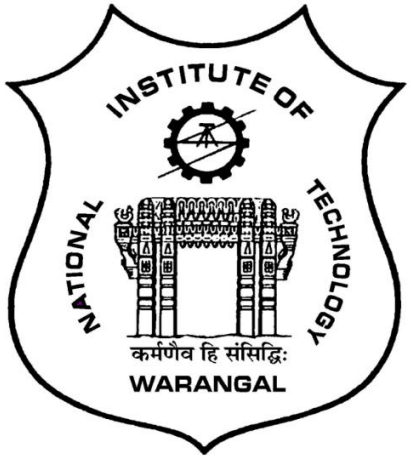

TRAFFIC MANAGEMENT DATABASE PROJECT

PROJECT MEMBERS

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ABOUT THE PROJECT

Our traffic management database system monitors and manages various aspects of urban transportation networks. It tracks intersections, capturing their locations and associated traffic signal IDs, allowing for efficient signal control. Additionally, the system monitors vehicles, recording their speed, location, and license plate numbers as they traverse roadways and intersect at various points.

Furthermore, the system facilitates incident management by tracking and recording traffic incidents, including their locations, types, and severities. This enables authorities to respond promptly to incidents and minimize disruptions to traffic flow. Moreover, the system utilizes traffic cameras strategically placed at intersections to provide real-time footage of traffic conditions, aiding in surveillance and decision-making processes.

Overall, our database system provides stakeholders with valuable insights into traffic patterns, facilitates optimized signal control strategies, enhances incident management capabilities, and contributes to the creation of safer and more efficient urban transportation systems.

CONTENTS

ER MODEL ASSUMPTIONS

In the Entity-Relationship (ER) model for our traffic management database system, we make several key assumptions to simplify the representation and management of data:

1. Intersection as a central entity: We assume intersections to be the focal points of our system, simplifying the model by treating them as central entities. This assumption allows us to efficiently manage traffic signals, monitor vehicle movements, and handle incidents at these critical points.

