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The structure of flow in open channels - a literature search
Volume 2

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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.

The layout of the contents of this report are the same as for Report No SR 96.

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 ACKERS P, CHARLTON F G

TITLE THE GEOMETRY OF SMALL MEANDERING STREAMS

PUB`N PICE, SUPPLEMENT 12, PAPER 7328S, 1970

DATA MEANDER LENGTH, WIDTH, BREADTH; PARTICLE SIZE, DISCHARGE, TRANSPORT RATE, SLOPE, SEDIMENT CONC.

KEY WORDS MEANDERS, SEDIMENT TRANSPORT, GEOMETRICAL RATIOS

CHANNEL TYPE EXP, SIMP, ROUGH, MEANDERS

FL 300 FT	FW 34 FT	FD
CL 300 FT	CW 3.23 FT	CD
FCS 2/2.6(-3)	Q 0.205 - 3.248 CUSECS	INST POINT GAUGES, SAND INJECTOR

AUTHOR ALFRINK B J, van RIJN L C

TITLE TWO EQUATION TURBULENCE MODEL FOR FLOW IN TRENCHES

PUB`N PASCE, J HYD D, VOL 109, HY3, JULY, 1983

DATA DEPTH, TURBULENCE ENERGY, FLOW VELOCITY, SHEAR STRESS, EDDY VISCOSITY, SHEAR VELOCITY

KEY WORDS TURBULENCE, TRENCH, SHEAR STRESS, EDDY VISCOSITY

CHANNEL TYPE THRY, EXP, COMP, SMOOTH

FL 17 M	FW 0.5 M	FD 0.7 M
CL	CW 1.0 M	CD 0.2 M
FCS	Q	INST LASER DOPPLER ANEMOMETER

AUTHOR AMER. SOC. OF CIV. ENG. - EDITOR M. ELLIOTT

TITLE RIVER MEANDERING - PROCEEDINGS OF THE CONFERENCE RIVERS `83

PUB`N PROCEEDINGS OF THE CONFERENCE RIVERS, NEW ORLEANS, LOUISIANA, OCT, 1983

DATA GEOMORPHOLOGY, EFFECTS OF MAN`S ACTIVITIES, ENGINEERING ANALYSIS, NUMERICAL & PHYSICAL MODELLING

KEY WORDS RIVER MEANDERING

CHANNEL TYPE

FL	FW	FD
CL	CW	CD
FCS	Q	INST

.AUTHOR AMERICAN SOCIETY OF CIVIL ENGINEERS .PUB`N PASCE, J HYD D, VOL 106, HY5, MAY, 1980

.TITLE SOURCES OF COMPUTER PROGRAMS IN HYDRAULICS

.DATA GROUND WATER, HYDRAULICS, HYDROLOGY, SURFACE WATER, THERMAL DISCHARGE, TIDAL RIVERS, ESTUARIES

.KEY WORDS HYDRAULICS, COMPUTER PROGRAMS

.CHANNEL TYPE

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR ANDERSON A G .PUB`N IAHR, 12 TH CONG, FORT COLLINS, 1967

.TITLE ON THE DEVELOPMENT OF STREAM MEANDERS

.DATA MEANDER LENGTH, TIME, RELATIVE MEANDER LENGTH, FROUDE NUMBER, DISCHARGE, DEPTH

.KEY WORDS MEANDERS, ALTERNATE BARS, FROUDE NO.

.CHANNEL TYPE THRY, SIMP, EXP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR ANDREWS E D .PUB`N JOURNAL OF HYDROLOGY, 46, 1980

.TITLE EFFECTIVE AND BANKFULL DISCHARGES OF STREAMS IN THE YAMPA RIVER BASIN, COLARADO AND WYOMING

.DATA DISCHARGE, SEDIMENT LOAD, DRAINAGE AREA, BED MATERIAL, RECURRENCE INTERVALS

.KEY WORDS BANKFULL DISCHARGES, SEDIMENT LOAD, EFFECTIVE DISCHARGE

.CHANNEL TYPE PROTO, THRY, SIMP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR ANWAR H O, ATKINS R

.TITLE TURBULENCE MEASUREMENTS IN SIMULATED TIDAL FLOW

.PUB`N PASCE, J HYD D, VOL 106, HY8, AUG, 1980

.DATA NONDIMENSIONAL SHEAR & MEAN VELOCITY, TURBULENT INTENSITY PROFILES, REYNOLDS STRESS, ENERGY SPECTRA

.CHANNEL TYPE EXP, THRY, SIMP, SMTH

.KEY WORDS TURBULENCE INTENSITY, REYNOLDS SHEAR STRESS, ENERGY SPECTRA

.FL 27 M .FW 0.6 M .FD 0.4 M

.CL 27 M .CW 0.6 M .CD 0.4 M

.FCS .Q 0.140 CUMECS .INST E.M. & MIN CURRENT METER, HOT FILM ANEMOMETER, PRESTON TUBE

.AUTHOR ARNOLD U, STEIN U, PASCHE E

.TITLE FIRST EXPERIENCES WITH AN ON AXIS LDV SYSTEM IN SPECIAL APPLICATION TO OPEN CHANNEL FLOW

.PUB`N INT SYMP ON LASER ANEMOMETRY, ASME, FLORIDA

.DATA DOPPLER BURST, POWER SPECTRA, VELOCITY

.KEY WORDS LASER DOPPLER ANEMOMETER

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

.FL 25 M .FW 1 M .FD

.CL .CW .CD

.FCS .Q .INST LASER DOPPLER ANEMOMETER

.AUTHOR BAGNOLD R A

.TITLE SOME ASPECTS OF THE SHAPE OF RIVER MEANDERS

.PUB`N GEOLOGICAL SURVEY PROFESSIONAL PAPER 282-E, 1960

.DATA RESISTANCE COEFFICIENT, CURVATURE CRITERION, CROSS SECTION

.KEY WORDS MEANDERS, ENERGY DISSIPATION, EDDY FORMATION

.CHANNEL TYPE THRY, EXP, SIMP, RGH, MEANDERS

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

AUTHOR BATHURST J C	PUB`N PASCE, J HYD D, VOL 112, HY5, JUNE, 1986
TITLE SLOPE AREA DISCHARGE GAGING IN MOUNTAIN RIVERS	
DATA MEASURED, PREDICTED (SLOPE AREA) & PREDICTED (SIMPLE METHOD), RELATIVE SUBMERGENCE	KEY WORDS FLOW GAUGING, SLOPE AREA METHOD, MOUNTAIN RIVERS
CHANNEL TYPE PROTO, THRY, SIMP, RGH	

FL	FW	FD
CL 5, 150 M	CW 5, 50 M	CD
FCS .398/3.73(-2)	Q 0.137 - 195 CUBIC METRES PER SECOND	INST ENGINEERS LEVEL, STAFF, TAPE MEASURE

AUTHOR BETTESS R, WHITE W R	PUB`N PICE, PART 2, 75, SEPTEMBER, 1983
TITLE MEANDERING AND BRAIDING OF ALLUVIAL CHANNELS	
DATA SLOPE, DISCHARGE, SEDIMENT SIZE, SEDIMENT CONC,	KEY WORDS MEANDERING, BRAIDING, ALLUVIAL CHANNELS, STABLE CHANNEL THEORY
CHANNEL TYPE EXP, THRY, SIMP, RGH, MEANDER, BRAID	

FL 24 M	FW 2.44 M	FD 0.61 M
CL 24 M	CW 0.22 M	CD 0.04 M
FCS 1.8 - 5.6(-3)	Q 0.001 - 0.0066 CUMECS	INST POINT GAUGES

AUTHOR BLINCO P H, SIMONS D B	PUB`N J ASME, VOL 100, EM2, APRIL, 1974
TITLE CHARACTERISTICS OF TURBULENT BOUNDARY SHEAR STRESS	
DATA TURBULENT INTENSITY, REYNOLDS NO., SHEAR STRESS PROBABILITY DENSITY, AUTOCORRELATION FUNCTION	KEY WORDS TURBULENCE, BOUNDARY SHEAR STRESS, HOT FILM ANEMOMETER
CHANNEL TYPE EXP, THRY, SIMPLE, SMOOTH	

FL 10 M	FW 20.4 CM	FD 20.4 CM
CL 10 M	CW 20.4 CM	CD 20.4 CM
FCS 0.5 to 10(-3)	Q 335 - 9460 CUBIC CM/S	INST HOT FILM ANEMOMETER, PIEZOMETRIC TAPPINGS

AUTHOR BROWNLIE W R	PUB`N PASCE, J HYD D, VOL 109, 7, JULY, 1983
TITLE FLOW DEPTH IN SAND BED CHANNELS	
DATA DENSIMETRIC FROUDE NO., SHEAR STRESS, DISCHARGE ., SLOPE, GRAIN FROUDE NO., DEPTH, VELOCITY, HYD RAD.	KEY WORDS FLOW DEPTH, SAND BED CHANNELS
CHANNEL TYPE THRY, EXP, SIMP,	

FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR BROWNLIE W R	PUB`N PASCE, J HYD D, VOL 109, NO 7, JULY, 1983
TITLE FLOW DEPTH IN SAND BED CHANNELS	
DATA DENSIMETRIC FROUDE NO, SHEAR STRESS, DISCHARGE, GRAIN FROUDE, VISCOUS EFFECTS, DEPTH, VELOCITY	KEY WORDS FLOW DEPTH, SAND BED CHANNELS
CHANNEL TYPE THRY, EXP, SIMP, RGH	

FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR BROWNLIE W R	PUB`N PASCE, J HYD D, VOL 111, NO 7, JULY, 1985
TITLE COMPILATION OF ALLUVIAL CHANNEL DATA	
DATA	KEY WORDS DATA COLLECTION
CHANNEL TYPE	

FL	FW	FD
CL	CW	CD
FCS	Q	INST

.AUTHOR CALLANDER R A

.PUB`N PROC 2ND AUSTRALASIAN CONF ON HYD & FLUID MECH, AUCKLAND UNIV., 1966

.TITLE CONSTRUCTION OF AN EXPERIMENTAL MEANDER

.DATA MEAN VELOCITY, FRICTION FACTOR

.KEY WORDS MEANDER, SAND CONCENTRATION, SHEAR VELOCITY

.CHANNEL TYPE EXP, SIMP, RGH, MEANDER

.FL 40 FT	.FW 8 FT	.FD
.CL 40 FT	.CW 30 IN	.CD 1.5 IN
.FCS	.Q 0.12 CUSECS	.INST

.AUTHOR CHANG H H

.PUB`N PASCE, J HYD D, VOL 110, NO 1, JANUARY, 1984

.TITLE ANALYSIS OF RIVER MEANDERS

.DATA MEANDER CURVATURE, SLOPE, DISCHARGE, SEDIMENT SIZE, WIDTH-DEPTH RATIO

.KEY WORDS MEANDER, MINIMUM STREAM POWER

.CHANNEL TYPE THRY, PROTO, EXP, SIMP, RGH, MEANDER

.FL	.FW	.FD
.CL	.CW 75 FT	.CD 6.2 FT
.FCS 1.57(-4)	.Q	.INST

.AUTHOR CHANG H H

.PUB`N PASCE, J HYD D, VOL 109, NO 7, JULY, 1983

.TITLE ENERGY EXPENDITURE IN CURVED OPEN CHANNELS

.DATA ENERGY GRADIENT, FROUDE NO, FLOW DEPTH, DEPTH - RADIUS RATIO, TRANSVERSE - TOTAL ENERGY LOSS RATIO

.KEY WORDS CURVED CHAN, ENERGY LOSS, LONGITUD RESISTANCE, TRANSVERSE CIRCULATION

.CHANNEL TYPE THRY, PROTO, SIMP, SMTH

.FL	.FW	.FD
.CL	.CW 12 FT	.CD 7.67 FT
.FCS 1.3(-3)	.Q 5.5 - 36.8 CUMECS	.INST CURRENT METER, STAFF GAUGES

.AUTHOR CHANG H H

.PUB`N PASCE, J HYD D, VOL 110, NO 2, FEBRUARY, 1984

.TITLE MODELING OF RIVER CHANNEL CHANGES

.DATA FLOOD HYDROGRAPH, CROSS SECTIONS

.KEY WORDS CHANNEL CHANGES, COMPUTATIONAL MODEL

.CHANNEL TYPE THRY, PROTO, SIMP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR CHANG H H

.PUB`N PASCE, J HYD D, VOL 110, NO 12, DECEMBER, 1984

.TITLE VARIATION OF FLOW RESISTANCE THROUGH CURVED CHANNELS

.DATA TRANSVERSE SURFACE VELOCITY, FRICTION FACTOR, ENERGY GRADIENT, BOUNDARY SHEAR STRESS

.KEY WORDS CURVED CHANNEL, FLOW RESISTANCE

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

.FL 116 FT .FW 6 FT .FD

.CL 116 FT .CW 6 FT .CD

.FCS 7.2(-4) .Q .INST

.AUTHOR CHANG H H

.PUB`N PASCE, J HYD D, VOL 111, NO 3, MARCH, 1985

.TITLE RIVER MORPHOLOGY AND THRESHOLDS

.DATA WIDTH, DEPTH, VELOCITY, ENERGY GRADIENT, WIDTH - DEPTH RATIO, SLOPE, STREAM POWER

.KEY WORDS CHANNEL GEOMETRY, CHANNEL PATTERNS, THRESHOLDS

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

.FL .FW .FD

.CL .CW 44.5, 121 FT .CD 2.1, 4.2 FT

.FCS 1.19(-3) .Q .INST

AUTHOR CHANG H H
PUB'N PASCE, J HYD D, VOL 112, NO 1, JANUARY, 1986
TITLE RIVER CHANNEL CHANGES:ADJUSTMENTS OF EQUILIBRIUM
DATA SLOPE, IDSCHARGE, DEPTH
KEY WORDS CHANNEL CHANGES, EQUILIBRIUM
CHANNEL TYPE THRY, PROTO, SIMP, RGH
FL
FW
FD
CL
CW
CD
FCS
Q
INST

AUTHOR CHANG H Y, SIMONS D B, WOOLHISER D A
PUB'N PASCE, J WH D, VOL 97, WW1, FEBRUARY, 1971
TITLE FLUME EXPERIMENTS ON ALTERNATE BAR FORMATION
DATA MEANDER WAVELENGTH, SLOPE, DEPTH, FROUDE, SEDIMENT SIZE
KEY WORDS ALTERNATE BAR FORMATION, WAVELENGTH
CHANNEL TYPE EXP, SIMP, RGH
FL 100 FT
FW 3 FT
FD
CL 100 FT
CW 1.5, 3 FT
CD
FCS 0.44 - 6.38(-3)
Q 0.076 - 0.5 CUSECS
INST POINT GAUGE

AUTHOR CHATLEY
PUB'N ENGINEERING, JUNE, 1940
TITLE THE THEORY OF MEANDERING
DATA CHANNEL GEOMETRY
KEY WORDS MEANDERING
CHANNEL TYPE THRY, PROTO, SIMP, RGH, MEANDERS
FL
FW
FD
CL
CW
CD
FCS
Q
INST

.AUTHOR COLEMAN N L, ALONSO C V .PUB`N PASCE, J HYD D, VOL 109, NO 2, FEBRUARY, 1983

.TITLE TWO DIMENSIONAL CHANNEL FLOWS OVER ROUGH SURFACES

.DATA VELOCITY PROFILE, VELOCITY DEFECT LAW

.KEY WORDS OPEN CHANNEL, ROUGH, BOUNDED SHEAR FLOW

.CHANNEL TYPE THRY, EXP, SIMP, SMTH, RGH

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

.AUTHOR CRORY P M, ELSAWY E M .PUB`N IAHR, SYMP. RIVER ENGINEERING, BELGRADE, MAY, 1980

.TITLE AN EXPERIMENTAL INVESTIGATION INTO THE INTERACTION BETWEEN A RIVERS DEEP SECTION AND ITS FLOODPLAIN

.DATA BED & WALL SHEAR STRESS, VELOCITY, DEPTH RATIO, WIDTH RATIO

.KEY WORDS TURBULENCE INTENSITY, COMPOUND CHANNEL, MOMENTUM TRANSFER

.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 0.102 M
.FCS 2.63(-4)	.Q 2.09 - 16.75 L/S	.INST LASER DOPPLER ANEMOMETER, PRESTON TUBE

.AUTHOR DE VRIEND H J .PUB`N J FLUID MECH., VOL 107, 1981

.TITLE VELOCITY REDISTRIBUTION IN CURVED RECTANGULAR CHANNELS

.DATA VELOCITY DISTRIBUTION, DEAN NO., POTENTIAL FLOW EFFECT, RADIAL & VERTICAL CONVECTION, ISOVELS

.KEY WORDS VELOCITY REDISTRIBUTION, BENDS, SECONDARY FLOW

.CHANNEL TYPE THRY, SMTH, DUCT

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

.AUTHOR de VRIEND H J, GELDOF H J .PUB`N PASCE, J HYD D, VOL 109, HY7, JULY, 1983

.TITLE MAIN FLOW VELOCITY IN SHORT RIVER BENDS

.DATA DEPTH, FLOW VELOCITY, SECONDARY FLOW, VELOCITY REDISTRIBUTION

.KEY WORDS VELOCITY DISTRIBUTION, BEND, COMPUTATIONAL MODEL

.CHANNEL TYPE PROTO, THRY, SIMP, RGH, BEND

.FL	.FW	.FD
.CL 285 M	.CW 6.1, 8 M	.CD

.FCS	.Q 1.27 CUMECS	.INST CURRENT METER, POINT GAUGE

.AUTHOR DRACOS T, HARDEGGER P .PUB`N J HYDRAULIC RESEARCH, VOL 25, 2, 1987

.TITLE STEADY UNIFORM FLOW IN PRISMATIC CHANNELS WITH FLOOD PLAINS

.DATA HYDRAULIC RADIUS, FLOW DEPTH, ROUGHNESS RATIO

.KEY WORDS CONVEYANCE, COMPOUND CHANNEL

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

.FL	.FW	.FD
.CL	.CW 0.178, 0.5 M	.CD 0.051, 0.1015 M

.FCS 6/30(-4)	.Q	.INST

.AUTHOR EINSTEIN H A, SHEN H W .PUB`N J GEOPHYSICAL RESEARCH, VOL 69, NO 24, 1964

.TITLE A STUDY ON MEANDERING IN STRAIGHT ALLUVIAL CHANNELS

.DATA VORTICES, CROSS SECTIONS

.KEY WORDS ALLUVIAL CHANNELS, MEANDERS, VORTICES

.CHANNEL TYPE

.FL	.FW 0.31, 1.22 M	.FD
.CL	.CW 0.31, 1.22 M	.CD

.FCS	.Q 1.43 - 567(-3) CUMECS	.INST

AUTHOR ENGELUND F, SKOVGAARD O
PUB`N J FLUID MECH, VOL 57, PART 2, 1973

TITLE ON THE ORIGIN OF MEANDERING AND BRAIDING IN ALLUVIAL STREAMS

DATA LATERAL & VERTICAL VELOCITY COMPONENT, AMPLIFICATION COEFFICIENT
KEY WORDS MEANDERS, BRAIDS, ALLUVIAL STREAM, BOUNDARY CONDITIONS

CHANNEL TYPE THRY, SIMP, SMTH, MEANDERS, BRAIDS

FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR ESCUDIER M P, ACHARYA M
PUB`N EXPERIMENTS IN FLUIDS, 5, 1987

TITLE CRITIQUE OF THE COMPUTATIONAL PRESTON TUBE METHOD

DATA MEAN VELOCITY PROFILES, SKIN FRICTION, REYNOLDS NO.,
KEY WORDS PRESTON TUBE, SKIN FRICTION, VON KARMAN, COMPUTATIONAL MODEL

CHANNEL TYPE EXP, THRY, SMTH, DUCT

FL	FW 800 MM	FD 100 MM
CL	CW 800 MM	CD 100 MM
FCS	Q AIR	INST HOT WIRE ANEMOMETER, FLOATING ELEMENT DEVICE

AUTHOR EVERS P, ROUVE G
PUB`N IAHR, SYMP RIVER ENGINEERING, BELGRADE, MAY, 1980

TITLE BASIC MODEL INVESTIGATIONS ON HYDRAULIC EFFECTS OF BANK AND FLOOD PLAIN VEGETATION

DATA VELOCITY DISTRIBUTIONS, DEPTH, DISCHARGE, WATER LEVEL
KEY WORDS COMPOUND CHANNEL, ROUGHNESS DISTRIBUTION, ROUGHNESS DENSITY

CHANNEL TYPE EXP, COMP, RGH

FL 25 M	FW 1.0 M	FD 0.85 M
CL 25 M	CW 0.124 M	CD 0.124 M
FCS 0 to 3(-3)	Q 5 - 70 L/S	INST LASER DOPPLER ANEMOMETER, POINT GAUGE

