

## Mass Properties Engineering The dbMASS Advantage

This document highlights many of the features provided by dbMASS and the benefits realized by working with them. The principal advantages of using dbMASS for mass properties engineering have been grouped under the following ten headings:

1. Database Structure
2. Configuration Management
3. Automated Part Calculations / Graphical Verification
4. Contingency / Weight Maturity
5. Material Usage
6. Weight Change Tracking
7. User Defined Fields
8. Import / Export Data
9. Sharing Data
10. User Interface

### 1. Database Structure

One of the fundamental strengths of dbMASS is its support of the product structure and its ability to build parts and assemblies in local coordinate systems. This capability enables the mass properties database to mirror the data structure used throughout the company to track a project. This makes verifying that everything is accounted for a simple task. Without it, it is difficult to identify discrepancies. The support of local coordinate system definitions also makes multiple references to assemblies and parts possible. The mass properties are defined in one place and then located and oriented for each instance. Thereby, any updates to the mass properties are done in one place and adjustments for each instance are automatically accounted for through the transformations. These features promote ease of use and eliminate potential sources of error.

### 2. Configuration Management

Since a fully relational data structure is maintained, configuration and effectivity management is reduced to managing uniqueness. New records are introduced to the database only as needed to track the uniqueness. Everything that is common between the various configurations and effectivities remains in common through references to existing records. This practically eliminates the need to do full database search and replace operations and the errors that can be introduced in the process. Furthermore, sequence mass properties are defined by simply referencing the various configurations that define the complement of equipment, its orientation and fuel state for each event. This makes sequence mass properties integral to the database so that the day to day updates that occur to the database will be automatically reflected in the sequence mass properties.

### 3. Automated Part Calculations / Graphical Verification

The automated "calc sheet" features of dbMASS make the calculations used to estimate mass properties integral to the database in a standardized format. This enables anybody to inspect the calculations made by another and clearly see what the bases of an estimate were. Any updates to the part calculations are automatically reflected wherever that part is used through the common references. Furthermore, the shapes used in the calculations are used for graphical verification of the location and orientation of the parts and assemblies. A display of an assembly will quickly identify mis-located entries. When working with multiple coordinate systems, graphical verification is all the more important for ensuring accurate model construction.

#### **4. Contingency / Weight Maturity**

The contingency field is used to assign growth margins and provide weight maturity status. The contingency field supports adding user-defined categories. Contingency groups can also be defined for summary reporting. The contingency factors (percentage) are fully integrated into the database. A change to the definition of the factor is done in one place. All parts that reference the contingency are automatically updated to reflect the change in contingency weight. Also, with a click of a button, the database contingency mode can be toggled to include or exclude the contingency weight in the total weight of the part. This, of course, affects the inertias, which are automatically recalculated and summed. The contingency assignments are used for reporting the weight maturity, which is given as the percentage of weight allocated to each of the contingency types. The weight maturity is given for each category in any user defined class field (see below).

#### **5. Material Usage**

The material field, associated with the items in a part, provides for standardized material densities. Each material is defined once. Any changes to the materials are automatically reflected in all parts that reference them. The materials definitions ensure consistent usage for part weight estimations.

#### **6. Weight Change Tracking**

The integrated weight change tracking features of dbMASS make it easy to track weight changes by category, provide a descriptive reason for change, record when the change was made and by whom. A comprehensive weight change history report can be created by specifying the top-level entry (e.g. a project or assembly) and the time period of interest. All recorded weight changes that are associated with entries that are reference by the top-level entry that occurred in the time period will be listed. One can also call up the history of an individual entry with a few mouse clicks. Weight change history is valuable in explaining what changed from month to month. The assignment of categories provides for parametrics that are useful for establishing weight growth projections on future projects.

#### **7. User Defined Fields**

dbMASS also supports user defined fields. These fields support additional text, numeric (with units), summation and class category data. The summation fields support assigning values to parts that are summed for the assemblies that reference them, e.g. spec. weight. The class fields support user defined hierarchical lists of categories that are commonly used for functional and WBS coding. With class field based reports, the weight and or the full mass properties can be totaled for each category. Weight maturity status for any assembly is also provided broken down, for any class field, by its categories. The custom report layout manager enables the user to define reports that have either the product structure or the class fields as the primary sort criteria. The report layouts provide the features to pick and choose which entry data fields to include in a report.

#### **8. Import / Export Data**

dbMASS supports multiple ways to import and export data. The Mass Properties Exchange (MPEX) format can be used to bring in any text based data into dbMASS through the use of Excel or other spreadsheet programs. Practically all data based applications support saving their data into text files, which once brought into the spreadsheet can be easily manipulated to comply with the MPEX standard. Full documentation of the MPEX format with examples is provided to get you up and running with this versatile format. dbMASS will create a graphical model from MPEX data when full mass properties are provided through the use of the "inertia shape" feature. By viewing this graphical model one can quickly verify the data.

