AR® SUSPENSION SYSTEM

MANUAL

VERSION: 4/2024

Anstar®

Joint solutions since 1981

Anstar®

JOINT SOLUTIONS FOR BUILDERS

Anstar Oy is a Finnish family owned company that has since 1981 been delivering joint solutions and composite structures to customers worldwide. With innovative product development and efficient production techniques we have created a comprehensive product catalogue that will speed up our customers building projects and save money.

We pride ourselves on quality products and prompt deliveries. Our products are authority approved and the external quality control is handled by Inspecta Certification. Anstar has certified quality and environmental management systems according to ISO 9001 and ISO 14001. Our production is certified according to standards EN 1090–1 and EN 3834–2.

Anstar®

Anstar Oy
Erstantie 2
15540 Villähde

Tel. 03 872 200
Fax. 03 872 2020

www.anstar.fi
anstar@anstar.fi

CONTENTS **Page**

1 THE USE OF THE SUSPENSION SYSTEM

The AR® suspension system is used for anchoring facade panels and brickwork supports to the building frame. The stainless steel parts transfer facade dead and wind loads, but can also in precast panels be used as transport anchors and in dowel connections.

Basic suspension parts:

- ARKL = fastening plate to be cast into concrete
- ARKLJ = fastening plate to be anchored in refurbishing projects
- ARS = threaded bar with frame fixing parts

Parts for concrete panels:

- ARR = panel anchor for suspension and transport
- ARN = transport anchor
- ARM = horizontal wind tie to be fixed to the ARR part (1 nut and 1 washer)
- ARQ = dowel for horizontal wind loads
- ARAK = socket for ARQ dowel

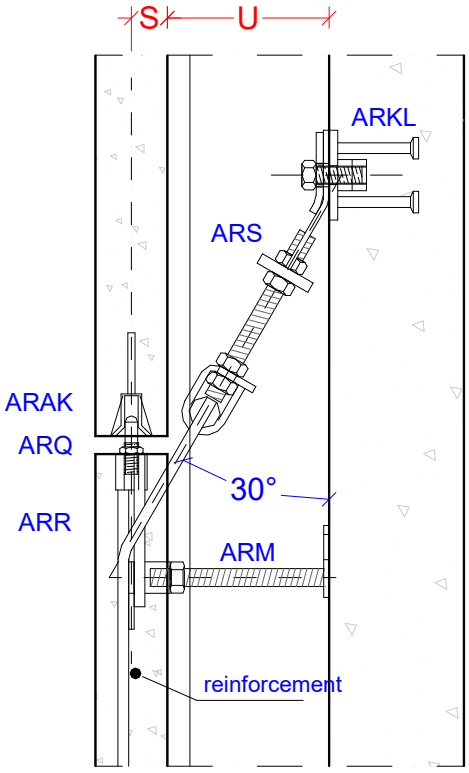


Fig 1. Suspension of facade panels

AR7	S+U ≥ 170 mm
AR14	S+U ≥ 190 mm
AR24	S+U ≥ 210 mm

Parts for brickwork suspension:

- ART = support beam fixing
- ARTK = high version of support beam fixing
- ARMM = horizontal wind tie (2 nuts + 2 washers)

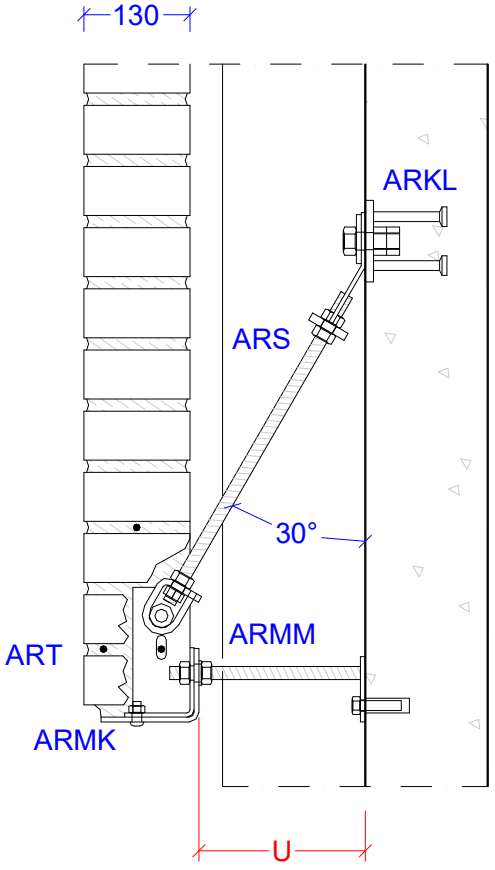


Fig 2. Suspension of brickwork

AR7	U ≥ 60 mm
AR14	U ≥ 80 mm
AR24	U ≥ 100 mm

2 SYSTEM COMPONENTS

2.1 Dimensions and materials

2.1.1 ARKL fastening plate

ARKL fastening plates are steel plates with stud anchor bars, which are fixed to the mould before casting of concrete. The tension rod ARS is fixed to the fastening plate with a screw, the size of which is given in table 1.

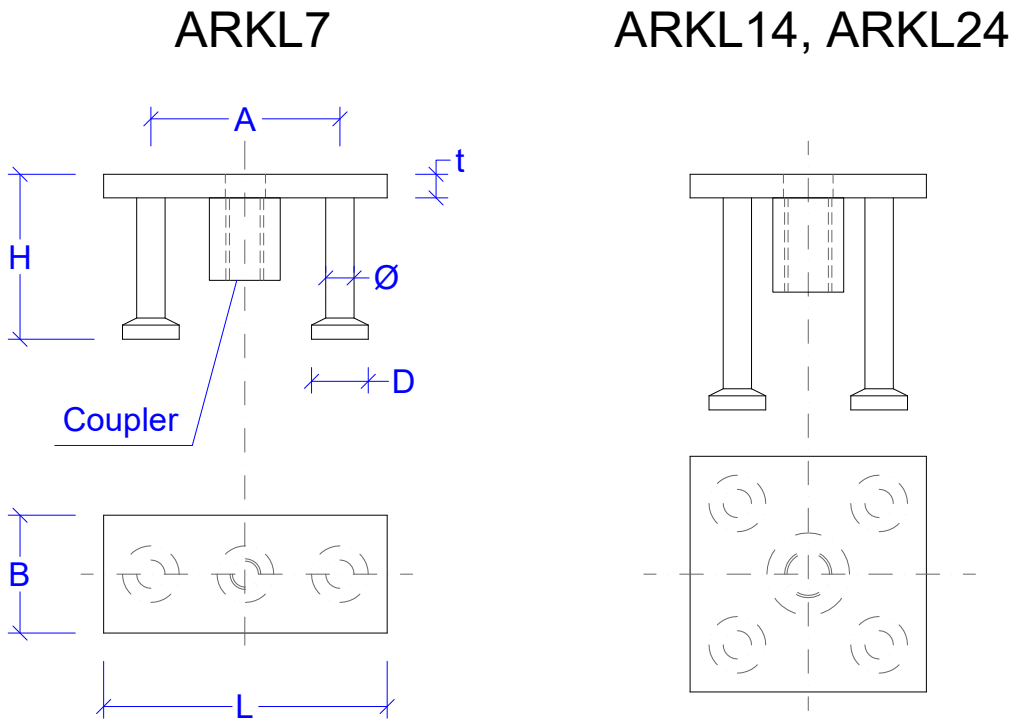


Fig 3. ARKL fastening plates

Table 1. ARKL structural dimensions

Type	B [mm]	L [mm]	t [mm]	H [mm]	A [mm]	Ø [mm]	D [mm]	Coupler [mm]
ARKL7	50	120	10	70	80	12	24	M16
ARKL14	100	100	10	100	60	12	24	M20
ARKL24	150	150	12	100	90	12	38	M24

Materials:

Steel plate, and coupler		1.4301	SFS-EN 10088
Stud anchors	ARKL7, ARKL14	S235JR+AR	SFS-EN 10025
	ARKL24	A500HW	SFS 1215

2.1.2 ARS tension tie

The threaded bar makes it possible to adjust the suspension length. The length of the threaded bar is calculated by using the equations below, when dimensions U and S are known (fig 1 and fig 2). The length L of the threaded bar is given in the type specification, eg. ARS7-250.

