Layher Allround Scaffolding®
Modular System
Allround Steel

General Building Authority Approval Z-8.22-64

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certified according to
DIN EN ISO 9001:2000
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General Building Authority Approval

Approval number: Z-8.22-64

Applicant: Wilhelm Layher GmbH & Co. KG
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Subject of approval: Modular system “Layher-Allround”

Validity until: 30. April 2012

The aforementioned subject of approval is herewith given general building authority approval. *

This general building authority approval comprises 21 pages plus Annex A (pages 1 to 4), Annex B (pages 1 to 69) and Annex C (pages 1 to 5).

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* This general building authority approval supersedes the general building authority approval No. Z-8.22-64 dated 17. August 2000, amended by the notification dated 29. August 2005.
The subject was first given general building authority / building law approval on 10. April 1984.

I. GENERAL SPECIFICATIONS

1 The General Building Authority Approval certifies the usability or applicability of the object of the approval in line with German building regulations.

2 The General Building Authority Approval does not replace the approvals, agreements and certification specified for carrying out construction work.

3 The General Building Authority Approval is granted notwithstanding the rights of third parties, in particular of private protected rights.

4 The manufacturer and seller of the object of the approval must, notwithstanding more extensive regulations in the “Special Specifications”, make copies of the General Building Authority Approval available to the persons using or applying the object of the approval, and must make clear that the General Building Authority Approval must be present at the site of use. Copies of the General Building Authority Approval must be made available to the responsible authorities on demand.

5 The General Building Authority Approval may only be reproduced in its entirety. The publication of extracts requires the agreement of the German Civil Engineering Institute. Text and drawings in advertising material must not conflict with the General Building Authority Approval. Translations of the General Building Authority Approval must contain the statement: “Translation of the original German version not approved by the German Civil Engineering Institute (Deutsches Institut für Bautechnik, DIBt)”.

6 The General Building Authority Approval can be revoked. The specifications in the General Building Authority Approval can be supplemented or changed at a later time, particularly when new engineering knowledge requires it.

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II. SPECIAL SPECIFICATIONS

1 Object of the approval and field of application

The object of this General Building Authority Approval is the “Layher Allround” modular system for the erection of working and protective scaffolding, support scaffolding and other temporary structures.

The modular system is composed of standards, ledgers, diagonal braces and decks as the fundamental components, with the addition of system components for side protection, access components and supplementary components. The standards, ledgers and diagonal braces are joined together using special “Layher Allround” connectors. Various types of these scaffolding connectors are available.

The approval also applies to the manufacture of the scaffolding components, unless it is stated that their manufacture is governed by General Building Authority Approval Z-8.1-16.2, or that the components are no longer manufactured, i.e. are only approved for continued use.

The scaffolding connectors consist of a rosette welded to a standard, and of connecting heads welded to U-ledgers or O-ledgers or swivel-mounted to vertical diagonal braces. The connecting heads surround the rosette, and are wedged to the rosette by hammering in a permanently attached wedge in such a way that the connecting head is forced against the standard. The horizontal diagonal braces are connected to these by inserting a bolt into the hole of the rosette.

A maximum of eight ledgers or diagonal braces can be connected to each rosette.

The standard safety verification of working and protection scaffolding is covered by the specifications of DIN EN 12811-1: 2004-03, together with the “Application Guideline for Working Scaffolding in Accordance with DIN EN 12811-1”[1], and, for verification of the stability of support scaffolding, the specifications of DIN 4421:1982-08, together with the “Adaptation Guideline for Steel Construction”[2]. The parameters applicable for the stability verification are given in this General Building Authority Approval.

A standard variant for application of the scaffolding components to facade scaffolding is described, for which the standard safety verification is provided. Variants differing from this require special verification. The standard variant applies to facade scaffolding with a height of up to 24 m above the ground, not including the spindle extension length. In its standard variant, the scaffolding system may be used with a system width b = 0.732 m, and with a bay width $\ell \leq 3.07$ m for working scaffolds in load classes ≤ 3 in accordance with DIN EN 12811-1:2004-03, as well as a brick guard and roof brick guard in accordance with DIN 4420-1:2004-03.

2 Specifications for scaffolding components

2.1 Properties

2.1.1 General

The individual parts of the “Layher Allround” scaffolding connector listed in Table 1, and the scaffolding components according to Table 2, must meet the specifications of Annex B, and the individual components of the scaffolding connector must also correspond to the document filed with the DIBt, as well as the regulations in the following sections.

1 See DIBt Bulletins, Volume 2/2006, Page 66 ff

2 See DIBt Bulletins, Special Volume 11/2

Table 1: Individual parts of the “Layher Allround” scaffolding connector

Individual part	Variant	According to Annex B, page	Regulations for manufacture and verification of compliance
Rosette	“Variant K 2000+”	5	Sections 2.1 to 2.3
	“Variant II”	12 and 13	Components are no longer manufactured, only permitted for continued use
	“Variant I”	23 and 24	
Connecting head for O-ledgers	“Variant K 2000+”	6	Sections 2.1 to 2.3
	“Variant II”	14 and 15	Components are no longer manufactured, only permitted for continued use
	“Variant I”	25	
	“Stamped variant”	29	
Connecting head for U-ledgers	“Variant K 2000+”	7	Sections 2.1 to 2.3
	“Variant II”	26	Components are no longer manufactured, only permitted for continued use
	“Variant I”	8	
Connecting head for U-brackets	“Variant K 2000+”	8	Sections 2.1 to 2.3
	“Variant II”	18 and 19	Components are no longer manufactured, only permitted for continued use
	“Variant I”	26	
Connecting head for vertical diagonal braces	“Variant K 2000+”	9	Sections 2.1 to 2.3
	“Variant II”	20	Components are no longer manufactured, only permitted for continued use
	“Variant IB”	27	
	“Variant IC”	28	
Wedge	“Variant K 2000+”	21 and 22	Sections 2.1 to 2.3
	“Variant II”	11	Components are no longer manufactured, only permitted for continued use
	“Variant I”		
Connecting head for horizontal diagonal braces	---	11	Sections 2.1 to 2.3

Table 2: Scaffolding components for use in the “Layher Allround” modular system

Name	Annex B, page	Regulations for manufacture and verification of compliance
Adjustable base plate	30	According to Z-8.1-16.2
Vertical base collar	31	Sections 2.1 to 2.3
Vertical standard with spigot	32	
O-ledger	33	
U-ledger	34	
Diagonal braces	36	

