

Investigation of Safety Factors in Ports According to Their Development (Case Study Jask Port)

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Abstract Nowadays 90 percent of world exchange to be achieved by marine transport and it can be said that the sea is undeniable dimension of economic affairs for every country. Substructure of ports, harbor and formation of suitable and safe conditions for vessel movement is helpful and acceleration affair in loading and offloading of goods, and also is the effective and important factor for vessels movement, In this research by using the library study and the results of numerical modeling with the descriptive and analytic method the effective parameters in vessels safety traffic in the harbor basins to be explained. For this purpose eastern harbor of Jask port is selected. The result are explained in two categories; direct results and results of the numerical models, that including; wind, tide, wave and current.

Keywords: harbor, breakwaters, numerical model, Mike21, marine transportation

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1. Introduction

Iran has 3698.04 Km coastline in north and south [1] in the vicinity of Caspian Sea, Persian Gulf and Oman Sea. So Iran is ranked 37th in term of coastline in the world [2]. Therefore Iran is known as a maritime country, which shows Iran good condition in marine potential, and can cause the development of improvement of marine potential in country economic growth.

Marin transport is the largest international industrial in the world, and very important for the development of foreign trade, in every country. Marine transport has positive feature like; low expense, high speed and high volumes, so it is one of the best methods in commercial transport [3]. About 90 percent of total trade in the world is carried by sea transport [4]. These statistics show the importance of marine transportation in the international scale. Suitable quantity and quality standard substructure in the harbors and ports, mobility shipping and the new generation of vessels is essential for the development and economic growth.

In this study the favorite conditions of harbor basin and berthing condition like: speed and direction of wave, current and wind, with using Figures and numerical modeling are discussed.

1.1. Area of Study

For studying circumferential and physical conditions of breakwater basin on eastern of Jask by using the

numerical modeling research which is located in 25° 36' to 25°44' northern and 57°42' to 57°56' eastern (Figure 1) this modeling was done by MIKE 21/3 Integrated Model.

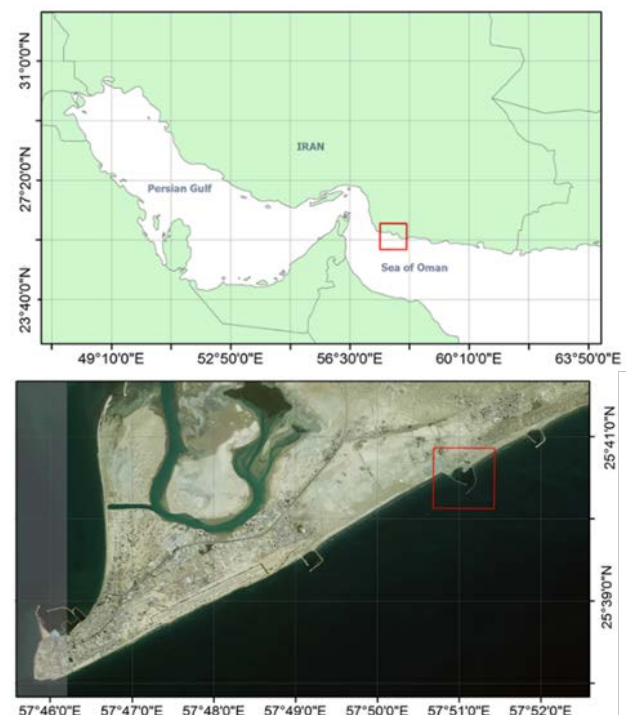


Figure 1. Position of Studied Breakwater in proportion to Iran (up) and Jask (down)

