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# 1. 調査団員・氏名

# 1-1 現地調査

No.	担当	氏名	所属
1	総括	小柳 桂泉	JIJCA
2	業務主任者/港湾計画	松浦榮一	Ides
3	港湾施設設計	浅野 敦	JPC
4	自然条件調査	佐瀬 攻	JPC
5	環境社会配慮	山田正穂	Ides
6	施工・調達計画/積算	西村進	JPC

# 1-2 概略設計説明

No.	担当	氏名	所属
1	総括	小柳 桂泉	JIJCA
2	計画管理	工藤 貴裕	JIJCA
3	業務主任者/港湾計画	松浦榮一	Ides
4	港湾施設設計	浅野 敦	JPC

# 2. 調査行程

# 2-1 現地調査

日付	曜日	総括/JICA	業務主任/港湾計画	調査 港湾施設設計	白然条件	施工・調達計画/精算	環境社会配慮
68208	н	1010A	成田→シンガポール	成田→シンガポール		成田→シンガポール	東先江女司恩
6月30日	火火		Arr Dili by Ml296 (14:20)	Arr Dili by MI296 (14:20)		Arr Dili by Ml296 (14:20)	
7月1日	<u>ж</u>		現地調査日程等協議 APORTILとの日程 等調整会議	現地調査日程等協議 APORTILとの日程 等調整会議		現地調査日程等協議 APORTILとの日程 等調整会議	
7月2日	木		IC/R等説明·協議	IC/R等説明協議		IC/R等説明協議	
7月3日	金		APORTIL打合せ	APORTIL打合せ		市場調査。 現地建設業者面談、調査票配布	
7月4日	±		APORTIL打合せ	APORTIL打合せ 2014年1月1日		APORTIL打合せ 光体開ま、彼然間期	
7月5日	в	Arr Dili by GA7300 (12:20)		宜村登埋 団内会議		里面詞堂。資料登埋 団内会議	
7月6日	月	JICA事務所協議 MD協議(APORTIL) IFC閉き取り調査	JICA事務所協議 MD協議(APORTIL) IFC閉き取り調査	MD協議(APORTL)	成田→シンガポール	MD協議(APORTIL)	成田→シンガポール
7月7日	火	GIZ Maritime Project聞き取り調査 MD 協議(APORTIL)	GIZ Maritime Project聞き取り調査 MD 協議(APORTIL)	GIZ Maritime Project聞き取り調査/MD協 議(APORTIL)	シンガポール→ディリ 現地調査準備	GIZ Maritime Project聞き取り調査 MD協議 (APORTIL)	シンガポール→ディリ 現地調査準 備
7月8日	水	MD協議(APORTIL)	MD協議(APORTIL)	MD協議(APORTIL)/現地再委託調査 応札書類開封·評価/契契約書署名	JICA表敬訪問 現地再委託業者能力評価	現地再委託調査応札書類開封·評価 /契契約書署名	APORTIL打合せ(IC/P, 質問表等)
7月9日	*	外務協力省 協議 Tibar新港開発状況視察 Dry port 状況視察	外務協力省 協議 Tibar新港開発状況視察 Dry port 状況視察	フェリー旅客ヒアリング項目の検討 /Tibar新港開発状況視察/Dry port 状 況視察	現地再委託土質調査業者との協議/ 契約書作成	関税率等調査 Tibar新港開発状況視察 Dry port 状況視察	環境社会配慮聞き取り調査スケ ジュールの検討/Tibar新港開発状況 視察/Dry port 状況視察
7月10日	숲	JICA事務所協議 MD協議(APORTIL) IFC聞き取り調査	JICA事務所協議 MD協議(APORTIL) IFC聞き取り調査	現地再委託業者(Package1)調査日 程打合せ/契約書作成・処理	現地再委託土質調査業者と契約 海上作業許可申請書作成	現地船会社面談 市場調査	環境社会配慮現地再委託業者内容 の精査/APOTIL打合せ
7月11日	±	火山噴火の影響による出発遅延	団内打合せ/資料整理	団内打合せ/資料整理	団内打合せ/現地再委託業者 (Package-2)との交渉/契約書作成/JI CA報告作成(現地再委託)	団内打合せ/資料整理 第3国調査票送付	団内打合せ/資料整理
7月12日	н	Dep Dili by GA7310 (13:20)	資料整理	資料整理	現地再委託業者(Package-2)との交 渉/契約書作成/JICA報告作成(現地 再委託)	資料整理	資料整理
7月13日	月		MOTC(Ferry 諸元、計画協議)	MOTC(Ferry 諸元、計画協議)	APORTIL協議(自然条件関連資料の 入手について)	税関本局面談。	現地再委託業者・調査日程打合せ
7月14日	火		現地再委託業者作業工程等調整 計画条件の検討	現地再委託業者作業工程等調整 計画条件の検討	現地再委託業者作業工程等調整 計画条件の検討	市場調査。 邦人建設会社調査票配布	資料収集
7月15日	水		MOTC (副大臣とMD内容の確認、署 名促進方依頼)	MOTC (副大臣とMD内容の確認、署 名促進方依頼)	自然条件資料の収集/再委託業務の 進行状況チェック	現地建設業者調査票回収 単価調査	環境省打合せ(環境関連法、資料入 手方法等)
7月16日	木		APORTIL打合せ(概略計画案の協議 と要望ヒアリング)	APORTIL打合せ(概略計画案の協議 と要望ヒアリング)	自然条件資料の収集/再委託業務の 進行状況チェック	邦人コンサルタント面談	現地再委託調査状況チェック/協議
7月17日	金		概略配置計画案の検討	概略配置計画案の検討	自然条件資料の収集/再委託業務の 進行状況チェック	施工計画検討	環境関連資料の収集
7月18日	±		東側海岸地域への山越えルート視察 /団内打合せ	団内打合せ/資料整理	再委託業務の進行状況チェック/資料 整理	現地建設業者面談/団内打合せ	団内打合せ/資料整理
7月19日	Π		資料整理	資料整理	資料整理	資料整理	資料整理
7月20日	月		APORTIL打合せ(調査進行状況報告 及び協議)	APORTIL打合せ(調査進行状況報告 及び協議) ナクロマ利用者ヒアリング調査	APORTIL打合せ(調査進行状況報告 及び協議)	APORTIL打合せ(調査進行状況報告 及び協議) 邦人コンサルタント面談	APORTIL打合せ(調査進行状況報告 及び協議)
7月21日	火		現地調査報告書案作成/補足調査	現地調査報告書案作成/補足調査	ビザ延長申請/自然条件資料の収集/ 再委託業務の進行状況チェック	邦人建設会社面談 単価調査。	APORTIL協議(管理運営体制・運営 管理等)
7月22日	水		現地調査報告書案作成/補足調査	現地調査報告書案作成/補足調査	自然条件資料の収集/再委託業務の 進行状況チェック	施工計画検討	現地再委託調査状況チェック/協議
7月23日	木		現地調査報告書案作成/補足調査	現地調査報告書案作成/補足調査	自然条件資料の収集/再委託業務の 進行状況チェック	概算事業費検討	環境関連資料の収集
7月24日	金		APORTIL打合せ	APORTIL打合せ	APORTIL打合せ/再委託業務の進行 状況チェック	APORTIL打合せ	APORTIL打合せ
7月25日	±		団内打合せ/資料整理	回内打合せ/資料整理	団内打合せ/再委託業務の進行状況 チェック/資料整理	回内打合せ/資料整理	回内打合せ/資料整理
7月26日	н		資料整理 100.172.6	資料整埋 100.1000	資料整理	資料整埋 100170年	資料整理
7月27日	月				JICA報告/再安託業務の進行状況 チェック		JICA報告/APORTIL1] 合せ(調査進 行状況報告及び協議) 現時調査報告書室作者、自然、環境
7月28日	火		ティリーシンカホール	シンガポール→成用	自然案件員符の収集/再要記業務の 進行状況チェック 自然条件姿料の加集/再素好要務の	シンガポール→成田	現地調査報告書条作成、自然・環境 調査業者との打合せ・確認作業 預地調査報告書家作成/補足調査
7月29日	水			1940 B	進行状況チェック		%~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
7月30日	木				自然条件収集資料の整理/再委託業 務の進行状況チェック		現地調査報告書案作成/補足調査
7月31日	金				自然条件収集資料の整理/再委託業 務の進行状況チェック		JICA打合せ APORTIL打合せ 環境調査状況確認
8月1日	±				団内打合せ/自然条件収集資料の整理/再委託業務の進行状況チェック		団内打合せ/資料整理
8月2日	н				現地調査報告書案作成/自然条件収 集資料の整理/再委託業務の進行状		資料整理
8月3日	月				JICAへの報告/再委託業者の進行状 況確認		JICAへの報告 環境調査状況確認
8月4日	火				日然常作資料の収集/再委託業務の 進行状況チェック		マイリ→ンンカホール
8月5日	水				ロニスポトリスロの収集/再安託業務の 進行状況チェック		>> パホール→ 成曲
8月6日	*				祝吧倘堂敢古書杀作成/補足調査		
8月7日	金				57-50両旦取口言朱TF风/ 悟足調査 自妖条件姿料の即生/面来好要改不		
8月8日	±				当前本日見行システ/ 侍女前未務の 進行状況チェック 資料整理		
8月9日	日				資料整理		
8月10日	月				谷料整理/再委託業者の進行状況		
8月11日	火				チェック JICAへの報告		
8月12日	水				ディリーシンガポール		
8月13日	木				シンガポール→成円		
8月14日	金						

# 2-2 概略設計説明

10105	日付	032 02	日/十 開日		調査	1. 内容	Distance and the second second
白順		PEED	総括/JICA	計画管理/JICA	業務主任/港湾計画	港湾施設設計	
1	1月25日	月	成田→シンガポール	成田ーシンガボール	成田→シンガポール	成田→シンガボール	
2	1月26日	火	シンガポール→ディリ JICA打合 せ	シンガボールーディリ JICA打合 せ	シンガボール→ディリ JICA打合 せ	シンガポール→ディリ JICA打合 せ	
3	1月27日	水	MTC副大臣説明 APORTIL説明・協議	MTC副大臣説明 APORTIL説明・協議	MTC副大臣説明 APORTIL説明・協議	MTC副大臣説明 APORTIL説明・協議	
4	1月28日	木	APORTIL説明·協議 財務省説明	APORTIL説明•協議 財務省説明	APORTIL説明·協議 財務省説明	APORTIL説明・協議 財務省説明	
5	1月29日	金	ミニッツ署名 JICA報告 大使館報告	ミニッツ署名 JICA報告 大使館報告	ミニッツ署名 JICA報告 大使館報告	ミニッツ署名 JICA報告 大使館報告	
6	1月30日	±	ディリーシンガボール	ディリーシンガボール	ディリーシンガボール	ディリーシンガポール	
7	1月31日	B	シンガポール→成田	シンガポールー成田	シンガポール→成田	シンガボール→成田	

# 3. 関係者(面会者)リスト

Organization	Name	Position
Ministry of Foreign Affairs and	Mr. Nuno Moniz Alves	Director
Cooperation	Mr. Ines Da Costa Moreira	Desk Officer for Asia and
		Middle-East
	Mr. Cristiana Gloria	Assistant Administration
Ministry of Finance	Mr. Elson Martinho da Costa	External Assistance
		Coordination Officer
	Ms. Miranda Santo	ditto
	Mr. Hideaki Maruyama	Advisor
Ministry of Public Works,	Mr. Inacio Moreira	Vice Minister II
Transport and	Mr. Constantino Ferreira	Advisor for Vice Minister
Communications	Soares	
	Mr. Rui Mannel Neto Fragh	Advisor for Vice Minister
	Mr. Teotonio de Assis	Advisor for Vice Minister
Ministry of Commerce,	Mr. Antonio Lelo Taci	Director of NDE
Industry and Environment	Mr. Francisco Poto	Chief of EIA Department
National Directorate for		
Environment (NDE) , State		
Secretariat for Environment		
APORTIL /DNTM	Mr. Constantino Ferreira	President
	Soares	
	Mr. Lino Barreto	Director of DNTM
	Mr. Gabriel Hilario	Engineer
	Fernandes	
	Mr. Jonas F. Alves Do Rego	Operational Security
	Mr. Joes M. Marques	Harbor Master/APORTIL &
		DNTM
	Mr. Helder da Silva	Technical officer/APORTIL &
		DNTM
	Ms. Adelina Andrade	Finance /APORTIL
	Mr. Moises de Araiyo	APORTIL
	Mr. Joao de F. Fernandes	DNTM
	Mr. Alberto F Percira	DNTM
	Mr. Hiroyuki Onishi	Advisor/JICA

Custom Department Office	Ms. Rosa de Silva	Head of Commercial
		Compliance
Meteorological Office	Mr. Eqidio da Costa Butares	Advisor
GIZ	Mr. Rodrigo Garcia-Bernal	Principal Advisor
	Ms. Nadezuda Nikolous	Junior Advisor
IFC	Ms. Milissa Day	Resident Representative,
		Timor Leste
在東ティモール日本国大使館	山本 栄二	特命全権大使
	川崎 敏秀	参事官
	米光 雅宜	二等書記官
	吉川 幸絵	専門調査員(経済担当)

# MINUTES OF DISCUSSIONS ON THE PREPARATORY SURVEY FOR THE PROJECT FOR URGENT SHIFT OF FERRY TERMINAL IN DILI PORT IN THE DEMOCRATIC REPUBLIC OF TIMOR-LESTE

In response to a request from the Government of Democratic Republic of Timor-Leste (hereinafter referred to as "Timor-Leste"), the Government of Japan decided to conduct a Preparatory Survey on "The Project for Urgent Shift of Ferry Terminal in Dili Port" (hereinafter referred to as "the Project"). In accordance with this decision, Japan International Cooperation Agency (hereinafter referred to as "JICA") decided to commence the survey.

IICA sent the Preparatory Survey Team for the Field Survey (hereinafter referred to as "the Team"), which is headed by Mr. Yoshimoto KOYANAGI, Deputy Director, Transportation and ICT Group, Infrastructure and Peacebuilding Department, JICA, and is scheduled to stay in the country from June 30<sup>th</sup> to August 4<sup>th</sup>, 2015.

The Team held discussions with the officials concerned of the Timor-Leste side, and conducted a field survey at the Project site.

In the course of discussions and field survey, the both sides confirmed the main items described on the attached sheets. The Team will proceed to further works and prepare a Draft Report of the Preparatory Survey.

Dili, August 25 , 2015

小柳桂泉

Mr. Yoshimoto Koyanagi Leader Preparatory Survey Team Japan International Cooperation Agency

Ministry of Public Works, Transportane Communications The Democratic Republic of Timor-Leste

(Witnessed by)

Ministry of Finance

The Democratic Republic of Timor-Leste

#### ATTACHMENT

#### 1. Objective of the Project

The objective of the Project is to achieve a safer port operation by construction of new ferry jetty and necessary facilities, thereby contributing to better environment to port users.

- 2. Title of the Preparatory Survey Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for Urgent Shift of Ferry Terminal in Dili Port".
- 3. Project Site Both sides confirmed that site of the Project is in Dili Port which is shown in Annex-1.
- 4. Line Ministry and Executing Agency

Both sides confirmed the line ministry and executing agency as follows:

- 4-1. The line ministry is Ministry of Public Works, Transport and Communications (MPWTC), which would be the agency to supervise the executing agency.
- 4-2. The executing agency is Administração dos Portos de Timor-Leste (APORTIL). The executing agency shall coordinate with all the relevant agencies to ensure smooth implementation of the Project and ensure that the Undertakings are taken by relevant agencies properly and on time.
- 4-3. The organization chart is shown in Annex-2.
- 5. Item requested by the Government of Timor-Leste
- 5-1. As a result of discussions, with the Team, both sides confirmed that the items requested by the Government of Timor-Leste are as follows:
  - Jetty to accommodate two(2) ferries at the same time and landing platform
  - Facilities such as water supply, power supply, fire hydrant, lighting system, and safety control system, etc.
- 5-2. The Team explained to the Timor-Leste side that the ferry to be procured by the Germany in future will be given the higher priority in the process of the examination of the design for new jetty.
- 5-3. The Timor-Leste side requested to the Team that the countermeasure for sedimentation would be considered for the design of the above mentioned jetty and facilities.
- 5-4. JICA will assess the appropriateness of the above requested items through the survey and will report findings to the Government of Japan. The final components of the Project

would be decided by the Government of Japan.

- 6. Japan's Grant Aid Scheme
- 6-1. The Timor-Leste side understood the Japan's Grant Aid Scheme and its procedures as described in Annex-3, Annex-4 and Annex-5, and necessary measures to be taken by the Government of Timor-Leste.
- 6-2. The Timor-Leste side agreed to take the necessary measures, as described in Annex-6, for smooth implementation of the Project, as a condition for the Japan's Grant Aid to be implemented. The detailed contents of the Annex-6 will be worked out during the survey and shall be agreed no later than by the Explanation of the Draft Preparatory Survey Report.

The contents of Annex-6 will be used to determine the following:

(1) The scope of the Project.

(2) The timing of the Project implementation.

(3) Timing and possibility of budget allocation

Contents of Annex-6 will be updated as the Preparatory Survey progresses, and will finally be the Attachment to the Grant Agreement.

- 7. Schedule of the Study
- 7-1. The Team will proceed with further field survey in Timor-Leste until August 4<sup>th</sup>, 2015.
- 7-2. JICA will prepare the draft Preparatory Survey Report and dispatch a mission to Timor-Leste in order to explain its contents around January, 2016.
- 7-3. If the contents of the draft Preparatory Survey Report is accepted in principle and the Undertakings are fully agreed by the Government of Timor-Leste side, JICA will complete the final report and send it to Timor-Leste around May, 2016.
- 7-4. The above schedule is tentative and subject to change.

#### 8. Environmental and Social Considerations

- 8-1. The Timor-Leste side confirmed to give due environmental and social considerations during implementation of the Project, and after completion of the Project, in accordance with the JICA Guidelines for Environment and Social Considerations (April, 2010).
- 8-2. The Timor-Leste side agreed to conduct the necessary procedures concerning the environmental assessment (including stakeholder meetings, Initial Environmental Examination (IEE) etc.) and submit required environmental report of the Project to the Ministry of Commerce, Industry and Environment. The period required from the request of approval till the obtainment of approval will be further examined, and the Timor-Leste side agreed to obtain the approval from Ministry of Commerce, Industry and Environment and submit it to JICA Timor-Leste Office preferably before the Cabinet

approval of the Project by the Government of Japan which is scheduled around April, 2016.

9. Disclosure of Information

Both sides confirmed that the study results excluding the Project cost will be disclosed to the public after the completion of the Survey. All the study results including the Project cost will be disclosed to the public after all the verification of contracts for the Project are concluded by JICA.

- 10. Other Relevant Issues
- 10-1. The Timor-Leste side explained to the Team that Tibar New Port development project is in progress exclusively for cargo handling and that Dili Port will be utilized as a passenger port even after completion of the Tibar Port project.
- 10-2. The Timor-Leste side explained to the Team their plan for procurement of new ferries of which the ferries from Portugal and Germany will be deployed in a few years. The detailed information on timing of deployment and operation plan by new ferries, etc., will be informed by the Timor-Leste side to the Team by July 27<sup>th</sup>, 2015.
- 10-3. The Timor-Leste side agreed that they will construct the passenger terminal building by their own expense by the completion of the project. The both sides will continue technical discussion during the Team's stay till July 27<sup>th</sup>, 2015, on layout plan of passenger terminal building which is alignment with the construction plan of new jetty and platform. The necessary condition for the outline design work for the new jetty and platform such as passengers' flow, access road route to the platform, shall be agreed during the Team's stay.
- 10-4. The Timor-Leste side assured that they will secure the necessary budget and personnel for operation and maintenance of the facilities to be provided by the Project.
- 10-5. The Timor-Lestc side agreed to secure the temporary construction yards and the dumping site around the Project site.
- 10-6. If the dredging work is required to secure the necessary water depth, the Timor-Leste side shall secure the dumping area for the dredged soil which accords to the environmental condition and requirement.
- 10-7. The Timor-Leste side agreed that the implementing agency (APORTIL) shall bear the cost, which is equivalent to the customs duties, internal taxes and other fiscal levies which may be imposed in Timor-Leste, instead of tax exemption system.
- 10-8. The both sides agreed to the issuance of the Working Visa for all workers who will be engaged in the project, and agreed that the Timor-Leste side shall take necessary actions to support for the smooth issuance of Working Visa and that the Japanese side shall follow the required procedure in a timely manner.

- 10-9. During implementation and after completion of the Project, the progress and issues will be monitored by using Project Monitoring Report. The format of Project Monitoring Report is attached as Annex-7.
- Annex-1 Project Site
- Annex-2 Organization Chart
- Annex-3 Japan's Grant Aid
- Annex-4 Flow Chart of Japan's Grant Aid
- Annex-5 Financial Flow of Japan's Grant Aid
- Annex-6 Major Undertakings to be taken by Each Government
- Annex-7 Project Monitoring Report



Project Site







#### JAPAN'S GRANTAID

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of ODA operations, and as a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on this law and the decision of the GOJ, JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

The Grant Aid is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of inaterials as such.

#### 1. Grant Aid Procedures

The Japanese Grant Aid is supplied through following procedures :

·Preparatory Survey

- The Survey conducted by JICA

·Appraisal & Approval

- Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet

·Authority for Determining Implementation

- The Notes exchanged between the GOJ and a recipient country

•Grant Agreement (hereinafter referred to as "the G/A")

- Agreement concluded between JICA and a recipient country · Implementation

- Implementation of the Project on the basis of the G/A

#### 2. Preparatory Survey

(1) Contents of the Survey

The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country arc not necessarily approved in their initial form as the contents of the Grant Aid project. The Outline Design of the Project is confirmed based on the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be

guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

#### (2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

#### (3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

#### 3. Japan's Grant Aid Scheme

#### (1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

#### (2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

#### (3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

#### (4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex.

#### (6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant Aid, to

assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant Aid.

#### (7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

#### (8) Banking Arrangements (B/A)

- a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.
- b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

#### (9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

#### (10) Social and Environmental Considerations

A recipient country must carefully consider social and environmental impacts by the Project and must comply with the environmental regulations of the recipient country and JICA socio-environmental guidelines.

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FLOW CHART OF JAPAN'S GRANT AID PROCEDURES

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### Major Undertakings to be taken by Each Government

#### Major Undertakings to be taken by Recipient Government

1. Before the Tender

NO	ltems	Deadline	In charge	Ref.
1	To approve IEE/EIA	before the Project approval by Japanese Cabinet	APORTIL	
2	To open Bank Account (Banking Arrangement (B/A))	within 1 month after G/A	MPWTC	
3	To secure lands <ol> <li>temporary construction yard and stock yard near the Project area</li> <li>borrow pit and disposal site near the Project area</li> </ol>	before notice of the tender document	APORTIL.	
4	To obtain the planning, zoning, building permit	before notice of the tender document	APORTIL	
5	To clear, level and reclaim the following sites when needed	before notice of the tender document	APORTIL	

#### 2. During the Project Implementation

мо	Ĭtems	Deadline	In charge	Ref.
1	To bear the following commissions to a bank of Japan for the banking services based upon the $B/\Lambda$			
	1) Advising commission of A/P	within 1 month after the singing of the contract	моғ	
	2) Payment commission for A/P	cvcry payment	APORTIL	
2	To issue the Working Visa for workers	before commencement of the Project	Ministry of Internal Affairs	,
3	To construct the passenger terminal building	during the Project	APORTIL	
4 .	To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country	during the Project	APORTIL	
5	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work	during the Project	APORTIL	
6	To bear the cost which is equivalent to the customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the Products and/or the Services, instead of tax exemption system. Such customs duties, internal taxes and other fiscal levies mentioned above include VAT, commercial tax, income tax and corporate tax of Japanese nationals, resident tax, fuel tax, but not limited, which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract	during the Project	APORTIL	
7	To bear all the expenses, other than those to be borne by the Grant Aid, necessary for the Project implementation	during the Project	APORTIL	
8	To submit environmental monitoring report to JICA Timor-Leste Office	during the Project	APORTIL	

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#### 3. After the Project

NO	Items	Deadline	In charge	Ref.
1	To maintain and use properly and effectively the facilities constructed and equipment	After completion of the	APORTIL	
	provided under the Grant Aid	construction		
	1) Allocation of maintenance cost			
	<ol> <li>Operation and maintenance structure</li> </ol>			
	3) Routine/Periodic inspection			

### Major Undertakings to be covered by the Grant Aid

No	Items	Deadline	Cost Estimated (Million Japanese Yen)*	
1	To construct ferry terminal jetty and necessary facilities (or To procure equipment)			
	- Improvement of ferry terminal jetty			
	- Improvement of necessary facilities			
	<ol> <li>To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country</li> </ol>		XX.XX	
	a) Marine(Air) transportation of the products from Japan to the recipient country			
	b) Internal transportation from the port of disembarkation to the project site			
	2) To construct access roads			
	a) Within the site			
2	To implement detailed design, tender support and construction supervision		YYYY	
	(Consultant)	. 18.		
3	Contingencies		ww.ww	
	Total		ZZ.ZZ	

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<u>(Sample)</u>	
Project Monitoring Report	
on <u>Project Name</u>	
Grant Agreement No. <u>XXXXXXX</u>	

### **Organization Information**

Authority (Signer of the G/A)	Person in Charge Contacts	(Division) Address: Phone/FAX: Email:	-	
Executing Agency	Person in Charge Contacts	(Division) Address: Phone/FAX: Email:	-	
Line Ministry	Person in Charge Contacts	(Division) Address: Phone/FAX: Email:	-	

# **Outline of Grant Agreement:**

4

Source of Finance	Government of Japan: Not exceeding JPYmil. Government of ():
Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:

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### 1: Project Description

#### **1-1 Project Objective**

#### **1-2** Necessity and Priority of the Project

- Consistency with development policy, sector plan, national/regional development plans and demand of target group and the recipient country.

# **1-3** Effectiveness and the indicators

- Effectiveness by the project

#### 2: Project Implementation

#### 2-1 Project Scope

#### Table 2-1-1a: Comparison of Original and Actual Location

Location	Original: (M/D)	Actual: (P/Rand PCR)	
	Attachment(s):Map	Attachment(s):Map	

#### Table 2-1-1b: Comparison of Original and Actual Scope

Items	Original	Actual
(M/D)	(M/D)	(P/R and PCR)
	· · · ·	
		· · · ·
		-

(P/R and PCR)

#### 2-2 **Implementation Schedule**

#### 2-2-1 Implementation Schedule

#### Table 2-2-1: Comparison of Original and Actual Schedule

Itome	Original		Ashaal	
iteniis	DOD	G/A	Acital	
[M/D]	(M/D)		<i>(P/R,PCR)</i> As of (Date of Revision)	
			Please state not only the most updated schedule but also other past revisions chronologically.	
Project Completion Date*		-	· · · · · · · · · · · · · · · · · · ·	

\*Project Completion was defined as \_\_\_\_\_\_ at the time of G/A.

**2-2-2** Reasons for any changes of the schedule, and their effects on the project.

(P/R and PCR)	 
i de la companya de l	

#### 2-3 Undertakings by each Government

2-3-1 Major Undertakings

See Attachment 2.

2-3-2 Activities See Attachment 3.

#### 2-4 **Project** Cost

#### 2-4-1 **Project Cost**

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Table 2-3-1 Comparison of Original and Actual Cost by the Government of Japan (Confidential until the Tender)

		e render)		
	Cost (Million Yen)			
	Original	Actual	Original	Actual
Construction			<b>-</b>	
Facilities				
(or Equipment)				
Consulting	- Detailed design		······	
Services	-Procurement Management			
	-Construction Supervision		· · · ·	
· \	- 16 -	· · · ·	· · · · · · · · · · · · · · · · · · ·	

		 		* 171	ic prop	urvu		<b>.</b>
Total						-		
<b>N</b> T	<i>c</i>							

Note: 1) Date of estimation:

2) Exchange rate: 1 US Dollar = Yen

#### Table 2-3-2 Comparison of Original and Actual Cost by the Government of XX

Items			Cost (Million USD)			
	Original		Actual		Original	Actual
Total			I			

Note: 1) Date of estimation:

2) Exchange rate: 1 US Dollar = (local currency)

# **2-4-2** Reason(s) for the wide gap between the original and actual, if there have been any, the remedies you have taken, and their results.

(P/R, PCR)

#### 2-5 Organizations for Implementation

#### 2-5-1 Executing Agency:

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

**Original:** (*M*/*D*)

Actual, if changed: (*P*/*R* and *PCR*)

#### 2-6 Environmental and Social Impacts

Report based on the agreed environmental checklist and monitoring form (See Attachment 4)

#### 3: Operation and Maintenance (O&M)

#### 3-1 O&M and Management

- Organization chart of O&M

- Operational and maintenance system (structure and the

number ,qualification and skill of staff or other conditions necessary to maintain the outputs and benefits of the project soundly, such as manuals, facilities and equipment for maintenance, and spare part stocks etc)

Original: (*M*/*D*)

Actual: (PCR)

#### 3-2 O&M Cost and Budget

- The actual annual O&M cost for the duration of the project up to today, as well as the annual O&M budget.

**Original:** (*M*/*D*)

M

#### 4: Precautions (Risk Management)

- Risks and issues, if any, which may affect the project implementation, outcome, sustainability and planned countermeasures to be adapted are below.

Original Issues and Countermeasure(s): (M/D)					
Potential Project Risks	Assessment				
1. Probability: H/M/L					
(Description of Risk)	Impact: H/M/L				
	Analysis of Probability and Impact:				
	Mitigation Measures:				
	Action during the Implementation:				

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	Contingency Plan (if applicable):
2.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	<b>2</b>
	Action during the Implementation:
	Contingency Plan (if applicable):
3.	Probability: H/M/L
Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
Actual issues and Countermoscuro(c)	

# 5: Evaluation

#### 5-1 Overall evaluation

Please describe your evaluation on the overall outcome of the project.

(PCR)

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- 19 -

#### 5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

(PCR)

#### Attachment

- 1. Project Location Map
- 2. Undertakings to be taken by each Government
- 3. Monthly Report
- 4. Monitoring report on environmental and social considerations

# MINUTES OF DISCUSSIONS ON THE PREPARATORY SURVEY FOR THE PROJECT FOR URGENT SHIFT OF FERRY TERMINAL IN DILL PORT (EXPLANATION ON DRAFT PREPARATORY SURVEY REPORT)

On the basis of the discussions and field survey in the Democratic Republic of Timor-Leste (hereinafter referred to as "Timor-Leste") in July, 2015, and the subsequent technical examination of the results in Japan, the Japan International Cooperation Agency (hereinafter referred to as "JICA") prepared a draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") on the Project for urgent shift of ferry terminal in Dili Port (hereinafter referred to as "the Project").

In order to explain the Draft Report and to consult with the concerned officials of the Government of Timor-Leste on its contents, JICA sent to Timor-Leste the Preparatory Survey Team for the explanation of the Draft Report (hereinafter referred to as "the Team"), headed by Mr. Yoshimoto KOYANAGI, Deputy Director, Transportation and ICT Group, Infrastructure and Peacebuilding Department, JICA, from January 26 to 30, 2016.

As a result of the discussions, both sides confirmed the main items described in the attached sheets.

小柳桂泉

Mr. Yoshimoto Koyanagi Leader Preparatory Survey Team Japan International Cooperation Agency Japan

(Witnessed by)

Dili, January 29<sup>th</sup>, 2016

Mr. Constantino Ferreira Soares Presidente Adminstração dos Portos de Timor-Leste The Democratic Republic of Timor-Leste

Mr. Cancio de Jesus Oliveira Director Development Partnership Management Unit Ministry of Finance The Democratic Republic of Timor-Leste

#### ATTACHEMENT

#### 1. Objective of the project

The objective of the Project is to achieve a safer port operation by construction of new ferry jetty and necessary facilities, thereby contributing to better environment to port users.

#### 2. Project Site

Both sides confirmed that site of the Project is in Dili Port which is shown in Annex-1.

- Line Agency and Executing Agency Both sides confirmed the line agency and executing agency as follows:
- 3-1. The line ministry is Ministry of Public Works, Transport and Communications (MPWTC), which would be the agency to supervise the executing agency.
- 3-2. The executing agency is Adminstração dos Portos de Timor-Leste (APORTIL). The executing agency shall coordinate with all the relevant agencies to ensure smooth implementation of the Project and ensure that the Undertakings are taken by relevant agencies properly and on time. The Timor-Leste side explained to the Team that APORTIL has been reorganized as a financially independent entity responsible for operation and maintenance of port facilities from January 2016, and is an authorized agency for implementation of the Project including budgetary authority.
- 3-3. The organization chart is shown in Annex-2.
- 4. Contents of the Draft Report

After the explanation of the contents of the Draft Report by the Team, the Timor-Leste side agreed in principle to its contents.

#### 5. Cost Estimation

Both sides confirmed that the Project cost estimation described in Annex-3 is provisional and would be examined further by the Government of Japan for its final approval.

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#### 6. Confidentiality of the Cost Estimation and Specifications

Both sides confirmed that the Project cost estimation and technical specifications in the Draft Report should never be duplicated or disclosed to any third parties until all the contracts of the Project are concluded.

#### 7. Japan's Grant Aid Scheme

The Timor-Leste side understood the Japan's Grant Aid Scheme and its procedures as described in Annex-4, Annex-5 and Annex-6, and necessary measures to be taken by the Government of Timor-Leste.

#### 8. Project Implementation Schedule

The Team explained to the Timor-Leste side that the expected implementation schedule is as attached in Annex-7.

#### 9. Expected outcomes and Indicators

Both sides agreed that key indicators for expected outcomes are as follows. The Timor-Leste side has responsibility to monitor the progress of the indicators and achieve the target in year 2021.

Indices	Basis	Target (at 2021, three years
	(at 2014)	after completion of the
		Project)
Berthing hours of Ferry	3 hours per day	24 hours
(hours per day)		
Annual number of	Atauro: 21,634 passengers	Atauro: 28,392 passengers
Passenger	Oecussi: 44,036 passengers	Oecussi :70,985 passengers

[Quantitative Effect]

[Qualitative Effect]

(1) Direct effects

- > Improvement of safety for the passenger's embarkation and disembarkation
- > Safe berthing of ferry regardless the tide level
- ➤ User-friendly terminal with the passenger terminal close by
- The jetty reduces the deflection of the ferry during the approach to the terminal. As a result, flexibility in bunkering work will be highly increased.
- Better transportation services for people because of more flexible navigation schedule and larger transportation volume due to the double berthing jetty
- Contribution to the development of new international Ferry Routes because of the character of the ferry (Ro/Ro type) to be introduced from Portugal.

(2) In-direct effects

- Contribution to the economic development of the enclave, islands and the northern coast with increased commodity between the rural areas and the capital city
- Conducing the rural economic development as potential transportation measures for tourists which are expected to increase in the future
- Clear demarcation of the role of Dili Port as nodal port for the International tourists and for domestic ferry after transfer of cargo function to the new port in Tibar.
- 10. Undertakings Taken by Both Sides

Both sides confirmed undertakings described in Annex-8. The Timor-Leste side assured to take the necessary measures and coordination including allocation of the necessary budget which are preconditions of implementation of the Project. It is further agreed that the costs are indicative, i.e. at Outline Design level. More accurate costs will be calculated at the Detailed Design stage. Contents of Annex-8 will be updated as the Detailed Design progresses, and will finally be the Attachment to the Grant Agreement.

11. Monitoring during the Implementation

The Project will be monitored every six months during the project period by the executing agency using the Project Monitoring Report (PMR) described in Annex-9.

#### 12. Ex-Post Evaluation

JICA will conduct ex-post evaluation three (3) years after the project completion with respect to five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact, Sustainability) of the Project. Result of the evaluation will be publicized. The Timor-Leste side is required to provide necessary support for them.

#### 13. Schedule of the Study

JICA will complete the Final Report of the Preparatory Survey in accordance with the confirmed items and send it to the Timor-Leste side around May, 2016.

- 14. Environmental and Social Considerations
- 14-1 General Issues

#### 14-1-1 Environmental Guidelines and Environmental Category

The Team explained that "JICA Guidelines for Environmental and Social Considerations (April 2010)" (hereinafter referred to as "the Guidelines") is applicable for the Project. The Project is categorized as B because the Project is not located in a sensitive area, nor has it sensitive characteristics, nor falls it into sensitive sectors under the Guidelines, and its potential adverse impacts on the environment are not likely to be significant.

14-1-2 Environmental Checklist

The environmental and social considerations including major impacts and mitigation measures for the Project are summarized in the Environmental Checklist attached as Annex-10. Both sides confirmed that in case of major modification of the content of the Environmental Checklist, The Timor-Leste side shall submit the modified version to JICA in a timely manner.

- 14-2 Environmental Issues
- 14-2-1 Initial Environmental Examination (IEE)

The Timor-Leste side agreed to conduct the necessary procedures concerning the environmental assessment (including stakeholder meetings, Initial Environmental Examination (IEE) etc.) and submit required environmental report of the Project to the Ministry of Commerce, Industry and Environment, and the Timor-Leste side agreed to obtain the approval of the necessary environment document from Ministry of Commerce, Industry and Environment and submit it to JICA Timor-Leste Office preferably before the Cabinet approval of the Project by the Government of Japan which is scheduled around April, 2016.

14-2-2 Environmental Monitoring Plan

The Timor-Leste side agreed that monitoring for environmental and social considerations will be conducted by the responsibility of APORTIL in accordance with the Environmental Monitoring Plan described in the Draft Report. The results of monitoring will be provided to JICA Timor-Leste Office by filling in the Environmental Monitoring Form attached as Annex-11, during construction phase and after completion of the Project.

14-3 Information Disclosure of Monitoring Results

Both sides confirmed that the Timor-Leste side will disclose results of environmental and social monitoring to local stakeholders in their office and/or through their website.

The Timor-Leste side agreed that JICA will disclose results of environmental and

social monitoring submitted by the Timor-Leste side as the monitoring forms attach as Annex-11 on its website.

- 15. Other Relevant Issues
- 15-1. Operation and Maintenance of the Facilities

The team explained the importance of operation and maintenance of the facilities constructed by the Project considering that proper asset management impacts greatly on life-span of the facilities and its maintenance cost. The Timor-Leste side shall secure enough staff and budgets necessary for appropriate operation and maintenance of the facilities. The annual operation and maintenance costs are estimated and shown in Annex 12.

15-2. Safety Measures

To avoid accidents on site during the implementation of the Project, the Timor-Leste side agreed to cause the consultant and the contractor to enforce safety measures such as setting safety assurance to the site, providing information for security control to public, and deploying adequate security personnel, based on "The Guidance for the Management of Safety for Construction Works in Japanese ODA Projects" which has been published on JICA's URL below.

http://www.jica.go.jp/activities/schemes/oda\_safety/ku57pq00001nz4eu-att/guida nce\_en.pdf

#### 15-3. Misconduct

If JICA receives information related to suspected corrupt or fraudulent practices in the implementation of the Project, APORTIL and relevant organizations will provide JICA with such information as JICA may reasonably request, including information related to any concerned official of the government and/or public organizations of Timor-Leste.

APORTIL and relevant organizations will not, unfairly or unfavorably treat the person and/or company which provided the information related to suspected corrupt or fraudulent practices in the implementation of the Project.

15-4. Disclosure of Information

Both sides confirmed that the study results excluding the Project cost will be disclosed to the public after completion of the Preparatory Survey. All the study results including the project cost will be disclosed to the public after all the contracts for the Project are concluded.

15-5. Operation of Dili Port

The Timor-Leste side explained to the Team that they don't have any plan of

concession contract on the operation of Dili Port to any private company from other country and that Dili port will be operated by the Government of Timor-Lest (APORTIL).

15-6. Temporary Construction Yard, Borrow Pit and Disposal Site

The Timor-Leste side agreed to secure the temporary construction yard, borrow pit and disposal site near the Project site before tender notice of the Project and also agreed to demolish the blockage in the construction yard before commencement of the construction work with the coordination/adjustment with contractor(s).

15-7. Passenger Terminal

The Timor-Leste side explained to the Team about construction plan of passenger terminal and also explained that the passenger terminal will be completed by the end of the Project.

15-8. Progress of New Ferries

The Timor-Leste side explained to the Team about the progress of procurement of new ferries of which the ferry from Portugal and Germany will be deployed around the end of 2016 and mid-term of 2017 respectively.

15-9. Working Visa

Both sides agreed the necessary procedure for the issuance of Working Visa for all workers who will be engaged in the project, and agreed that both sides shall follow the required procedure and take necessary actions in a timely manner respectively.

- Annex-1 Project site
- Annex-2 Organization Chart
- Annex-3 Project Cost Estimation
- Annex-4 Japan's Grant Aid
- Annex-5 Flow Chart of Japan's Grant Aid
- Annex-6 Financial Flow of Japan's Grant Aid
- Annex-7 Project Implementation Schedule
- Annex-8 Major Undertakings to be taken by Each Government
- Annex-9 Project Monitoring Report (PMR)
- Annex-10 Environmental Checklist
- Annex-11 Environmental Monitoring Form
- Annex-12 Operation and Maintenance Cost

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Project Sites



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Layout plan

Ticketing booth

North
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#### Organization Chart



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Annex-3

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#### **Project Cost Estimation**

#### (1) Cost Borne by the Government of Japan

Description	Estimated Cost
	(million Yen)
Facilities	1,999
Detailed design and Construction supervision	132
TOTAL	2,131

#### (2) Cost Borne by the Government of Timor-Leste

Description	Estimated Cost (USD)	Converted to Japanese Yen (million JPY)
Land purchased fee	State property	-
Demolition of the blockage in the construction yard	19,500	2.42
Construction of New Ferry Terminal Building	1,036,700	128.24
Import tax for the everlasting construction materials (2.5%)	72,500	8.97
Necessary cost of Banking Arrangement	17,200	2.13
TOTAL	1,145,900	141.76

Notes:

- (1)The cost estimates in the above table are provisional and will be further examined by the Government of Japan for the approval of the Grant.
- (2) The total cost of the project JPY 141.76 million is equivalent to USD 1.15 million at the current exchange rate; USD 1.0=JPY 123.70

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- Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet

•Authority for Determining Implementation

- The Notes exchanged between the GOJ and a recipient country

Grant Agreement (hereinafter referred to as "the G/A")

- Agreement concluded between JICA and a recipient country
- Implementation
  - Implementation of the Project on the basis of the G/A

#### 2. Preparatory Survey

#### (1) Contents of the Survey

The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Outline Design of the Project is confirmed based on the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be

guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

#### (2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

#### (3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

#### 3. Japan's Grant Aid Scheme

#### (1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

#### (2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

#### (3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

#### (4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex.

#### (6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant Aid, to

assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant Aid.

#### (7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

- a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.
- b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

#### (9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

#### (10) Social and Environmental Considerations

A recipient country must carefully consider social and environmental impacts by the Project and must comply with the environmental regulations of the recipient country and JICA socio-environmental guidelines.

#### Annex-5

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Financial Flow of Grant Aid

Annex-6

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#### Annex-8

# Major Undertakings to be taken by Each Government

Maior	Undertakings to	) be taken b	v Recipient	Government
1.1.1.1.	• mere	,	J	00.01 mmont

1. Before the Tender

NO	Items	Deadline	In charge	Cost Estimated (USD)	Ref.
1	To obtain the approval of IEE	before the Project approval by Japanese Cabinet	APORTIL		
2	To open Bank Account (Banking Arrangement (B/A))	within 1 month after G/A	MPWTC		
3	<ul> <li>To secure lands</li> <li>1) temporary construction yard and stock yard near the Project area</li> <li>2) borrow pit and disposal site near the Project area</li> </ul>	within 1 month after G/A	APORTIL		
4	To obtain the planning, zoning, building permit	before tender notice	APORTIL		
5	To clear, level and reclaim the following sites when needed	before tender notice	APORTIL		
6	To determine the plan of passenger terminal building	before tender notice	APORTIL		

#### 2. During the Project Implementation

NO	Items	Deadline	In charge	Cost Estimated (USD)	Ref.
1	To bear the following commissions to a bank of Japan for the banking services based upon the B/A				
	1) Advising commission of A/P	within 1 month after the singing of the contract	MOF	17,200	
	2) Payment commission for A/P	every payment	APORTIL		
2	To issue the Working Visa for workers	before commencement of the Project	Ministry of Internal Affairs		
3	To construct the passenger terminal building	during the Project	APORTIL	1,036,700*1	
4	To demolish the blockage in the construction yard	before commencement of the construction work	APORTIL	19,500	
5	To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country	during the Project	APORTIL		-
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work	during the Project	APORTIL		
7	To bear the cost which is equivalent to the customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the Products and/or the Services, instead of tax exemption system. Such customs duties, internal taxes and other fiscal levies mentioned above include VAT, commercial tax, income tax and corporate tax of Japanese nationals, resident tax, fuel tax, but not limited, which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract	during the Project	APORTIL	72,500	
8	To bear all the expenses, other than those to be borne by the Grant Aid, necessary for the Project implementation	during the Project	APORTIL		
9	To submit environmental monitoring report to JICA Timor-Leste Office	during the Project	APORTIL		

\*1/ Cost of construction of passenger terminal is subject to change based on the design and BoQ (Bill of Quantity).

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#### 3. After the Project

NO	Items	Deadline	In charge	Cost Estimated (USD)	Ref.
1	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) Operation and maintenance structure 3) Routine/Periodic inspection	after completion of the construction	APORT'IL.	Refer to Annex-12	
2	To submit environmental monitoring report to JICA Timor-Leste Office	after completion of the construction	APORTIL		

# Major Undertakings to be covered by the Grant Aid

No	Items	Deadline	Cost Estimated (Million Japanese Yen)	Ref.
1	To construct ferry terminal jetty and necessary facilities (or To procure equipment)         - Improvement of ferry terminal jetty         - Improvement of necessary facilities         To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country         a) Marine(Air) transportation of the products from Japan to the recipient country         b) Internal transportation from the port of disembarkation to the project site	Before end of contract	1,999	
2	To implement detailed design, tender support and construction supervision (Consultant)	Before end of contract	132	

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Annex-9

# Project Monitoring Report On <u>Project Name</u> Grant Agreement No. <u>XXXXXXX</u> 20XX, Month

# **Organization Information**

Authority (Signer	Person in Charge	(Division)	-	
of the G/A)	Contacts	Address: Phone/FAX: Email:		
Executing Agency	Person in Charge Contacts	(Division) Address: Phone/FAX: Email:		
Line Agency	Person in Charge Contacts	(Division) Address: Phone/FAX: Email:	-	_ _ 

# **Outline of Grant Agreement:**

Source of Finance	Government of Japan: Not exceeding JPYmil. Government of ():
Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:

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# 1: Project Description

# 1-1 Project Objective

# 1-2 Necessity and Priority of the Project

- Consistency with development policy, sector plan, national/regional development plans and demand of target group and the recipient country.

# **1-3** Effectiveness and the indicators

- Effectiveness by the project

Quantitative Effect (Operation and Effect indicators)					
Indicators	Original (Yr	)	Target (Yr	)	
·					
Qualitative Effect					

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#### 2: **Project Implementation**

#### **Project Scope** 2-1

Table 2-1-1a: Comparison of Original and Actual Location

Location	Original: (M/D)	Actual: (PMR)
LUCATION	Attachment(s):Map	Attachment(s):Map

## Table 2-1-1b: Comparison of Original and Actual Scope

Items	Original	Actual
(M/D)	(M/D)	(PMR)
		Please state not only the most updated schedule but also other past revisions chronologically.
		All change of design shall be recorded regardless of its degree.

# **2-1-2** Reason(s) for the modification if there have been any.

(PMR)

#### **Implementation Schedule** 2-2

#### 2-2-1 **Implementation Schedule**

# Table 2-2-1: Comparison of Original and Actual Schedule

Thomas	Orig	ginal	A sturil
Items	DOD	G/A	Actual
[M/D]	(M/D)		<i>(PMR)</i> As of (Date of Revision)
'Soft component' shall be stated in the column of 'Items'.			Please state not only the most updated schedule but also other past revisions chronologically.
Project Completion Date*			
*Project Completion was d	efined as		at the time of $G/A$

oject Compre .

# **2-2-2** Reasons for any changes of the schedule, and their effects on the project.

- 2-3 Undertakings by each Government2-3-1 Major Undertakings
- See Attachment 2. 2-3-2 Activities

See Attachment 3.

2-4 Project Cost

# 2-4-1 Project Cost

# Table 2-4-1a Comparison of Original and Actual Cost by the Government of Japan (Confidential until the Tender)

	Items			Cost
			(Mill	ion Yen)
	Original	Actual	Original	Actual
Construction	'Soft component' shall be			Please state not
Facilities	included in 'Items'.			only the most
(or Equipment)				updated
				schedule but
				also other past
				revisions
				chronologically.
Consulting	- Detailed design			
Services	-Procurement			
	Management			
	-Construction Supervision	ļ		
Total				

Note: 1) Date of estimation:

2) Exchange rate: 1 US Dollar = Yen

# Table 2-4-1b Comparison of Original and Actual Cost by the Government of Sri Lanka

	Items		(Mill	Cost ion USD)
	Original	Actual	Original	Actual
				Please state not
				only the most
				updated
				schedule but
				also other past
				revisions
				chronologically.
Total	·	••••••••••••••••••••••••••••••••••••••		

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Note:	1) Date of estimation:		
	<ol><li>Exchange rate:</li></ol>	1 US Dollar =	(local currency)

**2-4-2** Reason(s) for the wide gap between the original and actual, if there have been any, the remedies you have taken, and their results.

(PMR)

## 2-5 Organizations for Implementation

## 2-5-1 Executing Agency:

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original: (M/D)

Actual, if changed: (PMR)

# 2-6 Environmental and Social Impacts

- The results of environmental monitoring as attached in Attachment 5 in accordance with Schedule 4 of the Grant Agreement.

- The results of social monitoring as attached in Attachment 5 in accordance with Schedule 4 of the Grant Agreement.

- Information on the disclosed results of environmental and social monitoring to local stakeholders, whenever applicable.

# 3: Operation and Maintenance (O&M)

# 3-1 O&M and Management

- Organization chart of O&M

- Operational and maintenance system (structure and the

number ,qualification and skill of staff or other conditions necessary to maintain the outputs and benefits of the project soundly, such as manuals, facilities and equipment for maintenance, and spare part stocks etc)

Original: (M/D)

Actual: (PMR)

# 3-2 O&M Cost and Budget

- The actual annual O&M cost for the duration of the project up to today, as well as the annual O&M budget.

Original: (M/D)

# 4: Precautions (Risk Management)

- Risks and issues, if any, which may affect the project implementation, outcome, sustainability and planned countermeasures to be adapted are below.

Original Issues and Countermeasure(s): (M/I	))
Potential Project Risks	Assessment
1.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
2.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:

	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
3.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
Actual issues and Countermeasure(s)	
(PMR)	

# 5: Evaluation at Project Completion and Monitoring Plan

# 5-1 Overall evaluation

Please describe your overall evaluation on the project.

# 5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

#### 5-3 Monitoring Plan for the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

- 1. Project Location Map
- 2. Undertakings to be taken by each Government
- 3. Monthly Report
- 4. Environmental Monitoring Form / Social Monitoring Form
- 5. Monitoring sheet on price of specified materials
- 6. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)

(Final Report Only)

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		Environmental	Main Chade Itama	Yes: Y	Confirmation of Environmental Considerations
	Calegory	Item	MALLI VIECE LETIS	$N_0:N$	(Reasons, Mitigation Measures)
	1. Permits and	(1) EIA and	(a) Have EIA reports been already prepared in	(a) N	(a) It is assumed that APORTIL will prepare EIS (Category
	Explanation	Environmental	official process?		A Project) or SEIS (Category B Project) by end of April
		Permits	(b) Have EIA reports been approved by	(P) N	2016.
			authorities of the host country's government?		(b) APORTIL will proceed and Environmental License will
			(c) Have EIA reports been unconditionally	(c) N	be issued by the end of June 2016.
			approved? If conditions are imposed on the		(c) EIS/SEIS meets the requirements of NDE, therefore,
			approval of EIA reports, are the conditions		any collateral condition may not be required.
			satisfied?	N (þ)	
			(d) In addition to the above approvals, have other		(d) Permit for construction works will be prepared by
			required environmental permits been obtained		APORTIL and obtained by the commencement of the
26			from the appropriate regulatory authorities of the		construction work.
3			host country's government?		
		(2) Explanation	(a) Have contents of the project and the potential	(a) N	(a) It is assumed that this project will be classified as
		to the Local	impacts been adequately explained to the Local		Category B Project, therefore, the public consultation to be
		Stakeholders	stakeholders based on appropriate procedures,		held at the stage of SEIS and EMP is not mandatory.
			including information disclosure? Is		APORTIL will discuss with NDE on the Public
			understanding obtained from the Local		Consultation to be held or not. After NDE will review the
			stakeholders?	(P) N	SEIS and EMP, then NDE may require to hold the public
			(b) Have the comment from the stakeholders		consultation.
			(such as local residents) been reflected to the		(b) Comments and opinion collected at Public Consultation
			project design?		will be replied by APORTIL and those comments will be
					taken into account, if necessary.
		(3) Examination	(a) Have alternative plans of the project been	(a) Y	(a) Review of alternative plans including environmental
		of Alternatives	examined with social and environmental		and social considerations matter has already carried out.
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Environmental Checklist : 10 Ports and Harbors

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Environmental	Checklist : 10. Ports	and Harbors		
Cotorown	Environmental	Main Chaols Itams	Yes: Y	Confirmation of Environmental Considerations
Calegory	Item	INTALLY CITECLY LUCILLS	No : N	(Reasons, Mitigation Measures)
		considerations?		
2. Pollution	(1) Air Quality	(a) Do air pollutants, such as sulfur oxides (SOx),	(a) Y	(a) Field survey was conducted prior to the commencement
Control		nitrogen oxides (NOx), and soot and dust emitted		of construction work, all items clear the criteria.
	-	from ships, vehicles and project equipment		During construction and operation, number of vessels and
		comply with the country's emission standards?		vehicles will be increased, however, the impact to air
		Are any mitigating measures taken?		quality is minimal. During construction, water splay and
				tire cleaning facility will be provided and inspection and
				maintenance of engines for vessels and vehicles will be
				conducted for the improvement of exhausted gas quality.
	(2) Water Quality	(a) Do effluents from the project facilities comply	(a) Y	(a) Related facility (passenger terminal building) will be
		with the country's effluent and environmental		constructed and sewerage facility and rainwater drainage
		standards?		which meet the environmental quality standard will be
			(b) Y	provided. Present water quality clear the standard of
		(b) Do effluents from the ships and other project		Indonesia because local environmental quality standard
		equipment comply with the country's effluent and		has not been issued yet.
		environmental standards?		(b) Timor-Leste does not have own quality standard for
				discharge water and water quality, however, MARPOL
			(c) Y	(Annex IV), Marine Pollution Prevention Act 2008 and
		(c) Does the project prepare any measures to		other international agreements are applied.
		prevent leakages of oils and toxicants?		(c) Fuel supply to working vessels and construction
			N (P)	machine will be conducted in accordance with the
		(d) Does the project cause any alterations in		requirements of working procedural manual and project
		coastal lines and disappearance/appearance of		contractor must prepare the action plan for oil spill.
		surface water to change water temperature or		(d) Reclamation is not necessary, and the jetty and platform

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Environmental	Checklist: 10. Ports	and Harbors	•	
Catorom	Environmental	Main Chools Itoms	Yes: Y	Confirmation of Environmental Considerations
valegory	Item		$N_0: N$	(Reasons, Mitigation Measures)
		quality by decrease of water exchange or changes	(e) N	is supported by steel pipe piles and concrete piles,
		in flow regimes?		therefore, seawater exchange will not occur.
		(e) Does the project prepare any measures to		
		prevent polluting surface, sea or underground		(e) Reclamation is not necessary.
		water by the penetration from reclaimed lands?		
	(3) Wastes	(a) Are wastes generated from the ships and other	(a) Y	(a) Wastes are collected by APORTIL and disposed of at
		project facilities properly treated and disposed of		public landfill.
		in accordance with the country's regulations?		
		(b) Is offshore dumping of dredged soil properly	(b) Y	
		disposed in accordance with the country's		(b) In case dredging work is necessary, pollution prevention
		regulations?		membrane must be installed to prevent spreading muddy
			(c) Y	water. Dredged material must be dumped at authorized
		(c) Does the project prepare any measures to		offshore dumping area.
		avoid dumping or discharge toxicants?		(c) It is not planned that any hazardous substance is used.
				In case hazardous substance is used in this project, project
				contractor must prepare the procedural manual for
				handling hazardous substance and the operation must be
				carried out according to the procedural manual.
	(4) Noise and	(a) Do noise and vibrations from the vehicle and	(a) Y	(a) Level of noise and vibration clear the Indonesian
	Vibration	train traffic comply with the country's standards?		criteria because Timor-Lest does not have local criteria.
				Japanese criteria is used for forecasting the level of noise
				and vibration during piling work.
	(5) Subsidence	(a) In the case of extraction of a large volume of	(a) N	(a) Groundwater is not pumped up.
		groundwater, is there a possibility that the		

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	Catagory	Environmental	Main Charly Itama	Yes: Y	Confirmation of Environmental Considerations
	Vategury	Item	MALL CLECK LICHTS	No : N	(Reasons, Mitigation Measures)
			extraction of groundwater will cause subsidence?		
		(6) Odor	(a) Are there any odor sources? Are adequate odor	(a) Y	(a) In case dredging work is necessary, dredged material
			control measures taken?		may generate bad smell. If the bad smell is tremendous,
					some measure to neutralize ammonia is taken.
		(7) Sediment	(a) Are adequate measures taken to prevent	(a) Y	(a) MARPOL (Annex IV), Marine Pollution Prevention Act
			contamination of sediments by discharges or		2008 and Waste Management Act 2010 are applied,
			dumping of hazardous materials from the ships		therefore, vessels and related facilities do not dispose/dump
			and related facilities?		pollutant to the seawater.
	3. Natural	(1) Protected	(a) Is the project site located in protected areas	(a) N	(a) Protected area does not exist around the proposed
	Environment	Areas	designated by the country's laws or international		project area.
29			treaties and conventions? Is there a possibility		
)			that the project will affect the protected areas?		
		(2) Ecosystem	(a) Does the project site encompass primeval	(a) N	(a) There are not primary forest, tropical natural forest,
_			forests, tropical rain forests, ecologically valuable		important labitat of coral, mangrove, wetland, tidal
			habitats (e.g., coral reefs, mangroves, or tidal		wetland, etc. around the project site, however, coral which
			flats)?		is classified as Near Threatened (NT) is found at the area
					about 1,000 meters to north from the project site, and
					countermeasures to prevent giving impact due to
				N (q)	construction work on the coral above must be provided.
			(b) Does the project site encompass the protected		(b) There is not any important habitat for precious species
			habitats of endangered species designated by the		around project site.
			country's laws or international treaties and	(c) Y	
			conventions?		(c) There is no concern to give impact on ecological system,
_			(c) If significant ecological impacts are		however, visual observation must be conducted to find any
L	J.				

