**Speed limit Project**

Introduction to the project

Dear scientists,

We are requesting your services for the well-being of the community. We are looking into a road safety issue at a high-risk point near our campus. That point is right before and after the bridge coming or leaving our school from the main gate. We would like you to use your knowledge of mechanics and research skills to determine a safe speed limit for that segment of road. Please consider all elements necessary (see basic concepts below)

You will be presenting the results of your investigation and the proposed speed limit supported by a scientific argumentation and calculations to the scientific community in a 5 minute presentation. We will implement the most scientifically convincing proposal.

Yours sincerely,

The Major of UWC CSC

PS: all your sources have to be cited and included in the bibliography

**Key concepts:**

Primary [compulsory] concepts

* Speed

85% of the largest speed

* Total Stopping distance

\*calculation

* Reaction stopping distance

\*calculation 1

* Breaking distance

\*calculation 2

* Inertia

= mass

* Visibility

\*calculation

* Line of sight (sightline)

Secondary [optional] concepts

* Kinetic and potential energy
* Reaction force
* Dynamic friction
* Inclined plane and its forces
* Momentum
* Impulse
* Circular motion and centripetal force

**Guiding questions**

[Guiding questions have been colored in white] Only make them visible one at a time if you get stuck.

Why is a speed limit necessary?

What might be on the road?

People, cars, bikes, motorbikes, cars, trucks…

When will the driver be able to see a possible obstacle or person?

Are you considering the position of the driver and the size of the obstacle?

How much time will the driver take to react?

How much distance will it take the driver to stop?

What factors affect the stopping distance?

Friction, inclination…

What factors are the most important? (May affect the outcome the most?)

What mathematical model can you design that could describe the situation accurately enough?

Are your sources reliable and applicable to this scenario and context?

Considering the sightlines, what should be the maximum speed of a vehicle?

**Checkpoints:**

The following are a list of checkpoints where you have to contact your supervisor and share with him your progress so far.

By the end of the first lesson:

1. Strategy to approach the task with a diagram/sketch of the key elements of research
2. List of measurements that will be taken

By the end of the second lesson:

1. List of factors that may influence the stopping distance and realistically which ones will be taken into account.
2. Approximations and Mathematical calculations with final answer

On the presentation day

1. Send your teacher your slides
2. Final presentation

<http://www.cabobike.org/2010/01/30/ask-the-traffic-engineer-how-are-speed-limits-set/>

<http://www.sehinc.com/news/truth-about-speed-limits-explained-engineer>

Tables of speed and stopping distance:

<https://law.lis.virginia.gov/vacode/46.2-880/>

Video

<https://www.youtube.com/watch?v=w83O6jP1BB4>

Nature

* Weather
* Terrain
* Location
* Visibility

Engineering

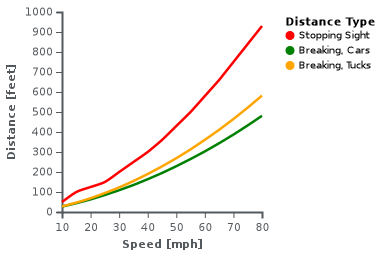
* Purpose of the road
* Crash risks
* Traffic flow
* Road material
* Shoulder space

Human

* Safety
* Ability

85th percentile rule

**Stopping Sight distance**



Stopping sight distance is the distance traveled during the two phases of stopping a vehicle: [perception-reaction time](https://en.wikipedia.org/wiki/Mental_chronometry) (PRT), and c (MT).

The design standards of the [American Association of State Highway and Transportation Officials](https://en.wikipedia.org/wiki/American_Association_of_State_Highway_and_Transportation_Officials) (AASHTO) allow 1.5 seconds for perception time and 1.0 second for reaction time.[[4]](https://en.wikipedia.org/wiki/Stopping_sight_distance#cite_note-4)[[5]](https://en.wikipedia.org/wiki/Stopping_sight_distance#cite_note-5)

The values of stopping sight distance used in design represent a near worst-case situation. For design, a conservative distance is needed to allow a vehicle traveling at design speed to stop before reaching a stationary object in its path. A generous amount of time is given for the perception-reaction process, and a fairly low rate of deceleration is used. The design sight distance allows a below-average driver to stop in time to avoid a collision in most cases.

**Driver perception/reaction distance**is calculated by:

dPRT = 0.278 Vt (Metric)

dPRT = 1.47 Vt (US Customary)

Where:

dPRT = driver perception-reaction distance, m (ft)

V = design speed, km/h (mph)

t = brake reaction time, in seconds

Based on the results of many studies, 2.5 seconds has been chosen for a perception-reaction time. This time will accommodate approximately 90 percent of all drivers when confronted with simple to moderately complex highway situations. Greater reaction time should be allowed in situations that are more complex.

**Braking distance** is calculated by:

dMT = ​0.039 V2⁄a (Metric)

dMT> = ​1.075 V2⁄a (US Customary)

Where:

dMT = braking distance, m (ft)

V = design speed, km/h (mph)

a = deceleration rate, m/s2 (ft/s2)

Actual braking distances are affected by the vehicle type and condition, the [incline](https://en.wikipedia.org/wiki/Inclined_plane) of the road, the available [traction](https://en.wikipedia.org/wiki/Road_slipperiness), and numerous other factors.

A deceleration rate of 3.4 m/s2 (11.2 ft/s2) is used to determine stopping sight distance.[[6]](https://en.wikipedia.org/wiki/Stopping_sight_distance#cite_note-6) Approximately 90 percent of all drivers decelerate at rates greater than that. These values are within most drivers' ability to stay within his or her lane and maintain steering control. Also, most wet pavement surfaces and most vehicle braking systems are capable of providing enough braking force to exceed this deceleration rate.

**Stopping Sight Distance** (SSD) is the sum of reaction distance and braking distance

SSD = dPRT + dMT

SSD = 0.278 Vt + ​0.039 V2⁄a (Metric)

SSD = 1.47 Vt + ​1.075 V2⁄a (US Customary)

Several methods exist to set up a speed limit:

* Engineering
* Harm minimization (people &environment)
* Economic optimization (fuel efficiency)
* importance