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Improved Geometrical Designs Of Conventional Tetrapod

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Abstract

This paper provides some results and new procedures to develop geometrical designs and its analysis w.r.t hydrodynamic aspects, & interaction between emerged breakwater and waves by CFD and CAD. Following are general methodologies and practices that can be followed by modelling of components in SolidWorks 2016. Which will help in capturing the design intent and features, that is to be moulded. Breakwaters, both submerged and emerged are numerically reconstructed by overlapping individual blocks under the conditions of gravity, collision and friction, according to geometry a very much like in real construction are compared with laboratory test models. A use of advanced technology, Flow3D for Virtually Testing of Geometrical Design Models was conducted. Here the results presents, a innovative approach towards the breakwater design and its testing, which were further compared with several design solutions in replacement with conventional one.

Keywords— Tetrapod; SolidWorks2016; Rubble Mound; Numerical Simulations; Volume of Fluid (VOF); Flow3D.

I. INTRODUCTION

This article guides a stepwise walkthrough, start with Designing and upto virtual testing of geometries. Tetrapod being a part of coastal protection since 1950. They are the type which used to prevent erosion caused by weather and longshore drifts, which harmful for human mankind..Day by day there is furious increase in these type of problems so there is need for developing new geometrical design. Numerical reconstruction of the breakwater are thus produced by cad software system for modeling 3D geometries. As it very easy to develop using various design software but practical testings are not possible. Once the breakwater geometry is defined, geometric configuration is imported into Computational Fluid Dynamics (CFD) system for further virtual testing's. So in this article the design procedures and its virtual testing's are shown.

II. OBJECTIVES

1. Understanding the design aspects of coastal structures (Rubble Mound Breakwater)
2. Analyze and provide grooves in geometry of conventional tetrapod structure by using "SOLIDWORKS 2016" software.
3. Assessing and Testing the designed Pods with Computational Fluid Dynamics(CFD) "Flow 3D" software
4. Carrying out experiments in wave flume for different wave heights and different time

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periods.

Articulation of the research work with ideas gathered in below steps by adopting below suitable approaches:

A. SolidWorks 2016

SolidWorks is a solid modeling computer-aided design (CAD) and computer-aided engineering (CAE) computer program. Building a model in SolidWorks usually starts with a 2D sketch,For design intent of geometry *Parameters* should be considered which refers to constraints whose values determine the shape, size or geometry of the model or assembly. For which we have to consider numeric parameters such as tangent, parallel, concentric, horizontal or vertical. After everything setup as per parameter now we can modify it into 3D vision.

The Below methodologies and Best practices followed will help in capturing the design intent of the Feature that is to be Modeled and will make the design robust and easy to navigate through.

B. Use of Simulation Software (Flow 3D)

Flow 3D a kind of Computational Fluid Dynamics (CFD) based software which determines geometry, and virtually tests geometrical models made to use as Breakwater structure. A large segment of coastal engineering design requires an analysis of the structural behavior of a variety of coastal structures, which has paramount importance having response of structures to wave attacks or interactions.

II. METHODOLOGY

1. Theoretical study of amour units.
2. Imagine various design idea for provision of grooves.
3. Modeling of design ideas with help of SolidWorks 2016.
4. Take consideration of various aspects.
5. Import designed format into Flow 3D and run Test
6. For comparative purpose practical test can be done In Wave Flume

A. Theoretical study of armour unit

Interlocking, single layer, concrete armour units for rubble mound breakwaters were placed in grid. Accurate placement should required for good interlocking and stable armour layer. The objective of study is to systematically placement and its unit interaction to determine a constructible and stable pattern for roundheads. In accordance with this study we notably took some important points for error less design of geometry. We came across various design ideas which has to be implemented and gives comparatively best result than conventional one.

