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Alleviation of Deadly Hazards of Rip and Circulation Currents Using Near Shore Self Lighting Floating Units

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Abstract: Ripand circulation currents occur every day on many beaches and not only after a storm or at high tide. Losses due to drowning from currents in particular rip and circulation currents are the most important hazard on global beaches; it is a major cause of surf drowning. In the United States, the currents kill nearly 200 to 500 people every year. In Costa Rica Analysis of data from the Judicial Investigation Organization of Costa Rica indicates that drowning is the leading cause of violent death in the country, with 1,391 drownings between 2001 and 2012. Approximately 590 of those drownings occurred in a marine environment and are listed as being the result of rip currents. In Egypt, according to official data from the Central Agency for Public Mobilization and Statistics (CAPMAS) issued in 2018 drowning accidents and immersion in water unintentionally is about 7% from total different accidents in Egypt, around 1054male and 220 female with total 1274people are drowned via drowning accidents. Study of the near shore is important in areas, where the coastline is influenced by erosion and accretion. These erosion and accretion need some protection structures like groins and detached breakwaters, which cause more circulations and rip currents. Many studies had been carried out to solve problem of rip current, but the problem still exist. This present study assesses the possibility of using new technique as a possible solution for the problems of drowning; also, it presents a vision for decision maker, using a new tool to alleviate the deadly hazards of circulation phenomena and rip currents. For this reason, finding a suitable tool to mark rip currents is important for warning the swimmers, from the possible hazards due to swimming in the path of rip currents. Furthermore, the objective of this research is determining the hazard area around marine structures of shore protection like groins and breakwaters as well as, the calculation of the characteristics of rip current like its influence distance and its minimum and maximum velocities. The proposed tool is floating self-lighting units, which can generate and save energy for lighting from energy of waves and different currents. The units can be positioned and arranged in the path of rip current, in particular the neck and head area of rip current. Achieving the goals of this research, field measurements had been carried out, also detailed observations of the effects of long shore varying bathymetry on near shore circulation. For this purpose numerical models (MIKE 21- SW) and (MIKE 21- FM) were applied on Rosetta promontory (eastern groin), and Baltim coast to determine the current direction and velocity, and also to investigate the circulation flow in the mentioned areas to avoid the dangerous effects of drowning for the swimmers. In addition, experimental work was performed at the physical model lab of Abu Quir research station, Alex. Egypt. The objective of the experiments is studying the stability of proposed floating units using different wave heights, water depth, and different diameters of units. It is concluded after the analysis of data that, the current's velocities beside the breakwaters are almost large values, where the speed of the rip currents can be 0.5 m/sec up to 1.50 m/sec and extend to 30 m up to 150 m towards the sea (in Egypt). It is recommended that for decision makers, the proposed floating units can be a tool for the reduction of hazard due to rip and circulation currents. For swimmers, be watchful at all times, especially when swimming at unguarded beaches. It is required to characterize the rip hazard at the most popular beaches on the coastal zone in Egypt.

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Keywords: Ripand circulation currents-Drowning near structures –Marine floating units-Egypt.

1. Introduction

1.1 Rip currents and hazards on global beaches and drowning accidents in Egypt

Isabel A. et al., (2015) studied the rip current hazard in Costa Rica, the study showed that losses due to drowning from currents in particular rip and circulation currents are the most important hazard on global beaches, but insufficient data are available at a national scale to upkeep the development of suitable intervention programs. Analysis of data from the

Judicial Investigation Organization of Costa Rica indicates that drowning is the leading cause of violent death in the country, with 1,391 drownings between 2001 and 2012. Nearly 590 of those drownings happened in a marine environment and are registered as being the result of rip and circulation currents. A majority (64 %) of the drownings attributed to rip currents, the study recommended that, additional study is required to characterize the rip hazard at the most popular beaches on the Pacific and Caribbean coasts and to determine the level of rip knowledge by both local and foreign beach users. B. Chris Brewster, et al., (2019), studied the estimations of rip current rescues and drowning in the United States. The study showed that rip currents are the maximum hazard to swimmers on surf beaches, United States Lifesaving Association has shown that rip currents are the primary cause of between 75.3% and 84.7% of all surf rescues on American regional beaches, with a 20-year average of 81.9%. Gensini and Ashley, (2009), studied the examination of rip current fatalities in the United States, the study showed that rip currents pull the swimmers directly towards the sea. CAPMAS (2018) issued report about statistics in Egypt, the report showed that according to official data from the Central Agency for Public Mobilization and Statistics (CAPMAS) issued in 2018 drowning accidents and immersion in water unintentionally is about 7% from total different accidents in Egypt, around 1054 male and 220 female with total 1274 people are drowned via drowning accidents as shown in Table (1).

Table (1) shows the numerical distribution of casualties by type during 2017

No.	Type	Male	Female	Total	% from Total
1	Road Accidents (Transportation)	6066	1304	7370	38.68
2	Water Transportation accidents	19	3	22	0.12
3	Fall Accidents	981	309	1290	6.77
4	Incidents of exposure to live / non-living mechanical forces	662	114	776	4.07
5	Drowning accidents and immersion in water without inadvertently	1054	220	1274	6.69
6	Suffocation accidents	39	20	59	0.31
7	Exposure to electrocution incidents	485	145	630	3.31
8	Exposure to heat and hot materials incidents	144	106	250	1.31
9	Incidents of exposure to animals or toxic substances	9	7	16	0.08
10	Exposure to natural forces accidents	22	18	40	0.21
11	Incidental poisoning of chemicals	69	60	129	0.68
12	Incidents caused by intentional injury	53	16	69	0.36
13	Incidents resulting from assault in different ways	912	177	1089	5.72
14	Other accidents	4347	1694	6041	31.70
Total		14862	4193	19055	100.00
Source: Issued by (CAPMAS) in 2018 According to official data from the Central Agency for Public Mobilization and Statistics					

