

Danish Steel Day 2018

Steel solutions for high-rise and long-span buildings

ArcelorMittal Europe – Longs | Sections & Merchant Bars Sales & Marketing | Technical Advisory

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ArcelorMittal: an introduction



- ArcelorMittal is the world's leading steel and mining company
- Around 197.000 employees in more than 60 countries and an industrial presence in 17 countries



Beyond supplying steel – the technical advisory team! ArcelorMittal				
Early phase	Optimise the	Technical	Fire design,	
UI	use of our	predesign	weiding,	
your projects	products	+ price	detailing,	
		estimation	connections	

We want to provide you with technical advice on how to optimise the use of our products and solutions in your projects

We are happy to discuss with you on any question on steel solutions, delivery, price...

11/9/2018

We have 2 particular specialties:



we roll the smallest to the heaviest sections in the world
we can produce them from 235 to 485 MPa full thickness



Heaviest Jumbo in the world 1299 kg/m - HD400x1299



Heaviest rolled shape in the world

1377kg/m HL920x1377



JUMBOS and HIGH STRENGTH?

11/9/2018

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High-rise columns







Trusses and King Post piles







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One example

The D2 tower in Paris

Architect: Anthony Béchu – Tom Sheehan Contractor: GTM Bâtiment Designer : DVVD, Setec TPI







WHY HIGH-RISE BUILDINGS?

11/9/2018

Scandinavia: not a land for high-rise buildings?





Is this trend changing? And why?



Timeline Denmark, All Companies, All Heights, 1885-No Max. Year Base - Completions 🔹 Base - Buildings 250 uniquid Height (Dot) in Meters 200 175 150 100 100 100 175 No. of Buildings Completed (Bar) 1 988 1 990 1 992 1 994 1 996

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What is our added value?

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HISTAR[®] <u>HIgh STrength Steels from ARcelorMittal</u>

DIFFERDANGE - Beginning in 1896





Gelsenkirchener Bergwerks-Aktien-Gesellschaft, Abt. Aachener Hütten-Verein. Adolf-Emil-Hütte zu Esch-Beles – Hochöfen, Stahl- und Walzwerke.

Manufacturing of rolled sections





Walking beam furnace

Quench and Self-Tempering





- 1. An intense water-cooling is applied to the whole surface of the beam
 - 2. Cooling is interrupted before the core is affected
- 3. The outer layers are tempered by the flow of heat from the core to the surface

Quenching and Self-Tempering (QST) and HISTAR production





ETA: Full compliance with EN10025-4 (-> CE-mark) and EN1993 / EN1994



European Technical Approval ETA-10/0156

Handelsbezeichnung Trade name	Langerzeugnisse aus HISTAR 355 / 355L und HISTAR 460 / 460L	
	Long products made of HISTAR 355 / 355L and HISTAR 460 / 460L	
Zulassungsinhaber Holder of approval	ArcelorMittal Belval&Differdange ArcelorMittal Commercial Sections S.A. 66, rue de Luxembourg 4221 ESCH/ALZETTE LUXEMBURG	
Zulassungsgegenstand und Verwendungszweck	Thermomechanisch gewalzte Langerzeugnisse aus Stahl	
Generic type and use of construction product	Thermomechanically hot-rolled long steel products	
Geltungsdauer: vom Validity: tram	7 July 2010	
bis to	7 July 2015	
Herstellwerk Manufacturing plant	ArcelorMittal Belval&Differdange ArcelorMittal Commercial Sections S.A.	
	66, rue de Luxembourg 4221 ESCH/ALZETTE LUXEMBURG	

English translation prepared by DIBt - Original version in German language

Limite d'élasticité minimale selon l'épaisseur de matière Minimum yield strength according to material thickness Abhängigkeit der Mindeststreckgrenze von der Materialstärke



Diese Zulassung umfasst This Approval contains

st 9 Seiten einschließlich 3 Anhänge 9 pages including 3 annexes



Europäische Organisation für Technische Zulassungen European Organisation for Technical Approvals



Advantages of using HISTAR®















HISTAR[®] - Column Design







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LEED includes a set of **rating systems** for the design, construction, operation, and maintenance of **green buildings**, homes, and neighborhoods that aims to help building owners and operators be **environmentally responsible and use resources efficiently.**

Leadership in Energy and Environmental Design (LEED)

