

# Trubolt/Trubolt+ Wedge Anchor Performance Comparison

## 3/8" Performance Comparison

Anchor Size	Design Information	Symbol	Units	RED HEAD®				HILTI				SIMPSON Strong-Tie		DEWALT							
				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		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			
		for s ≥	in	4		4-1/2		8		5		5		9		3-3/4		NA			
	Min. anchor spacing	Smin	in	2-1/2		2		8		2-1/2		3-1/2		3-3/4		3		3-1/2			
		for c ≥	in	3		3		8		3-5/8		6		5-1/4		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	6-1/2				
	Steel strength in tension	Nsa	lb	6,720				6,500				6,000				5,600					
	Pullout strength uncracked concrete	Np,uncr	lb	NC				2,160		2,515		4,110		2,120		2,490		NC		3,340	
	Pullout strength cracked concrete	Np,cr	lb	NC				NC		2,270		3,160		1,190		2,040		1,300		2,755	
	Pullout strength, seismic	Np,eq	lb	NC				NC				1,190		2,040		1,300		2,755		2,035	
	Steel strength in shear	Vsa	lb	3,720				2,180		3,595				1,930		2,730		1,800			
	Steel strength in shear, seismic	Vsa,eq	lb	3,000				2,180		2,255				1,930		2,480		1,800			
	Tension Steel Strength Reduction	φ	-	0.75				0.75				0.75				0.75					
	Shear Steel Strength Reduction	φ	-	0.65				0.65				0.65				0.65					
Tension Strength Reduction (concrete breakout or pullout) <sup>3</sup>	φ	-	0.65				0.55		0.65		0.65				0.65						
Shear Concrete Strength Reduction (breakout or pryout) <sup>3</sup>	φ	-	0.70				0.70				0.70				0.70						

## 1/2" Performance Comparison

Anchor Size	Design Information	Symbol	Units	RED HEAD®				HILTI				SIMPSON Strong-Tie		DEWALT															
				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															
	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	4-1/2	6	5-3/4	4	2-3/4	4	2-3/4			
	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	
		for s ≥	in	4		4-1/2		5-3/4		5-3/4		10		6		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	
		for c ≥	in	4-1/2		2-1/2		4-1/8		3-1/2		6		5		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	4	8	8	8	8	8	8	8	10	10			
	Steel strength in tension	Nsa	lb	11,000				10,705				10,770				12,100				9,080									
	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			
	Steel strength in shear	Vsa	lb	6,145				5,495				4,620				7,235				4,620									
	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									
	Shear Steel Strength Reduction	φ	-	0.65				0.65				0.65				0.65				0.65									
Tension Strength Reduction (concrete breakout or pullout) <sup>3</sup>	φ	-	0.65				0.65				0.65				0.65				0.65										
Shear Concrete Strength Reduction (breakout or pryout) <sup>3</sup>	φ	-	0.70				0.70				0.70				0.70				0.70										

<sup>1</sup>NC = Anchor pull out Strength does not control anchor design

<sup>2</sup>NA = Not available. Either not qualified or not available from ESR

<sup>3</sup>For Condition B; ACI 318

<sup>4</sup>Concrete strength = 2,500 psi

# Trubolt+ Market Performance Comparison

## 5/8" Performance Comparison

Anchor Size	Design Information		Symbol	Units	RED HEAD <sup>®</sup> Trubolt/Trubolt+			HILTI Hilti KB-TZ			SIMPSON Strong-Tie Hilti KB-VTZ		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					
	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			
			for s ≥	in	6	5-1/4		6-1/8	5-7/8		11	4-1/4		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			
			for c ≥	in	5	4-1/4		4-3/4	4-1/4		6-1/2	4-1/4		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				
	Pullout strength cracked concrete		Np,cr	lb	NC			NC			4,900	NC	4,900	NC	6,895		NC	4,450		NC	NC
	Pullout strength, seismic		Np,eq	lb	NC			NA			4,900	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) <sup>3</sup>		φ	-	0.65			0.65			0.65		0.65		0.65			0.65				
Shear Concrete Strength Reduction (breakout or pryout) <sup>3</sup>		φ	-	0.70			0.70			0.70		0.70		0.70			0.70				

## 3/4" Performance Comparison

Anchor Size	Design Information		Symbol	Units	RED HEAD <sup>®</sup> Trubolt/Trubolt+			HILTI Hilti KB-TZ			SIMPSON Strong-Tie Hilti KB-VTZ		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				
	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			
	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			
	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) <sup>3</sup>		φ	-	0.65			0.65			0.65		0.65		0.65			0.65			
Shear Concrete Strength Reduction (breakout or pryout) <sup>3</sup>		φ	-	0.70			0.70			0.70		0.70		0.70			0.70			

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