

Version
June 2011

Program

DSTV

**Typified Connections in Steel
Building Construction acc. to
EC 3 and DIN 18800 (2. Edition)**

Program Description

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1. Introduction

1.1 Add-on Module DSTV

DSTV is an add-on module that is completely integrated in RSTAB. Thus, it is not only an integral part of RSTAB in its appearance. The DSTV results can be included even in the RSTAB printout report. In this way, you can present the entire analysis very easily in a consistent form.

If you have any suggestions for improvement, please contact us and tell us your ideas.

We hope you enjoy working with RSTAB and DSTV.

Your team from Ing.-Software Dlubal

1.2 Features in DSTV

The RSTAB add-on module DSTV (German Steel Construction Association) designs moment resisting and pinned I-beam connections according to the German guideline "Typified Connections in Steel Building Construction" [1]. Possible connections for moment resisting joints are end plate connections, flush as well as extended on top and bottom, in a two- or four-row layout. For pinned nodal points you can also use end plate connections, connected in the center of the web or on flange/web, web cleat connections with angles having equal or unequal legs, both in combination with coped beams, angle connections with long angles and coped connections. Moreover, it is possible to check the load-bearing members and columns.

Due to DSTV's full integration in RSTAB you are able to select the relevant nodal points graphically and to use the design internal forces from load cases, load groups and load combinations already available in RSTAB to design the connections. To reduce the variety of possible connections, you can specify initial values like connection type, bolt size and strength grade. DSTV will show you only the possible connection types for selection.

Subsequent to the calculation, the loadings are compared to the load capacities and the design ratios are calculated. All connection details are clearly presented and arranged in tables.

The DSTV connection design is contained in the RSTAB printout report and is updated automatically if structural data and internal forces are modified. Depending on the subject, the printout presented in tables is described by additional graphics in the margin. The rendered views like all other RSTAB graphics, including required dimensions, can be transferred to the printout report, too.

Short description

- Design of bending-resistant and pinned connections for I-shaped rolled cross-sections, optionally according to EC 3 or DIN 18800
- Flush and extended moment-resisting connections with automatic dimensioning of required bolt size
- Checking column cross-sections for moment-resisting connections
- Checking required thickness of load-bearing member in shear connections
- Indicating the decisive reason for failure

- Output of all required structural details such as appliances, hole arrangements, necessary extensions, bolt number, end plate dimensions, welds etc.
- Output of stiffnesses $S_{j,ini}$ for bending-resistant connections
- Pinned connections using end plates, optionally with mounting either on web only or on web and flange
- Documentation of available loadings and comparison with load capacities. The design ratio is determined for each individual connection.
- Automatic determination of governing internal forces from different load cases, groups or combinations, also when several connection nodes are designed.

1.3 DSTV-Team

The following people were involved in the development of DSTV:

Program coordination

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2. Installation

2.1 System Requirements

Your computer must fulfill the following system requirements in order to use RSTAB and DSTV efficiently.

- Operating system Windows XP / Vista / 7
- x86 CPU with 2 GHz
- 2 GB RAM
- DVD-ROM and 3.5" disk drive for installation, alternatively a network installation is possible
- 10 GB hard disk capacity, thereof ca. 500 MB for installation
- Graphics card with OpenGL acceleration and resolution of 1024 x 768 pixels

No product recommendations are made, with the exception of the operating system, as RSTAB and its add-on modules basically run on all systems that fulfill the requirements mentioned above. However, make sure to have installed an appropriate computing environment because RSTAB and DSTV are CPU intensive programs.

2.2 Installation Process

The installation process is started automatically by inserting the RSTAB DVD. As the add-on module DSTV is completely integrated in RSTAB the program won't be mentioned explicitly during the installation. It will be installed automatically together with RSTAB when you have purchased a license including corresponding authorization.

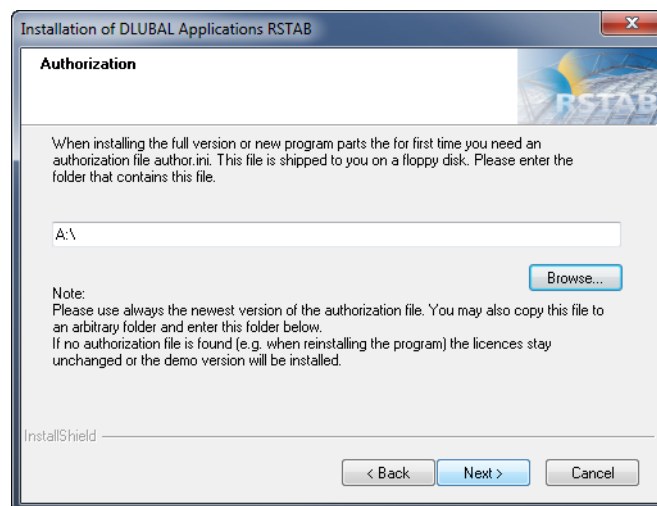


Figure 2.1: Query to insert the authorization disk

If at least one program license is detected on the authorization disk, three types of installation are displayed subsequently: [Standard], [User Defined] and [Minimum]. In case an authorization is missing or wrong, only two installation types [Standard] and [User Defined] are available.

Further, if an authorization is missing, a message appears additionally in the text referring to the installation of the demo version.

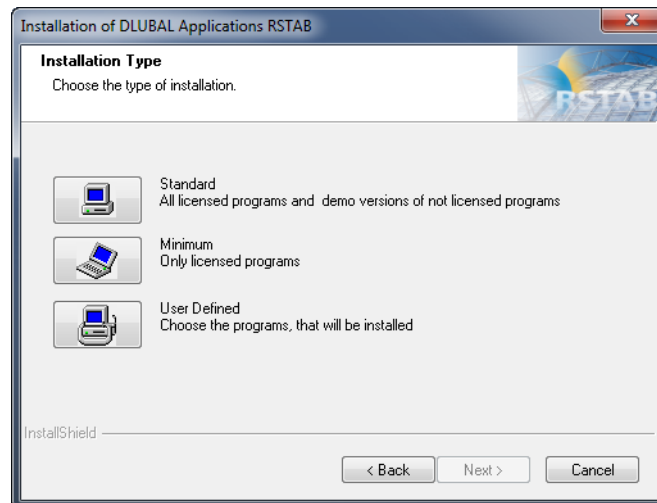


Figure 2.2: Installation types in case of available authorization

[Standard] installs all RSTAB applications and add-on modules (DSTV amongst others) as well as SHAPE-THIN. You can start the programs by using the shortcut on the desktop or the Start menu, either as full version (with successful authorization) or demo version only.

[Minimum] installs only programs for which a relevant license is available on the authorization disk. An exception represents RSTAB with its add-on modules because all of them will be installed even if no authorization is available for some modules.

[User Defined] allows you to select manually the individual programs that are available on the RSTAB DVD. Add-on modules that are not directly integrated in RSTAB and whose licenses are not available are indicated by [Demo].

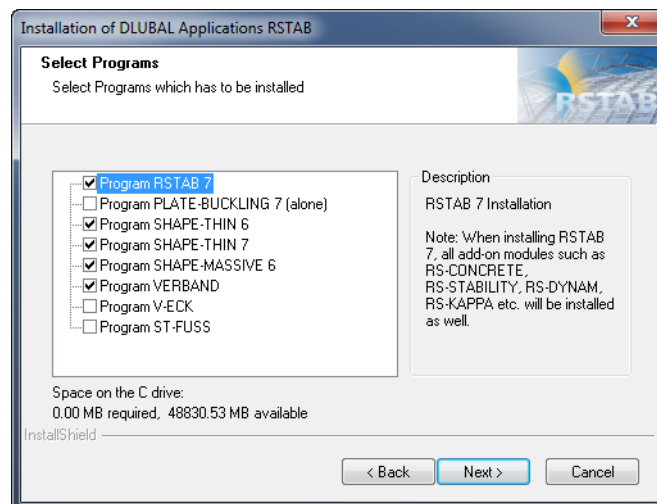


Figure 2.3: User-defined installation

An existing authorization will be overwritten during the RSTAB installation only if a new authorization is found in the specified drive. As long as no authorization is detected (no disk is inserted or authorization file is found), the present add-on modules can still be started.

3. Theoretical Background

In recent years, the design of connections has been a subject of national and international research. A new strategy for the design of steel connections has been developed with particular regard to efficiency. Also the introduction of new safety concepts in the German standard DIN 18800 and in Eurocode 3, which means the design for the ultimate limit state of load-bearing capacity, requires new approaches in the analysis of structures. Ductility which is the structure's ability to deform without losing its bearing capacity represents an important requirement for performing plastic designs [7].

Due to these recent developments, a new edition of the German DSTV guidelines was required. The new tools represent the state-of-the-art: Based on the component method, the civil engineer receives formularies with detailed sketches and design tables according to DIN 18800 and Eurocode 3 as well as short background information and model descriptions [7].

With the second edition the DSTV has extended the content describing the moment-resisting end plate connections (type IH) significantly. Cross-section tables not contained so far have now been taken into account. Furthermore, connection geometries with four bolts arranged in a horizontal line are included in the guidelines [9].

The present manual does not describe the individual analysis methods for rigid end plate connections (IH), pinned angle connections (IW), pinned end plate connections (IS), pinned connections with long angles (IG) and coped connections (IK) but refers to the DSTV guidelines. They describe in detail the calculation according to DIN 18800 and Eurocode 3 for each DSTV connection type. The analyses and results are summarized in tables, sorted by type of cross-section, material and bolt stiffness.

The comprehensive DSTV guidelines are stored in a special database integrated in the add-on module DSTV. Each connection contained in the guidelines is distinguished by a unique alphanumeric code = type description (find more information in chapters 3.1, 3.2, 3.3, 3.4 and 3.5). Considering the relevant definitions of the DSTV connection type (IH, IW, IS, IG and IK) and the cross-section that is used, you can filter all available DSTV connections and display them by means of the button [Database] in the module table 1.2.

The loadings are available in the form of internal forces in RSTAB as load cases, groups or combinations and can be compared to the load capacities and resistances. Thus, conclusions concerning the ultimate limit state for the selected connection are possible. The selection of the standard may be decisive: The design capacities mentioned in Eurocode 3 are a somewhat higher in comparison to the ones specified in the German standard.

3.1 Moment Resisting I-Beam Connections (IH)

Moment-resisting I-beam connections can be calculated with flushed end plates or plates extending on top or bottom, each connected with 2 or 4 vertical rows of high strength bolts (see Figure 3.1) [9]. The material of the end plate always corresponds to the material of the connected girder, thus S 235 or S 355 (see paragraph *Explanations to DSTV guidelines* or paragraph 3.6). Other materials are not allowed according to the DSTV guidelines.

Note: In order to ensure conformity of the connection's configurations with the standards currently valid and to avoid unsymmetrical hole arrangements for the types IH1 and IH2, the type standardizations are slightly modified in comparison to previous editions. Therefore, the type descriptions have been completed by an additional revision number.

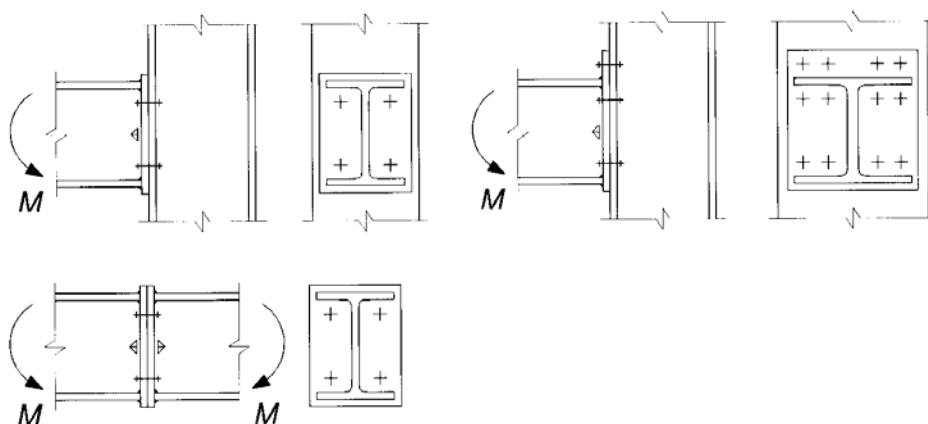
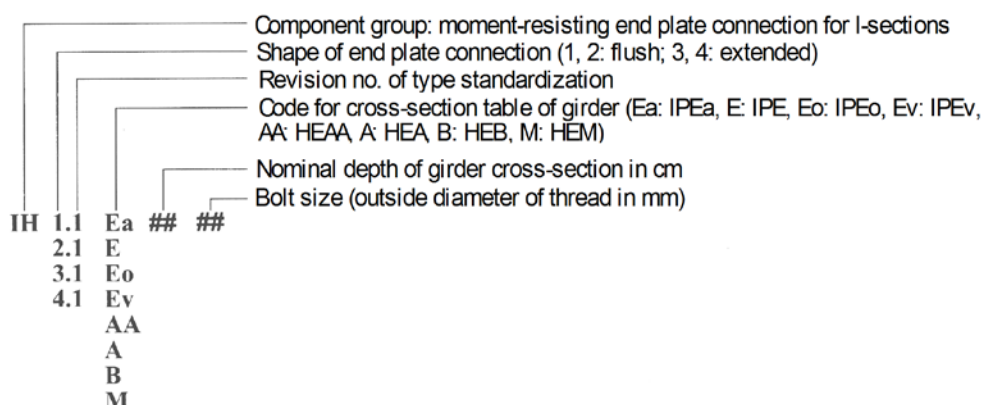


Figure 3.1: Possible beam connections with moment-resisting flush or overlapping end plates

Type description

Each connection type can be identified by an alphanumeric code number which is the following:



Examples

- IH 1.1 E 36 20 moment-resisting connection with flush end plate on a IPE 360 cross-section and bolt size M20
- IH 3.1 A 36 16 moment-resisting connection with extended end plate on a HE-A 360 cross-section and bolt size M16

Geometry, loading, limit states

The geometric values of the end plate, the design capacities of the connection and the limit states are specified for each DSTV connection.

- Geometric specifications (dimensions)
 - t_p Thickness of end plate
 - b_p Width of end plate
 - h_p Depth of end plate
- Load capacity
 - $M_{pl,y,Rd}$ Plastic limit moment of girder about y-axis
 - $M_{y,1,Rd}$ Limiting bending moment of connection about y-axis
 - $M_{y,2,Rd}$ Limiting bending moment of connection (reversal moment)
 - $V_{z,Rd}$ Limiting shear force of connection in direction z
- Limit states
 - CWS Column web stressed by shear
 - CWT Column web stressed by tension
 - CWC Column web stressed by compression
 - CWB Column web stressed by bending
 - EPB End plate stressed by bending
 - BT Bolts stressed by tension
 - BFC Girder flange stressed by compression
 - BWT Girder web stressed by tension

Explanations to DSTV guidelines

The tables indicating the load capacities can be used under the following conditions.

- Analysis method elastic-elastic or elastic-plastic
- Mainly static load
- Continuous column
- Small axial forces in girder with $N/N_{pl} < 0.1$
- Only minor differences in girder depths for girder-column connection on both sides
- Girder and column cross-sections
 - HE-B, HE-A, HE-M, IPE: rolled girder acc. to DIN 1025, part 2, 3, 4 and 5
 - IPEa, IPEo, IPEv, HEAA: rolled girder (not standardized)
- Pre-stressed or non-prestressed bolts M16 to M30 with strengths 8.8 and 10.9, nominal hole gap for M16-M24 $\Delta d = 2$ mm and for M27-M30 $\Delta d = 3$ mm. Pre-stressings of bolts are not taken into account anymore by the DSTV guidelines because only a design for the ultimate limit state of bearing capacity is required.
However, the bolts should be pre-stressed according to schedule in order to avoid gapping of joints in the serviceability limit state.
- Steel grade $t \leq 40$ mm (for the load capacity tables also calculations according to DIN were performed using a yield strength of 235 N/mm² or 355 N/mm² so that the results are the same values for DIN and EC)

DIN	St37	with	$f_y = 240 \text{ N/mm}^2$	$f_u = 360 \text{ N/mm}^2$
	St52	with	$f_{y,k} = 360 \text{ N/mm}^2$	$f_{u,k} = 510 \text{ N/mm}^2$
EC	S 235	with	$f_{y,k} = 235 \text{ N/mm}^2$	$f_{u,k} = 360 \text{ N/mm}^2$
	S 355	with	$f_{y,k} = 355 \text{ N/mm}^2$	$f_{u,k} = 510 \text{ N/mm}^2$

- Strength grade of bolts

DIN	8.8	with	$f_y = 640 \text{ N/mm}^2$	$f_u = 800 \text{ N/mm}^2$
	10.9	with	$f_{y,b,k} = 900 \text{ N/mm}^2$	$f_{u,b,k} = 1000 \text{ N/mm}^2$
EC	8.8	with	$f_y^b = 640 \text{ N/mm}^2$	$f_u^b = 800 \text{ N/mm}^2$
	10.9	with	$f_{yb} = 900 \text{ N/mm}^2$	$f_{ub} = 1000 \text{ N/mm}^2$

- If a column cross-section is marked by "St" in the tables, a stiffening of the column is required (always for the types IH2 and IH4):
 - A stiffener must be provided at the top and bottom column flange.
 - The thickness of the stiffener must be equal to the thickness of the column flange.
 - The width of the stiffener must be selected in such a way that the column is stiffened for the entire flange width.
 - The welds on the stiffeners must be designed as double fillet welds with a weld thickness corresponding to the thickness of the welded joint between flanges and end plate.
- In case no column cross-section is specified, it is not possible to use the corresponding cross-section type because of geometric restrictions, or none of the possible cross-sections reaches the load level.

3.2 Pinned I-Beam Connections (IW)

Connections as shown in figure 3.2 are often used in steel frame construction for connecting floor beams to downstand beams or downstand beams to columns because available weld and work tolerances can be adjusted during the mounting by the hole clearance in the bolt holes [7]. The material of the angle always corresponds to the material of the connected floor beam, (S 235 or S 355, see paragraph *Explanations to DSTV guidelines* or paragraph 3.6). Other materials are not allowed according to the DSTV guidelines.