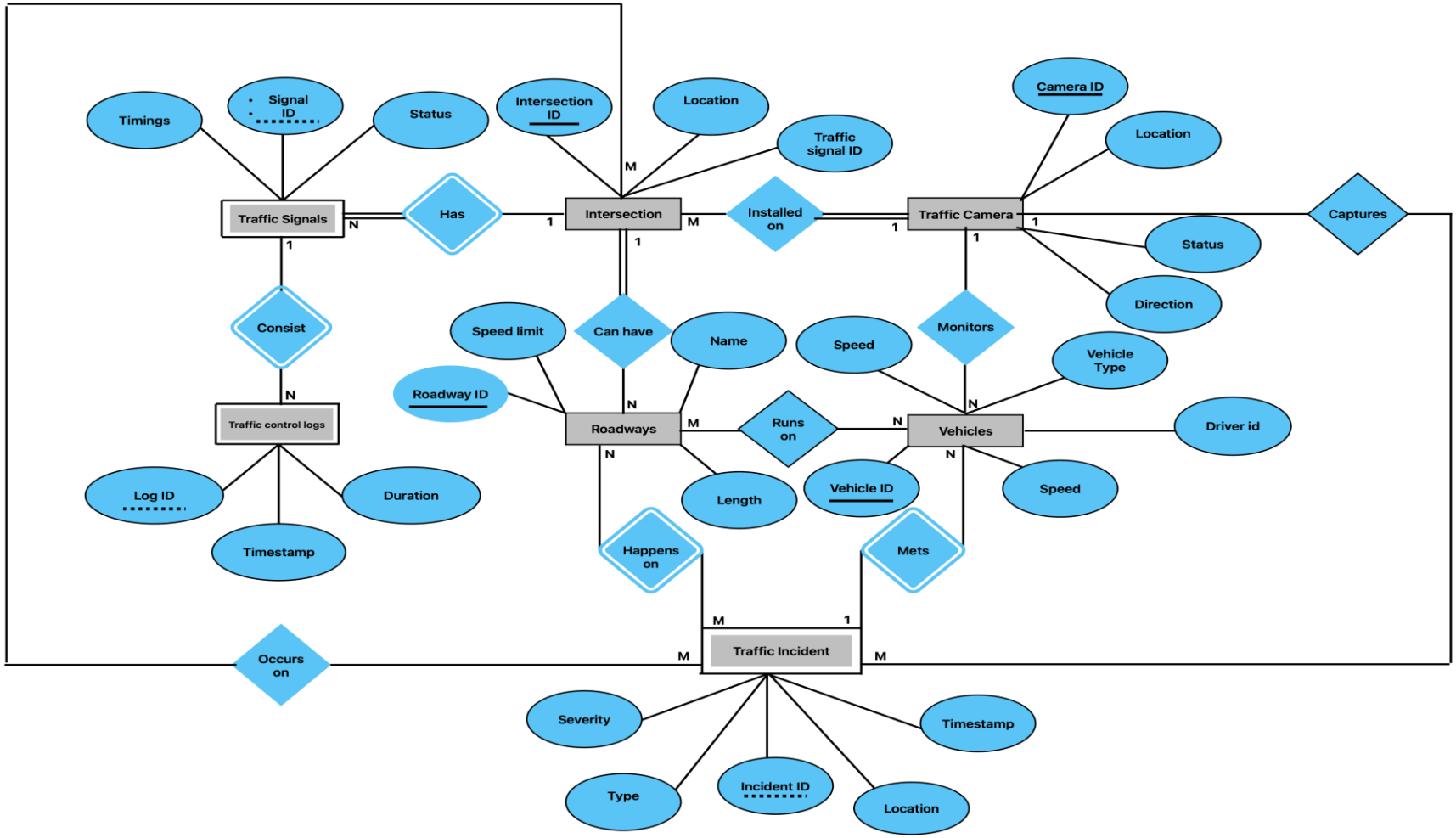
2. Traffic signals as weak entities: We model traffic signals as weak entities dependent on intersections. This assumption simplifies the representation, as it allows us to associate signal timings and statuses directly with specific intersections without the need for separate entities for each signal.

3. Vehicle interactions with intersections: We assume that vehicles primarily interact with intersections in our model. This simplifies the representation of vehicle movements and allows us to track vehicle data more effectively by focusing on their interactions with critical points in the transportation network.

4. Traffic incidents as weak entities: Similarly, we treat traffic incidents as weak entities, simplifying the model by associating incidents directly with intersections and roadways. This assumption streamlines incident management and allows for easier tracking and resolution of incidents at specific locations.

5. Traffic cameras as surveillance tools: We assume that traffic cameras are strategically placed at intersections to monitor traffic conditions. This simplifies the representation of surveillance data by focusing on intersections as the primary points of observation, aiding in decision-making and incident response.

ER DIAGRAM


Timings
Signal ID
Status
Intersection ID
Location
Traffic signal ID
Camera ID
Location
Traffic Signals
Has
Intersection
Installed on
Traffic Camera
Captures
Status
Direction
Consist
Speed limit
Can have
Name
Speed
Monitors
Vehicle Type
Roadway ID
Traffic control logs
Roadways
Runs on
Vehicles
Driver id
Log ID
Duration
Timestamp
Length
Vehicle ID
Speed
Happens on
Mets
Occurs on
Traffic Incident
Severity
Timestamp
Type
Incident ID
Location
1
M
N

NORMALISATION OF TABLES

1. Intersection:
   - Primary key: Intersection_ID
   - Dependencies:
     - Location (latitude, longitude) fully depend on Intersection_ID
   - Normalized Form:
     - 1NF: All attributes are atomic.
     - 2NF: All attributes depend on the entire primary key.
     - 3NF: All attributes depend directly on the primary key.
     - BCNF: All determinants (Intersection_ID) are candidate keys.

