Unmanned Aerial Vehicle Definition for DDDAS Example Problem

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1 General Arrangement

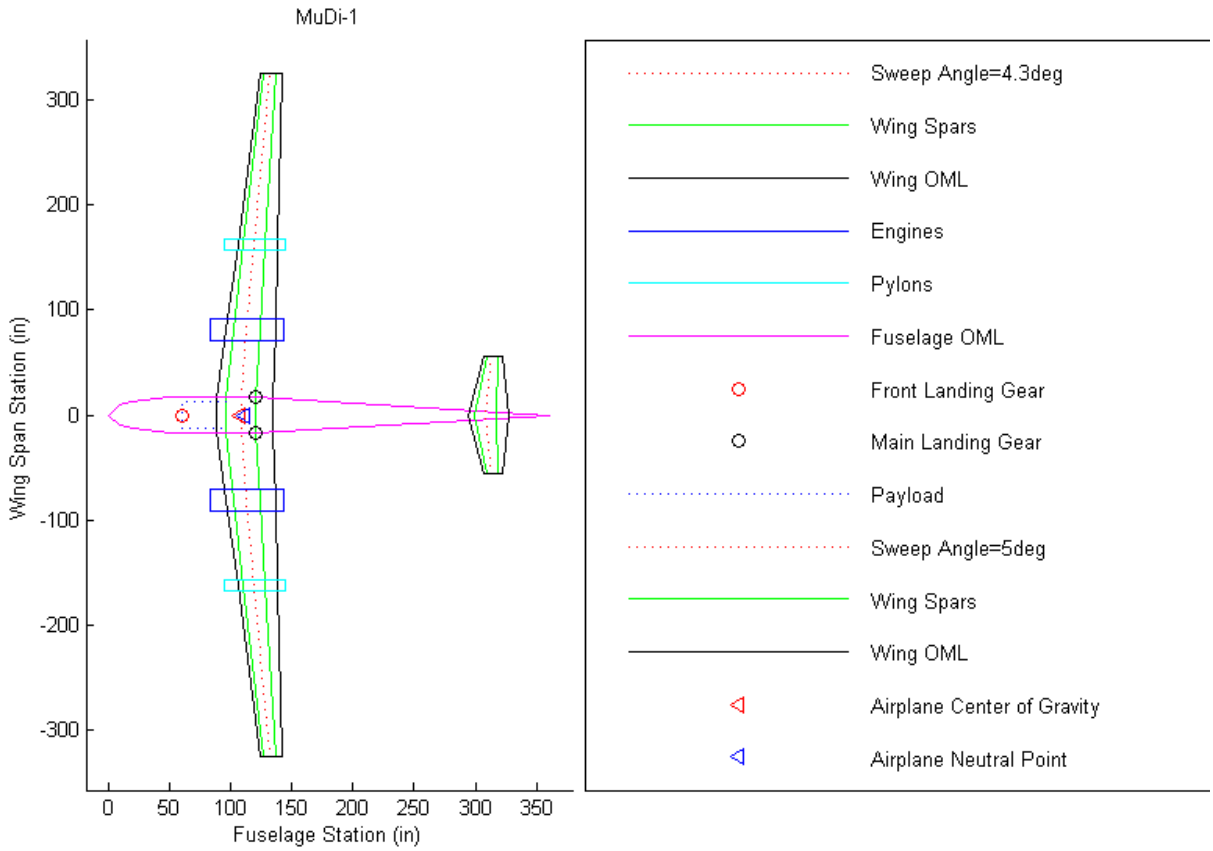

Figure 1: Planform of Unmanned Aerial Vehicle

2 Operational Variables

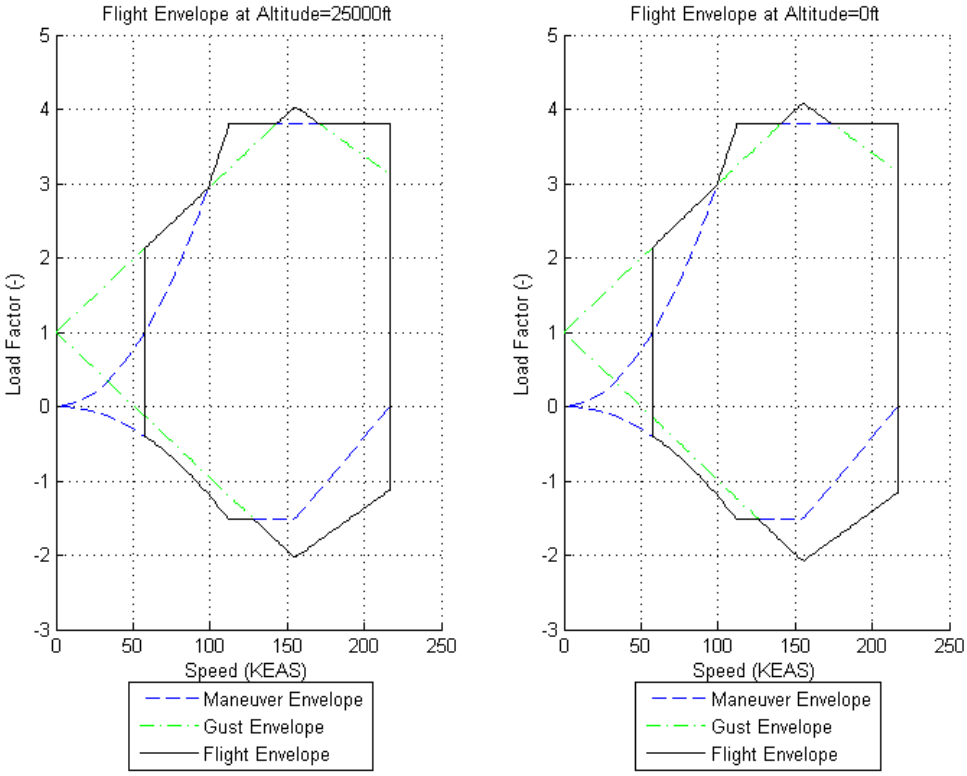

Figure 2: FAR 23 V-n Diagram

```
      h_t: 15000
     hmax: 25000
      V_A: 112.0881
      V_S: 57.5000
      V_D: 216.6857
      V_C: 154.9279
        h: [0 15000 25000]
       n1: 3.8000
       n2: -1.5200
   n3_V_C: [4.0864 4.2354 4.0372]
   n3_V_D: [3.1583 3.2626 3.1239]
   n4_V_C: [-2.0864 -2.2354 -2.0372]
   n4_V_D: [-1.1583 -1.2626 -1.1239]
V_max_n_max: 154.9279
V_max_n_min: 154.9279
h_max_n_max: 15000
h_max_n_min: 15000
```

