67 DRIVERLESS TWO- AND FOUR-CAR METRO TRAINS

Riyadh Metro Project

The Royal Commission for Riyadh City (RCRC) is in charge of building the Riyadh Public Transit System, the first project of its kind in the Kingdom of Saudi Arabia. Consisting of six lines, with a total route length of 176 km, it is one of the world's largest infrastructure projects, being built by three consortia. One of them, BACS, is led by US Company Bechtel and includes local construction companies Almabani and Consolidated Contractors Company, as well as Siemens Mobility.

In October 2013, BACS signed a contract with RCRC to build lines 1 (Blue) and 2 (Red) of the metro network with a total of 63 km. Siemens Mobility, as E+M partner is in charge of delivering the rolling stock, a total of 67 Riyadh Metro vehicles, built on the Inspiro platform, with 26 two-car and 41 four-car trains. Additionally, the turnkey contract includes the delivery of the automatic train control system for unattended operation, as well as electrification systems, platform screen doors, depot and workshop equipment, and the communication system.

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Highlights

- Fully automated, driverless operation (GoA4)
- Passenger compartment with First Class, Family Class and Single Class sections
- Lightweight aluminum carbody
- Energy saving LED lighting
- Transmission of CCTV data and passenger communication to control center
- Fire protection requirements according to NFPA 130 / EN 45545

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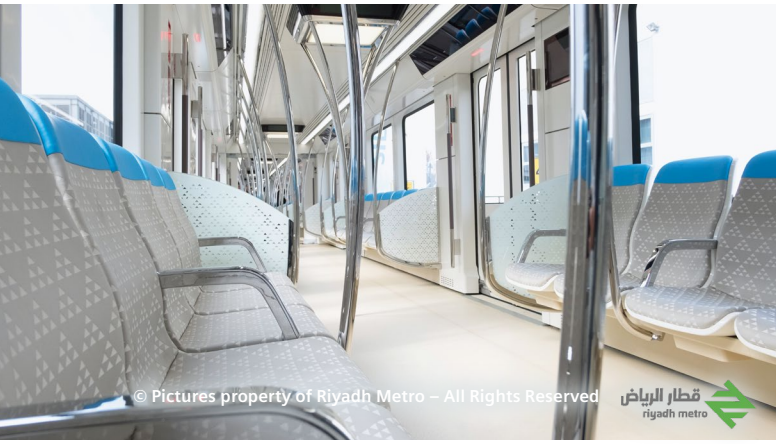
Capital Metro Company, a joint venture between RATP Dev and SAPTCO (Saudi Public Transport Company), the future metro operator of Line 1 and 2, also awarded Siemens Mobility a separate contract for a 22-month mobilization phase followed by maintenance of all components and systems delivered by Siemens Mobility as well as track system maintenance for an additional two years.

Delivery of the 67 driverless two and four-car metro trains to Riyadh was started in 2018.



Train concept

Each train comprises two or four aluminum cars in an MM or MMTM configuration (M: Motor car, T: Trailer car).

Each two-car / four-car train is capable of carrying up to 251 / 522 passengers (at 4 persons/m^2), with up to 55 / 123 seats. The trains are designed for tunnel operation and operation on elevated tracks. The cars of each train are connected with semipermanent couplers. The end cars are equipped with automatic couplers.

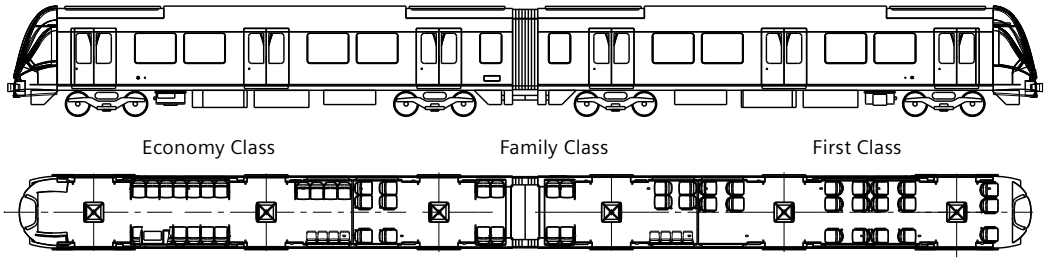
The wide and open gangways between the cars (vertical clearance approx. 1,950 mm, clear width approx. 1,600 mm) enable unrestricted passage through the train. All cars have three electrically operated sliding-plug doors per side with an opening width of 1,400 mm.

