PRINCIPLES COURSE

David Casaceli

Railroad Accident Investigator with the **National Transportation Safety Board**

JUNE 10-12, 2025

WRI2025HH

PRINCIPLES COURSE - JUNE 10, 2025

OVERVIEW

DAVID CASACELI

WRI2025HH

PRINCIPLES COURSE - JUNE 10, 2025

AGENDA

J.R.EDWARDS	1	TRACK STRUCTURES & COMPONENTS
E.TOMA	2	VEHICLE TYPES, SUSPENSIONS, AND COMPONENTS
R.STOCK	3	WHEEL-RAIL CONTACT: AN INTRODUCTION
A.WOELFE	4	VEHICLE-TRACK INTERACTION & DYNAMICS
R.STOCK	5	WHEEL-RAIL DAMAGE MECHANISMS
M.DICK	6	VEHICLE-TRACK MEASUREMENT TECHNOLOGIES

DERAILMENT CASE STUDY

1 TRACK STRUCTURE COMPONENTS
2 VEHICLE TYPES, SU AND COMPONENTS
3 WHEEL-RAIL CONT INTRODUCTION
4 VEHICLE-TRACK IN DYNAMICS
5 WHEEL-RAIL DAMA MECHANISMS
6 VEHICLE-TRACK ME TECHNOLOGIES

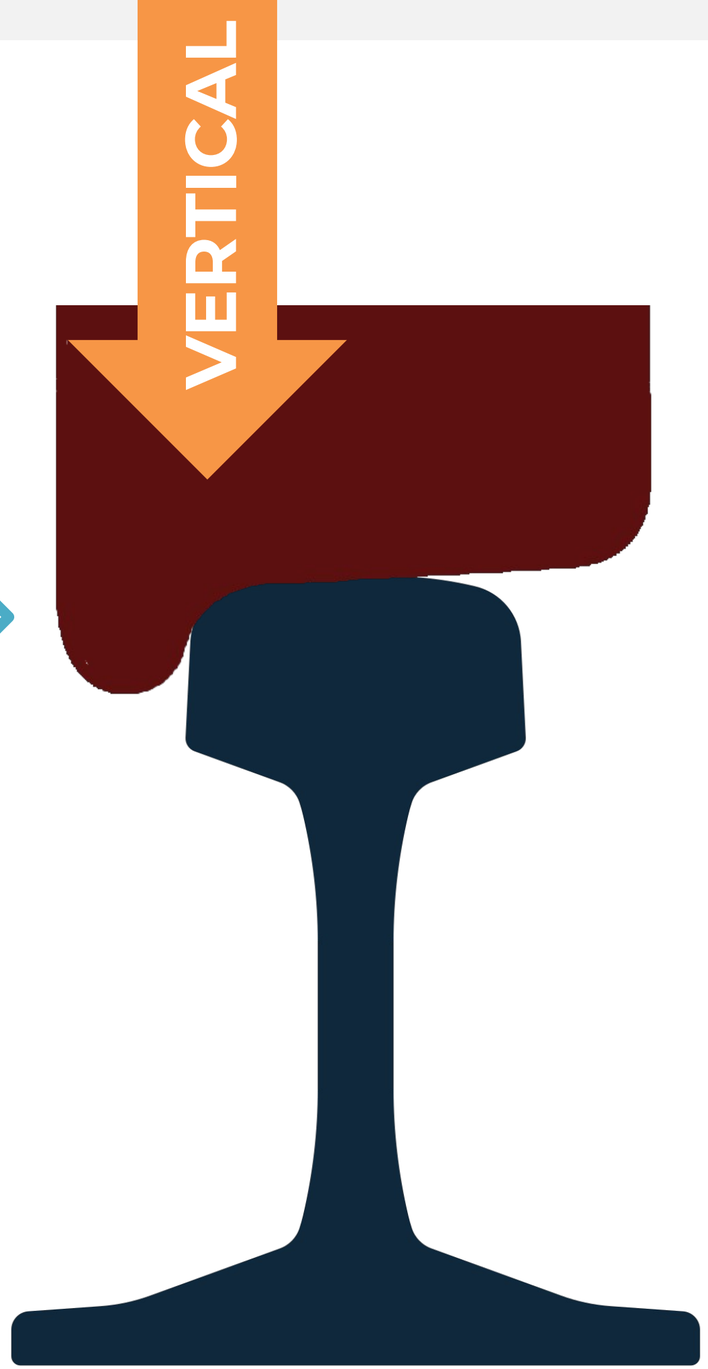
DERAILMENT CASE STUDY

PRINCIPLES COURSE - JUNE 10, 2025

WHY WHEELS DERAIL

WHAT IS L / V?

