STRUCTURAL STEELS

DILLINGER – only the best for your projects

DILLINGER

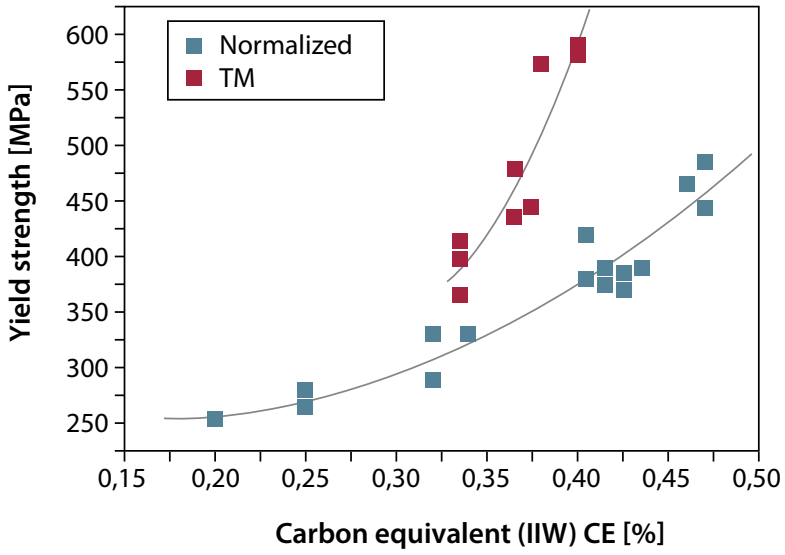
HIGH PERFORMANCE STEELS

As Europe's leading heavy plate producer Dillinger stands since more than 330 years for high class steels with leading capabilities. Our long experience has proven that for a designer or owner it pays off to select modern and innovative grades and high quality steels as early as the planning and design phase: this is how outstanding unique and sustainable structures engineered in steel evolve, via consistent exploitation of the potentials nowadays available thanks to smart product developments during steel production.

Innovative steel solutions permit not only more slender architectural aesthetics, but also highly efficient, cost optimized fabrication. The special benefits of such new developments in steel are summarized below and are illustrated by a number of selected high rise building projects which used the outstanding capabilities of Dillinger.

DI-MC - Thermomechanically rolled steels for excellent weldability

DI-MC – that is constructional steel at its best. DI-MC stands for the „Dillinger way" of producing a thermomechanically rolled steel according to EN 10025-4, e.g. a S460M corresponds to a DI-MC 460 B. Already per standard, thermomechanical rolled (TMCP) steels have improved weldability properties compared to its normalized equivalents acc. to EN 10025-3. This is especially of importance in the higher strength range, as normally to attain higher strengths additional elements must be alloyed into the steel, but will, however, necessitate greater care in welding. In these cases, higher strength thermomechanically rolled steels, such as S460M, provide the ideal compromise between high mechanical strength and excellent weldability, since the extra strength for these plates is very largely obtained by means of the special rolling process, instead of alloying. High alloying element contents are thus avoided and an extremely low carbon equivalent is achieved.



The widely used CEV and CET carbon equivalents serve as an indicator of weldability: the lower the CEV or CET, the better the weldability. Therefore these equivalents are also used to calculate the preheat temperature necessary for welding of a steel.
With DI-MC Dillinger even tops the standard: further reduced carbon equivalents compared to EN 10025-4, highest purity (sulphur and phosphorus contents) for excellent weldability and optional additional strengths above standard for an improved utilization of the steel. Ideal for top class performance. This is the "Dillinger way" of TMCP.
The very low carbon equivalent of Dillinger DI-MC steels, like DI-MC 460 B/S460M, means that this steel can be welded at a significantly reduced preheat temperature. Correct selection of welding parameters can, in fact, make it possible to dispense with preheating entirely, even in higher plate thickness ranges. DI-MC 460 thus achieves greater strengths with no losses of workability.
Because it produces its own feed material, Dillinger has at its disposal extremely thick, high quality slabs. Perfectly harmonized coordination with Dillinger's rolling and cooling technology thus permits production of heavy plates in the advantageous TMCP grades up to a plate thickness of 150 mm - with a guaranteed low CEV carbon equivalent.

