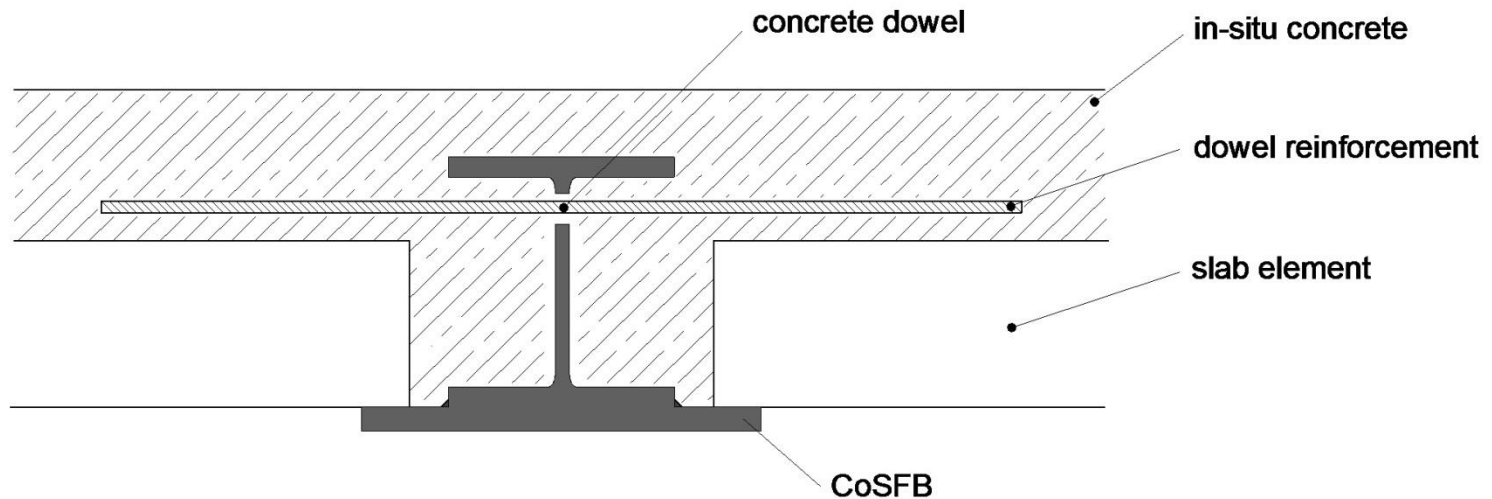




ArcelorMittal

## Slim-Floor Construction - CoSFB

German Technical Approval “CoSFB-Betondübel”



CoSFB-Betondübel = reinforced concrete dowel, new method to assure composite action

Fits perfectly to slim-floor construction (= integrated beams)

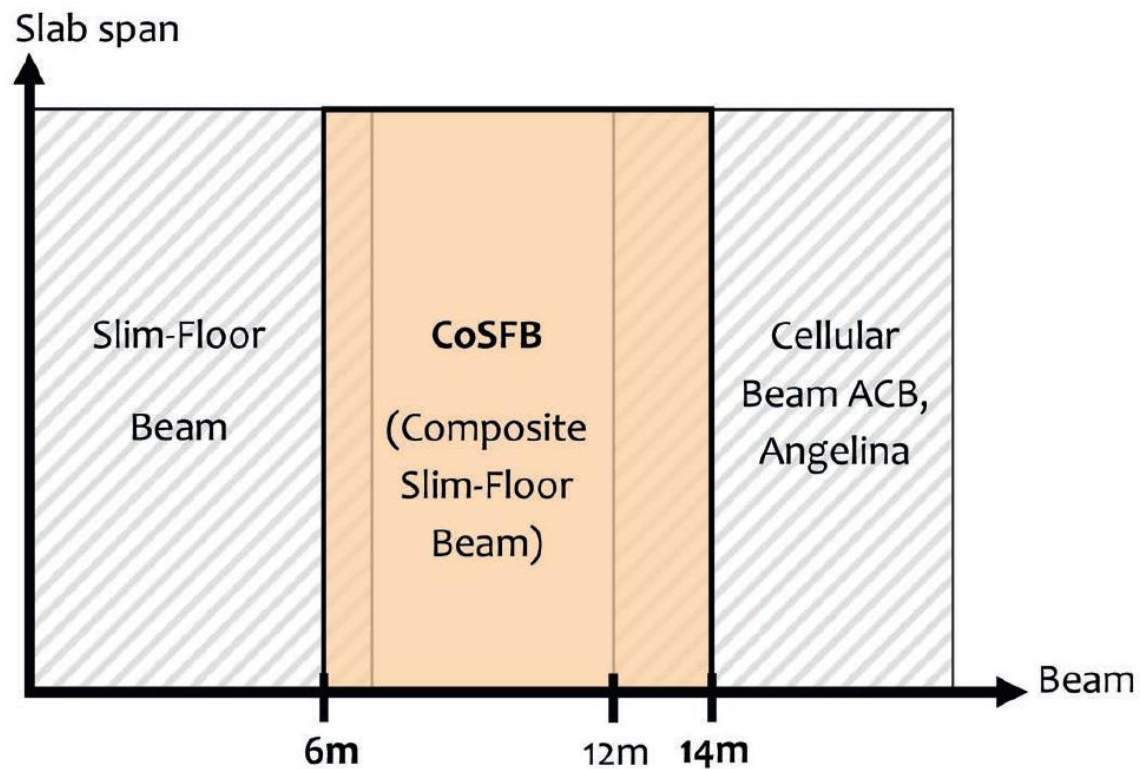
Allows for significant increase of the beam span (up to 14m)



