RSTEEL®



RPP-E-A1
Base Bolt

Technical manual

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1. DESCRIPTION OF THE SYSTEM

RPP-E-A1 bolts are designed to replace RPP-E bolts in applications where they need to be bent. All sizes consist of two rebars welded to the threaded part, which makes bending easier. RPP-E-A1 base bolts transfer tension, compression and shear forces to reinforced concrete base structures. Tension and compression forces are transferred by anchorage of the ribbed rebars.

Shear forces are transferred to the concrete by bearing onto the shank of the bolt.

2. MATERIALS AND DIMENSIONS

Table 1. Materials and standards of RPP-E-A1 base bolts

Part	Material	Standard
Rebars	B500B	EN 10080 (SFS 1300)
High strength steel bars	$f_{yk} \geq 640$MPa; $f_{uk} \geq 800$MPa; $f_{uk} / f_{yk} \geq 1.08$; $\varepsilon_{uk} \geq 5\%$	-
Washers	S355J2	EN 10025
Nuts	Property class 10	EN 20898-2

Base bolts have no surface treatment. Upon request, they can be supplied fully galvanized.

Table 2. RPP-E-A1 base bolt dimensions

Base bolt	Thread			Rebar	Washer	RPP-E-A1		Color
	Size	L_{thread}	Net tensile area	n × D	D_a / t	L	weight	
		[mm]	[mm^2]	[mm]	[mm]	[mm]	[kg]	
M30	30	190	561	2×Ø25	65 / 8	1030	8.7	
M36	36	190	817	2×Ø28	80 / 8	1255	13.8	
M39	39	200	976	2×Ø28	90 / 10	1465	16.8	
M45	45	220	1306	2×Ø32	100 / 10	1685	25.3	
M52	52	250	1758	2×Ø40	100 / 12	1935	42.6	

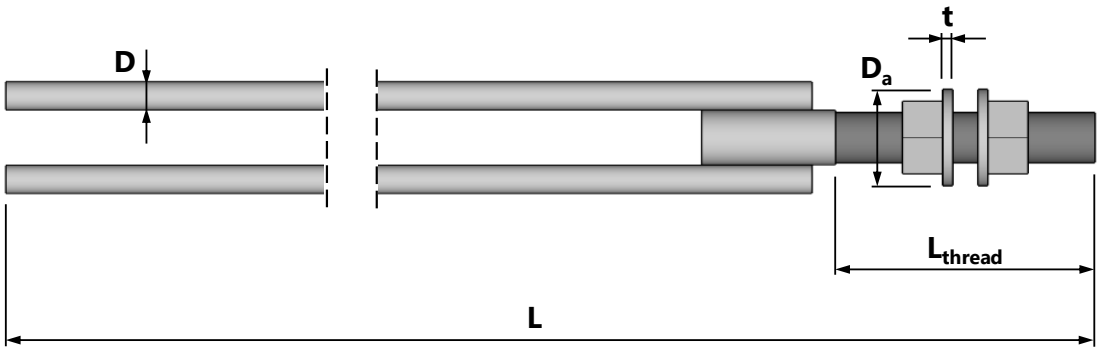


Figure 1. RPP-E-A1 type bolt dimensions

3. MANUFACTURING AND TOLERANCES

3.1. Manufacturing method

Rebars:	Mechanical cutting
High strength steel bars:	Mechanical cutting
	Thread coarse; ISO 68-1; ISO 261; ISO 965-1
	The threads are mechanically machined or rolled
Welding:	MAG welding, manual or robotic
Welding class:	B (EN ISO 5817)
Execution class:	EXC2 (EN 1090-2) [more demanding classes available on request]

The product shall be produced clean and dry. Light surface rusting may be present at delivery of the product. The product is to be stored in dry conditions. The product may be installed with light surface rusting, and in accordance with general requirements for reinforcement bars.