LATERAL



$$\frac{L}{V} = \frac{\text{LATERAL}}{\text{VERTICAL}}$$

APPLIED L/V

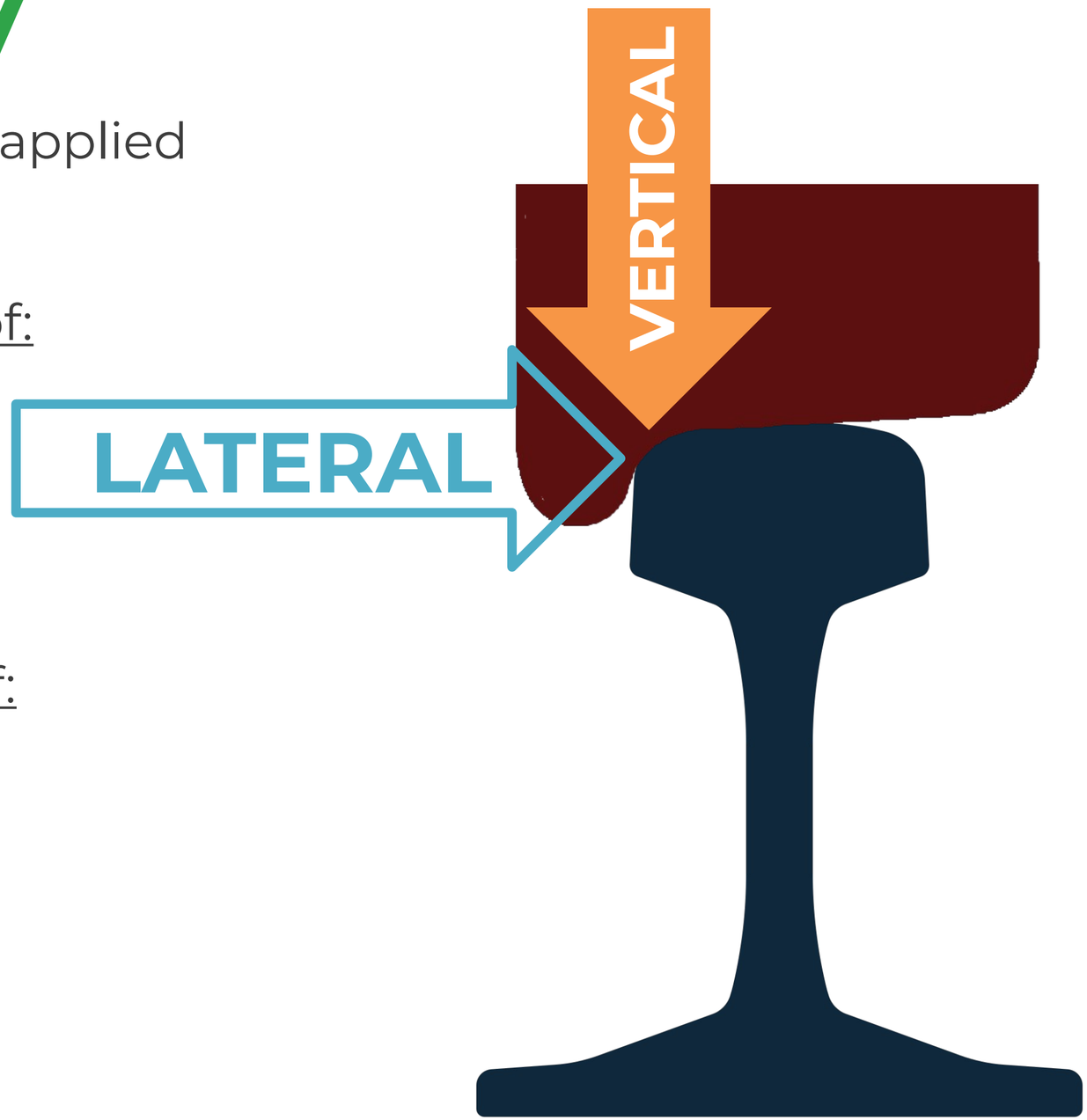
The ratio of the forces actually applied at the wheel-rail interface.

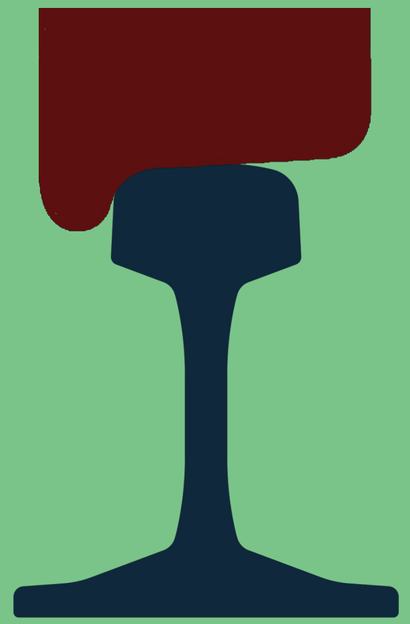
<u>Vertical Forces are a function of:</u>

- Vehicle weight
- Track geometry and speed
- Truck suspension
- Side bearing

<u>Lateral Forces are a function of:</u>

- Flange and creep forces
- Track geometry and speed
- In-train drawbar force
- Coupler angles
- Rail lubrication
- Truck condition





THE TWO L / V RATIOS

APPLIED L/V

The ratio of the forces actually applied at the wheel-rail interface.

