

Contents

Chapters	Pages
1 Introduction	1
1.1 General Features	1
1.2 Objectives	2
1.3 Organizational structure of the thesis	3
2 Hydrodynamics and sediment transport around cylindrical structures	5
2.1 General hydrodynamics aspects	5
2.1.1 A brief history of fluid mechanics	5
2.1.2 General hydrodynamics equations	6
2.1.3 A potential flow solution for a boundary layer of fluid past a cylindrical structure	10
2.1.4 Experimental studies of flow around a cylinder in steady current	12
2.2 General aspects about sediment transport	15
2.2.1 Incipient motion due to free flow	16
2.2.2 Incipient motion near to flow obstruction	19
2.2.3 Experimental studies of sediment transport near to a pile	25
2.3 Brief conclusion and research needs	28
2.4 Article: Coherent turbulent structures in front of a circular pile embedded on a granular bed and its relationship with the sediments incipient motion.	29
2.4.1 Abstract	29
2.4.2 Introduction	29
2.4.3 Experiments	32
2.4.4 Data analysis	34
2.4.5 Results	36
2.4.6 Discussion	50
2.4.7 Conclusions	53
3 Numerical modelling of pile scour	55
3.1 Numerical representation of hydrodynamics around a pile	55
3.1.1 Reynolds Averaged Navier-Stokes Equations: RANS	56
3.1.2 Turbulence closure modelling	59
3.2 Numerical representation of fluid/structure interaction	63
3.2.1 Fluid - free surface interaction	65
3.2.2 Fluid - mobile bed interaction	67
3.2.3 Fluid - rigid body interaction	68
3.3 Brief conclusion and research needs	70

3.4	Article: Numerical simulation of scour around circular piles due to unsteady currents and oscillatory flows	71
3.4.1	Abstract	71
3.4.2	Introduction	71
3.4.3	Materials and methods	75
3.4.4	Results	85
3.4.5	Discussion	92
3.4.6	Conclusions	95
3.5	Article: Numerical study of the hydrodynamics of waves and currents and their effects in pier scouring	96
3.5.1	Abstract	96
3.5.2	Introduction	96
3.5.3	Materials and Methods	99
3.5.4	Results	108
3.5.5	Discussion	125
3.5.6	Conclusions	129
4	Conclusions	130
4.1	General conclusions	130
4.2	About the coherent turbulent structures and incipient motion	131
4.3	About the numerical simulation of scour due to unsteady and oscillatory flow .	131
4.4	About the numerical simulation of scour due to waves and currents	132
	Bibliography	151