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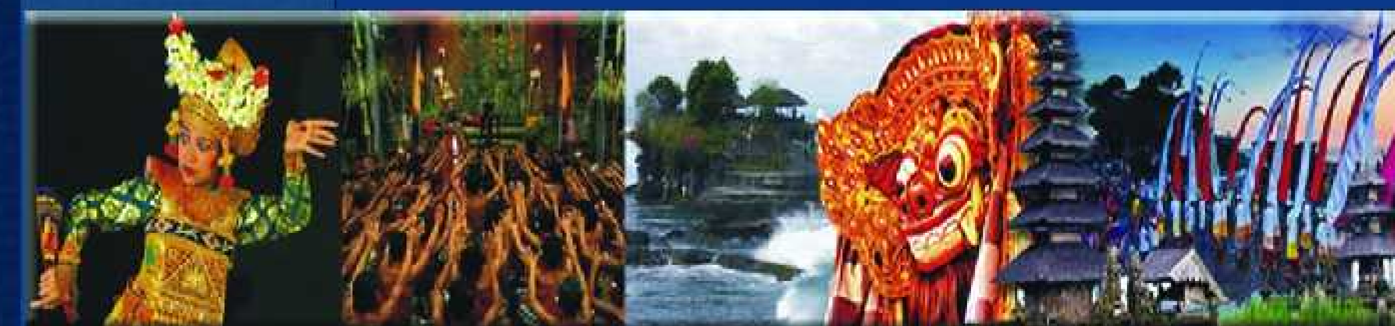
PROCEEDING

International Conference on Mathematics, Statistics and its Applications 2012

ICMSA

Mathematical and Statistical Thinking for Technology Development



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Published by:

MATHEMATICS DEPARTMENT

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA, INDONESIA

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INTERNATIONAL CONFERENCE ON MATHEMATICS, STATISTICS AND ITS APPLICATIONS 2012

ICMSA 2012

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Message

from the

Rector

Institut Teknologi Sepuluh Nopember

I would like convey my sincere congratulation to all involved parties for the successful organization of the IMT-GT International Conference on Mathematics, Statistics and its Applications. The ICMSA is annually conference organized by The Indonesia-Malaysia-Thailand Growth Triangle (IMT-GT), and this year ITS hosts the conference, organized by the Department of Mathematics and Department of Statistics. I would like also to express my deep appreciation to Department of Mathematics, Udayana University Bali for the collaboration. This ICMSA 2012 is held as part of our 52^{nd} Institute Anniversary.

It is great pleasure for me to welcome and thank all keynote speakers for the worthy time to share your experience and expertise to all conference participants. I do believe that your participation to this conference is a highlight and give a significant insight to all of us. I expect that your patronage and support towards the advancement of knowledge through this event, will contribute to the future development of Mathematics and Statistics.

As we know that the role of Mathematics and Statistics is vital in many aspects of live. This conference is a means to share and discuss a new knowledge and inventions among researchers, practitioners and students that may lead to a more real contribution of Mathematics and Statistics in solving problems arises in social, business, economic, environment, and many others.

Last but not least, I wish all participants have a very pleasant and valuable moment during the conference. Moreover, I hope that new collaborations among participants could be established. To our foreign guests, I wish you a memorable stay in Bali. We welcome you anytime to visit our university, Institut Teknologi Sepuluh Nopember (ITS) in Surabaya.

Prof. Dr. Ir. Triyogi Yuwono, DEA.
Rector of the Institut Teknologi Sepuluh Nopember (ITS) Indonesia

Message

from the

Dean Faculty of Mathematics and Natural Sciences

Institut Teknologi Sepuluh Nopember

On behalf of the Faculty of Mathematics and Natural Sciences, Institut Teknologi Sepuluh Nopember, it is a great honor and sincere to welcome all participants to the 8th IMT-GT International Conference on Mathematics, Statistics, and it's Applications (ICMSA 2012).

This year, Department of Mathematics and Department of Statistics, Institut Teknologi Sepuluh Nopember collaborate with Department of Mathematics, Udayana University, have honor to organize this meaningful international conference. I believe that the purpose of this conference is not only sharing knowledge among mathematician, statisticians, and scholars in related fields but also to hearten new generation of expertise in mathematics and statistics to realize the science and technology advancement.

It is undeniable that science and technology are the products of mathematics and statistics applications. Many disciplines like engineering, computer science, information technology, operational research, logistics management, risk management and many others are all the products of mathematics and statistics. Thus, it is essential that we must hold this annual conference as a stage for all scholars in finding new ideas and applications on Mathematics and Statistics.

Greatly thank to all supportive session including organizing committee, keynote speakers, invited speakers, paper reviewers, participants and sponsors. This event will not achieve without you all. Finally, I hope that the outcome of ICMSA 2012 will be pleasing and most useful to everybody.