3 Geometric Variables

Units are *in-lbs unless otherwise noted.*

```
    Vfuel: 3.6989e+004
    Sfwet: 2.4548e+004
      xCG: 107.5010
      xNP: 111.1319
    n_max: 4.2354
    n_min: -2.2354
  n_pylon: 2
    n_eng: 2
```

3.1 Fuselage

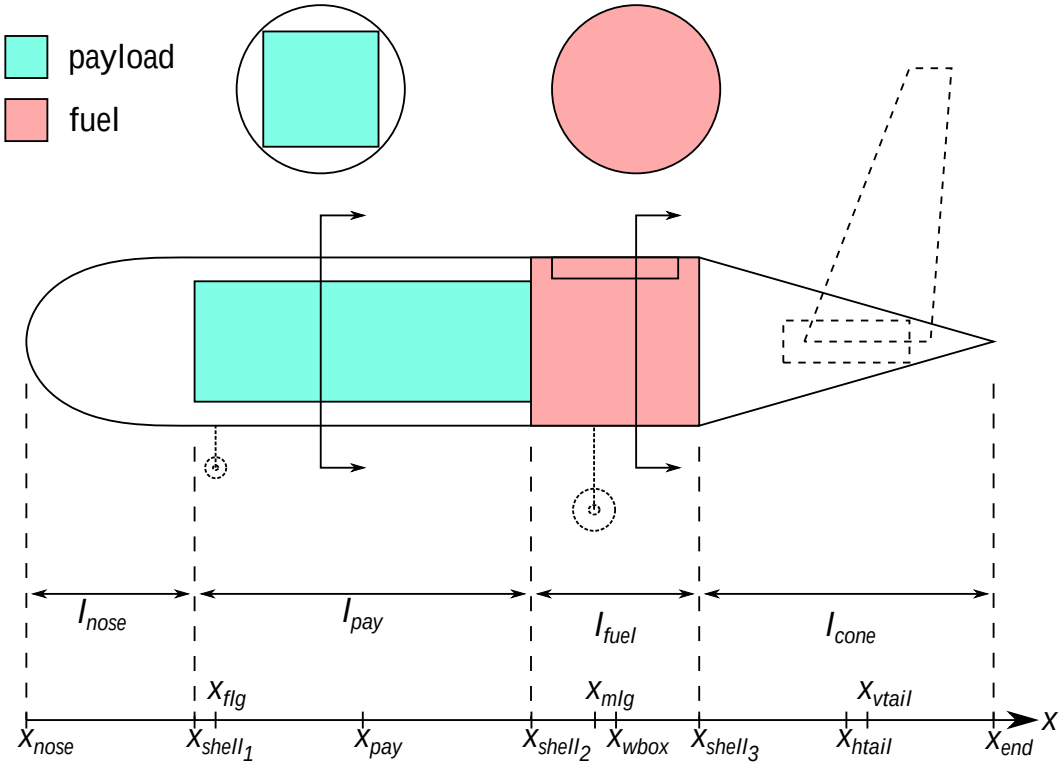

Figure 3: Fuselage Geometry

```
    h_pay: 24
    w_pay: 24
    l_pay: 36
   x_nose: 0
   l_nose: 60
   l_cone: 240
   l_fuel: 25.0000
   R_fuse: 16.9901
theta_longeron: 0.7854
```

```
  x_shell_1: 60
  x_shell_2: 96
  x_shell_3: 121
      x_pay: 78
      x_end: 361
     x_wbox: 108.5000
     x_hbox: 308.5000
     x_vbox: 308.5000
     x_wing: 117.6895
    x_vtail: 311.5138
     x_tail: 311.3037
      x_flg: 60
      x_mlg: 121
      x_eng: 113.3874
   x_pylon: 119.4966
  x_hpesys: 60
    l_fuse: 361
chi_shell_1: 0.1662
chi_shell_2: 0.2659
chi_shell_3: 0.3352
   chi_wbox: 0.3006
   chi_hbox: 0.8546
   chi_vbox: 0.8546
   chi_wing: 0.3260
  chi_htail: 0.8606
  chi_vtail: 0.8629
   chi_tail: 0.8623
    chi_flg: 0.1662
    chi_mlg: 0.3352
    chi_pay: 0.2161
  r_addfuel: 0.9500
      l_flg: 12.5595
      l_mlg: 25.3284
   alpha_lg: 5
```

3.2 Wing

```
          S: 21125
        c_o: 45.4545
      c_bar: 32.5000
designation: '64(4)-416'
          b: 650
        b_o: 32.5000
        b_e: 162.5000
        b_p: 325
      eta_o: 0.0500
      eta_e: 0.2500
      eta_p: 0.5000
         AR: 20
        c_e: 40.9091
        c_p: 31.8182
        c_t: 18.1818
```

