7/6/89

Hydraulics Research
Wallingford

The structure of flow in open channels - a literature search

Volume 3

P G Hollinrake, BSc

Report SR 209
June 1989

Registered Office: Hydraulics Research Limited, Wallingford, Oxfordshire OX10 8BA. Telephone: 0491 35381. Telex: 848552

SUMMARY

This report presents the result of a literature search into flow in open channels with particular interest in Flood Channels.

The search is presented in the form of three files:

- a card index file developed on the Apricot micro computer associated with the Flood Channel Facility which indicates the source of the publication and gives details of any experimental facility.

- a precis of each paper or book accessed indicating the channel type studied, the aims of the paper, conclusions drawn and the nature of the instruments used in the study.

- details of the channels studied in previous research into flow interaction, secondary flow, turbulence, momentum transfer etc, unified in S.1 units. Three relevant dimensionless parameters are also presented.

This report supplements The structure of flow in open channels - a literature search, January 1987 and January 1988.

The layout of the contents of this report are the same as for Reports Nos SR 96 and SR 153.

CONTENTS

1 ACKNOWLEDGEMENTS

This work was sponsored by the Ministry of Agriculture, Fisheries and Food, as part of the strategic research commission, number 13A, of Hydraulics Research.

The author carried out the work in Dr P G Samuels section in the River Engineering Department at Hydraulics Research, headed by Dr W R White.

The author is grateful to Dr D A Ervine of Glasgow University, Dr D W Knight of Birmingham University, Dr W R C Myers of Ulster University, Dr R H J Sellin of Bristol University and Dr P R Wormleaton of Queen Mary College, London University for their help in compiling the references in the literature search.

2 CARD INDEX OF PAPERS

The card index was compiled on the Apricot Xi-10 micro computer associated with the Flood Channel Facility at Hydraulics Research, using CARDBOX-PLUS, Version 3 as supplied by Business Simulations Ltd.

The field captions used in the card index are detailed below:

Author	self explanatory
Title	self explanatory
Pub'n	publication (see Abbreviation of Publications)
Data	form of data presentation, graphical notation
Key words	self explanatory
Channel type	channel types are defined as experimental, prototypical, theoretical, simple, compound, smooth, rough, bend, duct or pipe. Due to the restricted space available on the card format used, abbreviations of the above channel descriptions are frequently necessary.
FL, FW, FD	flume length, width and depth
CL, CW, CD	channel length, width and depth
FCS	flume or channel slope, eg 2(-3) represents a slope of 0.002
Q	discharge
INST	instruments used in experimental work

Abbreviation of Publications

AMER	American
ANN	Annual
ASME	American Society of Mechanical Engineers
ASP	Aspects
CH, CHAN	Channel
CIV	Civil
CONF	Conference
CONG	Congress
CONST	Construction
CONT	Control
DEPT	Department
D, DIV	Division
DPRI	Disaster Prevention Research Institute
ELEM	Elements
EM	Engineering Mechanics
ENG	Engineering
EXP	Experimental
FIN	Finite
FOUND	Foundation
GEOL	Geological
GEOPHYS	Geophysical
HYD, HYDR	Hydraulics
IAHR	International Association Hydraulic Research
ID	Irrigation and Drainage
IHW	Institut for Hydromechanik and Wasserwirtschaft
INST	Institute
INT	International

IWES	Institute of Water Engineers and Scientists
J	Journal
JICE	Journal Institute of Civil Engineers
JSCE	Japan Society of Civil Engineers
MEAS	Measurements
MECH	Mechanics
MIN	Ministry
MOD	Modelling
NACA	National Advisory Committee for Aeronautics
NO	Number
PASCE	Proceedings American Society of Civil Engineers
PICE	Proceedings Institute of Civil Engineers
PROC	Proceedings
REF	Refined
REG	Regional
RES	Research
REV	Review
SED	Sediment
SOC	Society
STN	Station
STR	Structures
SYMP	Symposium
TASCE	Transactions American Society of Civil Engineers
TASME	Transactions American Society of Mechanical Engineers
TECH	Technical
TN	Technical note

TRANS	Transactions
TUR	Turbulence
UKAEA	United Kingdom Atomic Energy Authority
UNIV	University
US	United States
USWES	United States Waterways Experimental Station
VOL	Volume
WH, WAT HAR	Waterways and Harbours

A copy of each of the papers detailed in the card index is kept on the Flood Channel Facility. Books referred to are kept in the library at Hydraulics Research Ltd. The author accepts that the literature search does not give a comprehensive coverage of papers and books relating to the structure of flow in open channels. The literature search will be updated as further material becomes available in recognition of this fact.

AUTHOR ABRAHAMS A D

PUB'N WATER RESOURCES RESEARCH, VOL 20, 12, DECEMBER 1984

TITLE THE DEVELOPMENT OF TRIBUTARIES OF DIFFERENT SIZES ALONG WINDING STREAMS AND VALLEYS

DATA SINUOSITY, TRIBUTARIES, BEND MIGRATION, JUNCTION ANGLE

KEY WORDS MEANDERS, TRIBUTARY DEVELOPMENT

CHANNEL TYPE PROTO, THRY, SIMP, RGH

FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR ALAVIAN A, CHU V H

PUB'N 21ST CONGRESS IAHR, MELBOURNE, AUGUST, 1985

TITLE TURBULENT EXCHANGE FLOW IN SHALLOW COMPOUND CHANNEL

DATA VELOCITY PROFILES, STABILITY CURVES, EDDY VISCOSITY COEFFICIENTS

KEY WORDS TURBULENCE, COMPOUND CHANNELS

CHANNEL TYPE THRY, EXP, COMP, SMTH, RGH

FL 2, 7 M	FW 0.6, 0.7 M	FD
CL 2, 7 M	CW 0.36, 0.45 M	CD 0.019, 0.064 M
FCS	Q	INST HOT FILM ANEMOMETER

AUTHOR AMERICAN SOCIETY OF CIVIL ENGINEERS

PUB'N 3 RD SYMPOSIUM, WATERWAYS, HARBORS & COASTAL ENG., FORT COLLINS, 1976, VOL 1/2.

TITLE SYMPOSIUM ON INLAND WATERWAYS FOR NAVIGATION, FLOOD CONTROL AND WATER DIVERSIONS

DATA VARIOUS PAPERS ON FLOOD ROUTING MODELS, HYDRODYNAMICS, FLOW RESISTANCE, UNSTEADY FLOW

KEY WORDS FLOOD ROUTING, RESISTANCE

CHANNEL TYPE

FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR ARNOLD U, HOTTGES J, ROUVE G

PUB'N PROC 3 RD INT SYMP REFINED FLOW MODELLING & TURB. MEASUREMENTS, TOKYO, 1988

TITLE COMBINED DIGITAL IMAGE AND FINITE ELEMENT ANALYSIS OF MIXING IN COMPOUND OPEN CHANNEL FLOW

DATA VELOCITY, REYNOLDS STRESS, TRACER PLUME IMAGE, CONCENTRATION FIELDS

KEY WORDS COMPOUND CHANNEL, TRANSVERSE MIXING, FINITE ELEMENT, DISPERSION MODEL

CHANNEL TYPE EXP, THRY, COMP, SMTH, RGH

FL 25 M	FW 1 M	FD
CL	CW	CD
FCS	Q	INST LASER DOPPLER ANEMOMETER, VIDEO, FLUOROMETER

AUTHOR ASHTON G

PUB'N ASCE, PROC. SPEC. CONF. COMPUTER & PHYSICAL MOD. IN HYD. ENG., CHICAGO, 1980

TITLE COMPUTER AND PHYSICAL MODELING IN HYDRAULIC ENGINEERING

DATA VARIOUS PAPERS ON NUMERICAL ANALYSIS OF OPEN CHANNEL FLOWS, MODELING NON UNIFORM FLOWS, SCALE EFFECTS

KEY WORDS OPEN CHANNEL FLOWS, NUMERICAL ANALYSIS, TURBULENCE, SCALING

CHANNEL TYPE

FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR BECHTELER W, FARBER K

PUB'N SYMP. ON MEASURING TECHNIQUES IN HYDRAULIC RESEARCH., DELFT, APRIL, 1985

TITLE INVESTIGATIONS OF VELOCITY AND PRESSURE FLUCTUATIONS IN OPEN CHANNEL FLOW BY A LDA AND A PITOT TUBE

DATA AUTOVARIANCE FUNCTION, TURBULENCE SPECTRA

KEY WORDS VELOCITY, PRESSURE FLUCTUATIONS, TURBULENCE, LASER DOPPLER, PITOT TUBE

CHANNEL TYPE EXPERIMENTAL, SIMPLE, ROUGH

FL 4.75 M	FW 0.4 M	FD 0.42 M
CL 4.75 M	CW 0.4 M	CD 0.35 M
FCS	Q	INST LASER DOPPLER VELOCIMETER, PITOT TUBE

.AUTHOR BOTCHEVA M, IONCHEVA V

.TITLE EST. OF ROUGHNESS COEFF IN PREDICTION OF THE GEOM. PARAM. OF STABLE RIVER BEDS WITH COMP. CROSS SECT.

.PUB'N INTERNATIONAL CONFERENCE ON FLUVIAL HYDRAULICS, BUDAPEST, JUNE, 1988

.DATA CHANNEL ROUGHNESS, FLOODPLAIN ROUGHNESS, CHANNEL SLOPE, BED LOAD, FLOW DEPTH, CHANNEL WIDTH

.KEY WORDS ROUGHNESS COEFFICIENTS, COMPOUND CHANNEL, COMPUTATIONAL MODEL

.CHANNEL TYPE THEORETICAL, COMPOUND, ROUGH

.FL	.FW	.FD
.CL	.CW 20, 90 M	.CD 1.7, 3.7 M
.FCS 2.5(-3)	.Q 350, 850 CUMECS	.INST

.AUTHOR BRUK S, VOLF Z

.TITLE DETERMINATION OF ROUGHNESS COEFFICIENTS FOR VERY IRREGULAR RIVERS WITH LARGE FLOODPLAINS

.PUB'N 12TH CONGRESS, IAHR, FORT COLLINS, 1967

.DATA VEGETATION DISTRIBUTION, CROSS SECTION

.KEY WORDS COMPOUND CHANNEL, VEGETATION, ROUGHNESS COEFFICIENTS

.CHANNEL TYPE THRY, COMP, RGH

.FL	.FW	.FD
.CL	.CW	.CD
.FCS	.Q	.INST

.AUTHOR CHU C C, FALCO R E

.TITLE VORTEX RING/VISCOUS WALL LAYER INTERACTION MODEL OF THE TURBULENCE PRODUCTION PROCESS NEAR WALLS

.PUB'N EXPERIMENTS IN FLUIDS, 6, 1988

.DATA VORTEX RING, WALL INTERACTION, STREAK SPACING, EDDIES, TURBULENT BOUNDARY LAYER, WALL LAYER

.KEY WORDS VORTEX, BOUNDARY LAYER, TURBULENCE

.CHANNEL TYPE EXP, SIMP, SMTH

.FL 2.44 M	.FW 0.32 M	.FD 0.41 M
.CL	.CW	.CD
.FCS	.Q	.INST LASER DOPPLER ANEMOMETER

AUTHOR DIDI DUMA	PUB'N HIDROTEHNICA, VOL 26, NO 7, JULY, BUCHAREST, 1981
TITLE INFLUENTA UNOR PARAMETRI ASUPRA CAPACITATTI DE TRANSPORT LA APE MARI A ALBIILOR RIURILOR INDIGUITE	
DATA RELATIVE VELOCITY, ROUGHNESS COEFFICIENTS, REL. DEPTHS	KEY WORDS MEANDERS, COMPOUND CHANNEL, ROUGHNESS CONCENTRATION
CHANNEL TYPE EXP, COMP, RGH	

FL 200 M	FW 6, 15 M	FD
CL 200 M	CW 2.8 M	CD 0.2 M
FCS 1(-3)	Q	INST

AUTHOR DIDI DUMA	PUB'N HIDROTEHNICA, VOL 29, NO 6, JUNE, BUCHAREST, 1984
TITLE INTERACTIUNEA DINTRE CURGEREA IN ALBIA MINORA SI CEA IN ALBIA MAJORA LA APE MARI	
DATA SHEAR STRESS, RELATIVE DEPTH, VELOCITY PROFILE, FLOW INTERACTION	KEY WORDS COMPOUND CHANNEL, FLOW INTERACTION, SHEAR STRESS
CHANNEL TYPE EXP, COMP, RGH	

FL 200 M	FW 15 M	FD
CL 200 M	CW 2.0 M	CD 0.2, 0.25 M
FCS	Q 0.388 CUMECS	INST

AUTHOR DIDI DUMA	PUB'N INSTITUTIL AGRONOMIC 'NICOLAE BALCESCU', BUCHAREST, 1984
TITLE LA PERFECTIONAREA METODELOR DE CALCUL HIDRAULIC AL. CURGERII APELOR MARI IN ALBILLE CURSURILOR DE APA ETC.	
DATA SHEAR STRESS, VELOCITY, RELATIVE DEPTH, INTERACTION WIDTH, ROUGHNESS COEFFICIENTS	KEY WORDS COMPOUND CHANNEL, FLOW INTERACTION
CHANNEL TYPE EXP, COMP, RGH	

