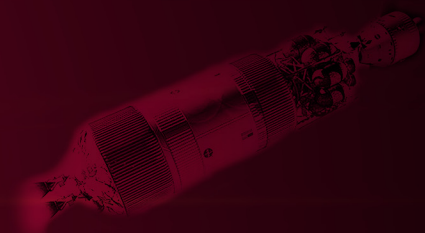


Design on the Lighter Side

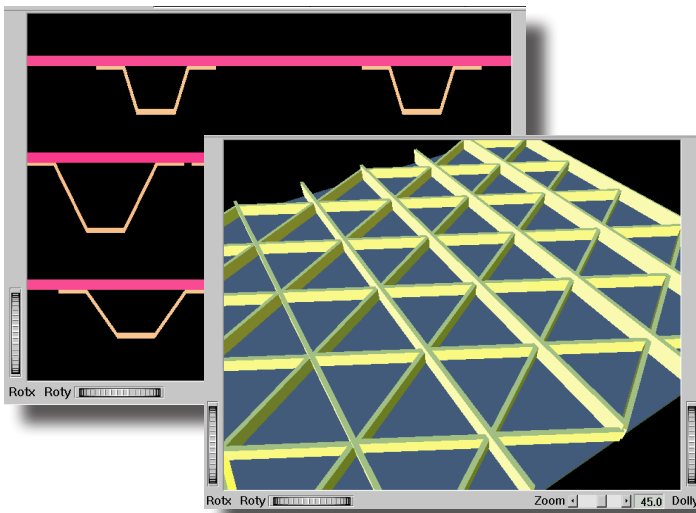
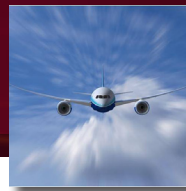


HyperSizer[®]
Structural Sizing Software

Basic[™] Software Product Guide



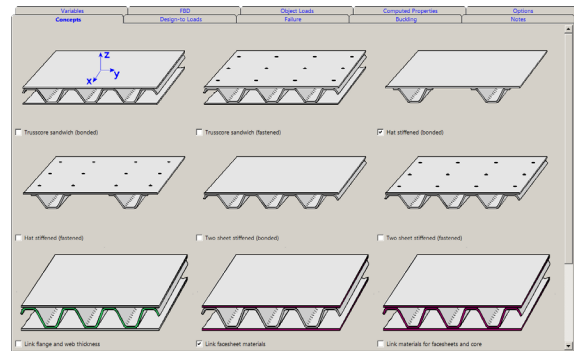
HyperSizer[®] Basic



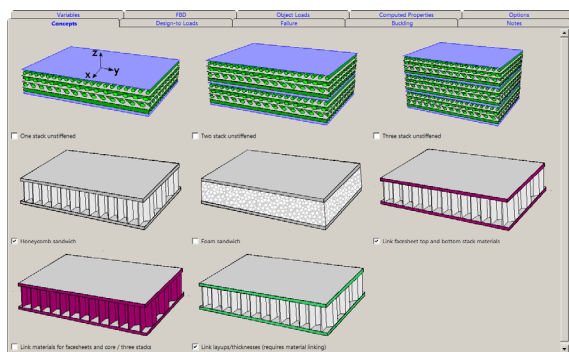
HyperSizer Basic™ includes all the functionality of **HyperSizer Material Manager™**, such as composite laminate analysis, and adds stress analysis and detailed design optimization for over 50 different stiffened and sandwich panel and beam concepts. Any material or cross sectional dimension can be optimized to all load cases. Apply general edge loadings and/or boundary conditions through the Free Body Diagram software tab and solve for the resulting stresses and structural integrity using over 100 different failure analyses. Analyses include traditional industry methods and modern analytical and numerical solutions.