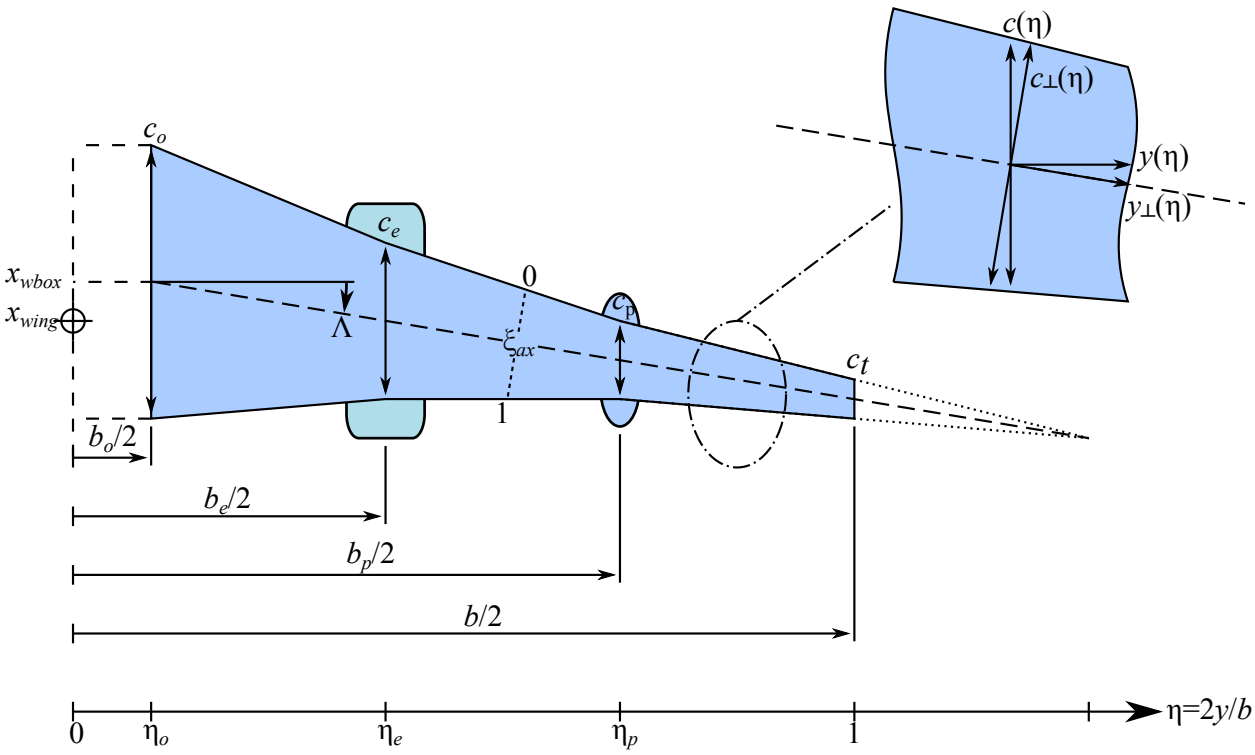

Figure 4: Wing Geometry

```
          c_ma: 34.7425
      lambda_e: 0.9000
      lambda_p: 0.7000
      lambda_t: 0.4000
    lambda_bar: 0.7150
     lambda_ma: 0.5465
    lambda_acx: 0.2689
  Delta_x_wing: 9.1895
   Delta_x_eng: 4.8874
 Delta_x_pylon: 10.9966
         sweep: 4.3000
      xi_fspar: 0.1500
      xi_rspar: 0.7000
         w_bar: 0.5500
     h_bar_rms: 0.1402
     h_bar_avg: 0.1388
     h_bar_max: 0.1601
    r_wingfuel: 0.3000
     Vwingfuel: 1.5560e+004
```

3.3 Vertical Tail

```
     c_vol_v: 0.0700
   C_L_vmax: 2.6000
        rMv: 0.7000
```

```
designation_v: 'DDDAS_VTail'
          b_v: 155.0151
        b_o_v: 0
      eta_o_v: 0
         AR_v: 5
          S_v: 4.8059e+003
        c_o_v: 41.3374
        c_t_v: 20.6687
      c_bar_v: 31.0030
       c_ma_v: 32.1513
   lambda_t_v: 0.5000
 lambda_bar_v: 0.7500
  lambda_ma_v: 0.5833
 lambda_acx_v: 0.3333
Delta_x_vtail: 3.0138
      sweep_v: 5
          l_v: 200
   xi_v_fspar: 0.1500
   xi_v_rspar: 0.7000
      w_bar_v: 0.5500
  h_bar_rms_v: 0.1154
  h_bar_avg_v: 0.1143
  h_bar_max_v: 0.1300
```

3.4 Horizontal Tail

```
          S_h: 2.7463e+003
      x_htail: 310.6852
         AR_h: 4.6000
      c_vol_h: 0.8000
     C_L_hmax: 2
          rMh: 0.4000
      dCLhdCL: 0.5000
designation_h: 'DDDAS_HTail'
          b_h: 112.3955
        b_o_h: 0
      eta_o_h: 0
        c_o_h: 32.5784
        c_t_h: 16.2892
      c_bar_h: 24.4338
       c_ma_h: 25.3388
   lambda_t_h: 0.5000
 lambda_bar_h: 0.7500
  lambda_ma_h: 0.5833
 lambda_acx_h: 0.3333
Delta_x_htail: 2.1852
      sweep_h: 5
          l_h: 200
   xi_h_fspar: 0.1500
   xi_h_rspar: 0.7000
      w_bar_h: 0.5500
  h_bar_rms_h: 0.1154
```

```
h_bar_avg_h: 0.1143
h_bar_max_h: 0.1300
```

4 Structural Variables

```
      t_min: 0.0158
         FS: 1.5000
  FSbuckle: 2
   tau_web: 17000
 tau_frame: 17000
  tau_skin: 17000
 sigma_cap: 23210
sigma_skin: 23210
sigma_frame: 23210
sigma_floor: 23210
     E_cap: 4221578
     E_web: 4221578
    E_skin: 4221578
   E_frame: 4221578
    nu_cap: 0.5378
    nu_web: 0.5378
   nu_skin: 0.5378
  nu_frame: 0.5378
     G_web: 1366284
   rho_cap: 0.0560
   rho_web: 0.0560
  rho_skin: 0.0560
  rho_fuel: 0.0300
   rho_rib: 0.0560
 rho_frame: 0.0560
 rho_floor: 0.0560
```

