ARCHITECTURAL STRUCTURES I:
STATICS AND STRENGTH OF MATERIALS
ENDS 231
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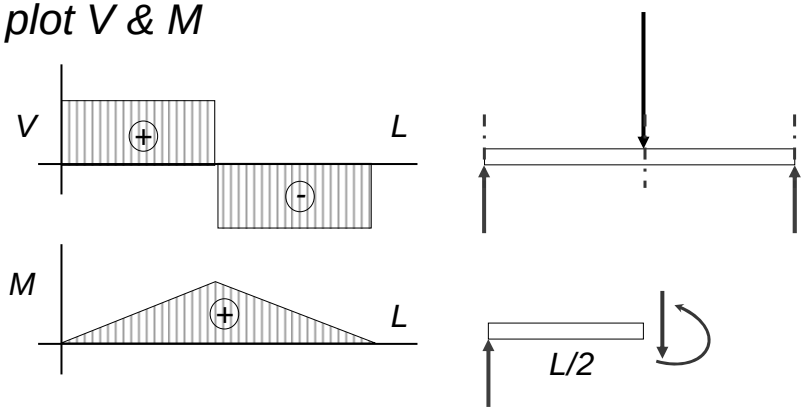
SPRING 2008

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

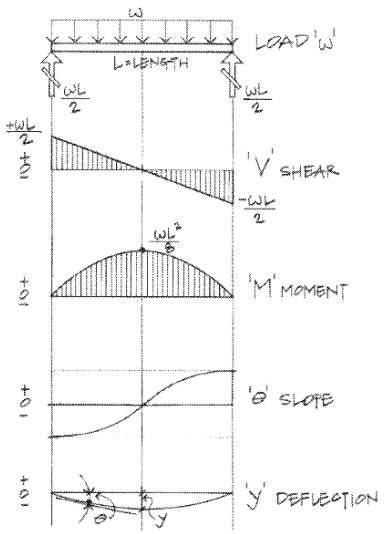
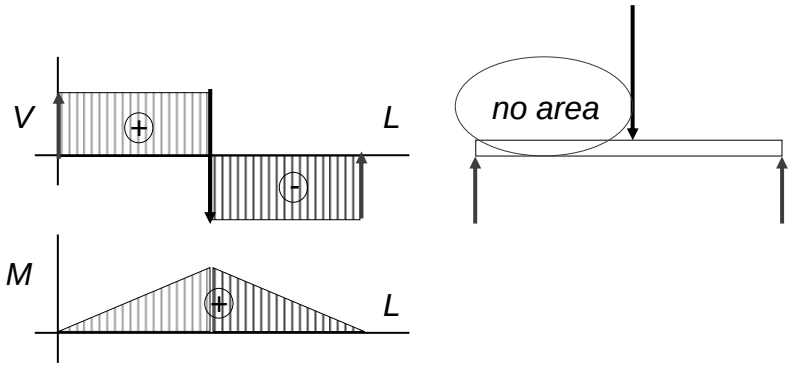


Figure 7.11 Relationship of load, shear, moment, slope, and deflection diagrams.

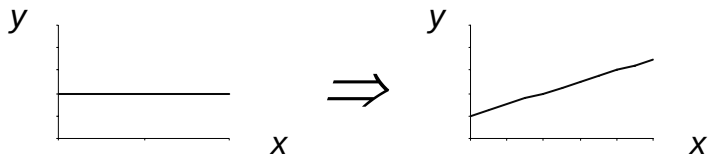
Method 2: Semigraphical

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



Curve Relationships

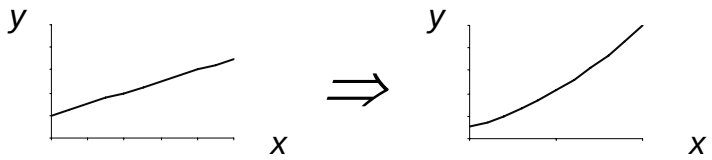
- integration of functions
- line with 0 slope, integrates to sloped



- ex: load to shear, shear to moment

Curve Relationships

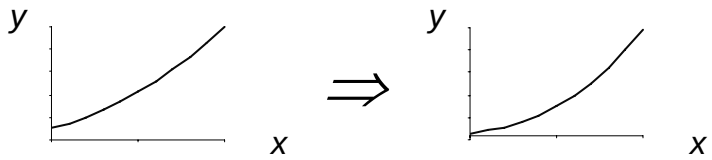
- line with slope, integrates to parabola



