Airfoil Design

ME 415

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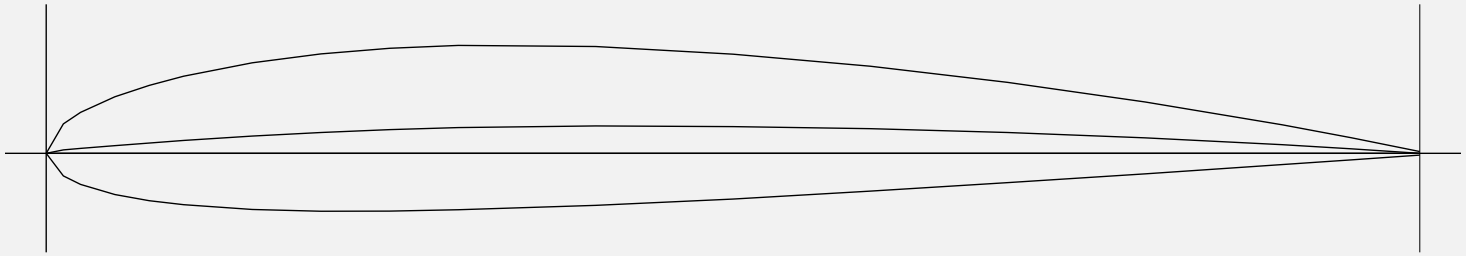
Nomenclature Review



Chord Line
Mean Camber Line
Max Thickness
Thickness Ratio
Position of Max Camber

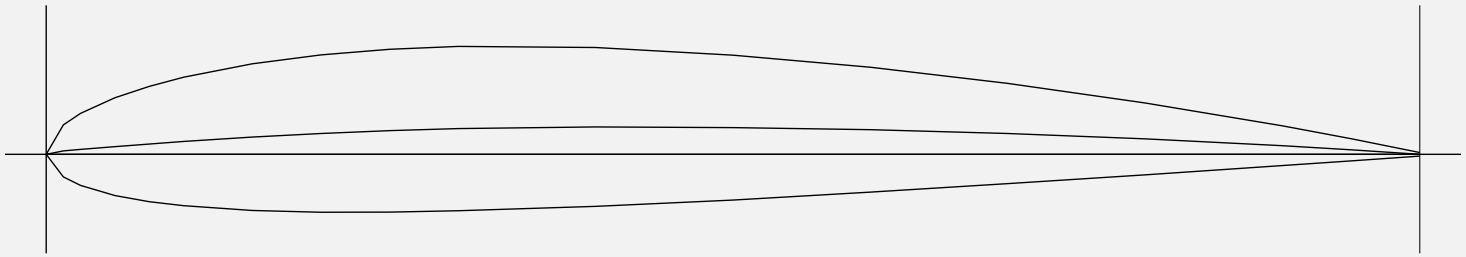
National Advisory Committee for Aeronautics (NACA)

USAAF/361st FG Association (via Al Richards) - http://www.ww2incolor.com/gallery/albums/U-S-Air-Force/361st_fg_p_51.jpg

NACA 4-Series Airfoils

NACA 2412

2 = Max Camber in %chord (0.02)
4 = Position of Max Camber in chord/10 (0.4)
12 = Max Thickness in %chord (0.12)



NACA 4-Series Airfoils

$$\pm y_t = 5t(.2969x^{0.5} - .126x - .3537x^2 + .2843x^3 - .1015x^4)$$

$$y_c = \begin{cases} \frac{m}{p^2}\left(2px - x^2\right), & 0 \le x \le p \\ \frac{m}{(1-p)^2}\left((1-2p) + 2px - x^2\right), & p \le x \le 1 \end{cases}$$

t = thickness ratio, p = position of max camber, m = max camber, x = %distance along chord
For NACA 2412: t = 0.12, p = 0.4, m = 0.02.

NACA 4-Series Airfoils

$$x_U = x - y_t \sin\theta$$
$$x_L = x + y_t \sin\theta$$
$$y_U = y_c + y_t \cos\theta$$
$$y_L = y_c - y_t \cos\theta$$

$$\theta = \arctan\frac{dy_c}{dx}$$

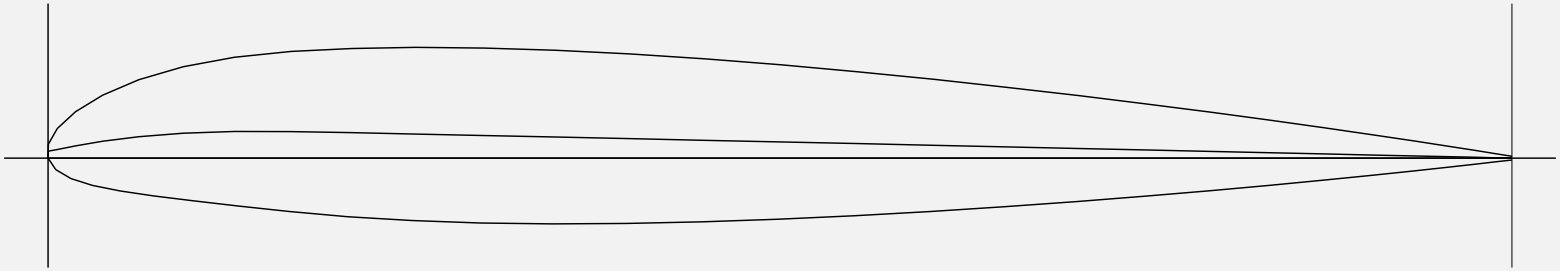
NACA 4-Series Airfoils

$$\frac{dy_c}{dx} = \begin{cases} \frac{2\,\mathrm{m}}{\mathrm{p}^2}(\mathrm{p} - x), & 0 \le \mathrm{x} \le \mathrm{p} \\ \frac{2\,\mathrm{m}}{(1-\mathrm{p})^2}(\mathrm{p} - x), & \mathrm{p} \le \mathrm{x} \le 1 \end{cases}$$

NACA 5-Series Airfoils

NACA 23012

2 = Max Camber in %chord
30 = Position of Max Camber in chord*2/100
12 = Max Thickness in %chord



XFOIL

homepages.wmich.edu/~liou/wp_AE3610xfoiltutorial-2014.doc

Airfoil Resources

- http://airfoiltools.com/
- http://m-selig.ae.illinois.edu/ads/coord_database.html

Some Examples:
NACA 2412
NACA 23012
Clark Y
S1223