= Stord Bridge =

The Stord Bridge (Norwegian : Stordabrua) is a suspension bridge which crosses Digernessundet between the islands of Stord and Føyno in Stord , Norway . The bridge is 1 @,@ 077 meters (3 @,@ 533 ft) long , has a main span of 677 meters (2 @,@ 221 ft) and a clearance below of 18 meters (59 ft) . It carries two lanes of European Route E39 and a combined pedestrian and bicycle pathway . It is part of the Triangle Link , a fixed link which connects Stord to Bømlo , and both to the mainland . In 2010 , the bridge had an average 5 @,@ 021 vehicles per day . The bridge and the link was a toll road from the opening until 30 May 2013 .

Plans for a crossing arose in the 1960s ; and until the 1990s proposals were for a pontoon bridge further north . The Stord Bridge was conceived after the decision to combine the crossing with the Bømlafjord Tunnel . The project was resisted both by local environmental groups and the Norwegian Public Roads Administration , the latter because the new plans would delay completion . Construction was undertaken by a joint venue between NCC and HBG Steel Structures . Construction started in 1999 and was the first bridge in Norway to have the cables spun on @-@ site . The bridge cost 442 million Norwegian krone (NOK) and was taken into use on 27 December 2000 .

= = Background = =

The motivation for the Triangle Link was the desire to have a fixed link between the islands of Stord and Bømlo . The first documented proposals were made in the 1960s and involved building a pontoon bridge across Stokksundet , inspired by the plans to build what would become the Nordhordland Bridge north of Bergen . In 1973 , the municipal councils of Bømlo , Stord and Fitjar decided to launch a planning process , which concluded that a pontoon bridge between Sørstokken and Foldrøyholmen would be optimal . The report also considered bridges across the Fitjar Archipelago and a crossing via Spissøy and Føyno . There were protests from the shipping industry , who wished to continue to use the strait for ship traffic . The islands were connected with a network of five ferry services : Skjersholmane ? Valevåg connected Stord and Sveio , Skjersholmane ? Utbjoa connected Stord and Vindafjord , Sagvåg ? Siggjarvåg connected Stord and Bølmo , and Bømlo was connected to the mainland both by the Mosterhamn ? Valevåg Ferry and the Langevåg ? Buavåg Ferry .

In the early 1980s , plans for Stord Airport , Sørstokken were launched . Thus the plans for a bridge crossing Stokksundet were again raised in 1982 , this time by the industry on Bømlo , who would have to travel by ferry to reach the new airport . A committee was established in May 1983 , which gave Engineer Harald Møyner the assignment of producing a new report . He launched three proposals : a pontoon or suspension bridge between Foldrøyholmen and Litlaneset ; a suspension bridge between Setraneset and Sokkbleikjo , which would terminate just south of the new airport ; and a combined fixed link between Spissøy and Digernes , without passing via the Fitjar Archipelago . The latter proposal was the first time a fixed link to the mainland was proposed . The Norwegian Civil Aviation Administration protested against a possible suspension bridge near the airport , but stated that one further away would be fine .

Surveys of traffic patterns on Bømlo were undertaken by Hordaland Public Roads Administration in 1984 . Based on it and other feedback , the agency stated that it preferred a pontoon bridge between Foldrøyholmen and Sørstokken , north of the ferry between Bømlo and Stord . It was estimated to cost NOK 190 million , in addition to auxiliary roads for NOK 40 million . In 1982 , plans were launched for a fixed link to the mainland further south , which would include a bridge over Digernessundet , a causeway and low bridge across Spissøysundet and a low bridge over Gassasundet . In addition , a tunnel would have to be built from Føyno to Sveio . This proposal was similar to the finalized Triangle Link . In 1985 , an all @-@ tunnel proposal , following the same route , was proposed . Hordaland Public Roads Administration stated that the proposals were unrealistic . The limited company Ytre Sunnhordland Bru- og Tunnelselskap AS (SBT) was founded in October 1986 by the municipalities of Bømlo , Stord , Fitjar and Sveio , Hordaland

County Municipality and five banks .

In December 1986 , the Public Road Administration recommended a bridge solution . SBT changed its name to Sunnhordland Bru- og Tunnelselskap , and a majority of the board shifted towards being in favor of a fixed link . The Norwegian Coastal Administration stated that they would not allow a pontoon bridge . On 26 June 1987 , SBT decided to work towards permission to collect advanced tolls on the ferry services . The board unanimously supported the triangular proposal on 16 September , which was estimated to cost NOK 660 million . This was criticized by Hordaland Public Roads Administration , who stated that it would take longer time to plan , and thus complete , the Triangle Link .

From 1988 , environmentalists started actively opposing the Triangle Link . The most active were the local chapter of the Norwegian Society for the Conservation of Nature and Nature and Youth , who stated that the road would have serious consequences for the local boat traffic to the recreational islands of Føyno and Nautøy . Instead , they recommended that the municipalities chose a pontoon bridge . Another opponent to the project was the Action Committee Against a Hasty Construction of the Triangle Link , who argued to delay the decision until after the 1991 municipal elections , to ensure that the municipal councils had backing in the public . Gisle Tjong stated that the risk in the project was large and that it was uncertain how long the tolls would last : they could just as well be 60 as 15 years . He instead wanted to collect tolls in advance .

