



Funded by  
the European Union

# ITS IN MONTENEGRO

Boško Matović, Radoje Vujadinović  
Faculty of Mechanical Engineering, University of Montenegro

*"Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them."*

**Transport of Dangerous Goods - Modernization of Curricula and Development of  
Trainings for Professionals in the Western Balkans HEIs / DGTRANS**

Call: ERASMUS-EDU-2022-CBHE-STRAND-2

Project number: 101082187



# RADIO SYSTEMS

- ❑ TETRA (TERRESTRIAL TRUNKED RADIO)
- ❑ MINISTRY OF INTERNAL AFFAIRS
- ❑ EMERGENCY MANAGEMENT SECTOR
- ❑ TETRA OPERATES IN THE 380–400 MHz RANGE
- ❑ ALL RELEVANT SERVICES ARE NETWORKED (POLICE, FIRE DEPARTMENT, EMERGENCY MEDICAL SERVICES, RESCUE AND PROTECTION SERVICES...)



# TOLL COLLECTION SYSTEMS



Funded by  
the European Union

- ❑ SOZINA TUNNEL;
- ❑ PRINCESS KSENIJA HIGHWAY;
- ❑ TOLL STATION;
- ❑ ELECTRONIC TOLL COLLECTION (ETC)

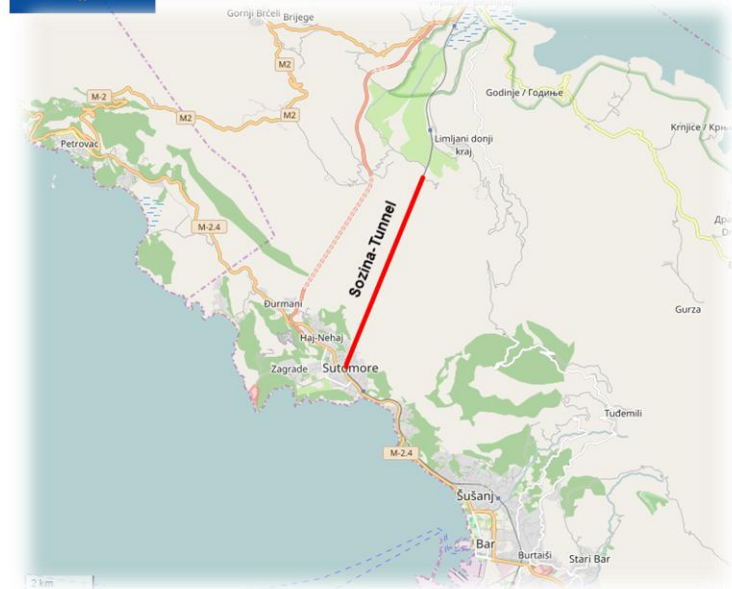


# TRAFFIC CONTROL SYSTEMS



Funded by  
the European Union

- ❑ SOZINA TUNNEL (LENGTH 4,189 m);
- ❑ SINGLE TUBE FOR TWO-WAY TRAFFIC;
- ❑ ELECTRICAL INSTALLATIONS AND ITS EQUIPMENT;
- ❑ MECHANICAL-VENTILATION EQUIPMENT, HYDRO AND FIRE PROTECTION INSTALLATIONS;
- ❑ TRAFFIC EQUIPMENT;
- ❑ CONTROL AND MONITORING SYSTEM



