University of Victoria

EcoCAR Team

University of Victoria
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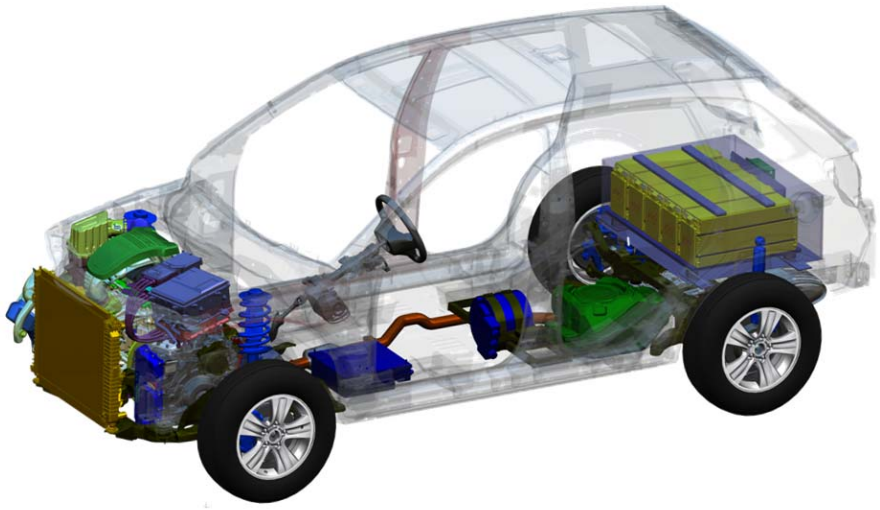
Unigraphics NX 6 Tips and Recommended EcoCAR CAD Procedures



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August 3, 2009

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PREAMBLE

This document is not intended to be a complete reference to the usage of Unigraphics NX 6.0 as it pertains to the UVic EcoCAR team CAD modelling activities. It is also not meant as a replacement to collaboration with experienced team members regarding component design procedures and strategies.

Review of this document is intended to provide an introductory insight into several of the tools in NX 6.0 that have been key to work carried out by the UVic EcoCAR team. This insight has been gained through the practical experience of EcoCAR mechanical team members through the first year of the competition. It is also intended to establish some basic document stewardship practices and standards to be employed in years 2 and 3 of the competition to correct some of the logistical problems that the team has run into during year 1.

New team members are encouraged to seek out additional training material on the usage of NX 6.0 in order to become fully competent in the use of the software for modelling and assembly. This document may be added to as new practices are discovered and developed.

1 BACKGROUND AND CURRENT ECOCAR CAD ACTIVITIES

The University of Victoria EcoCAR team utilizes many cutting edge technologies to conduct a real-world redesign of a production vehicle. Work is conducted in a collaborative manner, and many members may be working on a given portion of the project at once. Team procedures are currently employed for document stewardship regarding many of the files used by the team.

One area of the project which has experienced great challenge in document stewardship and consistency is the mechanical design team. Design of new mechanical components for vehicle integration activities involves utilization of an extensive CAD assembly built in Unigraphics NX 6.0. The assembly was provided by General Motors and is a nearly complete assembly model representing the Saturn Vue SUV.

1.1 CAD Models and Parts Table

General Motors provided the CAD models for the Saturn Vue in the form of a single folder of files organized in a 9 level parts tree (numbered 0-8) and containing over 3,000 parts. The parts are located by a global positioning value including X, Y, and Z Cartesian relative positions. Standard assembly parts are not constrained to each other (mated), and as such are completely moveable. The master assembly file name is AKW72624.

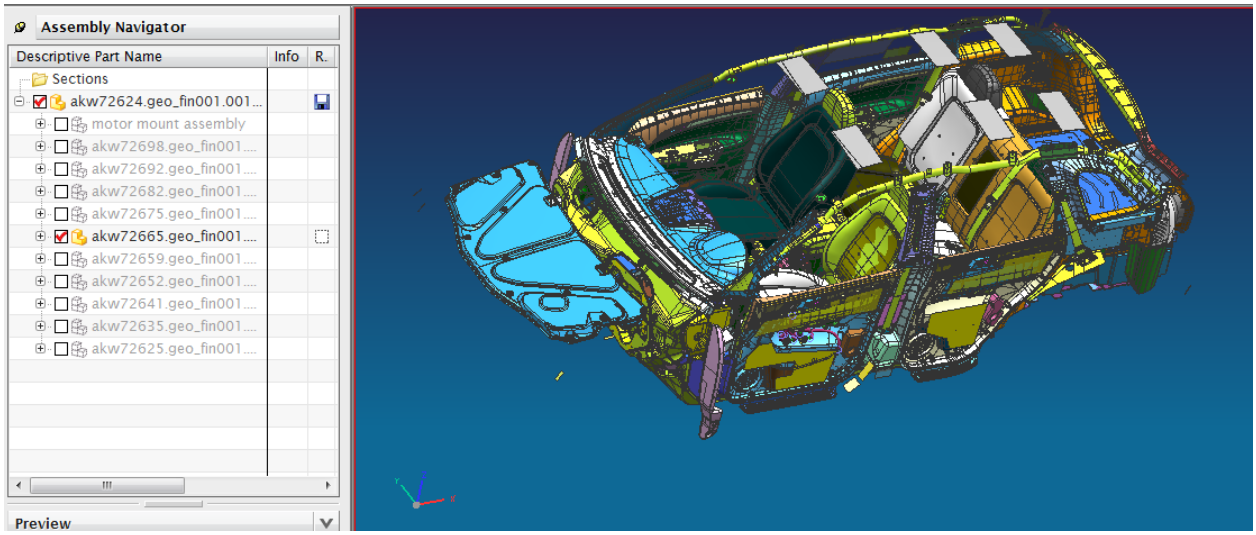
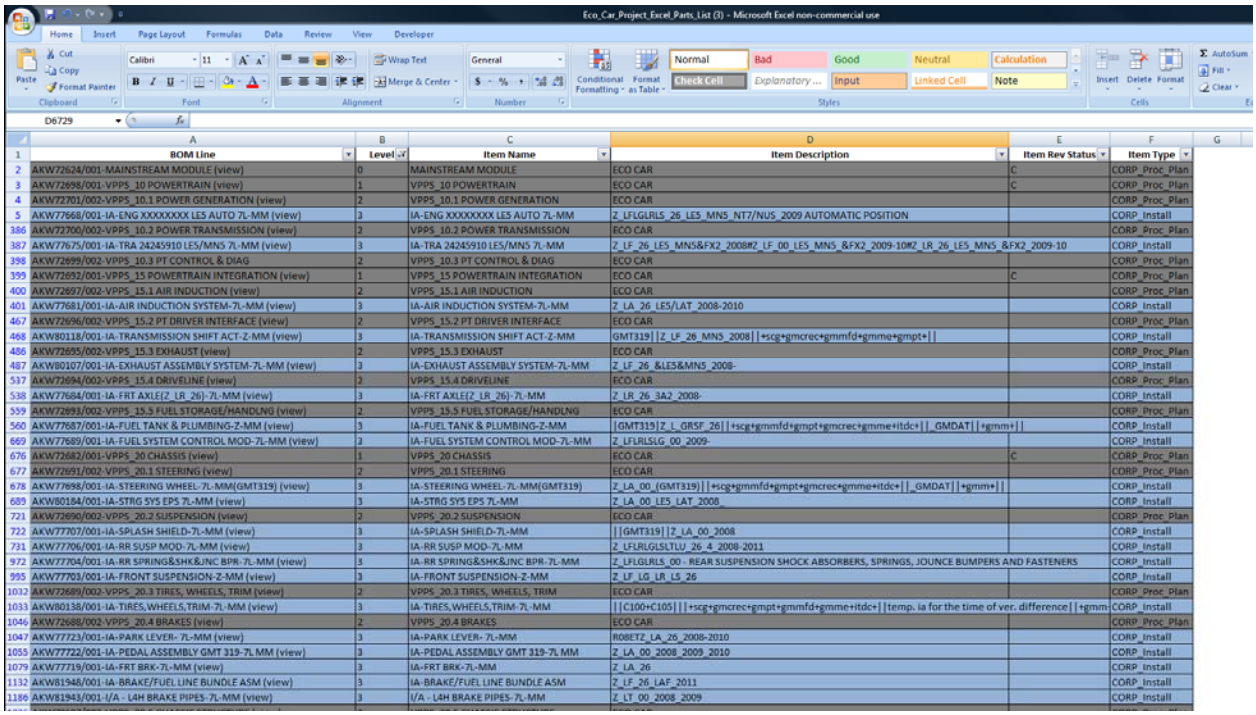


Figure 1 – Saturn Vue Interior in Assembly Tree

Components are numbered using a standardized code. All parts are catalogued in the master parts list excel table. Each assembly level is available in a drop down filter at the top of the second column.