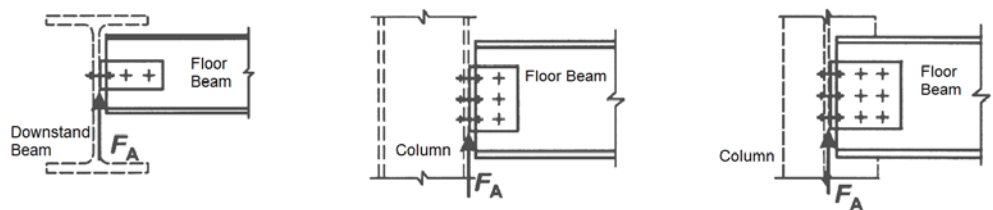
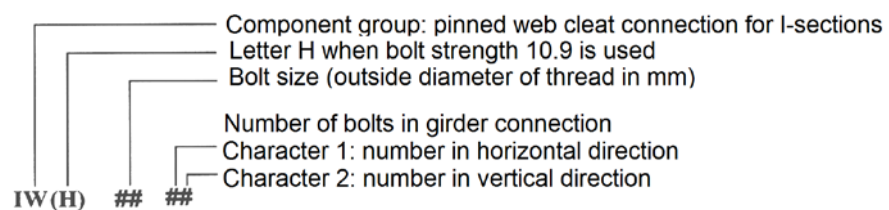


Figure 3.2 Possible beam connections with pinned angles arranged in pairs

Type description

Pinned web cleat connections (IW) are identified by the following alphanumeric code number:



Examples

- | | |
|-----------|-----------------------------------------------------------------------------------------------------|
| IWH 20 12 | pinned web cleat connection with high-strength bolts M20 (10.9), one vertical bolt row with 2 bolts |
| IW 16 23 | pinned web cleat connection with bolts M16 (4.6), two vertical bolt rows with 3 bolts each |

Geometry, loading, limit states, coped connections

The geometric values of the angle, the connection's design capacities, the limit states and the coped connections are specified for each DSTV connection.

- Geometric specifications (dimensions)
 - n_z Number of bolts in one vertical row
 - w_t Marking-out dimension
 - h_{wi} Height of web cleat
- Load capacity
 - $F_{A,Rd}$ Limiting connection force
 - s_u Required thickness of load-bearing member (column/downstand beam)
- Limit states

Relevant member:	B	Beam
	BT	Bolt
	CL	Web cleat
Reason:	b	Hole bearing
	s	Shear
	st	Rupture by shearing
Location:	B	on the beam
	C	on the column
- Coped connection
 - \ddot{u} Minimum distance of angle from edge of coped connection with full utilization of limiting connection force

Explanations to DSTV guidelines

The tables indicating the load capacities can be used under the following conditions.

- Rolled girders HE-M, HE-B, HE-A and IPE according to DIN 1025, part 2, 3 and 5 as well as IPEo and IPEv, girders as single-span beam supported on both sides
- Connecting angles for bolts of strength class 4.6
 - L 90x9, L 100x10, L 120x12 acc. to DIN 1028
 - L 150x75x9, L 180x90x10, L200x100x12 acc. to DIN 1029
- Connecting angles for bolts of strength class 10.9
 - L 90x9, L 100x12, L 120x12 acc. to DIN 1028
 - L 150x75x9, L 180x90x12, L200x100x12 acc. to DIN 1029
- Bolts M 16, M 20 and M 24, not pre-stressed, nominal hole gap $\Delta d \leq 1$ mm
- Distance of girder edge to load-bearing member $\Delta l \leq 10$ mm
- Steel grade $t \leq 40$ mm (for the load capacity tables also calculations according to DIN were performed using a yield strength of 235 N/mm² or 355 N/mm² so that the results are the same values for DIN and EC)

DIN	St37	with	$f_{y,k} = 240$ N/mm ²	$f_{u,k} = 360$ N/mm ²
	St52	with	$f_{y,k} = 360$ N/mm ²	$f_{u,k} = 510$ N/mm ²
EC	S 235	with	$f_{y,k} = 235$ N/mm ²	$f_{u,k} = 360$ N/mm ²
	S 355	with	$f_{y,k} = 355$ N/mm ²	$f_{u,k} = 510$ N/mm ²

- Strength grade of bolts

DIN	4.6	with	$f_{y,b,k} = 240$ N/mm ²	$f_{u,b,k} = 400$ N/mm ²
	10.9	with	$f_{y,b,k} = 900$ N/mm ²	$f_{u,b,k} = 1000$ N/mm ²
EC	4.6	with	$f_{yb} = 240$ N/mm ²	$f_{ub} = 400$ N/mm ²
	10.9	with	$f_{yb} = 900$ N/mm ²	$f_{ub} = 1000$ N/mm ²

3.3 Pinned I-Beam Connections (IS)

Connections as shown in figure 3.3 are often used in steel frame construction for connecting floor beams to downstand beams or downstand beams to columns because available weld and work tolerances can be adjusted during the mounting by the hole clearance in the bolt holes [7]. The material of the end plate always corresponds to the material of the connected girder, thus S 235 or S 355 (see paragraph *Explanations to DSTV guidelines* or paragraph 3.6). Other materials are not allowed according to the DSTV guidelines.

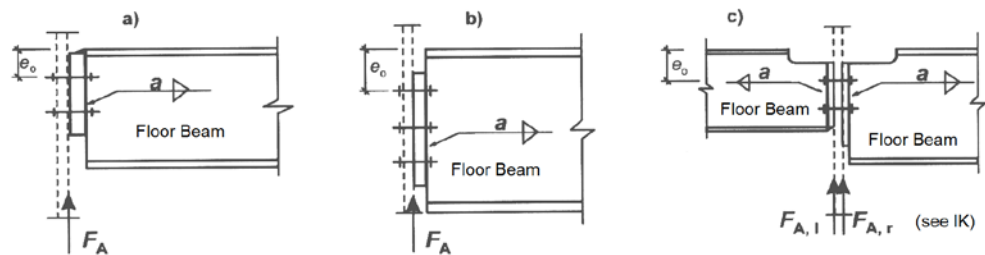
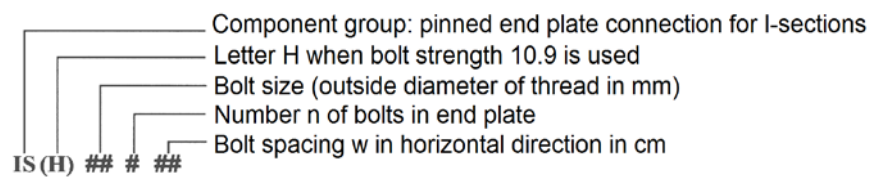


Figure 3.3: Possible beam connections with pinned end plates

Type description

Pinned end plate connections (IS) are identified by the following alphanumeric code number:



Examples

- | | |
|----------|-----------------------------------------------------------------------------|
| ISH 20 4 | pinned end plate connection with high-strength bolts M20 (10.9) and 4 bolts |
| IS 16 6 | pinned end plate connection with bolts M16 (4.6) and 6 bolts |

Geometry, loading, limit states

The geometric values of the end plate, the connection's design capacities and the limit states are specified for each DSTV connection.

- Geometric specifications (dimensions)

- | | |
|-----------------------|--------------------------------------------------------------|
| n | Total number of bolts |
| h_p | Depth of end plate |
| t_p | Thickness of end plate, depending on strength grade of bolts |
| $t_p = 10 \text{ mm}$ | strength grade of bolts 4.6 |
| $t_p = 10 \text{ mm}$ | strength grade of bolts 10.9 for M16 and M20 |
| $t_p = 12 \text{ mm}$ | strength grade of bolts 10.9 for M24 |

- Load capacity

- | | |
|------------|-------------------------------------------------------------------|
| $F_{A,Rd}$ | Limiting connection force |
| s_u | Required thickness of load-bearing member (column/downstand beam) |
| a | Thickness of double fillet weld on girder web |

- Limit states

Relevant member:	B	Beam
	BT	Bolt
	EP	End plate
Reason:	b	Hole bearing
	s	Shear
	bd	Bending
	st	Rupture by shearing according to EC3

Explanations to DSTV guidelines

The tables indicating the load capacities can be used under the following conditions.

- Rolled girders HE-M, HE-B, HE-A and IPE according to DIN 1025, part 2, 3 and 5 as well as IPEo and IPEv, girders as single-span beam supported on both sides
- Bolts M 16, M 20 and M 24, not pre-stressed, nominal hole gap $\Delta d \leq 1 \text{ mm}$
- Steel grade $t \leq 40 \text{ mm}$ (for the load capacity tables also calculations according to DIN were performed using a yield strength of 235 N/mm^2 or 355 N/mm^2 so that the results are the same values for DIN and EC)

DIN	St37	with	$f_{y,k} = 240 \text{ N/mm}^2$	$f_{u,k} = 360 \text{ N/mm}^2$
	St52	with	$f_{y,k} = 360 \text{ N/mm}^2$	$f_{u,k} = 510 \text{ N/mm}^2$
EC	S 235	with	$f_{y,k} = 235 \text{ N/mm}^2$	$f_{u,k} = 360 \text{ N/mm}^2$
	S 355	with	$f_{y,k} = 355 \text{ N/mm}^2$	$f_{u,k} = 510 \text{ N/mm}^2$

- Strength grade of bolts

DIN	4.6	with	$f_{y,b,k} = 240 \text{ N/mm}^2$	$f_{u,b,k} = 400 \text{ N/mm}^2$
	10.9	with	$f_{y,b,k} = 900 \text{ N/mm}^2$	$f_{u,b,k} = 1000 \text{ N/mm}^2$
EC	4.6	with	$f_{yb} = 240 \text{ N/mm}^2$	$f_{ub} = 400 \text{ N/mm}^2$
	10.9	with	$f_{yb} = 900 \text{ N/mm}^2$	$f_{ub} = 1000 \text{ N/mm}^2$

3.4 Pinned Web Cleat Connections (IG)

By using flush top connections for floor and downstand beams with long angles as shown in Figure 3.4, it is possible to avoid using expensive coped connections (see IK connections) although the girders' upper edges have equal girder positions [7]. The material of the web cleat always corresponds to the material of the connected girder, thus S 235 or S 355 (see paragraph *Explanations to DSTV guidelines* or paragraph 3.6). Other materials are not allowed according to the DSTV guidelines.

Note: Please note that such a connection does not represent a forked support for the floor beam. A support sufficiently resisting to rotation of the girder end must be provided by a different but appropriate method.

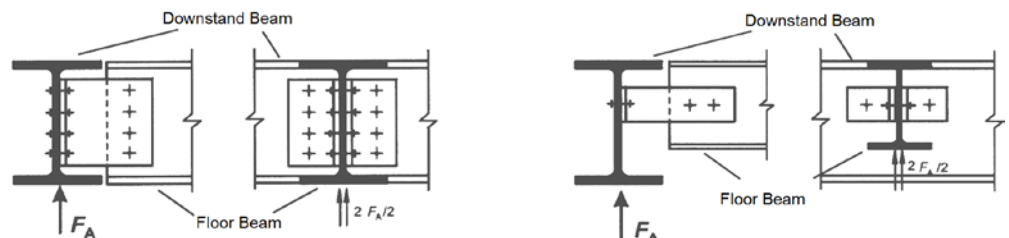
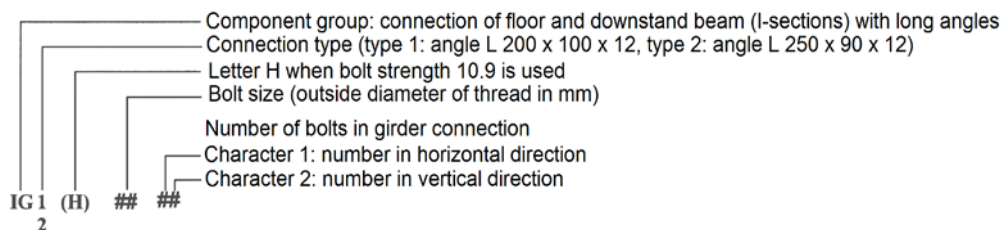


Figure 3.4 Possible floor beam-downstand beam connections with long angles (flush top)

Type description

Pinned IG connections with long angles are identified by the following alphanumeric code number:



Example

IG 1 H 20 13 Connection for floor and downstand beam with long angles (L100x100x12) and high-strength bolts M20 (10.9), one bolt row in horizontal direction and 3 in vertical direction

Geometry, loading, limit states, coped connections

The geometric values of the web cleat, the connection's design capacities, the limit states and the coped connections are specified for each DSTV connection.

- Geometric specifications (dimensions)
 - n_x Number of bolts horizontally
 - n_z Number of bolts vertically
 - h_{wi} Height of web cleat
- Load capacity
 - $F_{A,Rd}$ Limiting connection force
 - s_u Required thickness of load-bearing member (column/downstand beam)
- Limit states

Relevant member:	B	Beam
	BT	Bolt
	CL	Web cleat
Reason:	b	Hole bearing
	s	Shear
	c	Bending with pressure
	bt	Bending and torsion
Location:	B	on the beam
	C	on the downstand beam

Explanations to DSTV guidelines

The tables indicating the load capacities can be used under the following conditions.

- Rolled girders HE-M, HE-B, HE-A and IPE according to DIN 1025, part 2, 3 and 5 as well as IPEo and IPEv, girders as single-span beam supported on both sides
- Connecting angles
 - L 200x100x12 (type 1) acc. to DIN 1029
 - L 250x90x12 (type 2) acc. to DIN 1029
- Bolts M 12, M 16, M 20 and M 24, not pre-stressed, nominal hole gap $\Delta d \leq 1 \text{ mm}$

- Steel grade $t \leq 40$ mm (for the load capacity tables also calculations according to DIN were performed using a yield strength of 235 N/mm² or 355 N/mm² so that the results are the same values for DIN and EC)

DIN	St37	with	$f_{y,k} = 240$ N/mm ²	$f_{u,k} = 360$ N/mm ²
	St52	with	$f_{y,k} = 360$ N/mm ²	$f_{u,k} = 510$ N/mm ²
EC	S 235	with	$f_{y,k} = 235$ N/mm ²	$f_{u,k} = 360$ N/mm ²
	S 355	with	$f_{y,k} = 355$ N/mm ²	$f_{u,k} = 510$ N/mm ²

- Strength grade of bolts

DIN	4.6	with	$f_{y,b,k} = 240$ N/mm ²	$f_{u,b,k} = 400$ N/mm ²
	10.9	with	$f_{y,b,k} = 900$ N/mm ²	$f_{u,b,k} = 1000$ N/mm ²
EC	4.6	with	$f_{yb} = 240$ N/mm ²	$f_{ub} = 400$ N/mm ²
	10.9	with	$f_{yb} = 900$ N/mm ²	$f_{ub} = 1000$ N/mm ²

3.5 Coped Connections (IK)

Coped connections as shown in Figure 3.5 are required in framed structures for connecting floor beams to downstand beams in case the floor beams must be connected flush top. Coped connections imply additional work on the girder. Therefore, try to avoid using coped connections as far as possible considering structural feasibility [7]. The material of the angle always corresponds to the material of the connected girder, thus S 235 or S 355 (see paragraph *Explanations to DSTV guidelines* or paragraph 3.6). Other materials are not allowed according to the DSTV guidelines.

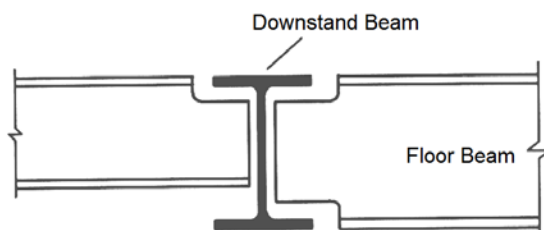
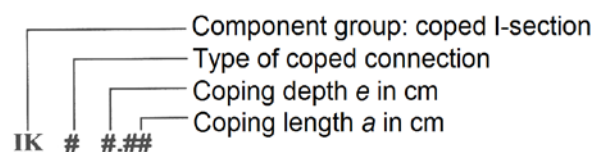


Figure 3.5 Coped flush top connection for a floor beam and a downstand beam

Type description

Coped connections (IK) are identified by the following alphanumeric code number:



Example

IK 1 6.15

Coped I-section of type 1 (flush top fillet due to drill out $d=17$ mm), coping depth is 6 cm, coping length is 15 cm

Type of coped connection, geometry and load capacity of coped connections

The cross-section, the type and the dimensions of the cope connection characterizing the corresponding load capacity are specified for each DSTV connection.

- Specifications for coped connection type
 - Type 1 flush top fillet due to drill out $d=17$ mm
 - Type 2 fillet flush at top and bottom due to drill out $d=17$ mm
 - Type 3 flush top fillet with radius $r=8.5$ mm
 - Type 4 fillet flush at top and bottom with radius $r=8.5$ mm
- Geometric specifications (dimensions)
 - e Coping depth
 - a Coping length
 - ha Remaining depth of coped area
- Resistance
 - $F_{A,Rd}$ Limiting connection force

Note: In case you design nothing else but IK connections, only the remaining bearing capacity of the coped cross-section is checked. Detailed designs for the weld, the bolts and the load-bearing members are performed only in combination with IW or IS connections.

Explanations to DSTV guidelines

The tables indicating the load capacities can be used under the following conditions.

- Rolled girders HE-M, HE-B, HE-A and IPE according to DIN 1025, part 2 to 5 as well as IPEo and IPEv
- Connection of floor beam/downstand beam stressed by shear force only, this means floor beam with pinned supports on both sides
- Coped connections with fillet

For all cross-sections a standard diameter of 17 mm was selected for a bored fillet (type IK 1 and type IK 2). For coped connections with a normal fillet the load capacities were calculated for a radius of $r=8.5$ mm (type IK 3 and type IK 4), accordingly leading to higher results. When smaller fillet dimensions are selected, the calculated results are on the safe side.
- Steel grade $t \leq 40$ mm (for the load capacity tables also calculations according to DIN were performed using a yield strength of 235 N/mm^2 or 355 N/mm^2 so that the results are the same values for DIN and EC)

DIN	St37	with	$f_{y,k} = 240 \text{ N/mm}^2$	$f_{u,k} = 360 \text{ N/mm}^2$
	St52	with	$f_{y,k} = 360 \text{ N/mm}^2$	$f_{u,k} = 510 \text{ N/mm}^2$
EC	S 235	with	$f_{y,k} = 235 \text{ N/mm}^2$	$f_{u,k} = 360 \text{ N/mm}^2$
	S 355	with	$f_{y,k} = 355 \text{ N/mm}^2$	$f_{u,k} = 510 \text{ N/mm}^2$

3.6 Allowed Steel Grades

As described by the *Explanations to DSTV guidelines* in the previous chapters, you have to use different steel grades depending on the selected standard (DIN 18800 or EC 3). The DSTV guidelines already omitted to determine the load capacities for the steel grades St 37 and St 52, and also the German standard DIN calculates with a yield strength of 235 N/mm^2 or 355 N/mm^2 so that the results are the same values for DIN and EC.

Therefore, also the DSTV guidelines are only working with steel grade S 235 and S 355. The following table shows the assignment of RSTAB materials to the recent steel grades, S 235 and S 355, valid in the DSTV guidelines insofar as RSTAB has not already used these materials in its calculations.

DSTV	RSTAB
S 235	Steel, Steel St 37 xx, Steel Ust 37 xx, Steel RSt 37 xx, FE 360 xx, S 235 xx
S 355	Steel St 52 xx,, FE 510 xx, S 355 xx

Table 3.1 Assignment of RSTAB materials to DSTV materials

4. Working with DSTV

4.1 Start DSTV

You can start the add-on module DSTV either in the RSTAB menu bar by pointing to **Connections** on the **Additional Modules** menu, or in the *Data navigator* by selecting the corresponding entry in the **Additional Modules** folder.