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Table 2: Continuation

Name	Annex B, page	Regulations for manufacture and verification fo compliance
Lift-off preventer	37	Sections 2.1 to 2.3
Allround toe board	38	
U-steel toe board	39	
U-bracket	40	
O-lattice girder	41	
Spigot for lattice girder	42	
U-lattice ledger	43	According to Z-8.1-16.2
Brick guard	44	Sections 2.1 to 2.3
Wall tie	45	According to Z-8.1-16.2
Locking pin	46	
Horizontal diagonal brace	47	Sections 2.1 to 2.3
U-steel deck 0.32 m (spot welded)	48	According to Z-8.1-16.2
U-steel deck 0.32 m (manually welded)	49	
U-steel deck 0.32 m T4 (spot welded)	50	
U-steel deck 0.32 m T4 (manually welded)	51	
U-Robust deck 0.61 m	52	
U-Robust deck 0.61 m	53	
U-Robust deck 0.32 m	54	
U-steel hatch deck 0.61 m	55	
Storey ladder	56	
U-Robust hatch 0.61 m with ladder	57	
Vertical base collar (“Variant II”)	58	Components are no longer manufactured, only permitted for continued use
Vertical standard with spigot (“Variant II”)	59	
O-ledger (“Variant II”)	60	
U-ledger 0.73 m (“Variant II”)	61	
Diagonal brace (“Variant II”)	62	
U-bracket 0.36 m (“Variant II”)	63	
O-lattice girder (“Variant II”)	64	
Brick guard (“Variant II”)	65	
Aluminium assembly guard rail	66	According to Z-8.1-16.2
Assembly post T5	67	
Post with wedge heads	68	Sections 2.1 to 2.3

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2.1.2 Materials

2.1.2.1 Metals

The metals must satisfy the Technical specifications according to Table 3, and their properties must be confirmed by test certificates in accordance with the specifications given in Table 3.

2.1.2.2 Solid wood

Solid wood must meet at least sorting category S 10 according to DIN 4074-1: 2003-06.

2.1.3 Corrosion protection

The specifications of DIN 18800-7:2002-09 apply.

Table 3: Technical specifications and test certificates for metal materials used for individual and scaffolding components.

Material	Material number	Short name	Technical specification	The certificate according to DIN EN 10204:2005-01
Structural steel	1.0039	S235JRH*)	DIN EN 10 219-1: 2006-07	2.2*)
	1.0149	S275JOH		
	1.0038	S235JR	DIN EN 10025-2: 2005-04	
	1.0070	E360		3.1
Malleable cast iron	EN-JM1030	EN-GJMW-400-5	DIN EN 1562: 2006-08	
	EN-JM1040	EN-GJMW-450-7		
Strip and plate	1.0242	S250GD	DIN EN 10326: 2004-09	
	1.0335	DD13	DIN EN 10111: 1998-03	

*) The increased apparent yield point $R_{eff} \geq 320$ N/mm² specified for some scaffolding components – these components are appropriately identified in the drawings in Annex B – must be achieved through work hardening when manufacturing the sections. The breaking elongation must not fall below the minimum requirements for steel S355JOH according to DIN EN 10025-2: 2005-04. The values of the apparent yield point and of the breaking elongation must be certified by an acceptance certificate 3.1 in accordance with DIN EN 10204:2005-01.

2.2 Manufacture and identification

2.2.1 Manufacture

Companies that manufacture welded scaffolding components in accordance with this approval must have demonstrated that they are capable of doing so.

For steel components, this verification is deemed to have been made if the company is certified at least to the manufacturer qualification for Class C (Small Suitability Certificate with Supplement) according to DIN 18800-7:2002-9, equivalent to the requirements of the manufacture of welded joints in accordance with this approval.

2.2.2 Identification

The delivery notes for scaffolding components as in Table 2, whose manufacture is regulated in this General Building Authority Approval, must be identified in accordance with the national conformity mark regulations.

In addition, the scaffolding components must be permanently and easily recognizably marked with

- the uppercase letter “Ü”,
- at least the abbreviated approval number “64”,
- the identifying mark of the part’s manufacturer and
- the last two numbers of the year of manufacture.

These identifying marks may only be applied when the conditions according to Section 2.3 have been satisfied.

The encoded form of the identifier can be found in Annex B, Page 69.

2.3 Conformity certificate

2.3.1 General

Confirmation of conformity of the individual parts of the connector according to Table 1 and of the scaffolding components according to Table 2 with the specifications of this General Building Authority Approval must be provided for every manufacturing plant by a Certificate of Conformity on the basis of the factory’s own production checks and of regular external supervision, including product tests on the individual and scaffolding components as defined in the following specifications.

In order to obtain the certificate of conformity and the external supervision, including the product tests that have to be conducted in that connection, the manufacturer of the individual components and scaffolding components must make use of a certifying authority and of a supervision authority recognized for this purpose.

A copy of the certificate of conformity that is granted must be given for information purposes to the German Civil Engineering Institute by the certifying authority, as must a copy of the supervision report by the supervising authority.

2.3.2 Factory production checks

An internal production monitoring system must be set up and operated at every manufacturing plant. “Factory production checks” refers here to the continuous monitoring of production to be carried out by the manufacturer, by means of which the manufacturer ensures that the individual parts and scaffolding components manufactured match the specifications of this General Building Authority Approval.

The factory production monitoring must include at least the measures listed below:

Scaffolding connectors:

- Checks and inspections of the individual parts according to Table 1:
  - It is necessary to check that inspection certificates in accordance with section 2.1.2 are available for the materials, and that the test results certified meet the requirements.
  - By examining at least 10 individual parts per production batch, comprising at least 1 individual part from every 10,000 parts manufactured, conformity of the important dimensions and angles with the documentation lodged with the German Civil Engineering Institute must be checked. The actual measurements must be documented.
  - The malleable cast iron connecting heads must be examined for absence of cracks.
- Tests to be conducted on the scaffolding connectors include:
  - 0.025 ‰ of the rosettes manufactured, and in any case at least one in each manufacturing week, must, after connection to a standard, be subjected to a tension test with normal force, in which an O-ledger is attached to one side and a U-ledger to the other, until failure; the failure loads must not have a value less than 34.1 kN. The tests must be conducted in accordance with

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the regulations in the "Approval Principles for Working and Protection Scaffolding, Requirements, Calculation Assumptions, Tests, Certificate of Conformity"[3].

- When manufactured using templates or automatic fabrication of the scaffolding connectors, the corresponding templates and/or machine settings must be inspected and documented prior to commissioning.

