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Expert's Report

Use of impact wrenches for inserting Würth screws

1 General

As a prerequisite for CE marking, screws are tested according to the specifications of EN 14592 or EAD 130118-01-0603. Neither of these documents deals with the possible influence of different screw-in methods on the strength properties of the screws. In contrast to conventional screwdrivers, the use of so-called impact wrenches causes stress peaks that potentially damage the steel structure of the screws and consequently their strength. On the other hand, impact wrenches generate much lower reaction forces and the torque required to drive in larger screws can therefore be applied more easily and without special supports. Comparative tests were carried out with different screw types and diameters to identify a possible influence of screw-in methods. Withdrawal tests as well as tensile tests and tests to determine the torsional strength of screws were performed after the screws were driven into structural softwood or softwood LVL.

For the tensile and torsional tests three different scenarios were considered in the tests:

- Unused screws as generally used for tests according to EN 14592 or EAD 130118-01-0603.
- Screws after driving them in into timber members and unscrewing and removing them. Here, two different insertion cases were distinguished: soft for the head against a timber member and hard for the head against a steel member.

Adolf Würth GmbH & Co. KG commissioned me to assess the suitability of tangential impact wrenches for inserting the following or shorter Würth screws as part of an expert's opinion:

- Partially threaded screws ASSY®4 CSMP 5x120, 6x200, 8x300 and 10x400 according to ETA-11/0190

- Fully threaded ASSY®PLUS VG 4 CSMP screws 6x200, 8x300 and ASSY® plus VG 4, CS 10x400, and 12x400 according to ETA-11/0190

This expert's report is mainly based on the following documents:

- Research Report „Tragfähigkeit von Verbindungen mit selbstbohrenden Holzschrauben mit Vollgewinde" by Blaß, Hans Joachim; Bejtka, Ireneusz; Uibel, Thomas (Karlsruher Berichte zum Ingenieurholzbau Band 4) ISBN: 3-86644-034-0
- Test Report 246111: Tests of Würth screws according to EAD 130118-01-0603 – Tests with impact wrench, Versuchsanstalt für Stahl, Holz und Steine, Karlsruher Institut für Technologie, 17.05.2024
- Bachelor's Thesis "Effects of using tangential impact screwdrivers on the material and load-bearing properties of wood construction screws" by Jonas Valentin Storrer, Fakultät für Holztechnik und Bau, Studiengang Holztechnik, Technische Hochschule Rosenheim, 22.08.2023
- Eurocode 5 (EN 1995-1-1): Design of timber structures - Part 1-1: General - Common rules and rules for buildings
- EAD 130118-01-0603 "Screws and threaded rods for use in timber constructions"
- EN 14592:2008+A1:2012 "Timber structures – Dowel-type fasteners – Requirements

2 Intended use

Würth screws are self-tapping screws to be used in timber constructions according to EN 1995-1-1:2008-09 (Eurocode 5) or an appropriate national code.

The screws are intended for use in connections subject to static or quasi static loading.

3 Test results

The essential test results from the test report 246111 and the bachelor's thesis by Jonas Valentin Storrer are compiled in the following.

3.1 Characteristic withdrawal parameter

The characteristic withdrawal parameter was determined according to EAD 130118-01-0603, 2.2.4 Method 1. The withdrawal parameter shall be determined by testing according to the test method given in EN 1382. At least 20 tests for every influencing parameter such as the outer thread diameter, drill tip, secondary rough thread and the angle between screw-axis and grain are required. Here, also the insertion method, electric screwdriver or impact wrench is considered as an influencing parameter. Additionally, it was distinguished between a hard and soft insertion. Hard insertion means fastening a steel plate to a timber member while soft insertion suggests a timber member under the screw head.

The number of specimens was 20 to 25 per diameter, insertion method, and screw type. The tests were performed at an angle of 90° between screw axis and grain direction. The penetration length including the drill tip was between 10 d and 20 d. The withdrawal parameter of each test was corrected with a factor $k_\rho = (\rho_k/\rho)^{0,8}$

according to EAD 130118-01-0603, 2.2.4 Method 1. The characteristic density was chosen as 350 kg/m³ for softwood timber and as 500 kg/m³ for softwood LVL.

From the corrected withdrawal parameters, the characteristic value of the withdrawal parameter was calculated according to EN 14358 (Table 2) for each diameter. This characteristic withdrawal parameter corresponds to the chosen characteristic density of the timber.