5 Loading Variables

5.1 Fuselage

```
 S_shell_1: [153.8648 40.4907 40.4907]
 S_shell_2: [3.1261e+003 822.6689 822.6689]
 S_shell_3: [1.4161e+003 372.6705 372.6705]
    S_tail: [111.2324 29.2717 29.2717]
     S_pay: [3.1118e+003 818.8896 818.8896]
S_wbox_for: [4.3689e+003 1.1497e+003 1.1497e+003]
S_wbox_aft: [2.6909e+003 708.1394 708.1394]
 M_shell_1: [849.5435 1.6381e+005 223.5641]
 M_shell_2: [5.9871e+004 2.7749e+005 1.5756e+004]
 M_shell_3: [8.2091e+004 2.9918e+005 1.1267e+006]
    M_tail: [60.7743 15.9932 15.9932]
     M_pay: [3.7353e+003 2.1364e+005 982.9861]
M_wbox_for: [1.0670e+005 3.1980e+005 2.8078e+004]
M_wbox_aft: [1.0776e+005 3.2417e+005 1.2061e+006]
       Q_v: 5.7155e+005
```

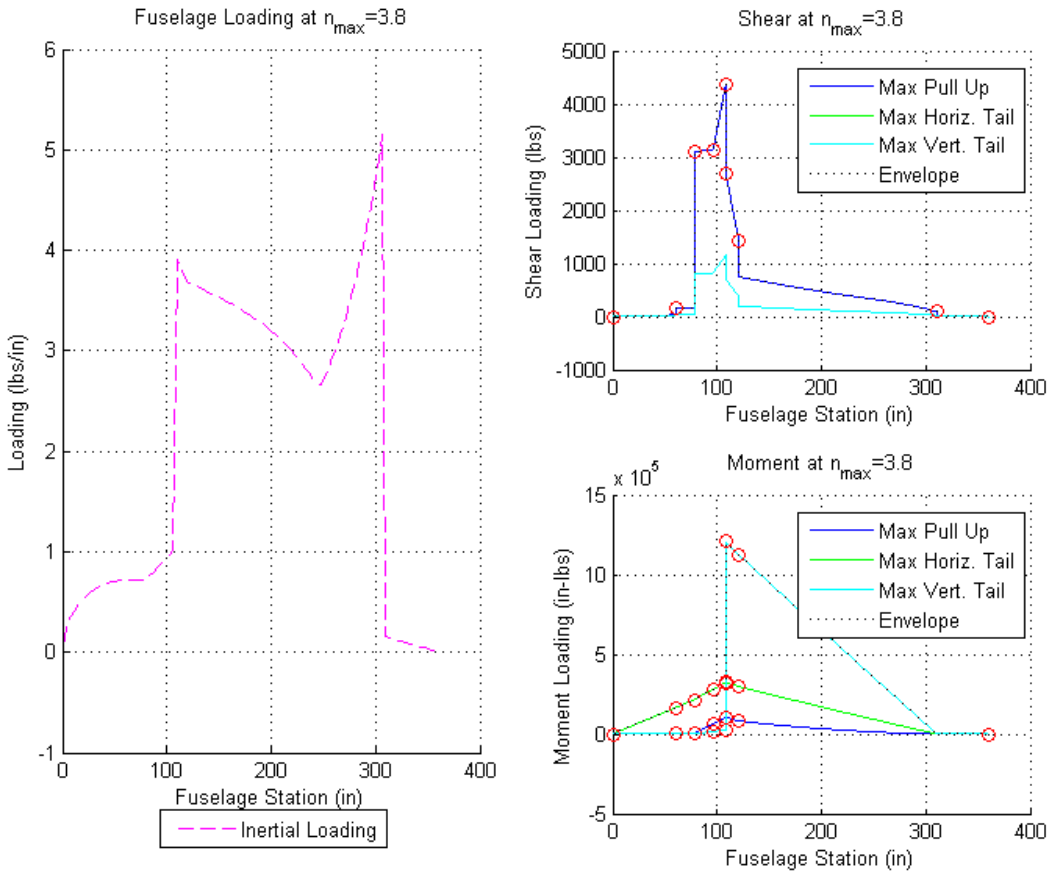

Figure 5: Loading along fuselage

5.2 Wing

```
Lwing: 2.7867e+003
  S_o: [3.6407e+003 -1.9162e+003]
  S_e: [3.2352e+003 -1.7027e+003]
  S_p: [1.9571e+003 -1.0300e+003]
  M_o: [5.5087e+005 -2.8993e+005]
  M_e: [3.5398e+005 -1.8631e+005]
  M_p: [1.4682e+005 -7.7273e+004]
```

