Table 1—Soil spring stiffnesses at each layer

Soil Stiffness Properties			
Soil Classification	**Springs**	**Depth, m**	**Stiffness, kN/m**
Sand	k_1	0	0
	k_2	0.3	14
	k_3	0.6	28.2
	k_4	0.9	42.2
	k_5	1.2	56.4
	k_6	1.5	70.5
	k_7	1.8	84.6
	k_8	2.1	98.7
	k_9	2.4	113
	k_{10}	2.7	127
	k_{11}	3.0	141
	k_{12}	3.3	164
	k_{13}	3.6	180
	k_{14}	3.9	195
	k_{15}	4.2	211
	k_{16}	4.5	226
	k_{17}	4.8	242
	k_{18}	5.1	257
	k_{19}	5.4	273
	k_{20}	5.7	288
	k_{21}	6.0	304
Clay	k_{22}	6.3	$1.9x10^5$
	k_{23}	6.6	$7.9x10^5$
	k_{24}	6.9	$1.4x10^6$
	k_{25}	7.2	$2.0x10^6$

[1kN/m = 5.65 lb/in]

Table 2—Limit States for each component [25]

Component	Slight	Moderate	Extensive	Complete
Abutment, mm	28.9	90	140	190
Bearing, mm	9.8	37.9	77	100
Column, μ*	1	1.6	3.5	7.6

*μ is the column curvature ductility

[1mm = 0.04 in]

Table 3 – Dispersion values for each Component

Component	Slight	Moderate	Extensive	Complete
Abutment, mm	0.59	0.60	0.64	0.65
Bearing, mm	0.70	0.61	0.65	0.65
Column, μ*	0.70	0.90	0.85	1.00

*μ is the column curvature ductility

[1mm = 0.04 in]

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Table 4—Percent difference of longitudinal and transversal response for each bridge component

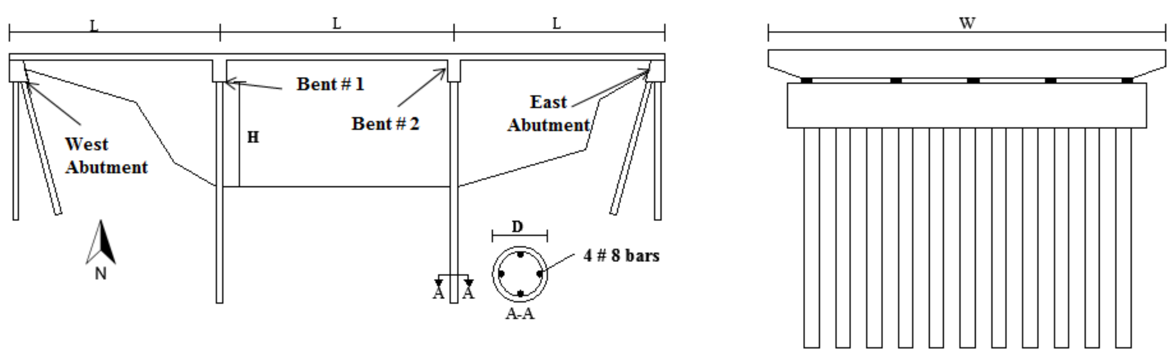
Scour Depth, m	Abutment		Bearing		Column	
	Maximum Displacement, mm	% Difference	Maximum Displacement, mm	% Difference	Maximum Displacement, mm	% Difference
			Longitudinal			
0	21		1.2		11	
3.7	47	76	1.3	10.3	41	115
7.3	68	106	3.8	104	70	146
			Transversal			
0	10		2.9		4.8	
3.7	38	117	3.0	3.4	35	151
7.3	42	123	4.4	41	58	169

[1 m = 3.28 ft; 1mm = 0.04 in]

Table 5—Percent difference of system fragility curves

Scour Depth, m	Slight		Moderate		Extensive		Complete	
	PGA, g	% Difference	PGA, g	% Difference	PGA, g	% Difference	PGA, g	% Difference
0	0.54		1.2		2.4		3.6	
3.7	0.29	60	0.5	85	0.8	101	1.2	102
7.3	0.26	70	0.4	102	0.6	121	0.84	123

[1 m = 3.28 ft]



(a)

(b)

Span	Span length (L), m	Pier column diameter (D), m	Column height (H), m	Deck width (W), m
End **Middle**	**11.73** **14.63**	**0.40**	**2.74**	**10.24**

(c)

[1.0 m = 3.28 ft]

Figure 1—Bridge schematic view: (a) elevation; (b) cross section; and (c) characteristics.

