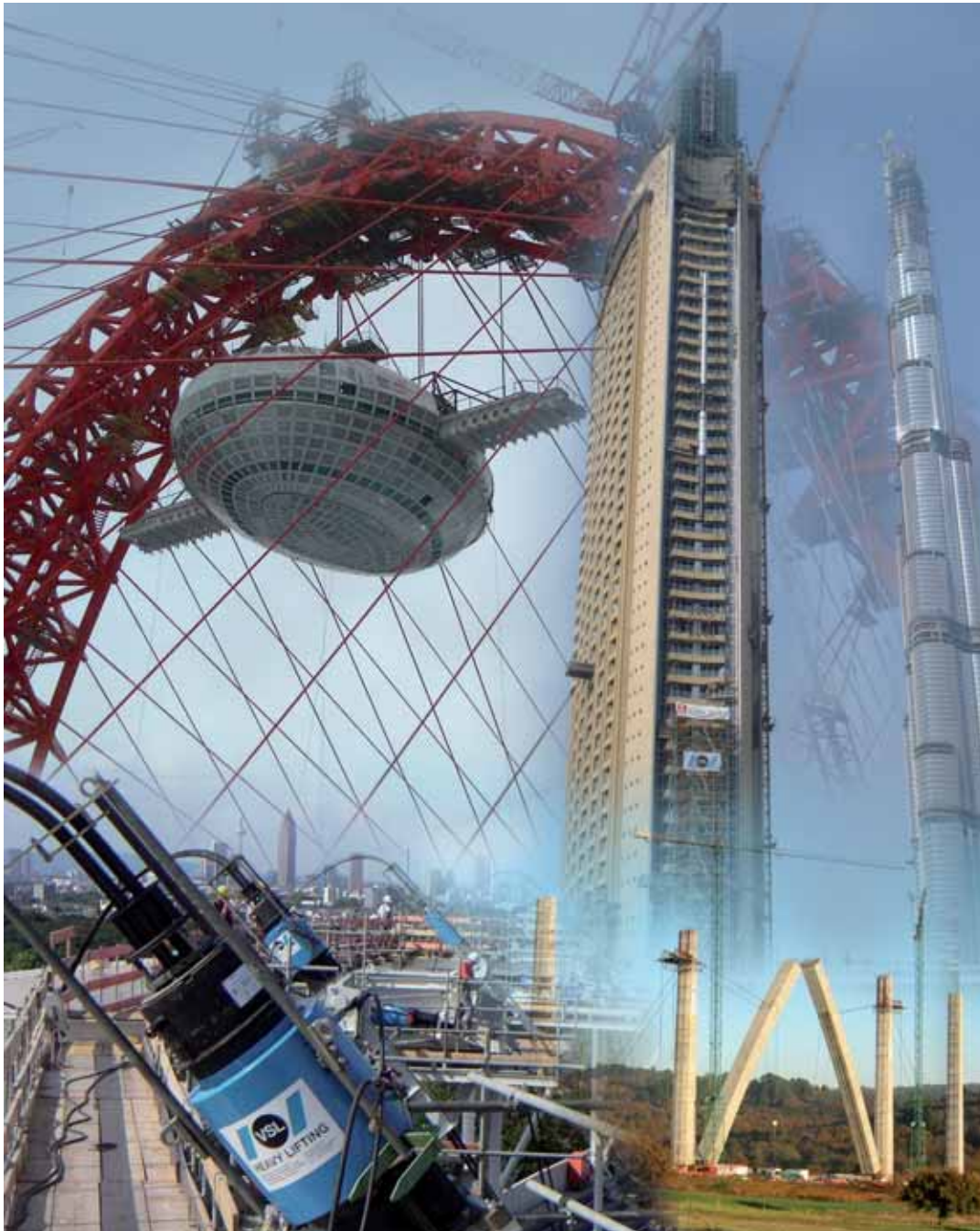


VSL HEAVY LIFTING



FEASIBILITY
STUDIES

DESIGN AND
PLANNING

HANDLING OF
EXCEPTIONAL
LOADS

SPECIAL
EQUIPMENT

RELIABILITY BASED ON DECADES OF EXPERIENCE

1970 Alumina Silo, Portoscuso, Sardinia, Italy
Lifting of silo roofs by 28m.
Roof weights: 490t each



1973 Setenave shipyard crane, Setubal, Portugal
Erection of two frame-legs of 450t each and lifting the main girder, weighing 1,640t. Lifting height: 86m