1.2 Rip current dynamics and near shore circulation

Haller, (1999), studied the rip current dynamics and nearshore circulation; the study showed that the nearshore circulation system occurring at the beach often includes non-uniform longshore currents, rip currents, and cross-shore flows. Irregular nearshore topography, manifested by shoreline protuberances, may produce nearshore circulation cells. In the onshore mass transport of water in the breaker zone, the rip current forms a closed circulation cell especially beside the groins to let water returns to the sea. Elmooty and Taha, (2012), studied the rip current causes and precautions, the study showed that the rip currents occur at locations of least resistance such as breaks in the offshore bars, rip currents also increase the size of shoreline irregularities and break in the bars. Elmooty, (2012), studied the hydrodynamic analysis of the rip currents, the study showed that rip currents extend from the shoreline and out past the line of breaking waves. Deposit sand forming sand bars or ridges parallel to the beach. These bars are not connected to each other to form one bar along the beach but are separated at different distance. Water collects up behind these sand bars as waves wash up onto the beach, and when a section of the bars give way, this water return back out to the sea perpendicularly to the beach forming a rip current. Church and Thornton, (1992), studied the bottom stress modification by breaking waves within a longshore current, the study showed that, rip currents are classified into three types. The first one is the fixed rips generally are the most common and occur when waves are smaller or have not changed quickly; they appear as dark gaps between areas of white water. The second is the flash rips which are bigger and occur when waves have increased quickly, they appear as more turbulent areas of water, and the third is the headland rips which are fixed rips, often permanent and occur next to headlands and structures, such as groins and jetties as shown in Figure (1). Bader, (1998) evaluated the dynamic forces and sediment transport using Fluorescent sand tracers along Alexandaria- Matrouh coast. The results indicated that, pattern of sediment transport revealed erosion and dispersion with considerable portions towards offshore and eastwards. Greatest tracer dispersal occurred in sea wad direction (46.67% offshore + 6.67% by rip currents). This confirmed that the well-known role, played by rip currents in carrying sediments offshore through the breaker zone. Also, this currents cause hazards to sea swimmers in the summer season.

1.3 Field observations and numerical simulation of rip current

MacMahan et al., (2011), studied the rip currents based on field observations; the study showed that, beach users are at risk due to rip currents at many places in all beaches of the world. Due to the effect of wave breaking, it has been observed that most floating objects move shoreward. Three components form rip currents; the first component is the feeder current which is formed by moving of water waves along the shore which is nearly parallel to the shore; the second component is the neck of rip that is continued and maintained by feeder currents from both side or, in some cases, by a feeder current from only one side. The characteristics of flow in the rip neck are narrow, offshore directed and exhibits the strongest flow velocities, which is called rip strength. The third component is the head of rip in which the velocities decrease and the flow diffuses. The rip current forms a closed circulation cell in conjunction with the onshore water mass transport in the breaker zone. In general, the rip velocity value is between 0.2 and 0.3 m/s and may reach 0.7 m/s. Dalrymple, (1978), studied the rip currents and their causes, the study showed that, rip current is not an undertow, which is strong, water current moving from the shallow water to deeper water, it does not pull a person under the water. Rip currents move large amounts of sand, so the rip may be deeper than the surrounding water. A rip current is similar to a little river. The currents only move a short distance, and then they diminish. Generally, the bigger the surf is, the stronger the rip current will be and the further from shore it will carry the swimmer. Vriend and Tire, (1987), studied the rip currents and nearshore currents on Quasi-3D model, the study showed that, higher bottom stress leads to more stable flow where the rip current meanders less and fewer eddies are generated. Morang et al., (1993) mentioned the need for coastal data for currents, both shore-normal and shore-parallel, where they play a significant role in shaping the geology of coasts. Elmooty M. A, and Taha, S. E, (2012), studied the numerical simulation using mathematical models of 2-D wave-induced nearshore current. The study showed that, the characteristics of the rip currents can be obtained, applying MIKE 21module, the locations, directions and velocities of the currents can be obtained, rip currents occur near groins, jetties, between gaps of sand bars in the long beaches and the maximum currents are formed between breakwaters. Bader and Shata, (2002) studied the effect of Baltim detached breakwaters on the grain size variations and littoral sand drift. The study showed that, rip currents played very important role in carrying sediments offshore through the breaker zone.

