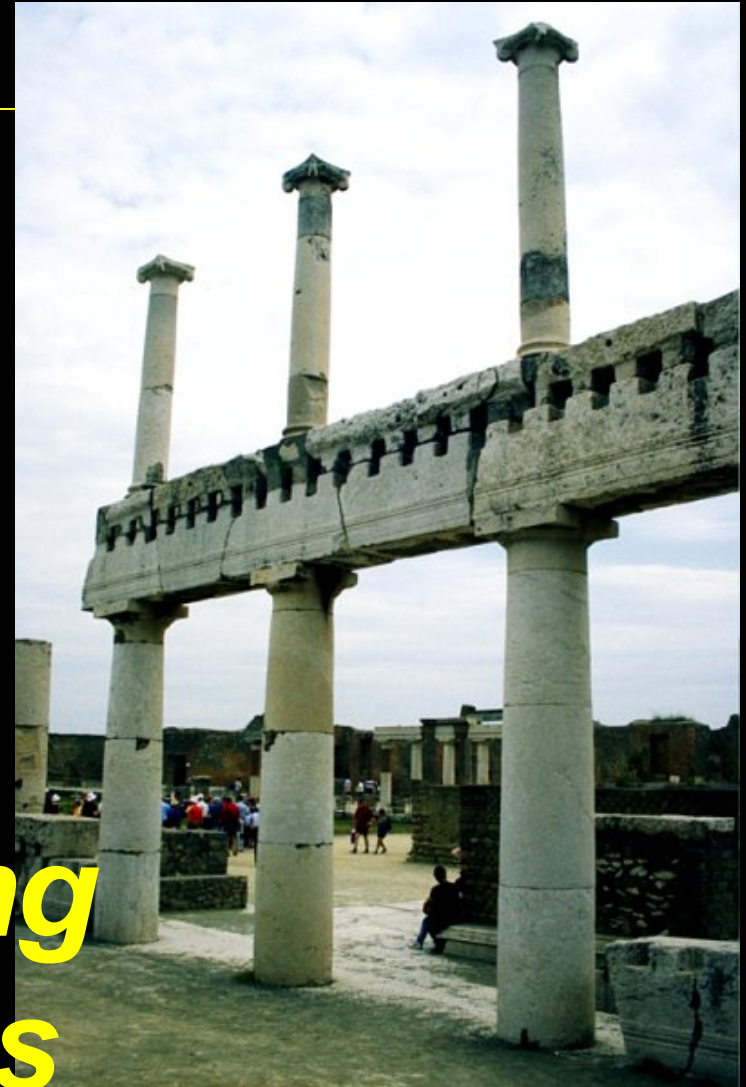


**ARCHITECTURAL STRUCTURES I:  
STATICS AND STRENGTH OF MATERIALS**  
ENDS 231

**DR. ANNE NICHOLS**  
**SUMMER 2006**

lecture  
**thirteen**

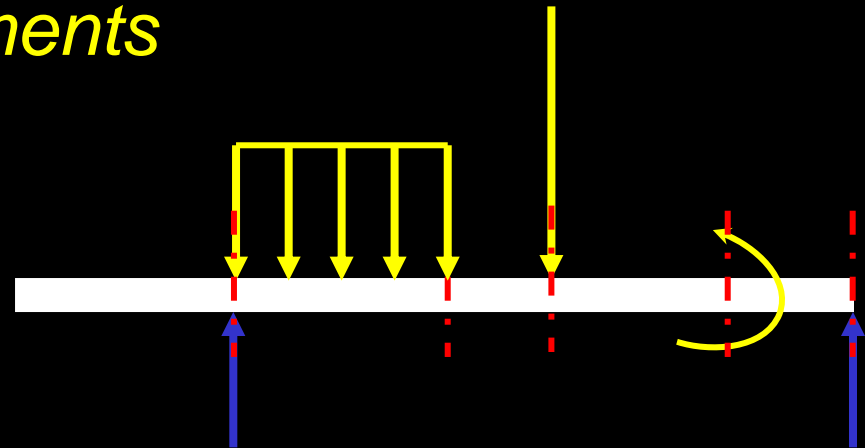
**shear and bending  
moment diagrams**



# Method 1: Equilibrium

---

- *important places*
  - *supports*
  - *concentrated loads*
  - *start and end of distributed loads*
  - *concentrated moments*
- *free ends*
  - *zero forces*