1974 Rhine Bridge Horchheim, Koblenz, Germany
Lifting of 1,200t bridge centre span from a barge. Lifting height: 22m



1978 Roihuvuori Water Tower, Helsinki, Finland
Lifting of 9,000t concrete bowl.
Lifting height: 30m



1980 SIA Hangar, Changi Airport, Singapore
Lifting by 27m of a steel roof structure weighing 3,600t.



1990

Collserola Telecommunication Tower, Barcelona, Spain
Lifting by 80m of a 12-storey service building, weighing 2,600t.
Lifting, in 3 stages, of the 100t antenna. Lifting units were installed 210m above ground level.



1993 Power Plant Beznau I, Switzerland
Transfer of two 18m-long steam generators, weighing 210t, from a truck to their final position inside the machine house.



2000 Kingston Bridge, Glasgow, UK
The heaviest lift of a single structure. The 52,000t deck was raised 15mm off its piers and held on supports over 9 months by means of a highly sophisticated jacking system.



2002 Da Chi Bridge, Taiwan
Lifting a pylon, constructed on the ground, by about 40m into a vertical position.



2004 Waldstadion Frankfurt, Germany
Lifting a steel cable roof consisting of 44 radial cables required a 21,000t pulling capacity.
Erection height: 40m



2006 Industrial Ring Road, Bangkok, Thailand
Complex construction of a completely elevated ring road. Part lifting of 60 stay cable bridge segments, each of 467t, about 50m high.



2008 Cortegada Viaduct, Spain
Rotation of triangular concrete structures weighing 2,700t and lifting of the central part of the main steel span with a weight of 240t and a length of 86m



VSL HEAVY LIFTING: CUSTOM ENGINEERED SOLUTIONS FOR THE TOUGHEST JOBS

The Company

The VSL organisation has grown from being a small Swiss post-tensioning subcontractor to an acknowledged world leader in special construction methods since its first commercial application of the VSL Post-Tensioning system in 1956. Today, the VSL Group is represented in 37 countries throughout the world and takes full advantage of the know-how within its highly qualified network. VSL Group's Heavy Lifting department provides a broad range of advantages to contractors, engineers and owners. VSL Heavy Lifting listens to the client's ideas, assists during the project phase and adapts its services to suit the customer's needs and requirements.

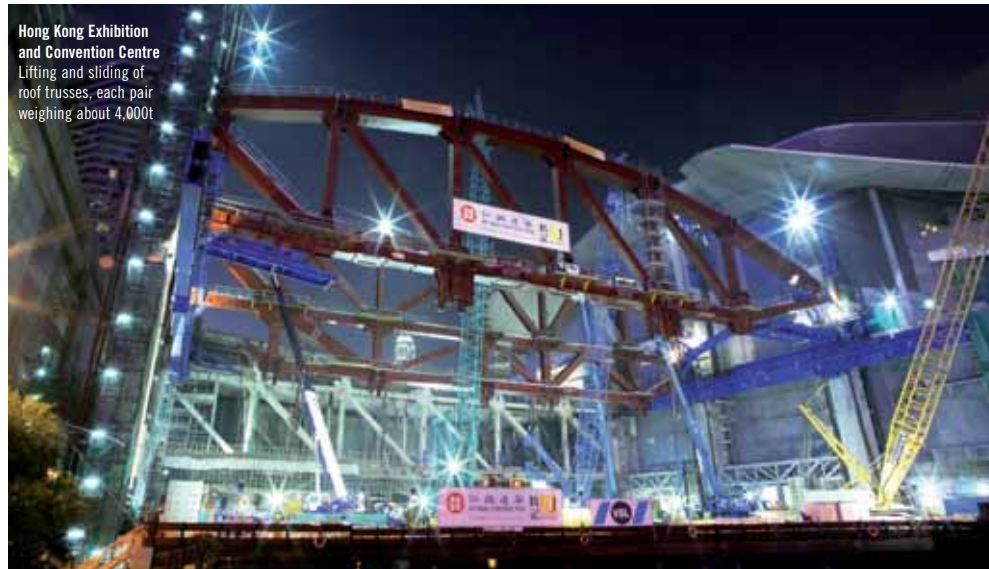
Quality Management

VSL adheres to corporate principles on trust and respect for the individual and conducts its business with uncompromising integrity. These values are enshrined in VSL policies worldwide and rigorously implemented to ensure that they are reflected in all business practices.