3.2. Manufacturing tolerances

Overall length:	±10 mm
Threaded length:	+5, -0 mm

3.3. Quality control

R-Group Baltic OÜ internal manufacturing and quality control in accordance with EN 1090-2. External quality control provided to R-Group Baltic OÜ by Kiwa Inspecta OÜ.

3.4. Markings

RPP-E-A1 base bolts are marked with at least the RSTEEL® logo, type and identifier, and manufacturing date.

4. RESISTANCES

The tension resistance of the base bolt is calculated in accordance with EN 1992 and EN 1993. The shear resistance of the base bolt is calculated in accordance with EN 1992-4:2018. The thickness of the grout layer, as well as the thickness of the base plate to the column shoe or steel column influences the shear resistance of the base bolt.

The tension/compression and shear resistances are governed by the net tensile area of the threaded section of the base bolt. Nominal design resistances are given below for individual base bolts. The nominal shear resistance of the base bolts has been calculated taking into account typical thickness of the grout layer. The total resistance of a bolt group is to be calculated in accordance with clause 6.2.2 of EN 1993-1-8 and EN 1992-4:2018.

Concrete grade C25/30. Anchorage coefficients, η_1 = 1.0 (good), lap factor α_2 =0.7 (see note), others α_1-α_5 =1.0.

NOTE: RPP-E-A1 are anchor bolts only. The standard lengths of the bolt's rebars are anchoring lengths. The lengths of the bent rebars and the extension lengths of the rebars are available separately when ordering.

Table 3. RPP-E-A1 base bolt resistances

Base bolt	N_{Rd} [kN]	$V_{Rd,u}$ [kN]	$V_{Rd,g}$ [kN]
M30	299.2	36.7	89.0
M36	435.7	55.5	129.7
M39	520.5	64.4	154.9
M45	696.5	92.6	207.3
M52	937.6	129.1	279.0

N_{Rd} - nominal design tension resistance, $V_{Rd,u}$ - nominal design shear resistance before grouting (during installation), and $V_{Rd,g}$ - nominal design shear resistance after grouting (final stage), see below.

4.1. RPP-E-A1 base bolt shear resistance before grouting

Table 4. RPP-E-A1 base bolt shear resistance before grouting

Base bolt	Shear	Net tensile area	Lever arm
	$V_{Rd,u}$ [kN]	A [mm²]	l [mm]
M30	36.7	561	78
M36	55.5	817	91
M39	64.4	976	103
M45	92.6	1306	110
M52	129.1	1758	124

EN 1992-4:2018:

$V_{Rd,u} = V_{Rk,s} / \gamma_{M,s}$

$V_{Rk,s} = \alpha_M \cdot M_{Rk,s} / l$

$M_{Rk,s} = M^{o}_{Rk,s} \cdot (1 - N_{sd} / N_{Rd,s})$

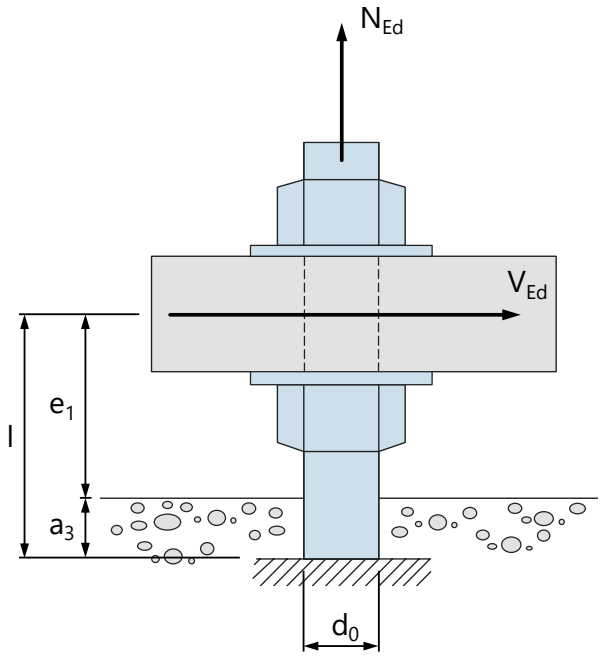
(N_{sd} = 0; shear only)

