## CATIA V5 Training

Foils

# CATIA V5 Surface Design



Version 5 Release 19
August 2008

EDU_CAT_EN_V5S_FI_V5R19

***Instructor Notes:***

# Lesson 1: Introduction to Generative Shape Design

## About this Course

### Introduction

CATIA is a robust application that enables you to create rich and complex designs. The goal of the course 'CATIA V5 for Surfaces' is to teach you how to build basic and advanced surfaces using Generative Shape Design workbench, and how to create a complex part in a simple way. This course focuses on the surface design concepts that enable you to achieve simple and complex shapes for your designs.

### Course Design Philosophy

This course is designed using a process-based approach to training. This course emphasizes on the processes and procedures required to complete a particular task, rather than individual features and functions. Using the case studies to illustrate these processes, you will learn the necessary commands, options, and menus within the context of completing a design task.

### Target Audience

- Users familiar with CATIA V5 Fundamentals
- Users who want to learn how to create advanced Mechanical Surfaces

### Prerequisites

Students attending this course must be familiar with:

- CATIA V5 Fundamentals
- Microsoft Windows Operating System




***Instructor Notes:***

$Speech:

Introduce the course. Explain the prerequisites for this course.

The course will run 2 days.

You should view the student manual as a supplement to, not a replacement for, the system documentation and on-line help. Once you have developed a good foundation in basic skills, you can refer to the on-line help for information on less frequently used command options.

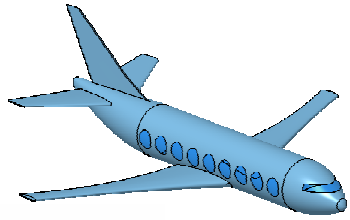
There are several other courses you can take to further develop and enhance your CATIA knowledge and skills. Please visit http://plm.3ds.com/education for a complete listing.%

$Show:

Load the part Lesson1.CATPart for demo%

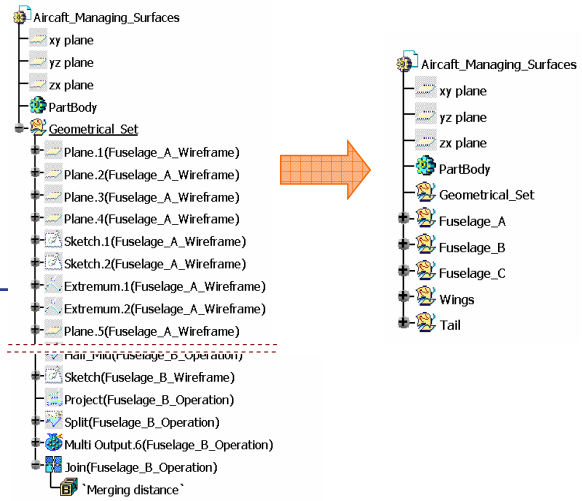
## Case Study

The case study for this lesson is to understand how to access Surface Design workbench and to manage few basic tools.



## Design Intent

- ✓ Get familiar with the user interface.
- ✓ Create separate containers for Surfaces, Wireframes and Operations for different parts of the Aircraft.
- ✓ Finally Group the features from each Geometrical Set ( which are referred in the model ), thus minimizing the tree length of the tree.




## Stages in the Process

1. Access the Generative Shape Design workbench.
2. Scan the model to better understand the modeling sequence.
3. Create the Geometrical Sets.
4. Group the features.



***Instructor Notes:***

$Speech:

Discuss the case study concept.

The case studies, as well as other exercises in the course do not necessary reflect real world examples. They are created to demonstrate the many tools CATIA has to offer.

Discuss the design intent concept.

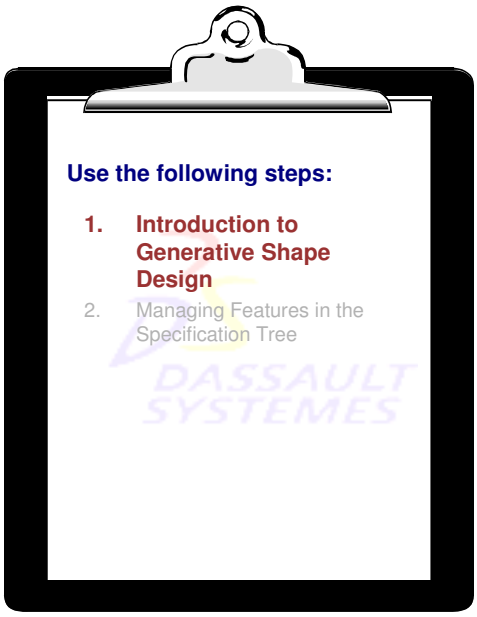
This lesson does not have a required design intent but there are still skills that should have been learned by the end of this lesson.

Discuss the concept of stages in the process.

