Integrated lifting and handling solutions

HEBETEC Engineering Ltd
www.hebetec.com
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Hebetec brings together an unrivalled set of skills in the specialised heavy lifting sector. It implements solutions with high added value in the following major fields: industry, on-/off-shore, construction and nuclear.

With its large equipment pool consisting a wide number of high-quality jacks and hydraulic pumps, Hebetec is involved in numerous major projects on five continents, making it to one of the leaders in its specialised areas of: lifting and moving of heavy loads; load out of ships and platforms; rental of temporary steel structures and engineering.

The lifting and lowering of heavy loads is a responsible assignment. Hebetec consequently makes every effort to keep the equipment in mint condition and to constantly improve its quality. The quality of the equipment as well as obeying the rules of security in dealing with heavy loads are two chief points in the heavy lifting business.

Hebetec is a subsidiary of the Freyssinet Group, a world leader in prestressing, cable-stayed structures, repairs, structural reinforcement, maintenance and nuclear work.

With its expertise and know-how, Hebetec Engineering is able to offer its customers integrated solutions in the field of structure handling and lifting, including installation method design, hydraulic equipment provision, temporary structure design and the implementation of specialised works.

Our expertise
Within many years of experience in lifting and handling not only the most imposing structures in the field of civil engineering but also in the construction and industrial sectors, Hebetec Engineering has taken part in numerous substantial design-and-build projects. The company has acquired world-renowned expertise and know-how.

Hebetec, your project partner
Lifting and handling are complex operations that often influence the successful completion of a project. Our teams support our customers throughout their projects, by being generally involved from the design phase onwards, in order to assess their objectives and to produce optimum solutions that fully meet their specifications in terms of structures, phasing of works, budget and lead times.

Proven technologies
Moving a structure demands absolute control over the stresses induced in the structure from the start to the end of the operation. Hebetec Engineering has therefore developed a range of specific lifting and handling equipment, with real-time control and precision enabling the most stringent requirements to be met in terms of managing reactions and movements at the jacking points.

Cover photos:
Platform moving NR2 (Korea)
Risk management
In accordance with the Hebetec safety policy, every lifting and moving process is subjected to a HAZID (HAZard IDentification study)/HAZOP (HAZard and OPERability study) type assessment involving the project method engineers and the specialist team using the equipment.

A comprehensive range of exclusive technologies
- **Strand lifting**
  - Hebetec strand jack system
- **Lifting and jacking structures**
  - MegaSteel® profile and tower systems
- **APS System**
  - Hebetec Air Pad Sliding System (APS)
- **Structure sliding**
  - Autoripage® using Hebetec strand jack system;
  - Autofonçage® using Hebetec strand jack system;
  - Air Pad Sliding (APS) using Hebetec strand jack system or a push-pull unit system.

An integrated service, from engineering studies to implementation
- Feasibility studies and operation sequencing;
- Detailed design of lifting and moving methods;
- Checks on permanent structures during stages of works (optional);
- Design of MegaSteel® temporary structures;
- Supply of specialised equipment;
- Supply and installation of MegaSteel® temporary structures;
- Performance of lifting and handling operations.

1 - Lifting the Duret water tower (France)
2 - Lifting the roof of Salzburg stadium (Austria)
3 - Bridge sliding in Boissy-Saint-Léger (France)
Strand lifting can be used to lift or lower almost any load, regardless of its height. It is a modular system that comprises setting up a jack and a lifting cable at as many points as necessary. All of the jacks are then operated and monitored simultaneously.

**Strand lifting cables**

Each bundle is made up of parallel high-strength steel strands, varying in number in line with the lifting capacity sought. A bundle may comprise a maximum of 55 strands and its maximum working load is calculated with a safety factor of 2.5.

**Hebetec strand jacks**

The bundle of strands passes through the hollow jack, which is anchored at two different levels. During lifting, the two anchors are successively placed under load: when the jack extends only the upper anchor is locked, pulling the cable, and when it retracts only the lower anchor is locked, holding the load. Because of their critical role in the success of the lifting operation, the jacks are designed and manufactured according to Hebetec requirements. This robust equipment has proven its durability and reliability during operations conducted in the course of numerous projects.