$M^{o}_{Rk,s} = 1.2 \cdot W_{el} \cdot f_{uk}$

$W_{el} = \pi d^3 / 32$

α_M = 2.0

γ_{Ms} = 1.25



$l = e_1 + a_3$

e_1 = base grout thickness + 0.5 × base plate thickness

$a_3 = 0.5 \cdot d_0$

4.2. RPP-E-A1 base bolt shear resistance after grouting

Table 5. RPP-E-A1 base bolt shear resistance after grouting

Base bolt	Shear	Net tensile area
	$V_{Rd,g}$ [kN]	A_{bolt} [mm^2]
M30	71.2	561
M36	103.7	817
M39	123.9	976
M45	165.8	1306
M52	223.2	1758

EN 1993-1-8; 6.2.2(7):

$V_{Rd} = \min \{F_{1,vb,Rd} ; F_{2,vb,Rd}\}$

$F_{1,vb,Rd} = (\alpha_v \cdot f_{bolt,u} \cdot A_{bolt}) / \gamma_{M2}$

$F_{2,vb,Rd} = (\alpha_b \cdot f_{bolt,u} \cdot A_{bolt}) / \gamma_{M2}$ – critical

$\alpha_b = 0.44 – 0.0003 \cdot f_{bolt,y}$

$f_{bolt,u}$ is the ultimate tensile strength of the bolt

$f_{bolt,y}$ is the yield strength of the bolt ≤ 640 N/mm^2

A_{bolt} is the net tensile area of the bolt

$Y_{M2} = 1.25$

$\alpha_v = 0.5$

4.3. Design criteria

$$V_{Ed} \leq V_{Rd}$$

$$N_{Ed} \leq N_{Rd}$$

$$N^1_{Ed} / 1.4N_{Rd} + V^1_{Ed} / V_{Rd} \leq 1$$

Where N^1_{Ed} and V^1_{Ed} are applied coincident axial force and shear force.

In accordance with EN 1992-4:2018 clause 7.2.3, the following requirements must also be taken into account for the coincident applied normal and shear forces:

- Base bolts without provision of additional reinforcement according to EN 1992-4:2018 clause 7.2.3.1, table 7.3
- Base bolts that are installed with additional reinforcement for normal and shear forces (see section 5.2) according to EN 1992-4:2018 clause 7.2.3.2

The tension and compression resistances of the cast-in-place base bolt are identical. The base bolt and bolt group capacities are to be calculated in accordance with EN 1992-4:2018, taking into account the dimensions of the foundations and the positions the bolts and bolt group.

The forces to be transferred through the base bolts influences the local reinforcement required to be provided to the concrete structures; the base bolt axial and shear forces are transferred to the concrete structures with the help of the local reinforcement. Reinforcement, base bolt edge and spacing distances, as well as their influence on the overall base bolt design resistance, are to be calculated in accordance with EN 1992-1-1 and EN 1992-4:2018.

4.4. Adjustment of the nominal design resistance for lower concrete grades

Base bolt nominal design resistances are to be adjusted according to the required concrete grade as follows:

The tension/compression design resistance is reduced according to the required concrete grade. The adjustment is only applied for lower concrete grades. The nominal tension/compression design resistance is reduced by factor:

$$n_1 = \frac{f_{cd}}{f_{cd}(C25/30)}$$

As an example, if the RPP-E-A1 M36 base bolt was used in C20/25 concrete grade, the reduction factor n_1 would be calculated as follows:

$$n_1 = \frac{20}{25} = 0.8$$

RPP-E-A1 M36 base bolt tension design resistance = 0.8 × 435.7 = 348.6 kN

The nominal design shear resistance is not adjusted for other grades of concrete.