Sincerely yours,

Prof. Dr. R.Y. Perry Burhan
Dean

Message
from the
Chairman
Organizing Committee

On behalf of the organizing committee, it is my great pleasure to welcome all participants of the 8th IMT-GT 2012 International Conference on Mathematics, Statistics, and it's Applications (ICMSA 2012). This conference had been held for seven times in Indonesia, Malaysia and Thailand. It is the fourth time that Indonesia hosts the conference and Department of Mathematics and Department of Statistics, Institut Teknologi Sepuluh Nopember collaborate with Department of Mathematics, Udayana University, are honored to organize this important event.

The theme of our conference is "Mathematical and Statistical Thinking for Technology Development" highlighting the importance of mathematical and statistical science as the major tools for solving problems and making right decisions. They play vital roles to the development of science and technology in the IMT-GT region and beyond. The regular meeting among researchers in the fields like this conference will promote the progress and advancement of the fields. This conference will surely serve as a venue for researchers in the fields to present their works, exchange ideas and seek collaboration. Participants from the IMT-GT region and many countries around the world will attend the conference. More than 10 distinguished speakers from many countries are invited to give talks in the conference. So, I hope all participants will enjoy attending to the talks and paper presentations as well as have very fruitful discussions.

I would like to take this opportunity to thank all the keynote and invited speakers for coming and sharing their knowledge with us. I am also very grateful to all international and local scientific committee and many others who have contributed to the accomplishment of the meeting. Without their helps and supports, the preparation for the conference would deem impossible to complete. Finally, I would like to thank all participants for joining the conference. I do hope all participants will have opportunity to explore Bali and enjoy staying in the island of Gods.
Sincerely yours,

Dr. Suhartono
Chairman

CONTENTS

TENTATIVE SCHEDULE

Monday, 19 November 2012

08.00 - 08.30 : Registration
08.30 – 08.50 : Opening Ceremony
09.00 - 09.45 : Keynote session 1 by Prof. Dr. Ir. Arnold W. Heemink (Netherland)
09.45 - 10.30 : Keynote session 2 by Prof. Virasakdi Chongsuvivatwong (Thailand)
10.30 - 11.00 : Break
11.00 - 11.45 : Keynote session 3 by Prof. Dato Dr. Rosihan M. Ali (Malaysia)
11.45 - 13.00 : Break
13.00 - 13.30 : Invited Speaker

- Dr. Darmaji (Class PM)
- Prof. Dr. Md. Azizul Baten (Class AM)
- Dr. Dedi Rosadi (Class SA)
- Dr.rar.net Heri Kuswanto (Class SB)

13.30 - 15.30 : Parallel Session

Tuesday, 20 November 2012

08.00 - 08.45 : Keynote session 4 by Prof. Philipp Sibbertsen (Germany)
08.45 - 09.30 : Keynote session 5 by Prof. Nur Iriawan, Ph.D (Indonesia)
09.30 - 10.00 : Coffee Break
10.00 - 10.45 : Keynote session 6 by Prof. Iwan Pranoto, Ph.D.(Indonesia)
10.45 - 12.30 : Break
12.30 - 14.30 : Parallel Session

Wednesday, 21 November 2012

Bali City Tour

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Mathematical Modeling of Circular Cylinder Drag Coefficient with I-Type as a Passive Control

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Abstract. Drag coefficient of a circular cylinder can be reduced by taking place an I-type passive control in front of a circular cylinder. We obtain a mathematical model of the drag coefficient on a circular cylinder. This is model further is solved Simpson's rule and Gauss-Jordan elimination. We obtain that the smallest drag coefficient is 0.90981 in S/D of 2.14943.
Keywords: Passive control, drag coefficient drag.

1 Introduction

To obtain an advanced technology, it is required continuous research. This encourages people to continue doing some various kinds of research, either by experiment or simulation. The results are expected to be employed to develop and discover new methods that are more useful. One area of research is the field of fluid dynamics research, i.e. the study of fluid flow through the cylinder. This research is conducted with aim to determine the effect of drag force on circular cylinder.

Fluid flow on the surface of the object, either laminar or turbulent flow, the particles around the surface move slowly due to viscous force. Fluid particles close to the boundary surface will stick to the surface and zero velocity relative to the boundary. Others fluid try to move slowly on the particles are relatively silent as a result of the interaction between fluid motion faster and slower fluid. This is a phenomenon that can increase the force or shear stress. Velocity gradient is affected by the shear viscosity due to a force called the boundary layer.

For example, offshore rig construction, structure overpass or other engineering products are often designed in groups. The force of each pile beside the load from above also receive forces from surrounding fluid. Piles are usually called the bluff body or the body is a major factor to be considered in the design. As it has been known, the force on a body that groups have different characteristics with a single body with the same shape. This is due to the combined interference of the flow around the body of the group that will show a variety of interesting phenomena and unexpected moment.