Table 1: Characteristic withdrawal parameter of Würth ASSY screws

Test Report	246111		246111		246111	
Screw type	ASSY 4 CSMP TG		ASSY plus VG 4 CSMP		ASSY 4 CSMP TG	
Diameter dxℓ/ℓ_g [mm]	5x120/62		6x200		10x400/120	
Insertion	Impact	Turn	Impact	Turn	Impact	Turn
	Soft	Soft	Soft	Soft	Soft	Soft
Material	LVL	LVL	LVL	LVL	LVL	LVL
Mean density [kg/m³]	560	563	567	572	566	572
Minimum [N/mm²]	20,0	20,1	17,4	16,3	15,9	15,5
Mean value [N/mm²]	21,5	22,6	19,6	19,7	17,1	16,8
Maximum [N/mm²]	25,1	24,3	22,2	21,9	18,8	18,6
$f_{ax,k}$ [N/mm²]	19,3	20,0	17,4	16,8	15,5	15,2
$f_{ax,k,impact}/f_{ax,k,turn}$	0,97		1,03		1,02	

Table 2: Characteristic withdrawal parameter of Würth ASSY screws

Test Report	246111		Bachelor's Thesis Storrer			
Screw type	ASSY plus VG 4 CSMP		ASSY 4 CSMP TG		ASSY plus VG 4 CSMP	
Diameter dxℓ/ℓ_g [mm]	10x400		6x200/70		8x200	
Insertion	Impact	Turn	Impact	Turn	Impact	Turn
	Soft	Soft	Soft	Soft	Soft	Soft
Material	LVL	LVL	Softwood timber		Softwood timber	
Mean density [kg/m³]	565	567	405	405	419	419
Minimum [N/mm²]	15,1	14,7	15,7	14,8	13,6	12,7
Mean value [N/mm²]	16,1	16,3	17,2	17,1	15,5	14,1
Maximum [N/mm²]	17,2	19,4	26,0	28,5	17,0	15,7
$f_{ax,k}$ [N/mm²]	14,7	14,2	14,0	13,0	13,8	12,8
$f_{ax,k,impact}/f_{ax,k,turn}$	1,03		1,08		1,08	

Table 3: Characteristic withdrawal parameter of Würth ASSY screws

Test Report	Bachelor's Thesis Storrer					
Screw type	ASSY plus VG 4 CSMP		ASSY plus VG 4 CSMP		ASSY plus VG 4 CSMP	
Diameter dxℓ [mm]	8x200		12x200		12x200	
Insertion	Impact	Turn	Impact	Turn	Impact	Turn
	Hard	Hard	Soft	Soft	Hard	Hard
Material	Softwood timber		Softwood timber		Softwood timber	
Mean density [kg/m³]	430	430	468	468	385	385
Minimum [N/mm²]	14,0	14,1	11,6	12,0	12,4	12,5
Mean value [N/mm²]	14,9	15,1	13,0	13,2	15,8	14,3
Maximum [N/mm²]	16,2	16,8	14,6	17,1	23,0	18,9
$f_{ax,k}$ [N/mm²]	13,6	13,7	11,6	11,3	10,9	11,4
$f_{ax,k,impact}/f_{ax,k,turn}$	1,00		1,02		0,96	

3.2 Characteristic tensile strength

Specifications for the calculation of the characteristic tensile strength are given in EAD 130118-01-0603, 2.2.6. The characteristic tensile strength of the self-tapping screws was determined by tests according to EN 14592, 6.3.4.5. The number of specimens was between 10 and 25 for every diameter, insertion method, and screw type. The characteristic value of the tensile strength calculated according to EN 14358 is given in Table 4 to Table 7.

Table 4: Characteristic tensile strength of Würth ASSY screws

Test Report	246111		24611		246111		24611	
Screw type	ASSY 4 CSMP TG							
Diameter dxℓ/ℓ_g[mm]	5x120/62		6x200/70		8x300/100		10x400/120	
Insertion	Impact	None	Impact	None	Impact	None	Impact	None
Minimum [kN]	9,90	10,0	14,3	14,1	24,8	24,9	37,9	38,1
Mean value [kN]	10,0	10,1	14,8	14,5	25,3	25,4	38,5	38,2
Maximum [kN]	10,1	10,2	15,1	15,1	26,2	25,9	39,1	38,6
$f_{tens,k}$ [kN]	9,02	9,09	13,3	13,1	22,9	22,9	34,7	34,5
$f_{tens,k,impact}/f_{tens,k,none}$	0,99		1,02		1,00		1,01	