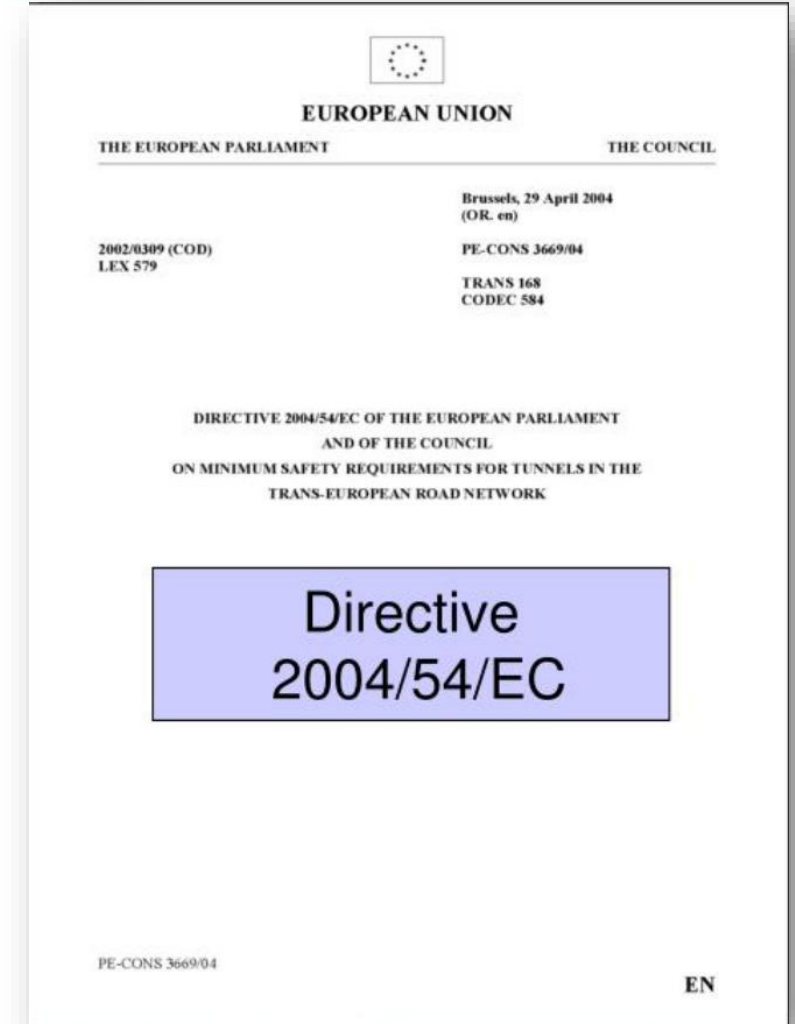
# TRAFFIC CONTROL SYSTEMS IN TUNNELS



Funded by  
the European Union

## THE ITS SYSTEM INCLUDES :

- OVERALL TRAFFIC CONTROL,
- VEHICLE COUNTING WITH CATEGORIZATION,
- TOLL COLLECTION SYSTEM CONTROL,
- DRIVER INFORMATION ON ROAD CONDITIONS AND WEATHER,
- SMOKE CONCENTRATION MEASUREMENT IN THE TUNNEL, AND
- COMPLETE VIDEO SURVEILLANCE OF THE TUNNEL.





## THE ITS SYSTEM COVERS

- ✓ OVERALL TRAFFIC CONTROL,
- ✓ VEHICLE COUNTING WITH CATEGORIZATION,
- ✓ TOLL COLLECTION SYSTEM CONTROL,
- ✓ DRIVER NOTIFICATIONS ABOUT ROAD CONDITIONS AND WEATHER,
- ✓ MEASUREMENT OF SMOKE CONCENTRATION IN THE TUNNEL, AND
- ✓ COMPLETE VIDEO SURVEILLANCE OF THE TUNNEL.