FL 200 M	FW 15 M	FD
CL 200 M	CW 2, 3.6 M	CD 0.2 M
FCS 1(-3)	Q	INST

.AUTHOR ERVINE D A, ELLIS J .PUB'N TRANS ROYAL SOC EDINBURGH: EARTH SCIENCES, 78, 315-325, 1987

.TITLE EXPERIMENTAL AND COMPUTATIONAL ASPECTS OF OVERBANK FLOODPLAIN FLOW

.DATA VELOCITY, STAGE, DISCHARGE, SHEAR STRESS, REYNOLDS, FRICTION FACTOR, SINUOSITY, FLOW DEPTH

.KEY WORDS FLOOD PROPOGATION, MEANDERING CHANNELS, NUMERICAL MODELLING, RIVERS, SHEAR INTERACTION

.CHANNEL TYPE PROTO, EXP, THRY, SMTH, RGH, MEANDERS

.FL	.FW	.FD
.CL	.CW	.CD
.FCS	.Q	.INST

.AUTHOR FLINTHAM T P, CARLING P A .PUB'N INT. CONF. ON RIVER REGIME, WALLINGFORD, MAY, 1988

.TITLE THE PREDICTION OF MEAN BED AND WALL BOUNDARY SHEAR IN UNIFORM AND COMPOSITELY ROUGH CHANNELS

.DATA SHEAR FORCE, SHEAR STRESS, ROUGHNESS RATIO, WIDTH/DEPTH RATIO, PERIMETER RATIO

.KEY WORDS BOUNDARY SHEAR, COMPOSITE ROUGHNESS

.CHANNEL TYPE EXP, PROTO, SIMP, RGH

.FL 13 M	.FW 0.3 M	.FD 0.45 M
.CL 13 M	.CW 0.3 M	.CD
.FCS 7.17 - 14.29(-3)	.Q	.INST POINT GAUGE, MINIATURE CURRENT METER

.AUTHOR GRIJSEN J G, VREUGDENHIL C B .PUB'N DELFT HYDRAULICS LABORATORY, PUB'N NO 165, JUNE, 1976

.TITLE NUMERICAL REPRESENTATION OF FLOOD WAVES IN RIVERS

.DATA PROPOGATION VELOCITY, DIFFUSIVE & KINEMATIC WAVES, DAMPING LENGTH, WAVE PERIOD, INERTIAL WAVES

.KEY WORDS FLOOD WAVES, RIVERS, COMPUTATIONAL MODEL

.CHANNEL TYPE THRY, PROTO, COMP, RGH

.FL	.FW	.FD
.CL	.CW	.CD
.FCS	.Q	.INST

AUTHOR HALVERSON M J, GULLIVER J S		PUB'N ADVANCEMENTS IN AERODYNAMICS, FLUID MECH., AND HYD., MINNEAPOLIS, JUNE, 1986
TITLE MEASUREMENTS OF SECONDARY FLOW IN A MOVING BED FLUME		
DATA VELOCITY PROFILES, SECONDARY CELLS, FLOW VISUALISATION		KEY WORDS MOBILE BED, SECONDARY FLOW
CHANNEL TYPE EXP, SIMP, RGH		
FL 15 M	FW 0.76 M	FD
CL 10.5	CW 0.71 M	CD
FCS	Q	INST HYDROGEN BUBBLES, LASER DOPPLER VELOCIMETER

AUTHOR HOLDEN A P, JAMES C S		PUB'N J HYDRAULIC RESEARCH, 27, 1989, NO 3
TITLE BOUNDARY SHEAR DISTRIBUTION ON FLOOD PLAINS		
DATA SHEAR STRESS PROFILES, PEAK SHEAR STRESS RATIO, DEPTH RATIO, INTERACTION ZONE, BED SHEAR		KEY WORDS BOUNDARY SHEAR, FLOOD PLAINS
CHANNEL TYPE EXP, THRY, COMP, SMOOTH		
FL	FW 920 MM	FD
CL	CW 361, 545 MM	CD 106 MM
FCS 1(-3)	Q 28 - 49.5 LITRES/SEC	INST PRESTON TUBE, PRESSURE TRANSDUCER

AUTHOR IKEDA S, NISHIMURA T		PUB'N PASCE, J HYD D, VOL 112, HY7, JULY, 1986
TITLE FLOW AND BED PROFILE IN MEANDERING SAND SILT RIVERS		
DATA SECONDARY FLOW, BED LOAD, SUSPENDED LOAD, BED TOPOGRAPHY		KEY WORDS MEANDERS, SECONDARY FLOW, SEDIMENT TRANSPORT
CHANNEL TYPE THRY, EXP, SIMP, RGH, MEANDER		
FL 11.9 M	FW 0.30 M	FD
CL 10.28 M	CW 0.30 M	CD
FCS 1.39(-3)	Q 2.6 LITRES/SEC	INST POINT GAUGES, SAND SAMPLERS

AUTHOR IMAMOTO H, ISHIGAKI T		PUB'N PROC 3 RD INT SYMP REFINED FLOW MODELLING & TURB. MEASUREMENTS, TOKYO, 1988
TITLE MEAN AND TURBULENCE STRUCTURE NEAR THE INCLINED SIDE WALL IN AN OPEN CHANNEL FLOW		
DATA MEAN VELOCITY & SECONDARY FLOW VECTORS, BOUNDARY SHEAR STRESS, TURBULENCE INTENSITY		KEY WORDS COMPOUND CHANNEL, BOUNDARY SHEAR STRESS, TURBULENCE STRUCTURE, SECONDARY FLOW
CHANNEL TYPE EXP, SIMP, SMOOTH		
FL 5.9, 13 M	FW 0.2, 0.39 M	FD
CL 5.9, 13 M	CW	CD
FCS 6.94 - 24.7(-4)	Q 0.001478 - 0.008539 CUMECS	INST LASER DOPPLER ANEMOMETER, MINIATURE CURRENT METER

AUTHOR INTERNATIONAL ASSOCIATION FOR HYDRAULIC RESEARCH		PUB'N IAHR, VOL 3, SEPTEMBER, 1983
TITLE PROCEEDINGS, 20 TH CONGRESS, MOSCOW, SEPTEMBER, 1983		
DATA PAPERS ON MATHEMATICAL MODELLING AND INSTRUMENTATION OF HYDRAULIC PROCESSES		KEY WORDS SHEAR STRESS, HOT FILM PROBE, FLOOD PLAIN, MATHEMATICAL MODEL
CHANNEL TYPE		
FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR JOHANNESSON H, PARKER G		PUB'N PASCE, J HYD D, VOL 115, HY3, MARCH, 1989
TITLE SECONDARY FLOW IN MILDLY SINUOUS CHANNEL		
DATA VELOCITY PROFILES, PRIMARY FLOW, SECONDARY FLOW, PHASE LAG, AMPLITUDE RATIO		KEY WORDS SINUOUS CHANNELS, SECONDARY FLOW
CHANNEL TYPE THRY, EXP, PROTO, SMTH, RGH		
FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR KAWAHARA Y, TAMAI N		PUB'N PROC 3 RD INT SYMP REFINED FLOW MODELLING & TURB. MEASUREMENTS, TOKYO, 1988
TITLE NUMERICAL CALCULATION OF TURBULENT FLOWS IN COMPOUND CHANNELS WITH AN ALGEBRAIC STRESS TURBULENCE MODEL		
DATA PRIMARY VELOCITY, SHEAR STRESS, SECONDARY FLOW, NORMAL STRESS		KEY WORDS COMPOUND CHANNEL, OPEN CHANNEL, DUCT, SECONDARY FLOW, SHEAR STRESS
CHANNEL TYPE EXP, THRY, SMOOTH, COMP		
FL	FW 0.195, 0.072 M	FD -, 0.072 M
CL	CW 0.087, 0.036 M	CD 0.0501, 0.018 M
FCS	Q	INST

AUTHOR KELLER R J, RODI W		PUB'N
TITLE PREDICTION OF FLOW CHARACTERISTICS IN MAIN CHANNEL/FLOOD PLAIN FLOWS		
DATA WALL SHEAR, CROSS SECTIONS, VEL DISTRIBUTION, BED SHEAR STRESS DISTRIBUTION		KEY WORDS COMPOUND CHANNEL, MOMENTUM TRANSFER, SHEAR STRESS
CHANNEL TYPE THRY, EXP, COMP, RGH, SMTH		
FL 12, 60 M	FW 1.179, 27 M	FD
CL 12, 60 M	CW 0.17, 5.0 M	CD 0.083, 0.8 M
FCS 2.5/10(-4)	Q 0.0091 - 9.17 CUMECS	INST PRESTON TUBE, LASER DOPPLER ANEM., E.M. METER

AUTHOR KELLER R J, PERERA B J C, RODI W		PUB'N PROC 3 RD INT SYMP REFINED FLOW MODELLING & TURB. MEASUREMENTS, TOKYO, 1988
TITLE PREDICTION OF DEPTH AVERAGED FLOW CHARACTERISTICS IN COMPOUND CHANNELS		
DATA DIMENSIONLESS VELOCITY, TRANSVERSE DISTANCE, DIMENSIONLESS BED SHEAR		KEY WORDS COMPOUND CHANNEL, BED SHEAR STRESS
CHANNEL TYPE THRY, EXP, SMTH, RGH, COMP		
FL	FW 1.179, 1.22 M	FD
CL	CW 0.102, 0.711 M	CD 0.0826, 0.174 M
FCS 0.25 - 0.94(-3)	Q 0.0091 - 0.03 CUMECS	INST

AUTHOR KLAASSEN G J, VAN URK A

PUB'N 21ST CONGRESS, IAHR, MELBOURNE, AUGUST, 1985, VOL 3

TITLE RESISTANCE TO FLOW OF FLOODPLAINS WITH GRASSES AND HEDGES

DATA CHEZY COEFF, DEPTH, NIKURADSE k, HEDGE DISCHARGE COEFF, DISCHARGE, TIME, RELATIVE DEPTH

KEY WORDS FLOODPLAINS, VEGETATION

CHANNEL TYPE EXP, PROTO, SIMP, RGH

FL 20 M	FW 0.6 M	FD 0.3 M
CL 20 M	CW 0.6	CD 0.3 M
FCS	Q 0.02 - 0.029 CUMECS	INST POINT GAUGES

AUTHOR LAI C J, KNIGHT D W

PUB'N PROC 3 RD INT SYMP REFINED FLOW MODELLING & TURB. MEASUREMENTS, TOKYO, 1988

TITLE DISTRIBUTIONS OF STREAMWISE VELOCITY AND BOUNDARY SHEAR STRESS IN COMPOUND DUCTS

DATA ISOVELS, VEL DISTRIBUTION, WALL & BED SHEAR STRESS, LATERAL FRICTION DISTRIBUTION, FRICTION FACTOR

KEY WORDS BOUNDARY SHEAR STRESS, FRICTION FACTOR, COMPOUND CHANNEL, DUCTS

CHANNEL TYPE EXP, THRY, COMP, DUCTS, SMTH

FL 17 M	FW 0.154, 0.378 M	FD 0.04158, 0.06276 M
CL 17 M	CW 0.077 M	CD 0.0385 M
FCS	Q AIR	INST PITOT TUBE, PRESTON TUBE

AUTHOR LARSSON R

PUB'N PROC 3 RD INT SYMP REFINED FLOW MODELLING & TURB. MEASUREMENTS, TOKYO, 1988

TITLE NUMERICAL SIMULATION OF FLOW IN COMPOUND CHANNELS

DATA NON DIMENSIONAL ISOVELS

KEY WORDS ALGEBRAIC STRESS MODEL, COMPOUND CHANNEL, SECONDARY CURRENTS

CHANNEL TYPE THRY, EXP, COMP, SMTH

FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR McKEE P M, ELSAWY E M, McKEOGH E J		PUB'N 21ST CONGRESS, IAHR, MELBOURNE, AUGUST, 1985
TITLE A STUDY OF THE HYDRAULIC CHARACTERISTICS OF OPEN CHANNELS WITH FLOOD PLAINS		
DATA VELOCITY,TURBULENCE AND SHEAR STRESS PROFILES, SHEAR FORCE, SHEAR STRESS AND VELOCITY RATIOS		KEY WORDS COMPOUND CHANNELS, SHEAR STRESS, TURBULENCE
CHANNEL TYPE EXP, COMP, SMTH		
FL 9.15 M	FW 0.61 M	FD
CL 9.15 M	CW 0.102, 0.254 M	CD 0.153 M
FCS 2.63(-4)	Q	INST LASER DOPPLER ANEMOMETER, PRESTON TUBE

AUTHOR NALLURI C, JUDY N D		PUB'N 21ST CONGRESS, IAHR, MELBOURNE, AUGUST, 1985
TITLE INTERACTION BETWEEN MAIN CHANNEL AND FLOOD PLAIN FLOW		
DATA ISOVELS, ROUGHNESS PATTERN, ROUGHNESS COEFF., SHEAR STRESS		KEY WORDS COMPOUND CHANNEL, FLOW INTERACTION, FLOODPLAIN ROUGHNESS
CHANNEL TYPE EXP, COMP, SMTH, RGH		
FL 9.5 M	FW 0.7 M	FD
CL 9.5 M	CW 0.195, 0.4 M	CD 0.075, 0.15 M
FCS 1.084(-3)	Q 9.74 - 12.19 LITRES/SEC	INST PITOT TUBE

AUTHOR NOKES R I, WOOD I R		PUB'N J FLUID MECH., VOL 187, 1988
TITLE VERTICAL AND LATERAL TURBULENT DISPERSION:SOME EXPERIMENTAL RESULTS		
DATA LATERAL DIFFUSIVITY, ISOVELS, CONCENTRATIONS, TURBULENT DIFFUSION COEFFICIENT		KEY WORDS TURBULENCE, DISPERSION
CHANNEL TYPE EXP, SMTH, SIMP		
FL 12 M	FW 0.560 M	FD 0.430 M
CL 12 M	CW 0.560 M	CD 0.430 M
FCS 4.7(-4)	Q 0.007 - 0.01 CUMECS	INST CONDUCTIVITY CELL

