ARCHITECTURAL STRUCTURES I:
STATICS AND STRENGTH OF MATERIALS

ENDS 231

DR. ANNE NICHOLS

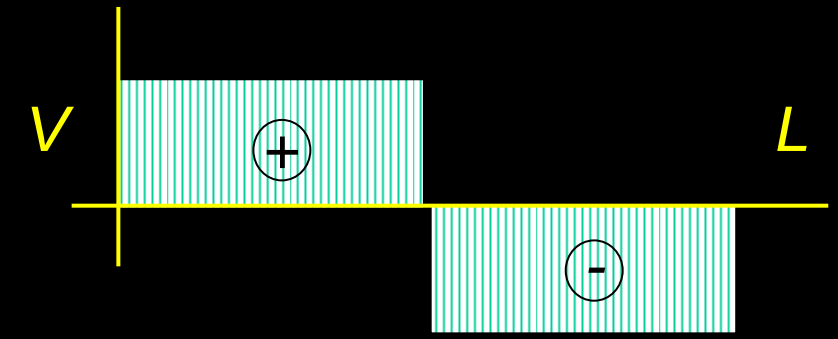
SPRING 2008

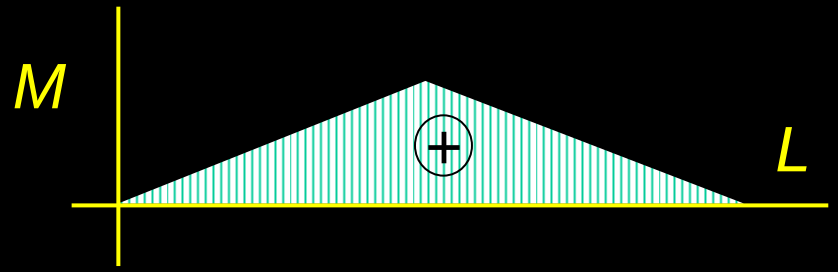
lecture
fourteen

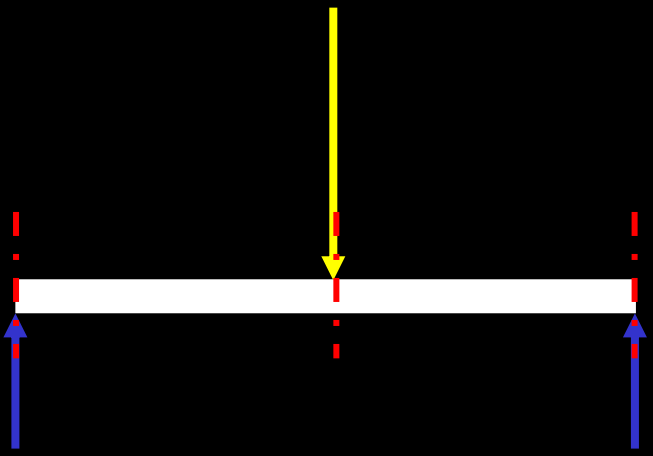
shear and bending moment diagrams

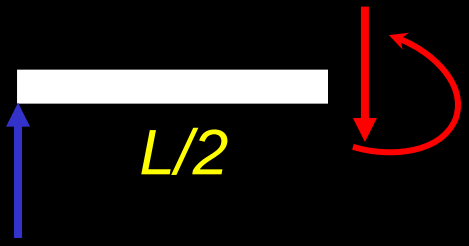
Method 1: Equilibrium

- *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*

$$V_D - V_C = -\int_{x_C}^{x_D} w\,dx \qquad M_D - M_C = \int_{x_C}^{x_D} V\,dx$$