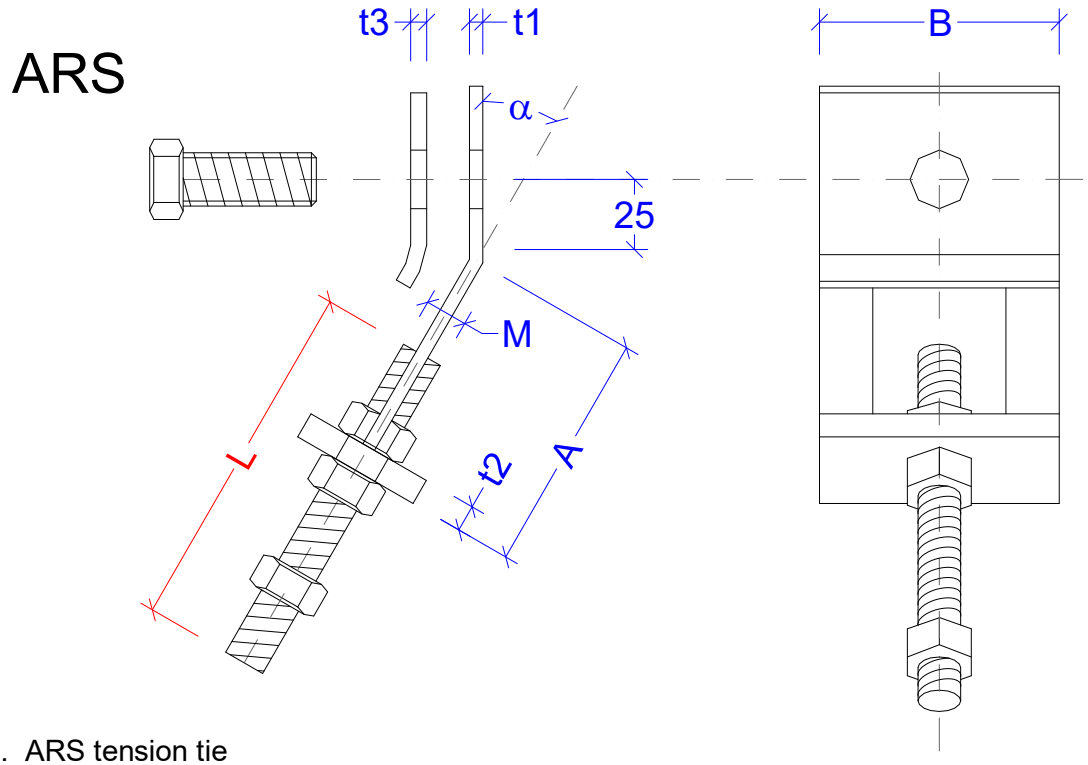


Fig 4. ARS tension tie

Table 2. Dimensions of the ARS component

Type	A [mm]	B [mm]	t_1 [mm]	t_2 [mm]	t_3 [mm]	Thread	X [mm]	Z [mm]	Screw A2-70
ARS7-L	83	70	4	8	6	M12	225	30	M16-40
ARS14-L	90	95	5	10	6	M16	240	30	M20-50
ARS24-L	97	120	6	12	8	M20	255	25	M24-60

Materials:

Steel plates and threaded bar	1.4301	SFS-EN 10088
Nuts	A2-70	DIN 934
Screws	A2-70	DIN 933

Length of threaded bar L [mm] with facade panels

$$L = \frac{S+U}{SIN\ \alpha^\circ} - X$$

(SIN30° = 0,5)

Length of threaded bar L [mm] with brickwork support

$$L = \frac{U}{SIN\ \alpha^\circ} + Z$$

U and S are given in figs 1 and 2
X and Z are given in table 2

When needed the screw that is delivered with the ARS component can be replaced with a threaded bar and nut.

2.1.3 ARR transport and anchoring component

The ARR component is used for transport of the prefabricated facade panel, anchoring of the suspension force and transferring of horizontal loads from the upper facade panel. The coupler with inner thread is also used for fixing the component to the formwork. The hinge connection with the round bar allows sidedways adjusting of the panel.

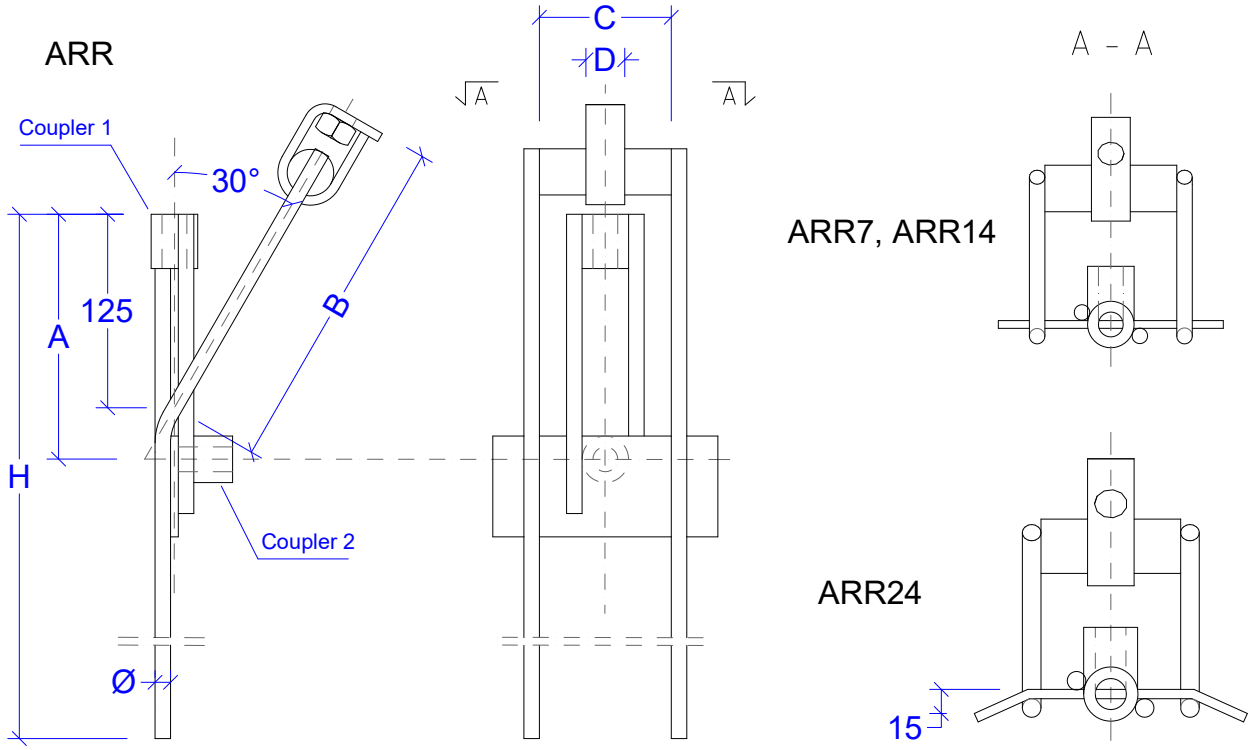


Fig 5. ARR transport- and anchoring component

Table 3. Dimensions of the ARR component, metric thread

Type	A [mm]	B [mm]	C [mm]	D [mm]	H [mm]	Ø [mm]	Coupler 1 & 2 [mm]
ARR7	155	200	80	25	380	8	M16
ARR14	160	225	85	30	490	10	M16
ARR24	170	255	90	40	625	12	M20

Materials:

Steel plates	1.4301	SFS-EN 10088
Bars and couplers	1.4301	SFS-EN 10088
Rebars	B600KX	SFS 1259
Nuts	A2-70	DIN 934

2.1.4 ARM and ARMM wind ties

The ARM component serves as a compression tie for the ARR anchoring part transferring horizontal loads from panel suspension and wind loads. Panel upper parts in vicinity of the connection is insulated after assembly, this way the ARM wind tie can be adjusted by turning the threaded bar. Finally the locking washer is tightened against the panel.

The ARMM component, with two nuts, is used with the brickwork support. The horizontal adjustment is made by turning the nut and the locking into right position is made by tightening the opposite nut. The base plate is provided with an elliptical hole for fastening with post-installed anchors to stabilize .

