

MI SYSTEM

BU Installation Systems Installation Technical Manual Technical Data MI System

Version 2.1 10.2018



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The product loading capacities published in these Technical Data Sheets are only valid for the mentioned codes or technical data generation methods and the defined application conditions (e.g. ambient temperature load capacity not valid in case of fire, data not valid in support structures when mixed with third party products), assuming sufficient fastener, base material and building structure strength. Additional calculations, checks and releases by the responsible structural engineer might be needed to clarify the capacity of base material and building structure. Suitability of structures combining different products for specific applications needs to be verified by conducting a system design and calculation, using for example Hilti PROFIS software. In addition, it is crucial to fully respect the Instructions for Use and to assure clean, unaltered and undamaged state of all products at any time in order to achieve this loading capacity (e.g. misuse, modification, overload, corrosion). As products but also technical data generation methodologies evolve over time, technical data might change at any time without prior notice. We recommend to use the latest technical data sheets published by Hilti.

In any case the suitability of structures combining different products for specific applications need to be checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for any specific facility. This book only serves as an aid to interpret the suitability of structures combining different products for specific applications without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application. User must take all necessary and reasonable steps to prevent or limit damage. The suitability of structures combining different products for specific applications are only recommendations that need to be confirmed with a professional designer and/or structural engineers to ensure compliance with User's specific jurisdiction and project requirements.



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| Product | Designation | Item number | Page |
|---|------------------------|--------------------|---------|
| MI Syster | m girders (channe | els) - section pro | perties |
| | MI-90 3m MI-90 6m | 304798 304799 | 7 7 |
| -B | MI-120 3m MI-120 6m | 304800 304801 | 7 7 |
| MI System conne | ectors | | |
| 3/16" (8) 2-15/16" (75) 5-11/16" (145) 3-3,8" (85) 5-11/16" (145) | MIC-BA | 2174677 | 9 |
| 3/16" (6) 2-15/16" (75) 5-11/16" (145) 3-3/8" (85) 5-11/16" (145) | "MIC-BAH | 2179532 | 15 |
| 100-76 8-77 192 | MIC-90-UH | 2179533 | 23 |
| MI-120 | MIC-120-UH | 2179534 | 31 |
| 140 75 8 14 5 315 | MIC-90-L | 304805 | 39 |
| 140 75 8 14 1 315 | MIC-90-L-AP | 305710 | 43 |
| | MIC-T | 304807 | 47 |
| | MIC-90-LH | 2165050 | 53 |
| a start and a start | MIC-90-E | 304809 | 57 |
| and the second second | MIC-120-E | 304810 | 61 |
| | | | |

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| Product | Designation | Item number | Page |
|--|-----------------------------|------------------------|-------------|
| MI System conr | nectors | | |
| 8, 120 130 012.5 00 197.5 | MIC-U-MA | 304806 | 65 |
| MI System base | material conne | ctors - concrete | |
| 90 90 10 10 10 10 10 10 10 10 10 10 10 10 10 | MIC-C90-AA | 304825 | 69 |
| 9-1/16° (230) 5-1/2° (140) Mi-90 11/16° (17.88) 9/16° (15) 11/16° (17.88) | MIC-C90-DH | 2174661 | 73 |
| 5-1/2" (140) MI-120 9-1/16" (230) 9/16" (15) 7"(178) 9/16" (15) 7"(178) 9/16" (15) 9/16" (15) | MIC-C120-DH | 2174662 | 77 |
| 3-15/16" (100) 41-50 0 0 0 0 0 0 0 0 0 0 0 0 0 | MIC-C90-UH | 2179535 | 81 |
| 7.78° (200) 1/2° (12.5) 1/2° (12.5) 1/4° (6) 1/4° (6) 1/4° (7) 3-1,8° (80) 1/4° (7) 1/4° (7) 1/4° (7) 3-1,5/1° 1/4° (7) 3-1,5/1° 1/4° (7) 3-1,5/1° 1/4° (7) 3-1,5/1° 1/4° (7) 3-1,5/1° 1/4° (7) 3-1,5/1° 1/4° (7) 1/4° | 889 MIC-CU-MAH 20 | 2174664 | 87 |
| MI System base | material conne | ctors - structural ste | el profiles |
| 143 13 60x13 | MIC-S90-AA | 304811 | 91 |
| 5-1/2" (140) M-90 9/16" (140) 11/16">2-1/6" 9/16" (140) 11/16">2-1/6" 11/16">2-1/6" 11/16" 11/16">2-1/6" | MIC-S90-AH | 2174665 | 97 |
| 5-1/2" (140) M1-90 9/16" (141) 11/16">9/16" (142) 9/16" (141) 11/16">9/16" (142) 9/16" (142) 11/16" (12) | MIC-S90-BH | 2174666 | 105 |
| 5-1/2" (140) MI-90 9/16" (14) 11/10" 22-1/2" (170e4) 11/10" 22-1/2" (170e4) | MIC-S90-CH | 2174667 | 113 |
| 5-1/2" (140) Mi-120 9/67 (14) 1/1/5" (12) 9/67 (14) 1/1/5" (12) 9/67 (17) 1/1/5" (12) 9/67 (17) 1/1/5" (12) 9/67 (17) 1/2" (12) | MIC-S120-AH | 2174668 | 121 |



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| Product | Designation | Item number | Page |
|--|--|---|-------------|
| MI System base | material connector | s - structural ste | el profiles |
| 5-1/2" (140) - MI-120 9/16" (14) 1/10" - 11/16" - 2/2" (17.864) | MIC-S120-BH | 2174669 | 129 |
| 5-1/2' (140)- MI-120 9/16' (14) 11/20 9/16' (14) 11/20 9/16' (14) 11/20 9/16' (14) | MIC-S120-CH | 2174670 | 137 |
| 9/16" (14) 1/2" (12) 3-1/6" (90) 1/4" (9) 1/4" (9) 1/4" (9) 1/4" (9) 1/155 8-11/16" (12) 1/155 8-11/16" (12) 1/155 8-11/16" (12) | MIC-SA-MAH | 2174671 | 145 |
| 9/16° (14) 1/2° (12.5) 3-18° (90) 1/4′ (9) 3-157° (100) 1/1/15° (115) 3-157° (100) 1/1/15° (115) 1/1/15° 1/1/10 | MIC-SB-MAH | 2174672 | 155 |
| 8/16" (14) 1/2" (12) 3-1/6" (805 3-1/6" (805 3-1/6" (100) 11/16" 8-1/10" (12) 11/16" 8-1/10" (12) | MIC-SC-MAH | 2174673 | 165 |
| | MI-DGC 90 | 233860 | 175 |
| | MI-DGC 120 | 233861 | 179 |
| MI System brack | kets - concrete | | |
| | MIC-C90-DH- 500 MIC-C90-DH- 750 MIC-C90-DH-1000 MIC-C90-DH-1500 MIC-C90-DH-2000 | 2203572 2203573 2203574 2203575 2203575 2203576 | 183 |
| 230 178 20 278 330 | MIC-C120-DH- 500 MIC-C120-DH- 750 MIC-C120-DH-1000 MIC-C120-DH-1500 MIC-C120-DH-2000 | 2203577 2203578 2203579 2203580 2203581 | 187 |
| MI System brack | kets - structural ste | el profiles | |
| B 15 155 17,64 | MIC-S90-AH- 500 MIC-S90-AH- 750 MIC-S90-AH-1000 MIC-S90-AH-1500 MIC-S90-AH-2000 | 2203582 2203583 2203584 2203585 2203585 2203586 | 191 |
| B 15 17/64 | MIC-S90-BH- 500 MIC-S90-BH- 750 MIC-S90-BH-1000 MIC-S90-BH-1500 MIC-S90-BH-2000 | 2203587 2203588 2203589 2203590 2203591 | 199 |

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| Product | Designation | Item number | Page |
|--|--|--|------|
| MI System bra | ckets - structural stee | l profiles | |
| B Y 15 15 17/64 | MIC-S90-CH- 500 MIC-S90-CH- 750 MIC-S90-CH-1000 MIC-S90-CH-1500 [®] MIC-S90-CH-2000 | 2203592 2203593 2203594 2203595 2203595 2203596 | 207 |
| 8-1/2° (140) 1/2° (12) 1/10° (14) 1/10° (14) 1/10° (14) 1/10° (17) 1/10° | MIC-S120-AH- 500 MIC-S120-AH- 750 MIC-S120-AH-1000 MIC-S120-AH-1500 MIC-S120-AH-2000 | 2203597 2203598 2203599 2203600 2203601 | 215 |
| 8-1/2" (140) 10/2" (12) 0/10" (14) 0/10" (14) 0/10" (14) 0/10" (14) 0/10" (14) 0/10" (12) 0/10" (12) 0/10 | MIC-S120-BH- 500 MIC-S120-BH- 750 MIC-S120-BH-1000 MIC-S120-BH-1500 MIC-S120-BH-2000 | 2203602 2203603 2203604 2203605 2203606 | 223 |
| 5-1/2" (140) MI-120 91/9" (14) 11/6"32-1/2" (17)64) 8-11/76" (2) | MIC-S120-CH- 500 MIC-S120-CH- 750 MIC-S120-CH-1000 MIC-S120-CH-1500 MIC-S120-CH-2000 | 2203607 2203608 2203609 2203570 2203571 | 231 |



MI-Girders

| Decimenties | | life and the second back | - | Yield strength |
|---|--------------------|--------------------------|---------------------|-------------------|
| | | | 1 | 1.5 Recommended |
| MI-90 6m | | 304790 | Characteristic load | capacity limit |
| MI-120 3m | | 304800 | | Self weight |
| MI-120 6m | | 304801 | - | Action Resistance |
| Technical data | | | MI-90 | MI-120 |
| For girder MI / cross section including torsion | | | Y | Y Z |
| Cross-sectional area | A | [mm ²] | 1057.4 | 1456.24 |
| Channel weight | | [kg/m] | 9.43 | 12.64 |
| Material | | | | |
| yield strength | f _{y,k} | [N/mm ²] | 235.0 | 235.0 |
| permissible stress* | σ_{rec} | [N/mm ²] | 167.9 | 167.9 |
| E-module | | [N/mm ²] | 210000 | 210000 |
| thrust-module | | [N/mm ²] | 81000 | 81000 |
| Surface | | | | |
| hot dip galvanized | | [µm] | 75 | 75 |
| Cross-section values Y-axis | | | | |
| Axis of gravity | e _y | [mm] | 45.0 | 60.0 |
| moment of inertia | l _y | [cm⁴] | 120.75 | 280.72 |
| Section modulus | Wy | [cm ³] | 26.83 | 46.79 |
| Radius of gyration | i _y | [cm] | 3.38 | 4.39 |
| Cross-section values Z-axis | | | | |
| Axis of gravity | e _z | [mm] | 45.00 | 45.00 |
| moment of inertia | ا _z | [cm ⁴] | 120.75 | 181.65 |
| Section modulus | Wz | [cm ³] | 26.83 | 40.37 |
| Radius of gyration | i _z | [cm] | 3.38 | 3.53 |
| Data to the torsion | | | | |
| torsional moment of inertia | lt | [cm ⁴] | 164.82 | 314.97 |
| torsional section modulus | W _t | [cm ³] | 38.82 | 71.69 |
| Material composition: DD11 MOD | - EN 10111, S235JI | R - EN 10025-2 | | |

Corrosion protection: Hot-dip galvanized, 75 μm - ASTM A123

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| Designation | | lte | m number |
|-----------------------|----------|------------------------------|----------|
| МІС-ВА | | 21 | 74677 |
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Toothed Plate | ISO 1461 | 45 | |
| Backing Plate (Min.) | ISO 1461 | 45 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |

Weight:

2227g incl. components

Description:

Hot dipped galvanized, 90° Hilti MI angle connector, used for connecting two perpendicular MI girders. The baseplate has a serrated slot for improved shear loads and fine adjustment.

| Material properties | | | | |
|---|------------------------------|------------------------------|-----------------------------|----------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Toothed Plate S235JR - (DIN EN10025-2) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Backing Plate (Min.) EN-GJMW-400-5 (DIN EN 1562) | $f_y = 220 \ \frac{N}{mm^2}$ | $f_u = 400 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:







| Possible loading cases | | |
|------------------------|--------|--|
| Standard | Double | |
| | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| • | EN 1990 | Basics of structural design | 03.2003 |
|---|-------------|---|---------|
| • | EN 1991-1-1 | Eurocode 1: Actions on structures –Part 1-1: General actions | |
| | | densities, self-weight, imposed loads for buildings | 09.2011 |
| • | EN 1993-1-1 | Eurocode 3: Design of steel structures –Part 1-1: General | |
| | | rules and rules for buildings | 03.2012 |
| • | EN 1993-1-3 | Eurocode 3: Design of steel structures –Part 1-3: General rules- | |
| | | Supplementary rules for cold-formed members and sheeting | 03.2012 |
| • | EN 1993-1-5 | Eurocode 3: Design of steel structures –Part 1-5:Plated | |
| | | structural elements | 06.2012 |
| • | EN 1993-1-8 | Eurocode 3: Design of steel structures –Part 1-8: Design | |
| | | of joints | 03.2012 |
| • | EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | | delivery conditions for non-alloy structural steels | 02.2005 |
| • | RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 18.2
- Mathcad 15.0
- Microsoft Excel

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

Simplified drawing:







| Loading case: Standard | Combinations covered by loading case | |
|--|---|--|
| Bill of Material for this loading case:For fixation on MI-90 girder1x MIC-BA2174677For fixation on MI-1201x MIC-BA21746771x MIC-BA21746771x MIA-EH120304888MIA-EH90 remains unused | Connector used for Connecting MI-90 girder on either MI-90 or MI-120 girder in a 90-degree angle | |





| Design loading capacity - 3D | 1/2 |
|--|--|
| Method | |
| Vield sterright Design bad Capacity limit Design bad Limit Action Registrate Action Registrate | |
| Limiting components of capacity evaluated | d in following tables: |
| 1. Connection system including connector, hardware and affected p | ortion of MI-90 girders, per FEA simulation |
| | Installation Technical Manual - Technical Data - MI system |



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

| Standard | Double | |
|----------|--------|--|
| | | |

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-90 girders, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 9.20 | 9.70 | 6.10 | 6.10 | 19.60 | 6.70 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 0.28 | 0.28 | 0.00 | 0.00 | 0.00 | 0.00 |

includes cross section resistance of steel plate and contact pressure Interaction:

$$\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{v.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} + \frac{M_{y.Ed}}{M_{v.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \le 1$$

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MIC-BA Connector

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.

| Standard | Double | |
|----------|--------|--|
| | | |

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. 1. Connection system, including connector, hardware and affected portion of MI-90 girders, per FEA simulation Resistance values for one side of the connection system**



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 8.28** | 8.60** | 6.10** | 6.10** | 8.60** | 6.03** |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 0.28** | 0.28** | 0.00 | 0.00 | 0.00 | 0.00 |

includes cross section resistance of steel plate and contact pressure Interaction:

```
\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \leq 1
```



| Designation MIC-BAH | | lte 21 | m number 79532 |
|------------------------|----------|------------------------------|-------------------|
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Toothed Plate | ISO 1461 | 45 | |
| Backing Plate (Min.) | ISO 1461 | 45 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |

Weight:

2227g

Description:

Hot dipped galvanized, 90° Hilti MI angle connector, used for connecting two perpendicular MI girders. The baseplate has a serrated slot for improved shear loads and fine adjustment. Suitable for cantilever applications only when used in Double configuration as defined in the IFU.

| Material properties | | | | |
|---|------------------------------|----------------------------|-----------------------------|----------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Toothed Plate S235JR - (DIN EN10025-2) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Backing Plate (Min.) EN-GJMW-400-5 (DIN EN 1562) | $f_y = 220 \ \frac{N}{mm^2}$ | $f_u = 400 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:







| Possible loading cases | | | | | |
|------------------------|--------------------|----------------------|--|--|--|
| Standard | Double One Side | Double Both Sides | | | |
| | | | | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| ٠ | EN 1990 | Basics of structural design | 03.2003 |
|---|-------------|---|---------|
| • | EN 1991-1-1 | Eurocode 1: Actions on structures –Part 1-1: General actions | |
| | | densities, self-weight, imposed loads for buildings | 09.2011 |
| • | EN 1993-1-1 | Eurocode 3: Design of steel structures –Part 1-1: General | |
| | | rules and rules for buildings | 03.2012 |
| • | EN 1993-1-3 | Eurocode 3: Design of steel structures –Part 1-3: General rules- | |
| | | Supplementary rules for cold-formed members and sheeting | 03.2012 |
| • | EN 1993-1-5 | Eurocode 3: Design of steel structures –Part 1-5:Plated | |
| | | structural elements | 06.2012 |
| • | EN 1993-1-8 | Eurocode 3: Design of steel structures –Part 1-8: Design | |
| | | of joints | 03.2012 |
| • | EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | | delivery conditions for non-alloy structural steels | 02.2005 |
| • | RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 18.2
- Mathcad 15.0
- Microsoft Excel

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

Simplified drawing:





| Standard | Double One Side | Double Both Sides | | |
|--|---|-------------------------|---|--|
| | | | | |
| Loading case: S | Standard | | Combinations covered b | y loading case |
| Bill of Material f For fixation on M 1x MIC-BAH For fixation on M 1x MIC-BAH 1x MIA-EH120 MIA-EH90 remai | for this loading ca <u>I-90 girder</u> 217953 <u>I-120</u> 217953 30488 ns unused | se: 2 2 8 | Connector used for Connecting MI-90 girder on either MI-90 or MI-120 girder in a 90-degree angle | |
| Recommend | ed loading cap | acity - simplifie | ed for most common a | pplications |
| Method Vield strength Permissible streas Characteristic load Staff weight Live load Action Resistar | Pecommended capacity limit co | | The cap | ± Fx,rec. ± Fy,rec. ± Fz,rec. [kN] [kN] [kN] 8.59 4.07 8.59 ses values are individual one directional maximal acity limits. For any combinations of multiple totons, use design values and their corresponding raction formulas. |
| Design loadii | ng capacity - 3l | D | | 1/2 |
| Method | Design load copecity land copecity land co | | | |
| Limiting com | ponents of cap | oacity evaluate | d in following tables: | |
| 1. Connection system | n, including connector, I | hardware and affected p | portion of MI-90 girders, per FEA sir | nulation |
| | | | Installation Technical Manu | ıal - Technical Data - MI syster |



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

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Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-90 girders, per FEA simulation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 12.88 | 20.80 | 6.10 | 6.10 | 20.80 | 12.88 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 0.62 | 0.62 | 0.00 | 0.00 | 0.00 | 0.00 |

includes cross section resistance of steel plate and contact pressure Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \leq 1$



| Standard | Double One Side | Double Both Sides | |
|--|-----------------------------------|----------------------|---|
| | | | |
| Loading case: D | ouble One Side | | Combinations covered by loading case |
| Bill of Material for For fixation on M | or this loading ca I-90 girder | se: | Connector used in pair for Connecting MI-90 girder |
| 2x MIC-BAH | 217953 | 2 | on either MI-90 or |
| 1xMI-FH90 and | 1xMIA-FH-P rem | ain unused | in a 90-degree |
| For fixation on M | <u>I-120</u> | | angle |
| 2x MIC-BAH | 217953 | 2 | |
| 1x MIA-TP | 305707 | | |
| 2x MIA-EH120 | 30488 | 8 | |
| 3xMIA-EH90 and | 2xMIA-EH-P rema | ain unused | |
| Pacammanda | d loading can | acity simplific | d for most common applications |



| Design loading capacity - 3D | 1/2 |
|---|---|
| Method | |
| Ved shrength Design load Design load Design load Acton Resistance | |
| Limiting components of capacity evaluated | d in following tables: |
| 1. Connection system, including connector, hardware and affected p | ortion of MI-90 girders, per FEA simulation |
| | |



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

2/2

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-90 girders, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 24.50 | 28.60 | 12.20 | 12.20 | 34.10 | 34.10 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 1.87 | 1.87 | 2.10 | 2.10 | 1. 16 | 1. 16 |

includes cross section resistance of steel plate and contact pressure Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \leq 1$



| Standard | Double One Side | Double Both Sides | |
|--|--|----------------------|---|
| | | | |
| Loading case: D | ouble Both Sides | 5 | Combinations covered by loading case |
| Bill of Material f For fixation on MI-S 2x MIC-BAH 1x MIA-TP 1x MI-EH90 and M unused For fixation on MI- 2x MIC-BAH 1x MIA-EH120 1x MIA-TP The 2x MIA-EH90 | or this loading ca <u>90 girder</u> 2179532 305707 IA-EH-P remain 120 2179532 304888 305707 and 2x MIA-EH-P rer | se: | Connector used in pair for Connecting 2xMI-90 girder on either MI-90 or MI-120 girder in a 90-degree angle |



| Design loading capacity - 3D | 1/2 |
|---|---|
| Method | |
| Veld strongth Design load Capacity limit 1.5 Live load Actor Resistance | |
| Limiting components of capacity evaluated 1. Connection system, including connector, hardware and affected p including connector, hardware and affected p | d in following tables: |
| | Installation Technical Manual - Technical Data - MI syste |



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

2/2

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-90 girders, per FEA simulation Resistance values for one side of the connection system**





| Designation MIC-90-UH | | Ite | m number 2179533 |
|--------------------------|----------|------------------------------|---------------------|
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Toothed Plate | ISO 1461 | 45 | |
| Backing Plate (Min.) | ISO 1461 | 45 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |

Weight:

•• • • •

2510 g incl. components

Submittal text:

Hot dipped galvanized, 90° Hilti MI angle connector, used for connecting two perpendicular MI girders. The baseplate has a serrated slot for improved shear loads and fine adjustment, and the connector is connected with an oblong hole. Not suitable for cantilever applications.

| MI-90 | 8 | | | 92 |
|--------|----------|---------|-------|------|
| Hardwa | re inclu | ded per | conne | ctor |
| | Ĩ | • | | 8 |
| 1x | 2x | 1x | 1x | 3x |

| Material properties | | | | |
|--|---------------------------------|------------------------------|-----------------------------|----------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Toothed Plate S235JR - (DIN EN10025-2) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Backing Plate (Min.) EN-GJMW-400-5 (DIN EN 1562) | $f_y = 220 \frac{N}{mm^2}$ | $f_u = 400 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Values for Madulus of Electicity and Obser Madul | the same second as the FNI 4000 | 4 4 and waad fan all Ewaaaad | | |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:



Installation Technical Manual - Technical Data - MI system



| Possible loading cases | | | | |
|------------------------|--------|--|--|--|
| Standard | Double | | | |
| | | | | |

Design criteria used for loading capacity

Methodology:

Analytic calculation

Standards and codes:

| • | EN 1990 | Basics of structural design | 03.2003 |
|---|-------------|---|---------|
| • | EN 1991-1-1 | Eurocode 1: Actions on structures –Part 1-1: General actions | |
| | | densities, self-weight, imposed loads for buildings | 03.2012 |
| • | EN 1993-1-1 | Eurocode 3: Design of steel structures –Part 1-1: General | |
| | | rules and rules for buildings | 03.2012 |
| • | EN 1993-1-3 | Eurocode 3: Design of steel structures –Part 1-3: General rules- | |
| | | Supplementary rules for cold-formed members and sheeting | 09.2010 |
| • | EN 1993-1-5 | Eurocode 3: Design of steel structures –Part 1-5:Plated | |
| | | structural elements | 06.2012 |
| • | EN 1993-1-8 | Eurocode 3: Design of steel structures –Part 1-8: Design | |
| | | of joints | 03.2012 |
| | | | |

Software:

- Mathcad 15.0
- Microsoft Excel

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**







| Bill of Material for this loading case For fixation on MI-90 girder Angle incl. all components 2179533 1x MIC-90-UH 2179533 For fixation on MI-120 MI-90 girder 1x MIC-90-UH 2179533 1x MIC-90-UH 2179533 1x MIC-90-UH 2179533 1x MIC-90-UH 2179533 1x MIA-EH120 304888 The MIA-EH90 remain unused Image: Connection of MI-90 or MI-120 girder | Loading case: Standard | Combinations covered by loading case | | |
|--|---|--|--|--|
| | Bill of Material for this loading case For fixation on MI-90 girder Angle incl. all components 1x MIC-90-UH 2179533 For fixation on MI-120 1x MIC-90-UH 2179533 1x MIA-EH120 304888 The MIA-EH90 remain unused | Connector used for connecting MI-90 girder on either MI-90 or MI-120 girder in a 90-degree angle | | |

Recommended loading capacity - simplified for most common applications





Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Steel connector



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|-----------------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 3.00 | Not decisive | 14.73 | 14.73 | 63.92 | 63.92 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 1.36 | 1.36 | 0.00 | 0.00 | 0.00 | 0.00 |

includes cross section resistance of steel plate and contact pressure Interaction: $F_{x,Ed} = F_{x,Ed} = F_{z,Ed} = M_{x,Ed}$

| ¹ x.Ed | + y.Ed | $+ \underline{z.Ed}$ | $+ \frac{m_{x.Ed}}{d} < $ | 1 |
|-------------------|-------------------|----------------------|---------------------------|---|
| F _{x.Rd} | ^F y.Rd | F _{z.Rd} | M _{x.Rd} | |



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 244.38 | 244.38 | 99.77 | 99.77 | 99.77 | 99.77 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 5.99 | 5.99 | 0.00 | 0.00 | 0.00 | 0.00 |

Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} \leq 1$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 26

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Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

3. One hand screw -in connection to MIC-90-U and MI90-channel



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 3.00 | 3.00 | 36.29 | 36.29 | 36.29 | 36.29 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 1.20 | 1.20 | 0.00 | 0.00 | 0.00 | 0.00 |

includes shear of the bolt, friction resistance, bearing resistance at connector plate and at channel MI90 Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} \leq 1$

4. Easy hand screw- in connection MIC-90-U to MI90/120-channel



F_{x.Rd} F_{z.Rd}

Installation Technical Manual - Technical Data - MI system

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Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Individual Steel connector



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] | |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--|
| 3.00 | Not decisive | 14.73 | 14.73 | 63.92 | 63.92 | |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] | |
| 1.36 | 1.36 | 0.00 | 0.00 | 0.00 | 0.00 | |
| nteraction: | | | | | | |

$$\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} \leq 1$$

2. Individual Welds



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 244.38 | 244.38 | 99.77 | 99.77 | 99.77 | 99.77 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 5.99 | 5.99 | 0.00 | 0.00 | 0.00 | 0.00 |

Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} \leq 1$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 29

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Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

| Standard | Double | |
|----------|--------|--|
| | | |

Design loading capacity - 3D

3/3





| Designation MIC-120-UH | | Ite | m number 2179534 |
|---------------------------|----------|------------------------------|---------------------|
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Toothed Plate | ISO 1461 | 45 | |
| Backing Plate (Min.) | ISO 1461 | 45 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |

Weight:

•• • • •

2786 g incl. components

Submittal text:

Hot dipped galvanized, 90° Hilti MI angle connector, used for connecting two perpendicular MI girders. The baseplate has a serrated slot for improved shear loads and fine adjustment, and the connector is connected with an oblong hole. Not suitable for cantilever applications.

| MI-120 | 100 | | | 20 |
|--------|-----------|---------|-------|------|
| Hardwa | re inclue | ded per | conne | ctor |
| | Ĩ | 0 | 0 | 8 |
| 1 1 | 2x | 1x | 1x | 3x |

| Material properties | | | | |
|--|---------------------------------|------------------------------|-----------------------------|----------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Toothed Plate S235JR - (DIN EN10025-2) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Backing Plate (Min.) EN-GJMW-400-5 (DIN EN 1562) | $f_y = 220 \frac{N}{mm^2}$ | $f_u = 400 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Values for Madulus of Electicity and Obser Madul | the same second as the FNI 4000 | 4 4 and waad fan all Ewaaaad | | |

Values for Modulus of Élasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:



Installation Technical Manual - Technical Data - MI system



| Possible loading cases | | | |
|------------------------|--------|--|--|
| Standard | Double | | |
| | | | |

Design criteria used for loading capacity

Methodology:

Analytic calculation

Standards and codes:

| • | EN 1990 | Basics of structural design | 03.2003 |
|---|-------------|---|---------|
| • | EN 1991-1-1 | Eurocode 1: Actions on structures –Part 1-1: General actions | |
| | | densities, self-weight, imposed loads for buildings | 03.2012 |
| • | EN 1993-1-1 | Eurocode 3: Design of steel structures –Part 1-1: General | |
| | | rules and rules for buildings | 03.2012 |
| • | EN 1993-1-3 | Eurocode 3: Design of steel structures –Part 1-3: General rules- | |
| | | Supplementary rules for cold-formed members and sheeting | 09.2010 |
| • | EN 1993-1-5 | Eurocode 3: Design of steel structures –Part 1-5:Plated | |
| | | structural elements | 06.2012 |
| • | EN 1993-1-8 | Eurocode 3: Design of steel structures –Part 1-8: Design | |
| | | of joints | 03.2012 |
| | | | |

Software:

- Mathcad 15.0
- Microsoft Excel

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**







| Bill of Material for this loading case For fixation on MI-90 girder Angle incl. all components 1x MIC-90-UH 2179534 For fixation on MI-120 1x MIC-90-UH 2179533 1x MIC-90-UH 2179533 1x MIC-90-UH 2179533 1x MIC-90-UH 2179533 1x MIA-EH120 304888 The MIA-EH90 remain unused Image: Connecting on either MI-90 on MI-120 girder in a 90-degree angle Image: Connecting on MI-120 on MI | Loading case: Standard | Combinations covered by loading case | | |
|---|---|---|--|--|
| | Bill of Material for this loading case For fixation on MI-90 girder Angle incl. all components 1x MIC-90-UH 2179534 For fixation on MI-120 1x MIC-90-UH 2179533 1x MIA-EH120 304888 The MIA-EH90 remain unused | Connector used for connecting MI-120 girder on either MI-90 or MI-120 girder in a 90-degree angle | | |

Recommended loading capacity - simplified for most common applications







Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Steel connector

2. Welds



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|-----------------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 2.60 | Not decisive | 15.83 | 15.83 | 63.92 | 63.92 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 1.14 | 1.14 | 0.00 | 0.00 | 0.00 | 0.00 |

includes cross section resistance of steel plate and contact pressure Interaction:

$$\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} \le 1$$

+Fx,Rd [kN] 336.02 +Mx,Rd [kNm]

| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 336.02 | 336.02 | 99.77 | 99.77 | 174.59 | 174.59 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 9.73 | 9.73 | 0.00 | 0.00 | 0.00 | 0.00 |

Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} \leq 1$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 34

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Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 2.00 | 2.00 | 41.47 | 41.47 | 41.47 | 41.47 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 1.99 | 1.99 | 0.00 | 0.00 | 0.00 | 0.00 |

includes shear of the bolt, friction resistance, bearing resistance at connector plate and at channel MI90

Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} \leq 1$

4. Easy hand screw- in connection MIC-90-U to M

| 90/120-channel | | | | | | |
|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 8 | +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
| | 2.59 | Not decisive | Not decisive | Not decisive | 16.99 | 16.99 |
| | +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| | Not decisive | Not decisive | 0.00 | 0.00 | 0.00 | 0.00 |

includes shear, bending and tension of the bolt, bearing resistance channel MI-90/120 and tooth plate, resistance of screw plate Interaction:

$$\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} \leq 1$$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 35

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Installation Technical Manual - Technical Data - MI system


MIC-120-UH Connector

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Individual Steel connector



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] | |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--|
| 2.60 | Not decisive | 15.83 | 15.83 | 63.92 | 63.92 | |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] | |
| 1.14 | 1.14 | 0.00 | 0.00 | 0.00 | 0.00 | |
| Interaction: | | | | | | |

| F _{x.Ed} | ^F y.Ed | F _{z.Ed} | $M_{x.Ed} < 1$ |
|-------------------|------------------------|-------------------|-----------------------------|
| F _{x.Rd} | $+\overline{F_{v.Rd}}$ | $F_{r_{z,Rd}}$ | $\frac{1}{M_{x.Rd}} \leq 1$ |

2. Individual Welds



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 336.02 | 336.02 | 99.77 | 99.77 | 174.59 | 174.59 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 9.73 | 9.73 | 0.00 | 0.00 | 0.00 | 0.00 |

Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} \leq 1$

Installation Technical Manual - Technical Data - MI system

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MIC-120-UH Connector

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D



* Explanation how to apply resistance values

 F_{7} , Rd = 9.00 kN

 F_{x} ,Rd = 2.59 kN

 F_{7} , Rd = 9.00 kN

 F_{x} , Rd = 2.59 kN

| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 2.00 | 2.00 | 41.47 | 41.47 | 41.47 | 41.47 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 1.99 | 1.99 | 0.00 | 0.00 | 0.00 | 0.00 |

includes shear of the bolt, friction resistance, bearing resistance at connector plate and at channel MI90 Interaction:

| F _{x.Ed} | Fy.Ed | F _{z.Ed} | M _{x.Ed} | 1 |
|-------------------|-------|-------------------|-------------------|---|
| F _{x Rd} | FyRd | F _{z Rd} | M _{x Rd} | Î |

| 4. Easy hand screw for double connection - resistance values for one connector* in connection MIC-90-U to MI90/120-channel | | | | | | | |
|---|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|--|
| A A A A A A A A A A A A A A A A A A A | +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] | |
| | 2.59* | Not decisive | Not decisive | Not decisive | 9.00* | 9.00* | |
| × | +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] | |
| z | Note decisive | Not decisive | 0.00 | 0.00 | 0.00 | 0.00 | |

includes shear, bending and tension of the bolt, bearing resistance channel MI-90/120 and tooth plate, resistance of screw plate Interaction:

$$\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} \le 1$$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 38

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| Designation | m number | | |
|-----------------------|----------|------------------------------|------|
| | | 30 | 4005 |
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Toothed Plate | ISO 1461 | 45 | |
| Backing Plate (Min.) | ISO 1461 | 45 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |

Weight:

4.05kg incl. components

Submittal text:

Hot dipped galvanized, 90° Hilti MI angle connector, typically used for connecting two perpendicular MI girders. The baseplate has a serrated slot for improved shear loads and fine adjustment, and the connector is connected with fixed holes instead of an oblong hole. Suitable for cantilever applications.



| Material properties | | | | |
|--|------------------------------|------------------------------|-----------------------------|----------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Toothed Plate S235JR - (DIN EN10025-2) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Backing Plate (Min.) EN-GJMW-400-5 (DIN EN 1562) | $f_y = 220 \ \frac{N}{mm^2}$ | $f_u = 400 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:



Installation Technical Manual - Technical Data - MI system



| Possible loading cases | | | | |
|------------------------|--|--|--|--|
| Standard | | | | |
| | | | | |

Design criteria used for loading capacity

Methodology:

- · Finite element analysis
- Analytic calculation

Standards and codes:

| • | EN 1990 03.2003 | Basics of structural design | |
|---|--------------------|---|---------|
| • | EN 1991-1-1 | Eurocode 1: Actions on structures –Part 1-1: General actions | |
| | | densities, self-weight, imposed loads for buildings | 09.2011 |
| • | EN 1993-1-1 | Eurocode 3: Design of steel structures –Part 1-1: General | |
| | | rules and rules for buildings | 03.2012 |
| • | EN 1993-1-3 | Eurocode 3: Design of steel structures –Part 1-3: General rules- | |
| | | Supplementary rules for cold-formed members and sheeting | 03.2012 |
| • | EN 1993-1-5 | Eurocode 3: Design of steel structures –Part 1-5:Plated | |
| | | structural elements | 03.2012 |
| • | EN 1993-1-8 | Eurocode 3: Design of steel structures –Part 1-8: Design | |
| | | of joints | 03.2012 |
| • | EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | | delivery conditions for non-alloy structural steels | 02.2005 |
| • | RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 18.2
- Mathcad 15.0
- Microsoft Excel

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

Simplified drawing:



Installation Technical Manual - Technical Data - MI system





Bill of Material for this loading case: For fixation on MI-90 girder Connector incl. all connecting hardware 1x MIC-90-L 304805 For fixation on MI-120 Connector incl. all connecting hardware 1x MIC-90-L 304804 2x MIA-EH120 304888 The MIA-EH90 remain unused

Connector used for Connecting MI-90 girder on either MI-90 or MI-120 girder in a 90-degree angle



Recommended loading capacity - simplified for most common applications







Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.





| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 14.10 | 63.30 | 25.30 | 25.30 | 32.00 | 32.00 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 2.95 | 2.95 | 1.30 | 1.30 | 0.53 | 0.53 |

Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \le 1$

2. Welds - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] | | |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--|--|
| 230.12 | 230.12 | 75.53 | 75.53 | 75.53 | 75.53 | | |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] | | |
| 5.64 | 5.64 | 3.45 | 3.45 | 3.45 | 3.45 | | |
| Interaction: | | | | | | | |

 $\frac{F_{x,Ed}}{F_{x,Rd}} + \frac{F_{y,Ed}}{F_{y,Rd}} + \frac{F_{z,Ed}}{F_{z,Rd}} + \frac{M_{x,Ed}}{M_{x,Rd}} + \frac{M_{y,Ed}}{M_{y,Rd}} + \frac{M_{z,Ed}}{M_{z,Rd}} \leq 1$

Installation Technical Manual - Technical Data - MI system

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Hardware included per connector

MIC-90-L-AP Connector



Submittal text:

Hot dipped galvanized, 90° Hilti MI angle connector, typically used for connecting two perpendicular MI girders. The baseplate has a serrated slot for improved shear loads and fine adjustment, and the connector is connected with fixed holes instead of an oblong hole. Suitable for cantilever applications.

| Material properties | | | | |
|--|-----------------------------|------------------------------|-----------------------------|----------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Values for Madulus of Floatisity and Cheer Madul | up are according to EN 1002 | 1.1 and used for all Europed | a adaulationa | |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:





| Possible loading cases | | | | |
|------------------------|--|--|--|--|
| Standard | | | | |
| | | | | |

Design criteria used for loading capacity

Methodology:

- · Finite element analysis
- Analytic calculation

Standards and codes:

| • | EN 1990 03.2003 | Basics of structural design | |
|---|--------------------|---|---------|
| • | EN 1991-1-1 | Eurocode 1: Actions on structures –Part 1-1: General actions | |
| | | densities, self-weight, imposed loads for buildings | 09.2011 |
| • | EN 1993-1-1 | Eurocode 3: Design of steel structures –Part 1-1: General | |
| | | rules and rules for buildings | 03.2012 |
| • | EN 1993-1-3 | Eurocode 3: Design of steel structures –Part 1-3: General rules- | |
| | | Supplementary rules for cold-formed members and sheeting | 03.2012 |
| • | EN 1993-1-5 | Eurocode 3: Design of steel structures –Part 1-5:Plated | |
| | | structural elements | 03.2012 |
| • | EN 1993-1-8 | Eurocode 3: Design of steel structures –Part 1-8: Design | |
| | | of joints | 03.2012 |
| • | EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | | delivery conditions for non-alloy structural steels | 02.2005 |
| • | RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 18.2
- Mathcad 15.0
- Microsoft Excel

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

Simplified drawing:



Installation Technical Manual - Technical Data - MI system





| Loading case: Standa | aru | Combinations covered by loading case |
|---|--|---|
| Bill of Material for this load 1x MIC-90-L-AP Components not included 2x MIA-EH-P 2x M12-F-SL WS3/4 2x MIA-OH90 For fixation on MI-90 girder 2x MIA-EH90 For fixation on MI-120 2x MIA-EH120 | ding case: 305710 304891 382897 304889 304887 304888 | Connector used for Connecting MI-90 girder on either MI-90 or MI-120 girder in a 90-degree angle |
| | | |







Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-90 girders, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 14.10 | 63.30 | 25.30 | 25.30 | 32.00 | 32.00 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 2.95 | 2.95 | 1.30 | 1.30 | 0.53 | 0.53 |

Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \le 1$

2. Welds - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] | |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--|
| 230.12 | 230.12 | 75.53 | 75.53 | 75.53 | 75.53 | |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] | |
| 5.64 | 5.64 | 3.45 | 3.45 | 3.45 | 3.45 | |
| nteraction. | | | | | | |

$\frac{F_{x,Ed}}{F_{x,Rd}} + \frac{F_{y,Ed}}{F_{y,Rd}} + \frac{F_{z,Ed}}{F_{z,Rd}} + \frac{M_{x,Ed}}{M_{x,Rd}} + \frac{M_{y,Ed}}{M_{y,Rd}} + \frac{M_{z,Ed}}{M_{z,Rd}} \leq 1$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 46

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| Designation MIC-T | | lte 30 | m number 04807 |
|-----------------------|----------|------------------------------|-------------------|
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Toothed Plate | ISO 1461 | 45 | |
| Backing Plate (Min.) | ISO 1461 | 45 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |
| Waight | | | |

Weight:

2510 g incl. components

Descriptions:

Hot dipped galvanized, 90° Hilti MI angle connector, typically used for connecting two perpendicular MI girders, where the horizontal girder sits on top of the vertical girder. Oblong holes enable fine adjustment and are serrated to improve holding and load values. Connector is used on the side of the girders.



| Material properties | | | | |
|---|----------------------------|------------------------------|-----------------------------|----------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Toothed Plate S235JR - (DIN EN10025-2) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Backing Plate (Min.) EN-GJMW-400-5 (DIN EN 1562) | $f_y = 220 \frac{N}{mm^2}$ | $f_u = 400 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |

Values for Modulus of Élasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:





| Possible loadi | Possible loading cases | | | | | | |
|----------------|------------------------|--|--|--|--|--|--|
| MIC-T 90-90 | MIC T 120-120 | | | | | | |
| | | | | | | | |

Design criteria used for loading capacity

Methodology:

- · Finite element analysis
- Analytic calculation

Standards and codes:

| • | EN 1990 03.2003 | Basics of structural design | |
|---|--------------------|---|---------|
| • | EN 1991-1-1 | Eurocode 1: Actions on structures –Part 1-1: General actions – densities, self-weight, imposed loads for buildings | 09.2011 |
| • | EN 1993-1-1 | Eurocode 3: Design of steel structures –Part 1-1: General | |
| | | rules and rules for buildings | 03.2012 |
| • | EN 1993-1-3 | Eurocode 3: Design of steel structures –Part 1-3: General rules- | |
| | | Supplementary rules for cold-formed members and sheeting | 03.2012 |
| • | EN 1993-1-5 | Eurocode 3: Design of steel structures –Part 1-5:Plated | |
| | | structural elements | 03.2012 |
| • | EN 1993-1-8 | Eurocode 3: Design of steel structures –Part 1-8: Design | |
| | | of joints | 03.2012 |
| • | EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | | delivery conditions for non-alloy structural steels | 02.2005 |
| • | RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 18.2
- Mathcad 15.0
- Microsoft Excel

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.







| MIC-T 90-90 | MIC-T 120-120 | |
|-----------------|---------------|--|
| | | |
| Loading case: I | MIC-T 90-90 | |

Bill of Material for this loading case:

Angle incl. all components **1x MIC-T (pair)**



Connector used for perpendicular connections of two MI-90 girders, where Horizontal girder sits on top of the vertical girder



Recommended loading capacity - simplified for most common applications







These values are individual one directional maximal capacity limits. For any combinations of multiple directions, use design values and their corresponding interaction formulas.





Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

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Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-90 girders, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 15.25 | 15.25 | 8.50 | 8.50 | 26.80 | 26.80 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 0.75 | 0.75 | 1.60 | 1.60 | 0.70 | 0.70 |

Interaction:

 $\frac{F_{x,Ed}}{F_{x,Rd}} + \frac{F_{y,Ed}}{F_{y,Rd}} + \frac{F_{z,Ed}}{F_{z,Rd}} + \frac{M_{x,Ed}}{M_{x,Rd}} + \frac{M_{y,Ed}}{M_{y,Rd}} + \frac{M_{z,Ed}}{M_{z,Rd}} \leq 1$



| MIC-T 90-90 | MIC-T 120-120 | |
|------------------------|-------------------|--------------------------------------|
| | | |
| Loading case: I | MIC-T 120-120 | Combinations covered by loading case |
| Bill of Material for t | his loading case: | Connector used |

Angle incl. all components **1x MIC-T (pair)**



Connector used For perpendicular connections of two MI-120 girders, where Horizontal girder sits on top of the vertical girder

Recommended loading capacity - simplified for most common applications





| ±Fx,rec. | ±Fy,rec. | ±Fz,rec. |
|----------|----------|----------|
| [kN] | [kN] | [kN] |
| 13.00 | 6.87 | 17.87 |

These values are individual one directional maximal capacity limits. For any combinations of multiple directions, use design values and their corresponding interaction formulas.





Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

2/2

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-120 girders, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 19.50 | 19.50 | 10.30 | 10.30 | 26.80 | 26.80 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 0.80 | 0.80 | 1.95 | 1.95 | 0.85 | 0.85 |

Interaction:

 $\frac{F_{x,Ed}}{F_{x,Rd}} + \frac{F_{y,Ed}}{F_{y,Rd}} + \frac{F_{z,Ed}}{F_{z,Rd}} + \frac{M_{x,Ed}}{M_{x,Rd}} + \frac{M_{y,Ed}}{M_{y,Rd}} + \frac{M_{z,Ed}}{M_{z,Rd}} \leq 1$



| Designation | m number | | |
|-----------------------|----------|------------------------------|-------|
| MIC-90-LH | | 21 | 65050 |
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Toothed Plate | ISO 1461 | 45 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |

Weight:

4840 g incl. components

Description:

Hot dipped galvanized, 90° Hilti MI angle connector, typically used for connecting two perpendicular MI girders, where the horizontal girder is connected to the side of the vertical girder. Oblong holes enable fine adjustment and are serrated to improve holding and load values. Connector is



| Material properties | | | | | | |
|---|------------------------------|----------------------------|-----------------------------|----------------------------|--|--|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus | | |
| Connector, Plate C30, 1.0528 (DIN EN 10250-2) | $f_y = 250 \ \frac{N}{mm^2}$ | $f_u = 480 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ | | |
| Toothed Plate S235JR - (DIN EN10025-2) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ | | |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ | | |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:



Installation Technical Manual - Technical Data - MI system



| Possible loading cases | | | |
|------------------------|--|--|--|
| Standard | | | |
| | | | |

Design criteria used for loading capacity

Methodology:

- Analytic calculation
- Finite element analysis
- Hardware tests

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**









| Loading case: Standard | Combinations covered by loading case | | |
|--|---|--|--|
| Bill of Material for this loading case: 1x MIC-90-LH connector 2048107 Connector incl. all connecting hardware | Connector used for perpendicular connections of various combinations two MI-90 or 120 girders, to enable a cantilever arm | | |

Recommended loading capacity - simplified for most common applications



| Design loading capacity - 3D | 1/2 |
|--|--|
| Method | |
| Visid strength Design load 1.5 Line load Action Resistance | |
| Limiting components of capacity evaluated | d in following tables: |
| 1. Connection system, including connector, nardware and affect | ted portion of Mi girders, per FEA simulation |
| | Installation Technical Manual - Technical Data - MI system |



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI girders, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 56.35 | 56.35 | 20.70 | 20.70 | 53.24 | 53.24 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 2.24 | 2.24 | 5.75 | 5.75 | 1.31 | 1.31 |

Interaction:

 $\frac{F_{xEd}}{F_{xRd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{xEd}}{M_{xRd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \leq 1$

Installation Technical Manual - Technical Data - MI system

2/2



| Designation MIC-90-E | | ignation Item number -90-E 304809 | | |
|---|----------|--------------------------------------|--|-------------|
| Corrosion protection: | | | | |
| Material | HDG per | Zinc thickness, min. (μm) | | 250 519 519 |
| Connector, Plate | ISO 1461 | 55 | | 2999 4000 1 |
| Bolt; Nut | ISO 1461 | 40; 45 | | |
| Weight: 8.12 lb (3685 g) incl. co | mponents | | | |

Description:

Hot dipped galvanized, Hilti MI extension connector typically used for connecting two MI-90 girders together to form a continuous girder. Fixed with 8 bolts and lock-nuts through the girder to enable a strong hold and vibration resistance.

| Material properties | | | | |
|--|------------------------------|------------------------------|-----------------------------|-----------------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Values for Modulus of Elasticity and Shear Modul | us are according to EN 1003 | 1 1 and used for all Eurocod | o calculations | mm |

Instruction For Use:



Installation Technical Manual - Technical Data - MI system



8x MIA-OH90

MIC-90-E



| Possible loading cases | | | | |
|------------------------|--|--|--|--|
| Standard | | | | |
| | | | | |

Design criteria used for loading capacity

Methodology:

- Analytic calculation .
- Finite element analysis
- Hardware tests

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, ٠ including those resulting from thermal or other expansion must be taken into account during design. Simplified drawing:







Recommended loading capacity - simplified for most common applications







Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Steel connector



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 118.82 | 118.82 | 19.00 | 19.00 | 19.00 | 19.00 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 2.10 | 2.10 | 1.95 | 1.95 | 1.95 | 1.95 |

Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \leq 1$

Installation Technical Manual - Technical Data - MI system

2/2



Hardware included per connector

4x

1x

MI-120

8x

4x

MIC-120-E Connector

| Designation MIC-120-E | | lte 3(| <u>em number</u> 04810 |
|--------------------------|----------|------------------------------|---------------------------|
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (μm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |
| Weight: | | | |

Description:

Hot dipped galvanized, Hilti MI extension connector typically used for connecting two MI-120 girders together to form a continuous girder. Fixed with 8 bolts and lock-nuts through the girder to enable a strong hold and vibration resistance.

| Material properties | | | | |
|--|------------------------------|------------------------------|-----------------------------|----------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Values for Medulus of Electicity and Shear Medul | up are according to EN 1002 | 1.1 and used for all Europed | a calculationa | |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculatio

Instruction For Use:





MIC-120-E Connector

| Possible loading cases | | | | |
|------------------------|--|--|--|--|
| Standard | | | | |
| | | | | |

Design criteria used for loading capacity

Methodology:

- Analytic calculation
- Finite element analysis
- Hardware tests

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**





Installation Technical Manual - Technical Data - MI system



1x MIC-120-E

304810

Connector incl. all connecting hardware

MIC-120-E Connector



Connector used for extension of MI-120 girder



Recommended loading capacity - simplified for most common applications





Installation Technical Manual - Technical Data - MI system



MIC-120-E Connector

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F). ٠
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

2/2

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

Connection system, including connector, hardware and affected portion of MI-120 girders, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 118.82 | 118.82 | 19.00 | 19.00 | 28.00 | 28.00 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 3.15 | 3.15 | 3.00 | 3.00 | 1.95 | 1.95 |

Interaction:

 $\frac{F_{x,Ed}}{F_{x,Rd}} + \frac{F_{y,Ed}}{F_{y,Rd}} + \frac{F_{z,Ed}}{F_{z,Rd}} + \frac{M_{x,Ed}}{M_{x,Rd}} + \frac{M_{y,Ed}}{M_{y,Rd}} + \frac{M_{z,Ed}}{M_{z,Rd}} \le 1$



MIC-U-MA Connector

| Designation | | lte 3 | m number |
|-----------------------|----------|------------------------------|----------|
| | | J | |
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Toothed Plate | ISO 1461 | 45 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |

Weight:

2630 g incl. components

Description:

Hot dipped galvanized Hilti MI connector, typically used for connecting two MI girders, where one girder is braced / supported by the other at an angle, to improve total load capacity of the structure. One oblong hole enables fine adjustment and is serrated to improve holding. Connector is used on the sides

| 130 ø1; | 8 | | | 197.5 |
|------------|---------|-------|-------|----------------|
| Hardwa | are inc | luded | per c | onnector |
| | | | ٢ | and the second |
| 2x | 1x | 1x | 2x | 1x |

| Material properties | | | | |
|--|------------------------------|------------------------------|-----------------------------|----------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Toothed Plate S235JR - (DIN EN10025-2) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:



Installation Technical Manual - Technical Data - MI system



MIC-U-MA Connector

| Possible loading cases | | | |
|------------------------|--|--|--|
| Standard | | | |
| | | | |

Design criteria used for loading capacity

Methodology:

- · Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**



Installation Technical Manual - Technical Data - MI system



MIC-U-MA Connector



 Bill of Material for this loading case:

 1x MIC-U-MA (pair)
 304806

 Connector incl. all connecting hardware

 Image: Connector incl. all connecting hardware

Recommended loading capacity - simplified for most common applications







Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F). •
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

 F_{α}

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

Connection system, including con

| nector, hardware and affected portion of MI-90 girders, per FEA simulation | | | | | | | |
|---|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| y | z | +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
| | (| 20.00 | 20.00 | 6.70 | 6.70 | 13.15 | 13.15 |
| | | +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| | | 0.75 | 0.75 | 0.00 | 0.00 | 0.00 | 0.00 |
| Note: The torsional moment M_x is referred to the local x direction of the inclined profile in plane x/z | | | | | | | |

x-direction of the inclined profile in plane x/z.

