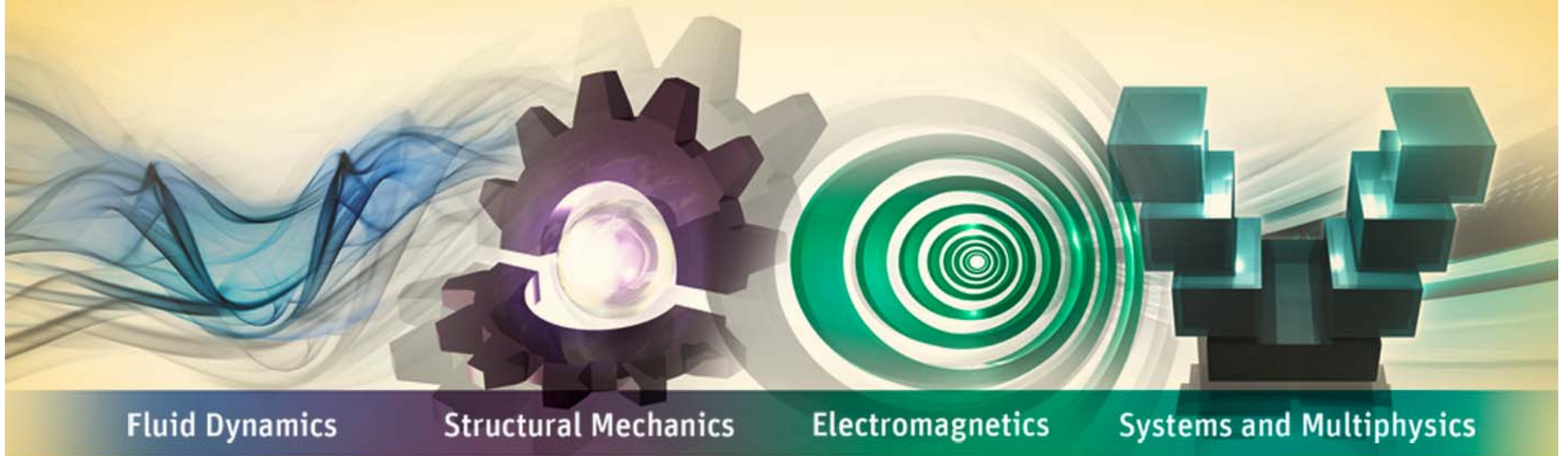


ANSYS Aqwa in Workbench



Fluid Dynamics

Structural Mechanics

Electromagnetics

