Wave Statistics for the North Atlantic — 1970 to 1982

R.E. Walker

Atlantic Oceanographic Laboratory
Ocean Science and Surveys, Atlantic
Department of Fisheries and Oceans

Bedford Institute of Oceanography
P.O. Box 1006
Dartmouth, Nova Scotia B2Y 4A2

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Canadian Data Report Of Hydrography and Ocean Sciences

These reports provide a medium for the documentation and dissemination of data in a form directly useable by the scientific and engineering communities.

Generally, the reports will contain raw and/or analyzed data but will not contain interpretations of the data. Such compilations will commonly have been prepared in support of work related to the programs and interests of the Ocean Science and Surveys (OSS) sector of the Department of Fisheries and Oceans.

Data Reports are produced regionally but are numbered and indexed nationally. Requests for individual reports will be fulfilled by the issuing establishment listed on the front cover and title page. Out of stock reports will be supplied for a fee by commercial agents.

Regional and headquarters establishments of Ocean Science and Surveys ceased publication of their various report series as of December 1981. A complete listing of these publications and the last number issued under each title are published in the *Canadian Journal of Fisheries and Aquatic Sciences*, Volume 38: Index to Publications 1981. The current series began with Report Number 1 in January 1982.

Rapport statistique canadien sur l'hydrographie et les sciences océaniques

Ces rapports servent de véhicule pour la compilation et la diffusion des données sous une forme directement utilisable par les scientifiques et les techniciens.

En général, les rapports contiennent des données brutes ou analysées mais ne fournissent pas d'interprétations des données. Ces compilations sont préparées le plus souvent à l'appui de travaux reliés aux programmes et intérêts du service des Sciences et Levés océaniques (SLO) du ministère des Pêches et des Océans.

Les rapports statistiques sont produits à l'échelon régional mais sont numérotés et placés dans l'index à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page de titre. Les rapports épuisés seront fournis contre rétribution par des agents commerciaux.

Les établissements des Sciences et Levés océaniques dans les régions et à l'administration centrale ont cessé de publier leurs diverses séries de rapports depuis décembre 1981. Vous trouverez dans l'index des publications du volume 38 du *Journal canadien des sciences halieutiques et aquatiques*, la liste de ces publications ainsi que le dernier numéro paru dans chaque catégorie. La nouvelle série a commencé avec la publication du Rapport n° 1 en janvier 1982.

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Dartmouth, Nova Scotia
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ABSTRACT

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Monthly wave height distributions of a 13 year (1970-1982) time series of wave data charts issued every 12 hours for the North Atlantic are presented. Also included are the combined 13 year wave height distributions.

The graphs presented have been expanded to permit extrapolation of the distribution to the 100 year probability value.

RÉSUMÉ

Walker, R.E. 1984. Wave Statistics for the North Atlantic - 1970 to 1982. Can. Data Rep. Hydrogr. Ocean Sci. 16: iv + 291 p.

On présente les répartitions mensuelles de la hauteur des vagues pendant une période de 13 ans (1970-1982 à partir de cartes émises chaque 12 heures) des données sur les vagues dans l'Atlantique-Nord. L'étude fournit également les répartitions combinées de la hauteur des vagues pour les 13 années.

On présente des courbes qui ont été prolongées afin de permettre l'extrapolation de la répartition jusqu'à la valeur probable pour 100 ans.

LIST OF FIGURES

INTRODUCTION

This report is the fourth in the Bedford Institute of Oceanography data series "Wave Climate of the North Atlantic" (see Walker, 1976; Walker, 1977 and Walker, 1978) which is based on a continuous time series from 1970 to 1982.

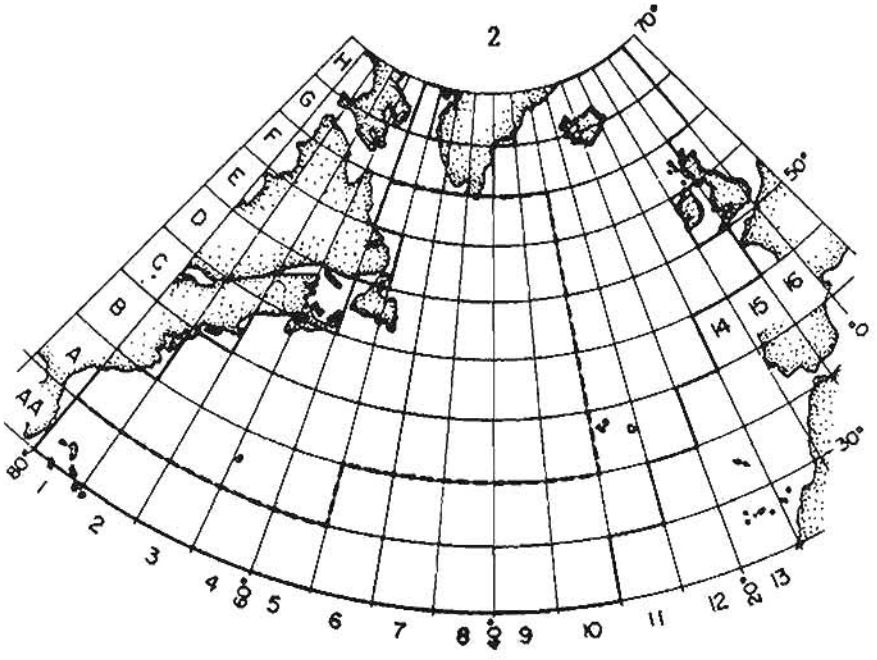
WAVE DATA CHARTS

The data are derived from wave charts issued twice daily by the Canadian Forces Meteorological and Oceanographic Centre (METOC) in Halifax, N.S. These charts are based upon synoptic visual observations of waves from ships at sea and on data from weather ships and oil exploration/ drilling rigs equipped with wave recorders.

As argued by Neu (1982) these waves reported are for all practical purposes significant waves, that is, their height is the mean of the highest one-third of all the waves during the observation, and their reported periods are about 10% less than the mean period of these one-third highest waves.

The study area from which the data were collected lies between latitudes 25 N and 70 N. Not included were the marginal seas, ocean embayments and the shallow areas of the coastal region in which waves are affected by shoaling, refraction and diffraction. The area around the Canary Islands was not included due to the scarcity of wave observations reported to METOC.

The study area is comprised of eighty-eight 5°x5° areas which include regions in coastal waters where the shore line infringes some grid areas. The entire study area is enclosed by a solid line shown in Figure 1.



8 POINT DIRECTION SYSTEM

WAVE HEIGHT

CODE	HEIGHT (m)
1	0.5 — 1.4
2	1.5 — 2.4
3	2.5 — 3.4
4	3.5 — 4.4
5	4.5 — 5.4
6	5.5 — 6.4
7	6.5 — 7.4
8	7.5 — 8.4
9	8.5 — 9.4
10	9.5 — 10.4
etc.	

WAVE PERIOD

CODE	T(S)
3	0 — 3.4
4	3.5 — 4.4
5	4.5 — 5.4
6	5.5 — 6.4
7	6.5 — 7.4
8	7.5 — 8.4
9	8.5 — 9.4
10	9.5 — 10.4
11	10.5 — 11.4
12	11.5 — 12.4
etc	

NOTES: Direction - from which waves are coming.
Height - vertical distance from crest to trough.
Period - interval required for successive crests or troughs to pass a fixed point.

Figure 1. BIO Grid System and Code of Wave Properties

As observations of periods and directions of the waves reported in the METOC charts were less frequent in the eastern North Atlantic than in the western North Atlantic, reading of these properties was restricted to the thirty-nine 5°x5° areas of the western North Atlantic. This region is outlined by the dashed line shown in Figure 1.

DATA PRESENTATION

In this report only the wave heights are presented. They are plotted by areas and months and by areas and years. The original data, which include periods and directions for the western North Atlantic, are on file at B.I.O. and may be obtained upon request.

DATA READING

Wave height, period and direction were read at the centre of the 5° area. The height was determined to the nearest metre. The period was read in seconds while the direction was read in one of the eight 45° sectors, with the north sector extending from 337.5° to 22.5°.

When sea ice cover was in excess of 50% of an area's surface it was assumed that there were no waves.

DATA SORTING

For this report, data have been sorted by height for each area and then grouped by month and by year for a complete time series for each of the 88 areas, 1970 through 1982. The number of observations was 9496.

DISTRIBUTION PLOTS

Each probability x logarithmic graph has been expanded to permit extrapolation of the distribution plots to the 100 year extreme value of wave heights. Values of the 100 year lines are as follows:

Percentage Exceedance	Date Series	Probability
0.01613	13 years	99.99863
0.01667	31 day months	99.98387
0.01777	30 day months	99.98333
0.00137	28 day months	99.98223

ACKNOWLEDGEMENT

I would like to thank the ship-borne observers who have shown considerable care and consistency in their reports and the staff of the Canadian Forces METOC Centre in Halifax, Nova Scotia who have maintained the quality control that has been vital to this report.

REFERENCES

NEU, H.J.A. 1982. 11-year Deep-Water Wave Climate of Canadian Atlantic Waters. Canadian Technical Report of Hydrography and Ocean Sciences No. 13, 1982.

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WALKER, R.E. 1977. Wave Statistics for the North Atlantic - 1970. Bedford Institute of Oceanography, Data Series BI-D-77-1, Dartmouth, N.S.

WALKER, R.E. 1978. Wave Statistics for the North Atlantic - 1972. Bedford Institute of Oceanography, Data Series BI-D-78-2, Dartmouth, N.S.

DISTRIBUTION PLOTS

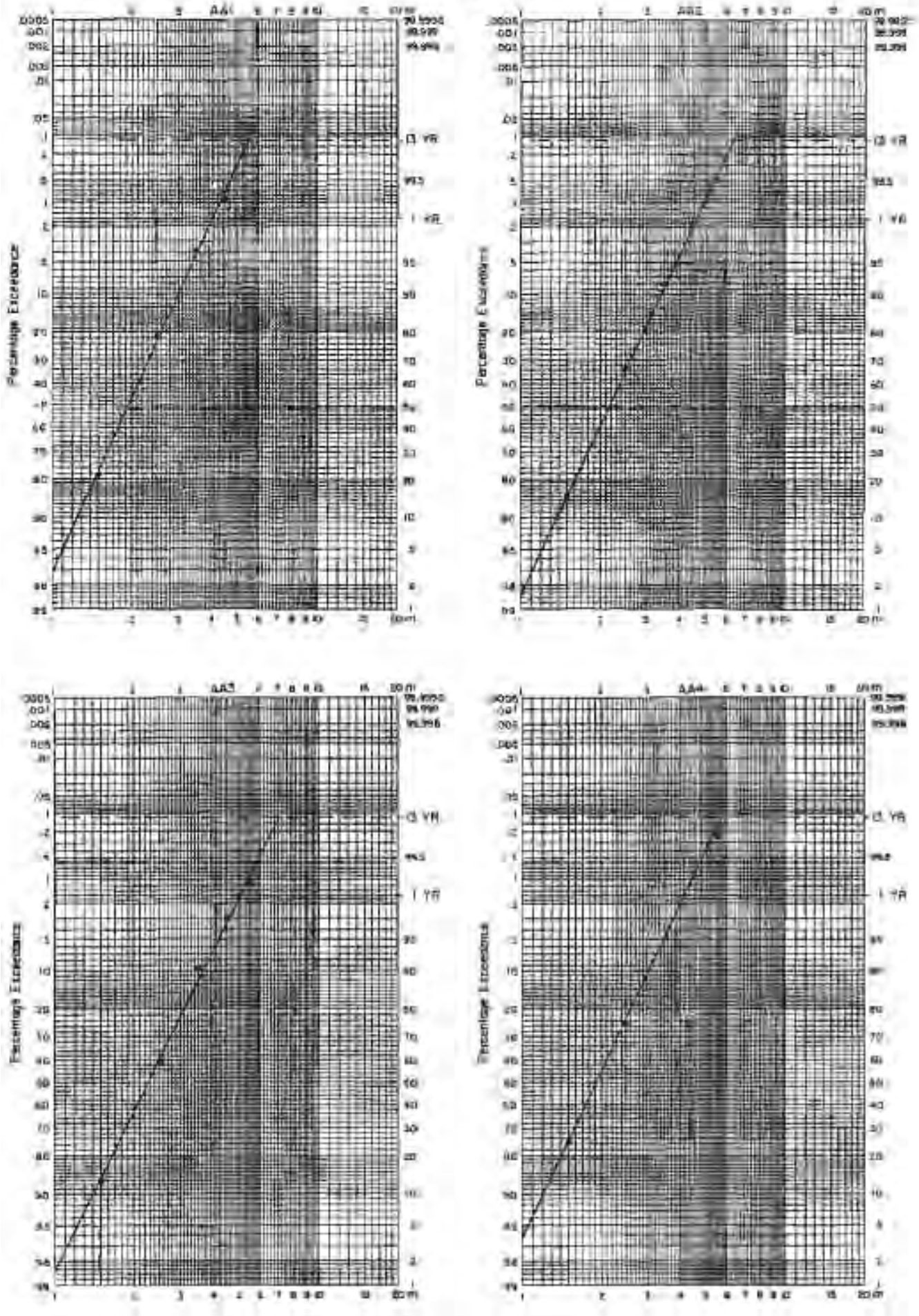


Figure 16 Monthly Wave Height Exceedance Distribution for January

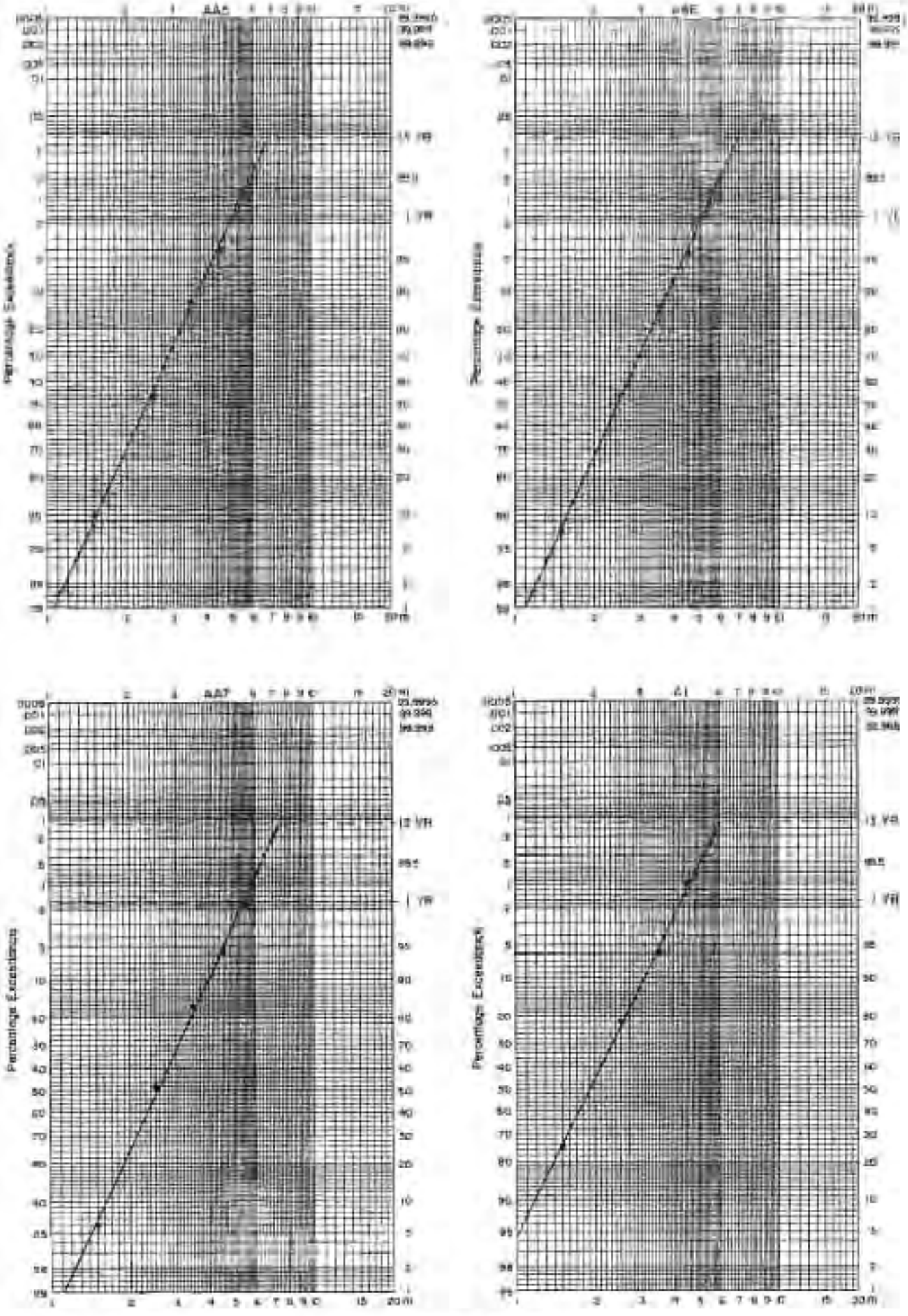


Figure 8. Monthly Wave Height Exceedance Distribution for January

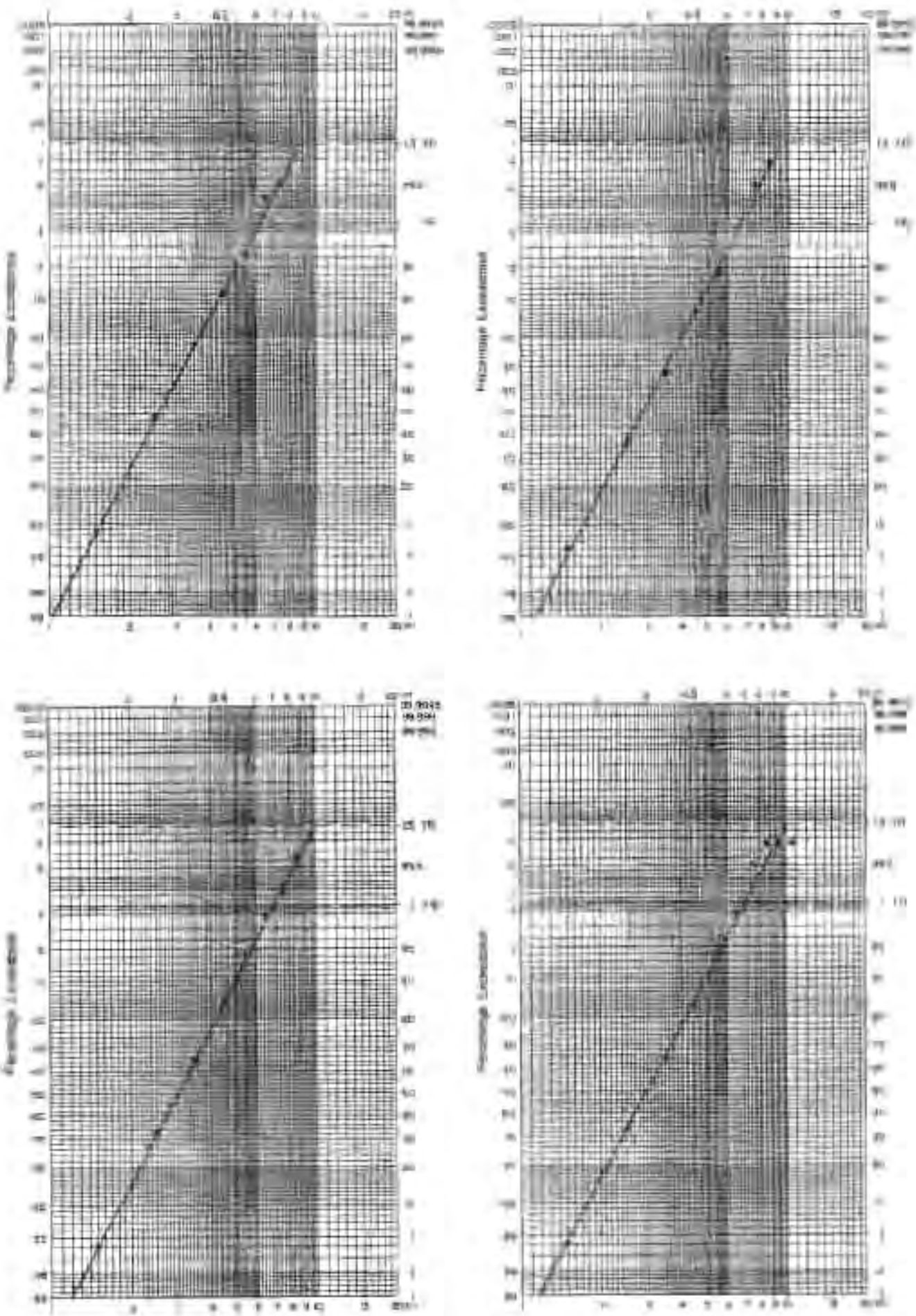


Figure 6. Monthly Flow Height Exceedance Distribution for January

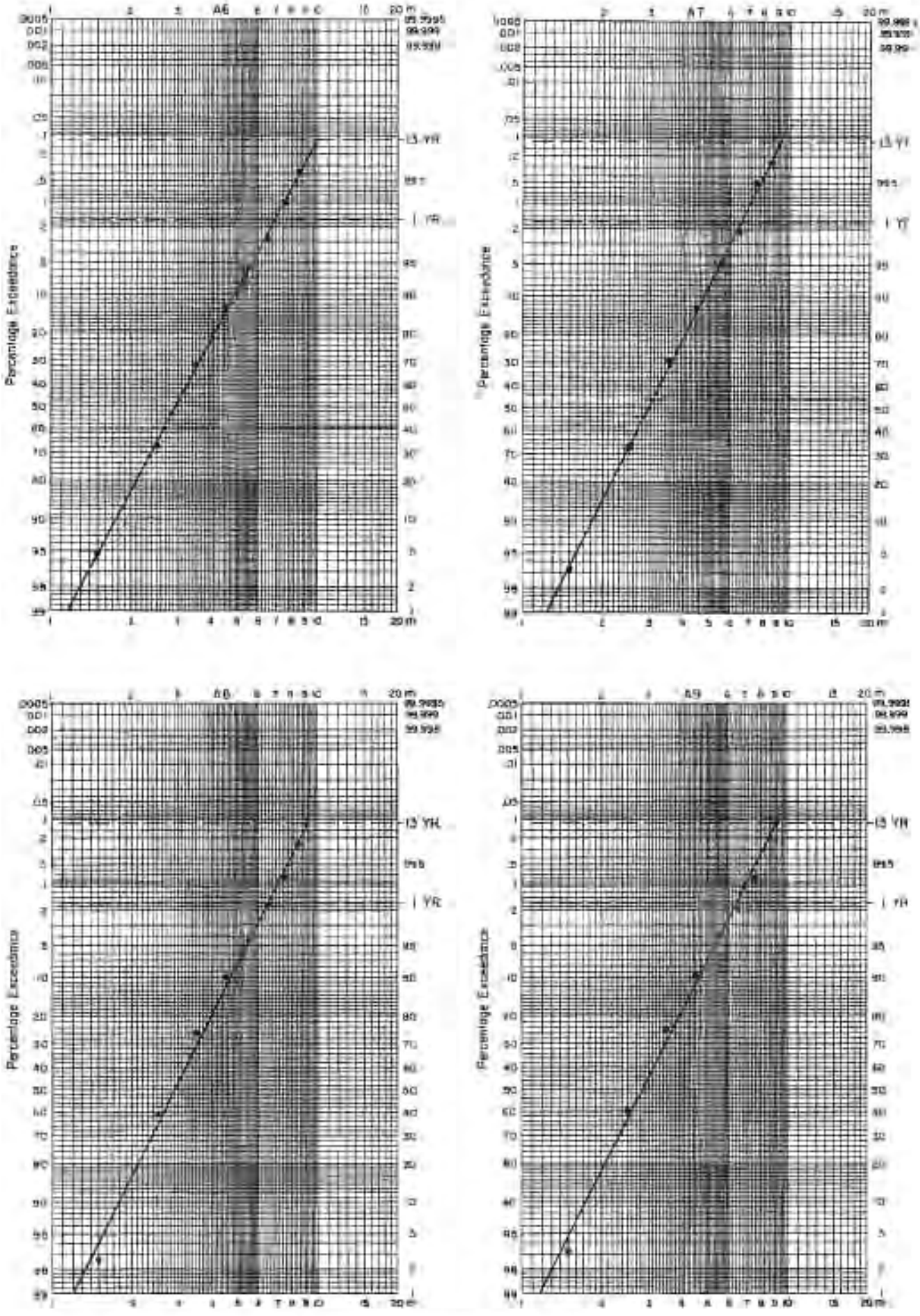


Figure 1d. Monthly Wave Height Exceedance Distribution for January

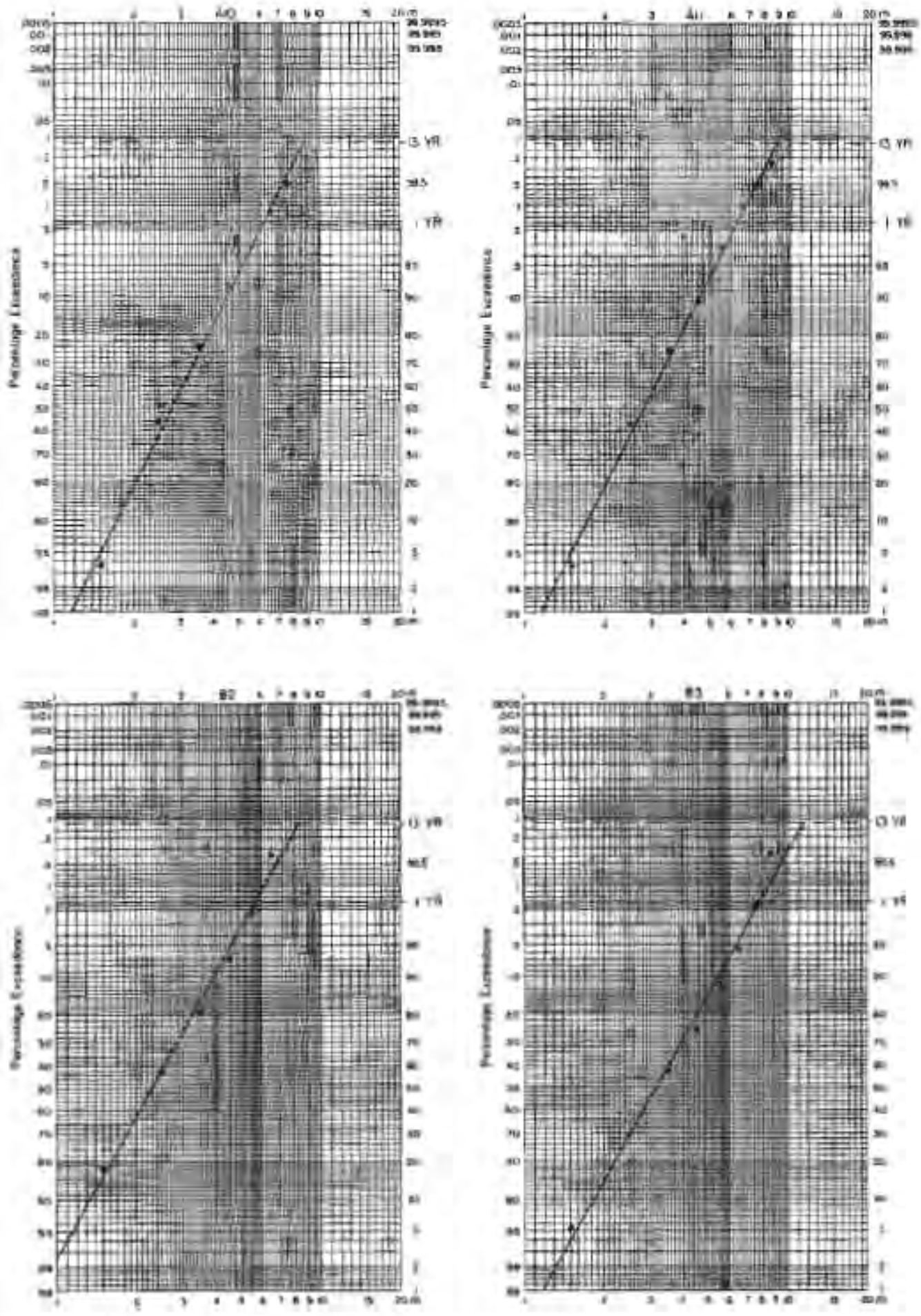


Figure 6 Monthly Wave Height Exceedance Distribution for January

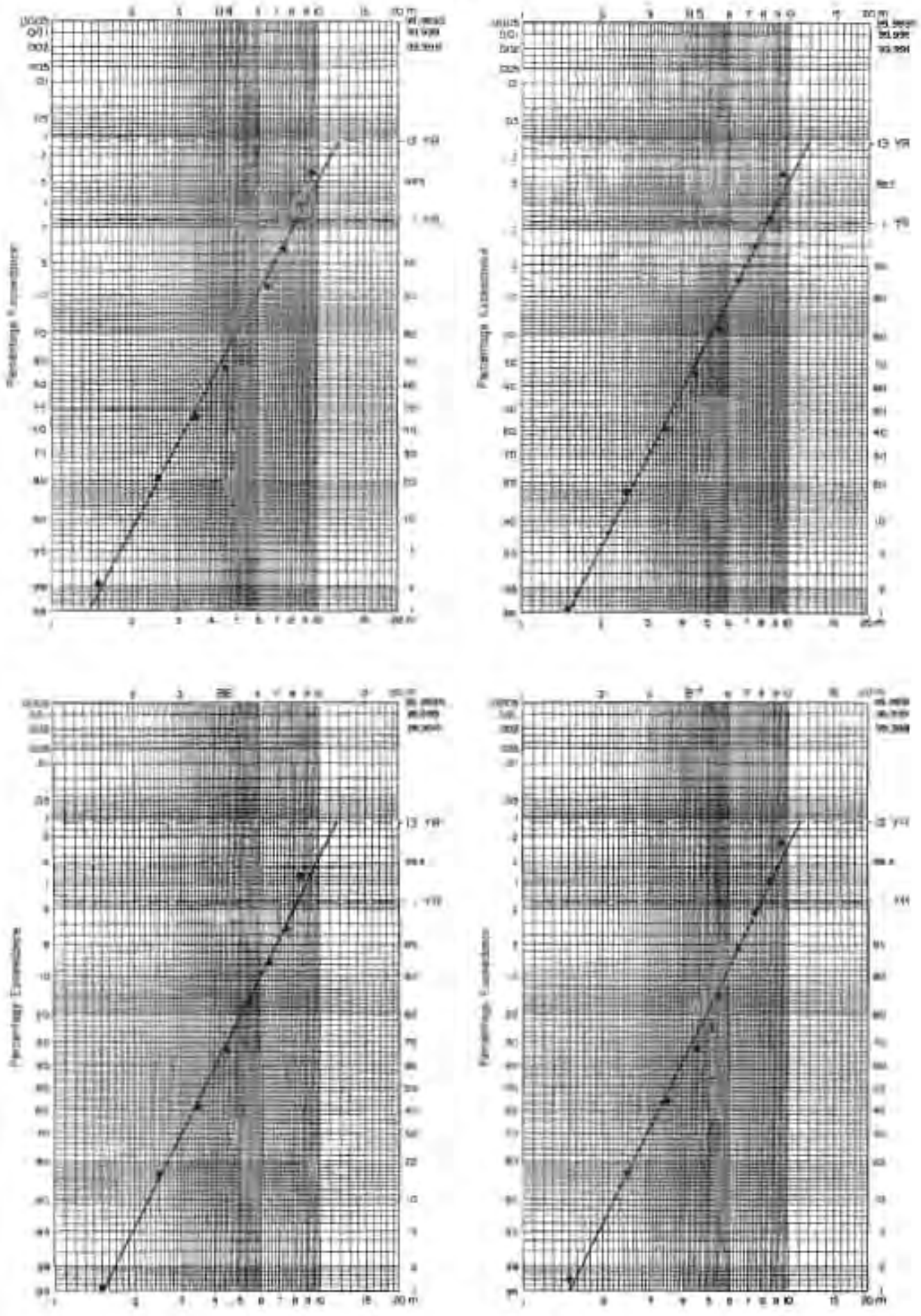


Figure 11 Monthly Wave Height Exceedance Distribution for January

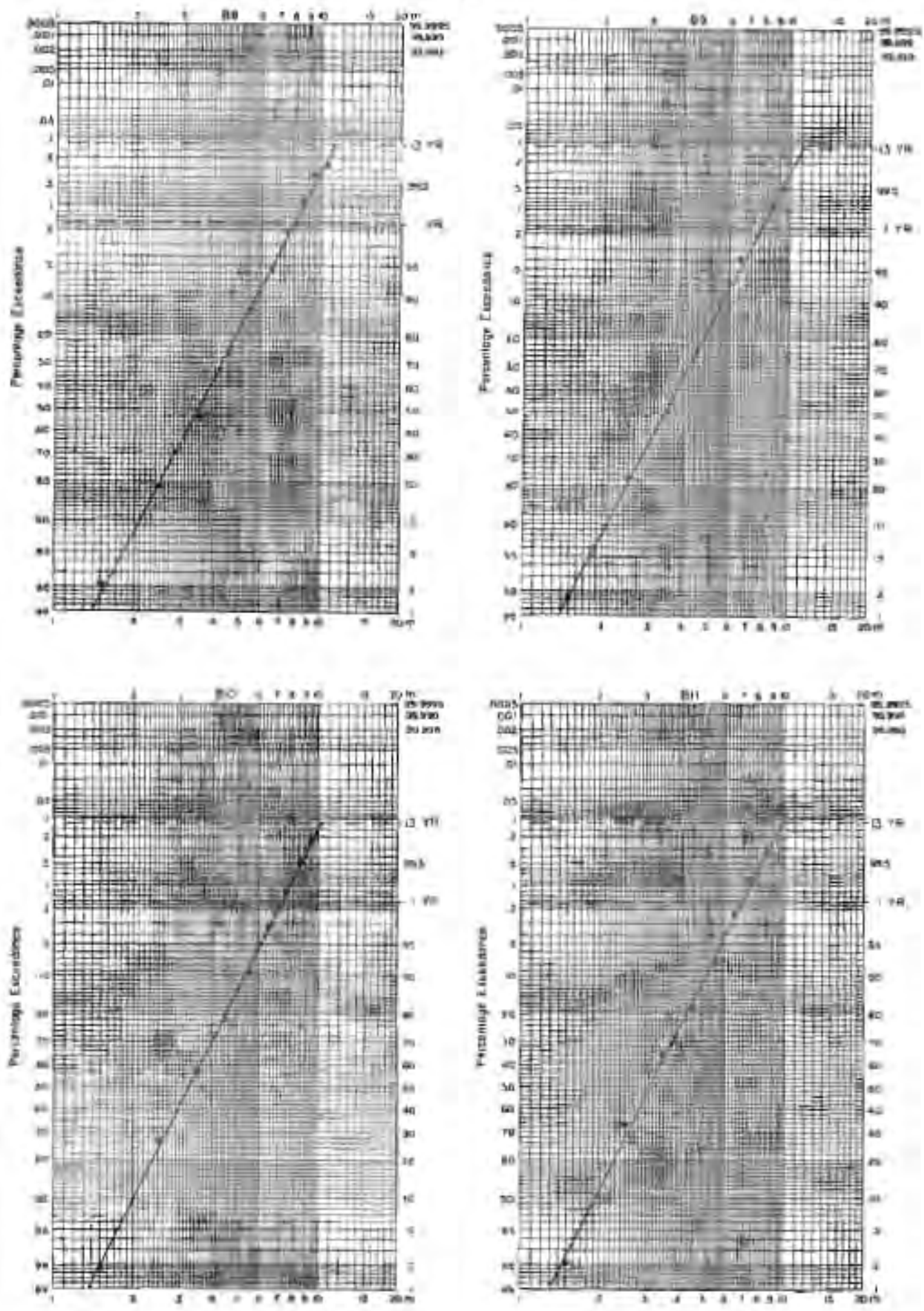
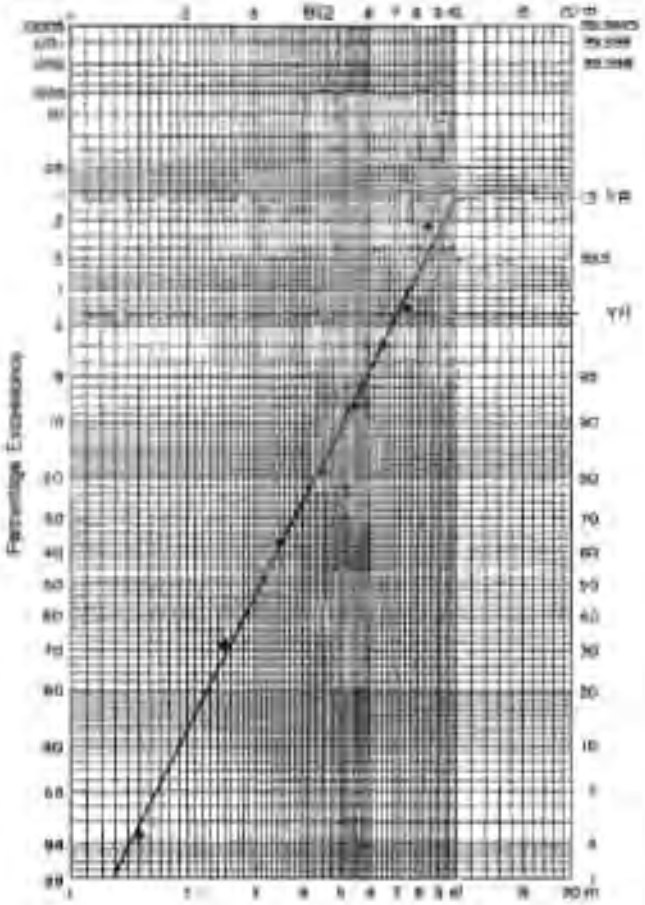
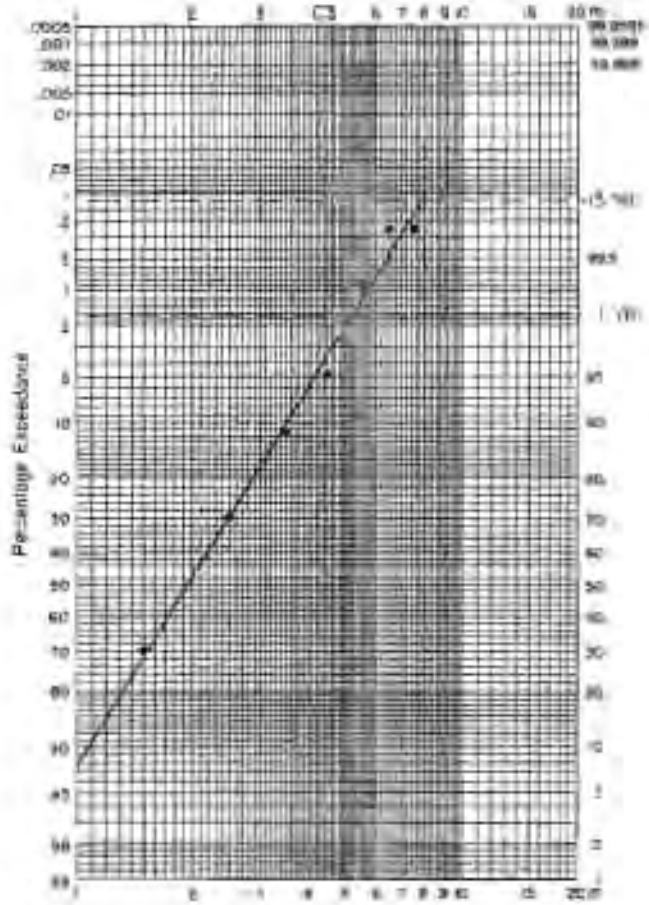
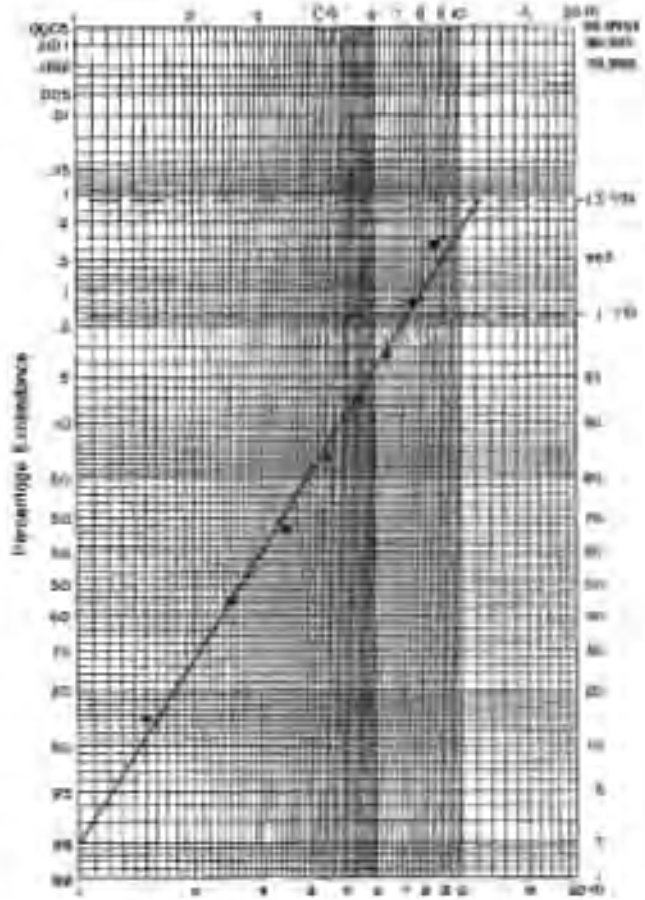


Figure 15. Monthly Wave Height Exceedance Distribution for January







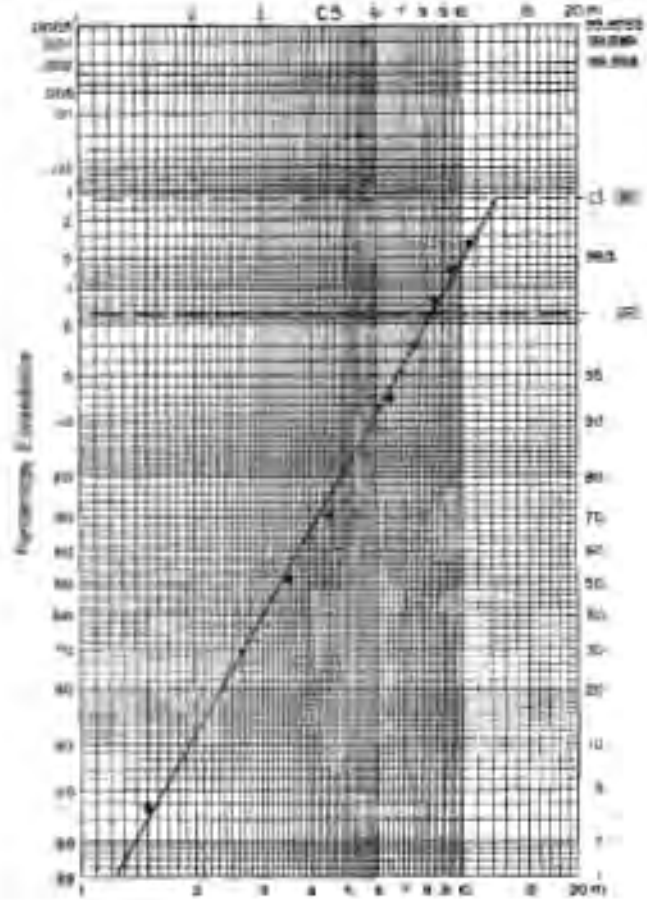


Figure 6: Monthly Wave Height Exceedance Distribution for January

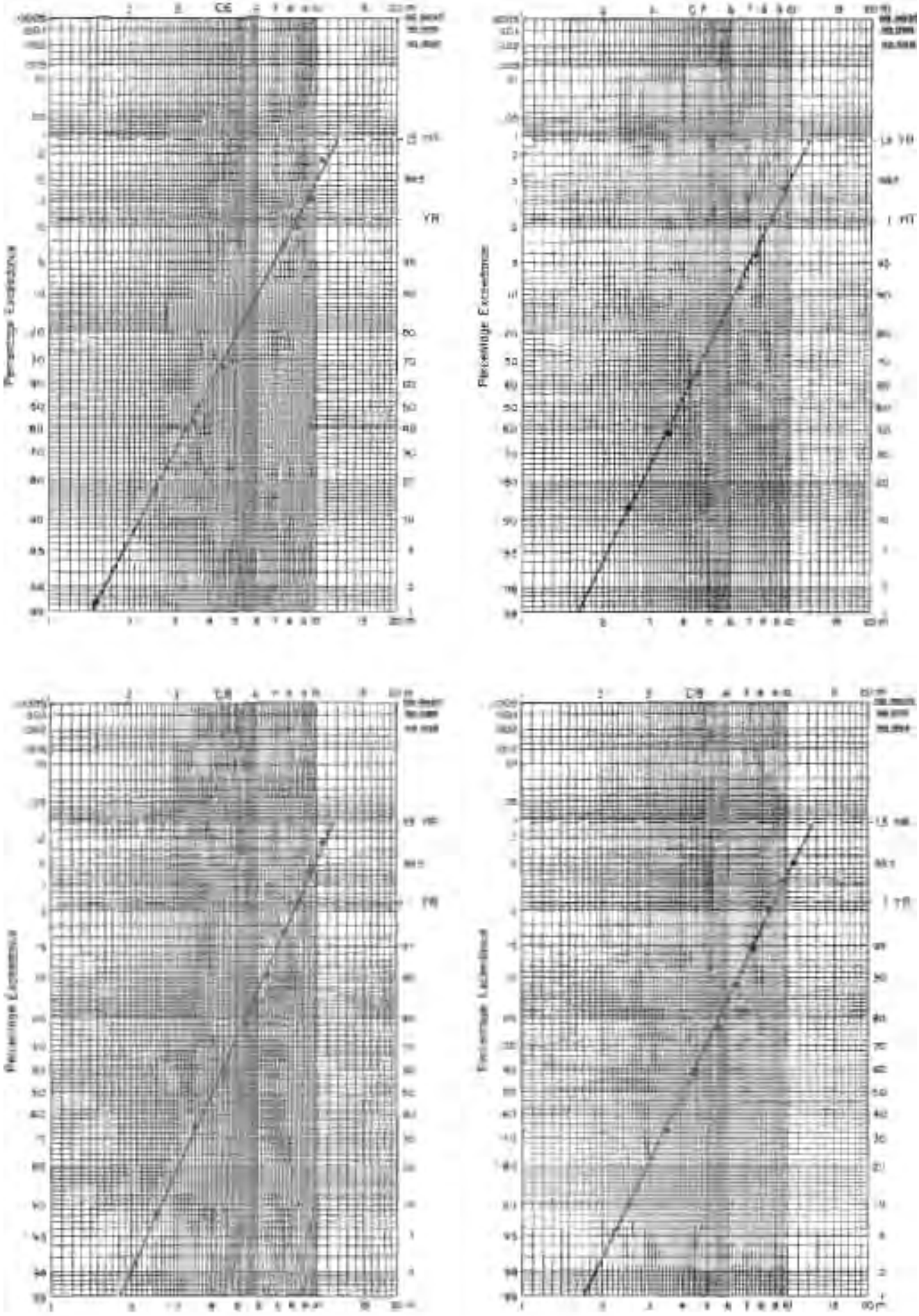


Figure 1: Monthly Wave Height Exceedance Distribution for January

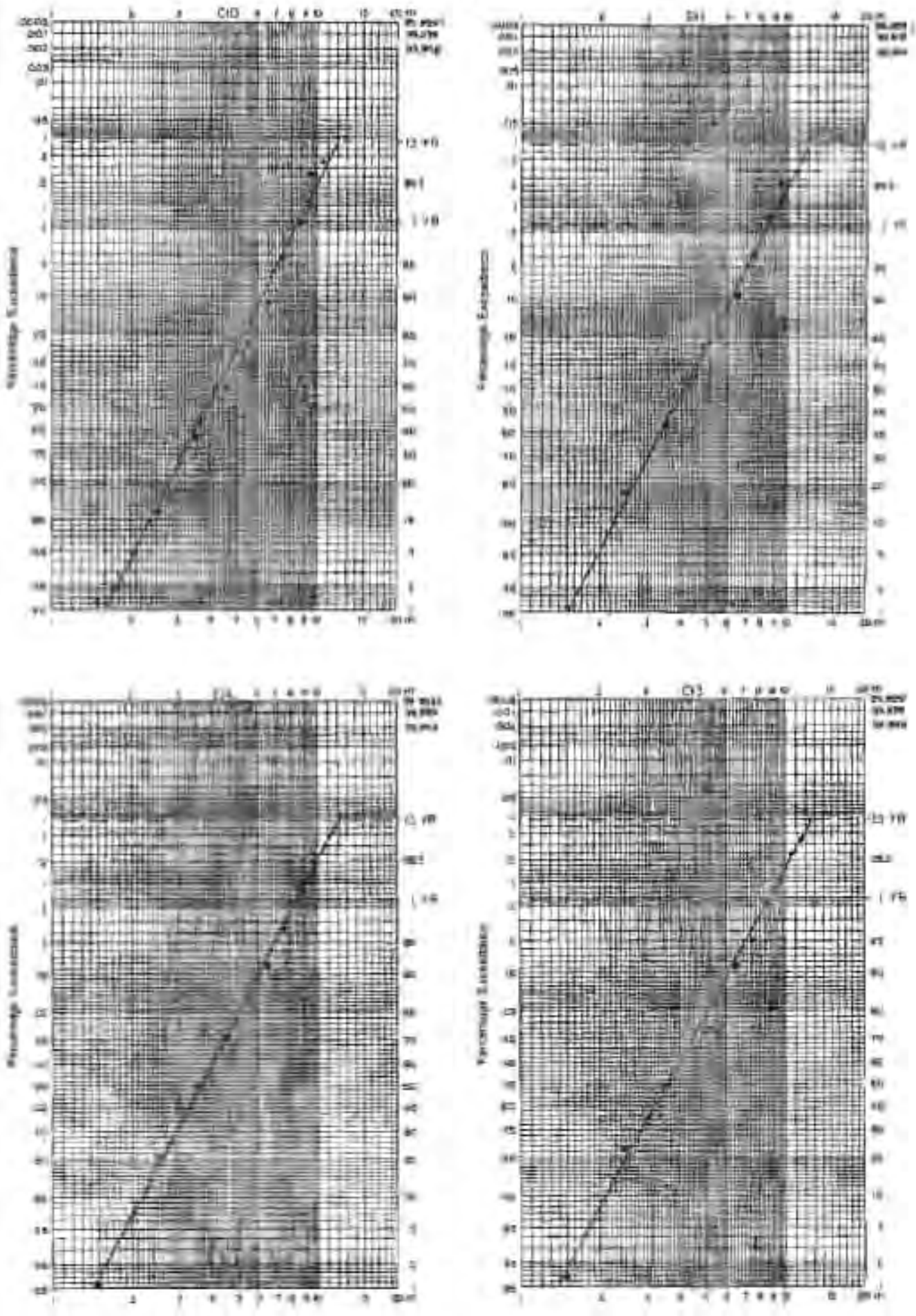


Figure 1) Monthly Wave Height Exceedance Distribution for January

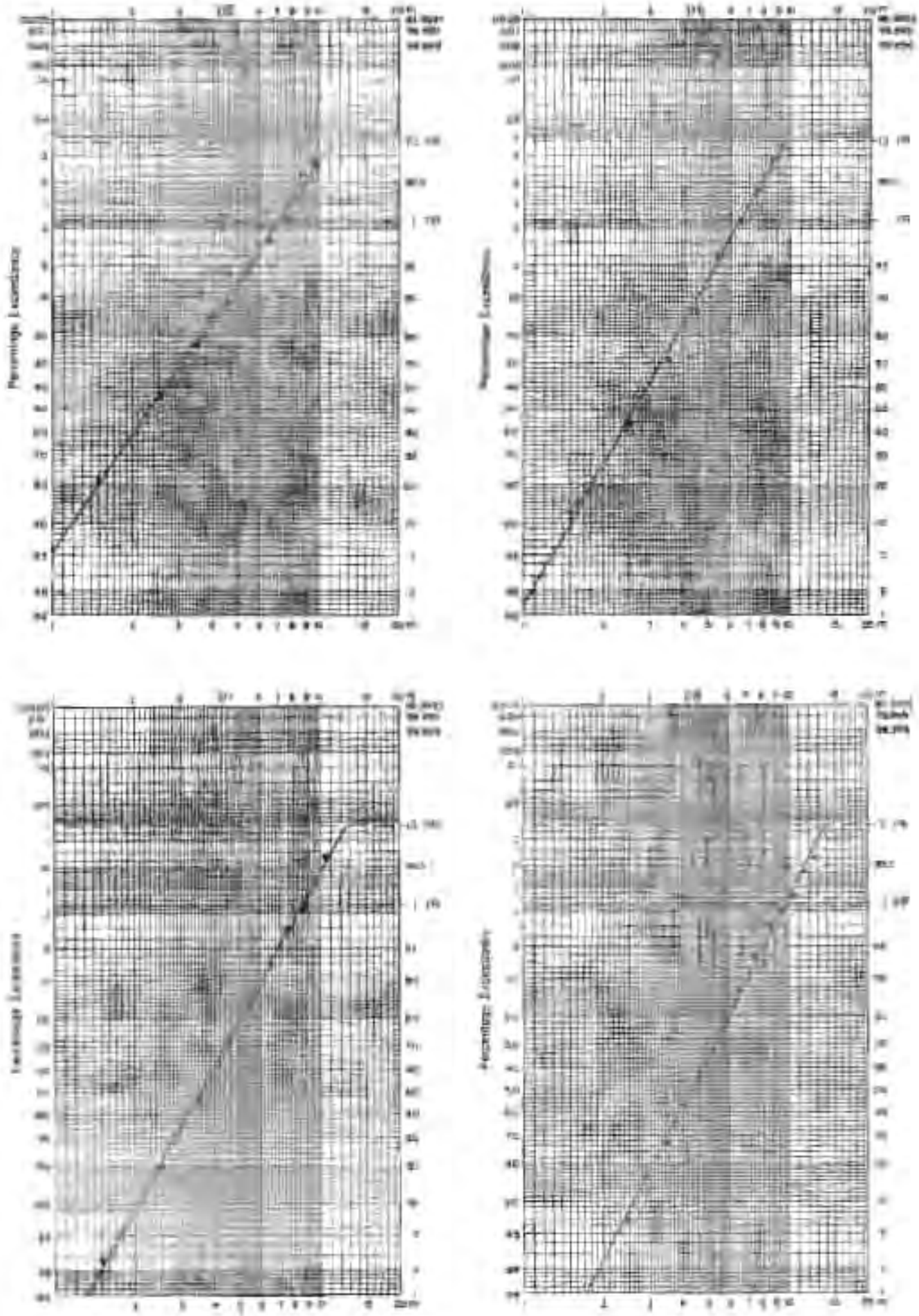


Figure 5 Monthly Wave Height Exceedance Distribution for January

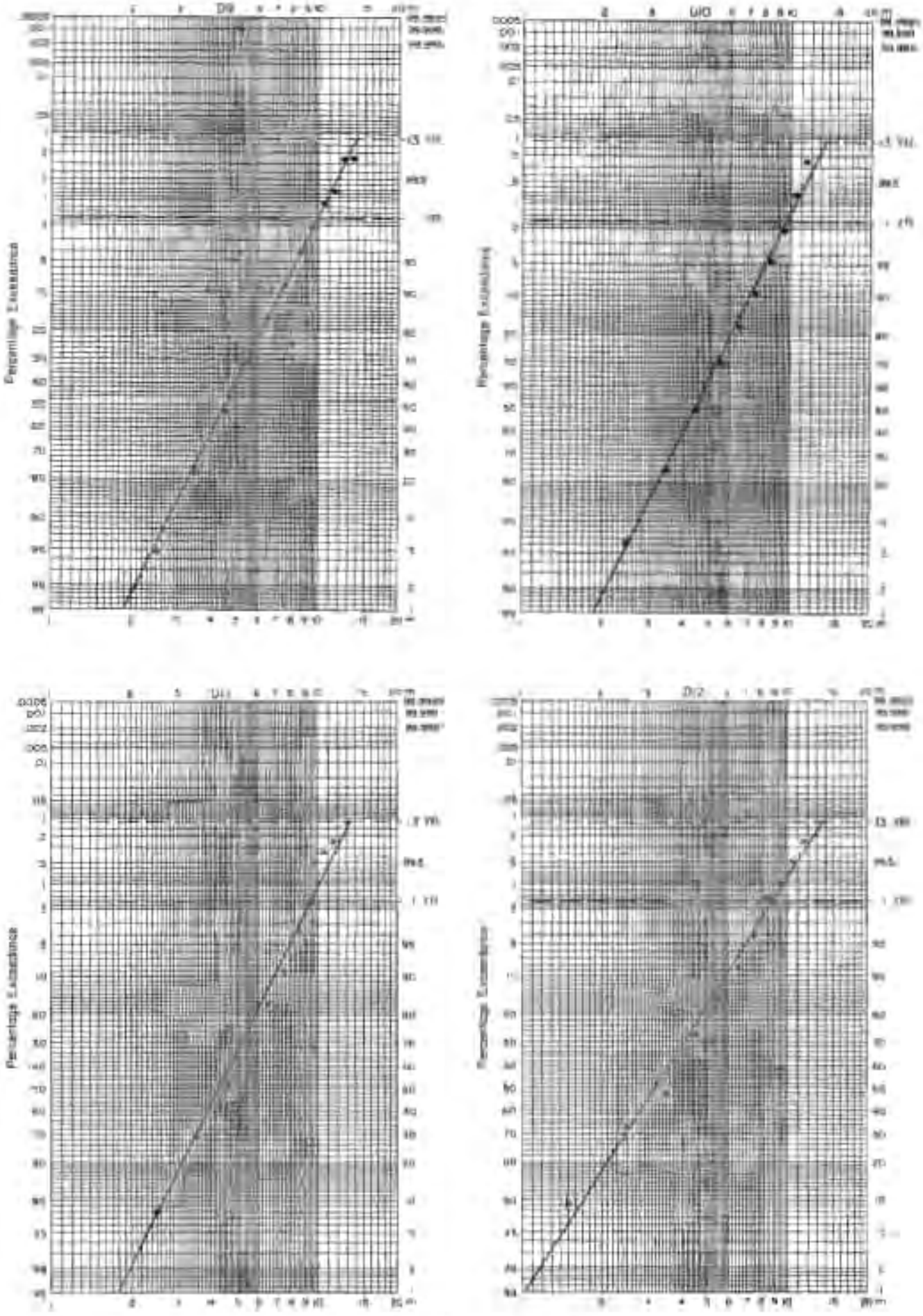


Figure 11 Monthly Wave Height Exceedance Distribution for January

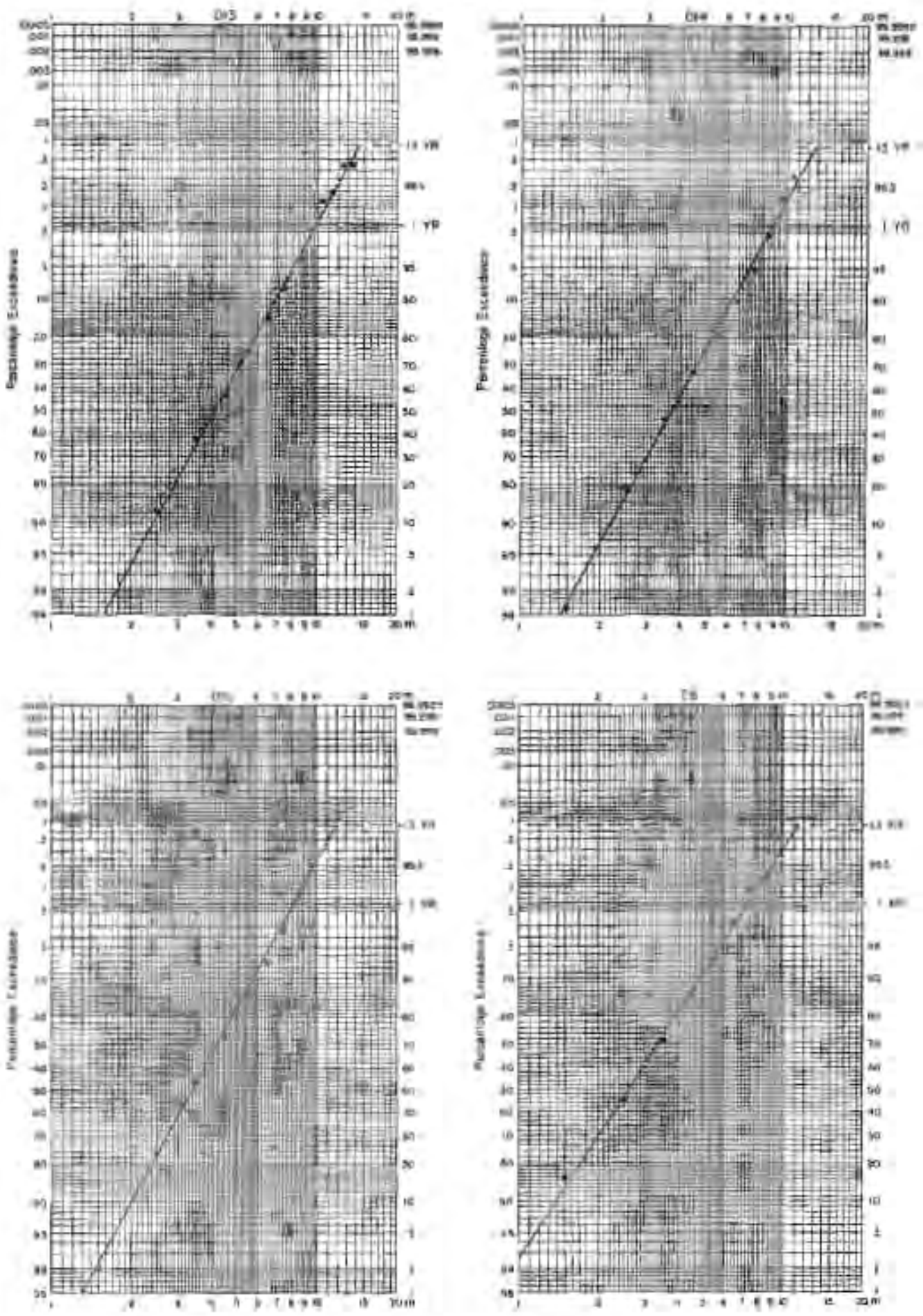


Figure 1m Monthly Wave Height Exceedance Distribution for January

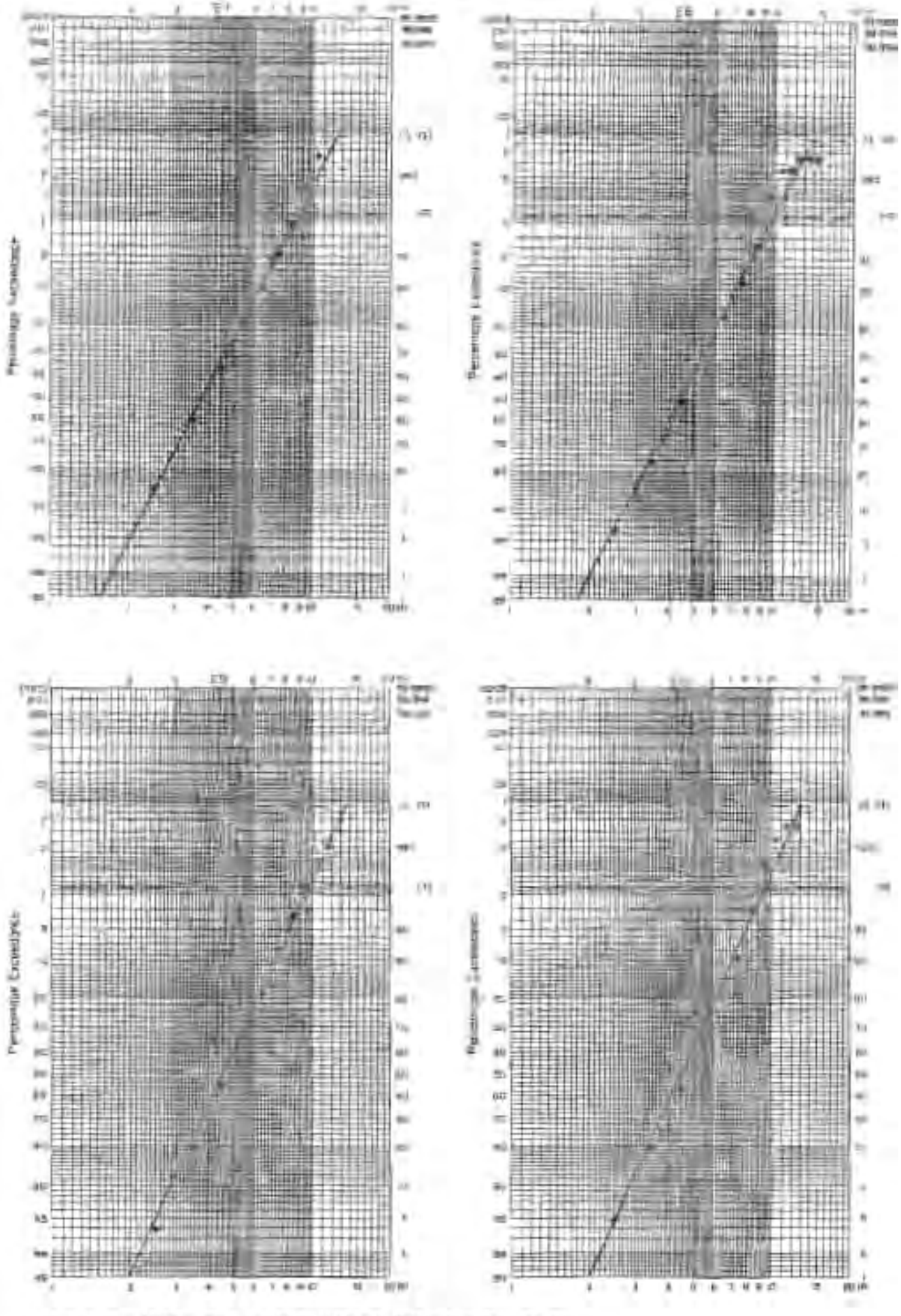
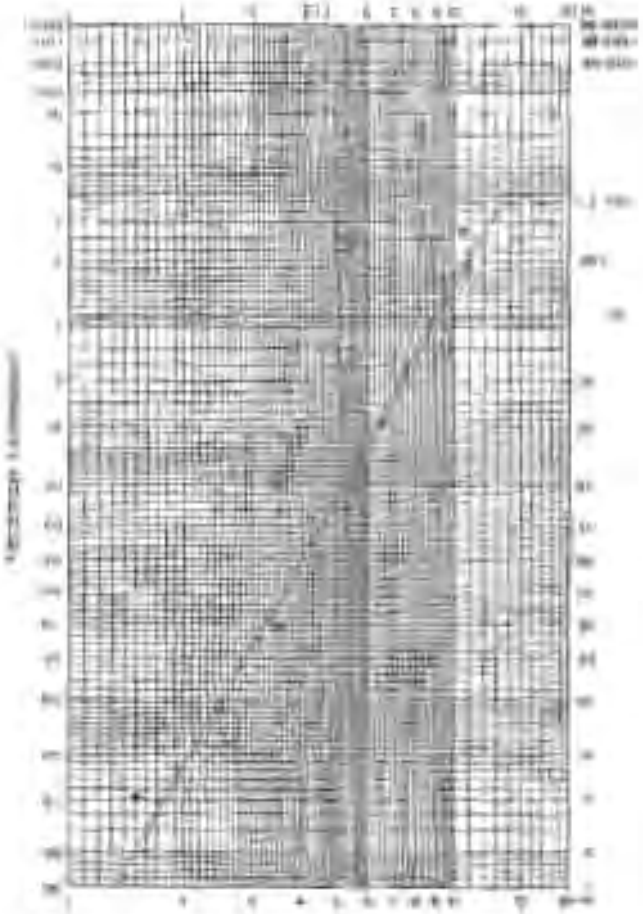
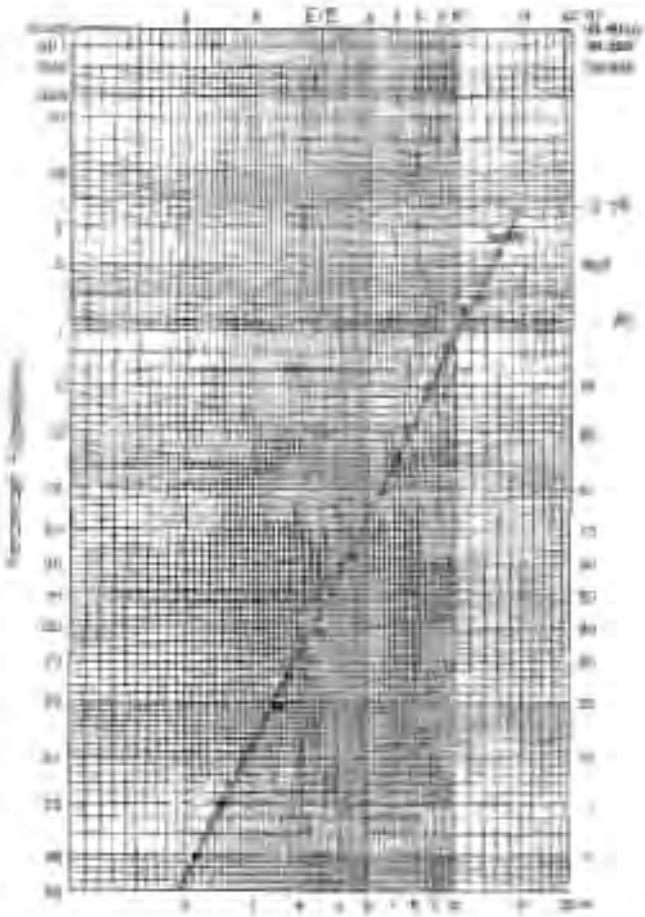
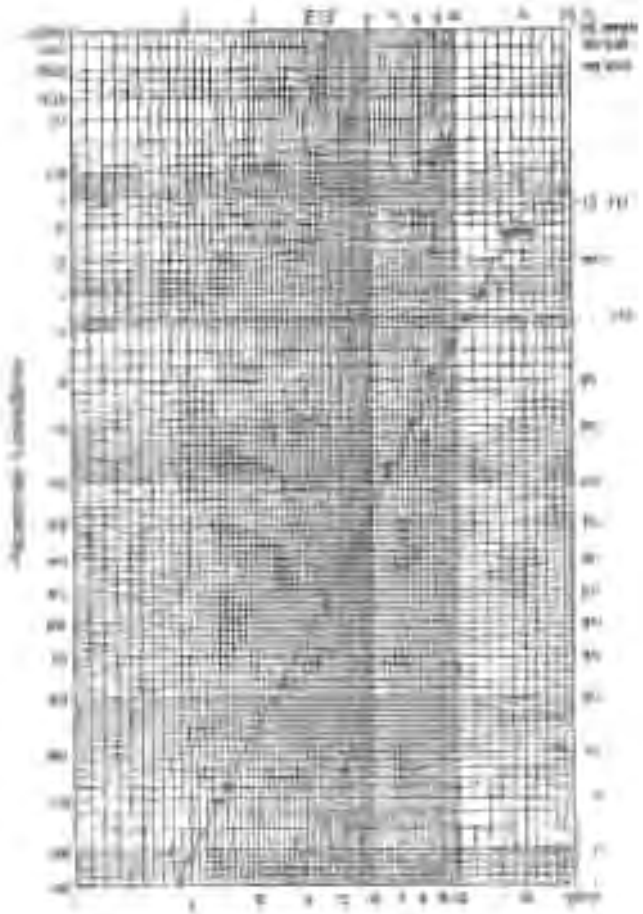
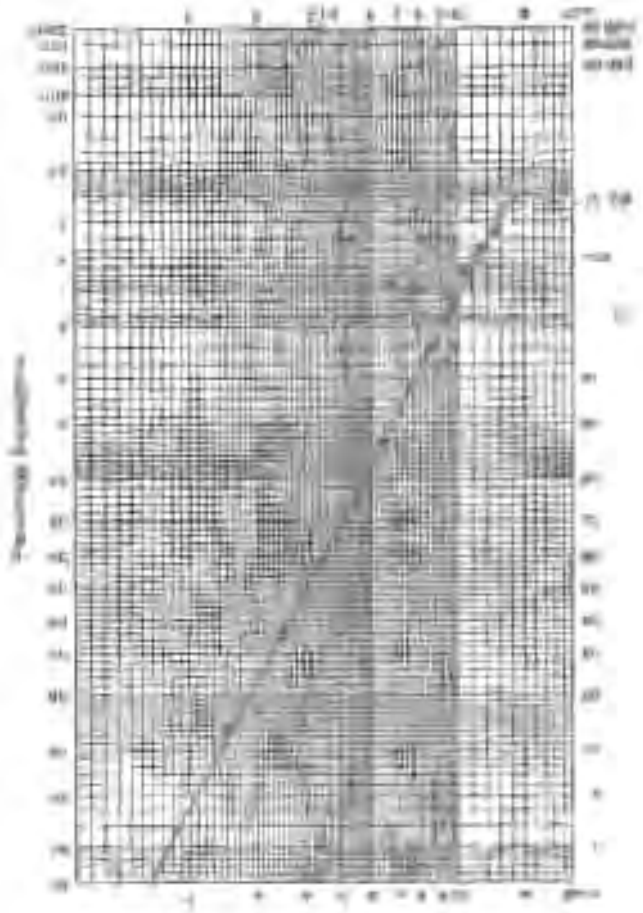


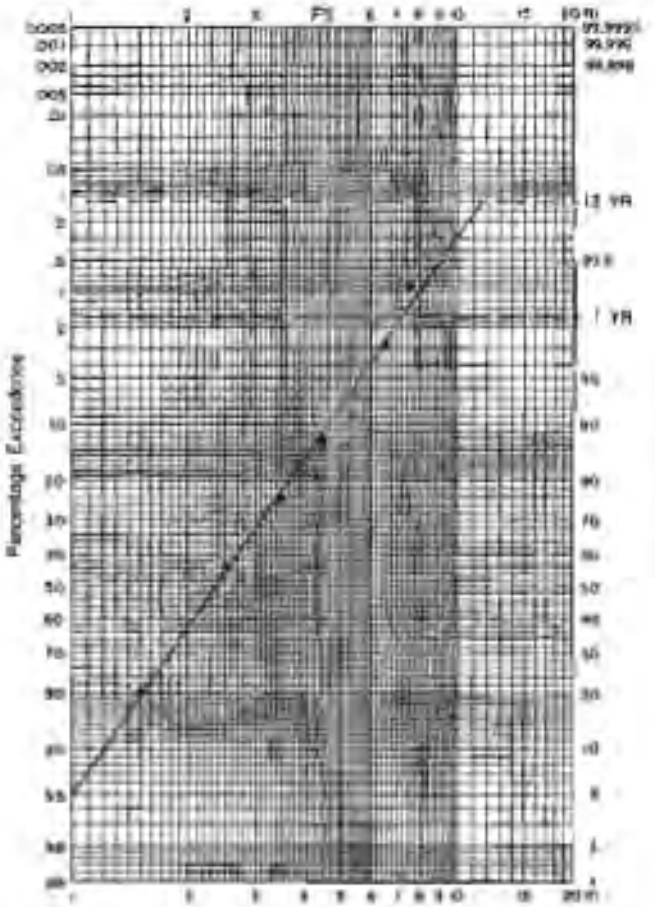
Figure (i) Monthly Wave Height Exceedance Distribution for January

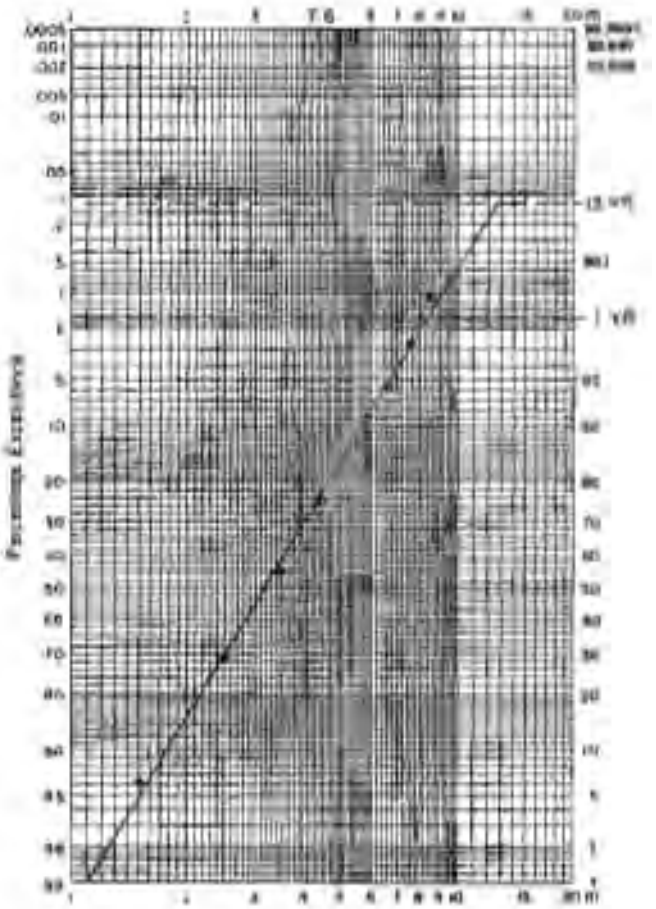


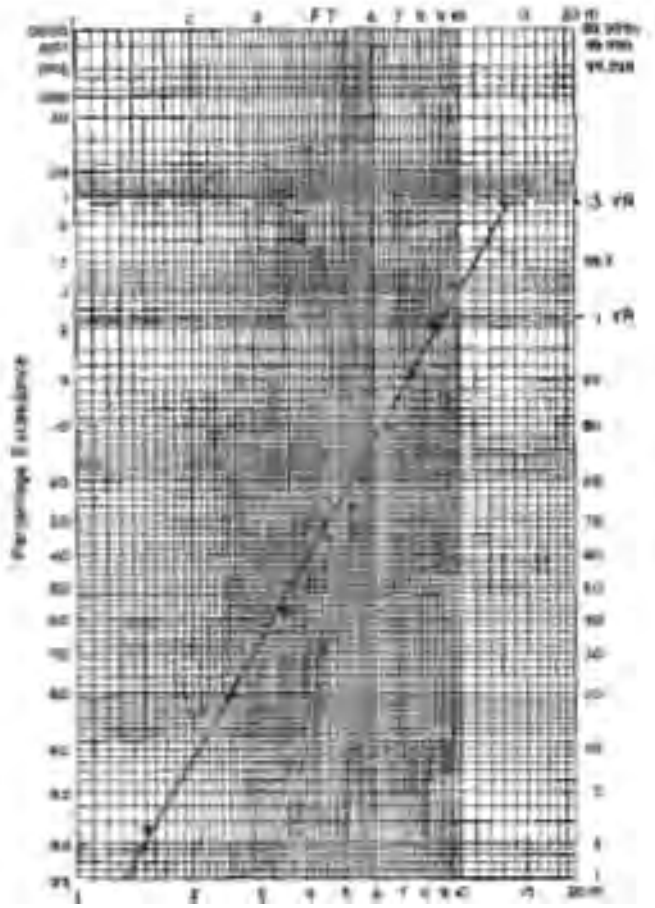


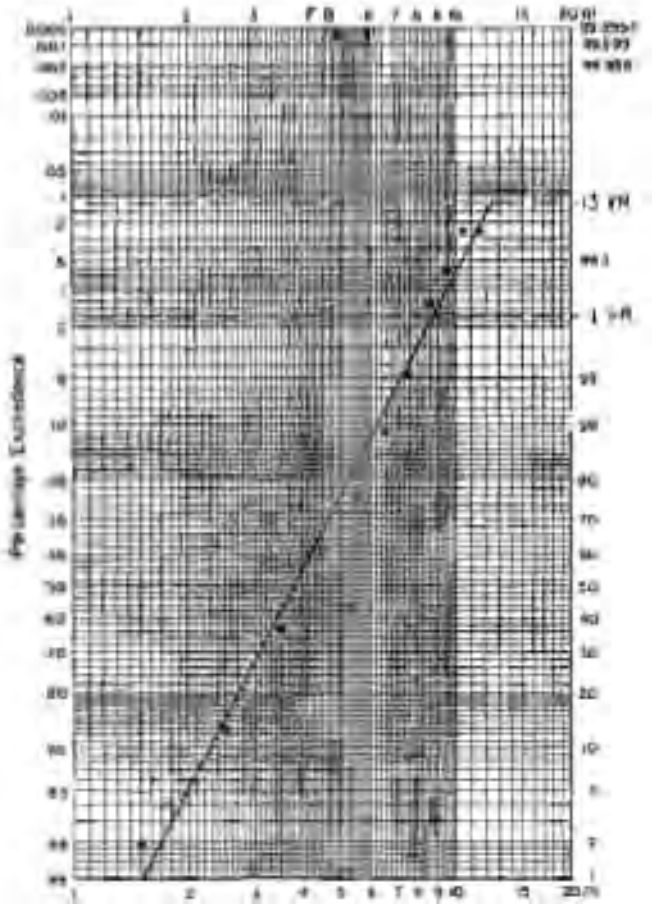


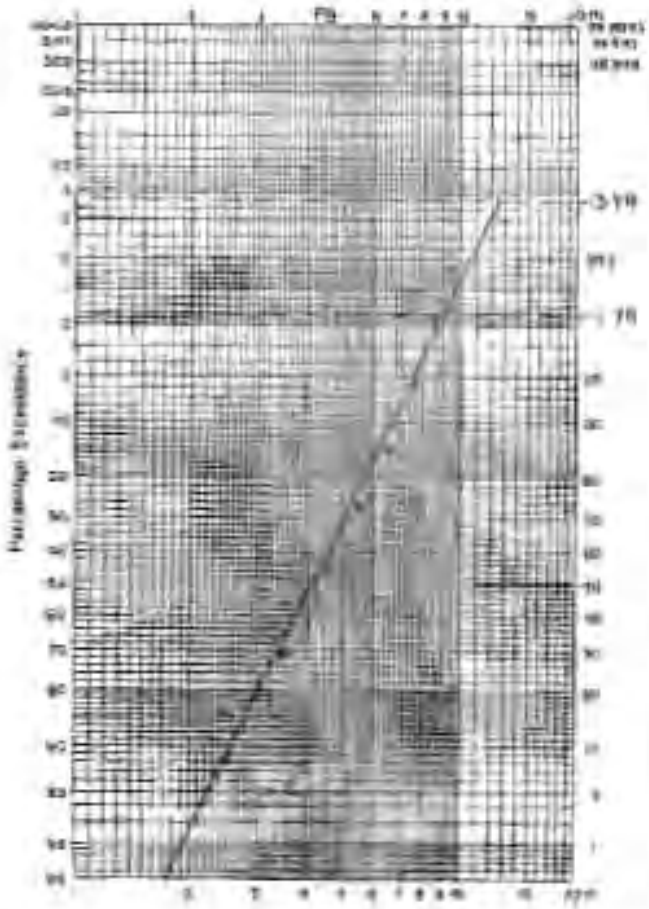


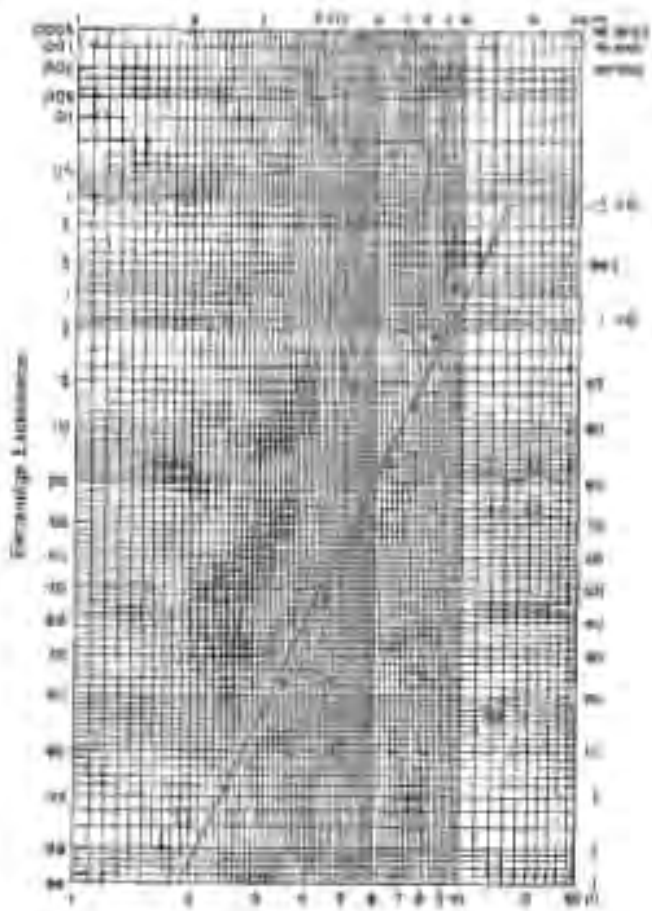


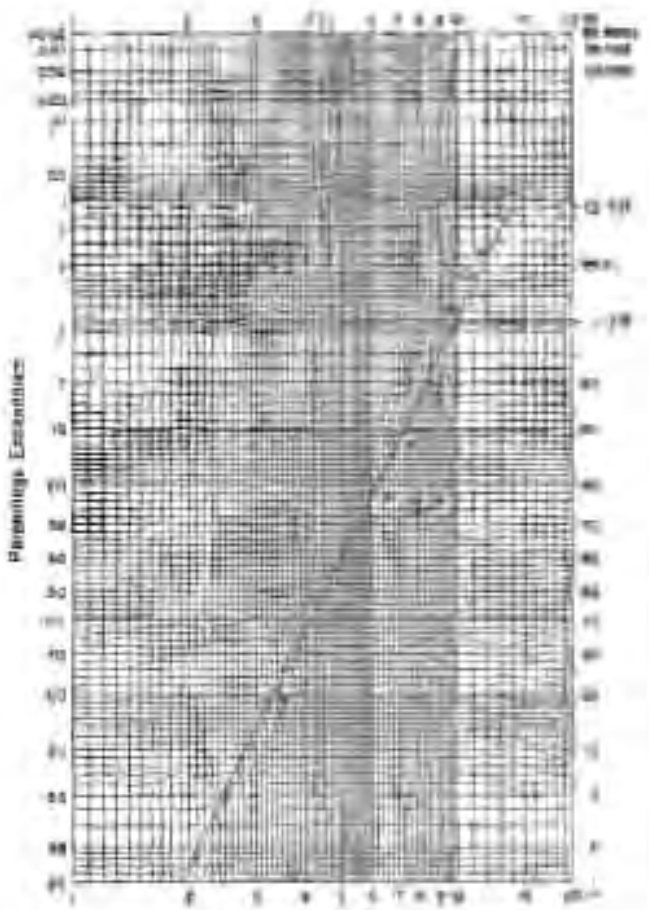


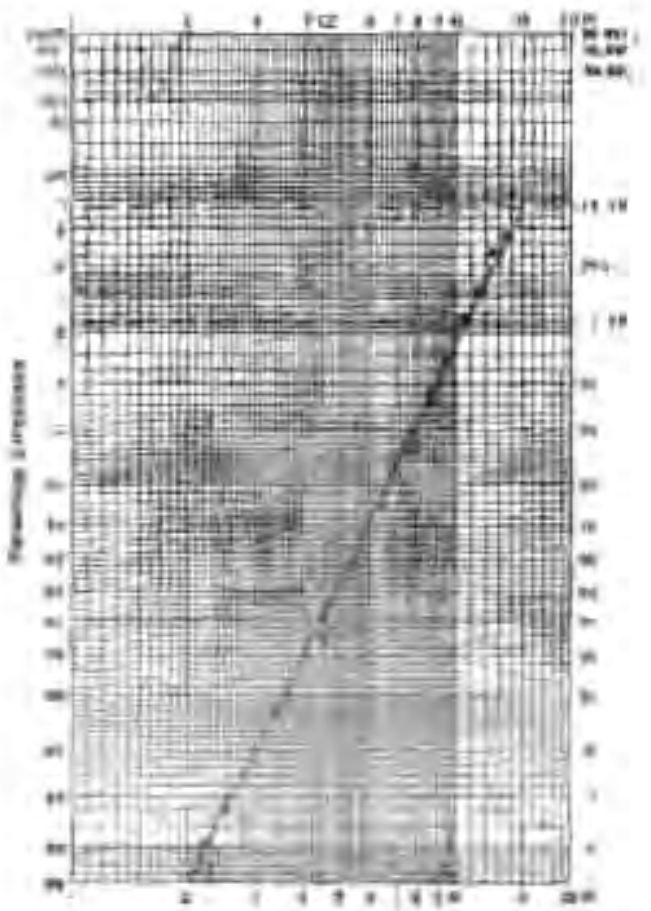












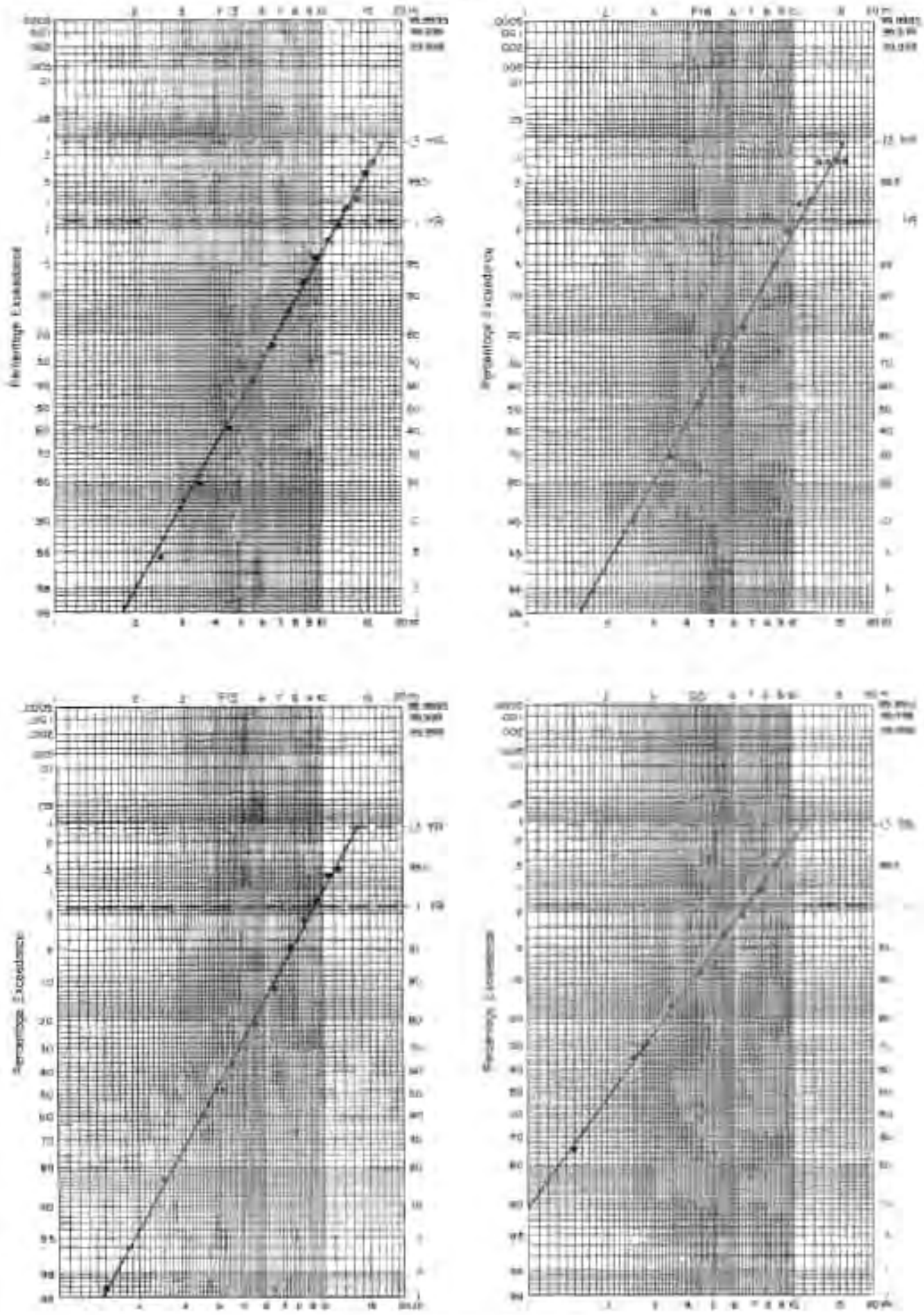


Figure 11 Monthly Wave Height Exceedance Distribution for January

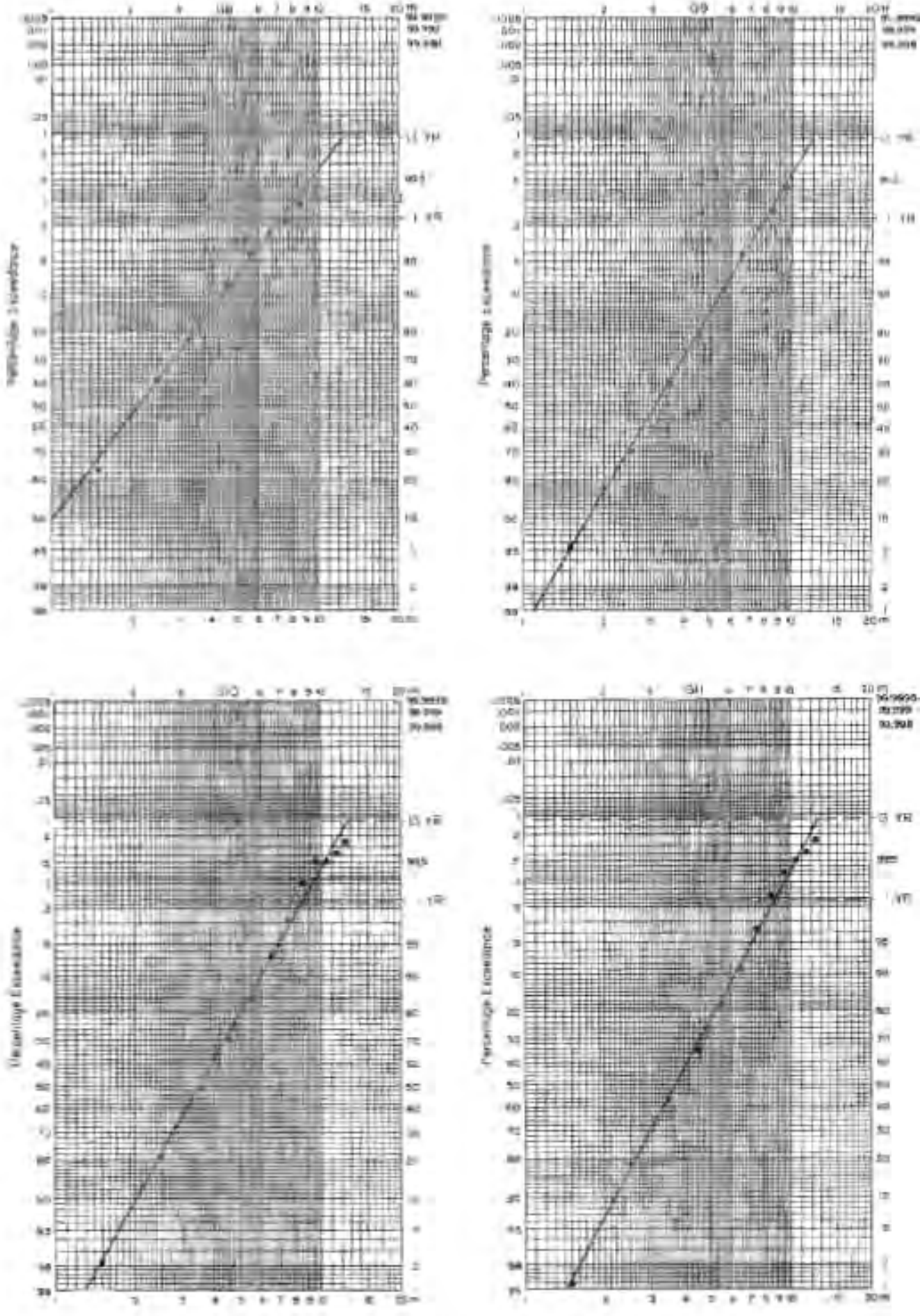


Figure 1: Monthly Wave Height Exceedance Distribution for January

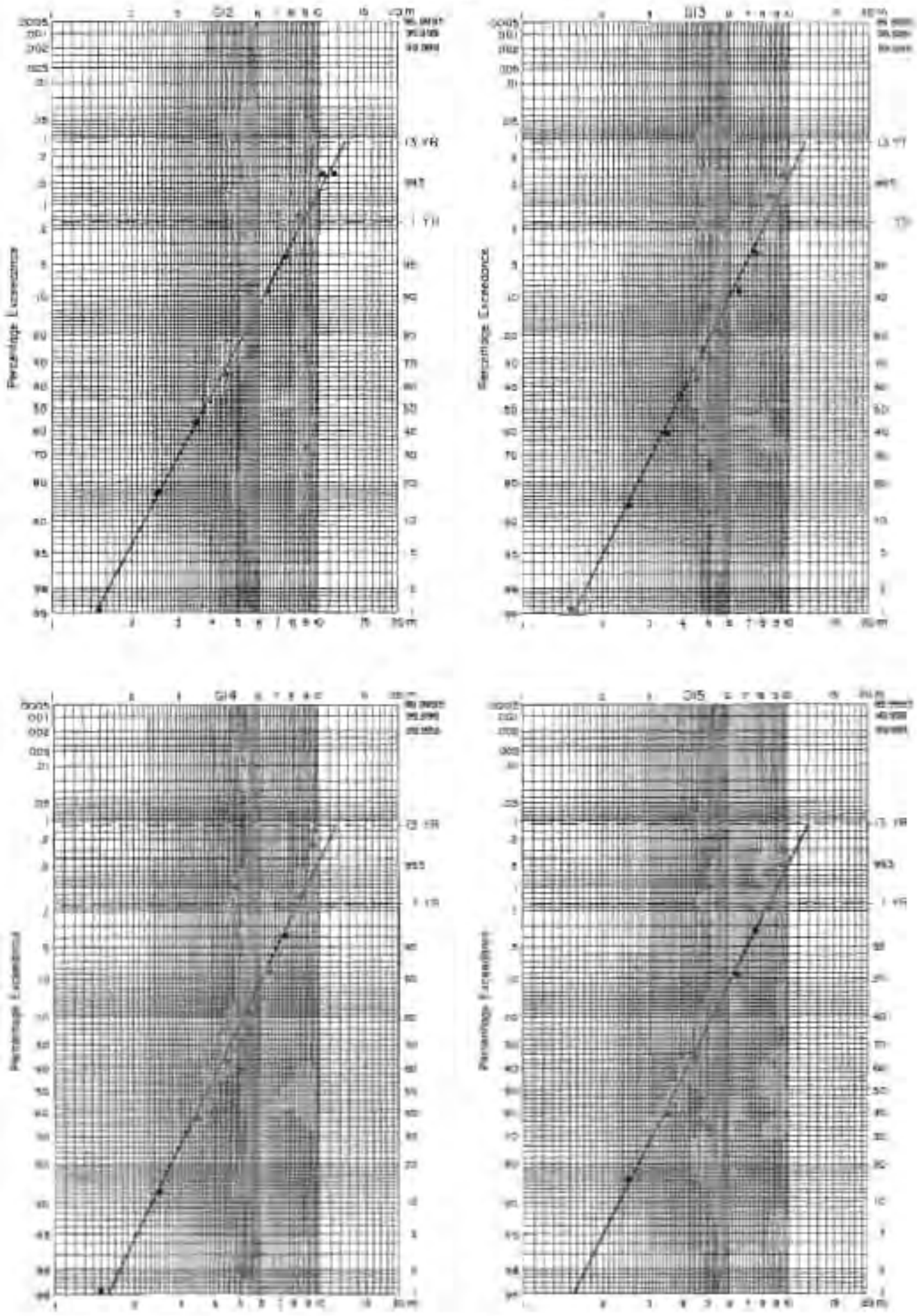


Figure 9 Monthly Wave Height Exceedance Distribution for January

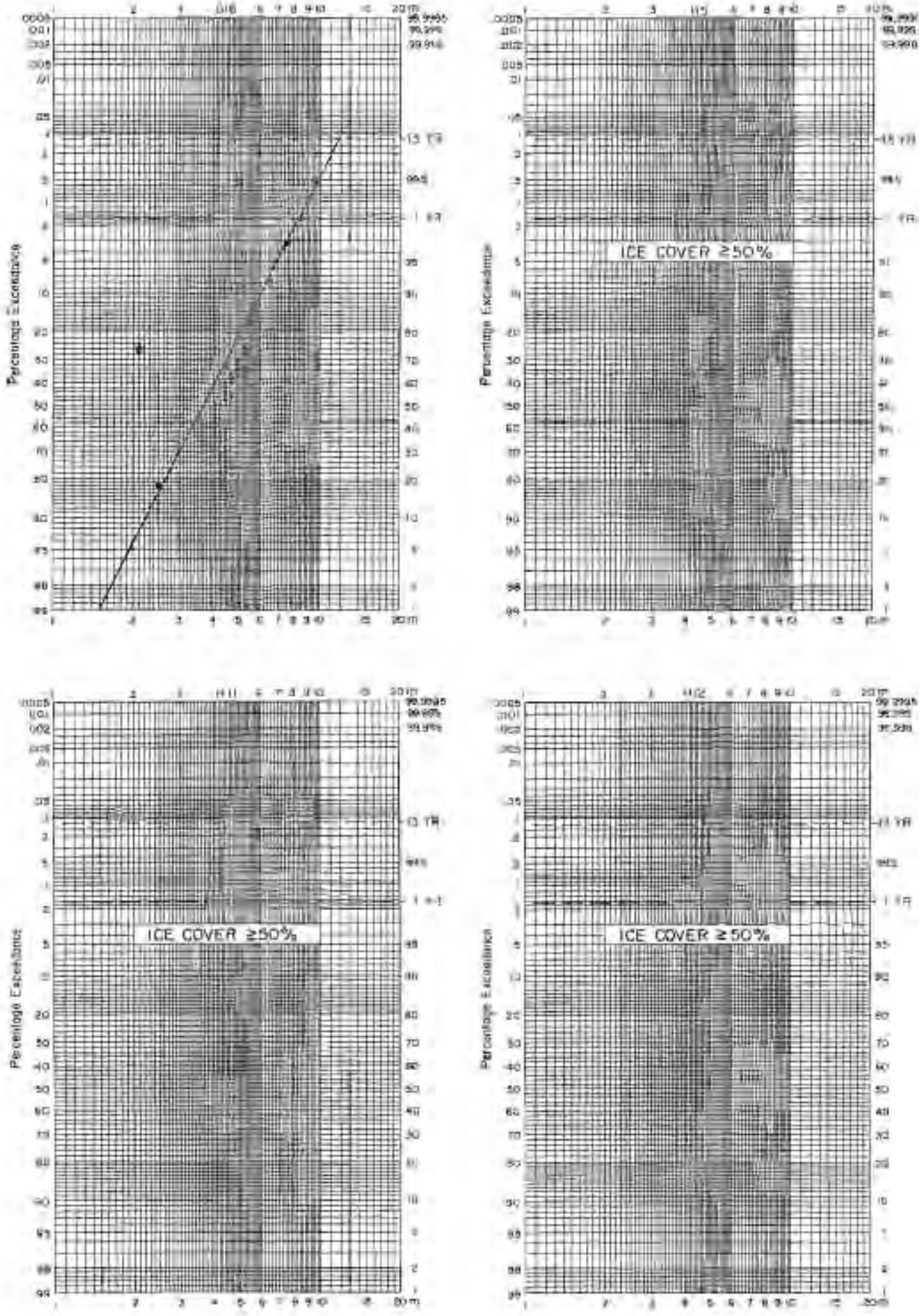
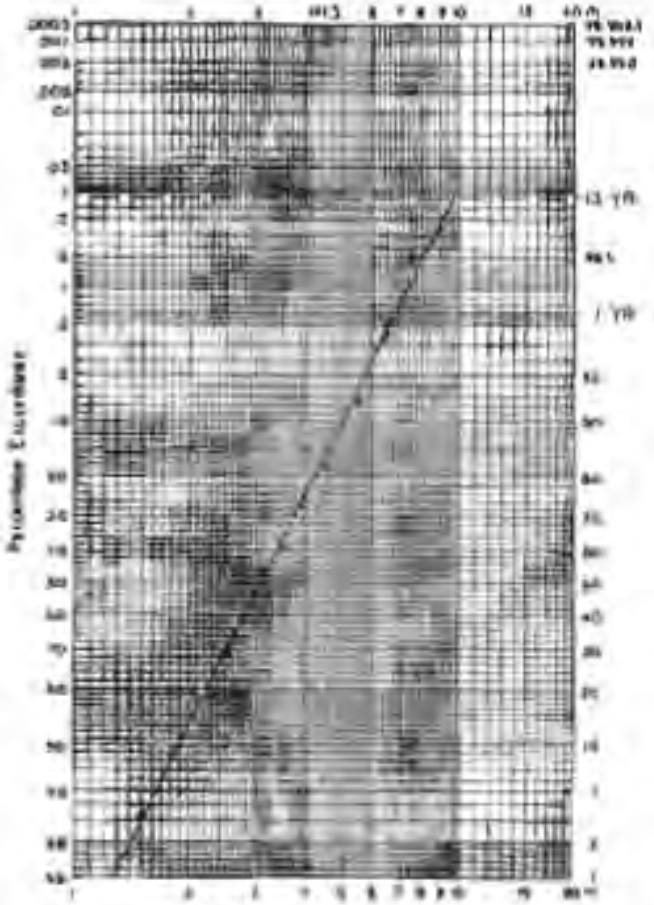
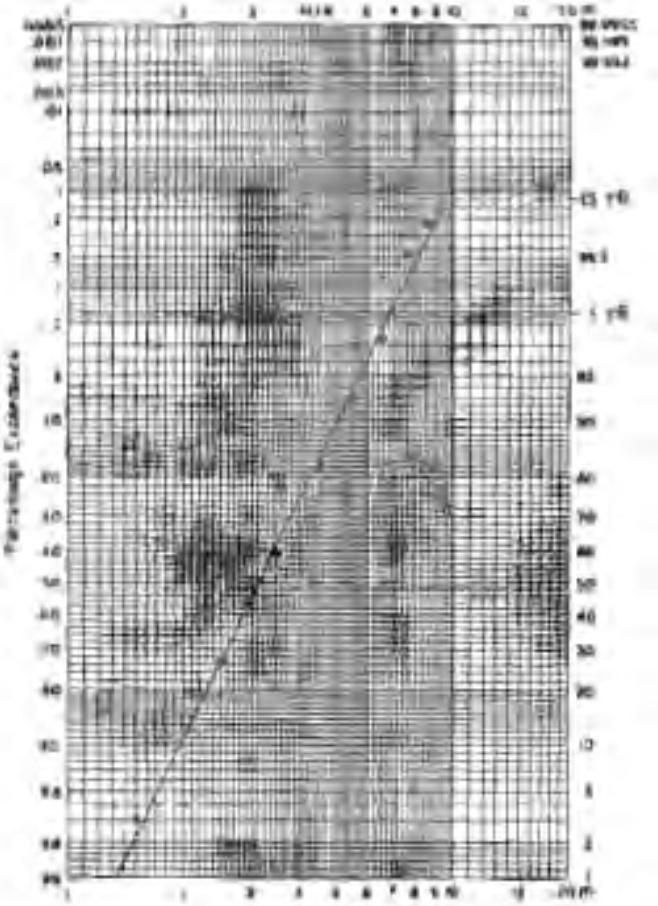
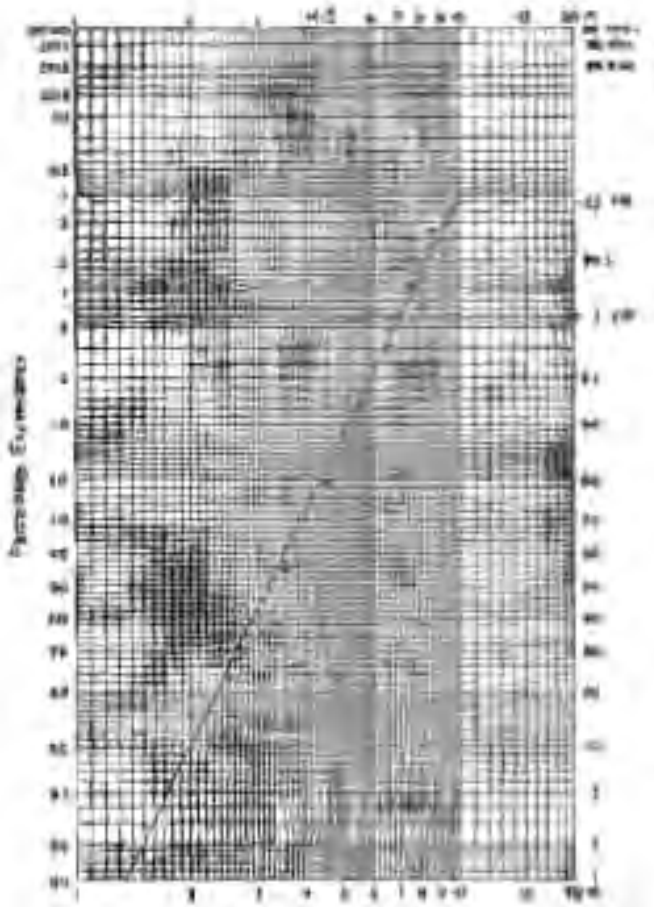
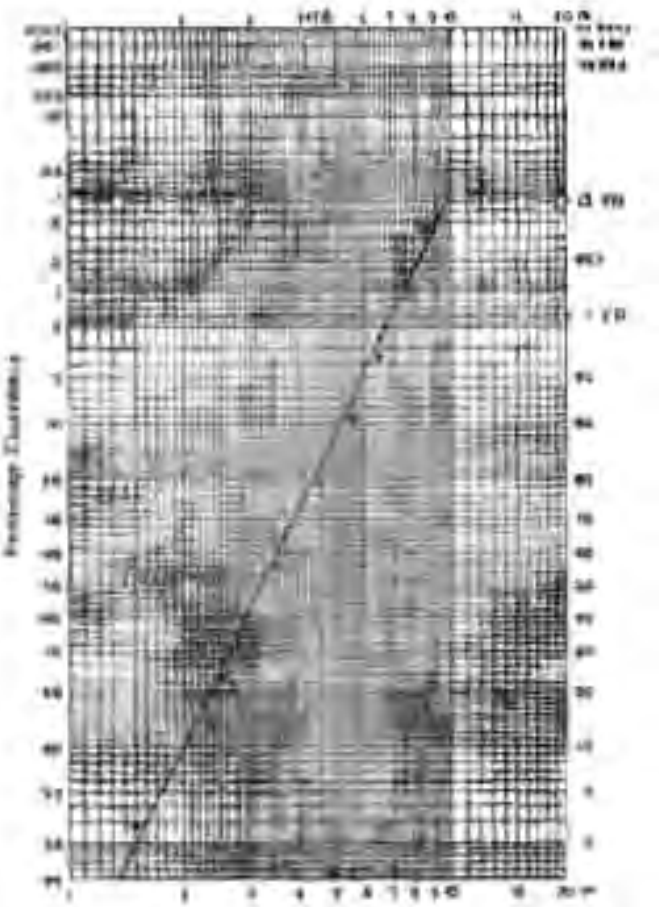


Figure 10 Monthly Wave Height Exceedance Distribution for January









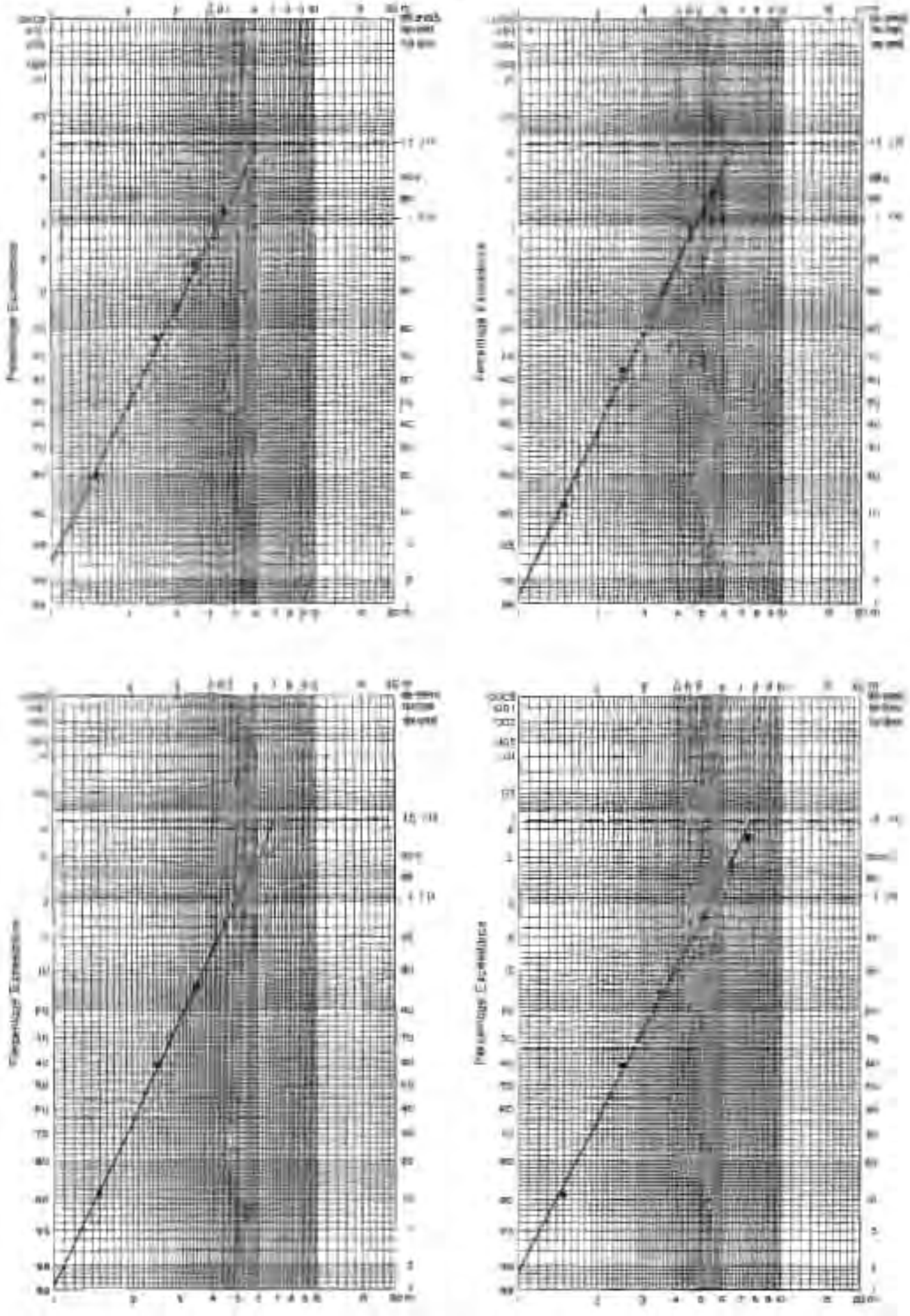
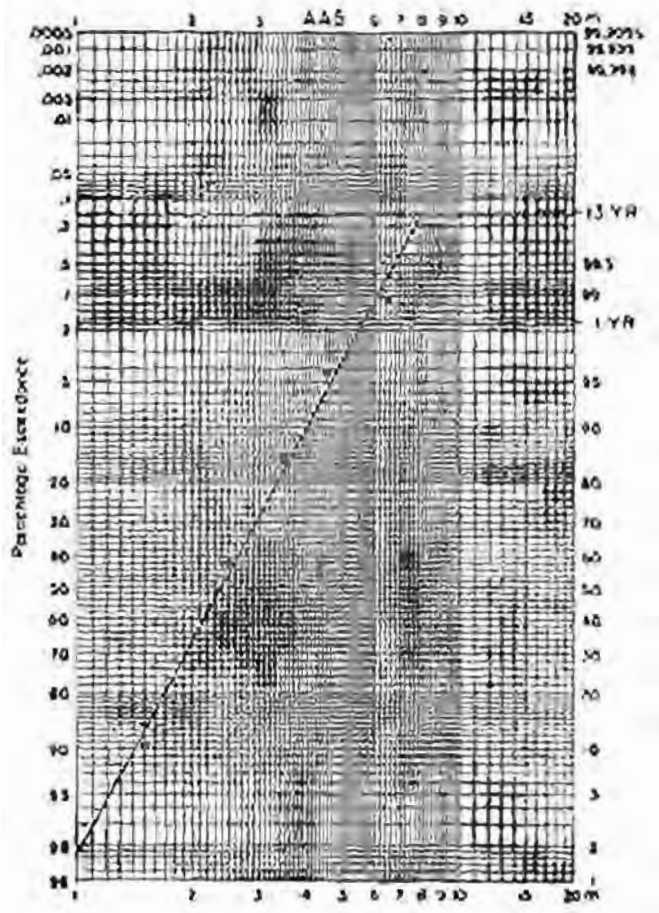


Figure 25 Monthly Wave Height Exceedance Distribution for February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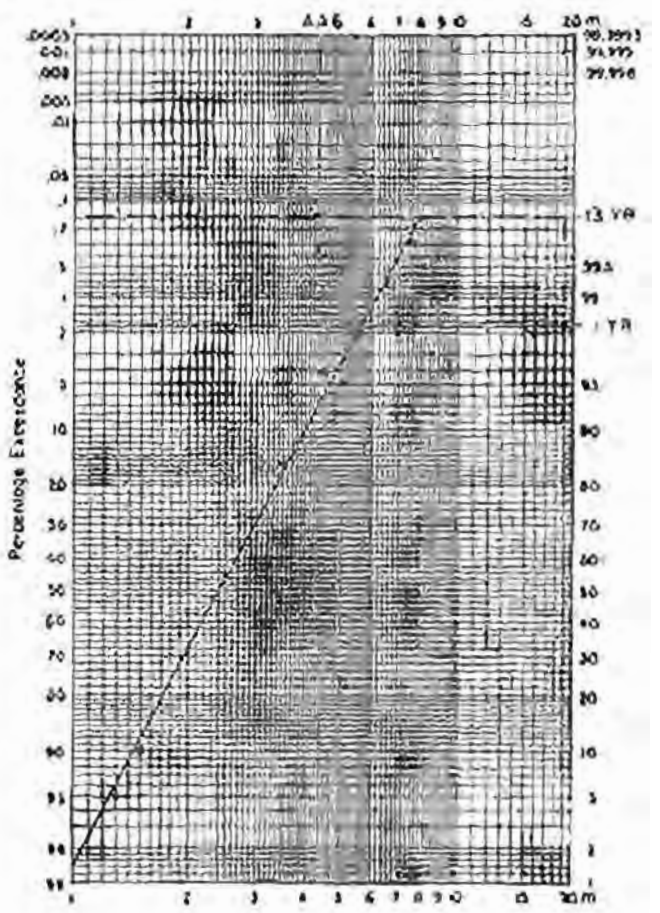
1 YR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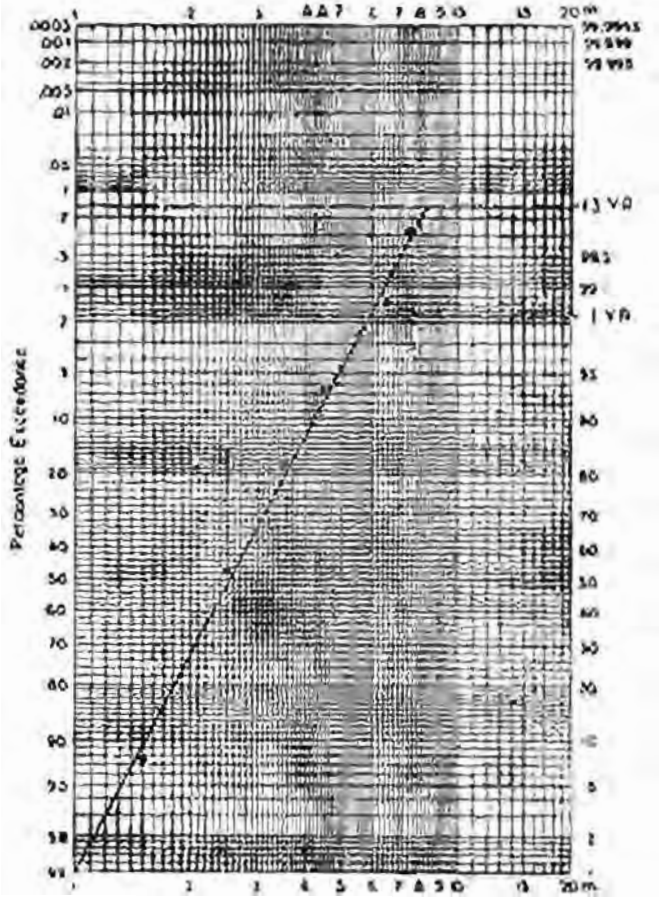
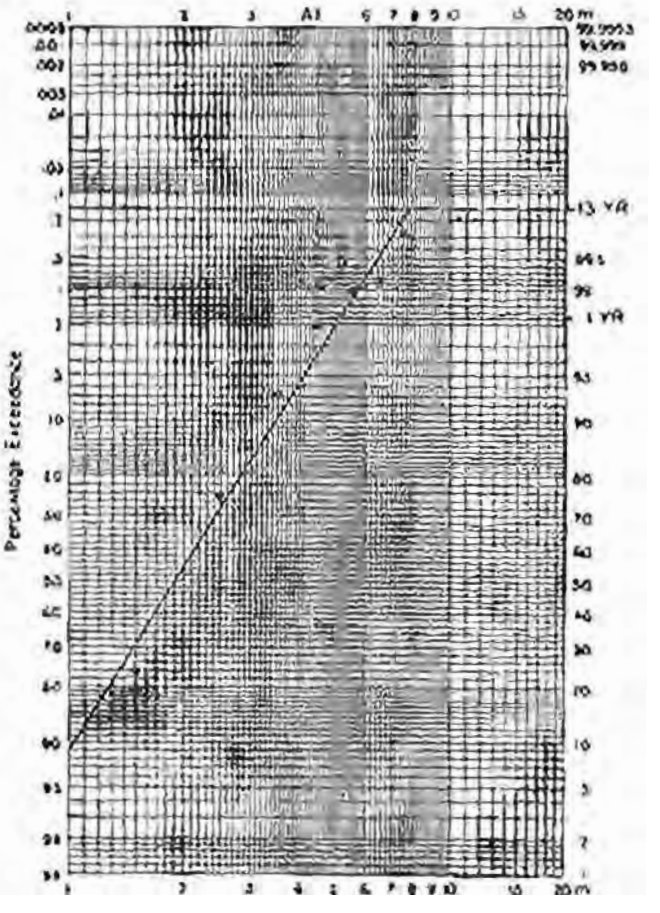
1 YR


AA7
Percentage Exceedance
13 YR
1 YR


A1
Percentage Exceedance
13 YR
1 YR

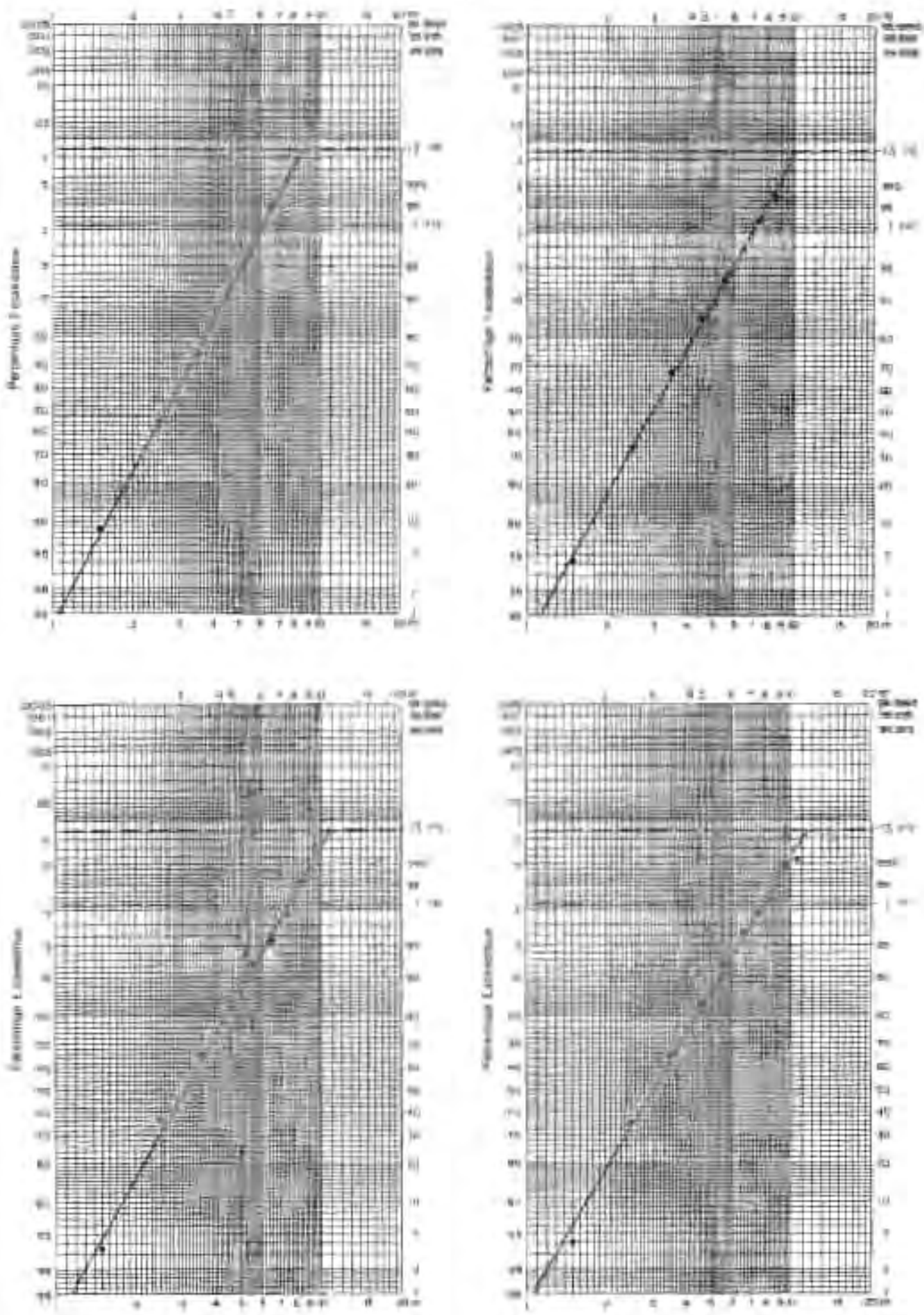
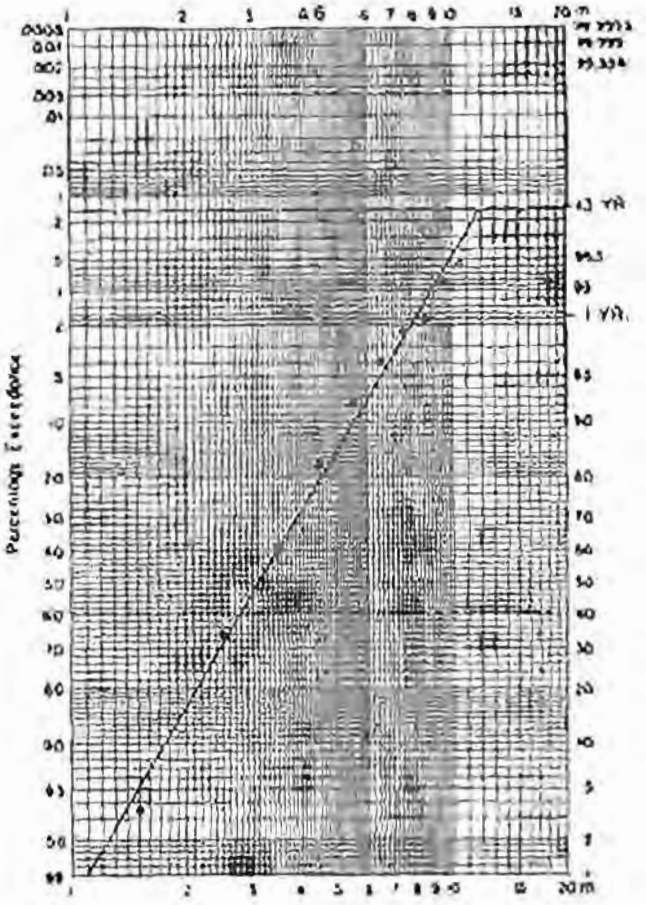
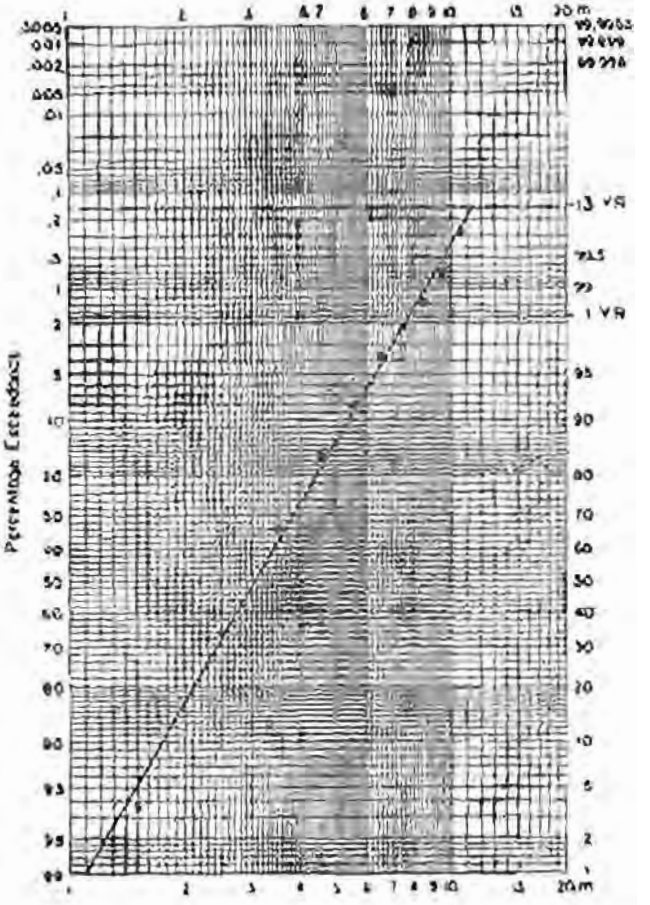
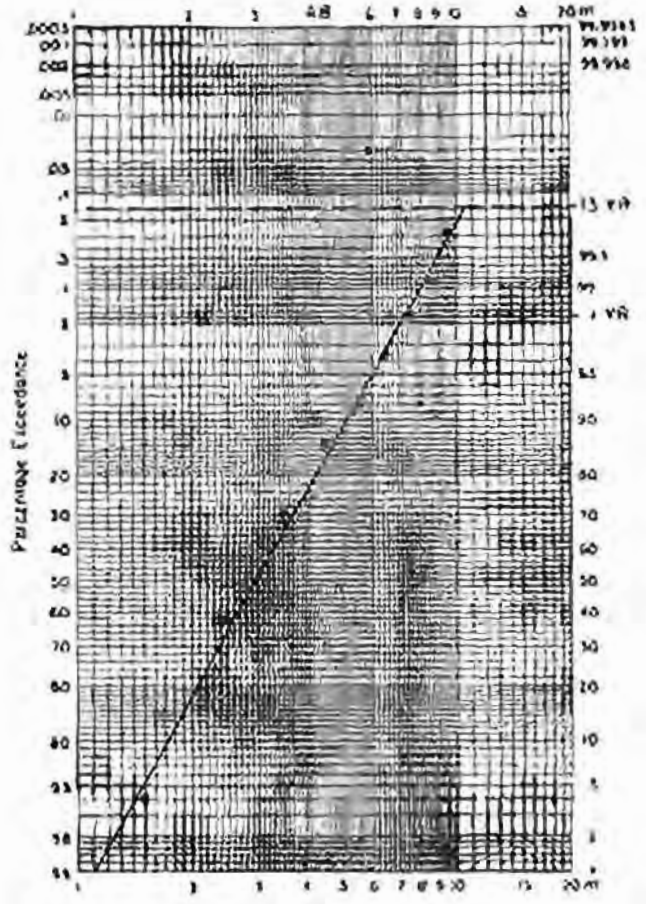
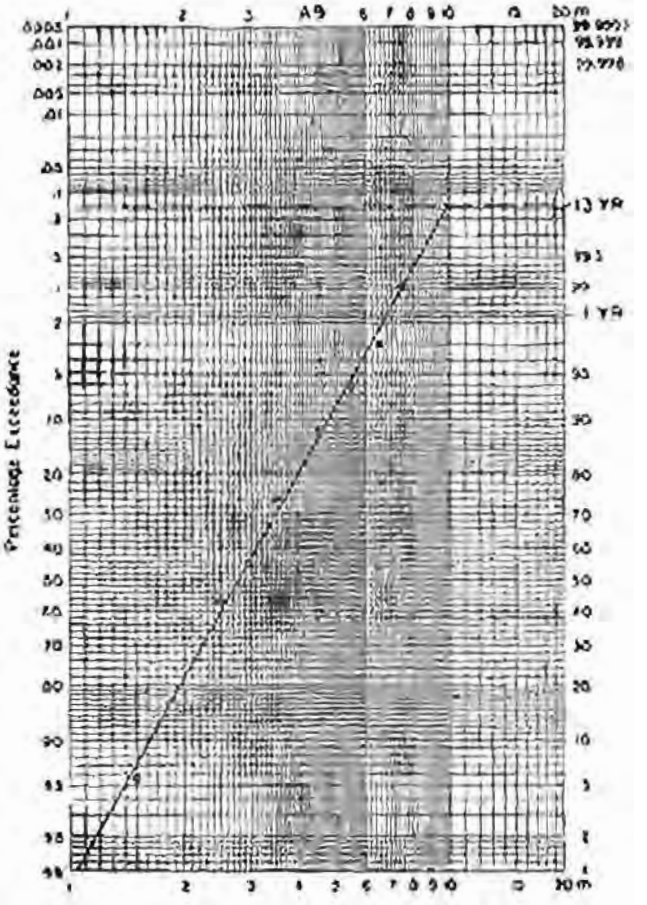


Figure 7c Monthly Wave Height Exceedance Distribution for February


Percentage Exceedance
43 YR
1 YR


Percentage Exceedance
13 YR
1 YR


Percentage Exceedance
13 YR
1 YR


Percentage Exceedance
13 YR
1 YR

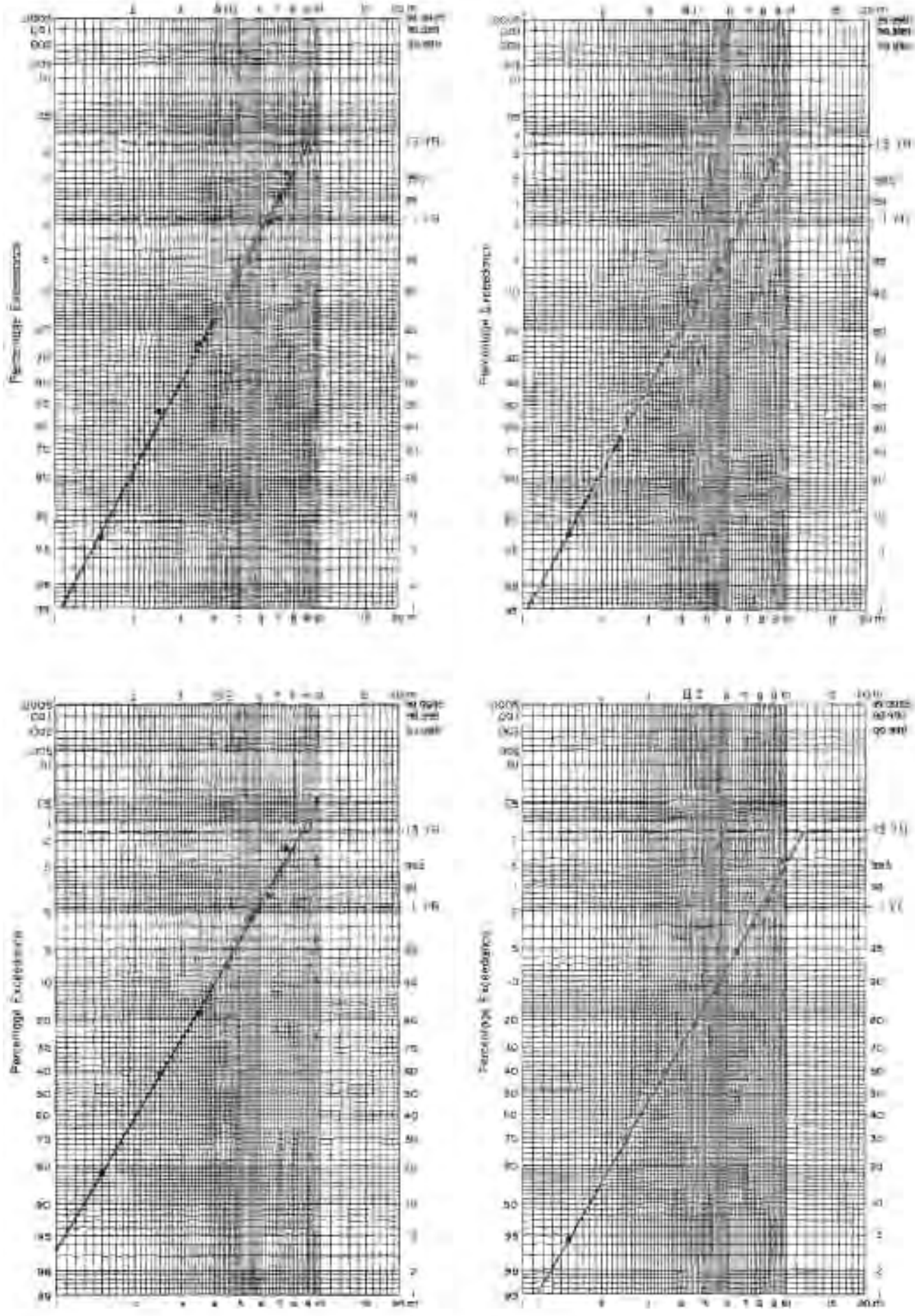
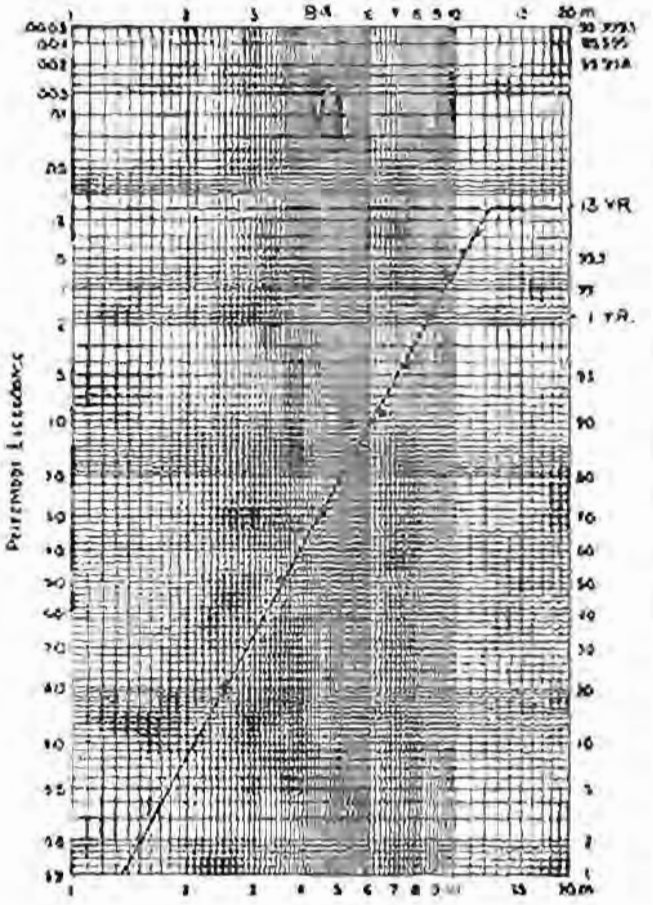
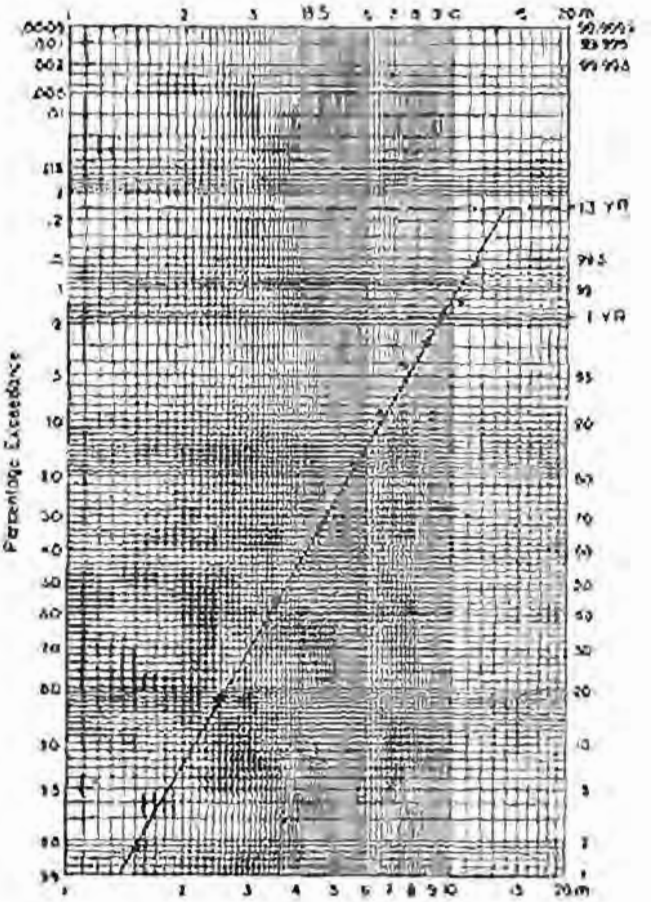
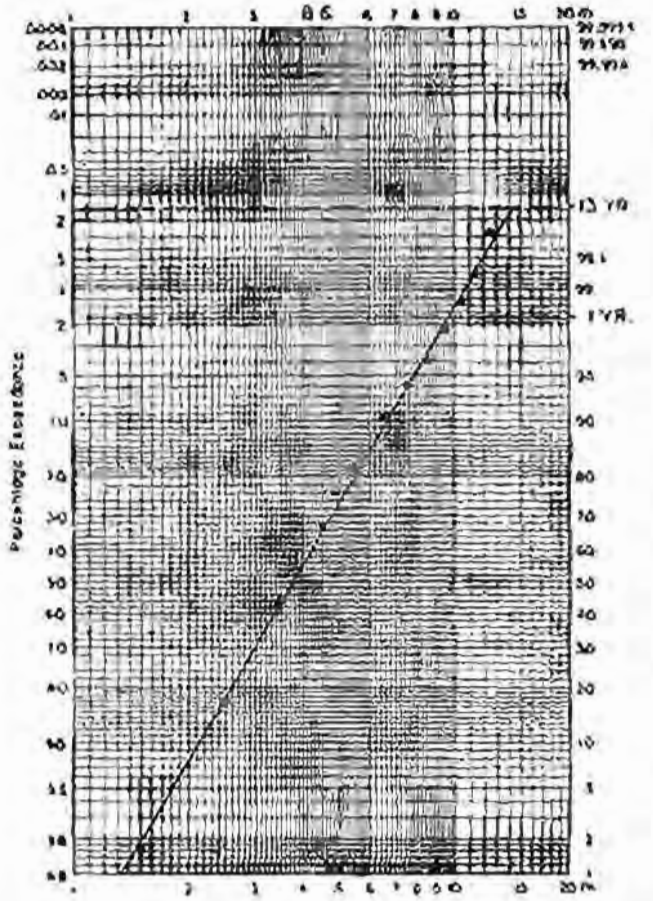
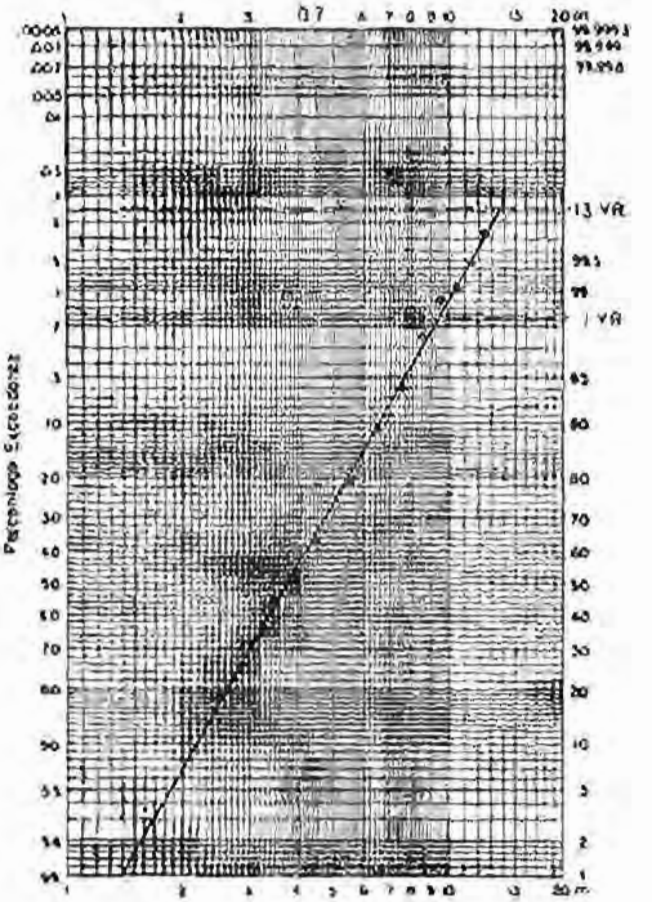


Figure 2e. Monthly Wave Height Exceedance Distribution for February









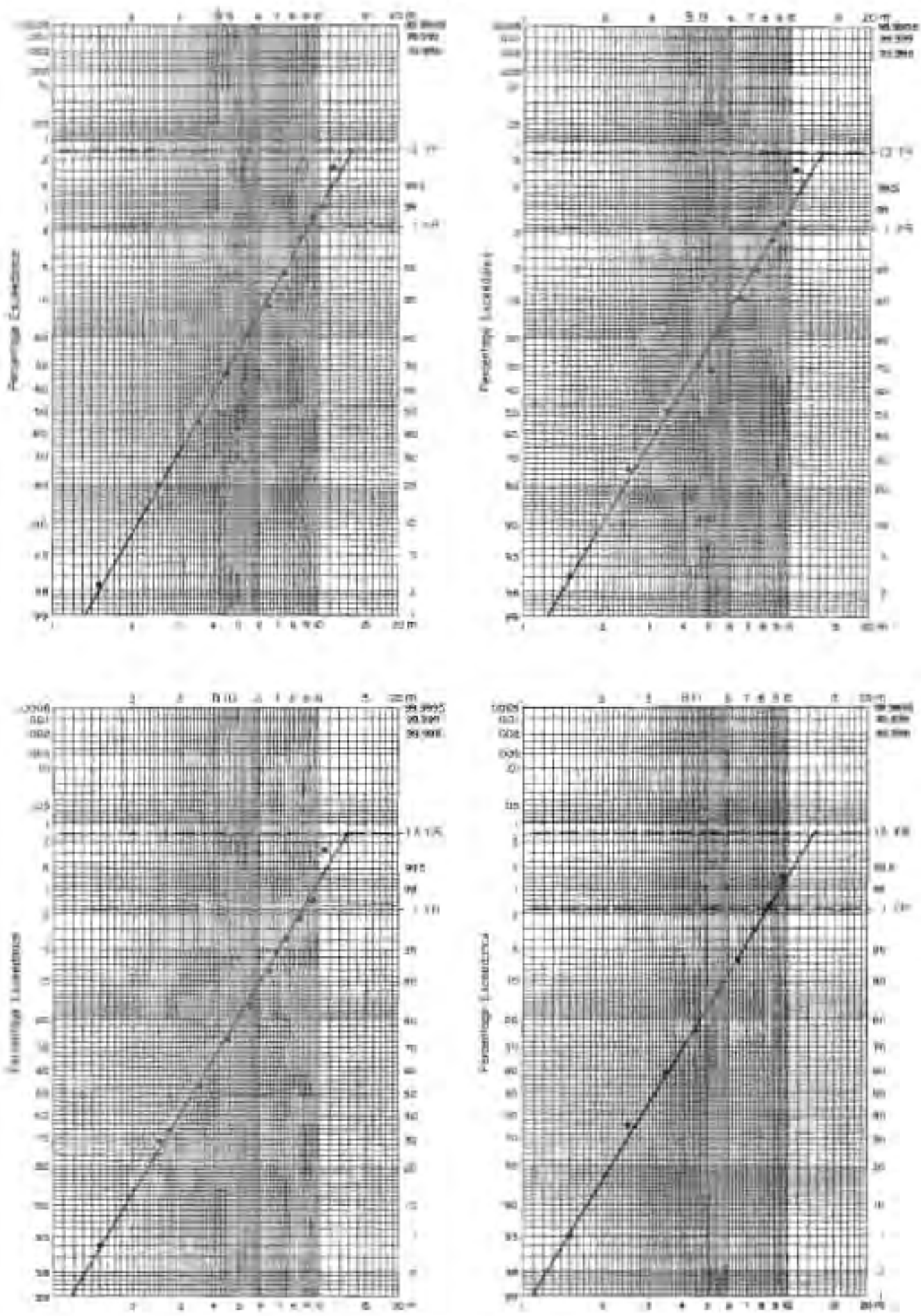


Figure 24 Monthly Wave Height Exceedance Distribution for February

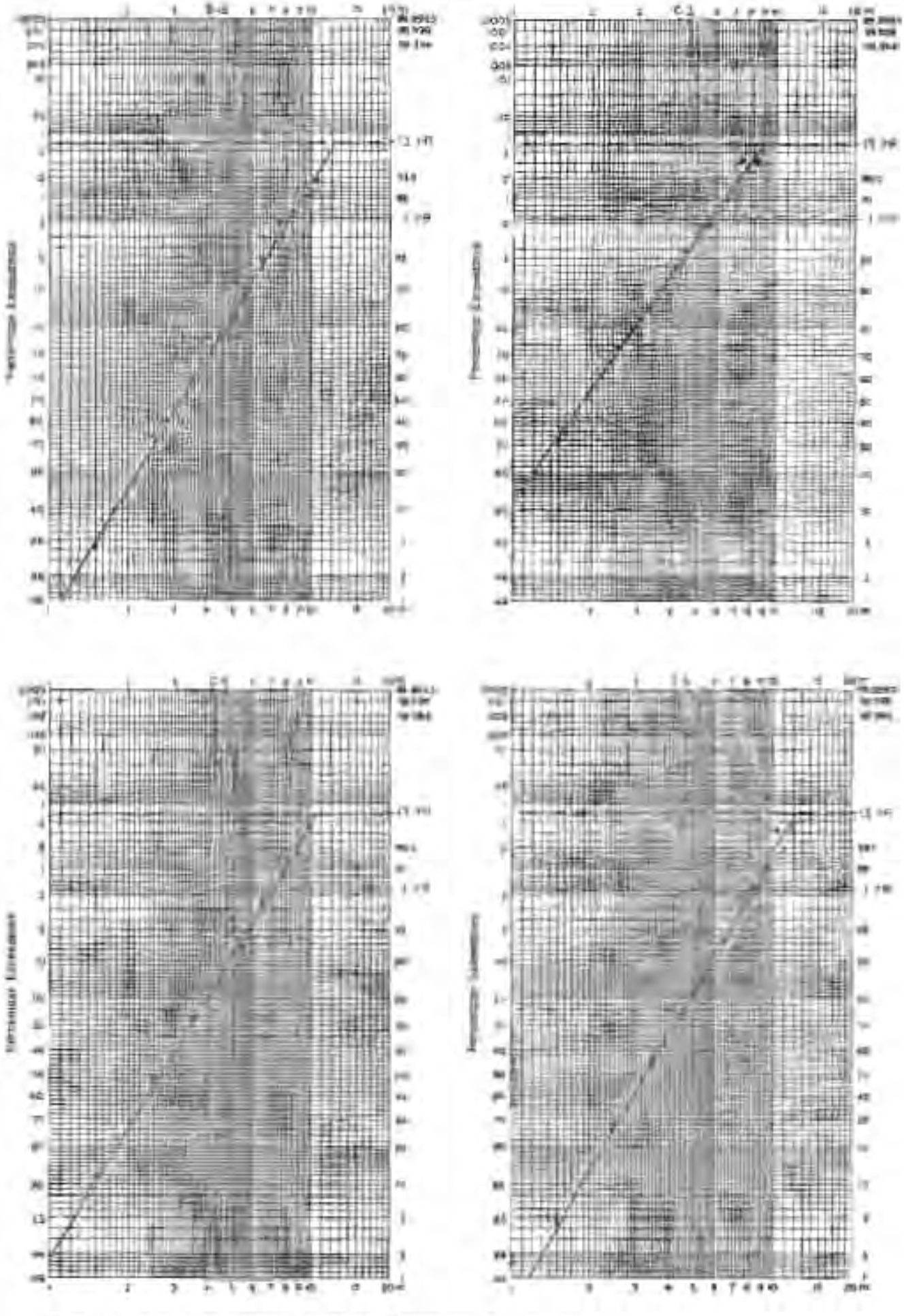


Figure 28. Monthly Wave Height Exceedance Distribution for February

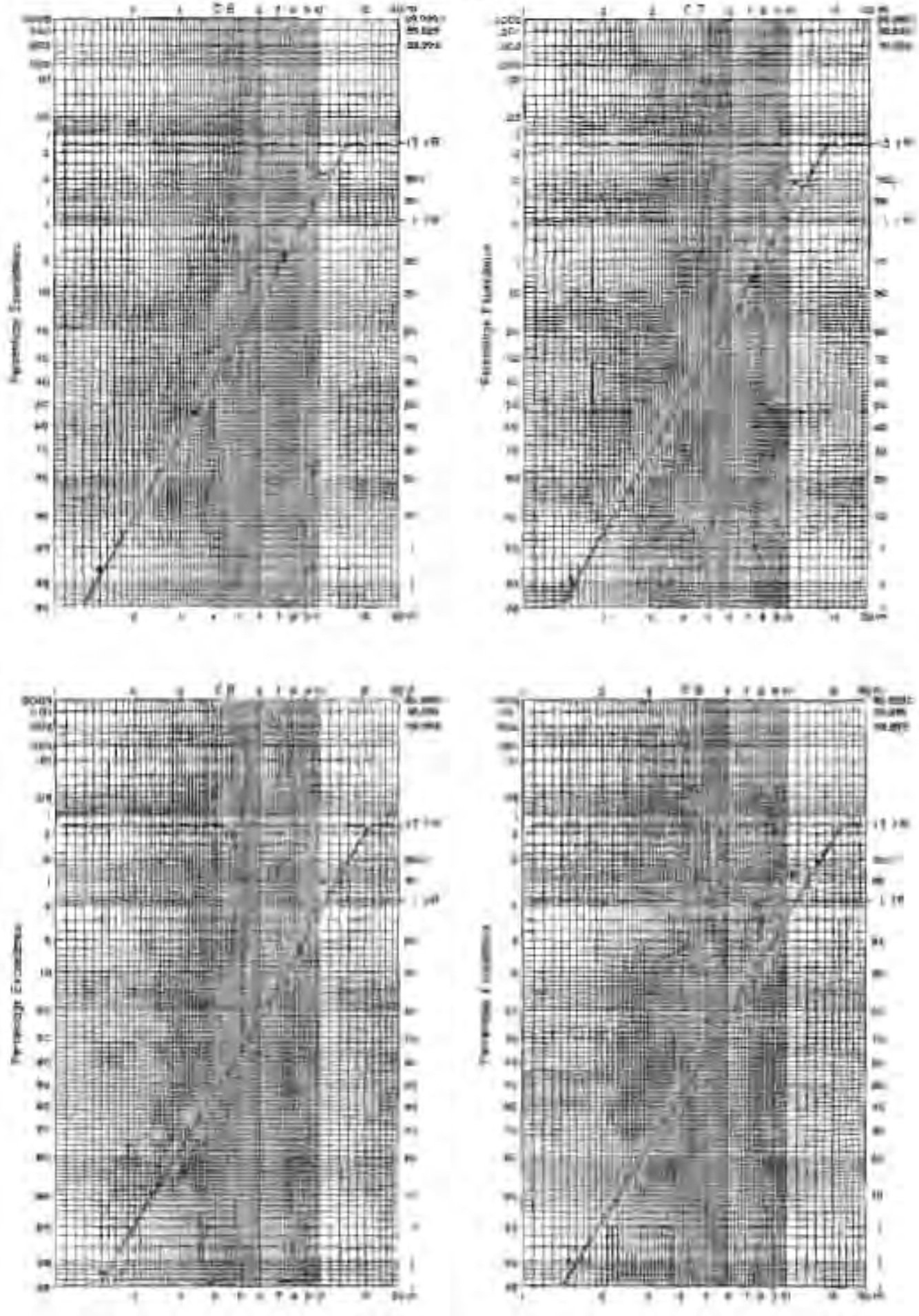


Figure [illegible] Monthly Wave Height Exceedance Distributions for February

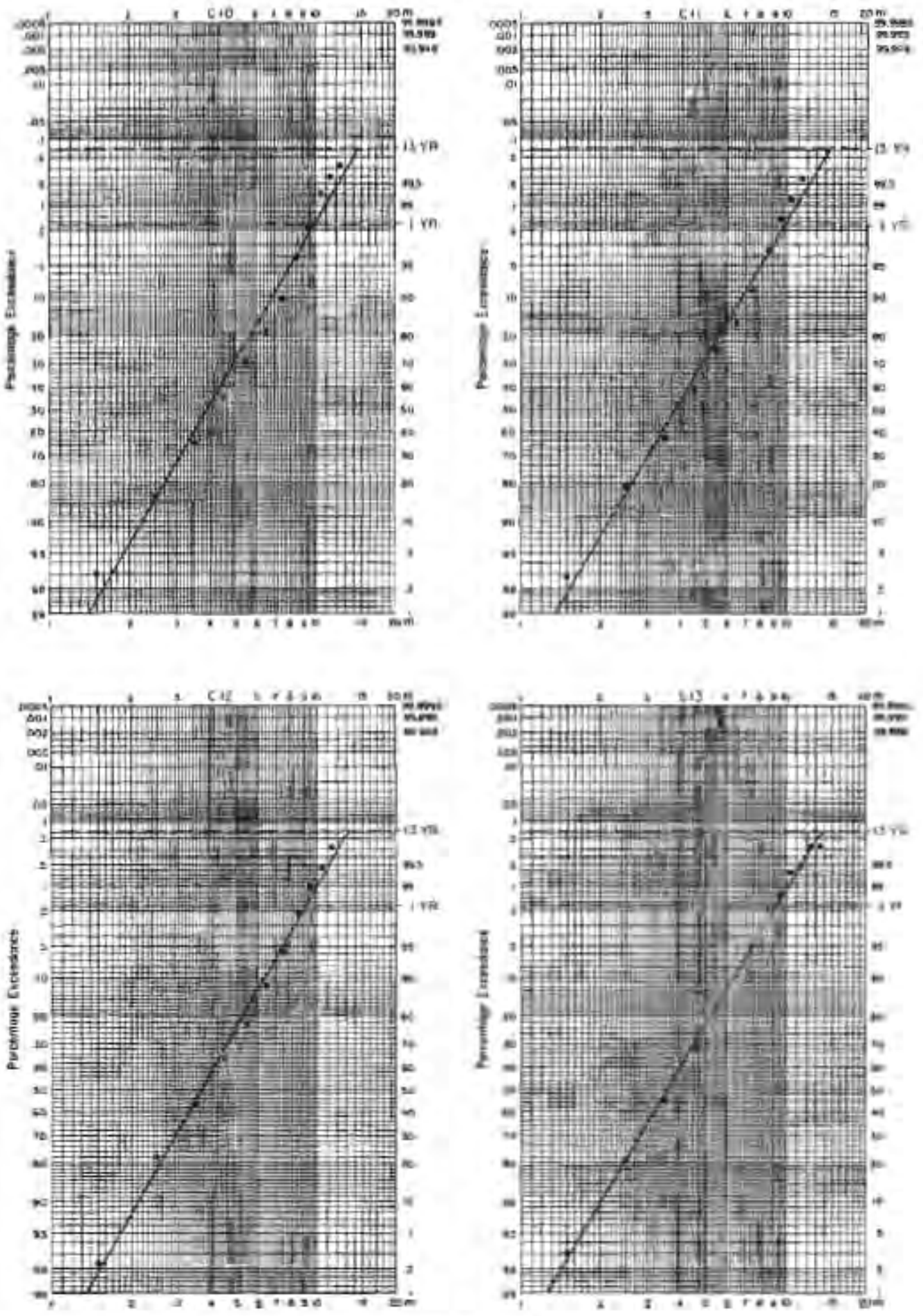


Figure 21. Monthly Wave Height Exceedance Distribution for February

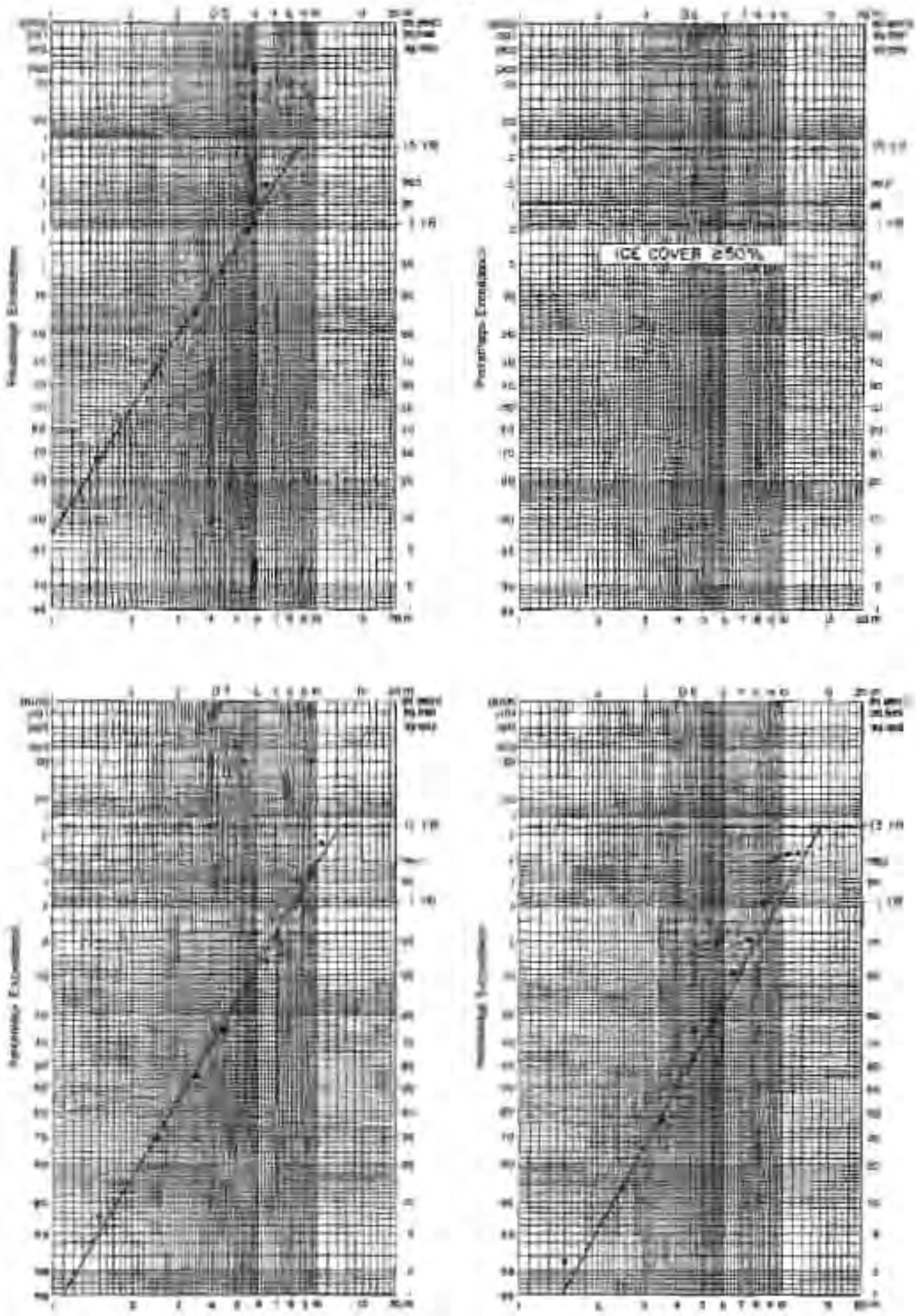


Figure 21 Monthly Wave Height Exceedance Distribution for Palmer

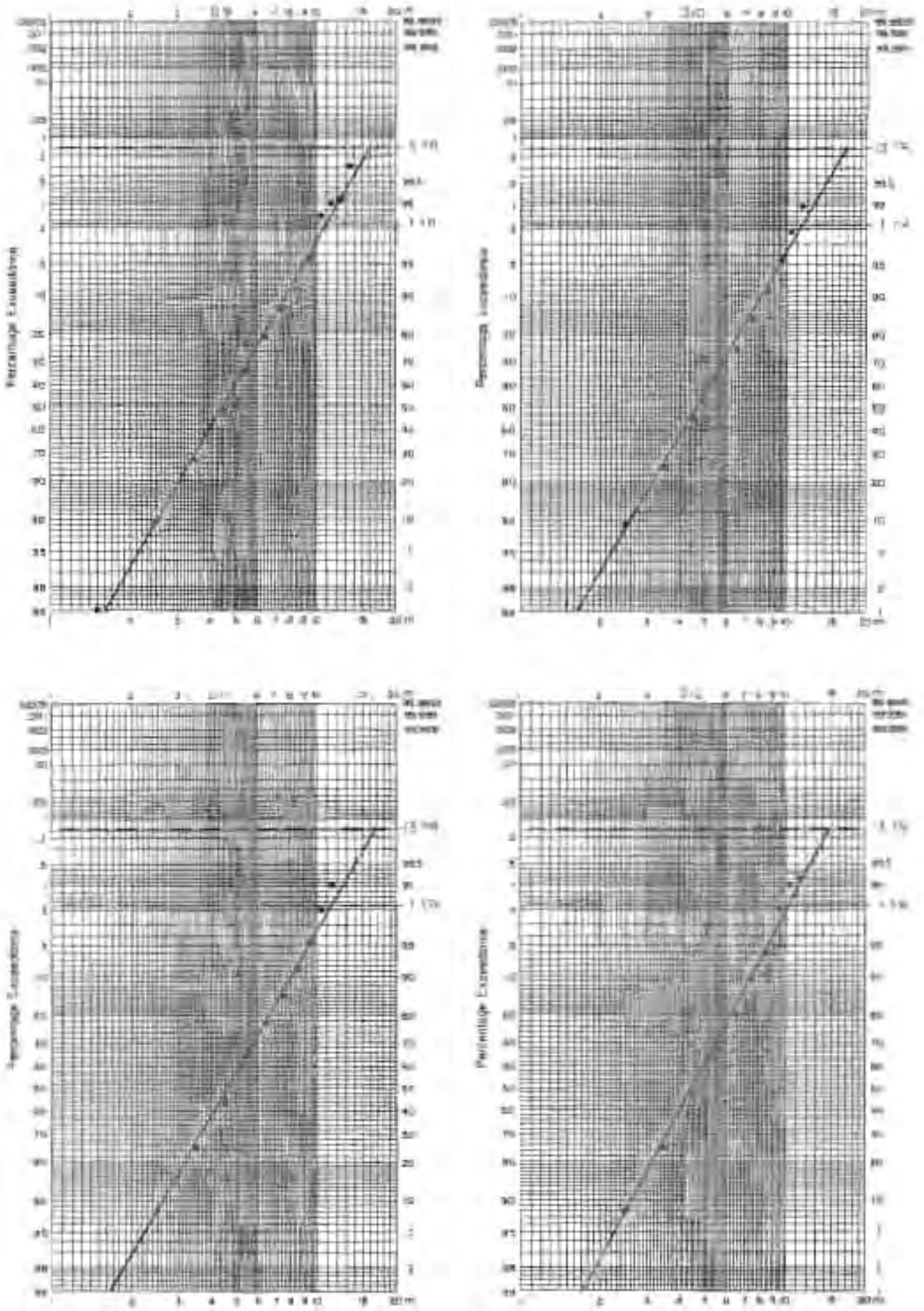


Figure 2: Monthly Wave Height Exceedance Distribution for February

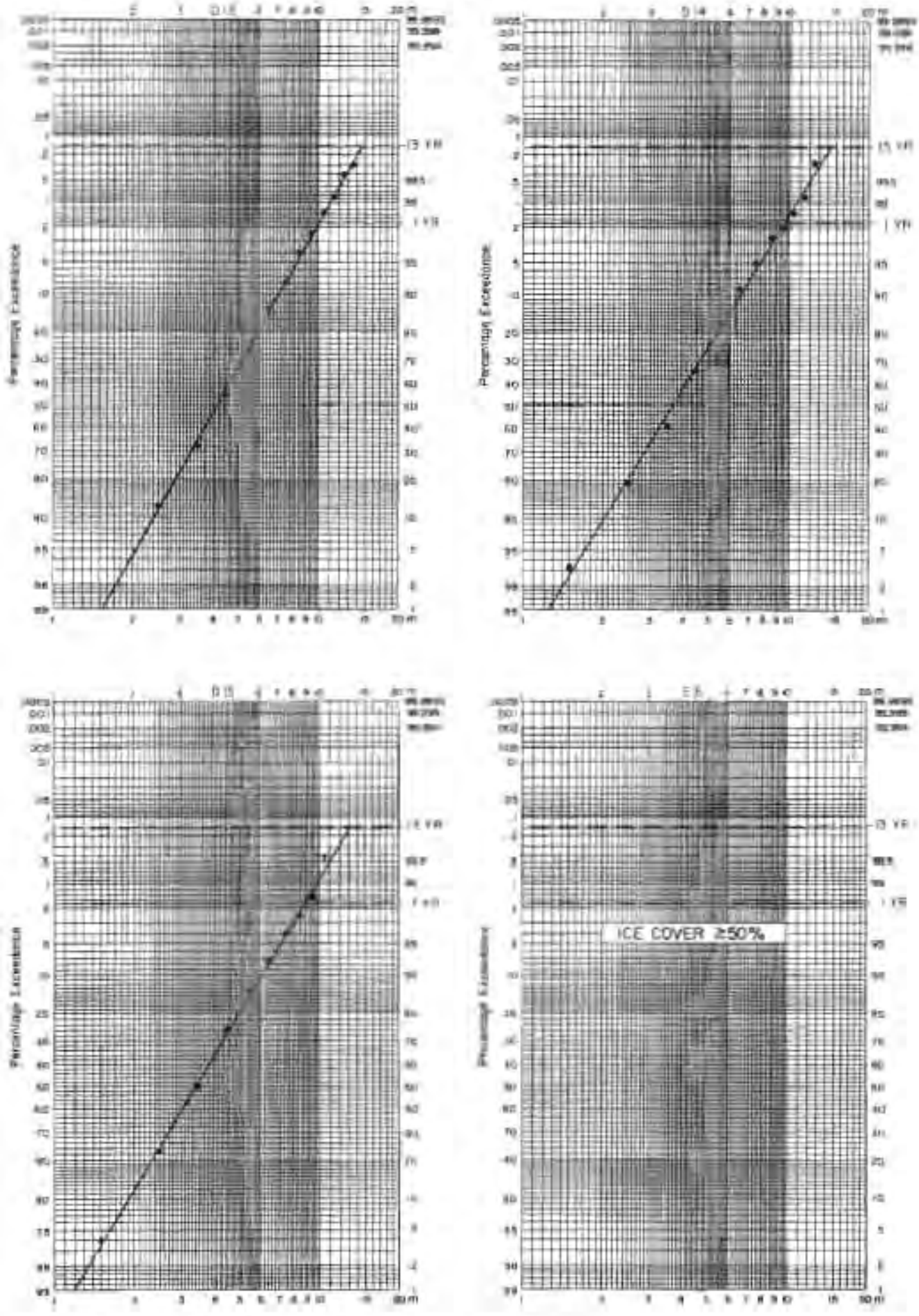
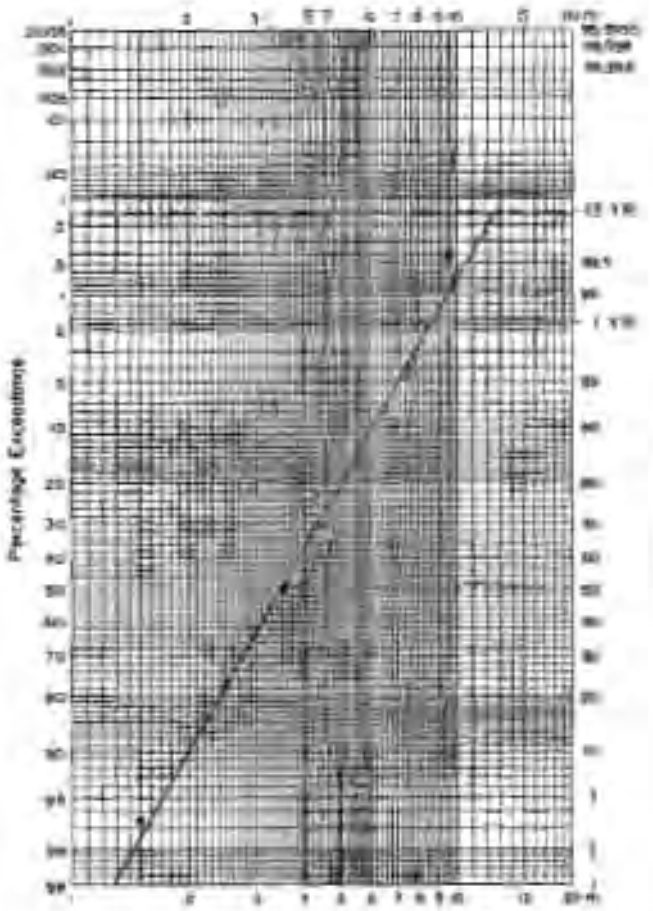
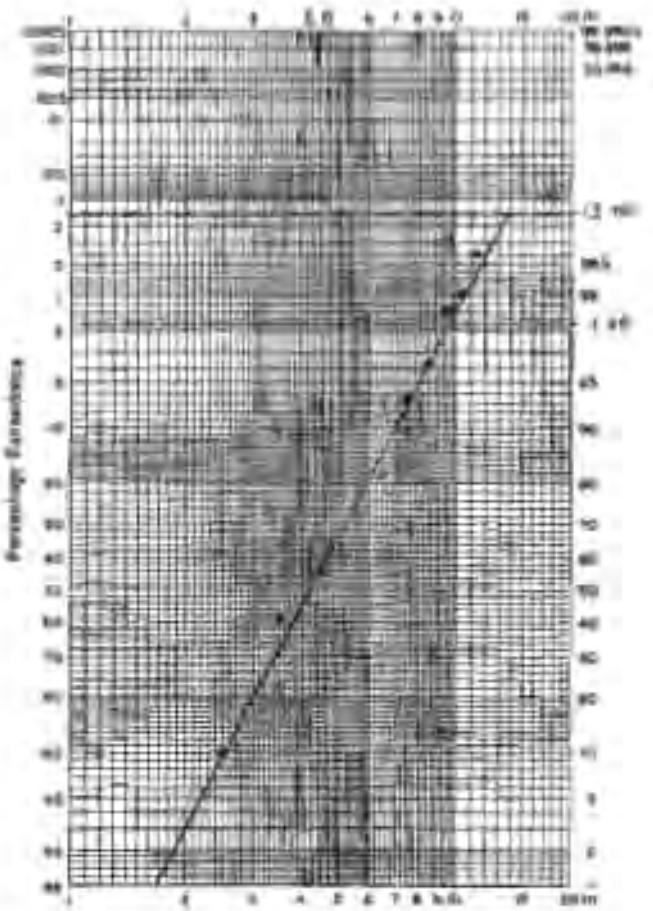
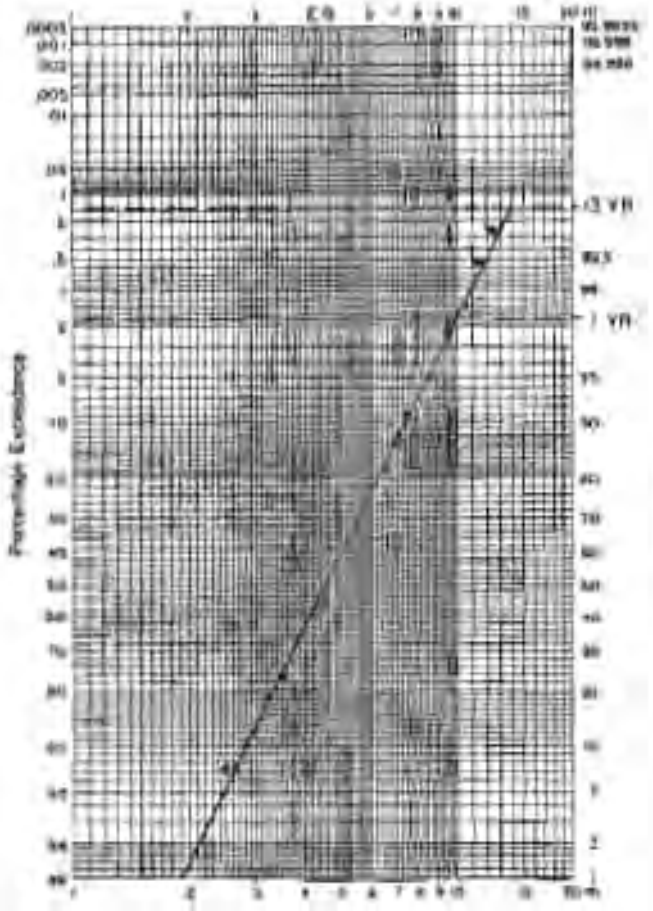
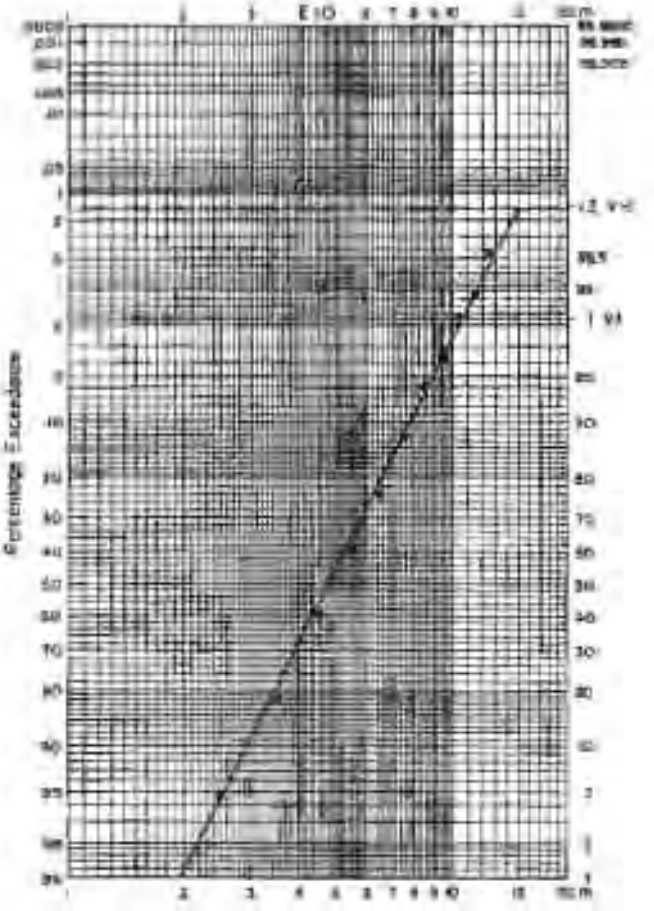


