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Modular Steel Construction

Modular steel construction

Usually, the steel construction for elevated conveyor systems such as APM accumulating conveyors is considered to be a special design.

While it is true that the steel construction is not only guided by the length and width of the conveyor technology, its superstructure and support must be in line with the plant layout, too.

This is why the steel construction is always a special solution specifically designed for the individual application.

However, special solutions may also include standard ones, as evidenced by the popularity of the Euro gripper system.

Here, the modular approach is key to standardization.

This presentation shows how our colleagues from Tünkers Iberica APM have implemented this approach to complex steel constructions.

The modular steel construction “Concept“

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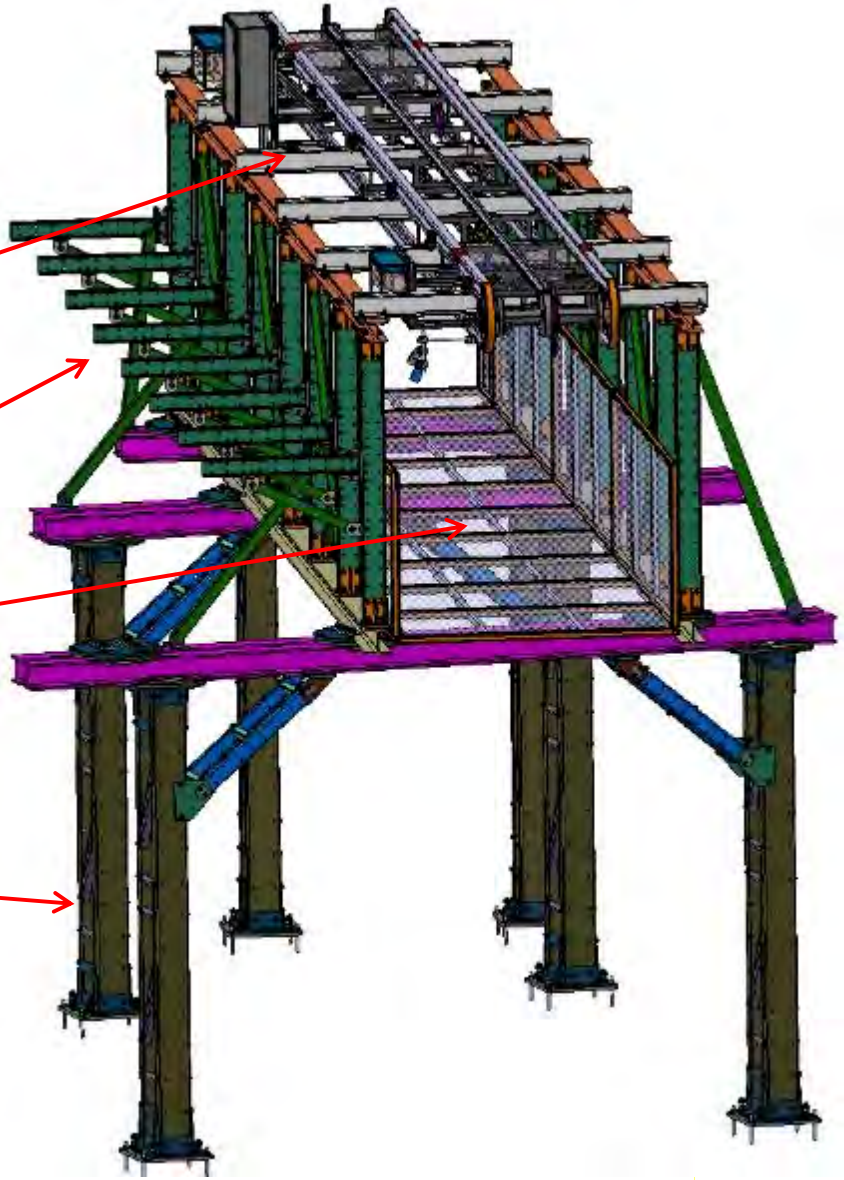
The accumulating conveyor belt is positioned on both sides of the cross member with horizontal connection

Support for maintenance bridge

Accessible workpiece guard

Pillars are assembled on site in line with plant layout



The modular steel construction “Concept“

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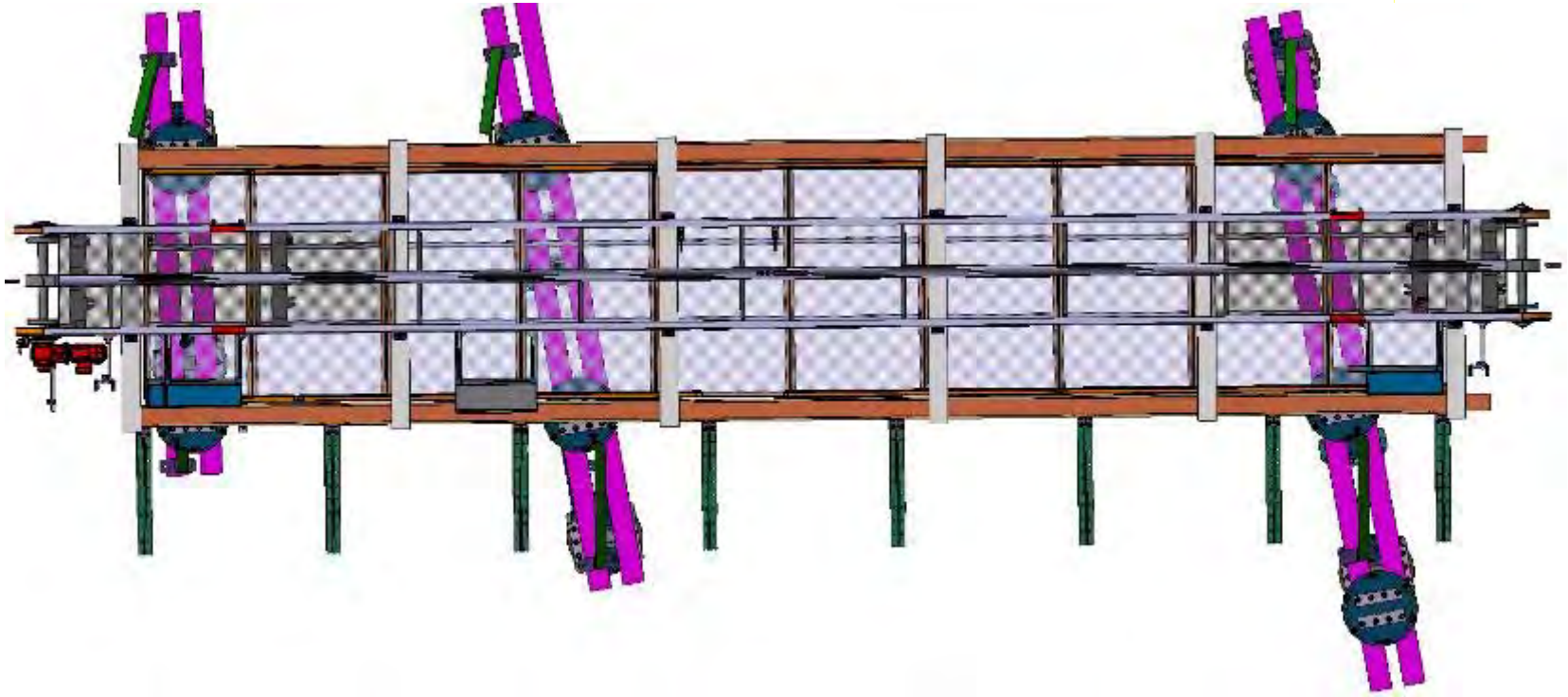
Bridge design with lateral laggings positioned on pillars.
The supports of the pillars may be positioned individually as specified by the plant manufacturer.



