

We make shipping possible.

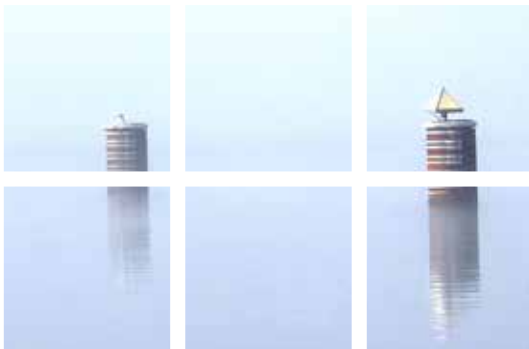


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Federal Waterways  
and Shipping  
Administration

# The Kiel Canal

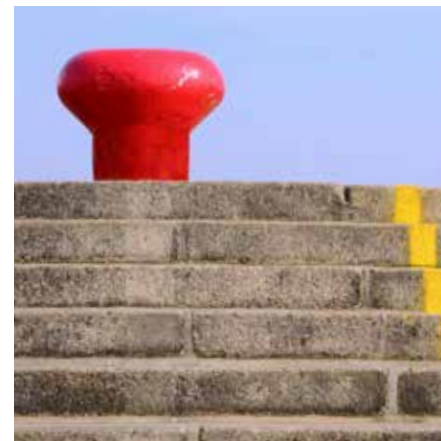
A major waterway of international importance



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## We connect seas



The Kiel Canal is the world's busiest man-made waterway navigable by seagoing ships. It is used by a similar number of ships as on the Panama and Suez Canals together.

The canal links the North Sea to the Baltic Sea and provides a direct link for the North Sea ports to the Baltic Sea region. For the seaports of Hamburg, Bremen, Bremerhaven and Wilhelmshaven, in particular, the Kiel Canal is an indispensable transit route enabling them to operate efficiently. The time and distance advantages (a saving of 460 km) offered by the Kiel Canal provide shipping with a competitive edge.

As the Federal Waterways and Shipping Administration, we ensure the continuous maintenance of the Kiel Canal and provide a safe and reliable transport route on a long-term basis.

To ensure that the Kiel Canal continues to be a high-capacity waterway for international shipping, extensive capital investment projects are being undertaken on the canal.

### Canal data

- Length: 98.6 km
- In 1895, the present-day Kiel Canal was officially opened by Emperor William II as the Kaiser Wilhelm Canal. The name was changed in 1948 to Nord-Ostsee-Kanal (North Sea to Baltic Sea Canal). Internationally, it is usually referred to as the Kiel Canal.
- Its direct predecessor was the Eider Canal, which opened in 1784
- First widened between 1907 and 1914
- Widened again between 1965 and 2002
- 10 bridges
- 2 tunnels
- 14 ferries
- 12 sidings
- Saves ships a circuitous route of around 460 km (around 250 nautical miles)
- Is the largest man-made receiving body of water in Schleswig-Holstein
- The Federal Waterways and Shipping Administration is responsible for the Kiel Canal.





# The direct route between the North Sea and the Baltic Sea

### Course

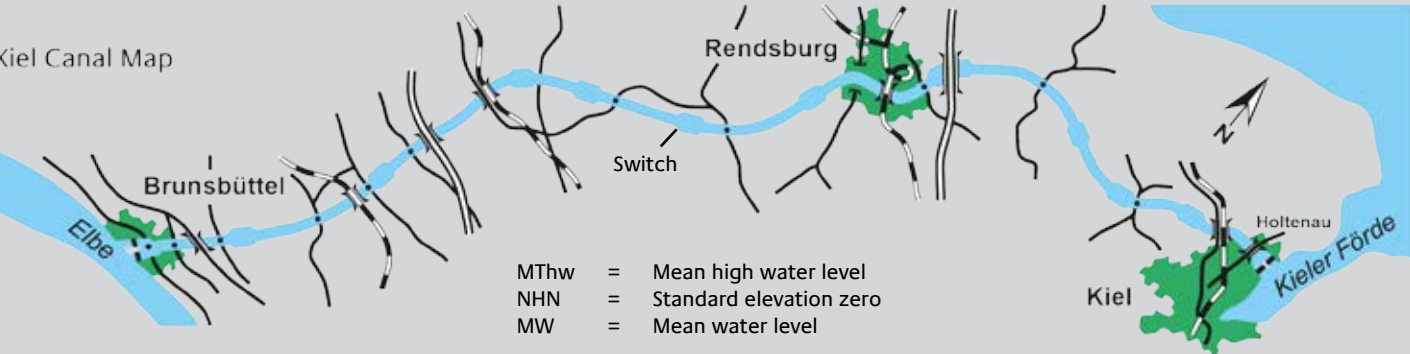
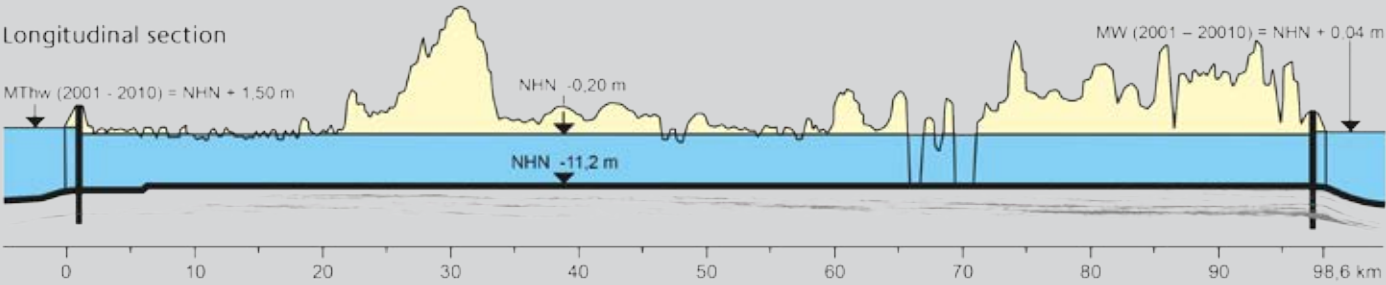
The Kiel Canal links the Elbe at Brunsbüttel to the Kiel Fjord. In a series of bends and straights, it crosses marsh-land in the West that is up to three metres lower and then cuts through the Geest Ridge, which is up to 25 m high. Subsequently, the canal follows the Eider lowland and then reaches the hill country of Holstein. After around 100 km, it arrives at its final point at Kiel-Holtenau on the Kiel Fjord. Between Brunsbüttel and Königsförde (at around canal km 80), the canal exhibits mainly curve radii of over 3,000 m and a width at the waterline of 162 m. However, the remaining section up to the Kiel Fjord has not been widened since 1914. This approximately 20 km section is characterized by sharp bends and a significantly lower waterline width of 102 m. To make it possible for a large ship to transit the canal and pass ships sailing in the opposite direction, passing places, aka sidings, have been constructed. In the sidings, the canal is significantly wider than the rest of the waterway, which means that ships can wait there for ships approaching from the opposite direction and slow ships or towed convoys can be overtaken.