5. USER INSTRUCTIONS

Base bolts are used for transferring vertical and shear forces, as well as bending moments, between the base of a column and its foundation. RPP-E-A1 base bolts are anchor bolts only. The standard lengths of the bolt's rebars correspond to the required anchorage lengths. Extension lengths of rebars can be ordered separately.

The strength of the grout to the joint must be at least as strong as the strongest grade of concrete used in the elements that are joined. The grout must be of non-shrinkage type.

5.1. Limits of Use

The resistances of the base bolts have been calculated for static loads. Increased load factors are to be adopted for case specific dynamic and fatigue effects. For seismic actions, see also EN 1992-4:2018 section 9. For design in accordance with the Eurocodes, the lowest operating temperature is calculated from EN 1991-1-5.

5.2. RPP-E-A1 type base bolt minimum edge distance and spacing

RPP-E-A1 base bolt minimum edge distance:

The required minimum edge distance of the long base bolt is determined from the concrete cover thickness and durability requirements that are based on the environmental conditions and design working life in which the base bolt is situated, EN 1992-1-1 section 4.

RPP-E-A1 base bolt minimum spacing:

The minimum spacing of the base bolts is determined by the minimum clear distance between rebars, EN 1992-1-1 clause 8.2.

5.3. Additional reinforcement

5.3.1. Concrete edge reinforcement

Additional reinforcement according to Figure 2 and Table 6 must be used to prevent concrete edge failure.

Table 6. Concrete edge reinforcement for RPP-E-A1 base bolts

Base bolt	Selected reinforcement ① per bolt
M30	3+1×Ø12
M36	3×Ø16
M39	3×Ø16
M45	3+1×Ø16
M52	3+2×Ø16

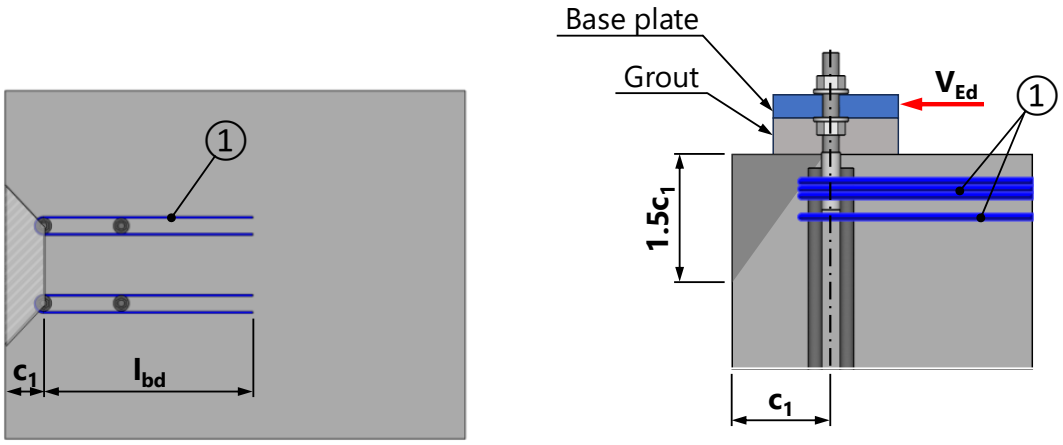


Figure 2. Concrete edge reinforcement for RPP-E-A1 base bolts

6. INSTALLATION

Template plates are to be used when forming bolt groups from the base bolts. The template plates help to obtain the correct spacing of base bolts and general alignment and positioning of the bolt groups relative to the building or structure. Furthermore, the template plates help to obtain the correct installation level of the bolts as well as help with protecting the threads of the base bolts during concrete casting.

6.1. Base bolt installation tolerances

The positional tolerance of the bolt group for installation of the precast concrete elements = ±10 mm. Tolerance for the level of the top of the base bolt = ±20 mm.