	A	B	C	D	E	F	G
1	BOM Line	Level	Item Name	Item Description	Item Rev Status	Item Type	
2	AKW72624/001-MAINSTREAM MODULE (view)	0	MAINSTREAM MODULE	ECO CAR	C	CORP_Proc_Plan	
3	AKW72698/001-VPPS_10 POWERTRAIN (view)	1	VPPS_10 POWERTRAIN	ECO CAR	C	CORP_Proc_Plan	
4	AKW72701/002-VPPS_10.1 POWER GENERATION (view)	2	VPPS_10.1 POWER GENERATION	ECO CAR		CORP_Proc_Plan	
5	AKW77668/001-IA-ENG XXXXXXXX LE5 AUTO 7L-MM (view)	3	IA-ENG XXXXXXXX LE5 AUTO 7L-MM	Z_LFLGLRLS_26_LE5_MN5_NT7/NU5_2009 AUTOMATIC POSITION		CORP_Install	
186	AKW72700/002-VPPS_10.2 POWER TRANSMISSION (view)	2	VPPS_10.2 POWER TRANSMISSION	ECO CAR		CORP_Proc_Plan	
387	AKW77675/001-IA-TRA 24245910 LE5/MN5 7L-MM (view)	3	IA-TRA 24245910 LE5/MN5 7L-MM	Z_LF_26_LE5_MN5&FX2_2008#Z_LF_00_LE5_MN5_&FX2_2009-10#Z_LR_26_LE5_MN5_&FX2_2009-10		CORP_Install	
398	AKW72699/002-VPPS_10.3 PT CONTROL & DIAG	2	VPPS_10.3 PT CONTROL & DIAG	ECO CAR		CORP_Proc_Plan	
399	AKW72692/001-VPPS_15 POWERTRAIN INTEGRATION (view)	1	VPPS_15 POWERTRAIN INTEGRATION	ECO CAR	C	CORP_Proc_Plan	
400	AKW72697/002-VPPS_15.1 AIR INDUCTION (view)	2	VPPS_15.1 AIR INDUCTION	ECO CAR		CORP_Proc_Plan	
401	AKW77681/001-IA-AIR INDUCTION SYSTEM-7L-MM (view)	3	IA-AIR INDUCTION SYSTEM-7L-MM	Z_LA_26_LE5/LAT_2008-2010		CORP_Install	
467	AKW72696/002-VPPS_15.2 PT DRIVER INTERFACE (view)	2	VPPS_15.2 PT DRIVER INTERFACE	ECO CAR		CORP_Proc_Plan	
468	AKW80118/001-IA-TRANSMISSION SHIFT ACT-Z-MM (view)	3	IA-TRANSMISSION SHIFT ACT-Z-MM	GMT319||Z_LF_26_MN5_2008||+scg+gmcrec+gmmfd+gmme+gmpt+||		CORP_Install	
486	AKW72695/002-VPPS_15.3 EXHAUST (view)	2	VPPS_15.3 EXHAUST	ECO CAR		CORP_Proc_Plan	
487	AKW80107/001-IA-EXHAUST ASSEMBLY SYSTEM-7L-MM (view)	3	IA-EXHAUST ASSEMBLY SYSTEM-7L-MM	Z_LF_26_&LE5&MN5_2008-		CORP_Install	
537	AKW72694/002-VPPS_15.4 DRIVELINE (view)	2	VPPS_15.4 DRIVELINE	ECO CAR		CORP_Proc_Plan	
538	AKW77684/001-IA-FRT AXLE(Z_LR_26)-7L-MM (view)	3	IA-FRT AXLE(Z_LR_26)-7L-MM	Z_LR_26_3A2_2008-		CORP_Install	
559	AKW72693/002-VPPS_15.5 FUEL STORAGE/HANDLNG (view)	2	VPPS_15.5 FUEL STORAGE/HANDLNG	ECO CAR		CORP_Proc_Plan	
560	AKW77687/001-IA-FUEL TANK & PLUMBING-Z-MM (view)	3	IA-FUEL TANK & PLUMBING-Z-MM	|GMT319|Z_L_GR5F_26||+scg+gmmfd+gmpt+gmcrec+gmme+itdc+||_GMDAT||+gmm+||		CORP_Install	
669	AKW77689/001-IA-FUEL SYSTEM CONTROL MOD-7L-MM (view)	3	IA-FUEL SYSTEM CONTROL MOD-7L-MM	Z_LFLRLSLG_00_2009-		CORP_Install	
676	AKW72682/001-VPPS_20 CHASSIS (view)	1	VPPS_20 CHASSIS	ECO CAR	C	CORP_Proc_Plan	
677	AKW72691/002-VPPS_20.1 STEERING (view)	2	VPPS_20.1 STEERING	ECO CAR		CORP_Proc_Plan	
678	AKW77698/001-IA-STEERING WHEEL-7L-MM(GMT319) (view)	3	IA-STEERING WHEEL-7L-MM(GMT319)	Z_LA_00_(GMT319)||+scg+gmmfd+gmpt+gmcrec+gmme+itdc+||_GMDAT||+gmm+||		CORP_Install	
689	AKW80184/001-IA-STRG SYS EPS 7L-MM (view)	3	IA-STRG SYS EPS 7L-MM	Z_LA_00_LE5_LAT_2008_		CORP_Install	
721	AKW72690/002-VPPS_20.2 SUSPENSION (view)	2	VPPS_20.2 SUSPENSION	ECO CAR		CORP_Proc_Plan	
722	AKW77707/001-IA-SPLASH SHIELD-7L-MM (view)	3	IA-SPLASH SHIELD-7L-MM	||GMT319||Z_LA_00_2008		CORP_Install	
731	AKW77706/001-IA-RR SUSP MOD-7L-MM (view)	3	IA-RR SUSP MOD-7L-MM	Z_LFLRLGL5LTLU_26_4_2008-2011		CORP_Install	
972	AKW77704/001-IA-RR SPRING&SHK&JNC BPR-7L-MM (view)	3	IA-RR SPRING&SHK&JNC BPR-7L-MM	Z_LFLGLRLS_00 - REAR SUSPENSION SHOCK ABSORBERS, SPRINGS, JOUNCE BUMPERS AND FASTENERS		CORP_Install	
995	AKW77703/001-IA-FRONT SUSPENSION-Z-MM (view)	3	IA-FRONT SUSPENSION-Z-MM	Z_LF_LG_LR_LS_26		CORP_Install	
1032	AKW72689/002-VPPS_20.3 TIRES, WHEELS, TRIM (view)	2	VPPS_20.3 TIRES, WHEELS, TRIM	ECO CAR		CORP_Proc_Plan	
1033	AKW80138/001-IA-TIRES,WHEELS,TRIM-7L-MM (view)	3	IA-TIRES,WHEELS,TRIM-7L-MM	||C100+C105|||+scg+gmcrec+gmpt+gmmfd+gmme+itdc+||temp. ia for the time of ver. difference||+gmm+		CORP_Install	
1046	AKW72688/002-VPPS_20.4 BRAKES (view)	2	VPPS_20.4 BRAKES	ECO CAR		CORP_Proc_Plan	
1047	AKW77723/001-IA-PARK LEVER- 7L-MM (view)	3	IA-PARK LEVER- 7L-MM	ROBETZ_LA_26_2008-2010		CORP_Install	
1055	AKW77722/001-IA-PEDAL ASSEMBLY GMT 319-7L MM (view)	3	IA-PEDAL ASSEMBLY GMT 319-7L MM	Z_LA_00_2008_2009_2010		CORP_Install	
1079	AKW77719/001-IA-FRT BRK-7L-MM (view)	3	IA-FRT BRK-7L-MM	Z_LA_26		CORP_Install	
1132	AKW81948/001-IA-BRAKE/FUEL LINE BUNDLE ASM (view)	3	IA-BRAKE/FUEL LINE BUNDLE ASM	Z_LF_26_LAF_2011		CORP_Install	
1186	AKW81943/001-I/A - L4H BRAKE PIPES-7L-MM (view)	3	I/A - L4H BRAKE PIPES-7L-MM	Z_LT_00_2008_2009		CORP_Install	

Figure 2 – Master Parts List

2 USEFUL NX TOOLS AND PRACTICES

2.1 Finding Components in the Master Assembly

While not important for the internal file naming practices, knowing how to find specific parts in the master assembly tree is important if one wishes to modify existing components or find particular assembly blocks. The following provides an example of how to find a component group within the master assembly.

