The Scharnebeck Shiplift

The Elbe-Seitenkanal, a canal in the Federal Republic of Germany, connects the sea port of Hamburg with the internal canal network (and thus to the western German and Peine-Salzgitter industrial areas) for ships up to 1350 tonnes carrying capacity. As an auxiliary canal, to the Elbe, it also improves the connection to central Germany, Berlin, and Czechoslovakia, in addition to these wide-ranging duties, the Elbe-Seitenkanal is of importance in the economic development of the area of Lüneberg and Uelzen on the border of the Federal Republic of Germany, *across which it passes. A connection with the sea* port of Lübeck by extending the Elbe-Lübeck canal is also planned for the future.

The Elbe-Seitenkanal, which connects the Elbe above Hamburg at Artlenburg with the Mittellandkanal to the west and the lock group Sülfeld from Braunschweig in the north, has a height difference of 61 m to overcome in its length of 115 km. To the foot of the Geesstrand in Scharnebeck the rise is 38 m and to south of Uelzen at Esterholz, 23 m *(see Fig. 1)*.

The long level stretches between the lock at Geesthacht on the Elbe, the two lifting devices of the Elbe-Seitenkanal and the locks at Sülfeld or Anderten on the Mittelkanal, and the increase in the section of the canal for Euro-barges, allows barge traffic to move swiftly along the Elbe Seitenkanal.

As the largest and most interesting engineering project on the Elbe-Seitenkanal, the project to *transfer ships* between two extreme levels, was put out to open tender. For this, there were 4 contenders, each of which was made up of a number of design offices and consortiums from the steel and machine building industries, both from Germany and overseas.

On the 28th November 1968, preliminaries for 5 types of installation (locks vertical lifts - longitudinal and sideways inclined lifts, and as an a special design, a water ramp) were submitted, each with a firm quotation.

After considering all the constructional, operational, and *economic points, a decision* was made on 30th June 1969 in favour of a double vertical shiplift with counterbalance weights and two independently operating lifting chambers.

This, of all the designs, exhibited the best performance, and also fulfills the requirements of the forecast for 8,4 million tonnes of goods per year moving "upstream", (with a maximum peak of 43000 tonnes per day), and 3,6 million tonnes moving "downstream" as forecast by Professor Dr. Berkenkopf in a paper on the development of the area.

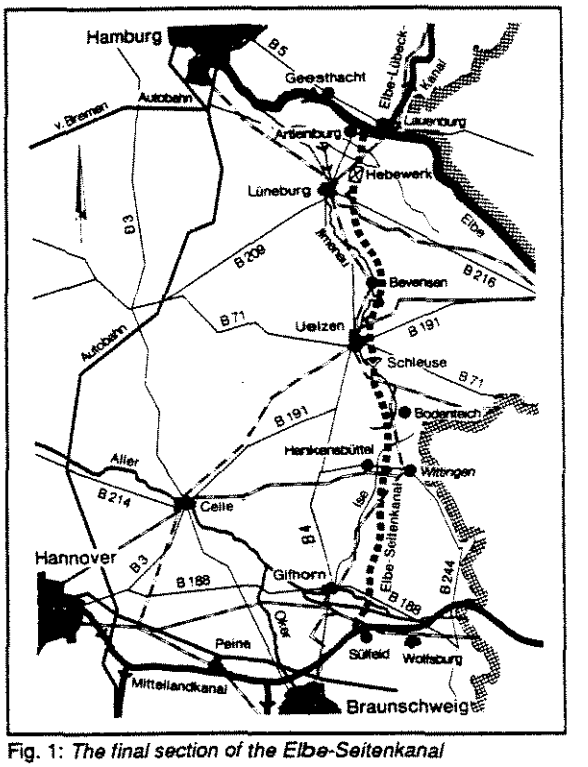


Fig. 1: *The final section of the Elbe-Seitenkanal*

The shiplift with its two chambers imparted an operational security to the Elbe-Seitenkanal and a particular usefulness as a connection between the sea port of Hamburg and the inland area which largely depends on this link. *Furthermore, when compared with the other possibilities,* it offered the lowest operating and maintenance costs, particularly considering the lack of a natural supply of sufficient water to operate the installation.

Site work started on the 15th September 1969, and the project completed in 1974/75.