### Specifications for a lifting strand:

As per EN 10138-1 & 3

- **Nominal diameter:** 15.2-15.7 mm
- **Transverse section:** 140-150 mm²
- **Tensile strength:** 1’860 MPa
- **Nominal breaking load:** 260-279 kN
- **Modulus of elasticity:** 195 GPa

### Hebetec strand jack specifications

<table>
<thead>
<tr>
<th>Designation</th>
<th>Lifting K=2.5 (kN)</th>
<th>Stroke (mm)</th>
<th>Weight (kg)</th>
<th>Dimensions (mm) (l, w, h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-10</td>
<td>100</td>
<td>280</td>
<td>65</td>
<td>250 x 250 x 1’054</td>
</tr>
<tr>
<td>H-40</td>
<td>400</td>
<td>280</td>
<td>160</td>
<td>300 x 300 x 1’122</td>
</tr>
<tr>
<td>H-70</td>
<td>700</td>
<td>280</td>
<td>290</td>
<td>400 x 400 x 1’194</td>
</tr>
<tr>
<td>H-140</td>
<td>1’400</td>
<td>280</td>
<td>520</td>
<td>400 x 400 x 1’193</td>
</tr>
<tr>
<td>H-200</td>
<td>2’000</td>
<td>280</td>
<td>770</td>
<td>500 x 500 x 1’330</td>
</tr>
<tr>
<td>H-400</td>
<td>4’000</td>
<td>280</td>
<td>1’800</td>
<td>700 x 700 x 1’503</td>
</tr>
<tr>
<td>H-600</td>
<td>6’000</td>
<td>280</td>
<td>3’850</td>
<td>800 x 800 x 1’745</td>
</tr>
</tbody>
</table>
Hydraulic power units

In order to complete lifting operations within a period that is often just a few hours, the lifting jacks are powered by very high capacity hydraulic power units. The heaviest loads are therefore generally lifted at a rate of between 5 and 10 m/h, whereas lighter loads are lifted at rates of up to 80 m/h.

Control systems

All of the hydraulic power units are controlled from a control centre that manages all of the lifting parameters: the pressure and stroke of each jack and the movements of the structure at critical points. As an option, surveying equipment can be used for long lifting strokes and wherever high geometric precision is required. Video cameras are frequently used for complex sequences.
**STRAND LIFTING PROJECTS**

**Load-Out Daewoo SHWE (Korea)**

- Weight of the platform: 30'000 t o
- Moving distance: 230 m
- Strand jack H-1000: 4 units
- Load cell 500 tons: 16 units

**Installation of a MOAB platform (Malaysia)**

- Weight: 3'600 to
- Lifting distance (platform): 12 m
- Lowering distance (legs): 20 m
- Strand jack H-400: 16 units
- Strand jack H-140: 8 units

**Bridge segment lifting Uljanovsk (Russia)**

- Weight: 5x 4'200 to
- Lifting distance: 45 m
- Strand jack H-400: 16 units
- Strand jack H-70: 4 units
Segment lifting Bosporus Bridge (Turkey)

- Weight bridge elements: 1000 to
- Length of the bridge: 1'400 m
- Number of segments: 17 pcs
- Gantry cranes: 4 pcs
- Strand jack HA-400: 16 units

Lifting of power plant components

Generator installation
MegaSteel® is a system of profiles and accessories used to build temporary high-capacity columns or lattice towers to a very great height. It is often an essential addition to the majority of lifting and jacking operations.

Very tall columns are by their very nature liable to buckle when subjected to vertical compression, and will do so even more quickly if their column load is off-centre due to deviations from straightness, vertical alignment and the effects of horizontal loads (including the effects of the wind on a moving load). Under no circumstances must they constitute a weak point during lifting or jacking operations.

Guaranteed turnkey service
- **Robust design** based on a fully modular system with towers made up of identical stages and used in predefined and controlled configurations;
- **High-quality manufacturing** designed to reduce internal stresses and geometric defects, thus obtaining precision parts;
- **Reliable installation** based on simple, robust assemblies and tried and tested ground support accessories;
- **Structural checking** that takes into account of column fastening systems and stabilising stay cables at several levels and in different directions;
- **Tower loading controlled** using standardised transfer headers.

