Lesson 19: More Influence Lines

- Distributed Loads
- Pattern Loads
- Application to Trusses

A. Distributed Loads:

Uniform Dist. Loads:

Load Effect is Area Under Influence Line Diagram Times Magnitude of Distributed Load.

Example: Given Influence Line Diagram, Find Moment (MA) Due to Distributed Load W_1.

\[ M_A = \frac{1}{2} (10 \text{ k-ft})(6 \text{ ft})(1.2 \text{ k/ft}) + \frac{1}{2} (10 \text{ k-ft})(6 \text{ ft})(1.2 \text{ k/ft}) \]

\[ M_A = 0 \text{ k-ft} \]

What about W_2?

\[ M_A = (1.2 \text{ k/ft}) \left( \frac{1}{2} \right)(16 \text{ ft})(-10 \text{ k-ft}) \]

\[ M_A = -76 \text{ k-ft} \]
B. PATTERN LOADS:

→ WHICH PATTERNS? EQUIVALENT STANDARD AXEL LOAD (ESAL)

\[ E = 72k \]
\[ 96 T \]

→ INCREASE - DECREASE METHOD

- METHOD TO DETERMINE EFFECT OF PATTERN LOADS
- APPLY PATTERN LOAD IN SUCCESSIVE POSITIONS TO KEEP PEAK VALUE

EXAMPLE SAMPLE BEAM

SAMPLE INFLUENCE DIAGRAM: \( M_e \)

SAMPLE PATTERN

FORWARD AT POSITION 1

FORWARD AT POSITION 2

NET INCREASE KEEP GOING

FORWARD AT POSITION 2

Net Decrease, Shr.

WORST CASE, FORWARD PASS Pos. 2

HS-20-44 STANDARD TRUCK LOAD
Z-AXLE TRUCK WITH SINGLE-AXLE TRAILER
(AASHTO STANDARD LOAD FOR BRIDGES)
Example cont...

Must repeat for other direction

**Backward**

**Position 1**

**Position 2**

**Position 3**

INCREASE:

Out of loading worst case (Backward Pass)

INCREASE:

**Net = +120 k-ft**

**Position 2**

**Position 3**

**Moment @ C**

**Forward Pass**

**Moment @ C**

**Backward Pass**

\[
M_c = 8 \left( \frac{6}{20} \right)(15) + (32)(15) + 32 \left( \frac{4}{10} \right)(15) = 708 \text{ k-ft} \]

\[
M_c = 32(15) + 32 \left( \frac{14/10}{15} \right)(15) + 8 \left( \frac{2/10}{15} \right)(15) = 678 \text{ k-ft} \]
C. Influence Diagrams in Trusses

- Can compute influence line diagrams for every bar.
- Requires successive applications of unit loads and solution of internal bar forces (connect via straight lines).
- Very long & tedious.
- Good for computers to do.
- Method of sections useful for single bar.

Ex:

[Diagram showing a truss structure with labeled sections and influence lines.]

And so forth...