Scaffolding components according to Table 2:

- Checks and inspections on the starting material:
  - The presence of test certificates in accordance with Section 2.1.2 must be checked; the certified test results must match the requirements.
    - Conformity with the dimensions and tolerances as defined in the data of the design drawings must be checked on at least 1 ‰ of the relevant components.
- Checks and inspections to be carried out on the scaffolding components:
  - Conformity with the dimensions, tolerances, and, where relevant, the welded seams and corrosion protection, as defined in the data of the design drawings, must be checked on at least 1 ‰ of the components concerned.
  - In the case of manufacture using templates or automatic fabrication of the scaffolding components, the corresponding templates and/or machine settings must be inspected and documented prior to commissioning.

The results of the factory production checks must be recorded and evaluated. The records must contain at least the following information:

- Identification of the individual part or scaffolding component
- Type of check
- Date of manufacture and inspection of the individual part or scaffolding component
- Result of the checks and inspections, and comparison with requirements
- Signature of the person responsible for the factory production checks.

The records must be kept for at least five years. They must be presented on demand to the German Civil Engineering Institute and to the responsible superior building inspection authority.

In the event of unsatisfactory test results, the manufacturer must immediately take the necessary measures to rectify the fault. Individual parts or scaffolding components that do not meet the requirements must be handled in such a way that they cannot become confused with conforming parts. Once the fault has been rectified, the test concerned must be repeated immediately, provided this is technically possible and necessary to demonstrate that the fault has been rectified.

2.2.3 External supervision

The factory's own production checks at every manufacturing plant must be regularly inspected by an external supervisory authority; this must be performed at least twice a year for individual parts as in Table 1, and every five years for scaffolding components as in Table 2. In the context of the external supervision, the factory must be inspected, as must the factory's internal production check systems, including the performance of a product test on the individual parts according to Table 1 and on the scaffolding components according to Table 2. The recognized authority is responsible for taking samples and for carrying out the tests.

At least the following tests must be carried out:

- Inspecting the requirements, in terms of both personnel and equipment, for the proper manufacture of the scaffolding connectors and scaffolding components
- Inspecting the factory's own production check system

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[3] Obtainable from the German Civil Engineering Institute.

- Checks on random samples for conformity of the scaffolding connectors and scaffolding components with the specifications of the approval in terms of
  - Construction type, shape, dimensions
  - Corrosion protection
  - Identification
- Inspection of the required welding suitability certificate
- Conformity with the dimensions and angles of at least 5 individual parts of the scaffolding connector with the documentation lodged with the German Civil Engineering Institute must be checked and compared with the permitted tolerances.
- Tension tests under normal force with U-ledgers and O-ledgers as described in Section 2.3.2 must be performed on at least 5 scaffolding connectors.

The individual parts, scaffolding connectors and scaffolding components must be drawn from current production.

The results of the certification and of the external supervision must be kept for at least five years. They must be presented on demand to the German Civil Engineering Institute and to the responsible superior building inspection authority.

3 Specifications for design and dimensioning

3.1 General

Unless and except this document specifies otherwise, construction engineering specifications, in particular for working and safety scaffolding the specifications of DIN EN 12811-1:2004-03, in association with the “Application Guidelines for Working Scaffolding in Accordance with DIN EN 12811-1”[1], as well as the “Approval Principles for Working and Safety Scaffolding, Requirements, Assumptions for Calculation, Tests, Certificate of Conformity”[3] and, for support scaffolding, the specifications of DIN 4421:1982-08 in association with the “Steel Construction Adaptation Guideline”[2], must be observed for the design and dimensions of the scaffolding to be constructed using the modular system. When using the scaffolding connectors in supporting scaffolding in accordance with DIN 4421:1980 2-08, the usable resistance “zulR” must be determined, by dividing the loading capacities quoted in the following sections by 1.5.

The stability of the scaffolding must be demonstrated in each individual case, or through a static type-calculation, if it does not match the standard implementation according to Annex C.

If it cannot be assured that only components for a single variant of the scaffolding connector are used in one scaffolding, or that the effect of different variants of the scaffolding connector has been determined in detailed calculation and design documentation, the data for the variants named below must be used for the verification of the scaffolding concerned:

Relationship between load and deformation:

a) Components of “Variant I” are used in the scaffolding (exclusively, or in combination with components of other variants): data for “Variant I”;
b) Only components of “Variant II” and “Variant K2000+” are used in the scaffolding: data for “Variant K 2000+”.

Verification of load bearing capacity:

a) Components of “Variant I” are used in the scaffolding (exclusively, or in combination with components of other variants): data for “Variant I”;
b) Only components of “Variant II” and “Variant K2000+” are used in the scaffolding: data for “Variant II”.

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Connecting heads of the “stamped version” must be classified the same as connecting heads of “Variant I”.

If vertical diagonals of different versions are used in one scaffolding, then when “Variant IC” is used, the data for “Variant IC” should be applied, whereas if the “Variant IB” or “Variant K2000+” are used, but not “Variant IC”, then the data for “Variant IB” must be used for the verification.

The differences between the constructions of these different variants can be found in Annex B, Pages 2 to 4.

3.2 System assumptions

The static systems must be modelled for calculation purposes according to Annex A, page 4. The short members specified there from the standards to the connectors may be assumed to be rigid. The indices quoted in the following sections refer to a local coordinate system, where the X-axis represents the axis of the ledgers and the Z-axis the axis of the standards (cf. Annex A, page 3).

When verifying the scaffolding system, it must be borne in mind that the bending moment at the joint between the ledger and the standard is taken with reference to the outer edge of the standard, and that the vertical components at the vertical diagonal connection must take account an eccentricity in the connection corresponding to the data in Annex A, page 4. The torsional moment resulting from the horizontal component at the vertical diagonal connection around the axis of the standard is transmitted by the connector, and must be verified in the ledgers.

The design must only call for the stresses listed in the load carrying capacities of Table 4 to be transferred at the connection of a ledger, depending on the variant of the scaffolding connector and the version of the ledger (U or O ledger).

The design must only transmit normal forces at the connections of the diagonals.

The data for the stiffness and load bearing capacity of the connections applies to connections made in the “small” and the “large” hole in the rosette.

In all the formulas in the following sections, the cutting forces N and V must be given in kN, while the bending and torsional moments M must be quoted in kNcm.