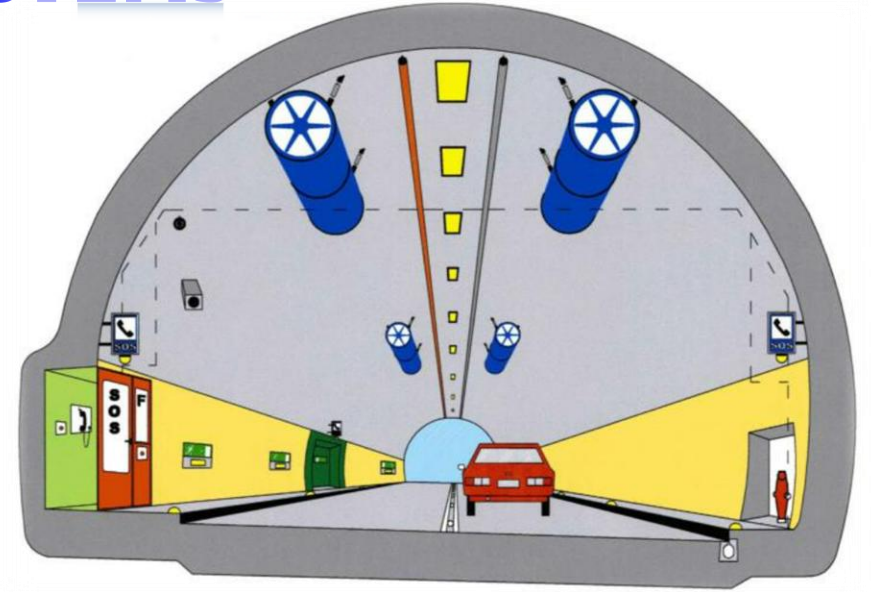


# TRAFFIC CONTROL SYSTEMS



## VENTILATION SYSTEM:

- ✓ JET FANS ON THE TUNNEL CEILING, WITH A NOMINAL THRUST OF 900 N AND 30 KW;
- ✓ FANS HAVE THE ABILITY TO DIRECT AIRFLOW IN BOTH DIRECTIONS.
- ✓ A TOTAL OF 24 JET FANS:
- ✓ 11 PAIRS OF FANS ARE LOCATED IN THE SOZINA TUNNEL, AND THE REMAINING TWO AT THE ENTRANCES TO THE EVACUATION TUNNEL.



# TRAFFIC CONTROL SYSTEMS

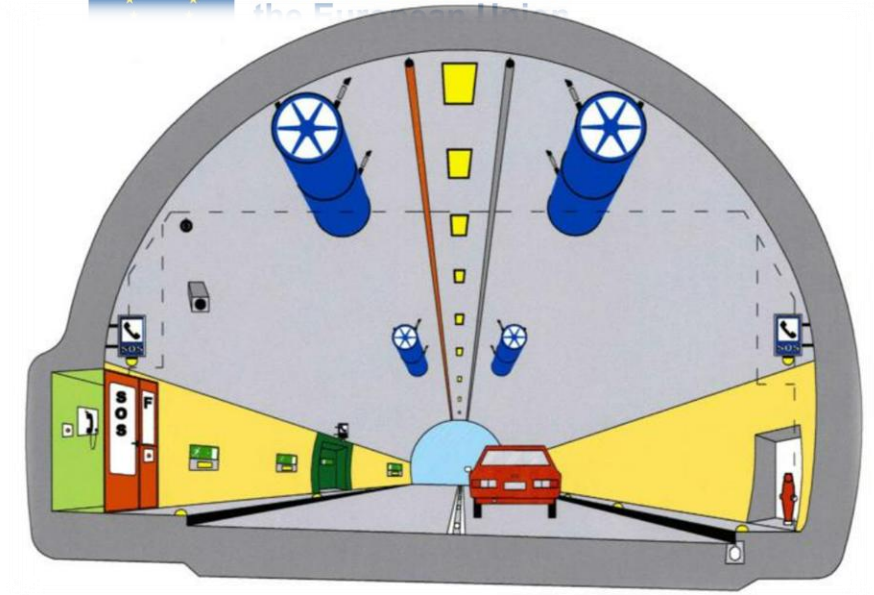


Funded by

the European Union

## LED LIGHTING SYSTEM:

- ✓ ADJUSTMENT OF VISUAL SENSORS;
- ✓ TRAFFIC SAFETY;
- ✓ CORROSIVE ENVIRONMENT (SALT, WATER, PARTICLES);
- ✓ ENERGY EFFICIENCY;
- ✓ LIFESPAN OF 10 YEARS.