## 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

- relationships

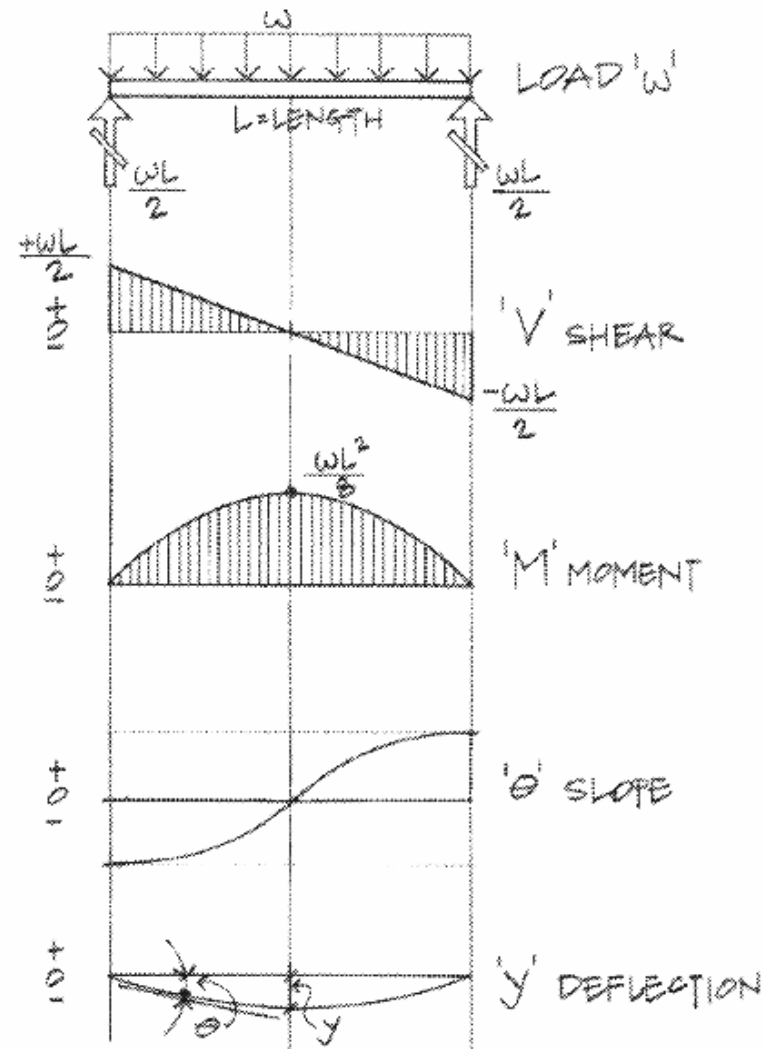
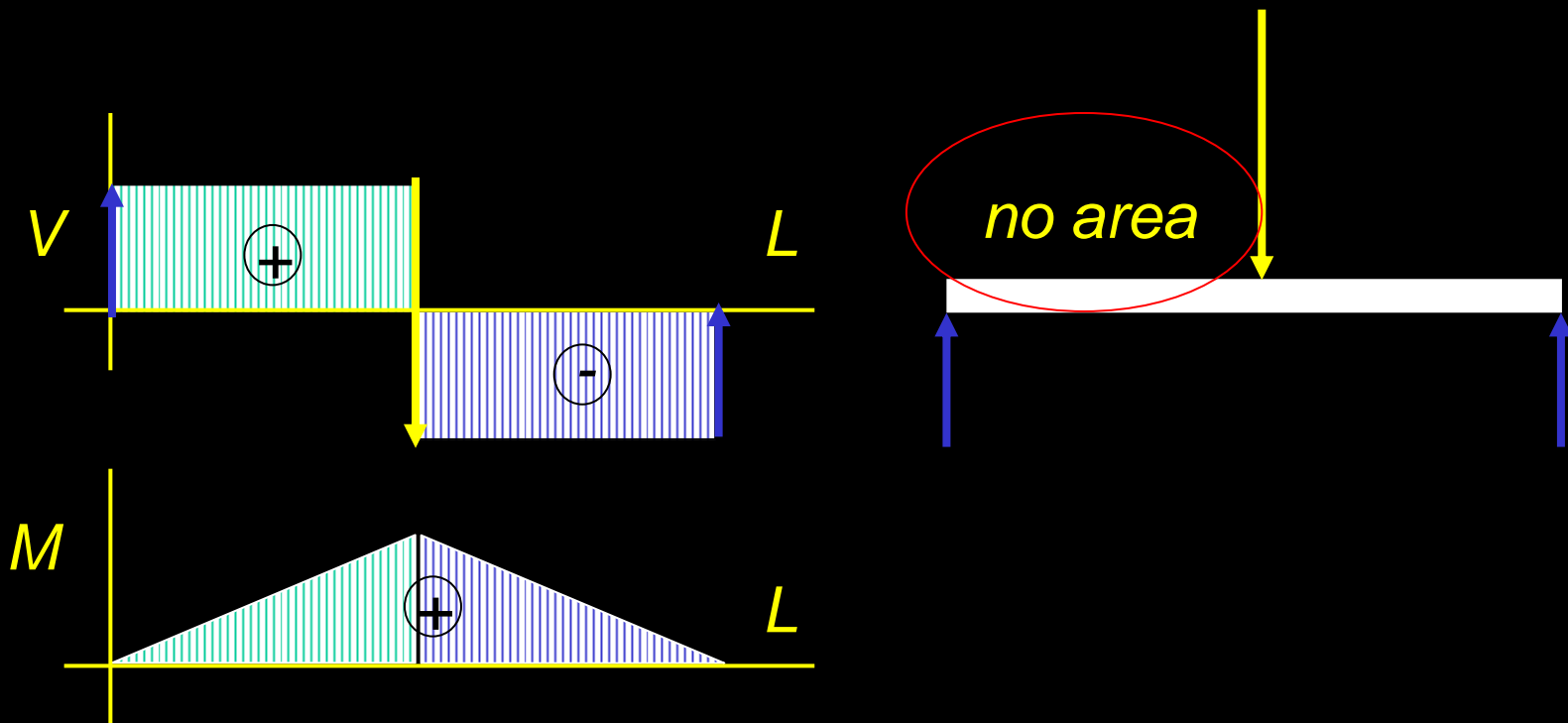