Method 2

- *relationships*

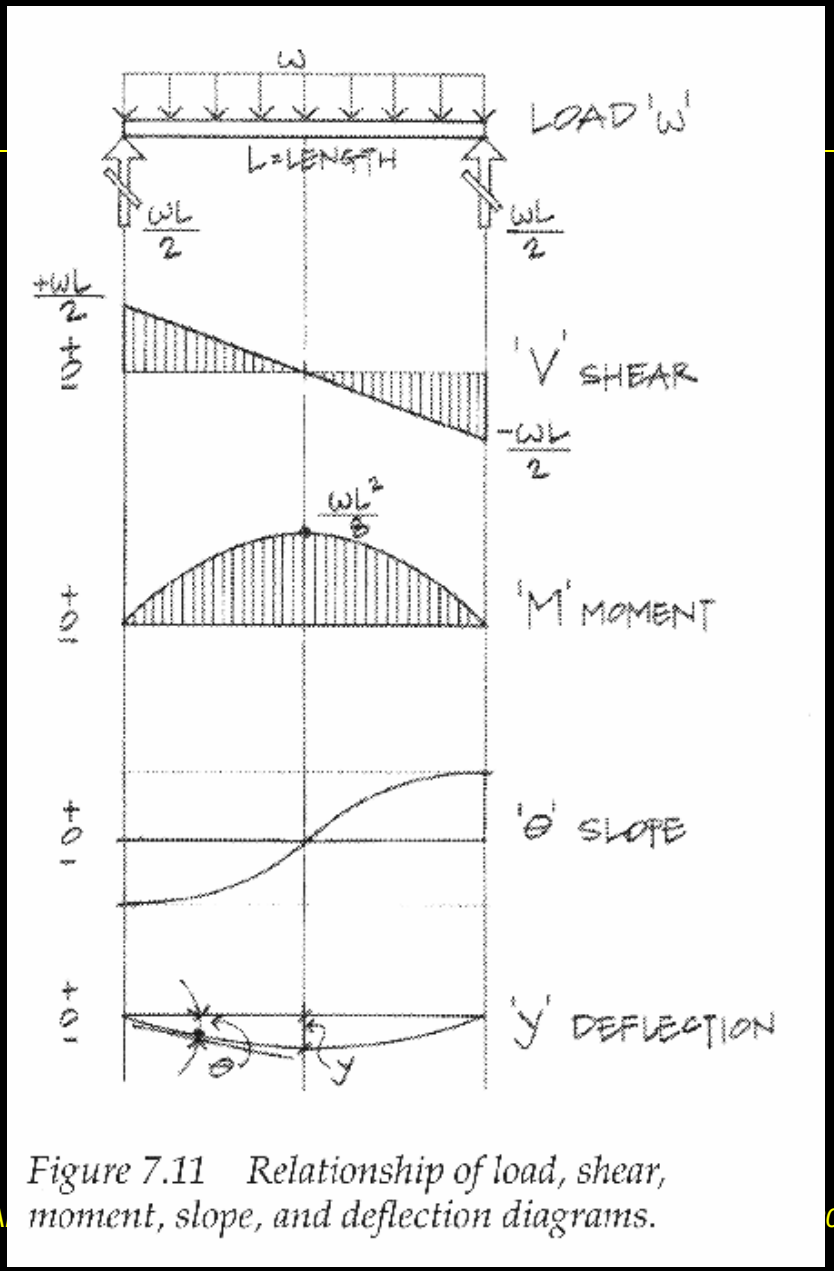
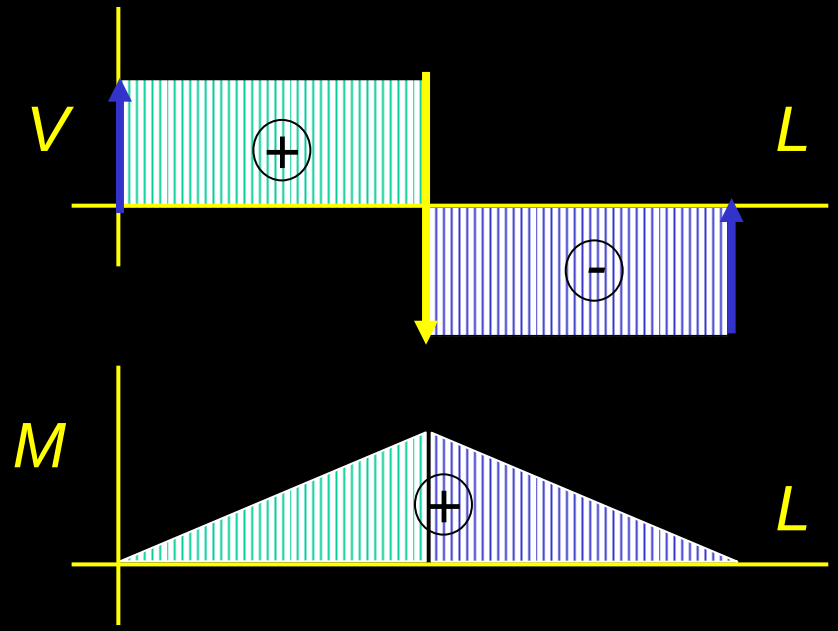