.AUTHOR FREDSOE J .PUB`N J FLUID MECH, VOL 84, PART 4, 1978

.TITLE MEANDERING AND BRAIDING OF RIVERS

.DATA BED CONCENTRATION, AMPLIFICATION FACTOR, MEANDER WAVELENGTH

.KEY WORDS MEANDERS, BRAIDS, STABILITY ANALYSIS

.CHANNEL TYPE THRY, SIMP, RGH, MEANDERS, BRAIDS

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR FUKUSHIMA Y, FUKUDA M .PUB`N J HYDROSCIENCE & HYDRAULIC ENG., VOL 4, NO 2, NOV, 1986

.TITLE ANALYSIS OF TURBULENT STRUCTURE OF OPEN CHANNEL FLOW WITH SUSPENDED SEDIMENTS *

.DATA VEL AND CONC. DISTRIBUTION, VISCOUS DISSIPATION TURBULENCE KINETIC ENERGY, EDDY VISCOSITY

.KEY WORDS TURBULENCE, SEDIMENT TRANSPORT

.CHANNEL TYPE EXP, THRY, SIMP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q 382 - 608 SQ CM/S PER CM .INST

.AUTHOR GUGANESHARAJAH K, THORN D G, EVANS T E, HARPIN R .PUB`N 2ND INT CONF HYDRAULICS OF FLOODS & FLOOD CONTROL, CAMBRIDGE, 1985

.TITLE MATHEMATICAL MODELLING OF THE RIVER CONON

.DATA MODEL COMPONENTS, WATER LEVEL, TIME

.KEY WORDS MATHEMATICAL MODEL, FLOOD ALLEVIATION, COMPOUND CHANNEL

.CHANNEL TYPE THRY, PROTO, COMP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR HAGER W H .PUB`N PASCE, J HYD D, VOL 111, NO 3, MARCH, 1985

.TITLE EQUATIONS FOR PLANE, MODERATELY CURVED OPEN CHANNEL FLOWS

.DATA RELATIVE DISCHARGE, CNOIDAL WAVE, SOLITARY WAVE

.KEY WORDS CURVED OPEN CHANNEL FLOW, EQUATIONS

.CHANNEL TYPE THRY

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR HAQUE M I, MAHMOOD K .PUB`N PASCE, J HYD D, VOL 112, NO 3, MARCH, 1986

.TITLE ANALYTICAL STUDY ON STEEPNESS OF RIPPLES AND DUNES

.DATA BEDFORM SHAPE FUNCTION, VELOCITY FUNCTION, BEDFORM STEEPNESS, FLOW DEPTH, BEDFORM LENGTH

.KEY WORDS RIPPLES, DUNES, STEEPNESS, TWO DIMENSIONAL

.CHANNEL TYPE THRY, EXP, SIMP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR HEY R D .PUB`N J IWES, VOL 40, NO 2, APRIL, 1986

.TITLE RIVER MECHANICS

.DATA DISCHARGE, RIFFLE SPACING, BANKFULL WIDTH, SECONDARY FLOW, SEDIMENT DISCHARGE

.KEY WORDS SHEAR STRESS, FLOW RESISTANCE, SECONDARY FLOW, BEDLOAD TRANSPORT

.CHANNEL TYPE PROTO, SIMP, COMP

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR HOLTORFF G
.PUB`N PASCE, J WH D, VOL 108, WW3, AUGUST, 1982

.TITLE STEADY FLOW IN ALLUVIAL CHANNELS

.DATA BOUNDARY LAYER, SHEAR STRESS, SEDIMENT BALANCE, BEDLOAD

.KEY WORDS SHEAR FLOW, BOUNDARY LAYER, SHEAR STRESS, CHANNEL MORPHOLOGY

.CHANNEL TYPE THRY, SIMP, MEANDER

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR HOLTORFF G
.PUB`N PASCE, J HYD D, VOL 108, HY9, SEPTEMBER, 1982

.TITLE RESISTANCE TO FLOW IN ALLUVIAL CHANNELS

.DATA SHEAR STRESS, BEDLOAD, WAVE NO., FROUDE NO., DEPTH

.KEY WORDS FRICTIONAL RESISTANCE, SHEAR STRESS, BEDLOAD TRANSPORT, BED FORMS

.CHANNEL TYPE THRY, SIMP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR HUPPERT H E, BRITTER R E
.PUB`N PASCE, J HYD D, VOL 108, HY12, DECEMBER, 1982

.TITLE SEPARATION OF HYDRAULIC FLOW OVER TOPOGRAPHY

.DATA FLOW GEOMETRY, FLOW VARIABLES, SPECIFIC ENERGY

.KEY WORDS FLOW SEPARATION, ONE LAYER FLOW, TWO LAYER FLOW

.CHANNEL TYPE THRY, EXP, SIMP, RGH

.FL 23 FT .FW 30 IN .FD

.CL 23 FT .CW 30 IN .CD

.FCS .Q 4800 - 19000 SQ MM PER SEC PER MM .INST

AUTHOR IKEDA S, NISHIMURA T

PUB`N PASCE, J HYD, VOL 111, HY11, NOVEMBER, 1985

TITLE BED TOPOGRAPHY IN BENDS OF SAND SILT RIVERS

DATA CONCENTRATION DISTRIBUTION, LATERAL CONVECTION, LATERAL DIFFUSION

KEY WORDS CONVECTION, DIFFUSION, SEDIMENT TRANSPORT

CHANNEL TYPE THRY, PROTO, EXP, SIMP, RGH

FL 13 M	FW 1 M	FD
CL 13 M	CW 1 M	CD
FCS 9.4 - 16.7(-4)	Q 15.8 - 27.1 LITRES PER SECOND	INST SAND SAMPLERS

AUTHOR INDLEKOFER H, ROUVE G

PUB`N IAHR, SYMP RIVER ENGINEERING, BELGRADE, MAY, 1980

TITLE ON HYDRAULIC CAPACITY OF RIVERS WITH VEGETATED BANKS AND FLOOD PLAINS

DATA APPARENT SHEAR FORCE, MEAN VELOCITY, VELOCITY RATIO, ROUGHNESS COEFFICIENTS

KEY WORDS COMPOUND CHANNEL, VEGETATION, MOMENTUM TRANSFER

CHANNEL TYPE THRY, EXP, PROTO, COMP, RGH

FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR ISHIKAWA T

PUB`N PASCE, J HYD, VOL 110, HY12, DECEMBER, 1984

TITLE WATER SURFACE PROFILE OF STREAM WITH SIDE OVERFLOW

DATA DISCHARGE, DEPTH, DISTANCE

KEY WORDS OVERFLOW, LEVEE, WATER SURFACE PROFILE

CHANNEL TYPE THRY, EXP, SIMP, COMP, SMTH

FL 30 M	FW 0.6 M	FD
CL 30 M	CW 0.2, 0.4 M	CD
FCS 3 - 10(-3)	Q 16.32 - 43.92 LITRES PER SEC	INST

.AUTHOR JAMES C S

.PUB`N WATER SA, VOL 13, NO 1, JANUARY, 1987

.TITLE THE DISTRIBUTION OF FINE SEDIMENT DEPOSITS IN COMPOUND CHANNEL SYSTEMS

.DATA VERTICAL CONCENTRATION PROFILE, DEPTH AVERAGED CONCENTRATION, DISTANCE, TRANSVERSE DISTRIBUTION

.KEY WORDS COMPOUND CHANNEL, SEDIMENT TRANSPORT, OVERBANK DEPOSITION

.CHANNEL TYPE THEORY, COMPOUND, ROUGH

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

.AUTHOR KALKWIJK J P TH, BOOIJ R

.PUB`N J HYDRAULIC RESEARCH, VOL 24, 1, 1986

.TITLE ADAPTATION OF SECONDARY FLOW IN NEARLY HORIZONTAL FLOW

.DATA SECONDARY FLOW PROFILES, BED SHEAR STRESS, CORIOLIS CURVATURE & ACCELERATION

.KEY WORDS SECONDARY FLOW

.CHANNEL TYPE THRY, EXP, SIMP, SMTH

.FL 25, 96 M	.FW 0.5, 6 M	.FD
.CL 25, 96 M	.CW 0.5, 6 M	.CD
.FCS	.Q	.INST

.AUTHOR KITANIDIS P K, KENNEDY J F

.PUB`N J FLUID MECH., VOL 144, 1984

.TITLE SECONDARY CURRENT AND RIVER MEANDER FORMATION

.DATA MEANDER WAVELENGTH, WIDTH, HYDRAULIC RADIUS, FRICTION FACTOR

.KEY WORDS SECONDARY CURRENT, MEANDER, STABILITY ANALYSIS

.CHANNEL TYPE THRY, SIMP, SMTH, MEANDER

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

AUTHOR KOMURA S

PUB`N PASCE, J HYD D, VOL 112, HY9, SEPTEMBER, 1986

TITLE METHOD OF COMPUTING BED PROFILES DURING FLOODS

DATA VELOCITY DISTRIBUTION, WATER SURFACE VELOCITY, CAMERON EFFECTS, BED & VEL. TRANSVERSE DISTRIBUTION

KEY WORDS AERIAL PHOTOGRAPHY, BED PROFILES, ISOVELS

CHANNEL TYPE THRY, PROTO, SIMP, RGH

FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR LEOPOLD L B, WOLMAN M G

PUB`N GEOLOGICAL SURVEY PROFESSIONAL PAPER 282-B

TITLE RIVER CHANNEL PATTERNS : BRAIDED, MEANDERING, STRAIGHT

DATA WATER SURFACE PROFILE, SLOPE, DISCHARGE, WIDTH, WAVELENGTH, FRICTION FACTOR, RELATIVE SMOOTHNESS

KEY WORDS SEDIMENT TRANSPORT, SHEAR, RESISTANCE, CHANNEL PATTERNS

CHANNEL TYPE PROTO, EXP, SIMP, RGH

FL 60 FT	FW 3 FT	FD
CL 60 FT	CW 1.5, 13.75 IN	CD 1.5, 3.33 IN
FCS 1.75 - 10.3(-3)	Q 0.01 - 0.085 CUSECS	INST POINT GAUGE, SEDIMENT INJECTOR

AUTHOR LEOPOLD L B, BAGNOLD R A, WOLMAN M G, BRUSH L M

PUB`N GEOLOGIC SURVEY PROFESSIONAL PAPER 282-D

TITLE FLOW RESISTANCE IN SINUOUS OR IRREGULAR CHANNELS

DATA SHEAR STRESS, FLOW VELOCITY, SLOPE, FROUDE NO, WIDTH, CHANNEL CURVATURE RATIO

KEY WORDS ENERGY LOSS, SUPERELEVATION, SINUOUS CHANNEL, RESISTANCE

CHANNEL TYPE EXP, SIMP, RGH

FL 52 FT	FW 4 FT	FD
CL 46 FT	CW 0.386 FT	CD
FCS 3.3 - 118(-4)	Q 0.09 - 0.133 CUSECS	INST POINT GAUGE

.AUTHOR LESCHZINER M A, RODI W .PUB`N PACSE, J HYD .D, VOL 105, HY10, .OCTOBER, 1979

.TITLE CALCULATION OF STRONGLY CURVED OPEN CHANNEL FLOW

.DATA WATER SURFACE SUPERELEVATION, TANGENTIAL VEL, .SECONDARY VELOCITY, TRANSVERSE VELOCITY

.KEY WORDS OPEN CHANNEL, .SUPERELEVATION

.CHANNEL TYPE THRY, EXP, SIMP, SMTH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR LEWANDOWSKI J B .PUB`N 2ND INT CONF .HYDRAULICS OF FLOODS .& FLOOD CONTROL, .SEPTEMBER, 1985

.TITLE THE USE OF AIR PHOTOGRAPHS FOR ESTIMATING THE .VALUE OF ROUGHNESS COEFFICIENT

.DATA CHANNEL AREA, MEAN FLOW DEPTH, ROUGHNESS COEFF.

.KEY WORDS ROUGHNESS .COEFFICIENT, AIR .PHOTOGRAPHS

.CHANNEL TYPE THRY, PROTO, COMP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR LEWIN J, HUGHES D .PUB`N J OF HYDROLOGY , 46, 1980

.TITLE WELSH FLOODPLAIN STUDIES - APPLICATION OF A .QUALITATIVE INUNDATION MODEL

.DATA STAGE, DISCHARGE, FLOOD HYDROGRAPH

.KEY WORDS INUNDATION, .FLOOD HYSTERESIS, .FLOODPLAIN RELIEF

.CHANNEL TYPE THRY, PROTO, COMP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR MAUBACH K

.PUB`N INT J MASS HEAT TRANSFER, VOL 15, 1972

.TITLE ROUGH ANNULUS PRESSURE DROP - INTERPRETATION OF EXPERIMENTS AND RECALCULATION FOR SQUARE RIBS

.DATA ROUGHNESS FUNCTION, RIB RATIO, FRICTION FACTOR, REYNOLDS NO

.KEY WORDS FRICTION FACTOR, ANNULI, RIBS

.CHANNEL TYPE THRY, EXP, RGH, ANNULI

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

.AUTHOR McALLISTER J E, PIERCE F J, TENNANT M H

.PUB`N TASME, J FLUIDS ENGINEERING, VOL 104, JUNE, 1982

.TITLE PRESTON TUBE CALIB & DIRECT FORCE FLOATING ELEMENT MEASUREMENTS IN A 2D TURBULENT BOUNDARY LAYER

.DATA WALL SHEAR, REYNOLDS NO

.KEY WORDS PRESTON TUBE, CALIBRATION, TURBULENT BOUNDARY LAYER

.CHANNEL TYPE EXP, THRY, SMTH, DUCT

.FL	.FW 0.91 M	.FD 0.61 M
.CL	.CW 0.91 M	.CD 0.61 M
.FCS	.Q AIR	.INST DIRECT FORCE FLOATING ELEMENT, PRESTON TUBE, PIEZOMETERS, MANOMETER.

.AUTHOR McLEAN S R, SMITH J D

.PUB`N PASCE, J HYD D, VOL 112, HY4, APRIL, 1986

.TITLE A MODEL FOR FLOW OVER TWO DIMENSIONAL BED FORMS

.DATA SHEAR STRESS, BOUNDARY SHEAR STRESS, VELOCITY

.KEY WORDS BED FORMS, COMPUTATIONAL MODEL, BOUNDARY SHEAR STRESS

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

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

.AUTHOR MIKKELSEN L, ENGELUND F

.PUB`N INST HYDRODYN & HYDRAULIC ENG., TECH UNIV DENMARK, REPORT 43, 1977

.TITLE FLOW RESISTANCE IN MEANDERING CHANNELS

.DATA CURVILINEAR COORDINATES, VELOCITY DISTRIBUTION

.KEY WORDS MEANDERS, FLOW RESISTANCE

.CHANNEL TYPE EXP, SIMP, RGH, MEANDER

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR MOORE D F

.PUB`N Wear, NO 13, 1969

.TITLE A HISTORY OF RESEARCH ON SURFACE TEXTURE EFFECTS

.DATA VOID WIDTH, FRICTION COEFF, BEARING AREA CURVE, SLIDING SPEED, BRAKE COEFF, ASPERITY DENSITY

.KEY WORDS SURFACE TEXTURE, PIPE FLOW ROUGHNESS, FRICTION FACTOR

.CHANNEL TYPE

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR MOTAYED A K, KRISHNAMURTHY M

.PUB`N PASCE, J HYD D, VOL 106, HY6, JUNE, 1980

.TITLE COMPOSITE ROUGHNESS OF NATURAL CHANNELS

.DATA CROSS SECTION, DISCHARGE, FLOW VELOCITY

.KEY WORDS COMPOSITE ROUGHNESS, MANNINGS n

.CHANNEL TYPE THRY, PROTO, SIMP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

AUTHOR MYERS W R C

PUB`N PASCE, J HYD D, VOL 113, HY6, JUNE, 1987

TITLE VELOCITY AND DISCHARGE IN COMPOUND CHANNELS

DATA RELATIVE DEPTH, REYNOLDS NO. VEL DISTRIBUTION, DEPTH, DISCHARGE RATIO, CHANNEL/FLOODPLAIN RATIO

KEY WORDS COMPOUND CHANNEL, VELOCITY & DISCHARGE DISTRIBUTION, SHEAR STRESS

CHANNEL TYPE EXP, THRY, COMP, SMTH

FL 9 M	FW 0.76 M	FD
CL 9 M	CW 0.160 M	CD 0.08, 0.12 M
FCS 2.2/22.8(-4)	Q	INST POINT GAUGE, MIN CURRENT METER, VENTURI

AUTHOR NAKAGAWA H, NEZU I

PUB`N J HYDRAULIC RESEARCH, VOL 25, 1, 1987

TITLE EXPERIMENTAL INVESTIGATION ON TURBULENT STRUCTURE OF BACKWARD FACING STEP FLOW IN AN OPEN CHANNEL

DATA MEAN VELOCITY, TURBULENCE INTENSITY, REYNOLDS STRESS, ISOVELS, REATTACHMENT LENGTH, ENERGY BALANCE

KEY WORDS TURBULENCE, STEP, SHEAR STRESS

CHANNEL TYPE EXP, THRY, SMTH, SIMP

FL 8 M	FW 30 CM	FD 20 CM
CL 8 M	CW 30 CM	CD 20 CM
FCS	Q	INST LASER DOPPLER ANEMOMETER

AUTHOR NAKAGAWA T

PUB`N SEDIMENTOLOGY, 30, 1983

TITLE BOUNDARY EFFECTS ON STREAM MEANDERING AND RIVER MORPHOLOGY

DATA VELOCITY DISTRIBUTION, CHANNEL WIDTH, ELAPSED TIME, CROSS SECTION DEVELOPMENT

KEY WORDS MEANDER, SHEAR STRESS, CHANNEL MORPHOLOGY

CHANNEL TYPE EXP, SIMP, RGH, MEANDER

FL 25 M	FW 2 M	FD
CL 20 M	CW 0.035, 0.30 M	CD 0.05 M
FCS	Q 0.34 - 0.73 LITRES PER SEC	INST MINIATURE CURRENT METER, DYE, POINT GAUGE

AUTHOR NANSON G C, HICKIN E J

PUB`N PASCE, J HYD, VOL 109, HY3, MARCH, 1983

TITLE CHANNEL MIGRATION AND INCISION ON THE BEATTON RIVER

DATA CHANNEL MIGRATION RATE, CHANNEL CURVATURE RATIO

KEY WORDS CHANNEL MIGRATION

CHANNEL TYPE PROTO, THRY, SIMP, MEANDERS

FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR NATIONAL PHYSICAL LABORATORY

PUB`N NATIONAL PHYSICAL LABORATORY, AERODYNAMICS DIV., NO 3185, MAY, 1958

TITLE ON THE MEASUREMENT OF LOCAL SURFACE FRICTION ON A FLAT PLATE BY MEANS OF PRESTON TUBES

DATA REYNOLDS, SHEAR STRESS, PRESSURE DIFFERENCE, SURFACE FRICTION, VELOCITY, YAW SENSITIVITY

KEY WORDS SHEAR STRESS, SURFACE FRICTION, REYNOLDS, TURBULENCE

CHANNEL TYPE EXP, THRY, SMTH, DUCT

FL	FW 9, 13 FT	FD 7, 9 FT
CL	CW 9, 13 FT	CD 7, 9 FT
FCS	Q AIR	INST PRESTON TUBES, MANOMETER

AUTHOR NIXON M

PUB`N PICE, VOL 12, FEBRUARY, 1959

TITLE A STUDY OF THE BANK FULL DISCHARGES OF RIVERS IN ENGLAND AND WALES

DATA DISCHARGE, DISCHARGE FREQUENCY, CATCHMENT AREA, WIDTH, DEPTH, VELOCITY, BANKFULL DISCHARGE, AREA

KEY WORDS BANK FULL DISCHARGE

CHANNEL TYPE PROTO, SIMP, RGH

FL	FW	FD
CL	CW 34, 257 FT	CD 3.12, 16.4 FT
FCS	Q 300 - 18000 CUSECS	INST

AUTHOR NOUH M A, TOWNSEND R D
PUB`N PASCE, J HYD D, VOL 105, HY10, OCTOBER, 1979
TITLE SHEAR STRESS DISTRIBUTION IN STABLE CHANNEL BEND
DATA SHEAR STRESS DISTRIBUTION, BED CONTOURS
KEY WORDS SHEAR STRESS, CHANNEL BEND
CHANNEL TYPE THRY, EXP, SIMP, SMTH, BEND

FL 10 M	FW 0.30 M	FD 0.15 M
CL 10 M	CW 0.30 M	CD 0.15 M
FCS	Q	INST LASER DOPPLER ANEMOMETER

AUTHOR NUTTALL H
PUB`N ENGINEERING, NO 3, SEPTEMBER, 1954
TITLE FLOW OF A VISCOUS INCOMPRESSIBLE FLUID - EXPRESSIONS FOR A UNIFORM TRIANGULAR DUCT
DATA DUCT PROPORTIONS, VELOCITY PROFILE
KEY WORDS LAMINAR FLOW, VISCOUS FLOW, INCOMPRESSIBLE FLUID, DUCT
CHANNEL TYPE THRY, SMTH, DUCT

FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR ODGAARD A J
PUB`N PASCE, J HYD D, VOL 108, HY11, NOVEMBER, 1982
TITLE BED CHARACTERISTICS IN ALLUVIAL CHANNEL BENDS
DATA RADIAL VELOCITY PROFILE, VEL PROF EXPONENT, REL DEPTH, SHIELDS PARAMETER, GRAIN SIZE
KEY WORDS ALLUVIAL CHANNEL BENDS, BED CHARACTERISTICS, GRAIN SIZE
CHANNEL TYPE THRY, PROTO, SIMP, RGH, BEND

FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR ODGAARD A J, KENNEDY J F
PUB`N PASCE, J HYD
D, VOL 109, HY8,
AUGUST, 1983

TITLE RIVER BEND BANK PROTECTION BY SUBMERGED VANES

DATA CROSS SECTIONS, BED TOPOGRAPHY, DEPTH, VELOCITY

KEY WORDS BEND, BANK
PROTECTION, SUBMERGED
VANES

CHANNEL TYPE THRY, EXP, SIMP, RGH, BEND

FL 265 FT
FW 8.00 FT
FD 24 IN

CL 265 FT
CW 4.75 FT
CD

FCS
Q 5.45 CUSECS
INST MIN CURRENT METER, SONIC
SOUNDER

AUTHOR ODGAARD A J
PUB`N PASCE, J HYD
D, VOL 110, HY7,
JULY, 1984

TITLE SHEAR INDUCED SECONDARY CURRENTS IN CHANNEL FLOWS

DATA MEAN VEL, ROUGHNESS STRIPE, REYNOLDS STRESS,
TRANSVERSE VELOCITY COMPONENT

KEY WORDS SECONDARY
CURRENTS, SHEAR,
CHANNEL FLOW

CHANNEL TYPE THRY, EXP, SIMP, SMTH

FL
FW
FD

CL
CW
CD

FCS
Q
INST

AUTHOR ONISHI Y, JAIN S C, KENNEDY J F
PUB`N PASCE, J HYD
D, VOL 102, HY7,
JULY, 1976

TITLE EFFECTS OF MEANDERING IN ALLUVIAL STREAMS

DATA SEDIMENT DISCHARGE, FLOW VELOCITY, WIDTH,
HYDRAULIC RADIUS, FRICTION FACTOR, FROUDE NO

KEY WORDS MEANDERS,
ALLUVIAL STREAMS,
FRICTION FACTORS,
SEDIMENT TRANSPORT

CHANNEL TYPE THRY, EXP, SIMP, RGH, MEANDER

FL 102 FT
FW 7.68 FT
FD 1.345 FT

CL 102 FT
CW 3.84 FT
CD 1.345 FT

FCS 3(-4)
Q
INST SEDIMENT SAMPLERS, PITOT TUBE,
PEIZOMETERS

.AUTHOR ONSRUD G, PERSEN L N, SAETRAN L R

.PUB`N EXPERIMENTS IN FLUIDS, 5, 1987

.TITLE ON THE MEASUREMENT OF WALL SHEAR STRESS

.DATA VELOCITY, SHEAR STRESS, HOLE DIAMETER, PRESSURE DIFFERENCE

.KEY WORDS SHEAR STRESS, STATIC HOLE PAIR

.CHANNEL TYPE EXP, THRY, SMTH, DUCT

.FL	.FW 1000 MM	.FD 500 MM
.CL	.CW 1000 MM	.CD 500 MM
.FCS	.Q AIR	.INST STATIC HOLE PAIR, HOT WIRE ANEMOMETER

.AUTHOR PARKER G

.PUB`N J FLUID MECH, VOL 76, 1976

.TITLE ON THE CAUSE AND CHARACTERISTIC SCALES OF MEANDERING AND BRAIDING IN RIVERS

.DATA BEDFORM RESISTANCE COEFF, MEANDER LENGTH, ANDERSON RELATION, HANSEN RELATION

.KEY WORDS MEANDERS, BRAIDS, CHANNEL INSTABILITY, BEDLOAD

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

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

.AUTHOR PARKER G, DIPLAS P, AKIYAMA J

.PUB`N PASCE, J HYD D, VOL 109, HY10, OCTOBER, 1983

.TITLE MEANDER BENDS OF HIGH AMPLITUDE

.DATA BEND EQUATION, FINITE AMPLITUDE BENDS, LINEAR STABILITY ANALYSIS

.KEY WORDS MEANDER BEND, HIGH AMPLITUDE MEANDER, ANALYTICAL SOLUTION

.CHANNEL TYPE THRY, PROTO, SIMP, RGH, MEANDER

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

.AUTHOR PATEL V C
.PUB`N AERONAUTICAL QUARTERLY, FEBRUARY, 1973

.TITLE A UNIFIED VIEW OF THE LAW OF THE WALL USING MIXING LENGTH THEORY

.DATA SHEAR STRESS, VELOCITY, SHEAR STRESS PROFILE, PRESSURE GRADIENT, REYNOLDS NO, VELOCITY RATIO
.KEY WORDS MIXING LENGTH, SHEAR STRESS, REYNOLDS NO

.CHANNEL TYPE THRY, EXP, SMTH, RGH, PIPE

.FL 0.4, 7.32 M .FW 0.305, 38.1 MM RADIUS .FD

.CL 0.4, 7.32 M .CW 0.305, 38.1 MM RADIUS .CD

.FCS .Q .INST

.AUTHOR PENDERGAST D, COBBLE M, SMITH P
.PUB`N INT J MECHANICAL SCIENCES, VOL 12, 1970

.TITLE LAMINAR FLOW THROUGH DUCTS OF ARBITRARY CROSS SECTION

.DATA VELOCITY PROFILE, RELATIVE WIDTH, RELATIVE DEPTH
.KEY WORDS LAMINAR FLOW, DUCTS

.CHANNEL TYPE THRY, EXP, SIMP, DUCT

.FL 10 FT .FW 2.00 IN .FD 1.502, 2.00 IN

.CL 10 FT .CW 2.00 IN .CD 1.502, 2.00 IN

.FCS .Q GLYCERINE .INST CAMERA, TRACER

.AUTHOR RASTOGI A K, RODI W
.PUB`N PACSE, J HYD D, VOL 104, HY3, MARCH, 1978

.TITLE PREDICTIONS OF HEAT AND MASS TRANSFER IN OPEN CHANNELS

.DATA SECONDARY FLOW, TEMPERATURE/CONCENTRATION & VELOCITY PROFILE, ISOTHERMS
.KEY WORDS OPEN CHANNELS, HEAT & MASS TRANSFER

.CHANNEL TYPE THRY, EXP, SIMP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

AUTHOR REHME K

PUB`N INT J HEAT MASS TRANSFER, VOL 15, 1972

TITLE PRESSURE DROP PERFORMANCE OF ROD BUNDLES IN HEXAGONAL ARRANGEMENTS

DATA PRESSURE DROP COEFF, ROD DIAM RATIO, REYNOLDS NO, FRICTION FACTOR, EQUIVALENT ANNULAR ZONE

KEY WORDS PRESSURE DROP, ROD BUNDLES, REYNOLDS NO

CHANNEL TYPE EXP, SIMP, RGH, DUCT

FL | FW | FD

CL | CW | CD

FCS | Q | INST

AUTHOR REHME K

PUB`N INT J HEAT TRANSFER, VOL 15, 1972

TITLE SIMPLE METHOD OF PREDICTING FRICTION FACTORS OF TURBULENT FLOW IN NON CIRCULAR CHANNELS

DATA GEOMETRY FACTOR, DIAMETER RATIO, FRICTION FACTOR RATIO, REYNOLDS NO

KEY WORDS FRICTION FACTOR, TURBULENT FLOW, NON CIRCULAR CHANNELS

CHANNEL TYPE THRY, EXP, SIMP, RGH, DUCT

FL | FW | FD

CL | CW | CD

FCS | Q | INST

AUTHOR SAMUELS P G

PUB`N HYDRAULICS RESEARCH LTD, REPORT NO. IT 183, DECEMBER , 1979

TITLE EMBER - A NUMERICAL MODEL OF AN EMBANKED RIVER

DATA CONVEYANCE, HYDRAULIC RADIUS, MANNINGS n, DROWNED FLOW FACTOR

KEY WORDS FLOOD ROUTING , EMBANKED RIVERS, COMPUTATIONAL MODEL

CHANNEL TYPE THRY, PROTO, COMP, RGH

FL | FW | FD

CL | CW | CD

FCS | Q | INST

.AUTHOR SAMUELS P G

.PUB`N HYDRAULICS RESEARCH LTD., REPORT NO SR 61, NOVEMBER, 1985

.TITLE MODELLING OF RIVER AND FLOOD PLAIN FLOW USING THE FINITE ELEMENT METHOD

.DATA LATERAL VEL, STREAM FUNCTION, CONVECTION TERM, WATER SURFACE PROFILES, CONVERGENCE PARAMETER, MESH

.KEY WORDS RIVER FLOW, FLOOD PLAIN FLOW, INTERACTION, FINITE ELEMENT METHOD

.CHANNEL TYPE THRY, PROTO, COMP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR SAMUELS P G

.PUB`N 2ND INT CONF HYDRAULICS OF FLOODS & FLOOD CONTROL, CAMBRIDGE, 1985

.TITLE MODELLING OPEN CHANNEL FLOW USING PRIESSMANN`S SCHEME

.DATA PRIESSMANN`S BOX SCHEME, ENERGY MULTIPLIER, STEADY FLOW ENERGY

.KEY WORDS OPEN CHANNEL, PRIESSMANNN`S SCHEME, FOURIER ANALYSIS, VOLUME CONSERVATION

.CHANNEL TYPE THRY, PROTO, COMP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR SCHUMM S A

.PUB`N SCIENCE, VOL 157, SEPTEMBER, 1967

.TITLE MEANDER WAVELENGTH OF ALLUVIAL RIVERS

.DATA MEANDER WAVELENGTH, DISCHARGE

.KEY WORDS MEANDER WAVELENGTH, SEDIMENT LOAD

.CHANNEL TYPE PROTO, SIMP, RGH, MEANDER

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR SCHUMM S A, KHAN H R

.TITLE EXPERIMENTAL STUDY OF CHANNEL PATTERNS

.PUB`N GEOLOGICAL SOCIETY OF AMERICA BULLETIN, JUNE, 1972

.DATA VALLEY SLOPE, THALWEG SINUOSITY, SEDIMENT LOAD, VELOCITY, WIDTH DEPTH RATIO, SHEAR, DISCHARGE

.KEY WORDS CHANNEL PATTERNS, SEDIMENT TRANSPORT

.CHANNEL TYPE EXP, SIMP, RGH, MEANDER, BRAID

.FL 100 FT .FW 24 FT .FD 3 FT

.CL 100 FT .CW 12 IN .CD 3 IN

.FCS 1 - 20(-3) .Q 0.15 CUSECS .INST POINT GAUGE

.AUTHOR SERC WORKING PARTY

.TITLE RESEARCH STRATEGY ON FLOWS IN COMPOUND CHANNELS

.PUB`N SERC WORKING PARTY, NOVEMBER, 1985

.DATA OBJECTIVES, METHODOLOGY, IMPLEMENTATION, DISSEMINATION OF RESULTS, MEMBERSHIP, REFERENCES

.KEY WORDS COMPOUND CHANNEL, RESEARCH, LITERATURE REVIEW

.CHANNEL TYPE EXP, COMP, SMTH, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR SHEN H W, KOMURA S

.TITLE MEANDERING TENDENCIES IN STRAIGHT ALLUVIAL CHANNELS

.PUB`N PASCE, J HYD D, VOL 94, HY4, JULY, 1968

.DATA FLOW DEPTH, VELOCITY, SCOUR DEPTH, TIME

.KEY WORDS ALLUVIAL CHANNELS, MEANDERS, ALTERNATE BARS

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

.FL 56 FT .FW 8.0 FT .FD 2.00 FT

.CL 56 FT .CW 2.5, 5 FT .CD 1.25 FT

.FCS 2.8 - 20.6(-4) .Q 0.242 - 1.254 CUSECS .INST POINT GAUGE, PITOT TUBE, FLOATS

.AUTHOR SILL B L
.TITLE NEW FLAT PLATE TURBULENT VELOCITY PROFILES
.PUB`N PASCE, J HYD D, VOL 108, HY1, JANUARY, 1982

.DATA SHEAR STRESS, DEPTH, EDDY VISCOSITY, VELOCITY PROFILE
.KEY WORDS VELOCITY PROFILE, SMOOTH PLATE, ROUGH PLATE, TURBULENT FLUID FLOW
.CHANNEL TYPE THRY, SIMP, SMTH, RGH

.FL
.FW
.FD

.CL
.CW
.CD

.FCS
.Q
.INST

.AUTHOR SOKOLOV Y N
.TITLE HYDRAULICS OF FLOODPLAIN FLOWS
.PUB`N GIDROTEKHNICHESKOE STROITEL`STVO, NO 5, MAY, 1986

.DATA ROUGHNESS COEFFICIENT, VEGETATION PARAMETER, FLOW CHARTS
.KEY WORDS FLOODPLAIN FLOW, ROUGHNESS, VEGETATION DENSITY
.CHANNEL TYPE EXP, PROTO, SIMP, COMP, RGH

.FL
.FW
.FD

.CL
.CW
.CD

.FCS
.Q
.INST

.AUTHOR STRUIKSMA N, OLESEN K W, FLOKSTRA C, DE VRIEND H
.TITLE BED DEFORMATION IN CURVED ALLUVIAL CHANNELS
.PUB`N J HYDRAULIC RESEARCH, VOL 23, NO 1, 1985

.DATA RELATIVE GRAIN SIZE, WATER DEPTH, WAVE NOS, DISTANCE WIDTH RATIO, BED & VELOCITY PROFILES
.KEY WORDS ALLUVIAL CHAN, BED DEFORMATION, SEDIMENT MOTION, FLOW DISTRIBUTION
.CHANNEL TYPE EXP, SIMP, RGH, BEND, MEANDER

.FL 6.6, 41.5 M
.FW 1, 2.3 M
.FD

.CL 6.6, 41.5 M
.CW 1, 2.3 M
.CD

.FCS 1.28 - 4.19(-2)
.Q 0.02 - 0.17 CUMECS
.INST

AUTHOR TAGG A F, SAMUELS P G

PUB`N HYDRAULICS RESEARCH LTD., REPORT NO IT 274

TITLE NUMERICAL MODELLING OF EMBANKED RIVERS

DATA CHANNEL & FLOODPLAIN CELLS, PROGRAM SENSITIVITY, HYSTERESIS EFFECTS, DROWNED FLOW FACTOR

KEY WORDS COMPUTATIONAL MODEL, EMBANKED RIVER, COMPOUND CHANNEL

CHANNEL TYPE THRY, PROTO, COMP, RGH

FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR TANNER W F

PUB`N J GEOPHYSICAL RESEARCH, VOL 65, NO 3, 1960

TITLE HELICOIDAL FLOW, A POSSIBLE CAUSE OF MEANDERING

DATA GRAVITY VECTOR, FALLING & RISING CURRENT, TOTAL VELOCITY

KEY WORDS HELICOIDAL FLOW, MEANDER

CHANNEL TYPE EXP, SIMP, SMTH, MEANDER

FL	FW	FD
CL	CW	CD
FCS	Q	INST

AUTHOR TEMPLE D M

PUB`N PASCE, J HYD D, VOL 112, HY3, MARCH, 1986

TITLE VELOCITY DISTRIBUTION COEFFICIENTS FOR GRASS LINED CHANNELS

DATA VELOCITY, DISTANCE, ENERGY COEFFICIENT

KEY WORDS MOMENTUM & ENERGY COEFFICIENTS, VELOCITY DISTRIBUTION, GRASS CHANNELS

CHANNEL TYPE THRY, EXP, SIMP, RGH

FL 96, 140 FT	FW 3, 20 FT	FD 1, 2 FT
CL 96, 140 FT	CW 1.5, 10 FT	CD 1, 2 FT
FCS 5 - 9(-2)	Q 0.9 - 54 CUSECS	INST PITOT TUBE, MANOMETER

.AUTHOR THE INSTITUTION OF ENGINEERS, AUSTRALIA .PUB`N 21ST CONGRESS, IAHR, MELBOURNE, AUGUST, 1985, VOL 2

.TITLE FUNDAMENTALS & COMPUTATION OF 2D & 3D FLOWS; TRANSPORT & MIXING IN RIVERS & RESERVOIRS

.DATA FREE SURFACE FLOW, 2D & 3D FLOW, SEDIMENT TRANSPORT, MIXING, STRATIFIED FLOWS

.KEY WORDS

.CHANNEL TYPE

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR THE INSTITUTION OF ENGINEERS, AUSTRALIA .PUB`N 21ST CONGRESS, IAHR, MELBOURNE, AUGUST, 1985

.TITLE FLOOD FLOWS IN CHANNELS & FLOOD PLAINS; SEDIMENT TRANSPORT IN RIVERS; HYDRAULIC STRUCTURES

.DATA CHANNEL INTERACTION, FLOOD FLOWS, RAINFALL RUNOFF, SEDIMENT TRANSPORT, HYDRAULIC STRUCTURES

.KEY WORDS

.CHANNEL TYPE

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR THORNE C R, HEY R D .PUB`N NATURE, VOL 280, JULY, 1979

.TITLE DIRECT MEASUREMENT OF SECONDARY CURRENTS AT A RIVER INFLEXION POINT

.DATA PRIMARY ISOVELS, SECONDARY VELOCITIES

.KEY WORDS SECONDARY CURRENTS, BENDS

.CHANNEL TYPE PROTO, SIMP, RGH, BEND

.FL .FW .FD

.CL .CW 27, 36 M .CD 1 M

.FCS .Q 13 - 22 CUMECS .INST ELECTRO MAGNETIC CURRENT METER

.AUTHOR TIFFANY J B

.TITLE STUDIES OF MEANDERING OF MODEL STREAMS

.PUB`N TRANS, AMER GEOPHYSICAL UNION, REPORTS & PAPERS, HYDROLOGY, 1939

.DATA THALWEG, MEANDER AMPLITUDE, DISCHARGE, SAND INJECTION RATE, TIME

.KEY WORDS MEANDERS, MOBILE BED

.CHANNEL TYPE EXP, SIMP, RGH, MEANDER

.FL 50 FT	.FW 15 FT	.FD
.CL 50 FT	.CW	.CD
.FCS 3 - 6(-3)	.Q	.INST

.AUTHOR TOWNSEND A A

.TITLE EQUILIBRIUM LAYERS AND WALL TURBULENCE

.PUB`N J FLUID MECHANICS, 1960

.DATA WALL STRESS, REYNOLDS NO., BOUNDARY LAYER DEV`T., LINEAR STRESS, CONSTANT STRESS, EQUILIBRIUM LAYER

.KEY WORDS TURBULENCE, EQUILIBRIUM LAYER, WALL STRESS

.CHANNEL TYPE THEORETICAL

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

.AUTHOR URBAN C, ZIELKE W

.TITLE STEADY STATE SOLUTION FOR TWO DIMENSIONAL FLOWS IN RIVERS WITH FLOOD PLAINS

.PUB`N 2ND INT CONF HYDRAULICS OF FLOODS & FLOOD CONTROL, CAMBRIDGE, 1985

.DATA COORDINATE SYSTEM, FINITE ELEMENT GRID, VELOCITY DISTRIBUTION

.KEY WORDS COMPUTATIONAL MODEL, COMPOUND CHANNEL

.CHANNEL TYPE THRY, PROTO, COMP, RGH

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

.AUTHOR WEBEL G, SCHATZMANN M

.TITLE TRANSVERSE MIXING IN OPEN CHANNEL FLOW

.PUB`N PACSE, J HYD
D, VOL 110, HY4,
APRIL, 1984

.DATA MIXING COEFF, WIDTH/DEPTH RATIO, ASPECT RATIO,
EFFECTIVE ROUGHNESS, FRICTION FACTOR, TURB INTENSITY

.CHANNEL TYPE EXP, THRY, SIMP, SMTH, RGH

.KEY WORDS TRANSVERSE
MIXING, OPEN CHANNELS,
DIMENSIONAL ANALYSIS

.FL 20 M .FW 1.82 M .FD

.CL 20 M .CW 0.486, 1.82 M .CD

.FCS 0.6 - 4(-4) .Q .INST DYE

.AUTHOR WEBEL G, SCHATZMANN

.TITLE THE ROLE OF BED ROUGHNESS IN TURBULENT DIFFUSION
AND DISPERSION

.PUB`N IAHR, SYMP
RIVER ENGINEERING,
BELGRADE, MAY, 1980

.DATA TRANSVERSE MIXING COEFFICIENT, WIDTH/DEPTH
RATIO, FRICTION FACTOR, ISOTHERMS

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

.KEY WORDS LATERAL
MIXING, MODEL
SIMILARITY

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR WERNER P W

.TITLE ON THE ORIGIN OF RIVER MEANDERS

.PUB`N TRANS, AMER
GEOPHYSICAL UNION,
VOL 32, NO 6,
DECEMBER, 1951

.DATA TIME, CRITICAL VELOCITY, DISCHARGE, MEANDER
LENGTH, DEPTH, WIDTH

.CHANNEL TYPE THRY, EXP, PROTO, SIMP, RGH, MEANDER

.KEY WORDS MEANDERS

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR WEST J R, KNIGHT D W, SHIONO K .PUB`N PASCE, J HYD D, VOL 112, HY3, MARCH, 1986