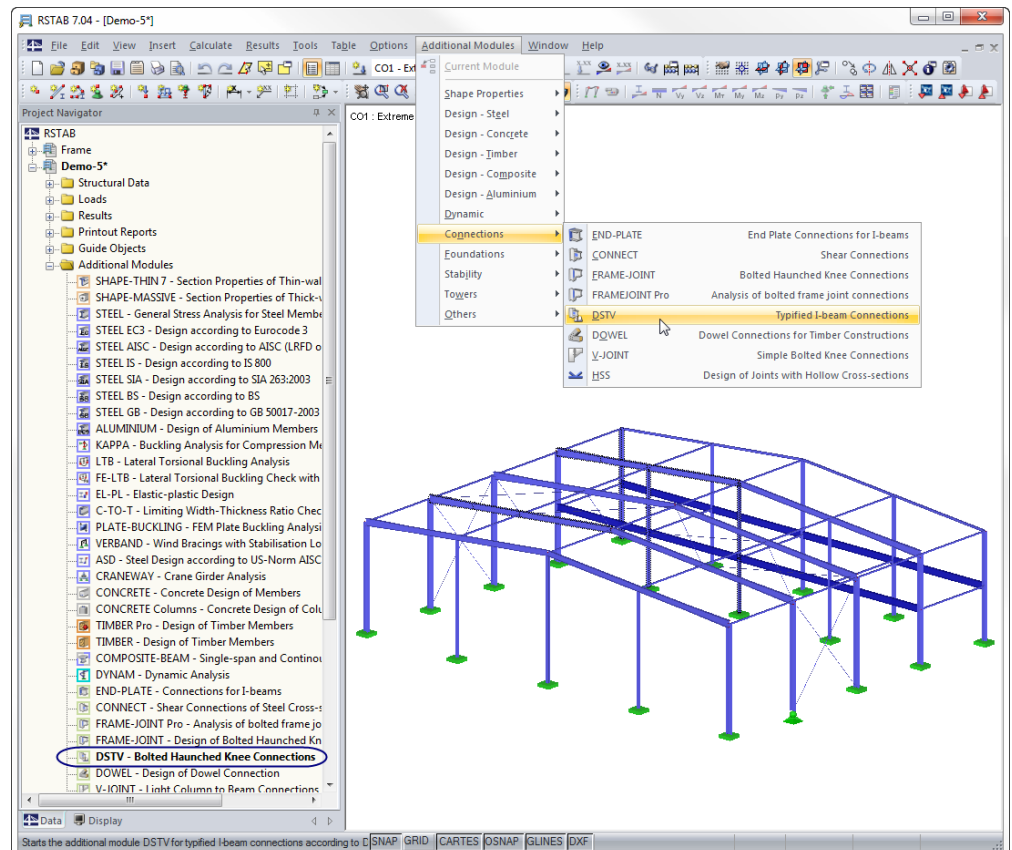


Figure 4.1: Starting DSTV on the *Additional Modules* menu or in the *Data navigator*.

All data entered in DSTV refers only to nodes of the active RSTAB structure. The relevant internal forces may result from any **load case**, **load group** or **load combination**. You can use them to design moment-resisting or pinned I-beam connections in accordance with the German guidelines "Typified Connections in Steel Building Construction".

4.2 Tables

The input required to define the DSTV cases as well as the numerical output of results is displayed in tables.

When you have started the add-on module, you see the DSTV navigator on the left. The pull-down list above the navigator contains the design cases of typified connections that are already available. To open the list, click the arrow button, and then you can select the relevant design case by clicking the corresponding entry.

In the right part of the DSTV window, additional graphics are shown, depending on the selected table. Table 2.1 *Results* represents an exception: For reasons of clarity it is described

chapter by chapter and in tables, showing the corresponding graphics of the right table part for each chapter.

To page through the tables, click the corresponding entry in the DSTV navigator or use the buttons shown on the left. You can also use the keyboard keys [F2] and [F3]. When the input is complete, start the calculation by clicking the [Calculation] button. Use the [Graphic] button to switch to the graphical results display where the current 3D rendering model of the calculated DSTV connection is set automatically.

Find further information on the display and output of results in chapter 5 of the present manual. To save the input and results before you quit DSTV, click [OK]. By clicking the [Cancel] button, you quit the add-on module but without saving the DSTV data. Use the [Help] button or the keyboard key [F1] to activate the online help system.

4.3 Input Tables

All settings required for the design are entered in the input tables. In addition, you can define the parameter settings that you want to use.

4.3.1 Table 1.1 General Data

Subsequent to the program start, the DSTV window opens showing table 1.1 **General Data** where you define basic data such as the DSTV connection type, the design standard and the assigned members.

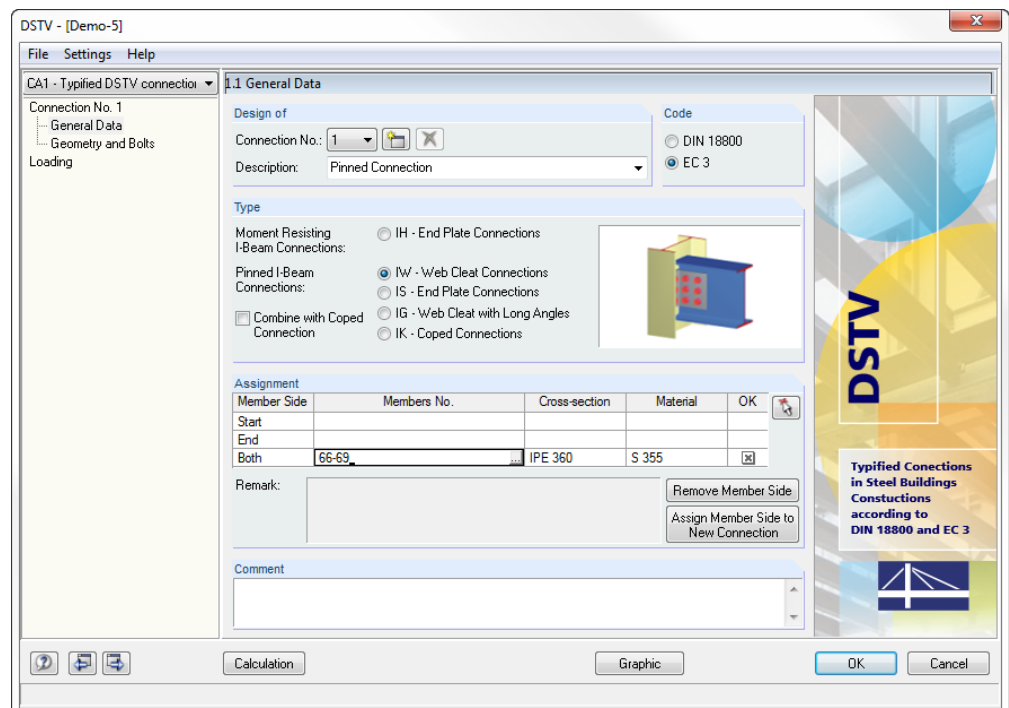


Figure 4.2: Table 1.1 General Data

The number of required connections for the current DSTV design case can be controlled by the buttons [New] and [Delete]. Thus, it is possible to specify each defined connection differently and independently of other connections. To select the corresponding DSTV connection, use the navigator on the left or the list *Connection No.*

Like in the DSTV guidelines, a *Code* must be selected for the calculation of such typified connections. The standards **DIN 18800** and **EC 3** are available for selection. The database

provided in table 1.2 *Geometry and Bolts* includes only the design capacities of the code set in the first table.

The general data of each connection must specify the connection type. You can select *Moment Resisting Connections* (IH), *Pinned Web Cleat Connections* (IW), *Pinned End Plate Connections* (IS) (both can be combined with coped connections) as well as *Pinned Connections with Long Angles* (IG) and pure *Coped Connections* (IK).

Possible layouts (extended or flush end plates, connections using angles with unequal legs etc.) can be defined in the subsequent table 1.2 *Geometry and Bolts*.

The combination of pinned web cleat (IW) or pinned end plate connections (IS) with coped connections is possible by means of the check box *Combine with Coped Connection*. If the check box is ticked, a new table appears in the navigator, which is table 1.3 *Geometry of Coped Beam*. When the parameters of the coped connection are defined, the program will design automatically the connection itself but also the coped connection for the remaining bearing capacity.



DSTV connection points are determined by the selection of members and/or member sides in the active RSTAB structure. In the dialog section *Assignment*, you can define them numerically or graphically by using the [Pick] button shown on the left. You can also use the table button [...] available in the column *Members No.* at the end of the active table cell.

DSTV divides all members of the RSTAB structure into three segments for the graphical selection. Thus, it is possible to select a member end or a member start. When you click a member in its center, you select the entire member. To select several members, member ends or member starts, hold down the [Shift] key while clicking. After the selection you can quit the workspace by clicking the [OK] button in the selection box.

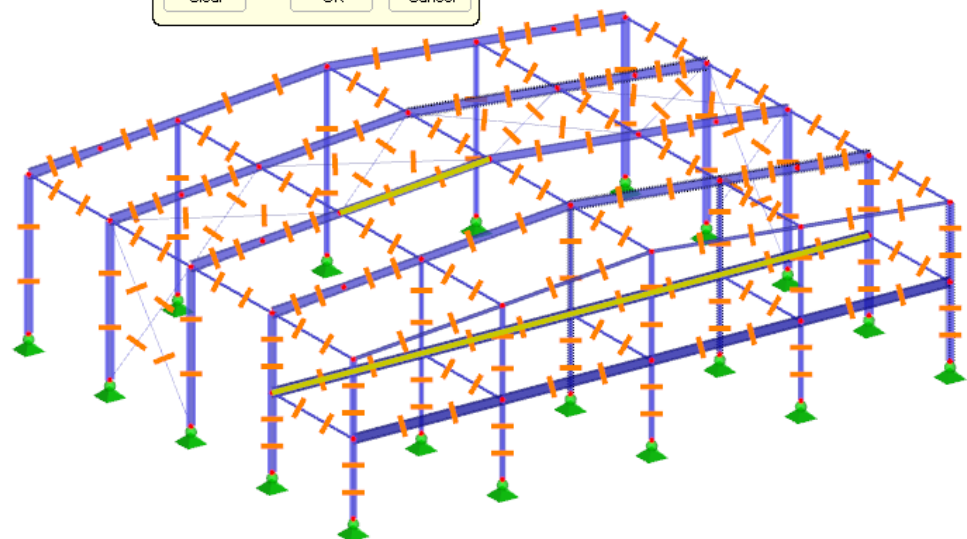
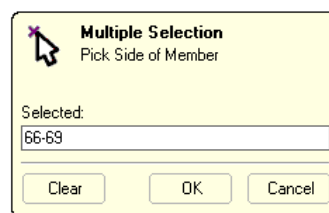


Figure 4.3: Graphical selection of member sides in the RSTAB work window

Remove Member Side

Assign Member Side to
New Connection

Depending on the definition of the DSTV connections per member side, the *Assignment* table shows the corresponding member numbers, the cross-section and the material in the respective table rows. The final column *OK* indicates if the program is able to design a DSTV connection by using the initial values.

To remove member sides listed in the dialog section *Assignment*, use the button [Remove Member Side] shown on the left. The pointer must be placed in the corresponding table row in order to use the function. With the button [Assign Member Side to New Connection], you can assign a selected member side to a new connection. A new connection will be created automatically and displayed in the navigator.

The *Remark* field below the table displays notes in case unacceptable member sides have been selected. DSTV only allows you to design member ends that correspond in its release definitions to the connection type. Moreover, they must be identical concerning material and cross-section. For a pinned connection, for example, it is necessary to define a release.

In chapter 3.6, the allowed steel grades are described. The DSTV guidelines specify load capacities only for grade S 235 and S 355. Therefore, Table 3.1 shows the assignment of RSTAB materials to the recent steel grades, S 235 and S 355, valid in the DSTV guidelines.

In the *Comment* box, you can enter notes to describe the current DSTV case.

4.3.2 Table 1.2 Geometry and Bolts

With the data specified in table 1.2 *Geometry and Bolts*, the program prepares a database of possible connections based on the DSTV guidelines and according to the values entered in table 1.1 *General Data*.

To select the corresponding DSTV connection, use the DSTV navigator or the list *Design of*. In this way, you can easily set the defined connection in the current DSTV design case to enter your specifications.

The required input may vary depending on the connection type. The following five chapters 4.3.2.1, 4.3.2.2, 4.3.2.3, 4.3.2.4 and 4.3.2.5 describe the input in detail.

4.3.2.1 Moment Resisting I-Beam Connections (IH End Plate Connections)

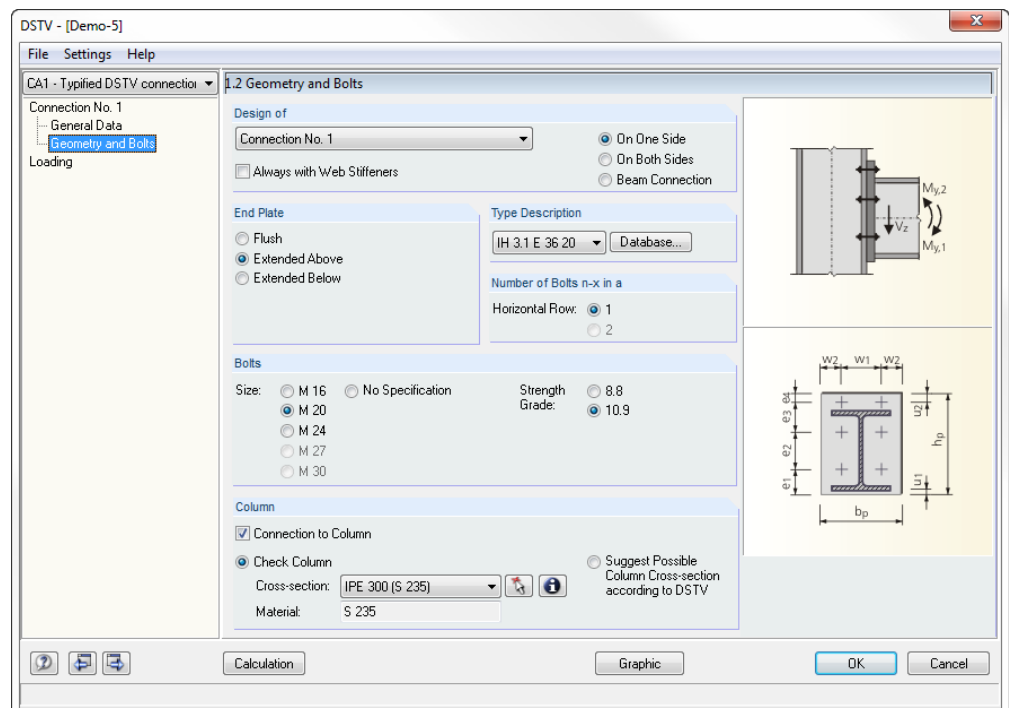


Figure 4.4: Table 1.2 *Geometry and Bolts* for moment-resisting end plate connections (IH)

If you design moment-resisting end plate connections (IH), you can choose out of three connection types (see Figure 3.1): connections *On One Side* (horizontal beam on column), connections *On Both Sides* (cross joint for multistory frame) or a pure *Beam Connection* (joint connection of horizontal or downstand beams). You can define the *End Plates* to be *Flush* but also *Extended Above* or *Below*. In addition, you can specify data concerning the size and strength grade of bolts.

Database...

Based on these entries, the program creates a database with possible DSTV connections. To access the database, use the [Database] button. You can also use the list in the dialog section *Type Description* to determine it. The bolt size and strength grade which are clearly defined in the type description are affecting the settings of the selection options. When specifying the bolts data the other way round, defining the bolt sizes and strength grades first, DSTV sets the type description automatically in the corresponding list. In addition, it is possible to control the calculation with the option *No Specification* so that the connection will be designed with the smallest possible bolt diameter.

The [Database] of the end plate connections (IH) is already filled with the remaining possible connections which are characterized by the alphanumeric code. The structure of the database dialog box is similar to the structure of the DSTV guidelines to allow for a familiar

data overview. The relevant connection, and thus the definition of the bolt diameter, the strength grade of bolts as well as the size of the end plate, is determined by selecting the corresponding entry using the mouse device.

Note: The specifications shown in the database dialog box concerning M_y , V_z , limit state and required column cross-section are always referring to a design ratio of 100 %. Depending on the connection's design ratio (80 % or 60 %), other column cross-sections are decisive.

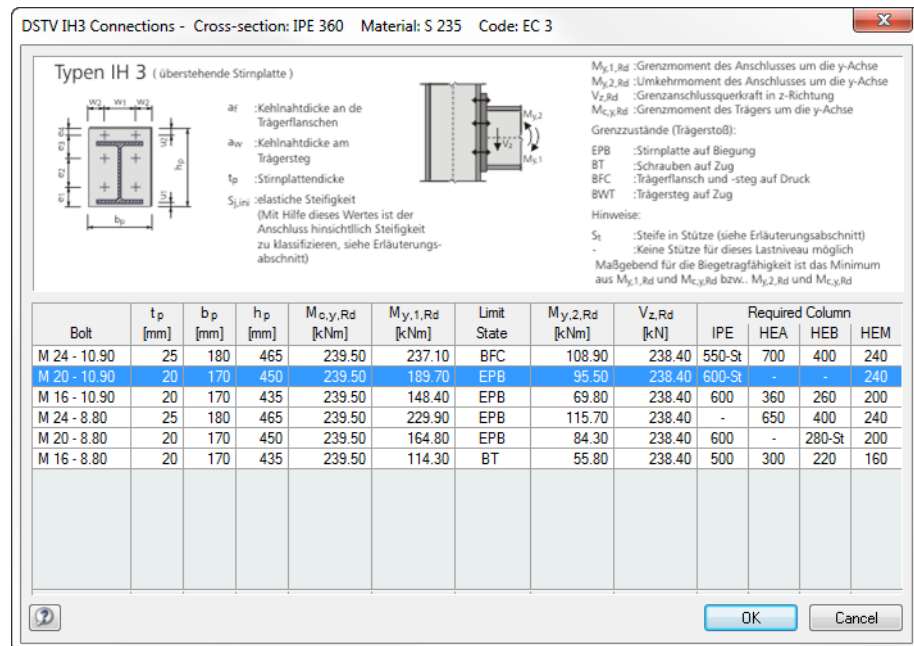


Figure 4.5: Library containing possible end plate connections (IH) extended on top (IPE 360, S 235, EC 3)

When you have selected a connection from the database, you return to table 1.2. According to the type of end plate that you have selected, DSTV shows the corresponding connection graphic in the right part of the window, including internal forces to be transferred (for IH connections $M_{y,1}$, $M_{y,2}$ and V_z).

Note: The material of the end plate must correspond to the one of the connected girder (defined in table 1.1).



If you tick the check box *Connection to Column*, you can compare the available column cross-section with the required minimum cross-section. When you have selected the connection type *On Both Sides*, checking the column cross-section is obligatory. In case of connections *On One Side*, checking the column is only an option. If the connection type *Beam Connection* is selected, the check is not available, of course. To check the column cross-section, select a cross-section in the selection field *Cross-section*. You can also use the [Pick] button shown on the left. The DSTV guidelines are listing the minimum dimensions of cross-sections, according to the connection's design ratio indicated in percent. DSTV checks if the column cross-section is sufficient by comparing the specifications.