Example: Finding the Rear Seats within the Master Assembly

Step 1 → Find the level 1 assembly that the component belongs to. In this case, we are looking at interior components. We know the part is under AKW72665

BOM Line	Level	Item Name
AKW72624/001-MAINSTREAM MODULE (view)	0	MAINSTREAM MODULE
AKW72698/001-VPPS_10 POWERTRAIN (view)	1	VPPS_10 POWERTRAIN
AKW72692/001-VPPS_15 POWERTRAIN INTEGRATION (view)	1	VPPS_15 POWERTRAIN INTEGRATION
AKW72682/001-VPPS_20 CHASSIS (view)	1	VPPS_20 CHASSIS
AKW72675/001-VPPS_30 HVAC & PT COOLING (view)	1	VPPS_30 HVAC & PT COOLING
AKW72665/001-VPPS_40 INTERIOR (view)	1	VPPS_40 INTERIOR
AKW72659/001-VPPS_50 BODY STRUCTURE (view)	1	VPPS_50 BODY STRUCTURE
AKW72652/001-VPPS_55 BODY CLOSURES (view)	1	VPPS_55 BODY CLOSURES
AKW72641/001-VPPS_60 EXTERIOR (view)	1	VPPS_60 EXTERIOR
AKW72635/001-VPPS_70 INFORMATION & CONTROLS (view)	1	VPPS_70 INFORMATION & CONTROLS
AKW72625/001-VPPS_80 ELECTRICAL FUNCTION (view)	1	VPPS_80 ELECTRICAL FUNCTION

Figure 3 – Master Parts List Tiers 2 and Above Filtered

Step 2 → Continue down the tiers until particular component is located.

AKW72665/001-VPPS_40 INTERIOR (view)	1	VPPS_40 INTERIOR
AKW72673/002-VPPS_40.1 INSTRUMNTPNL/CONSOLE (view)	2	VPPS_40.1 INSTRUMNTPNL/CONSOLE
AKW78065/001-IA-FLOOR CONSOLE-Z-MM (view)	3	IA-FLOOR CONSOLE-Z-MM
AKW78197/001-IA-INSTRUMENT PNL-7L-MM (view)	3	IA-INSTRUMENT PNL-7L-MM
AKW72672/002-VPPS_40.2 SEATS (view)	2	VPPS_40.2 SEATS
AKW78199/001-IA-FRONT SEAT-7L-MM (view)	3	IA-FRONT SEAT-7L-MM
AKW78201/001-IA-SECOND ROW SEAT-Z-MM (view)	3	IA-SECOND ROW SEAT-Z-MM
AKW72671/002-VPPS_40.3 INTERIOR TRIM (view)	2	VPPS_40.3 INTERIOR TRIM
AKW78205/001-IA-FLOOR TRIM-Z-MM (view)	3	IA-FLOOR TRIM-Z-MM
AKW78355/001-IA-REAR DOOR TRIM-Z-MM (view)	3	IA-REAR DOOR TRIM-Z-MM

Figure 4 – Master Parts List Tiers 4 and Above Filtered

We can see that the second row seats are located under:

- Tier 1 – AKW72665 (interior)
- Tier 2 – AKW72672 (seats)
- Tier 3 – AKW78201 (second row seats)

Step 3 → Access the component within the CAD master file (AKW72624).

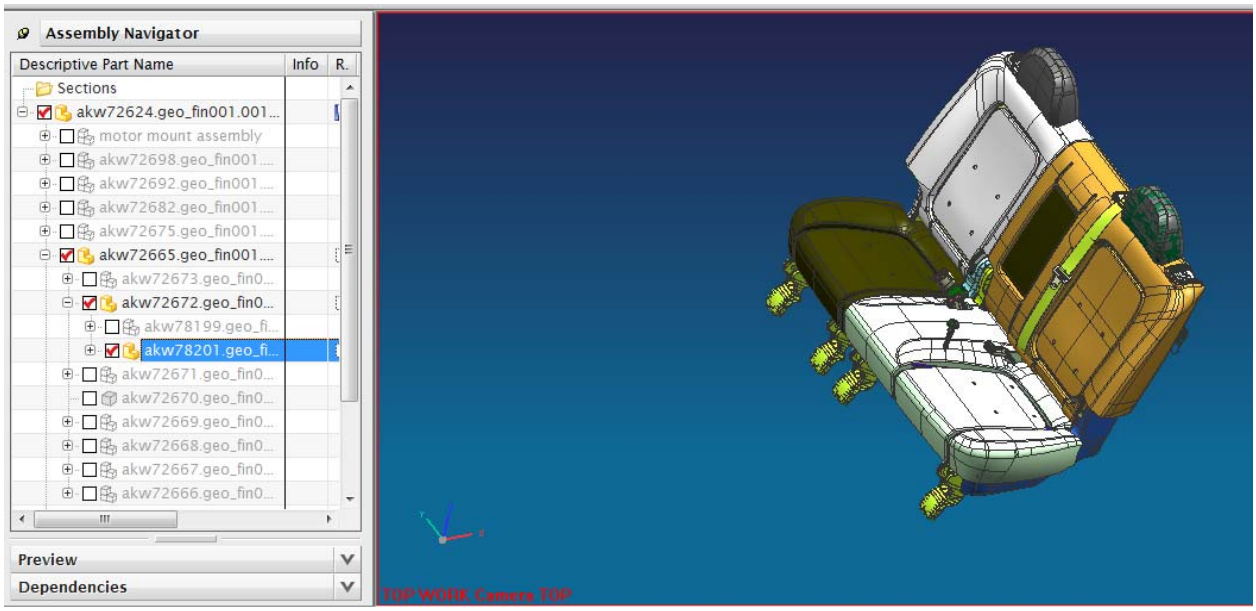


Figure 5 – Rear Seats Opened within Master CAD file.

Finding specific components within the main CAD file is not difficult with the use of the master parts table. Opening the component assembly file in question directly will also gain access to the desired part, but other components will not be accessible without opening individually.

2.2 Working with Very Large Assemblies

The number of components within the Saturn Vue CAD model package is very large, and this makes it unrealistic from a computing performance perspective to open the entire vehicle at once. In addition to being a hindrance to computer stability, it also quite often causes a full crash of NX 6 when such massive assemblies are opened at once.

To maintain smooth computer performance, it is recommended that only components which are required for the purposes of the work being done are opened at any given time. Work can still be done from the master assembly file if the following procedure is carried out:

Example: Opening an Assembly Without Opening Internal Components

Step 1 → Open Unigraphics NX 6
Step 2 → Open the master assembly file from within NX.
Step 3 → Check the "Do Not Load Components" checkbox.

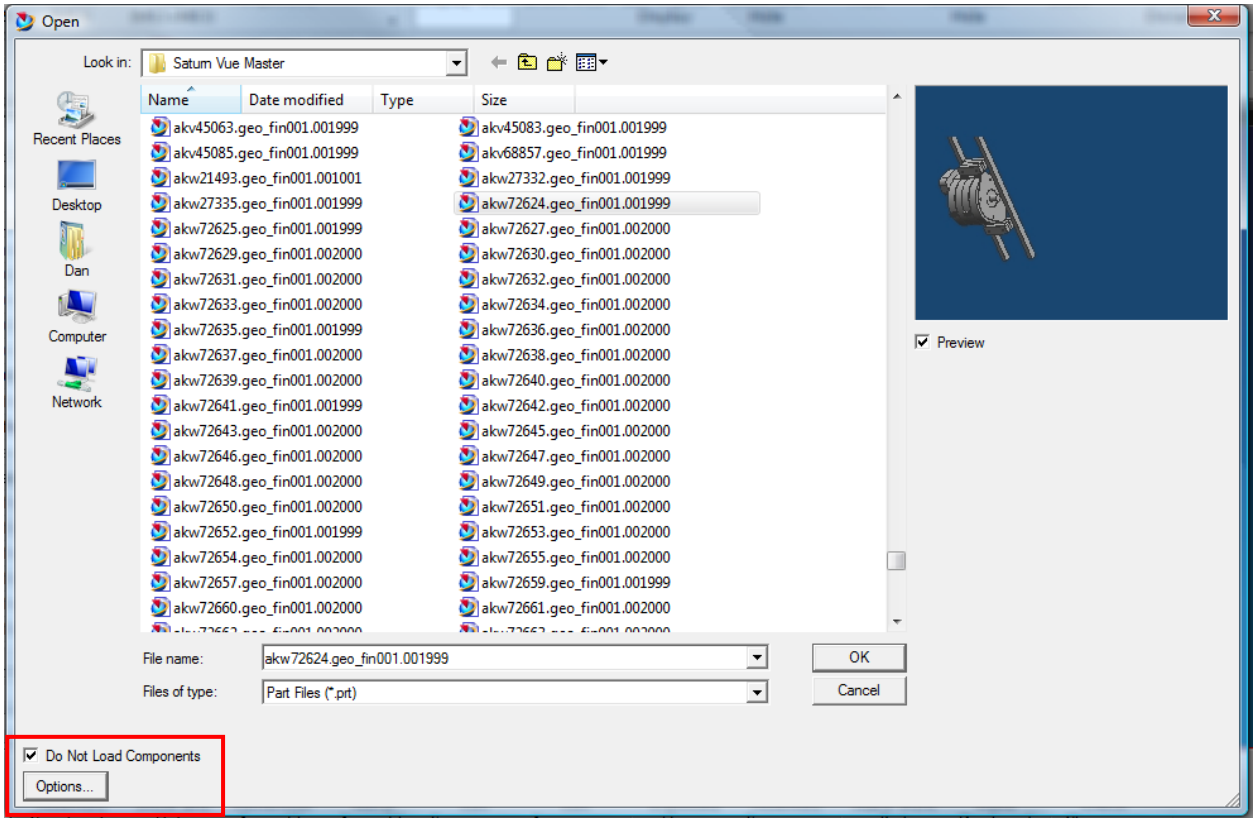


Figure 6 – Open Dialogue NX 6.0

It is important that file assemblies are not opened directly from windows, as all components within the assembly will load immediately, and may cause system crash.