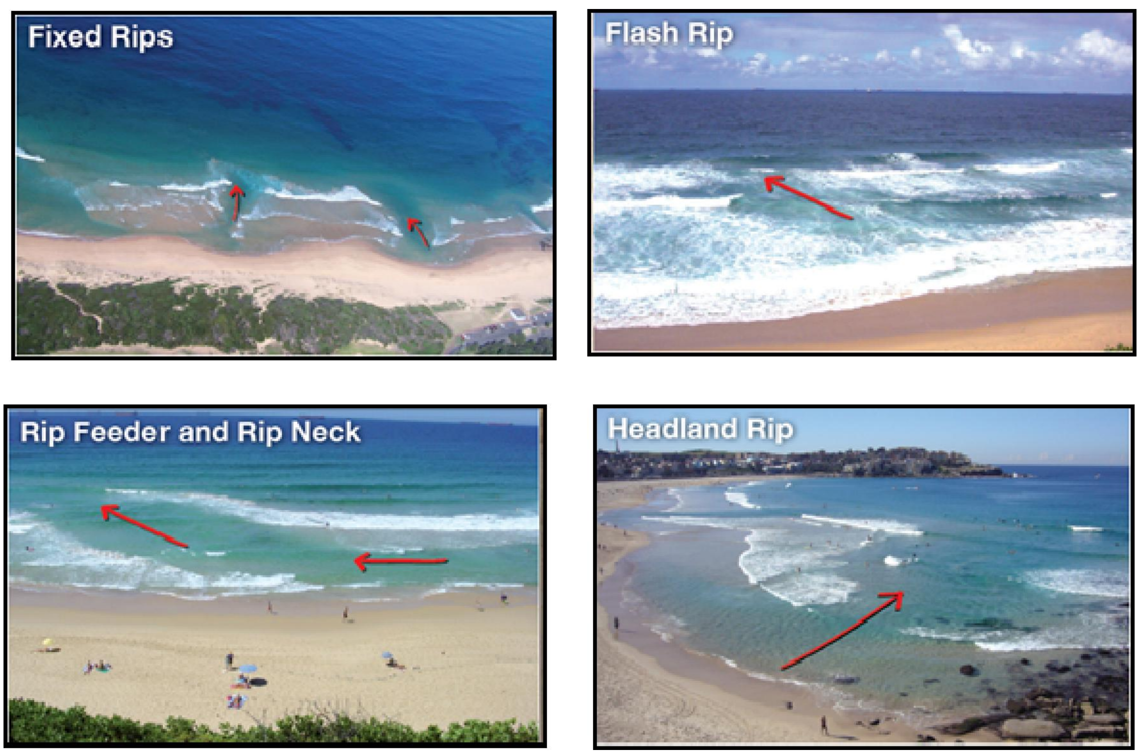

Figure (1) the rip currents shapes and types (Brander, 2016)

1.4 Wave energy harness and conversion devices

One of the major difficulties in the past, it had been to design a system strong enough to withstand the enormous energy of ocean and sea waves. Many studies and inventions had been carried out and submitted to practical applications, some of these inventions related to wave energy harness and wave conversion are presented in present study. Inventors Alan K. V., et al., (2018) introduced the patent no. GB2325708A in United Kingdom, the application granted in 2000, and published in 2018 with title “A wave energy converter with means to disengage the driven device to increase travel of wave follower" This invention relates generally to devices which are designed to extract energy from the action of waves on a body of fluid. This is achieved by converting the energy in the undulating waves into a useable form. Inventor Xiao Liang Li, (2019), introduced the patent no. US9780624B2 in United States, the application granted in 2017, and published in 2019 with title "Assembly for harnessing a pendulum motion from fluid wave energy for conversion to power" The invention relates generally to an assembly for harnessing a pendulum motion from fluid wave energy for conversion to power. South Korean Inventor Lee, (2013), introduced the patent no. KR101221688B1 in South Korea, the application granted in 2013, and published in 2013 with title "Buoy for detecting rip current". The invention has a size suitable for installation in surf zone, rip currents observed to exclude the influence of the wind and wave breaking and is designed to move along the flow of the rip currents to determine the flow of the rip currents within the surf zone. South Korean Inventors Kim N. et al., (2012), introduced the patent no. KR20120069253A in South Korea, the application granted in 2012, and published in 2012 with title "Disaster prevention and alarm system for rip current". They introduced an offshore current generation predicting/alarming device, and an offshore current generation preventing device using the same are provided to fundamentally prevent an offshore current generation by detecting critical pressure for the offshore current generation and installing a decompression structure to maintain underground water pressure below the critical pressure all the time. Inventors Thomas J. L. (2004) introduced the patent no. US6738992B2 in United States, the application granted in 2004, and published in 2004 with title "Method and apparatus for controlling break points and reducing rip currents in wave pools" The main idea of the invention is providing a grated section to a portion of the floor or the beach of a wave pool, the grates will allow water to pass into a cavity, which eliminates backflows and consequently rip currents will be averted. Inventors Roger D., (2019) introduced the patent no. US20080302357A1 in United States, the patent published in 2019 with title "Solar photovoltaic collector hybrid" The main idea of the invention is harnessing wave energy from a wave power device, by using a system for a hybrid solar energy collector and a floating platform supported CIGS PV array, a system of cooling or evaporative spray water is used over the panel to increase efficiency of the hybrid system. Inventors Alan A. W. (1997) introduced the patent no. WO1998032967A1 in France, worldwide applications in1997, and published with title "Wave energy converter" The invention relates to a structure for harnessing waves, offshore or in a large body of inland water, for the purpose of transforming wave energy into electrical or another readily utilizable form of energy. Inventors Marcel S. S. (1967) introduced the patent no. US3353787A in United States, the application granted in 1967, and published in 1984 with title "Useful power from ocean waves" The invention comprises generally a plurality of elongated tubes spaced one behind the other adjacent the floor of the ocean near the shoreline and parallel to the wave front. Sufficient compressible tubes are provided to average the effect of the waves, thus producing a substantially smooth flow of water into the collecting conduit. Inventors Miles H. (2014) introduced the patent no. US8907513B2 in United States, the application granted in 2014, and published in 2019 with title "Wave energy converter". The main idea of the invention is harnessing wave energy from a wave energy converter, which is consisted of a shell, a pendulum pivotally positioned in the shell. The pendulum has either a magnet or a coil connected or interconnected with a shaft, energy can be harnessed by the pivotal movement of the pendulum. Inventors Miles H. (2019) introduced the patent no. US8836152B2 in United States, the application granted in 2019, and published in 2019 with title "Hydraulic wave energy converter with variable damping". The invention relates to the conversion of mechanical energy to electrical energy. South Korean Inventor Thin D. M., (2016) introduced the patent no. KR101618112B1 in South Korea, the application granted in 2016, and published with title "Float member for wave energy converter". The invention relates to a wave of marine energy conversion device, a floating member for a wave energy conversion device.