If S_t appears additionally to the required column cross-section, you have to stiffen the connection in the column area. In case no column cross-section is indicated (-), only the connection type "Beam Connection" is allowed to be used.

Use the option *Suggest Possible Column Cross-section according to DSTV* to display the minimum cross-sections for every cross-section table in the results. In this case, you have to compare the cross-sections yourself.

At the same time DSTV is checking the *Material* of the column. The column material must be equivalent or even more load-bearing. Thus, an IH connection with S 355 requires a material with a steel grade of at least S 355 also for the column.

Note: Connections of type IH2 and IH4 must always be stiffened.

To display the cross-section details, use the [Info] button.

4.3.2.2 Pinned I-Beam Connections (IW Web Cleat Connection)

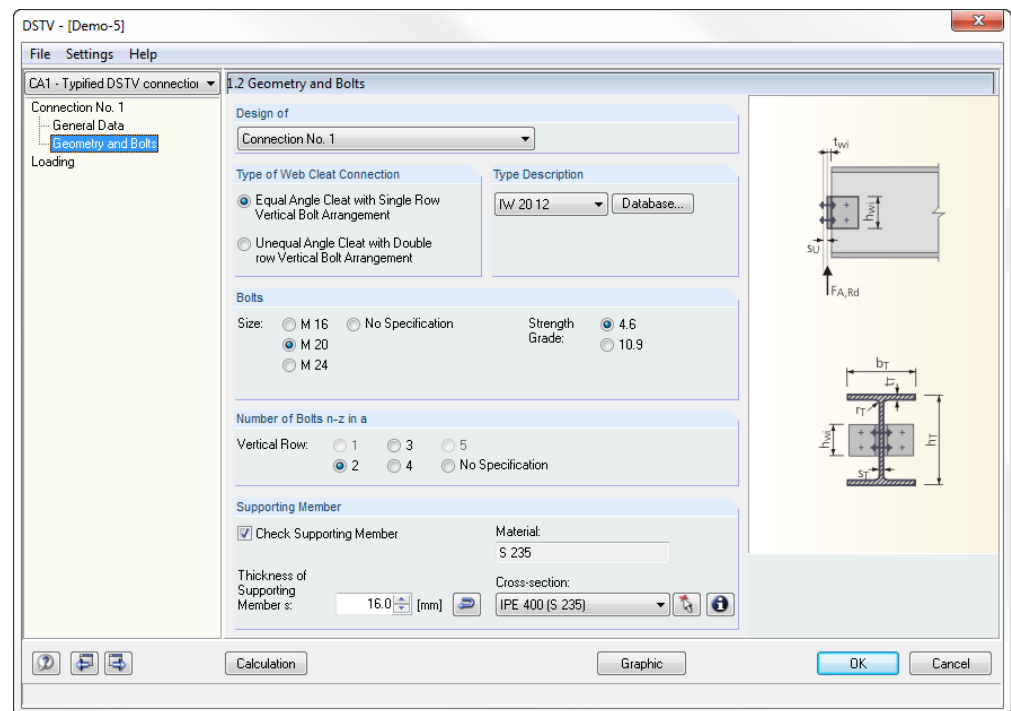


Figure 4.6: Table 1.2 *Geometry and Bolts* for pinned web cleat connections (IW)

Two different connection types are available for selection when you want to design pinned web cleat connections (IW): *Equal Angle Cleat with Single Row Vertical Bolt Arrangement* or *Unequal Angle Cleat with Double Row Vertical Bolt Arrangement*. In addition, you can specify data concerning the size and strength grade of bolts as well as the number of bolts n_z in a vertical bolt row.

Database...

Based on these entries, the program creates a database with possible DSTV connections. To access the database, use the [Database] button. You can also use the list in the dialog section *Type Description* to determine it. The bolt size, the strength grade and the number of bolts which are clearly defined in the type description are affecting the settings of the selection options. When specifying the bolts data the other way round, defining the bolt sizes, the strength grades and the number of bolts first, DSTV sets the type description automatically in the corresponding list. In addition, it is possible to control the calculation with the option *No Specification* so that the connection will be designed with the minimum number of bolts or the smallest possible bolt diameter.

The [Database] of the angle connections (IW) is already filled with the remaining possible connections which are characterized by the alphanumeric code. The structure of the database dialog box is similar to the structure of the DSTV guidelines to allow for a familiar data overview. The relevant connection, and thus the definition of the bolt diameter, the strength grade as well as the number of bolts, is determined by selecting the corresponding entry using the mouse device.

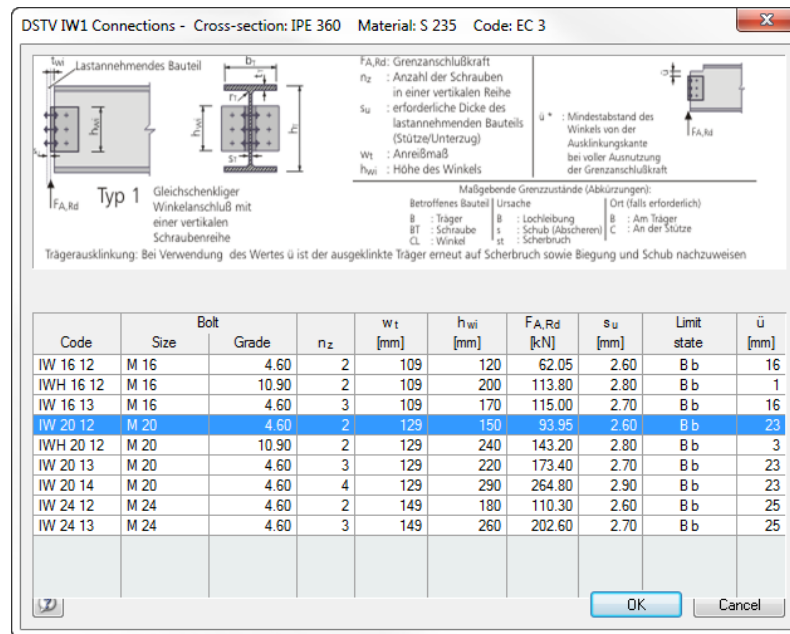
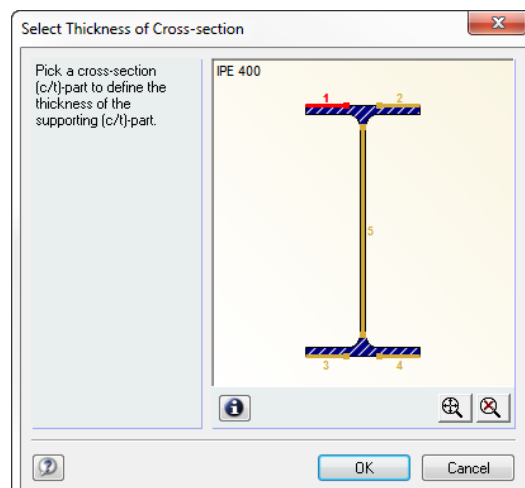


Figure 4.7: Library of possible IW angle connections (IPE 360, S 235, Eurocode 3)

When you have selected a connection from the database, you return to table 1.2. According to the type of web cleat connection (IW) that you have selected, DSTV shows the corresponding connection graphic in the right part of the window, including internal forces to be transferred (for IW connections $F_{A,Rd}$).

Note: The material of the angle must correspond to the one of the connected girder (defined in table 1.1).

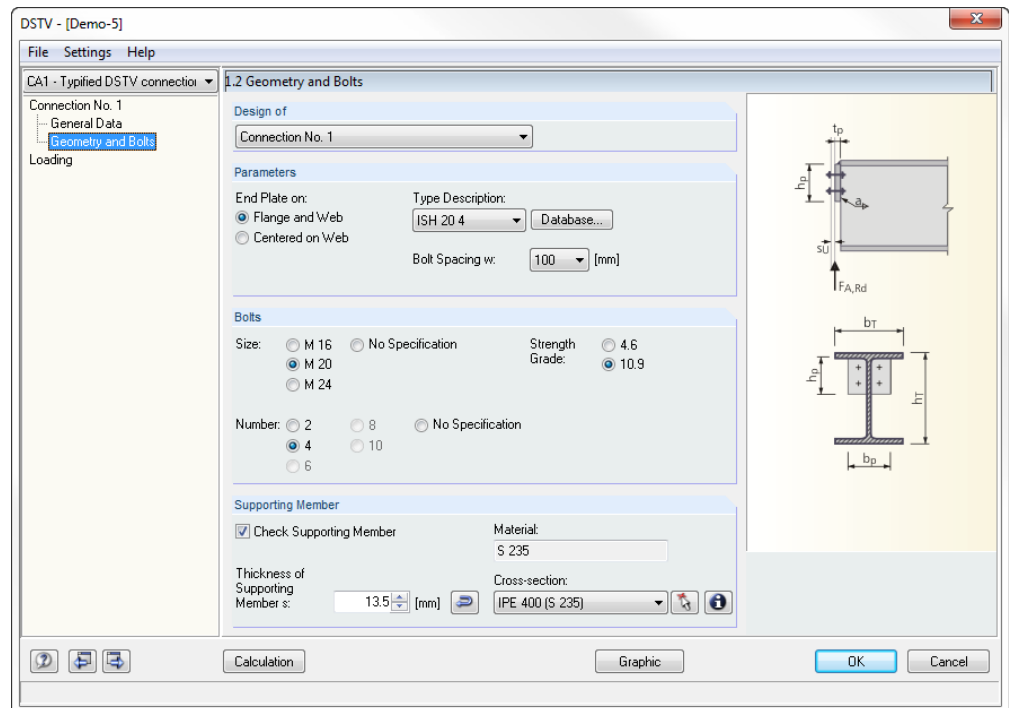
If you tick the check box *Check Supporting Member*, you can compare the available member thickness with the required minimum thickness of the selected connection. To check the thickness, select a cross-section in the selection field *Cross-section*. You can also use the [Pick] button. It is also possible to define the thickness of the member graphically by means of the [Import] button shown on the left.

Figure 4.8: Dialog box *Select Thickness of Cross-section*

At the same time DSTV is checking the *Material* of the supporting member. The material must be equivalent or even more load-bearing. Thus, an IH connection with S 355 requires a material with a steel grade of at least S 355 also for the supporting member.

To display the cross-section details, use the [Info] button.

4.3.2.3 Pinned I-Beam Connections (IS End Plate Connections)

Figure 4.9: Table 1.2 *Geometry and Bolts* for pinned end plate connections (IS)

Two different arrangement types are available for selection when you want to design pinned end plate connections (IS): You can fix the end plate on the *Flange and Web* or *Centered on Web*. In addition, you can specify data concerning the bolt spacing, the bolt size, the strength grade as well as the number of bolts.

Database...

Based on these entries, the program creates a database with possible DSTV connections. To access the database, use the [Database] button. You can also use the list in the dialog section *Type Description* to determine it. The bolt size, the strength grade and the number of bolts which are clearly defined in the type description are affecting the settings of the selection options. When specifying the bolts data the other way round, defining the bolt sizes, the strength grades and the number of bolts first, DSTV sets the type description automatically in the corresponding list. In addition, it is possible to control the calculation with the option *No Specification* so that the connection will be designed with the minimum number of bolts or the smallest possible bolt diameter.

The [Database] of the end plate connections (IS) is already filled with the remaining possible connections which are characterized by the alphanumeric code. The structure of the database dialog box is similar to the structure of the DSTV guidelines to allow for a familiar data overview. The relevant connection, and thus the definition of the bolt diameter, the strength grade of bolts as well as the number of bolts in a vertical row, is determined by selecting the corresponding entry using the mouse device.

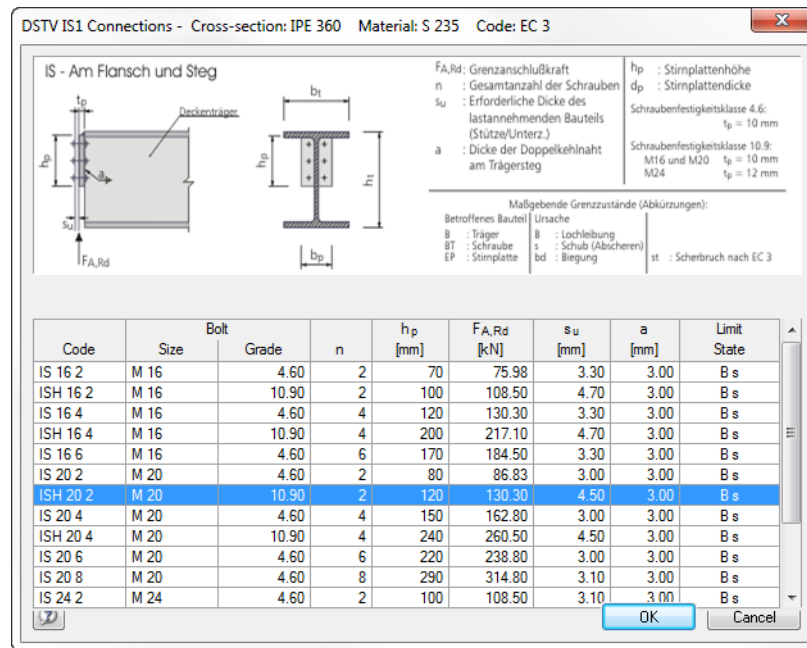


Figure 4.10: Library containing possible end plate connections (IS) (IPE 360, S 235, EC 3)

According to the type of end plate connection (IS) that you have selected, DSTV shows the corresponding connection graphic in the right part of the window, including internal forces to be transferred (for IS connections $F_{A,Rd}$).

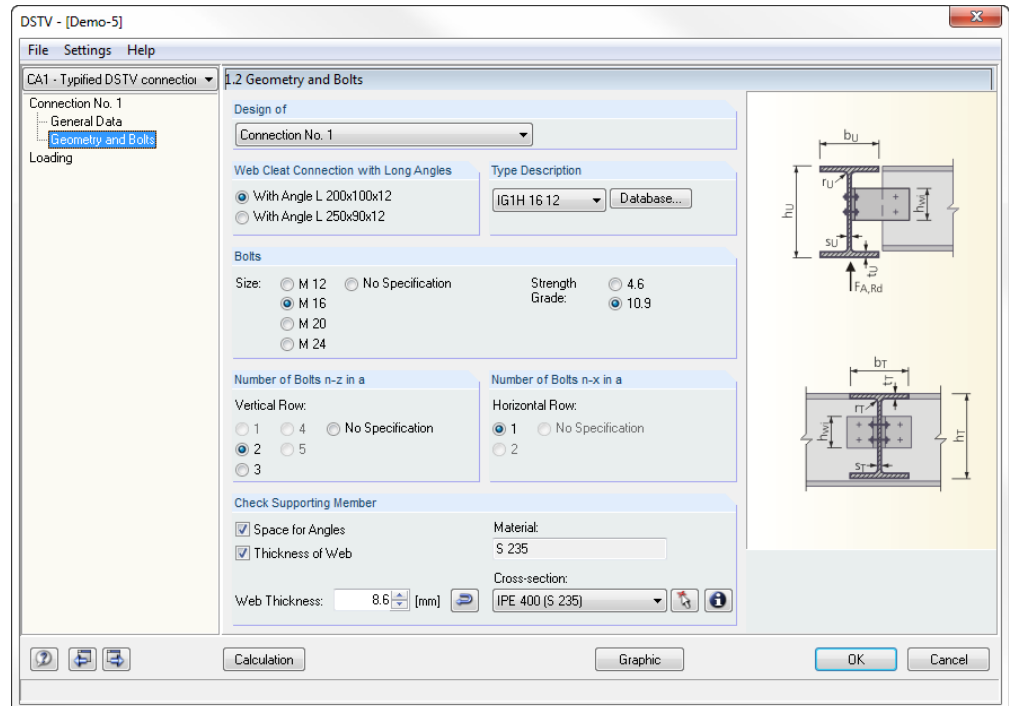
Note: The material of the end plate must correspond to the one of the connected girder (defined in table 1.1).

If you tick the check box *Check Supporting Member*, you can compare the available member thickness with the required minimum thickness of the selected connection. To check the thickness, select a cross-section in the selection field *Cross-section*. You can also use the [Pick] button. It is also possible to define the thickness of the member graphically by means of the [Import] button shown on the left (see Figure 4.8, page 26).

At the same time DSTV is checking the *Material* of the supporting member. The material must be equivalent or even more load-bearing. Thus, an IS connection with S 355 requires a material with a steel grade of at least S 355 also for the supporting member.

To display the cross-section details, use the [Info] button.

4.3.2.4 Pinned Web Cleat Connections (IG with Long Angles)

Figure 4.11: Table 1.2 *Geometry and Bolts* for pinned IG connections with long angles

Two different angle types are available for selection when you want to design pinned web cleat connections (IG): You can use connections *With Angle L 200x100x12* or *L 250x90x12*. In addition, you can specify data concerning the size and strength grade of bolts as well as the number of bolts n_z or n_x in a vertical or horizontal bolt row.

Based on these entries, the program creates a database with possible DSTV connections. To access the database, use the [Database] button. You can also use the list in the dialog section *Type Description* to determine it. The bolt size, the strength grade and the number of bolts which are clearly defined in the type description are affecting the settings of the selection options. When specifying the bolts data the other way round, defining the bolt sizes, the strength grades and the number of bolts first, DSTV sets the type description automatically in the corresponding list. In addition, it is possible to control the calculation with the option *No Specification* so that the connection will be designed with the minimum number of bolts or the smallest possible bolt diameter.

The [Database] of the IG connections with long angles is already filled with the remaining possible connections which are characterized by the alphanumeric code. The structure of the database dialog box is similar to the structure of the DSTV guidelines to allow for a familiar data overview. The relevant connection, and thus the definition of the bolt diameter, the strength grade of bolts as well as the number of bolts in a vertical and horizontal row, is determined by selecting the corresponding entry using the mouse device.

Database...

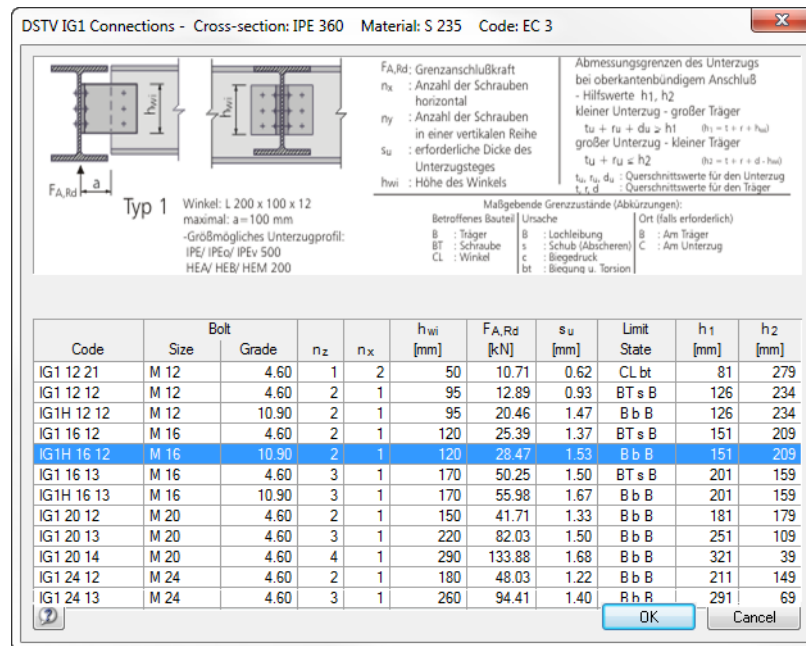


Figure 4.12: Library containing possible IG connections with long angles (IPE 360, S 235, EC 3)

When you have selected a connection from the database, you return to table 1.2. According to the type of IG connection that you have selected, DSTV shows the corresponding connection graphic in the right part of the window, including internal forces to be transferred (for IG connections $F_{A,Rd}$).