Sometimes it is necessary to have components open from many different assemblies at once, and finding each component in question individually is not practical. Such is the case when working envelopes are required for generation of a new component within a tight space where many other components are present. In this case, we can avoid opening a large amount of the car by using the "open by proximity" command:

Example: Opening by Proximity

Step 1 → Select Central Component
Step 2 → Right Click on Central Component and Select "Open by Proximity"

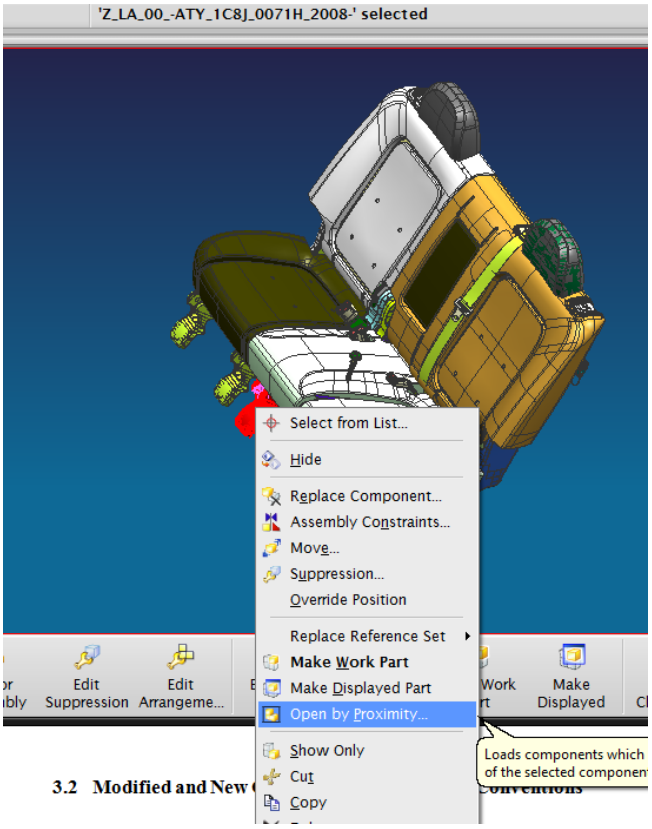


Figure 7 – Open by Proximity

Step 3 → Choose Range

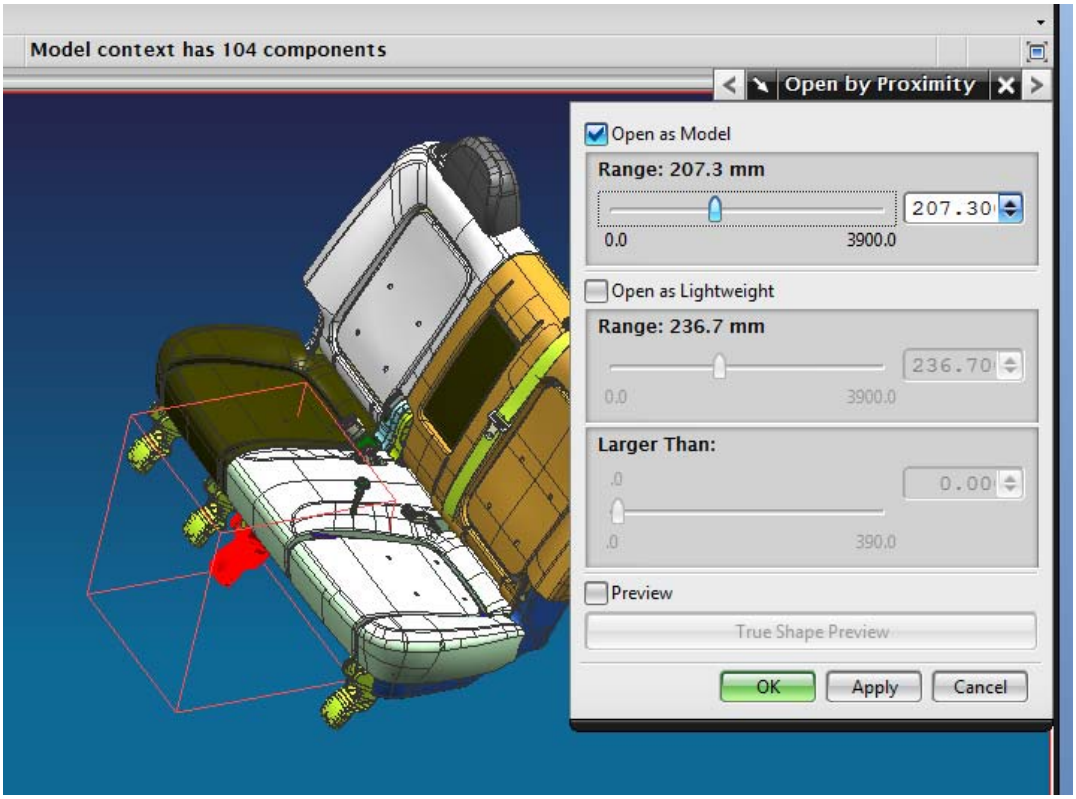


Figure 8 – Selecting Proximity Range

The dialogue box that appears has a slider to adjust the proximity range. A red wireframe box can be seen in the modelling window showing a visualization of the volume in question. Pressing okay will open all components that occupy space within the wireframe box range indicated. An indication of how many components will be open for the given range is noted above. It is recommended for best performance that this number be kept under 400 items.

2.3 Working Remotely

The master working assembly file for the EcoCAR team is contained on the primary CAD station computer. When work on more than an individual component at a time is required, this is the logical place to carry out the tasks. When more than one individual requires access to a collection of components, work can be conducted remotely if proper procedure is followed.

A complete copy of the working CAD file folder with every component included should be possessed by any team member seeking to complete substantial CAD work remotely. It is important that work be done on a copy of the working model whenever possible to prevent any conflicts with other work being completed from causing problems upon integration.

Work can be completed on the copied working files as require. Once complete, the changes can be re-integrated into the original master assembly by simply copying all files that have been modified into the original master folder, replacing the old files. The modifications can be tracked by simply sorting by date modified within Windows.

It is important that only files pertinent to the modifications be copied into the master work folder to prevent loss of other work. Components should only be replaced as far up in the parts tree as is required. For example, if new parts are added to a tier 4 assembly, and existing parts within that assembly are modified, only that assembly, and the parts within that have been altered need to be replaced within the master file. The tier 3 assembly that contains the altered tier 4 assembly should not be copied. So long as the highest level assembly being copied has not had its name changed, and all modified files under it are copied as well, higher level assemblies will automatically update when opened next. Positions within the assembly will remain accurate as a result of the global position references used within the Saturn Vue CAD assembly.

2.4 Tools for Checking Component Fit and Interferences

A major portion of the time spent on CAD modeling within the EcoCAR team is utilized determining whether or not components will fit, mate properly, or interfere. There are several tools in particular that aid in these processes:

- Assembly Constraints
- Move Component
- Clip Work Section

Assembly Constraints

Assembly constraints make up the formal tool for mating components within assemblies in NX 6. The stock Saturn Vue CAD part files are not mated using assembly constraints, but when working on small assemblies of EcoCAR components that will be added to the vehicle, it is sometimes useful to mate components to ensure they can be put together properly.

Using assembly constraints is simple. When the assemblies interface is activated, an icon exists on the assemblies toolbar. Pressing it will activate a dialogue box from which the user can select components to be mated, and parameters of the constraint. Options such as align, concentric, center, and tangent are offered under the drop down options.