Table 5: Characteristic tensile strength of Würth ASSY screws

Test Report	246111		24611		246111	
Screw type	ASSY plus VG 4 CSMP					
Diameter dxℓ [mm]	6x200		8x300		10x400	
Insertion	Impact	None	Impact	None	Impact	None
Minimum [kN]	14,0	14,1	25,4	25,0	35,5	36,4
Mean value [kN]	14,1	14,2	25,7	25,6	36,7	37,2
Maximum [kN]	14,2	14,2	26,1	26,4	37,8	38,2
$f_{tens,k}$ [kN]	12,7	12,8	23,2	23,1	33,1	33,6
$f_{tens,k,impact}/f_{tens,k,none}$		1,00		1,00		0,99

Table 6: Characteristic tensile strength of Würth ASSY screws

Test Report	Bachelor's Thesis Storrer								
Screw type	ASSY plus VG 4 CSMP								
Diameter dxℓ [mm]	6x200			8x200			10x200		
Insertion	None	Turn	Impact	None	Turn	Impact	None	Turn	Impact
Minimum [kN]	14,5	14,5	14,4	24,0	23,9	24,1	40,3	40,9	41,0
Mean value [kN]	14,5	14,5	14,5	24,6	24,3	24,3	41,6	41,3	41,4
Maximum [kN]	14,6	14,6	14,6	25,6	24,8	24,6	42,2	41,9	41,9
$f_{tens,k}$ [kN]	13,2	13,2	13,2	22,4	22,1	22,2	37,8	37,6	37,6
$f_{tens,k,insert}/f_{tens,k,none}$		1,00	1,00		0,99	0,99		0,99	0,99

Table 7: Characteristic tensile strength of Würth ASSY screws

Test Report	Bachelor's Thesis Storrer								
Screw type	ASSY plus VG 4 CSMP			ASSY 4 CSMP TG					
Diameter dxℓ [mm]	12x200			6x200			10x200		
Insertion	None	Turn	Impact	None	Turn	Impact	None	Turn	Impact
Minimum [kN]	52,6	52,7	52,7	13,4	13,3	13,4	36,7	36,8	36,6
Mean value [kN]	52,8	53,0	52,9	13,7	13,5	13,6	37,0	36,9	36,9
Maximum [kN]	53,3	53,1	53,3	14,3	13,6	13,7	37,4	37,1	37,0
$f_{tens,k}$ [kN]	48,1	48,2	48,2	12,4	12,3	12,4	33,7	33,6	33,6
$f_{tens,k,insert}/f_{tens,k,none}$		1,00	1,00		0,99	0,99		1,00	1,00

3.3 Characteristic torsional strength

Specifications for the calculation of the characteristic torsional strength are given in EAD 130118-01-0603, 2.2.8. The characteristic torsional strength of the self-tapping screws was determined by tests according to EN ISO 10666, 4.2.3. The number of specimens was 10 to 25 for every diameter, insertion method, and screw type. The characteristic value of the torsional strength calculated according to EN 14358 is given in Table 8.

Table 8: Characteristic torsional strength of Würth ASSY screws

Test Report	Bachelor's Thesis Storrer							
Screw type	ASSY plus VG 4 CSMP					ASSY 4 CSMP TG		
Diameter dxℓ[mm]	6x200							
Insertion	None	Turn soft	Impact soft	Turn hard	Impact hard	None	Turn soft	Impact soft
Minimum [Nm]	11,5	11,4	11,4	11,3	11,5	12,1	12,1	12,0
Mean value [Nm]	11,6	11,5	11,6	11,6	11,7	12,3	12,2	12,3
Maximum [Nm]	11,8	11,7	11,7	11,8	11,9	12,7	12,3	12,8
$f_{tor,k}$ [Nm]	10,5	10,4	10,4	10,5	10,5	11,1	11,0	11,0
$f_{tor,k,insert}/f_{tor,k,none}$		0,99	0,99	1,00	1,00		0,99	1,00

Table 9: Characteristic torsional strength of Würth ASSY screws

Test Report	Bachelor's Thesis Storrer				
Screw type	ASSY plus VG 4 CSMP				
Diameter dxℓ[mm]	8x200				
Insertion	None	Turn soft	Impact soft	Turn hard	Impact hard
Minimum [Nm]	26,8	27,3	27,0	27,2	24,3
Mean value [Nm]	27,6	28,3	28,4	28,3	27,5
Maximum [Nm]	29,5	29,4	29,4	29,3	30,1
$f_{tor,k}$ [Nm]	24,8	25,5	25,6	25,4	24,7
$f_{tor,k,insert}/f_{tor,k,none}$		1,03	1,03	1,02	1,00