The dbMASS solids modeling tool interfaces provide an efficient means to extract engineering design data. Typically, a menu pick will provide the mass properties model of an entire project or assembly

extracted for import into dbMASS. When data is imported into dbMASS, an “inertia shape” is created that model the parts mass properties and provides graphical verification of the data. This feature enables using the display features of dbMASS to quickly verify the imported data.

dbMASS supports several ways to export the data making it easy to bring the data into other applications. The entire database can be exported to the MPEX format or select information can be output to various text file formats using the reporting features. The Excel import wizard works well with the tab-delimited format. Special Word macros have been written to bring the standard report format, \*.prn, into Word. These macros add a dbMASS vocabulary item to the standard menu from which the macros are executed. A report can also be directly ported from the dbMASS report viewer to these and other Windows applications through copy and paste operations. These features provide convenient ways to share mass properties information between the various interested parties.

## **9. Sharing Data**

Sharing data is extensively supported through the database copy commands. One can copy an entire database (often used to create backups), or selectively copy from the active database or copy to the active database. In the process of copying assemblies, parts, etc. all reference data is brought over as well. An entire project can be copied from one database to another with a single copy command. Materials, standard parts, contingencies and report layouts can likewise be copied separately. In the process of copying between databases, duplicate record resolution is provided. This feature allows the user to decide how duplicate records, records that share a common id, description, etc. but have different associated data, are handled. The user can edit/view the conflicting records then decide whether to update the original, discard the update or maintain both. Sharing data leverages the mass properties work from one project to another and enables multiple individuals to work independently but still share their work with others on a project.

## **10. User Interface**

dbMASS features also make extensive use of the Graphical User Interface to provide mouse click initiated queries that make moving around the product structure of the database a quick and efficient process. For example, one can quickly determine which entries reference a particular piece of data by clicking on the data item and using a right mouse click.

dbMASS supports working in both English and metric units. By setting the active units, the user controls how the data is view and entered. The reports are generated in whatever the active units are at the time the report is created. Through the use of the units features, inertias can be expressed as standard inertia values or radius of gyration. They can be given about the cg or relative to a local coordinate system.

dbMASS also supports cg or two plane spin balancing and uncertainty analysis. Both of which are fully integrated into the dbMASS environment.

## **11. Summary**

With spreadsheets and other general-purpose database applications, it is all too easy to introduce spreadsheet programming or data entry errors that will go undetected. All it takes is one error that causes significant reengineering to occur late in a project development to realize how expensive using unverifiable applications can be. With dbMASS, the programming is tested and proven and the visual verification capabilities make it immediately obvious when data entry errors are introduced.

The ability to share information through the import and export features provided make it easier to work more effectively with others within your organization and with those your company may be teamed

with. The existing MPEX support can be used to bring in product structure data from another application. The solids modeling interfaces can be used to bring in the designers' data, significantly reducing the time required to build a mass properties database.

The reporting features offer a broad scope of flexible capabilities. They provide efficient methods for moving dbMASS information to spreadsheets and Word documents. The ability to create mass properties reports that are either product structure or functionally (class field) based is a unique and powerful advantage.

Over 25 major and minor aerospace companies and government institutions are currently realizing these benefits. A partial list of our clients follows:

The Aerospace Corporation, Allied Signal Aerospace, Beech Aircraft, GENCORP - Aerojet Division, Boeing North American Rocketdyne Division, Boeing North American Space Systems Division, Hughes - Santa Barbara Research Center, Kistler Aerospace, Korea Aerospace Research Institute, Loral Space Systems, Lockheed Martin, Naval Air Warfare Center, Northrop Grumman Corporation, Orbital Sciences Corporation, Raytheon Missile Systems Co., Teledesic Corp. Rohr Inc., Sandia National Labs, Teledyne Ryan Aeronautical, TRW Space Systems Division.

It is clear that dbMASS offers many significant advantages for performing mass properties activities. We also recognize that there is more work to be done. We have plans to transition our feature set to a Windows based application and to provide simultaneous multi-user access to the database. Our mission is to be the preeminent supplier of mass properties engineering software by offering the best methods and technologies for an efficient mass properties engineering process. We've shown commitment to our product and our mission and will continue into the future to deliver the leading mass properties engineering solution.

Sincerely,

Jerry Fleck  
i.e.Solutions, Inc.  
Tools designed with you in mind.