Stonecutters Bridge, Hong Kong
Lifting and moving of pier table segments together with simultaneous lifting of a double-deck span at each pylon. Maximum lifted weight: 4,000t, height: 70m.

VSL is committed to conducting its business in a manner that delivers leading environmental, health and safety performance. This is consistent with VSL's corporate identity and commitment to sustainability. These objectives are integrated into VSL's business planning, decision making, performance tracking and review process to ensure that goals are achieved and continually improved. VSL works hand in hand with its employees, suppliers, partners and customers.



The planning of a heavy lifting operation should start as early as possible. Early involvement of VSL specialists results in a handling scheme that optimises the project's economy, efficiency, schedule and safety.

Unique Solutions

Today's civil engineering structures and industrial plants are often assembled from large, heavy, prefabricated components for reasons of economy or practicality. Contractors, engineers and owners benefit from a wide range of advantages when using VSL Heavy Lifting, including:

- Economy and efficiency, through custom-designed solutions;
- Reliability, based on sound engineering and almost four decades of experience;
- The highest level of safety, through the use of reliable and advanced hydraulic and electronic equipment.

The VSL service range

VSL offers a complete range of services from initial concept through engineering, planning, equipment supply and execution of any Heavy Lifting project. The approach is flexible and the extent of VSL's services is tailored to specific project requirements. Services are provided worldwide by VSL Group and include:

- Feasibility studies and preliminary consultation for lifting, horizontal jacking and lowering operations;
- Project design and planning, equipment specification, scheduling and budgeting;
- Design, manufacture and supply of any special equipment and temporary structures required;
- Leasing and operation of VSL equipment and execution of work planned either by VSL or other parties.

VSL HEAVY LIFTING SYSTEMS: PROVEN EQUIPMENT FOR THE SAFE HANDLING OF HEAVY LOADS

The safety of personnel and components have first priority. VSL's specialised hydraulic lifting equipment is designed for the highest level of reliability and all equipment is rigorously tested and serviced through a quality control and maintenance programme. VSL field services also have a total commitment to safety.



SMU 40

The VSL Strand System

The VSL Strand System is designed for the lifting or lowering of suspended loads and for the pulling or sliding of loads. The system's main components are the motive unit, the tensile member with its anchorage for the load, the pump and its controls. The motive unit anchorages have a unique self-gripping feature, which maximises the inherent safety.

Motive Unit

The motive unit consists of a hydraulic centre-hole jack and upper and lower anchorages. The upper anchorage is attached to the jack piston. The jack is extended during lifting, which causes the individual strands of the tensile member to be gripped by the upper anchorage and thus moved upwards. At the start of the piston's downward movement, the strands are gripped by the lower anchorage as the upper anchorage opens. The load is therefore moved in a step-by-step process.

For lowering operations, VSL motive units are equipped with a device that automatically controls the opening and closing of the anchorages.

Lifting and lowering operations can therefore both be carried out with the same degree of safety and speed.

Hydraulic Pumps

The oil flow for the motive units is provided by electro-hydraulic pumps with either single or multiple outlets.

The characteristics of these pumps guarantee synchronised jacking, even under different loads. Built-in pressure gauges or remote pressure control devices allow pressure monitoring at all times. The pump size can be chosen to suit the load that is being moved. Movement speeds depend on the project and can exceed 20 m/hour, if required.

Tensile Member

The tensile member consists of 7-wire steel prestressing strands of 15mm nominal diameter. The tensile member is anchored to the load by a specially-designed end anchorage.

Control and monitoring systems

All VSL motive units, jacks and pumps can be operated either manually or by remote control with precision-controlled movements to within millimetres.