### Canal bed

The Kiel Canal is fed by numerous natural affluents. The locks perform an important function in regulating the water level of the canal. They ensure that shipping always has sufficient and guaranteed water depth and bridge clearance.

In the course of its over 100-year history, the Kiel Canal has been widened three times (see figure entitled “Cross sections”). Starting from a flat bottom, the canal embankments were designed as slightly inclined wherever possible.

Because of the heavy forces exerted on the banks by the wash of the waves, the lowering of the water level and the wake from passing ships, it is absolutely essential that the banks be paved.



Locks Brunsbüttel

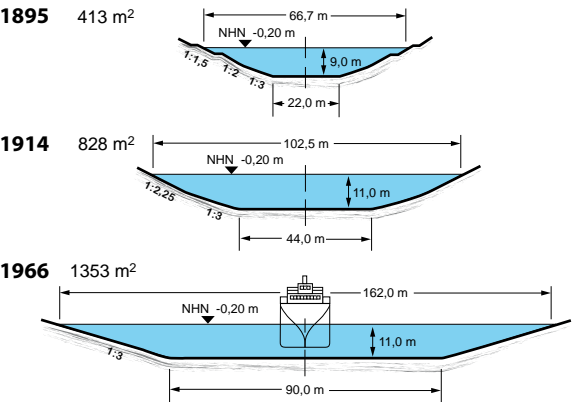
### Locks

Locks are structures that enable ships to move between different water levels. Since every locking operation means valuable navigation time for shipping, there were originally plans to construct the Kaiser Wilhelm Canal without locks.

However, tidal water level variations (especially the North Sea and the Elbe) and wind-induced water level variations would have meant that the flow velocities in the canal were too high. For this reasons, locks were constructed at the beginning and end of the Kiel Canal. When the Kiel Canal was opened in 1895, two lock chambers at Brunsbüttel and two at Kiel-Holtenau were used. Today, these are referred to as the Small Locks. As early as 1914, two additional, larger lock chambers were added at both locations. Today, these are referred to as the Large Locks.

Lateral and branch canals at the Small Locks and at the Large Lock in Holtenau reduce currents and turbulence in the lock chamber when the water level is being changed.

It is currently necessary, for safety reasons, to replace the Small Lock chambers at Kiel-Holtenau. They are thus closed to shipping until further notice.



Cross sections

### Distance and time benefits

Depending on the ports of origin and destination, navigating the Kiel Canal has significant distance benefits averaging 250 nautical miles (460 km). Depending on the speed of the ship, it is possible, through skilful route selection, to avoid losing a lot of time and to save fuel. At speeds of 12 km/h or 15 km/h, a passage of the canal takes between six-and-a-half and eight hours.

If, for instance, a ship sails from Dover to Kiel, it saves 368 nautical miles (682 km) and around 18 hours compared with a voyage via Skagen. A voyage from Hamburg to Stockholm or Riga using the Kiel Canal is 336 nautical miles (622 km) shorter and takes 16 hours less. And a ship sailing from Rotterdam to Klaipeda via the Kiel Canal can save 183 nautical miles (334 km) and two hours.

### Lock data

Small Locks, each with two chambers, at Brunsbüttel and Kiel-Holtenau

- Construction period: 1887-1895
- Usable length: 125 m
- Usable width: 22 m
- Depth on sill: - 10.20 m (standard elevation zero) – Brunsbüttel
- Depth on sill: - 9.80 m (standard elevation zero) – Holtenau

Large Locks, each with two chambers, at Brunsbüttel and Kiel-Holtenau

- Construction period: 1911-1914
- Usable length: 310 m
- Usable width: 42 m
- Depth on sill: - 14.00 m (standard elevation zero) – Brunsbüttel
- Depth on sill: - 14.00 m (standard elevation zero) – Holtenau



## Living and ...



Shipping on the Kiel Canal

The Kiel Canal is an amenity area for the residents of Schleswig-Holstein and a major tourist attraction. Because of their quiet and scenic location, the residential areas around the Kiel Canal are very popular.

There is a wide range of sporting and leisure facilities along the Kiel Canal. The banks of the canal are ideal places for resting, hiking and cycling.

Thousand of residents of Schleswig-Holstein, guests and amateur photographers follow the passages of the cruise ships. Others watch the large container ships sail by. Numerous events and a multiplicity of activities on and around the canal give it a high level of public amenity value. The approximately 100 km long canal is not only an important transit route for international shipping. The Kiel Canal is also a symbol of the State of Schleswig-Holstein and the pride of its inhabitants.



Recreational value Kiel Canal

## working on the canal and in Schleswig-Holstein

The Kiel Canal safeguards over 3,000 jobs in the region. These include not only the over 300 pilots and around 150 canal steersmen, but also shipbrokers, moorers, ferry crews, shipyards, craft enterprises, ship chandlers, tourism agencies, and restaurant and hotel operators.

In the rural regions, it is principally tourism that contributes to the development of the regional economy and thus to jobs.

Around 700 employees of the Federal Waterways and Shipping Administration not only ensure smooth operations for commercial shipping on the Kiel Canal. They also provide help and advice to yachtsmen and motor boat operators.

In Schleswig-Holstein, the maritime industry, with an annual turnover of 9.2 billion euros, is an important economic factor. Around 42,000 people are employed in around 1,400 enterprises in this sector.

Several shipyards, scores of small boatyards and numerous component suppliers underscore the importance of this production sector.

There are over 30 ports in the state, which handle over 51 million gross tonnes of cargo and more than 15 million passengers each year.

Schleswig-Holstein provides home ports for around 30,000 pleasure craft and a sizeable cutter fleet.