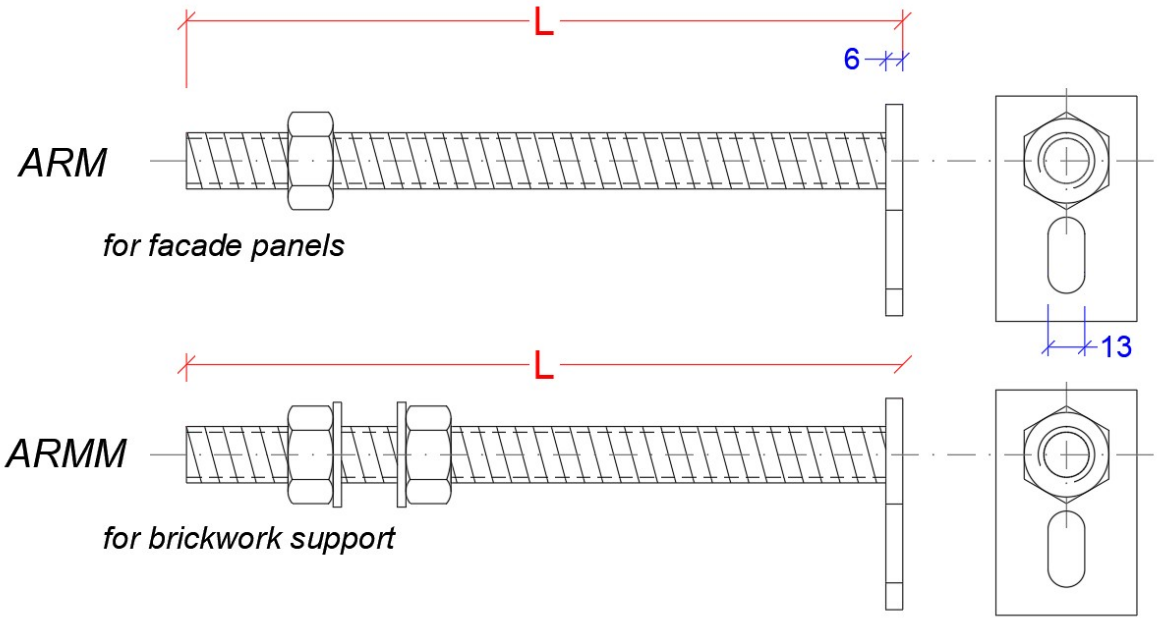


Fig 6. ARM and ARMM wind ties

Table 4. Dimensions of the ARM and ARMM wind ties

Type	Thread size	Wrench opening	End plate
ARM16-L, ARMM16-L	M16	24	80x50x6
ARM20-L, ARMM20-L	M20	30	80x50x6

Materials:

Steel plate	1.4301	SFS-EN 10088
Threaded bar	1.4301	SFS-EN 10088
Nut	A2-70	DIN 934
Washer	1.4301	DIN 125

ARM	Order length L [mm]:	L = U+S–15	U and S from fig 1
ARMM	Order length L [mm]:	L = U+50	U from fig 2

2.1.5 ARQ and ARAK dowel components

The facade surface is adjusted with the dowel components during panel assembly. The connection transfers wind loads (compression or tension) to the lower panel, when the eccentric dowel is locked with the nut. The dowel connection requires a horizontal joint size of 15..20 mm. The application of the standard dowel connection system must be checked when the panels are assembled in matched joints.

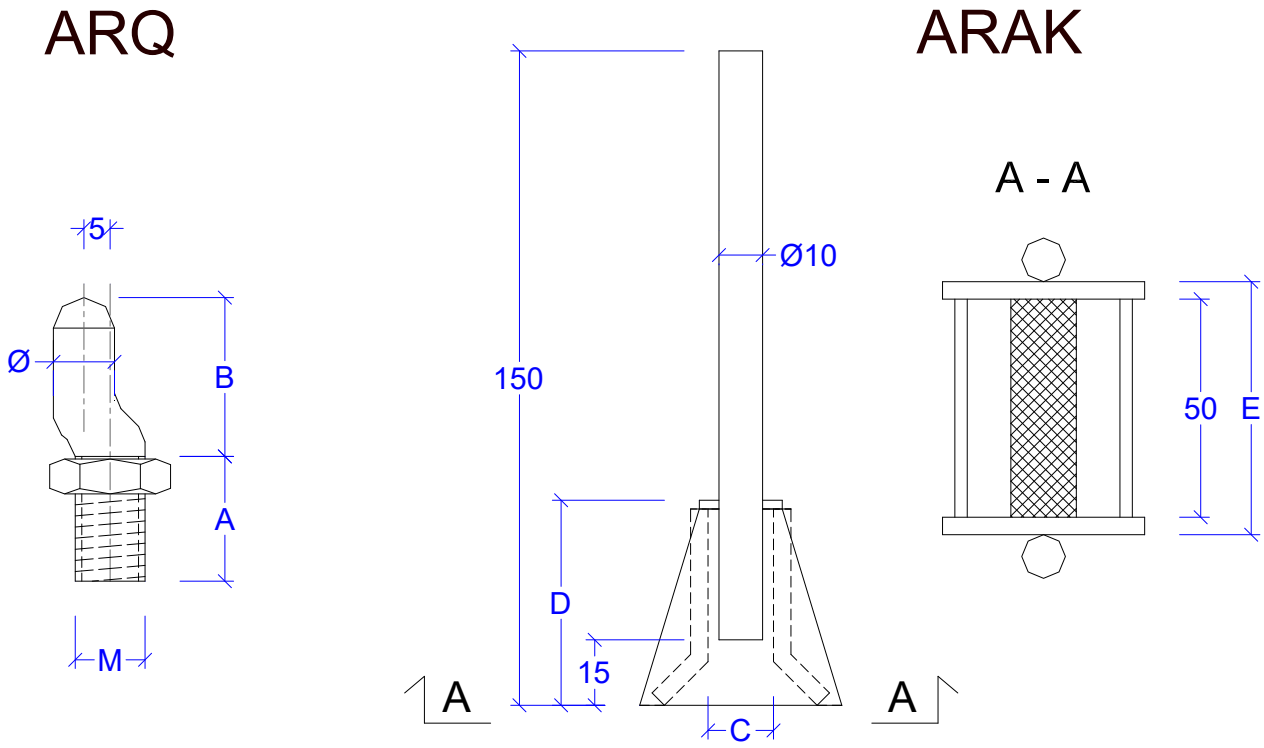


Fig 7. ARQ dowel and ARAK dowel socket

Table 5. Dowel connection dimensions

Type	Thread size	Ø [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	Connecting part
ARQ16	M16	14	30	40				ARR7, ARR14
ARQ20	M20	18	35	45				ARR24
ARAK16					15	48	78	ARQ16
ARAK20					19	53	80	ARQ20

Materials:

Steel plate	1.4301	SFS-EN 10088
Round and threaded bars	1.4301	SFS-EN 10088
Rebars	B600KX	SFS 1259
Flat nut	A2-70	DIN 439

2.1.6 ARN transport anchor

The ARN anchor is used in facade panels for transport or in dowel connections when there is no ARR component in the panel upper surface.

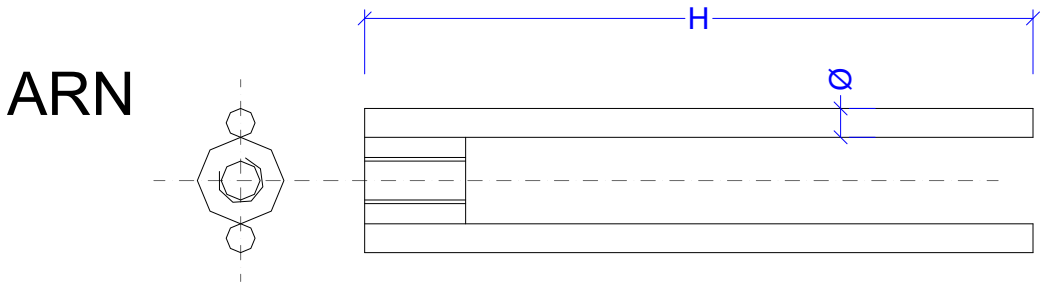


Fig 8. ARN transport anchor

Table 6. Dimension of the ARN transport anchor, metric thread

Type	H [mm]	Ø [mm]	Coupler
ARN14	350	10	M16
ARN24	485	12	M20

Materials:

Bars	1.4301	SFS-EN 10088
Rebars	B600KX	SFS 1259

2.1.7 ARMK brickwork support

The ARMK profile supports the brickwork and transfers the weight of the facade to the building frame behind the panel, when traditional lintels transfers the load to the vertical sides of opening. The ARMK profile is bolted to the suspension component ART or ARTK. The profile is systematically provided with holes to connect the suspension components every 150 mm. Standard length of the brickwork support is 3 metres.

