ANSYS®

3.0

3.0 RELEASE

ANSYS® Airpak® Technical Specifications

ANSYS® Airpak® software is a quick and easy-to-use design tool that simplifies the application of state-of-the art airflow modeling technology for the design and analysis of ventilation systems used to deliver indoor air quality (IAQ), thermal comfort, health and safety, air conditioning and contamination control solutions. The ability to rapidly create and automatically mesh ventilated spaces is coupled with the fast, accurate and well-proven unstructured solver engine of ANSYS® FLUENT® software. Additionally, post-processing features essential to the heating, ventilating and air conditioning (HVAC) industry allow ANSYS Airpak software users to effectively visualize ventilation system design performance and communicate analysis results to customers, internal team members, government agencies and prospective clients. ANSYS Airpak technology enables users to complete work in the shortest amount of time, compared to other airflow modeling software tools.

Model Building Features

- Mouse-driven selection, placement and sizing of predefined objects for use in model building; fast and easy, even for complex geometries
- Object-based model building with predefined objects including rooms, people, blocks, fans, partitions, vents, openings, sources, walls, ducts, resistances, heat exchangers and hoods
- Comprehensive object shapes including rectangular blocks, cylinders, ellipsoids, elliptical cylinders, concentric cylinders, prisms of polygonal cross section, prisms of varying cross section and ducts of arbitrary cross section
- Rectangular or circular 3-D/2-D fans with hubs, guards and power specifications; ability to dial-in operating and nominal RPM and fan curve changes automatically
- Polygonal and circular shapes allowed for fans, vents, resistances, partitions and openings
- Library functions to store or retrieve groups of objects in a parts library
- Inclined rectangular partitions, fans, vents, openings and resistances
- ModelManager: a graphical Explorer tree-style model management tool to quickly create, edit and manage objects, assemblies, libraries, projects, configurations and settings
- Mouse-driven interactive GUI controls including:
  - Mouse or keyboard control for placing, moving and sizing objects
  - Ruler option to guide in sizing/resizing objects
  - 3-D mouse-based view manipulation with dynamic rotation, translation and zoom
  - Undo/redo functions
  - Active/inactive option for all objects
  - Error and tolerance checking
  - Flexible/customizable units for all input fields
  - ModelManager entities
  - Graphical alignment tools
- Geometry inputs using local coordinates
- Geometry import using IGES, DXF or DWG file formats
- Capability to import and export model geometry information to spreadsheets
- Comprehensive model summaries in HTML format
- Comprehensive material property database
- Capability to set up user-defined macros

Meshing Features

- A full range of meshing options:
  - Automatic unstructured body conforming
  - Automatic structured Cartesian meshing for convenient analysis of models with predominantly rectangular geometric shapes
  - Automatic nonconformal (for unstructured and structured) to mesh regions of the model separately, simplify meshing and reduce cell count, thereby increasing speed of solutions
  - Embedded nonconformal meshing that allows assemblies to be embedded in other assemblies and then be meshed individually
  - Automatic tetrahedral mesher to accommodate the complex geometric shapes
  - Automatic mixed nonconformal meshing to mesh regions of the model individually with different mesh types to efficiently handle the presence of complicated geometries
- Unstructured mesh generation approach to model complex geometries with ease for true geometry representation (no stair-stepped approximations)

- Hexahedra, tetrahedra, pentahedra, prisms and mixed element mesh types for high-quality mesh on complex objects
- Coarse mesh generation option for first-cut analysis
- Full user control of meshing parameters and mesh deployment
- Intuitive mesh viewing tools that facilitate review of mesh quality

Comprehensive Modeling Capabilities

- Forced, natural and mixed convection heat transfer modes; conduction in solids; conjugate heat transfer between solid and fluid regions
- Surface-to-surface radiation heat transfer with automatic view-factor calculation
- Discrete ordinates radiation model
- Solar illumination shading model
- Ideal gas law available
- Laminar or turbulent flows
- Choice of turbulence models:
  - Zero-equation model calibrated for indoor airflow
  - Mixing-length turbulence model
  - Standard k-ε turbulence model
  - RNG k-ε turbulence model
  - Spalart–Almaras turbulence model
- Ability to model a predefined region as laminar when the rest of the modeling region is turbulent
- Species transport
- Steady or transient analyses
- Volumetric resistances and sources for momentum, energy and species
- Robust shell conduction model that accounts for planar/lateral conduction effects in zero-thickness partitions; available for cylindrical shells

Boundary Conditions for Flexible Model Building

- Wall/surface boundaries with options for specification of heat flux, temperature, convective heat transfer coefficient, radiation and symmetry conditions
- Openings and vents with options for specification of inlet/exit velocity, mass flow rate, exit static pressure, inlet total pressure, inlet temperature, turbulence parameters and species boundary conditions
- Specify water vapor boundary conditions in terms of moisture content or relative humidity
- Fans with options for specified flow rate (volume or mass) or fan performance curve
- Recirculating boundary conditions for external heat exchanger or species filter simulations
- Macro for solar load boundary condition specification
- Macro for setting atmospheric boundary layer profile boundary conditions
- Macros for modeling diffusers with simplified boundary conditions:
  - Nozzle
  - Slot
  - Valve
  - Displacement
  - Square ceiling
  - Round ceiling
  - Vortex ceiling
  - Grille
- Time- and temperature-dependent sources
- Time-varying boundary conditions
- Profiles of velocity, temperature, heat flux/heat transfer coefficients; species can be specified on openings and walls
- Pressure boundaries can be a function of time
- Variable time-stepping for transient problems; any desired time step variation can be specified; useful for problems in which changes of interest occur over very small time intervals
- Vents and resistances with automatic loss coefficient calculation based on free-area ratio
- Rotational speed can be specified for cylindrical/circular objects
- Optional automatic correlation-based heat transfer coefficient boundary conditions can be specified based on flow parameters