The lifting chambers have a length of 100 m, a width of 12 m and a water depth of 3,5 m. They can accept an extended Euro-barge of 85 m length, or a split train of pusher-tug barges with a width of 9,50 m. or exceptionally, lighters with a beam of 11,4 m. The need to split a train of pusher-tug barges proved to be no disadvantage. Compared to transport via a 185 m long lock system with the necessity to fill the lock chambers, the time taken to couple and de-couple the train is regained by the increase in lifting speed of the shiplift.

Technical data of the shiplift

Normal lift height	38	m
Usable chamber length between shock absorbers	100	m
Chamber width between fenders	12	m
Water depth in chamber	3,50	m ± 0,10 m
O/all weight of chamber (including water)	5 700	tonnes
O/all weight of moving parts of one chamber with water	11 400	tonnes
Weight of individual counterweights (each) (6,8 x 3,4 x 0,32 m)	26,5	tonnes

Chamber drive

4 electric motors each of	150	kW
Chamber travel time approx.	3	mins.
average travel speed	0,21	m/sec
	or 12,6	m/min
max. travel speed	0,24	m/sec.
	or 14,4	m/min
Acceleration and deceleration	0,012	m/s^2

Performance of the shiplift

Lifting time including entry and exit	15	min
Lift capacity in one direction (16 hrs/day, 310 days/yrs (taking a mean ship size and rounding the usage of the load capacity)	10,10	mill. t

Dimensions of the canal bridges upstream

Length	42	m
Width between fenders	12	m

Dimensions of the entrance harbours

Length of moorings above and below lift, per side of the canal	525	m
Width of entrance harbours	90	m