ArcelorMittal

## CoSFB – Application Range

CoSFB is perfectly closing the gap between non-composite slim-floor construction and cellular beams



# CoSFB – Technical Approval



ArcelorMittal

Deutsches  
Institut  
für  
Bautechnik

DIBt

## Allgemeine bauaufsichtliche Zulassung

**Zulassungsnummer:**  
**Z-26.4-59**

**Antragsteller:**

**ArcelorMittal Belval & Differdange S.A.**  
66, rue de Luxembourg  
4009 ESCH-SUR-ALZETTE  
LUXEMBURG

**Zulassungsgegenstand:**  
**CoSFB-Betondübel**

**Zulassungsstelle für Bauprodukte und Bauarten**

**Bautechnisches Prüfamt**

Eine vom Bund und den Ländern  
gemeinsam getragene Anstalt des öffentlichen Rechts

Mitglied der EOTA, der UEAtc und der WFTAO

Datum:

29.07.2014

Geschäftszeichen:

I 31.1-1.26.4-8/10

**Geltungsdauer**

vom: **29. Juli 2014**

bis: **29. Juli 2019**



# CoSFB – Technical Approval

ArcelorMittal

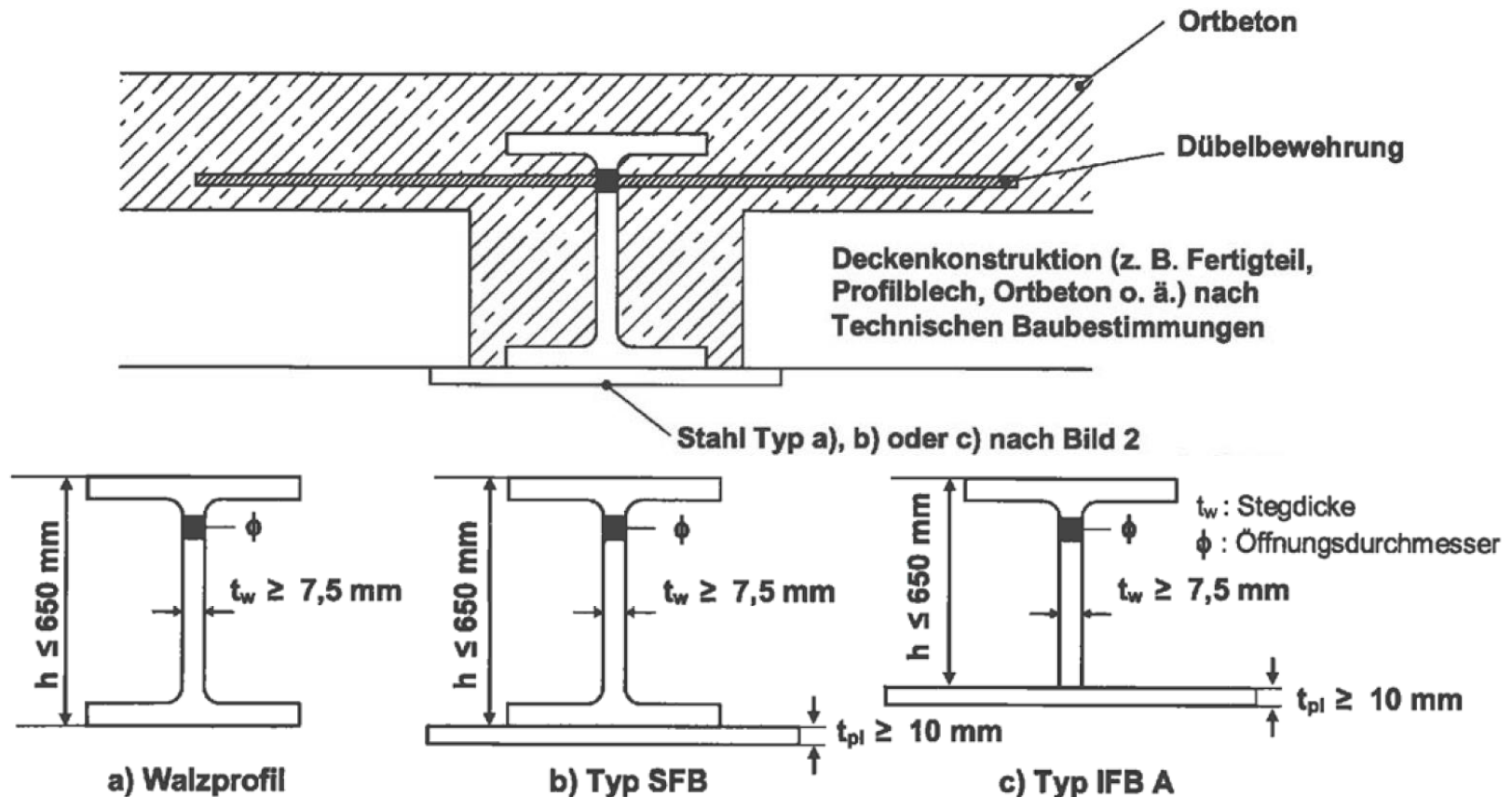


Bild 2 : Zulässige Querschnittsformen der Stahlträger



# CoSFB – Technical Approval

ArcelorMittal

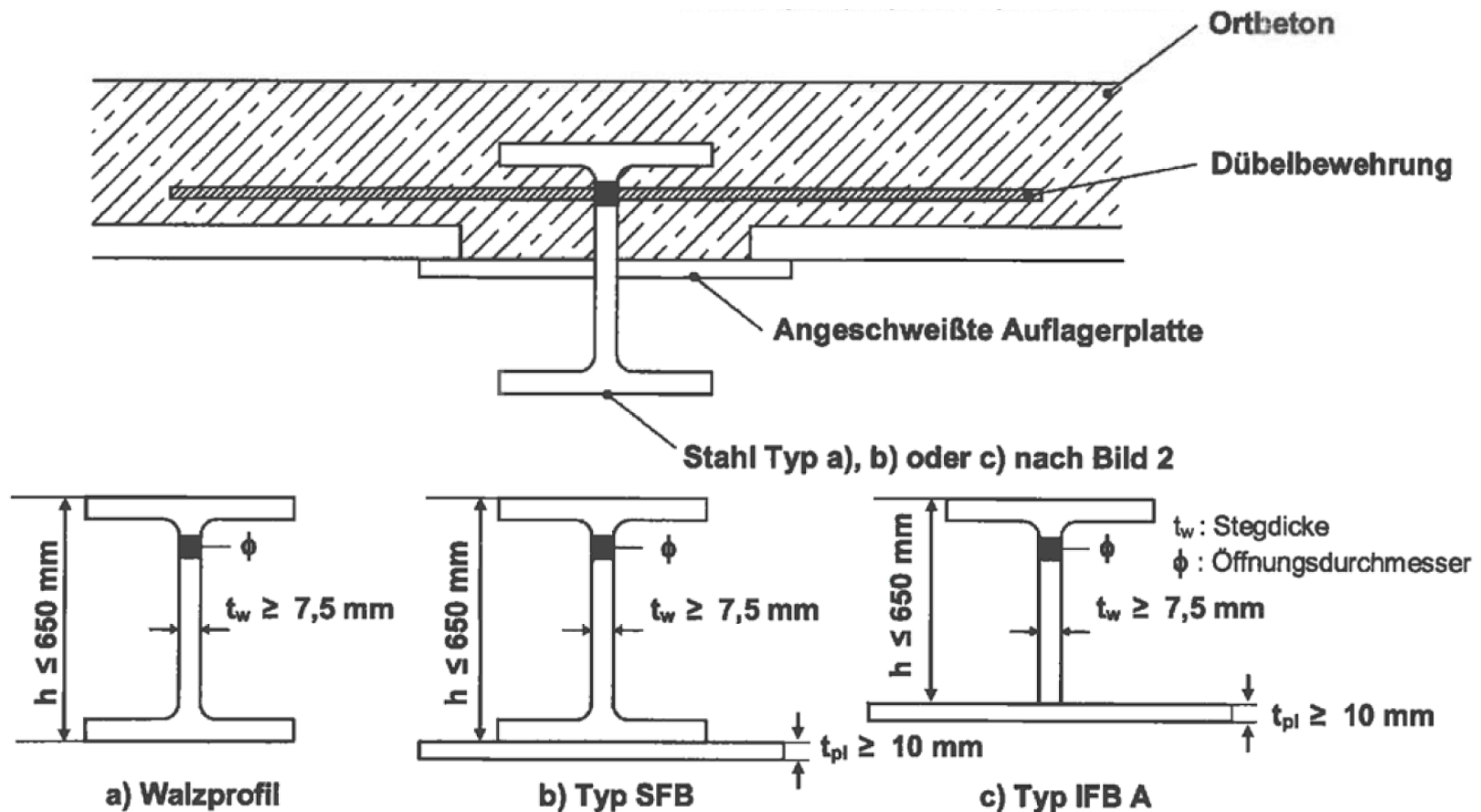


Bild 2 : Zulässige Querschnittsformen der Stahlträger



# CoSFB – Technical Approval

ArcelorMittal

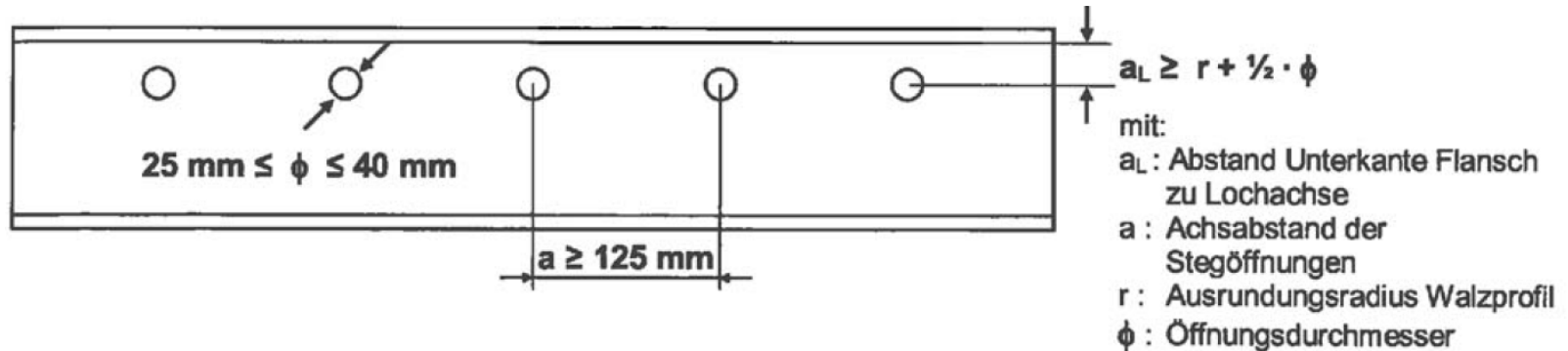


Bild 3 : Position der Bohrungen im Steg der Stahlträger

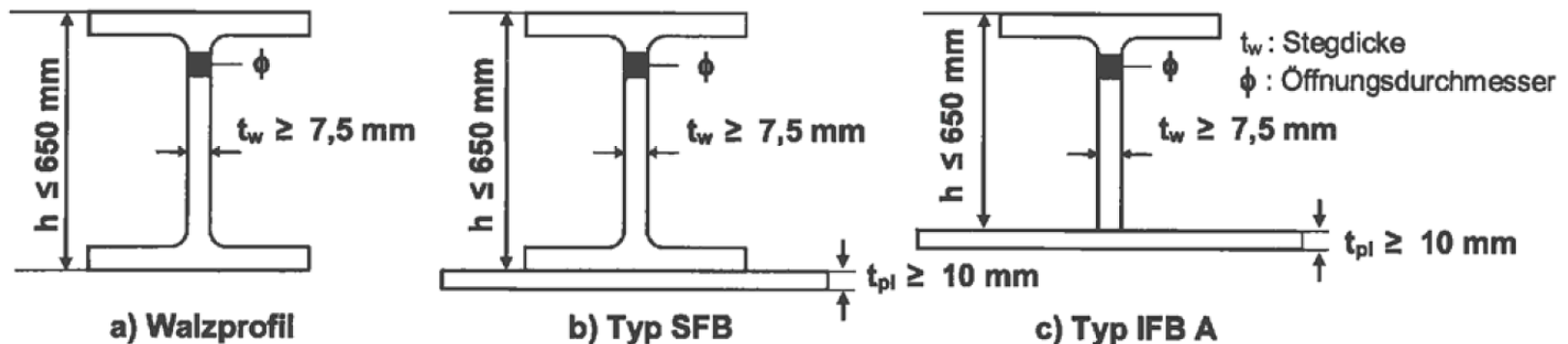


Bild 2 : Zulässige Querschnittsformen der Stahlträger



# CoSFB – Technical Approval

Tabelle 1: Charakteristische Werte der Längsschubtragfähigkeit je Ausnehmung  $P_{RK}$  in [kN]

| Betondruckfestigkeitsklasse/<br>Stegdicke   | C25/30 | C30/37 | C35/45 | C40/50 bis C55/67 |
|---|--------|--------|--------|-------------------|
| $7,5 \text{ mm} \leq t_w < 15,5 \text{ mm}$ | 117    | 125    | 135    | 122               |
| $15,5 \text{ mm} \leq t_w$                  | 148    | 157    | 166    | 122               |

Der Bemessungswert der Verbundtragfähigkeit  $P_{Rd}$  ist durch Division der charakteristischen Tragtragfähigkeit  $P_{RK}$  mit dem Teilsicherheitsbeiwert  $\gamma_V = 1,25$  zu bestimmen.



ArcelorMittal

# Sustainability on the floor: Base grade S355 for sections

ArcelorMittal Europe

Long Products - Technical Advisory

January 2014





ArcelorMittal

## Sustainability on the floor

It is common knowledge that building materials with higher strength enables to build with less material and thus more sustainable.

In practice typically design and execution is done "as always", which means quite often by using only low strength steel S235 or S275 (understood as cheapest per ton).

Innovations and material improvements like S460 are often unknown, not considered or denied in the worst case.