Solution

The state-of-the-art solver in the ANSYS Airpak product is the finite volume solver used in ANSYS FLUENT technology. Robust, fast and accurate, ANSYS Airpak software uses a segregated solution algorithm with a sophisticated multigrid solver to reduce computational time.

- State-of-the-art fluid flow and heat transfer solver for complex geometries
- Choice of first-order upwinding for first-cut solutions, or a higher-order scheme for improved accuracy
- Optional automatic adjustment of solver under relaxation for robust and fast convergence
- Parallel solver for multiprocessor machines or clusters, Windows® XP or Linux® is available – solver speedup depends on the size of the problem and the number of processors
- Batch queuing capability to spawn off multiple solution trials concurrently to multiple computers

- Grid-to-grid interpolation for restart available
- Ability to run without recreation of solver input files when geometry variables do not change parametrically
- Parametric analysis improvements
  - Single location to set up and control models
  - Can toggle between single trial, parametric trials or optimization
  - Can control basic solver settings
  - Design variables can be specified
- Design optimization
  - Embedded efficient gradient-based optimization module
  - Maximum of 50 design variables
  - Maximum of 10 constraint functions
  - Plots of design variables, objective and constraint functions with iterations

Visualization and Reporting

ANSYS Airpak software includes a full-function 3-D object-based post-processor, so users can interpret results with ease. Customized reports and plots help identify and compare trends during parametric analysis of design options.

- Fully integrated, interactive, object-based visualization
- Three-dimensional modeling
- Dynamic mouse-based view manipulation (rotation, translation, zoom)
- View selection and resetting options
- Hidden line/surface removal
- On/off toggling of object visualization
- Mouse-driven cut-plane determination
- Dynamic movement of cut-planes through the domain
- Viewing planes that are arbitrary planar surfaces in the domain
- Comprehensive user-defined post-processing functions and reporting on multiple data sets
- Object display
  - Textured maps can be applied to provide more realistic scenes
  - Ability to specify degrees of transparency
- Lighting options
  - Specify color and intensity of ambient lighting
  - Add up to four additional lights
  - Can also control how surfaces respond to lighting
- Diffuse, ambient, specular reflectances
- Shininess
- IAQ and thermal comfort post-processing variables can be computed using comfort-level graphical user interface and displayed like other post-processing variables:
  - Mean age of air
  - Predicted mean vote (PMV)
  - Relative humidity
  - Mean radiant temperature
  - Predicted percentage dissatisfied (PPD)
- Air diffusion performance index (ADPI) post-processing for cooling applications
- Point probes and XY plotting for data reporting
- Mouse probe for data probing on any post-processing object
- Point summary tables
- Contours of velocity components, speed, temperature, pressure, heat flux, heat transfer coefficient, flow rate, turbulence parameters and many more quantities
- Velocity vectors – color coded by temperature, velocity magnitude, pressure or other solved/derived quantities
- Animation for viewing particle and dye traces
- Animation of vectors and contours in transient analyses
- Reporting to user-specified ASCII files of all solved quantities and derived quantities (heat flux, mass flow rate, heat transfer coefficient, etc.) on all objects, parts of objects and user-specified regions of the domain
- Time history of solution variables at any point in the model
- Graphical monitoring of convergence history during solution process
- Additional convergence monitoring tool – point monitors for solved variables to monitor solution convergence
- Direct graphics output to printers and/or user-specified files; hard copy options include color or monochrome postscript, PPM, TIFF, GIF, JPEG, TIFF and VRML file formats
- Create animations directly from ANSYS Airpak software
- Animation capability to write out AVI, Flash, FLI, animated GIF and MPEG format files
- Single point object that can be used as a monitor point, post-processing object or for point reports
- Ability to report fan operating point
- Data can be saved in point format on all post-processing objects
- Ability to set up a variety of post-processing functions for optimization, reporting and plotting purposes

Miscellaneous

- Ability to remap mouse button preferences
- 3-D objects (such as block) can be converted to 2-D objects (partition) and vice versa
- Automatic save interval can be specified

Online Help and Documentation

- Context-sensitive online help for all panels/menus
- Tool tips available for all functional menus
- Tutorial manual
- Training manual

Supported Hardware

- Windows XP and Linux

www.ansys.com

GSA Contract Holder

ANSYS, Inc.
Southpointe
275 Technology Drive
Canonsburg, PA 15317
U.S.A.
724.746.3304
ansysinfo@ansys.com

Toll Free U.S.A./Canada:
1.866.267.9724
Toll Free Mexico:
001.866.267.9724
Europe:
44.870.010.4456
eu.sales@ansys.com

MKT0000440 7-09