Figure 7.11 Relationship of load, shear, moment, slope, and deflection diagrams.

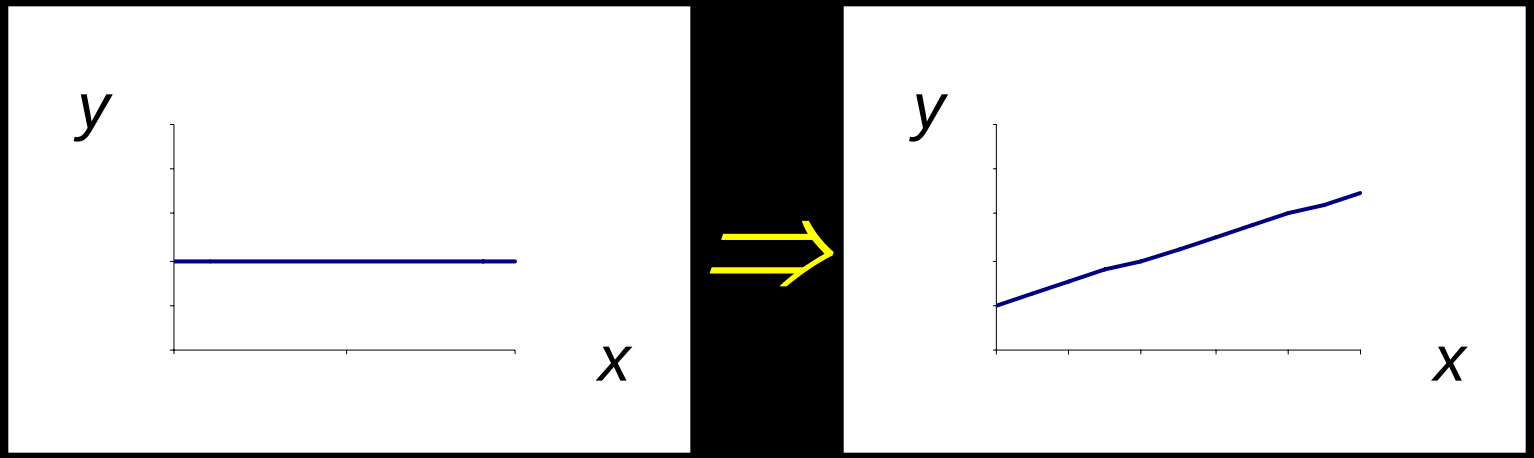
Method 2: Semigraphical

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



Curve Relationships