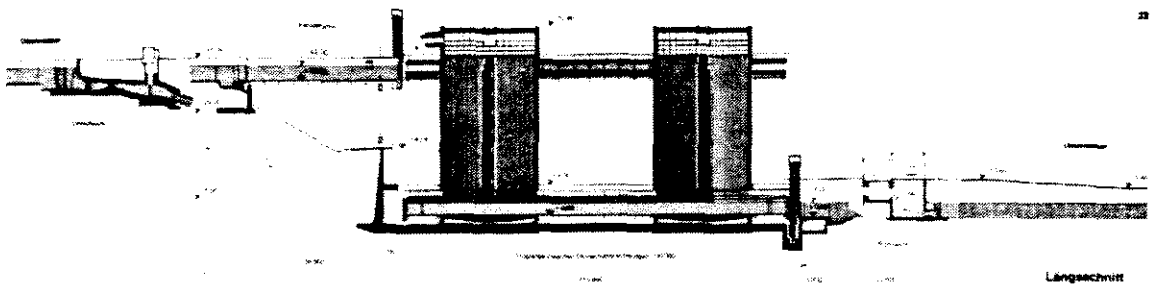


Fig. 2: *Shiplift Scharnebeck*

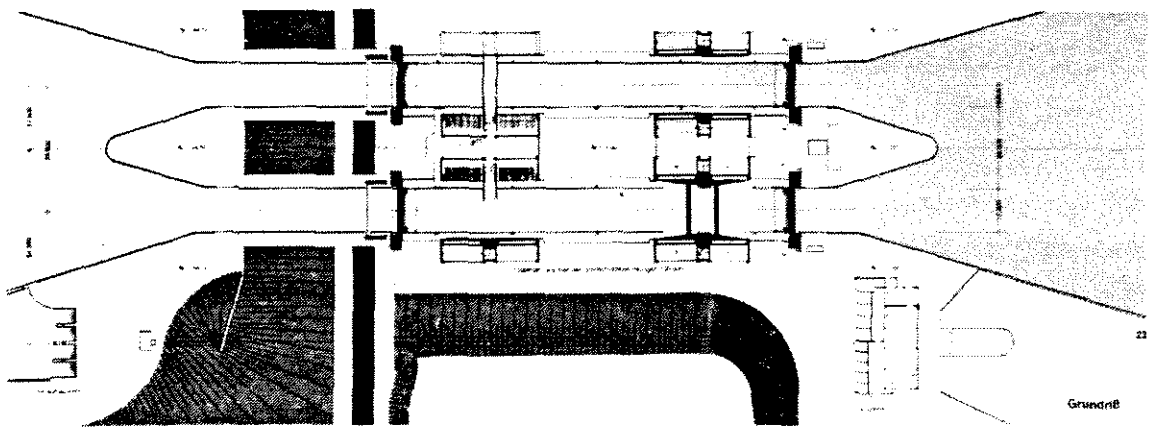


Fig. 3: *Shiplift Scharnebeck*

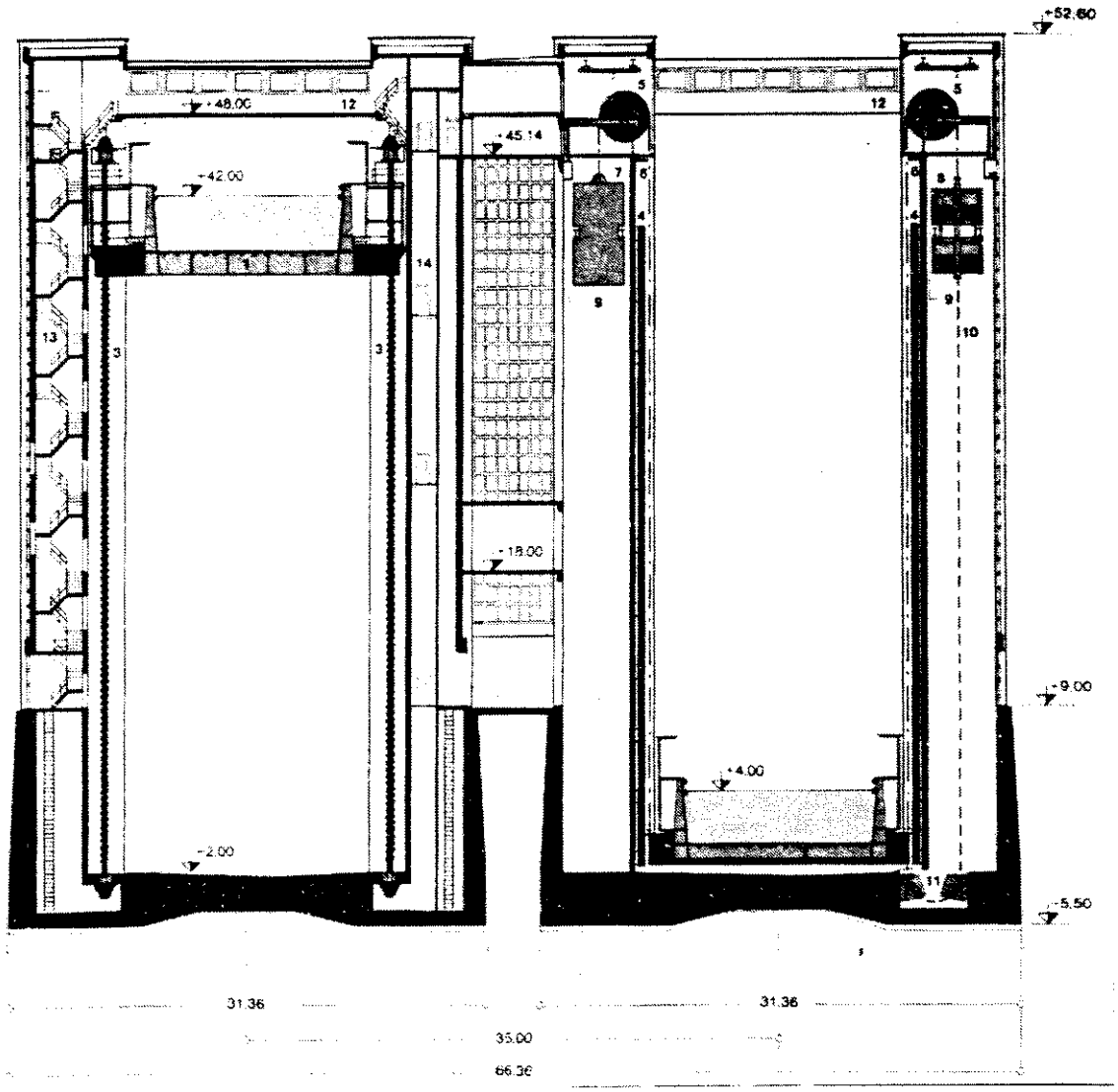


Fig. 4: *Shiplift Scharnebeck*

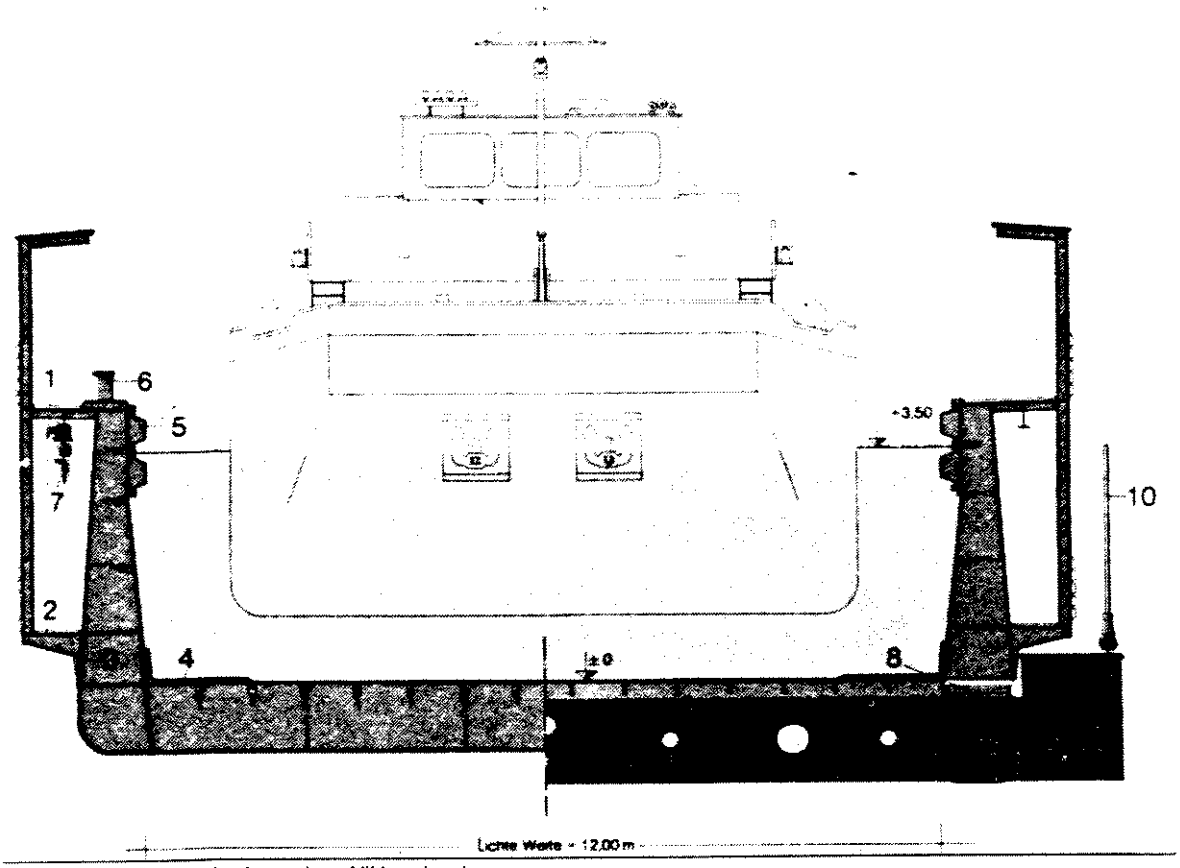


Fig. 5: *Shiplift Scharnebeck, section of lifting chamber*

1 Upper service access
2 Lower service access
3 Torsion box
4 Closing plate
5 Fender
6 Bollard
7 Travelling winch
8 Chamber bearings
9 Support frame
10 Counterweight rope

In the four guide and counterbalance towers, the water filled chamber with a weight of approximately 5700 tonnes is counterbalanced by 8 packages of 224 concrete plate like counterweights, each with a weight of about 26,5 tonnes, and also 8 extra balance weights made up of steel billets.

As each counter weight is connected to its own rope and the extra balance weights are connected to two steel cables, each chamber has 240 counterweight ropes. The 8 strand compensating cables are 54 mm diameter. These are connected to the chamber via the chamber support arms.

As the steel ropes are fitted close together, they are led around double grooved pulleys of 3,4 m dia., they thus have a diameter 65 times the rope diameter. The towers are not only used to support the rope pulleys, and thus to transfer the overall weight of 11400 tonnes to the foundations of the unit, but also to guide the chamber itself. In addition, the towers house the steps and passenger lifts.