Following the concept of the boundary layer that has been is found, research on the phenomenon of fluid flow across the outer surface of an object has changed rapidly. The concept successfully reveals some answers to the influence of shear stress plays a very important characteristic to drag force around objects. Several studies have been done in which fluid flow through a single circular cylinder by Ladjedel (2011). A modified circular cylinders into either D-type or I-type has been investigated by Igarashi (2006) and Triyogi (2010). Fluid flow through more than one cylinder of different sizes and arranged tandem has been investigated by Bouak (1998), Lee (2004), Triyogi (2003) and Tsutsui (2002).

In real world, the piling used is not a single, but it more than one. Fluid flow across a profile cylinder will produce drag force takes is often disadvantage. The size of the drag force is influenced by several parameters, one of which is the drag coefficient.

Bouak in 1998 have conducted experiments using small circular cylinder as a passive control to reduce the aerodynamic forces on a circular cylinder. Experimental results show that the average reduction in drag coefficient can achieve 48 % compared to the single circular cylinder without passive control, in which bluff body diameter and Reynolds number (R_e) are the same. Tsutsui and Igarashi (2002) has conducted a similar experiment with Bouak, by varying the Reynolds number: 1.5×10^4 to the 6.2×10^4. The results of the study showed that for Reynolds number variation, rising $R_e > 3 \times 10^4$ cause minimum pressure coefficient, ($C_{P_{min}}$) is the lower.

Igarashi and Shiba (2006), has also conducted research on a circular cylinder D-type and I-type. The result is a drag coefficient (C_D) achieve a minimum, which is 50% of the drag coefficient of a circular cylinder. Furthermore, Triyogi Y. *et al* (2003) have done research on the concept of combining the two previous studies. Passive control used is a cylinder-type D to investigate their effects on circular cylinders. As a result, passive control is able to provide a drag reduction of 7% compared to the passive control of circular cylinders.

The desire to obtain the best performance with a small drag of a fluid flow system across the bluff body behind the discovery of passive control. One of the efforts made to provide upstream disturbance in the form of an object in front of the bluff body bullies. Giving upstream disturbance is one of the efforts to put the location of the separation point on the bluff body. In principle, the content of the vortices in the shear layer generated by the upstream disturbance will be able to accelerate the formation of a turbulent boundary layer transition. The dominance of a turbulent boundary layer on the surface of the bluff body then the separation of the bluff body will be delayed further back.

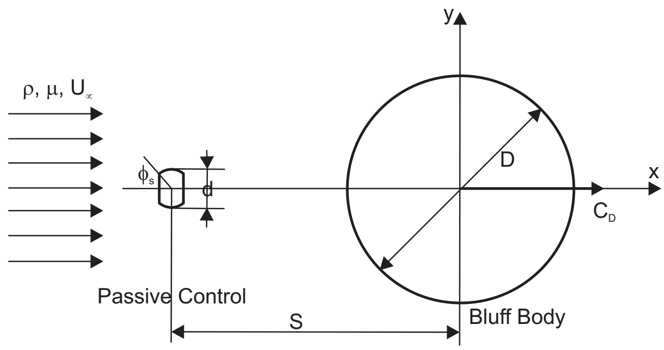

Fig. 1. Scheme of arrangement of two cylinders

Based on the above results, we consider a mathematical model of the drag coefficient received by the bluff body with passive control provisions are cylindrical type with $\theta_s = 65^o$ Reynolds number is $R_e = 3.2 \times 10^4$ in which the arrangement of these problems can be seen in Figure 1. Comparison between the S/D varies from 0.6 to 3 and $d/D = 0.125$. The results of this research can be used to shorten the experimental research.

2 Numerical Method

Navier-Stokes equations for unsteady incompressible fluid, as follow

$$\frac{\vartheta \mathbf{u}}{\vartheta t} + \mathbf{u}\nabla\mathbf{u} = -\nabla P + \frac{1}{Re}\Delta\mathbf{u} \quad (1)$$

$$\nabla \cdot \mathbf{u} = 0. \quad (2)$$

where $\mathbf{u}$ is the velocity vector, P is the pressure and Re is the Reynolds number.