The modular steel construction “Concept“

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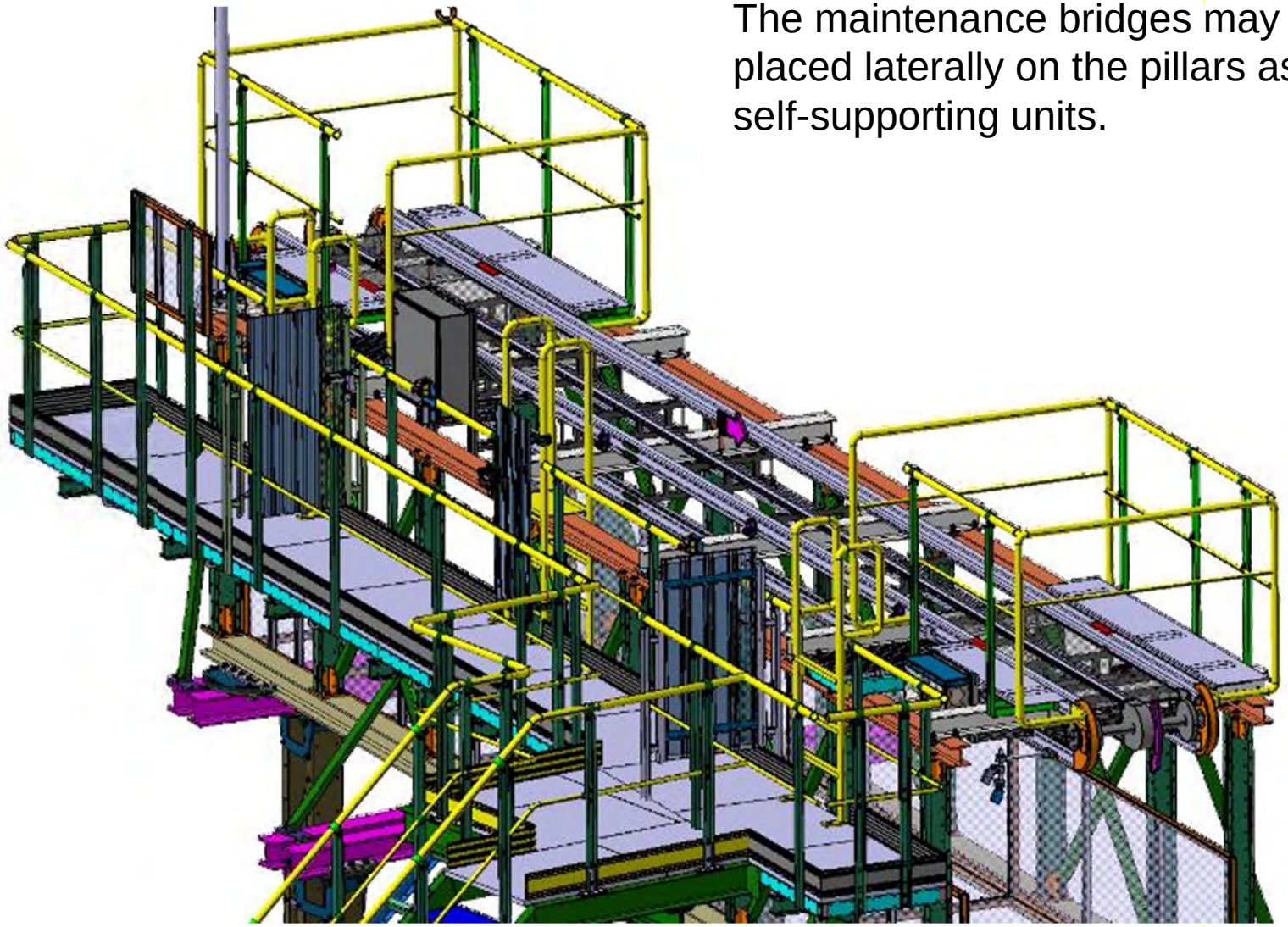

The maintenance bridges may be placed laterally on the pillars as self-supporting units.