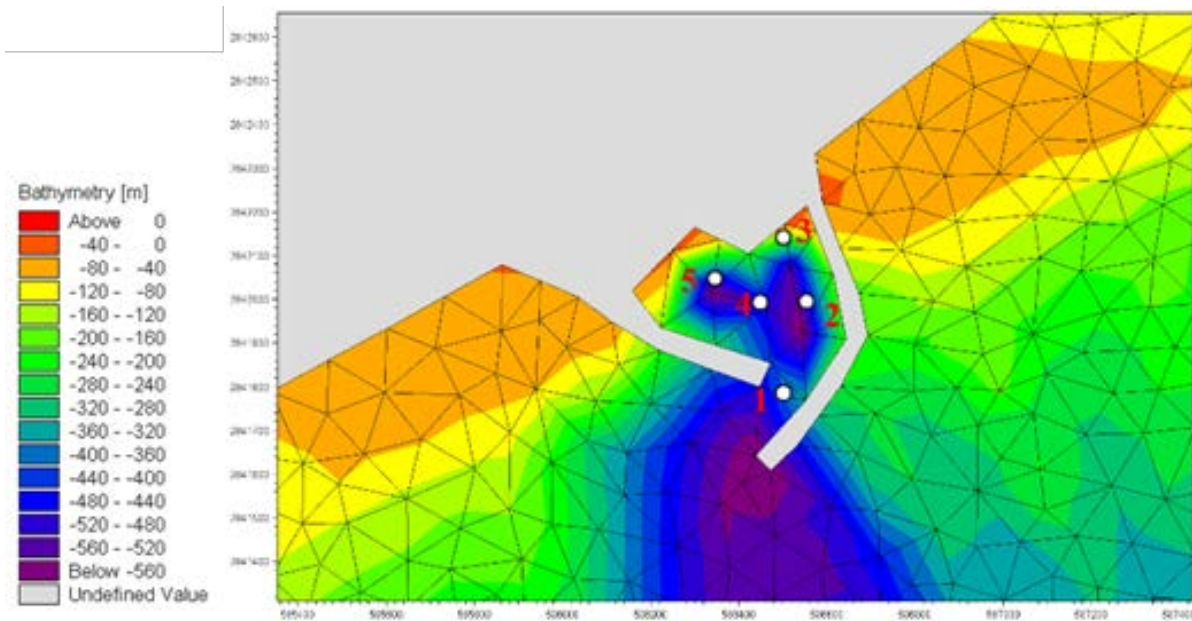


Figure 2. Hydrographic of area and selected points

The data used in this study are; wind, wave and surface level (tide) and using the prediction with artificial neural network. The point of option to extract the data is shown in Figure 2.

1.2. Introduction of Numerical Models

In this numerical modeling the data that use are wind and wave height concern to chronological span 2003 before construction of the breakwater and 2011 after construction of the breakwater, also because of unavailable data about of the construction predicted the artificial neural network of feed forward ANN with Perception type with Tan-sigmoid function [5,6].

For analysis of phenomenon which dominant on sea circumference, MIKE21 is prepared by the Denmark Hydraulic Institute. This is 2D modeling for estuaries, coastal areas, the seas and etc. This model is the useful tool for analysis of current and wave pattern,

sedimentation and erosion on the beaches and coastal sediment transport rate [7].

In this numerical modeling, spectral wave (SW) and Hydrodynamics module are used. Parameters and properties of this modeling is shown in Table 1. Also for calibration, White capping, Wave breaking and Bottom friction are used.

2. Report of Iran Active Ports

At the north of Iran; Bandar Amirabad, Noshahr, and Bandar-e Anzali are active as the major three port in north, and the another port are act as subsidiary ports.

At the south of Iran; Bandar Chabahar, Bandar Imam Khomeini, Bandar Bushehr, Bandar Abadan and Bandar Khorramshahr, Bandar Shahid Bahonar, Bandar Shahid Rajai are the major port, and the another port are subsidiary. Table 2 shows the specifications of Iran's ports [8].