	Total Possible Points**		110*	
1	0	Sustainable Sites	21	
Ĵ	0	Water Efficiency	11	
ĺ	0	Energy & Atmosphere	37	
Ľ	0	Materials & Resources	14	
1	0	Indoor Environmental Quality	17	

* Out of a possible 100 points + 10 bonus points

** Certified 40+ points, Silver 50+ points, Gold 60+ points, Platinum 80+ points

Leadership in Energy and Environmental Design





- 1) Location and transportation
 - 2) Materials and Resources
 - 3) Water efficiency
 - 4) Energy and atmosphere
 - 5) Sustainable sites
- 6) Indoor environmental quality

The **Materials and Resources (MR)** credit category focuses on **minimizing the embodied energy** and other impacts associated with the extraction, processing, transport, maintenance, and disposal of **building materials**. The requirements are designed to support a life-cycle approach that improves performance and promotes **resource efficiency**

Source: https://www.usgbc.org/credits/healthcare/v4/material-%26-resources

Our rolled sections in HISTAR contribute to 11 points (out of 14 maximum) to LEED rating, the highest achievable score for steel

Hearst Corp. HQ First NYC Commercial Building with LEED® Gold for New Construction & LEED® Platinum for Existing Buildings

3000 tons of HISTAR steel









Low and medium-rise buildings with steel sections





Schools





Residential



Car parks



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A complete package: Solutions for floor beams





Composite floor decking profiles





S350GD – steel thickness: 0,75 – 0,88 – 1,00 – 1,13 - 1,25 [mm]





ENOVOS – car park (Luxembourg)





A new approach to steel supplying





- Free of charge technical expertise on all steel solutions Alternative design analyses with hot rolled profiles
 - Value engineering for your projects
 - Fire engineering
 - Logistic/ pricing/ commercial information
 - Possibility to promote our steel solutions
- We are not competitive? Work for our R&D team!
 - > Better understanding of designers' needs
 - > Opportunities for formation/seminars
 - > (Hopefully) new case studies with AM steel!





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A new field of expertise: What about fire design?



Slim-Floor Construction – Fire resistance

• Integrated fire resistance-> up to R90 without protection.



EUROSTEEL 2017, September 13-15, 2017, Copenhagen, Denmark

Simplified Analytical Determination of the Temperature Distribution and the Load Bearing Resistance of Slim-Floor Beams

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Heating Conditions following the Slim Floor Solutions





Analytical calculations methods



1) Eurocode 4, Part 1-2, Annexe F, Table F5



Eurocode 4, Part 1-2, Annexe F, Figure F1

Analytical calculations methods



1.a) Eurocode 4, Part 1-2, Annexe F, Table F5 with adapted b_c



With bc = $\underline{\infty}$ a slim-floor with full concrete slab is modeled



With bc = b a slim-floor with steel decking is modeled



Method 1 - Simple calculation deduced from SAFIR (finite element software) simulations have been used:

$$T_{i} = A_{i} \cdot t_{pl} + B_{i} \cdot t_{pl} + C_{i}$$
With: $t_{pl} \leq t_{lim}$



• Temperature in the web – linear interpolation



Eurocode 4, Part 1-2, Annex F, with $b_c = b$ has to be used:

The distance h_l with the lower flange where the temperature reach 400° C is calculated

$$h_{I} = a_{1}/b_{c} + a_{2} \cdot e_{w}/(b_{c}.h) \le h_{I,min}$$

For a_1 and a_2 values, see Table F.3 of EN 1994-1-2 Above h_1 , no yield strength reduction (T < 400° C). Below, linear interpolation between 400° C and lower flange temperature



• Temperature in rebars and reduction factor k_r



Eurocode 4, Part 1-2, Annexe F, Table F5, has to be used: The reduction factor k_r of yield strength is calculated by:

$$k_r = (u \cdot a_3 + a_4) \cdot a_5 / [\left(\frac{A_m}{V}\right)^{\frac{1}{2}}]$$
 with $k_{r,min} < k_r < k_{r,max}$

- For $k_{r,min}$, $k_{r,max}$, a_3 , a_4 and a_5 values, see Table F.5 of EN 1994-1-2 - A_m/V : - in case of steel deck composite slab, $A_m/V = (2 \cdot h + b_c)/(h \cdot b_c)$ - in case of a full concrete slab, $b_c \rightarrow \infty$ and $A_m/V = 1/h$;