Note: The material of the angle must correspond to the one of the connected girder (defined in table 1.1).

With the check boxes in the dialog section *Check Supporting Member*, you can compare the available member thickness with the required minimum thickness of the selected connection. To check the thickness, select a cross-section in the selection field *Cross-section*. You can also use the [Pick] button. The *Web Thickness* can also be defined graphically by means of the [Import] button shown on the left (see Figure 4.8, page 26).

At the same time DSTV is checking the *Material* of the web. The material must be equivalent or even more load-bearing. Thus, an IG connection with S 355 requires a material with a steel grade of at least S 355 also for the web.

To display the cross-section details, use the [Info] button.

4.3.2.5 Coped Connections (IK)

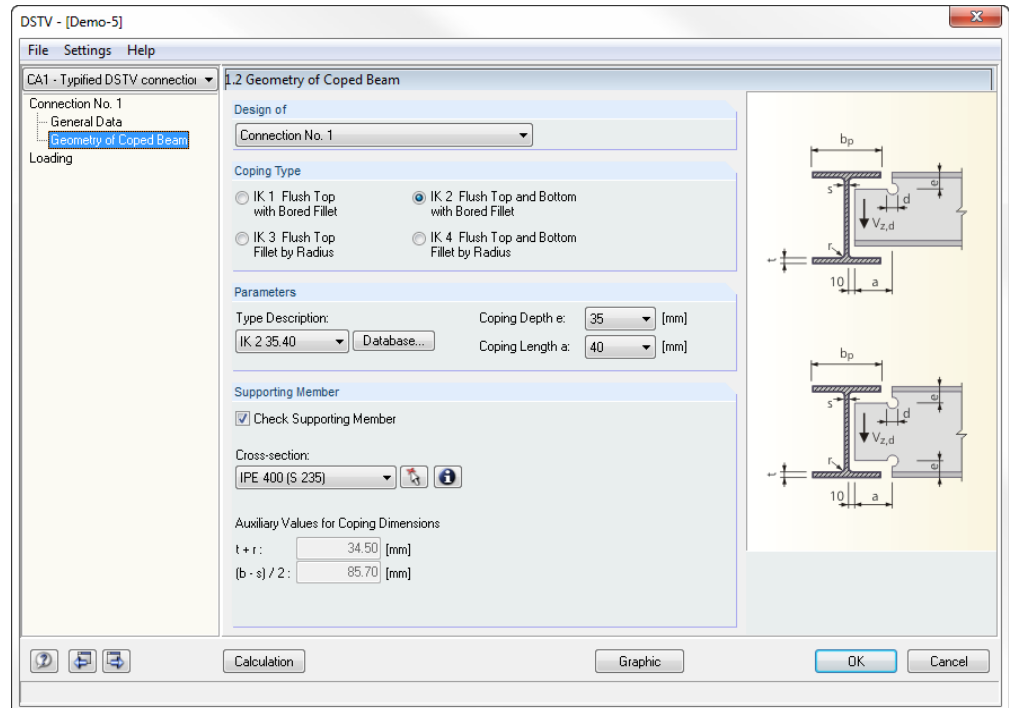


Figure 4.13: Table 1.2 *Geometry and Bolts* for coped connections (IK)

Four *Coping Types* are available for selection: You can use connections *with Bored Fillet* which are *Flush Top* or *Flush Top and Bottom* (IK1 and IK2). It is also possible to use connections with a *Fillet by Radius*, also *Flush Top* or *Flush Top and Bottom* (IK3 and IK4).

In addition, you can specify the *Coping Depth* and the *Coping Length*.

Moreover, it is possible to combine coped connections with pinned web cleat (IW) or end plate (IS) connections. You find the corresponding setting in table 1.1 *General Data* where you can tick the check box *Combine with Coped Connection* (see Figure 4.2, page 20). If the check box is ticked, table 1.3 *Geometry of Coped Beam* is activated for defining the coped connection (instead of entering data in table 1.2 available for "real" coped connections). The advantage is that DSTV checks the corresponding connection and the connection's remaining bearing capacity at the same time.

Database...

Based on these entries, the program creates a database with possible DSTV connections. To access the database, use the [Database] button. You can also use the *Type Description* list in the dialog section *Parameters* to determine it. The coping depth and length which are clearly defined in the type description are affecting the settings of the selection options. When specifying the coping data the other way round, defining the coping depth and length first, DSTV sets the type description automatically in the corresponding list.

The [Database] of the coped connections (IK) is already filled with the remaining possible connections which are characterized by the alphanumeric code. The structure of the database dialog box is similar to the structure of the DSTV guidelines to allow for a familiar data overview. The relevant connection, and thus the definition of the coping depth and the coping length, is determined by selecting the corresponding entry using the mouse device.

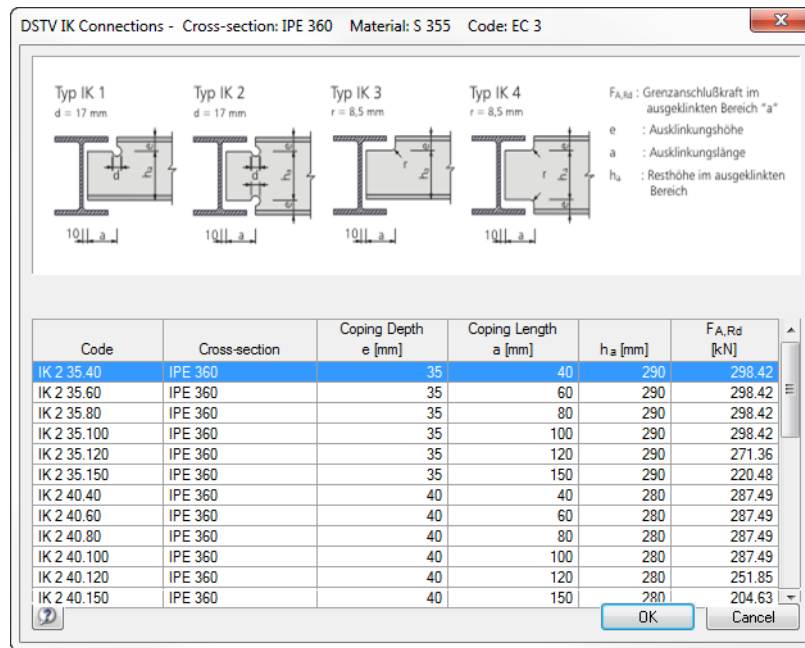


Figure 4.14: Library containing possible IK connections (IPE 360, S 355, EC 3)

When you have selected a connection from the database, you return to table 1.2. According to the type of coped connection (IK) that you have selected, DSTV shows the corresponding connection graphic in the right part of the window.



If you tick the check box *Check Supporting Member*, you can analyze the available cross-section (for example a downstand beam). DSTV determines the minimum dimensions for the coped beam on the basis of the auxiliary values. Select a cross-section in the selection field *Cross-section* or use the [Pick] button.

To display the cross-section details, use the [Info] button.

4.3.3 Table 1.3 Loading



In table 1.3 *Loading*, you select the relevant load cases, groups and combinations from RSTAB for the design of the DSTV connection. They are listed in the dialog sections *Available Load Cases* and *Load Groups and Load Combinations*. To select a load case, group or combination for the design, click the corresponding entry in one of the lists. Double-click the item or use the [>] button to transfer it to the right in the list *Selected for Design*. To transfer all list entries to the right, use the [> >] button. To delete an item, use the [<] button. If you want to empty the complete list, click the [< <] button.

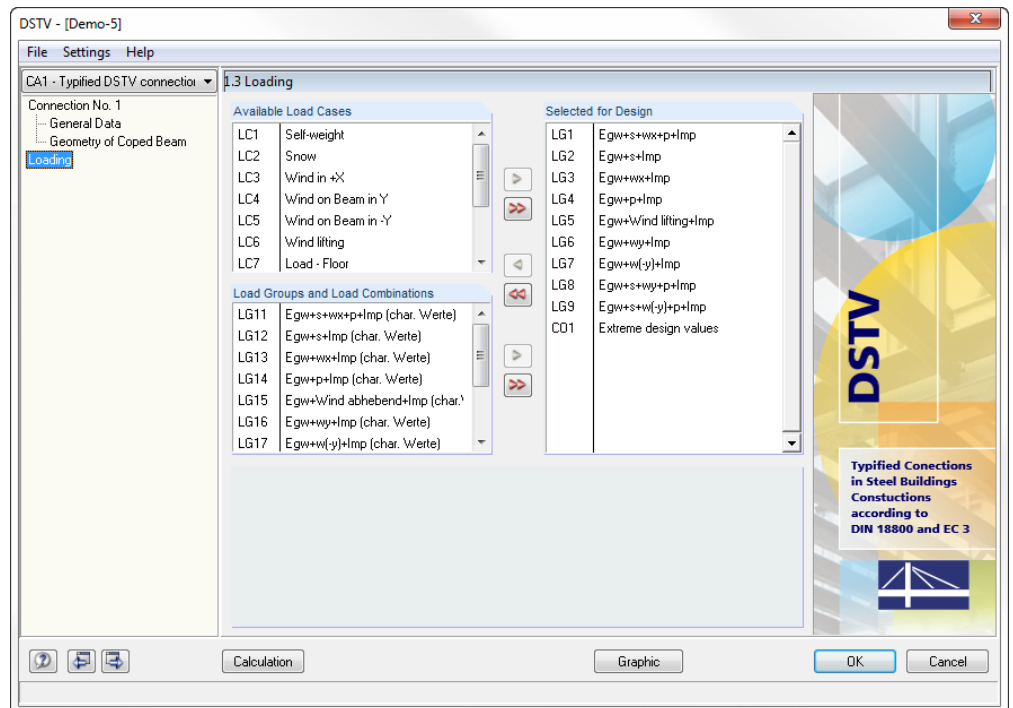


Figure 4.15: Table 1.3 Loading

The load cases, groups and combinations listed in the dialog section *Selected for Design* refer to all connections defined in the current DSTV case. The loading is defined only once for all defined connections contained in the DSTV case, which means that the loading is the same for all connections defined in a DSTV case.

If you want to design connections stressed by different loadings, you have to create a new DSTV case (see chapter 4.5.1, page 49). Using the same input data you can apply different loads for the calculation.

4.3.4 Adjustment of RSTAB Internal Forces

With the DSTV add-on module you can calculate end plates that are *Flush* as well as *Extended Above* or *Below*. It is also possible to design pinned web cleat (IW) and end plate (IS) connections. To facilitate a comparison of loadings with the load capacities specified in the DSTV guidelines, it is necessary to set up adjustment criteria. They allow you to convert the positive or negative RSTAB internal forces into positive DSTV loadings, which can then be compared to the design capacities.

When moment-resisting **end plate connections (IH)** are designed, the DSTV loading is the following for:

Flush end plates for

$$LC, LG: M_{y,1,d} = M_{y,2,d} = \text{Abs } |M_2|$$

$$CO: M_{y,1,d} = M_{y,2,d} = \text{maximum value of Abs } | \text{Max } M_2 | \text{ and Abs } | \text{Min } M_2 |$$

End plates extended on top for

LC or LG:

$$M_2 \text{ positive } M_{y,1,d} = 0$$

$$M_{y,2,d} = M_2$$

$$M_2 \text{ negative } M_{y,1,d} = \text{Abs } |M_2|$$

$$M_{y,2,d} = 0$$

CO:

Max M_2 positive and Min M_2 negative

$$M_{y,1,d} = \text{Abs } | \text{Min } M_2 |$$

$$M_{y,2,d} = \text{Max } M_2$$

Max M_2 positive and Min M_2 positive or zero

$$M_{y,1,d} = 0$$

$$M_{y,2,d} = \text{Max } M_2$$

Max M_2 negative and Min M_2 negative or zero

$$M_{y,1,d} = \text{Abs } | \text{Min } M_2 |$$

$$M_{y,2,d} = 0$$

End plates extended on bottom for

LC or LG:

$$M_2 \text{ positive } M_{y,1,d} = M_2$$

$$M_{y,2,d} = 0$$

$$M_2 \text{ negative } M_{y,1,d} = 0$$

$$M_{y,2,d} = \text{Abs } |M_2|$$

CO:

Max M_2 positive and Min M_2 negative

$$M_{y,1,d} = \text{Max } M_2$$

$$M_{y,2,d} = \text{Abs } | \text{Min } M_2 |$$

Max M_2 positive and Min M_2 positive or zero

$$M_{y,1,d} = \text{Max } M_2$$

$$M_{y,2,d} = 0$$

Max M_2 negative and Min M_2 negative or zero

$$M_{y,1,d} = 0$$

$$M_{y,2,d} = \text{Abs } | \text{Min } M_2 |$$

For pinned **web cleat (IW)** and **end plate connections (IS)**, **connections with long angles (IG)** and **coped connections (IK)** the program determines the loading on the basis of the maximum value of V_3 :

LC, LG:

$$V_{z,d} = V_z$$

CO:

$$V_{z,d} = \text{maximum value of Abs } | \text{Max } V_z | \text{ and Abs } | \text{Min } V_z |$$

Note: All other internal forces also available at the design location won't be taken into account but are displayed in the design details under *Non-Considered Internal Forces*.

4.4 Results

Calculation

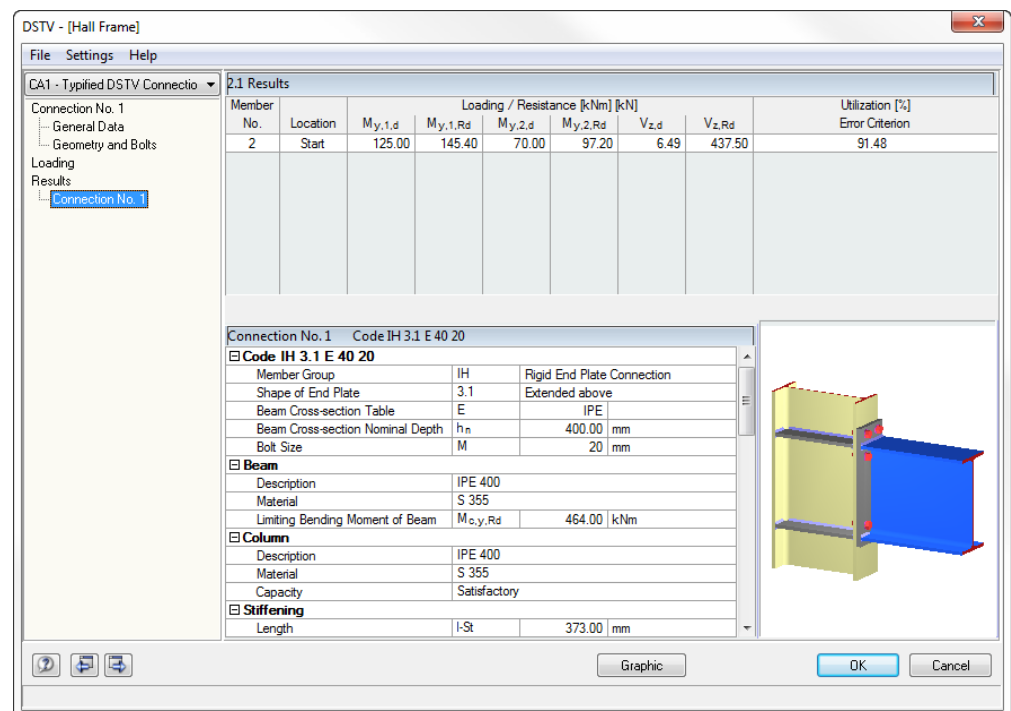
To start the calculation, click the [Calculation] button. In case the results of the actions to be designed are not yet available, the program determines the internal forces first before the connection design will be performed.

Table 2.1 *Results* is displayed immediately after the calculation. You can select the results for the individual DSTV connections by clicking the corresponding entries in the DSTV navigator.

In the upper part of the results table, the loading is compared with the resistance according to the assigned member sides. In addition, the limit state (only for pinned connections) and the connection's design ratio in percent is displayed. In the table part below, the results and intermediate values are evaluated in a list. The list contains main entries for the alphanumeric code, the beam, the bolts, the end plate and the end plate geometry as well as the fillet welds, the loadings, the resistances and finally the non-considered internal forces, each revealing the results and intermediate values. When a main entry is selected, the corresponding graphic is shown to the right explaining the abbreviations (mostly dimensions) used in the list.

To have a better overview, it is possible to open and close the secondary entries by clicking [-] and [+].

4.4.1 IH End Plate Connection



The screenshot shows the 'DSTV - [Hall Frame]' window. On the left is a tree view with 'CA1 - Typified DSTV Connection' expanded, showing 'Connection No. 1' selected. The main area displays '2.1 Results' with a table of member data and a detailed view for 'Connection No. 1'.

Member No.	Location	Loading / Resistance [kNm] [kN]						Utilization [%] Error Criterion
		$M_{y,1,d}$	$M_{y,1,Rd}$	$M_{y,2,d}$	$M_{y,2,Rd}$	$V_{z,d}$	$V_{z,Rd}$	
2	Start	125.00	145.40	70.00	97.20	6.49	437.50	91.48

Connection No. 1		Code IH 3.1 E 40 20
Code IH 3.1 E 40 20		
Member Group	IH	Rigid End Plate Connection
Shape of End Plate	3.1	Extended above
Beam Cross-section Table	E	IPE
Beam Cross-section Nominal Depth	h_E	400.00 mm
Bolt Size	M	20 mm
Beam		
Description	IPE 400	
Material	S 355	
Limiting Bending Moment of Beam	$M_{e,y,Rd}$	464.00 kNm
Column		
Description	IPE 400	
Material	S 355	
Capacity	Satisfactory	
Stiffening		
Length	I-St	373.00 mm

On the right, a 3D graphic shows the end plate connection geometry with dimensions.

Figure 4.16: Table 2.1 *Results* for bending-resistant end plate connections (IH)

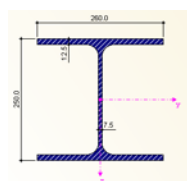
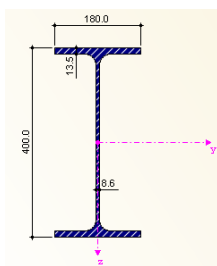
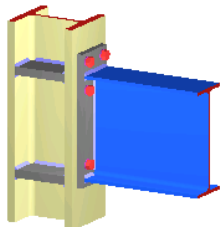
Database...

