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Wrecks submerged as Breakwater for the Agadir Harbor

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Abstract: The port of Agadir is taken for a study case because it represents the perfect example of an Atlantic opened harbor. Exposed ahead to the roughness of the sea elements, and any instantaneous or temporal degradation would have a major impact on the human lives and economics activities of the area and the country from its strategic roles.

Thus, infrastructures whose depends the nautical safety of the port are constantly struggled by the dynamical action of the waves, also, the challenge, is to build them enough resistant to support this mechanical and chemical violence and also, to check continually the evolution of the damages caused by storms, for possible repairs or change.

However, these two last operations are extremely expensive, the reason why, we willstudy us an intermediate solution quite as operative and accessible “immersion of wrecks, BLOCKSHIPS”. We will try to show the interest and benefits of the BLOCKSHIPS like a replacement solution.

Key words: Morocco, Wearing of Agadir, Anza, pier, swell, Multi-Faisceaux 3D, tetrapod, acropods, BCR, ripraps and KD, total climate warming.

———————————— ◆ ————————————

1 Introduction

Like all the ports opened on the Atlantic, Agadir is directly exposed to the sea elements. To start first we will examine the effect of the swell on the tetrapods of the dam of Anza.

Indeed, the recent expert testimonies carried out by several research departments revealed that this last decade was particularly marked on the whole in oceans by an increasing level of the seas whose origin is currently allotted to total climate warming, (KARROUK, 2012).
Knowing that, the dimensioning of the dams with slope is strongly depending on the hydraulic stress, like the tide and the swell. The rise in the sea level, involves an increasing waterdepth in the vicinity of the dams.
This depth evolution would lead to enforce the states of sea which would have like consequences a stronger deterioration of the riprap carapaces as well as an increasing crossing flows. (TRMAL, 2009). Basically, this study tries to contribute to the efforts expressedfor evaluating of the vulnerability of the harbors infrastructures after these changes. The choice of Agadir is justified by the fact that it has been an area strongly stressed for several decades.
The studies given predict the major difficulties to adapt, to a deep degradation of the sea situation, if no radical measurement is undertaken to protect them from these phenomena.

The analysis of the caused impacts and various simulations at the temporal horizon 2100, showed that three principal types of potential effects would affect this protective devices:

- An acceleration of erosion;
- A break and loss of tetrapods;
- A progressive destruction of the dam.

All these impacts will have an irreversible incidences on the integrity of the port, also on the economic and social activities of the area.
The profile of vulnerability reveals clear concentrations of damages on the level of certain points of the principal pier.
Consequently, actions of adaptation are strongly requested. The optionssuggested combine hard and soft technics, as well as accompaniment measures for the short and long times, (NIAZI, 2007).
A First approach (on the surface) is to realize a chronological state to know the extent of the aggressions, and a zoom on the real effect after this remarkable storm faced in 2010 which was particularly violent (details of the damage on the pier, to see figure 1):

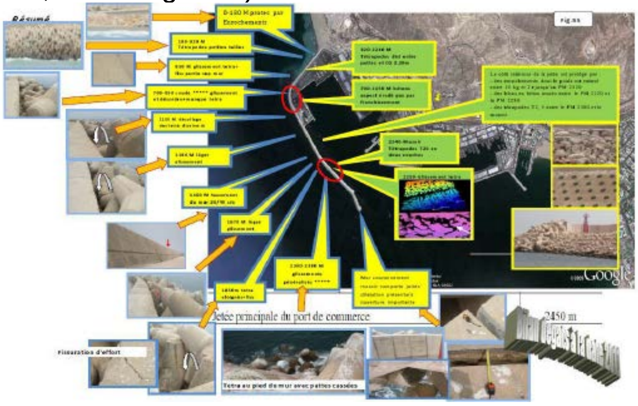

Figure 1. Situation of the principal pier after the storm of 2010

We would like to specify that this port has faced during this century more than 50 remarkable and decisive storms, quite as aggressive as destroying.