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	Category	Environmental Item	Main Check Items	Yes: Y No : N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
<u> </u>			anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	А (Р)	spreading of muddy water. When working vessel will be imported from foreign country, ship bottom cleaning prior to the mobilization and verification upon arrival must be carried out to prevent adventive to come in.
			(d) Is there a possibility that the project will adversely affect aquatic organisms? Are adequate measures taken to reduce negative impacts on aquatic organisms?	(e) N	<ul> <li>(d) Ditto above</li> <li>(a) No immediation and wild</li> </ul>
			(e) Is there a possibility that the project will adversely affect vegetation or wildlife of coastal zones? If any negative impacts are anticipated, are adequate measures taken to reduce the impacts on vegetation and wildlife?		animals.
<u> </u>		(3) Hydrology	<ul> <li>(a) Do the project facilities affect adversely flow regimes, waves, tides, currents of rivers and etc. if the project facilities are constructed on/by the seas?</li> </ul>	(a) N	(a) Jetty and platform are supported by steel pipe piles and concrete piles, therefore, ferry mooring facility does not give negative impact on flow condition, wave and tida current.
		(4) Topography and Geology	<ul> <li>(a) Does the project require any large scale changes of topographic/geographic features or cause disappearance of the natural seashore?</li> </ul>	(a) N	(a) Change of topography and geology and cease of natura seashore will not occur.
4	Social	(1) Resettlement	(a) Is involuntary resettlement caused by project	(a) N	(a) to (j) No land acquisition nor involuntary resettlement

Confirmation of Environmental Considerations (Reasons, Mitigation Measures)	occur because the project area is under the control of	APORTIL.																						
Yes: Y No : N		ŕ		(q)			(c) N				N (P)		(e) N	( <del>I</del> ) N				(g) N		(lh) N			(i) N	_
Main Check Items	implementation? If involuntary resettlement is	caused, are efforts made to minimize the impacts	caused by the resettlement?	(b) Is adequate explanation on compensation and	resettlement assistance given to affected people	prior to resettlement?	(c) Is the resettlement plan, including	compensation with full replacement costs,	restoration of livelihoods and living standards	developed based on socioeconomic studies on	resettlement?	(d) Are the compensations going to be paid prior	to the resettlement?	(e) Are the compensation policies prepared in	document?	(f) Does the resettlement plan pay particular	attention to vulnerable groups or people,	including women, children, the elderly, people	below the poverty line, ethnic minorities, and	indigenous peoples?	(g) Are agreements with the affected people	obtained prior to resettlement?	(h) Is the organizational framework established to	properly implement resettlement? Are the
Environmental Item																								
Category	vironment												-											

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vironmental Main Check Items Yet Item Item Capacity and budget secured to implement the (j) plan? capacity and budget secured to implement the (j) plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established? (j) Is the grievance redress mechanism established? (j) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) (b) Is there a possibility that changes in water uses (including fisheries and recreational uses) in the surrounding areas due to project will adversely affect the living conditions of inhabitants? (c) Is there a possibility that port and harbor facilities will adversely affect the surrounding areas? (d) Is there a possibility that the surrounding areas? (d) Is there a possibility that the surrounding areas? (d) Is there a possibility that the surrounding areas? (d) Is there a possibility that the surrounding areas? (d) Is there a possibility that the surrounding areas? (d) Is there a possibility that the surrounding areas? (d) Is there a possibility that the surrounding areas? (d) Is there a possibility that the surrounding areas? (d) is there a possibility that the surrounding areas? (d) is there a possibility that the surrounding areas? (d) Is there a possibility that the surrounding areas? (d) Is there a possibility that the surrounding areas? (d) is there a possibility that the surrounding areas? (d) is there a possibility that the surrounding areas? (d) is there a possibility that the surrounding areas?	project.	project.	(d) Any population inflow is i project.	N (d) Any population inflow is not	(c) Same as (a)	Y (c) Same as (a)			(b) There is no impact on the usage of wa	N surrounded residents.	minor. Work schedule is informed o	the number of vehicle is not many and ]	work may impact the traffic of surroundir	Y (a) During construction work, vehicles						7	: N (Reasons, Mitigation Mea	SY Confirmation of Environmental Co
Item Item iving and lihood	intectious diseases, such as HIV WILDE prought due to immigration of workers associated with the project? Are considerations given to public health, if necessary?	infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are considerations given to public health, if necessary?	(d) Is there a possibility that diseases, including infectious diseases, such as HIV will be brought	traffic and road traffic in the surrounding areas? (d) 1 (d) Is there a possibility that diseases, including	(c) Is there a possibility that port and harbor facilities will adversely affect the existing water	adversely affect the livelihoods of inhabitants? (c) (c) Is there a possibility that port and harbor	the surrounding areas due to project will	uses (including fisheries and recreational uses) in	(b) Is there a possibility that changes in water	(P) 1	to reduce the impacts, if necessary?	inhabitants? Are adequate measures considered	adversely affect the living conditions of	(a) Is there a possibility that the project will $(a)$	established?	(j) Is the grievance redress mechanism	impacts of resettlement?	(i) Are any plans developed to monitor the	plan?	capacity and budget secured to implement the (j) N	No INTALLI CILCUL LICENS	Main Charle Itoms
Category En [2] I.ive													Livelihood	(2) Living and							Category Item	Catagory Bnvironmental

' 						I
		Environmental		Yes: Y	Confirmation of Environmental Considerations	
	Category	Item	Main Cneck Items	$N_0$ : $N$	(Reasons, Mitigation Measures)	
		(3) Heritage	(a) Is there a possibility that the project will	(a) N	(a) There is no legacy nor historical places around the	
			damage the local archeological, historical,		project site.	
			cultural, and religious heritage? Are adequate			
			measures considered to protect these sites in			
			accordance with the country's laws?			
		(4) Landscape	(a) Is there a possibility that the project will	(a) N	(a) The area for this project is within the existing port area	
			adversely affect the local landscape? Are		therefore, it is assumed that the project has no negative	
			necessary measures taken?		impact on the landscape.	
		(5) Ethnic	(a) Are considerations given to reduce impacts on	(a) N	(a) and (b) The ethnic minority and indigenous people does	
		Minorities and	the culture and lifestyle of ethnic minorities and	N (q)	not exist around the project area and the fishery rights	
33		Indigenous	indigenous peoples?		does also not exist because the project area locates within	
3		Peoples	(b) Are all of the rights of ethnic minorities and		the existing port area.	
			indigenous peoples in relation to land and			
		-	resources respected?			
		(6) Working	(a) Is the project proponent not violating any laws	(a) Y	(a) Local regulations are observed.	
		Conditions	and ordinances associated with the working			
			conditions of the country which the project			
			proponent should observe in the project?			
			(b) Are tangible safety considerations in place for	(p) Y	(b) Safety measures, such as wearing life jackets (when	
			individuals involved in the project, such as the		working on the sea) and installing life float, safety fence	
			installation of safety equipment which prevents		and caution sign are planned.	
			industrial accidents, and management of			
A			hazardous materials?	(c) Y		
5	9		(c) Are intangible measures being planned and		(c) It is planned to provide the safety and health training to	

Environmental Checklist : 10. Ports and Harbors

onmental Checklist: 10. Ports and Harbors

	Confirmation of Environmental Considerations	(Reasons, Mitigation Measures)	understand the situation and make the negative impact	minimal.	(a) It is not assumed that the project has impact on	groundwater system (lowering of water level and	salination) and ground settlement due to usage of	groundwater.						(b) The project lies at northern side and central part of the	island of Timor-Leste, it is not assumed that the impact	caused by the project has cross-border impact.			
	Yes: Y	$N_{O}: N$			(a) N								N (q)						
s and Harbors	Main Chaol: Hama	MALIN CLIECK TREILS			(a) Where necessary, impacts on groundwater	hydrology (groundwater level drawdown and	salinization) that may be caused by alteration of	topography, such as land reclamation and canal	excavation should be considered, and impacts,	such as land subsidence that may be caused by	groundwater uses should be considered. If	significant impacts are anticipated, adequate	mitigation measures should be taken.	(b) If necessary, the impacts to transboundary or	global issues should be confirmed, if necessary	(e.g., the project includes factors that may cause	problems, such as transboundary waste	treatment, acid rain, destruction of the ozone	layer, or global warming).
Checklist : 10. Ports	Environmental	Item			Note on Using	Environmental	Checklist												
Environmental	Cotomont.	vategury																	

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# **MONITORING FORM (Before and during construction work)**

# 1. Responses/Actions to Comments and Guidance from Government Authorities and

#### the Public

Monitoring Item	<b>Monitoring Results during Report Period</b>
Responses/Actions to Comments and	
Guidance from Government Authorities	
Number and contents of comments made by	
stakeholders	
Number and contents of responses made by	
project proponent	

## 2. Mitigation Measures

#### Air Quality, Ecological System

Schedule	Condition of air quality, dust, ecological system, etc. by visual observation	Judgement, countermeasure
1st day		
2nd day		
3rd day		

In case any unusual situation of air quality is identified during visual observation, the following quality survey is implemented.

# - Air Quality (Emission Gas / Ambient Air Quality)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country' s Standard s	Referred Internationa I Standards	Remarks (Measuremen t Point, Frequency, Method, etc.)
SO <sub>2</sub>	µg/Nm 3	max.365/24hour s	max.900/hou r	N.A.	Indonesia	
NO <sub>2</sub>	µg/Nm 3	max.150/24hour s	max.400/hou r	N.A.	Indonesia	
CO	µg/Nm 3	max.10,000 /24hours	max.30,000 /hour	N.A.	Indonesia	
O <sub>3</sub>	µg/Nm	-	max.235/hou r	N.A.	Indonesia	

Y,

Dust (TSP	µg/Nm	max.230/24hour s	-	N.A.	Indonesia	
)						
HC	µg/Nm	max.160/3hours		N.A.	Indonesia	
Pb	µg/Nm	max.2/24hours	-	N.A.	Indonesia	

# Water Quality (by Visual Observation)

Schedule	Rain fall	Condition of water pollution	Condition of rain fall and drainage	Judgement, countermeasur e
1st day	yes/no			
2nd day	yes/no			
3rd day	yes/no			
•				

In case any unusual situation of water quality is identified during visual observation, the following quality survey is implemented.

#### Water Quality

Schedule	Item	Unit	Sample	Sample -2	Sample -3	Sample -4	Sample -5	*Criteria	Adjudica- tion
1 <sup>st</sup> day	Turbidity	NTU						Max. 5	
-	pH	-						7-8.5	
(Date)	Total	mg/L						0.1	
	nitrogen								
	Total	mg/L						0.015	
	phosphate	-							
	COD	mg/L						-	· · ·
	Oil &	mg/L			***			-	
•	grease								
	Total	mg/L						Max. 20	
	suspended								
	solids								
3 <sup>rd</sup> day	Turbidity	NTU						Max. 5	
	pH	-						7-8.5	
(Date)	Total	mg/L						0.1	
	nitrogen								
	Total	mg/L						0.015	
	phosphate								
	COD	mg/L				*************		-	
	Oil &	mg/L						<b>–</b> .	
	grease	-							
	Total	mg/L				***********		Max. 20	
	suspended								
	solids								
5 <sup>th</sup> day	Turbidity	NTU						Max. 5	
-	pН	-						7-8.5	
(Date)	Total	mg/L						0.1	
	nitrogen	Ŭ							
	Total	mg/L						0.015	
	phosphate	<sup>-</sup>							
	COD	mg/L						_	
	Oil &	mg/L							
	grease								
	Total	mg/L			**********	*******		Max. 20	
	*********	********			37	**********		*******	
1									K
-									p

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Schedule	Item	Unit	Sample -1	Sample -2	Sample -3	Sample -4	Sample -5	*Criteria	Adjudica- tion
	suspended solids								
7 <sup>th</sup> day	Turbidity	NTU						Max. 5	
	pH	-						7-8.5	
(Date)	Total nitrogen	mg/L						0.1	
	Total phosphate	mg/L						0.015	
	COD	mg/L						-	
	Oil & grease	mg/L						-	
	Total suspended solids	mg/L		-				Max. 20	

 solids
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#### Waste (within construction area)

Schedule	Contents	Quantity (m <sup>3</sup> )	Disposal method
1st day			
2nd day			
3rd day			
•			

#### Soil pollution

Schedule	Description of work	Yes/No of soil pollution	Mitigation method
1st day			
2nd day			
•			

## Noise / Vibration

Item (unit)	Measur ed value (average )	Measure d value (max)	Local standar d	Internatio nal standard referred	Frequenc y (during piling work)	Metho d	Measuring point
Noise level (dB)			NA	80 (7AM-7P M)	10 min.	Noise level meter	Border of lot
Vibratio n level (dB)			NA	70 (7AM-7P M)	Twice/day	Vibratio n meter	Border of lot

Note : Japanese standard of Ministry of Land, Infrastructure, Transport and Tourism is

\$ ¥

referred as International standard for noise and vibration.

Schedule	Description of work	Yes/No of odor	Mitigation method
1st day			
2nd day			

#### Odor

# 3. Natural Environment

#### - Ecosystem

Monitoring Item	Monitoring Results during Report Period
Negative effects/Actions to Valuable species	To be carried out together with Air Quality
	visual observation

## 4. Social Environment

Monitoring item	Item	Method	Frequenc y	Condition during reporting period
Resettlement	Not Applicab	le		
Livelihood	Traffic jam,	Visual	Once/wee	
	noise,	observation	k	
	vibration	and hearing		
Working environment	Implementatio n status of management of safety and health	Verification of monthly	Once/month	
Accident	Implementatio n status of management of safety and health	Verification of monthly accident report	Once/month	

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# **MONITORING FORM (During operation)**

# 1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Responses/Actions to Comments and	
Guidance from Government Authorities	
Number and contents of comments made by	
stakeholders	
Number and contents of responses made by	
project proponent	

#### 2. Social environment

Monitoring item	Item	Method	Frequency	Condition during reporting period
Accident	Implementation status of management of safety and health,	Verification of monthly accident report	Once/month	
	Safe traffic line of passengers			

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# **Operation and Maintenance Cost**

Item	Yearly Maintenance Cost	Periodical Maintenance Cost	Incidental Investment Cost
Overall Facilities	US\$3,600		
Jetty, Platform		US10,000/3 year	Concrete repair cost
Movable Ramp		US\$5,200/2 year	Repair cost for structural damage
Rubber Fender			US\$25,000/set (when damaged)
Bollard	US\$100		
Navigation Aids			
Lighting facility			US\$70/lamp (change)
Water supply & Hydrant	US\$100		
CCTV System			US\$50/No. (Camera) US\$200/No. (Monitor) US\$450/set (DC power source) (all for replace)
TOTAL	US\$3,800		

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£ \$

# 5. 参考資料

#### 5-1 フェリー利用者ヒアリング調査結果

#### 5-1-1 調査概要

ナクロマ利用客に対して下記の内容でヒアリング調査を実施した。

- ① 日 時:2015年7月21日(月) 13:00~17:00
- ② 場 所:ディリ港東側ゲート付近
- ③ ヒアリング人数:100名
- ④ ヒアリング項目:表 5-1 に示すヒアリング調査シートを作成して実施した。

#### 表 5-1 ヒアリング調査シート

) 4 <i>) 18 / ± )</i>	· · · · · · · · · · · · · · · · · · ·		· •] -	- / / [8]/	前且以	Japanes	· ·	
ヤヤ: 別	ロ男 ロ女	年齢			国籍	□東ディ <sup>2</sup> □インド <sup>2</sup> □その他(	Eール ネシア	)
住: 所	ロディリ Cオエクシ ロその他( )				職業	□学生 □白営業 □その他(	□会社員 □豊業	j )
利用目的	□仕事 □ 商川 □ 帰郷 □ 買い物 □旅行 □ その他( )				同伴者 見送り		<b>弁</b> 名	4 4
自動車利用か?	□YES □NO	自動車の	和類	口乗川車 口その他	E □トラ 1(	ック ロオ	~- トバイ	)
積荷の種類	□食料品 □衣料 □その他(	出口目	用雑貨	口学用。	品 口医药	製品 口嗜女	ŦijĹ	)
1ヶ月当たりの利用回数		2回 [	]3回	$\Box 4$	J 🗆 5	5回以上(	田)	
乗船に問題はないか?			□ YE:	s	□NO			
どの様な時が問題か?	<ul> <li>ーチケット購入が</li> <li>一乗船までの待合</li> <li>一乗船までにどの</li> <li>一連行時間の遅延</li> <li>一その他</li> </ul>	が難しい。 今場所がな いくらい時	□ い。 間がか	チケット  かるか?(	購入に時間	閉がかかる。 時間)		)
危険を感じたことはあるか?			ΠYE	8	□NO			
どの様な時か?	<ul> <li>□ 乗船までの通路</li> <li>□ 自動車の通行</li> <li>□ その他</li> </ul>	トロラ ロラ	ンプウ ンテナ	ェイから) の荷役機	70乗り込み 滅	9.時		
フェリーターミナルにあってほしい 設備はあるか?	<ul> <li>□待合室 □洗面</li> <li>□駐車場 □バイ</li> <li>□その他</li> </ul>	所 口売 ク置場	古 □ □川発	公衆電話 、到着時	□食堂 間掲示板	□授乳室	□遊威施	ī設 〕
その他、粟望はあるか?								

ディリ港フェリーターミナル利用者 (ディリ⇒オエクシ間)調査表 —Japanese—

#### 5-1-2 調査結果

ヒアリング調査結果をグラフ化して、図 5-1~5-2 に示す。

ナクロマ利用者の年齢は、21~23 歳が約 40%を占め、国籍はほぼ東ティモールでありディリ かオエクシの住居者が利用している。利用者の職業は、学生、会社員及び農業の順となっている。 利用目的は、帰郷が約 40%を占め、旅行、仕事の順となっている。同伴人数は、1~3 人が過半 数をしめている。見送り人数は、過半数がなしで、1~3 人程度である。モーターバイク利用者 は、全体の 25%で、1ヶ月当たりの利用回数は、1~2 回が約 85%である。

乗船時の問題点は、約 80%の人が問題ありと回答しており、待合室がない点とチケット購入 の難しさをあげている。乗船時に感じる危険としては、乗船までの通路、ランプウェイからの乗 り込み時及び自動車の通行をあげている。また、フェリーターミナルへの要望施設は、待合室、 出発・到着時間掲示板、洗面所、食堂及び授乳室の整備の要望が多い。

その他の回答の得られた要望を下記に示す。

- ・質の高い新しい港湾を建設して、施設、スタッフを増やして、健康のための良い環境が非常に 重要です。
- ・小さな庭を組み入れた快適な空間を創って下さい。
- ・旅客需要が現在非常に多いので、必要に応じて、フェリーをもう1隻建造して下さい。
- ・緊急事態に対応する、応急手当の為に治療とスタッフのためにスペースを確保して下さい。
- ・船内の混雑、狭い車道と待合室がないことが問題です。
- ・フェリーの運行と乗客が満足する様な、質の高い新しい港を建設して下さい。
- ・スタッフを増員すれば、乗客は彼らから情報を簡単に得られます。コンテナの一時置場として
   ターミナル地域を使わないで下さい。
- ・施設を増やして、良いシステムを構築して下さい。
- ・施設を増やして下さい。そして、安全装置システムを含む港湾システムは、国際標準でなけ ればなりません。
- ・可能であれば、オエクシ港と同じ様な新しい港湾を建設して下さい。そして、オエクシ港と同様な駐車場システムを造ってください。
- ・新しい港湾とフェリーターミナビルディングを作って下さい。そして、フェリーをもおう1隻 加えて下さい。
- ・港湾施設とターミナル設備を増やして、すべての乗客の為のスペースを確保して下さい。
- ・港湾施設(例えば乗降客用ターミナルと駐車場)を建設することを、国際社会に問います。
- ・コンテナ置き場と分離した待合室を含むすべての港湾港施設を増やしてください。










図 5-1 ヒアリング調査結果(1)









図 5-1 ヒアリング調査結果(2)





図 5-2 ヒアリング調査結果



ナクロマ係留状況



ゲート外待機状況



ヒアリング状況(1)



ヒアリング状況(2)



モーターバイク乗船状況



ゲート付近乗船券確認状況



旅客ゲート内徒歩状況



旅客乗船状況

調査時写真

#### Annex 1

表-1	性別		
性			
男	42 人		
女 女	58 人	表-8 見送り	人数
合計	100 人	見送り人数	
表-2	年齢	なし	55 人
年		1人	17 人
0~10 歳	<u>п</u> р	2人	15 人
11~20 歳	18 Å	<u>3</u> 人	7人
21~30 歳	10 火 39 人	<u>4</u> λ	<u>4 人</u>
31~40 歳	25 Å	5人以上	<u> </u>
41~50 歲	12 Å		<u>100 人</u>
51~60 歳			100 / 1
<u>51 00 歳</u> 61~70 歳	1 Å	自動車利用	-17 L
71~80 告			23 1
→ 卦	100 1		77 k
<u> 日 印</u> <u> </u>	100 八 		100 1
(1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	<u>当 和</u>		の利用同数
宙ティエール	<u>不同</u> Q& 人	1 た日当たりの利田同	<u>~~/雨/雨回冢</u> ]数
ホノイレール インドネシア	<u> </u>	1回	61 k
イントホンク			<u>01 八</u> 23 人
る計	2八		3 1
			<u> </u>
	工 ///	5 미나 년	2 1
ディル	19 1	J 回火上 Total	<u>2 八</u> 100 人
ノイソ	46 八		100 八
スエリン	30 八	2011 木加村の 垂����の問題占	问愿示
その他	10人	木加村の问题示	<b>Q1</b> Å
			<u>- 10 人</u>
2015	w 木 業		100 Å
一 一 一 一			問題占
<u></u> 一 一 工 一 一 一 工	<u></u>		间遮示
	29 /	千万ット購入が難しい	60 Å
日 西 未 	<u>0八</u> 10人	チケット購入に時間がかかる	<u>37</u> 人
辰木	19 / 8 /	手がするのなる家がない	<u>61 k</u>
会社	100	************************************	<u>04 八</u> 36 人
<u></u> 日 印 表-6 利	<u></u>	運行時間の遅延	23 Å
利田		その仲	
一	コロリ 16 人	表-13 6降を感じ	<u>、 ころか?</u>
	<u>10 八</u> 5 人	合除を成じるか?	
	30 1	成じろ	41 Å
買い物	<u></u>	感じない	<u>59</u> 人
族行	<u> </u>		100 1
その曲	20 X		- 100 八
		合陥を成じる状能	
日 四 四 四 四 四 四 四 四 四 四 四 四 四 四 四 四 四 四 四	人数	乗船主での通路	32 人
הדונייו ואל	31 1	ランプウェイからの乗り込み	<u></u> 29 人
、 、 、 、 、 、 、 、 、 、 、 、 、 、	<u>17 人</u>	時	<i>277</i>
9 k	24 Å	自動車の通行	27 人
3 λ	<u></u> 11 人	コンテナの荷役機械	17人
	8 Å	その他	<u>2 人</u>
5人以上	<u> </u>		- / 、
合計	100 人		

フェリーターミナルにあってい	ましい設備
待合室	96 人
洗面所	65 人
売店	34 人
公衆電話	29 人
食堂	47 人
授乳室	48 人
遊戯施設	6人
駐車場	21 人
モーターバイク置場	30 人
出発、到着時間掲示板	78 人
その他	0人

表-15 フェリーターミナルにあってほしい設備

#### 5-2 波浪条件解析結果

計画地は海面擾乱が発生しやすい地形であり、十分な波浪解析を行なって設計波浪条件を設定 する必要があるため、今回実施した深浅測量成果により長期間の波浪推算結果を用いて①計画す る桟橋等の設計波浪の設定と②計画地での静穏度解析の検討を行なった。

計画対象地点の設計波浪の推算

NOAA(アメリカ海洋大気庁)(35 か年間)をもとに、計画地の設計波浪条件を解析する。 検討フローを図 5-2 に示す。

② 計画対象地点での静穏度解析

5か年間の波浪推算をもとに、設計対象フェリーの利用限界波高に係る静穏率の算定を実施 する。検討フローを図 5-3 に示す。





図 5-3 静穏度検討フロー

#### 5-2-1 波浪解析

### 5-2-1-1 自然条件

# 5-2-1-1-1 地形・深浅測量

ディリ港付近の海図は、British Admiralty Paper Charts 942A 及び 3296 である。これらの海図を 図 5-4~図 5-6 に示す。また、深浅測量の結果を図 5-7 に示す。同図によれば、海底勾配は、汀 線(±0.0m) ~-10.0m で急激に落ち込んでおり、1:2 程度となっている。-10.0m から沖側の海 底勾配についても急で、1:10~1:20 となっている。



図 5-4 海図 942A (Timor 島近海抜粋)



図 5-5 海図 3296



図 5-6 海図 3296



図 5-7 地形深浅測量図及び桟橋設計予定付近の水深

#### 5-2-1-1-2 風

NOAA (アメリカ海洋大気局) におけるディリ港近郊の推算地点は、図 5-8 に示す通り、地点 M2 (南緯 8°、東経 125.5°) 及び地点 M3 (南緯 8.5°、東経 125.5°) である。



図 5-8 DILI 近郊推算地点 (NOAA)

図 5-9 及び表 5-2 に各地点での再解析データ(NOAA)の風配図、頻度表を示す。地点 M3 ではティモール島の影響を受けるので地点 M2 に対し風速は弱くなるが、風向は年間を通じ、同様の傾向にある。





表	5-2	風頻度表	(期間:	1980年1	月~2014	年12	月)
---	-----	------	------	--------	--------	-----	----

地点 M2																	Observed Missing Calm	10227
Wind Direction Wind Sneed(m/s)	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	ŴSW	W	WNW	NW	NNW	N	Total	(0.1%)
-4.99	2386	2431	3073	3888	5431	4908	3114	1966	2129	2956	4294	4641	4442	3750	3089	2470	54968	(537
5.00- 9.99	500	886	2387	4742	13198	12957	921	23	33	278	1967	3888	2469	804	713	625	46391	(453
10.00- 14,99			1	42	221	56	1		- 1		53	310	131	15	5		835	(8
15.00- 19.99			1								-	2	2				4	(0
20.00-	11.7 - 3					1	11 1		()							1	0	(0
Total	2886	3317	5461	8672	18850	17921	4036	1989	2162	3234	6314	8841	7044	4569	3807	3095	102198	
(0.1%) 地点 M3	(28)	(32)	(53)	(84)	(184)	(175)	(39)[	(19)	(21)	(31)	(61)	(86)	(68)	(44)	(37)	(30)	(999) Observed	102272
(0.1%) 地点 M3	(28)	(32)	(53)	(84) E	ESE	(175)	(39)  SSE	(19)	(21)	(31) SW	(61)	(86) W	(68)	(44)	(37)	(30)	(999) Dbserved Missing Calm	102272 0 122 (0.1%)
(0.1%) 地点 M3 Wind Direction Wind Speed(m/s)	(28)	(32) NE 4664	(53) ENE 6700	(84) E. 8051	(184) ESE 11465	(175) SE 18387	(39)  SSE 7142	(19) S	(21) SSW 1482	(31) SW 2093	(61) WSW 4457	(86) W	(68)	(44) NW	NNW 4374	(30)	(999) Diserved Missing Calm Total	102272 0 122 (0.1%) (947)
(0.1%) 地点 M3 Wind Direction Wind Speed(m/s) -4.99	NNE 4290	(32) NE 4664 334	(53) ENE 6200	(84) E 8051 604	ESE 11465	(175) SE 18387 817	(39)[ SSE 7142 40	(19) S 1818	(21) SSW 1482	(31) SW 2093	(61) WSW 4457 229	(86) W 6633	WNW 6223 652	(44) NW 5059	NNW 4374	(30) N 4518 62	(999) Dbserved Missing Calm Total Y6856 5290	102272 0 122 (0.1%) (947) (51)
(0.1%) 地点 M3 Wind Direction Wind Speed(m/s) -4.99 5.00- 9.99	(28) NNE 4290 96	(32) NE 4664 334	(53) ENE 6200 609	(84) E 8051 604	ESE 11465 618	(175) SE 18387 817	(39)] SSE 7142 40	(19) 5 1818 1	(21) SSW 1482	(31) SW 2093 9	(61) WSW 4457 229	(86) W 6633 1055	WNW 6223 652	(44) NW 5059 123	NNW 4374 41	(30) N 4518 62	(999) Diserved Missing Calm Total 96856 5290	102272 0 122 (0.1%) (947) (51)
(0.1%) 地点 M3 Wind Direction Wind Speed(m/s) -4.99 5.00- 9.99 10.00- 14.99	(28) NNE 4290 96	(32) NE 4664 334	(53) ENE 6200 609	(84) E 8051 604	ESE 11465 618	(175) SE 18387 817	(39)] SSE 7142 40	(19) S 1818 1 ,	(21) SSW 1482	(31) SW 2093 9	(61)1 WSW 4457 229 1	(86) W 6633 1055 3	WNW 6223 652	(44) NW 5059 123	NNW 4374 41	(30) (1) (30) (1) (30) (1) (30) (1) (1) (1) (1) (1) (1) (1) (1) (1) (1	(999) Diserved Missing Calm Total 96856 5290 4	102272 0 122 (0.1%) (947) (51) (0)
(0.1%) 地点 M3 Wind Direction Wind Speed(m/s) -4.99 5.00- 9.99 10.00- 14.99 15.00- 19.99	NNE 4290 96	(32) NE 4664 334	(53) ENE 6200 609	(84) E 8051 604	ESE 11465 618	(175) SE 18387 817	(39) SSE 7142 40	(19) 5 1818 1	\$\$\$W 1482	(31) 5W 2093 9	(61) WSW 4457 229 1	W 6633 1055 3	WNW 6223 652	(44) NW 5059 123	(37) NNW 4374 41	(30)	(999) Dbserved Missing Total 706856 5290 4 0	102272 0 122 (0.1%) (947) (51) (0) (0)
(0.1%) 地点 M3 Wind Direction Wind Speed(m/s) -4.99 5.00- 9.99 10.00- 14.99 15.00- 19.99 20.00-	(28)	(32) NE 4664 334	(53) ENE 6200 609	E 8051 604	ESE 11465 618	(175) SE 18387 817	(39)	(19) 5 1818 1	(21) SSW 1482	(31) SW 2093 9	(61) WSW 4457 229 1	W 6633 1055 3	WNW 6223 652	(44) NW 5059 123	(37) NNW 4374 41	(30)	(999) Dbserved Missing Total 70tal 96856 5290 4 0 0 0	102272 0 122 (0.1%) (947) (51) (0) (0) (0)

#### 5-2-1-1-3 波浪

波浪は、風の再解析データの M2、M3 地点における、NOAA による推算結果を利用した。図 5-10 ~図 5-11、表 5-3~表 5-8 に NOAA による推算結果の頻度図表を示す。同図表によれば地点 M2 はアロル島とティモール島の間からインド洋のうねりが来襲していることが分かる。また、 ウェタル島の影響のためか、NNE~ENE の出現頻度がきわめて少なくなっている。



図 5-10 頻度分布図(地点 M2)



図 5-11 頻度分布図(地点 M3)

	Month	198001-20	11412 All month	3													-1	Observed	102253	(99.98)
Wave	Direction:	All directic	urs.	2														Missing	19	(0.02)
Wave Period(s)		3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0		[
Nave Height(m)	2.9	3.9	4.9	5.9	6.9	7.9	0.00	9.6	10.9	6.11	12.9	13.9	14.9	15.9	16.9	17.9	18.9	1	Total	Exceedance
- 0.24	(111)	1558 (1.52)	518 (0.51)	(0.04)	(0.02)	1 (000)	(0.02)	35 (0.03)	490 (0.48)	2905 (2.84)	4617 (4.52)	4714 (4.61)	3452 (3.38)	2219	1286 (1.26)	744 (0.73)	183 (0.18)	247 (0.24)	24182 (23.65)	102253
0.25 - 0.49	8092 (1.91)	7250 (7.09)	5179 (5.06)	538 (0.53)	65 (0.06)	23 (0.02)	(0.00)	6 (10.0)	32 (0.03)	582 (0.57)	1984 (1.94)	3945 (3.86)	4586 (4.48)	3390 (3.32)	2029 (1.98)	1023	400 (0.39)	372 (0.36)	39501 (38.63)	78071 (76.35)
0.50 - 0.74	765 (0.75)	16965 (16.59)	2950 (2.89)	2025 (1.98)	(0.10)	20 (0.02)	(10.0)		1 (00:0)		(000)	(0.09)	442 (0.43)	802 (0.78)	645 (0.63)	321 (0.31)	125 (0.12)	86 (0.08)	25350 (24.79)	38570 (37.72)
0.75 - 0.99	4 (0.00)	3983 (3.90)	3357 (3.28)	1526 (1.49)	553 (0.54)	26 (0.03)	(10:0)				1 (0.00)			3 (000)	31 (0.03)	28 (0.03)	8 (10.0)	12 (0.01)	9539 (9.33)	13220 (12.93)
1.00 - 1.24		8 (001)	763	588 (0.58)	624 (0.61)	48 (0.05)	4 (000)							Ĭ				ĺ	2035	3681
1.25 - 1.49			54	284	409	65	6 (100)												821	1646
1.50 - 1.74			1 (0.00)	(0.07)	201 (0.20)	134 (0.13)	8 (0.01)												419 (0.41)	825 (0.81)
1.75 - 1.99				(0.00)	87 (0.09)	121 (0.12)	1 (000)												214 (0.21)	406 (0.40)
2.00 - 2.24					33 (0.03)	88 (0.0)	6 (0.01)												127 (0.12)	192 (0.19)
2.25 - 2.49					(10.0)	30 (0.03)	8 (0.01)												45 (0.04)	65 (0.06)
2.50 - 2.74					71 6-01	13	1 (00 0)												14	20
2.75 - 2.99						1 (000)	3 (000)												4	9
3.00 - 3.24						100.01	2 (0.00)												2 (000)	2 (0.00)
3.25 - 3.49							(Analy)												0 00 0)	0
3.50 - 3.74																			0	0
3.75 - 3.99																			0	0 000)
4.00 - 4.24																			0000	0 000
4.25 - 4.49																			0 00 0)	0 (00 0)
4.50 - 4.74																			0.00)	0(000)
4.75 - 4.99																			0(000)	0(000)
5.00 - 5.24																			0 (000)	0(000)
5.25 - 5.49																			0(000)	0(00:0)
5.50 - 5.74																			0(000)	0(00)
5.75 - 5.99																			0(000)	0(000)
6.00 -							Ī												0(000)	0(000)
Total	9995 (9.77)	29764 (29.11)	12822 (12.54)	5085 (4.97)	2096 (2.05)	570 (0.56)	78 (0.08)	44 (0.04)	523 (0.51)	3487 (3.41)	6607 (6.46)	8748 (8.56)	8480 (8.29)	6414 (6.27)	3991	2116 (2.07)	716 (0.70)	717 (0.70)	102253 (100.00)	
Exceedance	102253 (100.00)	92258 (90.23)	62494 (61.12)	49672 (48.58)	44587 (43.60)	42491 (41.55)	41921 (41.00)	41843 (40.92)	41799 (40.88)	41276 (40.37)	37789 (36.96)	31182 (30.49)	22434 (21.94)	13954 (13.65)	7540 (7.37)	3549 (3.47)	1433 (1.40)	717 (0.70)		

# 表 5-3 地点 M2 波高·周期頻度表

Wana Disaston																			ſ
Water Halahrfeil	NNE	NE	ENE	ш	ESE	SE	SSE	s	MSS	SW	WSW	M	WNW	WS.	MNN	z.	CAM	Total	Exceedance
- 0.24	100	57 (0.06)	149 (0.15)	94	(0.19)	118 (0.12)	58 (0.00)	27.	25. (0.02)	20862	207 (0.20)	254 (0.25)	838 (0.82)	352 (0.34)	445 (0.44)	397 (0.39)	0 (0.00)	24182 (23.65)	102253 (100.00)
0.25 - 0.49	304	216 (0.21)	610	2021	4625	1593	153	20	23	18383	423	1080	4776	1738	1880	1656		39501	78071
0.50 - 0.74	8	8	152	3264	11472	2134	15	I	2	2518	134	652	3098	724	568	600		25350	38570
	(0.01)	(10'0)	(0.15)	1376	(11.22) 4802	(2,09)	(0.01)	(00'0)	(00.00)	(2.46) 84	(£1.0)	(0,64)	(3.03)	(0.71)	(0.56)	(65.0)		(24.79) 9539	(37.72) 13220
66'0 - 22'0	(00.0)		(10.01)	(1,35)	(4.70)	(0.26)				(0.08)	(0.0)	(0.37)	(06'1)	(0.28)	(0,19)	(0,15)		(533)	(12.93)
1.00 - 1.24			(000)	(0.14)	422 (0.41)	(10.0)					(0.01)	218 (0.21)	1012 (0.99)	(0.11)	51 (0.05)	53 (0.05)		2035	3681 (3.60)
1.25 - 1.49				T. Carlor	28	In the					10	127	199	42	32	23		821	1646
1.24				10.00	(00'0)	(00.00)					10.01	121	318	mon y	14	0,020		410	805
1.50 - 1.74											(00.0)	(0.07)	(0.31)	(10.0)	(10.0)	(10.0)		(15.0)	(18.0)
1.75 - 1.99												20 (0.02)	(0.19)					214 (0.21)	406 (0.40)
2.00 - 2.24												13	114					127	192
01.0 - 20.0												710/01	45					45	05
													(0'04)					(10.04)	(90'0)
250 - 2.74													(00.01)					(0,01)	(0,02)
2.75 = 2.99													10.001					10 005	6 (0.01)
3.00 - 3.24													2					2	2
1. 10 2.40													100'05					0	0
21-0 pro-0																		(00'0)	(00'0)
3.50 - 3.74																		(000)	(00'0)
3.75 - 3.99																		0 (0.00)	0(000)
4.00 - 4.24																		0 001	0 000
4.25 - 4.49																		0	0
4.50 - 4.74																		0	0
4.75 - 4.99																		0	0
- 20 - 20																		(0.00)	(00.00)
\$7.0 - 0.0°C																		(00.0)	(00'0)
5.25 - 5.49																		(00.0)	(00.0)
5.30 = 5.74																		0(0.00)	0(000)
5,25 - 5.99																		0(0)	0.00)
6,00																		(0.00)	0(000)
Total	414 (0.40)	281 (0.27)	918 (0.90)	6908	21548	4119 (4.03)	226 (0.22)	48 (0.05)	50 (0.05)	41847 (40.92)	836- (0.82)	2812 (2.75)	12912 (12.63)	3258	3189	2887 (2.82)	(00,0)	102253	

5-18

# 表 5-4 地点 M2 波高·波向頻度表

	Month: Point:	198001-20 DILI(M2)	1412 All months														Observed Calm Missing	102253	(99.98) (0.00) (0.02)
Wave Direction	NNE	NE	ENE	(11	ESE	SE	SSE	S	SSW	SW	MSM	W	MNM	MN	MNN	Z	CAM	Total	Exceedance
Wave Period(s)																			
- 2.99	282 (0.28)	209 (0.20)	484 (0.47)	1391 (1.36)	2729 (2.67)	(1.07)	191 (0.19)	48 (0.05)	47 (0.05)	(0.09)	253 (0.25)	423 (0.41)	397 (0.39)	519 (0.51)	1081 (1.06)	(0.74)	0(000)	9995 (9.77)	102253 (100.00)
3.00 - 3.99	84 (0.08)	44 (0.04)	159 (0.16)	4643 (4.54)	16109 (15.75)	2962 (2.90)	35 (0.03)		3 (0.00)	15 (0.01)	267 (0.26)	879 (0.86)	2130 (2.08)	1150 (1.12)	798 (0.78)	486 (0.48)		29764 (29.11)	92258 (90.23)
4.00 - 4.99	46 (0.04)	21 (0.02)	104 (0.10)	866 (0.85)	2702 (2.64)	60 (0.06)					189 (0.18)	662 (0.65)	4978 (4.87)	1228 (1.20)	955 (0.93)	1011 (0.99)		12822 (12.54)	62494 (61.12)
5.00 - 5.99	1 (0.00)	4 (0.00)	81 (0.08)	(10.0)	8 (0.01)	No. A sol					6 (10.0)	419 (0.41)	3370 (3.30)	335 (0.33)	309 (0.30)	542 (0.53)		5085 (4.97)	49672 (48.58)
6:00 - 6:99	1 (0.00)	3 (0.00)	(10.07) 17	(0.00)								264 (0.26)	1599 (1.56)	26 (0.03)	42 (0.04)	89 (0.09)		2096 (2.05)	44587 (43.60)
7.00 - 7,99			17 (0.02)									126 (0.12)	419 (0.41)		4 (0.00)	4 (0.00)		570 (0.56)	42491 (41.55)
8.00 - 8.99			2 (0.00)							12 (0.01)	(10.01)	38 (0.04)	19 (0.02)					78 (0.08)	41921 (41.00)
9.00 - 9.99										41 (0.04)	3 (0.00)							(10,04)	41843 (40.92)
10.00 - 10.99										507 (0.50)	16 (0.02)							523 (0.51)	41799 (40.88)
11.00 - 11.99										3464	22	In only						3487	41276
12.00 - 12.99										(6.45) (6.45)	15	Innon						6607 (6.45)	37789
13.00 - 13.99										8738	10 01							8748	31182
14.00 - 14.99										8462 (8.28)	18 (0.02)							8480	22434
15.00 - 15.99										6405 (6.26)	6 (10.0)							6414 (6.27)	13954 (13.65)
16.00 - 16.99										3984	7 (0.01)							3991 (3.90)	7540
17.00 - 17.99										2108 (2.06)	8 (0.01)							2116 (2.07)	3549 (3.47)
18.00 - 18.99										715 (0.70)	(0.00)							716 (0.70)	1433 (1.40)
- 00.61										715 (0.70)	2 (0.00)							717 (0.70)	717 (0.70)
1																			
4																			
1																			
4																			
ą.			l													1			
1																			
-+-																			
Total	414 (0.40)	281 (0.27)	918 (0.90)	(92) (6.76)	21548 (21.07)	4119 (4.03)	226 (0.22)	48 (0.05)	50 (0.05)	41847 (40.92)	836 (0.82)	2812 (2.75)	12912 (12.63)	3258 (3.19)	3189 (3.12)	2887 (2.82)	0 (00.00)	102253 (100.00)	
Exceedance	102253 (100.00)	101839 (99.60)	101558 (99.32)	100640 (98.42)	93732 (91.67)	72184 (70.59)	68065 (66.57)	67839 (66.34)	(66.30)	67741 (66.25)	25894 (25.32)	25058 (24.51)	22246 (21.76)	9334 (9.13)	6076 (5.94)	2887 (2.82)	0 (00.0)		

# 表 5-5 地点 M2 周期・波向頻度表

5-19

(0.00)	Fundance	Excention	100342 (100.00)	14675 (14.62)	1231	98	11	0	0(000)	0(000)	0	0 000)	0000	0000	0000)	0 (00 0)	000)	0000)	0000)	0(00)	0(00)	0(000)	0(00)	0(00)	000)	0000)	0 00)		
1930	Tand	10,041	85667 (85.38)	13444	1145	75	11	0	00(0)	0 (000)	00(0)	0 000)	0 (000)	0000	0000)	0 00	00(0)	0 000)	0 (000)	00(0)	0000)	0 (000)	(000)	00(0)	0 (000)	0 (000)	(000)	(100.00)	
Calm	19,0		427 (0.43)																									427 (0.43)	427 (0.43)
	18.0	18.9	237 (0.24)																									237 (0.24)	664 (0.66)
	17.0	17.9	776 (0.77)										T	1														(116 (0.77)	1440
	16.0	16.9	1102			1							t	1	-													(1.10)	2542 (2.53)
	15.0	15.9	1291		F	-		T	-				t	1	F													1291 (1.29)	3823
	14.0	149	1796 (1.79)		-	-			-				t	T														1796 (1.79)	5629 (5.61)
	130	13.9	1592 (1.59)	2 (0.00)		-							t		-													1594 (1.59)	7223 (7.20)
	12.0	12.9	(1.06)											1														(1.06)	8286 (8.26)
	011	611	531 (0.53)		-	T							T	T													17	531 (0.53)	(8.79)
	10.0	10.9	(0.18)		1																							182 (0.18)	(8.97)
	0.6	6.6	124 (0.12)																									124 (0.12)	9123
	80	68	295 (0.29)	1 (0.00)	8 (00)	5 .000	10000						T	T														307 (0.31)	9430
	10	7.9	102 (0.10)	138	134	3	(0000)							-														375 (0.37)	9805 (8.77)
	6.0	6.9	547 (0.55)	763	34								F	1														1344 (1.34)	(11.11)
	20	6.9	2528 (2.52)	423		1							t	T														2951 (2.94)	14100
	4.0	6.4	5393 (5.37)	(002)	2 (0.00)	21	(100)						1															5446 (5.43)	19546 (19.48)
HOLDOLID II	3.0	3.9	5975 (8.95)	954 (0.95)	798	37	(600)						T															7764 (7.74)	(27.22)
rection A	1	29	61706 (61.50)	11119	169	11	1000						T	-														73032 (72.78)	100342
Wave D	Wave Period(s)	Vave Height(m)	- 0.24	0.25 - 0.49	0.50 - 0.74	0.75 - 0.99	1.00 - 1.24	1.25 - 1.49	1.50 - 1.74	1.75 - 1.99	2.00 - 2.24	225 - 249	2.50 - 2.74	2.75 - 2.99	3.00 - 3.24	325 - 3.49	350 - 374	3.75 - 3.99	4.00 - 4.24	4.25 - 4.49	4.50 - 4.74	4.75 - 4.99	5.00 - 5.24	5.25 - 5.49	5,50 - 5,74	5,75 - 5,99	- 00.9	Total	Exceedance

### 表 5-6 地点 M3 波高·周期頻度表

	Point:	DILIGENIS	All month														Calm	0	(00.00)
																	Missingl	1930	(68.1)
Wave Direction	NNE	NE	ENE	ы	ESE	SE	SSE	90	NSS	SW	WSW	N	WWW.	NW.	ANN	z	CAM	Total	бугоодалсо
- 0.24	3867 (3.85)	3599 (3.59)	5150 (5.13)	8048 (8.02)	10286 (10.25)	7478 (7.45)	2158 (2.15)	234 (0.23)	21 (0.02)	(6.17)	3766 (3.75)	5901 (5.88)	11141 (11.10)	5260 (5.24)	5911 (5.89)	6660 (8.64)	0(000)	85667 (85.38)	100342 (100.00)
0.25 - 0.49	326 (0.32)	592 (0.59)	1456 (1.45)	2407 (2,40)	2441 (2.43)	1186 (1.18)	195 (0.19)	(0.00)	1 (0.00)	4 (0.00)	64 (0.06)	1224 (1.22)	2885 (2.88)	316 (0.31)	92 (0.09)	250 (0.25)		13444 (13.40)	14675 (14,62)
0.50 - 0.74		2 (0.00)	32 (0.03)	62 (0.06)	131 (0.13)	60(0)	12 (0.01)				15 (0.01)	384 (0.38)	426 (0.42)	14 (0.01)	(0.00)	1 (0.00)		1145 (1.14)	1231 (1.23)
0.75 - 0.99			(0.00)	4 (0.00)	7 (0.01)	2 (0.00)	1 (0.00)					27 (0.03)	33 (0.03)					75 (0.07)	(60,0)
1.00 - 1.24												(0.01)						11 (0.01)	11 (0.01)
1.25 - 1.49																		0 (0.00)	0(00(0)
1.50 - 1.74																		0(00)	0 (000)
1.75 - 1.99																		0 (0.00)	0(000)
2.00 - 2.24																		0 00)	0 (00 00)
2.25 = 2.49																		0.00)	0(000)
2.50 - 2.74																		0 00)	0 (00)
2.75 - 2.99																		0 (00)	0 (0 00)
3,00 - 3.24																		0 (0.00)	0 (0.00)
3,25 - 3,49																		0.00)	0(000)
3.50 - 3.74																		0 (000)	0(0.00)
3.75 - 3.59																		0(00'0)	0(0(0)
4.00 - 4.24																		0(00)	0(00)
4.25 - 4.49																		0 (01.00)	0(0.00)
4.50 - 4.74																		0.00)	(0,00)
4.75 - 4.99																		0(0.00)	0(00)
5.00 - 5.24																		0 (0.00)	0(00)
5.25 - 5.49																		0(00)	0(0.00)
5,30 - 5,74																		0(00)	(00'0)
5.75 - 5.99																		0(0.00)	0(0.00)
6,00 -																		0(00)	0 (0.00)
Total	4193 (4.18)	4193 (4.18)	6639 (6.62)	10521 (10.49)	12865 (12.82)	8731 (8.70)	2366 (2.36)	239 (0.24)	22 (0.02)	(6191	3845 (3.83)	7547 (7,52)	14485 (14.44)	5590 (5.57)	6004 (5.98)	(6.89)	0(0.00)	100342 (100.00)	

### 表 5-7 地点 M3 波高·波向頻度表

5-21

	Point:	DILI(M3)	All months														Calm	0	(00.00)
																	Missing	1930	(1.89)
Wave Direction Wave Period(s)	NNE	NE	ENE	ш	ESE	SE	SSE	s	SSW	WS	WSW	W	WNW	MN	MNN	z	CAM	Total	Exceedance
- 2.99	4193 (4.18)	4177 (4.16)	6491 (6.47)	10206 (10.17)	12526 (12.48)	8531 (8.50)	2312 (2.30)	205 (0.20)	21 (0.02)	33 (0.03)	246 (0.25)	3620 (3.61)	5218 (5.20)	3130 (3.12)	5238 (5.22)	6885 (6.86)	0 (0.00)	73032 (72.78)	100342 (100.00)
3.00 - 3.99		16 (0.02)	148 (0.15)	315 (0.31)	339 (0.34)	200 (0.20)	54 (0.05)	34 (0.03)	1 (0.00)	4 (0.00)	202 (0.20)	3016 (3.01)	2247 (2.24)	864 (0.86)	320 (0.32)	4 (0.00)		7764 (7.74)	27310 (27.22)
4.00 - 4.99		1			The second		10000	10 as by	14 4 10	N 20 0	93 (0.09)	658 (0.66)	3310 (3.30)	1063 (1.06)	302 (0.30)	20 (0.02)		5446 (5.43)	19546 (19.48)
5.00 - 5.99											8 (0.01)	133 (0.13)	2273 (2.27)	427 (0.43)	108 (0.11)	2 (0.00)		2951 (2.94)	14100 (14.05)
6:00 - 6:99											5 (0.00)	64 (0.06)	1151 (1.15)	92 (0.09)	32 (0.03)			1344 (1.34)	11149 (11.11)
7.00 - 7.99										1 (0.00)	44 (0.04)	40 (0.04)	273 (0.27)	13 (0.01)	4 (0.00)			375 (0.37)	9805 (9.77)
8.00 - 8.99										139 (0.14)	143 (0.14)	11 (0.01)	13 (0.01)	1 (0.00)	inner			307 (0.31)	9430 (9.40)
9.00 - 9.99										21 (0.02)	96 (0.10)	4 (0.00)		1				124 (0.12)	9123 (9.09)
10.00 - 10.99										(0.08)	103 (0.10)	Janata V						182 (0.18)	(8.97)
11.00 - 11.99										374 (0.37)	157 (0.16)							531 (0.53)	8817
12.00 - 12.99										806	256 (0.26)	1 (0.00)						1063	8286 (8.76)
13.00 - 13.99										1175	419 (0.42)	SOUTO						1594	7223 (7.20)
14.00 - 14.99										1241 (1.24)	555 (0.55)							1796 (1.79)	5629 (5.61)
15.00 - 15.99										874 (0.87)	417 (0.42)	Ĩ						1291 (1 29)	3833 (3.82)
16.00 - 16.99										660	442 (0.44)							1102	2542 (7 53)
66'11 - 00'11										442 (0.44)	334 (0.33)							776 (0.77)	1440
18.00 - 18.99										118 (0.19)	119 (0.12)							237 (0.24)	664 (0.66)
- 00.61										224 (0.22)	203 (0.20)							427 (0.43)	427 (0.43)
ł																			
ł																			
ŀ																			
ł																			
-																			
Total	4193 (4.18)	4193 (4.18)	6639 (6.62)	10521 (10.49)	12865 (12.82)	8731 (8.70)	2366 (2.36)	239 (0.24)	22 (0.02)	6191 (6.17)	3845 (3.83)	7547 (7.52)	14485 (14.44)	5590 (5.57)	6004 (5.98)	(6.89)	0 (0.00)	100342 (100.00)	
Exceedance	100342 (100.00)	96149 (95.82)	91956 (91.64)	85317 (85.03)	74796 (74.54)	61931 (61.72)	53200 (53.02)	50834 (50.66)	50595 (50.42)	50573 (50.40)	44382 (44.23)	40537 (40.40)	32990 (32.88)	18505 (18.44)	12915 (12.87)	(6.89)	0 (0.00)		

