

Trubolt/Trubolt+ Wedge Anchor Performance Comparison

3/8" Performance Comparison

Anchor Size	Design Information	Symbol	Units	Trubolt/Trubolt+				Hilti KB-TZ				Hilti KB-VTZ		Simpson SB2		Powers SD1		Powers SD2							
	ESR Report			ESR-3772				ESR-1917				ESR-3904		ESR-3037		ESR-2818		ESR-2502							
3/8" Nominal Diameter	Anchor Category	1, 2, 3	-	1				2				1		1		1		1							
	Effective min, embedment	hef	in	1-5/8		2		1-1/2		2		2-3/4		1-1/2		2		2		2					
	Min. member thickness	hmin	in	4	5	4	3-1/4	4	5	5	3-1/4	4	3-1/4	4-1/2	3-3/4		4	4							
	Min. edge distance	Cmin	in	2		1-3/4		8		2-1/2		2-1/2		2-3/4		2-1/4		6		6	2-3/4	2-1/4	2-1/2		
		for s ≥	in	4		4-1/2		8		5		5		9		3-3/4		NA		NA		NA			
	Min. anchor spacing	Smin	in	2-1/2		2		8		2-1/2		3-1/2		3-3/4		3		3-1/2		9		3-3/4		3-1/2	
		for c ≥	in	3		3		8		3-5/8		6		5-1/4		NA		NA		NA		NA			
	Critical Edge	Cac	in	3-1/2	3	4	6	4-3/8	4	4-1/8	6	8	6-1/2	6	6-1/2		6-1/2		6-1/2						
	Steel strength in tension	Nsa	lb	6,720				6,500				6,000		5,600		5,455		6,625							
	Pullout strength uncracked concrete	Np,uncr	lb	NC				2,160		2,515		4,110		2,120		2,490		NC		3,340		2,865		2,775	
	Pullout strength cracked concrete	Np,cr	lb	NC				NC		2,270		3,160		1,190		2,040		1,300		2,755		2,035		2,165	
	Pullout strength, seismic	Np,eq	lb	NC				NC				1,190		2,040		1,300		2,755		2,035		2,165			
	Steel strength in shear	Vsa	lb	3,720				2,180		3,595		1,930		2,730		1,800		2,990		3,115					
	Steel strength in shear, seismic	Vsa,eq	lb	3,000				2,180		2,255		1,930		2,480		1,800		2,440		2,460					
	Tension Steel Strength Reduction	φ	-	0.75				0.75				0.75		0.75		0.75		0.75		0.75					
	Shear Steel Strength Reduction	φ	-	0.65				0.65				0.65		0.65		0.65		0.65		0.65					
Tension Strength Reduction (concrete breakout or pullout) ³	φ	-	0.65				0.55	0.65		0.65		0.65		0.65		0.65		0.65							
Shear Concrete Strength Reduction (breakout or pryout) ³	φ	-	0.70				0.70				0.70		0.70		0.70		0.70		0.70						