.TITLE TURBULENCE MEASUREMENTS IN THE GREAT OUSE ESTUARY

.DATA TURBULENT INTENSITIES, REYNOLDS STRESS, VELOCITY, DEPTH, MACROSCALE, FREQUENCY, SPECTRA

.KEY WORDS TURBULENT FLUCTUATIONS, ESTUARY

.CHANNEL TYPE PROTO, THRY, SIMP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST E M CURRENT METER , CURRENT METER, SALINOMETER, SED SAMPLER

.AUTHOR WHITE C M .PUB`N PROC. ROYAL SOC., VOL 123, 1929

.TITLE STREAMLINE FLOW THROUGH CURVED PIPES

.DATA REYNOLDS NO., RESISTANCE COEFFICIENT, DIMENSIONLESS RESISTANCE COEFFICIENT

.KEY WORDS FRICTION FACTOR, PIPES, STREAMLINE FLOW

.CHANNEL TYPE EXPERIMENTAL, THEORETICAL, PIPES, BENDS

.FL 0.978, 5.5 M .FW 0.0032, 0.0103 M DIAM .FD

.CL 0.978, 3.3 M .CW 0.0032, 0.0103 M DIAM .CD

.FCS .Q AIR, WATER .INST PRESSURE TAPPINGS, MANOMETER, THERMOMETER

.AUTHOR WHITE W R, BETTESS R, PARIS E .PUB`N PASCE, J HYD D, VOL 108, HY10, OCTOBER, 1982

.TITLE ANALYTICAL APPROACH TO RIVER REGIME

.DATA SLOPE, SEDIMENT CONCENTRATION, WIDTH, DISCHARGE

.KEY WORDS RIVER REGIME, SEDIMENT TRANSPORT, STABLE CHANNEL, COMPUTATIONAL MODEL

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

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR WIJBENGA J H A

.PUB`N 2ND INT CONF HYDRAULICS OF FLOODS & FLOOD CONTROL, CAMBRIDGE, 1985

.TITLE STEADY DEPTH AVERAGED FLOW CALCULATIONS ON CURVILINEAR GRIDS

.DATA GENERATED GRID, VELOCITY FIELD, WATER LEVELS, VELOCITIES, BED LEVELS

.KEY WORDS COMPUTATIONAL MODEL, FLOW CALCULATION, COMPOUND CHANNEL

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

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

.AUTHOR WILKIE D, COWIN M, BURNETT P, BURGOYNE T

.PUB`N INT J HEAT MASS TRANSFER, VOL 10, 1967

.TITLE FRICTION FACTOR MEASUREMENTS IN A RECT. CHANNEL WITH WALLS OF IDENTICAL AND NON IDENTICAL ROUGHNESS

.DATA VELOCITY PROFILE, STANTON NO., REYNOLDS NO., FRICTION FACTOR

.KEY WORDS ROUGHNESS, FRICTION FACTOR, DUCT, REYNOLDS NO.

.CHANNEL TYPE EXP, THRY, SMTH, RGH, DUCT

.FL 5 FT	.FW 6 IN	.FD 0.54 IN
.CL 5 FT	.CW 6 IN	.CD 0.54 IN
.FCS	.Q AIR, 0.6 LB/S	.INST PRESSURE TAPPINGS, PITOT TUBE, THERMOCOUPLE

.AUTHOR WILSON I G

.PUB`N NATURE, VOL 241, FEBRUARY, 1973

.TITLE EQUILIBRIUM CROSS SECTION OF MEANDERING AND BRAIDED RIVERS

.DATA SPIRAL FLOW MODELS, SLOPE, DISCHARGE, CROSS PROFILES, GRAIN SIZE

.KEY WORDS MEANDERS, BRAIDS, EQUILIBRIUM

.CHANNEL TYPE THRY, SIMP, RGH, MEANDER, BRAID

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

.AUTHOR WINTER K G

.PUB`N PROGRESS IN AEROSPACE SCIENCES, VOL 18, 1977

.TITLE AN OUTLINE OF THE TECHNIQUES AVAILABLE FOR THE MEASM`T OF SKIN FRICTION IN TURBULENT BOUNDARY LAYERS

.DATA SKIN FRICTION ERROR, PRESSURE GRADIENT, CLAUSER CHART, VEL. PROFILE, OIL FILM THICKNESS, PRESTON CAL.

.KEY WORDS TURBULENT BOUNDARY LAYERS, SKIN FRICTION

.CHANNEL TYPE EXP, SMTH, RGH, DUCT, CHANNEL

.FL .FW .FD

.CL .CW .CD

.FCS .Q

.INST FORCE MEASM`T BALANCES, PITOT TUBE, FENCES, STEPS, HOT WIRE FILM

.AUTHOR WOLMAN M G, BRUSH L M

.PUB`N GEOLOGICAL SURVEY PROFESSIONAL PAPER 282-G

.TITLE FACTORS CONTROLLING THE SIZE AND SHAPE OF STREAM CHANNELS IN COARSE NONCOHESIVE SANDS

.DATA DEPTH, SLOPE, SEDIMENT LOAD & SIZE, VELOCITY, DISCHARGE, WIDTH, TRACTIVE FORCE, TIME, SHEAR STRESS

.KEY WORDS EQUILIBRIUM CHANNEL, MOBILE BED, SHEAR STRESS

.CHANNEL TYPE EXP, PROTO, SIMP, RGH

.FL 52 FT .FW 4 FT .FD 8 IN

.CL 52 FT .CW 5, 10 IN .CD

.FCS 1.31 - 13.7(-3) .Q 0.011 - 0.28 CUSECS

.INST BUBBLER GAUGE, TRANSDUCER, POINT GAUGE, SEDIMENT INJECTOR

.AUTHOR WOLMAN M G, LEOPOLD L B

.PUB`N GEOLOGICAL PROFESSIONAL SURVEY PAPER 282-C

.TITLE RIVER FLOOD PLAINS : SOME OBSERVATIONS ON THEIR FORMATION

.DATA CROSS SECTION, SEDIMENT SIZE DISTRIBUTION, SEDIMENT CONCENTRATION, DISCHARGE, DEPTH

.KEY WORDS FLOOD PLAIN, OVERBANK DEPOSITS, FLOODING FREQUENCY, SEDIMENT CONCENTRATION

.CHANNEL TYPE PROTO, COMP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q

.INST

.AUTHOR WOODYER K D
.PUB`N J HYDROLOGY, VOL 6, 1968

.TITLE BANKFULL FREQUENCY IN RIVERS

.DATA CHANNEL WIDTH, BENCH LEVEL, BANKFULL FREQUENCIES, RECURRENCE INTERVALS, STAGE EXCEEDANCE

.KEY WORDS BANKFULL DISCHARGE, RECURRENCE INTERVAL

.CHANNEL TYPE

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR WORMLEATON P R, ALLEN J, HADJIPANOS P
.PUB`N IAHR, SYMP RIVER ENGINEERING, BELGRADE, MAY, 1980

.TITLE APPARENT SHEAR STRESSES IN COMPOUND CHANNEL FLOW

.DATA CALCULATED/OBSERVED DISCHARGE RATIO, DEPTH RATIO

.KEY WORDS COMPOUND CHANNEL, APPARENT SHEAR STRESS

.CHANNEL TYPE EXP, COMP, SMTH, RGH

.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 HOT FILM ANEMOMETER, PRESTON TUBE, POINT GAUGE

.AUTHOR WU J
.PUB`N PASCE, J HYD D, VOL 111, HY11, NOVEMBER, 1985

.TITLE HYDRODYNAMICALLY SMOOTH FLOWS OVER SURFACE MATERIAL IN ALLUVIAL CHANNELS

.DATA FRICTION FACTOR, VELOCITY, SEDIMENT SIZE, REYNOLDS NO.

.KEY WORDS SMOOTH FLOW, TRANSITIONAL FLOW, ALLUVIAL CHANNEL

.CHANNEL TYPE PROTO, THRY, COMP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR YAGLOM A M .PUB`N ANN. REVIEW FLUID MECHANICS, VOL 11, 1979

.TITLE SIMILARITY LAWS FOR CONSTANT PRESSURE & PRESSURE GRADIENT TURBULENT WALL FLOWS

.DATA TURBULENT WALL FLOWS, CONSTANT PRESSURE, PRESSURE GRADIENT, VEL PROFILES, SKIN FRICTION COEFF

.KEY WORDS WALL FLOWS, TURBULENCE, SIMILARITY, PRESSURE

.CHANNEL TYPE THRY, EXP, SMTH, RGH, DUCT, CHANNEL

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR YANG C T .PUB`N J HYDROLOGY, VOL 13, 1971

.TITLE ON RIVER MEANDERS

.DATA ENERGY EXPENDITURE, SLOPE, WIDTH, DISCHARGE, SEDIMENT CONCENTRATION, MEANDER WAVELENGTH

.KEY WORDS MEANDERS, ENERGY EXPENDITURE, STABLE CHANNEL THEORY

.CHANNEL TYPE EXP, SIMP, RGH

.FL .FW .FD

.CL .CW .CD

.FCS .Q .INST

.AUTHOR YEN B C .PUB`N INST HYDRAULIC RESEARCH, UNIVERSITY OF IOWA, IOWA CITY, 1965

.TITLE CHARACTERISTICS OF SUBCRITICAL FLOW IN A MEANDERING CHANNEL

.DATA WATER SURFACE PROF, FLOW DIRECT, BOUNDARY SHEAR ,VEL. DISTRIBUTION, TURB. INTENSITY, RADIAL DISCHARGE

.KEY WORDS SUBCRITICAL FLOW, MEANDERING, SHEAR , TURBULENCE

.CHANNEL TYPE EXP, THRY, SIMP, SMTH, MEANDER, DUCT

.FL 116 FT .FW 6 FT .FD

.CL 116 FT .CW 6 FT .CD

.FCS 2.9 to 14.4(-4) .Q .INST PITOT TUBE, PRESTON TUBE, HOT WIRE PROBE

AUTHOR YEN C L		PUB`N PASCE, J HYD D, VOL 96, HY1, JANUARY, 1970
TITLE BED TOPOGRAPHY EFFECT ON FLOW IN A MEANDER		
DATA SEDIMENT SIZE, BED TOPOGRAPHY, VELOCITY, SHEAR STRESS, FROUDE, FALL VELOCITY, REYNOLDS NO		KEY WORDS MEANDER, BEDFORM, SECONDARY FLOW, MOBILE BED
CHANNEL TYPE THRY, PROTO, SIMP, MEANDER		
FL 116 FT	FW 7.667 FT	FD
CL 116 FT	CW 7.667 FT	CD
FCS	Q	INST PRESTON TUBE, PITOT TUBE, HOT WIRE ANEMOMETER, POINT GAUGE

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.

ACKERS, CHARLTON 1971

The geometry of small meandering streams

1 Experimental, simple, rough, meanders

2 To investigate the conditions necessary for the development and maintenance of a regular sinuous channel in a homogeneous alluvium.

3 Meandering will begin in an initially straight channel in alluvium if instability in bed sediment transport leads to a series of relatively large shoals on alternate sides of the stream. Two main dynamically stable channel patterns exist, straight with minor irregularities and regular sinuous channels. Meander length correlates well with discharge. Poor correlation between meander breadth and discharge. Multiple correlation of meander length with discharge and sediment concentration does not prove any appreciable dependence on sediment concentration. Pitch of the shoals increases by some 10% as the channel widens and as the shoals develop. If the sediment injection rate is above the threshold value, after the formation of meanders on an aggrading channel the meander length tends to decrease as the sediment load increases. Migration of meanders was confirmed. There is a threshold value of sediment charge below which channels of small discharge tend to remain straight and above which they meander, provided the available valley slope does not prevent the development of the hydraulic gradient necessary to transport the discharge and sediment. When the valley slope is insufficient for the development of the hydraulic gradient necessary to transport the discharge and sediment as a straight or meandering channel, depending on the sediment charge, then a braided channel pattern develops.

4 Point gauges, camera

ALFRINK, van RIJN 1983

Two equation turbulence model for flow in trenches

1 Theoretical, experimental, compound, smooth

2 The turbulent flow in a steep sided trapezoidal trench placed perpendicular to the main flow direction is treated using an advanced mathematical model.

3 Steady recirculating flow can be predicted reasonably well by means of a mathematical model based on the full Reynolds equations and a k-e model for turbulence closure. The constants of the k-e model are related to the roughness conditions. Accurate data for the flow velocity profile at the inlet boundary are of minor importance. Accurate turbulent energy and dissipation rate profiles at the inlet are of minor importance. Computational results are most sensitive to changes in the kinetic energy constant in combination with the k-e constants. Sensitivity to changes in the turbulent Prandtl numbers is minimal.

4 -

AMERICAN SOCIETY OF CIVIL ENGINEERS 1980

Sources of computer programs in hydraulics

1 -

2/3 To make available a list of bibliographies and publications that had already compiled computer programs and numerical models in various areas of hydraulics to serve hydraulic engineers.

4 -

AMERICAN SOCIETY OF CIVIL ENGINEERS 1983

River Meandering - Proceedings of the conference rivers 1983

Contains papers under the headings:

Geomorphology

Effects of man`s activities

Engineering analysis

Numerical and physical modeling

Present knowledge and future directions

ANDERSON 1967

On the development of stream meanders

1 Theoretical, experimental, simple, rough, meanders

2 To describe the results of an analysis to relate the meanders length of alternate bars in straight alluvial channels and hence the meander length of meandering streams to the flow parameters.

3 Based upon a concept of transverse oscillations, the relative meander length is related to the Froude number of the mean flow and through the Froude number to the discharge. Results are compared with experimental data for the meanders generated in laboratory channels at constant discharge with generally good agreement. Analysis suggests that there is no unique relationship between meander length and discharge.

4 -

ANDREWS 1980

Effective and bankfull discharges of streams in the Yampa river basin,Colorado and Wyoming

1 Prototypical, theoretical, simple, rough

2 Paper describes a study of effective discharges and their geomorphic significance in the Yampa river basin. Streamflow and sediment data were collected from gauging stations located in self formed alluvial reaches of stream channel to form the basis for this analysis.

3 Effective discharge is defined as the increment of discharge that transports the largest fraction of the annual total sediment load over a period of years.Effective discharge is a relatively frequent event, being equalled or exceeded 0.4% and 3.0% of the time respectively in the year. Effective discharge becomes less frequent as drainage area decreases. Bankful discharge was equivalent to the effective discharge.

4 -

ANWAR, ATKINS 1980

Turbulence measurements in simulated tidal flow

1 Experimental, theoretical, simple, smooth

2 To study the effects induced by the temporal variations in the velocity field on the turbulence characteristics of unsteady flows.

3 Mean velocity distribution displayed the conventional logarithmic profile when the flow was accelerating or decelerating. When the flow is accelerating, the Reynolds stress varies linearly from a maximum near the bed to a minimum value near the surface. In decelerating flow the shear stress distribution is non linear and the location of the maximum shear stress is away from the bed. The turbulence intensity, turbulent energy, and the Reynolds shear stress are consistently higher in decelerating flow. Maximum shear stress lags the mean velocity in the decelerating phase of the flow. The distribution of the Reynolds

shear stress and the turbulent energy during the half cycle display the hysteresis effect due to the time lag. Surface slope varies linearly with time during the half cycle. The longitudinal and vertical energy psectra vary according to the five thirds law at the low frequency range where the major energy content occurs.Measured data agree with field data, thus the laboratory data obtained at low Reynolds number can be used to predict the field phenomenon.

4 Electro magnetic current meter, hot film anemometer, twim wire probes, Preston tube.

ARNOLD, STEIN, PASCHE

First experience with an pn axis LDV System in special application to open channel flow

1 Experimental, theory, compound, smooth, rough

2 To describe a modified TSI single colour, two frequency on axis LDV equipment and several alternatives of signal processing.

3 Non intrusive simultaneous measurement of the main and transverse velocity component in compound open channel flow requires the application of a two component on axis LDV system. A two frequency single colour system seems to be the most economical solution of channel separation especially for the extension of a conventional dual beam LDV equipment. The first experiences with a special two frequency on axis LDV apparatus and the experimental results can be summarized as follows:

With each of the downmix output signals sufficient single to noise ratios can be obtained which permit counter type signal processing and reliable measurement of turbulent quantities.

For the evaluation of the main velocity component the Doppler signal created by the centre and 40 MHz outer beam should be preferred to the outer beam pair generated signal due to higher signal to noise ratios and output bpeak level. The specially developed on axis calibrator turned out to be an effective instrument for the simulation of constant fluid flow velocities which are needed for calibration and comparitive signal quality investigations.

4 Laser Doppler Velocimeter

BAGNOLD 1960

Some aspects of the shape of river meanders

1 Theoretical, experimental, simple, rough, meanders

2 From consideration of the probable nature of flow resistance in curved channels, a simple dynamical model is proposed to relate resistance to a criterion of bend curvature applicable both to closed pipes and open channels.

3 Theory indicates that resistance should fall to a minimum when the radius of channel curvature bears a certain critical ratio and should have approximately the same value for both closed and open channels, irrespective of scale or of boundary roughness. Resistances of pipe bends are known to fall to a sharply defined minimum when the curvature ratio, mean radius to diameter, is between 2 and 3. Recently measured flow resistances of sinuous open channels disclose that the same minimum occurs at approximately the same curvature ratio. Theory therefore goes some way in explaining the mechanism tending to restrict the bends of rivers of all sizes to a curvature ratio between 2 and 3.

4 -

BATHURST 1986

Slope area discharge gauging in mountain rivers

1 Prototypical, theoretical, simple, rough

2 Paper describes the results of field tests of the slope area method in mountain rivers in Britain.

3 Slope area method of estimating discharge in mountain rivers indicates that the necessary surveying can be carried out with an accuracy which is unlikely to lead to errors of more than 9% in the predicted discharge. These errors may be dominated by the possible error of 25% in the evaluation of flow resistance function. Method requires detailed survey of the bed cross section and transverse water surface profile.

4 Engineers level, staff, tape measure

BETTESS, WHITE 1983

Meandering and braiding of alluvial channels

1 Experimental, theoretical, simple, rough, meander, braid.

2/3 Presentation of a framework within which the problems of the meandering and braiding of channels in equilibrium can be considered.

4 Point gauges

BLINCO, SIMONS 1974

Characteristics of turbulent boundary shear stress

1 Experimental, theory, smooth, simple

2 To present some experimental results obtained with a commercially available flush surface, hot film anemometer.

3 The relative turbulent intensity of the boundary shear stress decreased with increasing Reynolds number. The coefficients of skewness and kurtosis are dependent on the Reynolds number. The probability density function estimates of the boundary shear stress are Reynolds number dependent.The autocorrelation functions decreased rapidly from unity at zero delay time to a small value at delay time 0.3 sec. The area under the autocorrelation curve to zero crossing tended to decrease as the Reynolds number increased. The ratio of the turbulent macroscale of the boundary shear stress process to the thickness of the viscous sublayer was found to increase with increasing Reynolds number.

4 Hot film anemometer

BROWNLIE 1983

Flow depth in sand bed channels

1 Theoretical, experimental, simple, rough

2 Six methods for predicting friction factors are evaluated and a new method is presented.

3 Method predicts flow depth when discharge and slope are known. Proposed technique is based on dimensional analysis, a statistical analysis of a large body of laboratory and field data, and basic principles of hydraulics. Separate equations are developed for the lower and upper flow regimes. The technique solves for flow depths and mean velocities for the upper and low flow regimes and determines limits of the mean velocity for each regime. Neglecting viscous effects, the upper and lower transitional velocities can be determined from the slope and median grain size.

4 -

BROWNLIE 1985

Compilation of alluvial channel data

1 -

2/3 Investigation undertaken to develop a computer based collection of alluvial channel data. The data are available in a computer recognizable format through the William M Keck Laboratory of Hydraulics and Water Resources at the California Institute of Technology.

4 -

CALLANDER 1966

Construction of an experimental meander

1 Experimental, simple, rough, meander

2/3 An experimental study of the properties of a stable meandering channel is outlined.Details are given of the apparatus and techniques used to overcome difficulties arising from the small space available and from the resistance characteristics of a channel with loose boundaries.