The linear steps described in the stages of the process are not hard fast design rules for the most part. In the particular examples used in the lessons, it is one possible way of creating the geometry.%

# Step 1: Introduction to Generative Shape Design

*In this section you will learn how to access the Generative Shape Design workbench and become familiar with its various tools and terminologies.*





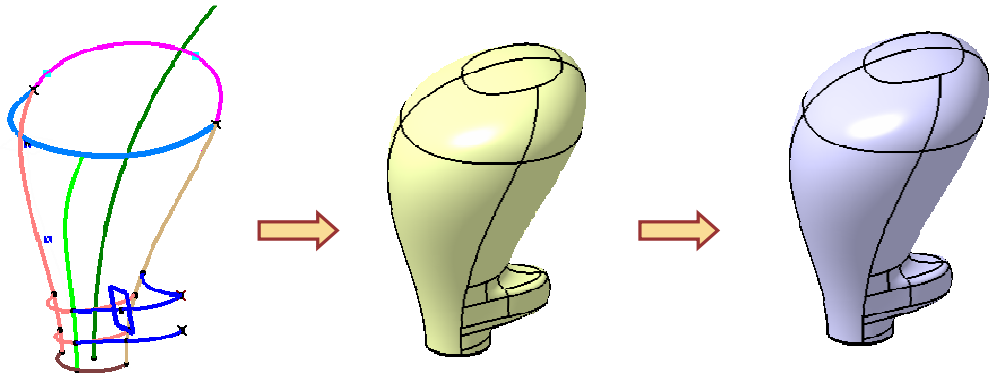

***Instructor Notes:***

$Speech:

Introduce the step%

## Introduction to Surface Design

**Complex 3D shapes** based on **Wireframe and Surface** geometries from which **solids** can be derived:



**Wireframe Geometry** **Surface Geometry** **Solid Geometry**



***Instructor Notes:***

$Speech:

Objective of the slide: tell what GSD can do

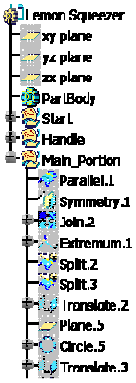
A. GSD offers tools necessary to create shapes complex 3D shapes composed of Wireframe and surfaces geometries

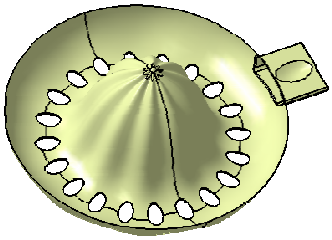
B. GSD + Part Design integrated: complete set of modeling capabilities to fully capture the design intent of what you want to do

The feature-based approach in GSD workbench offers a productive and intuitive design environment to capture and re-use design methodologies and specifications.%

## The Generative Shape Design Workbench (GSD)

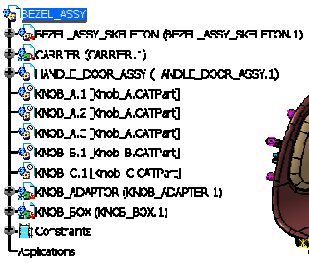
- **Comprehensive set of tools:**
  - → Basic wireframe and surface features
  - → Advanced mechanical surfaces

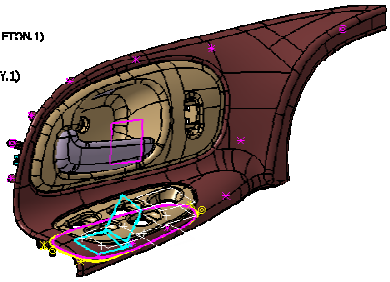


- **Easily handled workbench :**
  - → beginners quickly create simple features

- **Specifications captured in a tree:**
  - → Parent-children relationships created
  - → Geometry modifications
  - → Input replacement



**BEWARE**: Links creation = possibility to generate loops and to get lost in the model specifications



***Instructor Notes:***

$Speech:

Objective of the slide: Gives some characteristics of the workbench

As seen on the slide: GSD perfect to design the plastic parts

BUT not only: can be involved in all industries and goods type

Other characteristic:

- GSD offers complete set of tools to create mechanical surfaces and so is adapted to advanced shape designers

- But GSD remains easy to use :

  - because philosophy of the tools not very different from PDG tools  For those who come from part design: GSD is easy to handle

  - specifications of what you do is transparently captured during your work: feel like you are designing explicit shapes

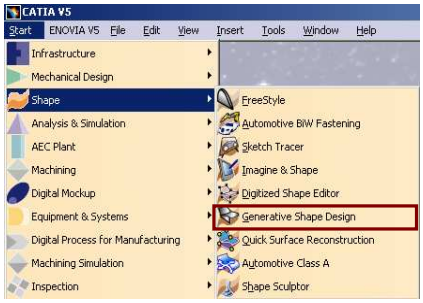
BUT: beware: GSD creates ASSOCIATIVE surfaces and curves

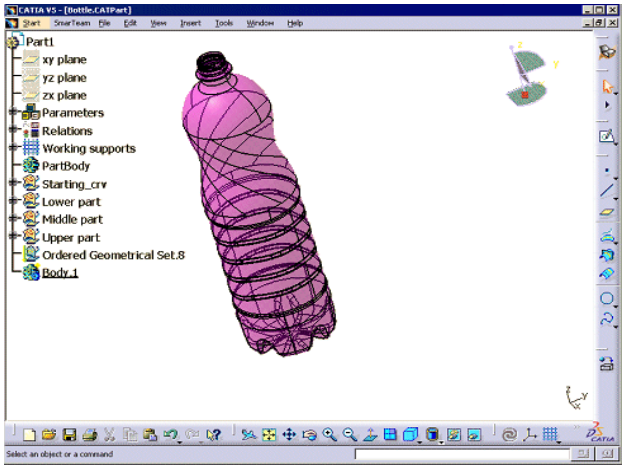
 Data organization very important to avoid loops