Table 10: Characteristic torsional strength of Würth ASSY screws

Test Report	Bachelor's Thesis Storrer							
Screw type	ASSY plus VG 4 CSMP					ASSY 4 CSMP TG		
Diameter dxℓ[mm]	10x200							
Insertion	None	Turn soft	Impact soft	Turn hard	Impact hard	None	Turn soft	Impact soft
Minimum [Nm]	55,6	55,7	56,2	55,3	56,1	53,8	53,4	53,3
Mean value [Nm]	57,2	57,2	56,6	56,6	57,1	54,1	54,1	53,9
Maximum [Nm]	58,7	57,9	57,0	57,2	58,1	54,7	54,8	54,4
$f_{tor,k}$ [Nm]	51,5	51,5	50,9	50,9	51,4	48,7	48,7	48,6
$f_{tor,k,insert}/f_{tor,k,none}$		1,00	0,99	0,99	1,00		1,00	1,00

Table 11: Characteristic torsional strength of Würth ASSY screws

Test Report	Bachelor's Thesis Storrer				
Screw type	ASSY plus VG 4 CSMP				
Diameter dxℓ[mm]	12x200				
Insertion	None	Turn soft	Impact soft	Turn hard	Impact hard
Minimum [Nm]	85,9	86,5	86,1	86,0	86,4
Mean value [Nm]	87,0	87,0	86,8	86,9	87,0
Maximum [Nm]	87,6	87,9	87,3	87,6	87,8
$f_{tor,k}$ [Nm]	78,3	78,4	78,1	78,3	78,3
$f_{tor,k,insert}/f_{tor,k,none}$		1,00	1,00	1,00	1,00

4 Influence of the insertion method

4.1 Axial withdrawal capacity

The characteristic withdrawal parameter was determined according to EAD 130118-01-0603 2.2.4 Method 1 for each of the 18 test series considered. The test results for the six test series with 10 mm screws from the bachelor's thesis Storrer led to non-plausible results and the detailed properties of the test specimens related to the single tests cannot be tracked anymore. They are hence disregarded. For the remaining 18 test series Table 12 shows the comparison between the characteristic withdrawal parameter from the tests based on a characteristic density ρ_k = 350 kg/m³ and the characteristic withdrawal parameter in ETA-11/0190. The shaded lines refer to insertion by impact wrench.

All characteristic values from the test series, where the screws were inserted by impact wrench are equal or larger than the correspondent values in ETA-11/0190. Insertion by impact wrench consequently leads to sufficient load-carrying capacities in withdrawal of Würth ASSY screws at least for the tested screws with diameters between 5 mm and 12 mm and lengths – depending on the diameter – up to 400 mm.

If the test series with insertion method impact wrench and screwdriver are directly compared, the ratio of the characteristic withdrawal parameter for screws inserted by impact wrench to screwdriver is between 0,96 and 1,08 with an average of 1,02. Practically, there is hence no difference in characteristic withdrawal parameter between screws driven into timber or LVL by impact wrench or screwdriver. Driving with an impact wrench on average leads to slightly higher load-carrying capacities, however, the difference is most probably not systematic.

Table 12: Comparison between the $f_{ax,k}$ [MPa] from the tests based on ρ_k = 350 kg/m³ and $f_{ax,k}$ [MPa] in ETA-11/0190 – shaded lines refer to insertion by impact wrench

Screw type	Screw dimension	Material	$f_{ax,k}$ from tests	$f_{ax,k}$ from ETA-11/0190
ASSY 4 CSMP	5x120/62	LVL	14,5	12,0
ASSY 4 CSMP	5x120/62	LVL	15,0	12,0
ASSY plus VG 4 CSMP	6x200	LVL	13,1	11,5
ASSY plus VG 4 CSMP	6x200	LVL	12,6	11,5
ASSY 4 CSMP	10x400/120	LVL	11,6	11,0
ASSY 4 CSMP	10x400/120	LVL	11,5	11,0
ASSY plus VG 4 CS	10x400	LVL	11,0	11,0
ASSY plus VG 4 CS	10x400	LVL	10,7	11,0
ASSY 4 CSMP	6x200/70	Timber	13,0	11,5
ASSY 4 CSMP	6x200/70	Timber	14,0	11,5
ASSY plus VG 4 CS	8x200	Timber	12,8	11,0
ASSY plus VG 4 CS	8x200	Timber	13,8	11,0
ASSY plus VG 4 CS	8x200	Timber	13,7	11,0
ASSY plus VG 4 CS	8x200	Timber	13,6	11,0
ASSY plus VG 4 CS	12x200	Timber	11,3	10,0
ASSY plus VG 4 CS	12x200	Timber	11,6	10,0
ASSY plus VG 4 CS	12x200	Timber	11,4	10,0
ASSY plus VG 4 CS	12x200	Timber	10,9	10,0