We note also, that this representation is very expressive (fig.1), it gives us an analytic expertise on the ground carried out to see the damage, caused by the storm of 2010, in order to determinate the point having excessive exposure .

2 The storm effect analysis

The synthesis of the data indexed collected and the story of this port gives us:
Large swells: increasing;
Maximum level: 17m;
Average level: 6 -7 m;
Normal level: 3-4 m which remains rather high! ;
Damages: often;
Critical hours: between 03 and 0500 am, of the morning;
Fixing process: after each damage;
Waves directions : WNW, S, Wind: NW and SE;
Waves and winds combined: swell increasing with the wind.
Moreover on the visible side (look figure 1.2) we found:
Broken tetrapods;
Cracking;
Moved tetrapods;
Many failures in the master plan of the input on two layers;
A clear presence of wear due overall by the strength of jets, sprays and swells….

Figure 2. Damages on tetrapods - Breaks and losses

After the investigation on the surface side it was easy to see the deep weakness along the principal pier; it is on the Anza dam that we record the maximum of damages and according to the direction of the swell given (270°-310°) we focus on the elbow.
After, we proceed to a deep survey in the submerged parts, here will be exposed only some parts (the total 3D scanned files is too heavy)

3 Analysis

On the submerged parts:
With 3D Multi-Faisceaux-scans:
This is a very interesting method, for its precision, the various possibilities of calibrations offered andthe clearness of the results, without omitting the relative lightness of equipment in transportation on board.
Probe’s points along the principal pier:

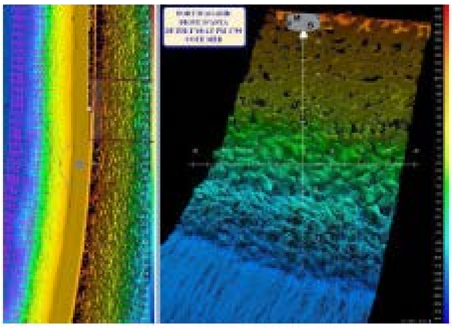

Figure 3. 3D Scans, along the pier with situation of tetrapods (extracted).

It is noticed that: after analyzing the whole scans (figures 3, 4, 5):
Movement of the tetrapods block to the bottom and overflow beyond the thrust foot;
Disorganization of the plan of pause;
failures in the tangle of the blocks.
Synthesis and reflections:
basically, the most dominating damages all the way along the pier dams Anza (seaside), are the slips and breaks of tetrapods.
We conclude:

- A high risk area;
- The port faces a large amount of waves and swell;
- Directions of swell WNW/S;
- The height of the swell even by normal time and weather remains high from 3 to 4m;
- The infrastructure is constantly stressed by the sea and the wind actions;
- The damages are always important.

4 Solutions and Suggestions

To manage those problems by improving the lifetime of the infrastructures we present a quick view of the various solutions undertaken and will also propose an original concept as a very interesting protecting way:

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Solutions	advantages	disadvantages	observations
Listing of breaking tetrapods	Constantly updated situation Continuous maintenance Increase the lifespan of the dike	Need budget tracking Specialized team mobilized	Effort and willingness of those responsible to reinforce the wall marina side ADOPTED SOLUTIONS
Clogging cracks on dike crown Reducing or stopping seawater infiltration			
Reorganization of the upper layer pause plane of the tetrapods	Fill the cracks Reinforce dikes	Estimation of the pause plane expensive	Use the stock of existing blocks
Pause a layer of natural rocks at the foot of the dike	Stop sliding blocks Effective Decreasing the height at de dike foot	Difficulty in performing Find the right riprap Precision in the work	Feasible Need specific equipment
Resize the dike	New estimations of the elements effective	Expensive Resizing from the top	This solution was adopted
Clear tetrapods and replace them by BCR	Very effective	Very expensive Need more time and equipment	The best solution Extreme Adopted in many new harbors
Submerge off sensitive point some blocks, wrecks…to break the hul energy's	Breaking the energy	Availability of devices to submerge Cost of the operations	Used currently in Europe Natural refuge for aquatic species

Table 1. Listing of the various solutions undertaken with the advantages and thedisadvantages, added to a concept suggested "the immerged wrecks".