5.3 Vertical Tail

```
Lvmax: 8.2958e+003
S_o_v: [4.1374e+003 0]
M_o_v: [1.4265e+005 0]
```

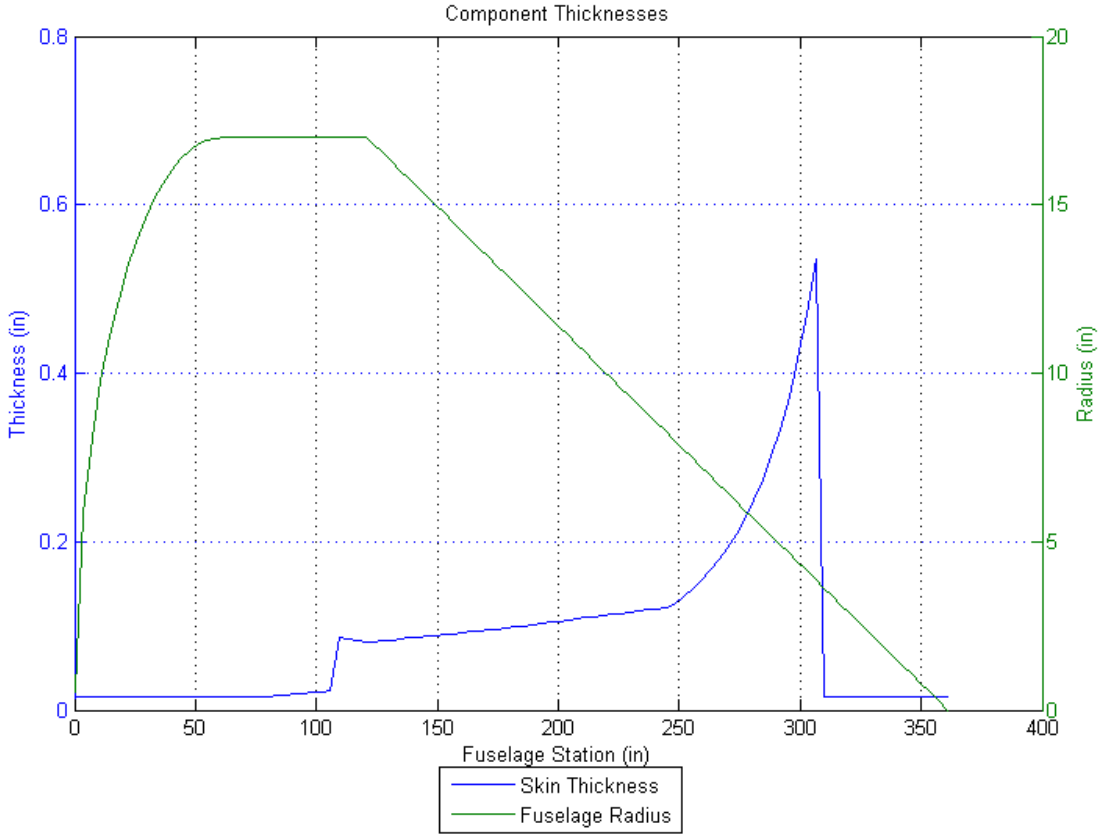

Figure 6: Fuselage structural sizing

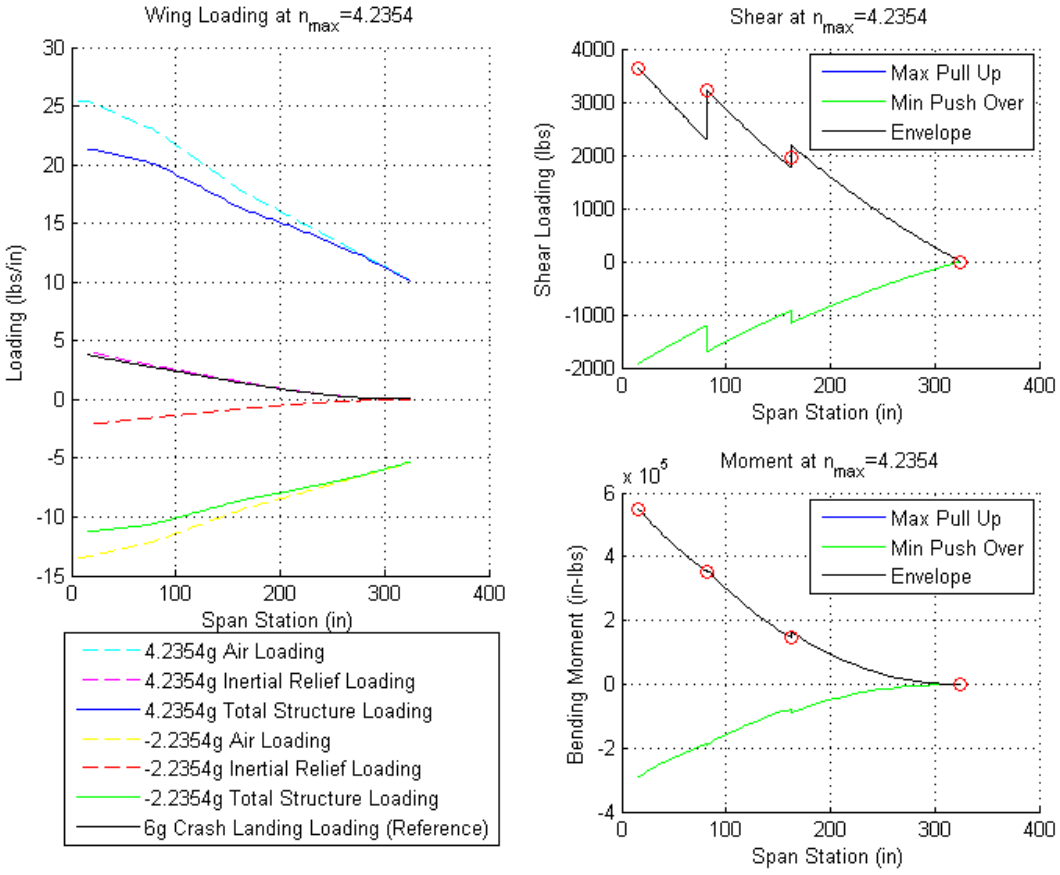

Figure 7: Loading along wing

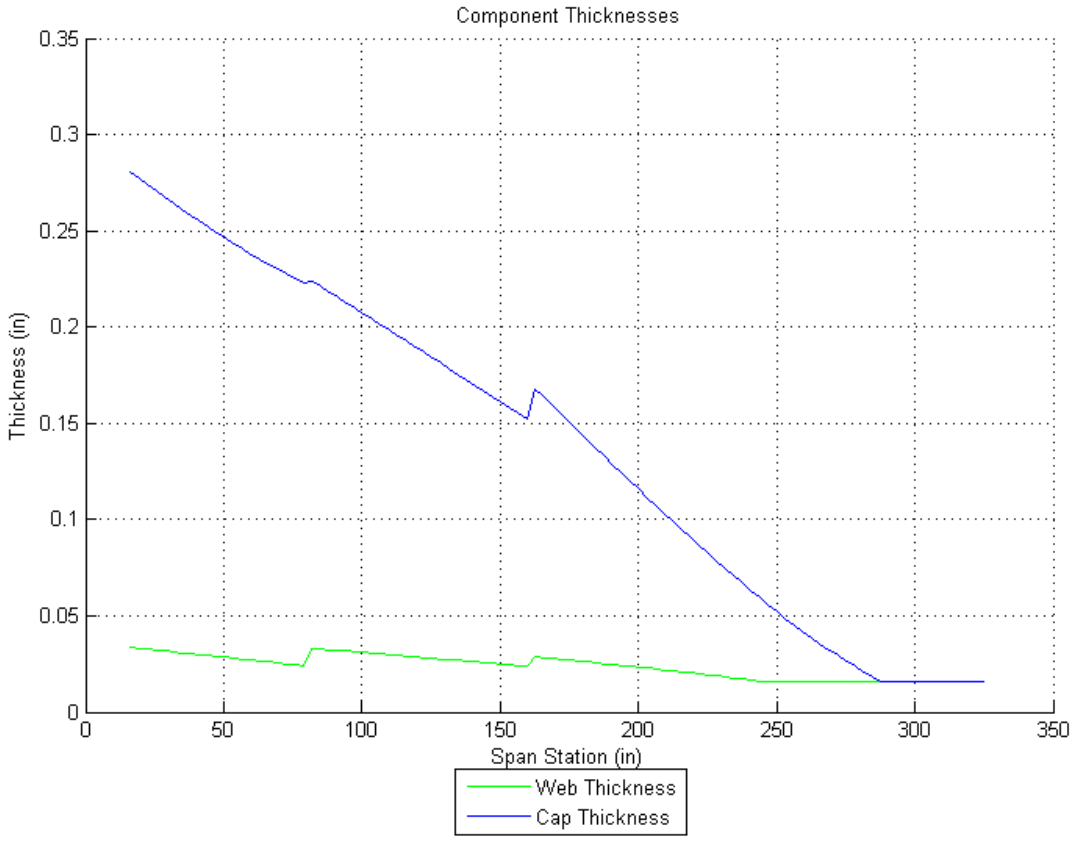