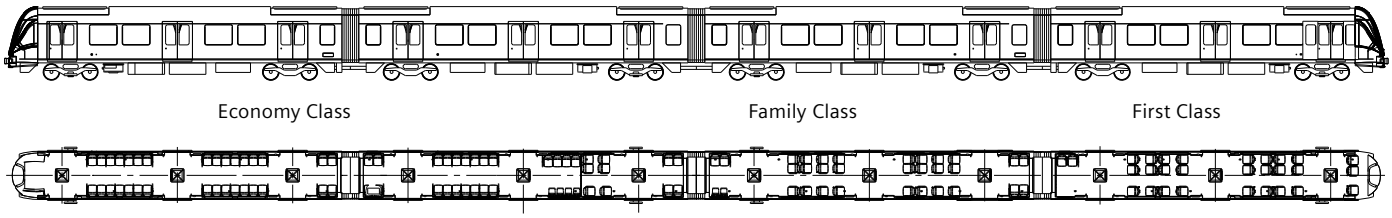
The trains meet the high fire protection requirements according to NFPA 130 / EN 45545. In addition, implementation of the Inspiro design solutions ensure optimized energy consumption, low maintenance costs, and high recyclability of the trains at the end of their service life.

Design concept

The Royal Commission for Riyadh City (RCRC), through the French design bureau Avant Premiere, and Siemens Mobility developed the interior and exterior design of the trains. The train design concept reflects the dynamism, elegance, and technological progress of Riyadh. The technical specifications for the rolling stocks were developed by RCRC.

The interiors are equipped with LED lighting; indirect lighting below the passenger seats generates a pleasant sense of space and supports safety and cleanliness in the train.





The interior color concept of traditional symmetrical patterns with a modern interpretation in the entry area symbolizes the vitality of Riyadh.

Passenger Compartments
Each train is divided into First Class, Family Class and Single Class areas. For higher comfort, the First Class area is separated by an automatic interior door. Family Class and Single Class are separated by glass partition walls. The First Class is equipped with comfortable seats and has more legroom. To ensure a comfortable climate in the passenger compartments, two compact HVAC units are installed per car. There are several wheelchair areas to suit the needs of handicapped passengers.

Fully automated operation
The trains are equipped for fully automated, driverless, and conductorless operation (GoA 4). A state of the art train automation system is integrated, ensuring reliable and highly available operation. In addition, the train is equipped with further safety systems such as obstruction sensors at the end bogies and a fire detection system.

Auxiliary driver's control desks at both ends of the train enable manual operation in emergency cases and in the depot. They are equipped with convenient touchscreen displays and all necessary controls for train operation.

Car bodies
The metro train has been designed as a lightweight aluminum construction.

The exterior car body surfaces are painted, stripes indicate the line's color.

Traction system
The trains are electrically driven. The traction power is supplied from the third rail via current collectors. Both cars of a two-car train and three cars of a four-car train are motorized. Each motor bogie is driven by two selfventilated traction motors from the proven 1TB 20 series. The motors are controlled without speed sensors for a high level of reliability.

The two traction motors in a motor bogie are each controlled by a forced aircooled Sibac® IGBT traction inverter.

The highly efficient slip / slide protection is implemented on a per bogie basis.
The Sitrac™ control allows electrodynamical braking until standstill. This feature provides the advantage of a nonwearing service brake under normal conditions and especially increases the stopping accuracy in stations.

Technical Data

Train configuration	M-M M-M-T-M
Wheel arrangement	Bo'Bo'+Bo'Bo' Bo'Bo'+Bo'Bo'+2'2'+Bo'Bo'
Carbody material	Aluminum
Track gauge	1,435 mm
Train length over couplers	Approx. 37,856 / 75,712 mm
Width of car over step ledge	2,740 mm
Floor height above top of rail	1,130 mm
Wheel diameter (new / worn)	850 / 770 mm
Max. axle load	13.5 t
Number of seats (2- / 4-car train) With tipup seats Without tipup seats	 63 / 129 55 / 123
Train capacity at 4 pers./m^2 (2- / 4-car train)	251 / 522
Passenger doors per car	6
Min. curve radius (main line / depot)	100 m / 60 m
Max. gradient	6.0 %
Max. speed (design / operation)	90 km/h / 80 km/h
Power supply	750 V DC / Third rail

Bogies

The bogie SF 1000, developed for advanced metro vehicles, has been further optimized and is suitable for operating speeds up to 90 km/h and for axle loads of approx. 13.5 tons. The bogie frame consists of high-strength, lowalloy steel.

Each axle of the bogie is equipped with one brake disk and one compact brake caliper unit. Spring brake actuators serve as parking brake.

Secondary suspension is provided by air springs, and metal rubber springs are used for primary suspension.

Current collectors are mounted on each side of the end bogies of a two-car train and additionally on the center bogies of a four-car train.

The traction motors are transversally installed and fully suspended on the bogie frame.

Passenger Safety and Information Systems

The Passenger Information Display & Announcement System provides both visual and audio information inside and outside the train. In the interior, dynamic route map displays are installed above each door showing the line with stations, the actual position of the train and the name of the next station.

Above the palmtree shaped grabpoles which are located in each entrance area, line displays are installed, which indicate the next station and the side of the exit. Additional displays for advertisement are located in the interior close to each passenger door.

For the safety of the passengers a video surveillance system (CCTV) is installed in the passenger compartments. Video data is transmitted on line to the control center. In case of emergency, passengers can communicate with an operator in the control center using the emergency passenger intercom stations in each entrance area.

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