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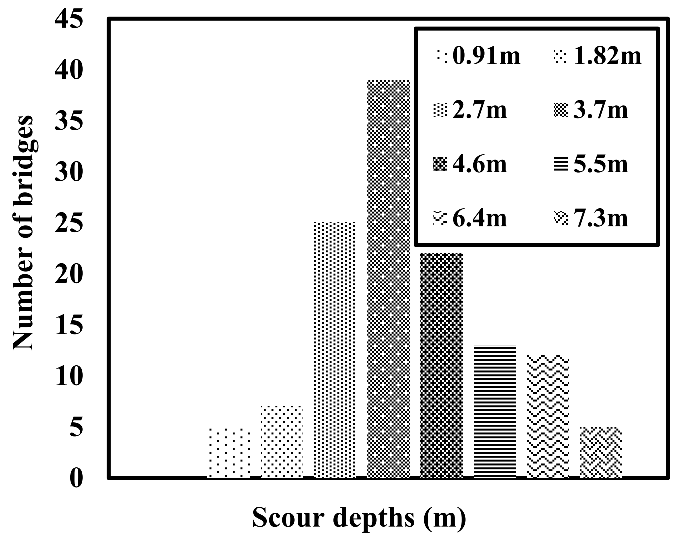
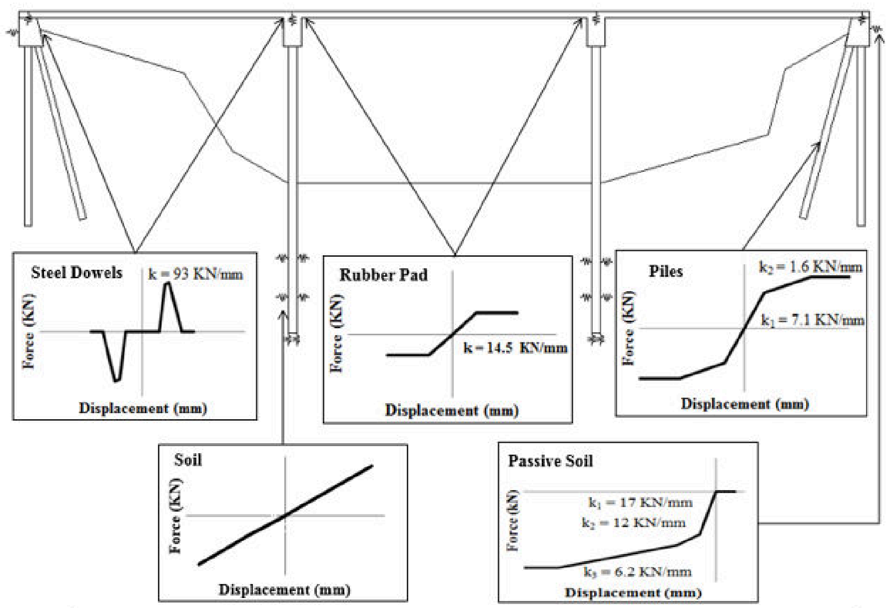


[1.0 m = 3.28 ft]

Figure 2—Iowa scour histogram



Spring	Direction			
	Longitudinal	Transversal	Vertical	Rotation
Dowels	X	X		
Pad	X	X		
Piles		X	X	
Soil	X	X	X	
Passive Soil	X			

[1.0 kN/mm = 65 kip/in]

