Influence Lines

- Influence lines are essential in the design of structures that resist large live loads.
- In our work up to this point, we have discussed analysis techniques for structures subjected to *dead* or *fixed loads*.

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- We learned that shear and moment diagrams are essential in determining the maximum internal force in a structure.
- If a structure is subjected to a *live* or *moving load*, the variation in shear and moment is best described using *influence lines*.

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Influence Lines

Definition of an *influence line*:

An *influence line* represents the variation of the reaction, shear, moment, or deflection at a *specific point* in a member as a concentrated force moves over the member.



Influence Lines

- Once the *influence line* is drawn, the location of the live load that will have the greatest influence on the structure can be found very quickly.
- Therefore, *influence lines* are essential in the design of a structure where the loads move along the span (bridges, cranes, conveyors, etc.).

Influence Lines

Although the procedure for constructing an influence line is relatively simple, it is essential to remember the difference between drawing an influence line and constructing a shear or moment diagram

Influence Lines

- Influence lines represent the effect of a moving load only at a specified point on a member.
- Whereas shear and moment diagrams represent the effect of fixed loads at **all points** along the member.

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Influence Lines

Tabular Procedure for determining the *influence line* at a point **P** for any function (reaction, shear, or moment).

- 3. Repeat Steps 1 and 2 for various values of *x* over the whole beam.
- 4. Plot the values of the reaction, shear, or moment for the member.

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Influence Lines

Influence-Line Equations Procedure for determining the *influence line* at a point **P** for any function (reaction, shear, or moment).

- 1. Place a unit load (a load whose magnitude equals one) at a point, *x*, along the member.
- Use the equilibrium equations to find the value of the reaction, shear, or moment at a specific point P due to the concentrated load as a function of *x*.

Influence Lines

Influence-Line Equations Procedure for determining the *influence line* at a point **P** for any function (reaction, shear, or moment).

3. Plot the values of the reaction, shear, or moment for the member.









































Influence Lines Example: Construct the *influence line* for the moment at C $A \xrightarrow[]{C} \xrightarrow[]{B} B \\ \hline ft. \xrightarrow{]}{} 5 ft. \xrightarrow{]}{} 5 ft. \xrightarrow{]}{} 5 ft. \xrightarrow{]}{} 3$



Influence Lines Concentrated Force - Since we use a unit force (a dimensionless load), the value of the function (reaction, shear, or moment) can be found by multiplying the ordinate of the influence line at position *x* by the magnitude of the actual force **P**.









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