HILONG Workshop

30 June, London
Natural high strength material

Silk made by a spider:

• Strength up to 5 times higher than steel
• Maximum elongation up to 300% …and more

The impact of prey animals is comparable with the kinetic energy of a fighter jet landing on an aircraft carrier!
Vallourec applications for Energy and Non-Energy markets

1. Oil & Gas
2. Power generation
3. Petrochemicals
4. Mechanical engineering
5. Automotive
6. Construction & other

Sales 2013

- 66%
- 10%
- 7%
- 6%
- 4%
- 7%
**Offshore Application**

**Exploration and Oil-, Gas-production**
- OCTG (Oil Country Tubular Goods);
  - Tubing, Casing, Riser, Drill Pipe
- Infield Offshore Products
- Feed Pipe / Line Pipe

**Offshore Structures**
- Jack-up-rigs & Oil-rigs
- Wind Turbine Installation Vessel (WTIV)
- Foundations
Infield Offshore Products

• Versatile application of pipes (Standard API 5L)
Offshore Structures

Development of steel grades which cover the requirements of:

• Offshore standards, such as EN10225
• Specifications of Offshore-Companies

Required features are:

• high mechanical values
• high Charpy values at low temperature
• excellent weldability

Oceanfit® comparable to grades specified in:
• API 5L, ABS + DNV-Rules, EN 10225 etc.
Wind Turbine Installation Vessel (WTIV)

The ‘legs‘ of each WTIV weigh about 2000 tons

(Requirements: YS min. 690 Mpa, 100 % US testing, through-thickness testing i.e. Z-test, etc.)
From Standard to High-Strength

Yield Strength

Impact Toughness

(old) standard

standard

higher strength

high strength

355 NLH

355 NH

420 NLH

460 NLH

420 NH

460 NH

St 37-2 / S 235 JRH

St 44-3 / S 275 J2H

S 355 J2H

FineXcell ® 550 - 960

Forterior ®

Development
Higher Loading Capacity

Designation:

- **S355J2H** Standard acc. to EN 10210
- **Forterior®400** Improved properties
- **Forterior®450**
- **Forterior®500**

- **FineXcell®690** High strength steel
- **FineXcell®780**
- **FineXcell®890**
- **FineXcell®960**

[http://www.vallourec.com/MECHANICALENGINEERING/EN/Products/](http://www.vallourec.com/MECHANICALENGINEERING/EN/Products/)
FineXcell® in Crane Structures

Lattice crawler cranes:
• boom cords
• Lacings
• Derrick
• Winch drums

Telescopic cranes:
• Lattice boom extension
• Weight reduction of the vehicle
  (mobility, max. axle load)
Advantages Hot Finished Compared to Cold Formed

- Different formulas in EN 10 210 and EN 10 219 for the calculation of static values

- Hot finished profiles have higher weights and higher static values than cold formed profiles with the same nominal size, due to smaller corner radii (acc. EN 10 210 - 2, Tab. B2 / B3, EN 10 219 - 2, Tab. C2 / C3)
**Buckling Curves: Hot “a” or “a₀” - Cold „c“**

Factor kappa dependent on slenderness of the column (buckling length and dimension)

Curve ‘a’ shows up to 27% higher values than curve ‘c’, curve ‘a₀’ even up to 36%

**source:** DIN 18800, Eurocode 3
Column design in Grade S 355

design load: 500 kN

hot finished:
- maximum load: 531 kN
- weight: 60.8 kg (≈ 100%)
- dimensions: 100 x 100 x 7.1 mm

cold formed:
- maximum load: 506 kN
- weight: 76.7 kg (≈ 126%)
- dimensions: 100 x 100 x 10 mm

300 cm
Hardness Distribution - Cold Formed - Hot Finished

Source: Versuchsanstalt für Stahl, Holz und Steine, University of Karlsruhe
Residual Stresses - Cold Formed - Hot Finished

EN 10 219

EN 10 210

Source: Versuchsanstalt für Stahl, Holz und Steine, University of Karlsruhe
Restrictions for Welding for Cold Formed Hollow Sections

Application Eurocode 3
cold formed hollow sections
acc. to EN 10219

\[ r_a = 2t \]

\[ r_i = r_i' + t \]
\[ r_i'/t = 1^* \]
\[ => r_i = t \]
\[ => r_a = 2t \]

*) Value for \( t = 5 \) mm

Example
Hollow section
100 x 100 x 5 mm

Welding not permitted

2t = 10
5t = 25
30 remaining weldable area
5t = 25
2t = 10
5t = 25
100
MSH - Advantages of hot finished hollow sections according to EN 10210

• Smaller corner radii which lead to higher static values (EN 10210 – EN10219)
• Larger contact area thanks to smaller corner radii
• Higher buckling load (up to 36%) due to better buckling curve
• Homogeneous hardness distribution
• Small residual stresses
• No restrictions for welding in the corner area
• Better resistance under dynamic alternating loads
• Appearance of seamless hot finished hollow sections not impaired by a weld seam
Train Station Lüttich (Gare Liège-Guillemins)

2,500 tons MSH-Profiles.
Steel grade:
• S355J2H
• S460NLH

Dimensional range (circular):
Outside Diameter 159 to 660 millimetres
Wall-thickness 5.6 to 80 millimetres

Dimensional range (rectangular):
Outside Diameter 120 x 80 millimetres
Wall-thickness 4 to 12 millimetres
Bridge over Bayerstrasse, Munich

• Principal: Bayerische Hausbau GmbH, Munich
• Architect: Ackermann und Partner Architekten BDA, Munich
• Construction and Assembly: Maurer Söhne GmbH & Co. KG, München

• Expert on high-strength steel and glass parapet: Prof. Dr.-Ing. Ömer Bucak, Munich
• Welding supervision and qualification testing: Laboratory for steel and light metal construction, Munich Technical University
• MSH sections used: 18 tonnes circular MSH sections 168.3 mm x 30 mm and 127.9 mm x 30 mm in high-strength S690 grade steel produced by Vallourec
Bridge over Bayerstrasse, Munich

Filigree structure in high-strength steel:
• Since the arch and bottom chord were executed using S690 grade steel, it was possible to use tubes with significantly smaller diameters, resulting in a 50 percent reduction in weight.
Bridge over Bayerstrasse, Munich

- A precision task, where two large cranes raised the pedestrian bridge in position; ties attached between the corners provided stability until the bridge was supported.
Thank you for your attention!