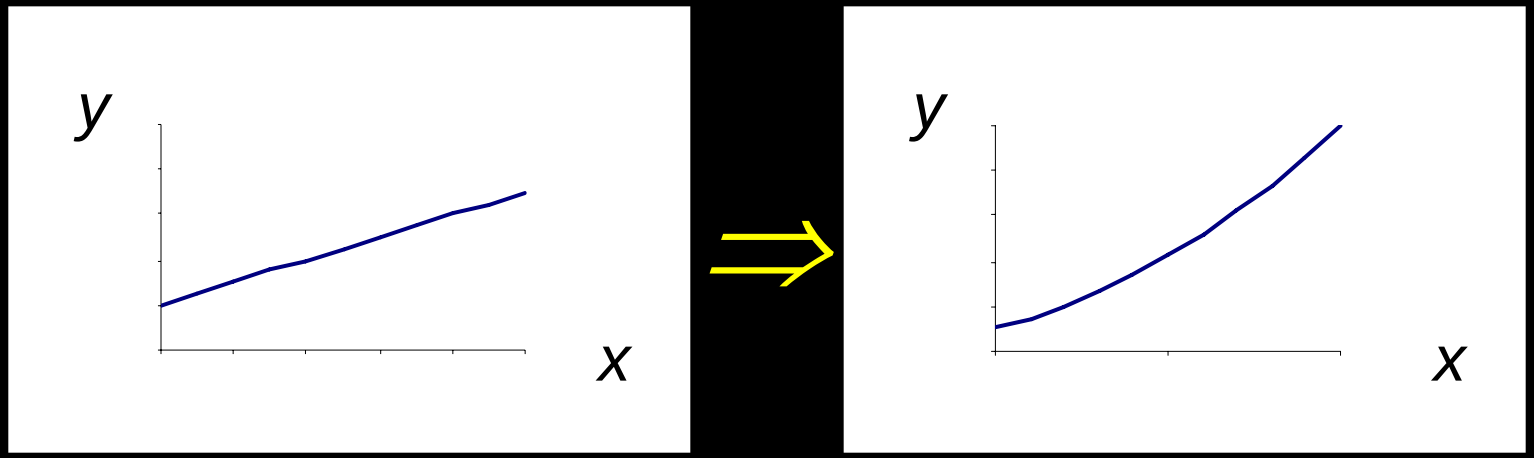
- *integration of functions*
- *line with 0 slope, integrates to sloped*



- *ex: load to shear, shear to moment*

Curve Relationships

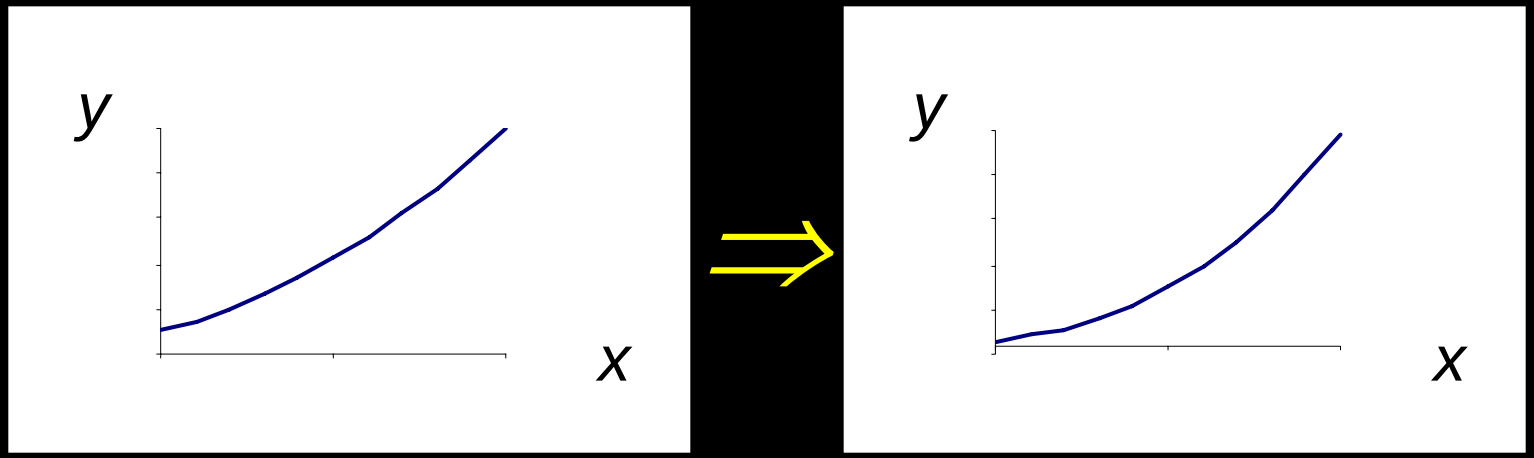
- *line with slope, integrates to parabola*