The modular steel construction “Concept“

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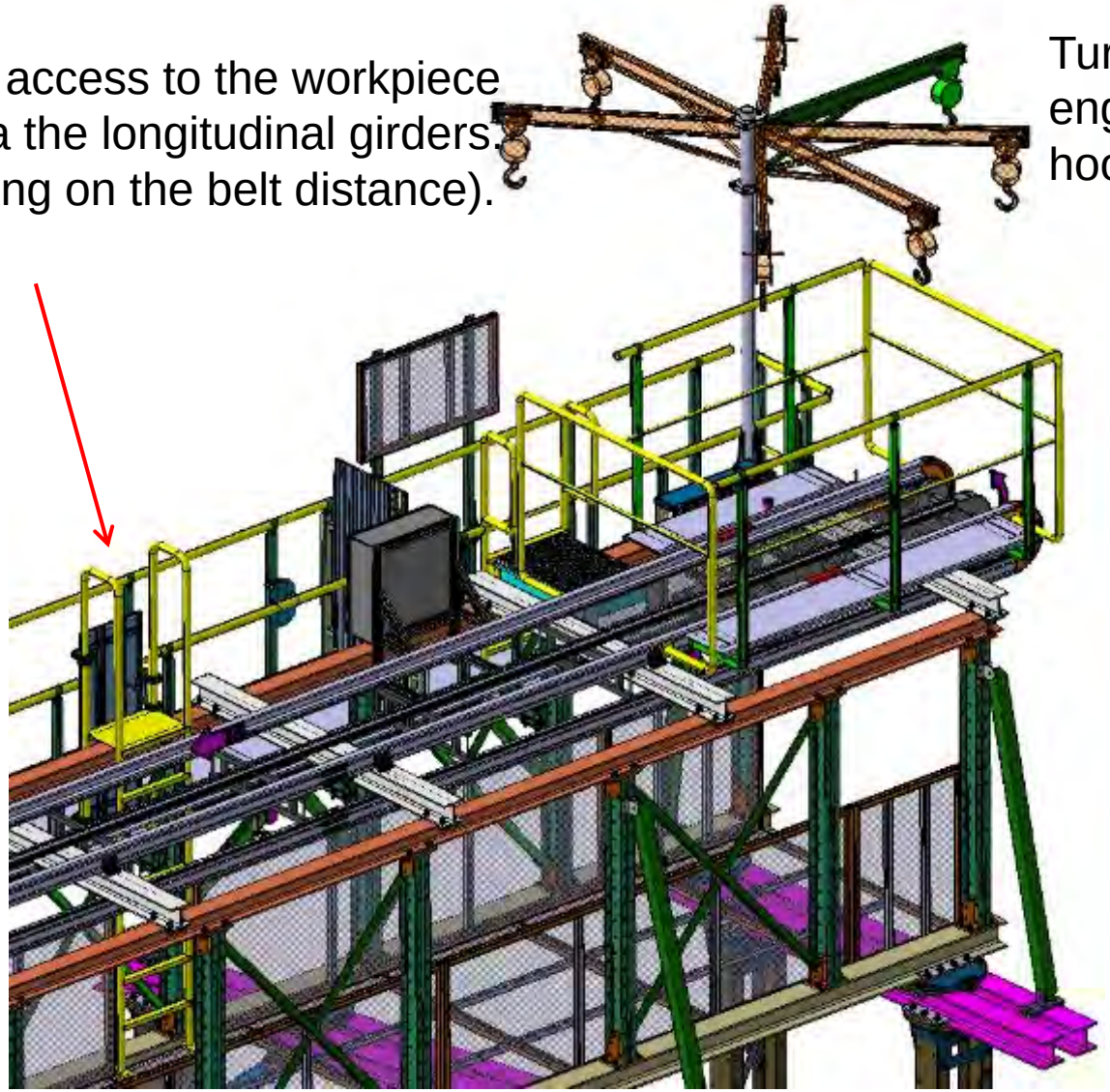
Optional access to the workpiece guard via the longitudinal girders. (depending on the belt distance).



Turning engine hooks

The modular steel construction “Concept“

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LADDER in modular design:

STAIRWAY in modular design:

The modular steel construction “Components“

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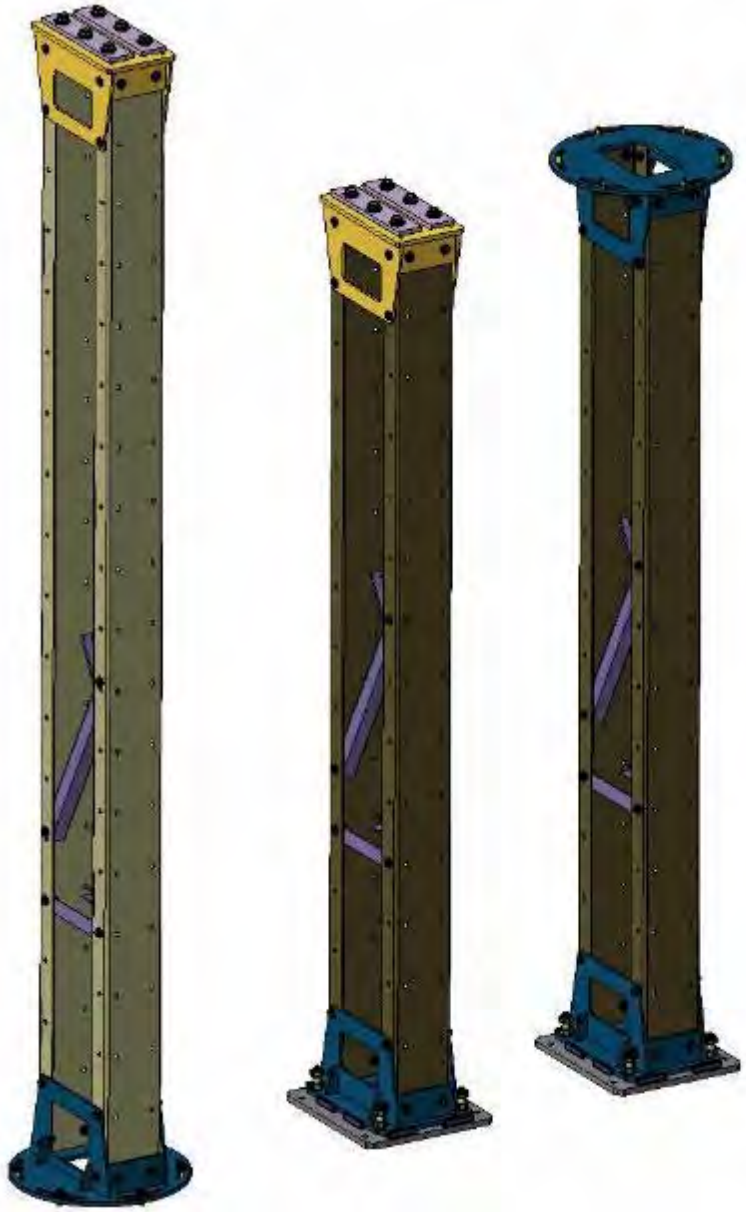