Figure 2m Monthly Wave Height Exceedance Distribution for February









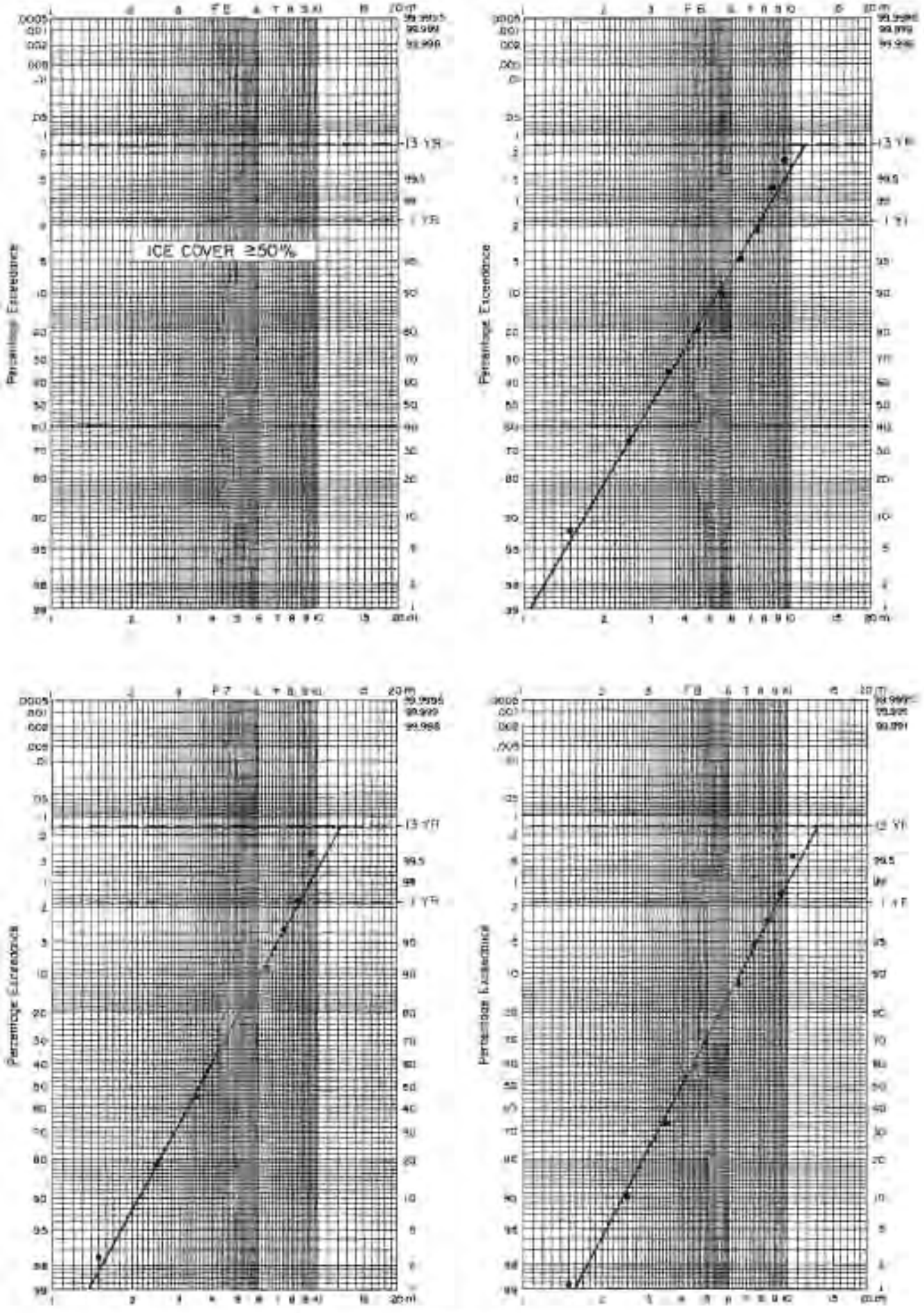


Figure 2a. Monthly Wave Height Exceedance Distribution for February

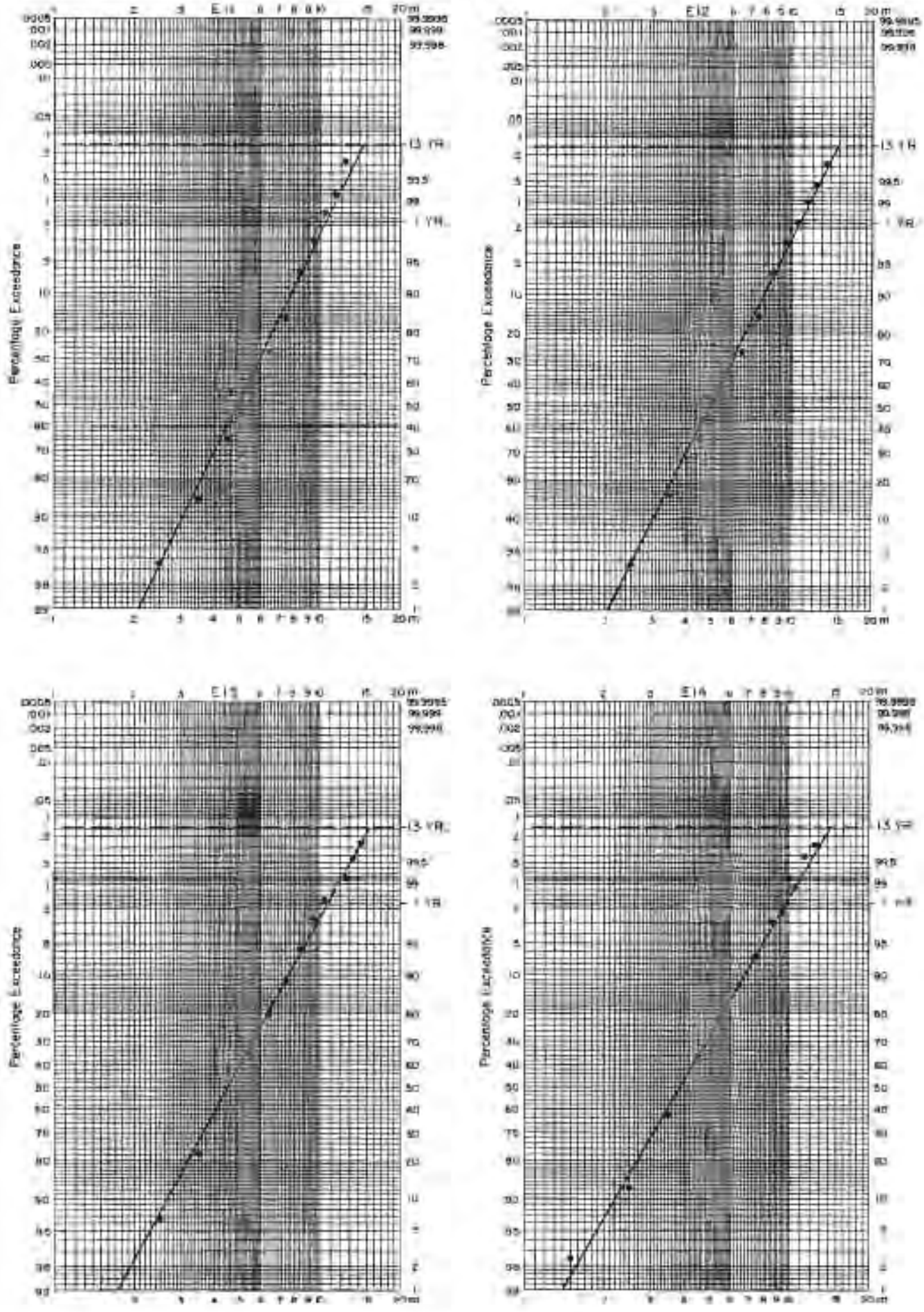


Figure 20. Monthly Wave Height Exceedance Distribution for February

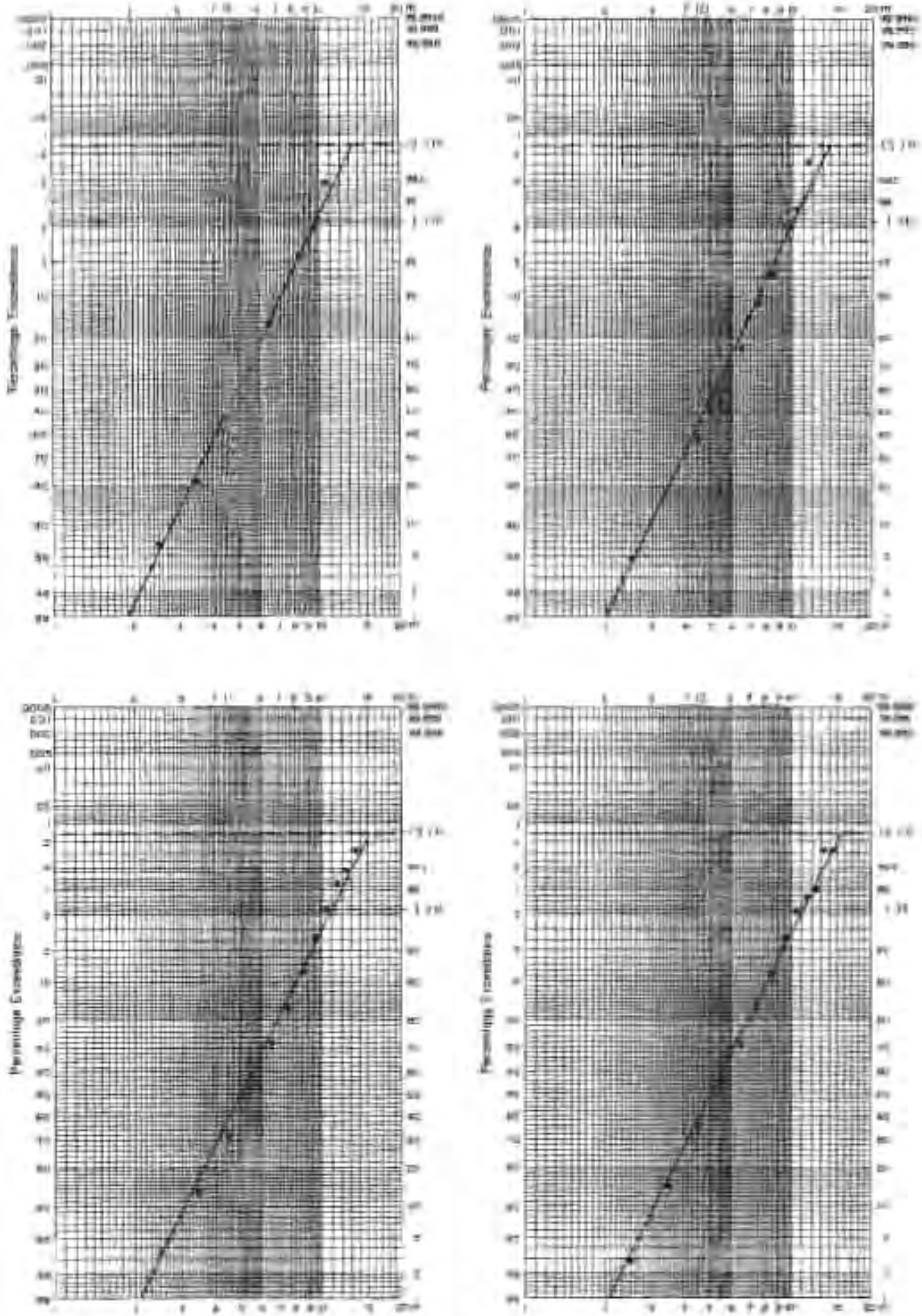


Figure 2v Monthly Wave Height Exceedance Distribution for February

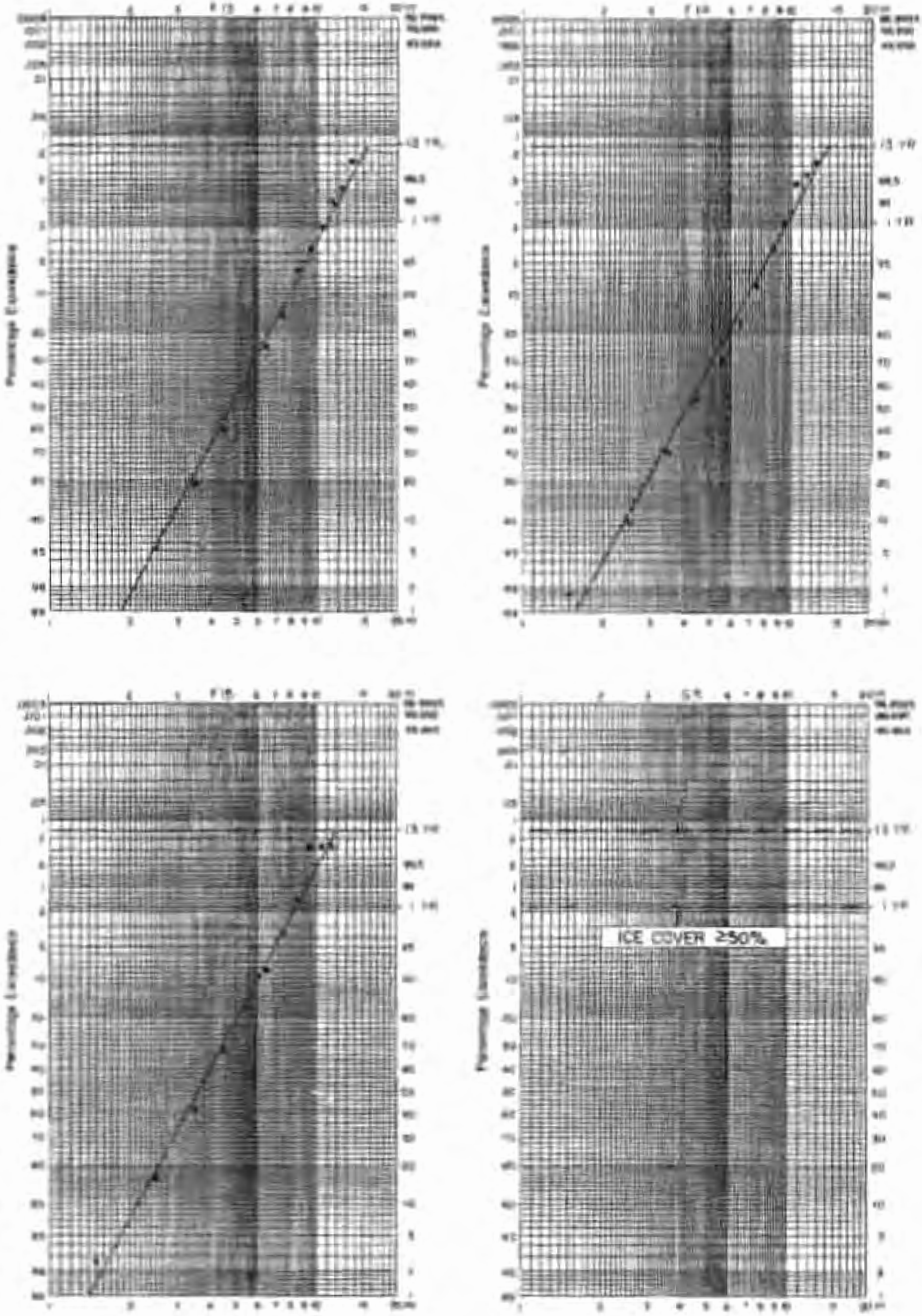


Figure 2) [illegible]

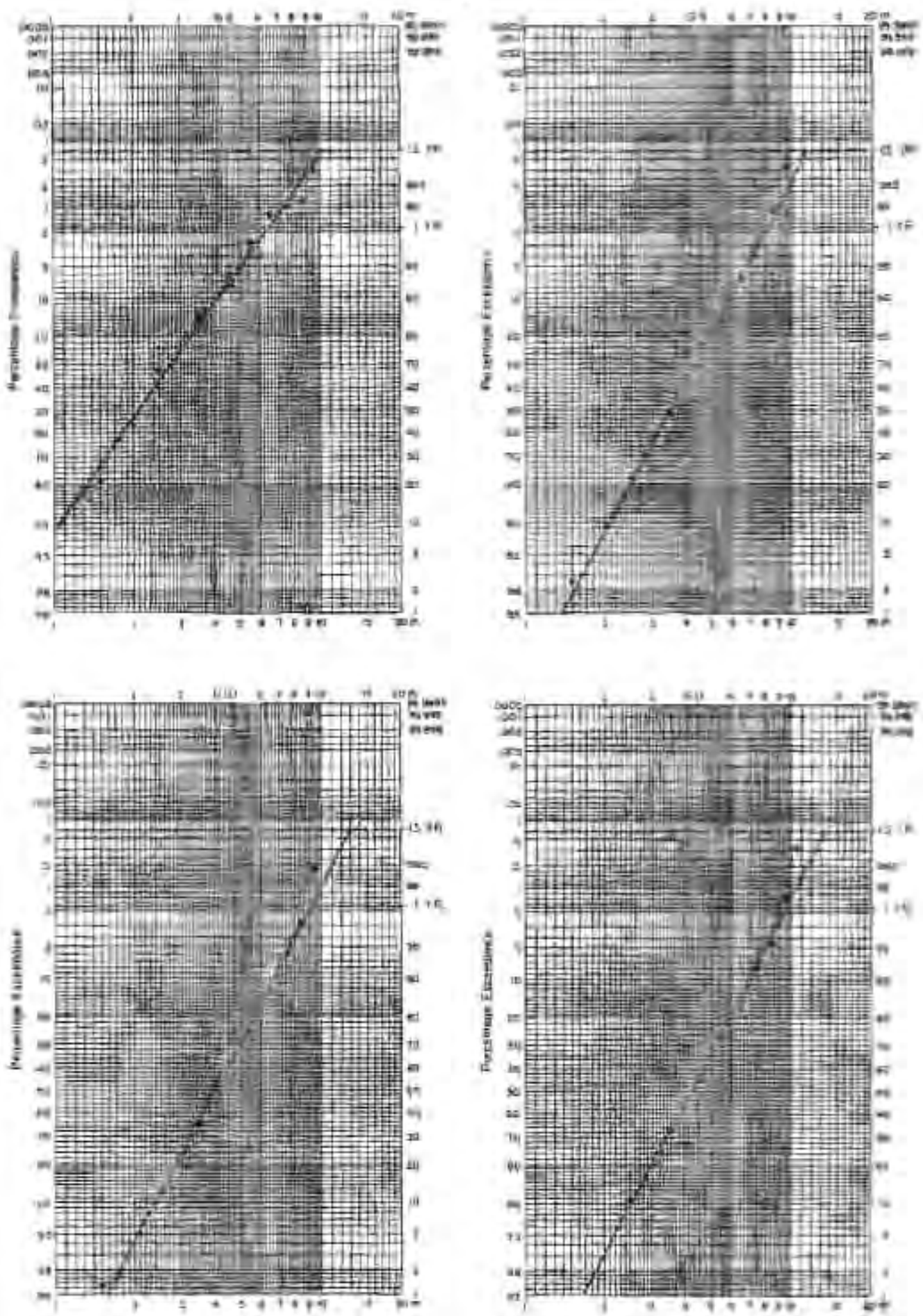


Figure 11 Monthly Wave Height Exceedance Distribution (in Percent)

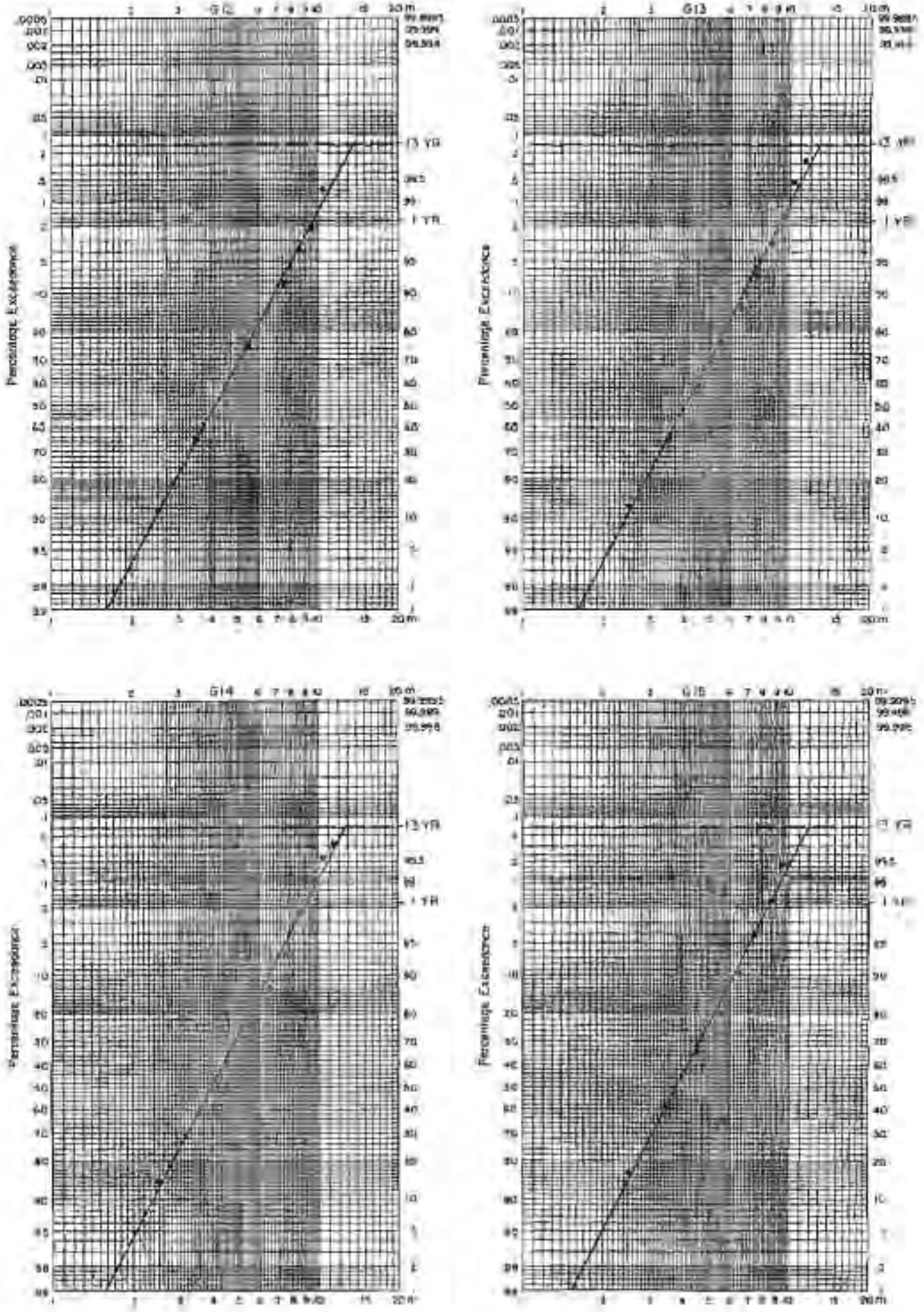


Figure 21 Monthly Wave Height Exceedance Distribution for February

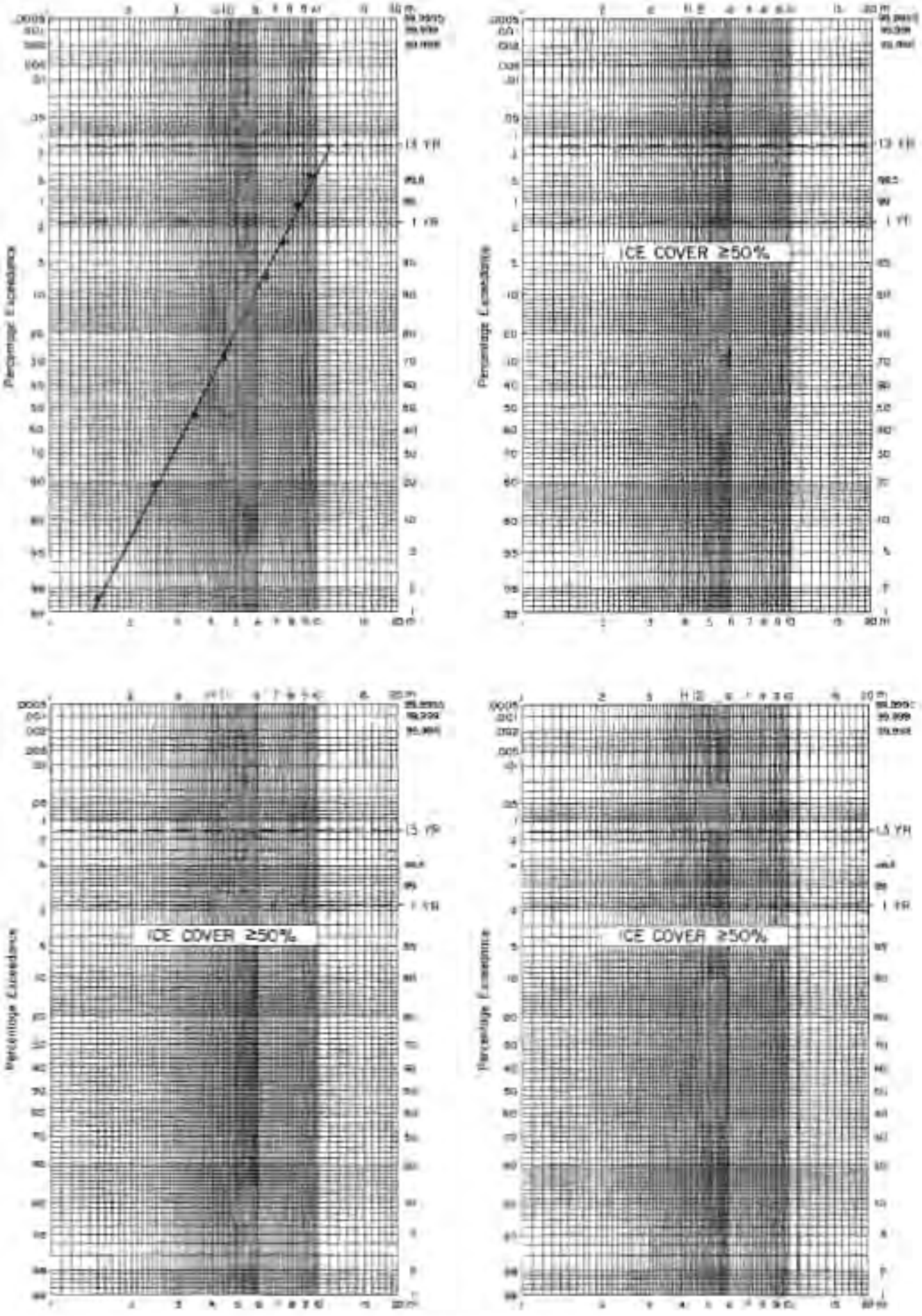
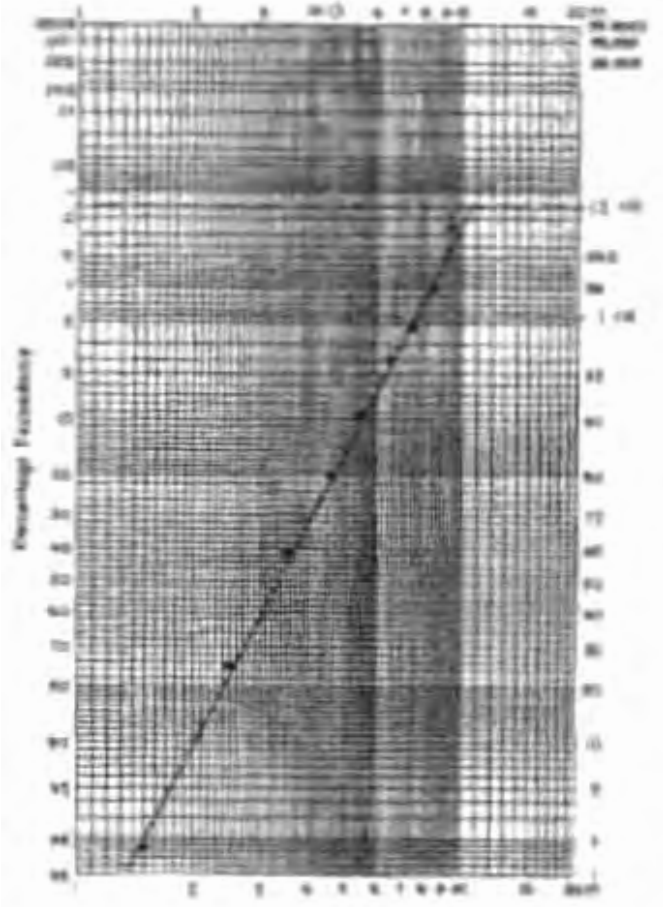
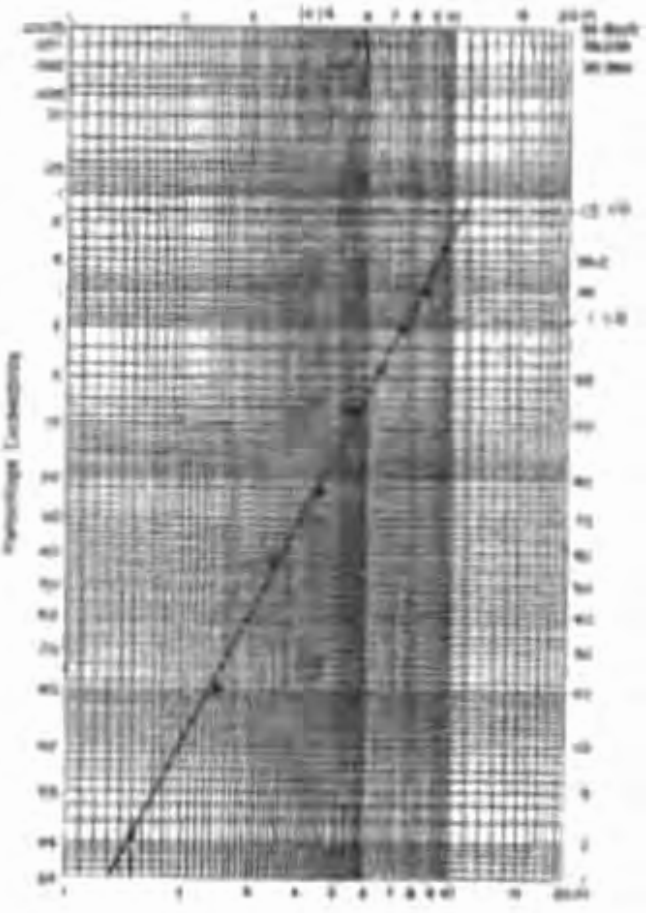
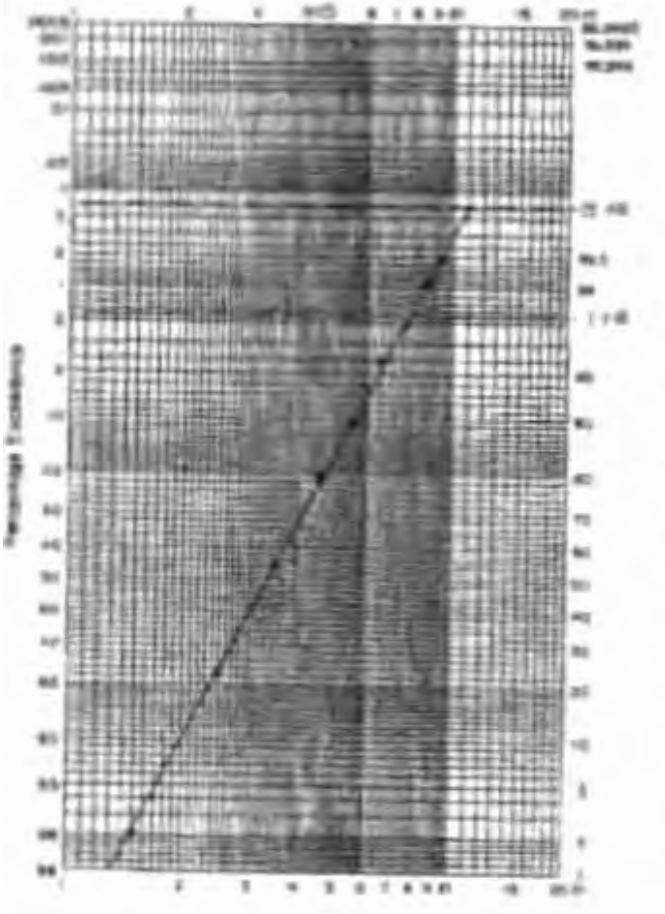
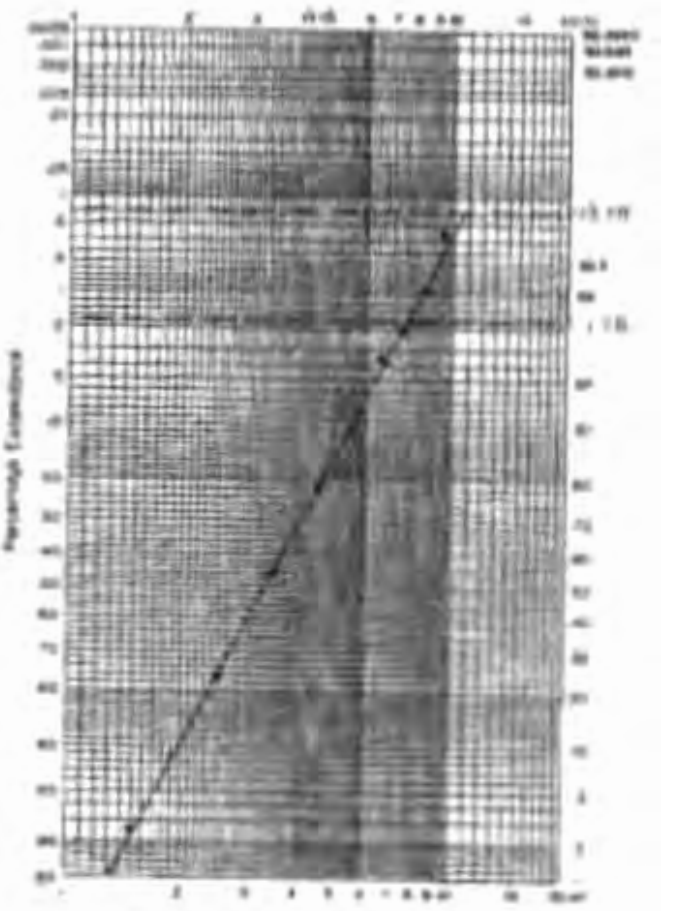


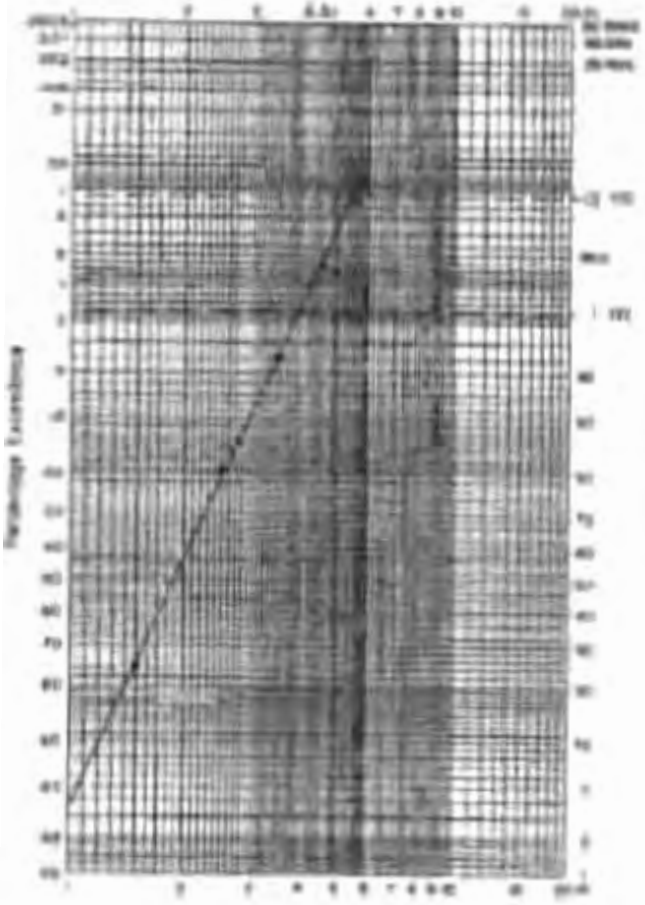
Figure 2a Monthly Wave Height Exceedance Distribution for February

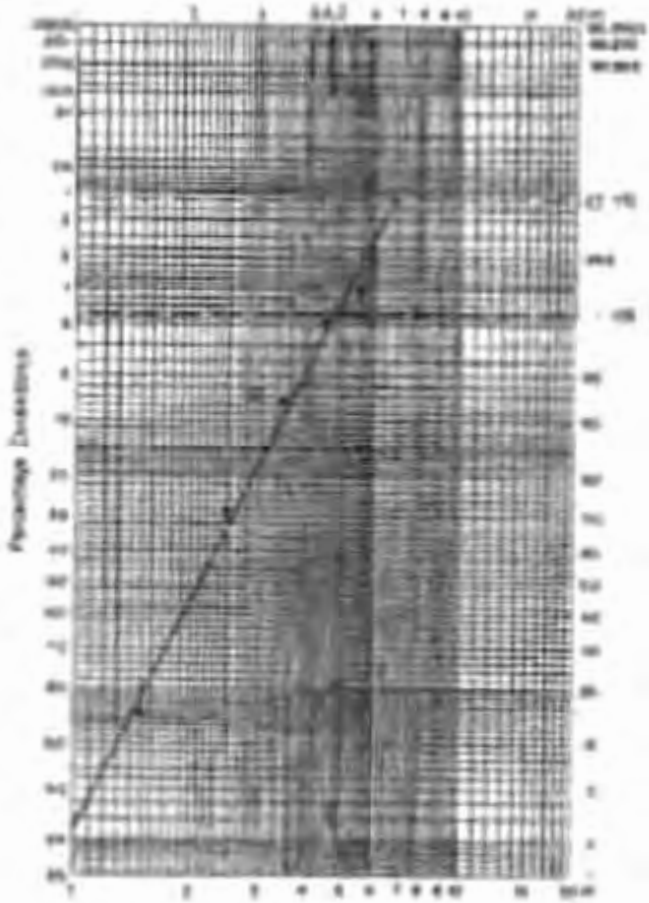


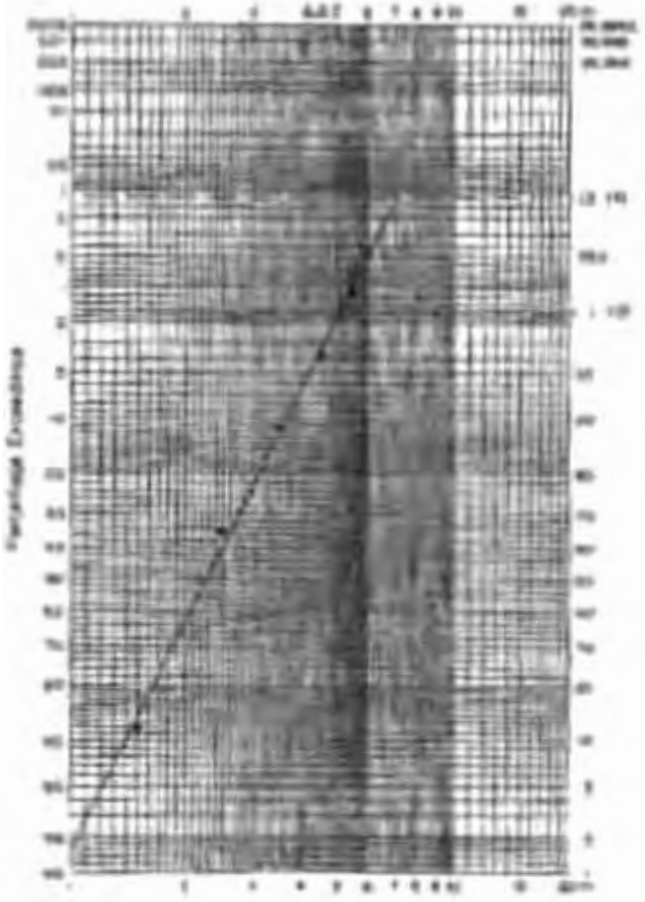


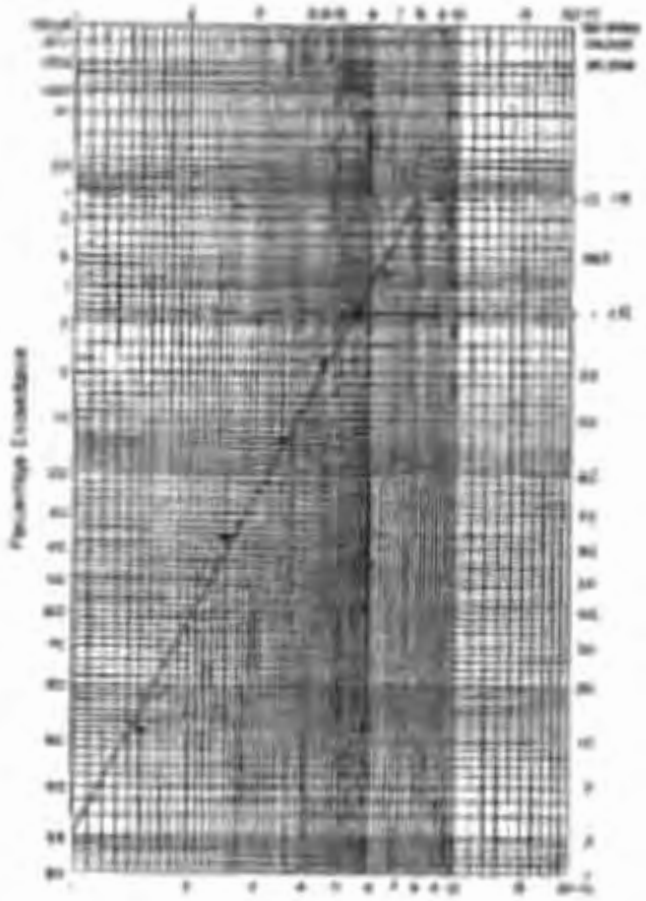












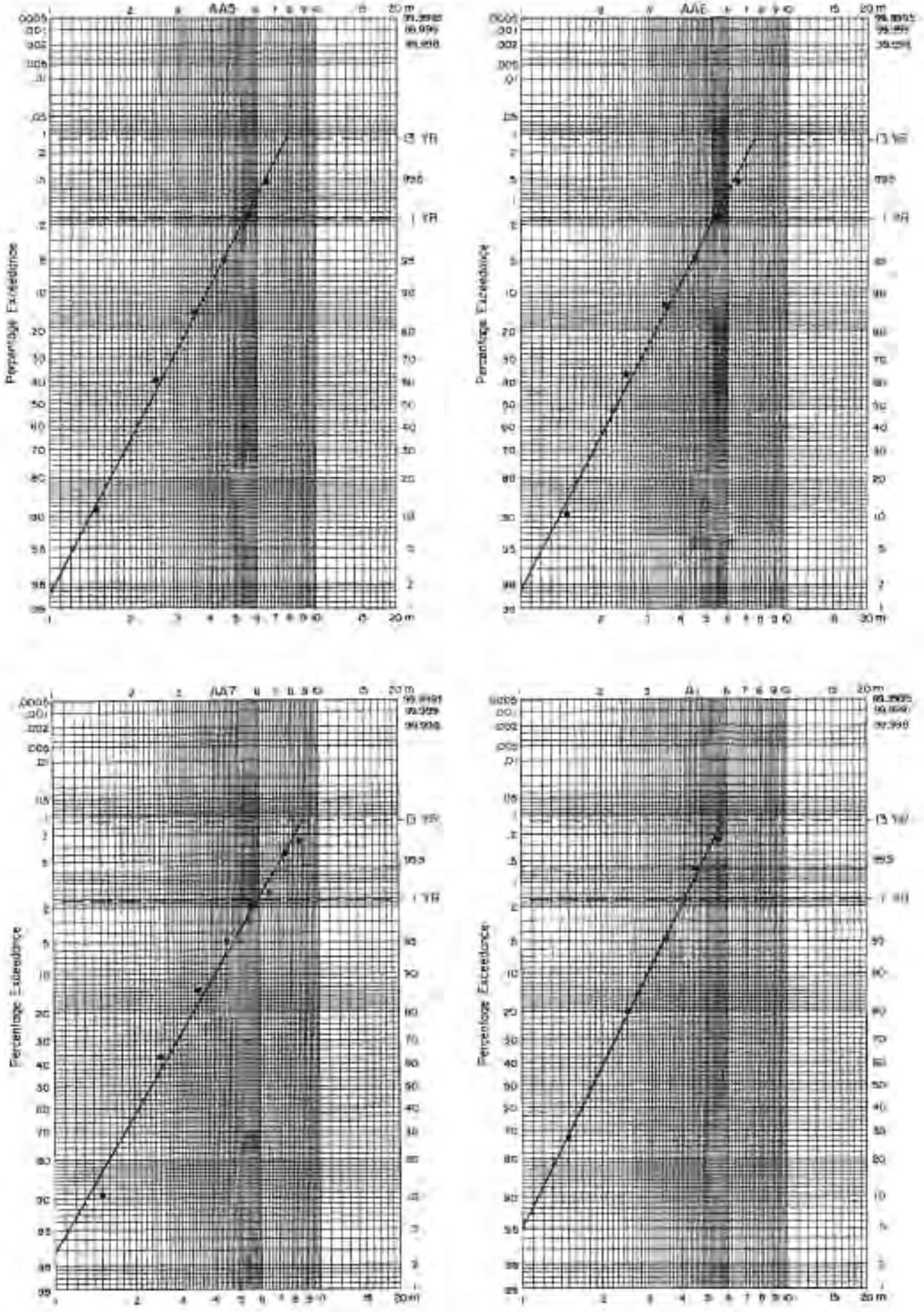


Figure 36 Monthly Wave Height Exceedance Distribution for March

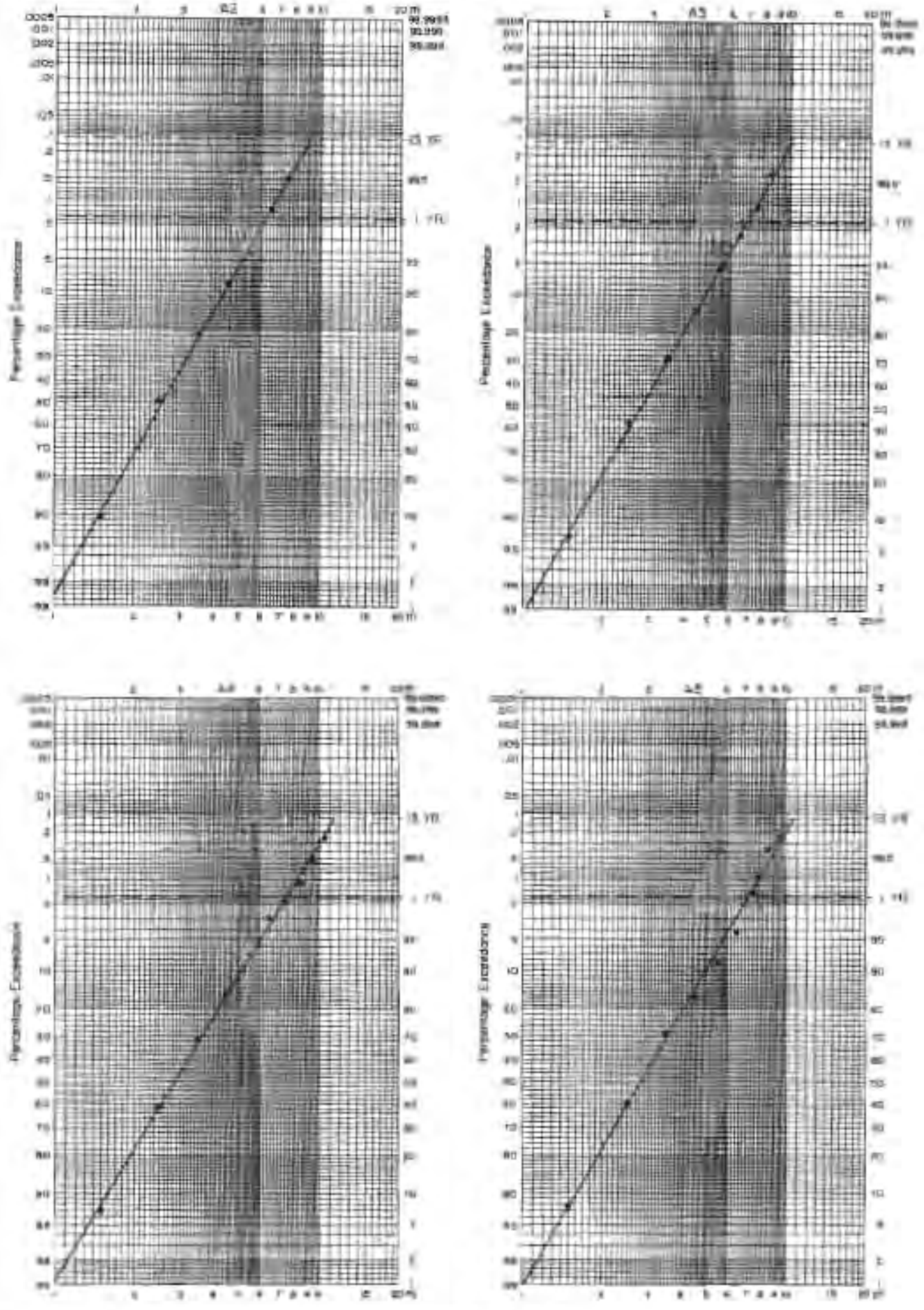


Figure 5c Monthly Wave Height Exceedance Distribution for March

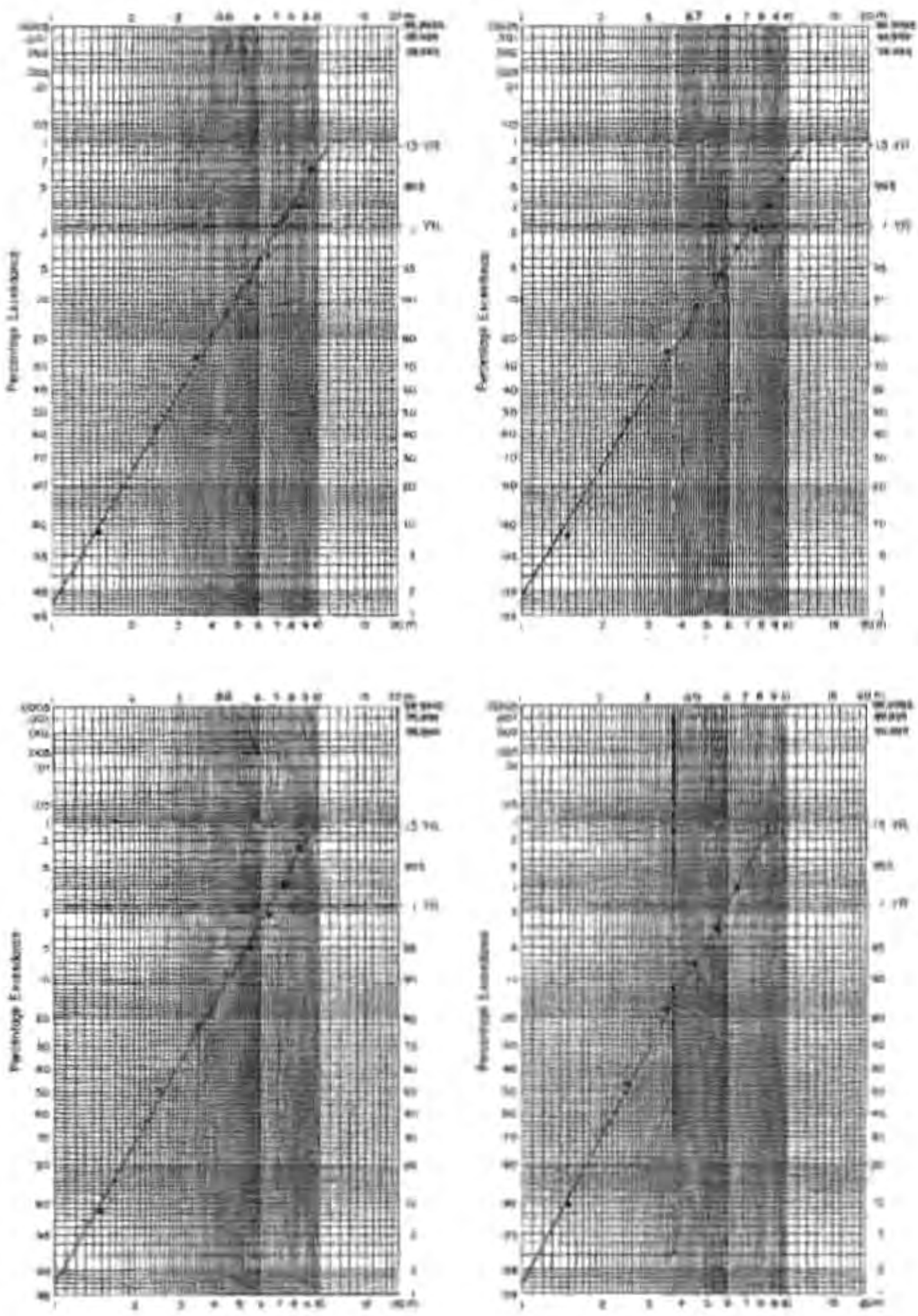


Figure 3d Monthly Mean Height Exceedance Distribution for March

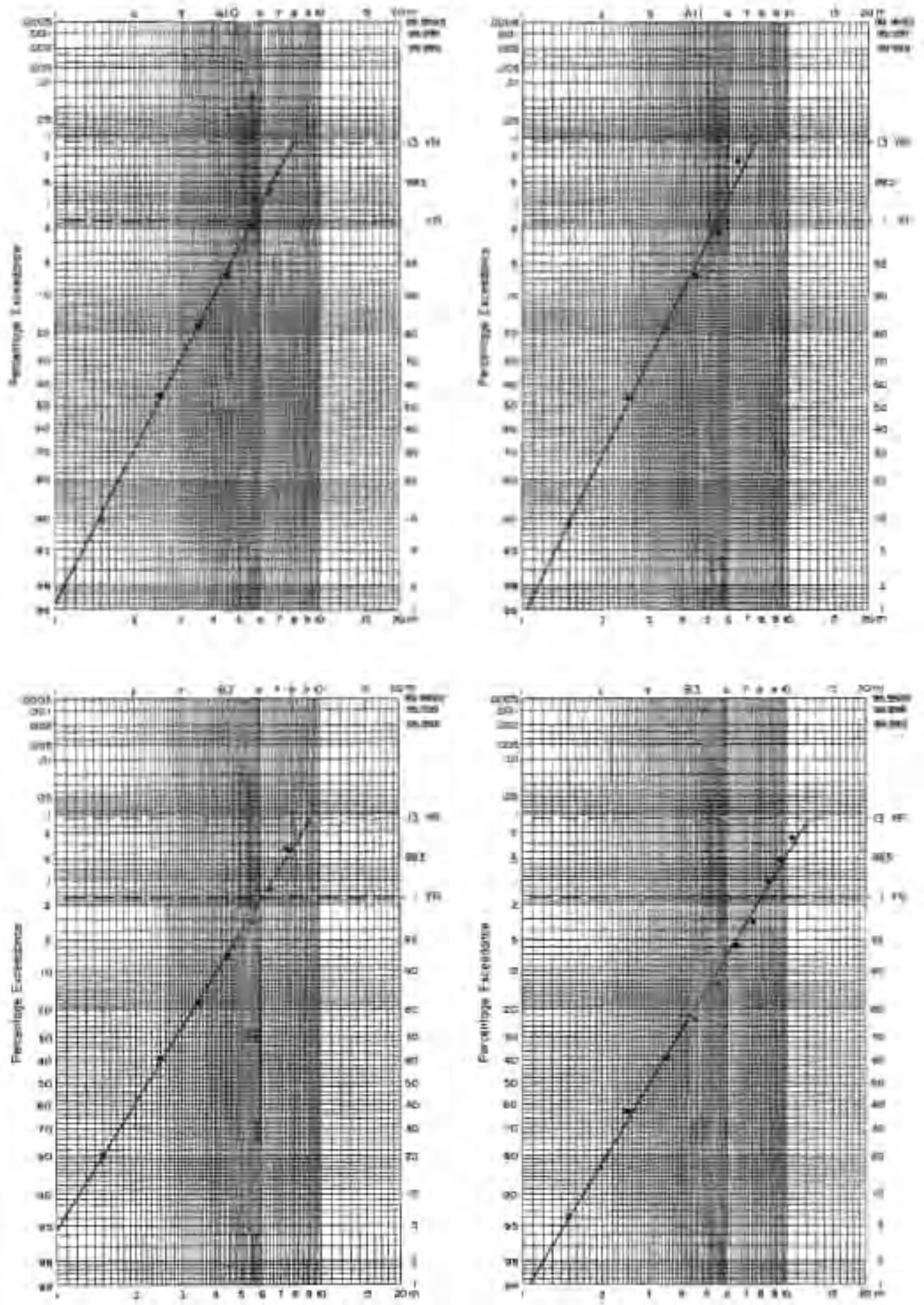
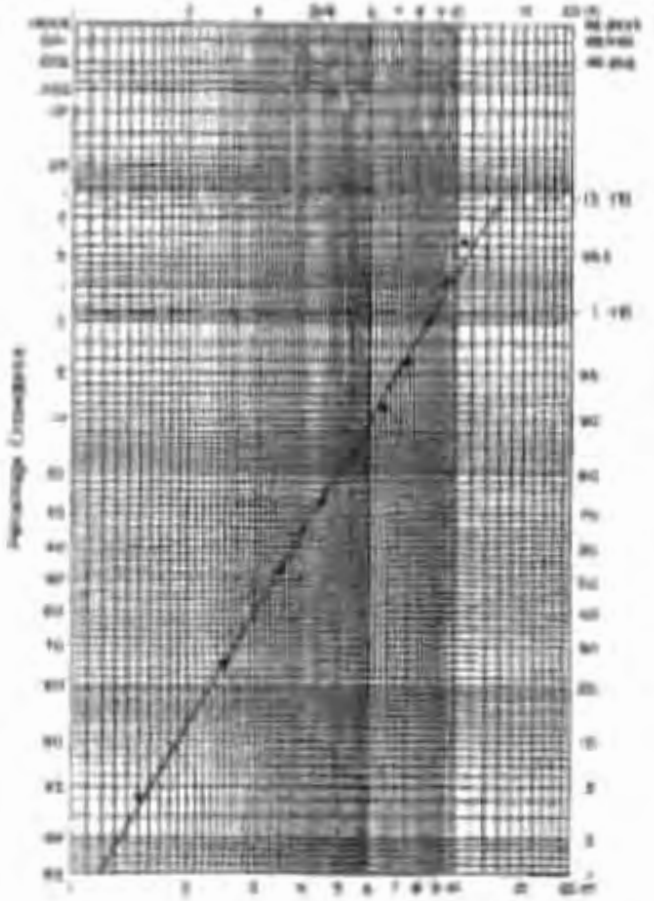
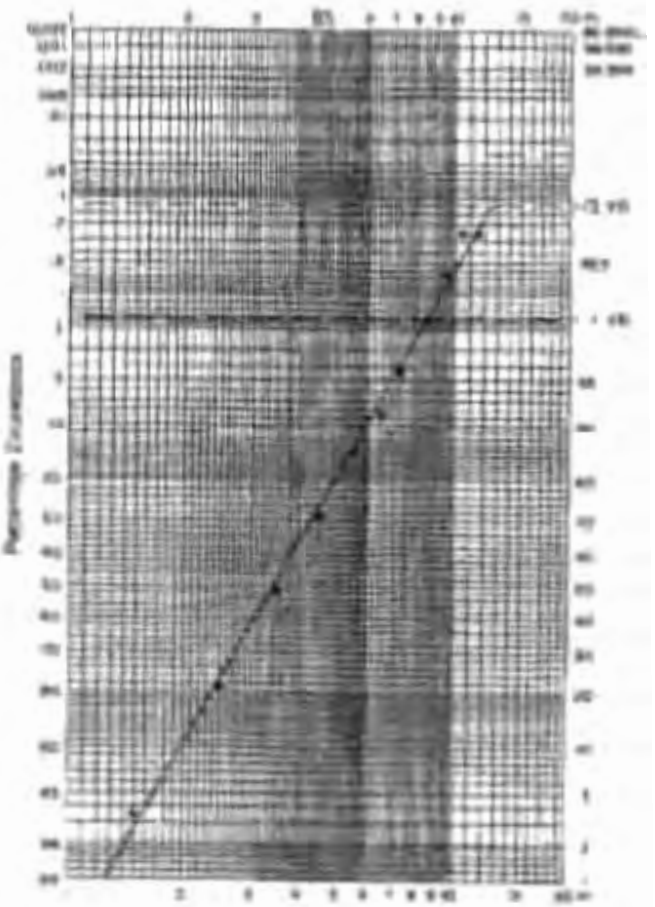
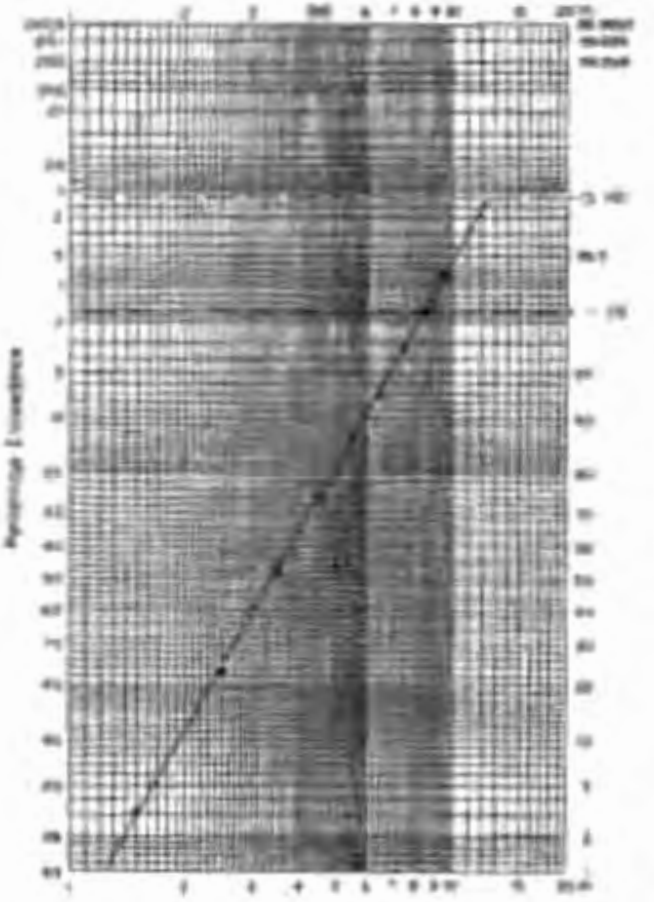
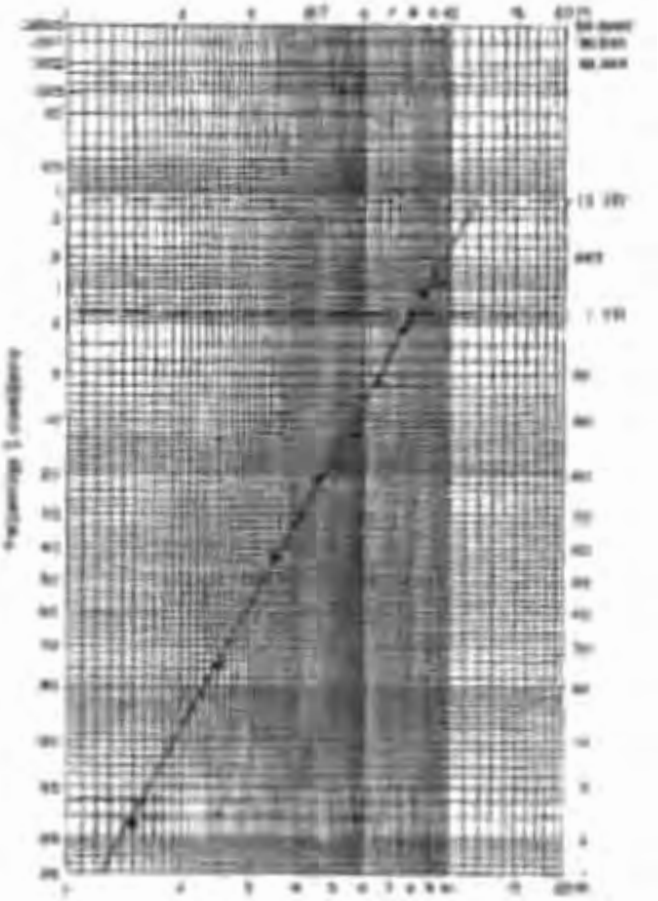


Figure 3e Monthly Wave Height Exceedance Distribution for March









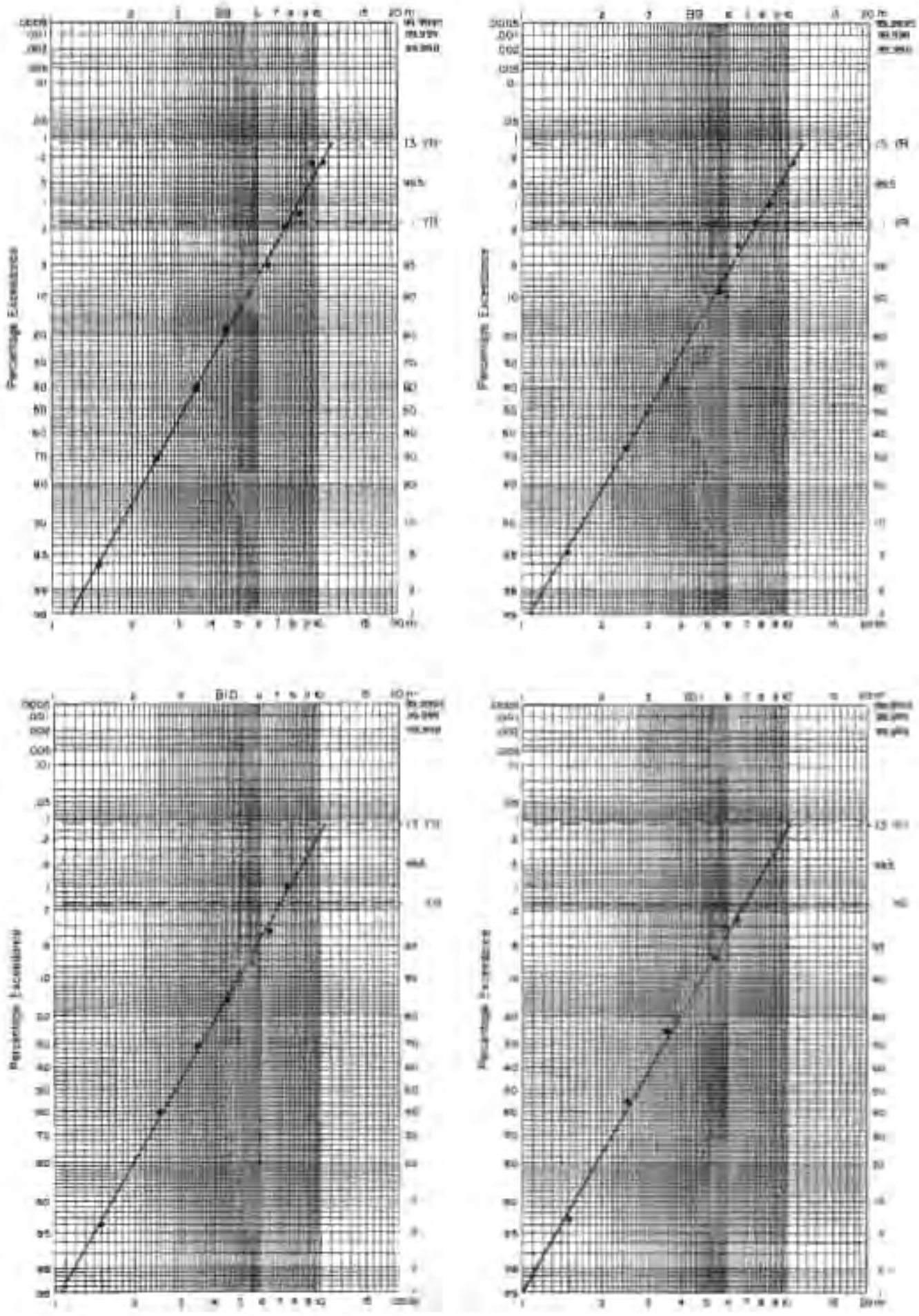


Figure 3g. Monthly Wave Height Exceedance Distribution for March

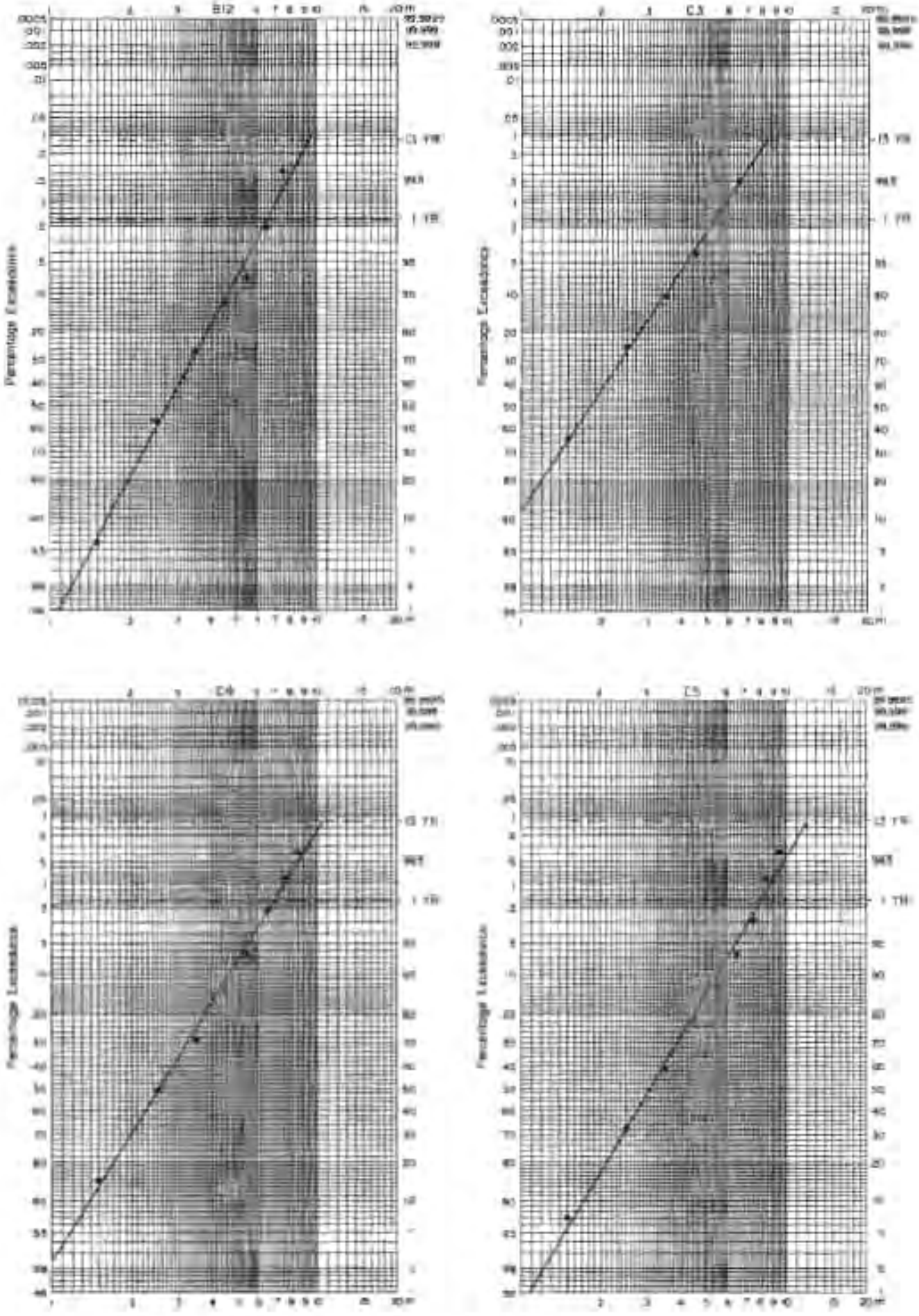
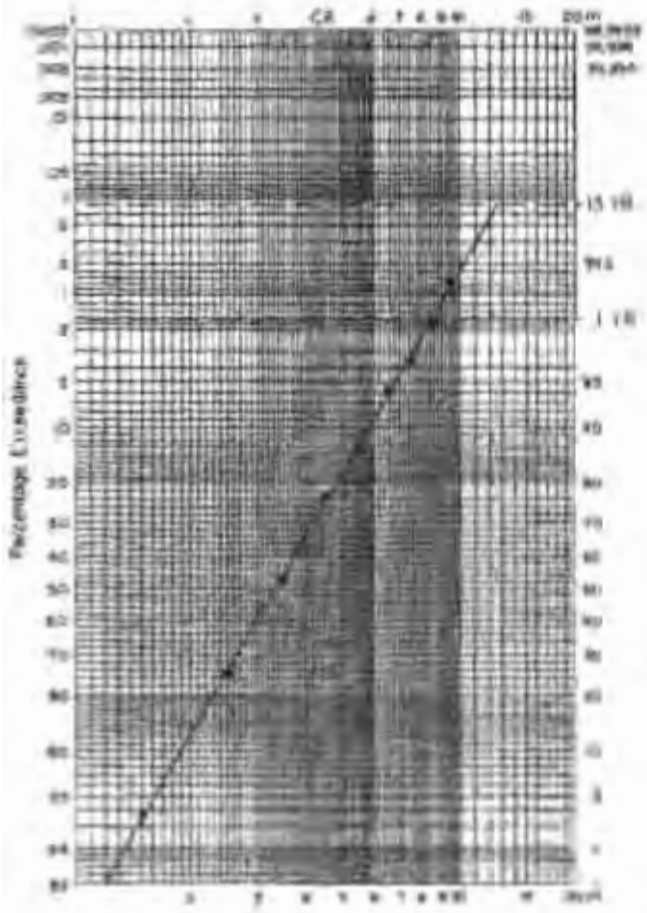
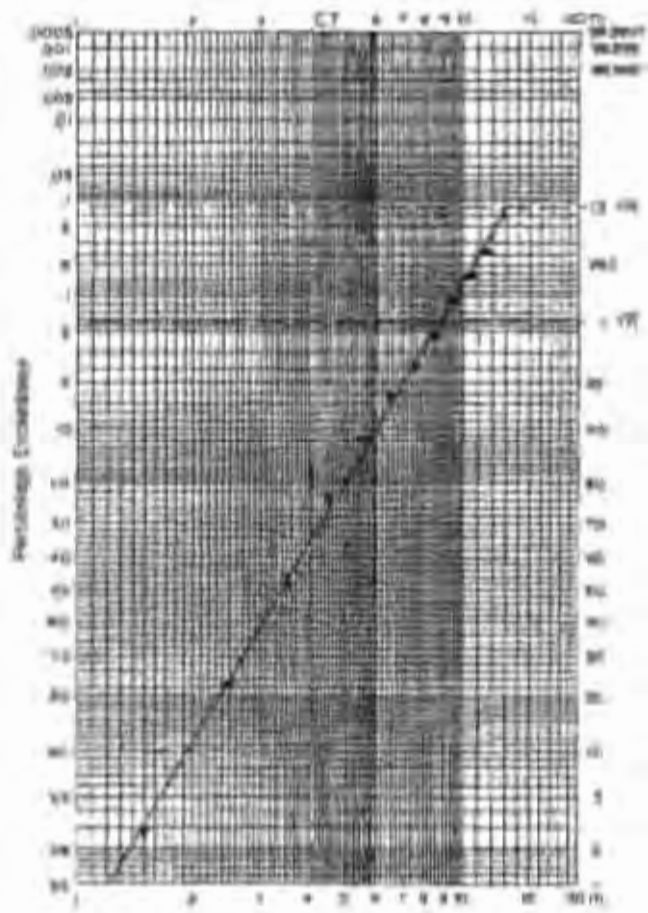
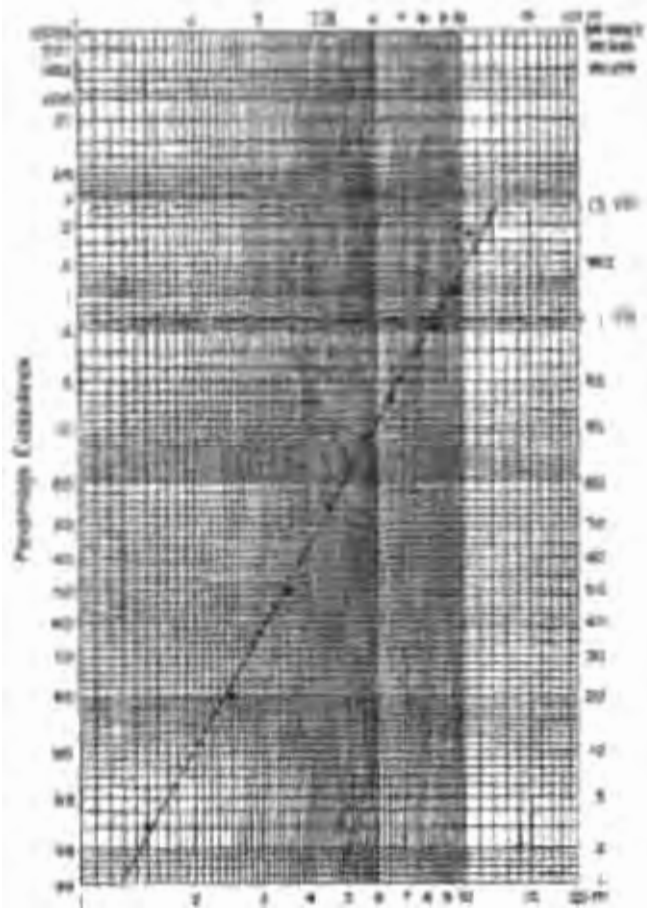
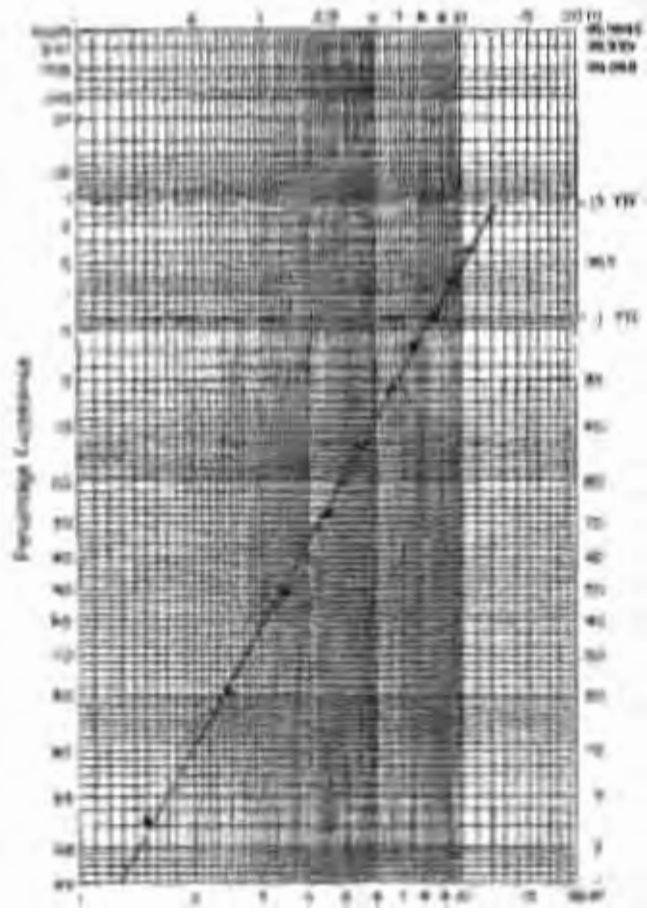


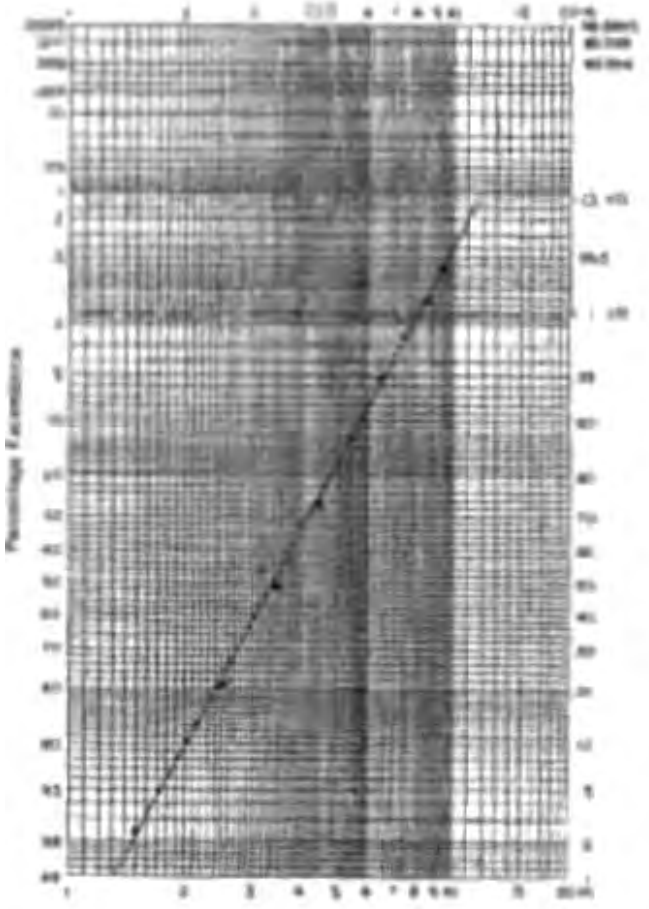
Figure 5h. Monthly Wave Height Exceedence Distribution for March

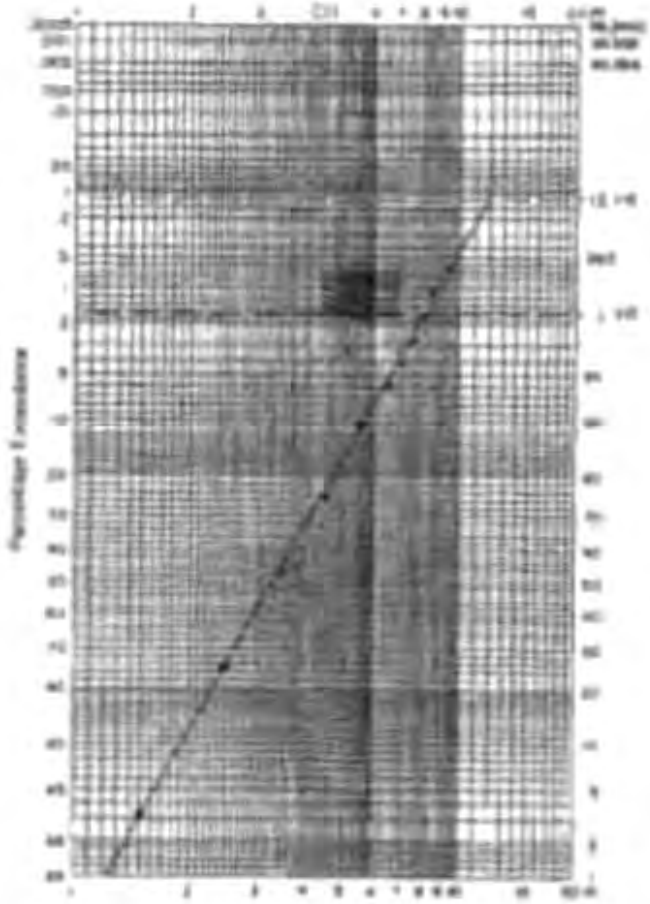


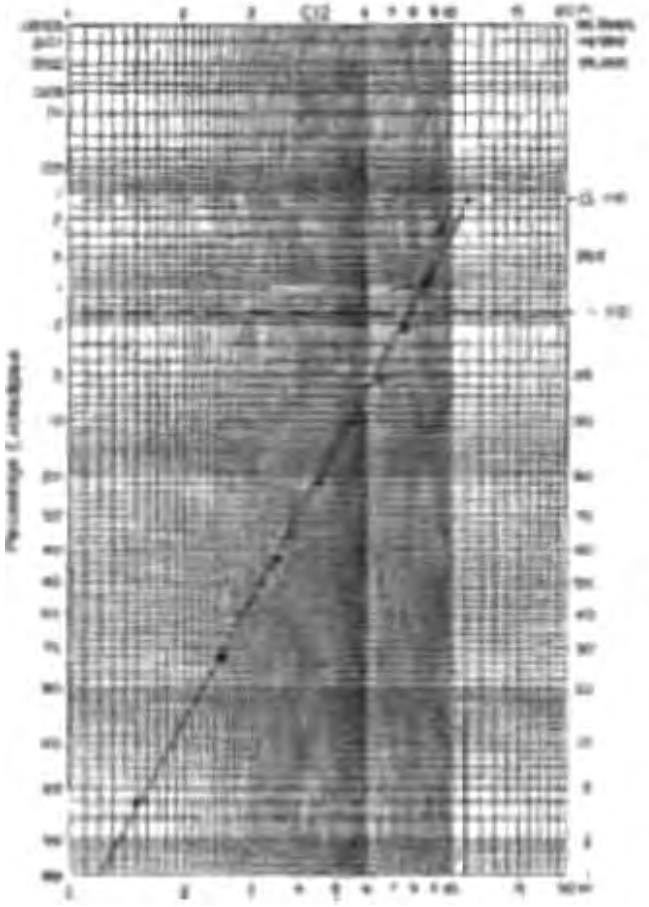


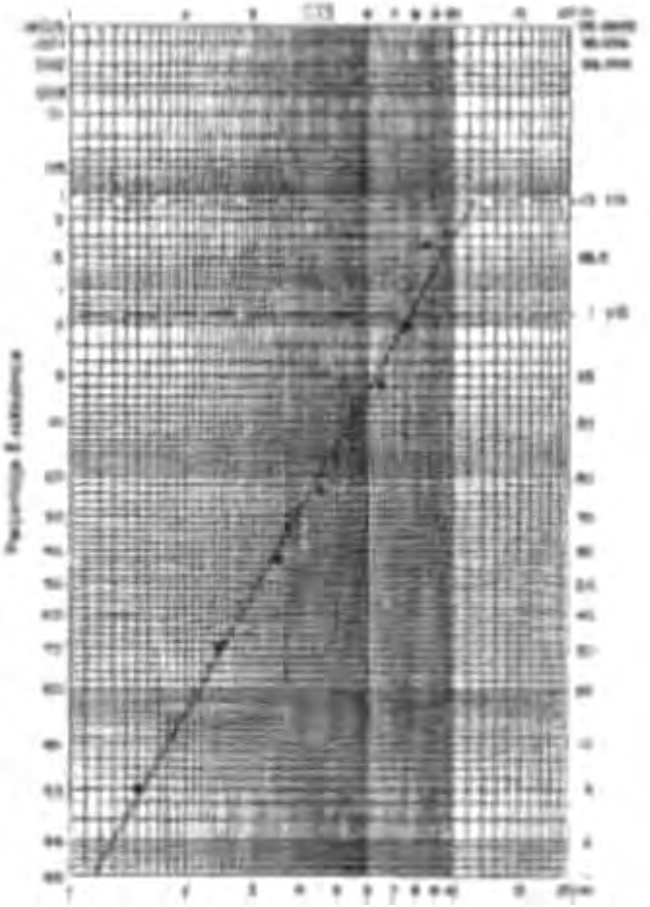












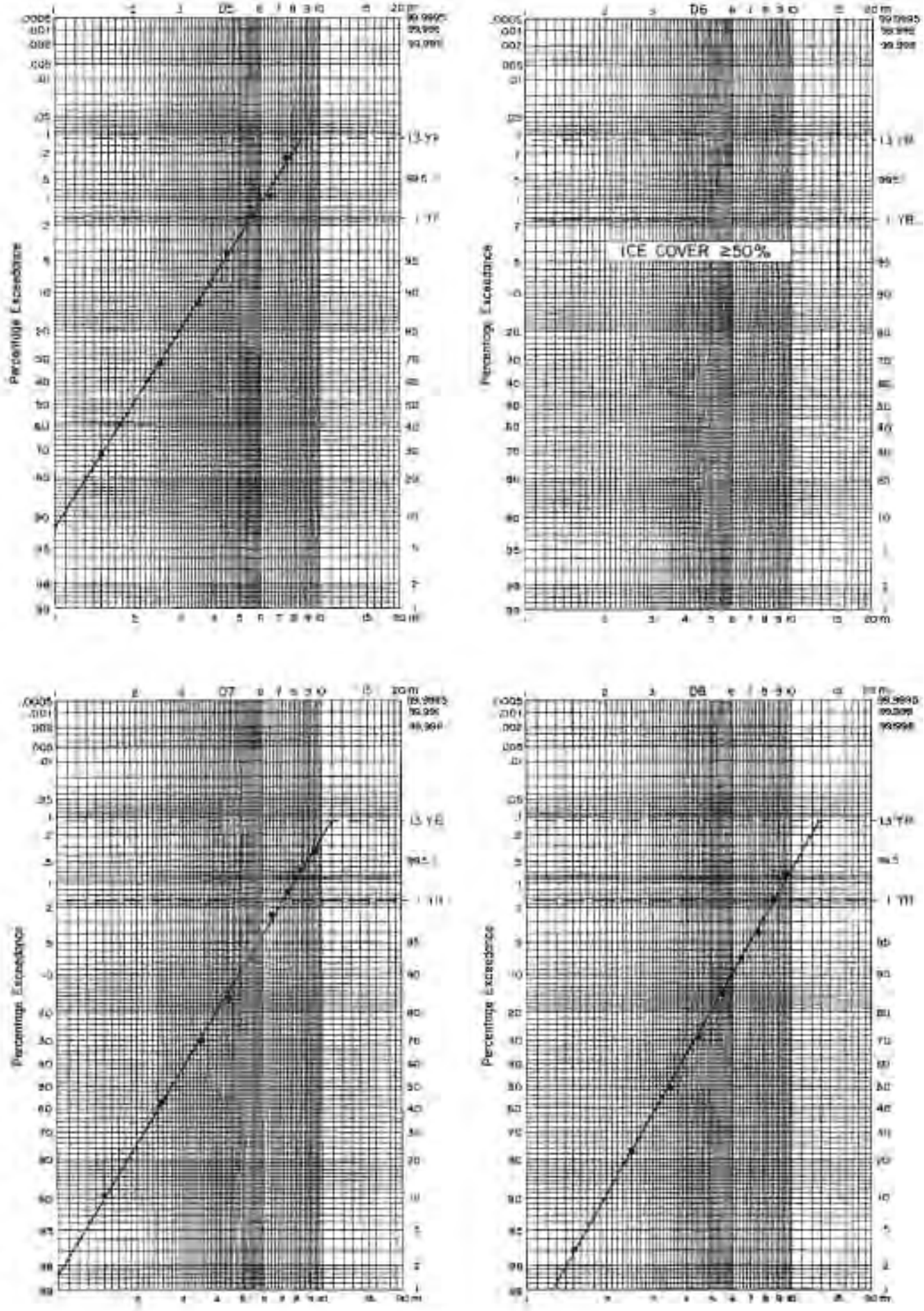


Figure 3x Monthly Wave Height Exceedance Distribution for March

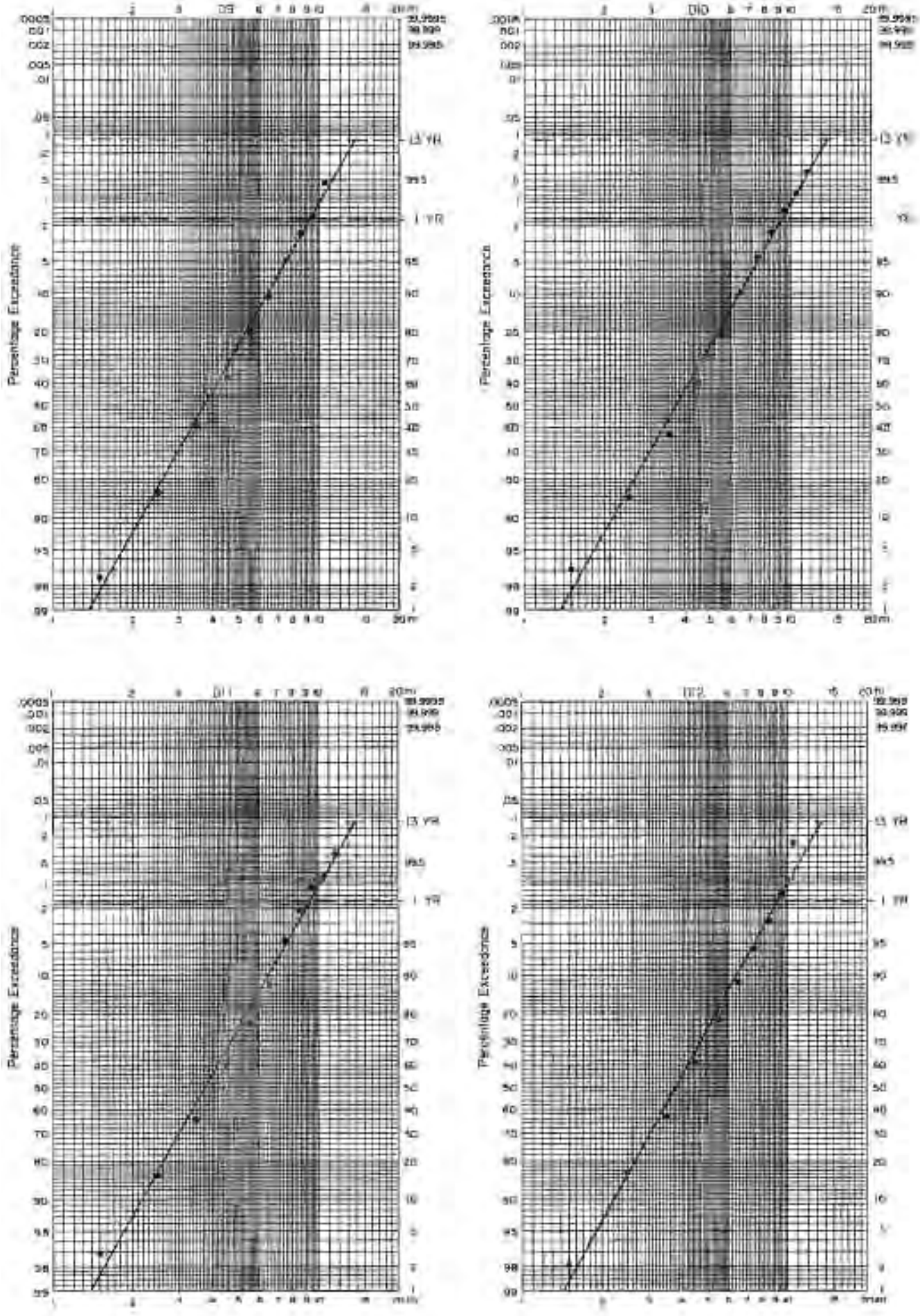
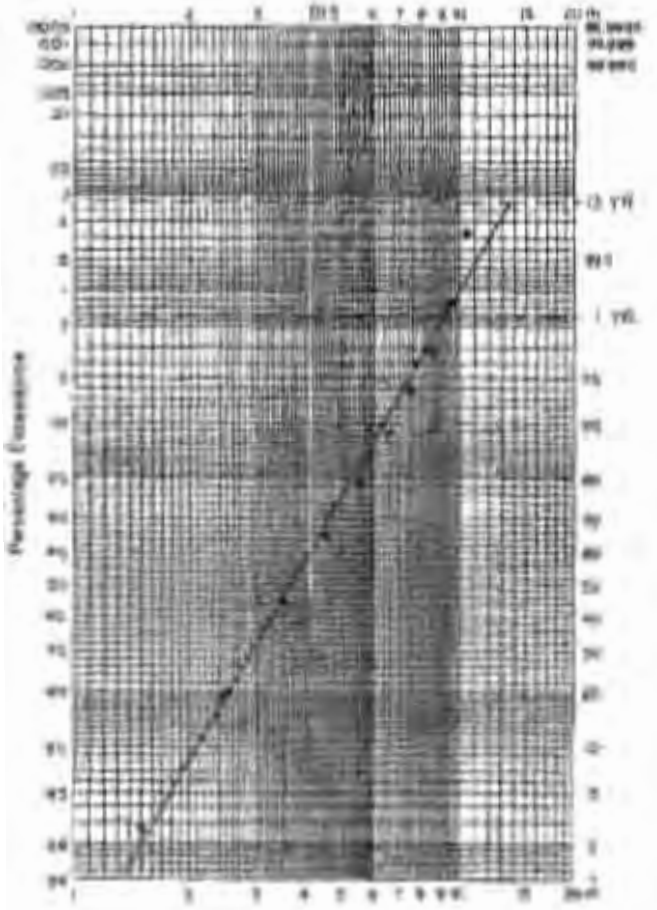
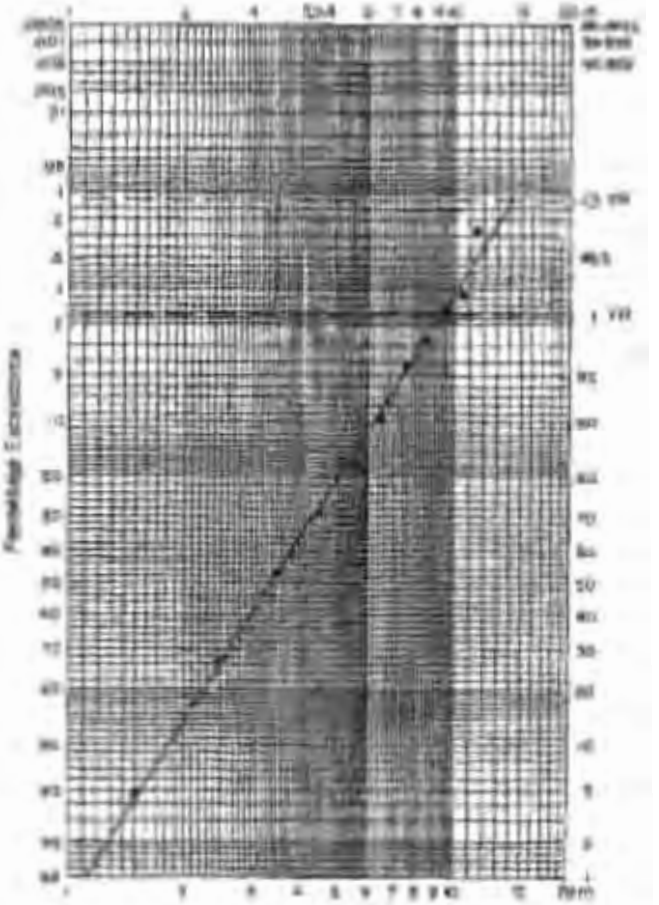
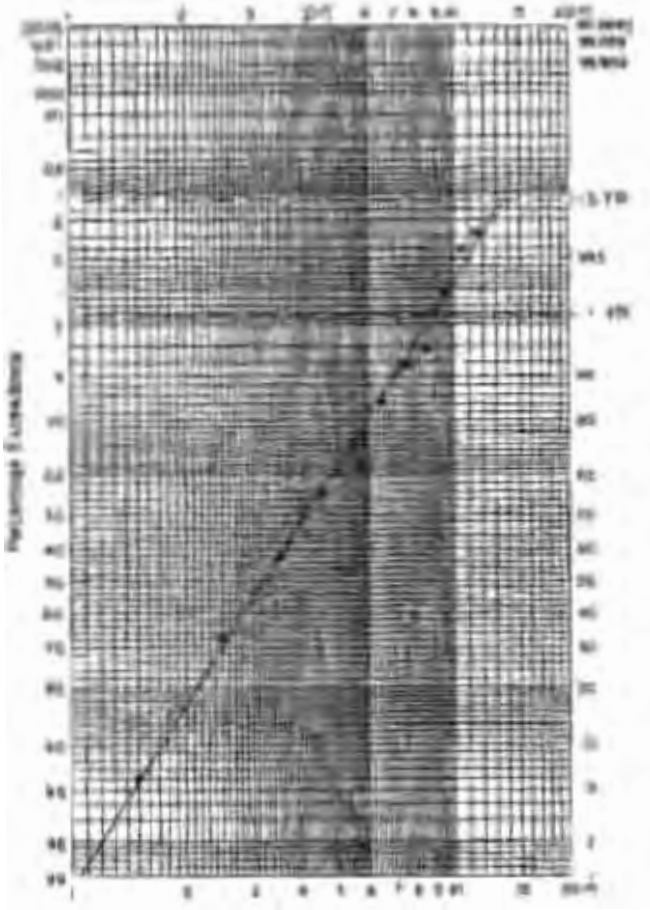
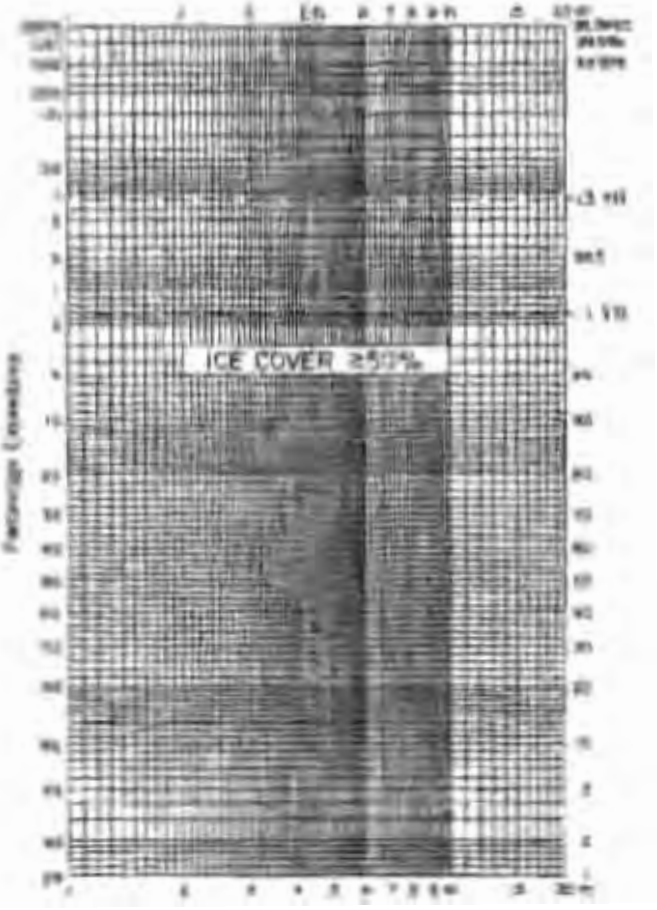


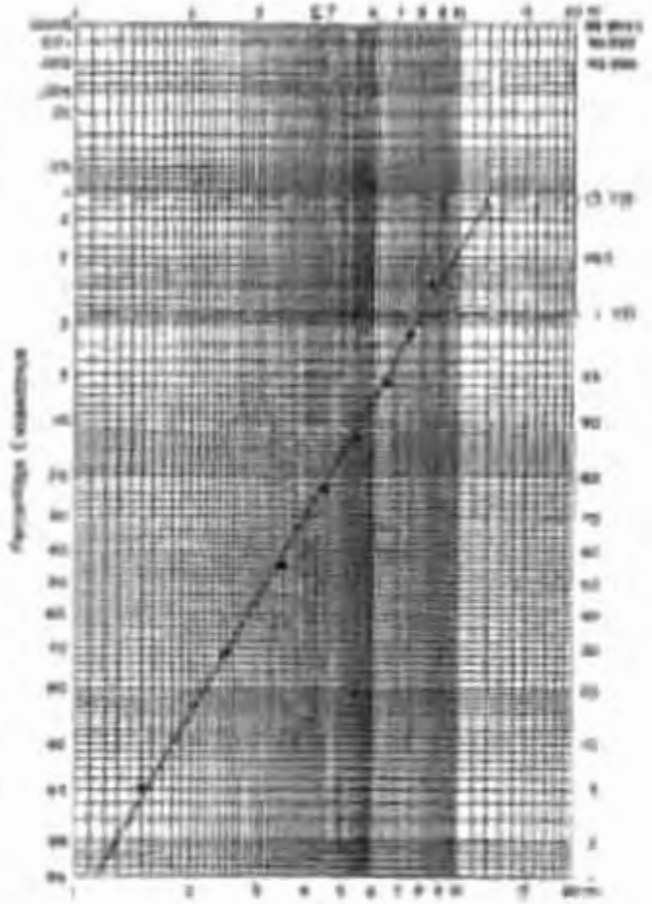
Figure 31 Monthly Wave Height Exceedance Distribution for March

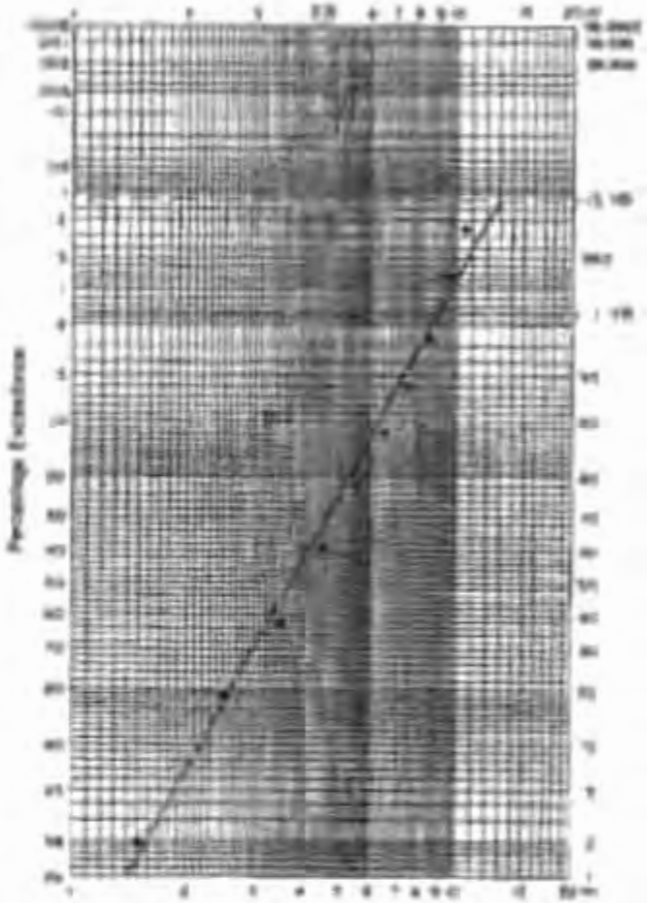


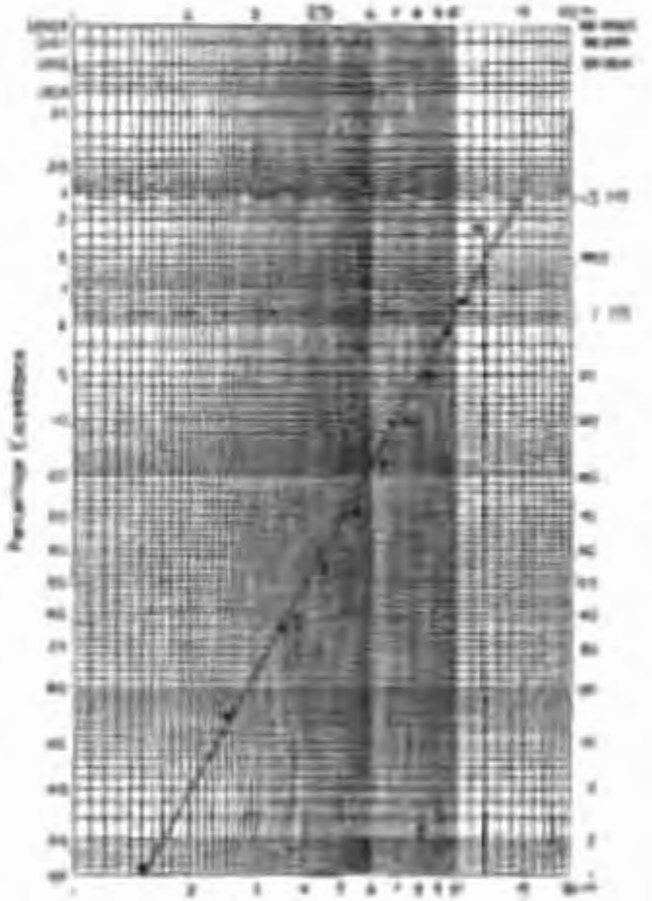


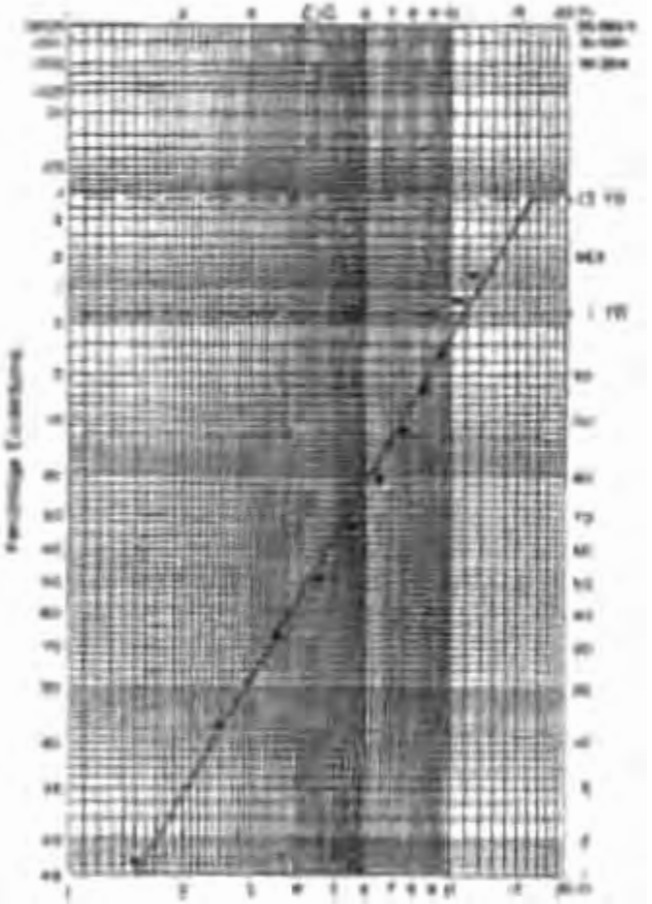



ICE COVER ≥50%









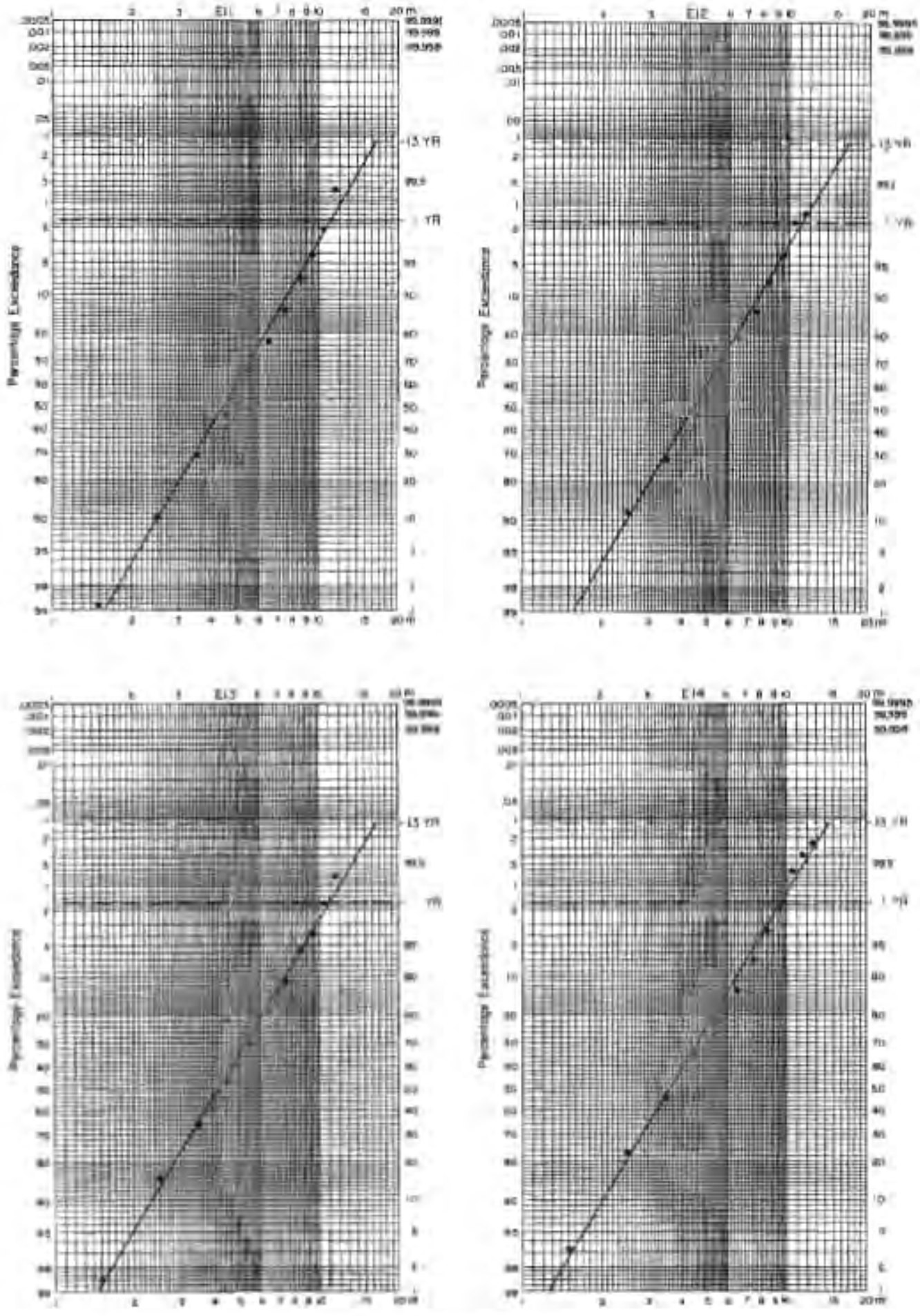


Figure 5a Monthly Wave Height Exceedance Distribution for March

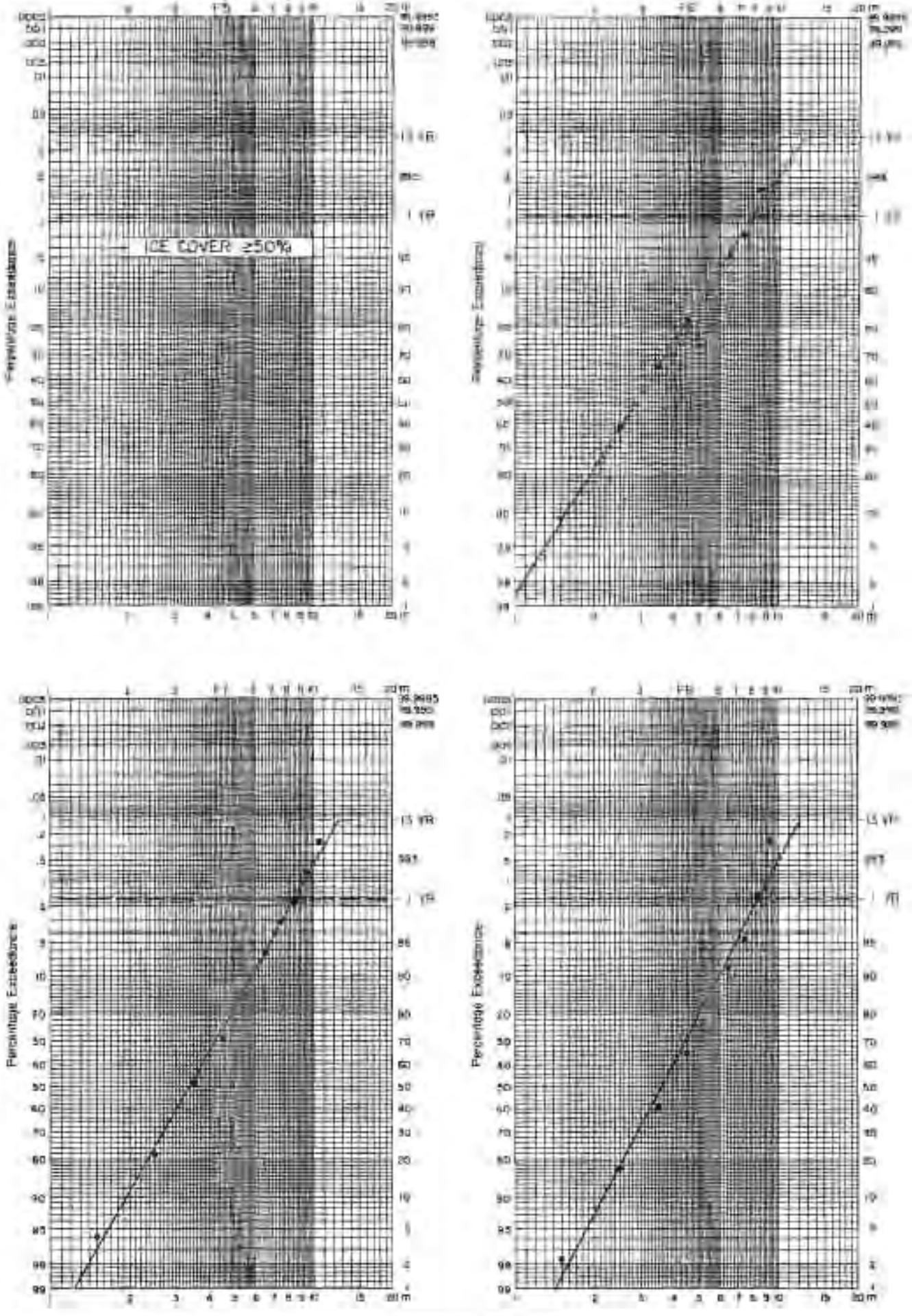


Figure 3p. Monthly Wave Height Exceedance Distribution for March

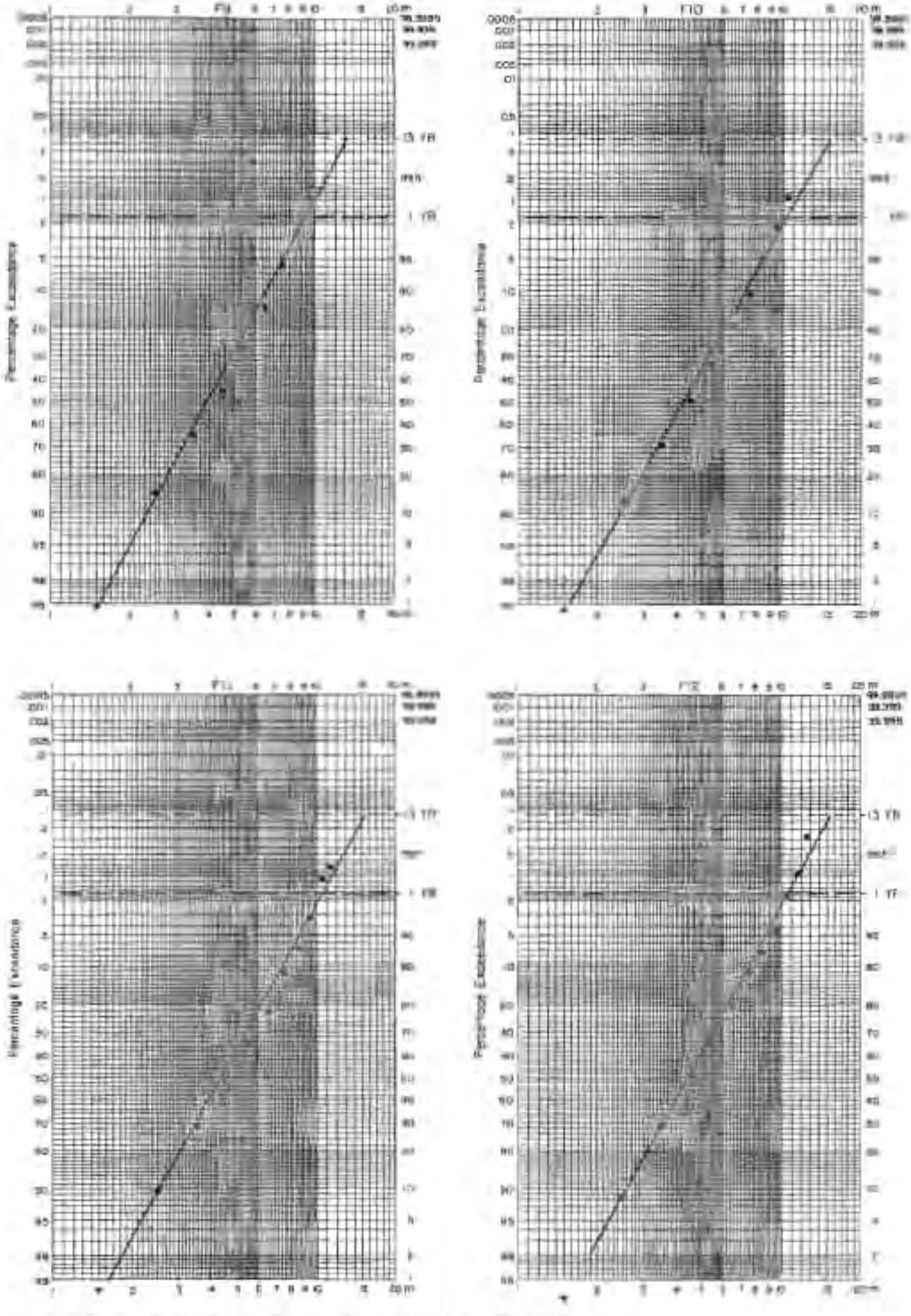


Figure 5g. Monthly Wave Height Exceedance Distribution for March

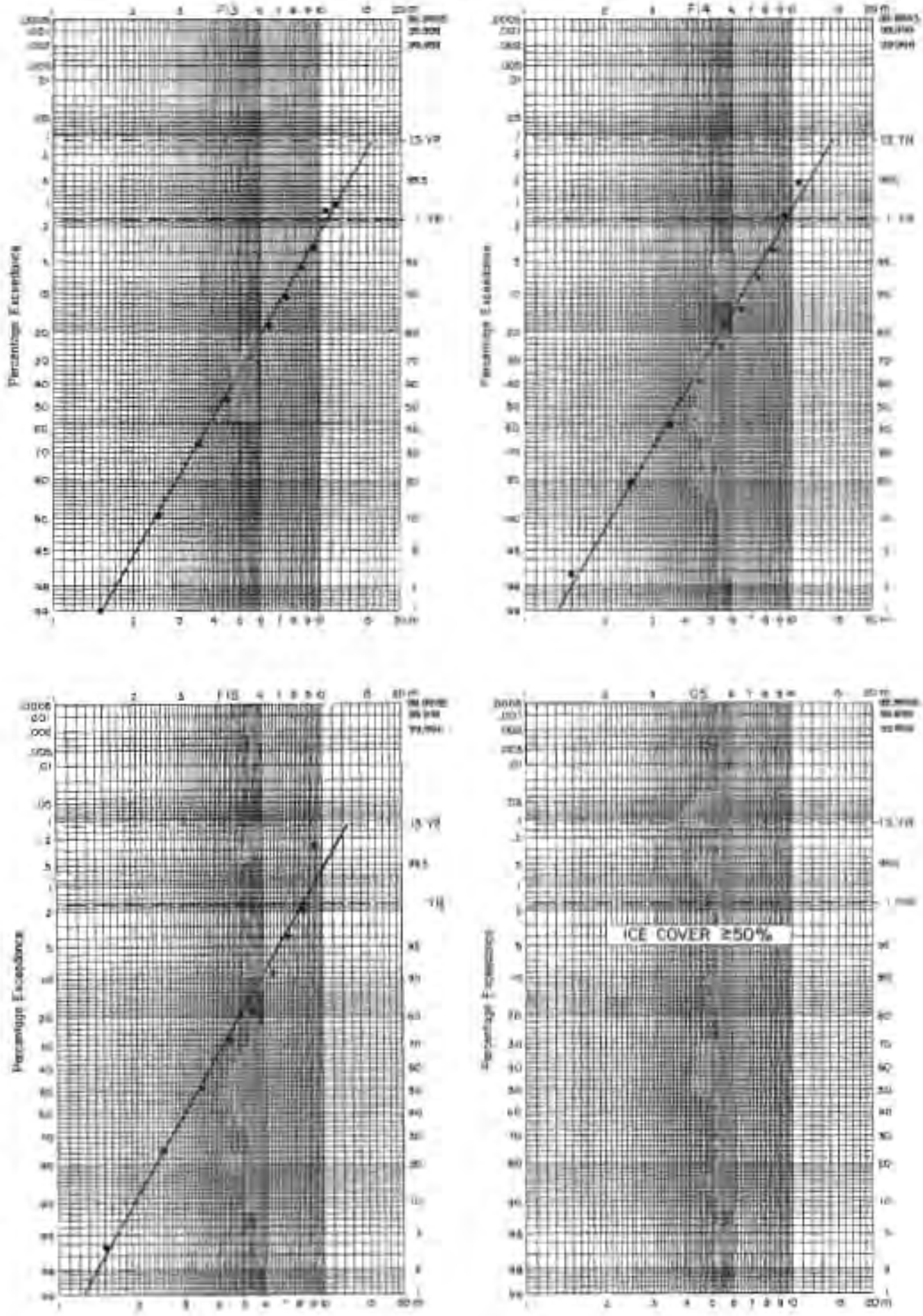
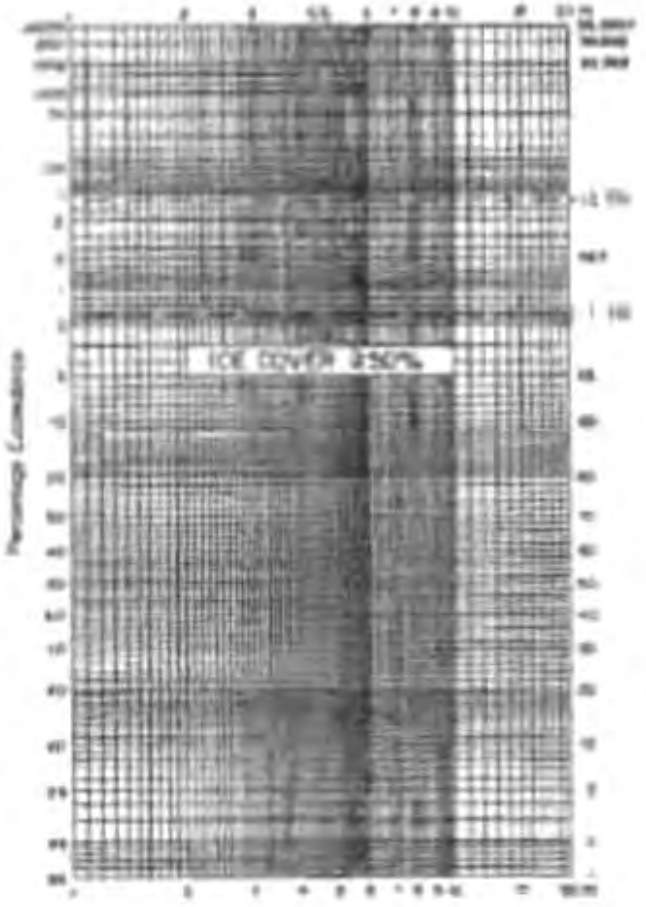
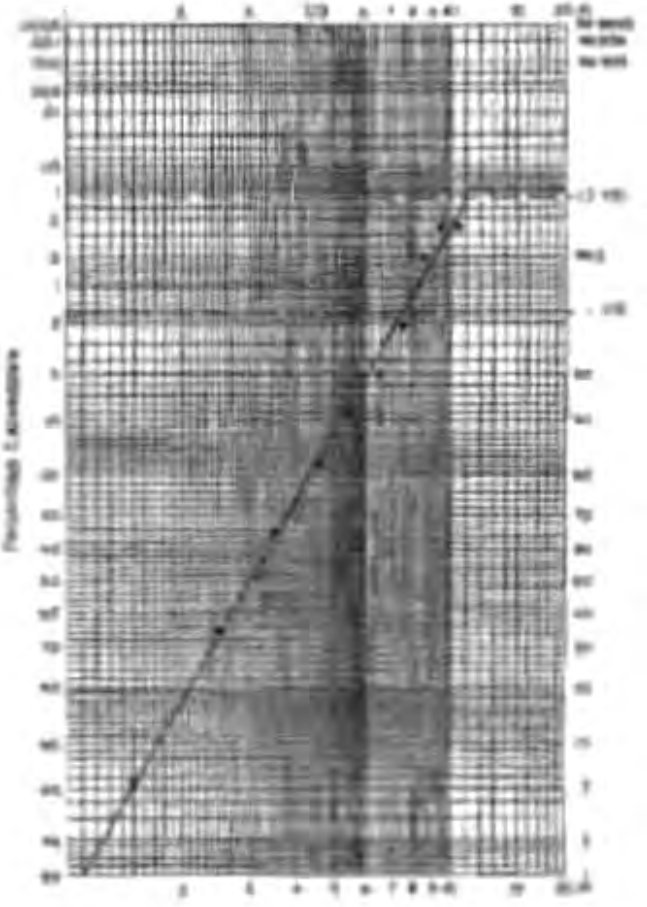
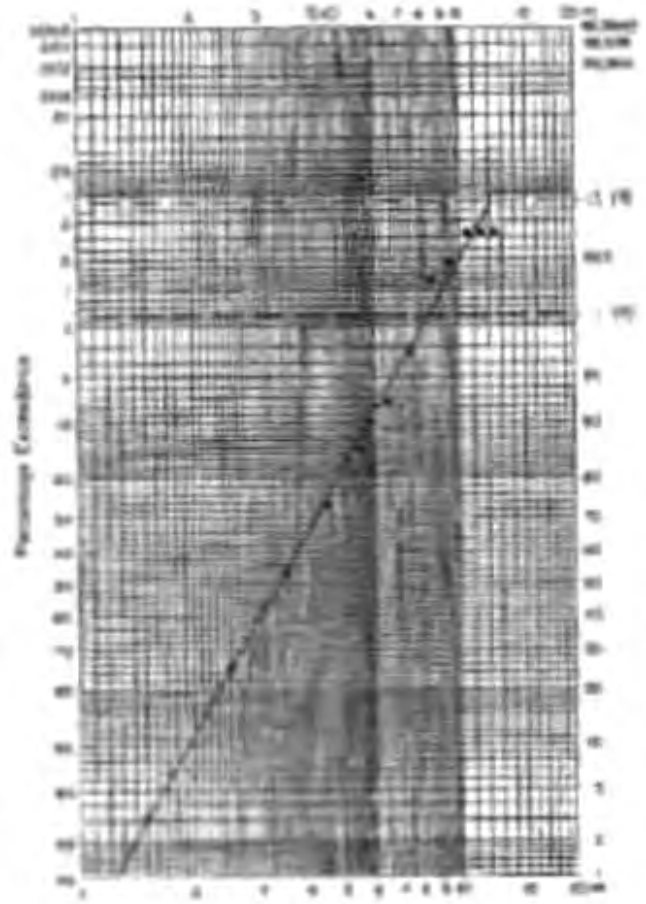
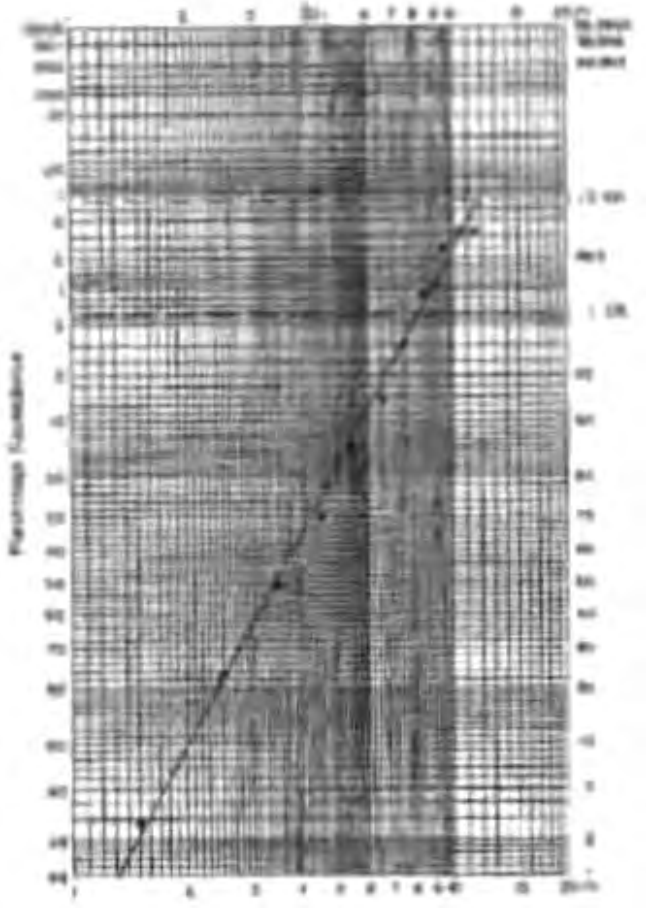


Figure 31 Monthly Wave Height Exceedance Distribution for March


ICE COVER 95%







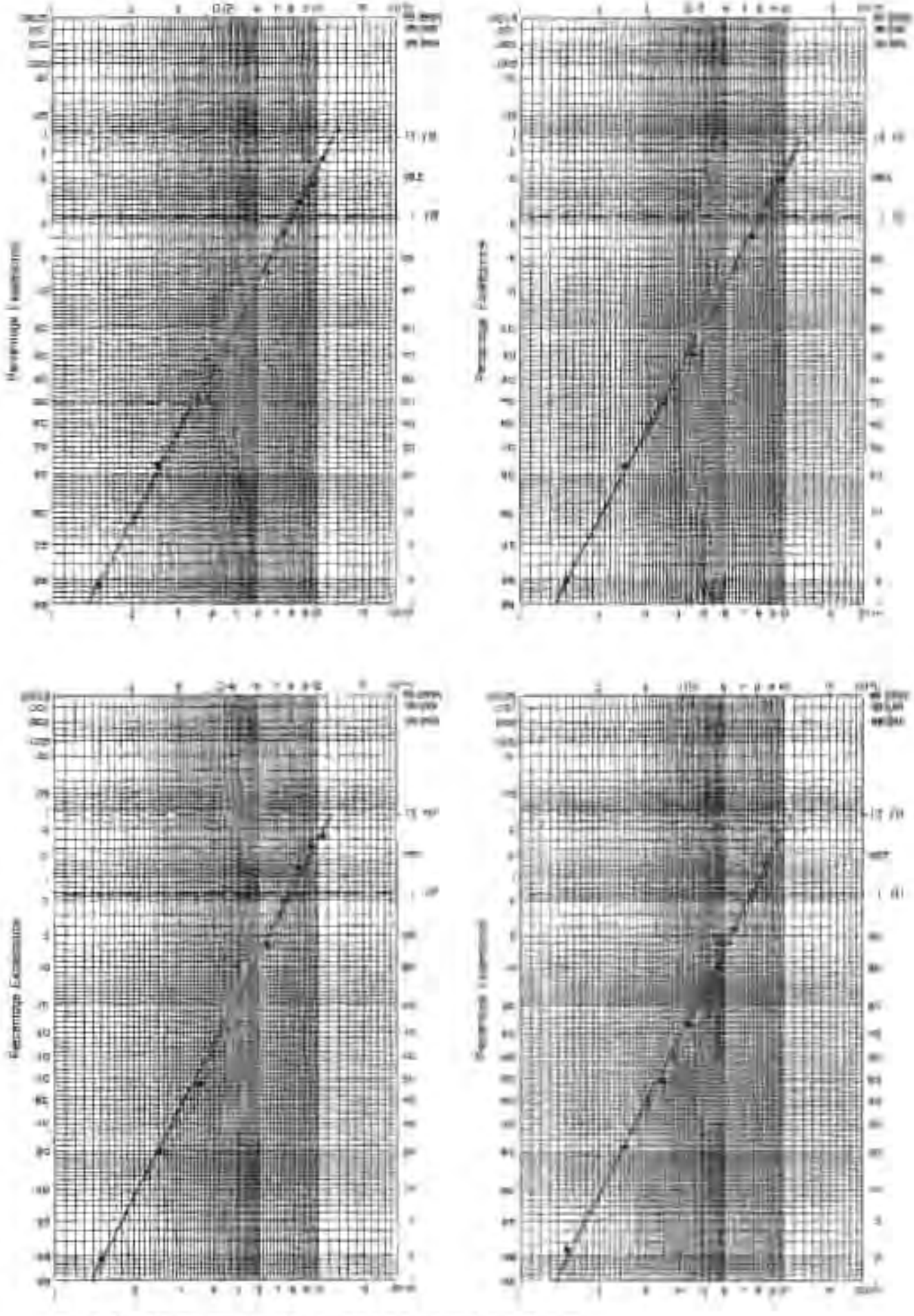


Figure 31 Monthly Wave Height Exceedance Distribution for March

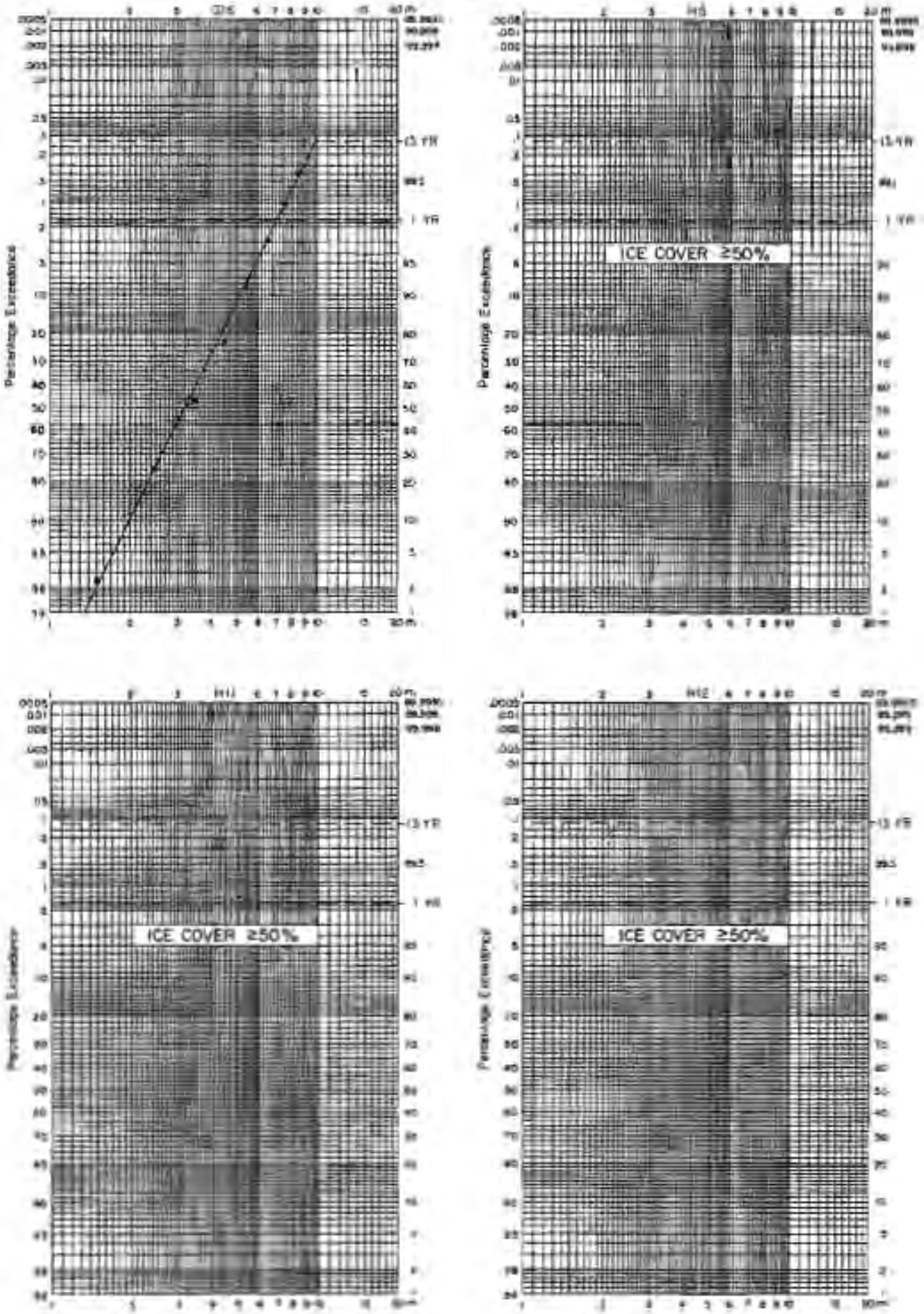
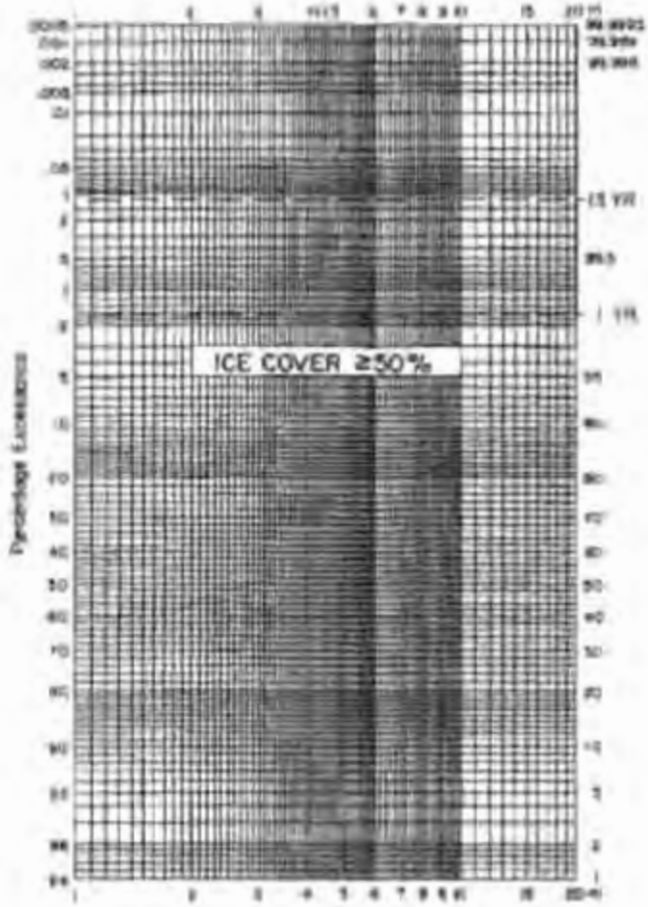
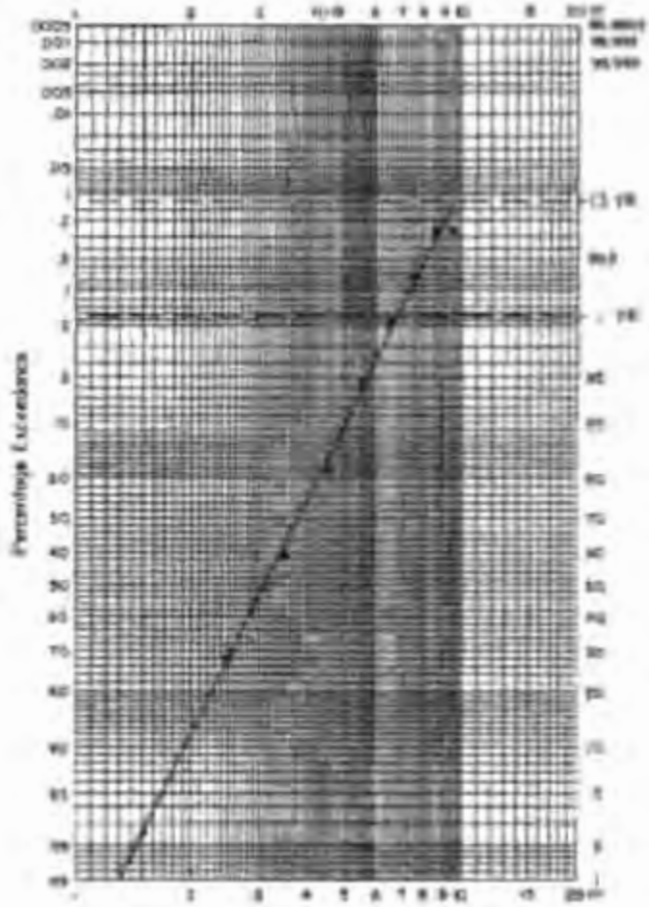
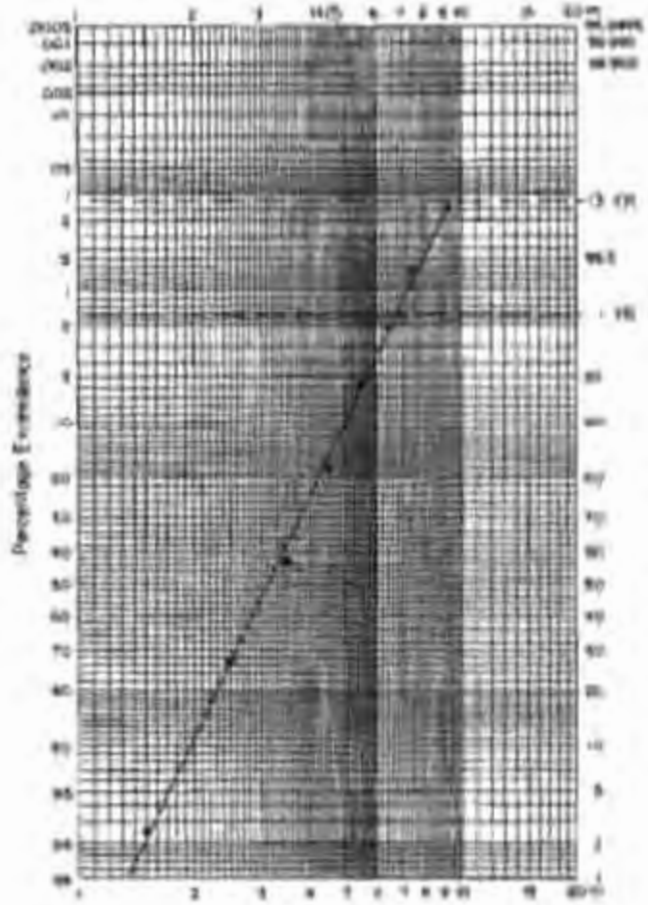


Figure 3a Monthly Wave Height Exceedance Distribution for March







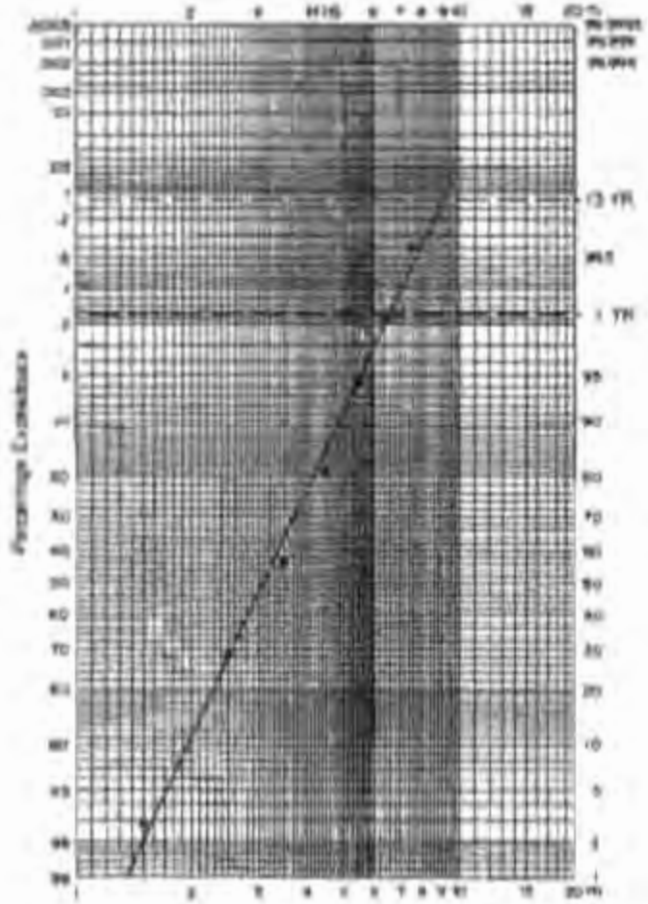


Figure 5a Monthly Wave Height Exceedance Distribution for March

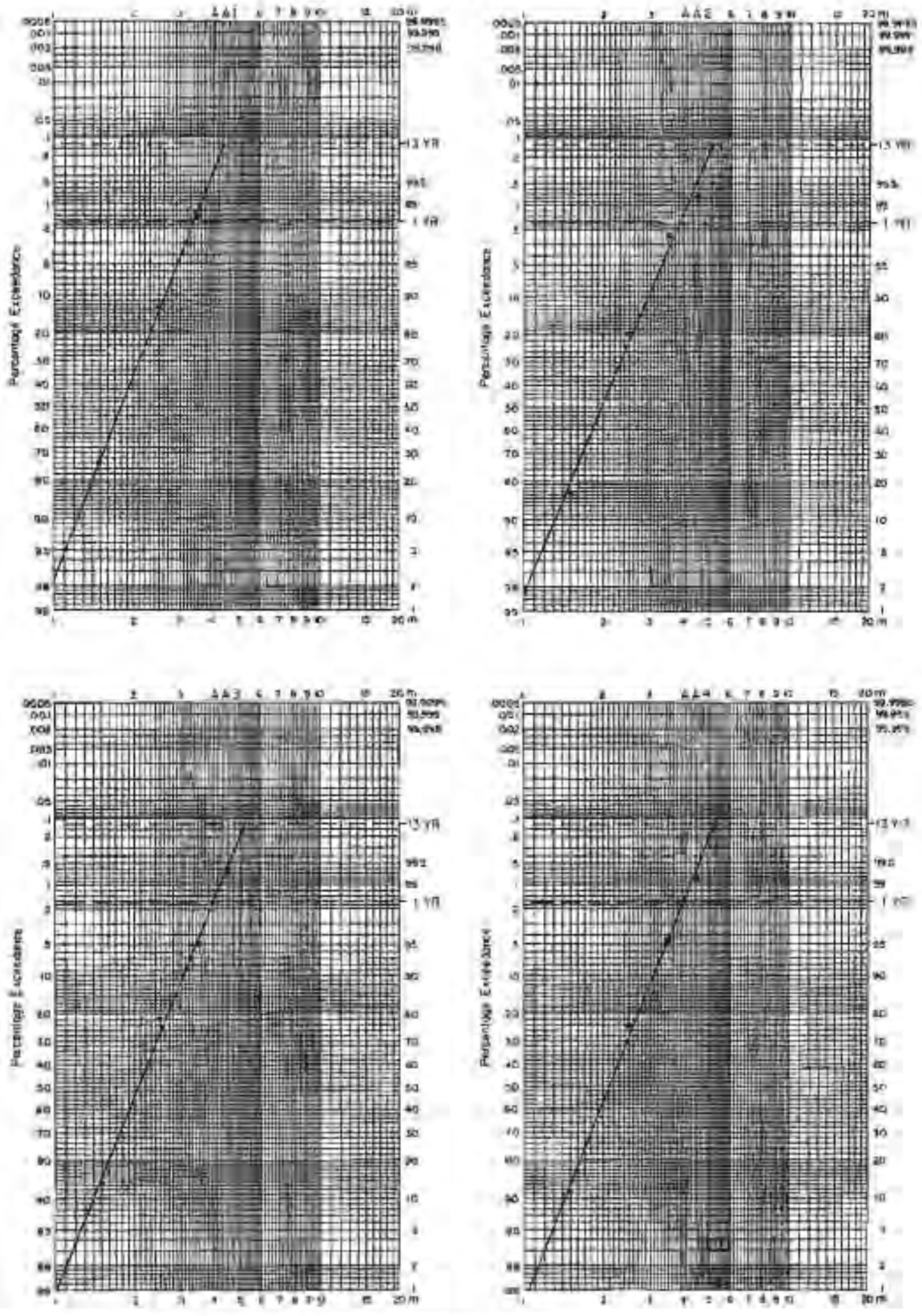
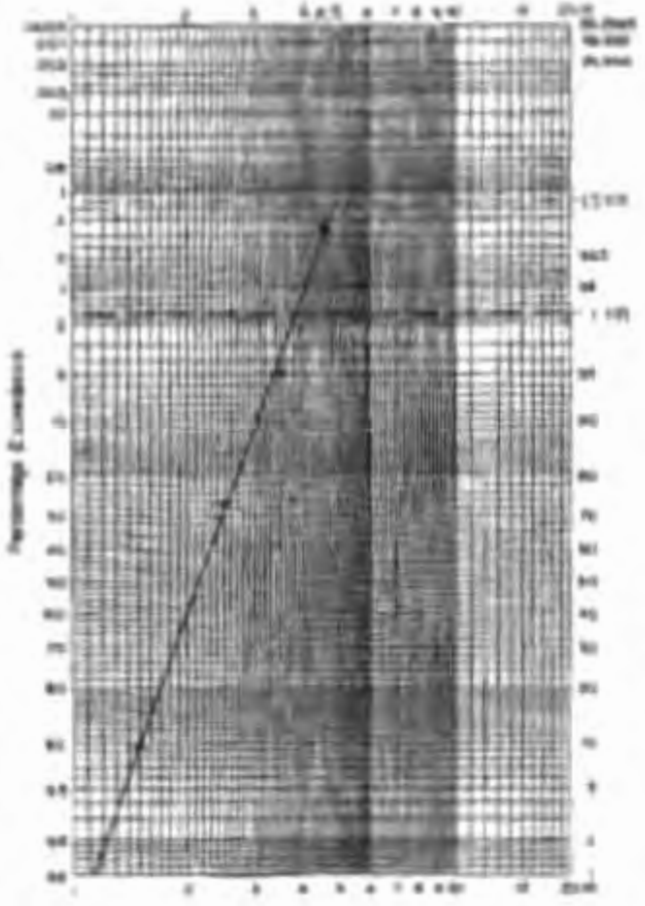
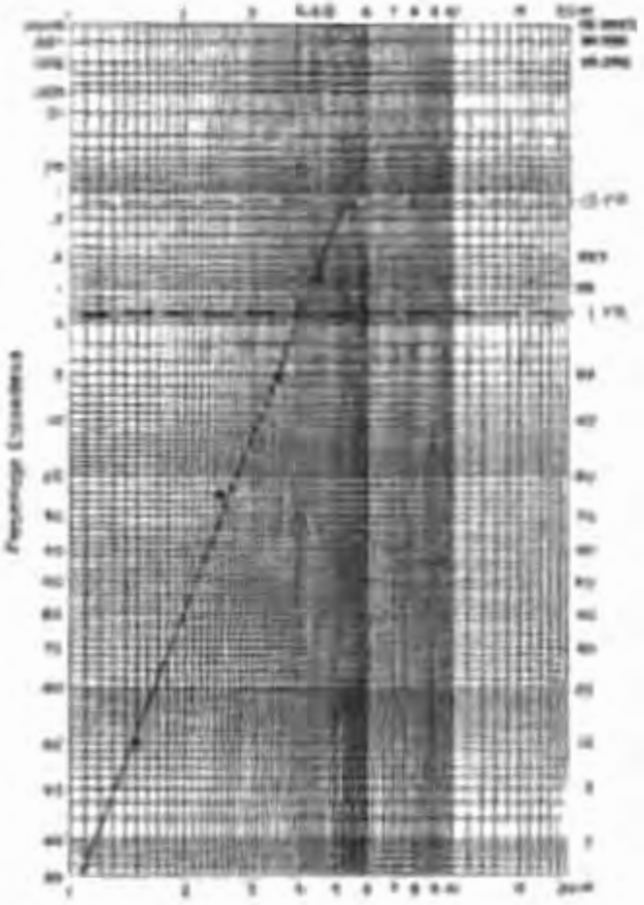
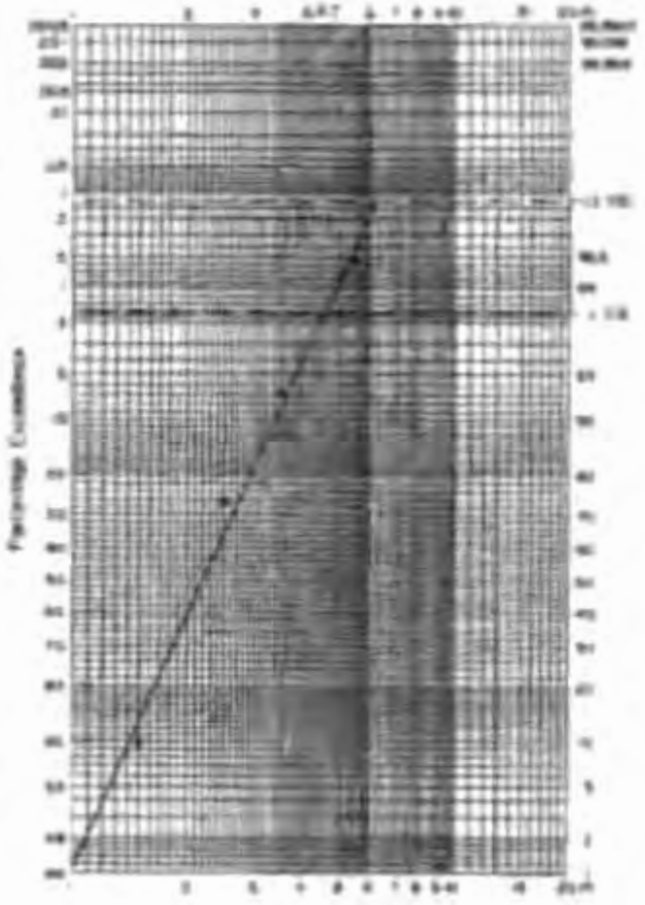
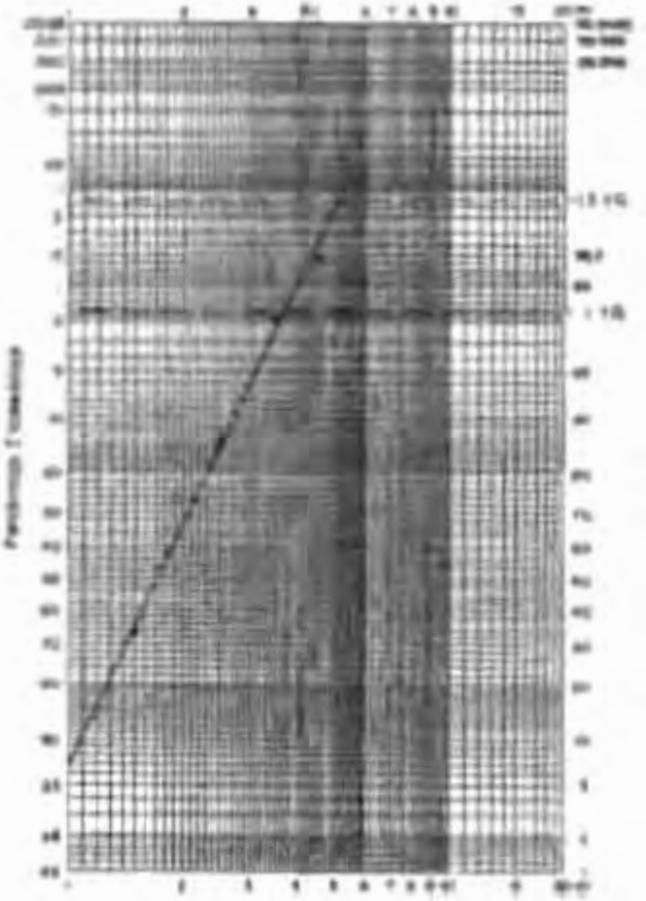