5 Conclusion

Through the table 1 above, we indexed the various possible and realizable solutions. Nevertheless, to find compromises, only the first suggested solution was adopted by the Port National Agency of thekingdom. Moreover, this port is strongly stressed by the increasing waves intensity, tides and storms, testing its infrastructures considerably. Only an urgent, and constant action can make it possible to reduce this degradation. but considering the huge interests and the very high cost of the fixing work, it is imperative to migrate in the long time towards the new models of dams, in fact the "BCR" (grooved cubic block), (see figure 6);
However, we can always suggest an intermediate solution, less expensive, easy to implement and which would enable us to gain at least about fifteen years of protection for the infrastructures andmore time, to find the required funds for a possible repair or a full change towardsdevices which consequently would be more accessible financially; installations which could make it possible to decrease the destroying energy of the swell falling down. Blockships, seem to be an efficientsolution; just, remains to show their effectiveness, that's what we will try to demonstrate.

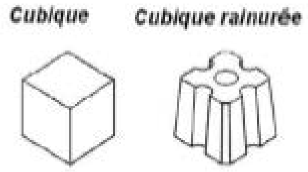

Figure 6. les BCR blocks cubiques rainurés.

6 Feasibility study

After surrounding all possible solutions and studying advantages and disadvantages, we will propose an alternative one, cheaper, easier; running wrecks as BLOCKSHIPS, which will play the shield role, in accordance to a several rules.
Indeed, the ecological effectiveness, if the conditions of scuttling of the stray hurdy-gurdies are observed, is not any more to prove, and constitute a viable artificial reef choice, also, what happens along the French, British or Japanese coasts, attest the success of this project.
Nevertheless, we have to prove the relevance of the idea, from the capacity to absorb the power of the swell and the waves in the vicinity immediate of our device.
This solution was already used initially like rampart from 1901, up to 1944, and then until our presents days, but only at ecological and touristic way; the navy technic engineering having evolved,
to technics and new models of dams and devices as, complicated, sophisticated,expensive, requiring many calculations, simulations, resources and knowledge.
In our case, to consider this solution, such a providing extension of at least fifteen years, wouldbe a considerable opportunity to prolong the lifetime of our device, to allow operations ofrepair, enforcement or change. However, the operation requires the respect ofcertain points and a battery of procedures:
The parameters to be determined for this study are:
Winds and tides major direction;
Significant sea leveldepths;
Weather forecasts;
Characteristics of the swell around the pier;Finding the adequate wreck;
Disarming the wreck;
Preparing the wrecks.
It should be noticed that the various adopted formulas rise from general measurements ofdimensioning of the

moles, but after several studies was simplified and adapted to the standard shape of the wreck.
The procedure to be followed is:
Determining the point of scuttling and the orientation of the wreck:
For the characteristics related to the site, we will need:
Climate states, duration of the swells action, and sea with tide, sea without tide, bathymetry, and slope of the seabed.
For the parameters of the point of settling:
Distance to the coast, depth of establishment, positions respective, positioning compared to the coast.
For the characteristics specific to the moles:
Length, /c Height removes of levelling course, width in peak, Slope of the slopes.
Figure7 gives a scheme of the various characteristics of the break water, the selected form is a rectangular