Table 1. Parameters of SW and HD module

No.	Parameter	entered information	Model
1	Basic equations	Spectral formulation-fully spectral formulation Time -unsteady formulation	SW/HD
2	White capping	Dissipation coefficient $C_{dis}=1$ و $\delta=0.8$	SW
3	Wave breaking	Gamma data with the value of 0.8 The calibration constant factor, $(\alpha=1)$	SW
4	Bottom friction	Nikuradse roughness ($kn=0.04$)	SW
		Chezy number 15	HD
5	Energy Transfer	Quadruplet-wave interaction	SW/HD
6	Wind forcing	ISWM wind statistics data with time step of 6 hours	SW/HD
7	Water level conditions	Tidal information Jask	SW/HD
8	Bathymetry	Admiral bathymetry map of Great Britain	SW/HD
9	Eddy viscosity	The Smagorinsky formulation= 0.28	HD
10	Wave radiation	SW module	HD

Table 2. Iran's ports and Wharf list

Port Name	State	Depth (m)	Number of Wharf	Port Name	State	Depth (m)	Number of Wharf
AmirAbad	Mazandaran	6	15	Siri	Hormozgan	-	-
Noshahr	Mazandaran	5.5	10	Shahid Bahonar	Hormozgan	12-5	12
Fereydunkenar	Mazandaran	4	2	Kish	Hormozgan	-	-
Anzali	Gilan	4.6	10	Tyab	Hormozgan	3.3	1
Astara	Gilan	4.6	3	Haqqani	Hormozgan	-	9
Chamkhaleh	Gilan	-	-	Jask	Hormozgan	4.7	-
Kiashahr	Gilan	-	-	Ciric	Hormozgan	7-3	-
Turkoman	Golestan	-	-	Hormoz	Hormozgan	5	5
Khvajhnfs	Golestan	-	-	Qeshm	Hormozgan	10-1	39
Neka	Mazandaran	4.8	5	Bushehr	Bushehr	6	15
Chabahar	Sistan and Baluchestan	13-2	10	Assaluyeh	Bushehr	15-10	10
Goiter	Sistan and Baluchestan	-	-	Kharg	Bushehr	4	2
Roddick	Sistan and Baluchestan	-	-	Ganaveh	Bushehr	5.2-3	3
Gishab	Sistan and Baluchestan	-	-	Kangan	Bushehr	4	1
Gordim	Sistan and Baluchestan	-	-	Daylam	Bushehr	3	1
Byrdf	Sistan and Baluchestan	-	-	dyer	Bushehr	6	1
Jad	Sistan and Baluchestan	-	-	Imam Khomeini	Khuzestan	14-10	37
Shahid Rajae	Hormozgan	17-11	35	Abadan	Khuzestan	5.5	8
Lengeh	Hormozgan	5.5	3	Arvandkenar	Khuzestan	-	-
Charak	Hormozgan	-	-	Chvydh	Khuzestan	-	-
Aftab	Hormozgan	-	-	Khorramshahr	Khuzestan	5.1-2.7	19
Lavan	Hormozgan	-	-				

2.1. Operation of Port Interpretation

Coastal areas are the main context of economic and social human activities for present and future generation, so that 90 percent of global trade to be accomplished by the oceans, and 80 percent of world big cities are located near of the sea. Humans advance to sea direction with the development targets, Is bring to a conclusion with the different manner, which is different regard with kind of the target. Nowadays the human is trying to achieve the development of social, economic and industrial its

community, so that we see the improvements developed countries with planning and prosper management in the twentieth century, as a result of these, we see the large fissure in global trade [9]. The important factor in global economy is quick exchange development in transport, communication and Information,

According to Annual reports of the Information and Communication Technology Office of Statistics and Informatics Department of Ports and Maritime Organization of Iran, total trade exchange volume of ports of Iran shown in Figure 3.