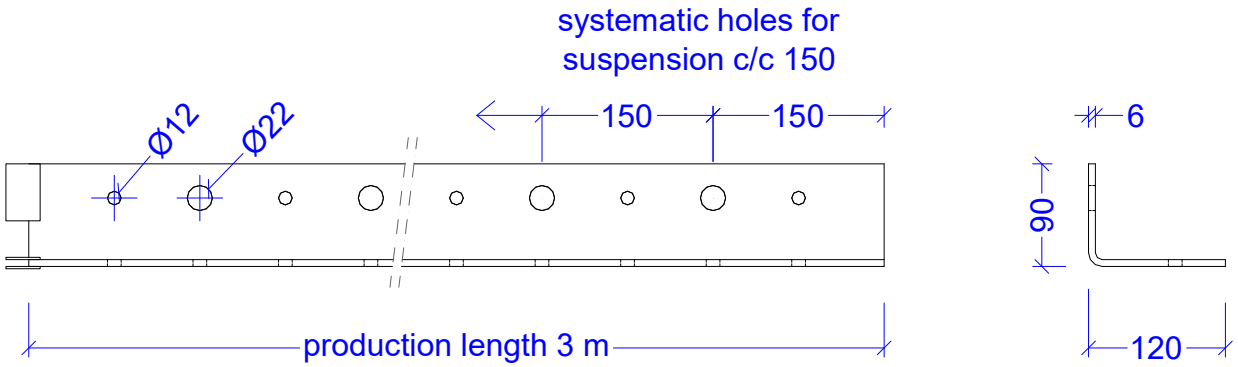


Fig 9. ARMK brickwork support

2.1.8 ART and ARTK brickwork support fixing

These steel parts are used to fix the brickwork support profile to the ARS suspension component. The hinge connection gives a horizontal adjustability (compare with corresponding panel component ARS). The higher ARTK type is meant for openings, where the standard compression tie would be situated too close to the edge. One rebar is placed into the flange holes to fix the brickwork to the support beam.

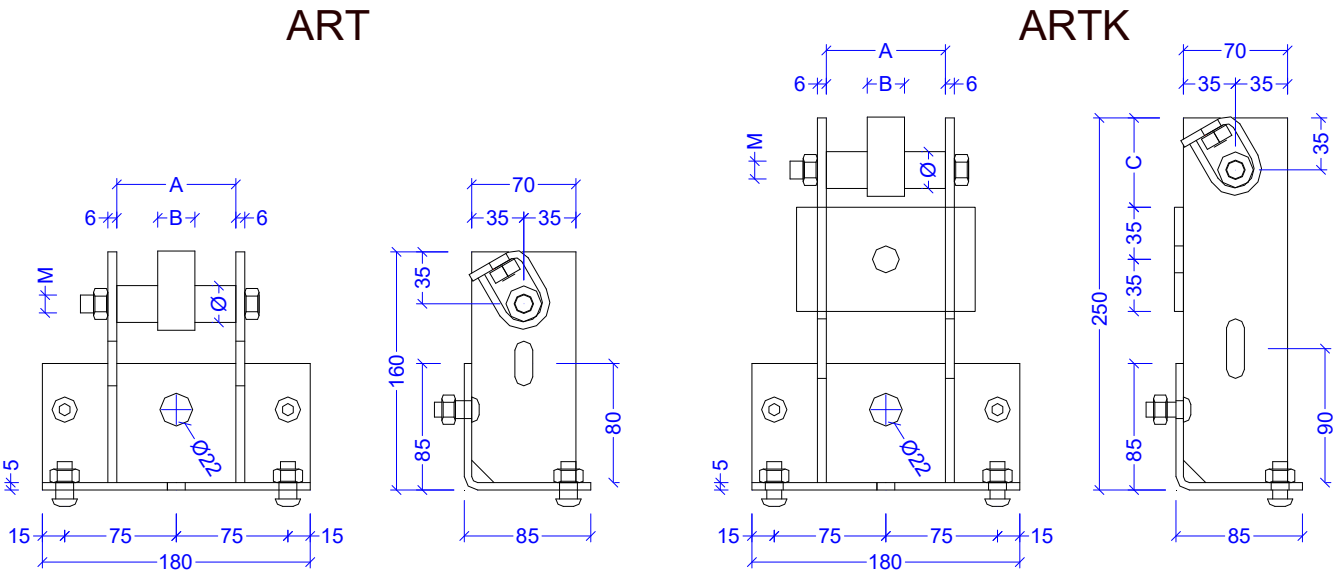


Fig 10. ART and ARTK support fixing

Table 7. Dimensions of the ART and ARTK fixing parts

Type	A [mm]	B [mm]	C [mm]	Ø [mm]	Screw M
ART7, ARTK7	80	20	60	25	M12
ART14, ARTK14	85	25	60	30	M16
ART24, ARTK24	90	30	50	35	M20

Materials:

Steel plates, tube	1.4301	SFS-EN 10088
Screw	A2-70	DIN 931
Hex recess set screw M10	A2-70	DIN 7380
Nuts	A2-70	DIN 934

2.2 Production methods

The stainless steel plates are cut, perforated and bent. The bars are mechanically cut. The stainless rebars and stud anchors are welded with MIG robot or handmethods. Welding class is C according to standard SFS-EN-ISO 5817. Welds situated outside the concrete cast are chemically post-treated.

2.3 Manufacturing tolerances

Plate side dimensions			
ARKL, ARMK	± 4 mm	Rebar length	± 10 mm
other parts	± 2 mm	Stud length	± 5 mm
Size of screw hole	± 1,5 mm	Stud position	± 5 mm
Screw hole position	± 2 mm	Stud inclination	± 5 °
Length of support beam	± 10 mm		
Support beam straightness (curvature)	< 10 mm		

3 PRODUCT MARKINGS

The steel components are marked with the producer name Anstar Oy, product type and Inspecta Certification control marking.

4 DESIGN CRITERIA

4.1 Design principle

The hanging joint is designed according to the following guidelines:

SFS-EN 1990	(1990 + amendment A1:2005 + correction AC:2008) Eurocode - Basis of Structural Design
SFS-EN 1992-1-1	(2004 + correction AC:2010) Eurocode 2: Design of Concrete Structures Part 1-1: General Rules and Rules for Buildings
SFS-EN 1993-1	(2005) Eurocode 3: Design of Steel Structures Part 1-1: General Rules and Rules for Buildings Part 1-8: Design of Joints
SFS-EN 1996-1-1	(1996 + correction AC:2005) Eurocode 6: Design of Masonry Structures Part 1-1: General Rules for Reinforced and Unreinforced Masonry Structures
RIL 202-2011/by61	Design Guide for Concrete Structures. Serviceability Limit States (SLS)
CEN/TS 1992-4-2	(2009) Design of Fastenings for Use in Concrete Part 4-2: Headed Fasteners

Design Manual for Structural Stainless Steel – third edition Euro Inox and the Steel Construction Institute, 2006

The lifting components are designed with a fourfold safety margin against fracture (Government Decision 13.8.1981/578).

Calculations are made at reliability class RC2 with a load factor K_{FI} = 1.0. The load-bearing concrete wall is designed as a compressed concrete structure.

4.2 Capacities

Capacities for ARKL, ARS, ARR, ART and ARM components when the given loads act simultaneously and the distance between the facade inner surface and building frame is U ≤ 270 mm (fig 1). Reinforced concrete C25/30 (f_{ctd} = 1,29 MPa).

Table 8. Design capacities for system components ARKL, ARS, ARR, ART and ARM

Type	Capacity ULS	
	Vertical load F_{Rd}	Horizontal load V_{Rd}
ARKL7, ARS7, ARR7, ART7, ARM16	9,5 kN	13,8 kN
ARKL14, ARS14, ARR14, ART14, ARM20	18,9 kN	14,4 kN
ARKL24, ARS24, ARR24, ART24, ARM24	32,4 kN	20,7 kN

The centric vertical load for the ARN transport anchor is designed for concrete C12/15. The horizontal load (dowel connection for wind loads) is designed for concrete C25/30 with a minimum thickness of 70 mm and a joint 15..20 mm between the facade panels.

Table 9. Design capacities for ARN, ARQ and ARAK components

Type	Capacity	
	Vertical load F_{Rd}	Horizontal load V_{Rd}
ARN14	18,9 kN	4,3 kN
ARN24	32,4 kN	4,7 kN
ARQ16, ARAK16	-	4,3 kN
ARQ20, ARAK20	-	4,7 kN

Table 10. Design capacities for the ARMK brickwork support beam

Type	Evenly distributed load [kN/m]
	Capacity g_{Rd}
ARMK, ART7, ARTK7	7,8 kN/m
ARMK, ART14, ARTK14	15,6 kN/m
ARMK, ART24, ARTK24	27,0 kN/m

Table 11. Stiffness data for the ARMK brickwork support beam

Type	e_x [mm]	I_x [mm^4]	W_x [mm^3]	e_y [mm]	I_y [mm^4]	W_y [mm^3]
ARMK	21,9	768500	11280	37,2	1636400	19760

For standard length L = 3000 it is recommended to use supports according to 450+1050+1050+450. When L ≤ 1950 only two suspension anchors can be used.