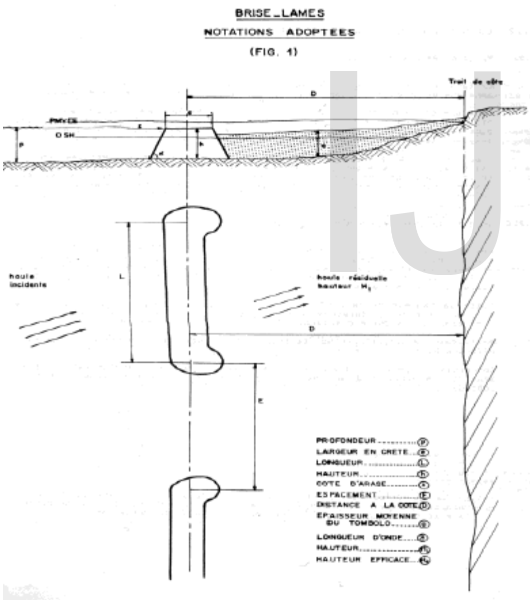

Figure 7. Break water and nomenclature.
Geometry to fit the boat shape.

Case of sea with or without tide:
The role of a break water is very different according to whether it is placed in a sea with tide or a sea without tide or at very low marling.
Will focus on the sea with tide case:
Swell and slopes of the funds:
The conditions of swell influence on the characteristics of the safety devices. The small swells take the sediments and feed the top of seaside, from where is necessary to notice their action. On the other hand, this is essentially the strong swells who dig the profile of the coast, which will impact on the dams.
In addition to the height of the swell, one of the most important parameters is its wavelength.
Also, intervene the obliqueness, the directions and periods.
For need, certain authors use the concept of height effective He of the swell which
is a height of remarkable swell, producing during one preset period, the same average evolution of the phenomenon as the natural swell.
Concerning the slope of the funds, this parameter influences primarily on the establishment distance from the device to the coastal line and also the cost of this one. Parameters of establishment (see figure 7), which depend on:
Distance between coastline and point of establishment;
Space between devices;
Adjustment compared to the coastline.
Indeed, the breakwater installation can be characterized by its distance to the feature of coastline D and /or its depth of establishment p, and its orientation compared to the dam.
Distance to the coastline and depth of establishment:
The distance to the dimension of a breakwater will depend on the expected function of the device(protection of dam…), efficiency, slope of the funds…
J.CARPENTIER, proposes approximates formulas which give an approach to be followedmore than a method. It is specified, that the optimal depth of establishment must be selected so that the effective swell causing sand transport, after trapped, breaks in the side up the breakwater in order the majority of the transit will be intercepted.
Knowing He makes it possible to determine the depth of establishment which is related to He by (1) and, consequently, the distance between devices and dam.
$p = 1.5\ He$ (1)
G.DELAGE, from the Laboratory Dauphine of Hydraulics showed, during tests on breakwaters immerged at sea without tides that the effectiveness of the device passes by a maximum for a distance from well determined.
It appeared clearly during this study that the depth relating to the device had an important influence on its effectiveness.
A breakwater can lose much its effectiveness if it’s exaggeratedly moves faraway it from the coast.
INMAN, noted on the Californian beaches, the absence of sedimentation behind a breakwater for (2):
$D \geq 3L$ (2)

On the other hand, for the short distances, the basin of dissipation, on the downstream of the breakwater, can be insufficient to absorb all the energy of the swell after breaking on the work.
All these rules was related to the seas without tide. In the case of the seas with tide, the effectiveness of the device varies with the water level. The distance from establishment remains however related to the zone of breaking of the swells at the origin of the movements.
Positioning and spacing:
A series of breakwaters can have the same effect as only a long one.
O.TOYOSHIMA, proposes, after analysis of the Japanese sites, an equivalent spacing from 0.5 to 1.5 times the wave length of the incidental swell, as spacing growing with the depth of settling.
J.CARPENTIER, recommends formulation of type (3), which shows that a series of breakwaters protect as much better the dam than when the swell is long, (case of the outer harbor of Agadir).
E< (0.83 D + λ /2) (3)
for our case, the more adapted spacing, after simulation is 100 ans.
for our case, the more adapted spacing, after simulation is 100 ans.
Positioning from the coastlineif it is a matter of blocking a littoral transit, we may find it beneficial to place it parallel to the coast. This isthe most usual case and it will used in modeling.
On the other hand, we have interest to direct them perpendicular to the local direction of swell direction, toincrease their effective length, (L.cos (Ө) if Ө is the angle formed by the peak of theswell and the axis of the device). The best, would be carrying out the two conditions.
The length L of the breakwater for a given position, is one of the most importantparameters, whatever the breakwater is sinkable or not, because it conditioning the length of coastprotected in our case “section from dam”.
The relative height h and the width in peak e of the breakwater, are also an important parameters, whicharise from the whole based test essentially to the measure of thetransmission of the swell over immersed device.
The length of the breakwater:
Some authors attach it to the distance from settling at the coast. These two interdependent parameters are generally connected to the local wavelength of the swell.
The Dauphine Laboratory of Hydraulics proposes in the case of (4)
p/λ =1 (4)
(Depth and wavelength of the swell at the bottom of the similar work)
L=1.25 λ (5)
J CARPENTIER proposes a relation of the type (6):
L>=1.2 (D+0.3 λ) (6)
O.TOYOSHIOMA, starting from the achievements on the Japanese coast, gives the following correspondences, (Table n° 2):