2. Objectives

Many studies had been carried out to solve problem of rip current, but the problem still exist. This present study assesses the possibility of using new technique as a possible solution for the problems of drowning; because losses due to drowning from currents in particular rip and circulation currents are the most important hazard on global beaches, also, it presents a vision for decision maker, using a new tool to alleviate the deadly hazards of circulation phenomena and rip currents. For this reason, finding a suitable tool to mark rip currents for warning the swimmers, from the possible hazards due to swimming in the path of rip currents is essential. Moreover, the objective of this research is determining the hazard area around marine structures of shore protection like groins and breakwaters as well as, the calculation of the characteristics of rip current like its influence distance and its minimum and maximum velocities. This present study proposed a new technique as a suitable tool to mark rip currents for warning coastal users from approach the area of the presence of dangerous rip and circulation currents. The new technique is self-lighting floating units which can be placed next to the protection marine structures and in the path of the rip currents coming from the shore towards the water, especially the neck and head area of rip currents. The units can also be used in port entrances and marine maneuvering places to guide ships through the entrances and exits of ports. The proposed floating self-lighting units, can generate and save energy for lighting from energy of waves and different currents. The units can be positioned and arranged in the path of rip current, in particular the neck and head area of rip current. One of the goals of this research is studying experimentally the stability of proposed floating units using different wave heights, water depth, and different diameters of circular units, at the physical model lab of Abu Quir research station, Alex. Egypt. The calculations of acting forces on the proposed floating units and straining actions in their components are not included in this paper. In addition, the values of generated energy from waves are not included in this paper; it will be in another future work.

3. Materials and Methods

3.1 Characterization of the study area

Two areas are chosen as case studies, the first one namely, Rosetta promontory east and west of Rosetta estuary and the second is Baltim coast. This choice is due to the importance of the two areas as investment areas and tourist areas in the same time. The area of Rosetta was formed as a head in the sea, as shown in Figure (2) it is located on the west side of the Delta Coast; Nile river was feeding its shore area by sedimentation during ancient centuries. The shoreline was receded and the erosion initiated in the area since 1900. One of the main reasons for the recession of shoreline is the construction of irrigation works on the Nile feeders. The erosion rate was very high at both sides of Rosetta promontory after the construction of the Aswan High Dam, and the situation became very serious. The Shore Protection Authority executed many protection works in order to protect the coast. Rosetta is located at the west branch of the Nile river at (31^0 $28^/$ $1.96^{//}$ N) latitude, and (30^0 $21^/$ $54.73^{//}$ E) longitude. The protection of Rosetta promontory was started from (1989: 1991), by constructing two seawalls, the east one is 1.5 Km long, which was covered by Dolos concrete blocks of 4:7 tons, and with crest level of 6.75 m above the mean sea level. There are five groins east the wall were constructed in 2003 with length varying from 400:500 m, and 800: 900 m spacing between each other. The second case study is Baltimresort, which is 15 km on the east ward far from Burullus inlet, and it is one of many coastal places attracts people during the summer season, system of detached breakwaters (14 breakwaters) was constructed in this area one stage to compact the erosion (9 breakwaters) (4:7) tons Dolos, 250:300 m length, 220:250 far from shoreline, 300: 400 m gap between each other's, 3:4 m depth, and (2.5 crest level) were constructed, Moreover short nine groins (75:100 m length, and 250:300 m apart) constructed on the west ward of Kitchener drain. The case of the groin is similar to any structure in the surf zone perpendicular to the shore. This research illustrates Baltim resort, where is protected by 14 detached break waters, which allow salient and tombolo formation, also adding areas of accreted land to Baltim beach, but there are two side effects, which transferred the problem to the adjacent areas, as the erosion is created in the down drift side of the breakwater, and also rip current is formed between the breakwaters, causing many drownings of the swimmers.

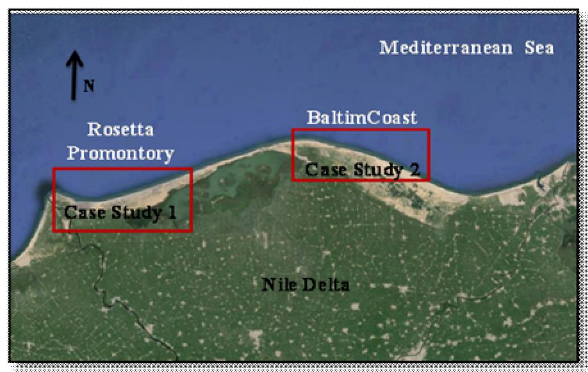

Figure (2) shows the Location of the study areas (Taha S., 2016)

3.2 The experimental work, field data, and sample collection

The experimental work was performed at the physical model lab of Abu Quir research station, Coastal Research Institute, Alexandria, Egypt. The physical model lab has a wide wave flume with dimensions (40.0×1.2×1.2 m). The flume has flab type wave generation, and passive type wave absorption systems. The objective of the experiments is studying the stability of proposed floating units using different wave heights, water depth, and different diameters of circular units. Carrying out the experiments, the flume was prepared to be suitable for the purpose of the experiments. Zero level of water was adjusted, two water depth were chosen 46 cm and 30.5 cm to simulate nearshore wave types. Different frequencies were chosen (25 Hz, 30Hz, 35 Hz, 40Hz, 45Hz, and 50Hz), the resulting no. of cycles per second due to the previous frequencies were (2.4,2.0,1.71,1.5,1.33, and 1.2), the measured wave heights were (4.0 cm, 5.5 cm, 7.5 cm, 9.0 cm, 10.5 cm, and 13 cm). After the preparation of flume, the preparation of floating units had been carried out using plastic plates with different diameters (13 cm, 18 cm, and 20cm). Two upper and lower plates and circular foam with the same diameter in between them were chosen, to simulate the floating part of proposed units. The floating part is connected with the submerged concrete block using insulated steel wire as shown in figures from (3) to (5); six concrete blocks were poured in site with average weight 625 grams. The experiments had been repeated six times using different wave heights and 3 times for different diameters using two different water depth. Achieving the goals of this research, field measurements had been carried out, also the effects due to variations of long shore bathymetry on near shore circulation were observed in details. The establishment of numerical models requires field data. The field measurements that have been performed to simulate the rip current problem at Baltim beach will be explained.