3.3 Ledger connection

3.3.1 Load-deformation relationship

3.3.1.1 Bending in the standard/ledger plane

When verifying the ledger under bending stresses in the standard/ledger plane, a torsionally sprung clamping at the ledger connection that for

“Variant I” corresponds to Annex A, page 1, Figure 1, for

“Variant II” corresponds to Annex A, page 1, Figure 2, and for

“Variant K 2000+” corresponds to Annex A, page 1, Figure 3

must be assumed.

3.3.1.2 Bending in a plane perpendicular to the plane of the standard/ledger (horizontal plane)

When verifying the ledger under bending stresses in the plane perpendicular to the plane of the standard/ledger (horizontal plane), a torsionally sprung clamping at the ledger connection that corresponds to Annex A, page 1, Figure 4 must be assumed for “Variant II” and for “Variant K 2000+”.

3.3.1.3 Horizontal load perpendicular to the axis of the ledger

If it is necessary to take into account the deforming effect of the connection to the ledger in a horizontal direction, then when verifying the ledger under stress from horizontal loads perpendicular to the axis of the ledger at the ledger connection – independently of the variant – a travel spring stiffness in respect of displacement according to Figure 7 in Annex A, page 3, must be assumed. The effect of this displacement is normally ignored.

3.3.1.4 Torsion

When verifying “Variant K 2000+” of the O-ledger under torsional stress, a torsionally sprung clamping at the ledger connection in accordance with the moment/twist angle ($M_T/_\varphi$) relationship as shown in Annex A, page 2, Figure 5 must be assumed.

The design may not allow for the transmission of any torsion and connections to U-ledgers and brackets.

3.3.2 Verification of load-bearing capacity

3.3.2.1. General verifications

It must be demonstrated that at the connection of a ledger, the loads are not greater than the load-bearing capacities shown in Table 4.

Table 4: Load-bearing capacities of a ledger connection

Connection parameter	Load-bearing capacity		
	“Variant I”	“Variant II”	“Variant K 2000+”
Bending moment $M_{\gamma,R,d}$ [kNcm]	± 55.0	± 68.0	± 101.0
Vertical transverse force $V_{z,r}$ [kN]	± 17.4	± 17.4	± 26.4
Bending moment $M_{z,R,d}$ [kNcm]	---	± 37.2	± 37.2
Horizontal transverse force *) $V_{\gamma,R,d}$ [kN]	± 6.7	± 6.7	± 10.0
Horizontal transverse force **) $V_{\gamma,R,d}$ [kN]	± 5.9	± 5.9	± 5.9
Torsional torque *) $M_{T,R,d}$ [kNcm]	---	---	± 52.5
Normal force $N_{R,d}$ [kN]	± 18.9	± 22.7	± 31.0

*) Only for O-ledgers
**) Only for U-ledgers

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3.4 Connection of vertical diagonal brace

3.4.1 Load deformation behaviour

When verifying a scaffolding, the vertical diagonal braces including their connections must be taken into account regardless of the design using a travel spring with the dimension values according to Table 6.

Table 6: Dimension values for stiffness of travel spring of vertical diagonal braces

Bay lenght L [m]	Bay height L [m]	Rod length L [m]	Dimension value for stiffness of travel spring $C_{v,d}$ [kN/cm]	
			Stress under normal compressive force	Stress under normal tensile force
6.14	2.5	6.49	3.73	11.82
0.73	2.0	2.08	12.82	13.36
1.09		2.21	12.64	13.27
1.40		2.36	12.45	13.18
1.57		2.45	12.36	13.18
2.07		2.77	11.91	13.09
2.57		3.14	11.45	12.91
3.07		3.54	10.55	12.82
4.14		4.46	8.18	12.45
1.57	1.5	2.06	12.82	13.36
2.57		2.85	11.82	13.00
1.57	1.0	1.73	13.09	13.45
2.07		2.16	12.64	13.27
2.57		2.62	12.18	13.09
3.07		3.08	11.55	12.91
1.57	0.5	1.50	13.27	13.55
2.57		2.47	12.36	13.18
L, H see Annex A, page 4				

3.4.2 Load-bearing capacity verification

For the vertical diagonal braces, the following verification is required depending on the direction of stress:

$$\frac{N_V}{N_{V,R,d}} \leq 1$$

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where

N_V is the tensile or compressive force in the vertical diagonal braces

$N_{V,R,d}$ is the load capability of the vertical diagonal braces relative to the tensile or compressive force according to Table 7

Table 7: Load capabilities of the vertical diagonal braces

L [m]	H [m]	Connecting head											
		"Variant K 2000"			"Variant II"			"Variant IB"			"Variant IC"		
		Rosette variant			Rosette variant			Rosette variant			Rosette variant		
		K2000+	II	I	K2000+	II	I	K2000+	II	I	K2000+	II	I
		Normal tensile force $N_{V,R,d}^{(+)}$ [kN]											
6.14	2,5	17.9	13.5	6.6	8.4	8.4	6.6	7.8	7.8	6.6	6.6	6.6	6.6
0.73	2.0												
1.09													
1.40													
1.57													
2.07													
2.57													
3.07													
4.14													
1.57	1.5												
2.57													
1.57	1.0												
2.07													
2.57													
3.07													
1.57	0.5												
2.57													
L [m]	H [m]	Normal compressive force $N_{V,R,d}^{(-)}$ [kN]											
6.14	2.5	2.1	2.1	2.1	2.1	2.1	2.1	1.6	1.6	1.6	1.6	1.6	1.6
0.73	2.0	16.6	12.5	6.6	8.4	8.4	6.6	7.8	7.8	6.6	6.6	6.6	6.6
1.09		16.8	13.2										
1.40		15.5	13.7										
1.57		14.7	13.4										
2.07		12.4	12.4										
2.57		10.2	10.2										
3.07		8.4	8.4					6.6	6.6				
4.14		5.3	5.3	5.3	5.3	5.3	5.3	4.1	4.1	4.1	4.1	4.1	4.1
1.57	1.5	17.3	13.0	6.6	8.4	8.4	6.6	7.8	7.8	6.6	6.6	6.6	6.6
2.57		11.9	11.9										
1.57	1.0	17.7	13.4										
2.07		17.3	13.4										
2.57		13.5	12.9										
3.07		10.5	10.5										
1.57	0.5	16.7	12.6										
2.57		14.6	12.1										
L, H	see Annex A, page 4												

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3.7 Verification of the total system

3.7.1 Vertical load-bearing capacity of decking

The decking of the “Layher Allround” modular system must be verified in accordance with Table 9 for the live loads of load classes according to DIN EN 12811-1:2004-03, Table 3, and for use in brick guards and roof brick guards with fall heights of up to 2 m according to DIN 4420-1:2004-03 (Class D according to DIN EN 12810-1:2004-03).