Interaction:

$$F_{x.Ed\alpha} := F_{\alpha} \cdot \cos(\alpha)$$
$$F_{z.Ed\alpha} := F_{\alpha} \cdot \sin(\alpha)$$

$$\left(\frac{F_{x.Ed\alpha}}{F_{x.Rd}}\right)^2 + \left(\frac{F_{z.Ed\alpha}}{F_{z.Rd}}\right)^2 + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} \le 1$$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 68

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| Designation | lte | m number | |
|-----------------------|----------|------------------------------|------|
| MIC-C90-AA | | 30 | 4825 |
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |

Weight:

3490 g incl. components

Description:

Hilti Hot-dipped galvanized baseplate connector, typically used for anchoring an MI-90 girder to concrete. Two oblong anchor holes enable fine tuning of baseplate position, and girder is connected using bolts through fixed holes.



| Material properties | | | | |
|--|------------------------------|------------------------------|-----------------------------|-----------------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:



Installation Technical Manual - Technical Data - MI system



| Possible loadi | ng cases | |
|----------------|----------|--|
| Standard | | |
| | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.
 Simplified drawing:



Installation Technical Manual - Technical Data - MI system







Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

| Standard | |
|----------|--|
| | |

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-90 girder, per FEA simulation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 50.30 | 63.30 | 31.60 | 31.60 | 31.60 | 31.60 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 2.85 | 2.85 | 1.81 | 1.81 | 1.00 | 1.00 |
| | | | | | - |

Interaction:

$$\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \le 1$$

2. Welds - per analytical calculation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 230.12 | 230.12 | 49.31 | 49.31 | 49.31 | 49.31 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 5.64 | 5.64 | 3.45 | 3.45 | 3.45 | 3.45 |

Interaction:

$$\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \leq 1$$

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2/<u>2</u>


| Designation //IC-C90-DH | | lte 21 | <u>m number</u> 74661 |
|----------------------------|----------|------------------------------|--------------------------|
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (μm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |

Weight:

8228g incl. components

Description:

Hilti Hot-dipped galvanized baseplate connector, used for anchoring an MI-90 girder to concrete. Four round anchor holes of baseplate enable anchoring, and girder is connected using bolts through fixed holes.



| Material properties | | | | |
|--|------------------------------|------------------------------|-----------------------------|----------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Values for Modulus of Elasticity and Shear Module | us are according to EN 1993- | 1-1 and used for all Eurocod | e calculations | |

Instruction For Use:



Installation Technical Manual - Technical Data - MI system



| Possible loading cases | | | |
|------------------------|--|--|--|
| Standard | | | |
| | | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**



Installation Technical Manual - Technical Data - MI system





| Loading case: Standard | Combinations covered by loading case |
|---|--------------------------------------|
| Bill of Material for this loading case: | Baseplate connector used for |
| 1x MIC-C90-DH 2174661 | a perpendicular connection of |
| Connector incl. all connecting hardware | an MI-90 girder to concrete |

Recommended loading capacity - simplified for most common applications





Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

| Standard | |
|----------|--|
| | |

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-90 girder, per FEA simulation



| +FX,Ru [kN] | -FX,Ru [kN] | +Fy,Ru [kN] | -Fy,Ru [kN] | +F2,R0 [kN] | -F2,Ru [kN] |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|
| 90.00 | 118.82 | 45.40 | 45.40 | 45.40 | 45.40 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 3.60 | 3.60 | 3.00 | 3.00 | 3.00 | 3.00 |
| nteraction: | | | | | |
| $\frac{F_{x,Ed}}{F_{x,Rd}} + \frac{F_{y,Ed}}{F_{y,Rd}} + \frac{F_{z,Ed}}{F_{z,Rd}} + \frac{M_{x,Ed}}{M_{x,Rd}} + \frac{M_{y,Ed}}{M_{y,Rd}} + \frac{M_{z,Ed}}{M_{z,Rd}} \le 1$ | | | | | |

2. Welds – per analytical calculation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 230.12 | 230.12 | 49.31 | 49.31 | 49.31 | 49.31 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 5.64 | 5.64 | 3.45 | 3.45 | 3.45 | |

Interaction:

| Fx.Ed | F _{y.Ed} | F _{z.Ed} | M _{x.Ed} | M _{y.Ed} | $\frac{M_{z.Ed}}{1} \leq 1$ |
|-------------------|-------------------|-------------------|-------------------|-------------------|-----------------------------|
| F _{x.Rd} | F _{y.Rd} | F _{z.Rd} | M _{x.Rd} | My.Rd | M _{z.Rd} |

Installation Technical Manual - Technical Data - MI system



| Designation | | lte | m number |
|-----------------------|----------|------------------------------|----------|
| MIC-C120-DH | | 21 | 74662 |
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (μm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |

Weight:

8688 g incl. components

Description:

Hilti Hot-dipped galvanized baseplate connector, typically used for anchoring an MI-120 girder to concrete. Four round anchor holes in baseplate for attachment to concrete, and girder is connected using bolts through fixed holes.

| Material properties | | | | |
|---|------------------------------|------------------------------|-----------------------------|----------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \ \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:



Installation Technical Manual - Technical Data - MI system





| Possible loading cases | | | | |
|------------------------|--|--|--|--|
| Standard | | | | |
| | | | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**



Installation Technical Manual - Technical Data - MI system



 \pm Fz,rec.

[kN]

42.3

MIC-C120-DH Base Material Connector - Concrete



| Loading case: Standard | Combinations covered by loading case |
|---|--|
| Bill of Material for this loading case: Angle incl. all components 1x MIC-C120-DH 2174662 | Baseplate connector used for a perpendicular connection of an MI-90 girder to concrete |

Recommended loading capacity - simplified for most common applications







Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

| Standard | |
|----------|--|
| | |

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-120 girder, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 104.00 | 118.82 | 53.80 | 53.80 | 63.50 | 63.50 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 5.39 | 5.39 | 4.73 | 4.73 | 3.00 | 3.00 |

Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \leq 1$



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 316.42 | 316.42 | 81.16 | 81.16 | 100.68 | 100.68 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 9.16 | 9.16 | 5.18 | 5.18 | 6.04 | 6.04 |

Interaction:

$$\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \le 1$$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 80



| Designation MIC-C90-UH | | lte 21 | <u>m numbei</u> 1 79535 |
|---------------------------|----------|------------------------------|-----------------------------------|
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |

Weight:

2450 g incl. components

Description:

Hilti Hot-dipped galvanized baseplate connector, typically used for anchoring an MI-90 girder to concrete. Two oblong anchor holes enable fine tuning of baseplate position, and girder is connected using bolts through fixed holes.



2x M12-F-SL-WS 3/4" MIA-OH90

| Material properties | | | | |
|---|------------------------------|------------------------------|-----------------------------|--------------------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | $\mathbf{G} = 80769 \frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |

ulus are according to EN 1993-1-1

Instruction For Use:



Installation Technical Manual - Technical Data - MI system



| Possible loading cases | | | | | |
|------------------------|--|--|--|--|--|
| Standard | | | | | |
| | | | | | |

Design criteria used for loading capacity

Methodology:

Analytic calculation

Standards and codes:

| • | EN 1990 | Basics of structural design | 03.2003 |
|---|-------------|---|---------|
| • | EN 1991-1-1 | Eurocode 1: Actions on structures –Part 1-1: General actions | |
| | | densities, self-weight, imposed loads for buildings | 03.2012 |
| • | EN 1993-1-1 | Eurocode 3: Design of steel structures –Part 1-1: General | |
| | | rules and rules for buildings | 03.2012 |
| • | EN 1993-1-3 | Eurocode 3: Design of steel structures –Part 1-3: General rules- | |
| | | Supplementary rules for cold-formed members and sheeting | 09.2010 |
| • | EN 1993-1-5 | Eurocode 3: Design of steel structures –Part 1-5:Plated | |
| | | structural elements | 06.2012 |
| • | EN 1993-1-8 | Eurocode 3: Design of steel structures –Part 1-8: Design | |
| | | of joints | 03.2012 |
| | | | |

Software:

- Mathcad 15.0
- Microsoft Excel

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**



Installation Technical Manual - Technical Data - MI system





Recommended loading capacity - simplified for most common applications





Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

| Standard | |
|----------|--|
| | |

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connector body - per analytical calculation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 13.19 | 93.32 | 25.00 | 25.00 | 25.00 | 25.00 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 4.10 | 4.10 | 0.00 | 0.00 | 0.00 | 0.00 |

Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} \leq 1$

2. Welds - per analytical calculation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 244.38 | 244.38 | 99.77 | 99.77 | 99.77 | 99.77 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 5.99 | 5.99 | 0.00 | 0.00 | 0.00 | 0.00 |

Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} \leq 1$

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

| Standard | |
|----------|--|
| | |

Design loading capacity - 3D

3. Screws – per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 2.25 | 2.25 | 36.29 | 36.29 | 36.29 | 36.29 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 1.20 | 1.20 | 0.00 | 0.00 | 0.00 | 0.00 |

Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} \leq 1$

Installation Technical Manual - Technical Data - MI system



Data version 2.1 I Date 10.2018

Installation Technical Manual - Technical Data - MI system



| Designation | | Ite | m number |
|-----------------------|----------|------------------------------|----------|
| MIC-CU-MAH | | 21 | 74664 |
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |
| | | | |

Weight:

2261 g incl. components

Description:

Hilti Hot-dipped galvanized baseplate connector, used for anchoring a MI-90 girder to concrete in an angle, usually when it's used as a brace for another girder. Two round anchor holes in baseplate for attachment to concrete, and girder is connected using one bolt through a hole, which enables various angles.

| Material properties | | | | | | |
|--|------------------------------|------------------------------|-----------------------------|----------------------------|--|--|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus | | |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ | | |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ | | |
| Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations | | | | | | |

Instruction For Use:



Installation Technical Manual - Technical Data - MI system





| Possible loading cases | | | |
|------------------------|--|--|--|
| Standard | | | |
| | | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**



Installation Technical Manual - Technical Data - MI system





| Loading case: Standard | Combinations covered by loading case |
|--|---|
| Bill of Material for this loading case: Angle incl. all components 1x MIC-CU-MAH 2174664 | Baseplate connector used for an angled connection of an MI-90 girder to concrete (bracing) |





Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-90 girder, per FEA simulation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 16.70 | 16.70 | 6.60 | 6.60 | 16.70 | 16.70 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 0.70 | 0.70 | 0.00 | 0.00 | 0.00 | 0.00 |
| nteraction: | | | | | |

```
\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \le 1
```

2. Welds – per analytical calculation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 325.83 | 325.83 | 11.97 | 11.97 | 47.45 | 47.45 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 2.30 | 2.30 | 0.00 | 0.00 | 15.80 | 15.80 |

Interaction:

 $\frac{F_{x,Ed}}{F_{x,Rd}} + \frac{F_{y,Ed}}{F_{y,Rd}} + \frac{F_{z,Ed}}{F_{z,Rd}} + \frac{M_{x,Ed}}{M_{x,Rd}} + \frac{M_{y,Ed}}{M_{y,Rd}} + \frac{M_{z,Ed}}{M_{z,Rd}} \leq 1$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 90



Y = 170 mm

Hardware included per connector

2x

300

2x

MIC-S90-AA Base Material Connector - Steel

| Designation MIC-S90-AA | | lte 30 |
|---------------------------------|----------|------------------------------|
| Corrosion protection: | | |
| Material | HDG per | Zinc thickness, min. (μm) |
| Connector, Plate | ISO 1461 | 55 |
| Bolt; Nut | ISO 1461 | 40; 45 |
| Weight: 4370 g incl. components | | |

Submittal text:

Hilti Hot-dipped galvanized baseplate connector, typically used for anchoring an MI-90 girder to a steel beam. Two oblong anchor holes in perpendicular positions enable fine tuning of baseplate position, and girder is connected using bolts through fixed holes.

| Material properties | | | | |
|---|---|---|---|--|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) Values for Modulue of Electicity and Shorr Modul | $f_y = 235 \frac{N}{mm^2}$ $f_y = 640 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ G = 80769 $\frac{N}{mm^2}$ |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:



Installation Technical Manual - Technical Data - MI system



| Possible loading cases | | | | |
|------------------------|--|--|--|--|
| Standard | | | | |
| | | | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**



Installation Technical Manual - Technical Data - MI system





Recommended loading capacity - simplified for most common applications





Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-90 girder, per FEA simulation



| | | i iiii oo gira | | Simulatio | |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
| 24.40 | 63.30 | 31.60 | 31.60 | 31.60 | 31.60 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 2.85 | 2.85 | 1.81 | 1.81 | 1.00 | 1.00 |

Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \leq 1$

2. Welds - per analytical calculation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 230.12 | 230.12 | 49.13 | 49.13 | 49.13 | 49.13 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 5.64 | 5.64 | 3.45 | 3.45 | 3.45 | 3.45 |

Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \leq 1$

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

3. Beam Clamps - per analytical calculation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|-----------------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 17.40 | Not decisive | 5.16 | 5.16 | 5.16 | 5.16 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 0.32 | 0.32 | 0.90 | 0.90 | 0.78 | 0.78 |

Interaction:

Normal force interaction:

The eccentricity ey and ez between the point of force transfer channel / connector and baseplate, which generates an additional bending moment on the system , must be taken into account in the interaction formula.

$$\frac{F_{xEd}}{F_{xRd}} + \frac{F_{vEd}*ey}{\dot{M}_{zRd}} + \frac{F_{zEd}*ez}{\dot{M}_{yRd}} + \frac{M_{vEd}}{M_{yRd}} + \frac{M_{zEd}}{M_{zRd}} \le 1$$

Shear force interaction:

- Shear Interaction Equation is <u>only</u> valid for TENSILE $F_{x, Ed}$ loads ($F_{x, Ed} > 0$). Equation is <u>not</u> valid for

compressive $F_{x, Ed}$ loads ($F_{x, Ed} < 0$). - For Shear interaction, user must ADDITIONALLY verify: $F_{x, Ed} / F_{x, Rd} < 1$.

$$\sqrt{\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x',Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x',Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x',Rd}}\right)} \le 1$$

Installation Technical Manual - Technical Data - MI system

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Installation Technical Manual - Technical Data - MI system



Hardware included per connector

MIC-S90-AH

(12)

1v 🕥

M12-F-SL

8-11/16" (220)

MIC-S90-AH Base Material Connector - Steel

| Designation | | lte | m number |
|---|----------|------------------------------|----------|
| MIC-S90-AH | | 21 | /4665 |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |
| Weight: 7511 g_incl. component: | S | | |
| Description: | | | |

Description:

Hilti Hot-dipped galvanized baseplate connector, used for connecting a MI-90 girder to a steel beam using M16 mounting hardware. Four slotted holes enable fine tuning of baseplate position, and girder is connected using beam clamps or threaded rod. Comes in different plate sizes to fit various steel beam sizes.

| Material properties | | | | |
|---|-----------------------------|------------------------------|-----------------------------|--------------------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | $\mathbf{G} = 80769 \frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |

Instruction For Use:

For both loading cases



For clamped loading case

For boxed loading case (not attached to the packaging)



Installation Technical Manual - Technical Data - MI system



| Possible loading cases | | | | |
|------------------------|--|--|--|--|
| Clamped | | | | |
| | | | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**



Installation Technical Manual - Technical Data - MI system





| Loading case: Clamped | | Combinations covered by loading case | |
|--|--------------------------|--|--|
| Bill of Material for this loadingConnector incl. all associatedcomponents1x MIC-S90-AH217Beam clamps4x MI-SGC M16387 | g case: 74665 7398 | Connector used for a perpendicular connection of MI-90 girder to flange of structural steel profiles. For flange width 75-165mm. | |

Recommended loading capacity - simplified for most common applications





Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-90 girder, per FEA simulation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 54.80 | 118.82 | 45.40 | 45.40 | 45.40 | 45.40 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 3.60 | 3.60 | 3.00 | 3.00 | 3.00 | 3.00 |
| nteraction | | | | | |

```
\frac{F_{\mathbf{x}Ed}}{F_{\mathbf{x}Rd}} + \frac{F_{\mathbf{y}}Ed}{F_{\mathbf{y}}Rd} + \frac{F_{\mathbf{z}}Ed}{F_{\mathbf{z}}Rd} + \frac{M_{\mathbf{x}Ed}}{M_{\mathbf{x}Rd}} + \frac{M_{\mathbf{y}}Ed}{M_{\mathbf{y}}Rd} + \frac{M_{\mathbf{z}}Ed}{M_{\mathbf{z}}Rd} \leq 1
```

2. Welds – per analytical calculation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 230.12 | 230.12 | 49.31 | 49.31 | 49.31 | 49.31 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 5.64 | 5.64 | 3.45 | 3.45 | 3.45 | 3.45 |

Interaction:

$$\frac{F_{\mathbf{x}}Ed}{F_{\mathbf{x}}Rd} + \frac{F_{\mathbf{y}}\underline{Ed}}{F_{\mathbf{y}}\underline{Rd}} + \frac{F_{\mathbf{z}}\underline{Ed}}{F_{\mathbf{z}}\underline{Rd}} + \frac{M_{\mathbf{x}}Ed}{M_{\mathbf{x}}Rd} + \frac{M_{\mathbf{y}}\underline{Ed}}{M_{\mathbf{y}}\underline{Rd}} + \frac{M_{\mathbf{z}}\underline{Ed}}{M_{\mathbf{z}}\underline{Rd}} \leq 1$$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 100



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

3. Beam Clamps - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 102.40 | Not decisive | 10.31 | 10.31 | 10.31 | 10.31 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 0.84 | 0.84 | 6.66 | 6.66 | 4.51 | 4.51 |

Interaction:

Normal force interaction:

The eccentricity ey and ez between the point of force transfer channel / connector and baseplate, which generates an additional bending moment on the system , must be taken into account in the interaction formula.

$$\frac{F_{x \, Ed}}{F_{x \, Rd}} + \frac{F_{y \, Ed} * ey}{\dot{M}_{z \, Rd}} + \frac{F_{z \, Ed} * ez}{\dot{M}_{y \, Rd}} + \frac{M_{y \, Ed}}{M_{y \, Rd}} + \frac{M_{z \, Ed}}{M_{z \, Rd}} \le 1$$

Shear force interaction:

- Shear Interaction Equation is <u>only</u> valid for TENSILE $F_{x, Ed}$ loads ($F_{x, Ed} > 0$). Equation is <u>not</u> valid for compressive $F_{x, Ed}$ loads ($F_{x, Ed} < 0$). - For Shear interaction, user must ADDITIONALLY verify: $F_{x, Ed} / F_{x, Rd} < 1$.

$$\left| \left(\frac{F_{y Ed}}{F_{y Rd} \times \left(1 - \frac{F_{x Ed}}{F_{x Rd}} \right)} \right)^2 + \left(\frac{F_{z Ed}}{F_{z Rd} \times \left(1 - \frac{F_{x Ed}}{F_{x Rd}} \right)} \right)^2 + \frac{M_{x Ed}}{M_{x Rd} \times \left(1 - \frac{F_{x Ed}}{F_{x Rd}} \right)} \le 1 \right|$$

Installation Technical Manual - Technical Data - MI system





| Loading case: Boxed | Combinations covered by loading case |
|---|--|
| Bill of Material for this loading case: Connector incl. all associated components1x MIC-S90-AH2174665Base plate1746741x MIB-SAH21746741x MIB-SAH2174674Threaded rods cut to particular length 4x AM16x1000 8.8 HDGm419104Lock washer8x LW M16 HDG plus washer 2185343Nut304767 | Connector used for a perpendicular connection of MI-90 girder to flange of structural steel profiles. For flange width 75-165mm. |

Recommended loading capacity - simplified for most common applications





Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-90 girder, per FEA simulation



| | - | - | | | |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
| 57.70 | 118.82 | 45.40 | 45.40 | 45.40 | 45.40 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 3.60 | 3.60 | 3.00 | 3.00 | 3.00 | 3.00 |

Interaction:

 $\frac{F_{\mathbf{x}} \mathbf{E} \mathbf{d}}{F_{\mathbf{x}} \mathbf{R} \mathbf{d}} + \frac{F_{\mathbf{y}} \mathbf{E} \mathbf{d}}{F_{\mathbf{y}} \mathbf{R} \mathbf{d}} + \frac{F_{\mathbf{z}} \mathbf{E} \mathbf{d}}{F_{\mathbf{z}} \mathbf{R} \mathbf{d}} + \frac{M_{\mathbf{x}} \mathbf{E} \mathbf{d}}{M_{\mathbf{x}} \mathbf{R} \mathbf{d}} + \frac{M_{\mathbf{y}} \mathbf{E} \mathbf{d}}{M_{\mathbf{y}} \mathbf{R} \mathbf{d}} + \frac{M_{\mathbf{z}} \mathbf{E} \mathbf{d}}{M_{\mathbf{z}} \mathbf{R} \mathbf{d}} \leq 1$

2. Welds - per analytical calculation



| | | [IN] | [KN] | [kN] |
|------------------------------|-----------------|-----------------|-----------------|-----------------|
| 230.12 230.12 | 49.31 | 49.31 | 49.31 | 49.31 |
| +Mx,Rd -Mx,Rd [kNm] [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 5.64 5.64 | 3.45 | 3.45 | 3.45 | 3.45 |

Interaction:

 $\frac{F_{xEd}}{F_{xRd}} + \frac{F_{y}\underline{Ed}}{F_{y}\underline{Rd}} + \frac{F_{z}\underline{Ed}}{F_{z}\underline{Rd}} + \frac{M_{x}\underline{Ed}}{M_{x}\underline{Rd}} + \frac{M_{y}\underline{Ed}}{M_{y}\underline{Rd}} + \frac{M_{z}\underline{Ed}}{M_{z}\underline{Rd}} \leq 1$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 103



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those • resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

3. Base plate and through bolts - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 164.00 | Not decisive | 20.66 | 20.66 | 20.66 | 20.66 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 1.67 | 1.67 | 8.61 | 8.61 | 7.22 | 7.22 |

Interaction: Normal force interaction:

The eccentricity ey and ez between the point of force transfer channel / connector and baseplate, which generates an additional bending moment on the system , must be taken into account in the interaction formula.

$$\frac{F_{x Ed}}{F_{x Rd}} + \frac{F_{y Ed} * ey}{\dot{M}_{z Rd}} + \frac{F_{z Ed} * ez}{\dot{M}_{y Rd}} + \frac{M_{y Ed}}{M_{y Rd}} + \frac{M_{z Ed}}{M_{z Rd}} \le 1$$

Shear force interaction:

- Shear Interaction Equation is <u>only</u> valid for TENSILE $F_{x, Ed}$ loads ($F_{x, Ed} > 0$). Equation is not valid for compressive $F_{x, Ed}$ loads ($F_{x, Ed} < 0$). - For Shear interaction, user must ADDITIONALLY verify: $F_{x, Ed} / F_{x, Rd} < 1$.

$$\sqrt{\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)} \le 1$$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 104



/2" (12)

0

M12-F-SL

8-11/16" (220)

6-1/8['] (155)

(17x64)

Hardware included per connector

Y = 210 mm

1x MIC-S90-BH

MIC-S90-BH Base Material Connector - Steel

| Designation /IIC-S90-BH | | 1te 21 | <u>em number</u> 174666 |
|-----------------------------------|----------|------------------------------|----------------------------|
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (μm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |
| Weight: 8964 g incl. component | ts | | |
| | | | |

Description:

Hilti Hot-dipped galvanized baseplate connector, used for connecting a MI-90 girder to a steel beam using M16 mounting hardware. Four slotted holes enable fine tuning of baseplate position, and girder is connected using beam clamps or threaded rod. Comes in different plate sizes to fit various steel beam sizes.

| Material properties | | | | |
|--|------------------------------|-------------------------------|-----------------------------|----------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Values for Modulus of Flasticity and Shear Module | is are according to EN 1993- | -1-1 and used for all Eurocod | e calculations | |

Instruction For Use:

For both loading cases



For clamped loading case

For boxed loading case (not attached to the packaging)



Installation Technical Manual - Technical Data - MI system



| Possible loading cases | | | | | |
|------------------------|-------|--|--|--|--|
| Clamped | Boxed | | | | |
| | | | | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**



Installation Technical Manual - Technical Data - MI system





| Bill of Material for this loading case: Connector incl. all associated Connector used for a perpendicular connection of MI-90 girder to flange of structural steel profiles. 1x MIC-S90-BH 2174666 Beam clamps 387398 | Loading case: Clamped | | Combinations covered by loading case | | |
|---|---|--|--------------------------------------|---|--|
| | Bill of Material for this Connector incl. all assoc components 1x MIC-S90-BH Beam clamps 4x MI-SGC M16 | loading case: biated 2174666 387398 | | Connector used for a perpendicular connection of MI-90 girder to flange of structural steel profiles. For flange width 165-235mm. | |

Recommended loading capacity - simplified for most common applications







capacity limits. For any combinations of multiple directions, use design values and their corresponding interaction formulas.



Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

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Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-90 girder, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 40.10 | 118.82 | 45.40 | 45.40 | 45.40 | 45.40 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 3.60 | 3.60 | 3.00 | 3.00 | 3.00 | 3.00 |

Interaction:

$$\frac{F_{\mathbf{x}}Ed}{F_{\mathbf{x}}Rd} + \frac{F_{\mathbf{y}}Ed}{F_{\mathbf{y}}Rd} + \frac{F_{\mathbf{z}}Ed}{F_{\mathbf{z}}Rd} + \frac{M_{\mathbf{x}}Ed}{M_{\mathbf{x}}Rd} + \frac{M_{\mathbf{y}}Ed}{M_{\mathbf{y}}Rd} + \frac{M_{\mathbf{z}}Ed}{M_{\mathbf{z}}Rd} \leq 1$$

2. Welds - per analytical calculation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 230.12 | 230.12 | 49.31 | 49.31 | 49.31 | 49.31 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 5.64 | 5.64 | 3.45 | 3.45 | 3.45 | 3.45 |

Interaction:

$$\frac{F_{\mathbf{x}}Ed}{F_{\mathbf{x}}Rd} + \frac{F_{\mathbf{y}}Ed}{F_{\mathbf{y}}Rd} + \frac{F_{\mathbf{z}}Ed}{F_{\mathbf{z}}Rd} + \frac{M_{\mathbf{x}}Ed}{M_{\mathbf{x}}Rd} + \frac{M_{\mathbf{y}}Ed}{M_{\mathbf{y}}Rd} + \frac{M_{\mathbf{z}}Ed}{M_{\mathbf{z}}Rd} \leq 1$$

Installation Technical Manual - Technical Data - MI system


Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F). •
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

3. Beam Clamps - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 102.40 | Not decisive | 10.31 | 10.31 | 10.31 | 10.31 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 1.12 | 1.12 | 6.66 | 6.66 | 6.66 | 6.66 |

Interaction:

Normal force interaction:

The eccentricity ey and ez between the point of force transfer channel / connector and baseplate, which generates an additional bending moment on the system , must be taken into account in the interaction formula.

$$\frac{F_{x Ed}}{F_{x Rd}} + \frac{F_{v Ed} * ey}{\dot{M}_{z Rd}} + \frac{F_{z Ed} * ez}{\dot{M}_{y Rd}} + \frac{M_{v Ed}}{M_{y Rd}} + \frac{M_{z Ed}}{M_{z Rd}} \le 1$$

Shear force interaction:

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- Shear Interaction Equation is <u>only</u> valid for TENSILE $F_{x, Ed}$ loads ($F_{x, Ed} > 0$). Equation is <u>not</u> valid for $\begin{array}{l} \mbox{compressive } F_{x, Ed} \mbox{ loads } (F_{x, Ed} < 0). \\ \mbox{For Shear interaction, user must ADDITIONALLY verify: } F_{x, Ed} \ / \ F_{x, Rd} < 1. \end{array}$

$$\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)} \le 1$$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 109





| Loading case: Boxed | Combinations covered by loading case |
|---|---|
| Bill of Material for this loading case:1x MIC-S90-BH2174666Hardware not included in packaging:Base plate1x MIB-SBH2174675Threaded rods cut to particular length4x AM16x1000 8.8 HDGm419104Lock washer8x LW M16 HDG plus washer 2185343Nut8x M16-F nut304767 | Connector used for a perpendicular connection of MI-90 girder to flange of structural steel profiles. For flange width 165-235mm. |

Recommended loading capacity - simplified for most common applications







Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-90 girder, per FEA simulation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 40.10 | 80.50 | 45.40 | 45.40 | 45.40 | 45.40 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 3.60 | 3.60 | 3.00 | 3.00 | 3.00 | 3.00 |
| | | | | | - |

Interaction:

$$\frac{F_{xEd}}{F_{xRd}} + \frac{F_{yEd}}{F_{yRd}} + \frac{F_{zEd}}{F_{zRd}} + \frac{M_{xEd}}{M_{xRd}} + \frac{M_{yEd}}{M_{vRd}} + \frac{M_{zEd}}{M_{zRd}} \le 1$$



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 230.12 | 230.12 | 49.31 | 49.31 | 49.31 | 49.31 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 5.64 | 5.64 | 3.45 | 3.45 | 3.45 | 3.45 |

Interaction:

 $\frac{F_{\mathbf{x}}Ed}{F_{\mathbf{x}}Rd} + \frac{F_{\mathbf{y}}Ed}{F_{\mathbf{y}}Rd} + \frac{F_{\mathbf{z}}Ed}{F_{\mathbf{z}}Rd} + \frac{M_{\mathbf{x}}Ed}{M_{\mathbf{x}}Rd} + \frac{M_{\mathbf{y}}Ed}{M_{\mathbf{y}}Rd} + \frac{M_{\mathbf{z}}Ed}{M_{\mathbf{z}}Rd} \leq 1$

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D





| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 158.80 | Not decisive | 20.01 | 20.01 | 20.01 | 20.01 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 2.06 | 2.06 | 8.81 | 8.81 | 9.77 | 9.77 |

Interaction: Normal force interaction:

The eccentricity ey and ez between the point of force transfer channel / connector and baseplate, which generates an additional bending moment on the system , must be taken into account in the interaction formula.

$$\frac{F_{xEd}}{F_{xRd}} + \frac{F_{vEd} * ey}{\dot{M}_{zRd}} + \frac{F_{zEd} * ez}{\dot{M}_{vRd}} + \frac{M_{vEd}}{M_{vRd}} + \frac{M_{zEd}}{M_{zRd}} \le 1$$

Shear force interaction:

- Shear Interaction Equation is <u>only</u> valid for TENSILE $F_{x, Ed}$ loads ($F_{x, Ed} > 0$). Equation is <u>not</u> valid for compressive $F_{x, Ed}$ loads ($F_{x, Ed} < 0$). - For Shear interaction, user must ADDITIONALLY verify: $F_{x, Ed} / F_{x, Rd} < 1$.

$$\left| \left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \le 1$$

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1

M12-F-SL

WS 3/4

MIC-S90-CH

MIC-S90-CH Base Material Connector - Steel

| Designation | | lte | em number |
|-----------------------------------|------------------|------------------------------|----------------|
| MIC-S90-CH | | 21 | 74667 |
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (μm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |
| Weight: 10624 a_incl. componer | nts | | |
| | | | |
| Description: | | | |
| Hilti Hot-dipped galvaniz | zed baseplate co | nnector, used for co | onnectina |
| a MI-90 girder to a steel | heam using M1 | 6 mounting hardwar | e Four slotted |

a MI-90 girder to a steel beam using M16 mounting hardware. Four slotted holes enable fine tuning of baseplate position, and girder is connected using beam clamps or threaded rod. Comes in different plate sizes to fit various steel beam sizes.

| Material properties | | | | |
|---|------------------------------|------------------------------|-----------------------------|--------------------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | $\mathbf{G} = 80769 \frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Values for Modulus of Elasticity and Shear Modul | us are according to EN 1993. | 1-1 and used for all Eurocod | e calculations | |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1995-1-1 and used for all Eurocode call

Instruction For Use:

For both loading cases



For clamped loading case

For boxed loading case (not attached to the packaging)



Installation Technical Manual - Technical Data - MI system



| Possible loading cases | | | | |
|------------------------|-------|--|--|--|
| Clamped | Boxed | | | |
| | | | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**



Installation Technical Manual - Technical Data - MI system





| Bill of Material for this loading case:1x MIC-S90-CH2174667Hardware not included in packaging:Evan clampsBeam clamps3873984x MI-SGC M16387398 | Loading case: Clamped | Combinations covered by loading case |
|---|--|---|
| | Bill of Material for this loading case: 1x MIC-S90-CH 2174667 Hardware not included in packaging: Beam clamps 4x MI-SGC M16 387398 | Connector used for a perpendicular connection of MI-90 girder to flange of structural steel profiles. For flange width 235-300mm. |

Recommended loading capacity - simplified for most common applications





| ±Fx,rec. | ±Fy,rec. | ±Fz,rec. |
|----------|----------|----------|
| [kN] | [kN] | [kN] |
| 17.93 | 6.87 | 6.87 |

These values are individual one directional maximal capacity limits. For any combinations of multiple directions, use design values and their corresponding interaction formulas.



Installation Technical Manual - Technical Data - MI system



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- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-90 girder, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 26.90 | 118.82 | 45.40 | 45.40 | 45.40 | 45.40 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 3.60 | 3.60 | 3.00 | 3.00 | 3.00 | 3.00 |

Interaction:

| F _{xEd} | Fy.Ed | F _{z.Ed} | M _{xEd} | My.Ed | M _{z.Ed} |
|------------------|-------------------|-------------------|--------------------|---------------------|----------------------------|
| FxRd | F _{v.Rd} | Fz.Rd | M _{xRd} + | M _{v.Rd} + | M _{z.Rd} ≥ 1 |

2. Welds - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] | |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|--|
| 230.12 | 230.12 | 49.31 | 49.31 | 49.31 | 49.31 | |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] | |
| 5.64 | 5.64 | 3.45 | 3.45 | 3.45 | 3.45 | |
| Interaction: $\frac{F_{xEd}}{F_{xRd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{xEd}}{M_{xRd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \le 1$ | | | | | | |

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 116



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

3. Beam Clamps - per analytical calculation



with $e_v = e_z = 0.070 \text{ m}$

| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 102.40 | Not decisive | 10.31 | 10.31 | 10.31 | 10.31 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 1.41 | 1.41 | 6.66 | 6.66 | 8.45 | 8.45 |

Interaction:

Normal force interaction:

The eccentricity ey and ez between the point of force transfer channel / connector and baseplate, which generates an additional bending moment on the system , must be taken into account in the interaction formula.

$$\frac{F_{x,Ed}}{F_{x,Rd}} + \frac{F_{v,Ed} * ey}{\dot{M}_{z,Rd}} + \frac{F_{z,Ed} * ez}{\dot{M}_{y,Rd}} + \frac{M_{v,Ed}}{M_{y,Rd}} + \frac{M_{z,Ed}}{M_{z,Rd}} \le 1$$

Shear force interaction:

- Shear Interaction Equation is <u>only</u> valid for TENSILE $F_{x, Ed}$ loads ($F_{x, Ed} > 0$). Equation is <u>not</u> valid for $\begin{array}{l} \mbox{compressive } F_{x,\,Ed} \mbox{ loads } (F_{x,\,Ed} < 0). \\ \mbox{-} \mbox{For Shear interaction, user must ADDITIONALLY verify: } F_{x,\,Ed} \ / \ F_{x,\,Rd} < 1. \end{array}$

$$\left| \left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \le 1$$

Installation Technical Manual - Technical Data - MI system





| Loading case: Boxed | Combinations covered by loading case |
|---|---|
| Bill of Material for this loading case:1x MIC-S90-CH2174667Hardware not included in packaging:Base plate1x MIB-SCH2174676Threaded rods cut to particular length4x AM16x1000 8.8 HDGm419104Lock washer8x LW M16 HDG plus washer 2185343Nut8x M16-F nut304767 | Connector used for a perpendicular connection of MI-90 girder to flange of structural steel profiles. For flange width 235-300mm. |

Recommended loading capacity - simplified for most common applications





Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

2/3

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-90 girder, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 25.50 | 52.30 | 45.40 | 45.40 | 45.40 | 45.40 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 3.60 | 3.60 | 3.00 | 3.00 | 3.00 | 3.00 |

Interaction:

| FxEd | Fy.Ed | F _{z.Ed} | M _{xEd} | My.Ed | M _{z.Ed} |
|------------------|-------------------|-------------------|------------------|-------|-------------------|
| F _{xRd} | F _{y.Rd} | F _{z.Rd} | M _{xRd} | My.Rd | M _{z.Rd} |



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 230.12 | 230.12 | 49.31 | 49.31 | 49.31 | 49.31 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 5.64 | 5.64 | 3.45 | 3.45 | 3.45 | 3.45 |

Interaction:

 $\frac{F_{\mathbf{x}}E\mathbf{d}}{F_{\mathbf{x}}R\mathbf{d}} + \frac{F_{\mathbf{y}}\cdot E\mathbf{d}}{F_{\mathbf{y}}\cdot R\mathbf{d}} + \frac{F_{\mathbf{z}}\cdot E\mathbf{d}}{F_{\mathbf{z}}\cdot R\mathbf{d}} + \frac{M_{\mathbf{x}}\cdot E\mathbf{d}}{M_{\mathbf{x}}\cdot R\mathbf{d}} + \frac{M_{\mathbf{y}}\cdot E\mathbf{d}}{M_{\mathbf{y}}\cdot R\mathbf{d}} + \frac{M_{\mathbf{z}}\cdot E\mathbf{d}}{M_{\mathbf{z}}\cdot R\mathbf{d}} \leq 1$

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 150.80 | Not decisive | 19.00 | 19.00 | 19.00 | 19.00 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 2.57 | 2.57 | 8.82 | 8.82 | 12.29 | 12.29 |

Interaction: Normal force interaction:

The eccentricity ey and ez between the point of force transfer channel / connector and baseplate, which generates an additional bending moment on the system , must be taken into account in the interaction formula.

$$\frac{F_{xEd}}{F_{xRd}} + \frac{F_{yEd}*ey}{\dot{M}_{zRd}} + \frac{F_{zEd}*ez}{\dot{M}_{yRd}} + \frac{M_{yEd}}{M_{yRd}} + \frac{M_{zEd}}{M_{zRd}} \le 1$$

Shear force interaction:

- Shear Interaction Equation is <u>only</u> valid for TENSILE $F_{x, Ed}$ loads ($F_{x, Ed} > 0$). Equation is <u>not</u> valid for compressive $F_{x, Ed}$ loads ($F_{x, Ed} < 0$). - For Shear interaction, user must ADDITIONALLY verify: $F_{x, Ed} / F_{x, Rd} < 1$.

$$\left| \left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \le 1$$

Installation Technical Manual - Technical Data - MI system



| Designation MIC-S120-AH | | <u>Ite</u> 21 | <u>m number</u> 74668 |
|----------------------------|----------|------------------------------|--------------------------|
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |
| Weight: | | | |

7911 g incl. components

Description:

Hilti Hot-dipped galvanized baseplate connector, used for connecting a MI-120 girder to a steel beam using M16 mounting hardware. Four slotted holes enable fine tuning of baseplate position, and girder is connected using beam clamps or threaded rod. Comes in different plate sizes to fit various steel beam sizes.

| Material properties | | | | |
|--|------------------------------|------------------------------|-----------------------------|--------------------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | $\mathbf{G} = 80769 \frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Values for Modulus of Elasticity and Shear Modul | us are according to EN 1993- | 1-1 and used for all Eurocod | e calculations | |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calcu

Instruction For Use:

For both loading cases:



For clamped loading case

For boxed loading case (not attached to the packaging)



Installation Technical Manual - Technical Data - MI system





| Possible loadi | ng cases | |
|----------------|----------|--|
| Clamped | Boxed | |
| | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.
 Simplified drawing:



Installation Technical Manual - Technical Data - MI system





| Loading case: Clamped | Combinations covered by loading case |
|---|---|
| Bill of Material for this loading case: 1x MIC-S120-AH 2174668 Hardware not included in packaging: Beam clamps 4x MI-SGC M16 387398 | Connector used for a perpendicular connection of MI-120 girder to flange of structural steel profiles. For flange width 75-165mm. |

Recommended loading capacity - simplified for most common applications









Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-120 girders, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 56.80 | 118.82 | 53.80 | 53.80 | 63.50 | 63.50 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 5.39 | 5.39 | 4.73 | 4.73 | 3.00 | 3.00 |

Interaction:

```
\frac{F_{\mathbf{x}\mathbf{Ed}}}{F_{\mathbf{x}\mathbf{Rd}}} + \frac{F_{\mathbf{y}}\underline{Ed}}{F_{\mathbf{y}}\underline{Rd}} + \frac{F_{\mathbf{z}}\underline{Ed}}{F_{\mathbf{z}}\underline{Rd}} + \frac{M_{\mathbf{x}\mathbf{Ed}}}{M_{\mathbf{x}\mathbf{Rd}}} + \frac{M_{\mathbf{y}}\underline{Ed}}{M_{\mathbf{y}}\underline{Rd}} + \frac{M_{\mathbf{z}}\underline{Ed}}{M_{\mathbf{z}}\underline{Rd}} \leq 1
```

2. Welds - per analytical calculation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 316.42 | 316.42 | 81.16 | 81.16 | 100.68 | 100.68 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 9.16 | 9.16 | 5.18 | 5.18 | 6.04 | 6.04 |

Interaction:

 $\frac{F_{\mathbf{x}}Ed}{F_{\mathbf{x}}Rd} + \frac{F_{\mathbf{y}}Ed}{F_{\mathbf{y}}Rd} + \frac{F_{\mathbf{z}}Ed}{F_{\mathbf{z}}Rd} + \frac{M_{\mathbf{x}}Ed}{M_{\mathbf{x}}Rd} + \frac{M_{\mathbf{y}}Ed}{M_{\mathbf{y}}Rd} + \frac{M_{\mathbf{z}}Ed}{M_{\mathbf{z}}Rd} \leq 1$

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

3. Beam Clamps - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 102.40 | Not decisive | 10.31 | 10.31 | 10.31 | 10.31 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 0.84 | 0.84 | 7.48 | 7.48 | 4.51 | 4.51 |

Interaction:

Normal force interaction:

The eccentricity ey and ez between the point of force transfer channel / connector and baseplate, which generates an additional bending moment on the system , must be taken into account in the interaction formula.

$$\frac{F_{x \, Ed}}{F_{x \, Rd}} + \frac{F_{v \, Ed} * ey}{\dot{M}_{z \, Rd}} + \frac{F_{z \, Ed} * ez}{\dot{M}_{y \, Rd}} + \frac{M_{v \, Ed}}{M_{y \, Rd}} + \frac{M_{z \, Ed}}{M_{z \, Rd}} \le 1$$

Shear force interaction:

- Shear Interaction Equation is only valid for TENSILE F_{x, Ed} loads (F_{x, Ed} > 0). Equation is not valid for compressive $F_{x, Ed}$ loads ($F_{x, Ed} < 0$). • For Shear interaction, user must ADDITIONALLY verify: $F_{x, Ed} / F_{x, Rd} < 1$.

$$\sqrt{\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)} \le 1$$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 125





| Loading case: Boxed | Combinations covered by loading case |
|---|---|
| Bill of Material for this loading case:1x MIC-S120-AH2174668Hardware not included in packaging:Base plate1x MIB-SAH2174674Threaded rods cut to particular length4x AM16x1000 8.8 HDGm419104Lock washer8x LW M16 HDG plus washer2185343Nut304767 | Connector used for a perpendicular connection of MI-120 girder to flange of structural steel profiles. For flange width 75-165mm. |







| × | ±Fx,rec. [kN] | ±Fy,rec. [kN] | ±Fz,rec. [kN] | | | |
|---|--|------------------|------------------|--|--|--|
| | 39.00 | 13.77 | 13.77 | | | |
| | These values are individual one directional maximal capacity limits. For any combinations of multiple | | | | | |

capacity limits. For any combinations of multiple directions, use design values and their corresponding interaction formulas.



Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

2/3

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-120 girders, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 58.50 | 118.82 | 53.80 | 53.80 | 63.50 | 63.50 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 5.39 | 5.39 | 4.73 | 4.73 | 3.00 | 3.00 |

Interaction:

$$\frac{F_{\mathbf{x}\underline{Ed}}}{F_{\mathbf{x}\underline{Rd}}} + \frac{F_{\mathbf{y}}\underline{Ed}}{F_{\mathbf{y}}\underline{Rd}} + \frac{F_{\mathbf{z}}\underline{Ed}}{F_{\mathbf{z}}\underline{Rd}} + \frac{M_{\mathbf{x}\underline{Ed}}}{M_{\mathbf{x}}\underline{Rd}} + \frac{M_{\mathbf{y}}\underline{Ed}}{M_{\mathbf{y}}\underline{Rd}} + \frac{M_{\mathbf{z}}\underline{Ed}}{M_{\mathbf{z}}\underline{Rd}} \leq 1$$

2. Welds - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|
| 316.42 | 316.42 | 81.16 | 81.16 | 100.68 | 100.68 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 9.16 | 9.16 | 5.18 | 5.18 | 6.04 | 6.04 |
| Interaction: | | | | | |
| $\frac{F_{xEd}}{F_{xRd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{xEd}}{M_{xRd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \le 1$ | | | | | |

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

3. Base plate and through bolts - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 164.00 | Not decisive | 20.66 | 20.66 | 20.66 | 20.66 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 1.67 | 1.67 | 10.99 | 10.99 | 7.22 | 7.22 |

Interaction: Normal force interaction:

The eccentricity ey and ez between the point of force transfer channel / connector and baseplate, which generates an additional bending moment on the system , must be taken into account in the interaction formula.

$$\frac{F_{xEd}}{F_{xRd}} + \frac{F_{vEd}*ey}{\dot{M}_{zRd}} + \frac{F_{zEd}*ez}{\dot{M}_{vRd}} + \frac{M_{vEd}}{M_{vRd}} + \frac{M_{zEd}}{M_{zRd}} \le 1$$

Shear force interaction:

- Shear Interaction Equation is <u>only</u> valid for TENSILE $F_{x, Ed}$ loads ($F_{x, Ed} > 0$). Equation is <u>not</u> valid for compressive $F_{x, Ed}$ loads ($F_{x, Ed} < 0$). - For Shear interaction, user must ADDITIONALLY verify: $F_{x, Ed} / F_{x, Rd} < 1$.

$$\left| \left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \le 1 \right|$$

Installation Technical Manual - Technical Data - MI system



| Designation | | Ite | m number |
|-----------------------|----------|------------------------------|----------|
| MIC-S120-BH | | 21 | 74669 |
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |
| Weight: | | | |

9364 g incl. components

Description:

Hilti Hot-dipped galvanized baseplate connector, used for connecting a MI-120 girder to a steel beam using M16 mounting hardware. Four slotted holes enable fine tuning of baseplate position, and girder is connected using beam clamps or threaded rod. Comes in different plate sizes to fit various steel beam sizes.



Instruction For Use:

For both loading cases:



For clamped loading case

For boxed loading case (not attached to the packaging)



Installation Technical Manual - Technical Data - MI system





| Possible loadi | ng cases | |
|----------------|----------|--|
| Clamped | Boxed | |
| | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.
 Simplified drawing:



Installation Technical Manual - Technical Data - MI system





| Loading case: Clamped | Combinations covered by loading case |
|---|--|
| Bill of Material for this loading case: 1x MIC-S120-BH 2174669 Hardware not included in packaging: Beam clamps 4x MI-SGC M16 387398 | Connector used for a perpendicular connection of MI-120 girder to flange of structural steel profiles. For flange width 165-235mm. |

Recommended loading capacity - simplified for most common applications







interaction formulas



Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-120 girders, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 40.60 | 118.82 | 53.80 | 53.80 | 63.50 | 63.50 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 5.39 | 5.39 | 4.45 | 4.45 | 3.00 | 3.00 |

Interaction:

```
\frac{F_{xEd}}{F_{xRd}} + \frac{F_{yEd}}{F_{yRd}} + \frac{F_{zEd}}{F_{zRd}} + \frac{M_{xEd}}{M_{xRd}} + \frac{M_{yEd}}{M_{yRd}} + \frac{M_{zEd}}{M_{zRd}} \le 1
```



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 316.42 | 316.42 | 81.16 | 81.16 | 100.68 | 100.68 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 9.16 | 9.16 | 5.18 | 5.18 | 6.04 | 6.04 |

Interaction:

$$\frac{F_{\mathbf{x}\mathbf{Ed}}}{F_{\mathbf{x}\mathbf{Rd}}} + \frac{F_{\mathbf{y}\cdot\mathbf{Ed}}}{F_{\mathbf{y}\cdot\mathbf{Rd}}} + \frac{F_{\mathbf{z}\cdot\mathbf{Ed}}}{F_{\mathbf{z}\cdot\mathbf{Rd}}} + \frac{M_{\mathbf{x}\cdot\mathbf{Ed}}}{M_{\mathbf{x}\cdot\mathbf{Rd}}} + \frac{M_{\mathbf{y}\cdot\mathbf{Ed}}}{M_{\mathbf{y}\cdot\mathbf{Rd}}} + \frac{M_{\mathbf{z}\cdot\mathbf{Ed}}}{M_{\mathbf{z}\cdot\mathbf{Rd}}} \leq 1$$

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Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 132



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F). •
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

3. Beam Clamps - per analytical Calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 102.40 | Not decisive | 10.31 | 10.31 | 10.31 | 10.31 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 1.12 | 1.12 | 7.48 | 7.48 | 6.66 | 6.66 |

Interaction:

Normal force interaction:

The eccentricity ey and ez between the point of force transfer channel / connector and baseplate, which generates an additional bending moment on the system , must be taken into account in the interaction formula.

$$\frac{F_{xEd}}{F_{xRd}} + \frac{F_{vEd} * ey}{M_{zRd}} + \frac{F_{zEd} * ez}{M_{yRd}} + \frac{M_{vEd}}{M_{yRd}} + \frac{M_{zEd}}{M_{zRd}} \le 1$$

Shear force interaction:

١

- Shear Interaction Equation is <u>only</u> valid for TENSILE $F_{x, Ed}$ loads ($F_{x, Ed} > 0$). Equation is <u>not</u> valid for compressive $F_{x, Ed}$ loads ($F_{x, Ed} < 0$). - For Shear interaction, user must ADDITIONALLY verify: $F_{x, Ed} / F_{x, Rd} < 1$.

$$\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x',Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x',Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x',Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x',Rd}}\right)} \le 1$$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 133





| Loading case: Boxed | Combinations covered by loading case |
|---|--|
| Bill of Material for this loading case:1x MIC-S120-BH2174669Hardware not included in packaging:Base plate1x MIB-SBH2174675Threaded rods cut to particular length4x AM16x1000 8.8 HDGm419104Lock washer8x LW M16 HDG plus washer2185343Nut304767 | Connector used for a perpendicular connection of MI-120 girder to flange of structural steel profiles. For flange width 165-235mm. |









Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

2/3

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-120 girders, per FEA simulation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 40.60 | 85.90 | 53.80 | 53.80 | 63.50 | 63.50 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 5.39 | 5.39 | 4.45 | 4.45 | 3.00 | 3.00 |
| nteraction | | | | | |

$$\frac{F_{xEd}}{F_{xRd}} + \frac{F_{y.Ed}}{F_{v.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{xEd}}{M_{xRd}} + \frac{M_{y.Ed}}{M_{v.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \le 1$$

2. Welds - per analytical calculation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 316.42 | 316.42 | 81.16 | 81.16 | 100.68 | 100.68 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 9.16 | 9.16 | 5.18 | 5.18 | 6.04 | 6.04 |

Interaction:

$$\frac{F_{xEd}}{F_{xRd}} + \frac{F_{yEd}}{F_{yRd}} + \frac{F_{zEd}}{F_{zRd}} + \frac{M_{xEd}}{M_{xRd}} + \frac{M_{yEd}}{M_{yRd}} + \frac{M_{zEd}}{M_{zRd}} \leq 1$$

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D



| +F | Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|----------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 1: | 58.80 | Not decisive | 20.01 | 20.01 | 20.01 | 20.01 |
| +N [} | ∕lx,Rd kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 2 | 2.06 | 2.06 | 11.20 | 11.20 | 9.77 | 9.77 |

Interaction: Normal force interaction:

The eccentricity ey and ez between the point of force transfer channel / connector and baseplate, which generates an additional bending moment on the system, must be taken into account in the interaction formula.

$$\frac{F_{xEd}}{F_{xRd}} + \frac{F_{yEd}*ey}{\dot{M}_{zRd}} + \frac{F_{zEd}*ez}{\dot{M}_{yRd}} + \frac{M_{yEd}}{M_{yRd}} + \frac{M_{zEd}}{M_{zRd}} \le 1$$

Shear force interaction:

- Shear Interaction Equation is <u>only</u> valid for TENSILE $F_{x, Ed}$ loads ($F_{x, Ed} > 0$). Equation is <u>not</u> valid for compressive $F_{x, Ed}$ loads ($F_{x, Ed} < 0$). - For Shear interaction, user must ADDITIONALLY verify: $F_{x, Ed} / F_{x, Rd} < 1$.

$$\sqrt{\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)} \le 1$$

Installation Technical Manual - Technical Data - MI system



| Designation MIC-S120-CH | | | m number 4820 |
|----------------------------|----------|------------------------------|------------------|
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |
| Waight | | | |

Weight: 11024 g incl. components

Description:

Hilti Hot-dipped galvanized baseplate connector, used for connecting a MI-120 girder to a steel beam using M16 mounting hardware. Four slotted holes enable fine tuning of baseplate position, and girder is connected using beam clamps or threaded rod. Comes in different plate sizes to fit various steel beam sizes.

| Material properties | | | | |
|--|------------------------------|------------------------------|-----------------------------|----------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Values for Modulus of Elasticity and Shear Modul | us are according to EN 1993- | 1-1 and used for all Eurocod | e calculations | |

Instruction For Use:

For both loading cases:



For clamped loading case

For boxed loading case (not attached to the packaging)



Installation Technical Manual - Technical Data - MI system





| Possible loadi | ng cases | |
|----------------|----------|--|
| Clamped | Boxed | |
| | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.
 Simplified drawing:



Installation Technical Manual - Technical Data - MI system





| Loading case: Clamped | Combinations covered by loading case | | |
|---|--|--|--|
| Bill of Material for this loading case:1x MIC-S120-CH2174670Hardware not included in packaging: Beam clamps 4x MI-SGC M16387398 | Connector used for a perpendicular connection of MI-120 girder to flange of structural steel profiles. For flange width 235-300mm. | | |

Recommended loading capacity - simplified for most common applications





| ±Fx,rec. | ±Fy,rec. | ±Fz,rec. |
|----------|----------|----------|
| [kN] | [kN] | [kN] |
| 18.67 | 6.87 | 6.87 |

directions, use design values and their corresponding interaction formulas.



Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

2/3

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-120 girders, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 28.00 | 118.82 | 53.80 | 53.80 | 58.10 | 58.10 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNcm] | [kNcm] | [kNcm] | [kNcm] | [kNcm] | [kNcm] |
| 5.39 | 5.39 | 4.07 | 4.07 | 3.00 | 3.00 |

Interaction:

$$\frac{F_{xEd}}{F_{xRd}} + \frac{F_{yEd}}{F_{vRd}} + \frac{F_{zEd}}{F_{zRd}} + \frac{M_{xEd}}{M_{xRd}} + \frac{M_{yEd}}{M_{vRd}} + \frac{M_{zEd}}{M_{zRd}} \le 1$$

2. Welds - per analytical calculation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 316.42 | 316.42 | 81.16 | 81.16 | 100.68 | 100.68 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNcm] | [kNcm] | [kNcm] | [kNcm] | [kNcm] | [kNcm] |
| 9.16 | 9.16 | 5.18 | 5.18 | 6.04 | 6.04 |

Interaction:

$$\frac{F_{xEd}}{F_{xRd}} + \frac{F_{y}Ed}{F_{v}Rd} + \frac{F_{z}Ed}{F_{z}Rd} + \frac{M_{xEd}}{M_{xRd}} + \frac{M_{y}Ed}{M_{v}Rd} + \frac{M_{z}Ed}{M_{z}Rd} \leq 1$$

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

3. Beam Clamps - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 102.40 | Not decisive | 10.31 | 10.31 | 10.31 | 10.31 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 1.41 | 1.41 | 7.37 | 7.37 | 8.45 | 8.45 |

Interaction:

Normal force interaction:

The eccentricity ey and ez between the point of force transfer channel / connector and baseplate, which generates an additional bending moment on the system, must be taken into account in the interaction formula.

$$\frac{F_{xEd}}{F_{xRd}} + \frac{F_{vEd} * ey}{\dot{M}_{zRd}} + \frac{F_{zEd} * ez}{\dot{M}_{yRd}} + \frac{M_{vEd}}{M_{yRd}} + \frac{M_{zEd}}{M_{yRd}} \le 1$$

Shear force interaction:

- Shear Interaction Equation is <u>only</u> valid for TENSILE $F_{x, Ed}$ loads ($F_{x, Ed} > 0$). Equation is <u>not</u> valid for

$$\int_{V}^{F} \left(\frac{\sigma \operatorname{Shear} \operatorname{integraduon}_{x, Ed}}{F_{y, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}}\right)} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \operatorname{integraduon}_{x, Rd}}{F_{z, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}}\right)} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \operatorname{integraduon}_{x, Rd}}{F_{z, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}}\right)} \right)^{+} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \operatorname{integraduon}_{x, Rd}}{F_{z, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}}\right)} \right)^{+} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \operatorname{integraduon}_{x, Rd}}{F_{z, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}}\right)} \right)^{+} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \operatorname{integraduon}_{x, Rd}}{F_{z, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}}\right)} \right)^{+} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \operatorname{integraduon}_{x, Rd}}{F_{z, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}}\right)} \right)^{+} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \operatorname{integraduon}_{x, Rd}}{F_{z, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}}\right)} \right)^{+} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \operatorname{integraduon}_{x, Rd}}{F_{z, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}}\right)} \right)^{+} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \operatorname{integraduon}_{x, Rd}}{F_{z, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}}\right)} \right)^{+} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \operatorname{integraduon}_{x, Rd}}{F_{z, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}}\right)} \right)^{+} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \operatorname{integraduon}_{x, Rd}}{F_{z, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}}\right)} \right)^{+} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \operatorname{integraduon}_{x, Rd}}{F_{z, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}}\right)} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \operatorname{integraduon}_{x, Rd}}{F_{z, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}}\right)} \right)^{+} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \operatorname{integraduon}_{x, Rd}}{F_{z, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}}\right)} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \operatorname{Shear} \operatorname{Shear} \left(1 - \frac{F_{x, Rd}}{F_{x, Rd}}\right)^{+} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \operatorname{Shear} \left(1 - \frac{F_{x, Rd}}{F_{x, Rd}}\right)^{+} \left(1 - \frac{F_{x, Rd}}{F_{x, Rd}}\right)^{+} \right)^{+} \left(\frac{\sigma \operatorname{Shear} \left(1 - \frac{F_{x, Rd}}{F_{x, Rd}}\right)^{+} \left(1 - \frac{F_{x, Rd}}{F_{x, Rd}}\right)^{+} \right)^{+} \left(1 - \frac{F_{x, Rd}}{F_{x, Rd}}\right)^{+} \left(1 - \frac{F_{x,$$

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MIC-S120-CH Base Material Connector - Steel



| 5 | |
|---|--|
| Bill of Material for this loading case:1x MIC-S120-CH2174670Hardware not included in packaging:Base plate1x MIB-SCH2174676Threaded rods cut to particular length4x AM16x1000 8.8 HDGm419104Lock washer8x LW M16 HDG plus washer2185343Nut304767 | Connector used for a perpendicular connection of MI-120 girder to flange of structural steel profiles. For flange width 235-300mm. |

Recommended loading capacity - simplified for most common applications





Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

2/3

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector, hardware and affected portion of MI-120 girders, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 26.50 | 55.30 | 53.80 | 53.80 | 58.10 | 58.10 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 5.39 | 5.39 | 4.07 | 4.07 | 3.00 | 3.00 |

Interaction:

```
\frac{F_{\mathbf{x}\mathbf{Ed}}}{F_{\mathbf{x}\mathbf{Rd}}} + \frac{F_{\mathbf{y}}\underline{Ed}}{F_{\mathbf{y}}\underline{Rd}} + \frac{F_{\mathbf{z}}\underline{Ed}}{F_{\mathbf{z}}\underline{Rd}} + \frac{M_{\mathbf{x}}\underline{Ed}}{M_{\mathbf{x}}\underline{Rd}} + \frac{M_{\mathbf{y}}\underline{Ed}}{M_{\mathbf{y}}\underline{Rd}} + \frac{M_{\mathbf{z}}\underline{Ed}}{M_{\mathbf{z}}\underline{Rd}} \leq 1
```

2. Welds - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] | |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--|
| 316.42 | 316.42 | 81.16 | 81.16 | 100.68 | 100.68 | |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] | |
| 9.16 | 9.16 | 5.18 | 5.18 | 6.04 | 6.04 | |
| Interaction: | | | | | | |

$$\frac{\frac{1}{2} \frac{xEd}{F_xRd}}{F_xRd} + \frac{\frac{1}{2} \frac{xEd}{F_zRd}}{F_zRd} + \frac{\frac{M_xEd}{M_xRd}}{M_xRd} + \frac{\frac{M_yEd}{M_zRd}}{M_yRd} + \frac{\frac{M_zEd}{M_zRd}}{M_zRd} \le 1$$

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 150.80 | Not decisive | 19.00 | 19.00 | 19.00 | 19.00 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 2.57 | 2.57 | 10.86 | 10.86 | 12.29 | 12.29 |

Interaction: Normal force interaction:

The eccentricity ey and ez between the point of force transfer channel / connector and baseplate, which generates an additional bending moment on the system, must be taken into account in the interaction formula.

$$\frac{F_{xEd}}{F_{xRd}} + \frac{F_{yEd} * ey}{\dot{M}_{zRd}} + \frac{F_{zEd} * ez}{\dot{M}_{yRd}} + \frac{M_{yEd}}{M_{yRd}} + \frac{M_{zEd}}{M_{zRd}} \le 1$$

Shear force interaction:

- Shear Interaction Equation is <u>only</u> valid for TENSILE $F_{x, Ed}$ loads ($F_{x, Ed} > 0$). Equation is <u>not</u> valid for compressive $F_{x, Ed}$ loads ($F_{x, Ed} < 0$). - For Shear interaction, user must ADDITIONALLY verify: $F_{x, Ed} / F_{x, Rd} < 1$.

$$\sqrt{\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2} + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)} \le 1$$

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| Designation | | lte | m number |
|-----------------------|----------|------------------------------|----------|
| MIC-SA-MAH | | 21 | 74671 |
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |
| Waight: | | | |

Weight: 6701g incl. components

Description:

Hilti Hot-dipped galvanized baseplate connector, used for anchoring a MI-90 girder to a steel beam at an angle, usually when it's used as a brace for another girder. Four oblong anchor holes enable fine tuning of baseplate position, and girder is connected using one bolt through a hole, which enables various angles. For use with **M16** hardware.

| Material properties | | | | | |
|--|------------------------------|----------------------------|-----------------------------|----------------------------|--|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus | |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ | |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ | |
| Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations | | | | | |

Instruction For Use:

For both loading cases:



For clamped loading case For boxed loading case (not attached to the packaging)



Installation Technical Manual - Technical Data - MI system





| Possible loadi | ng cases | |
|----------------|----------|--|
| Clamped | Boxed | |
| | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**



Installation Technical Manual - Technical Data - MI system





| Loading case: Clamped | Combinations covered by loading case | | |
|---|--|--|--|
| Bill of Material for this loading case: MIC-SA-MAH 2174671 Hardware not included in packaging: Beam clamps 4x MI-SGC M16 387398 | Connector used for an angled connection of MI-90 to structural steel profiles (bracing). For flange width 75-165mm. | | |

Recommended loading capacity - simplified for most common applications





Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector and hardware, per FEA simulation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 16.70 | 16.70 | 6.60 | 6.60 | 16.70 | 16.70 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 0.70 | 0.70 | 0.00 | 0.00 | 0.00 | 0.00 |

Note: Design Strength values for girder Torsion about the α x-axis (M_{α x}) are valid for any bracing angle.

Values include verification of hexagonal bolt

Interaction:

Due to the fact, that the same resistance values as for MIC-CU-MA are decisive, the same interaction formulation can be used:

$$\left(\frac{F_{x Ed \alpha}}{F_{x Rd}^{'}}\right)^{2} + \left(\frac{F_{z Ed \alpha}}{F_{z Rd}^{'}}\right)^{2} + \frac{F_{v Ed}}{F_{y Rd}^{'}} + \frac{M_{x Ed}}{M_{x Rd}^{'}} \leq 1$$

Use of $F_{\alpha x}$: In case only the force along the brace axis (αx) is known, determinate load components as follows:

 $F_{x, Ed, \alpha} = F_{\alpha} \times \cos (\alpha)$ $F_{z, Ed, \alpha} = F_{\alpha} \times \sin (\alpha)$



Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

Installation Technical Manual - Technical Data - MI system



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MIC-SA-MAH Base Material Connector - Steel

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

2. Welds - per analytical calculation

| y x | +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|--|---|--|--|--|--|
| | 325.83 | 325.83 | 11.97 | 11.97 | 47.45 | 47.45 |
| | +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| atter and the | 2.30 | 2.30 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Note: Desigi are v Values inclu | n Strength v alid for any de verificati | values for gi bracing ang on of hexag | rder Torsion le. onal bolt | about the ι | xx-axis (M _{ax}) |
| М | Interaction: | _ | _ | _ | | |
| F _{ax} | <u> </u> | $\frac{F_{x E d \alpha}}{F_{x R d}} +$ | $\frac{F_{z E d \alpha}}{F_{z R d}}$ | + $\frac{F_{vEd}}{F_{yRd}}$ | + $\frac{M_{x Ec}}{M_{x Rc}}$ | ¹ ≤ 1 |
| | Use of $F_{\alpha x}$: I determinate | n case only load compo | the force al onents as fo | ong the bra llows: | ce axis (αx) | is known, |
| | $F_{z, Ed, \alpha} = F_{\alpha}$ $F_{z, Ed, \alpha} = F_{\alpha}$ $M_{x, Ed} = M_{ax}$ | $c \cos(\alpha)$ $c \sin(\alpha)$ | | | | |
| | | | | | F _{x,e} | d, α F _α |
| | | | | | | F _{x, Ed, α} |
| | Important no mounted mu connector re | ote: The res ist be check esistances th | istance of si ted appropri ne steel gird | teel girder o ately by the ler is consid | n which con client. For ered to be r | nector MIC-SA-MAI determination of igid. |



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 102.40 | Not decisive | 10.31 | 10.31 | 10.31 | 10.31 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 0.84 | 0.84 | 6.66 | 6.66 | 3.33 | 3.33 |

Normal force interaction:

The eccentricity e_y and e_z between the point of force transfer channel / connector and baseplate, which generates an additional bending moment on the system , must be taken into account in the interaction formula.

$$\frac{F_{x,Ed,\alpha}}{F_{x,Rd}} + \frac{F_{y,Ed} \times ey}{M_{z,Rd}} + \frac{F_{z,Ed,\alpha} \times ez}{M_{y,Rd}} + \frac{M_{z,Ed}}{M_{z,Rd}} \le 1$$

with $e_y = e_z = 0.070$ m

Shear force interaction:

Shear force interaction for +Fx (tensile normal force):

$$\left| \left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \le 1$$

Shear force interaction for -Fx (compressive normal force):

$$\left| \left(\frac{F_{y \ Ed}}{F_{y, \ Rd}} \right)^2 + \left(\frac{F_{z \ Ed}}{F_{z, \ Rd}} \right)^2 + \frac{M_{x \ Ed}}{M_{x, \ Rd}} \le 1 \right|$$

Note: Due to the fact, that depending on the inclination of the channel, the acting torsional moment Mαx can either generate shear or tension, it will be considered in both interactions.

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

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| Bill of Material for this loading case: 1x MIC-SA-MAH 2174671 Hardware not included in packaging: Base plate 1x MIB-SAH 2174674 Threaded rods cut to particular length 4x AM16x1000 8.8 HDGm 419104 Lock washer 8x LW M16 HDG plus washer 2185343 Nut 8x M16-F nut 304767Connector used for an angled connection of MI-90 to structural steel profiles (bracing). For flange width 75-165mm.Connector used for an angled connection of MI-90 to structural steel profiles (bracing). For flange width 75-165mm. | Loading case: Boxed | Combinations covered by loading case | | |
|---|---|--|--|--|
| | Bill of Material for this loading case: 1x MIC-SA-MAH 2174671 Hardware not included in packaging: Base plate 1x MIB-SAH 2174674 Threaded rods cut to particular length 4x AM16x1000 8.8 HDGm 419104 Lock washer 8x LW M16 HDG plus washer 2185343 Nut 8x M16-F nut 304767 | Connector used for an angled connection of MI-90 to structural steel profiles (bracing). For flange width 75-165mm. | | |

Recommended loading capacity - simplified for most common applications





Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector and hardware, per FEA simulation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 16.70 | 16.70 | 6.60 | 6.60 | 16.70 | 16.70 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 0.70 | 0.70 | 0.00 | 0.00 | 0.00 | 0.00 |

Note: Design Strength values for girder Torsion about the α x-axis (M_{α x}) are valid for any bracing angle.

Values include verification of hexagonal bolt

Interaction:

Due to the fact, that the same resistance values as for MIC-CU-MA are decisive, the same interaction formulation can be used:

$$\left(\frac{F_{x E d \alpha}}{F_{x R d}^{'}}\right)^{2} + \left(\frac{F_{z E d \alpha}}{F_{z R d}^{'}}\right)^{2} + \frac{F_{v E d}}{F_{y R d}^{'}} + \frac{M_{x E d}}{M_{x R d}^{'}} \leq 1$$

Use of $F_{\alpha x}$: In case only the force along the brace axis (αx) is known, determinate load components as follows:

 $F_{x, Ed, \alpha} = F_{\alpha} \times \cos (\alpha)$ $F_{z, Ed, \alpha} = F_{\alpha} \times \sin (\alpha)$



Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

2. Welds - per analytical calculation

| +Fx,F | Rd -Fx,F | d +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|-------|----------|-----------|--------|--------|--------|
| [kN] | [kN] | [[kN] | [kN] | [kN] | [kN] |
| 325.8 | 3 325.8 | 33 11.97 | 11.97 | 47.45 | 47.45 |
| +Mx,F | Rd -Mx,F | Rd +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm | ı] [kNm | 1] [kNm] | [kNm] | [kNm] | [kNm] |
| 2.30 | 2.30 | 0.00 | 0.00 | 0.00 | 0.00 |

Note: Design Strength values for girder Torsion about the α x-axis (M_{α x}) are valid for any bracing angle.

Values include verification of hexagonal bolt

Interaction:

$$\frac{F_{x E d \alpha}}{F_{x R d}} + \frac{F_{z E d \alpha}}{F_{z R d}} + \frac{F_{y E d}}{F_{y R d}} + \frac{M_{x E d}}{M_{x R d}} \le 1$$

Use of $F_{\alpha x}$: In case only the force along the brace axis (αx) is known, determinate load components as follows:

 $\begin{aligned} F_{x, Ed, \alpha} &= F_{\alpha} \times \cos \left(\alpha \right) \\ Fz'_{Ed, \alpha} &= F_{\alpha} \times \sin \left(\alpha \right) \\ M'_{x, Ed} &= M_{ax} \end{aligned}$

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.

Design loading capacity - 3D

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Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.





| Designation | | lte | m number |
|-----------------------|----------|------------------------------|----------|
| MIC-SB-MAH | | 21 | 74672 |
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |
| | | | |

Weight:

8154 g incl. components

Description:

Hilti Hot-dipped galvanized baseplate connector, used for anchoring a MI-90 girder to a steel beam at an angle, usually when it's used as a brace for another girder. Four oblong anchor holes enable fine tuning of baseplate position, and girder is connected using one bolt through a hole, which enables various angles. For use with **M16** hardware.

| Material properties | | | | |
|---|------------------------------|------------------------------|-----------------------------|--------------------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | $\mathbf{G} = 80769 \frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Values for Modulus of Elasticity and Shear Modul | us are according to EN 1993. | 1-1 and used for all Eurocod | e calculations | |

Instruction For Use:

For both loading cases:



For clamped loading case For boxed loading case (not attached to the packaging)



Installation Technical Manual - Technical Data - MI system





| Possible loading cases | | | | |
|------------------------|-------|--|--|--|
| Clamped | Boxed | | | |
| | | | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**



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| Loading case: Clamped | Combinations covered by loading case | | |
|--|--|--|--|
| Bill of Material for this loading case: MIC-SB-MAH 2174672 Hardware not included in packaging: Beam elempte | Connector used for an angled connection of MI-90 to structural steel profiles | | |
| 4x MI-SGC M16 387398 | (bracing). For flange width 165-235mm. | | |







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Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector and hardware, per FEA simulation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 16.70 | 16.70 | 6.60 | 6.60 | 16.70 | 16.70 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 0.70 | 0.70 | 0.00 | 0.00 | 0.00 | 0.00 |

Note: Design Strength values for girder Torsion about the α x-axis (M_{α x}) are valid for any bracing angle.

Values include verification of hexagonal bolt

Interaction:

Due to the fact, that the same resistance values as for MIC-CU-MA are decisive, the same interaction formulation can be used:

$$\left(\frac{F_{x Ed \alpha}}{F_{x Rd}}\right)^{2} + \left(\frac{F_{z Ed \alpha}}{F_{z Rd}}\right)^{2} + \frac{F_{v Ed}}{F_{y Rd}} + \frac{M_{x Ed}}{M_{x Rd}} \le 1$$

Use of $F_{\alpha x}$: In case only the force along the brace axis (αx) is known, determinate load components as follows:

 $F_{x, Ed, \alpha} = F_{\alpha} \times \cos (\alpha)$ $F_{z, Ed, \alpha} = F_{\alpha} \times \sin (\alpha)$



Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

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MIC-SB-MAH Base Material Connector - Steel

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

2. Welds - per analytical calculation

| y x | +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|---------------|---|---|--|--|--|---|
| | 325.83 | 325.83 | 11.97 | 11.97 | 47.45 | 47.45 |
| | +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| atter and the | 2.30 | 2.30 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Note: Desigi are v Values inclu | n Strength v alid for any de verificati | values for gi bracing ang on of hexag | rder Torsion le. onal bolt | about the a | xx-axis (M _{ax}) |
| M | Interaction: | | | | | |
| Fux | <u> </u> | $\frac{F_{x E d \alpha}}{F_{x R d}} +$ | $\frac{F_{z E d \alpha}}{F_{z R d}}$ | + $\frac{F_{vEd}}{F_{yRd}}$ | + $\frac{M_{x Ec}}{M_{x Rc}}$ | [⊥] ≤ 1 |
| | Use of $F_{\alpha x}$: I determinate | , n case only load compo | , the force al onents as fo | ong the bra llows: | , ce axis (αx) | is known, |
| | $F_{x, Ed, \alpha} = F_{\alpha}$ $F_{z', Ed, \alpha} = F_{\alpha}$ $M'_{x, C'}$ | $(\cos (\alpha))$ $(\sin (\alpha))$ | | | | |
| | $r x_{,Ld} = r x_{,dx}$ | | | | F _{x,} | ^α , α F _α |
| | | | | | | * x, Εα, α |
| | Important no mounted mu connector re | ote: The res ist be check esistances tl | istance of st and appropri ne steel gird | teel girder o ately by the ler is consid | n which con client. For c ered to be r | nector MIC-SA-M, determination of igid. |



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.

Design loading capacity - 3D

Summary of design loads*

 $F_{x, Ed, \alpha} = F_{\alpha} \times \cos (\alpha)$ $F_{z, Ed, \alpha} = F_{\alpha} \times \sin (\alpha)$

$$\begin{split} & M_{x, Ed} = M_{\alpha x} \, \mathbf{x} \, \cos \, (\alpha) \\ & M_{z, Ed} = M_{\alpha x} \, \mathbf{x} \, \sin \, (\alpha) \end{split}$$

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 102.40 | Not decisive | 10.31 | 10.31 | 10.31 | 10.31 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 1.12 | 1.12 | 6.66 | 6.66 | 6.66 | 6.66 |

Normal force interaction:

The eccentricity e_y and e_z between the point of force transfer channel / connector and baseplate, which generates an additional bending moment on the system , must be taken into account in the interaction formula.

$$\frac{F_{x,Ed,\alpha}}{F_{x,Rd}} + \frac{F_{y,Ed} \times ey}{M_{z,Rd}} + \frac{F_{z,Ed,\alpha} \times ez}{M_{y,Rd}} + \frac{M_{z,Ed}}{M_{z,Rd}} \le 1$$

with $e_y = e_z = 0.070$ m

Shear force interaction:

Shear force interaction for +Fx (tensile normal force):

$$\left| \left(\frac{F_{y, Ed}}{F_{y, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}} \right)} \right)^2 + \left(\frac{F_{z, Ed}}{F_{z, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}} \right)} \right)^2 + \frac{M_{x, Ed}}{M_{x, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}} \right)} \le 1$$

Shear force interaction for -Fx (compressive normal force):

$$\left| \left(\frac{F_{y \ Ed}}{F_{y \ Rd}} \right)^2 + \left(\frac{F_{z \ Ed}}{F_{z \ Rd}} \right)^2 + \frac{M_{x \ Ed}}{M_{x \ Rd}} \le 1 \right|$$

Note: Due to the fact, that depending on the inclination of the channel, the acting torsional moment Mαx can either generate shear or tension, it will be considered in both interactions.