Figure 7.11 Relationship of load, shear, moment, slope, and deflection diagrams.

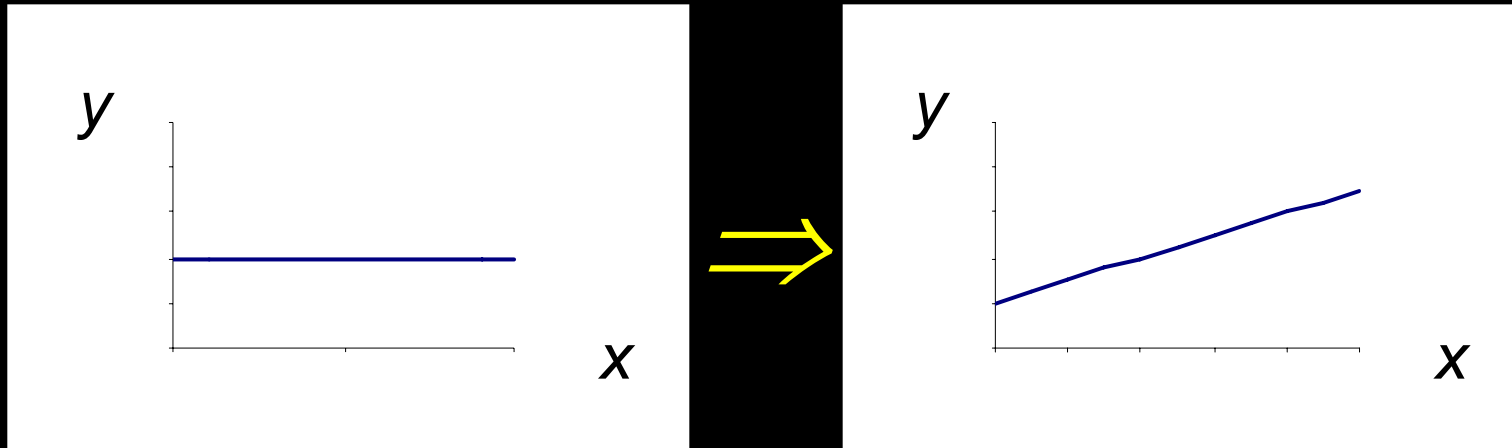
## Method 2: Semigraphical

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



# Curve Relationships

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

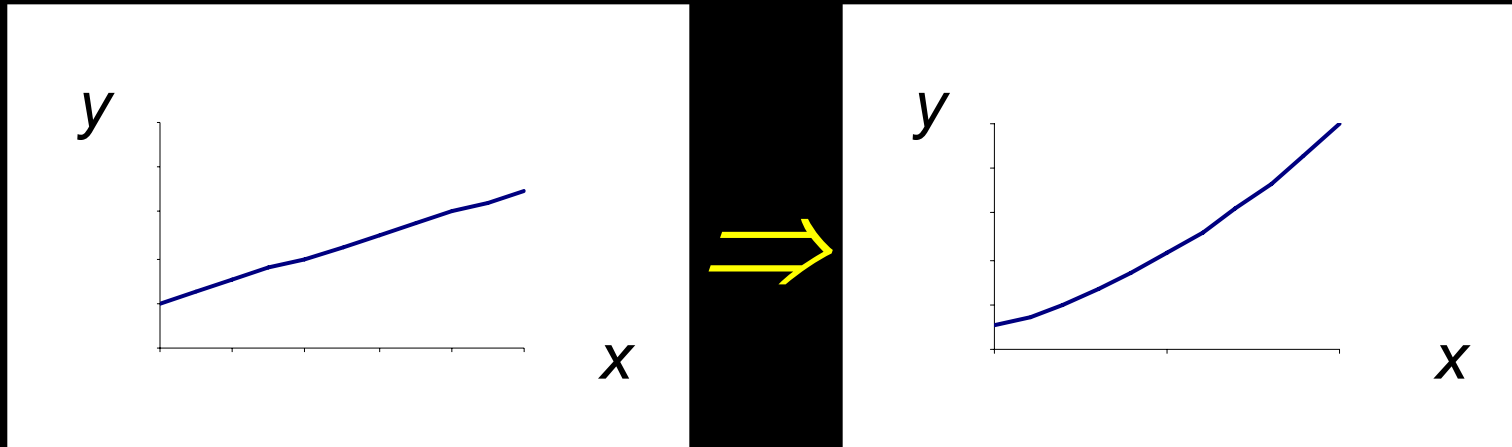