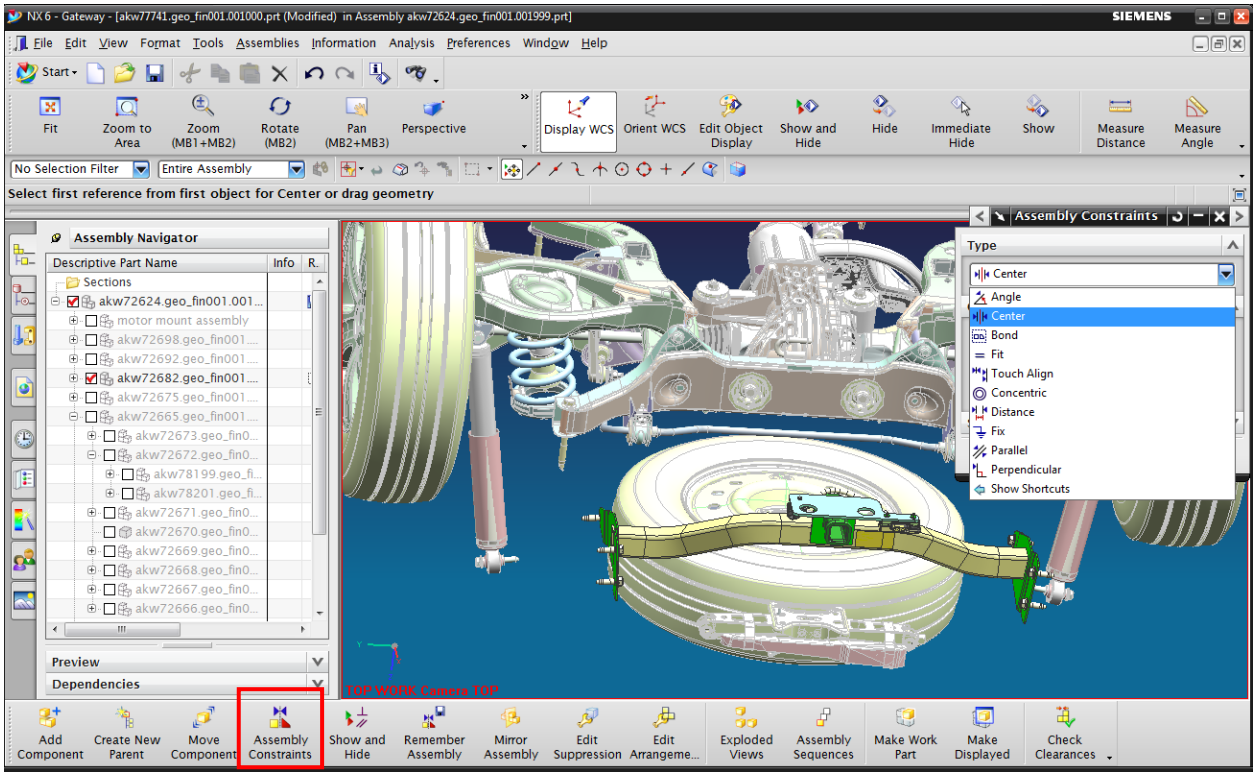


Figure 9 – Assembly Constraints

It should be noted that assembly constraints only work when the components being assembled are from the same level of the same tree. This means that when a new component for the Vue is generated, and formal assembly constraints are desirable, the component must be placed inside the existing parts hierarchy at a level in which the mated components are located.

Move Component

Moving components into their correct place is quite often the more effective way of adding components to the EcoCAR working model, simply due to the fact that the rest of the stock car is not constrained. This is especially the case for adding internally mated assemblies to the master car assembly, as constraints can cause inadvertent repositioning of stock components, which is difficult to correct if accidentally saved.

To move components, the "Move Component" button is pressed on the assemblies toolbar, which activates a dialogue specifying the repositioning of the component.

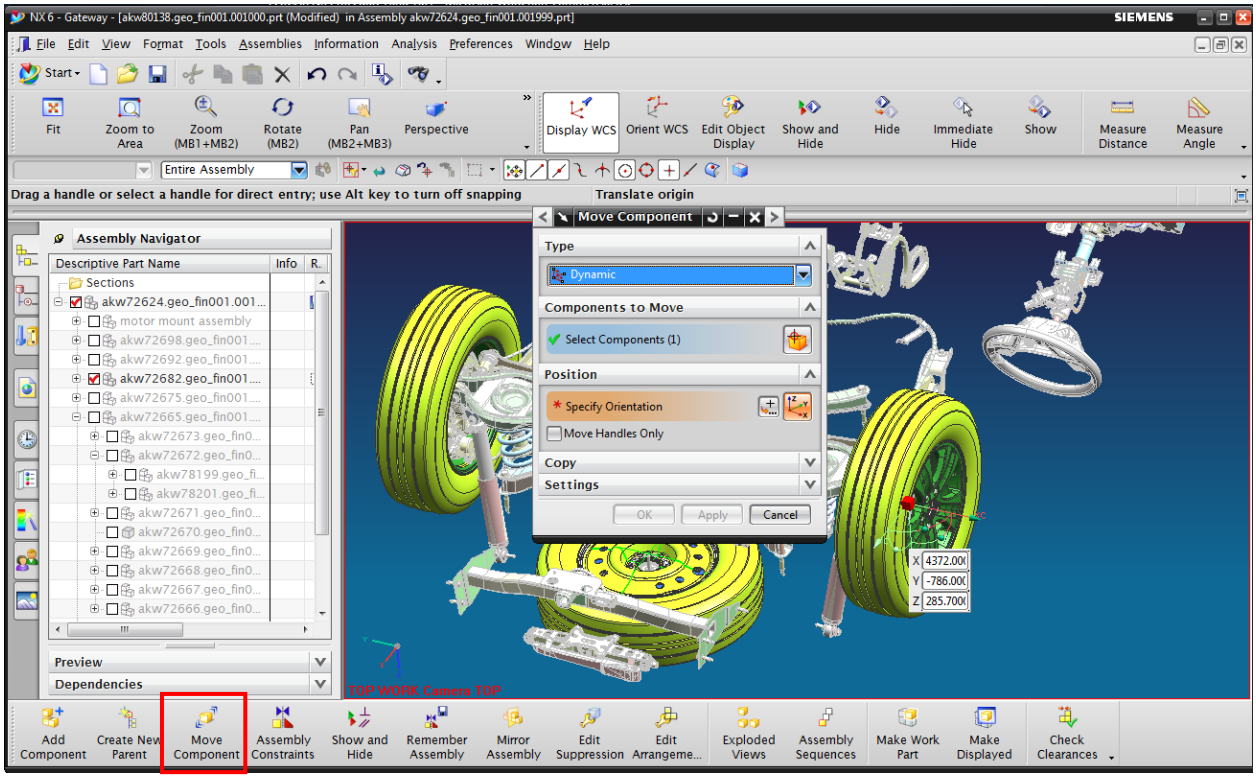


Figure 10 – Move Component

Many common EcoCAR CAD activities include relatively imprecise checks for proper fit. In this case, dynamic component repositioning is most convenient. Better control over component rotation and motion can be obtained through more precise motion options contained in the dialogue drop-down menu.

When dynamically rotating a component, it is often necessary to adjust the reference point for rotation. This is done by checking the box next to “Move Handles Only”. This relocates the dynamics component movement axes without moving the actual component.

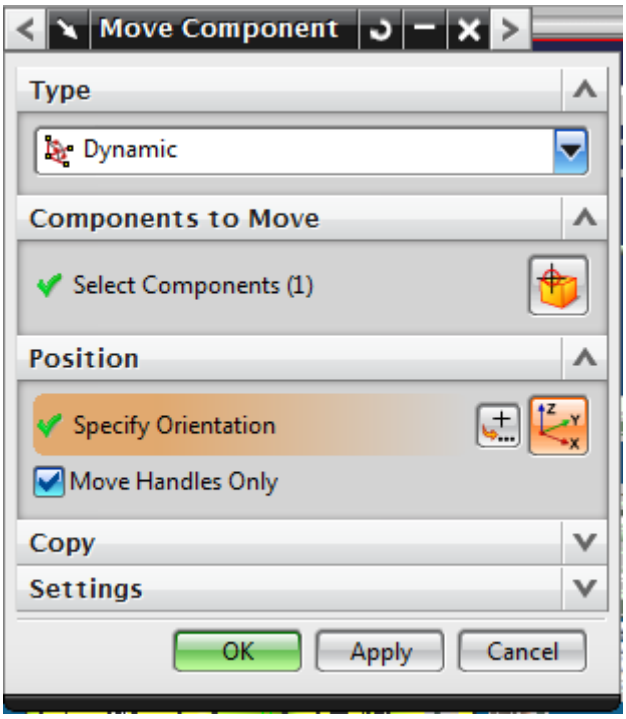


Figure 11 – Move Handles Only Option

Clip Work Section

Checking for component interferences can often be difficult due to the busy nature of the Saturn Vue part models. Clear views from certain perspectives are sometimes difficult to obtain due to components obstructing vision. This can be overcome by using the clip work section option.

This feature allows sectioning of the real-time model environment along a plane of the user's choice. The tool is contained under the View→Operation drop down menu. Control over to tool's parameters is under the same menu and labeled "edit work section".