Typical carbon equivalents for different steel grades (plate thickness 50 mm)

Steel grade	Typical CET [%]	Typical CEV [%]	Max. CEV [%] acc. EN 10025
S355J2+N	0.31	0.42	0.45
S355M/ML	0.22	0.34	0.40
S460M/ML	0.25	0.39	0.47

The world´s largest TM plate - a DI-MC 355 T

SAFE AND EFFICIENT STRUCTURAL DESIGNS

TMCP benefits now also available for designs based on ASTM grades:

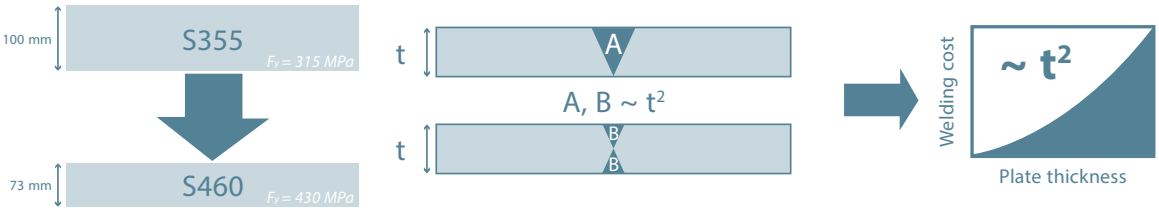
The ASTM standard A1066 *High Strength Low Alloy Structural Steel Plate Produced by Thermo-Mechanical Controlled Process (TMCP),* which was introduced in 2011 for the first time, describes plates produced by the advantageous process of thermomechanical rolling.
ASTM A1066 steels are defined in grade 50, 60, 65, 70, 80. Regarding its strength properties the ASTM A1066 grades are fully conform with the respective grades in ASTM A572, so from a design point of view A1066 grades can be applied in the identical way as before the A572 grades. But regarding processability, fabrication and safety, big benefits are exploitable when using A1066 steels. As TMCP steels generally need less alloying to achieve the strength properties, the ASTM standard A1066 guarantees these low alloying and beneficial weldability by restricting the carbon equivalent CEV of its steel grades to maximum values.
So by choosing ASTM A1066 steels all the benefits of TMCP steels (less preheating, better toughness, better surface quality, ...) will apply to the fabrication and construction. To facilitate the usage and application of A1066 steels, also from a regulatory point of view, a double certification to A572 steel grades can be possible (e.g. A1066-65/A572-65). This allows a smooth entry of these beneficial steels also in any of your projects, even when already designed.

Full strength independent of plate thickness – even in higher thicknesses

European material standards like EN 10025-4 define decreasing yield strength properties with increasing plate thickness, e.g. S355M in 100 mm has a minimum yield strength of 315 MPa. In order to save plate thickness and material, it is often beneficial to design even in high thicknesses with the strength defined for the lower thickness range. Dillinger offers therefore its thermomechanically grades optionally up to 150 mm with strength properties independent of the plate thickness, e.g. S460M with yield strength > 460 MPa even at 150 mm plate thickness. DI-MC offers strengths adjusted to your needs, not just standard.

Higher strength steels

A steel with a minimum yield strength of 355 MPa (e.g. S355N) used to be classified as a higher strength steel, whereas nowadays steels of a yield strength class of at least 460 MPa and up to 690 MPa are frequently deployed. There is a good reason for this: these new „higher strength“ steels permit significant savings on weight and space (e.g. when used in columns), and thus on costs, and provide hereby an ideal example for sustainable use of resources in structural engineering. Up to 30% of material thickness can be saved, depending on the stress situation, when using a S460 rather than a S355, thus allowing lighter designs, more slender columns and longer spans.