2. Traffic Signal:

- Primary key: (Signal_ID, Intersection_ID)
- Dependencies:
  - Timing, Status fully depend on Signal_ID and Intersection_ID
- Normalized Form:
  - 1NF: All attributes are atomic.
  - 2NF: All non-key attributes fully depend on the entire composite primary key.
  - 3NF: All attributes depend directly on the composite primary key.
  - BCNF: All determinants (Signal_ID, Intersection_ID) are candidate keys.

3. Vehicle:
- Primary key: Vehicle_ID
- Dependencies:
  - License Plate Number, Speed, Driver fully depend on Vehicle_ID

- Normalized Form:
  - 1NF: All attributes are atomic.
  - 2NF: All attributes depend on the entire primary key.
  - 3NF: All attributes depend directly on the primary key.
  - BCNF: All determinants (Vehicle_ID) are candidate keys.

4. Roadway:
  - Primary key: Roadway_ID
  - Dependencies:
    - Name, Length, Speed Limit fully depend on Roadway_ID
  - Normalized Form:
    - 1NF: All attributes are atomic.
    - 2NF: All attributes depend on the entire primary key.

- 3NF: All attributes depend directly on the primary key.
- BCNF: All determinants (Roadway_ID) are candidate keys.

5. Traffic Control Log:
- Primary key: (Log_ID, Signal_ID, Intersection_ID)
- Dependencies:
  - Timestamp, Duration (Green, Yellow, Red) fully depend on Log_ID
- Normalized Form:
  - 1NF: All attributes are atomic.
  - 2NF: All attributes depend on the entire composite primary key.
  - 3NF: All attributes depend directly on the composite primary key.
  - BCNF: All determinants (Log_ID, Signal_ID, Intersection_ID) are candidate keys.

6. Traffic Incident:

- Primary key: (Incident_ID, Vehicle_ID, Roadway_ID)
- Dependencies:
  - Type, Severity, Timestamp fully depend on Incident_ID
- Normalized Form:
  - 1NF: All attributes are atomic.
  - 2NF: All attributes depend on the entire composite primary key.
  - 3NF: All attributes depend directly on the composite primary key.
  - BCNF: All determinants (Incident_ID, Vehicle_ID, Roadway_ID) are candidate keys.

7. Traffic Camera:

- Primary key: Camera_ID
- Dependencies:

- Location, Direction, Status fully depend on Camera_ID

- Normalized Form:

- 1NF: All attributes are atomic.

- 2NF: All attributes depend on the entire primary key.

- 3NF: All attributes depend directly on the primary key.

- BCNF: All determinants (Camera_ID) are candidate keys.

8. has

Primary Key: (Intersection_ID, Signal_ID)

Normalized Form:

- 1NF: All attributes are atomic.

- 2NF: All attributes depend on the entire composite primary key.

- 3NF: All attributes depend directly on the composite primary key.

- BCNF: All determinants (Intersection_ID,Signal_ID) are candidate keys.