KEY DATA FOR VSL LIFTING UNITS

Type ¹⁾	Capacity ²⁾ kN	Max. numbers of strands	Cable diameter D (mm)	Overall dimensions		Weight ³⁾ kg
				H	W	
SLU-10	104	1	16	970	200	60
SLU-30	312	3	54	1130	250	120
SLU-40	416	4	67	1275	250	200
SLU-70	728	7	82	1122	400	230
SLU-120	1248	12	116	1400	400	430
SLU-220	2288	22	167	2100	520	1520
SLU-330	3224	31	190	2140	600	1820
SLU-440	4368	42	228	2050	610	2220
SLU-580	5720	55	254	1780	790	3250

Piston strokes vary between 160mm and 550mm, depending on the type of unit

¹⁾ The figures given in the table are also valid for Strand Moving Units of type SMU

²⁾ Capacity is based on grade 270 strands, according to ASTM A 416-90/A and a safety factor of $s = 2.5$ with respect to the minimum breaking load of the strands.

³⁾ Weights quoted are for the basic version of the lifting units.



The lifting of hangar roofs or other hyperstatic systems generally requires precise coordination of all movements. This is achieved by specially-designed, computer-based multi-point monitoring systems, which centrally control and monitor the operation to reach the final position precisely.

VSL's first priority is the safety of people, components and the environment.

Monitoring and control systems can be adapted to special requirements and are designed to provide the best solution for safe and successful execution.



Typical view of a Bravo control screen during operation

TAILOR-MADE SYSTEMS



Zhivopisni Bridge, Serebryany Bor – Moscow, Russia
Lifting by 55m of a panoramic restaurant with a weight of 660t

Flexibility

VSL's range of equipment allows to lift or lower single loads weighing well in excess of 10,000t. It includes a large selection of hydraulic jacks, pumps, control units, monitoring systems and modular lifting/jacking frames such as lifting towers, generator lifting frames and turntables. Together they give the capability and flexibility to carry out virtually any project that requires lifting, lowering or horizontal jacking.

Special Hydraulic Equipment

Our equipment range includes a large variety of hydraulic jacks with piston-strokes between 160mm and 550mm and capacities from 100kN to 5,800kN. Units can be used in tandem in cases involving exceptional loads and/or high speeds.

Equipment such as hydraulic coilers, emergency devices, sensor-controlled measuring units and other installations are also available to complete the system.

VSL can also design and supply custom-built hydraulic systems for special applications.



SMU 580,
capacity 5,800 kN, coiler set



Cable roof project
Lifting units with a specially-designed cradle

VERSATILE APPROACH

LIFTING

Stonecutters bridge, Hong Kong:
Lifting and shifting of pier table segments and simultaneous lifting of a double deck span of each pylon.



Applications are lifting, lowering, tilting, sliding

VSL is able to provide the most effective solutions for projects where excessive weight, dimensions or space limitations exclude the use of cranes or other conventional handling equipment.

LOWERING

CERN, European Organization for Nuclear Research, France:
Lowering of 15 elements of the CMS detector 97m deep into a cavern. Unit weight: up to 1,920t



TILTING

Berlin Main Railway Station, Germany:
Lowering-tilting of 4 steel structures of 1,250t each.



SLIDING

Lanjaron bridge, Spain: Launching works over a 90-m deep valley. The structure was first loaded with a counterweight and moved into a staging position. From this position, the bridge was then hoisted and pulled across the valley.



VSL HEAVY LIFTING FOR ROOF STRUCTURE



Detail: top of a temporary lifting tower

MAS (Malaysia Airlines Systems) Hangar, Kuala Lumpur, Malaysia
Lifting of a steel roof structure, weighing about 5,000t and covering 22,000m². Lifting height: 32m. In 2007 it became the hangar with the longest column-free span in the world.



Pusan Dome, South Korea
Lifting and tensioning of cable roof with a double tension ring cable and 2 x 48 radial cables.
Total installed lifting and pulling capacity: 8,000t

TURES



Airbus A380 Hangar "Saurous, Lagardère", Toulouse, France
Lifting by 18m of four 1,700t hangar roofs.