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Table 9: Assignment of decking to load classes

Name	Annex B, page	Bay width ℓ [m]	Use in load class
U-steel decking 0.32 m	48 to 51	≤ 2.07	≤ 6
		2.57	≤ 5
		3.07	≤ 4
U-Robust decking 0.61 m	52,53	≤ 3.07	≤ 3
U-Robust decking 0.32 m	54	≤ 1.57	≤ 6
		2.07	≤ 5
		2.57	≤ 4
		3.07	≤ 3
U-steel hatch deck 0.61 m	55	2.57	≤ 4
U-Robust hatch 0.61 m	57	≤ 3.07	≤ 3

3.7.2 Elastic support of the vertical frame sections

It can be assumed that non-anchored nodes of all standards in one axis are elastically supported in the plane perpendicular to the direction of loading of the decking (perpendicular to the facade in the case of facade scaffolding) by the horizontal planes (decking elements), provided the neighbouring horizontal nodes are anchored. This elastic support can be taken into account by assuming a tri-linear travel spring in accordance with Figure 2 having the parameters given in Table 10.

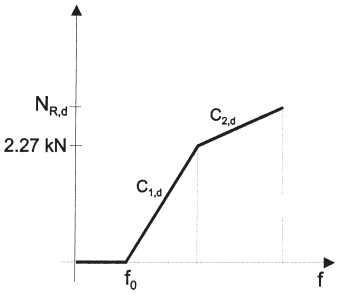

Figure 2: Tri-linear stiffness

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Table 10: Parameters of the horizontal travel springs

Deck	According to Annex B, page	Scaffolding width [m]	Bay width [m]	Slack f_0 [cm]	Stiffness [kN/cm]		Load carrying capacity of the spring $N_{R,d}$ [kN]
					$C_{1\perp,d}$	$C_{2\perp,d}$	
Steel deck 0.32 m	48 to 51	0.73	$\ell \leq 3.07$	4.1	0.51	0.31	2.61
		1.09		5.0	0.83	0.68	3.00
Robust deck 0.61 m	52	0.73	$\ell \leq 2.57$	4.9	0.58	0.30	2.91
	53		$\ell \leq 3.07$				2.72

3.7.3 Elastic coupling of the vertical levels

The internal and external vertical levels of a scaffolding can be assumed to be elastically coupled together by the decking in the direction of these levels (in the case of facade scaffolding, parallel to the facade). This elastic coupling may be taken into account by assuming coupling springs with the parameters listed in Table 11, regardless of the bay width.

Table 11: Parameters for the horizontal coupling springs

Decking	According to Annex B, page	Scaffolding width [m]	Slack f_0 [cm]	Stiffness [kN/cm] $C_{1\perp,d}$	Load carrying capacity of the spring $N_{R,d}$ [kN]
Steel deck 0.32 m	48 to 51	0.73	0.36	1.93	5.20
		1.09	0.59	1.55	8.88
Robust deck 0.61 m	52	0.73	0.28	1.70	8.93

3.7.4 Material parameters

For components manufactured from S235JRH with an increased apparent yield point (R_{eh} > 320 N/mm²) – these components are correspondingly marked on the drawings in Annex B – a yield point value of $f_{y,d}$ = 291 N/mm² can be used as a basis of calculation.

3.7.5 Welded seams

When verifying the welded seams of components manufactured from S235JRH with an increased apparent yield point (R_{eh} > 320 N/mm²) – these components are correspondingly marked on the drawings in Annex B – exploitation of the increased apparent yield point value of $f_{y,d}$ = 291 N/mm² is permitted for butt joints that are subject to compressive/bending compression stress. All other welded seams must be verified using the apparent yield point of the raw material for the components.

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3.7.6 Section properties of the scaffolding spindles

The substitute section properties for the stress verifications and deformation calculations in accordance with DIN 4495:1990-11 (Annex B of DIN EN 12811-1:2004-03) must be taken as follows for the scaffolding spindles in accordance with Annex B, page 30:

$A = A_S$ = 3.84 cm^2

I = 3.74 cm^4

W_{el} = 2.61 cm^3

W_{pl} = 1.25 • 2.61 cm^3 = 3.26 cm^3

4 Specifications for execution

4.1 General

The execution and inspection of scaffolding is not an object of this General Building Authority Approval.

4.2 Condition of the components

All components must be inspected before assembly to see that they are in proper condition. Damaged components may not be used.

4.3 Structural design

4.3.1 Components

The components named in Table 2 must be used for scaffolding in accordance with this approval. Only components that are identified in accordance with Section 2.2.2 or in accordance with the regulations of the General Building Authority Approval Z-8.1-16.2 may be used.

In exceptional cases they may be supplemented by steel tubes and couplers in accordance with DIN EN 12811-1:2004-03 or by scaffolding platforms and boards according to DIN 4420-1:2004-03.

Other than the scaffolding spindle illustrated in Annex B, other lightweight scaffolding spindles according to DIN 4425:1990-11, or base plates in accordance with Annex B of DIN EN 12811-1:2004-03, in accordance with the required load-carrying capacity, may also be used.

The following points apply to the use of the scaffolding connector:

A maximum of eight bars may be connected to each rosette.

The wedges of the connecting head must be hammered into place from above to below using a 500 g hammer until the blow bounces off.

4.3.2 Base area

The lower standards or vertical base collars must be placed on scaffolding spindles and aligned in such a way that the scaffolding layers are horizontal. It must be ensured that the end plates of the scaffolding spindles are horizontal and are contacting over the full area, and that the resultant forces from the scaffolding can be absorbed and dispersed by the supporting surface.

4.3.3 Scaffolding decks

Scaffolding decks must be secured to prevent them being accidentally lifted out.

4.3.4 Side protection

The specifications of DIN EN 12811-1:2004-03 apply to the side protection. Components intended for this purpose should be used in the first place, and only in exceptional cases may components such as steel tubes and couplers in accordance with DIN EN 12811-1:2004-03, or scaffolding platforms and boards in accordance with DIN 4420-1:2004-03 be used.

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4.3.5 Reinforcement

Scaffolding must be reinforced.

The vertical planes must be reinforced with longitudinal ledgers, or by longitudinal ledgers in association with vertical diagonal braces. System decking, together with U-ledgers can also be taken into account as longitudinal ledgers for the stability verification.