SO NOT TO FORGET: easy to create things in GSD but:

- Everything is captured  can lead to heavy models
  - can lead to unnecessary complicated data
  - tricky situations in the parent-children relationship inside the part%

## Generative Surface Design Access and Interface




**Accessing the Generative Shape Design Workbench**
**→Generative Shape Design Workbench Terminology**

**Let us discover the GSD interface (GSD_Interface.CATPart)**



***Instructor Notes:***

$Speech:

Now that we have quickly seen what the workbench is made for

We are going to see how to access it and we are going to briefly view its interface%

$Show:

Open the part

- About the tree: we see different containers

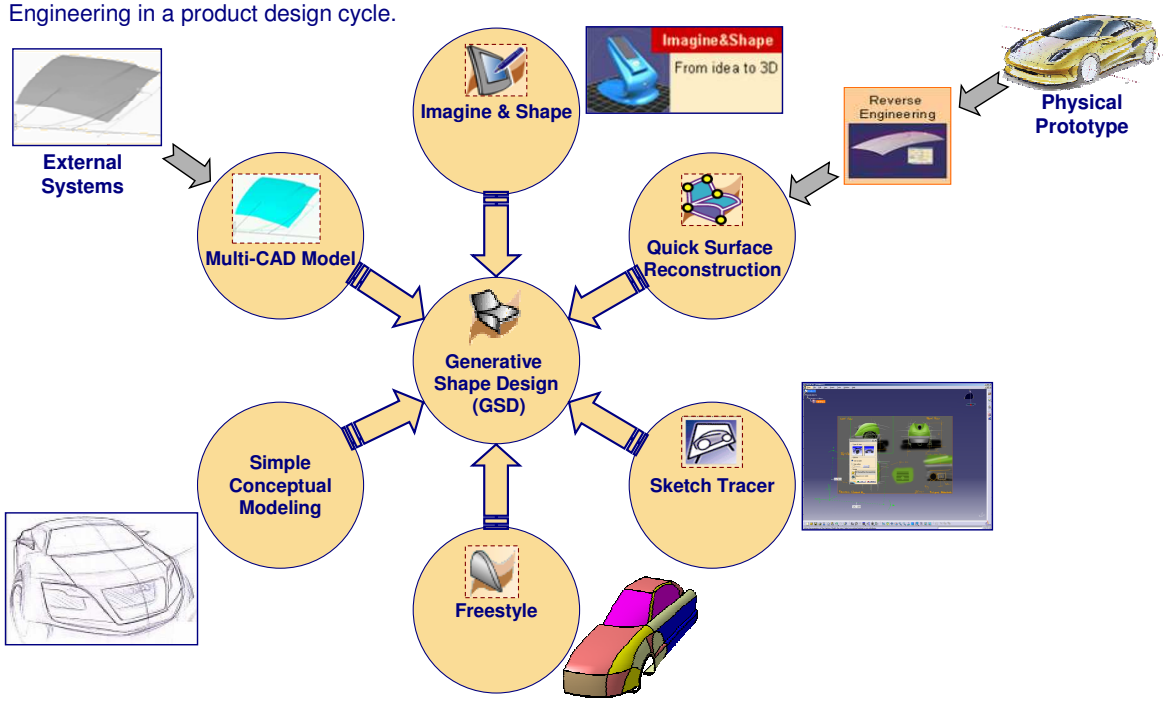
Explain that we will see this a little later in the lesson but briefly say that here we have what we call “geometrical sets”

- Talk about stacking commands (important in GSD) : demonstrate with simple entity creation

- Explain the toolbars%

## Surface Design Workbench General Process (1/2)

Generative Shape Design (GSD) plays an important role in the process of Forward and Reverse Engineering in a product design cycle.






***Instructor Notes:***

$Speech:

Explain that all the simple and complex shapes can be easily modeled in Generative shape design workbench. The workbench facilitates the design of shapes through the process of forward engineering or reverse engineering. GSD Workbench in combination with workbenches (dedicated for Forward and reverse engineering processes) can produce feature based and intuitive designs.

For example, the designer can quickly design a rough shape or concept in Imagine and Shape workbench and then shift to Generative shape design workbench to construct surfaces either by extracting or creating new associative surfaces.

The Input can be in the form a conceptual renderings from a stylist or a photograph, which can be placed in Freestyle workbench (FSK) workbench.

GSD and FSS workbench can be used to trace out all the curves in the photographs and surfaces can be generated.