B. SolidWorks 2016 Modeling Procedure

1. Drawing of conventional tetrapod in 2 Dimensional view
2. Start of with 1st leg of tetrapod considering parameters such as inner and outer diameter (in 50 cm)
3. Similarly replicate the leg into 4 parts

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4. Provide 109.24 degree angle between each leg and join to form a whole tetrapod.
5. The convert it into 3D vision
6. Now as per objective provide grooves on legs of tetrapod in reference with Accropod, X shape at end of pod leg, thread on quarter span of leg,etc

   Following is stepwise procedure is shown:

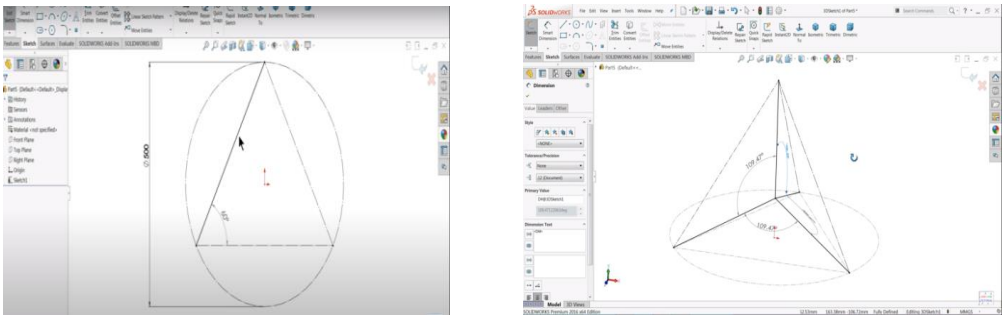
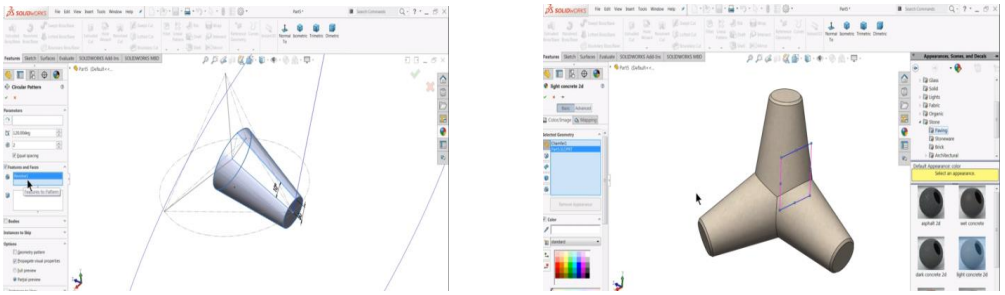
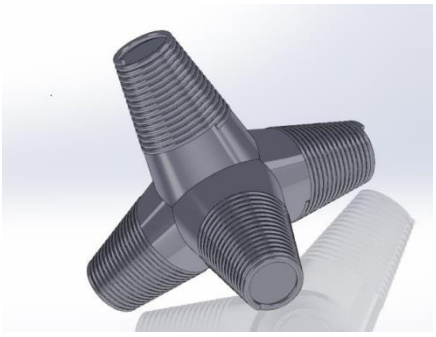


Fig.1-Standard Design of Conventional Tetrapod



C. Following Are Improved Ideal Geometries With Reason



TYPE -01-THREADED TETRAPOD
USE– Avoid sand Flow, To dissipate energy of waves, Improved interlocking, Increased Friction, improved KD value

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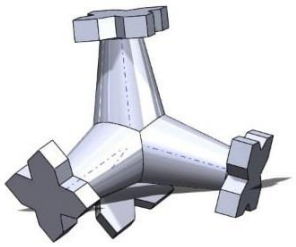
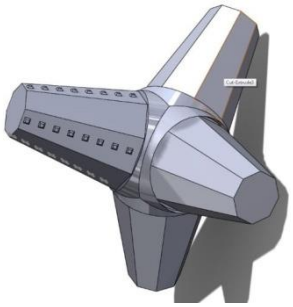
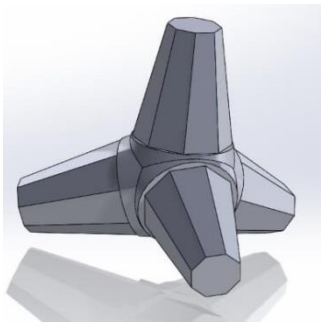


TYPE-02-XPOUTPOD
USE-Gives better interlocking, Avoids Overtopping, Works as armour shield, Easy layering.



