A review of Local Scour Research and references at bridge piers

Table (3S): A Review of Local Scour Research at bridge piers

	pier				**Bed sediments**			**Flow**				**Flume**			t (hr)	S (cm)	**relationship**
Investigator(s) **(1)**	**Pier shape** **(2)**	**Pier Dimen.** Dia. (cm) **(3)**	Len. (cm) **(4)**	Angle of attack **(5)**	d_{50} (mm) **(6)**	σ_g **(7)**	Type of sed. **(8)**	h (cm) **(9)**	U (m/s) **(10)**	U/U_c **(11)**	Q (l/s) **(12)**	Len. (m) **(13)**	Wide. (m) **(14)**	Dep. (m) **(15)**	**(16)**	**(17)**	**(18)**
Tison (1940)	Rectangular Round-nosed Triangular Flared lenticular	6 6 6 5.2 6, 3.4	24 24 24 21.5 24	0 0-14.5	0.48		sand	10.5	0.41		30		0.7			11.4 8.17 7 6.2 3.3-10	
Inglis (1948)	Rectangular & Round-nosed	5.38 to 28.25	9.19 to 48	0	0.3 to 1.3		sand								Equ.	<1.3 D	$\frac{h+S}{D}=1.7\left(\frac{q^{2/3}}{D}\right)^{0.78}$ (ft-unit)
Chabert and Engeldinger (1956)	Circular Round-nosed Lenticular Flared	2.5–30	– 50	0 0–30	0.26–3		-	10 to 35	0.65				0.8 3			15-38	
Laursen and Toch (1956)	Round-nosed, Elliptic, Lenticular, Circular	6	6 to 18	0-30	0.58		sand	9.2	0.38								$\frac{S}{D}=1.5\left(\frac{h}{D}\right)^{0.3}$ **Rectangular pier with zero angle of attack**
	Dumb-bell	6		30	0.44 to 2.25			6-27	0.3 to 0.76							9.6 to 16.5	
Varzeliotis (1960)	Square, Round-nosed, Lenticular, Bevel-nosed	2.5–15	2.5 to 50	0-45	1.7		sand	7.3 to 15.9	0.4 to 0.58							3-13.2	
Shen et al. (1966)	Circular	90,15		0	0.24, 0.44, 0.46		sand	61, 67	0.66, 0.5							55-67	$S=0.000059R_e^{0.512}$ (m-unit)
Maza et al. (1968)	Circular, Round-nosed, Rectangular	13.3		0	0.17, 0.56, 1.3		sand	5-51								1.5 D to 2 D	
Tarapore (1962)		5		0	0.15, 0.5		sand	>5								~ 1.4 D	

Table (3S): Continue

Investigator(s)	pier				Bed sediments			Flow				Flume			t (hr)	S (cm)	relationship
	Pier shape	Pier Dimen. Dia. (cm)	Len. (cm)	Angle of attack	d_{50} (mm)	σ_g	Type of sed.	h (cm)	U (m/s)	U/U_c	Q (l/s)	Len. (m)	Wide. (m)	Dep. (m)			
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**
Larras (1963)	Lenticular Elliptic Round-nosed Square	Data from Engeldinger & Chabert															$S_{max} = 1.05(D)^{0.75}$ (m–unit)
Hincu (1965)		3-20		0	0.5, 2, 5												$S/S_m = (2U/U_c - 1)$ $S_m/D = 2.24\left(U_c^2/(gD)\right)^{1/3}$ $U_c \approx 1.54 d_{50}^{0.3} h^{0.2} g^{0.5}$
Nicollet (1971 a,b)		5-20 5-20 50, 100		0	3-0.94 ″ 7-25		sand Bakelite gravel	20 20 150					4			8.5-31 ″ 65-150	
Basak et al. (1975)	Square	4-50		0	0.65		Sand	<14		>1							$S = 0.558(D)^{0.586}$
Torsethaugen (1975)		<75		0				0.2D to 0.65 D	0.8								$S_e/D = 1.8(U/U_c - 0.54)h/D$ $S/S_e = \exp\left[-(t_0/t)^{0.5}\right]$
Coleman (1971)		4.5, 7.6		0	0.1		data from Shen et. al. (1969)										$S/D = 1.49\left(\frac{U^2}{gh}\right)^{1/10}$
Dietz (1972)		4.3 to 13.5		0				7-50	0.1 to 0.14							5.2-8	
Bonasoundas (1973)	Circular	5-15		5	0.63 to 3.3			0.4D to 3D		1 to 6.1					2		
White (1975)				0	0.9		sand	F_r =0.8-1.2									
Chiew and Melville (1987)	Circular	3.18, 4 4.5		0	0.24 to 3.2	1.18 to 1.33		17 to 24		0.9 to 4		11.8	0.44	0.38			
Dargahi (1990)	Circular	15		0	0.36			20	0.26	0.85		22	1.5	0.65	12		