### 表 5-8 地点 M3 周期·波向頻度表

# 5-2-1-1-4 潮位

ディリ港の潮位は、現地再委託調査結果より、表 5-9の値とする。

名称	潮 位
大潮平均高潮面 High Water Spring (HWS)	+ 2.8 m
平均高高潮位面 Mean Higher High Water (MHHW)	+ 2.3 m
平均低高潮位面 Mean Lower High Water (MLHW)	+1.8 m
平均水面 Mean Sea Level (MSL)	+ <b>1</b> .4 m
平均高低潮位面 Mean Higher Low Water (MHLW)	+1.0 m
平均低低潮位面 Mean Lower Low Water (MLLW)	+0.4 m
大潮平均低潮面 Low Water Spring	$\pm 0.0$ m
最低水面 Chart Datum (CD)	$\pm 0.0~{ m m}$

表 5-9 潮位表

出典: Kepanduan Bahari Indonesia Wilayah III (Bahari Indonesia Scout Region III, Page 183), Indonesian Navy 2013

### 5-2-1-2 確率波の検討

### 5-2-1-2-1 波の確率波

(1) 年最大値の算出

波浪資料より、各地点における波向別年最大波を算出し、表 5-10 及び表 5-11 に整理した。 表 5-10 は、地点 M2 における波向別年最大波である。NNE~ENE 方向では、抽出下限値を 0.75m としたとき、最大値の抽出が少ないため抽出下限値を 0.3m とした場合の波向別年最大波も算出 した。表 5-11 は地点 M3 における波向別年最大波である。抽出下限値は全方向で 0.3m としてい る。

# 表 5-10 波向別年最大波(地点 M2)

				設計波外	対象方向													設計波対	橡方向	
曲	条件		0.3m 以上									0.75m	n 以上							
	波向	22.5	45	67.5	22.5	45	67.5	90	112.5	135	157.5	180	202.5	225	247.5	270	292.5	315	337.5	360
取得年月		NNE 0.2	NE	ENE 0.10	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW 0.2	NW	NNW 0.95	N 0.77
198010	T	1.95	2.4	3.39	-	-	-	5.01	494	-	-	-	-	17.77	-	5.97	7.25	5.63	5.41	5.05
198112	н	0.46	0.38	0.66	-	-	-	1	114	-	-	-	-	0.85	0.88	1.72	2.39	1.67	1.18	1.03
198112	т	2.67	2.71	7.76	-	-	-	4.63	435	-	-	-	-	17.45	4.03	6.21	8.07	5.91	6.4	6.07
198210	н	0.6	0.43	0.69	-	-	-	1.14	107	0.89	-	-	-	0.76	-	1.08	1.92	1.33	-	-
198210	т	3.08	2.77	3.52	-	-	-	4.47	432	3.82	-	-	-	21.48	-	6.87	6.38	5.64	-	-
198311	н	0.58	0.42	0.52	-		-	1.42	125	0.96	-			0.78		-	0.87	0.83	1.54	1.6
198311	T H	5.82	2.72	2.79	-	-	-	4.91	454	4.15	-	-	-	17.93	-	1.45	3.76	4.01	5.73	7.12
198412	T	2.81	2.99	3.12	-	-	-	4.48	461	4.43	-	-	-	-	-	5.73	5.58	5.19	5.23	-
198510	н	-	0.39	0.54	-	-	-	1.21	123	0.87	-	-	-	0.9	-	1.36	2.44	1.13	0.93	-
198510	т	-	2.56	2.92	-	-	-	4.8	471	3.73	-	-	-	16.99	-	7.76	6.97	4.63	3.85	-
198611	н	0.35	0.33	0.7	-	-	-	1.22	114	0.81	-	-	-	-	-	1.71	2.5	0.8	-	-
198611	т	2.35	2.5	3.32	-	-	-	4.77	437	3.78	-	-	-	-	-	7.91	7.35	4.96	-	-
198712	н	0.43	0.54	0.85			0.85	1.16	111	0.76		-			0.77	1.43	2.29	1.65	0.98	1.04
198712	н	2.52	5.21	3.66	-	-	3.66	4.6	439	3.94	-	-	-	- 0.79	3.95	5.71	6.93	0.45	5.68	6.35
198812	т. Т	2.5		3.35			-	4.11	442	3.84				18.14	4.3	5.55	6.56	5.86	5.13	
198911	н	-	0.36	0.48	-	-	-	0.94	0.9.9	0.83	-	-	-	-	1.34	1.28	2.26	0.91	-	-
198911	т	-	2.42	2.85	-	-	-	4.22	396	3.82	-	-	-	-	5.07	5.2	7.33	6.29	-	-
199012	н	0.44	0.52	0.63	-	-	-	1.03	101	-	-	-	-	0.82	1.12	1.56	1.36	0.99	0.85	1.05
199012	T	2.54	2.83	3.19	-	-	-	4.28	426	-	-	-	-	18.7	4.41	5.69	6.36	5.79	5.66	6.33
199112	н 	0.42	0.34	0.54				1.06	098	-						1.33	1.69	1.48	1.32	1.19
199212	н	0.45	0.43	0.62	-	-	-	1.03	104	0.82	-	-	-	0.92	-	1.05	1.49	1.22	0.96	1.06
199212	т	2.69	2.91	3.13	-	-	-	4.36	437	4.1	-	-		18.55	-	4.36	5.46	5.02	4.5	5.56
199312	н	0.93	0.33	1.06	0.93	-	1.06	1.2	1.4.9	1.3	-	-	-	0.86	1.1	2.14	2.88	1.47	1.34	0.9
199312	т	4.99	2.35	4.23	4.99	-	4.23	4.6	506	4.36	-	-	-	19.36	4.57	6.98	8.34	6.05	5.94	5.85
199409	H	0.4	0.44	0.58	-	-	-	1.1	12	0.82	-	-	-	-	-	-	1.22	1.71	1.61	0.94
199409	T	2.49	2.84	3.26	-	-	-	4.59	451	3.73	-	-	-	-	-	-	5.03	5.67	5.98	5.58
199512	т	2.49	2.86	3.03	-	-	-	4.59	432	3.79	-	-	-	-	-	4.74	7.15	6.06	5.58	5.97
199612	н	0.52	0.45	0.52	-	-	-	0.97	105	0.76	-	-	-	0.79	-	0.79	2.06	1.15	-	-
199612	т	2.78	2.55	2.89	-	-	-	4.17	435	3.86	-	-	-	15.29	-	4.01	7.5	6.48	-	-
199712	н	0.46	0.5	0.63	-	-	-	1.13	122	0.88	-	-	-	-	1.15	1.19	2.16	1.07	0.87	-
199712	T	2.67	2.88	3.1	-	-	-	4.5	454	4.01	-	-	-	-	4.49	5.08	7.22	5.91	4.82	-
199812	н т	0.43	67	0.58				1.04	107	3.07			+ <u>-</u>	0.8	1.18	1.16	4.18	1.16	5.86	5.00
199910	н	-	-	0.54	-	-	-	1	109	1.02	-	-	-	0.75	-	1.26	1.28	-	-	-
199910	т	-	-	2.87	-	-	-	4.02	436	4.29	-	-	-	16.21	-	5.01	6.24	-	-	-
200012	н	0.3	0.33	0.79	-	-	0.79	1.34	134	1.03	-	-	-	-	0.79	1.5	1.57	1.3	1.04	0.87
200012	т	4.04	2.19	3.76	-	-	3.76	4.87	502	4.14	-	-	-	-	3.46	5.19	6.08	5.92	5.37	5.51
200112	н	0.34	0.37	0.55				1.07	121	0.98			ļ	0.81	0.81	1.65	1.66	0.81		
200112	н	2.55	2.56	5.44	-	-	-	4.25	455	4.05	-	-	-	17.64	3.75	1.22	5.81	5.19	1.46	1.66
200212	Τ	2.57	2.73	3.09	-	-	-	4.5	4.4	3.83	-	-	-		-	5.1	5.22	5.16	6.41	6.5
200312	н	0.53	0.6	0.75	-	-	0.75	1.11	1.0.6	0.79	-	-	-	-	1.5	2.14	2.15	1.04	1.02	0.92
200312	Т	3.39	3.19	7.86	-	-	7.86	4.51	417	3.84	-	-	-	-	5.4	6.21	7.69	5.77	5.65	5.47
200412	н	0.43	0.46	0.57	-	-	-	0.95	1.3 1	0.89	-	-	-	-	0.75	1.98	3.07	0.81	0.76	-
200412	T	2.49	2.84	3.14	-	-	-	4.21	482	3.95	-	-	-	-	3.83	6.6	8.28	5.61	5.61	-
200509	н т	2 41	0.35	0.55			-	1.1	401	0.78				0.76	-	1.31	5.01	0.96		-
200611	н	0.49	0.44	0.82	-	-	0.82	1.22	115	0.82	-	-	-		-	1.26	2.65	1.07	-	-
200611	Т	2.71	2.56	3.47	-	-	3.47	4.31	435	3.8	-	-	-	-	-	6.24	7.72	6.2.4	-	-
200712	н	0.41	0.38	0.7	-	-	-	1.27	125	0.89	-	-	-	0.81	-	1.58	1.68	1.34	1	-
200712	Т	2.52	2.36	3.08	-	-	-	4.89	475	3.95	-	-	-	17.95	-	5.4	5.37	5.22	5.74	-
200812	н	0.49	0.46	0.78	-	-	0.78	1.14	128	1	-	-		-	-	1.88	2.33	0.78	-	
200812	T P	2.69	2.92	3.56	-	-	3.56	4.56	463	4.06	-	-	-	-	-	6.05	5.89	4.62	-	-
200912	ri T	2.46	27	3.08	-	-	-	4.3	421	3.74	-	-		-	-	7.1	6.76	5,32	-	-
201012	н	-	-	0.69	-	-	-	1.18	147	0.94	-	-	-	-	0.88	0.85	1.41	0.95	0.93	0.86
201012	т	-	-	8.32	-	-	-	4.64	505	3.93	-	-	-	-	3.94	4.01	6.09	4.65	5.05	5.07
201109	н	-	-	0.66	-	-	-	-	1.05	0.9	-	-	-	0.81	0.82	1.98	2.34	0.75	-	-
201109	T	-	-	777	-	-	-	-	419	4.01	-	-	-	2.57	4	6.27	7.5	4.44	-	-
201208	H Ŧ	-	-	0.37		-	-	-	109	1.04		-	-	0.95	-	1.06	1.6	1.19	1.61	1.59
201208	н	-	-	0.64	-	-	-	0.86	132	9.24	-	-	-	-	-	4./3	2.31	1.39	0.35	0.65
201312	T	-	-	777	-	-	-	3.81	469	3.84	-	-	-	-	-	6.7	7.41	5.12	-	-
201412	н	-	-	0.49	-	-	-	-	124	0.93	-	-	-	0.8	1.48	2.19	2.42	1.24	-	-
201412	т	-	-	7.21	-	-	-	-	4.6	4.03	-	-	- 1	16.37	5.45	6.96	7.41	5.78	-	-

H:波高(m) T:周期(s)

# 表 5-11 波向別年最大波(地点 M3)

		設	计波対象方	向				設計波対象方向									
抽出	条件								0.3m	以上							
	波向	22.5	45	67.5	90	1 1 2.5	135	157.5	1 80	202.5	225	247.5	270	292.5	315	337.5	360
取得年月		NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
198011	н	-	04	0.55	0.51	0.47	0.36	-	-	-	-	-	0.69	0.72	0.45	-	0.31
198011		-	2.52	2.97	2.96	2.88	2.57	-	-	-	-	-	0.71	0.69	0.45	-	2.48
198112	т	-	2.59	2.7	2.66	2.58	-	-	-	-	-	-	3.39	3.3	8.27	-	-
198211	н	0.31	0.42	0.53	0.45	0.36	0.3	-	-	-	-	-	0.4	0.61	0.56	031	0.3
198211	т	2.16	2.71	3.09	2.87	2.47	2.37	-	-	-	-	-	2.76	3.24	6.66	2.41	2.29
198311	н	0.32	0.33	0.43	0.46	0.43	0.35	-	-	-	-	-	-	0.36	0.36	035	0.31
198311	Т	2.25	2.54	2.79	2.88	2.73	2.53	-	-	-	-	-	-	2.52	2.53	249	2.52
198412	н	-	0.47	0.51	0.47	0.43	0.32	0.3	-	-	-	0.32	0.45	0.5	0.43	-	0.31
198412	T	-	2.89	2.89	2.84	2.69	2.52	2.33	-	-	-	2.57	2.83	2.99	2.8	-	2.38
198510	н	-	03	0.37	0.47	0.36	-	-	-	-	-	-	-	0.68	0.31	032	0.32
198510	1	-	22	2.49	2.82	2.38	-	-	-	-	-	-	-	3.31	5.95	254	2.34
198612	п т	-	0.34	0.45	2.0	0.38	-	-	-	-	-	0.33	4.25	0.97	-	-	0.3
198712	н	0.3	0.41	0.55	0.5	0.36	0.3	-	-	-	-	-	0.78	0.74	0.47		0.34
198712	т	2.17	25	3.11	2.85	2.48	2.36	-	-	-	-	-	3.74	3.67	2.86	-	2.5
198812	н	0.33	0.42	0.43	0.51	0.35	0.3	-	-	-	-	0.32	0.65	0.49	0.34	-	-
198812	Т	2.5	2.61	2.55	3.01	2.52	2.2	-	-	-	-	2.3	3.51	2.93	2.52	-	-
198912	н	-	0.36	0.54	0.4	0.3	-	-	-	-	-	0.48	0.49	0.68	-	-	0.32
198912	Т	-	2.32	2.95	2.69	2.4	-	-	-	-	-	2.88	3.06	3.4	-	-	2.44
199012	н	0.36	0.47	0.57	0.47	0.34	0.3	-	-	-		0.37	0.72	0.42	0.3	036	-
199012	Т	2.35	2.76	3.16	2.93	2.39	2.33	-	-	-	-	2.76	3.58	2.8	2.21	254	-
199112	H	0.37	0.49	0.57	0.37	0.34				-			0.37	0.53	0.31	-	0.3
199112	T	2.42	2.76	3.24	2.57	2.51	-	-	-	-	-	-	2.85	3.11	2.28	-	2.19
199212	н	0.33	0.51	0.6	0.41	0.34							0.45	0.57	0.47	-	-
199212	T	2.31	3.03	3.12	2.56	2.46	-	-	-	-	-	-	2.75	3.11	2.8	-	-
199312		2.65	2.05	2.46	2.20	0.44							2.74	0.8	6.02		-
199312	- H	0.36	0.4	0.4	0.49	0.45	0.31	-	-	-	-	-	0.37	0.57	0.03	0.3	-
199411	т	2.38	2.75	2.46	3.04	2.68	2.41	-	-	-	-	-	2.55	3.25	3.4	241	-
199512	н	0.31	0.47	0.5	0.44	0.38	0.33	-	-	-	-	-	0.66	0.57	0.3	-	-
199512	т	2.43	2.97	3.07	2.79	2.65	2.39	-	-	-	-	-	3.46	3.06	2.23	-	-
199612	н	0.3	0.35	0.37	0.39	0.35	-	-	-	-	-	-	0.59	0.59	0.61	-	-
199612	T	2.18	2.36	2.52	2.59	2.57	-	-	-	-	-	-	3.28	3.28	7.42	-	-
199712	н	0.39	04	0.57	0.42	0.36	-	-	-	-	-	0.33	0.68	0.58	0.42	-	0.3
199712	T	2.55	2.51	3.08	2.71	2.51	-	-	-	-	-	2.32	3.49	7.18	6.42	-	2.2
199812	Н	-	04	0.45	0.44	0.41	0.32	-		-	-	-	0.55	0.55	0.38	-	-
199812	T	-	2.53	2.88	2.87	2.67	2.44	-	-	-	-	-	3.2	3.21	5.67	-	-
199912	н т	-	0.31	0.47	0.5	0.36	0.33	0.33	-	-	-	-	0.56	0.43	-	-	-
200012	н	-	0.38	0.47	0.48	0.44	2.36	0.35	0.35	-	-	-	0.54	0.54	0.39		-
200012	т	-	256	2.95	2.99	2.87	2.49	2.53	2.46	-	-	-	3.13	3.12	6.03	_	
200109	Н	-	0.31	0.49	0.4	0.36	0.38	-	-	-	-	-	0.73	0.64	-	-	-
200109	т	-	2.37	2.9	2.7	2.63	2.65	-	-	-	-	-	3.53	3.49	-	-	-
200212	н	0.33	0.43	0.46	0.4	0.32	-	-	-	-	-	-	0.61	0.53	-	-	-
200212	Т	2.5	2.17	2.71	2.65	2.37	-	-	-	-	-	-	3.3	3.08	-	-	-
200312	н	-	0.37	0.52	0.46	0.35	-	-	-	-	-	-	0.8	0.62	0.42	-	-
200312	Т	-	2.67	2.97	2.94	2.36	-	-	-	-	-	-	3.81	3.1	2.69	-	-
200412	н	0.34	03	0.52	0.48	0.46	0.32	0.31		-			1.19	0.84	0.58		
200412	T	2.35	2.25	2.91	2.89	2.85	2.35	2.26	-	-	-	-	4.58	8.139999	7.38	-	-
200510	H	-	0.38	0.36	0.39		-	0.3	-	-	-	-	0.57	0.47	-	-	
200510	) ب	-	2.52	2.41	2.61	-	-	2.33	-	-	-	-	3.3	2.85	- 0.71	-	-
200011	T	2.24	239	2.82	2.81	2.54	2.53	2.34	-	-			3.59	4.01	7 79		
200712	н	0.31	0.48	0.49	0.44	0.39	-	-	_	-	-	_	0.67	0.74	0.43	-	
200712	т	2.19	2.84	2.95	2.79	2.54	-	-	-	-	-	-	3.61	3.58	2.84	-	-
200812	н	-	0.39	0.57	0.48	0.42	0.35	-	-	-	-	-	1.12	0.71	0.3	-	-
200812	Т	-	2.63	3.08	2.94	2.69	2.52	-	-	-	-	-	4.42	3.6	2.19	-	-
200911	Н	0.33	0.43	0.52	0.55	0.34	-	-	-	-	-	-	0.46	0.5	0.35	-	-
200911	т	2.73	2.69	2.92	3.14	2.39	-	-	-	-	-	-	2.78	2.9	2.47	-	-

H:波高(m) T:周期(s)

年最大波より確率統計処理を行い、M2 地点及び M3 地点各々の波向 WNW、 NW.NNW,N,NNE,NE,ENE の7方位について、確率波高を算出した。算出結果の一例として、M2 地点、波向 WNW を図 5-12 に示す。(付属資料1参照)。また、周期については図 5-13 及び図 5-14 に示す年最大値波高と周期の相関図より算出した。相関図作成にあたっては、インド洋から(SW, SSW 方向)の波向については、対象地点への影響が小さいので除外している。以上により算出 した確率波を表 5-12 に整理した。



図 5-12 確率波高算出結果(地点 M2、WNW)



図 5-13 年最大値波高と周期の相関図(地点 M2)



図 5-14 年最大値波高と周期の相関図(地点 M3)

			確率波(	地点M2)		++
波很貸科	波问	5年	10年	30年	50年	一世出余件
	WNW	2.35  m	2.64 m	3.02 m	3.17 m	
	VV IN VV	$7.5~\mathrm{s}$	8.1 s	8.8 s	$9.2 \mathrm{~s}$	
	NIM	1.36 m	1.51 m	1.70 m	1.78 m	
	1 1 1 1	$5.4 \mathrm{~s}$	$5.7~\mathrm{s}$	$6.1 \mathrm{~s}$	$6.3 \mathrm{\ s}$	
	NINIW	1.23 m	1.43 m	1.70 m	1.81 m	0.75m以上
	ININVV	$5.2 \mathrm{~s}$	$5.6~\mathrm{s}$	$6.1 \mathrm{~s}$	$6.4 \mathrm{\ s}$	
NOAA	N	1.07 m	1.28 m	1.57 m	1.70 m	
(地点M2)	IN	4.8 s	$5.3~\mathrm{s}$	$5.9~\mathrm{s}$	$6.1 \mathrm{~s}$	
	NINE	0.48 m	0.56 m	0.71 m	0.79 m	
	ININIZ	$3.6 \mathrm{\ s}$	$3.8 \mathrm{\ s}$	4.1 s	4.2 s	
	NE	0.47 m	0.51 m	0.56 m	0.58 m	0.2
	INE	$3.6 \mathrm{\ s}$	$3.7 \mathrm{\ s}$	$3.8 \mathrm{\ s}$	$3.8 \mathrm{\ s}$	0.3m以上
	FNF	0.73 m	0.81 m	0.92 m	0.98 m	
	ENE	4.1 s	4.3 s	4.5 s	4.6 s	

表 5-12 確率波算出結果

<b>冲</b> 冲次率	社内		確率波(	地点M3)		抽山冬州		
<b></b>	<i>(</i> ) () () () () () () () () () () () () ()	5年	10年	30年	50年	抽出来件		
		0.71 m	0.79 m	0.93 m	0.99 m			
	VV IN VV	4.0 s	4.3 s	4.9 s	$5.1~\mathrm{s}$			
	NIW	0.48 m	0.56 m	0.66 m	0.71 m			
		$3.1 \mathrm{~s}$	3.4 s	3.8 s	4.0 s			
NOAA	NNW		データ不足に					
	N	0.30 m	0.31 m	0.33 m	0.33 m	0.2 m 1 1 F		
(地点M3)	IN	2.4 s	2.4 s	$2.5 \mathrm{~s}$	$2.5 \mathrm{~s}$	0.3mkr		
	NNF	0.33 m	0.35 m	0.38 m	0.39 m			
		$2.5 \mathrm{~s}$	2.6 s	$2.7 \mathrm{\ s}$	$2.8~\mathrm{s}$			
-	NF	0.45 m	0.48 m	0.53 m	$0.55 \mathrm{~m}$			
	NE	3.0 s	$3.1 \mathrm{~s}$	3.3 s	$3.4 \mathrm{\ s}$			
	FNF	0.54 m	0.59 m	0.64 m	0.66 m			
	ENE	3.4 s	3.6 s	$3.7 \mathrm{\ s}$	$3.8 \mathrm{\ s}$			

#### 5-2-1-2-2 風波による確率波

表 5-12 に示した通り、波浪推算による M2、M3 地点での NNE~ENE 方向の確率波は、50 年 確率波で 1.0m 未満の結果である。この結果は設計波算出にあたって過小である可能性があるの で、ここでは、NNE~ENE 方向について SMB 法により確率波を算定した。

(1) 算出方法

M1 地点における確率波(NNE~ENE)は以下のフローチャートにより算出した。



図 5-16 有効吹送距離

#### (2) 年最大値の算出

地点 M3 の再解析風資料より、各地点における波向別年最大風速を算出し、表 5-13 に整理した。

	設計	+波対象方	٥,													
波向	22.5	45	67.5	90	112.5	135	157.5	180	202.5	225	247.5	270	292.5	315	337.5	360
取得年月	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	w	WNW	NW	NNW	N
198012	5.09	7.1	7.01	6.86	6.76	5.58	4.35	-	-	3.2	709	7.56	7.22	5.04	4.63	4.94
198112	5	5.97	6.07	5.99	5.6	5.15	4.09	-	-	3.45	625	8.03	7.17	6.73	4.74	5.2
198212	5.4	5.77	6.58	6.85	6.4	5.39	4.53	-	-	3.87	458	6.34	7.18	5.43	5.11	5.53
198312	5.23	5.38	6.43	6.4	6.32	6.78	4.76	3.1	3.32	-	3.4	4.49	5.49	5.23	5.45	4.83
198412	5.14	6.68	6.77	6.27	6.14	5.5	4.63	-	-	4.19	553	6.52	5.43	5.38	4.88	5.38
198512	5.17	5.13	5.49	6.38	6.35	5.37	4.48	-	-	3.41	448	7.65	7.06	4.72	5.35	5.06
198612	5.07	5.39	6.06	7.13	5.68	5.12	4.59	4.03	-	5.66	4.9	9.11	8.58	5.19	4.31	5.45
198712	5.92	6.29	6.46	6.68	6.05	5.32	4.01	-	-	-	488	7.79	9.01	6.12	4.12	5.54
198812	5.7	5.85	6.69	6.73	5.65	5.65	4.61	-	4.31	4.68	586	7.25	6.07	5.4	4.84	4.86
198912	4.8	6.08	7.22	5.76	5.34	5.18	4.59	3.42	3.47	5.55	648	6.76	7.25	6.36	4.87	5.32
199012	5.79	6.42	7.49	6.3	6.28	5.01	4.65	3.24	3.01	4.29	713	7.74	6.24	5.18	5.66	4.86
199112	5.49	6.79	7.22	5.86	5.32	5.26	4.37	-	-	-	469	5.95	6.14	5.43	4.69	5.21
199212	5.63	6.78	7.47	6.31	5.31	5.11	4.13	3.5	-	3.7	535	6.21	6.58	6.85	5.04	5.2
199312	5.72	6.7	7.15	8.35	6.56	5.42	5.35	-	3.96	3.39	639	8.44	6.99	6.63	4.71	4.57
199412	5.45	5.43	6.51	6.49	6.95	5.58	4.71	3.05	-	-	319	6.16	6.63	7.49	5.18	5.03
199512	4.89	6.04	6.84	6.06	6.2	5.48	4.7	3.12	-	3.35	583	7.5	6.01	4.76	5	4.97
199612	4.91	5.98	5.59	5.33	5.74	4.9	4.53	-	4.33	4.66	636	7.16	6.59	5.22	4.84	5.09
199712	5.54	6.37	7.26	6.51	5.58	5.65	4.63	-	-	4.07	737	7.68	6.52	5.27	4.71	4.82
199812	4.98	5.72	6.21	6.1	5.76	5.31	4.25	3.23	3.14	4.74	564	6.78	7.03	5.57	5.36	4.99
199912	4.79	5.47	6.49	6.77	5.24	5.34	4.86	3.1	-	-	8.5	6.89	5.18	5.35	3.98	4.24
200012	4.5	5.92	6.74	6.06	6.73	5.61	4.95	3.48	3.81	4.03	497	6.69	6.95	5.11	4.05	4.36
200112	4.93	5.03	6.5	5.73	5.64	5.63	4.93	-	3.02	3.38	718	7.85	7.01	5.02	4.18	4.1
200212	5.51	6.53	6.35	5.58	5.16	4.79	4.52	3.11	-	3.25	636	7.29	5.92	4.52	4.8	5
200312	5.38	5.95	6.87	6.07	6.14	4.89	4.57	-	-	4.34	791	8.47	9.22	5.81	4.3	4.75
200412	5.62	5.56	5.31	6.86	6.58	6.1	4.59	-	3.25	-	615	10.32	8.95	6.58	4.5	4.51
200512	4.99	5.39	6.04	5.81	5.31	4.84	4.79	-	-	4.21	668	6.99	5.99	5.16	4.19	5.18
200612	6.8	6.09	5.93	5.86	6.13	5.95	4.93	3.36	-	3.48	612	7.8	8.69	5.78	5.22	8.7
200712	5.14	6.36	6.73	6.16	5.66	5.3	4.74	-	-	3.05	539	8.24	7.73	6.1	5.15	4.8
200812	5.28	6.25	7.18	6.69	5.9	5.94	5.1	-	-	3.77	1(.19	10.46	7.71	5.87	5.04	4.32
200912	5.29	6.32	6.93	6.83	6.17	5.03	4.2	3.23	-	3.01	498	6.05	6.24	5.11	4.32	4.62
201012	4.86	4.19	5.59	6.55	7.65	7.34	5.62	3.92	3.13	4	584	7.21	7.8	6.18	6.05	4.43
201112	5.39	4.76	6.77	7.13	6.67	7.21	5.72	-	3.88	5.51	672	6.73	5.61	6.43	6.7	5.54
201212	5.67	6.32	5.44	5.63	5.78	7.04	5.84	5.09	-	3.57	667	7.15	6.29	6.8	5.2	5.51
201312	5.06	5.47	6.11	6.21	6.81	7.14	5.83	3.64	3.88	4.71	672	6.78	8.14	5.94	6.11	5.01
201412	6.09	5.73	6.5	6.58	6.94	6.74	5.25	-	3.31	6.17	7.64	7.92	8.09	5.74	5.98	6.06

表 5-13 波向別年最大風速(地点 M3)

単位(m)

(3) 確率波の算定

年最大風速より確率統計処理を行ない、M2 地点及び M3 地点における風向 NNE、NE、ENE の3位の確率風速を算出した。算出結果の一例を図 5-17 に示す(付属資料2参照)。



図 5-17 確率風速算出結果(地点 M3、NNE)

波向	確率年	確率風速 (m/s)	吹送距離 (km)	<b>沖波波高</b> (m)	周期 (s)	沖波波長 (m)	波形勾配	Smax
	50	6.50	121.3	0.80	3.8	22.5	0.036	10
	30	6.32	121.3	0.80	3.7	21.4	0.037	10
ININE	10	5.92	121.3	0.70	3.6	20.2	0.035	10
	5	5.65	121.3	0.70	3.4	18.0	0.039	10
	50	7.36	78.7	0.90	3.8	22.5	0.040	10
	30	7.18	78.7	0.90	3.7	21.4	0.042	10
INE	10	6.75	78.7	0.80	3.6	20.2	0.040	10
	5	6.43	78.7	0.70	3.5	19.1	0.037	10
	50	7.88	59.9	0.90	3.8	22.5	0.040	10
	30	7.72	59.9	0.90	3.7	21.4	0.042	10
ENE	10	7.31	59.9	0.80	3.6	20.2	0.040	10
	5	6.99	59.9	0.80	3.5	19.1	0.042	10

表 5-14 確率波算出結果

### 5-2-1-2-3 確率波算定結果

以上の結果を図 5-14 及び図 5-18 に整理した。

波浪資料による確率波算定結果(M3地点)では、50年確率波で、全方向とも1.0m以下となっている。このことは、M3地点が浅海域であり、またアタウロ島とティモール島に囲まれており、精度良く推算されていない可能性が高いためと考えられる。

また、M2 地点の NNE~ENE 方向の推算結果は、風資料からの推算結果と同じような値であるが、アタウロ島の回折により波浪が減衰すると考えられることから、以降の検討は M2 地点での推算結果 WNW~N 方向と、風資料からの推算結果 NNE~ENE を採用とした。

	波向	5 <del>4:</del>	10年	304 <del>4</del>	50年	抽出条件	資料
	WINIW	2.35  m	2.64 m	3.02 m	3.17 m		
	VV IN VV	7.5 s	8.1 s	8.8 s	9.2 s		
	NIW	1.36 m	1.51 m	1.70 m	1.78 m		
		$5.4 \mathrm{~s}$	5.7 s	6.1 s	6.3 s	0.75m	
	NINIW	1.23 m	1.43 m	$1.70 \mathrm{~m}$	1.81 m	以上	
		5.2 s	5.6 s	6.1 s	6.4 s		波浪資料
確率波	N	1.07 m	1.28 m	$1.57~{ m m}$	1.70 m		NOAA
(地点 <b>M2</b> )	IN	4.8 s	5.3 s	5.9 s	6.1 s		(地点 <b>M</b> 2)
	NNF	0.48 m	0.56 m	0.71 m	0.79 m		
	ININE	3.6 s	3.8 s	4.1 s	4.2 s		
	NE	0.47 m	0.51 m	0.56 m	$0.58 \mathrm{~m}$	0.3m	
	NE	3.6 s	3.7 s	3.8 s	3.8 s	以上	
	ENE	0.73 m	0.81 m	0.92 m	0.98 m		
	EINE	4.1 s	4.3 s	$4.5 \mathrm{s}$	4.6 s		
	WNW	0.71 m	0.79 m	0.93 m	0.99 m		
	**1	4.0 s	4.3 s	4.9 s	5.1 s		
	NW	0.48 m	0.56 m	0.66 m	0.71 m		
		3.1 s	3.4 s	3.8 s	4.0 s		
	NNW		データ不足に	より第定不可			
確率波	N	0.30 m	0.31 m	0.33 m	0.33 m	0.3m	波浪資料 NOAA
(地点 <b>M3</b> )	IN	2.4 s	2.4 s	2.5 s	2.5 s	] 以上	NOAA (地点M3)
	NNE	0.33 m	0.35 m	0.38 m	0.39 m		(-0),((1)))
	ININE	2.5 s	2.6 s	2.7 s	2.8 s		
	NF	0.45 m	0.48 m	0.53 m	$0.55 \mathrm{~m}$		
	INE	3.0 s	3.1 s	3.3 s	3.4 s		
	ENE	0.54 m	0.59 m	0.64 m	0.66 m		
	LINE	3.4 s	3.6 s	3.7 s	3.8 s		
	NNF	0.70 m	0.70 m	0.80 m	0.80 m		
	ININE	3.4 s	3.6 s	3.7 s	3.8 s		
確率波	NF	0.70 m	0.80 m	0.90 m	0.90 m		風質料 NOAA
(地点 <b>M1</b> )	INE	3.5 s	3.6 s	3.7 s	3.8 s		(地点M3)
	ENE	0.80 m	0.80 m	0.90 m	0.90 m		( <u> </u>
	EINE	3.5 s	3.6 s	3.7 s	3.8 s		

表 5-15 確率波算定結果一覧表



# 5-2-1-3 ディリ港付近の設計波諸元

前項で求めた確率波(WNW~N)は地点 M2 であるため、ここでは M2 地点の確率波を波浪 変形して M1 地点での波を求めた。

### 5-2-1-3-1 手法

波浪変形計算はエネルギー平衡方程式を用いる。エネルギー平衡方程式の基礎方程式は付属資料3に示す。



図 5-19 地点 M1 位置図

### 5-2-1-3-2 条件

#### (1) 波浪条件

波浪条件は表 5-15 に示す確率波算定結果一覧より、表 5-16 に示す 50 年確率波とした。

50年確率波	(地点M2)			
沖波向	WNW	NW	NNW	Ν
沖波波高	3.17 m	1.78 m	1.81 m	1.70 m
周期	$9.2 \mathrm{~s}$	$6.3 \mathrm{\ s}$	6.4 s	6.1 s

表 5-16 沖波条件

(2) 水深及び地形

水深及び地形は下記に示した資料を使用した。

- ・海図 942A
- ・測量データ(貸与資料)
- ・GEBCO30 (出典:http://www.gebco.net/)
- (3) 潮位条件

前出の潮位条件より、HWL を使用する。

M.H.H.W=+2.30m

(4) 計算範囲及び計算格子間隔

<u>計算格子間隔 200m</u>



図 5-20 計算範囲

### 5-2-1-3-3 結果

波向 WNW、NW、NNW の3方位について検討を行ったが、計算結果の一例として、波向 WNW の計算結果を図 5-21 から図 5-26 に示す。なお、全ケースの計算結果は付属資料4参照。計算 結果より M1 地点での設計波諸元を求め、表 5-17 に整理した。

М	2 地点設計池	中波	M1	地点設計沖	皮	
波向	波高(m)	周期(s)	入射波向 ( <sup>°</sup> )	波高(m)	周期(s)	備考
WNW	3.17	9.2	324.0	1.63	9.2	
NW	1.78	6.3	327.0	1.13	6.3	波浪資料による値
NNW	1.81	6.4	330.0	1.17	6.4	外洋性波
N	1.70	6.1	360.0	1.36	6.1	

表 5-17 M1 地点設計沖波諸元(50 年確率波)

波向はNから時計まわりの角度

	2 47	2 47	9 47	2 47	2 17	2 47	2 47	2 47	2 47	2 47	2 47	2 47	2 17	2 47	2 47	2 47	2 47	2 47	2 47	2 47	2 47	2 47	2 47	2 47	
	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	
-	3.09	5.10	3.10	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	
		2.51	3.02	3.10	3.12	3.14	3.15	3.10	3.10	3.10	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	
			2.63	2.94	3.02	3.07	3.10	3.11	3.13	3,14	3.14	3.15	3.15	3.16	3.16	3.16	3.16	3.17	3.17	3.17	3.17	3.17	3.17	3.17	
		1	1.96	2.70	2.89	2.97	3.03	3.06	3.08	3.10	3.11	3.12	3.13	3.13	3.14	3.14	3.15	3.15	3.15	3.16	3.16	3.16	3.16	3.17	
		1	1.77	2.43	2.72	2.86	2.94	2.99	3.03	3.05	3.07	3.09	3.10	3.11	3.12	3.12	3.13	3.13	3.14	3.14	3.14	3.15	3.15	3.15	
		/	1.69	2.22	2.55	2.73	2.84	2.91	2.96	3.00	3.03	3.05	3.06	3.08	3.09	3.10	3.11	3.11	3.12	3.12	3.13	3.13	3.14	3.14	
/	/	1.08	1.65	2.08	2.39	2.60	2.74	2.83	2.89	2.94	2.98	3.00	3.03	3.04	3.06	3.07	3.08	3.09	3.10	3.11	3.11	3.12	3.12	3.13	
	0.53	1.21	1.63	1.98	2.27	2.48	2.64	2.74	2.82	2.88	2.92	2.96	2.98	3.01	3.03	3.04	3.06	3.07	3.08	3.08	3.09	3.10	3.11	3.11	
	0.83	1.27	1.60	1.91	2.17	2.38	2.54	2.66	2.75	2.81	2.87	2.91	2.94	2.97	2.99	3.01	3.03	3.04	3.05	3.06	3.07	3.08	3.09	3.09	
	0.98	1.32	1.58	1.86	2.10	2.29	2.45	2.58	2.67	2.75	2.81	2.86	2.90	2.93	2.95	2.98	3.00	3.01	3.03	3.04	3.05	3.06	3.07	3.08	
	1.07	1.34	1.57	1.83	2.03	2.22	2.37	2.50	2.60	2.68	2.75	2.80	2.85	2.88	2.92	2.94	2.96	2.98	3.00	3.01	3.03	3.04	3.05	3.06	
	1.14	1.36	1.56	1.79	1.98	2.16	2.30	2.43	2.54	2.62	2.69	2.75	2.80	2.84	2.88	2.91	2.93	2.95	2.97	2.99	3.00	3.02	3.03	3.04	
	1.18	1.37	1.55	1.76	1.94	2.10	2.24	2.37	2.47	2.56	2.64	2.70	2.75	2.80	2.84	2.87	2.90	2.92	2.94	2.96	2.98	2.99	3.01	3.01	
	1.21	1.38	1.55	1.74	1.91	2.06	2.19	2.31	2.42	2.51	2.58	2.65	2.71	2.75	2.80	2.83	2.86	2.89	2.91	2.93	2.95	2.97	2.84	3.02	
	1.24	1.39	1.54	1.72	1.88	2.02	2.15	2.26	2.36	2.46	2.53	2.60	2.66	2.70	2.75	2.79	2.83	2.86	2.88	2.90	2.87	/	2	2.78	
	1.26	1.39	1.54	1.71	1.86	1.99	2.11	2.22	2.32	(						/	)2.32	2.82	2.85	2.87	C	-	0.97	2.16	-
	1.29	1.40	1.54	1.70	1.84	1.96	2.07	2.18	2.17	(				_	~	0.44	1.71	2.63	2.81	2.75	1.66	0.47	0.41	~	-
	1.31	1.41	1.54	1.70	1.82	1.93	2.04	2.11	1.97	0.98			/	0.06	0.20	0.83	1.63	2.33	2.65	2.62	2.10	1.18	0.44	0.18	
	1.33	1.42	1.54	1.69	1.80	1.90	2.00	2.00	1.84	1.13	0.07	0.04	0.08	0.17	0.52	1.02	1.60	2.12	2.41	2.45	2.17	1.61	0.97	0.47	
	1.35	1.43	1.54	1.69	1.78	1.87	1.93	1.90	1.74	1.28	0.41	0.10	0.16	0.37	0.74	1.14	1.57	1.95	2.19	2.26	2.12	1,77	1.33	0.89	
/	1.35	1.45	1.54	1.69	1.76	1.83	1.86	1.80	1.67	1.33	0.72	0.21	0.29	0.56	0.88	1.20	1.53	1.82	2.01	2.09	2.01	1.80	1.50	1.17	
	1	1.45	1.54	1.68	1.72	1.78	1.78	1.73	1.61	1.34	0.92	0.42	0.45	0.71	0.97	1.23	1.47	1.71	1.87	1.94	1.89	1.76	1.56	1.33	
		U	4.53	1.67	1.68	1.73	1.71	1.66	1.56	1.33	1.03	0.66	0.61	0.81	1.02	1.23	1.42	1.62	1.75	1.82	1.78	1.70	1.56	1.40	
				X	1.63	1.68	1.64	1.61	1.51	1.32	1.11	0.86	0.75	0.88	1.05	1.21	1.37	1.53	1.64	1.71	1.69	1.63	1.53	1.41	
					×	M	1.57	1.56	1.47	1.32	1.17	1.01	0.88	0.93	1.05	1.19	1.32	1.46	1.56	1.62	1.61	1.57	1.50	1.40	
							1	1																	
								5																	
	Γ	Wave	e dir	ectio	on	WN	W (3:	24)		5	~														
	Γ	Wave	e hei	ght		3.	17 m					-	_												
	Г		0.000			0						1	)												

0 10	20km

図 5-21 換算沖波波高分布 (WNW)



図 5-22 波向ベクトル分布 (WNW)

292	292	292	292	292	292	292	292	292	292	292	292	292	292	292	292	292	292	292	292	292	292	292	293	
295	293	293	292	292	292	292	292	292	292	292	292	292	292	292	292	292	292	292	292	292	292	292	293	
1	307	297	295	294	293	293	293	293	293	293	292	292	292	292	292	292	292	292	292	292	292	292	293	
	1	307	300	297	296	295	294	294	294	293	293	293	293	293	293	293	293	292	292	292	292	292	293	
	/	321	305	301	299	297	296	295	295	294	294	294	294	293	293	293	293	293	293	293	293	293	293	
		325	312	305	302	300	298	297	296	296	295	295	295	294	294	294	294	294	293	293	293	293	293	
	/	327	316	309	305	302	300	299	298	297	296	296	296	295	295	295	294	294	294	294	294	294	293	
/	338	328	319	312	308	305	302	301	300	299	298	297	297	296	296	295	295	295	295	294	294	294	294	
346	336	328	321	315	311	307	305	303	301	300	299	298	298	297	297	296	296	296	295	295	295	295	295	
343	335	329	323	317	313	309	307	305	303	302	300	300	299	298	298	297	297	296	296	296	296	295	295	
340	334	329	324	319	315	311	309	306	304	303	302	301	300	299	299	298	298	297	297	296	296	296	296	
339	334	329	324	320	316	313	310	308	306	304	303	302	301	300	300	299	298	298	298	297	297	296	296	
338	334	330	325	321	318	314	312	309	307	306	304	303	302	301	301	300	299	299	298	298	297	297	297	
337	333	330	326	322	319	316	313	311	309	307	306	304	303	302	302	301	300	300	299	299	298	298	298	
336	333	330	326	323	320	317	314	312	310	308	307	306	304	303	302	302	301	300	300	299	299	297	304	
336	333	330	326	323	320	318	315	313	311	309	308	307	305	304	303	303	302	301	301	299	/	)	309	
335	333	330	327	324	321	319	316	314	C		-					) 317	303	302	301	(	~	356	316	-
335	333	330	327	324	322	319	317	312						~	365	326	307	303	299	280	320	318-	~	1
334	332	330	327	324	322	320	317	310	292			/	391	364	343	328	314	305	298	287	281	273	253	
334	332	330	327	325	323	320	316	308	297	290	387	380	363	349	340	329	317	308	299	289	281	272	266	
334	332	330	327	325	323	319	315	308	299	294	358	363	352	345	338	329	319	310	301	292	283	276	270	
334	332	330	327	325	323	319	314	308	301	295	325	353	348	343	336	328	319	311	303	294	286	279	274	
1	332	330	327	325	322	318	313	308	302	297	312	348	346	341	335	328	319	312	304	297	289	283	277	
	S	330	327	325	321	317	313	308	303	300	311	343	344	339	333	327	319	313	306	299	292	286	280	
			X	324	320	317	313	309	304	303	312	337	341	337	332	326	319	313	307	300	294	288	283	
			Y	×	N	317	313	309	306	306	313	331	338	335	330	325	319	313	308	302	296	291	286	
						1																		
							5								悉	b值·	Nth	こ時	計同	แก	角度	(de	σ)	
Γ	Wave	dir	ectio	n	WN	W (32	4)	1	~	~						. 의 .	11/3	O PO		,0,	円皮	140	5/	
	Wave	hei	ght		3.	17 m					-	_												
	Wave	per	iod	_	9.	20 se	ec				1													
									Y	$\propto$	r		1											
- 3	0			10		2	20km		X	X				1										
				1		_		1							1									

図 5-23 波向数值分布 (WNW)
				Wa	ave h ave p	eight erioc	1		1. 70 6. 10	m sec		o L			1	0		20kr
				Wa	ave d	irect	ion	10	N (3	360)							Ĭ	
																-	φ	-
-																		
1.64	1.63	1.63	1.62	1.60	_	/				4							1	
1.65	1.64	1.63	1.62	1.61	1.59	1.57	1.55	~	1.47	5	/	/	K					
1.65	1.64	1.63	1.62	1.61	1.59	1.57	1.55	1.52	1.49	1.46	1.41	1.38	1.36	1.29	~	~	1.32	_
1.66	1.65	1.64	1.63	1.61	1.60	1.58	1.55	1.51	1.47	1.44	1.38	1.35	1.32	1.31	1.32	1.35	1.38	
1.67	1.66	1.65	1.64	1.62	1.60	1.58	1.55	1.51	1.46	1.42	1.35	1.30	1.27	1.27	1.29	1.32	1.36	
1.68	1.67	1.66	1.65	1.63	1.61	1.59	1.56	1.51	1.46	1.39	1.31	1.25	1.21	1.21	1.24	1.28	1.34	
1.68	1.68	1.67	1.66	1.65	1.63	1.61	1.57	1.52	1.45	1.36	1.25	1.17	1.13	1.14	1.19	1.25	1.32	
1.69	1.69	1.68	1.67	1.66	1.65	1.63	1.60	1.54	1.46	1.34	1.18	1.05	1.02	1.05	1.13	1.22	1.32	
1.69	1.69	1.69	1.68	1.68	1.67	1.65	1.62	1.58	1.50	1.34	1.08	0.86	0.84	0.93	1.06	1.21	1.33	
1.70	1.70	1.69	1.69	1.69	1.68	1.67	1.65	1.62	1.55	1.39	0.98	0.54	0.50	0.82	1.02	1.22	1.34	
1.70	1.70	1.70	1.70	1.69	1.69	1.68	1.67	1.65	1.61	1.47	0.72			0.57	0.97	1.22	1.37	
1.70	1.70	1.70	1.70	1.70	1.70	1.69	1.69	1.68	1.65	1.59	(				0.89	1.23	1.39	
1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.69	1.68	1.69	1.00	1.90			0.74	1.27	1.43	
1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.09	1.07	/		ort	1.31	1.07	
1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.09	/		1.41	1.00	
1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	$ \$	1.69	1.70	
1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1./0	1.70	
1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	
1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	L
1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1





図 5-25 波向ベクトル分布 (N)





### 5-2-1-4 対象地点の設計波諸元

ここでは、M1地点より設計対象地点での設計波諸元を求めた。

#### 5-2-1-4-1 手法

手法は、エネルギー平衡方程式より算出した。

#### 5-2-1-4-2 条件

(1) 波浪条件

M1 地点における波浪諸元を表 5-18 に整理した。

	Ν	11地点		/ <b>#</b> 老
波	向	波高(m)	周期(s)	脈右
WNW	324.0	1.63	3.1	
NW	327.0	1.13	6.3	波浪資料による値
NNW	330.0	1.17	4.2	外洋性波
N	360.0	1.36	6.1	
NNE	22.5	0.80	3.8	
NE	45.0	0.90	3.8	風資料による値
ENE	67.5	0.90	3.8	

波向はNから時計まわりの角度

#### (2) 水深及び地形

水深及び地形は下記に示した資料を使用した。

- ・海図 3296
- ・現地再委託調査による測量データ
- ・GEBCO30 (出典:http://www.gebco.net/)
- (3) 潮位条件

前項と同様、下記に示す M.H.H.W とする。

M.H.H.W=+2.30m

表 5-18 波浪諸元(地点 M1)



計算格子間隔 10m

図 5-27 計算範囲

### 5-2-1-4-3 結果

計算は、波向 WNW、NW、NNW、N、NNE、NE、ENE の7方位について行ったが、計算結 果の一例として、波向 WNW の結果を図 5-28~図 5-33 に示す。なお、全てのケースの計算結 果は付属資料5参照。

	lit fit	_			0.90
4	Wave direction	WNW (324)			
0	Wave height	1.63 m			
T	Wave period	9.20 sec	0	50	100m

0.70 0.72 0.70 0.73 0.74 0.73 0.75 0.76 0.77 0.78 0.79 0.82 0.85 0.88 0.92 0.92 0.95 698 1.01

0.70 0.65 0.69 0.72 0.74 0.76 0.78 0.80 0.82 0.84 0.87 0.90 0.90 0.93 0.95 0.98 0.68 0.64 0.67 0.70 0.73 0.75 0.77 0.80 0.82 0.84 0.86 0.89 0.89 0.91 0.94 0.97 0.64 0.62 0.69 0.72 0.75 0.77 0.80 0.82 0.84 0.86 0.88 0.89 0.91 0.93 0.96

0.73 0.76 0.79 0.82 0.83 0.85 0.87 0.88 0.90 0.93 0.95

0.81 0.83 0.85 0.87 0.88 0.90 0.92 0.94 70,0 0.81 0.83 0.85 0.87 0.87 0.89 0.91 0.93 0.81 0.84 0.86 0.87 0.89 0.90 0.92 0.85 0.85 0.86 0.88 0.89 0.90 0.93 0.86 0.86 0.87 0.89 0.89 0.88 0.86 0.87 0.84 0.88 0.88

図 5-28 换算沖波波高分布 (WNW)

0.45 0.0

0.69 0.72 0.74 0.77 0.79 0.81 0.83 0.84 0.86 0.87 0.88 0.89 0.91 0.93 0.96 0.97 0.99 1.01 1.03 1.04 1.05 1.06 1.06 1.08 1.08 1.08 0.69 0.71 0.73 0.76 0.78 0.80 0.82 0.83 0.84 0.86 0.87 0.88 0.90 0.92 0.95 0.96 0.98 1.01 1.03 1.05 1.06 1.08 1.07 1.10 1.11 1.10 0.68 0.70 0.73 0.75 0.78 0.79 0.81 0.82 0.84 0.85 0.87 0.88 0.90 0.92 0.95 0.96 0.98 1.00 1.04 1.06 1.08 1.10 1.08 1.12 1.13 1.12 0.67 0.70 0.72 0.75 0.77 0.79 0.81 0.82 0.84 0.85 0.86 0.88 0.90 0.92 0.95 0.96 0.97 0.99 1.04 1.07 1.10 1.12 1.09 1.13 1.14 1.13 0.68 0.69 0.72 0.75 0.77 0.79 0.81 0.82 0.84 0.85 0.86 0.88 0.90 0.92 0.95 0.96 0.97 0.99 1.04 1.08 1.10 1.13 1.09 1.13 1.14 1.13 0.66 0.68 0.72 0.75 0.77 0.79 0.81 0.83 0.84 0.85 0.86 0.88 0.89 0.91 0.94 0.96 0.96 0.98 1.03 1.07 1.10 1.13 1.09 1.12 1.14 1.14 0.63 0.68 0.71 0.74 0.77 0.79 0.81 0.83 0.84 0.85 0.86 0.88 0.89 0.91 0.94 0.95 0.94 0.96 1.02 1.07 1.10 1.13 1.08 1.12 1.13 1.14 0.63 0.67 0.71 0.74 0.77 0.79 0.81 0.83 0.84 0.85 0.86 0.87 0.89 0.90 0.93 0.94 0.93 0.94 1.00 1.05 1.09 1.12 1.07 1.11 1.13 1.15 0.63 0.66 0.71 0.74 0.77 0.79 0.81 0.83 0.85 0.85 0.85 0.87 0.88 0.90 0.91 0.92 0.91 0.92 0.97 1.03 1.08 1.11 1.07 1.11 1.14 1.16 0.64 0.67 0.71 0.73 0.76 0.79 0.81 0.83 0.85 0.85 0.85 0.86 0.87 0.88 0.90 0.91 0.90 0.90 0.95 1.00 1.06 1.10 1.08 1.11 1.14 1.18 0.66 0.68 0.69 0.72 0.76 0.79 0.81 0.83 0.84 0.85 0.84 0.85 0.86 0.88 0.89 0.90 0.89 0.90 0.93 0.99 1.04 1.09 1.08 1.12 1.16 1.19 0.67 0.68 0.68 0.70 0.76 0.78 0.81 0.83 0.84 0.85 0.84 0.85 0.86 0.87 0.89 0.89 0.89 0.89 0.92 0.97 1.02 1.07 1.06 1.11 1.16 1.19 0.67 0.68 0.69 0.69 0.73 0.78 0.81 0.83 0.84 0.85 0.84 0.84 0.85 0.87 0.88 0.89 0.88 0.88 0.91 0.95 1.00 1.04 1.04 1.09 1.14 1.18 0.68 0.69 0.70 0.70 0.72 0.78 0.80 0.83 0.84 0.83 0.83 0.83 0.84 0.85 0.87 0.87 0.87 0.86 0.89 0.92 0.97 1.01 1.01 1.06 1.11 1.16 0.69 0.70 0.72 0.72 0.72 0.72 0.76 0.80 0.82 0.83 0.83 0.82 0.82 0.83 0.84 0.85 0.85 0.85 0.85 0.85 0.90 0.95 0.99 0.99 1.04 1.09 1.14 0.70 0.70 0.71 0.71 0.75 0.78 0.80 0.81 0.82 0.81 0.81 0.81 0.82 0.82 0.83 0.83 0.83 0.86 0.89 0.93 0.98 0.98 1.03 1.08 1.12 0.69 0.68 0.68 0.74 0.77 0.79 0.80 0.80 0.80 0.80 0.80 0.81 0.82 0.62 0.82 0.82 0.85 0.88 0.92 0.96 0.97 1.01 1.06 1.10 0.67 0.67 0.72 0.75 0.79 0.79 0.79 0.78 0.78 0.79 0.79 0.80 0.81 0.81 0.81 0.84 0.87 0.91 0.95 0.96 1.00 1.04 1.08 0.68 0.71 0.74 0.76 0.77 0.77 0.77 0.77 0.78 0.78 0.79 0.79 0.80 0.80 0.83 0.86 0.90 0.94 0.95 0.99 1.03 1.06 0.68 0.70 0.71 0.75 0.77 0.78 0.76 0.76 0.76 0.79 0.71 0.78 0.78 0.79 0.80 0.82 0.86 0.90 0.93 0.94 0.98 1.01 1.04 0.69 0.69 0.70 0.76 0.75 0.76 0.75 0.75 0.76 0.77 0.78 0.79 0.80 0.82 0.85 0.89 0.92 0.93 0.97 1.00 1.03