Figure 40: Monthly Wave Height Exceedance Distribution for April









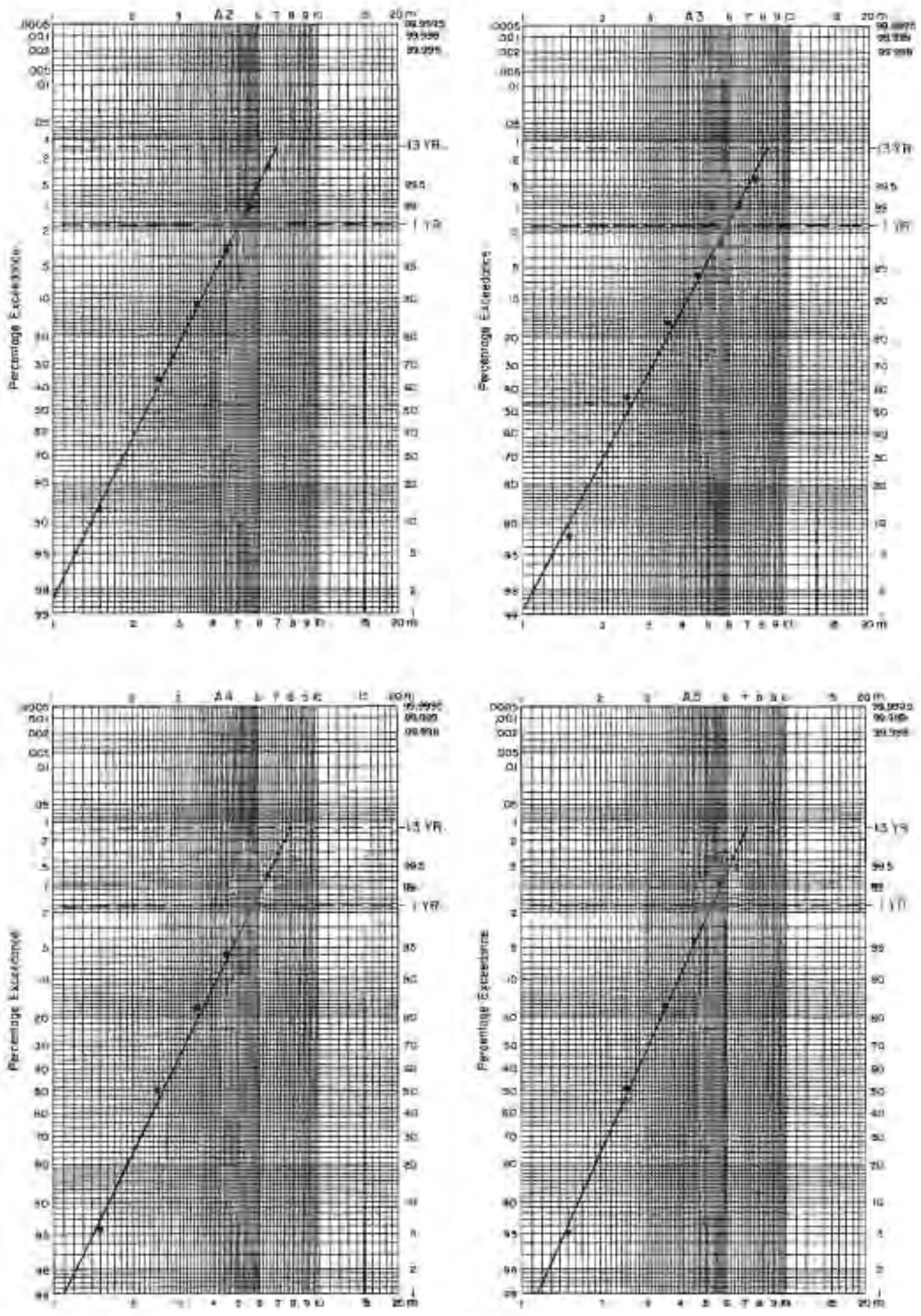


Figure 4c. Monthly Wave Height Exceedence Distribution for April

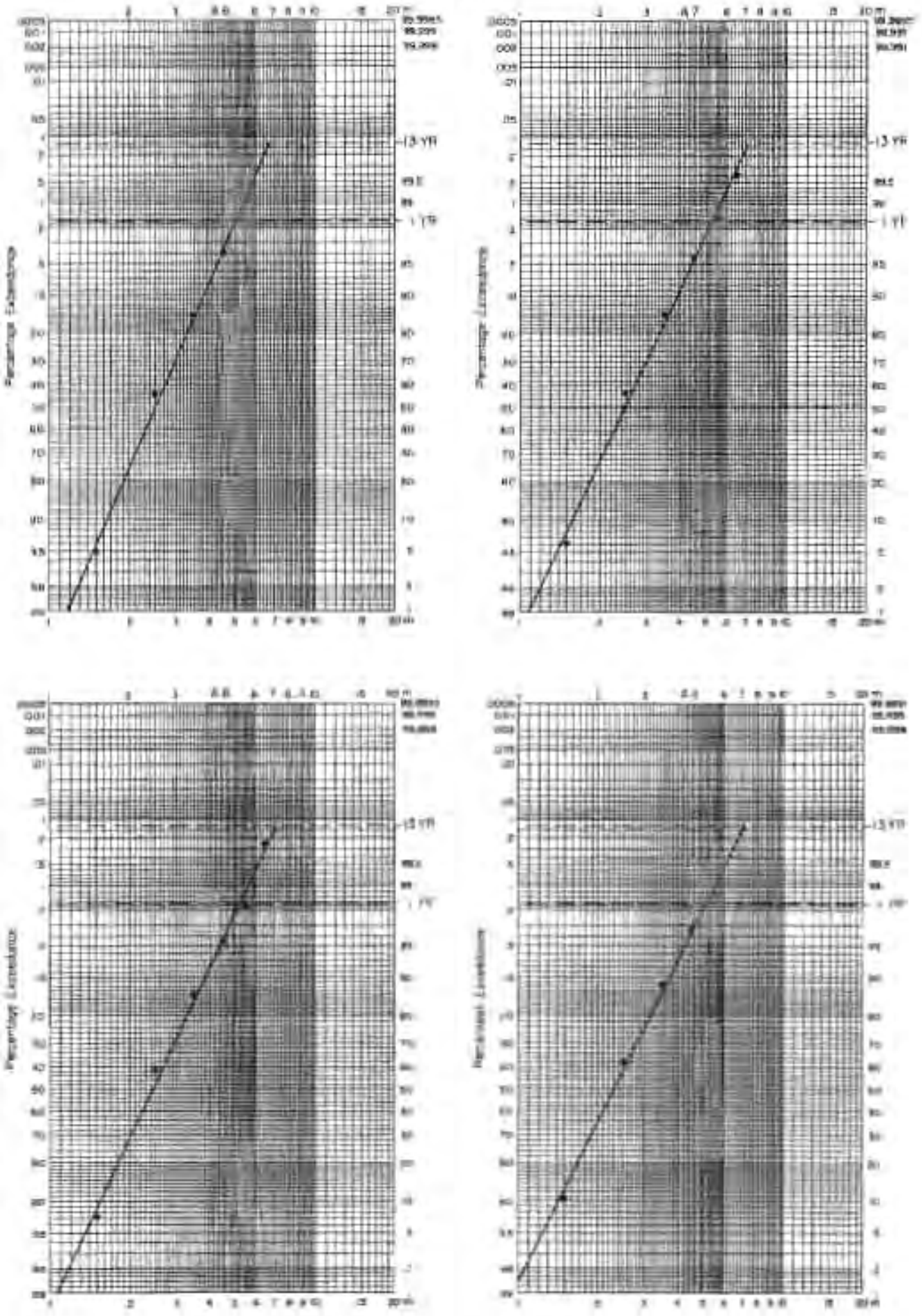


Figure 42. Monthly Wave Height Exceedance Distribution for April

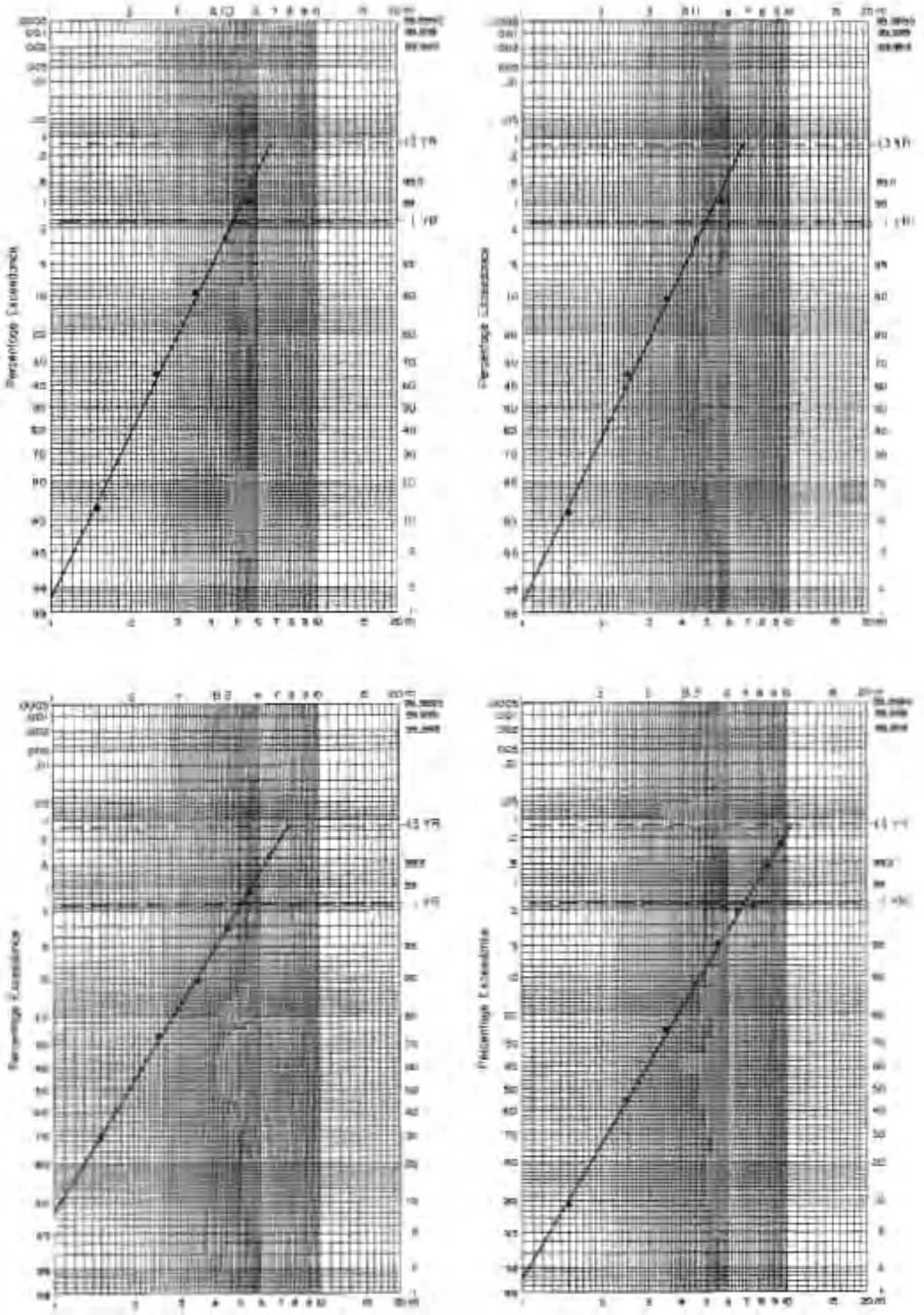


Figure 6a Monthly Wave Height Exceedance Distribution for April

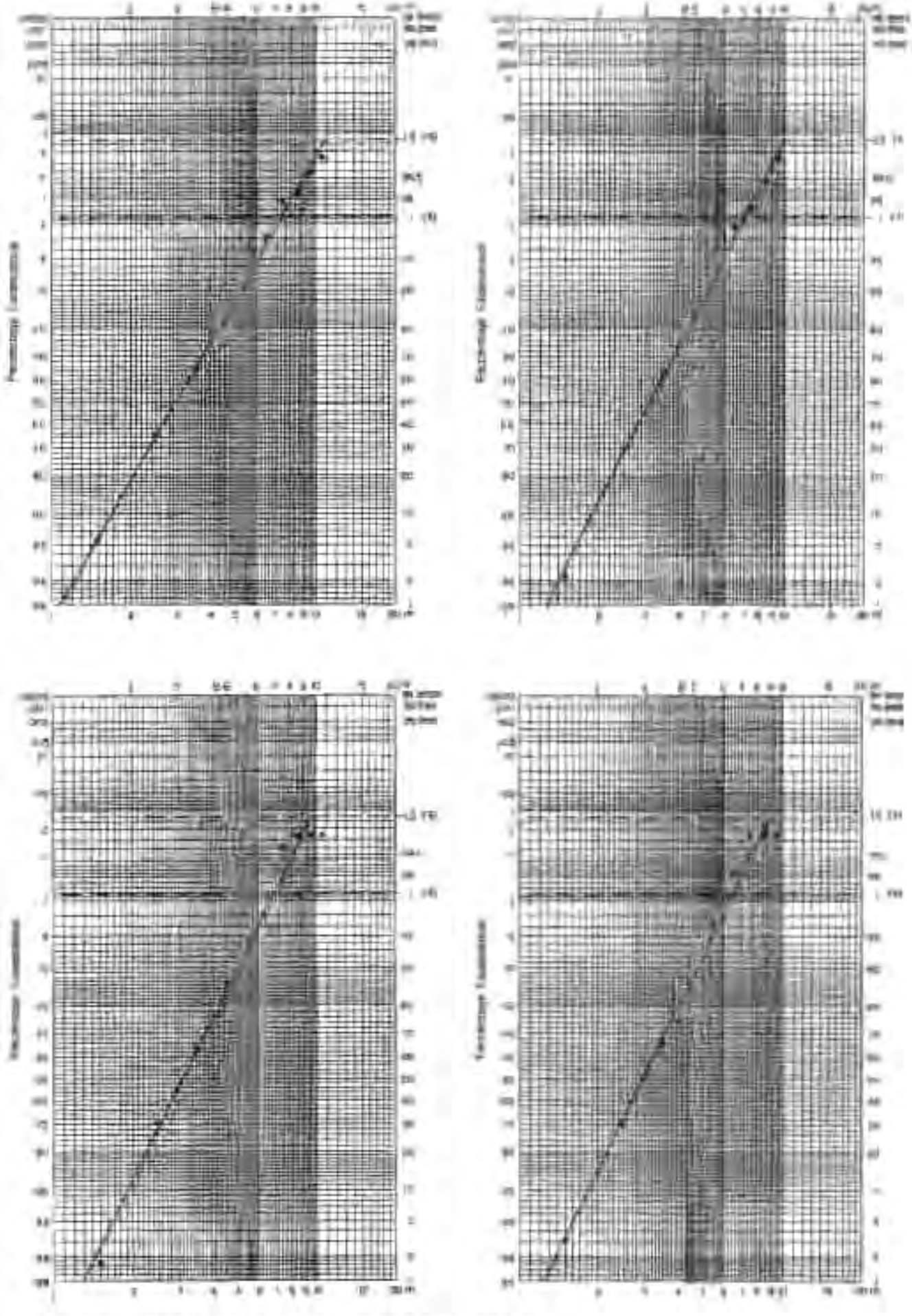
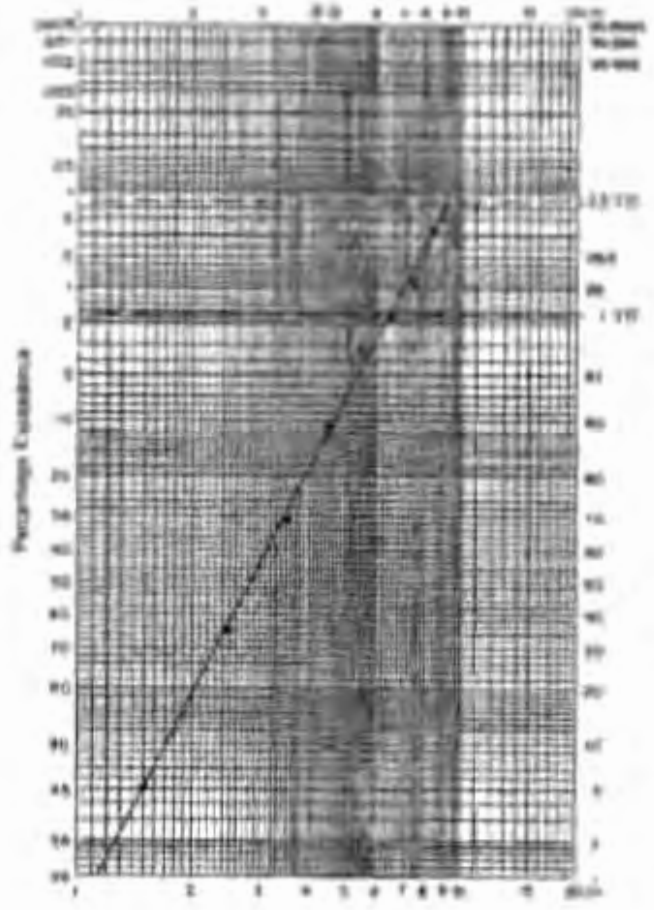
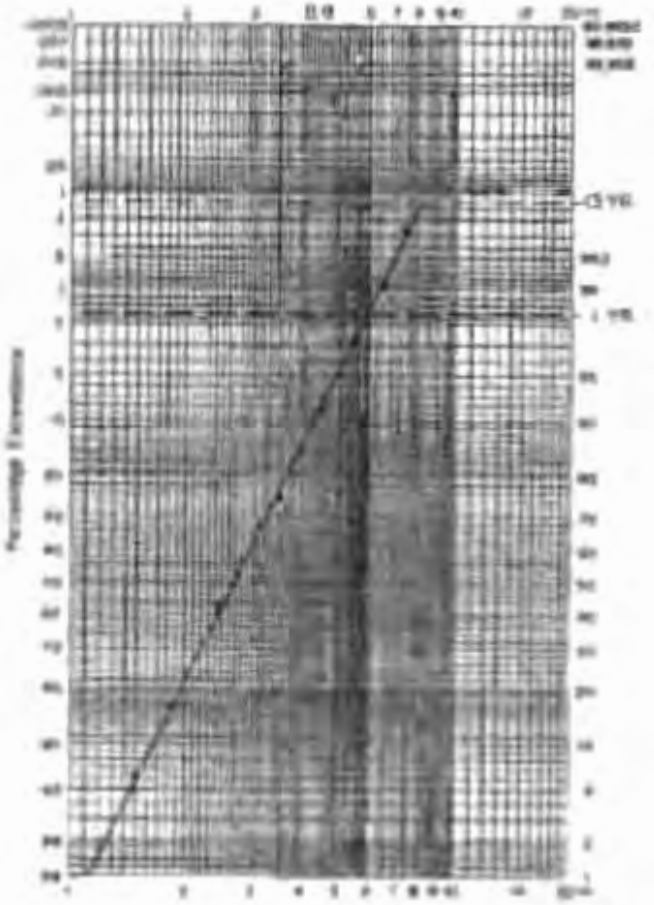
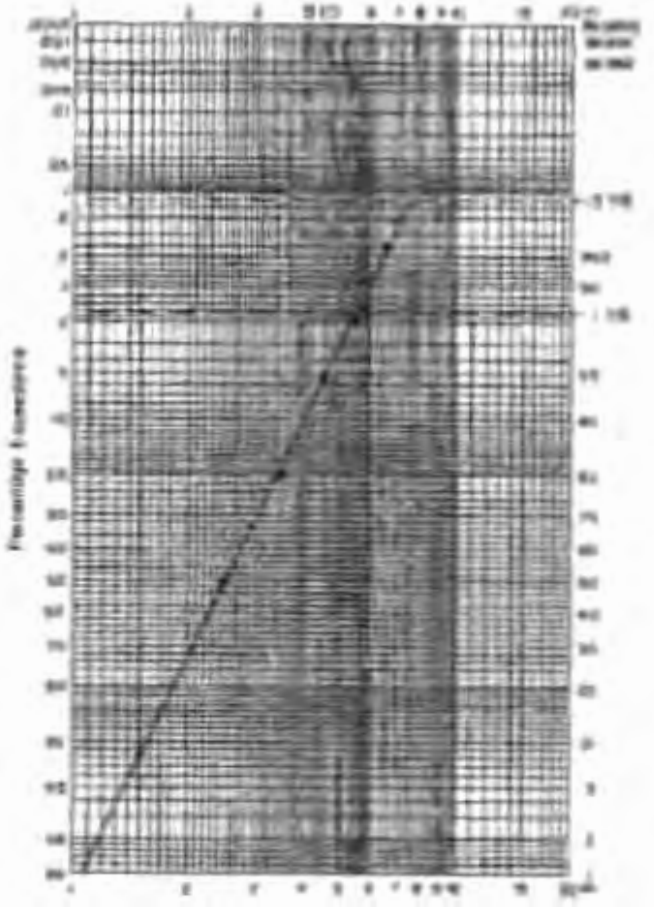
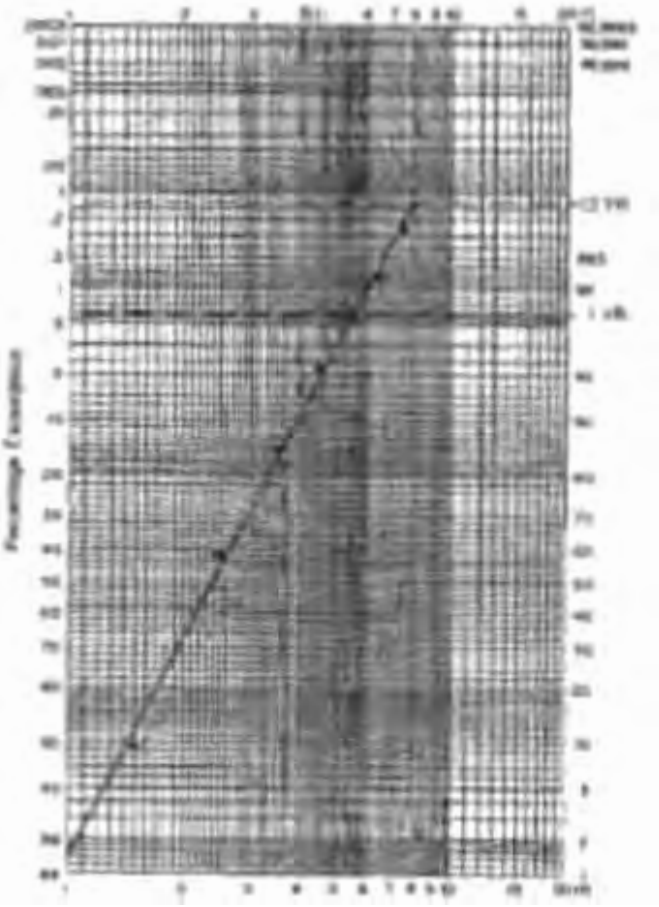


Figure 41 Monthly Wave Height Exceedance Distribution for April









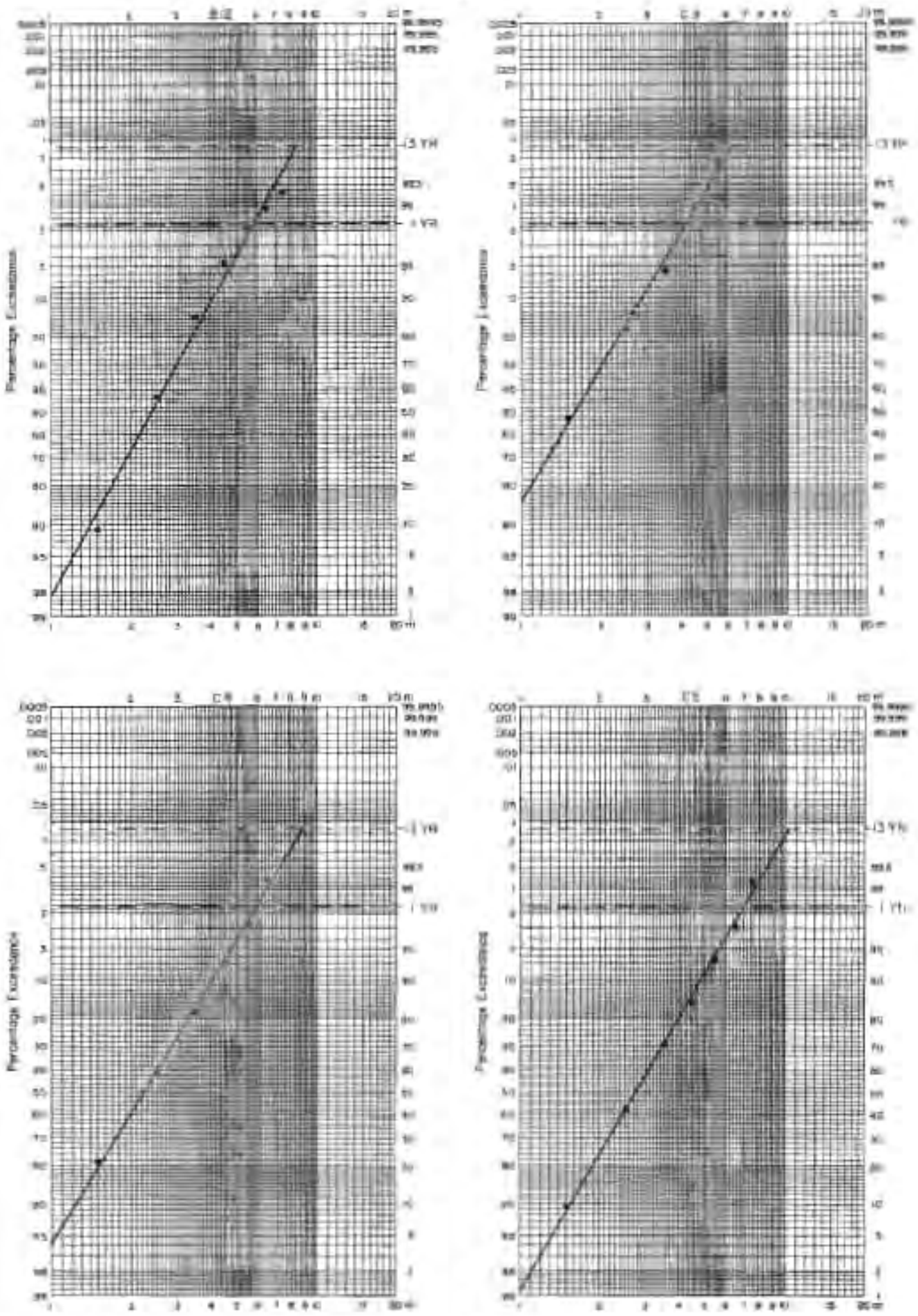


Figure 4h. Monthly Wave Height Exceedance Distribution for April

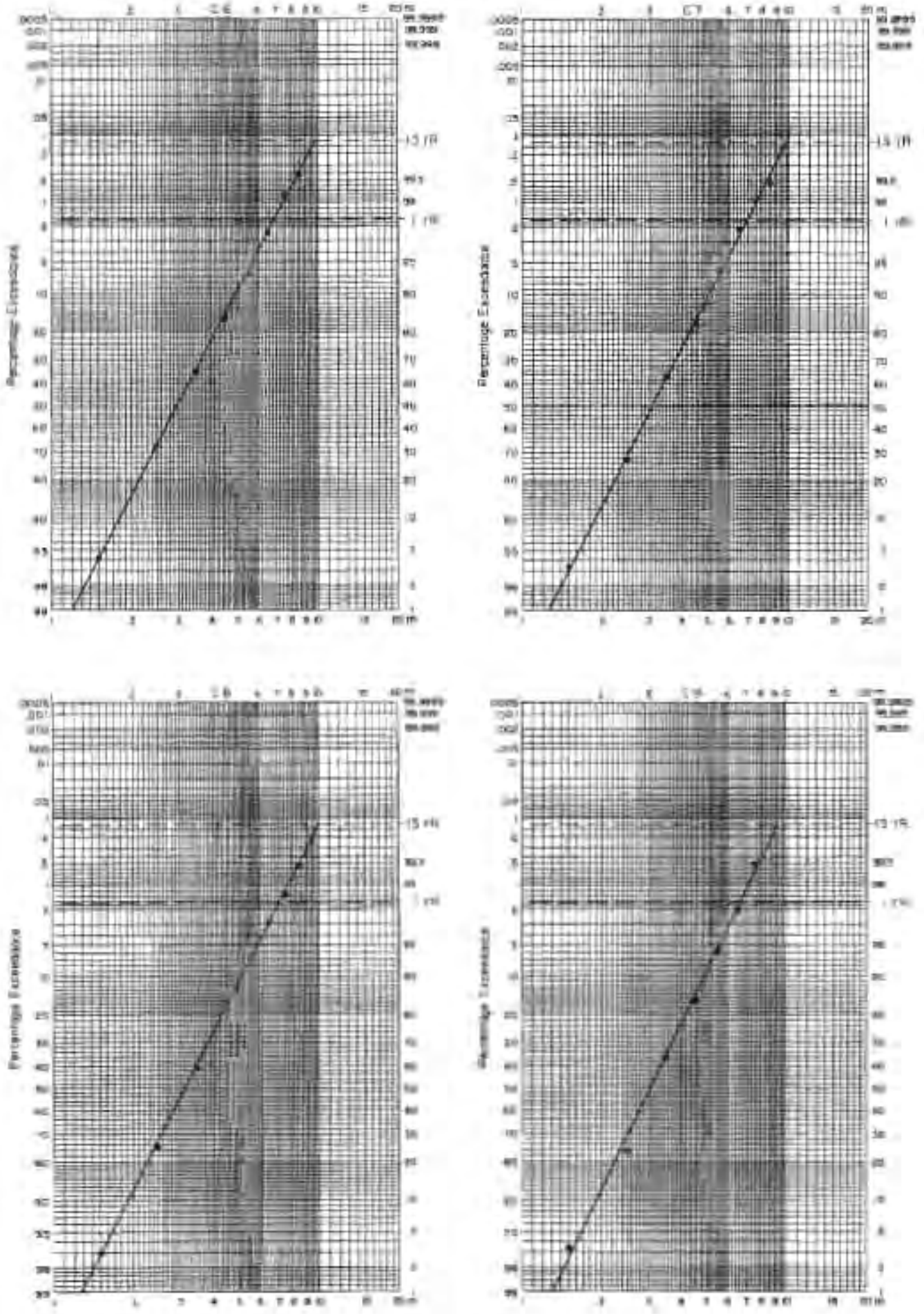


Figure 41 Monthly Wave Height Exceedance Distribution for April

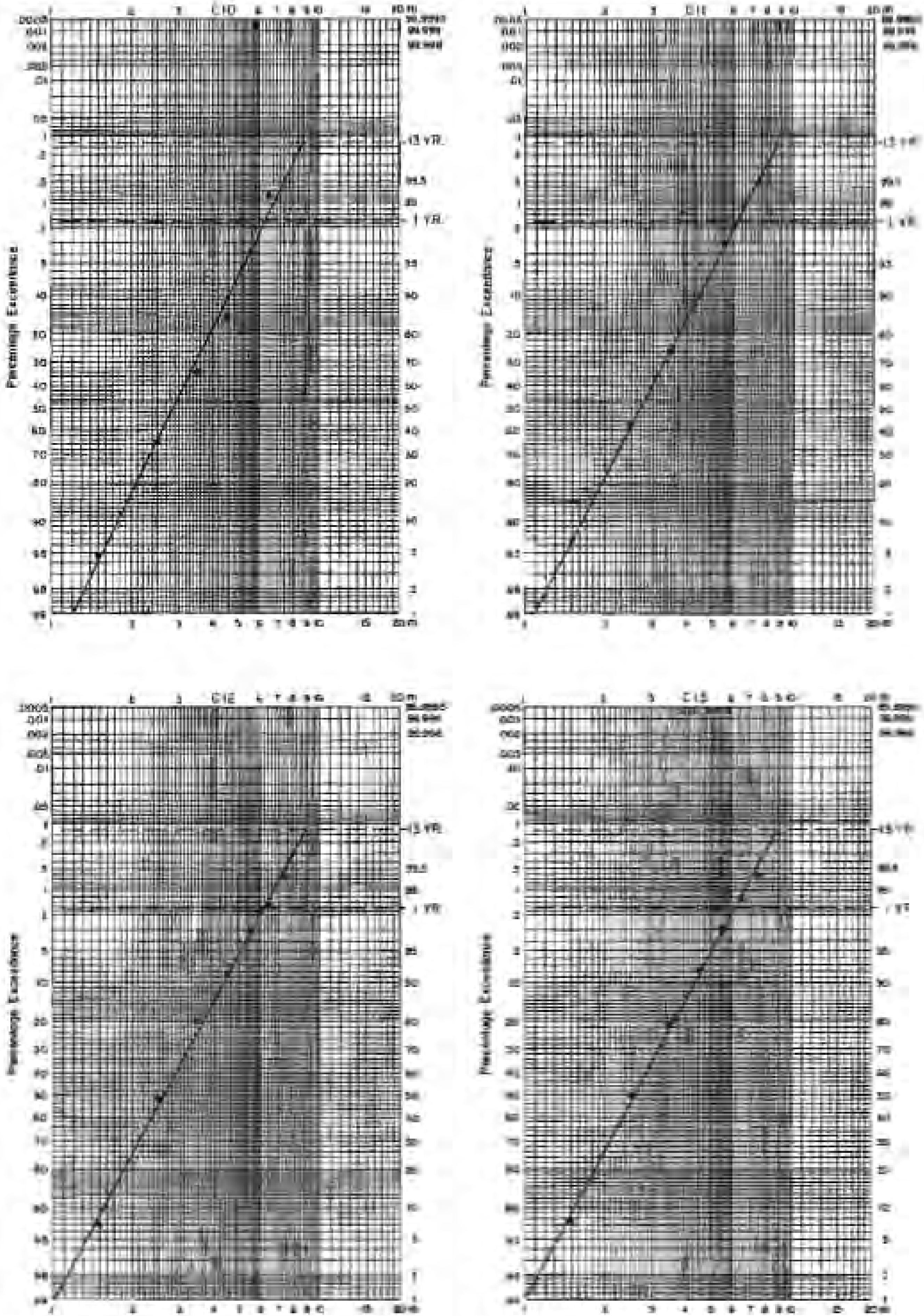


Figure 4(j). Monthly Wave Height Exceedance Distribution for [illegible]

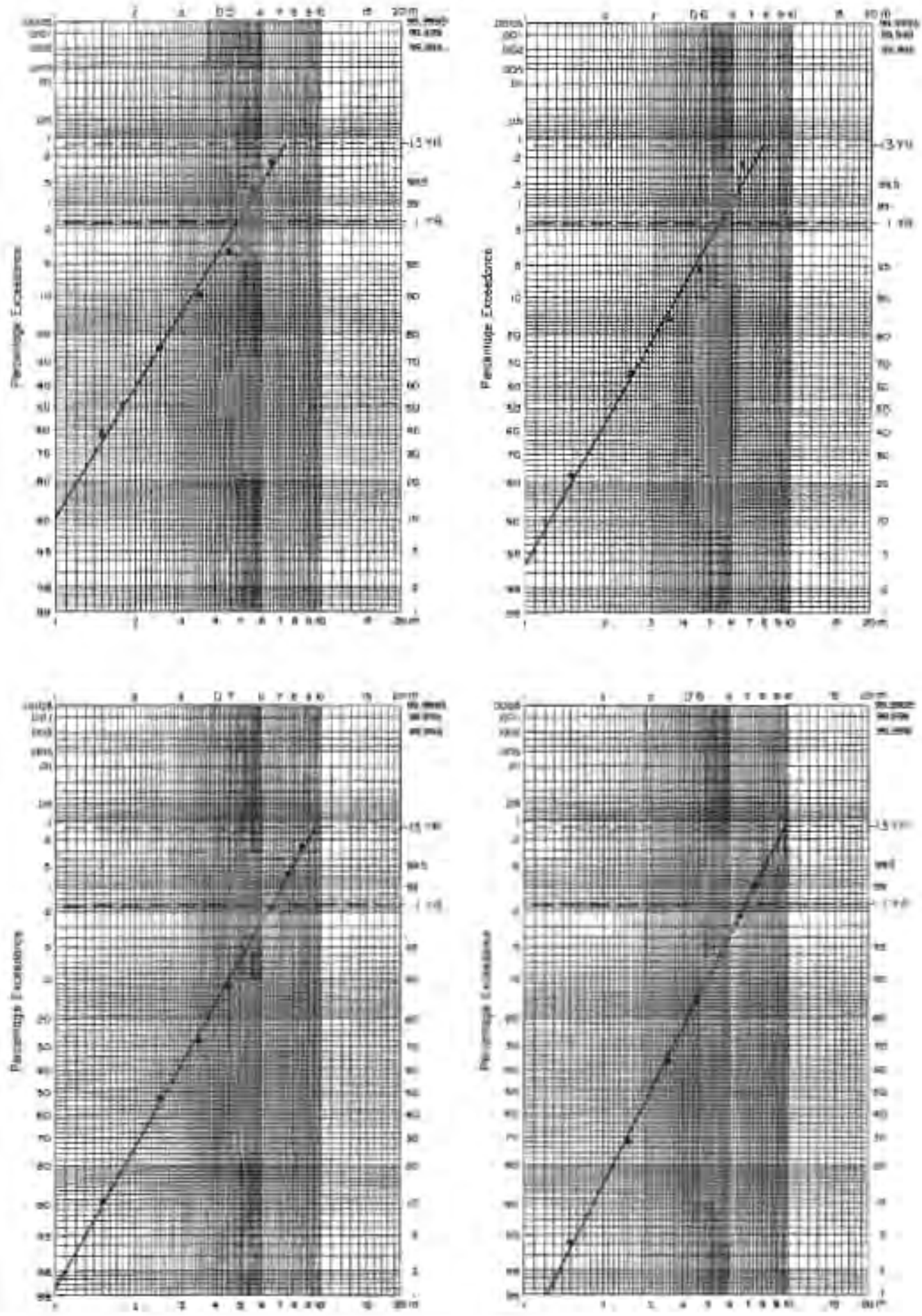


Figure A4 Monthly Wave Height Exceedance Distribution for April

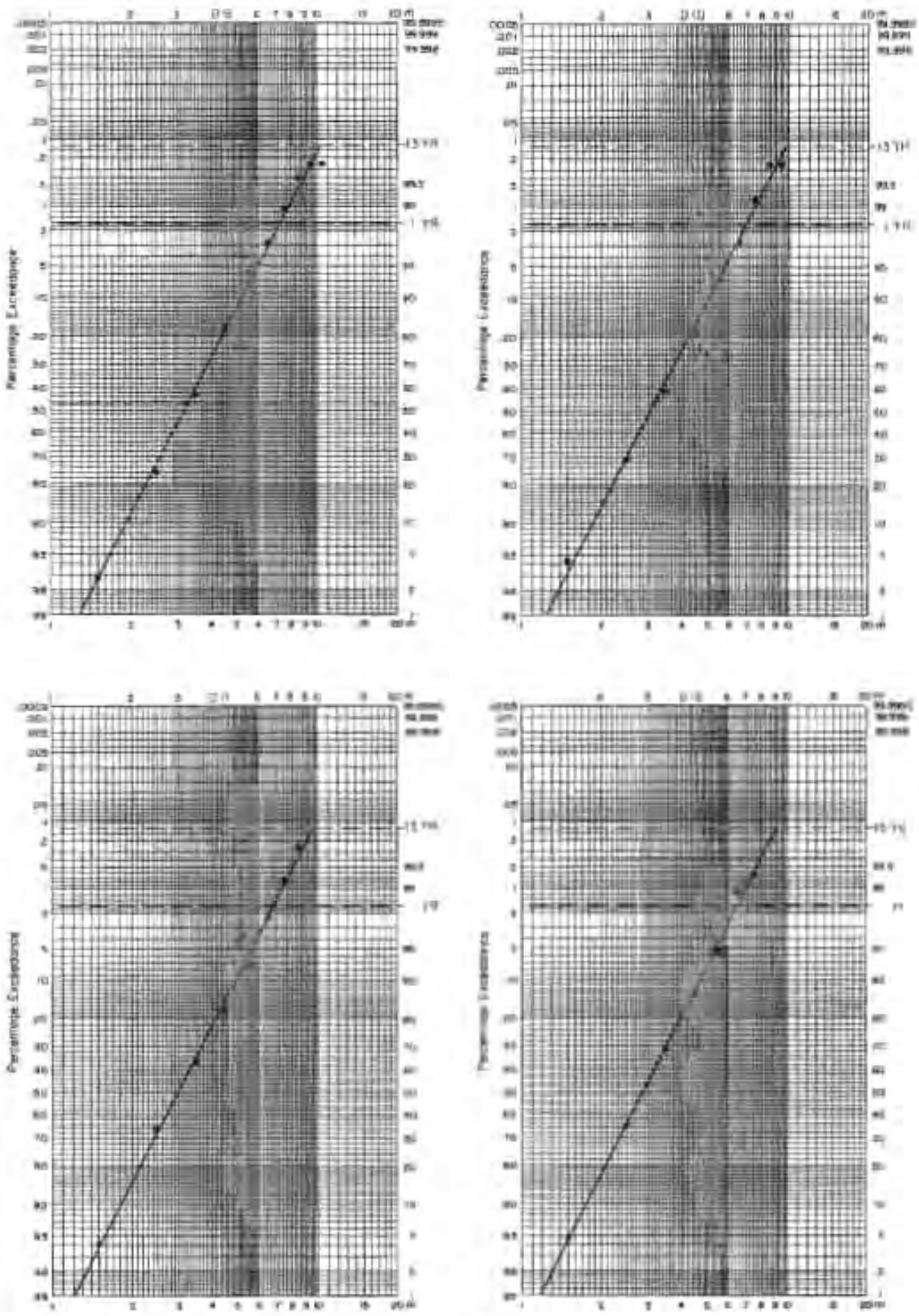


Figure 41 Monthly Wave Height Exceedance Distribution for April

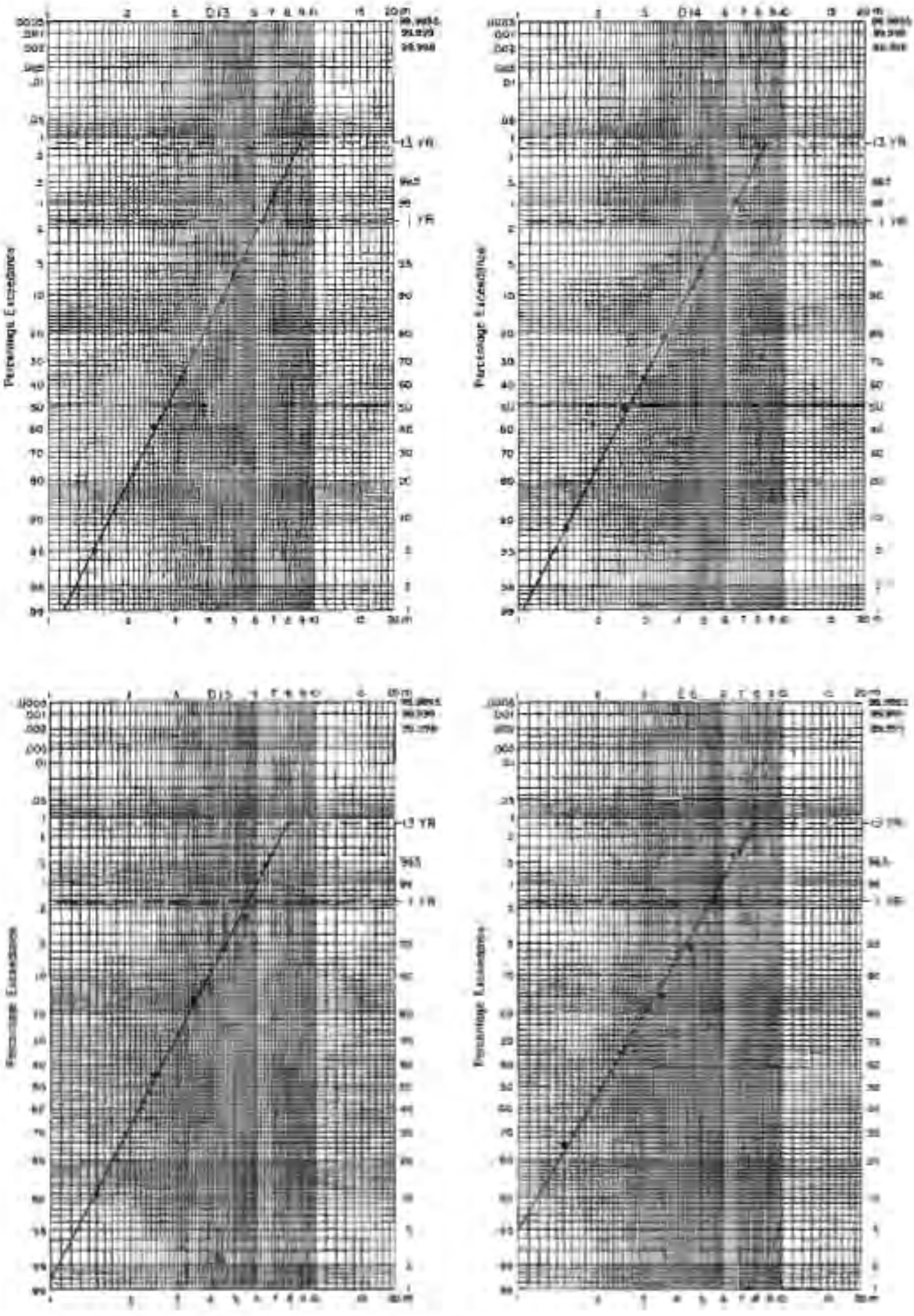


Figure 4m. Monthly Wave Height Exceedance Distribution for April

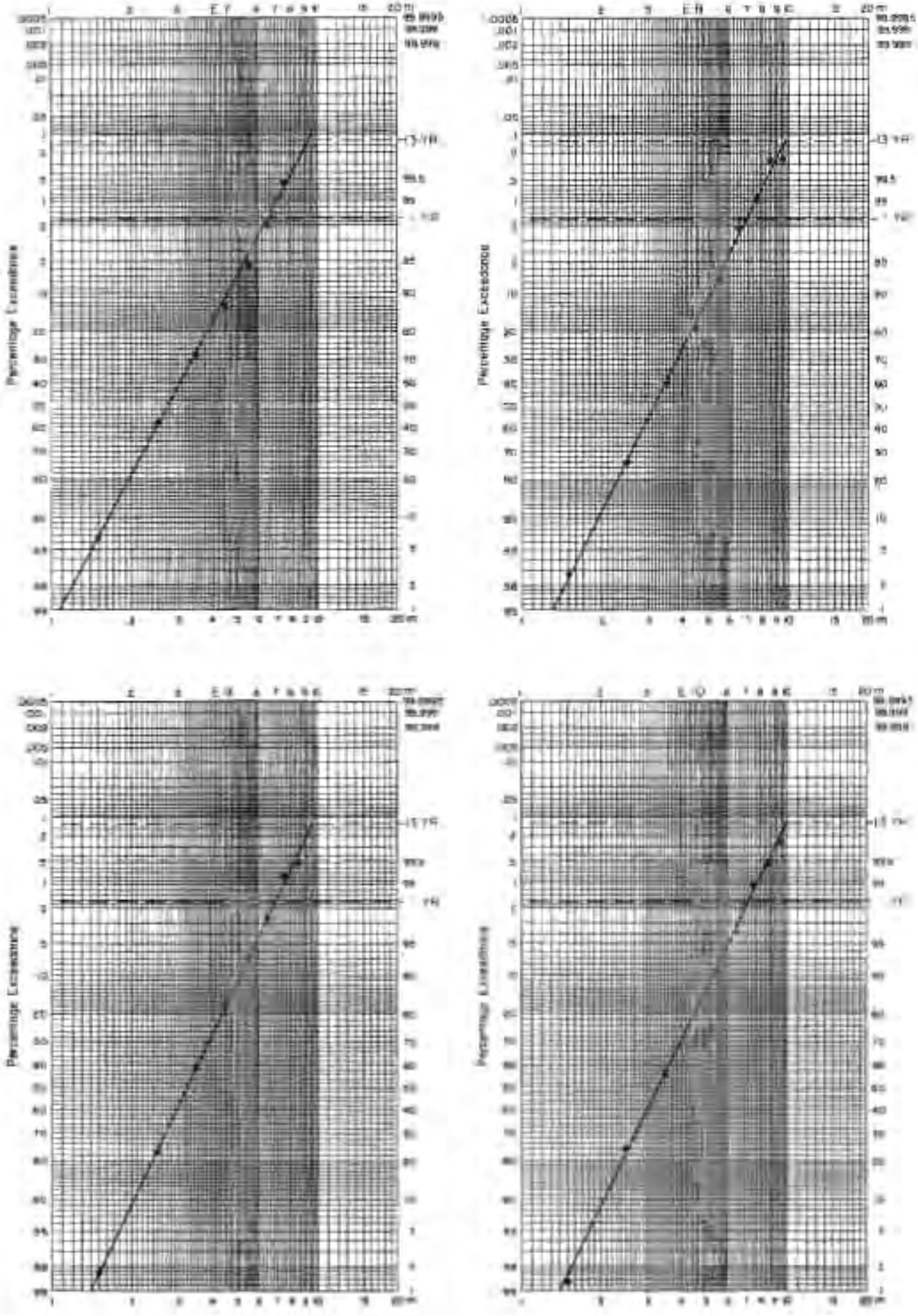


Figure 4.n Monthly Wave Height Exceedance Distribution for August

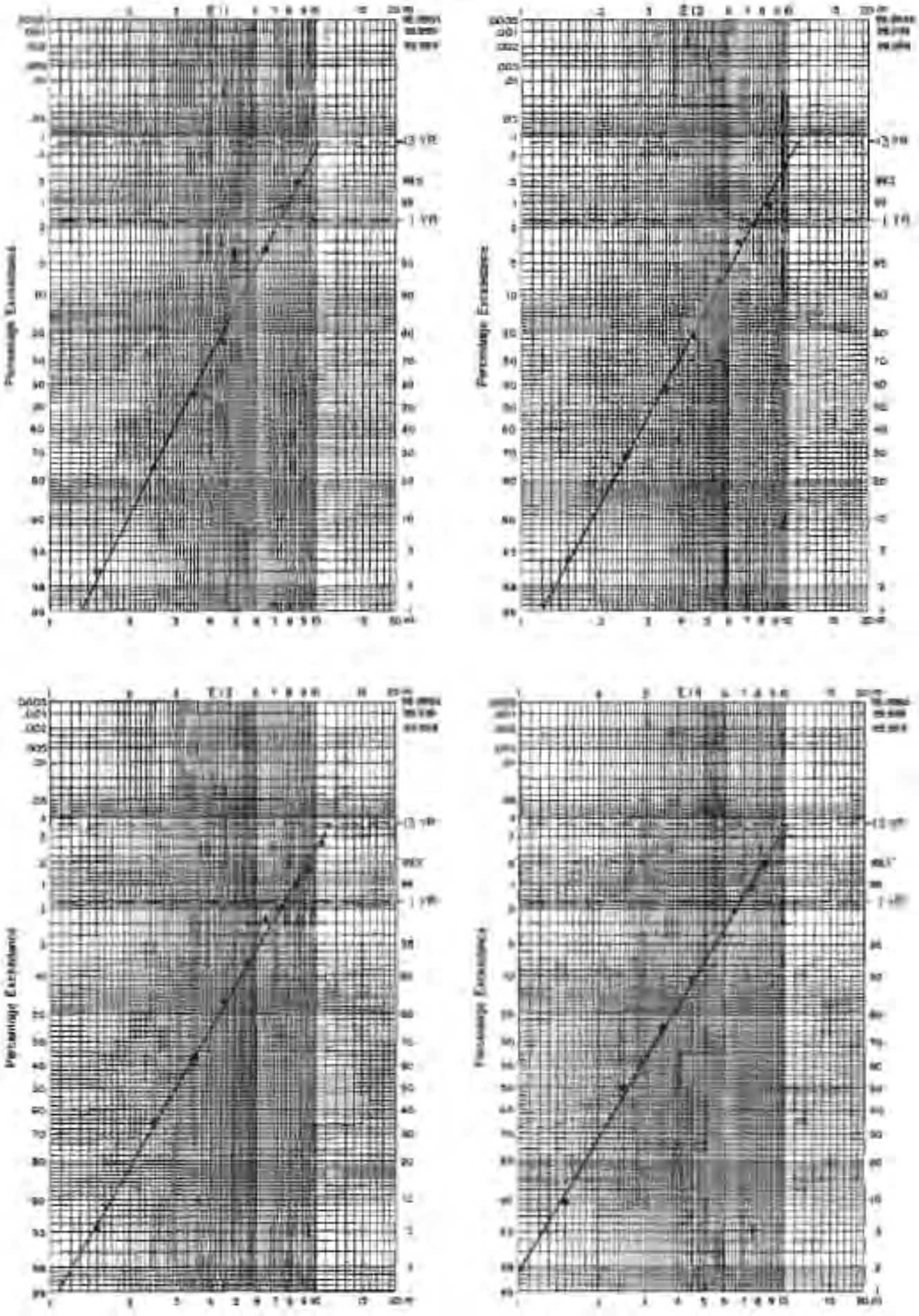


Figure 4.6 Monthly Wave Height Exceedance Distribution for April

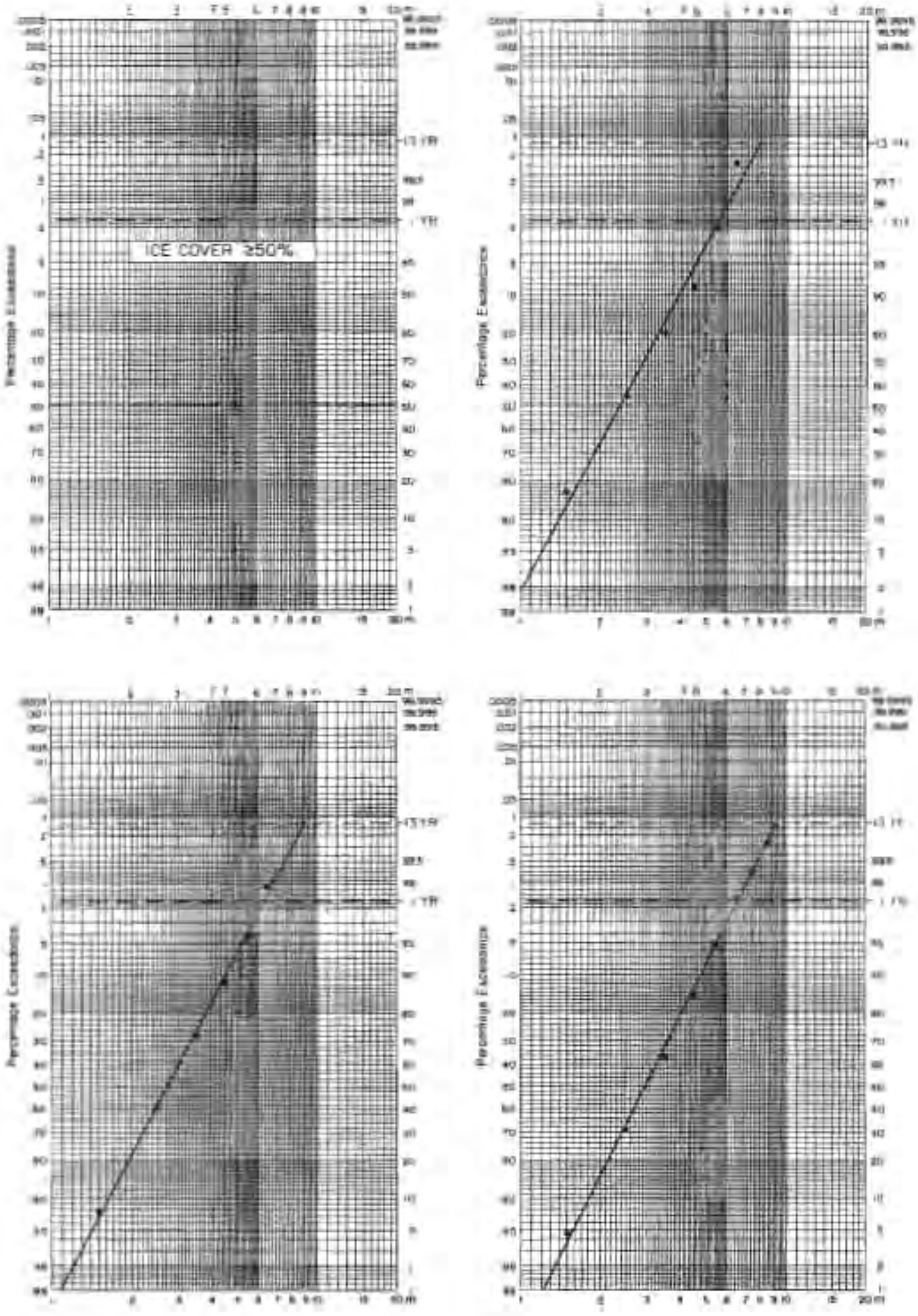


Figure 4g. Monthly Wave Height Exceedance Distribution for April

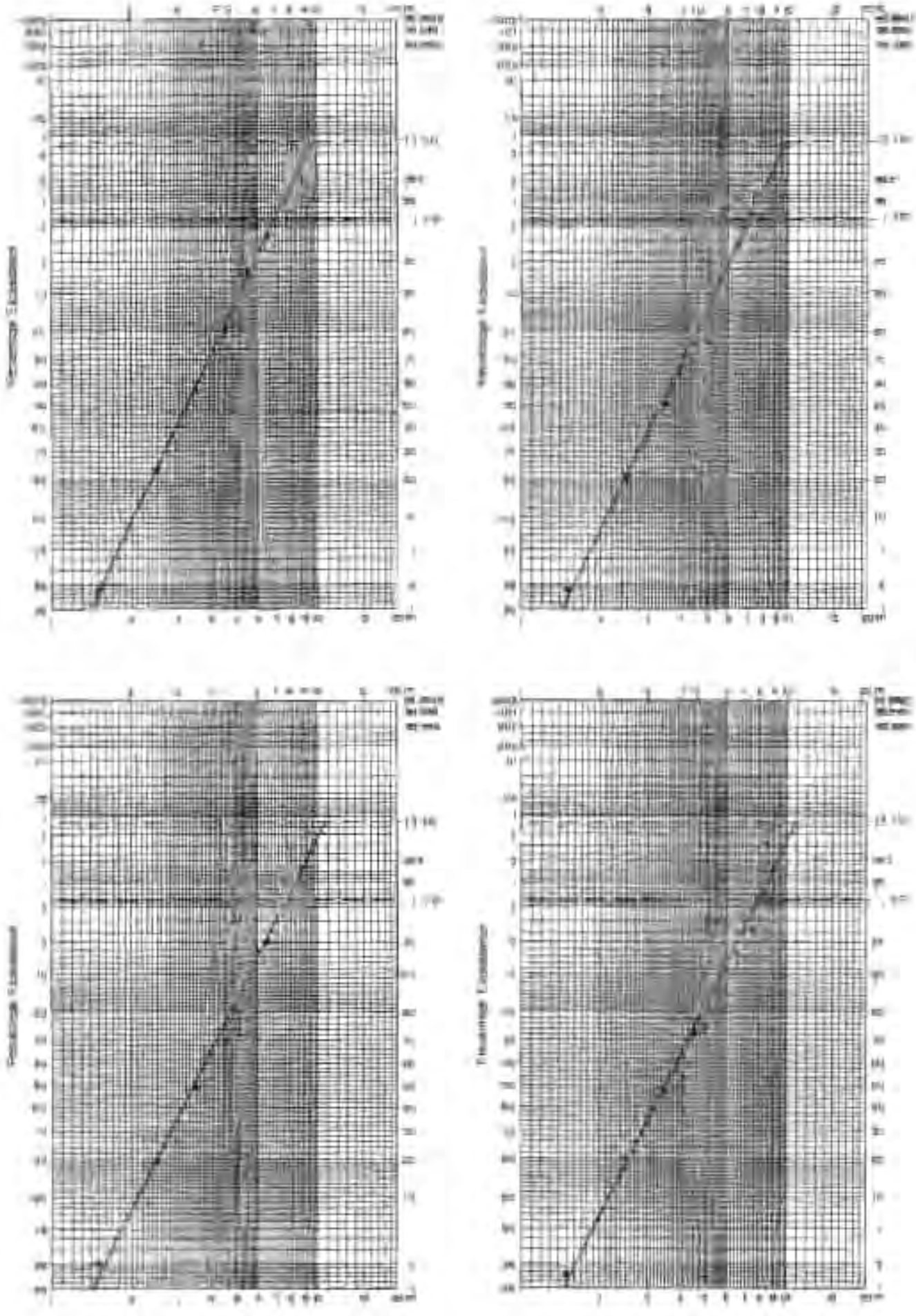


Figure 43 Monthly Wave Height Exceedance Distribution for April

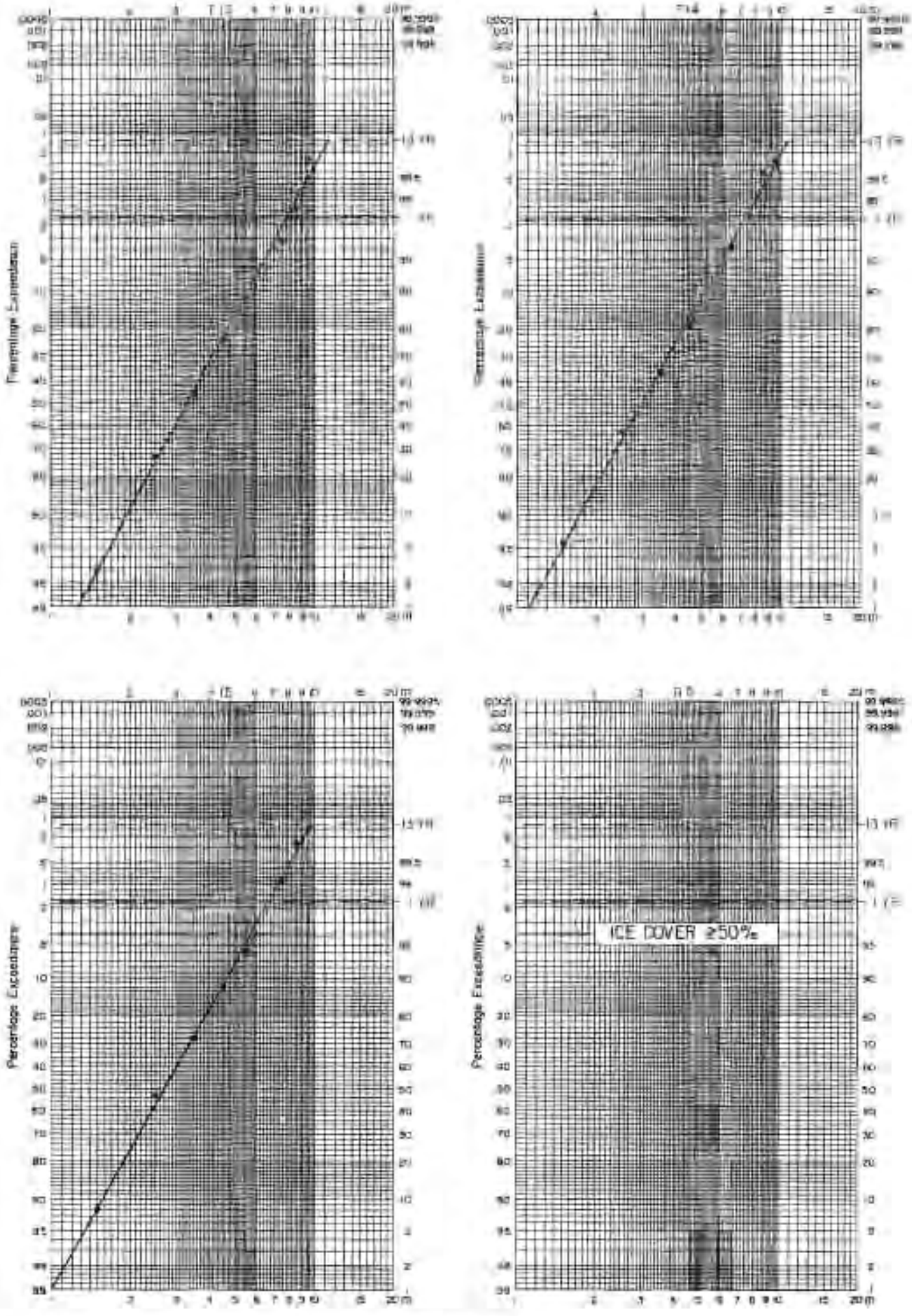


Figure 41. Monthly Wave Height Exceedance Distribution for April

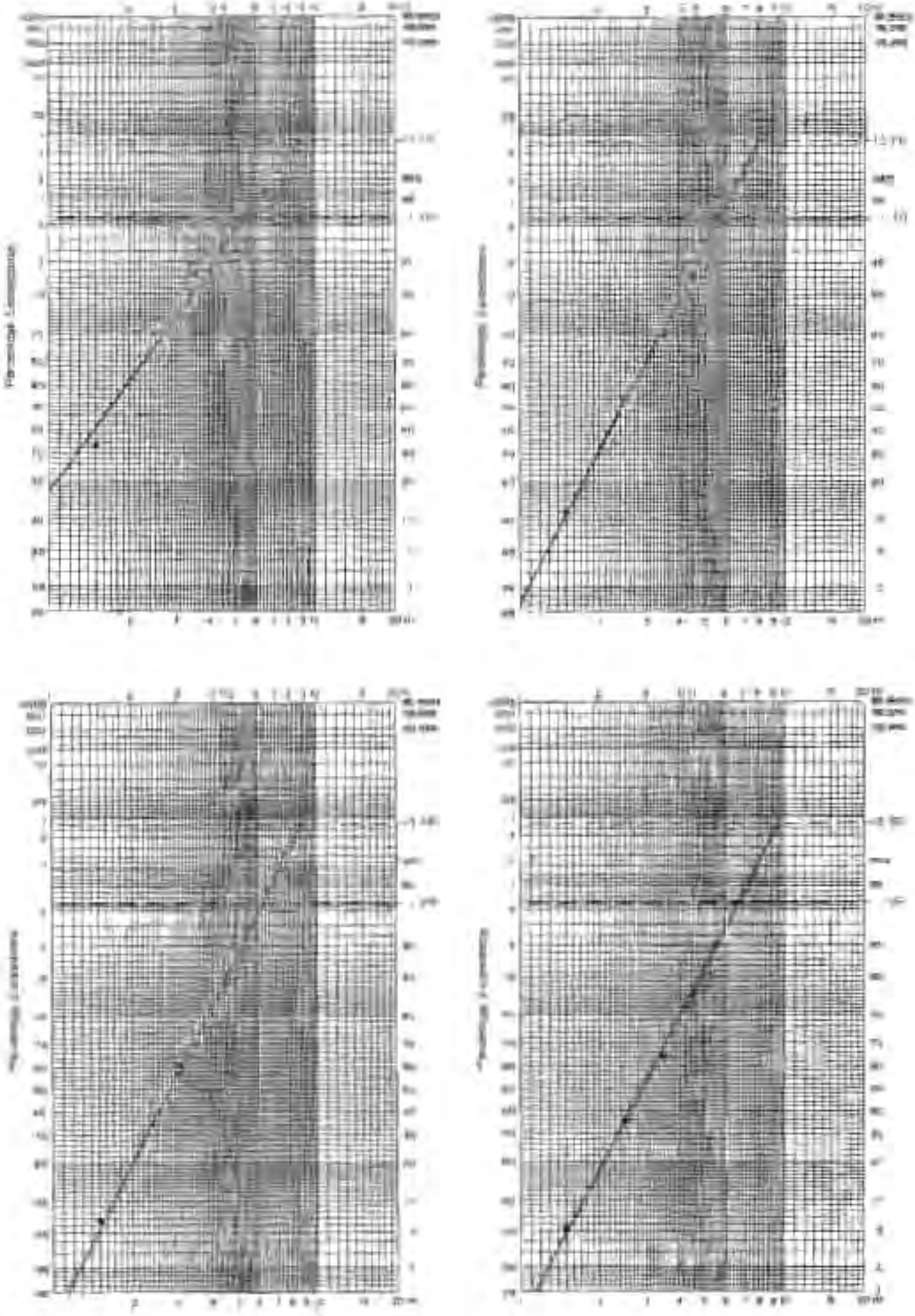


Figure [illegible] Monthly Wave Height Probability Distribution for April

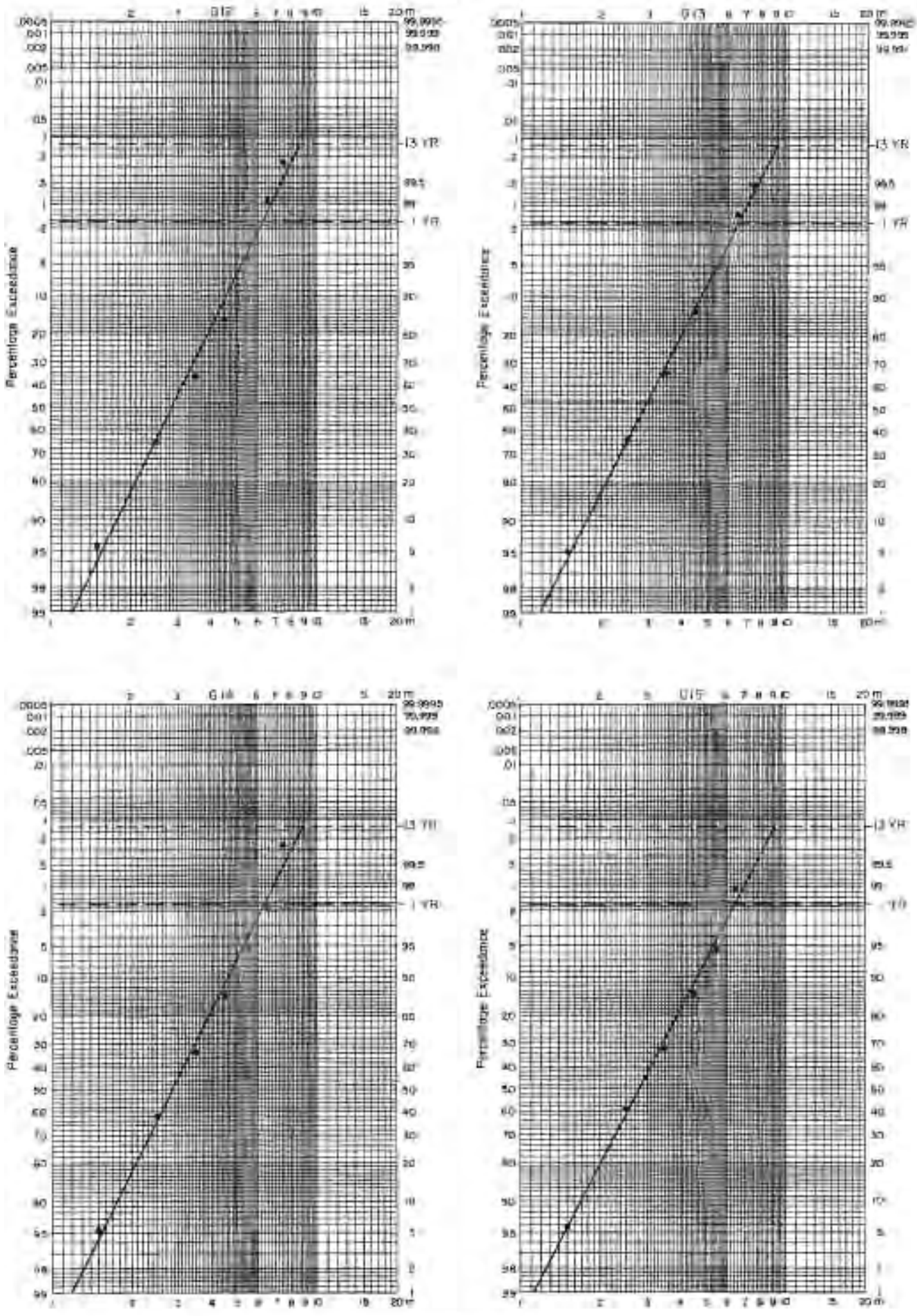


Figure 41 Monthly Wave Height Exceedance Distribution for April

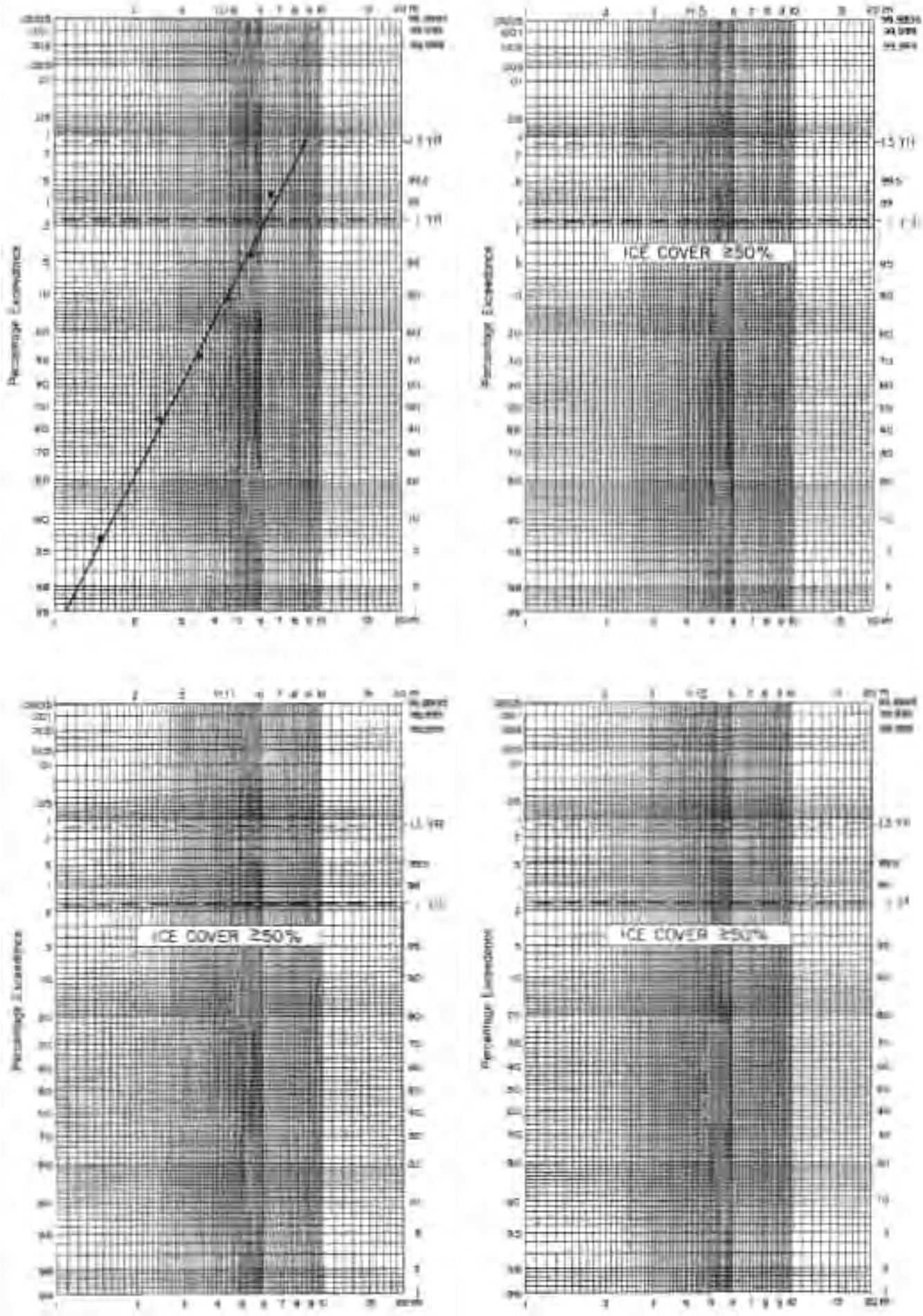


Figure 41. Monthly Wave Height Exceedance Distribution for April

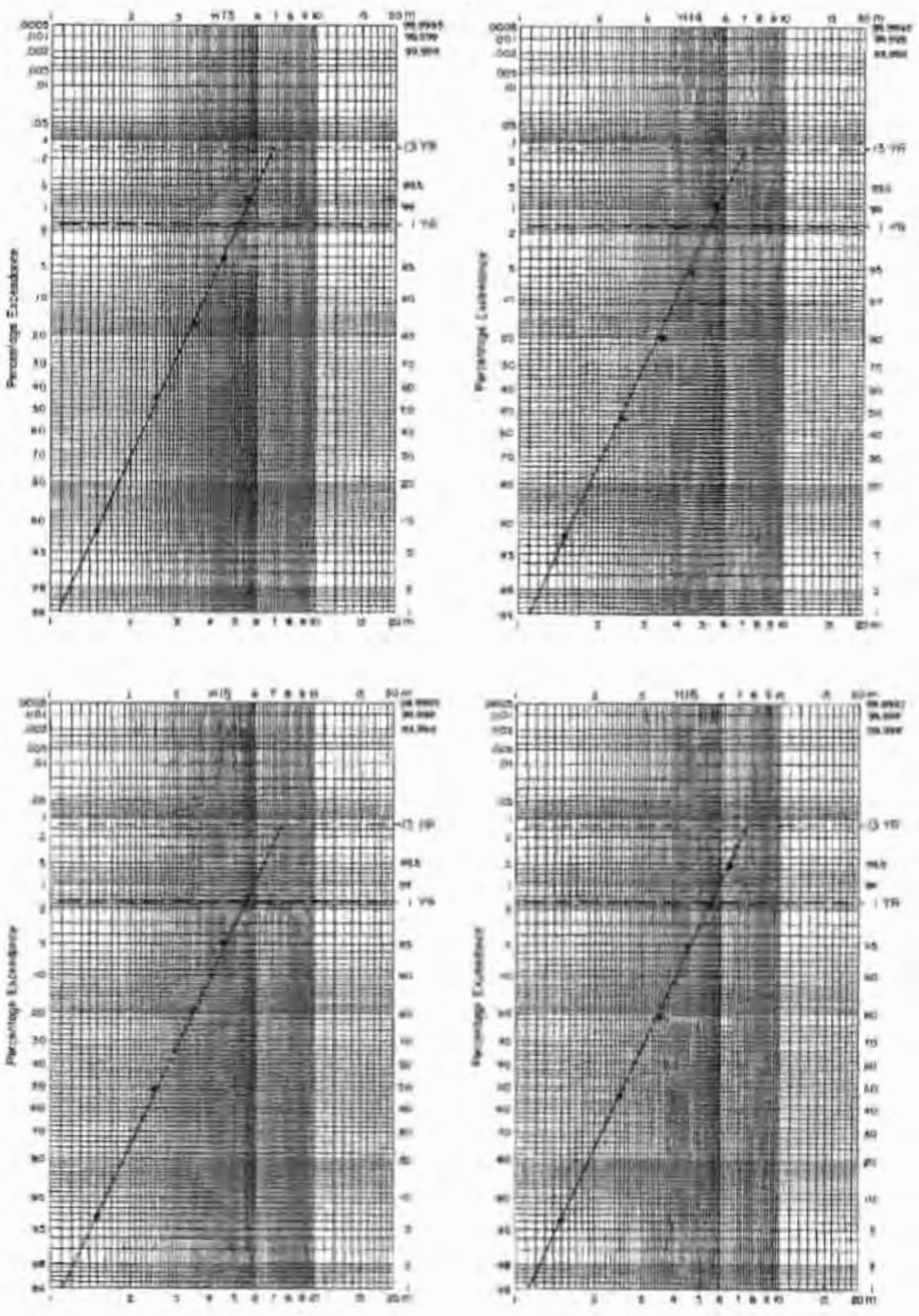


Figure 4.x Monthly Wave Height Exceedance Distribution for April

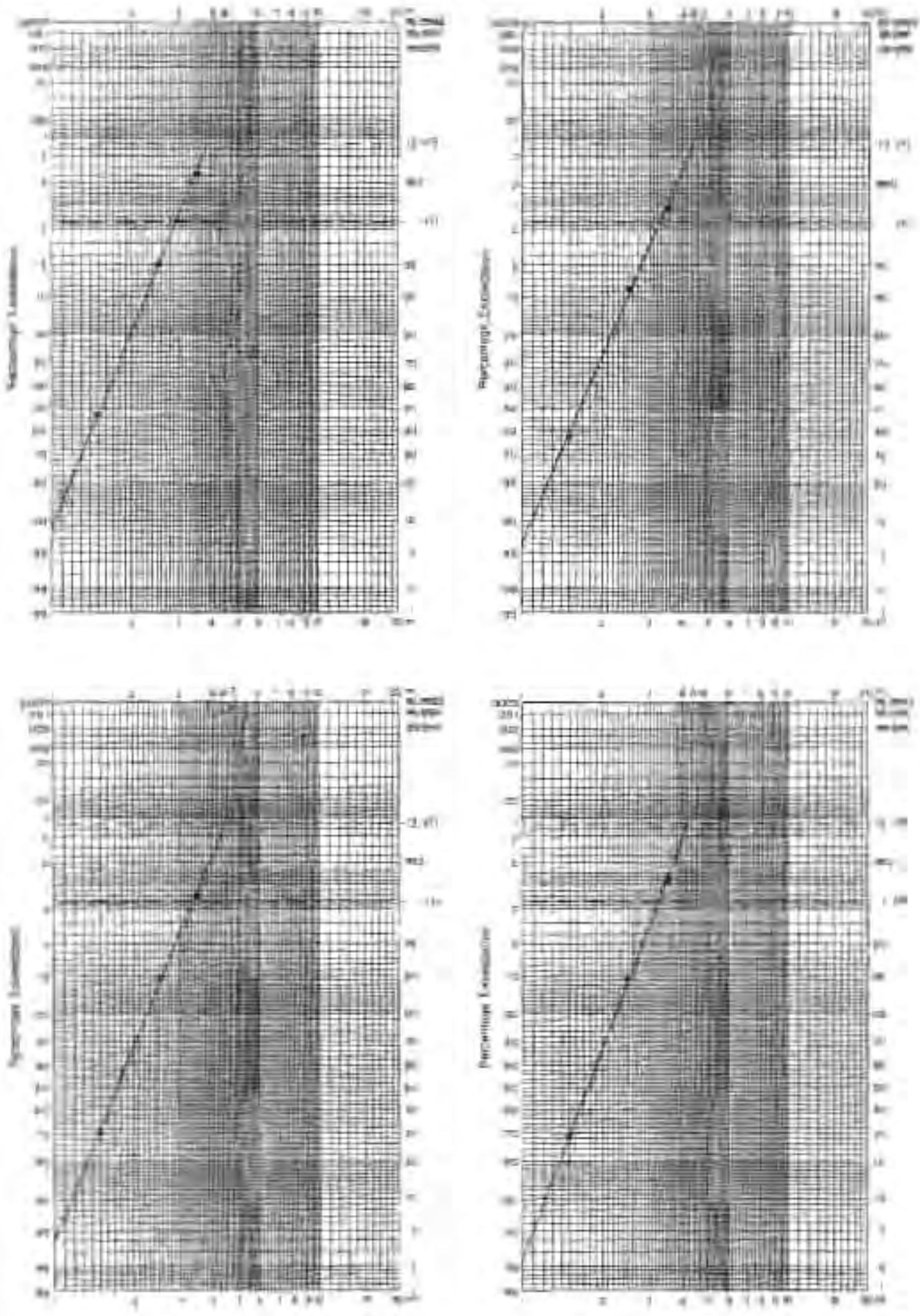


Figure 1-1 Monthly Wave Height Exceedance Distribution for May

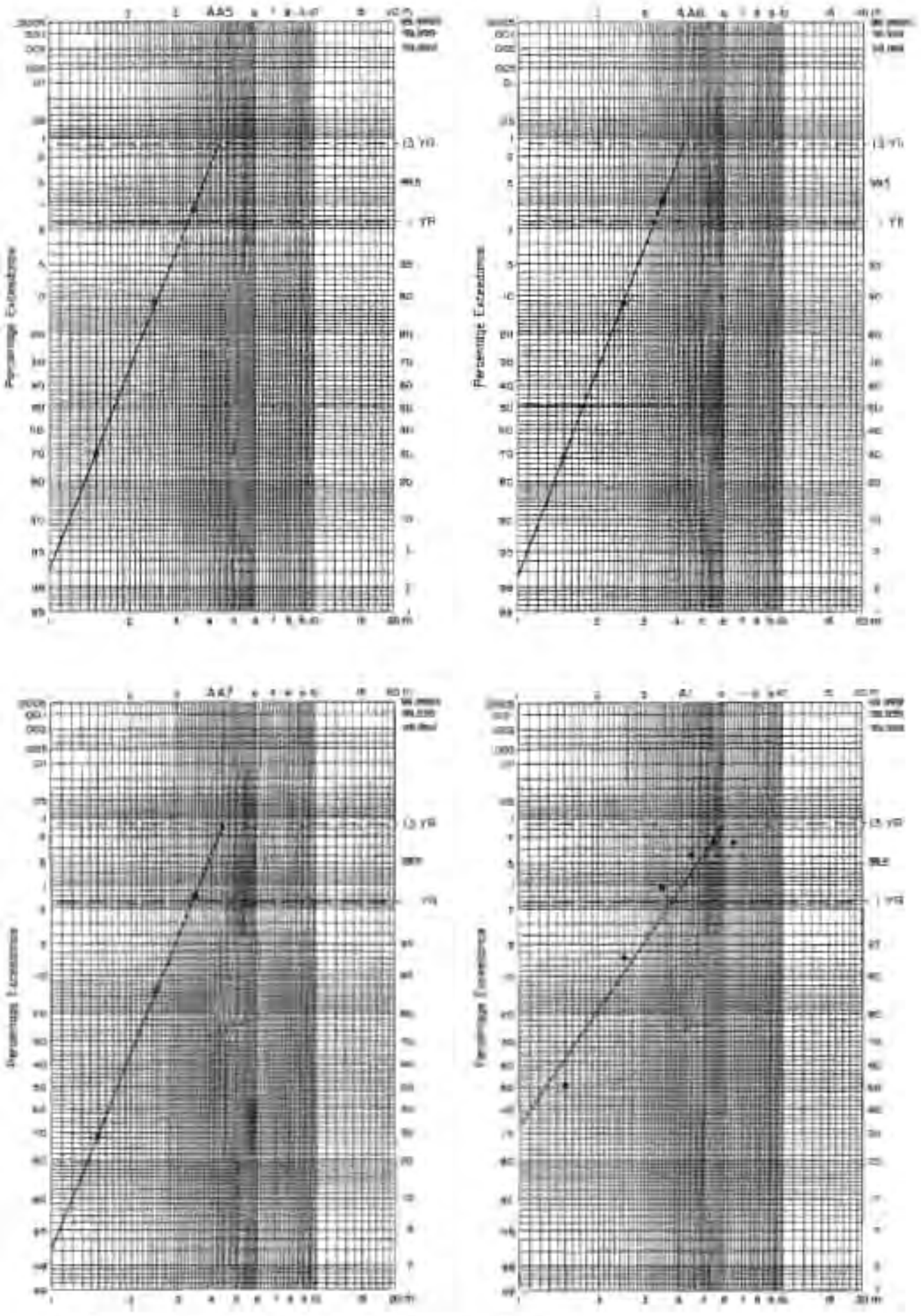
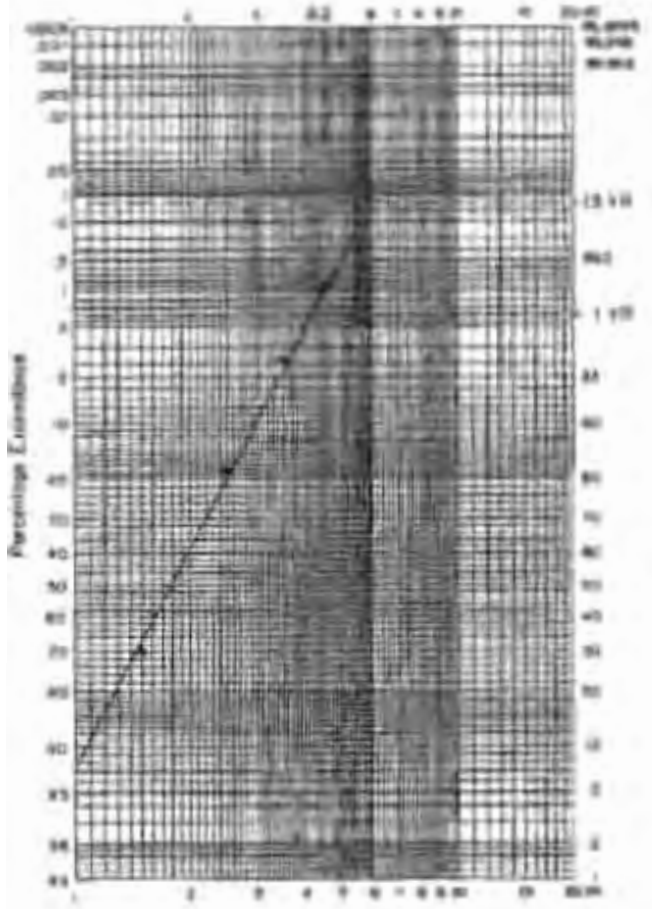
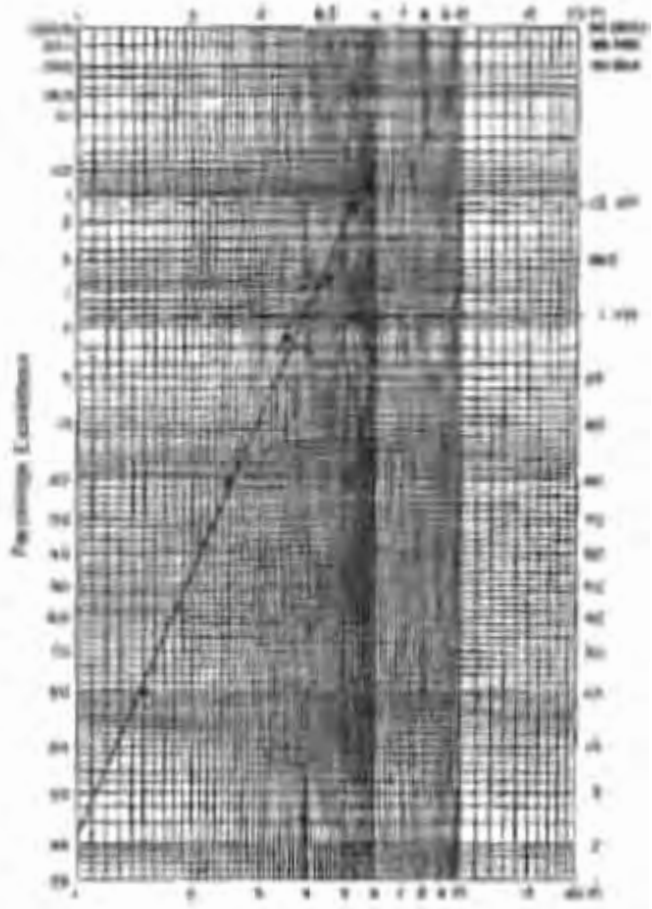
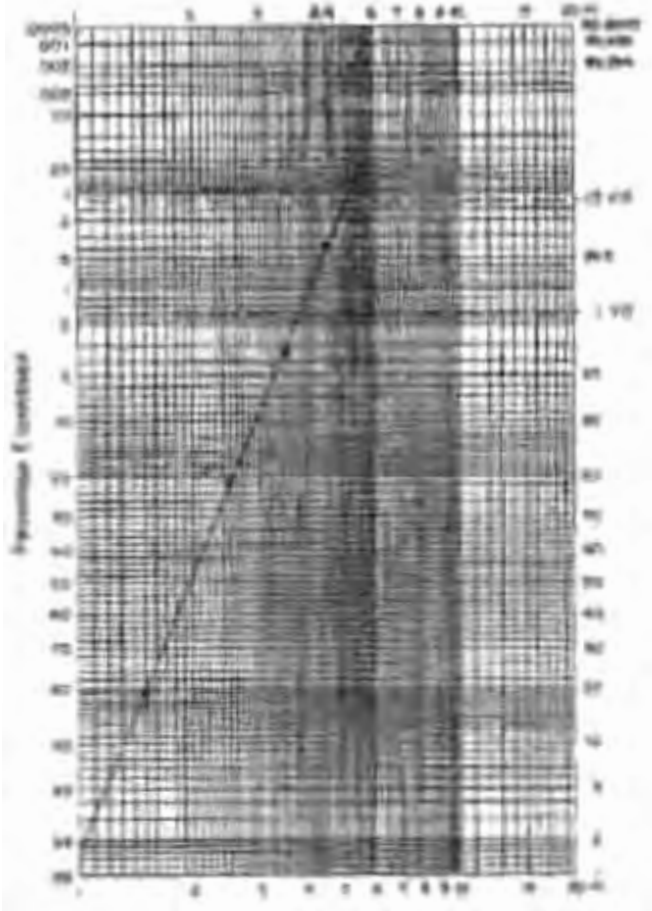
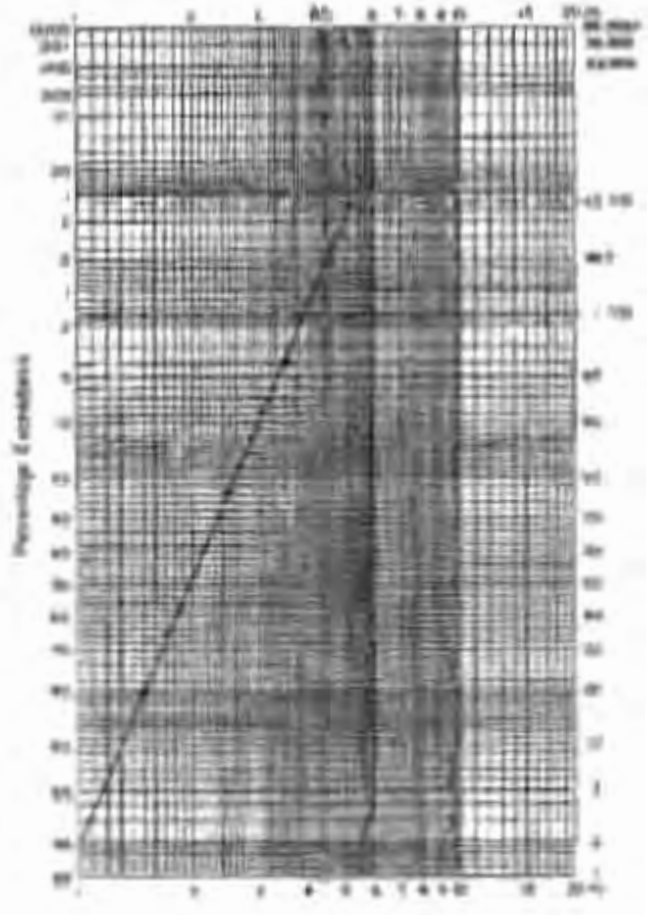


Figure 5c. Monthly Wave Height Exceedance Distribution for May









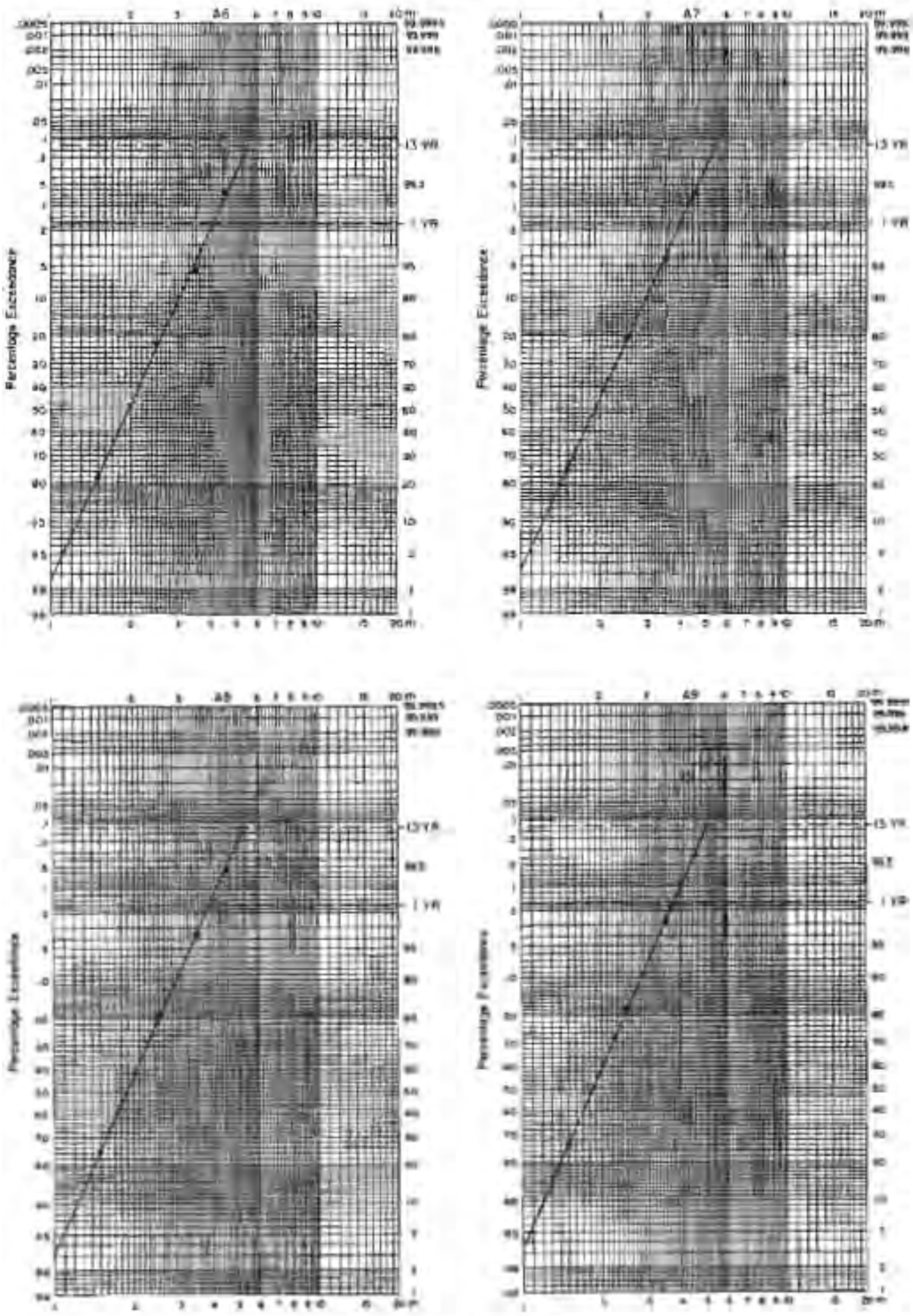
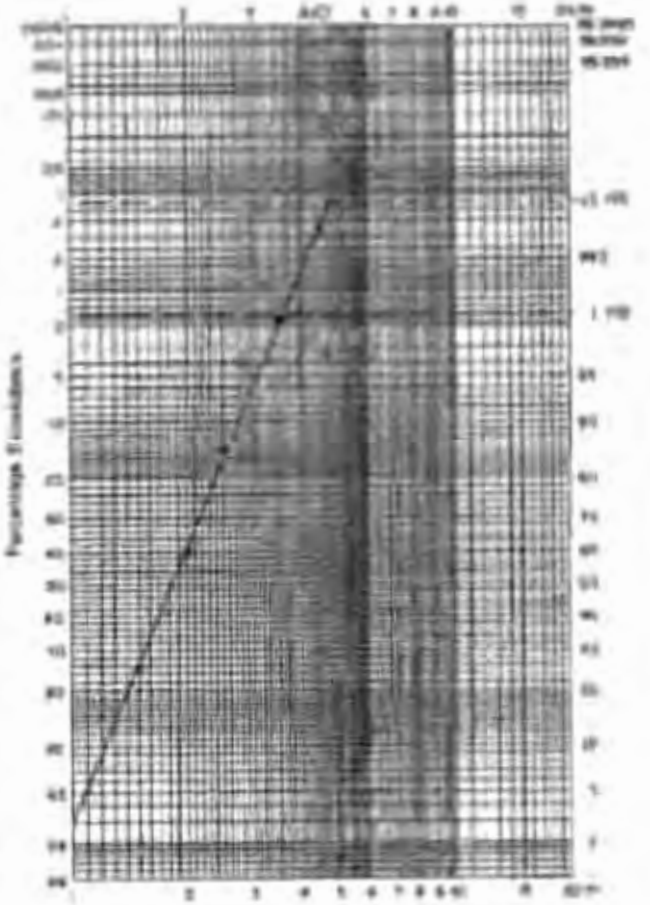
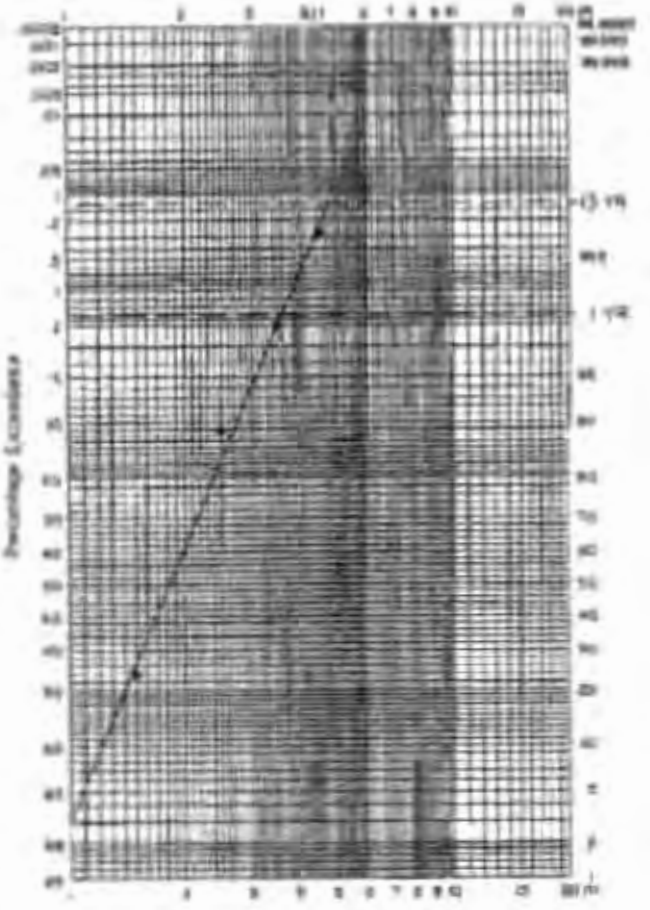
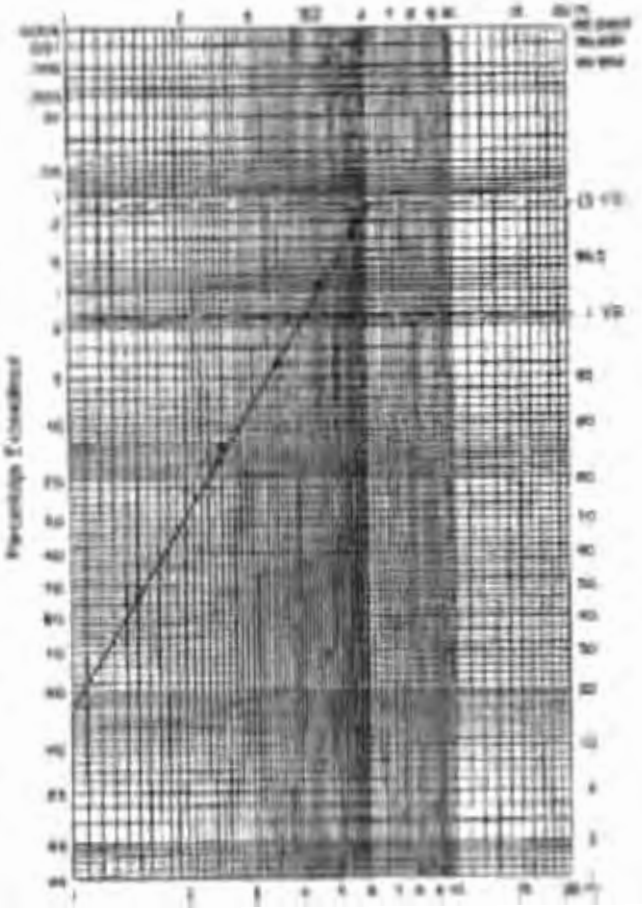
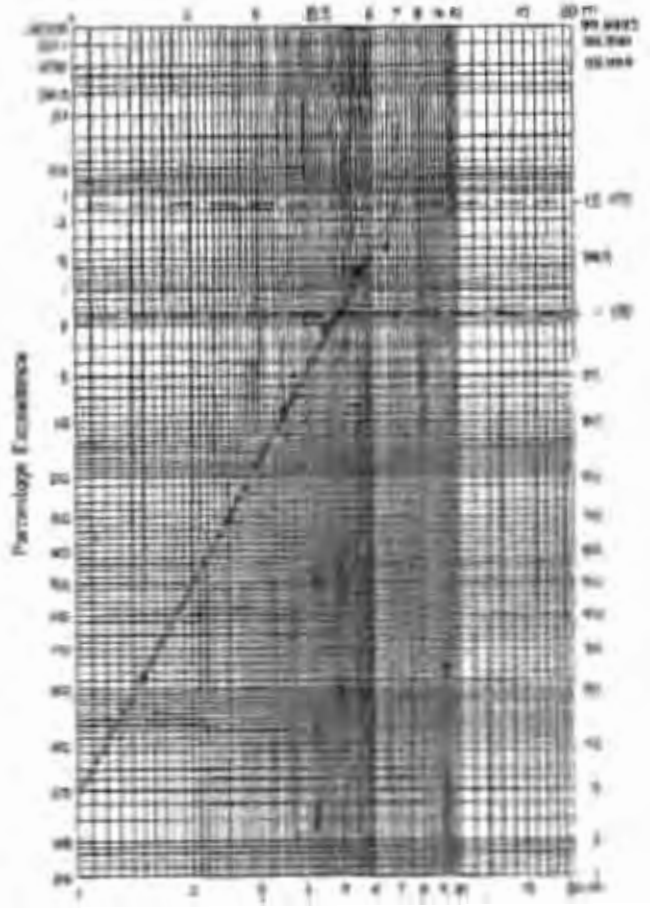


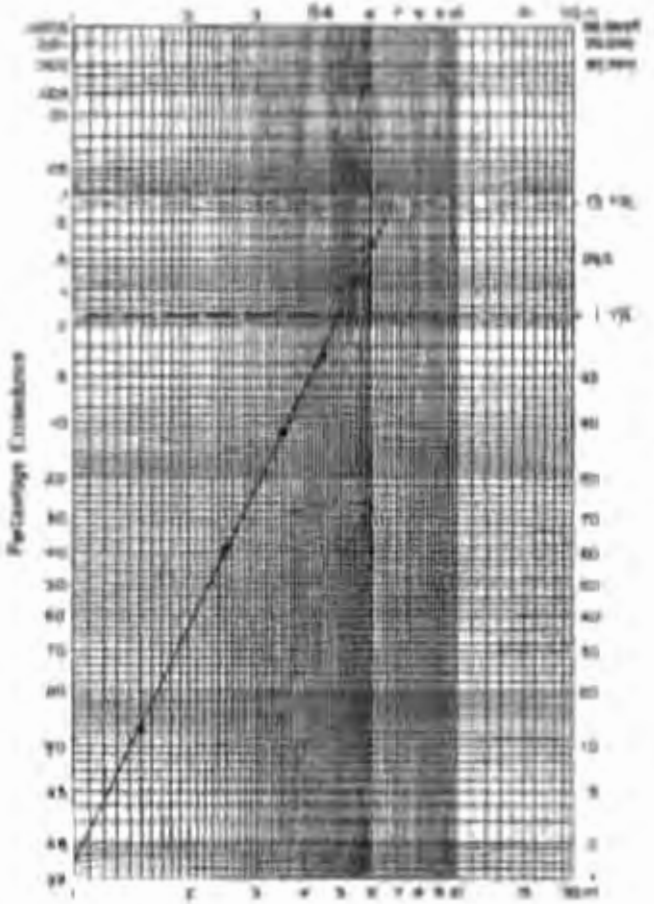
Figure 5d Monthly Wave Height Exceedance Distribution for May

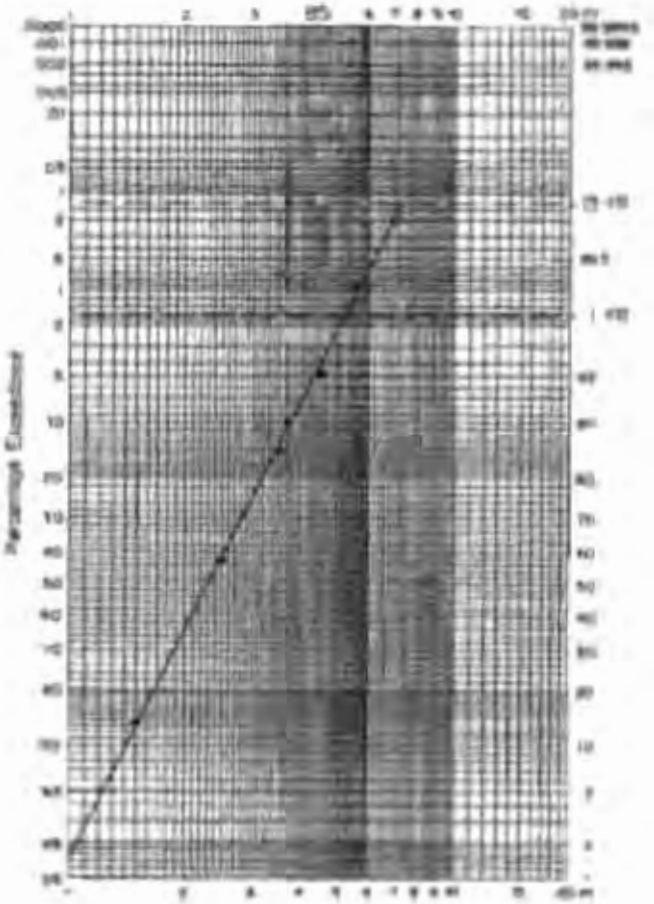


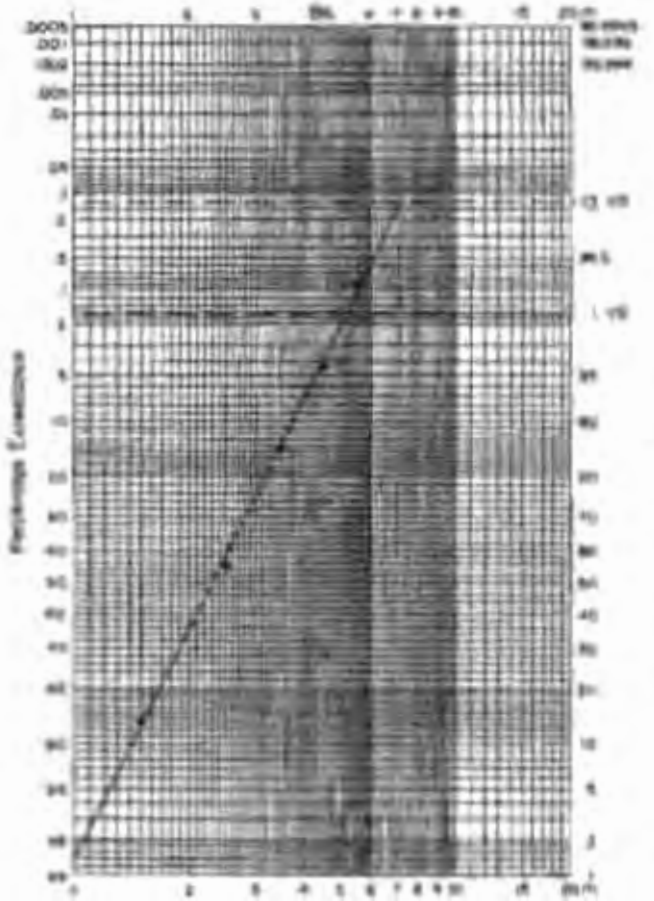


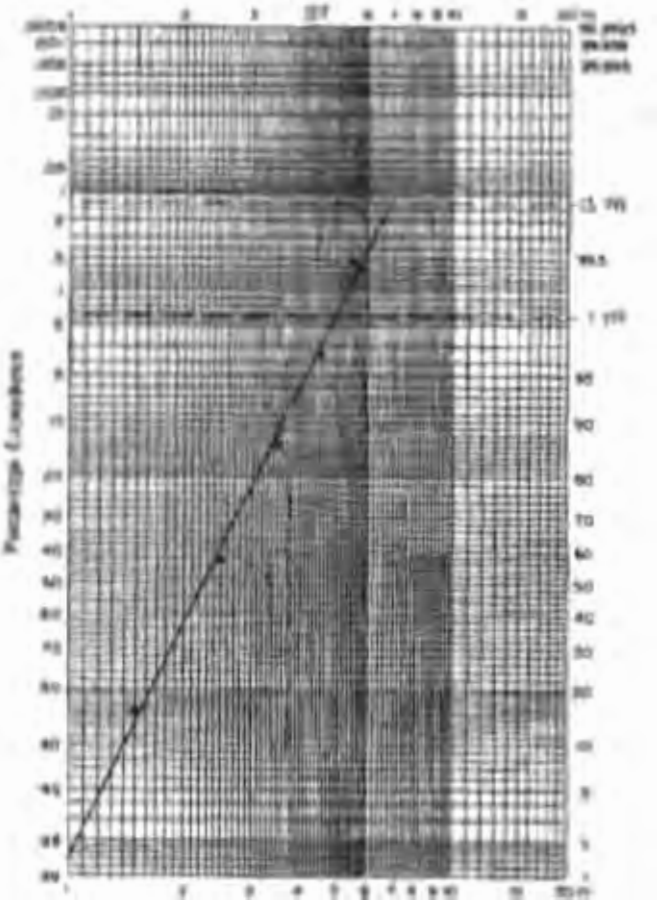


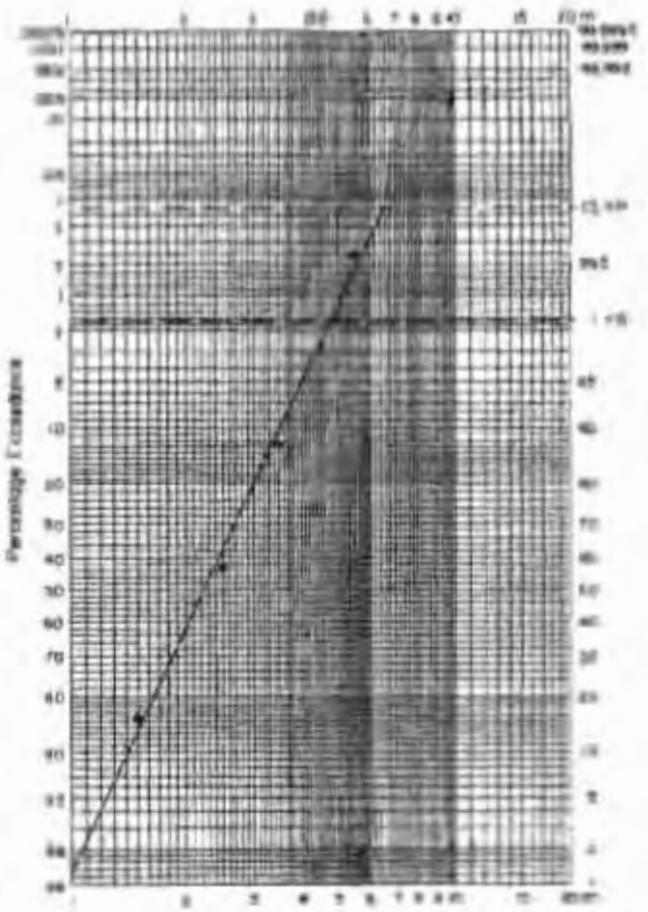


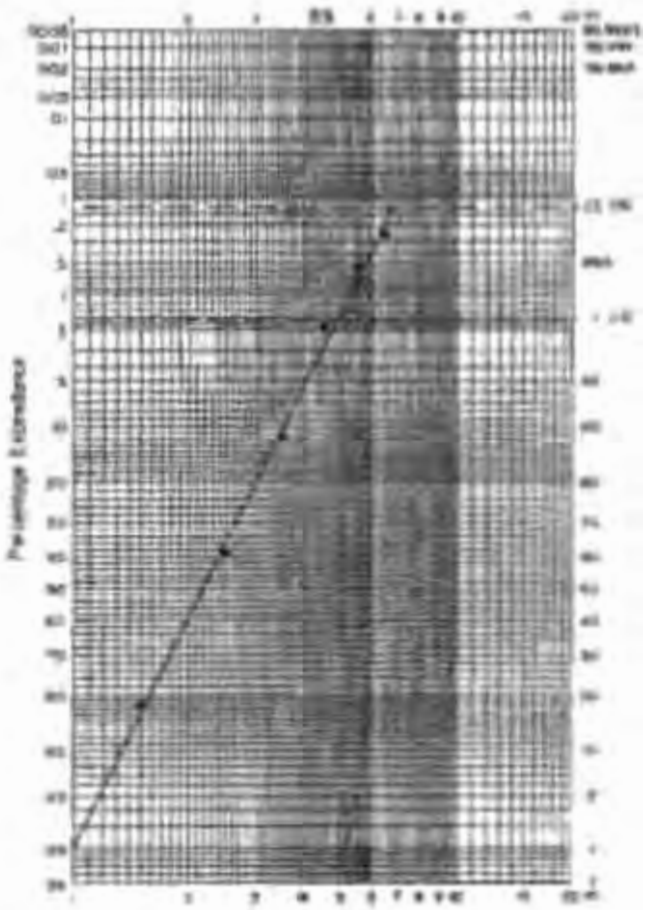


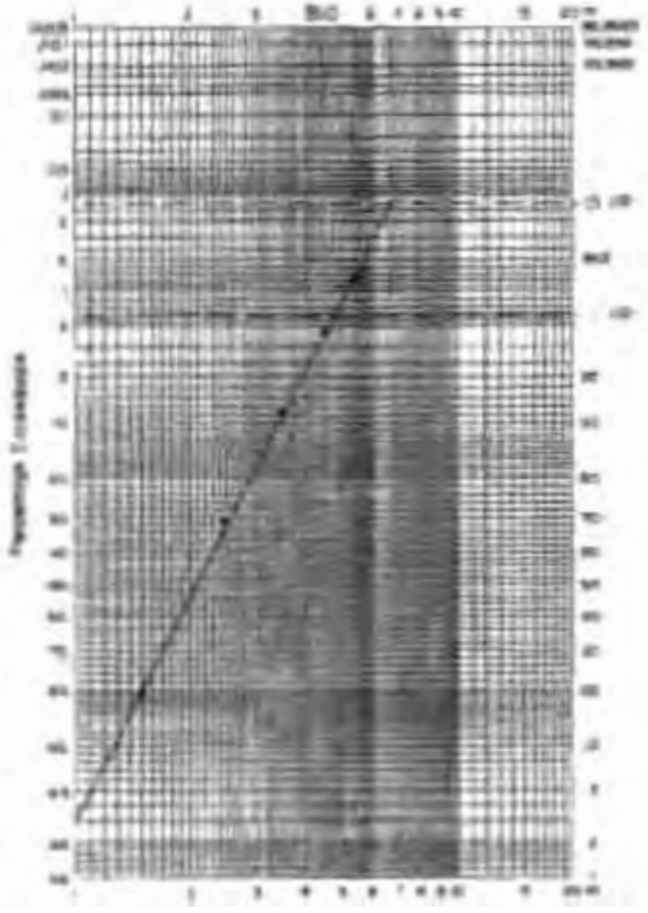


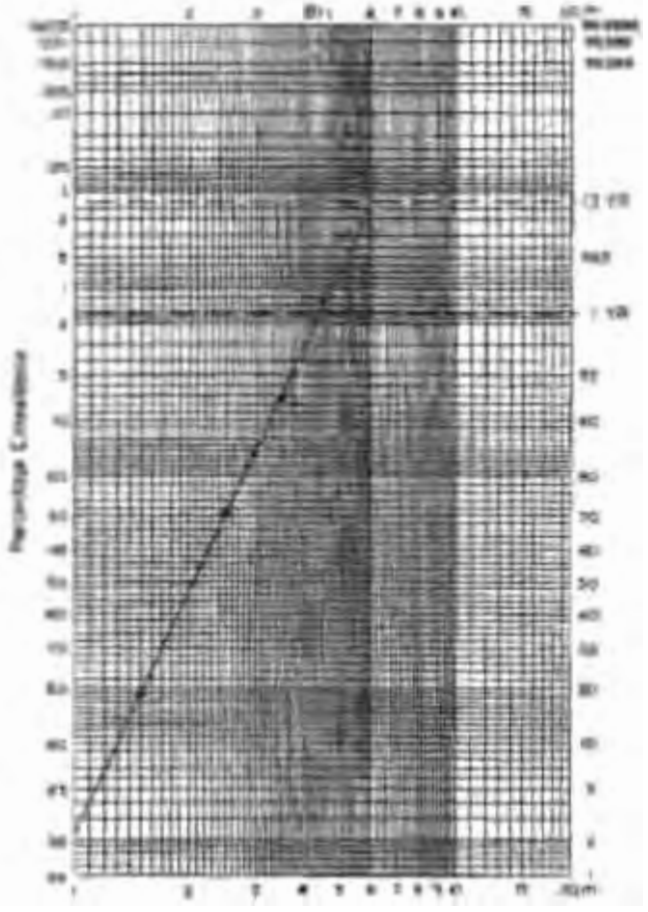


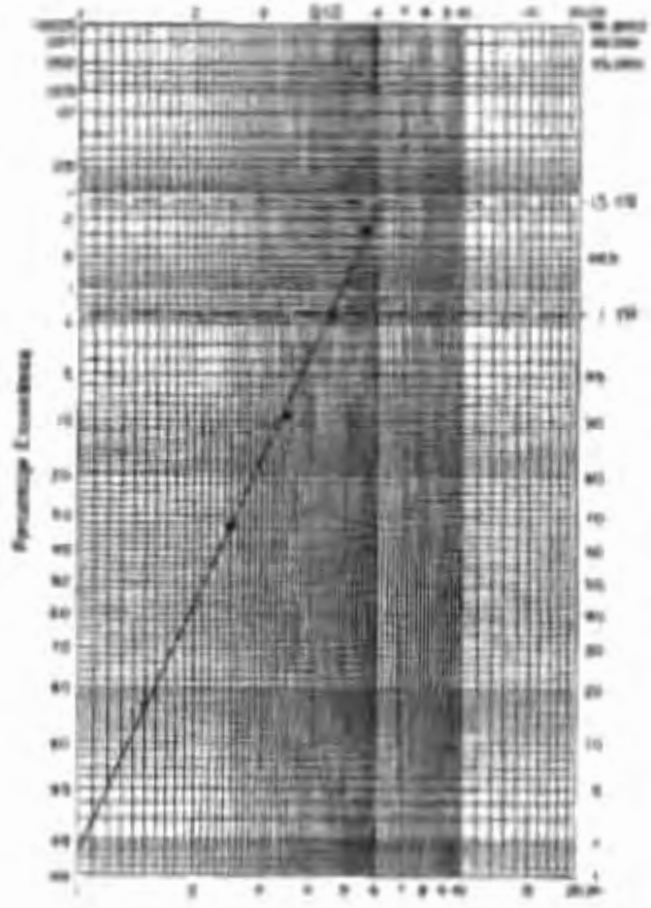


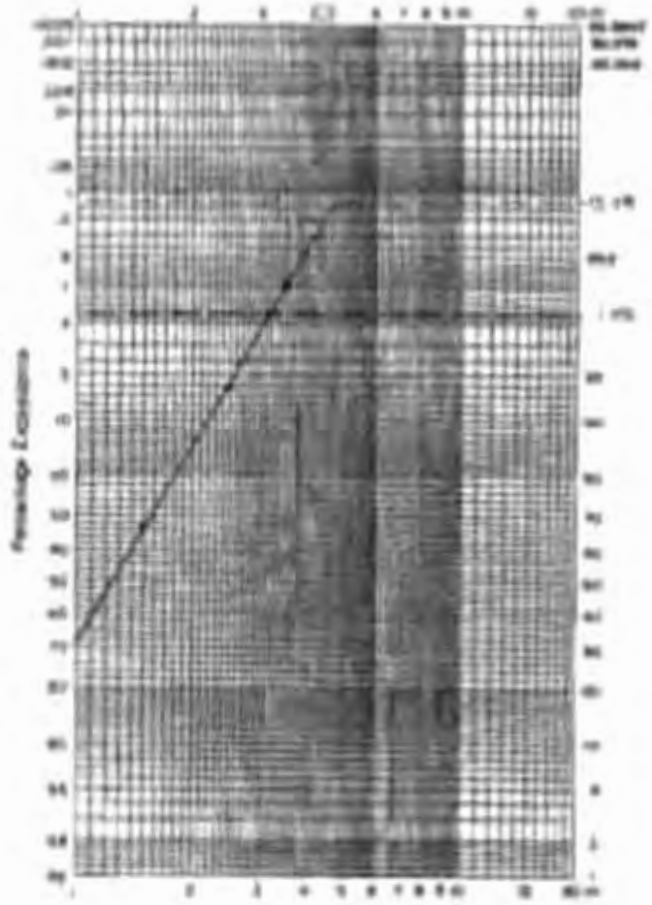


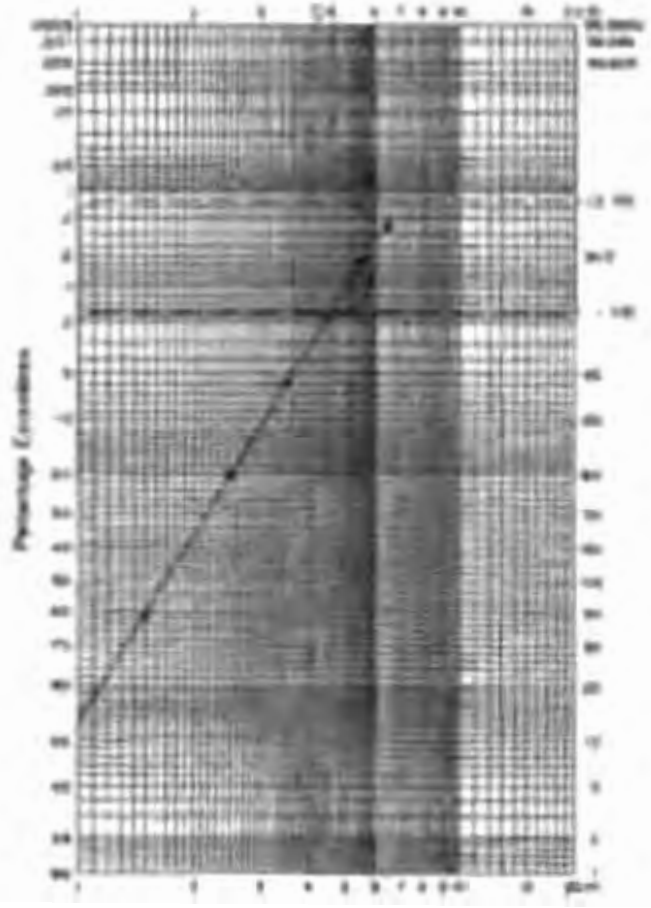


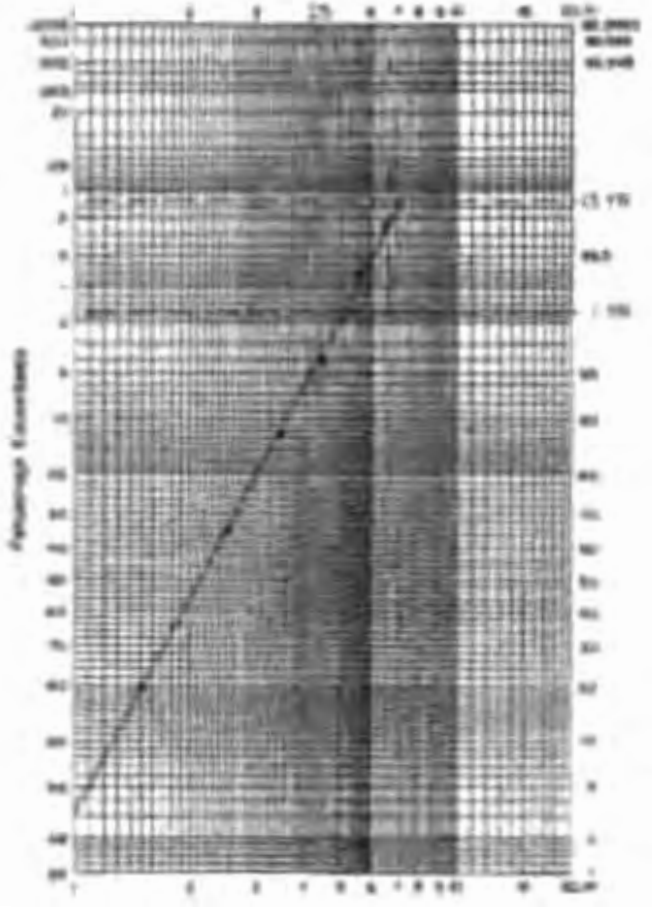


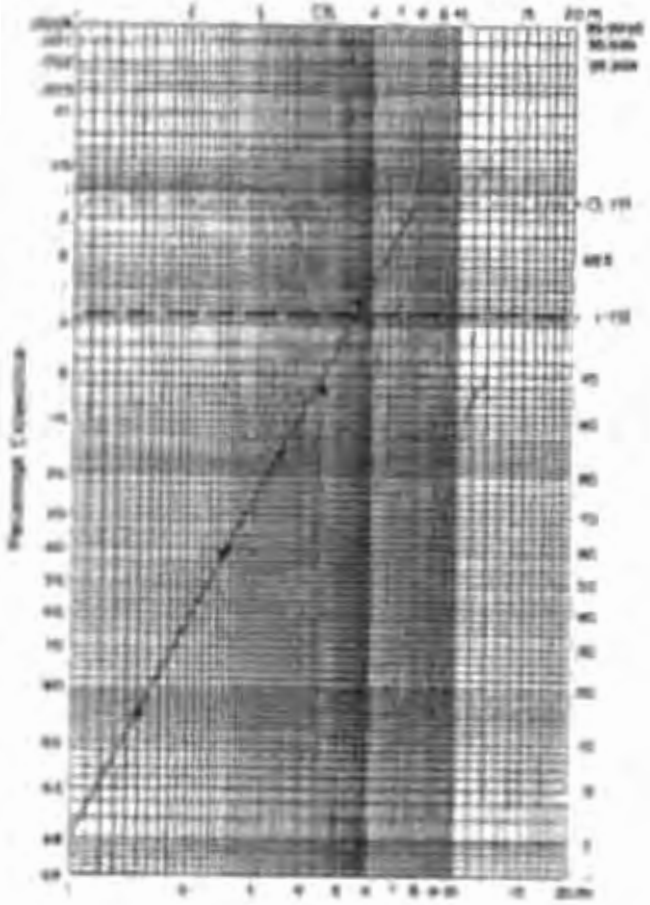


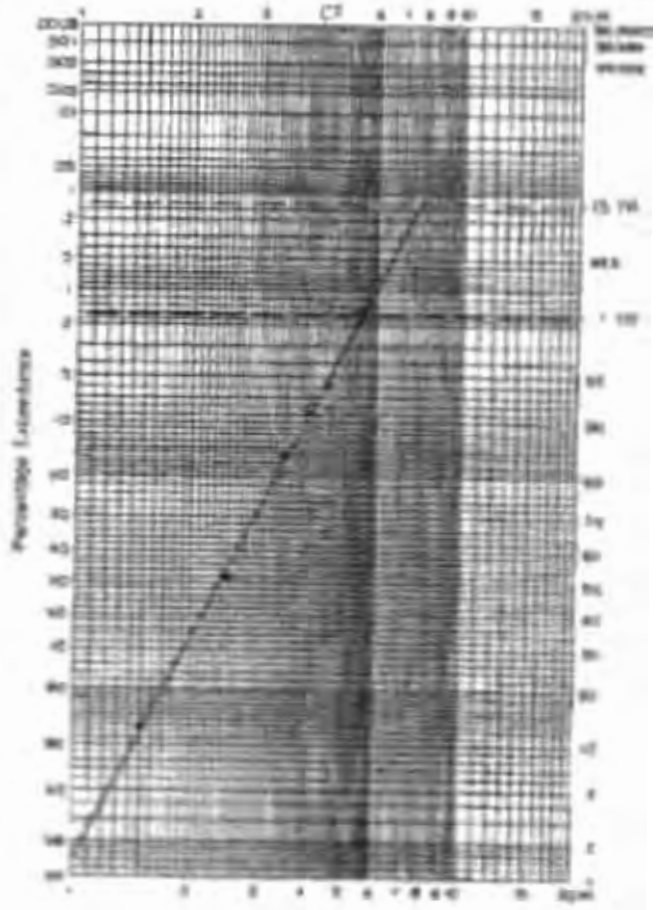


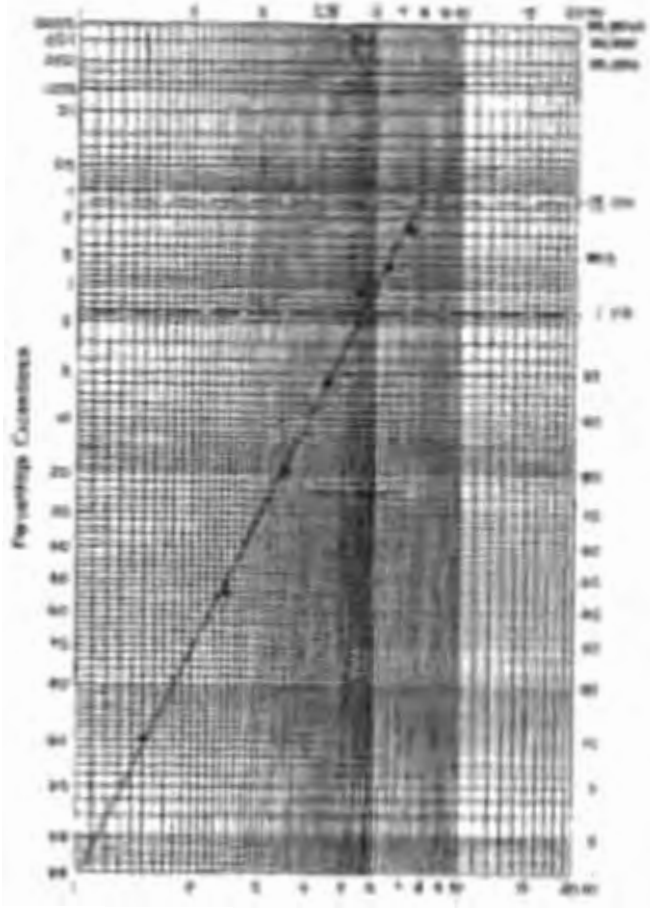


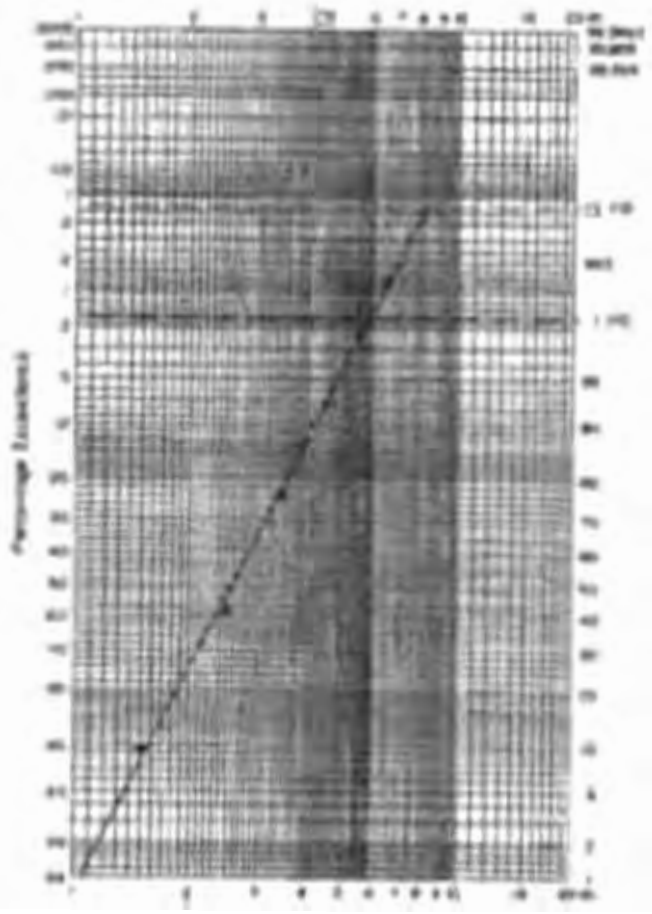












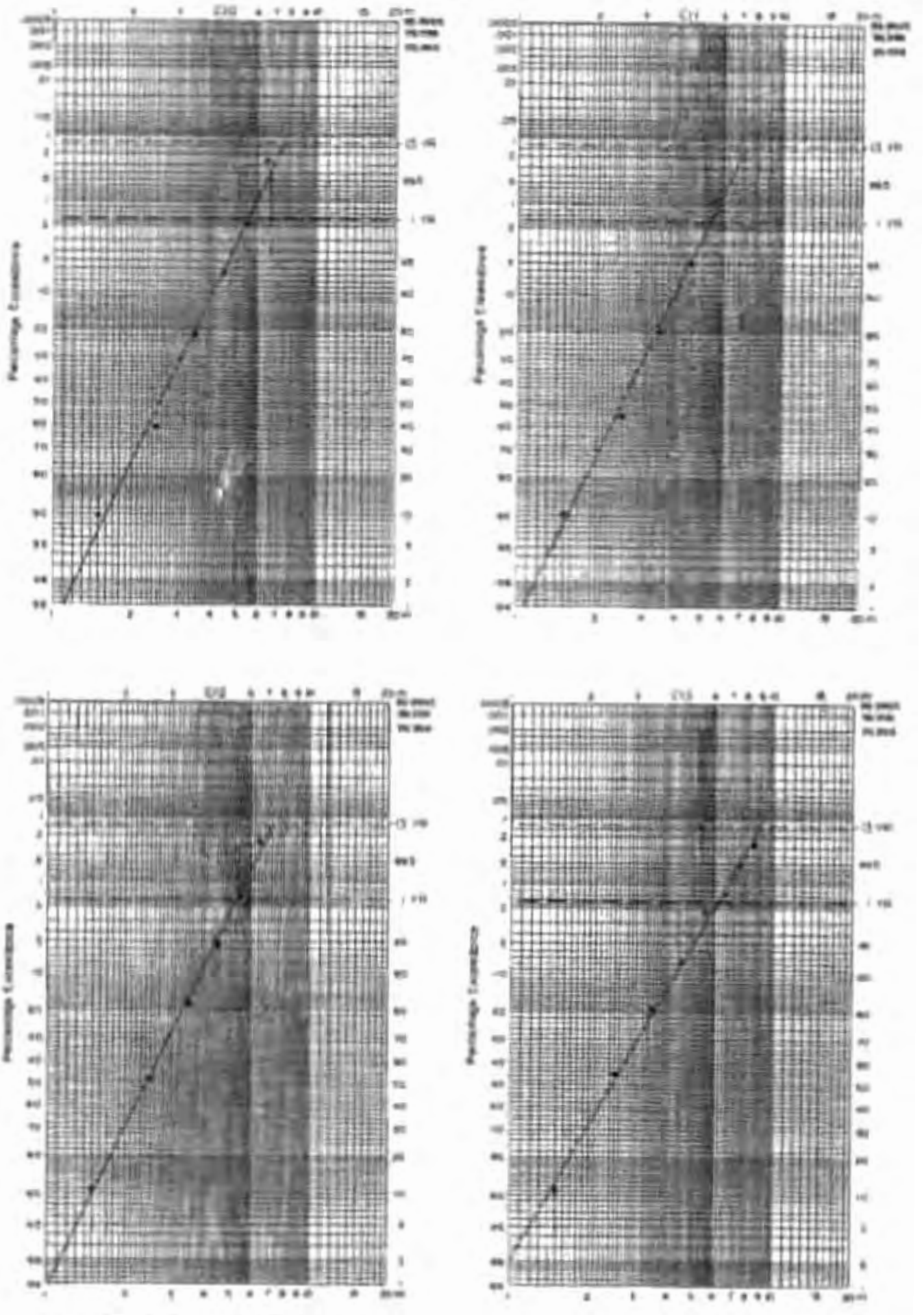


Figure 5: Monthly Wave Height Exceedance Distribution for May

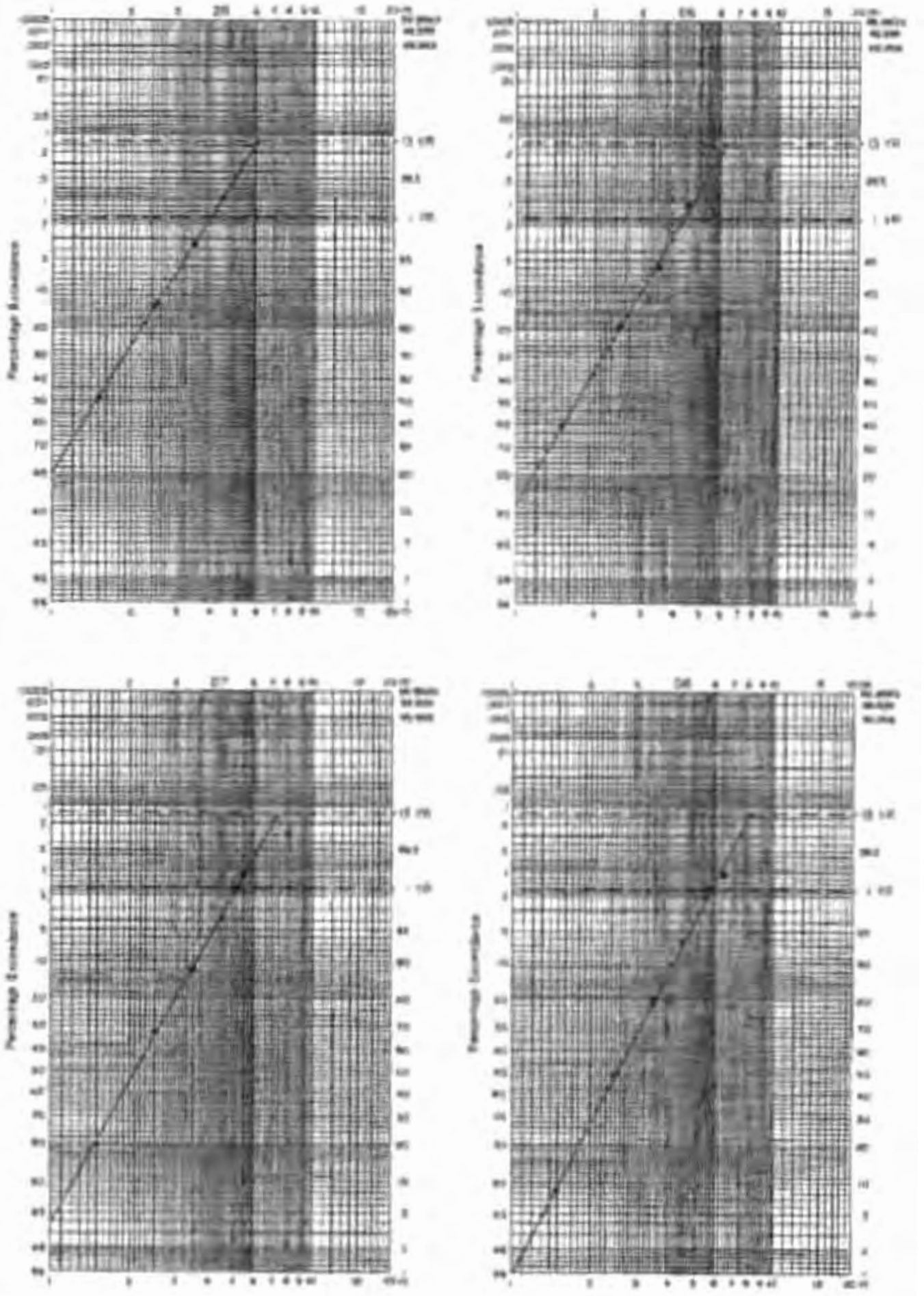
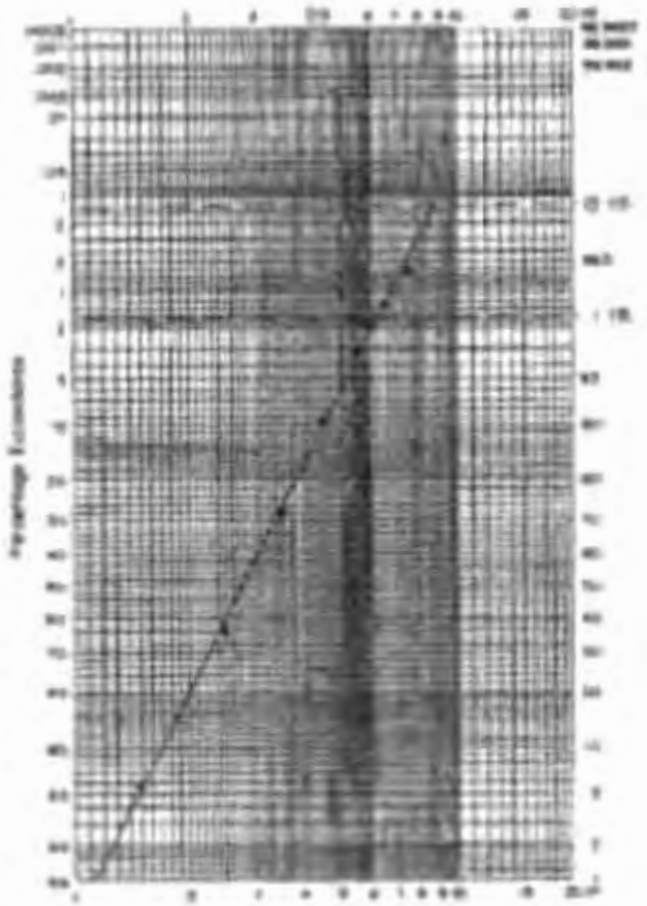
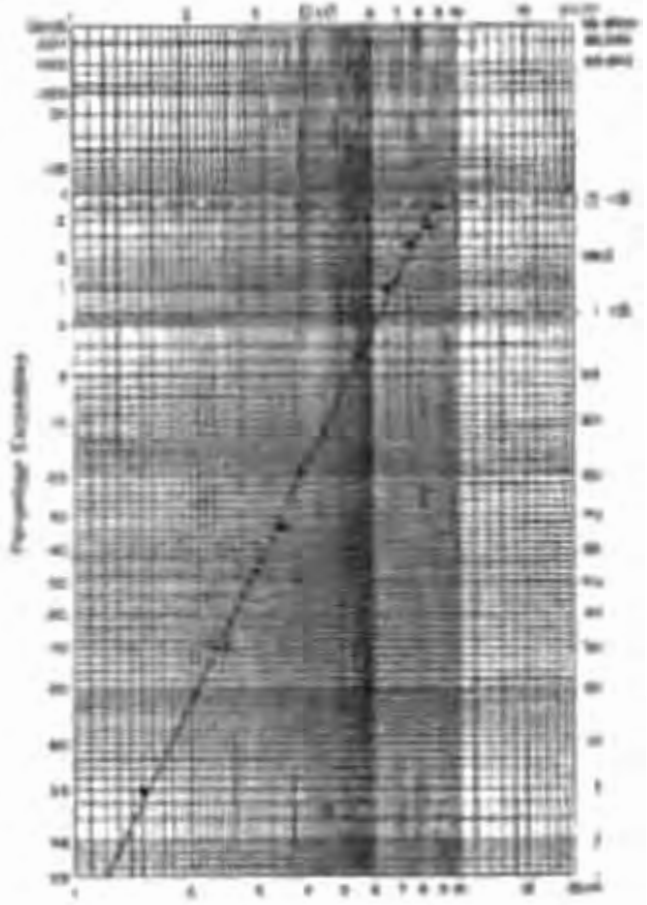
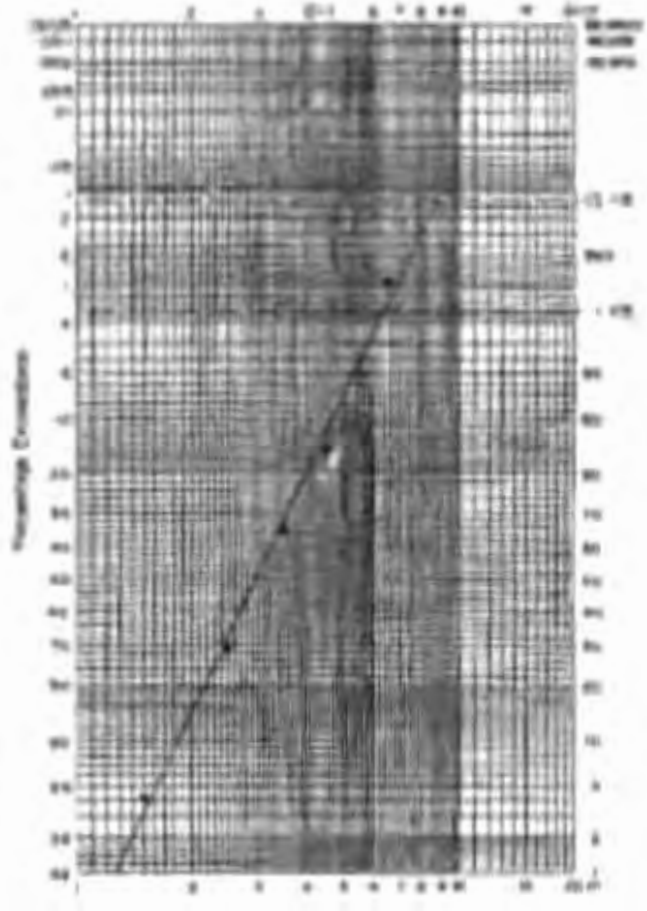
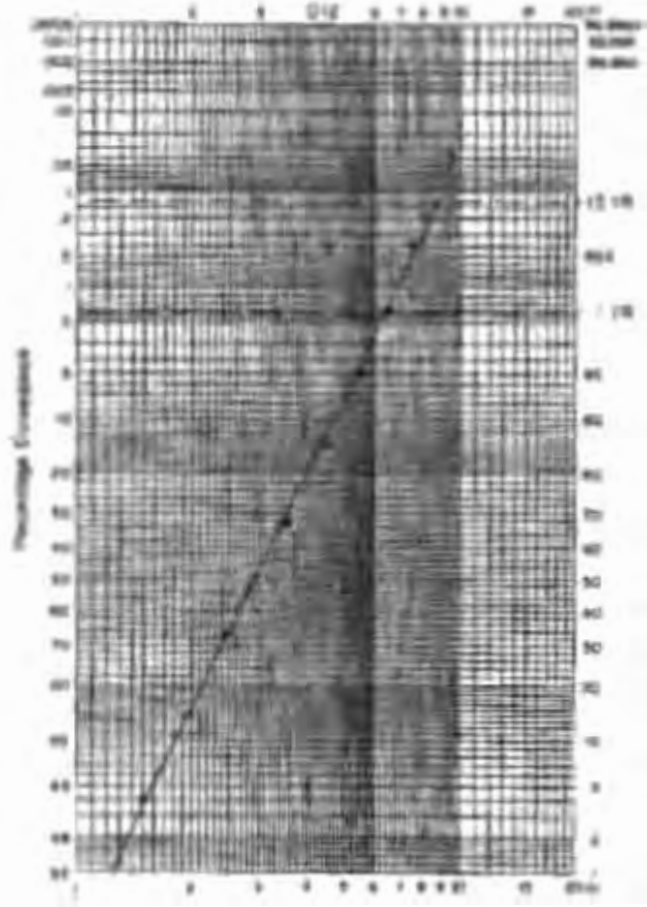


Figure 1a Monthly Wave Height Exceedance Distribution for May









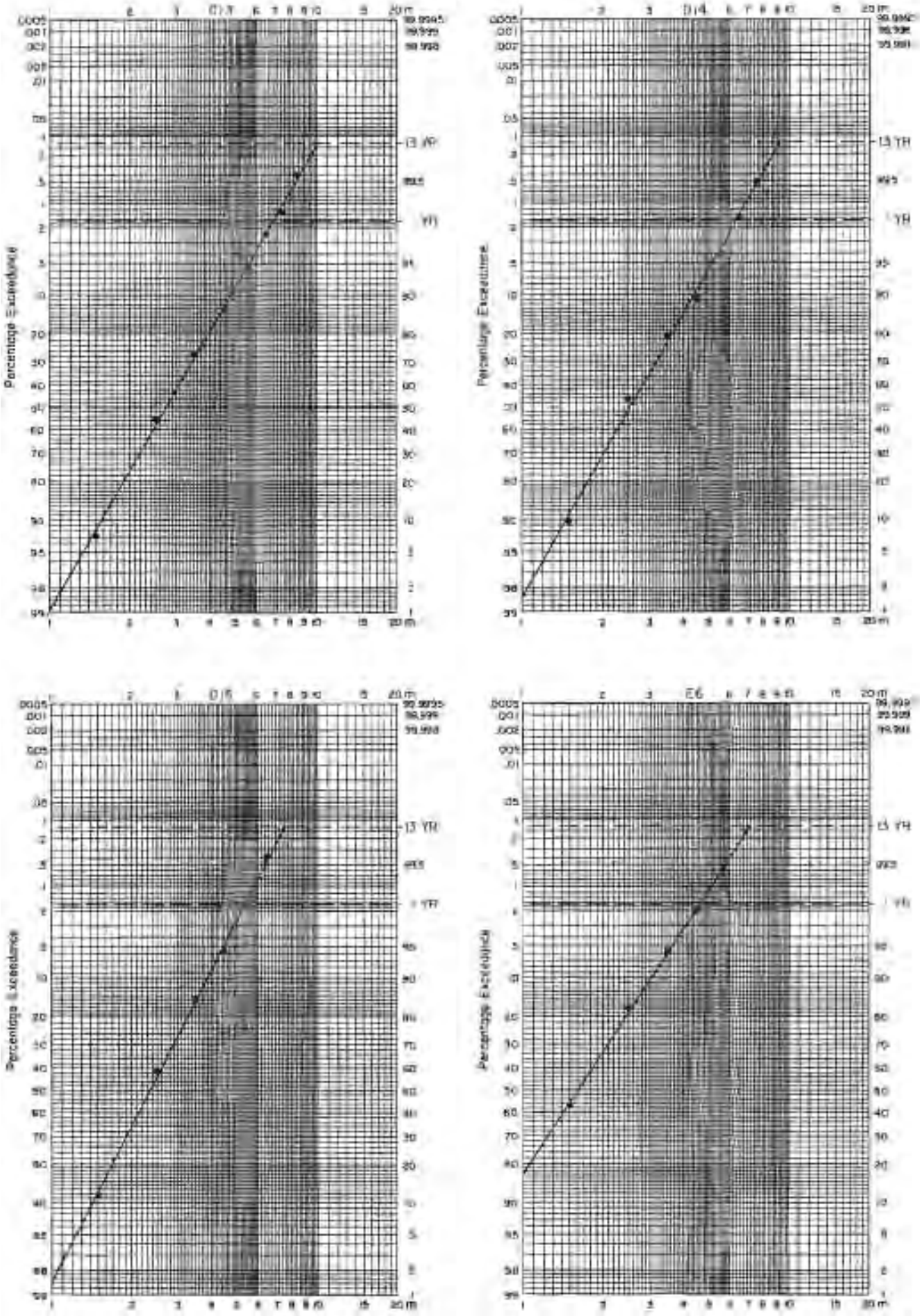


Figure 5m. Monthly Wave Height Exceedance Distribution for May

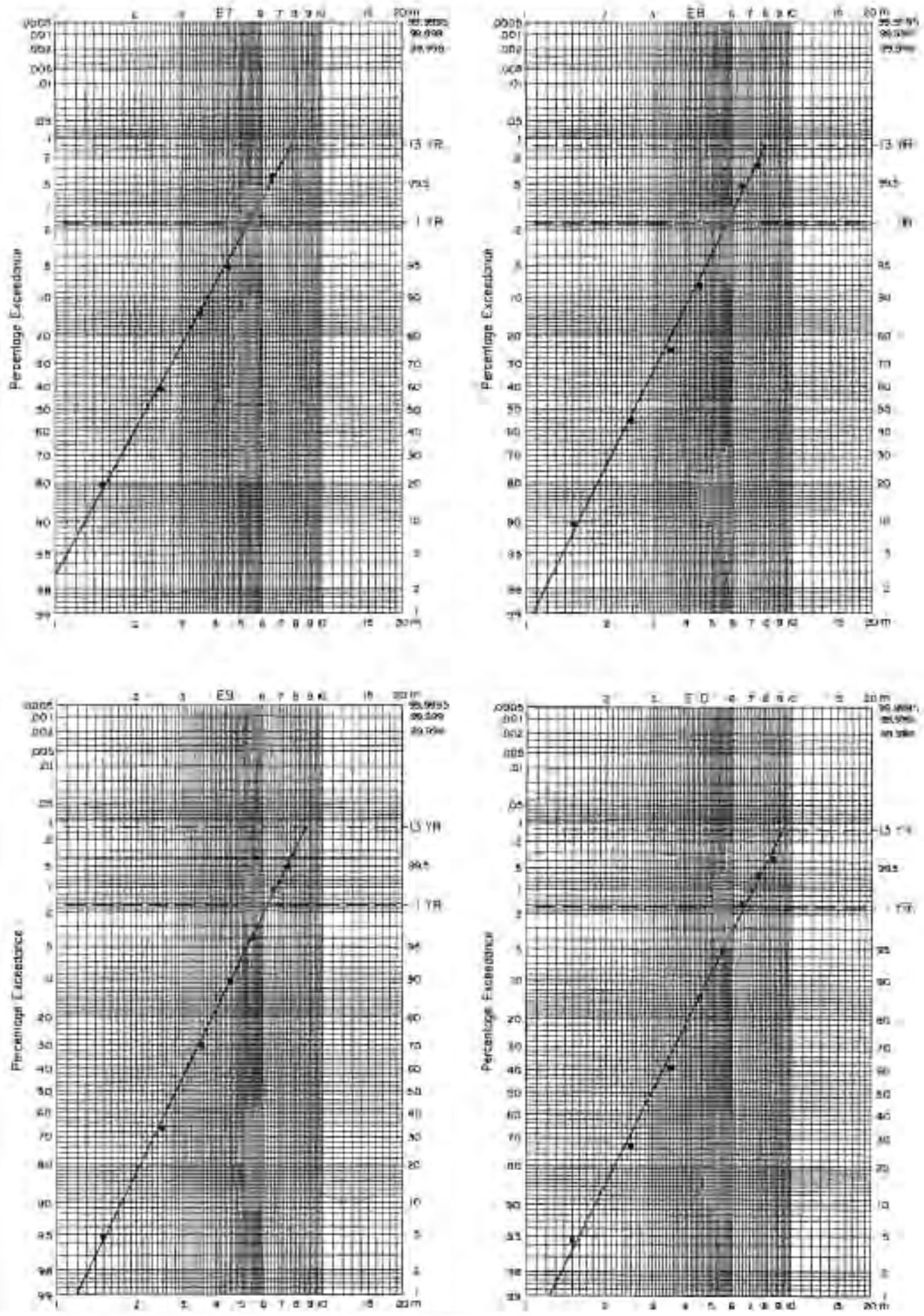


Figure 61 Monthly Wave Height Exceedance Distribution for May

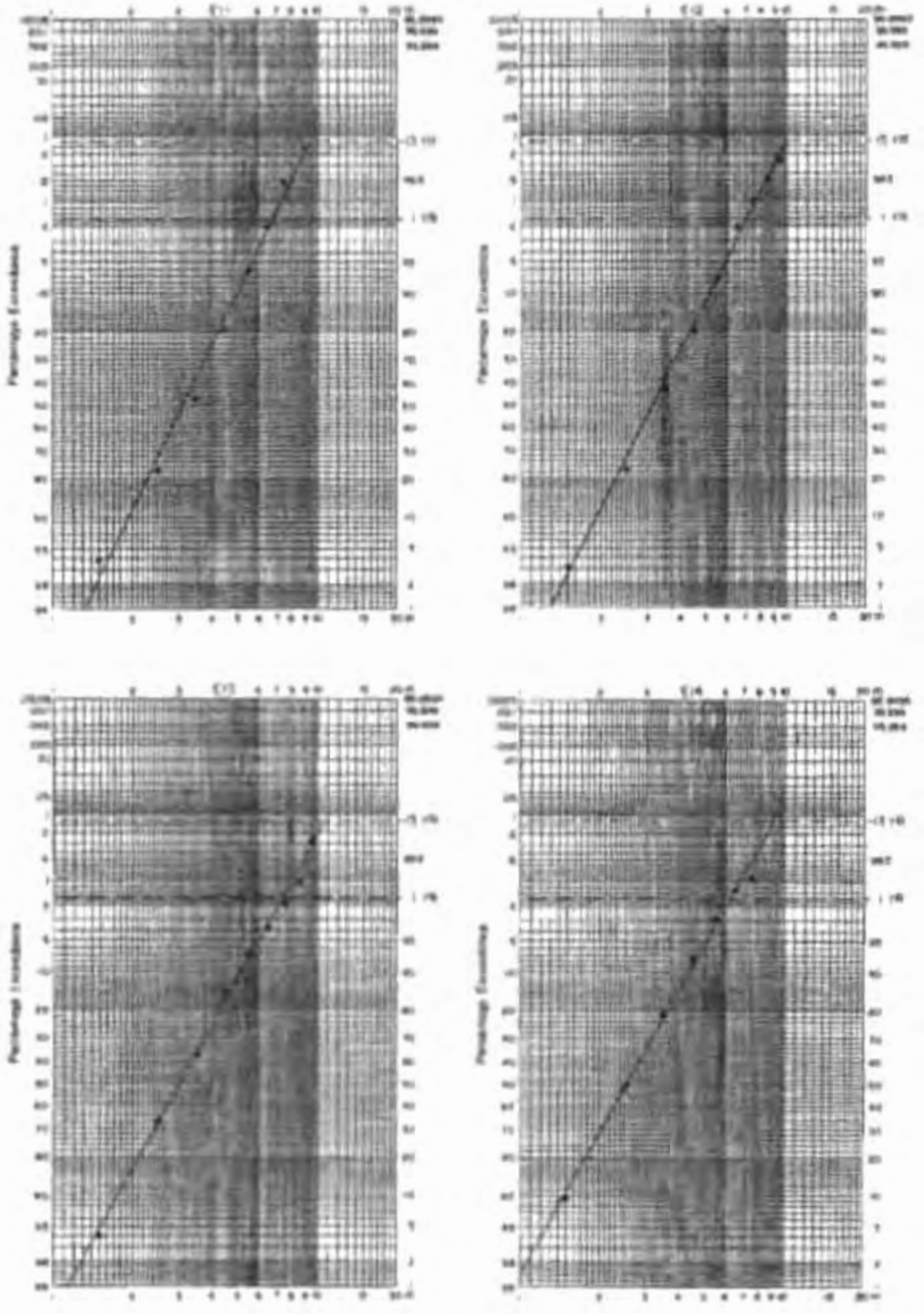


Figure 5a Monthly Wave Height Exceedance Distribution for May

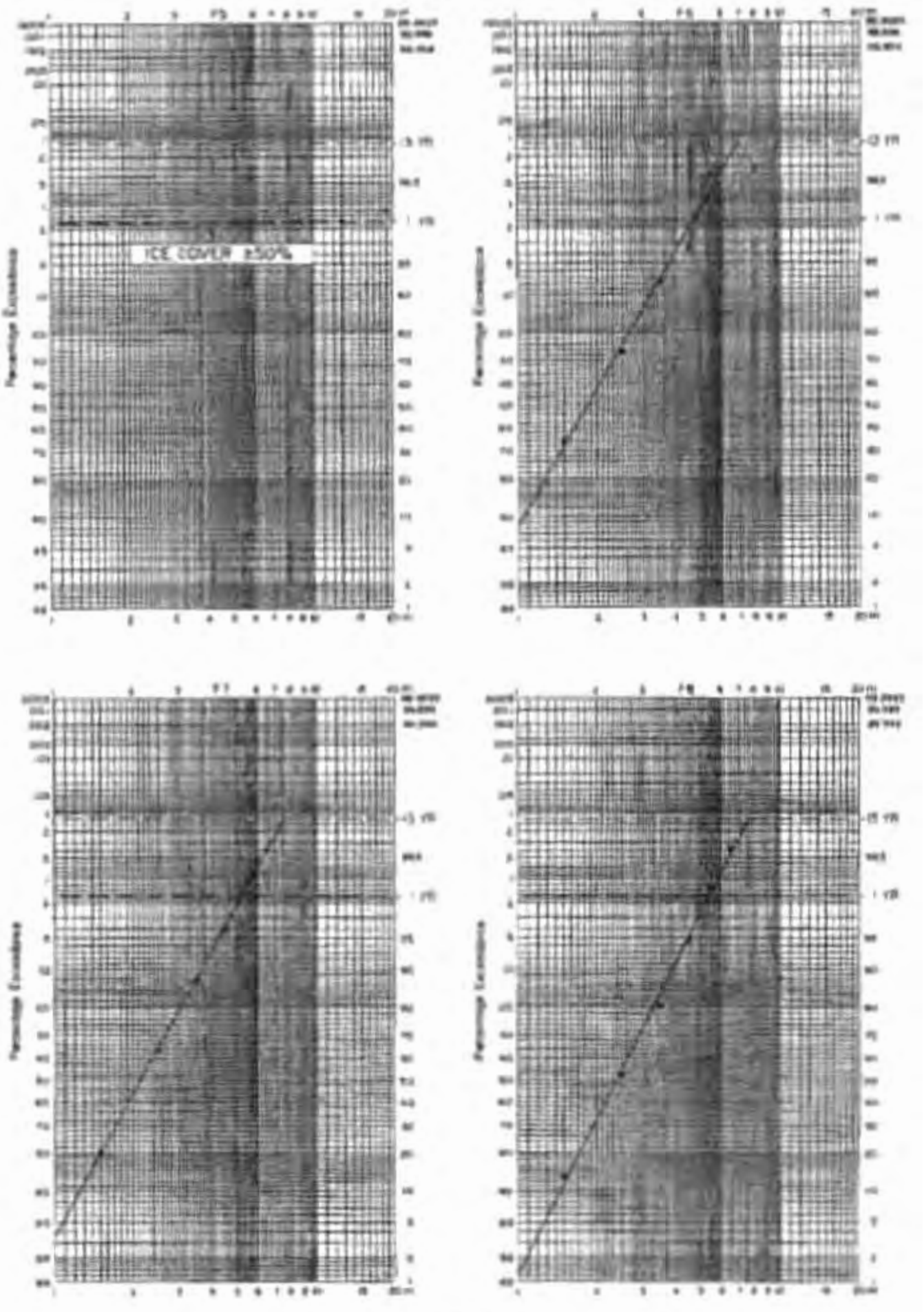


Figure 5b Monthly Wave Height Exceedance Distribution for May

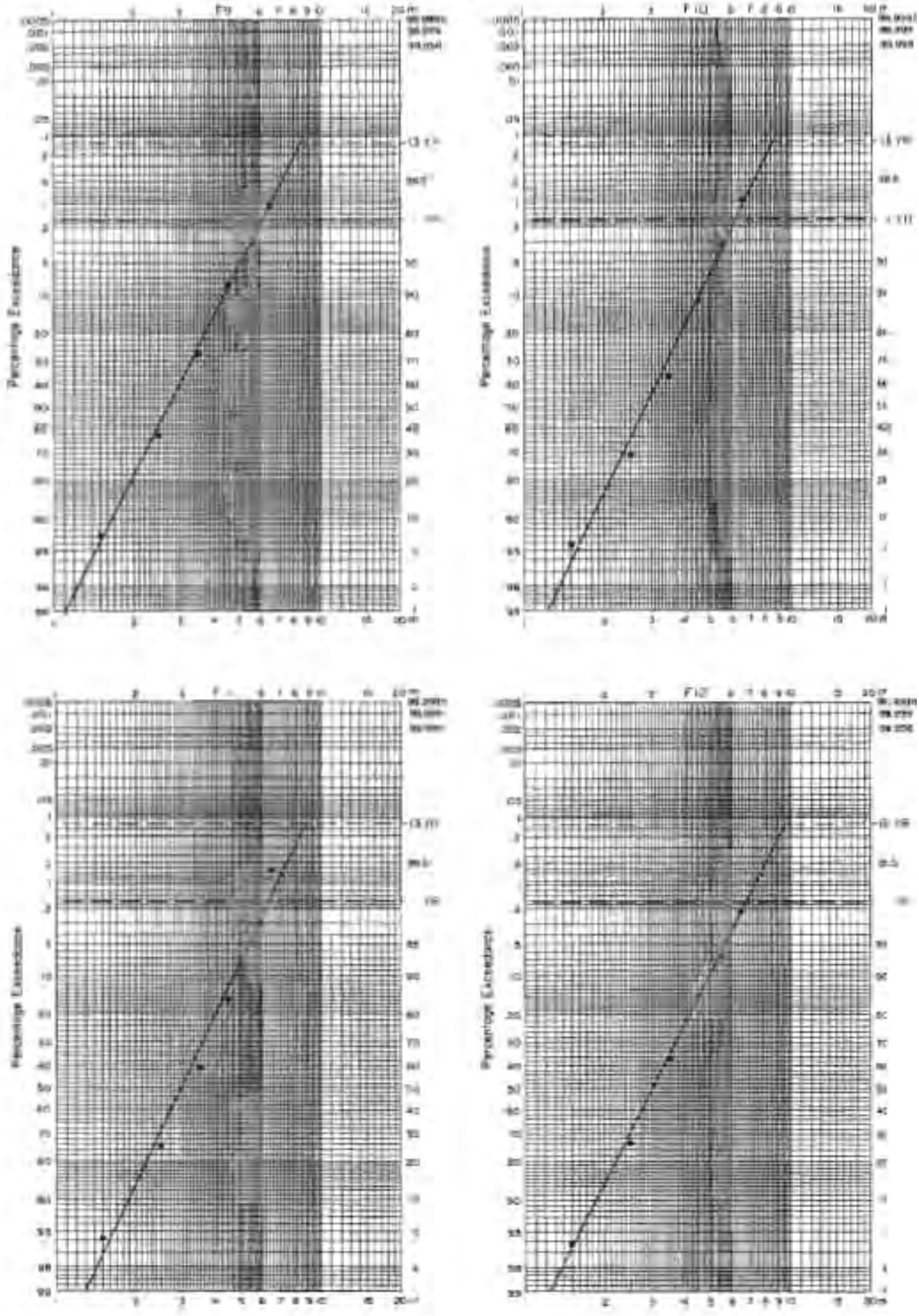


Figure 5a Monthly Wave Height Exceedance Distribution for May

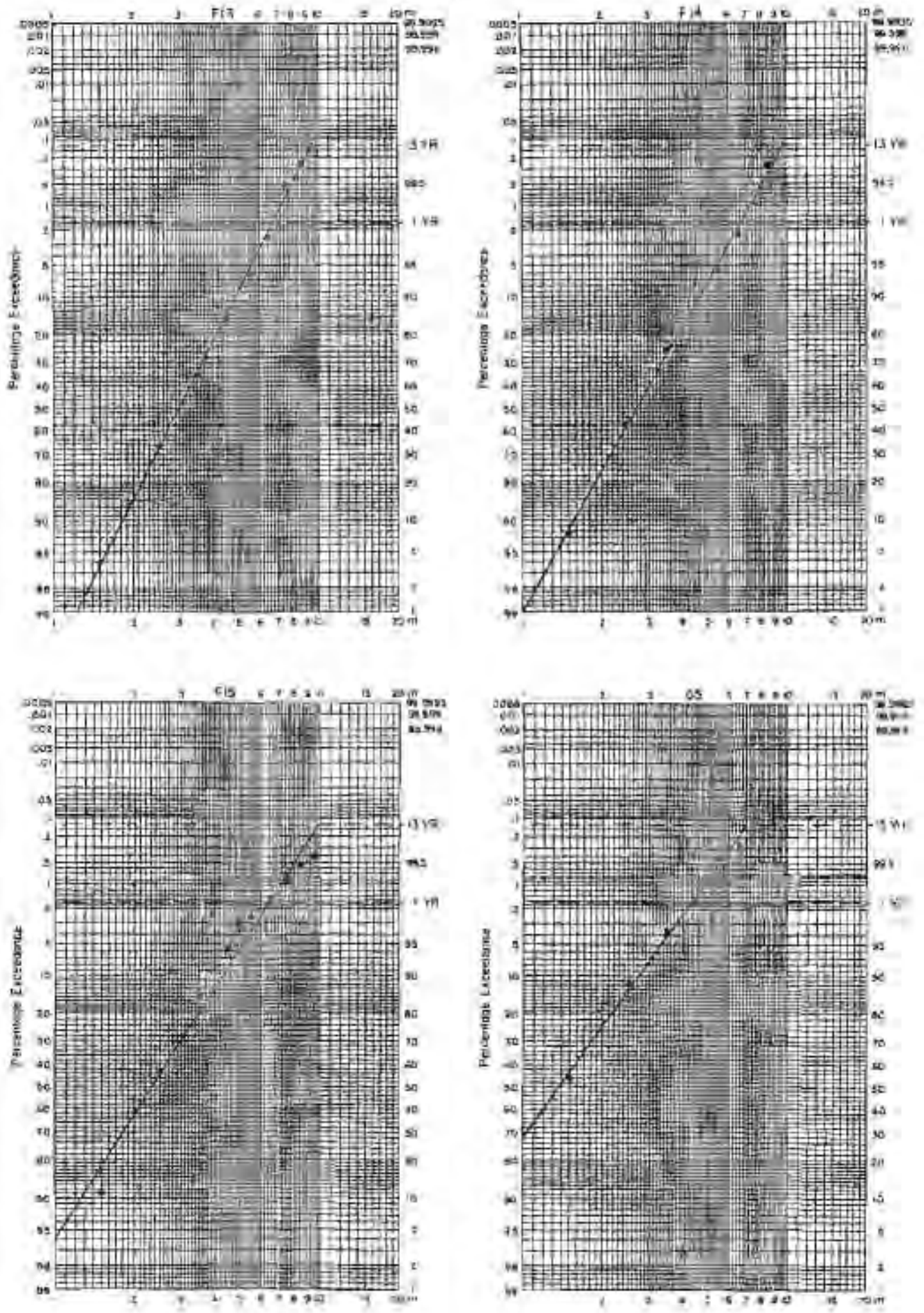


Figure 5: Monthly Wave Height Exceedance Distribution for May

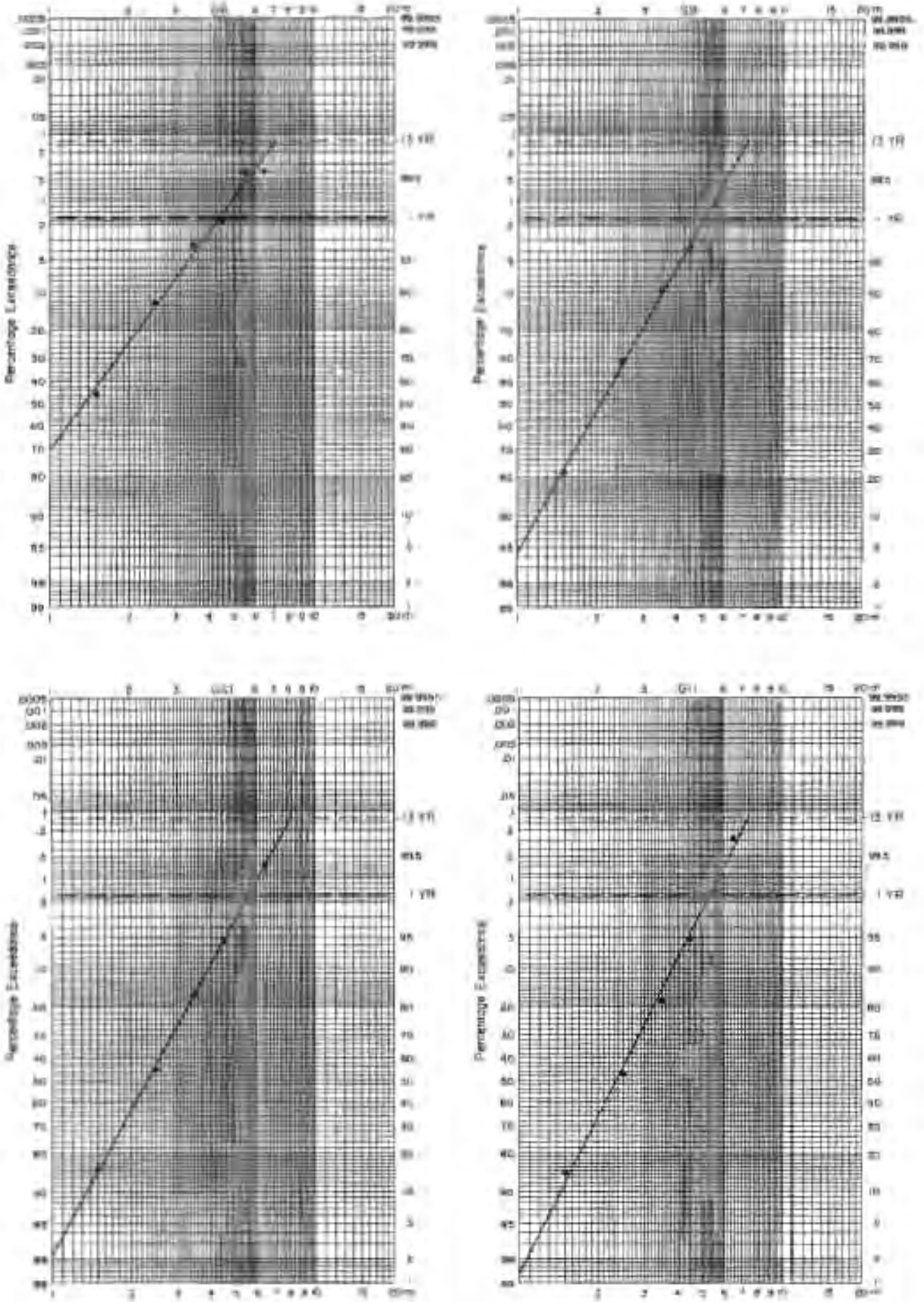


Figure 56 Monthly Wave Height Exceedance Distribution for May

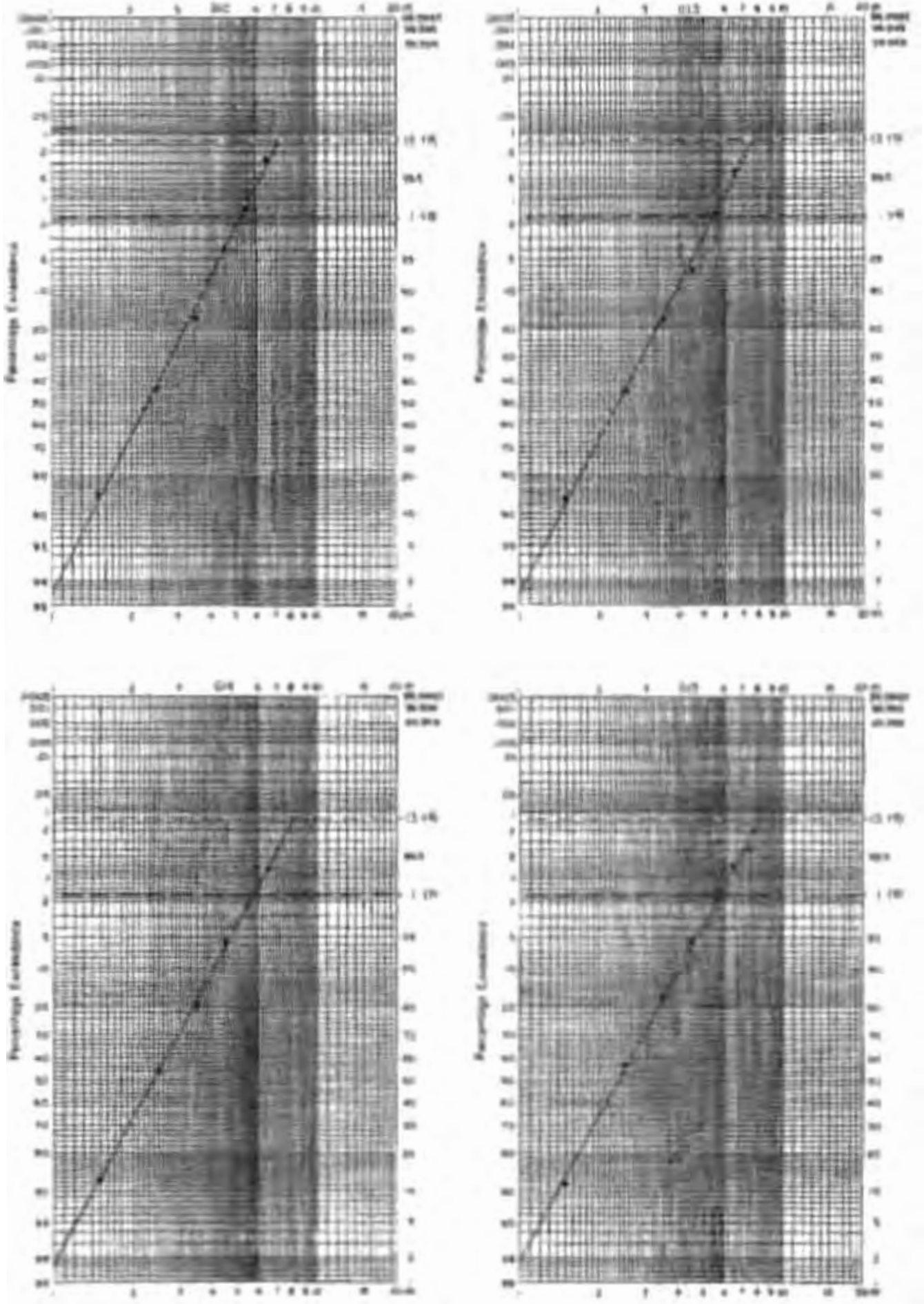


Figure 5: Monthly Wave Height Exceedance Distribution for May

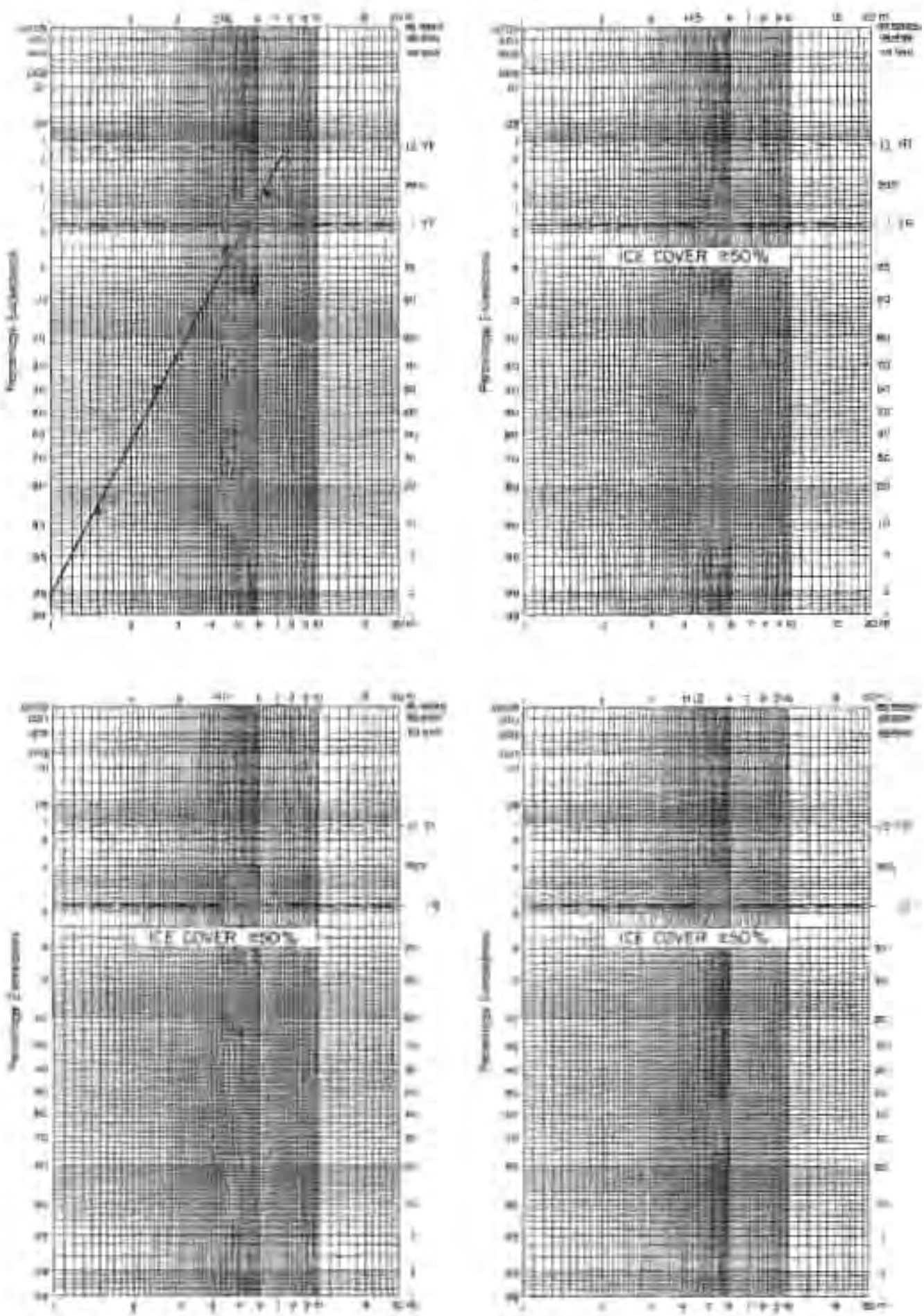
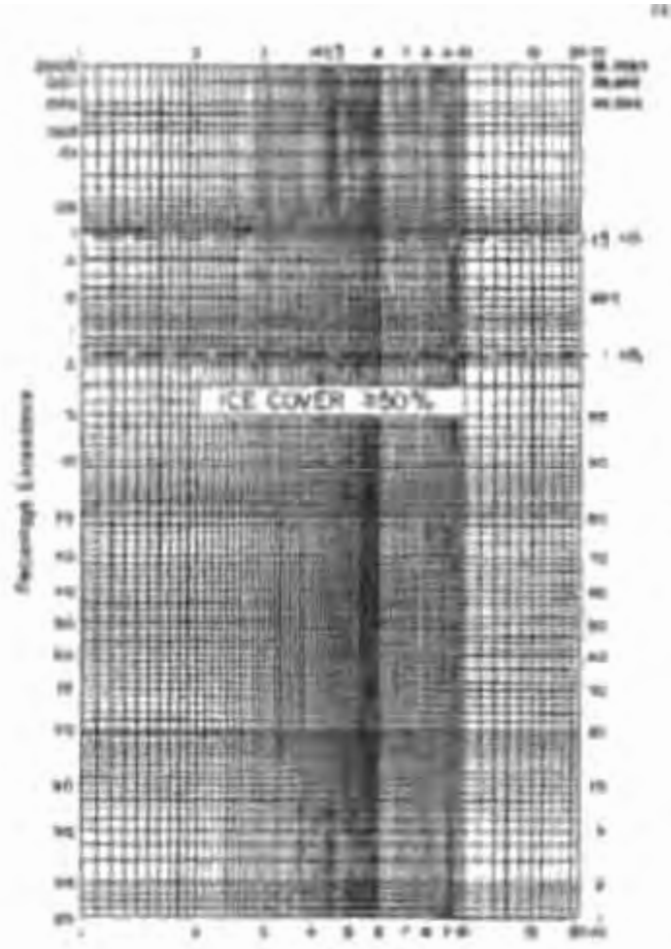
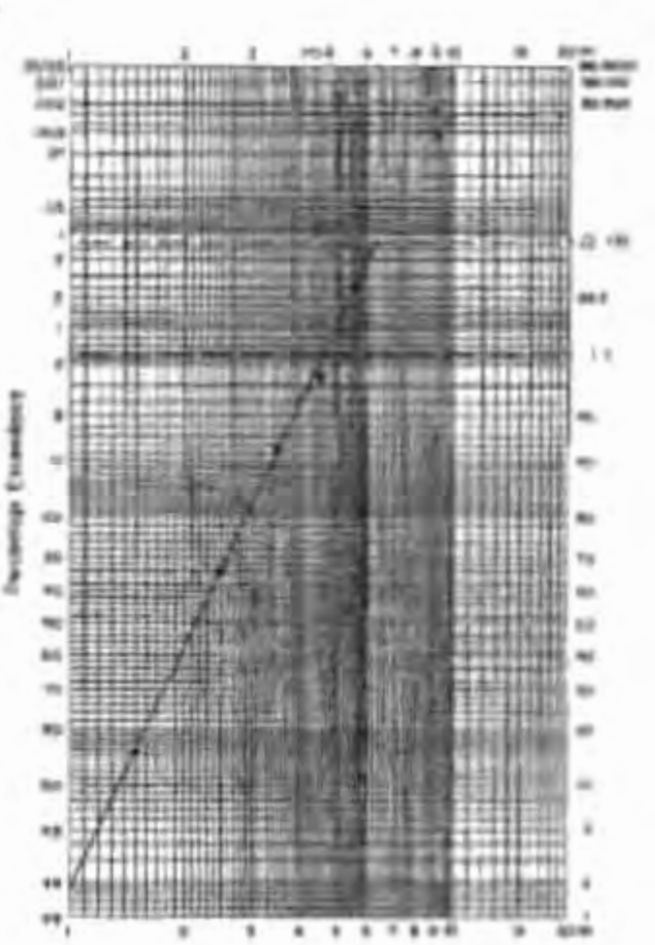
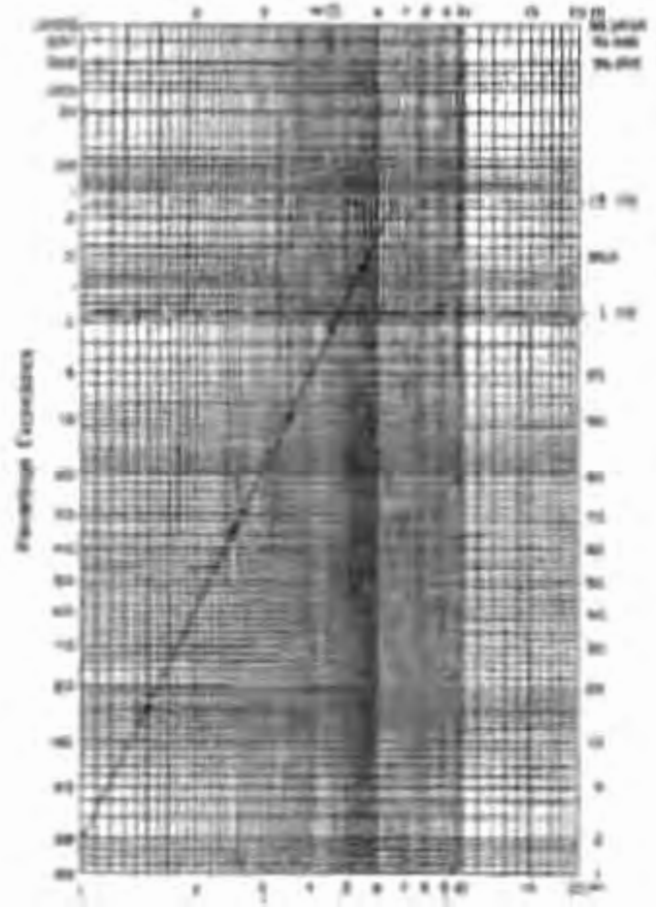
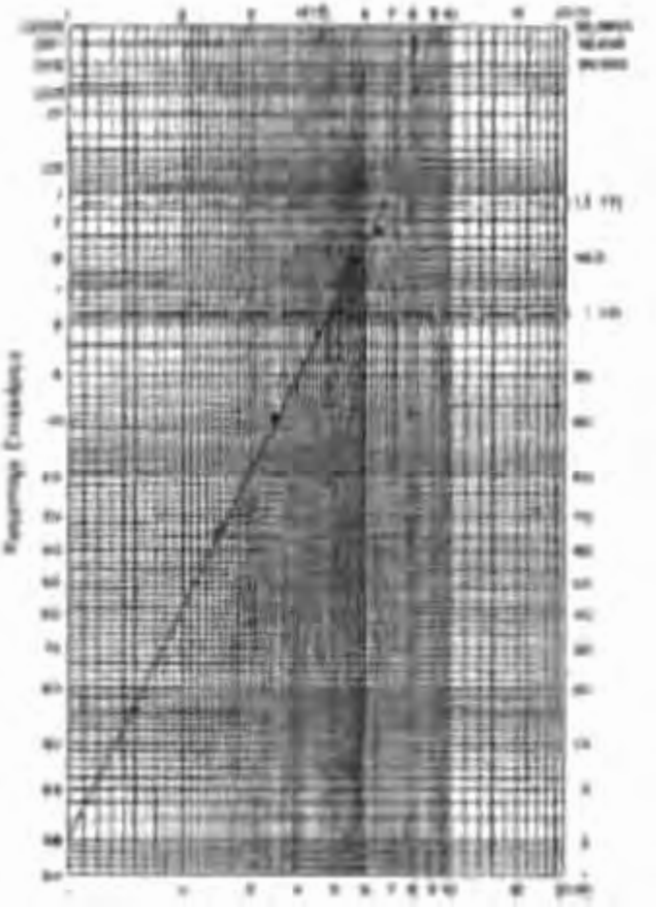