TYPE-03-GROOVE POD
USE-Avoid Shear Failure, Increase Ground holding, interlocking, friction



TYPE-04-SHREDED LEG
USE- Helps in dividing wave, Avoids Pores formation, Better in layering and Overtopping

D. Flow 3D Test Procedure

1. Import file format from SolidWorks 2016 CAD software to Flow 3D CFD software
2. After successful importing software gather all information about the geometry
3. By considering all the natural parameter into software manner such as Wave height, Wave interaction time, Armour unit layering, Orientation of Object or Geometry, etc.
4. After considering all parameter on right corner of window press RUN simulation button.
5. After 5-6 hr or less time depending upon the system capacity flow 3d shows result in format of Graph or thermal format

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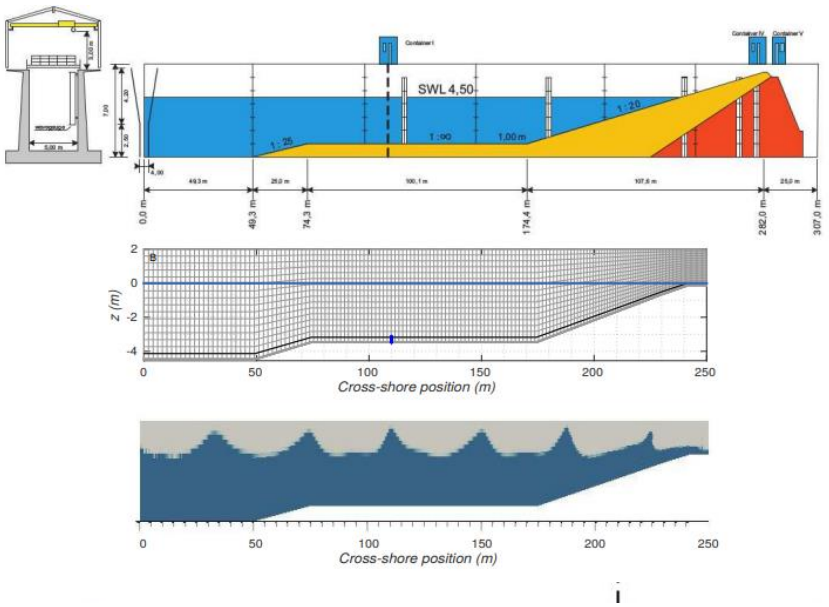

Fig 2 : General guidelines for setting up parameters such as slope, height, interaction wave, armour layering, etc