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

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4.40

90°

60°

MIC-SB-MAH Base Material Connector - Steel



| Bill of Material for this loading case:Connector used for an angled connection of MI-90 to structural steel profiles (bracing).Connector used for an angled connection of MI-90 to s | Loading case: Boxed | Combinations covered by loading case | | |
|--|--|---|--|--|
| | Bill of Material for this loading case:1x MIC-SB-MAH2174672Hardware not included in packaging:Base plate1x MIB-SBH2174675Threaded rods cut to particular length4x AM16x1000 8.8 HDGm419104Lock washer8x LW M16 HDG plus washer8x M16-F nut304767 | Connector used for an angled connection of MI-90 to structural steel profiles (bracing). For flange width 165-235mm. | | |









Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector and hardware, per FEA simulation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 16.70 | 16.70 | 6.60 | 6.60 | 16.70 | 16.70 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 0.70 | 0.70 | 0.00 | 0.00 | 0.00 | 0.00 |

Note: Design Strength values for girder Torsion about the α x-axis (M_{α x}) are valid for any bracing angle.

Values include verification of hexagonal bolt

Interaction:

Due to the fact, that the same resistance values as for MIC-CU-MA are decisive, the same interaction formulation can be used:

$$\left(\frac{F_{x E d \alpha}}{F_{x R d}^{'}}\right)^{2} + \left(\frac{F_{z E d \alpha}}{F_{z R d}^{'}}\right)^{2} + \frac{F_{v E d}}{F_{y R d}^{'}} + \frac{M_{x E d}}{M_{x R d}^{'}} \leq 1$$

Use of $F_{\alpha x}$: In case only the force along the brace axis (αx) is known, determinate load components as follows:

 $F_{x, Ed, \alpha} = F_{\alpha} \times \cos (\alpha)$ $F_{z, Ed, \alpha} = F_{\alpha} \times \sin (\alpha)$



Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

2. Welds - per analytical calculation

| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 325.83 | 325.83 | 11.97 | 11.97 | 47.45 | 47.45 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 2.30 | 2.30 | 0.00 | 0.00 | 15.80 | 153.80 |

Note: Design Strength values for girder Torsion about the α x-axis (M_{α x}) are valid for any bracing angle.

Values include verification of hexagonal bolt

Interaction:

$$\frac{F_{x E d \alpha}}{F_{x R d}} + \frac{F_{z E d \alpha}}{F_{z R d}} + \frac{F_{y E d}}{F_{y R d}} + \frac{M_{x E d}}{M_{x R d}} \le 1$$

Use of $F_{\alpha x}$: In case only the force along the brace axis (αx) is known, determinate load components as follows:

 $\begin{aligned} F_{x, Ed, \alpha} &= F_{\alpha} \times \cos \left(\alpha \right) \\ Fz'_{Ed, \alpha} &= F_{\alpha} \times \sin \left(\alpha \right) \\ M'_{x, Ed} &= M_{ax} \end{aligned}$

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

Installation Technical Manual - Technical Data - MI system



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MIC-SB-MAH Base Material Connector - Steel

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.





| Designation | | lte | m number |
|-----------------------|----------|------------------------------|----------|
| MIC-SC-MAH | | 21 | 74673 |
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Connector, Plate | ISO 1461 | 55 | |
| Bolt; Nut | ISO 1461 | 40; 45 | |
| Weight: | | | |

8154 g incl. components

Description:

Hilti Hot-dipped galvanized baseplate connector, used for anchoring a MI-90 girder to a steel beam at an angle, usually when it's used as a brace for another girder. Four oblong anchor holes enable fine tuning of baseplate position, and girder is connected using one bolt through a hole, which enables various angles. For use with **M16** hardware.

| Material properties | | | | |
|---|------------------------------|------------------------------|-----------------------------|-----------------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Connector, Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Values for Modulus of Elasticity and Shear Modul | us are according to EN 1993- | 1-1 and used for all Eurocod | e calculations | |

Instruction For Use:

For both loading cases:



For clamped loading case [For boxed loading case (not attached to the packaging)]



Installation Technical Manual - Technical Data - MI system





| Possible loading cases | | | |
|------------------------|-------|--|--|
| Clamped | Boxed | | |
| | | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**



Installation Technical Manual - Technical Data - MI system





| Loading case: Clamped | Combinations covered by loading case |
|---|---|
| Bill of Material for this loading case: MIC-SC-MAH 2174673 Hardware not included in packaging: Beam clamps 4x MI-SGC M16 387398 | Connector used for an angled connection of MI-90 to structural steel profiles (bracing). For flange width 235-300mm. |







Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector and hardware, per FEA simulation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 16.70 | 16.70 | 6.60 | 6.60 | 16.70 | 16.70 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 0.70 | 0.70 | 0.00 | 0.00 | 0.00 | 0.00 |

Note: Design Strength values for girder Torsion about the α x-axis (M_{α x}) are valid for any bracing angle.

Values include verification of hexagonal bolt

Interaction:

Due to the fact, that the same resistance values as for MIC-CU-MA are decisive, the same interaction formulation can be used:

$$\left(\frac{F_{x Ed \alpha}}{F_{x Rd}}\right)^2 + \left(\frac{F_{z Ed \alpha}}{F_{z Rd}}\right)^2 + \frac{F_{v Ed}}{F_{y Rd}} + \frac{M_{x Ed}}{M_{x Rd}} \le 1$$

Use of $F_{\alpha x}$: In case only the force along the brace axis (αx) is known, determinate load components as follows:

 $F_{x, Ed, \alpha} = F_{\alpha} \times \cos (\alpha)$ $F_{z, Ed, \alpha} = F_{\alpha} \times \sin (\alpha)$



Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

Installation Technical Manual - Technical Data - MI system



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MIC-SC-MAH Base Material Connector - Steel

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

2. Welds - per analytical calculation

| | +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|--|--|---|---|--|--|---|
| | 325.83 | 325.83 | 11.97 | 11.97 | 47.45 | 47.45 |
| and the second sec | +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| and a state of the | 2.30 | 2.30 | 0.00 | 0.00 | 15.80 | 15.80 |
| | Note: Desigi are v Values inclu | n Strength v alid for any de verificati | alues for gi bracing ang on of hexag | rder Torsion le. onal bolt | about the a | xx-axis (M _{ax}) |
| | Interaction: | | | | | |
| | <u> </u> | $F_{x_{Rd}}^{\underline{x} \in d \alpha} +$ | $\frac{F_{z E d \alpha}}{F_{z R d}}$ | + $\frac{F_{v Ed}}{F_{y Rd}}$ | + $\frac{M_{x Ec}}{M_{x Rc}}$ | ⁴ ≤ 1 |
| | Use of $F_{\alpha x}$: I determinate | n case only load compo | the force al | ong the bra llows: | ce axis (αx) | is known, |
| | $F_{x, Ed, \alpha} = F_{\alpha}$ $F_{z, Ed, \alpha} = F_{\alpha}$ $M_{x, Ed} = M_{\alpha x}$ | c cos (α) c sin (α) | | | | |
| | . <u>,,,,,,</u> ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | | | | F _{x,d} | a, α F _α |
| | | | | | | F _{x, Ed, α} |
| | Important no mounted mu connector re | ote: The res ist be check esistances th | istance of si ed appropri ne steel gird | teel girder o ately by the ler is consid | n which con client. For ered to be r | nector MIC-SA-MA determination of igid. |



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.

Design loading capacity - 3D

Summary of design loads*

 $F_{x, Ed, \alpha} = F_{\alpha} \times \cos (\alpha)$ $F_{z, Ed, \alpha} = F_{\alpha} \times \sin (\alpha)$

$$\begin{split} & M_{x, Ed} = M_{\alpha x} \, \mathbf{x} \, \cos \, (\alpha) \\ & M_{z, Ed} = M_{\alpha x} \, \mathbf{x} \, \sin \, (\alpha) \end{split}$$

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 102.40 | Not decisive | 10.31 | 10.31 | 10.31 | 10.31 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 1.41 | 1.41 | 6.66 | 6.66 | 8.70 | 8.70 |

Normal force interaction:

The eccentricity e_y and e_z between the point of force transfer channel / connector and baseplate, which generates an additional bending moment on the system , must be taken into account in the interaction formula.

$$\frac{F_{x,Ed,\alpha}}{F_{x,Rd}} + \frac{F_{y,Ed} \times ey}{M_{z,Rd}} + \frac{F_{z,Ed,\alpha} \times ez}{M_{y,Rd}} + \frac{M_{z,Ed}}{M_{z,Rd}} \le 1$$

with $e_y = e_z = 0.070$ m

Shear force interaction:

Shear force interaction for +Fx (tensile normal force):

$$\left| \left(\frac{F_{y, Ed}}{F_{y, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}} \right)} \right)^2 + \left(\frac{F_{z, Ed}}{F_{z, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}} \right)} \right)^2 + \frac{M_{x, Ed}}{M_{x, Rd} \times \left(1 - \frac{F_{x, Ed}}{F_{x, Rd}} \right)} \le 1$$

Shear force interaction for -Fx (compressive normal force):

$$\left| \left(\frac{F_{y \ Ed}}{F_{y \ Rd}} \right)^2 + \left(\frac{F_{z \ Ed}}{F_{z \ Rd}} \right)^2 + \frac{M_{x \ Ed}}{M_{x \ Rd}} \le 1 \right|$$

Note: Due to the fact, that depending on the inclination of the channel, the acting torsional moment Mαx can either generate shear or tension, it will be considered in both interactions.

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

Installation Technical Manual - Technical Data - MI system



MIC-SC-MAH Base Material Connector - Steel



| Bill of Material for this loading case:1x MIC-SC-MAH2174673Hardware not included in packaging:Base plate1x MIB-SCH2174676Threaded rods cut to particular length4x AM16x1000 8.8 HDGm419104Lock washer8x LW M16 HDG plus washer2185343Nut8x M16-F nut304767 | Loading case: Boxed | Combinations covered by loading case |
|--|--|---|
| | Bill of Material for this loading case:1x MIC-SC-MAH2174673Hardware not included in packaging:Base plate1x MIB-SCH2174676Threaded rods cut to particular length4x AM16x1000 8.8 HDGm419104Lock washer8x LW M16 HDG plus washer2185343Nut8x M16-F nut304767 | Connector used for an angled connection of MI-90 to structural steel profiles (bracing). For flange width 235-300mm. |

Recommended loading capacity - simplified for most common applications Method y x ±Fy,rec.





Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

1. Connection system, including connector and hardware, per FEA simulation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 16.70 | 16.70 | 6.60 | 6.60 | 16.70 | 16.70 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 0.70 | 0.70 | 0.00 | 0.00 | 0.00 | 0.00 |

Note: Design Strength values for girder Torsion about the α x-axis (M_{α x}) are valid for any bracing angle.

Values include verification of hexagonal bolt

Interaction:

Due to the fact, that the same resistance values as for MIC-CU-MA are decisive, the same interaction formulation can be used:

$$\left(\frac{F_{x E d \alpha}}{F_{x R d}^{'}}\right)^{2} + \left(\frac{F_{z E d \alpha}}{F_{z R d}^{'}}\right)^{2} + \frac{F_{v E d}}{F_{y R d}^{'}} + \frac{M_{x E d}}{M_{x R d}^{'}} \leq 1$$

Use of $F_{\alpha x}$: In case only the force along the brace axis (αx) is known, determinate load components as follows:

 $F_{x, Ed, \alpha} = F_{\alpha} \times \cos (\alpha)$ $F_{z, Ed, \alpha} = F_{\alpha} \times \sin (\alpha)$



Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.

2. Welds - per analytical calculation

| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 325.83 | 325.83 | 11.97 | 11.97 | 47.45 | 47.45 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 2.30 | 2.30 | 0.00 | 0.00 | 15.80 | 15.80 |

Note: Design Strength values for girder Torsion about the α x-axis (M_{α x}) are valid for any bracing angle.

Values include verification of hexagonal bolt

Interaction:

 $\frac{F_{xEd\,\alpha}}{F_{xRd}} + \frac{F_{zEd\,\alpha}}{F_{zRd}} + \frac{F_{yEd}}{F_{yRd}} + \frac{M_{xEd}}{M_{xRd}} \le 1$

Use of $F_{\alpha x}$: In case only the force along the brace axis (αx) is known, determinate load components as follows:

 $\begin{aligned} F_{x, Ed, \alpha} &= F_{\alpha} \times \cos \left(\alpha \right) \\ Fz'_{Ed, \alpha} &= F_{\alpha} \times \sin \left(\alpha \right) \\ M'_{x, Ed} &= M_{ax} \end{aligned}$

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

Installation Technical Manual - Technical Data - MI system



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MIC-SC-MAH Base Material Connector - Steel

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.





| Designation | | Ite | m number |
|-----------------------|-----------|------------------------------|----------|
| MI-DGC 90 | | 23 | 3860 |
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (µm) | |
| Bolt; Nut | ISO 1461 | 40; 45 | |
| Clamp | ISO 1461 | 55 | |
| Beam Clamp U-bolt | ASTM A153 | 56 | |
| | | | |

Weight:

1015.6 g incl. components

Submittal text:

Hilti Hot-dipped galvanized steel beam clamp, typically used to connect a horizontal MI-90 or MIQ-90 girder to steel beam. Two U-bolts carry the girder and are connected to the clamp with saddles and nuts.

| Material properties | | | | |
|---|------------------------------|------------------------------|-----------------------------|----------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Clamp EN-GJMB-450-6 (DIN EN 1562) | $f_y = 270 \frac{N}{mm^2}$ | $f_u = 450 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Beam Clamp U-bolt 41Cr4 (DIN EN 10083-3 2007.1) | $f_y = 800 \ \frac{N}{mm^2}$ | $f_u = 1000 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:



Installation Technical Manual - Technical Data - MI system





| Possible loading cases | | | | |
|------------------------|--|--|--|--|
| Standard | | | | |
| | | | | |

Design criteria used for loading capacity

Methodology:

- Analytic calculation
- Hardware tests

Standards and codes:

| ٠ | EN 1990 | Basics of structural design | 03.2003 |
|---|-------------|---|---------|
| • | EN 1991-1-1 | Eurocode 1: Actions on structures –Part 1-1: General actions | |
| | | densities, self-weight, imposed loads for buildings | 03.2012 |
| • | EN 1993-1-1 | Eurocode 3: Design of steel structures –Part 1-1: General | |
| | | rules and rules for buildings | 03.2012 |
| • | EN 1993-1-3 | Eurocode 3: Design of steel structures –Part 1-3: General rules- | |
| | | Supplementary rules for cold-formed members and sheeting | 09.2010 |
| • | EN 1993-1-5 | Eurocode 3: Design of steel structures –Part 1-5:Plated | |
| | | structural elements | 06.2012 |
| • | EN 1993-1-8 | Eurocode 3: Design of steel structures –Part 1-8: Design | |
| | | of joints | 03.2012 |
| | | | |

Software:

- Mathcad 15.0
- Microsoft Excel

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**







| Loading case: Stand | lard | Combinations covered by loading | j case |
|---|------------------------------------|---|--------|
| BOM: Connector incl. all associa | red | Connector used for horizontal connection | |
| components MI-DGC 90 | 233860 | of structural steel profiles. | |
| Associated MI System girc MI-90 3m MI-90 6m | ers (channels) 304799 304798 | Flange thickness 3-36mm. | |

Recommended loading capacity - simplified for most common applications







Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

| - | |
|----------|--|
| Standard | |
| | |

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.



Installation Technical Manual - Technical Data - MI system



| Designation | m number | | |
|-----------------------|-----------|------------------------------|------|
| MI-DGC 120 233 | | | 3861 |
| Corrosion protection: | | | |
| Material | HDG per | Zinc thickness, min. (μm) | |
| Bolt; Nut | ISO 1461 | 40; 45 | |
| Clamp | ISO 1461 | 55 | |
| Beam Clamp U-bolt | ASTM A153 | 56 | |
| | | | |

Weight:

1041.9 g incl. components

Submittal text:

Hilti Hot-dipped galvanized steel beam clamp, typically used to connect a horizontal MI-120 girder to a steel beam. Two U-bolts carry the girder and are connected to the clamp with saddles and nuts.

| Material properties | | | | |
|---|------------------------------|-----------------------------|-----------------------------|----------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Bolt; Nut F Class 8.8 (ISO 898-1); Grade 8 (ISO 898-2) | $f_y = 640 \ \frac{N}{mm^2}$ | $f_u = 800 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Clamp EN-GJMB-450-6 (DIN EN 1562) | $f_y = 270 \ \frac{N}{mm^2}$ | $f_u = 450 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Beam Clamp U-bolt 41Cr4 (DIN EN 10083-3 2007.1) | $f_y = 800 \frac{N}{mm^2}$ | $f_u = 1000 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:



Installation Technical Manual - Technical Data - MI system





| Possible loadi | ng cases | |
|----------------|----------|--|
| Standard | | |
| | | |

Design criteria used for loading capacity

Methodology:

- Analytic calculation
- Hardware tests

Standards and codes:

| • | EN 1990 | Basics of structural design | 03.2003 |
|---|-------------|---|---------|
| • | EN 1991-1-1 | Eurocode 1: Actions on structures –Part 1-1: General actions | |
| | | densities, self-weight, imposed loads for buildings | 03.2012 |
| • | EN 1993-1-1 | Eurocode 3: Design of steel structures –Part 1-1: General | |
| | | rules and rules for buildings | 03.2012 |
| • | EN 1993-1-3 | Eurocode 3: Design of steel structures –Part 1-3: General rules- | |
| | | Supplementary rules for cold-formed members and sheeting | 09.2010 |
| • | EN 1993-1-5 | Eurocode 3: Design of steel structures –Part 1-5:Plated | |
| | | structural elements | 06.2012 |
| • | EN 1993-1-8 | Eurocode 3: Design of steel structures –Part 1-8: Design | |
| | | of joints | 03.2012 |
| | | | |

Software:

- Mathcad 15.0
- Microsoft Excel

Environmental conditions:

- indoors, outdoors
- static loads
- no fatigue loads

Simplified drawing:




MI-DGC 120 Base Material Connector - Steel



| Loading case: Stan | dard | Combinations covered by loadin | g case |
|---|-------------------------------------|--|--------|
| BOM: Connector incl. all associa components MI-DGC 120 | ated 233861 | Connector used for horizontal connection of MI-120 to the flanges of structural steel profiles. | |
| Associated MI System gir MI-120 3m MI-120 6m | ders (channels) 304800 304801 | Flange thickness 3-36mm. | |

Recommended loading capacity - simplified for most common applications







MI-DGC 120 Base Material Connector - Steel

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing.



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MIC-C90-DH-500-2000 Bracket - Concrete

| Designation MIC-C90-DH- 500 MIC-C90-DH- 750 MIC-C90-DH-1000 MIC-C90-DH-1500 MIC-C90-DH-2000 | | Ite | m number 2203572 2203573 2203574 2203575 2203576 | |
|--|----------|------------------------------|---|--|
| sion protection: | | | | |
| erial | HDG per | Zinc thickness, min. (µm) | | and the second sec |
| racket | ISO 1461 | 55 | | |
| ight: | | | | |
| C-C90-DH- 500 | 11086g | | | |
| C-C90-DH- 750 | 13473g | | | Hard |
| IC-C90-DH-1000 | 15860g | | | |
| 1IC-C90-DH-1500 | 20634g | | | |
| MIC-C90-DH-2000 | 25407g | | | |
| Submittal text: | | | | Designat |

Hilti Hot-dipped galvanized bracket used as fixed to concrete. Four oblong anchor holes enable fine tuning of baseplate position, and girder is welded on the baseplate.

| Designation | L[mm] |
|------------------|-------|
| MIC-C90-DH - 500 | 500 |
| MIC-C90-DH - 750 | 750 |
| MIC-C90-DH -1000 | 1000 |
| MIC-C90-DH -1500 | 1500 |
| MIC-C90-DH -2000 | 2000 |

| Material properties | | | | |
|---|----------------------------|----------------------------|-----------------------------|----------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Girder DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:

No IFU attached to the packaging

Respect IFU from the used anchor



| Possible loading cases | | |
|------------------------|--|--|
| Standard | | |
| | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.
 Simplified drawing:



Installation Technical Manual - Technical Data - MI system













Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

| Standard | |
|----------|--|
| | |

Design loading capacity - 3D

2/2

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm.

1. Base plate and profile of MI-90 girder, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 116.60 | 101.54 | 57.20 | 57.20 | 57.20 | 57.20 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 4.50 | 4.50 | 6.20 | 6.20 | 6.20 | 6.20 |

includes cross section resistance of steel base plate and channel Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \leq 1$

2. Welds - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|
| 285.11 | 285.11 | 116.39 | 116.39 | 116.39 | 116.39 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 9.54 | 9.54 | 6.84 | 6.84 | 6.84 | 6.84 |
| Interaction: | | | | | |
| F _{x.Ed} F _{y.Ed} F _{z.Ed} M _{x.Ed} M _{y.Ed} M _{z.Ed} | | | | | |

$\frac{1}{F_{x,Rd}} + \frac{y,Lu}{F_{y,Rd}} + \frac{z,Lu}{F_{z,Rd}} + \frac{x,Lu}{M_{x,Rd}} + \frac{y,Lu}{M_{y,Rd}} + \frac{z,Lu}{M_{z,Rd}} \le 1$

Installation Technical Manual - Technical Data - MI system



| Designation | Item number |
|------------------|-------------|
| MIC-C120-DH- 500 | 2203577 |
| MIC-C120-DH- 750 | 2203578 |
| MIC-C120-DH-1000 | 2203579 |
| MIC-C120-DH-1500 | 2203580 |
| MIC-C120-DH-2000 | 2203581 |
| | |

Corrosion protection:

| Material | HDG per | Zinc thickness, min. (µm) |
|----------|----------|------------------------------|
| Bracket | ISO 1461 | 55 |

Weight:

| MIC-C120-DH- 500 | 18528a |
|------------------|--------|
| MIC-C120-DH- 750 | 21715g |
| MIC-C120-DH-1000 | 24903g |
| MIC-C120-DH-1500 | 31278g |
| MIC-C120-DH-2000 | 37653g |

Submittal text:

Hilti Hot-dipped galvanized bracket used as fixed to concrete. Four oblong anchor holes enable fine tuning of baseplate position, and girder is welded on the baseplate.

Material propert

| Material properties | | | | |
|---|------------------------------|------------------------------|-----------------------------|--------------------------------------|
| Material | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | $\mathbf{G} = 80769 \frac{N}{mm^2}$ |
| Girder DD11 MOD (EN 10111) | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Values for Modulus of Elasticity and Shear Modul | us are according to EN 1993- | 1-1 and used for all Eurocod | e calculations | |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:

No IFU attached to the packaging

Respect IFU from the used anchor





| Designation | L[mm] |
|------------------|-------|
| MIC-C120-DH- 500 | 500 |
| MIC-C120-DH- 750 | 750 |
| MIC-C120-DH-1000 | 1000 |
| MIC-C120-DH-1500 | 1500 |
| MIC-C120-DH-2000 | 2000 |



| Possible loadi | ng cases | |
|----------------|----------|--|
| Standard | | |
| | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 16.0
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.
 Simplified drawing:



Installation Technical Manual - Technical Data - MI system













Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

| Standard | |
|----------|--|
| | |

Design loading capacity - 3D

2/2

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm..

1. Base plate and profile of MI-120 girder, per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 132.00 | 132.97 | 62.60 | 62.60 | 94.80 | 94.80 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 6.80 | 6.80 | 10.00 | 10.00 | 8.72 | 8.72 |

includes cross section resistance of steel base plate and channel Interaction:

| F _{x.Ed} | Fy.Ed | Fz.Ed | M _{x.Ed} | My.Ed | Mz.Ed |
|-------------------|-------------------|-------|---------------------|-------------------|----------------------------------|
| Fx.Rd | F _{v.Rd} | Fz.Rd | M _{x.Rd} + | M _{v.Rd} | M _{z.Rd} ^{S 1} |

| 2 | Welds - | per ana | alvtical | calculation |
|----------|---------|---------|----------|--------------|
| <u> </u> | **0100 | per un | aryticui | ourounditorr |



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 346.20 | 346.20 | 116.39 | 116.39 | 166.28 | 166.28 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 13.34 | 13.34 | 11.91 | 11.91 | 10.28 | 10.28 |

Interaction:

 $\frac{F_{x.Ed}}{F_{x.Rd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{x.Ed}}{M_{x.Rd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \le 1$



| Designation MIC-S90-AH- 500 MIC-S90-AH- 750 MIC-S90-AH-1000 MIC-S90-AH-1500 MIC-S90-AH-2000 | | lte 2 2 2 2 2 2 2 2 | em number 203582 203583 203584 203585 203586 | | B 15 155 |
|---|--|---|---|---|--|
| Material | HDG per | Zinc thickness, min. | | | 17x64 |
| Bracket | ISO 1461 | (μm) 55 | | B = 280mm | |
| Weight: MIC-S90-AH- 500 MIC-S90-AH- 750 MIC-S90-AH-1000 MIC-S90-AH-1500 MIC-S90-AH-2000 Submittal text: Hilti Hot-dipped galvaniz The fixation could be dor First principle is clamping structural steel profile. | 11773g 14160g 16546g 21320g 26094g ed bracket used ne by two differer g, using four bea | as fixed to structur nt principles. m clams clamped o | al steel profiles. on flange of the | X = 200mn Y = 140mn Hardware Designatio MIC-S90-/ MIC-S90-/ MIC-S90-/ MIC-S90-/ MIC-S90-/ | n included per connector on L[mm] AH- 500 500 AH- 750 750 AH-1000 1000 AH-1500 1500 AH-12000 2000 |
| Material properties | | | | | |
| Material Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | | Yield strength $f_y = 235 \frac{N}{mm^2}$ | Ultimate strength $f_u = 360 \frac{N}{mm^2}$ | Modulus of elasticity E = 210000 $\frac{N}{mm^2}$ | Shear modulus G = 80769 ^N / _{mm²} |
| Girder DD11 MOD (EN 10111) | and Shoor Modulus are | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |

city and She al iniouulus are according to

Instruction For Use:

No IFU attached to the packaging

For clamped loading case

For boxed loading case (not attached to the packaging)





| Possible loading cases | | | | |
|------------------------|-------|--|--|--|
| Clamped | Boxed | | | |
| | | | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 18.2
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design. **Simplified drawing:**

B Designation L[mm] MIC-S90-AH- 500 500 MIC-S90-AH- 750 750 12 MIC-S90-AH-1000 1000 MIC-S90-AH-1500 1500 MIC-S90-AH-2000 2000 B = 280mm 155 220 X = 200mm Y = 140mm Ø14 60x13

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| Loading case: Clamped | Combinations covered by loading case | | |
|---|--|--|--|
| BOM: Brackets: 1x MIC-S90-AH- 500 2203582 MIC-S90-AH- 750 2203583 MIC-S90-AH- 1000 2203584 MIC-S90-AH-1500 2203585 MIC-S90-AH-1500 2203586 MIC-S90-AH-2000 2203586 Beam clamps 387398 | Pre-fab bracket for perpendicular connection to structural steel profiles flanges. Flange width 75-165mm. | | |





Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

| Clamped | Boxed | |
|---------|-------|--|
| | | |

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm...