Figure 8: Wing structural sizing

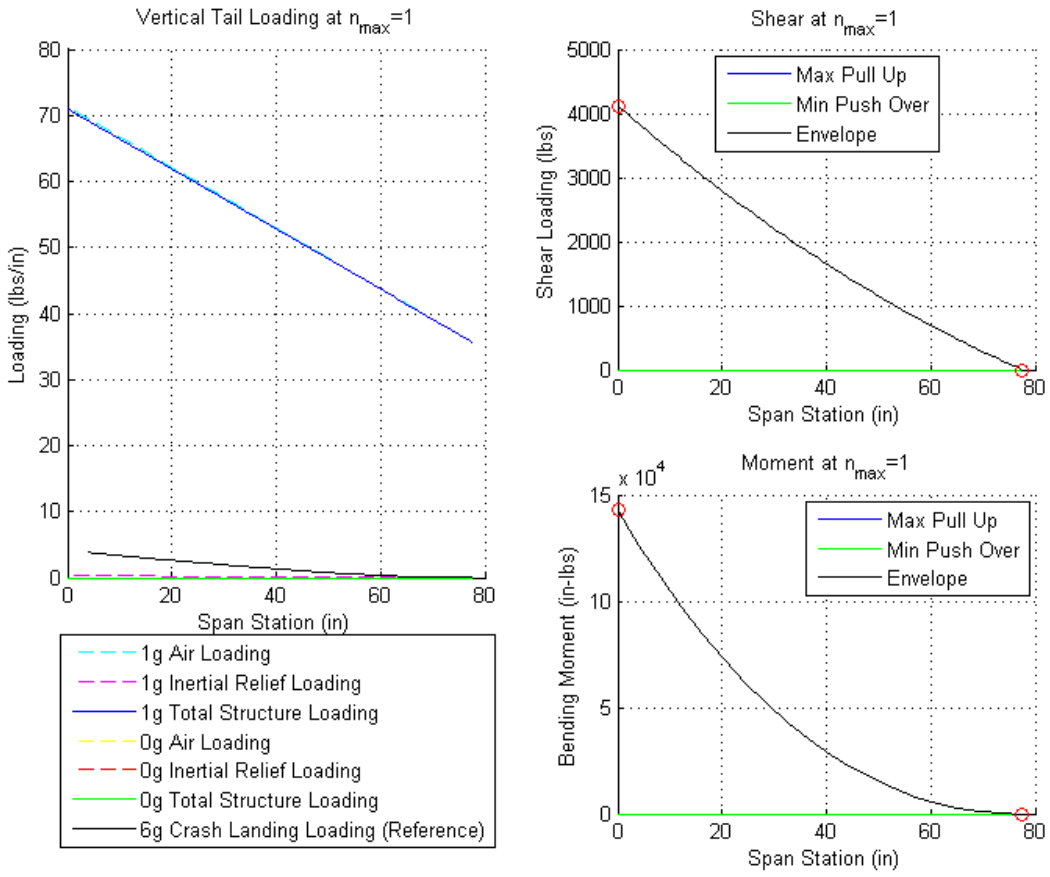

Figure 9: Loading along vertical tail

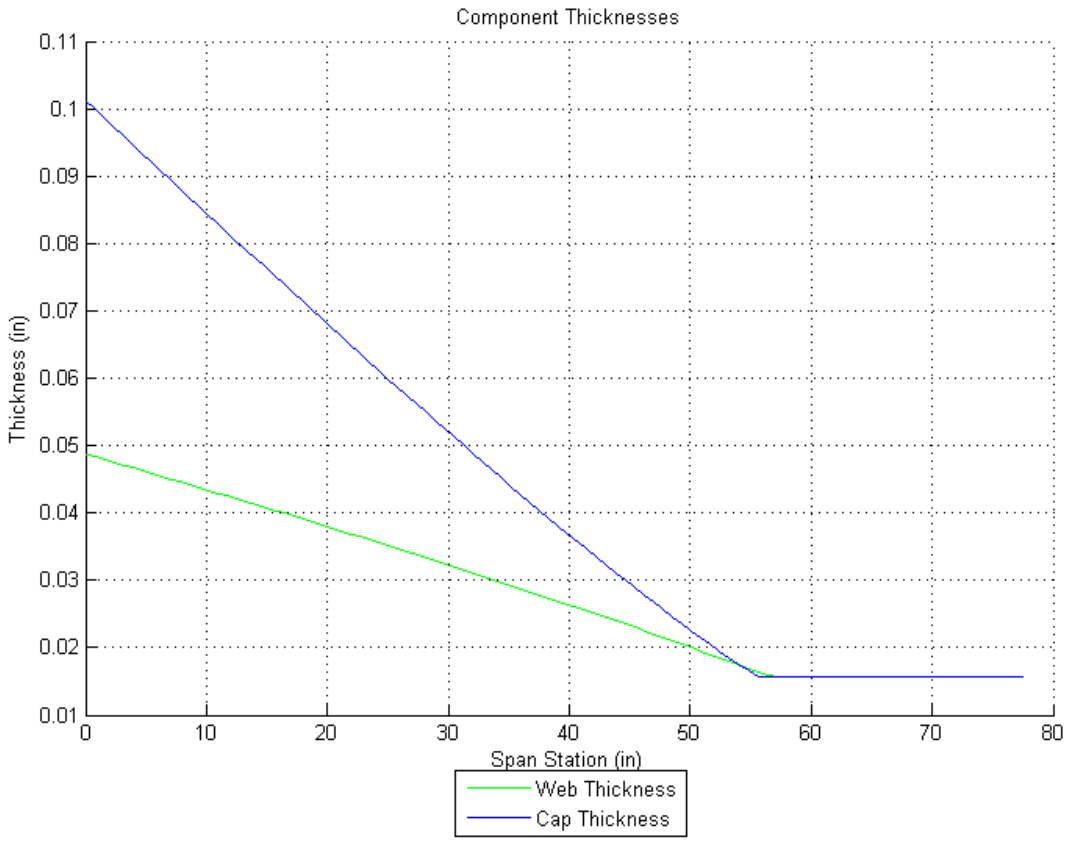

Figure 10: Vertical tail structural sizing

5.4 Horizontal Tail

```
Lhmax: 3.6465e+003
S_o_h: [1.8197e+003 0]