- *ex: load to shear, shear to moment*

# Curve Relationships

---

- *line with slope, integrates to parabola*

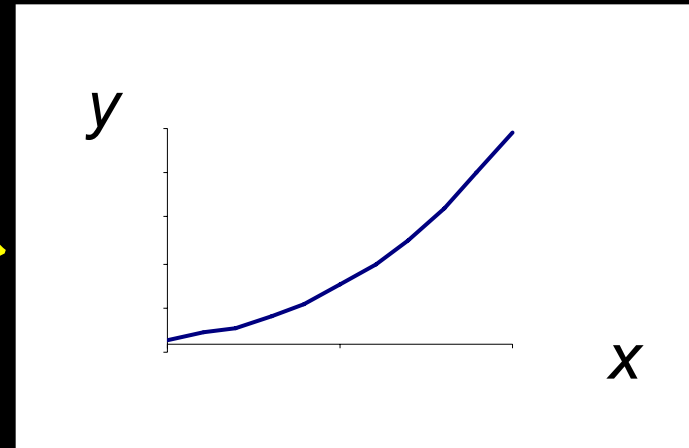
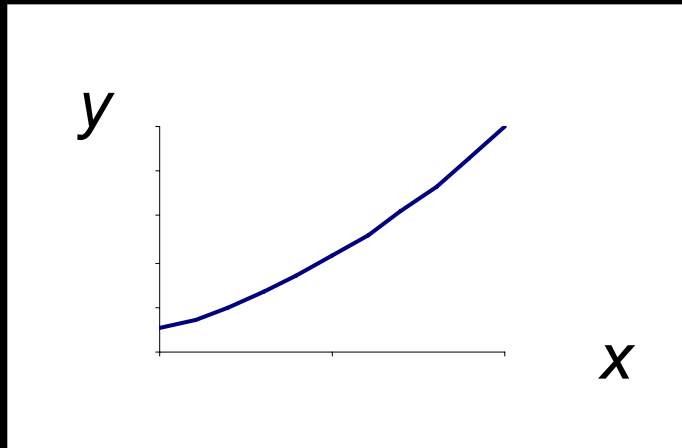


- *ex: load to shear, shear to moment*

# Curve Relationships

---

- *parabola, integrates to 3<sup>rd</sup> 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*

