	87.1	96.8	100.0	100.0	100.0	100.0	100.0

BASED ON MAX 10 MIN. MEANS OF WIND SPEED OBSERVED WITHIN 6 HOURS INTERVALS

W.SPEED<= BEAUFORT				1	2	3	4	5	6	7	8	9	10
1957	10	1	0	.	.	1	1	1	1	1	1	1	1
1957	10	1	6	.	.	1	1	1	1	1	1	1	1
1957	10	1	12	.	.	1	1	1	1	1	1	1	1
1957	10	1	18	.	.	1	1	1	1	1	1	1	1
1957	10	2	0	.	.	1	1	1	1	1	1	1	1
1957	10	2	6	.	.	.	1	1	1	1	1	1	1
1957	10	2	12	.	.	.	1	1	1	1	1	1	1
1957	10	2	18	.	.	.	1	1	1	1	1	1	1
1957	10	3	0	.	.	.	.	.	1	1	1	1	1
1957	10	3	6	.	.	.	.	.	.	1	1	1	1
1957	10	3	12	.	.	.	.	.	.	.	1	1	1
1957	10	3	18	.	.	.	.	.	1	1	1	1	1
1957	10	4	0	.	.	.	.	1	1	1	1	1	1
1957	10	4	6	.	.	.	1	1	1	1	1	1	1
1957	10	4	12	.	.	.	1	1	1	1	1	1	1
1957	10	4	18	.	.	.	1	1	1	1	1	1	1
1957	10	5	0	.	.	.	.	1	1	1	1	1	1
1957	10	5	6	.	.	.	1	1	1	1	1	1	1
1957	10	5	12	.	.	1	1	1	1	1	1	1	1
1957	10	5	18	.	.	.	1	1	1	1	1	1	1
1957	10	6	0	.	.	1	1	1	1	1	1	1	1
1957	10	6	6	.	.	.	1	1	1	1	1	1	1
1957	10	6	12	.	.	.	.	1	1	1	1	1	1
1957	10	6	18	.	.	.	.	1	1	1	1	1	1
1957	10	7	0	.	.	.	.	1	1	1	1	1	1
1957	10	7	6	.	.	.	1	1	1	1	1	1	1
1957	10	7	12	.	.	1	1	1	1	1	1	1	1
1957	10	7	18	.	.	.	1	1	1	1	1	1	1
1957	10	8	0	.	.	.	1	1	1	1	1	1	1
1957	10	8	6	.	.	.	1	1	1	1	1	1	1
1957	10	8	12	.	.	.	1	1	1	1	1	1	1
1957	10	8	18	.	.	.	1	1	1	1	1	1	1
1957	10	9	0	.	.	.	1	1	1	1	1	1	1
1957	10	9	6	.	.	.	.	1	1	1	1	1	1
1957	10	9	12	.	.	.	.	1	1	1	1	1	1
1957	10	9	18	.	.	.	1	1	1	1	1	1	1
1957	10	10	0	.	.	.	1	1	1	1	1	1	1
1957	10	10	6	.	.	.	1	1	1	1	1	1	1
1957	10	10	12	.	.	.	1	1	1	1	1	1	1
1957	10	10	18	.	.	1	1	1	1	1	1	1	1
1957	10	11	0	.	.	1	1	1	1	1	1	1	1
1957	10	11	6	.	.	1	1	1	1	1	1	1	1
1957	10	11	12	.	.	1	1	1	1	1	1	1	1
1957	10	11	18	.	.	1	1	1	1	1	1	1	1
1957	10	12	0	.	.	.	1	1	1	1	1	1	1
1957	10	12	6	.	.	.	1	1	1	1	1	1	1
1957	10	12	12	.	.	1	1	1	1	1	1	1	1
1957	10	12	18	.	.	.	1	1	1	1	1	1	1
1957	10	13	0	.	.	.	.	1	1	1	1	1	1
1957	10	13	6	.	.	.	.	1	1	1	1	1	1
1957	10	13	12	.	.	.	1	1	1	1	1	1	1
1957	10	13	18	.	.	.	1	1	1	1	1	1	1
1957	10	14	0	.	.	.	1	1	1	1	1	1	1
1957	10	14	6	.	.	1	1	1	1	1	1	1	1
1957	10	14	12	.	1	1	1	1	1	1	1	1	1
1957	10	14	18	.	1	1	1	1	1	1	1	1	1