Structure

SUPPORTS and BEAMS
are adapted on assembled on site

Beams to enhance rigidity

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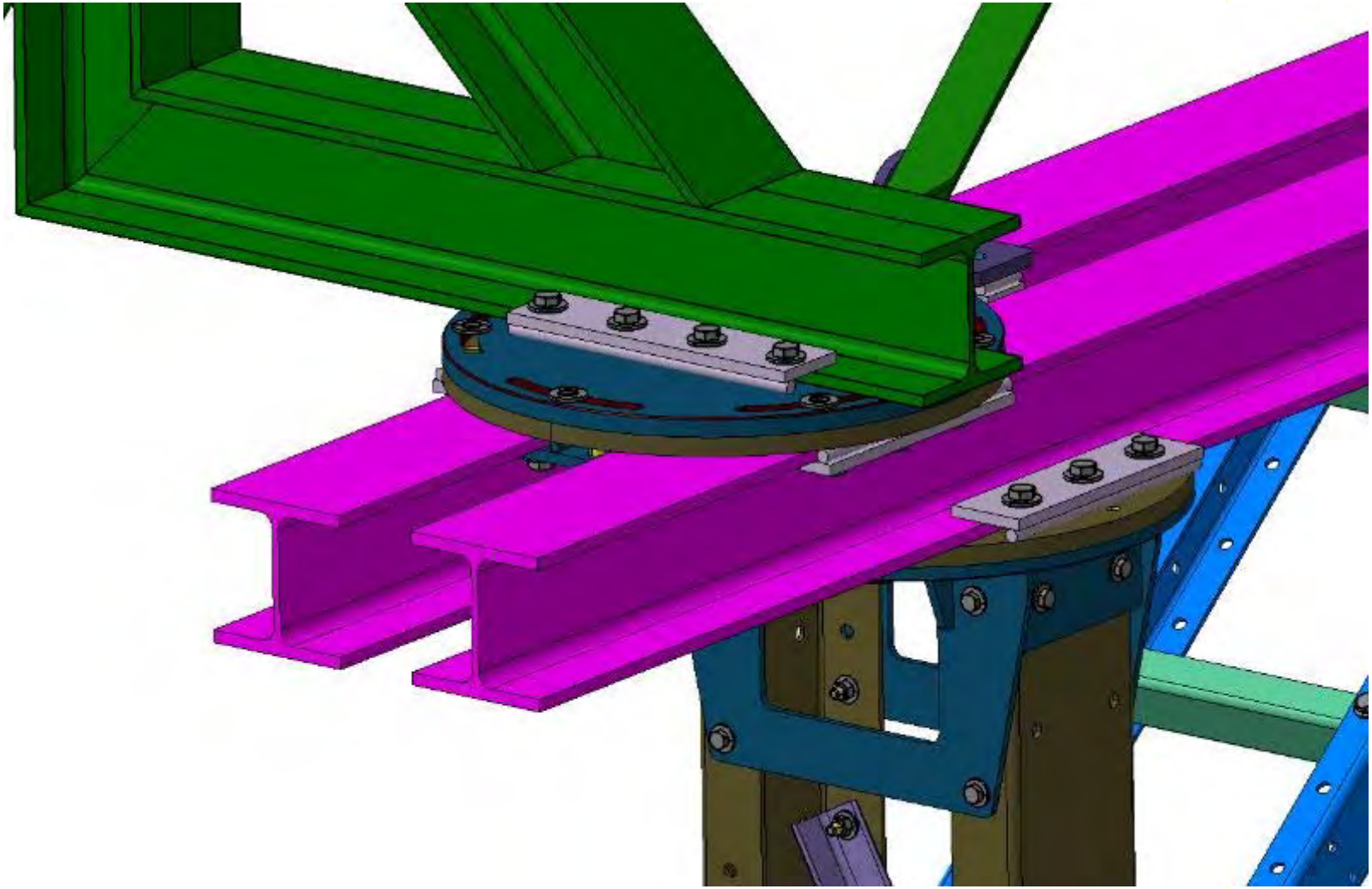
Standard modules



Application example of a connecting disc

The modular steel construction “Components“

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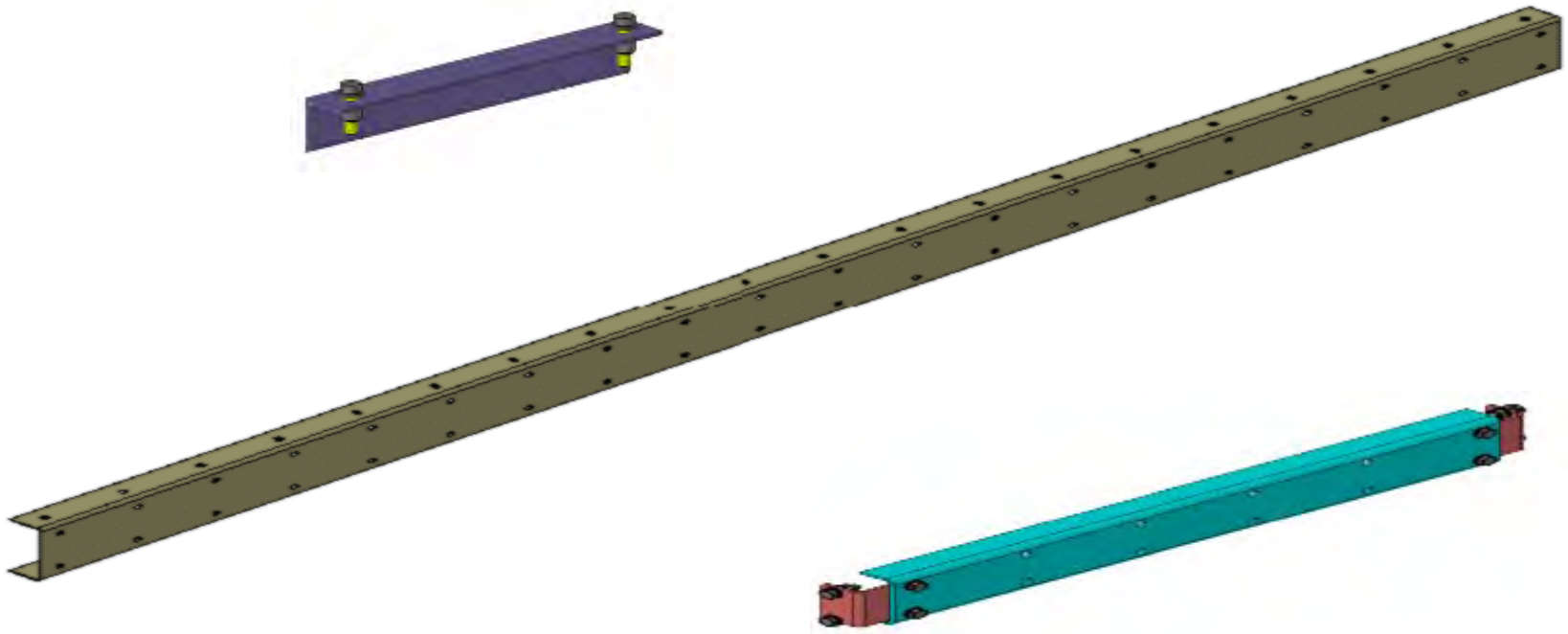
Standard modules