L/V THRESHOLD

The threshold for a specific wheel-rail combination that, if exceeded by the APPLIED L/V, will result in wheel climb or rail rollover

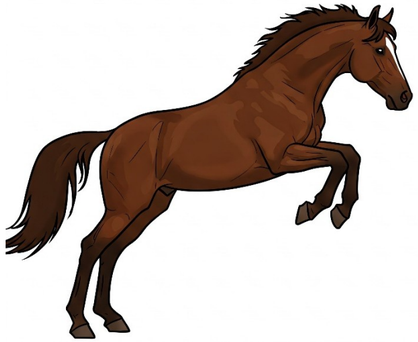
Dependent upon:

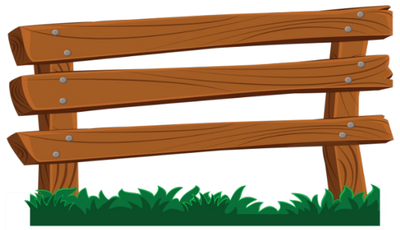
- Wheel Profile
- Rail Profile
- Friction at the interface

THE TWO L / V RATIOS

APPLIED L/V

The ratio of the forces actually applied at the wheel-rail interface.





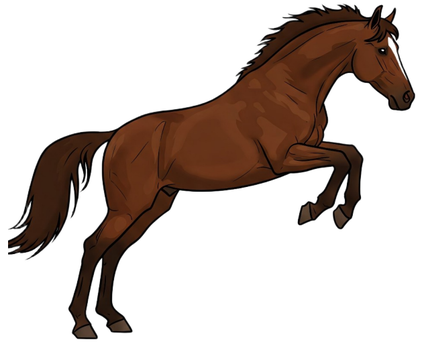
L/V THRESHOLD

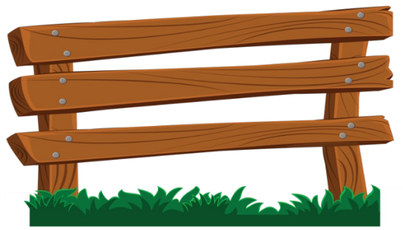
The threshold that, if exceeded, will result in a wheel climb or rail roll for a specific wheel-rail combination.

THE TWO L / V RATIOS

HOW DO WHEELS STAY ON THE RAIL?

APPLIED L/V **<** **THRESHOLD L/V**

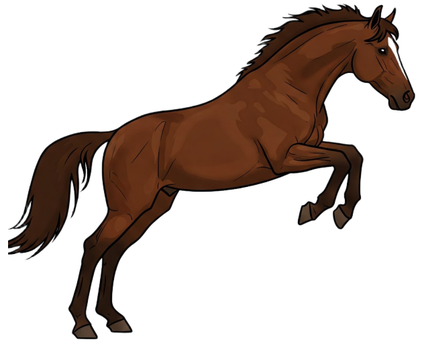


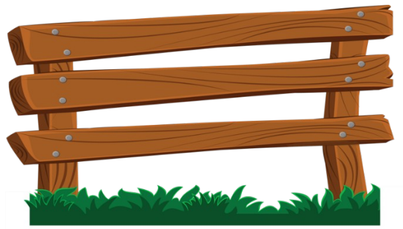


THE TWO L / V RATIOS

WHEN DO DERAILMENTS OCCUR?

APPLIED L/V > THRESHOLD L/V

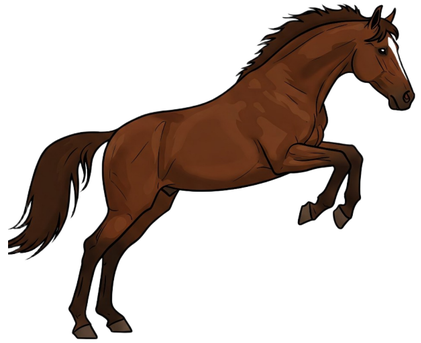


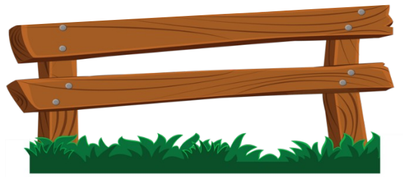


THE TWO L / V RATIOS

HOW DOES THIS HAPPEN?