BASED ON MAX 10 MIN. MEANS OF WIND SPEED OBSERVED WITHIN 6 HOURS INTERVALS

W.SPEED<=	BEAUFORT	1	2	3	4	5	6	7	8	9	10
1957 10 15	0	.	.	.	1	1	1	1	1	1	1
1957 10 15	6	.	.	.	1	1	1	1	1	1	1
1957 10 15	12	.	.	.	.	1	1	1	1	1	1
1957 10 15	18	.	.	.	.	1	1	1	1	1	1
1957 10 16	0	.	.	.	.	1	1	1	1	1	1
1957 10 16	6	.	.	.	.	1	1	1	1	1	1
1957 10 16	12	.	.	.	.	.	1	1	1	1	1
1957 10 16	18	.	.	.	.	.	1	1	1	1	1
1957 10 17	0	.	.	.	1	1	1	1	1	1	1
1957 10 17	6	.	1	1	1	1	1	1	1	1	1
1957 10 17	12	.	1	1	1	1	1	1	1	1	1
1957 10 17	18	.	.	.	1	1	1	1	1	1	1
1957 10 18	0	.	.	.	1	1	1	1	1	1	1
1957 10 18	6	.	.	.	1	1	1	1	1	1	1
1957 10 18	12	.	.	.	1	1	1	1	1	1	1
1957 10 18	18	.	.	.	1	1	1	1	1	1	1
1957 10 19	0	.	.	1	1	1	1	1	1	1	1
1957 10 19	6	.	.	1	1	1	1	1	1	1	1
1957 10 19	12	.	.	1	1	1	1	1	1	1	1
1957 10 19	18	.	.	.	1	1	1	1	1	1	1
1957 10 20	0	.	.	1	1	1	1	1	1	1	1
1957 10 20	6	.	1	1	1	1	1	1	1	1	1
1957 10 20	12	.	.	.	1	1	1	1	1	1	1
1957 10 20	18	.	.	.	.	1	1	1	1	1	1
1957 10 21	0	.	.	.	.	.	1	1	1	1	1
1957 10 21	6	.	.	.	.	1	1	1	1	1	1
1957 10 21	12	.	.	.	1	1	1	1	1	1	1
1957 10 21	18	.	.	.	1	1	1	1	1	1	1
1957 10 22	0	.	.	.	1	1	1	1	1	1	1
1957 10 22	6	.	.	1	1	1	1	1	1	1	1
1957 10 22	12	.	1	1	1	1	1	1	1	1	1
1957 10 22	18	.	.	1	1	1	1	1	1	1	1
1957 10 23	0	.	.	1	1	1	1	1	1	1	1
1957 10 23	6	.	.	.	.	.	1	1	1	1	1
1957 10 23	12	.	.	.	.	.	.	1	1	1	1
1957 10 23	18	.	.	.	1	1	1	1	1	1	1
1957 10 24	0	.	.	.	1	1	1	1	1	1	1
1957 10 24	6	.	.	.	.	.	1	1	1	1	1
1957 10 24	12	.	.	.	.	.	1	1	1	1	1
1957 10 24	18	.	.	.	.	1	1	1	1	1	1
1957 10 25	0	.	.	1	1	1	1	1	1	1	1
1957 10 25	6	.	1	1	1	1	1	1	1	1	1
1957 10 25	12	.	.	1	1	1	1	1	1	1	1
1957 10 25	18	.	.	.	1	1	1	1	1	1	1
1957 10 26	0	.	.	.	.	1	1	1	1	1	1
1957 10 26	6	.	.	.	.	1	1	1	1	1	1
1957 10 26	12	.	.	.	.	1	1	1	1	1	1
1957 10 26	18	.	.	.	1	1	1	1	1	1	1
1957 10 27	0	.	.	.	1	1	1	1	1	1	1
1957 10 27	6	.	.	.	.	1	1	1	1	1	1
1957 10 27	12	.	.	.	.	.	1	1	1	1	1
1957 10 27	18	.	.	.	.	.	1	1	1	1	1
1957 10 28	0	.	.	.	.	.	1	1	1	1	1
1957 10 28	6	.	.	1	1	1	1	1	1	1	1
1957 10 28	12	.	.	.	1	1	1	1	1	1	1
1957 10 28	18	.	.	.	1	1	1	1	1	1	1