1/2" Performance Comparison

Anchor Size	Design Information	Symbol	Units	Trubolt/Trubolt+				Hilti KB-TZ				Hilti KB-VTZ		Simpson SB2		Powers SD1		Powers SD2									
	ESR Report			ESR-3772				ESR-1917				ESR-3904		ESR-3037		ESR-2818		ESR-2502									
1/2" Nominal Diameter	Anchor Category	1, 2, 3	-	1				1				1		1		1		1									
	Effective min, embedment	hef	in	2		3-1/4		2		3-1/4		2		3-1/4		2-1/4		3-3/8		2		3-1/4		2-1/2		3-3/4	
	Min. member thickness	hmin	in	4	6	6	8	4	6	6	8	4	6	4-1/2	5-1/2	4		6		4-1/2	6	5-3/4					
	Min. edge distance	Cmin	in	2-1/2		1-3/4		2-3/4		2-3/8		3-1/4		2-3/4		7	4	4	6	3-1/4	4	2-3/4	4	2-3/4	4	2-3/4	
		for s ≥	in	4		4-1/2		5-3/4		5-3/4		10		6		NA		NA		NA							
	Min. anchor spacing	Smin	in	2-1/2		2		2-3/4		2-3/8		4-1/2		4		7	4	4	4-1/2	10	5	6	6	6	4	6	
		for c ≥	in	4-1/2		2-1/2		4-1/8		3-1/2		6		5		NA		NA		NA							
	Critical Edge	Cac	in	4	3	6-3/4	5-3/4	5-1/2	4-1/2	7-1/2	6	8	5	7	4	4	8	8	8	8	8	10					
	Steel strength in tension	Nsa	lb	11,000				10,705				10,770		12,100		9,080		10,445									
	Pullout strength uncracked concrete	Np,uncr	lb	NC				NC		5,515		3,050		5,460		3,615		5,255		3,220		5,530		NC		6,615	
	Pullout strength cracked concrete	Np,cr	lb	NC				NC		4,915		NC		3,260		NC		3,735		NC		2,505		NC		4,375	
	Pullout strength, seismic	Np,eq	lb	NC				NC				NC		3,260		NC		3,735		NC		2,505		NC		4,375	
	Steel strength in shear	Vsa	lb	6,145				5,495		4,620		7,235		4,620		4,815											
	Steel strength in shear, seismic	Vsa,eq	lb	6,145				5,495		4,620		6,510		3,960		4,815											
	Tension Steel Strength Reduction	φ	-	0.75				0.75				0.75		0.75		0.75		0.75									
	Shear Steel Strength Reduction	φ	-	0.65				0.65				0.65		0.65		0.65		0.65									
Tension Strength Reduction (concrete breakout or pullout) ³	φ	-	0.65				0.65				0.65		0.65		0.65		0.65										
Shear Concrete Strength Reduction (breakout or pryout) ³	φ	-	0.70				0.70				0.70		0.70		0.70		0.70										

¹NC = Anchor pull out Strength does not control anchor design
²NA = Not available. Either not qualified or not available from ESR
³For Condition B; ACI 318
⁴Concrete strength = 2,500 psi

Trubolt+ Market Performance Comparison

5/8" Performance Comparison



Anchor Size	Design Information		Symbol	Units	Trubolt/Trubolt+			Hilti KB-TZ			Hilti KB-VTZ		Simpson SB2		Powers SD1			Powers SD2			
	ESR Report				ESR-3772			ESR-1917			ESR-3904		ESR-3037		ESR-2818			ESR-2502			
5/8" Nominal Diameter	Anchor Category		1, 2, 3	-	1			1			1		1		1			1			
	Effective min. embedment		hef	in	2-3/4	4		3-1/8	4		2-3/4	4		2-3/4	4		3-1/4	4-1/4			
	Min. member thickness		hmin	in	5	6	8	5	6	8	6	7	5-1/2	7-7/8		6	7	5-3/4	6-1/2	8	
	Min. edge distance		Cmin	in	3-1/2	3		3-5/8	3-1/4		5-1/2	4-1/4		6-1/2		6	5-1/2	4-1/4		4-1/4	
			for s ≥	in	6	5-1/4		6-1/8	5-7/8		11	4-1/4		NA		NA			NA		
	Min. anchor spacing		Smin	in	3-1/2	3		3-1/2	3		6-1/2	4-1/4		5		6	11	4-1/4		4-1/4	
			for c ≥	in	5	4-1/4		4-3/4	4-1/4		6-1/2	4-1/4		NA		NA			NA		
	Critical Edge		Cac	in	8	8-3/4	6-3/4	6-1/2	8-3/4	6-3/4	6	9	7-1/2	9		6	10	8	15-3/4	10	
	Steel strength in tension		Nsa	lb	17,640			17,170			16,530		19,070		14,465			13,080			
	Pullout strength uncracked concrete		Np,uncr	lb	NC			NC	9,145		4,830	6,310		NC	9,025		NC			NC	NC
	Pullout strength cracked concrete		Np,cr	lb	NC			NC			NC	4,900		NC	6,895		NC	4,450		NC	NC
	Pullout strength, seismic		Np,eq	lb	NC			NA			NC	4,900		NC	6,895		NC	4,450		NC	NC
	Steel strength in shear		Vsa	lb	9,040			8,090			8,860		11,035		9,030			10,170			
	Steel strength in shear, seismic		Vsa,eq	lb	9,040			7,600			6,040		9,930		6,000			6,770			
	Tension Steel Strength Reduction		φ	-	0.75			0.75			0.75		0.75		0.75			0.75			
	Shear Steel Strength Reduction		φ	-	0.65			0.65			0.65		0.65		0.65			0.65			
Tension Strength Reduction (concrete breakout or pullout) ³		φ	-	0.65			0.65			0.65		0.65		0.65			0.65				
Shear Concrete Strength Reduction (breakout or pryout) ³		φ	-	0.70			0.70			0.70		0.70		0.70			0.70				