APPLIED L/V > THRESHOLD L/V



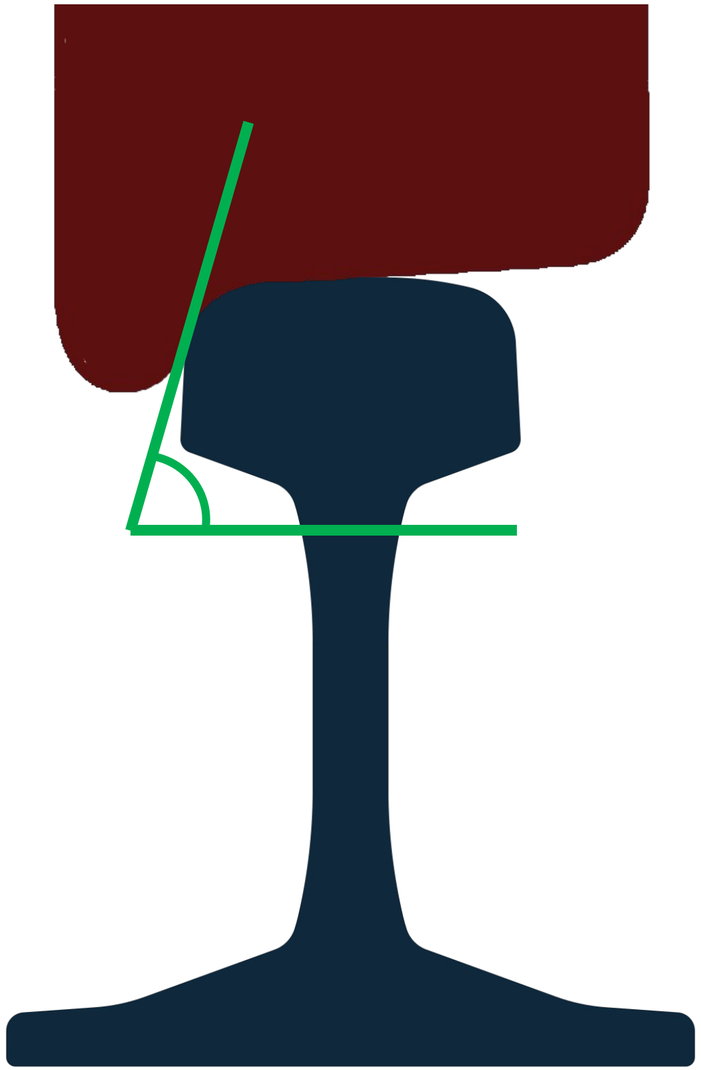


APPLIED L/V

HOW APPLIED L/V CAN INCREASE?

BIG $\frac{L}{V}$ LITTLE

L/V THRESHOLD
WHEEL CLIMB



The threshold that, if exceeded , will result in a **wheel-climb** or rail-rollover for a specific wheel-rail combination.

L/V Threshold for WHEEL CLIMB is a function of:

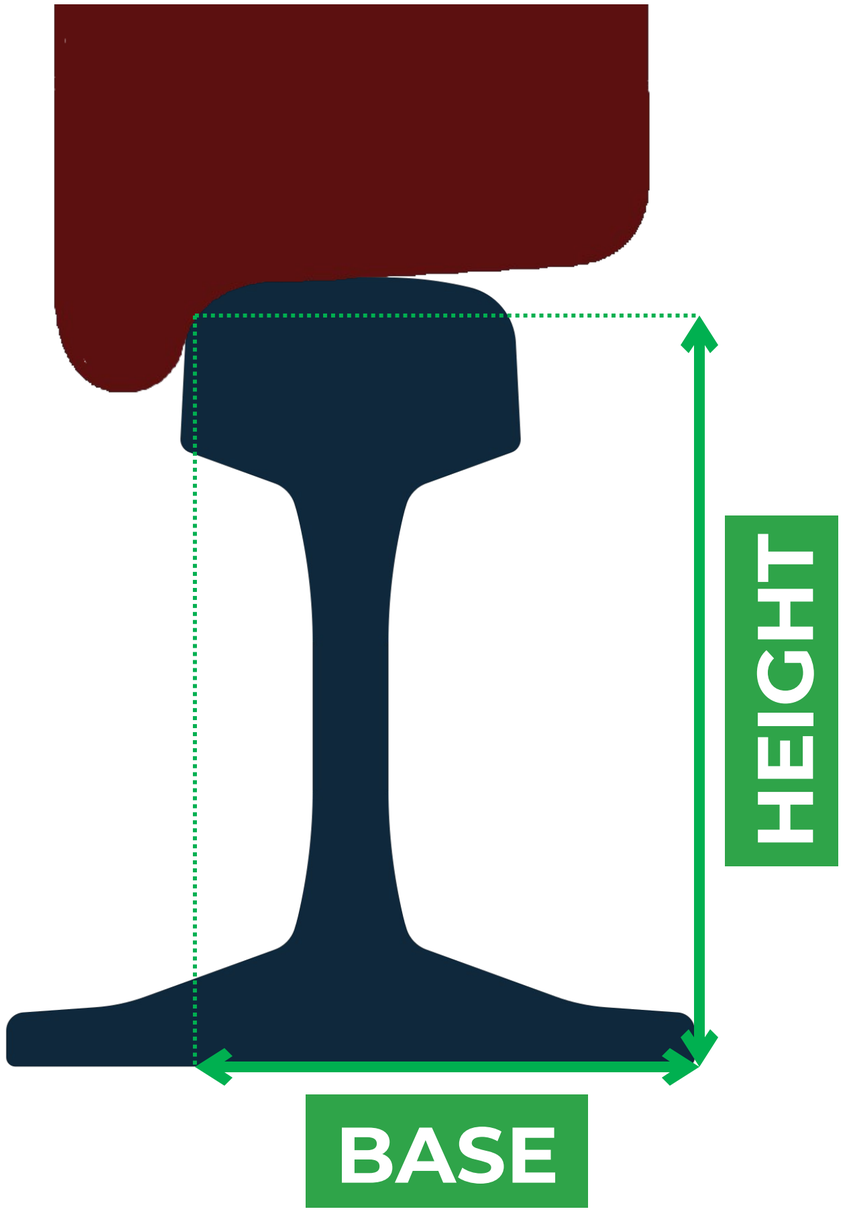
- Angle at the interface
- Friction at the interface