+Mx,Rd

[kNm]

9.54

Interaction:

-Mx,Rd

[kNm]

9.54

 $\frac{F_{xEd}}{F_{xRd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{xEd}}{M_{xRd}}$

+My,Rd

[kNm]

6.84

1. Bracket per FEA simulation



2. Welds - per analytical calculation

| 1 | +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd | | |
|---|--|-----------------|-----------------|-----------------|-----------------|-----------------|---|--|
| | [kN] | [kN] | [kN] | [kN] | [kN] | [kN] | | |
| | 95.90 | 101.54 | 57.20 | 57.20 | 57.20 | 57.20 | | |
| | +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] | | |
| | 4.50 | 4.50 | 6.08 | 6.08 | 6.08 | 6.08 | | |
| i | includes cross section resistance of steel base plate and channel Interaction: | | | | | | | |
| | $\frac{F_{\mathbf{x}}Ed}{F_{\mathbf{x}}Rd} + \frac{F_{\mathbf{y}}Ed}{F_{\mathbf{y}}Rd} + \frac{F_{\mathbf{z}}Ed}{F_{\mathbf{z}}Rd} + \frac{M_{\mathbf{x}}Ed}{M_{\mathbf{x}}Rd} + \frac{M_{\mathbf{y}}Ed}{M_{\mathbf{y}}Rd} + \frac{M_{\mathbf{z}}Ed}{M_{\mathbf{z}}Rd} \leq 1$ | | | | | | | |
| | +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] | | |
| | 285.11 | 285.11 | 116.39 | 116.39 | 116.39 | 116.39 | 1 | |

-My,Rd

[kNm]

6.84

M_{y.Ed} M_{v.Rd} +Mz,Rd

[kNm]

6.84

 $\frac{M_{z.Ed}}{1} \leq 1$

M_{z.Rd}

-Mz,Rd

[kNm]

6.84

T Z

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Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.

| Clamped | Boxed | |
|---------|-------|--|
| | | |

Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm.

3. Beam Clamps - per analytical calculation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 102.40 | Not decisive | 10.31 | 10.31 | 10.31 | 10.31 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 0.84 | 0.84 | 7.37 | 7.37 | 4.25 | 4.25 |

Interaction: Normal force interaction:

$$\frac{F_{xEd}}{F_{xRd}} + \frac{M_{yEd}}{M_{yRd}} + \frac{M_{zEd}}{M_{zRd}} \le 1$$

Shear force interaction:

$$\sqrt{\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)} \le 1$$

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

Installation Technical Manual - Technical Data - MI system



MIC-S90-AH-500-2000 Bracket - Steel



| Loading case: Boxed | Combinations covered by loading case |
|--|---|
| BOM: Brackets: 1x MIC-S90-AH- 500 2203582 MIC-S90-AH- 750 2203583 MIC-S90-AH-1000 2203584 MIC-S90-AH-1500 2203586 Base plate 174675 Threaded rods cut to particular length 4x AM16x1000 8.8 HDGm 419104 Lock washer 2185343 Nut 304767 | Pre-fab bracket for perpendicular connection to structural steel Profiles boxing it with two base plates. Flange width 75-165mm. |

| Recommended loading capacity - simplified for most common applications | | | | | | |
|---|--|--|--|--|--|--|
| Method | y x +Fx,rec. ±Fy,rec. ±Fz,rec. [kN] [kN] [kN] | | | | | |
| Yield strength | z 67.07 13.77 13.77 | | | | | |
| Permissible stress Permissible stress Permissible | ±My,rec. [kNm] | | | | | |
| Live load | 4.05 | | | | | |
| Action Resistance | These values are individual one directional maximal capacity limits. For any combinations of multiple directions, use design values and their corresponding interaction formulas. | | | | | |





Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

2/3

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm.

| 1. Bracket per FEA simulation | +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|---------------------------------------|---|---|---|---|-----------------|-----------------|
| | 100.60 | 101.54 | 57.20 | 57.20 | 57.20 | 57.20 |
| z | +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| | 4.50 | 4.50 | 6.08 | 6.08 | 6.08 | 6.08 |
| | includes cro | ess section r | resistance of | f steel base | plate and cl | nannel |
| | $\frac{F_{xEd}}{F_{xRd}} + \frac{F_{yEd}}{F_{yRd}}$ | $\frac{d}{d} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}}$ | $\frac{M_{xEd}}{M_{xRd}} + \frac{M_{y.E}}{M_{y.E}}$ | $\frac{d}{d} + \frac{M_{z.Ed}}{M_{z.Rd}} \le$ | 1 | |
| 2. Welds - per analytical calculation | +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
| | 285.11 | 285.11 | 116.39 | 116.39 | 116.39 | 116.39 |
| z z | +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| | 9.54 | 9.54 | 6.84 | 6.84 | 6.84 | 6.84 |
| | | | | | | |
| | Interaction | : | | | | |

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

3/3

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm.

3. Base plate and through bolts - per analytical calculation



| 7 | | | | | | |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
| | 164.00 | Not decisive | 20.66 | 20.66 | 20.66 | 20.66 |
| | +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| | 1.67 | 1.67 | 11.64 | 11.64 | 6.81 | 6.81 |

Interaction:

Normal force interaction:

$$\frac{F_{x Ed}}{F_{x Rd}} + \frac{M_{y Ed}}{M_{y Rd}} + \frac{M_{z Ed}}{M_{z Rd}} \le 1$$

Shear force interaction:

$$\left| \left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}} \right)} \le 1$$

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.



| Designation I MIC-S90-BH- 500 MIC-S90-BH- 750 MIC-S90-BH-1000 MIC-S90-BH-1500 MIC-S90-BH-2000 MIC-S90-BH-2000 | | | em number 2203587 2203588 2203589 2203590 2203591 | ~ | B 15 155 | | |
|---|--|--|--|---------------|--|--|--|
| Corrosion protection: | | _ , ,,, , , , | | | and the second s | 220 | |
| Material | HDG per | Zinc thickness, min. (µm) | | | | 17x64 | |
| Bracket | ISO 1461 | 55 | | В | = 350mm | l | |
| Weight: | | | | X | . = 300mm ' = 210mm | | |
| MIC-S90-BH- 500 | 13666g | | | | | included new connector | |
| MIC-S90-BH- 750 | 16052g | | | | naruware | | |
| MIC-S90-BH-1000 | 18439g | | | | | a lega and | |
| MIC-590-BH-1500 | 23213g | | | | | and a start of the | |
| MIC-390-DIT-2000 | 279009 | | | | 1 | A CONTRACTOR OF A CONTRACTOR OFTA CONTRACTOR O | |
| Submittal text: Hilti Hot-dipped galvanize The fixation could be dor First principle is clamping structural steel profile. | ed bracket used a ne by two different g, using four bean | is fixed to structur t principles. n clams clamped o | al steel profiles. on flange of the | | Designatio VIC-S90-B VIC-S90-B MIC-S90-E MIC-S90-E MIC-S90-E | n L[mm] 3H- 500 500 3H- 750 750 3H-1000 1000 3H-1500 1500 3H-2000 2000 | |
| Material properties | | | | | | | |
| Material | Y | ield strength | Ultimate strength | Modulus of el | lasticity | Shear modulus | |
| Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \ \frac{N}{mm^2}$ | E = 210000 | $\frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ | |
| Girder DD11 MOD (EN 10111) | nd Shear Modulus are a | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | E = 210000 | $\frac{N}{mm^2}$ | $\mathbf{G} = 80769 \frac{N}{mm^2}$ | |

city and She ar modulus are according to

Instruction For Use:

No IFU attached to the packaging

For clamped loading case

For boxed loading case (not attached to the packaging)





| Possible loading cases | | | | |
|------------------------|-------|--|--|--|
| Clamped | Boxed | | | |
| | | | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

В

Software:

- Ansys 18.2
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30'
- Published allowable loa
- including those resulting Simplified drawing:

B = 350mm

- X = 300mm
- Y = 210mm

| Designation | L[mm] | A A A A A A A A A A A A A A A A A A A |
|-----------------|-------|---------------------------------------|
| MIC-S90-BH- 500 | 500 | |
| MIC-S90-BH- 750 | 750 | ALL |
| MIC-S90-BH-1000 | 1000 | |
| MIC-S90-BH-1500 | 1500 | (– |
| MIC-S90-BH-2000 | 2000 | 17x64 |
| | | |

conditions. Non-static forces, en into account during design.

Installation Technical Manual - Technical Data - MI system

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15

155

220











Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm...



| | +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|---|--------|--------|--------|--------|--------|--------|
| | [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| (| 72.00 | 101.54 | 57.20 | 57.20 | 57.20 | 57.20 |
| | +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| | 4.50 | 4.50 | 6.08 | 6.08 | 6.08 | 6.08 |

includes cross section resistance of steel base plate and channel **Interaction:**

| F _{xEd} | Fy.Ed | F _{z.Ed} | M _{xEd} | My.Ed | M _{z.Ed} |
|------------------|---------------------|---------------------|------------------|-------------------|-----------------------|
| FxRd | F _{v.Rd} + | F _{z.Rd} + | M _{xRd} | M _{v.Rd} | M _{z.Rd} ≥ 1 |



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 285.11 | 285.11 | 116.39 | 116.39 | 116.39 | 116.39 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 9.54 | 9.54 | 6.84 | 6.84 | 6.84 | 6.84 |

Interaction:

 $\frac{F_{\mathbf{x}} \underline{Ed}}{F_{\mathbf{x}} \underline{Rd}} + \frac{F_{\mathbf{y}} \underline{Ed}}{F_{\mathbf{y}} \underline{Rd}} + \frac{F_{\mathbf{z}} \underline{Ed}}{F_{\mathbf{z}} \underline{Rd}} + \frac{M_{\mathbf{x}} \underline{Ed}}{M_{\mathbf{x}} \underline{Rd}} + \frac{M_{\mathbf{y}} \underline{Ed}}{M_{\mathbf{y}} \underline{Rd}} + \frac{M_{\mathbf{z}} \underline{Ed}}{M_{\mathbf{z}} \underline{Rd}} \leq 1$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 202



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm...



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 102.40 | Not decisive | 10.31 | 10.31 | 10.31 | 10.31 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 1.12 | 1.12 | 7.37 | 7.37 | 6.81 | 6.81 |

includes cross section resistance of steel base plate and channel Interaction:

Normal force interaction:

$$\frac{F_{xEd}}{F_{xRd}} + \frac{M_{yEd}}{M_{yRd}} + \frac{M_{zEd}}{M_{zRd}} \le 1$$

Shear force interaction:

$$\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)} \le 1$$

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

Installation Technical Manual - Technical Data - MI system



MIC-S90-BH-500-2000 Bracket - Steel



| Loading case: Boxed | Combinations covered by loading case |
|---|--|
| BOM: Brackets: 1x MIC-S90-BH- 500 2203587 MIC-S90-BH- 750 2203588 MIC-S90-BH-1000 2203589 MIC-S90-BH-1500 2203590 MIC-S90-BH-2000 2203591 Base plate 1174675 1x MIB-SBH 2174675 Threaded rods cut to particular length 4x AM16x1000 8.8 HDGm 4x AM16x1000 8.8 HDGm 419104 Lock washer 8x LW M16 HDG plus washer 2185343 Nut 304767 | Pre-fab bracket for perpendicular connection to structural steel Profiles boxing it with two base plates. Flange width 165-235mm. |

| Recommended loading capacity - simplified for most common applications | | | | | | |
|--|--|-----------------------------------|-----------------------|-------------------------|--|--|
| Method | | ±Fx,rec. [kN] | \pm Fy,rec. [kN] | ±Fz,rec. [kN] | | |
| Vield strength | | 49.93 | 13.34 | 13.34 | | |
| Characteristic load | z | | | | | |
| Action Resistance | These values are individual one directional maximal ouse design values and their corresponding interaction | capacity limits. For formulas. | any combinations of | of multiple directions, | | |





Validity:

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- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

2/3

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm.

1. Bracket per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 74.90 | 101.54 | 57.20 | 57.20 | 57.20 | 57.20 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 4.50 | 4.50 | 6.08 | 6.08 | 6.08 | 6.08 |

includes cross section resistance of steel base plate and channel Interaction:

$$\frac{F_{xEd}}{F_{xRd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{xEd}}{M_{xRd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \le 1$$

2. Welds - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] | |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--|
| 285.11 | 285.11 | 116.39 | 116.39 | 116.39 | 116.39 | |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] | |
| 9.54 | 9.54 | 6.84 | 6.84 | 6.84 | 6.84 | |
| nteraction: | | | | | | |

 $\frac{F_{\mathbf{x}} \underline{Ed}}{F_{\mathbf{x}} \underline{Rd}} + \frac{F_{\mathbf{y}} \underline{Ed}}{F_{\mathbf{y}} \underline{Rd}} + \frac{F_{\mathbf{z}} \underline{Ed}}{F_{\mathbf{z}} \underline{Rd}} + \frac{M_{\mathbf{x}} \underline{Ed}}{M_{\mathbf{x}} \underline{Rd}} + \frac{M_{\mathbf{y}} \underline{Ed}}{M_{\mathbf{y}} \underline{Rd}} + \frac{M_{\mathbf{z}} \underline{Ed}}{M_{\mathbf{z}} \underline{Rd}} \leq 1$

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

3/3

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm...

3. Base plate and through bolts - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 158.80 | Not decisive | 20.01 | 20.01 | 20.01 | 20.01 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 2.06 | 2.06 | 11.27 | 11.27 | 10.56 | 10.56 |

includes cross section resistance of steel base plate and channel Interaction:

Normal force interaction:

$$\frac{F_{x Ed}}{F_{x Rd}} + \frac{M_{y Ed}}{M_{y Rd}} + \frac{M_{z Ed}}{M_{z Rd}} \le 1$$

Shear force interaction:

$$\sqrt{\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)} \le 1$$

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.



| Designation MIC-S90-CH- 500 MIC-S90-CH- 750 MIC-S90-CH-1000 MIC-S90-CH-1500 MIC-S90-CH-2000 | | | tem number 2203592 2203593 2203594 2203595 2203596 | | | B > 10 minutes | 15 |
|--|----------|-----------------------------|---|------------|---|---|---|
| Corrosion protection: | | 7ine thickness min | | | Va | | 220 |
| wateriai | HDG per | zinc thickness, min (μm) | | | | 17×64 | |
| Bracket | ISO 1461 | 55 | | | B = 430mm | ı | |
| Weight: | | | | | X = 350 mm | 1 | |
| MIC-S90-CH- 500 | 15808g | | | | 1 - 2901111 | I | |
| MIC-S90-CH- 750 | 18195g | | | | Hardware | included p | er connector |
| MIC-S90-CH-1000 | 20582g | | | | | 0 | 0 |
| MIC-S90-CH-1500 | 25355g | | | | | 1 | |
| MIC-S90-CH-2000 | 30129g | | | | 1 | 111100 | 0 |
| Submittal text: Hilti Hot-dipped galvanized bracket used as fixed to structural steel profiles. The fixation could be done by two different principles. First principle is clamping, using four beam clams clamped on flange of the structural steel profile. | | | | | Designatic MIC-S90-0 MIC-S90-0 MIC-S90-0 MIC-S90-0 MIC-S90-0 | on CH- 500 CH- 750 CH-1000 CH-1500 CH-2000 | L[mm] 500 750 1000 1500 2000 |
| Material properties | | | | | | | |
| Material | | Yield strength | Ultimate strength | Modulus of | elasticity | Shear | modulus |
| Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | E = 2100 | $00 \frac{N}{mm^2}$ | G = 8 | $30769 \frac{N}{mm^2}$ |
| Girder DD11 MOD (EN 10111) | | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | E = 2100 | $00 \frac{N}{mm^2}$ | G = 8 | $30769 \frac{N}{mm^2}$ |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:

No IFU attached to the packaging For clamped loading case Fo

ase For boxed loading case (not attached to the packaging)



Installation Technical Manual - Technical Data - MI system



| Possible loading cases | | | | |
|------------------------|-------|--|--|--|
| Clamped | Boxed | | | |
| | | | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 18.2
- Microsoft Excel
- Mathcad 15

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.
 Simplified drawing:

Simplified drawing:



Installation Technical Manual - Technical Data - MI system





| Loading case: Clamped | Combinations covered by loading case | | |
|--|---|--|--|
| BOM: Brackets: 1x MIC-S90-CH- 500 2203592 MIC-S90-CH- 750 2203593 MIC-S90-CH-1000 2203594 MIC-S90-CH-1500 2203595 MIC-S90-CH-2000 2203596 Beam clamps 387398 | Pre-fab bracket for perpendicular connection to structural steel profiles flanges. Flange width 235-300mm. | | |



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Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm.

1. Bracket per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 44.90 | 101.54 | 57.20 | 57.20 | 57.20 | 57.20 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 4.50 | 4.50 | 6.08 | 6.08 | 6.08 | 6.08 |

includes cross section resistance of steel base plate and channel Interaction:

| F _{xEd} | Fy.Ed | F _{z.Ed} | M _{xEd} | My.Ed | M _{z.Ed} | < 1 |
|--------------------|-------|-------------------|------------------|-------|-------------------|-----|
| F _{xRd} ' | Fy.Rd | F _{z.Rd} | M _{xRd} | My.Rd | M _{z.Rd} | |

2. Welds – per analytical calculation



| _ | | | | | | | |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--|
| | | | | | | | |
| | +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] | |
| | 285.11 | 285.11 | 116.39 | 116.39 | 116.39 | 116.39 | |
| | +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] | |
| | 9.54 | 9.54 | 6.84 | 6.84 | 6.84 | 6.84 | |
| Interaction: | | | | | | | |
| $\frac{F_{xEd}}{F_{xRd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{xEd}}{M_{xRd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \le 1$ | | | | | | | |

Installation Technical Manual - Technical Data - MI system

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Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
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Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm...



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 102.40 | Not decisive | 10.31 | 10.31 | 10.31 | 10.31 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 1.41 | 1.41 | 7.37 | 7.37 | 8.45 | 8.45 |

includes cross section resistance of steel base plate and channel Interaction:

Normal force interaction:

$$\frac{F_{xEd}}{F_{xRd}} + \frac{M_{yEd}}{M_{yRd}} + \frac{M_{zEd}}{M_{zRd}} \le 1$$

Shear force interaction:

$$\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)} \le 1$$

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

Installation Technical Manual - Technical Data - MI system





| Loading case: Boxed | | Combinations covered by loading case | |
|---|--|--|--|
| BOM: Brackets: 1x MIC-S90-CH- 500 22 MIC-S90-CH- 750 22 MIC-S90-CH-1500 22 MIC-S90-CH-1500 22 MIC-S90-CH-2000 22 Base plate 1x MIB-SBH Threaded rods cut to particular let 4x AM16x1000 8.8 HDGm Lock washer 8x LW M16 HDG plus washer Nut 8x M16-F nut | 2203592 2203593 2203594 2203595 2203596 2174675 ength 419104 2185343 304767 | Pre-fab bracket for perpendicular connection to structural steel Profiles boxing it with two base plates. Flange width 235-300mm. | |

| Recommended loading capacity - simplified for most common applications | | | | | | | | |
|--|--|------------------|-------------------|------------------|--|--|--|--|
| Method | x x | ±Fx,rec. [kN] | ±Fy,rec. [kN] | ±Fz,rec. [kN] | | | | |
| Yield strength | | 31.27 | 12.67 | 12.67 | | | | |
| Permissible stress Capacity limit | | | ±My,rec. [kNm] | | | | | |
| Live load | | • | 4.05 | | | | | |
| Action Resistance | These values are individual one directional maximal capacity limits. For any combinations of multiple directions, use design values and their corresponding interaction formulas. | | | | | | | |



Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm.

1. Bracket per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 46.90 | 91.00 | 57.20 | 57.20 | 57.20 | 57.20 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 4.50 | 4.50 | 6.08 | 6.08 | 6.08 | 6.08 |

includes cross section resistance of steel base plate and channel Interaction:

 $\frac{F_{\mathbf{x}\mathbf{Ed}}}{F_{\mathbf{x}\mathbf{Rd}}} + \frac{F_{\mathbf{y}\cdot\mathbf{Ed}}}{F_{\mathbf{y}\cdot\mathbf{Rd}}} + \frac{F_{\mathbf{z}\cdot\mathbf{Ed}}}{F_{\mathbf{z}\cdot\mathbf{Rd}}} + \frac{M_{\mathbf{x}\cdot\mathbf{Ed}}}{M_{\mathbf{x}\cdot\mathbf{Rd}}} + \frac{M_{\mathbf{y}\cdot\mathbf{Ed}}}{M_{\mathbf{y}\cdot\mathbf{Rd}}} + \frac{M_{\mathbf{z}\cdot\mathbf{Ed}}}{M_{\mathbf{z}\cdot\mathbf{Rd}}} \leq 1$

2. Welds - per analytical calculation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 285.11 | 285.11 | 116.39 | 116.39 | 116.39 | 116.39 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 9.54 | 9.54 | 6.84 | 6.84 | 6.84 | 6.84 |

Interaction:

 $\frac{F_{\mathbf{x}} \underline{Ed}}{F_{\mathbf{x}} \underline{Rd}} + \frac{F_{\mathbf{y}} \underline{Ed}}{F_{\mathbf{y}} \underline{Rd}} + \frac{F_{\mathbf{z}} \underline{Ed}}{F_{\mathbf{z}} \underline{Rd}} + \frac{M_{\mathbf{x}} \underline{Ed}}{M_{\mathbf{x}} \underline{Rd}} + \frac{M_{\mathbf{y}} \underline{Ed}}{M_{\mathbf{y}} \underline{Rd}} + \frac{M_{\mathbf{z}} \underline{Ed}}{M_{\mathbf{z}} \underline{Rd}} \leq 1$

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 213



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

3/3

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm...

3. Base plate and through bolts - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 150.80 | Not decisive | 19.00 | 19.00 | 19.00 | 19.00 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 2.57 | 2.57 | 10.71 | 10.71 | 12.44 | 12.44 |

includes cross section resistance of steel base plate and channel Interaction:

$$\frac{F_{x Ed}}{F_{x Rd}} + \frac{M_{y Ed}}{M_{y Rd}} + \frac{M_{z Ed}}{M_{z Rd}} \le 1$$

Shear force interaction:

$$\sqrt{\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)} \le 1$$

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.



| Designation MIC-S120-AH- 500 MIC-S120-AH- 750 MIC-S120-AH-1000 MIC-S120-AH-1500 MIC-S120-AH-2000 | | | tem number 2203597 2203598 2203599 2203600 2203601 | L | B 15 155 220 |
|--|--|--|---|---|--|
| Material | HDG per | Zinc thickness, min | | • | |
| | | (μm) | | D - 000- | 17x64 |
| Bracket | ISO 1461 | 55 | | B = 280r | nm |
| Weight: MIC-S120-AH- 500 MIC-S120-AH- 750 MIC-S120-AH-1000 MIC-S120-AH-1500 MIC-S120-AH-2000 | 13374g 16562g 19750g 26125g 32500g | | | Y = 140r Hardwa | re included per connector |
| Submittal text: Hilti Hot-dipped galvanize The fixation could be dor First principle is clamping structural steel profile. | ed bracket us ne by two diff g, using four l | sed as fixed to structu erent principles. beam clams clamped | ral steel profiles. on flange of the | Designa MIC-S1 MIC-S1 MIC-S1 MIC-S1 MIC-S1 | ation L[mm] 20-AH- 500 500 20-AH- 750 750 20-AH-1000 1000 20-AH-1500 1500 20-AH-2000 2000 |
| Material properties | | | | | |
| Material | | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | E = 210000 $\frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Girder | | $f_v = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | $G = 80769 \frac{N}{mm^2}$ |

Values for Modulus of Elasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:

No IFU attached to the packaging

For clamped loading case For boxed loading case (not attached to the packaging)





| Possible loading cases | | |
|------------------------|-------|--|
| Clamped | Boxed | |
| | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation •

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 18.2
- Microsoft Excel
- Mathcad 15 .

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, ٠ including those resulting from thermal or other expansion must be taken into account during design.

Simplified drawing:



Installation Technical Manual - Technical Data - MI system




| Loading case: Clamped | Combinations covered by loading case |
|--|--|
| BOM: Brackets: 1x MIC-S120-AH- 500 2203597 MIC-S120-AH- 750 2203598 MIC-S120-AH- 1000 2203599 MIC-S120-AH-1500 2203600 MIC-S120-AH-1500 2203600 MIC-S120-AH-2000 2203600 MIC-S120-AH-2000 2203601 Beam clamps 387398 | Pre-fab bracket for perpendicular connection to structural steel profiles flanges. Flange width 75-165mm. |



Installation Technical Manual - Technical Data - MI system



Validity:

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- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm.

1. Bracket per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 105.20 | 132.97 | 62.60 | 62.60 | 94.80 | 94.80 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 6.80 | 6.80 | 10.17 | 10.17 | 8.03 | 8.03 |

includes cross section resistance of steel base plate and channel Interaction:

 $\frac{F_{xEd}}{F_{xRd}} + \frac{F_{y}Ed}{F_{y}Rd} + \frac{F_{z}Ed}{F_{z}Rd} + \frac{M_{xEd}}{M_{xRd}} + \frac{M_{y}Ed}{M_{y}Rd} + \frac{M_{z}Ed}{M_{z}Rd} \leq 1$

2. Welds – per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|
| 346.20 | 346.20 | 116.39 | 116.39 | 166.28 | 166.28 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 13.34 | 13.34 | 11.91 | 11.91 | 10.28 | 10.28 |
| Interaction: | | | | | |
| $\frac{F_{xEd}}{F_{y,Ed}} + \frac{F_{y,Ed}}{F_{y,Ed}} + \frac{F_{z,Ed}}{F_{z,Ed}} + \frac{M_{xEd}}{M_{y,Ed}} + \frac{M_{y,Ed}}{M_{y,Ed}} + \frac{M_{z,Ed}}{M_{z,Ed}} \le 1$ | | | | | |

Installation Technical Manual - Technical Data - MI system

Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 218



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm...