Table (3S): Continue

Investigator(s)	**pier**				**Bed sediments**			**Flow**				**Flume**			t (hr)	S (cm)	**relationship**
	Pier shape	**Pier Dimen.** Dia. (cm)	Len. (cm)	Angle of attack	d_{50} (mm)	σ_g	Type of sed.	h (cm)	U (m/s)	U/U_c	Q (l/s)	Len. (m)	Wide. (m)	Dep. (m)			
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**
Yanmaz et al. (1991)	Circular & Square	4.7-6.7		0	0.84 to 1.07	1.13 to 1.28	sand	4.5 to 16.5			5-40	10.9	6.7		3-6	3.2 to 14.1	**Study of time dependent local scour**
Kothyari (1992)	Circular	2.5-17		0	0.41-4	1.4 to 7.8		4.2 to 6	0.82 to 0.98	0.1 to 0.35		30	1	0.6	96		
Dey et al. (1995)	Circular			0	0.58, 0.26		sand					10	0.81	0.25	12		
Briaud et al. (1999)		2.5 to 2.29		0	0.0062		cohesive	16 to 40	0.2 to 0.84						150	12	$S(mm) = 0.18R_e^{0.635}$
Melville and Chiew (1999)		1.6-20		0	0.8 to 0.96		sand	7-23	0.165 to 0.32							3.33 to 119	$\frac{S}{S_e} = \exp\left\{-0.03\left\|\frac{U_c}{U}\ln\left(\frac{t}{t_e}\right)\right\|^{1.6}\right\}$
Oliveto and Hager (2002)	Circular	2-50		0	0.55 to 5.3	1.25 to 2.15	Sand	2-30							1 to 1167		$Z = 0.068N\sigma_g^{-1/2}F_d^{1.5}\log(T)$
Mia and Nago (2003)	Circular	6		0	1.28	1.29	sand	16 to 30	0.31 to 0.39	0.71 to 0.82	30 to 70	16	0.6	0.4	2.5 to 5	7.1 to 10.6	**Study of time dependent local scour**
Rambabu and Rao (2003)	Circular	5-11		0			cohesive		0.192 to 0.328						4	0.7-3.8	$S/D = \left(U/\sqrt{gh}\right)^{0.641}\left(UD/\nu\right)^{0.64}\left(C/(\gamma h)\right)^{-0.9}$
Ansari et al. (2002)	Circular	11.25		0			cohesive	5-18	0.21 to 0.48						6-60	7.5 to 17.9	
Sheppard et. al. (2004)	Circular	11.4 to 91.4		0	0.22 to 2.9	1.2 to 1.5	Sand	17 to 190	0.29 to 0.76	0.75 to 1.21		38.4	6.1	6.4	41 to 616		$S/D = f_1(\frac{h}{D})f_2(\frac{U}{U_c})f_3(\frac{D}{d_{50}})$ $f_1 = \tanh\left[(h/D)^{0.4}\right]$ $f_2 = 1-1.75\left[\ln(U/U_c)\right]^2$ $f_3 = \frac{(D/d_{50})}{[0.4(D/d_{50})^{1.2}+10.6(D/d_{50})^{-0.13}]}$

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