AUTHOR ODGAARD A J	PUB'N PASCE, J HYD D, VOL 112, HY12, DECEMBER, 1986
TITLE MEANDER FLOW MODEL. 1:DEVELOPMENT	
DATA RADIAL VELOCITY, NORMALISED DEPTH, BEND RATIO, ASPECT RATIO, TRANSVERSE BED SLOPE	KEY WORDS MEANDER, BED TOPOGRAPHY, FLOW PROFILE
CHANNEL TYPE THRY, EXP, PROTO, SIMP, RGH, MEANDER	

FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR ODGAARD A J	PUB'N PASCE, J HYD D, VOL 112, HY12, DECEMBER, 1986
TITLE MEANDER FLOW MODEL. 2:APPLICATIONS	
DATA WIDTH, VELOCITY, DEPTH, SEDIMENT SIZE, SLOPE	KEY WORDS MEANDER, BED TOPOGRAPHY, FLOW PROFILE
CHANNEL TYPE THRY, PROTO, SIMP, RGH, MEANDER	

FL	FW	FD
CL 60, 150 M	CW 4, 7.8 M	CD 0.34, 0.4 M
FCS 1.4 - 1.73(-3)	Q 1.1 - 1.4 CUMECS	INST

AUTHOR PASCHE E, ROUVE G, EVERS P	PUB'N 21ST CONGRESS, MELBOURNE, AUGUST, 1985
TITLE FLOW IN COMPOUND CHANNELS WITH EXTREME FLOOD PLAIN ROUGHNESS	
DATA VELOCITY RATIO, SHEAR RATIO, FRICTION FACTOR, ROUGHNESS DENSITY	KEY WORDS COMPOUND CHANNEL, TURBULENT SHEAR STRESS
CHANNEL TYPE THRY, EXP, COMP, SMTH, RGH	

FL	FW 1.55 M	FD
CL	CW 0.314, 0.438 M	CD 0.124 M
FCS 0.5 - 1(-3)	Q	INST LASER DOPPLER ANEMOMETER, PRESTON TUBE

.AUTHOR PASCHE E, ARNOLD U, ROUVE G | .PUB'N ADVANCEMENTS IN AERODYNAMICS, FLUID MECH., AND HYD., MINNEAPOLIS, JUNE, 1986

.TITLE A REVIEW OF OVERBANK FLOW MODELS

.DATA APPARENT SHEAR STRESS, TURBULENT SHEAR STRESS, EDDY VISCOSITY, k-e MODEL | .KEY WORDS TURBULENCE, SHEAR STRESS, COMPOUND CHANNEL

.CHANNEL TYPE EXP, COMP, RGH

.FL 25.5 M	.FW 1 M	.FD 1.M
.CL 25.5 M	.CW 0.5, 0.675 M	.CD
.FCS 0.5 - 1(-2)	.Q	.INST 1, 2 COMPONENT LDA SYSTEMS, PRESTON TUBE

.AUTHOR PRINOS P, TAVOULARIS S, TOWNSEND R | .PUB'N PASCE, J HYD D, VOL 114, 1, JANUARY, 1988

.TITLE TURBULENCE MEASUREMENTS IN SMOOTH AND ROUGH WALLED TRAPEZOIDAL DUCTS

.DATA ISOVELS, SHEAR STRESS, TURBULENT VELOCITY, TURBULENT KINETIC ENERGY, TURBULENT SHEAR STRESS | .KEY WORDS TURBULENCE, DUCTS, SHEAR STRESS

.CHANNEL TYPE EXP, SMTH, RGH, DUCT

.FL 12, 17 M	.FW 0.305, 0.406 M	.FD 0.102 M
.CL	.CW	.CD
.FCS	.Q AIR	.INST PRESTON TUBE, HOT WIRE PROBE

.AUTHOR PURI A N, KUO C Y | .PUB'N APPLIED MATHEMATICAL MODELLING, VOL 9, 2, APRIL, 1985

.TITLE NUM. MOD. OF SUBCRITICAL OPEN CHANNEL FLOW USING THE k-e TURB. MOD. & THE PENALTY FUNCTION F.E.M.

.DATA MESH CONFIGURATION, WATER DEPTHS, BOTTOM SHEAR STRESS, REYNOLDS SHEAR STRESS, MOMENTUM DISPERSION | .KEY WORDS BEND, SHEAR STRESS, NUMERICAL MODEL

.CHANNEL TYPE THRY, SIMP, SMTH, BEND

.FL	.FW	.FD
.CL	.CW	.CD
.FCS	.Q	.INST

AUTHOR RADOJKOVIC M, DJORDJEVIC S		PUB'N 21ST CONGRESS, IAHR, MELBOURNE, AUGUST, 1985, VOL 3
TITLE COMPUTATION OF DISCHARGE DISTRIBUTION IN COMPOUND CHANNELS		
DATA DISCHARGE, RELATIVE DEPTH; SEPARATE CHANNEL , k-e , DIMENSIONLESS EDDY VISCOSITY METHODS		KEY WORDS COMPOUND CHANNEL, DISCHARGE DISTRIBUTION
CHANNEL TYPE EXP, THRY, COMP, SMOOTH		
FL	FW	FD
CL	CW 0.152 M	CD 0.076 M
FCS 9.66(-4)	Q 0 - 18.0 LITRES/SEC	INST

AUTHOR RADOJKOVIC M		PUB'N 3RD SYMP WATERWAYS, HARBOURS & COASTAL ENG DIV, ASCE, VOL 1, 1976
TITLE MATHEMATICAL MODELLING OF RIVERS WITH FLOODPLAINS		
DATA RELATIVE DEPTH, COMPOUND CHANNEL PARAMETERS		KEY WORDS COMPOUND CHANNEL, COMPUTATIONAL MODEL, FLOOD ROUTING
CHANNEL TYPE THRY, EXP, COMP, SMOOTH		
FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR RAJARATNAM N, MURALIDHAR D		PUB'N DEPT. CIVIL ENGINEERING, ALBERTA UNIVERSITY, EDMONTON, CANADA, SEPT, 1967
TITLE YAW AND PITCH PROBES		
DATA VELOCITY VECTOR, CALIBRATION FACTOR, SHEAR FLOW, CALIBRATION COEFFICIENTS		KEY WORDS YAW & PITCH PROBE
CHANNEL TYPE EXP, THRY, SIMP, SMTH		
FL	FW	FD
CL	CW	CD
FCS	Q	INST YAW PROBE, PITCH PROBE

AUTHOR RODI W

PUB'N PROC 3 RD INT SYMP REFINED FLOW MODELLING & TURB. MEASUREMENTS, TOKYO, 1988.

TITLE RECENT DEVELOPMENTS IN TURBULENCE MODELLING

DATA STREAMLINES, VELOCITY PROFILES, DAMPING FUNCTION, DISSIPATION RATE, NORMAL STRESS

KEY WORDS TURBULENCE, REYNOLDS STRESS, PRESSURE STRAIN

CHANNEL TYPE THEORY

FL	FW	FD
CL	CW	CD

FCS	Q	INST

AUTHOR ROHR J J, ITSWEIRE E C, HELLAND K N, VAN ATTA C W.

PUB'N J FLUID MECH., VOL 187, 1988

TITLE AN INVESTIGATION OF THE GROWTH OF TURBULENCE IN A UNIFORM MEAN SHEAR FLOW

DATA VELOCITY PROFILE, TURBULENT INTENSITY, TURBULENT KINETIC ENERGY, VELOCITY SPECTRA

KEY WORDS TURBULENCE, SHEAR FLOW

CHANNEL TYPE EXP, SMTH, DUCT

FL 5.00 M	FW 0.25 M	FD 0.40 M
CL 5.00 M	CW 0.25 M	CD 0.40 M

FCS	Q	INST HOT FILM ANEMOMETER

AUTHOR SAMUELS P G

PUB'N INT. CONF. OF FLUVIAL HYDRAULICS, BUDAPEST, 1988

TITLE LATERAL SHEAR LAYERS IN COMPOUND CHANNELS

DATA CHANNEL CHARACTERISTICS, VELOCITY, DISTANCE, SHEAR LAYER

KEY WORDS LATERAL SHEAR LAYERS, COMP. CHANNEL

CHANNEL TYPE THRY, PROTO, COMP, RGH

FL	FW	FD
CL	CW 30 M	CD 4 M

FCS 5(-4)	Q	INST

.AUTHOR SCHULZ A .PUB'N BERLIN, INSTITUT FUR WASSERBAU UND WASSERWIRTSCHAFT, BERLIN, MITTEILUNG 107

.TITLE ZUR NAHERUNGSBERECHNUNG DES ABFLUSSES IN NATURNAH GESTALTETEN FLIESSGEWASSERN

.DATA VELOCITY, DEPTH, REYNOLDS, ROUGHNESS ELEMENT, ISOVELS, MOMENTUM TRANSFER

.KEY WORDS COMPOUND CHANNELS, MOMENTUM TRANSFER

.CHANNEL TYPE EXP, PROTO, THRY, COMP, RGH

.FL 15 M	.FW 0.6 M	.FD 1.0 M
.CL 15 M	.CW 0.6 M	.CD 1.0 M
.FCS	.Q	.INST STRAIN GAUGE, CURRENT METER

.AUTHOR SELLIN R H J, GILES A .PUB'N UNIV. OF BRISTOL, DEPT. CIVIL ENGINEERING, JULY, 1988

.TITLE TWO STAGE CHANNEL FLOW

.DATA ISOVELS, APP. SHEAR FORCE, APP. SHEAR STRESS, FRICTION FACTOR, DEPTH, DISCHARGE, STAGE, SINUOSITY

.KEY WORDS COMPOUND CHANNEL, SINUOSITY, VEGETATION

.CHANNEL TYPE PROTO, EXP, COMP, RGH

.FL 9.5 M	.FW 1.2 M	.FD 0.3 M
.CL 6.0 M	.CW 0.048 M	.CD 0.025 M
.FCS	.Q 0 - 14.8 L/S	.INST ORIFICE PLATES, CAPACITANCE PROBE, PITOT TUBE, PRESSURE TRANSDUCER

.AUTHOR SHIONO K, KNIGHT D W .PUB'N PROC 3 RD INT SYMP REFINED FLOW MODELLING & TURB. MEASUREMENTS, TOKYO, 1988

.TITLE TWO DIMENSIONAL ANALYTICAL SOLUTION FOR A COMPOUND CHANNEL

.DATA REL DEPTH, NORMAL DEPTH, FRICTION FACTORS, TRANSVERSE BED SHEAR STRESS & VELOCITY, DISCHARGE RATIO

.KEY WORDS COMPOUND CHANNEL, BOUNDARY SHEAR STRESS, EDDY VISCOSITY

.CHANNEL TYPE EXP, COMP, SMOOTH

.FL 56 M	.FW 10 M	.FD
.CL 50 M	.CW 1.5 M	.CD 0.150 M
.FCS 1.027(-3)	.Q 1.1 CUMECS	.INST MINIATURE CURRENT METERS, PRESTON TUBES, POINT GAUGES

AUTHOR SILL B L		PUB'N ADVANCEMENTS IN AERODYNAMICS, FLUID MECH., AND HYD., MINNEAPOLIS, JUNE, 1986.
TITLE VELOCITY PROFILES IN THE TURBULENT BOUNDARY LAYER		
DATA SHEAR STRESS, von KARMAN'S CONSTANT, VEL DEFECT PLOT, VEL PROFILE, LAW OF THE WALL, POWER LAW PROFILE		KEY WORDS TURBULENCE, BOUNDARY LAYER
CHANNEL TYPE THRY, EXP, SIMP, SMTH		
FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR SLEATH J F A		PUB'N J FLUID MECH., VOL 182, 1987
TITLE TURBULENT OSCILLATORY FLOW OVER ROUGH BEDS		
DATA REYNOLDS STRESS, VEL. SPECTRA, FRICTION COEFF., SHEAR STRESS, EDDY VISCOSITY, DEFECT VEL.		KEY WORDS TURBULENCE, SHEAR STRESS, VISCOSITY
CHANNEL TYPE EXP, RGH, DUCT		
FL 3.66 M	FW 0.305 M	FD 0.45 M
CL 3.66 M	CW 0.305 M	CD 0.45 M
FCS	Q	INST LASER DOPPLER ANEMOMETER

AUTHOR SOCIETE HYDROTECHNIQUE DE FRANCE		PUB'N LA HOUILLE BLANCHE, NO 7/8, 1987
TITLE TURBULENCE:LES DERNIERS PROGRES DE LA CONNAISSANCE		
DATA VARIOUS PAPERS ON TURBULENCE;MEASUREMENT OF;VISUALISATION OF		KEY WORDS TURBULENCE, SHEAR, WALL FLOW, DRAG, SEPARATION, VORTICES
CHANNEL TYPE		
FL	FW	FD
CL	CW	CD
FCS	Q	INST LASER DOPPLER ANEMOMETER, HOT WIRE ANEMOMETER

.AUTHOR STEIN C J, ROUVE G
.PUB'N INTERNATIONAL CONFERENCE ON FLUVIAL HYDRAULICS, BUDAPEST, JUNE, 1988

.TITLE 2D LDV TECHNIQUE FOR MEASURING FLOW IN A MEANDERING CHANNEL WITH WETTED FLOODPLAINS

.DATA NORMALISED VELOCITY PROFILES, SECONDARY FLOW
.KEY WORDS MEANDER, COMPOUND CHANNEL, LASER DOPPLER VELOCIMETER

.CHANNEL TYPE EXPERIMENTAL, COMPOUND, SMOOTH, MEANDER

.FL 15 M	.FW 3 M	.FD 0.3 M
.CL 13.7 M	.CW 0.40 M	.CD 0.10 M
.FCS 5(-4)	.Q 54.6 LITRES/SEC	.INST LASER DOPPLER VELOCIMETER, MINIATURE CURRENT METER

.AUTHOR TAMAI N
.PUB'N PROC 3 RD INT SYMP REFINED FLOW MOD. ELLING & TURB. MEASUR. EMENTS, TOKYO, 1988

.TITLE COHERENT STRUCTURES IN THE FLOW IN RIVERS AND OPEN CHANNELS

.DATA COHERENT & VORTICAL STRUCTURES, TRANSVERSE UNDULATION, REVERSE VEL, PRESSURE VEL CORRELATION
.KEY WORDS COHERENT STRUCTURES, SECONDARY FLOW, VORTICES

.CHANNEL TYPE THRY, EXP, SMTH, COMP

.FL	.FW	.FD
.CL	.CW	.CD
.FCS	.Q	.INST

.AUTHOR THIRRIOT C
.PUB'N INT. SYMP. ON UNSTEADY FLOWS IN OPEN CHANNELS, APRIL 1976, NEWCASTLE

.TITLE UNSTEADY FLOWS IN DOUBLE PROFILED CHANNELS

.DATA SURGE, WAVE FRONT, SUPERFICIAL WAVE, PROFILE DISCONTINUITY
.KEY WORDS UNSTEADY FLOW, MOMENTUM TRANSFER, COMPOUND CHANNELS

.CHANNEL TYPE THRY, EXP, COMP, RGH

.FL	.FW	.FD
.CL	.CW	.CD
.FCS	.Q	.INST

.AUTHOR TOMINAGA A, EZAKI K, NEZU I

.PUB'N PROC 3 RD INT SYMP REFINED FLOW MODELLING & TURB. MEASUREMENTS, TOKYO, 1988

.TITLE TURBULENT STRUCTURE IN COMPOUND CHANNEL FLOWS WITH RECTANGULAR AND TRAPEZOIDAL MAIN CHANNEL

.DATA SECONDARY CURRENT VECTORS, ISOVELS, TURBULENCE ENERGY, SHEAR STRESS

.KEY WORDS COMP CHAN, SECONDARY CURRENTS, TURBULENCE ENERGY, SHEAR STRESS, MOMENTUM TRANSER.