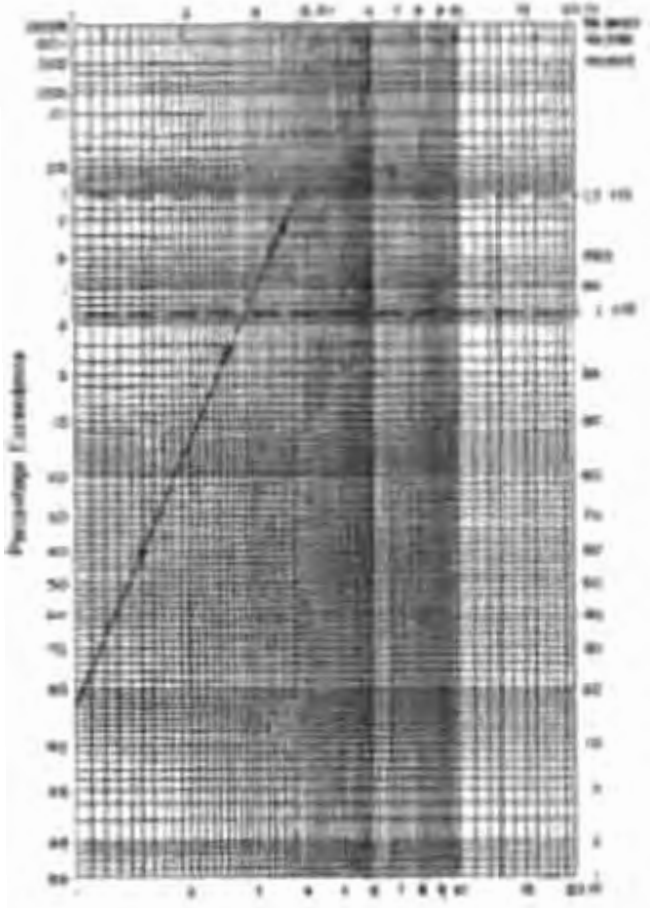
Figure [illegible] Monthly Wave-height Exceedance Distribution for May

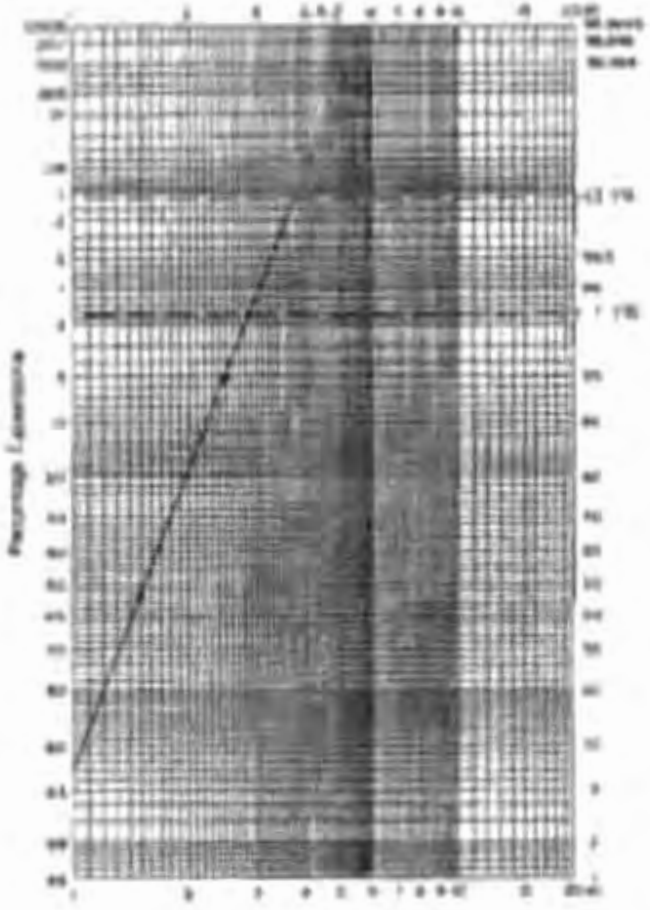

ICE COVER ≈50%

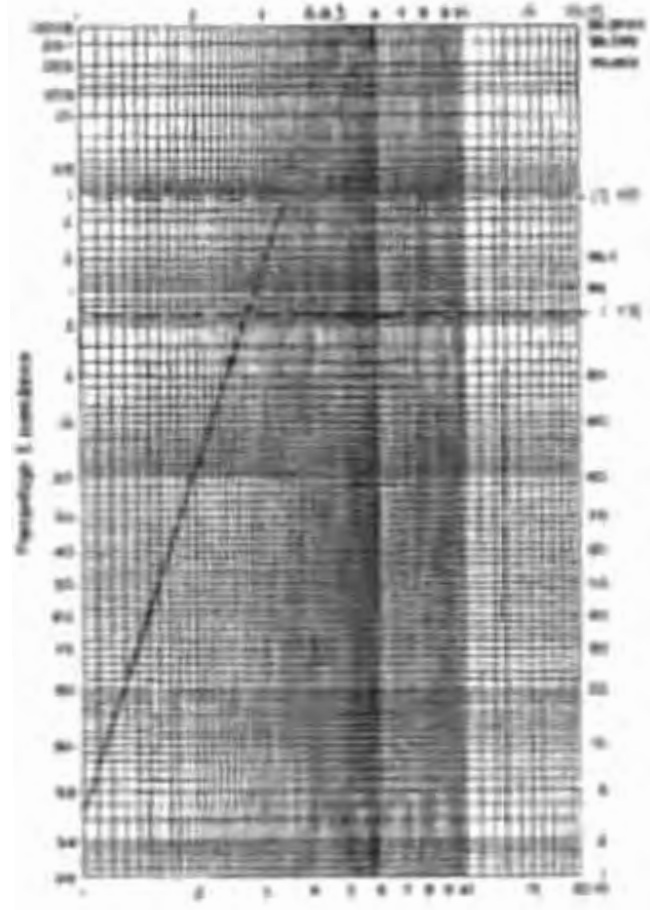


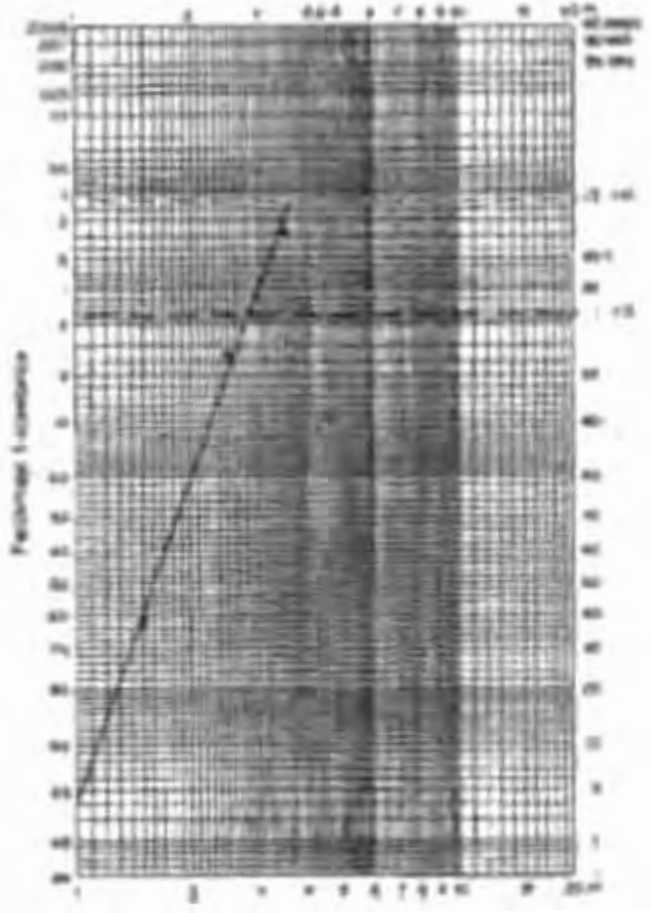


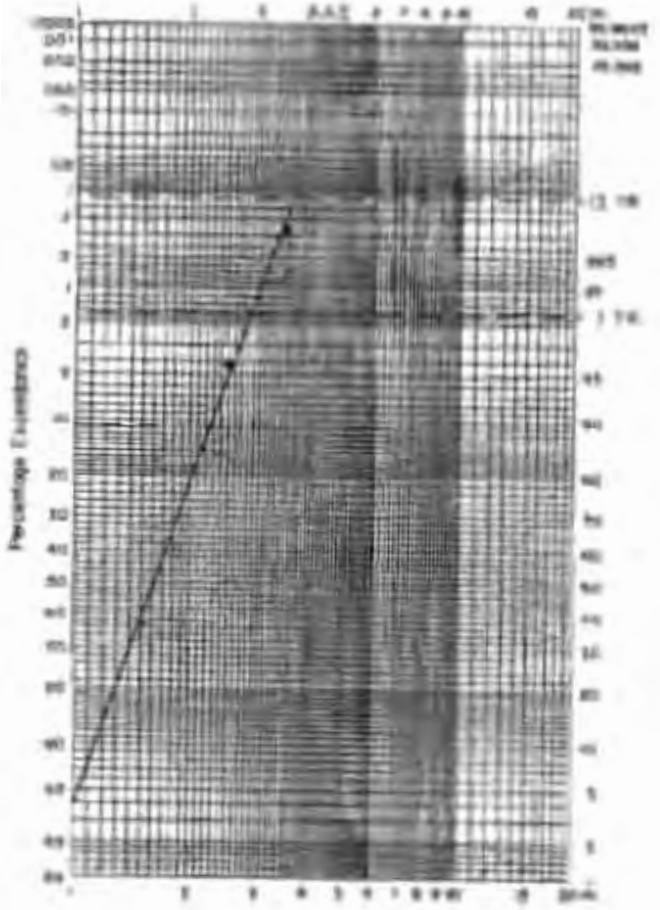


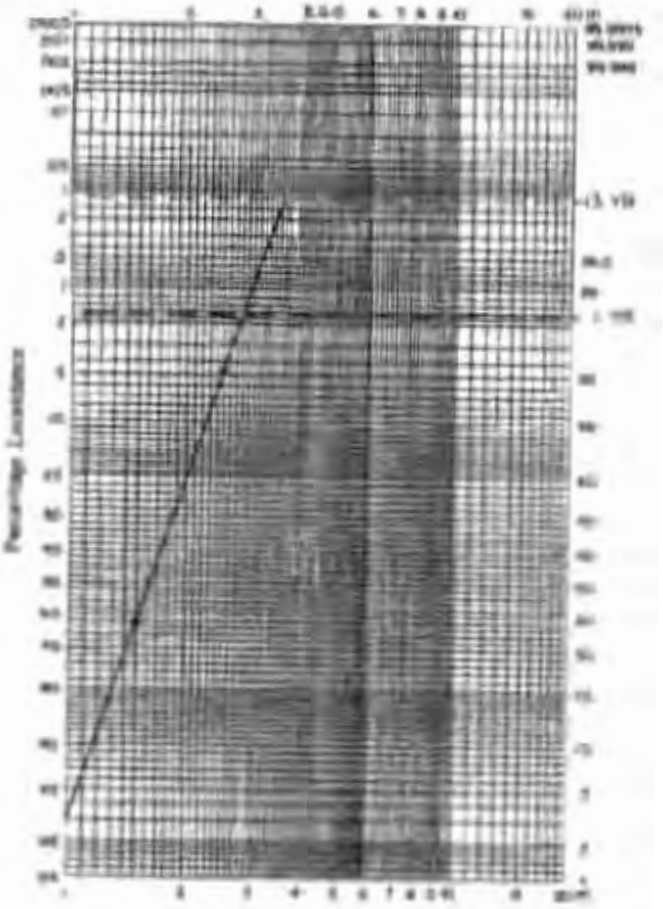


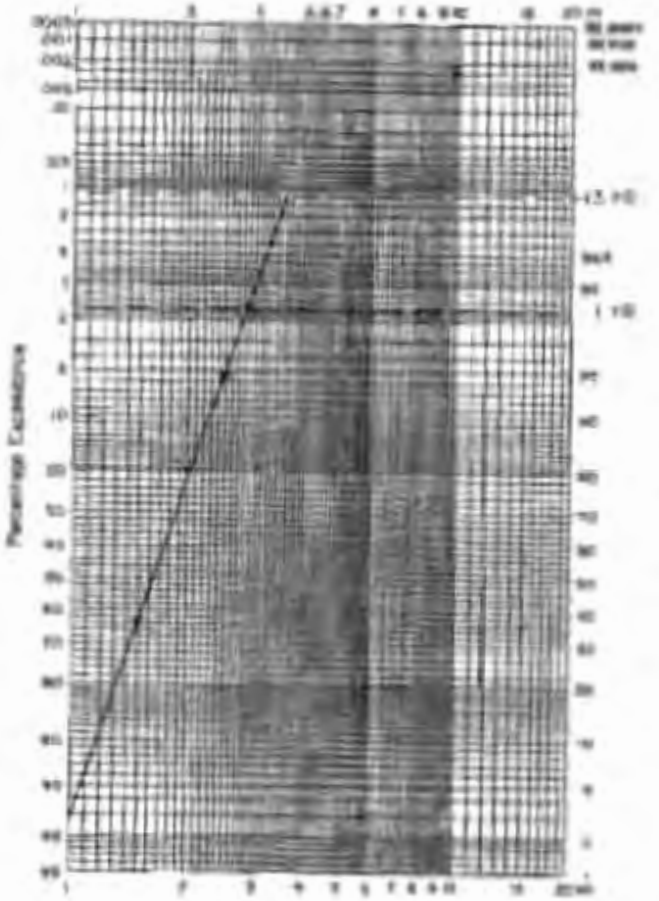


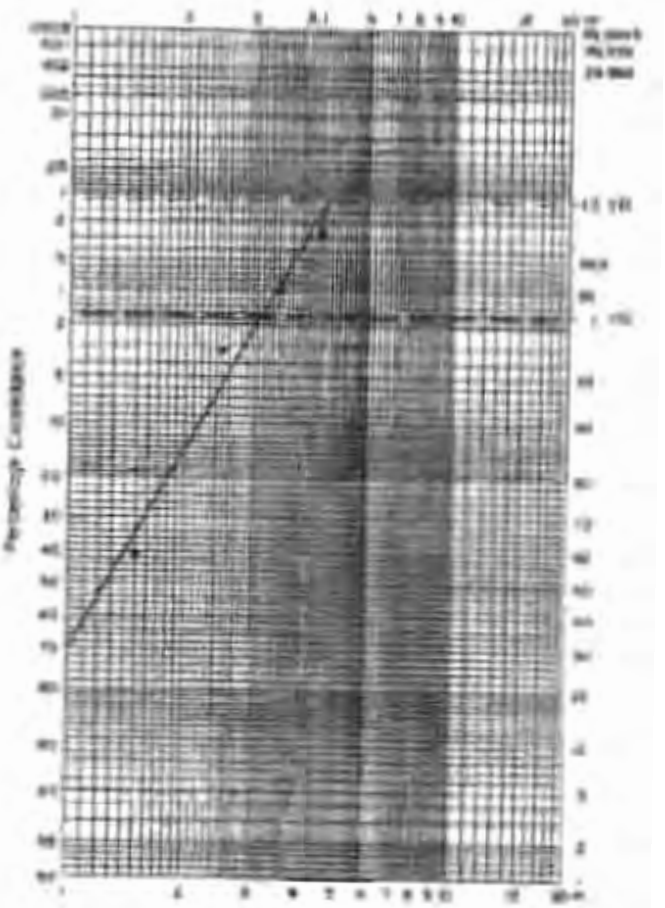












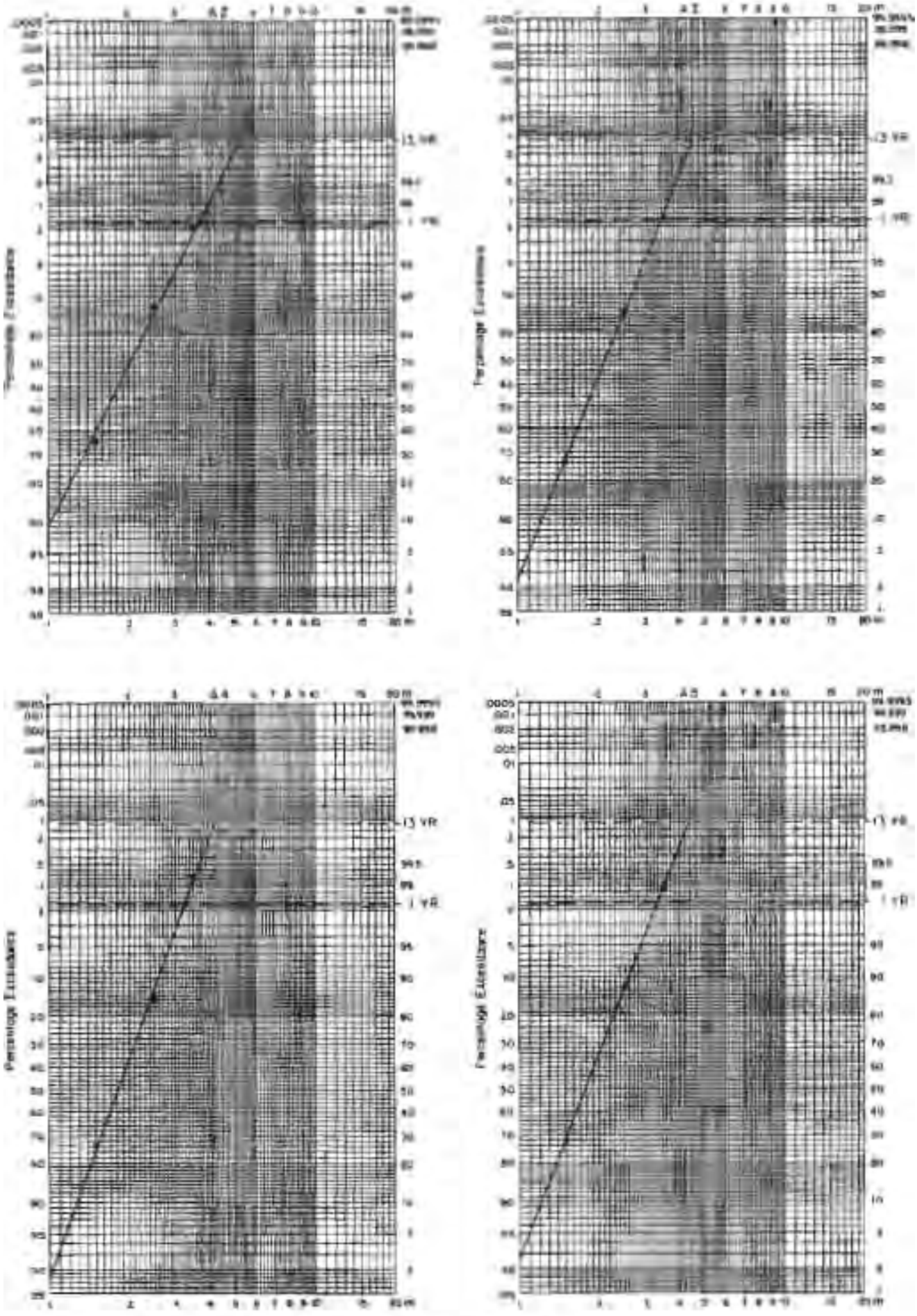


Figure 4c. Monthly Wave Height Exceedance Distribution for June

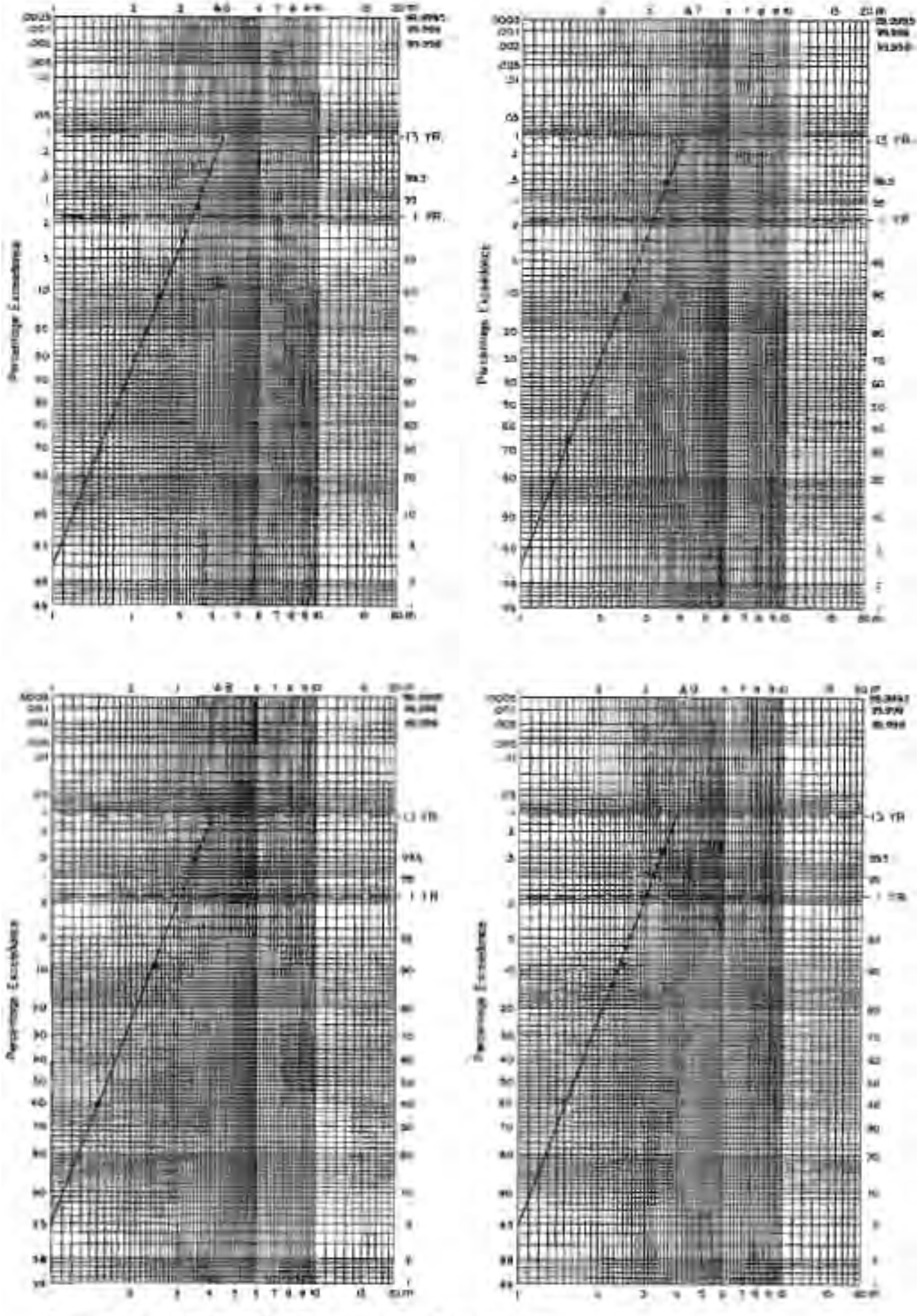
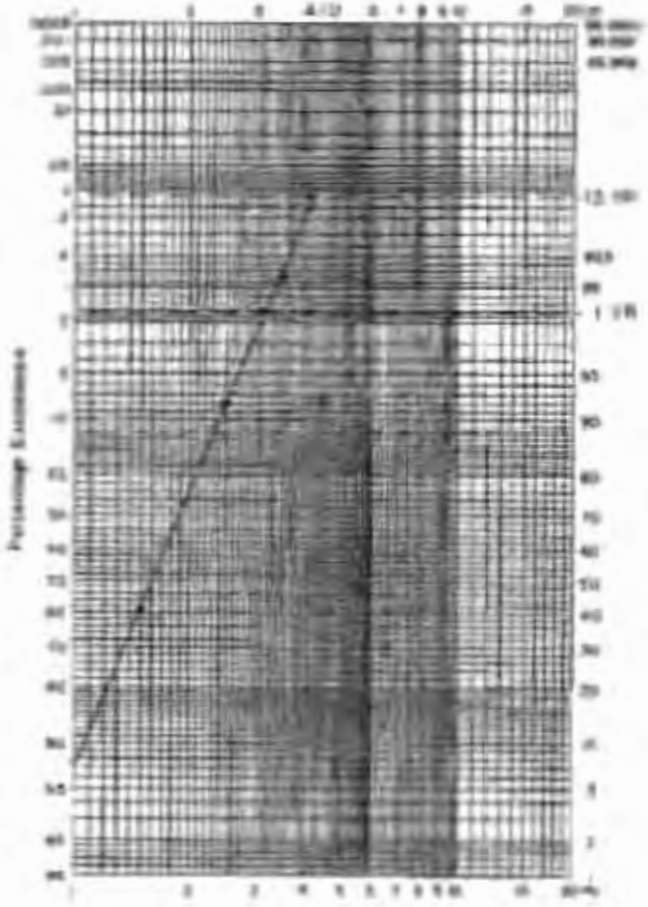
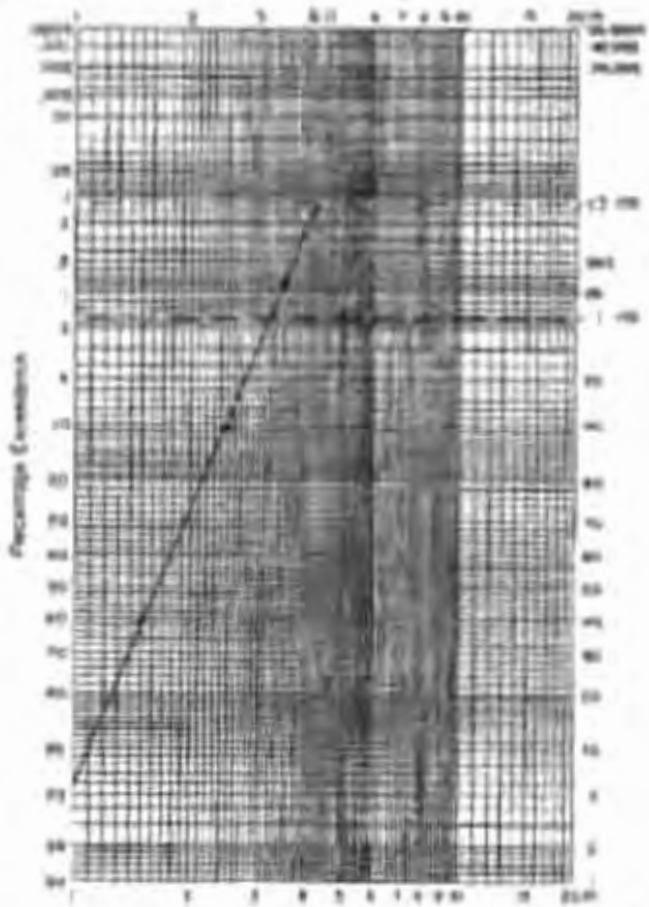
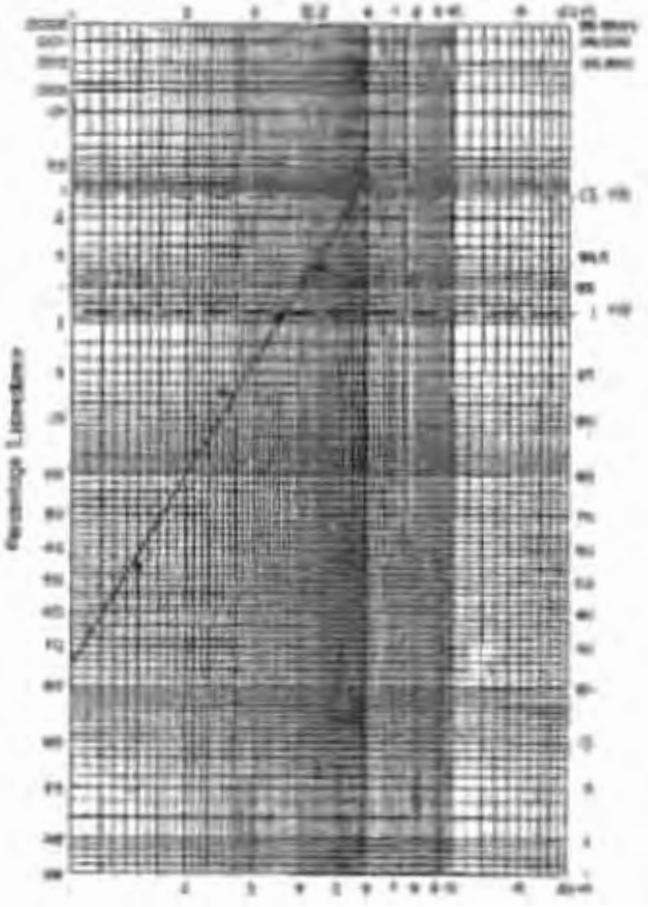
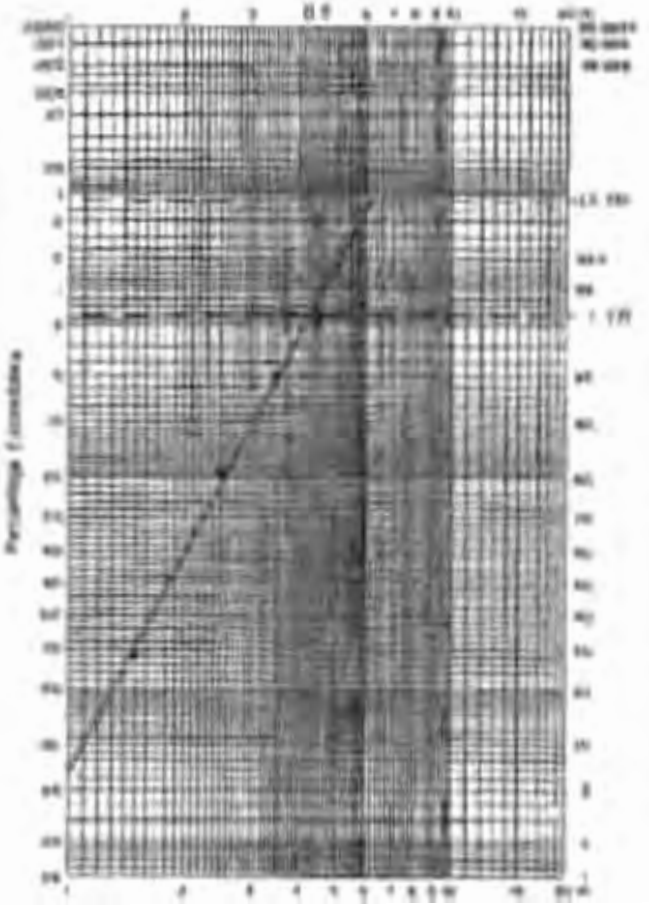


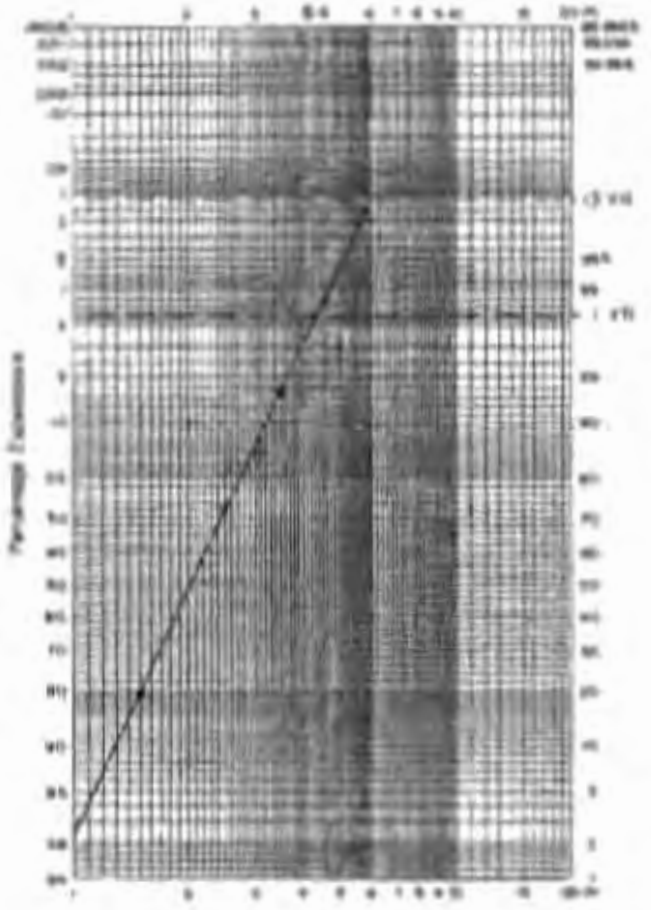
Figure 6a. Monthly Wave Height Exceedance Distribution for June

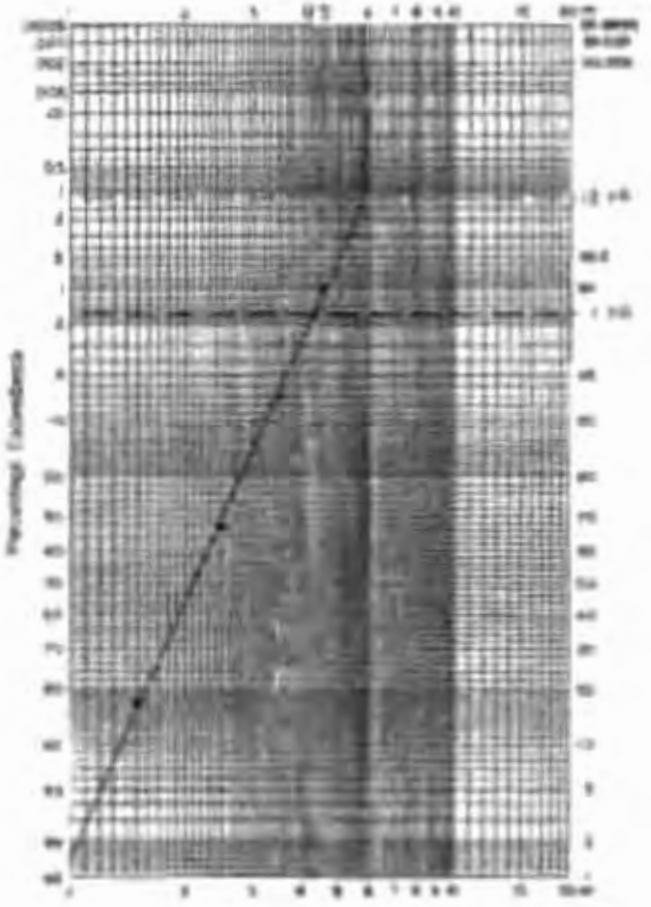


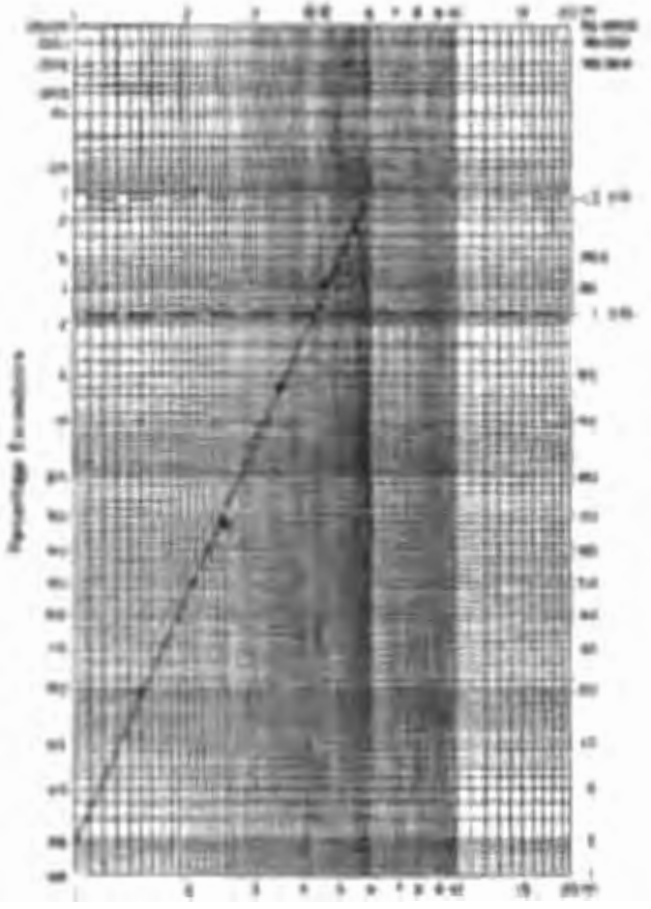


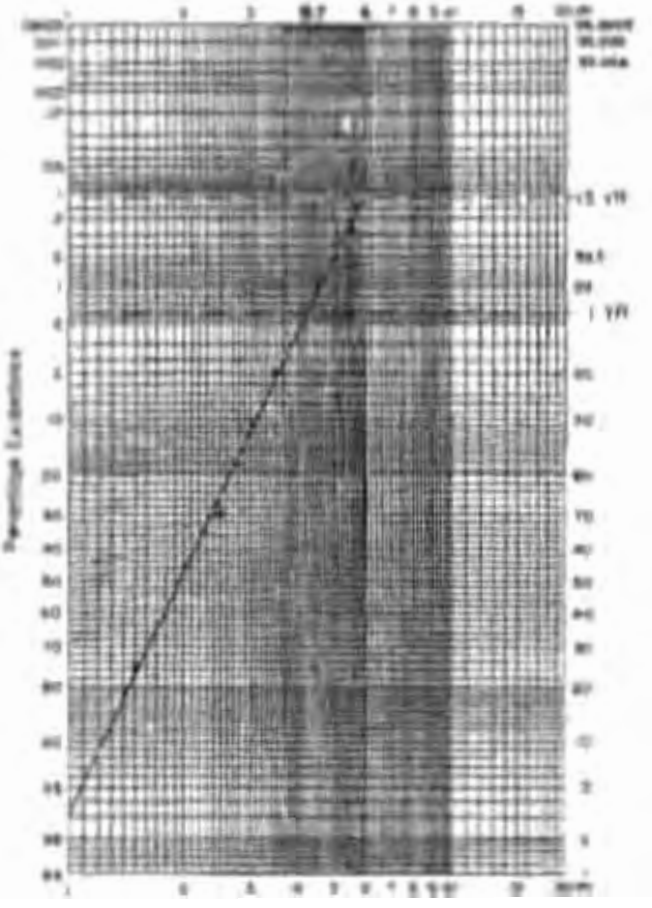












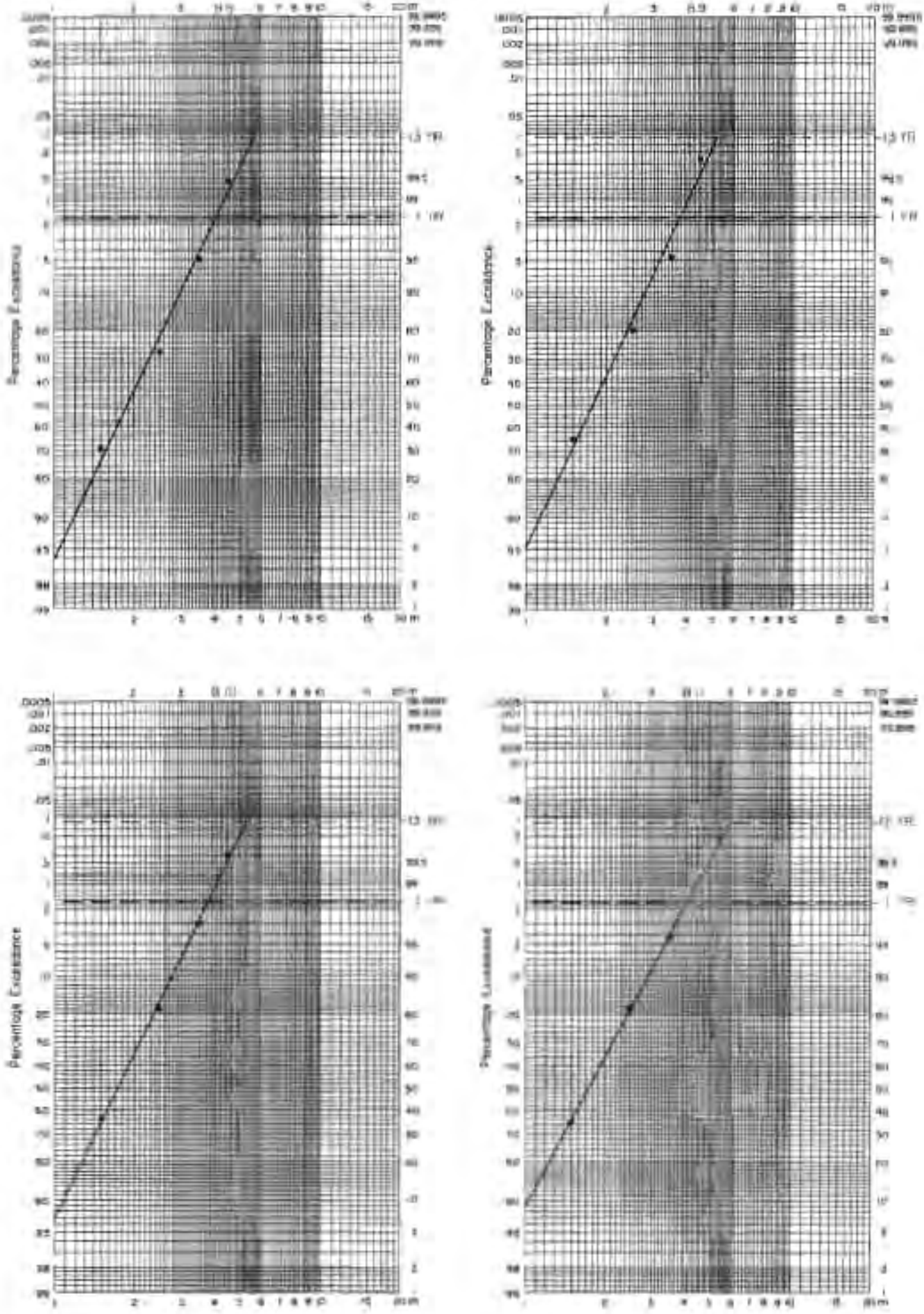


Figure 6g. Monthly Wave Height Exceedance Distribution for June

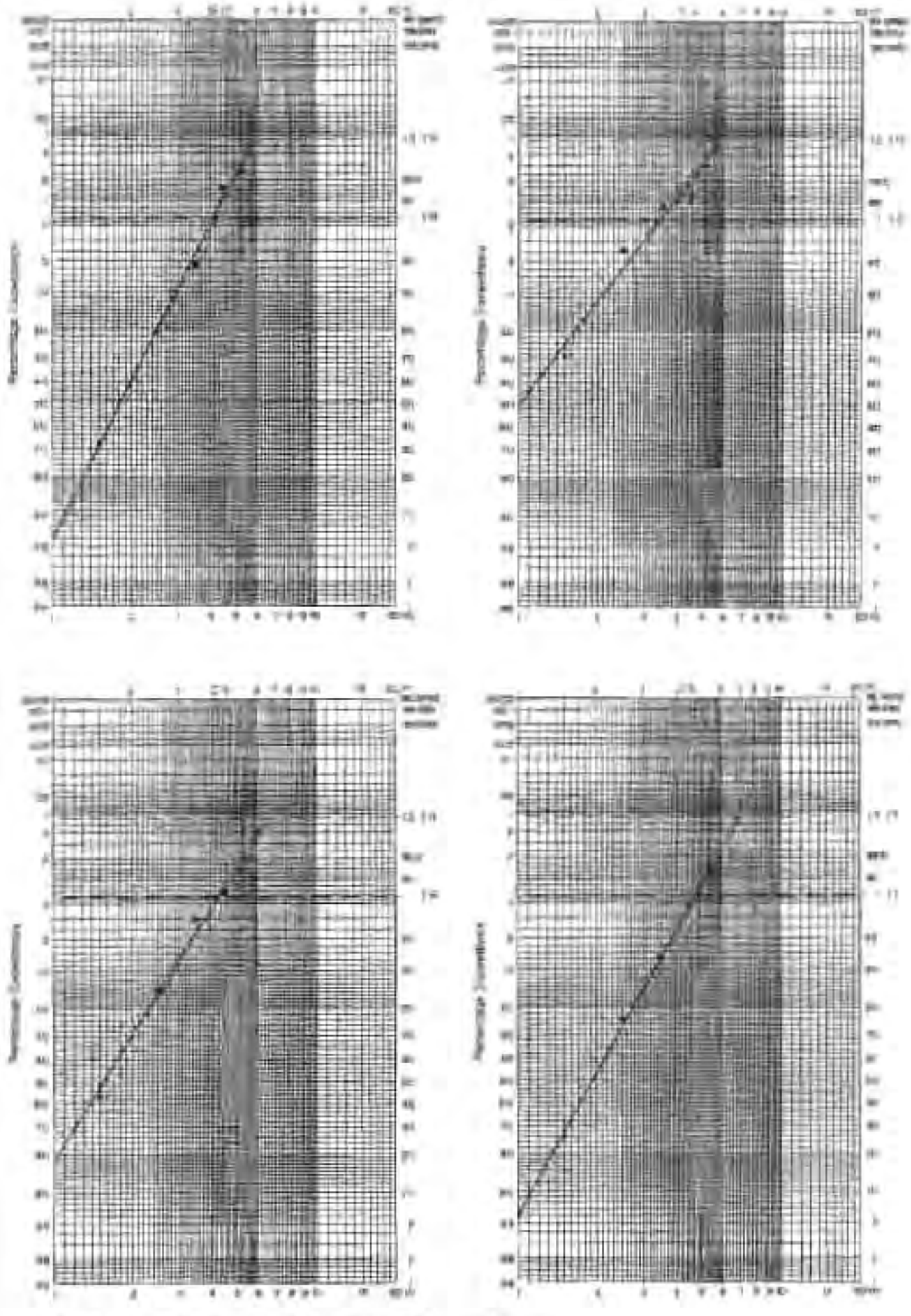


Figure 6.1 Monthly Wave Height Exceedance Distribution for June

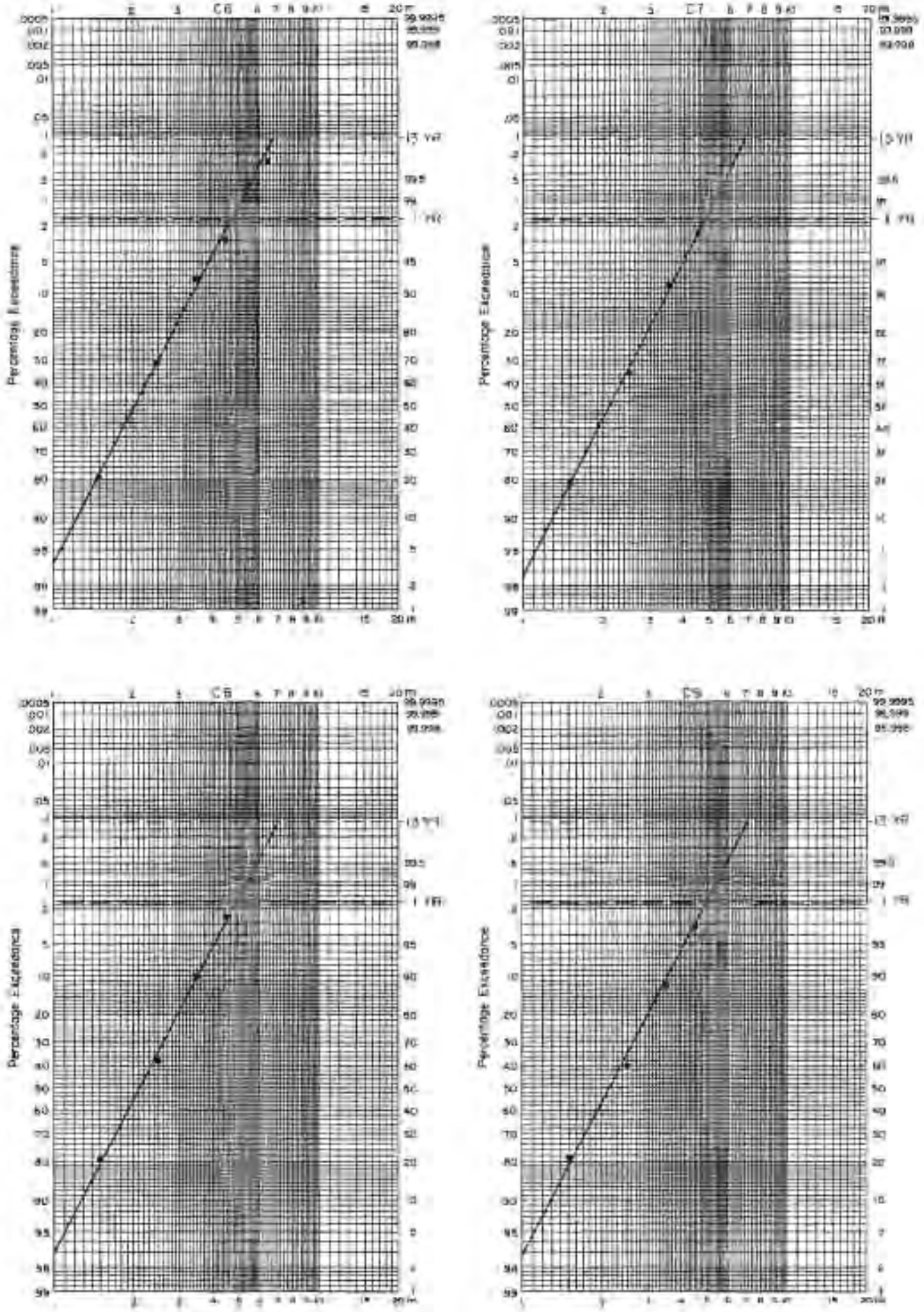


Figure 61. Monthly Wave Height Exceedance Distribution for June

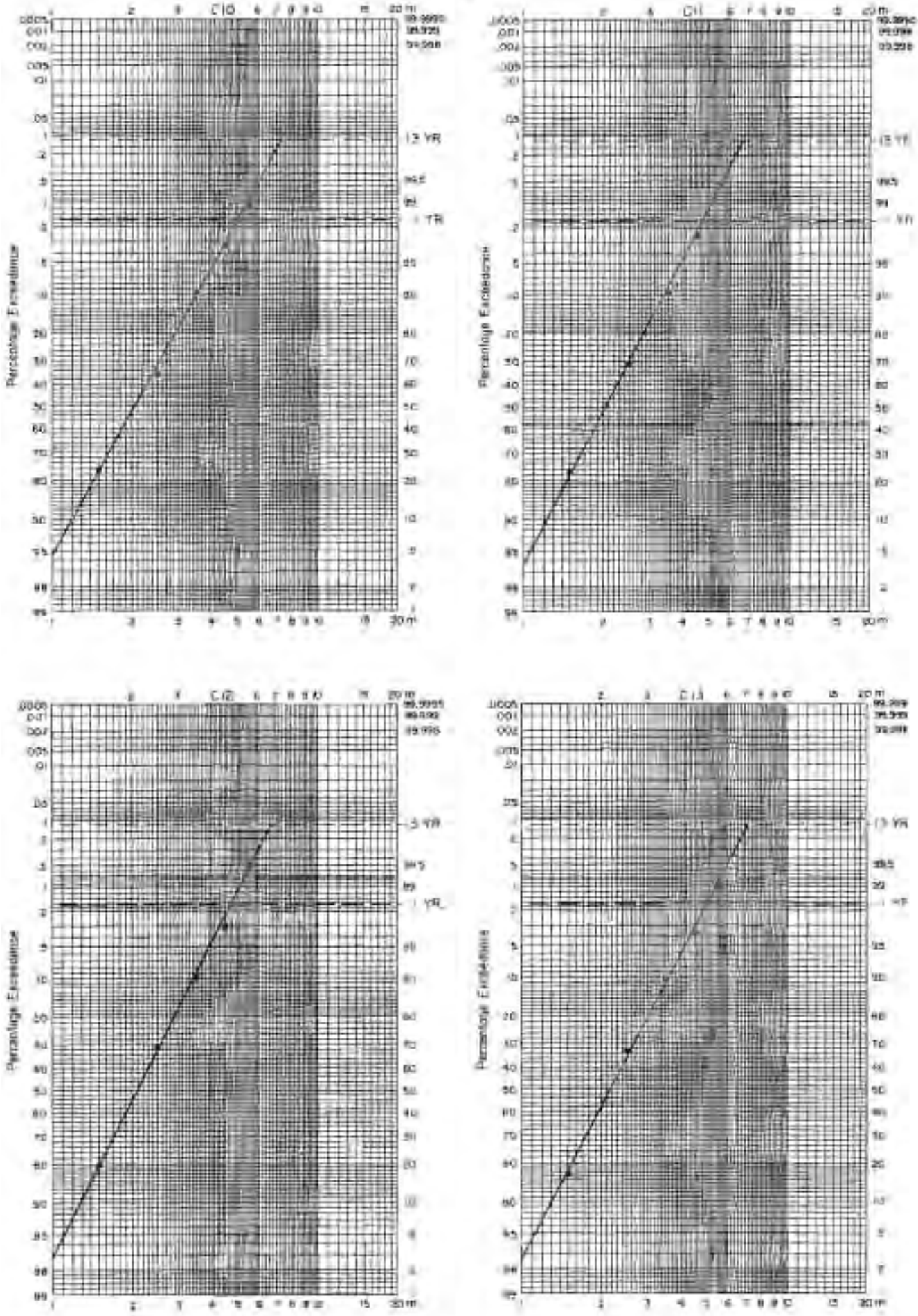


Figure 61. Monthly Wave Height Exceedance Distribution for June

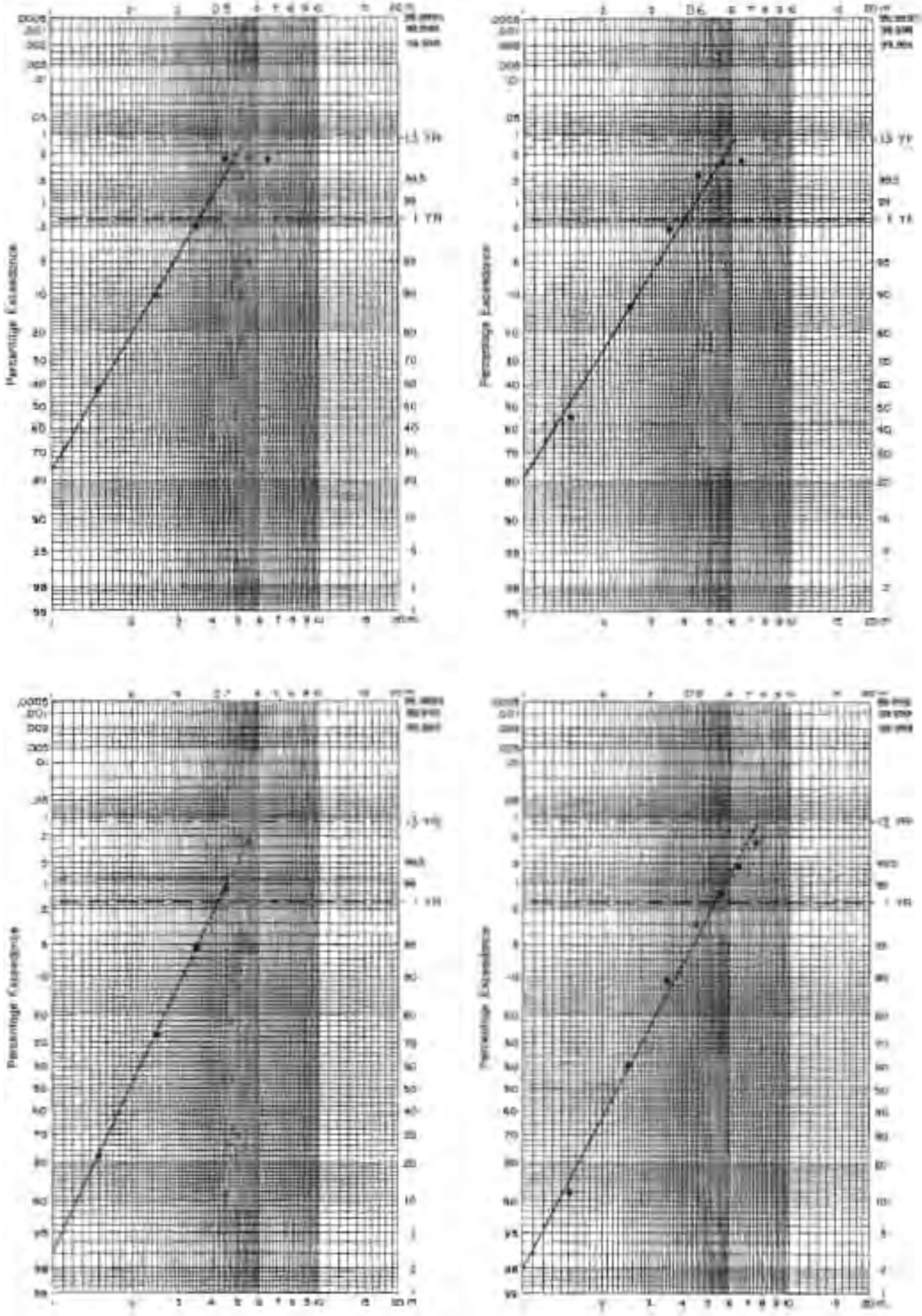


Figure 64 Monthly Wave Height Exceedance Distribution for June

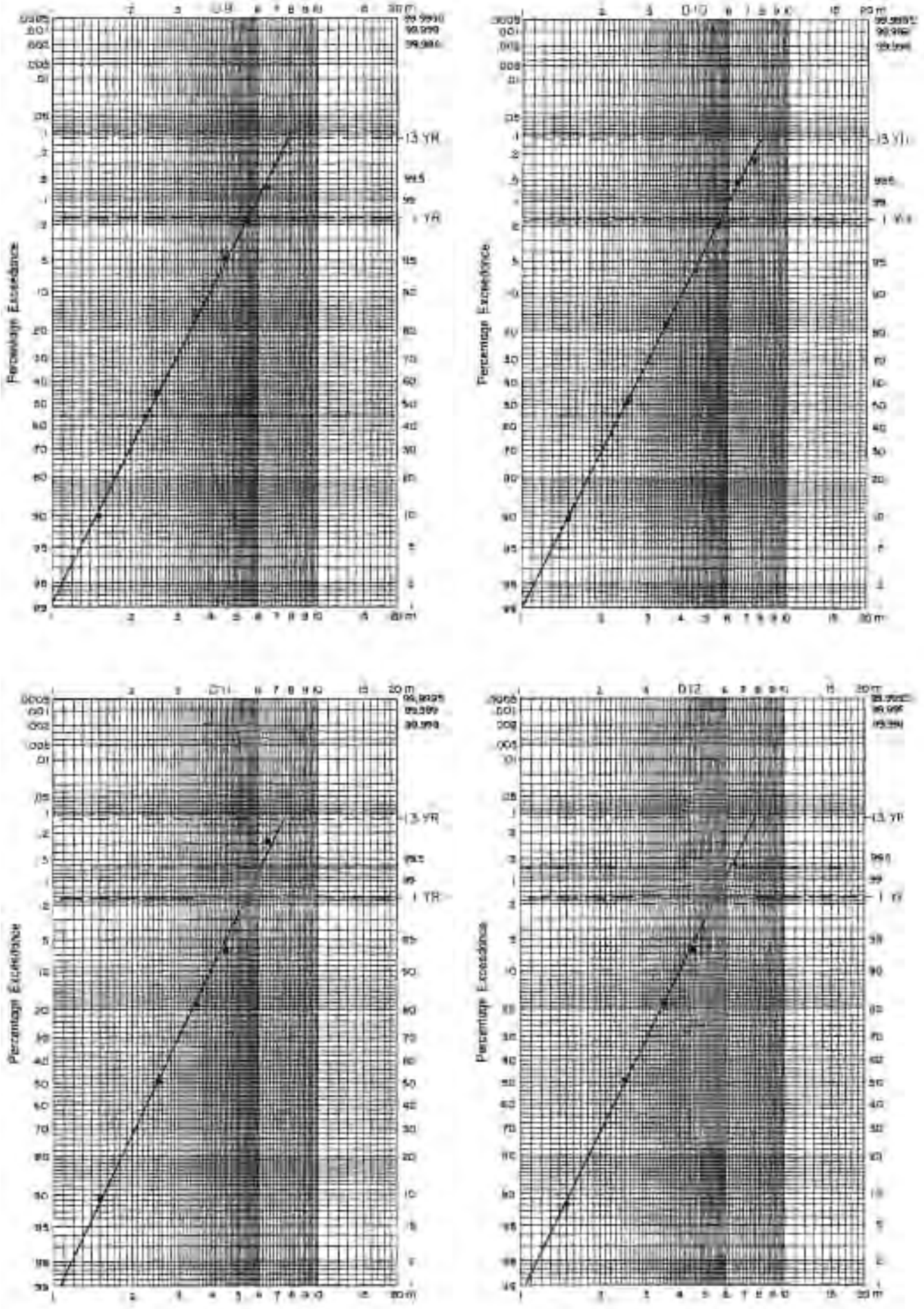


Figure 61 Monthly Wave Height Exceedance Distribution for June

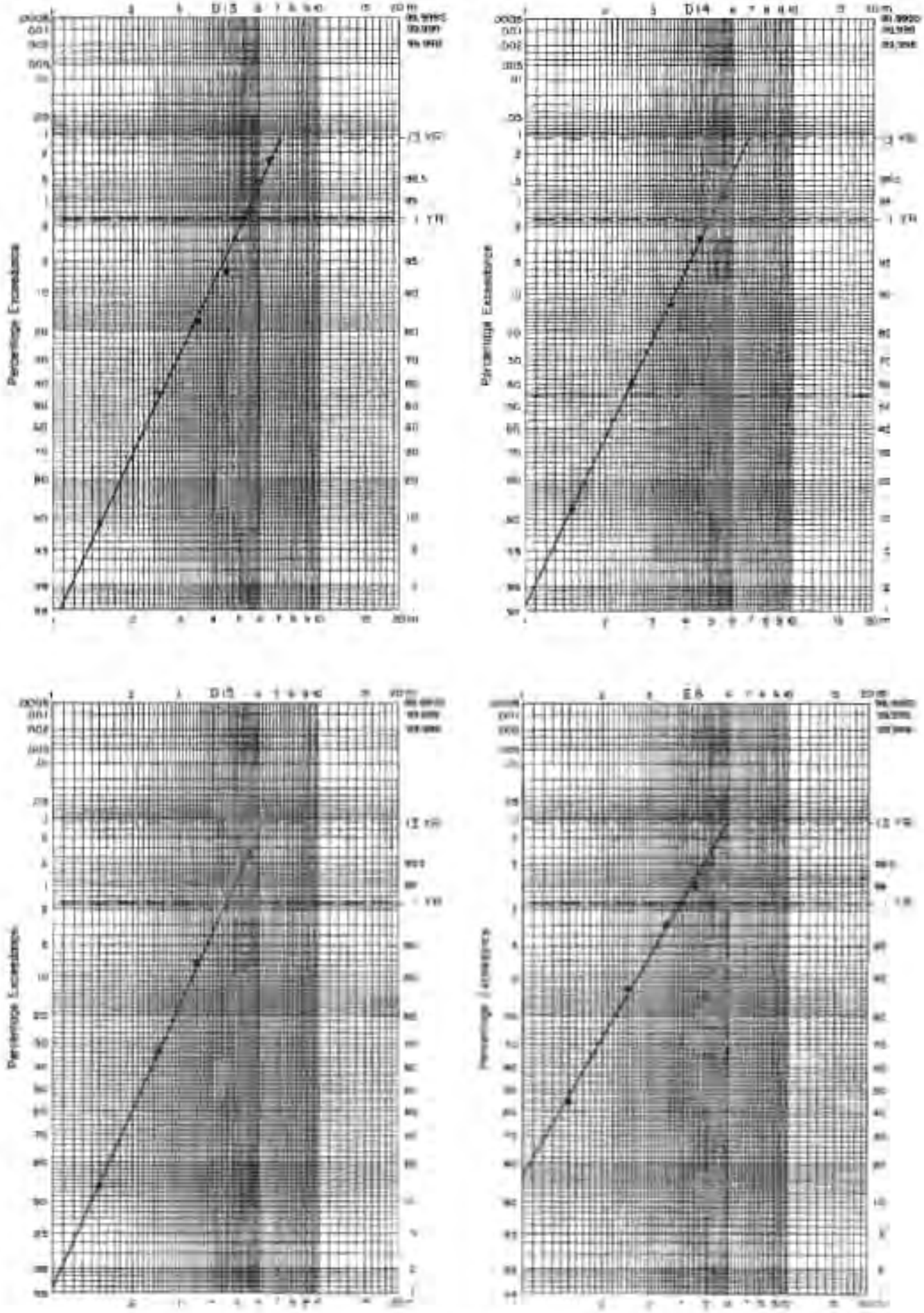


Figure 6-7 Monthly Wave Height Exceedance Distribution for June

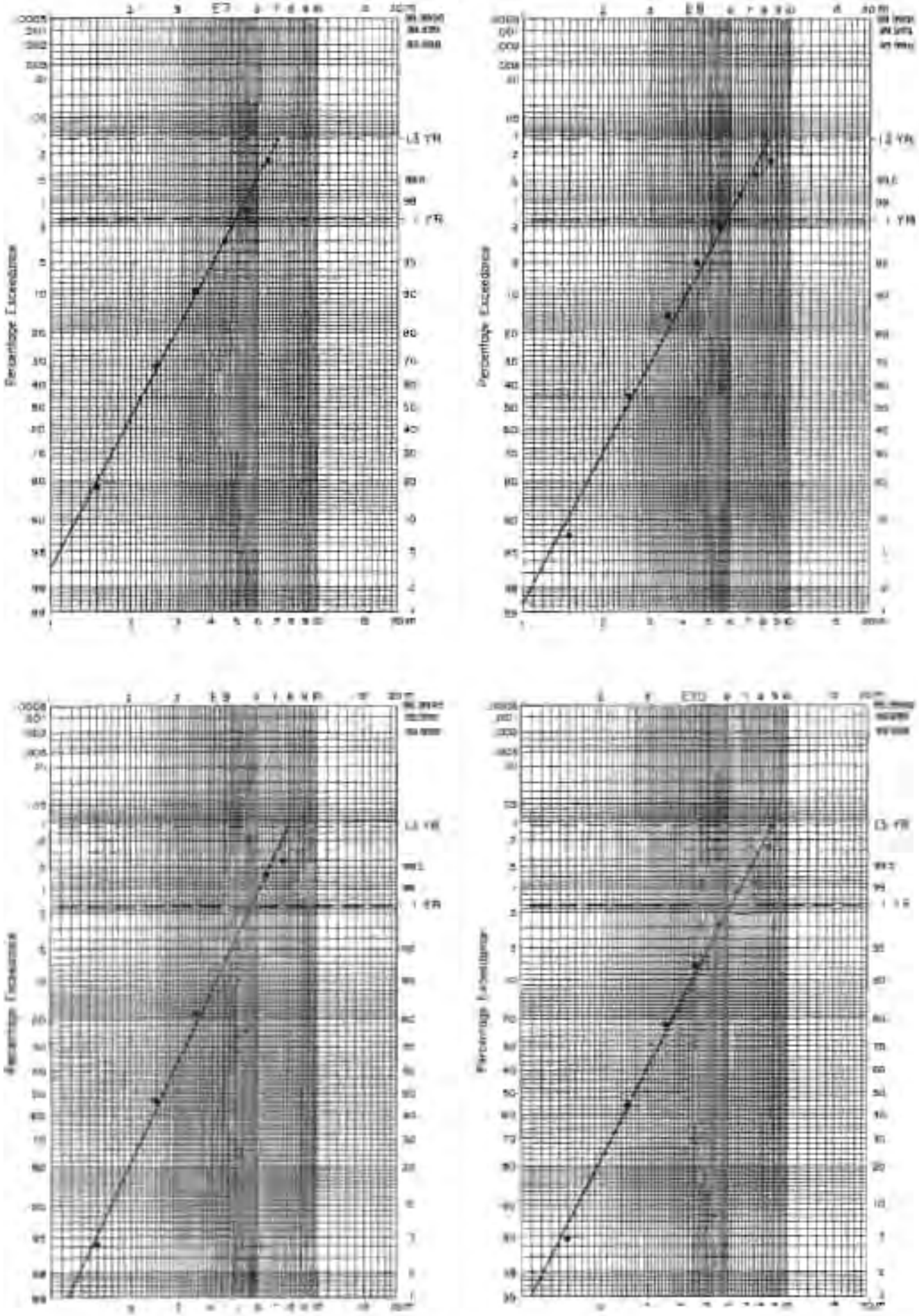
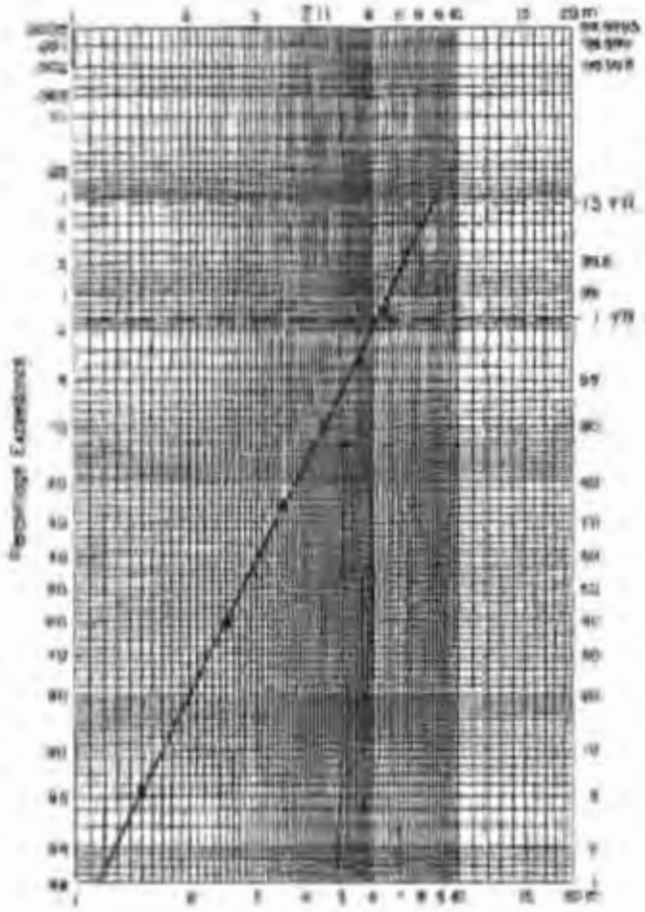
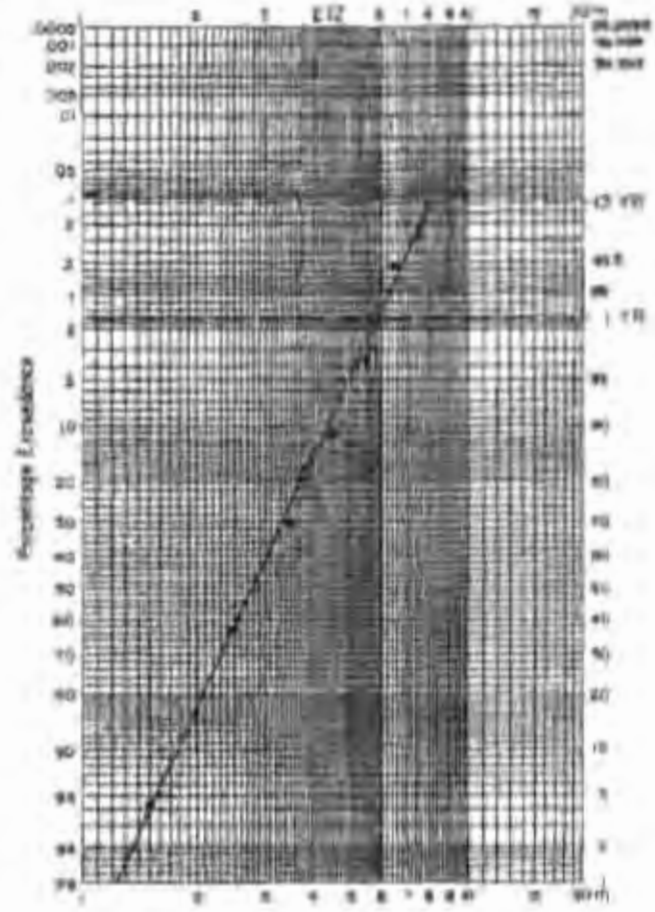
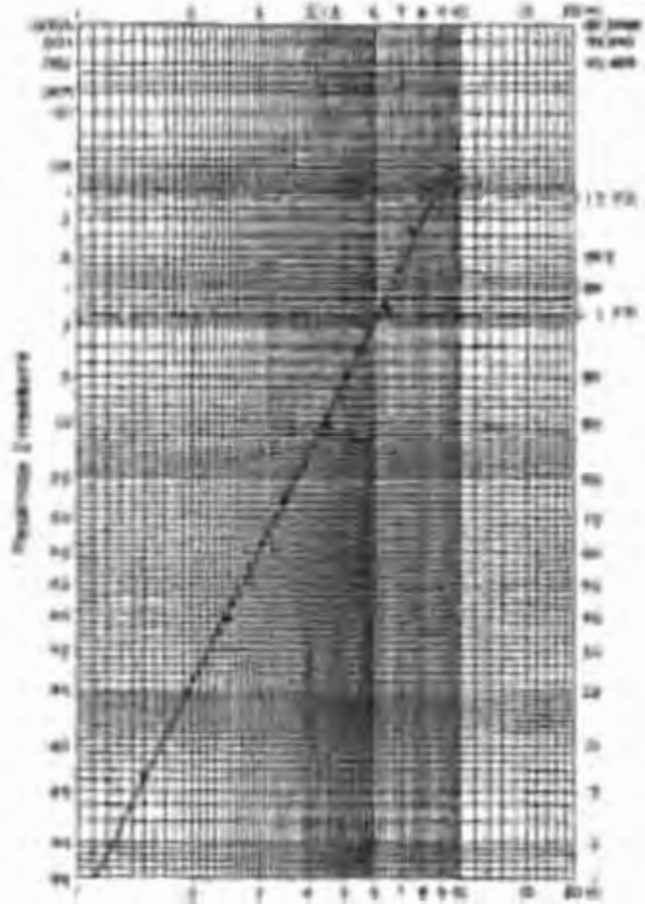
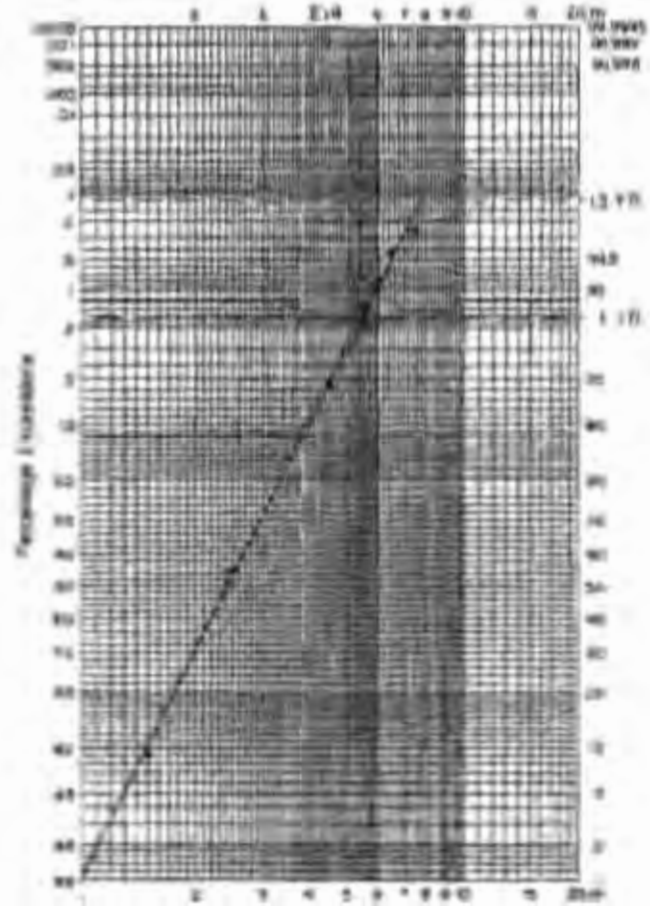


Figure E-1 Monthly Wave Height Exceedance Distribution for June









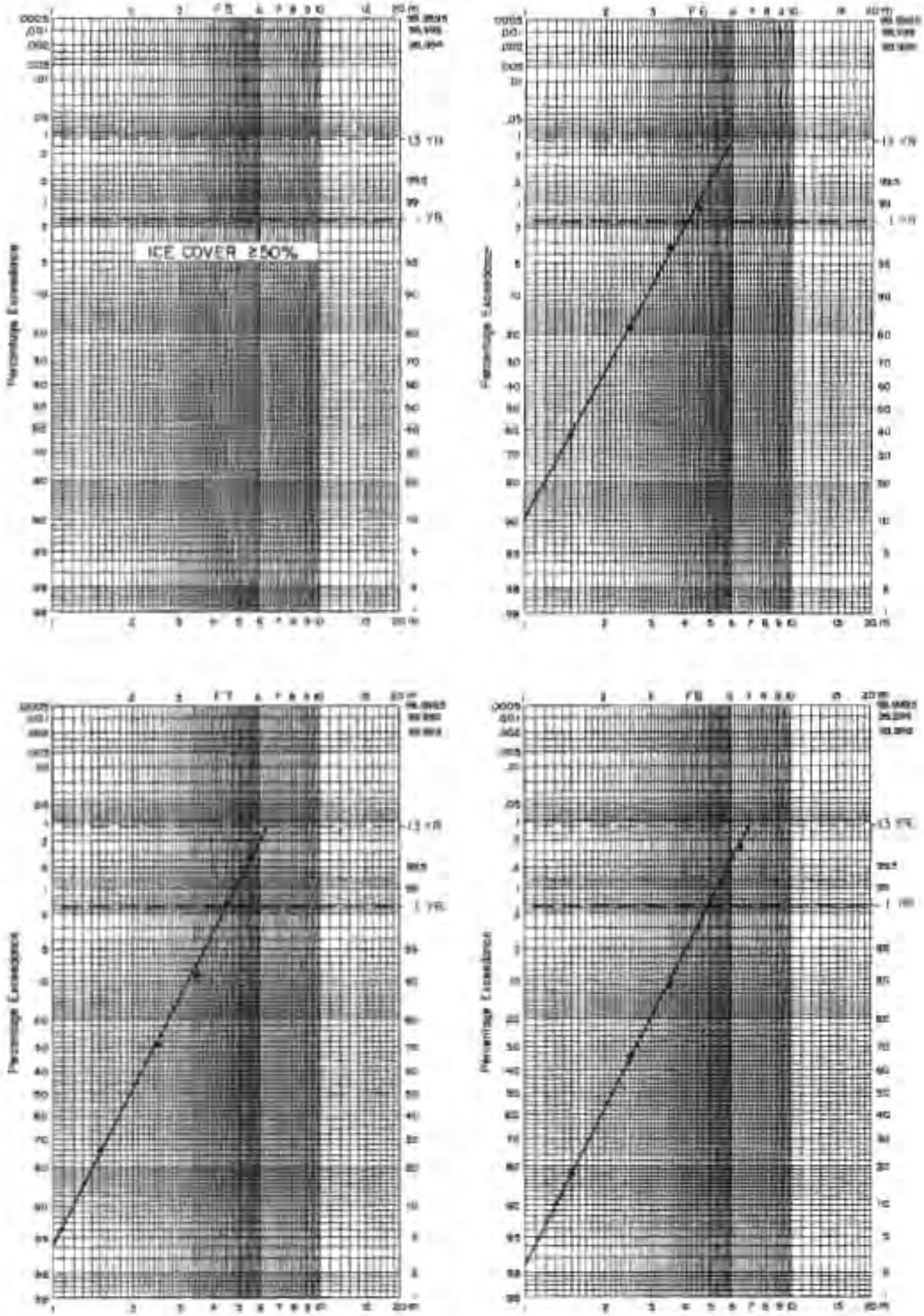
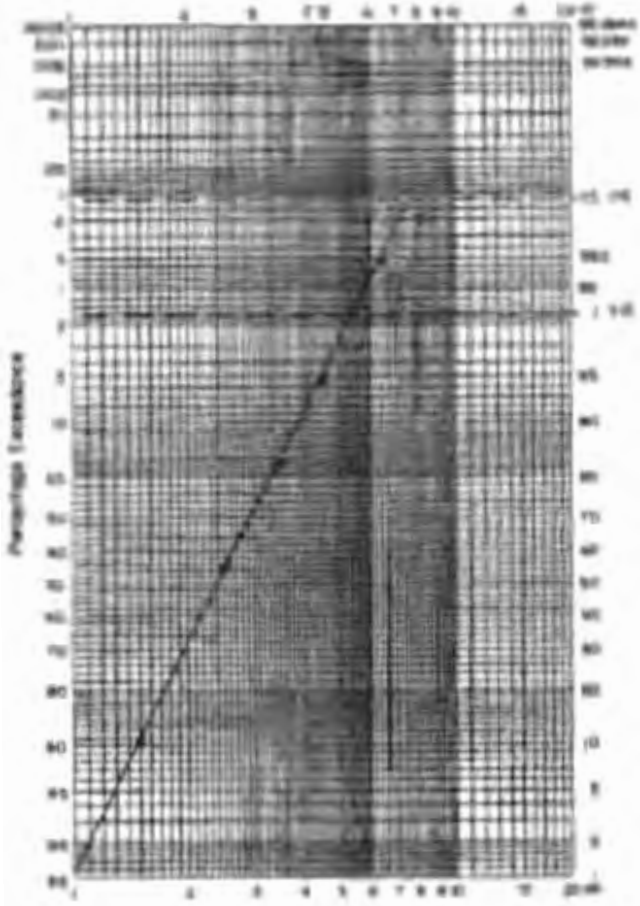
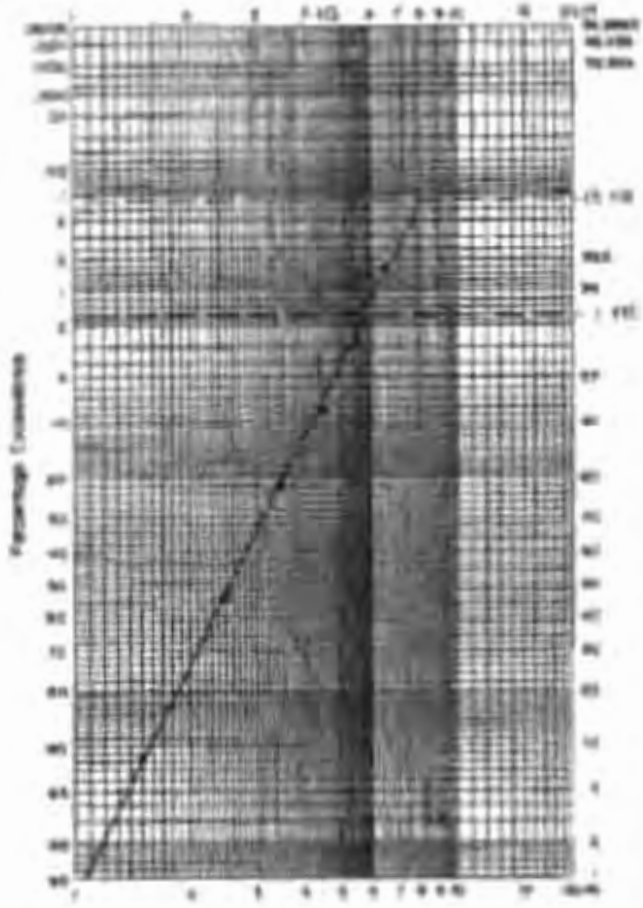
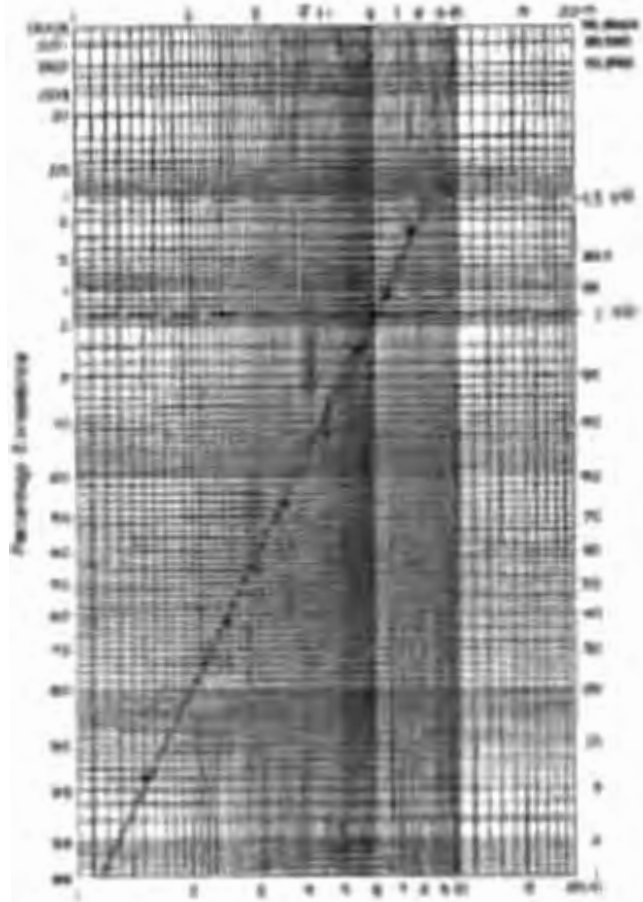
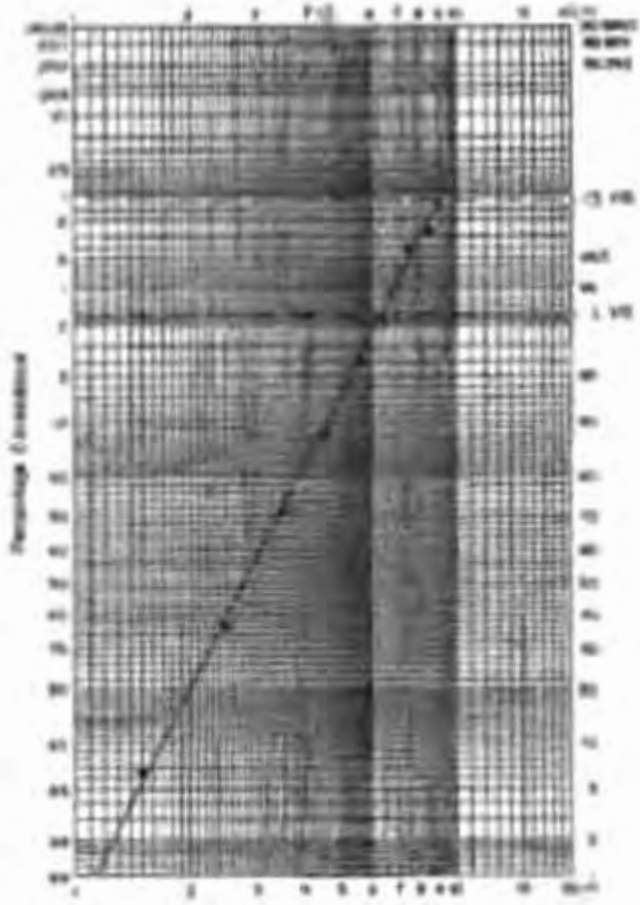


Figure 6(c) Monthly Wave Height Exceedance Distribution for June









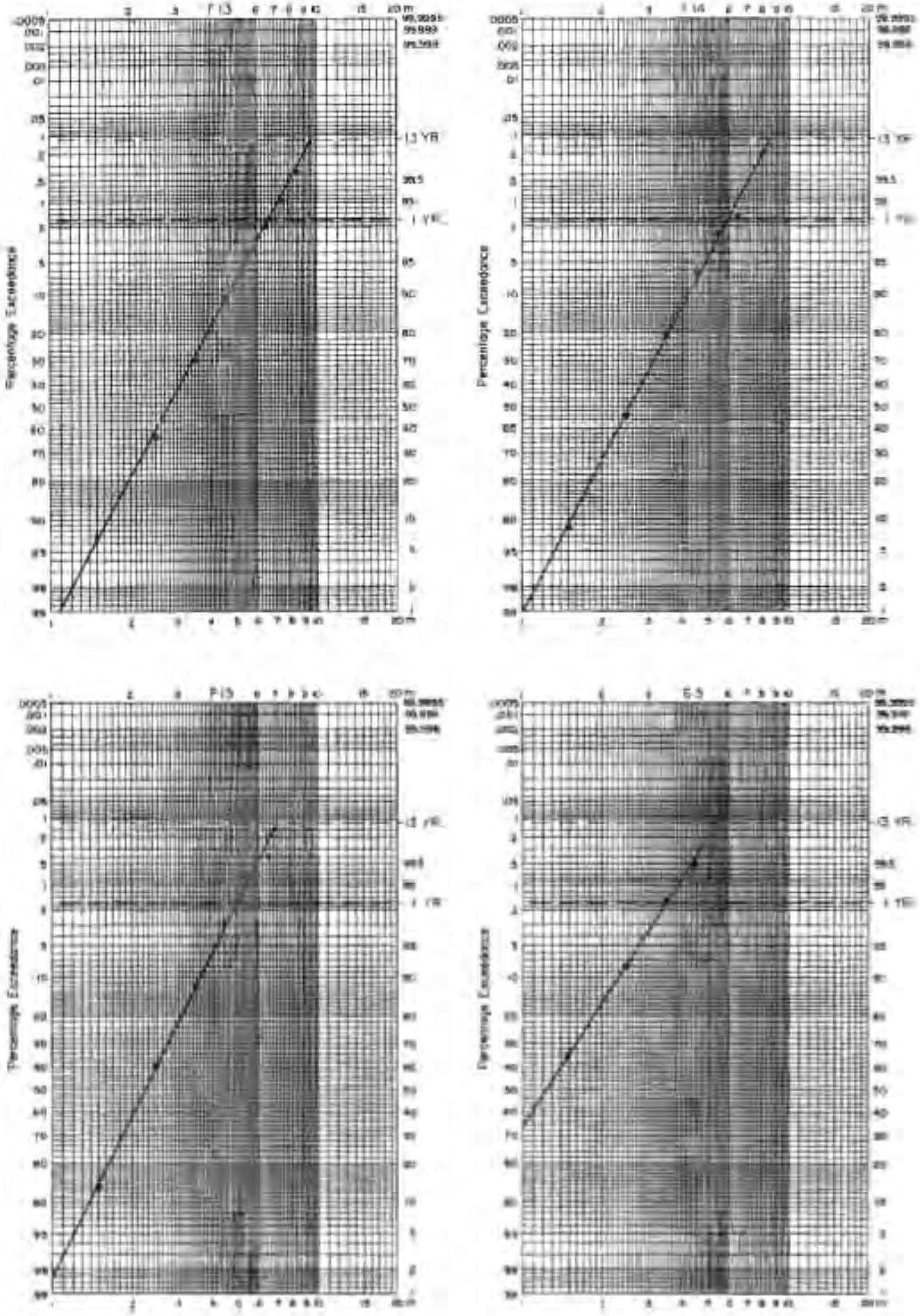


Figure 7: Monthly Wave Height Exceedance Distribution for June

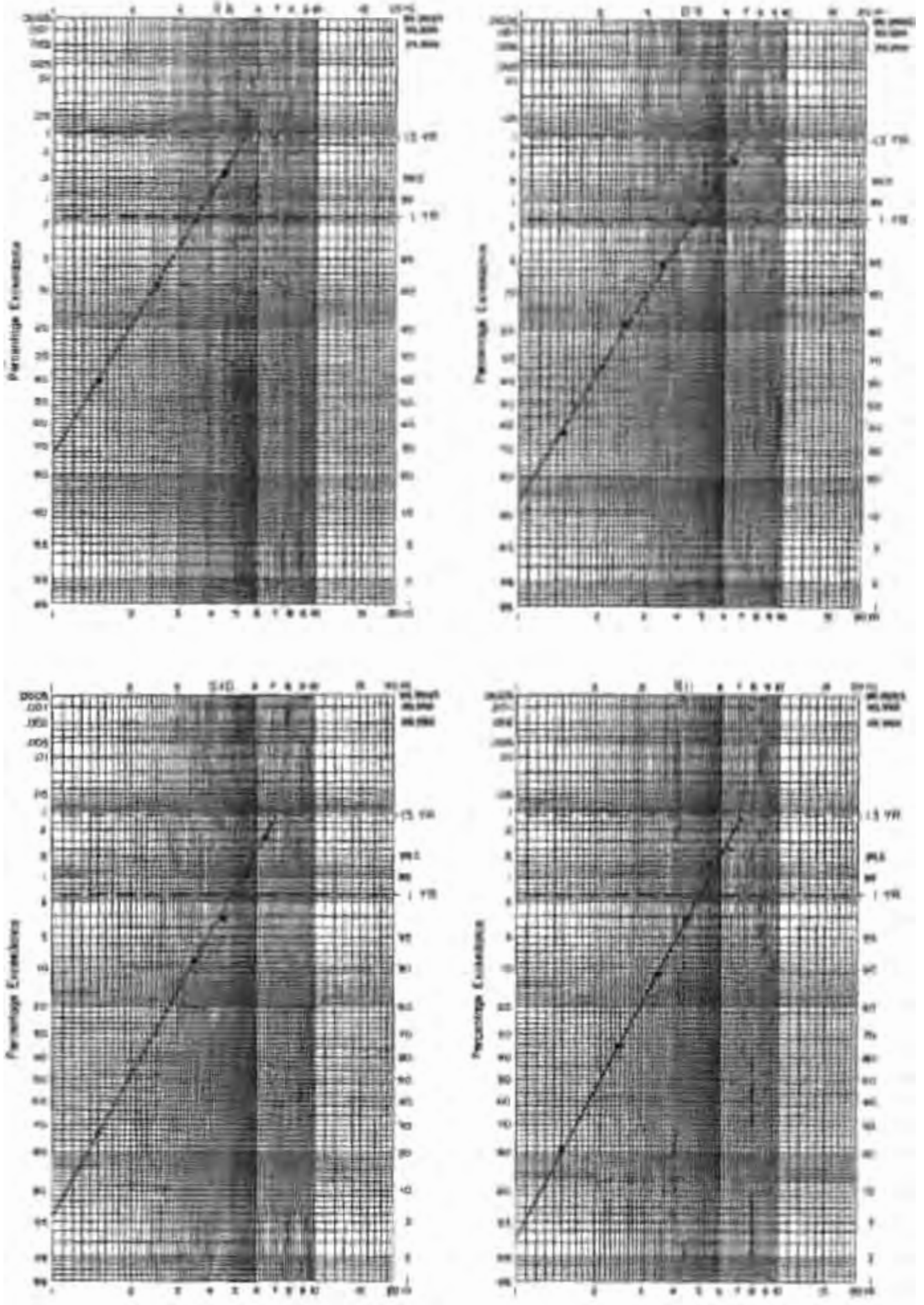


Figure 3a. Monthly Wave Height Exceedance Distribution for June

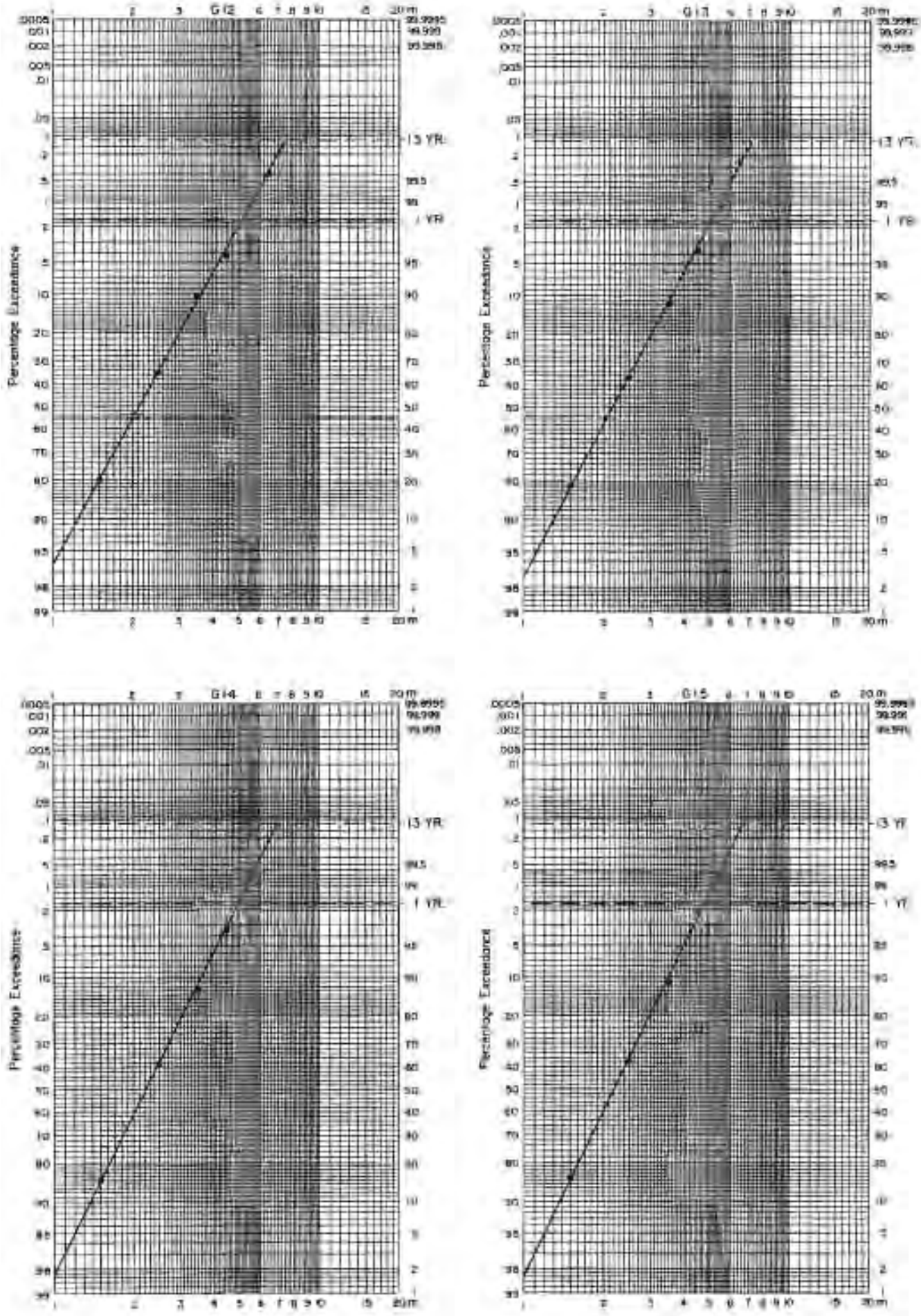
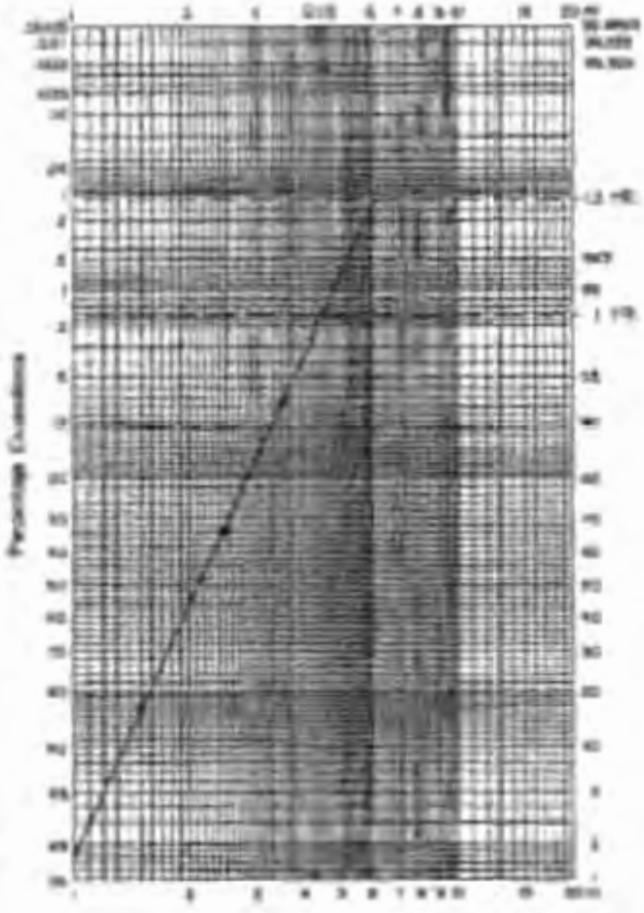
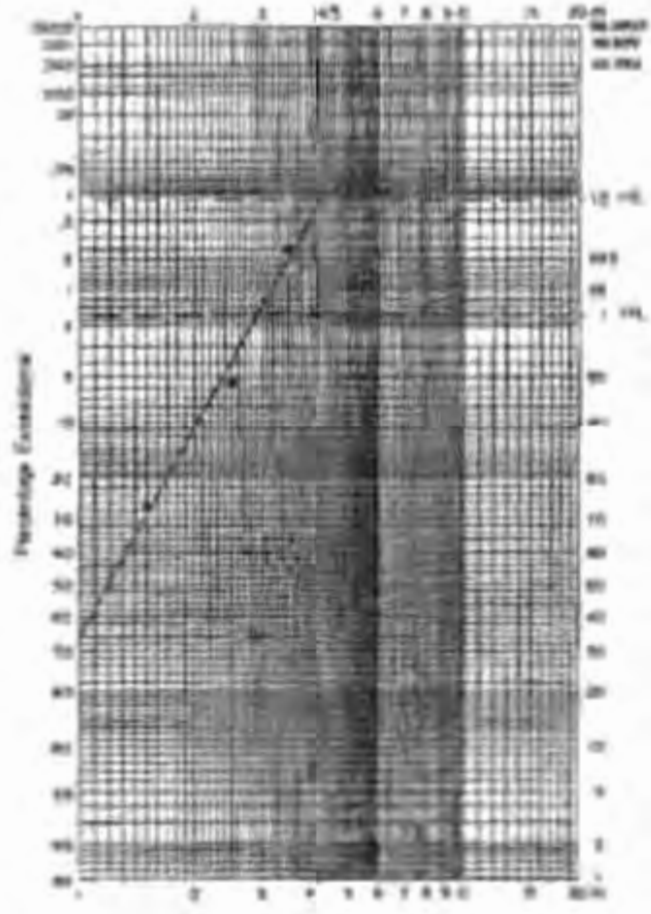
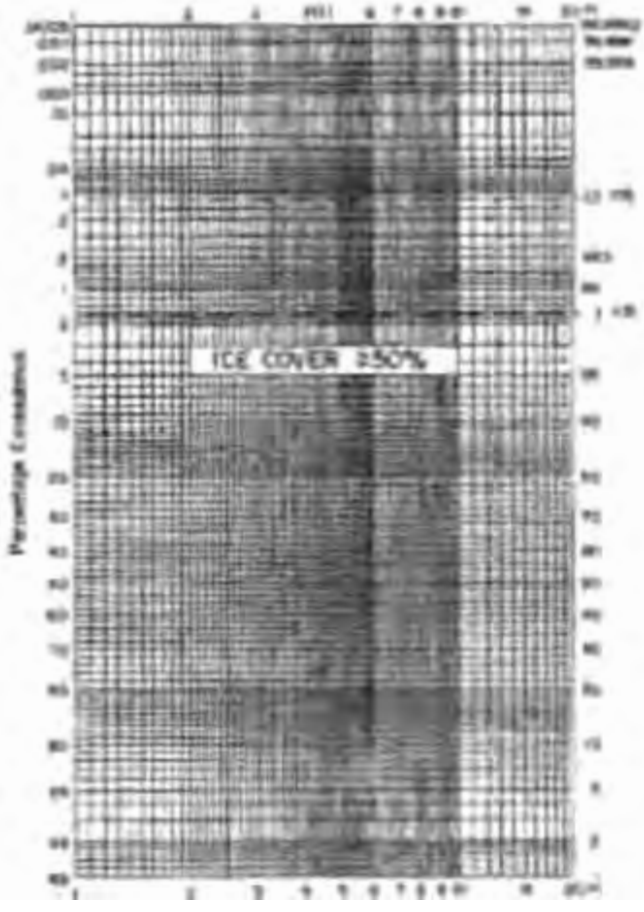
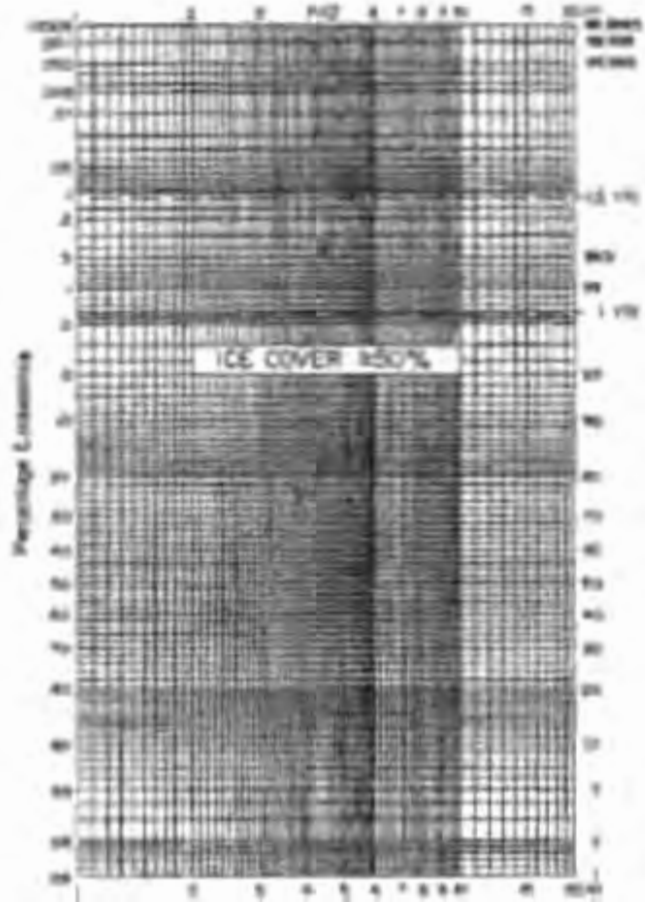


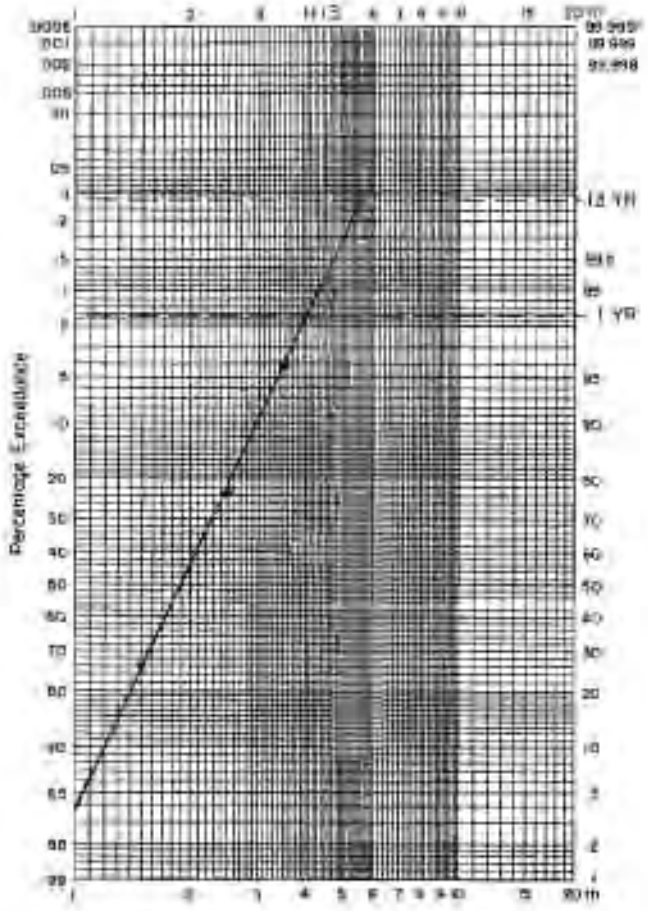
Figure 61. Monthly Wave Height Exceedance Distribution for June

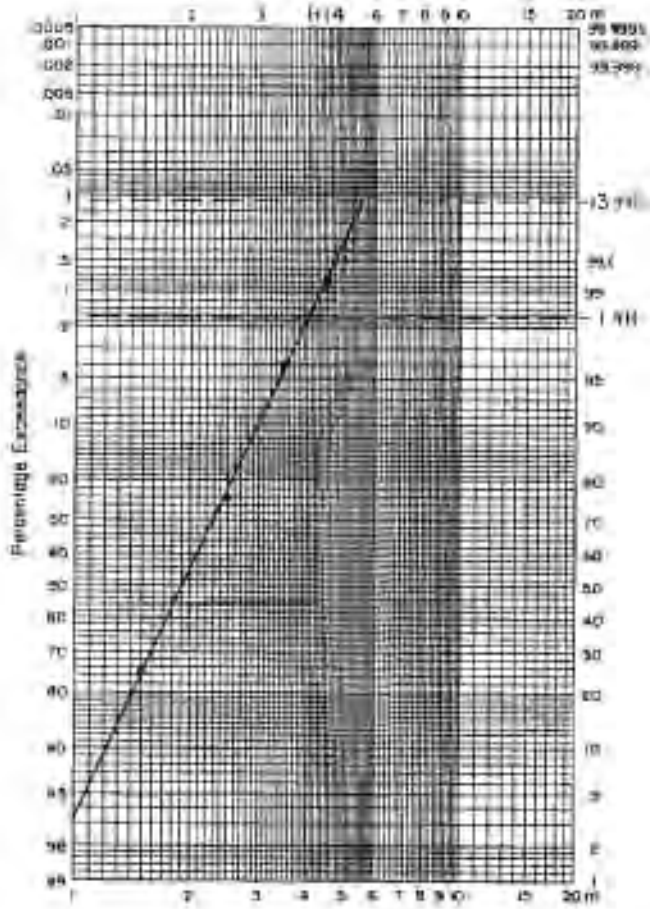


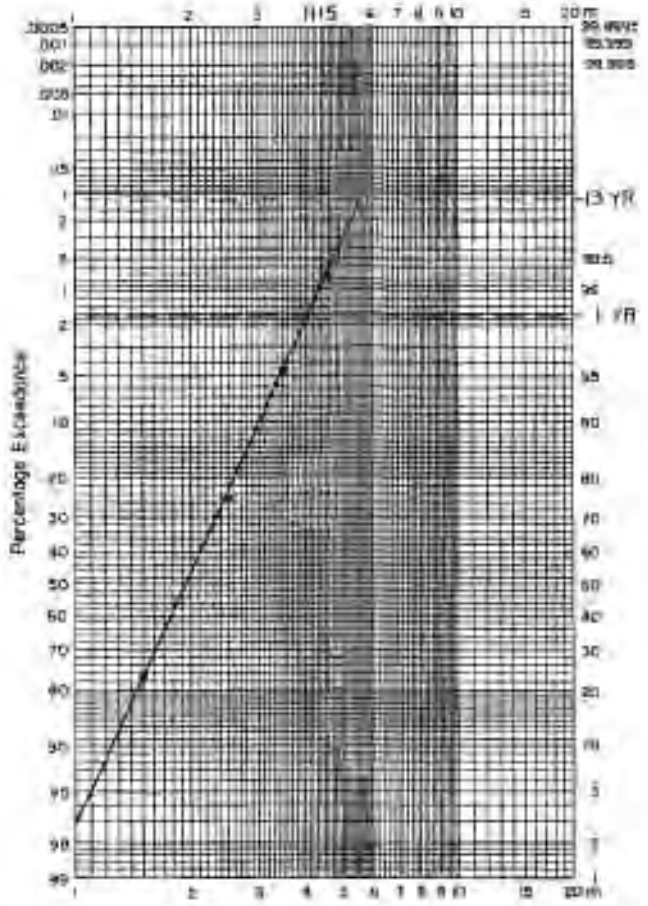



ICE COVER ≥50%


ICE COVER ≥50%







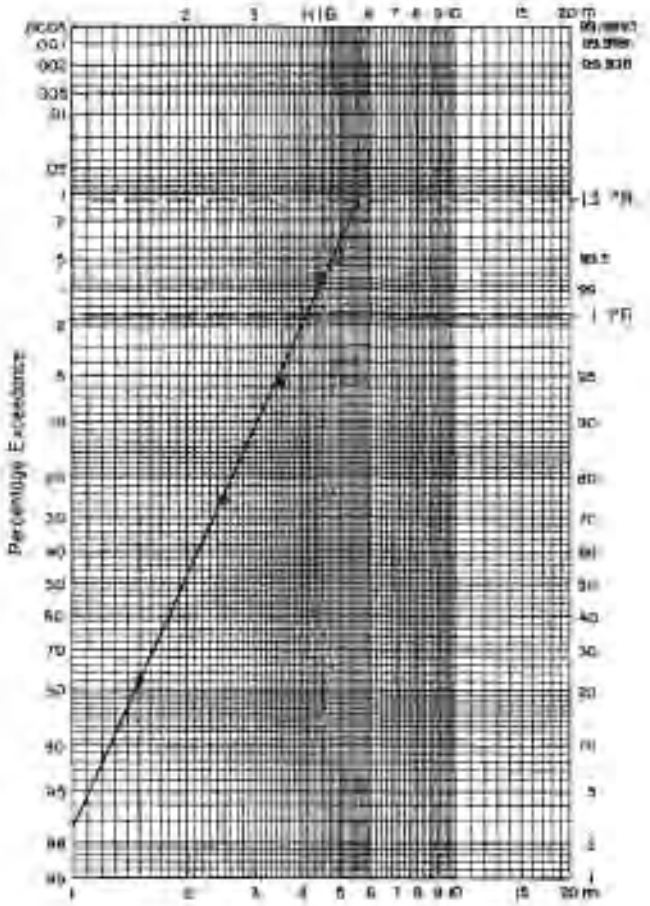


Figure 64 Monthly Wave Height Exceedance Distribution for June

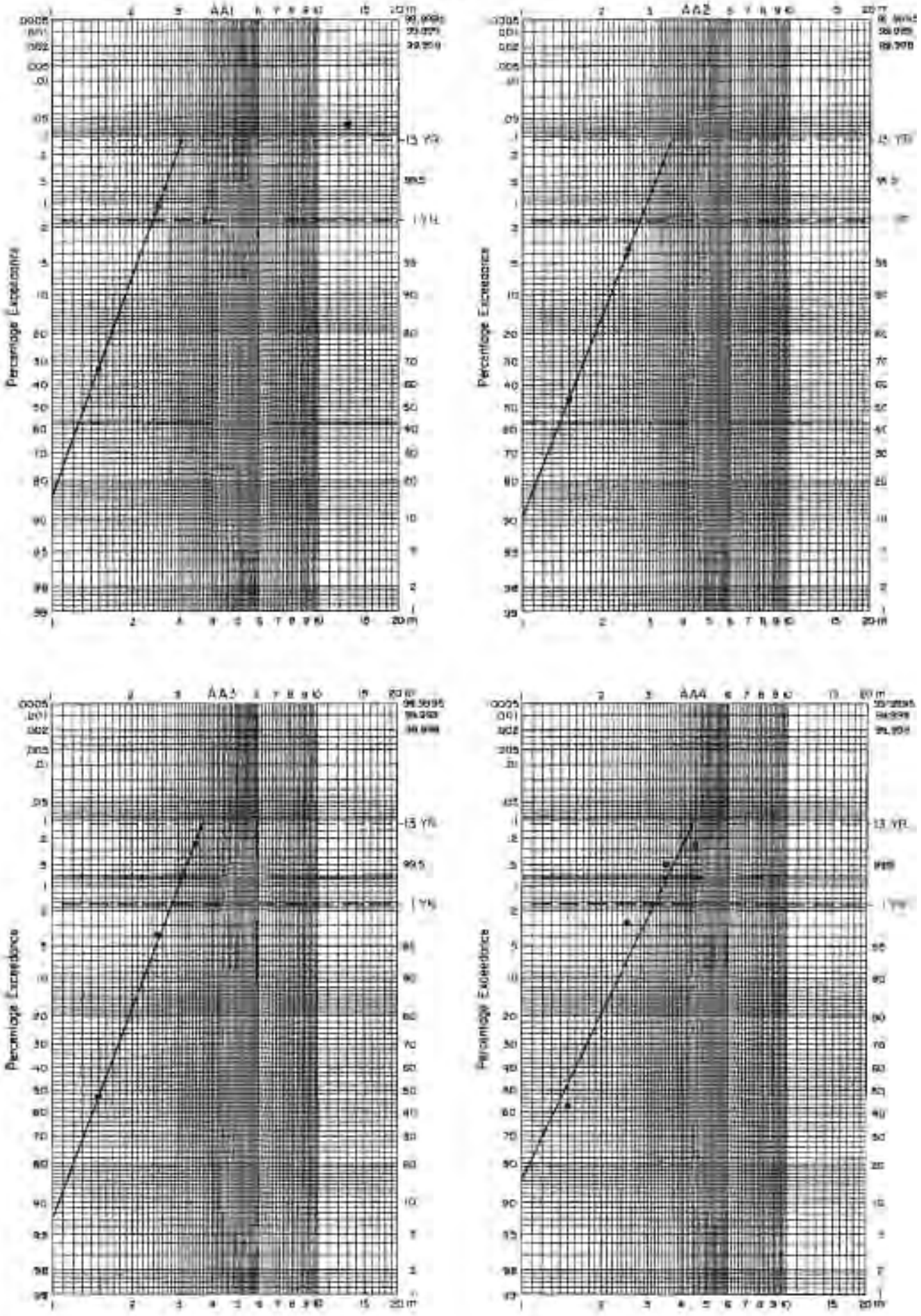
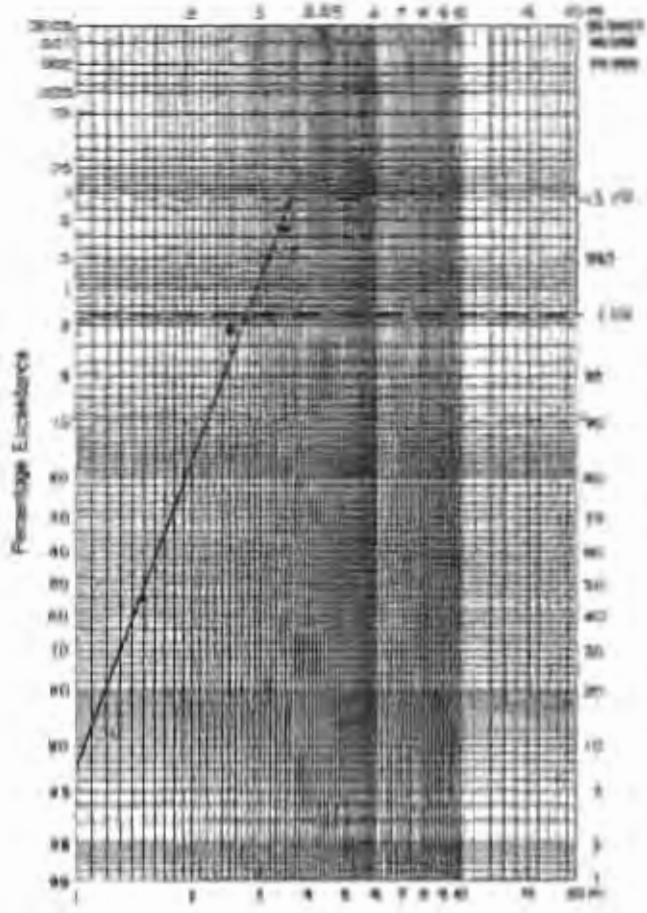
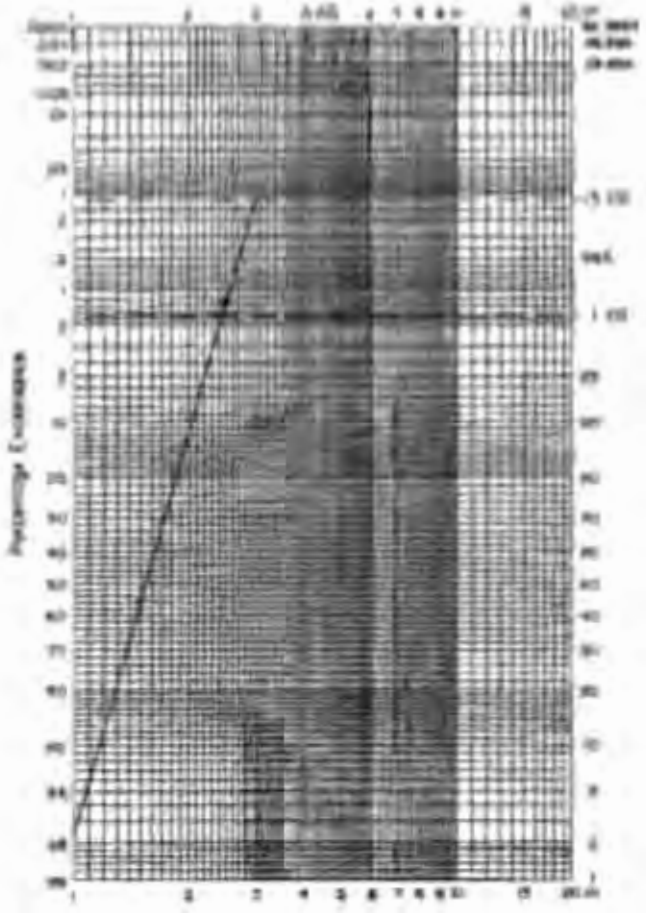
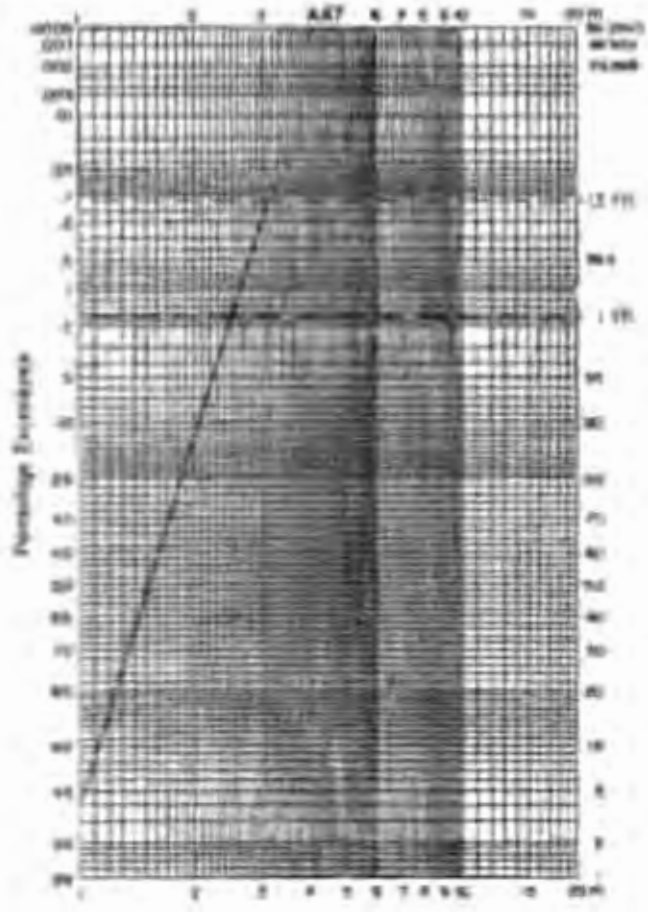
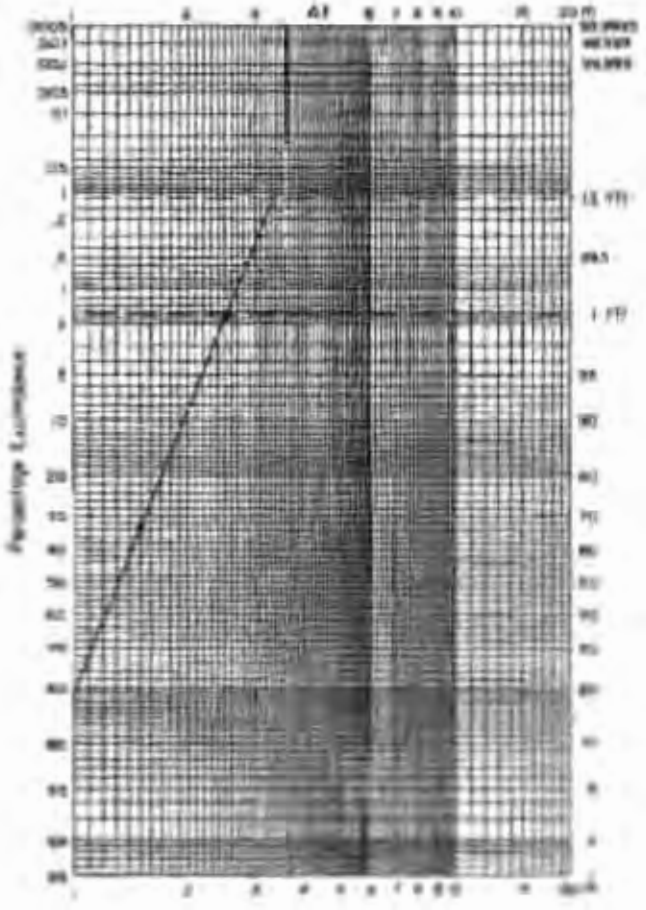


Figure 7c Monthly Wave Height Exceedance Distribution for July









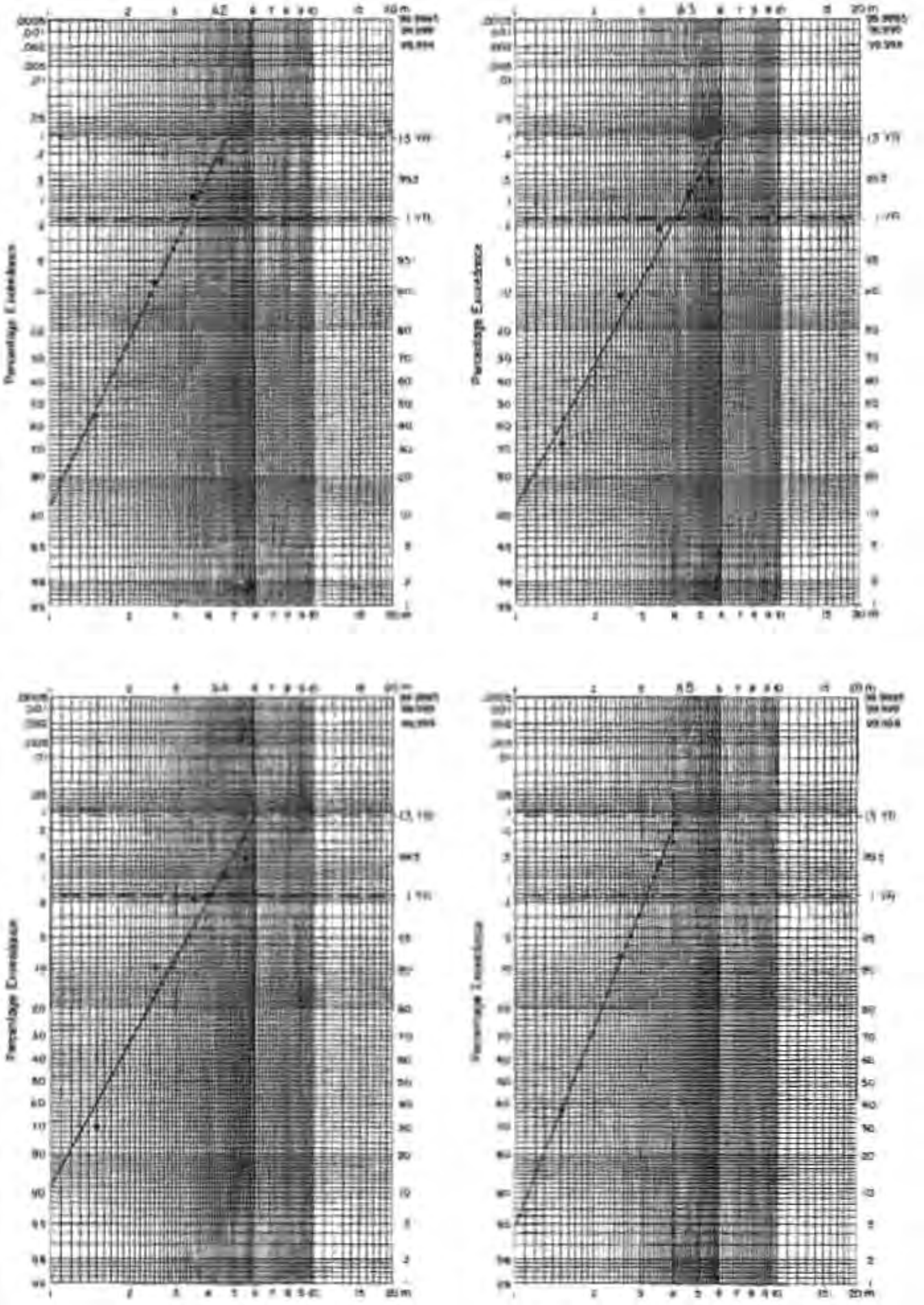


Figure 72 Monthly Wave Height Exceedance Distribution for study

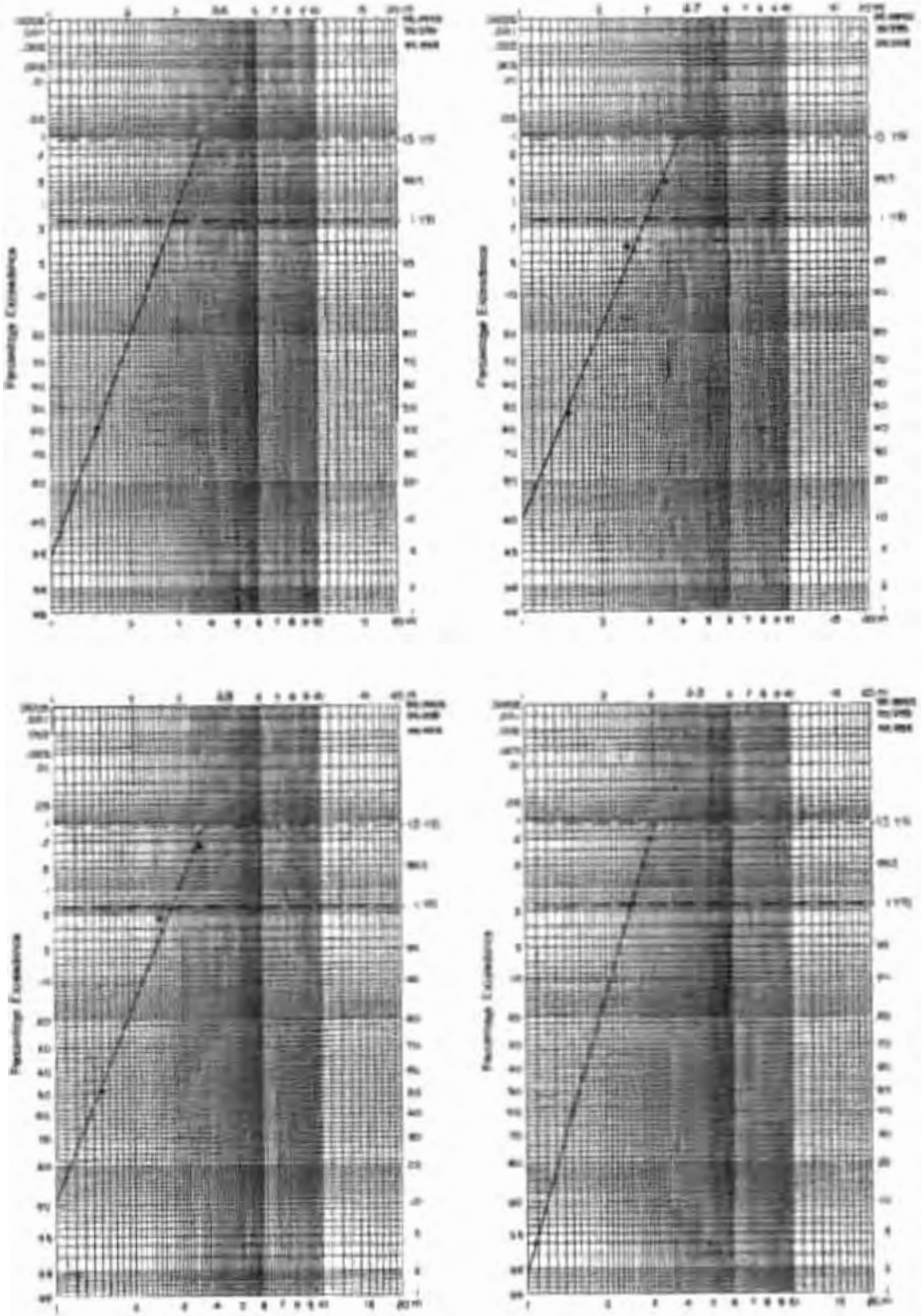


Figure 74. Monthly Wave Height Exceedance Distribution for July

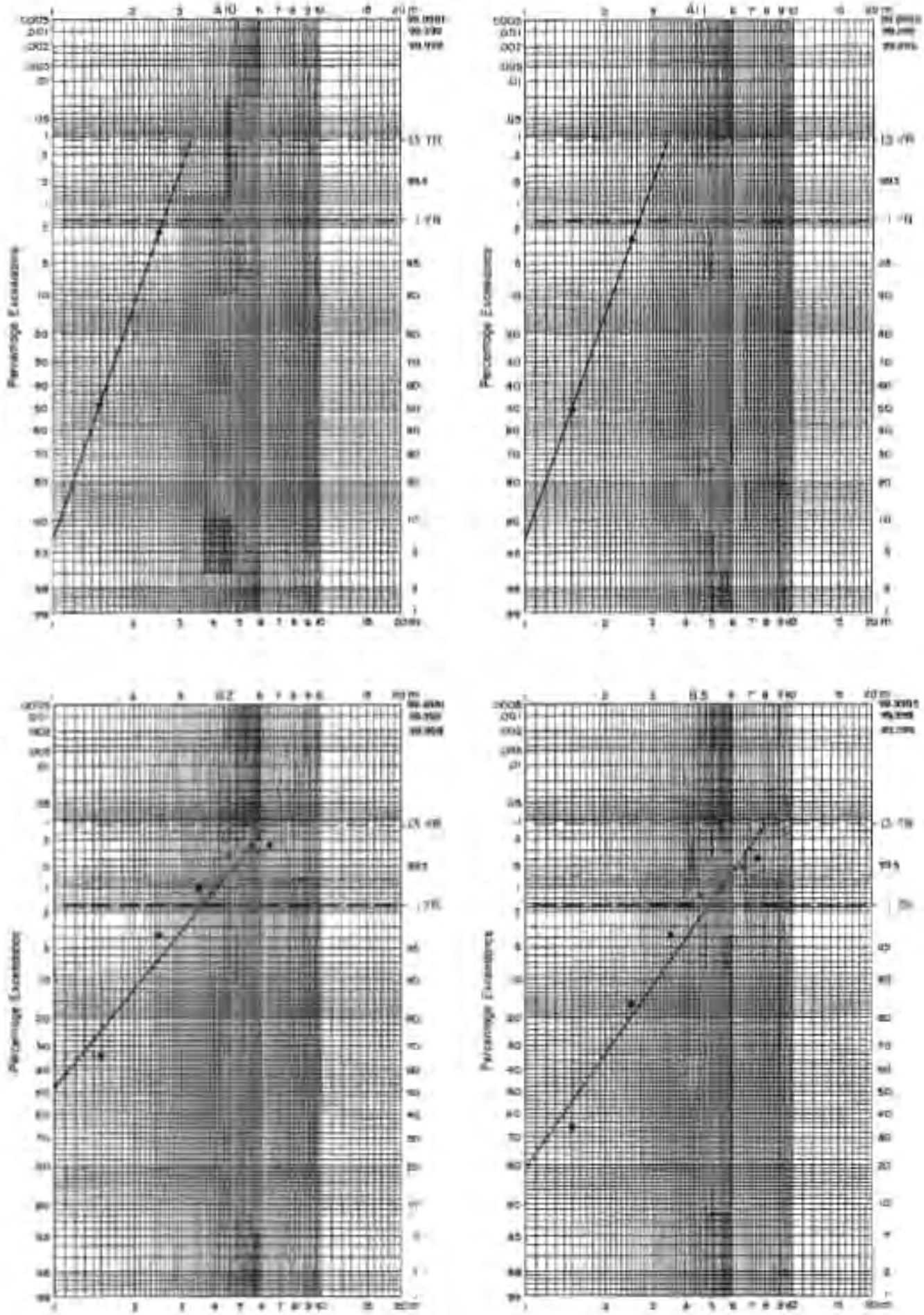


Figure 7e. Monthly Wave Height Exceedance Distribution for July

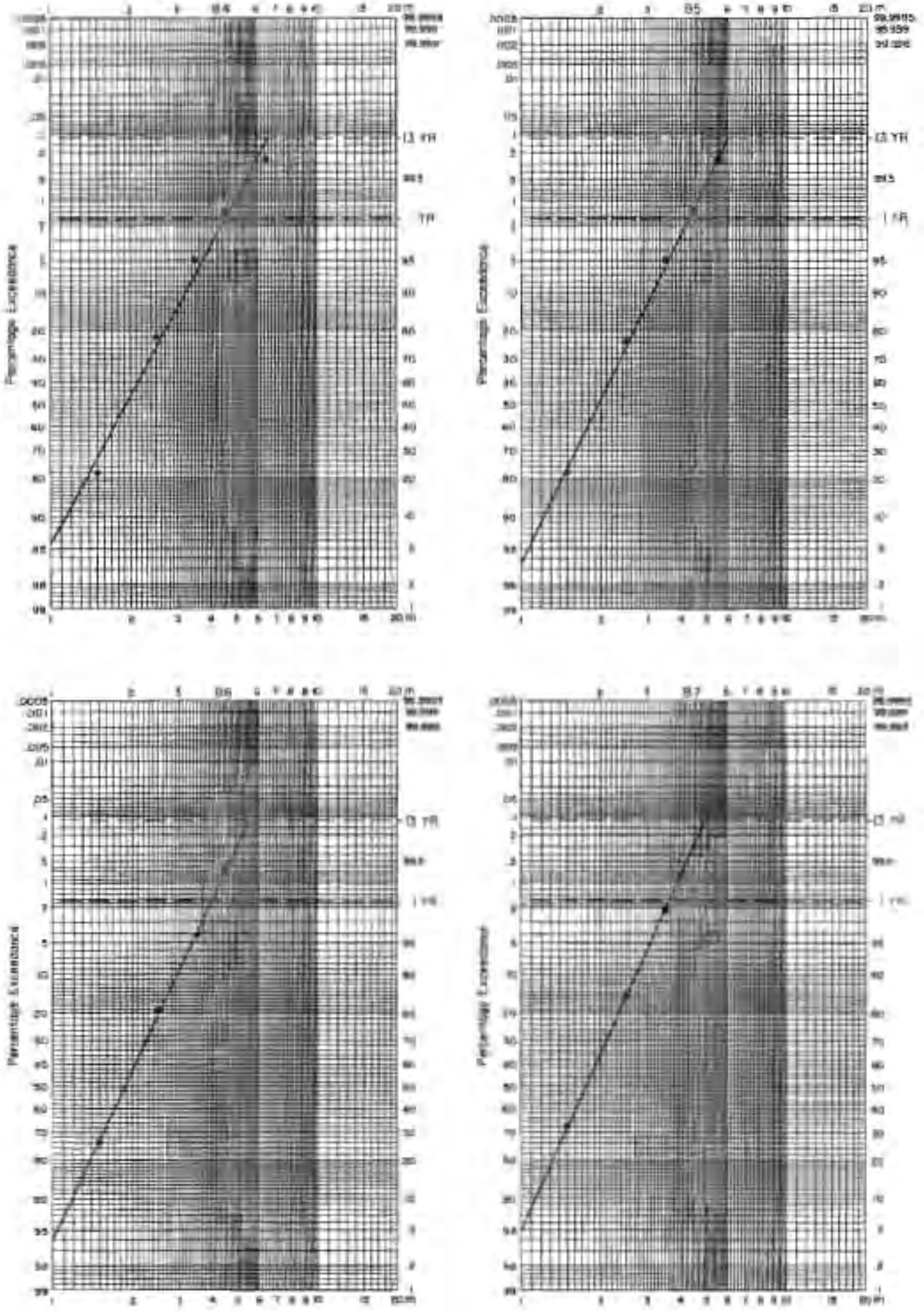
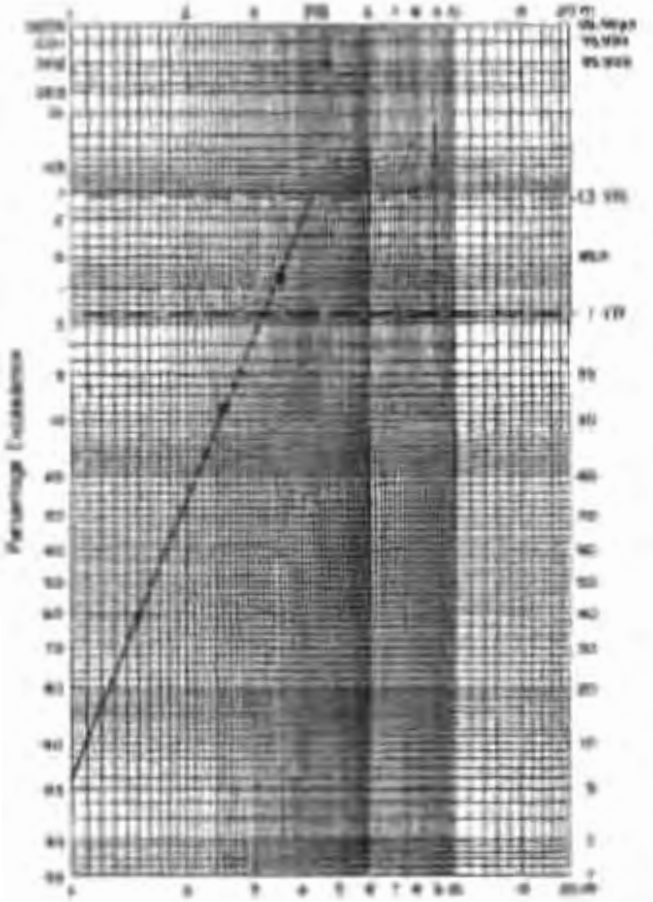
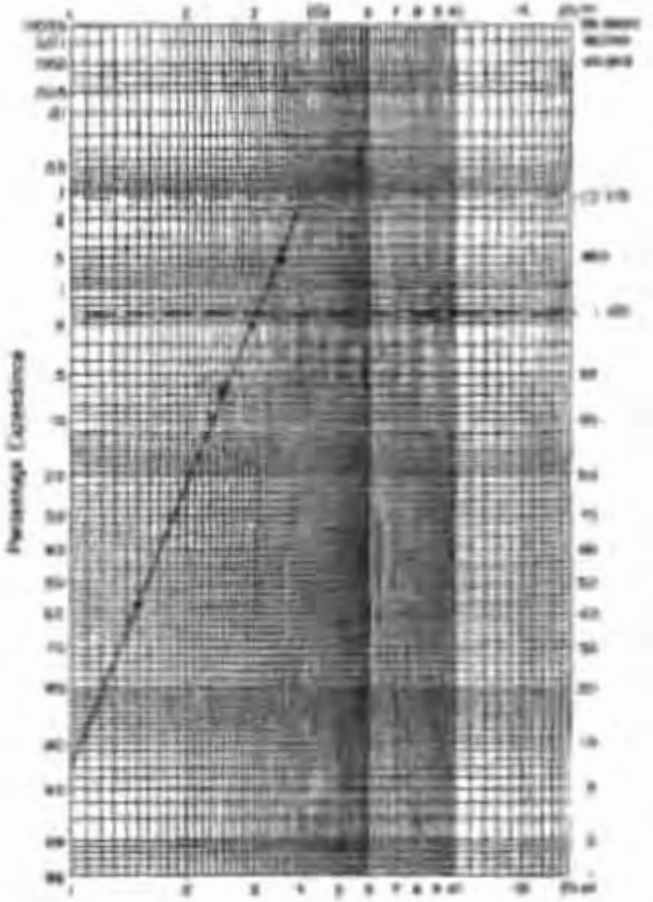
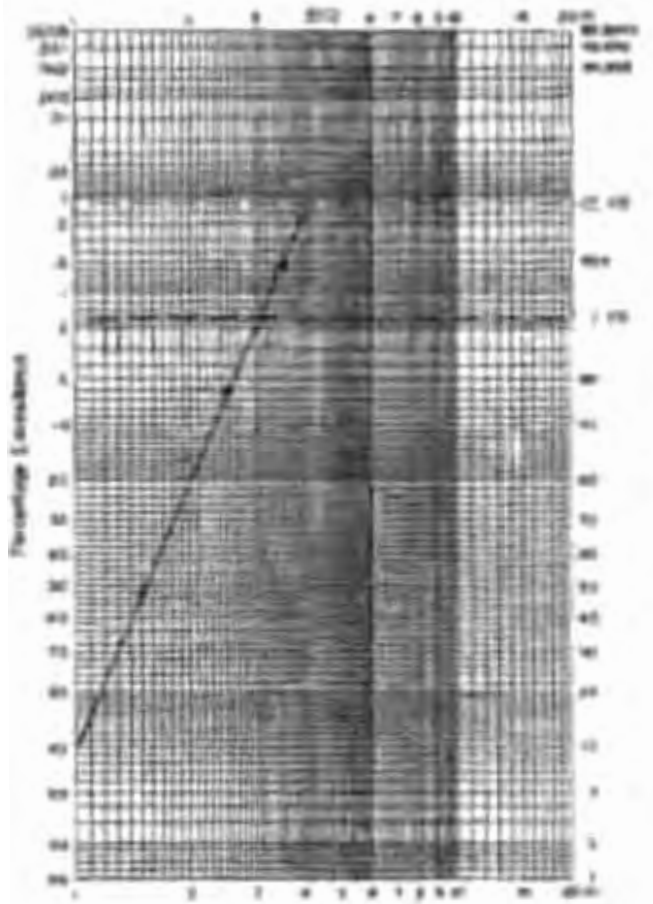
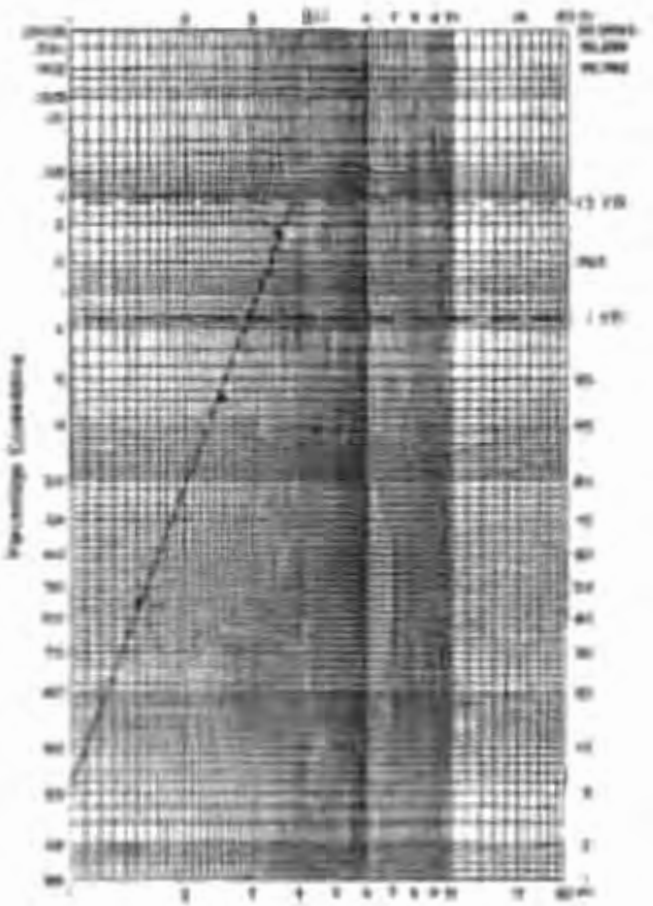