- *ex: load to shear, shear to moment*

Curve Relationships

- *parabola, integrates to 3rd order curve*



- *ex: load to shear, shear to moment*

Basic Procedure

1. *Find reaction forces & moments*

   Plot axes, underneath beam load diagram

V:

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

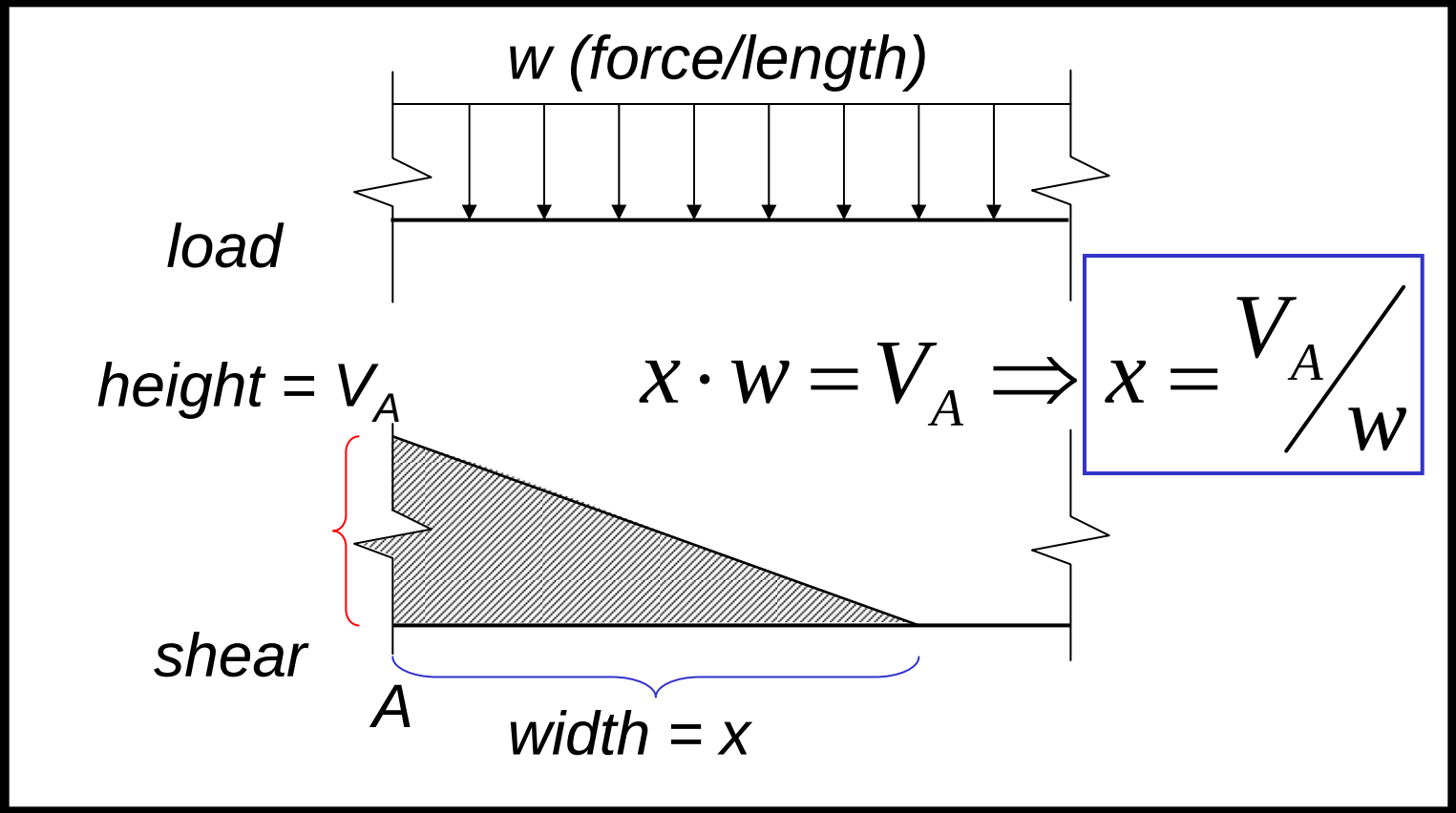
Basic Procedure

M:

6. *Starting at left*
7. *Moment is 0 at free ends*
8. *Moment jumps with moment*
9. *Moment changes with area under V*