Figure 3—Analytical bridge model for the concrete slab bridge

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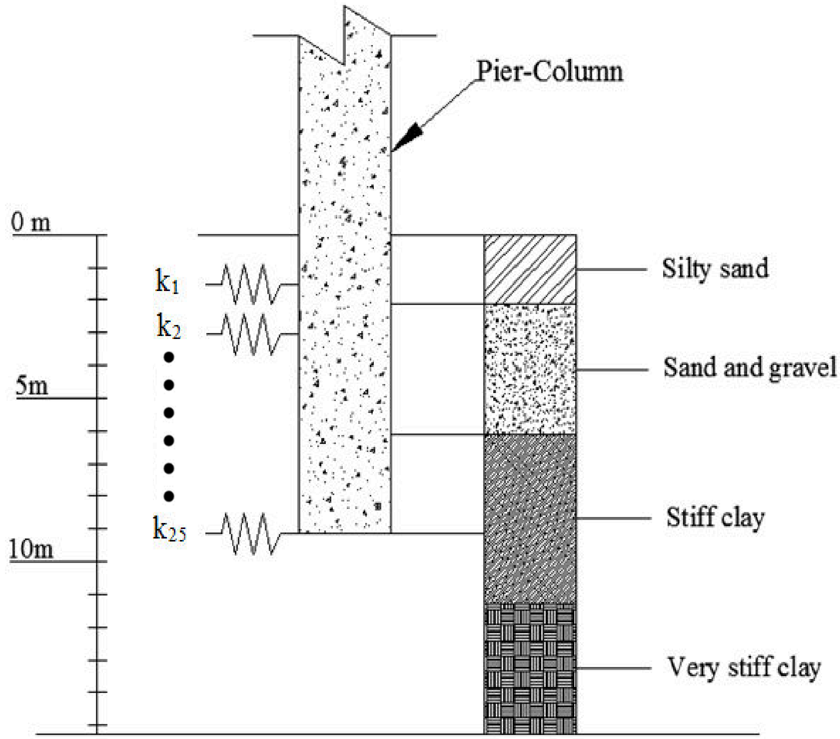

[1.0 m = 3.28 ft]

Figure 4—Soil-column interaction model
**All the dimensions of the springs are not at a scale.*

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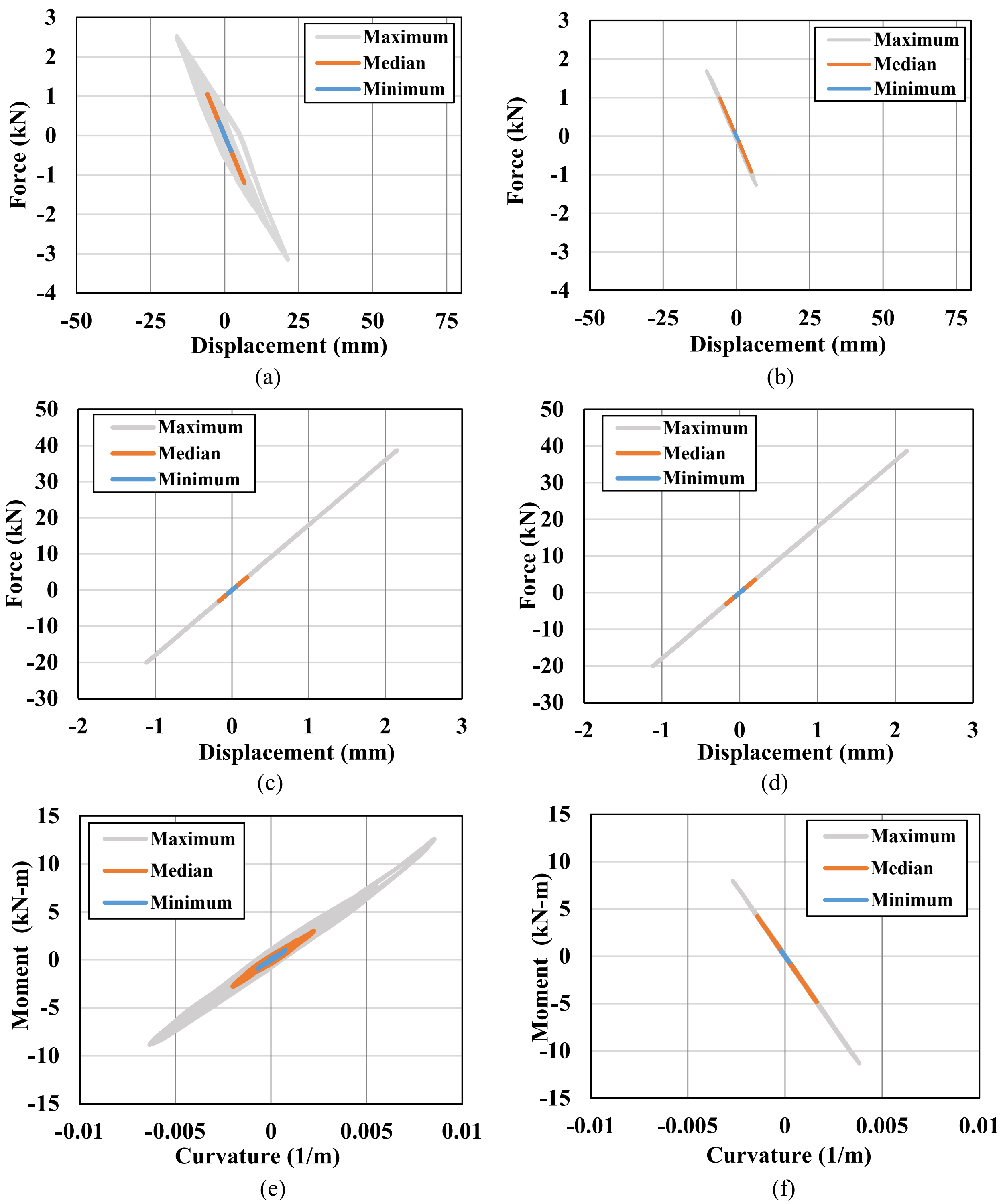