Figure 71 Monthly Mean Height Exceedance Distribution for July









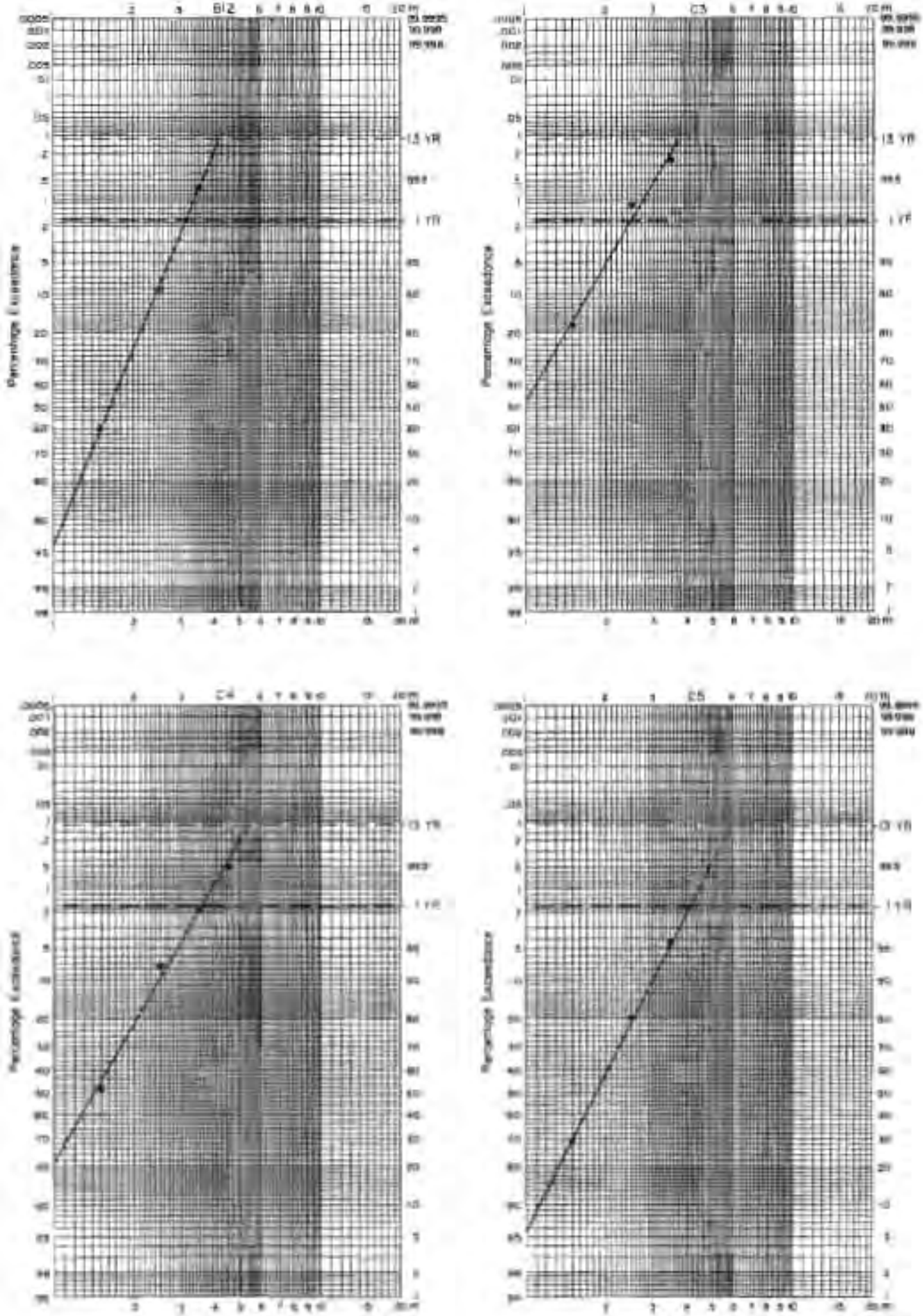


Figure 71 Monthly Wave Height Exceedance Distributions for July

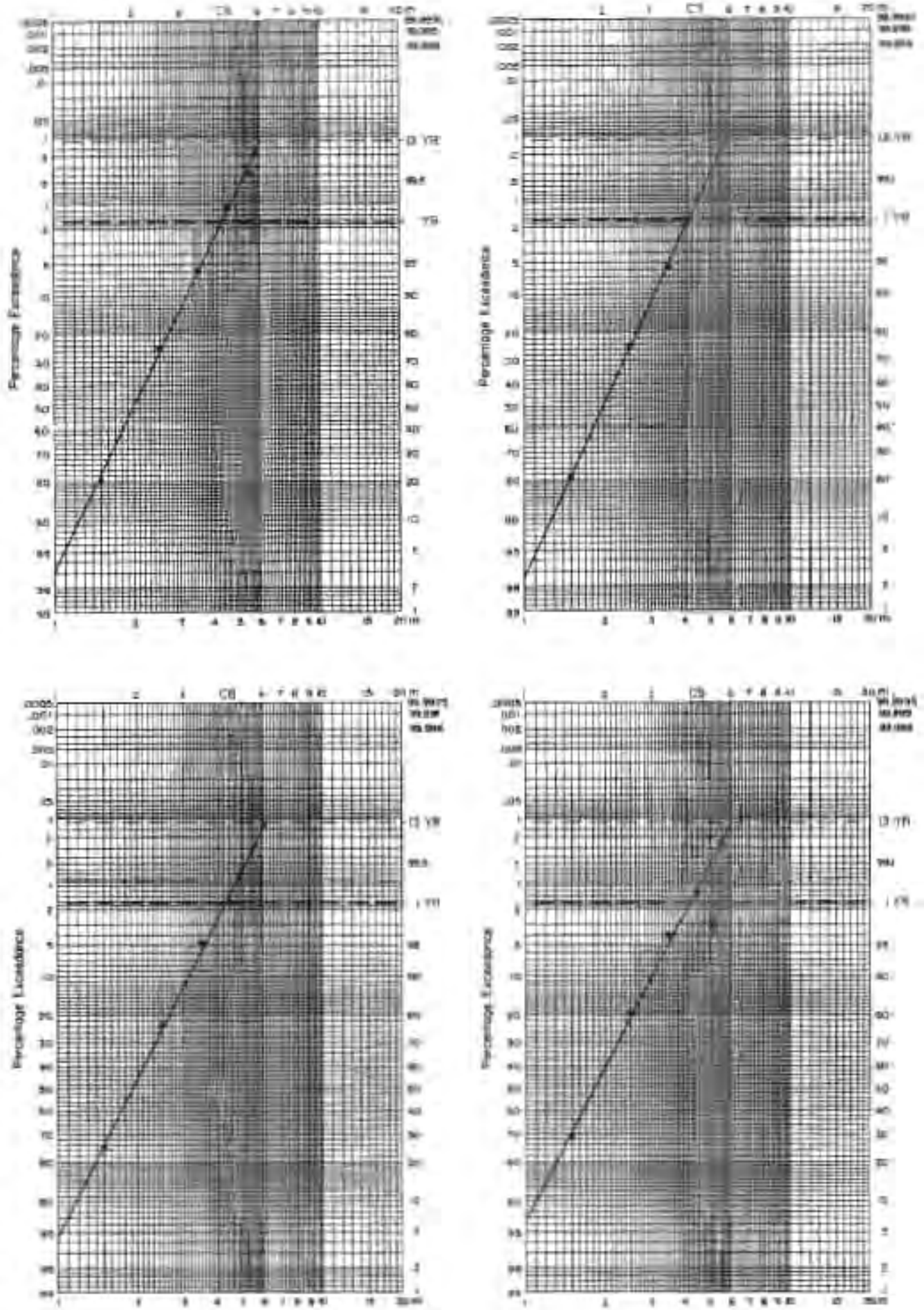
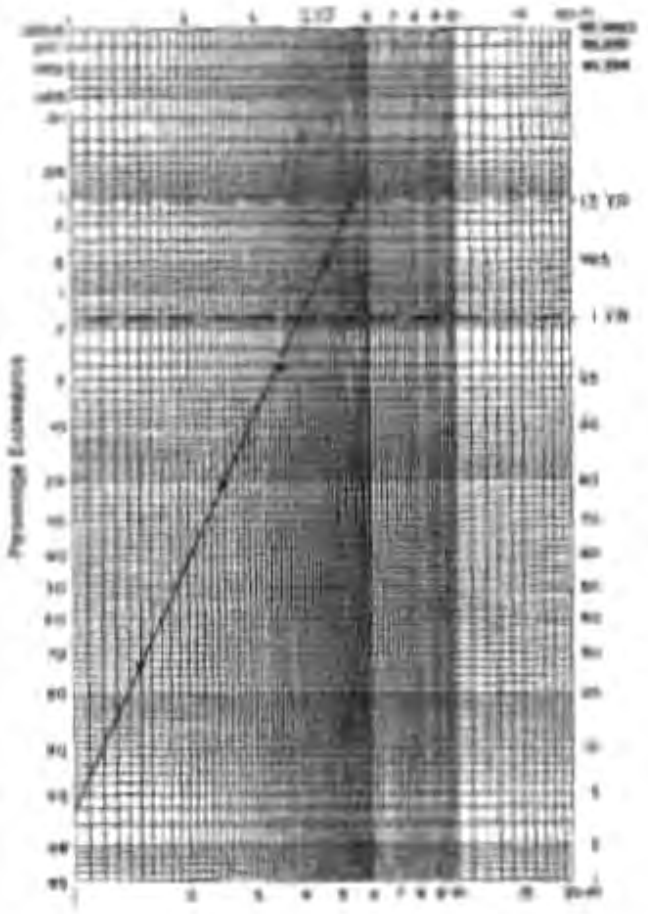
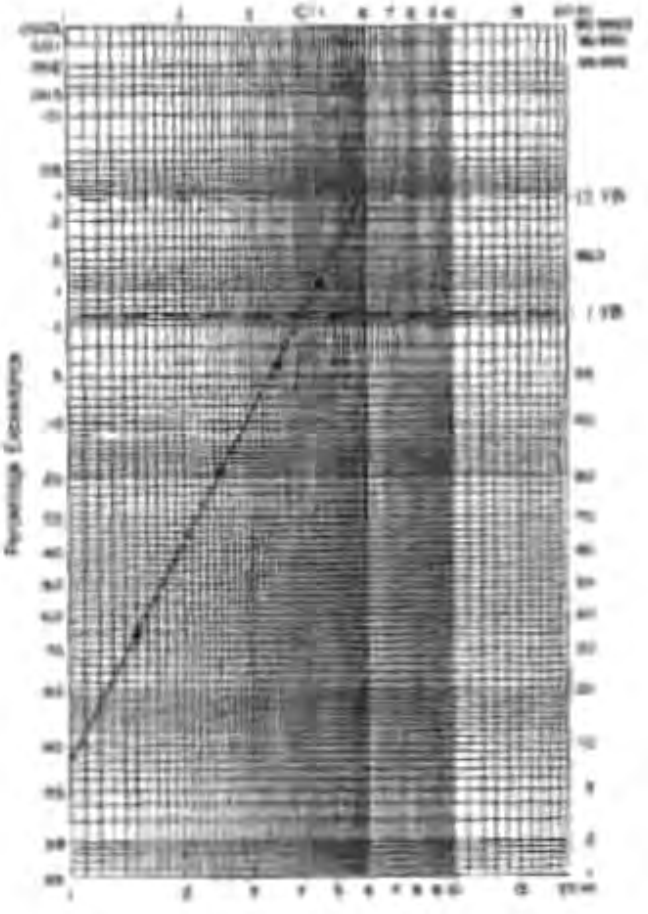
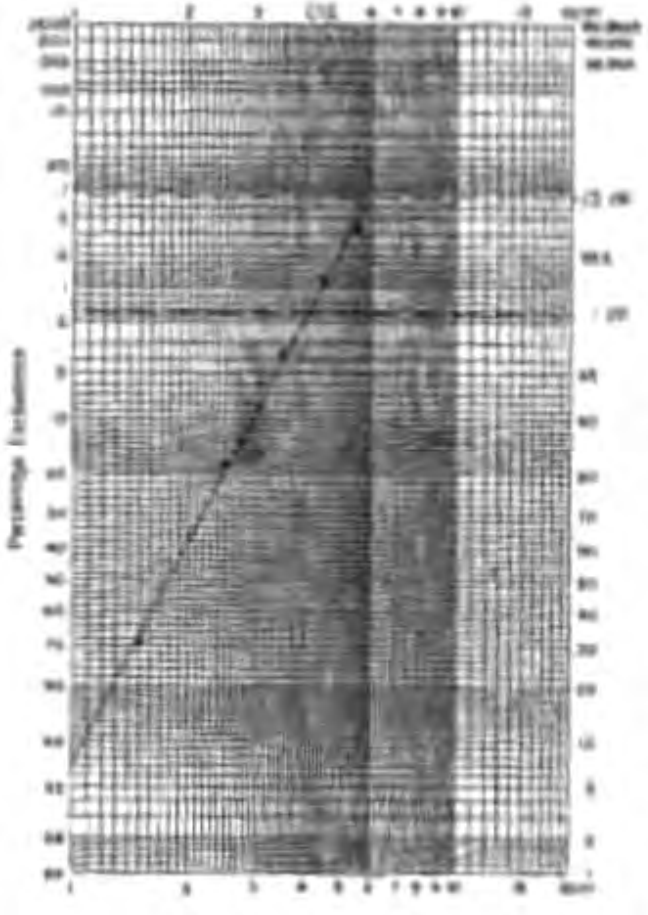
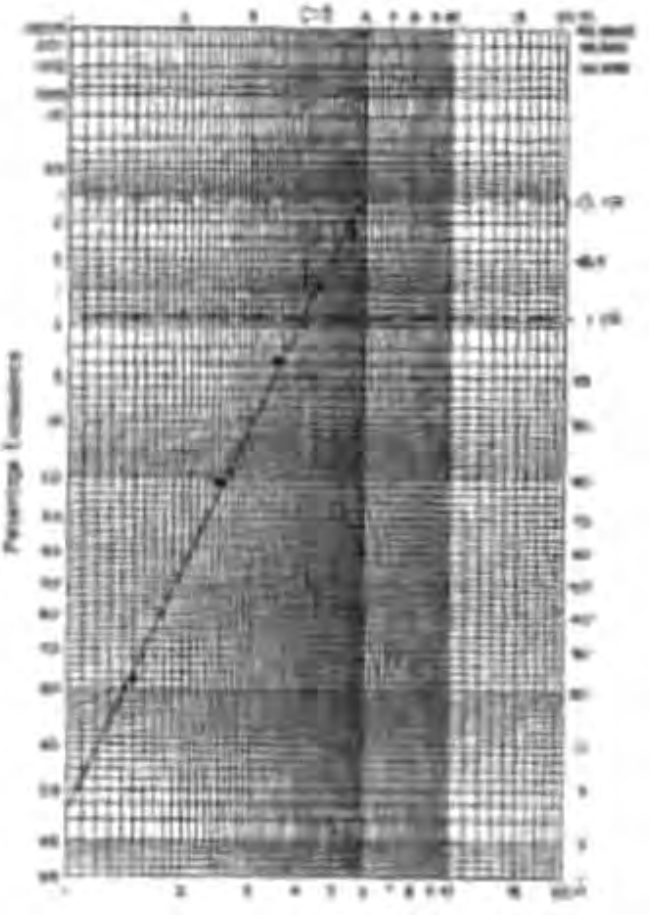


Figure 71 Monthly Wave Height Exceedance Distribution for July









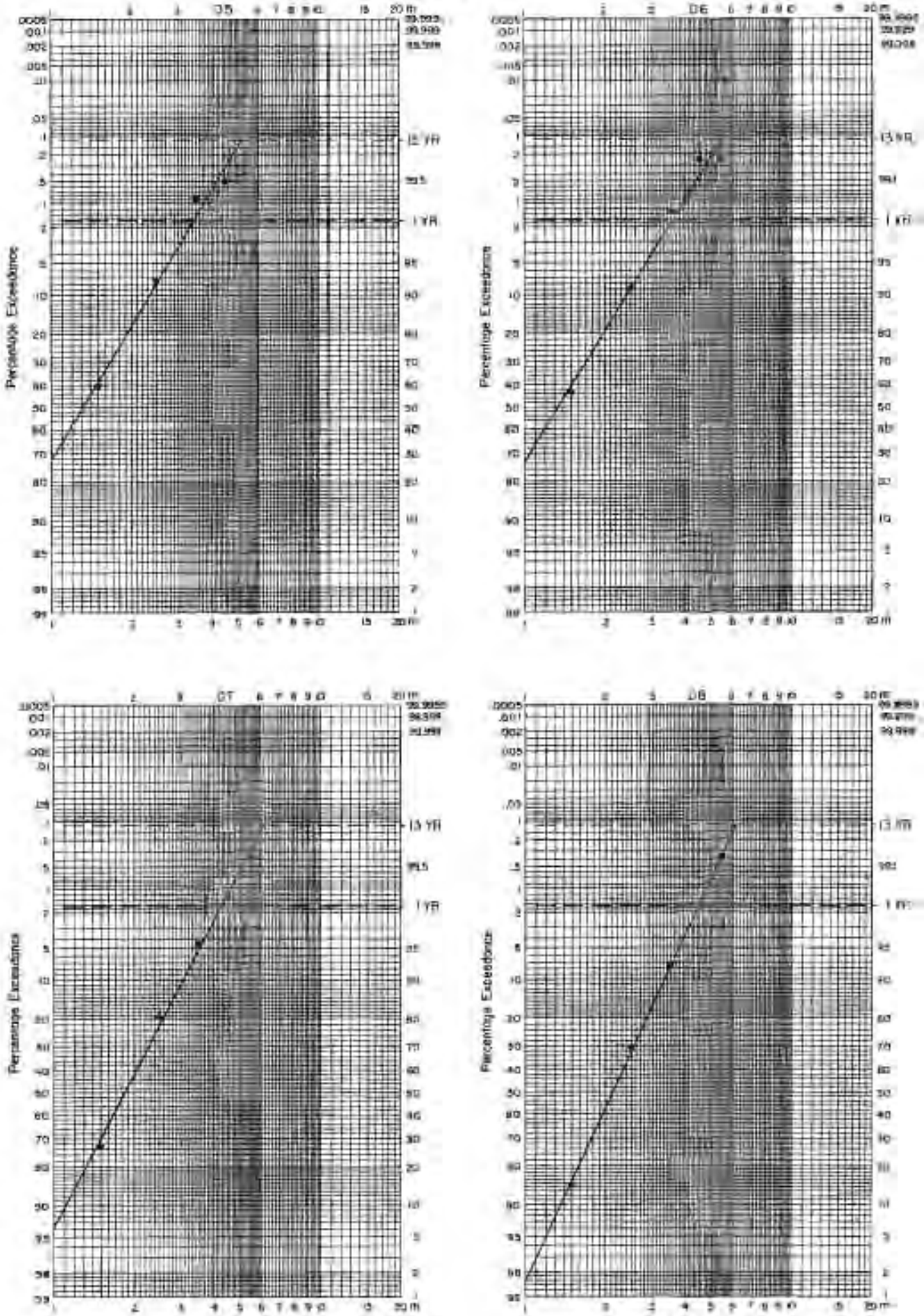


Figure 7b Monthly Wave Height Exceedance Distribution for July

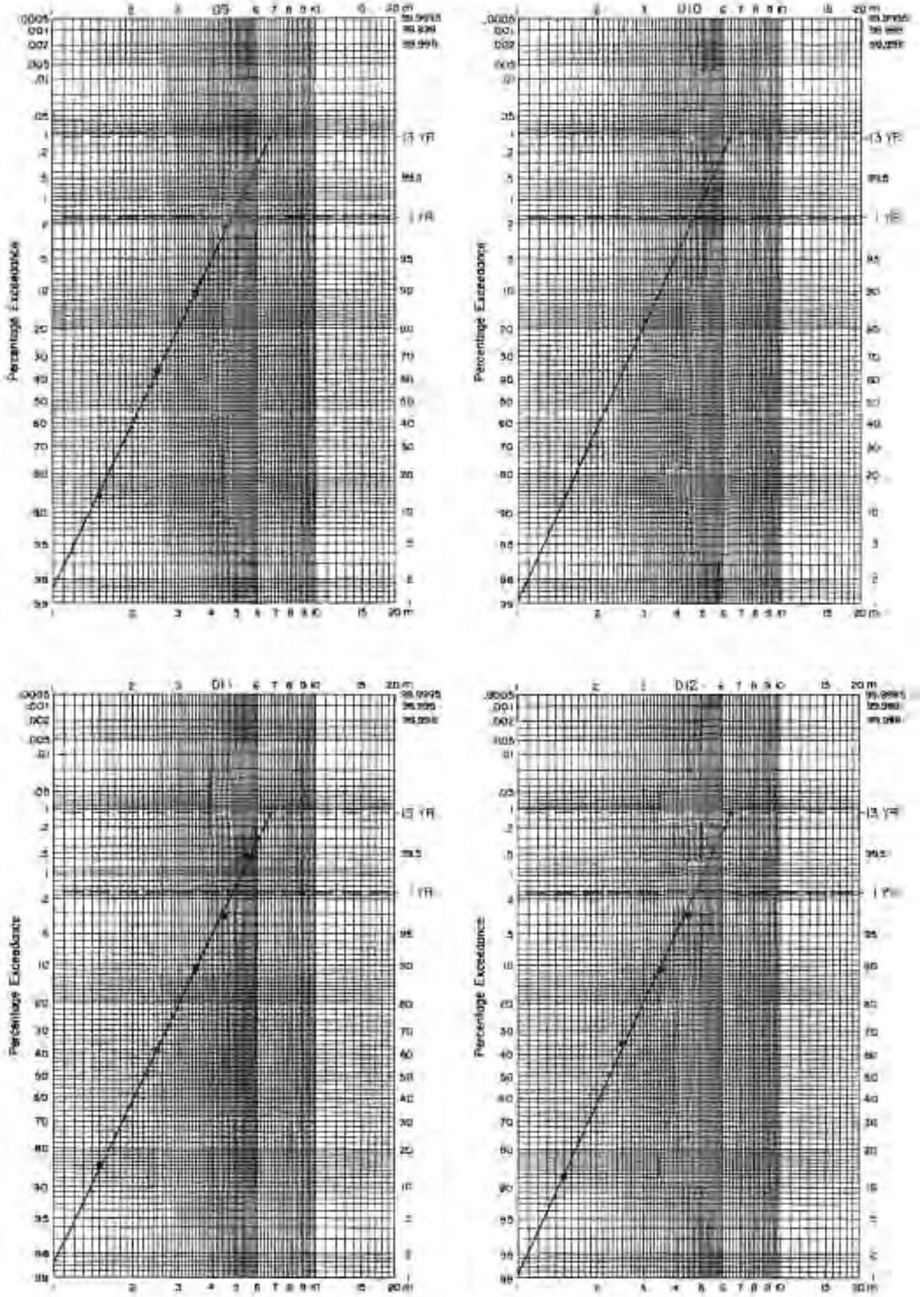


Figure 7: Monthly Wave Height Exceedance Distribution for July

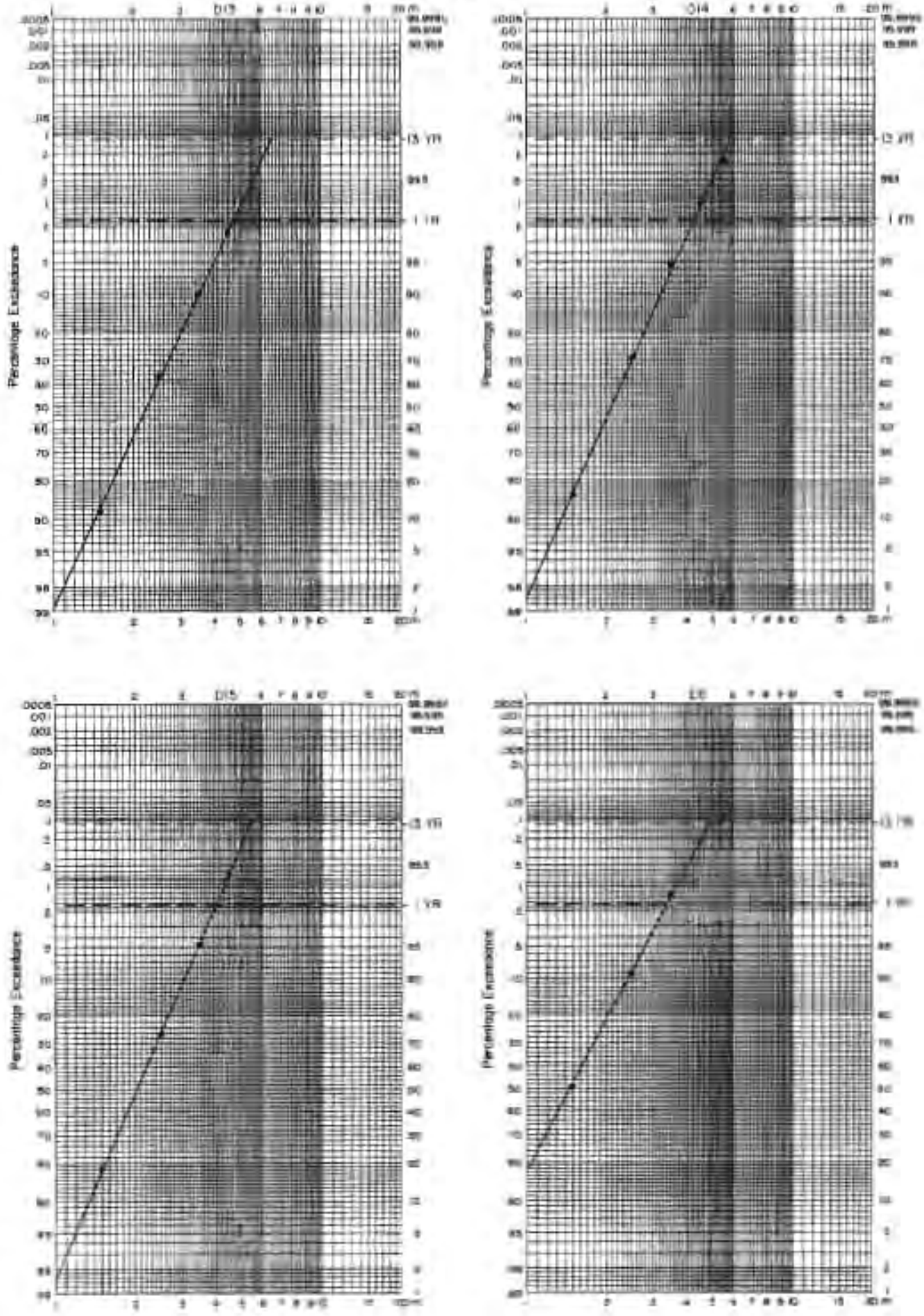
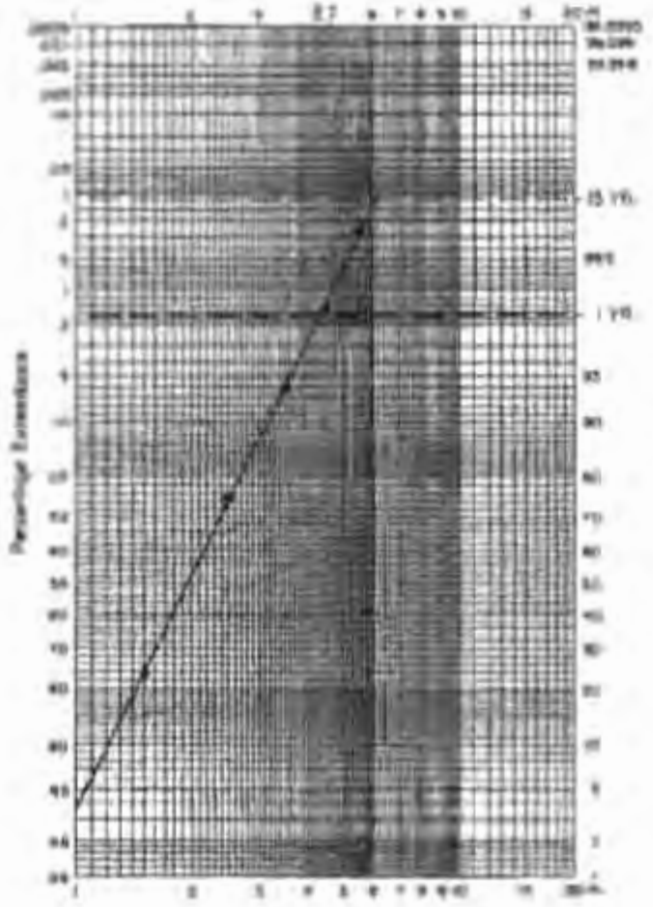
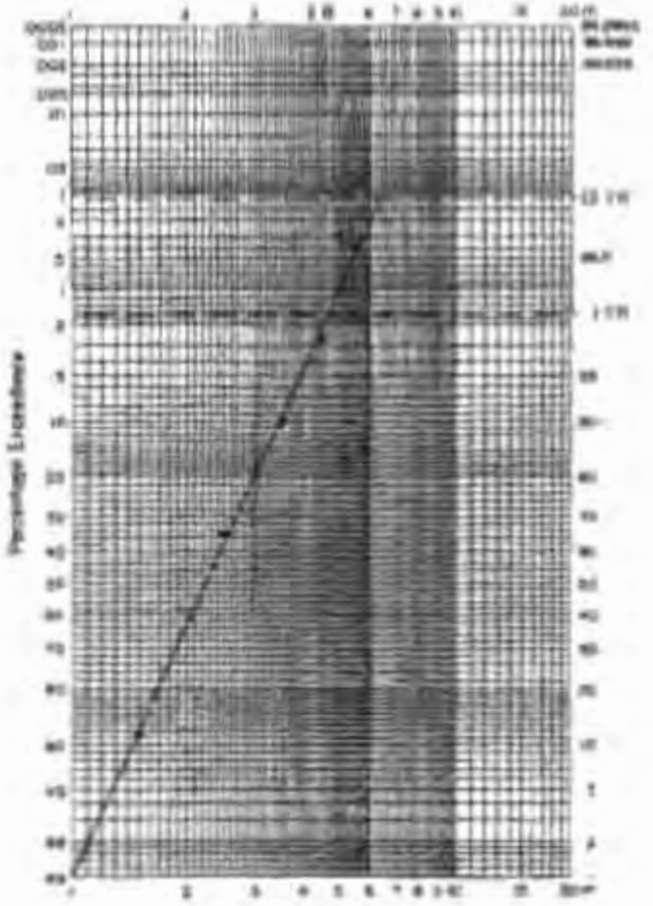
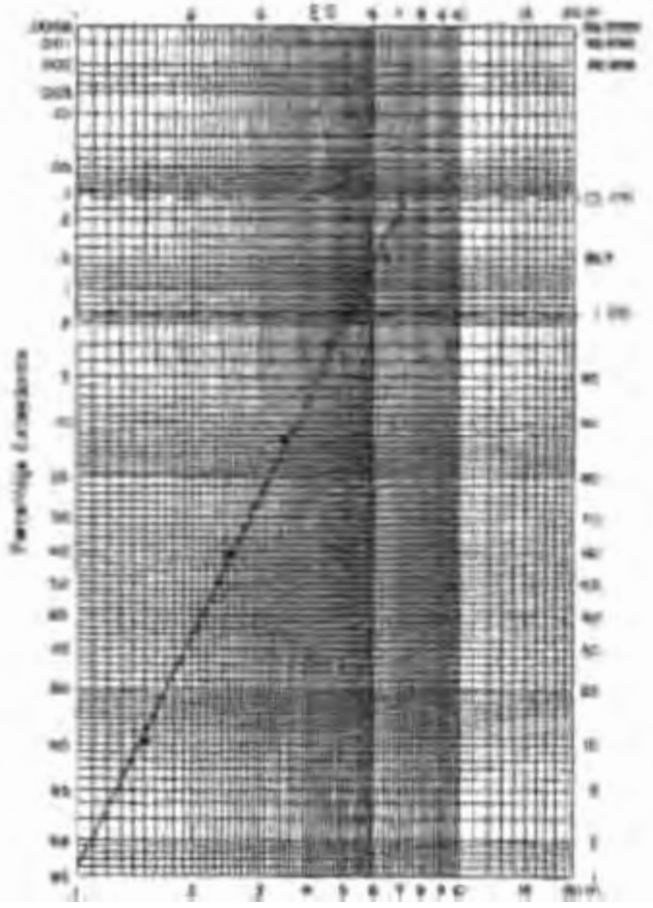
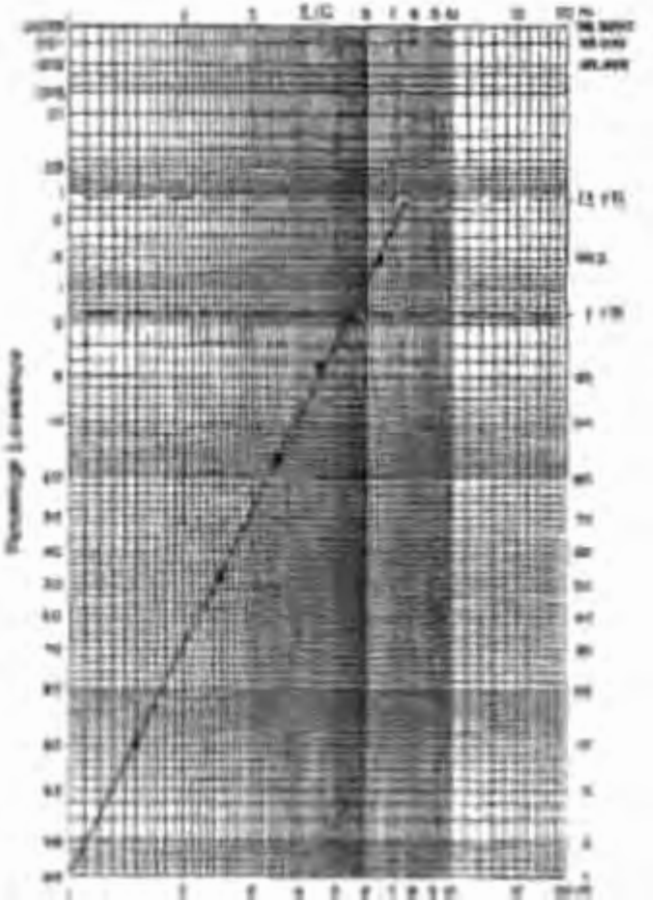


Figure 7m Monthly Wave Height Exceedance Distribution for July









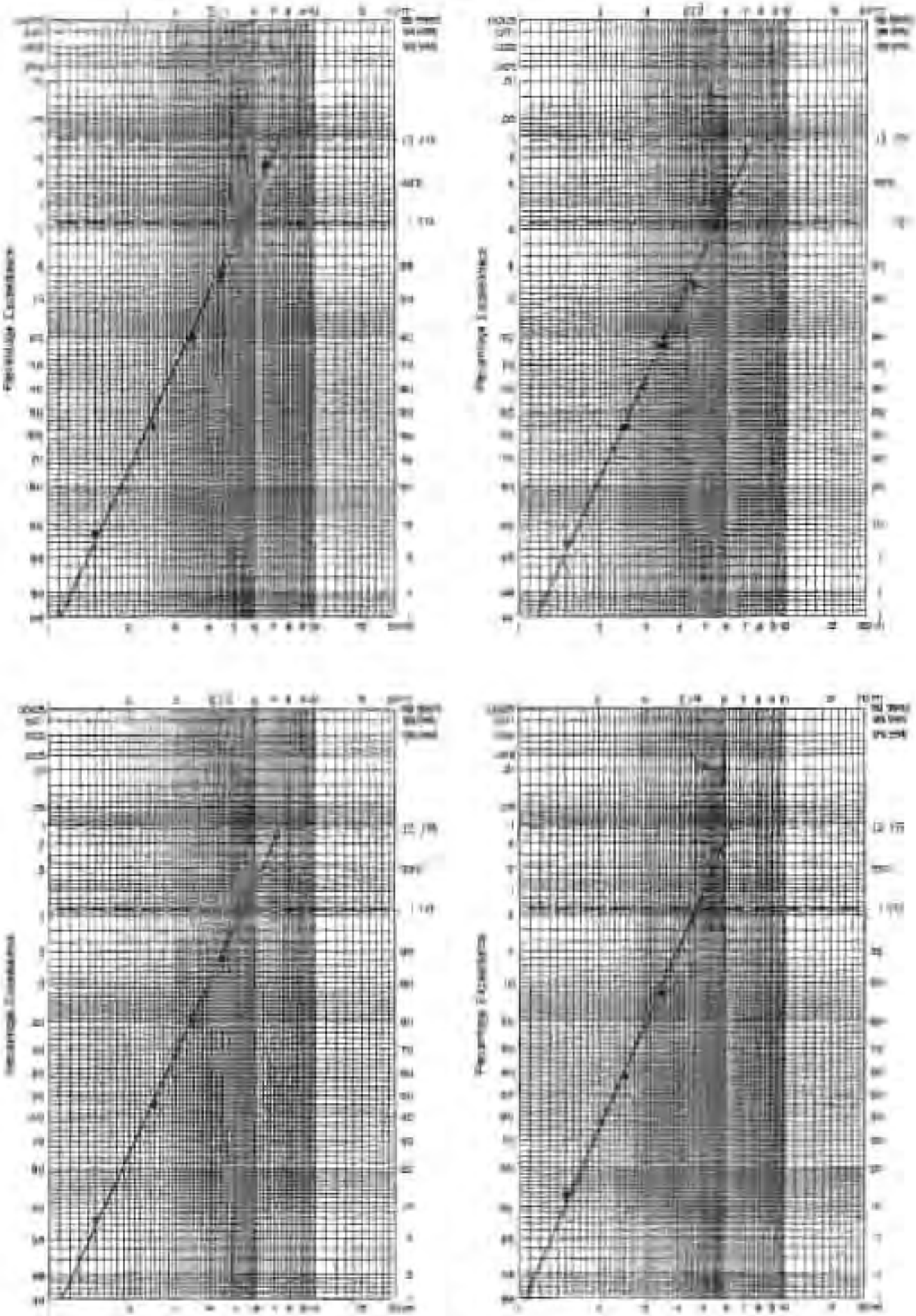


Figure 7c. Monthly Wave Height Exceedance Distribution for [illegible]

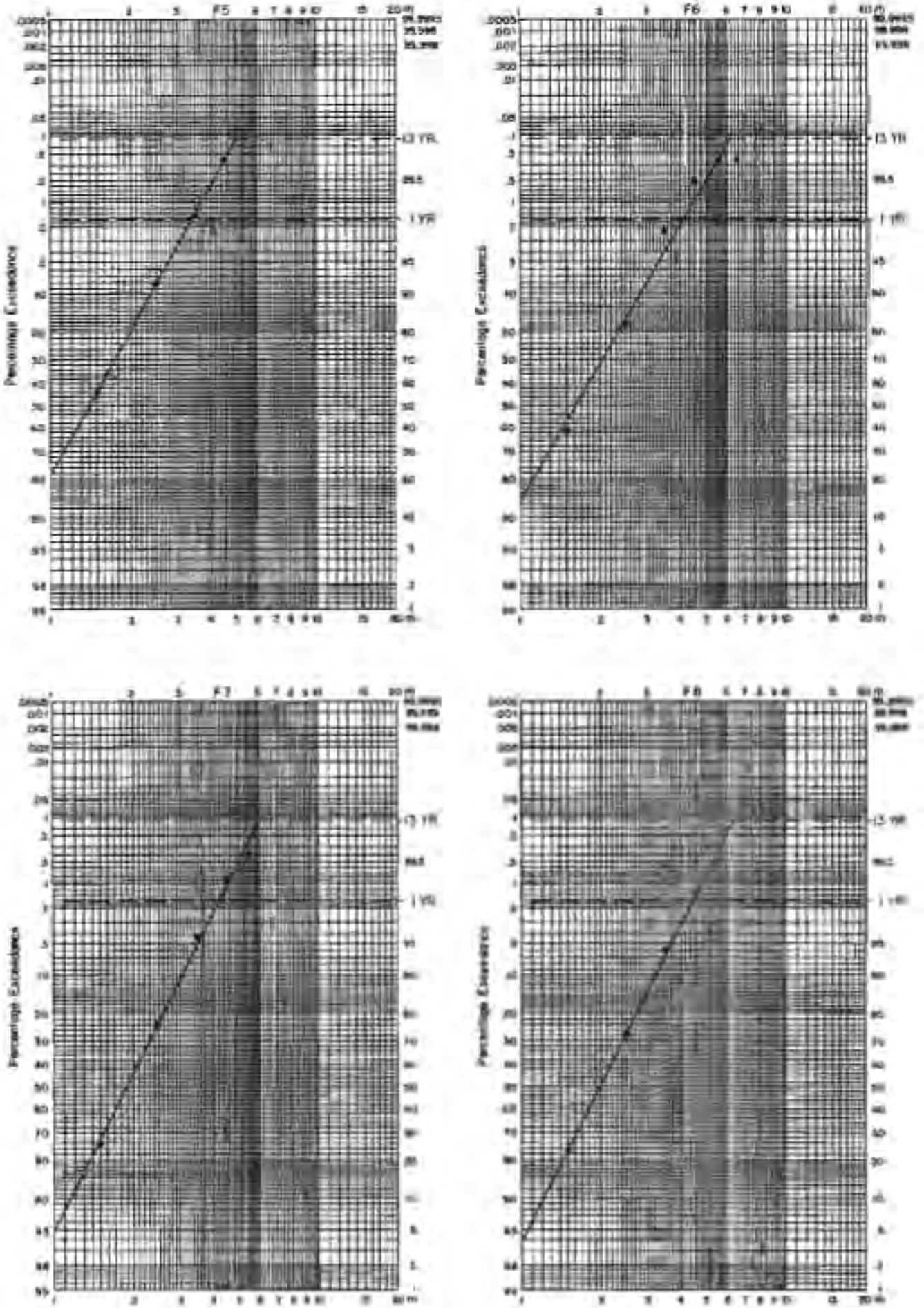


Figure 7b Monthly Wave Height Exceedance Distribution for July

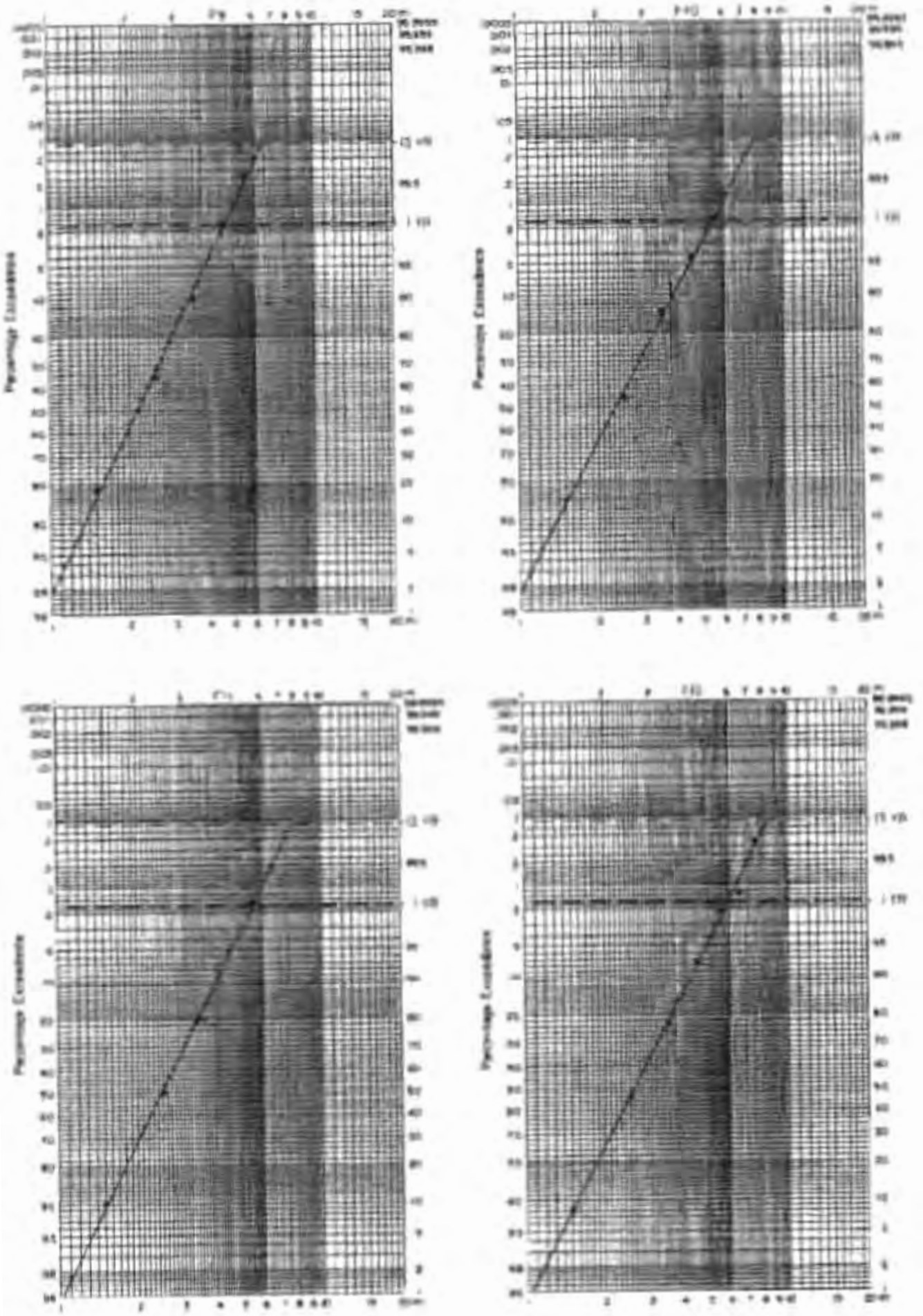


Figure 71 Monthly Wave Height Exceedance Distribution for July

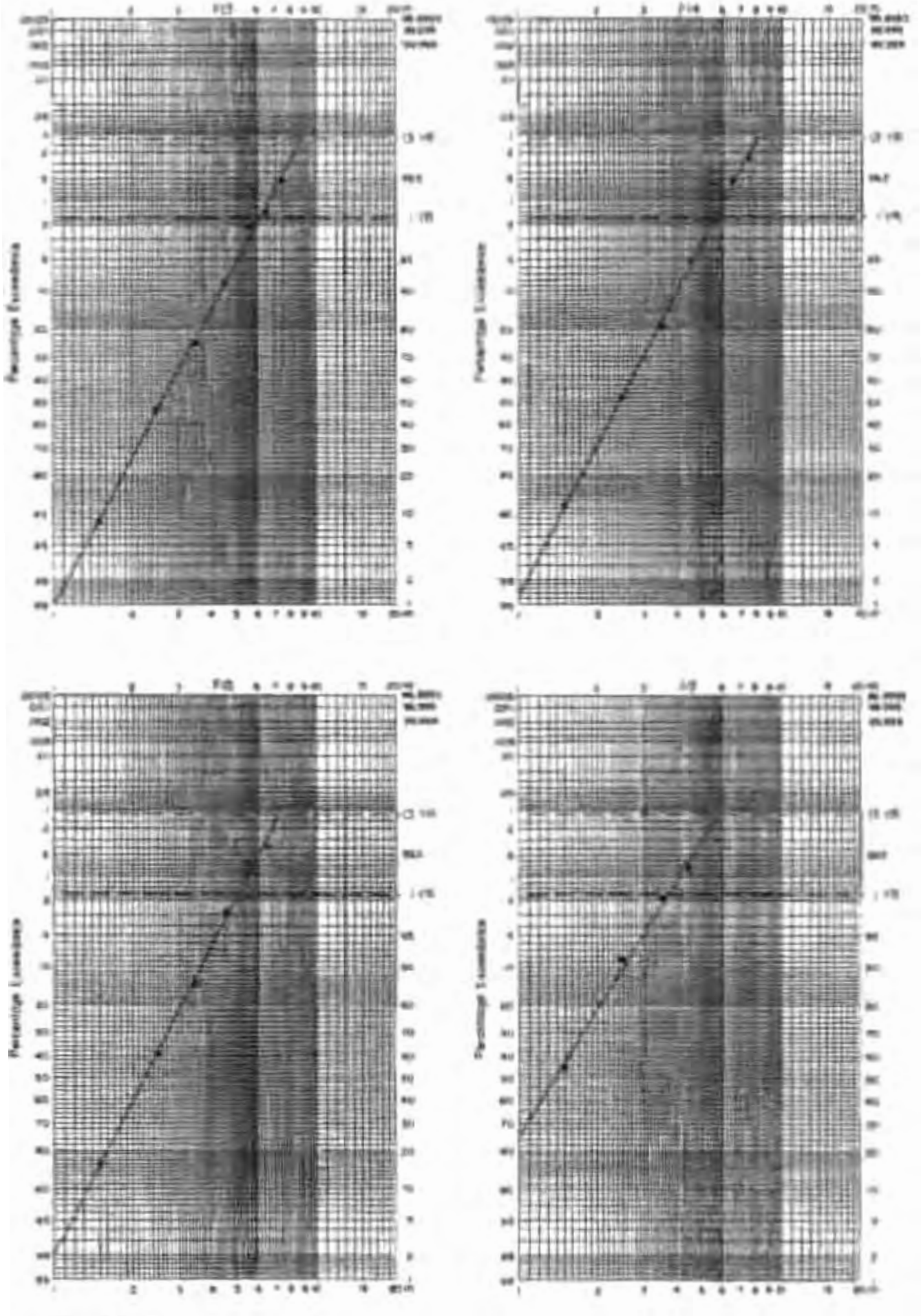


Figure 7

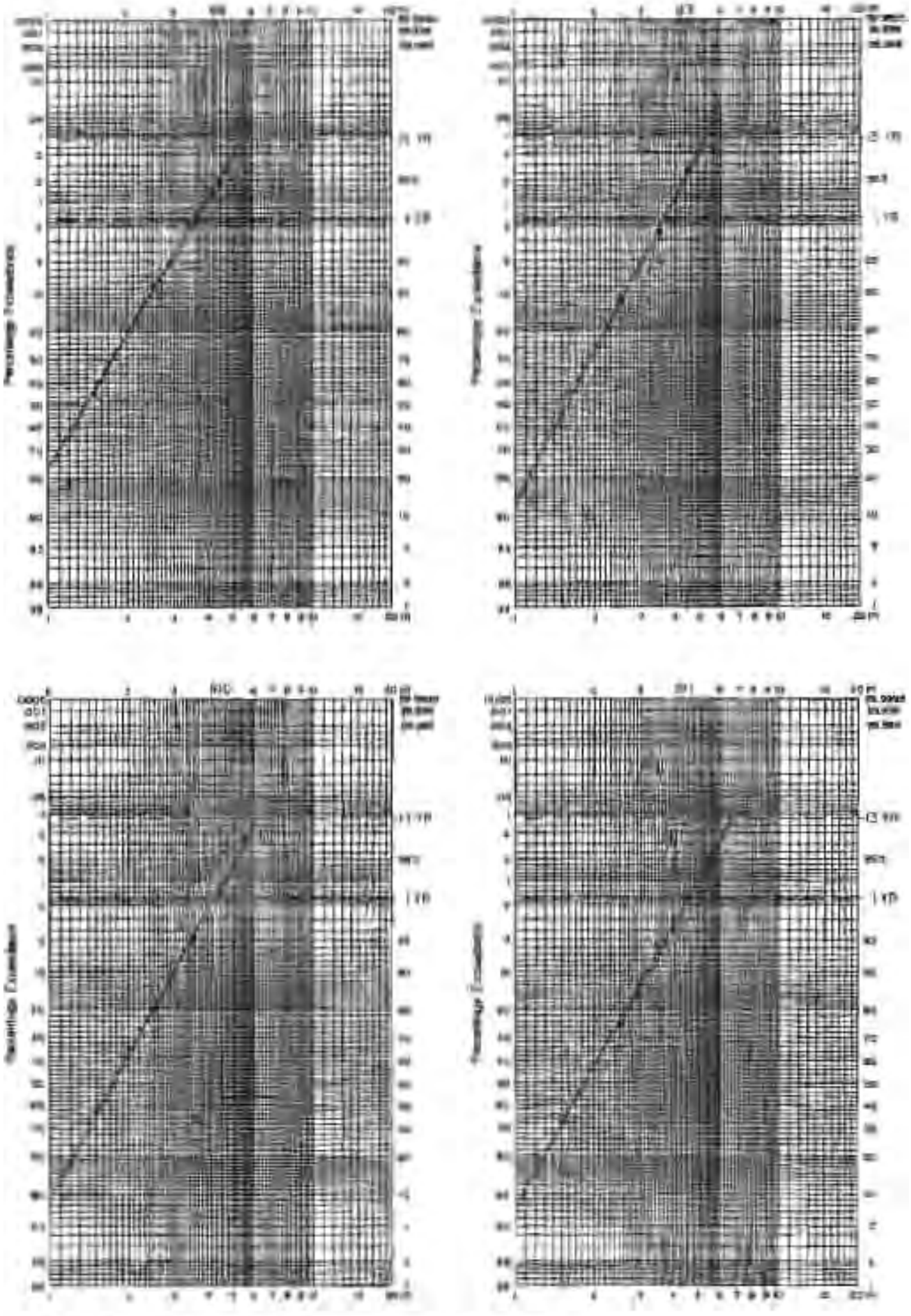
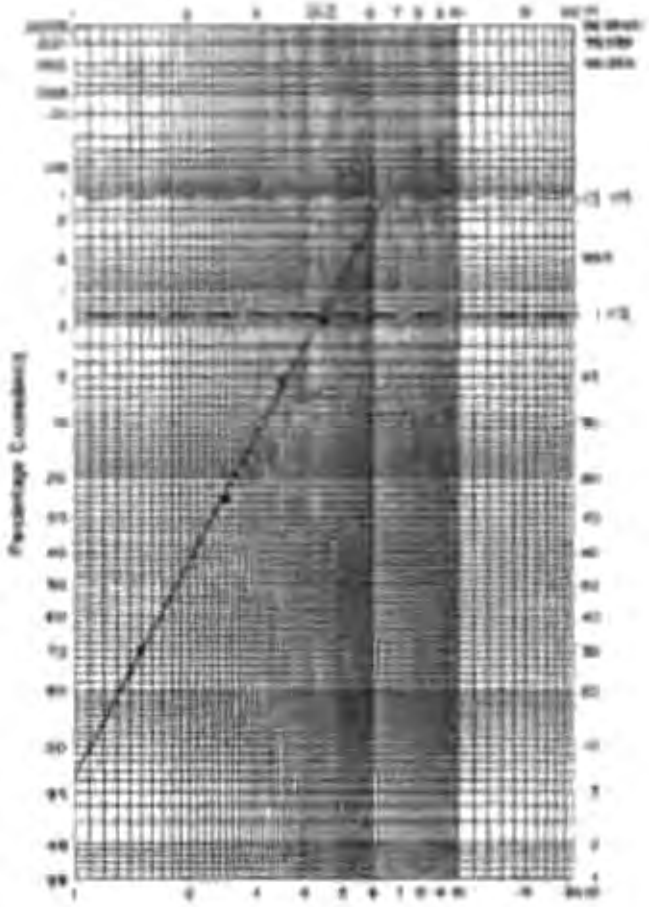
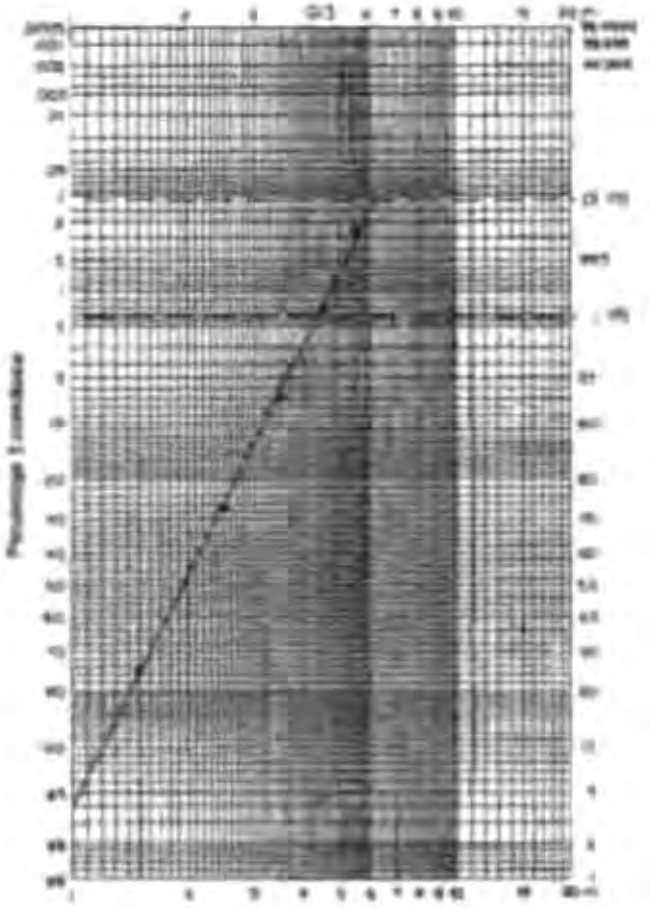
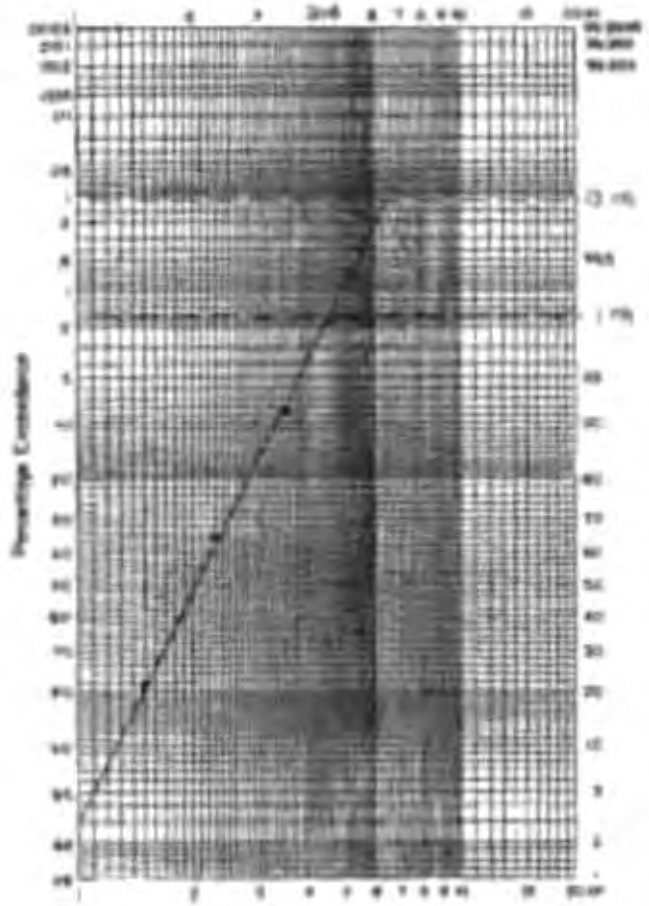
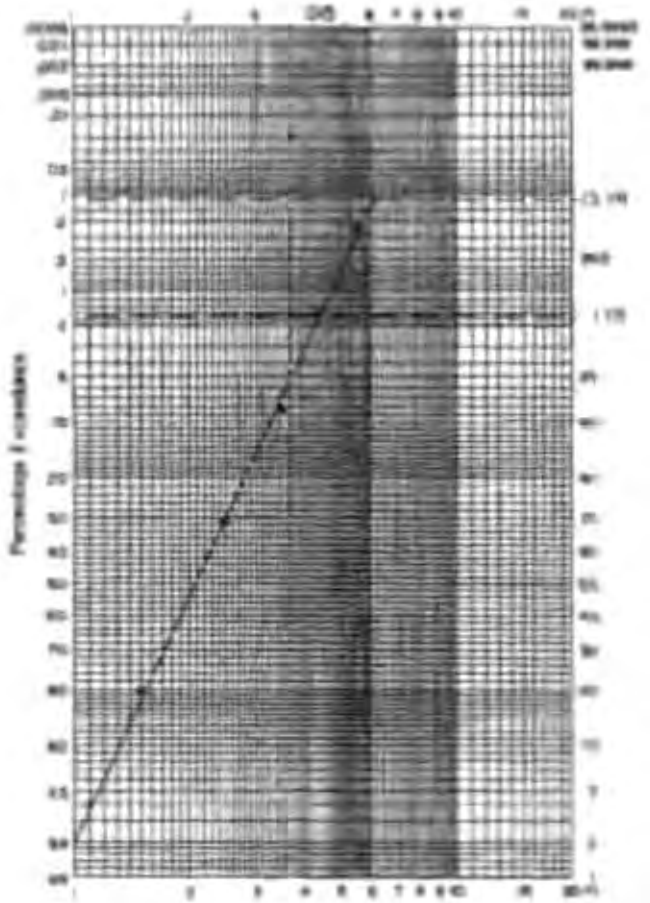


Figure 7: Monthly Snow Height Exceedance Distribution, Int. Way









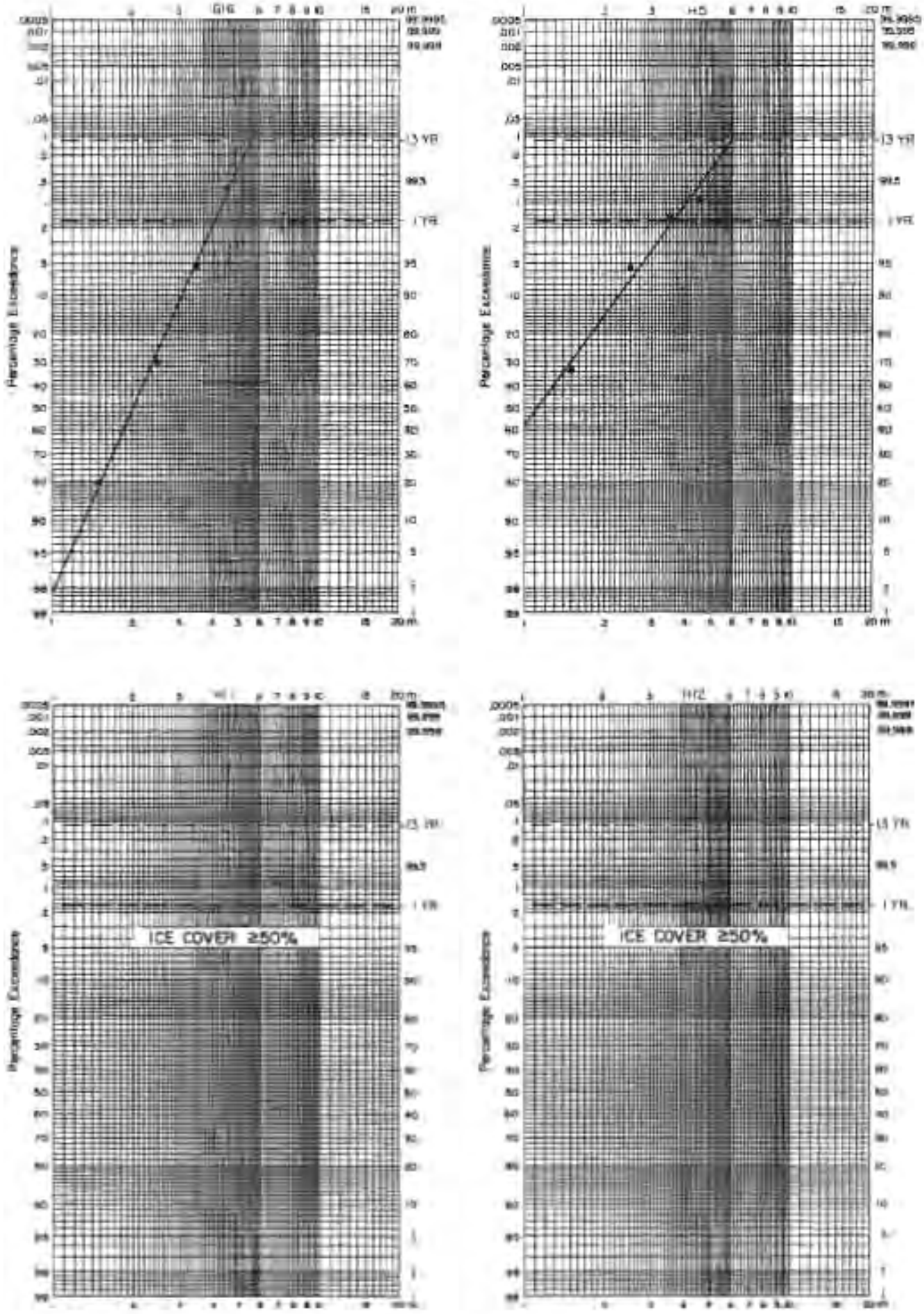


Figure 7. Monthly Wave Height Exceedance Distribution for July

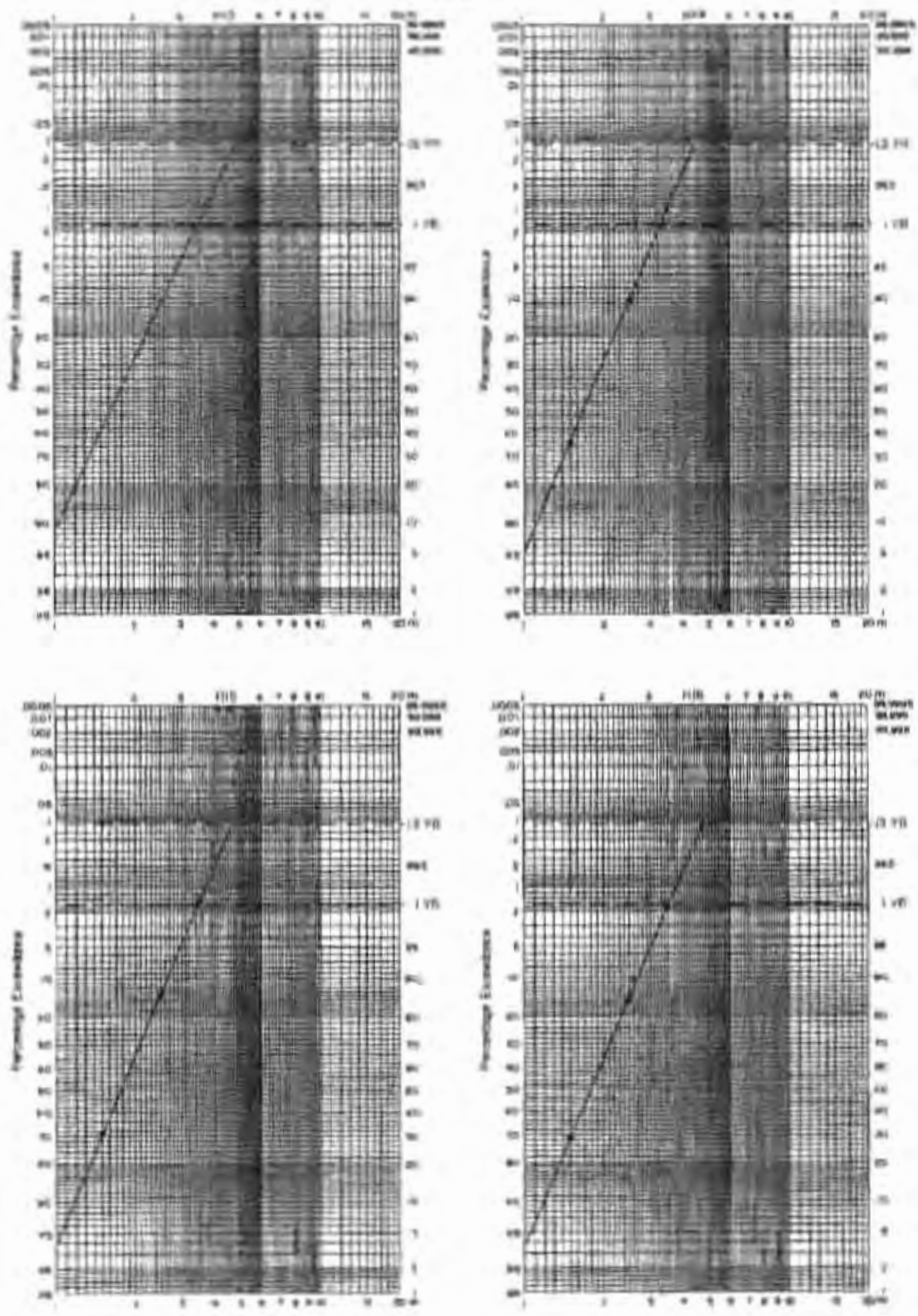


Figure 7a Monthly Wave Height Exceedance Distribution for July

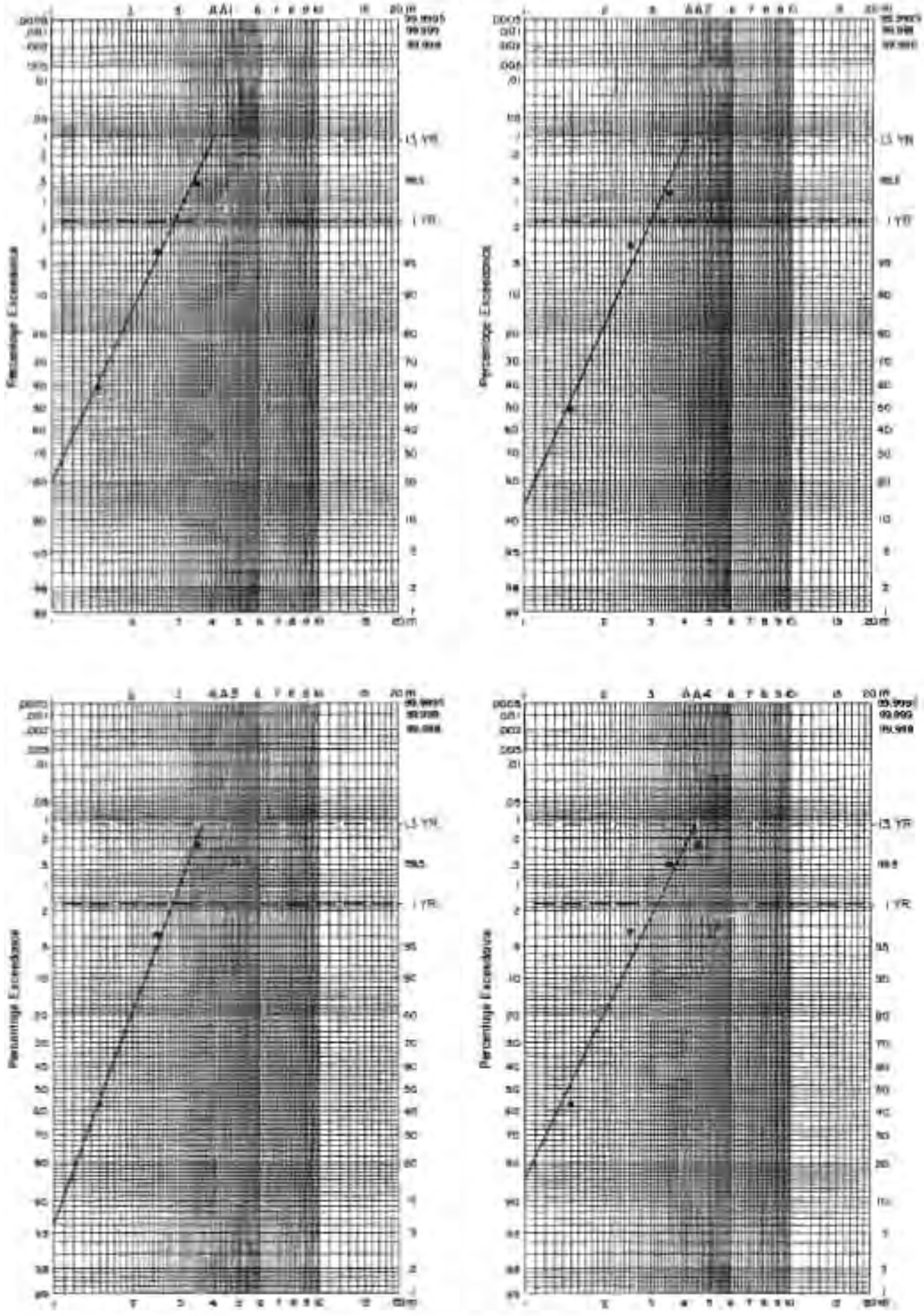
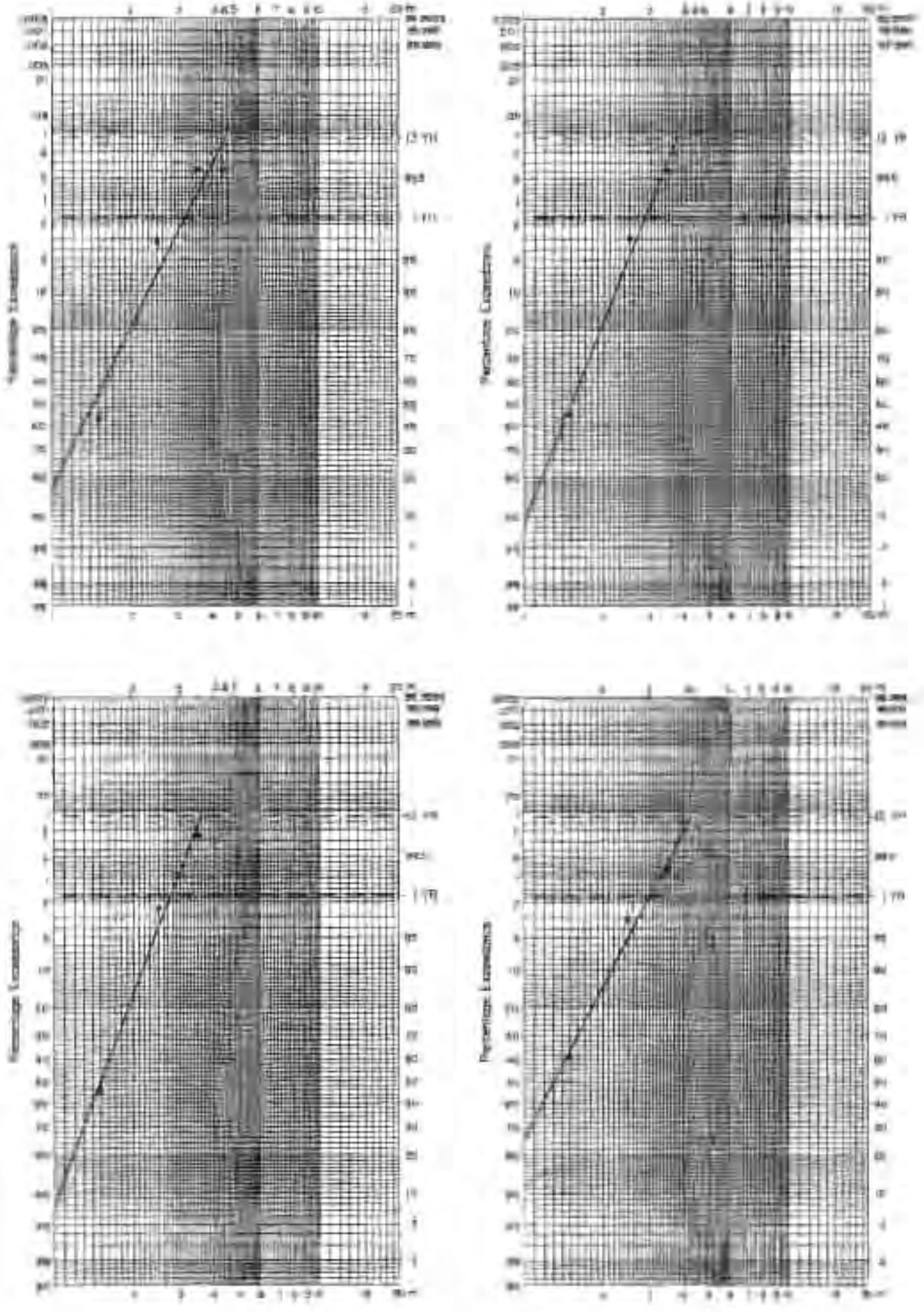
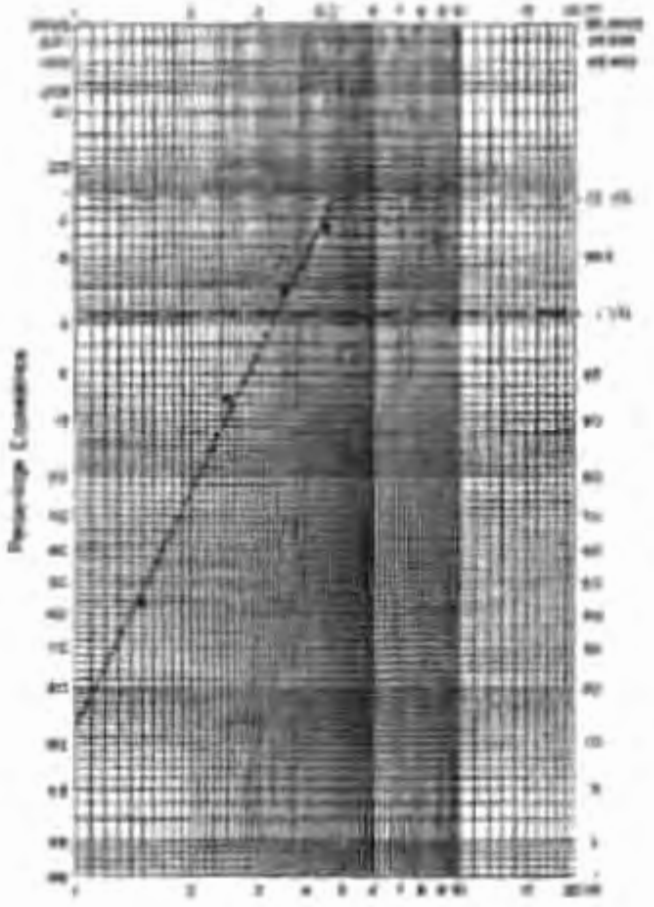
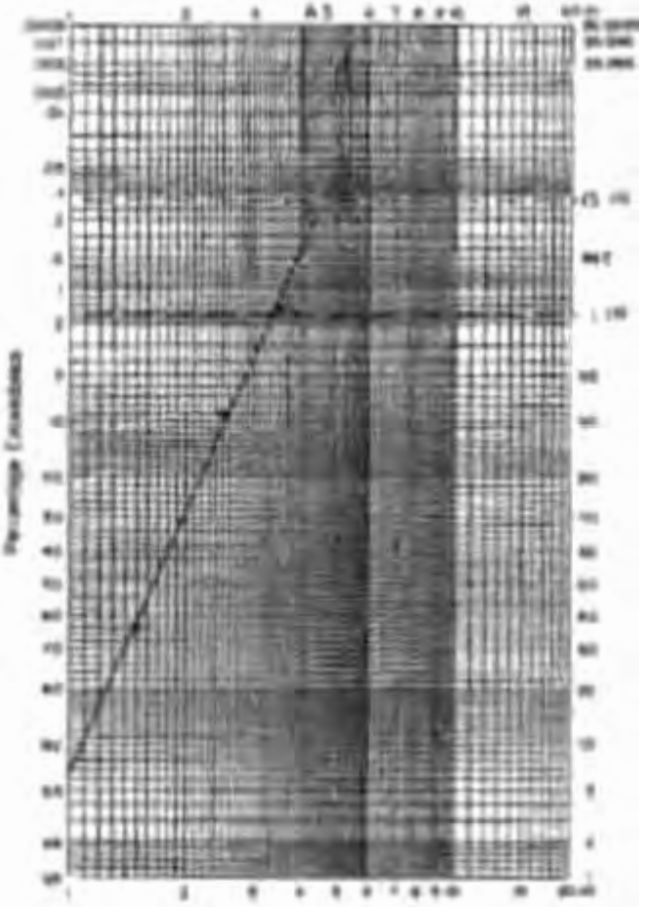
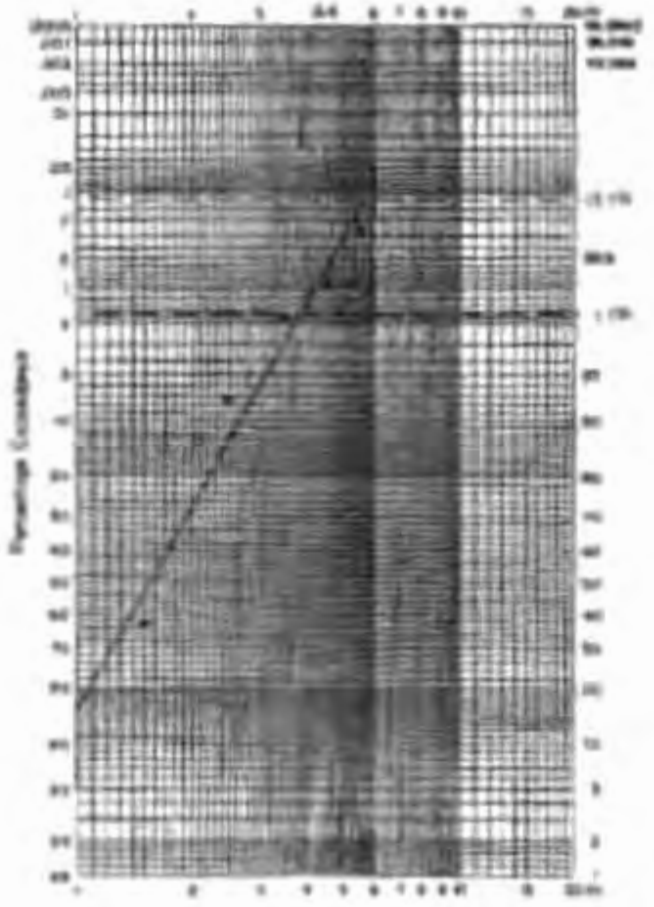


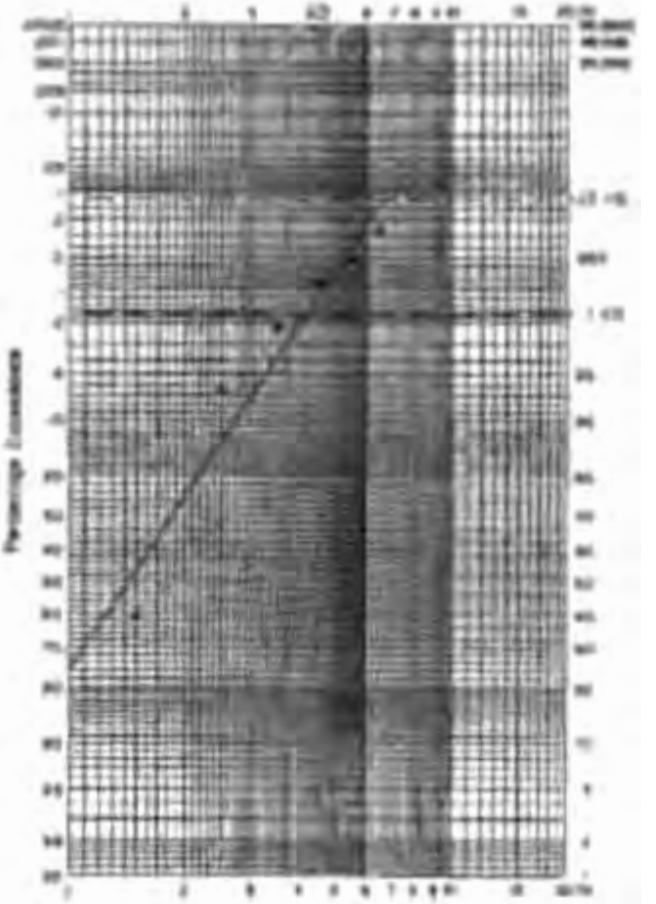
Figure 91. Monthly Wave Height Exceedance Distribution for August

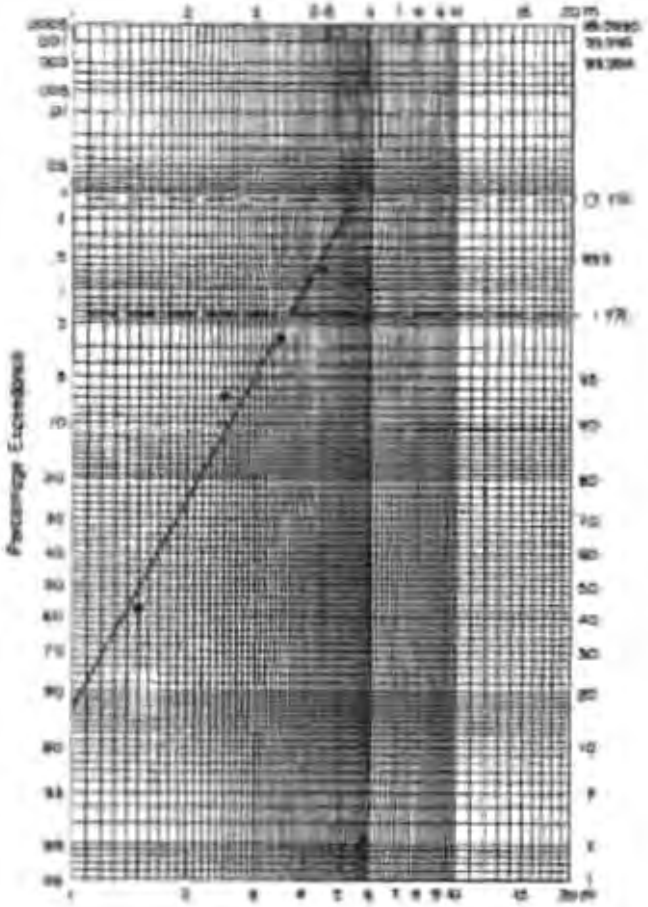


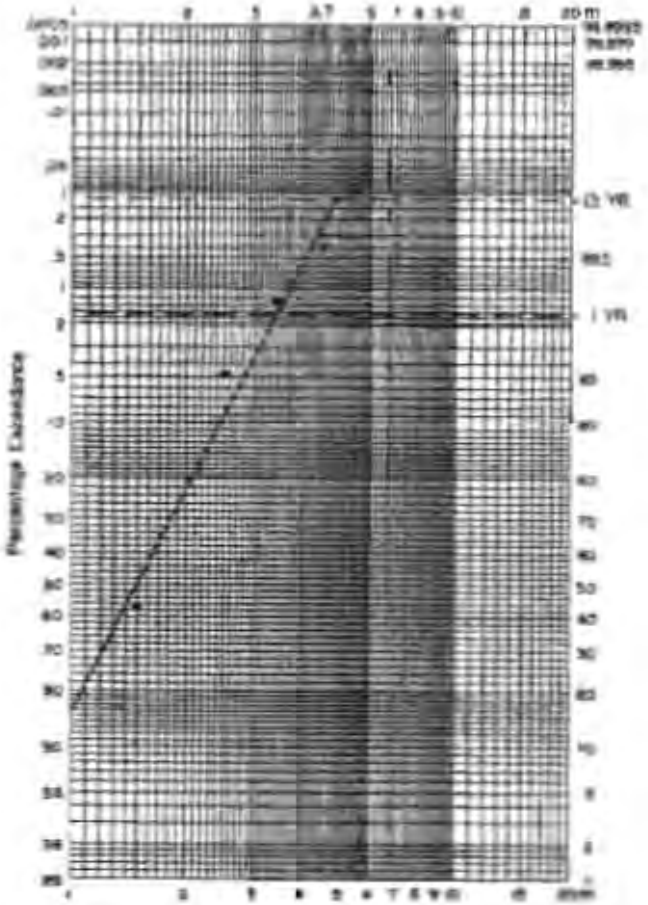


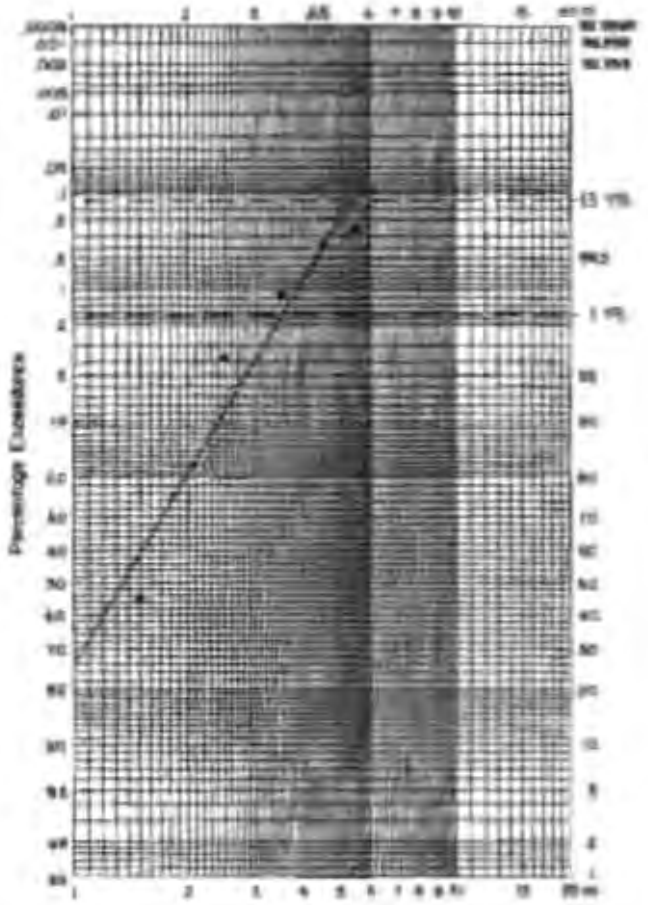


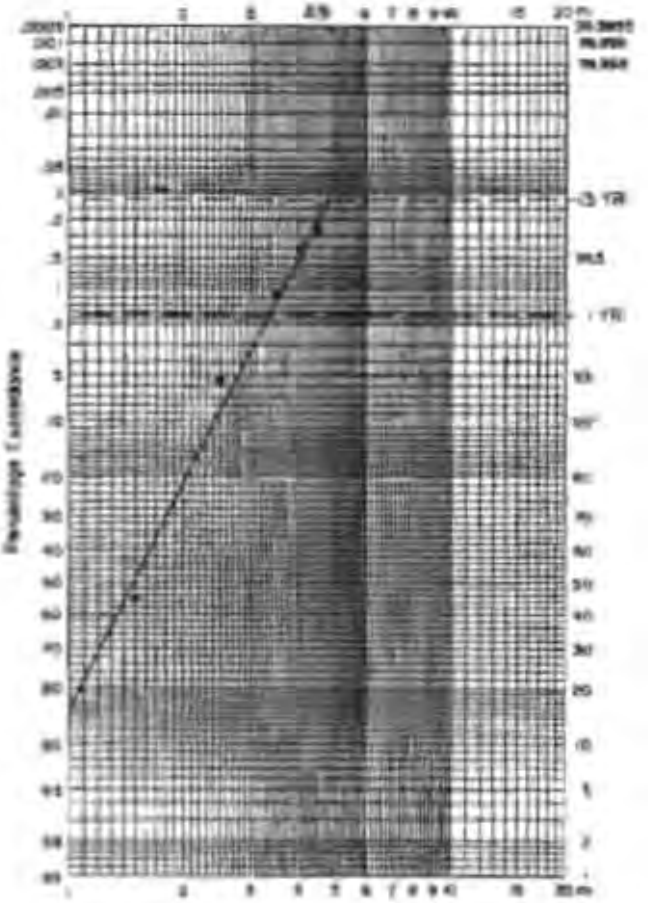





Percentage Exceedance


Percentage Exceedance


Percentage Exceedance


Percentage Exceedance

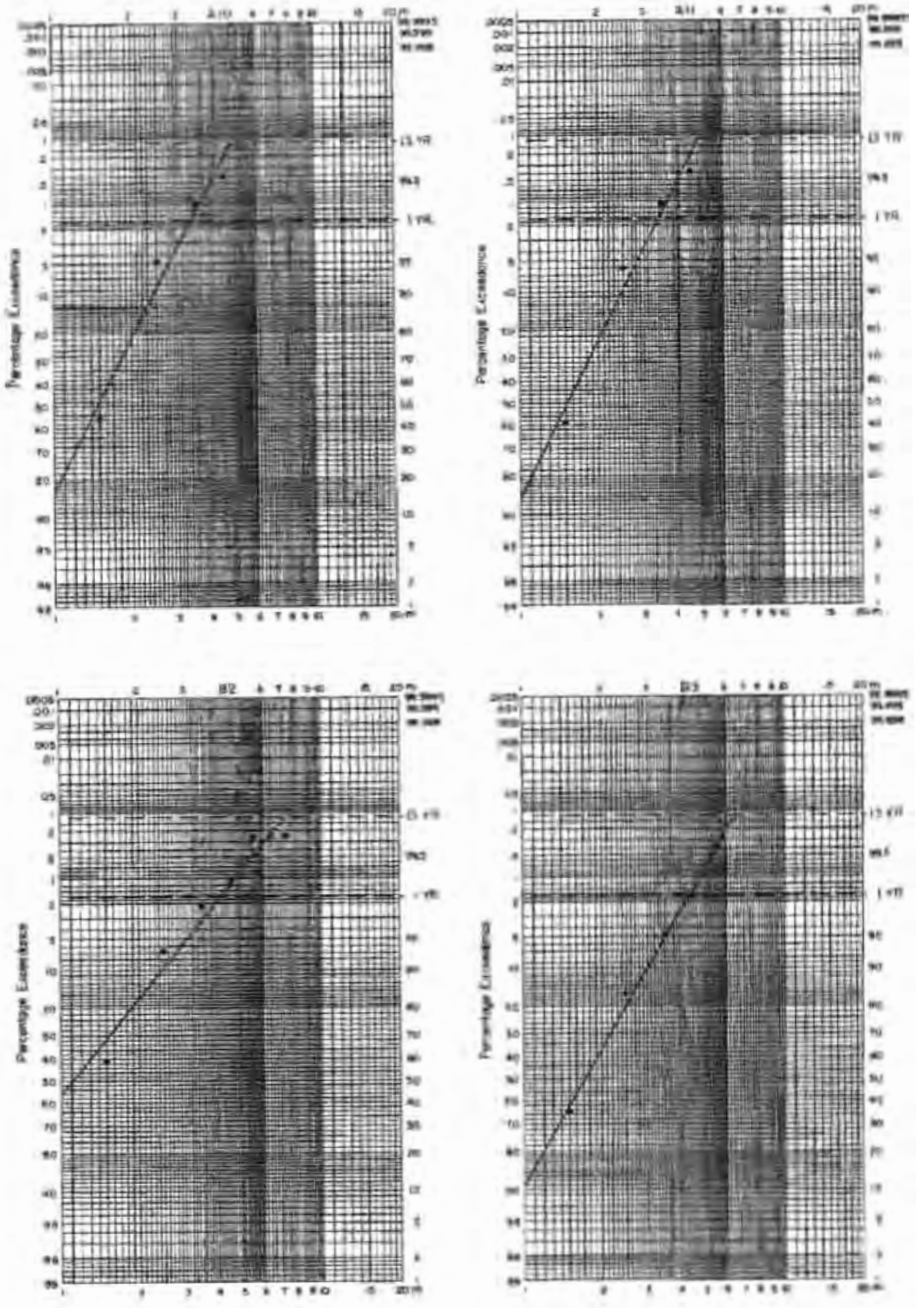
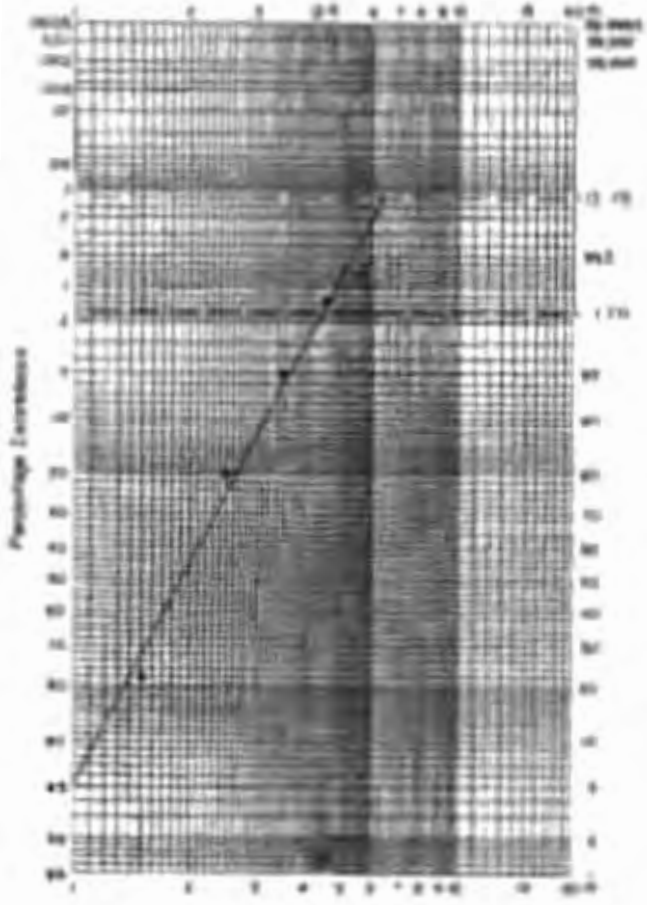
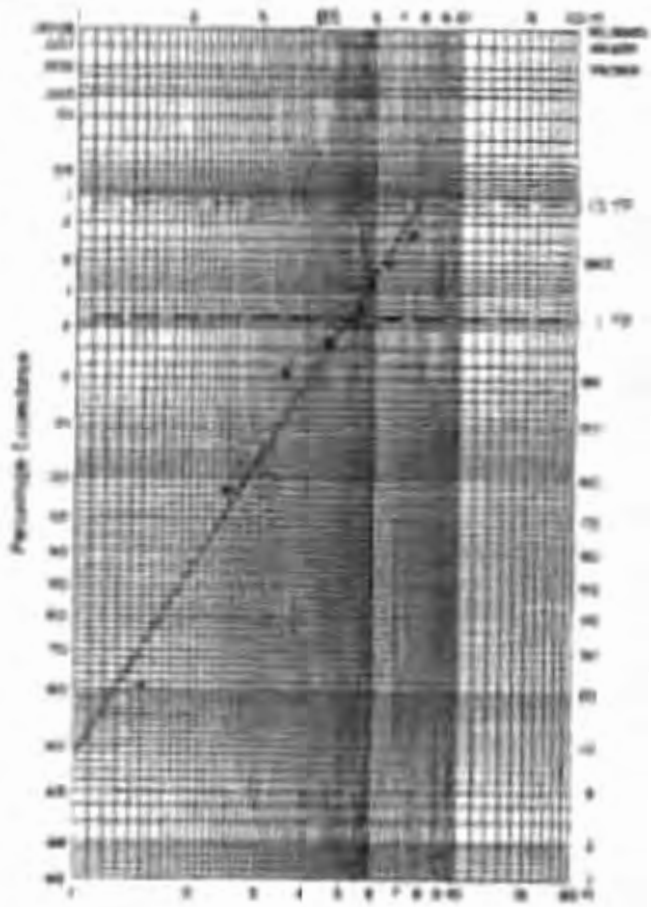
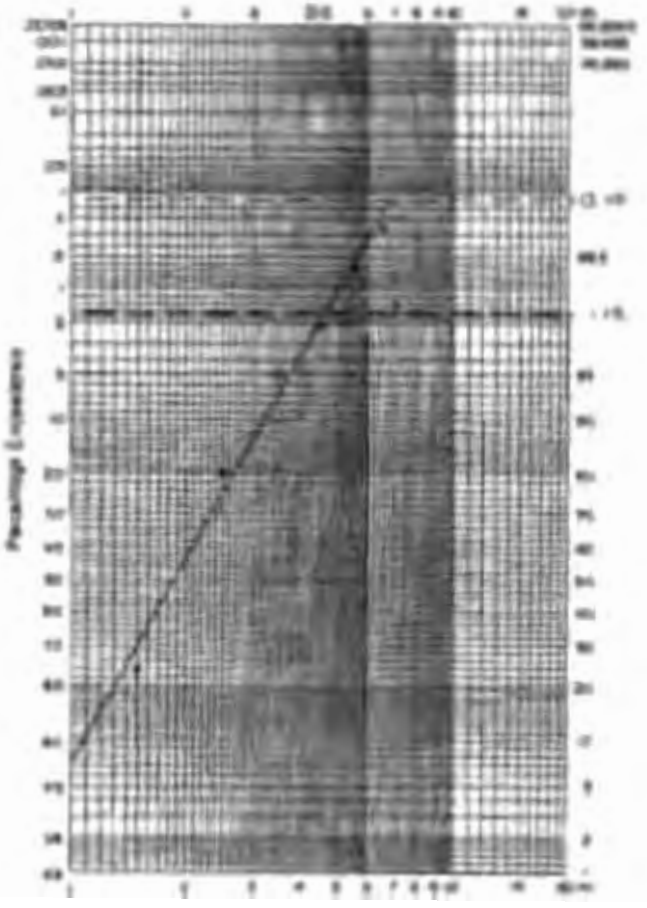
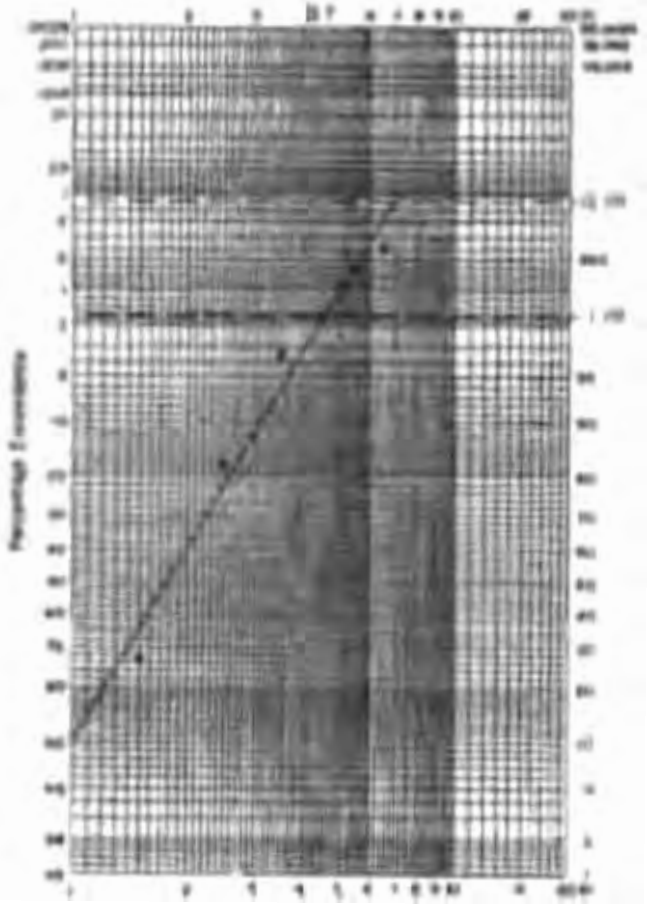


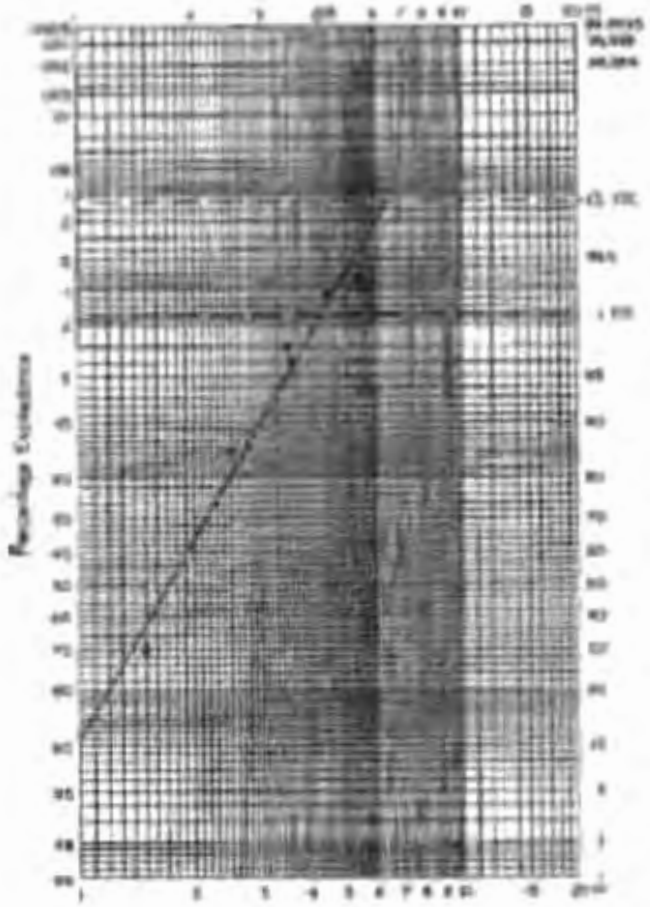
Figure 8e Monthly Wave Height Exceedance Distribution for August

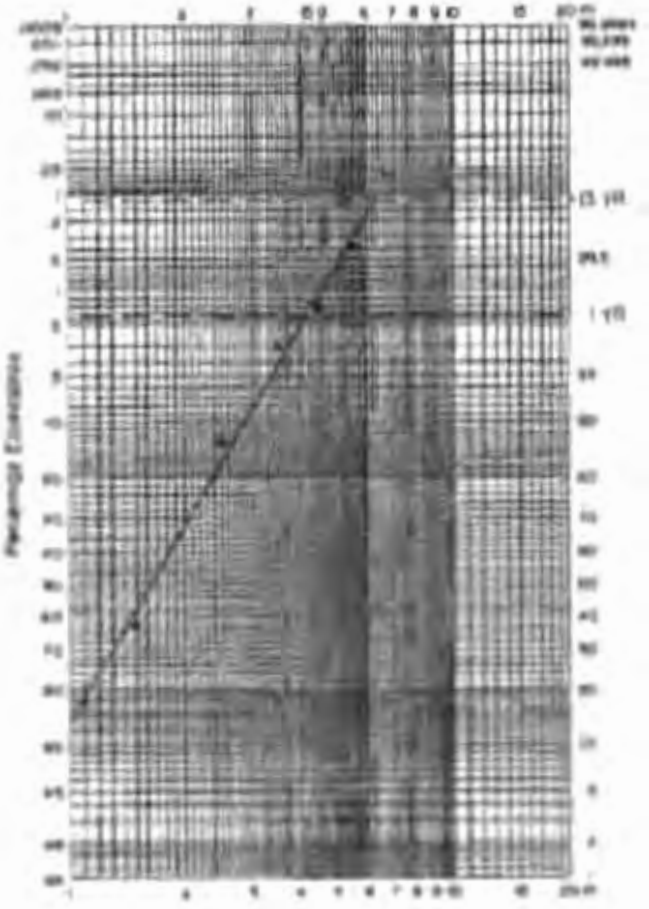


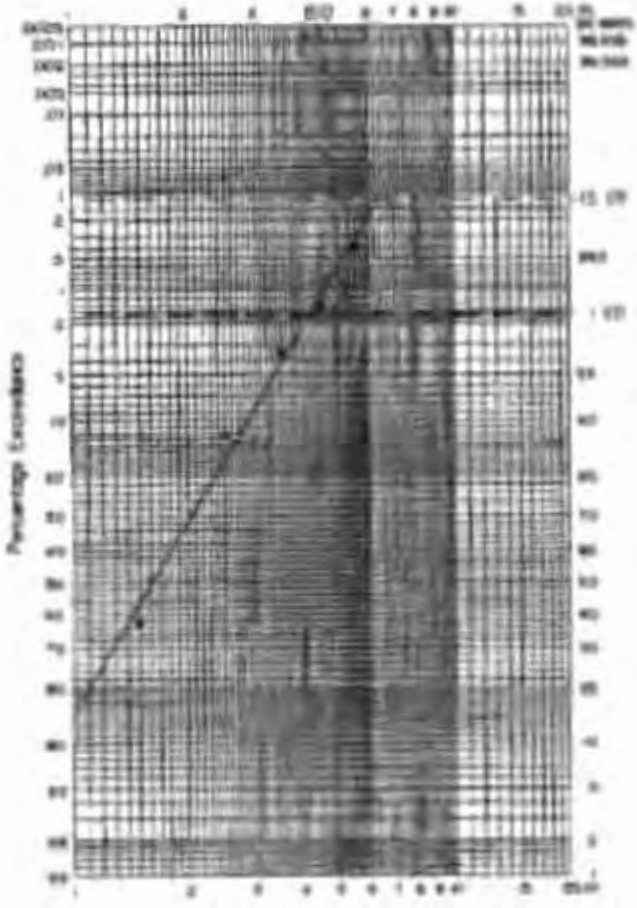


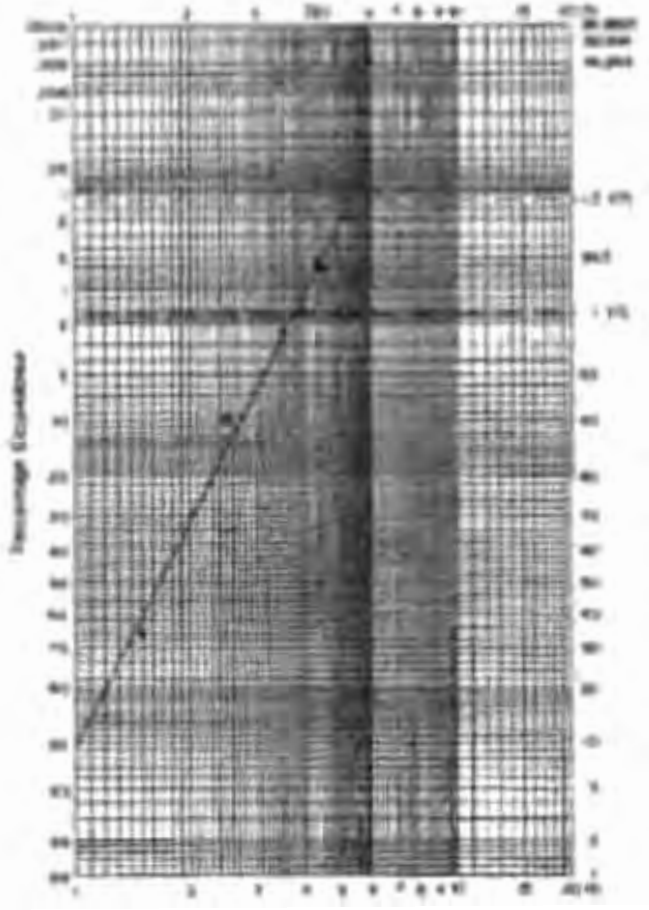


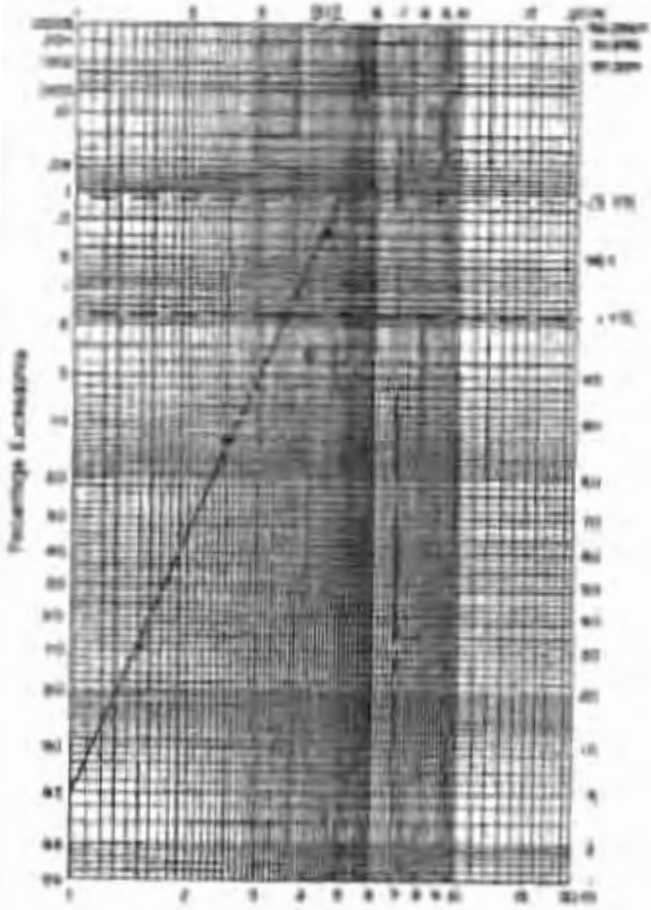


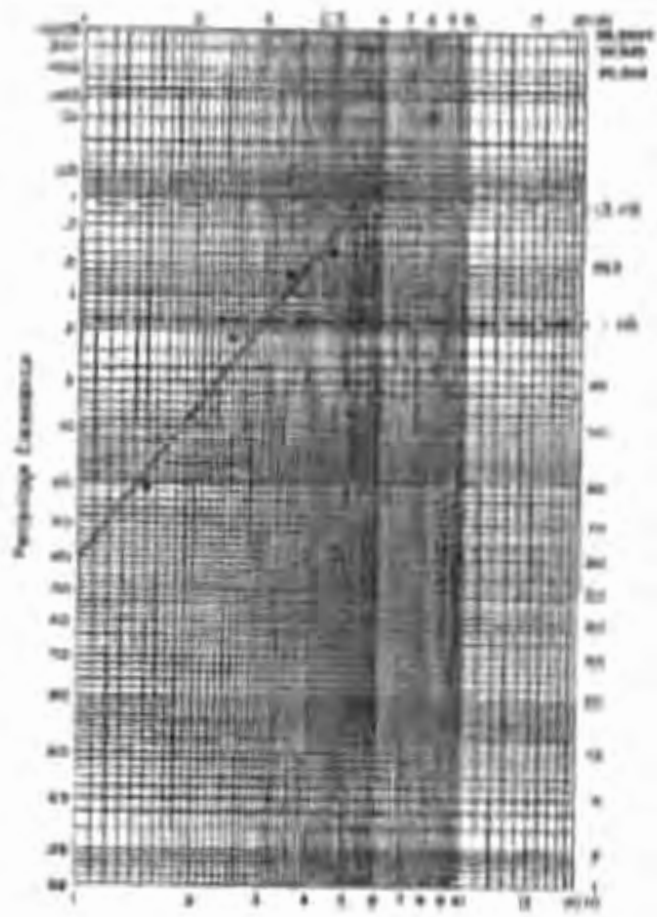


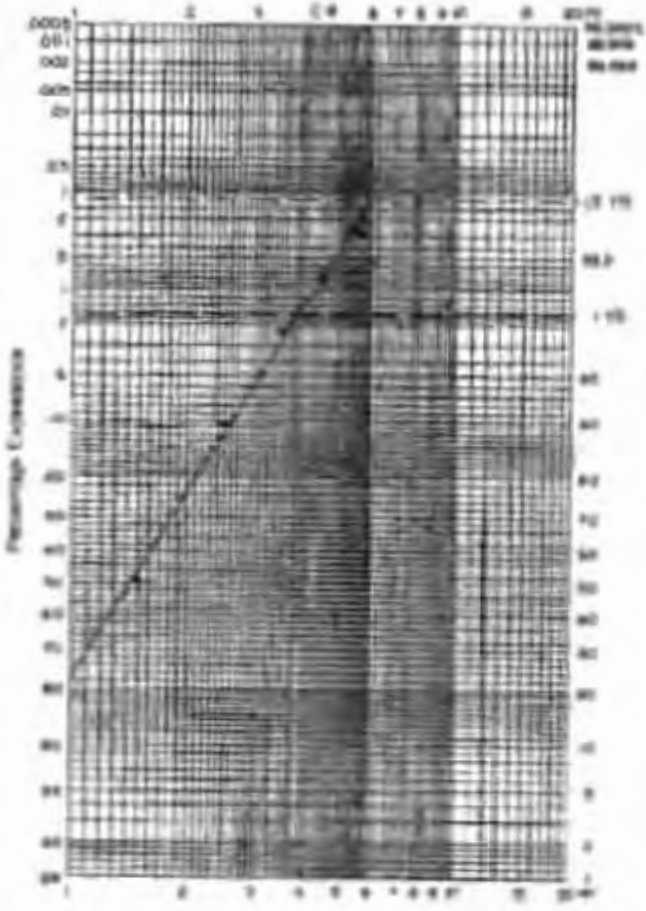


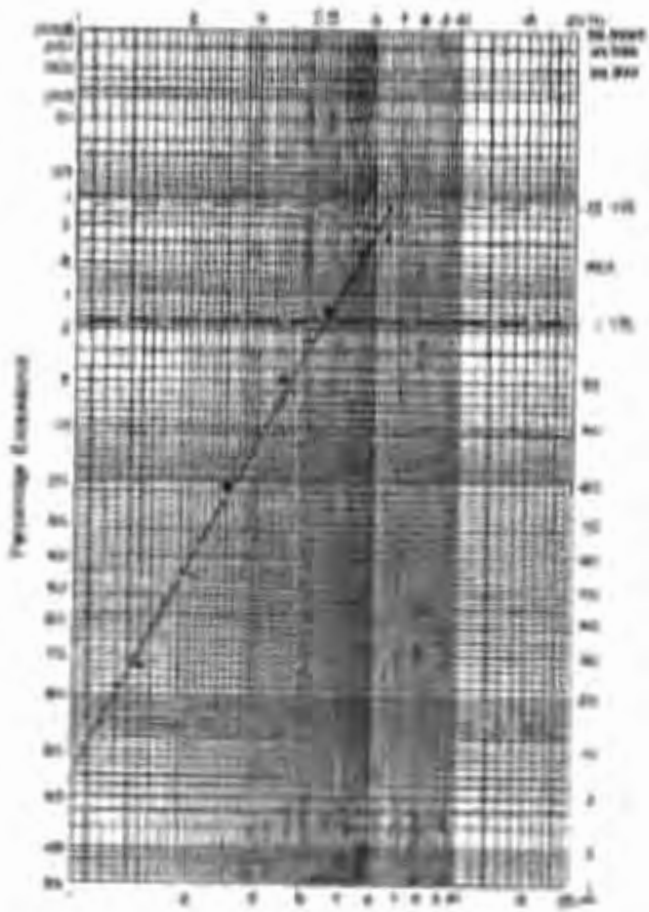












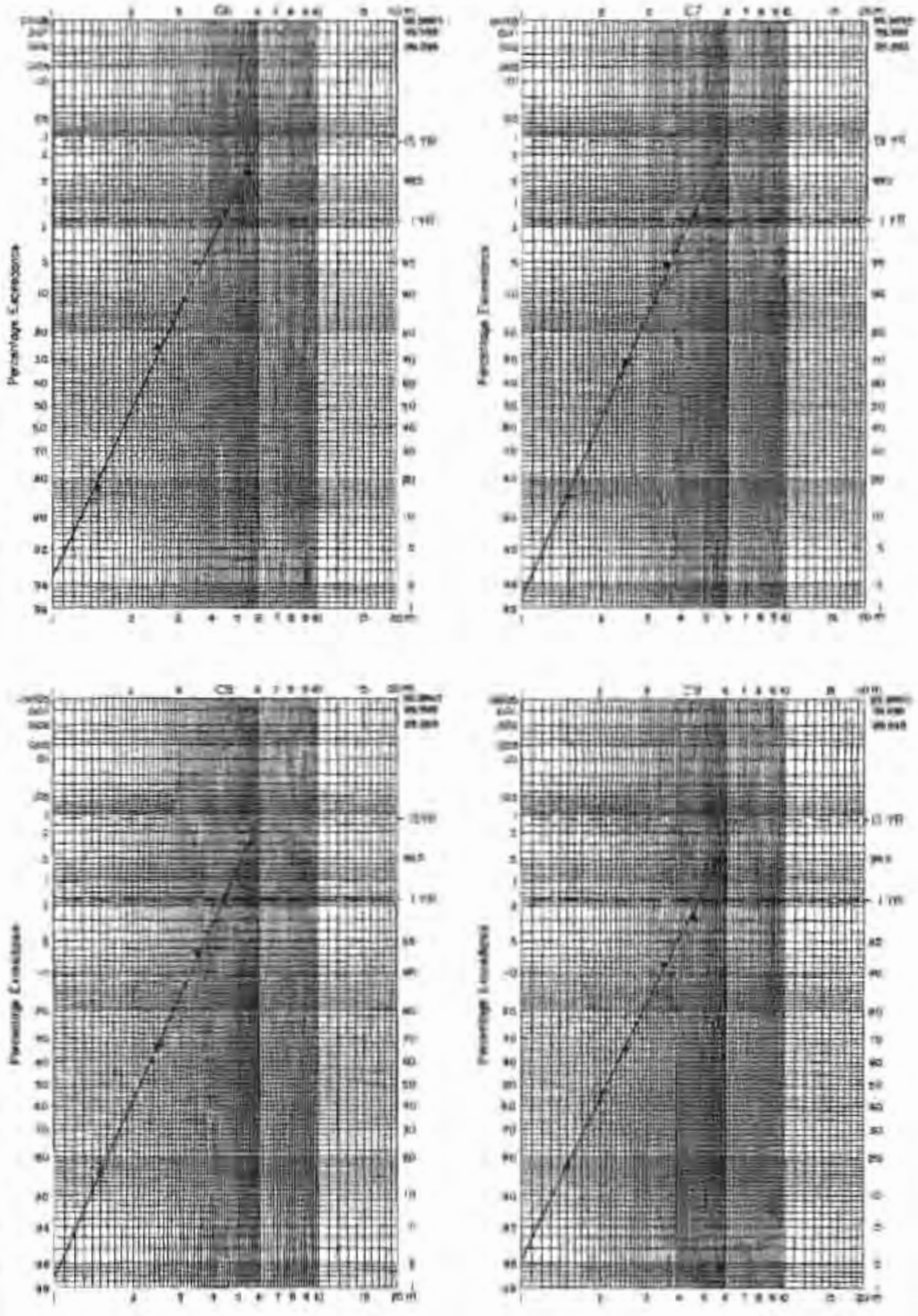


Figure 51 Monthly Wave Height Exceedance Distribution for August

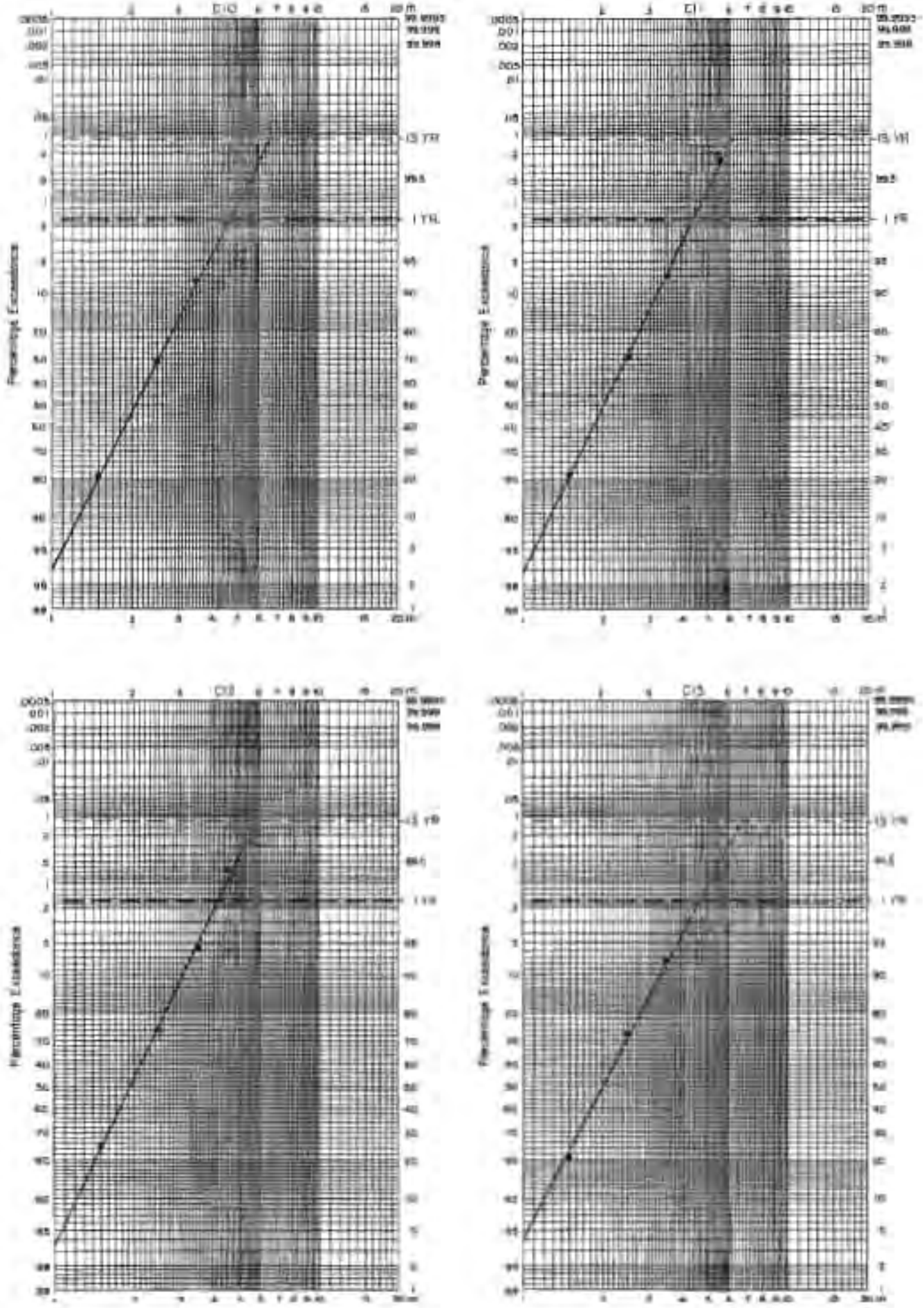
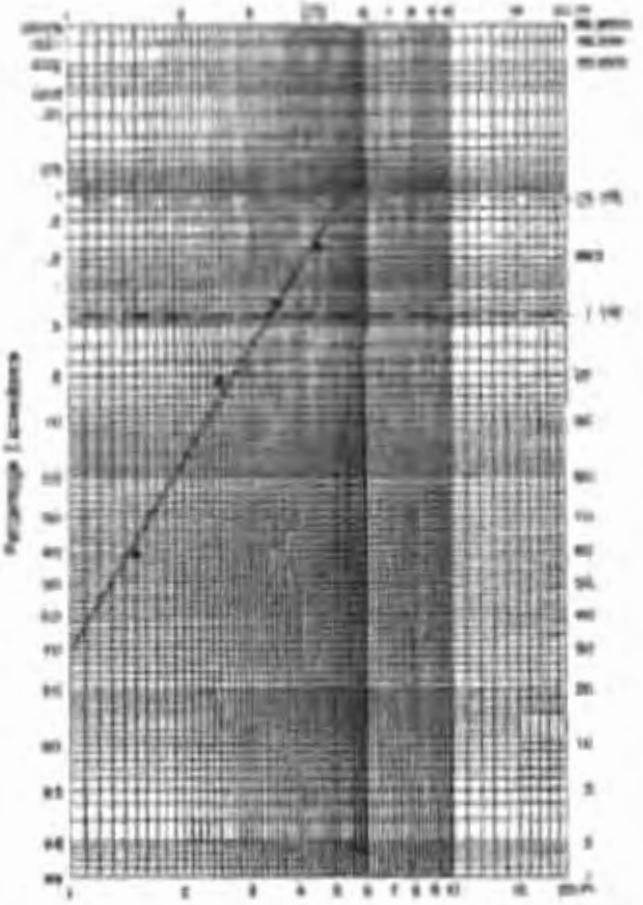
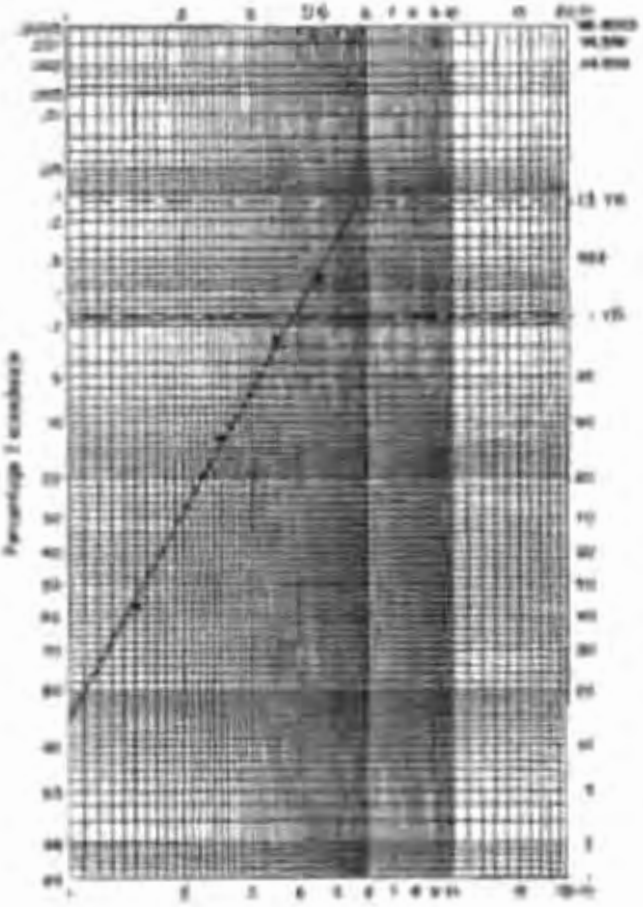
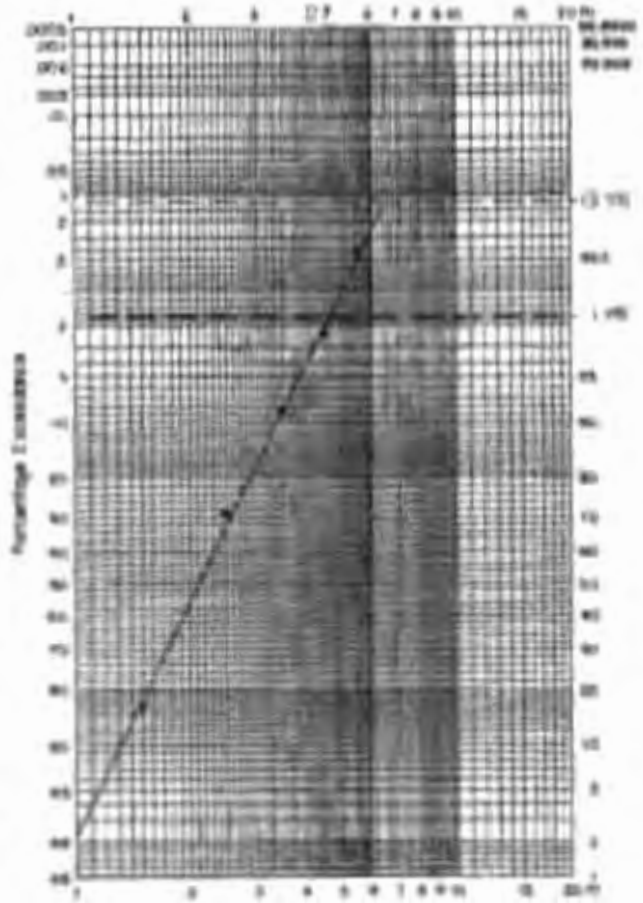
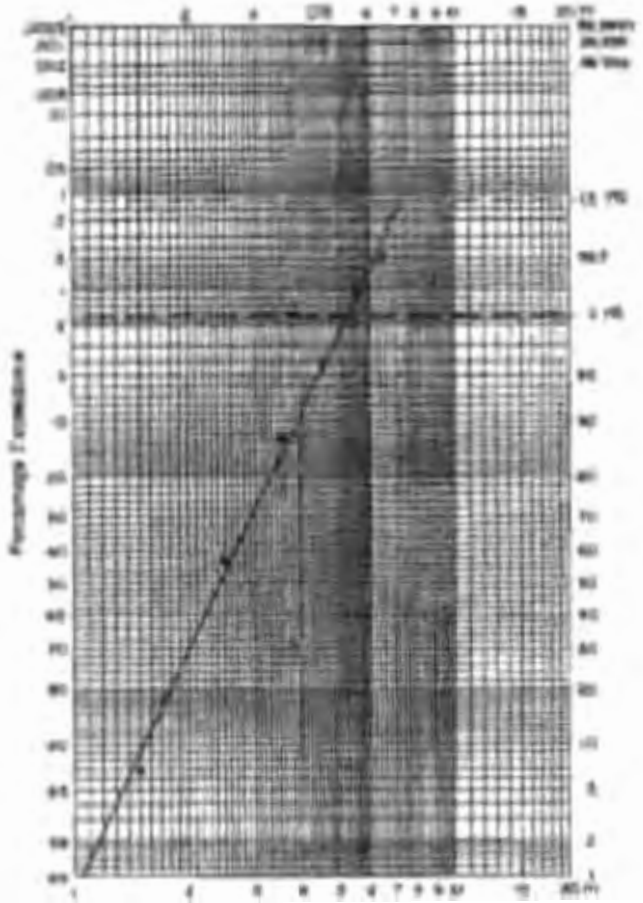


Figure 8: Monthly Wave Height Exceedance Distribution for August









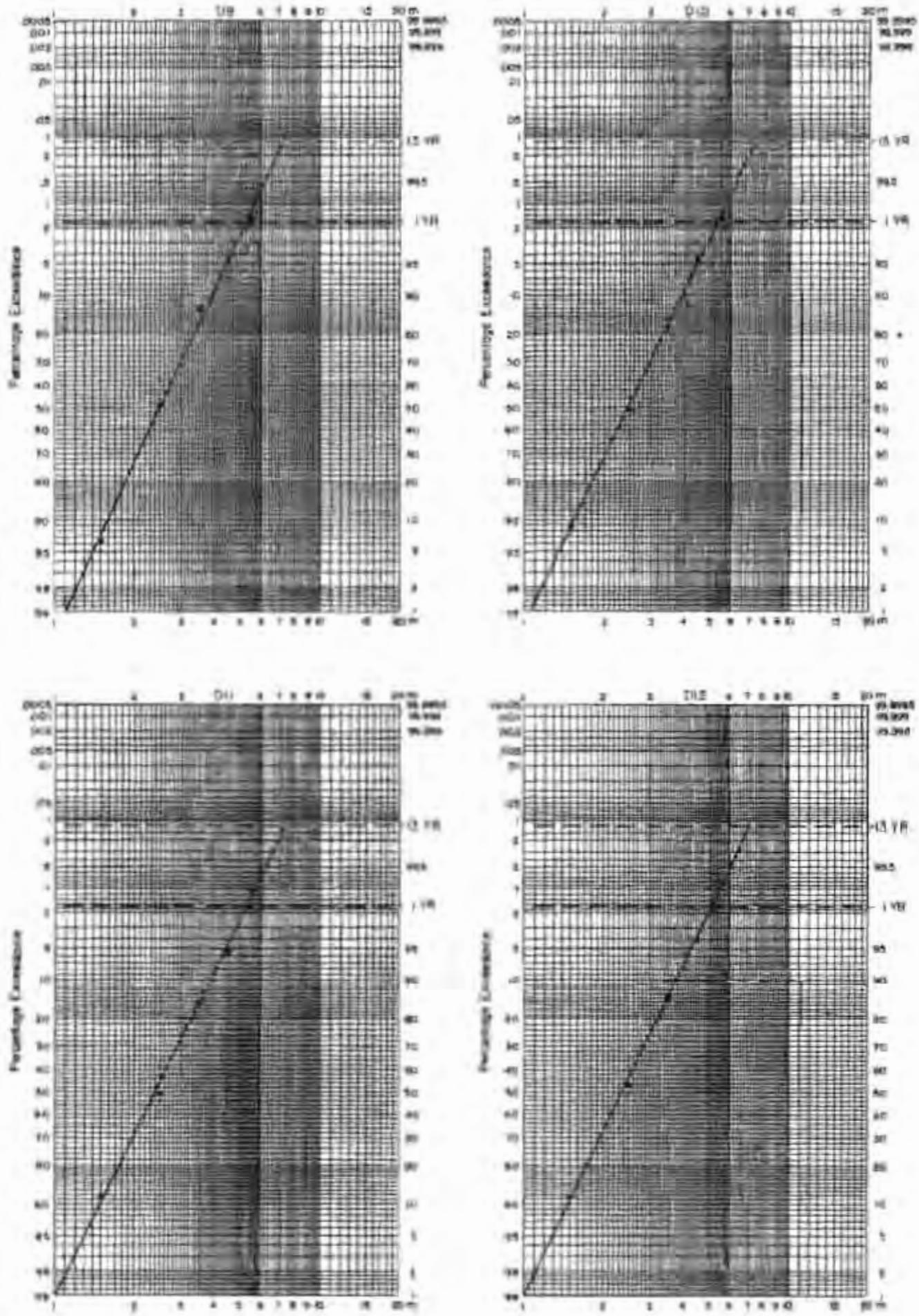
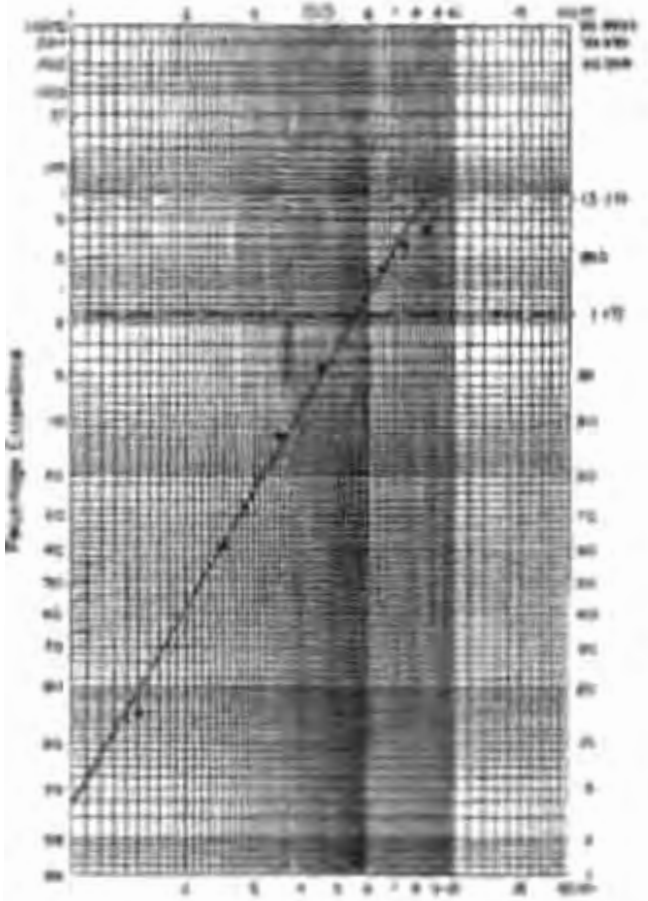
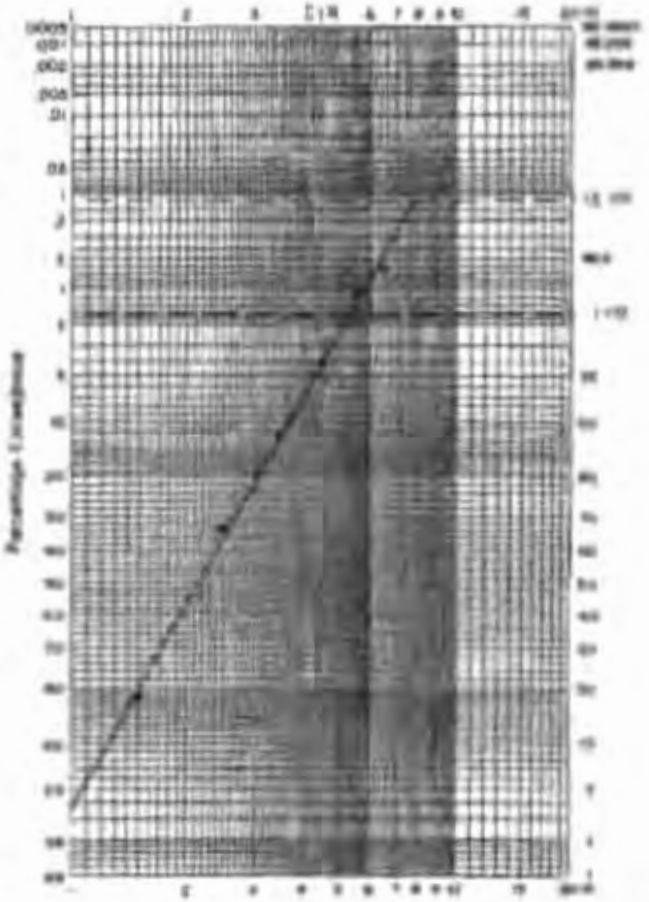
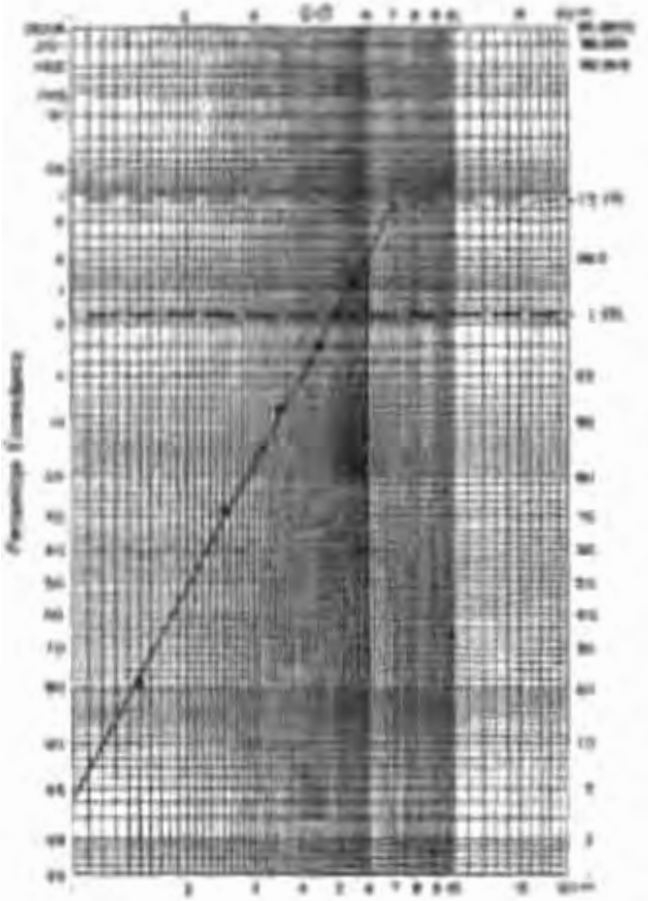
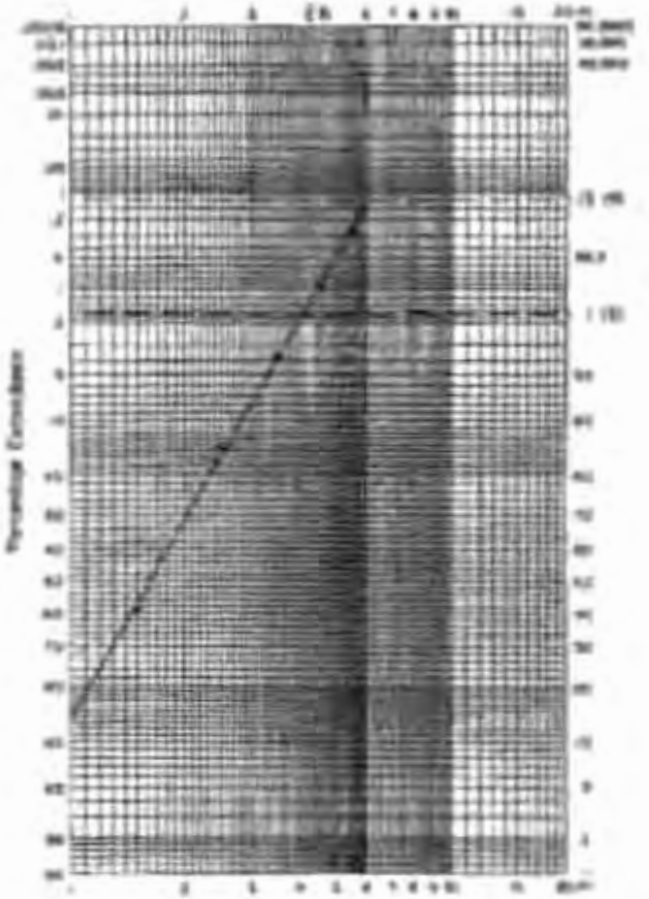


Figure 8: Monthly Wave Height Exceedance Distribution for August









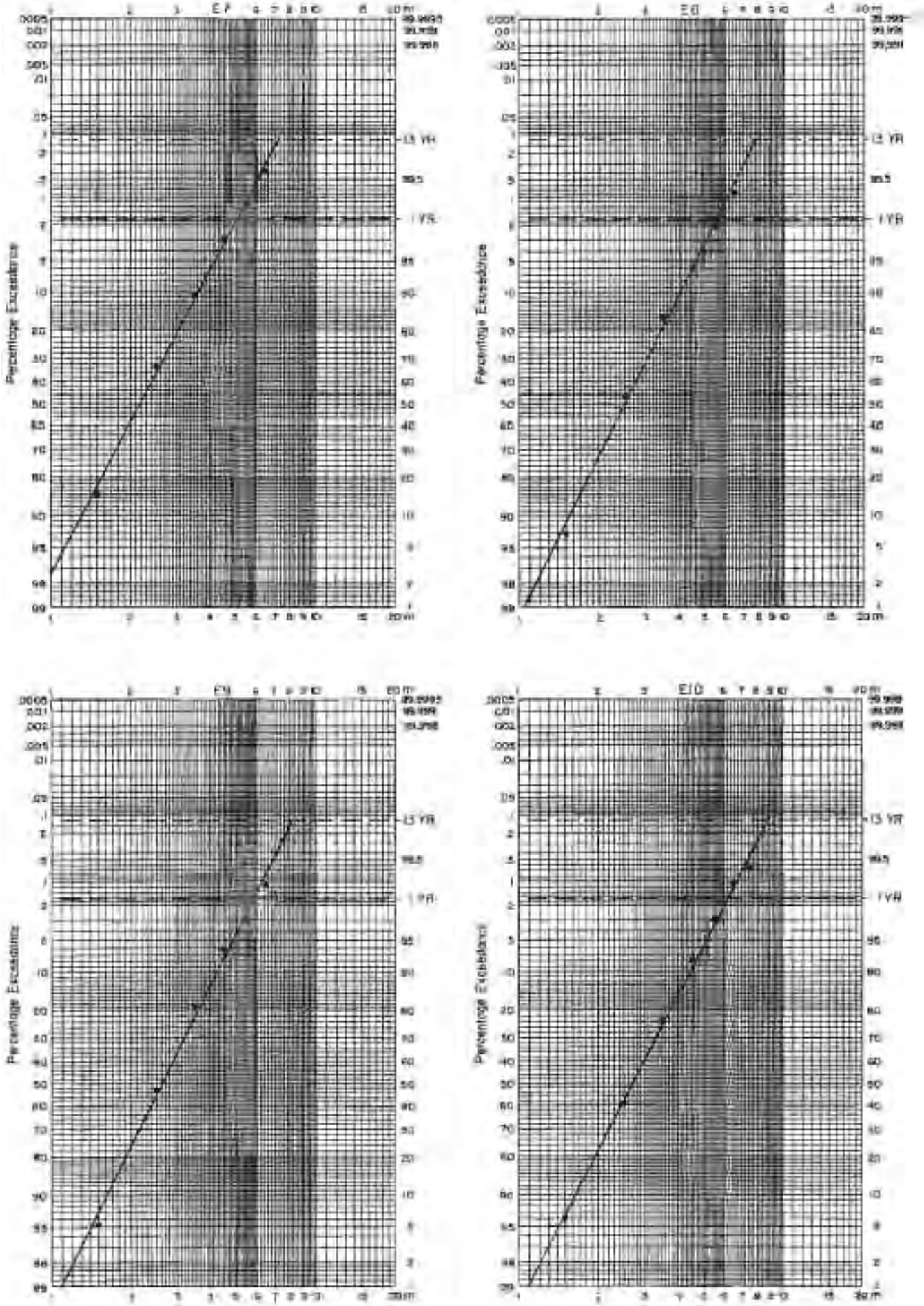
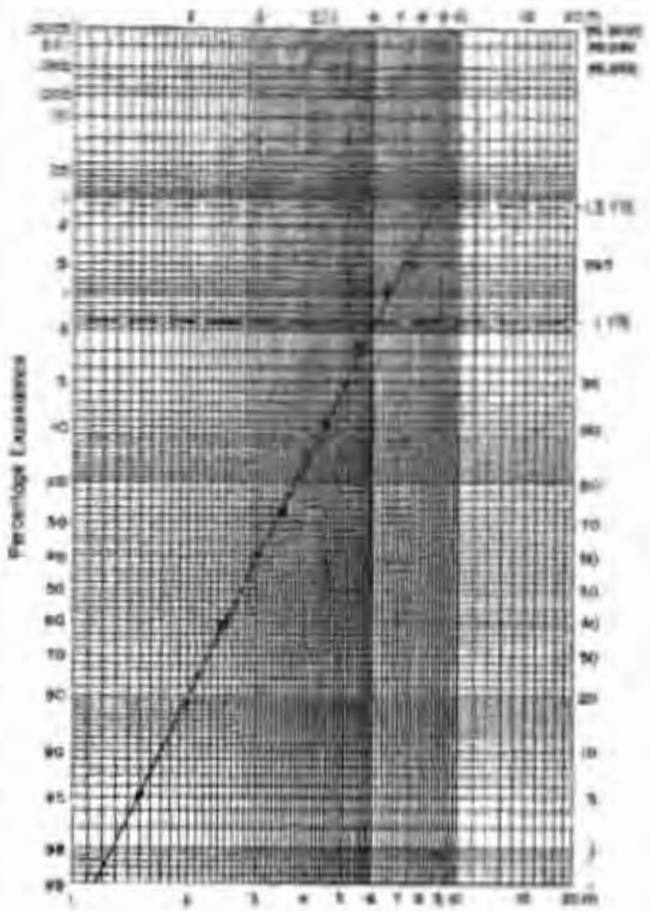
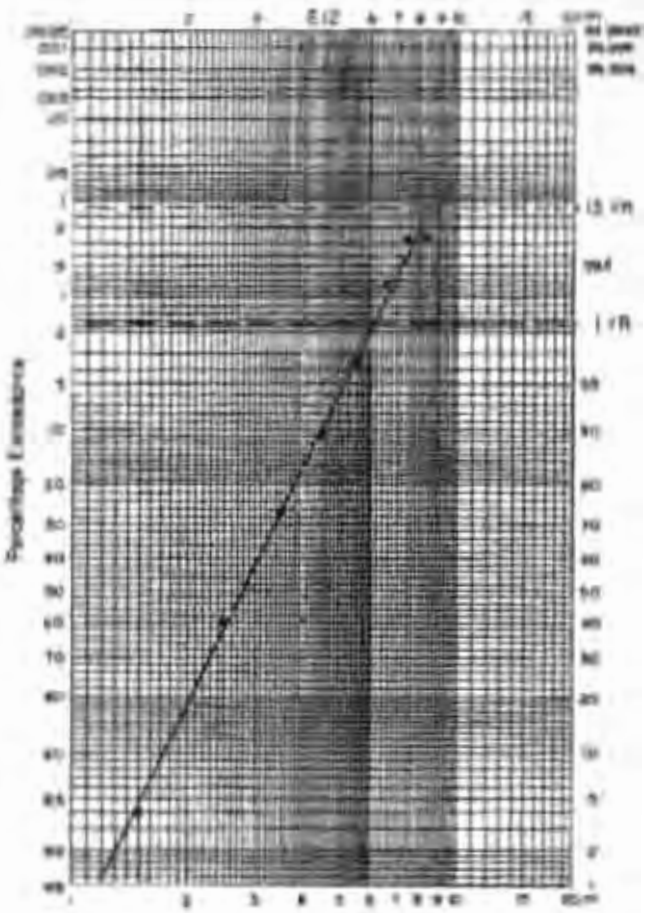
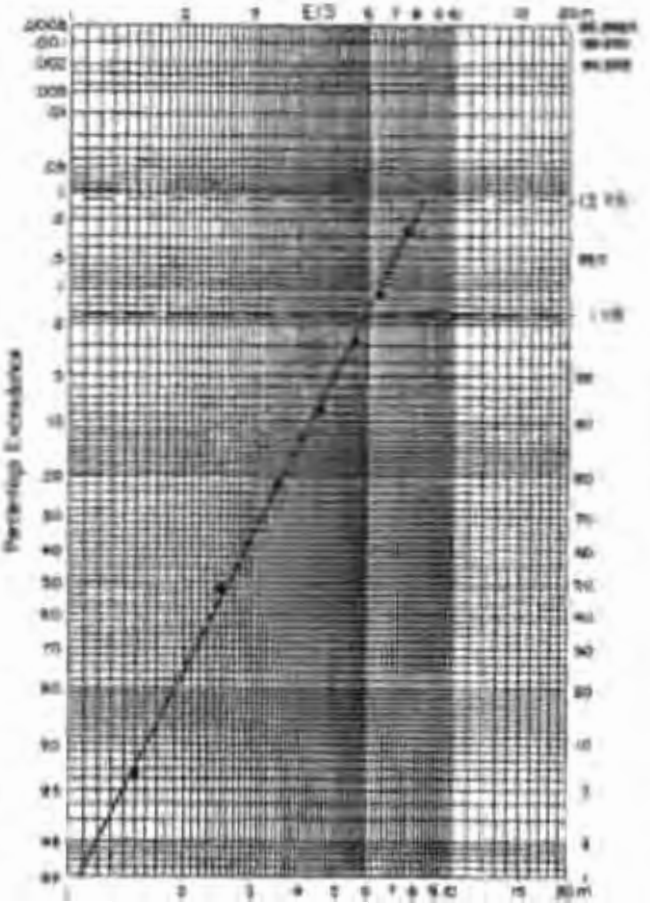
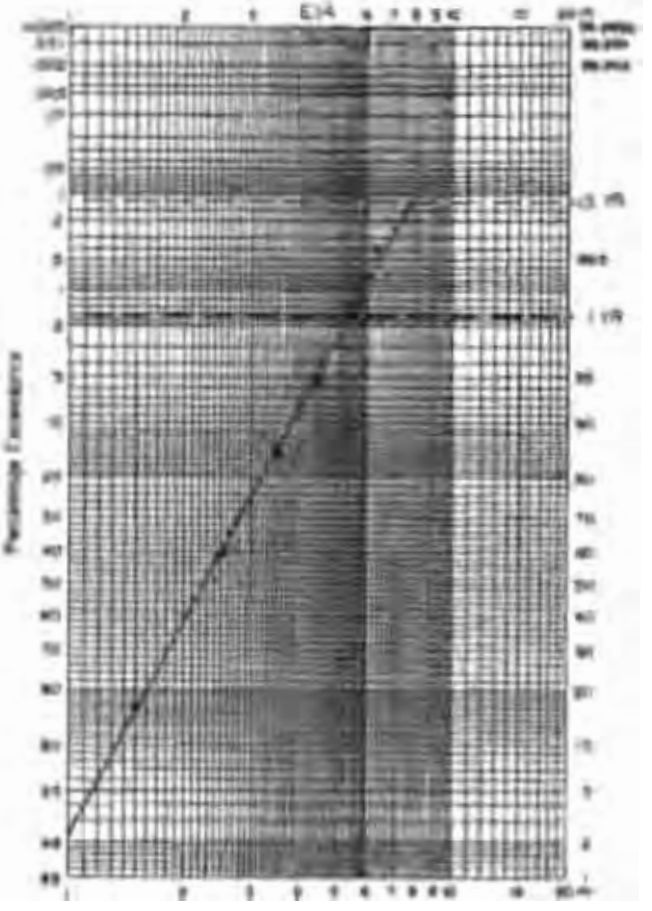


Figure 81 Monthly Wave Height Exceedance Distribution for August









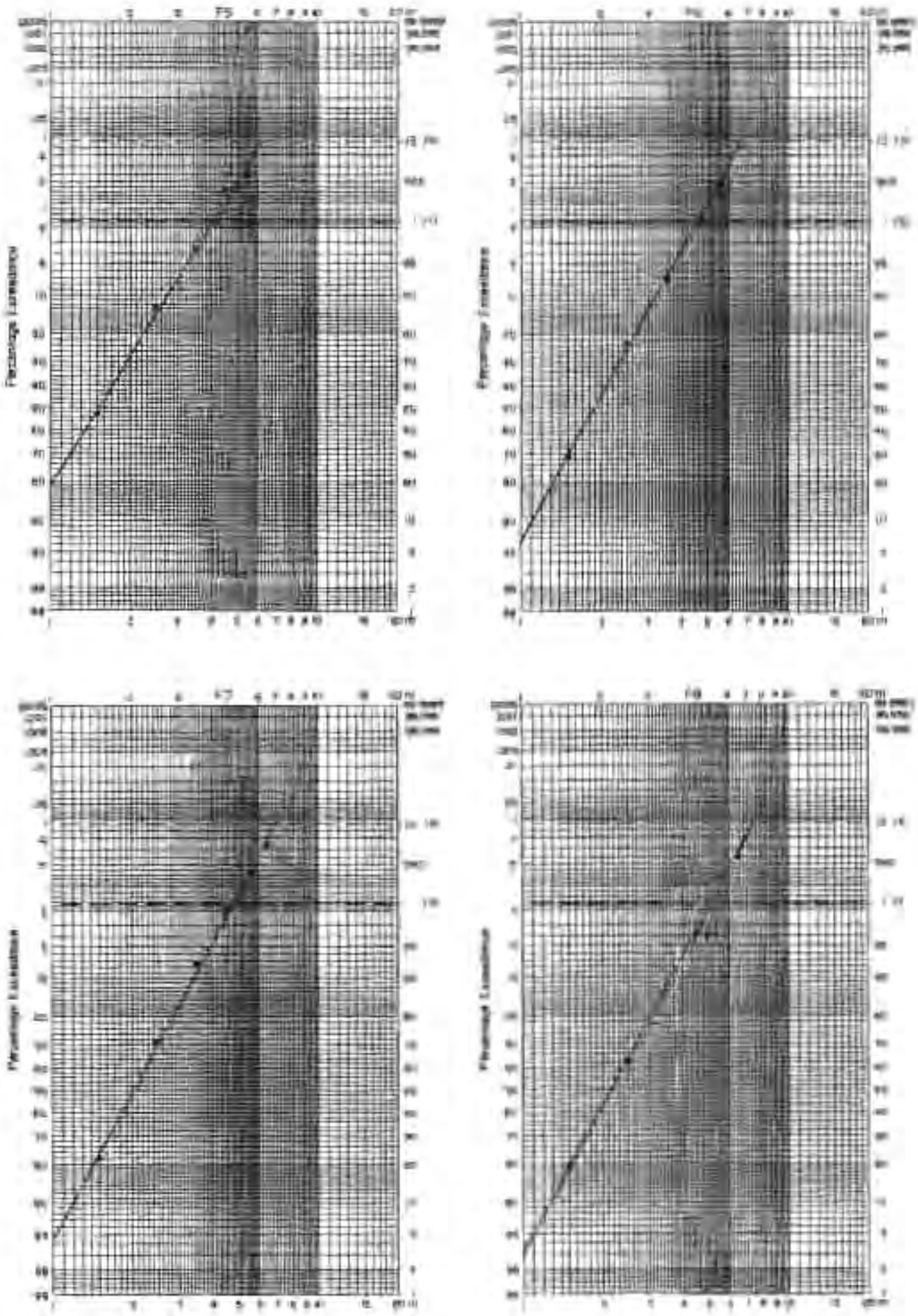


Figure 60 Monthly Wave Height Exceedance Distribution for August

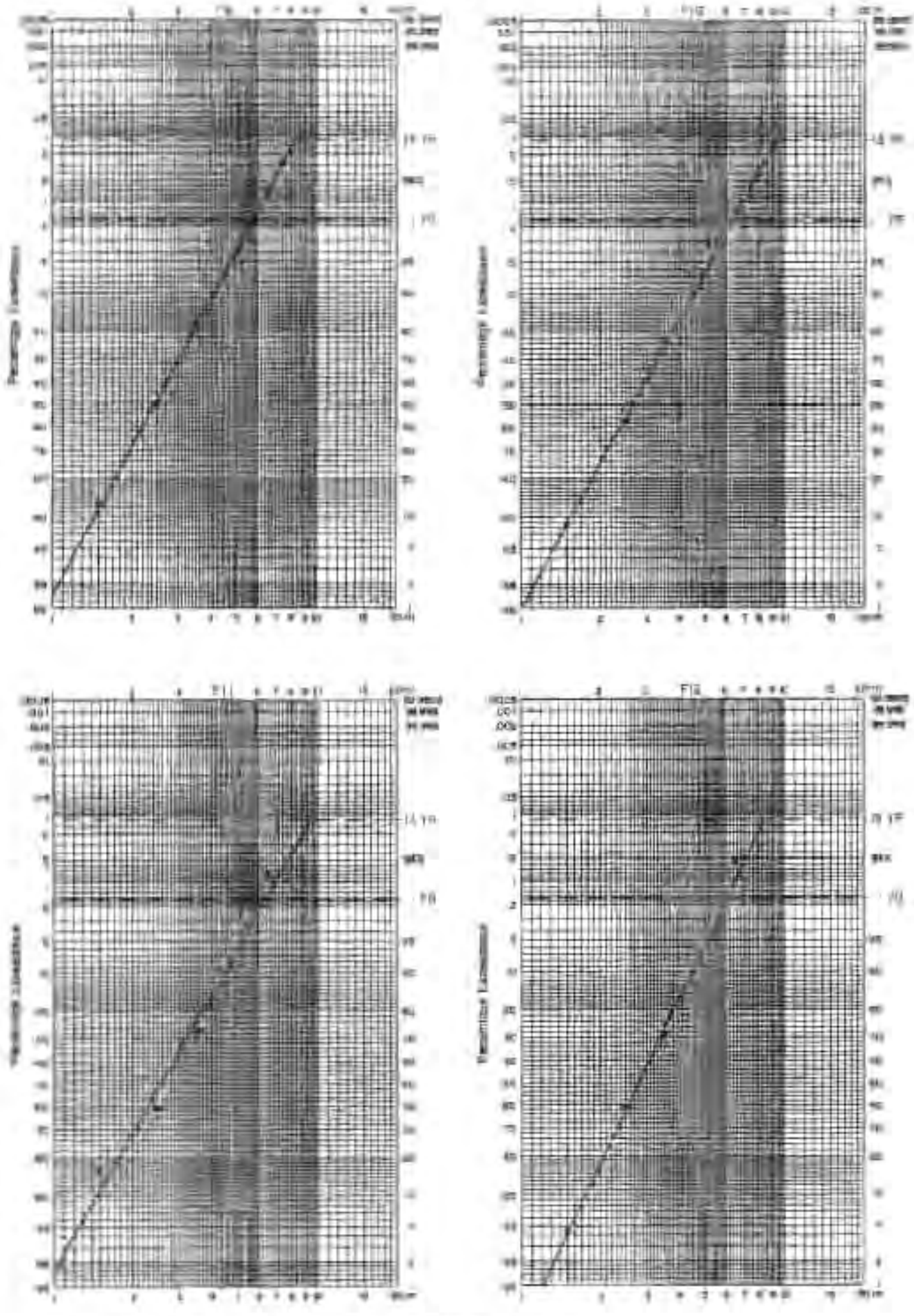


Figure 6.1 Monthly Wave Height Exceedance Distribution for August

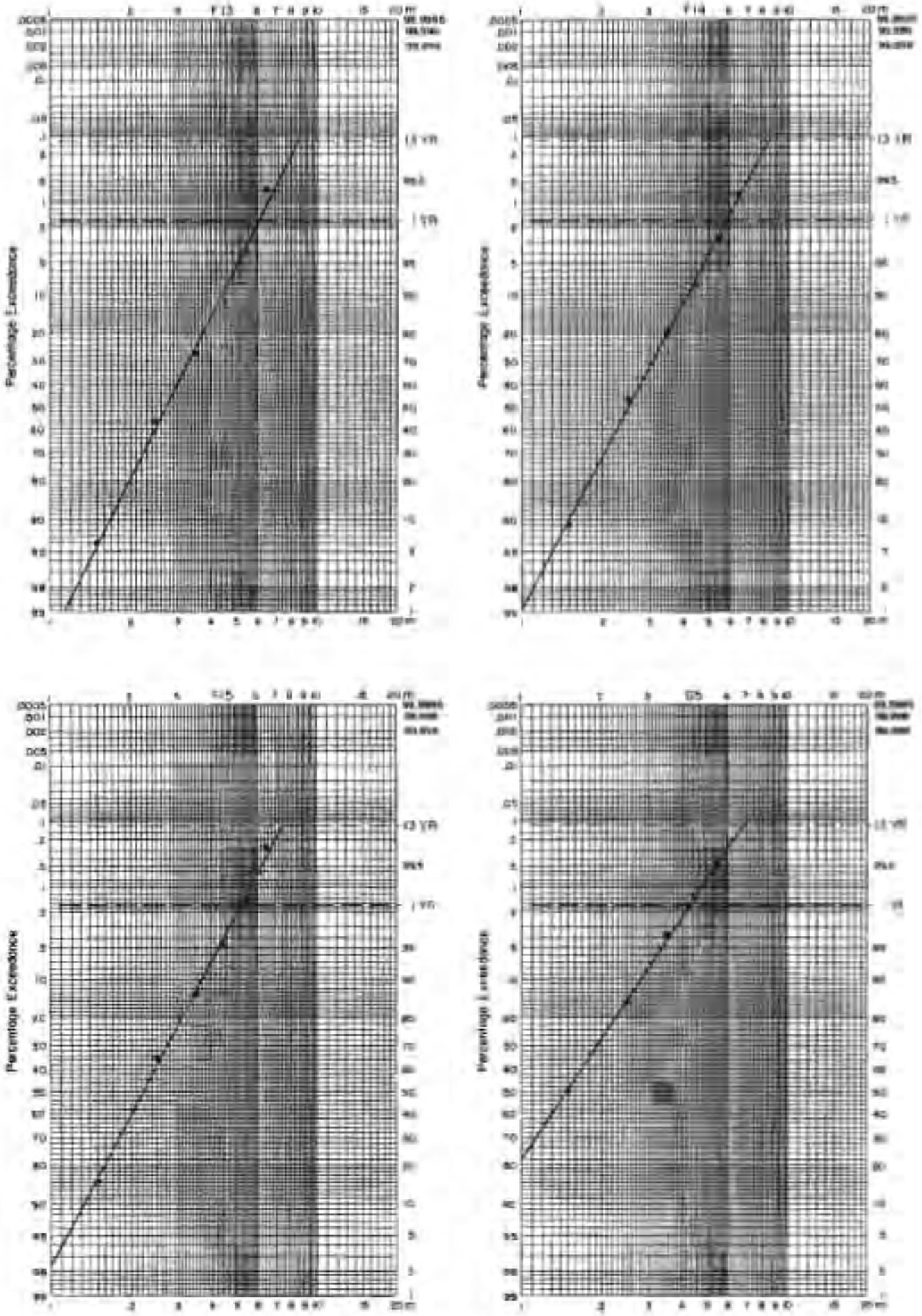


Figure 81 Monthly Wave Height Exceedance Distribution for August

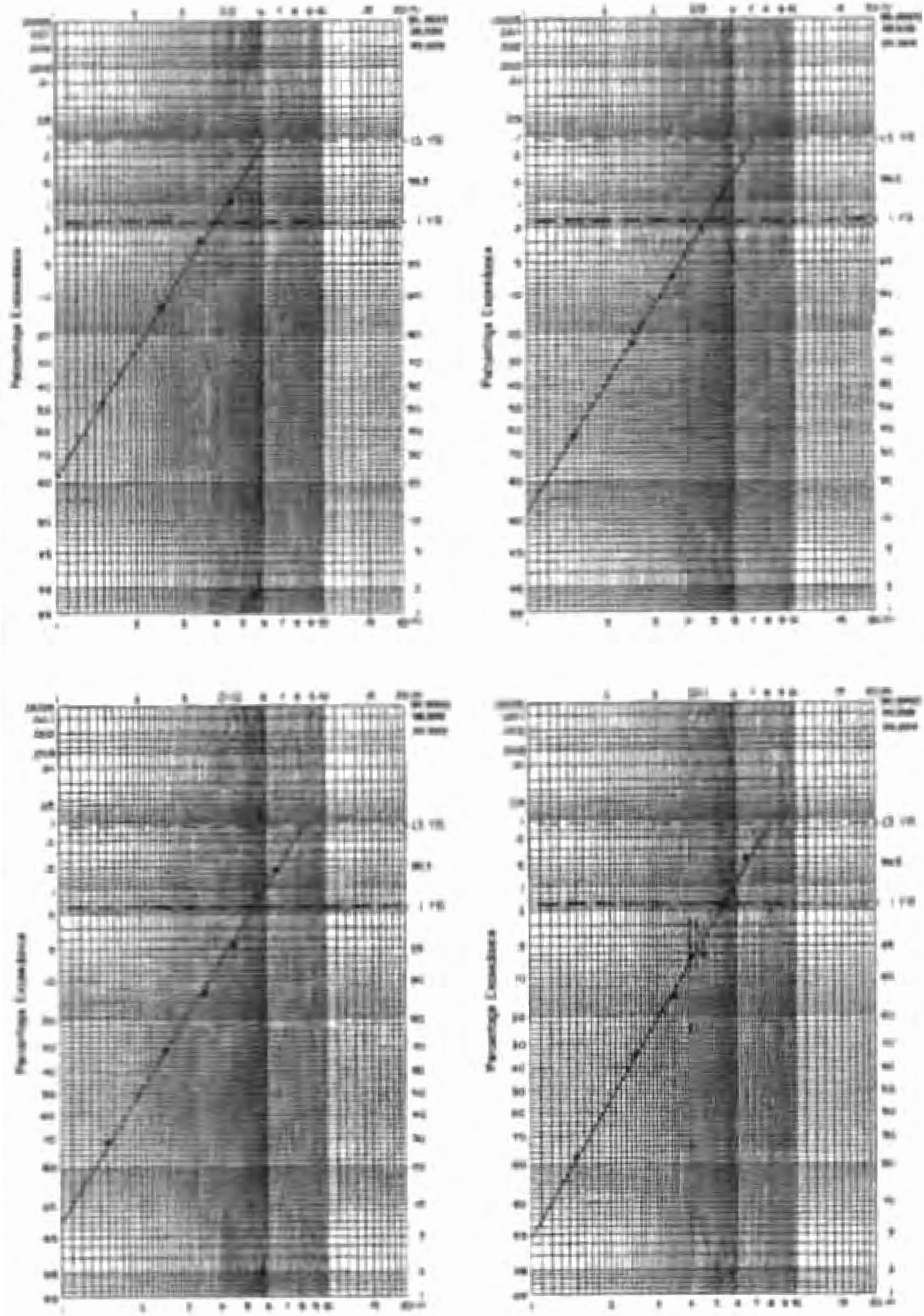
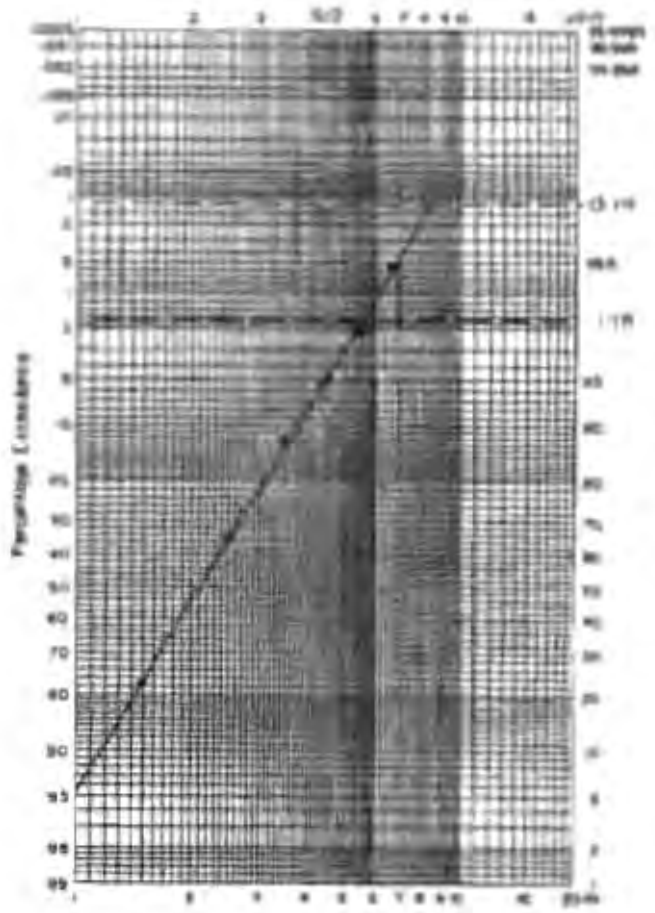
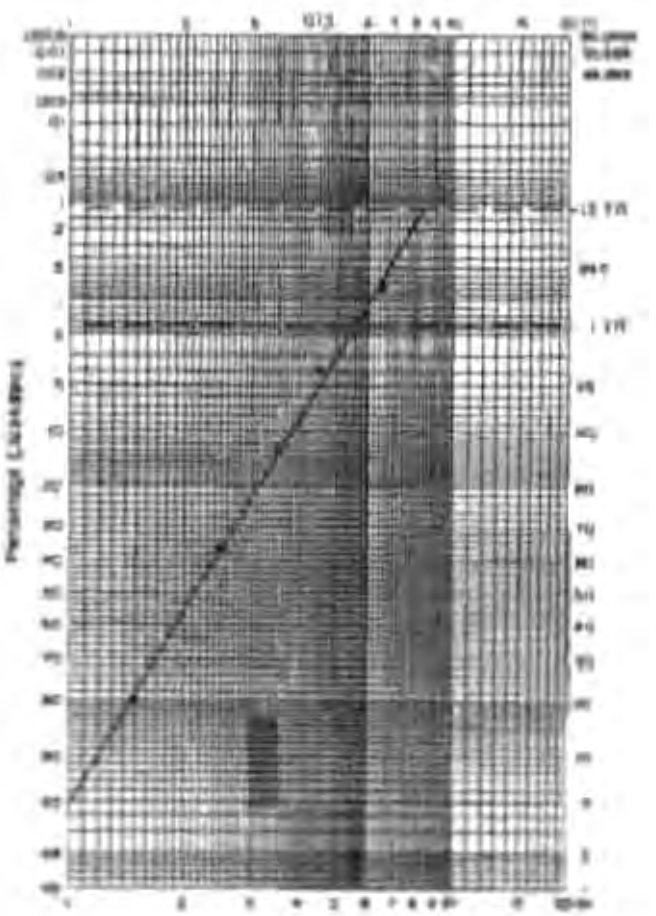
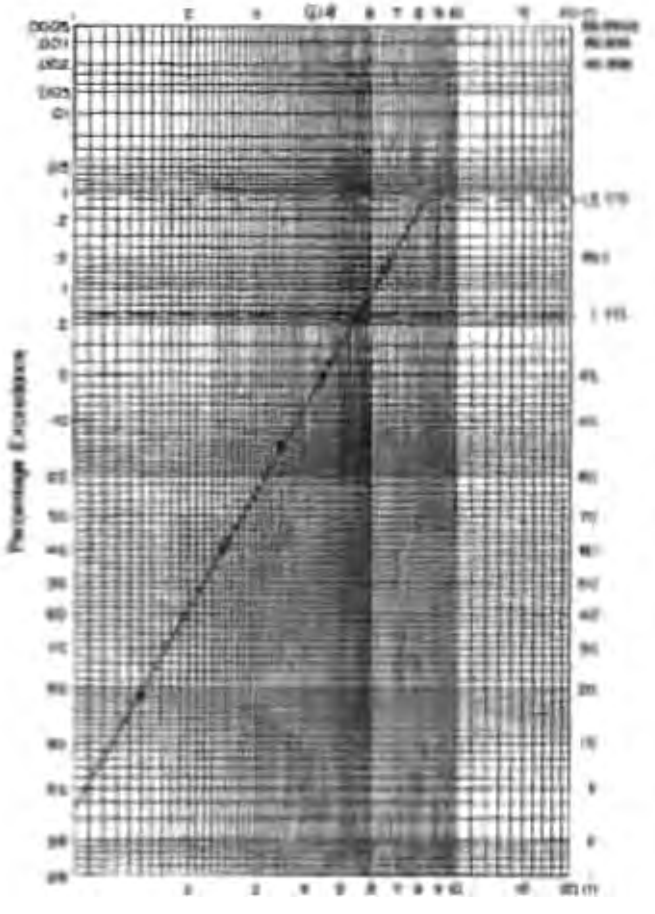
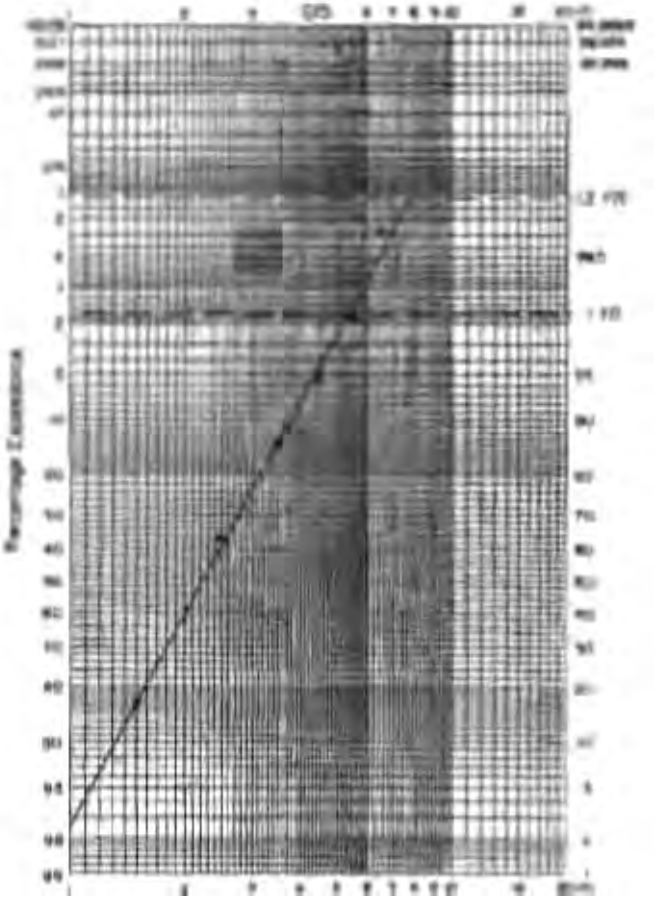