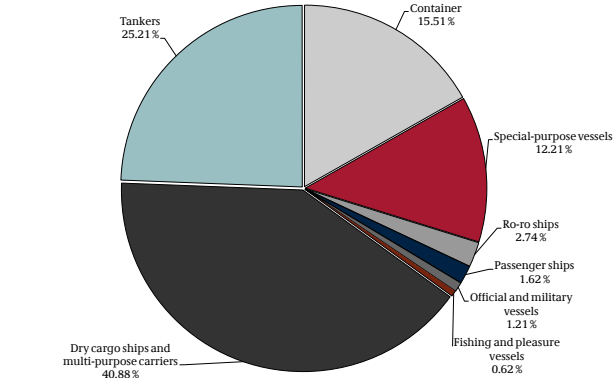


Rendsburg district port



Lürssen shipyard in Schacht-Audorf

# We connect economic areas



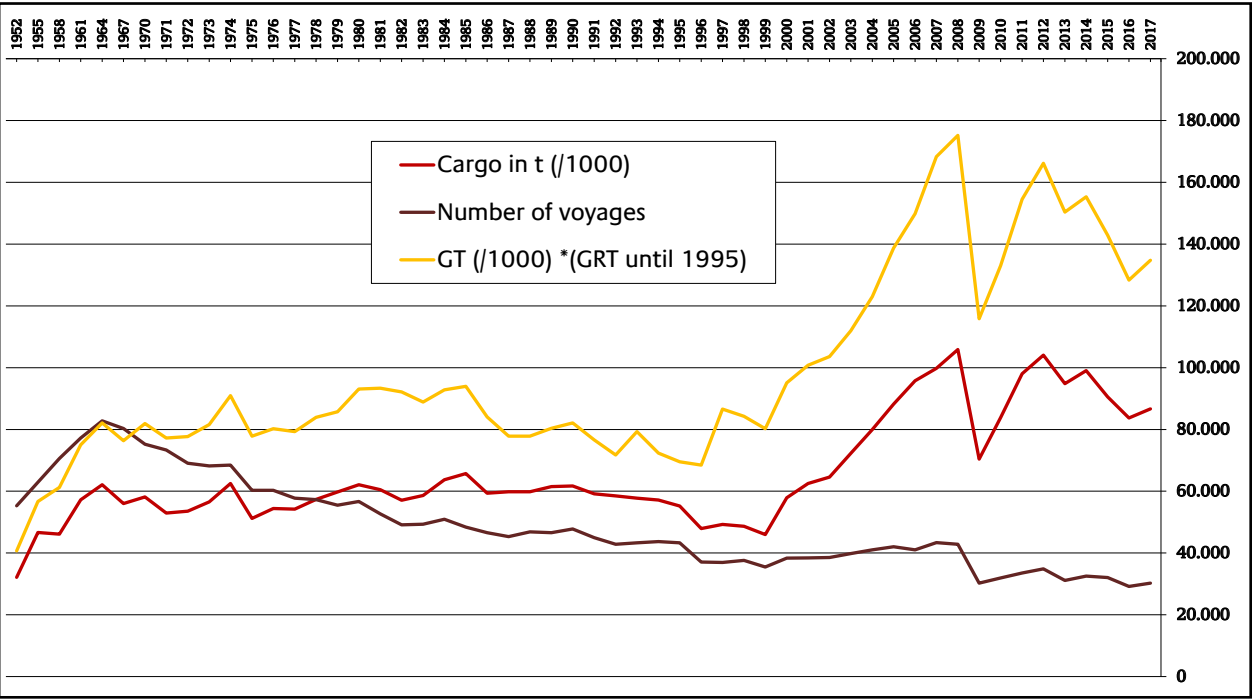
Types of ship on the Kiel Canal in 2016

The Kiel Canal is one of the major transport arteries of Northern Europe. It connects Scandinavia and the Baltic States to international traffic. The Kiel Canal, which is a federal waterway, is an attractive link between the North Sea ports in Belgium, the Netherlands and Germany and the Baltic Sea ports and the adjacent economic areas.

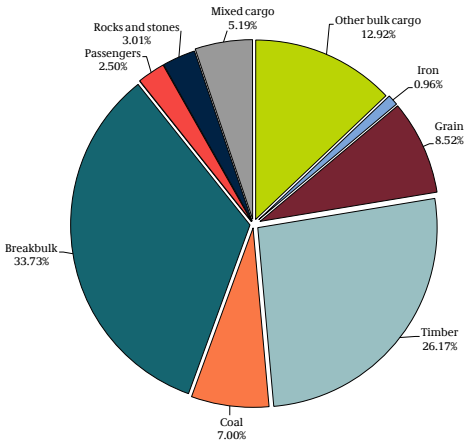
The opening of the Iron Curtain in the early 1990s and the collapse of the economies of Eastern Europe initially resulted in a sharp decline in shipping traffic.

From the late 1990s until the 2008/2009 economic crisis, there was a steady rise in the volume of shipping traffic. In 2008, over 105 million tonnes of cargo were transported on the Kiel Canal. This was the highest annual result in the history of the canal. This figure was almost equalled in 2012, when 104 million tonnes were moved. The Baltic States (Latvia, Estonia and Lithuania)

in particular, but also Poland and Russia, have contributed to a steady growth in the volume of cargo carried to date and to an increase in the volume of shipping traffic on the Kiel Canal. As the tonnage rose, the fleet structure also changed. In feeder traffic, in particular, the number and size of the ships has increased. Since 2014, the number of ships, cargo volumes and gross tonnages have been on the decline (see graph below), although the last two are still at a relatively high level. According to a study commissioned by the Federal Ministry of Transport and Digital Infrastructure on the maritime traffic forecast, there is likely to be a growing volume of cargo handled at the German seaports over the period to 2030. For the Kiel Canal, this means increasing numbers of movements. Various construction schemes are scheduled to take place in the years ahead to ensure that the Kiel Canal remains available as a high-capacity transport route for a long time to come.



Trends in shipping traffic, 1952 to 2017



Types of goods in 1900

### Maintaining the Kiel Canal

Maintenance of the Kiel Canal is funded partly from public charges (transit charge). The transit charge is used to maintain part of the canal infrastructure. Ships transiting the canal also have to pay service costs (fees for pilots and canal steersmen) and pilotage dues. The purpose of pilotage dues is to fund the pilotage infrastructure such as shore-side and seaborne pilot stations and the pilot launches. The fees for pilots and canal steersmen are the income of the pilots and canal steersmen.