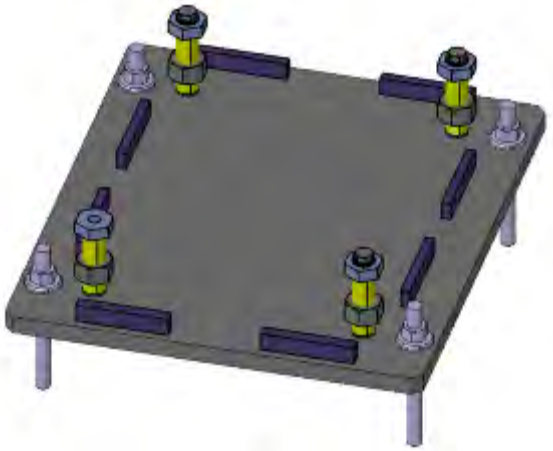
Beam and tension rod:



The modular steel construction “Components“

Standard modules

Preassembled components
Manufactured with material and quality documentation
Welding certificate to DIN EN ISO 9606-1:2013



The modular steel construction “Components“

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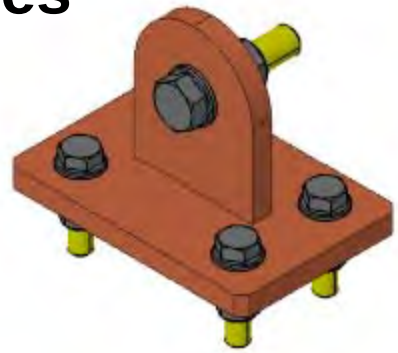
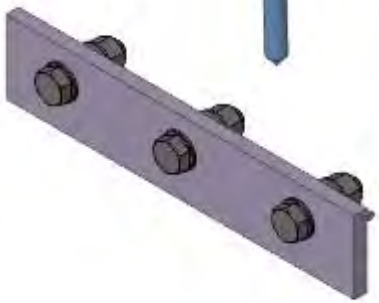
Standard modules





Mechanical connections in modular construction are manufactured in series

The modular steel construction “Components“

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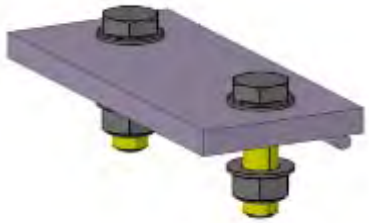
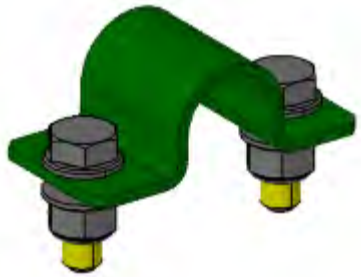
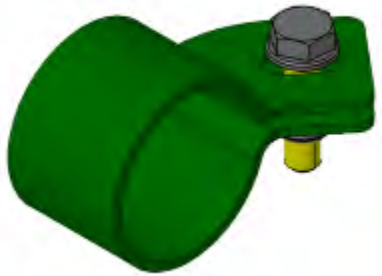
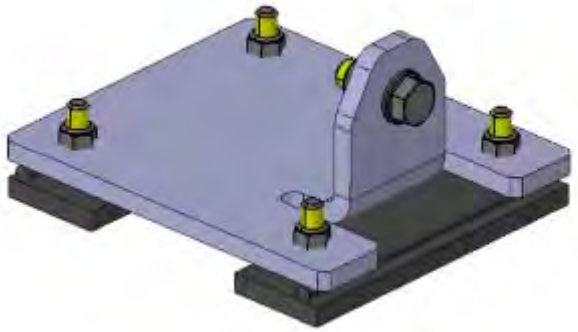




Standard modules

Mechanical connections in modular construction are manufactured in series





The modular steel construction “Assembly“

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- The material is delivered in compact packages. The individual parts may be removed manually.

- The entire material may be stored in a small area on site.

- Staff can start with any steel construction.

- Large parts like supports or struts are assembled into structural components on site.

- After assembly of the supports in the required position, the steel construction is assembled without welding, allowing for a very flexible assembly approach on site.

The modular steel construction “Assembly“

- The tips of the fitted supports and struts are provided with series-manufactured standard
- Together with the bars and brackets, everything is assembled into an entire steel construction.
- The bars of the steel construction may also be added at the end of the assembly and adapted to the surrounding conditions such as cable ducts, electric cabinets, etc.

The modular steel construction “Quality/Standards“

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The following standards are included/met

Eurocode 1: Actions on structures (EN 1991)

Eurocode 3: Design of steel structures (EN 1993)

Eurocode 8: Design of structures for earthquake resistance (EN 1998)

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SCREW CONNECTIONS

Elements used:

Hexagon head cap screw:
DIN EN 14399-4: M12, M16 Property class10.9

High-strength preload nuts:
DIN EN 14399-4: M12, M16

Conical spring washer:
DIN 6796: M12, M16

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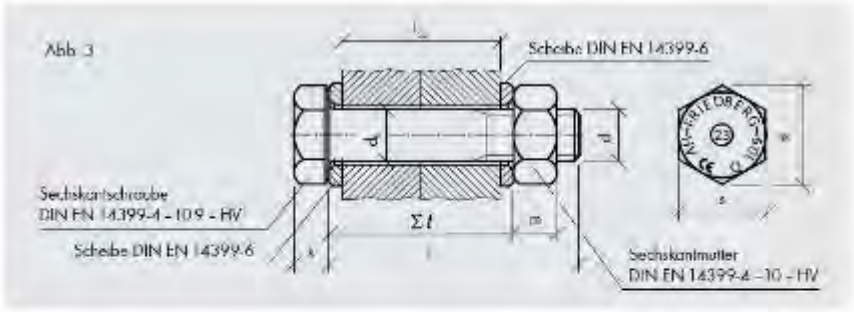
Elements used: High-strength preload screw connections

Hexagon head cap screw DIN EN 14399-4: M12, M16
High-strength preload nuts DIN EN 14399-4 : M12, M16
Property class10.9



Gewinde-Ø	d	M12	M16	M20	M22	M24	M27	M30	M36
Schaft-Ø	d_s	= Gewinde-Ø d							
Kopfhöhe	k	8	10	13	14	15	17	19	23
Mutternhöhe	m	10	13	16	18	20	22	24	29
Schlüsselweite	s	22	27	32	36	41	46	50	60
Eckenmaß	e	23,91	29,56	35,03	39,55	45,20	50,85	55,37	66,44