L/V THRESHOLD
WHEEL CLIMB

MOST WHEEL CLIMB DERAILMENTS ARE LITTLE V

$$\text{APPLIED } \frac{L}{V} = \frac{\text{LATERAL}}{\text{VERTICAL}}$$

L/V THRESHOLD
RAIL ROLLOVER

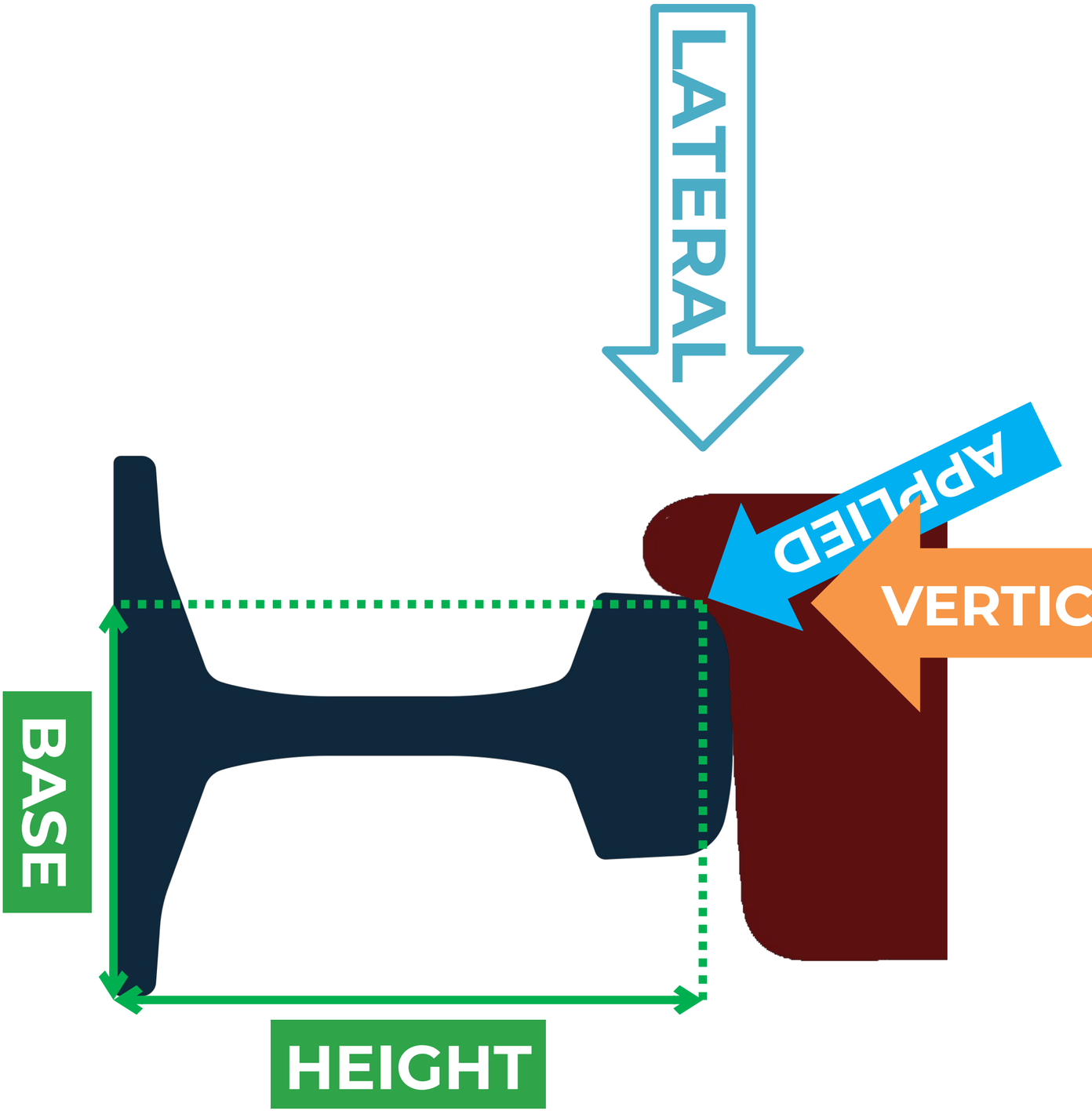


The threshold that, if exceeded , will result in a wheel-climb or **rail-rollover** for a specific wheel-rail combination.