2.1 Numerical Procedure

Several steps will be taken to solve the above equation. The first equation with neglect pressure, so the equation becomes

$$\frac{\vartheta \mathbf{u}}{\vartheta t} + \mathbf{u}\nabla\mathbf{u} = \frac{1}{Re}\Delta\mathbf{u} \quad (3)$$

this can be simplified becomes

$$\frac{\vartheta \mathbf{u}}{\vartheta t} = -\mathbf{u}\nabla\mathbf{u} + \frac{1}{Re}\Delta\mathbf{u} \quad (4)$$

or written by

$$\frac{\mathbf{u}^{**} - \mathbf{u}^{*}}{\triangle t} = -\mathbf{u}\nabla\mathbf{u} + \frac{1}{Re}\Delta\mathbf{u} \quad (5)$$

The equation 5 further can be stated by

$$\mathbf{u}^{**} = \mathbf{u}^{*} - \triangle t \left(\mathbf{u}\nabla\mathbf{u} + \frac{1}{Re}\Delta\mathbf{u} \right) \tag{6}$$

As well as

$$\frac{\mathbf{u}^{**} - \mathbf{u}^{*}}{\triangle t} = -\nabla P \tag{7}$$

if both sides of the divergence, the results

$$\frac{\nabla\mathbf{u}^{**} - \nabla\mathbf{u}^{*}}{\triangle t} = -\Delta P \tag{8}$$

or

$$\nabla \cdot \mathbf{u}^{**} - \nabla \cdot \mathbf{u}^{*} = -\triangle t \Delta P \tag{9}$$

Because of $\nabla\mathbf{u}^{**} = 0$, then it becomes

$$\frac{\nabla \cdot \mathbf{u}^{*}}{\triangle t} = -\Delta P \tag{10}$$

This equation is called the Poisson equation and we will get the P. The last step is a correction velocity,

$$\frac{\partial \mathbf{u}}{\partial t} = -\nabla P \tag{11}$$

2.2 Mathematical Modeling

Table 1. Pressure distribution (C_p) on Circular Cylinder with 10^{-5}

S/D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0.6	10.1	4.5	7.5	3.6	0.6	-0.7	-3.0	-5.2	-4.2	-10.3	-4.0	-5.8	-5.4	-4.2	-4.3	-5.8	-7.1	-5.8
1.8	3.7	1.5	2.7	2.6	1.3	0.1	-0.2	-4.7	-4.2	-10.5	-4.1	-5.8	-5.3	-4.1	-4.1	-5.3	-6.0	-4.6
3.0	8.7	3.3	3.9	1.9	0.0	-1.2	-3.5	-6.3	-5.4	-14.1	-5.7	-8.4	-7.8	-6.0	-6.0	-7.7	-8.2	-5.6
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
-16.0	-6.6	-9.6	-9.0	-7.0	-7.0	-9.1	-9.8	-6.7	-16.8	-6.5	-8.0	-5.1	-0.2	-0.3	2.7	6.6	0.4	10.1
-12.6	-5.3	-8.1	-7.9	-6.20	-6.1	-7.9	-8.4	-5.7	-13.9	-5.3	-5.8	-2.8	-0.4	0.8	2.0	2.1	1.4	3.7
-13.5	-5.0	-6.1	-5.1	-3.7	-3.6	-4.6	-5.0	-3.5	-9.2	-3.7	-4.5	-2.5	-0.7	0.3	2.0	4.0	3.3	8.7

Three calculations has been done, resulting in the pressure distribution on a circular cylinder as shown in Table 1. There are 37 points on the cylinder data taken with an increment of 10^o. Using the drag coefficient formula, namely

$$C_D = \frac{1}{2}\int_{0}^{2\pi} C_p \cos\theta d\theta \tag{12}$$

Table 2. Koefisien Drag

S/D	0.6	1.8	3.0
C_D	1.17538	0.923321	0.989853

By using Equation 12 and Simpson's rule derived drag coefficients in Table 2. With three data from the drag coefficient above and the approach that the drag coefficient is a function of S/D, it can let us assume that the equation is probably the parabolic equation, namely

$$y = ax^2 + bx + c \tag{13}$$

by letting y as the coefficient of drag C_D and x as S/D. Data obtained from three

$$\begin{aligned} 1.17538 &= 0.36\ a + 0.6\ b + c \\ 0.923321 &= 3.24\ a + 1.8\ b + c \\ 0.989853 &= 9.0\ a + 3.0\ b + c \end{aligned} \tag{14}$$

of three equations with three unknown variables that are a, b and c. The three equations are solved by using the Gauss-Jordan elimination, it found that $a = 0.1106$, $b = -0.4755$ and $c = 1.4209$, to obtain the parabolic equation

$$y = 0.1106x^2 - 0.4755x + 1.4209 \tag{15}$$

To obtain the smallest of circular cylinder drag coefficient, then it looks for a value of y are the smallest of the equation 15. Derive Equation 15 to x and equate to zero, obtained a line of symmetry is $x = 2.14943$ so the minimum value is $y = 0.90981$.

3 Conclusion

Mathematical models of the drag coefficient of a circular cylinder with the passive control type-I is the Equation 15. From these equations it can be found that the smallest drag coefficient obtained in $S/D = 2.14943$ for $C_D = 0.90981$.

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