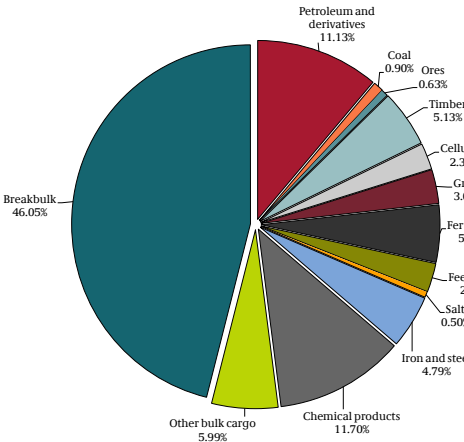
### Cargo and ship statistics

The statistics that have been kept since the Kiel Canal opened give an insight into the number and type of ships, the types and volume of cargo they carry, ports of origin and destination, gross tonnage and flag state. In addition, evaluation of the statistics provides valuable indicators of trends in economic activity and thus the needs of the canal's customers.

The canal is most frequently used by dry cargo ships (bulk carriers and break-bulk vessels), followed by tankers and container ships.

The volume of cargo carried on the Kiel Canal rose continuously until 2008. In 1990, 61.7 million tonnes of cargo were transported. By 2008, this figure had risen to 105.9 million tonnes. The economic crisis resulted in a downward trend, although the figures were still high. Thus, in 2014, the volume of cargo transported was still as much as 99 million tonnes.

International factors such as the worldwide decline in the volume of cargo handled, low bunker oil prices, a fall in shipping traffic to and from China and the economic sanctions imposed by the EU on Russia in mid-2014 have resulted in a further drop in tonnage and the



Types of goods in 2016

number of ships in recent years. Petroleum products and chemical products account for over 60 % of the total volume of cargo. It should not be forgotten that around 30 % of the total traffic and just under 10 % of the total cargo is generated by the enterprises located directly on the Kiel Canal.

### Ports

The inland port and port of refuge of Brunsbüttel, the oil port of Brunsbüttel, the port of Ostermoor, the district port of Rendsburg, the heavy-duty port of Rendsburg, Rendsburg Port at Osterrönfeld, Kiel northern port and the inland port of Kiel-Holtenau are located directly on the Kiel Canal. In its immediate vicinity are the Elbe port of Brunsbüttel, the port of refuge of Kiel-Holtenau (aka Tiessenkai) and a guest jetty for pleasure craft. The seaport of Kiel is both a cargo handling site and a place of departure for passengers travelling to Scandinavia and the Baltic States.

### Shipyards

There are several shipyards on the Kiel Canal, at Rendsburg and Schacht-Audorf. There is a large shipyard at the port of Kiel. Numerous shipyards are also located in the west and east of the Kiel Fjord. The shipyards provide jobs in the maritime environment and in turn benefit from the vibrant transport artery that is the Kiel Canal.

### Shipbrokers

At the locks in Kiel and Brunsbüttel, shipbrokers are represented, who provide their customer-focused services around the clock. These include, for instance, the supply of provisions or spare parts and the notification procedure that is necessary for a ship to pass through the canal.



## We ensure safe shipping traffic

The International Maritime Organization (IMO), a specialized agency of the United Nations, has required state governments to establish traffic safety services everywhere where the density of traffic or the hazard level are especially high. The Federal Ministry of Transport and Digital Infrastructure and the Federal Waterways and Shipping Agency jointly operate vessel traffic service (VTS) centres along the entire German coast between Germany's borders with the Netherlands, Denmark and Poland. These VTS centres inform, support and regulate shipping traffic on the German coast and on the federal waterways (maritime traffic safety). The VTS centres operated by the Waterways and Shipping Administration are executive bodies of the river and shipping police with the following responsibilities:

- traffic safety;
- averting threats to the safety and efficiency of navigation;
- preventing dangers and harmful environmental impacts that emanate from shipping.

### The vessel traffic service centres:

- inform shipping about traffic in the VTS areas;
- assist the masters by providing information, warnings and advice;
- regulate and organize traffic;
- initiate enforcement measures



Traffic management on the Kiel Canal

### Maritime traffic safety on the Kiel Canal

Maritime traffic safety on the Kiel Canal is the responsibility of the Kiel Canal Vessel Traffic Service Centre at Brunsbüttel. This VTS centre:

- regulates and organizes traffic around the clock;
- locks ships into and out of the canal;
- takes counter-terrorist measures; and
- checks the canal-worthiness of vessels.

For these functions to be performed safely and rapidly, shipping traffic must be detected, observed and monitored. This is done using state-of-the-art equipment. On the one hand, radar is used to detect the vessels, and on the other hand, the ships automatically identify themselves at short, regular intervals. This involves transmitting all available ship data, such as size, name, position, course and speed to the Vessel Traffic Service Centre.

### Traffic detection

The automatic identification system (AIS) is an important basis for maritime traffic safety.

This system was introduced worldwide in 2004 and made mandatory for all sea-going ships of 300 GT or more. The basis of on-board positioning is the Global Positioning System (GPS).

The navigators at the VTS centre use the collected and processed data to plan the locking-in and locking-out of the ships at Brunsbüttel and Kiel-Holtenau. Between the locks, the flow of traffic on the Kiel Canal is organized by the VTS centre in such a way that there are no dangerous encounters or unnecessary delays.



View from the bridge of a container ship

### Pilots on the Kiel Canal

Pilots are advisors to ships' managements. In difficult and busy pilotage waters, they contribute their extensive knowledge of the area and their experience. They thus play a crucial part in ensuring the safety of shipping. A person wishing to become a pilot must demonstrate that they have at least two years of professional experience in a responsible navigational position and complete an additional course of training as a pilot candidate. Once they have passed the examination, the Federal Waterways and Shipping Agency in Kiel commissions them as pilots.

There are two maritime pilots' associations on the Kiel Canal: NOK I in Brunsbüttel and NOK II/Kiel/Lübeck/Flensburg in Kiel-Holtenau, both of which are responsible up to the halfway point of the canal. The pilots change over at Rüsterbergen pilot station near Rendsburg.

