



MTR[®] C BEAM

DATA SHEET



THE MTR® SYSTEM

The MTR® System, produced by **Metal.Ri Srl**, is a mixed steel-concrete constructive system alternative to the traditional construction systems such as the common reinforced concrete, the prestressed concrete and the steel structures. The MTR® System is composed of three different types of trusses: MTR® A, MTR® T and MTR® C, made of structure steel according to the EN 10025. They are assembled in a processing centre with production controls according to the EN 1090-1:2012. Metal.Ri Srl controls the welding processes following the criteria of the quality management system in accordance with the international EN ISO 3834-2 standard. They are filled with in-situ concrete. The beams are suitable for any kind of floor or vertical structure.

The MTR® Beams are **steel-concrete composite structures** with certification of **belonging to the class "A"** of the "Linee guida per l'utilizzo di travi tralicciate in acciaio conglomerate nel getto di calcestruzzo collaborante e procedure per il rilascio dell'autorizzazione all'impiego" (*Guidelines for the use of steel trusses embedded in concrete and procedures for authorized use*). (Advice no. 9638 of 06/12/2013 issued by the President of the C.S.LL.PP., S.T.C. - Superior Council of Public Works - Central Technical Service). Their design is carried out taking account of these norms.

The specific application software Software MTR® does the calculations of the MTR® Beams. It is developed following the EN ISO 9001:2008 quality standard requirements.

The system represents the alternative and ideal solution against the limitations of the traditional systems. This building structure solution makes possible to build **structural frames no matter what seismic design category** and to satisfy any architectural requirement through the best combination of floor and beam, according to the kind of building and its performances. Since the sections of beams are reduced if compared to the reinforced concrete structures, the MTR® System follows the rules of NTC 2018 concerning the **dimensionless ratio between beam and column**. In particular, it is possible to make MTR® elements integrated in the floor with small bases without oversizing the columns as required by the production of reinforced concrete beams integrated in the floor with suitable width. In addition, both smaller sections and the selfsupporting feature reduce the buckling (bending moment) in the columns; it becomes easier to respect the **capacity design procedure based on column - beam joints**.

The MTR® System is **simple and quick to assemble**. It does not require the use of specialized workers. Assembly diagrams accompany each delivery and each



beam arrives on site marked for identification by a label that indicates beam. Each beam is provided with an identification label that indicates where exactly to place them. Even the additional reinforcement bars used for the beam-column connection are wrapped and provided with an identification label that indicates where exactly to place them and they have to be assembled according to the assembly diagrams.

The **CE MARKING** appears on all the Metal.Ri Srl products according to the EN 1090-1:2012. Metal.Ri Srl controls the production in the factory in order to assure the correct production.

The base of MTR® C Beam is CE marked in accordance with EN 13225 and therefore are pre-designed in factories equipped with a specific factory production control management system for linear precast concrete elements.

The elements of the MTR® System have no standard dimensions so they represent the suitable solution to get **architectural and structural thinness**; in addition, they can be used for both **new constructions and restorations**.

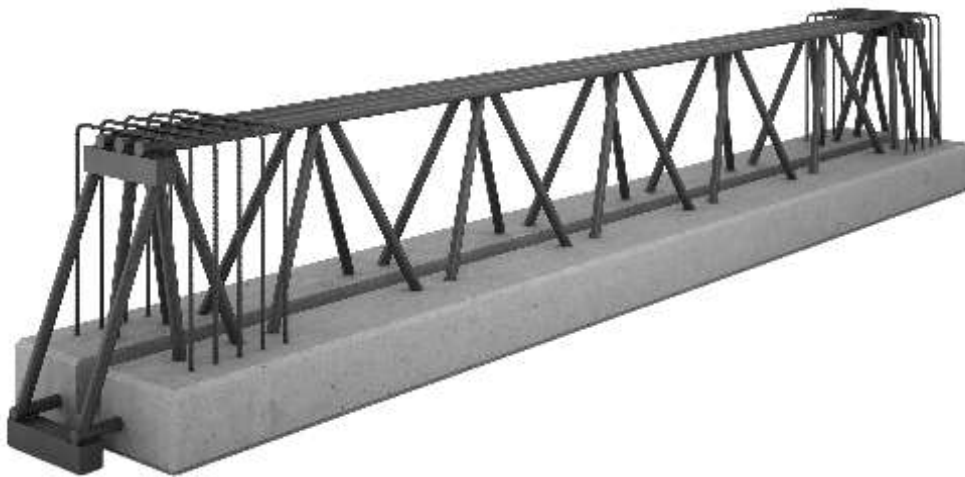
ADVANTAGES OF THE MTR® C BEAM

Easy and simple installation. The MTR® C Beams allow the:

Reduction of the construction time of the horizontal structures by 70%
Reduction of works in situ and the reduction of manpower costs and risks
Reduction of the number of columns and their sections, permit to optimize the interior spaces
Reduction of beam sections (integrated beams in the floor can be made where it is not possible for reinforced concrete)
Reduction of column buckling
Reduction of the concrete used for beams
Total elimination of formworks and props
Fire resistance with no additional costs and work

MTR® C BEAM

The MTR® C BEAM is made of top and bottom chords, in round steel bars or in square steel bars, which are connected to additional end diagonal braces by truss webs. The beam is made of steel grade according to the EN ISO 10025-2, norms and they are cast with composite concrete during the construction. The bottom chords are cast in concrete slab and **functions as formwork and support for the floor.**



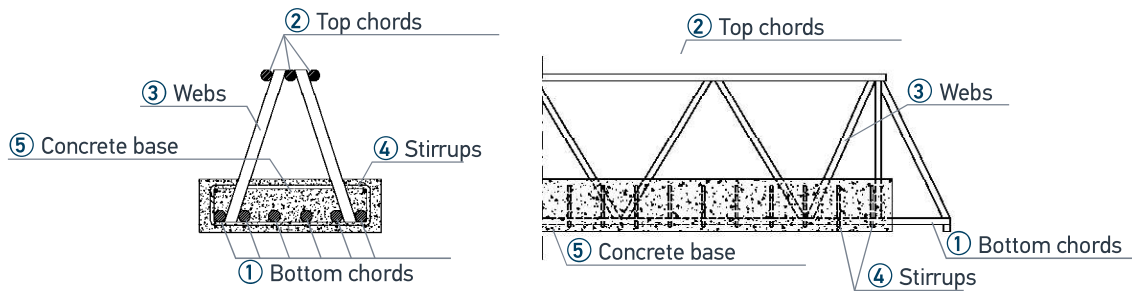
Its static behaviour depends on the two different building phases of the structure:

Phase 1, up to the consolidation of the cast-in-place concrete, the MTR® C BEAM is provided with a lower slab will be a partially coated steel-concrete mixed section and provided with shear connections to prevent sliding and separation between concrete and steel, as specified in both Chapter 4.3 of the NTC 2018, and at point 1.5.2.1 of EN 1994-1-1. For the purpose of structural resistance, safety, we consider only the presence of structural steel of the structure, verifying that the concrete of the slab is not subject to crackling. In this phase, the MTR® C BEAM is a metallic isostatic trussed frame bearing its own load, the load of its pertaining floor and the load of the concrete used for filling, with a static scheme which is generally isostatic (simple supporting beam)

Phase 2, after the consolidation, the MTR® C BEAM is connected to the adjoining self-supporting elements (beams and columns), with a statistically indeterminate (hyper-static) scheme of the structure (frame or continuous beam). It is subject to both permanent and live incremental loads in the second phase. It has prestressed framework resulting from the actions of Phase 1 and resistant composite steel-concrete section.

During the design phase, the differences between the first phase and the second phase are considered both for the stress calculation and for verifications.

The static structure of the MTR® C BEAM is given below:



1. *Bottom chords made of round or square bars;*
2. *Top chords made of round or square bars;*
3. *Webs or web members, connection elements, made of round bars welded both to bottom chords and top chords;*
4. *Stirrups made of B450C steel;*
5. *Concrete sole-plate*

Completely, self-supporting in the first phase, the MTR® C Beam allows the total elimination of formwork and props.

The MTR® C BEAM can be used with any kind of vertical structure (columns or cross wall) and floor (floors made of clay bricks and concrete, lattice girders or pre-stressed lattice girders, expanded polystyrene (eps) lightweight blocks, slabs (PREDALLE), self-supporting hollowcore floors or wooden floors) according to the design requirements

The MTR® C BEAM type is suitable for industrial establishments, commercial centres, multi-storey parking, hotels, congress centres and schools.