Table 7. RPP-E-A1 base bolt height positions and positional tolerances

Base bolt	Grout thickness [mm]	Height of top of bolt above the top of the concrete surface [mm]	Base bolt spacing tolerance within the bolt group [mm]
M30	50	150	±3
M36	55	170	±4
M39	60	190	±4
M45	65	205	±4
M52	70	235	±5

6.2. Bending and welding of the base bolts

Where space for installation is limited, the straight anchorage section of the ribbed bar to the base bolt may be bent. If the bolts need to be bent, they can be ordered from the manufacturer. The following dimensions must be specified in the order:

- M(...) – bolt size
- L_{bolt} – bolt length [mm]
- α – bend angle [deg]
- $Ø_m$ – mandrel diameter [mm]
- H_{total} – total height of the bolt [mm]
- L_{thread} – threaded part length [mm]

RPP-E-A1 M(...) - L_{bolt} - Bent(α) - $Ø_m$ - H_{total} - L_{thread}

Example: RPP-E-A1 M30 - 1200 - Bent90 - 265 - 500 - 210

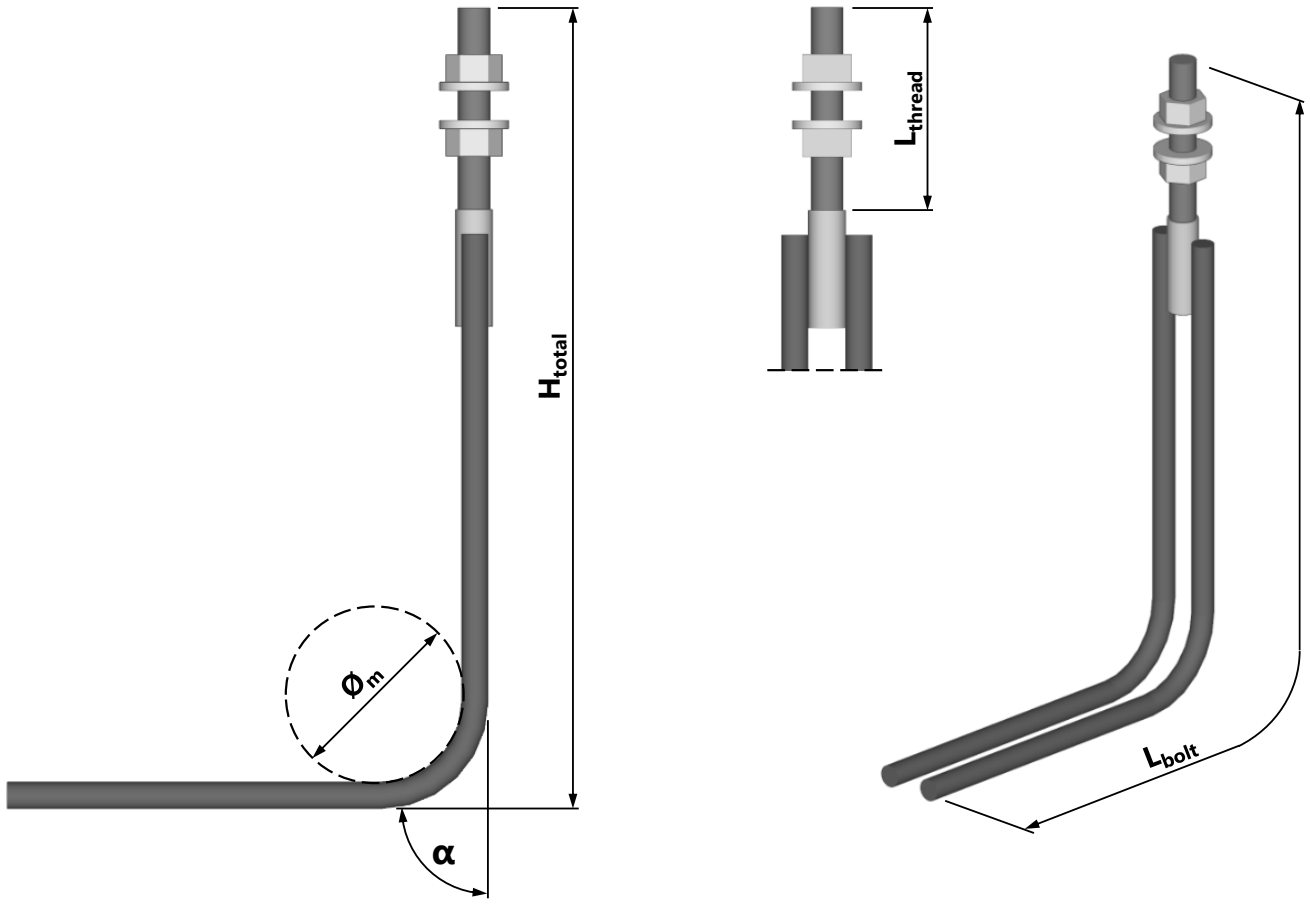


Figure 3. Dimension markings of RPP-E-A1 type bolt bent version

If the thread length is not specified in the order, the standard thread length for that bolt size will be used. If the bend diameter is not specified in the order, the minimum diameter allowed for that reinforcement bar diameter will be used, in accordance with EN 1992-1-1.

The base bolts can be welded using all common fusion welding methods. All welding of the reinforcement to reinforced concrete structures must be performed taking into account the requirements and instructions presented in EN 17660-1.

It is not allowed to weld connection plates or fasteners to the base bolts without prior approval from the structural designer.

6.3. Installation of the column

The column is installed to the correct level by adjusting at the nuts of the base bolts and by using packer plates placed under the columns. The verticality of the columns is checked, and the nuts are tightened,

for example using an impact wrench. Sufficient tightening torque is usually achieved with 10-15 blows to the ring slogging wrench (DIN 7444) or open-end slogging wrench (DIN 133) with a 1.5 kg hammer. A gap between the base plate of the column shoe and the nut of the bolt must be avoided. The space below the base plate and (where required) the void presented by the column shoes, must be grouted prior to further installation of structural elements on top of the column. The column joint must not be loaded before the grout has reached the required strength for the design.