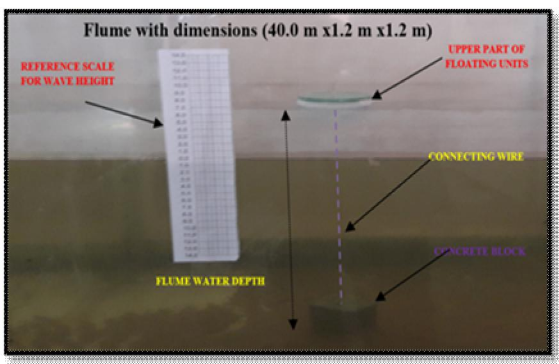

Figure (3) shows the experimental work for one floating unit in the flume

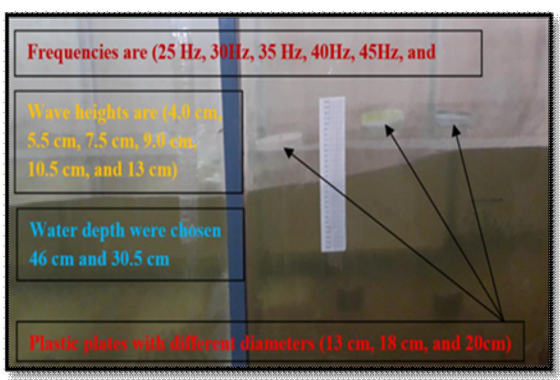

Figure (4) shows the frequencies, wave heights and different dimensions of experimental work for three floating units in the flume

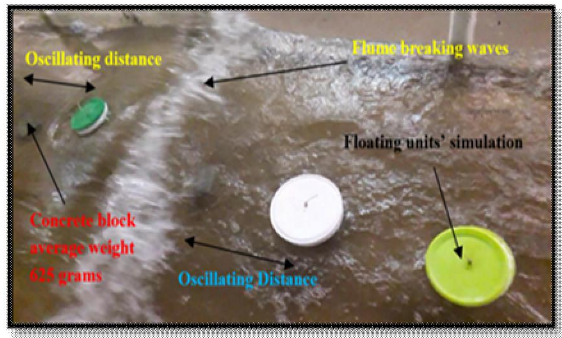

Figure (5) shows the experimental work for three floating units at breaking waves

The field data have been collected from Coastal Research Institute (CORI) and Egyptian Authority for Shore Protection (SPA). Input wave data have been recorded at Damietta harbor during 2010. Significant wave height, mean wave period and direction time series had been obtained. At May 2015 the field investigations were carried out by the second author in this present work to make the calibration of the MIKE 21 model on the current velocity and direction. The calibration was carried out by comparing the obtained field data with the output of the model, nine points were selected for the calibration field work, the field data were obtained for the wave characteristics and current characteristics. The model was applied to calculate the shape and velocity of the currents at Rosetta promontory, the agreement between the measured and calculated wave heights is generally good, the agreement between the measured and calculated wave directions is also good. Bathymetry and the hydrodynamic conditions are influencing rip currents. Numerical modeling of this research is based on (MIKE21Flow Model FM) software, which is based on a flexible mesh approach as a new modelling system. Thesoftw are has been developed for variety of applications with inoceanographic, coastal and estuarine environments; also the modeling system is composed of many modules, the main modules are the Hydrodynamic Module, the Transport Module, the ECO Lab Module, the Particle Tracking Module, the Mud Transport Module, and the sand Transport Module. This study based on thenumerical solution of the equations of two-dimensional shallow water using Hydrodynamic Module, and the equations of the depth-integrated in compressible Reynolds averaged Navier-Stokes. Thus, the model is using equations of continuity, temperature, momentum, salinity and density. Inthehorizontal domain, both spherical and Cartesian coordinates can be used. Providing (MIKE21Flow Model FM) with a appropriate mesh is important forobtain ingreliable results from the model.

Setting up the mesh includes selection of the appropriate area to be modelled, adequate resolution of the bathymetry, wave, wind and flow field sunder consider ation and definition of codes forclosed and open boundaries. The study area problem including groins, breakwaters, and the whole system at Rosetta promontory and Baltim beach are shown in Figures from (6) to (11).

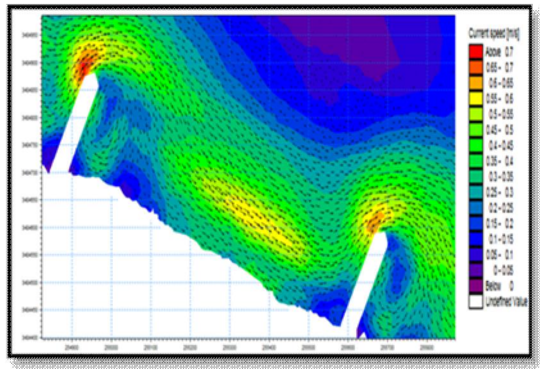

Figure (6) shows flow velocity field for studied reach groins from field data (Taha Sh. 2016)