The results table compares the loading with the resistance for the member ends defined in table 1.1. The specifications concerning the possible design capacity are based on the DSTV guidelines. You can also check them by using the [Database] button available in table 1.2.

However, the DSTV database in table 1.2 contains only load capacities for a design ratio of 100 %. These capacities are decisive for "beam joints" and "beam connections on one side without column". If you use "beam connections on one side with column" or "beam connections on both sides" (always with column), a resistance of 80 % or 60 % is allowed as well

(provided that the reduced resistance is higher than the loading). Generally, this leads to required column cross-sections that are significantly smaller. Also the limit states will be different, of course.

The first entry in the table below represents the alphanumeric code (for example *IH 3.1 E 40 20*) of the calculated connection. The type description is described in chapter 3.1.



Code IH 3.1 E 40 20

Member Group	IH	Rigid End Plate Connection	
Shape of End Plate	3.1	Extended above	
Beam Cross-section Table	E	IPE	
Beam Cross-section Nominal Depth	h_n	400.00	mm
Bolt Size	M	20	mm

The beam indicated in the connection code is displayed in detail with its material properties. $M_{c,y,Rd}$ represents the girder's plastic limit moment about the y-axis (axis 2) specified in the DSTV guidelines.

Beam

Description	IPE 400		
Material	S 355		
Limiting Bending Moment of Beam	$M_{c,y,Rd}$	464.00	kNm

When the option "connection to column" has been activated in table 1.2, an additional entry appears listing the column description, the column material and a note referring to the bearing capacity. In accordance with the connection's design ratio in percent (100 %, 80 % or 60 %), the program compares the column with the required column cross-section specified in the DSTV guidelines. While comparing the program considers also the required columns that are specified for higher percent ratios in the DSTV guidelines. The column's bearing capacity is fulfilled if the entry of the selected column is found in the DSTV guidelines. If the selected column is larger than the maximum column cross-section specified in the DSTV guidelines, the bearing capacity of the column must be designed separately. If only a "-" sign is indicated in the same case for a 100 % utilization, the bearing capacity is not fulfilled. Columns with the indication "St" must be stiffened additionally (for example all connections of type IH2 and IH4).

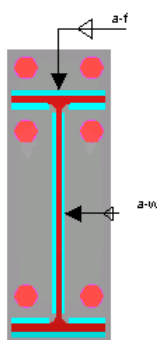
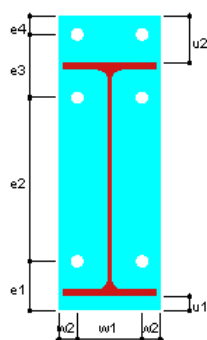
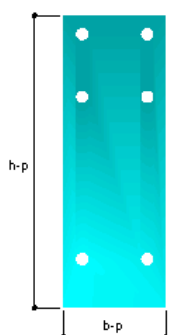
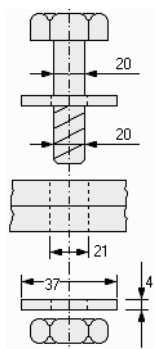
Column

Description	HE-A 200		
Material	S 355		
Capacity	Satisfactory		

In case a column suggestion is set, the required minimum cross-sections listed in the guidelines are shown in the output. When the option "Suggest possible column cross-sections" has been selected, the material of the specified column will follow the material of the girder.

When you have ticked the option "connection to column" in table 1.2 and the required column is marked by "St" in the DSTV guidelines, or when you have selected the option "with stiffeners", the results table will show the additional entry *Stiffening* listing the dimensions and welds as well as the material. The material grade of the stiffening follows the material with which the connection was calculated.

Note: If girder and column consist of different materials, DSTV calculates the entire connection (stiffening and end plate) always with the inferior material grade for reasons of safety.



Stiffening			
Length	l-St	373.00	mm
Width	b-St	85.70	mm
Thickness	t-St	15.00	mm
Coping	c-St	21.00	mm
Welds	a-St	9.00	mm
Material	S 355		

Similar to the detailed list for the beam, the column and the stiffening, DSTV also describes the bolts that are used. First the size and the strength grade of bolts are indicated (set in table 1.2). The number of used bolts follows.

Bolts			
M 20 - 10,9			
Maximal Nominal Hole Gap	dI	1.00	mm
Number of Bolts	Number	6	

The subsequent entry reveals information about the end plate's dimensions. The width and the depth of the end plate can vary, depending on the end plate selection (flush, extended, two- or four-row connection).

Note: If girder and column consist of different materials, DSTV calculates the entire connection (stiffening and end plate) always with the inferior material grade for reasons of safety. If the column is not checked, or when the option "Suggest possible column cross-sections" has been selected, the grade of the end plate will always correspond to the material grade of the girder.

End plate			
Material	S 355		
Width	b _p	180.00	mm
Depth	h _p	500.00	mm
Thickness	t _p	20.00	mm

Workshops do not only require data of end plate dimensions for production, also the arrangements of bore holes and their dimensioning relating to the end plate are necessary. Therefore, the subsequent entry contains information concerning the relevant edge and hole spacings as well as the end plate extension on which the calculation of design capacities were based. Moreover, the required thicknesses of fillet welds (double fillet weld) for flange and web are displayed.

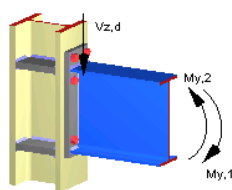
Hole Arrangement (End Plate Geometry)			
Vertical Edge Spacing	e 4	30.00	mm
Vertical Hole Spacing	e 3	95.00	mm
Vertical Hole Spacing	e 2	290.00	mm
Vertical Edge Spacing	e 1	85.00	mm
Extension	u 1	30.00	mm
Extension	u 2	70.00	mm
Horizontal Hole Spacing	w 1	90.00	mm
Lateral Edge Spacing	w 2	45.00	mm
Fillet Welds			
Flange Fillet Weld	a f	9.00	mm
Web Fillet Weld	a w	3.00	mm

The design is performed by comparing loading and load capacity. The loading corresponds to the RSTAB internal forces available for the design loads (LC, LG, CO). The comparison of the min/max moment ($M_{y,1,d}$ and $M_{y,2,d}$) as well as the corresponding shear force ($V_{z,d}$) with the load capacities "limiting bending moment of connection" ($M_{y,1,Rd}$ and $M_{y,2,Rd}$) and "limiting shear force of connection" ($V_{z,Rd}$) results in the *Utilization* of the connection. It is displayed in the final column of table 2.1 *Results*.

The detailed results also show the decisive limit of failure (*Ultimate Limit State*). In chapter 3.1 you find explanations to the abbreviations.

Note: In case of connections designed "on one side" set with the option "connection to column" and connections designed "on both sides", the comparison is not carried out with the resistances of a connection used to a capacity of 100 % as you can design it with 80 % or 60 % of the load capacity. Normally, connections with reduced load capacities require smaller column cross-sections.

To some internal forces the calculation method based on the DSTV guidelines cannot be applied. Double bending, which means moment and shear force (in direction of or about the minor axis), as well as torsional and axial forces cannot be taken into account. This is the reason why they are listed under "Non-Considered Internal Forces (Maximum)".



☐ Loading (maximal)			
☐ Moment	$M_{y,1,d}$	0.00	kNm
Governing Member		2	
Location		Start	
Governing LC/LG/CO	LG	1	
☐ Moment	$M_{y,2,d}$	0.00	kNm
Governing Member		2	
Location		Start	
Governing LC/LG/CO	LG	1	
☐ Shear Force	$V_{z,d}$	6.49	kN
Governing Member		2	
Location		Start	
Governing LC/LG/CO	LG	1	
☐ Resistance EC 3 (Edition 4.11.2002)			
Moment	$M_{y,1,Rd}$	145.40	kNm
Reverse Moment	$M_{y,2,Rd}$	97.20	kNm
Shear Force	$V_{z,Rd}$	437.50	kN
Ultimate Limit State	EPB	End Plate in Bending	
☐ Non-Considered Internal Forces (Maximum)			
☐ Torsion	$M_{T,d}$	0.00	kNm
☐ Shear Force	$V_{y,d}$	0.00	kN
☐ Axial Force	N_d	-40.12	kN

Due to the elastic stiffness $S_{j,ini}$ (not valid for the reversal moment), it is possible to classify the connection to be ductile or rigid by comparing the girder stiffness (see descriptions in the DSTV guidelines). The minimum required column cross-section specified in the DSTV guidelines is considered respectively in the stiffnesses (not stiffened column cross-section, girder connected on one side).

If the bearing capacity of the column is not sufficient, the DSTV output includes no values for the stiffness. When the option "Suggest possible column cross-sections according to DSTV" was activated in table 1.2, the final detail results show the minimum cross-sections with the corresponding stiffnesses.

☐ Stiffness $S_{j,ini}$			
Column IPE 400	$S_{j,ini}$	38.90	MNm/rad

4.4.2 IW Web Cleat Connection

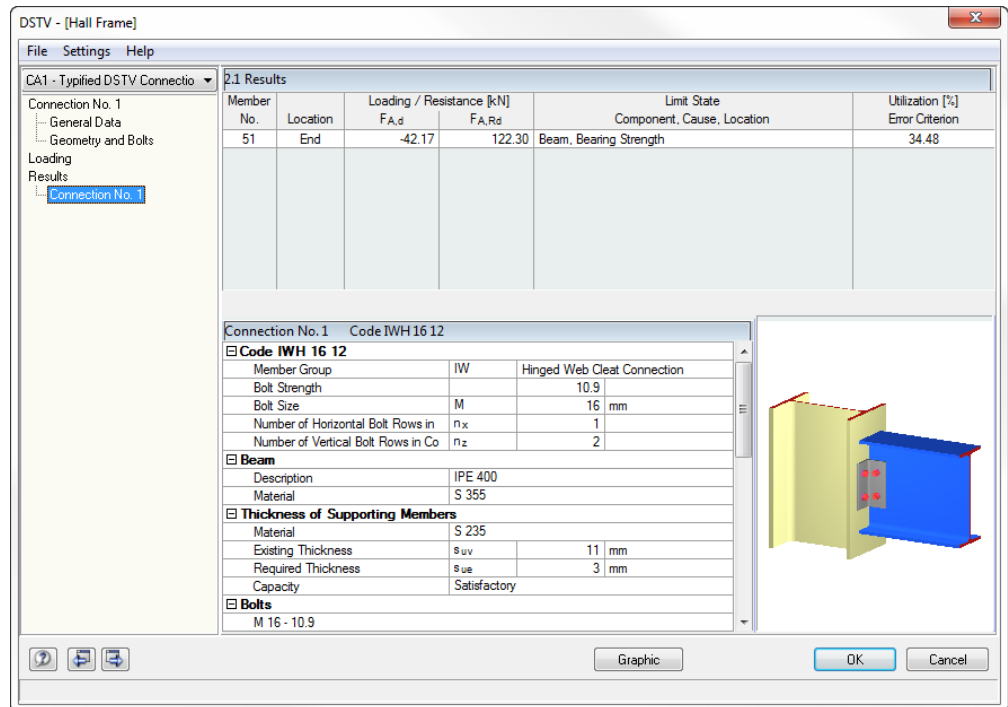


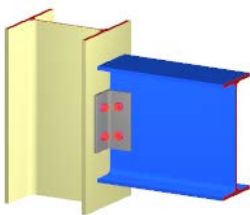
Figure 4.17: Table 2.1 Results for web cleat connections (IW)

Database...

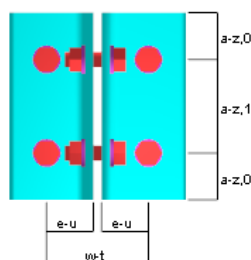
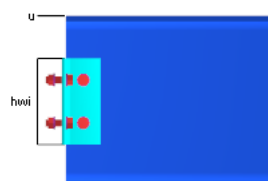
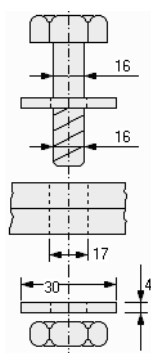
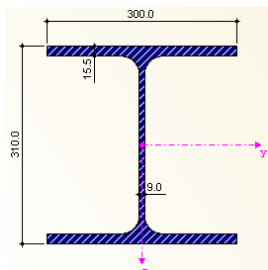
The results table compares the loading with the resistance for the member ends defined in table 1.1. The specifications concerning the possible design capacity are based on the DSTV guidelines. You can also check them by using the [Database] button available in table 1.2.

The first entry in the results list represents the alphanumeric code (for example *IWH 16 12*) of the calculated connection. The type description is described in chapter 3.2. It is based on the settings defined in table 1.2. When you have selected the option *No Specification* for the bolt size and the number of bolts n_z in a vertical row, the results table displays the bolt size and the number of the vertical bolts that have been determined for the design.

Code IWH 16 12			
Member Group	IW	Hinged Web Cleat Connection	
Bolt Strength		10.9	
Bolt Size	M	16	mm
Number of Horizontal Bolt Rows in	n_x	1	
Number of Vertical Bolt Rows in Co	n_z	2	



When you have activated the option for checking the supporting member in table 1.2, additional information appears concerning girder and member thickness. In this way you can evaluate the bearing capacity of the supporting member by means of the required thickness mentioned in the DSTV guidelines.



Beam			
Description	IPE 400		
Material	S 355		
Thickness of Supporting Members			
Material	S 235		
Existing Thickness	s_{uv}	11	mm
Required Thickness	s_{ue}	3	mm
Capacity	Satisfactory		

In addition to the information given by the connection code (bolt size, number of bolts in a vertical row), the maximum nominal hole gap is indicated.

Bolts			
M 16 - 10.9			
Maximal Nominal Hole Gap	dl	1	mm
Number in a Vertical Row	n_z	2	

Moreover, the output shows you the web cleat, the number of angles and the required length of the angles. Furthermore, you can see the possible extension of the angle from the notched edge.

Note: If girder and supporting member consist of different materials, DSTV calculates the entire connection (web cleat) always with the inferior material grade for reasons of safety.

Angle (equal)			
L 90x9	Number	2	
Material	S 235		
Depth of Angle	h_{wi}	200	mm
Minimal Spacing from Notched Edg	u	1	mm

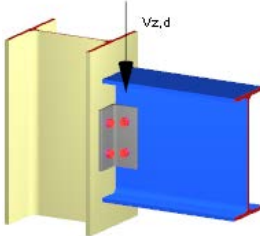
Workshops do not only require data of the angle geometry for production, also the arrangements of bore holes and their dimensioning relating to the angle legs are necessary. Therefore, the arrangement entry contains information concerning the relevant edge and hole spacings as well as the marking-out dimensions that are related respectively to the smaller and larger edge.

Hole Arrangement in Angle			
Horizontal Edge Spacing	e_u	50	mm
Vertical Edge Spacing	$a_{z,0}$	50	mm
Vertical Hole Spacing	$a_{z,1}$	100	mm
Hole Spacing	$w-t$	109	mm

The design is performed by comparing loading and load capacity. The loading corresponds to the RSTAB internal forces available for the design loads (LC, LG, CO). The comparison of the shear force ($V_{z,d}$) with the possible limiting shear force of the connection ($V_{z,Rd}$) results in the connection's *Utilization*. It is displayed in the final column of table 2.1 *Results*.

The detailed results also show the decisive limit of failure (*Ultimate Limit State*). In chapter 3.2 you find explanations to the abbreviations.

To some internal forces the calculation method based on the DSTV guidelines cannot be applied. Bending, torsion and axial force as well as shear force V_y in direction of the minor axis cannot be taken into account. This is the reason why they are listed separately under "Non-Considered Internal Forces (Maximum)".



☐ Loading (maximal)			
☐ Shear Force	$V_{z,d}$	-42.17	kN
Governing Member		51	
Location		End	
Governing LC/LG/CO	CO	1	
☐ Resistance EC 3 (Edition 14.7.2000)			
Shear Force	$F_{A,Rd}$	122.30	kN
☐ Ultimate Limit State			
- Component	B	Beam	
- Cause	b	Bearing Strength	
☐ Non-Considered Internal Forces (Maximum)			
☐ Moment	$M_{y,d}$	0.00	kNm
☐ Moment	$M_{z,d}$	0.00	kNm
☐ Torsion	$M_{T,d}$	-0.01	kNm
☐ Shear Force	$V_{y,d}$	-0.08	kN

4.4.3 IS End Plate Connection

DSTV - [Hall Frame]

File Settings Help

CA1 - Typified DSTV Connectio

Connection No. 1

General Data

Geometry and Bolts

Loading

Results

Connection No. 1

2.1 Results

Member No.	Location	Loading / Resistance [kN]		Limit State Component, Cause	Utilization [%] Error Criterion
		$F_{A,d}$	$F_{A,Rd}$		
51	End	-56.38	241.30	Bolt, Shear (Shearing)	23.37
9	Start	56.30	241.30	Bolt, Shear (Shearing)	23.33

Connection No. 1 Code IS 20 4

☐ Code IS 20 4 10

Member Group	IS	Hinged End Plate Connection
Bolt Strength		4.6
Bolt Size	M	20 mm
Number of Bolts in End Plate	n	4
Horizontal Bolt Spacing	w	100 mm

☐ Beam

Description	IPE 400
Material	S 355

☐ Thickness of Supporting Members

Material	S 355
Existing Thickness	s_{uv} 14 mm
Required Thickness	s_{ue} 4 mm
Capacity	Satisfactory

☐ Bolts

M 20 - 4.6

Graphic

OK Cancel

Figure 4.18: Table 2.1 Results for end plate connections (IS)

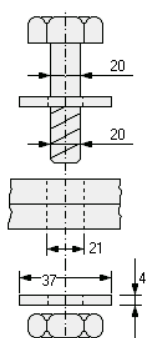
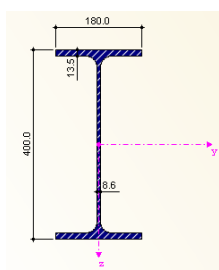
The results table compares the loading with the resistance for the member ends defined in table 1.1. The specifications concerning the possible design capacity are based on the DSTV guidelines. You can also check them by using the [Database] button available in table 1.2.

Database...

The first entry in the results list represents the alphanumeric code (for example *IS 20 4 10*) of the calculated connection. The type description is described in chapter 3.3. When you have selected the option *No Specification* for the size and number of bolts, the results table displays the bolt size and the number of bolts that have been determined for the design.

Code IS 20 4 10			
Member Group	IS	Hinged End Plate Connection	
Bolt Strength		4.6	
Bolt Size	M	20	mm
Number of Bolts in End Plate	n	4	
Horizontal Bolt Spacing	w	100	mm

When you have activated the option for checking the supporting member in table 1.2, additional information appears concerning girder and member thickness. In this way you can evaluate the bearing capacity of the supporting member by means of the required thickness mentioned in the DSTV guidelines.