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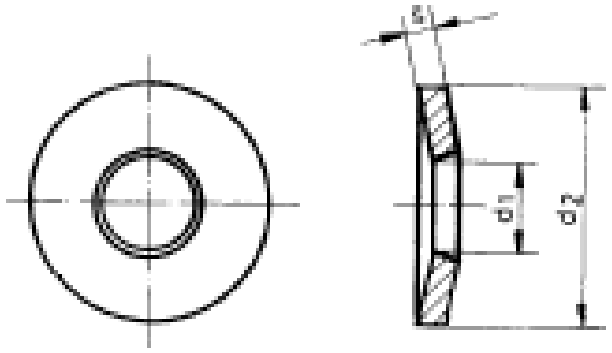
Elements used:

Conical spring washer DIN 6796 M12, M16

Spannscheiben DIN 6796



für Gewinde	d_1 x d_2	s
M 3	3,2x 7	0,6
M 4	4,3x 9	1
M 5	5,3x11	1,2
M 6	6,4x14	1,5
M 8	8,4x18	2
M 10	10,5x23	2,5
M 12	13x 29	3
M 14	15x 35	3,5
M 16	17x 39	4
M 18	19x 42	4,5
M 20	21x 45	5
M 24	25x 56	6

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Instruction for tightening moments for socket cap screws

Anziehmoment für Schaftschrauben mit Kopfauflagen nach DIN 912, 931, 934 und einem Reibbeiwert von μ ges.=0,14 nach Bauer und Schaute. Werden die Schrauben in AL – Werkstoffe eingeschraubt, sind die Anzugsmomente der Spalte 8.8 anzuwenden, unabhängig von der Schraubenfestigkeit.

Schaftschrauben

verwendete Schraubenqualität 10.9

	Abmessung	Vorspannkraft F_V [N]			Anziehdrehmoment M_A [Nm]		
		8.8	10.9	12.9	8.8	10.9	12.9
Regelgewinde	M 4	3900	5750	6700	3,0	4,4	5,1
	M 5	6400	9400	11000	5,9	8,7	10
	M 6	9000	13200	15500	10	15	18
	M 8	16500	24300	28400	25	36	43
	M10	26300	38700	45200	49	72	84
	M12	38400	56500	66000	85	125	145
	M14	52500	77500	90500	135	200	235
	M16	72500	107000	125000	210	310	365
	M18	91000	129000	152000	300	430	500
	M20	117000	166000	195000	425	610	710
	M22	146000	208000	244000	580	830	970
	M24	168000	240000	281000	730	1050	1220
	M27	222000	316000	369000	1100	1550	1800
	M30	269000	384000	449000	1450	2100	2450

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Proof of life and strength

Steels for steel construction: hot-rolled structural steels

St 44-2 to DIN 17100, S 275 JR to EN 10025-2

Mechanical properties:

	Material number	max. tensile strength Rm (N/mm²) < 3 mm	Yield point Re (N/mm²) < 16 mm	Ductile yield A [%]
S 275 JR	1.0044	430 - 580	275	22

• The high-quality materials and the generously dimensioned connections ensure a long life even when subject to intense dynamic effects (vibrations caused by man or machine).

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Fatigue strength of screw connections

• The **high-strength prestress screw connections** used in modular steel construction provide for low-slippage and low-ductility screw connections which are used mainly in designs where undesired deformation within the connections would limit the properties of the structures. The key parameters of connections of this kind are the static friction coefficient and the preload in the screws.

• The screws are manufactured with a lower thread dimension of tolerance class 6az (thread play) before adding the surface protection (DIN EN ISO 10684). After galvanization, the screws are “ISO compliant”.

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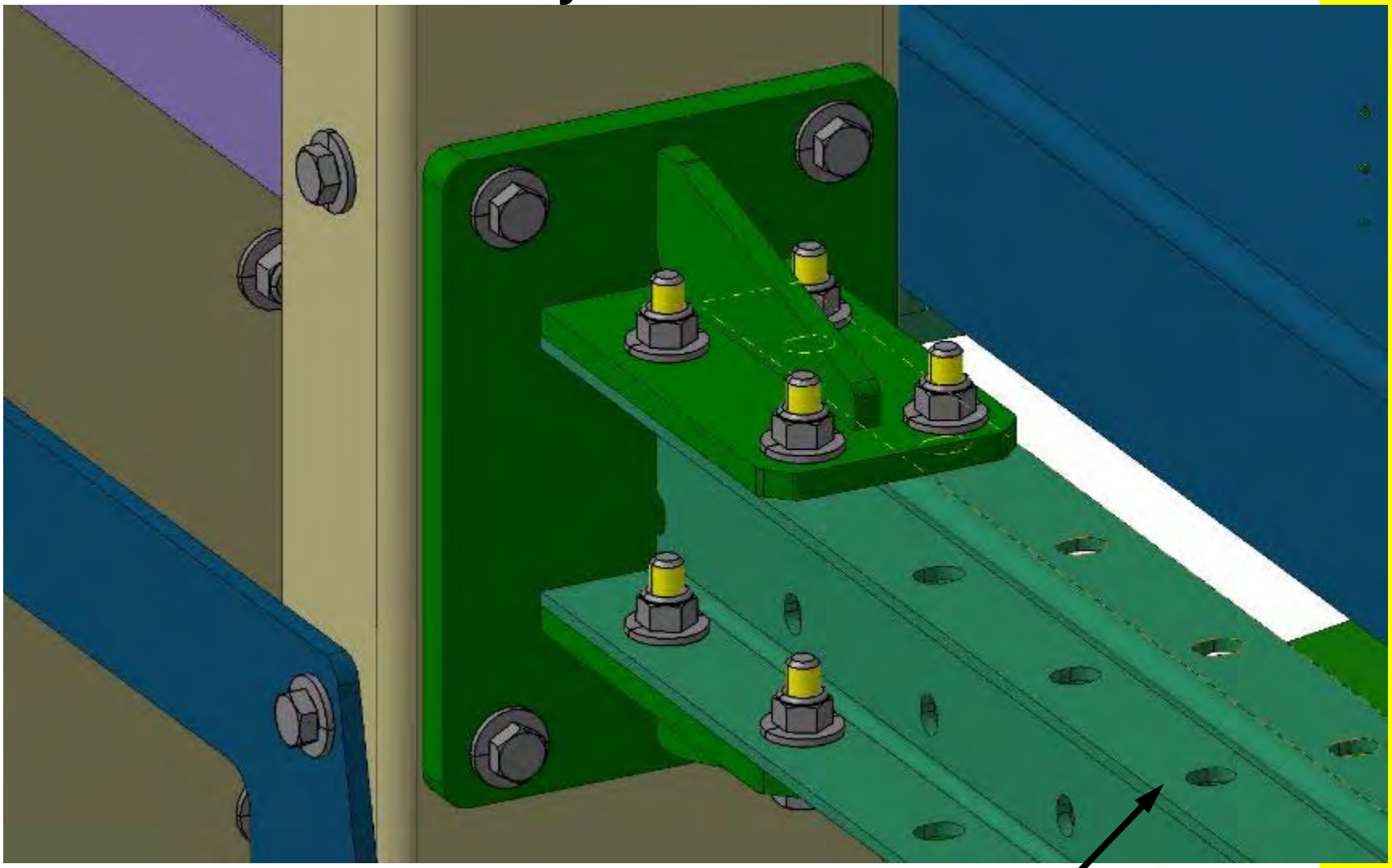
Play of holes