4 -

CHANG 1984

Analysis of river meanders

1 Theoretical, prototypical, experimental, simple, rough, meanders

2 An analysis is presented to explain quantitatively the geometric relation that exists between the radius of curvature of a meander bend and the channel width.

3 Meander geometry and its development are analysed using an energy approach. Geometric variables of meanders are obtained so that the inflow water discharge and sediment load from the watershed are transported with minimum power expenditure per unit channel length and equal power along the reach.Minimum power also means minimum channel slope or energy gradient for the given conditions.

4 -

CHANG 1983

Energy expenditure in curved open channels

1 Theoretical, prototypical, simple, smooth

2 The rate of energy expenditure in curved open channels is studied. The approach is based upon the established velocity distributions, from which the rate of work done by the fluid is obtained.

3 An analytical model has been developed to compute the rate of energy expenditure in curved open channels by calculating the energy loss due to the transverse circulation associated with the channel curvature. The energy loss is evaluated using the velocity field which is implicitly dependent on the turbulent shear and channel roughness. For a given channel configuration, energy expenditure due to transverse circulation is directly proportional to the Froude number, the depth radius ratio and the roughness. The ratio of transverse loss to total loss is directly related to the depth radius ratio but inversely proportional to the channel roughness.

4 -

CHANG 1984

Variation of flow resistance through curved channels

1 Theoretical, experimental, prototypical, simple, rough, smooth

2 A mathematical model which evaluates spatial variations of transverse velocity, flow resistance and other flow characteristics through curved channels is formulated and developed.

3 The excess flow resistance due to transverse circulation is directly related to the circulation strength which varies along a curved channel. In the process of circulation growth and decay, the transverse velocity profile is assumed to remain similar. The growth and decay of transverse circulation is under the interaction of centrifugal force and internal turbulent shear. In a long curve, transverse circulation will become fully developed. In a short curve, this circulation and its associated resistance reach the maximum at the curve exit and they persist at higher values for a considerable distance in the downstream tangent. The rate of circulation decay is directly related to internal turbulent shear and inversely related to flow depth.

4 -

CHANG 1984

Modelling of river channel changes

1 Theoretical, prototypical, simple, rough

2 Paper describes computational model which simulates channel bed aggradation, degradation and width variation and its application to a case study

3 Model used to simulate flood and sediment routing and associated river channel changes in the San Dieguito river near the Via de Santa Fe

bridge. Simulated results using this model are supported by field observations and measurements.

4 -

CHANG 1985

River morphology and thresholds

1 Theoretical, prototypical, experimental, simple, rough

2/3 The regime geometry and channel patterns of alluvial rivers are analysed using an energy approach together with physical relationships of flow continuity, flow resistance and sediment transport. Because of the discontinuity in flow resistance, and thus in power expenditure, between lower and upper flow regimes, the adjustment in river regime consists of sudden changes in channel geometry, channel pattern, and sometimes silt clay content, when such a discontinuity is crossed. Thresholds or discontinuities in river morphology are obtained in the analysis. In accordance with such thresholds, rivers of distinct morphological features are classified into four regions based upon the bankfull discharge, channel slope, and median size of bed sediment. Their respective features are described, and certain regime relationships for channel width and depth are established. The predicted channel geometries are compared with river data.

4 -

CHANG 1986

River channel changes:adjustments of equilibrium

1 Theoretical, prototypical, simple, rough

2/3 A method for predicting river channel`s adjustments of equilibrium is presented and illustrated by examples. The method is based upon the quantitative relationships among the variables of water discharge, bed material discharge, slope, sediment size, channel width and depth for sand bed rivers under dynamic equilibrium. In response to changes of certain variables, the directions and magnitudes of adjustments for the others may be determined using this method.

4 -

CHANG, SIMONS, WOOLHISER 1971

Flume experiments on alternate bar formation

1 Experimental, simple, rough

2 Study to obtain data on alternate bar geometry and to see how well the data are represented by the formulas proposed for determining the alternative bar length.

3 Based on experimental data,the dimensionless wave length of the alternate bar formation has been found to be related to the Froude number of the channel flow.

4 Point gauge

CHATLEY 1940

The theory of meandering

1 Theoretical, prototypical, simple, rough, meanders

2/3 Paper investigates the hydraulic and geometrical characteristics of a meandering channel.

4 -

COLEMAN, ALONSO 1983

Two dimensional channel flows over rough surfaces

1 Theoretical, experimental, simple, smooth, rough

2 Three computational models,two in respect of the inner region velocity profile and one for the velocity profile in the outer region beyond the inertial part of a bounded shear flow, provide a unified formulation of the multiple zone structure of the velocity distribution in bounded shear flows, and also apply to flow over hydraulically smooth boundaries, and the transitional cases that lie between these two extreme cases.

3 Model presented for predicting the velocity profile throughout the complete inner and outer regions of the channel or conduit flow by means of a single equation. Model predicts within q20% of measured data in the logarithmic zones of velocity profiles.

4 -

CRORY, ELSAWY 1980

An experimental investigation into the interaction between a rivers deep section and its flood plain.

1 Experimental, compound, rough

2 To investigate the effect of varying geometrical dimensions such as width to depth ratio and flood plain to main channel width ratios on velocity distribution, turbulence intensity fluctuation and shear stress.

3 Main energy transfer is from deep channel to floodplain. Amount of energy transfered depends on the main channel/floodplain width ratio and on the depth ratio. If deep section is narrow, then at high depths

the floodplain transfers energy to the channel. As main channel to floodplain width ratio increases then channel velocity increases. For relative flow depths of 0.1 to 0.3 the flow interaction between channel and floodplain is at a maximum. Areas of low turbulence coincide with areas of high mean velocity. Maximum turbulence level increases with decreasing width and depth ratios.

4 Laser Doppler Anemometer, Preston tube

DRACOS, HARDEGGER 1987

Steady uniform flow in prismatic channels with flood plains

1 Experimental, theory, compound, smooth, rough

2 A single channel method is proposed which will allow the direct determination for the stage discharge relation in a channel with a flood plain

3 Set of relations developed empirically to allow one to determine the apparent roughness coefficient of a compound channel. Using this coefficient the stage discharge relation in compound channels with flood plains can be computed by the single channel method. For channels with roughness of the flood plains different from the roughness of the main channel the effective roughness coefficient must first be computed by using the Einstein - Horton formula.

4 -

EINSTEIN, SHEN

A study on meandering in straight alluvial channels

1 Experimental, simple, rough, meanders

2 Experimental study to define one particular type of channel irregularity, the meander pattern between solid banks, and to explain the reason for its occurrence.

3 Channel bed pattern is dependent upon the nature of bank roughness. If the banks are coarse then formation of deep scour adjacent to the bank, due to differential shear stress at the bank will occur. Between unerodible banks no scour holes develop as the channel pattern travels rapidly downstream with the flow.

4 -

ENGELUND, SKOVGAARD 1973

On the origin of meandering and braiding in alluvial streams

1 Theoretical, simple, smooth, meanders, braids

2/3 The paper describes a hydrodynamic stability analysis of the flow in an alluvial channel in which dunes have developed along the bed. The purpose is to develop a mathematical model describing the three dimensional flow leading to instability of an originally straight channel. The model offers an explanation of the fact that some channels tend to meander while others braid.

4 -

ESCUDIER, ACHARYA 1987

Critique of the computational Preston tube method

1 Theoretical, experimental

2 The general validity of the Computational Preston tube method proposed by Nitsche et al is disputed. The method involves the determination of

both the skin friction coefficient and the von Karman constant from fitting two near wall mean velocity measurements to a generalized van Driest family of velocity profiles.

3 It is demonstrated by a detailed examination of measured mean velocity profiles that for the laminar turbulent transition of a flat plate boundary layer the method fails completely or leads to non unique results.

4 Preston tubes, hot wire anemometer, floating element device.

EVERS, ROUVE 1980

Basic model investigations on hydraulic effects of bank and flood plain vegetation

1 Experimental, compound, smooth, rough

2 To investigate the flow characteristics of channels with vegetated flood plains in order to find a better theoretical basis for a calculation procedure.

3 Formation of vortices at boundary between the main channel and floodplain of a composite cross section leads to flow instability. Strength of the vortex street increases with discharge, flow velocity and also depends on the density of the roughness elements.

4 Laser Doppler Anemometer

FREDSOE 1978

Meandering and braiding of rivers

1 Theoretical, simple, rough, meanders, braids

2 Paper describes flow pattens using a two dimensional linearized flow model. The linearized equations are solved numerically, the effect of

the transverse slope of the bed is accounted for and the total amount of sediment is transported partly as bed load and partly in suspension.

3 Stability theory developed which predicts whether a river meanders, braids or remains straight. By taking into account the effect of the transverse slope in a correct manner and including a description of the behaviour of the suspended sediment, the theory gives results in agreement with experimental findings. Indicates that river will always remain straight if its width is smaller than 8 times its depth and it will braid if its width is 60 times its depth.

4 -

FUKUSHIMA, FUKUDA 1986

Analysis of turbulent structure of open channel flow with suspended sediments

1 Theoretical, experimental, simple, rough

2 Application of the k-e model for two dimensional uniform flow with suspended sediments.

3 The k-e model explains the change of the turbulent structure, mean velocity and sediment concentrations. Parameters included in the model are functions of the overall Richardson number.

4 -

GUGANESHARAJAH, THORN, EVANS, HARPIN 1985

Mathematical modelling of the River Conon

1 Theoretical, prototype, compound, rough

2 Paper details use of a computational hydraulic model. Model first used to study the effects of channel improvements on unsteady flood flows.

3 Generalised hydraulic model has been used to study the effects of various design options for various flood events in the Lower Conon river system. Steady state results used to provide the initial data for transient runs. Model features the ability to accomodate loops in the river system and to predict water levels, discharge and duration of flows for both the river reaches and complex flood plains. Major advantage of the model is the ease with which the channel can be reconfigured.

4 -

HAGER 1985

Equations for plane,moderately curved open channel flows

1 Theoretical

2 Steady flows in open channels are usually computed by assuming uniform cross sectional velocity and hydrostatic pressure distributions. The present investigation incorporates effects of moderate streamline slope and curvature by relatively simple formulation.

3 Surface profiles may be determined with a relatively simple relation, of which the first order approximation is well known as the Boussinesq equation. Formulae able to predict the surface profiles of cnoidal and solitary waves. Applications of the present formulation include steady and non steady flows over spillways, in distribution channels, and backwater profiles.

4 -

HAQUE, MAHMOOD 1986

Analytical study on steepness of ripples and dunes

1 Theoretical, experimental, simple, rough

2 Paper deals with the steepness of two dimensional ripples and dunes, which are in a limiting equilibrium state. The analytical results are compared with the data observed in laboratory flumes, canals and rivers.

3 If local sediment transport is taken proportional to the m th power of local velocity, the limiting equilibrium steepness of the ripples and dunes depends only on the geometry of the flow region and the value of m. Bedforms tend to be steeper in deeper flows and the bedform steepness approaches rapidly the asymptotic values. For shallower flows the relative roughness rapidly attains the asymptotic values.

4 -

HEY 1985

River mechanics

1 Prototypical, simple, compound

2 Paper reviews recent research on river mechanics and considers the application of these principles for river engineering practice.

3 The degree and extent of channel response to river engineering works depend on the nature of the imposed changes and the natural characteristics of the river.

4 -

HOLTORFF 1982

Steady flow in alluvial channels

1 Theoretical, simple, meander

2 To analyse the evolution of alluvial channels by means of classical mechanics in order to better understand the physical and morphological processes of channel formation.

3 The flow channel system is a feedback system in which the effect (geometry of the channel) and cause(transported substances) are interrelated and interdependent. The parameters of the geometry of the channel and those of the transported substances consist of seven variables that can be related to one another by six independent relationships. If the channel morphology corresponds with the fluid dynamics, the flow deforms the channel into a single meandering channel. If both are incompatible, the channel splits into several branches of a braided channel. Alluvial channels are unstable because the stability criteria for the channel bottom and banks are different.

4 -

HOLTORFF 1982

Resistance to flow in alluvial channels

1 Theoretical, simple, rough

2 A theory is presented to predict the geometry of the bed patterns (ripples, dunes antidunes, and bars) and to evaluate the influence of the transport rate of sediment on the flow resistance.

3 For steady flow, the bed assumes a stable form. The friction factor due to the form resistance is related to the height, and to a minor degree, to the length of the bed form. The amplification factor `m` presented in the paper distinguishes between the patterns to be expected for a flow. Ripples and bars are bed forms that do not depend on the Froude number but on the friction factor. Dunes depend on both the Froude

number and the friction factor. Antidunes depend only on the Froude number. In some cases, ripples are superimposed on dunes, i.e.the flow can produce dunes and conjugate ripples.

4 -

HUPPERT, BRITTER 1982

Separation of hydraulic flow over topography

1 Theoretical, experimental, simple, rough

2 Analytical demonstration that hydraulic flow of a single shallow layer of fluid will separate on the lee face of a smooth topographic feature whenever the flow is subcritical everywhere, unless the height of the feature is very small. The analysis is extended to derive a simple criterion for separation in a two layer flow.

3 Conclusion from analysis and experimental investigation is that separation always occurs when a single shallow layer of fluid flows subcritically over smooth topography, unless it is very low. The flow will remain attached, however, if it is anywhere supercritical.

4 -

IKEDA, NISHIMURA 1985

Bed topography in bends of silt bed rivers

1 Theoretical, prototypical, experimental, simple, rough

2 Paper presents a model for predicting the lateral bed profile in curved sand silt rivers. Model accounts for lateral bed load transport rate on side slopes, the rate of lateral diffusion due to turbulence, the rate of convective transport of suspended sediment and secondary flow.

3 The major agency determining the lateral bed profile is the lateral force balance between fluid force exerting on bed materials and gravitational force, even for sand silt rivers. The lateral convective transport of suspended sediment induced by secondary flows considerably modifies the bed profile at the outer region of bends, while the lateral diffusion has negligible effect on the profile everywhere. The sample calculation reveals that the lateral bed profile in actual sand silt rivers is considerably affected by suspended sediment.

4 -

INDLEKOFER, ROUVE 1980

On hydraulic capacity of rivers with vegetated banks and flood plains

1 Theoretical, compound, rough

2 To investigate the flow interaction of compound cross sections, and the hydraulic effects of roughness elements varying over the wetted perimeter.

3 Three computational procedures outlined.

4 -

INTERNATIONAL ASSOCIATION FOR HYDRAULIC RESEARCH, 1985

21 st CONGRESS - MELBOURNE

VOLUME 2

Various papers on the numerical computation of 2D and 3D flows, transport and mixing in rivers and reservoirs

Authors - ROGOUNOVICH & SHNIPOV; TAMAI & IKEYA; CHIU & CHIOU;
KALKWIJK & KOPPEL; MENDOZA & SHEN; NEZU & RODI;

PAVLOVIC & RODI; PRZEDWOJSKI; WIJBENGA; ABEL-GAWAD & McCORQUODALE; ARNOLD, PASCHE & ROUVE; IWASA & AYA; SHARP & HERAT.

VOLUME 3

Various papers on the interaction of main channel and flood plain flows.

AUTHORS - McKEE, ELSAWY & McKEOGH; RADOJKOVIC & DJORDJEVIC; ZHELEZNYAKOV; NALLURI & JUDY; PASCHE, ROUVE & EVERS; APELT, LAWRENCE, WELLINGTON & YOUNG; GABOS & MINQIN; RAJAGOPALAN, BELGAL & HARDIKAR; TINGSANCHALI; VONGVISESSOMAJI, TINGSANCHALI & CHAIWAT; YEN, CAMACHO, KOHANE & WESTRICH; LAVIAN & CHU; CHEE & RAY; YEN; CHRISTENSEN; KLAASSEN & VAN URK; OGINK; REED; ROBERTS, PERNIK & BENKE; WONG.

ISHIKAWA 1984

Water surface profile of stream with side overflow

1 Theoretical, experimental, simple, compound, smooth

2 Overflow depth on a levee crown is studied using one dimensional analysis of a stream with side overflow.

3 Two typical profiles of a flow with gradual levee overtopping exist. Overflow depth of type 1 is not so great because the water stage is controlled by a small flow rate in the downstream reach. Type 2 is caused by an obstacle such as bridge piers or weirs and gives a greater overflow depth on the levee crown.

4 -

JAMES 1987

The distribution of fine sediment deposits in compound channel systems

1 Theoretical, compound, rough

2 Two numerical models are presented which can be used in conjunction to describe the suspended distributions as well as the distribution of deposits on the main channel and flood plain surfaces. One model describes the vertical and transverse distributions over the flood plain and the other describes the vertical and longitudinal distribution along the main channel.

3 The complex problem of describing the three dimensional distribution of suspended sediment concentration in a compound channel can be solved by decomposition. Two two dimensional models, based on the diffusion analogy can be used in conjunction to solve the three dimensional problem. Hypothetical application illustrates how the distribution pattern of the deposits of specific particles through a compound channel can be predicted. Also demonstrates the effect of transfer to overbank sections on the longitudinal distribution of suspended sediment within the main channel.

4 -

KALKWIJK, BOOIJ 1986

Adaptation of secondary flow in nearly horizontal flow

1 Theoretical, experimental, simple, smooth

2 Method proposed which takes account of the convection of momentum of secondary flow in streamwise direction by implementing the generation and decay of secondary flow in steady or quasi steady nearly horizontal flow.

3 Method is employed for both the effects of Coriolis acceleration and curvature. Both effects are shown to be almost equivalent. The method is verified by results obtained from flume experiments.

4 -

KITANDIS, KENNEDY 1984

Secondary current and river meander formation

1 Theoretical, simple, smooth, meander

2 Development of small perturbation stability analysis investigates the role of the secondary current in the initiation and early development of meanders in alluvial and ice and rock incised channels.

3 An analytical model was developed to investigate the role of secondary flow in the initiation and early development of river meandering. The model shows that the amplitude of a small sinusoidal perturbation in the alignment of an initially straight channel tends to increase exponentially with time. The dominant wavelength and the corresponding phase shift between the channel meander wave and the strength of the spiral motion was calculated. Analytical expressions were also developed for the rate of amplitude increase and the celerity of meander migration. The model is limited to quasi steady flow in weakly meandering prismatic flow.

4 -

KOMURA 1986

Method for computing bed profiles during floods

1 Theoretical, prototypical, simple, rough

2 Paper presents a simplified analytical model for computing transverse river bed profiles using aerial photographs.

3 Method presented is considered to be a reasonable first attempt for computing transverse river bed profiles during floods using aerial photographs. It should be emphasized that observed transverse river bed profiles are usually obtained by surveying after the flood. Consequently some discrepancies exist between observed results during flood and post flood survey. Information during floods could be useful for river rectification works.

4 -

LEOPOLD, WOLMAN 1957

River channel patterns:braided,meandering,and straight

1 Prototypical, experimental, simple, rough

2 To study the interrelationship between channels of different patterns.

3 When streams of different patterns are considered in terms of hydraulic variables, braided patterns seem to be differentiated from meandering patterns by certain combinations of slope, discharge, and width to depth ratio. Straight channels have less diagnostic combinations of these variables. The regular spacing and alternation of shallows and deeps is characteristic of all three patterns.

4 Sediment injector, point gauge

LEOPOLD, BAGNOLD, WOLMAN, BRUSH 1960

Flow resistance in sinuous or irregular channels

1 Experimental, simple, rough

2 Paper presents experimental tests made under controlled conditions to assess the relative magnitude of resistance due to boundary irregularities of large scale as compared with small roughness elements.

3 The resistance to fully developed turbulent flow at constant depth in an open channel increases as the square of the mean velocity as long as the boundary conditions remain completely unchanged. The presence of the free water surface allows the possibility of departure from the relationship of resistance to the square of the velocity. Condition under which this discontinuous increase in resistance occurs is definable by the mean Froude number for the whole flow which may be as small as 0.4. At this initial state, the rate of resistance increase with the square of the velocity may be more than double.

4 Point gauge

LESCHZINER, RODI 1979

Calculation of strongly curved open channel flow

1 Theoretical, experimental, simple, smooth

2/3 Presentation of a model configuration exhibiting all the essential features of a natural meander, namely the formation, decay and reversal of the transverse surface slope and of transverse circulation, and the characteristic radial shift of the tangential velocity maximum either towards the inner or towards the outer bank.

4 -

LEWANDOWSKI 1985

The use of air photographs for estimating the value of roughness coefficient

1 Theoretical, prototypical, compound, rough

2 Paper presents the development of a modified Cowan`s procedure for estimating the value of roughness coefficient.

3 Results show that Cowan`s method of estimating the roughness coefficient, with a certain modification of his table of values, may be used for medium rivers. Air photographs can be used to enable assessments of the channel and flood plain roughness.