The design capacity of the ARMK brickwork support beam is presented in table 10, when dimensions and suspension force requirements according to fig 11 are fulfilled. The deflection from flexure with maximum service loads is about 1 mm.

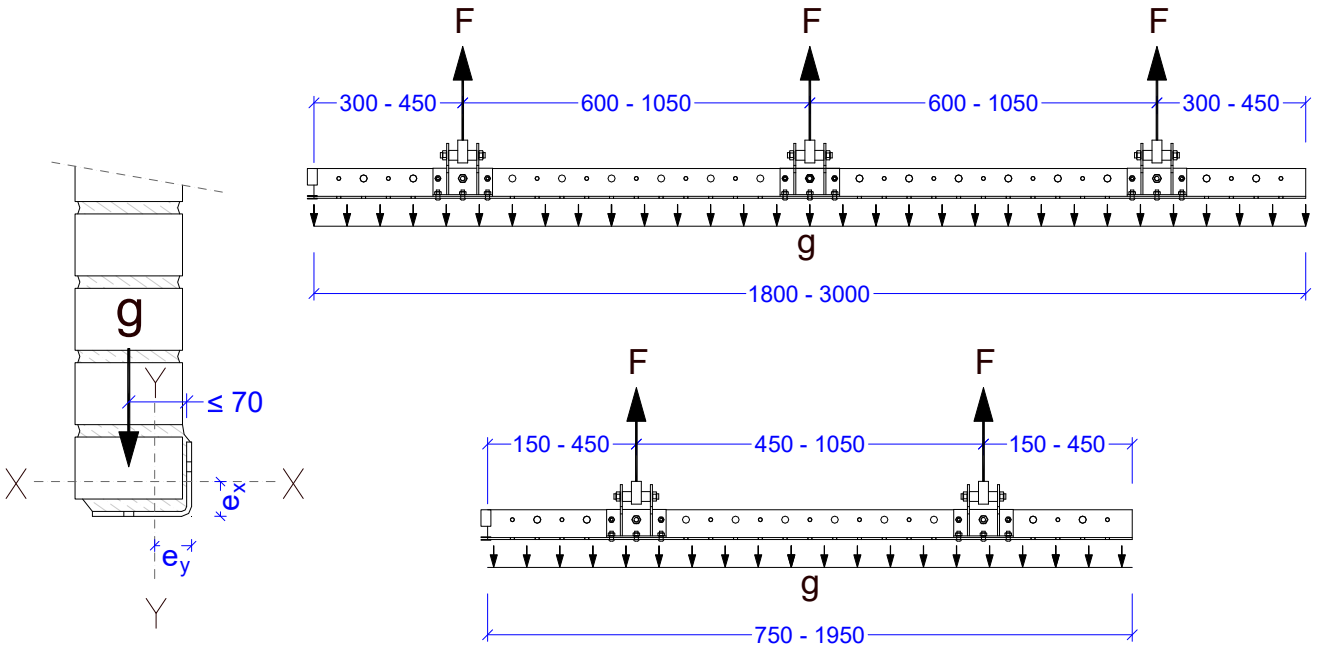


Fig 11. ARMK brickwork support beam dimensions for which capacities have been calculated [mm]

4.3 Modification of capacity values

4.3.1 Fixing to building frame

Suspension system components ARKL, ARS, ARR, ART, ARTK and ARM are designed for concrete C25/30. If the concrete strength class is lower than this during assembly, the anchoring capacities should be reduced in proportion to the characteristic tensile strengths of the concrete (f_{ctd} / $f_{ctd,C25/30}$ < 1,0).

4.3.2 Facade panel

ARN lifting parts of the facade panel are designed for concrete C12/15. If the strength of the concrete at the time of lifting is lower than this, the values of section 4.2 should be reduced in proportion to the characteristic tensile strengths of the concrete (f_{ctd} / $f_{ctd,C12/15}$ < 1.0).

Eurocode design is carried out in reliability class RC2. In reliability class RC3, the resistances are adjusted by a factor of 0.9 (1/1.1).

The dowel connection between the facade panels is designed for concrete C25/30 and a minimum panel thickness of 70 mm. The dowel is designed for a joint dimension of 15..20 mm. By increasing the thickness of the panel and using stronger concrete, the resistance of the concrete against edge splitting can be increased. Similarly, increasing the joint size reduces the bending resistance of the dowel. The dowel connection is designed so that the forces exerted on the facade side are also considered in terms of concrete shell manufacturing technique and installation.

Table 12. Correction factors for dowel joint under horizontal load

Panel thickness	Concrete C25/30		Concrete ≥ C35/45	
[mm]	ARQ16	ARQ20	ARQ16	ARQ20
70	1,00	1,00	1,14	1,21
80	1,14	1,22	1,14	1,47
90	1,14	1,46	1,14	1,77
100	1,14	1,72	1,14	2,08

4.3.3 Brickwork support

If the distance from the resultant load of the brickwork exceeds 70 mm from the vertical flange of the ARMK bracket (Figure 11), the maximum load of the bracket is reduced as follows:

$$70 * g_{Rd}/e$$

where e > 70 is the load resultant distance from vertical flange
g_{Rd} is capacity from table 10

The service load deflection 1 mm has been calculated with maximum dimensions (fig 11). When needed the deflection can be restricted by reducing the load.

$$f * g_{Rd}$$

where f < 1 mm is the actual restricted service load deflection

5 USE OF THE AR® SUSPENSION SYSTEM

5.1 Design principles and restrictions

5.1.1 General

The AR® suspension system transfer vertical and horizontal loads, that must be considered when designing the building frame. This manual is written for two suspension forces per facade panel or 2-3 suspension forces per brickwork support. The suspension components should be placed so that they are equally loaded. Height adjustment is made with the threaded bar, before assembly it should be secured that the tension bar is provided with locking nuts.

The suspension components are designed to carry facade dead load and wind load, other loads must be considered separately in the design calculations. The fastening plate ARKL can be used for transferring other than facade dead loads only when the designer has made a separate analysis of the situation. Vertical live loads will decrease the total safety against concrete pull-out failure.

The concrete surrounding the ARKL fastening plate must be reinforced against actual tension (pull-out) forces. The minimum reinforcement according to fig 12 should be placed close to the stud anchors. When needed the rebar ends are bent to secure proper anchoring. The fastening plate edge distances are given in table 13.

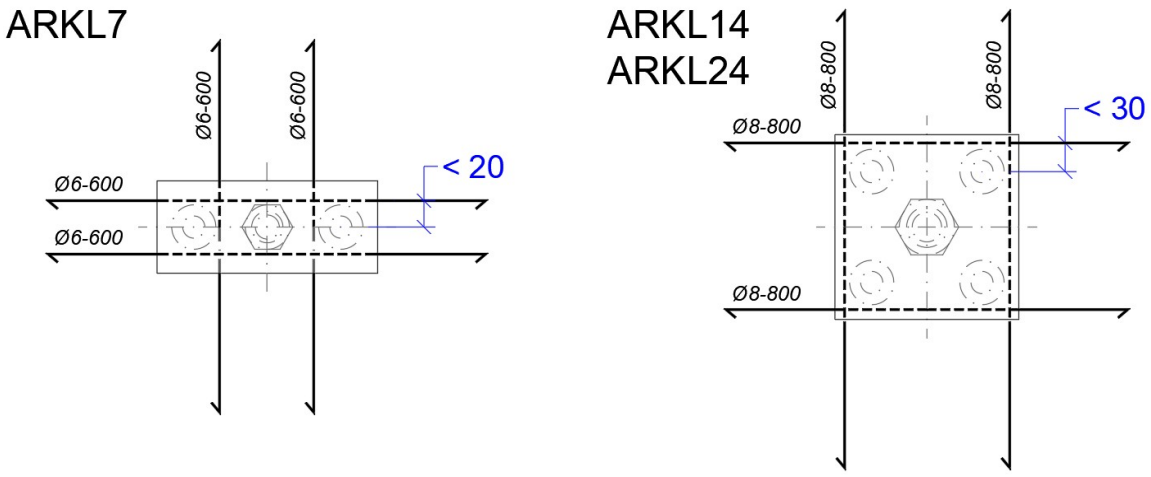


Fig 12. Minimum reinforcement (f_{yk} ≥ 500 MPa) around stud anchors, the distance to stud anchor must not be exceeded.