The MegaSteel® system has been specially designed for fast construction and dismantling. Because of its modularity, it can be transported without any particular restrictions.

Using standard, robust equipment, Hebetec’s MegaSteel® range guarantees the highest level of safety.
### MegaSteel®

<table>
<thead>
<tr>
<th>Designations</th>
<th>Types</th>
<th>Section lengths (mm)</th>
<th>Reference loads (kN)</th>
<th>Usual heights (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MS Series</strong></td>
<td>Columns</td>
<td>90 to 2'700</td>
<td>1'000 (1)</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Towers</td>
<td>2'700</td>
<td>4'000 (2)</td>
<td>40</td>
</tr>
<tr>
<td><strong>MSt Series</strong></td>
<td>Columns</td>
<td>90 to 2'700</td>
<td>2'000 (1)</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Towers cable-stayed at top</td>
<td>2'700</td>
<td>6'000 (2)</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Towers cable-stayed at 2 levels</td>
<td>2'700</td>
<td>6'000 (2)</td>
<td>80</td>
</tr>
<tr>
<td><strong>MT Series</strong></td>
<td>Columns</td>
<td>487 to 5'850</td>
<td>6'500 (3)</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Towers cable-stayed at top</td>
<td>6'480</td>
<td>15'000 (4)</td>
<td>120</td>
</tr>
</tbody>
</table>

The reference load is shown for a buckling lead of:
1. 3m
2. 40m
3. 7m
4. 100m

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1 - Self Erecting Tower System
2 - MegaSteel® single profile and tower
3 - Stay cable system for a lattice Tower
4 - Lifting the roof of an Airbus A380 hangar in Frankfurt (Germany)
5 - Lifting of a roof in Othmarsingen (Switzerland)
**APS-SYSTEM**

**How a Hebetec module works**

APS can be used to move almost any load, regardless of its dimension. It is a modular system that comprises setting up a module with a jack at as many points as necessary. All of the modules are then operated and monitored simultaneously.

The APS (Air Pad Sliding) system is an air pad technology-based sliding system used for moving large loads. Due its reduced friction coefficient (<1%), only small horizontal forces are required to move very heavy loads.

During the moving process the generously designed jack stroke of the individual modules allow significant settlings within the foundation area, while the load is controlled by a three-point suspension.

**Hebetec APS module specifications**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Plan dimensions (mm)</th>
<th>Vertical load capacity (kN)</th>
<th>Height in retracted position</th>
<th>Stroke (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 250</td>
<td>1'125 x 1'125</td>
<td>2'500</td>
<td>868</td>
<td>330</td>
</tr>
<tr>
<td>M 385</td>
<td>1'125 x 1'125</td>
<td>3'850</td>
<td>973</td>
<td>400</td>
</tr>
<tr>
<td>M 385</td>
<td>1'125 x 1'125</td>
<td>3'850</td>
<td>1'242</td>
<td>600</td>
</tr>
</tbody>
</table>

The lifting and moving capacity can be randomly expanded by the arrangement of additional modules; the simultaneous use of several hundred modules is considered best practice. Due to these properties and its high forward motion speed (up to 80 m/h), the APS system is perfectly suitable for moving platforms, ships, caissons, bridges, etc.
APS Module

APS modules are generally laid out along a sliding track (Skidways) equipped with side guides which enable sliding speeds of 20 to 80 m/h (with speeds of up to 150 m/h possible, if required). Every APS system is equipped with a high-capacity hydraulic jack used to transfer its load before and after the movement, or to adjust reaction at any time during the move. Multidirectional lifting and sliding are thus combined in one and the same compact system. The APS bearing plate is a patented device. The dedicated hydraulic power units and the control centre enable the hydraulic jacks for several APS modules to be controlled simultaneously.

Push & Pull Unit

The Push & Pull Unit is the propulsion unit of the APS system. It is basically comprised of two long-stroke cylinders attached to the skidway, thus moving the lifted object. The Push & Pull Units enable forward and backward movement of the load and are available with various capacities.