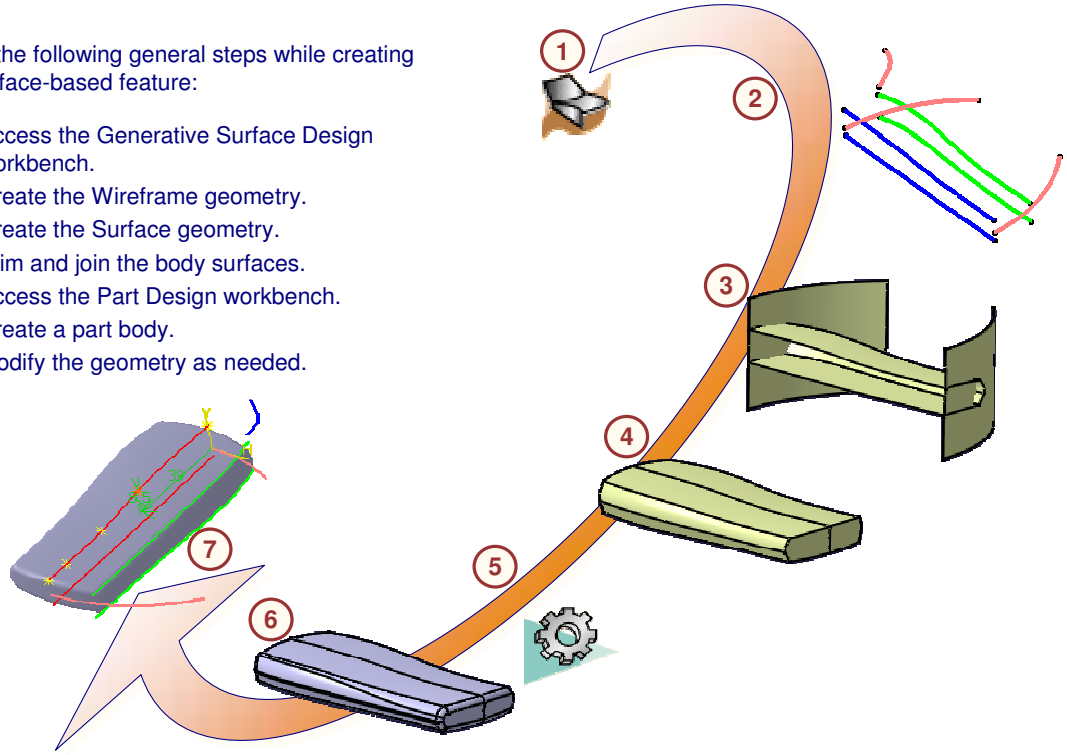
Or the Designer may get a reverse engineered data like scans, point cloud data by scanning a physical prototype, then the scanned data is analyzed in Quick surface reconstruction and Digitized shape editor and then GSD can be used to create associative surfaces.

Different companies may be involved in the development of a product which may be using different CAD platforms other than V5, in such cases designer can import this multi CAD data in V5 to construct surfaces in GSD.%

## Surface Design Workbench General Process (2/2)

Use the following general steps while creating a surface-based feature:

- Access the Generative Surface Design workbench.
- Create the Wireframe geometry.
- Create the Surface geometry.
- Trim and join the body surfaces.
- Access the Part Design workbench.
- Create a part body.
- Modify the geometry as needed.





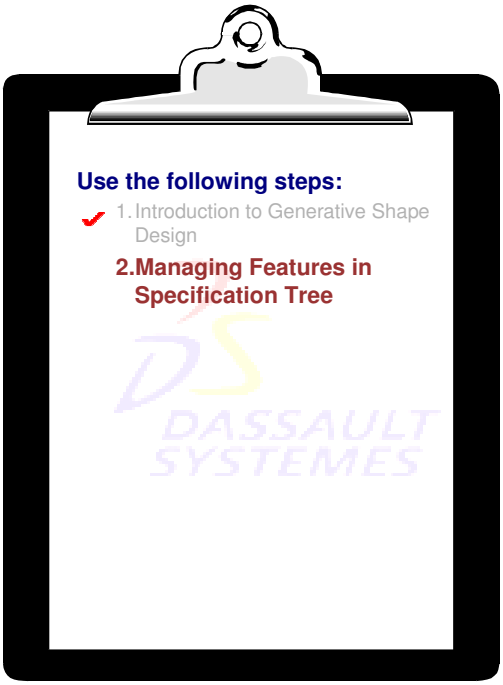

***Instructor Notes:***

$Speech:

Classical process that will be used during this course%

# Step 2: Managing Features in Specification Tree

*In this section, you will learn in detail about tools to manage features in GSD workbench.*






***Instructor Notes:***

$Speech:

Introduce the step%

## Managing Features and Geometrical Sets

As you build complex geometries, management of your model becomes important. A good structured model, with logical grouping of geometries gives a better understanding of the design process.