5.1.2 Instructions for facade panels

The standard steel parts can be used in reinforced concrete panels with thicknesses 70..120 mm.

Only transport anchors may be used to lift the panel. When panel height is to be adjusted, the panel will be lifted by its transport anchors, not by turning suspension bar nuts.

The durability of the transport anchors is specified for vertical lifting. The system does not account for horizontal loads, such as those generated during the demolding of the panel. Lifting loops with metric standard threads are used with transport anchors.

The dowel connection is meant for horizontal loads only. The system has not been designed for transferring dead load from upper panel to lower panel, this kind of a statical system must always be analysed separately by the designer. The dowel connection causes tension stresses (small cracks) in the facade surface, special attention should be paid to these stresses when the facade material is sensitive to aesthetical damages. When needed the dowel connection capacity can be increased by adding ARN+ARQ+ARAK components.

The suspension system has been designed to be used in reinforced concrete. The ARR anchor bars are placed on the facade side of the panel horizontal bars (fig 1).

5.1.3 Instructions for brickwork support

The brickwork support can be

- a temporary support when the brickwork is reinforced (eg. window openings)
- a permanent support carrying all the vertical load from brickwork (eg. renovation projects without foundation support for the new facade).

The temporary AR® support system is fixed above the opening and adjusted to right height level. The support beam will carry the dead load of the structure to be reinforced. The beam structure is designed according to regulations.

The permanent support transfers all vertical loads through suspension. Arch effect can be considered according to regulations (EC6: 6.5 & 8.5) and brickwork wind loads must be transferred with ties. Brickwork expansion joints should be placed considering the suspension anchor capacities.

If bolting suspension anchors to the support beam is not estethically sound, the plates can be hidden with steel sheet or the standard structure can be manufactured by welding ART/ARTK anchor plates directly to the ARMK support beam. These special details must always be negotiated with the manufacturer (drawings, delivery schedule).

When cutting standard support beams to shorter lengths there should always be at least 2 support anchors in every beam part.

In outer corners it is advantageous to weld the corner beams together thus receiving a greater beam stiffness. It is recommended not to weld together more than two standard beams (6 m), because the thermal expansion coefficient for stainless steel is more than two times greater than that of the brickwork.

5.2 Placing suspension anchors

5.2.1 Placing into building frame

ARKL fastening plates must be positioned with following edge distances.

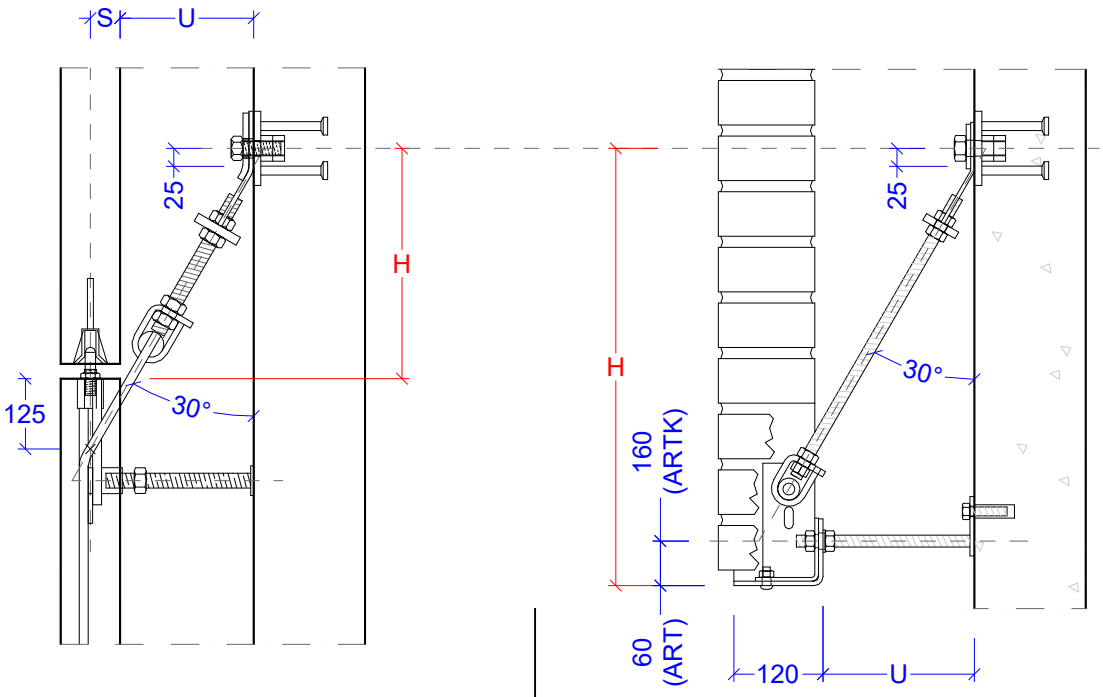
Table 13. Minimum edge distance E (plate side to concrete edge) for ARKL fastening plates (fig 14).

ARKL 7	100 mm
ARKL 14	150 mm
ARKL 24	150 mm

If the edge distance in table 13 is not fulfilled or the fastening plate is situated in concrete tension zone, all loads must be transferred via reinforcement well beyond the stud anchor pull-out cone.

The height level of the fastening plate considering the suspended structure is determined according to fig 13. In post-installed systems the thickness of the plate structure must be taken into account in the dimension U.

5.2.2 Placing into facade panels



H = (S+U)/tan30° – 100 [mm]

H distance from middle of fixing screw to panel upper surface

S distance between anchor center and panel inner side

U distance between panel inner side and fastening plate

H = U/tan30° + 235 [mm] **ART**

H = U/tan30° + 325 [mm] **ARTK**

H distance from middle of fixing screw to beam lower surface

U distance between beam vertical flange and building frame

Fig 13. Fastening plate position in the AR® suspension system.

ARR, ARN and ARAK components are placed according to designer's drawing, the minimum edge distance should be according to table 14. The components are optimally situated when in the centre of gravity, the panel can then be lifted and assembled vertically (note facade grooves, tiles etc).

Table 14. The minimum distances from plate center to vertical side of the panel.

ARR7, ARN7, ARAK16	100 mm
ARR14, ARN14, ARAK16	200 mm
ARR24, ARN24, ARAK20	420 mm

5.3 Suspension system details

5.3.1 New buildings

The designer must for every project decide upon structural joints, like

- upper- and lower edges
- corners
- dowel connections in panel vertical joints

Topmost panel

Edge distances must be observed (chapter 5.2). The structural details can be designed by modifying fig 14. In case 1 the panel cantilever length must be analyzed and possibly supported. In case 2 the upper panel must be supported with a separately designed steel part.

If the upper panel is supported by the lower one, this added load must be considered when designing the suspension system. The dowel connection has not been designed for transferring vertical loads.

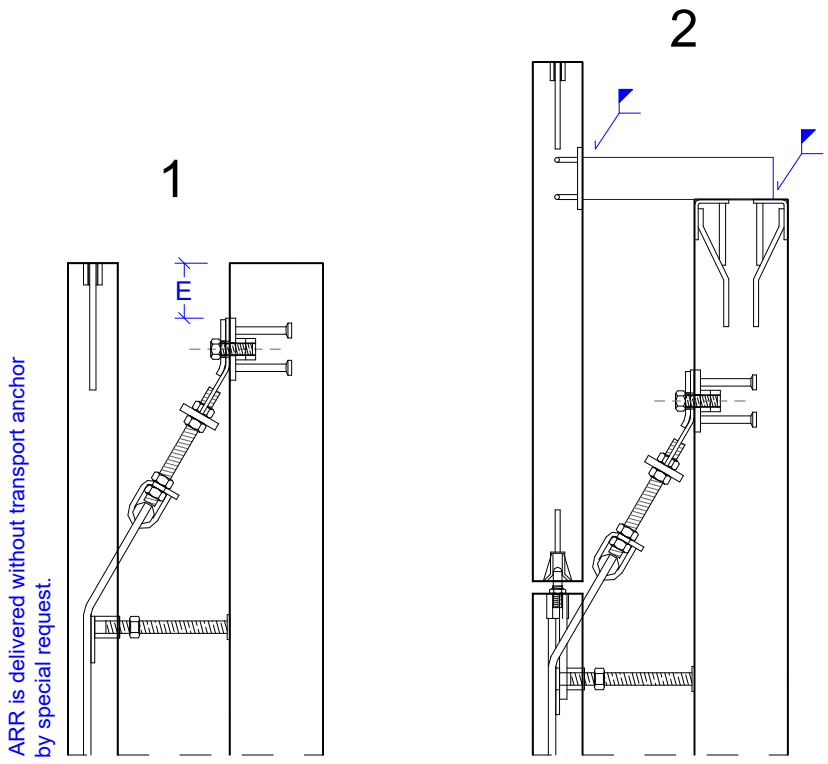


Fig 14. Structural details at the topmost panel.

