

## Numerical Simulation of Heat Transfer Enhancement due to a Gap in an Inclined Continuous Rib Arrangement in a Solar Air Heater Duct

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### ABSTRACT

In the present work, numerical simulation has been carried out to investigate the effect of an inclined rib with a gap on the performance of a solar air heater duct. The geometry is numerically modeled and three-dimensional Navier-Stokes equation has been solved using a commercial code Ansys Fluent 14. 5 for the Reynolds number range of 3500 to 19, 000. The flow geometry of the rectangular duct has rectangular cross-section of 181 mm in width and 31 mm in height. The artificial roughness was generated using square ribs of 2 mm size having a gap with fix roughness parameters, namely relative roughness height ( $e/D_h$ ) of 0. 037, relative pitch ( $P/e$ ) of 8, relative gap position ( $g/W$ ) of 0. 25, relative gap width ( $g/e$ ) of 1. 0 and relative roughness angle ( $\alpha$ ) of  $60^\circ$ . The absorber plate is heated with a constant heat flux of  $1000 \text{ W/m}^2$  keeping in view of the heat generated by incidence solar radiation. The effect of the roughness geometry on heat transfer and flow field characteristics of the duct has been investigated numerically. The boundary layer elements were attached near the heating wall and total hexahedral elements of around 2. 1 million are used based on grid independency analysis. Different turbulent models are used and their results are compared. Realizable  $k-\epsilon$  model with standard wall treatment showed good agreement with available experimental results. The comparison of numerical results with the experimental results shows the deviation in the range of 3-20% for Nusselt number for the range of investigation.

**Keywords:** Solar air heater duct, heat transfer, artificial roughness, computational fluid dynamics, turbulence

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### **Table of Contents Numerical Simulation Of Heat Transfer Enhancement Due To A**

1. Understanding the eBook Numerical Simulation Of Heat Transfer Enhancement Due To A
  - The Rise of Digital Reading Numerical Simulation Of Heat Transfer Enhancement Due To A
  - Advantages of eBooks Over Traditional Books
2. Identifying Numerical Simulation Of Heat Transfer Enhancement Due To A
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Numerical Simulation Of Heat Transfer Enhancement Due To A
  - User-Friendly Interface
4. Exploring eBook Recommendations from Numerical Simulation Of Heat Transfer Enhancement Due To A
  - Personalized Recommendations
  - Numerical Simulation Of Heat Transfer Enhancement Due To A User Reviews and Ratings
  - Numerical Simulation Of Heat Transfer Enhancement Due To A and Bestseller Lists

5. Accessing Numerical Simulation Of Heat Transfer Enhancement Due To A Free and Paid eBooks
  - Numerical Simulation Of Heat Transfer Enhancement Due To A Public Domain eBooks
  - Numerical Simulation Of Heat Transfer Enhancement Due To A eBook Subscription Services
  - Numerical Simulation Of Heat Transfer Enhancement Due To A Budget-Friendly Options
6. Navigating Numerical Simulation Of Heat Transfer Enhancement Due To A eBook Formats
  - ePub, PDF, MOBI, and More
  - Numerical Simulation Of Heat Transfer Enhancement Due To A Compatibility with Devices
  - Numerical Simulation Of Heat Transfer Enhancement Due To A Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Numerical Simulation Of Heat Transfer Enhancement Due To A
  - Highlighting and Note-Taking Numerical Simulation Of Heat Transfer Enhancement Due To A
  - Interactive Elements Numerical Simulation Of Heat Transfer Enhancement Due To A
8. Staying Engaged with Numerical Simulation Of Heat Transfer Enhancement Due To A
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Numerical Simulation Of Heat Transfer Enhancement Due To A
9. Balancing eBooks and Physical Books Numerical Simulation Of Heat Transfer Enhancement Due To A
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Numerical Simulation Of Heat Transfer Enhancement Due To A
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Numerical Simulation Of Heat Transfer Enhancement Due To A
  - Setting Reading Goals Numerical Simulation Of Heat Transfer Enhancement Due To A
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Numerical Simulation Of Heat Transfer Enhancement Due To A
  - Fact-Checking eBook Content of Numerical Simulation Of Heat Transfer Enhancement Due To A
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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