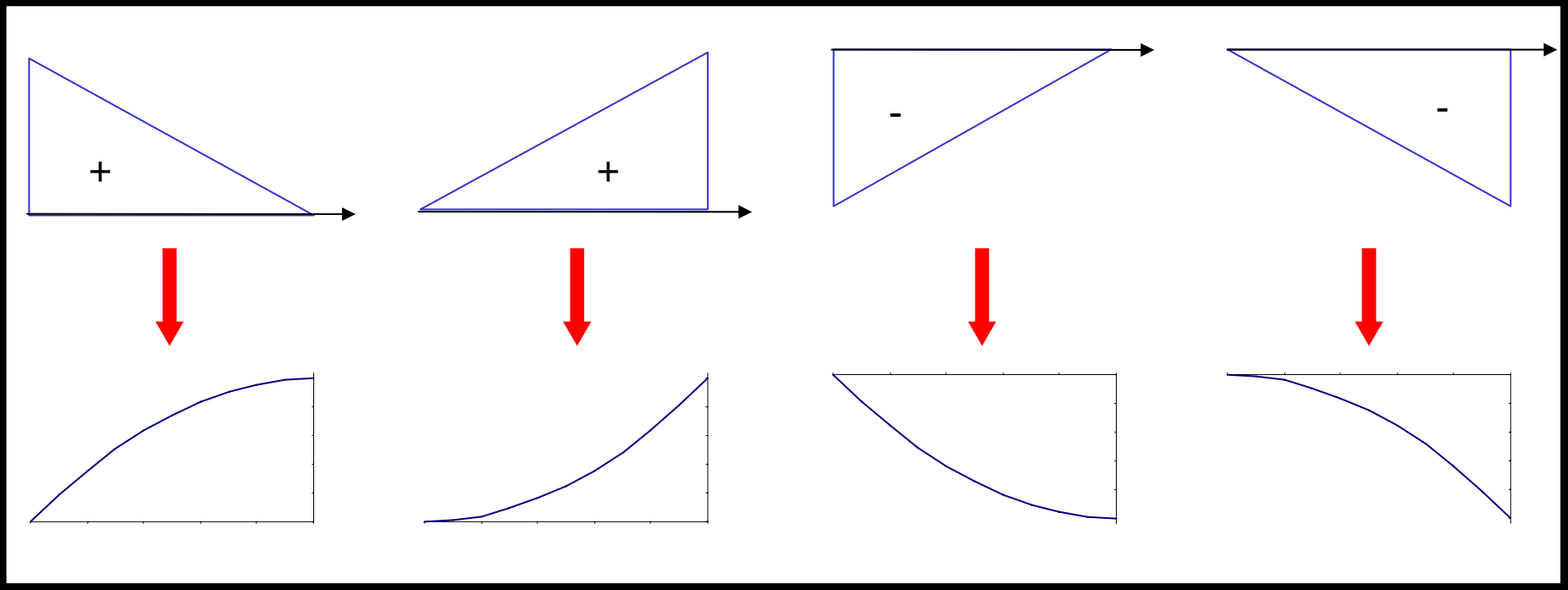
Triangle Geometry

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



Parabolic Shapes

- cases



up fast, then slow

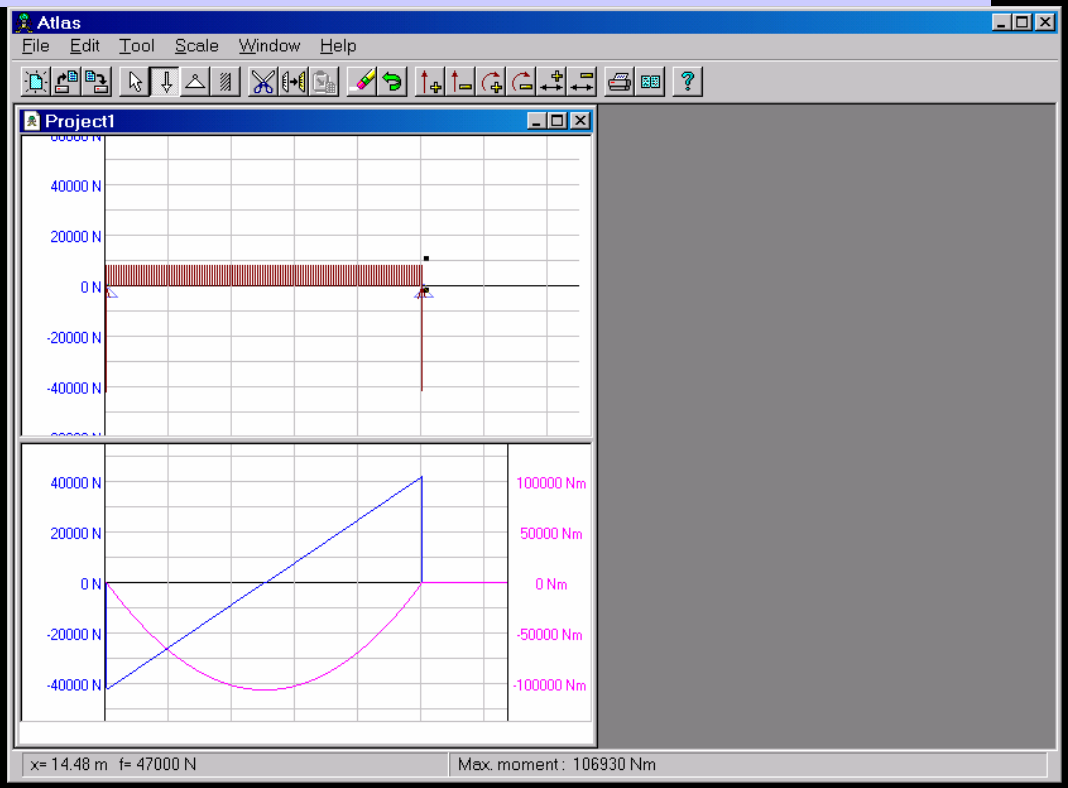
up slow, then fast

down fast, then slow