M_o_h: [4.5473e+004 0]
```

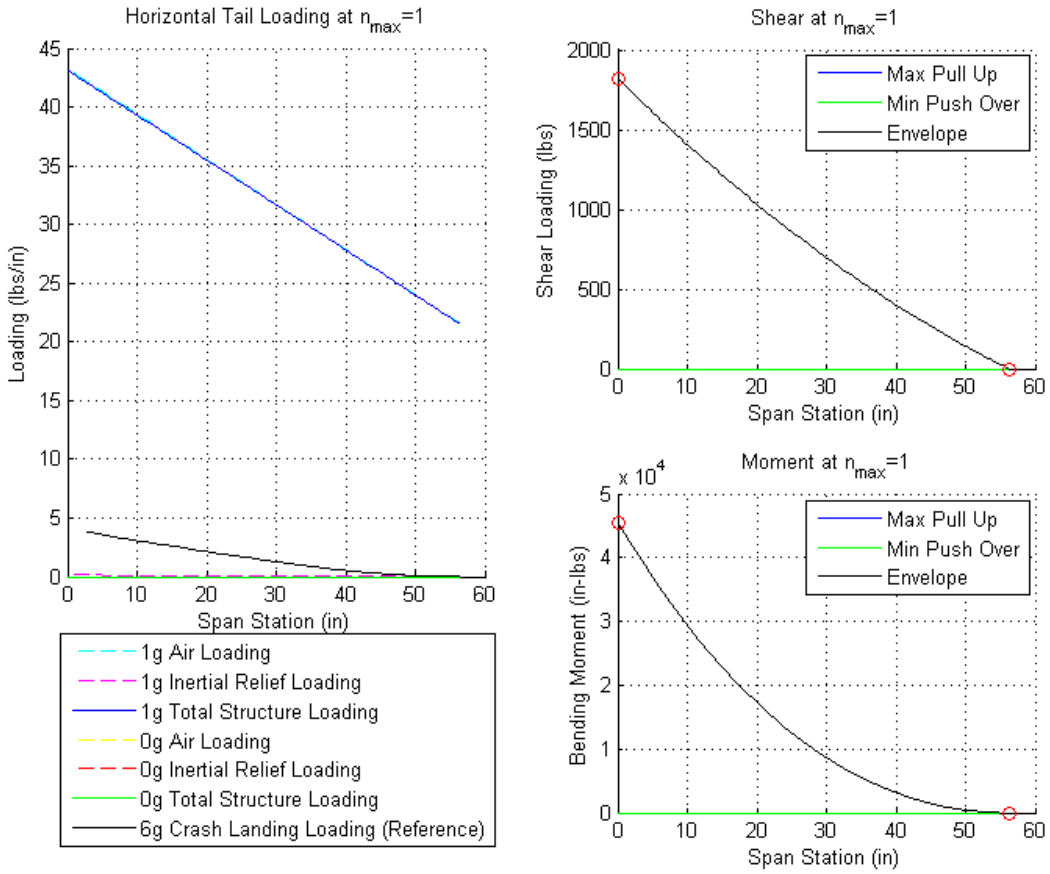

Figure 11: Loading along horizontal tail

6 Weight

```
     W: 3.2573e+003
 Wfuel: 1.1097e+003
Webare: 350
 Wfuse: 476.1615
 Wwing: 262.9438
Whtail: 7.1756
Wvtail: 21.1285
  Weng: 423.5000
Wpylon: 25
```