In addition to the obvious cost benefits of using less material, higher strength steels also offer other advantages: Firstly, the lower overall weight has beneficial implications for foundation design. Secondly, welding costs are significantly lower since they decrease at a greater rate than plate thickness.
Dillinger's high strength steels (e.g. DI-MC 460 B/S460M) are therefore an excellent alternative to a classical S355J2+N. They possess excellent workability properties and can be used with great cost efficiency even at high thickness. If a steel with a 460 MPa yield strength should run up against its limitations, particularly in heavily stressed components, however, the use of a steel with a minimum yield strength of 690 MPa will open up new design potentials. Here, thanks to this steel's good workability, Dillinger can also provide the ideal solution for even more lightweight and filigree structures in structural engineering - in the form of DILLIMAX 690.

Outstanding dimensional program by Dillinger

Using large, wide and heavy steel plates allows significant savings in fabrication cost and time by e.g. reducing the number of welds or improving the fatigue life of a steel structure. Due to the long plate rolling tradition and the exceptional production facilities of Dillinger, including strong rolling forces and the thickest slab in the world, Dillinger heavy plates can enter dimensional ranges hardly accessible by any other mill.
Widths up to 5,200 mm, single plate weights up to 42 t and plate thickness exceeding 500 mm; for the beneficial delivery condition TMCP, like DI-MC 460 B/S460M up to 150 mm.
These outstanding possibilities help the fabricator and designer to economize, e.g. by reducing lamellar welds in thick walled steel columns or by using wide plates to reduce butt welds in a bridge deck. Furthermore, the high deformation ratio possible with Dillinger production capabilities enables to deliver these plates even in high thicknesses with excellent toughness and through thickness properties.

Dillinger steel enables the opening and the closing of the Medina's sunshades (2,600 t of DILLIMAX 690 and DILLIMAX 965 in plate thicknesses of up to 70 mm): 250 gigantic sunshades cover an area of more than 156,000 m² - the equivalent of about 22 football pitches. Reaching a weight of 45 t and a height of 20 m, each sunshade protects an area of 625 m² shielding up to 800 pilgrims against the sun.

PROVEN IN IMPOSING PROJECTS

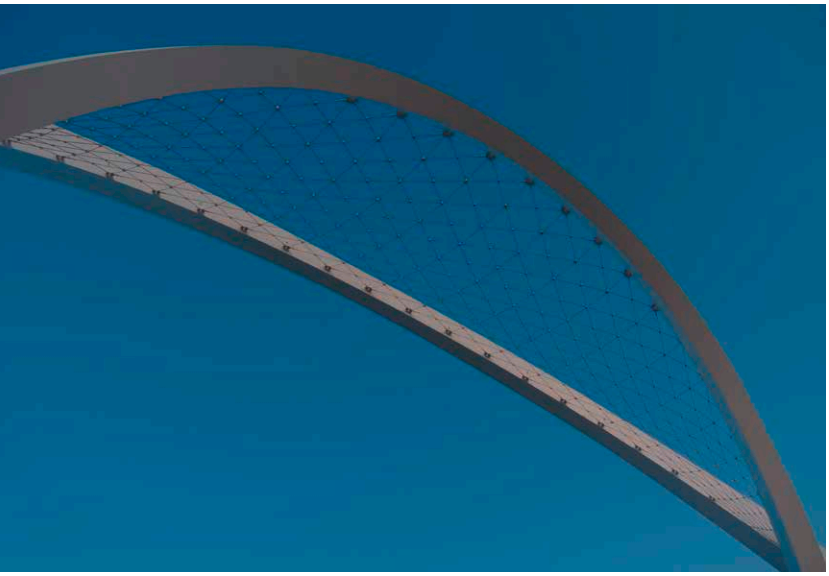
Ain Dubai

Thermomechanically rolled steels for excellent weldability | **Higher strength steels** | **Outstanding dimensional program by Dillinger**

Dillinger high grade steel rotates and ascends in Dubai's most spectacular entertainment project, the Ferris wheel Ain Dubai. Located on the Bluewaters Island, the 210 m (668 ft) high observation wheel is the largest and highest in the world, providing 360° views of the city and its coastline. Simply impressive: Boasting 9,000 t of steel, which is almost 25% more than the amount used to construct the Eiffel Tower in Paris, the wheel with a diameter of 80 m weighs more than the equivalent of eight Airbus A380s. More than 10,000 t of Dillinger steel (S690QL, S460 QL, S355NL, S355ML) in thicknesses up to 150 mm have been used for the erection of this record-breaking and breathtaking attraction.