図 5-29 波向ベクトル分布 (WNW)



図 5-30 波向数值分布 (WNW)

1			1			1			1					1		1 1	/				_	-	1-
0.99	1.01 1.03	3 1.05	1.07	1.08	1.09 1.	10 1,11	1 1.12	1.14	1.15	1.16	1.18	1.19	1.20	1.21	1.22	1,24	1.26	1.27	1.28	1.28	1.29	1.29	1.28
0.98	1,00 1.0	2 1.05	1.06	1.08	1.09 1.	10 1.11	1.12	1.13	1.14	1.16	1.17	1.19	1.20	1.21	1.22	1.25	1.26	1.27	1.27	1.28	1.30	1.30	1.31
0.97	1.00 1.0	2 1.04	1.06	1.07	1.08 1.	09 1.10	1.12	1.13	1.14	1.16	1.17	1.19	1.20	1.20	1.23	1.25	1.26	1.27	1.28	1.28	1.30	1.31	1.31
0.96 (	0.99 1.0	1 1.04	1.05	1.07	1.08 1.	09 1.10	1.11	1.13	1.14	1.15	1.17	1.18	1.19	1 20	1.22	1.25	1.27	1.28	1.28	1.28	1.30	1.31	1.31
0.95	0.98 1.0	1.03	1.05	1.06	1.08 1.	09 1.10	1.11	1.12	1.14	1.15	1.17	1.18	1.19	1.20	1 22	1.25	1.27	1.28	1.28	1.28	1.30	1.31	1.31
0.94	0.97 1.0	1.03	1.05	1.06	1.08 1.	09 1.10	1.11	1.12	1.13	1.15	1.16	1.18	1.18	1.19	1.22	1.25	1.27	1.28	1.28	1.27	1.30	1.30	1.31
0.91	0.96 0.9	9 1.02	1.04	1.06	1.07 1.	09 1.10	1.10	1.12	1,13	1.14	1.16	1.17	1.18	1.19	1.22	1.25	1.26	1.27	1.28	1.27	1.29	1.30	1.31
0.89 (	0.95 0.9	8 1.01	1.04	1.05	1.07 1.	08 1.09	1.10	1.11	1.13	1.14	1.15	1.16	1,17	1.18	1.20	1.24	1.26	1.27	1.27	1.27	1.29	1.30	1.31
0.88 (	0.92 0.9	1.01	1.03	1.05	1.07 1.	08 1.09	9 1.10	191	1.12	1.13	1.15	1.16	1.17	1.17	1.19	1.22	1.25	1.27	1.27	1.26	1.28	1.30	1.30
0.88 (	0.92 0.9	0.99	1.02	1.05	1.06 1.	08 1.09	9 1.10	1.10	1.11	1.13	1.14	1.15	1.16	1.16	1.18	1.21	1.24	1.26	1.27	1.27	1.28	1.29	1.30
0.89 (	0.92 0.94	4 0.98	1.01	1.04	1.06 1.	07 1.09	9 1.09	1.10	1.11	1 12	1.13	1.14	1.15	1.16	1.17	1.20	1.23	1.25	1.27	1.27	1.29	1.30	1.31
0.89 (	0.92 0.93	3 0.95	0.99	1.03	1.05 1.	07 1.08	3 1.09	1.09	1.10	1.91	1.12	1.14	1.15	1.15	1.17	1.19	1.22	1.24	1.26	1.26	1.29	1.31	1.31
0.89	0.91 0.93	2 0.93	0.98	1.01	1.04 19	86 1.07	7 1.08	1.09	1.09	1.10	1.12	1.13	1.14	1.15	1.16	1.19	1.21	1.23	1.25	1.25	1.28	1.29	1.29
0.89	0.91 0.9	2 0.93	0.95	1.00	1.03 1.	05 1.07	1.08	1.08	1.09	1.10	1.11	1.12	1.13	114	1.15	1.18	1.20	1.22	1.23	1.24	1.26	1.27	1.28
0.90.0	0.91 0.9	3 0.94	0.94	0.99	1.03 1.	05 1.06	5 1.07	1.07	1.08	1.09	1.10	1.11	1.12	1.13	1.14	1.17	1.19	1.20	1.22	1.23	1.25	1.26	1.27
1 ale	0.91 0.9	0.92	0.92	0.96	1.00 1.	03 1.05	5 1.06	1.06	1.07	1.08	1.09	1.10	-I	1.12	1.14	1.16	1.18	1.19	1.21	1.22	1.24	1.25	1.26
~	0.9	0.89	0.88	0.95 (	0.98 1.	01 1.03	3 1.05	1.05	1.06	1.07	1.08	1.09	1/10	1.11	1.13	1.15	1.17	1.18	1.20	1.21	1.22	1.24	1.25
	1	0.88	0.87	0.93 (	0.96 1.	00 1.02	2 1.03	1.04	1.05	1.06	1.07	1.08	1.09	1.10	1.12	1.14	1.16	1.18	1.19	1.20	1.21	1.23	1.23
		1 h	0.88	0.91 (	0.95 0.	98 1.00	0 1.01	1.03	1.04	1.05	1.06	1.07	1.09	1.10	1.11	1.13	1.15	1.17	1.18	1.19	1.20	1.22	1.22
			0.88	0.90 (	0.91 0.9	96 0.98	3 1.00	1.01	1.03	1.04	1.00	9.07	1.08	1.09	1.11	1.12	1.14	1.16	1.17	1.18	1.20	1.20	1.21
				0.89 (	0.90 0.	91 0.99	0.99	1,00	1.01	1203	1.05	1.06	1.07	1.09	1.10	1.12	1.13	1.15	1.16	1.17	1.19	1.19	1.20
					0	91 0.96	5 0.94	0.99	1.00	1.01	1.03	1.05	1.06	1.08	1.09	1.11	1.12	1.14	1.16	1.16	1.17	1.18	1.19
						0.97	0.95	0.96	0.97	0.99	1.01	1:04	1.06	1.07	8.09	1.10	1,12	1.13	1.15	1.15	1.16	1.17	1.18
						1	X	0.96	0.89	0.95	0.99	1.02	1.05	1.07	1.09	1.10	1.12	1.13	1.14	1.15	1,15	1.16	1.16
						1		0.94	0.88	0.92	0.91	1.01	1.04	1.07	1.09	1.10	1.11	1.12	1.13	1.14	1.14	1.15	1.15
					A		~	$\sim$	0.88	0.00	0.95	0.99	1.03	1.06	1.08	1.10	1.11	1.11	1.12	1.13	1.13	1.14	1.15
					A	4		/•		0.00	0.0	A	1.0%	1.05	1.01	1.09	1.10	1.11	1.11	1.12	1.13	25	1.15
				$/\!/$	$\langle \rangle$	>	1		/	1	7		11		1.04	10.0	1.09	1.10	1.11	1.10	1.12	1.10	1 13
		1	5	Ì.	10	1		/	5	1	1			1		104	1.00	1.03	1.10	1.10	1.11	1.12	1 12
		1	1.	1.		/	5			1	1	1			>	5	V	104	1.07	1.08	1.09	1.10	1.11
		/	1.	1	X	/	/						1	/	1	$\langle \ \rangle$	1		1.07	1.05	1.07	1.09	1.09
			1	1	X:	Y								~		1		1		1.07	1.05	1.06	1.07
				1	1	es.											)	1	1	)	1.04	1.06	1.05
					1.	1.	8												X	1		1	1.06
					1	19	14	c.									1	V		1			1
		4		Wave	e dir	ectio	n	N	(3	860)								1			1	1	
	-(	Ð		Wave	e hei	ght		1.	36 r	n													1
		T	Ī	Wave	e peri	od		6.	10 :	sec		0					50				1	00	n

図 5-31 換算沖波波高分布 (N)



図 5-32 波向ベクトル分布 (N)



図 5-33 波向数值分布 (N)

算出した換算沖波波高分布より H<sub>1/3</sub>, H<sub>max</sub> を表 5-19、表 5-20 に整理した。算出例を図 5-35 に示す。また同表より水深と H<sub>1/3</sub>, H<sub>max</sub>の関係を図 5-34 に整理した。

同図によれば、浅海域においては $H_{1/3}$ ,  $H_{max}$  共に WNW が高く、それ以外の水深ではN が高い値を示している。よってこれ以降の波頂高の検討については、N, WNW を対象とする。

M2波	句(°)	波高(m)	周期(s)	潮位(m)	Lo	勾配 (1/x x=)	水深 h(m)	Ho'(m)	H1/3(m)	Hmax(m)
							16.0	0.87	0.80	1.40
							15.0	0.84	0.80	1.40
							12.5	0.80	0.70	1.30
							11.5	0.78	0.70	1.30
							10.0	0.76	0.70	1.30
							9.0	0.76	0.70	1.30
							8.0	0.76	0.70	1.30
							7.0	0.76	0.70	1.30
WNW	324	3.17	9.2	2.30	132.04	10	6.0	0.76	0.70	1.30
							5.0	0.76	0.80	1.40
							4.0	0.76	0.80	1.40
							3.0	0.76	0.80	1.50
							2.0	0.76	08.0	1.50
							1.0	0.76	0.90	1.70
							0.0	0.76	1.20	2.10
							-1.0	0.76	1.30	1.80
							-2.0	0.70	0.30	0.80
							16.0	0.70	0.70	1.20
							10.0	0.66	0.60	1.20
							11.5	0.60	0.60	1.10
							10.0	0.63	0.00	1.00
							9.0	0.61	0.60	1.00
							8.0	0.61	0.60	1.00
							7.0	0.61	0.60	1.00
NW	327	1.78	6.3	2.30	61.92	10	6.0	0.60	0.50	1.00
	<b>v</b> -,		*		•		5.0	0.60	0.60	1.00
							4.0	0.59	0.50	1.00
							3.0	0.59	0.60	1.00
							2.0	0.58	0.60	1.00
							1.0	0.58	0.60	1.10
							0.0	0.58	0.60	1.20
							-1.0	0.58	0.90	1.50
							-2.0	0.58	0.40	0.60
							16.0	0.74	0.70	1.30
							15.0	0.72	0.70	1.20
							12.5	0.70	0.60	1.20
							11.5	0.68	0.60	1.10
							10.0	0.67	0.60	1.10
							9.0	0.67	0.60	1.10
							7.0	0.00	0.60	1.10
NINIW	220	1.9.1	6.4	2 20	63.00	10	7.0	0.00	0.60	1.10
ININW	330	1.01	0.4	2.30	03.90	10	5.0	0.05	0.00	0.00
							4.0	0.55	0.00	1.10
							3.0	0.64	0.00	1.10
							2.0	0.63	0.60	1.10
							1.0	0.63	0.60	1.20
							0.0	0.62	0.70	1.30
							-1.0	0.62	0.90	1.50
							-2.0	0.62	0.40	0.60
							16.0	1.14	1.10	2.00
							15.0	1.11	1.10	1.90
							12.5	1.08	1.00	1.80
							11.5	1.07	1.00	1.80
							10.0	1.05	1.00	1.70
							9.0	1.05	1.00	1.70
							8.0	1.04	1.00	1.70
							7.0	1.04	0.90	1.70
N	360	1.70	6.1	2.30	58.05	10	6.0	1.03	0.90	1.70
							5.0	1.03	0.90	1.70
							4.0	1.02	1.00	1.70
							2.0	1.02	1.00	1.20
							1.0	1.01	1.00	1.00
							0.0	0.99	1.20	2.10
							-1.0	0.99	1.20	1.70
							-2.0	0.99	0.50	0.70

表 5-19 換算沖波波高, H<sub>1/3</sub>, H<sub>max</sub>一覧

波向はNから時計まわりの角度

表 5-20 換算沖波波高, H<sub>1/3</sub>, H<sub>max</sub>一覧

M3波	向(°)	波高(m)	周期(s)	<b>潮位</b> (m)	Lo	<b>勾配</b> (1/x x=)	水深 h(m)	Ho'(m)	H1/3(m)	Hmax(m)
							16.0	0.80	0.80	1.40
							15.0	0.80	0.80	1.40
							12.5	0.79	0.80	1.40
							11.5	0.79	0.80	1.40
							10.0	0.78	0.80	1.40
							9.0	0.78	0.80	1.40
							8.0	0.77	0.80	1.40
							7.0	0.77	0.80	1.40
NNE	22.5	0.80	3.8	2.30	22.53	10	6.0	0.76	0.70	1.30
							5.0	0.76	0.70	1.30
							4.0	0.75	0.70	1.30
							3.0	0.75	0.70	1.30
							2.0	0.74	0.70	1.20
							1.0	0.74	0.70	1.20
							0.0	0.73	0.70	1.20
							-1.0	0.73	0.80	1.30
							-2.0	0.73	0.40	0.50
							16.0	0.86	0.90	1.50
							15.0	0.85	0.80	1.50
							12.5	0.85	0.80	1.50
							11.5	0.84	0.80	1.50
							10.0	0.83	0.80	1.50
							9.0	0.83	0.80	1.50
							8.0	0.83	0.80	1.50
							7.0	0.82	0.80	1.40
NE	45	0.90	3.8	2.30	22.53	10	6.0	0.82	0.80	1.40
							5.0	0.82	0.80	1.40
							4.0	0.82	0.80	1.40
							3.0	0.81	0.80	1.40
							2.0	0.81	0.70	1.30
							1.0	0.81	0.70	1.30
							0.0	0.80	0.80	1.40
							-1.0	0.80	0.90	1.40
<u> </u>							-2.0	0.80	0.40	0.50
							16.0	0.74	0.70	1.30
							15.0	0.73	0.70	1.30
							12.5	0.72	0.70	1.30
							11.5	0.72	0.70	1.30
							10.0	0.71	0.70	1.30
							9.0	0.71	0.70	1.30
							8.0	0.71	0.70	1.30
							7.0	0.71	0.70	1.30
ENE	67.5	0.90	3.8	2.30	22.53	10	6.0	0.71	0.70	1.20
							5.0	0.70	0.70	1.20
							4.0	0.70	0.70	1.20
							3.0	0.70	0.60	1.20
							2.0	0.70	0.60	1.20
							1.0	0.70	0.60	1.20
							0.0	0.69	0.70	1.20
							-1.0	0.69	0.80	1.30
							-2.0	0.69	0.40	0.50

波向はNから時計まわりの角度

WNW

WNW



図 5-34 砕波帯内の有義波高算定図



図 5-35 水深と H<sub>1/3</sub>, H<sub>max</sub>の関係(M.H.H.W 時)

水深別に波頂高(C<sub>max</sub>)を算出した結果を表 5-21 に示す。C<sub>max</sub>/H<sub>max</sub> は図 5-36 より読み取っ た。表 5-21 によれば、汀線付近において約 1.5m の値が算出された。

Cmax //timax	090	0.60	0.61	0.61	0.61	0.62	0.62	0.62	0.62	0.63	0.64	0.65	0.67	0.70	0.71	0.76	0.83	BUTUS
H13 /h	0.06	0.06	0.07	10:0	0.08	60.0	0.09	0.10	0.11	0.13	0.15	0.18	0.23	0.32	0.51	1.00	1.73	ax=H13#1
Hmax /Ho	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.86	2.10	231	1.07	Litt Hum
H13 /H0	560	680	660	660	260	0.92	0.91	160	0.91	26.0	0.93	0.94	96'0	1.04	1,18	1.71	0.69	0.74.0 BL
h /Ho	16.05	15.59	13.70	12.90	11.11	10,76	9.90	8.94	8.06	80'1	6.18	5.20	4.26	330	2.32	171	0.39	书/H(住
h/10	0.315	0.298	0255	0.238	2120	0.195	0.177	0.160	0.143	0.126	0.109	0.091	0.074	19070	01-010	0100	0.002	
Ha' /La	0.020	0.019	0.019	8100	0.018	0.018	0.018	0.018	0.018	0.018	810.0	0.018	0.017	1100	0.017	0.006	0.006	
Cmax (m)	1.16	1.13	1.10	1.10	1.07	1.09	1.06	1.06	1.05	1.17	1.18	1.20	122	1.30	1.48	1.34	0.67	
Hmax (m)	1.94	1.83	1.80	1.80	1.75	1.75	1.71	1.71	1.69	1.85	1.84	1.84	1.82	1.86	2.08	1.76	180	
(m)	1.08	1.05	1.00	1.00	160	18.0	0.95	0.95	10.94	0.95	0.95	0.96	16.0	1.04	1.17	1.30	0.52	
Ho (m)	1.14	1.11	1.08	1.07	1.05	1.05	1.04	1.04	1.03	1.03	1.02	1.02	1.01	1.00	66'0	0.76	0.76	
来 h(m)	16	15	12.5	11.5	10	9.0	8.0	2.0	6.0	5.0	4.0	3.0	2.0	1.0	0.0	-1.0	-20	
<b>勾配</b> (1/× ×=)								10								9	2	
潮位 (m)								2.30								00.5	007	
Lo								50.85										
渡回								360.0								0.000	01-70	
周期 (s)								6.1	1							50	7R	
演局 (m)								1.36									201	
M2波向								z	1							-		

表 5-21 水深別波頂高(50 年確率波、潮位 M.H.H.W)



出典:港湾構造物の耐波設計 P212 図 5-36 最高波頂高の観測

## 5-2-2 静穏度検討

# 5-2-2-1 計算方法

静穏度の検討フローを図 5-37 に示す。





#### 5-2-2-2 対象施設沖合地点の波浪検討

#### 5-2-2-2-1 推算データを対象施設沖合に換算

図 5-20 に示す波向別換算率により M2 地点の波浪データを M1 地点の波浪にする。

(1) 手法

波浪変形計算はエネルギー平衡方程式を用いる。エネルギー平衡方程式の基礎方程式は参考資料3に示す。

- (2) 条件
  - ・波浪

5か年間(2010年~2014年)

·波浪換算

換算対象波向: M1 地点の地形を考慮(前出図 5-28 参照)して WNW~N~ENE の7 方向とした。換算沖波周期: WNW~N~ENE 方向の周期はほぼ 3.0~8.0sec であるので、4, 6, 8secを設定した。

・その他

水深及び地形、潮位、計算範囲及び計算格子間隔は 5-2-1-3-2 条件に同様とする。

油油油白	波	【高換算値(n	n)	換算	算後の波向(	° )
/ 中//又//又四	4.0s	6.0s	8.0s	4.0s	6.0s	8.0s
WNW	0.51	0.51	0.51	324	324	324
NW	0.63	0.63	0.63	327	327	327
NNW	0.84	0.84	0.83	329	329	329
N	0.80	0.80	0.79	0	0	0
NNE	0.83	0.82	0.81	29	29	29
NE	0.82	0.81	0.80	43	43	43
ENE	0.74	0.74	0.73	48	48	48

表 5-22 波浪換算

波向はNから時計まわりの角度





図 5-38 波浪換算

(3) 結果

表 5-3、図 5-38 は波向別、周期別に波浪変形計算を行ない、沖合から M1 地点への換算率を 求めたものである。アロル島、アタウロ島の影響で開口している NNW、NNE、NE への換算率 が高くなっている。この換算率をもとに、表 5-23~表 5-25 に示す M2 地点の波を M1 地点の波 に変換した結果を表 5-26~表 5-28 に示す。

(99.87) (0.00) (0.13)	Evendance		14589 (100.00)	8925 (61.18)	4913 (33.68)	(13.09)	629 (4.31)	313 (2.15)	152 (1.04)	69 (0.47)	29 (0.20)	7 (0.05)	0(000)	0 (0 0)	0 (00.00)	0(0.00)	0	0 (00 0)	0 (00 0)	0(000)	0(000)	0(000)	0(000)	0(00:00)	0(00:00)	0(00:0)	0(000)		
14589	Total	IPIO	5664 (38.82)	4012 (27.50)	3003 (20.58)	1281 (8.78)	316 (2.17)	161	83 (0.57)	40 (0.27)	22 (0.15)	7 (0.05)	00(0)	0 00)	00(0)	0 (0.00)	0 000	0000)	00(0)	0(000)	0(000)	0(0:00)	0(000)	0(000)	(000)	0(000)	0(0.00)	14589 (100.00)	
bserved Calm Missing	19.0		49 (0.34)	30 (0.21)	6 (0.06)																							88 (0.60)	88 (0.60)
911	18.0	18.9	(0.15)	20 (0.14)	8 (0.05)																							50 (0.34)	138 (0.95)
	071	17.9	172 (1.18)	95 (0.65)	30 (0.21)									1														297 (2.04)	435 (2.98)
	16.0	16.9	225 (1.54)	146	43 (0.29)	3 (0.02)												-										417 (2.86)	852 (5.84)
	15.0	15.9	411 (2.82)	236	49 (0.34)																							696 (4.77)	1548
	14.0	14.9	928 (6.36)	448 3.07)	29 0.20)									-					-									1405 9.63)	2953 20.24) (
	13.0	13.9	1129	316 2.17) (	6 (0.04)		_							-				-	-						-			1451 9.95) (	4404 (30.19) (3
	12.0	12.9	1109	123 (0.84) (	1 (100	1 (100	-												-									8.46) (	5638 (3.65) (3
	0.11	11.9	707 (.	25 ((			_									-			-						_			732 1	370 3.66) (3
	10.0	10.9	140 (4	2 (0			-						-	-				-										42 (5	512 64) (4
	9.0	9.9	07) (0	6 (0			_							-		-			-						_			11) (0	328 6. .75) (44
	8.0	8.9	7 (0	01) (0	7 05)	6 04)	3 02)		-					-			-	-	-		-		_		_		-	4 (0	52 65 91) (44
	0'2	7.9	0)	4) (0.	3) 4 (0)	0	9 (0)	11	18 2)	18 2)	14	5) 7	-	-				-	-						-			0) (0.	59 65 51) (44
	0.1	6	4	(0.0)	(0.0)	02	0.0)	86	52 (0.1	22 (0.1	8 (0.1	(0.0)																87 (0.6	(45.5
	9	9	(01.0)	(0.13)	(0.27)	1(0.70)	(0.66)	(0.67)	(0.36)	(0.15)	(0.05)																	451 (3.09)	7090 (48.60)
5	5.0	5.9	(0.19)	126 (0.86)	290 (1.99)	(1.24)	91 (0.62)	42 (0.29)	(0.09)																			771 (5.28)	7861 (53.88)
I412 All month Is	4.0	4.9	223 (1.53)	712 (4.88)	345 (2.36)	437 (3.00)	(113	(001)																				(12.61)	9701 (66.50)
01001-20 01LI(M2wa) VII direction	3.0	3.9	411 (2.82)	844 (5.79)	2025 (13.88)	547 (3.75)	3 (0.02)																					3830 (26.25)	13531 (92.75)
Month: 2 Point: 1 irection: /	1	2.9	79 (0.54)	857 (5.87)	118 (0.81)	(0.03)																						1058 (7.25)	14589 (100.00)
Wave D	Wave Period(s)	Wave Height(m)	- 0.24	0.25 - 0.49	0.50 - 0.74	0.75 - 0.99	1.00 - 1.24	1.25 - 1.49	1.50 - 1.74	1.75 - 1.99	2.00 - 2.24	2.25 - 2.49	2.50 - 2.74	2.75 - 2.99	3.00 - 3.24	3.25 - 3.49	3.50 - 3.74	3.75 - 3.99	4.00 - 4.24	4.25 - 4.49	4.50 - 4.74	4.75 - 4.99	5.00 - 5.24	5.25 - 5.49	5.50 - 5.74	6.75 - 5.99	6.00 -	Total	Exceedance

# 表 5-23 地点 M2 波高・周期頻度表

(99.87) (0.00) (0.13)	Esceedance	14589 (100.00)	8925 (61.18)	4913 (33.68)	1910	629	313	152	69	29 (0.20)	7 (11.05)	0 000	0 (0 00)	0 (0.00)	0 0000	0	0 (000)	0(00)	0(0.00)	0(00)	0(00:0)	0(0.00)	0(00)	0(000)	0(00)	0(0.00)		
14589 0 19	Total	5664 (38.82)	4012 (27.50)	3003 (20.58)	1281 (8.78)	316	161	83	40	22 (0.15)	10.05	0 000	0 000	0 00)	0.001	0 001	0 000)	0 00)	0(0.00)	0(0.00)	0.00)	0(0.00)	0 (0.00)	0 (0.00)	0(0.00)	0(0.00)	14589 (100.00)	
Observed Calm Missing	CAM	0 (00.0)																									0(0.00)	0(0.00)
	ż	63 (0.43)	48 (0.33)	15 (0.10)	7 (0.05)	6 (0.04)	8 (0.05)	2	Itaini																		149 (1.02)	(1.02)
	MNN	67 (0.46)	62 (0.42)	30 (0.21)	17 (0.12)	5 (0.03)	2 (0.01)	3	- and																		186 (1.27)	335 (2.30)
	MN	66 (0.45)	115 (0.79)	49	29 (0.20)	12 (0.08)	4	linatal																			275 (1.88)	610 (4.18)
	MNM	255 (1.75)	746 (5.11)	579 (3.97)	368 (2.52)	180	115	72	38	20	10.051	- Thorne															2380 (16.31)	2990 (20.49)
	w	79 (0.54)	105 (0.72)	103	29 (0.20)	14 (0.10)	13	6	2 (0.01)	2 (0.01)																	353- (2.42)	3343 (22.91)
	WSW	83 (0.58)	50 (0.34)	17 (0.12)	8 (0.05)	3 (0.02)	8	100-01																			(2171) 121	3514 (24.09)
	SW	4849 (33.24)	1445 (9.90)	176	5 (0.03)																						6475 (44.38)	9989 (68.47)
	MSS																										0,00()	9989 (68.47)
	s																										0(000)	6866
	SSE	5 (0.03)	3 (0.02)	Sector 1																							8 (0.05)	9997 (68.52)
	SE	10.07)	135 (0.93)	207	37 (0.25)	1 (0.01)	Ventor																				390 (2.67)	10387 (71.20)
	ESE	77 (0.53)	1136	1754 (12.02)	756 (5.18)	89 (0.61)	11	200-00																			3823 (26.20)	14210 (97.40)
	ш	13 (0.09)	93 (0.64)	61	25 (0.17)	6 (0.04)	Chanta L				-																198 (1.36)	14408 (98.76)
All months	ENE	85 (0.58)	74 (0.51)	12 (0.08)	- Longer					1	T		1					1									171 (1.17)	14579 (99.93)
11001-2014	N	8 (0.05)					T	T		1			1										-				8 (0,05)	14587 (99.99)
Month: 2 Point: D	NNE	2 (0.01)									1																2 (0.01)	14589 100.00)
	Wave Direction	- 0.24	0.25 - 0.49	0.50 - 0.74	0.75 - 0.99	1.00 - 1.24	1.25 - 1.49	1.50 - 1.74	1.75 - 1.99	2.08 - 2.24	2.25 - 2.49	2.50 - 2.74	2.75 - 2.99	3.00 - 3.24	3,25 - 3,49	3,50 - 3,74	3.75 - 3.99	4.00 - 4.24	4.25 - 4.49	4.50 - 4.74	4.75 - 4.99	5.00 - 5.24	5.25 - 5.49	5.30 = 5.74	5.75 - 5.99	6.00 -	Total	Exceedance

### 表 5-24 地点 M2 波高·波向頻度表

$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	17     26     4     11       112     0.08     0.03     0.08     0       131     360     90     78     0       94     967     151     71     6       94     967     151     71     6       0.42     (1.04)     0.53)     0     6       0.42     (1.04)     0.20)     71     6       0.42     (1.04)     0.20     28     29       184     97     1.0     0     10       0.42     (1.04)     0.20     20     10       0.18     7.2     1     0.01     0       194     9.1     0.201     0.16     0       1056     1     0.201     0.16     0       118     7.2     0.1001     0.010     0       119     7.2     0.1001     0.010     0       114     1.2     1.1     2.1     1.0       114     1.2     0.1001     0.010     0       114     1.2     1.1     1.0     1.0       114     1.2     1.1     1.0     1.0       114     1.1     0.101     0.1     1.0       12     1.1     1.0	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	26         4         11         0.03         0.03         0.03         0.03         0.03         0.03         0.03         0.03         0.04         0.05 <th0.05< th=""> <th0.05< th="">         0.05<th>26         4         11         0.083         0.033         0.033         0.033         0.033         0.033         0.033         0.033         0.03         0.033         0.03         0.033         0.03         0.033         0.03         0.033         0.03</th><th><math display="block">\begin{array}{c ccccccccccccccccccccccccccccccccccc</math></th><th>4         11         0.03         0.03         0.03         0.04         0.03         0.04         0.03         0.04</th><th>4         11         4         11           0.03         0.08         0.08         0           51         51         71         6           1         71         6         1         6           23         24         0         1         1         1           1         1         2         0         1</th><th><math display="block">\begin{array}{c ccccccccccccccccccccccccccccccccccc</math></th><th><math display="block">\begin{array}{c ccccccccccccccccccccccccccccccccccc</math></th></th0.05<></th0.05<>	26         4         11         0.083         0.033         0.033         0.033         0.033         0.033         0.033         0.033         0.03         0.033         0.03         0.033         0.03         0.033         0.03         0.033         0.03	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	4         11         0.03         0.03         0.03         0.04         0.03         0.04         0.03         0.04	4         11         4         11           0.03         0.08         0.08         0           51         51         71         6           1         71         6         1         6           23         24         0         1         1         1           1         1         2         0         1	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	360         90         78           361         90         78           367         151         151           151         151         17           153         123         10           386         29         29           386         29         29           386         29         10           386         1         0.20           72         1         0.20           72         0.40         1         10.20           12         2         1         1         1           72         0.40         1         1         2	360         90         78           (2.47)         (0.52)         (0.55)           (2.47)         (0.52)         (0.52)           (56)         1.1         (1.01)           (6.10)         (0.20)         (0.1)           366         (0.21)         (0.20)           72         (0.49)         (0.20)         (0.1)           72         (0.49)         (0.20)         (0.2)           72         (0.49)         (0.20)         (0.2)	0 90 78 0 1062) 052 0 1100 051 0 120 052 0 1100 052 0 1100 052 0 120 05	90 73 00.52) 0.55 (0.55) (0.55) (0.55) (0.55) (0.55) (0.55) (0.52) (0.11) (0.22) (0.11) (0.2) (0.11) (0.2) (0.11) (0.2) (0.11) (0.2)	90 51 51 51 51 51 51 51 51 51 51	23 24 24 24 24 24 24 24 24 24 24	23 (0.5) 24 (0.5) 24 (0.5) 24 (0.5) 27 (0.
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	2)         (0.90)         (2.47)         10           91         967         1         1           50         (0.54)         (6.53)         1           51         (0.42)         (4.04)         (0           26         366         3         3           62         580         3         3           62         586         3         3           0         0.42)         (1.04)         (0           26         356         3         3           1         14         14         14           14         0.49)         14         3           61         0.40)         0.49)         3           63         0.40)         0.49)         3           64         0.40)         3         3           65         0.40)         3         3           65         0.40)         3         3           66         3         3         3           67         0.40)         3         3           68         3         3         3           61         3         3         3           62	0         (0.90)         (2.47)         10           94         967         1           96         62         58(3)         1           9         (6.24)         (1.04)         10           26         366         14         10           9         14         0.49)         10           14         0.40)         14         10           10         14         72         10           10         14         0.49)         10           10         14         10.49         10           10         14         10.49         10           10         14         10.49         10           10         14         10.49         10           10         14         10.49         10           10         14         10         10           10         14         10         10           10         14         10         10           10         10         10         10	(0.90)         (2.47)         (0           94         967         1           (0.64)         663         663         1           (0.42)         (1.04)         (0         26           26         366         1         1           1         0         9         23         1           1         1         1         1         1           1         1         1         1         1           1         1         1         1         1         1           1         1         1         1         1         1           1         1         1         1         1         1         1           1	2.47) (0) 94 967 1 94 967 1 62 59 (6.63) 1.049 (0) 2.26 366 0.100 (0,49) 1.4 1.4 0.100 (0,49) 1.4 0.100 (0,49) 1.4 0.100 (0,49) 1.4 1.4 0.100 (0,49) 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4	0         (2.47)         (0           967         (1         967           0         (1,04)         (0           586         (1,04)         (0           0         (1,04)         (0           1         72         (1           1         72         (1	(2, 47)         (0           967         1           967         1           668         1           686         1           636         1           72         1           72         1           1	(2, 47)         (0           967         (1           589         (1, 04)           (1, 04)         (0           (1, 04)         (0           72         (0, 49)           72         (0, 49)		8 7 7 8 8		51 51 51 51 51 51 51 51 51 51 51 51 51 5	2016 Q & 201 - 0
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	22         94           0.155         0.055           0.055         0.042           0.055         0.042           0.055         0.042           1         0.055           0.055         0.042           1         0.055           0.055         0.042           1         0.055           0.056         1.14           0.100         0.101           0.12         0.101           0.12         0.101           0.12         0.101           0.12         0.101           0.12         0.101	0         94           0         654           0         652           652         6042           62         606           14         0           14         0           15         0           16         0           17         0           18         0           10         0           11         0           12         0           13         0           14         0           15         0           16         0           17         0	0 0.054 0.42 0.4	94 6254 6254 918 918 10 10 11 11 11	94 0.164 0.186 0.186 0.10	The second			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0.49) 0 0.49) 0 0.49) 0 0.49)	967 967 10 10 10 10 10 10 10 10 10 10	967         1a1           10         (6.5)         (204)           888         294         1           888         1         (0.20)         (0.20)           72         (0.149)         (0.149)         (0.149)           72         (0.149)         (0.149)         (0.149)	967         1at           10         (653)         293           586         293         295           586         294         0.201           72         0.0         0.203           72         0.0         0.493
1 (0.01) 16 (0.11) 128 (0.88)	1 16 16 16 128 128 128 128 128 128 (0.88) 720 (4.94)			$\begin{array}{c} 7 \\ 7 \\ (0.0) \\ 14 \\ (0.0) \\ 12 \\ 12 \\ 12 \\ 12 \\ 12 \\ 10 \\ 11 \\ 10 \\ 10$	$\begin{array}{c} 0.0 \\ 7 \\ 0.0 \\ 0$	7 (0.05) (0.05) (0.05) (0.05) (0.05) (0.05) (0.05) (0.05) (0.05) (0.05) (0.02) (0.02) (0.02)	$\begin{array}{c} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 $	$\begin{array}{ccccccc} 0.42 & 0.42 & 0.42 & 0.42 & 0.42 & 0.42 & 0.42 & 0.42 & 0.42 & 0.42 & 0.42 & 0.16 & 0.06 & 0.16 & 0.06 & 0.16 & 0.06 & 0.16 & 0.06 & 0.16 & 0.06 & 0.16 & 0.06 & 0.11 & 0.06 & 0.11 & 0.06 & 0.11 & 0.06 & 0.11 & 0.06 & 0.11 & 0.06 & 0.01 & 0.10 & 0.01 & 0.0$	$\begin{array}{ccccccc} 0.100 & 0.020 & 0.020 \\ 7 & 7 & 0.035 & 0.042 \\ 0.055 & 0.060 & 0.060 \\ 7 & 7 & 0.060 & 0.100 \\ 12 & 0.068 & 0.100 & 0.101 \\ 12 & 0.068 & 0.100 & 0.101 \\ 11 & 0.088 & 0.100 & 0.101 \\ 11 & 0.088 & 0.010 & 0.101 \\ 11 & 0.001 & 0.011 & 0.000 & 0.101 \\ 11 & 0.001 & 0.011 & 0.000 & 0.101 \\ 11 & 0.001 & 0.000 & 0.101 & 0.000 & 0.000 & 0.000 \\ 11 & 0.000 & 0$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{c} 0.10 \\ 0.10 \\ 0.05 \\ 1 \\ 1 \\ 0.06 \\ 1 \\ 1 \\ 0.08 \\ 0.08 \\ 0.08 \\ 0.08 \\ 0.08 \\ 0.08 \\ 0.00 \\ 1 \\ 1 \\ 0.08 \\ 0.08 \\ 0.00 \\ 1 \\ 1 \\ 0 \\ 0.00 \\ 1 \\ 1 \\ 0 \\ 0.00 \\ 1 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\$	$\begin{array}{c} 0.05 & 0.020 \\ 0.05 & 0.42 \\ 0.05 & 0.42 \\ 0.06 \\ 12 \\ 0.08 \\ 0.08 \\ 0.10 \\ 11 \\ 0.08 \\ 0.10 \\ 12 \\ 0.08 \\ 0.10 \\ 12 \\ 0.00 \\ 12 \\ 0.00 \\ 1 \\ 0.01 \\ 0 \\ 0.01 \\ 0 \\ 0.01 \\ 0 \\ 0.01 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
a second se		1 (0.11) 16 (0.11) 128 (1.28) (1.28) (1.28) (1.29) (1.29) (1.29) (1.29) (1.29)	1 (0.01) 16 (0.11) 128 (0.88) 729 (1.23 (1.23) (1.23) (1.23) (1.23) (1.23) (1.23) (1.23) (1.23)	(0.11) 16 16 16 16 1.138 1288 1.289 1.289	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1 (0.01) (0 (0.01) (0 (0.01) (0 (0.01) (0 (0.01) (0 (0.01) (0 (0.01) (0 (0.01) (0 (0.01) (0 (0.01) (0 (0.01) (0 (0.01) (0 (0.01) (0 (0 (0 (0 (0 (0 (0 (0 (0 (0 (0 (0 (0	1         1         0           1         1         0         0           16         0.11         0         0           15         0.13         0         0           128         0         0         128           1283         0         0         0           1283         0         1283         0           1283         0         0         0           1299         0         0         0           1273         0         0         0           1283         0         0         0           1283         0         0         0           1273         0         0         0           1273         0         0         0           144         0         9399         1           1389         1         1389         0         0           1417         (2.265)         0         0         296           296         (2.203)         0         0         (2.203)         0	1 (0.11) (0 (0.11) (0 (0.11) (0 (0.11) (0 (0.11) (0 (0.11) (0 (0.11) (0 (0.11) (0 (0.11) (0 (0.11) (0 (0.11) (0 (0.11) (0 (0.11) (0 (0.11) (0 (0.11) (0 (0.11) (0 (0.11) (0 (0.11) (0 (0 (0 (0 (0 (0 (0 (0 (0 (0 (0 (0 (0	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1         1         0           1         1         0         0           16         (0.01)         16         0           173         0         123         0           1233         0         1233         0           1233         0         1233         0           1233         1233         0         1233           1233         1233         0         1233           1233         0         1223         0           1234         0         1233         0           1339         1233         0         1233           14475         0         1233         0           69.5         1339         0         1349           0         1339         0         1349           0         5.266         2.266         0           5.385         0         0.341         0           60.341         0         6.6.60         0           6.6.60         0         0         3.6           6.6.60         0         0         0           6.6.60         0         0         0           6.6.60	1         1         0           16         0.11         0           16         0.11         0           17         0         0           128         0         0           128         0         0           128         0         0           128         0         0           129         0         0           1233         0         0           1233         0         0           1233         0         0           1233         0         0           1233         0         0           1389         0         0           1339         0         0           1417         2286         0           1339         0         0           1417         2286         0           138         0         0           138         0         0           138         0         0           138         0         0	1         1         0           16         (0.01)         16           16         (0.11)         10           173         (0.123)         (0.123)           1233         (0.123)         (0.123)           1233         (0.123)         (0.123)           1233         (0.123)         (0.123)           1233         (0.144)         (0.123)           1233         (0.144)         (0.153)           1233         (0.156)         (0.156)           1339         (0.156)         (0.156)           14,755         (0.156)         (0.156)           138         (0.156)         (0.156)	1 (0.11) (0 (0 (0.11) (0 (0.11) (0 (0 (0 (0 (0 (0 (0 (0 (0 (0 (0 (0 (0	1         1         0           1         0.11         0           16         0.11         0           16         0.1383         0           128         0         128           1283         0         128           1233         0         1233           1233         0         1233           1233         0         1233           1233         0         1233           1233         0         1233           1233         0         1233           1233         0         1233           1233         0         1233           1233         0         1233           1233         0         1233           1389         1         1233           147         2365         0           138         1389         10           83         0         138           83         0         10           83         0         10	1         1         0           16         (0.01)         16           16         (0.11)         10           173         0         123           1233         0         123           1233         0         123           1233         0         123           1233         0         123           1234         0         123           1235         0         123           1234         0         123           1339         123         0           14,755         0         123           1339         0         123           14,755         0         123           1339         0         123           14,755         0         133           1339         10         133           134         0         134           135         13         134           14,775         13         13           138         13         13           14,475         14         14           14,475         14         14
(10)															
-											2 2 2 2 2 2 2 2 2 2 2	0.09 2.99 5.99 6.99 8.99 8.99	0.99 1.99 2.99 5.99 6.99 8.99	2.99 2.99 5.99 2.99 2.99 2.99 2.99 2.99	66 66 66 66 66 66 66 66 66 66 66 66 66

## 表 5-25 地点 M2 周期·波向頻度表

(0.13)	Turandarroa		3431 (23.52)	1591	431 (2.95)	98	(0.67)	(0.17)	5 (0.03)	0 (000)	0(000)	0 (000)	0 000	0	0	0	0000	0	0	0	0 (000)	0(0.00)	0	0	0 (0 00)	0(000)	(0.00)	0(000)		
19	Total	-	(12.61)	1160	333	73	(0.50)	(0.14)	5 (0.03)	0 (000)	0 (000)	0(000)	0 00	0 (000)	0	0	0000	0	0000	0	00(0)	0 (000)	0	00(0)	0 00()	0 (000)	0(00)	0(000)	3431 (23.52)	
Aissing	19.0	1				t	-									1	T			1				T					(000)	0(000)
-	18.0	18.9				t									-		t	1	t	1		T		1	F				000)	0.00)
	17.0	17.9				1									-	t	t	-	+	-		-		-	-				0000	0(000)
	16.0	16.9	-		-	+							-	-	-	+	t	-	+	+	-	-	-	+	-		-		00) (00	00) (00
	15.0	159			-	+		1							-	+	t	-	+	-		-	-	-	-				0) (00	00) (00
	14.0	149			-	+		-	_					-	-	-	+	-	+	-	-	-		-	-				0) (0	0) (0
	3.0	3.9	-		-	-		-					-	-	-	-	-	-	-	-	-	-		-	-				0.0) (0.0	0 (0.0
	20	2.9	_			-										-	-	_	-			_		-	_				0.00	0.00
	1 0.1	1 6				-											-			_								-	00:00	0000
	11 0	11 6																											(000)	0(000)
	10	10:																										1	(0.00)	(0.00)
	0.6	9.9																											(0.00)	0(000)
	8.0	8.9	(0.10)	1 (100)	1 (100)	1 and																							16 (0.11)	16 (0.11)
	1.0	7.9	(0.04)	25 (0.17)	33 (0 23)	16	(1110)	(0.05)									T			1				-					87 (0.60)	103 (0.71)
	90	6.9	42 (0.29)	215	137	40	(0.27)	(10.0)	4 (0.03)							T	t		1	T		-		T	t				448 (3.07)	551 (3.78)
	2:0	5.9	219	390	117	16	(11)	0.02)	1 (100						-	1	t		-					-					746 5.11)	(297 8.89)
	4.0	4.9	898 (16)	456	43	1	(10)	0	0						-	+	t	-	+			+		-	-				398 (58) (	695 (3.47) (0
	30	3.9	601 (6	47) (5	2 010		8								-	1	+	-	+	-	-	+		-	-				71 17 160) (09	366 2 2 (1
	-	2.9	60 (4	5 (0		2		-					-	-	-	-	+	+	+	-		-		+	-				5 6 15) (4	31 3.
	d(s)	(H	24 (0.4	49 (0.0	74	90	8	24	46	74	66	24	49	74	66	24	48	74	66	24	49	74	66	24	46	74	66	-	9 00	a 34
	Wave Period	Wave Height(r	- 0	0.25 - 0.	0.50 - 0.	0.76 - 0.0		1.00 - 1.	1.25 - 1.	1 - 021	1.75 - 1.	2.00 - 2.	2.25 - 2.	2.50 - 2.	275 - 25	3.00 - 3.1	3.25 - 3.4	3.50 - 3.	3.75 - 3.5	4.00 - 4.	4.25 - 4.	4.50 - 4.	4.75 - 4.1	5.00 - 5.2	5.25 - 5.4	5.50 - 5.	5.75 - 5.1	6.00 -	Total	Exceedano

# 表 5-26 地点 M1 波高・周期頻度表

101101 61	stal Exceedance	998 14589 .09) (100.00)	(60 1591 95) (10.91)	33 431 28) (2.95)	3 98 50) (0.67)	14) (0.17)	5 5 03) (0.03)	0 00) (0.00)	0 00) (0.00)	0 00(0)	0 00) (0.00)	0 (0.00)	0 00) (0.00)	0 0 00000000000000000000000000000000000	0 0 0	0 0 0	0 0 0 0 000)	0 0 0 0 0000	0 00) (0.00)	0 000) (000)	0 00) (0.00)	0 0 0 0000	0 0000000000000000000000000000000000000	0 0 0 000)	100000 1000	00) 000	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Strice	P W	58 12 48) (89	26	r 0	.0		9	9	9	0)	0	9		0)	0)	9	0	9	0	(0)	.0	9)	0	9		(0)	0) 0)
ane	CA	111					_											_									
	z	75 (0.51)	14 (0.10)	8 (0.05)	4 (0,03)	0.03)																					
	MNN	86 (0.59)	50 (0.34)	33 (0.23)	12 (0.08)	7 (60.03)	5 (0.03)	(And tax)																			
	MN	238 (1.63)	153 (1.05)	57 (0,39)	7 (0.05)																						
	WNW-	1069 (7.33)	876 (6.00)	232 (1.59)	50 (0.34)	8 (0.05)																					
	Ŵ	211 (1.45)	(61.0)	(0.01)																					Ī		
	WSW																										
	MS																										
	NSS																										
	so																										
	SSE																										
	SE																							-		1	
	ESE																										-
	щ	16 (0.11)					-					-	<b></b>				-								T	-	
	ENE	31 (0,21)	(10,01)																						T		
	NE	112 (0.77)	47 (0.32)	(0.01)			1					-					1							-			
	NNE	2 (0.01)											-		1		1							-			
	Wave Direction	- 0.24	0.25 - 0.49	0.50 - 0.74	0.75 - 0.99	1.00 - 1.24	1.25 - 1.49	1.30 - 1.74	1.75 - 1.99	2.00 - 2.24	2.25 - 2.49	2.50 - 2.74	2.75 - 2.99	3.00 = 3.24	3.25 - 3.49	3.50 - 3.74	3.75 - 3.99	4.00 - 4.24	4.25 - 4.49	4.50 - 4.74	4.75 - 4.99	5.00 - 5.24	5.25 - 5.49	5.30 - 5.74	K 7R - 5 QU	010 010	6.00 - 0.00

# 表 5-27 地点 M1 波高・波向頻度表

	Month: Point:	201001-20 DJL40M2m3	11412 () All mont	ų													Observed Calm Missing	11589	(99.87) (76.48) (0.13)
Wave Direction Wave Pariod(s)	NNE	NE	ENE	ίĽΪ	ESE	SE	SSE	s	SSW	SW	WSW	w	WNW.	MN	MNN	N	CAM	Total	Exceedance
- 2.99			9 (0.06)	4 (0.03)								(90.0)	25 (0.17)	9 (0.06)	1 (0.05)	2 (0.01)	11158 (76.48)	11223 (76.93)	14589 (100.00)
3.00 - 3.99	1 (0.01)	20 (0.14)	8 (0.05)	8 (0.05)								58 (0.40)	318 (2.18)	149 (1.02)	73 (0.50)	36 (0.25)		671 (4.60)	3366 (23.07)
4,00 - 4,99	1 (0.01)	62 (0.42)	7 (0.05)	4 (0.03)								71 (0.49)	899 (6.16)	233 (1.60)	74 (0.51)	47 (0.32)		1.398 (9.58)	2695 (18.47)
5.00 - 5.99		35 (0.24)	4 (0.03)									47 (0.32)	563 (3.86)	55 (0.38)	31 (0.21)	11 (0.08)		746 (5.11)	1297 (8.89)
6,00 - 6.99		35 (0.24)	4 (0.03)									24 (0.16)	358 (2.45)	9 (0.06)	8 (0.05)	(0.07)		448 (3.07)	551 (3.78)
7,00 - 7,99		6 (0.04)										6 (0.06)	72 (0.49)					87 (0.60)	103 (0.71)
8.00 - 8.99		2 (0.01)										14 (0.10)						16 (0.11)	16 (0.11)
66.6 - 9.99																		(00.0)	0(0.00)
10,00 - 10.99																		(0000)	0(0.00)
11.00 - 11.99																1		(00.0)	0.001
12.00 - 12.00																Ĩ		(0.00)	0(000)
13.00 - 13.99																		0 (0.00)	0(00.0)
14.00 = 14.99																		0 (000)	0 (00.0)
15.00 - 15.99																		(000)	0.00)
16.00 - 16.99																		(0.00)	0(000)
17,00 - 17.99																		(00'0)	0 (00.00)
18.00 - 18.99																		0 (000)	0(0.00)
- 00'61																		(00.00)	0(000)
¢																			
1																			
,																			
6																			
9																			
a.																			
Total	(0,01)	160 (01.10)	32 (0.22)	16 (0.11)	(0.00)	0 (0.00)	0 (0.00)	0(0.00)	(00'0)	0 (0.00)	(0.00)	232 (1.59)	2235 (15.32)	455 (3.12)	193 (1.32)	106 (0.73)	11158 (76,48)	14589 (100.00)	
Exceedance	14589 (100.00)	14587 (99.99)	14427 (98.89)	14395 (98,67)	14379 (98.56)	14379 (98.56)	14379 (98.56)	14379 (98.56)	14379 (98,56)	14379 (98.56)	14379 (98.56)	14379 (98.56)	(16:96)	(81.65)	(18.53)	(17.21)	11158 (76.48)		

### 表 5-28 地点 M1 周期·波向頻度表

### 5-2-2-2-2 風波の推算

(1) 手法

SMB 法により算出した。

- (2) 条件
  - ・風

M3 地点における 5 か年間(2010年~2014年)の風を使用した。

- ・有効吹送距離 有効吹送距離は、図 5-16 に示す値を使用した。なお、推算にあたっては、設計波算出の時と同 様に NNE~ENE 方向を対象とした。
- (3) 結果

推算結果を表 5-29~表 5-31 に示す。

	Exceedance	6717 (45.98)	1203	11	(0.08)	(000)	(0.00)	0 (000)	0 (000)	0 (00 0)	0 (000)	0	0	0	0 (000)	0 (000)	0 (000)	0 000)	0 (000)	0 (000)	0 00)	0 (0 00)	0 (0 00)	0 (0 (0)	0(000)	0 (000)	0 (00 0)		
	Total	5514 (37.75)	1192	11	(0.08)	(00.0)	(0.00)	0 000)	0 (000)	0(000)	0 000)	0	0	0	0 000	0 000)	0000)	0000)	0 00)	0(000)	0(00:0)	0 00)	0.00)	000)	0(000)	0(000)	0(000)	6717 (45.98)	
19.0	1				T								1	-														(000)	00.00
18.0	1 8			t	t								1	1										-				0.00)	0.00)
17.0	118			1	t																							000	0.00)
16.0	1 8 8			1	1								-	-	-			-	-					-				0 (000	0 (000
15.0	1 8 9			+	t		-	-	-			-	-	-	-			-						-				00) (00	00) (00
14.0	- 1		-	+	t		-	-	-			-	-	+	-			-	-					-	-		_	00 (00	00) (00
13.0	1 20			-	+		_		-			-	-	-	-			-						-				(0)	(0)
12.0	1 00			-	+							-	-	+	-			-						-				0) (0	0) (00
1.0	12			-	-		_		_			-	-	-				-	-	_	_					_	_	0.0) (0	0 (0.0)
1 01	1.0			_	-		_																	_				0.00	0.00
0																												(0.00)	0.00)
9.	1 a																											0(000)	0.00)
8.0	1 68																											0 (000)	0(000)
1.0	10																											0(0:00)	00(0)
6.0	1 8 9				T																1							0.00)	(0.00)
5.0	1 8				t																			-				0 (000)	0 (00 (0)
4.0	1 84			1									-															0 000)	0 (00)
3.0	1 8	161	29	3	02)		-						-	-	-			-						-		1		193 (	193
ŀ	1 6 6	5353 (1	1163	80	02) (0		_	-	-	-		-	-	+	+	-		+	-					-				(24 (66) ()	117 (198)
Period(s)	aieht(m)	- 0.24 (36	- 0.49	- 0.74	0)	- 0.99	- 124	- 1,49	+1.74	66'1 -	- 224	- 249	- 274	- 2.99	- 3.24	- 3.49	- 3.74	- 3.99	- 424	- 4.49	- 434	- 4.99	- 5.24	- 5.49	- 5.74	- 5.99	.,	ota) 66	edance 61
Wave	Marce H		0.25	0.50		0,75	1.00	1.25	1.50	1.75	2,00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	6.75	6.00	To	Exce

## 表 5-29 波高・周期頻度表

201001-201412 ÷ Mor

### 表 5-30 波高・波向頻度表

5-67

10.00																	Missing	0	(0.0)
Wave Direction Wave Period(a)	NNE	NE	ENE	щ	ESE	SE	SSE	N	NSS	MS.	MSM-	M	WNW	MN	MNN	z	CAM	Total	Exceedanc
- 2.99	1784 (12.21)	807 (5,52)	3933 (26.92)														7891 (54.02)	14415 (98.68)	14608 (100.00)
3.00 - 3.99	97 (0.66)	43 (0.29)	53. (0,36)															193 (1.32)	193 (1.32)
4.00 = 4.99																		0(0.00)	0(00:0)
5.00 - 5.99																		0(0.00)	0 (00:0)
6.00 - 6.99																		0(0.00)	(00.0)
7.00 - 7.99																		0(0.00)	0(00)
8.00 - 8.99																		0(0.00)	0(00)
9.00 ~ 9.99																		0.00)	0(00)
10.00 - 10.99																		0(0.00)	0 (00)
11.00 - 11.99																		0.00)	0(000)
12,00 - 12.99																		0(0.00)	0(00:0)
13.00 - 13.99																		0(0.00)	0(00.0)
14.00 - 14.99																		0(0.00)	0 (00.00)
15,00 - 15,99																		0(0.00)	0(00.0)
16,00 - 16.99																		0(0.00)	0(00.0)
17.00 - 17.99																		0(0.00)	(00:0)
18.00 - 18.99																		0(0.00)	(000)
19.00 -																		0(0.00)	0 (00.00)
1																			
1																			
1																			
4																			
,																			
4			. 1																
Total	1881 (12.88)	850 (5,82)	3986 (27.29)	0 (0.00)	0(000)	0 (00.00)	0(000)	0(0.00)	0 (000)	0(000)	(0,00)	0(0,00)	0(0.00)	(0.00)	0(000)	0 (000)	7891 (54.02)	14608 (100,00)	
Exceedance	14608 (100,00)	12727 (87.12)	(81.30)	7891 (54.02)	7891 (54.02)	7891 (54.02)	7891 (54.02)	7891 (54.02)	7891 (54.02)	7891 (54,02)	7891 (54.02)	7891 (54,02)	7891 (53.02)	7891 (54.02)	7891 (54.02)	7891 (54.02)	7891		