Bottommost panel

If there is a foundation beam the panel connection will be made in the traditional way. If there is no foundation beam the connection can be made according to fig. 15. Usually only one vertical panel side can be accessed during assembly, that is why the nut joint must be made from below. The U-profile is fixed to the panel and the threaded bar in locked to the building frame before starting the panel assembly. After horizontal adjustment the locking nut will be tightened. The connection area will be insulated after panel assembly.

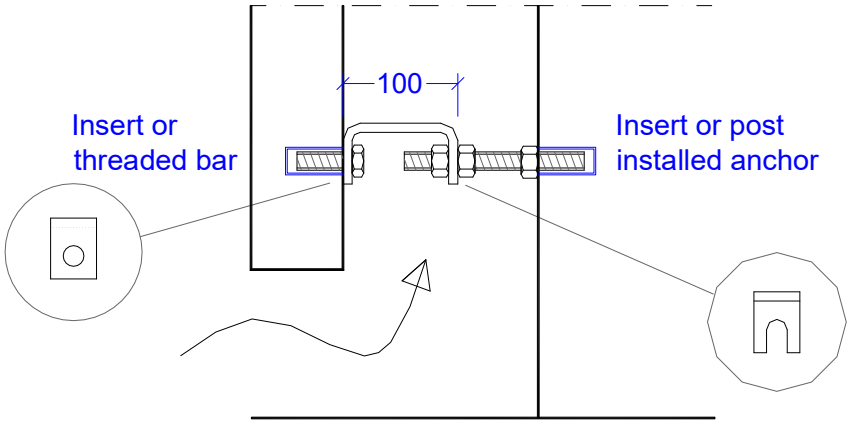


Fig 15. Ground panel structural detail.

Dowel connection in panel vertical joints

The panel vertical tongue and groove joint is usually too narrow for the standard dowel connection. The horizontal loads must therefore be transferred in some other way. The panel free lower edge can be assembled by using an anchor according to fig 15. The facing edge can be fixed by using a dowel connection in panel vertical joint (fig 16). The dowel socket gives the joint adjustability for assembly tolerances. The socket is grouted during assembly. The panel must be kept in place, eg with wedges, during hardening of the grouting.

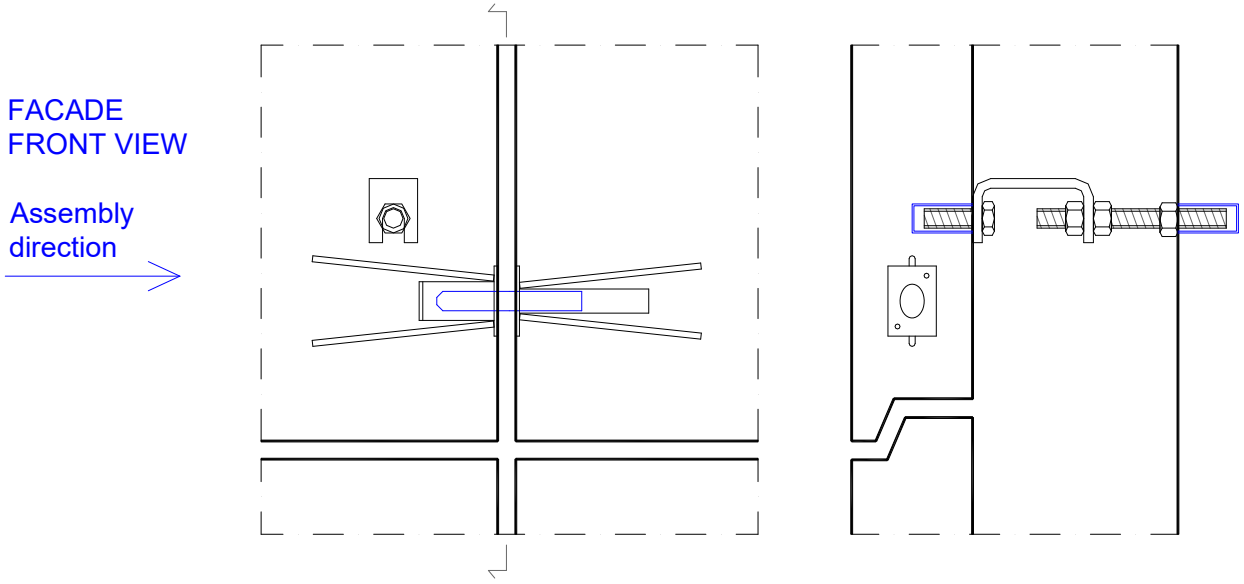


Fig 16. Structural detail with horizontal tongue and groove joint where the dowel connection is placed in the panel vertical joint.

5.3.2 Post-installation

In projects where fastening plates cannot be cast into the concrete, post-installation anchors must be used. In the structural design following things should be considered:

- strength of building frame concrete
- position of structural reinforcement
- the thickness of the concrete structure
- characteristics of the stainless steel anchors in use (strength, edge- and c/c-distances, required amount of anchors, distance between drilled holes etc)

Because of varying conditions the post-installation steel plate in fig 17 cannot be standardized, the designer must check the necessary dimensions for each project.

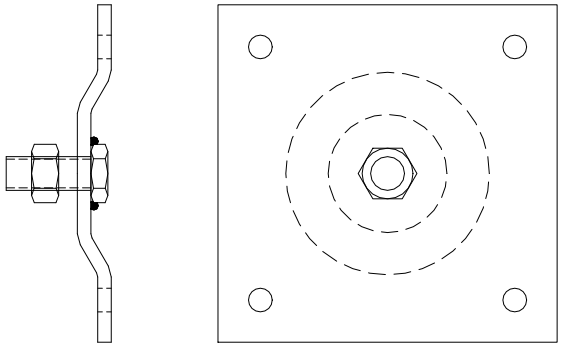


Fig 17.
Post-installed steel plate
for building frame anchoring.

6 SUSPENSION SYSTEM ASSEMBLY

6.1 Fixing steel parts to formwork

The steel parts must be carefully fixed to the formwork so that the parts are in correct position. Suspension anchoring components can be fixed by using the threaded coupler. Care should be taken, especially in vertical formwork, for the compression tie coupler. In thin panels 70 .. 80 mm the coupler will protrude the panel side and with thicker panels the coupler will be cast into the concrete. Inner threads and the ARR hinge-bar must be protected against concrete spilling.

Besides using the coupler inner thread, the suspension anchor ARR and the fastening plate ARKL must also be fixed to the reinforcement to prevent the steel part from turning during concrete casting. Special care should be taken in fixing fastening plates into in-situ cast structures, so that the assembly tolerances can be kept acceptable.

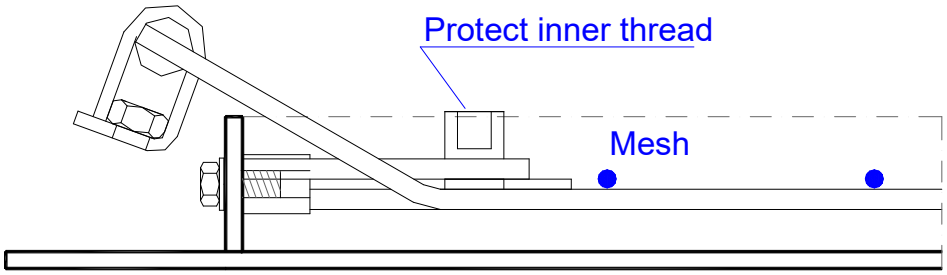


Fig 18. Fixing ARR suspension anchor to horizontal formwork.

6.2 Panel assembly on site

The assembly work is started by adjusting the ARM compression tie as close as possible to its final length and by fixing the insulation to the building frame. The insulation in vicinity of diagonal- and compression ties are installed after panel assembly.

The lower panel transport couplers are provided with ARQ eccentric dowels. The dowel with its flat nut at the end of the thread (fig 7) is turned into the coupler so that the dowel still can be turned about half a round, this way the dowel can be adjusted freely. The dowel is turned with the eccentricity to the facade, this way the socket tolerance will be as big as possible allowing an easy panel assembly.

Before assembly the ARS threaded bar is tightened to the ARR anchoring component. The threaded bar is locked to its position with the ARS nut and all adjusting procedures will be done at the other end of the bar. The length of the threaded bar is adjusted to designed length.