4.2 Tensile capacity

The characteristic tensile strength was determined according to EAD 130118-01-0603 2.2.6 for each of the 32 test series considered. Table 13 shows the comparison between the characteristic tensile strength from the tests and the characteristic tensile strength in ETA-11/0190. The shaded lines refer to insertion by impact wrench.

If the test series with insertion method impact wrench are directly compared to new screws not inserted before, the ratio of the characteristic tensile strength for screws inserted by impact wrench to new screws is between 0,99 and 1,02 with an average of 1,00. Practically, there is hence no difference in characteristic tensile strength between screws driven into timber by impact wrench and new screws. The same applies to screws driven with a screwdriver.

Table 13: Comparison between the $f_{tens,k}$ [kN] from the tests and $f_{tens,k}$ [kN] in ETA-11/0190 – shaded lines refer to insertion by impact wrench

Screw type	Screw dimension	Insertion	$f_{tens,k}$ from tests	$f_{tens,k}$ from ETA-11/0190
ASSY 4 CSMP	5x120/62	Impact	9,02	7,9
ASSY 4 CSMP	5x120/62	None	9,09	7,9
ASSY 4 CSMP	6x200/70	Impact	13,3	12,5
ASSY 4 CSMP	6x200/70	None	13,1	12,5
ASSY 4 CSMP	8x300/100	Impact	22,9	21,5
ASSY 4 CSMP	8x300/100	None	22,9	21,5
ASSY 4 CSMP	10x400/120	Impact	34,7	26,0
ASSY 4 CSMP	10x400/120	None	34,5	26,0
ASSY plus VG 4 CSMP	6x200	Impact	12,7	12,5
ASSY plus VG 4 CSMP	6x200	None	12,8	12,5
ASSY plus VG 4 CSMP	8x300	Impact	23,2	22,0
ASSY plus VG 4 CSMP	8x300	None	23,1	22,0
ASSY plus VG 4 CSMP	10x400	Impact	33,1	33,0
ASSY plus VG 4 CSMP	10x400	None	33,6	33,0
ASSY plus VG 4 CSMP	6x200	None	13,2	12,5
ASSY plus VG 4 CSMP	6x200	Turn	13,2	12,5
ASSY plus VG 4 CSMP	6x200	Impact	13,2	12,5
ASSY plus VG 4 CSMP	8x200	None	22,4	22,0
ASSY plus VG 4 CSMP	8x200	Turn	22,1	22,0
ASSY plus VG 4 CSMP	8x200	Impact	22,2	22,0
ASSY plus VG 4 CS	10x200	None	37,8	36,0
ASSY plus VG 4 CS	10x200	Turn	37,6	36,0
ASSY plus VG 4 CS	10x200	Impact	37,6	36,0
ASSY plus VG 4 CS	12x200	None	48,1	45,0
ASSY plus VG 4 CS	12x200	Turn	48,2	45,0
ASSY plus VG 4 CS	12x200	Impact	48,2	45,0
ASSY 4 CSMP	6x200	None	12,4	12,5
ASSY 4 CSMP	6x200	Turn	12,3	12,5
ASSY 4 CSMP	6x200	Impact	12,4	12,5
ASSY 4 CSMP	10x200	None	33,7	26,0
ASSY 4 CSMP	10x200	Turn	33,6	26,0
ASSY 4 CSMP	10x200	Impact	33,6	26,0

4.3 Torsional capacity

The characteristic torsional strength was determined according to EAD 130118-01-0603 2.2.8 for each of the 26 test series considered. Table 14 shows the comparison between the characteristic torsional strength from the tests and the characteristic torsional strength in ETA-11/0190. The shaded lines refer to insertion by impact wrench.