Alumina Silo, Sohar Port, Sultanate of Oman
Lifting by 50m of two delicate 250t steel silo roofs.

Sound engineering
and innovation provide
a guarantee of reliable
and cost-effective
solutions



Al Sheik Jaber Al-Ahmad Stadium, Kuwait
Lifting and tensioning of a fully-locked cable roof structure
by 32 units with a total pulling capacity of 10,560t.

VSL HEAVY LIFTING FOR INDUSTRIAL A



Camisea Gas Project, Malvinas Plant, Peru
Lifting of two deethanizer towers, each with
a height of 49m and weighing 300t.

VSL Heavy Lifting provides a high level
of safety, based on sound engineering
and decades of experience



Castelnou CCCP, Spain
Lifting of 24 modules for
two boiler units.
Lifting height: 20m.
Weight: 1,800t each



AND POWER PLANT PROJECTS



Maureen Alpha Platform decommissioning, Stord, Norway
 Skidding of a 12,000t deck by 90m onto the wharf. Lifting of storage tanks and lattice substructure for dismantling.
 Platform base area: 7,800m².; height: 235m; weight: 105,000t



Celulosa Itata, Chile
 Lifting of a 110t drum and moving it into final position at a height of 75m.



Afsin Elbistan B 4x 360 MW PP, Turkey
 Lifting of 520t suspension grillages to a height of 120m. Total weight of structures lifted in the four boiler houses: 10,000t

Severnaya 400 MW CCPP, Baku, Azerbaijan
 Positioning of a gas turbine and generator, each of 350t, required lifts of 15m and sliding by 60m. Twelve HRSG boiler modules of 1,700t total weight were also lifted.



VSL HEAVY LIFTING FOR BRIDGES



Elbebridge, Niederwartha, Germany
Erection/lifting of ten 120t deck segments by 14m.



Salgesch Railway Bridge, Sion, Switzerland
Lifting, sliding and lowering of the 400t superstructure onto its abutments



Bridge over Werkkanal, Bürglen, Switzerland
Lifting and lowering of a 500t bridge deck by means of jacks and packers.





Woronora Bridge, Sydney, Australia
Integrated launch and braking system, with 6.5% downhill launch of the 521m-long superstructure, weighing 20,000t.

VSL services are based on total commitment to client satisfaction, safety and international standards

Railway Bridge Hochdonn, Germany
Replacement of the centre span weighing 1,465t. Lowering/lifting 40m combined with tilting movements to preserve the original supports.



Woodrow Wilson Bridge, crossing the Potomac River at Alexandria, USA
Lifting two 500t spans by 40m from a barge. Span dimensions: 47m by 17m each



6th Bridge of Rouen, France
Lowering by about 15m of four 3,000t concrete caissons and two 2,400t foundations into the River Seine for the 175m-high bridge pylons.



High Speed Railway Miraflores Viaduct, Spain
Tilting into final position of 132m support arches. Weight: 1,400t each

VSL HEAVY LIFTING FOR BUILDINGS AND



Taipei 101 Building, Taipei, Taiwan
Jacking up of the 460t, 60m-long pinnacle from the 60th floor to top of what was the highest building in the world from 2003 to 2007. Final height: 508m



Suvarnabhumi International Airport, Bangkok, Thailand
Lifting and positioning of 210m-long giant 'super trusses' weighing between 1,600t and 2,200t. Lifting height: 25m



Marriott Apartments, world record sky bridge span, Dubai, UAE
Lifting the 56m-long centre part of the 280t sky bridge to the 60m-high level of the 19th floor.

AND OTHER PROJECTS



Ski Dome, Dubai Mall, Dubai, UAE
Lifting of a 2,800t steel structure complete with concrete slab and partial cladding to a height of 60m to form part of a 400m indoor ski slope.



Dammam Water Tower, Damman Al-Khobar, Saudi Arabia
Lifting a 8,100t concrete bowl to a height of about 60m.



Tunnel under Vltava River, Prague Metro Line C, Czech Republic
Underwater pulling of a 168m-long concrete tunnel in a pre-excavated trench.
Tunnel weight: 6,700t

**VSL Heavy Lifting provides
contractors, engineers and owners
with a wide range of advantages**

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