.CHANNEL TYPE EXP, THRY, COMP, SMOOTH

.FL 12.5 M	.FW 0.40 M	.FD
.CL 12.5 M	.CW 0.098, 0.188 M	.CD 0.0501 M
.FCS	.Q 0.00264 - 0.00912 CUMECS	.INST HOT FILM ANEMOMETER, PITOT STATIC TUBE

.AUTHOR UTNES T

.PUB'N INT. J. FOR NUMERICAL METHODS IN FLUIDS, VOL 8, 1988

.TITLE TWO EQUATION (k-e) TURBULENCE EQUATIONS BY THE USE OF A FINITE ELEMENT MODEL

.DATA VELOCITY PROFILE, KINETIC ENERGY, SHEAR STRESS, BOUNDARY CONDITIONS, FEM GRID

.KEY WORDS FINITE ELEMENT METHOD, TURBULENT FLOW, GALERKIN METHOD

.CHANNEL TYPE THEORY, SIMPLE, SMOOTH, STEP

.FL	.FW	.FD
.CL	.CW	.CD
.FCS	.Q	.INST

.AUTHOR VINCENT J, STRAUSS V

.PUB'N 16TH CONGRESS, IAHR, SAO PAULO, VOL 3, 1975

.TITLE CULTIVATION OF WOODS IN FLOOD PLAINS OF LARGE RIVERS AND ITS EFFECT ON THE RUNOFF OF HIGH FLOOD DISCHARGES.

.DATA ROUGHNESS DISTRIBURION, MEAN VELOCITY, DEPTH, ROUGHNESS COEFFICIENT, STEM DIAMETER

.KEY WORDS FLOODPLAIN, VEGETATION, ROUGHNESS DENSITY, DISCHARGE COMPUTATION

.CHANNEL TYPE EXP, THRY, SIMP, RGH

.FL 20 M	.FW 0.6 M	.FD
.CL 20 M	.CW 0.6 M	.CD
.FCS 0 - 2(-2)	.Q	.INST

AUTHOR WANG S S Y

PUB'N INTERNATIONAL CONFERENCE ON FLUVIAL HYDRAULICS, BUDAPEST, JUNE, 1988

TITLE THREE DIMENSIONAL MODELS FOR FLUVIAL HYDRAULIC SIMULATION

DATA VELOCITY PROFILES, VELOCITY FIELD, SEDIMENT TRANSPORT

KEY WORDS COMPUTATIONAL MODEL, FLOW SIMULATION

CHANNEL TYPE THRY, EXP, COMP, SMTH, RGH

FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR WORMLEATON P G

PUB'N INT CONF ON FLUVIAL HYDRAULICS, BUDAPEST, 1988

TITLE DETERMINATION OF DISCHARGE IN COMPOUND CHANNELS USING THE DYNAMIC EQUATION FOR LATERAL VEL. DISTRIBUTION.

DATA VELOCITY VARIATION, DEPTH RATIO, WIDTH RATIO, SHEAR FORCE

KEY WORDS COMPOUND CHANNEL, LATERAL VELOCITY DISTRIBUTION, SHEAR FORCE

CHANNEL TYPE EXP, COMP, RGH

FL 56 M	FW 10 M	FD
CL 15 M	CW 1.5 M	CD 0.15 M
FCS 1(-3)	Q 1.1 CUMECS	INST CURRENT METERS, PRESTON TUBE, POINT GAUGES

AUTHOR WORMLEATON P R, HADJIPANOS P

PUB'N PROC INT CONF HYD ENG SOFTWARE,(HYDROCOMP), PORTOROZ,YUGOSLAVIA, SEPT, 1984

TITLE MODELLING OF DISCHARGE IN COMPOUND CHANNELS

DATA MOMENTUM TRANSFER, DEPTH RATIO, ROUGHNESS, DISCHARGE RATIO

KEY WORDS COMPOUND CHANNEL, MOMENTUM TRANSFER

CHANNEL TYPE EXP ,THRY, COMP, SMOOTH, ROUGH

FL 10.75 M	FW 1.21 M	FD
CL 10.75 M	CW 0.29 M	CD 0.12 M
FCS 4.3(-4)	Q	INST PRESTON TUBE, MICROMANOMETER, PRESSURE TRANS, MCM, HOT FILM ANEM.

AUTHOR YOSHIDA S, YAGI S	PUB'N J HYDROSCIENCE & HYD ENGINEERING, VOL 5, 1, JULY, 1987
TITLE DEVELOPMENT OF LASER DOPPLER ANEMOMETRY FOR RIVER FLOW MEASUREMENT	
DATA FLOW VELOCITY, POWER SPECTRUMS, PROBABILITY DISTRIBUTIONS	KEY WORDS VELOCITY MEASUREMENT, LASER DOPPLER ANEMOMETRY
CHANNEL TYPE PROTO, RGH	

FL	FW	FD
CL	CW	CD 4.1 M
FCS	Q	INST LASER DOPPLER ANEMOMETER, HOT FILM ANEMOMETER, CURRENT METER

3 PRECIS OF PAPERS

The precis of papers relating to turbulence and flow characteristics in channels, ducts and pipes was compiled on the Apricot Xi-10 micro computer using Wordstar 3.40 supplied by Micro Pro.

This file indicates the aims and conclusions as detailed in the papers as well as the channel types investigated and instruments used in the experimental work.

The channel type detailed is described either as an experimental (flume), prototypical (river, irrigation canal) or theoretical (mathematical, computational) channel.

Channel form is detailed as simple; rectangular flume, channel or duct; or compound, a channel in which the geometry of the cross-section changes significantly at one particular elevation, giving rise to the discontinuity in the shape of the channel.

Smooth flumes, channels or ducts are considered to be formed of wood, steel floated concrete, glass or perspex. Rough channels are considered to be flumes and ducts with artificial roughening elements attached to the channel surface or river channels whose boundaries are considered to be naturally rough.

The aims, conclusions and details of instrumentation used are self explanatory.

ABRAHAMS 1984

The development of tributaries of different sizes along winding streams and valleys

1 Prototype, theoretical, simple, rough

2 To examine the possibility and, in the event there is a differential effect, to investigate the mechanism giving rise to the development of tributaries of different sizes along winding streams and valleys.

3 An analysis of 40 winding streams and valleys reveals that a higher proportion of large tributaries than small ones occur on the concave (out) side of bends. Pricipal reason for this is that large tributaries experience greater difficulty than small ones forming in the limited amount of space on the convex (in) side of bends. Proportion of small and large tributaries on the concave side of bends are determined largely by the spatial requirements of tributaries, valley sinuosity, mean valley bend length, and mean rate of bend migration. In addition, the proportion of large tributaries on the concave side of bends is affected by junction angle adjustments that deflect a main stream toward a large tributary, thereby creating a bend with the large tributary on its concave side. These adjustments increase the proportion of large tributaries on the concave side of bends, especially along low sinuosity headwater streams.

4 -

ALAVIAN, CHU 1985

Turbulent exchange flow in shallow compound channel

1 Experimental, compound, smooth, rough

2/3 Formulation of turbulent exchange flow from a set of depth averaged equations. Mean velocity profile of the exchange flow is obtained from the integration of the depth averaged equations. The width of the shear layer is related to a turbulent Reynolds number whose value has been determined from comparing the theoretical profile with experimental data and from a stability analysis of the mean flow.

4 -

AMERICAN SOCIETY OF CIVIL ENGINEERS 1976

RIVERS 76 : Symposium on Inland Waterways for Navigation, Flood Control and Water Diversions

Volume 1/2

Various papers relating to flood routing models, hydrodynamics, flow resistance, unsteady flows

Authors - FREAD; RADOJKOVIC; CHEN, LI & SIMONS; CHRISTENSEN; REED & WOLFKILL; HOU & CHRISTENSEN; ROBBINS; PONCE & MAHMOOD; THEURER, BARNES & RICHARDSON; LIN, SCOTTRON & SOONG; KAO & DEAN PERRY

ARNOLD, HOTTGES, ROUVE 1988

Combined Digital Image and Finite Element Analysis of mixing in compound open channal flow

1 Experimental, theoretical, compound, smooth, rough

2 To investigate the transverse mixing in channels with compound cross section and non submerged flood plain roughness

3 The apparent shear stress model and its wall turbulence assumptions for the interaction zone of the main channel is both physically well founded and very efficient for the computation of the velocity profile. The heterogeneity of geometry and roughness in compound open channels leads to a domination of large scale non Fickian mixing mechanisms in the regions adjacent to the channel banks. The model presented for the

calculation of the transverse diffusivity takes into account the effects of interaction induced mixing and significantly improves the accuracy of the transport model

4 Laser Doppler Anemometer, Fluorometer

ASHTON 1980

Computer and physical modeling in hydraulic engineering

Various papers on the numerical analysis of open channel flows, modeling of non uniform flows, effect of scale distortion on turbulent mixing

Authors - WYLIE; LAI, BALTZER & SCHAFFRANEK; FERRICK; BROWN & INGRAM; FINDIKAKIS & STREET; ROBERTS & STREET; CHANG; CAVES & JOHNSON

BECHTELER, FARBER 1985

Investigations of velocity and pressure fluctuations in open channel flow by a LDA and a Pitot tube

1 Experimental, simple, rough

2 The different performances of a LDA and a pressure measurement system with respect to the determination of turbulence parameters in open channel flow is demonstrated. The measurements are made simultaneously to investigate the correlations between the pressure and velocity signals

3 Differences are expressed in plots of autocovariance functions of velocities, time scales and spectra of turbulence

4 Laser Doppler Velocimeter, Pitot tube

BOTCHEVA, IONCHEVA 1988

Estimation of the roughness coefficients in the prediction of the geometrical parameters of stable river beds with compound cross sections

1 Theoretical, compound, rough

2 A mathematical model is developed for the investigation of the influence of the roughness coefficients on the geometrical parameters of streams with compound cross section

3 The choice of channel roughness is of prime importance for the determination of the geometrical parameters of a trained compound channel. The flood plain roughness value is only of importance for high overbank flow depths. Bed sediment transport is directly related to channel and flood plain roughness and consequently it is important to accurately determine the roughness coefficient to prevent aggradation or degradation of the proposed channel.

4 -

CHU, FALCO 1988

Vortex ring/viscous wall layer interaction model of the turbulence production process near walls

1 Experimental, simple, tank

2 To simulate experimentally the interaction of vortex ring like eddies with the sub layer of a turbulent boundary layer

3 Long low speed streaks are formed in pairs as the result of the interactions of microscale very coherent vortex ring like eddies propogating over the wall. Streamwise vortices are not required to streamwise streaks. When the streak spacings obtained in the simulation are conditioned by the probability of occurrence of typical eddy scales found in the boundary layer, the simulation provides the correct streak spacing of approximately 100 wall units.

4 Laser doppler anemometer

DUMA 1981

Influenta unor parametri asupra capacitatii de transport la ape mari a albilor riurilor indiguite

1 Experimental, rough, meanders.

2 To investigate the effect of roughened floodplains upon the conveyance of a meandering river.

3 Results are presented for meandering channels with a range of sinuosity. Relationships are shown between channel/floodplain depth ratios and discharge, sinuosity, channel/floodplain roughness ratio. Roughness coefficients are related to flow depth and density of vegetated cover.

4 -

DUMA 1984

Interactiunea dintre curgerea in alba minora si cea in albia majora la ape mari

1 Experimental, theoretical, compound, rough

2 To investigate the interaction of channel and flood plain flows

3 Presentation of results from experimental work on a straight compound channel with berms of different level. Velocity and shear stress results detailed. Paper also relates to meandering work by same author in 1981

4 -

DUMA 1984

La perfectionarea metodelor de calcul hidraulic al curgerii apelor mari in abiile cursurilor de apa amenajate prin lucraride indiguire si de regularizare

1 Experimental, theoretical, rough, compound, straight, meandering

2 Collation of author's work on the interaction of flow between channel and flood plain for straight and meandering channels

3 Presentation of data on velocity distribution, flow patterns, shear stress, relative flow depths, sinuosity, roughness coefficients, roughness density, asymmetric berm heights and widths, relative channel widths.