4 -

LEWIN, HUGHES 1980

Welsh floodplain studies:application of a qualitative inundation model

1 Theoretical, prototypical, compound, rough

2 Paper proposes a qualitative model for floodplain inundation. Model applied to two specific study areas.

3 A general qualitative flood inundation model is proposed emphasizing the systematic and sequential relationship between flood stage, flood inundation and floodplain morphology. This may involve hysteretic effects, and relationships which are contrasted in different floodplain environments. Detailed consideration of individual flood events illustrates the complex nature of inundation processes, partly as a result of human floodplain modifications, in relation to local relief features. Nevertheless the spatial and temporal incidence of components of the inundation model (such as bank spilling, breach flow

and floodplain pondage) could be specified, and reasons for the variable and contrasting behaviour of the two rivers suggested.

4 -

McLEAN, SMITH 1986

A model for flow over two dimensional bed forms

1 Theoretical, experimental, prototypical, simple, rough

2/3 Paper describes a model that predicts the velocity and boundary shear stress fields associated with bed forms. Model solves a boundary layer equation beneath a wake type velocity field that is matched to an appropriate interior flow profile. Present model is based on the salient features of flow in wakes and accelerating internal boundary layers and it provides substantial insight into the processes that shape an erodible bed. Model appears to produce fairly accurate stress and velocity fields, even when linear wake theory is forced on the near field.Most significant outcome of this analysis is the prediction of the location and magnitude of the stress maximum that arises from the interaction between the accelerative effects of the wake and the retarding influence of the boundary layer.

4 -

MAUBACH 1972

Rough annulus pressure drop - interpretation of experiments and recalculation for square ribs

1 Theory, experimental, rough, annuli

2 A method is presented which allows the interpretation of pressure drop measurements with rough tubes, annuli and parallel plates.

3 Paper summarizes the results of the interpretation of data with rectangular cross section roughness given by numerous authors in the literature. Examples of the re calculation of the friction factor are shown given the flow Reynolds number, channel and roughness geometries. Results show method proposed enables calculation of friction factors of isothermal turbulent flow in concentric annuli with rough inner tubes with sufficient precision for design problems.

4 -

McALLISTER, PIERCE, TENNANT 1982

Preston tube calibrations and direct force floating element measurements in a two dimensional turbulent boundary layer.

1 Experimental, theory, smooth, duct

2 To present the results of an experimental study comparing a large number of direct force local wall shear stress measurements in a near zero pressure gradient two dimensional turbulent boundary layer.

3 Results indicate consistent and excellent agreement between the Patel intermediate calibration formula and the direct force measurements. Typical differences between the direct force measurements and several other proposed calibrations are shown.

4 Direct force floating element, Preston tube, piezometers, manometer.

MIKKELSEN, ENGELUND 1977

Flow resistance in meandering channels

1 Experimental, simple, rough, meander

2 Paper investigates the main stream in a meander and its

relationship to the inflexion point of the channel and the flow resistance at this point.

3 Resistance to flow was less at relatively small depths and larger at relatively large depths compared to a straight channel with the same flow parameters. At small depths, the largest energy losses are located at the point of inflexion, while at the larger depths the largest energy losses are located upstream of the bend.

4 -

MOORE 1969

A history of research on surface texture effects

1 Theory, experimental

2 A historical survey of survey texture effects ranging from pipe flow roughness factors to molecular roughness concepts is presented.

3 Metallic and elastomeric contact problems discussed and reviewed. Techniques for measuring surface features are classified and methods are tabulated. Evaluation of the profile resulting from these techniques may be statistical or mathematical. One parameter modelling of surface features is reviewed and a summary of three parameter representation given in tabular form. It is suggested that at least five parameters are required to uniquely and completely specify surface features in the general case.

4 -

MOTAYED, KRISHNAMURTHY 1980

Composite roughness of natural channels

1 Theoretical, prototypical, simple, rough

2 Paper presents investigation to evaluate existing formulas used to compute composite roughness using data from natural stream channels.

3 Where Manning`s formula is applicable to a natural channel Lotter`s formula for computing the composite roughness in stream channels, with laterally varying roughness along its wetted perimeter, predicts the composite roughness with least error.

4 -

MYERS 1987

Velocity and discharge in compound channels

1 Experimental, theory, compound, smooth

2 To understand the distribution of velocity and discharge in compound channels

3 Theoretical considerations are presented, which predict that the ratios of velocity and discharge in a smooth compound channel are independent of bed slope and are influenced by depth and geometry only. Predictions are confirmed by experimental data obtained from three smooth compound channel geometries. The ratios of channel velocity and discharge to those of the flood plain, and the proportions of flow in channel and floodplain follow straight line relationships with depth; equations describing these relationships are presented. Conventional methods of discharge assessment overestimate channel and full cross sectional flow capacity at large depths. Flood plain flow capacity is underestimated at all depths of flow. Findings underline the need for methods of compound channel analysis that accurately model proportions of flow in channels and floodplains, as well as full cross sectional discharge capacity.

4 Point gauge, min current meter, venturi meter

NAKAGAWA 1983

Boundary effects on stream meandering and river morphology

1 Experimental, simple, rough, meandering

2 An examination is made of five experiments which have different boundary conditions at the wetted perimeter of the channel, in order to test the conjectured hypothesis of stream meandering.

3 Transverse shear distribution at the wetted perimeter of the channel is intimately associated with the origin of stream meandering. Proposed that a necessary condition for the formation of stream meandering is an appropriately small ratio of total bank shear force to total bed shear force both per unit length downstream. Flow pattern, channel morphology and sand waves on the bed are dependent upon the boundary conditions at the wetted perimeter.

4 Point gauge, miniature current meter.

NAKAGAWA, NEZU 1987

Experimental investigation on turbulent structure of backward facing step flow in an open channel.

1 Experimental, theoretical, simple, smooth

2 Turbulence measurements of the backward facing step flow, including the reverse flow region, in an open channel were conducted using a two component Laser Doppler anemometer.

3 The mean velocity deviates from the log law distribution immediately downstream of the step. The reattachment length decreases with an increase of the Reynolds number. The turbulence intensities increase up to about 1.5 times the initial values along the line $y/Hs = 1.0$.

The shear stress distribution can be reasonably evaluated from the momentum equation. The specific momentum is approximately conserved downstream of the step. The turbulent energy is generated along the dividing streamline by the shear layer, and its energy dissipated mostly in the recirculation region.

4 Laser Doppler anemometer.

NANSON, HICKIN 1983

Channel migration and incision on the Beatton river

1 Prototypical, theoretical, simple, meanders

2 To investigate bend radius to channel width ratio and the discontinuous nature of channel migration in meanders.

3 Relationship between bend migration and bend radius/channel width ratio confirms earlier work though greater degree of variance evident in the data than originally thought. Any predictions from a single reach of river should be seen in the context of a general lateral migration model. This should include stream power, resistance of bank materials to lateral erosion, the height of the convex bank, the degree of incision, the sediment supply rate,and the influence of bend plan form.

4 -

NATIONAL PHYSICAL LABORATORY 1958

On the measurement of local surface friction on a flat plate by means of Preston tubes

1 Experimental, theory, smooth, duct

2 To establish the corresponding calibration curve for surface friction and pressure head on a flat plate relative to the relationship for a pipe.

3 Relation for turbulent flow on a flat plate has same order of accuracy as for pipe relationship but not identical in form. Inner law of turbulent flow near a wall differs between a plate and a pipe.

4 Pitot tube, manometer

NIXON 1959

A study of the bank full discharges of rivers in England and Wales.

1 Prototypical, simple, rough

2 Paper presents a study of the bank full discharges of rivers in England and Wales.

3 Concluded that a self formed river channel will remain stable if equations relating channel width, depth, velocity

and area to the bank full discharge are satisfied. The bank full discharge is that which is equalled or exceeded 0.6% of the time.

4 -

NOUH, TOWNSEND 1979

Shear stress distribution in stable channel bends

1 Theoretical, experimental, simple, smooth, bend

2 To investigate the flow field in the vicinity of an open channel bend; the development of a mathematical model to predict the corresponding

boundary shear stress distribution; to validitate the model results by comparison with direct measurements obtained in a laboratory flume.

3 Strong secondary currents generated by stream curvature in channel bends are primarily responsible for local asymmetry in the flow field and in the related boundary shear stress distribution. The logarithmic velocity distribution law could be applied to a vertical plane in the low field. Maximum scour in the bend section increased with increasing bend angle and moved further downstream with increasing bend angle. Computed steady state boundary shear stress distributions compare favorably with the experimental data.

4 Laser doppler anemometer

ODGAARD 1982

Bed characteristics in alluvial channel bends

1 Theoretical, prototypical, simple, rough, bend

2 To present a new approach to the description of the steady state flow and bed characteristics in an alluvial channel bend.

3 The steady state transverse variation of depth, depth averaged velocity, and mean grain size in a river bend with fully developed bend flow can be described by combining the principle of conservation of moment of momentum flux with a critical shear stress analysis. The transverse bed slope was then found to vary linearly with the ratio of depth to the radius of curvature and almost linearly with the bed surface particle Froude number. Specific relationship for variation in depth averaged velocity across the channel section if the bed sediment is uniform and the grain size distribution is the same across the width of the channel.

4 -

ODGAARD, KENNEDY 1983

River bend bank protection by submerged vanes

1 Theoeretical, experimental, simple, rough, bend

2 Presentation of a new concept for a bank protection structure.

3 Vanes proved to be effective in nullifying the secondary currents produced in channel bends,which often lead to undermining and accelerated erosion of river banks. Attenuation achieved with one set of vanes, further reduction could be achieved using a second set of vanes.

4 Miniature current meter, sonic sounder

ODGAARD 1984

Shear induced secondary currents in channel flows

1 Theoretical, experimental, simple, smooth

2 To propose a simple analytical relationship between the strength of the secondary flow and the transverse variation of shear velocity; to evaluate the effect of the secondary flow on the streamwise velocity profile.

3 Theory developed explains the relationship between secondary motion and roughness variation. Flow and stress profiles developed compared favorably with experimental findings in which the bed stress varied by a factor of more than 2.5 across the width of the channel.

4 -

NUTTALL 1954

Flow of a viscous incompressible fluid - expressions for a uniform triangular duct.

1 Theory, smooth, duct

2/3 Numerical results are obtained for the volume of a viscous incompressible fluid flowing in unit time past the cross section of a uniform triangular duct. The flow is assumed to be streamlined and end effects at entry and exit of the ducts are neglected.

4 -

ONISHI, JAIN, KENNEDY 1976

Effects of meandering in alluvial streams

1 Theoretical, experimental, simple, rough, meander

2 To investigate the effects of meandering and width of sinuous channels on the friction factors and sediment transport capacities of alluvial streams.

3 For a given set of flow conditions, the sediment discharge per unit width in the full width meandering channel was found to be greater than in the straight flume, which in turn was greater than the unit sediment discharge in the half width meandering channel. Considered to be principally due to the effects of secondary circulation on the entrainment and suspension of sediment, and to the non uniformity of the distribution of the unit water discharge across the channel which was produced by the point bars. The bend loss coefficient was found to increase with the Froude number, the ratio of the bed hydraulic radius to mean sand diameter, and the ratio of channel width to radius of curvature of channel.

4 Point gauges, ultrasonic distance meter.

ONSRUD, PERSEN, SAETRAN 1987

On the measurement of wall shear stress

1 Experimental, smooth, duct

2 To apply a method where the wall shear stress may be determined from measurements of the wall static pressure.

3 The number of flow variables that could influence the static hole pressure readings were reduced as far as possible, i.e. a two dimensional zero pressure gradient flow. The calibration values for the local wall shear stress were determined from the universal scaling laws for the inner part of the

turbulent boundary layer which were measured by using hot wire anemometry. The static hole pair is a device which can favourably be used to measure the local wall shear stress; any pair must be calibrated separately and the two constants dependent on hole diameter and inclination of hole must be experimentally established.

4 Static hole pair, hot wire anemometer.

PARKER 1976

On the cause and characteristic scales of meandering and braiding in rivers

1 Theoretical, prototypical, experimental, simple, rough

2 Paper considers a two dimensional stability model due to Hansen and Callander for determining channel characteristics.

3 Meandering and braiding are treated as different degrees of the same instability phenomenon. Sediment transport and friction are indicated to be essential factors for the occurrence of instability, whereas helicity is not essential. A relation for meander wavelength, a

criterion for meandering and braided regimes, and an estimate of the number of braids are obtained; all these results are esentially independent of the magnitude of the sediment transport. Most rivers have a tendency to form bars even though they are in a graded state. If slope and width/depth ratio are sufficiently low then meandering is favoured. If the slope and width/depth are high then braiding is favoured. Aggradation by increasing the slope can lead from a meandering to a braided state, or can increase the tendency for braiding. Existence of sediment transport is a dynamically necessary condition for the formation of instability leading to meandering.

4 -

PARKER, DIPLAS, AKIYAMA 1983

Meander bends of high amplitude

1 Theoretical, prototypical, simple, rough, meander

2/3 Meander bends of high amplitude in alluvial rivers often display a high degree of coherency. The only analytical equation to date to describe such bends is the sine generated curve, which has no rigorous derivation in the linear bend equation, based on a dynamical description of flow in bends and a kinematical description of bank erosion is used to describe channel migration. This equation admits solutions of constant amplitude that migrate downstream with constant speed. The solution at high amplitude displays a prominent skewing that reveals the direction of flow. At low amplitude, the solution reduces to the sine generated curve.

4 -

PATEL 1972

A unified view of the law of the wall using mixing length theory

1 Theory, experimental, smooth, rough, pipe

2 Comparisons have been made with a wide variety of experimental data to demonstrate the general validity of the mixing length model in describing the flow close to a smooth wall.

3 An extension of the re laminarisation criterion of Patel and Head, and some experimental evidence, suggest that the thick axysymmetric boundary layer on a slender cylinder placed axially in a uniform stream cannot be maintained in a fully
turbulent state for values of the Reynolds number, based on friction velocity and cylinder radius, below a certain critical value.

4 -

PENDERGAST, COBBLE, SMITH 1970

Laminar flow through ducts of arbitrary cross section

1 Theory, experimental, simple, duct

2 An analytical solution for the velocity of steady incompressible laminar flow through ducts of constant area, but having an arbitrary cross section, is developed. Experimental verification of the theory was achieved by constructing a test duct with dimensions of a zero velocity surface predicted from the theory by an assumed wall velocity function.

3 The experimentally determined velocity profiles agreed with the theoretical velocity profiles with a difference of less than the maximum expected experimental error over the entire cross section of the duct.

4 Camera, tracer

RASTOGI, RODI 1978

Predictions of heat and mass transfer in open channels

1 Theoretical, experimental, simple, rough

2/3 Two models are described for the prediction of velocity and pollutant distribution in rivers; a three dimensional model and, as a depth averaged version of this, a two dimensional model that, however, cannot account for buoyancy effects.

4 -

REHME 1972

Pressure drop performance of rod bundles in hexagonal arrangements

1 Theory, experimental, simple, rough, duct

2 Literature survey in respect of the pressure drop coefficient for turbulent flow along parallel rods. Comparison of data from survey with new measured results in order to predict safely pressure drop in rod bundles.

3 Pressure drop coefficient for isothermal, incompressible, fully developed turbulent flow in rod bundles does not exceed an upper limit, i.e. annular zone solution.For rod bundles with channel walls, the pressure drop coefficient is lower than with the annular zone solution, depending on the type and position of the channel walls. For rod bundles with uniform flow distribution the pressure drop coefficient is close to the upper limit.

4 -

REHME 1973

Simple method of predicting friction factors of turbulent flow in non circular channels

1 Experimental, simple, rough, duct

2 On the basis of friction factor relationships of a simple model a method is developed which allows the prediction of friction factors for turbulent flow in non circular channels if only the geometry factor of the pressure drop relationship for laminar flow is known. Proposed method of calculation is tested with numerous experimental results from the literature with respect to non circular channels such as triangular shaped ducts, eccentric annuli and rod bundles in hexagonal and square arrays in circular tubes, hexagonal and square channels.

3 Friction factors calculated by the method outlined for turbulent flow in channels with non circular cross sections provide a good description for the experimental data at hand.

4 -

SAMUELS 1979

EMBER : a numerical model of an embanked river

1 Theoretical, prototypical, compound, rough

2 The EMBER model consists of a set of programs developed to simulate flows which do not have a uniform water surface level across a river valley at any one particular section, such as in the case of an embanked river system.

3 The EMBER computer programs form the basis for constructing a computational model of flow in an embanked river. The programs analyse and check data from surveys of the river valley and compute flows

either restricted to the main channel or freely passing between the main channel and the flood plain.

4 -

SAMUELS 1985

Modelling of river and flood plain flow using the finite element method

1 Theoretical, prototypical, compound, rough

2 Thesis examines several models of flow in a river and over its flood plain. Investigation has been limited to two dimensional models in plan. Models are based upon standard principles of fluid dynamics incorporating a variety of physically realistic simplifications. The finite element method is used to generate numerical approximations to the solution of the resulting flow equations.

3 Concluded that the integration of the convective accelerations through the depth of flow requires particular care. The effect of the turbulent stress terms on the lateral velocity distribution has been quantified through a new analytic solution for rectangular geometry. This leads to estimates of shear layer width at the boundary between the flood plain and an incised river channel. Further work is required to establish why the stream function formulation converges as slowly as it does. The first order variation form of the potential formulation converged rapidly when applied to flume data when the convection term was excluded. Model equations need to be extended to include the velocity distribution coefficient in the convection term, and to include the turbulent stress terms.

4 -

SAMUELS 1985

Modelling open channel flow using Preissmann's scheme

1 Theoretical, prototypical, compound, rough

2 To present some observations on the conservation of volume during flow simulation using Priessmann`s scheme and Newton iteration to solve the resultant non linear algebraic equations. Also to present new results in two areas of the analysis of Priessmann`s scheme.

3 Preissmann`s scheme applied to the linearised St Venant equations of open channel flow including the friction slope has been shown to be stable when weighted towards the forward time level in the case where roll waves can not exist. There is no restriction on the time step of the simulation on the Froude number of the flow. This analysis could be extended to look at other friction laws, the use of different weighting parameters and the accuracy of the numerical phase speeds. Coarse section data has been identified as a possible cause of numerical instability when using Preissmann`s scheme for steady frictionless flow.

4 -

SCHUMM 1967

Meander wavelength of alluvial rivers

1 Prototypical, simple, rough, meander

2/3 Data on river channel and sediment characteristics were collected at 36 cross sections of stable alluvial river channels in Australia and western United States. These data demonstrate that the meander wavelength of a river is dependent not only on water discharge, but also on the type of sediment load moved through the channel. The meander wavelength of rivers that are transporting a high proportion of their total sediment load as both sand and gravel will be greater than the meander wavelengths of channels of similar discharge which are transporting mainly fine sediment loads.

4 -

SCHUMM, KHAN 1972

Experimental study of channel patterns

1 Experimental, simple, rough, meanders, braids

2 Paper presents the series of experiments that were performed to determine the effect of slope and sediment load on channel patterns.

3 Experiments demonstrate that threshold values of slope and sediment load exist above which river patterns are significantly altered. Effect of size of sediment load has not been investigated. Data collected does not allow an explanation of the thresholds but suggestion is that the lower threshold between straight and meandering channels reflects the velocity at which secondary currents become effective in distributing sediment in the channel. The upper threshold between meandering and braiding is most likely to be related to a high Froude number. Experiments have shown that a meandering thalweg channel may not produce true meanders, these only forming when the bed load was decreased and the suspended load increased.

4 Point gauge

SCIENCE AND ENGINEERING RESEARCH COUNCIL

FLOOD CHANNEL FACILITY

Research strategy submitted to SERC by the SERC WORKING PARTY ON FLOOD CHANNELS.

Indicates objectives;methodology; implementation; dissemination of results, references, and members of the working party

SHEN, KOMURA 1968

Meandering tendencies in straight alluvial channels

1 Theoretical, experimental, prototypical, simple, rough

2 Paper considers two types of meandering patterns exist in straight alluvial channels. Considered that alternating diagonal bar patterns result from surface waves on the water. The alternating scour holes pattern possibly caused by the difference between shear stresses at the two sides of the flow cross section. Purpose of the paper is to consider the scour hole case.

3 Scour holes require unsteady non uniform flow conditions in order to develop. Alternate scour holes disappeared when unsteady conditions reverted to steady and uniform flow conditions. Average maximum scour depth for the alternate scour holes increased with the increasing rate of drainage. Rough banks are required to develop alternate scour hole patterns within the hydraulic conditions tested. Maximum scour depths were much greater in alternate scour holes than in irregular bed patterns for the same mean flow conditions. No alternate scour hole pattern was found for flows between one smooth wall and one rough wall. Variation of flow depth did not produce alternate scour hole patterns within rough banks.

4 Pitot tube, point gauge, thermometer

SILL 1982

New flat plate turbulent velocity profiles

1 Theoretical, simple, smooth, rough

2 Purpose of the paper is to demonstrate the derivation of a new general velocity profile

3 The results are presented in the form of a relatively simple equation which is explicit for velocity and which combines into a single expression the laminar sublayer, buffer region, and log region for both smooth and rough plates.