devices	Close to the feature of coast	low depth	average depth	high depth
Corresponding depth	<1m	1 à 2 m	2 à 6m	>6m
Length L	L=2 à 3λ	3 à 5λ	3 à 10λ	

Table n° 2, calculation of L according to the depth according to TOYOSHIOMA

Height of the breakwater
Breakwater depends primarily by the height.
On the seas with tides (medium and strong), the choice of the coast of levelling coast is very difficult.
Many tests on the crossing of the swell over immersed breakwater, emphasize the importance of breakwater height, or more especially the height reported to the depth of water in foot of the device, the coefficient of transmission Ct (is the swell transmitted Ht per the incidental swell Hi) increases in the same direction as the p/h.
Searches by SOGREAH (Grenoble-Company of Studies and Hydraulic Applications) on the influence height of a dam submarine show that an immersed device candeaden validly the swell only if the level of water is very little above the peak of the dam. To obtain a coefficient of transmission lower than 0.5, the p/h must be lower than 1,125.
The levelling coast, is also function of distance to the feature of coast. The agitation produced by the repercussion of the breaking, in the back of the mole, diminishes in its propagation towards the dam more especially as the device is distant from that.
The width at the peak:
To be effective, the width at the peak of an immersed breakwater must be sufficient to cause areduction of the energy by breaking of the swell.
The tests of the SOGREAH show the influence of the width e of the peak of the submerging breakwater.
For a p/h>1, the coefficient of transmission of the swell decrease when the width in dike Creteof the breakwater increases and this, whatever the characteristics of the incidental swell.For a p/h >1, the swelling of the swell is all the more raised that the breakwater is large and thecoefficient of Ct transmission increases. However, after, the decrease of Ct with the incidentalswell is then faster. For the strong incidental swells, Ct becomes all the smaller as the width atthe peak of the breakwater is large.
J.DATTARI, notes an optimal value of the width at the peak, related to the wave length of the incidental swell of (7):

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L//λ= 0.2 to 0.3 (7)
Other parameters:
The other parameters which act in a way at least active are:
Excavation side slopes, SOGREAH 'works show that generally:
The softening of the slope supports the transmission;
The form of the device, of which the effect does not seem dominating, its influence differs with theconditions from swell;
The roughness and the permeability of the device, of which the effects remain relatively weak.

7 Execution procedure of

We saw the various parameters here intervening in, the choice of the breakwater and the localizationof the site; so, knowing the characteristics of our swell, owe will be able to consider the start ofexecuting our operation.
Conditions of wreck:
The blockShip is a trading or military vessel voluntarily done not very deep water toconstitute an obstacle or an artificial protection. It must be: Painted with a nonpolluting anti-rustingpaint (marine); Disarmed of any valuable equipment, significant, electric or electronic; To haveonly the super structure, deprived of any superfluity, (figures 8-9); To remove any trace of asbestos or all other metals…. or toxic products;

Figure 8. Wreck example.