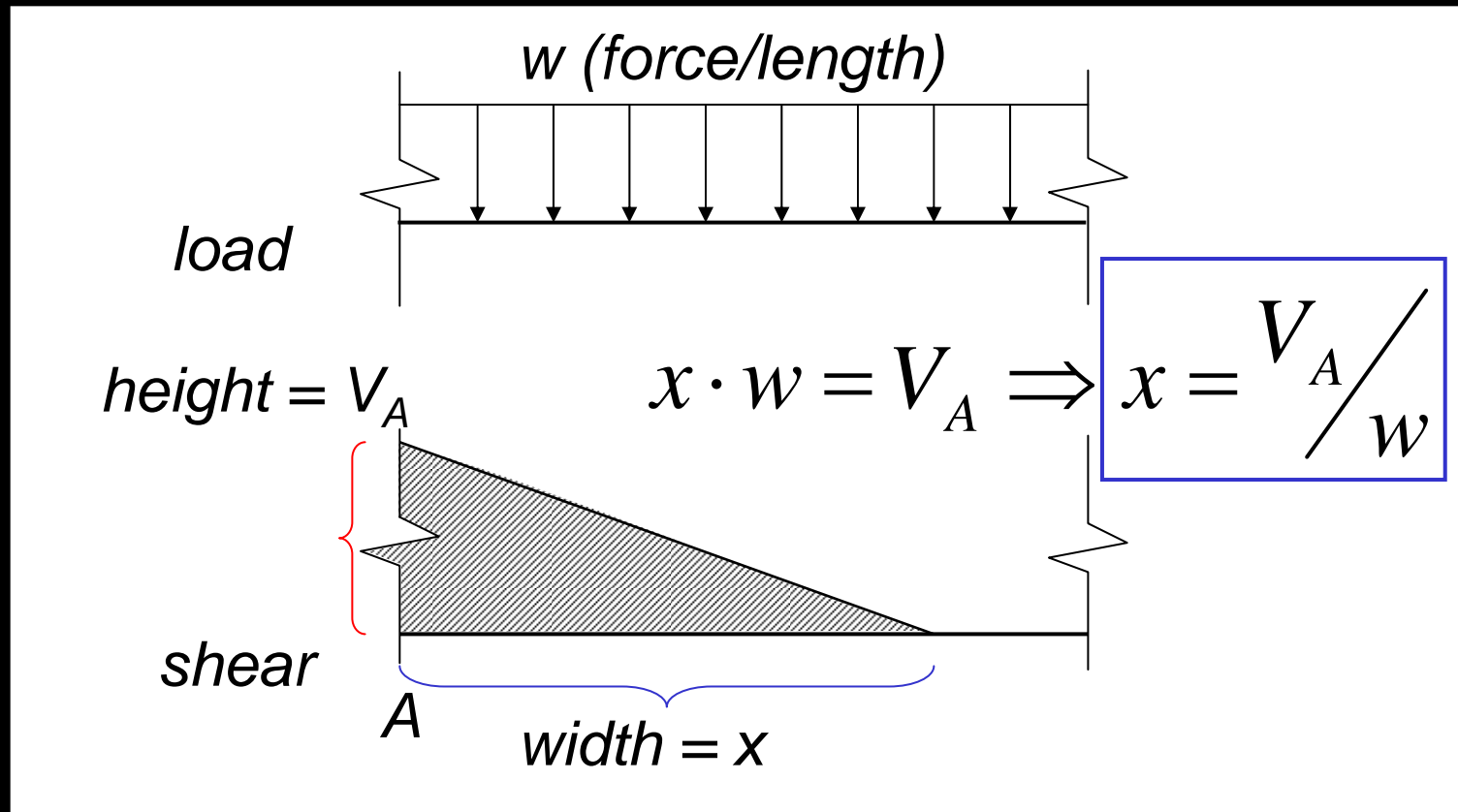
*7. Moment is 0 at free ends*

*8. Moment jumps with moment*

*9. Moment changes with area under V*

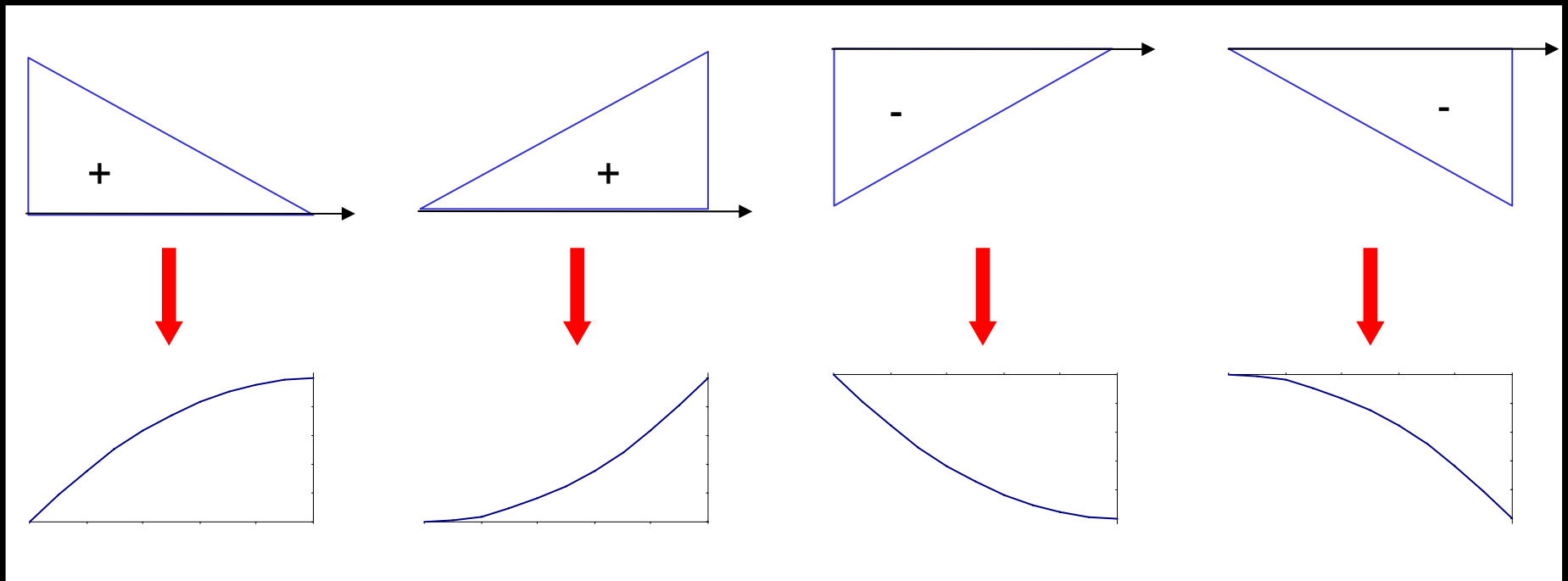
# Triangle Geometry

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



# Parabolic Shapes

- cases



*up fast,  
then slow*

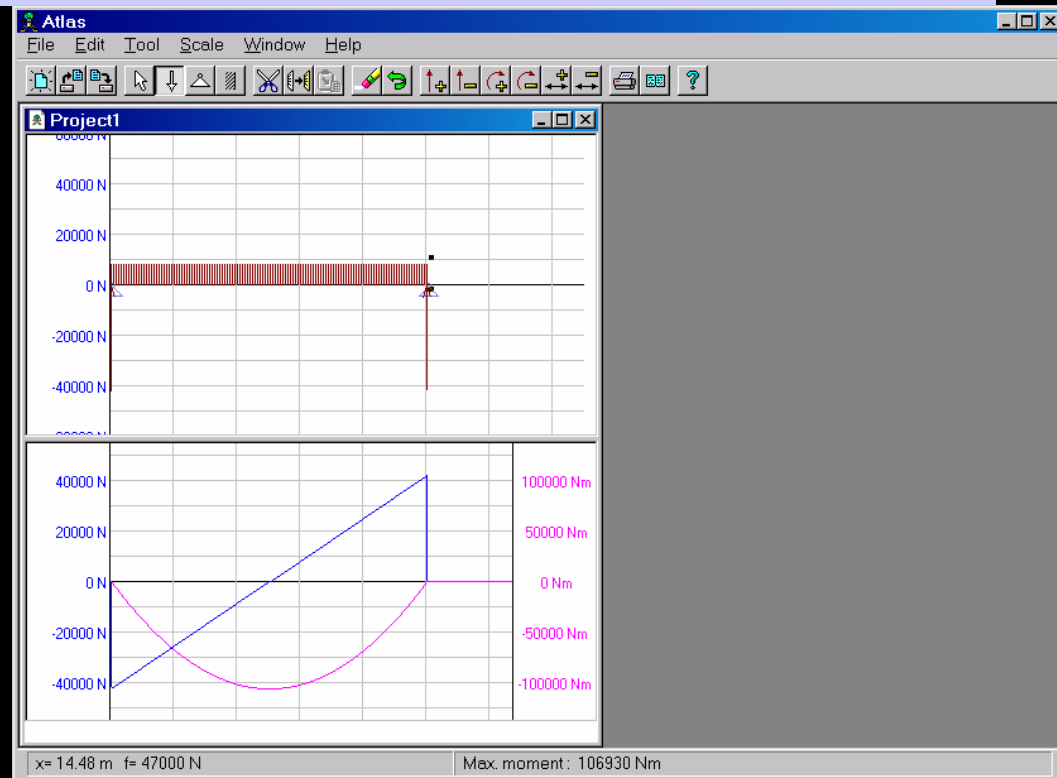
*up slow,  
then fast*

*down fast,  