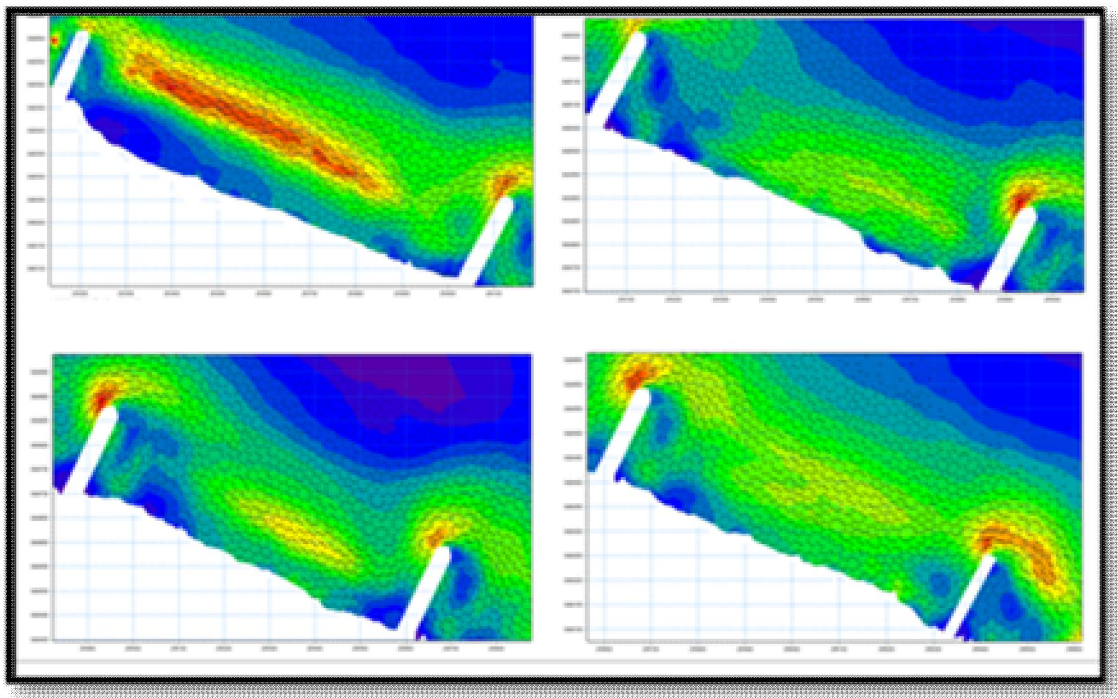

Figure (7) shows the flow velocity field for the studied reach at groins from (1) to (5)

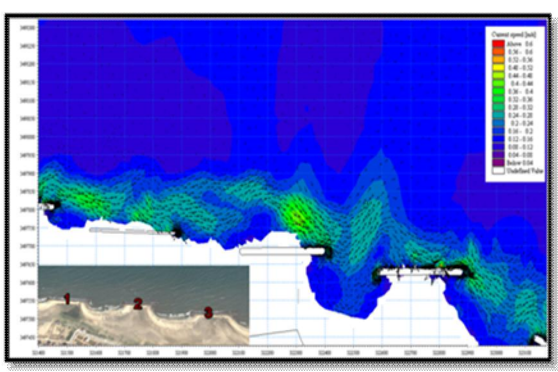

Figure (8) shows the flow velocity field for the studied reach at breakwaters 1, 2, and 3

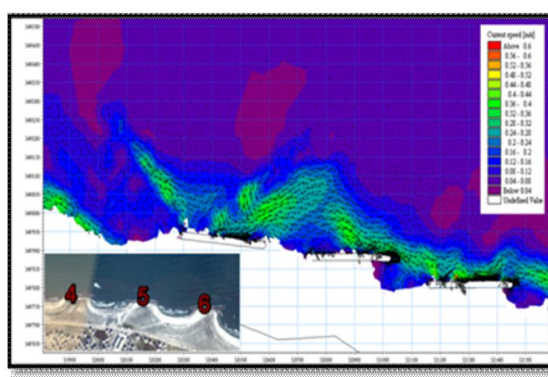

Figure (9) shows the flow velocity field for the studied reach at breakwaters 4, 5, and 6

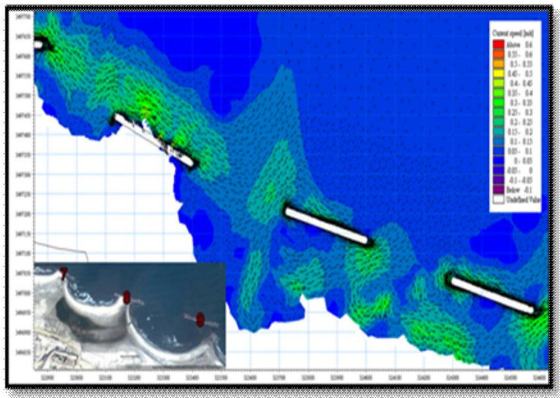

Figure (10) shows the flow velocity field for the studied reach at breakwaters 7, 8, and 9

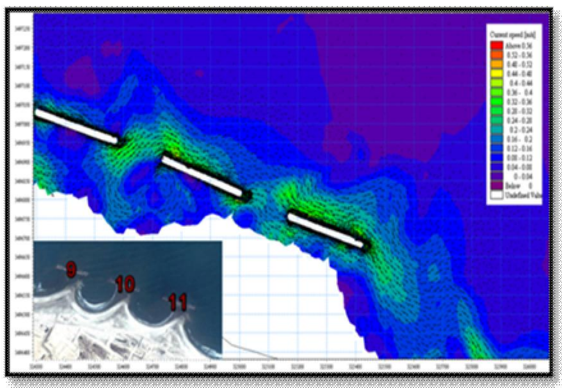

Figure (11) shows the flow velocity field for the studied reach at breakwaters 9, 10, and 11

3.3 Description of the floating units

The proposed device consists of floating units on the water surface, and another attached submersible small units under the water surface. These units attached to each other by PVC chains, circular rings, and spherical joints to allow the units to move and circulate around in all directions, without resisting any moment forces but only resist chain tension forces in all directions. This tensile strength in chains is resisted by concrete blocks whose weight is determined by tensile strength value in the chain (the block weight should be greater than tension force in chain). The device transmits the movements of the waves and the currents below and above the surface to electric energy, by a set of free-motion cylindrical magnets, whose magnetic field is excited by two copper multi turn coils. The resulting electrical charges, from the coils and magnet movements, are received by regulators of current and voltage, in addition to capacitors. These electrical charges turn into a continuous electric current, which are stored in a rechargeable batteries, thereby a set of lamps (LED or Fiber Optics) can be lighted on the entire perimeter of the units. All the internal elements are isolated from water. Warning signs and drawings can be written on outer surface of the units.