- 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*

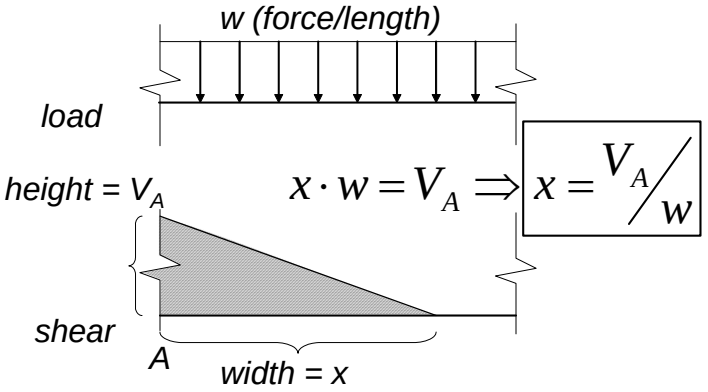
Basic Procedure

M:

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

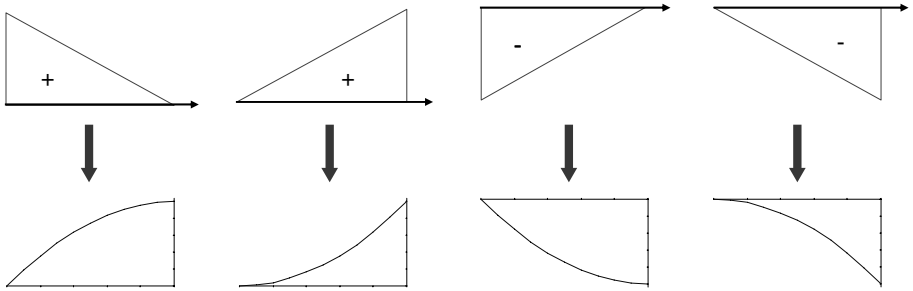
Triangle Geometry

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



Parabolic Shapes

- *cases*



up fast, then slow

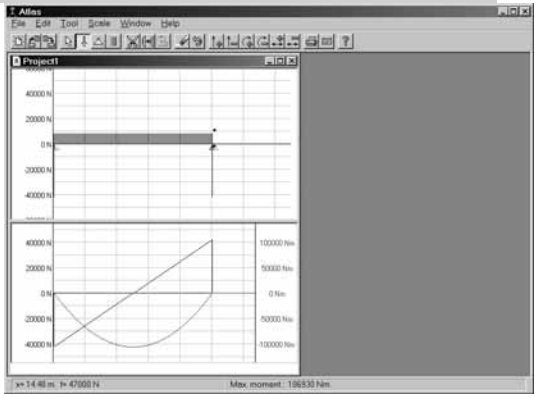
up slow, then fast

down fast, then slow

down slow, then fast

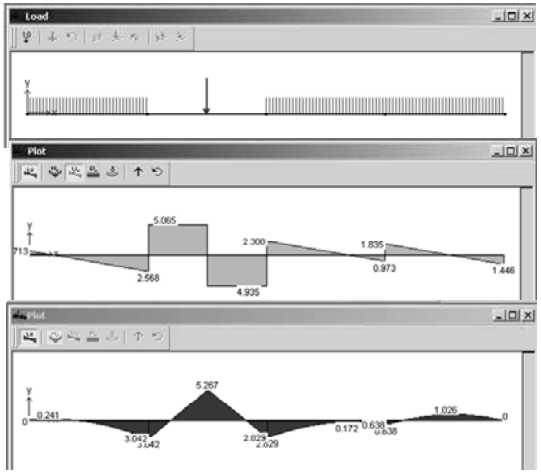
Tools

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



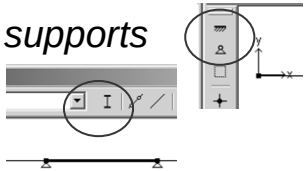
Tools – Multiframe4D

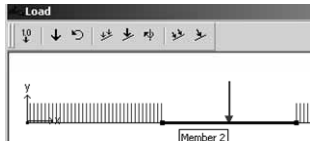
- *in computer lab*



Tools – Multiframe4D

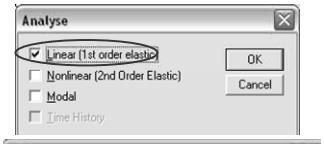
- *frame window*
  - *define beam members*
  - *select points, assign supports*
  - *select members, assign section*
- *load window*
  - *select point or member, add point or distributed loads*

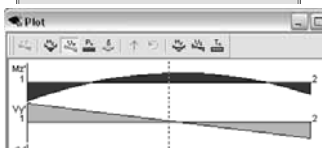


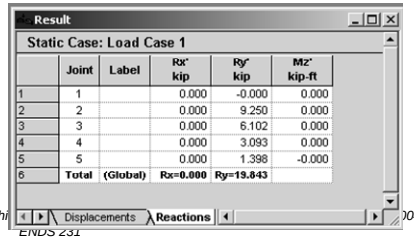


Tools – Multiframe4D

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







	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	Total	(Global)	Rx=0.000	Ry=19.843	