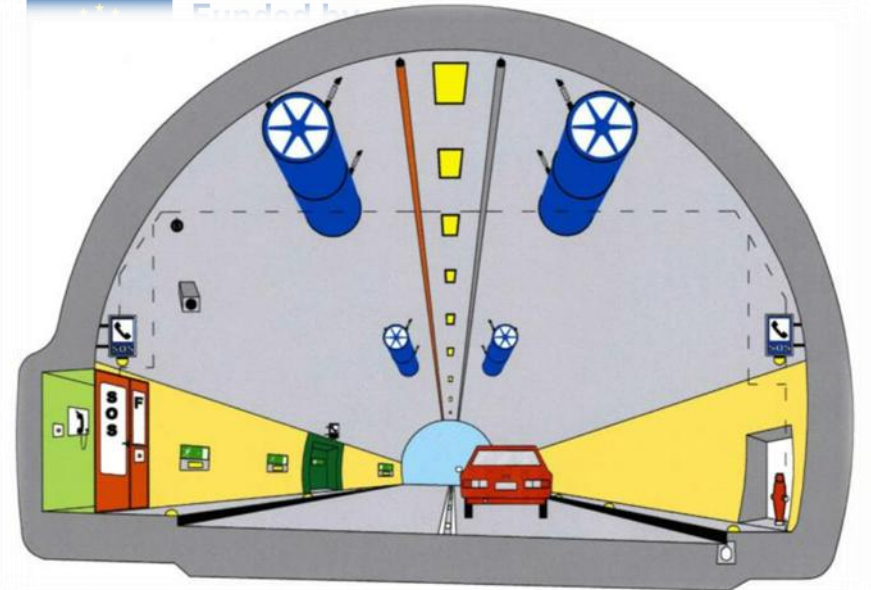


# TRAFFIC CONTROL SYSTEMS



## VIDEO SURVEILLANCE SYSTEM:

- ✓ 24/7 RECORDING;
- ✓ DISPLAY ON DIGITAL CCD CAMERAS IN COLOR;
- ✓ RESISTANCE TO WEATHER CONDITIONS;
- ✓ CAMERA CONTROL, MONITORING, AND RECORDING REPRODUCTION;
- ✓ 74 CAMERAS; 20 MONITORS;
- ✓ RECORDING ON HDD (60 DAYS STORAGE).





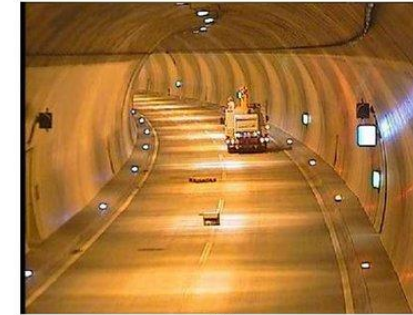
# TRAFFIC CONTROL SYSTEMS



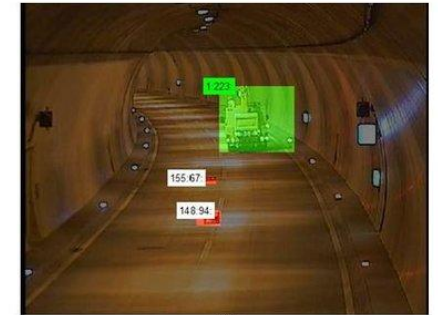
Funded by

## AUTOMATIC INCIDENT DETECTION SYSTEM (AID):

- ✓ STOPPED VEHICLE;
- ✓ SLOW MOVEMENT;
- ✓ VEHICLE MOVING IN THE OPPOSITE DIRECTION;
- ✓ PEDESTRIAN PRESENCE ON THE ROADWAY.
- ✓ THE SYSTEM FOCUSES THE CAMERA ON THE INCIDENT LOCATION AND CHANGES THE TRAFFIC LIGHT TO YELLOW FLASHING;
- ✓ AFTER THE INCIDENT, THE SYSTEM AUTOMATICALLY RETURNS TO THE PREVIOUS STATE AND THE TRAFFIC LIGHT SHOWS FLASHING GREEN.



(a)



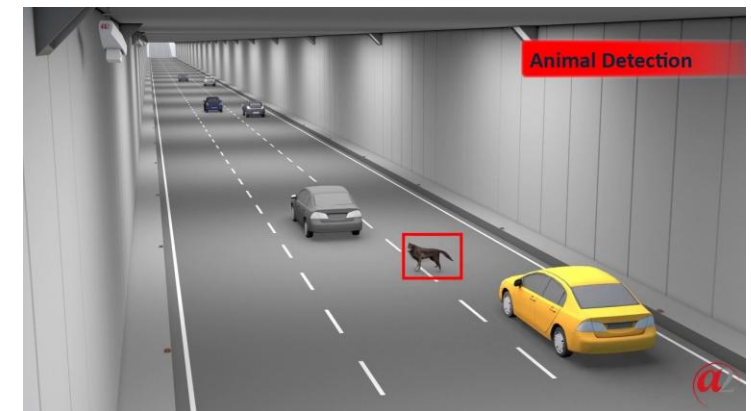
(b)



(c)



(d)