Beam			
Description	IPE 400		
Material	S 355		
Thickness of Supporting Members			
Material	S 355		
Existing Thickness	s_{uv}	14	mm
Required Thickness	s_{ue}	4	mm
Capacity	Satisfactory		

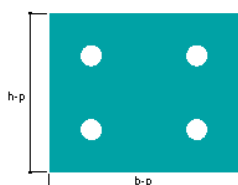
Moreover, the used bolts are described. In addition to bolt size and strength grade of bolts (set in table 1.2), the output lists the number of bolts (the DSTV guidelines include only IS connections with two vertical bolt rows).

Bolts			
M 20 - 4.6			
Maximal Nominal Hole Gap	dl	1	mm
Number of Bolts	Number	4	

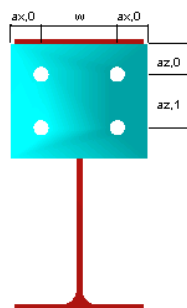
The subsequent entry reveals information about the end plate's dimensions. The material used for the end plate corresponds to the girder material: If the girder is designed with S 235, the end plate is also designed with S 235. Further results are values indicating the width, depth and thickness of the end plate.

Note: If girder and supporting member consist of different materials, DSTV calculates the entire connection (end plate) always with the inferior material grade for reasons of safety.

End plate			
Material	S 355		
Width	b_p	180	mm
Depth	h_p	150	mm
Thickness	t_p	10	mm



Workshops do not only require data of end plate dimensions for production, also the arrangements of bore holes and their dimensioning relating to the end plate are necessary. Therefore, the arrangement entry contains information concerning the relevant edge and hole spacings respectively in horizontal and vertical direction. Moreover, the required thicknesses of fillet welds (double fillet weld) for flange and web are displayed.

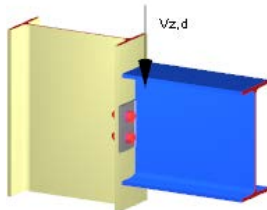


Hole Arrangement (End Plate Geometry)			
Horizontal Edge Spacing	$a_{x,0}$	40	mm
Horizontal Hole Spacing	w	100	mm
Vertical Edge Spacing	$a_{z,0}$	40	mm
Vertical Hole Spacing	$a_{z,1}$	70	mm
Offset Top Edge End Plate-Beam	$v-p$	5	mm
Fillet Welds			
Flange Fillet Weld, Constructive			
Web Fillet Weld	a	4	mm

The design is performed by comparing loading and load capacity. The loading corresponds to the RSTAB internal forces available for the design loads (LC, LG, CO). The comparison of the shear force ($V_{z,d}$) with the possible limiting shear force of the connection ($V_{z,Rd}$) results in the connection's *Utilization*. It is displayed in the final column of table 2.1 *Results*.

The detailed results also show the decisive limit of failure (*Ultimate Limit State*). In chapter 3.3 you find explanations to the abbreviations.

To some internal forces the calculation method based on the DSTV guidelines cannot be applied. Bending, torsion and axial force as well as shear force V_y (minor axis) cannot be taken into account. This is the reason why they are listed separately under "Non-Considered Internal Forces (Maximum)".



☐ Loading (maximal)			
☐ Shear Force	$V_{z,d}$	-56.38	kN
Governing Member		51	
Location		End	
Governing LC/LG/CO	CO	1	
☐ Resistance EC 3 (Edition 14.7.2000)			
Shear Force	$F_{A,Rd}$	241.30	kN
☐ Ultimate Limit State			
- Component	BT	Bolt	
- Cause	s	Shear (Shearing)	
☐ Non-Considered Internal Forces (Maximum)			
⊕ Moment	$M_{y,d}$	0.00	kNm
⊕ Moment	$M_{z,d}$	0.00	kNm
⊕ Torsion	$M_{T,d}$	-0.05	kNm
⊕ Shear Force	$V_{y,d}$	0.25	kN
⊕ Axial Force	N_d	-20.40	kN

4.4.4 IG Connection With Long Angles

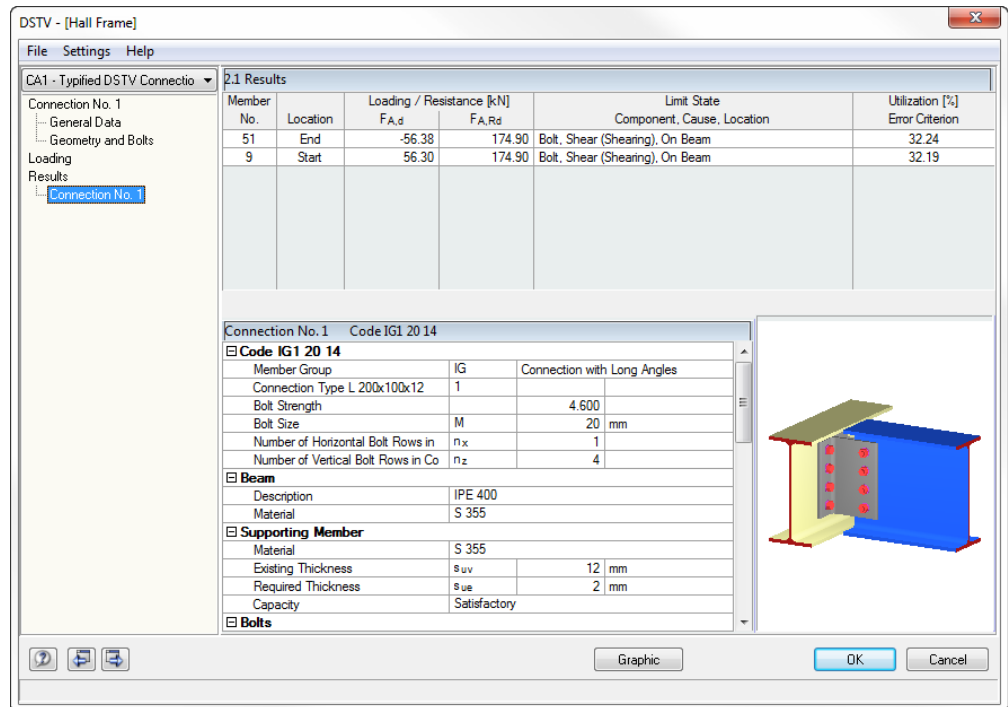


Figure 4.19: Table 1.2 Results for IG connections with long angles

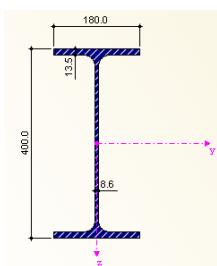
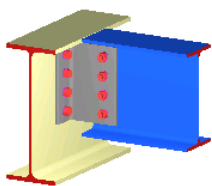
Database...

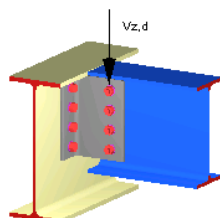
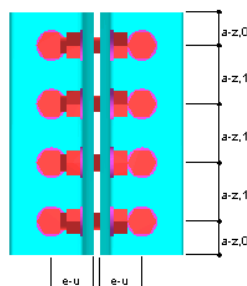
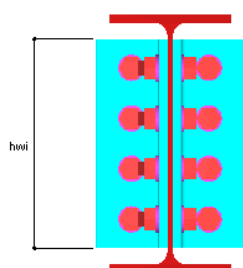
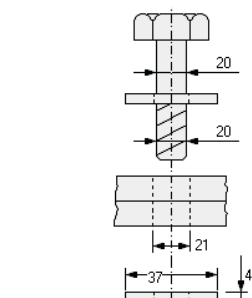
The results table compares the loading with the resistance for the member ends defined in table 1.1. The specifications concerning the possible design capacity are based on the DSTV guidelines. You can also check them by using the [Database] button available in table 1.2.

The first entry in the results list represents the alphanumeric code (for example *IG1 20 14*) of the calculated connection. The type description is described in chapter 3.4. When you have selected the option *No Specification* for the size and number of bolts, the results table displays the bolt size and the number of bolts that have been determined for the design. In addition to the strength grade of bolts, DSTV displays the horizontal bolt spacing that was defined in table 1.2.

Code IG1 20 14			
Member Group	IG	Connection with Long Angles	
Connection Type L 200x100x12	1		
Bolt Strength		4.600	
Bolt Size	M	20	mm
Number of Horizontal Bolt Rows in	n_x	1	
Number of Vertical Bolt Rows in Co	n_z	4	

When you have activated the option for checking the supporting member in table 1.2, additional information appears concerning girder and member thickness. In this way you can evaluate the bearing capacity of the supporting member by means of the required thickness mentioned in the DSTV guidelines.





Beam			
Description	IPE 400		
Material	S 355		
Supporting Member			
Material	S 355		
Existing Thickness	s_{uv}	12	mm
Required Thickness	s_{ue}	2	mm
Capacity	Satisfactory		

Moreover, the used bolts are described. In addition to bolt size and strength grade of bolts (set in table 1.2), the output lists the number of bolts.

Bolts		
M 20 - 4.6		
Maximal Nominal Hole Gap	d_l	1 mm
Number in a Vertical Row	n_z	4
Number in a Horizontal Row	n_x	1

Furthermore, the output shows you the web cleat, the number of angles, the required length of the angles and, if applicable, the extension of the angle from the edge of the coped connection.

Angle		
L 200x100x12	Number	2
Material	S 355	
Depth of Angle	h_{wi}	290 mm

Workshops do not only require data of the angle geometry for production, also the arrangements of bore holes and their dimensioning relating to the angle legs are necessary. Therefore, the arrangement entry contains information concerning the relevant edge and hole spacings as well as the marking-out dimensions that are related respectively to the smaller and larger edge.

Hole Arrangement in Angle		
in Narrower Flange		
Horizontal Edge Spacing	e_u	50 mm
Vertical Edge Spacing	$a_{z,0}$	40 mm
Vertical Hole Spacing	$a_{z,1}$	70 mm
in Wider Flange		
Horizontal Edge Spacing	$a_{x,0}$	50 mm
Horizontal Edge Spacing	$a_{x,2}$	150 mm
Vertical Edge Spacing	$a_{z,0}$	40 mm
Vertical Hole Spacing	$a_{z,1}$	70 mm

The design is performed by comparing loading and load capacity. The comparison of the shear force ($V_{z,d}$) with the possible limiting shear force of the connection ($V_{z,Rd}$) results in the connection's *Utilization*. It is displayed in the final column of table 2.1 *Results*.

The detailed results also show the decisive limit of failure (*Ultimate Limit State*). In chapter 3.4 you find explanations to the abbreviations.

To some internal forces the calculation method based on the DSTV guidelines cannot be applied. Bending, torsion and axial force as well as shear force V_y (minor axis) cannot be taken into account. This is the reason why they are listed separately under "Non-Considered Internal Forces (Maximum)".

▢ Loading (maximal)			
▢ Shear Force	$V_{z,d}$	-56.38	kN
Governing Member		51	
Location		End	
Governing LC/LG/CO	CO	1	
▢ Resistance EC 3 (Edition 14.7.2000)			
Shear Force	$F_{A,Rd}$	174.90	kN
▢ Ultimate Limit State			
- Component	BT	Bolt	
- Cause	s	Shear (Shearing)	
- Location	B	On Beam	
▢ Non-Considered Internal Forces (Maximum)			
⊕ Moment	$M_{y,d}$	0.00	kNm
⊕ Moment	$M_{z,d}$	0.00	kNm
⊕ Torsion	$M_{T,d}$	-0.05	kNm
⊕ Shear Force	$V_{y,d}$	0.25	kN

4.4.5 IK Coped Connection

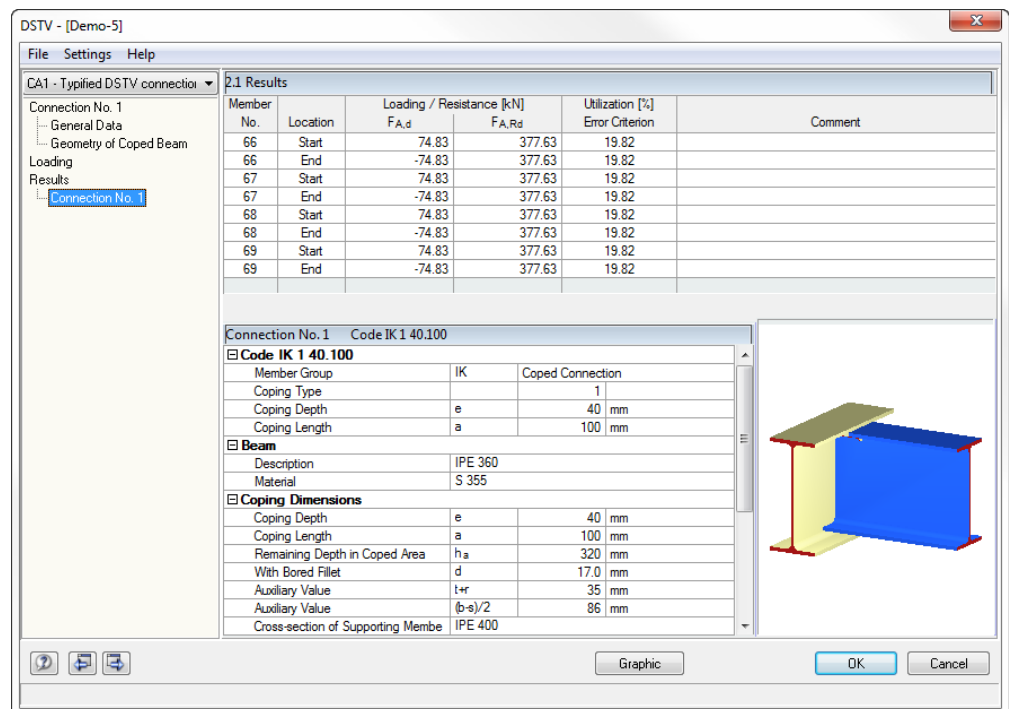


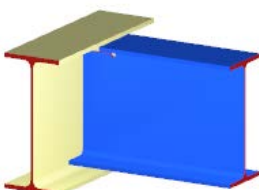
Figure 4.20: Table 2.1 Results for IK connection with coped beam

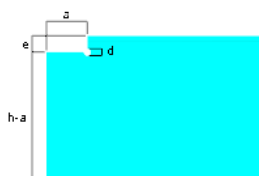
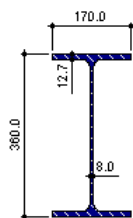
The results table compares the loading with the resistance for the member ends defined in table 1.1. The specifications concerning the possible design capacity are based on the DSTV guidelines. You can also check them by using the [Database] button available in table 1.2.

The first entry in the results list represents the alphanumeric code (for example *IK1 40.100*) of the calculated connection. The type description is described in chapter 3.5. It is based on the settings defined in table 1.2: coping type, coping length and coping depth.

▢ Code IK 1 40.100		
Member Group	IK	Coped Connection
Coping Type		1
Coping Depth	e	40 mm
Coping Length	a	100 mm

Database...





Then the girder to be coped is indicated including cross-section description and material.

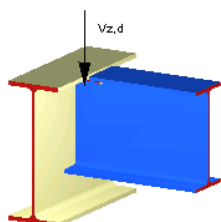
Beam	
Description	IPE 360
Material	S 355

The entry specifying the "coping dimensions" lists again the dimensions of the coped connection (IK) which were used to determine the auxiliary values for the selected connection geometry. If the supporting member is also checked, DSTV displays the cross-section together with the material.

Coping Dimensions			
Coping Depth	e	40	mm
Coping Length	a	100	mm
Remaining Depth in Coped Area	h _a	320	mm
With Bored Fillet	d	17.0	mm
Auxiliary Value	t+r	35	mm
Auxiliary Value	(b-s)/2	86	mm
Cross-section of Supporting Membe	IPE 400		
Material	S 235		

The design is performed by comparing loading and load capacity. The comparison of the shear force ($V_{z,d}$) with the possible limiting shear force of the connection ($V_{z,Rd}$) results in the connection's *Utilization*. It is displayed in the penultimate column of table 2.1 *Results*.

To some internal forces the calculation method based on the DSTV guidelines cannot be applied. Bending, torsion and axial force as well as shear force V_y (minor axis) cannot be taken into account. This is the reason why they are listed separately under "Non-Considered Internal Forces (Maximum)".



Loading (maximal)			
Shear Force	$V_{z,d}$	74.83	kN
Governing Member		66	
Location		Start	
Governing LC/LG/CO	CO	2	
Resistance EC 3 (Edition 14.7.2000)			
Shear Force	$F_{A,Rd}$	372.39	kN
Non-Considered Internal Forces (Maximum)			
Torsion	$M_{T,d}$	-0.01	kNm
Axial Force	N_d	184.90	kN
Governing Member		68	
Location		Start	
Governing LC/LG/CO	CO	2	

When you also check the supporting member, "comments" appear at the end of the list, describing available geometric problems.

Comment	
Coping depth e is Greater than auxiliary value t+r.	
Coping width a is Greater than auxiliary value (b-s)/2.	

4.4.6 Graphical Output

Graphic



Use the [Graphic] button to activate the 3D rendering display for the current DSTV connection. With the toolbar list in the upper right corner of the window it is possible to set another connection.

The toolbar and the menus provide common RSTAB functions for controlling the graphical view and the printout. To display the dimensions in the 3D rendering, use the [Dimensions] button shown on the left.

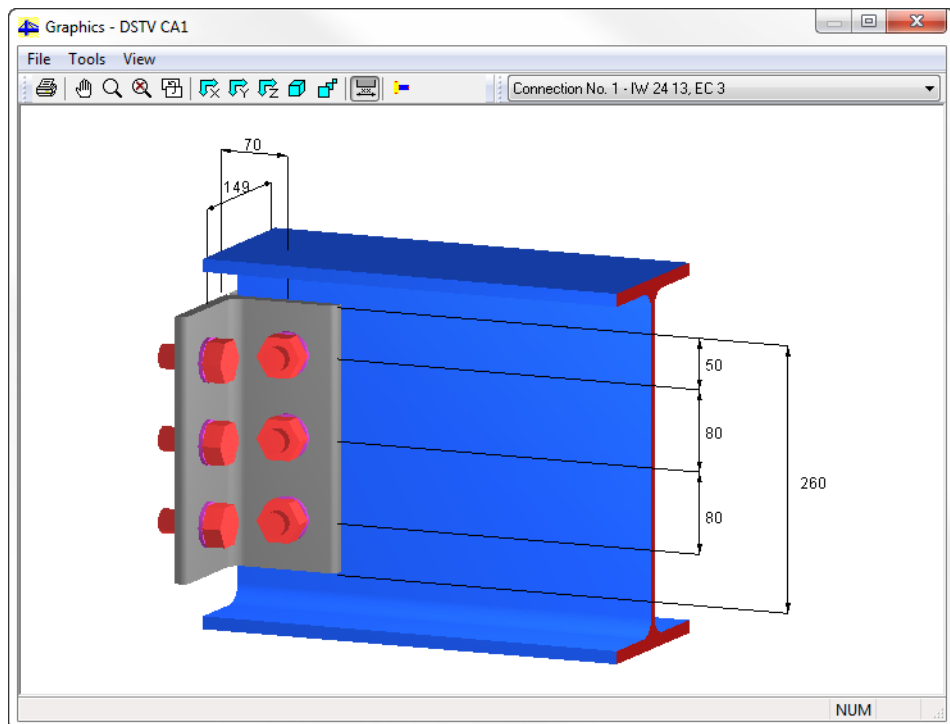


Figure 4.21: 3D rendering view of a IW connection with dimensions



Use the [Printer] button to open the dialog box *Graphic Printout* that you already know from RSTAB. Now you can print the current graphic directly. It is also possible to integrate it in the printout report.