The ships navigating the canal are sometimes so large that no water is visible from the bridge. On such a narrow and busy channel as the Kiel Canal, with frequent oncoming traffic and few opportunities for passing, it is imperative that masters be provided with advice by a person with knowledge of the local area. Entering and exiting the locks at Brunsbüttel and Holtenau is a difficult manoeuvre that requires a competent advisor. Maritime pilots do not work shifts but in a sequence in

which the pilot who has most recently worked takes their place at the bottom of the list. Working hours depend on the volume of traffic and are thus difficult to predict. Their income, which comes from pilot fees, is determined by an official tariff (Pilotage Tariff Regulations). Ships navigating the pilotage area are also charged pilotage dues. These are used by the Federal Government for the maintenance and operation of maritime pilotage facilities such as pilot stations and pilot launches.

### Canal steersmen

The occupational profile of the canal steersman has been in existence on the Kiel Canal for over 100 years. In the early days of canal navigation, accidents were a frequent occurrence. The causes were mostly to be found in the hydrodynamic effects of the narrow channel. Almost one in every 20 ships became wrecked, because the helmsmen and masters were not sufficiently familiar with the physical interaction between the ship and the embankment and between meeting ships. For this reason, the then canal authority, the Imperial Canal Office, decided that only approved canal steersmen should be allowed to steer the ships. This put an end to the series of accidents. The specially trained canal steersmen amalgamated to form the Association of Canal Steersmen. Today, they are supervised by the Federal Waterways and Shipping Agency in Kiel.



Rüsterbergen pilot station



Two-way traffic on the canal



# Managing the quantities of water

Construction of the Kiel Canal resulted in a sustained improvement in precipitation runoff in a large part of Schleswig-Holstein. The canal receives water from a catchment area of around 1,530 km², with an area of around 250 km² being drained with the help of pumping stations. The fact that the canal is connected to a section of the Eider and numerous other small rivers – or their upper reaches – means that their water flows via the canal directly into the North Sea and Baltic Sea. Thus, the Kiel Canal serves as a receiving body of water for ten percent of the area of Schleswig-Holstein.

By means of the locks in Brunsbüttel and the drainage sluice in Kiel, the water level in the canal can be kept at approximately sea level. A water level that is as constant as possible is important for both shipping and the stability of the embankments and structures.

It also ensures uniform bridge clearances and smooth cross traffic with the canal ferries.

Without these drainage facilities, the run-off rainwater entering the canal would disrupt shipping operations and build up in the tracts of land in the catchment area.

When balancing the interests of shipping, the requirements of the ferry crossings and hydrological and meteorological conditions, the drainage for the Kiel Canal must be controlled such that the water does not exceed or fall below its maximum and minimum levels respectively. This is known as water management.

Particular weather constellations, for instance stormy weather and persistent heavy precipitation, can result in inland flooding, which has to be regulated.

If, despite the drainage installations, it is not possible to prevent the water level in the canal from rising in the event of storm surges with high water levels in the North Sea and Baltic Sea, a speed limit will be imposed on shipping to protect the embankments and dykes against damage by wave action. If necessary, shipping must be suspended completely.



Drainage sluice at Projensdorf



Backwater of precipitation in the Burg Lowland at Hochdonn, photo: Helga Panknin

In addition, ferry operations will be discontinued, because interaction between a ferry and a landing stage is not possible when there are high water levels.

In recent years, there have repeatedly been situations in which shipping and ferry operations have had to be temporarily suspended. For this reason, the drainage situation of the Kiel Canal was also included in the Federal Ministry of Transport and Digital Infrastructure’s research project on the consequences of climate change for the inland waterways (KLIWAS).

These studies were conducted by the following specialized agencies:

- Federal Institute of Hydrology
- Federal Waterways Engineering and Research Institute
- Federal Maritime and Hydrographic Agency
- German Meteorological Service

A sea level rise of around 20 cm in the past 100 years has already noticeably reduced the drainage times available. Looming climate change will result in a further rise in sea level.

Thus, in 2013, the Federal Institute of Hydrology started to develop a canal balance model as a basis for forecast tools for “short-term and long-term simulations”. This will involve establishing a short-term forecast tool for simulations of the next two days and a long-term forecast tool for the period to 2100. This will make it possible to optimize adaptation measures, for instance day-to-day drainage operations, by means of anticipatory drainage of reserves and adapted pumping station operations.

The aim is to minimize disruption to shipping, ferry operations and drainage. In addition, long-term options for action, such as the creation of floodplains or the construction of a new “Kiel Canal pumping station”, can be studied and appraised.

The work is taking place with the participation of the State of Schleswig-Holstein and the water and soil boards. On the basis of the current planning status, the work on the operational forecast is likely to be completed in 2018.

In 2014, this project was notified to the Federal Ministry of Transport and Digital Infrastructure by the Federal Waterways and Shipping Agency as a contribution to the 2008 German Strategy for Adaptation to Climate Change and the 2011 German Action Plan.

## Facts and figures

- The catchment area covers 1,530 km², of which 250 km² are low-lying areas that are drained into the canal via 18 pumping stations.
- The Kiel Canal drains around 10 % of the area of Schleswig-Holstein.
- After the Eider, Trave and Stör, the catchment area of the Kiel Canal is the fourth largest, and the largest man-made, in the state of Schleswig-Holstein.
- Inflow into the canal averages around 20 m³/s of water. This is equivalent to an annual volume of 630 million m³ or four to five times the water content of the Kiel Canal.
- The mean daily drainage is 2.7 hours in Kiel-Holtenau and 2.1 hours in Brunsbüttel.
- Maximum discharge in Kiel-Holtenau is only one Tenth of the amount that can be discharged in Brunsbüttel at a rate of 600 m³/s at low tide. (600 m³/s is equivalent to the mean discharge of the Oder).



# Our bridges



Rendsburg high-level railway bridge

Construction of the Kaiser Wilhelm Canal severed some existing land routes. Bridges and ferry links closed the gaps that had been created.

In addition to the high-level bridges at Grünental and Levensau, four swing bridges and one pontoon swing bridge were constructed. The swing bridges soon proved to be a serious obstacle to shipping, rail and road traffic. As part of the first canal widening, they were almost all replaced by high-level bridges.

Together with the high-level road bridge in Kiel-Holtenau and the high-level railway bridge in Hochdonn, the high-level bridge in Rendsburg was constructed between 1911 and 1913, and is today the city’s landmark. With a length of 2,486 m and a weight of 17,700 tonnes, this giant bridge installation for the mainline from Hamburg via Neumünster to Flensburg was the largest and, technologically, the most spectacular steel structure.