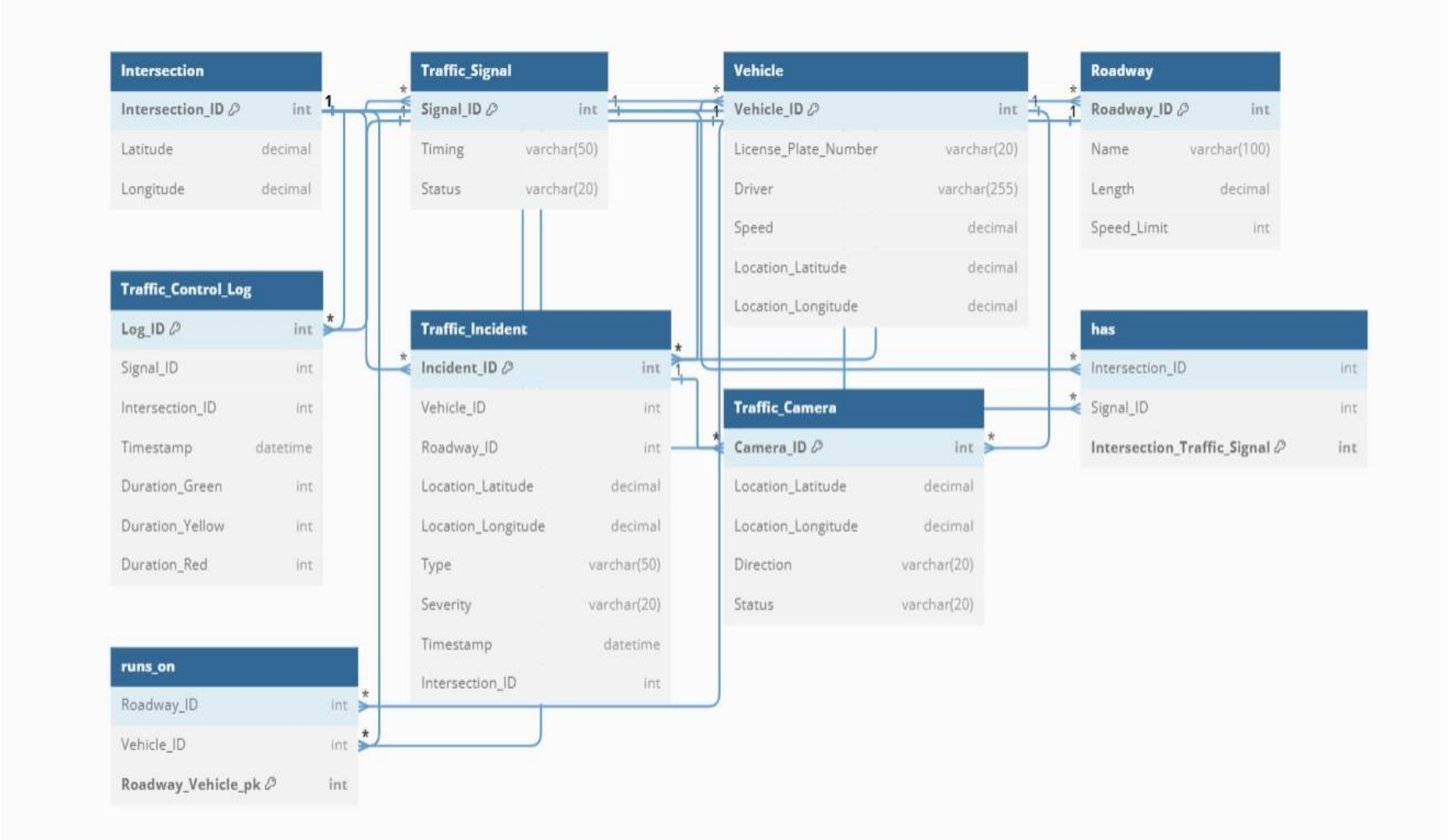
9. runs_on

Primary key: (Vehicle_ID, Roadway_ID)

Normalized Form:

- 1NF: All attributes are atomic.
- 2NF: All attributes depend on the entire composite primary key.
- 3NF: All attributes depend directly on the composite primary key.
- BCNF: All determinants (Vehicle_ID,Roadway_ID) are candidate keys.