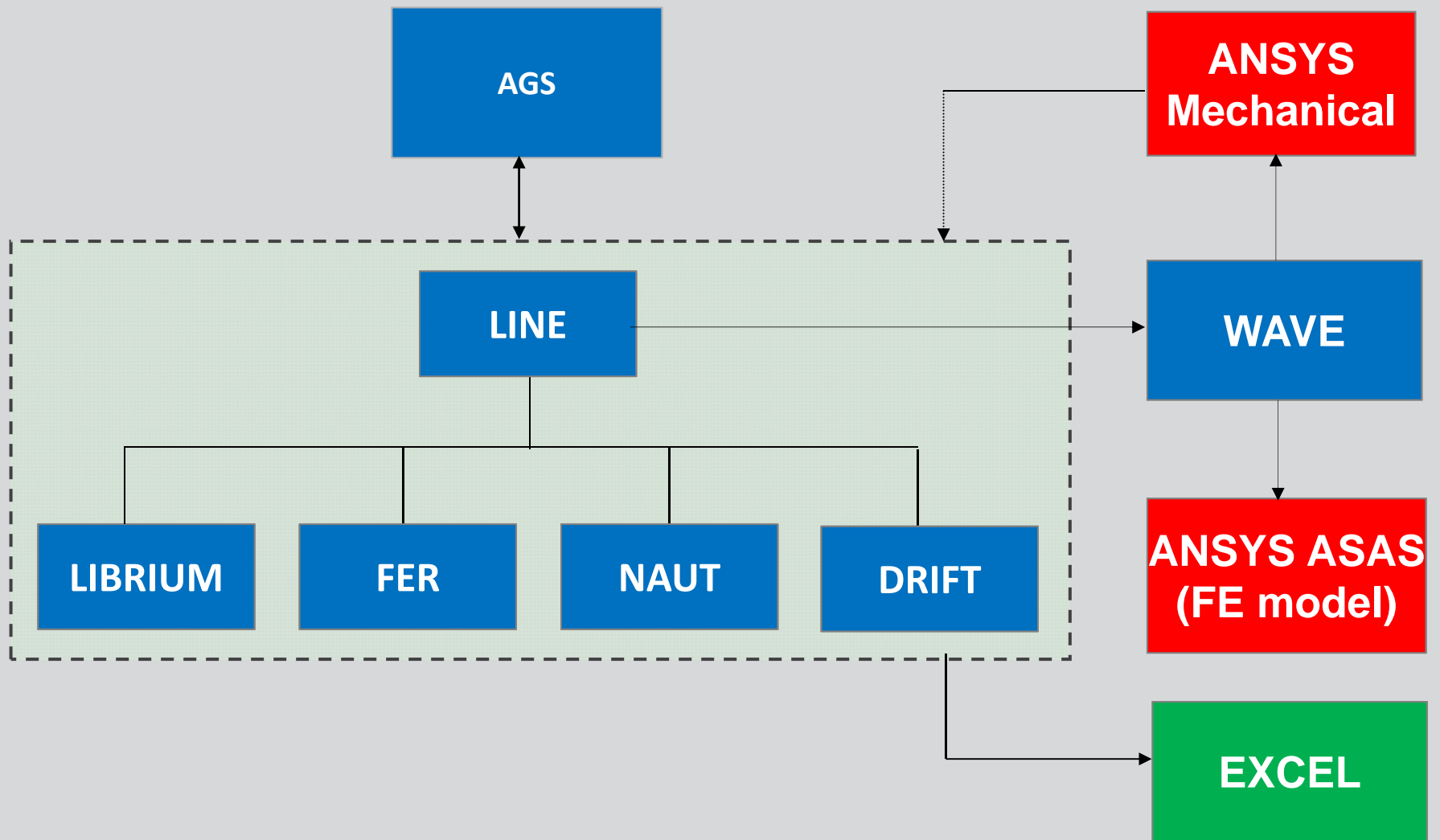
Systems and Multiphysics

Paul Schofield – ANSYS Houston

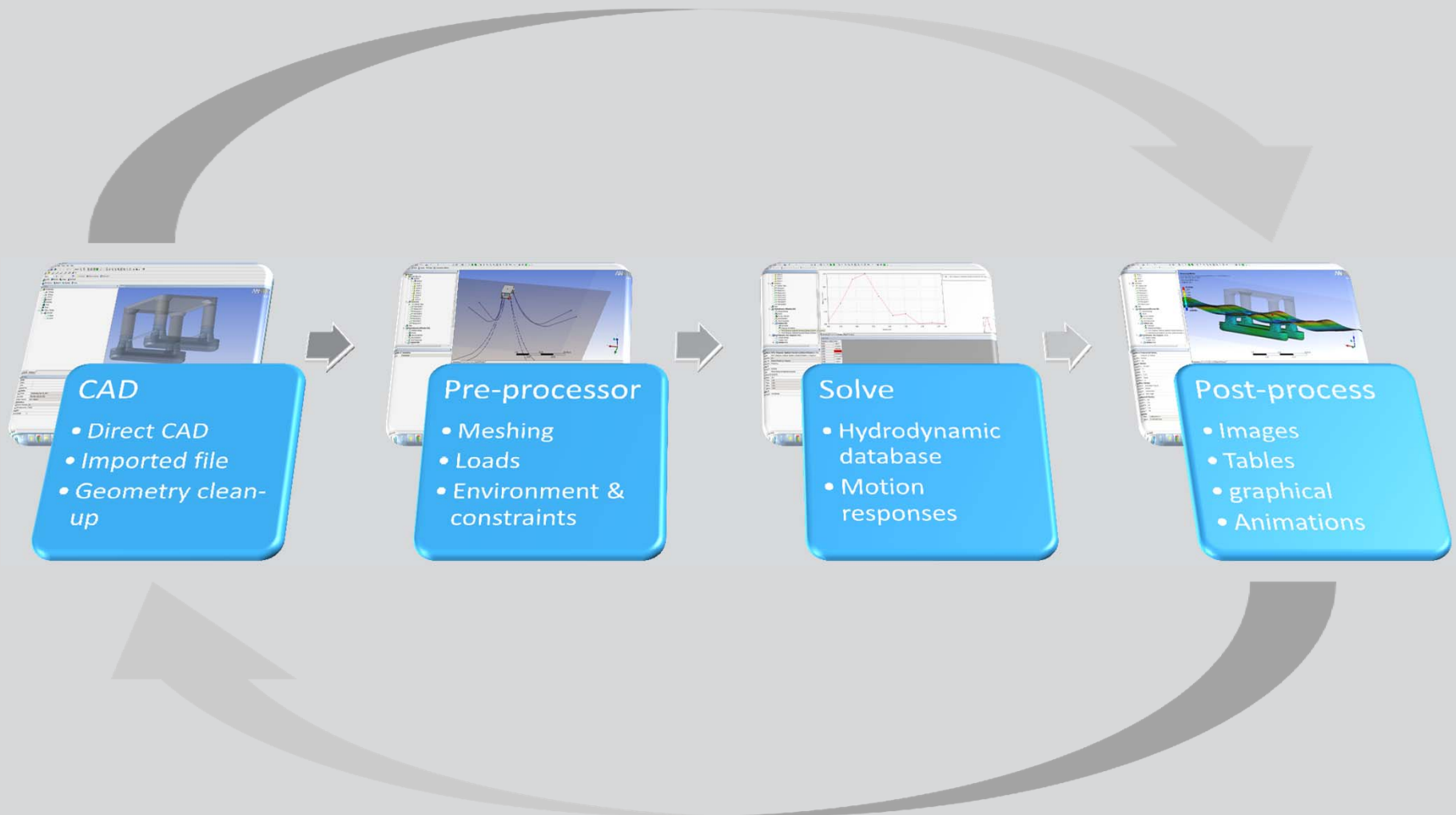
- **Introduction**
- **ANSYS Workbench overview**
- **Data integrated applications**
 - **DesignModeler**
 - **Aqwa**
- **Load mapping**
- **Demonstration**