down slow, then fast

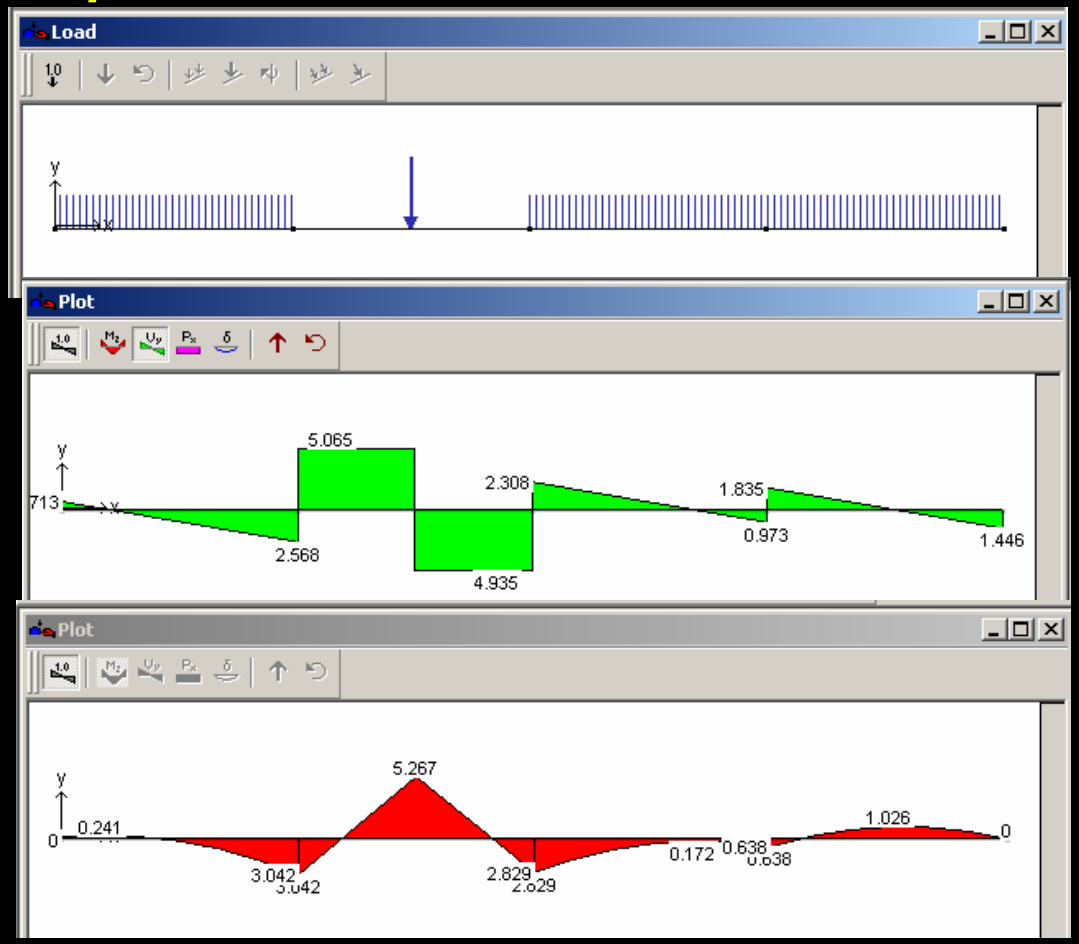
Tools

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



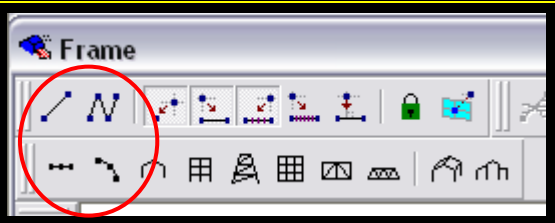
Tools – Multiframe4D

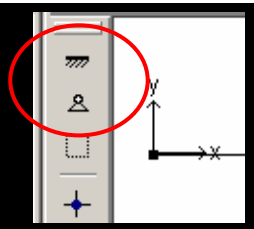
- *in computer lab*

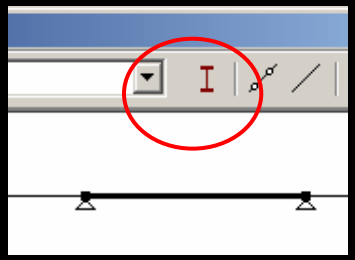


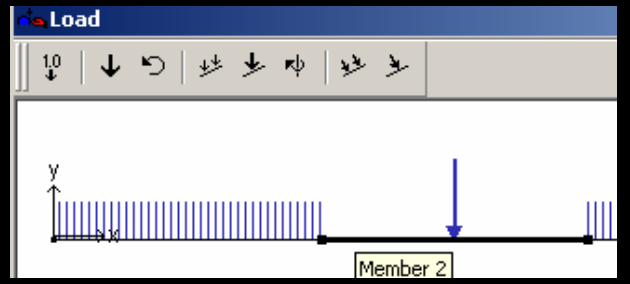
Tools – Multiframe4D

- *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

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