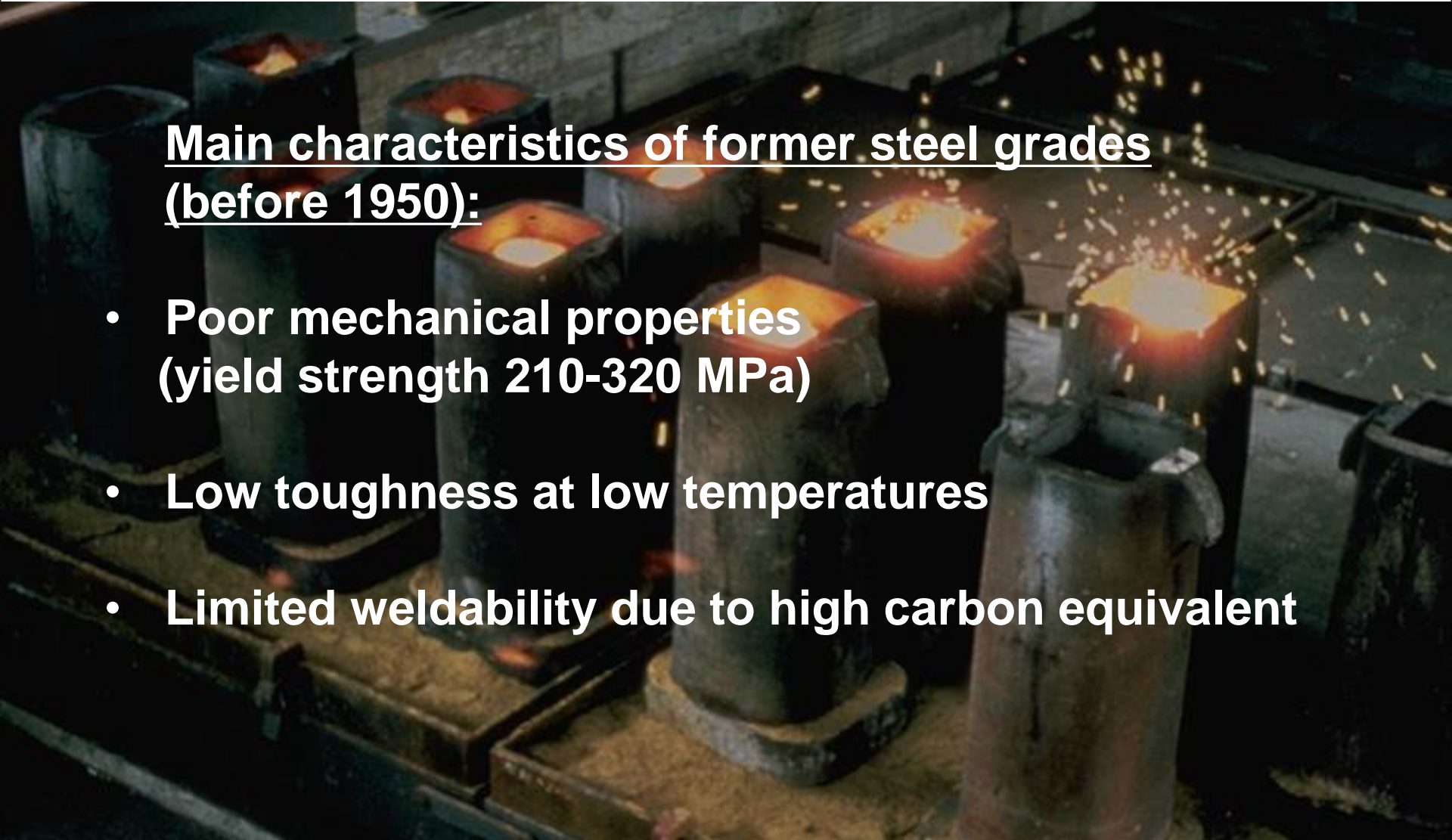


ArcelorMittal

## History of steel production

### Main characteristics of former steel grades (before 1950):

- Poor mechanical properties (yield strength 210-320 MPa)
- Low toughness at low temperatures
- Limited weldability due to high carbon equivalent





ArcelorMittal

## Industrial development

- Improvements in steel production and rolling of beams:
  - Upcycling of lower strength steels due to scrap input in EAF electric arc furnace
  - Continuous casting
  - Rolling at lower temperatures with strong rolling stands
  - Selective cooling of heavy sections
  - QST (Quenching and Self Tempering) process



ArcelorMittal

## Normative situation

- Steel grades for sections from S235 to S460 covered by
  - design standard EN1993
  - product standard EN10025
  - execution standard EN1090

# CE-mark for steel vs. CE mark for steel structures



ArcelorMittal

EN10025 applies to hot-rolled products of structural steel, thus to (unfinished) products like sections and merchant bars leaving steel mills for being shipped to warehouses of distributors or to shops of steel fabricators.

EN1090-2 standard applies to execution of steel structures, thus this standard applies to structural steel members supplied by the steel fabricators to the construction jobsite.

**→ Conclusion: steel mills (of constituent products) certify their deliveries to EN10025, but not to EN1090-2.**

# CE-mark for steel vs. CE mark for steel structures



ArcelorMittal

**EN1090-2, chapter 5** : Concerning constituent products, execution classes (EXC) of EN1090-2 require customers to order specific certificates (EN10204) and options of EN10025 as appropriate.

| Steel Grade (EN10025)                   | Execution class of component (EN1090-2) | Certificate (EN 10204) |
|---|---|------------------------|
| S235 JR / J0, S275 JR / J0              | EXC1-EXC2-EXC3-EXC4                     | → 2.2                  |
| S235 J2, S275 J2                        | EXC1-EXC2-EXC3-EXC4                     | → 3.1                  |
| S355 JR / J0                            | EXC1                                    | → 2.2                  |
|   | EXC2 - EXC3 - EXC4                      | → 3.1                  |
| S355 J2 / K2 / M / ML, HISTAR355 / 355L | EXC1-EXC2-EXC3-EXC4                     | → 3.1                  |
| S450 J0, S460 M / ML, HISTAR460 / 460L  | EXC1-EXC2-EXC3-EXC4                     | → 3.1                  |

Summary of EN10025-2 Annex B (Table B.1), EN1090-2 (Table 1) and EN1993 Annex 10



# Steel grades - History and Outlook

ArcelorMittal

|                     | « yesterday » | « today »             | « tomorrow »           |
|---------------------|---------------|-----------------------|------------------------|
| « low strength »    | -             | -                     | <del>S235 / S275</del> |
| « standard »        | St37 / A36    | S235 / <del>A36</del> | S355 / Gr 50           |
| « higher strength » | -             | S355 / Gr 50          | S460 / Gr65            |
| « high-strength »   | St52 / Gr50   | S460 / Gr 65          | S500 / Gr 70           |



