System cabling for one of the world’s longest suspension bridges
Plug-and-play concept significantly reduces space requirements and installation costs

One of the world’s longest suspension bridges is currently under construction at the Gulf of Izmit, roughly 50 kilometres southeast of Istanbul. System cabling from Phoenix Contact helps to ensure that the countless I/O assemblies of the control system are connected to the field wiring both reliably and quickly. Significant reduction of the cabling installation time is essential in meeting the tight construction schedule (lead figure).

Given its total length of 2,700 meters and an average span of 1,550 meters, the Izmit Bay Bridge will be one the world’s longest suspension bridges.

The bridge of Izmit is one of the many modernisation infrastructure projects launched by the government in preparation for the 100th anniversary of the Republic of Turkey coming up in 2023. It will serve as a key element of the planned 420 km highway linking Istanbul and Izmir. This transportation project is expected to cut travel times between these two cities from 6.5 hours to 3.5 hours. The highway and bridge will make this enormous reduction possible, among other things, by shortening the total distance by 140 kilometres.
When planning the bridge, the engineers had to account for a special geographic condition at the building site: the North-Anatolian Fault. The Anatolian Plate is moving westwards, wedged in-between the northbound Arabian Plate and the Eurasian Plate. This causes tension at the North-Anatolian Fault, which can generate highly local yet severe earthquakes. In 1999, the most recent quake reached a severity of over 7.5 on the Richter scale and claimed 18,000 lives. Given this hazard, the bridge is being constructed to withstand such tremors. Reinforced concrete foundations were poured onto the seabed, and decoupled pylons were erected on top of these. This means that high-rising structural elements are isolated from the ground, allowing them to swing freely in the event of a quake.

**Evaluating approx. 4,500 I/Os**

IHI Corporation was commissioned with building the bridge. The Japanese company has assigned the various work packages of the project to subcontractors. The entire infrastructure and statics of the suspension bridge necessitate a complex operations system comprising data capture and power supply in order to avoid hazardous situations or to identify them quickly and initiate appropriate countermeasures. The SCADA (Supervisory Control and Data Acquisition) solution needed to monitor and control the processes and the bridge’s power supply system are being implemented by Siemens AG. For this purpose, main supply buildings were erected at the northern and southern termini of the bridge, each of which houses the high-, medium-, and low-voltage network. The different voltage levels maintained are 33, 11, and 0.4 kilovolts (Figure 1).

![Figure 1](image.png)

*Figure 1 - The main supply buildings used to route a medium-voltage cable to the switching systems are located at the northern and southern banks of the bridge; this, too, is where the various bridge data will be processed.*

From each of the main supply buildings, a medium-voltage line branches off to the maintenance levels of the individual deck segments at the pylons. There, an additional transformer station converts the voltage down to 0.4 kilovolts. The northern and southern
partial systems are redundantly interconnected as a safeguard against system failure. They are placed in special containers that house the various control cabinets. The different signal lines for data capture converge in the containers, as permanent monitoring is necessary to maintain the bridge’s infrastructure. This is why data on oscillations, the outer frame of the bridge, fire alerting and traffic monitoring systems, the statuses of the electrical facilities, and humidity levels inside the control cabinets are collected. Moreover, the proper lighting and signalling for vehicle, air, and ship traffic must be ensured at all times. Overall, the SCADA system processes data from approx. 4,500 I/Os, which is transmitted via fibre optics to the control centre located 15 kilometres away.

Routing 40 terminal contacts on a 70 mm component

The signals collected at the partial systems are evaluated using I/O assemblies based on the S7-300/ET 200M control system. Siemens employs Phoenix Contact’s system cabling solution to connect the assemblies. One of the reasons for this choice is that the local control cabinet construction contractor has little time to set up the control cabinets (Figure 2). The VIP-Power Cabling product family offers a pluggable terminal block that supports plug-and-play connection of the S7-300 control system’s I/O assemblies. Time-consuming single-wire cabling required in traditional terminal systems and the I/O function test for checking proper signal routing are therefore avoided. The preassembled VIP adapters undergo high-voltage testing after production, to name but one of the system’s advantages. Also, correct connection of the wires between the front adapter and the terminal block plug connector is ensured. As a result, the user receives an error-free and reliable connection. When combined with pluggable push-in double-level terminals, the 40 terminal contacts of the control system can be routed on a piece of hardware only 70 millimetres in length (Figure 3).
According to Project Manager Alper Arifoğlu, the decision-makers were particularly impressed with the space and time saved when combining system cabling with the directly pluggable terminal blocks. Normally, ten days are scheduled for setting up a large control cabinet with routing level, as is required for the application at hand. One day is needed for mechanical installation work, while the remaining nine days are used to implement the electrical components and perform the field acceptance test (FAT). “At first, control cabinet implementation really threatened our time schedule,” says Alper Arifoğlu. “Thanks to employing system cabling, our control cabinet construction contractor has managed to do the same job in just two days, so now we can meet the schedule with ease (Figure 4).”

Solution supports small switching signals and large loads

Siemens selected the components, which are mandatory for the project. The clear design of the VIP-Power Cabling product family was a key decision factor: There are precisely two versions, 20 or 40 pins, which are compatible with all I/O assemblies of the ET 200M, regardless of whether an analogue assembly or a relay output card needs to be connected. Owing to the large wire cross section and the terminal block plug connectors, weak switching signals and loads of up to 250 V AC and 6 A can be routed. A total of 24 control cabinets were wired on the Izmit bridge using system cabling from Phoenix Contact.

After successful FAT testing, the control cabinets are installed in special containers that are then inserted into the corresponding deck segments at a dockyard. Following this, a cargo barge transports the individual segments (a total of 112) below the bridge for installation at their respective locations (Figure 5). The Izmit Bay Bridge is scheduled for completion and traffic approval in 2017. The project will deliver a faster way of traveling between the Aegean and Bosporus, bringing Europe and the Near East closer together.
The Izmit Bay Bridge counts among the world’s longest suspension bridges. As regards the average span between pylons, it ranks fourth on an international scale. Such a wide structure cannot be constructed as a one-piece roadway. Instead, numerous individual segments are built at a dockyard and then shipped via cargo barge below the bridge for installation. A total of 112 segments will bridge the Gulf of Izmit from north to south (Figure 6).

The Izmit Bay Bridge has many more impressive specs:

- Approx. 2,700 meters long
- Pylon height of 234 meters
- Maximum span of 1550 meters
- Six lanes about 65 meters above the Sea of Marmara
- 85,000 tons of steel
- 125,000 cubic meters of poured concrete

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