then slow*

*down slow,  
then fast*

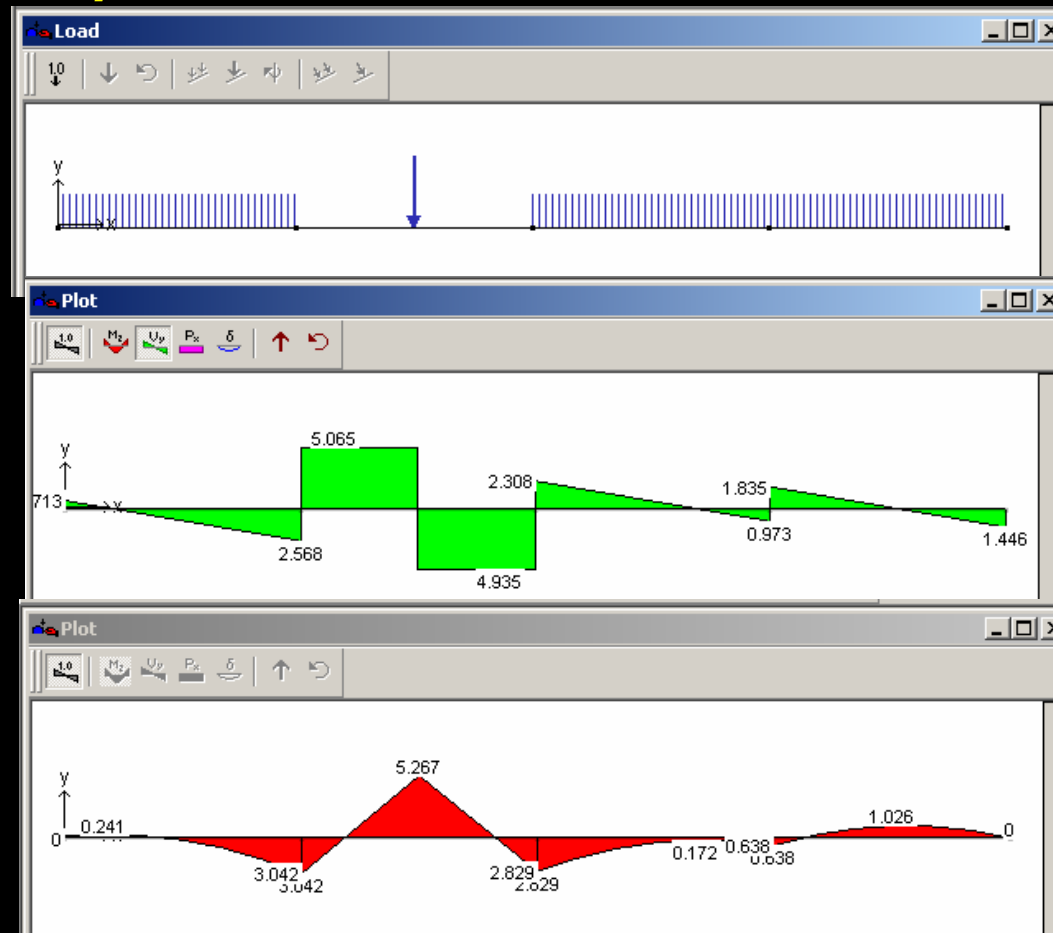
# Tools

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



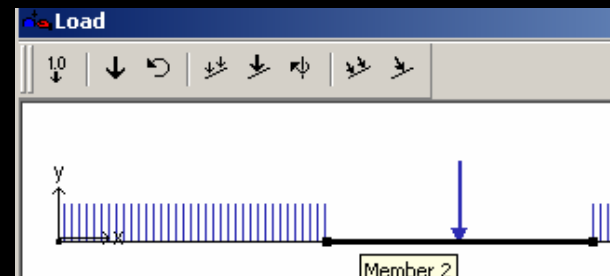
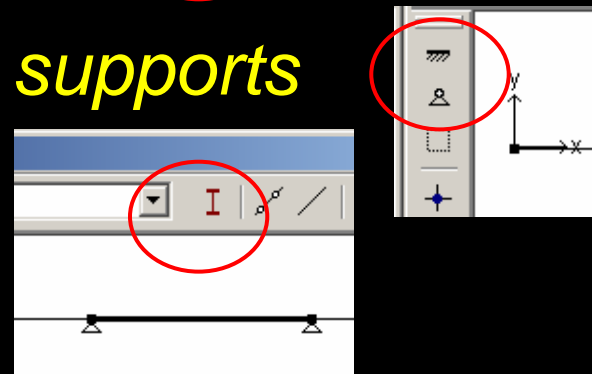
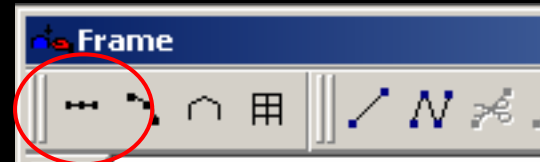
# Tools – Multiframe 2D

- *in computer lab*



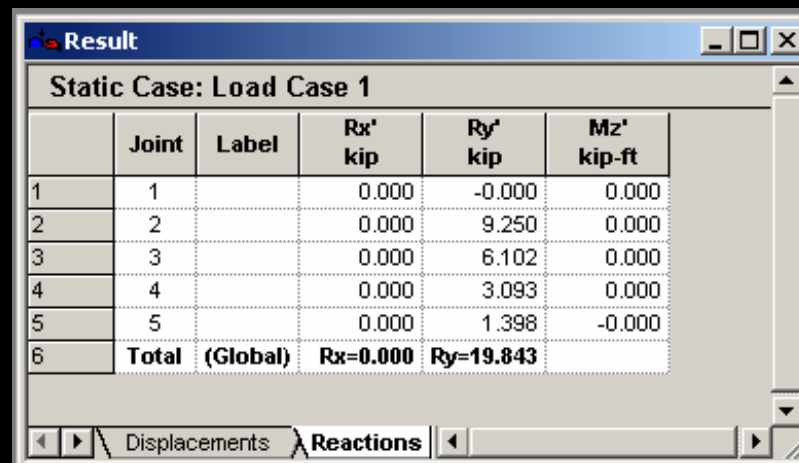
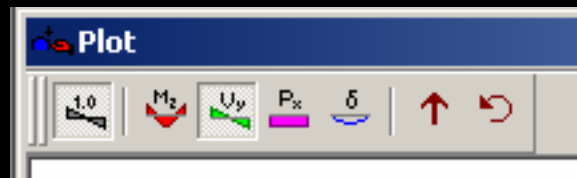