BASED ON MAX 10 MIN. MEANS OF WIND SPEED OBSERVED WITHIN 6 HOURS INTERVALS

.SPEED<= BEAUFORT				1	2	3	4	5	6	7	8	9	10
1957	10	29	0	.	.	.	1	1	1	1	1	1	1
1957	10	29	6	.	.	.	1	1	1	1	1	1	1
1957	10	29	12	.	.	.	.	1	1	1	1	1	1
1957	10	29	18	.	.	.	.	1	1	1	1	1	1
1957	10	30	0	.	.	.	.	1	1	1	1	1	1
1957	10	30	6	.	.	.	.	1	1	1	1	1	1
1957	10	30	12	.	1	1	1	1	1	1	1	1	1
1957	10	30	18	.	1	1	1	1	1	1	1	1	1
1957	10	31	0	.	.	.	1	1	1	1	1	1	1
1957	10	31	6	.	.	.	.	1	1	1	1	1	1
1957	10	31	12	.	.	.	.	1	1	1	1	1	1
1957	10	31	18	.	.	.	1	1	1	1	1	1	1
PERCENT <= LIMIT				0.0	7.3	27.4	67.7	88.7	97.6	99.2	100.0	100.0	100.0

2. Extreme statistics with monthly resolution.

For calculating monthly extreme values of 10 minute sustained wind speed and 3-5 sec. wind gusts at Hellisøy, we have used data from 01.01.1982 - 31.07.1992. In this period individual storm maxima can be taken from an electronic data storage. We have not used older data because of the time consuming procedure of transferring those data from paper-graphs to digital numbers.

Individual storm maxima for series of both 10 minute sustained wind speed and 3-5 sec. wind gusts are found for days when the wind speed exceeded a certain value. This critical value is defined as 2/3 of the largest value in the 10 (11) years period. With regard to independence, values fulfilling the criterion separated by one day or less contribute as a single storm value and the highest value is chosen. This criterium is much the same as used by Cook [1].

The same procedure is followed for each calendar months, giving one storm series for January, one for February and so on. The critical value now is defined as 2/3 of the largest value of each monthly series.

We have made a storm analysis as described by Cook [1], with a Fisher-Tippet Type 1 distribution on a monthly basis. However, due to the large dispersion of the data, the individual winter-months gave higher long-time (50-100 years) wind extremes than the all-year values. This is a paradox, and the method was not used.

We have then used a less refined method. The 5 highest storm values of each calendar month, and for the all-year series, are sorted, and listed in Table 1 (10 minute sustain wind speed) and Table 2 (3-5 sec. wind gusts). Transfer coefficients between the all-year value and the single monthly values are calculated for 1) the highest values only, 2) for the average of the 3 highest values, and 3) for the average of the 5 highest values.

As can be seen, the monthly values are high through the period October - February (transfer coefficients 0.88 - 1.00) and low through the summer period, May - August (transfer coefficients 0.58-0.73).

By inspecting Table 1 and Table 2, we find that the October values are slightly higher than the November and December values. This seems not reasonable, and is probably due to rather short time series. We therefore use a slightly conservative method when giving recommended transfer coefficients. These values are found by putting 0.61 - 0.65 to 0.65, 0.66 - 0.70 to 0.70, the average of the 5 highest values as the basic. However, if values during November - January are calculated lower than one of the other month, the maximum value is used also for those months. Besides, the June values are put equal to the July values due to few data from June.

The recommended transfer coefficients can be multiplied with the all-year value to give monthly extreme values. This may be done for all return periods. However, the values are valid only for single months. When periods of 2 months are actual, the winter period values (September-April) should be used if both of the months are within that season, and the summer values should be used if the two months are within May-August. If the period consists of April or September and one or more summer month, a transfer coefficient of 0.90 from the all-year value should be used. Summer and winter values are found in [2].

For Hanøytangen, the earlier given values [2] for the winter season (which are the same as the all-year values) can be multiplied with the transfer coefficients valid for Hellisøy, to produce the monthly values. This is done in chapter 3 below and the result presented in a set of tables (4a - 4c).

Table 1

10 minute sustain wind values (ms^{-1}) recorded at Hellisøy lighthouse 1982-1992. The 5 highest values of independent storms are given for each month and for the year. The highest value(s) for each month divided to the highest value(s) of the year, for 1, 3, and 5 values, are given as the factors F(1), F(3) and F(5). Recommended transfer coefficient, F, from the all-year to the monthly value are given in the last line.