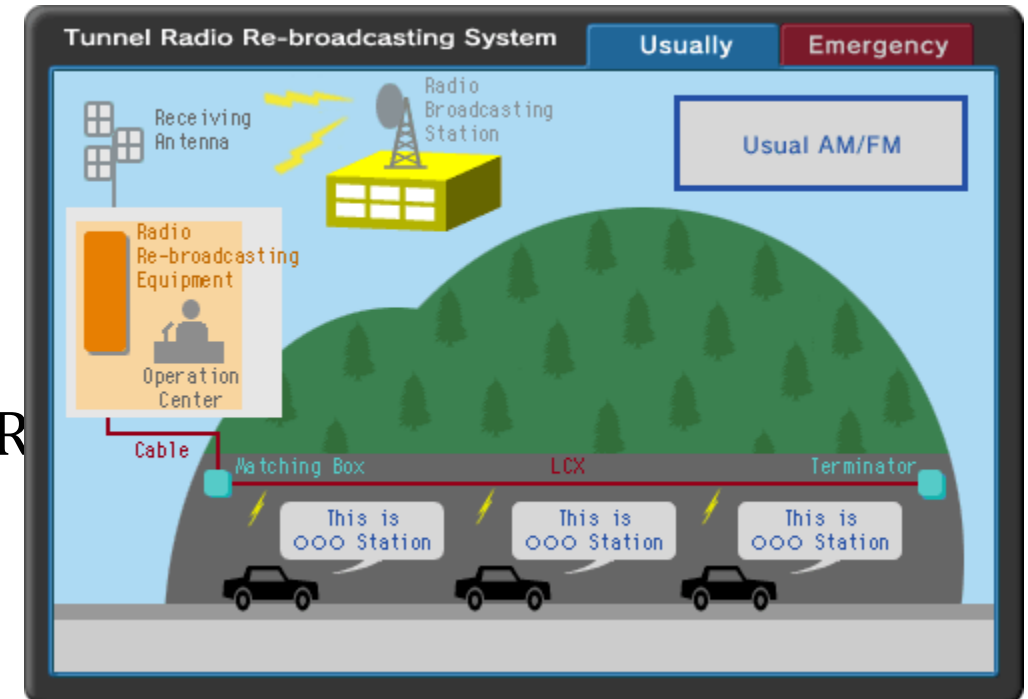
# TRAFFIC CONTROL SYSTEMS



Funded by  
the European Union

## RADIO DEVICES:

- ✓ POLICE,
- ✓ FIRE DEPARTMENT,
- ✓ EMERGENCY MEDICAL SERVICES,
- ✓ MAINTENANCE CREWS,
- ✓ FM RADIO PROGRAMS,
- ✓ MOBILE TELECOMMUNICATION OPERATOR

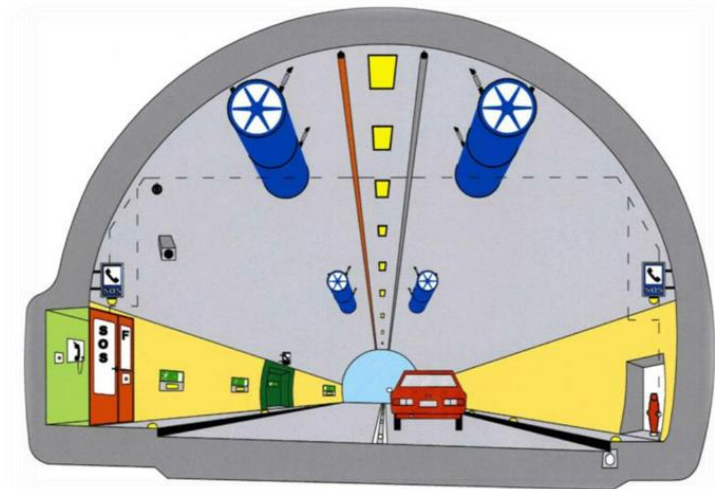
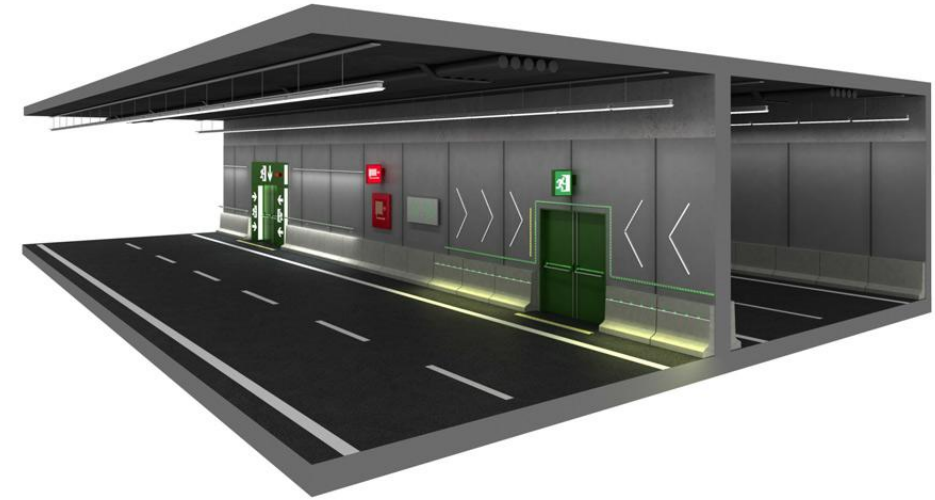