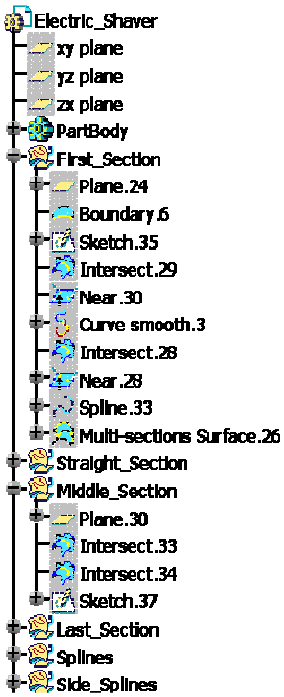
An organized model has the following advantages:

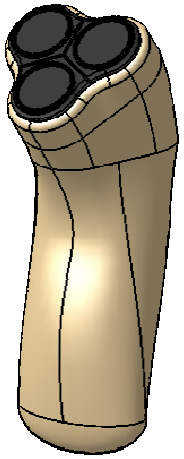
A. Related geometries are **clubbed together in (to) groups or sets**

B. Reduce the **size of the Specification tree**

C. It is **easier to reorder and replace** features

D. The root cause of the problem can be **easily identified**.





***Instructor Notes:***

$Speech:

Here we talk about the importance of managing the GSD containers:

- Complex geometry  Need to structure features in a logical way to be able to:

 Better understand the design process of the part: we have seen that the specifications were captured to be able to come back later on a parent feature: the better the model is organized, the easier it will be to find the right feature to manipulate and to understand the impacts of this manipulation

 Part readability by reducing tree size%

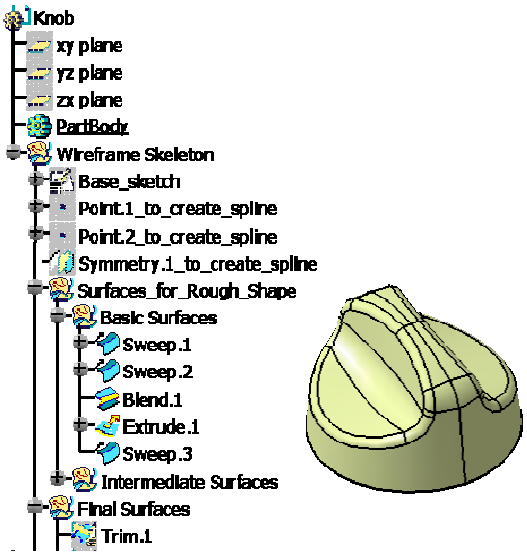
## Geometrical Sets

Geometrical set (GS): **default container** for wireframe and surface elements.

A. In a Geometrical Set, the **order is not important**

B. Geometrical Set enables to **organize** the specification tree

C. As **many Geometrical Sets** as needed can be added to the model.




**Let us discover the manipulations on geometrical sets (GSD_Interface.CATPart)**



***Instructor Notes:***

$Speech:

Here we see what is a geometrical set and how it behaves:

First: beware when you use a geometrical set because the features are not displayed according to the update logical order. It just “contains” features.

Some specificities of the GS:

A. You can put any surface element you wish in the geometrical set and they need not be in a structured logical way. The order of these elements is not important as their access and their visualization is managed independently without any rule.

SO: In a GS, a child feature can exist or can be reordered before the parent feature.

B. gather various features in a same set or sub-sets and organize the specification tree.

C. For example, one GS can be dedicated to contain only wireframes while the other can contain surfaces.%

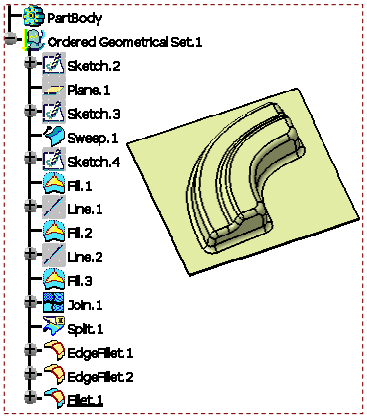
$Show:

Briefly Demonstrate that you can add many GS and that you can create GS in existing GS

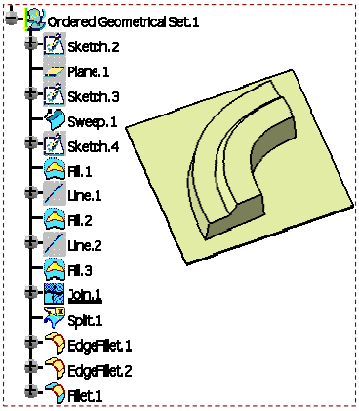
Demonstrate the manipulations that can be done on a GS (reorder, insert …) and say that more detail is available in the book%

## Ordered Geometrical sets

An Ordered Geometrical Set (OGS) is a Geometrical Set in which the **update order is taken into account to order the features.**




**Define in work object** is possible




**Let us discover the OGS behavior (OGS.CATPart)**



***Instructor Notes:***

$Speech:

Create geometry with history  features you create have parents  there's an update order in the geometries that are created with GSD.

In a OGS: the order of the features must respect this update order.

For instance: I cannot place a point before a plane in the tree if the point is placed on the plane because the plane is the parent of the point.

OGS are equivalent to part design bodies

And so (like in bodies): features can be defined in work object  OGS help understand the design process of a part

Another characteristic of the OGS:

Creation features create a new object in the tree and modification features create a new state in an existing object as well as absorb the preceding state(s).

