observe the inside flow as well as the outside flow at an arbitrary instant. The flows shown in the figures are on the mid-span plane. Here, all velocities are normalized as u/u_2. The maximum value of u/u_2 is about 1 at Re=2500. As a result, the flow can observe the eccentric-vortex revolution by using hot-wire measurements and flow visualizations. By HWV measurements and by conventional flow visualizations, the authors divide the flow around the impeller into three areas, and observe the eccentric-vortex revolution inside the impeller. Using a PIV tequnique, the authors quantitatively show velocity distributions, where accuracy is checked in comparison with HWV results. The aspect ratio effect on the outflow-rate coefficient C_{Qo} is not negligible at aspect ratios less than one.

T-1D-4. FLOW PREDICTIONS IN TRANSONIC COMPRESSOR ROTOR

V. R. KALAMKAR, G. R. SHEVARE and B. ROY, *Department of Aerospace Engineering, IIT, Bombay, India,* The simulation of complete flow field in a transonic axial compressor rotor represents a considerable challenge for flow prediction methods. The current paper reports on the study of complete flow physics and secondly applicability and limits of the steady state model for transonic compressor rotor. An in-house code is developed and applied to study this problem. . A steady state analysis of the transonic compressor rotor is carried out by using three dimensional finite volume based explicit RANS solver using structured multi-block meshes. The present investigation uses numerical scheme as AUSM. The code runs on parallel architecture by using MPI libraries. The effect of turbulence is taken care by using Spalart Allmaras model. The current paper reports investigations aimed at advancing the understanding of the flow field near the casing of a transonic compressor rotor. The role of tip clearance flow and its interaction with the passage shock at peak efficiency and near stall operating condition is analyzed. The numerical results such as the compressor performance maps as well as spanwise distribution of total pressure and total temperature have been first compared with the experimental data for design speed and for tip clearance of 0.356 mm. Then, the numerically obtained flow fields are interrogated to identify the roles of flow interactions between the tip clearance flow, the passage shock and the blade/end wall boundary layers. Mostly, study is carried out for the analysis of radial extension of shock/vortex interaction by presenting Mach number distributions on cross channel planes at different axial stations such as 20%, 108% and 138% chord from leading edge.

10:30 ~ 11:50 (Room 105)

Free Surface Flows (IV)

Session Chair : Prof. H. Liu, Shanghai Jiao Tong Univ/China

T-1E-1. SOLVING THE PROBLEM OF WATER WAVES OVER A STRATIFIED MUDDY BED BY MATHCAD

C. O. NG, H. S. CHIU, *The University of Hong Kong, Hong Kong,* This work marks the debut of a Mathcad worksheet, which has been developed to aid engineers in the calculation of properties of a surface wave propagating in water over a two-layer viscoelastic muddy bed. In each bed layer, the mud is modeled as a viscoelastic Voigt medium with constant viscosity and shear modulus of elasticity. The worksheet is a very easy-to-use calculation tool. With the input of some basic parameters, such as the wave period and the fluid properties, one may get almost instantly the key results (wavenumber, wave damping rate, velocity components, pressure, and so on) upon the pressing of a key. The worksheet has been extensively tested by comparing with published results in the literature to ensure that it can produce reliable and accurate results. The worksheet is of value not only to practicing engineers, but also to researchers in the areas of coastal engineering, wave mechanics, and so on. The Mathcad worksheet file is available upon request. Those who are interested are welcome to contact the first author for a copy of the file.

T-1E-2. CURRENT MODELING OF WATER IN A RIVER MEANDER CONSIDERING CIVIL ENGINEERING PROBLEMS IN BUILDING THE COASTAL WALLS