Al Wahda Arches, Doha

Higher strength steels



Dillinger steel is at the center of the impressive development of the Lusail Expressway in Doha (Qatar). With its complex network of tunnels, flyovers and junctions, this new infrastructure project responds to the growing traffic demands and delivers a modern road network that connects people and places with speed and ease. More than 10,000 t of Dillinger steel in thicknesses up to 120 mm are implemented in the Al Wahda Arches, the centerpiece of this new road infrastructure. The dimensions of the arches are simply spectacular: the bigger one having a length of 146.52 m and a height of 98.79 m while the smaller one spans across 139.84 m in length with a height of 77.56 m and weighing together 10,000 t.

MAKING THE EXCEPTIONAL POSSIBLE

SailTower Kempinski Hotel and Residences, Jeddah

Thermomechanically rolled steels for excellent weldability

Higher strength steels

Dillinger heavy plates in thicknesses up to 150 mm are also implemented in the 67-storey Kempinski Hotel & Residences located in Jeddah, Saudi Arabia, which is part of the Sail Tower mixed used complex. The 260 m (853 ft) tower, situated perpendicular to the shoreline in order to optimize solar exposure and maximize views, stands out through its slender rectangular shape.

ADNOC Headquarters, Abu Dhabi

Full strength independent of plate thickness

Higher strength steels

Outstanding dimensional program by Dillinger

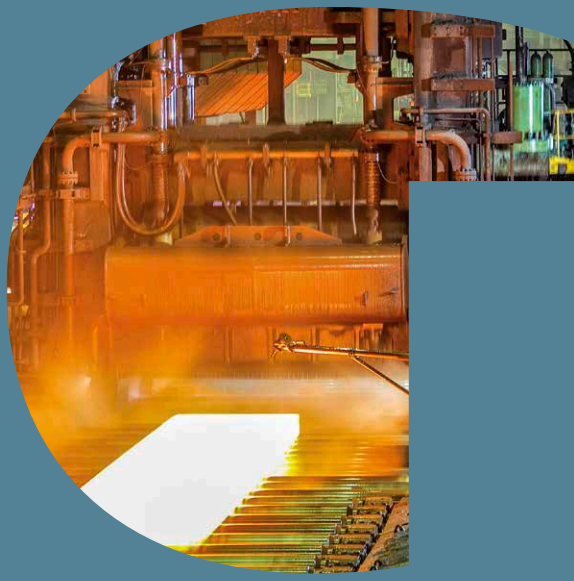
Rising to 343 m (1,100 ft) in height, the new slender 75-storey office tower of the innovative ADNOC Headquarters located at Corniche Road in a prestigious area of Abu Dhabi is eye-catching not only because of its highly asymmetrical architecture, massive from one angle and narrow from another, but also because of the parallelogram shape of the building footprint responding to the path of the sun. Elastic shortening and long term creep causes the building to twist around its vertical axis and to lean forward towards the column line.
Dillinger steel is embodied in this colossal sculpture facing and contrasting with the crystalline blue water of the Arabian Sea.

Makkah Royal Clock Hotel Tower

Thermomechanically rolled steels for excellent weldability

Higher strength steels

Boasting a height of 601 m (1,972 ft), the clock tower in the centre of the Islamic world‘s most important pilgrimage destination is the focal point of the Abraj Al-Bait complex. For this impressive and record-breaking building, Dillinger supplied 1,500 t of heavy plate in thicknesses up to 80 mm consisting, in particular, of a high strength thermomechanically rolled structural steel, for the tower‘s support structure and the crescent-tipped spire.



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