Figure 9. The Rance formal -BSM was moved towards Saint-Mandrier to be used as breakwater for the diving school.

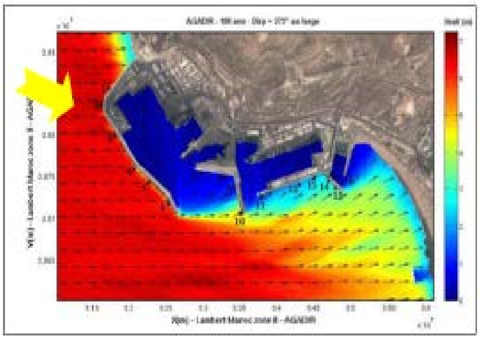

Figure 10. Harbor and attack's direction of the swell estimated in 100 years.

Practical case:
Determination of the point of scuttling based on (table 11):
Characteristics of the swellthe height to be considered is 9.5m (simulation on 100ans) we will have as a depth, according to (1):
p1 = 1.5 x 9.5 = 14.25 m
Privileged direction 270-310

AGADIR - ETATS DE MER AU LARGE 100 ans
SECTEUR DIRECTIONNEL AU LARGE [270° - 310°]
Conditions au large immédiat du port d'Agadir
Hm0 : 6,5 m
Tp : 16,5 s
Niveau d'eau : 4,6 m / ZH
Surcôte (100 ans) 0,5 m
Marée (HAT) 3,5 m
C.Clim (100 ans) 0,6 m

POINTS				PARAMETRES REDUITS			
Nom	x	y	Prof. / ZH (m)	Hm0	H1/3	Tp	Dirp
PT01	91721	388548	2,8	6,3	8,4	15,8	295
PT02	91621	388357	4,4	[illegible]	9,5	17,5	[illegible]
PT03	91802	387986	6,9	[illegible]	9,0	17,5	[illegible]
PT04	92072	387585	7,5	[illegible]	8,2	17,5	[illegible]
PT05	92252	387424	8,6	[illegible]	8,1	17,5	[illegible]
PT06	92533	387174	7,5	5,9	7,6	17,5	255
PT07	92974	387545	8,3	0,7	0,9	17,5	205
PT08	93298	387505	4,1	0,8	[illegible]	[illegible]	235
PT09	93435	387364	2,1	1,1	1,6	17,5	245
PT10	93505	387063	4,7	4,8	6,3	17,5	255
PT11	93795	387244	4,7	1,5	2,0	17,5	225
PT12	94306	387394	2,5	2,2	3,1	17,5	235
PT13	94497	387464	2,7	2,3	3,2	17,5	225
PT14	94707	387434	3,0	2,8	3,9	17,5	225
PT15	94797	387354	4,9	3,1	4,1	17,5	235
PT16	94958	387515	2,3	1,0	1,3	17,5	185

Figure 11. Table of the averages significant and remarkable heights estimated in 100 years by the CID.

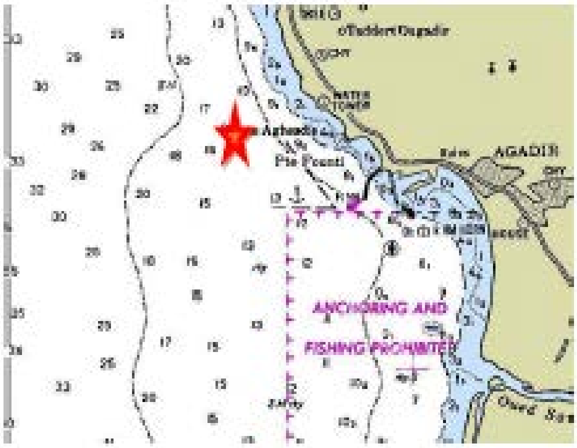

Figure 12. Chart n° 6178 cards Atlas, sit of scuttling.

