

DESIGNING DIFFERENT HIGHWAY INTERCHANGES

OVERVIEW

DURATION: 45 – 50 MINUTES

CATEGORY: TRANSPORTATION

NUMBER OF STUDENTS: 30 IN EACH SESSION APPROXIMATELY

ENRICHMENT COMPONENTS: D.I.Y., STEAM, TRANSPORTATION, ENGINEERING

QUALITY STANDARDS: CALIFORNIA STANDARDS OF LEARNING

LEARNING OBJECTIVE

STUDENTS WILL LEARN ABOUT THE VARIOUS TYPES OF HIGHWAY INTERCHANGES, RAMPS, HOW THEY ARE USEFUL IN OUR DAILY LIVES, AND THEIR ENGINEERING CONNECTIONS. SIMPLE DESIGNING OF HIGHWAY INTERCHANGES WILL HELP THEM TO RELATE TO REAL-LIFE SITUATIONS.

ENGINEERING VOCABULARY

- **Highways & Freeways:** Any public or private road is referred to as a highway when it is used for major transit routes, as well as minor public roads and tracks. Although all freeways are highways, not all highways are freeways. A freeway is a "controlled-access" highway (sometimes known as an express highway) built specifically for high-speed automotive traffic. Traffic flow is not affected because there are no traffic signals, crossroads, or at-grade crossings with other roads, pedestrian walkways, etc.
- **Highway Interchanges:** An interchange is a road junction that uses grade separations to allow traffic to move between two or more roadways or highways, and that uses a system of interconnecting roadways to allow traffic on at least one of the routes to pass through the junction without being interrupted by crossing traffic streams. It's not like a typical intersection, where the roads cross at grade. Although they are occasionally used at intersections between surface streets, interchanges are virtually always employed when at least one route is a controlled-access highway (freeway or motorway) or a limited-access divided highway (expressway).
- **Ramps:** A ramp, also known as a slip road in the United Kingdom or a link in Ireland, is a small stretch of road that allows vehicles to enter or exit a controlled-access highway. A directed ramp curves in the desired travel direction.
- **Overpass:** A bridge, road, railway, or other similar construction that passes over another road or railway is known as an overpass. A grade separation is created by combining an overpass and an underpass. Multiple overpasses make a stack interchange.
- **Underpass:** The crossing between a highway and another way (such as a road or railroad) at different levels. Also, can be defined as the lower level of such crossing.
- **Cloverleaf:** A form of interchange in which vehicles turn left by making right-hand turns and looping 270 degrees around a big ramp that resembles a cloverleaf.
- **Topology:** The branch of mathematics that studies how things or objects can be connected.

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STEPS FOR THE ACTIVITY

- 1.FSTI team members introduction.
- 2.Dividing students into equal groups.
- 3.Pre-Assessment forms distribution.
- 4.Discussion of the materials required to do the Highway Interchanges. Highway Interchanges to include: - **Exit routes, Overpass and Underpass, On-ramp and Off-ramp.** Explanation of terminology, and mock-up for the activity.
- 5.Each team using all the supplies they have shall do a model highway interchange. Posters of sample highway interchanges will be given for reference purposes only.
- 6.Giveaways to students.
- 7.Completion survey and post-assessment for the teachers and students.

MATERIALS REQUIRED

For each Model Highway:

Two 2-lane highway sections made of foam core
Wooden blocks
Masking tape
Markers

Per team:

1 model highway
Small pieces of rope
Scissors
Jumbo paper clips or binder clips
Small pieces of paper and pens for making road signs
Toy cars

DISCUSSION/ENGAGEMENT QUESTIONNAIRE

- How many ramps do you think your interchange will need?
- How did you decide which interchange would work best? Mention some advantages and disadvantages for the same.
- What if your interchange had to be built in a place with very cold, snowy winters and lots of blizzards? Would that affect the design you pick?
- If your team talked about whether to design a cloverleaf or an overpass, what made you choose one or the other? Or, if you came up with another solution, why was it better?
- What if your interchange was built in a country where you drive on the left side of the road instead of the right? How would your interchange differ?
- What is the best possible solution to overcome the construction barriers?
- What kind of calculations are required?
- What are the factors for the best possible solution?
- How to decide on the life of the roadways? etc.
- How are a detour, exit route, and roundabouts different?
- What warning signals do you notice at any interchanges?
- Do you observe any road markings at the interchanges, if yes, what are they?
- Do you understand all TCDs at interchanges?
- If given a chance, how would you like to change the design of highway interchanges?
- What factors are involved in making a highway interchange for example construction cost?

SOCIAL EMOTIONAL LEARNING

- **Growth Mindset:** Young people believe that they can, through their efforts, grow in their intelligence and abilities.
- **Self-Awareness:** Young people can recognize and understand their identity and feelings.
- **Interpersonal Skills:** Young people use effective communication and collaboration skills to establish and maintain positive and productive relationships.
- **Social Awareness:** Young people have the capacity for empathy, can consider and appreciate the diverse feelings, perspectives, and personal contexts of others.