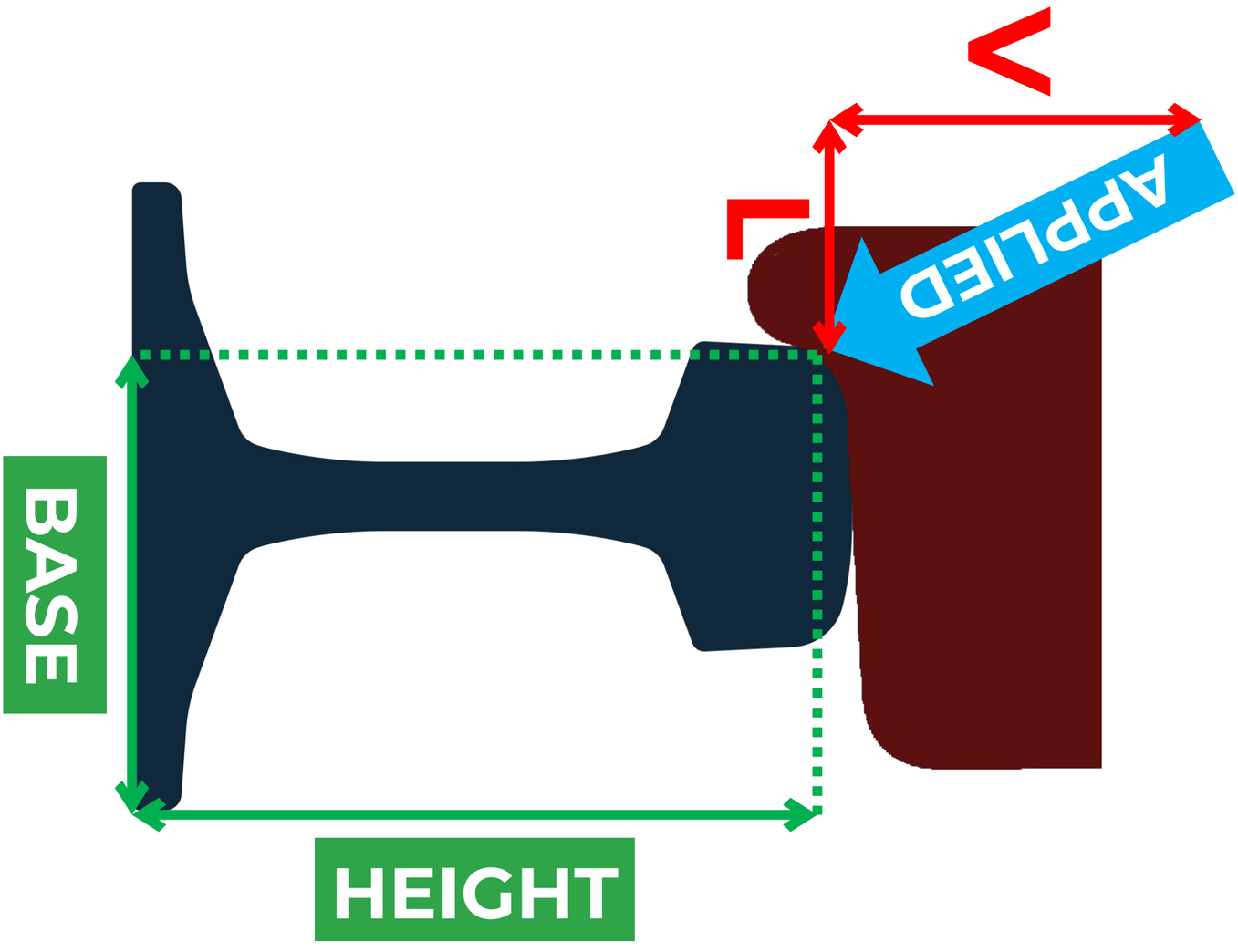
L/V threshold for RAIL-ROLLOVER is a function of:

- The wheel-rail contact point(s)
  - The “B/H Ratio”