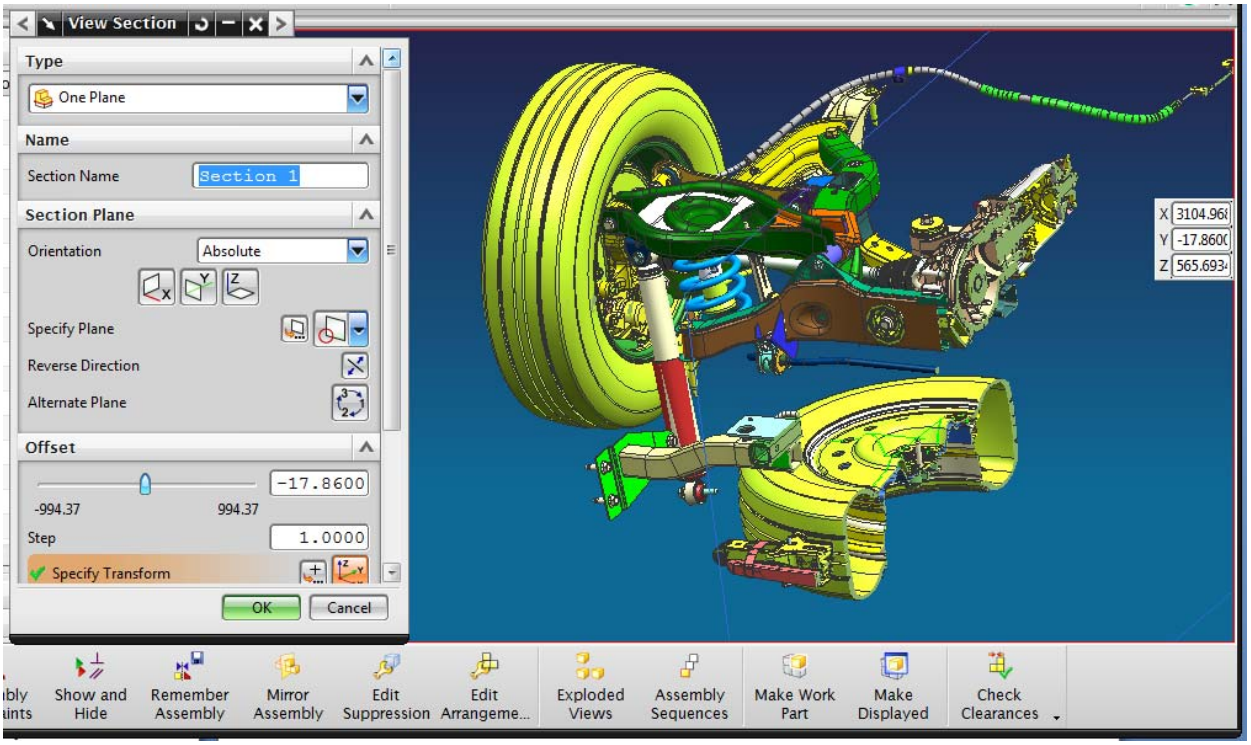


Figure 12 – Clip Work Section

2.5 Changing Part Appearances

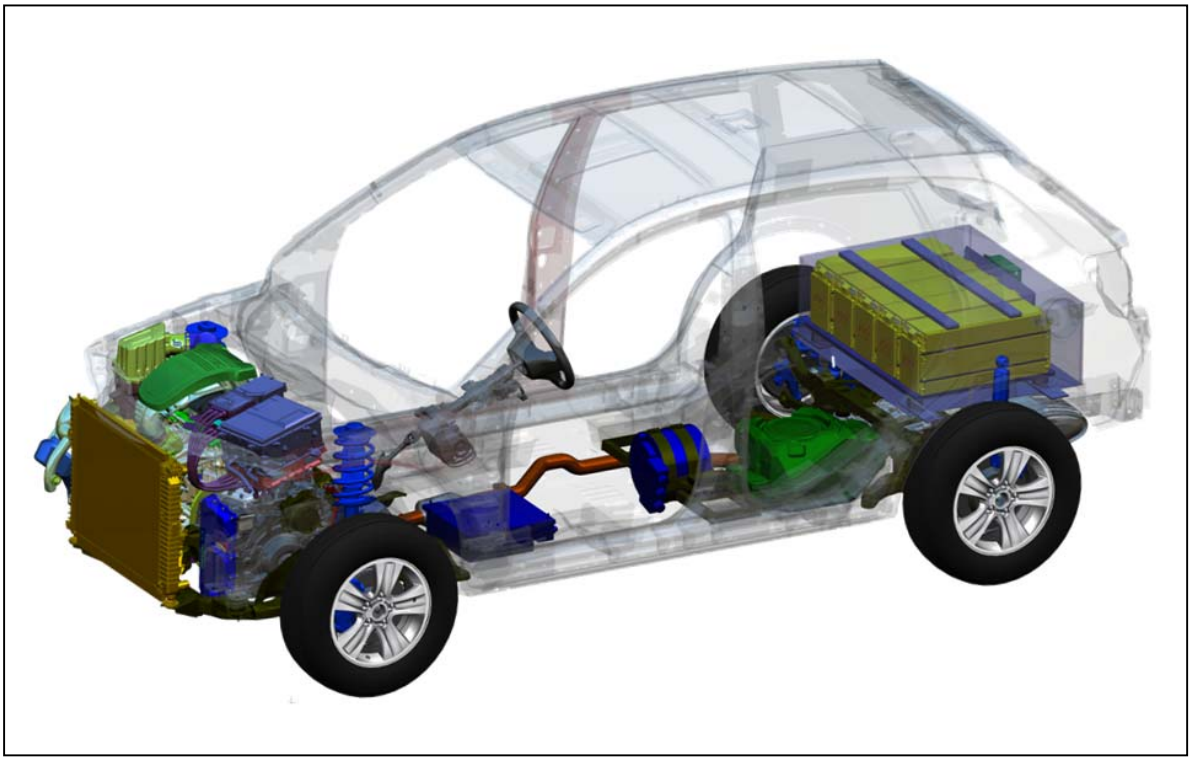


Figure 13 – Two-Mode Plus E-REV Architecture

A large component of the EcoCAR competition involves communication of ideas to both technical specialists and members of the general public. It is often desirable to change the appearance of components or assemblies in order to more clearly communicate technical ideas via CAD images. Figure 12 shows a display image generated for the purposes of showcasing the UVic EcoCAR team's general vehicle design and architecture.

NX has many built-on modules for professional rendering of CAD models, but these have not been used by the UVic EcoCAR team thus far. There are several options for altering the appearance of CAD models while staying within the standard modeling or assemblies mode of the software. These include:

- General display type
- Model Colour and Transparency
- Studio View Mode

General Display Type

There are three primary display types that are useful for the most common viewing requirements, including, wireframe, fully shaded, and shaded with edges. These are accessed from the upper icon bar along with zoom, pan, and various other primary interface tools. Figure 13 shows visualizations of the different options.

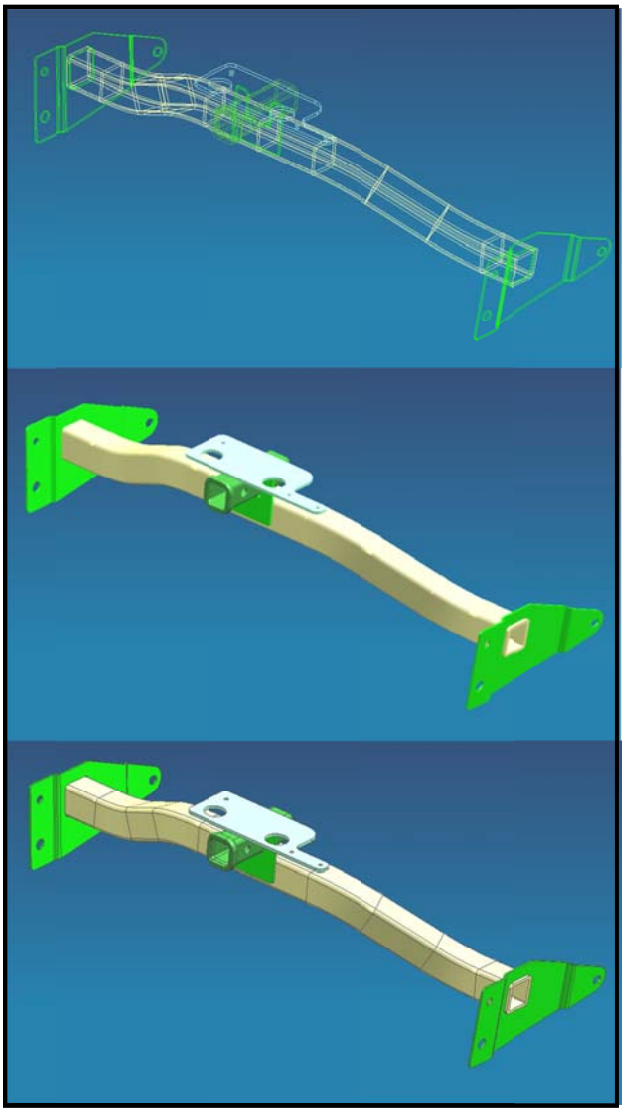


Figure 14 – Basic View Types
(Top: Wireframe, Middle: Shaded, Bottom: Shaded with Edges)