Figure 8a









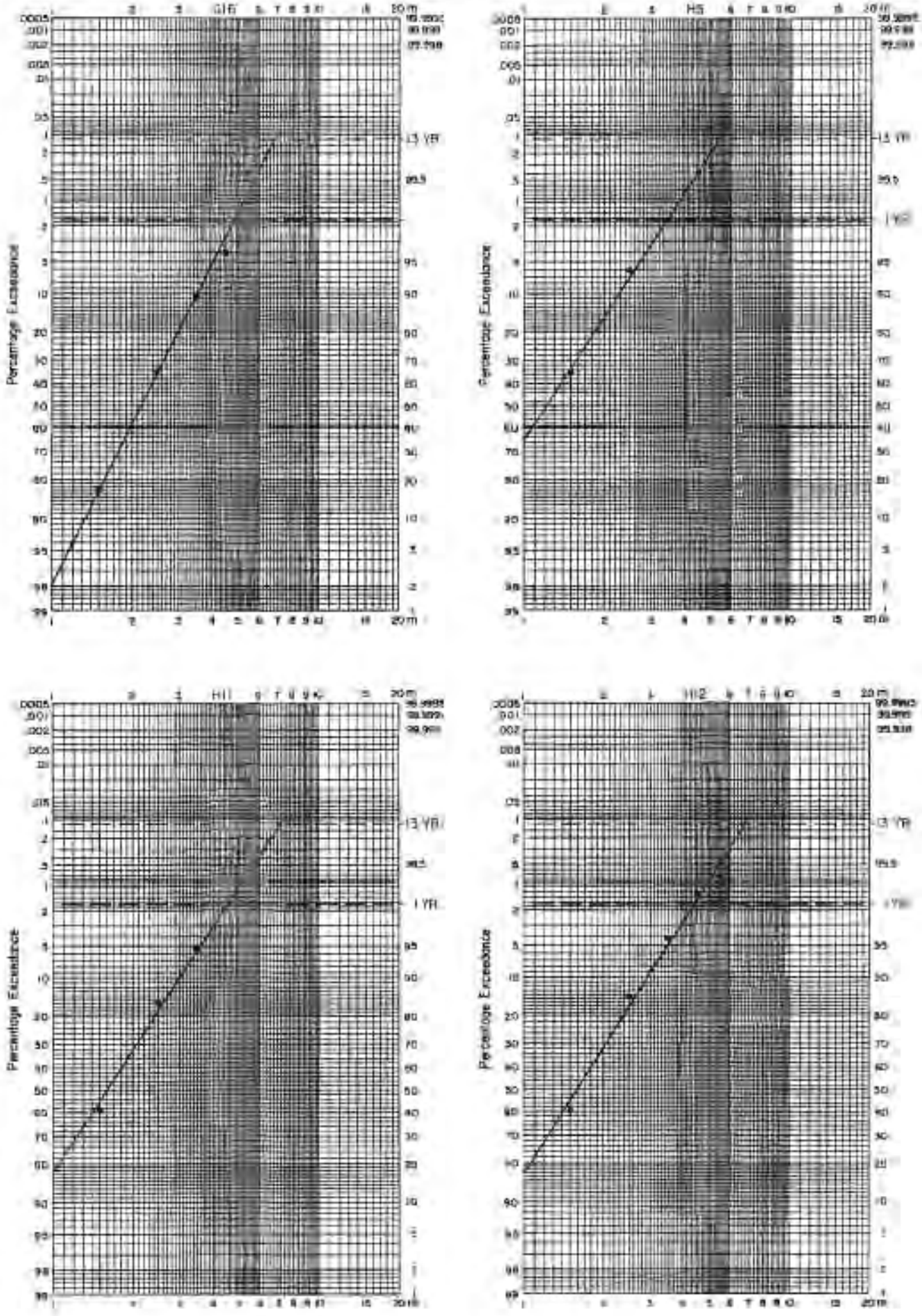
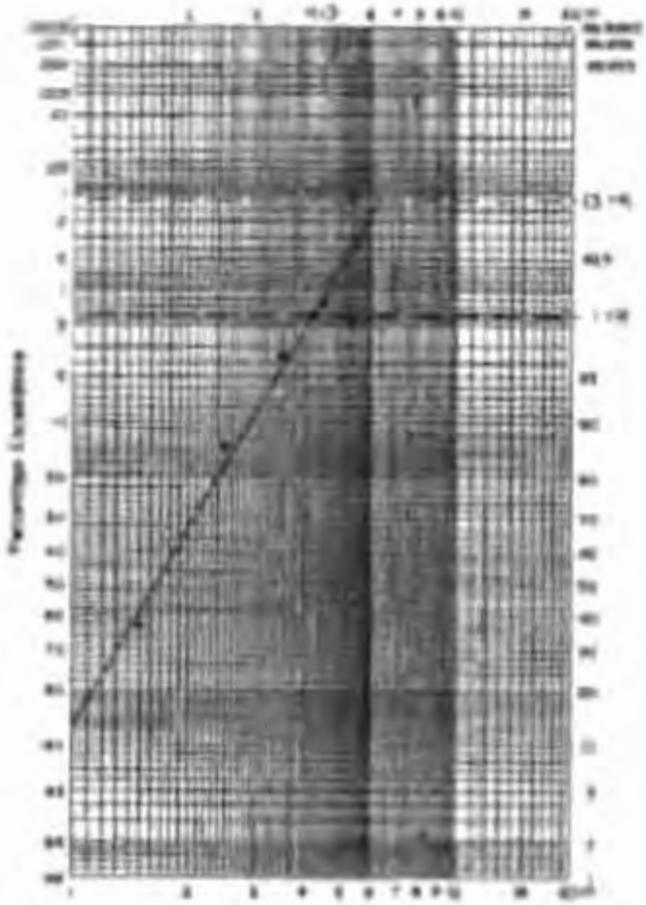
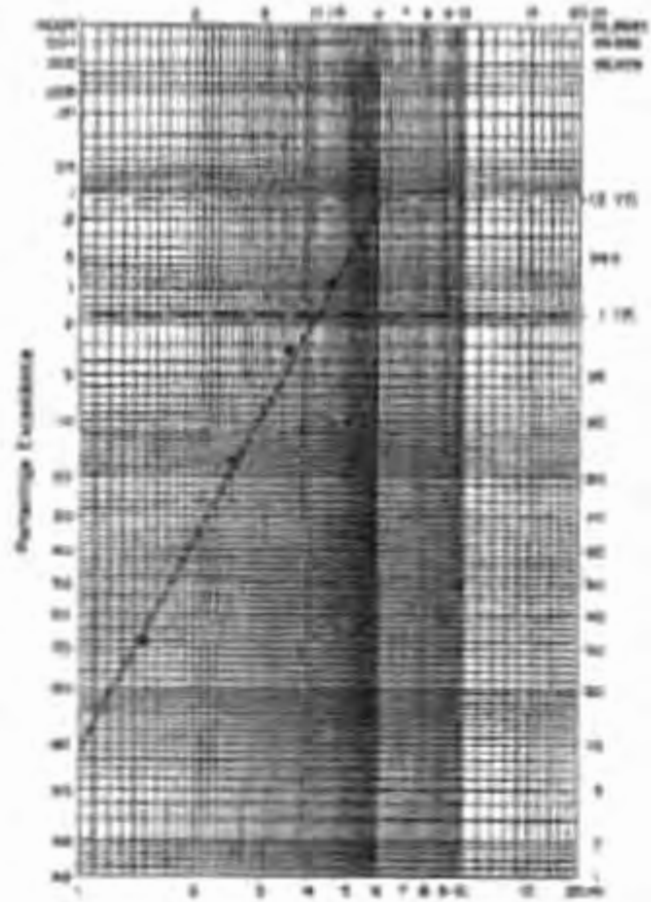
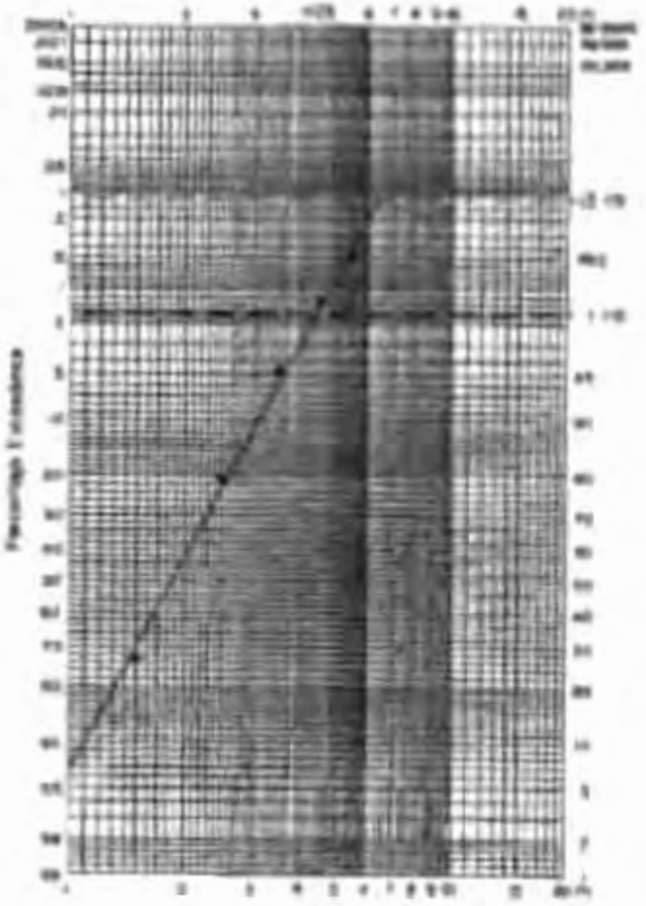
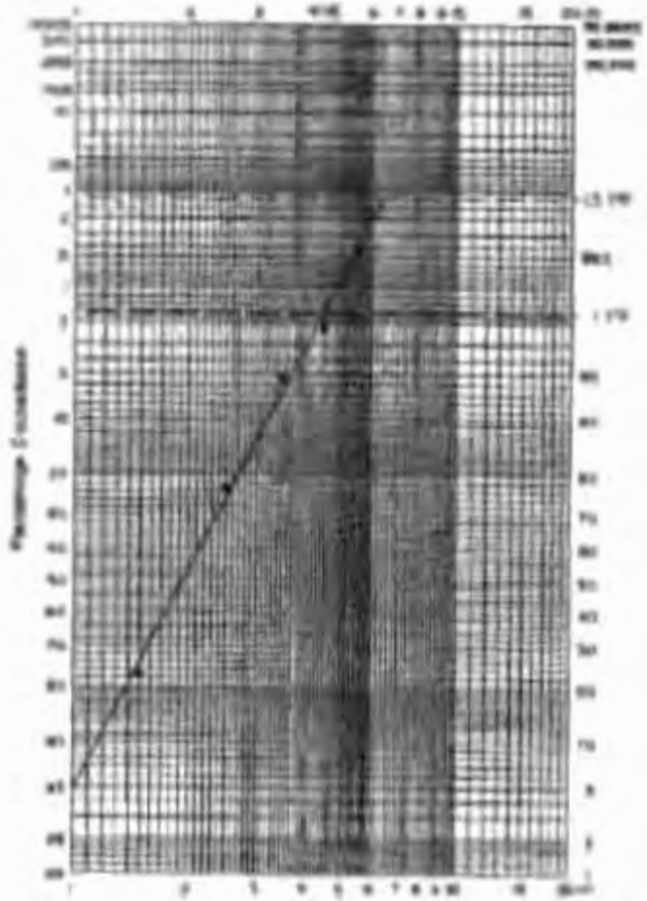


Figure 80. Monthly Wave Height Exceedance Distribution for August









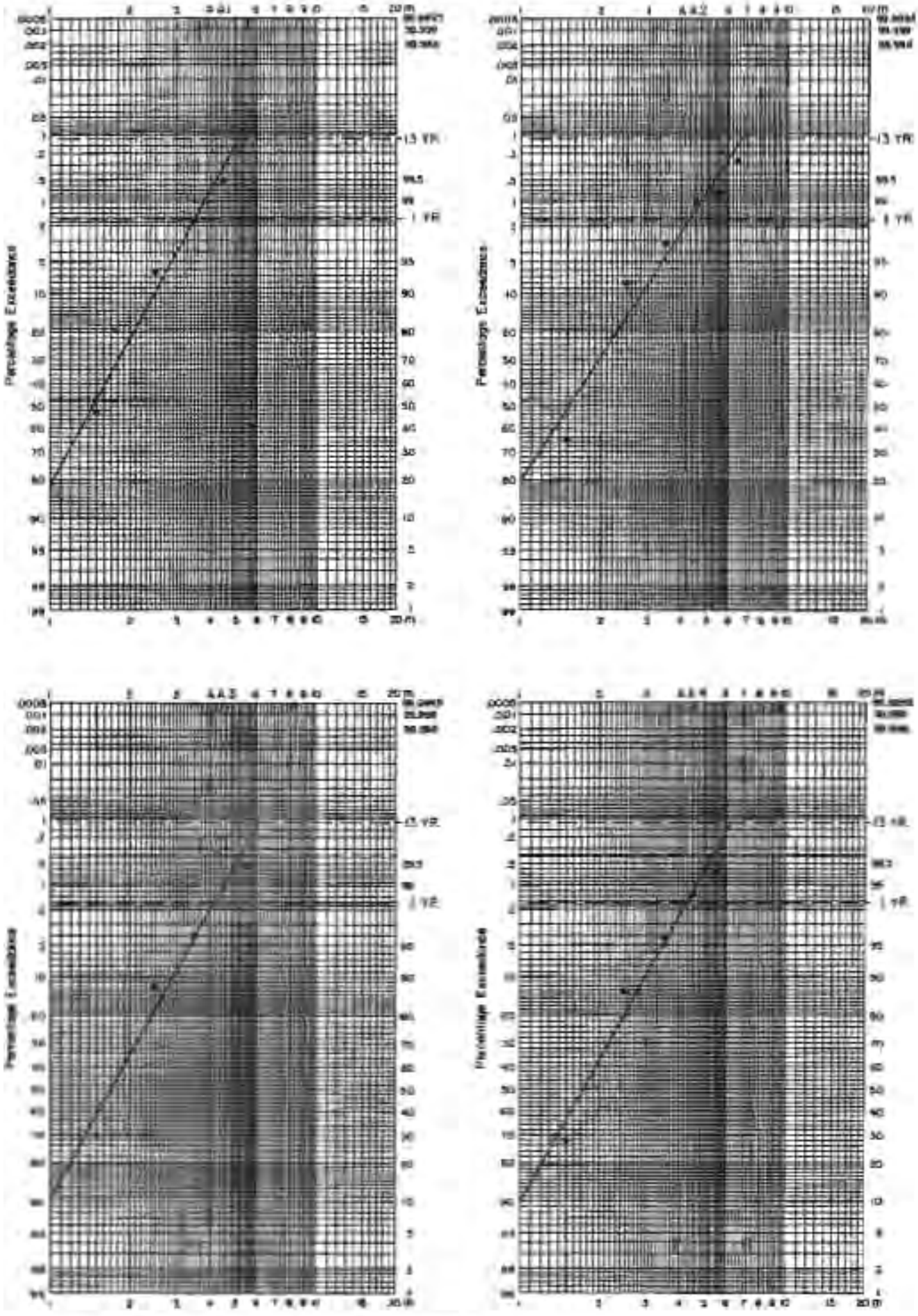


Figure 9c. Monthly Wave Height Exceedance Distribution for September

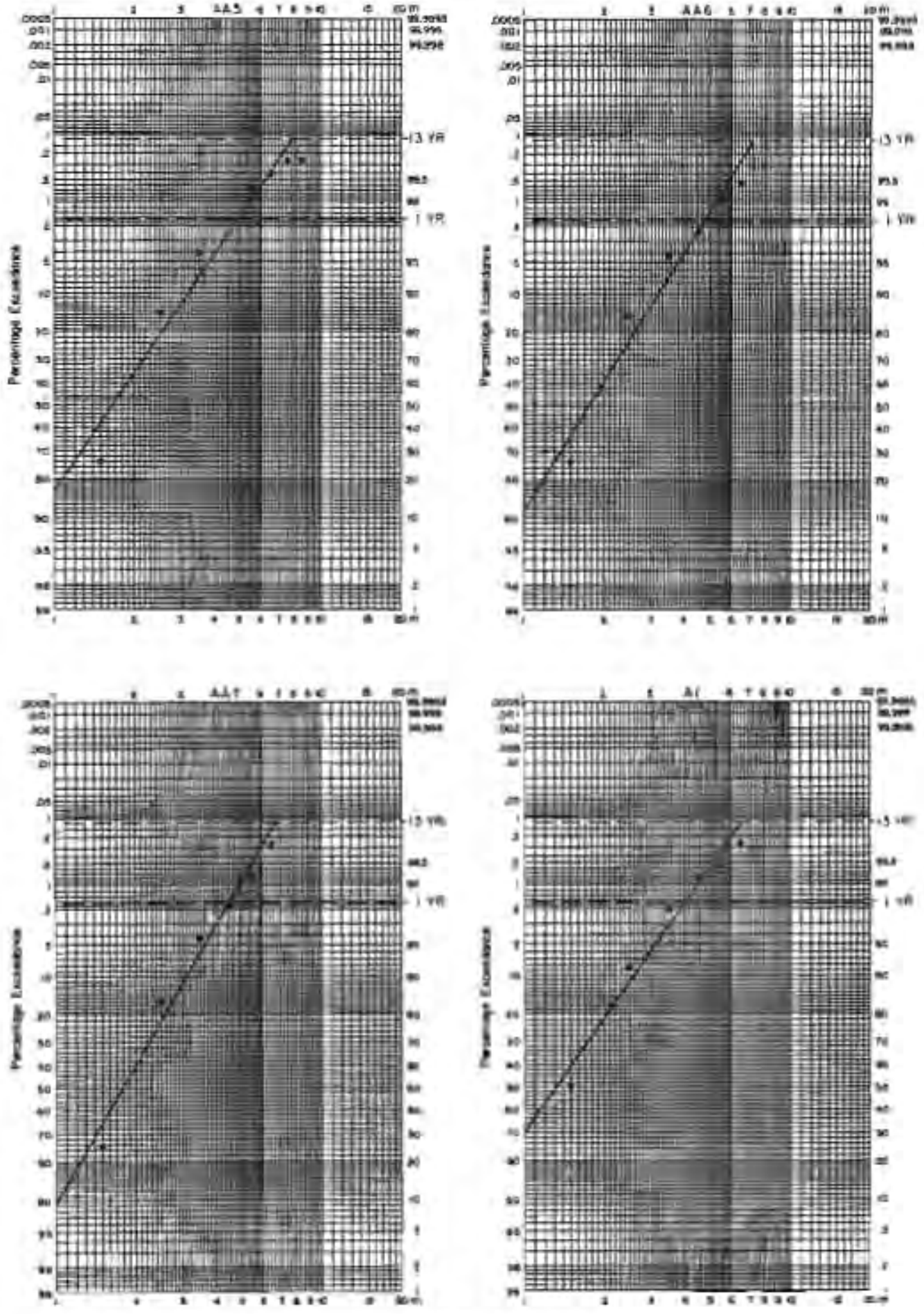


Figure 9b Monthly Wave Height Exceedance Distribution for September

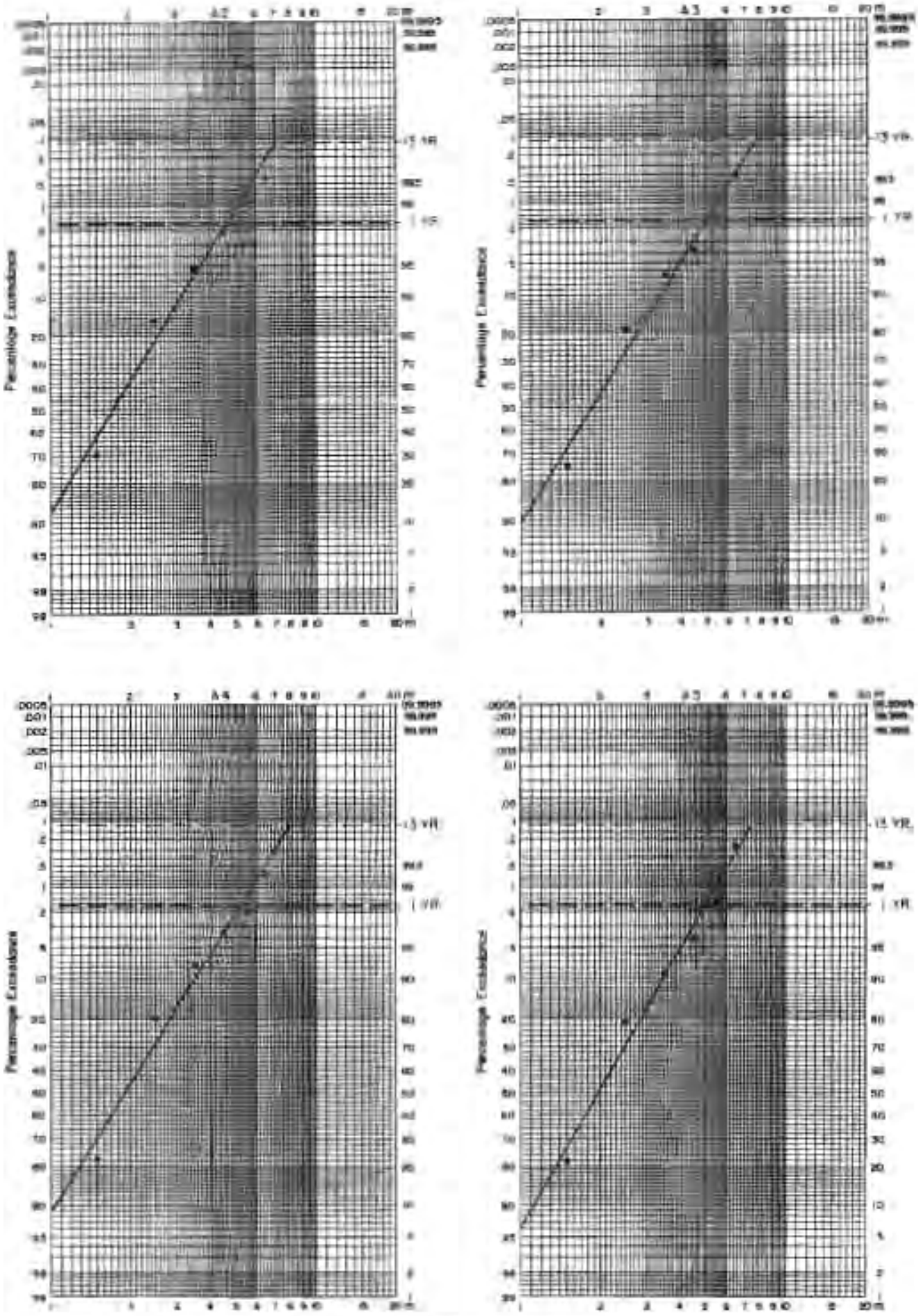


Figure 5c. Monthly Wave Height Exceedance Distribution for September

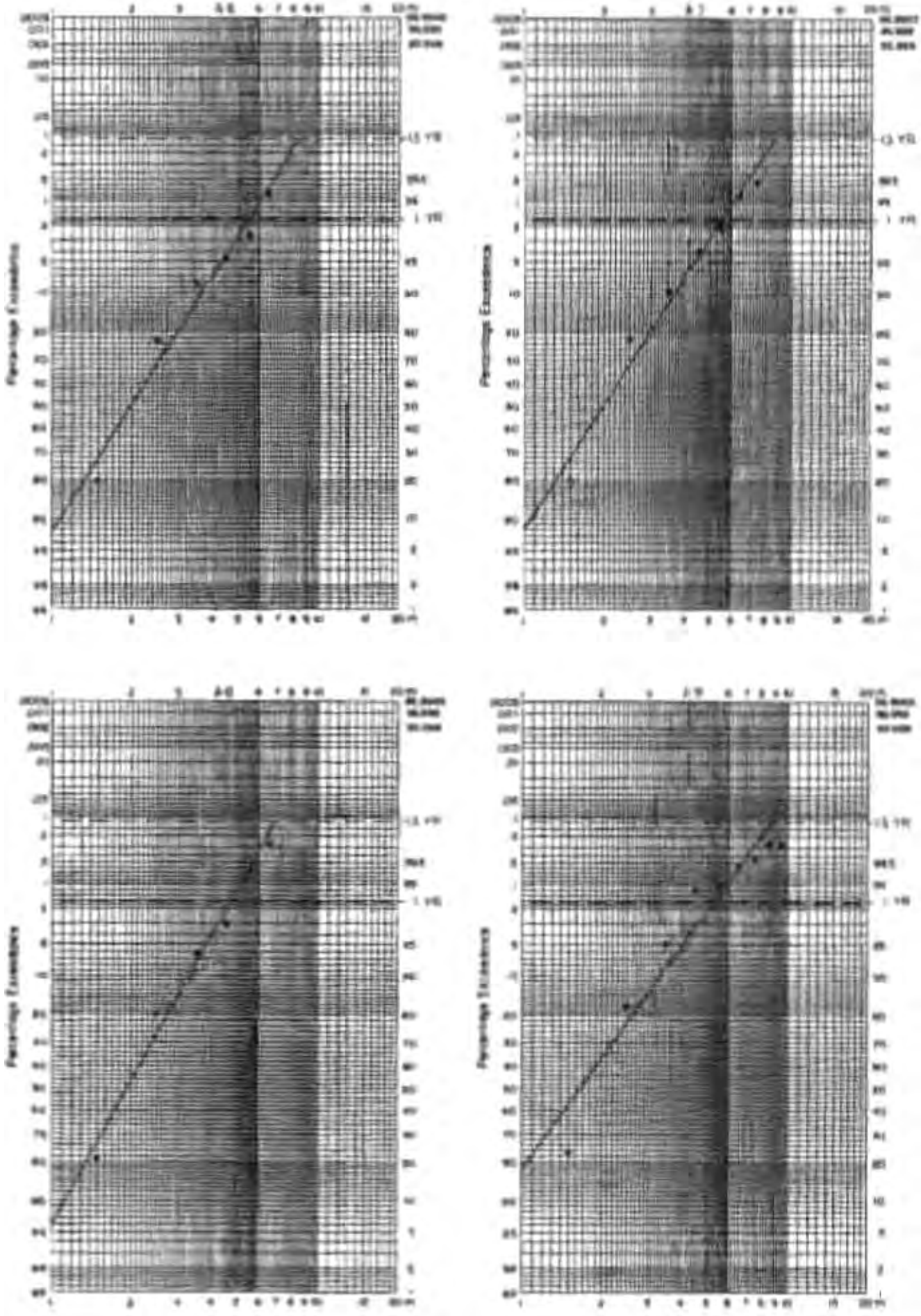
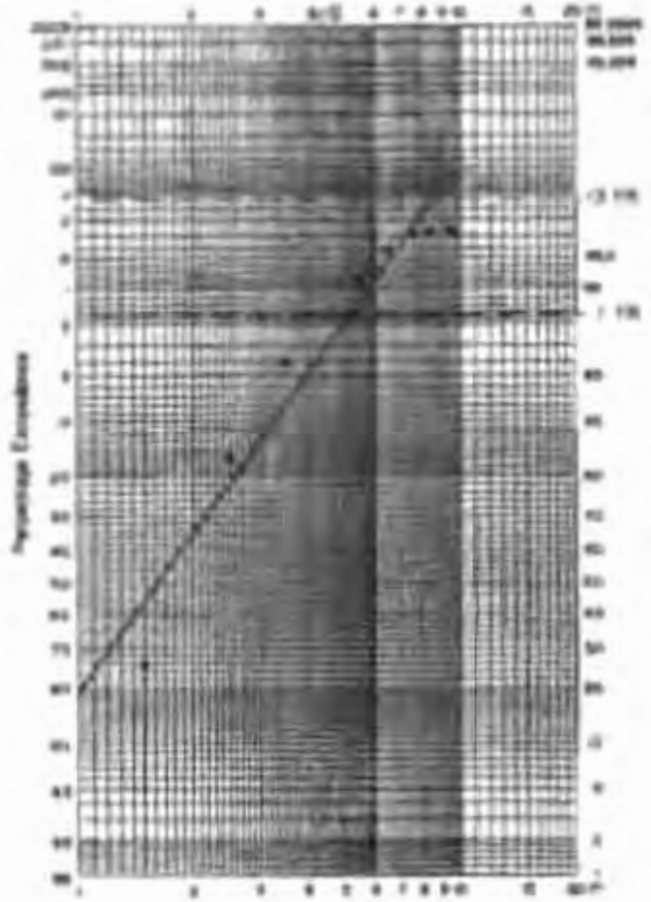
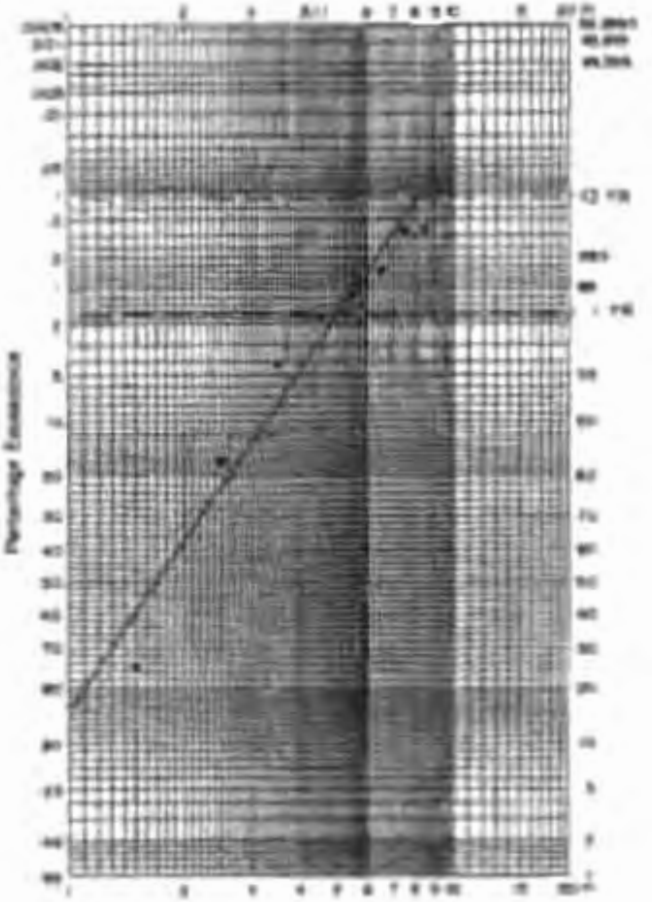
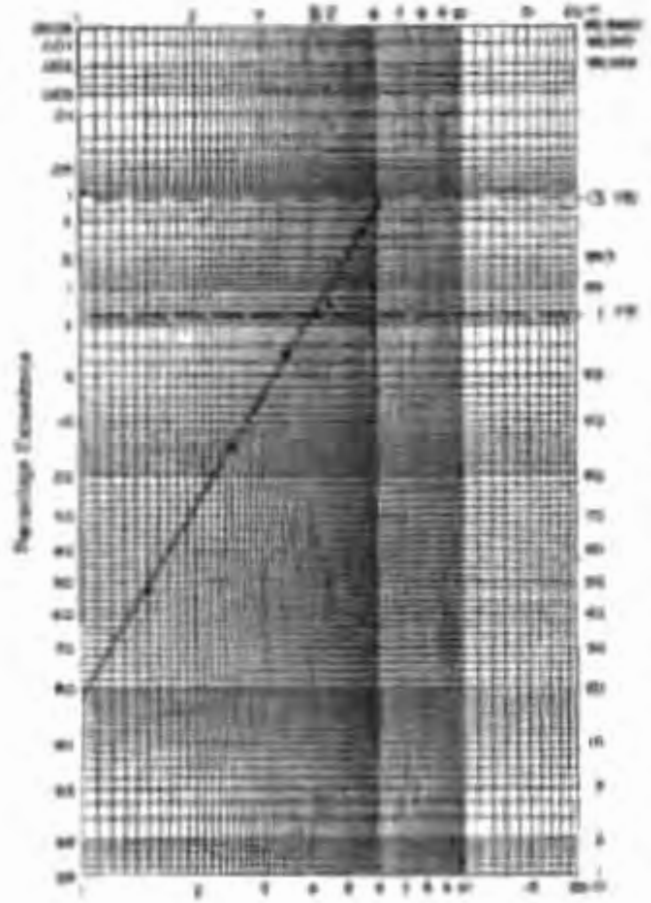


Figure 5c. Monthly Wave Height Exceedance Distribution for September







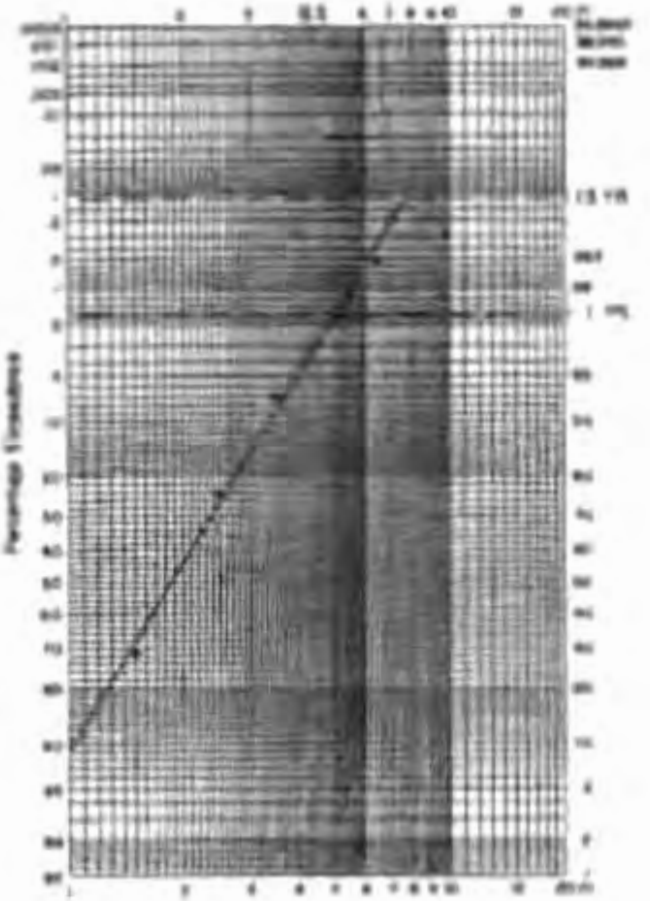


Figure 9a Monthly

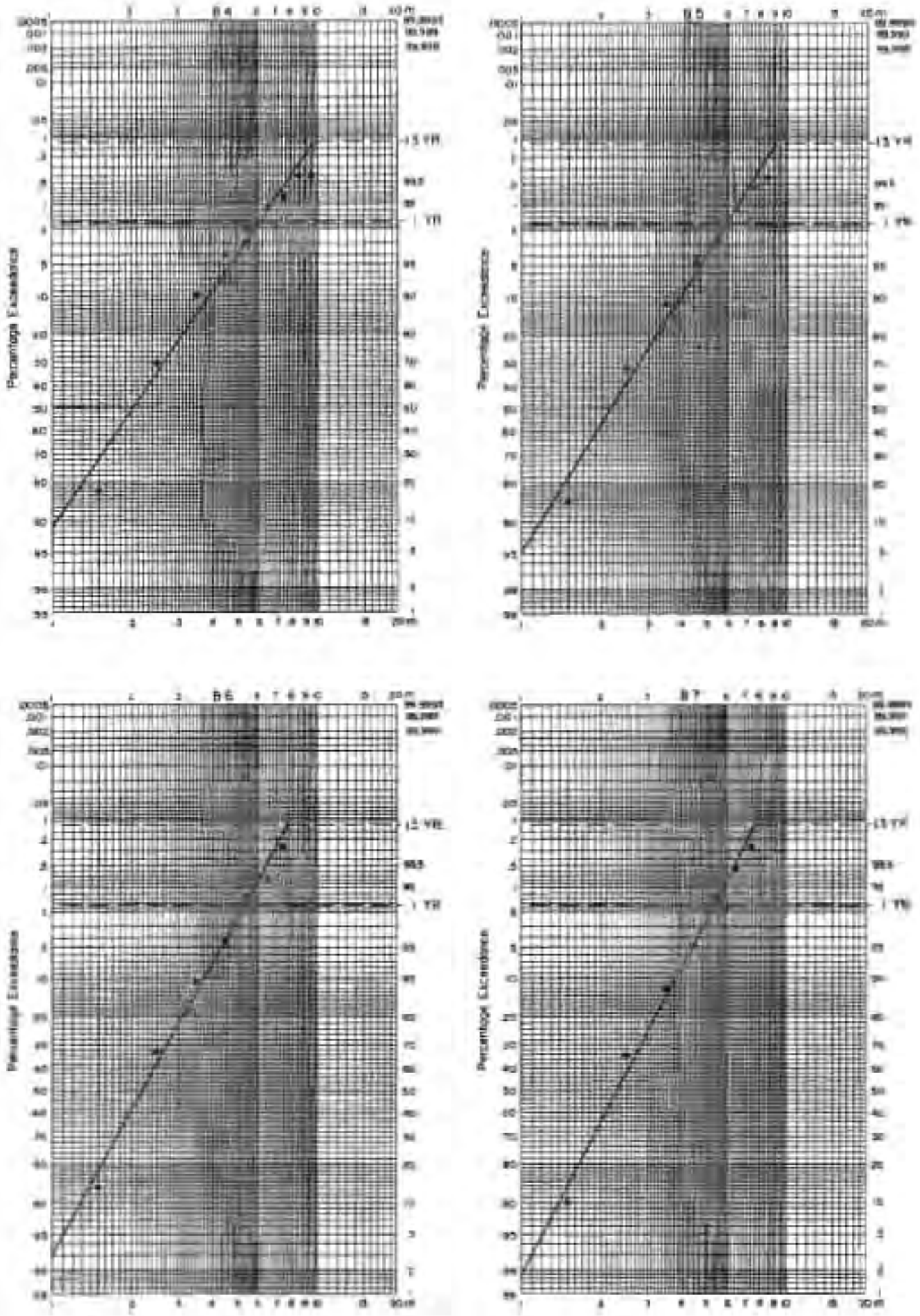


Figure 91 Monthly wave height Exceedance Distribution for September

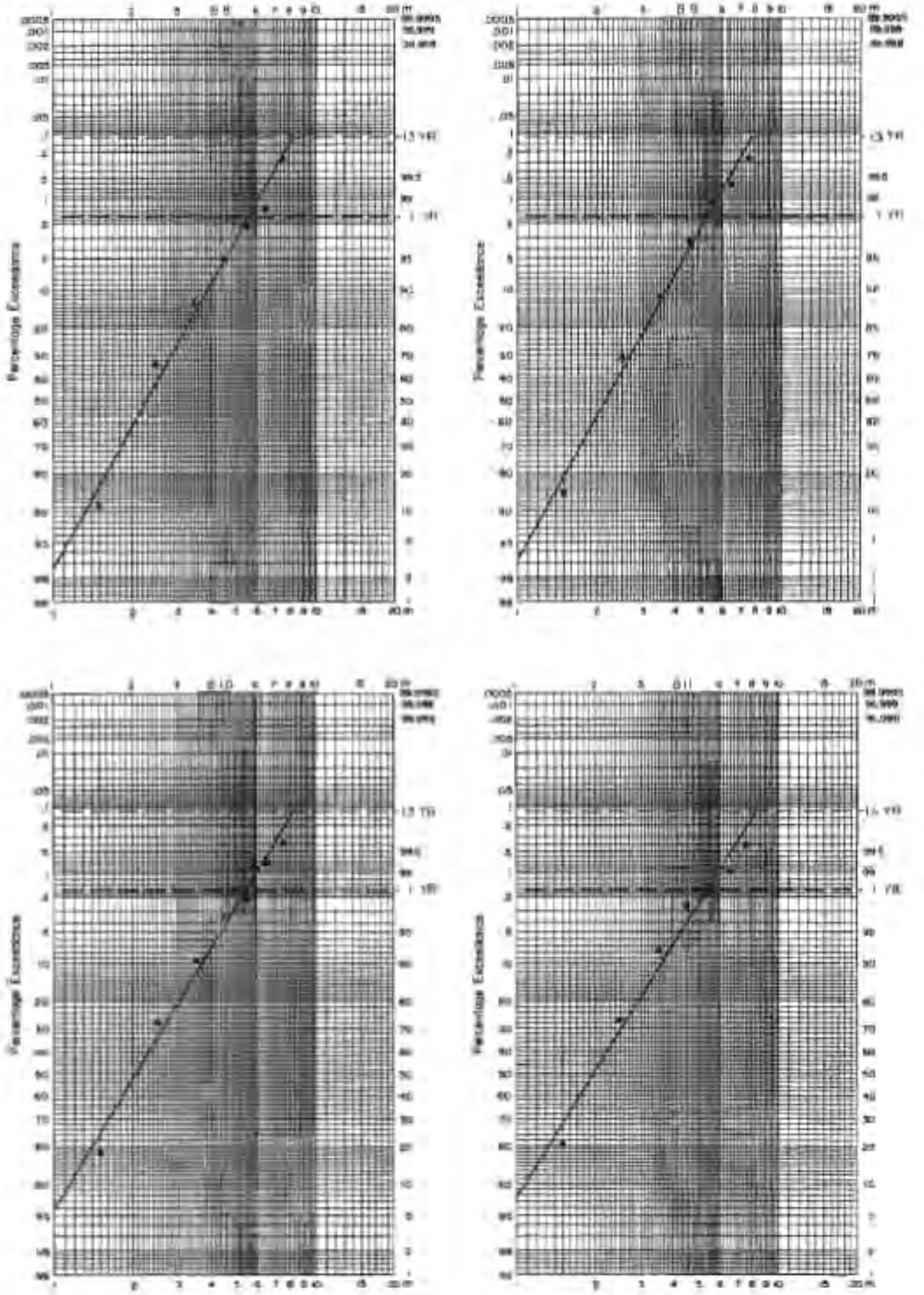
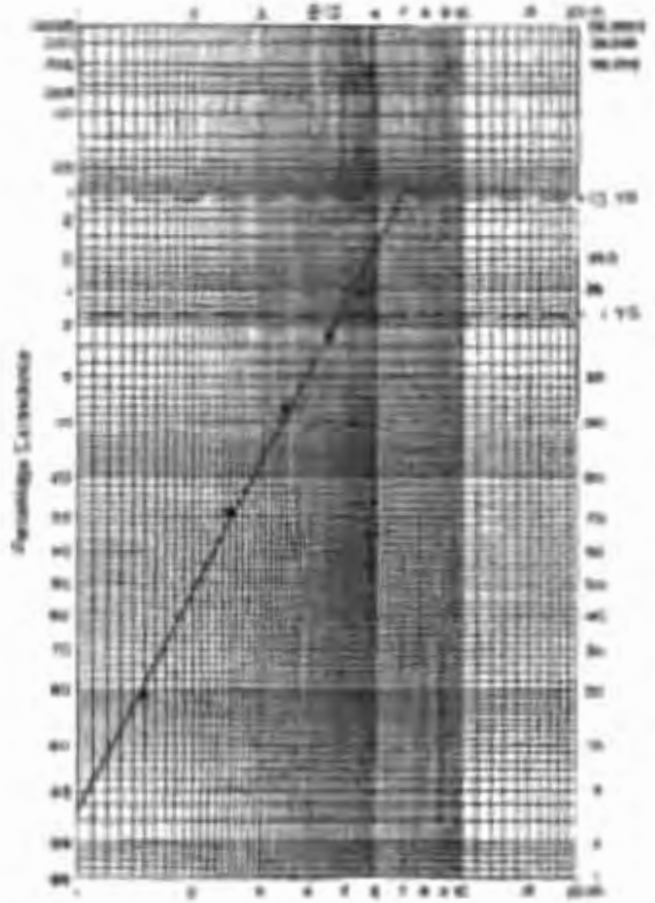
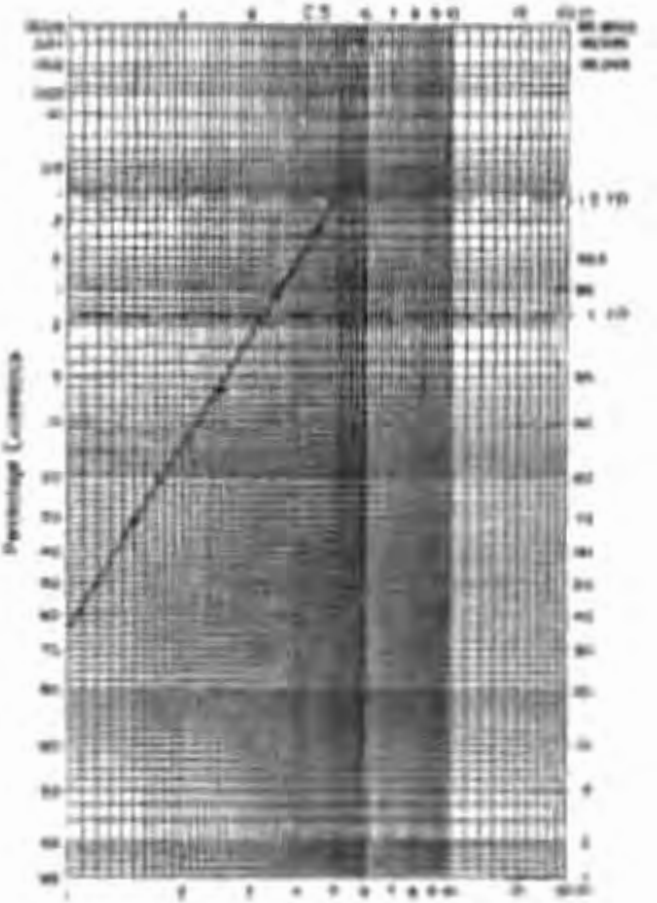
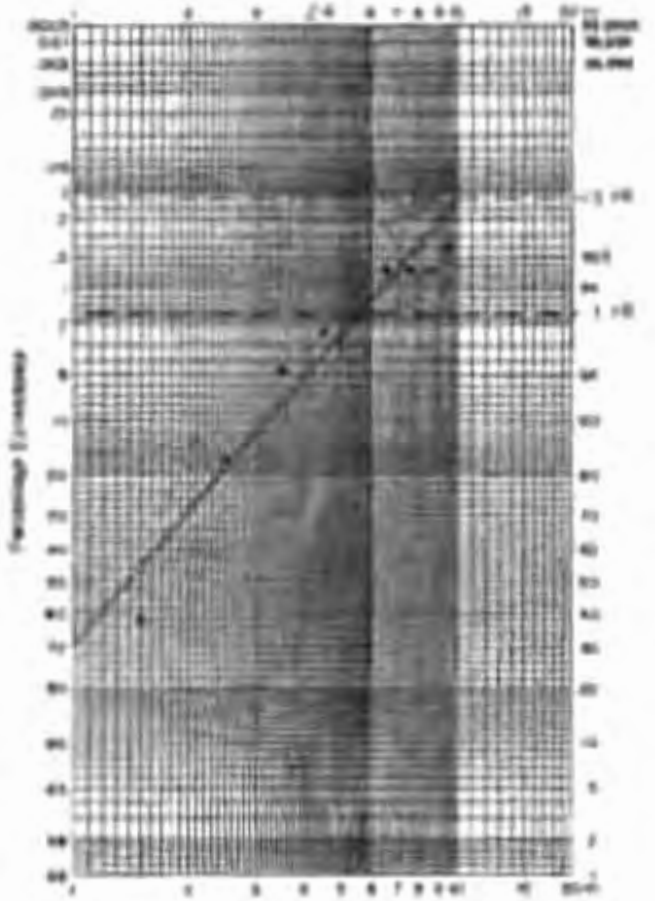
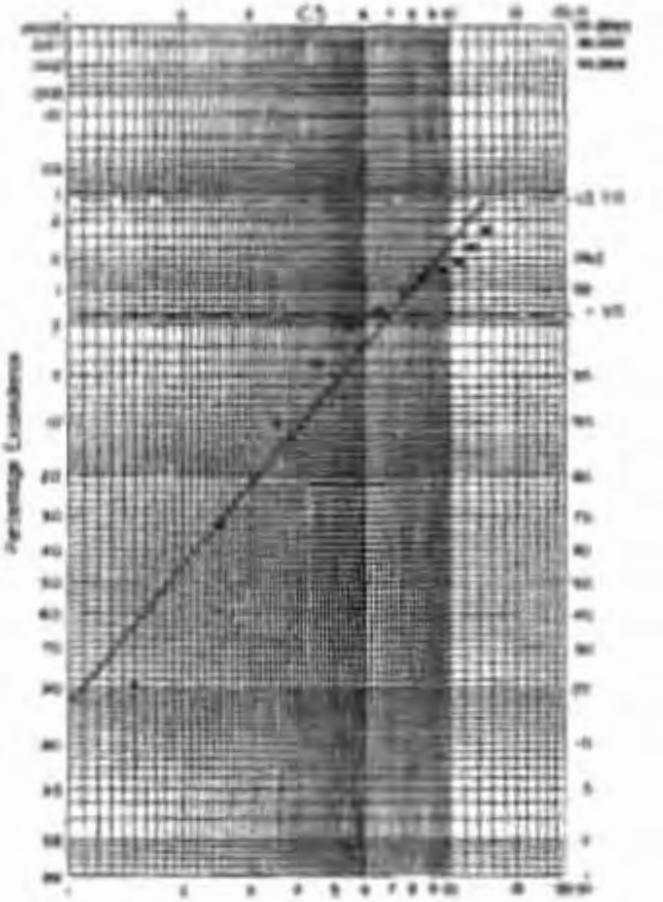


Figure 9g Monthly Wave Height Exceedance Distribution for September









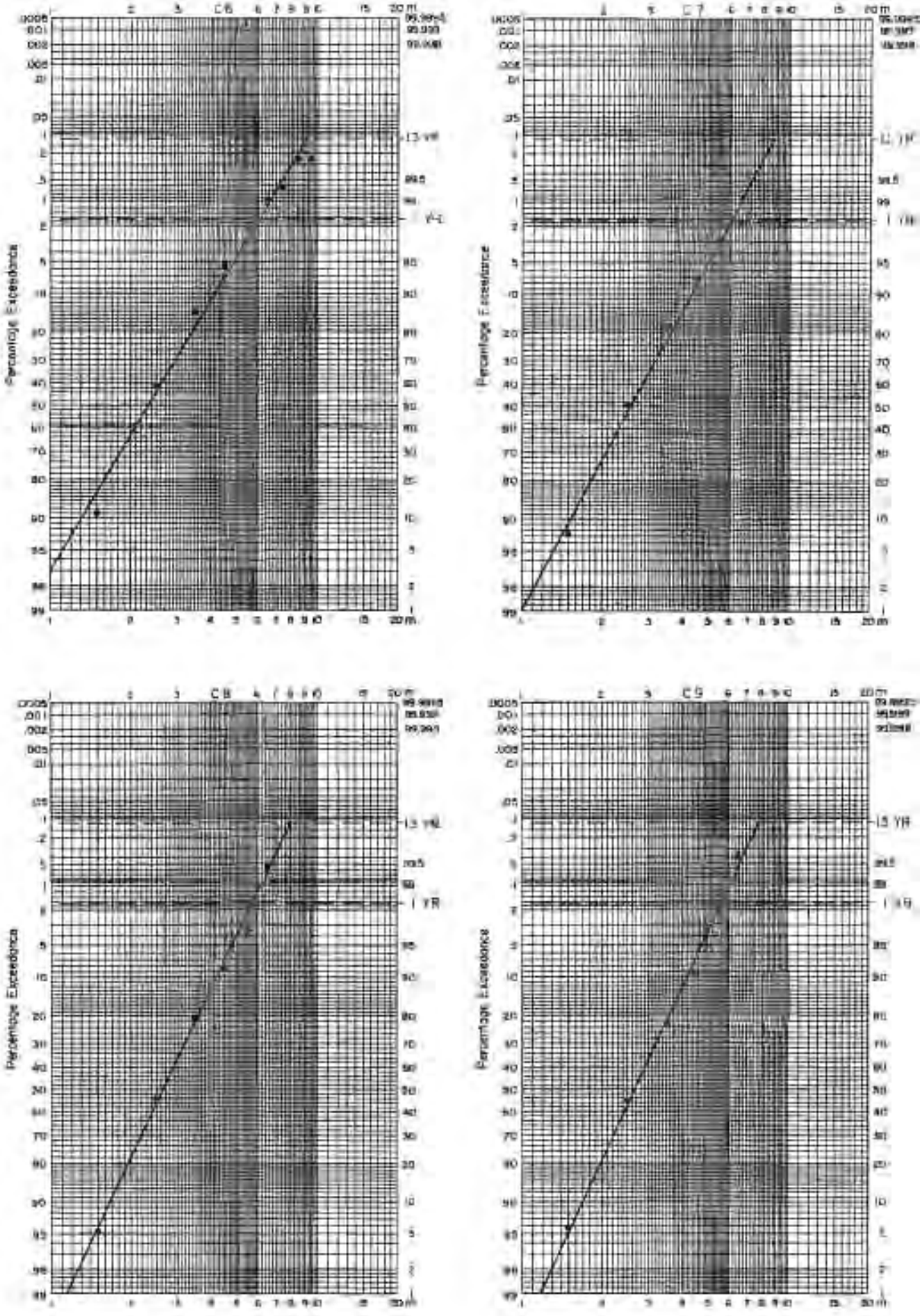
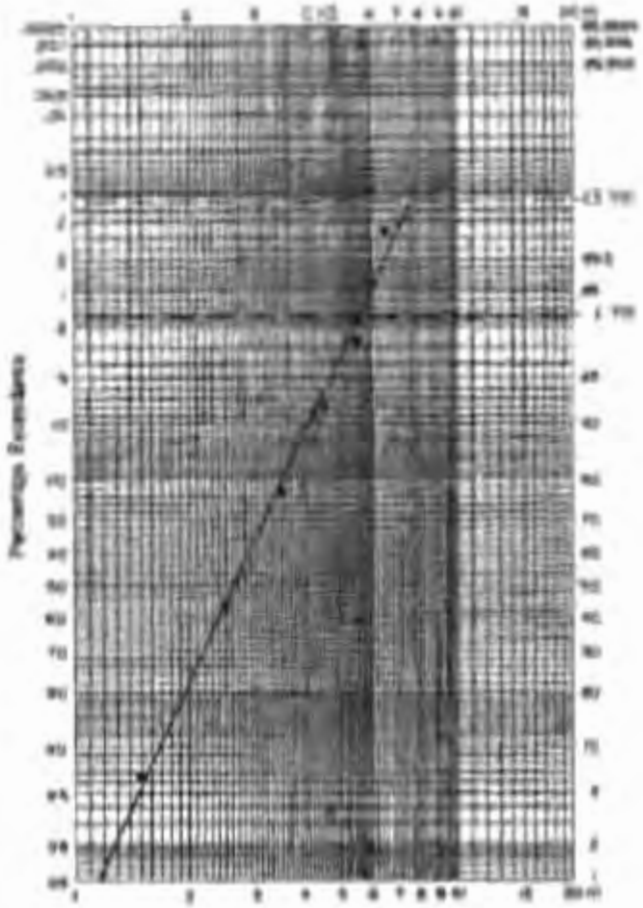
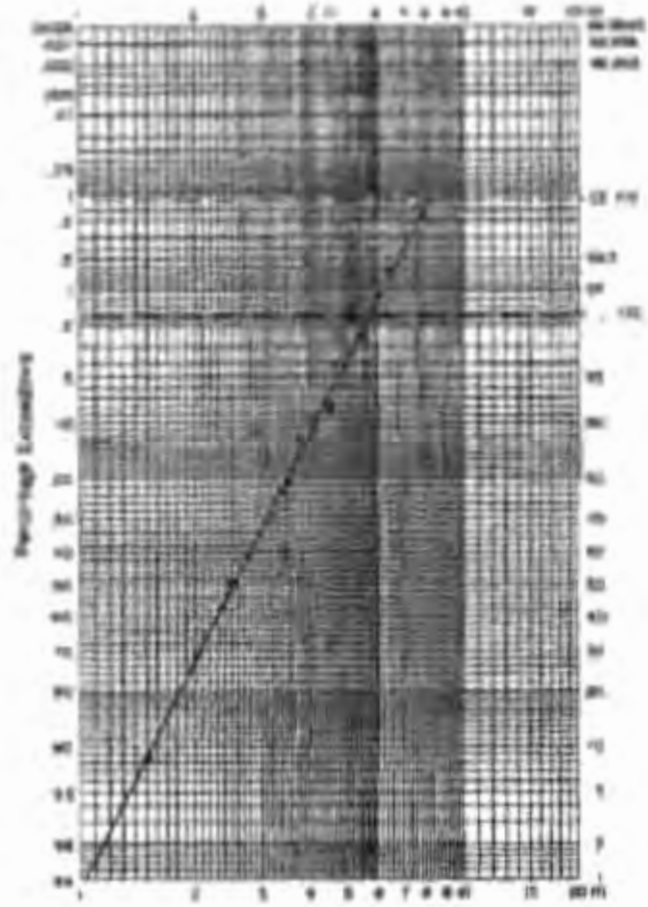
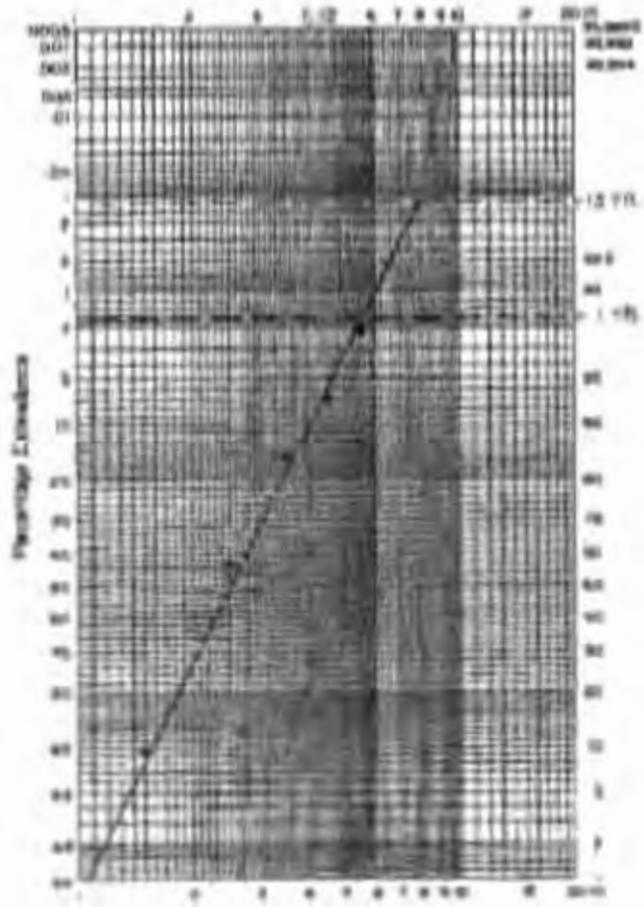
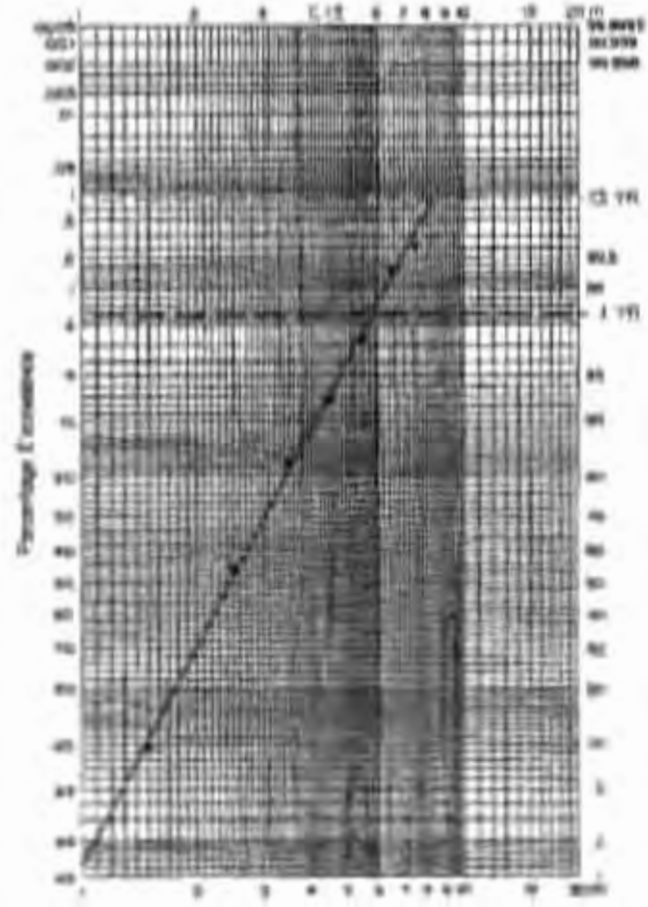


Figure (3) Monthly Wave Height Exceedance Distribution for September









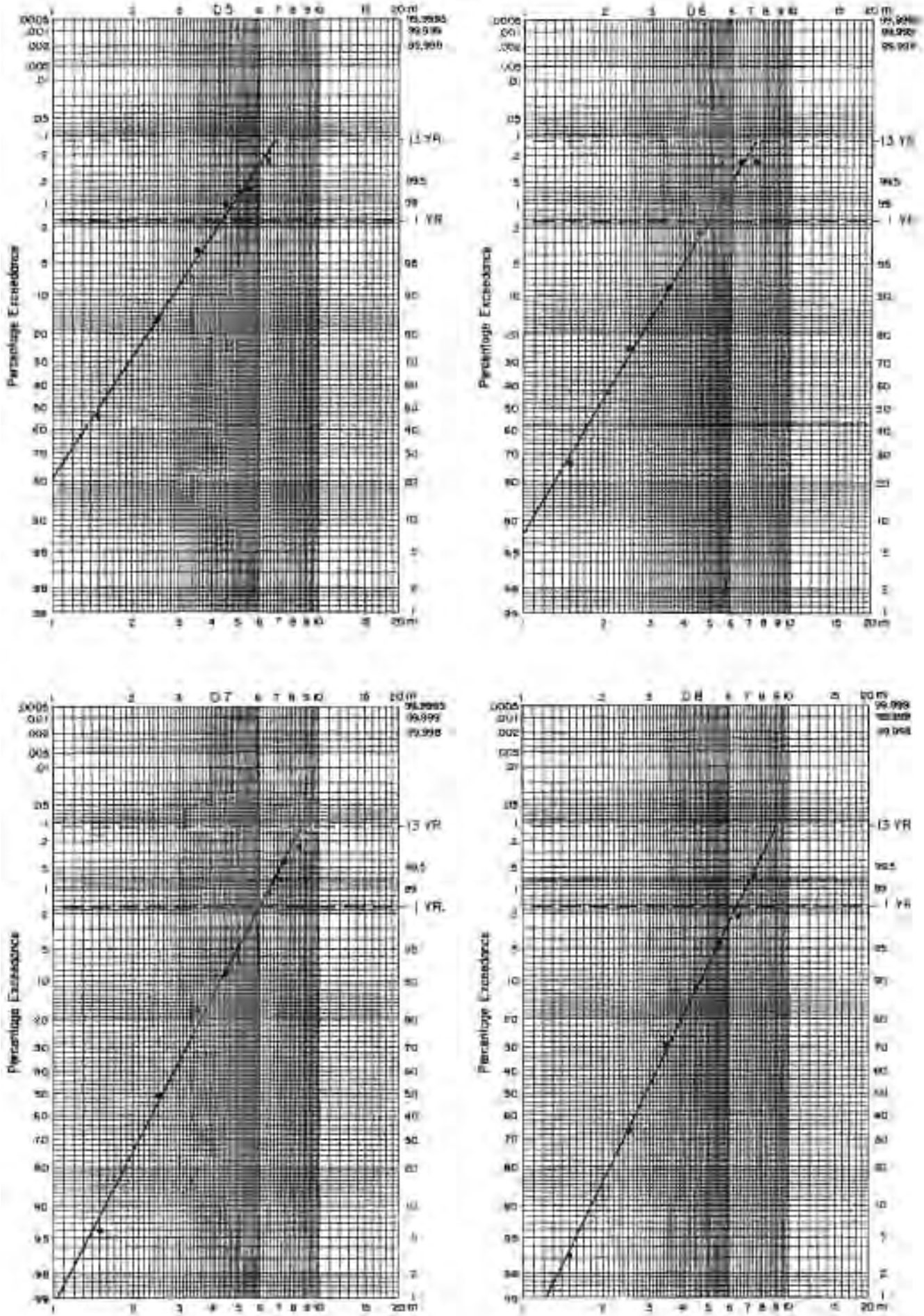


Figure 91 Monthly Wave Height Exceedance Distribution for September

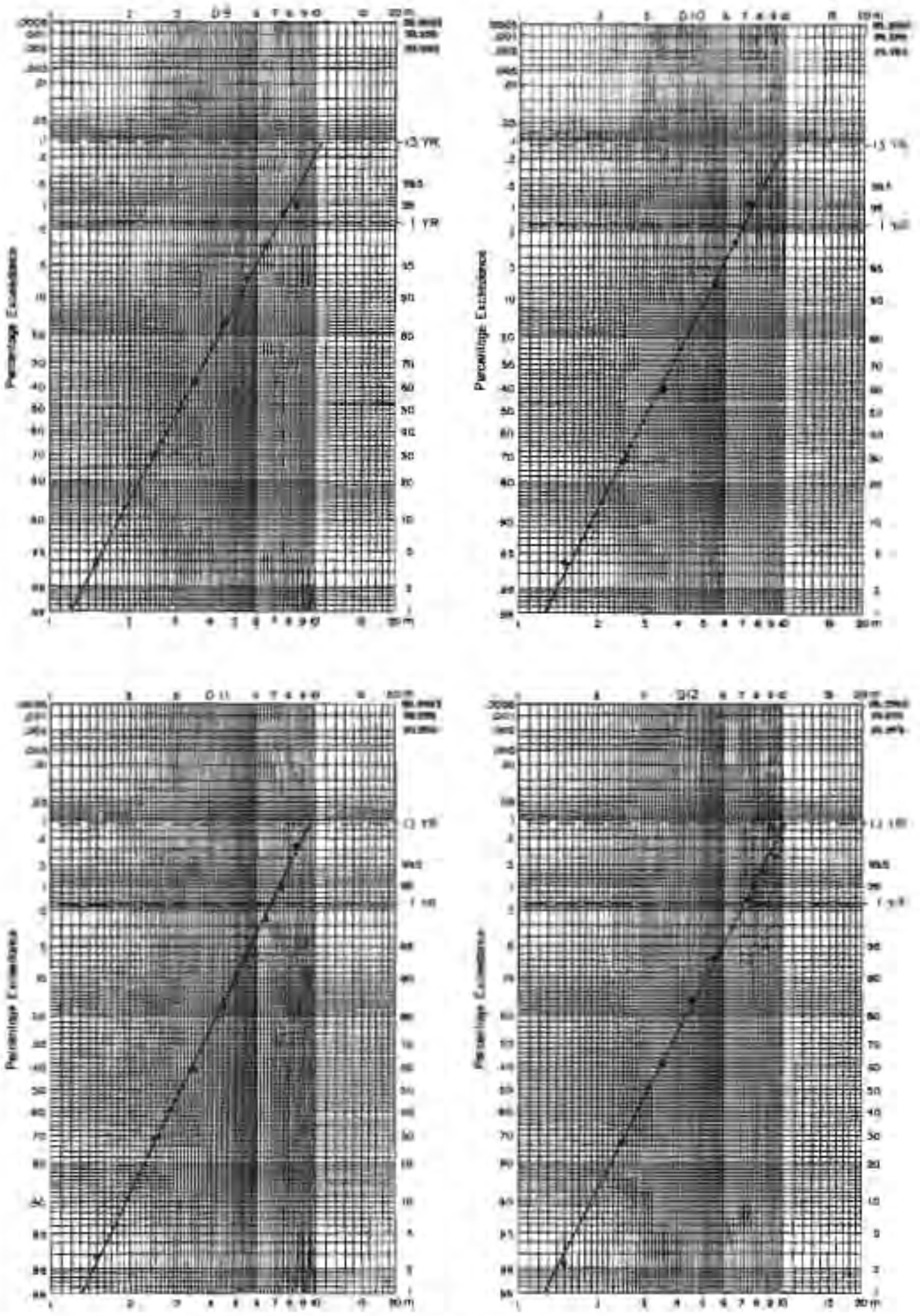


Figure 31 Monthly Wave Height Exceedance Distribution for September

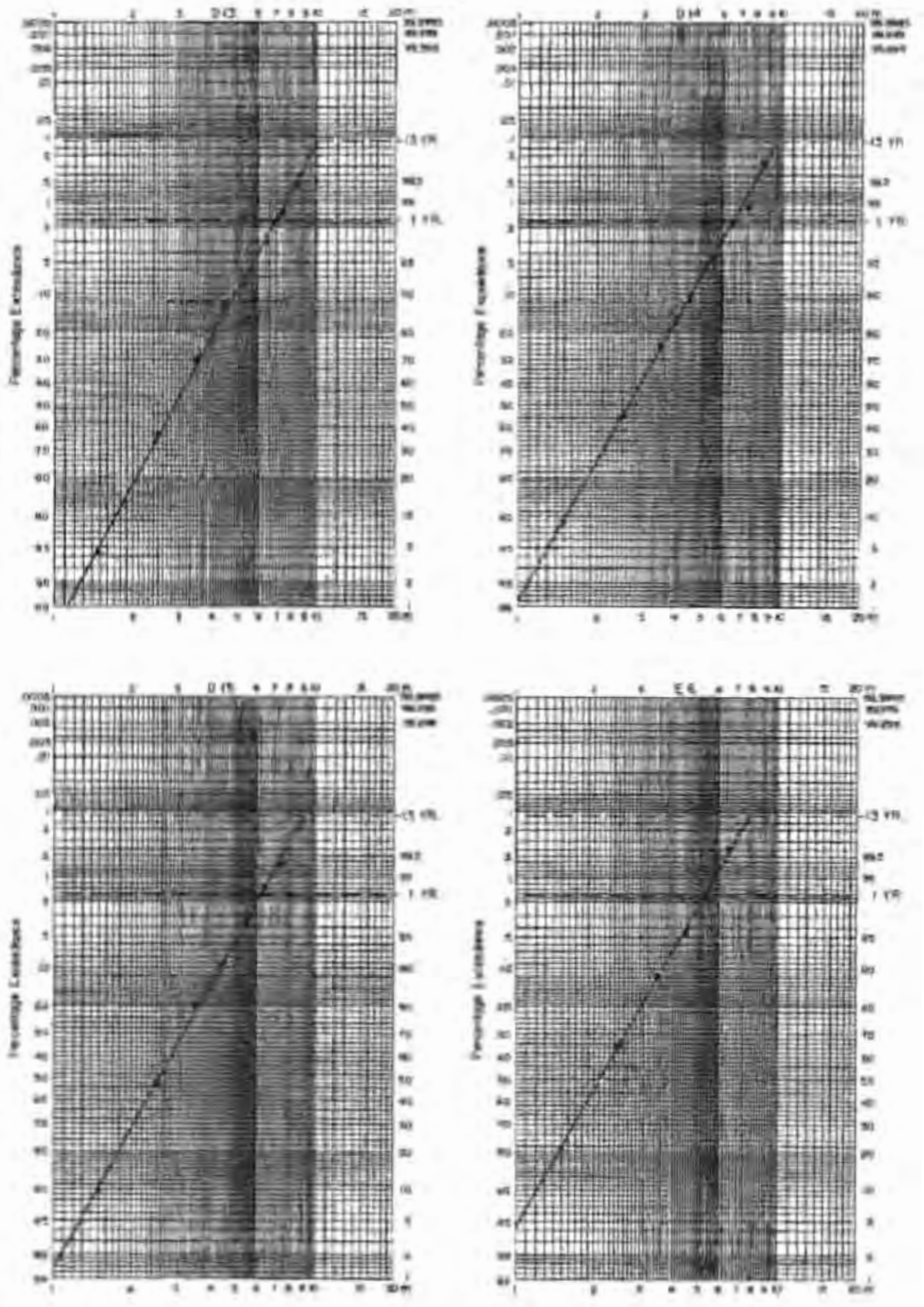
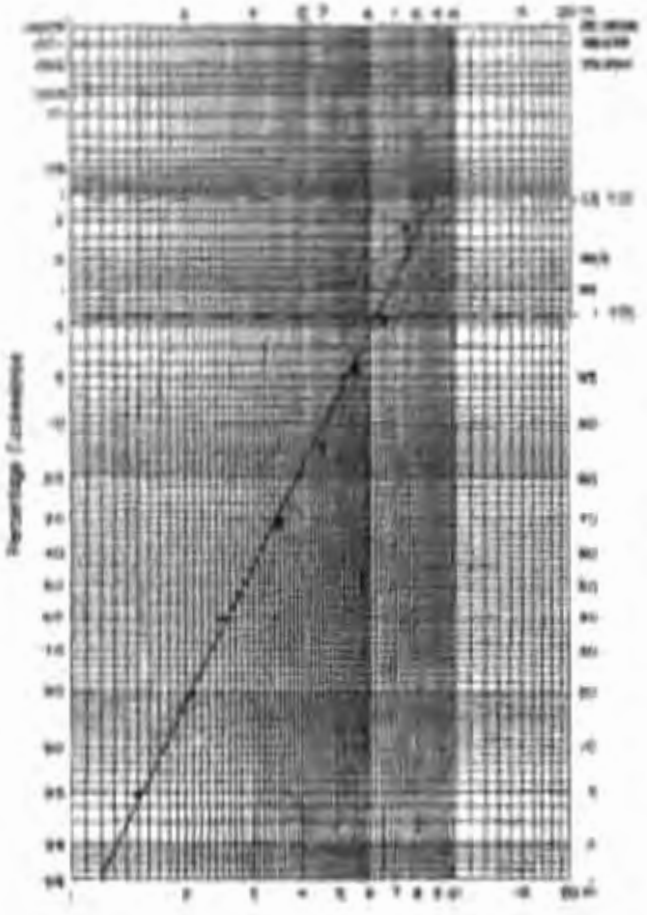
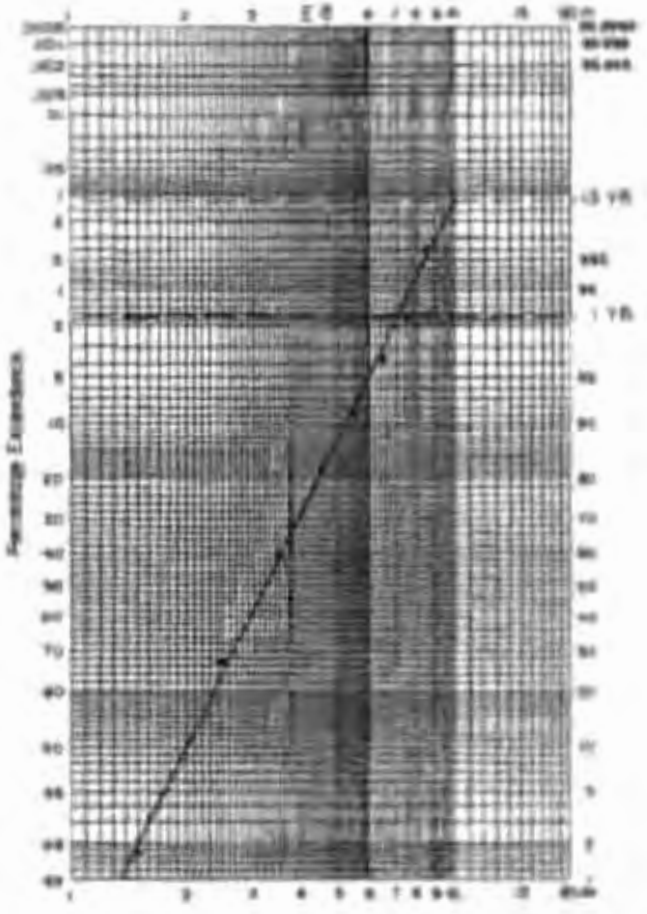
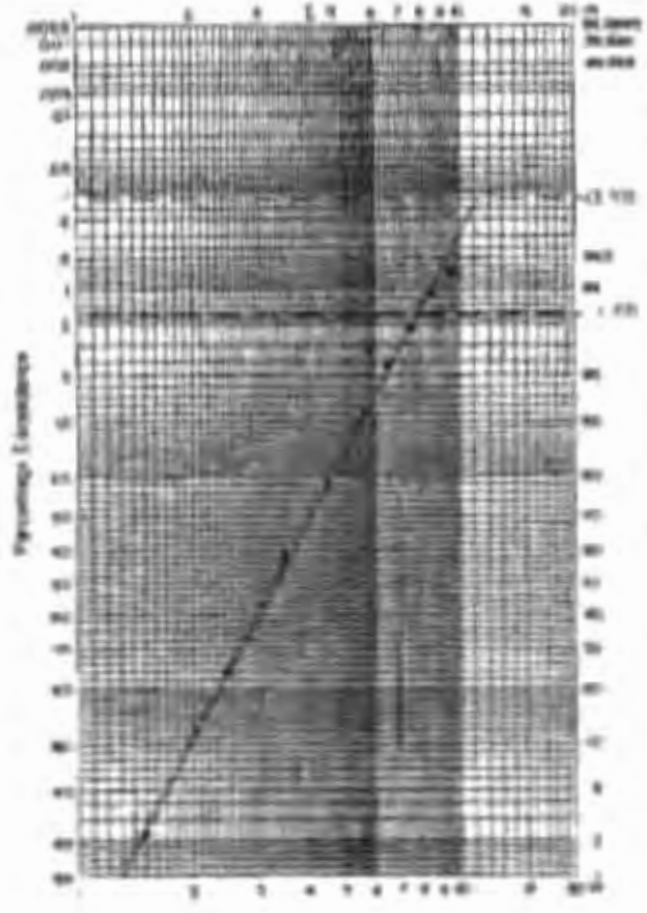


Figure 5m Monthly Wave Height Exceedance Distribution for September







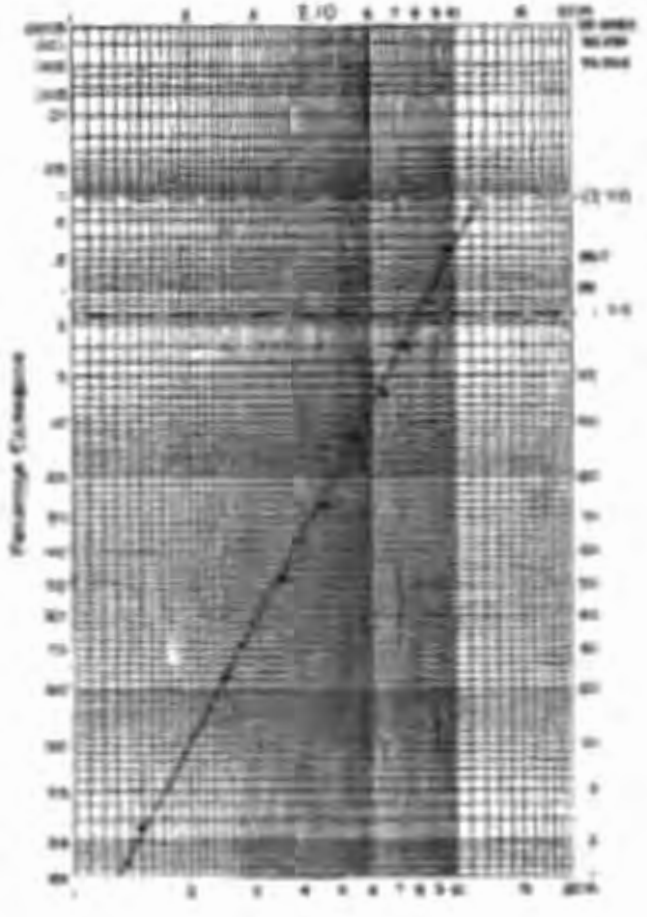


Figure 9a

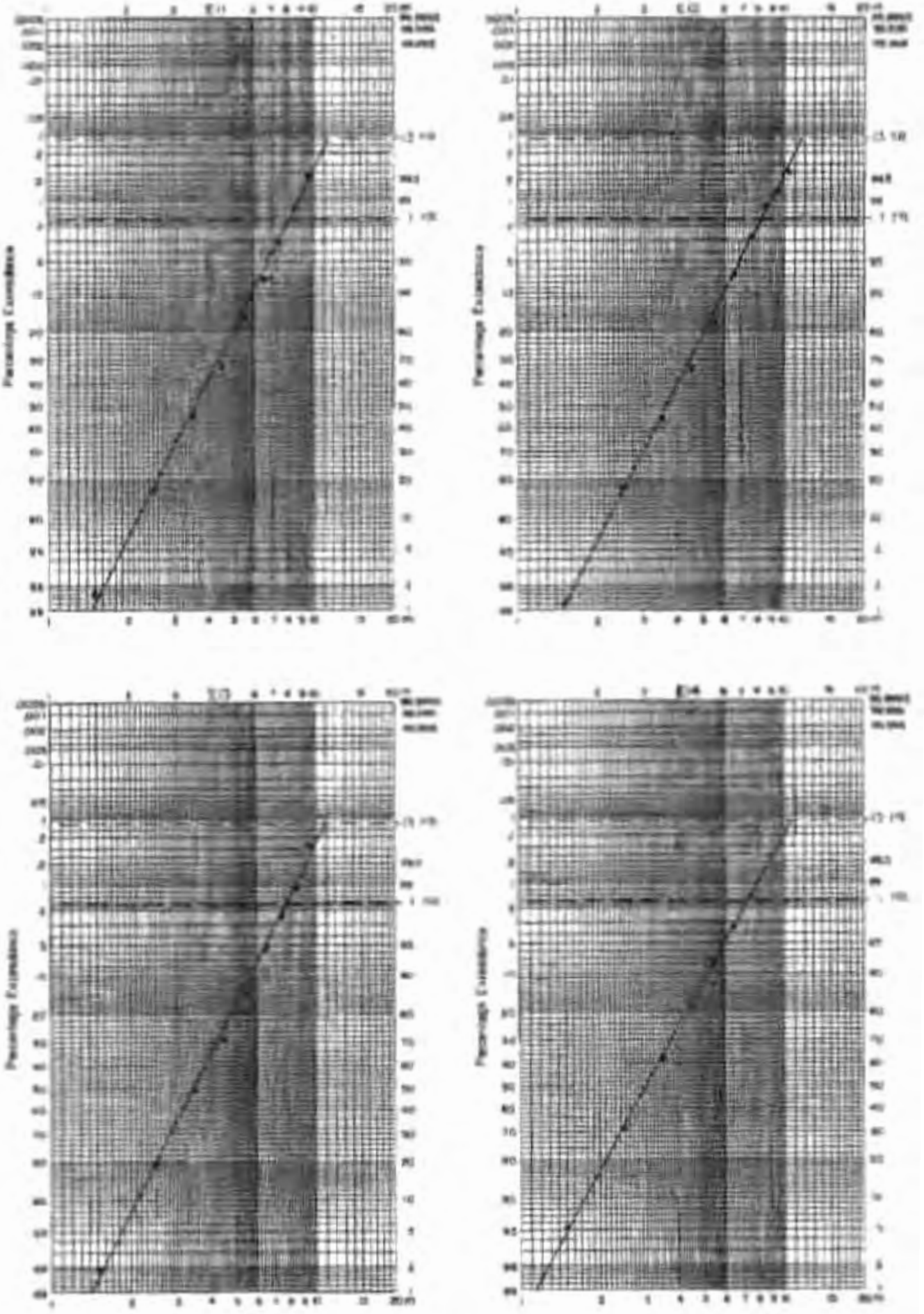


Figure 96. Monthly Wave Height Exceedance Distribution for September

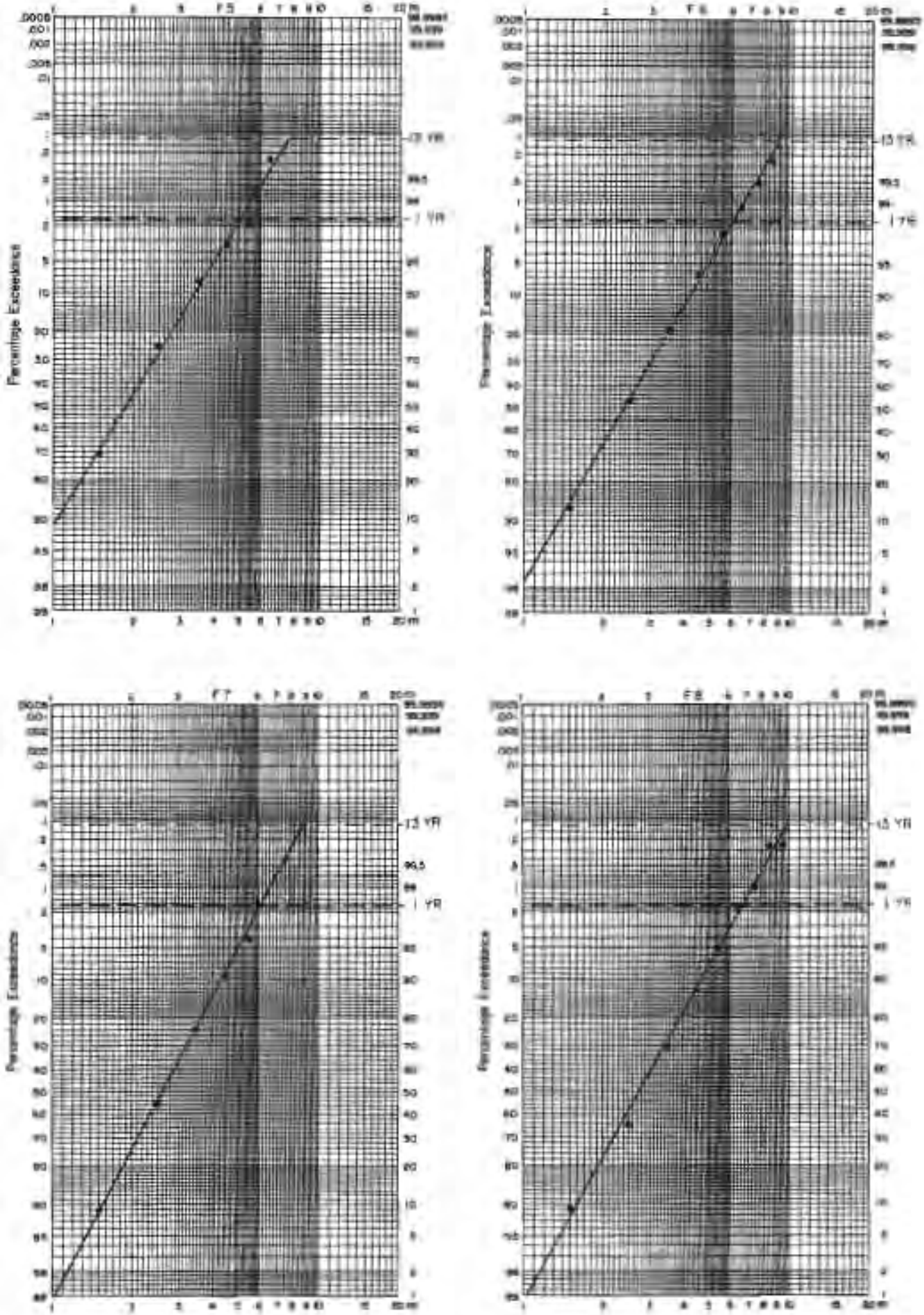


Figure 9p Monthly Wave Height Exceedance Distribution for September

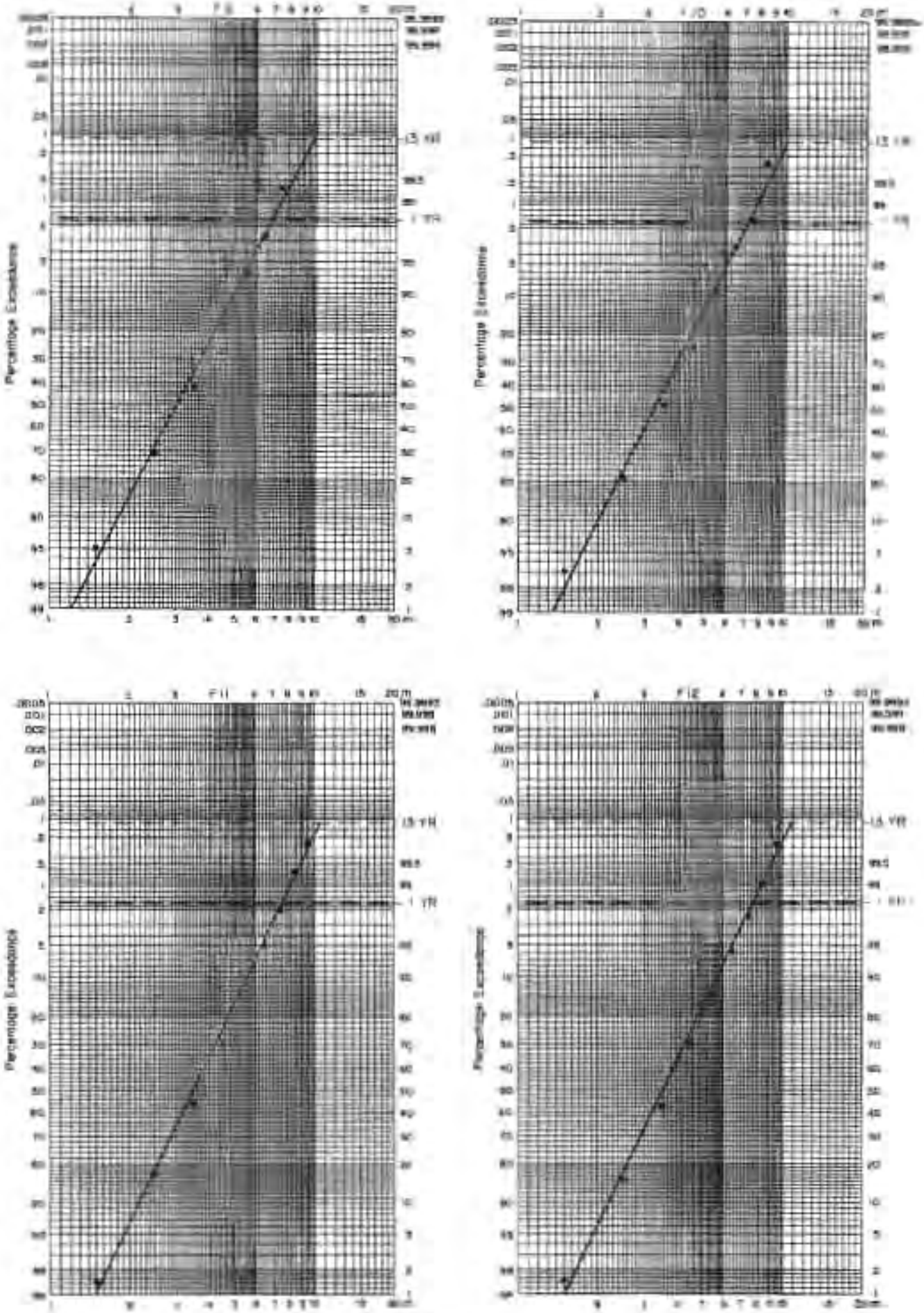


Figure 9b Monthly Wave Height Exceedance Distribution for September

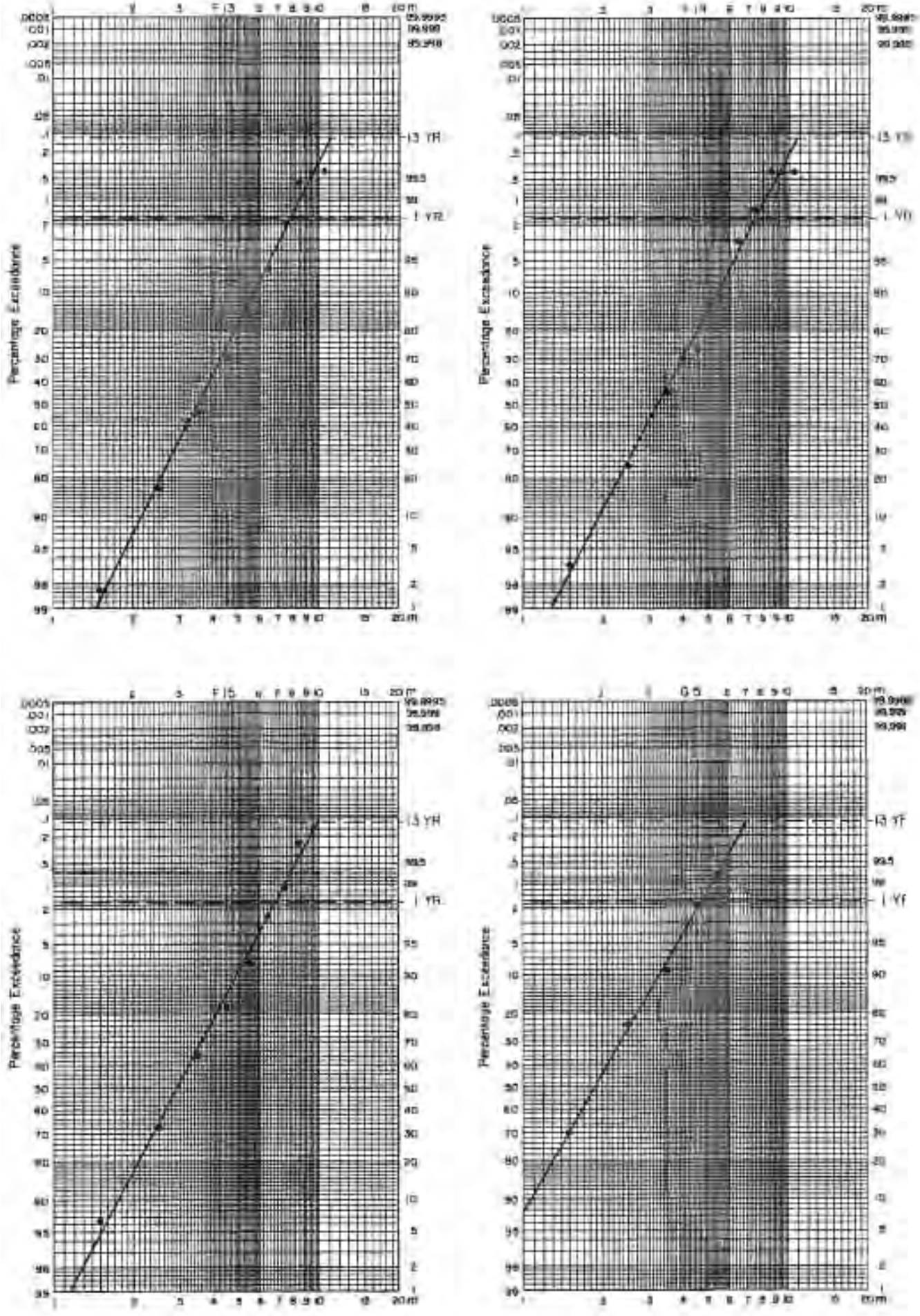


Figure 31 Monthly Wave Height Exceedance Distribution for September

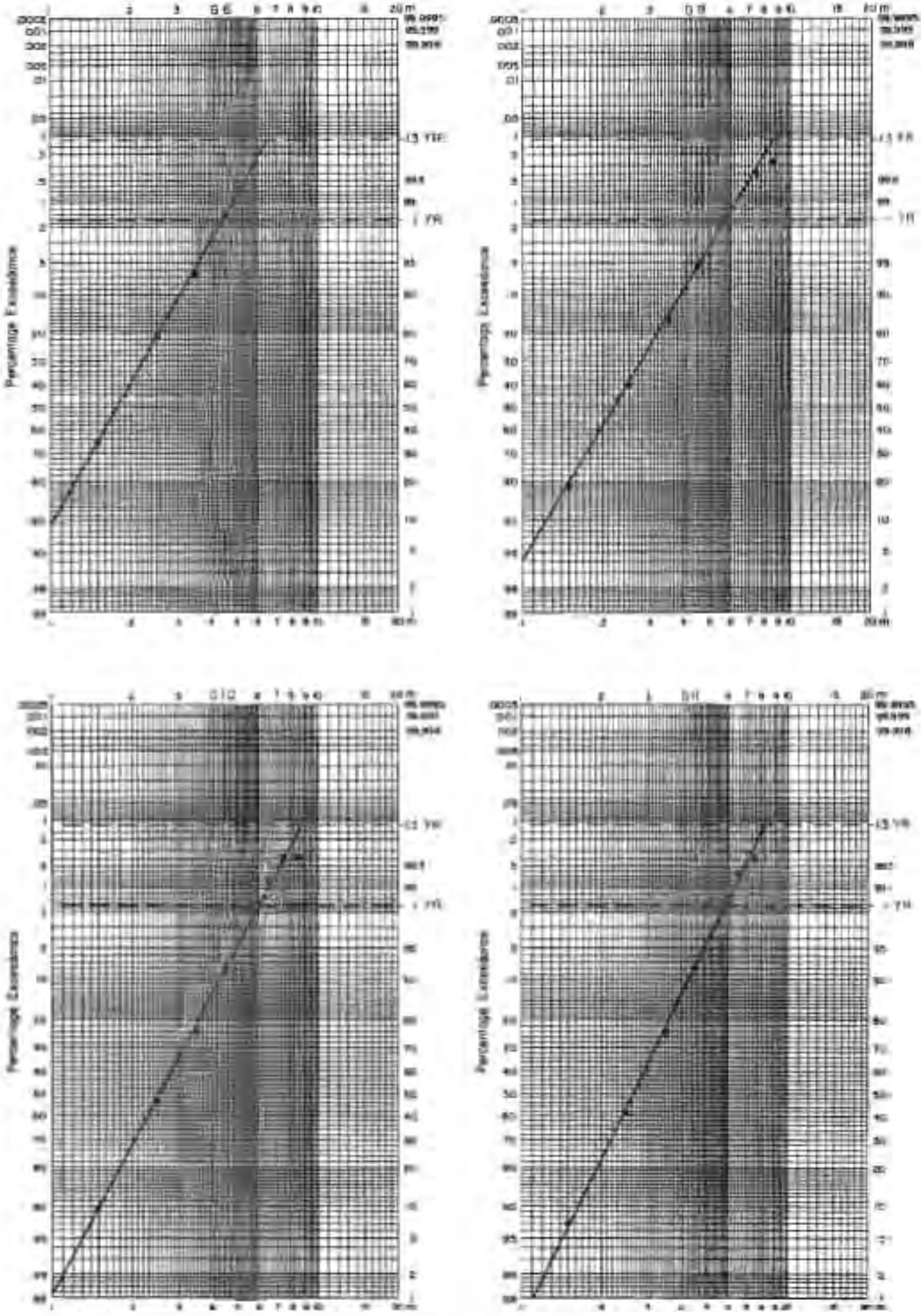
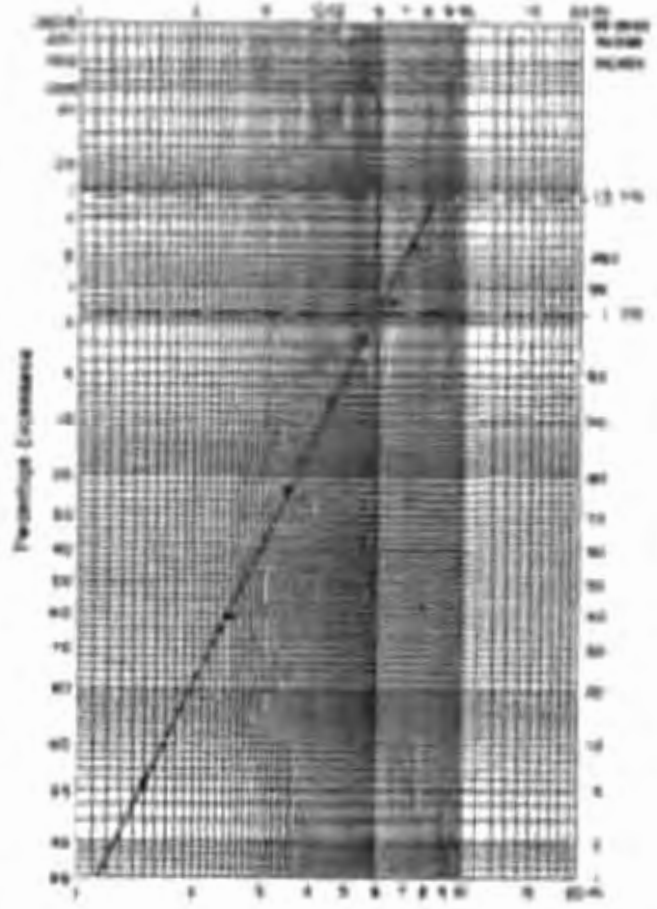
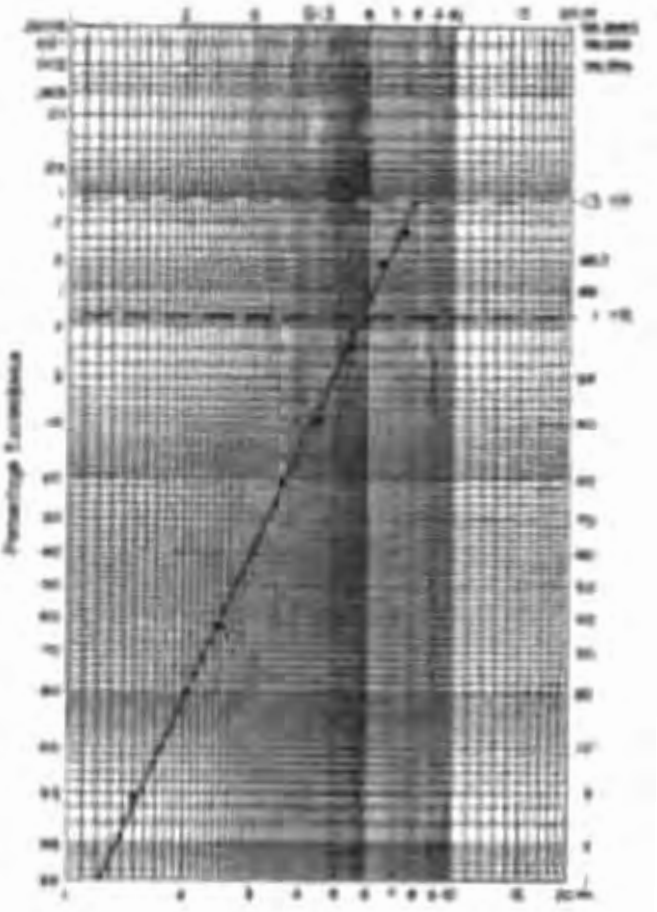
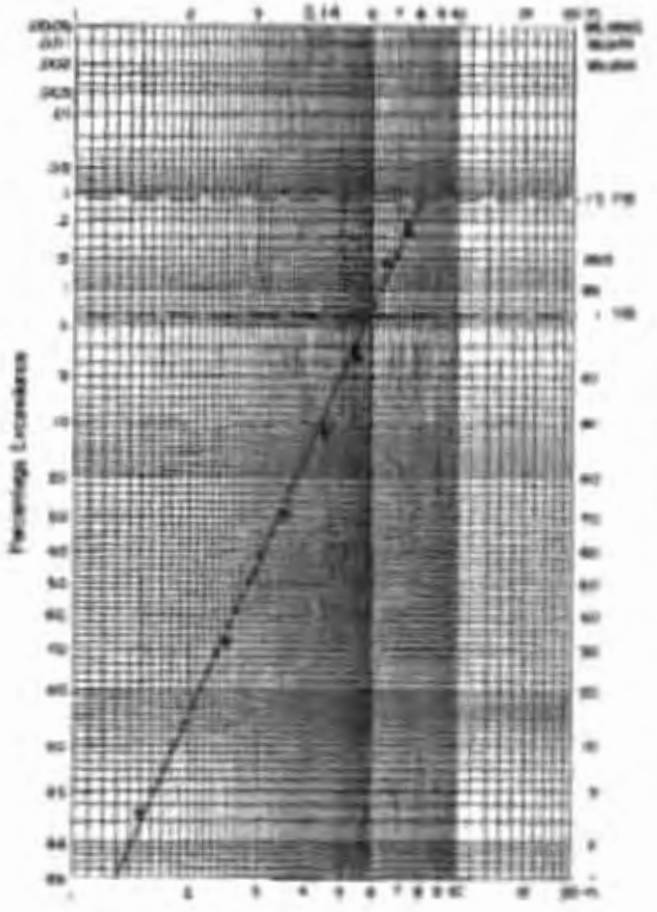


Figure 9c. Monthly Wave Height Exceedance Distribution for September







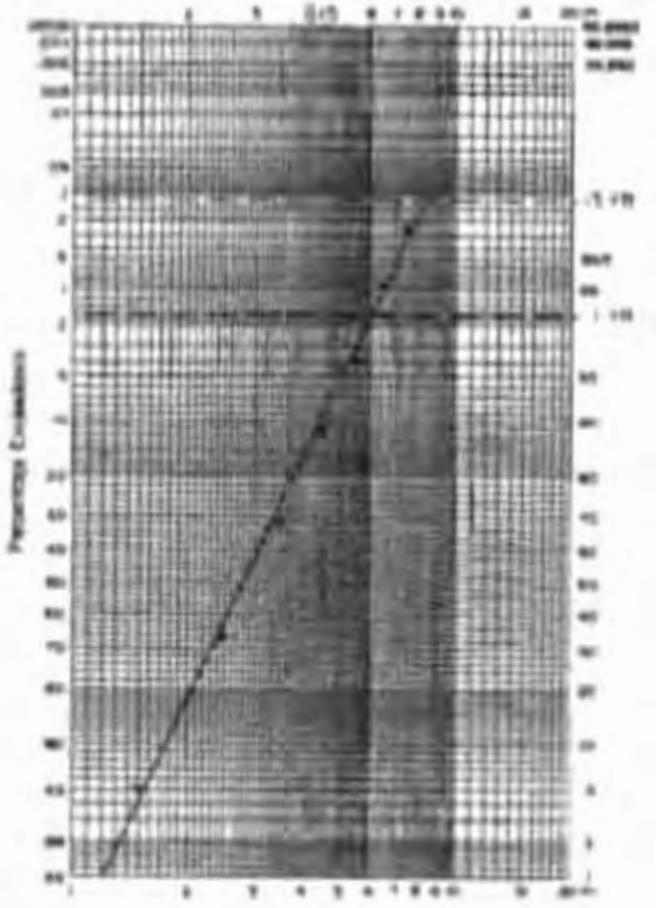


Figure 91 N

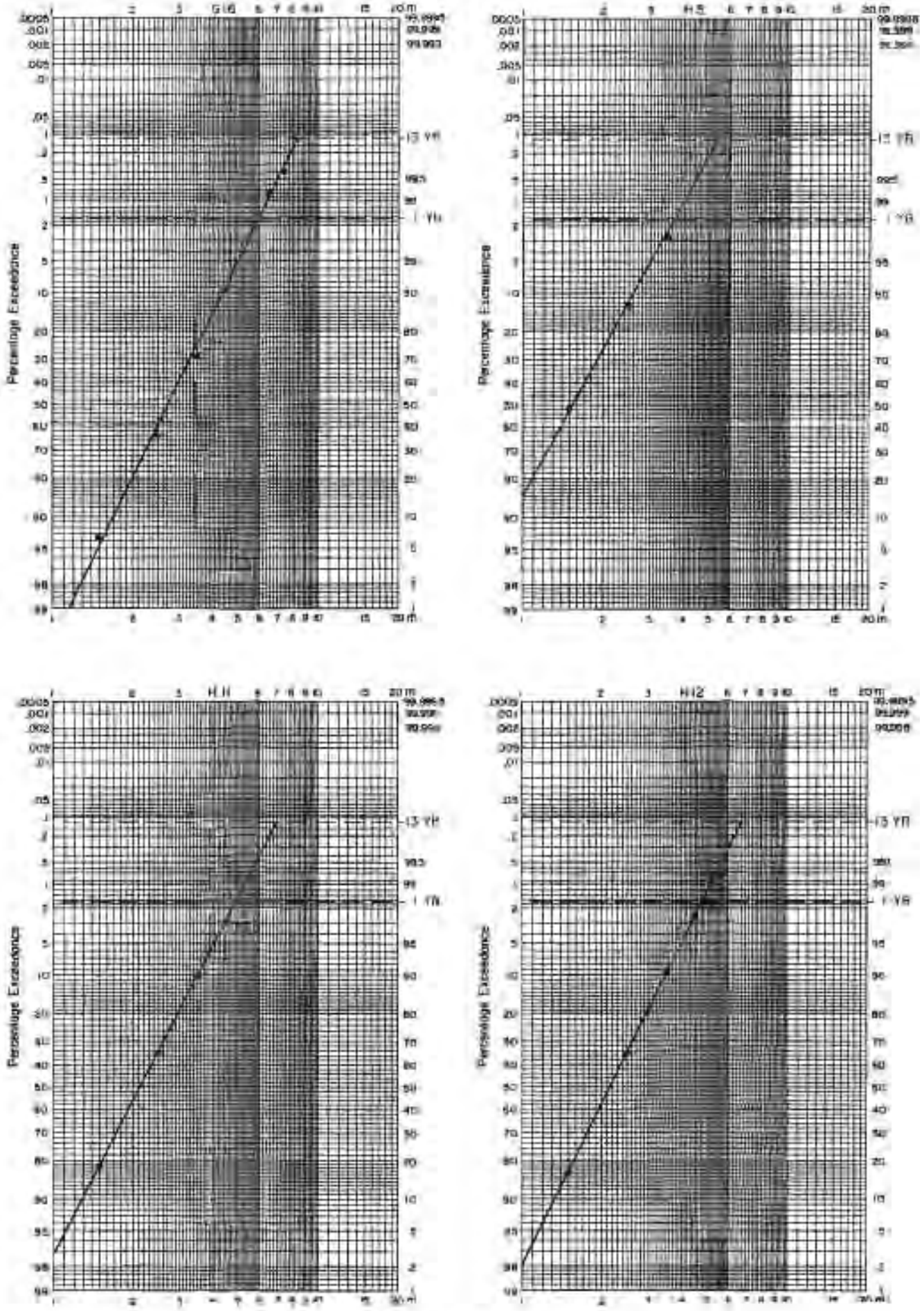


Figure 3u Monthly Wave Height Exceedance Distribution for September

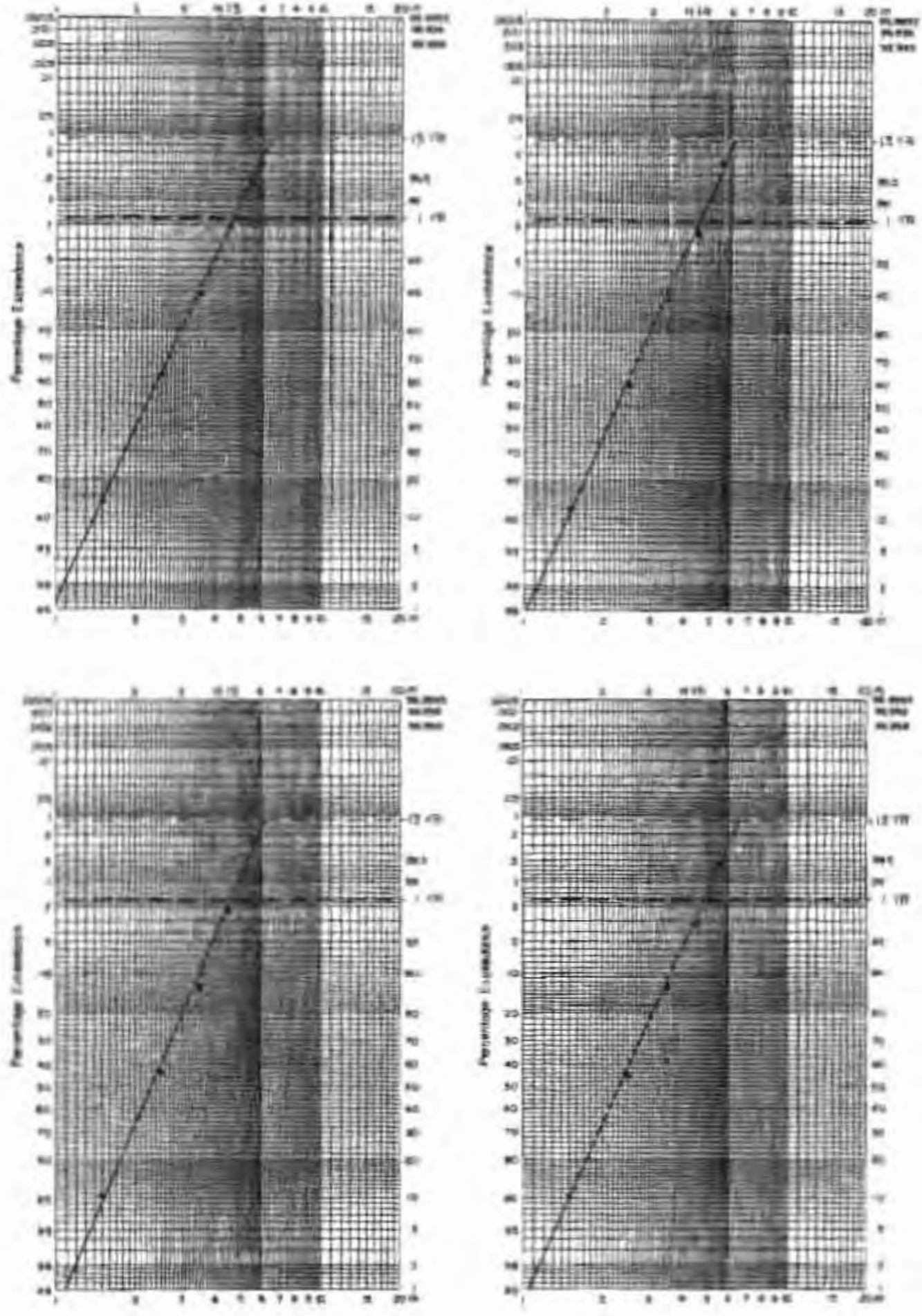


Figure 9v. Monthly Wave Height Exceedance Distribution for September

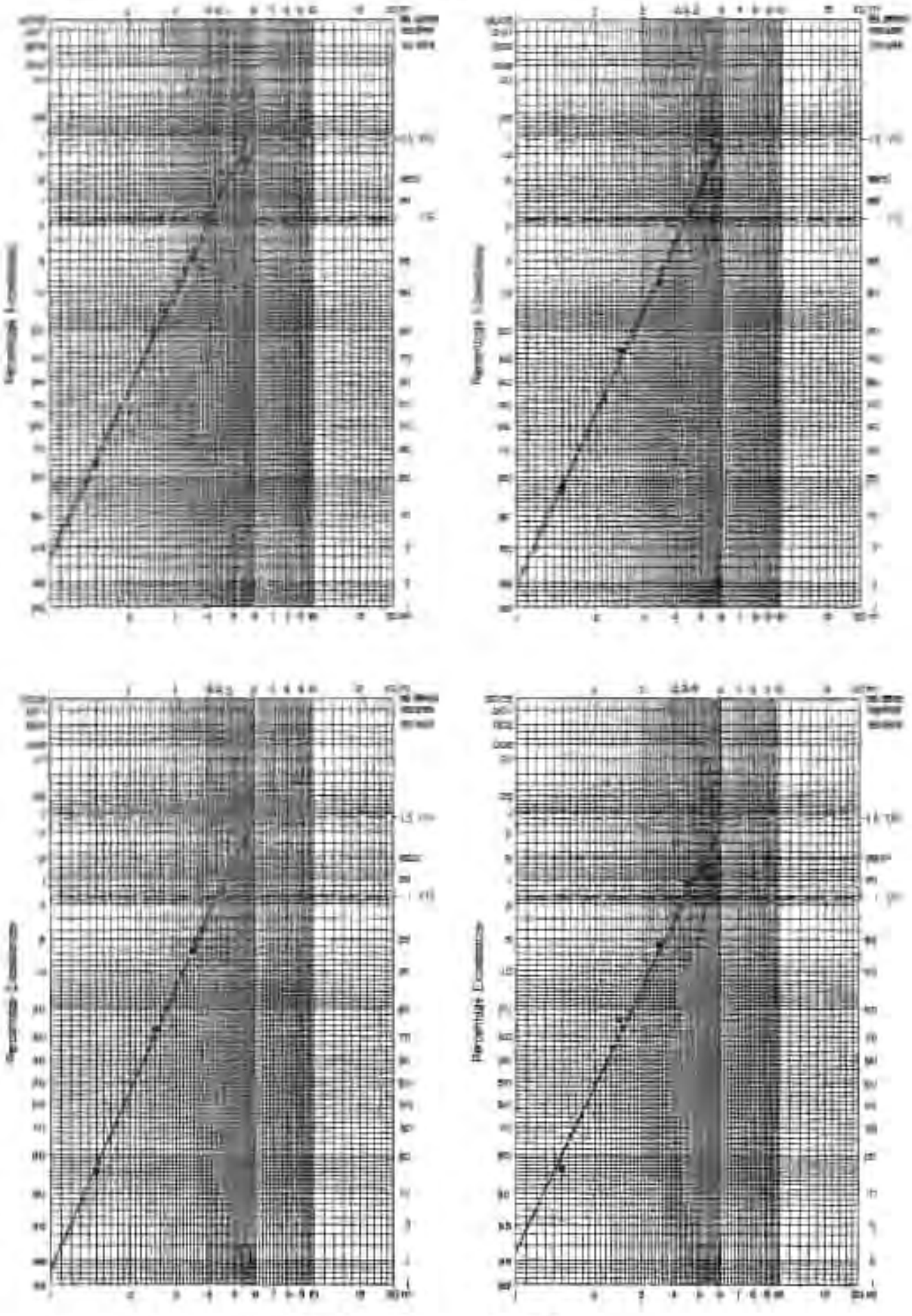
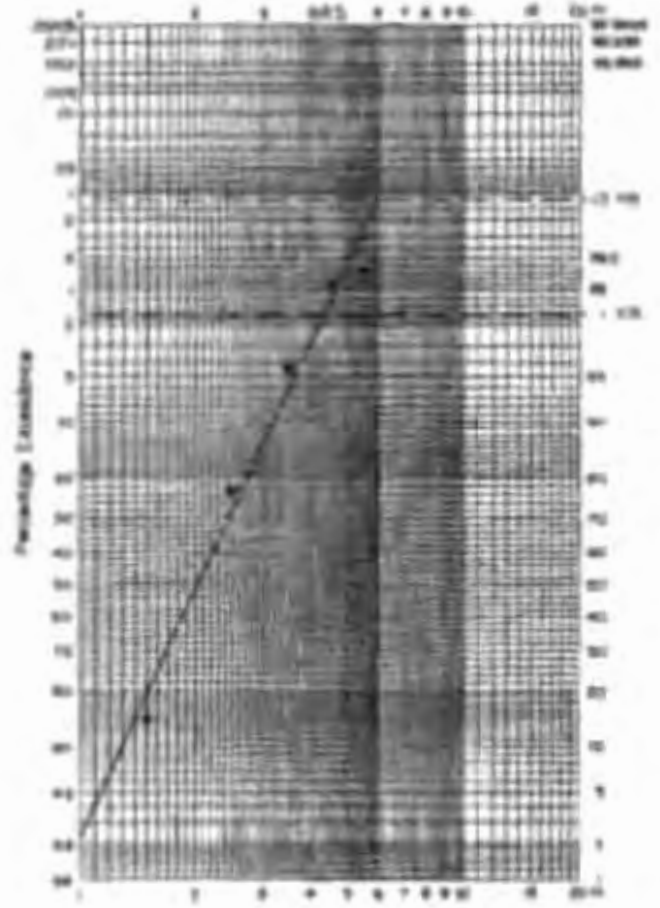
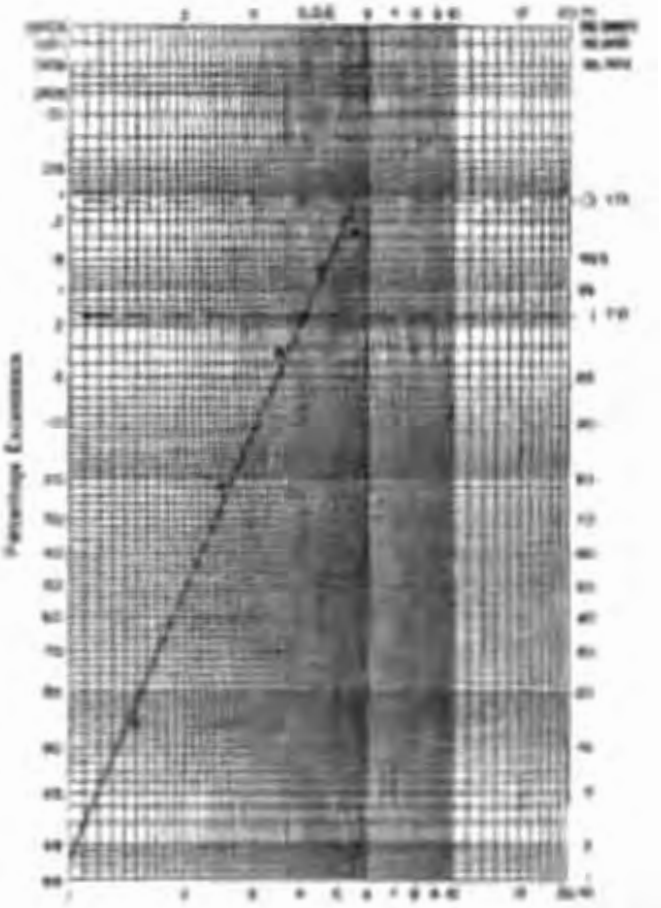
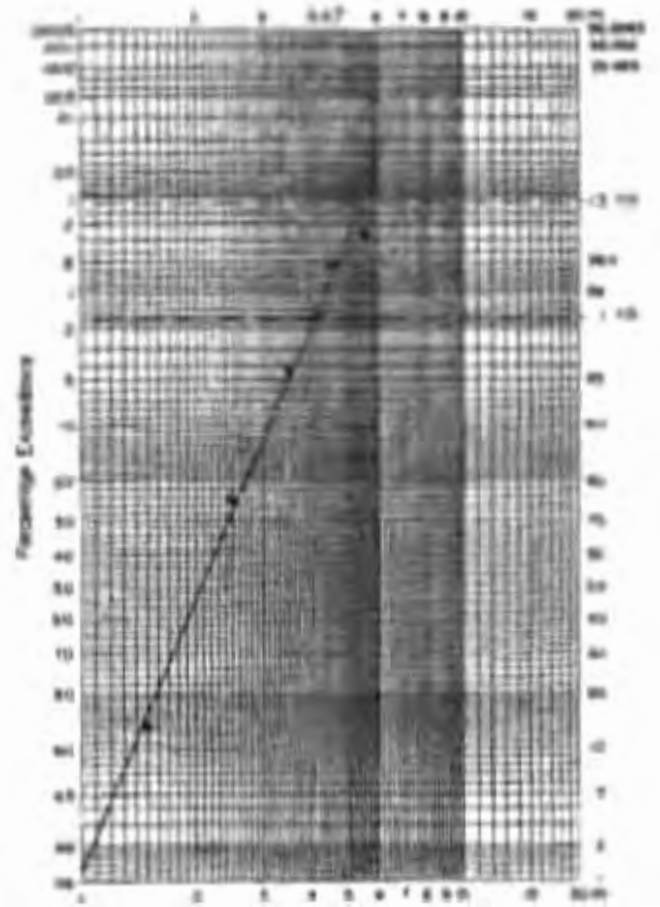
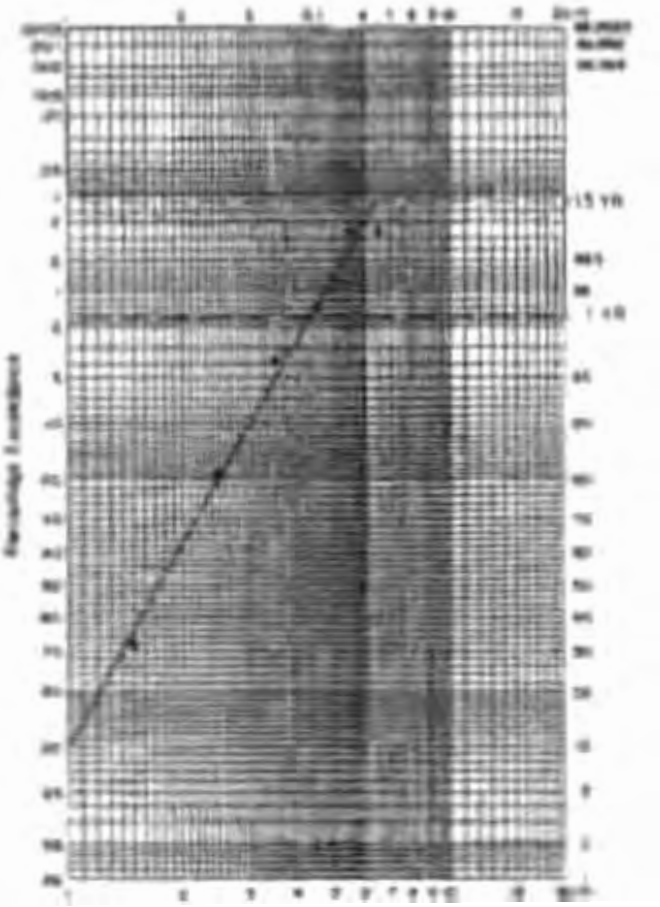


Figure II.3. Monthly Wave Height Exceedance Distribution for October









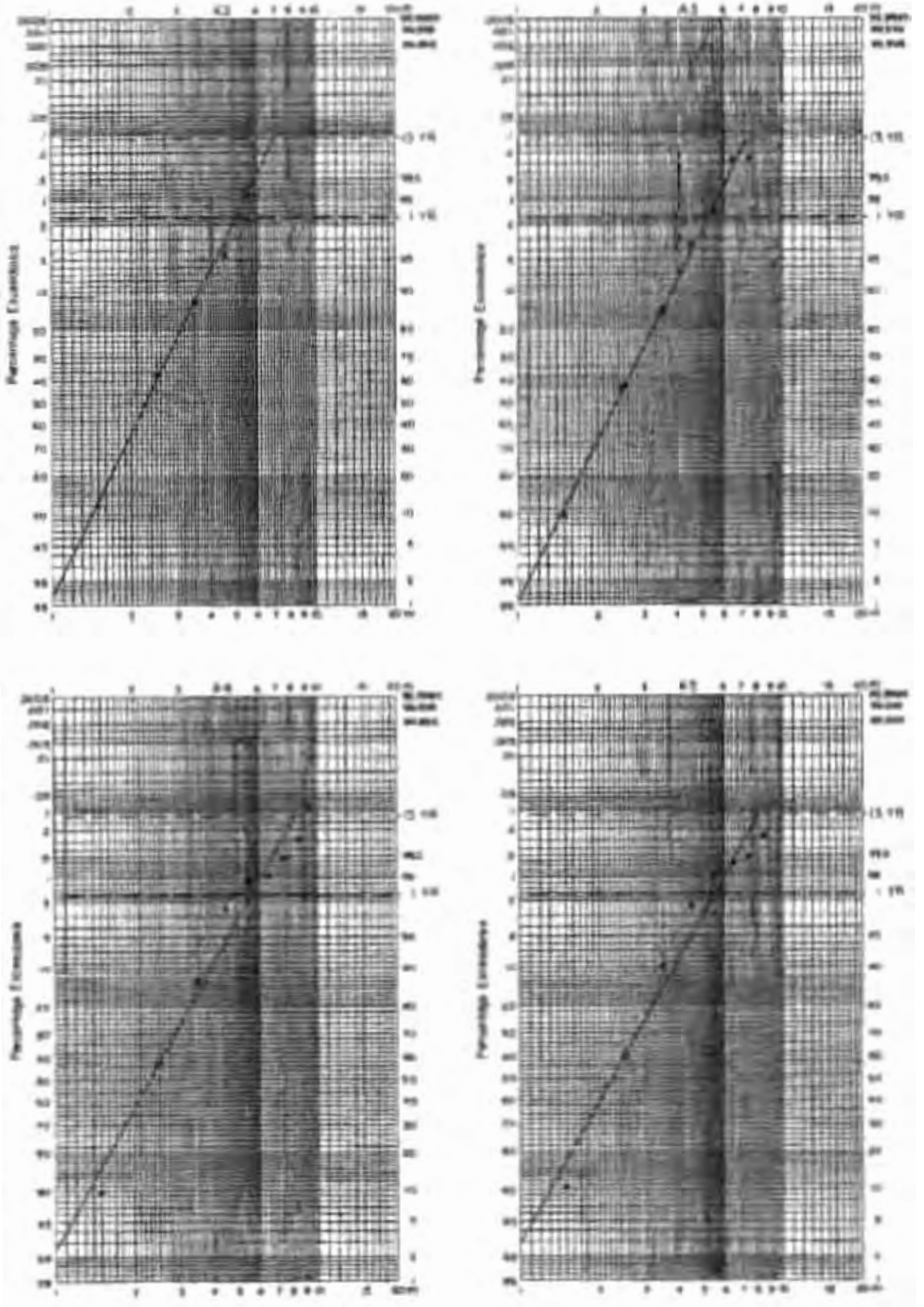
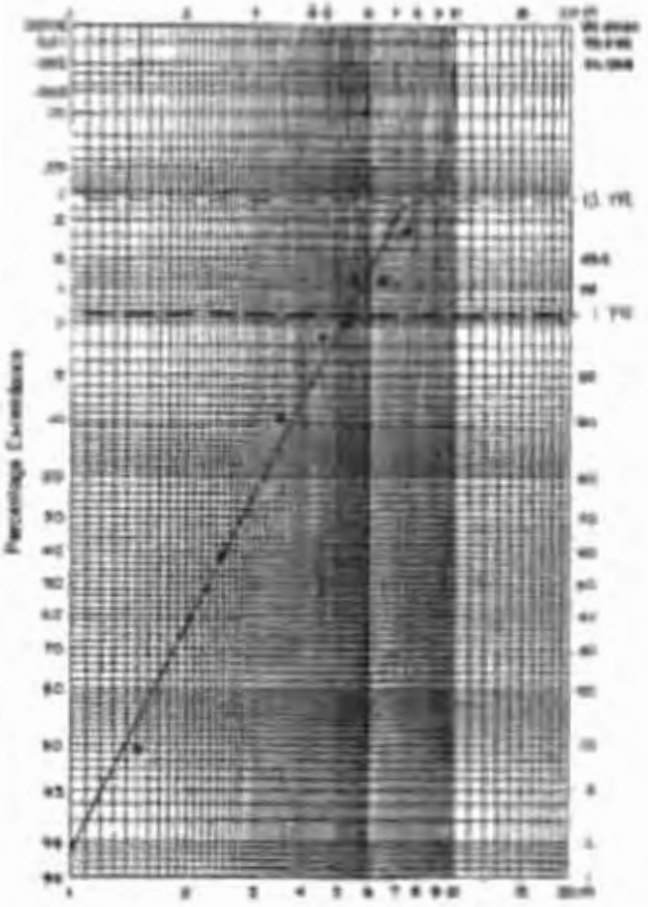
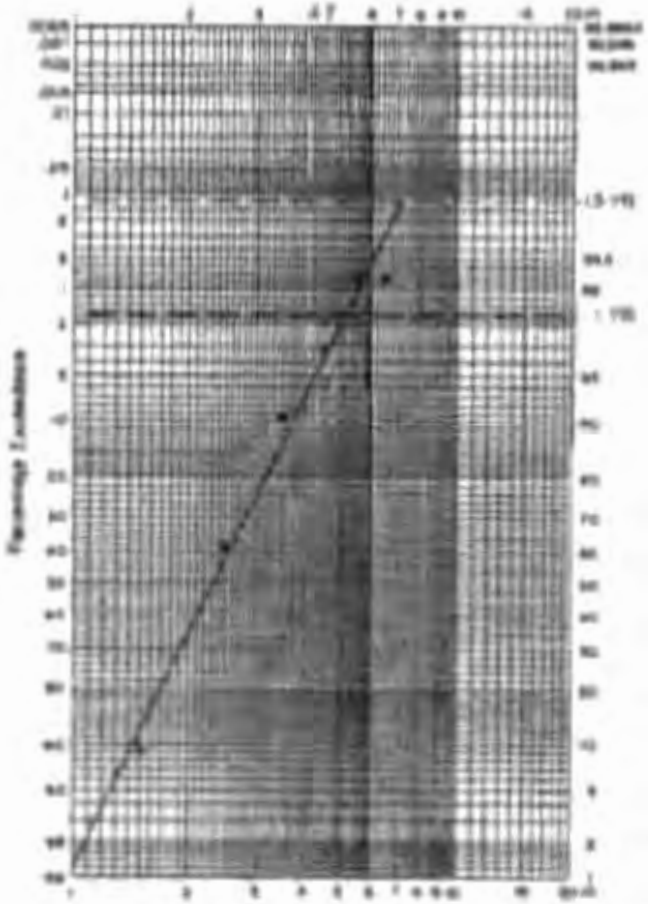
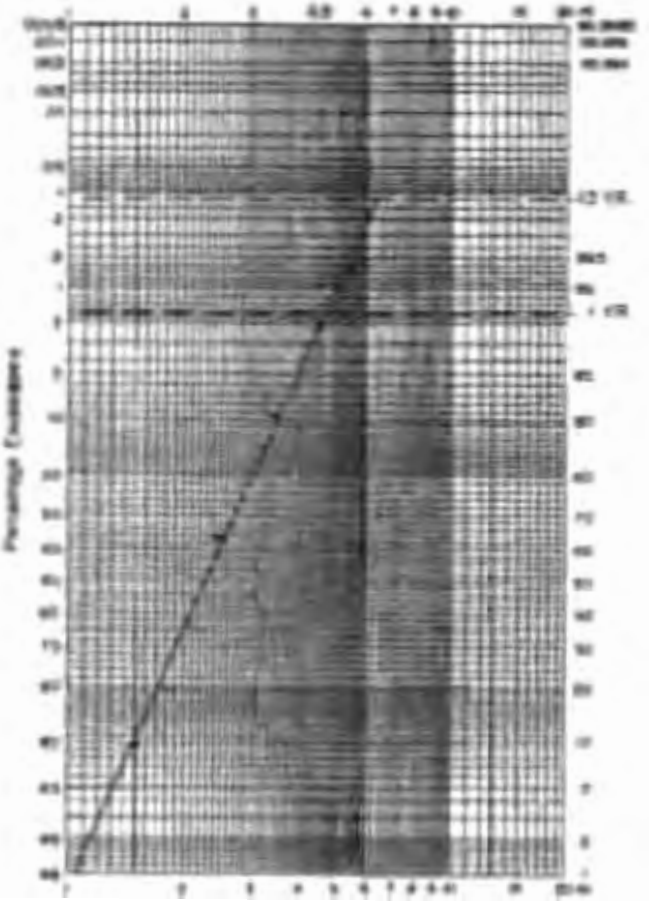
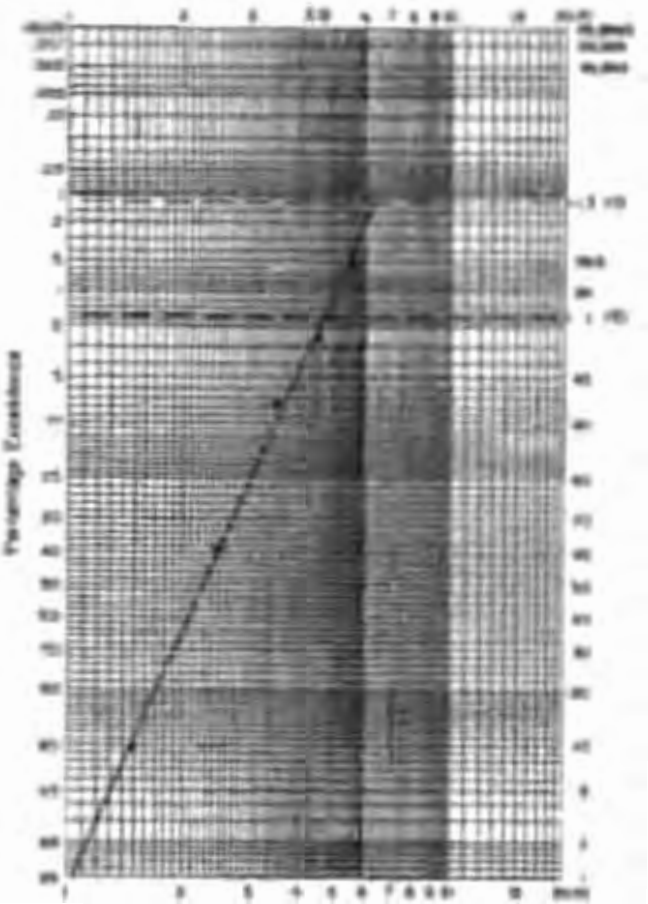


Figure 10c Monthly Wave Height Exceedance Distribution for October









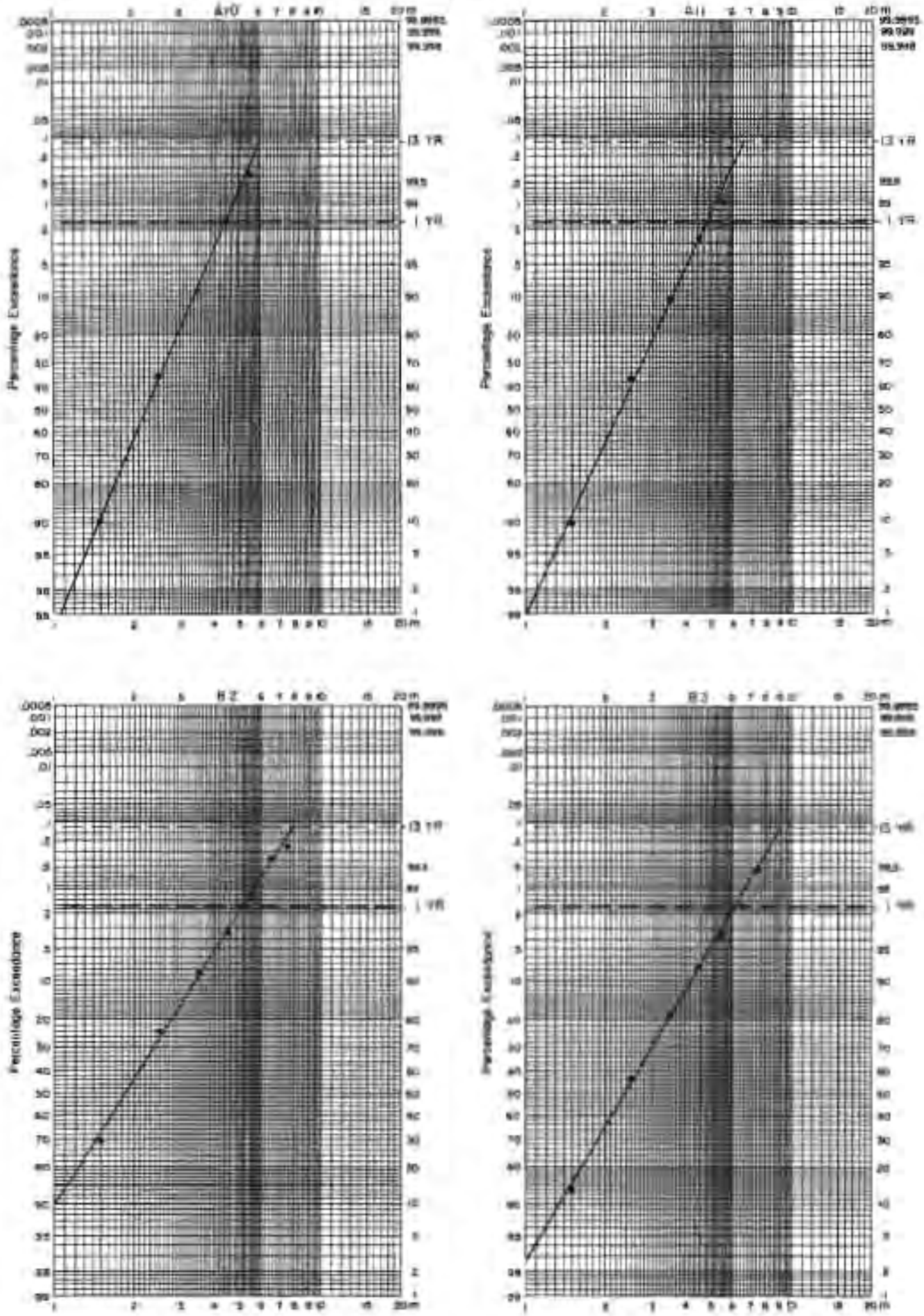
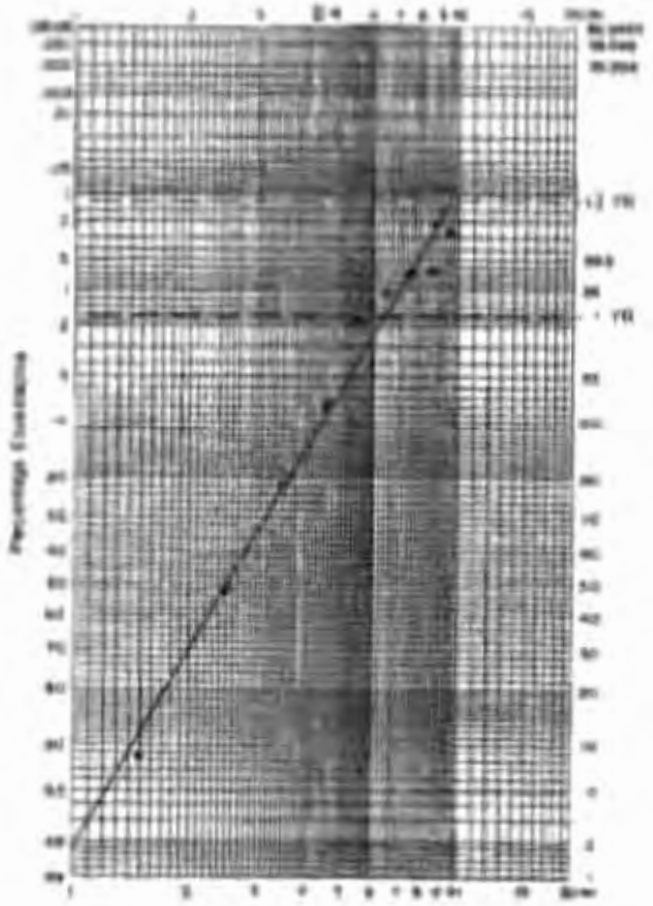
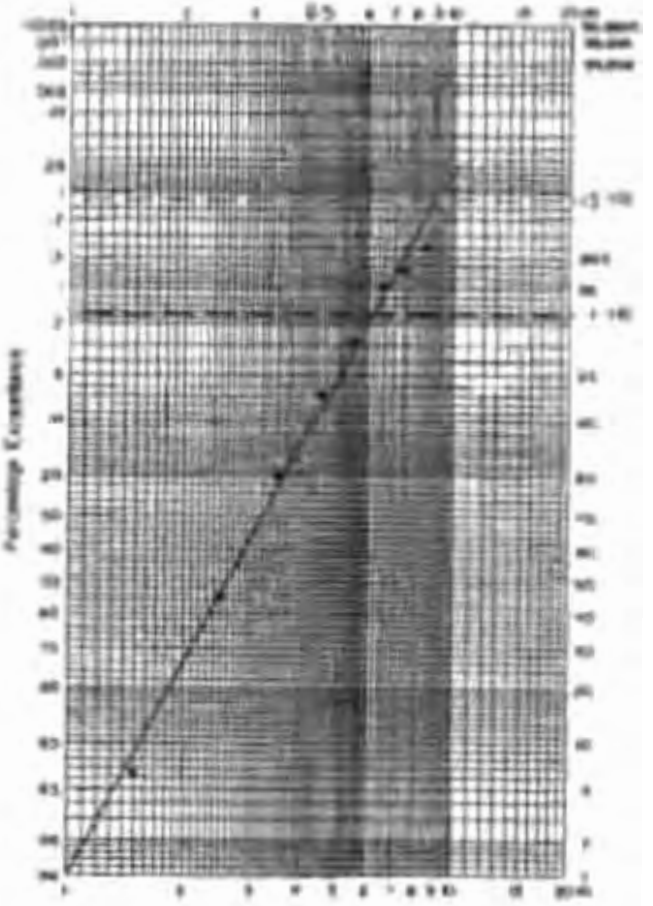
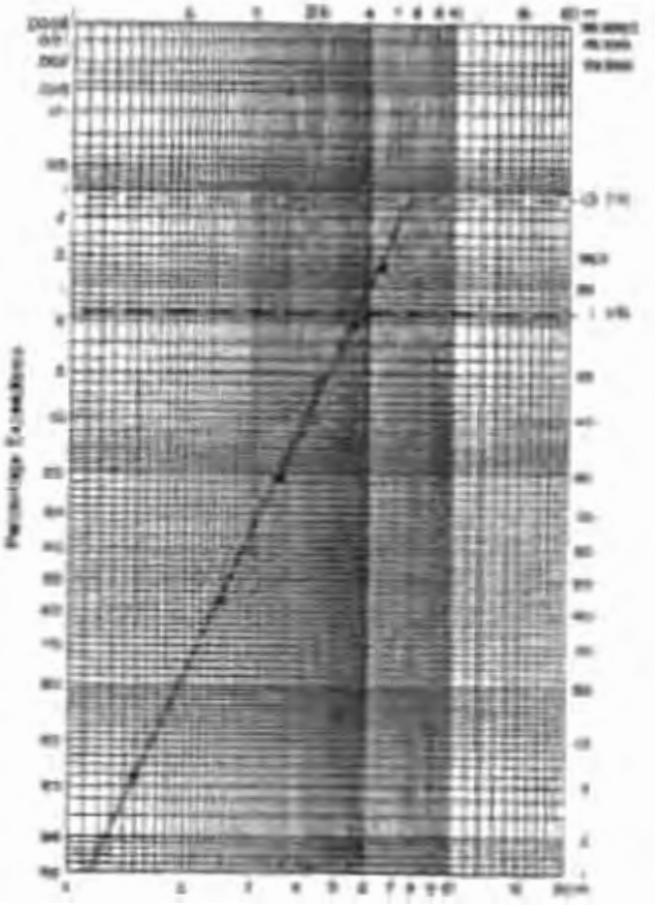
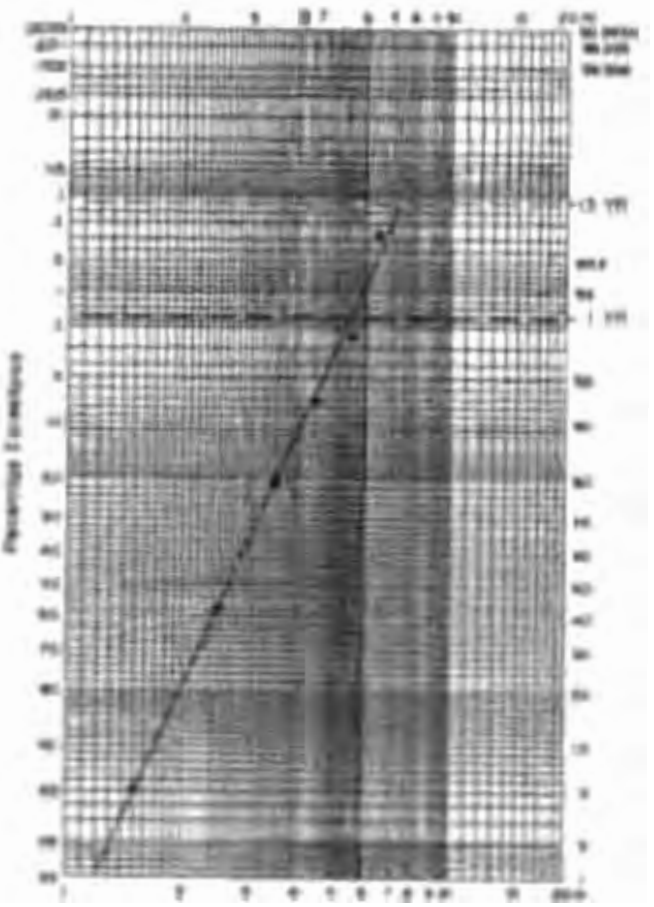


Figure 10e. Monthly Wave Height Exceedance Distribution for October









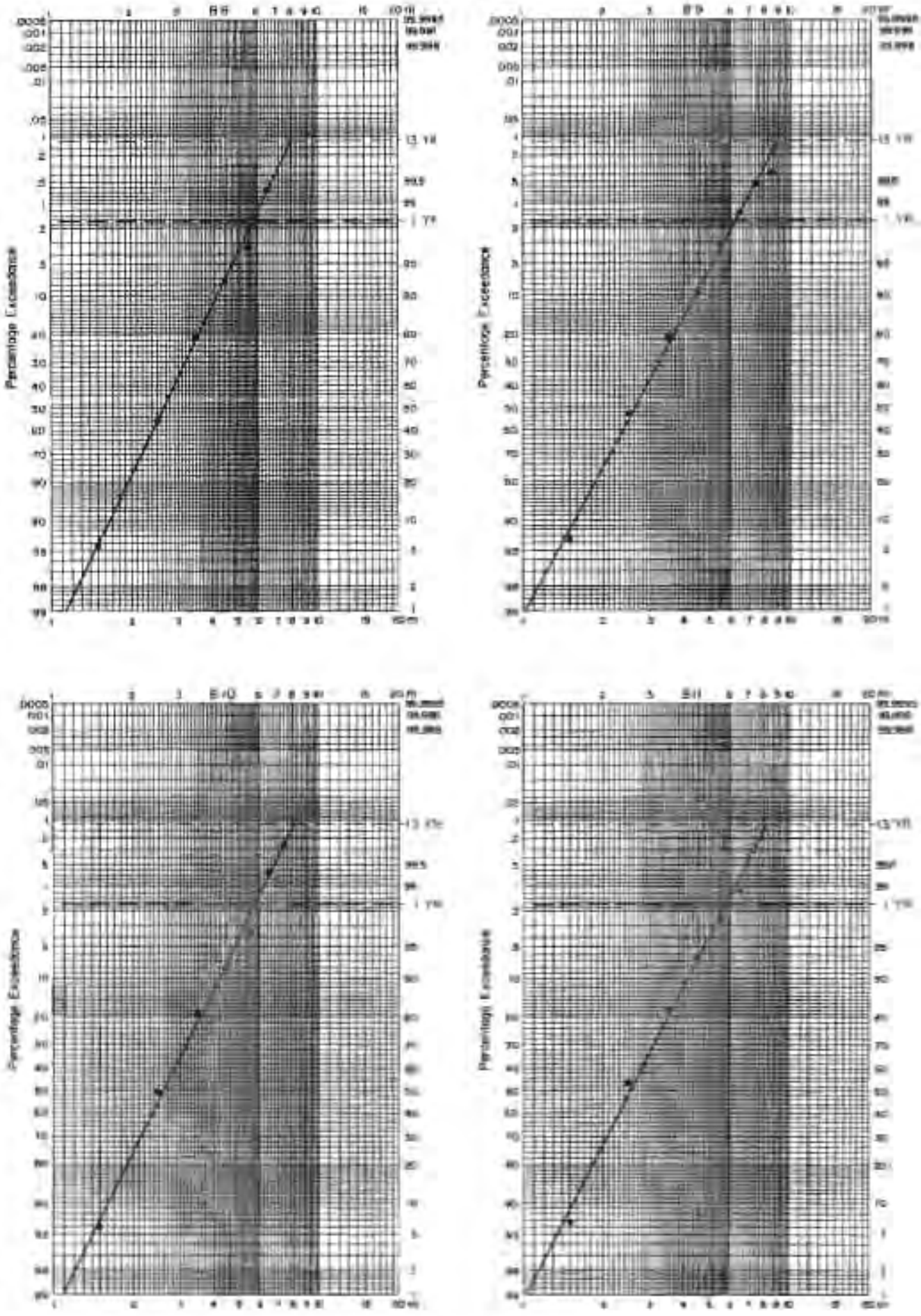
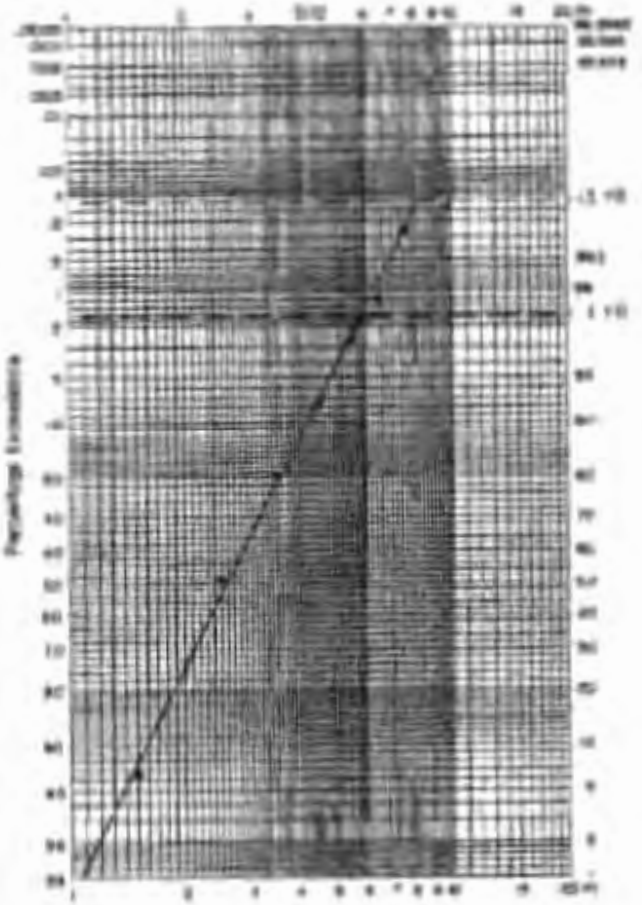
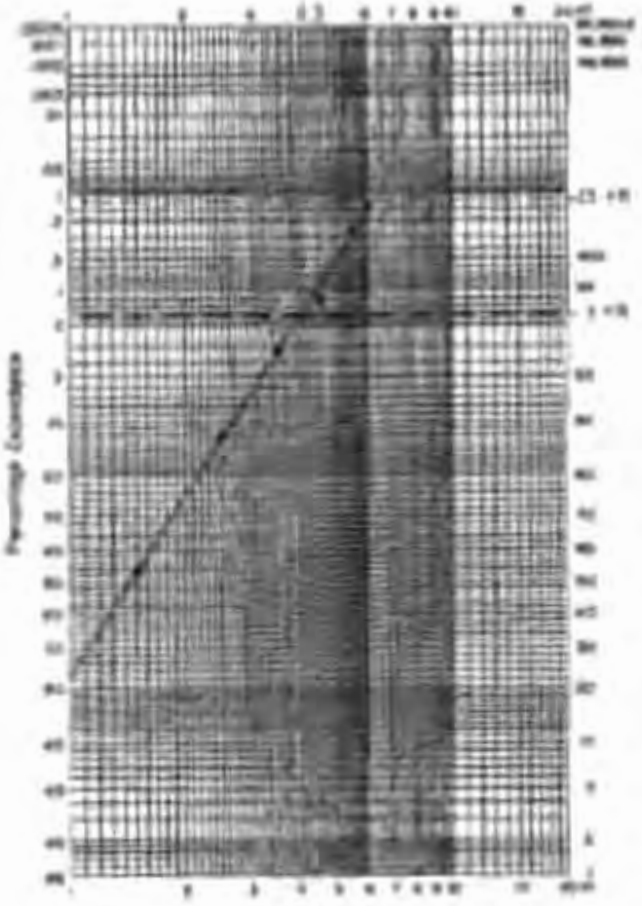
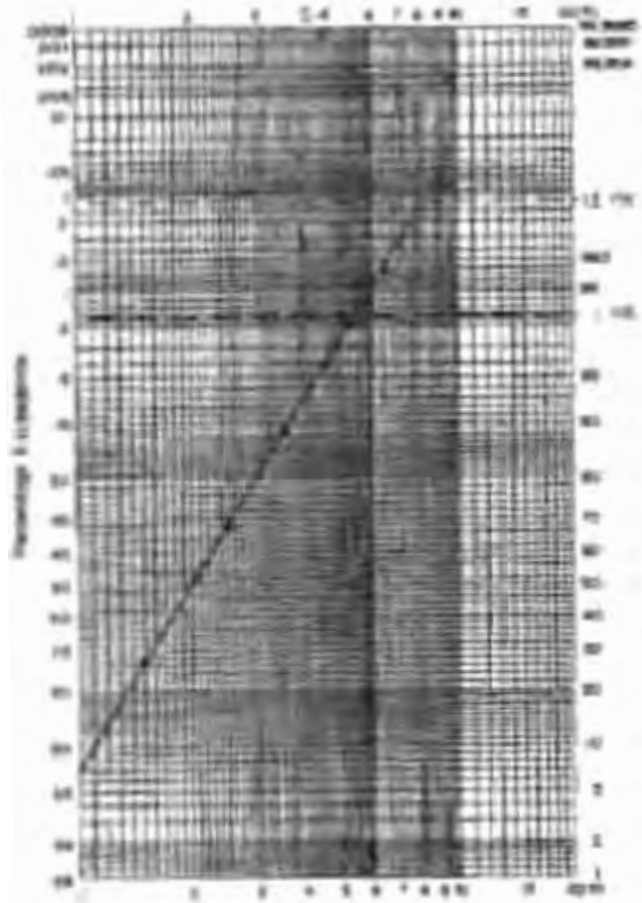
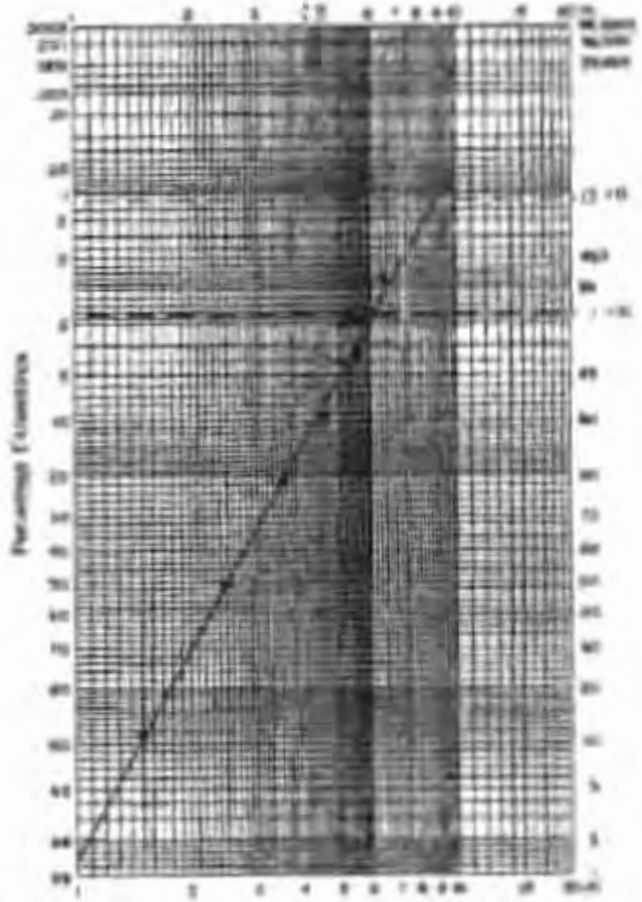


Figure 10g. Monthly Wave Height Exceedance Distribution for October









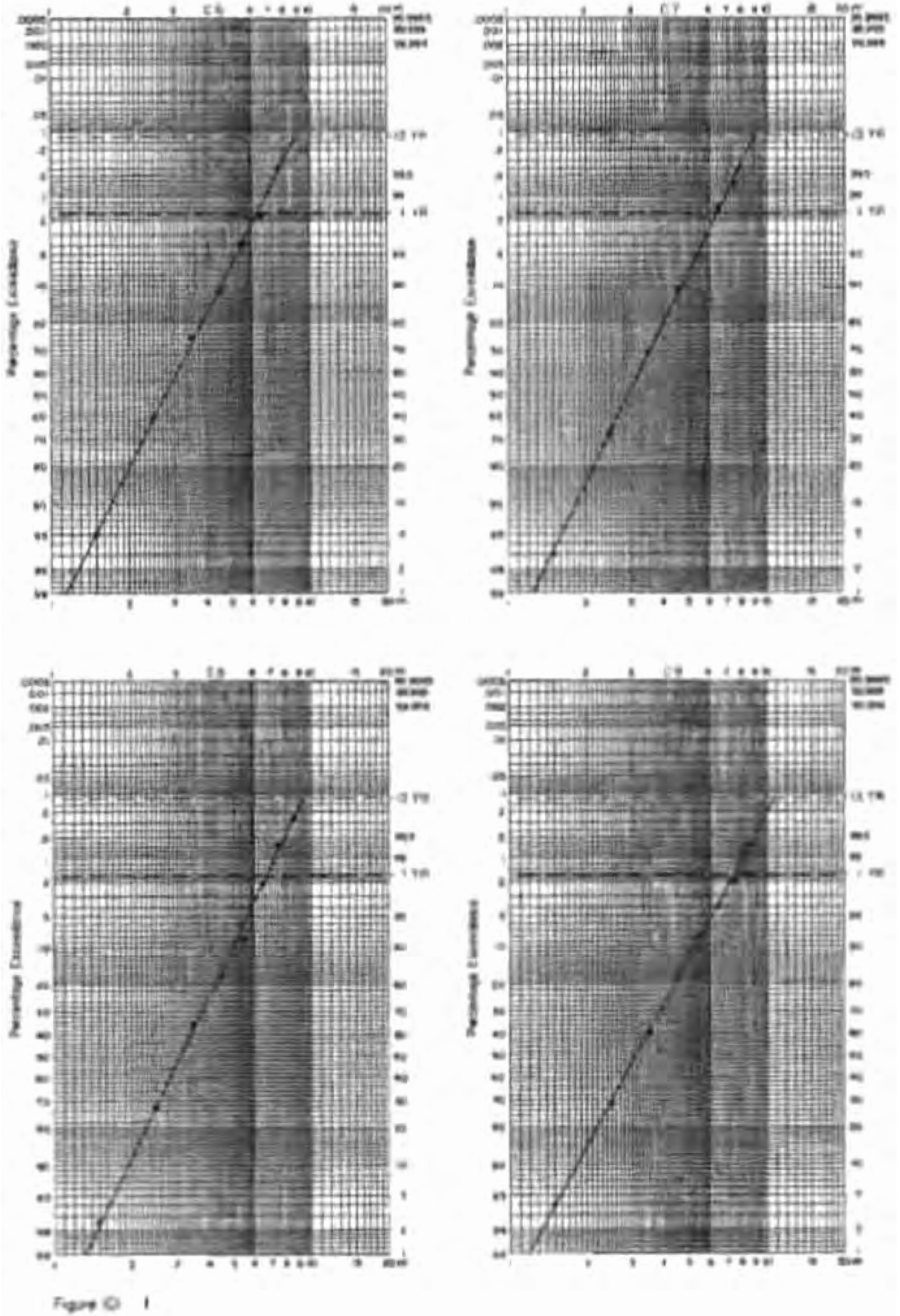

Percentage Exceedance
Percentage Exceedance
Percentage Exceedance
Percentage Exceedance

Figure C 1

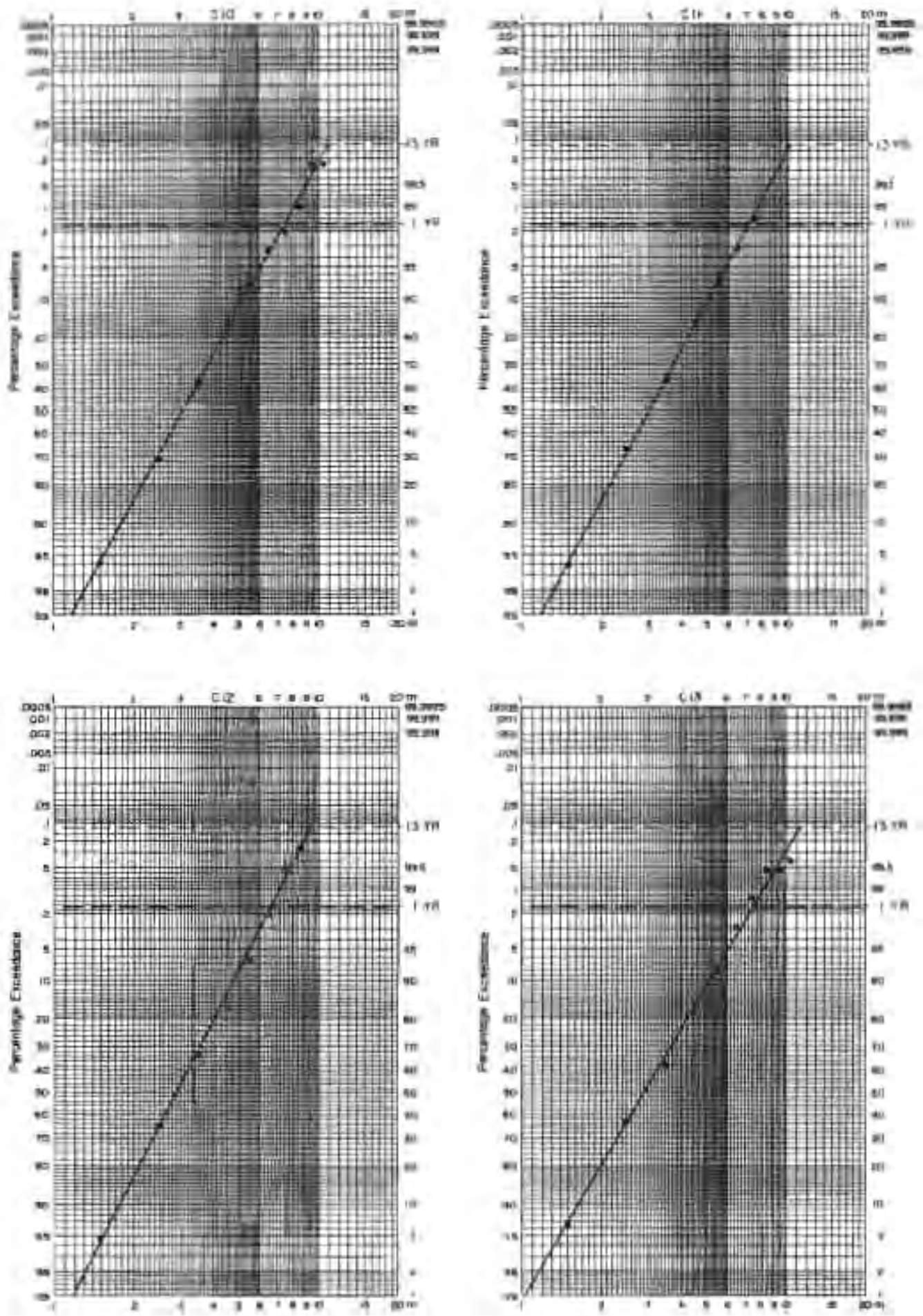
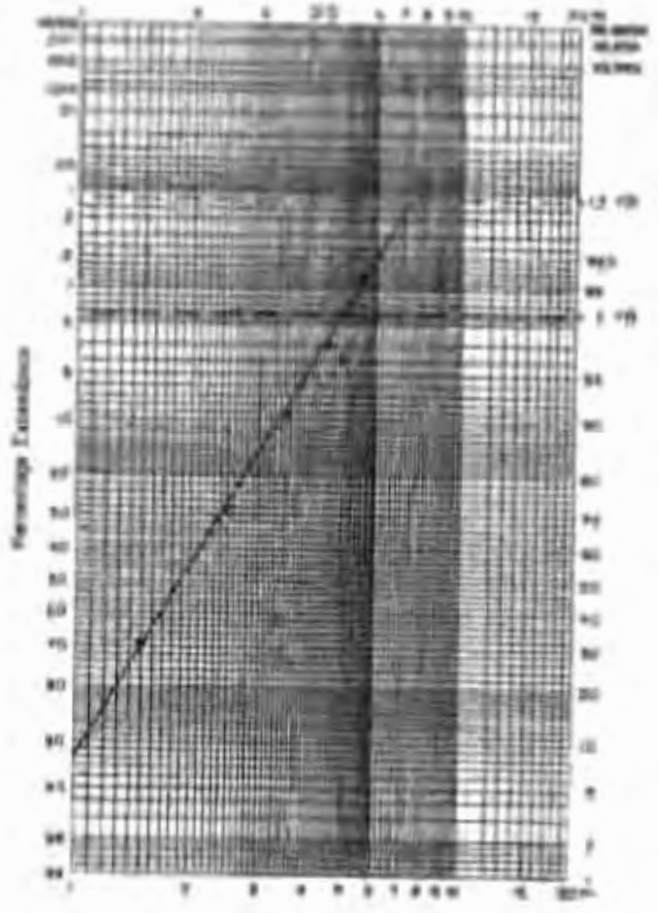
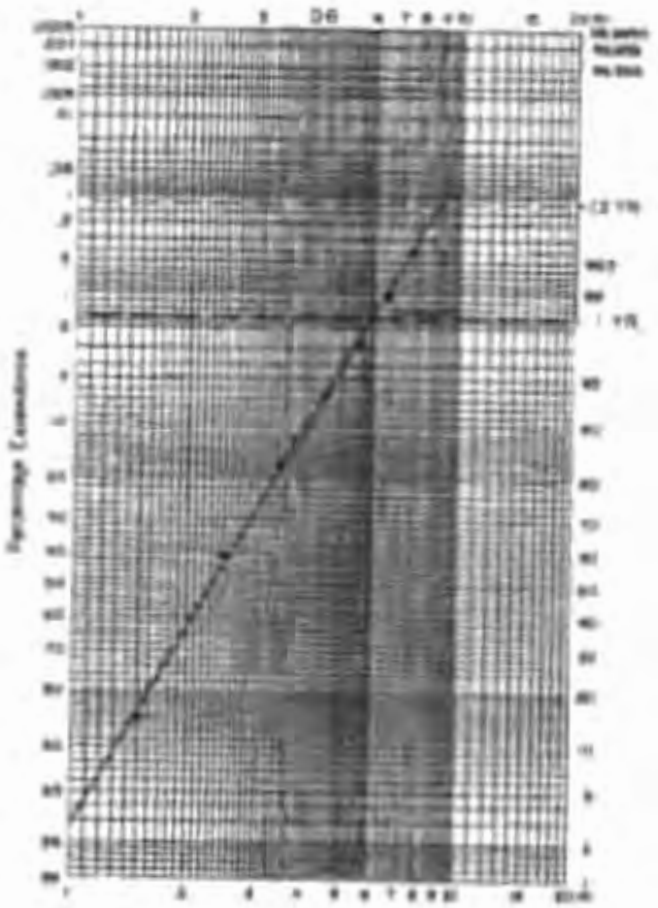
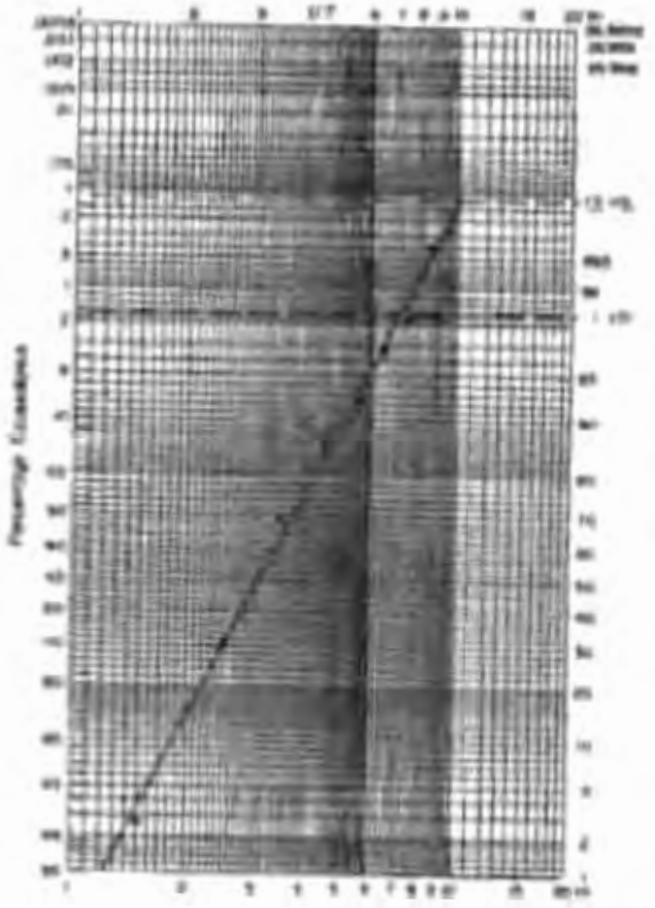
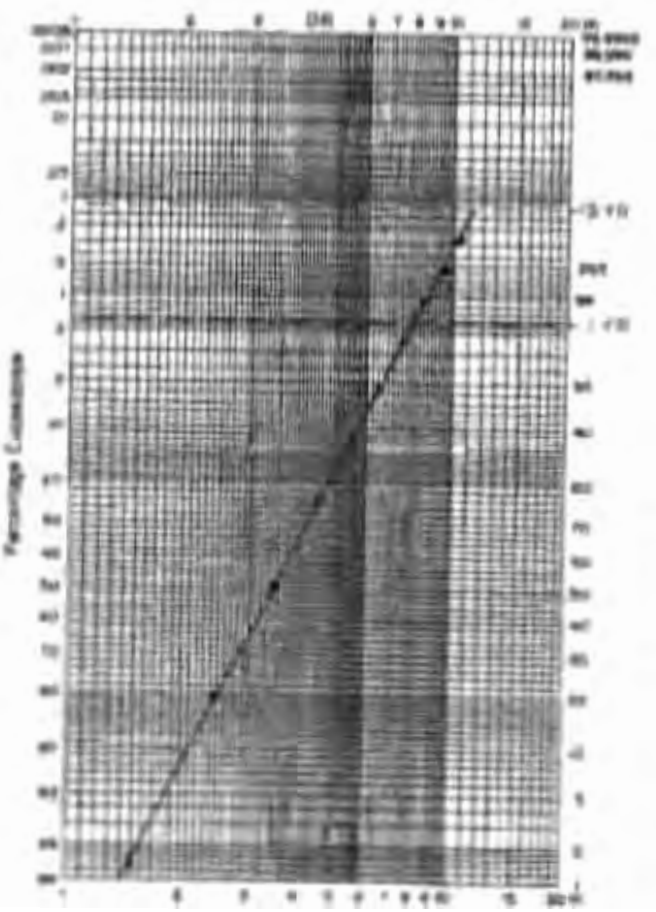