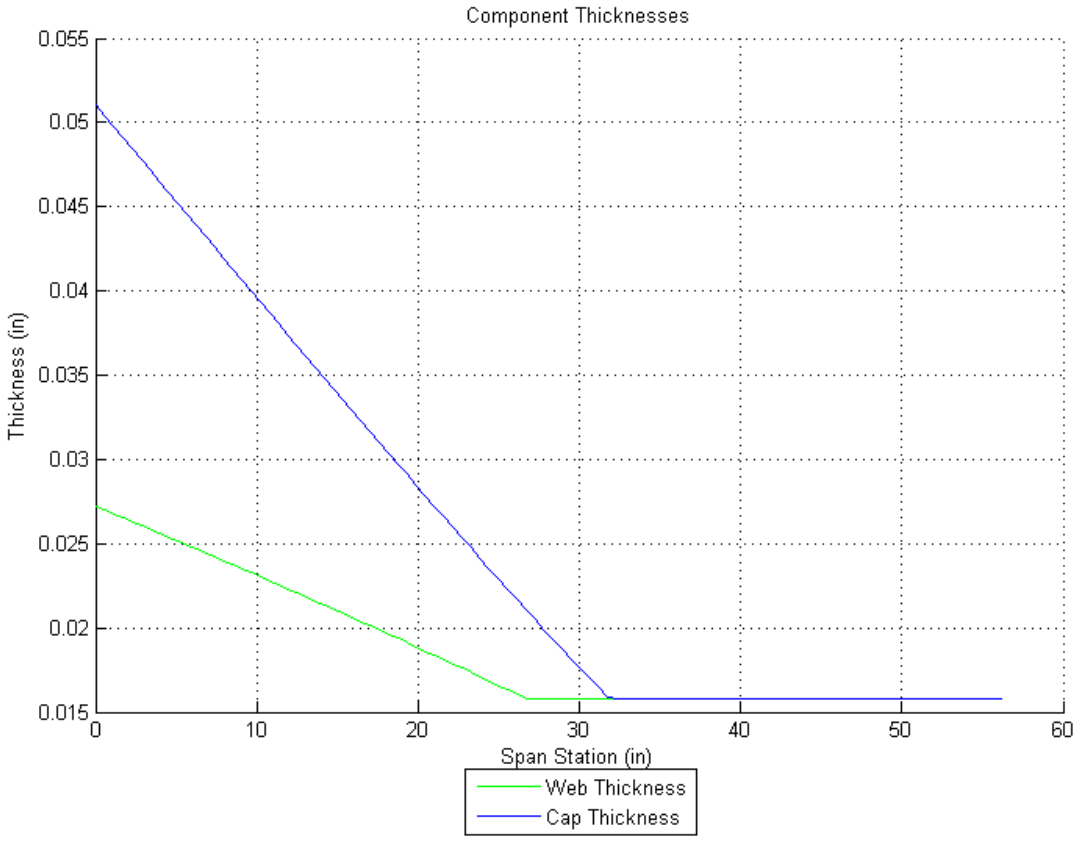

Figure 12: Horizontal tail structural sizing

```
Wwingfuel: 466.7925
 Waddfuel: 642.8750
  Whpesys: 225
     Wflg: 31.5748
     Wmlg: 175.1808
     Wpay: 500
    xWfuse: 6.0790e+004
    xWwing: 3.0027e+004
   xWhtail: 2.2252e+003
   xWvtail: 6.5597e+003
xWwingfuel: 5.4255e+004
 xWaddfuel: 6.9711e+004
```

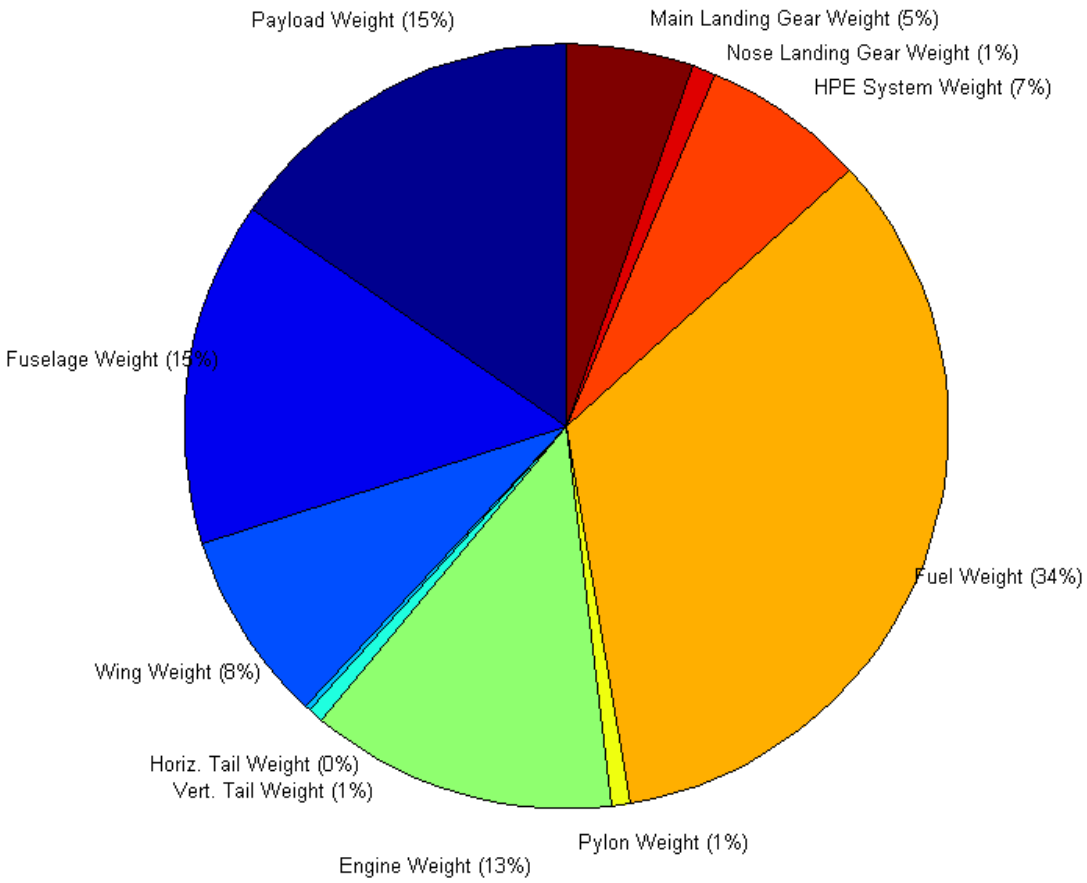

Figure 13: Weight Breakdown

6.1 Fuselage

```
 f_fadd: 0.6500
f_frame: 0.2000
f_string: 0.1500
```

```
  f_padd: 0.5500
f_mlgadd: 0.2500
f_flgadd: 0.1000
   Wskin: 100.5807
  Wfloor: 0
  Wframe: 20.1161
```

6.2 Wing

```
  f_flap: 0.0200
  f_slat: 0
  f_aile: 0.0200
  f_lete: 0.0700
  f_ribs: 0.0500
  f_spoi: 0
  f_watt: 0.0300
  f_elev: 0.2500
  f_rudd: 0.1500
  f_enac: 0.1000
  f_epyl: 0.1000
  f_eadd: 0
    Wcap: 214.9081
    Wweb: 6.0531
   Wribs: 11.0481
Wstrings: 0
```

6.3 Vertical Tail

```
   Wcap_v: 14.8376
   Wweb_v: 1.4151
  Wribs_v: 0.8126
Wstrings_v: 0
```

6.4 Horizontal Tail

```
   Wcap_h: 4.6743
   Wweb_h: 0.4511
  Wribs_h: 0.2563
Wstrings_h: 0
```