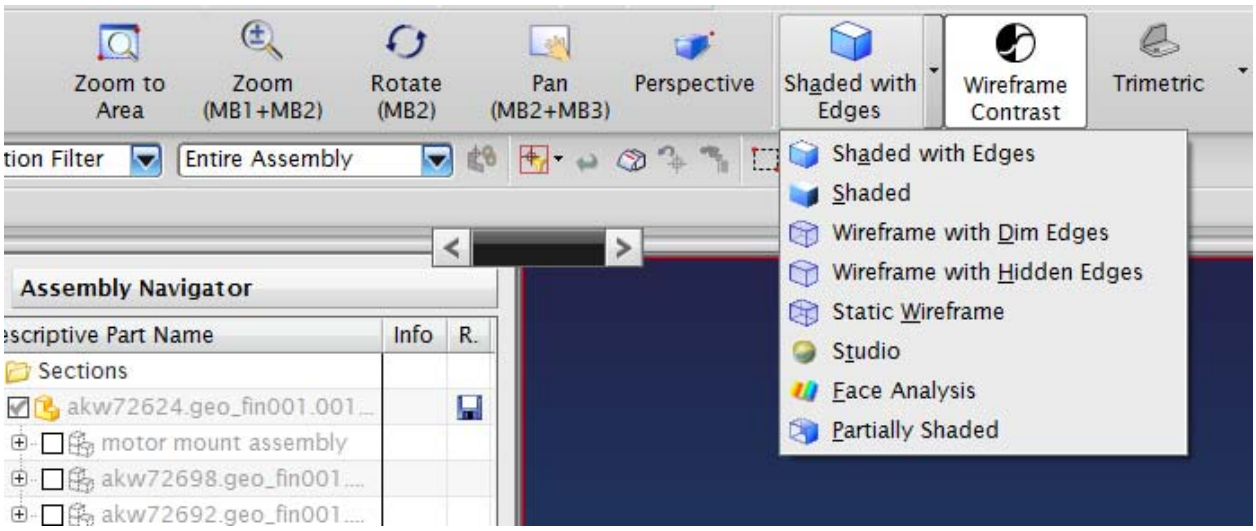


Figure 15 – Basic View Types

Model Colour and Transparency

Transparency and component/assembly colour display options can be accessed by right clicking on the components in question and selecting "Edit Display". Multiple objects can be changed at once if all are selected prior to right clicking.

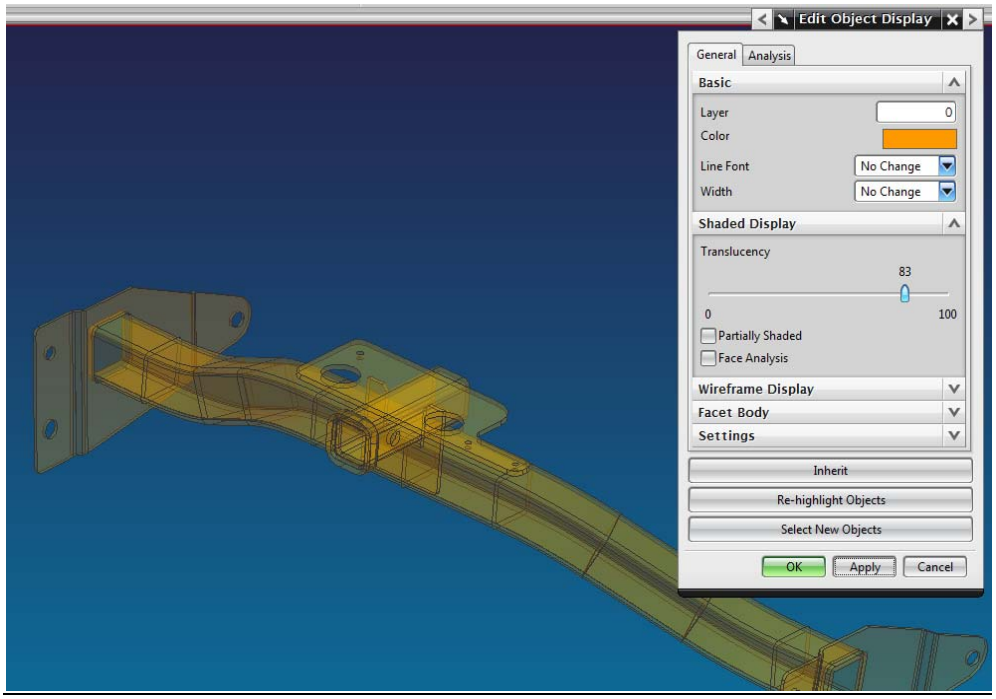


Figure 16 – Edit Object Display

Object display parameters are only modified for the assembly level file being opened. This means, that if colours and translucencies are set for a subassembly file being viewed, the changes will not be updated to the master assembly files. This is advantageous since lower level assemblies can have viewing parameters set up for specific visualizations without affecting the way the master assembly file is viewed.

It is recommended that any changes made to stock component colours for the purposes of image generation be made to a copy of the working CAD master folder, rather than changing the working files itself. This is necessary, as reverting to stock component colour codes would not be a viable option once changed due to the volume of components.

Studio View Mode

A view mode indicated in figure 14 but not mentioned with the other options is studio view mode. This mode is capable of producing much more complex visual effects including real light shading, surface textures, and background effects. It is also very taxing on computer hardware, and should only be activated for the purposes of media generation.

Access to the wide variety of visualizations available in studio view mode is located under the View→Visualizations drop down menu. Note that these visualization options will not apply to the view window until studio mode is activated under the view type icon options.

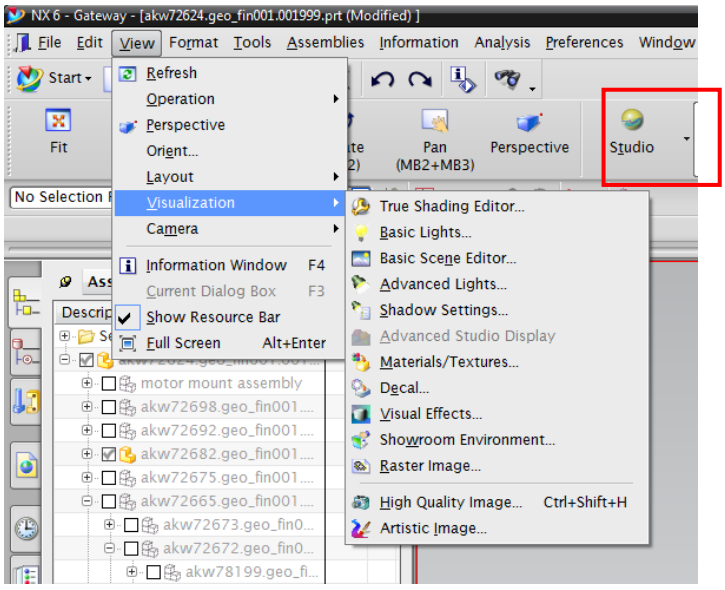


Figure 17 – Studio View Visualization Options

3 RECOMMENDED FUTURE TEAM STANDARDIZATIONS

Document stewardship is an important task when thousands of CAD files of various versions are involved. More strict guidelines and standardized procedures for modifying working CAD file master assemblies must be used in EcoCAR competition year 2 to prevent loss of pertinent data and corruption of assembly tree hierarchies.

Two primary methods of ensuring CAD model assembly integrity are proposed in the following sections, including a formal file checkout procedure, and modified and custom file naming conventions and cataloguing. Both processes will involve a modified parts list excel spreadsheet that includes all stock components, as well as all modified and new components under their respective tree levels.

In addition to these procedures, it is recommended that a complete dated backup of the working CAD folder be made every 3 days at a minimum to prevent accidental loss of data.

3.1 Working EcoCAR Parts List

The modified EcoCAR CAD parts list is a variation of the original parts list excel book provided by General Motors. Changes include a “Source” column and a “Checked Out By” Column. Through the use of auto-filters on the column headers, all team-generated components can be seen.

New components are added to the list using the same standard as existing assembly components, with filename being in the first column, and source marked as “EcoCAR Team”. Figure 18 shows 3 EcoCAR Team generated components that have been added to the parts list.

C	D	G	H
Item Name	Item Description	Source	Check Out By
MAINSTREAM MODULE	ECO CAR	General Motors	
VPPS_10 POWERTRAIN	ECO CAR	General Motors	
VPPS_10.1 POWER GENERATION	ECO CAR	General Motors	
New Engine Mount Assembly for 2-Mode	New Engine Mount Assembly	EcoCAR Team	Daniel Prescott
Engine Mount Peg	Peg	EcoCAR Team	Daniel Prescott
Engine Mount Pillow Block	Pillow Block	EcoCAR Team	Daniel Prescott
IA-ENG XXXXXXXX LE5 AUTO 7L-MM	Z_LFLGLRLS_26_LE5_MN5_NT7/NUS_2009 AUTOMATIC POSITION	General Motors	
ENG POS CYCS GMT319 LE5 4T45	X = 1447.70, Y = -106.00, Z = 385.30 and Angle D= -10 Deg.	General Motors	
EIA 2009 LE5 GMT319 A/TRANS	EIA 2009 LE5 GMT319 AUTO TRANS	General Motors	
VPPS_10.2 POWER TRANSMISSION	ECO CAR	General Motors	
IA-TRA 24245910 LE5/MN5 7L-MM	Z_LF_26_LE5_MN5&FX2_2008#Z_LF_00_LE5_MN5_&FX2_2009-10#Z_LR_26_LE5_MN5_&	General Motors	
TRANSAXLE ASM-AUTO (3.91 RATIO)	TRANSAXLE ASM-AUTO (3.91 RATIO)	General Motors	
VPPS_10.3 PT CONTROL & DIAG	ECO CAR	General Motors	

Figure 18 – Part Source and Checked Out Designations

In addition to adding new team-generated components, old team components as well as stock components that are obsolete and have been removed from the master assembly file are marked “OBS” under the revisions column. In addition text face for obsolete components is made a light grey to remove emphasis from these components. Filtering out obsolete items will thus provide a complete list of active parts both stock and team-generated.