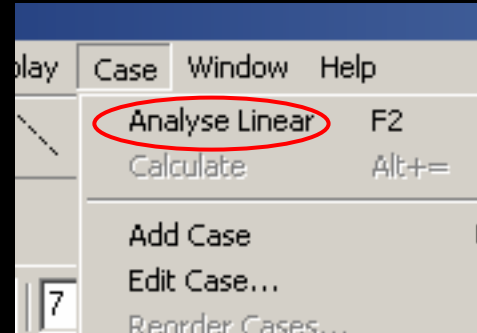
# Tools – Multiframe 2D

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



# Tools – Multiframe 2D

- *to run analysis choose*
  - *case menu*
    - *Analyse Linear*
- *plot*
  - *choose options*
- *results*
  - *choose options*



A screenshot of a 'Result' window titled 'Static Case: Load Case 1'. It contains a table with the following data:

	Joint	Label	Rx' kip	Ry' kip	Mz' kip-ft
1	1		0.000	-0.000	0.000
2	2		0.000	9.250	0.000
3	3		0.000	6.102	0.000
4	4		0.000	3.093	0.000
5	5		0.000	1.398	-0.000
6	<b>Total</b>	<b>(Global)</b>	<b>Rx=0.000</b>	<b>Ry=19.843</b>	

At the bottom of the window, there are tabs for 'Displacements' and 'Reactions', with 'Reactions' selected. The text 'ENDS 231' is visible at the bottom center of the window.