[1 kN= 224 lbs; 1mm = 0.03 in; 1 kN-m = 737 lb-ft; 1.0 m = 3.28 ft]

Figure 5—Hysteresis loops for each bridge component at no scour: (a) abutment longitudinal; (b) abutment transversal; (c) bearing longitudinal; (d) bearing transversal; (e) column curvature longitudinal; (f) column curvature transversal

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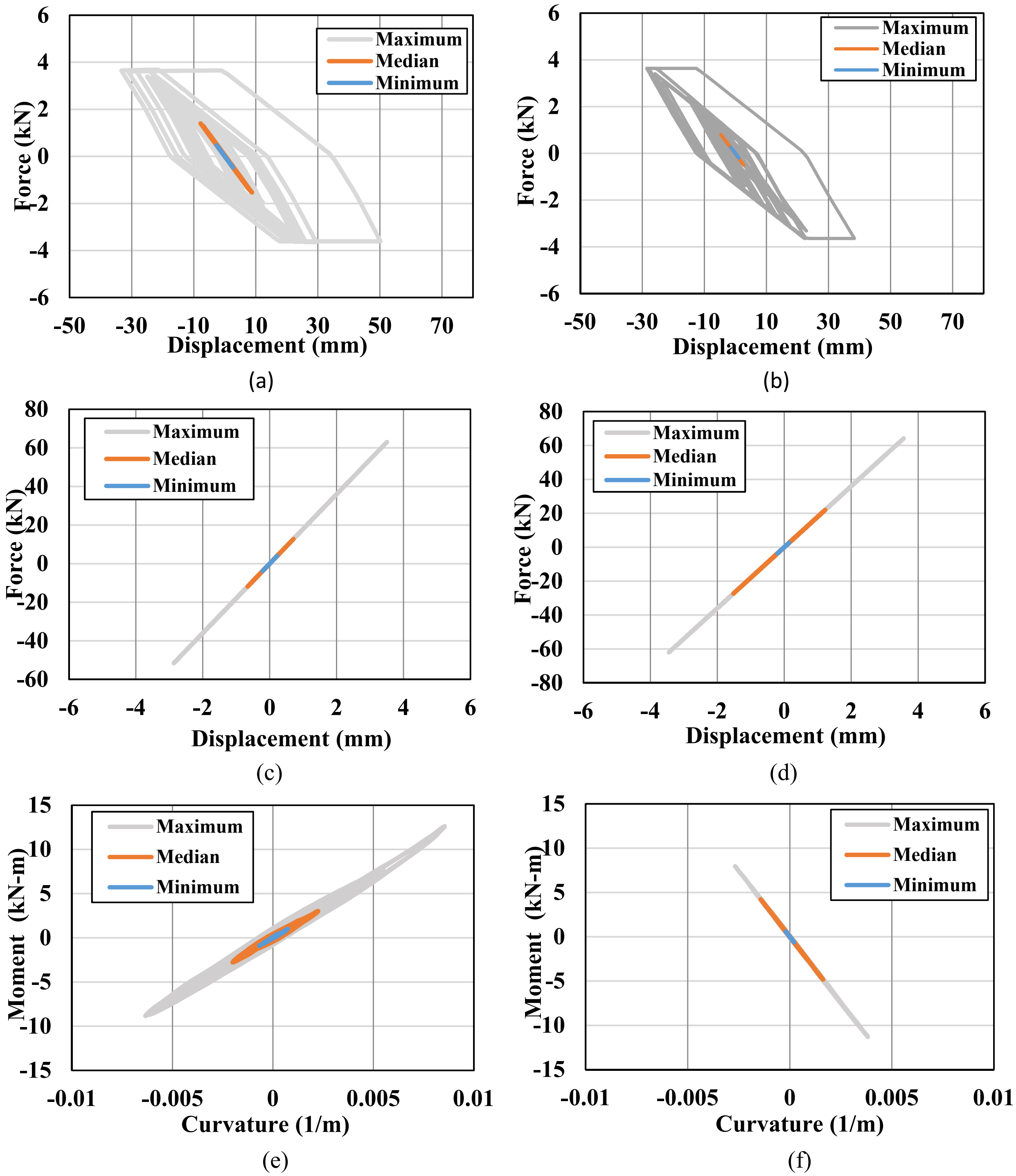