The horizontal planes must be reinforced by horizontal diagonals and ledgers, or by system decking in combination with U-ledgers.

The form and position of the individual reinforcing planes are found from the stability verification.

4.3.6 Anchoring

The spacing of anchors and the anchoring forces are found from the stability verification.

The anchorage of the wall ties to the facade or to other parts of the building is not covered by this approval. The user must ensure that these forces from the wall ties can be securely absorbed and dispersed. Vertical forces must not be transferred here.

4.3.7 Couplers

The couplers with screwed connectors must be tightened to a torque of 50 Nm when connecting to the standards; tolerances of ± 10% are permitted. The bolts must be kept easily movable by, for instance, a mixture of oil and grease.

5 Specifications for use and maintenance

5.1 General

The use of the scaffolding is no covered by this General Building Authority Approval.

5.2 Wooden scaffolding elements

To prevent moisture damage to wooden scaffolding elements, they must be stored in a dry place, off the ground, with adequate ventilation.

Dr.-Ing. Kathage Attested

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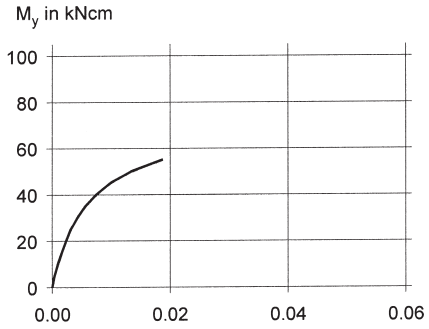
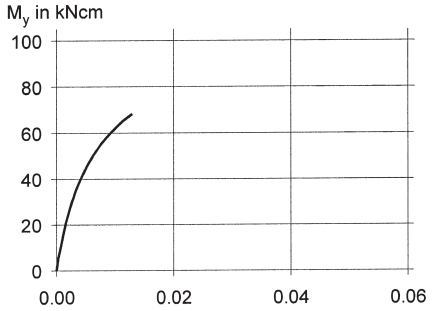


$$\varphi_d = \frac{M_y}{11790 - 161 \cdot |M_y|} \text{ [rad]}$$

with M_y in kNcm

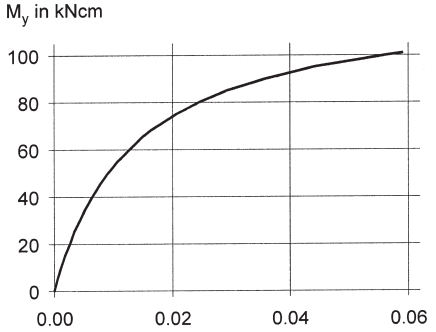
Figure 1: Torsional spring stiffness at the ledger connection for “Variant I” in the vertical plane



$$\varphi_d = \frac{M_y}{15940 - 157 \cdot |M_y|} \text{ [rad]}$$

with M_y in kNcm

Figure 2: Torsional spring stiffness at the ledger connection for “Variant II” in the vertical plane



$$\varphi_d = \frac{M_y}{9140 - 73{,}6 \cdot |M_y|} \text{ [rad]}$$

with M_y in kNcm

Figure 3: Torsional spring stiffness at the ledger connection for “Variant K 2000+” in the vertical plane

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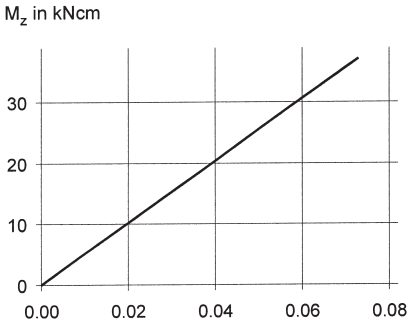
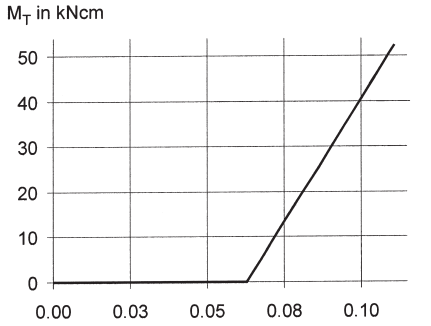


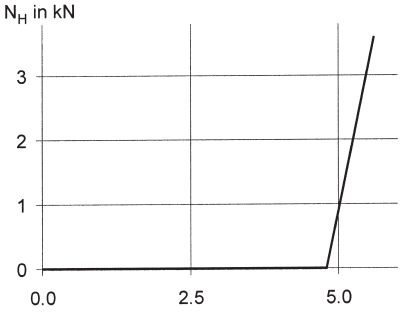
$$\varphi_d = \frac{M_z}{510} \text{ [rad]}$$
with M_Z in kNcm

Figure 4: Torsional spring stiffness at the ledger connection for “Variant II” and “Variant K 2000+” in the horizontal plane



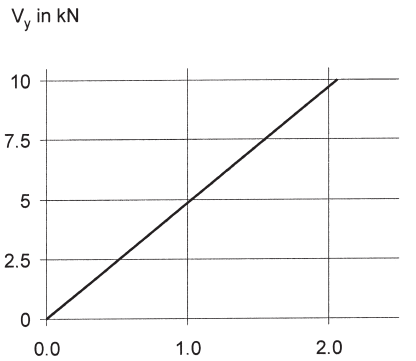
$$\varphi_d = 0.0629 + \frac{M_T}{1091} \text{ [rad]}$$
with M_T in kNcm

Figure 5: Torsional spring stiffness at the O-ledger connection for “Variant K 2000+” under torsional stress about the axis of the ledger



$$\delta_d = 4.8 + \frac{N_H}{4.5} \text{ [cm]}$$
with N_H in kN

Figure 6: Travel spring stiffness at the connection of a horizontal diagonal

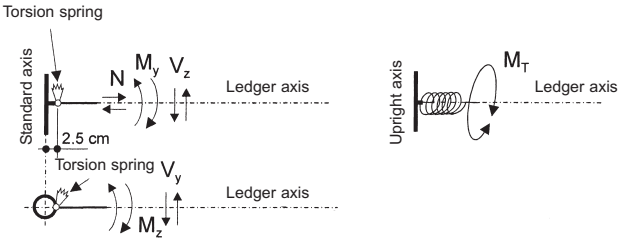


$$\delta_d = \frac{V_y}{4.85} \text{ [mm]}$$

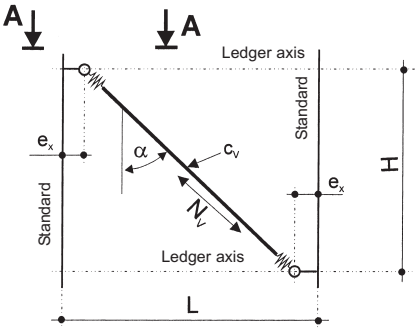
with V_y in kN

Figure 7: Force/displacement relationship of the ledger connection under transverse horizontal stress