Panel and Beam Concepts

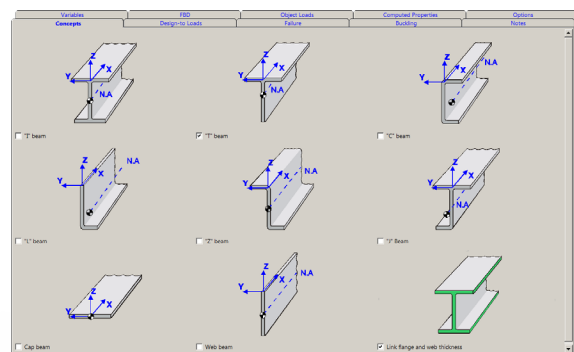
50 panel and beam concepts are available. The engineer simply clicks which concepts to be considered. **HyperSizer** will concurrently optimize panel/beam design concepts, all cross section dimensions, material selections, and composite layups. The panels and beams are categorized into families:



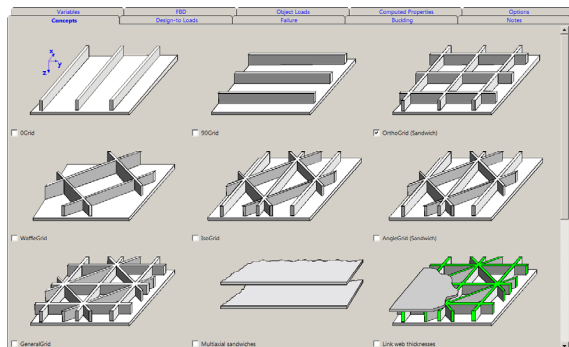
Corrugated hat, trusscore, two-sheet, etc.



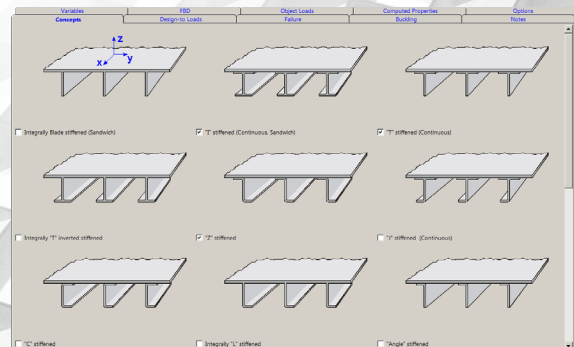
Unstiffened laminates, honeycomb and foam sandwich, etc.



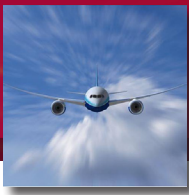
Open Beams I, Tee, C channel, angle, etc.



Grid Stiffened isogrid, orthogrid, biaxial waffle, etc



Uniaxial blade, Tee, Zee, J, etc.



HyperSizer® Basic

Design Optimization

To **analyze** an existing design or fabricated part, a user can click on each design variable, and input values for the cross section dimension and sheet thickness. To **optimize**, the engineer enters a starting and an ending value for each variable. These starting and ending values are labeled in **HyperSizer** as *minimum* and *maximum* variable ranges. Next, the user determines how many permutations for each variable and then selects the different materials to attempt for the facesheet skin, sandwich core, etc. The factorial combination of each variable's permutation and material choices creates a large matrix of possible **candidate designs**.

The candidate designs are evaluated for strength and stability structural integrity for all applied loadcases. If any strength or stability failure analysis indicates a negative **margin-of-safety** (a safety factor less than one) then that candidate design fails. The optimizer will quickly determine which candidate design is the

lightest that passes all failure analyses.