In the construction of the bridge, a trick was used that had never previously been used in flat country for such differences in height. A self-intersecting 4.5 km long loop was constructed on the then undeveloped land between the canal and the Eider, making it possible to reconnect Rendsburg station, which is only about 1,000 m from the canal bank, despite the bridge crossing the canal with a clear height above the waterline of 42 m. The high-level bridge at Rendsburg has become especially noted for the transporter bridge suspended below the central girder. It is one of the last ten structures of this type in the world and has been in operation since 1913, carrying road vehicles, cyclists and passengers. The transporter bridge was seriously damaged in a collision with a ship and was completely dismantled in 2016.



Inserting the middle section of the high-level railway bridge at Hochdonn.

As a result of the increase in the requirements of road traffic, further high-level bridges have been added or already replaced over the years. Today, ten bridges cross the Kiel Canal. The Waterways and Shipping Administration is responsible for four bridges: the two high-level railway bridges at Hochdonn and Rendsburg and the two combined rail/road bridges at Grünental and Levensau.

To ensure that the approximately 100-year-old high-level railway bridges at Rendsburg and Hochdonn plus the rail/road bridge at Grünental (replaced in 1986) can be safely operated in the decades ahead, their anti-corrosion coating has to be renewed at regular intervals. Wherever necessary, steel components, or even entire bridge components, that have become seriously rusted over the years are replaced.

In November 2006, a new middle section was installed on the bridge at Hochdonn. Planning is currently underway for replacement of the old high-level bridge at Levensau. Because of its design, the oldest bridge on the Kiel Canal constitutes a bottleneck for shipping and, in connection with the upgrading of the eastern section, is to be replaced by a new structure at the same site.



Ship passing under the high-level bridges at Levensau.

More detailed information on this upgrade scheme can be found on the Internet at [www.portalnok.de](http://www.portalnok.de).

Bridge data				
Clearance of all bridges: 42 m				
Type of bridge		Length	Constructed	
High-level road bridge				
Brunsbüttel	B 5	2.826 m	1979/83	
High-level railway bridge				
Hochdonn	-	2.218 m	1915/20	
High-level motorway bridge				
Hohenhörn	A 23	391 m	1985-89	
High-level rail/road bridge				
Grünental	B 204	405 m	1983/86	
High-level railway bridge				
Rendsburg	-	2.486 m	1911/13	
High-level motorway bridge				
Rade	A 7	1.498 m	1969/72	
1 <sup>st</sup> high-level rail/road bridge				
Levensau	K 27	180 m	1893/94	
2 <sup>nd</sup> high-level road bridge				
Levensau	B 76	365 m	1980/83	
1 <sup>st</sup> high-level road bridge				
Holtenau	B 503	518 m	1992/95	
2 <sup>nd</sup> high-level road bridge				
Holtenau	B 503	518 m	1969/72	



# Our ferries and tunnels

## Ferries

14 ferries cross the Kiel Canal. In all places where roads or municipalities were partly severed as a result of the construction of the Kiel Canal, these ferries link the two banks. Vehicles and passengers can use the ferries free of charge.

Because of the high volume of traffic, two ferries are in operation at Brunsbüttel and Nobiskrug near Rendsburg. A passenger ferry shuttles between the Kiel districts of Holtenau and Wik.



Ostermoor ferry service

The ferries on the Kiel Canal are inland waterway vessels that have a standard deadweight capacity of 45 tonnes and carry up to eight cars. Two Voith-Schneider propellers make them highly manoeuvrable. The payload of the ferries operating regularly at Brunsbüttel is 100 tonnes. They can carry over 20 passenger cars at the same time. The skippers of the ferries must be in possession of a certificate of competency for navigation. A deck hand assists them in loading and unloading the vehicle ferry. Thanks to the deployment of modern technology, it is possible, if certain conditions are met, to dispense with

the deck hand at Breiholz ferry crossing. This makes safe ferry operations less expensive. The transporter bridge below the high-level railway bridge at Rendsburg, which is six metres above the water level, offers what is arguably the most unusual crossing of the canal. It is electrically powered and carries pedestrians, cyclists and up to four vehicles not exceeding 3.5 tonnes in weight. The person operating the transporter bridge does not require a certificate but must have knowledge of radar and VHF marine radio. The transporter bridge was seriously damaged in a collision with a ship and was completely dismantled in 2016. Since it is no longer possible to repair it, preparations are currently underway for the construction of a new transporter bridge. The new transporter bridge will be designed such that it resembles the historical model. Operations are not likely to recommence before 2019.

## Tunnels

Two tunnels cross below the Kiel Canal at Rendsburg. Motorized road users pass through the tunnel that forms part of the B 77 federal highway. This tunnel comprises two 640 m long bores, each with two lanes. Frost and de-icing salt have damaged the 50-year-old structure so badly that it is in need of restoration to strengthen it for the decades ahead. Alongside the installation of a cathodic corrosion protection system for the concrete, the outdated technical installations and fire safety equipment will be brought up to the state of the art. Because the tunnel is of outstanding importance not only for the city and region of Rendsburg but also for the entire road network in central Schleswig-Holstein, the road will have to remain open to traffic while the works are being carried out.

In the Rendsburg pedestrian tunnel, a total of four 55 metre long escalators lead down to the 130 metre long circular tunnel bore. Models at the new control centre on the Rendsburg side of the tunnel provide information about the two tunnel structures.