4 -

FLINTHAM, CARLING 1988

The prediction of mean bed and wall boundary shear in uniform and compositely rough channels

1 Experimental, prototypical, simple, rough

2 Experimental procedures and data compilations are presented which relate to the prediction of mean bed and wall boundary shear in uniform and compositely roughened channels. A tentative empirical model is proposed to predict the mean bed and side wall shear stresses for straight symmetrical trapezoidal and rectangular channels having uniform or composite roughness

3 Equations are derived to determine the mean bed and wall shear stresss. Shear related to channel wall/bed ratio and composite roughness ratio

4 Miniature current meter, point gauge

GRIJSEN, VREUGDENHIL 1976

Numerical representation of flood waves in rivers

1 Theoretical, prototype, compound, rough

2 An attempt to classify the different types of long waves and to study the properties of a numerical method, when applied to each of them.

3 The velocity of propagation for the general case of dynamic waves to the characteristic velocity of inertial waves is presented. If the ratio is unity, the waves have an inertial character. With increasing unsteadiness and non uniformity the kinematic wave case is approached. Effective velocities of propagation for the diffusive and kinematic waves are compared with the dynamic wave. Both methods give correct velocities of propagation if the unsteadiness and non uniformity is large, but the diffusive wave approach has a much wider range of application than the kinematic wave. Flood waves in rivers may not be described by the diffusion analogy if the unsteadiness and non uniformity is small, ie if the discharge varies quickly. Flood waves may, therefore, have the character of a dynamic wave. Damping length for the diffusive wave is compared to the dynamic wave; systematic deviation remains for large values of unsteadiness and non uniformity. This can be improved by accounting for the inertial and convective terms in the momentum equation in an approximate way.

4 -

HALVERSON, GULLIVER 1986

Measurements of secondary flow in a moving bed flume

1 Experimental, simple, rough

2 Hydrogen bubbles illuminated by a plane of laser light are used to visualise and measure secondary currents in a moving bed flume.

3 Number of secondary cells in a cross section is six for a depth/width ratio of 1:5 and 10 for a ratio of 1:10. Velocity components of secondary flow seem to be higher in a moving bed flume than in previous fixed bed flume tests. Maximum secondary flow velocities between 6% and 12% of the bed velocity with a tendency to decrease as bed velocity increased.

4 Laser Doppler Velocimeter, hydrogen bubbles.

HOLDEN, JAMES 1989

Boundary shear distribution on flood plains

1 Experimental, theoretical, compound, smooth

2 Experiments in a compound channel are described in which the inclination of the main channel bank was varied

3 The shape of the bank between the bed of the main channel and the flood plain affects the interaction between main channel and flood plain flows. In general for a given flow depth, the intensity of the interaction decreases slightly as the slope becomes milder but at very low flow depths the intensity was observed to be greater for a steeply sloping bank than for both vertical and milder slopes. The intensity of the interaction between the main channel and flood plain flows is determined by channel slope as well as geometric and roughness parameters. The net effect can be described in terms of the relative apparent shear stress. As the intensity of interaction decreases, the form of distribution of bed shear stress on the flood plain changes from a simple exponential decrease from the plain channel junction at high intensities, to a flat topped distribution at intermediate intensities and a peaked distribution with the maximum shear stress displaced from the junction at low intensities. Equations are developed to describe these distributions, and are based on laboratory data and have not been verified for larger channels.

4 Preston tube, pressure transducer

INTERNATIONAL ASSOCIATION FOR HYDRAULIC RESEARCH 1983

20th CONGRESS - MOSCOW

VOLUME 3

Various papers on the mathematical modelling and instrumentation of hydraulic processes

Authors - DI MONACO & MOLINARO; BEMOVA, KOLAR & POLIERT; KIA; DEBIUS

IKEDA, NISHIMURA 1986

Flow and bed profile in meandering sand silt rivers

1 Theoretical, experimental, simple, rough, meander

2 A mathematical model for predicting flow and large scale bed topography in sinuous channels with suspendable bed materials is presented

3 Secondary flow in sinuous channels shows a reduction in magnitude from that of uniformly curved channels; it also shows a phase lag relative to the channel plan form. Model allows for predicting the magnitude and location of local scour and deposition in meandering sand silt rivers. Analysis on bed topography is valid for sinuous channels with well sorted bed material.

4 Preston tube, pressure transducer

IMAMOTO, ISHIGAKI 1988

Mean and Turbulence Structure near the inclined side wall in an open channel flow

1 Experimental, simple, smooth

2 To investigate the effect of the channel boundary on the mean and turbulence structure in a trapezoidal channel section

3 For the trapezoidal channel,boundary shear stress at bthe foot of the inclined side wall does not show zero value but a larger value than the immediate vicinity. For the rectangular channel the value at the toe of the side wall is zero. Results from velocity measurements and flow visualisations show that the above phenomena is related to the coherent structure near the side wall which is originated by a dominant secondary flow to the corner and depth scale eddy motions induced by the flow. On the water surface, the divergent part of the upwelling flow has large turbulence intensity and the convergent part of the downwelling flow a low turbulence intensity.

4 Laser Doppler Anemometer, Miniature current meter

JOHANNESSON, PARKER 1989

Secondary flow in mildly sinuous channel

1 Theoretical, experimental, prototypical, smooth, rough

2 Secondary flow in river bends is driven by the local imbalance between the centrifugal force and the transverse pressure force generated by super elevation of the water surface. Analytical solutions for secondary flows have previously not retained the effect of fluid inertia in the equation governing the secondary flow. Consequently, no phase shift is found between secondary current strength and local centreline channel curvature.

3 Theoretical model for the calculation of secondary flow in mildly sinuous channels is developed. Downstream convective acceleration of the secondary flow is shown to give rise to a phase lag between the secondary flow and channel centreline curvature, and also to suppress the magnitude of the flow. Analysis indicates that although the

predicted lag must be accounted for in the simulation of the flow field and the bed topography in many experiments, it can be neglected without making a large error for most natural meandering rivers.

4 -

KAWAHARA, TAMAI 1988

Numerical calculation of turbulent flows in compound channels with an Algebraic Stress Turbulence model

1 Experimental, theoretical, compound, smooth

2 To present an algebraic stress turbulence model for calculating flows in compound prismatic channels with turbulence driven secondary motion

3 Model tested by application to a developed open channel flow and also to a developed duct flow. Comparisons indicate that the model is able to predict the mean velocity fields in compound channel flows, but is incapable of explaining correctly the generation mechanism of turbulence driven secondary flow in compound channels.

4 -

KELLER, PERERA, RODI 1988

Prediction of depth averaged flow characteristics in compound channels

1 Theoretical, experimental, smooth, rough, compound

2 To describe the development of a two dimensional mathematical model and its application to the flow predictions in compound channels

3 A two dimensional model utilising the k-e turbulence model for calculating depth averaged turbulent shear stesses, can be utilised to predict velocity and bed shear stress distributions in compound channel

flows. In using the model, none of the empirical coefficients were tuned to match the experimental results but were simply adopted from the literature. Two areas for improvement of the model are identified; the determination of the bed shear stress, and the correct modelling of turbulence production on submerged vertical or strongly inclined walls. The flow in the region of the bed discontinuity is strongly three dimensional and it is apparent that the simplified bed shear stress model is inadequate in this region.

4 -

KELLER, RODI 1987

Prediction of flow characteristics in main channel/flood plain flows

1 Theoretical, experimental, compound, rough

2 Paper presents a series of predictions of depth averaged flow characteristics for a variety of compound channels and compares them with the corresponding experimental data.

3 Indicated that a two dimensional model utilizing the k-e turbulence model for calculating depth averaged turbulent shear stresses, can be utilized to predict velocity and bed shear stress distributions in compound channel flows. Empirical coefficients used were from literature without adjustment based upon experimental work. Two areas for improving the model were identified: determination of the bed shear stress; the correct modelling of turbulence production on submerged vertical or strongly inclined walls.

4 Laser doppler anemometer, Preston tube, electro magnetic current meter

KLAASSEN, VAN URK 1985

Resistance to flow of floodplains with grasses and hedges

1 Experimental, prototype, simple, rough

2 To study the resistance to flow of floodplains with grasses and hedgerows

3 Field measurements of the hydraulic roughness of grasses and the derivation of a method to determine the resistance of flow of drowned hedges is presented. The latter investigation is supported by some flume experiments. Nikuradse k of floodplain of R Rhine larger than 0.07 m previously accepted, reaching k values between 1.4 and 6.0 m. Reduces to between 0.25 and 0.52 m in a flood. Characteristic roughness length is larger during growing season. Resistance to flow of drowned hedges can be schematised as a system of submerged openings and a short crested weir. Discharge coefficient for the flow over hedges is only slightly affected by the flow through a hedge. Coefficient value of 1 can be used for the full range of flow depths when the hedge is drowned.

4 -

LA HOUILLE BLANCHE

Turbulence: Les derniers progres de la connaissance

Various papers on the measurement and visualisation of turbulence

Authors - COANTIC; GENCE; BURNAGE; COUSTEIX; JAEGGY & BERNER; FRAUNIE; LEUCHTER; LESIEUR

LAI, KNIGHT 1988

Distributions of streamwise velocity and boundary shear stress in compound ducts

1 Experimental, theoretical, smooth, compound, ducts

2 To present the results of several measurements on streamwise time averaged velocity and boundary shear stress in compound shaped ducts.

3 Flows in compound ducts are strongly related to the relative depth. The relative width is a less significant parameter. A value of 0.3 may be used as a division of high and low relative depth. At high relative depth,the law of the wall is suitable for most part of the duct, but is not suitable for low relative depths. At high relative depths, the local friction factors are distributed laterally more evenly than for low relative depths. This factor should be considered in numerical simulation. A linear function may be sufficient for computational purposes.

4 Pitot tube, Preston tube

LARSSON 1988

Numerical simulation of flow in compound channels

1 Theoretical, experimental, smooth, compound channels

2 To present the numerical simulation of compound duct and open channel flow using three different turbulence models

3 Fully developed 3 dimensional compound channel flow is amenable to numerical simulation. The simulations suggest that the secondary currents are essential for the downstream velocity distribution. The algebraic stress model without wall proximity corrections is not adequate for compound channel simulations. However, the inclusion of such corrections makes the simulated velocity distribution agree quite well with the measured one for the duct case. When there is a free surface the model does not give satisfactory results. Gross parameters such as division of flow are not so sensitive to the detailed structure of the flow. With decreasing relative depth over the flood plain, the influence of the secondary currents on the flood plain/main channel

interaction will also decrease. It is therefore likely that refined models, while necessary to predict detailed velocity and wall shear stress distributions, are not needed for estimates of integral characteristics.

4 -

McKEE, ELSAWY, McKEOGH 1985

A study of the hydraulic characteristics of open channels with flood plains

1 Experimental, compound, smooth

2 To provide a semi empirical correlation between channel geometry and the variables of the hydraulic characteristics of the flow under inter acting and non interacting conditions.

3 The main channel can lose up to 25% of its energy at low depths and low width ratios while flood plain energy was increasedby up to 250%, as a result of the interaction mechanism. Discharge ratios under inter acting conditions were found to be equally affected by the depth ratio and the width ratio. The discharge ratio was greater by up to 47% than ratios for non inter acting conditions. Correlation of velocity and shear stress provided semi empirical formulae for discharge estimation in an attempt to quantify the interaction between main channel and flood plain.

4 Laser doppler anemometer, Preston tube

NALLURI, JUDY 1985

Interaction between main channel and flood plain flow

1 Experimental, compound, smooth, rough

2 To investigate the velocity and shear distributions in compound channels

3 Experiments effectively demonstrated that the momentum transfer mechanism at rising stage plays a large part in raising the velocities on the flood plain while lowering the velocities in the main channel specifically at low flow depths and heavy vegetation on the flood plain. Friction factor is found to be widely affected by the type and shape of roughness elements and variations of more than 100% with depths are experienced. Friction factors of the flood plain and main channel above bankfull depths are found to be influenced by the shape, spacing and distribution of the roughness elements. Comparisons of different empirical methods for discharge calculation in compound channel were made. Suggested that a varied roughness coefficient is used with stage or the degree of submergence of roughness elements. The apparent shear stress used as a representative of the rate of momentum transfer is found to be dependent on the width ratio of main channel to floodplain.

4 Pitot tube

NOKES, WOOD 1988

Vertical and lateral turbulent dispersion:some experimental results

1 Experimental, smooth, simple

2 To present the results of an experimental programme designed to investigate turbulent dispersion of a continuous contaminant source in a wide channel

3 Experimental results for vertical dispersion support the use of the eigenfunction solution with a parabolic diffusivity and logarithmic velocity distribution. Measurements of the lateral diffusivity in the near field mixing zone and the three dimensional eigenfunction suggest that the vertical and lateral diffusion processes are uncoupled. Implies that the lateral diffusivity distribution has the same form as the velocity distribution

4 -

ODGAARD 1988

Meander flow model. 2 : Applications

1 Theoretical, prototypical, simple, rough, meander

2 An analytical model for simulating the flow and bed topography in a meandering alluvial channel is tested with data from two field studies.

3 One set of data is used for testing a technique which involves discretizing the river channel into a number of straight and constant radius reaches, and solving a set of governing equations for each reach, using appropriate boundary conditions. The other set of data is used for testing a solution for a sequence of sine generated meander curves. In both cases the simulated flow and bed features are in good agreement with those measured without the need to use calibration factors

4 -

PASCHE, ROUVE, EVERS 1985

Flow in compound channels with extreme flood plain roughness

1 Theoretical, experimental, compound, smooth, rough

2 Experimental and theoretical investigations to develop a model by which the flow in compound channels with highly vegetated flood plains can be predicted.