ArcelorMittal

# Today's steel grades in EN

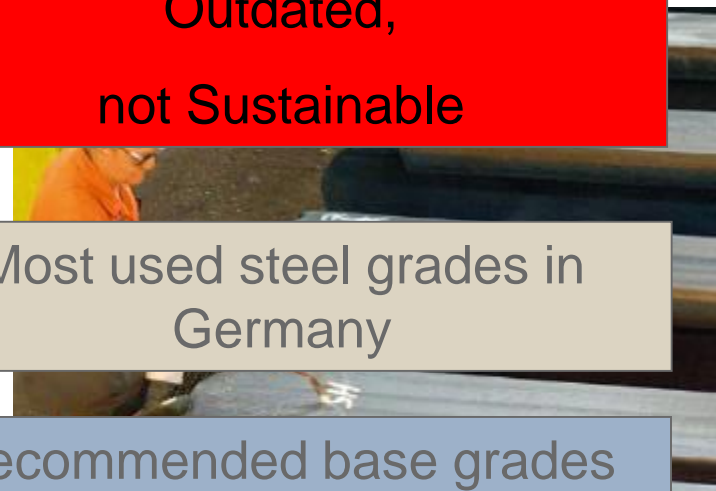
| EN 10025-2:2004   | EN 10025:1990<br>+A1:1993 |
|-------------------|---------------------------|
| neu               | alt                       |
| <del>S235JR</del> | S235JR                    |
| <del>S235J0</del> | S235J0                    |
| <del>S235J2</del> | S235J2G3                  |
| <del>S275JR</del> | S275JR                    |
| <del>S275J0</del> | S275J0                    |
| <del>S275J2</del> | S275J2G4                  |
| S355JR            | S355JR                    |
| S355J0            | S355J0                    |
| S355J2            | S355J2G3                  |
|                   | S355J2G4                  |
|                   | S355K2G3                  |
| S355K2            | S355K2G4                  |
| S450J0            |                           |

| EN 10025-4:2004 | EN 10113-3:<br>1993 |
|-----------------|---------------------|
| neu             | alt                 |
| S355M           | S355M               |
| S355ML          | S355ML              |
| S460M           | S460M               |
| S460ML          | S460ML              |

Outdated,  
not Sustainable

Most used steel grades in  
Germany

Recommended base grades







ArcelorMittal

## Market share 2011/2012

| Rolled sections | S235, S275 /<br>A36<br>(250 MPa) | S355 /<br>Grade 50<br>(345 MPa) | S420, S460 /<br>Grade 65<br>(450MPa) | Steel in building<br>construction* |
|-----------------|----------------------------------|---------------------------------|--------------------------------------|------------------------------------|
| USA, Canada     | < 1%                             | > 95%                           | > 1%                                 | 60%                                |
| UK              | 10%                              | 90%                             | < 1%                                 | 70%                                |
| Scandinavia     | 10%                              | 90%                             | < 1%                                 | 40%                                |
| Italy           | 50%                              | 50%                             | < 1%                                 | 10%                                |
| Poland          | 60%                              | 40%                             | < 1%                                 | 30%                                |
| Germany         | 80%                              | 20%                             | < 1%                                 | 10%                                |
| France          | 90%                              | 10%                             | < 1%                                 | 10%                                |
| Spain           | 90%                              | 10%                             | < 1%                                 | 10%                                |

\* estimated

Is there a correlation of the market share of steel if grades of higher strength are typically used?

Material efficiency = Cost efficiency = Sustainability



ArcelorMittal

## European context

The trend towards S355 as base-grade can be monitored for the majority of the European markets.

S460 is used project based for value-engineering and optimization.

Driven by cost effective construction the material consumption is reduced with higher strength steels. The less material is used the lower is the environmental impact.

S235 and S275 should not be used by the designers and steel fabricators anymore.

In order to accelerate and stimulate the change this information need to be made available to the designers and steel fabricators.

**IPO's to get actively involved (e.g. all publications in S355 and S460).**

# Further advantage: Improved traceability



ArcelorMittal

| Steel grade<br>(EN10025, ETA-10/0156)      | Execution class of<br>component (EN1090-2) | Certificate<br>(EN 10204) |
|--|--|---------------------------|
| <del>S235 JR / J0, S275 JR / J0</del>      | <del>EXC1 EXC2 EXC3 EXC4</del>             | <del>&gt; 2.2</del>       |
| <del>S235 J2, S275 J2</del>                | <del>EXC1 EXC2 EXC3 EXC4</del>             | <del>&gt; 3.1</del>       |
| S355 JR / J0                               | <del>EXC1 ?</del>                          | <del>&gt; 2.2</del>       |
|  | EXC2 - EXC3 - EXC4                         | → 3.1                     |
| S355 J2 / K2 / M / ML,<br>HISTAR355 / 355L | EXC1-EXC2-EXC3-EXC4                        | → 3.1                     |
| S450 J0, S460 M / ML,<br>HISTAR460 / 460L  | EXC1-EXC2-EXC3-EXC4                        | → 3.1                     |