Skidways

There are two types of skidways available:

**Skidway Heavy**: represents the “heavy-duty” version of the skidway, which can usually be layed directly on the ground without further necessary measures.

**Skidway Light**: represents the “light” version of the skidway, which required an additional, concrete foundation for load distribution.

Skidways enable a safe, rapid and proven moving process.

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1 - Push & Pull Unit on skidway, bridge sliding Lustenau (Austria)
2 - Bridge sliding on APS Modules in Lustenau (Austria)
3 - Sliding on APS Modules in Dijon (France)
4 - Bottom view of APS Modules, ship Load-Out (Korea)
APS-SYSTEM PROJECTS

Platform moving NR2 (Korea)

Weight: 32'000 to 60'000 t
Moving distance: 200 m

APS-250: 208 units
Push & Pull Unit PPU-160: 6 units

Platform moving MARS-B (Korea)

Weight: 32'000 to 50'000 t
Moving distance: 91 m

APS-250: 140 units
Push & Pull Unit PPU-160: 4 units

Load-Out of 50 oil tankers (Korea)

Weight: 50x up to 22'000 t
Moving distance each: 91 m

APS-250: 140 units
Push & Pull Unit PPU-160: 4 units
Bridge moving in St. Margrethen (Switzerland)

Weight 2'300 to
Moving distance 90 m
APS-385 8 units
Push & Pull Unit PPU-32 4 units

Bridge moving Mionnay (France)

Weight 1'200 to
Moving distance 35 m
APS-385 12 units
Push & Pull Unit PPU-32 4 units

Generator moving Birr (Switzerland)

Weight 950 tons
Moving distance 24 m
APS-385 10 units
Push & Pull Unit PPU-32 2 units
Hebetec has the possibility to provide three different technologies for sliding complete structures from their fabrication area to their site of installation. They consist of prefabricating a structure next to the railway track or the road and quick transferring to its final position during a short period of track closure (approx. two days) in order to minimise traffic disruption.

Autoripage®

This technique consists of completely clearing the ground and sliding the structure onto bentonite grout using Hebetec 1'000-tonne jacks. Once the sliding is complete, backfilling takes place in order to re-open the route to traffic.

Autofonçage®

This technique consists of partly clearing the ground and then sliding and driving the structure forward into the infill as the excavation work progresses, using the same equipment as for the Autoripage® technique. No backfilling is required as the volume of earth excavated is identical to the volume of the structure.

Air Pad Sliding (APS)

This technique is identical to the Autoripage® technique, with air pad sliding bearings (APS modules) in lieu of bentonite. It consists of completely clearing the ground, installing skidways, then moving the structure onto APS modules, which have a friction coefficient of less than 1%. Once the sliding is complete, backfilling takes place in order to re-open the route to traffic.

The functional principle of the APS system is described in detail in the previous chapter.

The stages in putting a structure in place (Étampes - France)

1 - Prefabricating the structure next to the track and positioning the driving nose
2 - Start of excavation on Friday at the end of the day
3 - Excavation and sliding
Autoripage® in Micheville (Luxembourg)

World record

The Autoripage Technology was used® to slide a 60 m long structure weighing 21'000 t in 14 hours during a 72-hour track closure.

Seven 1'000 t jacks and twelve 500 t jacks were used to move the structure over a bentonite bed, reaching a maximum speed of 6.2 m/h.

Authoripage® of a rail bridge in Saint-Chéron (France)

In order to remove Saint Chéron level crossing 36, the Autoripage Technology was used to move a 37 m long structure weighing 2'400 t and equipped with approach spans (a patented procedure). Autoripage® over 21.50 m was completed in four hours during a 48-hour track closure.

APS of a rail bridge in Dijon (France)

As part of the Dijon bypass project (LINO), a 2'600 t structure over a distance of 38 m was moved, using the air pad sliding method. It was positioned in two hours during a 45-hour track closure. Twelve APS modules, each with a capacity of 385 t, and four pushing jacks with a stroke of 1'200 mm and a capacity of 32 t each, were used to move the structure at a speed of 20 m/h.

4 - Final sliding and backfilling
5 - Track back in service on Monday morning
Integrated lifting and handling solutions

MOVING HEAVY LOADS

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