[1 kN= 224 lbs; 1mm = 0.03 in; 1 kN-m = 737 lb-ft; 1.0 m = 3.28 ft]

Figure 6— Hysteresis loops for each bridge component at 3.65m scour depth: (a) abutment longitudinal; (b) abutment transversal; (c) bearing longitudinal; (d) bearing transversal; (e) column curvature longitudinal; (f) column curvature transversal

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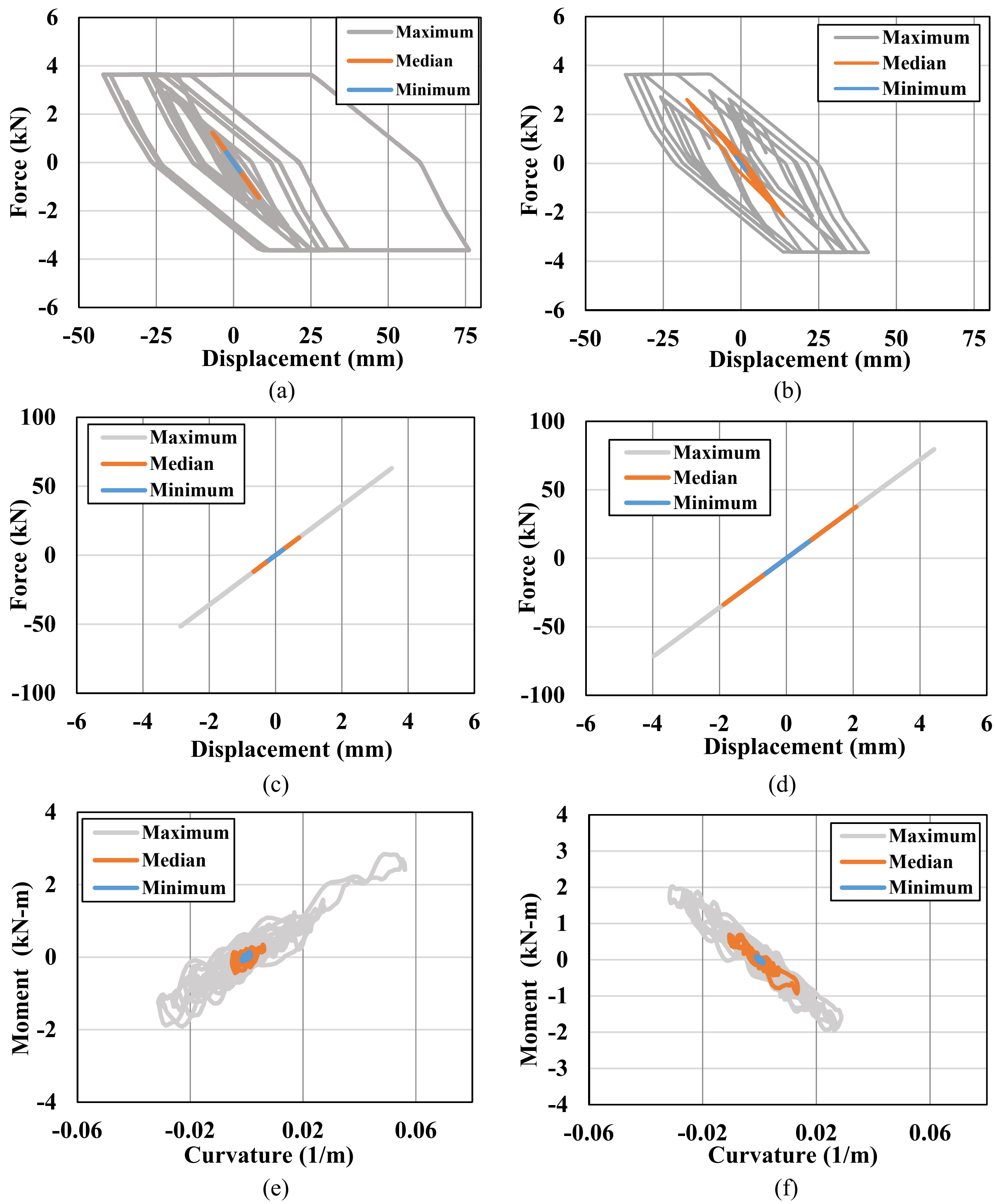