So, on the map our wreck should be cast at the STAR point about 0.8 mile of

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the Anza dam perpendicular to the axis of swell 270-310, and//with the elbow:

Determination of the characteristics of our wreck:

Length/width:

J CARPENTIER proposes a relation for the length of the type:

L>1.2 (D+0.3 λ) (8)

The length is expressed by: L/λ = 0.2 to 0.3. In general in Atlantic zone, around Agadir and of the Canary Islands, one takes a swell celerity long wave length:

C = √ (G x h/2) (9)

With the amplitude which equals half the height,

L =C * T (10)

C =√ (9.81 ' 9.5/2) = 6,824 m/s

For a period of storm T = 20 S we have λ=20*6.824 = 136.48 m thus,

L1 =0.2 * 136.48 = 27.297m

L2 = 0.3 x 6,824 = 40.944m

This fact a wreck ≥ 40m length would have a width of 11 m, like a trawler or a small coastal patrol craft.

On the other hand, if one uses the method of O.TOYOSHIOMA, by the achievements on the Japanese coast, where the following correspondences (Table n° 3):

devices	Close to the feature of coast	low depth	average depth	high depth
Corresponding depth	<1m	1 à 2 m	2 à 6m	>6m
Length L	L = 2 à 3 λ	3 à 5 λ	3 à 10 λ	

This method is not adapted to our conditions and environment moreover it returns us towards values extremely hugs (example, to see figure 13), some models:

Figures 13. Cargo liner 80 m.

8 Summary

After having, to determine the characteristics of the remarkable swell, essential to the establishment, of calculations of depth, dimensions of the wreck and the position of scuttling (figure 14), it remains to find the adequate boat, to prepare and tow at the quoted point and to achieve the operation, and we can even consider a series of four wrecks separated by100m.

To make a beneficial choice, it must carry out several conditions, like, effectiveness, facility and profitability.

We saw, that unquestionably, the ecological shutter is effective, remains to prove the effectiveness and profitability, on our device the principal dam Anza, zones bend.

It's why it would be judicious to estimate the price of feasibility and compare it with that of repair previously considered and then, to carry out a simulation of the device with and without wreck, to inquire degree of attenuation of the destroying effect of swells. And finally, to start theproject.

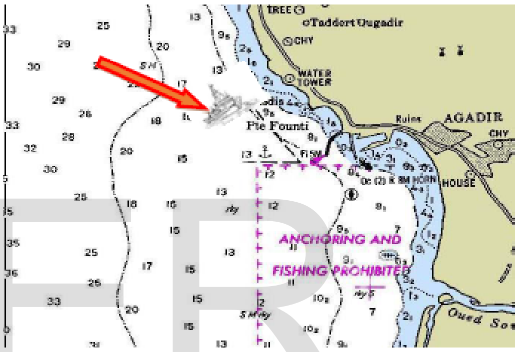

Figure 14.Chart wreak position.

Figures 15. Principal pier with bent zone.

The 100 years simulations, gave results as table below: the significant swell for the various periods of return as well as Kd are equivalent by opposite calculation of the formula of Hudson.

PR (Année)	Hs(m)	Kd
1	4,5	1,81
5	5,6	3,5
10	6,1	4,53
20	6,4	5,24
50	6,8	6,27
100	7,1	7,14

Table n° 4.significant Heights and Kd.

We notice that as from one period of 20 years (T16, tetrapod of 16 m3) became thetheoretical limit of stability, the Kd of dimensioning suggested in the literature for the elbow (in zone of breaking) being about 5 (for damage between 0 and 5%.
To be specified, that the principal pier is covered with tetrapod with the T16 type.
9 Comparative study:
One of the factors determining the choice of the device to adopt is the cost, we
proceed then to the comparison between a standard confortement and an installation using a wreck.
Estimation of the cost of confortement:
The estimation of the operations by zone of confortement (figure 16), is based on the ratios available on database calculated by the C.I.D, (the Council, Engineering and Development, Morocco). The first table corresponds if T16 of normal density are maintained, the second corresponds to substitution by the tetrapods of weighted concrete (d=2, 6).