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 102.40 | Not decisive | 10.31 | 10.31 | 10.31 | 10.31 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 0.84 | 0.84 | 7.37 | 7.37 | 4.25 | 4.25 |

includes cross section resistance of steel base plate and channel Interaction:

Normal force interaction:

$$\frac{F_{xEd}}{F_{xRd}} + \frac{M_{yEd}}{M_{yRd}} + \frac{M_{zEd}}{M_{zRd}} \le 1$$

Shear force interaction:

$$\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)} \le 1$$

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

Installation Technical Manual - Technical Data - MI system





| Loading case: Boxed | Combinations covered by loading case |
|--|---|
| BOM: Brackets: 1x MIC-S120-AH- 500 2203597 MIC-S120-AH- 750 2203598 MIC-S120-AH-1000 2203599 MIC-S120-AH-1500 2203600 MIC-S120-AH-2000 2203601 Hardware not included in packaging: Base plate 1x MIB-SAH 2174674 Threaded rods cut to particular length 4x AM16x1000 8.8 HDGm 419104 Lock washer 8x LW M16 HDG plus washer 2185343 Nut 8x M16-F nut 304767 | Pre-fab bracket for perpendicular connection to structural steel Profiles boxing it with two base plates. Flange width 75-165mm. |

| Recommended loading capacity - simplified for most common applications | | | | | |
|---|------------------------------------|--|---|--|--|
| y x | ±Fx,rec. [kN] | ±Fy,rec. [kN] | ±Fz,rec. [kN] | | |
| z | 78.13 | 13.77 | 13.77 | | |
| | | ±My,rec. [kNm] | | | |
| | | 7.00 | | | |
| These values are individual one directional maximal or use design values and their corresponding interaction | apacity limits. For a formulas. | any combinations of | multiple directions, | | |
| | ed for most common a | ed for most common applicat Fx,rec. [kN] 78.13 These values are individual one directional maximal capacity limits. For a use design values and their corresponding interaction formulas. | ed for most common applications $\begin{array}{c} & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & &$ | | |

| Design loading capacity - 3D | 1/3 |
|--|-----|
| Method | |
| Design tool Live bool Live bool And a month of Live bool And a month of Live bool And a month of Live bool | |

Limiting components of capacity evaluated in following tables:

1. Bracket per FEA simulation



3. Base plate and through bolts - per analytical calculation

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those ٠ resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm.

1. Bracket per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 117.20 | 132.97 | 62.60 | 62.60 | 94.80 | 94.80 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 6.80 | 6.80 | 10.51 | 10.51 | 8.03 | 8.03 |

includes cross section resistance of steel base plate and channel Interaction:

```
\frac{F_{\mathbf{x}}Ed}{F_{\mathbf{x}}Rd} + \frac{F_{\mathbf{y}}Ed}{F_{\mathbf{y}}Rd} + \frac{F_{\mathbf{z}}Ed}{F_{\mathbf{z}}Rd} + \frac{M_{\mathbf{x}}Ed}{M_{\mathbf{x}}Rd} + \frac{M_{\mathbf{y}}Ed}{M_{\mathbf{y}}Rd} + \frac{M_{\mathbf{z}}Ed}{M_{\mathbf{z}}Rd} \leq 1
```

2. Welds - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|
| 346.20 | 346.20 | 116.39 | 116.39 | 166.28 | 166.28 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 13.34 | 13.34 | 11.91 | 11.91 | 10.28 | 10.28 |
| Interaction: $F_{xEd} + \frac{F_{yEd}}{F_{xEd}} + \frac{M_{xEd}}{F_{xEd}} + \frac{M_{yEd}}{F_{xEd}} + \frac{M_{zEd}}{F_{xEd}} \le 1$ | | | | | |
| $\frac{1}{F_{xRd}} + \frac{1}{F_{xRd}} + \frac{1}{M_{xRd}} + \frac{1}{M_{yRd}} + \frac{1}{M_{zRd}} \le 1$ | | | | | |

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Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 221



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

3/3

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm...

3. Base plate and through bolts - per analytical calculation



| - | | | | | |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
| 164.00 | Not decisive | 20.66 | 20.66 | 20.66 | 20.66 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 1.67 | 1.67 | 11.64 | 11.64 | 6.81 | 6.81 |

includes cross section resistance of steel base plate and channel Interaction:

Normal force interaction:

$$\frac{F_{x\,Ed}}{F_{x\,Rd}} + \frac{M_{y\,Ed}}{M_{y\,Rd}} + \frac{M_{z\,Ed}}{M_{z\,Rd}} \le 1$$

Shear force interaction:

$$\sqrt{\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)} \le 1$$

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.



| Designation MIC-S120-BH- 500 MIC-S120-BH- 750 MIC-S120-BH-1000 MIC-S120-BH-1500 MIC-S120-BH-2000 | | | tem number 2203602 2203603 2203604 2203605 2203606 | | B Y 15 155 |
|---|--|---|---|---|---|
| Material | HDG per | Zinc thickness, min | | A. | |
| | | | | | 17x64 |
| Bracket | ISO 1461 | 55 | | B = 350m | m |
| Weight: MIC-S120-BH- 500 MIC-S120-BH- 750 MIC-S120-BH-1000 MIC-S120-BH-1500 MIC-S120-BH-2000 | 15267g 18455g 21642g 28018g 34393g | | | X = 300m Y = 210m Hardwar | m m e included per connector |
| Submittal text: Hilti Hot-dipped galvaniz The fixation could be dor First principle is clamping structural steel profile. | ed bracket use ne by two differ g, using four be | d as fixed to structu ent principles. eam clams clamped | ral steel profiles. on flange of the | Designat MIC-S12 MIC-S12 MIC-S12 MIC-S12 MIC-S12 | ion L[mm] 0-BH- 500 500 0-BH- 750 750 0-BH-1000 1000 0-BH-1500 1500 0-BH-2000 2000 |
| Material properties | | | | | |
| Material | | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| Plate S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Girder DD11 MOD (EN 10111) | | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |

Values for Modulus of Élasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:

No IFU attached to the packaging

For clamped loading case For boxed loading case (not attached to the packaging)





| Possible loading cases | | | |
|------------------------|-------|--|--|
| Clamped | Boxed | | |
| | | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation •

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 18.2
- Microsoft Excel
- Mathcad 15 .

Validity:

Temperature limits: -30°C (-22°F) to +93°C (200°F).

P

Published allowable loads for applications are based on static loading conditions. Non-static forces, ٠ including those resulting from thermal or other expansion must be taken into account during design. Simplified drawing:







Installation Technical Manual - Technical Data - MI system



1.5

MIC-S120-BH-500-2000 Bracket - Steel



| Loading case: Clamped | Combinations covered by loading case |
|---|---|
| BOM: Brackets: 1x MIC-S120-BH- 500 2203602 MIC-S120-BH- 750 2203603 MIC-S120-BH-1000 2203604 MIC-S120-BH-1500 2203605 MIC-S120-BH-1500 2203605 MIC-S120-BH-2000 2203606 Beam clamps 4x MI-SGC M16 | Pre-fab bracket for perpendicular connection to structural steel profiles flanges. Flange width 165-235mm. |





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Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm.

1. Bracket per FEA simulation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 71.90 | 132.97 | 62.60 | 62.60 | 94.80 | 94.80 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 6.80 | 6.80 | 8.80 | 8.80 | 8.03 | 8.03 |

includes cross section resistance of steel base plate and channel Interaction:

| F _{xEd} | Fy.Ed | F _{z.Ed} | M _{xEd} | My.Ed | M _{z.Ed} | < 1 |
|------------------|-------|-------------------|------------------|-------|-------------------|-----|
| FxRd | Fy.Rd | F _{z.Rd} | M _{xRd} | My.Rd | M _{z.Rd} | |

2. Welds - per analytical calculation



| +Fx,Rd [kN]-Fx,Rd [kN]+Fy,Rd [kN]-Fy,Rd [kN]+Fz,Rd [kN]-Fz,Rd [kN] | | | | | | | | |
|---|--|--|--|--|--|--|--|--|
| 346.20 346.20 116.39 116.39 166.28 166.28 | | | | | | | | |
| +Mx,Rd -Mx,Rd +My,Rd -My,Rd +Mz,Rd -Mz,Rd [kNm] [kNm] [kNm] [kNm] [kNm] [kNm] | | | | | | | | |
| 13.34 13.34 11.91 11.91 10.28 10.28 | | | | | | | | |
| Interaction: | | | | | | | | |
| $\frac{F_{xEd}}{F_{xPd}} + \frac{F_{yEd}}{F_{xPd}} + \frac{F_{zEd}}{F_{xPd}} + \frac{M_{xEd}}{M_{xPd}} + \frac{M_{yEd}}{M_{xPd}} + \frac{M_{zEd}}{M_{xPd}} \le 1$ | | | | | | | | |

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Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm...



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 102.40 | Not decisive | 10.31 | 10.31 | 10.31 | 10.31 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 1.12 | 1.12 | 7.37 | 7.37 | 6.81 | 6.81 |

includes cross section resistance of steel base plate and channel Interaction:

Normal force interaction:

$$\frac{F_{xEd}}{F_{xRd}} + \frac{M_{yEd}}{M_{yRd}} + \frac{M_{zEd}}{M_{zRd}} \le 1$$

Shear force interaction:

$$\sqrt{\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)} \le 1$$

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

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| Loading case: Boxed | Combinations covered by loading case |
|--|--|
| BOM: Brackets: 1x MIC-S120-BH- 500 2203602 MIC-S120-BH- 750 2203603 MIC-S120-BH-1000 2203604 MIC-S120-BH-1500 2203606 Hardware not included in packaging: Base plate Hardware not included in packaging: Base plate 1x MIB-SAH 2174674 Threaded rods cut to particular length 4x AM16x1000 8.8 HDGm 419104 Lock washer 8x LW M16 HDG plus washer 2185343 Nut 8x M16-F nut | Pre-fab bracket for perpendicular connection to structural steel Profiles boxing it with two base plates. Flange width 165-235mm. |

| Recommended loading capacity - simplified for most common applications | | | | | | | |
|---|------------------------------------|--------------------------------|--|--|--|--|--|
| y x | ±Fx,rec. [kN] | ±Fy,rec. [kN] | ±Fz,rec. [kN] | | | | |
| Z | 51.40 | 13.34 | 13.34 | | | | |
| | | ±My,rec. [kNm] | | | | | |
| | | 6.18 | | | | | |
| These values are individual one directional maximal or use design values and their corresponding interaction | apacity limits. For a formulas. | any combinations of | multiple directions, | | | | |
| | ed for most common a | the d for most common applicat | ed for most common applications $\begin{array}{c} & & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & \\ & & & \\ & & & \\ & & & & \\ & & & \\ & & & \\ & & & \\ &$ | | | | |

| Method | Design loading capacity - 3D | 1/3 |
|---|--|-----|
| Vidid strungth Onsign Nadl Design Nadl capacity first Design Nadl 1.5 | Method | |
| | Design had Design had Design had T Design had Design had | |

Limiting components of capacity evaluated in following tables:

1. Bracket per FEA simulation



3. Base plate and through bolts - per analytical calculation

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm.

1. Bracket per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 77.10 | 132.97 | 62.60 | 62.60 | 94.80 | 94.80 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 6.80 | 6.80 | 9.27 | 9.27 | 8.03 | 8.03 |

includes cross section resistance of steel base plate and channel Interaction:

 $\frac{F_{\mathbf{x}}Ed}{F_{\mathbf{x}}Rd} + \frac{F_{\mathbf{y}}Ed}{F_{\mathbf{y}}Rd} + \frac{F_{\mathbf{z}}Ed}{F_{\mathbf{z}}Rd} + \frac{M_{\mathbf{x}}Ed}{M_{\mathbf{x}}Rd} + \frac{M_{\mathbf{y}}Ed}{M_{\mathbf{y}}Rd} + \frac{M_{\mathbf{z}}Ed}{M_{\mathbf{z}}Rd} \leq 1$

 $\frac{F_{\mathbf{x}}\mathbf{Ed}}{F_{\mathbf{x}}\mathbf{Rd}} + \frac{F_{\mathbf{y}}\mathbf{.Ed}}{F_{\mathbf{y}}\mathbf{.Rd}} + \frac{F_{\mathbf{z}}\mathbf{.Ed}}{F_{\mathbf{z}}\mathbf{.Rd}} + \frac{M_{\mathbf{x}}\mathbf{Ed}}{M_{\mathbf{x}}\mathbf{.Rd}} + \frac{M_{\mathbf{y}}\mathbf{.Ed}}{M_{\mathbf{y}}\mathbf{.Rd}} + \frac{M_{\mathbf{z}}\mathbf{.Ed}}{M_{\mathbf{z}}\mathbf{.Rd}} \leq 1$

2. Welds - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] | | |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--|--|
| 346.20 | 346.20 | 116.39 | 116.39 | 166.28 | 166.28 | | |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] | | |
| 13.34 | 13.34 | 11.91 | 11.91 | 10.28 | 10.28 | | |
| Interaction: | | | | | | | |

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Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

3/3

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm...

3. Base plate and through bolts - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 158.80 | Not decisive | 20.01 | 20.01 | 20.01 | 20.01 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 2.06 | 2.06 | 11.27 | 11.27 | 10.56 | 10.56 |

includes cross section resistance of steel base plate and channel Interaction:

Normal force interaction:

$$\frac{F_{x \, Ed}}{F_{x \, Rd}} + \frac{M_{y \, Ed}}{M_{y \, Rd}} + \frac{M_{z \, Ed}}{M_{z \, Rd}} \le 1$$

Shear force interaction:

$$\sqrt{\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)} \le 1$$

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.



| Designation MIC-S120-CH- 500 MIC-S120-CH- 750 MIC-S120-CH-1000 MIC-S120-CH-1500 MIC-S120-CH-2000 | | | Item number 2203607 2203608 2203609 2203570 2203571 | | B Y 15 155 220 |
|--|--|---|--|--|---|
| Material | HDG per | Zinc thickness, mi | n. | - | |
| Bracket | ISO 1461 | (μm) 55 | | B = 430m | 17X64 Š |
| Weight: MIC-S120-CH- 500 MIC-S120-CH- 750 MIC-S120-CH-1000 MIC-S120-CH-1500 MIC-S120-CH-2000 | 17410g 20597g 23785g 30160g 36535g | | | X = 350m Y = 290m Hardward | m e included per connector |
| Submittal text: Hilti Hot-dipped galvanize The fixation could be dor First principle is clamping structural steel profile. | ed bracket use he by two diffe g, using four b | ed as fixed to struct erent principles. beam clams clampe | ural steel profiles. d on flange of the | Designat MIC-S12 MIC-S12 MIC-S12 MIC-S12 MIC-S12 MIC-S12 | ion L[mm] D-CH- 500 500 D-CH- 750 750 D-CH-1000 1000 D-CH-1500 1500 D-CH-2000 2000 |
| Material properties | | | | | |
| Material | | Yield strength | Ultimate strength | Modulus of elasticity | Shear modulus |
| S235JR - (DIN EN10025-2) or DD11 MOD (EN 10111) | | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | G = 80769 $\frac{N}{mm^2}$ |
| Girder DD11 MOD (EN 10111) | | $f_y = 235 \frac{N}{mm^2}$ | $f_u = 360 \frac{N}{mm^2}$ | $E = 210000 \frac{N}{mm^2}$ | $G = 80769 \frac{N}{mm^2}$ |

Values for Modulus of Élasticity and Shear Modulus are according to EN 1993-1-1 and used for all Eurocode calculations

Instruction For Use:

No IFU attached to the packaging

For clamped loading case For boxed loading case (not attached to the packaging)





| Possible loading cases | | | | |
|------------------------|-------|--|--|--|
| Clamped | Boxed | | | |
| | | | | |

Design criteria used for loading capacity

Methodology:

- Finite element analysis
- Analytic calculation •

Standards and codes:

| EN 1990 | Basics of structural design | 03.2003 |
|-------------|---|---------|
| EN 1991-1-1 | Eurocode 1: Actions on structures – Part 1-1: General actions | |
| | densities, self-weight, imposed loads for buildings | 09.2011 |
| EN 1993-1-1 | Eurocode 3: Design of steel structures – Part 1-1: General | |
| | rules and rules for buildings | 03.2012 |
| EN 1993-1-3 | Eurocode 3: Design of steel structures – Part 1-3: General | |
| | rules- Supplementary rules for cold-formed members and sheeting | 03.2012 |
| EN 1993-1-5 | Eurocode 3: Design of steel structures – Part 1-5: Plated | |
| | structural elements | 03.2012 |
| EN 1993-1-8 | Eurocode 3: Design of steel structures – Part 1-8: Design of | |
| | joints | 03.2012 |
| EN 10025-2 | Hot rolled products of structural steels- Part 2: technical | |
| | delivery conditions for non-alloy structural steels | 02.2005 |
| RAL-GZ 655 | Pipe Supports | 04.2008 |

Software:

- Ansys 18.2
- Microsoft Excel
- Mathcad 15 .

Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, ٠ including those resulting from thermal or other expansion must be taken into account during design. Simplified drawing:



X = 300mm

```
Y = 210mm
```



Installation Technical Manual - Technical Data - MI system





| Loading case: Clamped | Combinations covered by loading case |
|---|---|
| BOM: Brackets: 1x MIC-S120-CH- 500 2203607 MIC-S120-CH- 750 2203608 MIC-S120-CH-1000 2203609 MIC-S120-CH-1500 2203570 MIC-S120-CH-2000 2203571 Beam clamps 387398 | Pre-fab bracket for perpendicular connection to structural steel profiles flanges. Flange width 235-300mm. |



Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm.

1. Bracket per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 47.70 | 132.97 | 62.60 | 62.60 | 94.80 | 94.80 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 6.80 | 6.80 | 8.03 | 8.03 | 8.03 | 8.03 |

includes cross section resistance of steel base plate and channel Interaction:

| ^r xEd | ry.Ed | ^F z.Ed | MxEd | My.Ed | Mz.Ed < | 1 |
|------------------|-------------------|-------------------|------------------|-------|-------------------|---|
| F _{xRd} | F _{y.Rd} | F _{z.Rd} | M _{xRd} | My.Rd | M _{z.Rd} | 1 |

2. Welds - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] | |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|--|
| 346.20 | 346.20 | 116.39 | 116.39 | 166.28 | 166.28 | |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] | |
| 13.34 | 13.34 | 11.91 | 11.91 | 10.28 | 10.28 | |
| Interaction: | | | | | | |
| $\frac{F_{xEd}}{F_{xRd}} + \frac{F_{y.Ed}}{F_{y.Rd}} + \frac{F_{z.Ed}}{F_{z.Rd}} + \frac{M_{xEd}}{M_{xRd}} + \frac{M_{y.Ed}}{M_{y.Rd}} + \frac{M_{z.Ed}}{M_{z.Rd}} \le 1$ | | | | | | |

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Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm...



| _ | | | | | | |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
| | 102.40 | Not decisive | 10.31 | 10.31 | 10.31 | 10.31 |
| | +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| | 1.41 | 1.41 | 7.37 | 7.37 | 8.45 | 8.45 |

includes cross section resistance of steel base plate and channel Interaction:

Normal force interaction:

$$\frac{F_{xEd}}{F_{xRd}} + \frac{M_{yEd}}{M_{yRd}} + \frac{M_{zEd}}{M_{zRd}} \le 1$$

Shear force interaction:

$$\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)} \le 1$$

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.

Installation Technical Manual - Technical Data - MI system





| Loading case: Boxed | Combinations covered by loading case |
|--|--|
| BOM: Brackets: 1x MIC-S120-CH- 500 2203607 MIC-S120-CH- 750 2203608 MIC-S120-CH-1000 2203609 MIC-S120-CH-1500 2203570 MIC-S120-CH-2000 2203571 Hardware not included in packaging: Base plate 1x MIB-SAH 2174674 Threaded rods cut to particular length 4x AM16x1000 8.8 HDGm 419104 Lock washer 8x LW M16 HDG plus washer 2185343 Nut 8x M16-F nut 304767 | Pre-fab bracket for perpendicular connection to structural steel Profiles boxing it with two base plates. Flange width 235-300mm. |

| Recommended loading capacity - simplified for most common applications | | | | | | | |
|--|---------------------------------|--|--|--|--|--|--|
| y x | ±Fx,rec. [kN] | ±Fy,rec. [kN] | ±Fz,rec. [kN] | | | | |
| z | 32.73 | 12.67 | 12.67 | | | | |
| | ±My,rec. [kNm] | | | | | | |
| | | 5.48 | | | | | |
| These values are individual one directional maximal c use design values and their corresponding interaction | apacity limits. For a formulas. | any combinations of | multiple directions, | | | | |
| | ed for most common a | these values are individual one directional maximal capacity limits. For a use design values and their corresponding interaction formulas. | the d for most common applications $\begin{array}{c} \downarrow & \downarrow &$ | | | | |

| Design loading capacity - 3D | 1/3 |
|--|-----|
| Method | |
| Cesign teat Cesign teat Cesig | |
| Action Designation | |

Limiting components of capacity evaluated in following tables:

1. Bracket per FEA simulation



3. Base plate and through bolts - per analytical calculation

Installation Technical Manual - Technical Data - MI system



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm.

1. Bracket per FEA simulation



| +Fx,Rd | -Fx,Rd | +Fy,Rd | -Fy,Rd | +Fz,Rd | -Fz,Rd |
|--------|--------|--------|--------|--------|--------|
| [kN] | [kN] | [kN] | [kN] | [kN] | [kN] |
| 49.10 | 97.70 | 62.60 | 62.60 | 94.80 | 94.80 |
| +Mx,Rd | -Mx,Rd | +My,Rd | -My,Rd | +Mz,Rd | -Mz,Rd |
| [kNm] | [kNm] | [kNm] | [kNm] | [kNm] | [kNm] |
| 6.80 | 6.80 | 8.22 | 8.22 | 8.03 | 8.03 |

includes cross section resistance of steel base plate and channel Interaction:

```
\frac{F_{\mathbf{x}}Ed}{F_{\mathbf{x}}Rd} + \frac{F_{\mathbf{y}}Ed}{F_{\mathbf{y}}Rd} + \frac{F_{\mathbf{z}}Ed}{F_{\mathbf{z}}Rd} + \frac{M_{\mathbf{x}}Ed}{M_{\mathbf{x}}Rd} + \frac{M_{\mathbf{y}}Ed}{M_{\mathbf{y}}Rd} + \frac{M_{\mathbf{z}}Ed}{M_{\mathbf{z}}Rd} \leq 1
```

2. Welds - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] | | | |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--|--|--|
| 346.20 | 346.20 | 116.39 | 116.39 | 166.28 | 166.28 | | | |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] | | | |
| 13.34 | 13.34 | 11.91 | 11.91 | 10.28 | 10.28 | | | |
| Interaction: | | | | | | | | |

 $\frac{F_{\mathbf{x}\mathbf{Ed}}}{F_{\mathbf{x}\mathbf{Rd}}} + \frac{F_{\mathbf{y}.\mathbf{Ed}}}{F_{\mathbf{y}.\mathbf{Rd}}} + \frac{F_{\mathbf{z}.\mathbf{Ed}}}{F_{\mathbf{z}.\mathbf{Rd}}} + \frac{M_{\mathbf{x}\mathbf{Ed}}}{M_{\mathbf{x}\mathbf{Rd}}} + \frac{M_{\mathbf{y}.\mathbf{Ed}}}{M_{\mathbf{y}.\mathbf{Rd}}} + \frac{M_{\mathbf{z}.\mathbf{Ed}}}{M_{\mathbf{z}.\mathbf{Rd}}} \leq 1$

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Boundary conditions - Terms of common cooperation / Legal disclaimer and guidelines as defined at the beginning of this book need to be mandatorily respected. 237



Validity:

- Temperature limits: -30°C (-22°F) to +93°C (200°F).
- Published allowable loads for applications are based on static loading conditions. Non-static forces, including those
 resulting from thermal or other expansion must be taken into account during design.



Design loading capacity - 3D

2/3

Summary of design loads*

NOTE: all values in interaction formulas should be used in absolute values! The values below are referred to the coordinate system shown in the drawing and independent from the cantilever length. So they are valid equally for L=500, 750, 1000, 1500, 2000mm...

3. Base plate and through bolts - per analytical calculation



| +Fx,Rd [kN] | -Fx,Rd [kN] | +Fy,Rd [kN] | -Fy,Rd [kN] | +Fz,Rd [kN] | -Fz,Rd [kN] |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 150.80 | Not decisive | 19.00 | 19.00 | 19.00 | 19.00 |
| +Mx,Rd [kNm] | -Mx,Rd [kNm] | +My,Rd [kNm] | -My,Rd [kNm] | +Mz,Rd [kNm] | -Mz,Rd [kNm] |
| 2.57 | 2.57 | 10.71 | 10.71 | 12.44 | 12.44 |

includes cross section resistance of steel base plate and channel Interaction:

Normal force interaction:

$$\frac{F_{x \, Ed}}{F_{x \, Rd}} + \frac{M_{y \, Ed}}{M_{y \, Rd}} + \frac{M_{z \, Ed}}{M_{z \, Rd}} \le 1$$

Shear force interaction:

$$\sqrt{\left(\frac{F_{y,Ed}}{F_{y,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \left(\frac{F_{z,Ed}}{F_{z,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)}\right)^2 + \frac{M_{x,Ed}}{M_{x,Rd} \times \left(1 - \frac{F_{x,Ed}}{F_{x,Rd}}\right)} \le 1$$

Important note: The resistance of steel girder on which connector MIC-SA-MAH is mounted must be checked appropriately by the client. For determination of connector resistances the steel girder is considered to be rigid.



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