## 表 5-31 周期・波向頻度表

# 5-2-2-3 合成波算出

ここでは、前項で算出したM1地点での換算波浪とSMB法にて推算した波浪結果を合成した。 合成にあたっては、換算波浪とSMB法による推算波を比較して波高の大きい値を採用した。合成した結果を表 5-32~表 5-34 に示す。

(0.11)	voandance	an innanov	9722 (66.63)	2778 (19.04)	442 (3.03)	98 (0.67)	25 (0.17)	5 (0.03)	0 (000)	0 (000)	0 (000)	0	0	0	0	(0.00)	(000)	0.00)	0(000)	0 00	0000	0 00()	0	(00:00)	(00.0)	00.00)	00(00)	0 (0:00)	0(000)		
16	Total	1000	6944 (47.59)	2336 (16.01)	344 (2.36)	73 (0.50)	20 (0.14)	5 (0.03)	0(000)	0 000	0 00 0	0 00 0	0	0	0	(00.00)	(0.00)	0(0.00)	0(000)	0 (000)	0,000)	0(000)	0	(0.00)	(00.0)	(000)	0(000)	0(000)	0(000)	9722 (66.63)	
Missing	19.0															1		Ī						1						0(0.00)	0(000)
1	18.0	18.9		1											Ī	1		T						T						0(0.00)	0(000)
	17.0	17.9											-		t	+							-	t						0(000)	0()()()
	16.0	16.9					_				-				+	+		T												00(00	00) (00
	15.0	15.9									-		-	-	+	+		_	_				-			-				0) (0	0) (00
	14.0	14.9									-	-	-	-	+	+	_	_	_		-	-		-	_			_		(0)(0)	0) (0.0
	30	3.9									_				-	_	_	_						-						0.0(	0.0)
	0	9																												0.00)	00.00)
	12	12																												0.00)	0.00)
	11.0	11.9																												0(000)	0(000)
	10.0	10.9																												0(0:00)	0(0:00)
	9.0	9.9													1			T						T						0(0.00)	0(000)
	8.0	8.9	14 (0.10)	1 (10:0)	1 (10:0)								1		t	T														16 (0.11)	16 (0.11)
	1.0	7.9	6 0.04)	25 0.17)	33 0.23)	16 0.11)	7 0.05)								T	1		T						T		_				87 0.60)	103 0.71)
	0.9	6.9	40 (27) (0	215 (147) (1	137 (94) (0	40 (27) (0	10 (10)	4 (03)		-			1	-	+	+	_	-		-		-				_				46 (0	.76) (0
	5.0	5.9	32) (0	389 (1	117 (0	11) (0	3 (0	1 (0			-		-	-	+	+	-	-						+						92) (3	67 5 68) (3
	4.0	4.9	803 (1.	453 (2.1	43 (0.	1 (0.	(0)	0		-	-		-	-	-	+	_	_			-	_	-		_	_				0 71	7 12 (8.)
	0.0	3.9	07 (5.50	96 (3.10	5 (0.2)	(0.0)			-		-		-		-	+	_	_						-	_					130 (8.9	256 (17.5
		6	2 (4.85)	7 (0.66)	8 (0.03											_												_		808 (5.54)	3375 (23.13
		2	518 (35.51)	(7.93)	(0.05)																									6347 (43.50)	9722 (66.63)
	Wave Period(s)	Wave Height(m)	- 0.24	0.25 - 0.49	0.50 - 0.74	0.75 - 0.99	1.00 - 1.24	1.25 - 1.49	1.50 - 1.74	1.75 - 1.99	2.00 - 2.24	2.25 - 2.49	2.50 - 2.74	2.75 - 2.99	300 - 324		3.25 - 3.49	3.50 - 3.74	3.75 - 3.99	4.00 - 4.24	4.25 - 4.49	4.50 - 4.74	4.75 - 4.99		5.00 - 5.24	5.25 - 5.49	5.50 - 5.74	5.75 - 5.99	6.00 -	Total	Exceedance

# 表 5-32 波高・周期頻度表

We         Ex         Ex         State         State <th>Month: Point:</th> <th>201001-20 DILI00M2P</th> <th>) All month</th> <th></th> <th>Observed Calm Missing</th> <th>14592 4870 16</th> <th>(33,37) (11.0)</th>	Month: Point:	201001-20 DILI00M2P	) All month														Observed Calm Missing	14592 4870 16	(33,37) (11.0)
1         1000         1         1         1000 <th>N</th> <th></th> <th>ENE</th> <th>щ</th> <th>ESE</th> <th>Æ</th> <th>SSE</th> <th>s</th> <th>MSS</th> <th>SW</th> <th>MSM</th> <th>M</th> <th>WNW</th> <th>MN</th> <th>MNN</th> <th>N</th> <th>CAM</th> <th>Total</th> <th>Excedance</th>	N		ENE	щ	ESE	Æ	SSE	s	MSS	SW	MSM	M	WNW	MN	MNN	N	CAM	Total	Excedance
0.0         0.0 <td>- 12</td> <td>19</td> <td>3089 (21.17)</td> <td>1 (0.01)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>203</td> <td>980 (6.72)</td> <td>228 (1.56)</td> <td>82' (0.56)</td> <td>73</td> <td>4870 (33.37)</td> <td>11814 (80.96)</td> <td>14592 (100.00)</td>	- 12	19	3089 (21.17)	1 (0.01)								203	980 (6.72)	228 (1.56)	82' (0.56)	73	4870 (33.37)	11814 (80.96)	14592 (100.00)
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	2 2	176	837 (5.74)	1 march								19 (0.13)	876 (6.00)	153	50 (0.34)	14 (0.10)	Parentee's	2336 (16.01)	2778 (19.04)
0.201         0.201         0.001 <th< td=""><td></td><td>(10%)</td><td>10 (0.07)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>2 (0.01)</td><td>232 (1.59) 50</td><td>57 (0.39) 7</td><td>33 (0.23) 12</td><td>8 (0.05) 4</td><td></td><td>344 (2.36) 73</td><td>442 (3.03) 98</td></th<>		(10%)	10 (0.07)									2 (0.01)	232 (1.59) 50	57 (0.39) 7	33 (0.23) 12	8 (0.05) 4		344 (2.36) 73	442 (3.03) 98
1         0													(0.34) 8	(0,05)	(0.08)	(0.03) ž		(0.50) 20	(0.67) 25
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$													(0,05)		(0.05)	(0.03)		(0.14)	(21.0)
1         1															5 (0.03)			8 (0.03)	5 (0.03)
No.         No. <td></td> <td>Í</td> <td>0.000</td> <td>0(000)</td>																	Í	0.000	0(000)
$ \left( \begin{array}{cccccccccccccccccccccccccccccccccccc$																		0 (00.00)	0(00)
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$																		0(000)	0 (0.00)
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$																		0 (00)	0 00)
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$																		0 000	0 000)
$ \left( \begin{array}{cccccccccccccccccccccccccccccccccccc$																		0	0
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$																		0 (0.00)	0.00)
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$																		0 (0.00)	0(000)
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$																		0.00)	0(0.00)
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$																		0.00)	0(000)
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$																		0(000)	0(000)
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$																		0(000)	0(000)
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$																		0(0.00)	0(000)
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$																		0(0.00)	0(000)
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$																		0(0,00)	0(00(0)
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$																		0	0 (0.00)
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$																		0 (00)	0 (0 00)
938         3936         1         0 <td></td> <td>0 (0.00)</td> <td>0 (0.00)</td>																		0 (0.00)	0 (0.00)
938 3936 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0																		(0.00)	0(000)
		938 (6.43)	3936 (26.97)	(10.0)	(0,00)	(00.0)	0(00)	0.00)	0(000)	0(000)	0(000)	224 (1.54)	2146 (14.71)	445 (3.05)	189 (1.30)	101 (0.71)	4870 (33.37)	14592 (100.00)	

# 表 5-33 波高・波向頻度表

	Month	201001-20 DILI(qM2F	) All month														Observed Calm Missing	14592 4870	(68.89) (33.37) (11.0)
Wave Direction	ANE	NE	ENE	щ	ESE	SE	SŚĖ	w	WSS	SW	WSW	W	WXW	WN	MAN	N	CAM	Total	Exceedance
- 2.99	1645 [11.27)	776 (5.32)	3875 (26.56)	1 (10,01)								(90'0)	24 (0.16)	(90,0)	6	2 (0.01)	4870	11217 (76,87)	14592 (100.00)
3.00 - 3.99	93 (0.64)	54 (0.37)	55 (0.38)									57 (0.39)	300 (2.06)	144 (0.99)	71 (0.49)	34 (0.23)		808 (5.54)	3375 (23.13)
4.00 = 4.99	1 (10.01)	37 (0.25)	2 (0.01)									68 (0.47)	841 (5.76)	231 (1.58)	73 (0.50)	47 (0.32)		1300 (8.91)	2567 (17.59)
5.00 - 5.99		30 (0.21)										43 (0.29)	351 (3.78)	52 (0.36)	31 (0.21)	11 (0.08)		718 (4.92)	1267 (8.68)
6,00 - 6.99		33 (0.23)	4 (0.03)									24 (0.16)	355 (2.45)	9 (0.06)	8 (0.05)	10 (0.07)		446 (3.06)	549 (3.76)
7.00 - 7.99		(0.04)										9 (0.06)	72. (0.49)					87 (0.60)	103 (0.71)
8.00 - 8.99		2 (0.01)										14 (0.10)						16 (0.11)	16 (0.11)
9.00 - 9.99																		0(000)	0(0.00)
10.00 - 10.99																		0(0.00)	0 (0.00)
11.00 - 11.99																		0.00)	0(00)
12.00 - 12.99																		0.00)	0(00)
13.00 - 13.99																		0 (0.00)	0(00)
14.00 - 14.99																		0(0.00)	0 (0.00)
15.00 - 15.99																		0.00)	0(000)
16.00 - 16.99																		0 (0.00)	0(00)
17.00 - 17.99																		0 (00)	0(000)
18.00 - 18.99																		0 (0.00)	0(00.0)
- 00'61																		0(00)	0(000)
X																			
×.																			
×.																			
,																			
,																			
i.																			
Y																			
Total	1739 (11.92)	938 (6.43)	3936 (26,97)	(0.01)	0 (00'0)	0(000)	0(00:0)	0(00)	0(000)	0(00)	0 (00.00)	224 (1.54)	2146 (14.71)	445 (3.05)	189 (1.30)	104 (0.71)	4870	14592 (100.00)	
Exceedance	14592 (100.00)	12853 (88.08)	11915 (81.65)	7979 (54.68)	7978 (54.67)	7978	7978 (54.67)	7978 (54.67)	7978 (54,67)	7978 (54.67)	7978	7978 (54.67)	7754 (53.14)	5608 (38.43)	5163 (35.38)	4974 (34.09)	4870 (33.37)		

## 表 5-34 周期・波向頻度表

#### 5-2-2-3 各種諸元の設定

稼働率算出にあたって必要な諸元を設定した。

#### 5-2-2-3-1 代表波向

対象地点の地形及び合成波の波向を考慮して代表波向を図 5-40 に示す NW、NNW、N、NNE、 NE とした。

#### 5-2-2-3-2 代表周期

合成波高・周期の頻度表によれば卓越する周期帯は 5.0~7.0sec であるので、ここでは代表周期を 6.0sec とした。

#### 5-2-2-3-3 静穏の目標

表 5-35 は、荷役限界波高の参考値である。この表より荷役限界波高(H<sub>1/3</sub>)を0.3m、0.5mの2種とした。

船形	荷役限界波高(H1/3)
小型船	0.3m
中・大型船	0.5m
超大型船	0.7 $\sim$ 1.5m

表 5-35 荷役限界波高の参考値

※うねり性の波浪及び長周期波による影響が無い場合

出典:港湾の施設の技術上の基準・同解説(平成19年7月) p.809

#### 5-2-2-3-4 稼働率評価エリア

評価点は、図 5-39 に示す桟橋の西側(A)と東側(B)を設定した。



図 5-39 稼働率評価エリア

### 5-2-2-4 バース位置への波浪変形計算

### 5-2-2-4-1 バース位置までの波浪変形計算

代表波向、代表周期を用いて浅海域の波浪変形計算を行なった。

(1) 手法

解析手法は、エネルギー平衡方程式により算出した。 (2) 条件

・波浪

代表波向:NW、NNW、N、NNE、NE 代表周期:6.0sec

・計算範囲及び計算格子間隔

計算格子間隔 10m



図 5-40 計算範囲

(3) 結果

計算結果を図 5-41 から図 5-45 に示す。
				1/		12
0.46 0.48 0.49 0.50	0.51 0.52 0.53 0.54 0.55	0.56 0.57 0.57 0.58	0.59 0.60 0.60	0.61 0.61 0.62 0.63	0.63 0.64 0.64 0.65 0.	65 0.65
0.46 0.47 0.48 0.49	0.51 0.52 0.53 0.53 0.54	0.55 0.56 0.57 0.58	0.59 0.60 0.60	0.61 0.61 0.62 0.63	0.63 0.64 0.64 0.65 0.	66 0.66
0.45 0.47 0.48 0.49	0.50 0.51 0.52 0.53 0.54	0.55 0.56 0.57 0.57	0.58 0.59 0.60	0.60 0.61 0.62 0.63	0.63 0.64 0.64 0.65 0.	66 0.66
0.45 0.46 0.47 0.48	0.50 0.51 0.52 0.53 0.54	0.54 0.55 0.56 0.57	0.58 0.59 0.60	0,60 0.60 0.62 0.63	0.63 0.64 0.64 0.65 0.	66 0.66
0.43 0.45 0.46 0.48	0.49 0.50 0.51 0.52 0.53	0.54 0.55 0.56 0.57	0.58 0.59 0.59	0.60 0.60 0.61 0.62	0.63 0.64 0.64 0.65 0.	65 0.66
0.43 0.44 0.46 0.47	0.49 0.50 0.51 0.52 0.53	0.54 0.54 0.55 0.56	0.57 0.58 0.59	0.59 0.59 0.61 0.62	0.63 0.64 0.63 0.64 0.	65 0.66
0.42 0.43 0.45 0.47	0.48 0.49 0.50 0.51 0.52 (	0.53 0.54 0.55 0.56	0.57 0.58 0.58	0.59 0.59 0.60 0.61	0.62 0.64 0.63 0.64 0.	65 0.66
0.41 0.42 0.44 0.46	0.47 0.49 0.50 0.51 0.52 0	0.53 0.53 0.54 0.55	0.56 0.57 0.58	0.58 0.58 0.60 0.61	0.62 0.63 0.63 0.64 0.	64 0.65
0.41 0.41 0.42 0.45	0.46 0.48 0.49 0.50 0.51 (	0.52 0.53 0.54 0.55	0.56 0.56 0.57	0.57 0.58 0.59 0.60	0.61 0.63 0.62 0.63 0.	64 0.65
0.42 0.41 0.42 0.43	0.46 0.47 0.49 0.50 0.51 (	0.52 0.52 0.53 0.54	0.55 0.56 0.56	0.57 0.57 0.58 0.59	0.61 0.62 0.62 0.63 0.	64 0.65
0.42 0.42 0.41 0.42	0.44 0.46 0.48 0.49 0.50 0	0.51 0.52 0.53 0.54	0.54 0.55 0.56	0.56 0.57 0.57 0.59	0.60 0.62 0.62 0.63 0.	64 0.65
0.43 0.42 0.41 0.41	0.43 0.45 0.47 0.49 0.50	0.51 0.52 0.52 0.53	0.54 0.55 0.55	0.56 0.56 0.57 0.58	0.60 0.61 0.62 0.63 0.	64 0.66
0.44 0.42 0.41 0.41	0.42 0.44 0.46 0.48 0.49	0.50 0.51 0.52 0.52	0.53 0.54 0.55	0.55 0.56 0.56 0.58	0.59 0.60 0.61 0.62 0.	64 0.65
0.45 0.43 0.42 0.41	0.41 0.43 0.45 0.47 0.49	0.50 0.51 0.51 0.52	0.53 0.54 0.54	9.55 0.55 0.56 0.57	0.58 0.59 0.60 0.61 0.	63 0.65
0.44 0.44 0.43 0.42	0.40 0.42 0.44 0.46 0.48 0	0.49 0.50 0.50 0.51	0.52 0.53 0.53	0.54 0.54 0.55 0.56	0.57 0.59 0.59 0.61 0.	62 0.64
0.43 0.43 0.42	0.40 0.40 0.42 0.45 0.47	0.48 0.49 0.50 0.50	0.51 0.52 0.53	0.53 0.53 0.54 0.55	0.57 0.58 0.59 0.60 0.	62 0.63
0.42 0.41	0.40 0.40 0.41 0.43 0.45	0.47 0.48 0.49 0.49	0.50 0.51 0.52	0.52 0.53 0.54 0.55	0.56 0.57 0.58 0.59 0.	61 0.62
0.40	0:40 0.40 0.40 0.42 0.44	0.46 0.47 0.48 0.49	0.50 0.50 0.51	0.52 0.52 0.53 0.54	0.55 0.57 0.57 0.59 0.	60 0.62
0.40	0.40 0.41 0.41 0.41 0.42	0.44 0.46 0.47 0.48	049 0 50 0.50	0.51 0.52 0.53 0.54	0.55 0.56 0.57 0.58 0.	60 0.61
	0.39 0.41 0.41 0.41 0.42 0	0.43 0.44 0.46 0.47	0.48 0.49 0.50	0.50 0.51 0.52 0.53	0.54 0.56 0.56 0.58 0.	59 0.60
	0.40 0.41 0.41 0.43 (	0.43 0.43 0.44 0.46	0.47 0.48 0.49	0.50 0.51 0.51 0.53	0.54 0.55 0.56 0.57 0.	58 0.60
	0.41 0.44	0.44 0.43 0.43 0.44	0.46 0.47 0.48	0.49 0.50 0.51 0.52	0.53 0.54 0.55 0.56 0.	58 0.59
	0.44	0.44 0.45 0.43 0.42	0.45 0.46 0.47	0.48 29.49 0.50 0.51	0.53 0.54 0.55 0.56 0.	57 0.58
		0.44 0.42 0.41	0.43 0.45 0.47	0.48 0.49 0.50 0.51	0.52 0.53 0.54 6 55 0.	56 0.57
		0.43 0.41 0.40	0.41 0.44 0.46	0.47 0.49 0.50 0.51	0.52 0.53 0.54 0.55 0.	56 0.57
		0.41 0.40	0.40 0.42 0.45	0.47 0.48 0.49 0.50	0.51 0.52 0.53 0.54 0.	55 0.56
	2 4	0.36 0.31	0.0 0.42	0.45 0.47 0.49 0.50	0.51 0.52 0.53 0.54 0.	55 0.56
		/ / )	× /	0.44 0.48 0.50	0.51 0.52 0.53 0.54 0.	55 0.55
1	K. / /	N		9,44 0.48	0.50 0.51 0.52 0.53 0.	54 0.55
·)		5 1		0.45	0.49 0.51 0.52 0.52 0.	53 0.54
	NY /	/		12	0.46 0.49 0.51 0.52 0.	53 0.54
	V.V.II				0.47 0.48 0.50 0.	52 0.53
	II K				0.47 0.48 0.	49 0.51
	fil fil				0.47 0.	48 0.49
	13 14	2				0.48
1	II .	23			XX	
4	Wave direction	NW				
$\oplus$	Wave height	1.0 m				1
	Wave period	6.0 sec	0	50	10	Om

図 5-41 波高比分布 (NW)

0.57 0.59 0.60 0.62 0.63 0.64 0.65 0.66 0.67 0.68 0.69 0.70 0.71 0.71 0.72 0.73 0.74 0.74 0.75 0.76 0.76 0.77 0.77 0.78 0.78 0.79 0.56 0.58 0.59 0.61 0.62 0.63 0.64 0.65 0.66 0.67 0.68 0.69 0.70 0.71 0.72 0.73 0.73 0.74 0.75 0.76 0.76 0.77 0.77 0.78 0.79 0.79 0.79 0.56 0.57 0.59 0.60 0.62 0.63 0.84 0.65 0.66 0.67 0.68 0.69 0.70 0.71 0.72 0.73 0.73 0.74 0.75 0.76 0.77 0.77 0.77 0.79 0.79 0.79 0.79 0.55 0.57 0.58 0.60 0.61 0.63 0.64 0.65 0.66 0.67 0.68 0.69 0.70 0.71 0.72 0.72 0.73 0.73 0.75 0.76 0.77 0.78 0.77 0.79 0.79 0.80 0.54 0.56 0.58 0.59 0.61 0.62 0.63 0.64 0.65 0.66 0.67 0.68 0.69 0.70 0.71 0.72 0.72 0.73 0.75 0.76 0.77 0.78 0.77 0.78 0.79 0.80 0.53 0.55 0.57 0.59 0.60 0.62 0.63 0.64 0.65 0.66 0.67 0.68 0.69 0.70 0.71 0.72 0.72 0.73 0.74 0.76 0.77 0.78 0.77 0.78 0.79 0.80 0.51 0.54 0.56 0.58 0.60 0.61 0.63 0.64 0.65 0.65 0.66 0.68 0.69 0.70 0.71 0.71 0.72 0.72 0.74 0.75 0.76 0.77 0.77 0.78 0.79 0.80 0.50 0.52 0.55 0.57 0.59 0.61 0.62 0.63 0.64 0.65 0.66 0.67 0.68 0.69 0.70 0.71 0.71 0.72 0.74 0.75 0.76 0.77 0.76 0.78 0.79 0.80 0.50 0.51 0.54 0.56 0.59 0.60 0.62 0.63 0.64 0.65 0.65 0.67 0.68 0.69 0.70 0.70 0.70 0.71 0.73 0.75 0.76 0.77 0.76 0.77 0.78 0.79 0.51 0.52 0.53 0.55 0.58 0.60 0.61 0.62 0.64 0.64 0.65 0.66 0.67 0.68 0.69 0.70 0.70 0.71 0.72 0.74 0.75 0.77 0.76 0.77 0.78 0.80 0.51 0.52 0.53 0.54 0.57 0.59 0.61 0.62 0.63 0.64 0.65 0.65 0.66 0.67 0.68 0.69 0.70 0.70 0.72 0.73 0.75 0.77 0.78 0.79 0.80 0.52 0.52 0.52 0.52 0.55 0.58 0.60 0.61 0.63 0.64 0.64 0.65 0.66 0.67 0.68 0.69 0.69 0.70 0.71 0.73 0.74 0.76 0.76 0.78 0.79 0.80 0.54 0.53 0.52 0.52 0.54 0.57 0.59 0.51 0.62 0.63 0.64 0.64 0.65 0.66 0.67 0.68 0.69 0.69 0.71 0.72 0.74 0.75 0.76 0.77 0.79 0.80 0.55 0.54 0.53 0.52 0.53 0.55 0.58 0.60 0.62 0.63 0.63 0.64 0.65 0.66 0.67 0.68 0.69 0.70 0.71 0.73 0.74 0.75 0.77 0.78 0.80 0.55 0.55 0.55 0.53 0.52 0.54 0.57 0.59 0.61 0.62 0.63 0.63 0.64 0.65 0.66 0.67 0.6 0.68 0.69 0.71 0.72 0.74 0.74 0.76 0.77 0.79 0.55 0.55 0.54 0.52 0.53 0.56 0.58 0.60 0.61 0.62 0.63 0.63 0.64 0.65 0.65 0.67 0.67 0.69 0.70 0.71 0.73 0.74 0.75 0.77 0.78 0.54 0.54 0.52 0.53 0.54 0.56 0.59 0.60 0.61 0.62 0.63 0.63 0.64 0.65 0.66 0.67 0.68 0.69 0.71 0.72 0.73 0.75 0.76 0.77 0.53 0.52 0.53 0.54 0.55 0.57 0.59 0.60 0.61 0.62 0.63 0.64 0.65 0.66 0.68 0.69 0.70 0.72 0.72 0.74 0.75 0.77 0.52 0.52 0.55 0.55 0.55 0.56 0.58 0.59 0.60 0.61 0.62 0.63 0.64 0.65 0.65 0.67 0.68 0.70 0.71 0.72 0.73 0.75 0.76 0.52 0.54 0.55 0.55 0.55 0.56 0.57 0.59 0.69 0.61 0.62 0.63 0.64 0.65 0.66 0.68 0.69 0.70 0.71 0.73 0.74 0.75 0.53 0.54 0.55 0.58 0.56 0.56 0.57 0.59 0.81 0.62 0.63 0.63 0.64 0.66 0.67 0.68 0.70 0.71 0.72 0.73 0.74 0.55 0.59 0.58 0.57 0.56 0.57 0.59 0.61 0.62 0.63 0.64 0.65 0.66 0.68 0.69 0.70 0.71 0.72 0.73 0.59 0.58 0.59 0.56 0.55 0.58 0.60 0.61 0.62 9.63 0.65 0.66 0.67 0.68 0.69 0.70 0.72 0.73 0.59 0.55 0.53 0.56 0.59 0.61 0.62 0.63 0.64 0.65 0.67 0.68 0.69 8 70 0.71 0.72 0.58 0.54 0.53 0.54 0.57 0.60 0.61 0.63 0.64 0.65 0.66 0.67 0.68 0.69 0.70 0.71 0.54 0.53 0.53 0.56 0.59 0.61 0.62 0.64 0.65 0.66 0.67 0.68 0.68 0.69 0.70 0.48 0,41 0.0 0.50 0.60 0.62 0.63 0.65 0.65 0.66 0.67 0.68 0.69 0.70 0.59 0.62 0.64 0.65 0.66 0.67 0.68 0.69 0.70 9.60 0.63 0.64 0.66 0.66 0.67 0.68 0.69 0.60 0.63 0.65 0.66 0.67 0.67 0.68 0.60 0.63 0.65 0.66 0.67 0.68 0.62 0.62 0.64 0.65 0.67 0.62 0.62 0.63 0.65 0.62 0.62 0.62 0.62 Wave direction NNW Wave height 1.0 m 50 100m 0 6.0 sec Wave period

図 5-42 波高比分布 (NNW)

1				100				1									1	1							1-
0.69	0.71	0.73	0.74	0.75	0.77	0.78	0.78	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.86	0.86	0.87	0.88	0.89	0.89	0.90	0.90	0.91	0.91	0.91
0.69	0,70	0.72	0.74	0.75	0.76	0.77	0.78	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.86	0.86	0.87	0.88	0.89	0.89	0.90	0.90	0.91	0.92	0.92
0.68	0.70	0.72	0.73	0.74	0.76	0.77	0.78	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.85	0.86	0.87	0.88	0.89	0.89	0.90	0.90	0.91	0.92	0.92
0.67	0.69	0.71	0.73	0.74	0.75	0.76	0.77	0.78	0.79	0.80	0.81	0.83	0.84	0.85	0.85	0,86	0.87	0.88	0.89	0.90	0.90	0.90	0.91	0.92	0.92
0.66	0.69	0.71	0.72	0.74	0.75	0.76	0.77	0.78	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.85	0 86	0.88	0.89	0.90	0.90	0.90	0.91	0.92	0.92
0.65	0.68	0.70	0.72	0.73	0.75	0.76	0.77	0.78	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.85	0.86	0.88	0.89	0.90	0.90	0.90	0.91	0.92	0.92
0.64	0.67	0.69	0.71	0.73	0.74	0.75	0.76	0.77	0.78	0.79	0,81	0.82	0.83	0.84	0.84	0.85	0.86	0.88	0.89	0.89	0.90	0.89	0.91	0.91	0.92
0.63	0.65	0.68	0.71	0.73	0.74	0.75	0.76	0.77	0.78	0.79	0.80	0.81	0.82	0.83	0.84	0.84	0.86	0.88	0.89	0.89	0.89	0.89	0.90	0.91	0.92
0.62	0.64	0.67	0.70	0.72	0.74	0.75	0.76	0.77	0.78	0.78	0.80	0.81	0.82	0.83	0.83	0.84	0.85	0.87	0.88	0.89	0.89	0.89	0.90	0.91	0.92
0.63	0.65	0.67	0.69	0.72	0.73	0.75	0.76	0.77	0.77	0.78	0.79	0.80	0.81	0.82	0.83	0.83	0.84	0.86	0.88	0.89	0.89	0.89	0.90	0.91	0.92
0.64	0.65	0.66	0.67	0.71	0.73	0.74	0.75	0.76	0.77	0.78	0.78	0,80	0.81	0.81	0.82	0.83	0.84	0.86	0.87	0.88	0.89	0.90	0.91	0.91	0.92
0.65	0.66	0.66	0.66	0.69	0.72	0.74	0.75	0.76	0.77	0.77	0.78	0.79	0.80	0.81	0.82	0.82	0.83	0.85	0.87	0.88	0.89	0.90	0.91	0.92	0.92
0.67	0.67	0.66	0.66	0.67	0.71	0.73	0.94	0.75	0.76	0.77	0.77	0.78	0.80	0.80	0.81	0.82	0.83	0.84	0.86	0.87	0.89	0.89	0.91	0.91	0.92
0.68	0.68	0.67	0.66	0.66	0.69	0.92	0.74	0.75	0.76	0.76	0.77	0.78	0.79	0.80	0.91	9.81	0.82	0.84	0.85	0.86	0.88	0.88	0.90	0.91	0.91
0.68	0.69	0.69	0.68	0.66	0.68	0.71	0.73	0.74	0.75	0.76	0.76	0.77	0.78	0.79	0.80	0.81	0.82	0.83	0.84	0.86	0.87	0.87	0.89	0.90	0.90
1 M	0.69	0.69	0.68	0.66	0.67	0.69	0.72	0.73	0.74	0.75	0.75	0.76	0.77	0.78	0.79	0.80	0.81	0.82	0.84	0.85	0.86	0.87	0.88	0.89	0.90
	Re	0.68	0.68	0.66	0.67	0.68	0.70	0.72	0.73	0.74	0.75	0.76	0.76	0.77	0,78	0.79	0.80	0.82	0.83	0.84	0.85	0.86	0.87	0.88	0.89
	7	196	0.67	0.66	0.68	0.68	0.69	0.70	0.72	0.73	0.74	0.75	0.76	0.77	0.78	0.78	0.79	0.81	0.82	0.83	0.85	0.85	0.86	0.87	0.88
		3	0.67	0.67	0.69	0.69	0.69	0.69	0.71	0.72	0.73	0.74	0.75	0.76	0.77	0.78	0.79	0.80	0.82	0.83	0.84	0.85	0.86	0.87	0.87
				0.67	0.69	0.69	0.69	0.68	0.69	0.70	0.72	0.73	0.74	0.75	0.76	0.77	0.78	0.79	0.81	0.82	0.83	0.84	0.85	0.86	0.86
					0.68	0.68	0.69	0.72	0.70	0.69	0.70	0.72	0.73	0.74	0.75	0.76	0.77	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.85
						12	0.69	0.73	0.72	0.70	0.69	0.70	0.72	0.74	0.75	0.76	0.77	0.78	0.79	0.80	0.81	0.82	0.83	0.84	0.85
							200	0.74	0.73	0.73	0.69	0.68	0.71	0.73	0.74	0.75-	9.76	0.77	0.78	0.80	0.81	0.81	0.82	0.83	0.84
								1	P	0.73	0.68	0.66	0.69	0.72	0.73	0.75	0.76	0.77	0.78	0.79	0.80	0.81	8.81	0.82	0.83
								1	2	0.71	0.67	0.66	0.67	0.70	0.73	0.74	0.76	0.77	0.78	0.78	0.79	0.80	0.80	0.81	0.82
							1	~		X	0.67	0.66	0.66	0.69	0.72	0.74	0.75	0.77	0.77	0.78	0.79	0.79	0.80	0.80	0.81
						1	1		~	2	0.60	0.50	0.0	2	0.70	0.73	0.75	0.76	0.77	0.77	0.78	0.79	0.79	0.80	0.81
					1		1		1		1		5	1		1	0.72	0.75	0.76	0.77	0.78	0.78	0.79	0.80	0.80
			1	1		1		1	1	1	6	/			1		1	0,73	0.75	0.76	0.77	0.78	0.78	0.79	0.80
		3	1	1	1	/	.,	/	1	/	-	(	1				V	/	0.72	0.75	0.76	0.77	0.77	0.78	0.79
			1	1	5	1	/		1					The second second			$\square$	$\geq$		0.72	0.75	0.76	0.77	0.77	0.78
				1.		V	1	/								$\checkmark$	1	1	1		0.74	0.73	0.75	0.76	0.77
					1	1	.7									4			1	1		0.73	0.73	0.74	0.75
					1	1	12	2												1	1	/	0.73	0.73	0.73
						1.	A	13	2									1			$\geq$	2			0.73
							6	1	14											Y		1	1		1
					Way	/e d	irec	tion		N													1	1	
		-	Ð		Way	ve h	eigh	t		1.	0 m														1
			Γ	Ī	Wav	ve pe	erioo	ł		6.	0 s	ec		0					50				1	00m	

0.000.0

図 5-43 波高比分布 (N)



図 5-44 波高比分布 (NNE)



図 5-45 波高比分布 (NE)

# 5-2-2-4-2 評価エリアの波高比分布

計算結果より評価エリア内の最大値を抽出し、表 5-36にまとめた。

波向	評価エリアA	評価エリアB
NW	0.54	0.54
NNW	0.68	0.68
N	0.81	0.82
NNE	0.89	0.90
NE	0.85	0.86

## 表 5-36 評価エリア別波高比

代表周期: 6.0s

# 5-2-2-5 稼働率

前項までの結果を踏まえて稼働率を算定した結果を図 5-46 に示す。算出にあたっては、限界 波高を 0.3m と 0.5m として M1 地点での限界波高(限界波高/波高比)を求め、ついで M1 地点 での限界波高以上の出現頻度を求めた。

稼働率は <u>100%-(M1 地点での限界波高以上の出現頻度)</u>として算出した(付属資料6参照)。 限界波高 0.5m においては、評価エリア A, B とも稼働率 97.5%を超える結果となった。









乾季:12月~5月 雨季:6月~11月

図 5-46 季節別稼働率

- 5-3 桟橋構造計算結果
- 桟橋 5-3-1
- 5-3-1-1 防舷材の検討
  - 1 設計冬件

項	8	設計条件	単位
船種	- Contract - 1	ナクロマ	
重量トン数	(DWT)	287.00	(t)
総トン数	(GT)	1134.00	(t)
船長	(L)	46.76	(m)
垂線間長	(L <sub>pp</sub> )	41.33	(m)
型幅	(B)	12.00	(m)
型深さ	(D)	10.00	(m)
満載喫水	(d)	2.42	(m)
接岸速度	(V)	0.35	(m/s)

2. 接岸エネルギーの算出 船舶の接岸エネルギーは、下記により算出します。

```
E_{f} = (M_{s} \cdot V^{2}/2) \times C_{e} \times C_{m} \times C_{s} \times C_{c}
```

ここに、

- E: 船舶の接岸エネルギー (kJ)
- M<sub>s</sub>: 船舶の質量(t)
- V: 船舶の接岸速度 (m/s)
- Ce: 偏心係数
- C<sub>m</sub>: 仮想質量係数
- Cs: 柔軟性係数(1とします)
- C.: バースの形状係数(1とします)
- (1). 船舶の排水量 (M<sub>s</sub>)

船舶の排水量は、下記の通りとする。

M.=925t

(2). 偏心係数

偏心係数は、下記の式により算出します。

 $C_e = 1/[1+(1/r)^2]$ 

ここに、

- C<sub>e</sub>:偏心係数
  - 1: 船舶の接岸点から係留施設の法線に平行に測った当該船舶の重心までの距離( r: 船舶の重心を通る鉛直軸回りの回転半径 (m)

回転半径は、下記の式より算出します。

- $r = (0.19C_b + 0.11)L_{pp}$
- $=(0.19 \times 0.7518926 + 0.11) \times 41.33$

=10.45069

図1に示すように、船舶がP点で最も係船岸に近づき防舷材F1及びF2に接触するとき、係留 施設に平行に測った接岸点から船舶重心までの距離は、下記の式によって求めます。ただ し、Iはk>0.5のときL1を、k<0.5のときはL2を用います。k=0.5のときは、L1、L2のうち、Ceが大 きくなる方の値をとります。

```
L_1 = \{0.5 \alpha + e(1-k)\} L_{pp} \cos \theta
    L_2 = \{0.5 \alpha - ek\} L_{pp} \cos \theta
    EZIE.
          L1: 船舶が防舷材F1に接触するときの係留施設に平行に測った接岸点から船舶の重
              心までの距離(m)
          L<sub>2</sub>: 船舶が防舷材F2に接触するときの係留施設に平行に測った接岸点から船舶の重
              心までの距離 (m)
          \theta: 接岸角度
          e: 船の長手方向に測った防舷材間隔(20m)と垂線間長との比
              e = 20/41.33
               =0.48391とします
          α:防舷材との接岸点高さにおける船舶の側面の平行舷(パラレルサイド)の長さと垂
              線間長との比
              α=0.5とします
           k: 防舷材F1とF2の間において船舶と係船岸が最も近づく点を表すパラメーター
             k=0.5とします
    k=0.5ですから、lはL1、L2のうち小さい方をを用います。
    L_1 = \{0.5 \times 0.5 + 0.48391 \times (1 - 0.5)\} \times 41.33 \times \cos(10^\circ)
      =20.0236
    L_2 = \{0.5 \times 0.5 - 0.48391 \times 0.5\} \times 41.33 \times \cos(10^\circ)
      = 0.3274492
    したがって、1=0.3274492とします。
    よって、
    C_{a} = 1/[1+(0.3274492/10.45069)^{2}]
      = 0.9990192
(3). 仮想質量係数 (C<sub>m</sub>)
    船舶の仮想質量係数は、下記の式により算出します。
 C_m = 1 + [\pi/(2 \cdot C_h)] (d/B)
    ここに、
          C<sub>b</sub>: ブロック係数
             C_b = \nabla / (L_{pp} Bd)
          ▽:船舶の排水体積 (m<sup>3</sup>)
              \nabla = M_s / \omega_0
         L<sub>pp</sub>: 垂線間長 (m)
          B: 型幅 (m)
          d: 満載喫水 (m)
         ω<sub>0</sub>:海水の単位体積重量(1.025t/m<sup>3</sup>)
    C_{b} = 925/(41.33 \times 12 \times 2.42 \times 1.025)
      =0.7518926
    C_m = 1 + [\pi/(2 \times 0.7518926)] \times (2.42/12)
       =1.421306
(4). 接岸エネルギー (E<sub>f</sub>)
```

```
E_{f} = (925 \times 0.35^{2}/2) \times 0.9990192 \times 1.421306 \times 1 \times 1
= 80.44691 (kJ)
```

1. 設計条件

項	目	設計条件	単位
船種		ナクロマ2	
重量トン数	(DWT)	1050.00	(t)
総トン数	(GT)	2359.35	(t)
船長	(L)	67.30	(m)
垂線間長	(L <sub>pp</sub> )	61.20	(m)
型幅	(B)	16.00	(m)
型深さ	(D)	8.90	(m)
満載喫水	(d)	3.30	(m)
接岸速度	(V)	0.35	(m/s)

2. 接岸エネルギーの算出

船舶の接岸エネルギーは、下記により算出します。

E<sub>f</sub>=(M<sub>s</sub>·V<sup>2</sup>/2)×C<sub>e</sub>×C<sub>m</sub>×C<sub>s</sub>×C<sub>o</sub> ここに、 E<sub>f</sub>: 船舶の接岸エネルギー(kJ) M<sub>s</sub>: 船舶の質量(t) V: 船舶の接岸速度(m/s) C<sub>e</sub>: 偏心係数 C<sub>m</sub>: 仮想質量係数 C<sub>s</sub>: 柔軟性係数(1とします) C<sub>o</sub>: バースの形状係数(1とします)

(1). 船舶の排水量 (M<sub>s</sub>)

船舶の排水量は、下記の通りとする。

 $M_{s} = 2,503t$ 

(2). 偏心係数

偏心係数は、下記の式により算出します。

 $C_e = 1/[1+(l/r)^2]$ 

ここに、

C<sub>e</sub>:偏心係数

1: 船舶の接岸点から係留施設の法線に平行に測った当該船舶の重心までの距離( r: 船舶の重心を通る鉛直軸回りの回転半径(m)

回転半径は、下記の式より算出します。

 $r = (0.19C_b + 0.11) L_{pp}$ = (0.19 × 0.7557039 + 0.11) × 61.2 = 6.732

図1に示すように、船舶がP点で最も係船岸に近づき防舷材F1及びF2に接触するとき、係留施設に平行に測った接岸点から船舶重心までの距離Iは、下記の式によって求めます。ただし、Iはk>0.5のときL1を、k<0.5のときはL2を用います。k=0.5のときは、L1、L2のうち、Ceが大きくなる方の値をとります。

 $L_1 = \{0.5 \alpha + e(1-k)\} L_{pp} \cos \theta$  $L_2 = \{0.5 \alpha - ek\} L_{pp} \cos \theta$ 

ここに、

- L<sub>1</sub>: 船舶が防舷材F1に接触するときの係留施設に平行に測った接岸点から船舶の重 心までの距離(m)
- L<sub>2</sub>: 船舶が防舷材F2に接触するときの係留施設に平行に測った接岸点から船舶の重 心までの距離(m)
- θ:接岸角度
- e: 船の長手方向に測った防舷材間隔(20m)と垂線間長との比 e=20/61.2
  - =0.326797とします
- α:防舷材との接岸点高さにおける船舶の側面の平行舷(パラレルサイド)の長さと垂線間長との比
   α=0.5とします
- k:防舷材F1とF2の間において船舶と係船岸が最も近づく点を表すパラメーター k=0.5とします

```
k=0.5ですから、lはL<sub>1</sub>、L<sub>2</sub>のうち小さい方をを用います。
L<sub>1</sub>= \{0.5 \times 0.5 + 0.3267974 \times (1 - 0.5)\} \times 61.2 \times \cos(10^{\circ})
= 24.91564
L<sub>2</sub>= \{0.5 \times 0.5 - 0.3267974 \times 0.5\} \times 61.2 \times \cos(10^{\circ})
= 5.219481
```

したがって、1=5.219481とします。

よって、 C<sub>e</sub>=1/{1+(5.219481/6.732)<sup>2</sup>} =0.6245599

(3). 仮想質量係数 (C<sub>m</sub>)

船舶の仮想質量係数は、下記の式により算出します。

```
\begin{split} & C_{m} = 1 + \left[ \pi / (2 \cdot C_{b}) \right] (d/B) \\ & \square C_{b} : \ \vec{\mathcal{I}} \square \mathcal{P} \mathcal{P} \mathcal{K} \mathcal{B} \\ & C_{b} = \nabla / (L_{\rho\rho} Bd) \\ \nabla : \ \mathfrak{M} \mathfrak{M} \mathcal{O} \mathfrak{k} \mathfrak{k} \mathfrak{k} \mathfrak{k} \mathfrak{f} \quad (m^{3}) \\ & \nabla = M_{s} / \omega_{0} \\ \\ & L_{\rho\rho} : \ \mathfrak{m} \mathfrak{k} \mathfrak{m} \mathfrak{g} \mathfrak{K} \quad (m) \\ & \mathsf{B} : \ \mathfrak{M} \mathfrak{m} \quad (m) \\ & \mathsf{d} : \ \breve{\mathfrak{m}} \mathfrak{k} \mathfrak{g} \mathfrak{K} \quad (m) \\ & \omega_{0} : \ \mathfrak{m} \mathcal{N} \mathcal{O} \ \mathfrak{m} \mathfrak{b} \mathfrak{L} \mathfrak{h} \mathfrak{k} \mathfrak{f} \mathfrak{m} \mathfrak{m}^{3} ) \\ \\ & C_{b} = 2503 / (61.2 \times 16 \times 3.3 \times 1.025) \\ & = 0.7557039 \\ \\ & C_{m} = 1 + \left[ \pi / (2 \times 0.7557039) \right] \times (3.3/16) \\ & = 1.428709 \end{split}
```

(4). 接岸エネルギー (E<sub>f</sub>)

```
E_{f} = (2503 \times 0.35^{2}/2) \times 0.6245599 \times 1.428709 \times 1 \times 1
= 136.7996 (kJ)
```

1. 設計条件

項	8	設計条件	単位
船種	- CT 2011	ポルトガルフェリー	
重量トン数	(DWT)	0.00	(t)
総トン数	(GT)	0.00	(t)
船長	(L)	71.30	(m)
垂線間長	(L <sub>pp</sub> )	59.34	(m)
型幅	(B)	12.60	(m)
型深さ	(D)	10.00	(m)
満載喫水	(d)	3.70	(m)
接岸速度	(V)	0.35	(m/s)

 2. 接岸エネルギーの算出 船舶の接岸エネルギーは、下記により算出します。

 $E_f = (M_s \cdot V^2/2) \times C_e \times C_m \times C_s \times C_c$ 

ここに、

E<sub>f</sub>:船舶の接岸エネルギー(kJ)

- M<sub>s</sub>: 船舶の質量(t)
- V: 船舶の接岸速度 (m/s)
- C<sub>e</sub>:偏心係数
- C<sub>m</sub>: 仮想質量係数
- C<sub>s</sub>: 柔軟性係数(1とします)
- C。: バースの形状係数(1とします)
- (1). 船舶の排水量 (M<sub>s</sub>)

船舶の排水量は、下記の通りとする。

 $M_{s} = 2,870t$ 

(2). 偏心係数

偏心係数は、下記の式により算出します。

 $C_e = 1/[1+(1/r)^2]$  $C_e = 1/[1+(1/r)^2]$ 

C<sub>e</sub>:偏心係数

1: 船舶の接岸点から係留施設の法線に平行に測った当該船舶の重心までの距離( r: 船舶の重心を通る鉛直軸回りの回転半径(m)

回転半径は、下記の式より算出します。

 $r = (0.19C_b + 0.11) L_{pp}$ = (0.19 × 1.012134 + 0.11) × 59.34 = 17.93881

図1に示すように、船舶がP点で最も係船岸に近づき防舷材F1及びF2に接触するとき、係留施設に平行に測った接岸点から船舶重心までの距離Iは、下記の式によって求めます。ただし、Iltk>0.5のときL1を、k<0.5のときはL2を用います。k=0.5のときは、L1、L2のうち、Ceが大きくなる方の値をとります。

```
L_1 = \{0.5\alpha + e(1-k)\}L_{pp}\cos\theta
   L_2 = \{0.5 \alpha - ek\} L_{pp} \cos \theta
   ここに、
         L1: 船舶が防舷材F11に接触するときの係留施設に平行に測った接岸点から船舶の重
             心までの距離(m)
         L<sub>2</sub>: 船舶が防舷材F2に接触するときの係留施設に平行に測った接岸点から船舶の重
             心までの距離(m)
          θ:接岸角度
          e: 船の長手方向に測った防舷材間隔(20m)と垂線間長との比
             e=20/59.34
              =0.337041とします
          α:防舷材との接岸点高さにおける船舶の側面の平行舷(パラレルサイド)の長さと垂
             線間長との比
             α=0.5とします
          k: 防舷材F1とF2の間において船舶と係船岸が最も近づく点を表すパラメーター
             k=0.5とします
   k=0.5ですから、lはL1、L2のうち小さい方をを用います。
   L_1 = \{0.5 \times 0.5 + 0.3370408 \times (1 - 0.5)\} \times 59.34 \times \cos(10^\circ)
      =24.4577
   L_2 = \{0.5 \times 0.5 - 0.3370408 \times 0.5\} \times 59.34 \times \cos(10^\circ)
     =4.761546
   したがって、1=4.761546とします。
   よって、
   C_{e} = 1/\{1+(4.761546/17.93881)^{2}\}
      = 0.9341826
(3). 仮想質量係数 (C_)
   船舶の仮想質量係数は、下記の式により算出します。
   C_m = 1 + [\pi/(2 \cdot C_b)] (d/B)
    ZZIZ.
         C<sub>b</sub>: ブロック係数
             C_b = \nabla / (L_{oo}Bd)
         ▽:船舶の排水体積 (m<sup>3</sup>)
             \nabla = M_s / \omega_0
        L<sub>pp</sub>: 垂線間長 (m)
          B: 型幅 (m)
          d: 満載喫水 (m)
         ω<sub>0</sub>:海水の単位体積重量(1.025t/m<sup>3</sup>)
   C_{\rm b} = 2870/(59.34 \times 12.6 \times 3.7 \times 1.025)
      =1.012134
   C_m = 1 + [\pi/(2 \times 1.012134)] \times (3.7/12.6)
      =1.455735
 (4). 接岸エネルギー (E<sub>f</sub>)
     E_{f} = (2870 \times 0.35^{2}/2) \times 0.9341826 \times 1.455735 \times 1 \times 1
```

= 239.0574(kJ)

## ■ DA-A500H 圧縮性能





図 5-48 防舷材取付け位置検討図

# 5-3-1-2 耐力照查

									BD BH	13 接岸時(	(1/4)
Pile No.	X	у	Z	鉛直角	平面角	杭径	肉厚	腐食代	材質	突出長	全長
	(m)	(m)	(m)	$^{\circ}$	(	(m)	(m)	(m)		(m)	(m)
1	0.000	0.000	10.450	15.00	0.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
0	0.000	0.000	9.550	15.00	180.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
3	0.450	0.000	5.000	15.00	270.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
4	-0.450	0.000	5.000	15.00	90.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
5	0.000	0.000	0.450	15.00	180.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
6	0.000	0.000	-0.450	15.00	0.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
7	0.450	0.000	-5.000	15.00	270.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
8	-0.450	0.000	-5.000	15.00	90.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
6	0.000	0.000	-9.550	15.00	180.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
10	0.000	0.000	-10.450	15.00	0.00	0.9000	0.012	0.0010	SKK400	13.257	38.900

表 5-37(1/2) 耐力照查(BH-3、接岸時)

# 料子 ¢

	>	[/m)	96.50	96.50	96.50	96.50	96.50	96.50	96.50	96.50	96.50	96.50
寺 (2/4)	¥	) (k)	157,5	157,5	157,5	157,5	157,5	157,5	157,5	157,5	157,5	157,5
BH3 接岸時	$\mathrm{K}_\mathrm{D}$	(kN-m/rad)	25,647.41	25,647.41	25,647.41	25,647.41	25,647.41	25,647.41	25,647.41	25,647.41	25,647.41	25,647.41
BD	$\mathrm{K}_{\mathrm{Z4}}$	(kN-m/rad)	129,698.94	129,698.94	129,698.94	129,698.94	129,698.94	129,698.94	129,698.94	129,698.94	129,698.94	129,698.94
	$\mathbf{K}_{\mathrm{X4}}$	(kN-m/rad)	129,698.94	129,698.94	129,698.94	129,698.94	129,698.94	129,698.94	129,698.94	129,698.94	129,698.94	129,698.94
	$\mathrm{K}_{\mathrm{Z2}}$	(kN/rad)	10,655.68	10,655.68	10,655.68	10,655.68	10,655.68	10,655.68	10,655.68	10,655.68	10,655.68	10,655.68
	$\mathbf{K}_{\mathbf{X2}}$	(kN/rad)	10,655.68	10,655.68	10,655.68	10,655.68	10,655.68	10,655.68	10,655.68	10,655.68	10,655.68	10,655.68
	${ m K}_{ m Z1}$	(kN/m)	1,178.36	1,178.36	1,178.36	1,178.36	1,178.36	1,178.36	1,178.36	1,178.36	1,178.36	1,178.36
	$\mathbf{K}_{\mathrm{X1}}$	(kN/m)	1,178.36	1,178.36	1,178.36	1,178.36	1,178.36	1,178.36	1,178.36	1,178.36	1,178.36	1,178.36
	β	(m <sup>-1</sup> )	0.2071	0.2071	0.2071	0.2071	0.2071	0.2071	0.2071	0.2071	0.2071	0.2071
	断面2次 モーメント	$(cm^4)$	301,502	301,502	301,502	301,502	301,502	301,502	301,502	301,502	301,502	301,502
	断面係数	$(\mathrm{cm}^3)$	6,715	6,715	6,715	6,715	6,715	6,715	6,715	6,715	6,715	6,715
定数	断面積	$(\mathrm{cm}^2)$	306.53	306.53	306.53	306.53	306.53	306.53	306.53	306.53	306.53	306.53
2. バネ	Pile No.		1	2	ю	4	5	9	7	8	6	10

# 三次元杭基礎の設計

1. 入力条件

Ship

818.000 kN 17,648.000 kN -2,045.000 kN

Xo= Yo= Zo=

2,751.000 kN-m 0.000 kN-m 493.000 kN-m

Mx= My= Mz=

N/cm<sup>3</sup>

10 4.930 Ч

杭本数 n= Kh= 有効座屈長

	ā	a	$m^2$ )	235	235	235	235	235	235	235	235	235	235
(3/4)	σþ	σt	(N/m										
H3 接岸時	o ca	o ta	$(N/mm^2)$	202	202	202	202	202	202	202	202	202	202
BD B	$\sigma$ bc	o bt	$(N/mm^2)$	67	71	63	71	72	67	63	72	73	67
	σс	σt	$(N/mm^2)$	67	43	108	7	47	73	112	11	50	78
	1/r	1/1		42.27	42.27	42.27	42.27	42.27	42.27	42.27	42.27	42.27	42.27
	Me	ATAT	(kN-m)	447.140	479.306	424.595	479.178	483.267	448.810	425.854	484.111	487.721	450.369
	Mz	777.47	(kN-m)	-183.118	245.131	-364.166	428.533	252.788	-187.160	-361.813	430.886	261.202	-190.868
	MW	6TAT	(kN-m)	-0.893	-2.025	4.731	-7.649	-2.025	-0.893	4.731	-7.649	-2.025	-0.893
	Mv	VINI	(kN-m)	-407.924	411.877	218.295	-214.341	411.877	-407.924	224.570	-220.616	411.877	-407.924
	$p_{7}$	77	(kN)	-45.470	45.795	20.763	-20.438	45.795	-45.470	21.457	-21.132	45.795	-45.470
	Đy	۲ کر <del>-</del>	(kN)	2,058.323	1,332.325	3,306.366	214.166	1,428.662	2,226.079	3,436.251	344.051	1,534.525	2,379.984
Ł	рv	V T	(kN)	16.812	-23.670	40.586	-47.704	-24.516	17.259	40.326	-47.964	-25.447	17.669
3. 杭応	Pile	No.		1	2	ю	4	5	9	7	8	6	10

BD BH3 接岸時 (4/4)