	Prix au ml (DH)	Longueur (m)	Prix (MDH)
Zone 1	180 000	300	54
Zone 2	180 000	550	100
Zone 3	35 000	825	29
		Total HT	183

	Prix au ml (DH)	Longueur (m)	Prix (MDH)
Zone 1	250 000	300	75
Zone 2	180 000	550	100
Zone 3	35 000	825	29
		Total HT	204

Table n° 5. Price by zone and by length

Figures 16. Zones distribution in the harbor.

Analysis of table 3, shows clearly that the tetrapods installation operations, is very expensive.
Estimates of operation BLOCKSHIP:
To find the wrecks it’s an easy way, remain only the operations of disarming and preparing for scuttling, which should not exceed the fifty miles, addition with the fact that price of towing which is very cheaper (harbor service), for only one wreck, after if we has several (not more than three), we will agree on an all-in price symbolic; scuttling, also will not be expensive.
Therefore, a fortiori, the total operation is not expensive at all, however, the process in it self,requires more technicality and of precision, which are easily mastered by the specialists in the field, MARSA MOROCCO, ANP, MARINE ROYALE.

10 General Conclusion

We analyzed the state of the dam, the various solutions considered, the BLOCKSHIPS and finally the estimation of the prices.
The comparative study clearly revealed the difference between costs, therefore, if we conform to the various conditions of implementation our alternative solution will be correct, remains to be attested of itsoperational effectiveness, for that, it is necessary to have of a basin of experimentation and a physicalmodel of simulation.
But what is sure, it is that it is necessary to act quickly, because the evolution of the destroying force of the swell accelerates with climate warming! , the repetitive frequency of the storms confirms it, it isenough to see the advanced state of degradation of the tetrapods, (figure 17).

Figures 17. Tested tetrapods.

References

[1]Agadir, History and Geography;
[2]Agadir \ Marsa Morocco available online onURL (http://www.sodep.co.ma/web/marsamaroc/espacecorporate/
Agadir);
[3]Atlas of the cards of the SHOM;
CAMINADE D (1987), Work of protection against the swell;

ISSN 2229-5518
[4]CARPENTIER & DELAGE & INMAN &DATTARI & TOYOSHIOMA; BOUJIS (2000),wrecks;
[5]CAZENAVE A (2005), rise of the sea level (Extracted the Letter of the total Change n°19 - International Program Geosphere Biosphere(IGBP) - World Research Programme onClimate (WCRP) - International Program“Human dimensions” (IHDP) - Diversitas- Earth System Science Partnership (ESSP)),LEGOS/OMP UMR Univ/CN RS/CNES/IRD,(2005);
[6]DUCHET et al. (2004), Works on the Waves;
[7]Evaluation of the impact of the Climate change on the dimensioning of the dams with slope, Congress, New approaches on the coastal risks. Risks, vulnerability, climate change, variations of the feature of coast. Day, Paris,France, (2008) available on URL (http://Evaluation of the impact of the climate change on the dimensioning of the dams with slope);
[8] Geography on URL(http://mfd.agadir.free.fr/founti/structure/bibliographie.html);
[9]HUDSON RY (1984), works of protection of the coasts;
[10]KARROUK MR. S (2012), Morocco will not miss rain;
[11]LEBRETON& TRMAL (2009), Evaluation of the impact of the climate change on thedimensioning of the dams with slope;
[12]NIAZI S, (2007), the rise in the sea level onlittoral northern vulnerability and adaptation,thesis Faculty ofScience Agdal, Reduction,Morocco, available on URL(http://toubkal.imist.ma/feedback);
[13]PARALIA (2004), digital Study of the interaction swells/passable moles;
[14] Rock Manual (2008), published by the CETMEF (Center of Maritime and River Technical studies), the dams of coastal protection;
[15]SOGREAH (2000), (Grenoble-native Companyof Studies and Hydraulic Applications), moles.