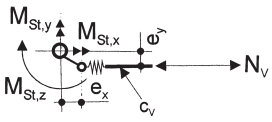
Static ledger connection system



Static vertical diagonal system



Section A-A



Node torques as a result of diagonal force N_V

$M_{St,x} = N_V \bullet \cos \alpha \bullet e_y$

$M_{St,y} = N_V \bullet \cos \alpha \bullet e_x$

$M_{St,z} = N_V \bullet \sin \alpha \bullet e_y$

The node torques must be absorbed by the standard and the ledgers.

Eccentricities e_x and e_y

Connecting head	e_x [mm]	e_y [mm]
Variant K 2000+ Variant II	77.5	50.0
Variant IB	87.5	
Variant IC	50.0	77.0

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C.1 General

In its standard variant, the scaffolding system may be used for working scaffolding in load classes ≤ 3 with a system width b = 0.732 m, and with a bay width ℓ ≤ 3.07 m in accordance with DIN EN 12811-1:2004-03, as well as a brick guard and roof brick guard in accordance with DIN 4420-1:2004-03.

The topmost horizontal plane (scaffolding layer) may not be more than 24 m above the ground, not including the spindle extension length. The standard version of the scaffolding system is dimensioned for use in a scaffolding level in accordance with DIN EN 12811-1:2004-03, Section 6.2.9.2 in front of an “open” facade with an open proportion of 60%, and in front of a closed facade. When determining the wind load, a service life factor of χ = 0.7, assuming a maximum service life of 2 years, is taken into account. Covering the scaffolding with nets or tarpaulins is not verified for the standard version.

Without additional verification, the standard version may only be used when only forces that are not greater than the definitive working loads according to DIN EN 12811-1:2004-03, Table 3, act in the scaffolding bays.

The following identification according to DIN EN 12810-1:2004-03 must be used for the standard version of the “Layher Allround” scaffolding system:

Scaffolding EN 12810 – 3D – SW06/307 – H2 – A – LA

C.2 Brick guards

The standard version of the scaffolding system has been verified for a drop height of up to 2.0 m in accordance with DIN 4420-1:2004-03. Access hatches must not be fitted into shelves.

C.3 Components

The planned components can be found in Table B.1. In addition, steel tubes with a diameter of 48.3 • 3.2 mm and couplers may be used for horizontal reinforcement of the bridging girders, while standard couplers in accordance with DIN EN 12811-1: 2004-03 can be used for fastening the wall ties and V-anchors to the standards.

C.4 Reinforcement

In order to reinforce the scaffolding horizontally, continuous 0.73 m U-ledgers and, in each case, two 0.32 m U-steel decks or 0.32 m U-Robust decks or 0.61 m U-Robust decks must be fitted with a vertical spacing of 2 m.

If there is ladder access, then either U-steel hatch decks or U-Robust hatch decks must be used instead of the decks.

The decks and the hatches must be secured against accidentally being lifted out by lift-off preventers.

To reinforce the outer vertical plane, O-ledgers must be used as guard rails (1 m above the deck surface) and as intermediate side protection (0.5 m above the deck surface) through every scaffolding bay above the second scaffolding level.

Immediately above the scaffolding spindles, vertical base collars must be fitted, and must be connected by the longitudinal ledgers on the inner and outer planes parallel to the facade, and by transoms at right angled the facade. In addition, each pair of standards must be connected at right angles to the facade at the height of the first rosette of the standards by transoms.

At the height of the first scaffolding level, O-ledgers (longitudinal ledgers) must be fitted on the outer plane parallel to the facade.

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C.5 Anchoring

Anchoring must be provided by means of a wall ties in accordance with Annex B, Page 45.

The wall ties must be fastened as pairs of anchors at an angle of 90° (V-anchors) or as “short” wall ties only on the inner vertical frame standards using standard couplers. The connectors, which are anchored by means of V-anchors, must be joined to the neighbouring row of standards by O-ledgers (longitudinal ledgers) on the inner plane parallel to the facade.

The V-anchors and wall ties must be attached in the immediate neighbourhood of the node points formed by the standards and the transoms.

The fastening facilities to be positioned at the front of the building in order to accept the anchor forces must be designed to have characteristics at least meeting those quoted in Annex C, page 4 (γ_F = 1.0).

Every row of standards must be anchored at a vertical spacing of 8 m; the anchor points of neighbouring vertical frames must be arranged here with a vertical offset of half the spacing. The rows of standards at the edge of a scaffolding must be anchored at a vertical spacing of 4 m. Every upright must be anchored on the top and second scaffolding levels.

C.6 Bridging

The bridging girders may only be used to bridge gate entrances or similar openings when the scaffolding levels underneath the bridging part are omitted.

The bridging girders must be anchored in the region where they are supported and in the centre, and must also be reinforced by a horizontal brace made of tubes and couplers (cf. Annex C, page 5).

C.7 Ladder access

U-steel hatch decks with storey ladders or U-Robust hatches must be used for internal ladder access.

C.8 Widening brackets

The U-brackets may be used on the inside of the scaffolding at all scaffolding levels.