	JAN	FEB	MAR	APR	MAY	JUN*	JUL**	AUG**	SEPT**	OCT**	NOV**	DEC**	YEAR
1	30.3	30.3	26.7	26.7	21.1	20.1	22.1	22.1	25.7	30.3	27.8	27.8	30.3
2	26.7	28.8	26.7	24.2	20.6	19.5	19.5	21.6	24.7	28.3	27.8	27.8	30.3
3	26.2	25.7	25.7	23.7	20.6	19.0	18.5	20.1	23.7	27.3	27.3	27.3	30.3
4	25.7	25.7	24.7	22.6	19.5	17.0	18.5	19.5	23.7	25.7	26.7	26.2	28.8
5	25.2	25.2	23.7	22.1	19.5	16.5	18.0	19.0	21.6	25.2	25.7	26.2	28.3
F(1)	1.00	1.00	0.88	0.88	0.70	0.66	0.73	0.73	0.85	1.00	0.92	0.92	1.00
F(3)	0.92	0.93	0.87	0.82	0.68	0.64	0.66	0.70	0.82	0.94	0.91	0.91	1.00
F(5)	0.91	0.92	0.86	0.81	0.68	0.64	0.65	0.69	0.81	0.92	0.91	0.91	1.00
F	0.95	0.95	0.90	0.85	0.70	0.65	0.65	0.70	0.85	0.95	0.95	0.95	1.00

*June: Data exist only for 1990, 1991 and 1992.

**August - December: Data missing for 1992.

Table 2

3 - 5 sec. wind gust values (ms^{-1}) recorded at Hellisøy lighthouse 1982-1992. The 5 highest values of independent storms are given for each month and for the year. The highest value(s) for each month divided to the highest value(s) of the year, for 1, 3, and 5 values, are given as the factors F(1), F(3) and F(5). Recommended transfer coefficient, F, from the all-year to the monthly value are given in the last line.

	JAN	FEB	MAR	APR	MAY	JUN*	JUL**	AUG**	SEPT**	OCT**	NOV**	DEC**	YEAR
1	42.2	41.2	36.0	35.0	28.3	28.3	28.3	28.8	32.9	41.2	37.6	37.0	42.2
2	36.0	39.1	36.0	31.9	27.3	24.7	26.2	27.8	32.4	38.1	37.0	36.5	41.2
3	35.0	36.0	35.5	31.9	27.3	22.1	24.7	27.3	30.9	35.5	36.0	36.0	41.2
4	34.0	36.0	33.4	30.9	26.7	21.1	23.7	25.7	30.9	35.0	35.0	36.0	39.1
5	33.4	33.4	31.9	30.9	26.7	21.1	23.7	25.7	30.3	34.5	35.0	36.0	38.1
F(1)	1.00	0.98	0.85	0.83	0.67	0.67	0.67	0.68	0.78	0.98	0.89	0.88	1.00
F(3)	0.91	0.93	0.86	0.79	0.67	0.60	0.64	0.67	0.77	0.92	0.89	0.88	1.00
F(5)	0.89	0.92	0.86	0.80	0.68	0.58	0.63	0.67	0.78	0.91	0.89	0.90	1.00
F	0.95	0.95	0.90	0.80	0.70	0.65	0.65	0.70	0.80	0.95	0.95	0.95	1.00

*June: Data exist only for 1990, 1991 and 1992.

**August - December: Data missing for 1992.

3. Application of the transfer coefficients.

In [2] table 4 the estimates of extreme wind speed for different wind directions and return periods 10 and 100 years at Hanøytangen, valid for 10 m above the fjord are given both for summer conditions (May-August) and winter (September-April). The winter estimates are the same as the all-year value as mentioned above. From this table the all-directional extremes can be extracted an the values are given in Table 3 below.

Table 3
Estimates of extreme wind speed (m/s) at Hanøytangen for winter (May-August) and summer (September-April), valid for 10 m above the fjord.

Duration	Ret.per.	Summer	Winter
10 min	10 yr.	19.8	25.3
	100 yr.	23.6	28.6
1 min	10 yr.	24.5	31.4
	100 yr.	29.3	35.4
3 sec.	10 yr.	29.5	37.8
	100 yr.	35.2	42.7

Table 4 a
Estimates of extreme wind speed (m/s) at Hanøytangen (10 minute mean) for 10 and 100 years return period and with monthly resolution,valid for 10 m above the fjord. F is the transfer coefficient from table 1.

Period	F	10 yr.	100 yr.
Year	1.00	25.3	28.6
Jan	.95	24.0	27.2
Feb	.95	24.0	27.2
Mar	.90	22.8	25.7
Apr	.85	21.5	24.3
May	.70	17.7	20.0
Jun	.65	16.4	18.6
Jul	.65	16.4	18.6
Aug	.70	17.7	20.0
Sep	.85	21.5	24.3
Oct	.95	24.0	27.2
Nov	.95	24.0	27.2
Dec	.95	24.0	27.2

Table 4 b
Estimates of extreme wind speed (m/s) at Hanøytangen (1 minute mean) for 10 and 100 years return period and with monthly resolution,valid for 10 m above the fjord. F is the transfer coefficient from table 1.