# 4. 杭の応力判定及び変位量

Pile	杭径	肉厚	応力比	X 方向変位	Y 方向変位	Z 方向変位
	(m)	(m)		(m)	(m)	(m)
	0.9000	0.0120	0.617	0.009016	0.011106	-0.039471
5	0.9000	0.0120	0.519	0.009069	0.011182	-0.039471
ŝ	0.9000	0.0120	0.804	0.009337	0.011151	-0.039444
4	0.9000	0.0120	0.338	0.009337	0.011990	-0.039497
5	0.9000	0.0120	0.538	0.009605	0.011959	-0.039471
9	0.9000	0.0120	0.645	0.009658	0.012036	-0.039471
~	0.9000	0.0120	0.826	0.009926	0.012004	-0.039444
~	0.9000	0.0120	0.362	0.009926	0.012843	-0.039497
6	0.9000	0.0120	0.558	0.010194	0.012812	-0.039471
10	0.9000	0.0120	0.671	0.010247	0.012889	-0.039471

# 5-91

# 表 5-37(2/2) 耐力照查(BH-3、接岸時)

 $\alpha_0$  (rad) 0.000085  $\beta$   $_0$  (rad) -0.000059 (rad) -0.000933

0.009632 0.011997 -0.039471

(II) (ii) (ii)

 $\mathbf{x}_0$  $\mathbf{y}_0$ 

原点の変位

 $\gamma_0$ 

三次元杭基礎の副	요금†									Е	3D BH3 地	震時_橋軸	直角方向(	(1/4)
1. 入力条件			Pile No.	×	y	z	鉛直角	平面角	杭径	肉厚	腐食代	材質	突出長	全長
L1				(m)	(m)	(m)	(。)	()	(m)	(m)	(m)		(m)	(m)
			1	0.000	0.000	10.450	15.00	0.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
X0=	0.000	kN	5	0.450	0.000	9.550	15.00	180.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
$Y_{0}=$	13,648.000	kN	n	0.450	0.000	5.000	15.00	270.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
Z0=	2,047.000	kN	4	-0.450	0.000	5.000	15.00	90.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
			5	0.000	0.000	0.450	15.00	180.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
$M_{X}=$	-2,047.000	kN-m	9	0.000	0.000	-0.450	15.00	0.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
My=	0.000	kN-m	7	0.450	0.000	-5.000	15.00	270.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
Mz=	0.000	kN-m	~	-0.450	0.000	-5.000	15.00	90.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
			6	0.000	0.000	-9.550	15.00	180.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
杭本数 n=	10		10	0.000	0.000	-10.450	15.00	0.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
Kh=	5.900	N/cm <sup>3</sup>												
有効座屈長	Ч													
2. バネ定数									Ш	D BH3 担	震時_橋軸	直角方向	(2/4)	

バネ市業

2. バネ	、定数								BD BH	43 地震時_橋	軸直角方向	(2/4)
Pile No.	断面積	断面係数	断面2次 モーメント	β	$\mathbf{K}_{\mathbf{Xl}}$	$\mathrm{K}_{\mathrm{Zl}}$	$\mathrm{K}_{\mathrm{X2}}$	$\mathrm{K}_{\mathrm{Z2}}$	$\mathrm{K}_{\mathrm{X4}}$	$\mathrm{K}_{\mathrm{Z4}}$	$K_{\rm D}$	Kv
	$(\mathrm{cm}^2)$	$(cm^3)$	$(\mathrm{cm}^4)$	(m <sup>-1</sup> )	(kN/m)	(kN/m)	(kN/rad)	(kN/rad)	(kN-m/rad)	(kN-m/rad)	(kN-m/rad)	(kN/m)
1	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50
2	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50
3	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50
4	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50
5	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50
9	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50
7	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50
8	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50
6	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50
10	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50

# 表 5-38(1/2) 耐力照查(BH-3、橋軸直角方向地震時)

- 1				=					BD BH3	地震時樁	軸直角方向	(3/4)
, P,	ď	~	P7	Mv	Mv	Mz	Me	1/r	σc	$\sigma$ bc	o ca	σ ba
-	-	2	7 7	VINI	6141	TTAT	ATAT	1/1	σt	o bt	o ta	o ta
1) (k	A)	(N)	(kN)	(kN-m)	(kN-m)	(kN-m)	(kN-m)		$(N/mm^2)$	$(N/mm^2)$	$(N/mm^2)$	$(N/mm^2)$
298 1,6	1,6	24.393	48.603	432.213	-0.985	232.166	490.622	42.27	53	73	202	235
741 1,:	1	512.597	-48.499	-430.933	-0.031	-173.568	464.574	42.27	49	69	202	235
131		-66.337	-15.180	-193.150	-12.394	445.614	485.753	42.27	2	72	235	235
)52 2,	2	,973.954	15.294	194.530	11.379	-391.285	437.048	42.27	97	65	202	235
<u>)</u> 80 1		,285.437	-48.488	-430.833	-0.031	-175.706	465.285	42.27	42	69	202	235
791 1	1	,515.522	48.603	432.213	-0.985	227.637	488.494	42.27	49	73	202	235
90€		-174.483	-14.931	-190.932	-12.394	443.601	483.026	42.27	9	72	235	235
277 2	$  \mathcal{O}  $	,865.809	15.046	192.312	11.379	-393.298	437.872	42.27	93	65	202	235
<del>)</del> 66 1	-	,169.028	-48.488	-430.833	-0.031	-175.577	465.236	42.27	38	69	202	235
326 ]	-	,415.641	48.603	432.213	-0.985	223.481	486.572	42.27	46	72	202	235
		-			-	-						

4. 杭の応力判定及び変位量

e .	杭径	肉厚	応力比	X 方向変位	Y 方向変位	Z 方向変位
	(m)	(m)		(m)	(m)	(m)
	0.9000	0.0120	0.574	0.002728	0.009940	0.040241
	0.9000	0.0120	0.539	0.002746	0.010672	0.040250
	0.9000	0.0120	0.317	0.002838	0.010349	0.040250
	0.9000	0.0120	0.758	0.002838	0.008756	0.040231
	0.9000	0.0120	0.503	0.002931	0.009229	0.040241
	0.9000	0.0120	0.555	0.002949	0.009166	0.040241
	0.9000	0.0120	0.330	0.003041	0.009639	0.040250
	0.9000	0.0120	0.741	0.003041	0.008046	0.040231
	0.9000	0.0120	0.484	0.003133	0.008519	0.040241
	0.9000	0.0120	0.538	0.003151	0.008455	0.040241

# 表 5-38(2/2) 耐力照查(BH-3、橋軸直角方向地震時)

BD BH3 地震時\_橋軸直角方向 (4/4)

(rad) -0.00020 (rad) 0.001770

0.002940 0.009198

(II)

(II)

 $\begin{array}{c|c} X_0 \\ Y_0 \\ Z_0 \end{array}$ 

0.040241

(rad) -0.000071

 $\frac{\alpha_0}{\beta_0}$ 

原点の変位

三次元杭基礎の設	計										BD Bł	13 地震時	橋軸方向	(1/4)
1. 入力条件			Pile No.	x	y	Z	鉛直角	平面角	杭径	肉厚	腐食代	材質	突出長	全長
L1				(m)	(m)	(m)	(°)	( )	(m)	(m)	(m)		(m)	(m)
			1	0.000	0.000	10.450	15.00	0.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
X0=	2,047.000	kN	7	0.000	0.000	9.550	15.00	180.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
Yo= 1	3,648.000	kN	б	0.450	0.000	5.000	15.00	270.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
Zo=	0.000	kN	4	-0.450	0.000	5.000	15.00	90.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
			5	0.000	0.000	0.450	15.00	180.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
$M_{X}=$	0.000	kN-m	9	0.000	0.000	-0.450	15.00	0.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
My=	0.000	kN-m	7	0.450	0.000	-5.000	15.00	270.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
Mz=	2,047.000	kN-m	~	-0.450	0.000	-5.000	15.00	90.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
			6	0.000	0.000	-9.550	15.00	180.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
杭本数 n=	10		10	0.000	0.000	-10.450	15.00	0.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
Kh=	5.900	N/cm <sup>3</sup>												
有効座屈長	h													

数	
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<u>کر ک</u>	定数								ā	D BH3 地震I	時_橋軸方向	(2/4)	
Pile No.	断面積	断面係数	断面2次 モーメント	β	$\mathbf{K}_{\mathrm{Xl}}$	$\mathrm{K}_{\mathrm{Zl}}$	$\mathrm{K}_{\mathrm{X2}}$	$\mathrm{K}_{\mathrm{Z2}}$	$\mathrm{K}_{\mathrm{X4}}$	$\mathrm{K}_{\mathrm{Z4}}$	$\mathrm{K}_\mathrm{D}$	$\mathrm{K}_{\mathrm{V}}$	
	$(\mathrm{cm}^2)$	$(\mathrm{cm}^3)$	$(\mathrm{cm}^4)$	(m <sup>-1</sup> )	(kN/m)	(kN/m)	(kN/rad)	(kN/rad)	(kN-m/rad)	(kN-m/rad)	(kN-m/rad)	(kN/m)	
1	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
5	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
3	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
4	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
5	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
9	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
7	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
8	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
6	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
10	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	

# 表 5-39(1/2) 耐力照查(BH-3、橋軸方向地震時)

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3. 抗応	Ę								BD	BH3 地震時	「橋軸方向	(3/4)
Pile	$\mathbf{P}_{\mathbf{X}}$	Py	Pz	Mx	My	Mz	Me	l/r	a c a t	σbc σht	σ ca σ ta	σ ba σ ta
.011	(kN)	(kN)	(kN)	(kN-m)	(kN-m)	(kN-m)	(kN-m)		$(N/mm^2)$	$(N/mm^2)$	$(N/mm^2)$	$(N/mm^2)$
1	-10.895	2,777.778	6.728	59.921	-1.928	240.098	247.466	42.27	91	37	202	235
7	4.777	121.047	-6.330	-55.141	-1.590	-185.424	193.452	42.27	4	29	202	235
с	-9.911	1,493.830	-4.268	-175.397	-30.176	87.725	197.265	42.27	49	29	202	235
4	3.873	1,366.706	4.665	180.176	26.658	-33.763	184.276	42.27	45	27	202	235
5	4.094	60.158	-6.330	-55.141	-1.590	-179.319	187.609	42.27	2	28	202	235
9	-9.903	2,767.242	6.728	59.921	-1.928	231.233	238.874	42.27	90	36	202	235
7	-9.831	1,455.542	-3.408	-167.714	-30.176	87.012	190.139	42.27	47	28	202	235
8	3.953	1,328.418	3.806	172.494	26.658	-34.476	176.909	42.27	43	26	202	235
6	3.343	-6.753	-6.330	-55.141	-1.590	-172.611	181.208	42.27	0	27	235	235
10	-8.993	2,757.577	6.728	59.921	-1.928	223.099	231.010	42.27	90	34	202	235

4. 杭の応力判定及び変位量

Pile No.	杭径	肉厚	応力比	X 方向変位	Y 方向変位	Z 方向変位
	(m)	(m)		(m)	(m)	(m)
	0.9000	0.0120	0.607	0.032493	0.009541	0.005547
2	0.9000	0.0120	0.142	0.032556	0.009519	0.005547
3	0.9000	0.0120	0.367	0.032875	0.011308	0.005579
4	0.9000	0.0120	0.338	0.032875	0.007500	0.005515
5	0.9000	0.0120	0.129	0.033195	0.009290	0.005547
9	0.9000	0.0120	0.599	0.033258	0.009267	0.005547
7	0.9000	0.0120	0.356	0.033577	0.011056	0.005579
8	0.9000	0.0120	0.327	0.033577	0.007249	0.005515
6	0.9000	0.0120	0.116	0.033896	0.009038	0.005547
10	0.9000	0.0120	0.593	0.033960	0.009016	0.005547

BD BH3 地震時\_橋軸方向 (4/4)

# J BH3 地质时\_倚粗刀[4/4/

	-0.000025	-0.000070	0.004231
	(rad)	(rad)	(rad)
う変位	$\alpha_0$	$\beta_{0}$	$\gamma_0$
原点0	0.033226	0.009278	0.005547
	(m)	(m)	(m)
		_	

# 表 5-39(2/2) 耐力照查(BH-3、橋軸方向地震時)

三次元杭基礎の副	<u> </u>											BD BH	14 接岸時	(1/4)
1. 入力条件			Pile No.	×	y	Z	鉛直角	平面角	杭径	肉厚	腐食代	材質	突出長	全長
Ship				(m)	(m)	(m)	(°)	(°)	(m)	(m)	(m)		(m)	(m)
			1	0.000	0.000	10.450	15.00	0.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
$X_{0}=$	818.000	kN	2	0.000	0.000	9.550	15.00	180.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
Yo=	17,648.000	kN	ю	0.450	0.000	5.000	15.00	270.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
Z0=	-2,045.000	kN	4	-0.450	0.000	5.000	15.00	90.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
			5	0.000	0.000	0.450	15.00	180.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
$M_{X}=$	2,751.000	kN-m	6	0.000	0.000	-0.450	15.00	0.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
My =	0.000	kN-m	7	0.450	0.000	-5.000	15.00	270.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
Mz=	493.000	kN-m	8	-0.450	0.000	-5.000	15.00	90.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
			6	0.000	0.000	-9.550	15.00	180.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
杭本数 n=	10		10	0.000	0.000	-10.450	15.00	0.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
Kh=	4.930	N/cm <sup>3</sup>												
有効座屈長	h													

じ	BH4 接岸	BD		
	SKK400 SKK400	0.0010 0.0010	0 0	0.01

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1,178.36         1,178.36         10,655.68         10,655.68         129,698.9           1,178.36         1,178.36         10,655.68         10,655.68         129,698.9           1,178.36         1,178.36         10,655.68         10,655.68         129,698.9           1,178.36         1,178.36         10,655.68         10,655.68         129,698.9           1,178.36         1,178.36         10,655.68         10,655.68         129,698.9           1,178.36         1,178.36         10,655.68         10,655.68         129,698.9           1,178.36         1,178.36         10,655.68         10,655.68         129,698.9           1,178.36         1,178.36         10,655.68         10,655.68         129,698.9           1,178.36         1,178.36         10,655.68         10,655.68         129,698.9           1,178.36         1,178.36         10,655.68         10,655.68         129,698.9           1,178.36         1,178.36         10,655.68         10,655.68         129,698.9           1,178.36         1,178.36         10,655.68         10,655.68         129,698.9	0.2071	301,502	6,715 301,502
	0.2071	301,502	6,715 301,502
	0.2071	301,502	6,715 301,502
	0.2071	301,502	6,715 301,502
1,178.36 1,178.36 10,655.68 10,655.68 129,698.9	2071	301,502 0.	6,715 301,502 0.
1.178.36 1.178.36 10,655.68 10,655.68 129,698.9	2071	301.502 0.	6,715 301,502 0.

# 表 5-40(1/2) 耐力照查(BH-4、接岸時)

	3		$n^2$ )	35	35	35	35	35	:35	35	:35	35	35
(3/4)	σþ	σtέ	(N/mr				14	ιN		ιN.	(1	14	(1
H4 接岸時	o ca	o ta	$(N/mm^2)$	202	202	202	202	202	202	202	202	202	202
BD B	$\sigma$ bc	o bt	$(N/mm^2)$	67	71	63	71	72	67	63	72	73	67
	σс	σt	$(N/mm^2)$	67	43	108	7	47	73	112	11	50	78
	1/r	1/1		42.27	42.27	42.27	42.27	42.27	42.27	42.27	42.27	42.27	42.27
	Me	<b>CIVI</b>	(kN-m)	447.140	479.306	424.595	479.178	483.267	448.810	425.854	484.111	487.721	450.369
	M7	TIM	(kN-m)	-183.118	245.131	-364.166	428.533	252.788	-187.160	-361.813	430.886	261.202	-190.868
	Mu	6141	(kN-m)	-0.893	-2.025	4.731	-7.649	-2.025	-0.893	4.731	-7.649	-2.025	-0.893
	Mv	VIAI	(kN-m)	-407.924	411.877	218.295	-214.341	411.877	-407.924	224.570	-220.616	411.877	-407.924
	p <sub>7</sub>	77	(kN)	-45.470	45.795	20.763	-20.438	45.795	-45.470	21.457	-21.132	45.795	-45.470
	Pv	۰. ۲	(kN)	2,058.323	1,332.325	3,306.366	214.166	1,428.662	2,226.079	3,436.251	344.051	1,534.525	2,379.984
F	pv	с <del>т</del>	(kN)	16.812	-23.670	40.586	-47.704	-24.516	17.259	40.326	-47.964	-25.447	17.669
3. 杭応.	Pile	No.		1	2	б	4	5	6	7	8	6	10

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5 力判定及び変位量	杭径   肉厚   応力比   X 方向変位  Y 方向変位  Z 方向変位	(m) (m) (m) (m) (m)	0.9000 0.0120 0.617 0.009016 0.011106 -0.039471	0.9000 0.0120 0.519 0.009069 0.011182 -0.039471	0.9000 0.0120 0.804 0.009337 0.011151 -0.039444	0.9000 0.0120 0.338 0.009337 0.011990 -0.039497	0.9000 0.0120 0.538 0.009605 0.011959 -0.039471	0.9000 0.0120 0.645 0.009658 0.012036 -0.039471	0.9000 0.0120 0.826 0.009926 0.012004 -0.039444	0.9000 0.0120 0.362 0.009926 0.012843 -0.039497	0.9000 0.0120 0.558 0.010194 0.012812 -0.039471	
応力判定	杭径	(m)	0.9000	0.9000	0.9000	0.9000	0.9000	0.9000	0.9000	0.9000	0.9000	0,000
4. 杭の	Pile No.		1	2	3	4	5	9	7	8	6	10

BD BH4 接岸時 (4/4)

表 5-40(2/2) 耐力照查(BH-4、接岸時)

 $\alpha_0$  (rad) 0.000085  $\beta_{\ 0}$  (rad) -0.000059 (rad) -0.000933

0.009632 0.011997 -0.039471

(m) (II)

 $\mathbf{X}_{0}$  $\mathbf{y}_0$  $^{0}_{\rm Z}$ 

原点の変位

 $\gamma_0$ 

三次	元杭基礎の言	設計									BD	BH4 掲	震時_橋軸	直角方向 (	1/4)
1. J	、力条件			Pile No.	X	y	Z	鉛直角	平面角	杭径	肉厚 個	<b>荡</b> 食代	材質	突出長	全長
	L1				(m)	(m)	(m)	(°)	(°)	(m)	(m)	(m)		(m)	(m)
					0.000	0.000	10.450	15.00	0.00	0.9000	0.012 (	0.0010	SKK400	13.257	38.900
	$X_{0}=$	0.000 1	kN	7	0.450	0.000	9.550	15.00	180.00	0.9000	0.012 (	0.0010	SKK400	13.257	38.900
	$Y_{0}=$	13,648.000 1	kN	с	0.450	0.000	5.000	15.00	270.00	0.9000	0.012 0	0.0010	SKK400	13.257	38.900
	Z_0=	2,047.000 1	kN	4	-0.450	0.000	5.000	15.00	90.00	0.9000	0.012 0	0.0010	SKK400	13.257	38.900
				5	0.000	0.000	0.450	15.00	180.00	0.9000	0.012 0	0.0010	SKK400	13.257	38.900
	$M_{X}=$	-2,047.000 1	kN-m	9	0.000	0.000	-0.450	15.00	0.00	0.9000	0.012 (	0.0010	SKK400	13.257	38.900
	My=	0.000 1	kN-m	7	0.450	0.000	-5.000	15.00	270.00	0.9000	0.012 0	0.0010	SKK400	13.257	38.900
	Mz=	0.000 1	kN-m	~	-0.450	0.000	-5.000	15.00	90.00	0.9000	0.012 (	0.0010	SKK400	13.257	38.900
				6	0.000	0.000	-9.550	15.00	180.00	0.9000	0.012 (	0.0010	SKK400	13.257	38.900
	杭本数 n=	10		10	0.000	0.000	-10.450	15.00	0.00	0.9000	0.012 (	0.0010	SKK400	13.257	38.900
	Kh=	5.900	N/cm <sup>3</sup>		-		-	-		-					
	有効座屈長	Ч													
2. 115	<b>下定数</b>									BD	BH4 地震	時_橋軸[	直角方向。	(2/4)	ŗ
Pile No.	断面積	断面係数	断画2次 モーメント	β	K <sub>X1</sub>		$\mathbf{K}_{\mathrm{Zl}}$	$\mathbf{K}_{\mathrm{X2}}$	$\mathrm{K}_{\mathrm{Z2}}$	$\mathbf{K}_{\mathrm{X4}}$	$K_{Z4}$		$\mathbf{K}_{\mathrm{D}}$	${\rm K}_{\rm V}$	
	$(cm^2)$	$(cm^3)$	$(\mathrm{cm}^4)$	(m <sup>-1</sup> )	(kN/n	n) (l	kN/m)	(kN/rad)	(kN/rad)	(kN-m/rac	1) (kN-m/	rad) (kl	N-m/rad)	(kN/m)	
1	306.53	6,715	301,502	0.216	6 1,225	5.04 1	,225.04	10,947.95	10,947.95	131,576.7	1 131,576	5.71 25	5,951.65	157,596.50	
2	306.53	6,715	301,502	0.216	6 1,225	5.04 1	,225.04	10,947.95	10,947.95	131,576.7	1 131,576	5.71 25	5,951.65	157,596.50	
3	306.53	6,715	301,502	0.216	6 1,225	0.04 1	,225.04	10,947.95	10,947.95	131,576.7	1 131,576	5.71 25	5,951.65	157,596.50	
4	306.53	6,715	301,502	0.216	6 1,225	6.04 1	,225.04	10,947.95	10,947.95	131,576.7	1 131,576	5.71 25	5,951.65	157,596.50	
5	306.53	6,715	301,502	0.216	6 1,225	0.04 1	,225.04	10,947.95	10,947.95	131,576.7	1 131,576	5.71 25	5,951.65	157,596.50	
9	306.53	6,715	301,502	0.216	6 1,225	0.04 1	,225.04	10,947.95	10,947.95	131,576.7	1 131,576	5.71 25	5,951.65	157,596.50	
7	306.53	6,715	301,502	0.216	6 1,225	.04 1	,225.04	10,947.95	10,947.95	131,576.7	1 131,576	5.71 25	5,951.65	157,596.50	

表 5-41(1/2) 耐力照查(BH-4、橋軸直角方向地震時)

25,951.65 157,596.50 25,951.65 157,596.50 25,951.65 157,596.50

 1,225.04
 10,947.95
 10,947.95
 131,576.71
 131,576.71

 1,225.04
 10,947.95
 10,947.95
 131,576.71
 131,576.71

1,225.04 1,225.04 1,225.04

301,502 301,502 301,502

306.53 306.53 306.53

8 9 01

10,947.95 131,576.71 131,576.71

1,225.04 10,947.95

0.2166 0.2166 0.2166

6,715 6,715 6,715

		-	-	-	-	-	-		BD BH4	地震時橋	曲直角方向	(3/4)
Рv		pv	D7	Mv	MW	M	Me	1/r	ος	σ bc	o ca	o ba
<u>د</u> 1		۲,	7 7	VIAT	6141	TTAT	2141	T /T	σt	σ bt	σ ta	o ta
(kN)		(kN)	(kN)	(kN-m)	(kN-m)	(kN-m)	(kN-m)		$(N/mm^2)$	$(N/mm^2)$	$(N/mm^2)$	$(N/mm^2)$
-19.298		1,624.393	48.603	432.213	-0.985	232.166	490.622	42.27	53	73	202	235
12.741		1,512.597	-48.499	-430.933	-0.031	-173.568	464.574	42.27	49	69	202	235
-50.131		-66.337	-15.180	-193.150	-12.394	445.614	485.753	42.27	2	72	235	235
44.052		2,973.954	15.294	194.530	11.379	-391.285	437.048	42.27	97	65	202	235
12.980		1,285.437	-48.488	-430.833	-0.031	-175.706	465.285	42.27	42	69	202	235
-18.791		1,515.522	48.603	432.213	-0.985	227.637	488.494	42.27	49	73	202	235
-49.906		-174.483	-14.931	-190.932	-12.394	443.601	483.026	42.27	9	72	235	235
44.277		2,865.809	15.046	192.312	11.379	-393.298	437.872	42.27	93	65	202	235
12.966		1,169.028	-48.488	-430.833	-0.031	-175.577	465.236	42.27	38	69	202	235
-18.326		1,415.641	48.603	432.213	-0.985	223.481	486.572	42.27	46	72	202	235
	L											

4. 杭の応力判定及び変位量

Z 方向変位 0.040250 0.040241 0.040250 0.040241 0.040250 0.040231 0.040241 0.040231 0.040241 0.040241 (H) Y 方向変位 0.008519 0.009940 0.010672 0.010349 0.008756 0.009229 0.009166 0.009639 0.008046 0.008455 (H) X 方向変位 0.002728 0.002746 0.002838 0.002838 0.002931 0.002949 0.003041 0.003133 0.003041 0.003151 (H) 応力比 0.330 0.574 0.539 0.317 0.758 0.503 0.555 0.538 0.4840.741 0.0120 0.0120 0.0120 0.0120 0.0120 0.0120 0.0120 0.0120 0.0120 0.0120 肉厚 (H 0.9000 0.9000 0.9000 0.9000 0.9000 0.9000 0.9000 0.9000 0.9000 0.9000 杭径 (II) Pile No. 10Ś 9 6 Ļ  $\sim$  $\mathbf{c}$ 4  $\sim$  $\infty$ 

BD BH4 地震時\_橋軸直角方向 (4/4)

		原点の	り変位		
$\mathbf{X}_{0}$	(m)	0.002940	$\alpha_0$	(rad)	-0.000071
$\mathbf{y}_0$	(m)	0.009198	$\beta_{0}$	(rad)	-0.000020
$\mathbf{Z}_0$	(m)	0.040241	$\gamma_0$	(rad)	0.001770

# 表 5-41(2/2) 耐力照查(BH-4、橋軸直角方向地震時)

								BU BF	14 泗震時	倚粗ク回	(1/4)
Pile No.	X	y	Z	鉛直角	平面角	杭径	肉厚	腐食代	材質	突出長	全
	(m)	(m)	(m)	( )	()	(m)	(m)	(m)		(m)	(m)
1	0.000	0.000	10.450	15.00	0.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
7	0.000	0.000	9.550	15.00	180.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
ς	0.450	0.000	5.000	15.00	270.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
4	-0.450	0.000	5.000	15.00	90.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
5	0.000	0.000	0.450	15.00	180.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
9	0.000	0.000	-0.450	15.00	0.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
5	0.450	0.000	-5.000	15.00	270.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
~	-0.450	0.000	-5.000	15.00	90.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
6	0.000	0.000	-9.550	15.00	180.00	0.9000	0.012	0.0010	SKK400	13.257	38.900
10	0.000	0.000	-10.450	15.00	0.00	0.9000	0.012	0.0010	SKK400	13.257	38.900

三次元杭基礎の設計 1. 入力条件

L1

kN kN kN	kN-m kN-m kN-m	N/cm <sup>3</sup>
2,047.000 13,648.000 0.000	0.000 0.000 2,047.000	10 5.900
Xo= Yo= Zo=	Mx= My= Mz=	沆本数 n= Kh=

5.900Ч 有効座屈長 Kh=

2. バネ定数

2. バネ	定数								Β	D BH4 地震	時_橋軸方向	(2/4)	
Pile No.	断面積	断面係数	断面2次 モーメント	β	$\mathbf{K}_{\mathrm{X1}}$	$\mathrm{K}_{\mathrm{Zl}}$	$\mathrm{K}_{\mathrm{X2}}$	$\mathrm{K}_{\mathrm{Z2}}$	$\mathrm{K}_{\mathrm{X4}}$	$\mathrm{K}_{\mathrm{Z4}}$	$\mathrm{K}_\mathrm{D}$	$\mathrm{K}_{\mathrm{V}}$	
	$(\mathrm{cm}^2)$	$(cm^3)$	$(\mathrm{cm}^4)$	(m <sup>-1</sup> )	(kN/m)	(kN/m)	(kN/rad)	(kN/rad)	(kN-m/rad)	(kN-m/rad)	(kN-m/rad)	(kN/m)	
1	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
2	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
Э	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
4	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
5	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
9	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
7	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
8	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
6	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	
10	306.53	6,715	301,502	0.2166	1,225.04	1,225.04	10,947.95	10,947.95	131,576.71	131,576.71	25,951.65	157,596.50	

# 表 5-42(1/2) 耐力照查(BH-4、橋軸方向地震時)

杭応	Ч Г								BD	BH4 地震時	橋軸方向	(3/4)
0	pv	Dv	p <sub>7</sub>	Ŵv	Mw	Mz	Me	1/r	σς	σ bc	o ca	o ba
~	VT	бт	7 7	VIAT	ΛTΛT	TTAT	<b>NIN</b>	1/1	σt	σ bt	o ta	o ta
	(kN)	(kN)	(kN)	(kN-m)	(kN-m)	(kN-m)	(kN-m)		$(N/mm^2)$	$(N/mm^2)$	$(N/mm^2)$	$(N/mm^2)$
Ι	-10.895	2,777.778	6.728	59.921	-1.928	240.098	247.466	42.27	91	37	202	235
5	4.777	121.047	-6.330	-55.141	-1.590	-185.424	193.452	42.27	4	29	202	235
	-9.911	1,493.830	-4.268	-175.397	-30.176	87.725	197.265	42.27	49	29	202	235
+	3.873	1,366.706	4.665	180.176	26.658	-33.763	184.276	42.27	45	27	202	235
2	4.094	60.158	-6.330	-55.141	-1.590	-179.319	187.609	42.27	2	28	202	235
5	-9.903	2,767.242	6.728	59.921	-1.928	231.233	238.874	42.27	90	36	202	235
2	-9.831	1,455.542	-3.408	-167.714	-30.176	87.012	190.139	42.27	47	28	202	235
$\sim$	3.953	1,328.418	3.806	172.494	26.658	-34.476	176.909	42.27	43	26	202	235
<u> </u>	3.343	-6.753	-6.330	-55.141	-1.590	-172.611	181.208	42.27	0	27	235	235
0	-8.993	2,757.577	6.728	59.921	-1.928	223.099	231.010	42.27	90	34	202	235

4. 杭の応力判定及び変位量

0.005515 Z 方向変位 0.005547 0.005547 0.005579 0.005515 0.005547 0.005547 0.005579 0.005547 0.005547 (m) Y 方向変位 0.009519 0.009290 0.007249 0.009016 0.009541 0.011308 0.007500 0.009267 0.011056 0.009038 (II) X 方向変位 0.032493 0.032875 0.032875 0.033195 0.033258 0.032556 0.033577 0.033577 0.033896 0.033960 (II) 応力比 0.338 0.116 0.142 0.367 0.129 0.599 0.356 0.327 0.593 0.607 0.0120 0.0120 0.0120 0.0120 0.0120 0.0120 0.0120 0.0120 0.0120 0.0120 肉厚 (H) 0.9000 0.9000 0.90000.9000 0.90000.9000 0.9000 0.9000 0.9000 0.9000 杭径 (H Pile 10 No. S 9  $\infty$ 6 \_ 2  $\mathcal{C}$ 4  $\sim$ 

BD BH4 地震時\_橋軸方向 (4/4)

	-0.000025	-0.000070	0.004231
	(rad)	(rad)	(rad)
)変位	$\alpha_{0}$	$\beta_{0}$	$\gamma_0$
原点の	033226	009278	005547
	0.	0.0	0.0
	(m) 0.	(m) 0.0	(m) 0.(

# 表 5-42(2/2) 耐力照查(BH-4、橋軸方向地震時)

# 表 5-43 BH-3 接岸時支持力算定結果

杭の静的最大軸方向押込み抵抗力及び静的最大引抜き抵抗力

1. 杭諸元

杭径(mm)	肉厚(mm)	斜角(°)	腐食代(mm)
900	12	15	0

2.先端抵抗力R<sub>pk</sub>

 $R_{pk}$ =300NAp  $\alpha$ 

 $R_{pk}$ =6CpAp  $\alpha$ 

N	Ср	$A_p (m^2)$	閉塞率( $\alpha$ )	R <sub>pk</sub> (kN)
50		0.636	0.400	3,817.0

3.周面抵抗力R<sub>tk</sub>

 $R_{fk} = \Sigma r_{fki} A_{si}$ 

r<sub>fki</sub>=2N

 $r_{fki} = C_a$ 

NIA	上端	下端	J	層厚	As	NT	C	2NA <sub>s</sub>	C <sub>a</sub> A <sub>s</sub>
INO.	(m)	(m)	li (m)	$li/\cos\theta$ (m)	(m <sup>2</sup> )	IN	$(kN/m^2)$	(kN)	(kN)
	-11.20	-14.40	3.20	3.31	9.367		35.0	0.0	327.8
2	-14.40	-18.00	3.60	3.73	10.538	4.0		84.3	0.0
3	-18.00	-33.80	15.80	16.36	46.249		65.0	0.0	3,006.2
4	-33.80	-36.00	2.20	2.28	6.440	50.0		644.0	0.0
5									
6									
7									
8									
9									
1									
	-			R <sub>fk</sub> , R <sub>tk</sub>				4,0	62.3

4.静的最大軸方向押込み抵抗力

γa		$R_{td} = (\gamma_N, \gamma_{c'})$	$\times$ (R <sub>pk</sub> +R <sub>fk</sub> )		$\gamma_{a} {\boldsymbol{\cdot}} R_{td}$
0.66	1.0 × (	3,817.0 +	4,062.3 )=	7,879.4	5,200.4

γa	1.100-1	$R_{td} = (\gamma_{N}, \gamma_{c'}) \times R_{fk}$				
0.40	1.0	×	4,062.3 =	4,062.3	1,624.9	

# 表 5-44 BH-3 地震時支持力算定結果

杭の静的最大軸方向押込み抵抗力及び静的最大引抜き抵抗力

1. 杭諸元

杭径(mm)	肉厚(mm)	斜角(°)	腐食代(mm)
900	12	15	0

2.先端抵抗力R<sub>pk</sub>

 $R_{pk}$ =300NAp  $\alpha$ 

 $R_{pk}$ =6CpAp  $\alpha$ 

N	Ср	$A_p (m^2)$	閉塞率( $\alpha$ )	R <sub>pk</sub> (kN)
50		0.636	0.400	3,817.0

3.周面抵抗力R<sub>fk</sub>

 $R_{fk} = \Sigma r_{fki} A_{si}$ 

r<sub>fki</sub>=2N

 $r_{\rm fki} {=} C_{\rm a}$ 

NIa	上端	下端	1	層厚	$A_s$	N	C	2NA <sub>s</sub>	C <sub>a</sub> A <sub>s</sub>
NO.	(m)	(m)	li (m)	$li/cos \theta$ (m)	(m <sup>2</sup> )	(m <sup>2</sup> )	$(kN/m^2)$	(kN)	(kN)
	-11.20	-14.40	3.20	3.31	9.367		35.0	0.0	327.8
2	-14.40	-18.00	3.60	3.73	10.538	4.0		84.3	0.0
3	-18.00	-33.80	15.80	16.36	46.249		65.0	0.0	3,006.2
4	-33.80	-36.00	2.20	2.28	6.440	50.0		644.0	0.0
6									
6									
7									
8									
9									
10									
		· · · · ·		R <sub>fk</sub> , R <sub>tk</sub>				4,0	62.3

4.静的最大軸方向押込み抵抗力

γa		$R_{td} = (\gamma_N, \gamma_c)$	$\times$ (R <sub>pk</sub> +R <sub>ik</sub> )		$\gamma_{a} \cdot R_{td}$
0.66	1.0 ×(	3,817.0 +	4,062.3 )=	7,879.4	5,200.4

γa	$R_{td} = (\gamma_N, \gamma_{c'}) \times R_{fk}$				$\gamma_a \cdot R_{td}$
0.40	1.0	×	4,062.3 =	4,062.3	1,624.9

# 表 5-45 BH-4 接岸時支持力算定結果

杭の静的最大軸方向押込み抵抗力及び静的最大引抜き抵抗力

1. 杭諸元

杭径(mm)	肉厚(mm)	斜角(°)	腐食代(mm)
900	14	15	0

2.先端抵抗力R<sub>pk</sub>

 $R_{pk}$ =300NAp  $\alpha$ 

 $R_{pk}$ =6CpAp  $\alpha$ 

N	Ср	$A_p$ (m <sup>2</sup> )	閉塞率(α)	R <sub>pk</sub> (kN)
50		0.636	0.400	3,817.0

3.周面抵抗力R<sub>ik</sub>

 $R_{fk} = \Sigma r_{fki} A_{si}$ 

r<sub>fki</sub>=2N

 $r_{fki} = C_a$ 

NT-	上端	下端	)	<b>督</b> 厚	As	N	C	2NA <sub>s</sub>	C <sub>a</sub> A <sub>s</sub>
NO.	(m)	(m)	li (m)	$li/cos \theta$ (m)	(m <sup>2</sup> )	IN	$(kN/m^2)$	(kN)	(kN)
	-21.60	-38.40	16.80	17.39	49.177		25.0	0.0	1,229.4
2	-38.40	-40.40	2.00	2.07	5.854	16.0		187.3	0.0
3	-40.40	-42.40	2.00	2.07	5.854	50.0		585.4	0.0
4									
(5)									
6									
$\overline{O}$	-								-
(8)									
9	-								
10									
				R <sub>fk</sub> , R <sub>tk</sub>				2,0	02.2

4.静的最大軸方向押込み抵抗力

Уa		$R_{td} = (\gamma_N, \gamma_{c'})$	$\times$ (R <sub>pk</sub> +R <sub>fk</sub> )		$\gamma_a {\boldsymbol{\cdot}} R_{td}$
0.66	1.0 ×(	3,817.0 +	2,002.2 )=	5,819.2	3,840.7

Ya		R <sub>td</sub>	$= (\gamma_{N}, \gamma_{c}) \times R_{fk}$	1000	$\gamma_a \cdot R_{td}$
0.40	1.0	×	2,002.2 =	2,002.2	800.9

# 表 5-46 BH-4 地震時支持力算定結果

杭の静的最大軸方向押込み抵抗力及び静的最大引抜き抵抗力

1.杭諸元

杭径(mm)	肉厚(mm)	斜角(°)	腐食代(mm)
900	14	15	0

2.先端抵抗力R<sub>pk</sub>

 $R_{pk}$ =300NAp  $\alpha$ 

 $R_{pk}$ =6CpAp  $\alpha$ 

N	Ср	$A_p$ (m <sup>2</sup> )	閉塞率(α)	R <sub>pk</sub> (kN)
50		0.636	0.400	3,817.0

3.周面抵抗力R<sub>fk</sub>

 $R_{fk} = \Sigma r_{fki} A_{si}$ 

r<sub>fki</sub>=2N

r<sub>fki</sub>=C<sub>a</sub>

NI	上端	下端	)	層厚	As	NT	C	2NAs	C <sub>a</sub> A <sub>s</sub>
INO.	(m)	(m)	li (m)	$li/cos \theta$ (m)	(m <sup>2</sup> )	IN.	$(kN/m^2)$	(kN)	(kN)
1	-21.60	-38.40	16.80	17.39	49.177		25.0	0.0	1,229.4
2	-38.40	-40.40	2.00	2.07	5.854	16.0		187.3	0.0
3	-40.40	-42.40	2.00	2.07	5.854	50.0		585.4	0.0
4	1								
(5)									
6									
Ø									
8									
9			_						
10								1	
			1	R <sub>fk</sub> , R <sub>tk</sub>				2,0	02.2

4.静的最大軸方向押込み抵抗力

γa		$R_{td} = (\gamma_{N}, \gamma_{c'})$	$\times$ (R <sub>pk</sub> +R <sub>fk</sub> )		$\gamma_{a} \cdot R_{td}$
0.66	1.0 ×(	3,817.0 +	2,002.2 )=	5,819.2	3,840.7

γa		R <sub>td</sub>	$= (\gamma_N, \gamma_{c'}) \times R_{fk}$		$\gamma_a \cdot R_{td}$
0.40	1.0	×	2,002.2 =	2,002.2	800.9

# 5-3-2 プラットホーム

# 5-3-2-1 鋼管杭部

表 5-47(1/4) 耐力照查(BH-2、法線直角方向地震時)

									な緑画用ク	回泡澱時(	(1/4)
Pile No.	Х	у	Z	鉛直角	平面角	杭径	肉厚	腐食代	材質	突出長	全長
	(m)	(m)	(m)	(°)	(°)	(m)	(m)	(m)		(m)	(m)
-	5.250	0.000	25.875	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
5	0.500	0.000	25.875	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
3	-4.250	0.000	25.875	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
4	5.250	0.000	20.000	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
S	0.500	0.000	20.000	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
9	-4.250	0.000	20.000	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
7	5.250	0.000	14.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
×	0.500	0.000	14.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
6	-4.250	0.000	14.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
10	5.250	0.000	9.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
11	0.500	0.000	9.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
12	-4.250	0.000	9.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
13	5.250	0.000	3.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
14	0.500	0.000	3.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
15	-4.250	0.000	3.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
16	5.250	0.000	-3.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
17	0.500	0.000	-3.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
18	-4.250	0.000	-3.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
19	5.250	0.000	-9.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
20	0.500	0.000	-9.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
21	-4.250	0.000	-9.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
22	5.250	0.000	-14.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
23	0.500	0.000	-14.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
24	-4.250	0.000	-14.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
25	5.250	0.000	-20.000	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
26	0.500	0.000	-20.000	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
27	-4.250	0.000	-20.000	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
28	5.250	0.000	-25.875	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
29	0.500	0.000	-25.875	00.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
30	-4.250	0.000	-25.875	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000

# 三次元杭基礎の設計

1. 入力条件 Ship

kN kN	kN	kN-m	kN-m	kN-m		N/cm <sup>3</sup>	
3,453.000 23,018.000	0.000	0.000	0.000	0.000	30	18.000	Ч
Xo= Yo=	Z0=	$M_{X}=$	My=	Mz=	杭本数 n=	Kh=	有効座屈長

2. バネ	、定数								PL BI	H2 法線直角	方向地震時	(2/4)
Pile No.	断面積	断面係数	断回2次 モーメント	β	$\mathbf{K}_{\mathrm{Xl}}$	$\mathrm{K}_{\mathrm{Zl}}$	K <sub>X2</sub>	$\mathrm{K}_{\mathrm{Z2}}$	$\mathbf{K}_{\mathrm{X4}}$	${ m K}_{ m Z4}$	$K_{\mathrm{D}}$	$K_V$
	$(\mathrm{cm}^2)$	$(cm^3)$	$(cm^4)$	(m <sup>-1</sup> )	(kN/m)	(kN/m)	(kN/rad)	(kN/rad)	(kN-m/rad)	(kN-m/rad)	(kN-m/rad)	(kN/m)
-	271.97	5,278	210,602	0.3041	1,917.29	1,917.29	13,122.76	13,122.76	120,587.64	120,587.64	23,669.03	156,303.26
5	271.97	5,278	210,602	0.3041	2,685.62	2,685.62	16,367.37	16,367.37	134,306.28	134,306.28	26,581.82	155,410.10
3	271.97	5,278	210,602	0.3041	3,183.67	3,183.67	18,288.38	18,288.38	141,718.28	141,718.28	28,201.41	155,410.10
4	271.97	5,278	210,602	0.3041	1,917.29	1,917.29	13,122.76	13,122.76	120,587.64	120,587.64	23,669.03	156,303.26
5	271.97	5,278	210,602	0.3041	2,685.62	2,685.62	16,367.37	16,367.37	134,306.28	134,306.28	26,581.82	155,410.10
9	271.97	5,278	210,602	0.3041	3,183.67	3,183.67	18,288.38	18,288.38	141,718.28	141,718.28	28,201.41	155,410.10
7	271.97	5,278	210,602	0.3041	1,917.29	1,917.29	13,122.76	13,122.76	120,587.64	120,587.64	23,669.03	156,303.26
~	271.97	5,278	210,602	0.3041	2,685.62	2,685.62	16,367.37	16,367.37	134,306.28	134,306.28	26,581.82	155,410.10
6	271.97	5,278	210,602	0.3041	3,183.67	3,183.67	18,288.38	18,288.38	141,718.28	141,718.28	28,201.41	155,410.10
10	271.97	5,278	210,602	0.3041	1,917.29	1,917.29	13,122.76	13,122.76	120,587.64	120,587.64	23,669.03	156,303.26
11	271.97	5,278	210,602	0.3041	2,685.62	2,685.62	16,367.37	16,367.37	134,306.28	134,306.28	26,581.82	155,410.10
12	271.97	5,278	210,602	0.3041	3,183.67	3,183.67	18,288.38	18,288.38	141,718.28	141,718.28	28,201.41	155,410.10
13	271.97	5,278	210,602	0.3041	1,917.29	1,917.29	13,122.76	13,122.76	120,587.64	120,587.64	23,669.03	156,303.26
14	271.97	5,278	210,602	0.3041	2,685.62	2,685.62	16,367.37	16,367.37	134,306.28	134,306.28	26,581.82	155,410.10
15	271.97	5,278	210,602	0.3041	3,183.67	3,183.67	18,288.38	18,288.38	141,718.28	141,718.28	28,201.41	155,410.10
16	271.97	5,278	210,602	0.3041	1,917.29	1,917.29	13,122.76	13,122.76	120,587.64	120,587.64	23,669.03	156,303.26
17	271.97	5,278	210,602	0.3041	2,685.62	2,685.62	16,367.37	16,367.37	134,306.28	134,306.28	26,581.82	155,410.10
18	271.97	5,278	210,602	0.3041	3,183.67	3,183.67	18,288.38	18,288.38	141,718.28	141,718.28	28,201.41	155,410.10
19	271.97	5,278	210,602	0.3041	1,917.29	1,917.29	13,122.76	13,122.76	120,587.64	120,587.64	23,669.03	156,303.26
20	271.97	5,278	210,602	0.3041	2,685.62	2,685.62	16,367.37	16,367.37	134,306.28	134,306.28	26,581.82	155,410.10
21	271.97	5,278	210,602	0.3041	3,183.67	3,183.67	18,288.38	18,288.38	141,718.28	141,718.28	28,201.41	155,410.10
22	271.97	5,278	210,602	0.3041	1,917.29	1,917.29	13,122.76	13,122.76	120,587.64	120,587.64	23,669.03	156,303.26
23	271.97	5,278	210,602	0.3041	2,685.62	2,685.62	16,367.37	16,367.37	134,306.28	134,306.28	26,581.82	155,410.10
24	271.97	5,278	210,602	0.3041	3,183.67	3,183.67	18,288.38	18,288.38	141,718.28	141,718.28	28,201.41	155,410.10
25	271.97	5,278	210,602	0.3041	1,917.29	1,917.29	13,122.76	13,122.76	120,587.64	120,587.64	23,669.03	156,303.26
26	271.97	5,278	210,602	0.3041	2,685.62	2,685.62	16,367.37	16,367.37	134,306.28	134,306.28	26,581.82	155,410.10
27	271.97	5,278	210,602	0.3041	3,183.67	3,183.67	18,288.38	18,288.38	141,718.28	141,718.28	28,201.41	155,410.10
28	271.97	5,278	210,602	0.3041	1,917.29	1,917.29	13,122.76	13,122.76	120,587.64	120,587.64	23,669.03	156,303.26
29	271.97	5,278	210,602	0.3041	2,685.62	2,685.62	16,367.37	16,367.37	134,306.28	134,306.28	26,581.82	155,410.10
30	271.97	5,278	210,602	0.3041	3,183.67	3,183.67	18,288.38	18,288.38	141,718.28	141,718.28	28,201.41	155,410.10

# 表 5-47(2/4) 耐力照查(BH-2、法線直角方向地震時)

3. 杭応	Ц Г								PL BH2	法線直角力	5向地震時	(3/4)
Pile	рv	Ď	p <sub>7</sub>	Mv	My	Mz	Me	1/r	ος	o bc	o ca	o ba
No.	V T	۲ ک	7 7	VIN	ίτλτ.	77111	ATAT	1/1	σt	σ bt	o ta	o ta
	(kN)	(kN)	(kN)	(kN-m)	(kN-m)	(kN-m)	(kN-m)		$(N/mm^2)$	$(N/mm^2)$	$(N/mm^2)$	$(N/mm^2)$
-	84.843	868.529	0.000	0.000	0.000	-576.619	576.619	37.37	32	109	208	235
7	119.110	765.612	0.000	0.000	0.000	-721.325	721.325	31.98	28	137	216	235
с	141.347	667.658	0.000	0.000	0.000	-807.093	807.093	29.47	25	153	219	235
4	84.843	868.529	0.000	0.000	0.000	-576.619	576.619	37.37	32	109	208	235
5	119.110	765.612	0.000	0.000	0.000	-721.325	721.325	31.98	28	137	216	235
9	141.347	667.658	0.000	0.000	0.000	-807.093	807.093	29.47	25	153	219	235
7	84.843	868.529	0.000	0.000	0.000	-576.619	576.619	37.37	32	109	208	235
8	119.110	765.612	0.000	0.000	0.000	-721.325	721.325	31.98	28	137	216	235
6	141.347	667.658	0.000	0.000	0.000	-807.093	807.093	29.47	25	153	219	235
10	84.843	868.529	0.000	0.000	0.000	-576.619	576.619	37.37	32	109	208	235
11	119.110	765.612	0.000	0.000	0.000	-721.325	721.325	31.98	28	137	216	235
12	141.347	667.658	0.000	0.000	0.000	-807.093	807.093	29.47	25	153	219	235
13	84.843	868.529	0.000	0.000	0.000	-576.619	576.619	37.37	32	109	208	235
14	119.110	765.612	0.000	0.000	0.000	-721.325	721.325	31.98	28	137	216	235
15	141.347	667.658	0.000	0.000	0.000	-807.093	807.093	29.47	25	153	219	235
16	84.843	868.529	0.000	0.000	0.000	-576.619	576.619	37.37	32	109	208	235
17	119.110	765.612	0.000	0.000	0.000	-721.325	721.325	31.98	28	137	216	235
18	141.347	667.658	0.000	0.000	0.000	-807.093	807.093	29.47	25	153	219	235
19	84.843	868.529	0.000	0.000	0.000	-576.619	576.619	37.37	32	109	208	235
20	119.110	765.612	0.000	0.000	0.000	-721.325	721.325	31.98	28	137	216	235
21	141.347	667.658	0.000	0.000	0.000	-807.093	807.093	29.47	25	153	219	235
22	84.843	868.529	0.000	0.000	0.000	-576.619	576.619	37.37	32	109	208	235
23	119.110	765.612	0.000	0.000	0.000	-721.325	721.325	31.98	28	137	216	235
24	141.347	667.658	0.000	0.000	0.000	-807.093	807.093	29.47	25	153	219	235
25	84.843	868.529	0.000	0.000	0.000	-576.619	576.619	37.37	32	109	208	235
26	119.110	765.612	0.000	0.000	0.000	-721.325	721.325	31.98	28	137	216	235
27	141.347	667.658	0.000	0.000	0.000	-807.093	807.093	29.47	25	153	219	235
28	84.843	868.529	0.000	0.000	0.000	-576.619	576.619	37.37	32	109	208	235
29	119.110	765.612	0.000	0.000	0.000	-721.325	721.325	31.98	28	137	216	235
30	141.347	667.658	0.000	0.000	0.000	-807.093	807.093	29.47	25	153	219	235

表 5-47(3/4) 耐力照查(BH-2、法線直角方向地震時)

PL BH2 法線直角方向地震時 (4/4)

		原点の	り変位	ŕ	
$\mathbf{x}_{0}$	(II)	0.045160	$\alpha^{0}$	(rad)	0.00000
$\mathbf{y}_0$	(m)	0.004860	$\beta_{0}$	(rad)	0.000000
$\mathbf{Z}_{0}$	(m)	0.000000	$\gamma_0$	(rad)	0.000133

4. 杭の	応力判定及	及び変位量				
Pile No.	杭径	肉厚	応力比	X 方向変位	Y 方向変位	Z 方向変位
	(m)	(m)		(m)	(m)	(m)
1	0.8000	0.0120	0.618	0.045160	0.005557	0.000000
2	0.8000	0.0120	0.712	0.045160	0.004926	0.000000
ю	0.8000	0.0120	0.763	0.045160	0.004296	0.000000
4	0.8000	0.0120	0.618	0.045160	0.005557	0.000000
5	0.8000	0.0120	0.712	0.045160	0.004926	0.000000
9	0.8000	0.0120	0.763	0.045160	0.004296	0.000000
7	0.8000	0.0120	0.618	0.045160	0.005557	0.000000
8	0.8000	0.0120	0.712	0.045160	0.004926	0.000000
6	0.8000	0.0120	0.763	0.045160	0.004296	0.000000
10	0.8000	0.0120	0.618	0.045160	0.005557	0.000000
11	0.8000	0.0120	0.712	0.045160	0.004926	0.000000
12	0.8000	0.0120	0.763	0.045160	0.004296	0.000000
13	0.8000	0.0120	0.618	0.045160	0.005557	0.000000
14	0.8000	0.0120	0.712	0.045160	0.004926	0.000000
15	0.8000	0.0120	0.763	0.045160	0.004296	0.000000
16	0.8000	0.0120	0.618	0.045160	0.005557	0.000000
17	0.8000	0.0120	0.712	0.045160	0.004926	0.000000
18	0.8000	0.0120	0.763	0.045160	0.004296	0.000000
19	0.8000	0.0120	0.618	0.045160	0.005557	0.000000
20	0.8000	0.0120	0.712	0.045160	0.004926	0.000000
21	0.8000	0.0120	0.763	0.045160	0.004296	0.000000
22	0.8000	0.0120	0.618	0.045160	0.005557	0.000000
23	0.8000	0.0120	0.712	0.045160	0.004926	0.000000
24	0.8000	0.0120	0.763	0.045160	0.004296	0.000000
25	0.8000	0.0120	0.618	0.045160	0.005557	0.000000
26	0.8000	0.0120	0.712	0.045160	0.004926	0.000000
27	0.8000	0.0120	0.763	0.045160	0.004296	0.000000
28	0.8000	0.0120	0.618	0.045160	0.005557	0.000000
29	0.8000	0.0120	0.712	0.045160	0.004926	0.000000
30	0.8000	0.0120	0.763	0.045160	0.004296	0.000000

# 表 5-47(4/4) 耐力照查(BH-2、法線直角方向地震時)

1			4 <del>4</del> 4	#  -  -	AV 71	[[ -{	シンを払	-555 T T		11
	y	Z	鉛直角	半回角	杭徐	肉厚	腐食代	材質	<u></u> ЗШΕ	金
-	(m)	(m)	。) )	(°)	(m)	(m)	(m)		(m)	(m)
	0.000	25.875	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
	0.000	25.875	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
	0.000	25.875	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
	0.000	20.000	0.00	00.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
	0.000	20.000	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
	0.000	20.000	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
	0.000	14.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
	0.000	14.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
	0.000	14.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
	0.000	9.125	0.00	00.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
	0.000	9.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
	0.000	9.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
	0.000	3.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
	0.000	3.125	0.00	00.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
	0.000	3.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
	0.000	-3.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
	0.000	-3.125	00.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
	0.000	-3.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
	0.000	-9.125	0.00	00.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
	0.000	-9.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
	0.000	-9.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
-	0.000	-14.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
	0.000	-14.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
	0.000	-14.125	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
1	0.000	-20.000	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
	0.000	-20.000	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
	0.000	-20.000	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000
	0.000	-25.875	0.00	0.00	0.8000	0.012	0.0010	SKK400	10.400	34.800
	0.000	-25.875	00.00	0.00	0.8000	0.012	0.0010	SKK400	8.900	35.000
	0.000	-25.875	0.00	0.00	0.8000	0.012	0.0010	SKK400	8.200	35.000