# Inspection documents

## EN 10204: 2004



ArcelorMittal

Table A.1 — Summary of inspection documents

| EN 10204<br>Reference | Designation of the document type         |                        |   | Document<br>content   | Document<br>validated by  |
|-----------------------|--|------------------------|---|---|---|
|                       | English version                          | German version         | French version                          |   |   |
| Type 2.1              | Declaration of compliance with the order | Werksbescheinigung     | Attestation de conformité à la commande | Statement of compliance with the order  | The manufacturer  |
| Type 2.2              | Test report                              | Werkszeugnis           | Relevé de contrôle                      | Statement of compliance with the order, with indication of results of non-specific inspection | The manufacturer  |
| Type 3.1              | Inspection certificate 3.1               | Abnahmeprüfzeugnis 3.1 | Certificat de réception 3.1             | Statement of compliance with the order, with indication of results of specific inspection     | The manufacturer's authorized inspection representative independent of the manufacturing department   |
| Type 3.2              | Inspection certificate 3.2               | Abnahmeprüfzeugnis 3.2 | Certificat de réception 3.2             | Statement of compliance with the order, with indication of results of specific inspection     | The manufacturer's authorized inspection representative independent of the manufacturing department and either the purchaser's authorized inspection representative or the inspector designated by the official regulations |

# Too good to be true ?



ArcelorMittal

| Steel grade | Cost         | Strength    | Material reduction | Traceability    | Weldability | Mill availability          |
|-------------|--------------|-------------|--------------------|-----------------|-------------|----------------------------|
| S235        | 100%         | 100%        | 100%               | Non-specific    | Good        | Good                       |
| S275        | 101%         | 117%        | 85%                | Non-specific    | Good        | Good                       |
| <b>S355</b> | <b>105%*</b> | <b>150%</b> | <b>70%</b>         | <b>Specific</b> | <b>Good</b> | <b>Good</b>                |
| S460        | 115%         | 196%        | 50%                | Specific        | Good        | > 300 sizes upon agreement |

\* Grade extra is expected to disappear once S355 is base grade for sections



ArcelorMittal

# Summary steel grades

## Recommendable steel specification for sections – Rule of thumb related to member weight

| Member type  | Steel grade   | Weight     | Section  |
|--|---|------------|--|
| <b>Ordinary steel work:</b> <ul style="list-style-type: none"><li>• Standard columns</li><li>• Floor beams</li><li>• Roof girder</li><li>• ...</li></ul>   | S355J0 or S355J2<br>(EN10025-2)<br><br>or equivalent ASTM grades                    | < 100 kg/m | IPE 80 – IPE 750<br>HE 100 – HE 320<br>UB 127 – UB 1016<br>UC 152 – UC 254<br><br>or equivalent ASTM sizes |
| <b>Large projects:</b> <ul style="list-style-type: none"><li>• Heavy columns</li><li>• Transfer beams</li><li>• Bridge girder</li><li>• Trusses</li><li>• Cellular beams</li><li>• ...</li></ul> | S355M or S355ML,<br>S460M or S460ML<br>(EN10025-4)<br><br>or equivalent ASTM grades | ≥ 100 kg/m | ≥ IPE 600<br>≥ HE 260<br>≥ HL 920<br>≥ HD 260<br>≥ UB 610<br>≥ UC 254<br><br>or equivalent ASTM sizes      |