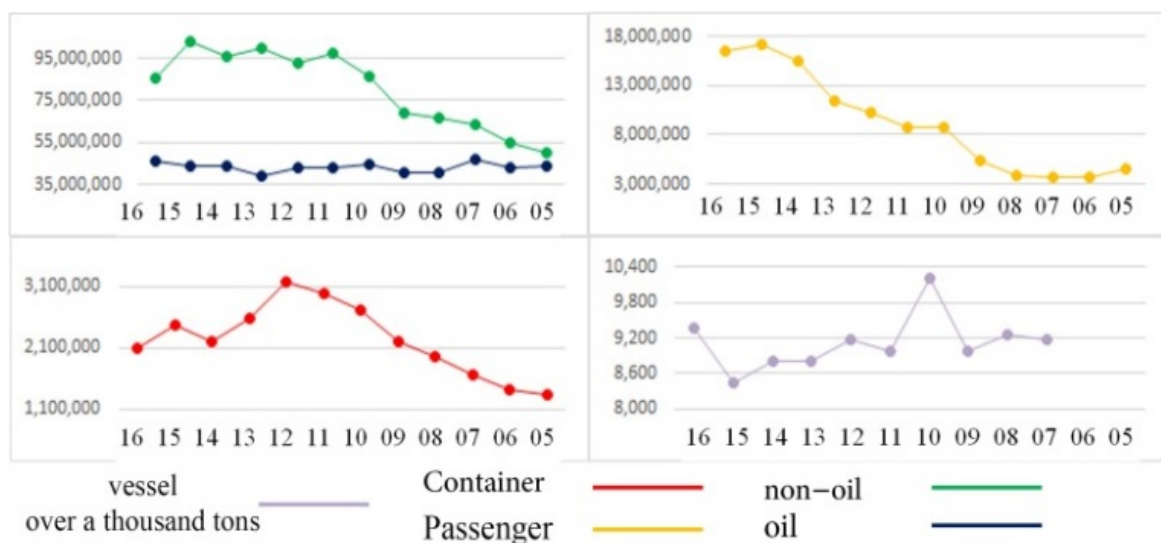


Figure 3. Loading and unloading, (oil, non-oil) container, Passenger and vessel movement from 2005-2016 (ton)

Table 3. The incoming and outgoing vessels in the ports of Iran

	year	Imam Khomeini	Khorram Shahr	Abadan	Shahid Rajae	Shahid Bahonar	Shahid Haqqani	Lengeh	Bushehr	Chabahar	Anzali
over a thousand tons	2016	1715	537	1	3052	597	0	503	557	139	804
	2015	1815	694	4	3119	546	0	432	496	168	800
	2014	1718	529	0	3175	445	0	191	499	102	699
under a thousand tons	2016	73	2341	1328	960	2676	10516	4840	745	427	51
	2015	78	3989	2459	800	3432	9165	5922	829	570	62
	2014	57	3400	1535	789	2379	1806	4352	173	113	56
	year	Noshahr	Amirabad	Neka	Qeshm	Jask	Ganaveh	Fereidoon'kenar	Astara	Total	
over a thousand tons	2016	303	789	50	325	0	57	50	43	9522	
	2015	267	813	47	3	0	17	88	59	9368	
	2014	214	771	47	9	0	0	34	0	8433	
under a thousand tons	2016	4	0	0	313	353	895	0	11	25533	
	2015	8	4	0	44	299	318	0	8	27987	
	2014	1	0	0	157	2	520	1	1	15342	

The amount of loading and unloading, (oil, non-oil) container, and passenger and vessel movement from 2005 until 2016 are shown in Figure 3. The amount of passenger movement from 2008 until 2016 has been a rapid growth, about 17 million passengers. The amount of the loading and unloading Oil goods from 2005 until 2016 has a similar trend, but non-oil-loading and non-oil – unloading goods from 2009 has been increased. The amount of container (empty- full) movement from 2006 has been increased, but from 2012 has been reduced, because of the economic sanctions. The chart of amount vessel movement over are thousand tons is not regular, but can say the average of vessels movement from the all Iran's ports is about 9 thousand vessel per year.

In Table 3 the amount of the movement of incoming and outgoing vessels to the ports of Iran is shown, in order, Shahid Rajae port and Bandar Imam Khomeini have highest traffic ports with Vessel over one thousand tons in Iran. Also Shahid haqany, Lengeh, Khorramshahr and Shahid bahonar ports have high traffic ports with Vessel under one thousand tons in Iran.