# 表 5-48(1/4) 耐力照查(BH-2、法線平行方向地震時)

三次元杭基礎の設計 1. 入力条件

Ship

kN-m kN-m kN-m

0.000 0.000 0.000

Mx= My= Mz=

0.000 kN 23,018.000 kN 3,453.000 kN

Xo= Yo= Zo=

5-110

N/cm<sup>3</sup>

30 18.000 h

抗本数 n= Kh= 有効座屈長
(2/4)	$\mathrm{K}_{\mathrm{V}}$	(kN/m)	156,303.26	155,410.10	155,410.10	156,303.26	155,410.10	155,410.10	156,303.26	155,410.10	155,410.10	156,303.26	155,410.10	155,410.10	156,303.26	155,410.10	155,410.10	156,303.26	155,410.10	155,410.10	156,303.26	155,410.10	155,410.10	156,303.26	155,410.10	155,410.10	156,303.26	155,410.10	155,410.10	156,303.26	155,410.10	155 410 10
方向地震時	$\mathrm{K}_\mathrm{D}$	(kN-m/rad)	23,669.03	26,581.82	28,201.41	23,669.03	26,581.82	28,201.41	23,669.03	26,581.82	28,201.41	23,669.03	26,581.82	28,201.41	23,669.03	26,581.82	28,201.41	23,669.03	26,581.82	28,201.41	23,669.03	26,581.82	28,201.41	23,669.03	26,581.82	28,201.41	23,669.03	26,581.82	28,201.41	23,669.03	26,581.82	28 201 41
12 法線平行	$\mathrm{K}_{\mathrm{Z4}}$	(kN-m/rad)	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141.718.28
PL BF	$\mathrm{K}_{\mathrm{X4}}$	(kN-m/rad)	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141,718.28	120,587.64	134,306.28	141.718.28
	$\mathrm{K}_{\mathrm{Z2}}$	(kN/rad)	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18 288 38
	$\mathrm{K}_{\mathrm{X2}}$	(kN/rad)	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18,288.38	13,122.76	16,367.37	18 288 38
	$\mathrm{K}_{\mathrm{Zl}}$	(kN/m)	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3 183 67
	$\mathbf{K}_{\mathrm{Xl}}$	(kN/m)	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3,183.67	1,917.29	2,685.62	3 183 67
	β	(m <sup>-1</sup> )	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0.3041	0 3041
	断回2次 モーメント	$(cm^4)$	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210,602	210.602
	断面係数	$(\mathrm{cm}^3)$	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5,278	5.278
定数	断面積	$(\mathrm{cm}^2)$	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97	271.97
2. バネ	Pile No.		-	2	с	4	5	9	7	~	6	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

# 表 5-48(2/4) 耐力照查(BH-2、法線平行方向地震時)

	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
(3/4)	σ ba	o ta	$(N/mm^2)$	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235
5向地震時	o ca	o ta	$(N/mm^2)$	208	216	219	208	216	219	208	216	219	208	216	219	208	216	219	208	216	219	208	216	219	208	216	219	208	216	219	208	216	219
法線平行力	σ bc	σ bt	$(N/mm^2)$	111	138	153	111	138	153	111	138	153	111	138	153	111	138	153	111	138	153	111	138	153	111	138	153	111	138	153	111	138	153
PL BH2	ος	σt	$(N/mm^2)$	26	31	35	26	30	35	25	30	34	25	29	33	24	28	33	24	28	32	23	27	32	22	27	31	22	26	31	21	26	30
	1/r	1/1		37.37	31.98	29.47	37.37	31.98	29.47	37.37	31.98	29.47	37.37	31.98	29.47	37.37	31.98	29.47	37.37	31.98	29.47	37.37	31.98	29.47	37.37	31.98	29.47	37.37	31.98	29.47	37.37	31.98	29.47
	Me	ATAT	(kN-m)	584.273	725.867	807.677	584.242	725.814	807.611	584.229	725.783	807.568	584.230	725.773	807.550	584.248	725.781	807.552	584.286	725.813	807.579	584.340	725.866	807.632	584.399	725.928	807.694	584.484	726.019	807.790	584.585	726.132	807.909
	Mz	TTAT	(kN-m)	7.283	11.727	14.475	4.136	7.801	10.088	0.988	3.876	5.702	-1.690	0.535	1.969	-4.905	-3.474	-2.511	-8.253	-7.651	-7.177	-11.467	-11.660	-11.657	-14.146	-15.001	-15.390	-17.294	-18.926	-19.776	-20.441	-22.852	-24.163
	Mv	λτλτ (	(kN-m)	-0.966	-1.085	-1.151	-0.966	-1.085	-1.151	-0.966	-1.085	-1.151	-0.966	-1.085	-1.151	-0.966	-1.085	-1.151	-0.966	-1.085	-1.151	-0.966	-1.085	-1.151	-0.966	-1.085	-1.151	-0.966	-1.085	-1.151	-0.966	-1.085	-1.151
	Mv	VINI	(kN-m)	584.227	725.772	807.547	584.227	725.772	807.547	584.227	725.772	807.547	584.227	725.772	807.547	584.227	725.772	807.547	584.227	725.772	807.547	584.227	725.772	807.547	584.227	725.772	807.547	584.227	725.772	807.547	584.227	725.772	807.547
	p,	7 7	(kN)	85.433	119.182	140.685	85.433	119.182	140.685	85.433	119.182	140.685	85.433	119.182	140.685	85.433	119.182	140.685	85.433	119.182	140.685	85.433	119.182	140.685	85.433	119.182	140.685	85.433	119.182	140.685	85.433	119.182	140.685
	p <sub>v</sub>	۲ ک	(kN)	715.826	832.948	954.160	700.545	817.754	938.967	685.264	802.561	923.773	672.259	789.630	910.842	656.653	774.113	895.325	640.397	757.950	879.162	624.791	742.433	863.645	611.786	729.502	850.714	596.505	714.308	835.521	581.224	699.115	820.327
Ł	pv	× ٦	(kN)	-1.802	-2.855	-3.568	-1.342	-2.211	-2.804	-0.883	-1.567	-2.041	-0.491	-1.019	-1.391	-0.022	-0.361	-0.611	0.468	0.324	0.201	0.937	0.982	0.981	1.329	1.530	1.631	1.788	2.174	2.395	2.248	2.819	3.158
3. 杭応.	Pile	No.		1	2	3	4	5	9	7	~	6	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

表 5-48(3/4) 耐力照查(BH-2、法線平行方向地震時)

PL BH2 法線平行方向地震時 (4/4)

		原点0	う変位		
$\mathbf{X}_0$	(m)	-0.001008	$\sigma_0$	(rad)	-0.000017
$\mathbf{y}_0$	(m)	0.005011	$\beta_{0}$	(rad)	-0.000041
$\mathbf{Z}_0$	(m)	0.044459	$\gamma_0$	(rad)	-0.000164

4. 杭の	応力判定?	及び変位量				
Pile No.	杭径	肉厚	応力比	X 方向変位	Y 方向変位	Z 方向変位
	(m)	(m)		(m)	(m)	(m)
1	0.8000	0.0120	0.597	-0.002064	0.004580	0.044673
2	0.8000	0.0120	0.727	-0.002064	0.005360	0.044479
б	0.8000	0.0120	0.811	-0.002064	0.006140	0.044285
4	0.8000	0.0120	0.595	-0.001824	0.004482	0.044673
5	0.8000	0.0120	0.725	-0.001824	0.005262	0.044479
9	0.8000	0.0120	0.809	-0.001824	0.006042	0.044285
7	0.8000	0.0120	0.592	-0.001584	0.004384	0.044673
~	0.8000	0.0120	0.722	-0.001584	0.005164	0.044479
6	0.8000	0.0120	0.806	-0.001584	0.005944	0.044285
10	0.8000	0.0120	0.590	-0.001380	0.004301	0.044673
11	0.8000	0.0120	0.720	-0.001380	0.005081	0.044479
12	0.8000	0.0120	0.804	-0.001380	0.005861	0.044285
13	0.8000	0.0120	0.587	-0.001135	0.004201	0.044673
14	0.8000	0.0120	0.717	-0.001135	0.004981	0.044479
15	0.8000	0.0120	0.801	-0.001135	0.005761	0.044285
16	0.8000	0.0120	0.584	-0.000880	0.004097	0.044673
17	0.8000	0.0120	0.714	-0.000880	0.004877	0.044479
18	0.8000	0.0120	0.799	-0.000880	0.005657	0.044285
19	0.8000	0.0120	0.581	-0.000635	0.003997	0.044673
20	0.8000	0.0120	0.712	-0.000635	0.004777	0.044479
21	0.8000	0.0120	0.796	-0.000635	0.005557	0.044285
22	0.8000	0.0120	0.579	-0.000431	0.003914	0.044673
23	0.8000	0.0120	0.710	-0.000431	0.004694	0.044479
24	0.8000	0.0120	0.794	-0.000431	0.005474	0.044285
25	0.8000	0.0120	0.577	-0.000191	0.003816	0.044673
26	0.8000	0.0120	0.707	-0.000191	0.004596	0.044479
27	0.8000	0.0120	0.791	-0.000191	0.005376	0.044285
28	0.8000	0.0120	0.574	0.000049	0.003719	0.044673
29	0.8000	0.0120	0.705	0.000049	0.004499	0.044479
30	0.8000	0.0120	0.789	0.000049	0.005278	0.044285

# 表 5-48(4/4) 耐力照查(BH-2、法線平行方向地震時)

# 表 5-49 BH-2 地震時支持力算定結果

杭の静的最大軸方向押込み抵抗力及び静的最大引抜き抵抗力

1.杭諸元

杭径(mm)	肉厚(mm)	斜角(°)	腐食代(mm)
800	12	0	0

2.先端抵抗力R<sub>pk</sub>

 $R_{pk}$ =300NAp  $\alpha$ 

 $R_{pk}$ =6CpAp  $\alpha$ 

Ν	Ср	$A_p (m^2)$	閉塞率(α)	R <sub>pk</sub> (kN)
	78	0.503	0.000	0.0

3.周面抵抗力R<sub>fk</sub>

 $R_{fk} = \Sigma r_{fki} A_{si}$ 

r<sub>fki</sub>=2N

 $r_{fki} = C_a$ 

	上端	下端	J	層厚	As	NT	C	2NA <sub>s</sub>	C <sub>a</sub> A <sub>s</sub>
NO.	(m)	(m)	li (m)	$li/cos \theta$ (m)	$(m^2)$	IN	$(kN/m^2)$	(kN)	(kN)
D	-7.61	-13.10	5.49	5.49	13.798	12.0		331.1	0.0
2)	-13.10	-17.30	4.20	4.20	10.556		45.0	0.0	475.0
3)	-17.30	-22.70	5.40	5.40	13.572	17.0		461.4	0.0
4	-22.70	-28.00	5.30	5.30	13.320		77.5	0.0	1,032.3
5)									
6					1				
7)								_	
8)									
9)									
10)								· · · · · ·	
				R <sub>fk</sub> , R <sub>tk</sub>				2,2	99.9

4.静的最大軸方向押込み抵抗力

Ya		-	$R_{td} = (\gamma_N, \gamma_c) \times$	$(R_{pk} + R_{fk})$		$\gamma_{a} \cdot R_{td}$
0.50	1.0	imes (	0.0 +	2,299.9 )=	2,299.9	1,150.0

5.静的最大引抜き抵抗力

γ <sub>a</sub>		$R_{td} = (\gamma_{N}, \gamma_{c'}) \times R_{fk}$		$\gamma_{a} \cdot R_{td}$
0.40	1.0	× 2,299.9 =	2,299.9	920.0

# 5-3-2-2 PHC 杭部

## 5-3-2-2-1 設計条件

- (1) 一般事項
  - ・データファイル名:PL PHC.F8F
  - ・タイトル :プラットホーム

## (2) 杭の条件

・杭種		: ]	PHC杭 (スパイラル鉄筋を考慮する)
・施工工法		:	打込み杭(打撃)
・杭頭接合条件		:	剛結・ヒンジ
・杭先端条件		:	ヒンジ
・杭の種類		:)	摩擦杭
・杭の許容変位量	常時	:	50.0 (mm)
t	地震時	:	100.0 (mm)
・杭体のヤング係数		:	4.00 $\times 10^4$ (N/mm <sup>2</sup> )
・杭本数		:	50(本)
・杭径		:	800.0 (mm)
・厚さ		:	110.0 (mm)
・設計杭長,種類		:	31.00 (m) C種

#### (3) 適用基準及び参考文献

・道路橋示方書Ⅰ共通編(平成24年3月)
・道路橋示方書Ⅲコンクリート橋編(平成24年3月)
・道路橋示方書Ⅳ下部構造編(平成24年3月)
・道路橋示方書Ⅴ耐震設計編(平成24年3月)
・杭基礎設計便覧(平成19年1月)
・道路橋の耐震設計に関する資料(平成9年3月)

#### (4) 使用材料および許容応力度

設計基準強度 σ<sub>ck</sub>=80.00(N/mm<sup>2</sup>)

単位: $N/mm^2$ 

No	<b>生</b> 旧 色 参	許容曲げ圧縮応力度	許容曲げ引張	応力度 σ ta	許容せん断応力度
NO	口12日 [77.33	σ <sub>ca</sub>	$\sigma_{ce} < 7.8$	σ <sub>ce</sub> ≧7.8	τ <sub>a</sub>
1	1.50	40.00	3.00	5.00	1.275

# (5) 杭配置図·側面図





--- 設計地盤面(常時)
 -- 設計地盤面(地震時)
 (b)側面図(橋軸直角方向)

杭頭座標(m)

X方向(橋軸直角方向)

No	1	2	3	4	5
座標	-10.675	-5.337	0.000	5.337	10.675
·	→, <b>∠</b> , \		•	•	•

Y方向(橋軸方向)

No.	1	2	3	4	5	6	7	8
座標	26.000	20.222	14.444	8.667	2.889	-2.889	-8.667	-14.444
No	9	10						

座標 -20.222 -26.000

※各方向の座標の向きは図中(a)に示す。

(6) 地層データ

困		層厚	(m)	亚均	<b>α</b> • E <sub>c</sub>	$(kN/m^2)$	γ(kN	/m <sup>3</sup> )	f (kN	$I/m^2$ )
/音 No	層種	常時	地震時	平均 N値	常 時	地震時	γ	γ'	f	fn
*		7.300	7.300							
1	砂質土	9.100	9.100	12.0	33,600	67,200	18.00	9.90	24.0	24.0
2	粘性土	4.200	4.200	10.0	28,000	56,000	15.00	4.90	45.0	45.0
3	砂礫土	5.400	5.400	17.0	47,600	95,200	15.00	4.90	34.0	34.0
4	粘性土	5.000	5.000	22.0	61,600	123,200	15.00	4.90	77.5	77.5

\*は突出部を表わす。

- (7) ばね定数,許容支持力・引抜力,断面二次モーメント
  - ・杭軸方向ばね定数 Kv(kN/m)

常 時	456,671
地震時	456,671

・許容支持力・引抜力 (kN/本)

新宏士博力	常 時	756
计谷义行力	地震時	1,152
許容引抜力	常 時	528
	地震時	938

・水平方向地盤反力係数 k<sub>H</sub>(kN/m<sup>3</sup>)

層No	層厚(m)		橋軸直	〔角方向	橋軸方向		
	常時	地震時	常時	地震時	常時	地震時	
突出部	§ 7.300 7.300 — — —						
1	9.100	9.100	32,377	64,754	32,377	64,754	
2	4.200	4.200	26,981	53,962	26,981	53,962	
3	5.400	5.400	45,868	91,735	45,868	91,735	
4	5.000	5.000	59,358	118,716	59,358	118,716	

・杭体断面二次モーメント I(m<sup>4</sup>)

第1断面 0.014551221

※断面の取扱い:総断面

## (8) 作用力

(a) 橋軸直角方向

No	荷重ケース名称	割増 係数	鉛直力 V(kN)	水平力 H(kN)	モーメント M(kN.m)
1	地震時	1.50	41,517.00	6,228.00	0.00

(b) 橋軸方向

No	荷重ケース名称	割増 係数	鉛直力 V(kN)	水平力 H(kN)	モーメント M(kN.m)
1	地震時	1.50	41,517.00	6,228.00	0.00



### 5-3-2-2-2 安定計算

### (1) 杭軸直角方向ばね定数

橋軸直角方向

杭頭剛結

	単位	常時	地震時
K1 K2 K3 K4	kN/m kN/rad kN.m/m kN.m/ra d	5,936 30,807 30,807 215,956	6,972 34,472 34,472 229,308

橋軸方向

杭頭剛結

	単位	常時	地震時
K1 K2 K3 K4	kN/m kN/rad kN.m/m kN.m/ra d	5,936 30,807 30,807 215,956	6,972 34,472 34,472 229,308

#### (2) 杭基礎の剛性行列

1. 変位法による底版中心の変位と外力の関係

Γ	V	] [	Azz	Azx	Aza	δz
	Н	=	Axz	Axx	Axa	δx
L	Μ		Aaz	Aax	Aaa	

#### 2. 剛性行列要素

Aza=Aaz:鉛直と回転の連成ばね(kN/rad, kN.m/m)

A<sub>xx</sub> :水平方向ばね(kN/m)

Axa=Aax :水平と回転の連成ばね(kN/rad, kN.m/m)

- A<sub>aa</sub> :回転ばね(kN.m/rad)
- V : 原点に作用する鉛直力(kN)
- H : 原点に作用する水平力(kN)
- M : 原点に作用するモーメント(kN.m)
- K<sub>vi</sub>: : 杭軸方向ばね定数(kN/m)
- K1<sub>i</sub>~K4<sub>i</sub>: 杭軸直角方向ばね定数(kN/m, kN/rad, kN. m/m, kN. m/rad)
- X<sub>i</sub>: : 杭頭の水平座標(m)
- $\theta_{i}$ : 杭軸が鉛直軸となす角度(rad)
- δ<sub>z</sub> : 原点鉛直変位(m)
- δ<sub>x</sub> : 原点水平変位(m)
- *α* : 原点回転角(rad)
- 注)式中のiはi番目の杭を示す。
- (a) 橋軸直角方向

杭頭剛結

吊時					
Azz	Azx	Aza	22833550	0	0
Axz	Axx	Axa =	0	296801	-1540329
Aaz	Aax	Aaa _	0	-1540329	1311754814
地震時					
Azz	Azx	Aza	22833550	0	0
Axz	Axx	Axa =	0	348583	-1723608
_ Aaz	Aax	Aaa	0	-1723608	1312422418

(b) 橋軸方向

杭頭剛結

لحر	14 m++	
15	さけて	
	1.1 1.1 1.1	

114 . 4					
Azz	Azx	Aza	22833550	0	0
Axz	Axx	Axa =	0	296801	-1540329
_ Aaz	Aax	Aaa 🔤 🗌	0	-1540329	6299256291
地震時					
Azz	Azx	Aza	22833550	0	0
Axz	Axx	Axa =	0	348583	-1723608
_ Aaz	Aax	Aaa _	0	-1723608	6299923895

#### (3) 杭反力及び変位の計算

 $Kv \cdot cos θ$   $Kv \cdot sin θ$   $Kv \cdot X \cdot cos θ$ PN δz  $-K1 \cdot \sin \theta \quad K1 \cdot \cos \theta \quad -K1 \cdot X \cdot \sin \theta - K2$ δx PH =  $K3 \cdot \sin \theta - K3 \cdot \cos \theta \quad K3 \cdot X \cdot \sin \theta + K4$ Mt li i  $\alpha$ 0  $\delta zi = (\delta z + \alpha \cdot Xi) \cdot \cos \theta i + \delta x \cdot \sin \theta i$  $\delta x i = -(\delta z + \alpha \cdot X i) \cdot \sin \theta i + \delta x \cdot \cos \theta i$ ここに、 PN<sub>i</sub>: 杭軸方向反力(kN/本) PH<sub>i</sub>: 杭軸直角方向反力(kN/本) Mt<sub>i</sub>: 杭頭モーメント(kN.m/本) Kvi: 杭軸方向ばね定数(kN/m) K1i~K4i: 杭軸直角方向ばね定数(kN/m,kN/rad,kN.m/m,kN.m/rad) X<sub>i</sub>: 杭頭座標(m) θi: 杭軸が鉛直軸となす角度(rad) δ<sub>z</sub>:原点鉛直変位(m)  $δ_x$ :原点水平変位(m)  $\alpha$ :原点回転角(rad) δz<sub>i</sub>: 杭頭の杭軸方向変位(m) δx<sub>i</sub>: 杭頭の杭軸直角方向変位(m) 杭頭での鉛直反力V<sub>i</sub>,及び水平反力H<sub>i</sub>は、次式による。  $Vi = PN_i \cdot cos\theta_i - PH_i \cdot sin\theta_i$  $H_i = PN_i \cdot sin\theta_i + PH_i \cdot cos\theta_i$ 注)式中のiはi番目の杭を示す。 (a) 橋軸直角方向 杭頭剛結 地震時 ·原点変位 ·原点作用力 V<sub>o</sub> = 41,517.00 (kN)  $\delta_z$  = 1.82 (mm)  $H_o$  = 6,228.00 (kN)  $\delta_x \quad = \quad$ 17.98 (mm) M<sub>o</sub> = 0.00 (kN.m)  $\alpha =$ 0.00002362 (rad) ・杭反力 Ν H<sub>i</sub>(kN) X(m) 本数 PN(kN) PH(kN) M<sub>t</sub>(kN.m) V<sub>i</sub>(kN)  $\delta f_x(mm)$ 0 -10.675 715.20 124.56 715.20 124.56 1 10 -614.51 2 -5.337 772.78 -614.51 772.78 124.56 10 124.56 3 0.000 124.56 -614.51 124.56 10 830.34 830.34 4 5.337 10 887.90 124.56 -614.51 887.90 124.56 5 10.675 945.48 124.56 945.48 124.56 10 -614.51 PN<sub>max</sub> = 945.48  $(kN) \leq R_a =$ (kN) : OK 1,152.00  $PN_{min} =$ 715.20  $(kN) \ge P_a =$ -938.00 (kN) : OK  $\delta_f =$ 3.56  $(mm) \leq \delta_a =$ 100.00 (mm) : OK

3.56

3.56

3.56

3.56

3.56

# (b) 橋軸方向

杭	頭剛	結													
봐	也震時	寺													
	・原	京点作用力	J				・原点変位								
		V <sub>o</sub> =	41,51	7.00	(kN)			δ	$\delta_z =$	1.	82 (r	nm)			
		H <sub>o</sub> =	6,22	8.00	(kN)			δ	$\delta_x =$	17.	89 (r	nm)			
		M <sub>o</sub> =		0.00	(kN.m)			0	ι =	0.0	000004	89 (ra	nd)		
	・杭	反力													
	N o	Y(m)	本数	Р	N(kN)	]	PH(l	kN)	M <sub>t</sub> (k)	N.m)	V <sub>i</sub>	(kN)	H <sub>i</sub> (k	kN)	δf <sub>x</sub> (mm)
	1	26.000	5		888.46		124	4.56	-615	5.61	8	88.46	12	4.56	3.55
	2	20.222	5	:	875.54		124	4.56	-615	5.61	8	75.54	12	4.56	3.55
	3	14.444	5		862.63		124	4.56	-615	5.61	8	62.63	12	4.56	3.55
	4	8.667	5		849.71		124	4.56	-615	5.61	8	49.71	12	4.56	3.55
	5	2.889	5		836.80		124	4.56	-615	5.61	8	36.80	12	4.56	3.55
	6	-2.889	5		823.88		124	4.56	-613	5.61	8	23.88	12	4.56	3.55
	7	-8.667	5		810.97		124	4.56	-613	5.61	8	310.97	12	4.56	3.55
	8	-14.444	5	,	798.05		124	4.56	-613	5.61	7	98.05	12	4.56	3.55
	9	-20.222	5	,	785.14		124	4.56	-615	5.61	7	85.14	12	4.56	3.55
	10	-26.000	5	,	772.22		124	4.56	-615	5.61	7	72.22	12	4.56	3.55
	· 1	$PN_{max} =$	88	8.46	(kN)	$\leq$	Ra	=	1,152	.00	(kN)	) : OK	C .		
		$PN_{min} =$	772	2.22	(kN)	$\geq$	Pa	=	-938.0	00	(kN)	: OK			

 $\delta_{\rm f} = 3.55 \quad ({\rm mm}) \leq \delta_{\rm a} = 100.00 \quad ({\rm mm}) : {\rm OK}$ 

# 5-3-2-2-3 断面計算

## (1) 杭体断面力

#### 表 5-50 杭体断面力(橋軸直角方向 地震時)

		杭頭剛結			杭頭ヒンジ	;	
杭頭作用力							
H (kN)		124.56			124.56		
M (kN.m)		-614.51		0.00			
杭軸直角方向ばね定数							
K1(kN/m)		6,972			1,789		
K2(kN/rad)		34,472			0		
K3(kN.m/m)		34,472			0		
K4(kN.m/rad)		229,308			0		
$M_t$ (kN.m)		-614.51			0.00		
M <sub>max</sub> (kN.m)		344.32			932.28		
Z (m)		8.181			7.688		
$1/2M_{max}(kN.m)$		466.14			466.14		
S (kN)		124.56			-221.84		
Z (m)	δx(mm)	M (kN.m)	S (kN)	δx(mm)	M (kN.m)	S (kN)	
0.000	17.983	-614.51	124.56	69.609	0.00	124.56	
0.500	17.844	-552.23	124.56	64.381	62.28	124.56	
1.000	17.468	-489.95	124.56	59.180	124.56	124.56	
1.500	16.881	-427.67	124.56	54.033	186.84	124.56	
2.000	16.110	-365.39	124.56	48.965	249.12	124.56	
2.500	15.182	-303.11	124.56	44.005	311.40	124.56	
3.000	14.125	-240.83	124.56	39,179	373.68	124.56	
4.000	11.725	-116.27	124.56	30.034	498.24	124.56	
5.000	9.127	8.29	124.56	21.745	622.80	124.56	
6.000	6.542	132.85	124.56	14.527	747.36	124.56	
7.000	4.185	257.41	124.56	8.592	871.92	124.56	
7.300	3.555	294.78	124.56	7.094	909.29	124.56	
8.000	2.268	342.58	19.80	4.150	919.73	-76.94	
9.000	0.923	316.50	-60.36	1.257	763.47	-210.63	
10.000	0.114	240.27	-85.15	-0.335	536.48	-229.67	
11.000	-0.282	156.32	-79.34	-1.002	322.84	-191.90	
12.000	-0.408	85.83	-60.57	-1.107	158.69	-135.54	
13.000	-0.384	35.85	-39.61	-0.931	50.68	-82.02	
14 000	-0.295	5 50	-21.87	-0.662	-9 47	-40.63	
15 000	-0.195	-9.60	-9.20	-0.403	-35 29	-13.23	
16.000	-0.110	-14.53	-1.41	-0.203	-39.94	2.19	
16.400	-0.082	-14.68	0.57	-0.142	-38.31	5.74	
17.000	-0.048	-13.80	2.24	-0.069	-33.97	8.43	
18 000	-0.011	-10.83	3.43	0.006	-24 68	9.61	
19 000	0.009	-7 34	3.41	0.039	-15 51	8 51	
20.000	0.015	-4.18	2.85	0.045	-7.93	6.61	
20,600	0.016	-2 59	2.45	0.042	-4 31	5 47	
21,000	0.015	-1 70	2.00	0.038	-2.36	4 29	
22,000	0.011	-0.20	1.05	0.026	0.69	1.25	

※ $M_{max}$ :地中部最大モーメント,  $1/2M_{max} = 1/2 \cdot max(M_{max}, M_t)$ ,  $M_t$ :杭頭モーメント

## 表 5-51 杭体断面力(橋軸方向 地震時)

		杭頭剛結			杭頭ヒンジ		
杭頭作用力							
H(kN)		124.56			124.56		
M(kN.m)		-615.61			0.00		
お前面もち向げわ		010101					
1111110円月月円1は43 空粉							
		6,972			1,789		
K1(KN/m)		34,472			0		
K2(kN/rad)		34,472			0		
K3(kN.m/m)		229.308			0		
K4(kN.m/rad)		,			<u> </u>		
M <sub>t</sub> (kN.m)		-615.61			0.00		
M <sub>max</sub> (kN.m)		343.32			932.28		
Z (m)		8.182			7.688		
$1/2M_{max}(kN.m)$		466.14			466.14		
S (kN)		124.56			-221.84		
Z (m)	δx(mm)	M (kN.m)	S (kN)	δx(mm)	M (kN.m)	S (kN)	
0.000	17.891	-615.61	124.56	69,609	0.00	124.56	
0 500	17 761	-553 33	124 56	64 381	62.28	124.56	
1,000	17 393	-491.05	124.56	59 180	124 56	124.56	
1.000	16 814	-428 77	124.56	54 033	186.84	124.50	
2 000	16.051	-366.49	124.56	48 965	240.12	124.50	
2.000	15 131	-300.42	124.50	40.905	249.12	124.30	
2.300	14.090	-304.21	124.50	20.170	272.69	124.30	
3.000	14.000	-241.93	124.30	39.179	575.00	124.30	
4.000	0.104	-117.37	124.30	30.034	498.24	124.30	
5.000	9.104	121.75	124.30	21.745	622.80	124.50	
6.000	6.528	131.75	124.56	14.527	/4/.36	124.56	
7.000	4.178	256.31	124.56	8.592	871.92	124.56	
7.300	3.549	293.68	124.56	7.094	909.29	124.56	
8.000	2.265	341.55	19.98	4.150	919.73	-76.94	
9.000	0.922	315.70	-60.09	1.257	763.47	-210.63	
10.000	0.115	239.73	-84.89	-0.335	536.48	-229.67	
11.000	-0.281	156.02	-79.14	-1.002	322.84	-191.90	
12.000	-0.407	85.70	-60.43	-1.107	158.69	-135.54	
13.000	-0.383	35.83	-39.53	-0.931	50.68	-82.02	
14.000	-0.295	5.53	-21.84	-0.662	-9.47	-40.63	
15.000	-0.195	-9.55	-9.19	-0.403	-35.29	-13.23	
16.000	-0.109	-14.49	-1.42	-0.203	-39.94	2.19	
16.400	-0.082	-14.64	0.56	-0.142	-38.31	5.74	
17.000	-0.048	-13.76	2.23	-0.069	-33.97	8.43	
18.000	-0.011	-10.80	3.42	0.006	-24.68	9.61	
19,000	0.009	-7 32	3 40	0.039	-15 51	8 51	
20,000	0.005	-4 17	2 85	0.035	_7 93	6.61	
20.000	0.015	-7.17	2.85	0.043	_/ 21	5 17	
20.000	0.010	-2.30	2.44	0.042	-4.31	J.47 4 20	
21.000	0.013	-1.70	2.00	0.038	-2.30	4.29	
22.000	0.011	-0.20	1.04	0.026	0.09	1.90	

※M<sub>max</sub>:地中部最大モーメント, 1/2M<sub>max</sub> = 1/2 · max(M<sub>max</sub>,M<sub>t</sub>), M<sub>t</sub>:杭頭モーメント



5-124



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(3) 杭体応力度

PHC杭

第1断面

杭外径 D = 800.0(mm) 厚さ t = 110.0(mm) 種別 C種 有効プレストレス  $\sigma_{ce}$  = 10.000(N/mm<sup>2</sup>) 換算断面積  $A_e$  = 2512.00×10<sup>2</sup>(mm<sup>2</sup>) 換算断面係数  $Z_e$  = 38,340.00×10<sup>3</sup>(mm<sup>3</sup>)

曲げ応力度の照査

$$\sigma = \sigma \operatorname{ce} + \frac{\mathrm{N}}{\mathrm{Ae}} \pm \frac{\mathrm{M}}{\mathrm{Ze}}$$

(a)橋軸直角方向

N o	荷重名略称	着 行	目杭 列	M (kN.m)	N (kN)	$\sigma_c, \sigma_{ca}$ (N/mm <sup>2</sup> )	$\sigma_{t,\sigma_{ta}}$ (N/mm <sup>2</sup> )	$M_r(kN.m)$ $M_r_L(m)$
	1	5	614.51	945.48	29.79 40.00	-2.26 -5.00	719.41	
1	地辰时	1	1	614.51	715.20	28.88 40.00	-3.18 -5.00	684.26

上段がN<sub>max</sub>,下段がN<sub>min</sub>を示す。M<sub>r</sub>LはM<sub>r</sub>と実モーメントとの交点深度を示す。

(b)橋軸方向

Ν	荷重夕败称	着	目杭	М	Ν	$\sigma_c, \sigma_{ca}$	$\sigma_t, \sigma_{ta}$	M <sub>r</sub> (kN.m)
0	间里石哈尔	行列		(kN.m)	(kN)	$(N/mm^2)$	$(N/mm^2)$	$M_r L(m)$
1	北雷哇	1	1	615.61	888.46	29.59 40.00	-2.52 -5.00	710.70
1	地辰时	10	1	615.61	772.22	29.13 40.00	-2.98 -5.00	692.96

上段がN<sub>max</sub>,下段がN<sub>min</sub>を示す。M<sub>r</sub>LはM<sub>r</sub>と実モーメントとの交点深度を示す。

せん断応力度の照査

コンクリートのみでせん断力を負担する場合

а

$$\tau = \frac{S}{\mathbf{b} \cdot \mathbf{d}} \leq \tau$$

 $\tau a = CN \cdot \tau_{a1}$ 

ここに、

S : せん断力(kN)

b : 部材断面幅(等積箱形断面の腹部の合計幅とする) b = 195 (mm)

d : 部材断面の有効高(等積箱形断面の有効高とする) d = 710 (mm)

r<sub>s</sub> : 部材軸方向鉄筋の配置半径 r<sub>s</sub> = 395.0 (mm)

τ<sub>a</sub> : 軸方向圧縮力により割増しされた許容せん断応力度 (N/mm<sup>2</sup>)

$$CN = 1 + \frac{Mo}{M}$$
  $\hbar t$ ,  $1 \le CN \le 2$ 

:軸方向圧縮力によりコンクリートの応力度が部材引張縁で零となる  $M_{o}$ 曲げモーメント(kN.m) Mo =  $\left(\sigma \operatorname{ce} + \frac{N}{Ac}\right) \cdot \frac{\operatorname{Ic}}{y}$ :部材断面に作用する軸方向圧縮力(kN) Ν  $\sigma_{ce}$ : 有効プレストレス  $\sigma_{ce} = 10.00 (N/mm^2)$ A<sub>c</sub> : 部材断面積 A<sub>c</sub> = 2,384.4689×10<sup>2</sup> (mm<sup>2</sup>) Ic: 部材断面の図心軸に関する断面二次モーメントIc=1,455,122.1741×104 (mm4) y : 部材断面の図心より部材引張縁までの距離 y = 400 (mm)斜引張鉄筋(スパイラル鉄筋)と共同してせん断力を負担する場合  $P_s = S_c + S_s$  $S_c = \tau_{a1} \cdot CN \cdot b \cdot d$  $Ss = \frac{Aw \cdot \sigma sa \cdot d \cdot (sin \theta + cos \theta)}{2}$ 1.15 • s  $S \leq P_s$ ここに、 P<sub>s</sub> : 許容せん断力 (kN) Sc : コンクリートの負担するせん断力 (kN) S。: 斜引張鉄筋の負担するせん断力 (kN) τal: コンクリートのみでせん断力を負担する場合の許容せん断応力度 (N/mm<sup>2</sup>) : 部材断面幅(等積箱形断面の腹部の合計幅とする)(mm) b d : 部材断面の有効高(等積箱形断面の有効高とする)(mm)  $A_w$ : 間隔sおよび角度 $\theta$ で配筋される斜引張鉄筋の断面積  $A_w = 0.000 \times 10^2 (mm^2)$ σ<sub>sa</sub>:斜引張鉄筋の許容引張応力度  $\sigma_{sa} = 50.00 (N/mm^2)$ (地震時の基本値) 11  $\sigma_{sa} = 50.00 (N/mm^2)$ s : 斜引張鉄筋の部材軸方向の間隔 (mm) s = 80 (mm)θ : 斜引張鉄筋が部材軸方向となす角度(90°とする)

(a) 橋軸直角方向

Ν	荷重夕败称	着E	1杭	М	Ν	M <sub>o</sub> (kN.m)	S <sub>c</sub> (kN)	$\tau$ (N/mm <sup>2</sup> )	S (kN)
0	间里石而小	行	列	(kN.m)	(kN)	CN	$S_{s}(kN)$	$\tau_a(N/mm^2)$	P <sub>s</sub> (kN)
1	1 地震時	1	5	614.51	945.48	508.02 1.827	322.46 0.00	0.900 2.329	124.56 322.46
1		1	1	614.51	715.20	472.89 1.770	312.37 0.00	0.900 2.256	124.56 312.37

上段がN<sub>max</sub>,下段がN<sub>min</sub>を示す。

(b) 橋軸方向

N o	荷重名略称	着目行	目杭 列	M (kN.m)	N (kN)	M <sub>o</sub> (kN.m) CN	S <sub>c</sub> (kN) S <sub>s</sub> (kN)	$\tau$ (N/mm <sup>2</sup> ) $\tau_a$ (N/mm <sup>2</sup> )	S (kN) P <sub>s</sub> (kN)
1	业雪吐	1	1	615.61	888.46	499.33 1.811	319.71 0.00	0.900 2.309	124.56 319.71
1	地震時	10	1	615.61	772.22	481.59 1.782	314.62 0.00	0.900 2.272	124.56 314.62

上段がN<sub>max</sub>,下段がN<sub>min</sub>を示す。

# 5-3-2-2-4 基礎杭計算結果一覧表

### (1) 橋軸直角方向

## 表 5-52 基礎杭計算結果一覧表(橋軸直角方向)

荷重	重ケースN	o. 略称	1
	原点作用	力	地震時
	Vo Ho Mo	kN kN kN.m	41,517.0 6,228.0 0.0
	原点変化	<u>т</u>	
	$\delta_x \\ \delta_z \\ \alpha$	mm mm rad	17.98 1.82 0.00002362
抽出	o <sub>f</sub> , o <sub>a</sub> 出杭番号	mm 行,列	$3.56 \ge 100.00$ (1,1)
	鉛直反為	力	
PM 抽出 PI 抽出	N <sub>max</sub> , R <sub>a</sub> 出杭番号 N <sub>min</sub> , P <sub>a</sub> 出杭番号	kN 行,列 kN 行,列	$\begin{array}{r} 945.48 \leq 1,152.00 \\ (1,5) \\ 715.20 \geq -938.00 \\ (1,1) \end{array}$
	水平反为	力	
抽出	PH 出杭番号	kN 行,列	124.56 (1,1)
杭	作用モー	メント	
杭 抽 抽 地 中 抽 日 地 日 日 日 日 日 日 日 日 日 日 日 日 日	頭 M <sub>t</sub> 出杭番号 户部 Mm 出杭番号	kN.m 行,列 kN.m 行,列	-614.51 (1,1) 932.28 (1,1)
	杭体応力	度	
1 断 面	<b>σ</b> c, <b>σ</b> ca 抽出杭 <b>σ</b> t, <b>σ</b> ta 抽出杭 τ, τ <sub>a</sub> 抽出杭 <b>S</b> , P <sub>s</sub> 抽出杭	N/mm <sup>2</sup> 行,列 N/mm <sup>2</sup> 行,列 行,列 KN 行,列	$\begin{array}{rrrr} 29.79 \leq & 40.00 \\ & (1,5) \\ -3.18 \geq & -5.00 \\ & (1,1) \\ 0.900 \leq & 2.256 \\ & (1,1) \\ 124.56 \leq & 312.37 \\ & (1,1) \end{array}$
	判定		ОК

杭 種:打込み杭打擊工法 PHC杭

- 杭 径: $\varphi = 800.0$  (mm) 厚 さ:t = 110.0 (mm) 杭 長:L = 31.00 (m) 種 類: C種

## (2) 橋軸方向

# 表 5-53 基礎杭計算結果一覧表(橋軸方向)

荷	重ケースN	o. 略称	1
	原点作用	力	地震時
	Vo	kN	41,517.0
	$H_0$	kN	6.228.0
	Mo	kN.m	0.0
	原点変化	过	
	$\delta_x$	mm	17.89
	$\delta_z$	mm	1.82
	α	rad	0.00000489
	$\delta_f, \delta_a$	mm	$3.55 \leq 100.00$
抽	旧杭番号	行,列	(1,1)
	鉛直反	力	
F	PN <sub>max</sub> , R <sub>a</sub>	kN	888.46≦ 1,152.00
抽	出杭番号	行,列	(1, 1)
I	PN <sub>min</sub> , P <sub>a</sub>	kN	772.22≧ -938.00
抽	出杭番号	行,列	(10, 1)
	水平反为	力	
	PH	kN	124.56
抽	出杭番号	行,列	(1, 1)
杧	亢作用モー	メント	
枋	面 Mt	kN.m	-615.61
抽	出杭番号	行列	(1, 1)
1世	中部 M	kN m	932.28
抽	出枯悉号	行列	(1, 1)
1111		11,23	(1,1)
	杭体応力	度	
	$\sigma_c, \sigma_{ca}$	N/mm <sup>2</sup>	$29.59 \le 40.00$
	抽出杭	行,列	(1,1)
1	$\sigma_t, \sigma_{ta}$	N/mm <sup>2</sup>	<i>-2.98</i> ≧ <i>-5.00</i>
下	抽出杭	行,列	(10, 1)
両	τ, τ <sub>a</sub>	N/mm <sup>2</sup>	$0.900 \leq 2.272$
ш	抽出杭	行,列	(10, 1)
	S, P <sub>s</sub>	kN	$124.56 \leq 314.62$
	抽出杭	行,列	(10, 1)
	判定		OK
杭	種:打込み	>杭打撃]	L法 PHC杭
杭	径:φ=	800.0	(mm)

杭	長:L	=	31.00	(m)

厚 さ:t = 110.0 (mm)

種類: C種

# 5-3-2-2-5 予備計算

# (1) 水平方向地盤反力係数

杭外径		D =	0.8000	(m)
杭体ヤング係数		$\mathbf{E} =$	$4.00  imes 10^7$	$(kN/m^2)$
杭体断面二次モーメント		I =	0.014551221	(m <sup>4</sup> )
杭の特性値(換算載荷幅算出)	常時	$\beta =$	0.324771	(m <sup>-1</sup> )
	地震時	$\beta =$	0.324771	$(m^{-1})$
水平抵抗に関する	常時	$1 \swarrow \beta =$	3.0791	(m)
地盤の深さ	地震時	$1 \swarrow \beta =$	3.0791	(m)
$\frac{1}{\beta}$ の範囲の平均 $\alpha \cdot \text{Eo} = \frac{\Sigma(\alpha)}{\beta}$	$\alpha \cdot \text{Eoi} \cdot \frac{1 \ \beta}{\beta}$	Li) =	33600.0 (kN	[/m²) (常時)
_		=	33,600.0 (k	N/m <sup>2</sup> )(地震時)
杭の換算載荷幅 BH = $\sqrt{-1}$	$\frac{D}{\beta}$	=	1.5695 (m)	(常時)
		=	1.5695 (m	h) (地震時)
$\mathrm{kHo} = \frac{1}{0.}$	$\frac{1}{3} \cdot \alpha \cdot E$	o = 1	12000.0 (kN/	´m³) (常時)
		_ =	112,000.0 (k	N/m <sup>3</sup> )(地震時)
kH = kHc	$ \cdot \left(\frac{\mathrm{BH}}{0.3}\right) $	$-\frac{3}{4}$		
$\beta = \sqrt[4]{\frac{\mathrm{kH} \cdot \mathrm{D}}{4 \cdot \mathrm{E} \cdot \mathrm{I}}} = 0.324771$	(m <sup>-1</sup> ) (常日	時), 0.3	24771 (m <sup>-1</sup> ) (±	地震時)

※地震時BH算出時のα・Eoの取扱い:地震時の1/2

層No	層厚(m)		$\alpha \cdot E_o$	(kN/m <sup>2</sup> )	k <sub>H</sub> (kN/m <sup>3</sup> )	
)官INO	常 時	地震時	常 時	地震時	常時	地震時
突出部	7.300	7.300				
1	9.100	9.100	33,600	67,200	32,377	64,754
2	4.200	4.200	28,000	56,000	26,981	53,962
3	5.400	5.400	47,600	95,200	45,868	91,735
4	5.000	5.000	61,600	123,200	59,358	118,716

(2) 杭軸方向鉛直ばね定数

$$Kv = a \cdot \frac{Ap \cdot Ep}{L}$$

杭 種:PHC杭

工 法:打込み杭打撃工法

 $a = 0.014 \cdot (L' / D) + 0.72 = 1.1348$ 

Ap: 杭の純断面積	= 0.23845	$(m^2)$
Ep: 杭体のヤング係数	$= 4.00 \times 10^7$	$(kN/m^2)$
L : 杭長	= 23.700	(m)
L': 杭長(補正係数a算出用)	= 23.700	(m)
D : 杭径	= 0.8000	(m)

Kv = 456,671 (kN/m)

#### (3) 最大周面摩擦力度

杭周面に働く最大周面摩擦力度を以下に示す。

(a) 最大周面摩擦力度の推定方法

	砂質土	粘性土
打込み杭工法	2N ( $\leq 100$ )	cまたは10N (≦150)
シャンシタ豆のいは	いよいに的しのかいよう	<u> 生 イ い / 2) ナ 二 ナ</u>

※Nは各層のN値、cは地盤の粘着力 $(kN/m^2)$ を示す。

※粘性土の最大周面摩擦力度は、N値および粘着力cから推定した結果のうち小さい方を 採用する。

※N値から推定する場合、N値が5未満となる軟弱層の最大周面摩擦力度は0とする。

層 No	標高 (m)	層厚 (m)	土質	平均 N値	粘着力c (kN/m <sup>2</sup> )	$f_i$ (kN/m <sup>2</sup> )
1	-4.000 -13.100	9.100	砂質	12.0	0.0	24.0
2	-13. 100 -17. 300	4.200	粘性	10.0	45.0	45.0
3	-17. 300 -22. 700	5.400	砂礫	17.0	0.0	34.0
4	-22. 700 -44. 600	21.900	粘性	22.0	77.5	77.5

(b)	)最了	大周面	摩擦力	度
	/ HX /		ノー・ションノノ	$\mathcal{X}$

※現地盤面から全層の最大周面摩擦力度を示す。

### (4) 許容支持力の計算

```
(a) 杭の諸元
  杭
        種
              : PHC杭 φ 800.0 (mm)
  T
        法:打込み杭(打撃)
  設計杭長 : L = 31.000 (m)
  突出杭長 : Lo = 7.300 (m) (現地盤面から上を示す)
  杭の種類 : 摩擦杭
(b) 軸方向許容押込み支持力の計算
 Ra = \frac{\gamma}{n} \cdot (Ru - W_S) + W_S - W
   \mathbf{R}_{u} = \mathbf{U} \cdot \boldsymbol{\Sigma} (\mathbf{L}_{i} \cdot \mathbf{f}_{i})
                        (常 時), (地震時(液無))
   R_u = U \cdot \Sigma(L_i \cdot f_i \cdot DE_i) (地震時(液有))
      R<sub>a</sub>: 杭頭における杭の軸方向許容押込み支持力 (kN)
                     3.0 (常時)
      n :安全率
                     2.0 (地震時)
      y:安全率の補正係数 = 1.0
      R<sub>u</sub>: 地盤から決まる杭の極限支持力 (kN)
      U : 杭の周長(m)
             U = \pi \cdot 0.8000 = 2.513 (m)
      L<sub>i</sub>:層厚(m)
      fi: 層の最大周面摩擦力度(kN/m<sup>2</sup>)
     DE<sub>i</sub>:土質定数の低減係数(地震時のみ)
      Ws: 杭で置き換えられる部分の土の有効重量(kN)
           Ws = Ap \cdot \Sigma(\gamma i \cdot Li)
     γi: 土の有効単位重量(kN/m<sup>3</sup>)
```

周面摩擦力および杭で置き換えられる部分の土の有効重量

・常時

層 No	土質	平均 N値	粘着力 (kN/m <sup>2</sup> )	層厚 L <sub>i</sub> (m)	$\gamma_i$ (kN/m <sup>3</sup> )	W <sub>s</sub> (kN)	f <sub>i</sub> (kN/m <sup>2</sup> )	$\begin{array}{c} L_i \bullet f_i \\ (kN/m) \end{array}$
1	砂質	12.0	0.0	9.100	9.90	45.28	24.0	218.40
2	粘性	10.0	45.0	4.200	4.90	10.34	45.0	189.00
3	砂礫	17.0	0.0	5.400	4.90	13.30	34.0	183.60
4	粘性	22.0	77.5	5.000	4.90	12.32	77.5	387.50
計				23.700		81.24		978.50

・地震時(液無)

層 No	土質	平均 N値	粘着力 (kN/m <sup>2</sup> )	層厚 Li(m)	$\gamma_i$ (kN/m <sup>3</sup> )	W <sub>s</sub> (kN)	f <sub>i</sub> (kN/m <sup>2</sup> )	$L_i \cdot f_i$ (kN/m)
1	砂質	12.0	0.0	9.100	9.90	45.28	24.0	218.40
2	粘性	10.0	45.0	4.200	4.90	10.34	45.0	189.00
3	砂礫	17.0	0.0	5.400	4.90	13.30	34.0	183.60
4	粘性	22.0	77.5	5.000	4.90	12.32	77.5	387.50
計				23.700		81.24		978.50

地盤から決まる極限支持力

常 時

 $R_u = U \cdot \Sigma(L_i \cdot f_i)$ = 2.513 · 978.5 = 2,459 (kN) 地震時(液無)  $R_u = U \cdot \Sigma(L_i \cdot f_i)$ 

 $= 2.513 \cdot 978.5 = 2,459 \,(\text{kN})$ 

### W : 杭の有効重量(kN)

$$\mathbf{W} = \Sigma(\mathbf{W}^{"} \cdot \mathbf{L} + \mathbf{W}_{o} \cdot \mathbf{L}_{o}) (\mathbf{kN})$$

W":水中部単位長重量 (kN/m)

L :水中部杭長 (m)

W。: 水位上部単位長重量(kN/m)

L<sub>o</sub> : 水位上部杭長 (m)

断面	W"	L	(m)	Wo	Lo	(m)	$\mathbf{W}_{\mathrm{i}}$	(kN)
No	(kN/m)	常時	地震時	(kN/m)	常時	地震時	常時	地震時
1	3.672	29.100	29.100	6.080	1.900	1.900	118.398	118.398
							118.398	118.398

許容支持力

常時 Ra =  $\frac{1.0}{3.0}$  · ( 2459 - 81.2) + 81.2 - 118.4 = 756 (kN) 地震時(液無) Ra =  $\frac{1.0}{2.0}$  · ( 2459 - 81.2) + 81.2 - 118.4 = 1152 (kN)

(c) 軸方向許容引抜き抵抗力の計算

$$P_{a} = \frac{1}{n} \cdot P_{u} + W$$

$$P_{u} = U \cdot \Sigma(L_{i} \cdot f_{i}) \quad (常 時), (地震時(液無))$$

$$P_{u} = U \cdot \Sigma(L_{i} \cdot f_{i} \cdot DE_{i}) \quad (地震時(液有))$$

$$P_{a} : 杭頭における杭の軸方向許容引抜き抵抗力 (kN)$$

$$n : 安全率 \quad 6.0 (常 時)$$

$$3.0 (地震時)$$

$$P_{u} : 地盤から決まる杭の極限引抜き抵抗力 (kN)$$

$$P_{u} = 2.513 \cdot 978.5 = 2,459 (kN) (常 時)$$

$$P_{u} = 2.513 \cdot 978.5 = 2,459 (kN) (地震時(液無))$$

$$W : 杭の有効重量 \quad 118.4 (kN) (常 時)$$

$$118.4 (kN) (地震時)$$

許容引抜力

常時  $Pa = \frac{1}{6.0}$  · 2459 + 118.4 = 528 (kN) 地震時(液無)  $Pa = \frac{1}{3.0}$  · 2459 + 118.4 = 938 (kN)

# (d) 計算結果一覧

		(kN/本)
許容支持	常時	756
	地震時(液無)	1,152
許容引抜力	常時	528
	地震時(液無)	938

# 付属資料1 確率波高算出結果



データ数	27 (35年)
最適関数	WEIBULL分布
	(k = 0.75)
相関係数	0.955
確率年	期待値
5	0.48
1 0	0.56
20	0.65
30	0.71
4 0	0.75
50	0.79
60	0.82

図1 M2地点(NNE)確率波高



データ数	28 (35年)
最適関数	₩EIBULL分布
	(k = 2.00)
相関係数	0.994
確率年	期待值
5	0.47
1 0	0.51
20	0.54
3 0	0.56
4 0	0.57
50	0.58
60	0.59

図2 M2地点(NE)確率波高



データ数	35 (35年)
最適関数	GUMBEL 分布
相関係数	0.988
確率年	期待值
5	0.73
1 0	0.81
20	0.88
3 0	0.92
40	0.95
50	0.98
60	1.00

図3 M2地点(ENE)確率波高



データ数	35 (35年)
最適関数	WEIBULL分布
	(k = 2.00)
相関係数	0.984
確率年	期待值
5	2.35
1 0	2.64
2 0	2.89
3 0	3.02
4 0	3.11
50	3.17
60	3.23

図4 M2地点(WNW)確率波高



データ数	34 (35年)
最適関数	₩EIBULL分布
	(k = 2.00)
相関係数	0.993
確率年	期待値
5	1.36
1 0	1.51
2 0	1.64
3 0	1.70
4 0	1.75
50	1.78
60	1.81

図5 M2地点(NW)確率波高



データ数	22 (35年)
最適関数	WEIBULL分布
	(k = 1.50)
相関係数	0.977
確率年	期待値
5	1.23
1 0	1.43
20	1.60
30	1.70
4 0	1.76
50	1.81
60	1.85

図6 M2地点(NNW)確率波高



データ数	16 (35年)
最適関数	₩EIBULL分布
	(k = 1.25)
相関係数	0.964
確率年	期待值
5	1.07
1 0	1.28
20	1.47
3 0	1.57
4 0	1.65
50	1.70
60	1.75

図7 M2地点(N)確率波高



データ数	17 (35年)
最適関数	WEIBULL分布
	(k = 1.50)
相関係数	0.984
確率年	期待値
5	0.33
1 0	0.35
2 0	0.37
3 0	0.38
4 0	0.38
50	0.39
60	0.39

図8 M3地点(NNE)確率波高



データ数	30 (35年)
最適関数	WEIBULL分布
	(k = 2.00)
相関係数	0.989
確率年	期待值
5	0.45
1 0	0.48
20	0.51
30	0.53
4 0	0.54
50	0.55
60	0.55

図9 M3地点(NE)確率波高



データ数	30 (35年)
最適関数	WEIBULL分布
	(k = 2.00)
相関係数	0.983
確率年	期待値
5	0.54
1 0	0.59
20	0.62
3 0	0.64
4 0	0.65
50	0.66
60	0.67

図10 M3地点(ENE)確率波高



データ数	28 (35年)
最適関数	GUMBEL 分布
相関係数	0.989
確率年	期待値
5	0.77
1 0	0.90
20	1.02
30	1.09
40	1.13
50	1.17
60	1.20

図11 M3地点(W)確率波高


データ数	30(35年)
最適関数	GUMBEL分布
相関係数	0.994
確率年	期待値
5	0.71
1 0	0.79
20	0.88
3 0	0.93
4 0	0.96
50	0.99
60	1.01