# Comparison reinforcing steel – lacking behind state of the art



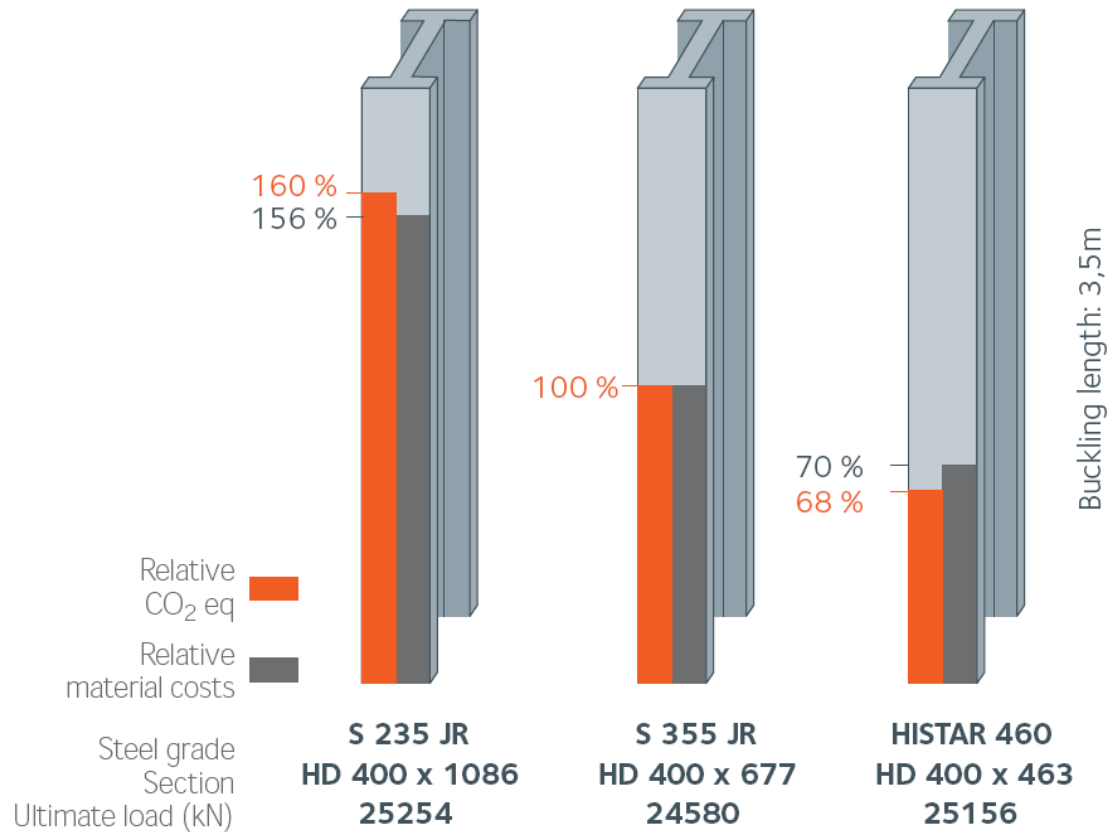
ArcelorMittal

| Reinforcing steel grade | Strength | Availability | Comparable steel grade for sections |
|-------------------------|----------|--------------|-------------------------------------|
| BSt 22/34<br>FeB 220    | 220 MPa  | Out of use   | S235                                |
| BSt 34/50<br>FeB 400    | 360 MPa  | Out of use   | S355                                |
| BSt 500<br>FeB 500      | 500 MPa  | Basis        | S460                                |

# CO<sub>2</sub> reduction of high-strength steels in heavy columns



ArcelorMittal





# Reference project – Milan / Italy



ArcelorMittal



Torre Diamante

Height 130 m – 30 floors

Architect: Kohn Pedersen Fox – USA

Fabricator: Stahlbau Pichler – Italy

700t HD column sections in S460M made in Luxembourg  
out of 100% Western European recycled steel scrap

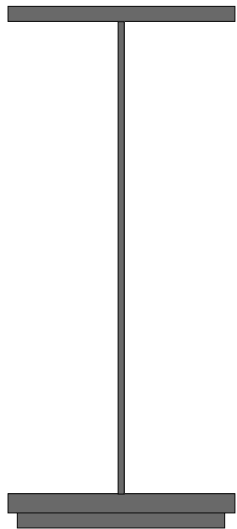


LEED Gold certificate

# Reference project – Sinzig bridge / Germany



ArcelorMittal



## Tender

S355J2

2x plate girder

581 kg/m

plus 2,6 to ext. lamella

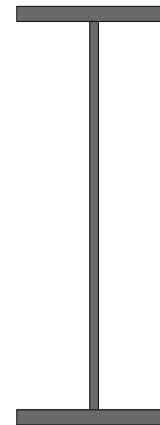
plus 6 to cross beams

**Total: 43,92 to**

Ca. 300m longitudinal welds

Construction height

1380mm + 350mm = 1730mm



## Value engineering

HISTAR460

3x rolled shape HL 1100M

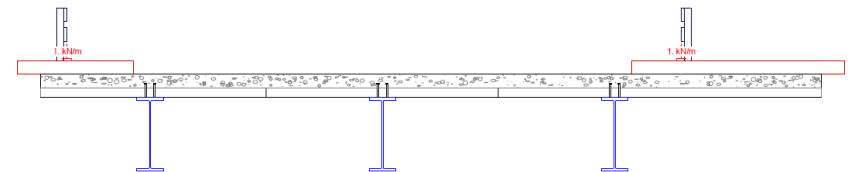
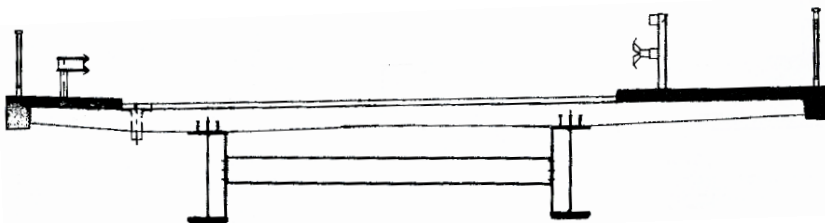
412 kg/m

**Total: 37,57 to**

No longitudinal welds

Construction height

1108mm + 350mm = 1458 mm



Thank You!  
[www.arcelormittal.com/sections](http://www.arcelormittal.com/sections)



ArcelorMittal

Home Sitemap Contact Login EN | FR | DE | ES | PL | RU | TR

ArcelorMittal

Sections and Merchant Bars

Search →

Network Products & Services Download Center Library Price Infos Sustainability News

## Sustainability

### Sustainability

#### Steel: an eco-friendly material.

Thanks to its ability to recover the original properties without loss of quality after melting makes steel the most recycled material in the world.

In the built environment, 99% of the hot-rolled steel sections can be re-used or recycled at their end of life. Being flexible and adaptable, the functional life of steel sections can be extended in refurbished and new constructions. As 100% of the recovered scrap will be used as a raw material in the steel industry and thus provides between 65% and 95% energy savings compared to primary production, recycling process contributes to resources savings and a better environment.

Life Cycle Assessment (LCA) of steel sections such as the Environmental Product Declaration (EPD-BFS-20130094-IBG1) based on World Steel Association database are built on the most appropriate "End-of-Life recycling rate" methodology which takes into account the environmental benefits of the re-use and the recycling. As stated in ISO 14025, those LCA were reviewed by independent verifiers to confirm that all these calculations are in line with the standard ISO 14040-44.

#### Sustainable hot-rolled steel solutions