The chambers are driven by four drives, which are mounted in the support frame in the vicinity of the towers. The rectifier drive of the fully controllable drives has a power of 150 kW. The motors drive the chambers via gearboxes, and pinions, which engage in racks fitted into the towers. These drives impart a speed of 14,4 m/minute to the chamber, allowing the lift height of the unit (38 m) to be covered in three minutes.

The four drives are connected together via a synchronising shaft system. Four nuts also run on spindles in synchronism with the main drives. These nuts run on spindles mounted in the towers and have an axial thread clearance with respect to the spindles of 30 mm in each direction. Should, catastrophically, heavy loads be applied to the main drive, and the drive pinions overloaded, the main drive motors will stop and the pinion rotate backwards to relieve the load in the direction of the excess load. The safety nuts then engage on the spindles to safely hold the chamber in position *(Figs. 6 and 7)*.

Trogantrieb – schematisch

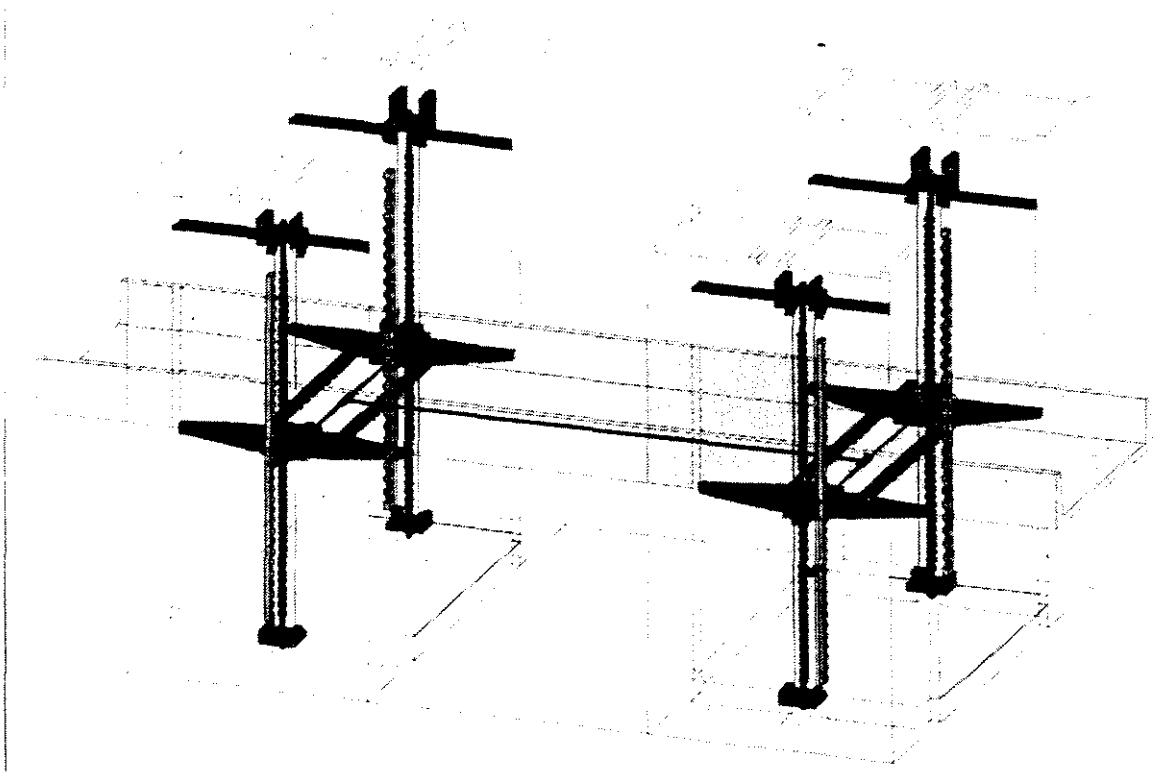


Fig. 6: Shiplift Schranebeck, schematic of chamber drive

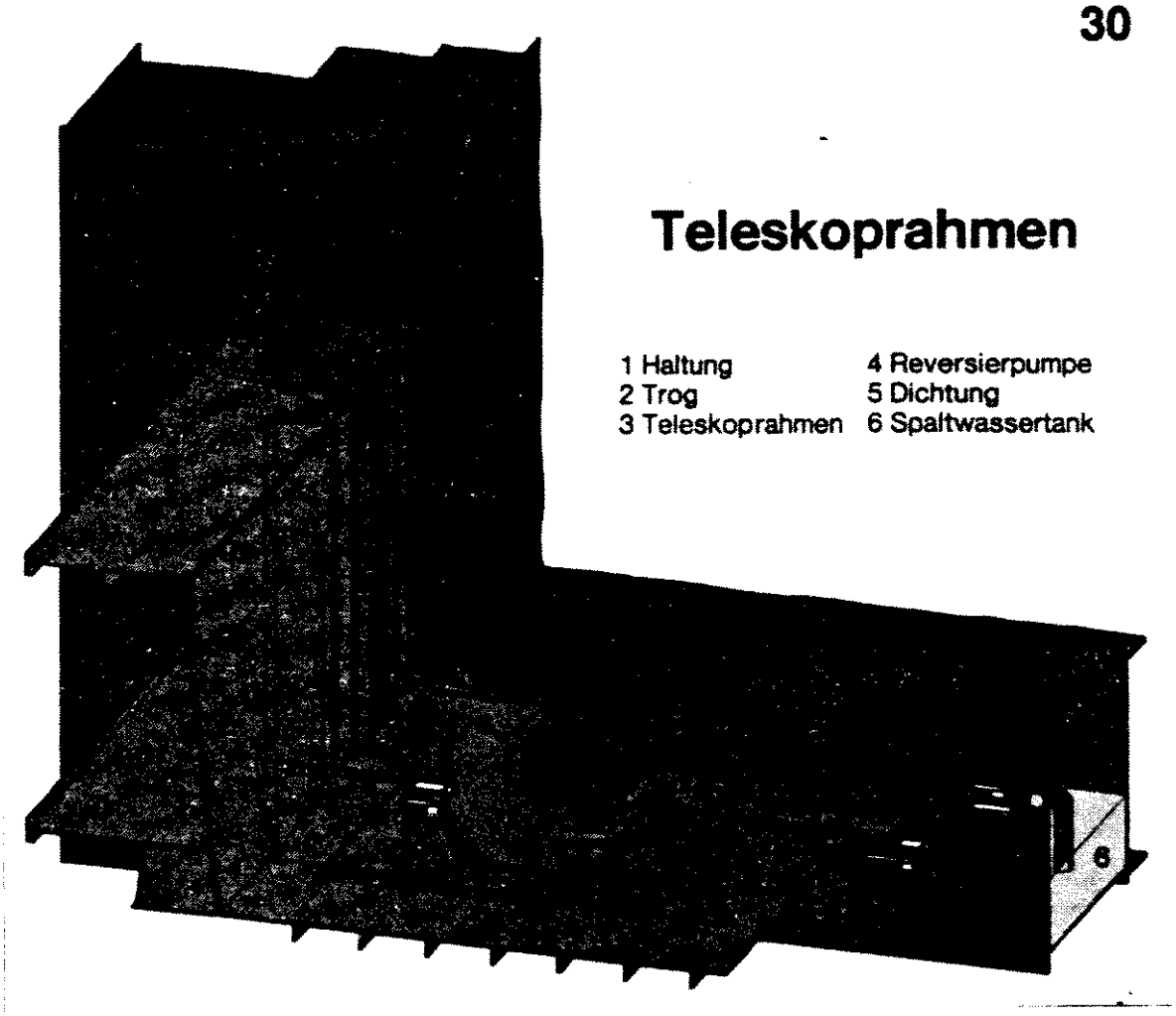
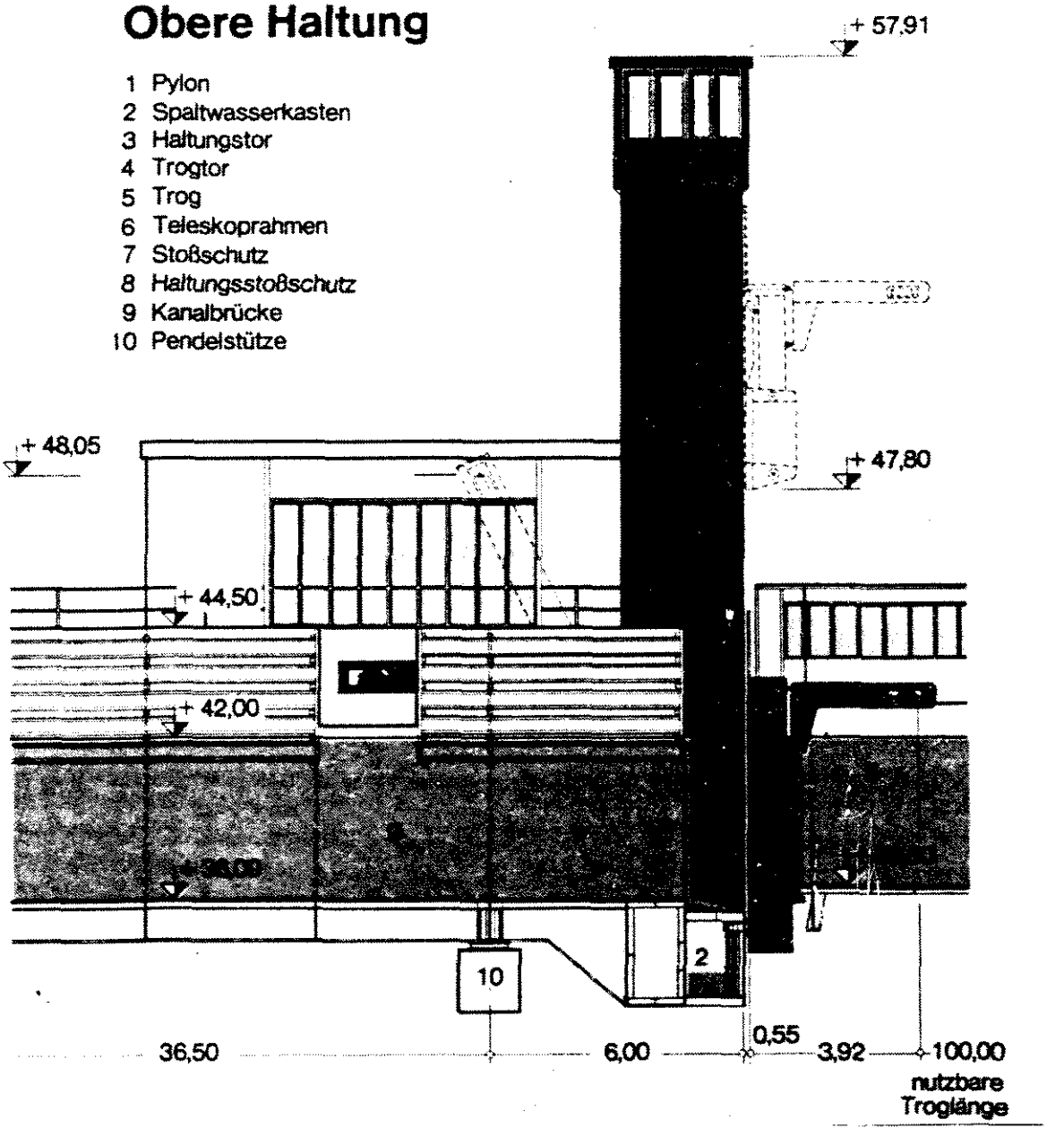