[1 kN= 224 lbs; 1mm = 0.03 in; 1 kN-m = 737 lb-ft; 1.0 m = 3.28 ft]

Figure 7— Hysteresis loops for each bridge component at 7.31m scour depth: (a) abutment longitudinal; (b) abutment transversal; (c) bearing longitudinal; (d) bearing transversal; (c) column curvature longitudinal; (f) column curvature transversal

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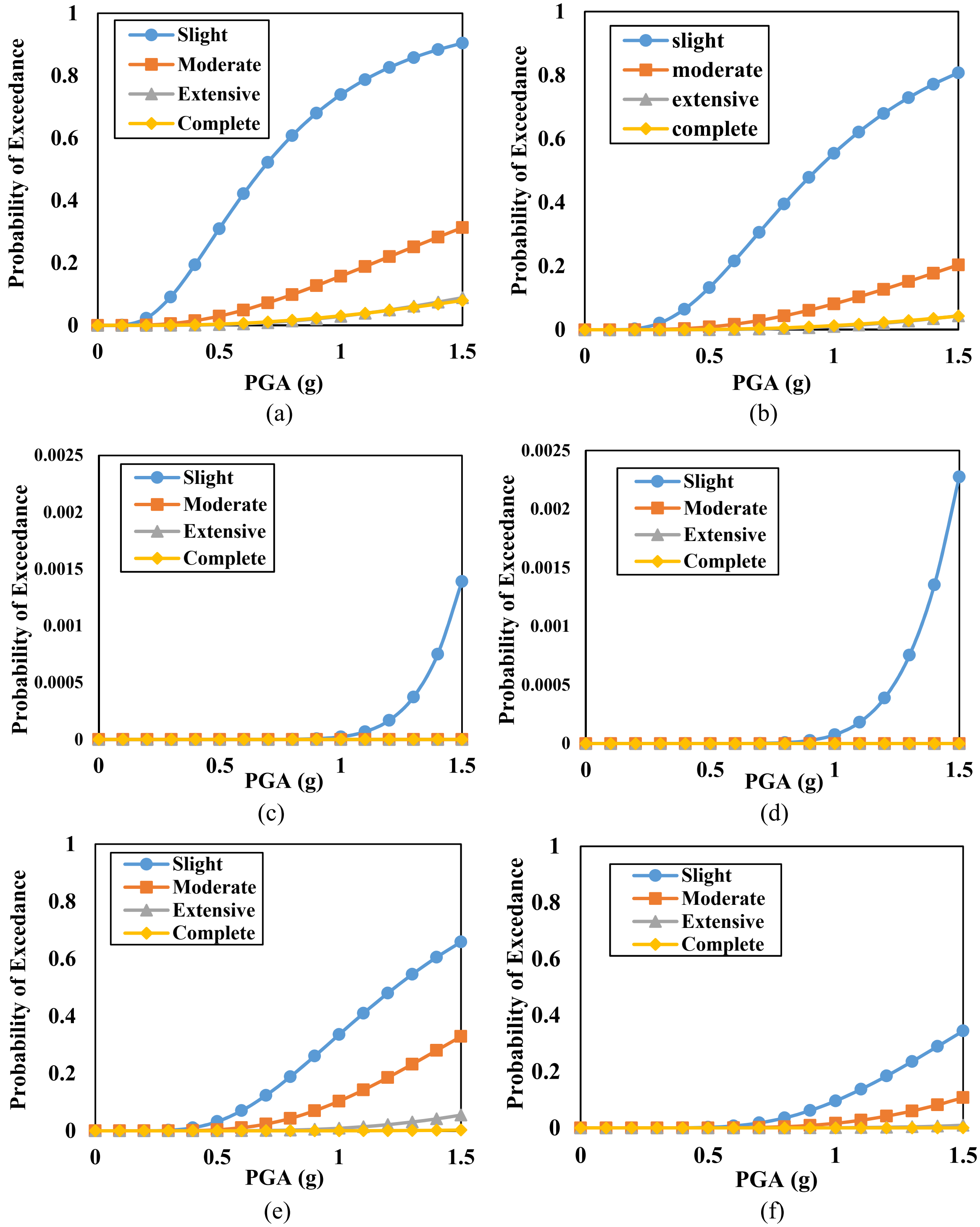