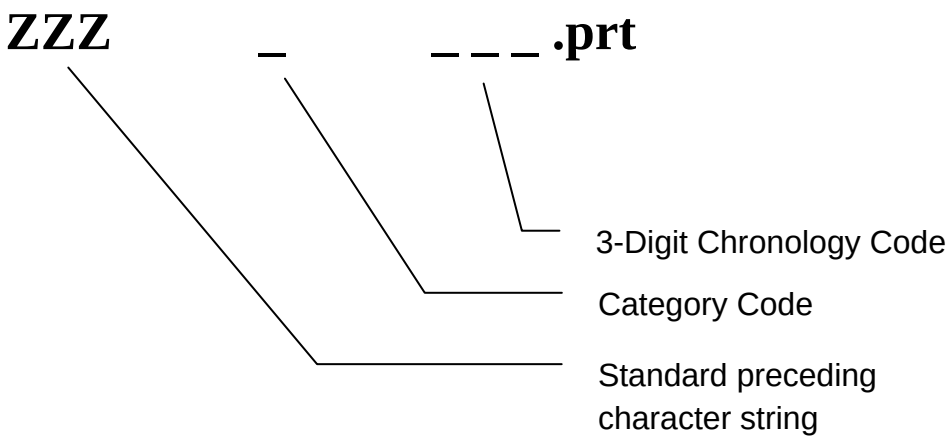
BOM Line / file name	Level	Item Rev Status	Source
ZZZ-Modified VUE	0		EcoCAR Team
AKW72624/001-MAINSTREAM MODULE (view)	0	OBS	General Motors
AKW72698/001-VPPS_10 POWERTRAIN (view)	1	C	General Motors
AKW72692/001-VPPS_15 POWERTRAIN INTEGRATION (view)	1	C	General Motors
AKW72682/001-VPPS_20 CHASSIS (view)	1	C	General Motors
AKW72675/001-VPPS_30 HVAC & PT COOLING (view)	1	C	General Motors
AKW72665/001-VPPS_40 INTERIOR (view)	1	C	General Motors
AKW72659/001-VPPS_50 BODY STRUCTURE (view)	1	C	General Motors
AKW72652/001-VPPS_55 BODY CLOSURES (view)	1	C	General Motors
AKW72641/001-VPPS_60 EXTERIOR (view)	1	C	General Motors
AKW72635/001-VPPS_70 INFORMATION & CONTROLS (view)	1	C	General Motors
AKW72625/001-VPPS_80 ELECTRICAL FUNCTION (view)	1	C	General Motors

Figure 19 – Obsolete Items

3.2 Component File Naming Convention and Standards

Experience from the first year of competition has shown that it is beneficial to have team-generated component filenames preceded by a repeating set of characters to allow easy location of files within the master folder. This is due to the large volume of files present. A prefix of “ZZZ” to any filename will make locating the file quick and simple.

File naming so far has not been standardized, and the number of team-generated and modified components is now reaching the upper limit where this will be an effective strategy. The following file name standards are to be employed to allow proper organization of added files:



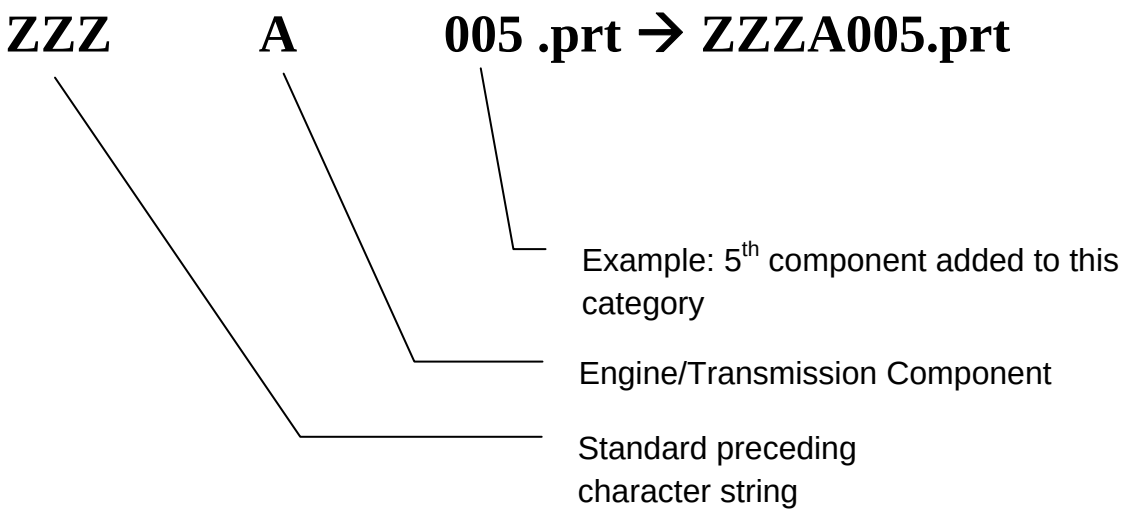
1. The preceding characters “ZZZ” are always present in the part name. This provides a means for easy file location in the master working folder.
2. The category code is a letter representing what vehicle system the component belongs to. Category codes are listed in table 1.
3. The 3-digit chronology code is a 3 digit number representing what order the components were added to the master assembly. This code is always 3 digits long, and has leading zeroes if necessary to accomplish this.

Table 1 – Part Category Codes

Vehicle System	Category Code Letter
Engine/Transmission	A
Rear Traction Motor	B
Energy Storage System	C
Vehicle Cooling Systems	D
Vehicle Structural Modifications	E
Powertrain Integration	F

Example of Part Naming

Suppose the pillow block shown in figure 17 is to be added to the master working folder. The name of the file would be created as follows:



Using this standard filename procedure will make EcoCAR team-generated component filenames easier to locate and document within the parts spreadsheet.

When do File Naming Standards Apply?

New component names are required when stock component models are altered or new components are added. Any stock components replaced by a modified part must be marked as obsolete in the components spreadsheet.

Assemblies that have been modified to include new components should not be renamed, but new assemblies of entirely new components that are to be added should have an appropriate standardized filename.

3.3 File Checkout Procedure

File checkout with the standardized system is simple and prevents any accidental non-applicable changes being made to the master working file. All parts modification and generation work is to be done on a copy of the master working file. File checkout is therefore not an actual removal of a file being worked on, but rather a signal to others that the file is under construction remotely.

Checking out a file simply involves entering one's name in the "Checked Out By" column. Strict adherence to this method will ensure much simpler integration of work as well as effective collaboration between team members working on the same sets of files or related files.

D	G	H
Item Description	Source	Check Out By
ECO CAR	General Motors	
ECO CAR	General Motors	
ECO CAR	General Motors	
New Engine Mount Assembly	EcoCAR Team	Daniel Prescott
Peg	EcoCAR Team	Daniel Prescott
Pillow Block	EcoCAR Team	Daniel Prescott
Z_LFLGLRLS_26_LE5_MN5_NT7/NUS_2009 AUTOMATIC POSITION	General Motors	
X = 1447.70, Y = -106.00, Z = 385.30 and Angle D= -10 Deg.	General Motors	
EIA 2009 LE5 GMT319 AUTO TRANS	General Motors	
ECO CAR	General Motors	
Z_LF_26_LE5_MN5&FX2_2008#Z_LF_00_LE5_MN5_&FX2_2009-10#Z_LR_26_LE5_MN5_&	General Motors	
TRANSAXLE ASM-AUTO (3.91 RATIO)	General Motors	
ECO CAR	General Motors	

Figure 20 – Example: File Being Worked on Remotely by Daniel Prescott

4 OTHER USEFUL DOCUMENTATION

The information contained in this report will be useful to new EcoCAR team members seeking to complete mechanical work using CAD modelling. The practices and standardizations mentioned in this document will do a great deal towards reducing the learning curve of using the Saturn Vue CAD models and producing useful EcoCAR component designs.

Further information on the usage of NX 6.0 can be found on the EcoCAR team SharePoint site:

-<INSERT REFERENCE TO LARGE TUTORIAL FROM Dr. DONG'S CLASS>
-<INSERT REFERENCE TO MY UPDATE TO LARGE TUTORIAL>