Fig. 7: *Shiplift Scharnebeck, telescopic chamber*
1 Sealing unit
2 Lifting chamber
3 Telescopic chamber
4 Reversing pump
5 Sealing
6 Intermediate water tank

The holding gates at the "upper" *(Fig. 8)* and "lower" channel gates and also the gates in the ends of the chambers are lifting gates. These chamber gates do not have their own drives, but are hooked onto the relevant channel gate and the whole, together with the crash barrier is then lifted and lowered as one. All drives, with the exception of the main drives are hydraulic. All together, a total of 28 hydraulic stations are installed.

Fig. 8: *Shiplift Scharnebeck, upper sealing unit*
1 Pylon
2 Intermediate water chamber
3 Holding gate
4 Chamber gate
5 Lifting chamber
6 Telescopic chamber
7 Arrester
8 Upper channel arrester
9 Aqueduct
10 Double sided arrester



When the water level of the electronically controlled chamber is at the same height as the water in the upper or lower channels, a telescopic connection is made between the chamber and the channel. When the sealing elements are locked, the gap can be filled with water and the holding door together with the chamber door opened as one. A shield gate at the low water end with a hanging holding door matches its position to the water level which can vary by up to 4 m *(Fig. 9)*.

The whole lifting operation can be controlled from a central control stand between the two centre towers at the upper water level, from where, ship movements and the entire lifting and lowering operations are signalled. All movements of the lifting installation including the opening and closing of the gates are then fully automatic. For repair and maintenance purposes, the individual motions can be controlled locally.

Set on the eastern side of the low water end, is a pumping station with 3 pumps, each with a capacity of 2250 L/sec. This pumping station is used to make up for leakage and evaporation, and also for irrigation purposes, to replace water in the upper channel.

The pump pipelines (each having an internal of 2,5 m) can allow flow in the opposite direction via two valves to allow flows of up to 25 m^3/sec to relieve flood water.

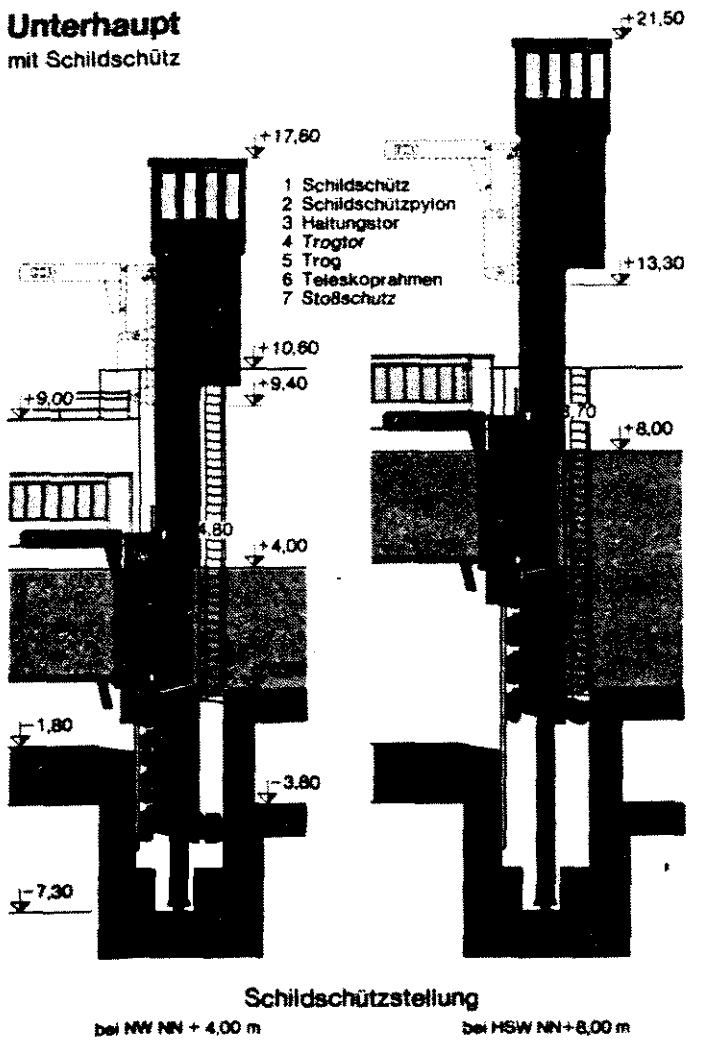


Fig. 9: *Shiplift Scharnebeck, Downstream side with shield gate*
1 Shield gate
2 Shield gate pylon
3 Holding gate
4 Chamber gate
5 Lifting chamber
6 Telescopic chamber
7 Arrester

Shiplifting Scharnebeck

Working group

Fried. Krupp GmbH
Maschinen- und Stahlbau Rheinhausen

Dinglerwerke Aktiengesellschaft

Gutehoffnungshütte Sterkrade AG

Aug. Klönne

M.A.N. Werk Gustavsburg

Rheinstahl Union Aktiengesellschaft

Christiani & Nielsen Ingenieurbau AG

Building owner

Wasser- und Schiffahrtsdirektion
Hamburg
Neubauabteilung für den Bau des
Elbeseitenkanals
Neubauamt Abstiegsbauwerke

Notes