Figure 63. Monthly Wave Height Exceedance Distribution for October









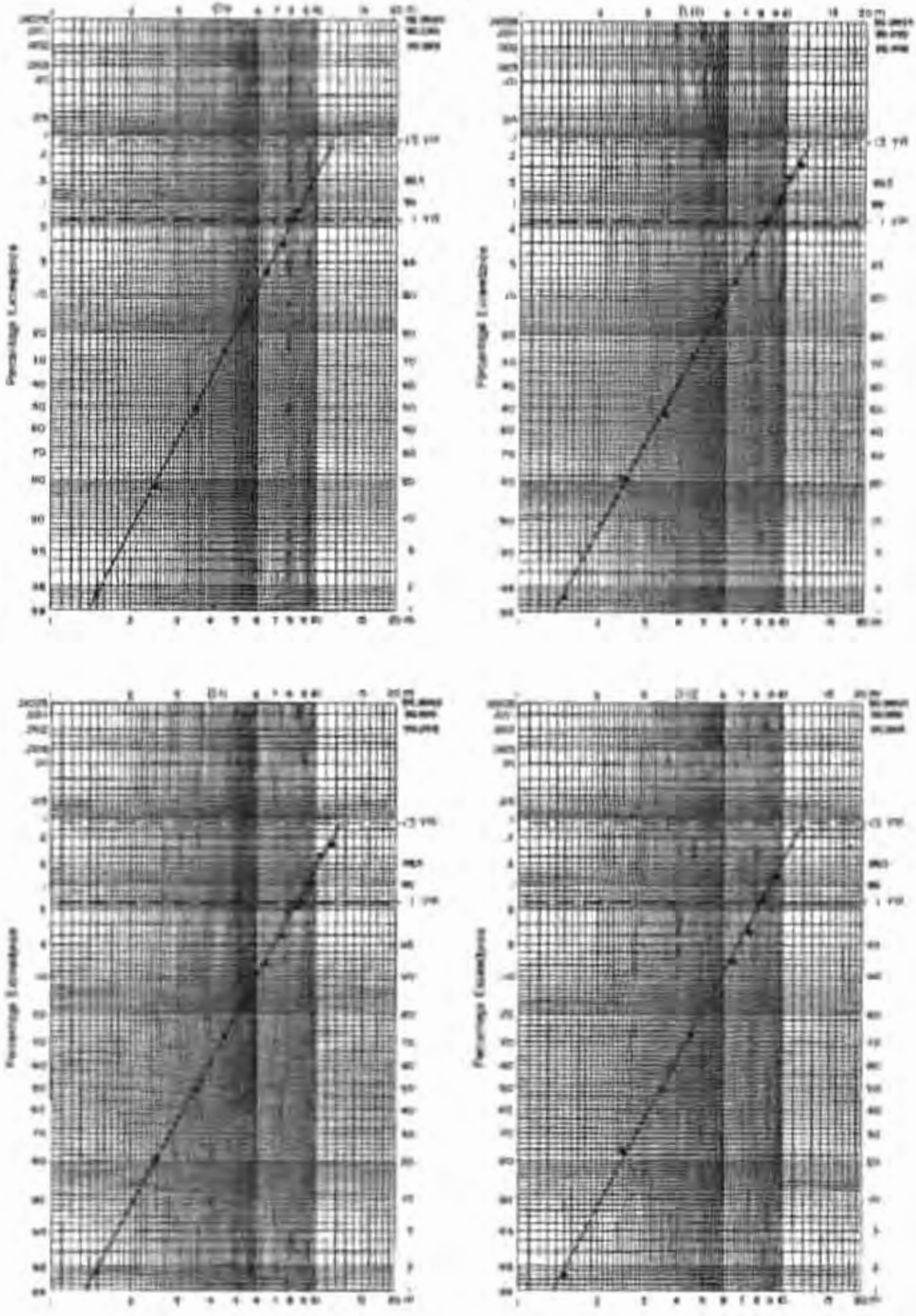


Figure 10 Monthly Wave Height Exceedance Distribution for October

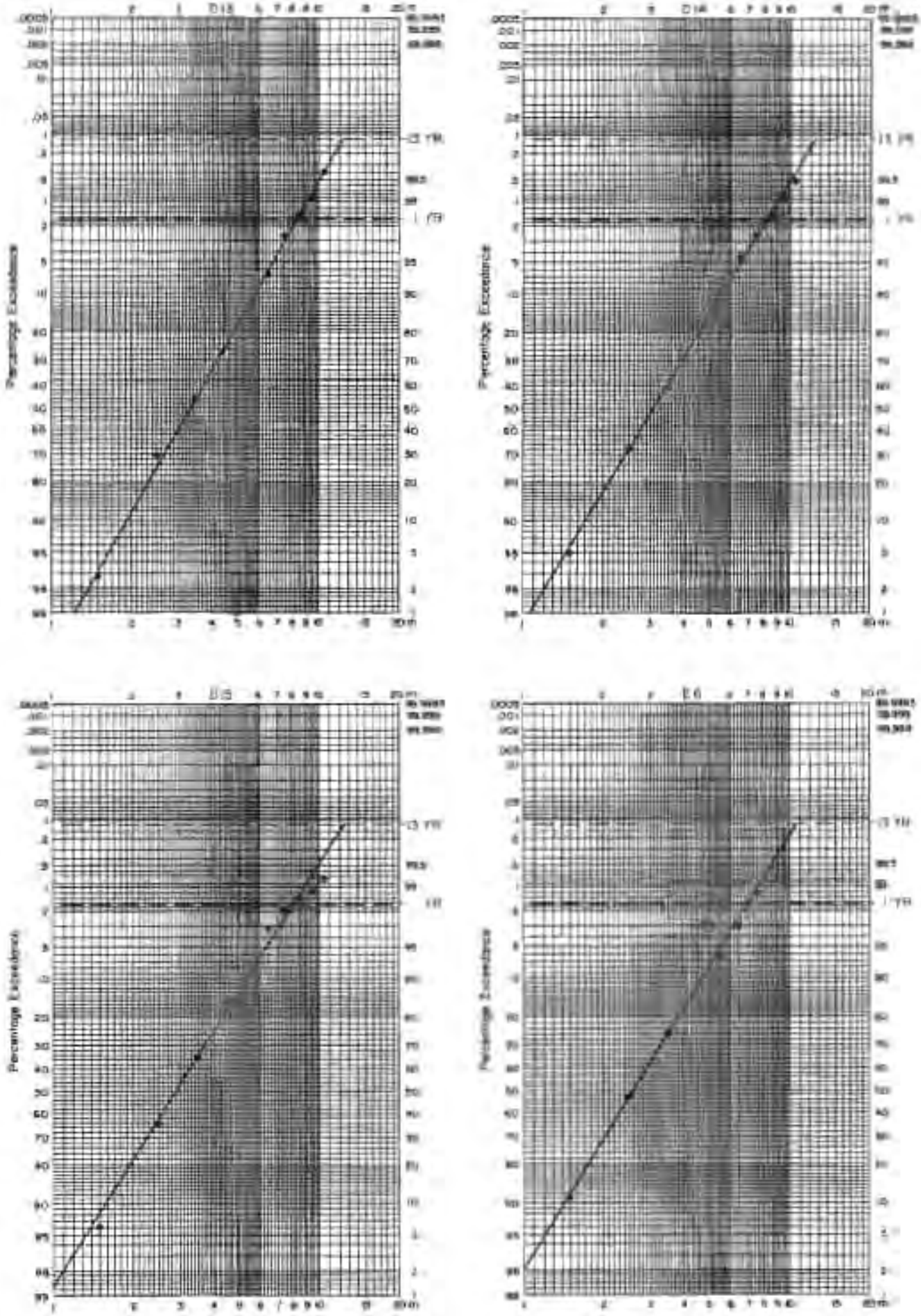
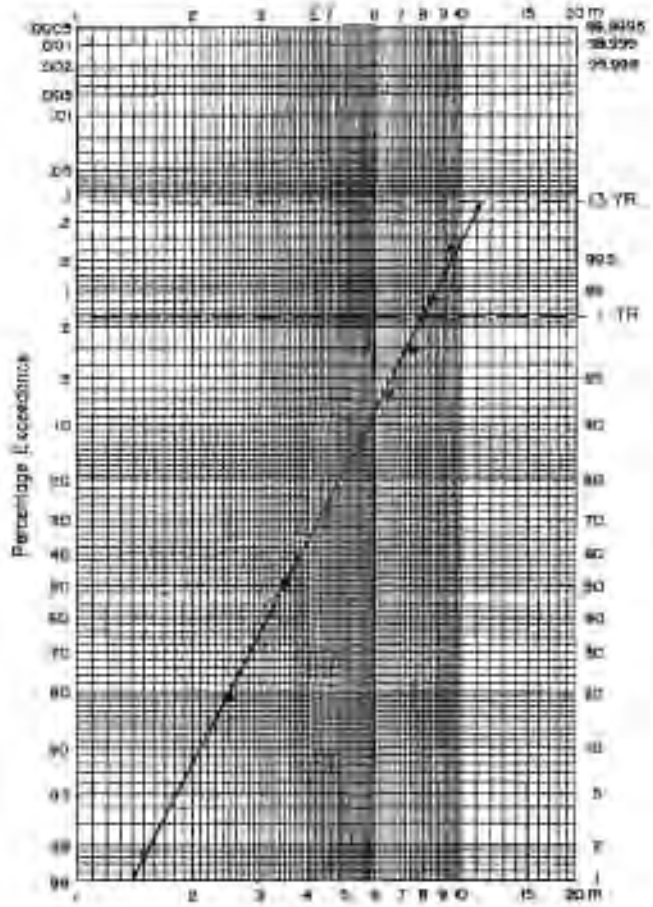
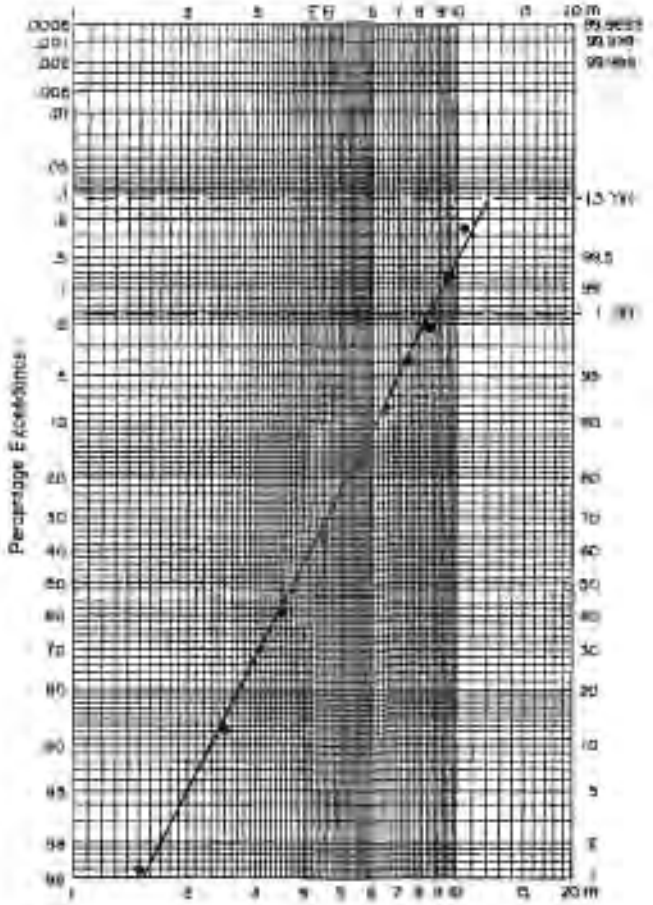
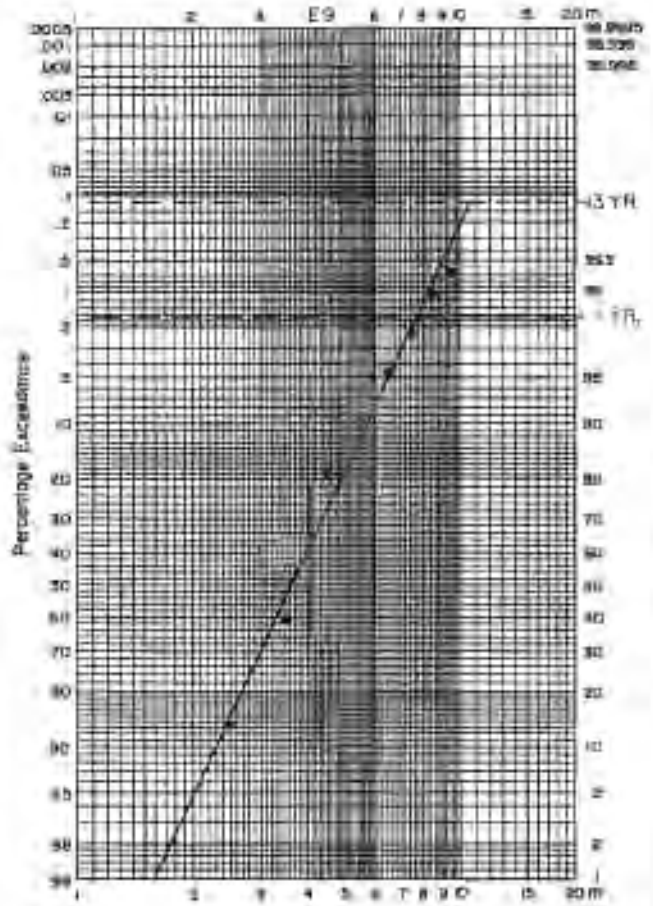


Figure 10m. Monthly Wave Height Exceedance Distribution for October







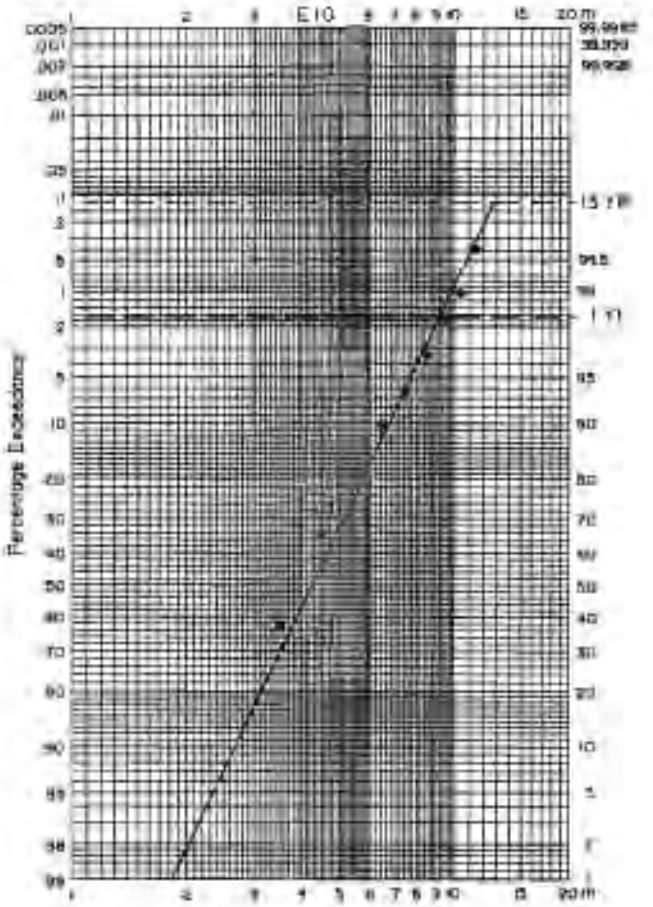


Figure D11. Monthly Wave Height Exceedance Distribution for October

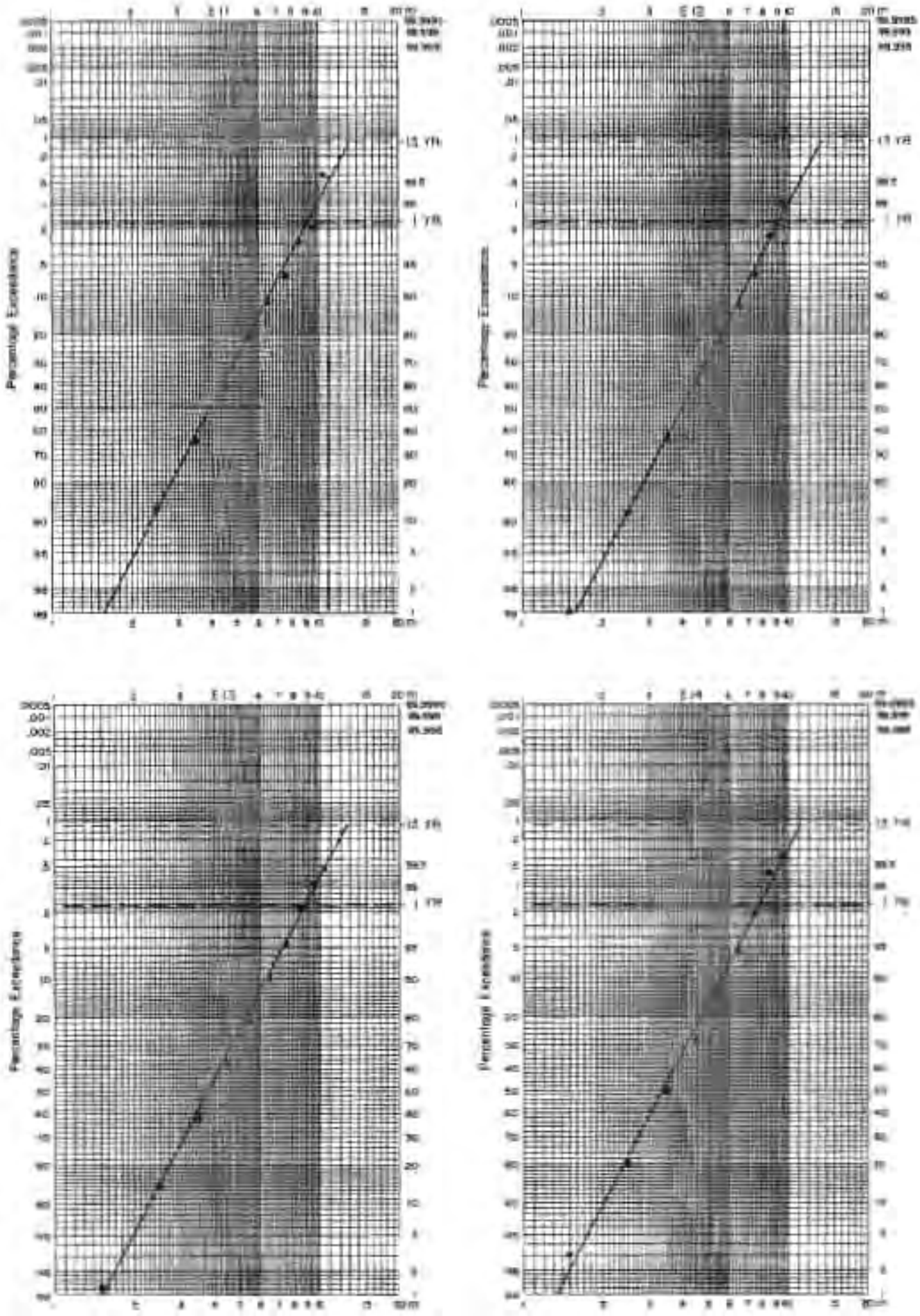
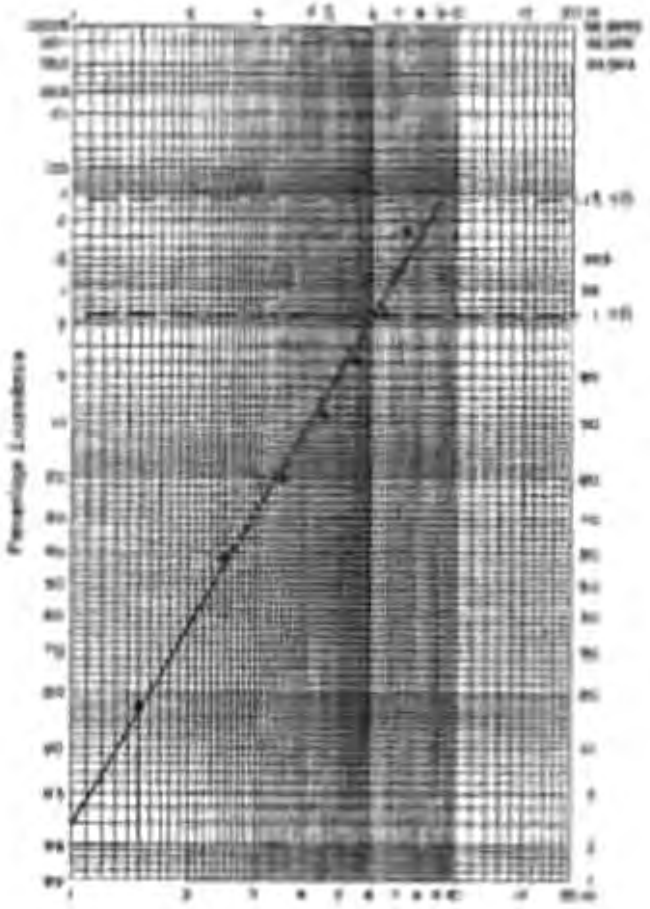
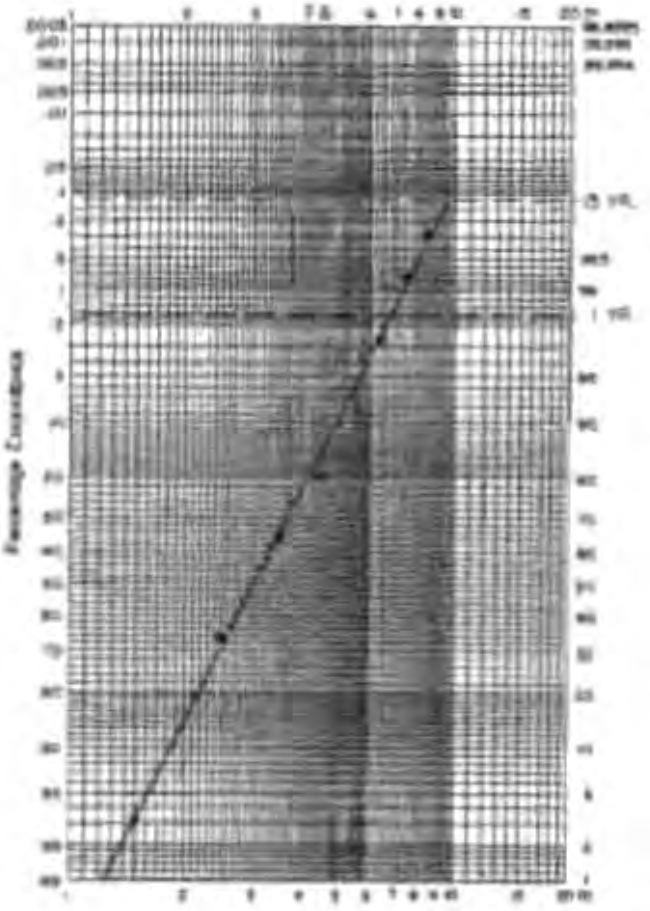
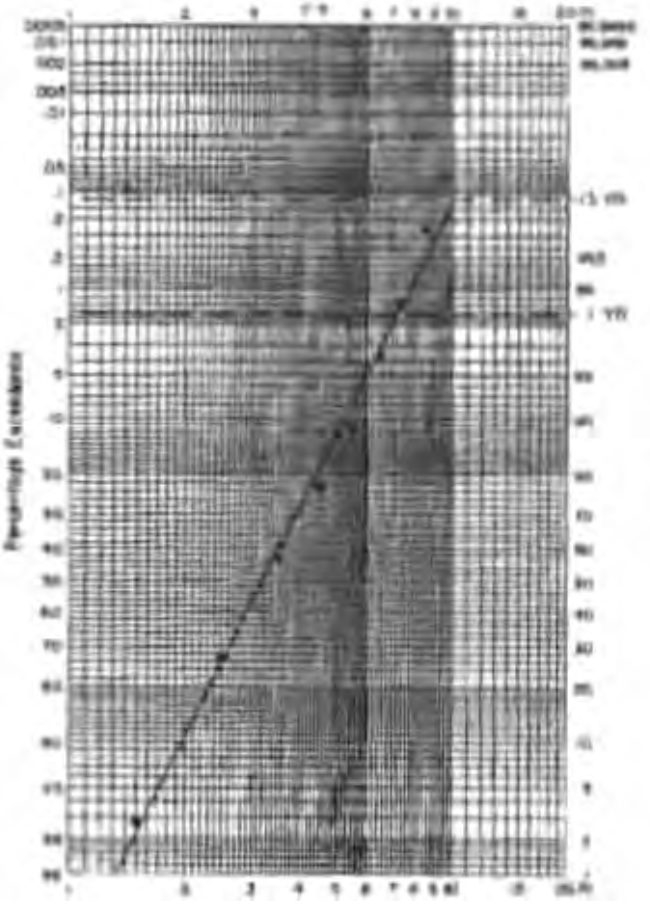
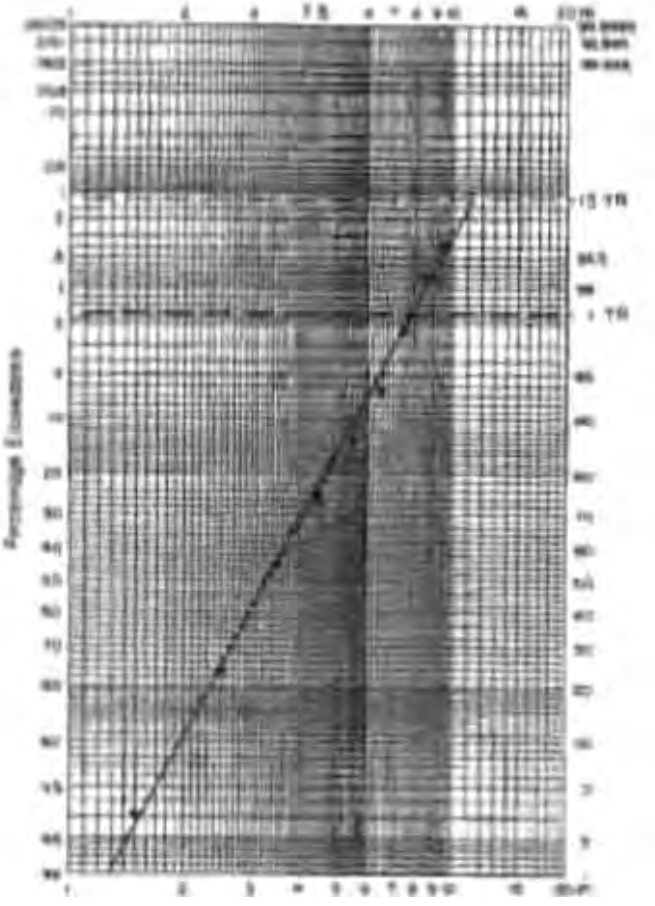


Figure 4.2a Monthly Wave Height Exceedance Distribution for October









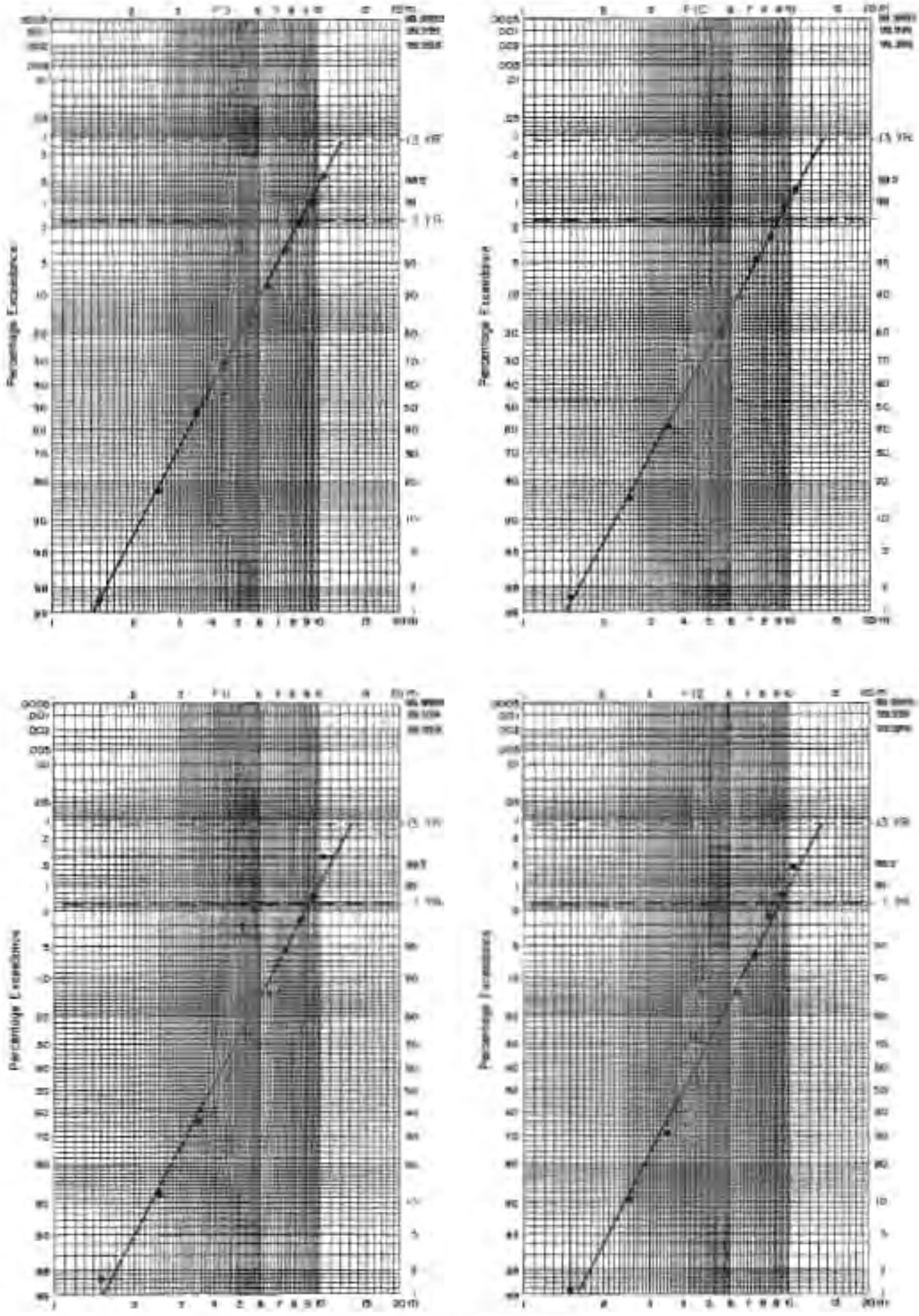


Figure 10.g Monthly Wave Height Exceedance Distribution for October

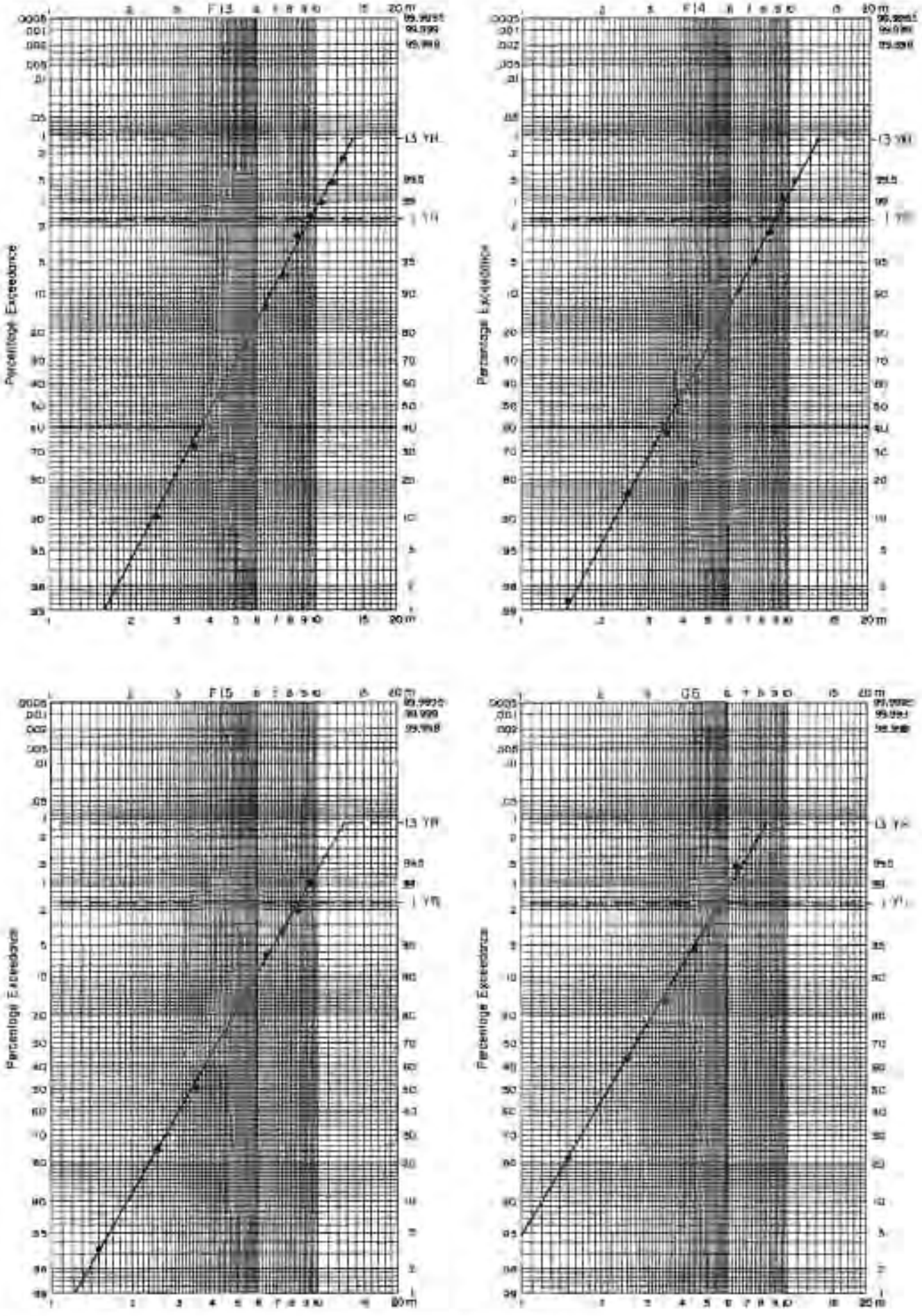


Figure 10r Monthly Wave Height Exceedance Distribution for October

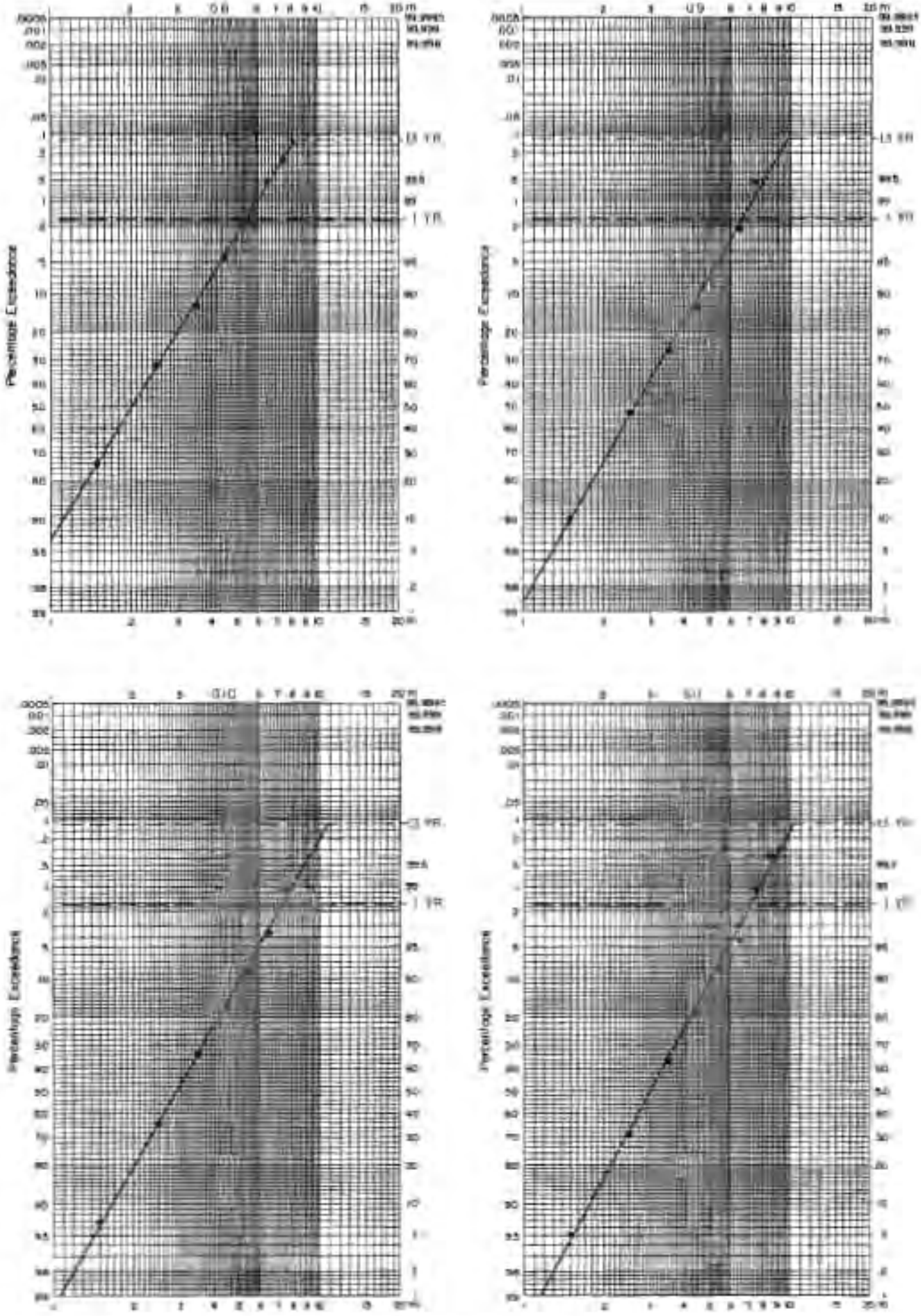


Figure 10. Monthly Wave Height Exceedance Distribution for October

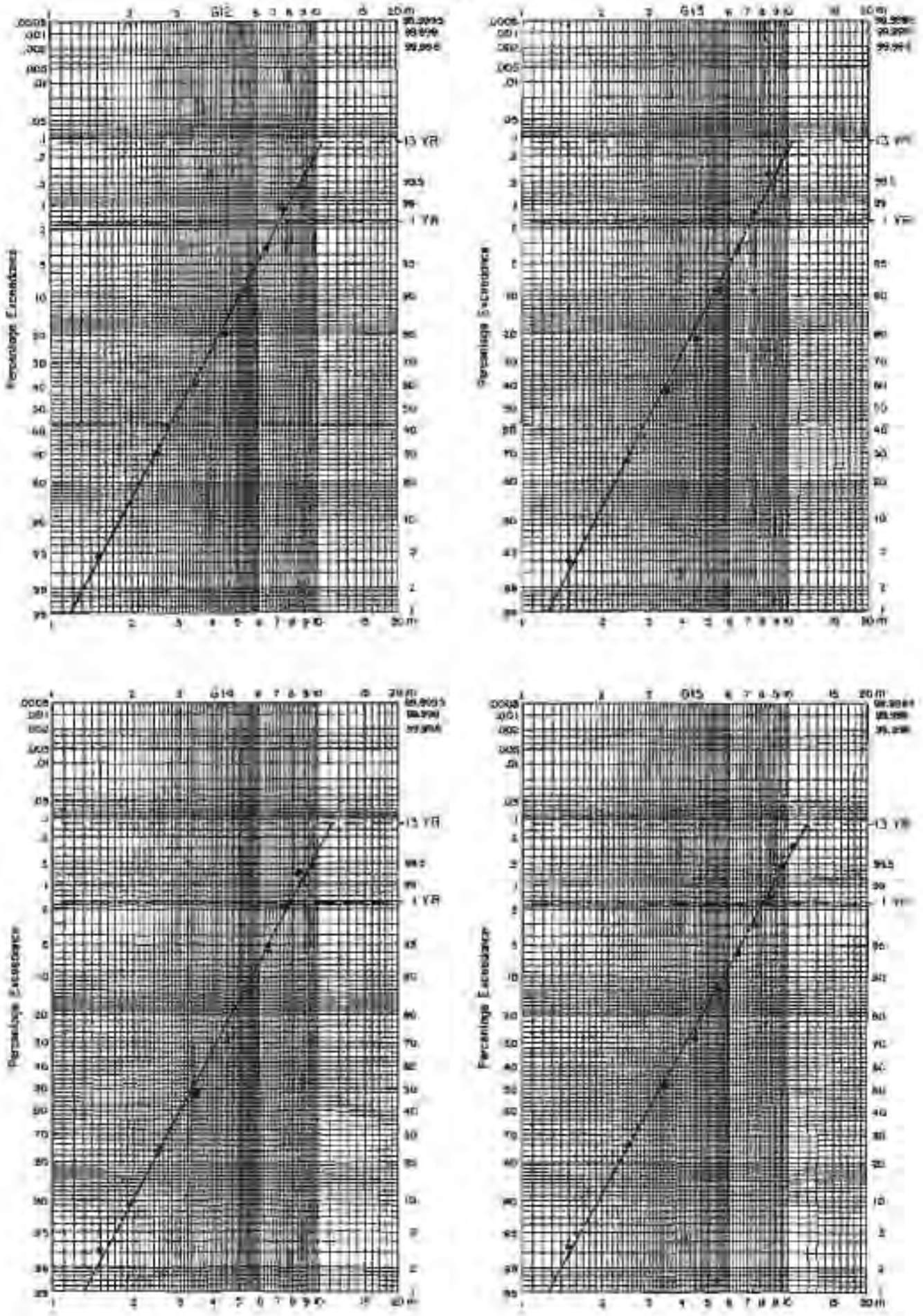


Figure 101 Monthly Wave Height Exceedance Distribution for October

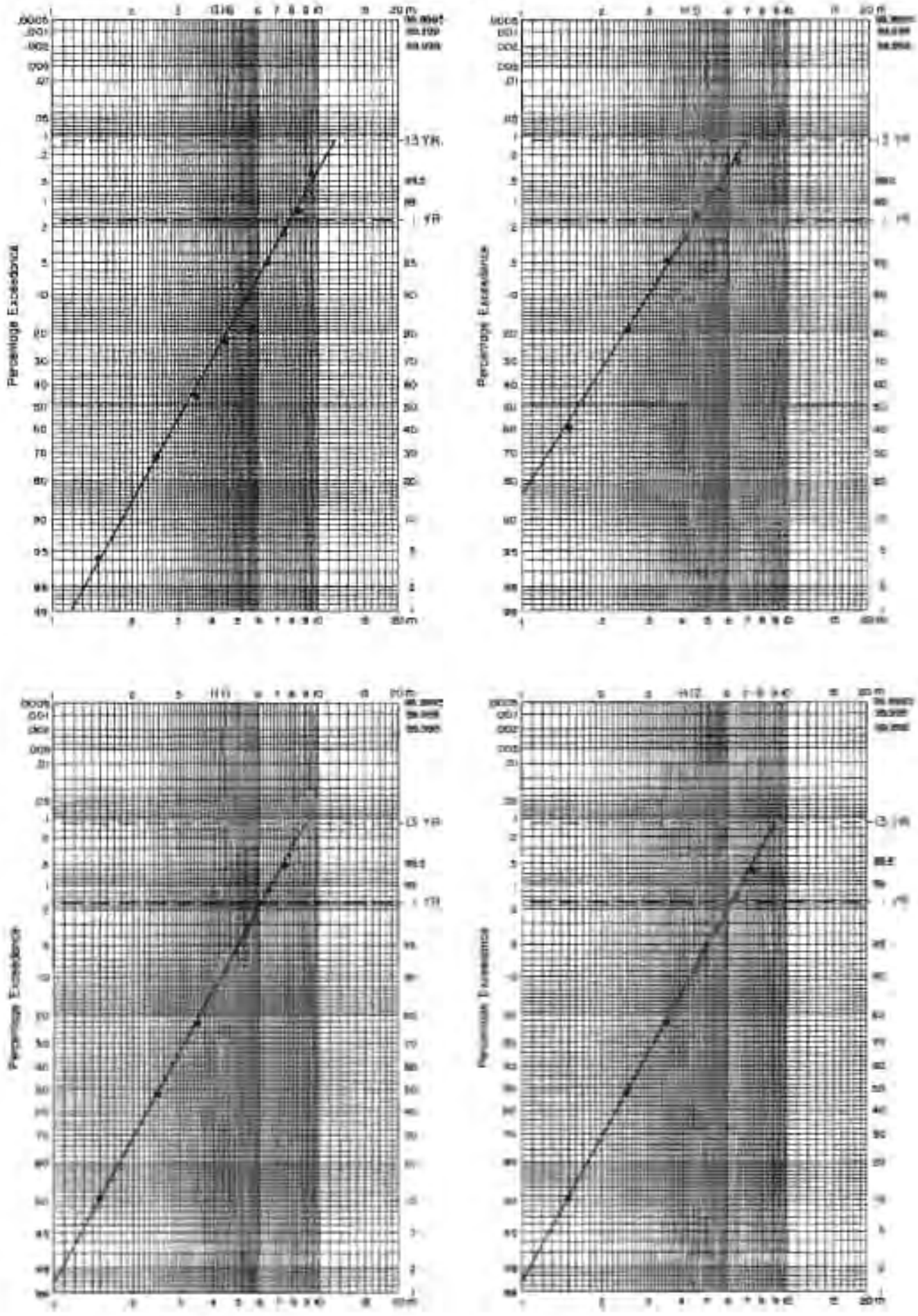


Figure 20u. Monthly Wave Height Exceedance Distribution for October

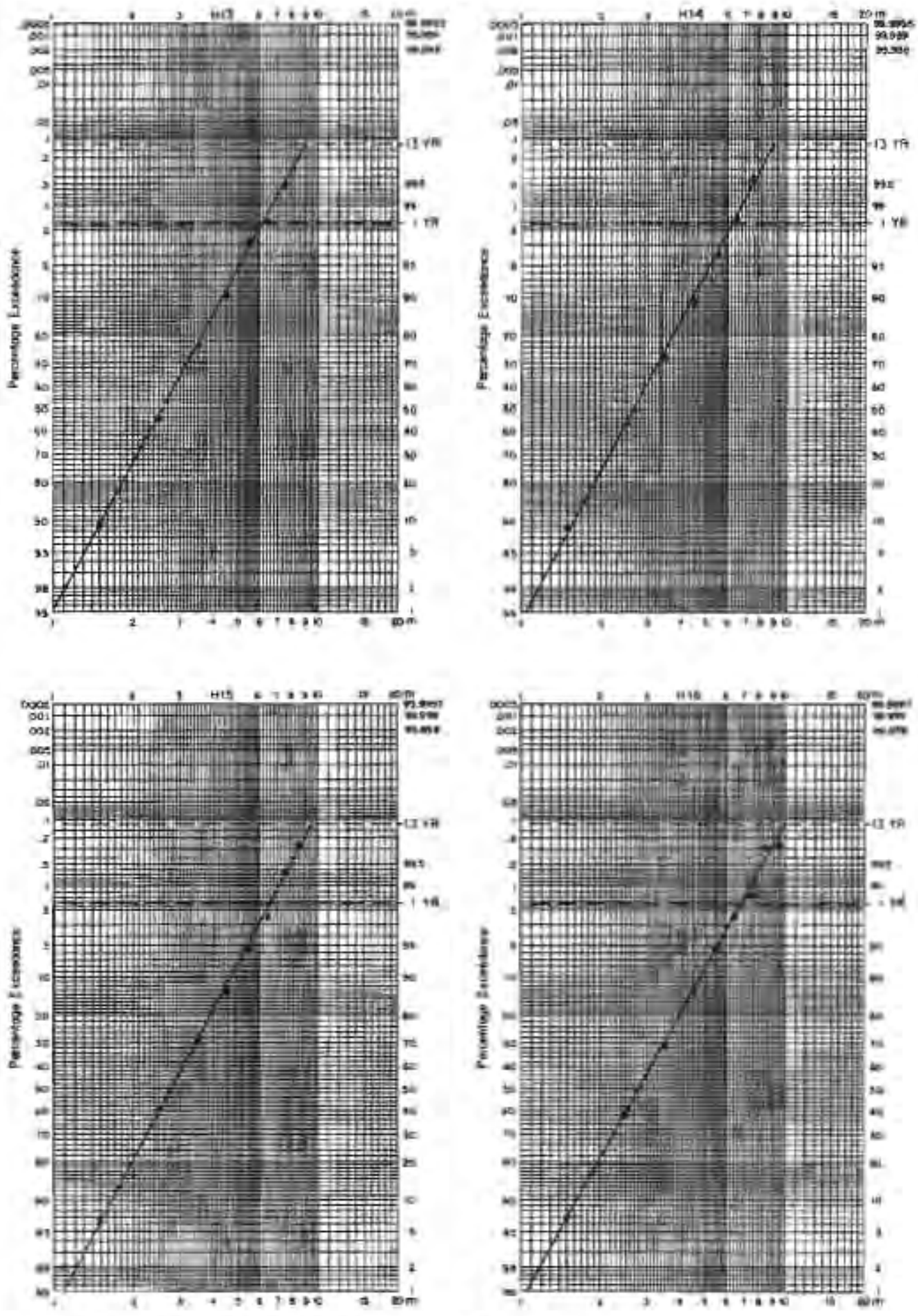


Figure 10. Monthly Wave Height Exceedance Distribution for October

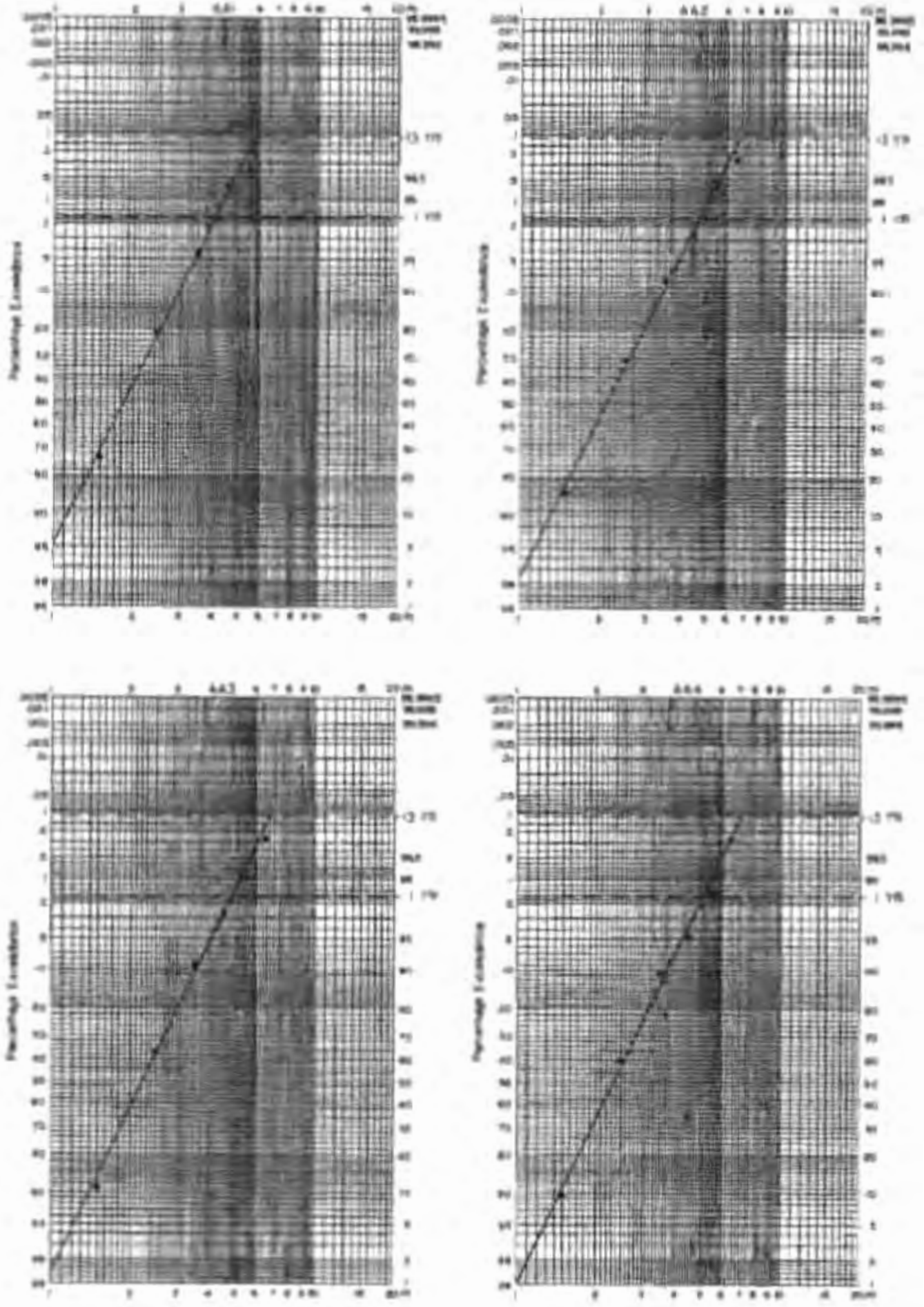


Figure [illegible] Monthly Wave Height Exceedance Distribution for November

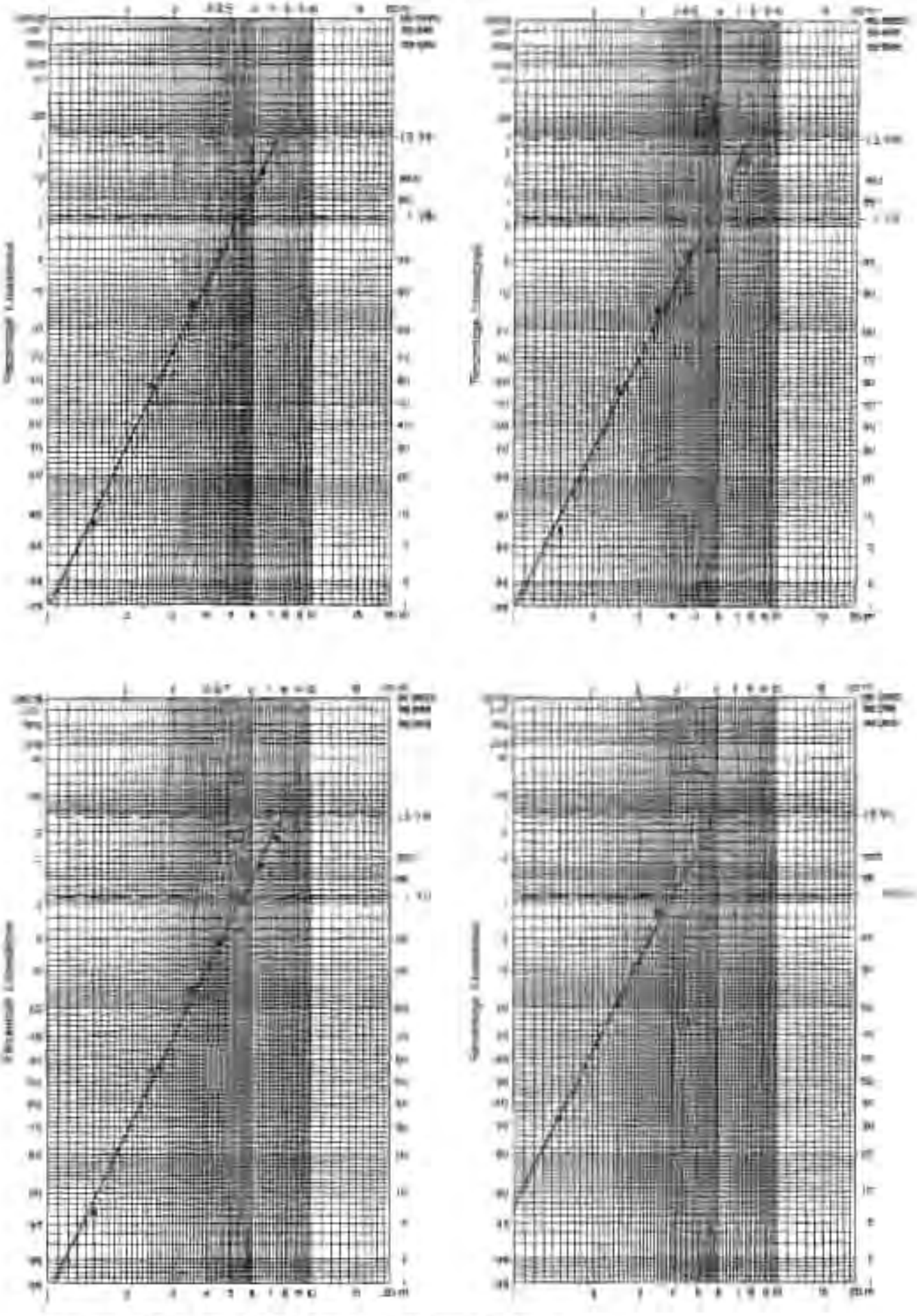


Figure (1) Monthly Wave Height Exceedance Distribution for November

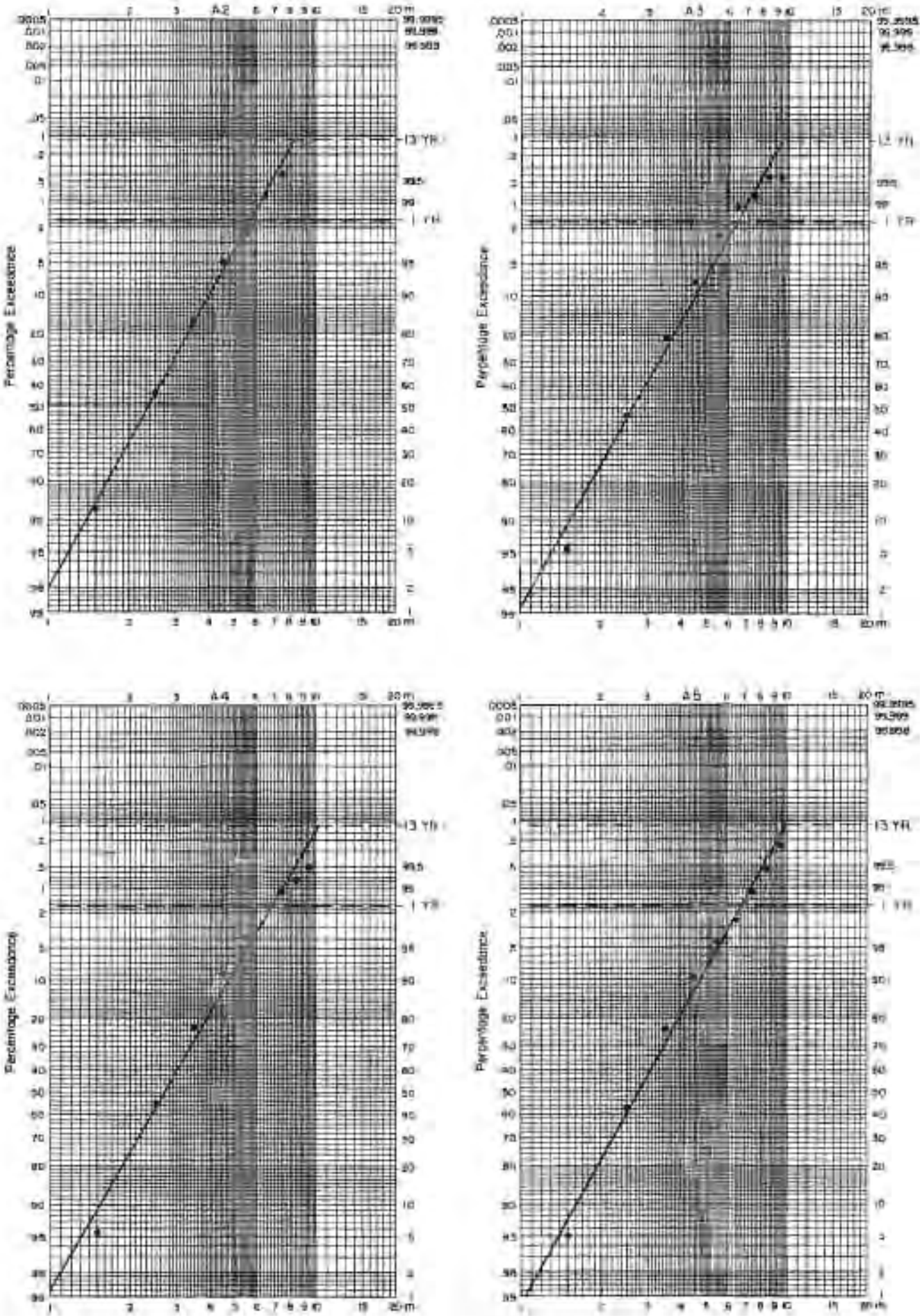
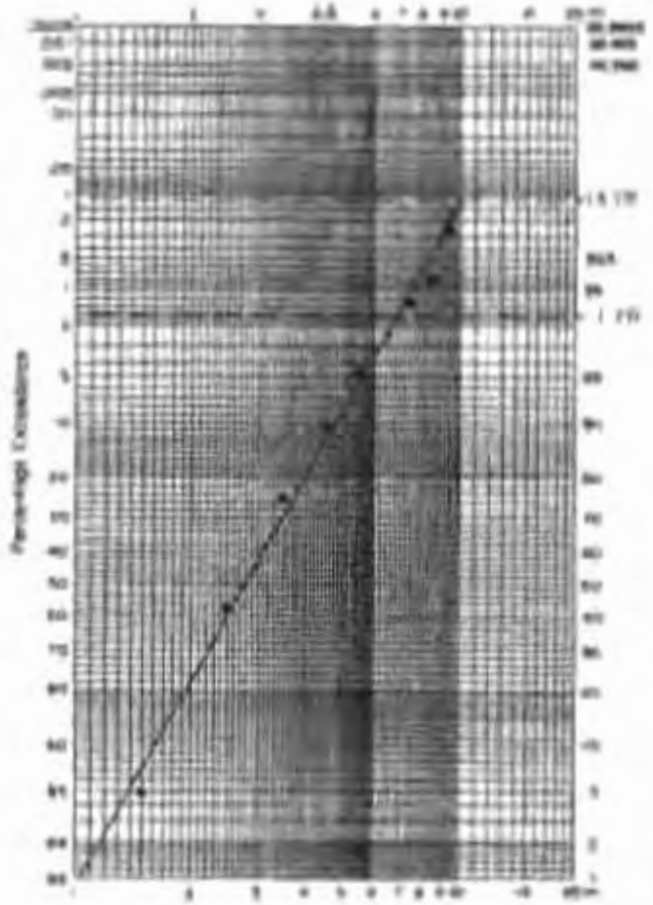
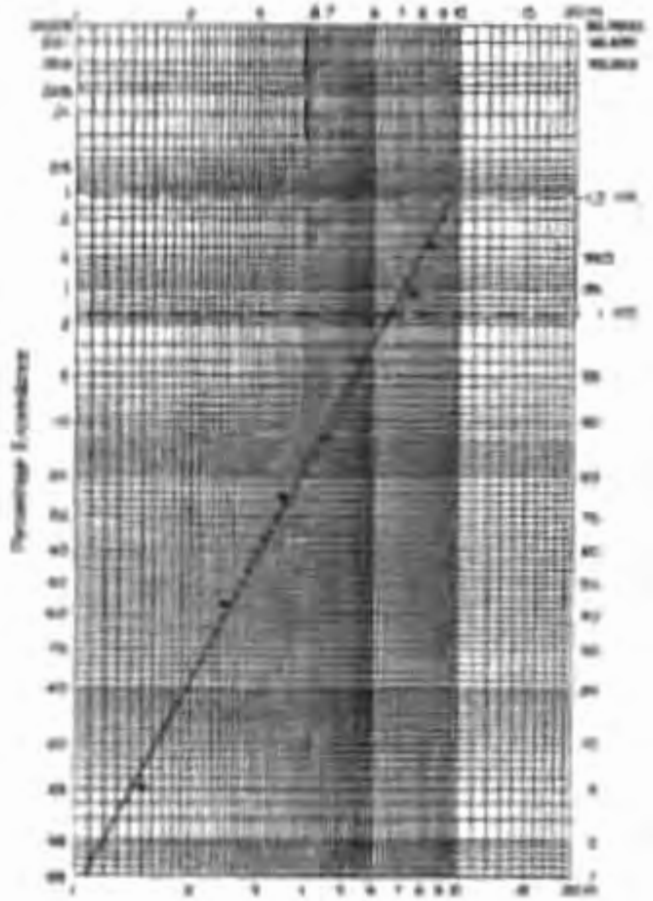
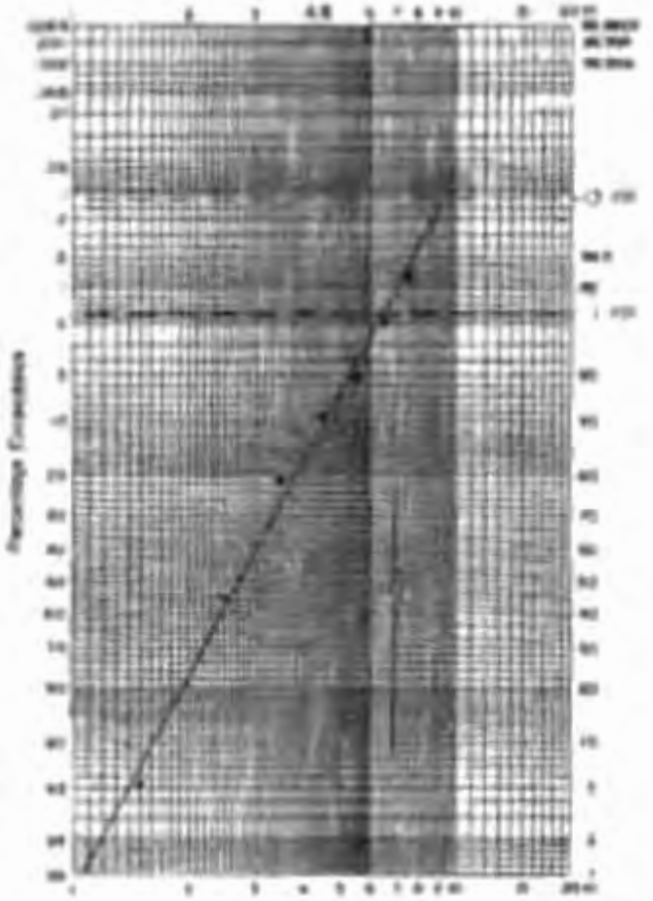
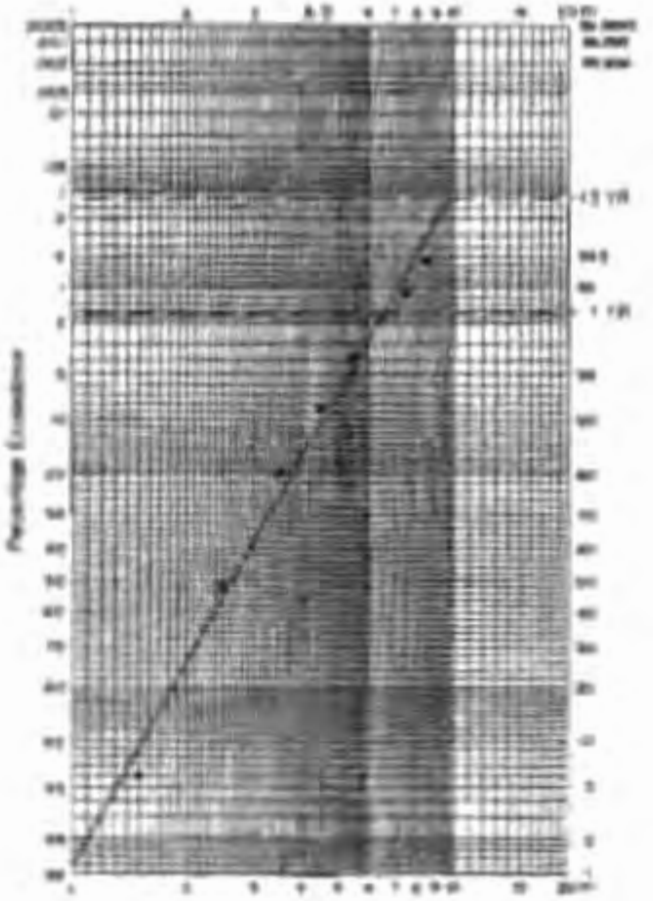


Figure 11c Monthly Wave Height Exceedance Distribution for November









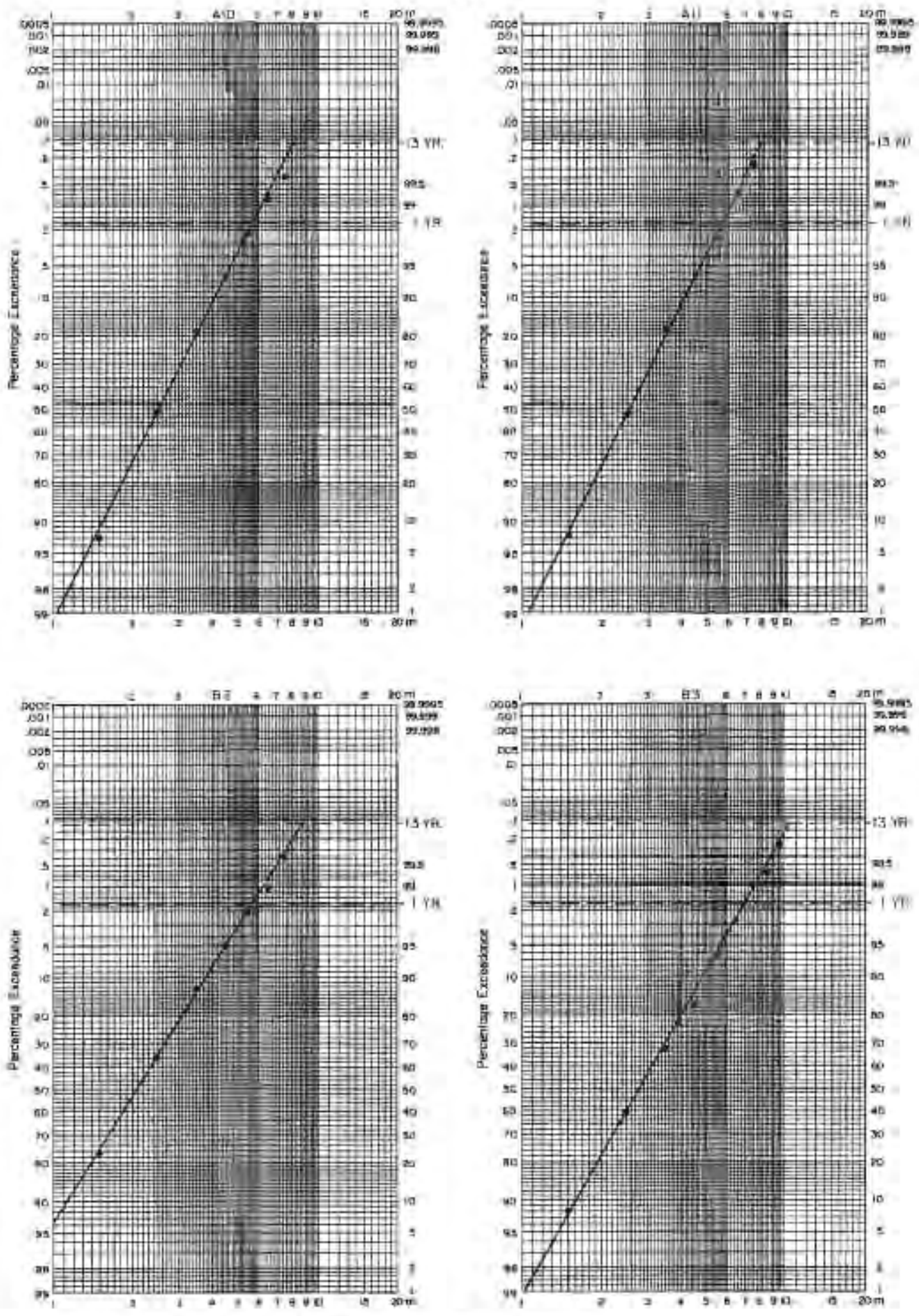


Figure 11e Monthly Wave Height Exceedance Distribution for November

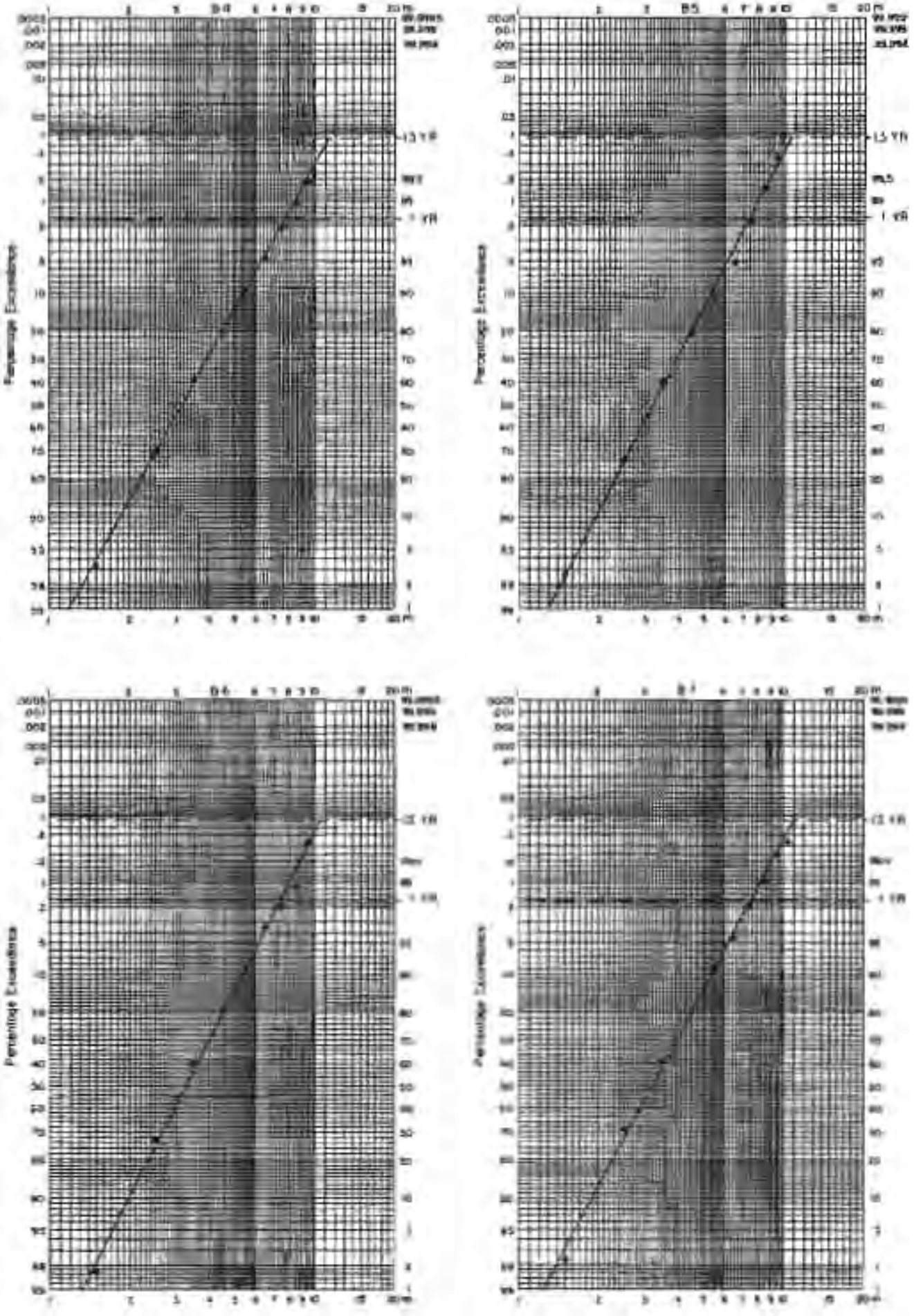
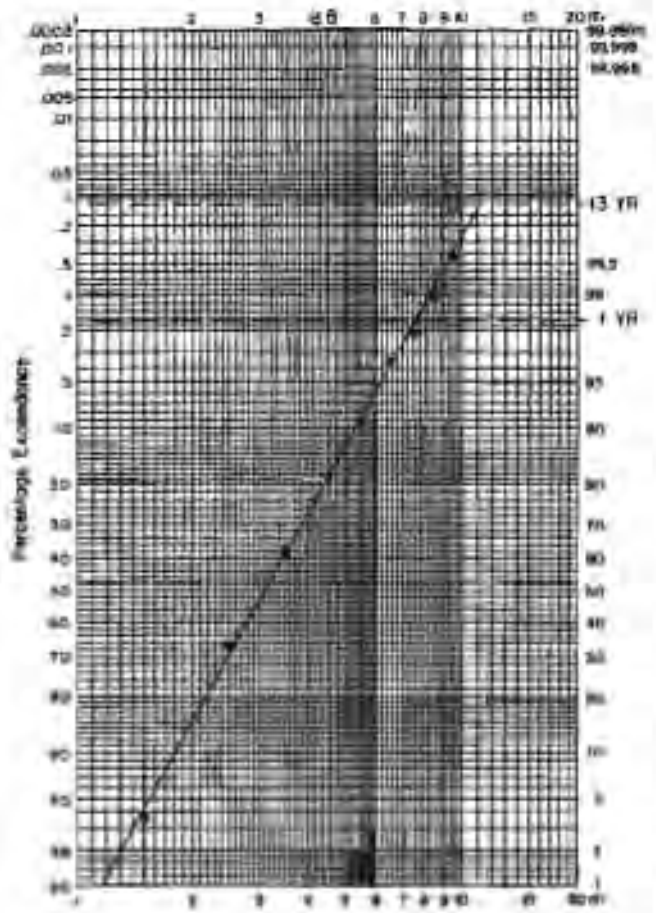
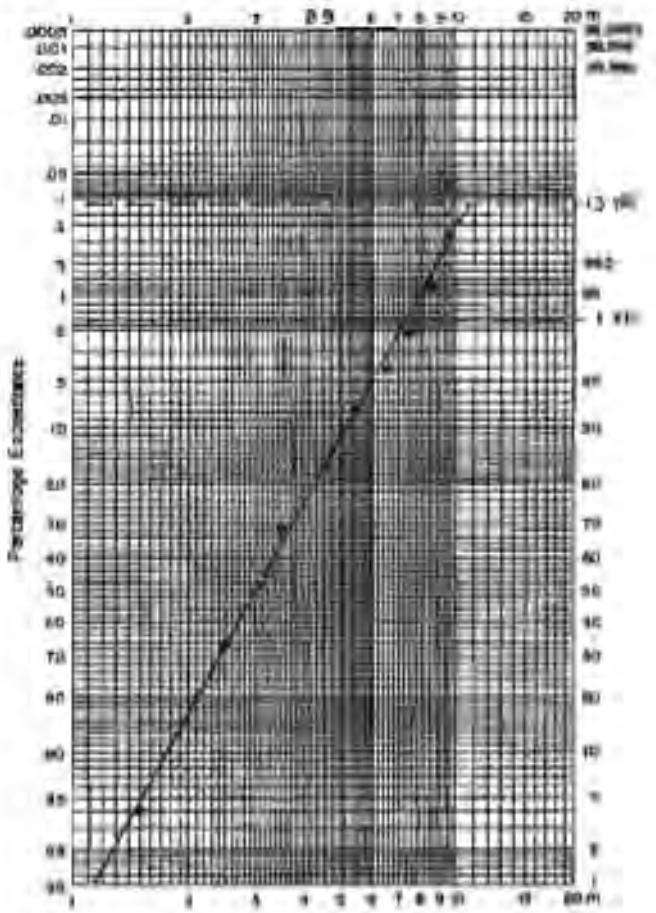
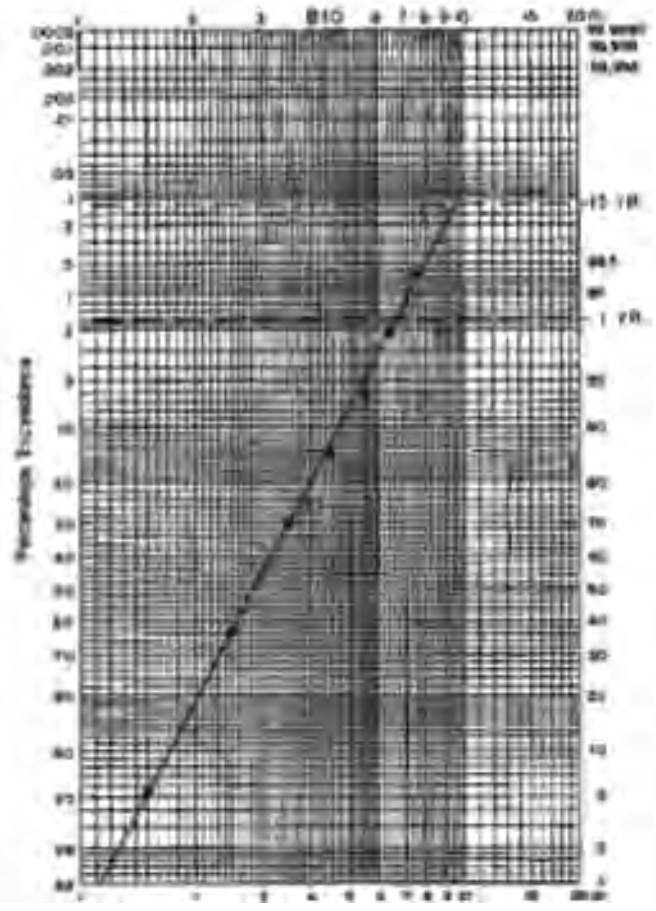
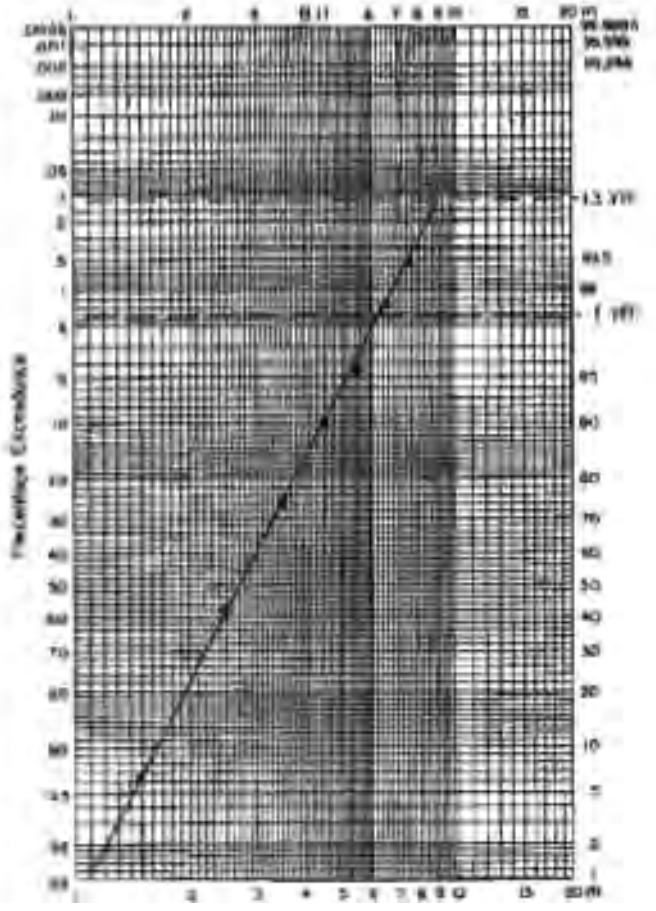


Figure 111 Monthly Wave Height Exceedance Distribution for November









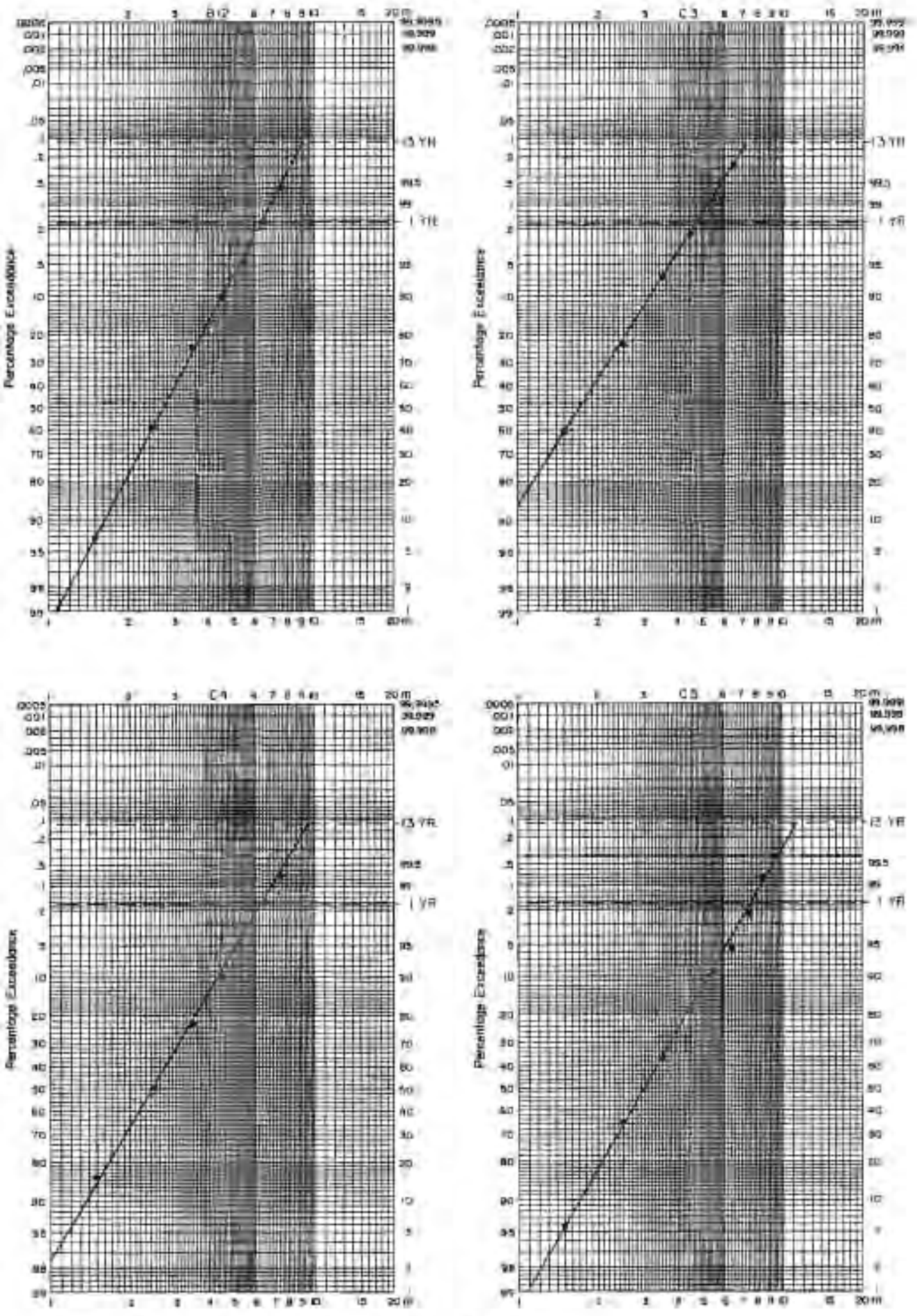


Figure 11h. Monthly Wave Height Exceedance Distribution for November

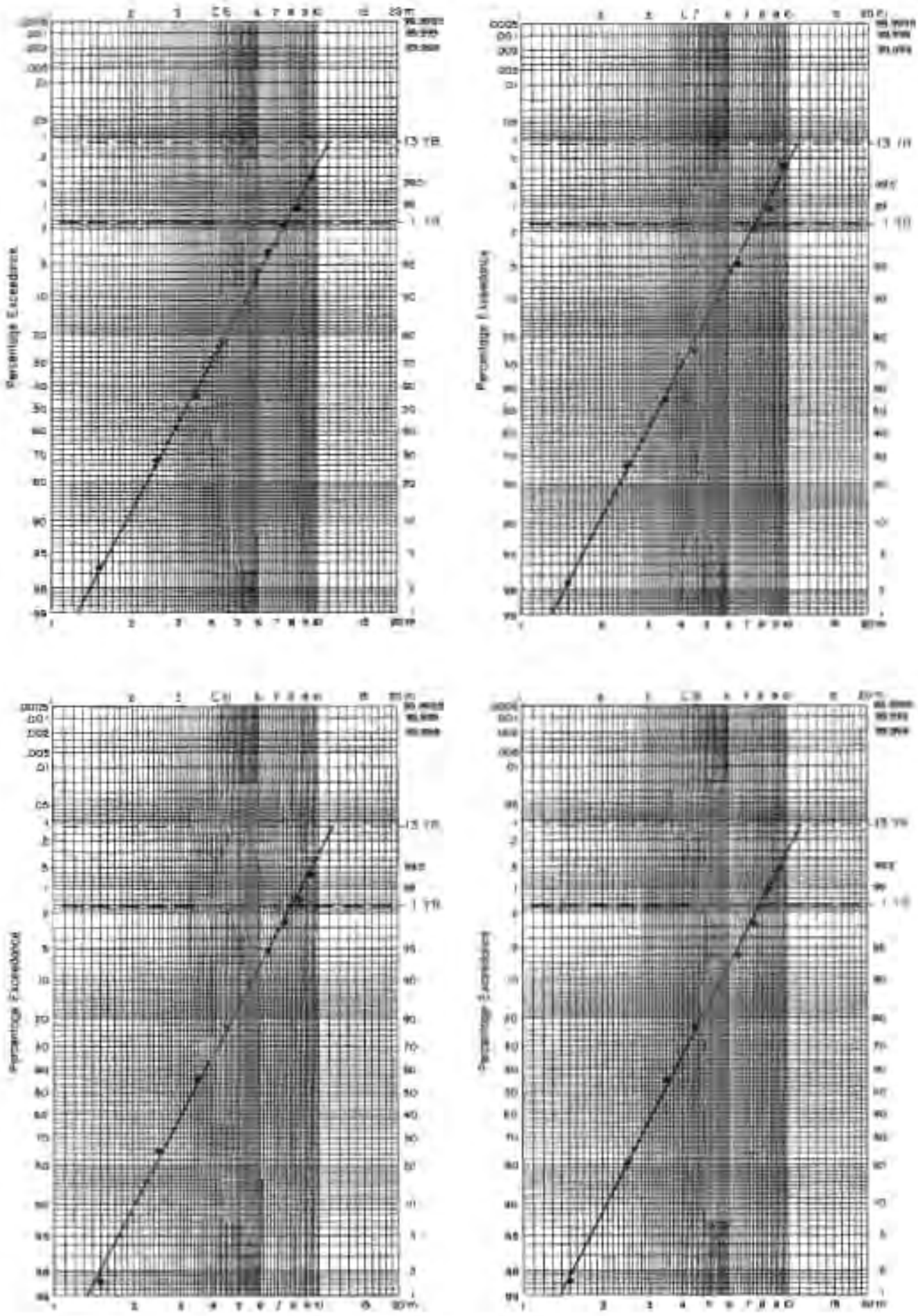


Figure III Monthly Wave Height Exceedance Distribution for November

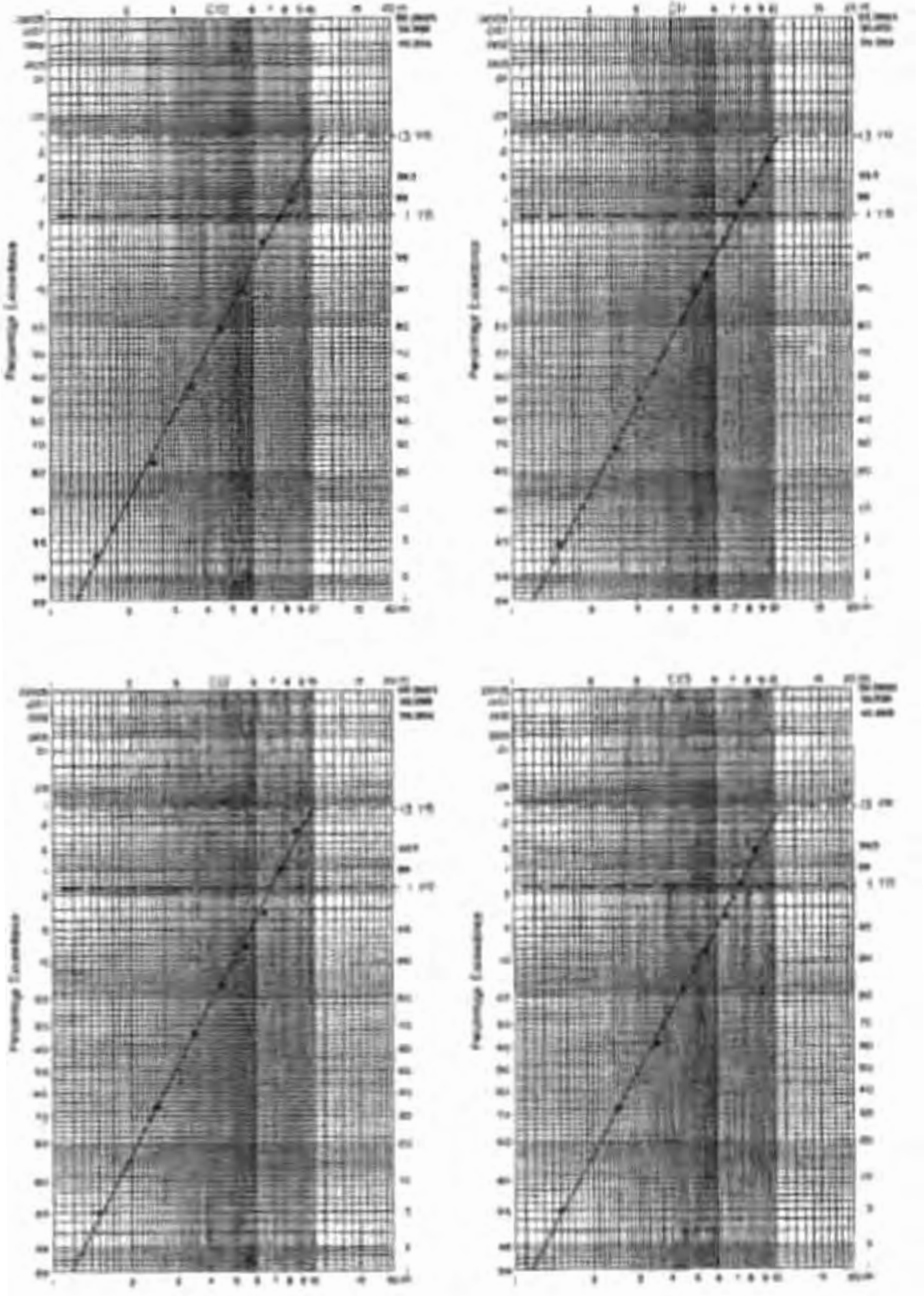


Figure 11 Monthly Wave Height Exceedance Distribution for November

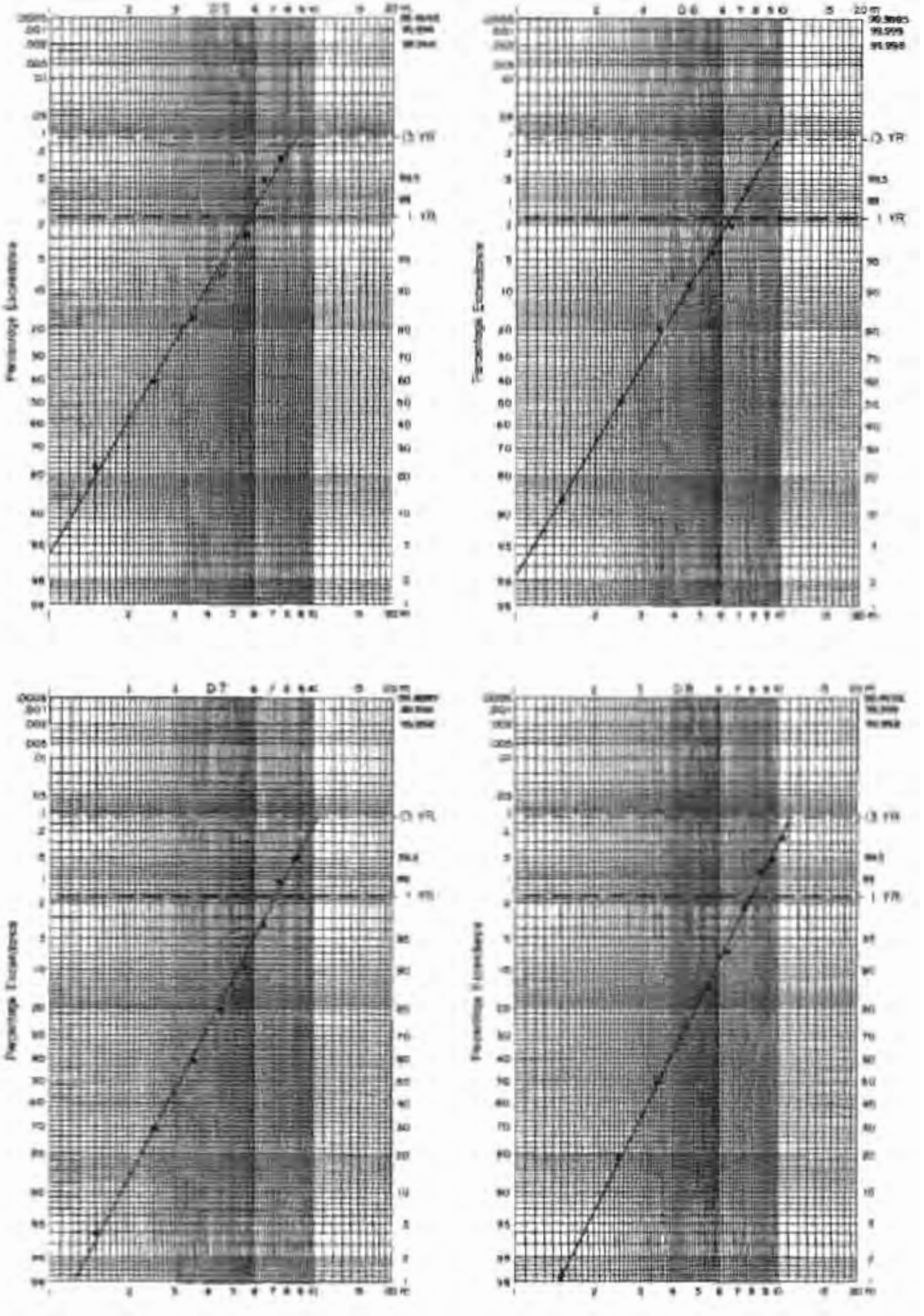
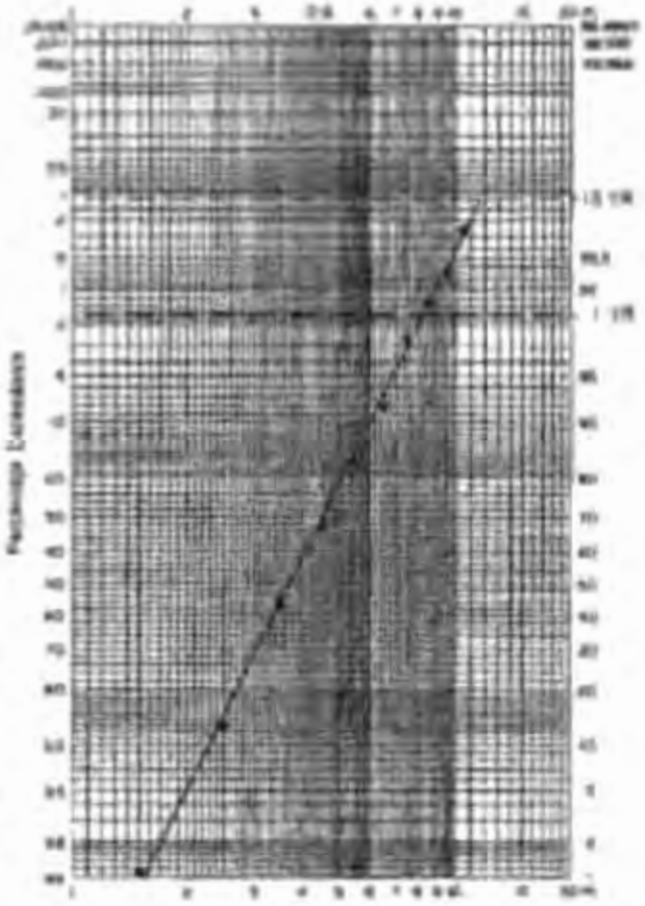
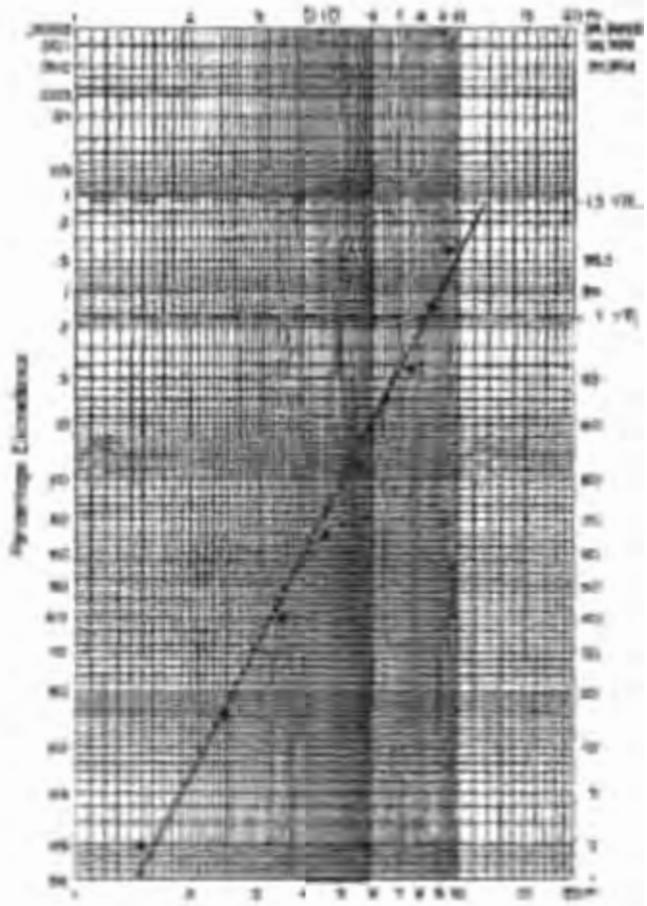
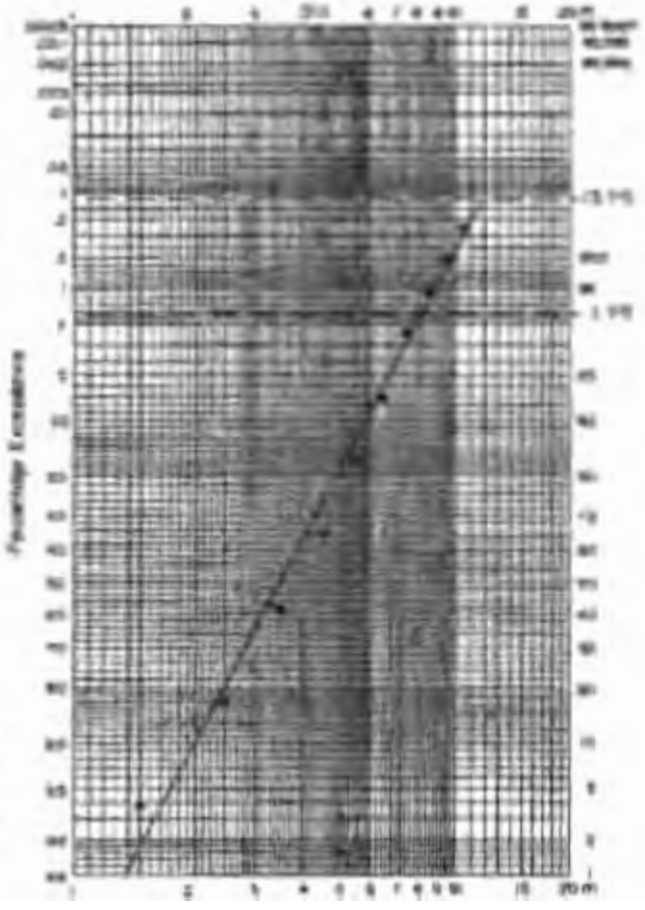
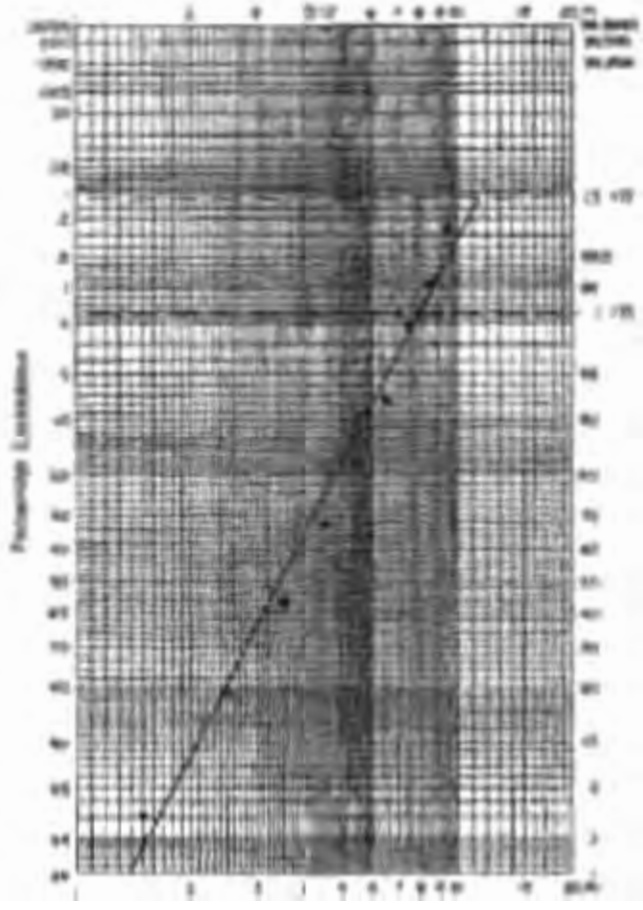


Figure 11e Monthly Wave Height Exceedance Distribution for November









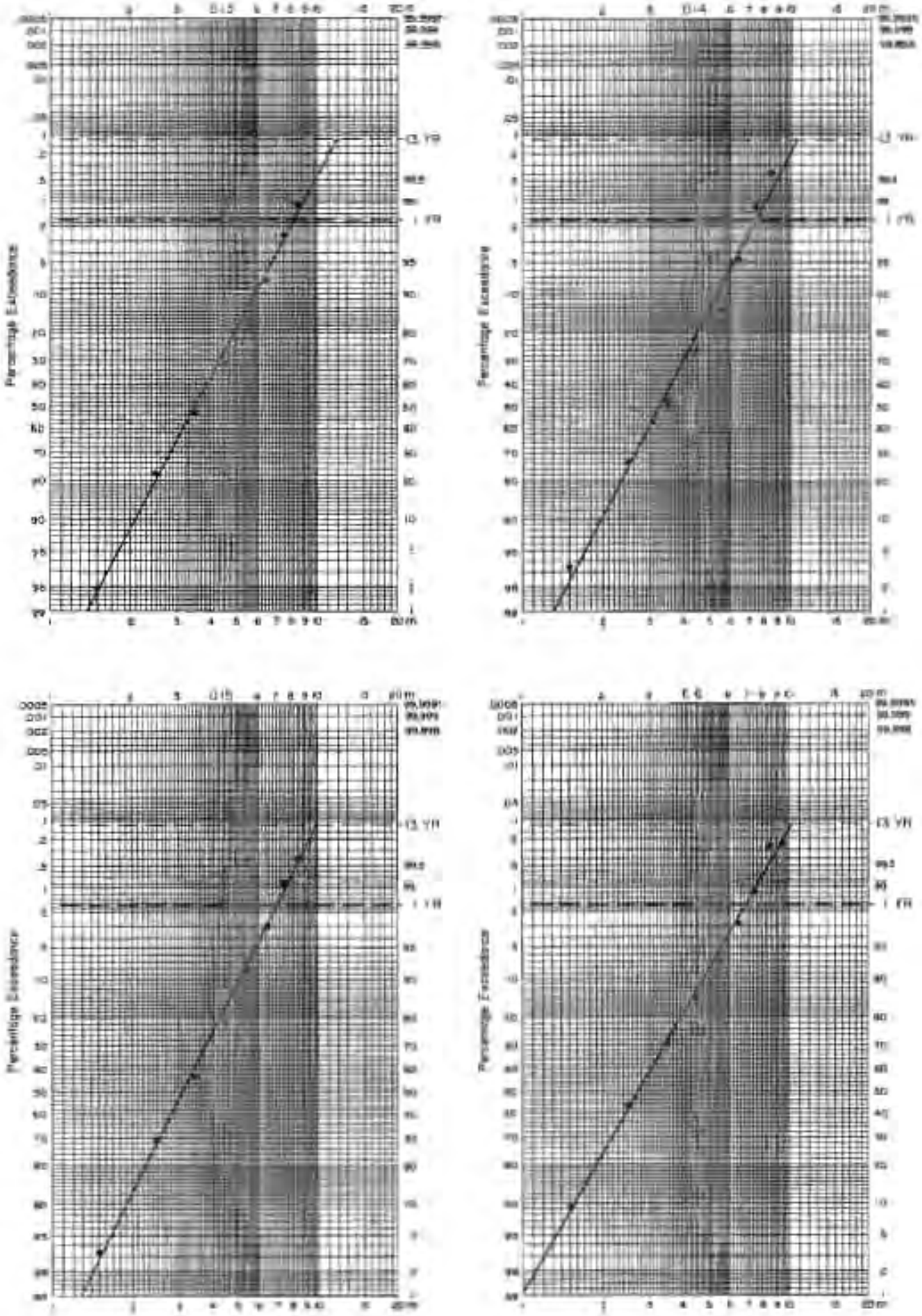
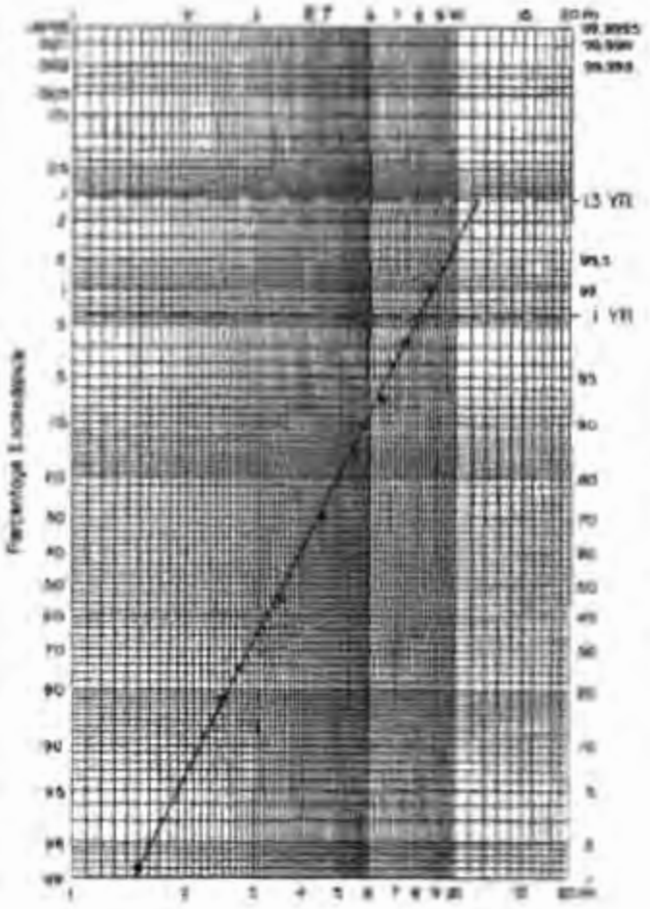
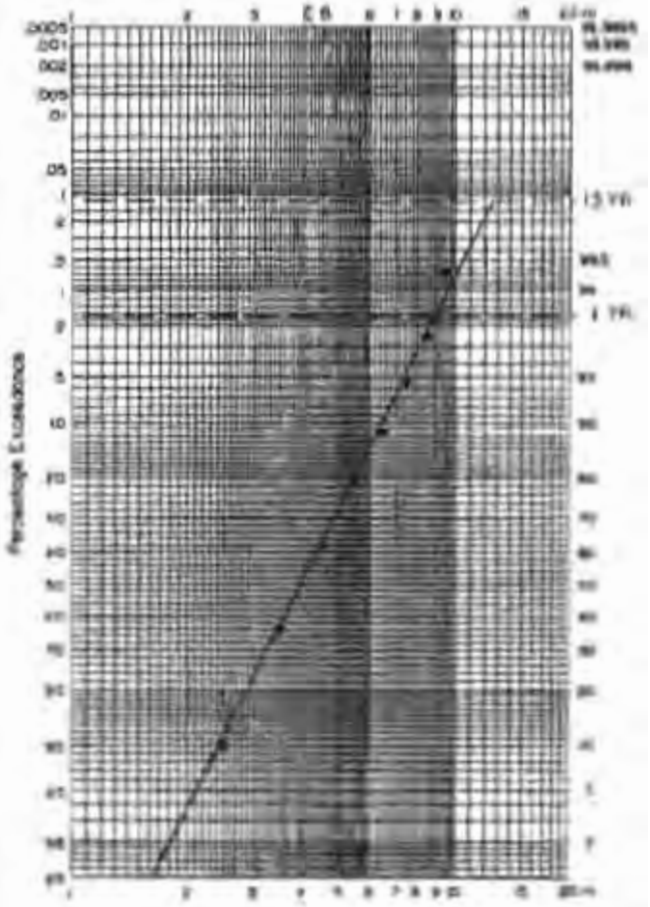
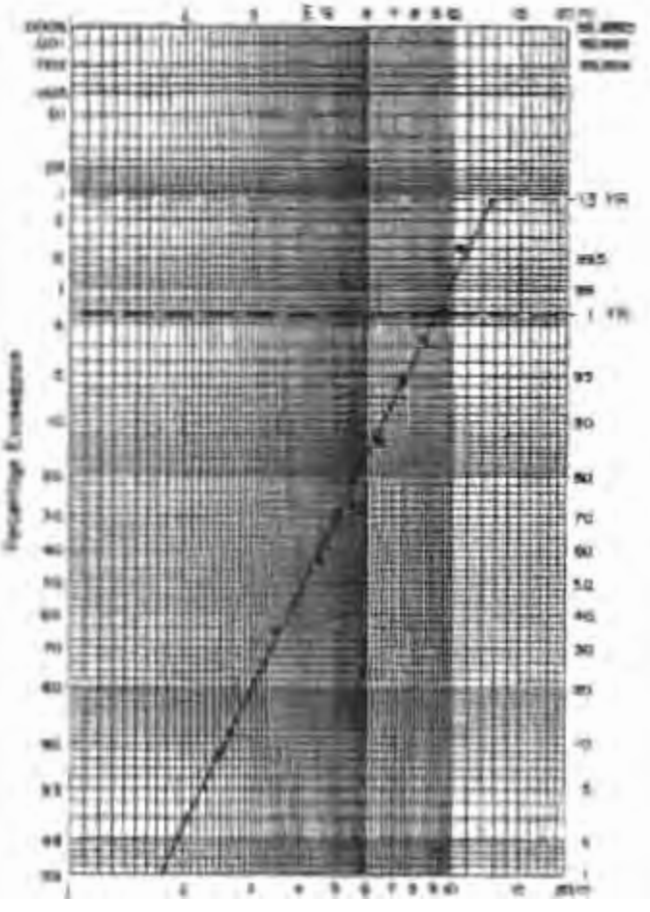
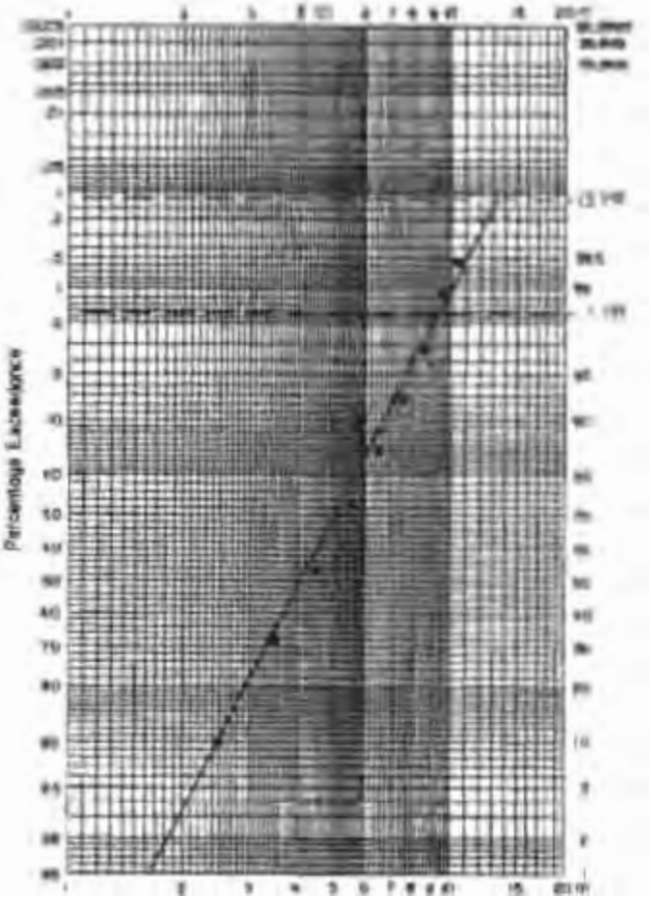


Figure 1.11 Monthly Wave Height Exceedance Distribution for November









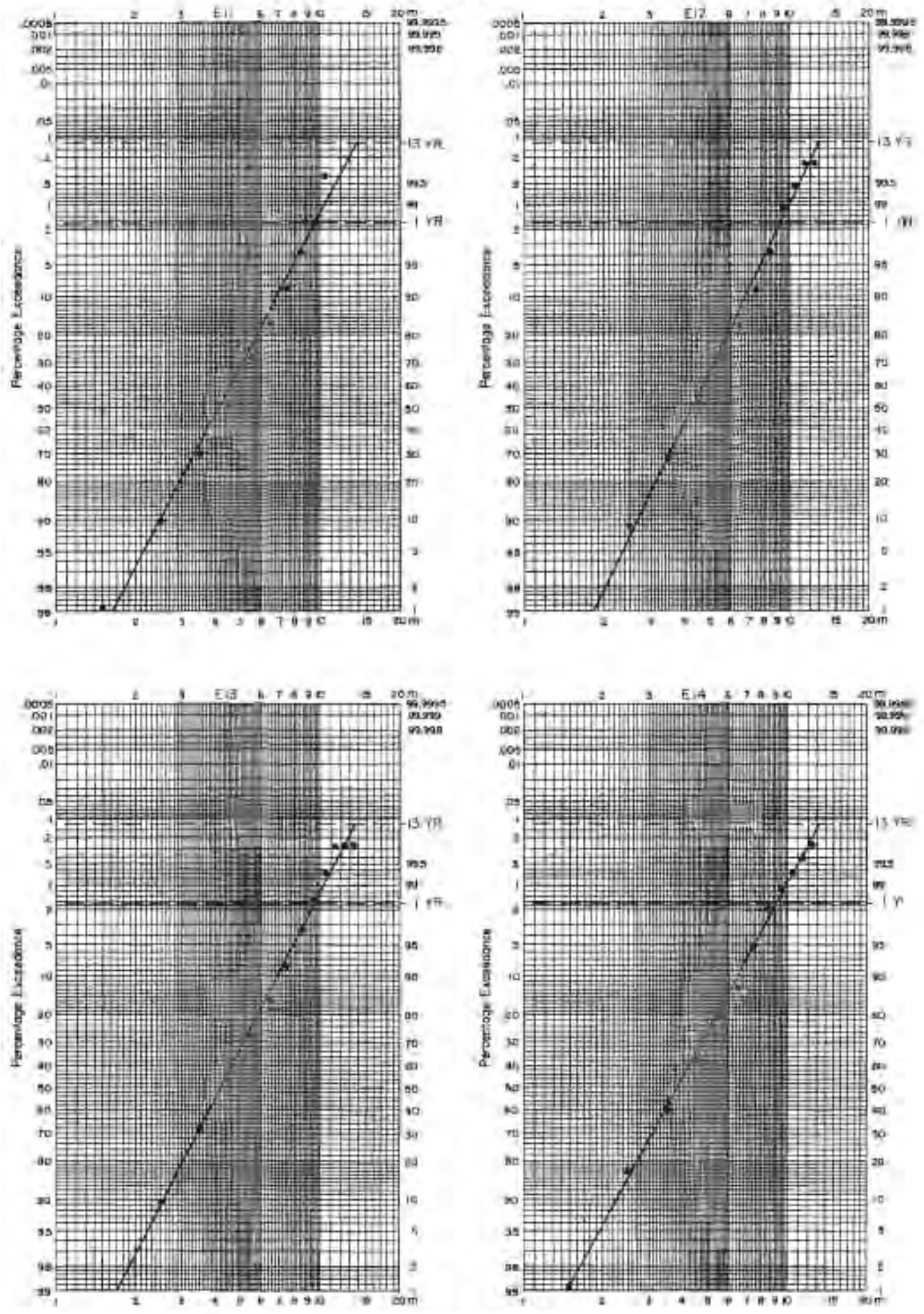


Figure 11a Monthly Wave Height Exceedance Distribution for November

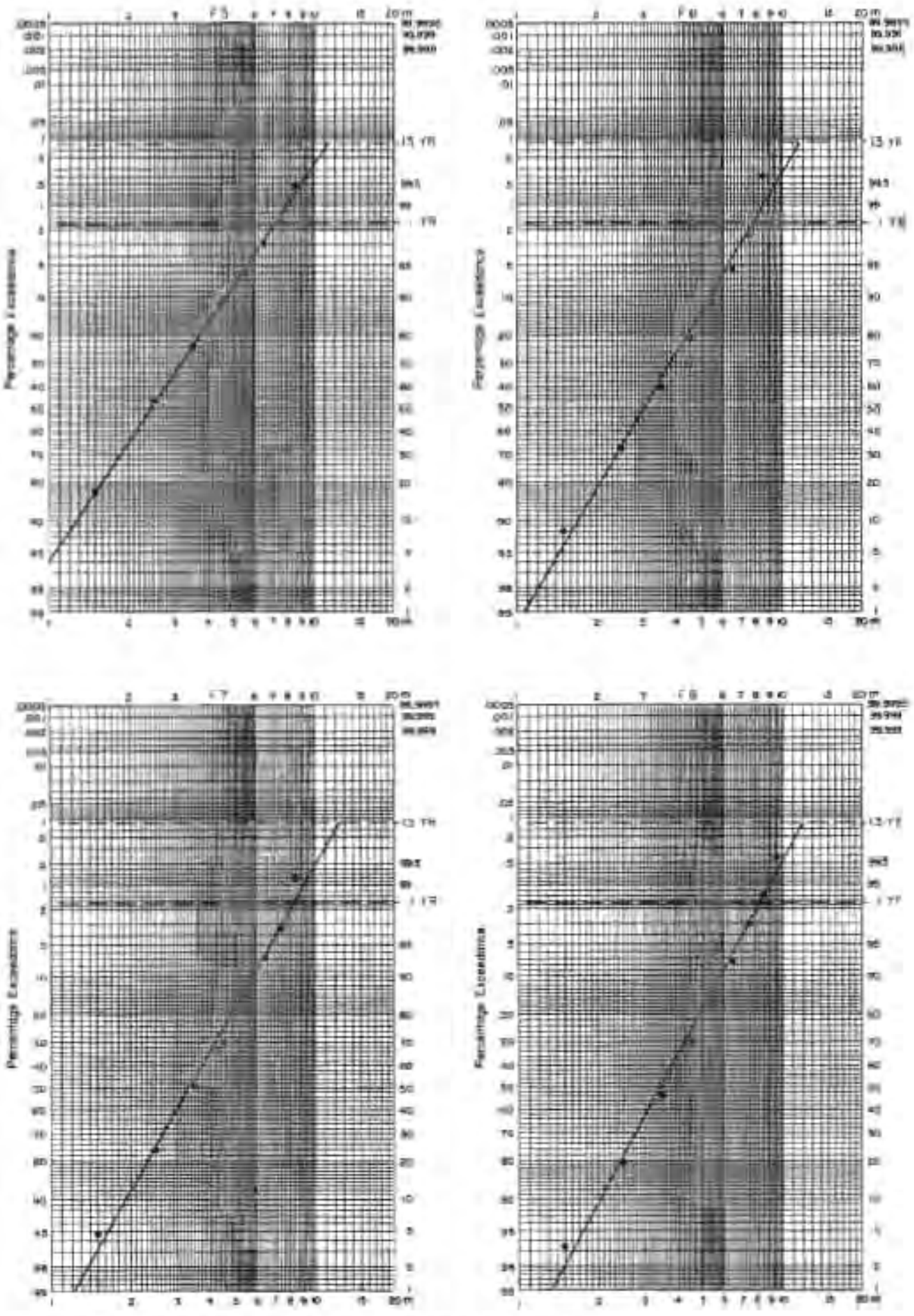


Figure 11b. Monthly Wave Height Exceedance Distribution for November

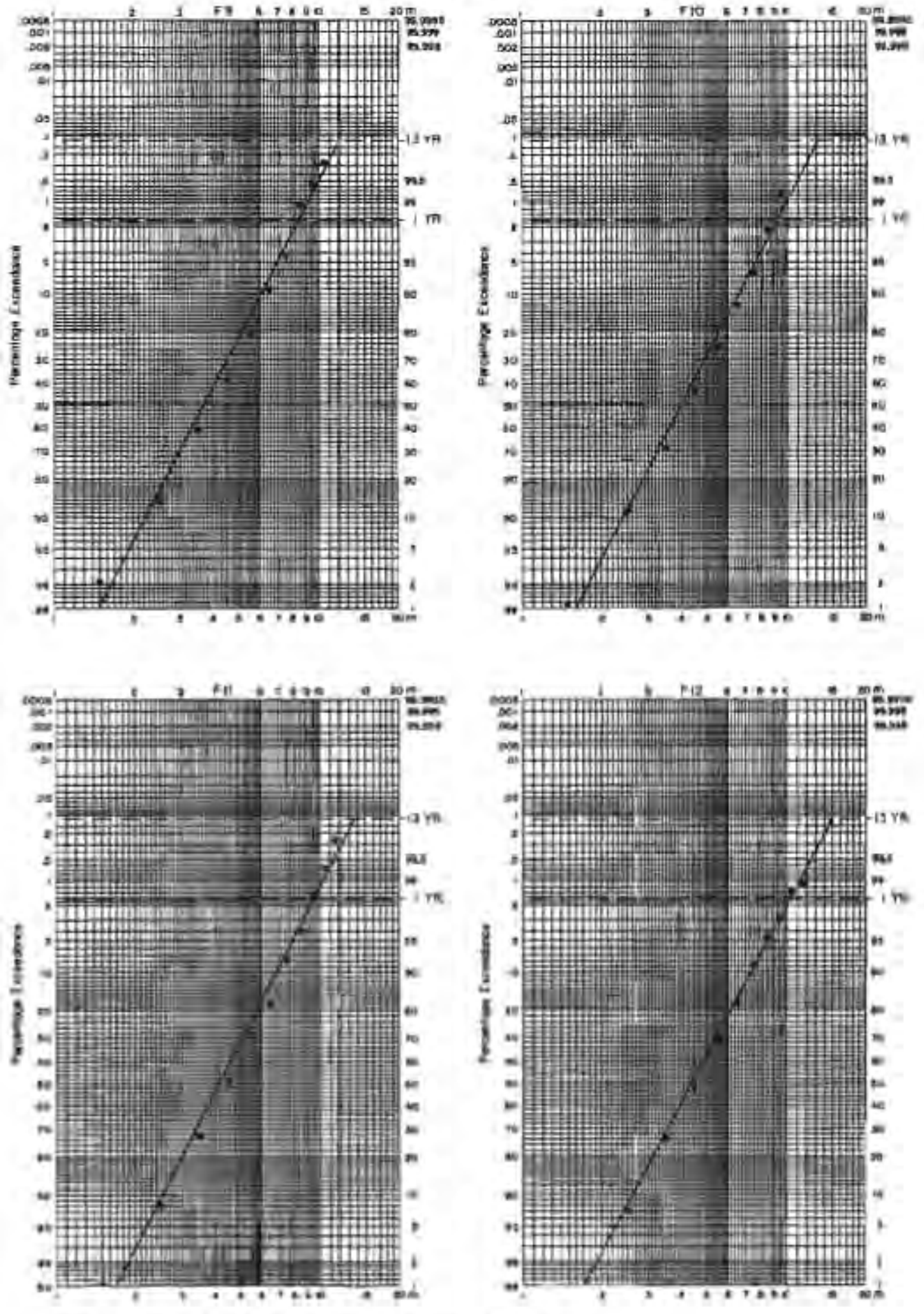
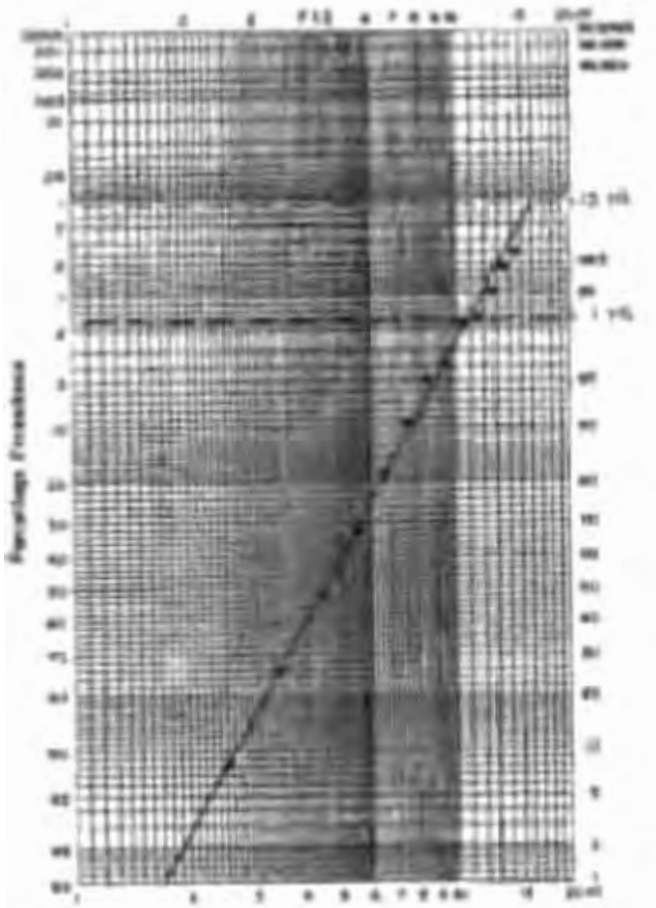
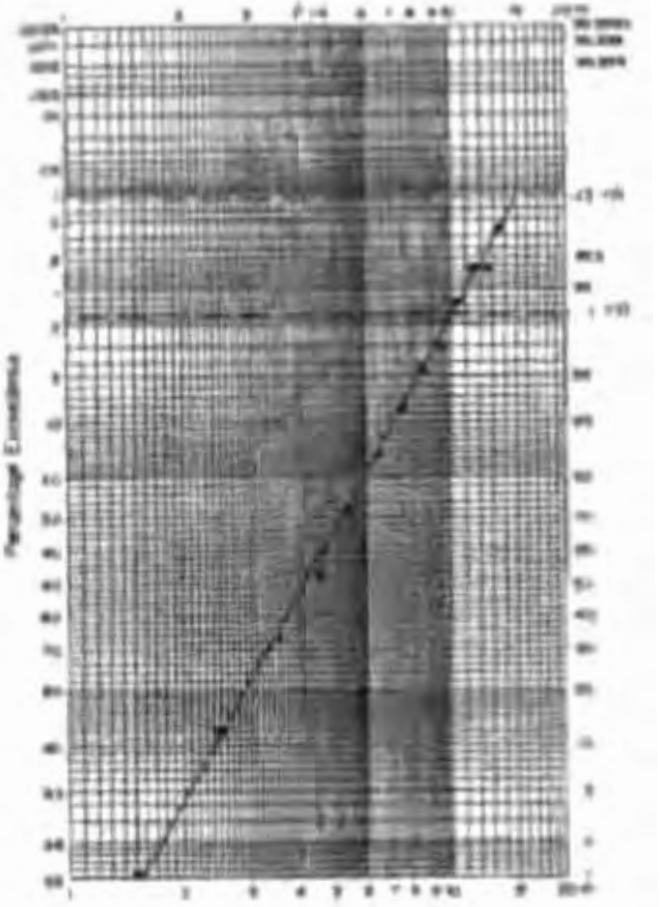
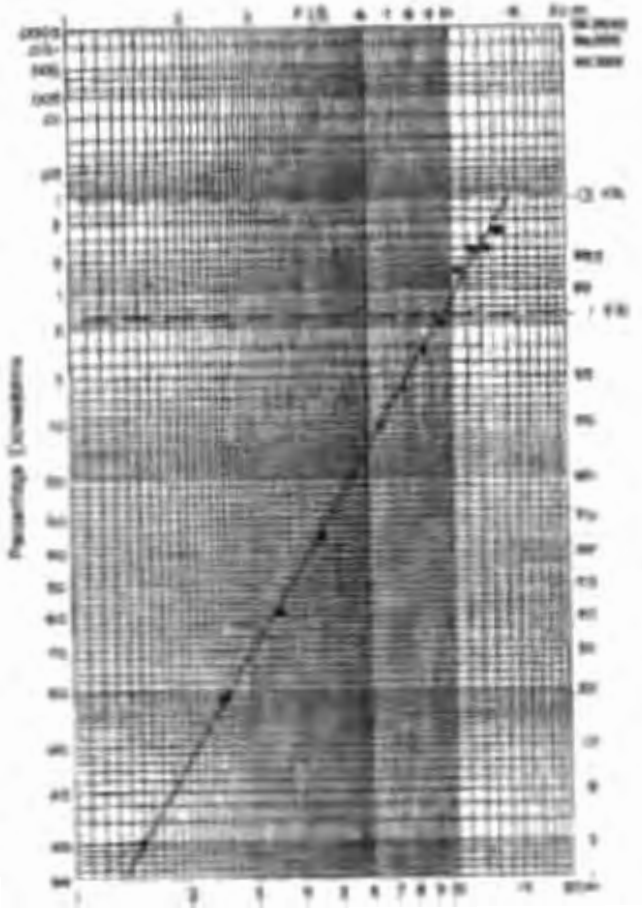
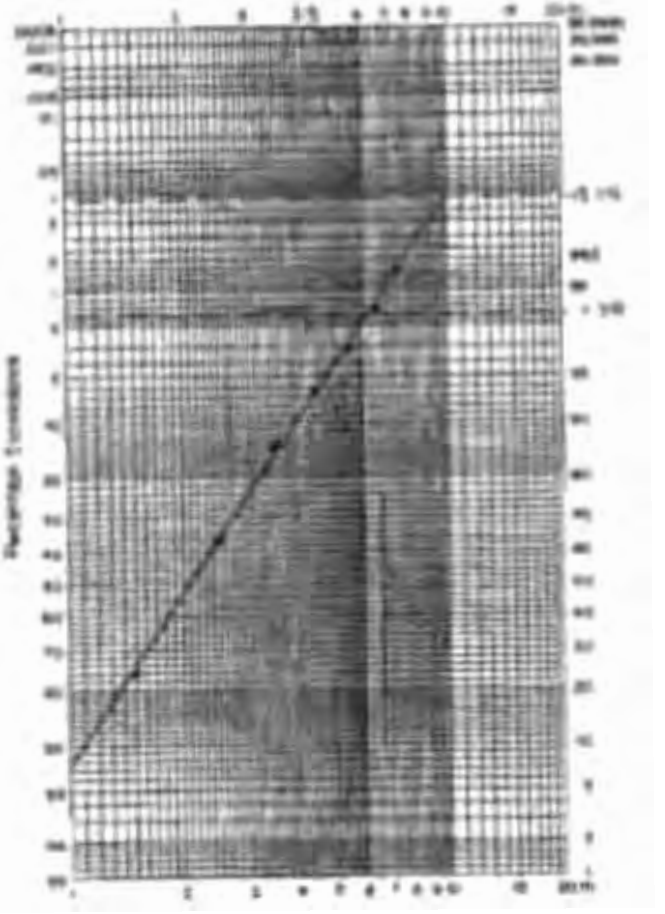


Figure 114 Monthly Wave Height Exceedance Distribution for November









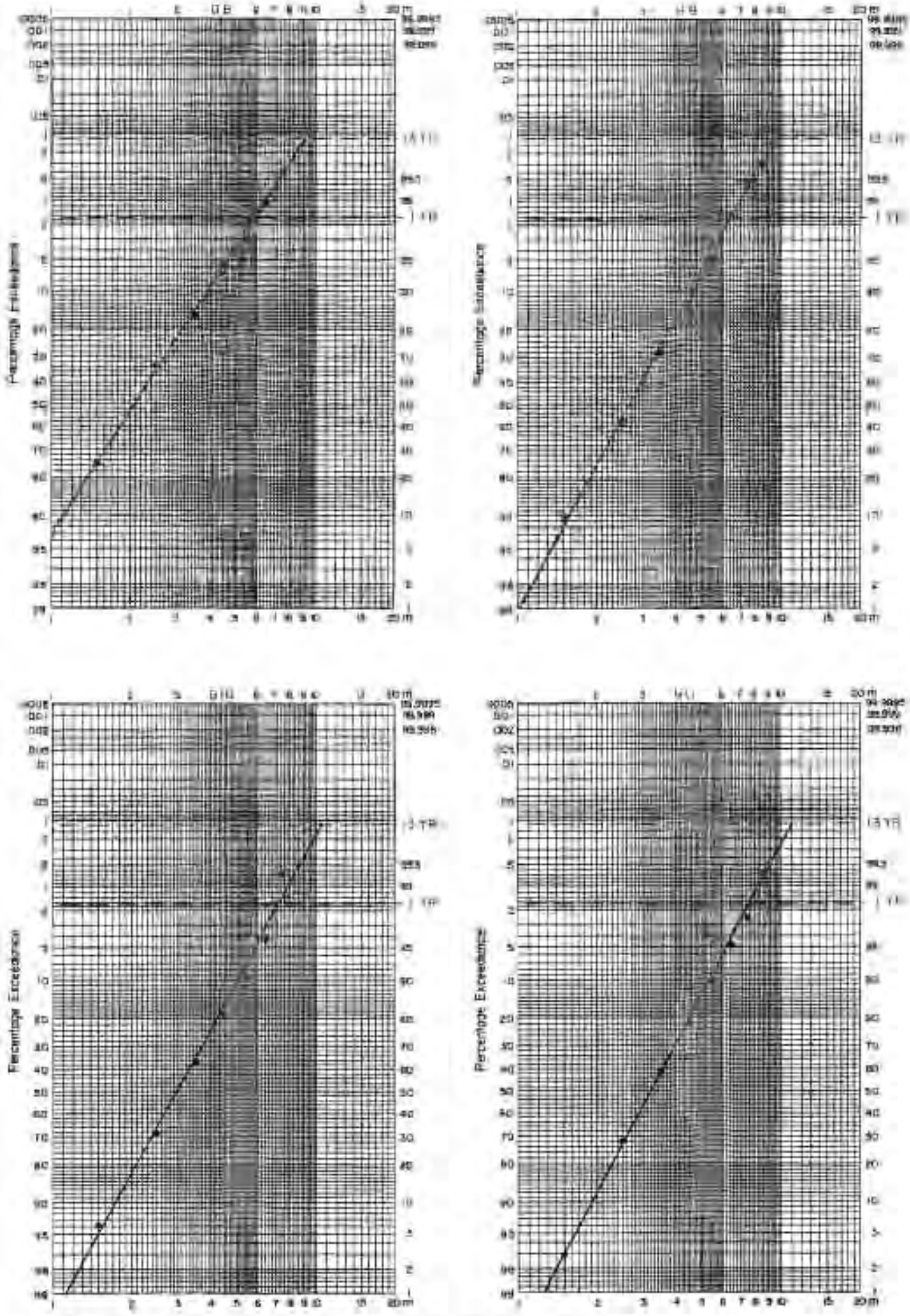
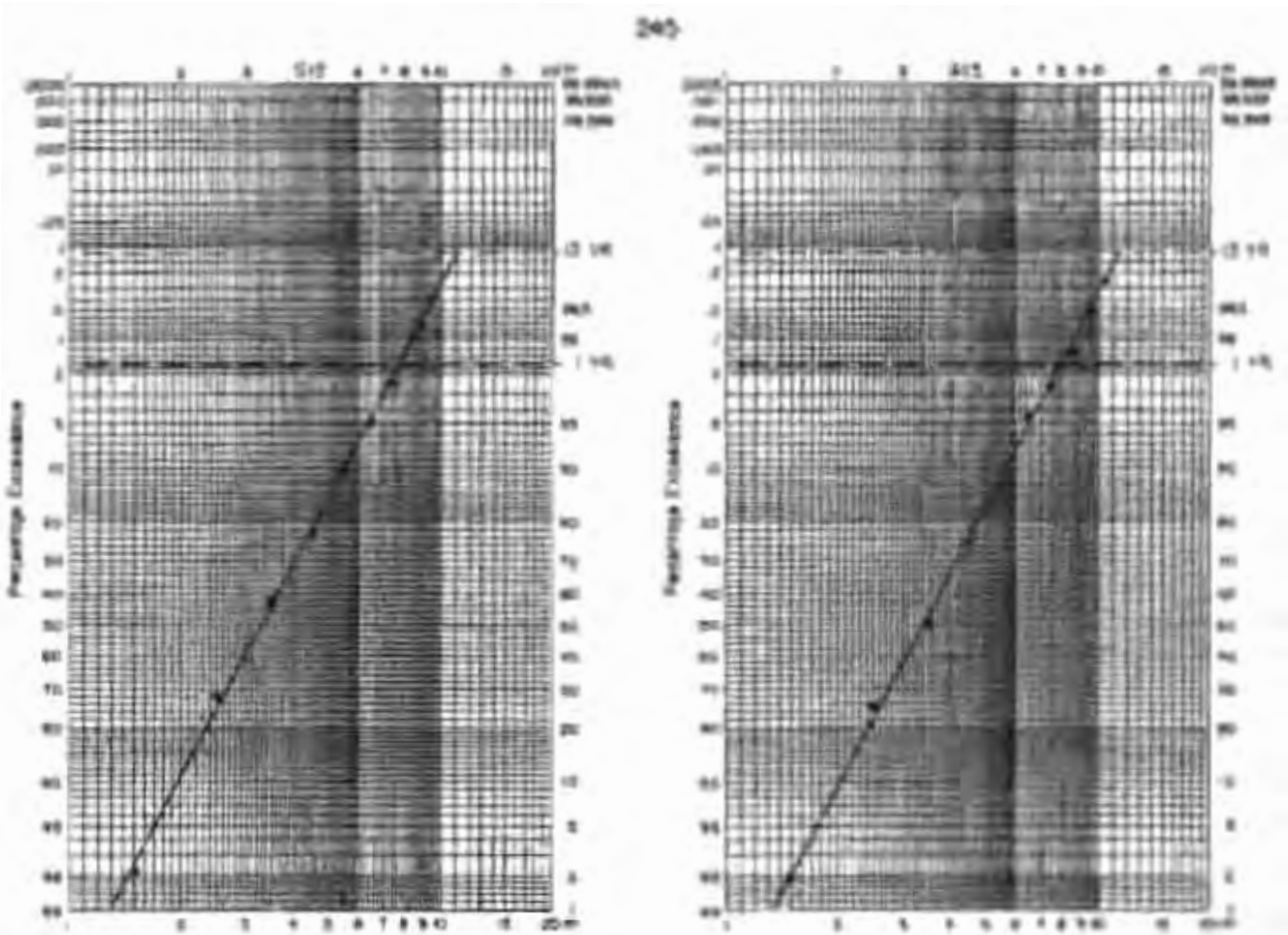
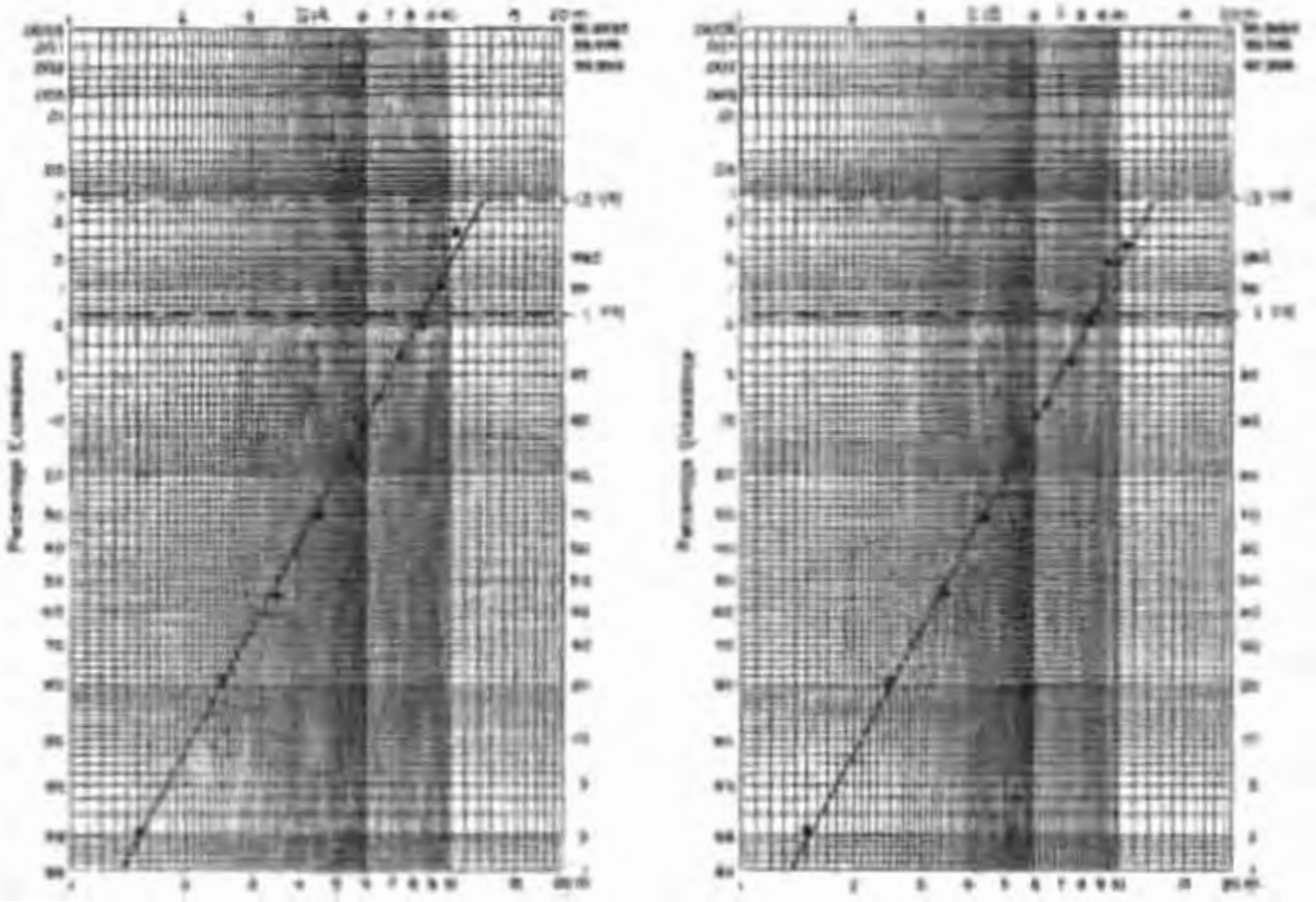


Figure 11s Monthly Wave Height Exceedance Distribution for November





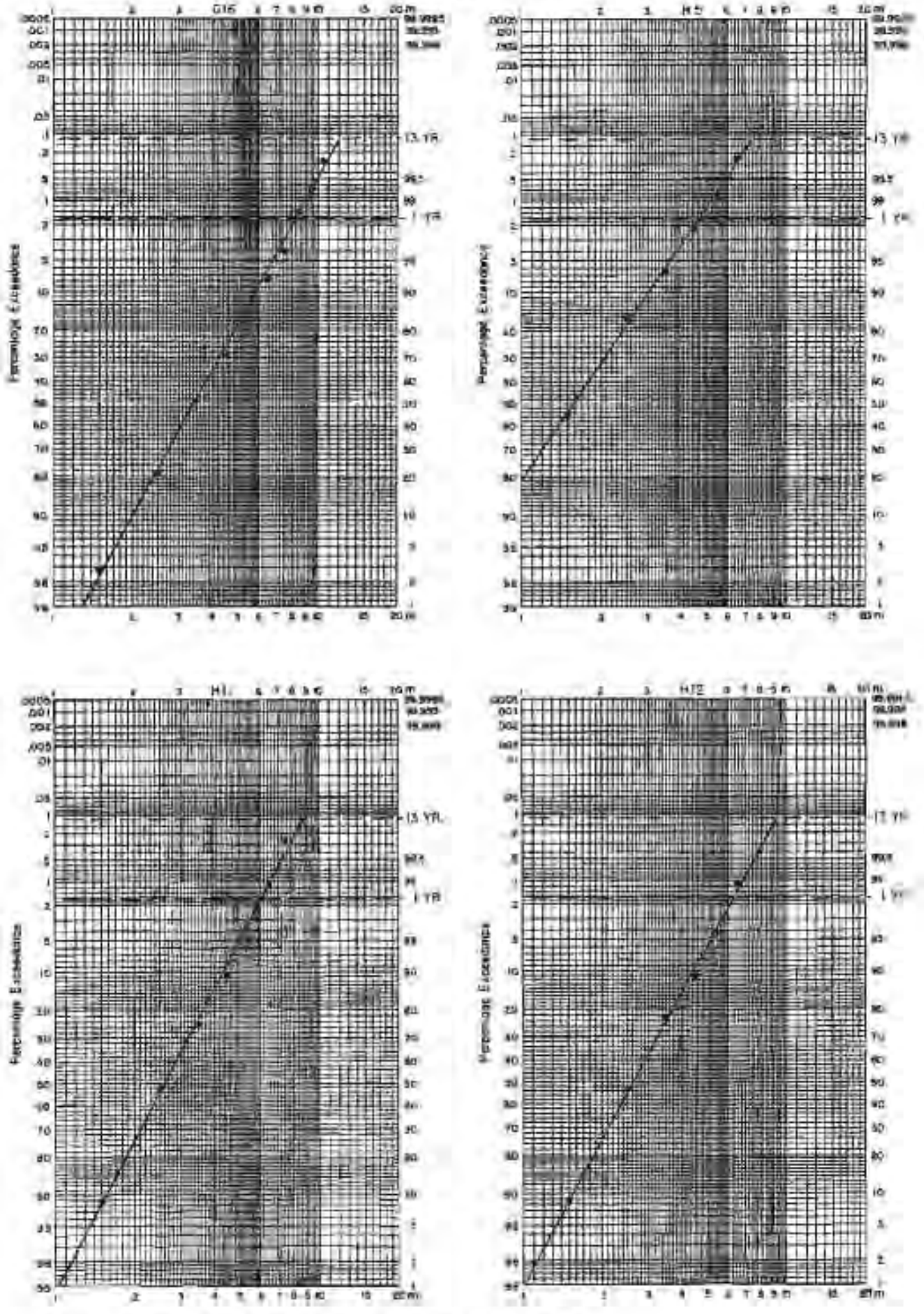


Figure 111. Monthly Wave Height Exceedance Distribution for November

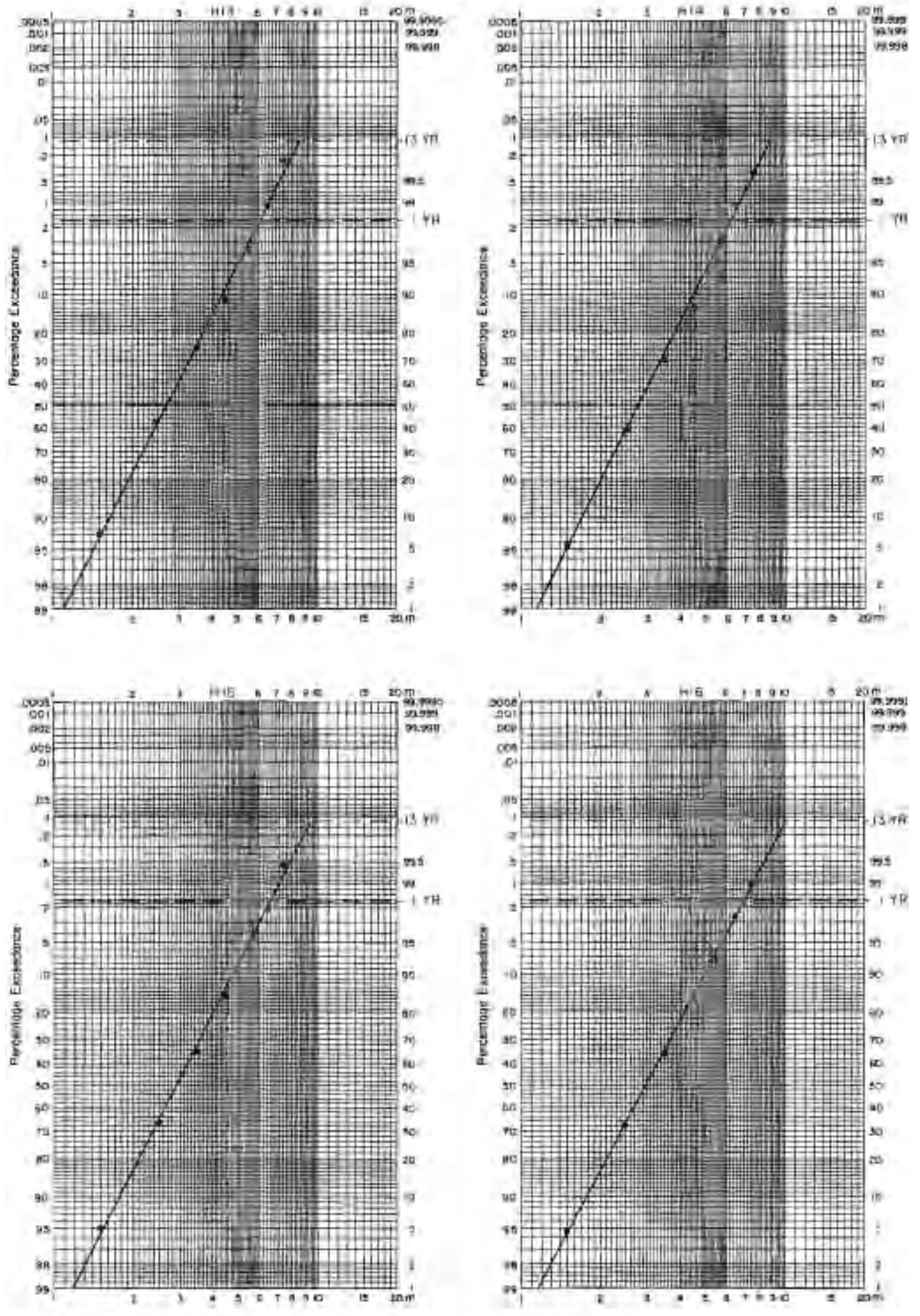
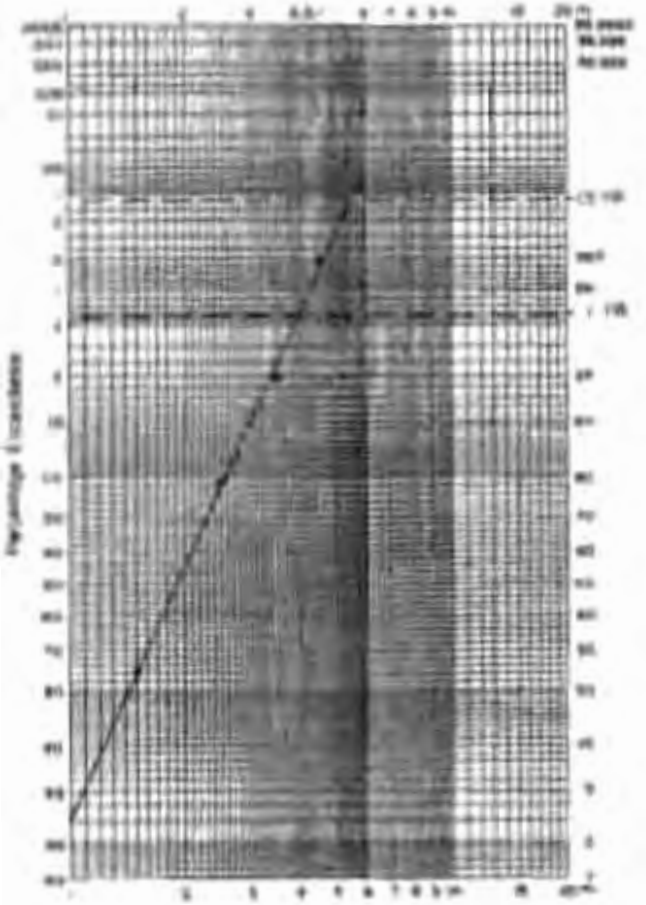
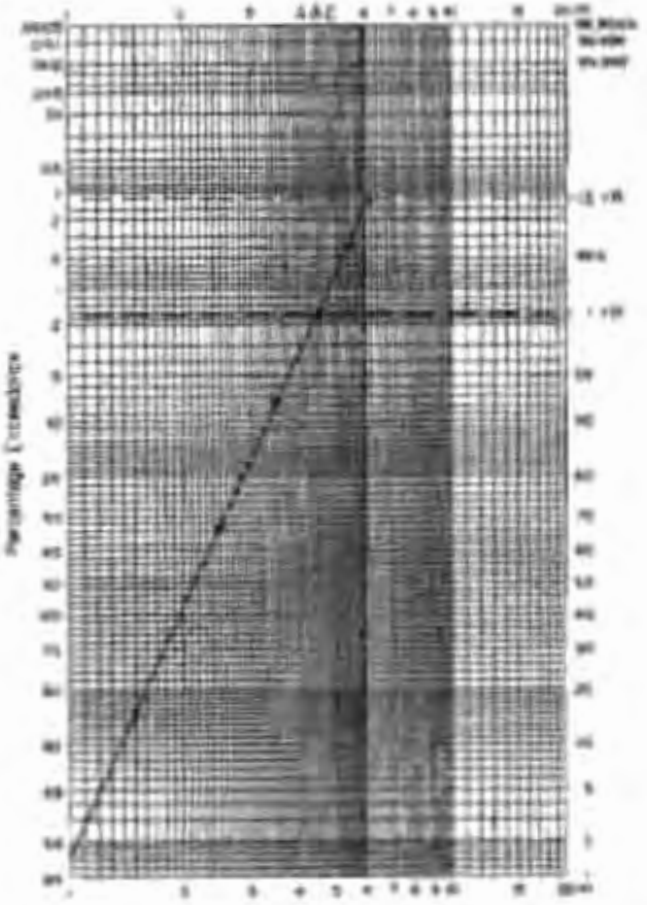
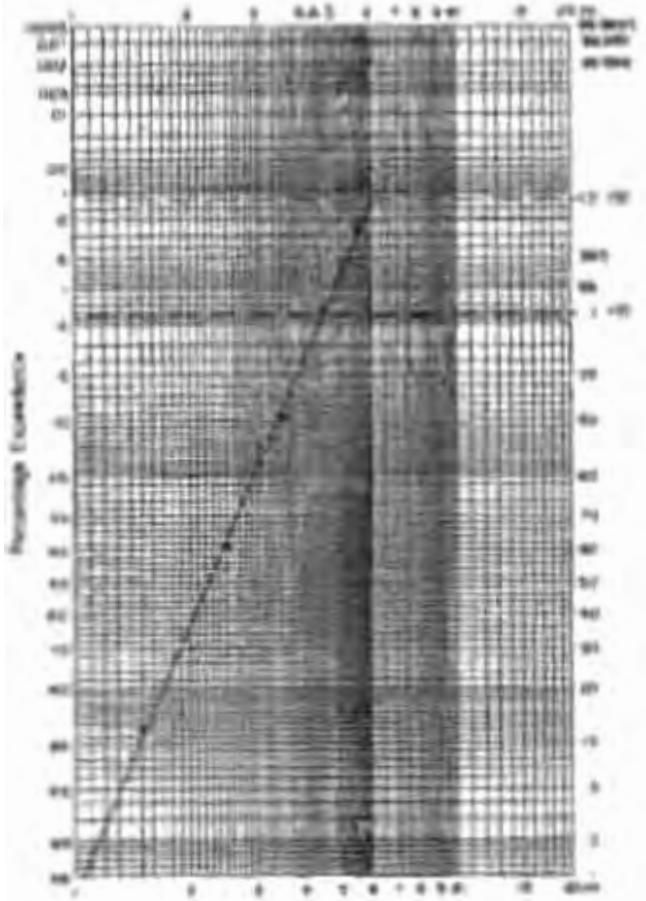
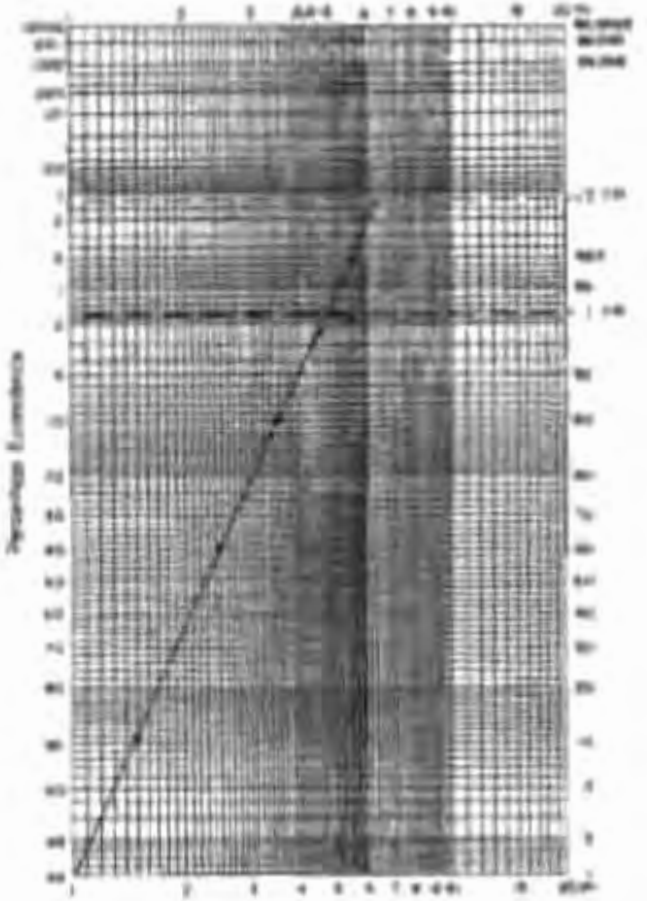