3.3.1 The method of operation of the floating units

The proposed device can be used as a guide to warn swimmers from the hazards of rip currents, also as guide to warn beach users at the locations of shore protection structures like groins and breakwaters. The proposed device can also be used in port entrances and marine maneuvering places to guide ships through the entrances and exits of ports. The units are placed after determining the path of the rip currents by means of an environmentally friendly color material that propagates with the current to indicate direction of current, so that the distances among units are proportional to the depth of water, so that the horizontal distances are not less than four times the depth of floating units from the water surface to shore bed. The vertical distance between floating units and concrete blocks equals to 1.5 depth of the water. In the case of placing the units next to the marine structures for the shore protection purposes, they should be positioned within 100 meters from the shore protection marine structures as shown in Figures from (12) to (16). The proposed device transmits the movements of the waves and the currents below and above the surface to electric energy, by a set of free-motion cylindrical magnets, whose magnetic field is excited by four copper multi turn coils. The resulting electrical charges, from the magnet and coils movements are received by regulators of current and voltage, in addition to capacitors. These electrical charges turn into a continuous electric current, which are stored in a rechargeable batteries, thereby a set of lamps (LED or Fiber Optics) can be lighted on the entire perimeter of the units. All the internal elements are isolated from water. Warning signs and drawings can be written on outer surface of the units.

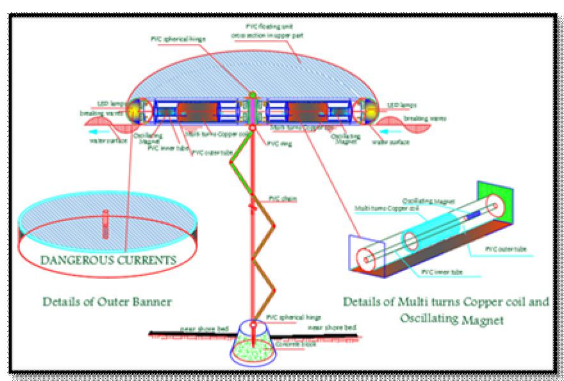

Figure (12) shows cross section and perspective view of self-lighting floating units

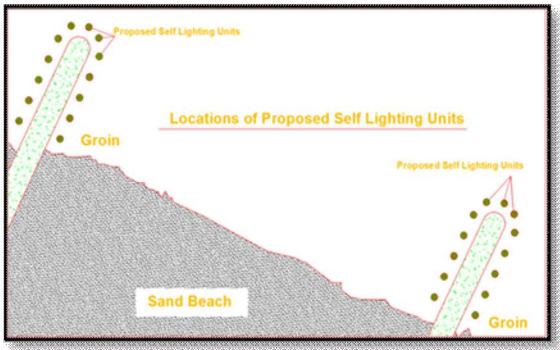

Figure (13) shows the Plan of floating units' arrangement in rip current at groins

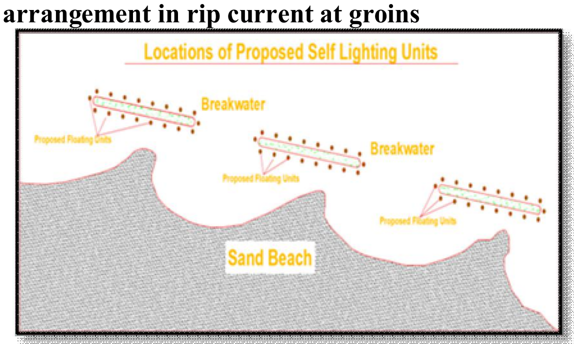

Figure (14) shows the floating units' arrangement in rip current at breakwaters

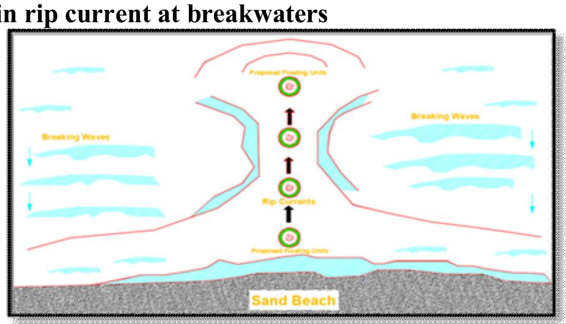

Figure (15) shows the Plan of floating units' arrangement in neck of rip current

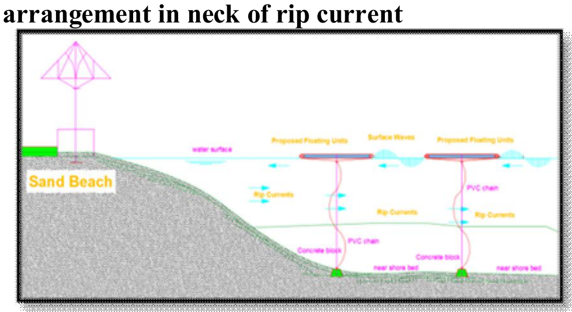

Figure (16) shows the Cross section of floating units' arrangement in rip current