3 An uncalibrated two dimensional model,based on the k-e model, was tested for its ability to predict the boundary shear stresses and depth averaged velocities. Depth averaged velocities reproduced well but the boundary shear stresses were over estimated. Adjusting the empirical

constants of the k-e model did not improve results. Calibration of the model with respect to the non dimensional diffusivity led to good prediction of both boundary shear stresses and depth averaged velocities.

4 Laser doppler anemometer, Preston tube

PASCHE, ARNOLD, ROUVE 1986

A Review of Overbank Flow Models

1 Experimental, compound, rough

2 Attention is given to methods in which turbulent shear stresses are directly evaluated in order to reach a most sophisticated level of overbank flow modelling.

3 By introducing vertical interface planes between the flood plain and the main channel the apparent shear stresses acting on these interfaces are equivalent to the turbulent shear stresses occuring in this part of the flow domain. Apparent shear stress model can be recommended in a 1D computation of overbank flow. Depth averaged k-e model calculates 2D flow reliably. Depth averaged velocities, turbulent shear stresses and bed shear stresses are predicted well. 3D flow elements occuring in the main channel have only a minor influence on the flow field. Non dimensional diffusivity coefficientwas numerically evaluated at 0.613 for non submerged flood plain roughness. Zero order turbulence models with a constant eddy viscosity in the whole channel give satisfactory results for most practical applications Eddy viscosity needs to be determined by calibration or by calculations using the k-e model.

4 1 and 2 component laser doppler anemometers, Preston tube.

PRINOS, TAVOULARIS, TOWNSEND 1988

Turbulence measurements in smooth and rough walled trapezoidal ducts

1 Experimental, smooth, rough, duct

2 To measure mean flow and turbulence characteristics in a smooth trapezoidal duct and to examine the effect of a roughened top surface on these characteristics.

3 Mean velocities and turbulent stresses near the wall are compatible with strong secondary currents, which are approximately symmetric about the bisectors of corner angles between two smooth walls. Flow pattern changes dramatically when one wall is roughened, normal stresses are doubled and shear stresses are nearly tripled by the roughness to the extent that the secondary currents in the acute corner between the smooth and rough wall are strongly suppressed.

4 Preston tube, hot wire probe

PURI, KUO 1985

Numerical modelling of subcritical open channel flow using the k-e turbulence model and the penalty function finite element technique.

1 Theoretical, simple, smooth, bend

2 To extend a free surface steady state hydrodynamic model based upon the penalty function finite element method and utilizing a simplified one equation turbulence closure. Extension to include an advanced two equation turbulence model, and also examine different momentum dispersion closure schemes.

3 The curvature modification adopted appears to have little effect on the computation of strongly curved subcritical open channel flows that do not exhibit separation. Momentum dispersion closure schemes computed using a three dimensional normal velocity profile based upon helicoidal flow in a wide, gentle, channel bend are not significant for the prediction of strongly curved open channel flows that do not exhibit separation. The optimal computational model, results in excellent agreement between model predictions and experimental data. The maximum

discrepancy between the predicted and observed normalized water depth profiles is approximately 2.5%, and the predicted and observed velocity fields also appear to be in good agreement. Model predictions are as good as those made with a more expensive and restricted three dimensional model. Simulation model is capable of predicting separation in subcritical strongly curved open channel flow due to the elliptic nature of the governing equations. Care must be taken to avoid simulating flows in which the local Froude number exceeds unity.

4 -

RADOJKOVIC 1976

Mathematical modelling of rivers with flood plains

1 Theoretical, experimental, compound, smooth

2 The basic physical aspects of interacting mechanism between the main channel and flood plains during flood periods is analysed using experimental data.

3 The method for the determination of parameters defining the interaction mechanism between the main channel and flood plains during flood periods on a rational physical basis are described. These parameters are introduced into a flood routing procedure and a guideline for a numerical solution is proposed.

4 -

RADOJKOVIC, DJORDJEVIC 1985

Computation of discharge distribution in compound channels

1 Theoretical, experimental, compound, smooth, rough

2 To analyse two models for evaluation of eddy viscosity in the application of the depth averaged momentum equation for computation of discharge distribution in compound channels.

3 The depth averaged k-e model containing standard constants cannot be used as a predictive tool without improvement to the constants. Further experimental investigation of turbulent shear stresses is required. Calibration of the dimensionless eddy viscosity used in a computational model is required before practical computations can be made.Further investigations to improve the evaluation of resistance coefficient are needed.

4 -

RAJARATNAM, MURALIDHAR 1967

Yaw and pitch probes

1 Experimental, theoretical, simple, smooth

2 Presentation of the details of the development and calibration of yaw and pitch probes for measurement of velocity and static pressure in two dimensional flow.

3 In two dimensional flows,when the velocity vector is in the horizontal plane of the probe, its magnitude and the direction can be conveniently determined by means of a yaw probe.When the velocity vector is in the vertical plane of the probe, a pitch probe is used to determine its magnitude and the direction. Static pressure easily determined using either probe.

4 -

RODI 1988

Recent developments in Turbulence Modelling

1 Theoretical

2/3 The paper first summarises recent work in the area of turbulence modelling in near wall regions. Separated flow calculations are presented that were obtained with a two layer model in which the near wall region is resolved with a one equation model and the core region with the standard k-e modelLow Reynolds number k-e models and their damping functions and boundary conditions for e are scrutinised with the aid of results from direct simulations. Attempts to extend existing Reynolds number regions are discussed. Finally,the paper reports on some recent proposals for modelling the pressure strain term in the Reynolds stress equations and for improving the e equation.

4 -

ROHR, ITSWEIRE, HELLAND, VAN ATTA 1988

An investigation of the growth of turbulence in a uniform mean shear flow

1 Experimental, smooth, duct

2 Investigation to study the growth of the turbulent intensity as functions of the mean shear, centreline velocity, and initial disturbance lengthscales.

3 Wind tunnel and water channel experiments suggest that the measure of the largest scale of motion in the flow must grow linearly with down - stream distance and be independent of shear. Prediction for the growth of turbulence for moderate dimensionless time scales is good. Latter prediction shown to be independent of previous assumptions that the asymptotic turbulence structure and turbulent kinetic energy are constant with depth.

4 Hot film anemometer.

SAMUELS 1988

Lateral shear layers in compound channels

1 Theoretical, prototypical, simple, compound, rough

2 Presentation of a new analytical solution to a simplified dynamic equation for lateral velocity distribution for depth averaged flow in a channel of single or compound rectangular section.

3 The drag of the flood plain flow in the main channel may influence the velocity and hence shear stress across the entire width of British rivers. There is a need to establish firm estimates of the momentum exchange coefficient. In physical hydraulic models lateral extent of the shear layers between the channel and flood plain, and hence the distribution of shear stress, may depend upon the scale distortion adopted.

4 -

SCHULZ 1987

Zur naherungsberechnung des abflusses in naturnah gestalteten fliessgewassern

1 Experimental, prototypical, compound, rough

2 To propose a method for calculating discharge in compound channels with densely vegetated banks and berms using a modified Manning - Strickler coefficient.

3 Presents results from experimental work in which the roughness coefficient for the vegetated berm is determined. Berm roughness parameter is related to channel roughness coefficient by taking account

of characteristic vegetation length, drag coefficient for vegetation, surface area of roughness elements. Drag on roughness elements determined experimentally using natural roughness and artificial roughness elements of varying density.

4 -

SELLIN, GILES 1988

Two stage channel flow

1 Prototype, experimental, compound, rough

2 To investigate the capacity of two stage channels with variable channel and berm roughness. To investigate the turbulence effect between the main channel and berm flows. To examine the range of practical variation in the geometry of the two stage channel in terms of hydraulic and economic efficiency and environmental acceptability. To consider the criteria concerned with the satisfactory management of the channel berms. To improve the knowledge of flows in two stage channels particularly where the main channel follows a strongly meandering course.

3 For shallow berm flows the surface flows are clearly influenced by the underlying flow where the two meet. Projecting berm banks result in slack or dead water in their lee. Deep berm flows have surface flows little influenced by the presence of the lower channel. Main flow confined to main channel for low berm flow depths. For deep berm flows main discharge is on the berm. Flow interaction mechanism associated with the two stage channel generates higher friction values than that predicted by straight channel results. The flow leaving a berm at the crossover point of the meandering main channel dominates the secondary circulation associated with the sinuous main channel. Manning`s n values of 0.05 - 0.06 are predicted for a fully cut berm. Roughness values of 0.05 - 0.09 are suggested for the uncut berms. Design recommendations are given for main channel and berm channel realignment, berm cutting policy; future channel plan arrangements, design roughness

values, berm maintenance, wild-life conservation, bank erosion, future research requirements.

4 Orifice plates, capacitance probes, pitot tube, camera, pressure transducer, point gauge.

SHIONO, KNIGHT 1988

Two dimensional analytical solution for a compound channel

1 Experimental, compound, smooth

2 To describe an exact analytic solution to the transverse variation of depth averaged velocity or boundary shear stress in a trapezoidal compound channel. The equations governing the shear layer between a river channel and a flood plain are based on a dimensionless eddy viscosity model which allows for lateral variations in depth.

3 Results indicate that the analytical solution predicts certain hydraulic features of flow in a compound channel quite well especially for relative depths less than 0.3.As the depth increases the solution copes well despite the flow becoming increasingly three dimensional.

4 Miniature current meters, Preston tubes, point gauges

SILL 1986

Velocity profiles in the turbulent boundary layer

1 Theoretical, experimental, simple, smooth

2 Engineering analysis often balances between the rigours of the physical sciences, and pragmatism of design problem solving, particularly for complex situations. The broad topic of turbulent fluid flows and more specifically the turbulent boundary layer are prime examples of compromise between rigour and empiricism. Suggestions for a new

composition for the current complex of engineering profiles are developed and shown to be both sufficiently accurate and utilitarian.

3 Investigation suggests that both logarithmic and power law expressions are valid in describing turbulent boundary layer profiles but in different portions of the layer. Implies a profile complex of adjacent to the wall, near wall, and outer near wall components moving from the boundary layer inwards.

4 -

SLEATH 1987

Turbulent oscillatory flow over rough beds

1 Experimental, rough, duct

2 To present velocity measurements for turbulent oscillatory flow over rough beds.

3 Turbulence intensities fluctuate significantly during the course of a cycle. The variation has the approximate form of a modulated sine wave with two maxima per cycle. Close to the bed the turbulence reaches its maximum intensity as the flow decelerates. Further out, peak turbulence diffuses steadily out at an approximately constant velocity. In this outer region there is no obvious correlation between the phase of maximum turbulence intensity and any of the flow parameters. Reynolds stress is significantly smaller than the shear stress evaluated using the usual momentum integral approach. In particular, the maximum Reynolds stress is much less than the mean horizontal force per unit area on the bed. Suggested that this discrepancy is due to the effect of the mean pressure gradient in oscillatory flows with rough beds and to the momentum transfers associated with vortex ejection on flow reversal. Maximum Reynolds stress occurs at approximately the same phase as one of the maxima of turbulence intensity. However, as distance from the bed increases another peak,in phase with the second maximum of turbulence intensity, begins to appear and eventually

dominates the record. Close to the bed the time mean eddy viscosity at any given height is negative. This region correlates roughly with the region in which maximum Reynolds stress occurs at the first maximum of turbulence rather than the second. It is suggested that these effects are also produced by the jets of fluid associated with vortex ejection on flow reversal. Further out, time mean eddy viscosity increases steadily with height up to a maximum and then declines. In the region where eddy viscosity increases with height the rate of growth is slower than that usually found in steady flows. Variation of eddy viscosity during the course of the cycle is significant. Variation of mixing length with time and with height is similair to that for eddy viscosity. Mean velocity profiles appear to show that, in the outer layer away from the bed, the non dimensionalised defect velocity is a function of the distance measured vertically up from the crest level of the bed roughness; the Nikuradse roughness size;the orbital amplitude of fluid particles outside the boundary layer.

4 Laser doppler anemometer.

STEIN, ROUVE 1985

2D LDV Technique for measuring flow in a meandering channel with wetted flood plains - a new application and first results

1 Experimental, compound, smooth, meander

2 A physical model was designed and built to simulate various flow processes of meandering rivers with confined flood plains. An Off-Axis LDV system was used to measure two dimensional mean flow values and their associated turbulent quantities.

3 Distinct secondary motion in the bends has an extreme influence on the flow in the main channel as well as on the flood plain. Highly turbulent fluid mass welling out of the main channel is responsible for slowing down the flow on the long part of the flood plain. The maximum velocity in the main channel can be found at the inner bank. Since flood plain flow is almost parallel to the x axis, it forces the upper

part of the main channel flow in the same direction. This means that there are not only vertical shear layers in the transition between flood plain and main channel but also a horizontal shear layer between upper and lower part of the main channel.

4 Laser Doppler Velocimeter, Miniature current meter

TAMAI 1988

Coherent structures in the flow in rivers and open channels

1 Theoretical, experimental, smooth, compound

2/3 The paper directs itself at the topic of coherent eddies relevant to river mechanics. Fundamental structures and their effect on the mean flow field or engineering problem are stressed. The paper also looks at longitudinal eddies in inner and outer layers, boils or kolk eddies which are represented by vortices with vertical axes.