4 -

SOKOLOV 1986

Hydraulics of floodplain flows

1 Experimental, prototypical, simple, compound, rough

2 To develop a method of experimental investigations combining the main advantages of laboratory modeling and an on site experiment to refine the calculation method of determining the hydraulic roughness of individual plant species.

3 Relation between roughness coefficient and generalized vegetation parameter is presented.

4 -

STRUIKSMA, OLESEN, FLOKSTRA, DE VRIEND 1985

Bed deformation in curved alluvial channels

1 Experimental, simple, rough, bend, meander

2 Bed deformation in river bends is described by considering the results of experiments in some curved laboratory flumes with fixed banks under well defined steady flow conditions.

3 Point bar and pool formation in river bends cannot be described on the basis of local conditions alone. The lateral balance between the

upslope force induced by the spiral flow and the downslope gravitational force acting on the grains moving along the bed. The lateral bed slope in a bend is also influenced by transitional effects due to the difference between the conditions upstream and those in the bend. The wave form of the longitudinal bed profiles in long circular bends is explained with the aid of a linear analysis of the water and sediment motion for the steady state. A simplified linear analysis, in which the influence of streamline curvature is totally neglected, clearly indicates which effects are the most important for the bed deformation in alluvial rivers. The wavelength and damping are shown to depend mainly on the ratio between the adaptation lengths of the bed topography and the main flow. This implies that the wave length and damping is primarily determined by a dynamic response of the bed to the changing distribution of the water and sediment motion at the bend entrances and exits.

4 -

TAGG, SAMUELS 1984

Numerical modelling of embanked rivers

1 Theoretical, prototypical, compound, rough

2 Report describes the further development and application of the computational model EMBER, which is appropriate for studying flood flows within embanked river systems. The model treats the channel and flood plains as three seperate flow paths, linked by lateral flow over the river banks. The report is essentially concerned with the analysis of problems, both theoretical and practical, of calculating this bank flow and with the various improvements that have been implemented in the model.

3 The EMBER model may produce oscillatory predictions of stage and discharge, resulting from the extreme sensitivity of the bank flow calculations to the water level either side of the embankment. The bank flow algorithm has been improved by providing an additional check

on flow through breaches in the flood banks and by a re ordering of the algorithm to ensure that the flow does not exceed a global limit specified by the user. Model is sensitive to the computer precision being used and hence to small data errors. Potential improvements to the model include basing the flood plain calculations on stored volume and not plan area, calculating the flow over the flood embankments with an implicit method, and using an iterative numerical method to calculate the flow conditions at each time step.

4 -

TANNER 1960

Helicoidal flow,a possible cause of meandering

1 Experimental, simple, smooth, meander

2/3 Sediment free model streams, suspended from the lower sides of nearly horizontal glass plates, meander in the same way as do alluvial rivers. Meandering cannot, therefore, be ascribed to granular bed load. It is suggested that an alternative causative mechanism is helicoidal flow, which, in turn, is the product of turbulence within the stream. The sequence of events is, therefore suggested as turbulence, helicoidal flow, meandering, unless prevented by resistant materials in channel walls.

4 -

TEMPLE 1986

Velocity distribution coefficients for grass lined channels

1 Theoretical, experimental, simple, rough

2 Paper presents relationships developed to routinely estimate the coefficients necessary to compute the momentum or energy flux through a cross section of a grass lined channel.

3 Velocity profile distortion associated with low velocity flow through the vegetal cover of a grass lined channel results in comparatively large values of the momentum and energy coefficients. If these values are not considered then errors in the computed values of the momentum or energy flux through a cross section or in the computed value of the Froude number will result.

4 -

THORNE, HEY 1979

Direct measurements of secondary currents at a river inflexion point

1 Prototype, simple, rough

2 Presentation of data relating to the reach around the inflexion point between bends.

3 The secondary flow pattern at the exit from the upstream bend is dominated by the skew induced cell from the upstream bend. At the entrance into the downstream bend the secondary flow has a skew induced cell of the opposite rotation to the upstream bend. Difference noted from prototype relative to model work is that the skew induced cell at the downstream bend in the prototype was fully developed whilst in the model a remnant of the upstream circulation was present in the downstream bend. This is due to the asymmetrical profile of the bed not being represented in the flume model, instead the channel being represented as a channel with a rectangular profile.

4 Electro magnetic current meter.

TIFFANY, NELSON 1939

Studies of meandering of model streams

1 Experimental, simple, rough, meanders

2 Paper reports series of tests which were intended to throw light upon the meandering tendencies of alluvial streams.

3 Pools and crossings developed immediately after a test was started with cut offs occuring towards the end of a test. Channel developments resulted from a combination of ideal conditions; a constant flow through a bed of uniform composition and with no tributaries discharging variable bed load into the channel. Tests furnished little information of direct mathematical applicability to full scale problems. Tests provided general data on the natural meander tendencies of an uncontrolled fluvial channel.

4 -

TOWNSEND 1960

Equilibrium layers and wall turbulence

1 Theoretical

2/3 The purpose of this paper is to set out the necessary conditions for the existence of an equilibrium layer and to derive a slightly more general relation between the velocity gradient and the shear stress than the mixing length relation. With this, a unified description of the layers is possible and this description is applied to correct and extend the theory of the development of self preserving boundary layers in adverse pressure gradients.

4 -

URBAN, ZIELKE 1985

Steady state solution for two dimensional flows in rivers with

flood plains

1 Theoretical, prototypical, compound, rough

2 Presentation of a finite element method for the calculation of stationary flows for application to the two dimensional modelling of channel and flood plain flows.

3 Previous publications presented time dependent solution techniques with time dependent boundaries for calculating quasi stationary velocity distributions. This paper proves that special algorithms for stationary flows can be significantly more economical. An attractive feature of the method lies in the linear approximation of velocities, flows and water levels within the finite element scheme. This contradicts previous work that indicates that quadratic approximations are needed for velocities and flows.

4 -

de VRIEND

Velocity redistribution in curved rectangular channels

1 Theoretical, smooth, duct

2 The main velocity redistribution in steady flow through curved conduits of shallow rectangular cross section is considered.

3 The transverse transport of main flow momentum by the secondary circulation is shown to be the principal cause of this velocity redistribution. The importance of the side wall regions, even in

shallow channels, is assessed and the neglect of the influence of the side walls in the commonly applied simplified models of flow through shallow curved channels is shown to be strongly limiting in the case of long bends with a rectangular cross section.

4 -

de VRIEND, GELDOF 1983

Main flow velocity in short river bends

1 Prototypical, theoretical, simple, rough, bend

2 Paper deals with the velocity field in a curved stream, assuming the bed to be fixed and the discharge to be constant. The main velocity distribution in this type of flow is analysed using field measurements and a mathematical model of steady flow in shallow rivers.

3 Velocity distribution measured shows essentially the same features as observed in other channels of similar geometry. Mathematical model simulating channel bends works well if secondary flow convection is ignored. The inward skewing tendency of the velocity distribution near the entrance of a bend is due to main flow inertia combined with the longitudinal pressure gradients arising from the growth of the transverse surface slope.The gradual outward shift of the main velocity maximum further downstream in the bend is a matter of retarded adaptation of the flow to the bed configuration, rather than of secondary flow convection. Secondary flow convection is only important in the last part of each of the surveyed bends; there it seems to hamper the outward skewing of the flow instead of enhancing it. As the flow stage becomes higher, the main velocity maximum tends to shift towards the inner bank.

4 Current meter, point gauge

WEBEL, SCHATZMANN 1980

The role of bed roughness in turbulent diffusion and dispersion

1 Experimental, theoretical, prototypical, simple, rough

2 To present a state of the art review on the similarity laws to be satisfied in transverse mixing experiments, and the dependence of the transverse mixing coefficient on channel parameters.

3 Laboratory investigations on initial mixing should be carried out in undistorted Froude models. Due to low Reynolds number in models, the bottom roughness needs to be adjusted to obtain a channel resistance matching the prototype. Choice of a particular roughness structure which provides the required friction factor is difficult but solvable. Mechanisms contributing to transverse mixing remain poorly understood.

4 -

WEBEL, SCHATZMANN 1984

Transverse mixing in open channel flow

1 Experimental, theoretical, simple, smooth, rough

2 An experimental study motivated by dimensional analysis was carried out to investigate the variation in the transverse mixing coefficient in straight, rectangular, smooth, and rough open channel flows. The study was aimed at determining the functional dependence of the transverse mixing coefficient on the governing dynamic and geometric parameters.

3 Experiments indicate that for low aspect ratio channels, turbulent diffusion is the main contributor to the mixing coefficient. Mixing coefficient constant under hydraulically rough flow conditions for

rivers with large width to depth ratios. For turbulent flows over a smooth channel bottom the transverse mixing coefficient increases with reducing friction factor. Turbulence measurements reveal that the increase in the transverse mixing coefficient can be explained by the fact that in hydraulically smooth turbulent flows, the scale of the energy containing eddies is larger than in hydraulically rough but otherwise identical channel flows.

4 -

WERNER 1951

On the origin of river meanders

1 Theory, experimental, prototypical, simple, rough, meander

2 Paper deals with the origin of meanders. Study aims at a clarification, in principle, of the origin of serpentines and meanders.

3 The main factors governing the initial formation of serpentines are correlated in a simple formula. Aside from minor discrepancies, this formula agrees at least qualitatively with the general behaviour of meandering streams, so far known from observations in nature and in models.

4 -

WEST, KNIGHT, SHIONO 1986

Turbulence measurements in the Great Ouse estuary

1 Prototypical, theoretical, simple, rough

2 Objectives are to determine the usefulness of an electromagnetic flowmeter for measuring turbulent fluctuations of velocity in estuary flows; to compare the estuarine turbulence data with other laboratory and field data; and to elucidate the nature of estuarine turbulence processes.

3 A 5 cm diameter electromagnetic flowmeter transducer was found to be a suitable instrument for detecting turbulence structure in the stratified flows of the Great Ouse estuary. Dimensionless groups containing representative turbulence parameters were found to have similar values and distributions with relative depth as steady and neutrally stable flume and wind tunnel data. The effect of stable stratification was seen in the length scale. The energy spectra were found to behave in a similar manner to atmospheric data in the presence of stable stratification. A quadrant analysis showed that good agreement existed between the flume data and the Ouse estuary data. At higher values of Richardson number the contributions of each quadrant to the normalised Reynolds stress tended to increase.

4 Electromagnetic flowmeter transducer.

WHITE, BETTESS, PARIS 1982

Analytical approach to river regime

1 Theoretical, experimental, prototypical, rough, simple

2 Rational regime relationships for the width, depth and slope of a channel in equilibrium are developed using the Ackers White sediment transport formulas and the White, Paris and Bettess friction relationships, together with the principle of maximum sediment transporting capacity.

3 A new method based on maximizing sediment transport rates, has been developed to predict the hydraulic and geometrical characteristics of alluvial channels. The method can be used without modification for both sand and gravel channels. The method uses the sediment transport formula of Ackers and White and the frictional relationships of White, Paris and Bettess. In addition, either the principle of maximum sediment transporting capacity is used or minimum channel slope. These two variational principles have been shown to be equivalent. Comparisons with available data has shown that prediction of slopes show scatter when compared with observations with a slight tendency to overestimate, prediction of width is excellent except for very large sand channels and for meandering laboratory channels where there is a tendency to underpredict.

4 -

WHITE 1929

Streamline flow through curved pipes

1 Experimental, theoretical, pipe, bends

2 General study of flow through curved pipes with initial intention of re examining early experimental work on curved pipes in order to provide information concerning the circumstances determining the limits within which flow must be streamline in character.

3 Develops a formula relating loss of head in a pipe to pipe length, pipe diameter, mean flow velocity, kinematic viscosity and a coefficient which is dependent upon both the flow and pipe curvature.

4 Manometer, thermometer.

WIJBENGA 1985

Steady depth averaged flow calculations on curvilinear grids

1 Theoretical, experimental, prototypical, simple, rough

2 Paper describes a computer program for depth averaged flow calculations. The program is used with a reduced number of computational points in which use is made of curvilinear coordinates.

3 Two dimensional depth averaged flow calculations on curvilinear coordinates yield results that have a similar accuracy as calculations on rectangular grids. The use of curvilinear grids together with a specific method of grid generation has some advantage over the use of Cartesian coordinates. In the case of flow calculations where flow separation occurs, advanced turbulence models may need to be employed.

4 -

WILKIE, COWIN, BURNETT, BURGOYNE 1967

Friction factor measurements in a rectangular channel with walls of identical and non identical roughness.

1 Experimental, theory, smooth, rough, duct

2 To investigate the influence of smooth and rough boundaries on the velocity profile and the friction factor associated with flow.

3 For non identically roughened walls a theory allows the the friction factor of each surface to be separated and applied to other passages having ribs with the same ratios of pitch to height and height to equivalent diameter. The experiments indicate that the application of the theory produces friction factors, which compared with those for identically roughened plates for which no transformation is required, vary similarly with Reynolds number but differ in magnitude.

4 Pressure tappings, pitot tube, thermocouple

WILSON 1973

Equilibrium cross section of meandering and braided rivers

1 Theoretical, simple, rough, meander, braids

2/3 Paper proposes two simple models to describe the equilibrium state of a channel cross section with constant conditions; these being static and dynamic. The static model is said to hold when the bed grains are at the threshold of movement, the dynamic model when fluid drag is actively moving the sediment. Using fluid drag and gravitational influence paper proposes reasons for the equilbrium characteristics of river channels.

4 -

WINTER 1977

An outline of the techniques available for the measurement of skin friction in turbulent boundary layers.

1 Experimental, smooth, rough, ducts, pipes

2 Review of the techniques available for the measurement of skin friction in turbulent boundary layers.

3 None of the techniques can be considered an absolute and reliable standard. Direct measurement of surface shear stress by force balance has many problems associated with it. The most reliable instrument at present would appear to be the Preston tube due to most work having been undertaken on this instrument. Still room for further work on the effects of pressure gradient, of flow unsteadiness and of heat transfer and of three dimensional flow in respect of the Preston tube. Potentially sub layer fences most useful measuring technique, with heated element instrument most reliable.

4 Force measurement balances, pitot tubes, sub layer fence, steps, razor blade, hot wire anemometer, pulsed heated film.

WOLMAN, BRUSH 1961

Factors controlling the size and shape of stream channels in coarse noncohesive sands

1 Experimental, prototypical, simple, rough

2 Experiments designed to study the size and shape of small self formed channels under ideal laboratory conditions in which discharge, slope, and both bed and bank material could be controlled.

3 In channels composed of uniform coarse noncohesive sands, the channel size is a function of the discharge and the hydraulic roughness produced by the granular material. The shape is determined primarily by the angle of repose of the noncohesive bank material and by the force required to move the particles in the banks. The force competent to initiate movement of the particles on the bed appears to be a function of both the tractive force and the velocity, the influence of the latter increasing as the size of the particles increase.

4 Point gauge, bubbler gauge, transducer

WOLMAN, LEOPOLD 1957

River flood plains:some observations on their formation

1 Prototypical, compound, rough

2 Paper investigates formation of river flood plains, in particular the development from deposition on the inside of river curves and deposition from overbank flows.

3 Floodplains are composed of channel deposits, or point bars, and some overbank deposits. Proportion of overbank material appears to be small. This conclusion is supported by the uniform frequency of

flooding and by the small amount of deposition observed in great floods. Lateral migration, and the decrease in sediment concentration at high flows contribute to this result. Point bars are extremely heterogeneous, and where overbank deposition does take place the small amount of material deposited and its irregular distribution make it difficult to identify. Frequency studies indicate that many flood plains are subject to flooding at approximately yearly intervals. Study indicates that the flood plain is also related to the regime of the existing river. A flood plain is distinguished from a terrace by the frequency with which it is overflowed.

4 -

WOODYER 1968

Bankfull frequency in rivers

1 Prototypical, theoretical, compound, rough

2 Paper examines the possibilty of a common bankfull frequency.

3 The frequencies with which the present flood plain level is exceeded for streams can be regarded as belonging to one frequency distribution with a reasonable degree of confidence.

4 -

WORMLEATON, ALLEN, HADJIPANOS 1980

Apparent shear stresses in compound channel flow

1 Experimental, compound, rough, smooth

2 To quantify the apparent shear stress for a range of flows in a compound channel with symmetrical flood plains.

3 Rational way of explaining the accuracy and properties of the different design methods in locating the shear interfaces between the sub sections in compound channels is presented. At low flood plain depths the momentum transfer from channel to flood plain is high, whilst at higher depths there is a net transfer of momentum from the over bank section to the channel.

4 Point gauge, hot film anemometer, Preston tube

WU 1985

Hydrodynamically smooth flows over surface material in alluvial channels

1 Experimental, simple, rough

2/3 Generally flow in alluvial channels is treated in two scales: the micro scale over bed materials, and the macro scale over bed forms. Previously flow has been considered to be hydrodynamically rough. Assessment of existing data shows no cases belonging to the hydrodynamically rough flow regime. In general, the flow in a stream is seen to be hydrodynamically rougher than that in a laboratory channel; most of the laboratory studies being conducted in hydrodynamically smooth flows, whilst most of the field cases dealt with the transition region. The boundary layer regimes over grains is not hydrodynamically rough, this fact explaining why the roughness resistance coefficient of grains still varies with the Reynolds number.

4 -

YAGLOM 1979

Similarity laws for constant pressure and pressure gradient turbulent wall flows

1 Theoretical, experimental, smooth, rough, duct, open channel

2/3 Review devoted to the similarity and dimensional analysis of some types of turbulent wall flows and comparison of the results obtained with experimental data.

4 -

YANG 1971

On river meanders

1 Theoretical, prototypical, simple, meander

2 Study is restricted to the investigation of unbraided channels under the condition of dynamic equilibrium or during the evolution toward their equilibrium conditions.

3 According to the law of least time rate of energy expenditure the smooth sinuous meandering course is the only course that a natural unbraided stable channel can take. The over all time rate of potential energy expenditure per unit mass of water should decrease in the downstream direction causing an increase in channel width and a decrease in channel slope. The over all time rate of potential energy expenditure per unit mass of water of a stream depends on water discharge, sediment concentration, valley slope and geological constraints. A natural stream always adjusts its channel slope and channel geometry in order to minimize the energy expenditure. An increase in sediment concentration or discharge brings about an increase in channel slope. An increase in channel width causes a decrease in energy expenditure. For a well developed meandering channel, further decrease in its channel slope by meandering will cause a decrease in channel width such that the energy expenditure can be maintained at a constant determined by its environment.

4 -

YEN 1965

Characteristics of subcritical flow in a meandering channel

1 Experimental, theoretical, simple, smooth, meander, duct

2 Presentation of attempt to study the meandering river problem systematically using a laboratory model with a fixed bed channel of uniform cross section of large width depth ratio with clear water subcritical flow. To overcome the problems in measuring turbulence in water an air model of similar geometry for air turbulence was considered and the results compared with the water channel results.

3 Spiral motion and superelevation are two of the most evident characteristics of the flow and that the effect of the bend extends both upstream and downstream. Highest velocity occurs very near the inner bank at the entrance to a bend and gradually shifts outwards with downstream direction. Non dimensional flow pattern is a function of the width/depth ratio but not of the Froude number, provided that the superelevation is small and the Froude number is appreciably less than unity. Measured turbulence intensity of the flow ranges from 3 to 9%. Air model results did not lead to a conclusion. Indicated that the loss of energy of flow in an open channel meander is greater than that of its air duct simulation and increases with Froude number because of wave resistance.

4 Pitot tube, manometers, Preston tube, hot wire probe

YEN 1970

Bed topography effect on flow in a meander

1 Theoretical, experimental, simple, rough, meander

2 Paper presents information regarding bed topography, and mean flow characteristics in a mobile bed meander with fixed boundaries.

3 Transverse slope at a given point on the stabilized bed is directly proportional to the parameter which characterizes the relative importance of fluid inertia against the gravity acting on a particle, moving along the bed. The fact of proportionality amalgamates the effects of drag, lift, longitudinal bed slope, and friction between the particle and the bed.

4 Point gauge, Preston tube, Pitot tube, manometer, hot wire anemometer.

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.

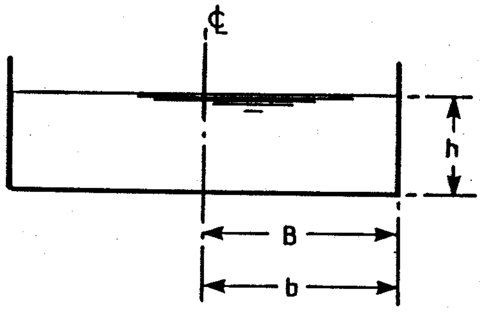
In respect of rectangular flumes or ducts the channel dimensions, with the possible exception of the length, are the same as the flume dimensions.

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.