Period	F	10 yr.	100 yr.
Year	1.00	31.4	35.4
Jan	.95	29.8	33.6
Feb	.95	29.8	33.6
Mar	.90	28.3	31.9
Apr	.85	26.7	30.1
May	.70	22.0	24.8
Jun	.65	20.4	23.0
Jul	.65	20.4	23.0
Aug	.70	22.0	24.8
Sep	.85	26.7	30.1
Oct	.95	29.8	33.6
Nov	.95	29.8	33.6
Dec	.95	29.8	33.6

Table 4 c
Estimates of extreme wind speed (m/s) at Hanøytangen (3-5 sec mean) for 10 and 100 years return period and with monthly resolution, valid for 10 m above the fjord. F is the transfer coefficient from table 2.

Period	F	10 yr.	100 yr.
Year	1.00	37.8	42.7
Jan	.95	35.9	40.6
Feb	.95	35.9	40.6
Mar	.90	34.0	38.4
Apr	.80	30.2	34.2
May	.70	26.5	29.9
Jun	.65	24.6	27.8
Jul	.65	24.6	27.8
Aug	.70	26.5	29.9
Sep	.80	30.2	34.2
Oct	.95	35.9	40.6
Nov	.95	35.9	40.6
Dec	.95	35.9	40.6

4. References

[1] **Cook, N.J.:**
Towards better estimation of extreme winds.
Journal of Wind engineering and Industrial Aerodynamics, 9 (1982) 295-323.

[2] **Iden, K.A., and Reistad, M.:**
Climatological Statistics for Hanøytangen at Askøy near Bergen.
DNMI no. 43/92, Oslo 1992.

Kværner Concrete Construction a.s

Troll Olje - EPCI for Substructure
NH Contract No. 17-1A-NH-B45-00008

Kværner Concrete Construction a.s
Troll Olje
P.O. Box 18
N-1322 Høvik
Norway

Telephone : 67 59 59 90
Telefax : 67 59 47 20

The Norwegian Meteorological Institute
P.O. Box 43 - Blindern
0313 OSLO

Att.: Knut A. Iden

Your ref.

Our ref.
00008/KCC-O/118

Oslo, April 26, 1993

Subject: **PURCHASE ORDER NO. PAC 001**

Enclosed, please find subject order issued in duplicate. Please sign one copy and return to us as your acknowledgement of the order.

Yours faithfully
per Kværner Concrete Construction a.s

R. J. Strand
Project Director

E. Bakkland
Procurement Manager

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Kværner Concrete Construction a.s
Troll Olje
P.O. Box 18
N-1322 Høvik
Norway

Telephone : 67 59 59 90
Telefax : 67 59 42 20

To: The Norwegian Meteorological Institute
P.O. Box 43 - Blindern
0313 OSLO

Att.: Knut A. Iden

Order No	
PAC 001	
Date of issue	
23.04.93	
Terms of payment 30 Days Net	Place of delivery KCC, Høvik
Terms of delivery N/A	Date of delivery See Order Text
Total commitment this Purchase Order: NOK 19.000,-	

PACKAGE TITLE: **Additional Environmental Data at Hanøytangen.**

Scope of work:

Preparation and delivery of montly reports for additional environmental data at Hanøytangen, according to your proposal 343.2/1000/93 dated 20.04.93.

1. DURATION STATISTICS — NOK 7.000,-

Prepare software for the presentation of the data on a monthly basis in the form agreed. Data for this month will be produced within May 3, 1993. Presentation of data to be approved by KCC before any further processing is done.

2. EXTREME STATISTICS WITH MONTHLY RESOLUTION — NOK 12.000,-

- Establish a set of transfer coefficients.

- Compute monthly extreme value estimate

The report for this month (first report issue) to be produced by 10.05.93.

The complete year reports to be submitted by end June 1993.

TOTAL PRICE, EXCL. MERVERDIAVGIFT — NOK 19.000,-

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Contact person at KCC:

Mr. Gregoire Lavignolle

Order acknowledgement

This Purchase Order is issued in two copies. Seller is requested to sign one copy and return it to us as acknowledgement of order.

SELLER	BUYER
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Sign. Bjørn Aunli	Sign.
Name BJØRN AUNLI	Name OLE STRAND
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