Table 14: Comparison between the $f_{tor,k}$ [Nm] from the tests and $f_{tor,k}$ [Nm] in ETA-11/0190 – shaded lines refer to insertion by impact wrench

Screw type	Screw dimension	Insertion	$f_{tor,k}$ from tests	$f_{tor,k}$ from ETA-11/0190
ASSY plus VG 4 CSMP	6x200	None	10,5	11,5
ASSY plus VG 4 CSMP	6x200	Turn	10,4	11,5
ASSY plus VG 4 CSMP	6x200	Impact	10,4	11,5
ASSY plus VG 4 CSMP	6x200	Turn	10,5	11,5
ASSY plus VG 4 CSMP	6x200	Impact	10,5	11,5
ASSY 4 CSMP	6x200	None	11,1	10,0
ASSY 4 CSMP	6x200	Turn	11,0	10,0
ASSY 4 CSMP	6x200	Impact	11,0	10,0
ASSY plus VG 4 CSMP	8x200	None	24,8	25,0
ASSY plus VG 4 CSMP	8x200	Turn	25,5	25,0
ASSY plus VG 4 CSMP	8x200	Impact	25,6	25,0
ASSY plus VG 4 CSMP	8x200	Turn	25,4	25,0
ASSY plus VG 4 CSMP	8x200	Impact	24,7	25,0
ASSY plus VG 4 CSMP	10x200	None	51,5	45,0
ASSY plus VG 4 CSMP	10x200	Turn	51,5	45,0
ASSY plus VG 4 CSMP	10x200	Impact	50,9	45,0
ASSY plus VG 4 CSMP	10x200	Turn	50,9	45,0
ASSY plus VG 4 CSMP	10x200	Impact	51,4	45,0
ASSY 4 CSMP	10x200	None	48,7	45,0
ASSY 4 CSMP	10x200	Turn	48,7	45,0
ASSY 4 CSMP	10x200	Impact	48,6	45,0
ASSY plus VG 4 CSMP	12x200	None	78,3	75,0
ASSY plus VG 4 CSMP	12x200	Turn	78,4	75,0
ASSY plus VG 4 CSMP	12x200	Impact	78,1	75,0
ASSY plus VG 4 CSMP	12x200	Turn	78,3	75,0
ASSY plus VG 4 CSMP	12x200	Impact	78,3	75,0

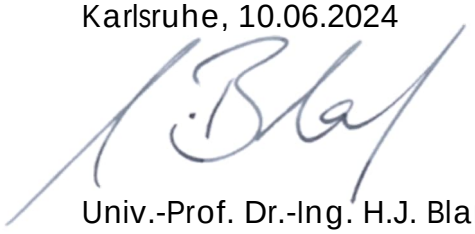
If the test series with insertion method impact wrench are directly compared to new screws not inserted before, the ratio of the characteristic torsional strength for screws inserted by impact wrench to new screws is between 0,99 and 1,03 with an average of 1,00. Practically, there is hence no difference in characteristic torsional strength between screws driven into timber by impact wrench and new screws. The same applies to screws driven with a screwdriver.

5 Summary

ASSY®4 CSMP partially threaded screws and ASSY®PLUS VG 4 fully threaded screws from Adolf Würth GmbH & Co. KG in Künzelsau were screwed into non-pre-drilled test specimens made of solid timber or LVL using an electrically driven screwdriver or an impact wrench, unscrewed again and then the tensile and torsional strength of all screws was determined. For comparison, the tensile and torsional strength of new screws was also established. Additionally, comparative withdrawal tests were carried out from solid timber and LVL. The test results are documented in Test Report No. 246111 of the Versuchsanstalt für Stahl, Holz und Steine, Karlsruhe Institute of Technology and in the bachelor's thesis by Jonas Valentin Storrer, Technische Hochschule Rosenheim.

The aim was to demonstrate a possible influence of the two different screw-in methods on the strength and pull-out resistance of ASSY screws from Adolf Würth GmbH & Co. KG. It can be seen from the test results that the driving method – continuous or impact – has no significant effect on the strength of the screw itself or on the withdrawal resistance for ASSY®4 CSMP partially threaded screws and ASSY®PLUS VG 4 fully threaded screws with diameters between 5 mm and 12 mm and lengths of up to 120 mm (d = 5 mm), 200 mm (d = 6 mm), 300 mm (d = 8 mm), and 400 mm (d = 10 mm or 12 mm). For the screws mentioned, there are hence no objections to using an impact wrench as an alternative to an electric screwdriver for inserting screws into solid wood, glulam, cross laminated timber or laminated veneer lumber made of softwood.

Karlsruhe, 10.06.2024



Univ.-Prof. Dr.-Ing. H.J. Blaß