図12 M2地点(WNW)確率波高



データ数	24 (35年)
最適関数	WEIBULL分布
	(k = 1.50)
相関係数	0.990
確率年	期待值
5	0.48
1 0	0.56
20	0.63
3 0	0.66
4 0	0.69
50	0.71
60	0.72

図13 M3地点(NW)確率波高



データ数	10 (35年)
最適関数	WEIBULL 分布
	(k = 1.00)
相関係数	0.977
確率年	期待值
5	0.30
1 0	0.31
20	0.32
3 0	0.33
4 0	0.33
50	0.33
60	0.34

図14 M3地点(N)確率波高

## 付属資料2 確率風速算出結果



データ数	16 (35年)
最適関数	WEIBULL分布
	(k = 1.50)
相関係数	0.989
確率年	期待值
5	5.98
1 0	6.62
20	7.17
30	7.46
4 0	7.66
50	7.80
60	7.92

図1 M2地点(NNE)確率風速



データ数	32(35年)
最適関数	G U M B E L 分布
相関係数	0.996
確率年	期待値
5	7.50
1 0	8.05
20	8.58
30	8.89
4 0	9.10
50	9.27
60	9.40

図2 M2地点(NE)確率風速



	(k = 2.	00)
相関係数	0.971	
確率年	期待值	
5	11.05	

1 0	11.92
20	12.66
30	13.06
4 0	13.33
50	13.53
60	13.68

図3 M2地点(ENE)確率風速



データ数	10 (35年)
最適関数	WEIBULL分布
	(k = 0.75)
相関係数	0.949
確率年	期待値
5	5.10
1 0	5.45
20	5.90
3 0	6.19
4 0	6.41
50	6.58
60	6.73

図4 M2地点(N)確率風速



データ数	35 (35年)
最適関数	WEIBULL分布
	(k = 2.00)
相関係数	0.992
確率年	期待值
5	7.90
1 0	8.48
20	8.99
30	9.26
4 0	9.44
50	9.57
60	9.68

図5 M3地点(WNW)確率風速



データ数	35 (35年)
最適関数	₩EIBULL分布
	(k = 2.00)
相関係数	0.991
確率年	期待值
5	6.29
1 0	6.67
20	7.00
30	7.18
40	7.29
50	7.38
60	7.45

図6 M3地点(NW)確率風速



データ数	35(35年)
最適関数	G U M B E L 分布
相関係数	0.993
確率年	期待値
5	5.42
1 0	5.80
20	6.16
3 0	6.37
4 0	6.52
50	6.63
60	6.72

図7 M3地点(NNW)確率風速



データ数	35 (35年)
最適関数	WEIBULL分布
	(k = 0.75)
相関係数	0.928
確率年	期待值
5	5.40
1 0	5.94
20	6.53
3 0	6.90
4 0	7.17
50	7.38
60	7.56

図8 M3地点(N)確率風速

## 付属資料3 エネルギー平衡方程式

## エネルギー平衡方程式基礎方程式

波の不規則性を考慮したエネルギー平衡方程式に基づく計算法は、沖側での波浪諸元(スペクトル形を含む)を与え、これが水深変化に伴って変形する過程を次式のエネルギー平衡方程 式を数値的に解くことによって求め、対象地点での換算沖波波高等を算定するものである。

$$\frac{\partial}{\partial x} \left( C_g \cos \theta \cdot D \right) + \frac{\partial}{\partial y} \left( C_g \sin \theta \cdot D \right) + \frac{\partial}{\partial \theta} \left( \frac{Cg}{C} \left( \frac{\partial C}{\partial x} \sin \theta - \frac{\partial C}{\partial y} \cos \theta \right) D \right) = 0$$
(3.1)

ここで、x,yは座標,は波向き,Dは方向スペクトル,Cgは群速度,Cは波速である。

計算方法の詳細は以下の通りである。

方向スペクトルを*D*とし、外部エネルギーの授受を*Q*、エネルギー伝播速度ベクトルを*v*とすると、エネルギー平衡方程式は次のように表される。

$$\frac{\partial D}{\partial t} + \nabla \cdot \left( D \vec{V} \right) + Q = 0 \tag{3.2}$$

$$\begin{split} \Xi \equiv k \Xi_{x} \\ \nabla &= \left( \frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial f}, \frac{\partial}{\partial \theta} \right) \\ \vec{V} &= \begin{cases} V_{x} \\ V_{y} \\ V_{f} \\ V_{\theta} \\ \end{cases} = \begin{cases} C_{g} \cos \theta \\ C_{g} \sin \theta \\ \frac{\partial f}{\partial t} \\ \frac{C_{g}}{C} \left( \frac{\partial C}{\partial x} \sin \theta - \frac{\partial C}{\partial y} \cos \theta \right) \\ C_{g} &= \frac{C}{2} \left( 1 + \frac{2kd}{\sinh 2kd} \right) \end{cases} \end{split}$$
(3.3)

Cgは群速度、Cは速度、kは波数、dは水深 である。

ここで、①波は時間的に変化しない、②成分波の周期は変化しない、③外部からはエネルギー を受けないと仮定すると式(3.1)は次のように書き直せる。

$$\frac{\partial (DV_x)}{\partial x} + \frac{\partial (DV_y)}{\partial y} + \frac{\partial (DV_\theta)}{\partial \theta} = 0$$
(3.4)

式(3.4)を D について解けば、ある地点における波の状態がわかることになる。しかし、 一般に、式(3.4)を解析的に解くことは困難なため、実際には各項について差分法を使用して 式(3.4)は解かれる。

すなわち、対象領域を一定間隔の格子網で覆い各格子点で水深等の条件を与え地形を格子 で近似して計算を行う。

計算は、まず、最も沖側格子行でその地点の方向スペクトルが提案方向スペクトル(通常は 深海波のスペクトル)に等しいという条件を与える。沖側境界以降は、各行ごとにエネルギー 平衡方程式(式(3.4))を差分法で解き方向スペクトルの分布を求める。この各行毎の計算を沖 から岸側に向かって順次進め、対象領域内すべての格子点における方向スペクトルの分布が 求められる。

この際の側方の境界条件は、海域側と陸域側を分けて次のような条件とする。

- ・海域側: 内外のスペクトルを同一とする
- ・陸域側: 波のエネルギーは陸部で吸収されるものとする

このようにして、ある地点の方向スペクトルが求まれば、それから屈折・浅水変形後の波 浪諸元が求まることになる。また、島や構造物背後の遮蔽効果は、島、構造物よりエネルギ 一の流入が無いものとすると方向分散効果が考慮される。

不規則波のスペクトル形としては、周波数スペクトルとしてブレッドシュナイダー・光易型を、方向分布関数には光易型を用いる。

١

$$S(f) = 0.257H_{1/3}^{2}T_{1/3}(T_{1/3}f)^{-5} \exp[-0.103(T_{1/3}f)^{-4}]$$

$$G(f,\theta) = G_0 \cos^{2s}(\theta/2) , \quad G_0 = \left[\int_{\theta_{\min}}^{\theta_{\max}} \cos^{2s}(\theta/2)d\theta\right]^{-1}$$

$$S = \begin{cases} S_{\max}\left(f/f_p\right)^{-2.5} & (f > f_p) \\ S_{\max}\left(f/f_p\right)^{5} & (f < f_p) \end{cases}$$
(3.5)

 $f_p = 1/(1.05T_{1/3})$ 

ここで、 $S_{\max}$ は方向集中度を示すパラメータで、スペクトルのピーク周波数におけるSの値である。

## a) 浅水変形

微小振幅波理論による浅水変形は、次式で計算する。

$$K_{s} = \frac{H}{H_{0}} = \sqrt{\frac{1}{2n} \frac{C_{0}}{C}}$$

$$n = \frac{1}{2} \left\{ 1 + \frac{4\pi h/L}{\sinh(4\pi h/L)} \right\}$$

$$C_{0} = \frac{g}{2\pi} T$$

$$C = \frac{L}{T} = \sqrt{\frac{gL}{2\pi} \tanh\frac{2\pi h}{L}}$$

$$(3.6)$$

ここで、Ksは浅水係数, Hは水深 hにおける波高, Hoは換算沖波波高, Coは深海での波速, Cは水深 hにおける波速, Lは水深 hにおける波長である。

上記の浅水変形に関する式は、浅海域を進行した波が砕波点に近づき、波形勾配が大 きくなるとこの式が成り立たなくなるため、次に示す非線形長波理論による浅水変形を 考慮する。

$$K_{s} = \frac{1}{\sqrt{\left\{1 + \frac{4\pi h/L}{\sinh(4\pi h/L)} \tanh\frac{2\pi h}{L}\right\}}} \qquad \left(\frac{gHT^{2}}{h^{2}} \le 30\right)$$

$$Hh^{2/7} = const. \qquad \left(30 \le \frac{gHT^{2}}{h^{2}} < 50\right)$$

$$Hh^{5/2} \left\{\sqrt{gHT^{2}/d^{2} - 2/\sqrt{3}}\right\} = const. \qquad \left(50 \le \frac{gHT^{2}}{h^{2}}\right)$$

$$(3.7)$$

付属資料4 DILI 港付近の設計波計算結果

3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	
3.09	3.16	3.16	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	
	2.57	3.02	3.10	3.12	3.14	3.15	3.16	3.16	3.16	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	
		2.63	2.94	3.02	3.07	3.10	3.11	3.13	3.14	3.14	3.15	3.15	3.16	3.16	3.16	3.16	3.17	3.17	3.17	3.17	3.17	3.17	3.17	
	(	1.96	2.70	2.89	2.97	3.03	3.06	3.08	3.10	3.11	3.12	3.13	3.13	3.14	3.14	3.15	3.15	3.15	3.16	3.16	3.16	3.16	3.17	
		1.77	2.43	2.72	2.86	2.94	2.99	3.03	3.05	3.07	3.09	3.10	3.11	3.12	3.12	3.13	3.13	3.14	3.14	3.14	3.15	3.15	3.15	
	1	1.69	2.22	2.55	2.73	2.84	2.91	2.96	3.00	3.03	3.05	3.06	3.08	3.09	3.10	3.11	3.11	3.12	3.12	3.13	3.13	3.14	3.14	
/	1.08	1.65	2.08	2.39	2.60	2.74	2.83	2.89	2.94	2.98	3.00	3.03	3.04	3.06	3.07	3.08	3.09	3.10	3.11	3.11	3.12	3.12	3.13	
0.53	1.21	1.63	1.98	2.27	2.48	2.64	2.74	2.82	2.88	2.92	2.96	2.98	3.01	3.03	3.04	3.06	3.07	3.08	3.08	3.09	3.10	3.11	3.11	
0.83	1.27	1.60	1.91	2.17	2.38	2.54	2.66	2.75	2.81	2.87	2.91	2.94	2.97	2.99	3.01	3.03	3.04	3.05	3.06	3.07	3.08	3.09	3.09	
0.98	1.32	1.58	1.86	2.10	2.29	2.45	2.58	2.67	2.75	2.81	2.86	2.90	2.93	2.95	2.98	3.00	3.01	3.03	3.04	3.05	3.06	3.07	3.08	
1.07	1.34	1.57	1.83	2.03	2.22	2.37	2.50	2.60	2.68	2.75	2.80	2.85	2.88	2.92	2.94	2.96	2.98	3.00	3.01	3.03	3.04	3.05	3.06	
1.14	1.36	1.56	1.79	1.98	2.16	2.30	2.43	2.54	2.62	2.69	2.75	2.80	2.84	2.88	2.91	2.93	2.95	2.97	2.99	3.00	3.02	3.03	3.04	
1.18	1.37	1.55	1.76	1.94	2.10	2.24	2.37	2.47	2.56	2.64	2.70	2.75	2.80	2.84	2.87	2.90	2.92	2.94	2.96	2.98	2.99	3.01	3.01	
1.21	1.38	1.55	1.74	1.91	2.06	2.19	2.31	2.42	2.51	2.58	2.65	2.71	2.75	2.80	2.83	2.86	2.89	2.91	2.93	2.95	2.97	2.84	3.02	- /
1.24	1.39	1.54	1.72	1.88	2.02	2.15	2.26	2.36	2.46	2.53	2.60	2.66	2.70	2.75	2.79	2.83	2.86	2.88	2.90	2.87	/	)	2.78	
1.26	1.39	1.54	1.71	1.86	1.99	2.11	2.22	2.32	(		-					)2.32	2.82	2.85	2.87	(	~	8.97	2.16	
1.29	1.40	1.54	1.70	1.84	1.96	2.07	2.18	2.17					-	~	9.44	1.71	2.63	2.81	2.75	1.66	0.47	0.41	~	
1.31	1.41	1.54	1.70	1.82	1.93	2.04	2.11	1.97	0.58			/	0.06	0.20	0.83	1.63	2.33	2.65	2.62	2.10	1.18	0.44	0.18	~
1.33	1.42	1.54	1.69	1.80	1.90	2.00	2.00	1.84	1.13	0.07	0.04	0.08	0.17	0.52	1.02	1.60	2.12	2.41	2.45	2.17	1.61	0.97	0.47	
1.35	1.43	1.54	1.69	1.78	1.87	1.93	1.90	1.74	1.28	0.41	0.10	0.16	0.37	0.74	1.14	1.57	1.95	2.19	2.26	2.12	1.77	1.33	0.89	
1.35	1.45	1.54	1.69	1.76	1.83	1.86	1.80	1.67	1.33	0.72	0.21	0.29	0.56	0.88	1.20	1.53	1.82	2.01	2.09	2.01	1.80	1.50	1.17	
/	1.45	1.54	1.68	1.72	1.78	1.78	1.73	1.61	1.34	0.92	0.42	0.45	0.71	0.97	1.23	1.47	1.71	1.87	1.94	1.89	1.76	1.56	1.33	
	0	4.53	1.67	1.68	1.73	1.71	1.66	1.56	1.33	1.03	0.66	0.61	0.81	1.02	1.23	1.42	1.62	1.75	1.82	1.78	1.70	1.56	1.40	
			X	1.63	1.68	1.64	1.61	1.51	1.32	1.11	0.86	0.75	0.88	1.05	1.21	1.37	1.53	1.64	1.71	1.69	1.63	1.53	1.41	
				×	M	1.57	1.56	1.47	1.32	1.17	1.01	0.88	0.93	1.05	1.19	1.32	1.46	1.56	1.62	1.61	1.57	1.50	1.40	
						2																		
							5																	
Γ	Wave	e dir	ectio	on	W	W (3)	24)			-														

Wave di	rection	WNW (324)	
Wave he	ight	3.17 m	
Wave pe	riod	9.20 sec	
0	10	20km	$\bigotimes$
			図1

1.05 1.17 1.27 1.37 1.45 1.52 1.58 1.62 1.65 1.68 1.70 1.72 1.73 1.74 1.75 1.76 1.76 1.77 1.77 1.77 1.78 1.78 1.78 1.78 1.08 1.17 1.26 1.36 1.44 1.50 1.56 1.60 1.63 1.66 1.68 1.70 1.72 1.73 1.74 1.75 1.76 1.76 1.77 1.77 1.77 1.78 1.78 1.78 1.09 1.18 1.26 1.35 1.42 1.48 1.54 1.58 1.62 1.64 1.67 1.69 1.70 1.72 1.73 1.74 1.75 1.75 1.76 1.76 1.77 1.77 1.76 1.78 1.11 1.18 1.26 1.34 1.41 1.47 1.52 1.56 1.60 1.63 1.65 1.67 1.69 1.71 1.72 1.73 1.74 1.75 1.75 1.76 1.70 1.71 1.12 1.18 1.26 1.34 1.40 1.46 1.50 1.54 1.57 1.60 1.74 1.73 1.69 0.87 1.49 1.13 1.19 1.26 1.33 1.39 1.44 1.48 1.50 1.37 0.52 1.37 1.67 1.68 1.57 0.81 0.43 0.32 1.14 1.19 1.26 1.33 1.38 1.42 1.43 1.39 1.20 0.32 0.12 0.38 0.86 1.30 1.53 1.58 1.47 1.07 0.63 0.20 0.05 1.15 1.20 1.25 1.32 1.35 1.37 1.36 1.29 1.11 0.62 0.04 0.09 0.18 0.38 0.66 0.95 1.23 1.42 1.47 1.38 1.12 0.78 0.42 0.19 1.16 1.20 1.24 1.30 1.31 1.31 1.29 1.20 1.04 0.71 0.25 0.22 0.38 0.56 0.76 0.97 1.18 1.32 1.35 1.29 1.10 0.85 0.59 0.38 1.15 1.19 1.22 1.27 1.26 1.25 1.22 1.14 1.00 0.76 0.45 0.37 0.50 0.65 0.81 0.97 1.13 1.23 1.26 1.21 1.07 0.88 0.68 0.51 1.17 1.19 1.23 1.21 1.21 1.16 1.08 0.97 0.79 0.60 0.49 0.58 0.70 0.83 0.96 1.07 1.15 1.17 1.13 1.02 0.88 0.73 0.59 16 1.20 1.17 1.16 1.11 1.05 0.96 0.82 0.69 0.59 0.63 0.73 0.83 0.94 1.02 1.09 1.10 1.07 0.98 0.87 0.75 0.64 13 1.13 1.08 1.03 0.96 0.84 0.75 0.67 0.67 0.74 0.83 0.91 0.98 1.03 1.04 1.01 0.95 0.85 0.76 0.66 1.05 1.01 0.96 0.86 0.79 0.73 0.70 0.75 0.82 0.88 0.94 0.98 0.98 0.97 0.92 0.83 0.75 0.68

Wave di	rection	NW (324)	
Wave he	ight	1.78 m	
Wave per	riod	6.30 sec	
0	10	20km	$\bigotimes$
L	1		
			図2 換算沖波波高分布(NW

1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	
1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	
	1.79	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	
		1.80	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	
	(	1.69	1.80	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	
		1.64	1.78	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	
		1.63	1.75	1.80	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	
	1.42	1.61	1.72	1.78	1.80	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	
1.14	1.46	1.61	1.70	1.76	1.79	1.80	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	
1.30	1.49	1.60	1.68	1.74	1.77	1.80	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	
1.37	1.50	1.59	1.67	1.72	1.76	1.78	1.80	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	
1.41	1.51	1.59	1.66	1.71	1.75	1.77	1.79	1.80	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	
1.43	1.52	1.59	1.65	1.70	1.73	1.76	1.78	1.80	1.80	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	
1.45	1.52	1.58	1.64	1.69	1.72	1.75	1.77	1.79	1.80	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	
1.46	1.53	1.58	1.64	1.68	1.71	1.74	1.76	1.78	1.79	1.80	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.80	1.80	1.80	1.81	
1.47	1.53	1.58	1.63	1.67	1.71	1.73	1.75	1.77	1.79	1.80	1.80	1.81	1.81	1.80	1.80	1.80	1.79	1.78	1.75	1.59	1		1.79	1
1.48	1.53	1.58	1.63	1.67	1.69	1.71	1.72	1.67	-	/	~	-			~	)1.72	1.74	1.69	1.58	1	_	1.19	1.60	
1.48	1.52	1.56	1.60	1.63	1.64	1.63	1.57	1.30	(						9.72	1.54	1.66	1.58	1.37	0.57	0.56	0.34	~	
1.47	1.50	1.53	1.56	1.57	1.56	1.51	1.39	1.09	0.24			/	0.21	0.56	1.09	1.44	1.54	1.47	1.25	0.80	0.50	0.12	0.02	~
1.45	1.47	1.49	1.51	1.50	1.46	1.39	1.24	0.98	0.49	0.06	0.16	0.29	0.55	0.88	1.15	1.36	1.43	1.36	1.17	0.84	0.51	0.14	0.03	
1.42	1.43	1.44	1.45	1.42	1.37	1.29	1.14	0.91	0.58	0.27	0.35	0.54	0.76	0.96	1.14	1.28	1.32	1.25	1.10	0.85	0.56	0.27	0.09	
1.38	1.39	1.39	1.39	1.35	1.29	1.20	1.06	0.88	0.65	0.48	0.53	0.69	0.84	0.99	1.12	1.20	1.22	1.16	1.03	0.84	0.61	0.39	0.20	
	1.35	1.33	1.33	1.28	1.22	1.13	1.01	0.88	0.73	0.63	0.65	0.76	0.87	0.99	1.08	1.13	1.13	1.08	0.97	0.82	0.64	0.46	0.30	
	V	1.28	1.28	1.22	1.17	1.08	0.99	0.90	0.78	0.73	0.72	0.79	0.88	0.97	1.03	1.07	1.06	1.01	0.92	0.79	0.65	0.51	0.38	
			V	117	1.13	1.05	0.98	0.91	0.83	0.79	0.78	0.81	0.88	0.94	0.99	1.01	1.00	0.95	0.87	0.77	0.65	0.54	0.43	
			9	$\mathcal{O}$	A	1.03	0.98	0.93	0.85	0.82	0.81	0.82	0.87	0.92	0.95	0.95	0.94	0.90	0.84	0.75	0.65	0.56	0.47	
						1																		
							5																	
								1																

Wave di	rection	NNW (330)	
Wave he	ight	1.81 m	
Wave pe	eriod	6.40 sec	
0	10	20km	X \
	1		図3 換算沖波波高分布(NNW)

																			5
		. = .		$\sim$		/						/				12	/ (		
	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	5
	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	$\left  \right\rangle$
	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	$\cup$
	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	
	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	
	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	~	1.69	1.70	
	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.69	/		1.41	1.66	
	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.69	1.67	/		~	/1.31	1.57	
	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.69	1.69	1.00	1.50			0.35	1.21	1.49	
	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.69	1.68	1.66	1.41				0.74	1.25	1.43	
1	1.70	1.70	1.70	1.70	1.70	1.70	1.69	1.69	1.68	1.65	1.59	1			1	0.89	1.23	1.39	
5	1.70	1.70	1.70	1.70	1.69	1.69	1.68	1.67	1.65	1.61	1.4/	0.72			0.57	0.97	1.22	1.37	
	1.70	1.70	1.69	1.69	1.69	1.08	1.07	1.05	1.62	1.55	1.39	0.98	0.54	0.50	0.82	1.02	1.22	1.34	
	1.09	1.69	1.69	1.68	1.68	1.0/	1.05	1.62	1.58	1.50	1.34	1.08	0.86	0.84	0.93	1.00	1.21	1.33	
	1.69	1.69	1.68	1.07	1.00	1.05	1.63	1.60	1.54	1.40	1.34	1.18	1.05	1.02	1.05	1.13	1.22	1.32	
	1.00	1.00	1.07	1.00	1.00	1.03	1.01	1.57	1.52	1.45	1.30	1.25	1.17	1.13	1.14	1.19	1.20	1.32	
	1.00	1.07	1.00	1.05	1.60	1.01	1.59	1.50	1.51	1.40	1.09	1.31	1.20	1.21	1.21	1.24	1.20	1.34	
	1.66	1.00	1.64	1.04	1.61	1.60	1.50	1.55	1.51	1.40	1.42	1.30	1.30	1.27	1.21	1.29	1.32	1.30	
	1.65	1.03	1.62	1.03	1.61	1.50	1.50	1.55	1.51	1.47	1.44	1.30	1.35	1.52	1.01	1.52	1.55	1.30	_
	1.65	1.64	1.63	1.62	1.61	1.59	1.57	1.55	1.52	1.43	1.40	/	1.50	Z	1.25	,		1.ve/	
	1.64	1.63	1.63	1.62	1.60	1.00	1.01	1.00			2							٨	
	1.04	1.00	1.00	1.02	1.00													4	





5-171





図8 波向ベクトル分布(N)

292       293       293       293       293       293       293       293       293       303       301       302       301       302       3	292       292       292       292       292       292       292       292         293       292       292       292       292       292       292       292         293       294       294       294       294       294       294       294       294       295       295       295       295       295       295       295       295       295       295       295       296       297       298       298       297       290       298       297       291       295       300       300       299       298       293       301       300       290       303       302       301       300       303       302       301       303       302       301       303       303       303       303       303       304       303       304       303       304       303       304       303       304       303       304       303       304       303       304       303       3	292         292         292         292         292           292         292         292         292         292           293         293         293         293         293           294         294         293         293         293           295         295         295         294         294           296         295         295         294         294           296         296         295         296         296           296         297         297         296         296           298         298         297         297         300         302           300         299         298         296         302         301         301           301         300         299         298         302         302         302           301         302         301         303         302         302         303           301         304         303         302         302         302           301         363         349         340         336         336           343         346         344         339         332	2 292 29 2 292 29 2 292 29 3 293 29	02 292 02 292 02 292	292 292	292	292	292	293
295       293       293       292       293       294       294       294       294       294       294       294       294       294       2	292       292       292       292       292       292       292         293       292       293       294       294       294       294       294       294       295       295       295       295       295       295       295       295       295       295       295       295       295       295       303       302       301       300       299       298       299       298       299       298       290       293       301       301       301       301       301       301       301       301       301       301       301       301       301       301       301       303       302       301       301       303       303       304       303       304       303       304       303       304       303       303       303       3	292     292     292     292     292       293     293     293     293       294     294     293     293       295     295     294     294       296     295     294     294       296     296     295     296       297     297     296     296       298     298     297     297       300     299     298     296       301     300     299     296       302     301     300     302       304     303     302     303       307     305     304     303       308     363     349     340       353     348     343     366       343     344     339     333       331     338     335     336	2 292 29 2 292 29 3 293 29	2 292	292				
307       297       295       294       293       294       294       294       294       294       294       294       294       294       294       294       294       294       294       2	293         292         292         293         294         294         294         294         294         294         294         295         295         295         295         295         295         295         295         295         296         306         301         300         290         306         301         303         302         301         306         303         302         301         306         303         302         301         306         303         304         303         304         303         304 <td>292         292         293         293         293           293         293         293         293         293           294         295         294         294         294           296         295         294         294         294           296         296         295         294         294           296         297         297         296         296           298         298         297         296         296           300         299         298         296         301           301         300         299         298         302           301         300         299         298         302           301         302         301         301         302           307         305         304         303         302           380         363         349         340         334           363         352         345         336           343         344         339         333           331         338         335         304</td> <td>2 292 29 3 293 29</td> <td>2 292</td> <td></td> <td>292</td> <td>292</td> <td>292</td> <td>293</td>	292         292         293         293         293           293         293         293         293         293           294         295         294         294         294           296         295         294         294         294           296         296         295         294         294           296         297         297         296         296           298         298         297         296         296           300         299         298         296         301           301         300         299         298         302           301         300         299         298         302           301         302         301         301         302           307         305         304         303         302           380         363         349         340         334           363         352         345         336           343         344         339         333           331         338         335         304	2 292 29 3 293 29	2 292		292	292	292	293
307       300       297       296       295       294       294       293       293       293       293         321       305       301       299       297       296       295       295       294       2	293       293       293       293       293       293       293         294       294       294       294       294       294       294       294       294       294       295       290       290       298       297       290       290       290       290       290       290       290       290       290       290       290       290       290       290       290       300       300       299       290       303       302       301       300       303       302       301       303       302       301       303       303       303       303       304       303       303       303       304       303       304       303       304       303       304       303       304       303       304       303       304       303       304       303       304       303       304       303       304       303       304       3	293       293       293       293       293         294       294       293       293         295       295       294       294         296       296       295       295         297       297       296       297         290       298       297       297         300       299       298       296         301       300       299       296         302       301       300       302         303       302       301       301         304       303       302       302         307       305       304       303         308       363       349       340         380       363       349       340         353       348       343       336         343       344       339       332         331       338       335       336	3 293 29		292	292	292	292	293
321       305       301       299       297       296       295       294       294       294       295       295       294       294       295       305       300       207       305       303       302       300       207       305       303       302       301       300       3	294         294         294         294         295         300         290         298         298         295         301         300         290         293         301         302         301         300         290         305         300         302         301         303         302         301         303         303         303         303         304         303         305         304         303         304         304         303         304         304         303         304         303         304         303         304         303         305         304         303         304         303         304 <td>294         293         293         293           295         294         294         294           296         296         295         294           296         297         296         296           298         297         297         296           300         299         298         296           301         300         299         298           301         300         299         296           301         300         299         296           301         300         299         296           301         300         299         296           301         300         299         296           302         301         301         302           306         304         303         302           307         305         304         303           380         363         349         340           363         348         343         366           343         344         339         333           331         338         335         360</td> <td></td> <td>3 292</td> <td>292</td> <td>292</td> <td>292</td> <td>292</td> <td>293</td>	294         293         293         293           295         294         294         294           296         296         295         294           296         297         296         296           298         297         297         296           300         299         298         296           301         300         299         298           301         300         299         296           301         300         299         296           301         300         299         296           301         300         299         296           301         300         299         296           302         301         301         302           306         304         303         302           307         305         304         303           380         363         349         340           363         348         343         366           343         344         339         333           331         338         335         360		3 292	292	292	292	292	293
325       312       305       302       300       298       297       296       295       295       295       295         327       316       309       305       302       300       299       298       297       296       296       295       295       295       295         338       328       319       312       308       305       302       301       300       299       298       297       296       296       295       295         346       336       328       321       315       311       307       305       303       301       300       299       298       297       296       296       295       295       295         343       326       328       317       313       309       307       305       303       302       300       302       301       302       301       302       301       303       302       301       302       301       303       302       301       303       302       301       303       302       301       303       302       301       303       302       301       303       302       301       3	296         295         295         295         295         295           297         296         296         296         296         296         297         295           299         298         297         297         298         298         298         293           300         299         298         297         297         295           300         299         298         298         298         295           302         300         300         299         295           303         302         301         300         295           304         303         302         301         300         303           306         304         303         302         301         303           307         306         304         303         304         303           308         307         306         304         303         304           290         387         380         363         342           294         358         363         352         348           300         311         343         344         33           306	295         294         294           296         295         295         295           297         297         296         297           298         298         297         297           300         299         298         297           301         300         299         298           302         301         300         302           304         303         302         302           306         304         303         302           307         305         304         303           3080         363         349         340           380         363         349         340           353         348         343         336           343         346         341         335           337         341         337         330           331         338         335         330	3 293 29	3 293	293	293	293	293	293
327       316       309       305       302       300       299       298       297       296       296       297         338       328       319       312       308       305       302       301       300       299       298       297       298       297       298       297       298       297       298       297       298       297       298       297       298       297       298       297       298       297       298       298       297       298       297       298       297       298       297       298       297       298       297       298       297       298       297       298       297       298       297       298       297       298       297       298       297       298       297       298       297       298       297       298       297       298       297       298       297       290       300       300       300       300       300       300       300       300       300       300       300       301       302       301       302       301       302       301       303       302       301       302       301       3	297         296         296         296         296         295           299         298         297         297         298           300         299         298         298         298         298           300         299         298         298         298         298           302         300         300         299         298           303         302         301         300         299           303         302         301         300         293           304         303         302         301         300         293           306         304         303         302         301         303           306         307         306         304         303         302           309         308         307         306         304         303           290         387         380         363         344           294         358         363         352         344           295         325         353         348         344           300         311         343         344         33           306	296         296         295         295           297         297         296         297           298         298         297         296           300         299         298         296           301         300         299         298           301         300         299         296           302         301         300         302           303         302         301         301           304         303         302         302           307         305         304         303           307         305         304         303           380         363         349         340           363         352         345         336           343         344         339         333           331         338         335         330	4 294 29	4 294	293	293	293	293	293
338       328       319       312       308       305       302       301       300       299       298       297       29         346       336       328       321       315       311       307       305       303       301       300       299       298       293         343       335       329       323       317       313       309       307       305       303       302       300       300       29       298       29         340       334       329       324       319       315       311       309       306       304       303       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       303       302       301       303       302       301       303       302       301       303       302       301       303       302       301       303<	299         298         297         297         29           300         299         298         298         29           302         300         300         299         29           303         302         301         300         299         25           303         302         301         300         299         25           303         302         301         300         29         25           304         303         302         301         302         301         30           306         304         303         302         301         30         303         302         303           307         306         304         303         302         30         303         302         30           309         308         307         305         30         30         304         30           290         387         380         363         352         34           294         358         363         352         34         34         33           303         312         337         341         33         33         36         31	297         297         296         297           298         298         297         297           300         299         298         296           301         300         299         298           302         301         300         300           303         302         301         301           304         303         302         302           306         304         303         302           307         305         304         303           307         305         304         303           307         305         304         303           308         363         349         340           363         352         345         346           348         346         341         335           337         341         337         332           331         338         335         330	5 295 29	4 294	294	294	294	294	293
346       336       328       321       315       311       307       305       303       301       300       299       298       29         343       335       329       323       317       313       309       307       305       303       302       300       300       299       298       29         340       334       329       324       319       315       311       309       306       304       303       302       301       302         339       344       329       324       320       316       313       310       308       306       304       303       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       303       302       301       302       301       302       301       303       302       301       302       301	300         299         298         298         298         298           302         300         300         299         29           303         302         301         300         299         29           303         302         301         300         299         29           303         302         301         300         29         30           304         303         302         301         302         301         30           306         304         303         302         301         303         302         301           306         304         303         302         301         30         303           308         307         306         304         303         302         30           309         308         307         305         30         30         34           290         387         380         363         352         34           294         358         363         352         34         32           300         311         343         344         33         30         31         338         33	298         298         297         297           300         299         298         296           301         300         299         298           302         301         300         302           303         302         301         301           304         303         302         302           306         304         303         302           307         305         304         303           308         363         349         340           363         352         345         336           353         348         343         346           343         344         339         333           331         338         335         336	6 295 29	5 295	295	294	294	294	294
343       335       329       323       317       313       309       307       305       303       302       300       300       29         340       334       329       324       319       315       311       309       306       304       303       302       301       303       302       301       303       302       301       303       302       301       303       302       301       303       302       301       303       301       303       30	302       300       300       299       25         303       302       301       300       299       25         304       303       302       301       300       29         304       303       302       301       300       29         306       304       303       302       301       30         307       306       304       303       302       30         308       307       306       304       303       30         309       308       307       305       30         290       387       380       363       342         294       358       363       352       34         295       325       353       348       34         300       311       343       344       33         303       312       337       341       33         306       313       331       338       33	300         299         298         296           301         300         299         296           302         301         300         300           303         302         301         301           304         303         302         302           306         304         303         302           307         305         304         303           307         305         304         302           307         305         304         303           308         363         349         340           363         352         345         336           353         348         343         336           343         346         341         335           337         341         337         332           331         338         335         330	7 296 29	6 296	295	295	295	295	295
340       334       329       324       319       315       311       309       306       304       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       301       302       302       302       302       302       302       302       302       302       302       302       302       302       303       302       302       303       302       302       303       302       302       303       302       302       303       302       302       303       302       302       303       303       302       304       303       302       304       303       302       304       303       302       304       303       302       304       303       303       303       302       304       303       303       307       306       304       303       307       306       304       303       307       306       307       306       307       306       307       306       307       306       307       306       3	303       302       301       300       25         304       303       302       301       302       301       302         306       304       303       302       301       302       301       302         306       304       303       302       301       302       301       302       301         306       304       303       302       304       303       302       303         308       307       306       304       303       302       301       303         309       308       307       306       304       303       304         290       387       380       363       342         294       358       363       352       344         295       325       353       348       344         300       311       343       344       333         306       313       331       338       335	301         300         299         299           302         301         300         300           303         302         301         301           304         303         302         302           306         304         303         302           307         305         304         303           308         363         349         340           363         352         345         336           343         344         339         333           331         338         335         336	8 297 29	7 296	296	296	296	295	295
339       334       329       324       320       316       313       310       306       304       303       302       303         338       334       330       325       321       318       314       312       309       307       306       304       303       302       303         337       333       330       326       322       319       316       313       311       309       307       306       304       303       306         336       333       330       326       323       320       317       314       312       310       308       307       306       304       303         336       333       330       326       323       320       318       315       313       311       309       308       307       306       307       306       307       306       307       306       308       307       308       307       308       307       308       307       308       307       308       307       308       307       308       307       308       307       308       308       307       308       308       307       3	304         303         302         301         30           306         304         303         302         30           307         306         304         303         302         30           307         306         304         303         302         30           308         307         306         304         303         30           309         308         307         305         30           290         387         380         363         34           294         358         363         352         34           295         325         353         348         34           300         311         343         344         33           306         313         331         338         33	302         301         300         300           303         302         301         301           304         303         302         302           306         304         303         302           307         305         304         303           307         305         304         303           307         305         304         303           308         363         349         340           363         352         345         336           348         346         341         335           337         341         337         332           331         338         335         330	9 298 29	8 297	297	296	296	296	296
338       334       330       325       321       318       314       312       309       307       306       304       303       30         337       333       330       326       322       319       316       313       311       309       307       306       304       303       306         336       333       330       326       322       319       316       313       311       309       307       306       304       303         336       333       330       326       323       320       318       315       313       311       309       308       307       306       304       303         335       333       330       327       324       322       319       316       314         344       332       330       327       324       322       320       317       310       292       387       380       36         344       332       330       327       325       323       319       314       308       301       295       325       353       34         332       330       327       325       321<	306       304       303       302       30         307       306       304       303       30         308       307       306       304       30         309       308       307       306       304       30         309       308       307       305       30         290       387       380       363       34         294       358       363       352       34         295       325       353       348       34         297       312       348       346       34         300       311       343       344       33         306       313       331       338       33	303       302       301       301         304       303       302       302         306       304       303       302         307       305       304       303         307       305       304       303         307       305       304       303         380       363       349       340         363       352       345       336         353       348       343       346         343       344       339       333         337       341       337       332         331       338       335       336	0 299 29	8 298	298	297	297	296	296
337       333       330       326       322       319       316       313       311       309       307       306       304       30         336       333       330       326       323       320       317       314       312       310       308       307       306       30         336       333       330       326       323       320       318       315       313       311       309       308       307       306       30         336       333       330       326       323       320       318       315       313       311       309       308       307       306       30         335       333       330       327       324       322       319       317       310       292       39         334       332       330       327       325       323       319       315       308       207       290       387       380       36         344       332       330       327       325       323       319       314       308       301       295       325       353       34         332       330       327	307         306         304         303         30           308         307         306         304         30           309         308         307         305         30           309         308         307         305         30           309         308         307         305         30           290         387         380         363         34           294         358         363         352         34           297         312         348         346         34           300         311         343         344         33           306         313         331         338         33	304       303       302       302         306       304       303       302         307       305       304       303         307       305       304       303         307       305       304       303         391       364       343         380       363       349       340         363       352       345       336         348       346       341       335         337       341       337       332         331       338       335       330	1 300 29	9 299	298	298	297	297	297
336       333       330       326       323       320       317       314       312       310       308       307       306       30         336       333       330       326       323       320       318       315       313       311       309       308       307       306       307       308       307       308       307       308       307       308       307       308       307       308       307       308       307       308       307       308       307       308       307       308       307       308       307       308       307       308       307       308       308       307       308       30	308         307         306         304         30           309         308         307         305         30           309         308         307         305         30           309         308         307         305         30           309         308         307         305         30           290         387         380         363         34           294         358         363         352         34           295         325         353         348         34           297         312         348         346         34           300         311         343         344         33           306         313         331         338         33	306         304         303         302           307         305         304         303           307         305         304         303           307         305         304         303           307         305         304         303           391         364         343           380         363         349         340           363         352         345         336           353         348         343         336           343         344         339         333           331         338         335         336	2 301 30	0 300	299	299	298	298	298
336       333       330       326       323       320       318       315       313       311       309       308       307       30         335       333       330       327       324       321       319       316       314         335       333       330       327       324       322       319       317       312         334       332       330       327       324       322       320       316       308       297       290       387       380       36         334       332       330       327       325       323       320       316       308       297       290       387       380       36         334       332       330       327       325       323       319       315       308       301       295       325       353       34         332       330       327       325       323       319       314       308       301       295       325       353       34         332       330       327       325       321       317       313       308       303       300       311       34 <tr< td=""><td>309         308         307         305         30           391         36         391         36           290         387         380         363         34           294         358         363         352         34           295         325         353         348         34           297         312         348         346         34           300         311         343         344         33           306         313         331         338         33</td><td>307         305         304         305           391         364         343           380         363         349         340           363         352         345         336           348         346         341         335           348         346         341         335           337         341         337         332           331         338         335         330</td><td>2 302 30</td><td>1 300</td><td>300</td><td>299</td><td>299</td><td>297</td><td>304</td></tr<>	309         308         307         305         30           391         36         391         36           290         387         380         363         34           294         358         363         352         34           295         325         353         348         34           297         312         348         346         34           300         311         343         344         33           306         313         331         338         33	307         305         304         305           391         364         343           380         363         349         340           363         352         345         336           348         346         341         335           348         346         341         335           337         341         337         332           331         338         335         330	2 302 30	1 300	300	299	299	297	304
335       333       330       327       324       321       319       316       314         335       333       330       327       324       322       319       317       312         334       332       330       327       324       322       320       317       310       292       393         334       332       330       327       325       323       320       316       308       297       290       387       380       36         334       332       330       327       325       323       319       315       308       297       290       387       380       36         334       332       330       327       325       323       319       314       308       301       295       325       353       34         332       330       327       325       322       318       313       308       302       297       312       348       34         330       327       325       321       317       313       308       303       300       311       343         330       327       325       321 </td <td>391       36         290       387       380       363       34         294       358       363       352       34         295       325       353       348       34         297       312       348       346       34         300       311       343       344       33         306       313       331       338       33</td> <td>391         364         343           380         363         349         340           363         352         345         336           353         348         343         336           343         344         339         333           337         341         337         332           331         338         335         330</td> <td>3 303 30</td> <td>2 301</td> <td>301</td> <td>299</td> <td>/</td> <td>2</td> <td>309</td>	391       36         290       387       380       363       34         294       358       363       352       34         295       325       353       348       34         297       312       348       346       34         300       311       343       344       33         306       313       331       338       33	391         364         343           380         363         349         340           363         352         345         336           353         348         343         336           343         344         339         333           337         341         337         332           331         338         335         330	3 303 30	2 301	301	299	/	2	309
335       333       330       327       324       322       319       317       312         334       332       330       327       324       322       320       317       310       292       39         334       332       330       327       324       322       320       317       310       292       39         334       332       330       327       325       323       320       316       308       297       290       387       380       36         334       332       330       327       325       323       319       315       308       299       294       358       363       35         334       332       330       327       325       323       319       314       308       301       295       325       353       34         332       330       327       325       322       318       313       308       302       297       312       348       34         330       327       325       321       317       313       308       303       300       311       343         340       324 <td>391       36         290       387       380       363       34         294       358       363       352       34         295       325       353       348       34         297       312       348       346       34         300       311       343       344       33         303       312       337       341       33         306       313       331       338       33</td> <td>391         364         343           380         363         349         340           363         352         345         336           353         348         343         336           348         346         341         335           343         344         339         333           337         341         337         332           331         338         335         330</td> <td>317 30</td> <td>3 302</td> <td>301</td> <td>C</td> <td>~</td> <td>356</td> <td>316</td>	391       36         290       387       380       363       34         294       358       363       352       34         295       325       353       348       34         297       312       348       346       34         300       311       343       344       33         303       312       337       341       33         306       313       331       338       33	391         364         343           380         363         349         340           363         352         345         336           353         348         343         336           348         346         341         335           343         344         339         333           337         341         337         332           331         338         335         330	317 30	3 302	301	C	~	356	316
334       332       330       327       324       322       320       317       310       292       393         334       332       330       327       325       323       320       316       308       297       290       387       380       36         334       332       330       327       325       323       319       315       308       297       290       387       380       36         334       332       330       327       325       323       319       315       308       299       294       358       363       355         334       332       330       327       325       323       319       314       308       301       295       325       353       34         332       330       327       325       322       318       313       308       302       297       312       348       34         330       327       325       321       317       313       308       303       300       311       343       34         330       327       325       321       317       313       309       304 <td>391       36         290       387       380       363       34         294       358       363       352       34         295       325       353       348       34         297       312       348       346       34         300       311       343       344       33         303       312       337       341       33         306       313       331       338       33</td> <td>391         364         343           380         363         349         340           363         352         345         336           353         348         343         336           343         344         339         333           337         341         337         332           331         338         335         330</td> <td>5 326 30</td> <td>7 303</td> <td>299</td> <td>280</td> <td>320</td> <td>318-</td> <td>~</td>	391       36         290       387       380       363       34         294       358       363       352       34         295       325       353       348       34         297       312       348       346       34         300       311       343       344       33         303       312       337       341       33         306       313       331       338       33	391         364         343           380         363         349         340           363         352         345         336           353         348         343         336           343         344         339         333           337         341         337         332           331         338         335         330	5 326 30	7 303	299	280	320	318-	~
334       332       330       327       325       323       320       316       308       297       290       387       380       36         334       332       330       327       325       323       319       315       308       299       294       358       363       35         334       332       330       327       325       323       319       314       308       201       295       325       353       34         332       330       327       325       322       318       313       308       301       295       325       353       34         332       330       327       325       322       318       313       308       302       297       312       348       34         330       327       325       321       317       313       308       303       300       311       343       34         330       327       325       321       317       313       309       304       303       312       337       34         340       324       320       317       313       309       306       306	290         387         380         363         342           294         358         363         352         344           295         325         353         348         344           297         312         348         346         34           300         311         343         344         33           303         312         337         341         33           306         313         331         338         33	380         363         349         340           363         352         345         338           353         348         343         336           348         346         341         335           343         344         339         333           337         341         337         332           331         338         335         330	3 328 31	4 305	298	287	281	273	253
334       332       330       327       325       323       319       315       308       299       294       358       363       35         334       332       330       327       325       323       319       314       308       301       295       325       353       34         332       330       327       325       322       318       313       308       302       297       312       348       34         330       327       325       321       317       313       308       302       297       312       348       34         330       327       325       321       317       313       308       303       300       311       343       34         330       327       325       321       317       313       309       304       303       312       337       34         324       320       317       313       309       306       306       313       331       33         317       313       309       306       306       313       331       33         317       313       309       306	294         358         363         352         34           295         325         353         348         34           297         312         348         346         34           300         311         343         344         33           303         312         337         341         33           306         313         331         338         33	363         352         345         336           353         348         343         336           348         346         341         335           343         344         339         333           337         341         337         332           331         338         335         336	0 329 31	7 308	299	289	281	272	266
334       332       330       327       325       323       319       314       308       301       295       325       353       34         332       330       327       325       322       318       313       308       302       297       312       348       34         330       327       325       321       317       313       308       302       297       312       348       34         330       327       325       321       317       313       308       303       300       311       343       34         324       320       317       313       309       304       303       312       337       34         317       313       309       306       306       313       331       33         Wave direction       WNW (324)       317       m       317       m       317       313       317       313	295       325       353       348       348       342         297       312       348       346       34         300       311       343       344       33         303       312       337       341       33         306       313       331       338       33	353         348         343         336           348         346         341         335           343         344         339         333           337         341         337         332           331         338         335         330	8 329 31	9 310	301	292	283	276	270
332       330       327       325       322       318       313       308       302       297       312       348       34         330       327       325       321       317       313       308       303       300       311       343       34         330       327       325       321       317       313       309       304       303       312       337       34         324       320       317       313       309       304       303       312       337       34         317       313       309       306       306       313       331       33         Wave direction       WNW (324)	297 312 348 346 34 300 311 343 344 33 303 312 337 341 33 306 313 331 338 33	348         346         341         335           343         344         339         333           337         341         337         332           331         338         335         336	6 328 31	9 311	303	294	286	279	274
Wave direction         WNW (324)           Wave height         3.17	300 311 343 344 33 303 312 337 341 33 306 313 331 338 33	343 344 339 333 337 341 337 332 331 338 335 330	5 328 31	9 312	304	297	289	283	277
Wave direction         WNW (324)           Wave height         3.17	303 312 337 341 33	337 341 337 332 331 338 335 330	3 327 31	9 313	306	299	292	286	280
Wave direction         WNW (324)           Wave height         3.17 m	306 313 331 338 33	331 338 335 331	2 326 31	9 313	307	300	294	288	283
Wave direction WNW (324) Wave height 3.17 m			0 325 31	9 313	308	302	296	291	286
Wave direction WNW (324) Wave height 3,17 m									
Wave direction WNW (324) Wave height 3,17 m			数值:N7	から時	計回	90	角度	(de	g)
Wave height 3,17 m									
Wave period 9.20 sec	$\mathcal{X}$								

315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315
315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315
	320	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315
		320	316	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315
		331	319	316	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315
		334	323	319	317	316	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315
		336	327	322	319	317	316	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315
	346	336	329	324	321	319	317	316	316	315	315	315	315	315	315	315	315	315	315	315	315	315	315
356	344	337	331	326	323	320	319	318	317	316	316	315	315	315	315	315	315	315	315	315	315	315	315
351	343	337	332	328	324	322	320	319	318	317	316	316	315	315	315	315	315	315	315	315	315	315	315
348	342	338	333	329	326	323	321	320	319	318	317	316	316	316	315	315	315	315	315	315	315	315	315
347	342	338	333	330	327	324	322	321	320	319	318	317	317	316	316	315	315	315	315	315	315	315	315
346	342	338	334	331	328	325	324	322	321	319	319	318	317	317	316	316	316	315	315	315	315	315	315
345	341	338	334	331	329	326	324	323	321	320	319	319	318	317	317	316	316	316	315	315	315	315	315
344	341	338	335	332	329	327	325	324	322	321	320	319	319	318	317	317	317	316	316	316	315	315	316
344	341	338	335	332	330	328	326	325	323	322	321	320	319	319	318	317	317	317	316	313	/	>	319
343	341	338	335	333	331	329	327	325	C						)	324	317	316	313	C	~	353	325
343	341	338	336	333	331	329	326	317					~	~	363	333	319	314	308	287	356	330-	~
342	341	338	336	333	331	327	322	313	294		_	/	387	365	350	334	321	313	306	295	302	287	256
342	340	338	335	333	329	325	319	311	298	342	382	373	365	356	345	333	322	314	305	296	288	273	267
342	340	338	334	331	327	323	317	310	301	314	370	365	358	350	341	332	323	314	306	297	287	277	271
341	339	336	333	330	326	321	316	310	304	317	362	359	353	346	339	331	322	315	307	298	289	280	275
1	337	335	331	328	324	320	316	311	309	320	351	355	350	343	337	329	322	315	307	299	291	284	278
	0	334	330	327	323	320	316	314	314	322	342	351	346	341	335	328	321	315	308	301	293	287	281
			4	327	323	320	317	316	317	323	335	346	344	339	333	327	321	315	308	302	295	289	284
			-	×	~	321	319	318	319	323	331	340	341	337	332	326	320	315	309	303	297	291	287
						1	1																
-					_		~								数	牧值:	Nか	ら時	計回	りの	角度	(de	g)
	Wave	dir	ectio	n	NW	(32	27)	1	~	~													
L	Wave	hei	ght		1.	78 m				-	1	-											
	Wave	per	iod		6.	30 se	ec				1												

図10 波向数值分布(NW)

lave direc	tion	NNW (330)	1
ave heigh	t	1.81 m	
lave perio	d	6.40 sec	
	10	20km	
	-		/

0

.

波向数值分布(NNW)

义11



付属資料5 対象地点の設計波計算結果



図1 換算沖波波高分布(WNW)







図3 換算沖波波高分布(NNW)


0.99 1.01 1.03 1.05 1.07 1.08 1.09 1.10 1.11 1.12 1.14 1.15 1.16 1.18 1.19 1.20 1.21 1.22 1.24 1.26 1.27 1.28 1.28 1.29 1.29 1.29

図4 換算沖波波高分布(N)



図5 換算沖波波高分布(NNE)



図6 換算沖波波高分布(NE)



図7 換算沖波波高分布(ENE)



図8 波向数值分布(WNW)



図9 波向数值分布(NW)



図10 波向数值分布(NNW)



図11 波向数值分布(N)



図12 波向数值分布(NNE)



図13 波向数值分布(NE)

51 50 50 50 (50 48) .48 .47 -45 (44 15.0 44 46-4 45 45 43 43 -46 10.0 44 \_\_\_\_46 44 / 44 10.0 -46 45 45 45 44 44 5 44 44 43 45 45 AT -45 5.0 47 45 44 2.5 50 . 48 47 45 0.0 10:42 数値:Nから時計回りの角度(deg) • Wave direction ENE (67.5) Wave height 0.90 m . Wave period 3.8 sec 0 0 0 0 100m

図14 波向数值分布(ENE)



図15 波向ベクトル分布(WNW)



図16 波向ベクトル分布(NW)



図17 波向ベクトル分布(NNW)



図18 波向ベクトル分布(N)



図19 波向ベクトル分布(NNE)



図20 波向ベクトル分布(NE)



図21 波向ベクトル分布(ENE)

# 付属資料6 稼働率計算結果

### 表1 稼働率計算結果 評価エリアA(利用限界波高 0.3m)

#### 稼働率計算結果

利用限界波高 0.3m

形状 DILI港

区 域 評価エリアA

利用限界出現率 <u>0.000</u> 0 00 乾季 波向 波高比 沖波波高 通年 1.962 3.930 NW 0.540 0.56 0.472 0.002 NN₩ 0.680 0.440.943 Ν 0.810 0.37 0.167 0.005 0.324 NNE 0.890 0.34 0.932 1.572 0.288 NE 0.850 0.35 4.244 6.712 1.760 合計 7.776 8.291 7.245

稼働率 92.224 91.709 92.755 乾季:12月~5月

雨季:6月~11月

区 域 評価エリアA

### 表2 稼働率計算結果 評価エリアA(利用限界波高 0.5m)

# 稼働率計算結果 形 状 DILI港

利用限界波高 0.5m

利用限界出現率

波 向	波高比	沖波波高	通年	乾季	雨季		
NW	0.540	0.93	0.162	0.000	0.328		
NNW	0.680	0.74	0.169	0.000	0.348		
N	0.810	0.62	0.091	0.000	0.177		
NNE	0.890	0.56	0.008	0.008	0.000		
NE	0.850	0.59	0.051	0.064	0.032		
		合計	0.481	0.072	0.886		
		稼働率	99.519	99.928	99.114		
						乾季:12月	~5月

雨季:6月~11月

## 表 3 稼働率計算結果 評価エリア B(利用限界波高 0.3m) 稼働率計算結果

### 利用限界波高 0.3m 形状 DILI港 区域 評価エリアB

### 利用限界出現率

波 向	波高比	沖波波高	通年	乾季	雨季		
NW	0.540	0.56	1.962	0.000	3.930		
NNW	0.680	0.44	0.472	0.002	0.943		
N	0.820	0.37	0.167	0.005	0.324		
NNE	0.900	0.33	0.989	1.669	0.306		
NE	0.860	0.35	4.244	6.712	1.760		
		合計	7.834	8.389	7.263		
	-	稼働率	92.166	91.611	92.737		

乾季:12月~5月 雨季:6月~11月

表4 稼働率計算結果 評価エリア B(利用限界波高 0.5m)

#### 稼働率計算結果

利用限界波高 0.5m

形状 DILI港

区 域 評価エリアB

利用限界出現率

		小 J	<b>用 </b> 限 列	山乃	- <del>1-</del>		
波 向	波高比	沖波波高	通年	乾季	雨季		
NW	0.540	0.93	0.162	0.000	0.328		
NNW	0.680	0.74	0.169	0.000	0.348		
Ν	0.820	0.61	0.094	0.000	0.182		
NNE	0.900	0.56	0.008	0.008	0.000		
NE	0.860	0.58	0.054	0.068	0.034		
		合計	0.487	0.076	0.892		
		稼働率	99.513	99.924	99.108		
乾季,12日~5日							

乾季:12月~5月 雨季:6月~11月