Absorbed features are no longer visible nor accessible, as if "masked" by their absorbing feature. State that in the example above, Sweep.1 is used to create Join.1 gets absorbed in it. %

$Show:

Use part OGS with already created geometry and show the define in work object and also the impossibility to reorder as you want. Show the scan and what it does when you exit the scan (compare OGS and GS)%

## Geometrical Set Vs Ordered Geometrical Set

| Sr. No. | Geometrical Sets (GS) | Ordered Geometrical Sets (OGS) |
|---|---|---|
| 1 | Elements in this set can be shuffled irrespective of their sequence of creation. | Elements in this set maintain the linearity with respect to their order of creation. |
| 2 | The parent element in this set is not absorbed after any operation. Hence an element can be used & reused at different levels. | The parent in this set is absorbed after performing an operation and cannot be reused again. |
| 3 | Features in this set cannot be set as “in work object” | Any feature in this set can be set as “in work object” and the features located after it are neither accessible nor visible. |
| 4 | Maintains better flexibility. | Maintains better linearity for understanding the design flow. |
| 5 | Geometrical Sets cannot be converted to Ordered Geometrical Sets. | Ordered Geometrical Sets can be converted to Geometrical sets. |
| 6 | Two or more features can be grouped to form a “Grouped Geometrical Set”. | Ordered Geometrical Sets cannot be grouped. |

It is recommended to use OGS when you want to maintain linearity in your model.

Use Geometrical Sets if you want to design a model with the existing surfaces.



***Instructor Notes:***

$Speech:

To recap what we have seen and what you have manipulated in the previous exercise

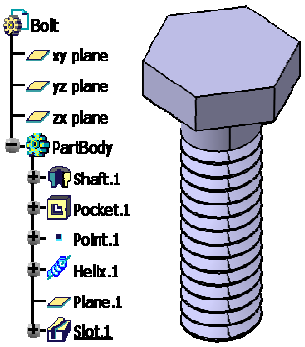
OGS helps to maintain parent children relationships, but prevents re-using creation features

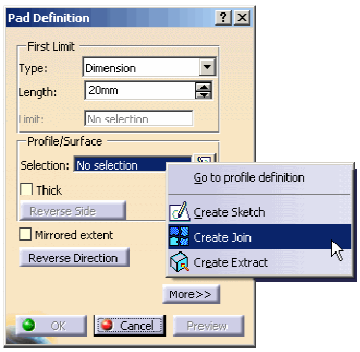
You can reorder the features in the OGS only by respecting parent child relations

GS helps to re-use creation features but scanning of the part is not possible. %

# Hybrid Design

Hybrid Design provides you with a high degree of flexibility while structuring the design.




**Generative Shape Design (GSD) features available in the part design stacking commands**

**Hybrid**: **Wireframe/surface features integration in update cycle of the body:**
→ Better understanding of the part
→ Useful when the design is a close mix of both solids and surfaces

**Non Hybrid**: **Allows you to efficiently sort out the solid:**
→ Useful when the surfaces and wireframe are a preliminary design to the solid but are not integrated to the solid conception
→ Allows you to efficiently manipulate (hide/show) objects which are not solid, and that too with less number of clicks.



***Instructor Notes:***

$Speech:

Explain to students that they have the possibility to mix solid and ordered surfaces features if they choose to work in hybrid mode in GSD.

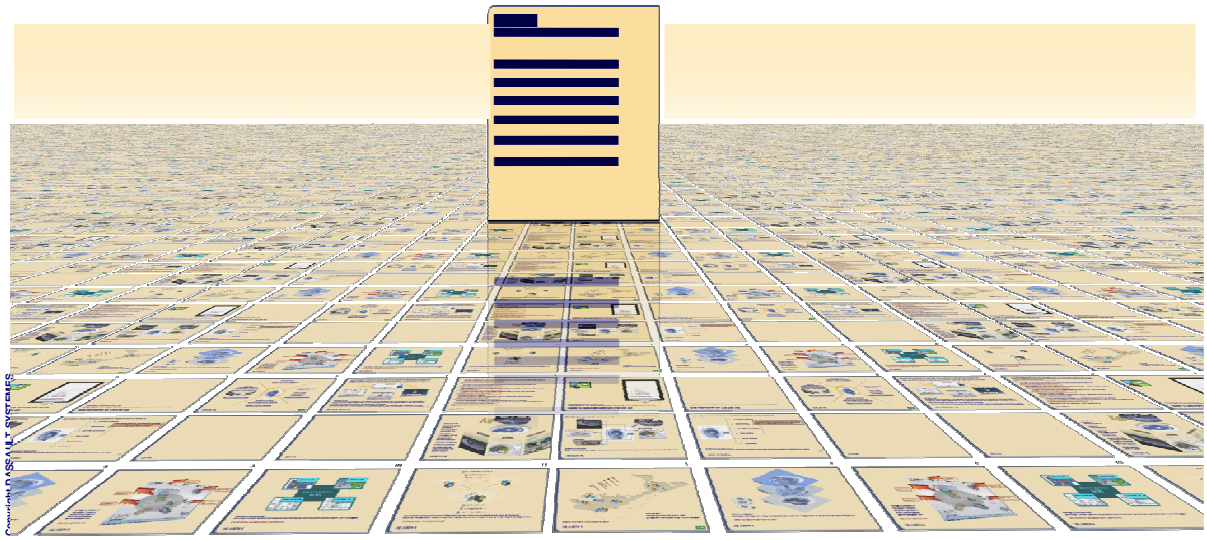
HYBRID CONTAINER:

- the bodies ARE by default the containers that will welcome the solids and the surfaces (as seen on the picture).