The panel is lifted by using the transport couplers, at first a little higher (5-10 mm) than its final position and the ARS component is fixed with a stainless screw (table 2) into the fastening plate ARKL. When lowering the panel care should be taken so that the panel dowels are guided into the sockets. The height adjustment is made by turning the upper nut and locking into correct position is done by tightening the upper nuts.

Lifting or upward moving must always be done by using transport anchors, do not use the threaded bar for this purpose.

Panel lower edge is adjusted to the vertical facade surface line and the ARQ dowel is locked by turning the nut against the coupler. Panel upper edge is adjusted by turning the ARM compression tie.

For working safety reasons it is recommended to do all adjusting procedures with the panel connected to the lifting device.

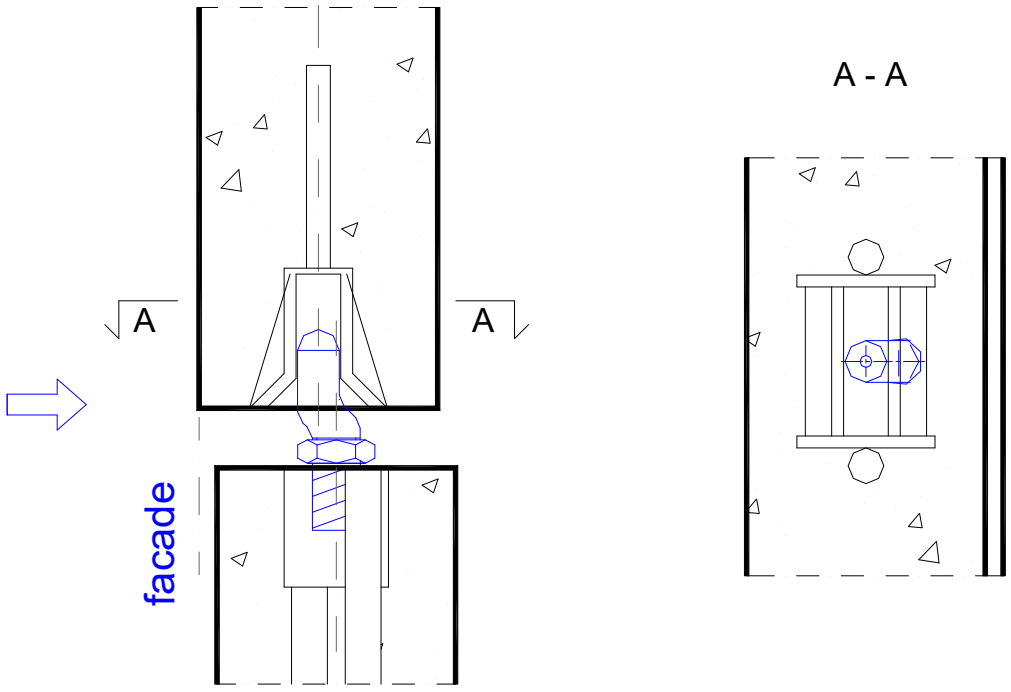


Fig. 19. Adjustable wind load dowel connection

6.3 Assembly of brickwork support

The brickwork is supported by the ARMK steel beam profile, which is suspended to the building frame with the standard AR® system. The beam is placed to its correct position considering the beam straightness by using a setting-out line. Components ART or ARTK are fixed with screws to positions determined by the designer so, that the load is transferred evenly to all suspension anchors. The delivery contains all necessary fixing screws.

The beam profile ARMK is delivered in standard length 3 m, which on site can be cut into lengths according to plan. There must always be at least two suspension anchors for each cut beam and anchor edge and c/c-distances must be according to fig 11. Short pieces of support beam must be welded with single-V butt welds to longer beam parts so that the support will act as continuous. Welding can also be used in building corners.

Bricks placed against the ART and ARTK anchors must be shaped - cut or using prefabricated tiles (fig 20). The background is carefully filled with mortar eg. by using a background board. The brickwork mortar is reinforced according to designer's instructions. At least one stainless rebar is always put through the ART or ARTK anchor using the flange holes (fig. 20).

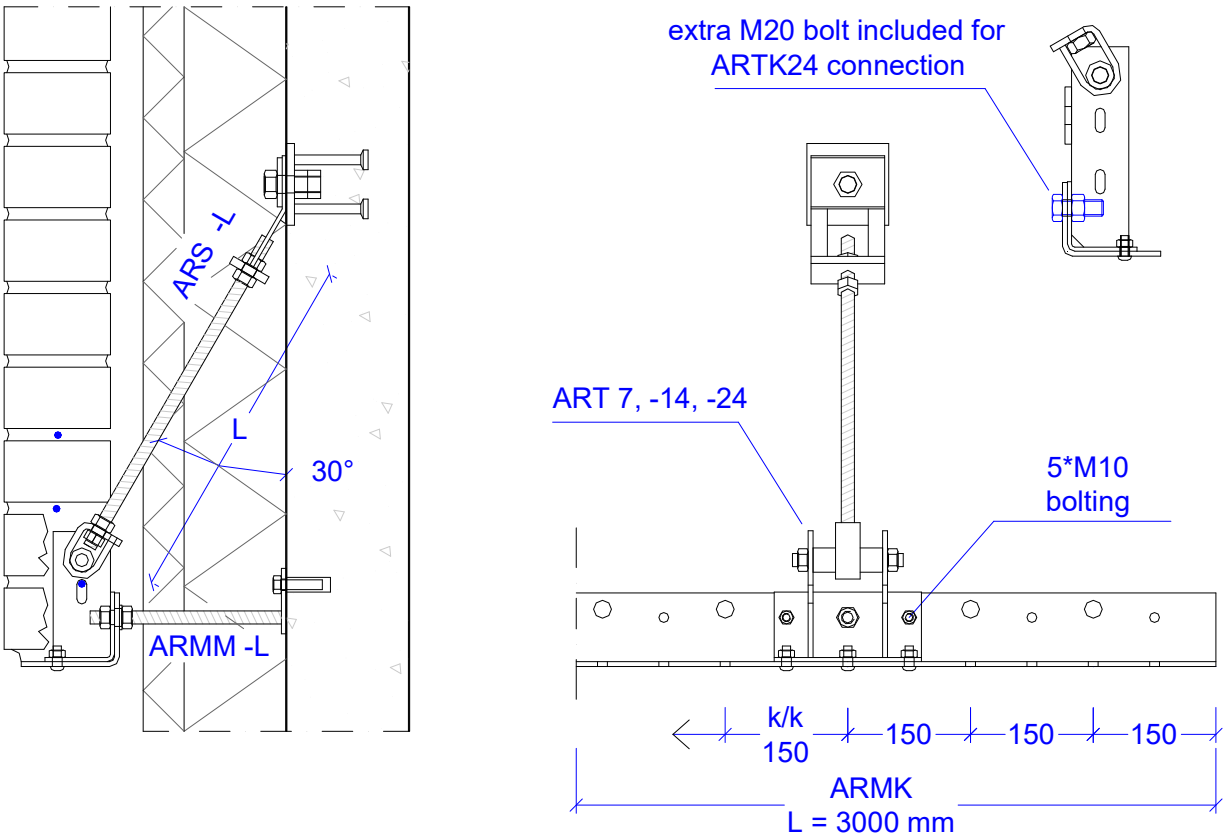


Fig 20. Brickwork support with the AR® suspension system

6.4 Assembly tolerances

The AR® suspension system gives the following adjustability

- suspension angle	30° ± 5°
- tension tie horizontal position	± 30 mm
- building frame vertical fixing position	± 20 mm
- compression tie horizontal length	± 10 mm

dowel connection:

- position in panel thickness	± 5 mm
- panel horizontal position	± 15 mm

If the compression tie tolerance is exceeded the threaded bar must be changed to proper length.

7 QUALITY CONTROL

Anstar Oy has a quality control agreement with Inspecta Certification Oy.

8 ASSEMBLY CONTROL PROCEDURES

8.1 Fixing steel parts to formwork

Before concrete casting it should be checked that

- the steel parts to be used are of correct size
- steel parts are fixed properly into correct position
- threaded and protruding parts are protected

After removal of formwork

- check anchor positions
- check threaded and protruding parts, clean them when necessary
- threaded parts are protected for storage and transport

8.2 Facade assembly on site

The assembly is carried out according to designer's plan. Care should be taken that

- building frame anchors are according to tolerances
- the ARS component has the correct length (distance between panel inner side and building frame)
- the brickwork support beam is connected to ART or ARTK anchors according to designer's instructions.