TECHNICAL SPECIFICATIONS OF THE MTR® C BEAM

Steel Structure	It is made of structure steel according to the EN ISO 10025-2 standard
Concrete finishing	Class C25/30, unless otherwise indicated
Self-supporting capacity	The beam carries it self and the floor since it has been placed on the columns, before the concrete casting
Welding	Continuous wire welding with shielding gas (Process EN ISO 4063-135) in accordance with European technical standard
Normative References	<ul style="list-style-type: none"> - In the first phase, Eurocode 3 - In the second phase, Eurocodes 2, 3 and 4 - For the structures built in seismic zones, Eurocode 8
How a beam is supported	The MTR® Beams are supported by walls or columns through the specific end anchored systems
Engineering Design Process	Our engineers follow the calculation procedure of the Software MTR® according to the existing law
Post-fire mechanical properties (R)	It depends on the bottom concrete cover
Base	Concrete bottom base finished functioning as formwork and support of the floor



CALCULATION OF THE MTR® C BEAM

The calculation procedure developed for the mixed steel-concrete beams of the MTR® System produced by METAL.RI S.r.l. incorporates the constructive technology of the specific construction system, and follows the recommendations and indications provided by the Structural Eurocodes according also to Technical Standards for the Buildings attached to the Ministerial Decree of the Interior Ministry and Civil Protection of the 17 January 2018.

The construction technology of the MTR® C Beam is divided into two construction phases characterized not only by a specific static operating condition, but also by the material.

In **phase 1**, the beam function as a steel truss with concrete basement. Consequently, in this phase the reference standards can only be those concerning steel constructions that is:

- EN 1993-1-1:2005 (1/08/2005) Eurocode 3 - Design of steel structures -Part 1-1: General rules and rules for buildings (integrated with corrigenda of February 2006, October 2007, September 2008 and April 2009);
- EN 1992-1-1:2005 (November 2005) Eurocode 2 - Design of concrete structures - Part 1-1: General rules and rules for buildings.

In **phase 2**, the MTR® C Beam from a material point of view is bi-component and consequently the reference standard is:

- EN 1994-1-1:2005 (March 2005) Eurocode 4 - Design of composite steel and concrete structures - Part 1-1: General rules and rules for buildings

The aforementioned standard refers to the norms listed below when concerning the verification of specific stress conditions at the ultimate limit state or the verification of the operating limit states:

- EN 1993-1-1:2005 (1/08/2005) Eurocode 3 - Design of steel structures - Part 1-1: General rules and rules for buildings (integrated with corrigenda of February 2006, October 2007, September 2008 and April 2009);
- EN 1992-1-1:2005 (November 2005) Eurocode 2 - Design of concrete structures - Part 1-1: General rules and rules for buildings.



In phase 1 the MTR® C Beam is self-supporting, and it is exclusively a steeltrussed frame so it is subject to the verifications as follows:

1. Local verifications of the truss members:
 - *Verification of buckling behavior during axial bending and compression of the top chord;*
 - *Verification of buckling behavior during axial bending and compression of the diagonal members.*
2. Global verifications:
 - *Verification of buckling behavior during compression and torsion of the metallic beam.*
3. Local verifications on the plate:
 - *Verification during the plate punching in phase 1.*
4. Verification of the concrete slab:
 - *Resistance verification of the concrete slab of the bearing elements of the floor;*
 - *Crackling control of the concrete slab.*

In the phase 2 when the MTR® C Beam becomes a composite steel-concrete structure it is subject to the verifications as follows:

5. Compression and bending verification of the steel-concrete beam;
6. Shear verification of the steel-concrete beam;
7. Slip verification of connectors;
8. Serviceability Limit States (SLS) Verification.



The MTR® System is the result of testing carried out in collaboration with the Polytechnic University of Bari, the University La Sapienza of Rome and the University of Basilicata.

Metal.Ri Srl holds the following product and quality certifications:

- CE Marking on products according to the EN 1090-1 (Factory Production Control);
- CE Marking on products according to the EN 13225 (Factory Production Control for Linear Precast Concrete Elements);
- EN ISO 9001 (Certificate of Quality Management System for product);
- EN ISO 3834-2 (Certificate of the Welding Processes);
- INTERNATIONAL CERTIFICATE of management system in accordance with the EN ISO 3834-2 standard;
- Certificate for the MTR® System classified as Class A issued by the Central Technical Service;
- Certificate as processing centre no. 2529/13 issued by the C.S.LL.PP. - Servizio Tecnico Centrale (Superior Council of Public Works - Central Technical Service);
- EUROPEAN UNION PATENT of the MTR® System.

Metal.Ri Srl reserves the right to make technical changes of any kind without prior notice. The customer is also required to verify that this technical data sheet is still valid and subsequent editions have not replaced it.



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