RELATIONAL SCHEMA



SQL CODE

```
-- Intersection table
CREATE TABLE Intersection (
    Intersection_ID INT PRIMARY KEY,
    Location_latitude DECIMAL(9,6),
    Location_longitude DECIMAL(9,6)
);

-- Traffic Signal table
CREATE TABLE Traffic_Signal (
    Signal_ID INT,
```

```
    Intersection_ID INT,
    Timing_Green INT,
    Timing_Yellow INT,
    Timing_Red INT,
    Status VARCHAR(10),
    PRIMARY KEY (Signal_ID, Intersection_ID),
    FOREIGN KEY (Intersection_ID) REFERENCES Intersection(Intersection_ID)
);

-- Vehicle table
CREATE TABLE Vehicle (
    Vehicle_ID INT PRIMARY KEY,
    License_Plate_Number VARCHAR(20),
```

```
    Driver VARCHAR(255),
    Speed DECIMAL(5,2),
    Location_latitude DECIMAL(9,6),
    Location_longitude DECIMAL(9,6),
    Intersection_ID INT,
    FOREIGN KEY (Intersection_ID) REFERENCES Intersection(Intersection_ID)
);

-- Roadway table
CREATE TABLE Roadway (
    Roadway_ID INT PRIMARY KEY,
    Name VARCHAR(255),
    Length DECIMAL(8,2),
```

```
    Speed_Limit INT
);

-- Traffic Control Log table
CREATE TABLE Traffic_Control_Log (
    Log_ID INT,
    Signal_ID INT,
    Intersection_ID INT,
    Timestamp TIMESTAMP,
    Duration_Green INT,
    Duration_Yellow INT,
    Duration_Red INT,
    PRIMARY KEY (Log_ID, Signal_ID, Intersection_ID),
```

```
    FOREIGN KEY (Signal_ID, Intersection_ID) REFERENCES Traffic_Signal(Signal_ID,
Intersection_ID)
);

-- Traffic Incident table
CREATE TABLE Traffic_Incident (
    Incident_ID INT,
    Vehicle_ID INT,
    Roadway_ID INT,
    Location_latitude DECIMAL(9,6),
    Location_longitude DECIMAL(9,6),
    Type VARCHAR(50),
    Severity VARCHAR(20),
```

```
    Timestamp TIMESTAMP,
    PRIMARY KEY (Incident_ID, Vehicle_ID, Roadway_ID),
    FOREIGN KEY (Vehicle_ID) REFERENCES Vehicle(Vehicle_ID),
    FOREIGN KEY (Roadway_ID) REFERENCES Roadway(Roadway_ID)
);

-- Traffic Camera table
CREATE TABLE Traffic_Camera (
    Camera_ID INT PRIMARY KEY,
    Location_latitude DECIMAL(9,6),
    Location_longitude DECIMAL(9,6),
    Direction VARCHAR(20),
    Status VARCHAR(10)
```

```
);

-- has table (Many-to-Many)
CREATE TABLE has (
    Intersection_ID INT,
    Signal_ID INT,
    PRIMARY KEY (Intersection_ID, Signal_ID),
    FOREIGN KEY (Intersection_ID) REFERENCES Intersection(Intersection_ID),
    FOREIGN KEY (Signal_ID, Intersection_ID) REFERENCES Traffic_Signal(Signal_ID,
Intersection_ID)
);

-- runs_on table (Many-to-Many)
```

```
CREATE TABLE runs_on (
    Vehicle_ID INT,
    Roadway_ID INT,
    PRIMARY KEY (Vehicle_ID, Roadway_ID),
    FOREIGN KEY (Vehicle_ID) REFERENCES Vehicle(Vehicle_ID),
    FOREIGN KEY (Roadway_ID) REFERENCES Roadway(Roadway_ID)
);
```