S. M. MOSADDAD, *Islamic Azad University, Shooshtar branch, Iran*, A. A. BIDOKHTI, *Researching assistant of Geophysics Institute, Tehran university, Iran* and M. EZAM, *Ph.d of physical oceanography, IAU, Researches and sciences brach, Tehran, Iran,* River flows are not often straight and any small deviation in their paths can be enhanced due to the secondary flows. There are quite a few places in the south of Iran in which the rivers pass through cities which have lead to serious erosions. The example here is the Karoon River passing through the Shoushtar city, Shotteit branch. there are numerous water structures which are often known as "Pole-Band" meaning bridge-dam that are used for water flow control as well as for crossing from one side to another side of river. Using the analysis of secondary flow in one bend of this river with and without crevasse we showed that the role of this old structure is substantial in reducing the secondary flow as well as flood control and also water resource management. The studied hydraulic structure called Band Mizzan is built at the meander of the Karoon River near the center of Shoushtar city as a crevasse channel about 1800 years ago (Sasanian Persian kingdom) that depth of the main channel is typically 4 m (±1 m inthe bend). It is as a result of existence of vorticity component normal to the main flow which goes through a curved path. So Drainage of bottom slow moving fluid into the channel, secondary circulation in the side channel can lead to deposition and blocking of the channel. We mainly find through this study that: Water division decreases discharge of water and coastal erosion would be decreased.

T-1E-3. NUMERICAL INVESTIGATION OF WAVE BEHAVIOR OF THERMAL DISTRIBUTION USING NON FOURIER CONDUCTION

E. IZADPANAH, *Yazd University, Iran*, S. TALEBI, *Yazd University, Iran*, M. MIRZAEI, *K. N. Toosi University, Iran,* M. H. HEKMAT, *K. N. Toosi University, Iran,* In this paper, temperature distribution in the flat plate and semi infinite plate has been investigated for three different boundary conditions (constant surface temperature, instant and constant heat flux) by means of Fourier and non-Fourier conduction equations. Governing equations have been solved by implicit finite difference method and a central difference scheme is employed in discretizing the spatial derivatives and a first and two orders in discretizing the time derivatives. In all problems, Non dimensional time step is taken as 0.00001 and non dimensional spatial step is considered 0.0001. The results show that in non-Fourier conduction, heat transfer has a wave movement. The formed thermal wave in the flat plate has a reciprocating movement. This movement repeats until the plate reach to thermal equilibrium. Also in initial times, the results of Fourier and non-Fourier conduction have difference with each other. Therefore, in problems which the time scale is small and the heat conduction to a body is rapid such as laser radiation to a body, applying the non-Fourier conduction is noticeable. The investigation of results shows that for a semi-infinite plate, Fourier conduction model at boundary condition of constant flux, can not predict temperature distribution in the initial times accurately. The results of Fourier model for heat flux distribution in semi-infinite plate at constant temperature state in initial times is incorrect. Totally, the Fourier equation is acceptable when the all three conditions exist:

-The length scale is large.
-The time scale is large.
-The initial temperature of body is much grater than Kelvin zero.

T-1E-4. SIMULATION OF TSUNAMI WAVEGUIDING IN AN INDONESIAN COASTAL AREA

D. ADYTIA *LabMath-Indonesia*, A. SOPAHELUWAKAN *LabMath-Indonesia*, ANDONOWATI *LabMath-Indonesia & ITB Bandung Indonesia,* E. Van GROESEN *LabMath-Indonesia & UTwente Netherlands,* Field observations of effects of tsunamis on the coast show a high spatial variability that is not well captured by many numerical simulations. As one possible cause for this variability we introduced the phenomenon of Near-Coast Tsunami Waveguiding. Using a simple, synthetic bathymetry and geometry, we showed that the coastal approach over sloping bottom leads to largely enhanced wave amplifications by the presence of a narrow ridge that act as waveguide. In this paper we show that also in a realistic coastal area tsunami waveguiding can be convincingly observed in simulations.

10:30 ~ 11:50 (Room 106)

Drops and Bubbles (I)

Session Chair : Prof. Mohammad Ali, BUET/Bangladesh

T-1F-1. CAPILLARY INSTABILITY OF A CYLINDRICAL LIQUID COLUMN

Mohammad ALI, *BUET, Bangladesh,* A. UMEMURA, *Nagoya University, Japan,* This paper describes the formation of capillary wave and its instability during the contraction of a square cylindrical liquid column. The breakup behavior for the present configuration of the liquid column is investigated and found some significant differences from those predicted by conventional jet atomization theories. The formation of capillary wave is initiated by the surface tension on the sharp edge of the square end of the