Method 1: Equilibrium

- cut sections at important places
- plot V & M

Method 2: Semigraphical

- by knowing
  - area under loading curve = change in V
  - area under shear curve = change in M
  - concentrated forces cause “jump” in V
  - concentrated moments cause “jump” in M

\[
V_D - V_C = - \int_{x_C}^{x_D} w\,dx \quad M_D - M_C = \int_{x_C}^{x_D} V\,dx
\]
Method 2: Semigraphical

- $M_{\text{max}}$ occurs where $V = 0$ (calculus)

\[ V + M \text{ no area} \]

\[ M \text{ } L \]

Curve Relationships

- Integration of functions
- Line with 0 slope, integrates to sloped

\[ \text{ } \]

- Ex: load to shear, shear to moment

\[ y \quad x \quad \Rightarrow \quad y \quad x \]

\[ y \quad x \quad \text{parabola, integrates to 3rd order curve} \]

- Ex: load to shear, shear to moment

\[ y \quad x \quad \Rightarrow \quad y \quad x \]
**Basic Procedure**

1. **Find reaction forces & moments**
   - Plot axes, underneath beam load diagram

2. **Starting at left**
3. **Shear is 0 at free ends**
4. **Shear jumps with concentrated load**
5. **Shear changes with area under load**

**Triangle Geometry**

- **slope of V is w (w:1)**

\[
x \cdot w = V_A \\
x = \frac{V_A}{w}
\]

**Parabolic Shapes**

- **cases**

  - **up fast, then slow**
  - **up slow, then fast**
  - **down fast, then slow**
  - **down slow, then fast**
Tools

• software & spreadsheets help
• http://www.rekenwonder.com/atlas.htm

Tools – Multiframe4D

• frame window
  – define beam members
  – select points, assign supports
  – select members, assign section
• load window
  – select point or member, add point or distributed loads

Tools – Multiframe4D

• in computer lab

• to run analysis choose
  – case menu
    • Analyse...
      – Linear (1st order elastic)
• plot
  – choose options
  – double click (all)
• results
  – choose options