4 -

THIRRIOT 1976

Unsteady flows in double profiled channels

1 Theoretical, experimental, compound, rough

2 To examine theoretically the effects of canal form on unsteady flows, especially on the propogation of surges.

3 Surges in compound channels composed of two parallel flows related to each other by exchange flow. At the inception of overflow the exchange can be calculated as for the discharge over a lateral spillway. This overflow causes a rapid attenuation of the flood front height of the propogating wave in the central part. The flow tends to a gradually varying one with time and space. With sufficient submergence the

exchange flow takes place without any appreciable transverse head loss. Level is almost constant across the section for the latter case. Celerity of the disturbances is very close to the two celerities obtained considering a single equivalent profile, except for the appearance of a third celerity which is only a convective velocity.

4 -

TOMINAGA, EZAKI, NEZU 1988

Turbulent structure in compound channel flows with rectangular and trapezoidal main channel

1 Experimental, theoretical, compound, smooth

2 To investigate the structure of turbulence in compound open channel flows with rectangular and trapezoidal main channel cross section

3 Secondary current structure in compound channel flow is characterised by the strong upflow from the junction edge and the flood plain vortex regardless of the main channel shape. Secondary currents on the trapezoidal main channel are different from those in a rectangular main channel. Primary mean velocity, turbulent structure and boundary shear stress in both the trapezoidal and rectangular cross section channels are not markedly different. The apparent shear stress on the junction interface is smaller in the trapezoidal main channel case, however, the mechanism of momentum transfer from the main channel to the flood plain is almost equal in both cases.

4 Hot film anemometer, pitot static tube

UTNES 1988

Two equation (k-e) turbulence computations by the use of a finite element model

1 Theoretical, simple, smooth, step

2 Paper presents a finite element method which solves problems with time dependent boundary conditions

3 The basic equations are the Reynolds averaged momentum equations in conjunction with a two equation (k,e) turbulence model. The equations are written in time dependent form and stationary problems are solved by a time iteration procedure. The advection parts of the equations are treated by the use of a method of characteristics, while the continuity requirement is satisfied by a penalty function approach. The general numerical formulation is based on Galerkin`s method. Computational results are presented for 1D steady state and oscillatory channel flow problems and for steady state over a two dimensional backward facing step

4 -

VINCENT, STRAUSS 1975

Cultivation of woods in flood plains of large rivers and its effect on the runoff of high flood discharges

1 Experimental, theoretical, simple, rough

2 To present the results obtained from studies into the hydraulic resistance of flood plains planted with forests composed of fast growing tall trees.

3 Model investigation results enabled derivation of Manning`s roughness coefficient dependent upon stem spacing, stem thickness and stream depth.

4 -

WANG 1988

Three dimensional models for fluvial hydraulic simulation

1 Theoretical, experimental, compound, smooth, rough

2 To summarise the development of 3D computational models and their utilisation in conjunction with 1D and 2D models

3 Effective numerical methodologies and reliable empirical functions have been applied to construct the 3D computational models. Validity and accuracy of hydrodynamic and sediment transport phenomena predictions have been verified by comparing the FEM model against flume data.

4 -

WORMLEATON 1988

Determination of discharge in compound channels using the dynamic equation for lateral velocity distribution.

1 Theoretical, experimental, compound, smooth

2 An equation is derived,describing depth averaged velocity distribution in a compound channel and applied to experimental data.

3 Equation provides good agreement between observed and calculated depth averaged velocity profiles in laboratory compound channels of different sizes,particularly at low overbank depths. Total discharge and in particular the main channel component of discharge are more accurately modelled by the equation than by the method of channel/floodplain sub division at a vertical interface. The eddy viscosity can be modelled in terms of two components representing bed generated and lateral velocity generated turbulence. Equation to be used with care where the flow becomes significantly three dimensional, ie large overbank depths or narrow flood plains.

4 Miniature current meters,Preston tube.

WORMLEATON, HADJIPANOS 1984

Modelling of discharge in compound channels

1 Experimental, theoretical, compound, smooth, rough

2 To develop a method of discharge calculation that takes proper account of the apparent shear stresses at the interface between a main channel with its flood plains

3 Momentum transfer parameters suggested by Radojkovic can be used to characterise the momentum transfer across either a vertical or horizontal interface between main channel and flood plain in a compound channel. In terms of total discharge, the vertical momentum transfer method is generally an improvement over the traditional vertical interface methods of either including or excluding the interface in the main channel wetted perimeter. The distribution of discharge between main channel and flood plain is modelled more closely by the horizontal interface methods than by those using the vertical interface. In general the vertical interface methods tend to overestimate the main channel discharge and underestimate flood plain flow.

4 Preston tube, micromanometer, pressure transducer, miniature current meter, hot film anemometer.

YOSHIDA, YAGI 1987

Development of laser doppler anemometry for river flow measurement

1 Prototype, simple, rough

2 Description of the use of a diode laser and an active band path filter to overcome the problem of the optical head interfering with the flow and to facilitate the operation of the signal processing procedure.

3 Flow velocity rises by 1% in the measuring volume due to the instrument. The system can measure an extremely variable velocity as induced by high frequency waves with large amplitude.

4 -

4 GEOMETRIC PARAMETERS

This file detailing the dimensions of the channels studied in investigations relating to flow in open channels, ducts and pipes was compiled on the Apricot Xi-10 micro computer using Wordstar 3.40 supplied by Micro Pro.

All dimensions have been unified in S.1 units to enable comparison between individual research work.

The data is presented in three lines representing the flume dimensions, the channel dimensions and three dimensionless parameters that are considered to be representative of the channel form.

The flume dimensions enable an assessment of the size of research facility used in any particular work study and are essentially restricted to experimental facilities. Channel dimensions can relate to experimental, prototypical or theoretical investigations.

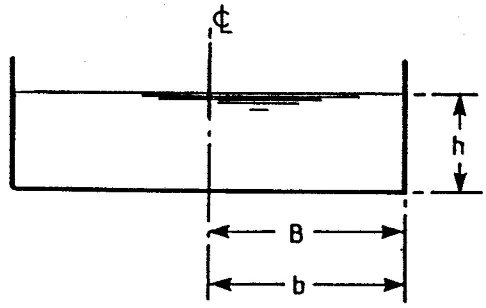
In respect of rectangular flumes or ducts the channel dimensions, with the possible exception of the length, are the same as the flume dimensions.

In respect of compound channels, the channel dimensions with the possible exception of the length, will essentially be different than the flume dimensions, as the width and depth of channel refer to the incised channel within the berms or flood plains.

Data referable to prototype research will only be found in the lines relating to channel dimensions and dimensionless parameters.

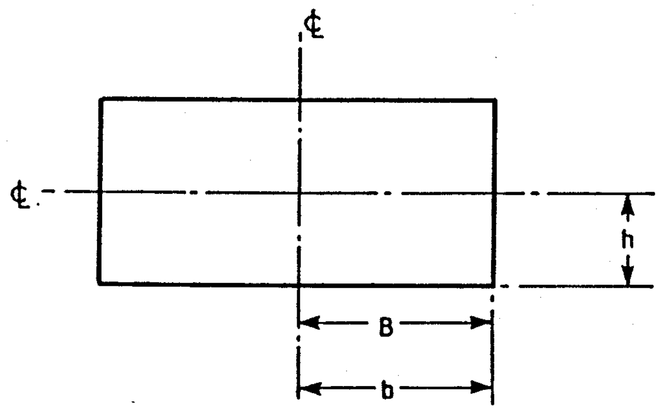
The notation used in defining the dimensionless parameters is illustrated in the diagrams a, b and c.

(a) Rectangular flume, simple channel



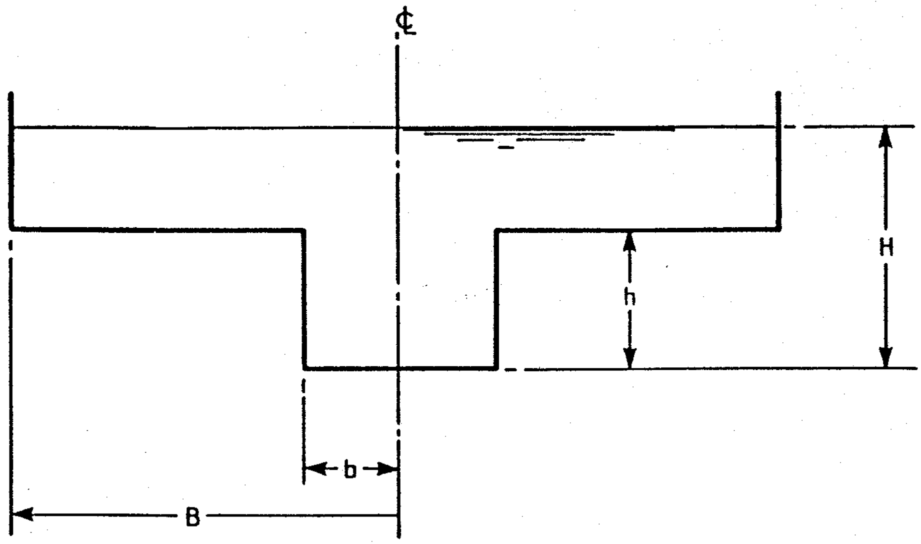
ie B/b = 1; H-h/H not applicable; b/h dependent upon flow depth.

(b) Duct - rectangular



B/b = 1; H-h/H not applicable; b/h = constant.

(c) Compound channel or duct



B/b = constant; H-h/H dependent upon flow depth; b/h = constant.

Asymmetric compound channels or ducts are treated as if representing half a complete compound channel or duct and consequently the same dimensionless parameters apply.

In respect of all channels, b, represents half the base width of the channel whether it is rectangular or trapezoidal in section.

Geometric parameters

Dimensions in metres : L = Length; W = Width; D = Depth

Ratios:

B/b = Floodplain width/Channel width
H-h/H = Flow depth - Channel depth/Flow depth
b/h = Channel width/Channel depth

where B represents half the total Floodplain width in respect of a symmetrical compound channel and b represents half the main channel width, both being related to the main channel centreline. and h represents flow depth in case of rectangular channels and depth of channel below floodplain for compound channels

AUTHOR / TITLE / PUBLICATION	FLUME (M) L,W,D / CHANNEL (M) L,W,D / CHANNEL RATIOS B/b,H-h/H,b/H			SLOPE	DISCHARGE (Cumecs) / INSTRUMENTATION
ALAVIAN V, CHU V H	2/7	.6/.7	-	-	-
TURBULENT EXCHANGE FLOW IN SHALLOW					
COMPOUND CHANNEL	2/7	.36/.45	.019/.064		HOT FILM ANEMOMETER
IAHR, 21 ST CONG, VOL 3, MELBOURNE, 1985					
	1.5/1.7	-	5.6/23.7		
ARNOLD U, HOTTGES J, ROUVE G	25	1	-	-	-
COMBINED DIGITAL IMAGE AND FINITE ELEMENT					
ANALYSIS OF MIXING IN COMPOUND OPEN CHANNEL	-	-	-		LASER DOPPLER ANEMOMETER
FLOW					FLUOROMETER
PROC 3RD INT SYMP REFINED FLOW MODELLING &	-	-	-		VIDEO
TURBULENCE MEASUREMENTS, TOKYO, 1988					
BECHTELER W, FARBER K	4.75	0.4	0.42	-	-
INVESTIGATIONS OF VELOCITY AND PRESSURE					
FLUCTUATIONS IN OPEN CHANNEL FLOW BY A LDA	4.75	0.4	0.35		LASER DOPPLER ANEMOMETER
AND A PITOT TUBE					PITOT TUBE

SYMPOSIUM ON MEASURING TECHNIQUES IN	1	-	0.57		
HYDRAULIC RESEARCH, DELFT, APRIL, 1985					
BOTCHEVA M, IONCHEVA V	-	-	-	2.5(-3)	350/850
ESTIMATION OF THE ROUGHNESS COEFFICIENTS IN					
THE PREDICTION OF THE GEOMETRICAL PARAMETERS	-	20/90	2.5		-
OF STABLE RIVER BEDS WITH COMPOUND CROSS					
SECTIONS	2/7.25	0/0.5	6.4/38		
INTERNATIONAL CONFERENCE ON FLUVIAL HYDRAULICS,					
BUDAPEST, JUNE, 1988					
CHU C C, FALCO R E	2.44	0.32	0.41	-	-
VORTEX RING/VISCOUS WALL LAYER INTERACTION					
MODEL OF THE TURBULENCE PRODUCTION PROCESS	2.44	0.32	0.41		LASER DOPPLER ANEMOMETER
NEAR WALLS					
EXPERIMENTS IN FLUIDS, 6, 1988	1	-	-		
DUMA D	200	6/15	-	1(-3)	-
INFLUENTA UNOR PARAMETRI ASUPRA CAPACITATII					
DE TRANSPORT LA APE MARI A ALBIILOR RIURILOR	200	2.8	0.2		-
INDIGUITE					
HIDROTEHNICA, VOL 26, 7, BUCHAREST, JULY, 1981	2/6	.05/.29	7		
DUMA D	200	15	-	1.09(-4)	0.388
INTERACTIUNEA DINTRE CURGEREA IN ALBA MINORA					
SI CEA IN ALBIA MAJORA LA APE MARI	200	2.0	0.2/0.25		-
HIDROTEHNICA, VOL 29, 6, BUCHAREST, JUNE, 1984					
	7.5	.29/.6	5		
DUMA D	200	6/15	-	1.09/10(-4)	0.388
LA PERFECTIONAREA METODELOR DE CALCUL HIDRAULIC					
AL CURGERII APELOR MARI IN ALBIILE CURSURILOR	200	2/2.8	0.2/0.25		-
DE APA AMENAJATE PRIN LUCRARI DE INDIGUIRE SI					
DE REGULARIZARE	2/7.5	.05/.6	5/7		
INSTITUT AGRONOMIC `NICOLAE BALCESCU`,					
FACULTATEA DE IMBUNATATIRI FUNCIARE, BUCHAREST,					
JULY, 1984					