3. Results

3.1. Annual Wind

Extracting the data which exist in the underground from 2012 until 2016 is shown in Figure 4 [10]. During these five year, the maximum of wind speed is about 32 m/h, but average of the wind speed is 24 m/h, according to the chart at the Figure 5 the wind speed from Mid-June to Mid-September is highest and prevailing wind is from the northwest, and there is a southeast wind at a time of year, which has a period fewer but higher speed.

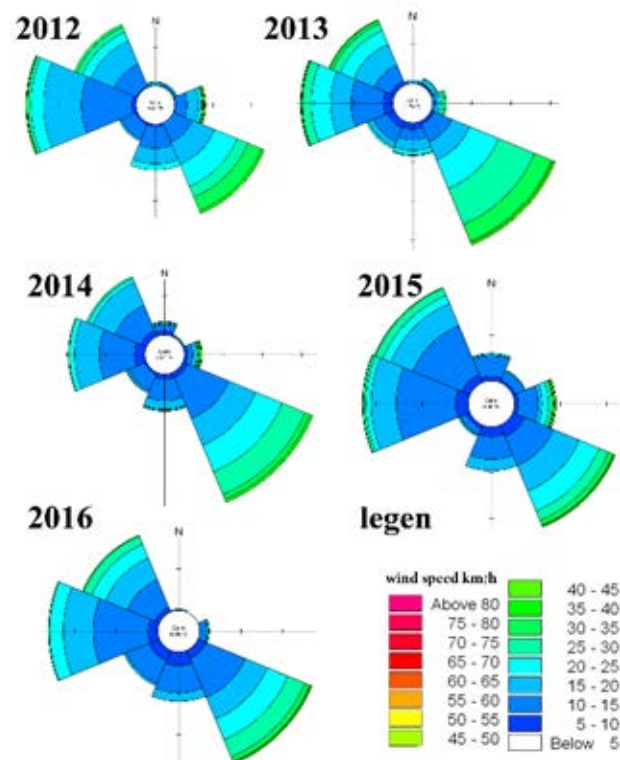
3.2. Monthly Wind

In all of the month prevailing wind is from the northwest, but in July, August and September The prevailing wind direction is oriented to the southeast, and

in April the wind speed is highest from northwest (Figure 5).

3.3. Tide

According to the data of Hydrographic Mapping Agency of Iran [11], monthly tidal graph of Jask from 1/12/2015 until 1/11/2016 is shown in Figure 6. By considering this monthly tidal graph we can see the condition of Neap tide and Spring tide in terms of perfect moon or imperfect moon condition of the different days of one month. Therefore, the highest water level in the Spring tide condition is about 2.7 m and the highest water level in the Neap tide is about 2.1 m.