INSERTION OF VALUES

```
INSERT INTO Intersection (Intersection_ID, Location_latitude, Location_longitude)
VALUES
    (1, 40.7128, -74.0060),
    (2, 34.0522, -118.2437),
    (3, 41.8781, -87.6298),
    (4, 29.7604, -95.3698),
    (5, 33.4484, -112.0740),
    (6, 39.9526, -75.1652),
    (7, 37.7749, -122.4194),
    (8, 32.7767, -96.7970),
    (9, 30.2672, -97.7431),
```

```
    (10, 28.5383, -81.3792);


INSERT INTO Traffic_Signal (Signal_ID, Intersection_ID, Timing_Green, Timing_Yellow,
Timing_Red, Status)
VALUES
    (1, 1, 30, 5, 30, 'Active'),
    (2, 2, 20, 4, 25, 'Active'),
    (3, 3, 25, 3, 20, 'Inactive'),
    (4, 4, 35, 6, 30, 'Active'),
    (5, 5, 30, 5, 30, 'Inactive'),
    (6, 6, 40, 7, 35, 'Active'),
    (7, 7, 25, 5, 25, 'Active'),
    (8, 8, 20, 4, 20, 'Inactive'),
```

```
    (9, 9, 30, 6, 25, 'Active'),
    (10, 10, 35, 7, 30, 'Active');


INSERT INTO Vehicle (Vehicle_ID, License_Plate_Number, Driver, Speed,
Location_latitude, Location_longitude, Intersection_ID)
VALUES
    (1, 'ABC123', 'John Doe', 60, 40.7128, -74.0060, 1),
    (2, 'XYZ456', 'Jane Smith', 55, 34.0522, -118.2437, 2),
    (3, 'DEF789', 'Alice Johnson', 65, 41.8781, -87.6298, 3),
    (4, 'GHI101', 'Bob Williams', 70, 29.7604, -95.3698, 4),
    (5, 'JKL121', 'Emily Brown', 50, 33.4484, -112.0740, 5),
    (6, 'MNO141', 'Michael Jones', 45, 39.9526, -75.1652, 6),
    (7, 'PQR161', 'Sarah Davis', 55, 37.7749, -122.4194, 7),
```

```
    (8, 'STU181', 'David Miller', 60, 32.7767, -96.7970, 8),
    (9, 'VWX191', 'Lisa Wilson', 65, 30.2672, -97.7431, 9),
    (10, 'YZA121', 'Chris Martinez', 70, 28.5383, -81.3792, 10);

INSERT INTO Roadway (Roadway_ID, Name, Length, Speed_Limit)
VALUES
    (1, 'Main Street', 5000, 45),
    (2, 'Broadway', 6000, 40),
    (3, 'First Avenue', 4000, 50),
    (4, 'Oak Street', 4500, 35),
    (5, 'Elm Avenue', 5500, 55),
    (6, 'Pine Street', 4800, 40),
    (7, 'Maple Avenue', 5200, 30),
```

```
    (8, 'Cedar Street', 4700, 35),
    (9, 'Walnut Avenue', 5100, 50),
    (10, 'Chestnut Street', 4900, 45);


INSERT INTO Traffic_Control_Log (Log_ID, Signal_ID, Intersection_ID, Timestamp,
Duration_Green, Duration_Yellow, Duration_Red)
VALUES
    (1, 1, 1, CURRENT_TIMESTAMP, 30, 5, 30),
    (2, 2, 2, CURRENT_TIMESTAMP, 20, 4, 25),
    (3, 3, 3, CURRENT_TIMESTAMP, 25, 3, 20),
    (4, 4, 4, CURRENT_TIMESTAMP, 35, 6, 30),
    (5, 5, 5, CURRENT_TIMESTAMP, 30, 5, 30),
    (6, 6, 6, CURRENT_TIMESTAMP, 40, 7, 35),
```

```
    (7, 7, 7, CURRENT_TIMESTAMP, 25, 5, 25),
    (8, 8, 8, CURRENT_TIMESTAMP, 20, 4, 20),
    (9, 9, 9, CURRENT_TIMESTAMP, 30, 6, 25),
    (10, 10, 10, CURRENT_TIMESTAMP, 35, 7, 30);

INSERT INTO Traffic_Incident (Incident_ID, Vehicle_ID, Roadway_ID, Location_latitude,
Location_longitude, Type, Severity, Timestamp)
VALUES
    (1, 1, 1, 40.7128, -74.0060, 'Accident', 'High', CURRENT_TIMESTAMP),
    (2, 2, 2, 34.0522, -118.2437, 'Road Closure', 'Medium', CURRENT_TIMESTAMP),
    (3, 3, 3, 41.8781, -87.6298, 'Accident', 'Low', CURRENT_TIMESTAMP),
    (4, 4, 4, 29.7604, -95.3698, 'Accident', 'Medium', CURRENT_TIMESTAMP),
    (5, 5, 5, 33.4484, -112.0740, 'Road Closure', 'High', CURRENT_TIMESTAMP),
```

```
    (6, 6, 6, 39.9526, -75.1652, 'Accident', 'Medium', CURRENT_TIMESTAMP),
    (7, 7, 7, 37.7749, -122.4194, 'Accident', 'High', CURRENT_TIMESTAMP),
    (8, 8, 8, 32.7767, -96.7970, 'Road Closure', 'Low', CURRENT_TIMESTAMP),
    (9, 9, 9, 30.2672,-84.8643,’Times Square’,’High’,
CURRENT_TIMESTAMP),
    (10,10,10,25.1838,-113.3219,’Woke Street’,’Low’,
CURRENT_TIMESTAMP);


INSERT INTO Traffic_Camera (Camera_ID, Location_latitude, Location_longitude,
Direction, Status)
VALUES
    (1, 40.7128, -74.0060, 'North', 'Active'),
    (2, 34.0522, -118.2437, 'South', 'Active'),
```

```
    (3, 41.8781, -87.6298, 'East', 'Inactive'),
    (4, 29.7604, -95.3698, 'West', 'Active'),
    (5, 33.4484, -112.0740, 'North', 'Inactive'),
    (6, 39.9526, -75.1652, 'South', 'Active'),
    (7, 37.7749, -122.4194, 'East', 'Active'),
    (8, 32.7767, -96.7970, 'West', 'Inactive'),
    (9, 30.2672, -97.7431, 'North', 'Active'),
(10, 28.5383, -81.3792, 'South', 'Active');

INSERT INTO has (Intersection_ID, Signal_ID)
VALUES
    (1, 1),
    (1, 2),
```

```
    (2, 3),
    (2, 4),
    (3, 5),
    (3, 6),
    (4, 7),
    (4, 8),
    (5, 9),
    (5, 10);

INSERT INTO runs_on (Vehicle_ID, Roadway_ID)
VALUES
    (1, 1),
    (1, 2),
```