FLINTHAM T P, CARLING P A	13	0.3	0.45	7.17/14.29(-3)	-
THE PREDICTION OF MEAN BED AND WALL BOUNDARY					
SHEAR IN UNIFORM AND COMPOSITELY ROUGH CHANNELS	13	0.3	-		MIN CURRENT METER
INTERNATIONAL CONFERENCE ON RIVER REGIME,					POINT GAUGE
WALLINGFORD, MAY, 1988	1	-	1.5/9.7		
HALVERSON M J, GULLIVER J S	15	0.76	-	-	-
MEASUREMENTS OF SECONDARY FLOW IN A MOVING					
BED FLUME	10.5	0.71	-		LASER DOPPLER VELOCIMETER
ADVANCEMENTS IN AERODYNAMICS,FLUID MECHANICS,					HYDROGEN BUBBLES
AND HYDRAULICS, MINNEAPOLIS, JUNE, 1986	1	-	-		
HOLDEN A P, JAMES C S	-	0.92	-	1(-3)	0.028/0.0495
BOUNDARY SHEAR DISTRIBUTION IN FLOOD PLAINS					
J HYDRAULIC RESEARCH, 27, 3, 1989	-	.361/.545	0.106		PRESTON TUBE
					PRESSURE TRANSDUCER
	1.7/2.6	.57/.90	3.41/5.14		
IKEDA S, NISHIMURA T	11.9	0.30	-	1.39(-3)	0.0026
FLOW AND BED PROFILE IN MEANDERING SAND SILT					
RIVERS	10.28	0.30	-		POINT GAUGES
PASCE, J HYD D, VOL 112, HY7, JULY, 1986					SAND SAMPLERS
	1	-	2.79		
IMAMOTO H, ISHIGAKI T	5.9/13	0.2/0.39	-	6.94/24.7(-4)	0.001478/0.008539
MEAN AND TURBULENCE STRUCTURE NEAR THE					
INCLINED SIDE WALL IN AN OPEN CHANNEL FLOW	5.9/13	-	-		LASER DOPPLER ANEMOMETER
PROC 3RD INT SYMP REFINED FLOW MODELLING &					MINIATURE CURRENT METER
TURBULENCE MEASUREMENTS, TOKYO, 1988	1	-	-		
KAWAHARA Y, TAMAI N	-	.072/.195	.072/-	-	-
NUMERICAL CALCULATION OF TURBULENT FLOWS IN					
COMPOUND CHANNELS WITH AN ALGEBRAIC STRESS	-	.036/.087	.018/.0501		-
TURBULENCE MODEL					
PROC 3RD INT SYMP REFINED FLOW MODELLING &	2/2.24	0.5	1/1.74		
TURBULENCE MEASUREMENTS, TOKYO, 1988					

KELLER R J, PERERA, B J C, RODI W PREDICTION OF DEPTH AVERAGED FLOW CHARACTERISTICS IN COMPOUND CHANNELS PROC 3RD INT SYMP REFINED FLOW MODELLING & TURBULENCE MEASUREMENTS, TOKYO, 1988	- - 1.7/6.9	1.179/1.22 .102/.711 .112/.206	- .0826/.174 0.98/7.29	.2.5/.94(-3)	.0091/.03 -
KELLER R J, RODI W PREDICTION OF FLOW CHARACTERISTICS IN MAIN CHANNEL/FLOOD PLAIN FLOWS PUBLICATION UNKNOWN	12/60 12/60 1.7/6.9	1.179/2.7 .17/.711 .11/.43	- .08/.174 .98/7.29	.25/1(-3)	.009/9.17 LASER DOPPLER ANEMOMETER PRESTON TUBE E.M.CURRENT METER
KLAASSEN G J, VAN URK A RESISTANCE TO FLOW OF FLOODPLAINS WITH GRASSES AND HEDGES 21st CONGRESS, IAHR, MELBOURNE, AUGUST, 1985	20 20 1	0.6 0.6 -	0.3 0.3 -	-	0.02/0.029 POINT GAUGES
LAI C J, KNIGHT D W DISTRIBUTIONS OF STREAMWISE VELOCITY AND BOUNDARY SHEAR STRESS IN COMPOUND DUCTS PROC 3RD INT SYMP REFINED FLOW MODELLING & TURBULENCE MEASUREMENTS, TOKYO, 1988	17 17 2/4.91	.154/.378 0.077 0.08/0.63	.042/.063 0.0385 -	-	AIR PITOT TUBE PRESTON TUBE
McKEE P M, ELSAWY E M, McKEOGH E J A STUDY OF THE HYDRAULIC CHARACTERISTICS OF OPEN CHANNELS WITH FLOOD PLAINS IAHR, 21ST CONG, VOL 3, MELBOURNE, 1985	9.15 9.15 2.4/5.98	0.61 .102/.254 .139/.374	- 0.153 .66/1.66	2.63(-4)	- LASER DOPPLER ANEMOMETER PRESTON TUBE
NALLURI C, JUDY N D INTERACTION BETWEEN MAIN CHANNEL AND FLOOD PLAIN FLOW IAHR, 21ST CONG, VOL 3, MELBOURNE, 1985	9.5 9.5 1.75/3.6	0.7 .195/.4 .15/.5	- .075/.15 1.3/2.7	1.084(-3)	9.74/12.19(-3) PITOT TUBE

NOKES R I, WOOD I R	12	0.560	0.430	4.7(-4)	7/10(-3)
VERTICAL AND LATERAL TURBULENT DISPERSION: SOME EXPERIMENTAL RESULTS	12	0.560	0.430		CONDUCTIVITY CELL
J FLUID MECHANICS, VOL 187, 1988	1	-	4.3/5.6		
ODGAARD A J	-	-	-	1.4/1.73(-3)	1.1/1.4
MEANDER FLOW MODEL.2:APPLICATIONS PASCE, J HYD D, VOL 112, HY12, DEC, 1986	60/150	4/7.8	0.34/0.4		-
	1	-	5/11.47		
PASCHE E, ROUVE G, EVERS P	-	1.55	-	0.5/1(-3)	-
FLOW IN COMPOUND CHANNELS WITH EXTREME FLOOD PLAIN ROUGHNESS IAHR, 21ST CONG, VOL 3, MELBOURNE, 1985	-	.314/.438	0.124		LASER DOPPLER ANEMOMETER PRESTON TUBE
	3.5/4.9	.23/.38	2.53/3.53		
PASCHE E, ARNOLD U, ROUVE G	25.5	1	1	0.5/1(-2)	-
A REVIEW OF OVERBANK FLOW MODELS ADVANCEMENTS IN AERODYNAMICS, FLUID MECHANICS, AND HYDRAULICS, MINNEAPOLIS, JUNE, 1986	25.5	0.5/0.675	-		LASER DOPPLER VELOCIMETER (1 & 2 COMPONENT) PRESTON TUBE
	1.48/2	-	-		
PRINOS P, TAVOULARIS S, TOWNSEND R	12/17	.305/.406	.102	-	AIR
TURBULENCE MEASUREMENTS IN SMOOTH AND ROUGH WALLED TRAPEZOIDAL DUCTS PASCE, J HYD D, VOL 114, 1, JANUARY, 1988	12/17	.305/.406	.102		PRESTON TUBE HOT WIRE PROBE
	1	-	3/4		
PURI A N, KUO C Y	-	-	-	-	-
NUMERICAL MODELLING OF SUB CRITICAL OPEN CHANNEL FLOW USING THE k-e TURBULENCE MODEL AND THE PENALTY FUNCTION FINITE ELEMENT	-	-	-		-
TECHNIQUE APPLIED MATHEMATICAL MODELLING, VOL 9, 2, APRIL, 1985	1	-	6.66		

RADOJKOVIC M	-	-	-	-	-
MATHEMATICAL MODELLING OF RIVERS WITH FLOOD					
PLAINS	-	-	-		-
3RD ANNUAL SYMPOSIUM OF THE WATERWAYS,HARBOURS					
AND COASTAL ENG DIV, ASCE, VOL 1, 1976	1.76/3.8	0.57/0.91	0.8/1.0		
RADOJKOVIC M, DJORDJEVIC S	-	-	-	9.66(-4)	-
COMPUTATION OF DISCHARGE DISTRIBUTION IN					
COMPOUND CHANNELS	-	0.152	0.076		-
IAHR, 21ST CONG, VOL 3, MELBOURNE, 1985					
	1/4	0.1/0.5	1		
ROHR J J, ITSWEIRE E C, HELLAND K N,	5.00	0.25	0.40	-	-
VAN ATTA C W					
AN INVESTIGATION OF THE GROWTH OF TURBULENCE	5.00	0.25	0.40		HOT FILM ANEMOMETER
IN A UNIFORM MEAN SHEAR FLOW					
J FLUID MECHANICS, VOL 187, 1988	1	-	0.410		
SAMUELS P G	-	-	-	5(-4)	-
LATERAL SHEAR LAYERS IN COMPOUND CHANNELS					
INT. CONF. OF FLUVIAL HYDRAULICS, BUDAPEST,	-	30	4		-
1988					
	1/18.6	.2/.3	3.75		
SCHULZ A	15	0.6	1	-	-
ZUR NAHERUNGSBERECHNUNG DES ABFLUSSES IN					
NATURNAH GESTALTETEN FLIESSGEWASSERN	15	0.6	1		STRAIN GAUGE
INSTITUT FUR WASSERBAU UND WASSERWIRTSCHAFT,					CURRENT METER
TECHNISCHE UNIVERSITAT BERLIN, MITTEILUNG	1	-	.6/1.5		THERMOMETER
NO 107, MARCH, 1987					
SELLIN R H J, GILES A	9.5	1.2	0.3	-	0 - 0.0148
TWO STAGE CHANNEL FLOW					
UNIVERSITY OF BRISTOL, DEPT OF CIVIL	6.0	0.048	0.025		ORIFICE PLATES
ENGINEERING, JULY, 1988					CAPACITANCE PROBE
	6.67	0.77	3.0	(AVERAGE VALUES)	PITOT TUBE
					PRESSURE TRANSDUCER
					CAMERA

SHIONO K, KNIGHT D W	56	10	-	1.027(-3)	1.1
TWO DIMENSIONAL ANALYTICAL SOLUTION FOR A					
COMPOUND CHANNEL	56	1.5	0.150		MINIATURE CURRENT METERS
PROC 3RD INT SYMP REFINED FLOW MODELLING &					PRESTON TUBES
TURBULENCE MEASUREMENTS, TOKYO, 1988	1.2/6.67	0.05/0.5	5		
SLEATH J F A	3.66	0.305	0.45	-	-
TURBULENT OSCILLATORY FLOW OVER ROUGH BEDS					
J FLUID MECHANICS, VOL 182, 1987	3.66	0.305	0.45		LASER DOPPLER ANEMOMETER
	1	-	-		
STEIN C J, ROUVE G	15	3	0.3	0/1.5(-3)	0.0546
2D LDV TECHNIQUE FOR MEASURING FLOW IN A					
MEANDERING CHANNEL WITH WETTED FLOOD PLAINS -	13.7	0.40	0.1		LASER DOPPLER VELOCIMETER
A NEW APPLICATION AND FIRST RESULTS					MINIATURE CURRENT METER
INTERNATIONAL CONFERENCE ON FLUVIAL HYDRAULICS,	7.5	0.333	2		
BUDAPEST, JUNE, 1988					
TOMINAGA A, EZAKI K, NEZU I	12.5	0.4	-	-	0.00264/0.00912
TURBULENT STRUCTURE IN COMPOUND CHANNEL FLOWS					
WITH RECTANGULAR AND TRAPEZOIDAL MAIN CHANNEL	12.5	.098/.188	.0501		HOT FILM ANEMOMETER
PROC 3RD INT SYMP REFINED FLOW MODELLING &					PITOT STATIC TUBE
TURBULENCE MEASUREMENTS, TOKYO, 1988	2.1/4.1	.242/.5	0.978/1.876		
VINCENT J, STRAUSS V	20	0.6	-	0/2(-2)	-
CULTIVATION OF WOODS IN FLOOD PLAINS OF					
LARGE RIVERS AND ITS EFFECT ON THE RUNOFF OF	20	0.6	-		-
HIGH FLOOD DISCHARGES					
IAHR, 16TH CONGRESS, VOL 3, SAO PAULO, 1975	1	-	1/10		
WORMLEATON P R	56	10	-	1(-3)	1.1
DETERMINATION OF DISCHARGE IN COMPOUND					
CHANNELS USING THE DYNAMIC EQUATION FOR	15	1.5	0.15		MINIATURE CURRENT METERS
LATERAL VELOCITY DISTRIBUTION					PRESTON TUBE
INT. CONF. OF FLUVIAL HYDRAULICS, BUDAPEST, 1988	2.2/6.7	.111/.298	5		LASER DOPPLER ANEMOMETER

WORMLEATON P R, HADJIPANOS P MODELLING OF DISCHARGE IN COMPOUND CHANNELS	10.75	1.21	-	4.3(-4)	-
PROC INT CONF ON HYDRAULIC ENGINEERING SOFTWARE (HYDROCOMP), PORTOROZ, YUGOSLAVIA, SEPT, 1984	10.75	0.29	0.12		PRESTON TUBE MICROMANOMETER
	4.17	0.14/0.43	1.21		PRESSURE TRANSDUCER MIN CURRENT METER HOT FILM ANEMOMETER
YOSHIDA S, YAGI S DEVELOPMENT OF LASER DOPPLER ANEMOMETRY FOR	-	-	-	-	-
RIVER FLOW MEASUREMENT J HYDROSCIENCE & HYDRAULIC ENGINEERING, VOL 5,	-	-	4.1		LASER DOPPLER ANEMOMETER
JULY, 1987	1	-	-		