Name	Annex B, page
Standard spindle	30
Vertical base collar	31
Vertical standard with spigot	32
O-ledger	33
U-ledger	34
Diagonal	36
Lift-off preventer	37
Allround toe board	38
U-steel toeboard	39
U-bracket	40
O-lattice girder	41
Spigot for lattice girder	42

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Table C.1: Continued

Name	Annex B, page
U-lattice girder ledger	43
Brick guard	44
Wall tie	45
Locking pin	46
Horizontal diagonal	47
U-steel deck 0.32 m (spot welded)	48
U-steel deck 0.32 m (manually welded)	49
U-steel deck 0.32 m T4 (spot welded)	50
U-steel deck 0.32 m T4 (manually welded)	51
U-Robust deck 0.61 m	52
U-Robust deck 0.61 m	53
U-Robust deck 0.32 m	54
U-steel hatch deck 0.61 m	55
Storey ladder	56
U-Robust hatch 0.61 m with ladder	57
Vertical base collar (“Variant II”)	58
Vertical standard with spigot (“Variant II”)	59
O-ledger (“Variant II”)	60
U-ledger 0.73 m (“Variant II”)	61
Diagonal (“Variant II”)	62
U-bracket 0.36 m (“Variant II”)	63
O-lattice girder (“Variant II”)	64
Brick guard (“Variant II”)	65
Post with wedge head	68

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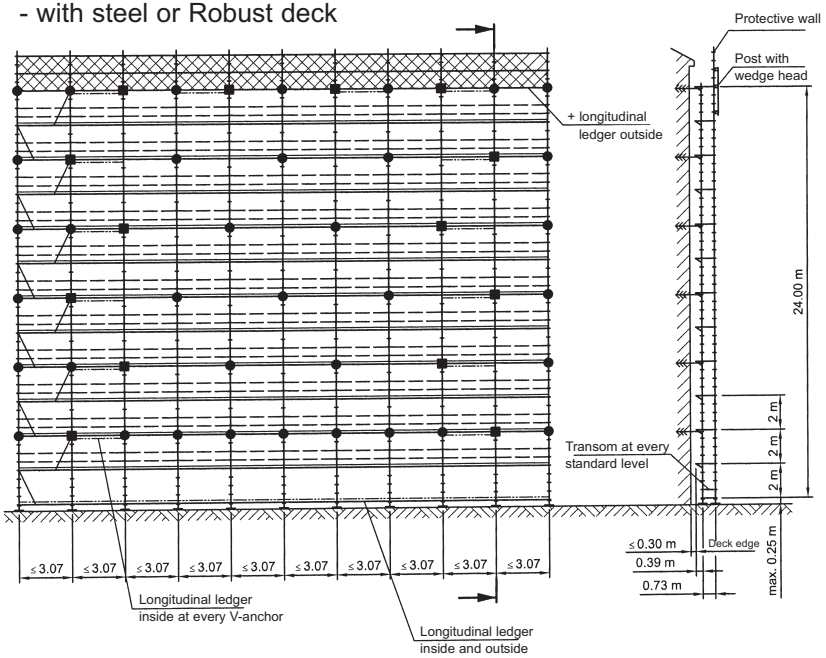
Partially open facade
Closed facade

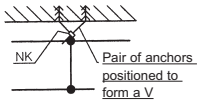
$L_{bay} \leq 3.07$ m

Uncovered scaffolding:

Bracket variant 1

Load class 3 (EN 12 811-1)
- with protective wall
- with steel or Robust deck

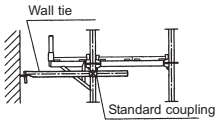




■ --> V-anchor

● --> Wall tie (only inner standards)

Anchorage detail



		Open facade	Closed facade
Spindle loads	inside	15.7 kN	
	outside	13.1 kN	
Anchoring forces	orthogonal: H = 24 m	3.5 kN	2.3 kN
	orthogonal: H ≤ 22 m	3.6 kN	1.2 kN
	V-anchor: parallel	6.4 kN	
	V-anchor: inclined load	4.5 kN	

Layher

More possibilities. The Scaffolding System.

Wilhelm Layher GmbH & Co. KG
www.layher.com

12.10.05	Muth	Z-ÜB 500

Allround scaffolding system

Standard structure 24.0 m
L_{bay} 3.07 m

Annex C, Page 4, for the General Building Authority Approval Z-8.22-64 dated 17 April 2007
German Civil Engineering Institute

Issued October 2005

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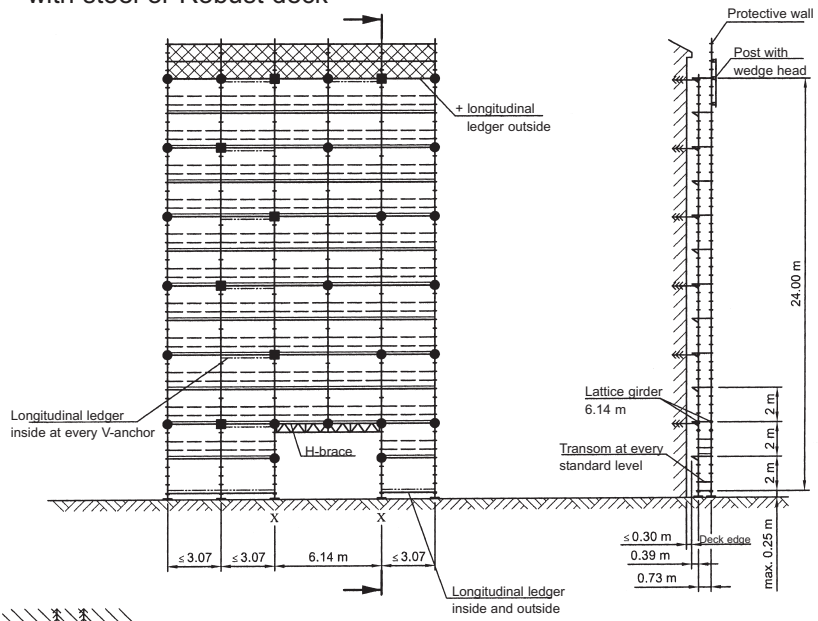
Partially open facade
Closed facade

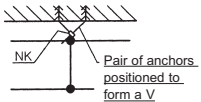
$L_{bay} \leq 3.07$ m

Uncovered scaffolding:

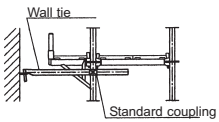
Bracket variant 1

Load class 3 (EN 12 811-1)
- lattice girder bridging 6.14 m
- with protective wall
- with steel or Robust deck

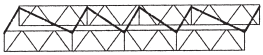




Anchorage detail



H-brace
with scaffolding tube and couplers



■ ⟶ V-anchor

● ⟶ Wall tie (only inner standards)

		Open facade	Closed facade
Spindle loads in the X-axis	inside	22.8 kN	
	outside	19.0 kN	

Other spindle loads and anchoring forces as in standard version Z-ÜB 500

Layher
More possibilities.The Scaffolding System.
Wilhelm Layher GmbH & Co. KG
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12.10.05	Muth	Z-ÜB 501

Allround scaffolding system

Lattice girder bridging
L_{bay} 3.07 m

Annex C, Page 5, for the General Building Authority Approval Z-8.22-64 dated 17 April 2007
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