# TRAFFIC CONTROL SYSTEMS



## FIREPROOF DOORS WITH LOUVERS

- ✓ OPEN/CLOSE USING ELECTRIC MOTORS
- ✓ LEAD TO THE HYDROTECHNICAL TUNNEL FOR EVACUATION.
- ✓ 9 DOORS
- ✓ DISTANCE 400 M



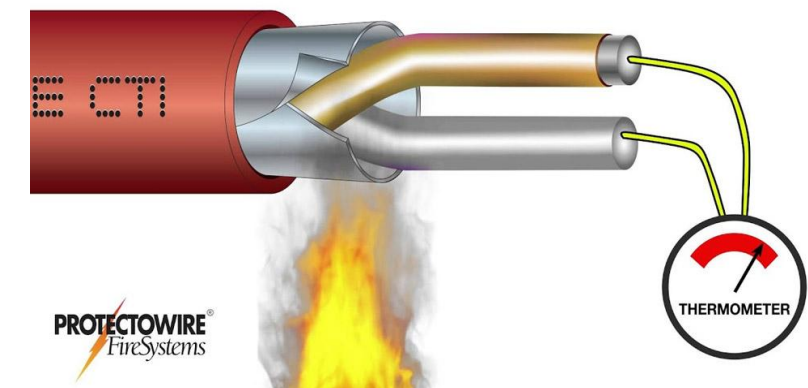
# TRAFFIC CONTROL SYSTEMS



Funded by  
the European Union

## FIRE DETECTION CABLE (LISTEC)

- ✓ HAZARDOUS MATERIALS;
- ✓ ELECTRIC VEHICLES;
- ✓ DETECTS FIRE LOCATION WITH A DEVIATION OF  $< 5$  m;
- ✓ CABLE IS INSTALLED ON THE TUNNEL CEILING;
- ✓ MEASURES AIR TEMPERATURE AND DETECTS FIRE.



# TRAFFIC CONTROL SYSTEMS



Funded by  
the European Union

## SOS CABIN SYSTEM:

- ✓ TELEPHONE FOR COMMUNICATION WITH THE COMMAND CENTER,
- ✓ TWO FIRE EXTINGUISHERS FOR POWDER FIRE EXTINGUISHING (6KG AND 9KG),
- ✓ BONPET AMPULAS AND MANUAL FIRE DETECTORS.
- ✓ THERE ARE 29 SOS CABINS IN THE TUNNEL.