6.4. Inspection instructions for installation of the base bolts

Before casting:

- Check that the correct base bolts and the correct installation frame are being used (centerline to centerline dimensions, thread size), and that the base bolts have not been damaged during delivery.
- Check that the positions of the base bolts and bolt groups within the formwork are within the required tolerances.
- Check that the levels of the top of the base bolts are within the required tolerances.
- Check that the reinforcement required for the base bolts is installed.
- Check that the installation frame is horizontal and within required tolerances.
- Protect the threads of the base bolts until the column is installed.

After casting:

- Check the position of the base bolt group. Dimensions that are greater than the tolerance requirements are to be reported to the structural designer.
- Protect the thread of the base bolt until the column is installed (using for example tape, plastic tube, etc.)

6.5. Inspection instructions for installation of the column

The column is to be installed in accordance with the project's erection plans. The installation inspector must check the following items:

- Installation sequence of the elements as presented in the erection plan.
- Temporary support requirements for the column during erection.
- Tightness of the nuts to the base bolts.
- Timing of joint grouting as well as the type of grout to be used.

NOTES

TECHNICAL MANUAL REVISIONS

SUPPORT MATERIAL

DESIGN TOOLS

RSTEEL® Design Tool was created to facilitate the work of designers and offer the best and most transparent design process on the market. The free and fully cloud-based software guarantees seamless workflow within the design organization, as well as continuous support and updates.

rsteel-design.com

DESIGN COMPONENTS

We have created design components for Tekla as well as Revit and AutoCAD. More products will be created, and existing products will receive steady updates and fixes when needed.

warehouse.tekla.com/#/organization/u7be79e90-ace8-46ca-a26c-849a5dc4c283

prodlib.com/rsteel

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Our excellent sales and support team will assist you with all your challenges and questions.

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DOCUMENTATION

All our products have been tested and have all necessary approvals and markings. You can find all related information on each products page.

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