Figure I.v. Monthly Wave Height Exceedance Distribution for November









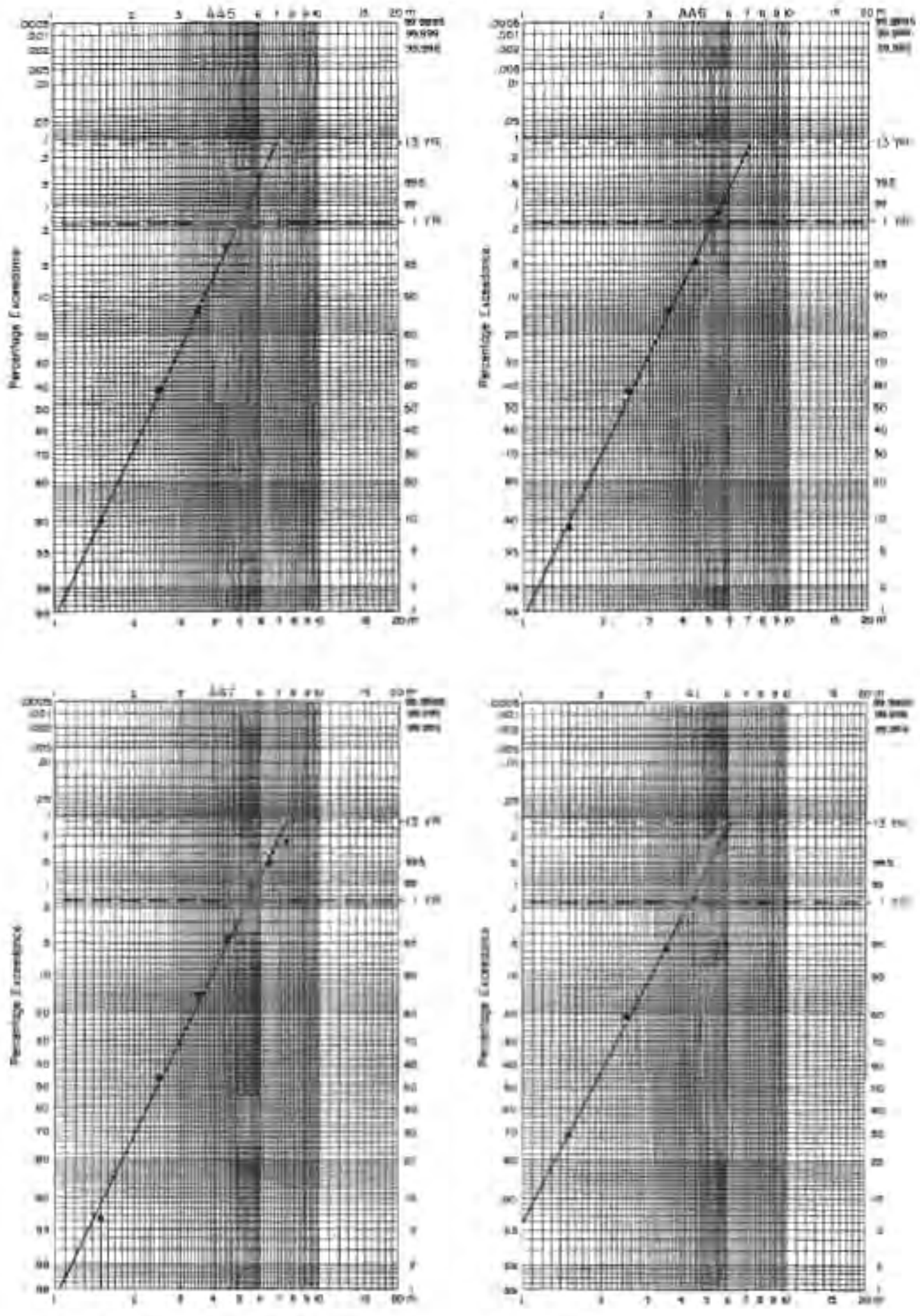


Figure (j) b. Monthly Wave Height Exceedance Distribution for December

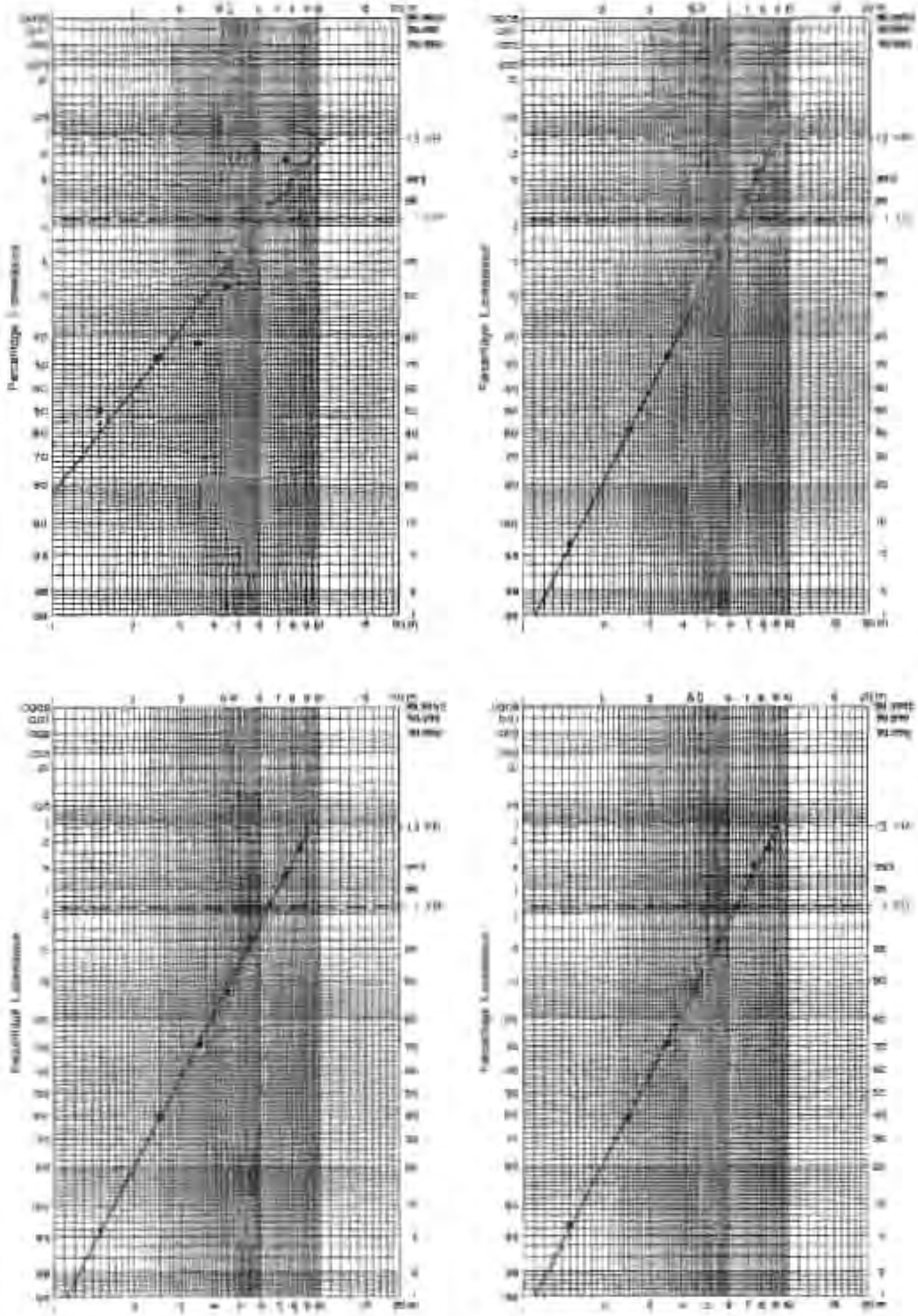


Figure 61 Monthly Wave Height Exceedance Distribution for December

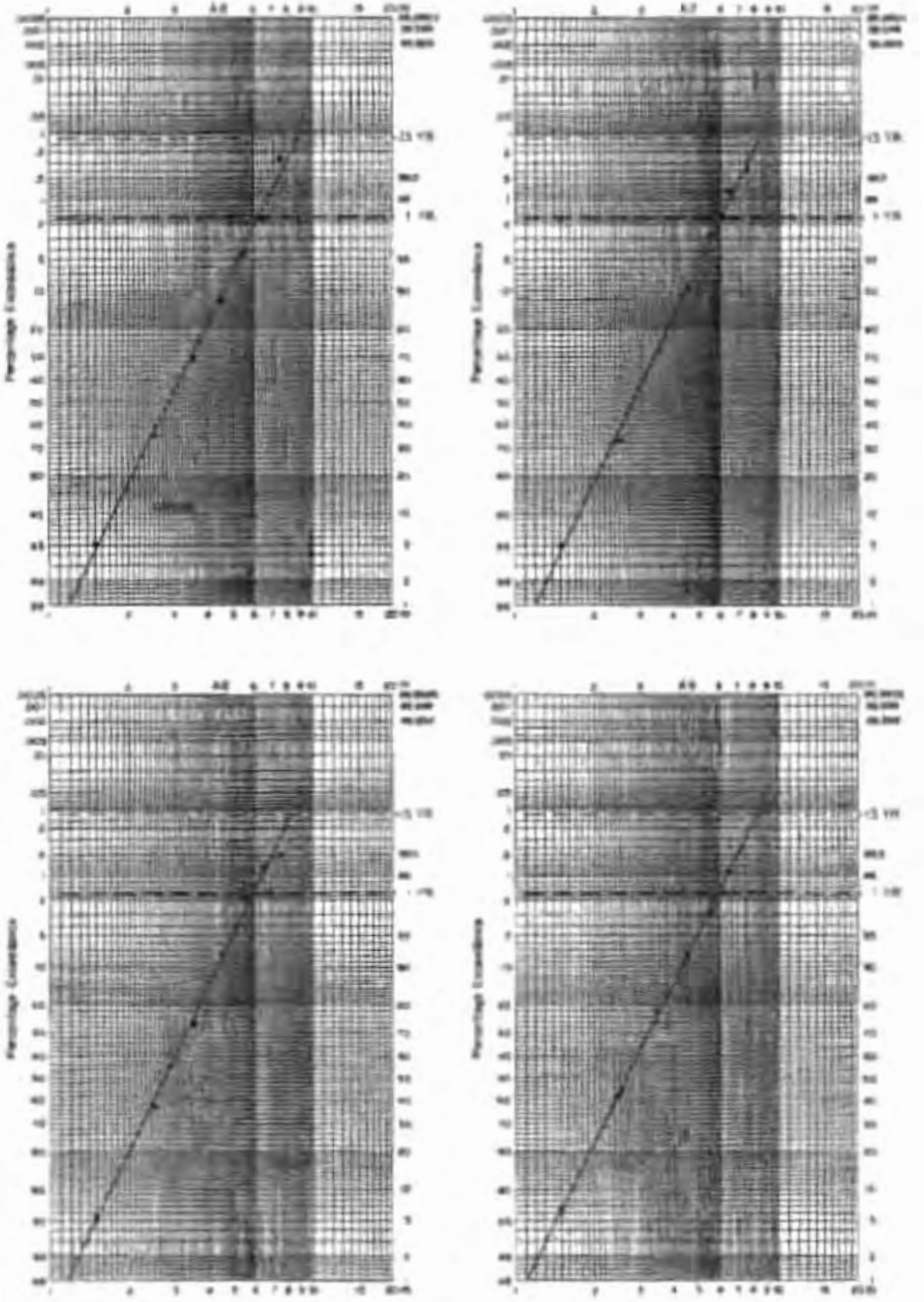


Figure 42a. Monthly Wave Height Exceedance Distribution for December

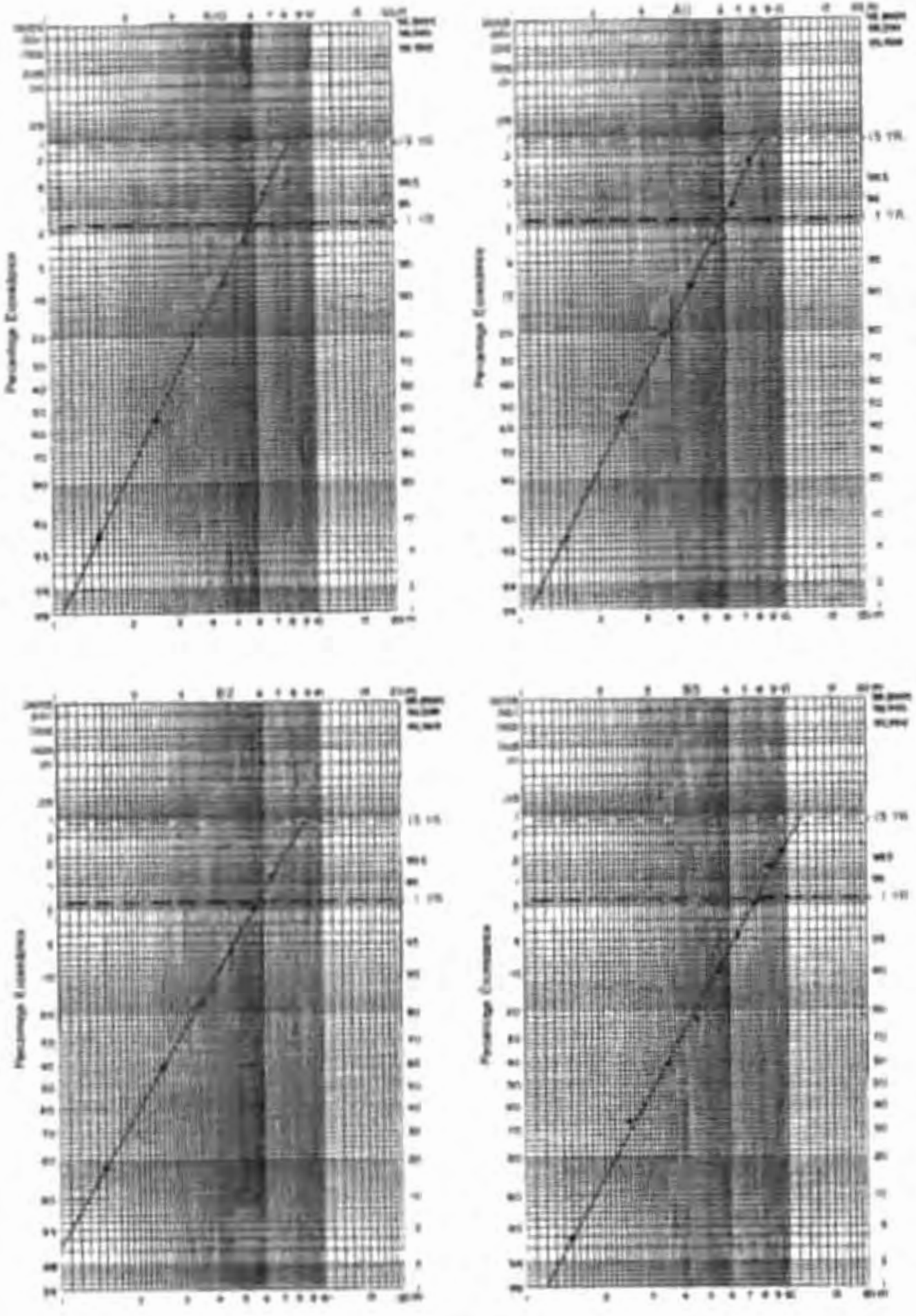


Figure D-4 Monthly Wave Height Exceedance Distribution for December

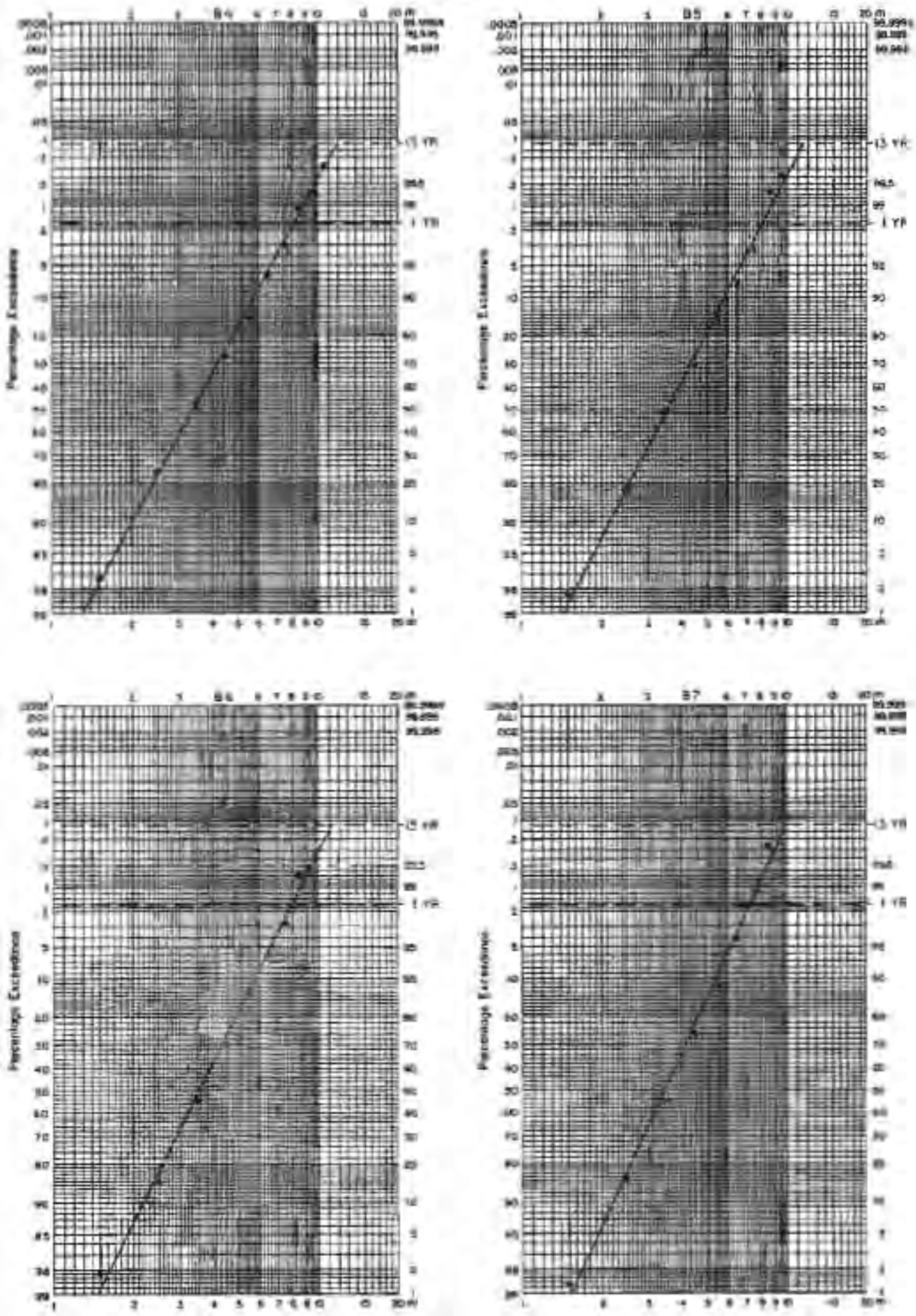


Figure 121 Monthly Wave Height Exceedance Distribution for December

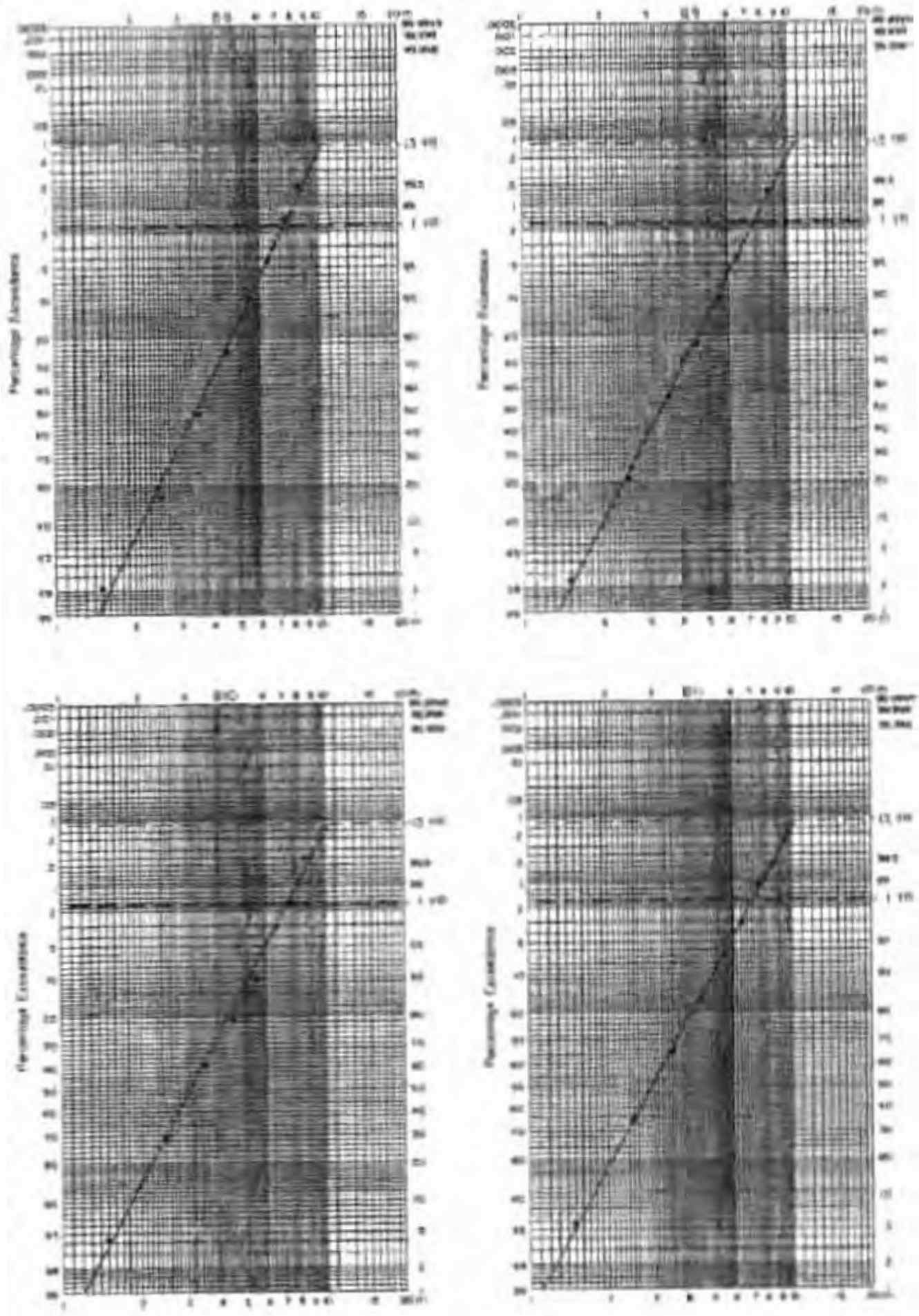


Figure 12g Monthly Wave Height Exceedance Distribution for December

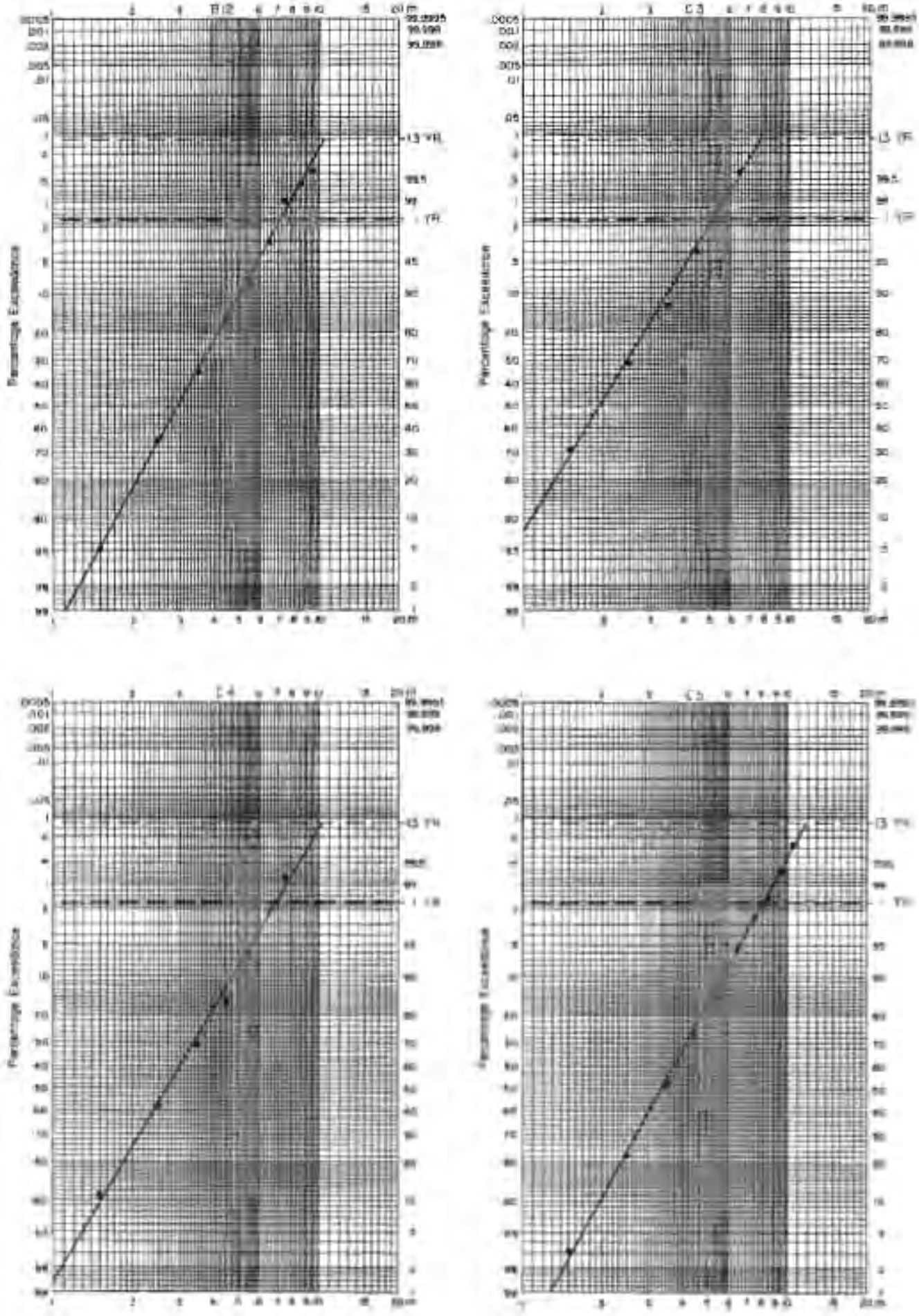


Figure 121. Monthly Wave Height Exceedance Distribution for December

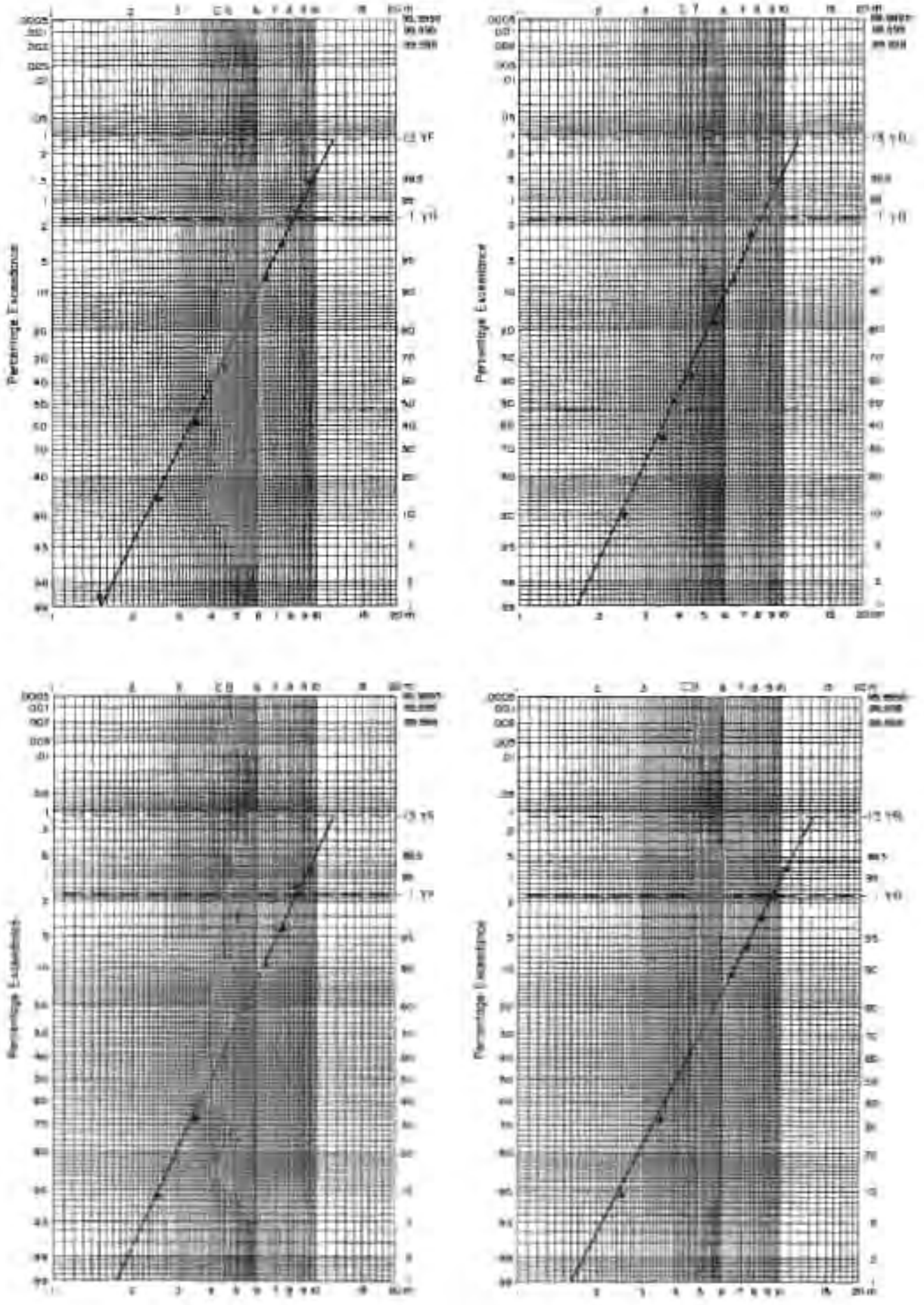


Figure 2. Morning Wave Height Exceedance Distribution for December

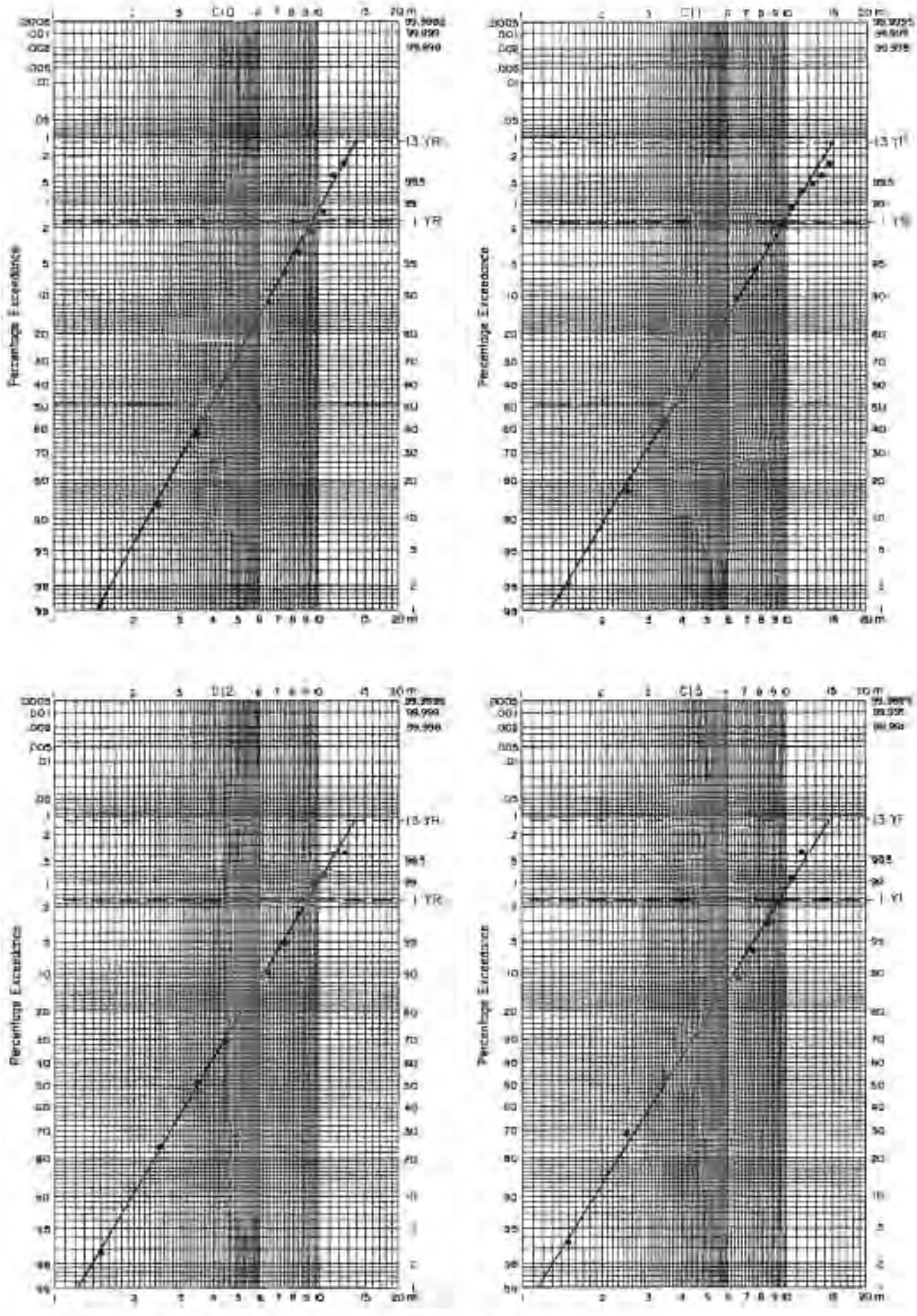
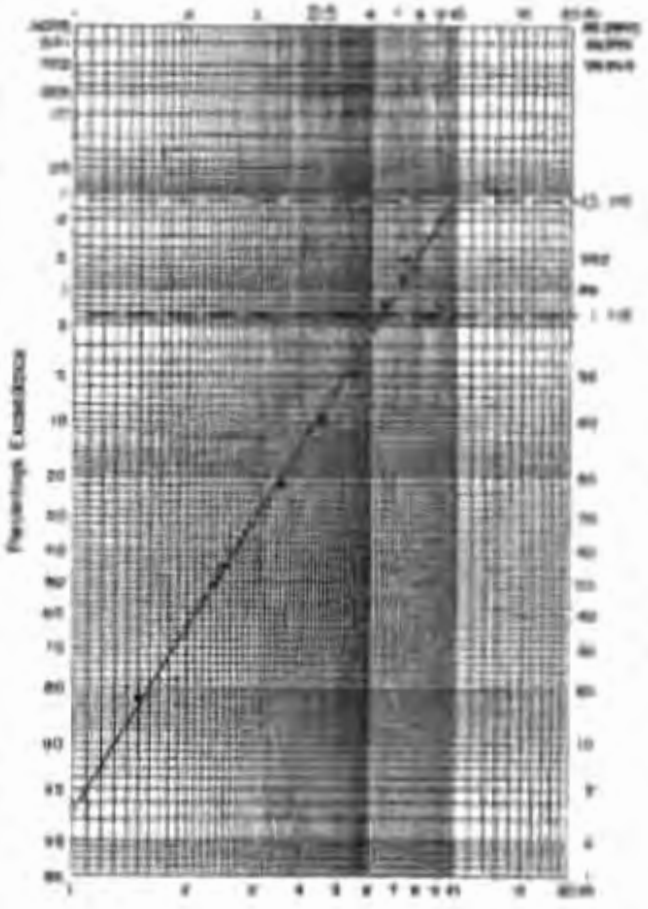
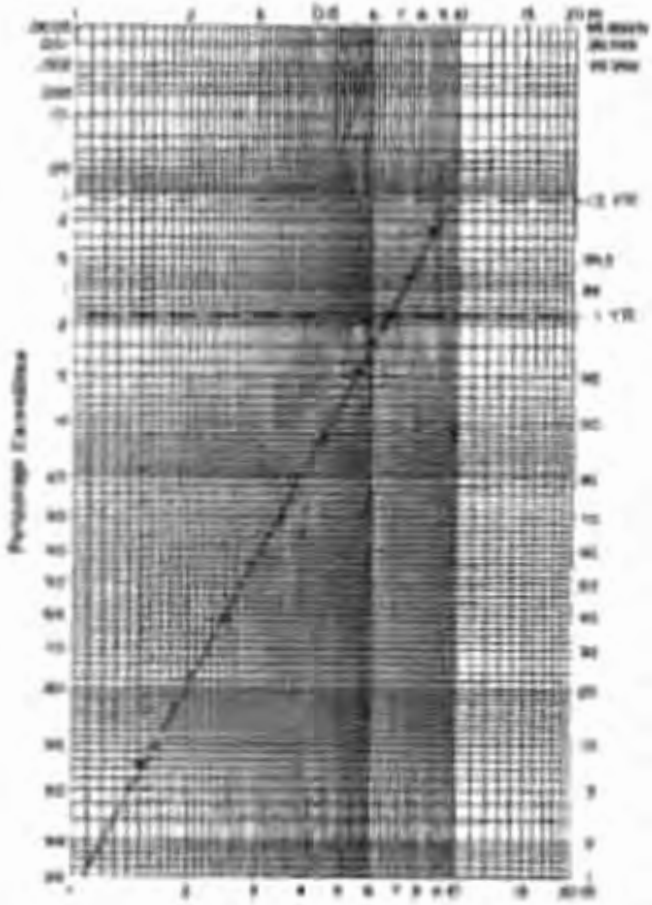
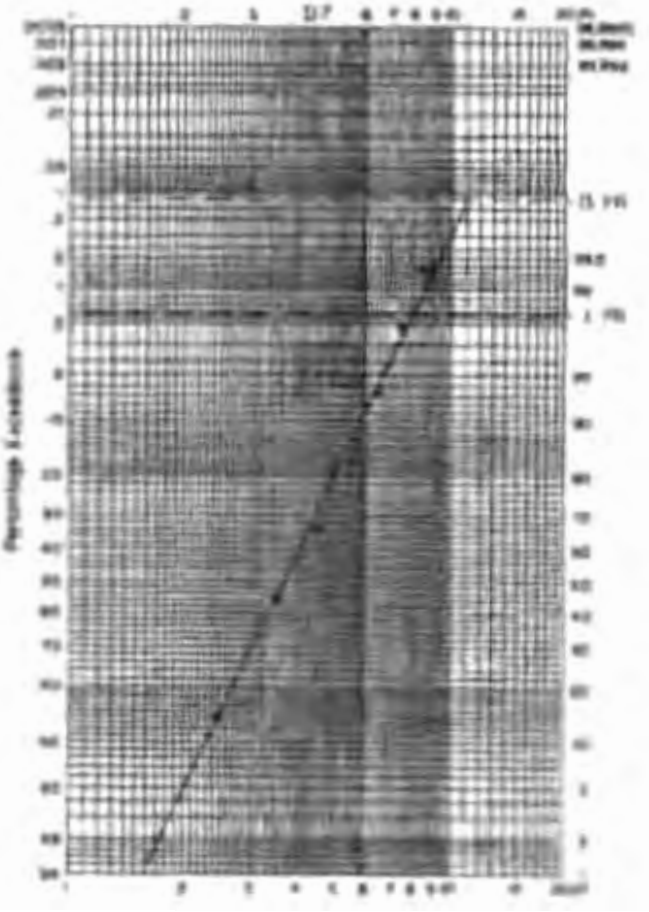
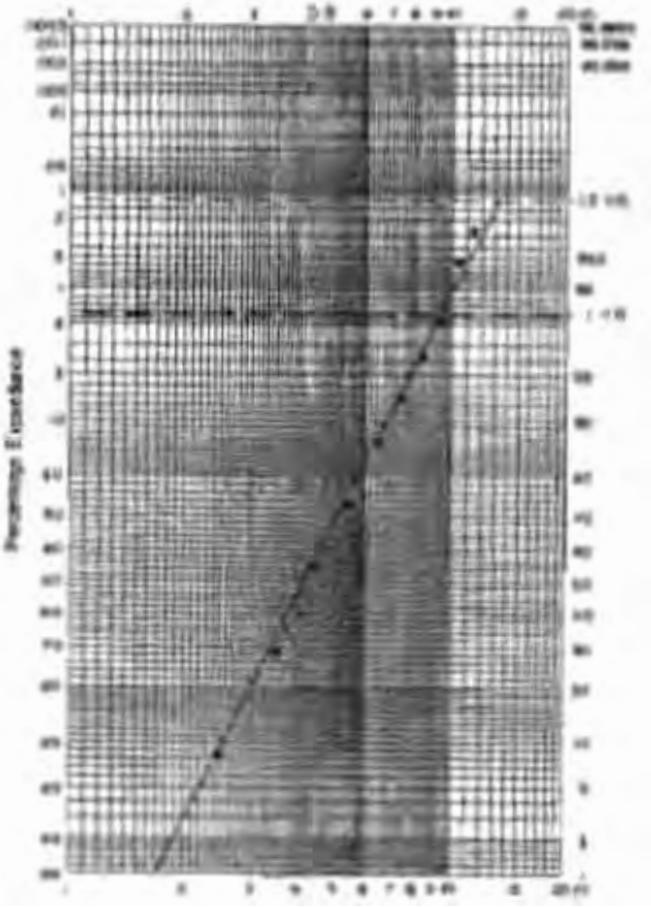


Figure (2) Monthly Wave Height Exceedance Distribution for December









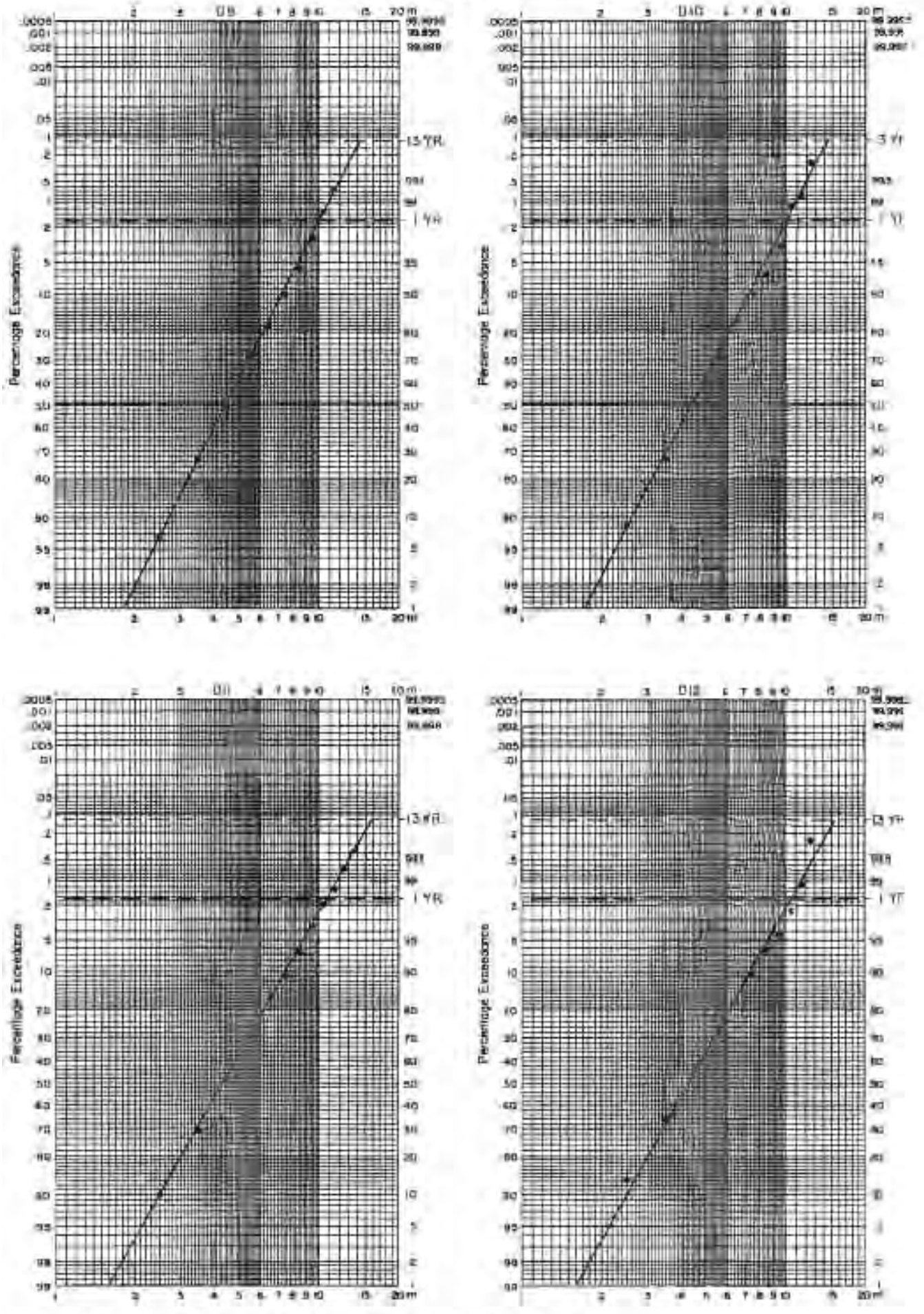


Figure 121 Monthly Wave Height Exceedance Distribution for December

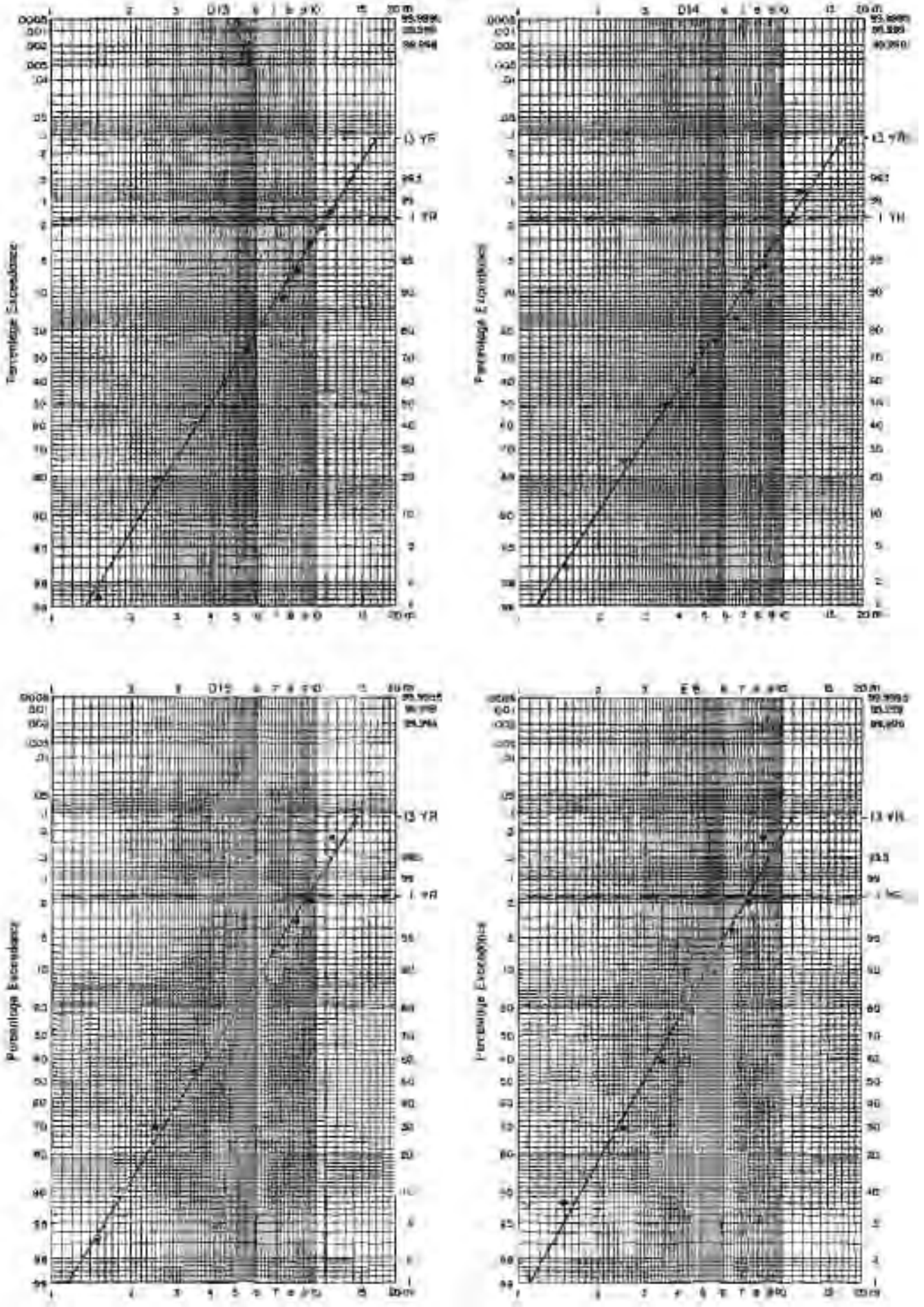


Figure 12m Monthly Wave Height Exceedance Distribution for December

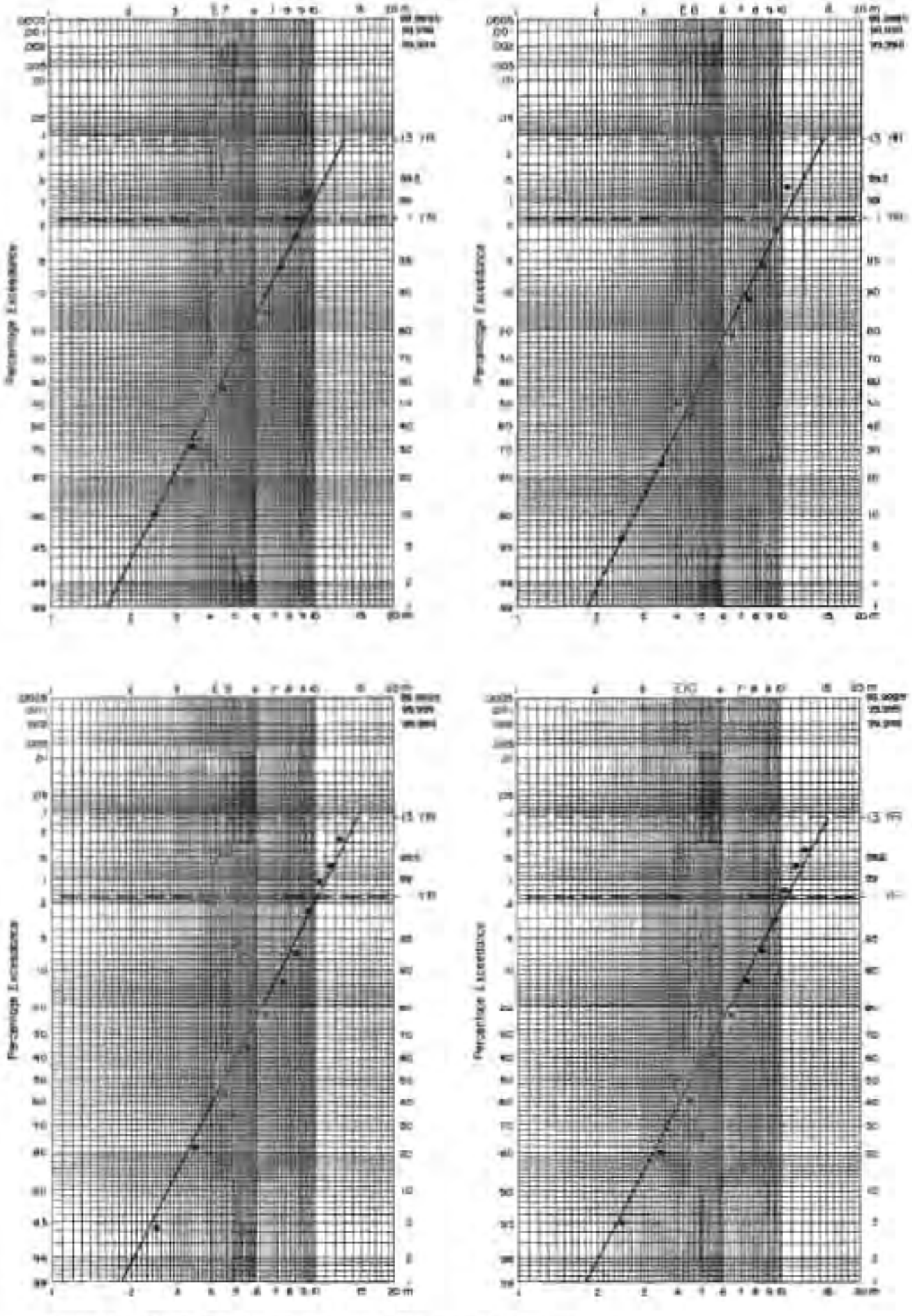


Figure 12n. Monthly Wave Height Exceedance Distribution for December

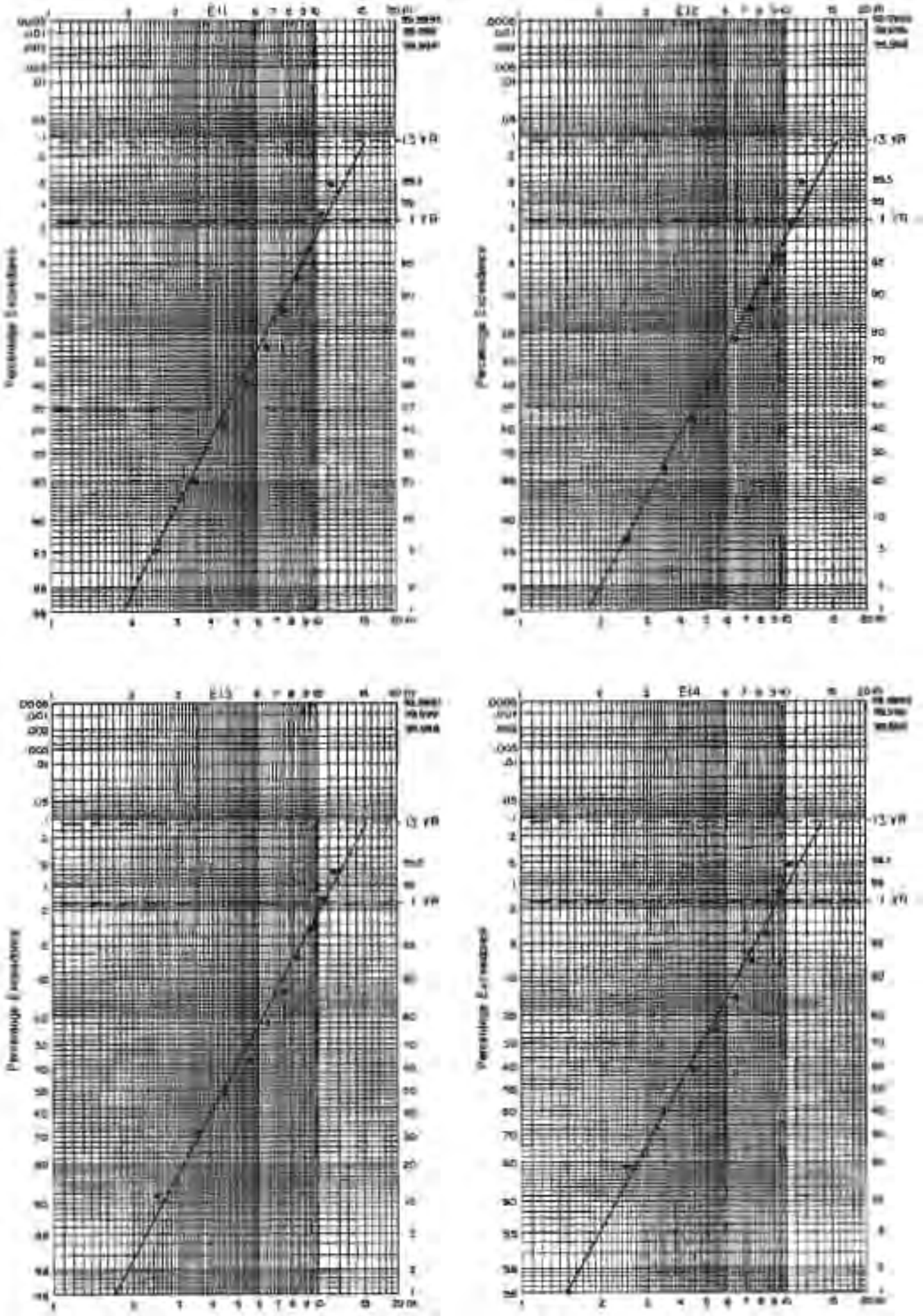


Figure 120. Monthly Wave Height Exceedance Distribution for December

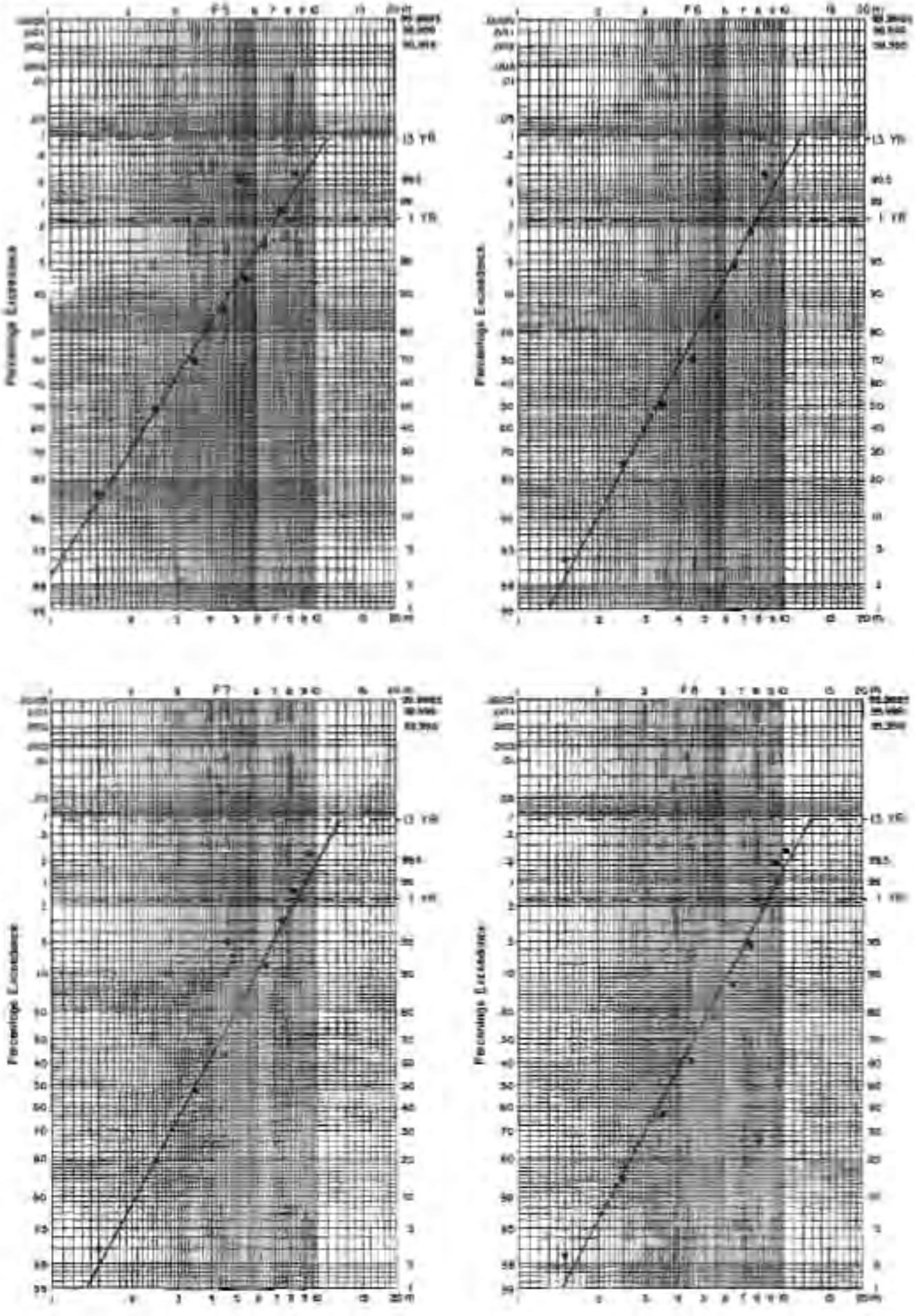


Figure 12p. Monthly Wave Height Exceedance Distribution for December

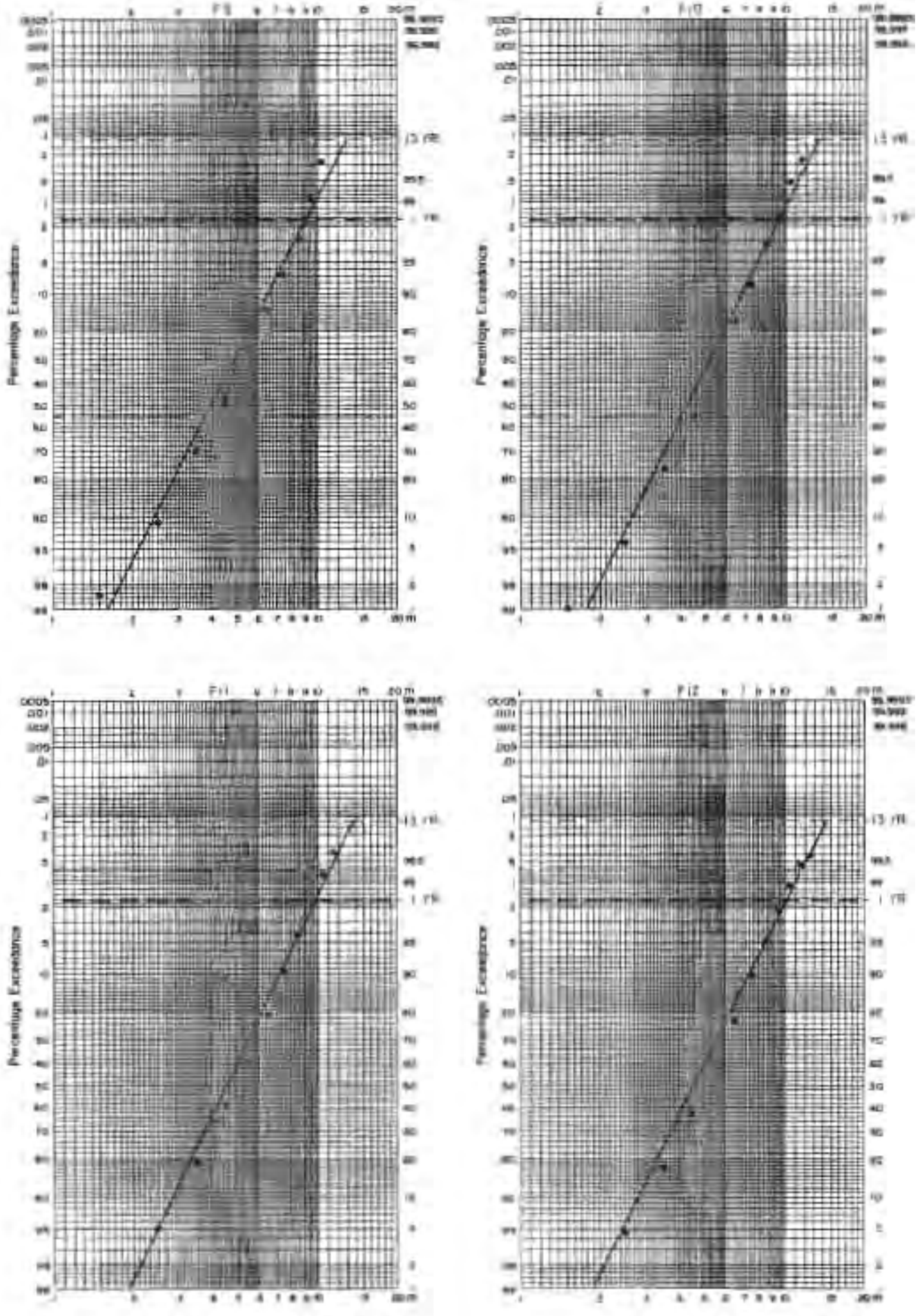


Figure 42. Monthly Wave Height Exceedance Distribution for December

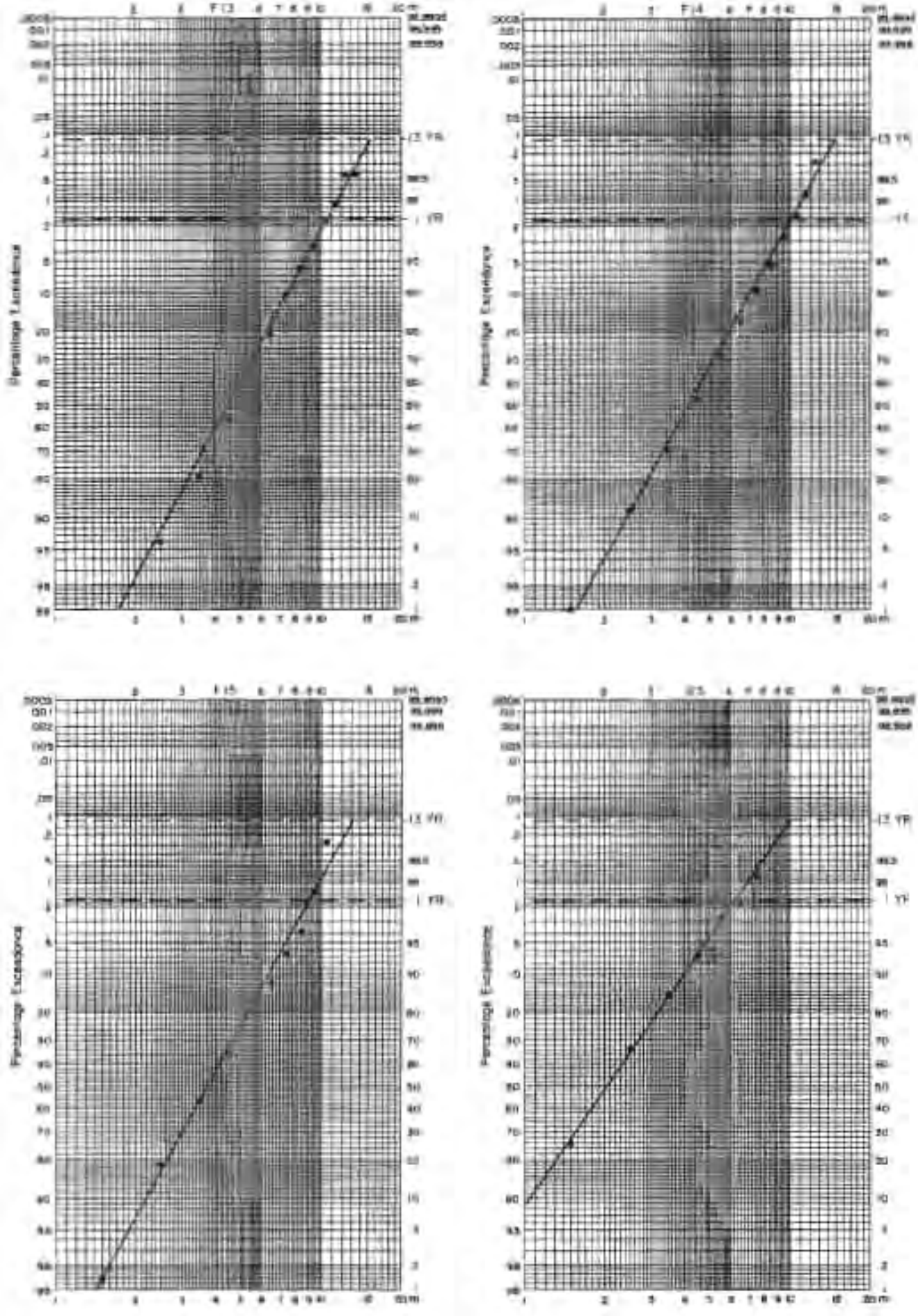


Figure (2.r. Monthly Wave Height Exceedance Distribution for December

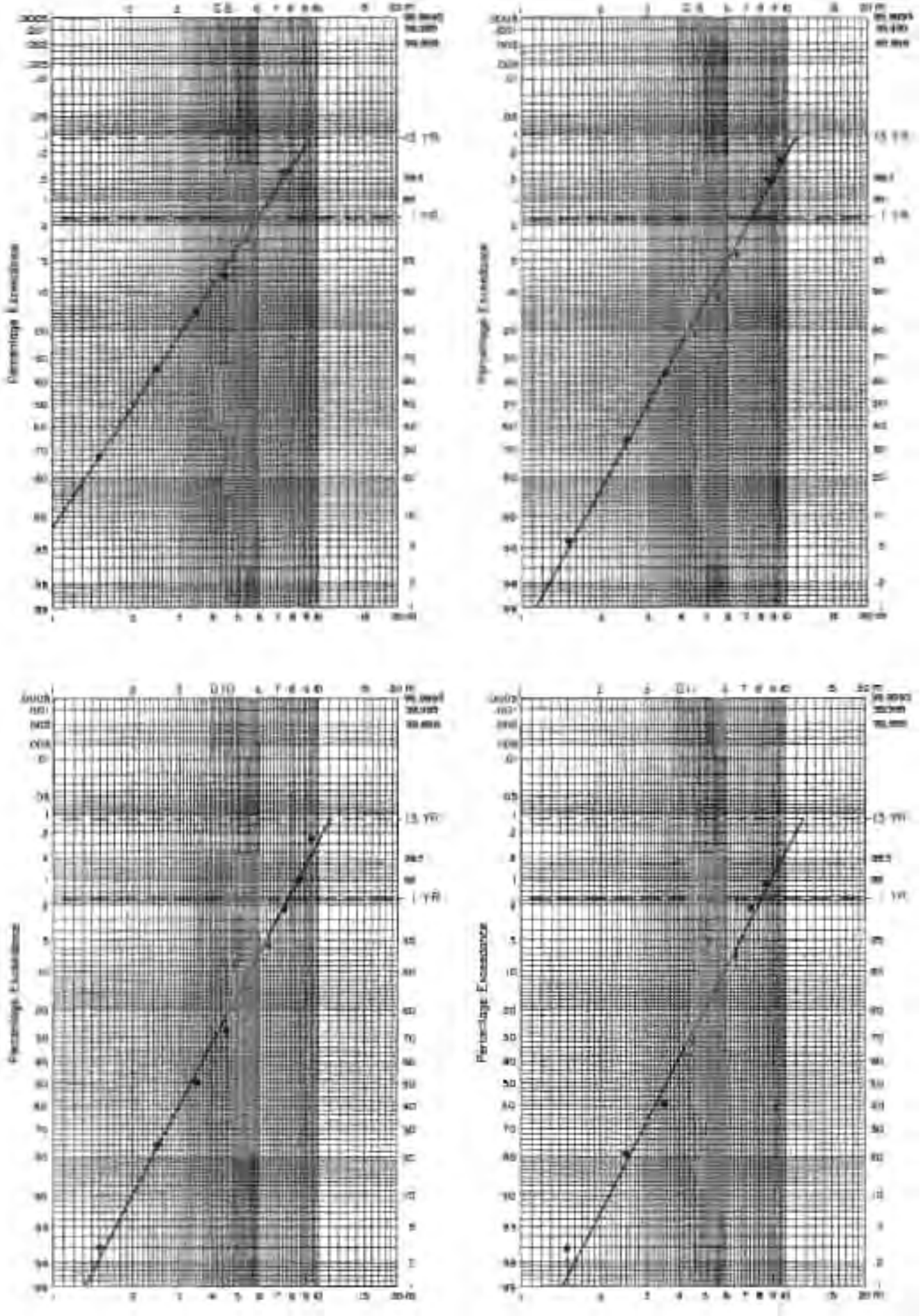


Figure 12.3 Monthly Wave Height Exceedance Distribution for December

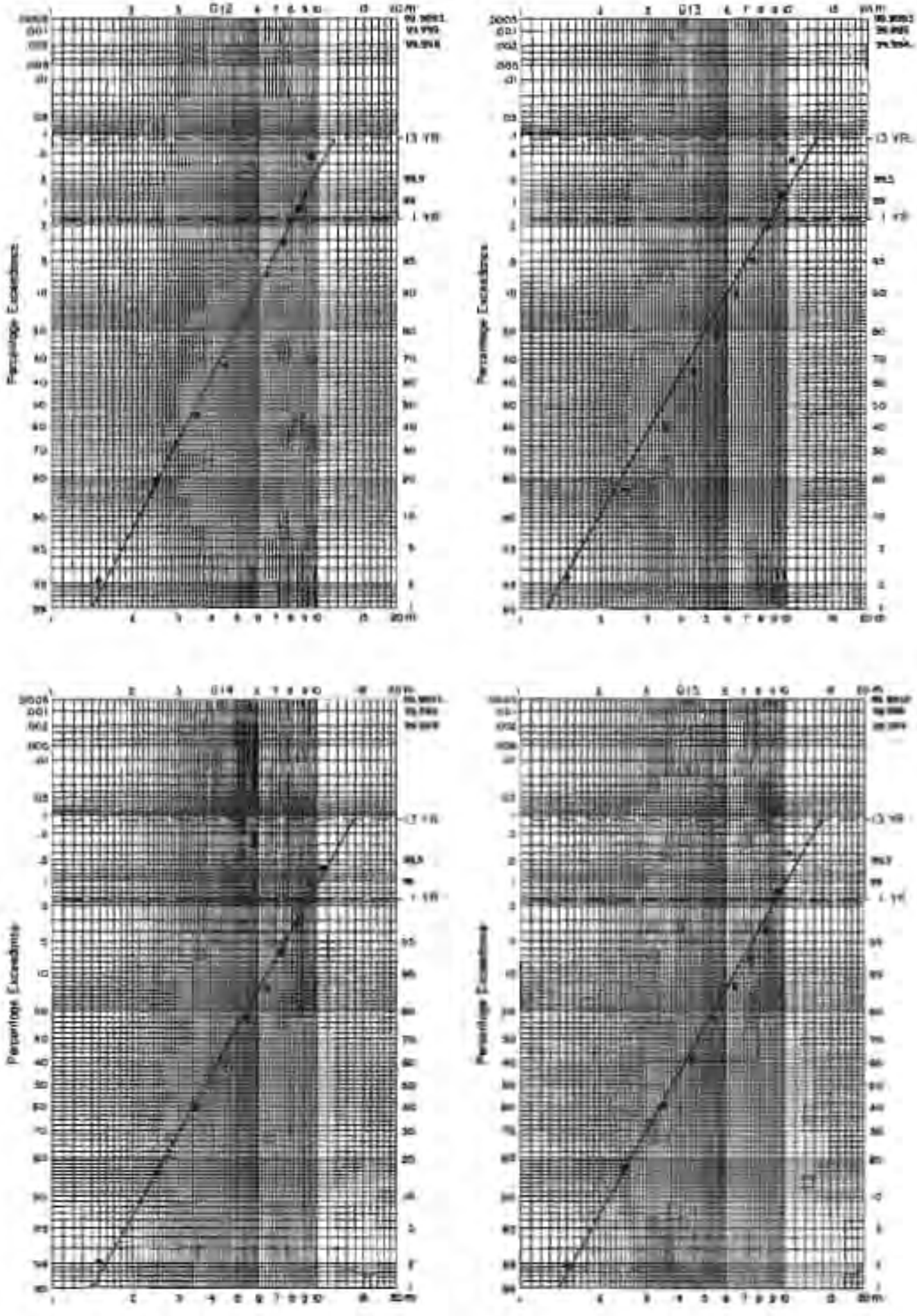


Figure (2) Monthly Wave Height Exceedance Distribution for December

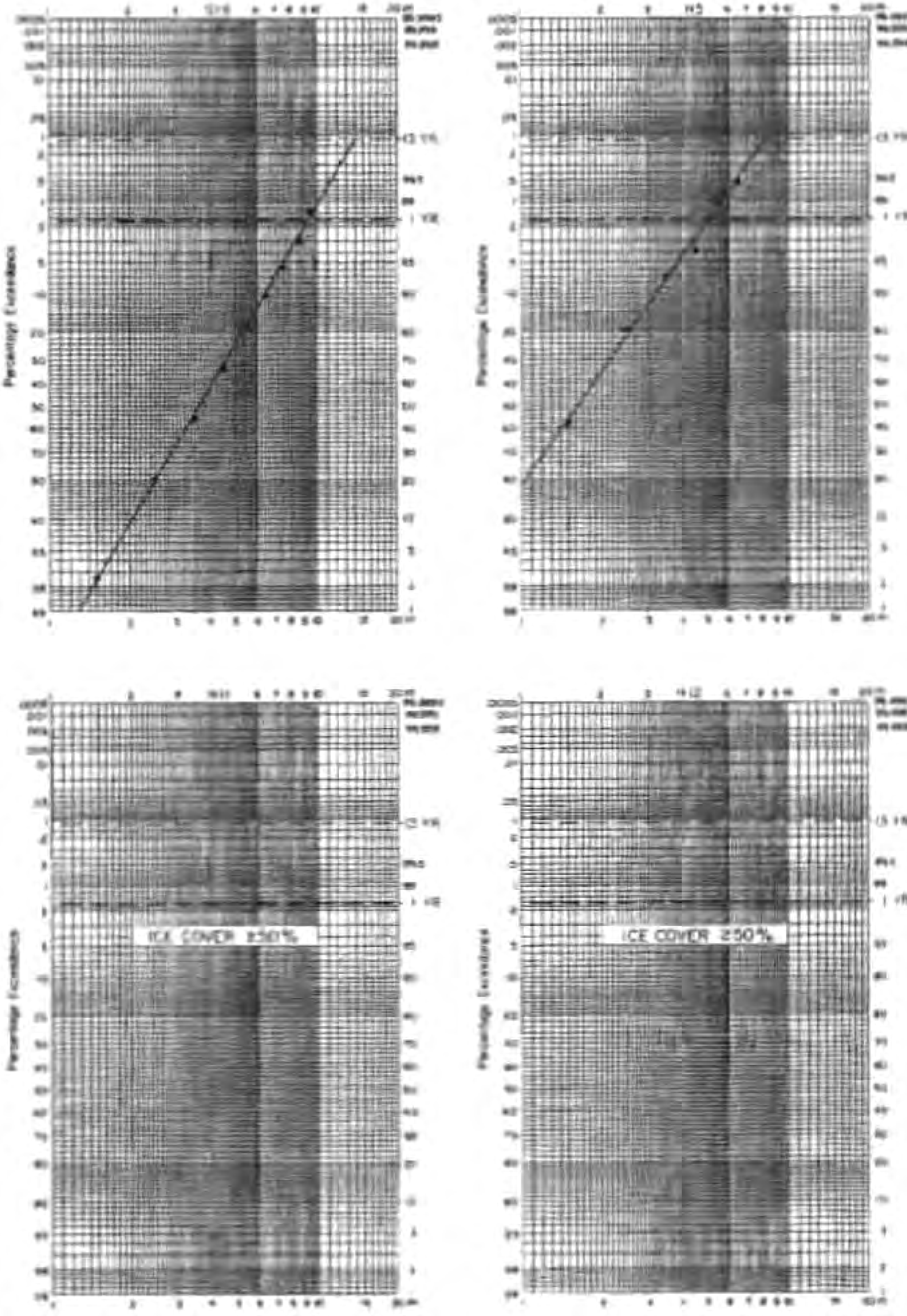


Figure 12 Monthly Wave Height Exceedance Distribution for December

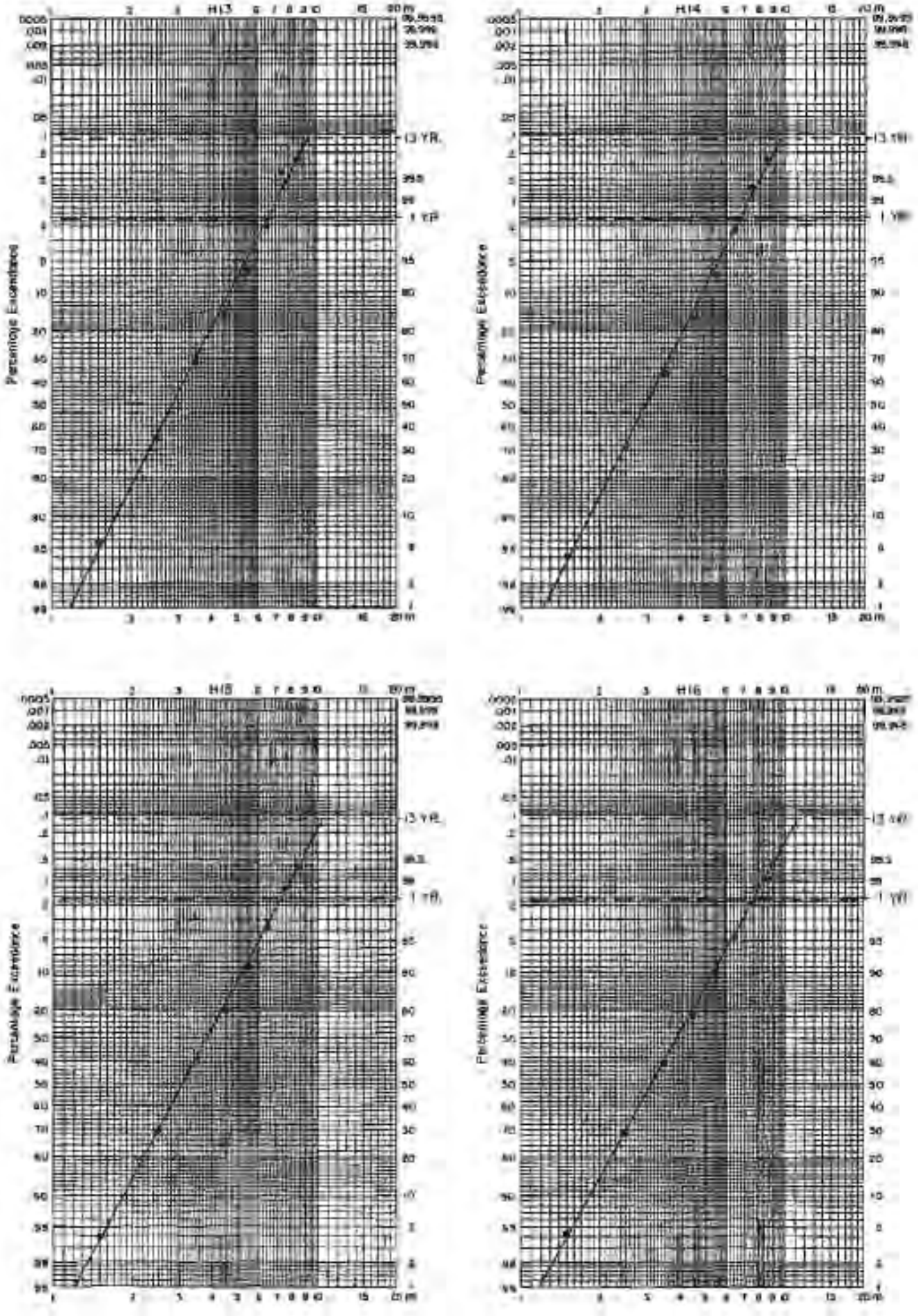


Figure 12v. Monthly Wave Height Exceedance Distribution for December

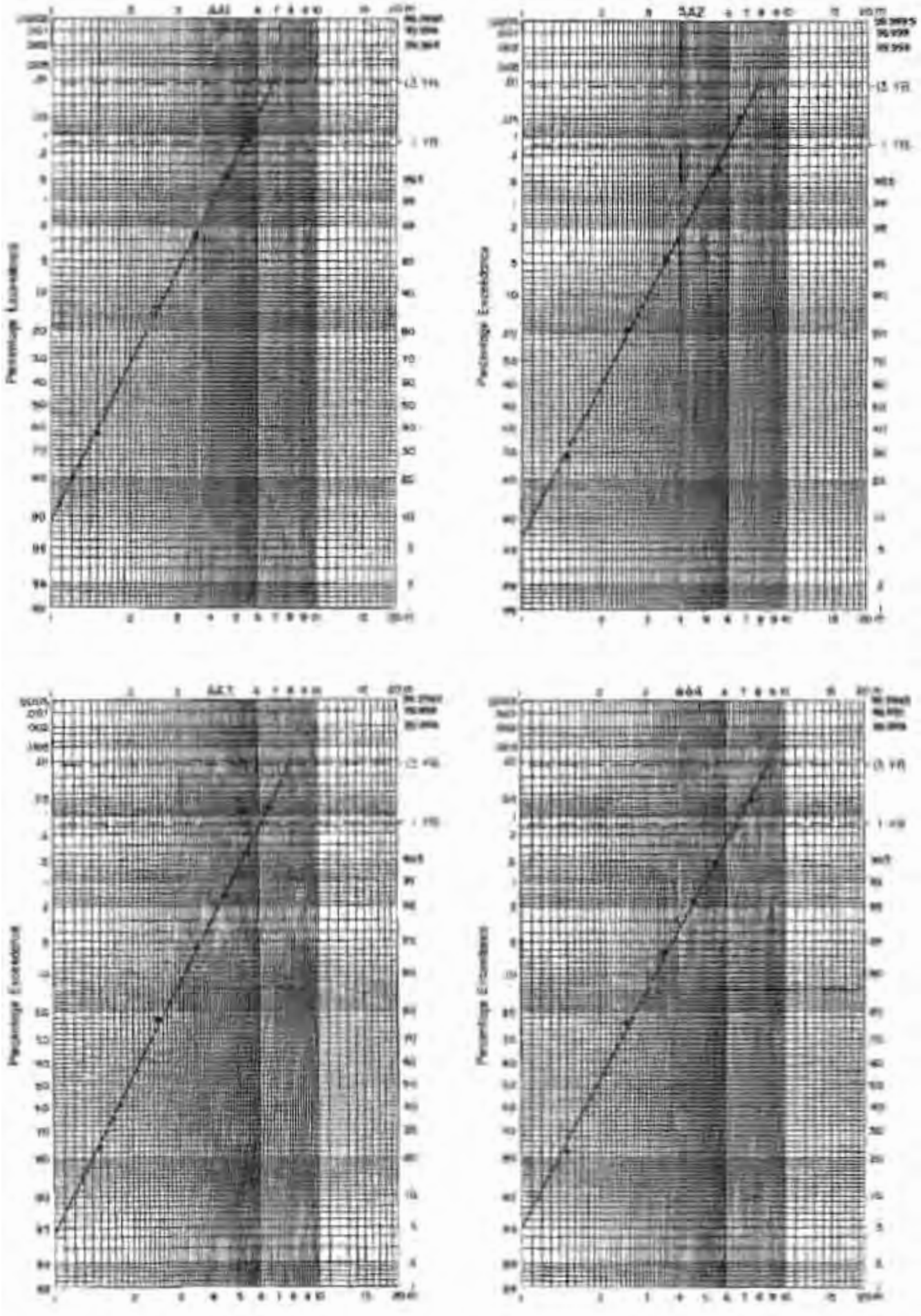


Figure 3a. 13 Years Wave Height Exceedance Distribution

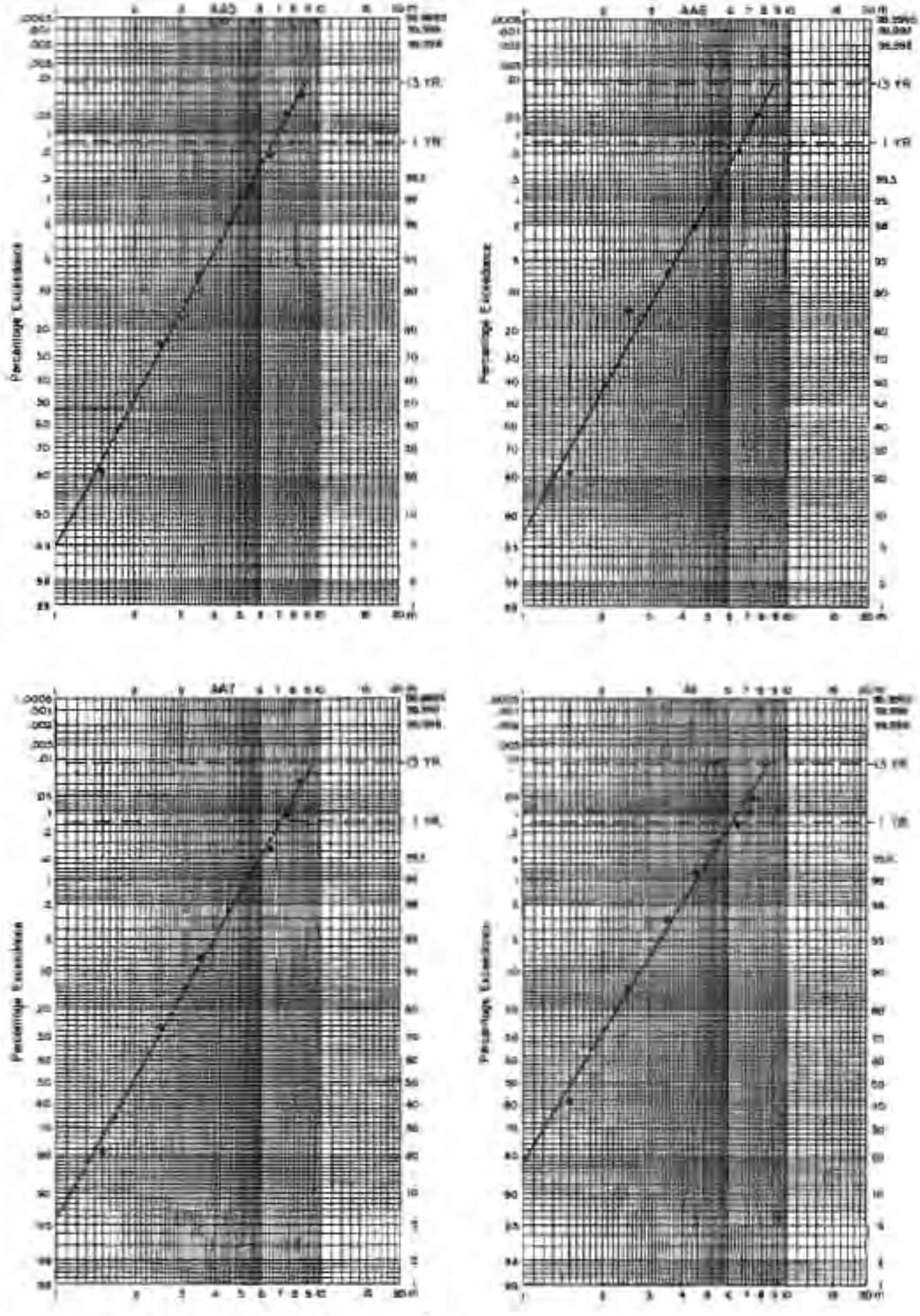


Figure 13b 13 Years Wave Height Exceedance Distribution

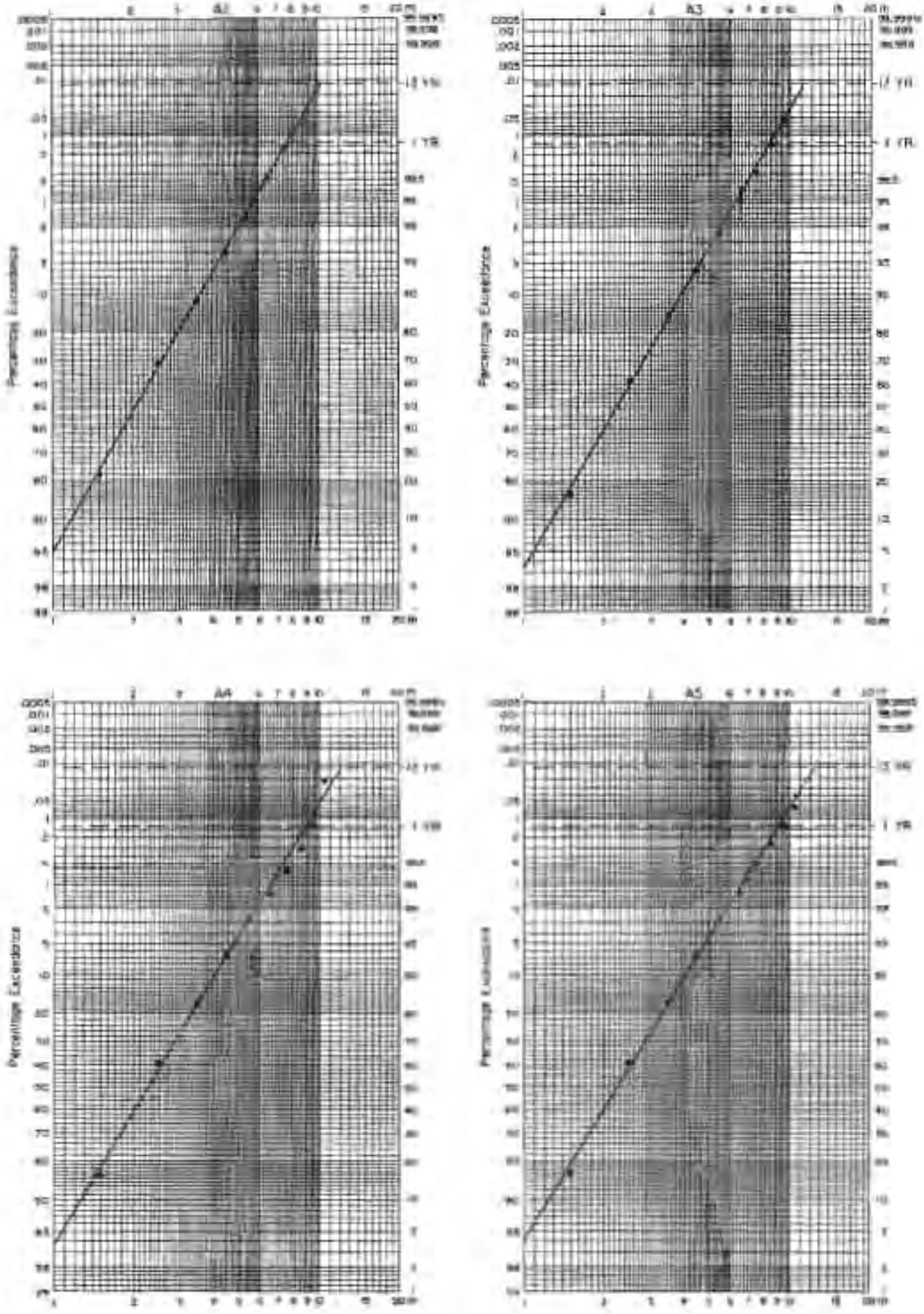


Figure 3c. 13 Years Wave Height Exceedance Distribution

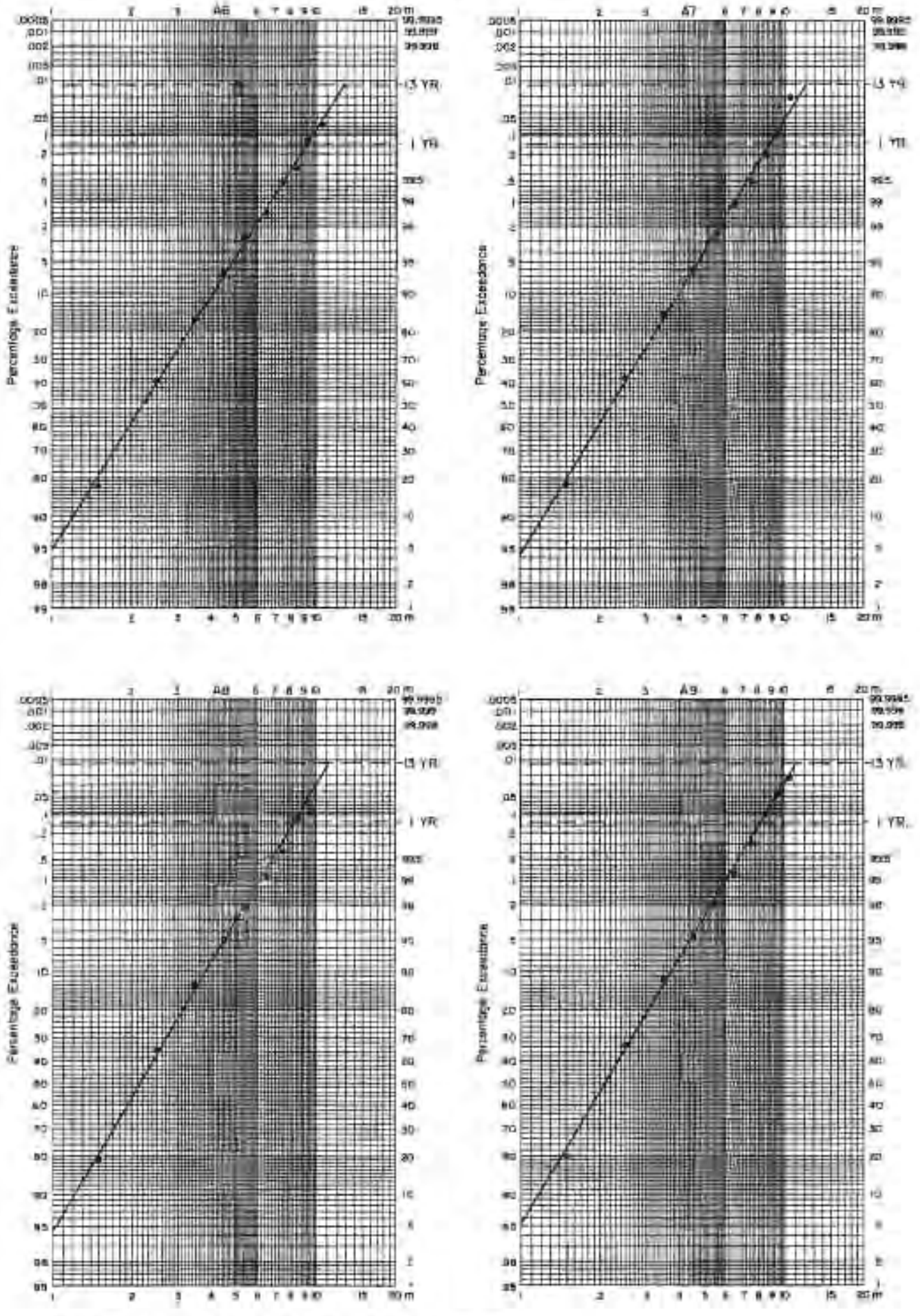


Figure 3d 15 Years Wave Height Exceedance Distribution

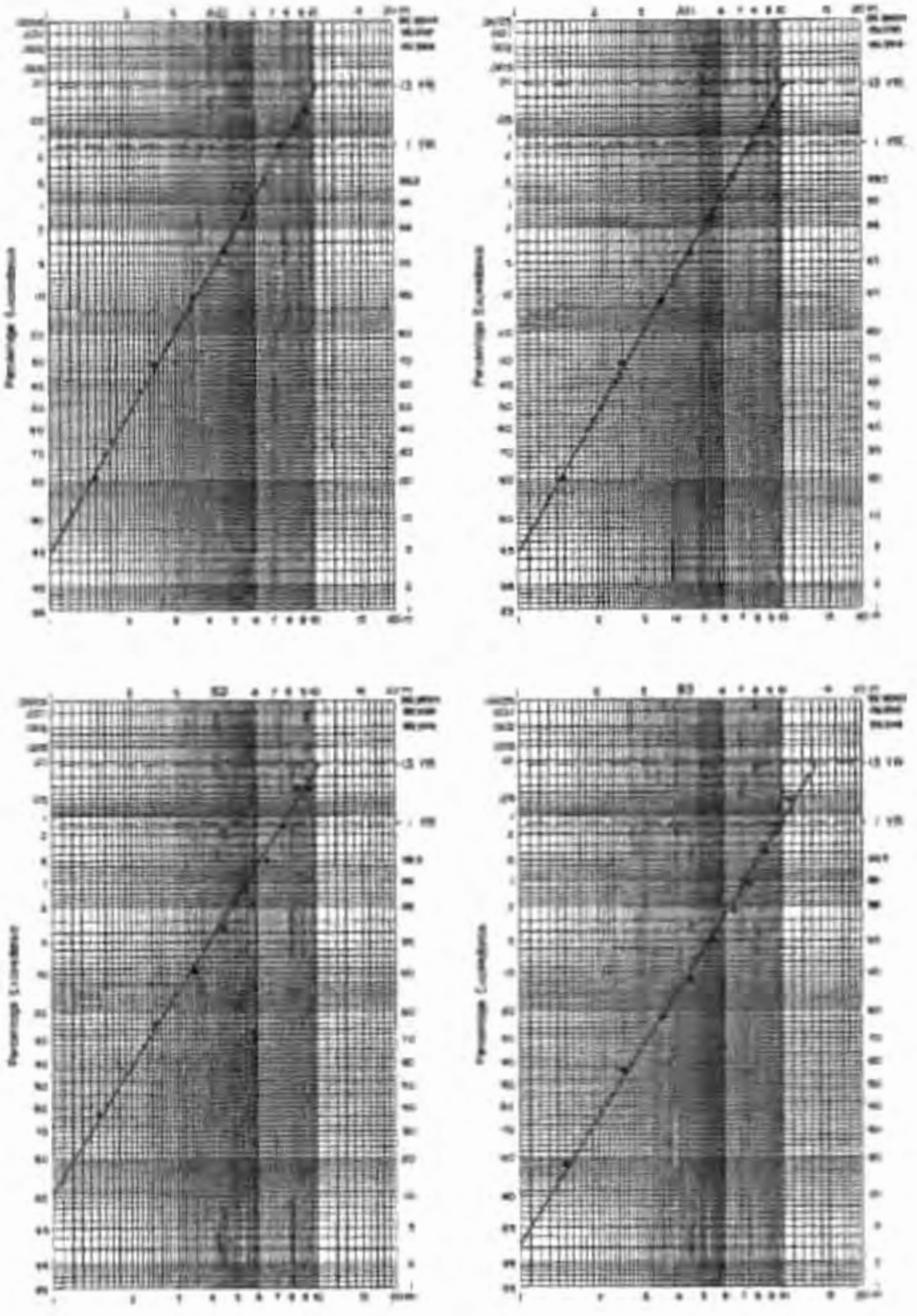


Figure C4 Q Years Wave Height Exceedance Distribution

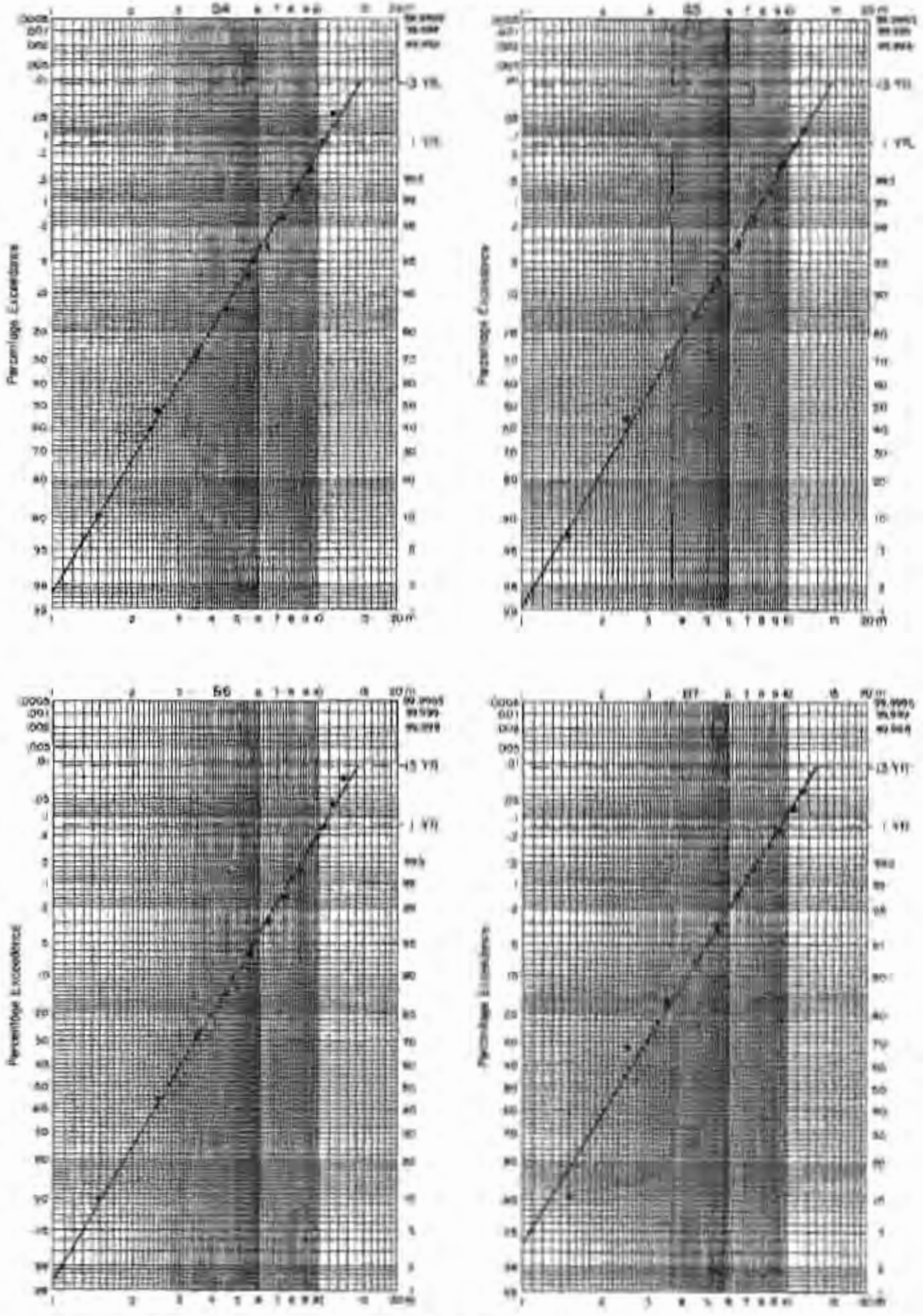


Figure 131 13 Years Wave Height Exceedance Distribution

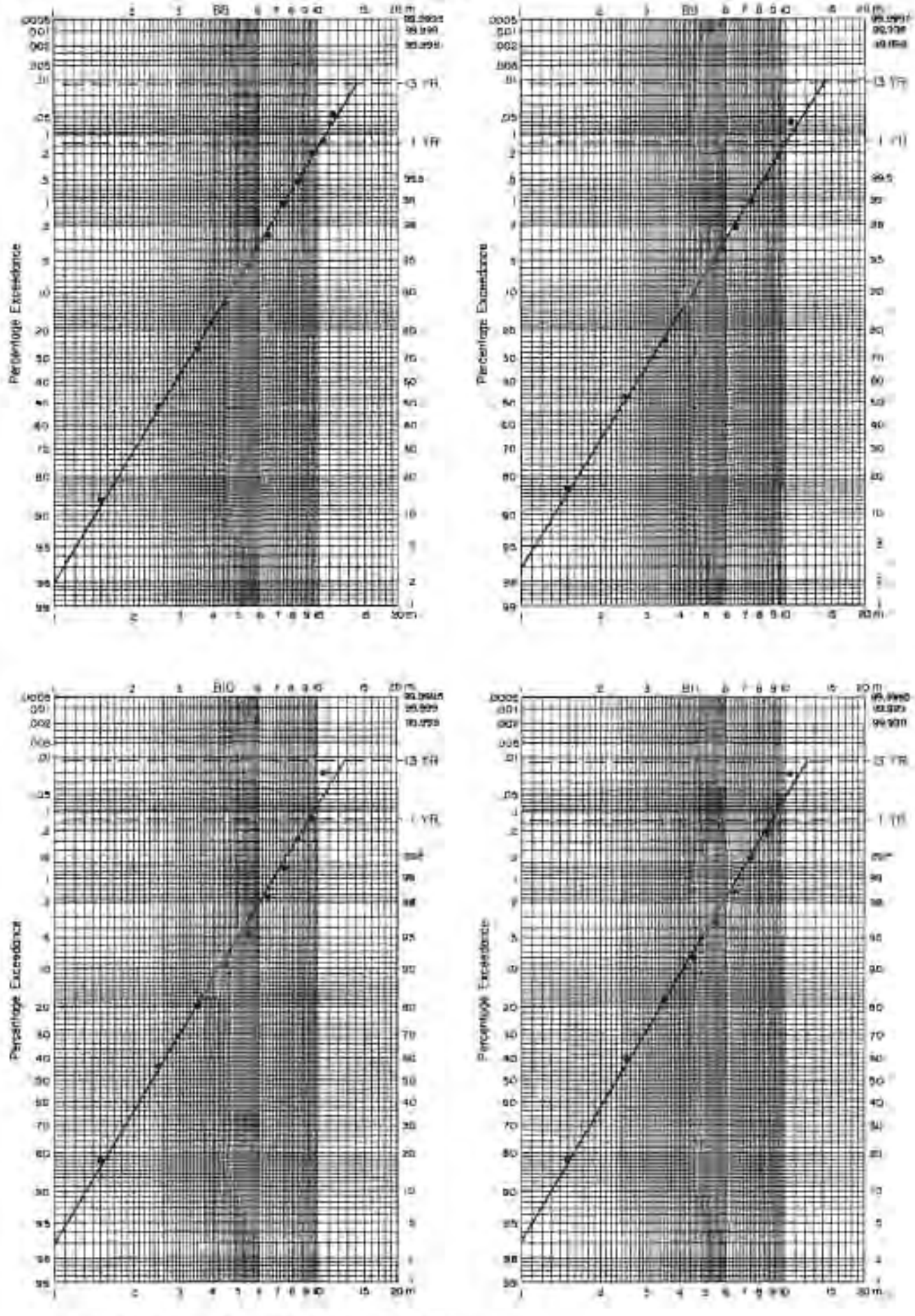


Figure 13g 13 Years Wave Height Exceedance Distribution

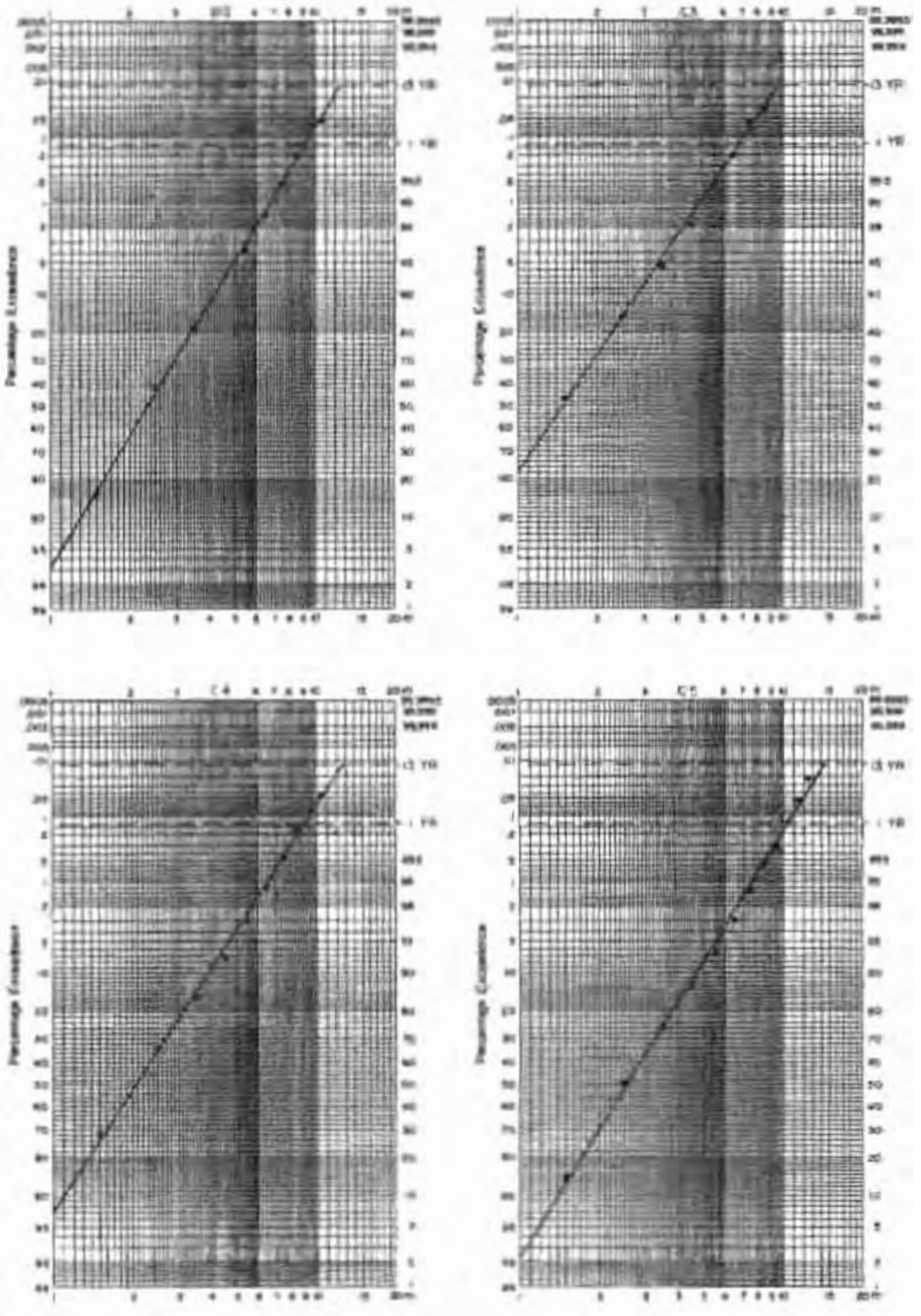


Figure (3): 15 Years Wave Height Exceedance Distribution

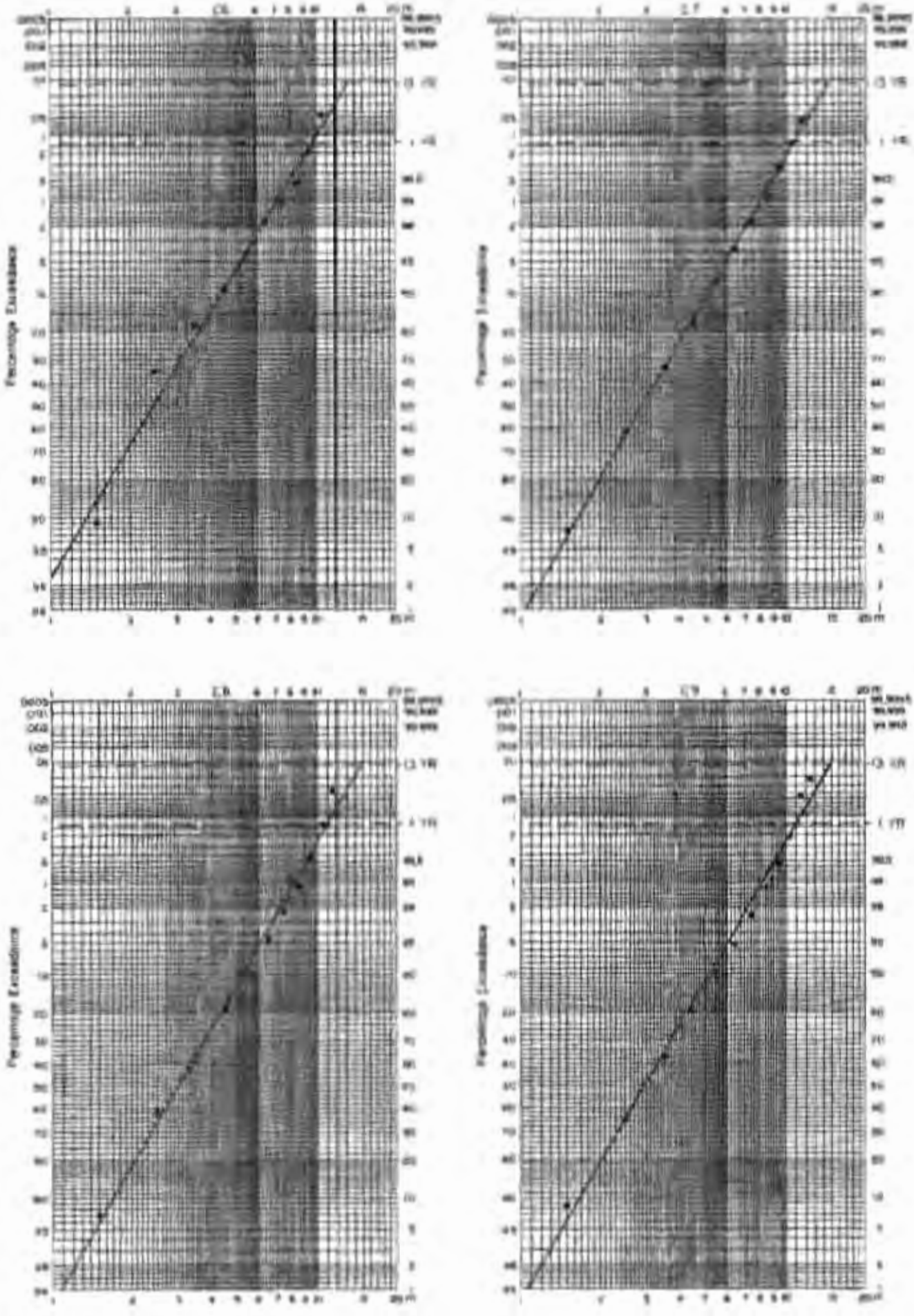


Figure C: 3 Years Wave Height Exceedance Distribution

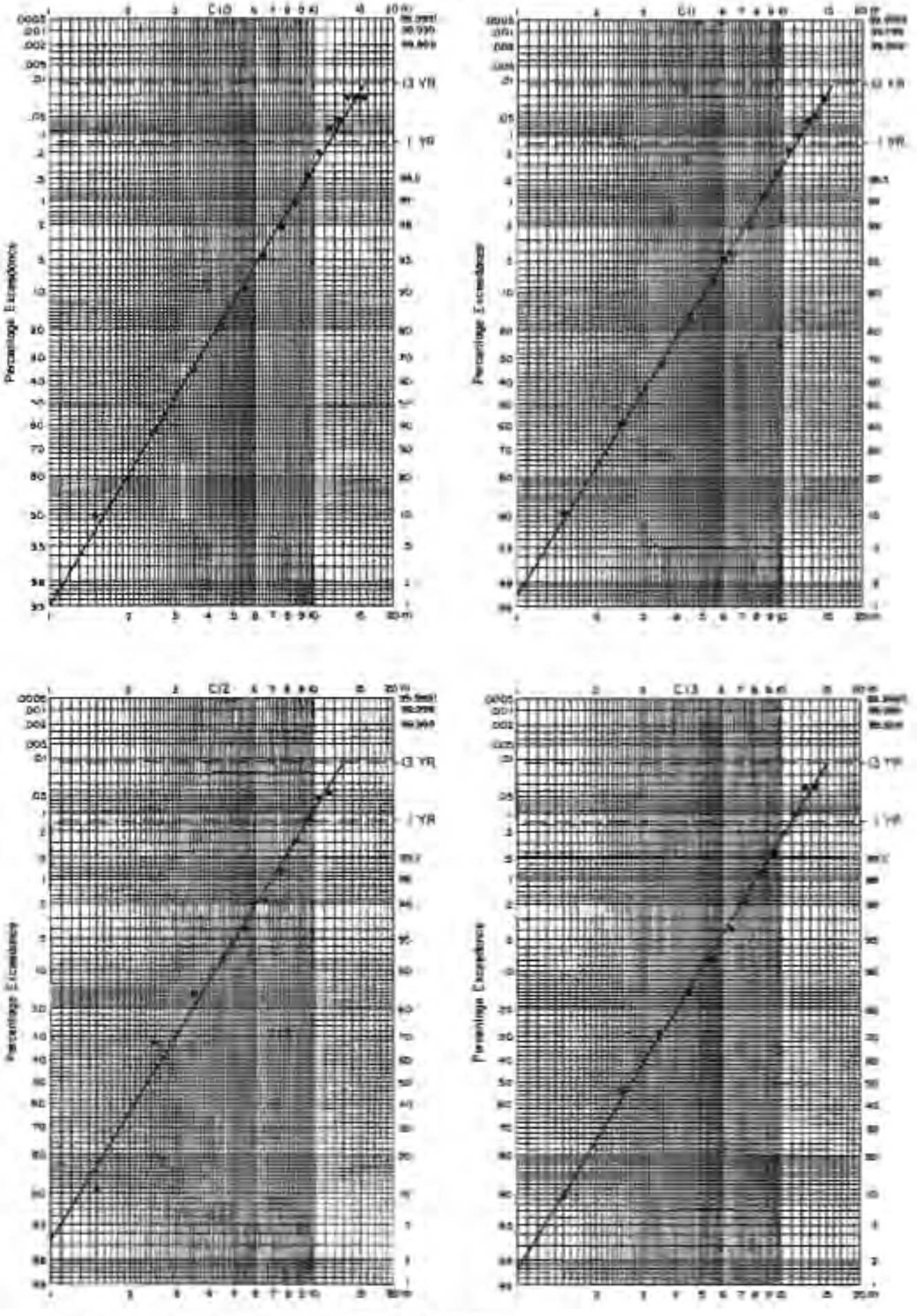


Figure (3) 15 Years Wave Height Exceedance Distribution

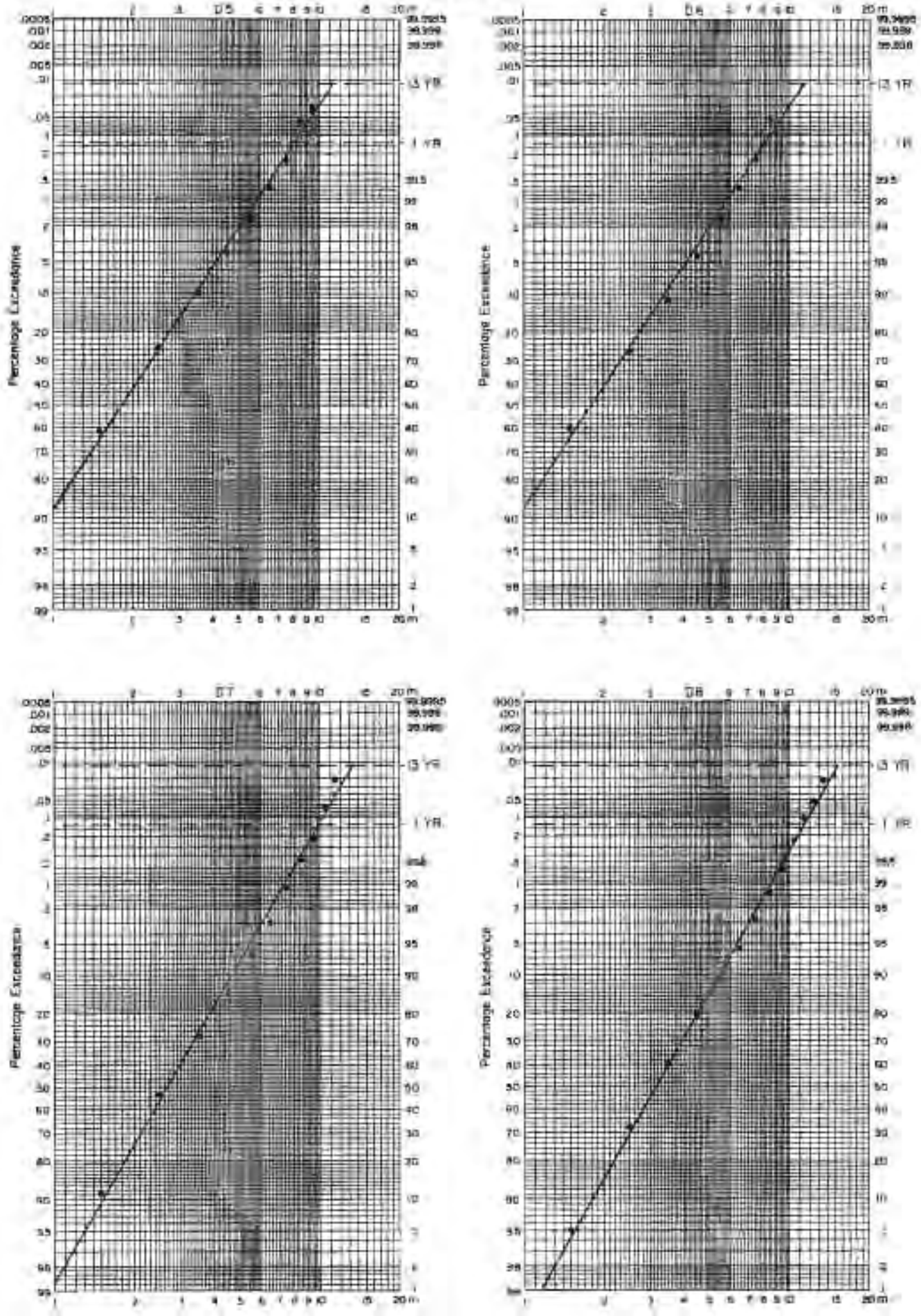


Figure 134. 13 Years Wave Height Exceedance Distribution

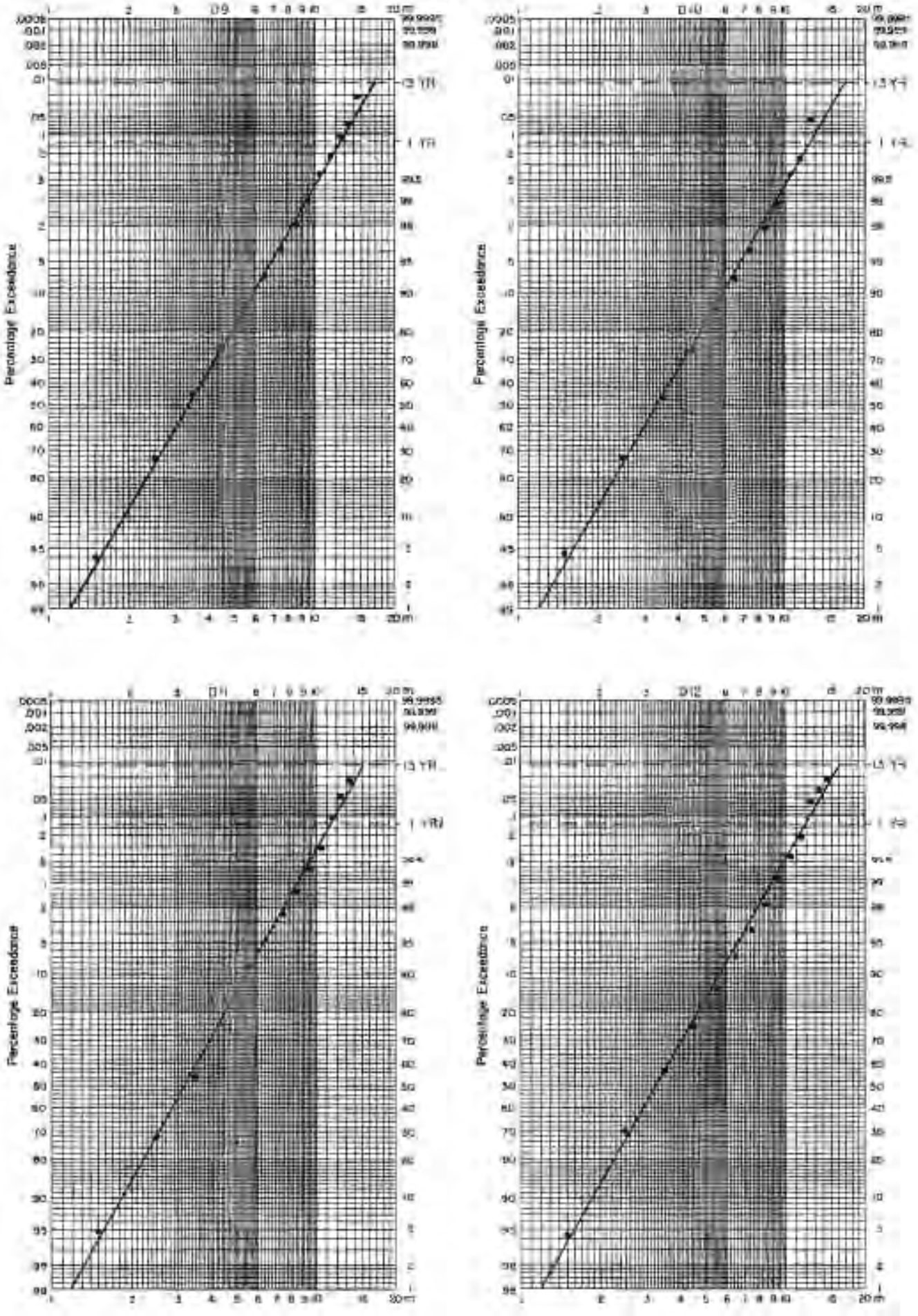


Figure (5) 13 Years Wave Height Exceedance Distribution

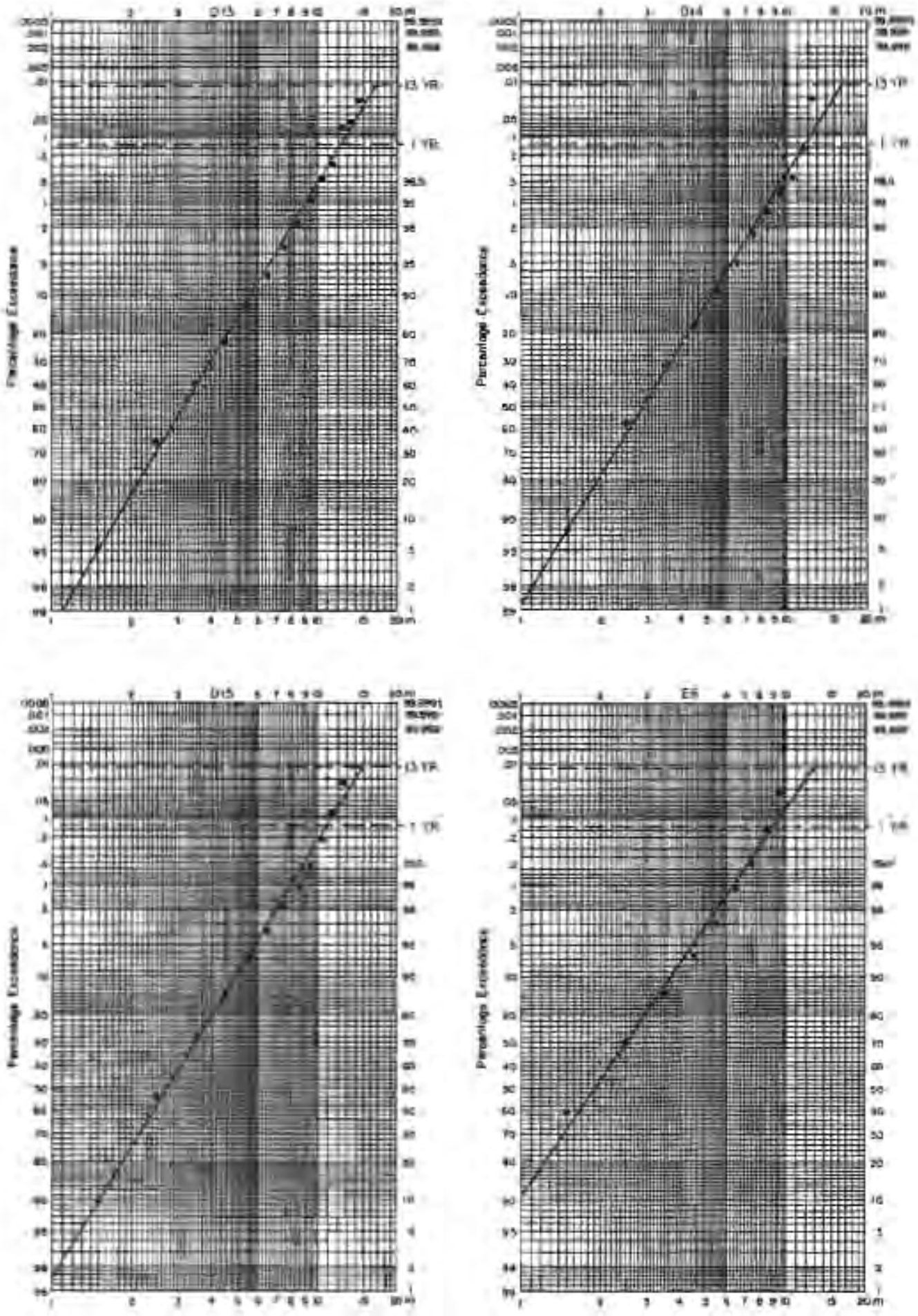
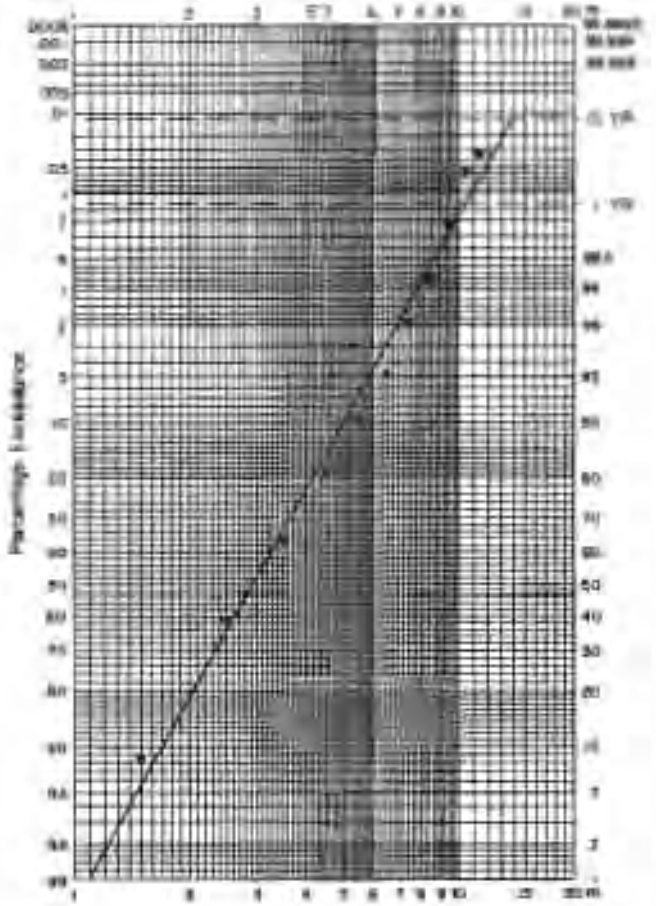
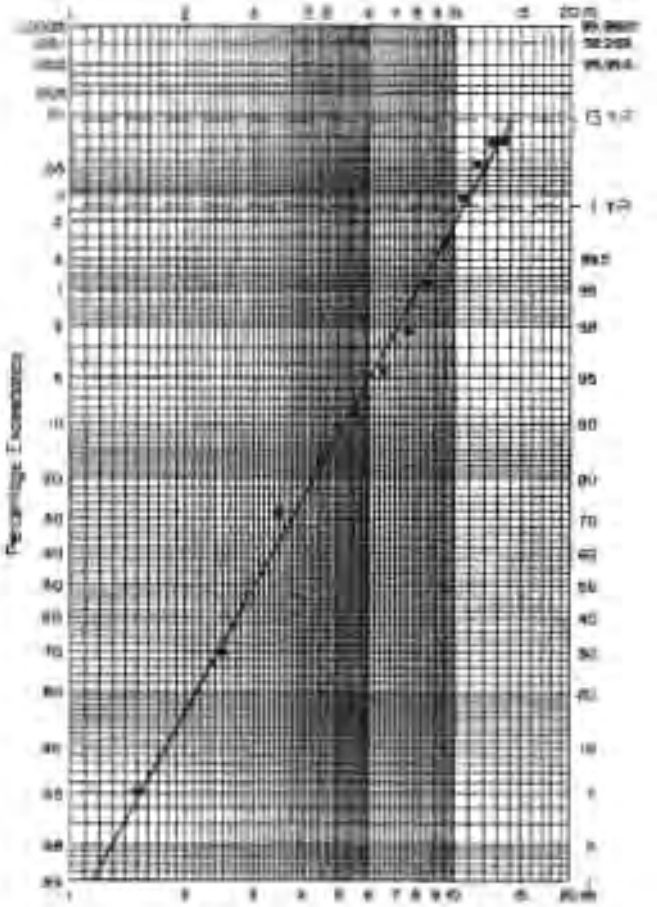
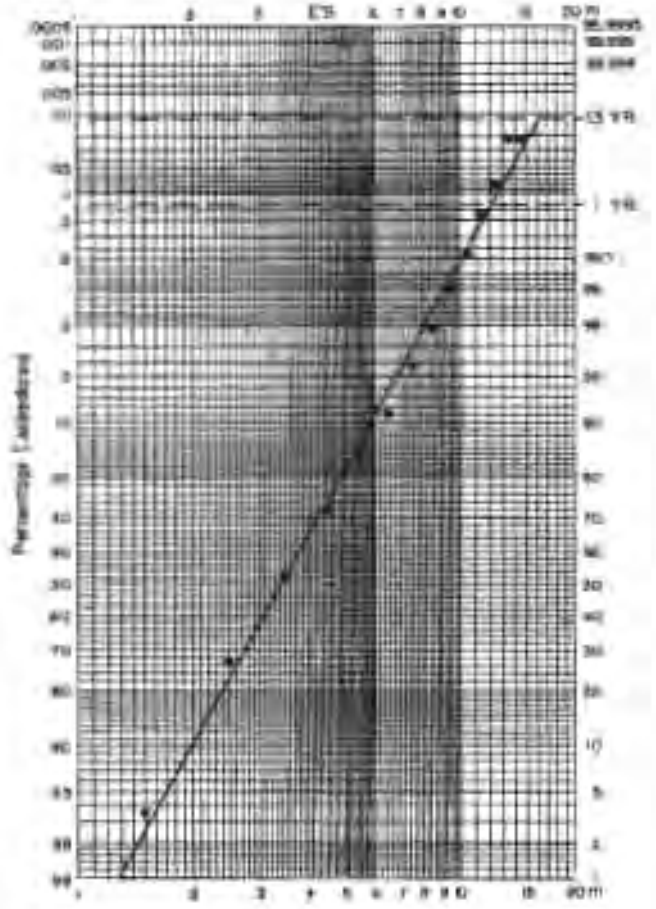


Figure 13a. 13 Years Wave Height Exceedance Distribution







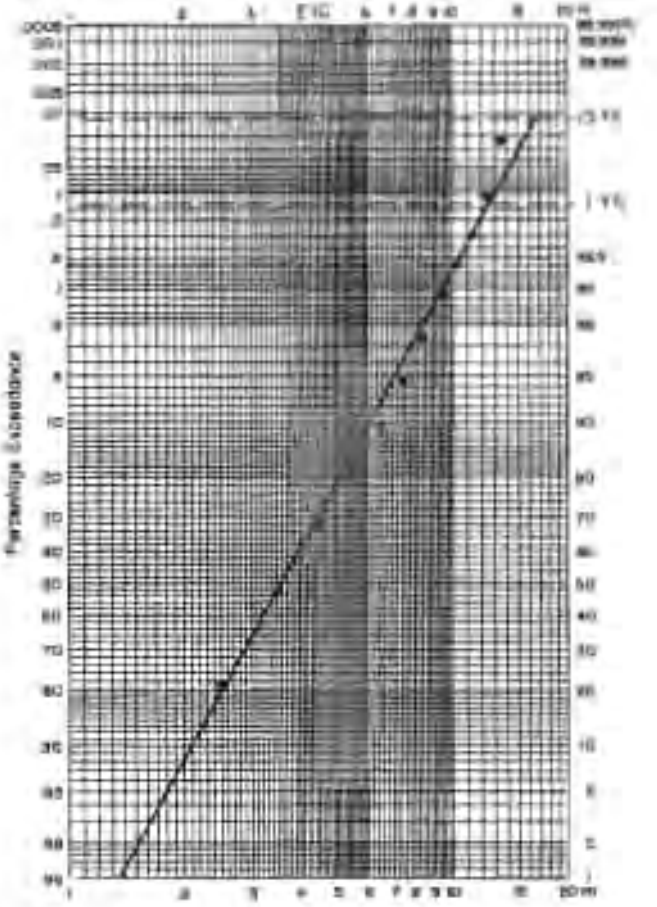


Figure (3)ᵢ 13 Years Wave Height Exceedance Distribution

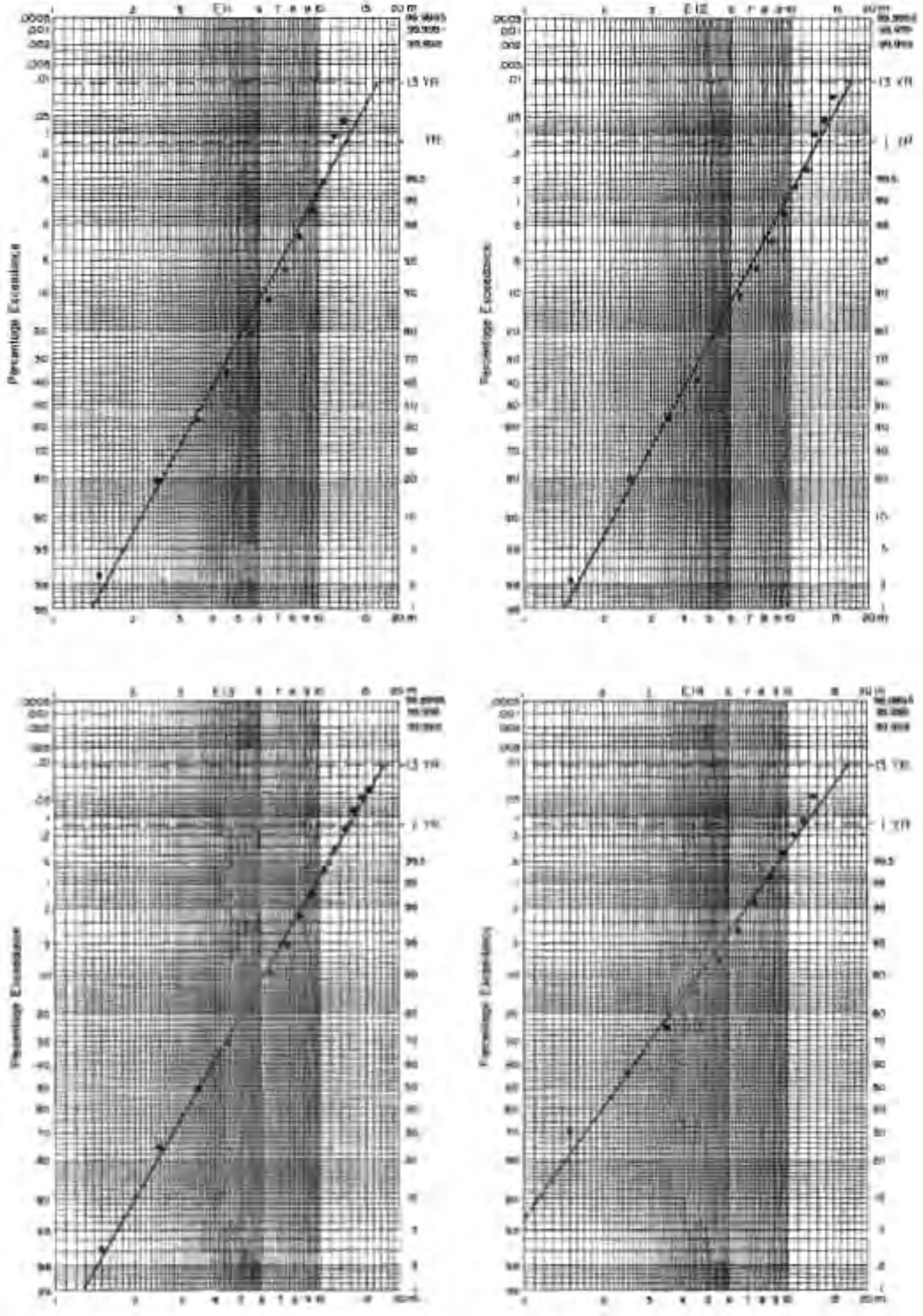


Figure (3c 15 Years Wave Height Exceedance Distribution

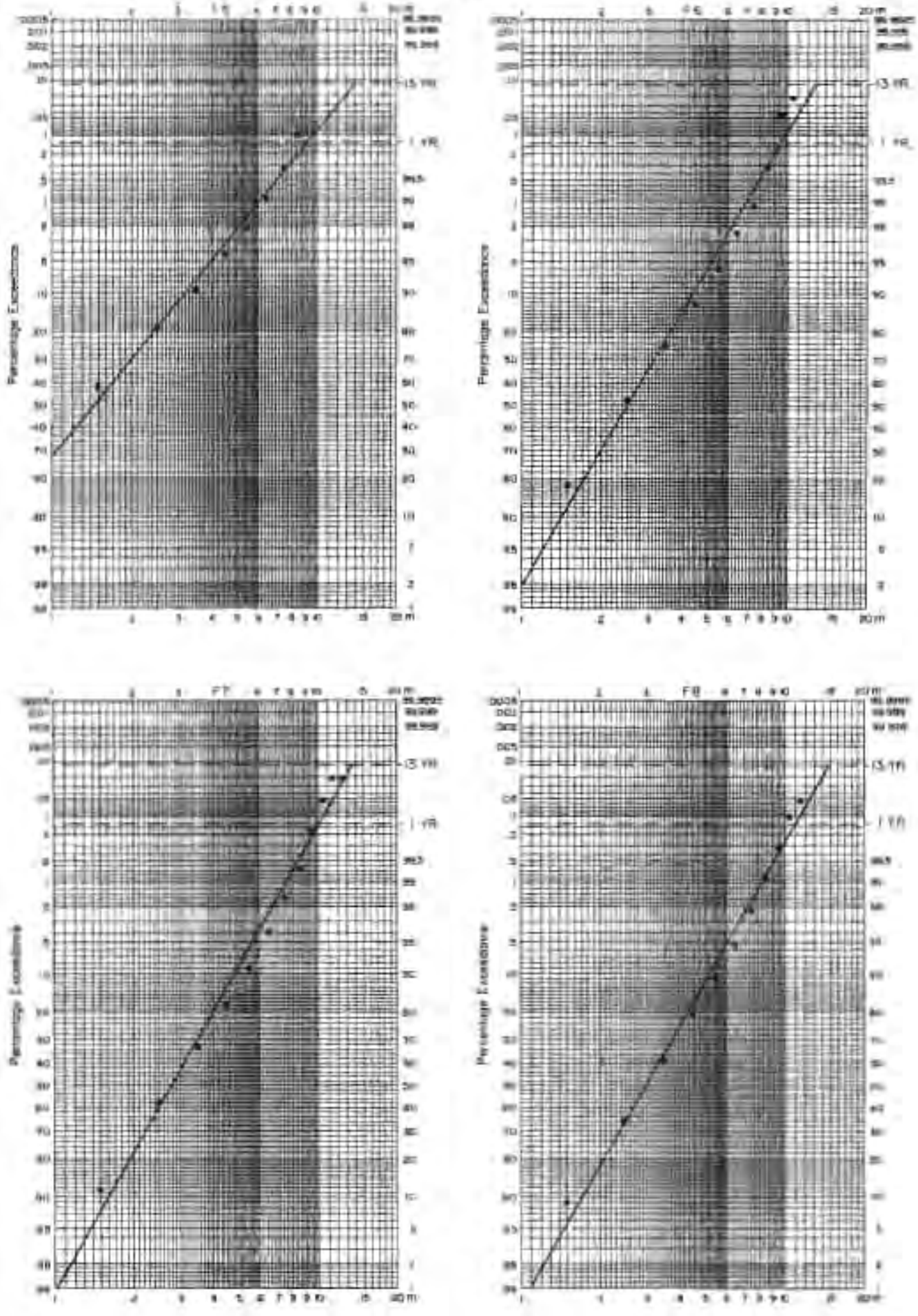
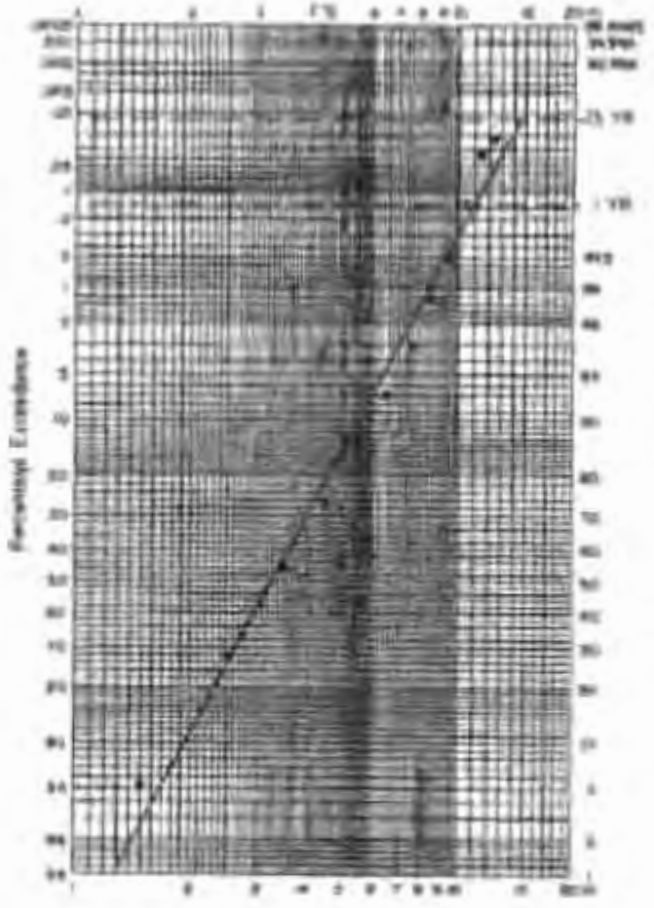
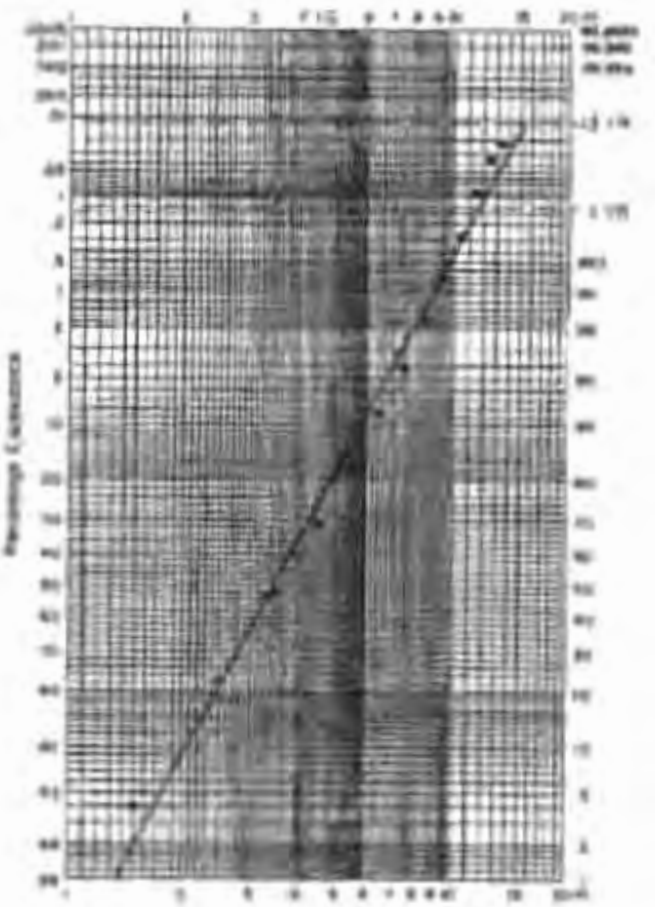
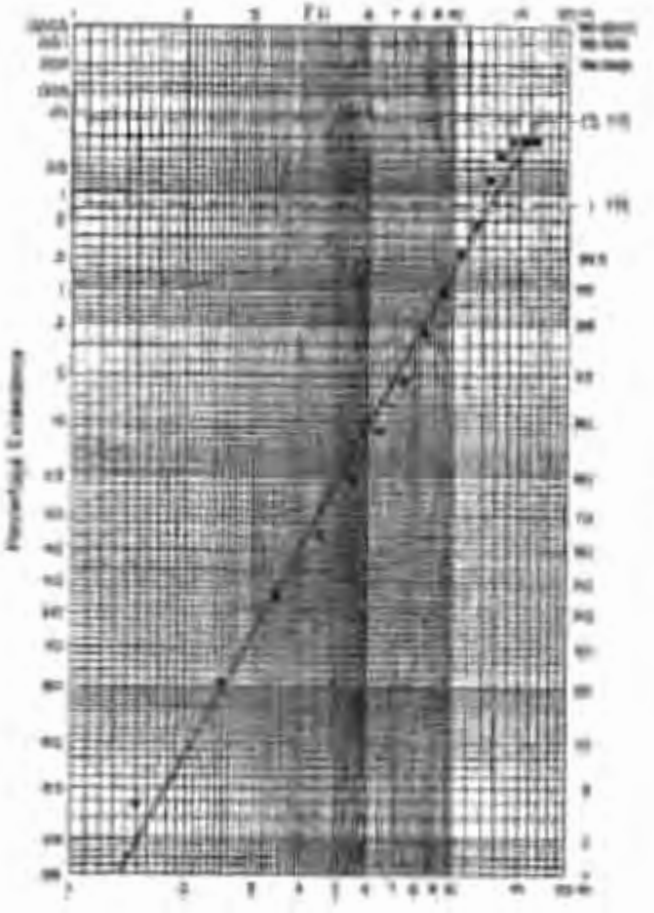
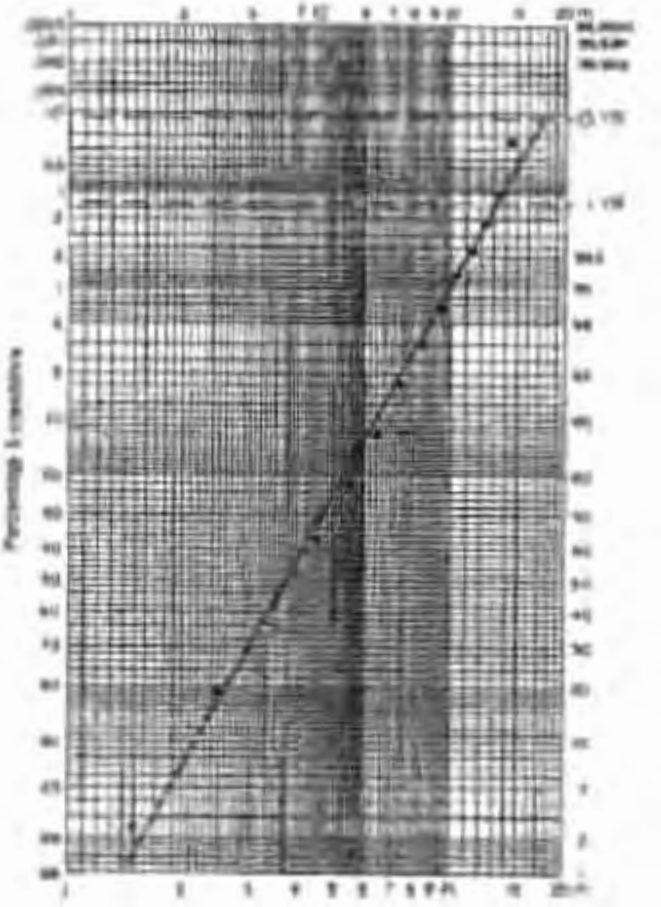


Figure 13p. 13 Years Wave Height Exceedance Distribution









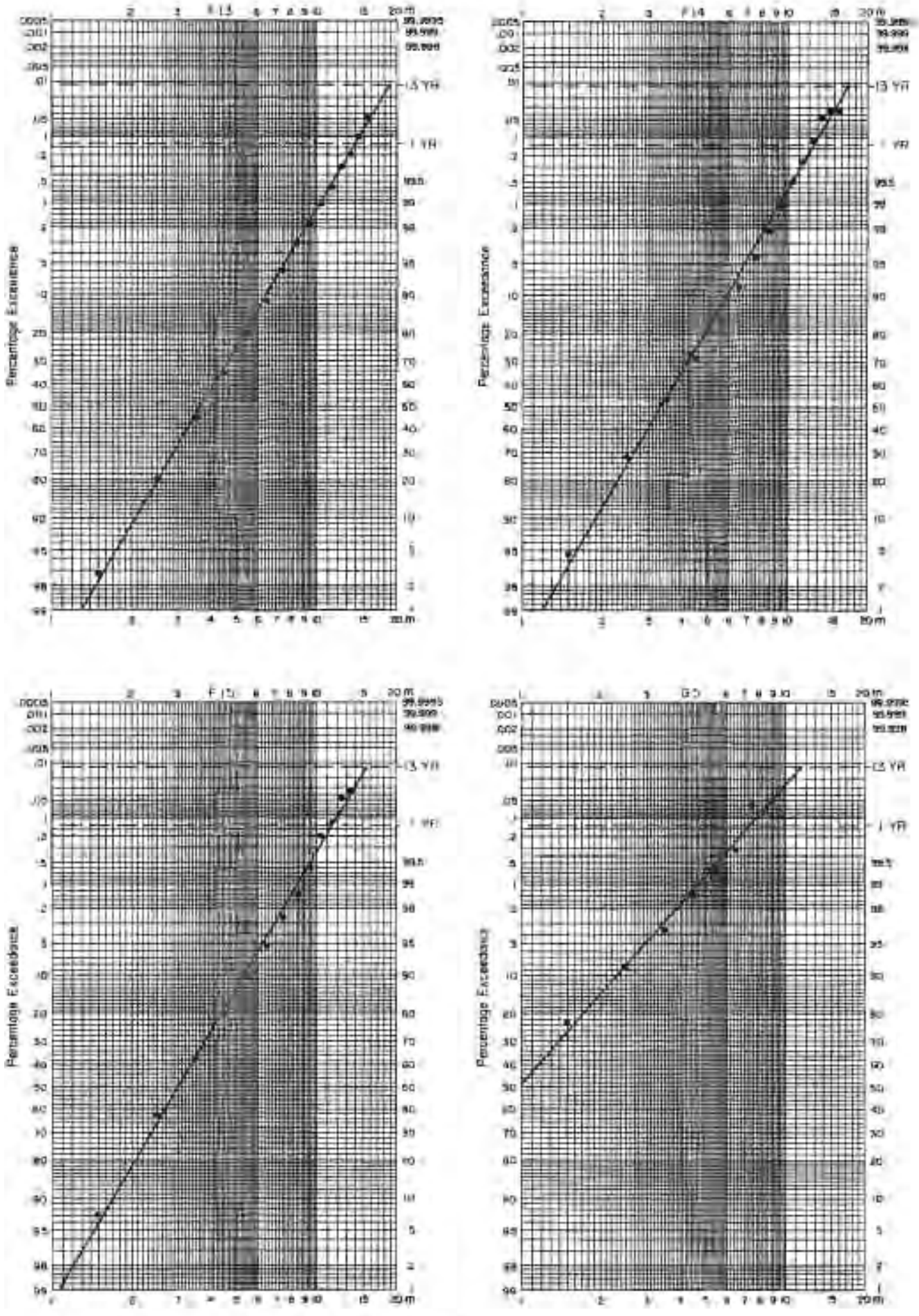


Figure 13: 13 Years Wave Height Exceedance Distribution

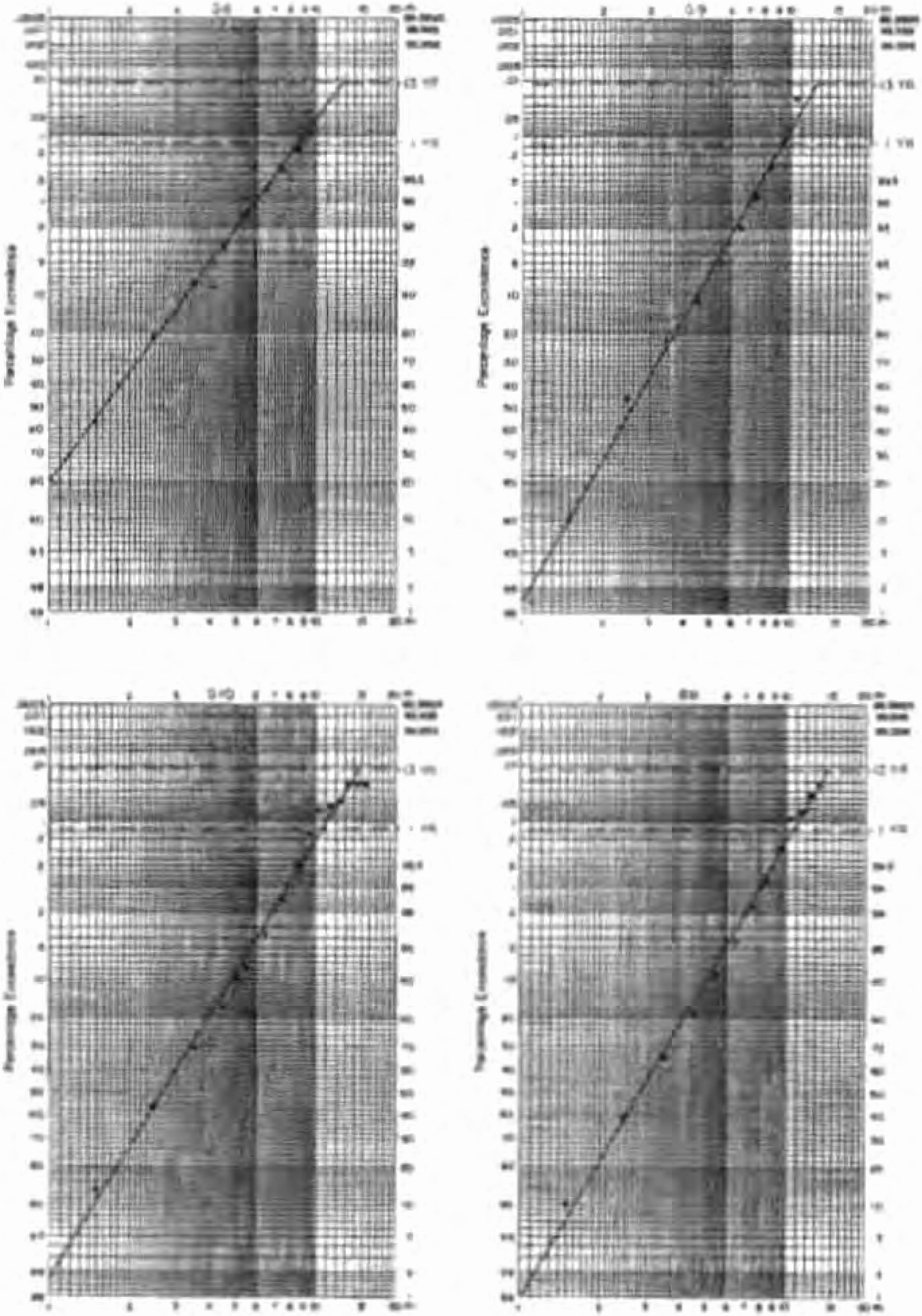
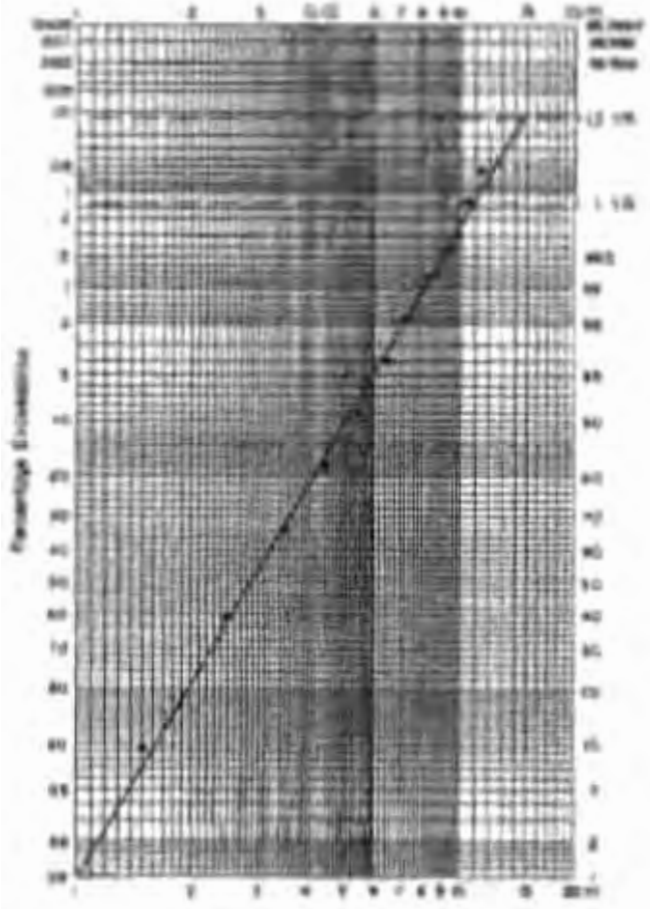
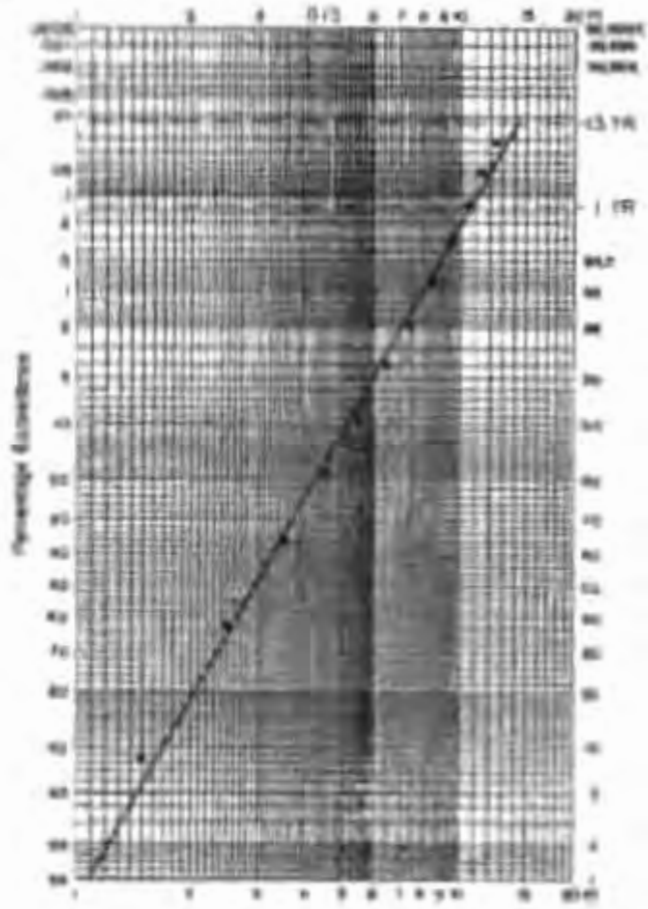
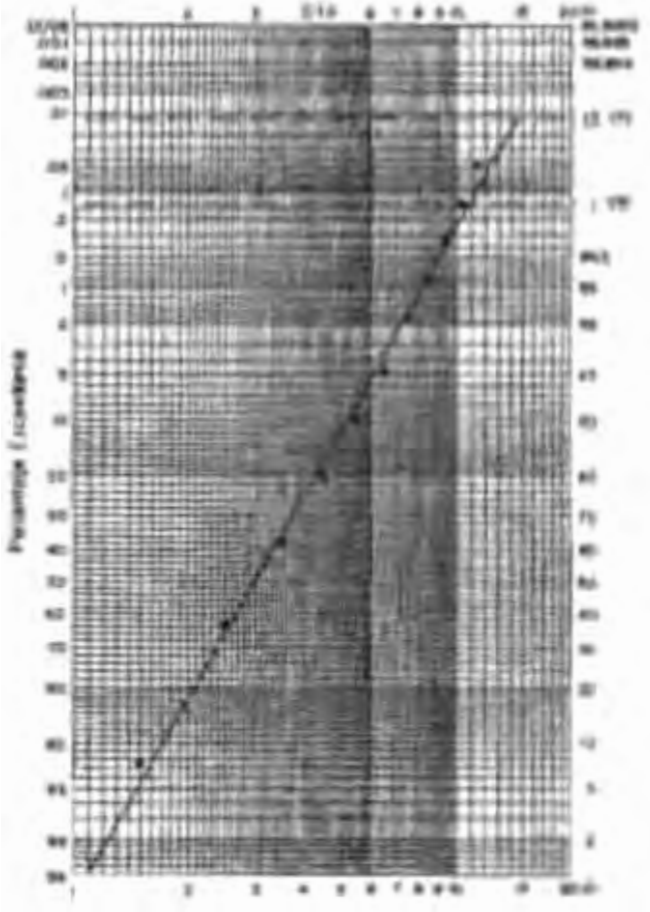
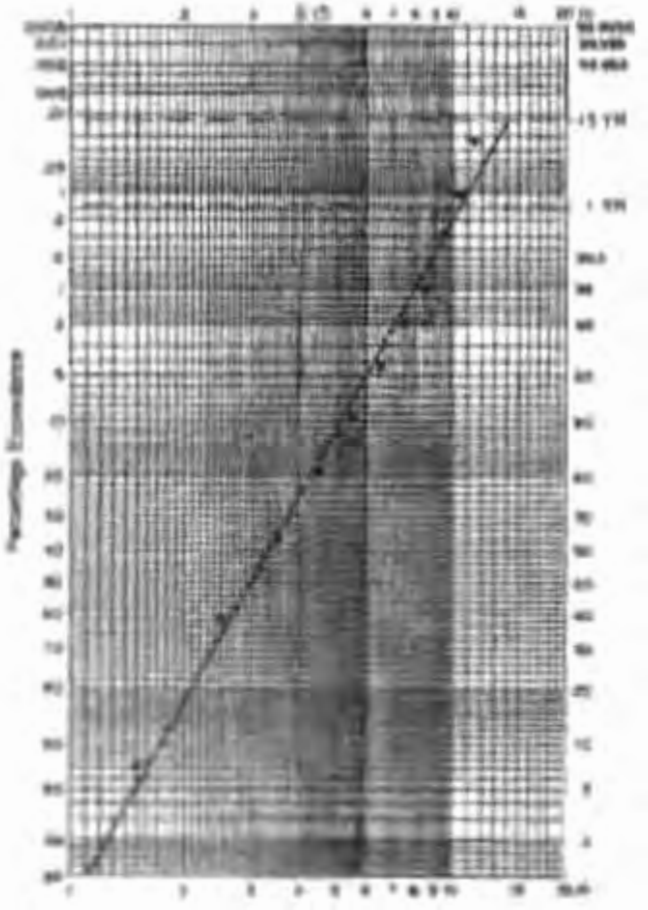


Figure C3a. 15 Years Wave Height Exceedance Distribution









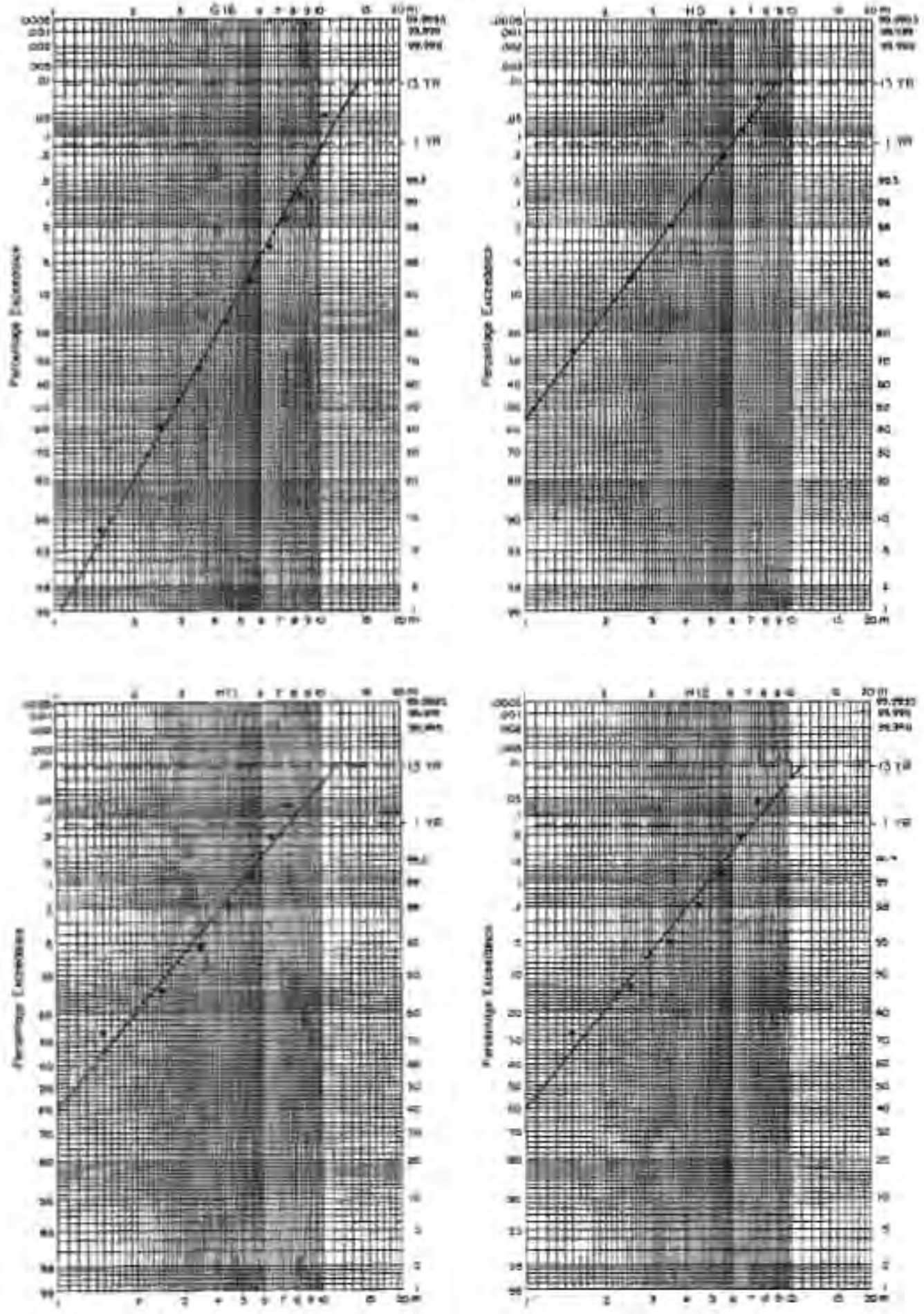


Figure (3.4) 15 Years Wave Height Exceedance Distribution

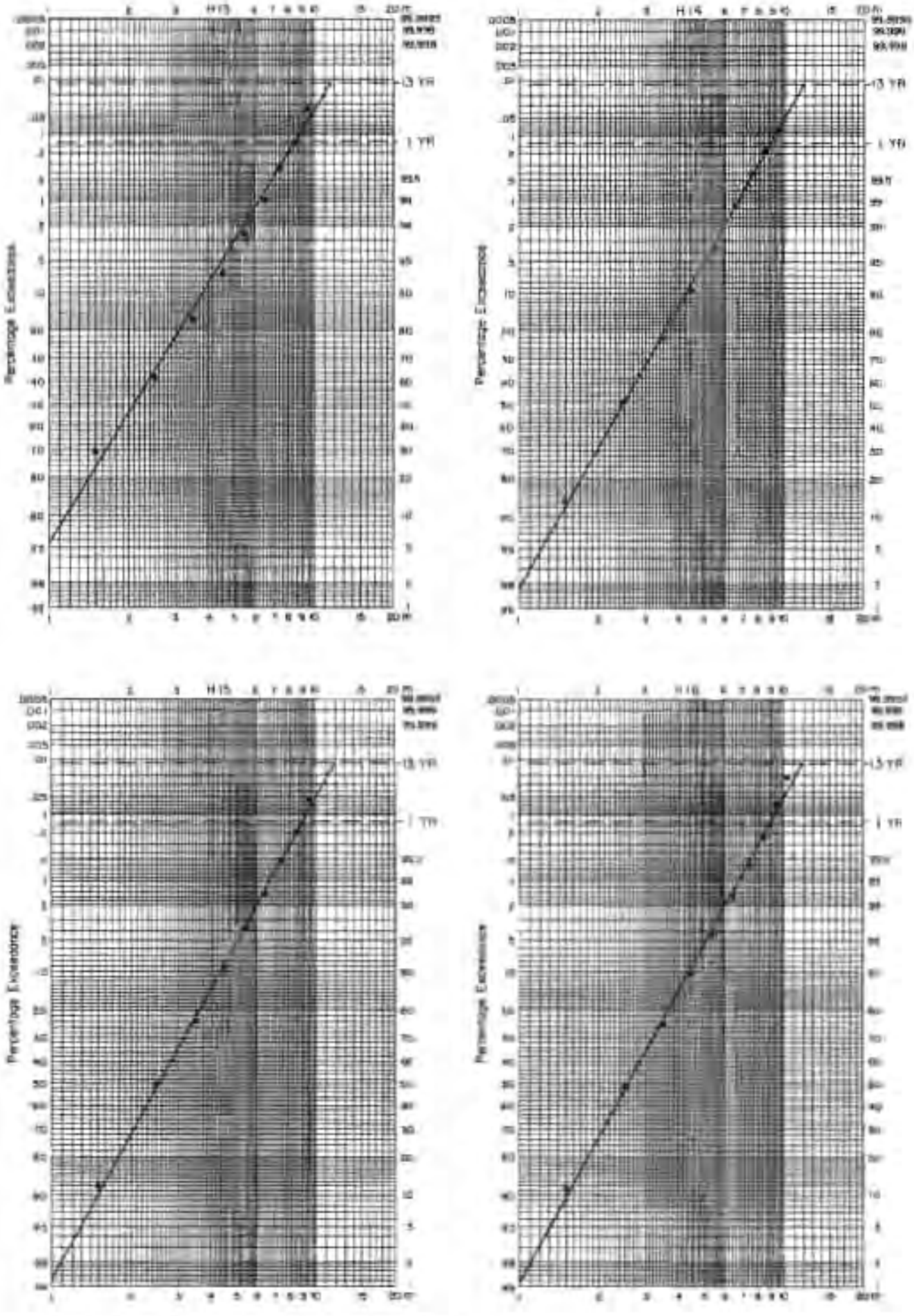


Figure 13c. 13 Years Wave Height Exceedance Distribution