Figure 8— Fragility curves for each bridge component at no scour: : (a) abutment longitudinal; (b) abutment transversal; (c) bearing longitudinal; (d) bearing transversal; (e) column curvature longitudinal; (f) column curvature transversal

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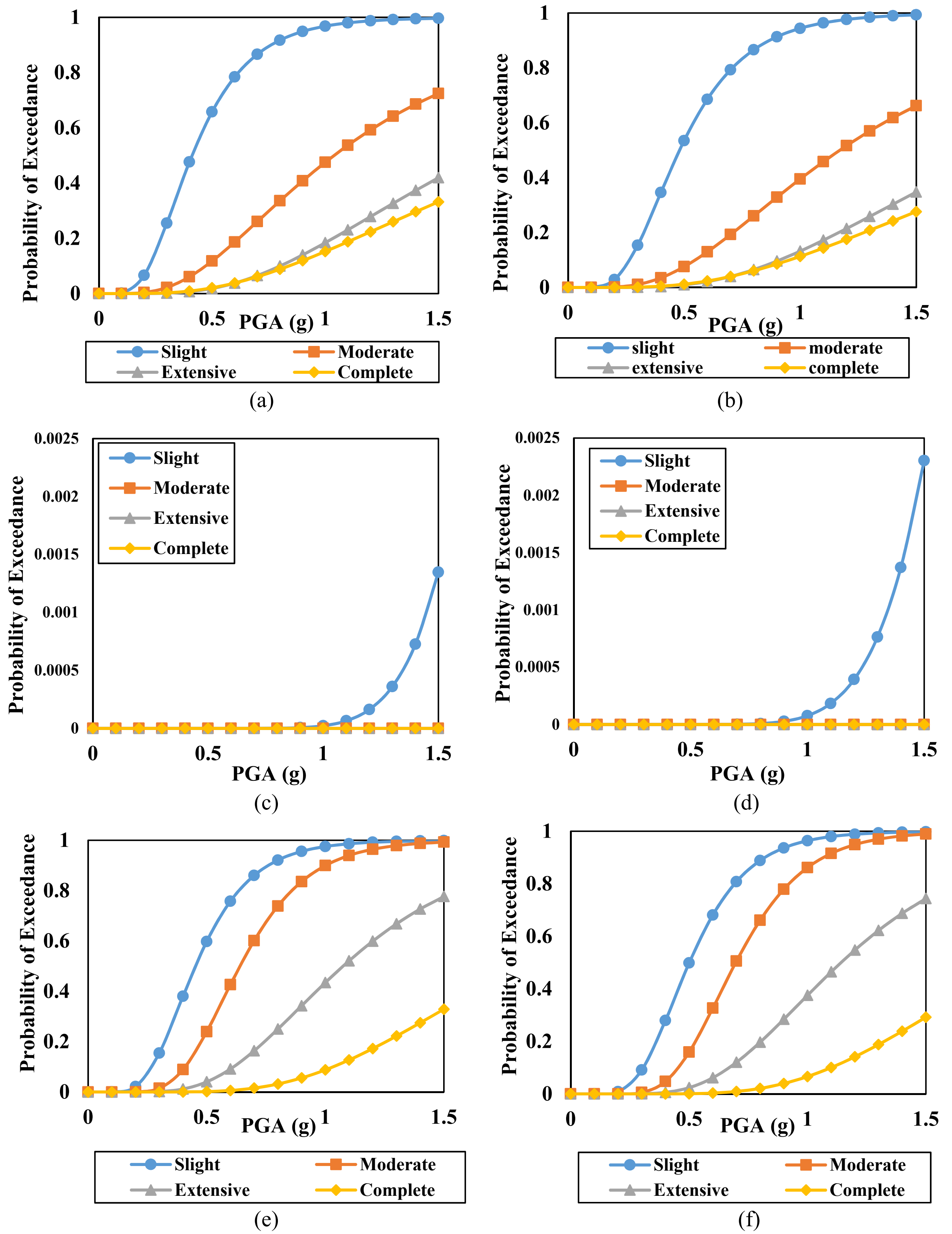