The Triangle Link was passed by the various municipal councils in February and March 1988 . Hordaland Public Roads Administration still supported a pontoon bridge , and stated that two and a half years of work on a master plan had been wasted . A new master plan for the Triangle Link was published in early 1989 . During late 1989 , advance tolls on the ferries was approved by the municipal councils and the county council . They recommended that collection start on 1 July 1990 , but this was not immediately supported by the government .

In July 1991 , the master plan was passed by the Council of State . On 10 December 1992 , Parliament approved advanced payment of tolls on the ferry , which were made effective from 1 January 1993 . Ticket prices increased with between NOK 10 and 12 . This resulted in protests from the ferry employees who stated that they would have to collect the tolls which would remove their jobs . Work on the development plan started in 1992 . It included safety and environmental improvements which increased the project 's cost by NOK 200 million . In May 1994 , the plans was made subject to consultative statements . In May , SBT proposed building a culvert on Digernes as a compromise to avoid a new plan which could have postponed the project several years . On 11 June 1996 , Parliament approved with 144 against 20 votes to build the Triangle Link . The original name proposal for the bridge was Stordbrua ; this was later changed to Stordabrua after input from the municipal councils and name committees .

= = Construction = =

The construction of the Stord Bridge was undertaken as part of the same contract as the Bømla Bridge , which was awarded in December 1998 to Triangle Contractors , a joint venture between NCC and HBG Steel Structures . Most of the work was carried out by NCC with HBG having responsibility for the steel parts of the deck and the cables . HBG had previously built the steel for the Osterøy Bridge , which opened in 1997 . The responsibility for the cables was given to Brown Beach Associates and Hordaland Mekaniske Verksted . Construction started on 20 February 1999 . After the pylons were completed on 25 September 1999 , two catwalks were erected between them , with the constructors choosing two continuous catwalks instead of three separate pairs . Extra stability to the catwalks was achieved by building connections between the two .

The cables were spun on @-@ site using a reel because of the problems which had arisen using a bundle on the Great Belt Bridge in Denmark . This also allowed for cost savings , as the reels could be used two times . The cables were spun using air spinning with controlled tension , which allowed spinning with little space and with a crew with limited spinning experience . This involved installing a carrier which shuttles forward and back over the catwalk ; it spins the upper side of the cable in the one direction and the lower side in the other direction . The system has two reel racks , each with

four reels of wire . Each rack only uses one reel at a time , allowing for minimum down @-@ time when changing reels . Wires were connected using pressure casing . The balance in the system is kept in place using a counterbalance tower . Spinning of the main cable started on 2 March 2000 and was concluded on 14 April . In all 11 @,@ 600 kilometers (7 @,@ 200 mi) of steel wire were used to create the cables . The two bridges were the first time that on @-@ site spinning was chosen in Norway , and it gave a cost saving of NOK 10 to 11 million .

The cables consist of seven bundles which consist of 420 wires ? each with a diameter of 5 @.@ 35 millimeters (0 @.@ 211 in) . When compressed , this gives a diameter of 320 millimeters (13 in) and a quality of 1 @,@ 570 megapascals . The fastening poles were delivered five weeks after schedule ; a new mounting method was developed which allowed them to be installed in a quarter of the time , in part by using a helicopter , and the whole five @-@ week delay was eradicated . This allowed the deck sections to be installed as scheduled . There arose problems with small holes being created in the coating ; as these had also been found on the Great Belt Bridge , it was decided that nothing would be done with the issue .

The deck sections were produced by HBG in Schiedam , Netherlands , and transported by Barge to Stord . Each section is 36 meters (118 ft) long and consisted of two welded subsections . They were mounted using the crane ship Uglen , allowing up to nine and an average of four sections to be installed per day and completed in June 2000 . The section of the bridge built as a beam bridge on the Føyno side was built by filling in the shallow fjord under the bridge with earthwork , building the bridge and then removing the earthwork again . Construction took 700 @,@ 000 man @-@ hours and cost NOK 442 million . The bridge was taken into use along with the Bømlafjord Tunnel on 27 December 2000 . The bridge allowed , along with the rest of the Triangle Link , four ferry services to terminate .

= = Specifications = =

The Stord Bridge is a 1 @,@ 077 @-@ meter (3 @,@ 533 ft) long suspension bridge with a 677 @-@ meter (2 @,@ 221 ft) long main span . It carries two lanes of European route E39 and a combined pedestrian and bicycle path across Digernessundet , connecting the islands of Stord and Føyno . The bridge has a width of 13 @.@ 5 meters (44 ft) and a clearance below of 18 meters (59 ft) . It has two concrete pylons , each 97 meters (318 ft) tall , one on Digernesklumpen on Stord , the other on a small islet just off Føyno . The pylons consist of 2 @,@ 800 cubic meters (99 @,@ 000 cu ft) of concrete and 700 tonnes (690 long tons ; 770 short tons) of steel . The deck between the towers consists of 19 pre @-@ built steel sections , each 36 meters (118 ft) long and 2 @.@ 6 meters (8 ft 6 in) tall . They are connected to the main suspended cable , which is 360 millimeters (14 in) thick and 1 @,@ 142 meters (3 @,@ 747 ft) long , by vertical cables every 12 meters (39 ft) . The bridge 's vertical curvature has a radius of 11 @,@ 640 meters (38 @,@ 190 ft) . In 2012 , the bridge had an average 5 @,@ 284 vehicles per day . The bridge was paid off and the tolls removed on 30 April 2013 .