- the container can be an OGS if you insert it at startup the OGS is then inserted in the body (not possible if non hybrid mode)%

## To Sum Up

In the following slides you will find a summary of the topics covered in this lesson.



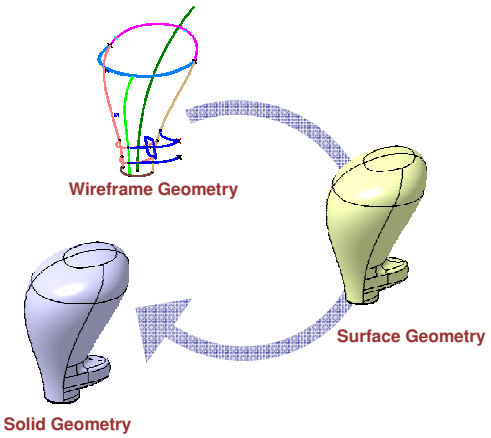
***Instructor Notes:***

## Introduction to Generative Shape Design

Generative Shape Design workbench allows you to define models with complex shapes using wireframe and surface geometry. Surface geometry may be integrated into the solid model to capture its design intent.

Use the following general steps while creating a surface-based feature:

- ✓ Access the Generative Surface Design workbench.
- ✓ Create the Wireframe geometry.
- ✓ Create the Surface geometry.
- ✓ Trim and join the body surfaces.
- ✓ Access the Part Design workbench.
- ✓ Create a part body.
- ✓ Modify the geometry as needed.





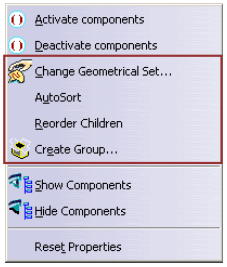

***Instructor Notes:***

## Managing Features in Specification Tree

In complex models, features must be structured in a logical way. It helps in better understanding of the designing process and reduction in tree size. Structuring can be done using a Geometrical Set or an Ordered Geometrical Set.

Geometrical Set (GS): This is a default container for wireframe and surface elements. The features are not displayed according to the logical update order.

Ordered Geometrical Set (OGS): It takes into account the update order of the features. OGS are equivalent to part design bodies.




Commonly used Feature Management Tools



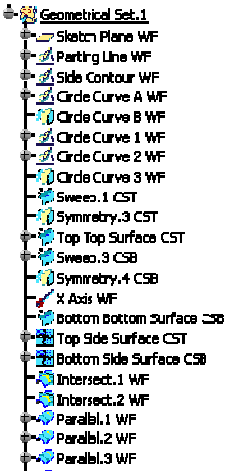
***Instructor Notes:***

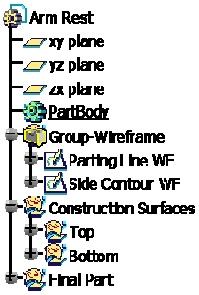
# Exercises Overview 1A and 1B

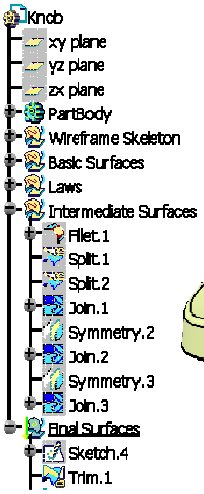
*Recap Exercise / Case Study*

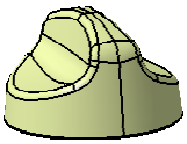
*Exercise 1A*

***You will practice what you have learned by working on two exercises***



**Exercise 1B**



***Instructor Notes:***

$Speech:

Present the exercise

Have the students begin the exercise and note the time

Assist students as needed with the exercise

1A: reorganize a tree

1B: see the characteristics of Ordered Geometrical Sets, see the consequence of using hybrid mode

Students have 15 minutes%

## Case Study: Introduction to Generative Shape Design

***In this exercise, you will practice feature management in the specification tree and see how to reorganize the specification tree when it becomes too complex or too long.***

- ✓ Open the given part consisting of the 'Air Craft' model in the **Generative Shape Design** Workbench.
- ✓ Get familiar with the user interface.
- ✓ Study the *Surface, Wireframe and Operations.*
- ✓ Create separate containers for Surfaces, Wireframes and Operations for different parts of the Aircraft..
- ✓ Finally Group the features from each Geometrical Set ( which are often referred in the model ), thus minimizing the tree length.