**Figure 4.** Windrose from Jask in 2012-2016

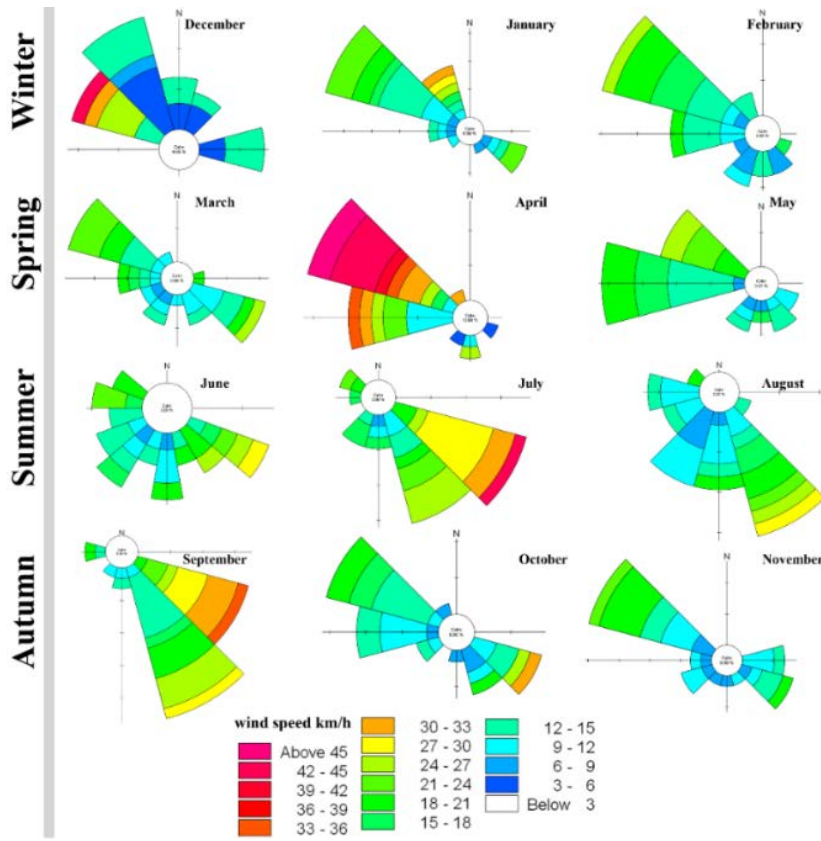


Figure 5. Monthly wind conditions of Jask in 2012-2016

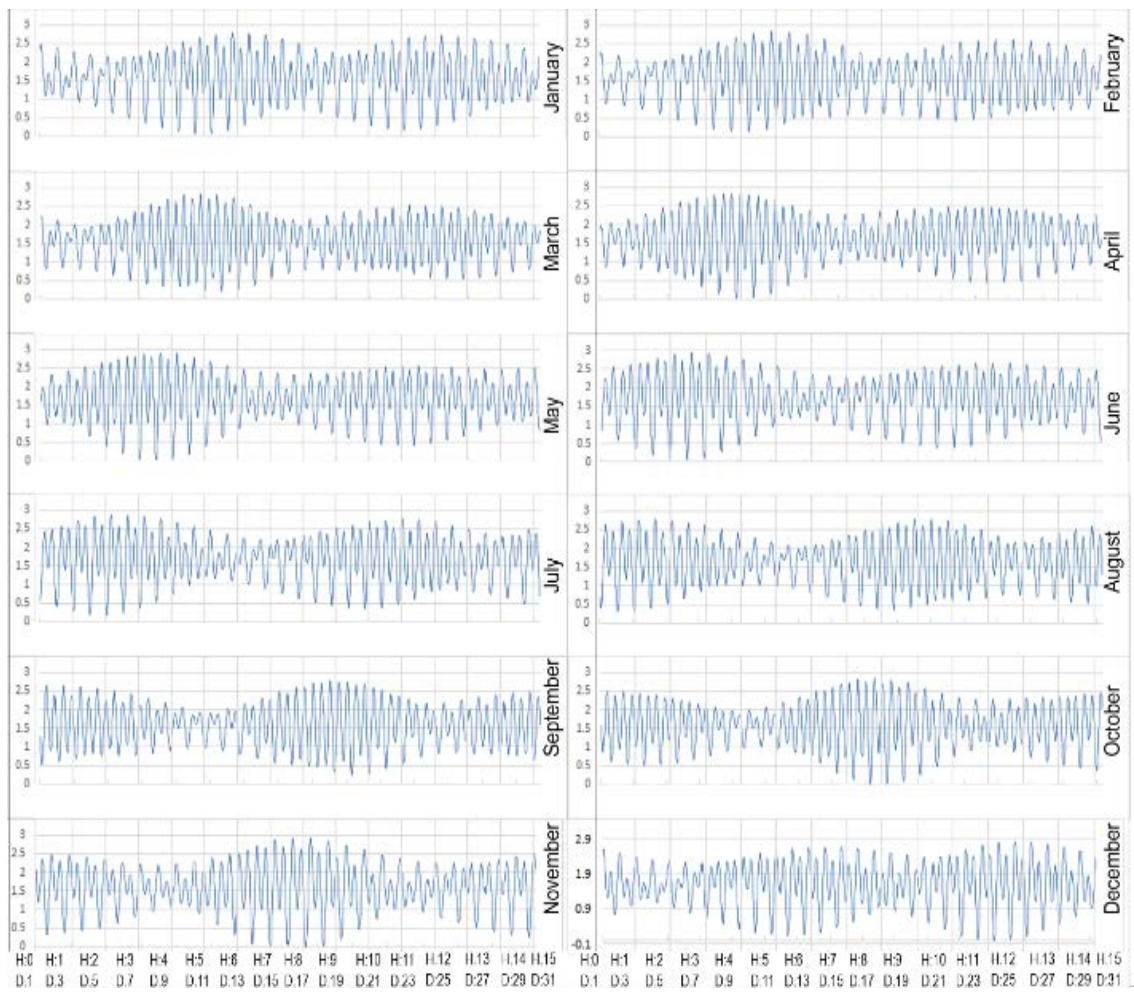


Figure 6. Monthly tidal conditions of Jask from 12/01/2015 to 1/11/2016

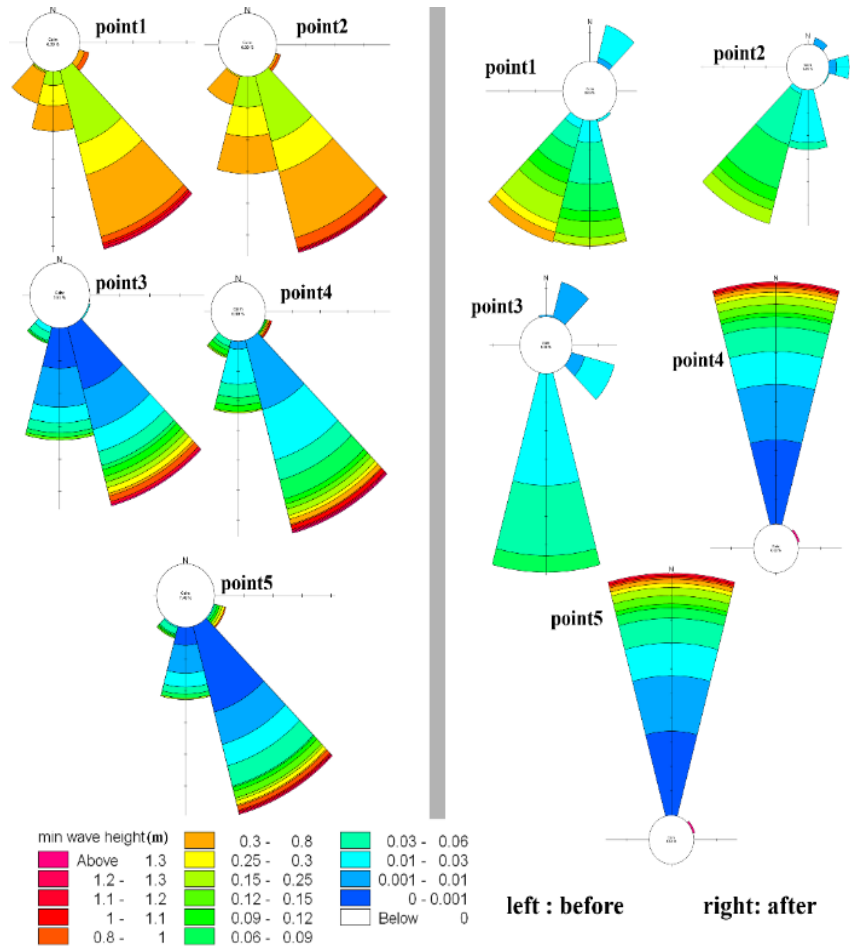


Figure 7. Wavesrose in 5 point at basin of harbor of east Jask

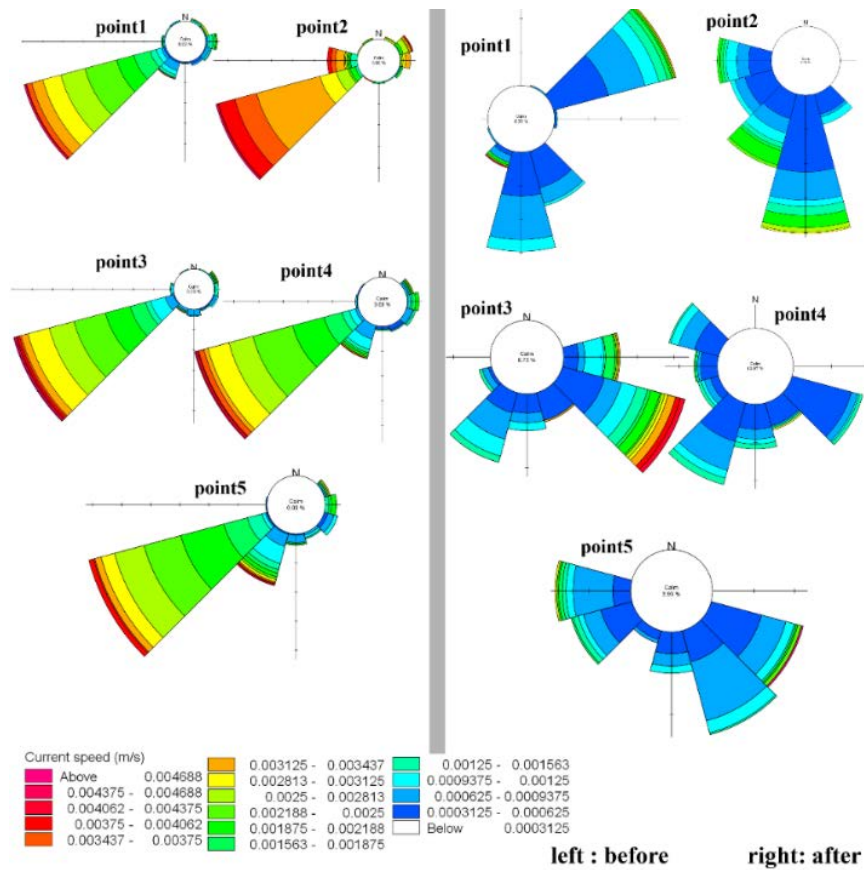


Figure 8. Currentrose in 5 point at basin of harbor of east Jask

3.4. Waves and Currents

In order to consider the status of waves and currents in harbor basin at east of Jask port, for the extract required data from numerical models, five desirable points were selected (from Figure 2). Point 1 located at the mouth of breakwaters, Point 3 located at the Nera of mooring vessel and point 2, 4 and 5 are located among the basins, were selected.

Waverose of five points before and after the constructing breakwaters is drawn in Figure 7. Before the construction of breakwaters, prevailing directional waves is the