Detail: laser-cut elongated holes

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Play of holes

In order to check whether the spring preload of the washers (spring washers) is sufficient, a restraint was removed. It was fastened with three M12 screws. A paint coat thickness of 0.2 mm was measured at the component. With a travel of 0.4 mm, the spring washer was in line with the reference value in the table. In the area of the screw pressure, the paint coat was compressed to 0.05 to 0.1 mm.
From this finding, we can derive that a residual preload of 0.4 mm corresponding to 9000N preload remains when two spring washers are added with M12 screws and a total travel of 0.8 mm after deduction of 4* paint thickness 0.1=0.4, if the paint dissolves completely.

When the number of screws is adapated to the load, the connection may be regarded as fatigue endurable.

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Assembly certificates

- All screws tightened are marked with red sealing wax.

- Parts in Poka Yoke design in order to avoid mixing up modules.

Certificate of qualification of assembling staff

- All components are checked and approved by a head mechanical engineer on site.
- No welders required, as no welding is done on site.

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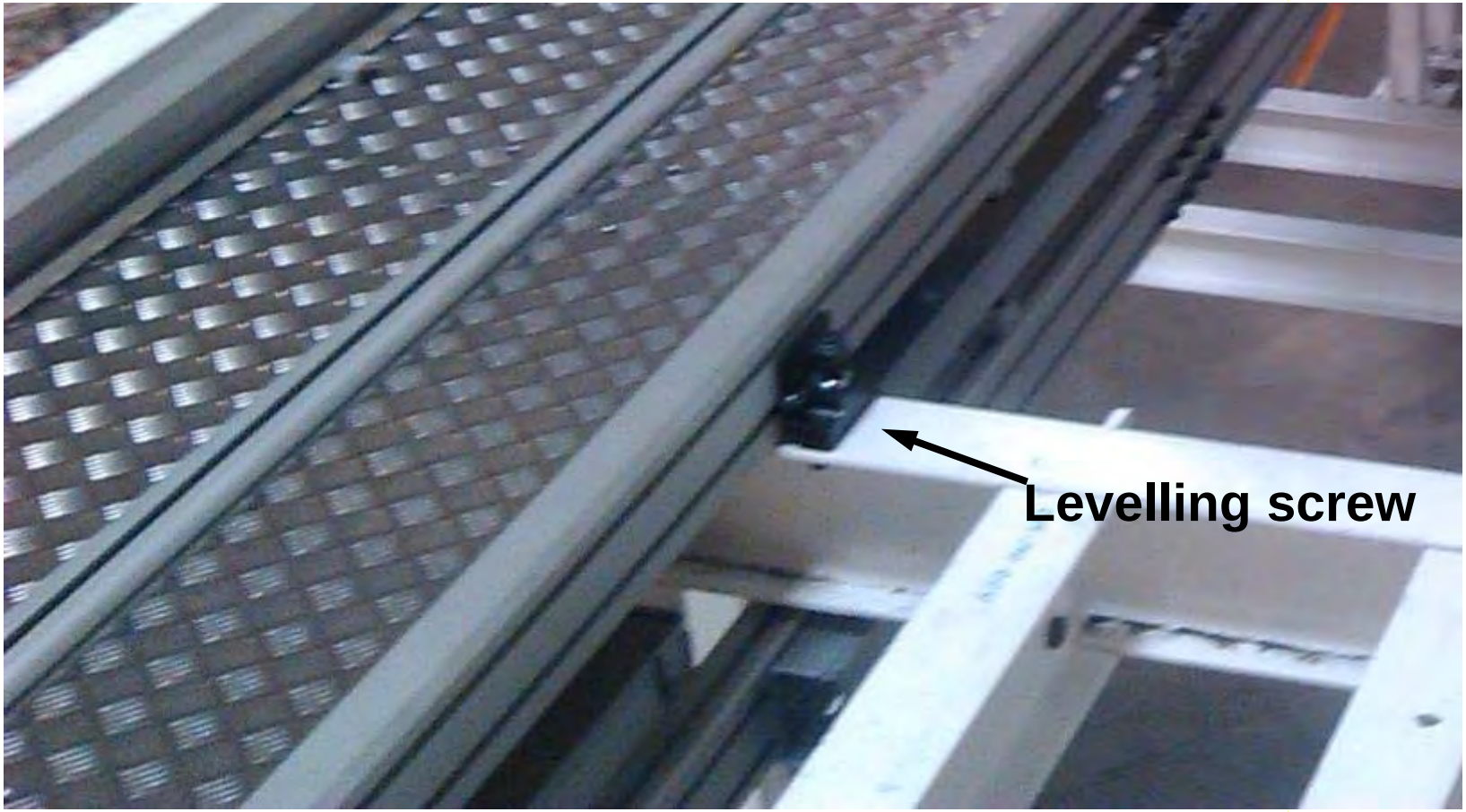
Levelling of belt