***Using the techniques you have learned in this lesson and previous exercises, create the model without detailed instruction.***



***Instructor Notes:***

$Speech:

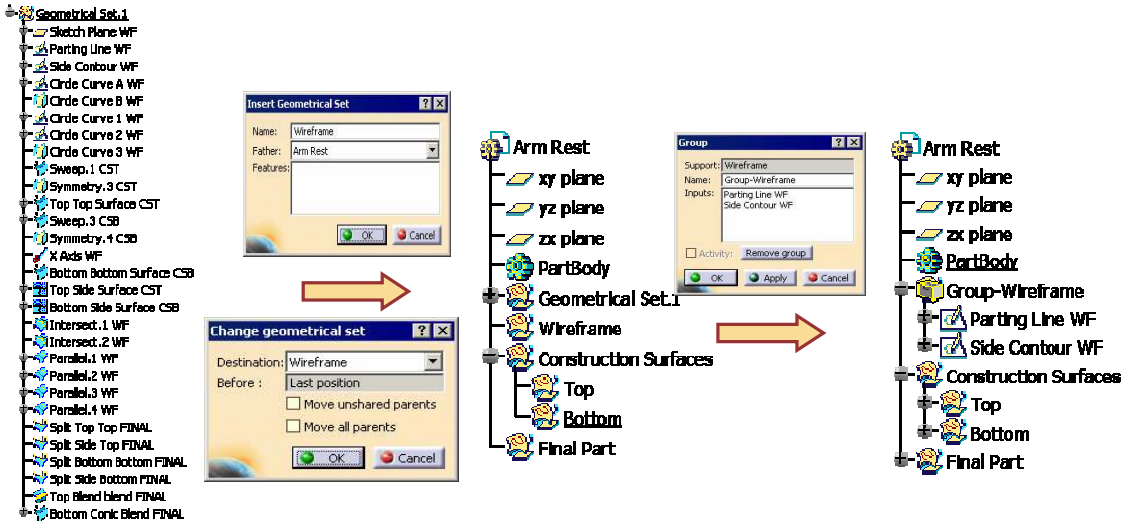
Present the recap exercise.

The same manipulations as before are done except that now, you have less instructions and the organization that you give to the part will depend on your study of the data.

They have 30 minutes to do this.%

## Exercise 1A: Recap

- ✓ Scan the Geometrical sets
- ✓ Group features into different geometrical sets
- ✓ Create a Group of Geometrical sets






***Instructor Notes:***

$Speech:

Review the Exercise Recap slides after the students have attempted the exercises. Try to encourage group discussion on the exercises they have just completed.

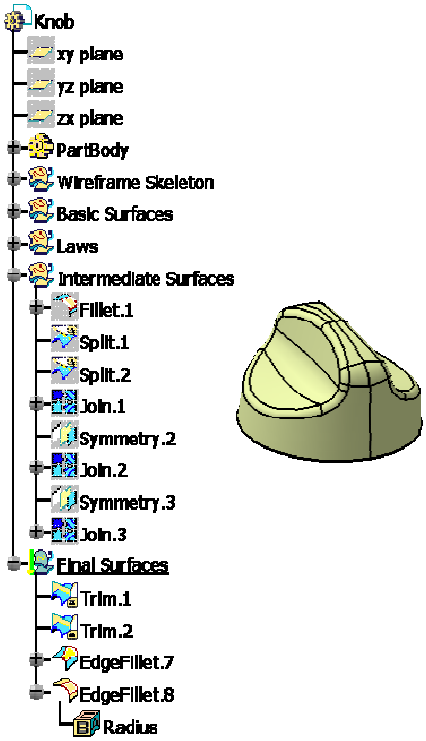
Discuss the different tools used.%

$Ask:

Ask if there are any questions about this exercise, any difficulties?%

## Exercise 1B: Recap

- ✓ Understand the behavior of OGS and GS when implied with reorder command.
- ✓ Understand the Parent/Child structure under a Hybrid design environment.






***Instructor Notes:***

$Speech:

Review the Exercise Recap slides after the students have attempted the exercises. Try to encourage group discussion on the exercises they have just completed.

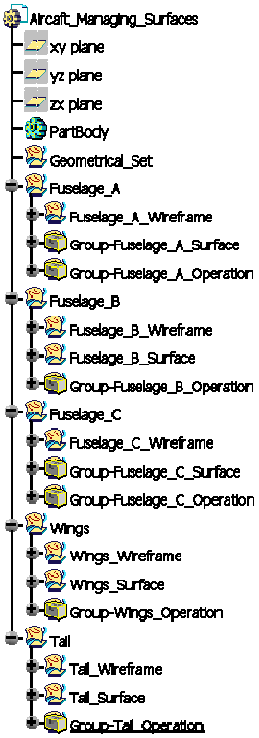
Discuss the different tools used.%

$Ask:

Ask if there are any questions about this exercise, any difficulties?%

## Case Study: Introduction to GSD Recap

- ✓ Open the given part consisting of the 'Air Craft' model in the Generative Shape Design Workbench.
- ✓ Get familiar with the user interface.
- ✓ Study the Surface, Wireframe and Operations.
- ✓ Create separate containers for Surfaces, Wireframes and Operations for different parts of the Aircraft..
- ✓ Finally Group the features from each Geometrical Set ( which are often referred in the model ), thus minimizing the tree length.






***Instructor Notes:***

$Speech:

Recap what has been seen in the lesson:

Now they should be familiar with the GSD interface and containers.

By now, you have the tools to organize the GSD data correctly and you have the keys to be able to choose between the different working modes that are proposed (GS, OGS, Hybrid or not)

Next lesson: now we can go on and begin to learn how to create geometry%