# TRAFFIC CONTROL SYSTEMS



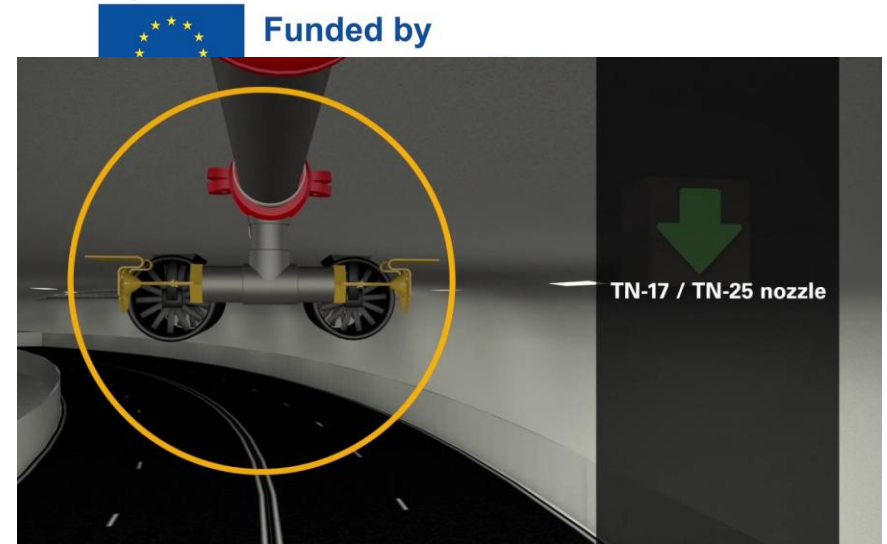
## ❑ HYDRANT NETWORK

- ✓ 43 HYDRANTS SUPPLIED WITH WATER FROM THE FIRE WATER RESERVOIR (VOLUME 100 M<sup>3</sup>).

## ❑ SENSORS FOR MEASURING CO<sub>2</sub> CONCENTRATION AND VISIBILITY:

- ✓ INSTALLED IN THE MAIN TUNNEL AND EVACUATION GALLERIES.

## ❑ OPTICAL SMOKE DETECTORS (39 IN TOTAL)



# TRAFFIC CONTROL SYSTEMS



Funded by

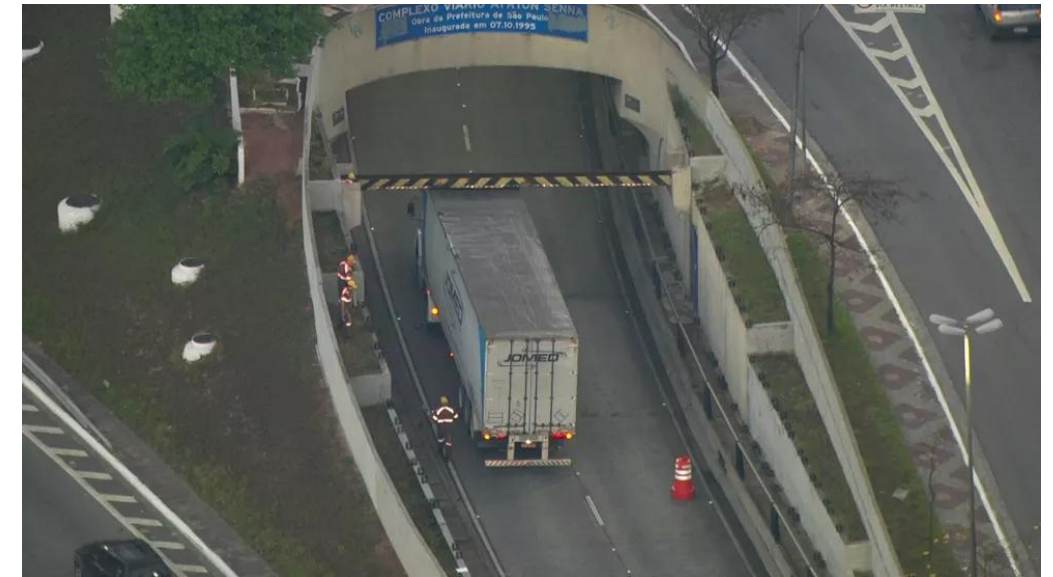
## ❑ SIGNALIZATION SYSTEM

- ✓ THREE-PART AND SINGLE-PART TRAFFIC LIGHTS,
- ✓ VARIABLE TRAFFIC SIGNS;
- ✓ ELECTRONIC PANELS FOR NOTIFICATIONS.



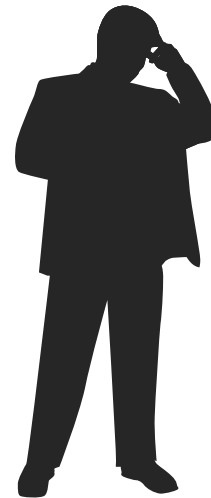
## ❑ VEHICLE HEIGHT MEASUREMENT DEVICES

- ✓ LOCATED IN FRONT OF BOTH ENTRIES TO THE TUNNEL. VEHICLES WITH A HEIGHT ABOVE 4.7 METERS ARE NOT ALLOWED TO PASS THROUGH THE TUNNEL.





# QUESTIONS





Funded by  
the European Union

**THANK YOU FOR  
YOUR ATTENTION!**