Analysis

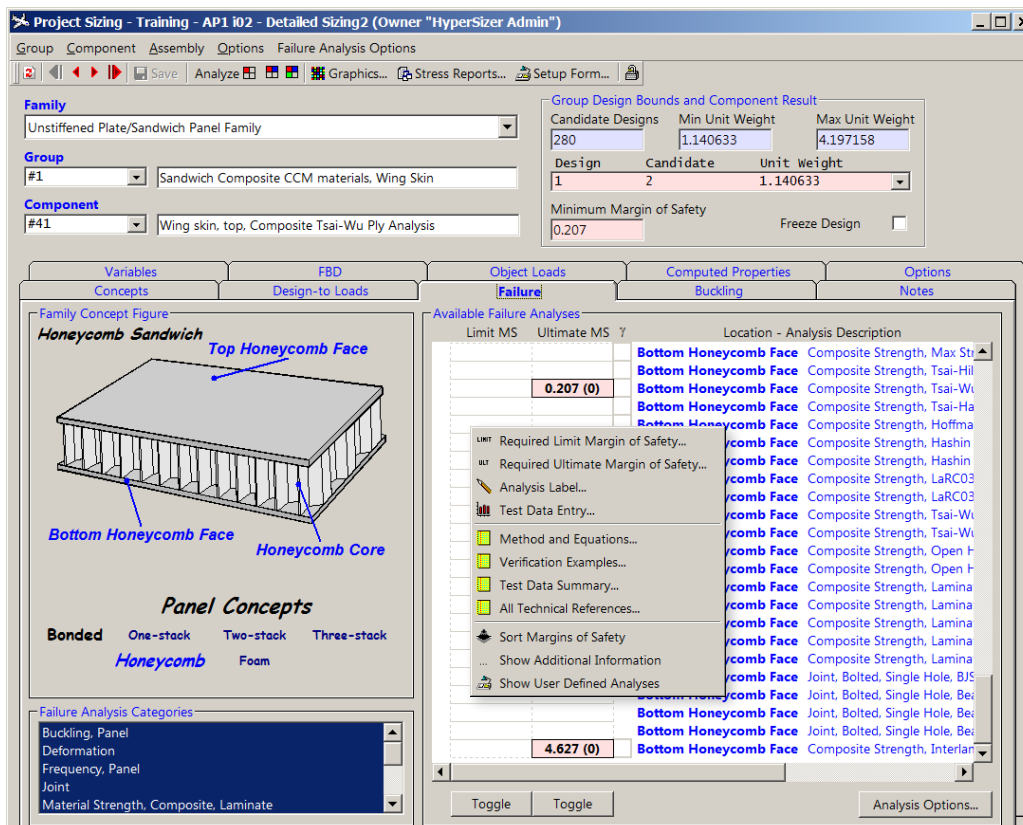
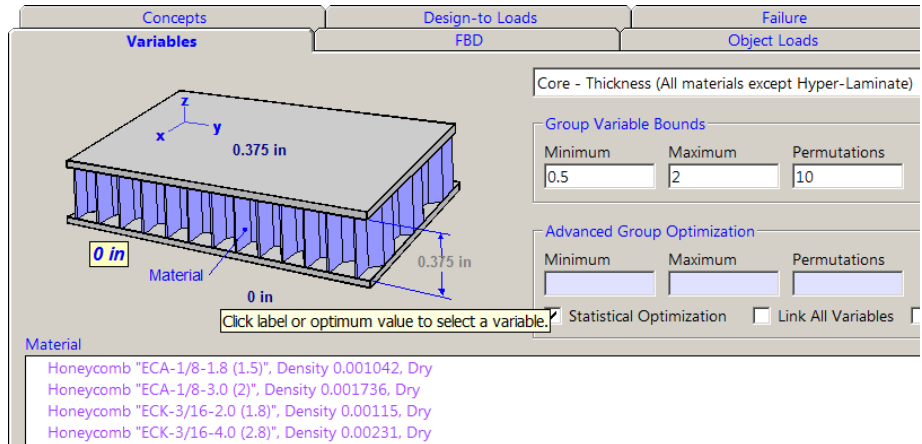
Failure Analyses

Most analyses apply to all panel/beam concepts, such as buckling, cross section crippling, and modal frequency. However, design concepts have unique failure mechanisms. For a honeycomb panel, additional failures to consider are facesheet wrinkling and dimpling, and core shear and crushing. For stiffened panels, analyses are performed for each

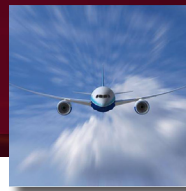
individual span segment, such as ply-by-ply material strength, local buckling, crippling, and flange to skin adhesive bonded joint strength.