southeast, and the measure wave height in point 1 and 2 is more than the other point, because of the point 1 and 2 are located far away from the beach. But after the construct of breakwaters prevailing directional waves are irregular, but prevailing directional waves in point 1 and 2 are consistent with the mouth of the breakwater. The measure wave height at the each of five points is decreased.

Currentrose of the five desirable points in before and after the constructing of breakwaters is drawn in Figure 8. Before the constructing of breakwaters prevailing direction current is from east to west (normal condition of water circumference of the Persian Gulf) [12], and the maximum flow rate is about 0.0034 m/s. After the constructing of breakwaters prevailing direction current is irregular, and flow rate in these five point is weak, which represents calm conditions in the basin of the harbor.

4. Conclusion

According to statistics are listed, for the development and economic expansion of Iran, the ports have important role. In marine transport issue, paying attention to the ports and harbors for safe and quick mooring, movement, loading and unloading is very important affair, so knowledge, scientific study of environmental conditions of the ports and harbor are required.

In this study by selecting a harbor for evaluate the important parameter in safety of vessel in port and harbor

when they are enter and leave the harbor for management and developing of Iran's port.

The results were classified in two categories; direct results and obtained from numerical models, that including; wind, tidal, wave and current. The results of the wind show the dominant prevailing direction of wind is northwest and the dominant prevailing direction in summer is changes.

Tidal graphs show Spring tide and Neap tide condition which respectively are 2.7 meter and 2.1 meter. The second category showed positive effect of breakwater in harbor and port with creating a calm condition in the basin of the harbor.

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