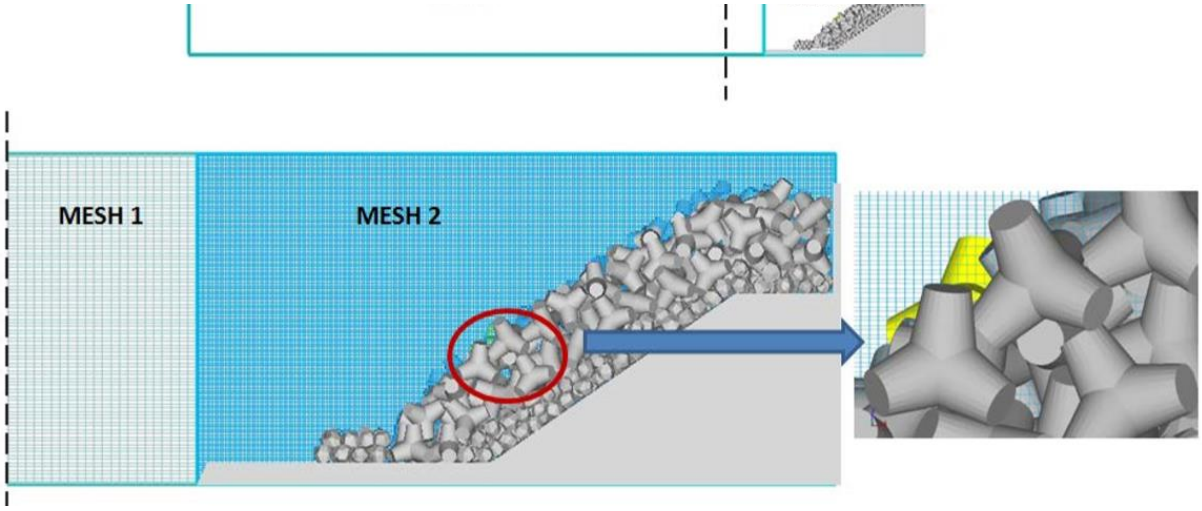

Fig 3 : Armour layering

E. Practical Test in Wave Flume

Fig. 4 Wave Flume

Fig. 5 Mould

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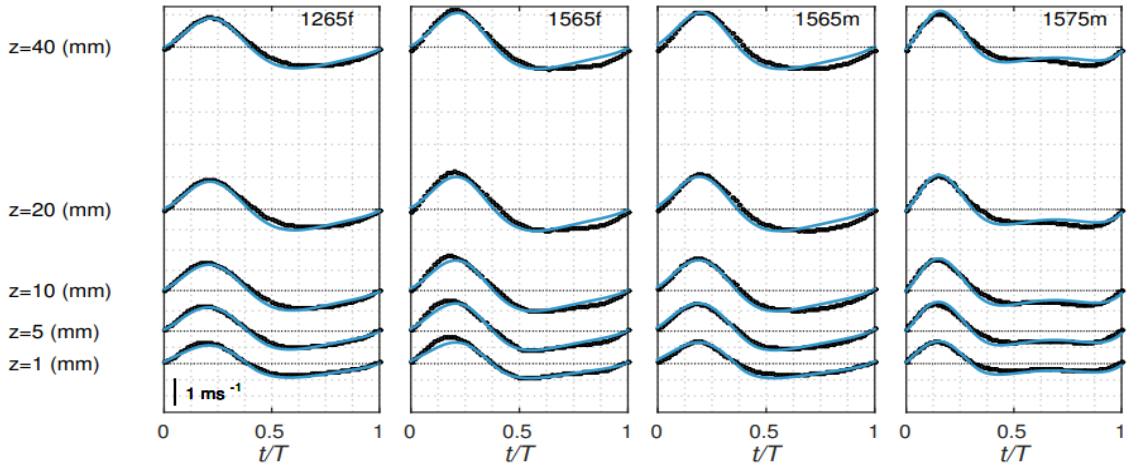
III. EXPECTED RESULTS



	Experimental Results	Simulation Results
Outflow Height / Step Height	0.094	0.094
Pool Height / Step Height	0.45	0.45
Angle Of Nappe At Bottom	55 Degree	57 Degree
Energy Loss / Initial Energy	0.29	0.296

Aspect

1. Run-up/overtopping conditions are generally important for seawalls.
2. Toe erosion of seawall has to be critically examined for stability of seawall as well as stability of coast along sides of seawall.
3. Seawalls are constructed parallel to the shoreline along the coast, whereas breakwater are normal to the coast, protruding into the sea from the shore.
4. Construction of a seawall is comparatively simpler than that of the breakwater.

IV. CONCLUSIONS

1. A updated approach has been set up and tested, to evaluate wave action on breakwater in tetrapods within SolidWorks 2016 and Flow 3D hydrodynamic simulations.
2. Unlike conventional procedures mound is treated as simple seepage flow , but now A virtual structure is molded as it happens in real construction practice and evaluate the flow passage between the blocks.
3. Easy to Develop and Can be tested for impossible parameter as like real life
4. Less time consuming , and easy to operate

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5. Gives a visionary perspective to Future Disasters management

An assessment described here, shown that methodology needs to calibrate physical parameters. A combination CAD and CFD techniques are relatively easy rather creating expensive tools, investigate the interaction between mound and the waves motion.

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REFERENCES

[1] Prof. SupriyaShinde,Mr.AdityaUkalkar,Mr.AkshayTambe,Mr.AshimPrakash(Apr2017)[8]"*DESIGN OF BREAKWATERS FOR THE DEVELOPMENT OF FISHERY HARBOUR –A CASE STUDY*",International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395 -0056,p-ISSN: 2395-0072,Volume: 04 Issue: 04 — Apr -2017

[2] N.R.K.Patnaik K. Anil Kumar(Feb-2015)"*SAFETY OF COASTAL STRUCTURE AS A BREAK WATER*" IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 — pISSN: 2321-7308, STRUCTURE

[3] Matthew K Vickaryous,Jean-Yves Sire (2009)*COASTAL DEFENSE ACTIVITIES* Coastal Structures 2007: (In 2 Volumes), 480-489, 2009 "The integumentary skeleton of tetrapods: origin, evolution, and development".

[4] TUda, M Sumiya, Y Kobayashi (1986-87)*Analysis of beach erosion around largescale coastal structures* Coastal Engineering 1986, 2329-2343, 1987.

[5] Matthew K Vickaryous, Jean-Yves Sire:*The integumentary skeleton of tetrapods: origin, evolution, and development,Anatomy* 214 (4), 441-464, 2009

[6] N.S Soni (1972-73)"*Systematic study of coastal erosion and defence works in the southwest Coast of India*".Coastal Engineering 1972, 1427-1450, 1973;

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