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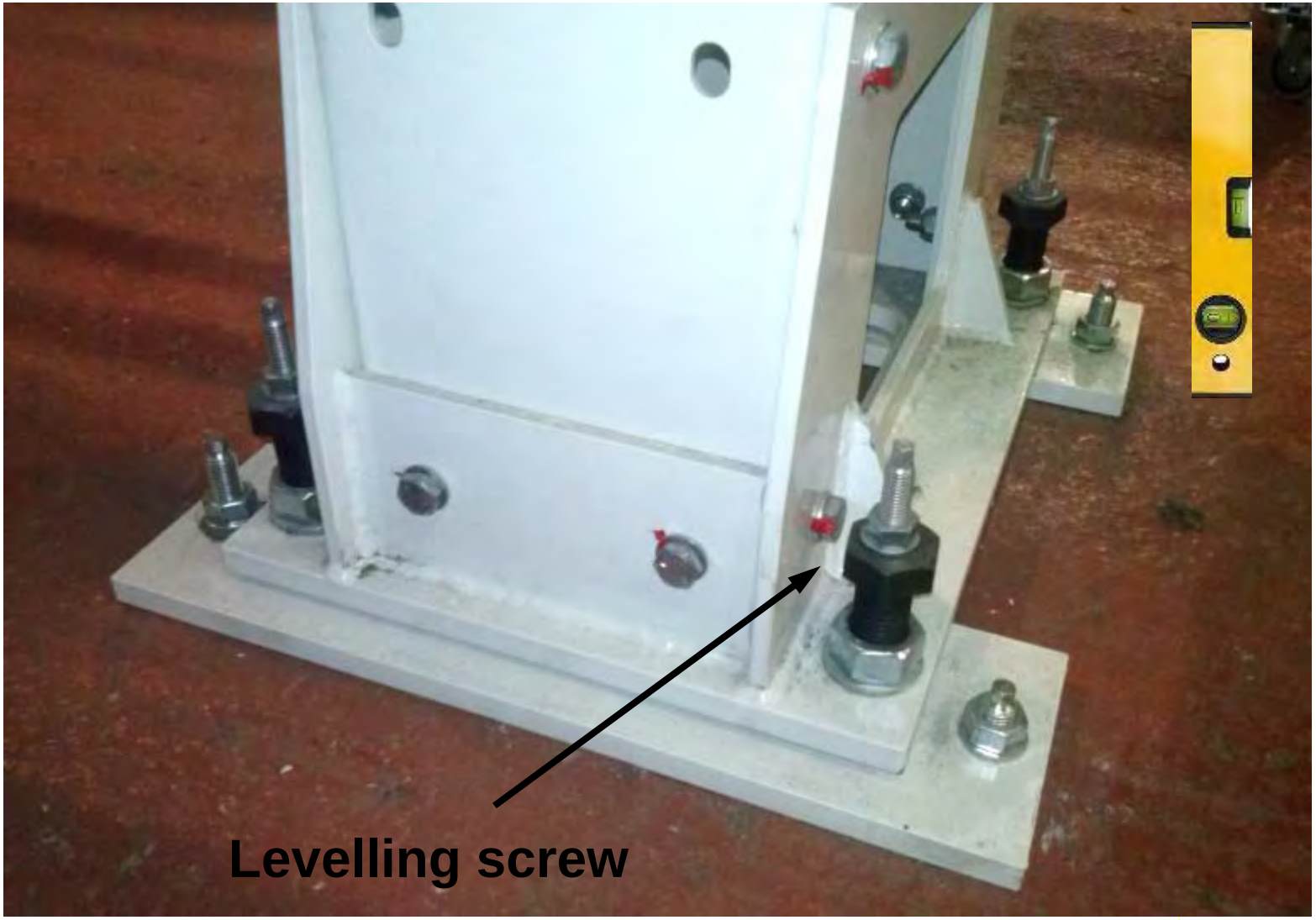
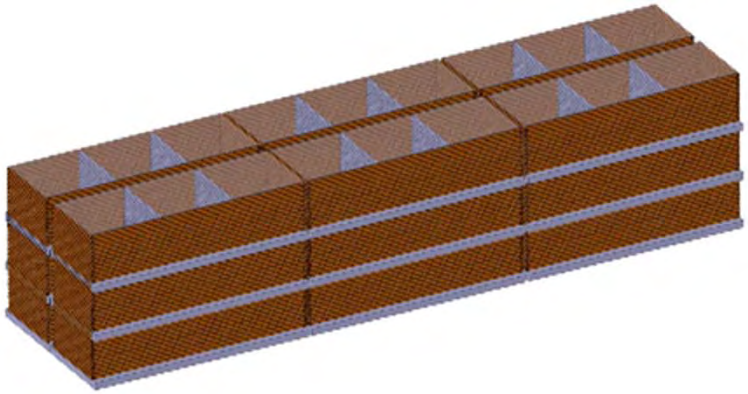
Levelling of steel construction

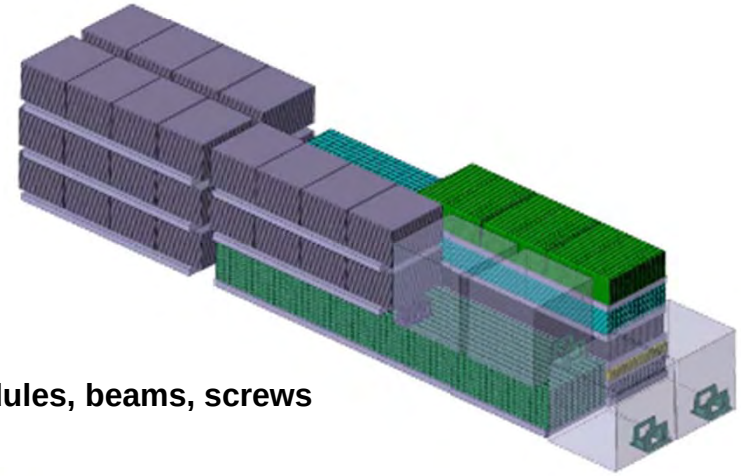


The modular steel construction “Logistics“

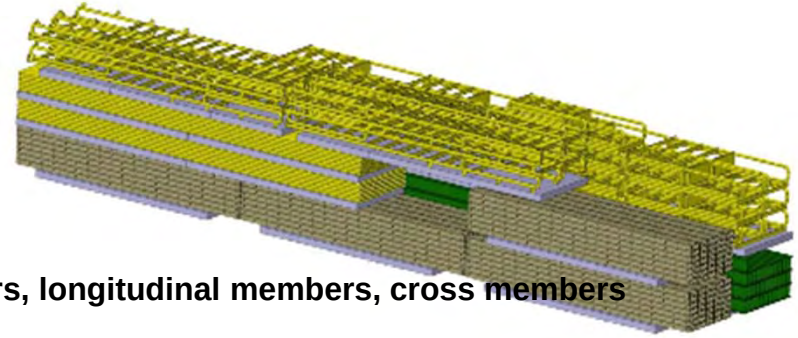
Dispatch in 40´containers,
Irrespective of the size of the steel structures



Workpiece guard



Modules, beams, screws



Ladders, longitudinal members, cross members

Ca. 5 containers are required for 15 medium-sized steel structures

The modular steel construction “Benefits“

- The benefits at a glance

  - Planning of all standard parts irrespective of the specific design
  - Complete final assembly on site
  - High flexibility with regard to modifications
  - Low transport costs thanks to modules
  - “Space-saving” assembly thanks to low number of lifting devices required

- As compared to conventional steel construction
  - Individual special design
  - Pre-assembly of complete complex welding modules
  - A lot of transportation required
  - Final assembly of large components on site requires lifting devices
  - It is not possible to modify the basic design on site
  - All modifications on site are very difficult to handle

Your contacts

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