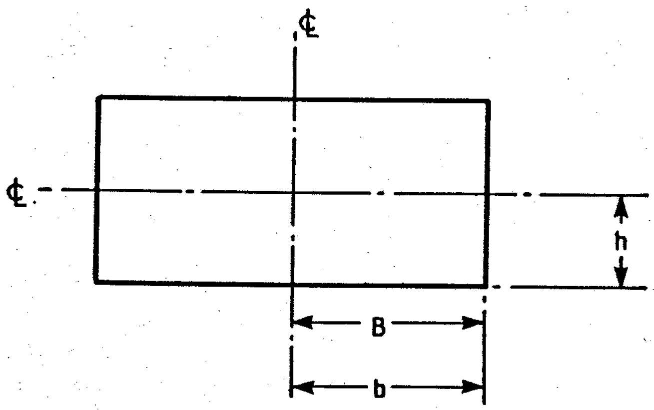
The notation used in defining the dimensionless parameters is illustrated in the diagrams a, b and c.

(a) Rectangular flume, simple channel



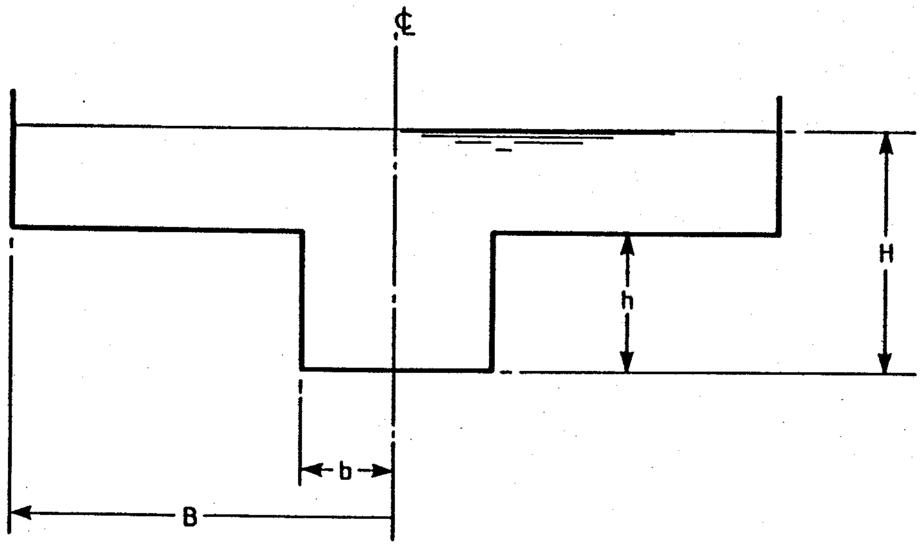
ie B/b = 1; H-h/H not applicable; b/h dependent upon flow depth.

(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.

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
ACKERS P, CHARLTON F G	91.44	10.36	-	2/2.6(-3)	0.0058/0.092
THE GEOMETRY OF SMALL MEANDERING STREAMS					
PICE, SUPPLEMENT 12, PAPER 7328S, 1970	91.44	0.985	-		POINT GAUGES SAND INJECTOR
	1	-	-		
ALFRINK B J, VAN RIJN L C	17	0.5	0.7	-	-
TWO EQUATION TURBULENCE MODEL FOR FLOW IN TRENCHES	-	1.0	0.2		LASER DOPPLER ANEMOMETER
PASCE, J HYD D, VOL 109, HY3, JULY, 1983	-	0.5	2.5		
ANWAR H O, ATKINS R	27	0.6	0.4	-	0.140
TURBULENCE MEASUREMENTS IN SIMULATED TIDAL FLOW	27	0.6	0.4		E. M. CURRENT METER HOT FIIM ANEMOMETER
PASCE, J HYD D, VOL 106, HY8, AUGUST, 1980	1	-	0.6		MIN CURRENT METER PRESTON TUBE TWIN WIRE PROBES

ARNOLD U, STEIN U, PASCHE E FIRST EXPERIENCES WITH AN ON AXIS LDV	25	1	-	-	-
SYSTEM IN SPECIAL APPLICATION TO OPEN CHANNEL FLOW	-	-	-		LASER DOPPLER VELOCIMETER
INT SYMP ON LASER ANEMOMETRY, ASME	-	-	-		
BATHURST J C	-	-	-	.398/3.73(-2)	0.137/195
SLOPE AREA DISCHARGE GAUGING IN MOUNTAIN RIVERS	5/150	5/50	-		LEVEL STAFF TAPE MEASURE
PASCE, J HYD D, VOL 112, HY5, JUNE, 1986	1	-	-		
BETTESS R, WHITE W R MEANDERING AND BRAIDING IN ALLUVIAL CHANNELS	24	2.44	0.61	1.8/5.6(-3)	0.001/0.0066
PICE, PART 2, 75, SEPTEMBER, 1983	24	0.22	0.04		POINT GAUGES SEDIMENT INJECTOR
	1	-	2.75		
BLINCO P H, SIMONS D B CHARACTERISTICS OF TURBULENT BOUNDARY SHEAR	10	0.204	0.204	0.5/10(-3)	0.00034/0.0095
STRESS J ASME, VOL 100, EM2, APRIL, 1974	10	0.204	0.204		HOT FIIM ANEMOMETER PIEZOMETERS
	1	-	1.99/3.19		
CALLANDER R A CONSTRUCTION OF AN EXPERIMENTAL MEANDER	12.19	2.44	-	-	0.0034
PROC. 2nd AUSTRALASIAN CONF. ON HYDRAULICS AND FLUID MECHANICS, UNIV. OF AUCKLAND, 1966	12.19	0.483	0.038		SAND INJECTOR WEIGH SCALES
	1	-	6.3/10		
CHANG H H ANALYSIS OF RIVER MEANDERS	-	-	-	0.000157	-
PASCE, J HYD D, VOL 110, HY1, JAN, 1984	-	22.86	1.89	-	
	1	-	6.05		

CHANG H H	-	-	-	0.0013	5.5/36.8
ENERGY EXPENDITURE IN CURVED OPEN CHANNELS					
PASCE, J HYD D, VOL 109, HY7, JULY, 1983	-	3.66	2.34		CURRENT METER
					STAFF GAUGES
	1	-	0.92/2.73		
CHANG H H	35.36	1.829	-	7.2(-4)	-
VARIATION OF FLOW RESISTANCE THROUGH					
CURVED CHANNELS	35.36	1.829	-		-
PASCE, J HYD D, VOL 110, HY12, DEC, 1984					
	1	-	5.86		
CHANG H H	-	-	-	1.19(-3)	-
RIVER MORPHOLOGY AND THRESHOLDS					
PASCE, J HYD D, VOL 111, HY3, MARCH, 1985	-	13.6/36.9	0.64/1.28		-
	1	-	5.3/28.8		
CHANG H Y, SIMONS D B, WOOLHISER D A	30.48	0.914	-	0.44/6.38(-3)	2.15/14(-3)
FLUME EXPERIMENTS ON ALTERNATE BAR					
FORMATION	30.48	.457/.914	-		POINT GAUGE
PASCE, J WH D, VOL 97, WW1, FEB, 1970					VENTURI METER
	1	-	5.85/23.25		
CRORY P M, ELSAWY E M	9.15	0.61	-	2.63(-4)	2.09/16.75(-3)
AN EXPERIMENTAL INVESTIGATION INTO THE					
INTERACTION BETWEEN A RIVERS DEEP SECTION	9.15	.102/.254	0.102		LASER DOPPLER ANEM.
AND ITS FLOOD PLAIN					PRESTON TUBE
IAHR, SYMP RIVER ENGINEERING, BELGRADE, 1980	2.4/5.98	.138/.376	1/2.49		
DRACOS T, HARDEGGER P	-	-	-	6/30(-4)	-
STEADY UNIFORM FLOW IN PRISMATIC CHANNELS					
WITH FLOOD PLAINS	-	.178/.5	.051/.1015		-
J HYDRAULIC RESEARCH, VOL 25, 2, 1987					
	2/7.99	-	1.75/4.93		

EINSTEIN H A, SHEN H W	-	0.31/3.05	-	-	1.43/567(-3)
A STUDY ON MEANDERING IN STRAIGHT					
ALLUVIAL CHANNELS	-	0.31/3.05	-		FLOATS
J GEOPHYSICAL RESEARCH, VOL 69, 24,					
DEC, 1964	1	-	1.79/15.45		
ESCUDIER M P, ACHARYA M	-	0.80	0.10	-	AIR
CRITIQUE OF THE COMPUTATIONAL PRESTON TUBE					
METHOD	-	0.80	0.10		HOT WIRE ANEMOMETER
EXPERIMENTS IN FLUIDS, 5, 1987					FLOATING ELEMENT -
	1	-	8		BALANCE
EVERS P, ROUVE G	25	1.0	0.85	0/3(-3)	0.005/0.07
BASIC MODEL INVESTIGATIONS ON HYDRAULIC					
EFFECTS OF BANK AND FLOOD PLAIN VEGETATION	25	0.124	0.124		LASER DOPPLER ANEM.
IAHR, SYMP RIVER ENGINEERING, BELGRADE, 1980					POINT GAUGE
	6.5	.409/.504	1		
HUPPERT H E, BRITTER R E	7	0.76	-	-	3.65/14.4(-3)
SEPARATION OF HYDRAULIC FLOW OVER					
TOPOGRAPHY	7	0.76	-		DYE
PASCE, J HYD D, VOL 108, HY12, DEC, 1982					
	1	-	.013/.295		
IKEDA S, NISHIMURA T	13	1	-	9.4/16.7(-4)	0.0158/0.0271
BED TOPOGRAPHY IN BENDS OF SAND SILT RIVERS					
PASCE, J HYD D, VOL 111, HY11, NOV, 1985	13	1	-		SAND SAMPLERS
	1	-	5.38/6.58		
ISHIKAWA T	30	0.6	-	3/10(-3)	0.0163/0.538
WATER SURFACE PROFILE OF STREAM WITH					
SIDE OVERFLOW	30	0.2/0.4	-	-	
PASCE, J HYD D, VOL 110, 12, DEC, 1984					
	1	-	0.5/0.75		

KALKWIJK J P TH, BOOIJ R ADAPTATION OF SECONDARY FLOW IN NEARLY	25/96	0.5/6	-	-	-
HORIZONTAL FLOW J HYDRAULIC RESEARCH, VOL 24, 1, 1986	25/96	0.5/6	-		-
	1	-	0.08/0.2		
LEOPOLD L B, WOLMAN M G RIVER CHANNEL PATTERNS:BRAIDED,MEANDERING	18.29	0.914	-	1.75/10.3(-3)	2.83/26.3(-4)
AND STRAIGHT GEOL SURVEY PROFESSIONAL PAPER 282-B, 1957	18.29	.038/.349	.038/0.085		POINT GAUGE VENTURI METER
	1	-	1.042/22.556		
LEOPOLD L B, BAGNOLD R A, WOLMAN M G, BRUSH L M	15.85	1.219	-	3.3/118(-4)	4.81/32.5(-4)
FLOW RESISTANCE IN SINUOUS OR IRREGULAR CHANNELS	14.02	0.117	-		POINT GAUGE MANOMETER
GEOL SURVEY PROFESSIONAL PAPER 282-D, 1960	1	-	1.447/2.139		
McALLISTER J E, PIERCE F J, TENNANT F H PRESTON TUBE CALIBRATION AND DIRECT FORCE	-	0.91	0.61	-	AIR
FLOATING ELEMENT MEASUREMENTS IN A TWO DIMENSIONAL TURBULENT BOUNDARY LAYER	-	0.91	0.61		DIRECT FORCE - FLOATING ELEMENT
TASME, J FLUIDS ENGINEERING, VOL 104, 1982	1	-	1.492		PRESTON TUBE PIEZOMETERS MANOMETER
MYERS W R C VELOCITY AND DISCHARGE IN COMPOUND CHANNELS	9	0.76	-	2.2/22.8(-4)	-
PASCE, J HYD D, VOL 113, HY6, JUNE, 1987	9	0.160	0.08/0.12		POINT GAUGE MIN CURRENT METER
	3.3/4.8	0.17/0.46	0.66/1		VENTURI
NAKAGAWA T BOUNDARY EFFECTS ON STREAM MEANDERING	25	2	-	-	0.00034/0.00073
AND RIVER MORPHOLOGY SEDIMENTOLOGY, 30, 1983	20	.035/.30	0.05		MIN CURRENT METER POINT GAUGE
	1	-	1.029/50		DYE

NAKAGAWA H, NEZU I	8	0.30	0.20	-	-
EXPERIMENTAL INVESTIGATION ON TURBULENT STRUCTURE OF BACKWARD FACING STEP FLOW IN AN OPEN CHANNEL	8	0.30	0.20		LASER DOPPLER ANEM.
J HYDRAULIC RESEARCH, VOL 25, 1, 1987	1	-	0.94/1.72		
NATIONAL PHYSICAL LABORATORY	-	2.74/3.96	2.13/2.74	-	AIR
ON THE MEASUREMENT OF LOCAL SURFACE FRICTION ON A FLAT PLATE BY MEANS OF PRESTON TUBES	-	2.74/3.96	2.13/2.74		PRESTON TUBES MANOMETER
NATIONAL PHYSICAL LABORATORY, AERODYNAMICS DIVISION, NO 3185, MAY, 1958	1	-	1.286/1.445		
NIXON M	-	-	-	-	8.5/510
A STUDY OF THE BANKFULL DISCHARGES OF RIVERS IN ENGLAND AND WALES	-	10.4/78.3	0.95/4.99		-
PICE, VOL 12, FEB, 1959	1	-	1.74/13.82		
NOUH M A, TOWNSEND R D	10	0.30	0.15	-	-
SHEAR STRESS DISTRIBUTION IN STABLE CHANNEL BENDS	10	0.30	0.15		LASER DOPPLER ANEMOMETER
PASCE, J HYD D, VOL 105, HY10, OCT, 1979	1	-	1.875		
ODGAARD A J, KENNEDY J F	80.8	2.44	0.610	-	0.154
RIVER BEND BANK PROTECTION BY SUBMERGED VANES	80.8	1.448	-		MIN CURRENT METER SONIC SOUNDER
PASCE, J HYD D, VOL 109, 8, AUG, 1983	1	-	7.125		
ONISHI Y, JAIN S C, KENNEDY J F	31.1	2.34	0.41	3(-4)	-
EFFECTS OF MEANDERING IN ALLUVIAL STREAMS	31.1	1.17/2.34	0.41		SEDIMENT SAMPLERS PIEZOMETERS PITOT TUBE
PASCE, J HYD D, VOL 102, HY7, JULY, 1976	1	-	4.46/14.75		

ONSRUD G, PERSEN L N, SAETRAN L R	-	1.0	0.5	-	AIR
ON THE MEASUREMENT OF WALL SHEAR STRESS					
EXPERIMENTS IN FLUIDS, 5, 1987	-	1.0	0.5		STATIC HOLE PAIR HOT WIRE ANEMOMETER
	1	-	2		
PATEL V C	.4/7.32	.003/.038R	-	-	-
A UNIFIED VIEW OF THE LAW OF THE WALL USING					
MIXING LENGTH THEORY	.4/7.32	.003/.038R	-		-
AERONAUTICAL QUARTERLY, FEBRUARY, 1973					
	-	-	-		
PENDERGAST D, COBBLE M, SMITH P	3.048	0.0508	0.038/0.0508	-	GLYCERINE
LAMINAR FLOW THROUGH DUCTS OF ARBITRARY					
CROSS SECTION	3.048	0.0508	0.038/0.0508		CAMERA
INT J MECHANICAL SCIENCES, VOL 12, 1970					TRACER
	1	-	0.75/1.0		
SCHUMM S A, KHAN H R	30.48	7.315	0.914	1.0/20(-3)	4.25(-3)
EXPERIMENTAL STUDY OF CHANNEL PATTERNS					
GEOL SOC OF AMERICA BULLETIN, JUNE, 1972	30.48	0.305	0.076		POINT GAUGE MANOMETER
	1	-	3.4/52		VENTURI
SHEN H W, KOMURA S	17.07	2.438	0.61	2.8/20.6(-4)	6.85/35.5(-3)
MEANDERING TENDENCIES IN STRAIGHT ALLUVIAL					
CHANNELS	17.07	0.76/1.52	0.381		POINT GAUGE
PASCE, J HYD D, VOL 94, HY4, JULY, 1968					PITOT TUBE
	1	-	4.31/22.73		FLOATS
STRUIKSMA N, OLESEN K W, FLOKSTRA C,	6.6/41.5	1/2.3	-	1.28/4.19(-2)	0.02/0.17
de VRIEND H J					
BED DEFORMATION IN CURVED ALLUVIAL CHANNELS	6.6/41.5	1/2.3	-		-
J HYDRAULIC RESEARCH, VOL 23, 1, 1985					
	1	-	4.25/9.58		

TEMPLE D M	29/43	0.91/6.1	0.305/0.61	5/9(-2)	0.025/1.529
VELOCITY DISTRIBUTION COEFFICIENTS FOR GRASS LINED CHANNELS	29/43	.457/3.05	-		PITOT TUBE MANOMETER
PASCE, J HYD D, VOL 112, HY3, MARCH, 1986	1	-	-		
THORNE C R, HEY R D	-	-	-	-	13/22
DIRECT MEASUREMENT OF SECONDARY CURRENTS AT A RIVER INFLEXION POINT	-	27/36	-		E.M.CURRENT METER
NATURE, VOL 280, JULY, 1979	1	-	13.5/18		
TIFFANY J B	15.24	4.572	-	3/6(-3)	-
STUDIES OF MEANDERING OF MODEL STREAMS	15.24	-	-		-
TRANSACTIONS, AMERICAN GEOPHYSICAL UNION, REPORTS & PAPERS, HYDROLOGY, 1939	1	-	-		
de VRIEND H J, GELDOF H J	-	-	-	-	1.27
MAIN FLOW VELOCITY IN SHORT RIVER BENDS PASCE, J HYD D, VOL 109, 7, JULY, 1983	285	6.1/8	-		CURRENT METER POINT GAUGE
	1	-	6.1		
WEBEL G, SCHATZMANN M	20	1.82	-	.06/.4(-3)	-
TRANSVERSE MIXING IN OPEN CHANNEL FLOW PASCE, J HYD D, VOL 110, 4, APRIL, 1984	20	0.486/1.82	-		DYE
	1	-	2.7/22.75		
WHITE C M	.98/5.5	.003/.01D	-	-	AIR/WATER
STREAMLINE FLOW THROUGH CURVED PIPES PROC. ROYAL SOC., VOL 123, 1929	.98/3.3	.003/.01D	-		PRESSURE TAPPINGS MANOMETER THERMOMETER
	-	-	-		

WILKIE D, COWIN M, BURNETT P, BURGOYNE T	1.524	0.152	0.0137	-	AIR, 1.32
FRICTION FACTOR MEASUREMENTS IN A RECTANGULAR					
CHANNEL WITH WALLS OF IDENTICAL AND NON	1.524	0.152	0.0137		PRESSURE TAPPINGS
IDENTICAL ROUGHNESS					PITOT TUBE
INT J HEAT MASS TRANSFER, VOL 10, 1967	1	-	11.09		THERMOCOUPLE
WOLMAN M G, BRUSH L M	15.85	1.219	0.203	1.31/13.7(-3)	3.1/79.3(-4)
FACTORS CONTROLLING THE SIZE AND SHAPE OF					
STREAM CHANNELS IN COARSE NONCOHESIVE SANDS	15.85	.127/.254	-		BUBBLER GAUGE
GEOL SURVEY PROFESSIONAL PAPER 282-G, 1961					TRANSDUCER
	1	-	1.904/20		POINT GAUGE
					SEDIMENT INJECTOR
WORMLEATON P R, ALLEN J, HADJIPANOS P	10.75	1.21	-	4.3(-4)	-
APPARENT SHEAR STRESSES IN COMPOUND CHANNEL					
FLOW	10.75	0.29	0.12		HOT FILM ANEMOMETER
IAHR, SYMP RIVER ENGINEERING, BELGRADE, 1980					PRESTON TUBE
	4.17	.125/.75	1.208		POINT GAUGE
YEN B C	35.36	1.83	-	2.9/14.4(-4)	-
CHARACTERISTICS OF SUBCRITICAL FLOW IN A					
MEANDERING CHANNEL	35.36	1.83	-		PITOT TUBE
INSTITUTE OF HYDRAULIC RESEARCH, UNIVERSITY					PRESTON TUBE
OF IOWA, IOWA CITY, 1965	1	-	3.99/8.50		HOT WIRE PROBE
YEN C L	35.35	2.337	-	-	-
BED TOPOGRAPHY EFFECT ON FLOW IN A MEANDER					
PASCE, J HYD D, VOL 96, HY1, JAN, 1970	35.35	2.337	-		PRESTON TUBE
					PITOT TUBE
	1	-	9/15		HOT WIRE ANEMOMETER
					POINT GAUGE
					MANOMETER