(2, 3),

(2, 4),

(3, 5),

(3, 6),

(4, 7),

(4, 8),

(5, 9),

(5, 10);

SQL QUERIES

1.)Select the average speed of vehicles on each roadway.

->SELECT Roadway_ID, AVG(Speed) AS Average_Speed

FROM Vehicle

GROUP BY Roadway_ID;

2.)To count the number of incidents per roadway.

->SELECT ti.Roadway_ID, r.Name AS Roadway_Name, COUNT(ti.Incident_ID) AS Incident_Count

FROM Traffic_Incident ti

INNER JOIN Roadway r ON ti.Roadway_ID = r.Roadway_ID

GROUP BY ti.Roadway_ID, r.Name;

3.)Select all traffic incidents with high severity.

->SELECT * FROM Traffic_Incident

WHERE Severity = 'High';

4.Delete a vehicle with vehicle id = 6.

->DELETE FROM Vehicle

WHERE Vehicle_ID = 6;

5.To get information about vehicles and their corresponding intersections.

->SELECT v.Vehicle_ID, v.License_Plate_Number, v.Driver, v.Speed, v.Location_latitude AS Vehicle_Latitude, v.Location_longitude AS Vehicle_Longitude, i.Intersection_ID,

```
i.Location_latitude AS Intersection_Latitude, i.Location_longitude AS
Intersection_Longitude

FROM Vehicle v

INNER JOIN Intersection i ON v.Intersection_ID = i.Intersection_ID;
```