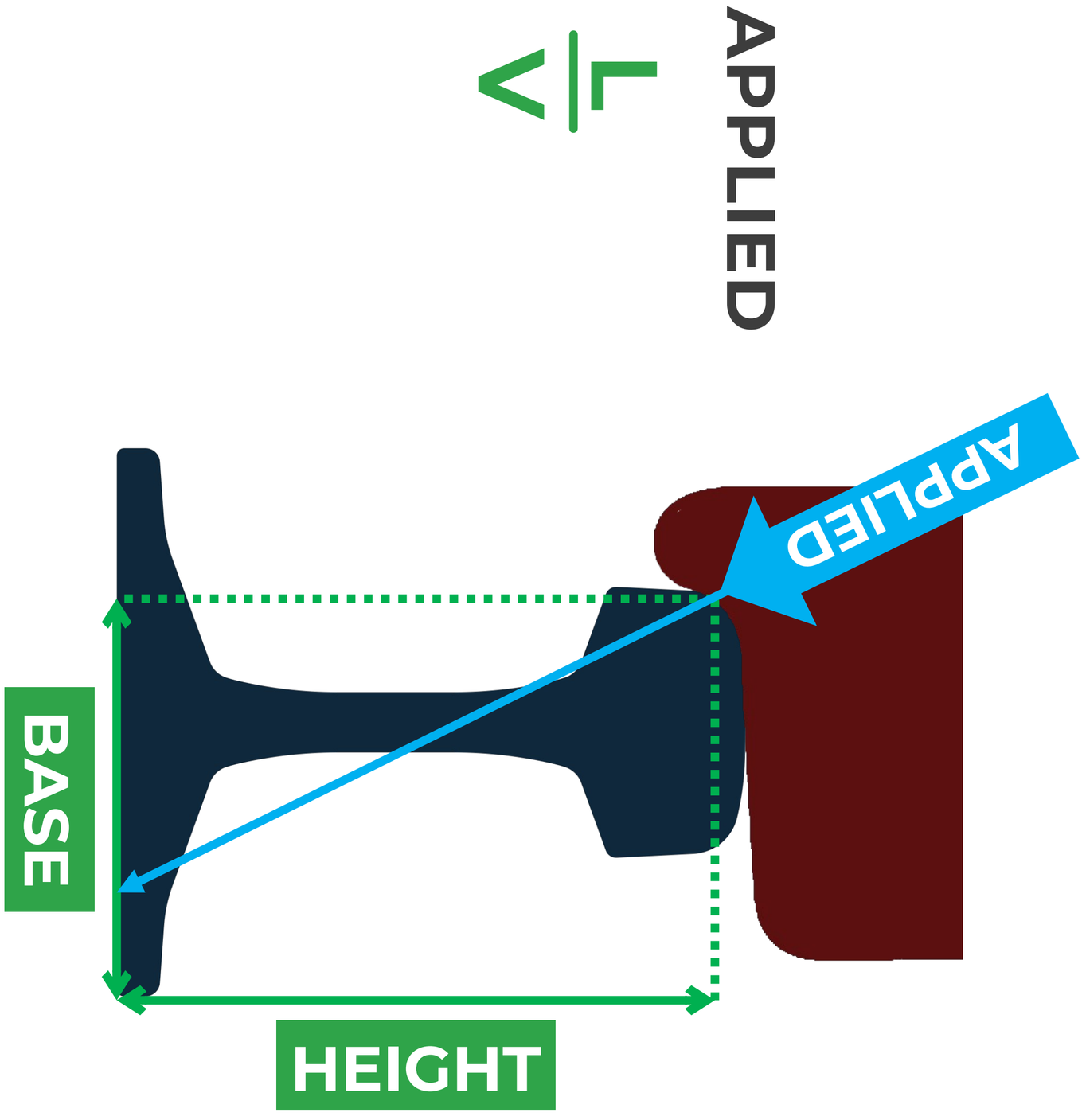
L/V THRESHOLD
RAIL ROLLOVER



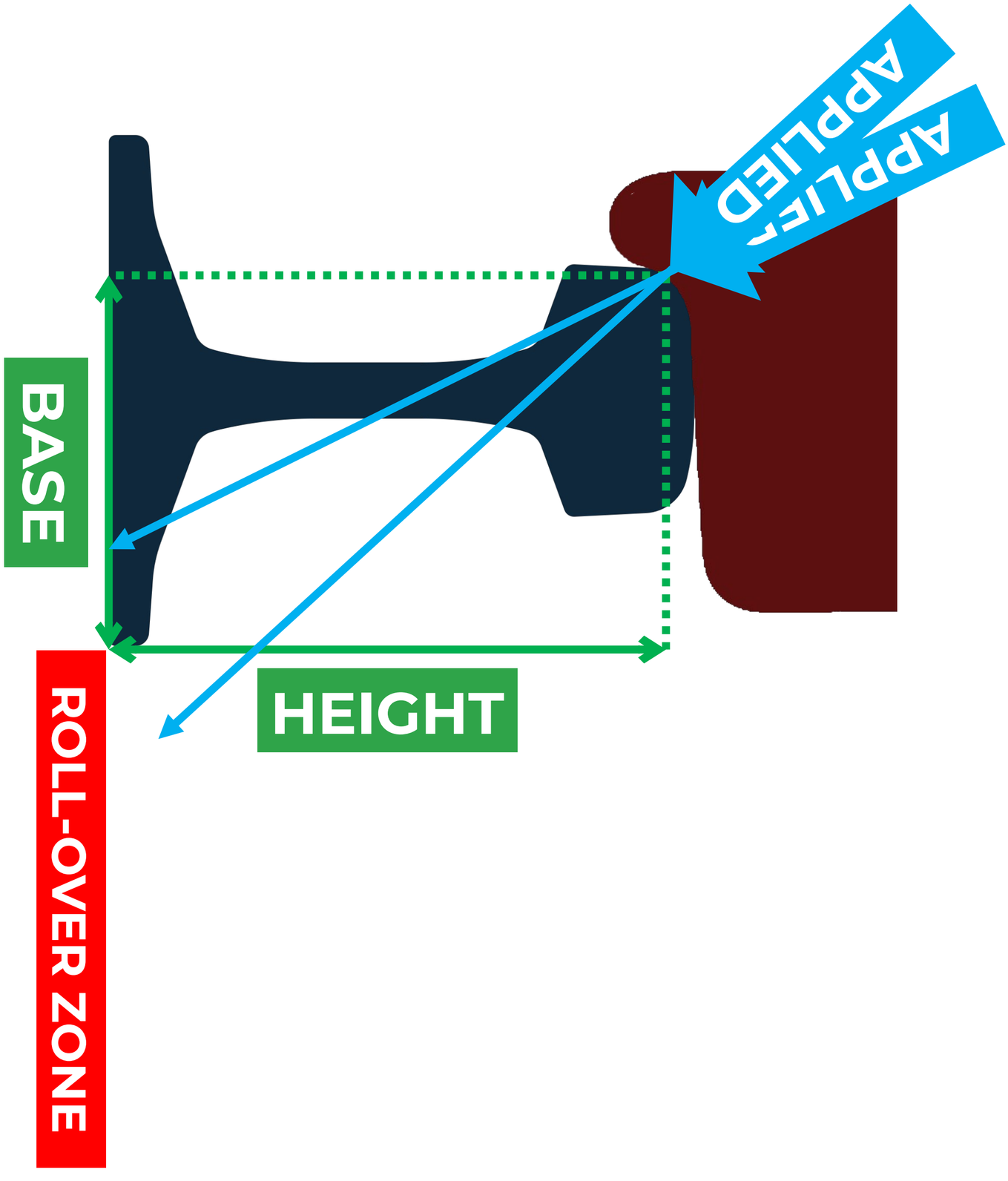
L/V THRESHOLD
RAIL ROLLOVER



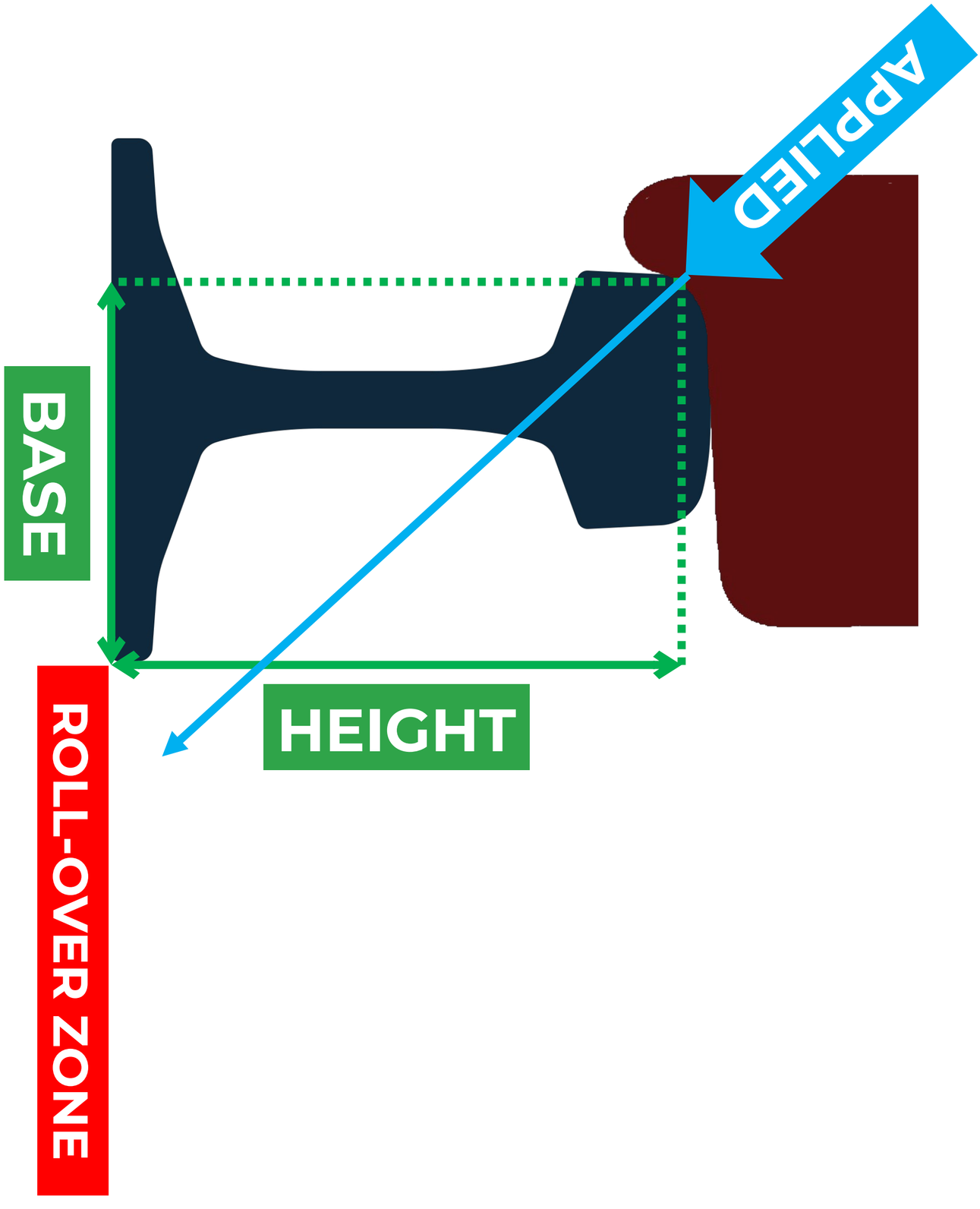
L/V THRESHOLD
RAIL ROLLOVER



L/V THRESHOLD
RAIL ROLLOVER



L/V THRESHOLD
RAIL ROLLOVER



L/V THRESHOLD
RAIL ROLLOVER

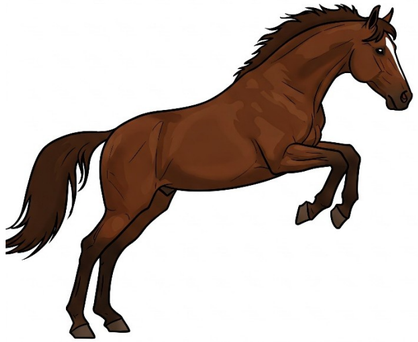
MOST RAIL ROLLOVER DERAILMENTS ARE BIG L

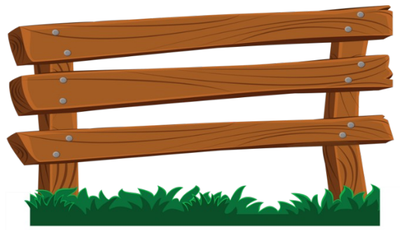
$$\frac{L}{V} = \frac{\text{LATERAL}}{\text{VERTICAL}}$$

THE TWO L / V RATIOS

APPLIED L/V

The ratio of the forces actually applied at the wheel-rail interface.





L/V THRESHOLD

The threshold that, if exceeded, will result in a wheel climb or rail roll for a specific wheel-rail combination.

THE CASE STUDY

- Your phone rings at 4:30 AM on a Monday morning in July.
- A westbound 126 car mixed manifest train has derailed.
- The crew reports that 10 - 20 cars are off the track near the back of the train.
- They are derailed at a grade crossing in town (population 20,000).

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