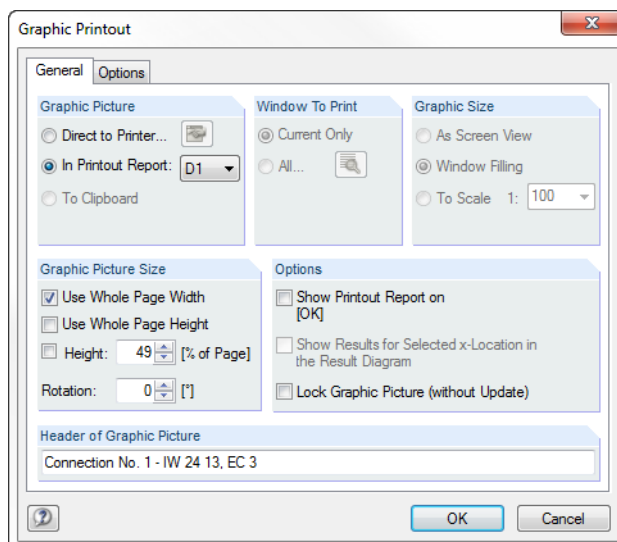
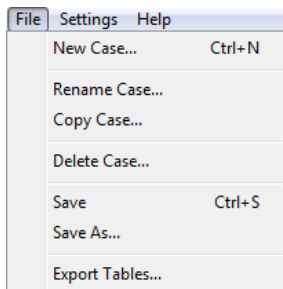


Figure 4.22: Dialog box *Graphic Printout*

4.5 Menus

The three menus of the DSTV add-on module provide all functions necessary to work with various DSTV cases and their results. To open a menu, click the menu name, or press the [Alt] key together with the keyboard key of the letter that is underlined in the menu description.

[Alt+F]



4.5.1 File

The *File* menu functions are used for the DSTV case management.

Create a new case [Ctrl+N]

Use this function to create a new DSTV case (typified connection).

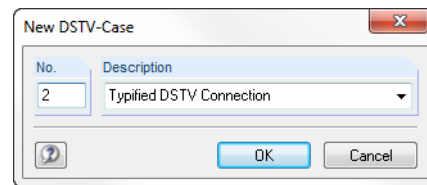


Figure 4.23: Dialog box *New DSTV-Case*

Specify a *No.* and a *Description*.

Rename a case

You can assign another *Description* and, if required, a new *No.* to the current DSTV case.

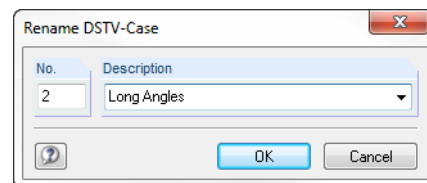


Figure 4.24: Dialog box *Rename DSTV-Case*

You can only assign numbers that have not been assigned yet.

Copy a case

This function allows you to copy an already created DSTV case. Select the DSTV case that you want to copy in the list.

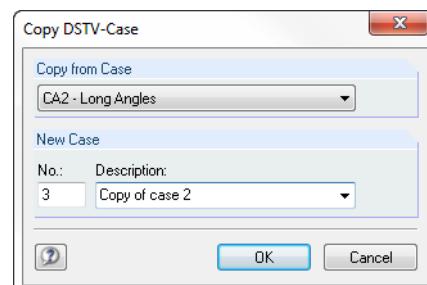


Figure 4.25: Dialog box *Copy DSTV-Case*

Numbers that have already been assigned cannot be reassigned.

Delete a case

The dialog box shows all available DSTV cases in a list.

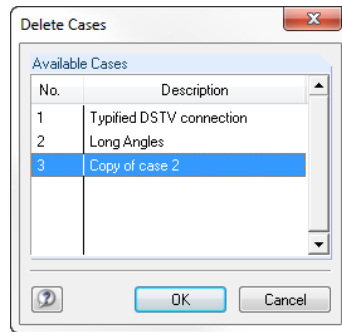


Figure 4.26: Dialog box *Delete Cases*

To delete a case, select the corresponding entry and click [OK].

Save [Ctrl+S]

Use this function to save the current connection.

Save As...

The connection data can be saved under a different file name. First, a dialog box appears where you can define the relevant data.

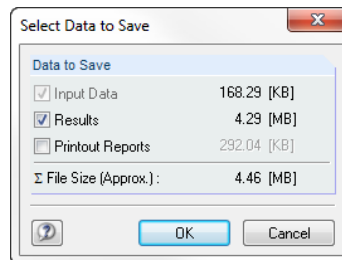


Figure 4.27: Dialog box *Select Data to Save*

Export Tables

The data of the tables can be exported to MS Excel or OpenOffice.org Calc. The following dialog box opens:

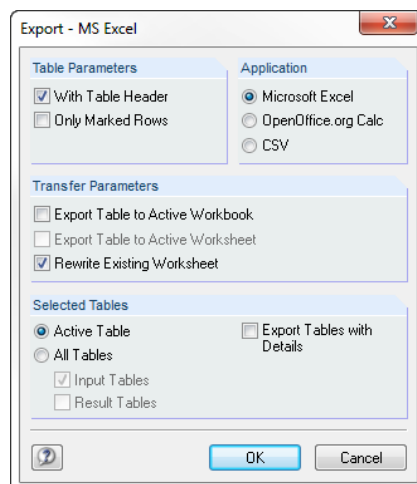


Figure 4.28: Dialog box *Export - MS Excel*

Find further information in the RSTAB manual, chapter 12.5.2.3.

[Alt+S]

4.5.2 Settings

The *Settings* menu provides only the entry *Units and Decimal Places*. Click it to open the dialog box below.

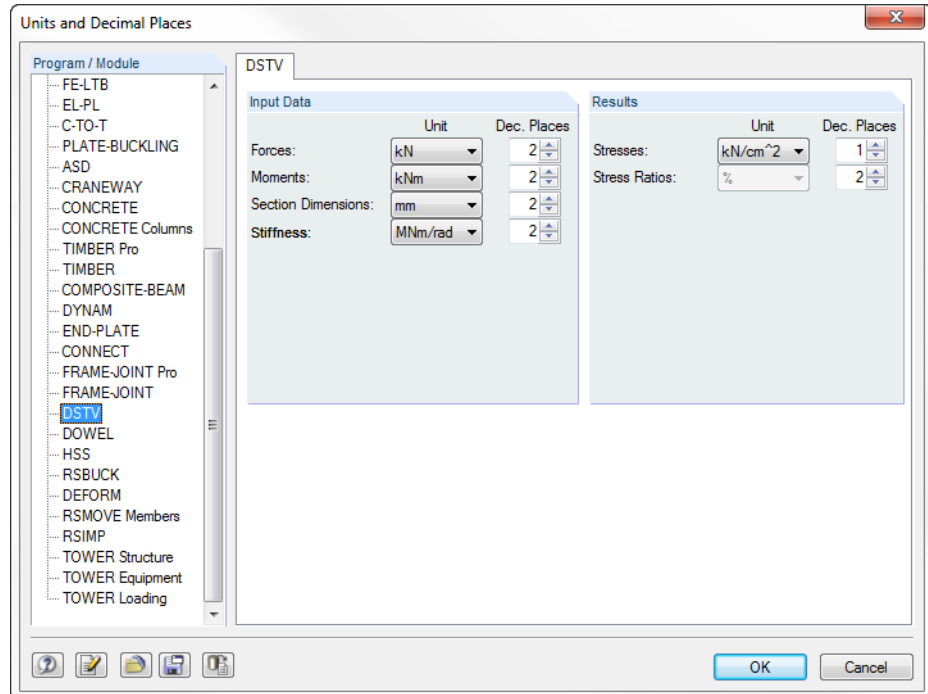
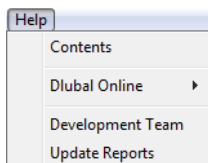


Figure 4.29: Dialog box *Units and Decimal Places*

You know the dialog box already from RSTAB. The add-on module DSTV is preset. The units and decimal places can be defined separately for input and results.

[Alt+H]



4.5.3 Help

This menu gives you access to the online help system and the update reports.

5. Results

5.1 Screen Display

Graphic

OK

Subsequent to the calculation, you can evaluate the results of the respective connection in table 2.1. You can also use the connection's 3D rendering model. To activate the rendering view, click the [Graphic] button shown on the left (cf. chapter 4.3).

Click [OK] to jump to the RSTAB work window. The current DSTV case is preset. The calculated connections are displayed together with their specific code numbers shown as comments at the member ends. They can be printed accordingly.

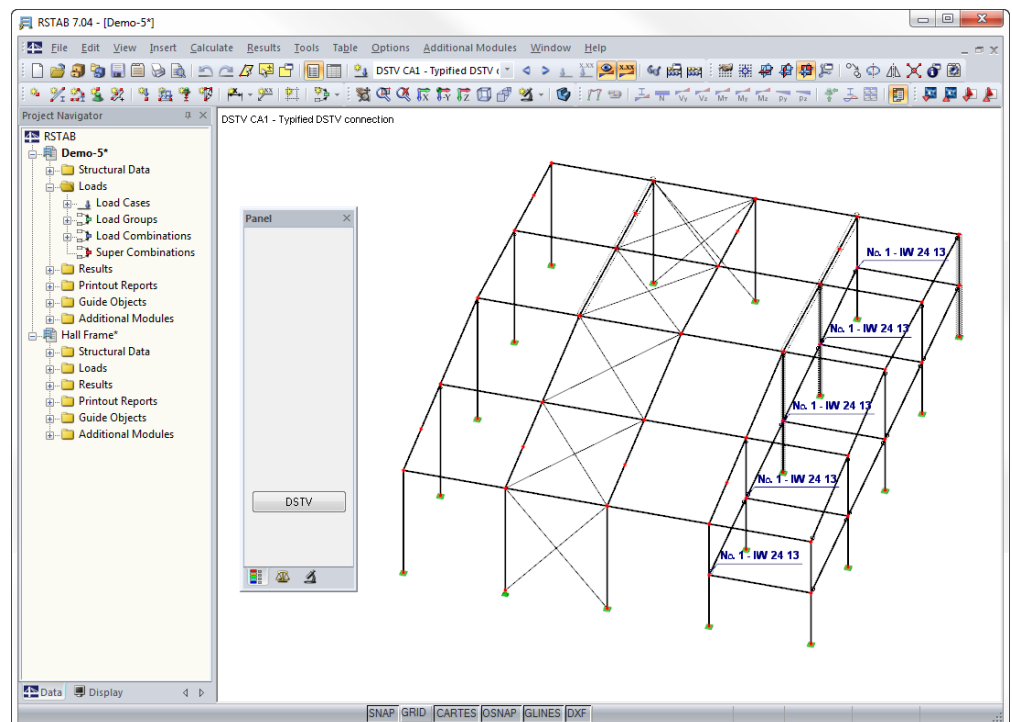


Figure 5.1: Graphical display of alphanumeric codes for calculated connections

The comments are displayed when the results display for the DSTV case is set active.

Use the [Print] button to print the current graphic directly or to integrate it into the printout report.

5.2 Printout



To print the numerical results, return to RSTAB where you open the [Current Printout Report] using the button shown on the left.

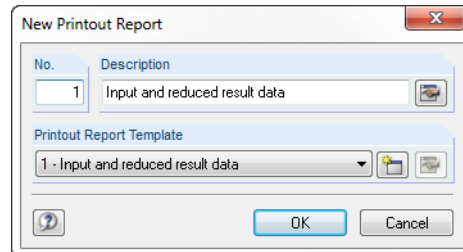


Figure 5.2: Dialog box *New Printout Report*

When the decisions for the relevant settings are made, click [OK] to create the printout report including DSTV results.

The printout report represents a global overview about all data determined with RSTAB, DSTV and further add-on modules. By selecting particular contents you can avoid generating large amounts of data which is difficult to be checked.

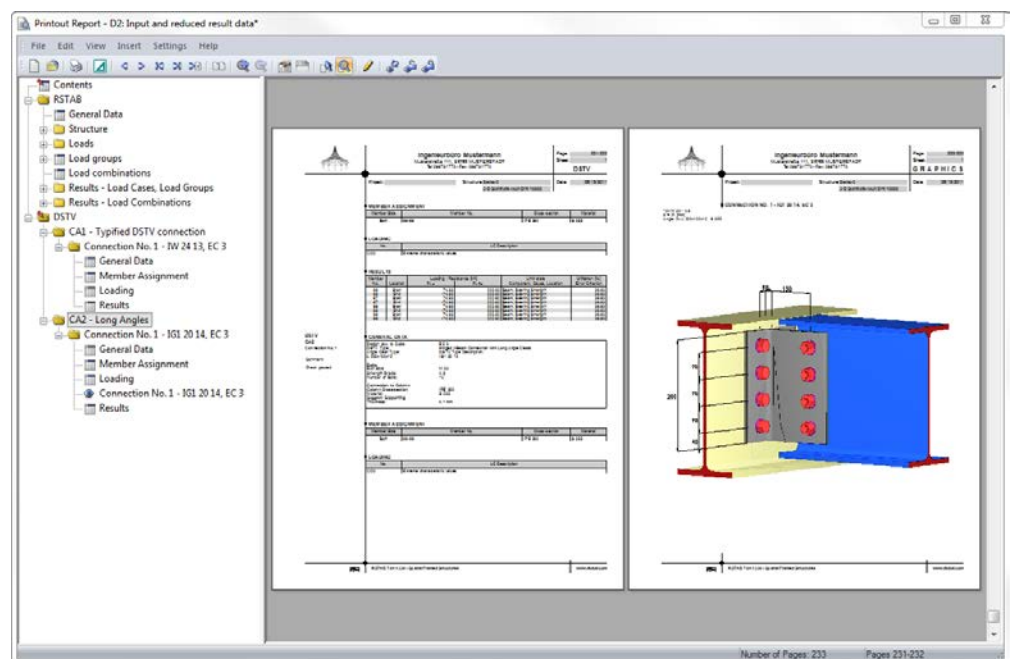


Figure 5.3: DSTV data and results in the printout report



All options to edit and prepare report data in the printout are available as described in detail in the RSTAB manual. In addition, you can specify special selection settings for the DSTV results by using the button [Select Topics for Printout Report] shown on the left. If the entry for the DSTV add-on module is not active when the dialog box *Printout Report Selection* opens, select it in the list *Program / Modules* displayed in the dialog navigator (see the following Figure 5.4).

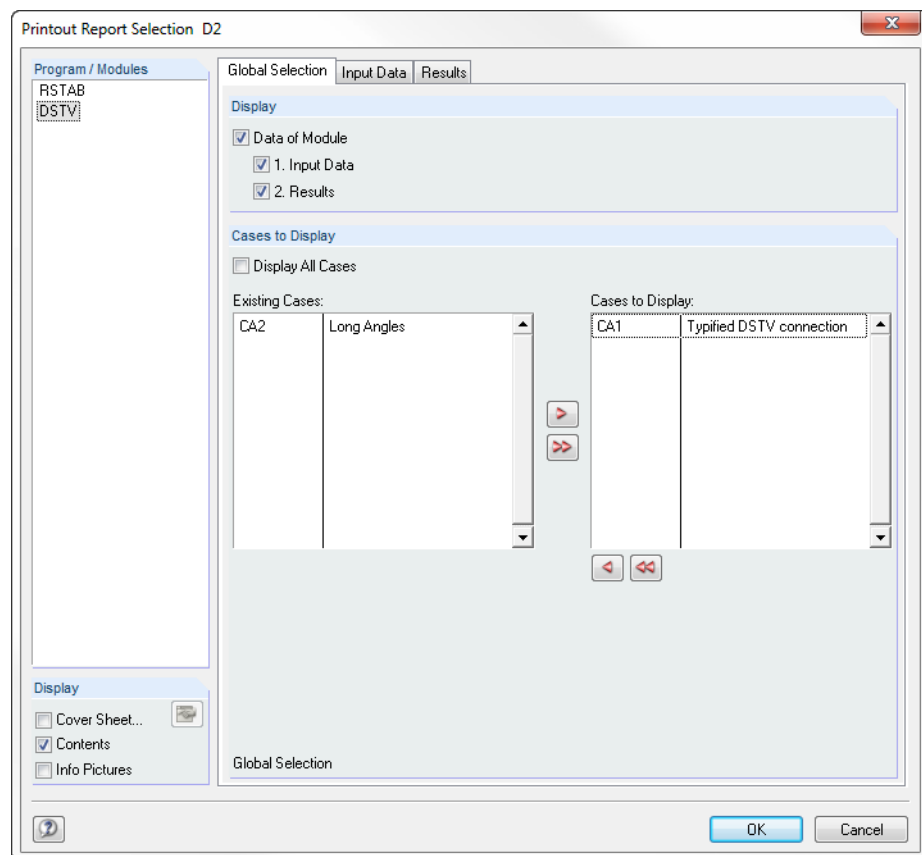


Figure 5.4: Dialog box *Printout Report Selection*, tab *Global Selection* for DSTV data

With the *Global Selection* settings you determine the main chapters that you want to appear in the printout report.

If you don't want to *Display All Cases*, clear the corresponding check box. Then you can remove particular cases from the list *Cases to Display*. To transfer cases from one list to the other, use the relevant buttons.

The *Input Data* tab manages all general data as well as the settings for connections and loading. In the *Results* tab, you can decide if you want to show the results with or without connection details.

To confirm the selection, use the [OK] button that is available for each tab. The printout report is displayed after closing the dialog box. By clicking the [Cancel] button, you close the dialog box without saving the input.

A: Literature

- [1] DIN 18 000, Teil 1, November 1990, Stahlbauten; Bemessung und Konstruktion
- [2] EN 1993 Teil 1-1, Ausgabe Juli 2005, Eurocode 3: Bemessung und Konstruktion von Stahlbauten, Teil 1-1: Allgemeine Bemessungsregeln und Regeln für den Hochbau
- [3] DAST-Richtlinie 103, Ausgabe 11.93, Nationales Anwendungsdokument (NAD)-Richtlinie zur Anwendung von DIN V ENV 1993 Teil 1-1
- [4] CEN-Europäisches Komitee für Normung, ENV 1993-1-1:1992/A2:1998: Revised Annex j, October 1998, Annex J-Joints in building frames
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- [7] DSTV/DAST-Ringbuch, Typisierte Verbindungen im Stahlhochbau, 2000, Stahlbau-Verlagsgesellschaft mbH, Köln
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- [9] DSTV/DAST-Ringbuch, Typisierte Verbindungen im Stahlhochbau, 2. Auflage 2002, Stahlbau-Verlagsgesellschaft mbH, Köln