HyperSizer includes all of these types of failure analyses, and returns a margin-of-safety for each.

Documentation of analytical methods are presented in PDF format with the equations used for each failure analysis included along with verification models and validation test data. The user may click on a failure method and then view the equations and the method described along with related verification data.



HyperSizer® Basic



Free Body Diagram Approach

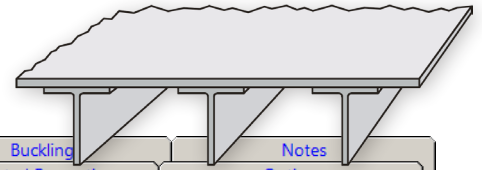
Using a Free Body Diagram Approach, the analysis process begins by specifying any general combination of panel or beam edge loads and/or boundary conditions. Shown below is the Free Body Diagram (FBD) software tab. The FBD includes four types of allowed input (Free, Constrained, Load, or Deformation) for the eight separate membrane, bending, and out-of-plane transverse edge conditions. Based on the panel's length, width, concept, shape, materials, and layups; **HyperSizer** will compute the corresponding *virtual loads* that bring the panel/beam into FBD force equilibrium and strain compatibility.

In addition to edge loadings, the engineer may also apply temperature changes, through-the-thickness temperature gradients, and out-of-plane pressures. **HyperSizer** will analytically compute and superimpose the resulting membrane and bending loads to the

edge loads. This combination of loads are the '*design-to*' loads used for strength and stability analyses.

These external loads are resolved internally into forces (also known as stress resultants) on each analysis object, such as sandwich facesheets and cores, stiffened panel skins, flanges, webs, and bonded joint regions.

The FBD state of internal stresses and strains for all of the panel segments are integrated and summed to verify equilibrium of forces and strain compatibility for the panel/beam as a whole. This process of analysis for manually entered loads is identical to the analysis performed for automatically entered loads from an FEA as described in the Pro software brochure.



Input (Per Load Case)

***ULTIMATE-MECHANICAL** Load Case #1 "Mechanical Load Set #101 (Run Deck #1) "Wing Pressure", Thermal None." (Mechanical Set #101, No Thermal Set)

Mechanical Load Set #101 "Wing Pressure" Ref Temp 72 Temp
 No Thermal Load Double-click frame to apply enclosed values to each component in current group Pressure 11.85 TT Grad

FEA Loads

User Loads Applied Unit Value Nx,Ex Ny,Ey Nxy,xy Mx,kx My,ky Mxy,ky Ox Oy

For Strength Analysis	-3400	Constrained	Deformation	0.0077	Constrained	Constrained	Free	Load	Load
For Buckling Analysis	-2000			0.0055					

Superimposed Loads

Panel Pressure Beam-Column Moments

Zero Out FEA Computed Moments FIXED Boundary Condition

MidSpan	Mx	Mv	Ox	Ov
EdgeCntr	-642.6599	-306.6202	0	0
	1294.63	790.9313	243.8882	138.4075

Point Free Body Diagram (Constant Forces)

Diagram showing forces (Nx, Ny, Mx, My, Qx, Qy) and moments (Mx, My) acting on a panel element. Dimensions a (X length) and b (Y length) are indicated.

a (X length) 30
b (Y length) 60

Free Body Diagram Output (Controlling Factored Loadcase)

Controlling Analysis Load: STRENGTH	Nx,Ex	Ny,Ey	Nxy,xy	Mx,kx	My,ky	Mxy,ky	Ox	Oy
Virtual Loads	0	-1741.67	10646.6	-6746.79	-2304.06	9389.63	0	0
Design-to Loads	-5100	-1609.93	10646.6	-5452.16	-1513.13	14084.4	243.888	138.407
Design-to Deformation	-2.559714E-03	0	0.01155	2.950478E-04	4.747792E-05	0		

For more information,
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