Sehestedt ferry crossing  
Rendsburg pedestrian tunnel

## Ferry and tunnel data

Ferry-crossing	Ferry-operating hours	Heaviest-single vehicle
Brunsbüttel 2nd ferry:	0:00 – 24:00 hrs	38 t
Apr. - Oct.	5:00 – 23:00 hrs	
Nov. - Mar.	5:00 – 22:00 hrs	
Ostermoor	0:00 – 24:00 hrs	38 t
Kudensee	0:00 – 24:00 hrs	38 t
Burg	0:00 – 24:00 hrs	38 t
Hochdonn	0:00 – 24:00 hrs	38 t
Hohenhörn	0:00 – 24:00 hrs	38 t
Fischerhütte	6:00 – 22:00 hrs	38 t
Oldenbüttel	0:00 – 24:00 hrs	38 t
Breiholz	0:00 – 24:00 hrs	38 t
Rendsburg transporter bridge		3,5 t
- Currently not in operation -		
Nobiskrug 2nd ferry:	0:00 – 24:00 hrs	38 t
Mon. – Sat.	6:00 – 20:00 hrs	
Sun. and holidays	13:00 – 20:00 hrs	
Sehestedt	0:00 – 24:00 hrs	38 t
Landwehr	0:00 – 24:00 hrs	38 t
Holtenau-Wik		Passengers only
Mon. – Fri.	6:30 – 22:00 hrs	
Sat. – Sun. and holidays	9:30 – 22:00 hrs	

## Rendsburg road tunnel

- Total length 1,278 m
- Enclosed tunnel section 640 m
- Two bores, each with two lanes and a width of 6.80 m
- Lowest point: Upper edge of tunnel 14.55 m below standard elevation zero
- Upper edge of carriageway 20.15 m below standard elevation zero

## Rendsburg pedestrian tunnel

- One bore with a length of 130 m
- Inner diameter 4.5 m
- In the canal axis: upper edge of tunnel 17.88 m below standard elevation zero
- Upper edge of footway 21.47 m below standard elevation zero



## We are investing in the future

Since 1998, shipping traffic on the Kiel Canal has risen by more than 25 percent. At the same time, the volume of cargo carried has doubled. In 2014, over 32,000 ships carried over 99 million tonnes of cargo through the canal. One third of all ships are dependent on the large locks and carry around two thirds of all cargo.

To ensure the safety and efficiency of navigation on the Kiel Canal, maintenance of the canal and its installations is absolutely essential. Any failure of a lock chamber can mean considerable delays for shipping.

The locks at Brunsbüttel and Kiel-Holtenau, which were constructed in 1895 and 1914, have to be adapted

to the requirements of shipping and to the constantly growing sizes of ships, for instance by regular maintenance and modernization work.

The Large Locks at Brunsbüttel will be restored to make them fit for the requirements of the decades ahead. Since this cannot be done without closing them to shipping, a new large lock chamber will be constructed beforehand as a kind of bypass.

Until this fifth lock chamber is opened to traffic in the second half of 2020, the existing lock chambers will be kept open and continue to provide a reliable service.



Siding dolphins

The flight of locks at Kiel-Holtenau is also in need of major repair/refurbishment. The first step will involve replacing the two Small Lock chambers.

Larger and larger ships and the infestation of the current wooden dolphins by the naval shipworm teredo navalis make it necessary to replace the jetty and siding dolphins by steel dolphins. The 16-pile wooden dolphins will gradually be replaced by single-tube steel dolphins.

Knowledge of the water depth is of vital importance for the safety of shipping. For this reason, the “Orka” sounding vessel regular surveys the bottom and underwater slopes of the Kiel Canal.

Dredging operations in the area around the locks at Brunsbüttel remove shoals. The sediment input from the Elbe is returned to the Elbe.

Shoals have to be removed by dredging at intervals of several years over the entire length of the canal. The material excavated here is relocated to especially deep areas within the canal.



Shipping in the lock at Brunsbüttel



The “Okra” sounding vessel



# Construction and repair

### The locks at Brunsbüttel

At the western end of the Kiel Canal in Brunsbüttel, four lock chambers are available to shipping. After over a century of use, the solid hydraulic steel structure is in need of restoration. To preserve traffic and operational safety, the mechanical and electrical systems of the Large Lock have to be restored.

Extensive scoping studies have shown that the construction of a fifth lock chamber and the subsequent restoration of the two Large Lock chambers makes sense from a value-for-money and engineering point of view and will generate the greatest benefit to the national economy, especially because it will be necessary to close one chamber for several years during the restoration work.

The impact of the construction works on nature and the environment has been closely studied. As part of a plan approval procedure with public participation, all interests were weighed up against one another.

The plan approval will create the legal framework for the construction site of the century on the canal.

The usable length for shipping of the fifth lock chamber will be 330 m – around 20 m longer than that of the Large Lock chambers. Its usable width will be 42 m – the same as the existing Large Lock. Restoration of the Large Lock will also involve renewing the sliding gates so that in the future, the sliding gates, which are designed as robust steel structures, can be exchanged between the chambers. The contracts for construction of the new, fifth lock chamber were awarded in 2014.

### Gate repair dock

A gate repair dock will be constructed in Brunsbüttel for the maintenance and repair of the eight lock gates (plus four spare gates) of the Kiel Canal. The lock gates have to be maintained regularly and given a complete overhaul every 18 years, which takes around ten months per gate. In addition, the gates are inspected every six years.



Locks at Brunsbüttel



Replacing the rails in the large chambers at Kiel-Holtenau

### The locks at Kiel-Holtenau

The Large and Small Locks at Holtenau are exhibiting damage caused by use and age, which necessitates extensive repair and modernization. Planning has commenced.

Before work starts, a new culvert crossing under the entire lock installation will be built. A new replacement sliding gate for the Large Locks is also planned. This will be less sensitive to ships running foul of it and will enhance the availability of the locks.

The fabric of the Small Lock at Kiel-Holtenau, dating from 1895, is heavily damaged. Numerous cracks at various places in the supporting masonry of the Small Lock made it impossible to take remedial action to put the lock back into operation, either in whole or in part, by the beginning of the refurbishment work. The Small Lock had to be permanently closed.

To secure the Small Lock, it will be filled in. The two chambers will then be replaced on the basis of a secured building site. First, the small chambers are to be replaced and the approaches adapted. This is to be followed by refurbishment of the large chambers.

When a large chamber is being refurbished, shipping will normally have three other chambers at its disposal, which will make it possible to avoid serious disruption. A plan approval procedure will be carried out for the construction of new replacement Small Locks and the adaptation of the approaches at Kiel-Holtenau.

### Construction of new service culverts at the locks in Brunsbüttel and Kiel-Holtenau

Culverts run below the lock installations at Brunsbüttel and Kiel-Holtenau. These underground cable ducts are used to house the necessary data and utility lines for servicing the lock installations.

The existing culverts in the lock heads have been in operation for over 100 years. They have reached the end of their life and no longer satisfy the latest safety standards. Before work starts on repairing the locks, provision has been made for constructing a new culvert under both lock installations.