3/4" Performance Comparison



Anchor Size	Design Information		Symbol	Units	Trubolt/Trubolt+			Hilti KB-TZ			Hilti KB-VTZ		Simpson SB2		Powers SD1			Powers SD2			
	ESR Report				ESR-3772			ESR-1917			ESR-3904		ESR-3037		ESR-2818			ESR-2502			
3/4" Nominal Diameter	Anchor Category		1, 2, 3	-	1			1			1		1		1			1			
	Effective min. embedment		hef	in	3-3/4	4-3/4		3-1/4	3-3/4	4-3/4	3-1/8	4-3/4		3-3/8	5	3-1/8	4-3/4	3-3/4	5		
	Min. member thickness		hmin	in	6	8		8	5-1/2	6	8	8	6	10	6-3/4	8-3/4	6	10	7	10	
	Min. edge distance		Cmin	in	3-1/2	4		9-1/2	4-3/4		4-1/8	5	6	6-1/2		5	6	5	4-1/2		
			for s ≥	in	10	8-3/4		5	10-1/2		8-7/8	6	6-1/2		8			NA		NA	
	Min. anchor spacing		Smin	in	3-3/4	3-3/4		5	5		4	5	6	7		6	6-1/2		6		
			for c ≥	in	8	7-1/2		9-1/2	9-1/2		7-3/4	6	6-1/2		8		NA			NA	
	Critical Edge		Cac	in	10	8	9	12	10	8	9	11	16		9	8	11	16		12	
	Steel strength in tension		Nsa	lb	26,250			25,120			22,550		29,700		19,000			21,230			
	Pullout strength uncracked concrete		Np,uncr	lb	NC			NC	8280	10,680		NC	10,570		7,115	8,870		NC			NC
	Pullout strength cracked concrete		Np,cr	lb	NC			NC			NC		NC	8,500		NC			NC	7,795	
	Pullout strength, seismic		Np,eq	lb	NC			NC			NC		NC	8,500		NC			NC	7,795	
	Steel strength in shear		Vsa	lb	15,990			13,675			10,330	10,620		14,480		10,640	11,655		12,610		
	Steel strength in shear, seismic		Vsa,eq	lb	14,730			11,745			9,010	10,310		11,775		8,580	9,635		8,060		
	Tension Steel Strength Reduction		φ	-	0.75			0.75			0.75		0.75		0.75			0.75			
	Shear Steel Strength Reduction		φ	-	0.65			0.65			0.65		0.65		0.65			0.65			
Tension Strength Reduction (concrete breakout or pullout) ³		φ	-	0.65			0.65			0.65		0.65		0.65			0.65				
Shear Concrete Strength Reduction (breakout or pryout) ³		φ	-	0.70			0.70			0.70		0.70		0.70			0.70				

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²NA = Not available. Either not qualified or not available from ESR
³For Condition B; ACI 318
⁴Concrete strength = 2,500 psi