Figure 9—Fragility curves for each bridge component at no scour: (a) abutment longitudinal; (b) abutment transversal; (c) bearing longitudinal; (d) bearing transversal; (e) column curvature longitudinal; (f) column curvature transversal

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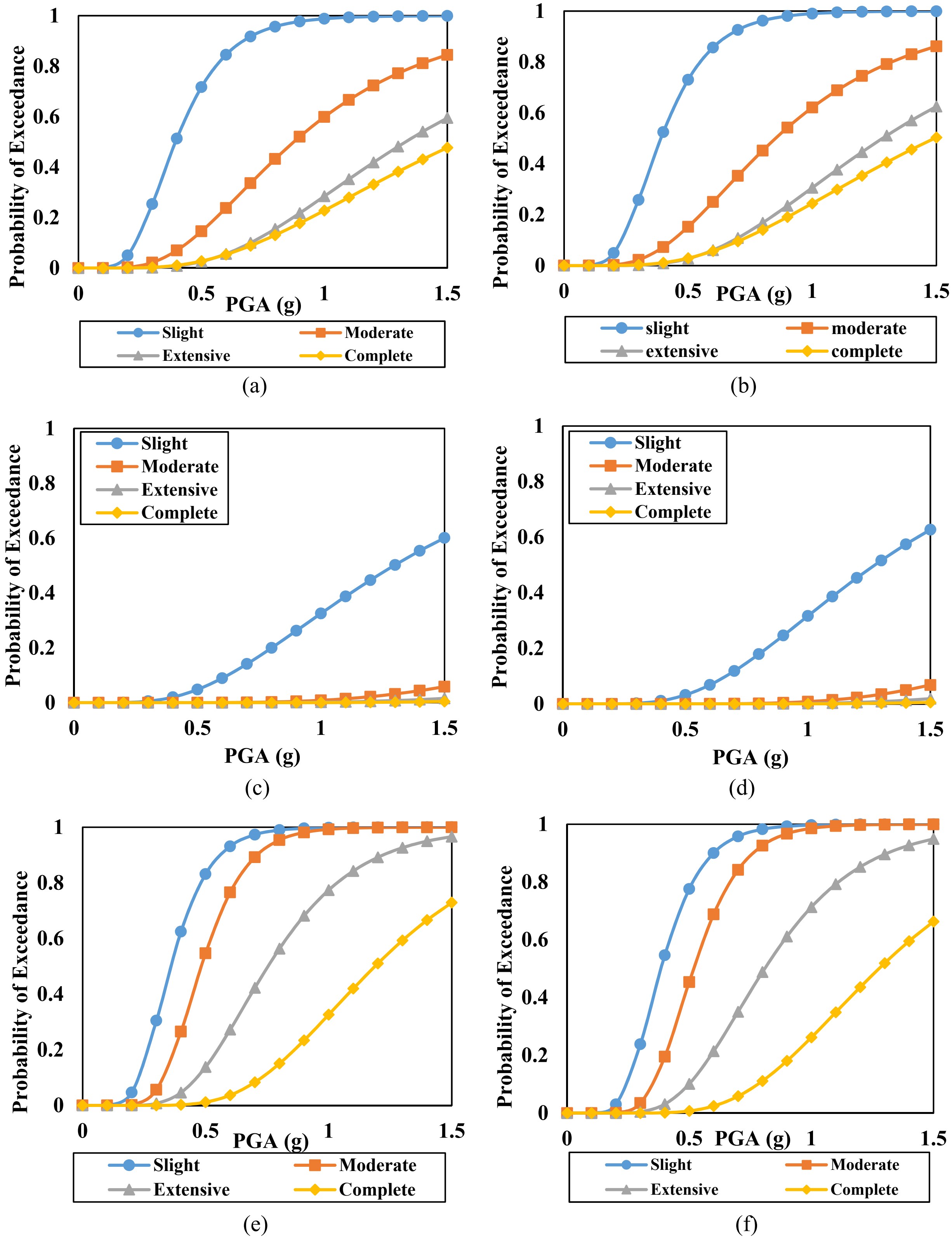

Figure 10—Fragility curves for each bridge component at no scour: : (a) abutment longitudinal; (b) abutment transversal; (c) bearing longitudinal; (d) bearing transversal; (e) column curvature longitudinal; (f) column curvature transversal

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