The culverts are both over 400 m long and run at a depth of more than 30 m. Construction of the culvert at Brunsbüttel has been completed, and the culvert at Kiel-Holtenau is very close to completion.



## Adaptation and deepening

### Adaptation of the eastern section

The approximately 20 km long, non-upgraded eastern section of the Kiel Canal will represent a pinch point for the shipping of the future. The section between the locks at Königsförde and Kiel-Holtenau inland port, in particular, has become a bottleneck. For this reason, bend easements and widening work are planned there. Adaptation of the eastern section will allow today's largest ships (length = 253 m, width = 32.5 m, depth = 7.0 m) to have higher laden draughts. By providing more passing points, transit times will be reduced. The higher laden draughts will result in significant improvements in cargo transport costs and times and will benefit mainly the German seaports with their great share of Baltic Sea trade. The submission of the request for plan approval of the first section in 2009 launched the public approval procedure. Plan approval was granted on 4 December 2013, thus giving the construction go-ahead for the scheme. Initial preparatory work has been carried out in the area around Flemhude.

### Replacement of the high-level bridge at Levensau

The plan approval procedure for replacement of the high-level bridge at Levensau was launched in 2015. Ever larger ships, the low width at the waterline and the fact that the horizontal clearance below the old high-level bridge cannot be used over its entire width impose constraints on shipping traffic and are increasingly resulting in delays. The bridge is over 120 years old, which makes it the oldest canal bridge, and has almost reached the end of its useful life. For this reason, the bridge will be replaced by a new one. In this way, space will also be created for the necessary canal widening. The arches of the new bridge design (two-hinged arch bridge) echo the typical features of the old high-level bridge at Levensau.

**More detailed information on these upgrade schemes can be found on the Internet at [www.portalnok.de](http://www.portalnok.de).**



Shipping at Neuwittenbek

## Committed to the environment

The Kiel Canal is a man-made navigable waterway connecting the Baltic Sea to the point where the Elbe flows into the North Sea. Although the Kiel Canal is a civil engineering structure, it constitutes an important element in the ecosystem. Thanks to its biotope structures, which have evolved over decades, it offers a wide range of different habitats for native fauna and flora.

Over 75 species of fish have been identified in the Kiel Canal. The most well-known are herrings, eels, pike-perch, roach, bream, carp and flounder. Alongside the suspended solids and oxygen content, the salinity is a key parameter for the resident fish communities. The Kiel Canal also constitutes an important channel for migratory fish species such as maraena whitefish, sea trout and river and sea lampreys.

In addition to the canal bottom and the body of water, the embankments, in particular the stones used to protect them, also have a special importance as a habitat. This hard man-made substrate with its system of gaps is densely populated, for instance by invertebrates such as mysids and polychaetes, which in turn form the staple diet of the fish.

On both banks of the canal, a continuous 100 km long belt has evolved comprising a diverse range of semi-natural and natural habitats such as grasslands, woody strips, tuffaceous limestone sources or drylands, so that the Kiel Canal is part of the integrated system of protected areas and biotopes in Schleswig-Holstein.

The areas of the canal embankments that are exposed to the sun and richly structured are especially important for reptiles, among other things. Thus, for instance, there is an incidence of common vipers that is significant on a state-wide basis. In the immediate vicinity of the canal, there are also important foraging habitats for bats, which are among the species protected by European law, such as the common noctule and the common pipistrelle.



Common noctule, photo: Florian Gloza-Rausch

The abutments of the old high-level bridge at Levensau constitute a winter roosting site that is of Europe-wide importance and thus has to be protected accordingly, because they provide ideal hibernation opportunities for the bats.

Along the Kiel Canal, there is also a series of spoil fields onto which the dredged material has been, or still is, pumped and deposited. Valuable biotopes have developed in those places. Some of the old spoil fields have even been designated as protected areas. The characteristic feature of the spoil field complexes is a small-scale diversity of specific habitats such as dry grassland, fenland, forest and shrubland biotopes and small bodies of water.

One example that deserves mention is the incidence of orchids at the now disused Reichswald spoil field near Rendsburg with five different species of the orchis genus.

Whenever we carry out upgrade schemes or routine maintenance work, we take the aspects of nature conservation and water resource management into account.

Thus, for instance, when we prune back the copses as part of our maintenance activities, we take care to avoid the breeding seasons of birds. In the individual plan approval procedures for the upgrade schemes, the ecological encroachments have to be identified and appropriately compensated for. Prior to every procedure, there is close cooperation with the respective specialist environmental authorities to identify and take into account regional and European species protection.



Indigenous orchid/orchis, photo: Helga Panknin

# Focus on tourism



Sehestedt

Waterways unite nature and culture and offer countless opportunities for leisure and adventure. Each year, the Kiel Canal attracts thousands of tourists. Side-by-side with container ships, pleasure craft and luxury liners, well developed towpaths along the Kiel Canal provide an ideal space for hikers, joggers and cyclists. Free ferries make it possible to cross the canal. The Kiel Canal is also an attractive location for anglers and water sports enthusiasts.

Around 12,000 operators of pleasure craft use this federal waterway each year. As the Waterways and Shipping Administration, we see ourselves as a service provider and point of contact for people who wish to experience the waterway. We provide tips for navigating waterways, issue boatmasters' licences and ensure that professional and recreational shipping coexist safely.

Our structures can be experienced. Evidence of maritime life can be found all around the canal – the historical lock installations in Kiel-Holtenau and Brunsbüttel, high-level bridges such as the high-level railway bridge and the transporter bridge in Rendsburg (currently not in operation) and much more besides.

We are committed to the harmonious co-existence of culture and nature. At both ends of the canal, in Kiel-Holtenau and Brunsbüttel, people can watch ships being locked in and out. In Brunsbüttel, they can visit the maritime exhibition near the locks.

We make it possible for numerous festivals and events to be held on and around the Kiel Canal. One of the most prestigious boat races in the world, the E.ON Hanse Cup, is held on the Kiel Canal. Each autumn, the canal is illuminated by the “NOK Romantika” festival of lights.

## Tourism: Schleswig-Holstein facts and figures

- Around 150 cruise ships per annum in Kiel Docks
- Around 170,000 persons employed in the tourism sector
- Around 32,000 privately run accommodation establishments
- Around 4,500 commercial enterprises
- Around 9,500 catering businesses
- Around €7.7 billion turnover in the tourism industry



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