4. Discussion and Conclusion

for Applying (MIKE21) the following results are presented we need to perform the following mesh which is wide in the offshore and very smooth at the study area (near the shoreline) shows the mesh was smoothed in a number of times after the generation and before interpolating the bathymetry. The smoothing process will change the position of the generated node points in order to obtain the best overall resolution of the triangular elements while trying to avoid small angles in too many elements, the mesh generator setup for the initial resulting mesh was just a starting point for optimizing the mesh to the final stage. In the following, the initial mesh setup was modified in a number of ways to achieve a better representation of the bathymetry. The bathymetry mesh of Baltim coast from 317000 N to 327000N and from 3498000 E to 3499500 E was created from scratch and optimized to a satisfactory levels, it describe the water depths in the worked area, and the model simulation times acceptable to the user the bathymetry was shown in a shaded contour line. The sign wave height of Baltim coast with the existing structure, it reveals the values of sign wave height which increase from 0.15 meter near the shoreline and it was increased in the offshore direction to reach to 1.20 meter at the north boundary. The Mean wave Direction of Baltim coast with the existing structure, and it was recorded about 345 degree from the north direction. The presence of two circulation systems as a primary system consisting of longshore feeder currents and strong offshore-directed rip currents are the results from the experimental investigations. The results can be specified from this study in the following points. Due to the large amounts of water pushed up the beach by breaking waves, the water escapes back to the sea as a concentrated flow through a near shore sand bar causing rip currents. The rip currents have a serious impact on beaches and their users. The rip currents are caused due to the interaction between the bottom and the lateral boundaries. The current velocity in the offshore equal to zero. Rip currents fields consist of semi enclosed large-scale vorticity. As the velocity of the rip currents is higher than the littoral currents, so the grain size spectrum of the beaches is transported offshore in spite of the grain size. The radiation stresses is the main factor in determining the details of the rip currents. The calculated radiation stresses in this study can be used directly to evaluate the rip currents along the coastal area of the delta. Using MIKE 21 module and the collected data of the required study area, give reasonable details of circulation and rip currents. It is clear that circulations occur at the up drift and at the down drift of groins. Circulations occur between breakwaters. The currents velocities beside the breakwaters is almost large value. The speed of the Rip current can be 0.5 m up to 1.50 m/sec and extend to 30 m up to150 m towards the sea (in Egypt). The rip currents are caused due to the interaction between the bottom and the lateral boundaries. The current velocity in the offshore equal to zero. Rip currents fields consist of semi enclosed large-scale vorticity. As the velocity of the rip currents is higher than the littoral currents, so the grain size spectrum of the beaches is transported offshore in spite of the grain size. The radiation stresses is the main factor in determining the details of the rip currents. The calculated radiation stresses in this study can be used directly to evaluate the rip currents along the coastal area of the delta. Using MIKE 21 module and the collected data of the required study area, give reasonable details of circulation and rip currents. It is clear that circulations occur at the up drift and at the down drift of groins. Circulations occur between breakwaters. The currents velocities beside the breakwaters is almost large value. The speed of the rip current can be 0.5 m up to 1.50 m/sec and extend to 30 m up to150 m towards the sea (in Egypt). After applying MIKE21 flow model, the obtained current direction and speed at the area around breakwaters and groins are shown in the Figures from (6 to 13). The Figures (6) and (7) show the current velocity between groins from number one to number five. The groins one and two were measured above 0.60 m/s (not safe velocity) on the 1.00 m depth under the sea water, it was also showed that, the current flow was recorded from west to the east direction, the circulation and rip currents are obvious in the obtained results. The current velocity between groins number two and three were measured above 0.55 m/s (not safe velocity) on the 0.75 m depth under the seawater, it also shows the current flow was recorded from west to the east direction, the circulation and rip currents are clear in the obtained results. The current velocity between groins number three and four and it was recorded above 0.45 m/s (not safe velocity) on the 0.75 m depth under the seawater. The current velocity between groins number four and five and it was recorded nearly 0.45 m/s (not safe velocity) on the 0.70 m depth under the seawater, it also show the current flow was recorded from west to the east direction the circulation and rip currents are clear in the obtained results. The current velocity after the last groin (groin number 5) was recorded nearly 0.25 m/s, it also shows the current flow from west to the east direction, the circulation and rip currents are clear in the obtained results as shown in the figures. Figure (8) illustrates the current circulations at breakwaters number 1, 2 and 3, this area is located from 321400 E to 323100 E and from 3497450 N to 3498300 N and it also reveals the currents velocity in this worked area which is recorded from 0.15 m/s to 0.45 m/s (not safe for swimming). Figure (9) shows the current circulations at breakwaters number 4, 5 and 6, this area is located from 319900 E to 321500 E and from 3497650 N to 3498500 N and it also reveals the currents velocity in this worked area which is recorded from 0.20 m/s to 0.55 m/s (not safe for swimming). Figure (10) illustrates the current circulations at breakwaters number 7, 8 and 9, where this area is located from 322900 E to 324600 E and from 3496850 N to 3497700 N. It also reveals the velocity of currents in this worked area, which were recorded from 0.20 m/s to 0.55 m/s in front of breakwater no (7) (not safe for swimming). Figure (11) illustrates the current circulations at breakwaters number (9), (10) and (11), this area is located from 324300 E to 326000 E and from 3496400 N to 34977250 N and it also reveals the currents velocity in this worked area which is recorded from 0.16 m/s to 0.44 m/s in front of breakwater no 10 (not safe for swimming), in all figures the current velocity in offshore equal to zero. The experimental work showed that, for water depth 46 cm and wave heights (4.0 cm, 5.5 cm, 7.5 cm, 9.0 cm, 10.5 cm, and 13 cm) the proposed floating units were stable and the floating parts were moving up and down according to the wave heights, the units were circulating around their central axis at their connections with wire. The motion of floating units was noticed like pendulum motion, the motion increased with the wave height increasing. For the water depth, 30.5 cm the waves became breaking waves and the proposed system were undergo from movements at the biggest wave height (13 cm). The noticed motion was for the big circular diameters of the system. It is concluded that, whenever possible, swim at a lifeguard-protected beach. Swimming in the surf zone is not the same as swimming in a pool or lake. When swimming at unguarded beaches it is recommended to keep at least 100 m away from shore protection structures like piers and jetties. It is concluded that the proposed system can be more stable at small diameters of floating units and for non-breaking zone area but it can be fixed at bed in breaking zone area.

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