Introduction

Core Programs – The historical Perspective

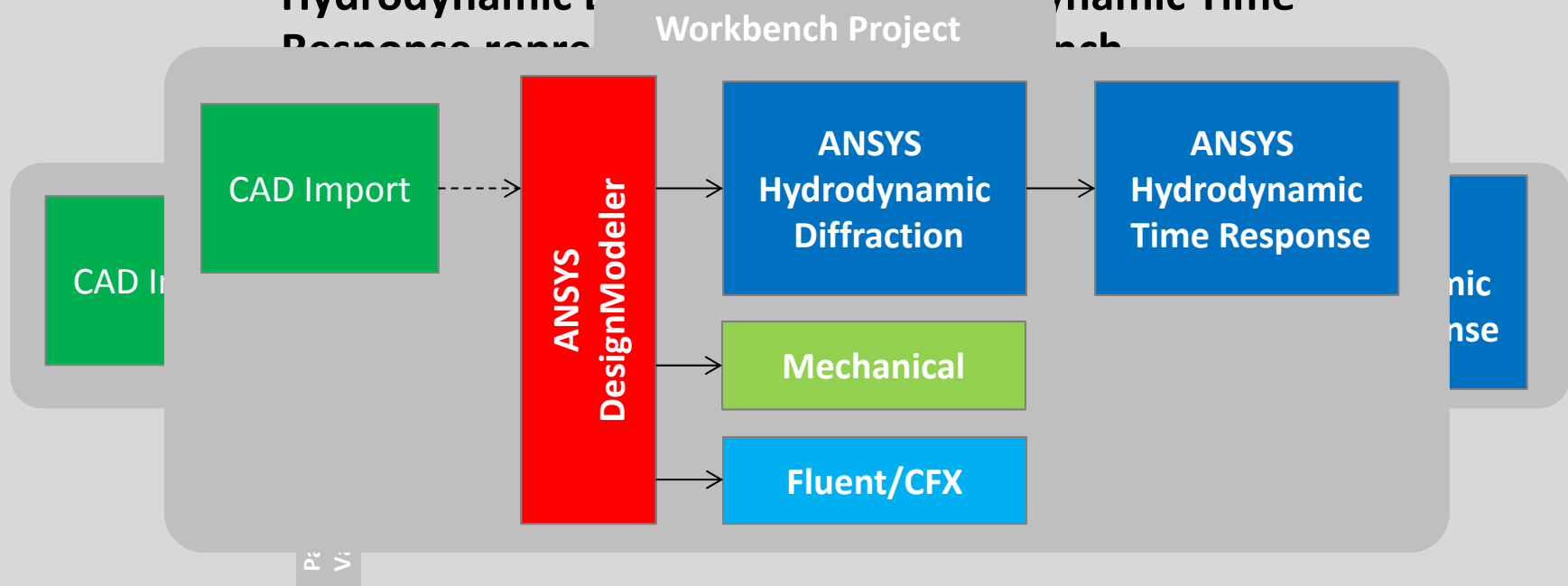


AQWA Hydrodynamic Simulation Procedure

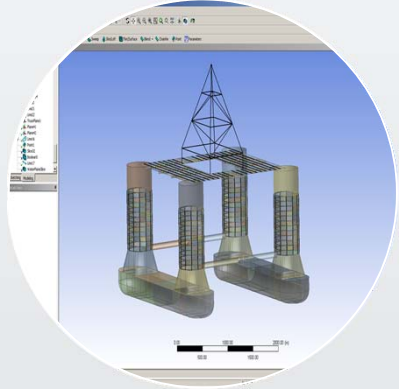


AQWA Workbench Application

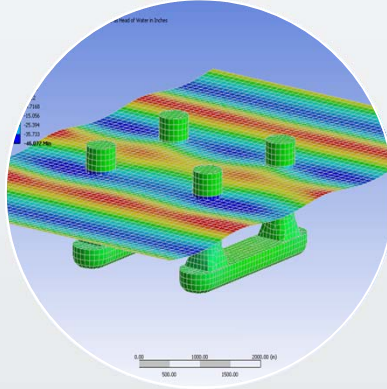
- Hydrodynamic Diffraction and Hydrodynamic Time Response



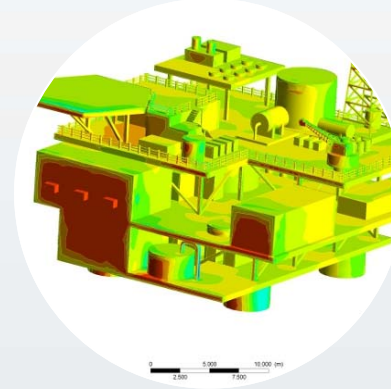
Multiphysics Simulation



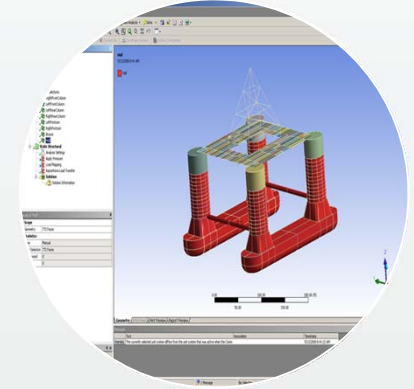
Geometry
modelling



AQWA



CFX/Fluent



Mechanical

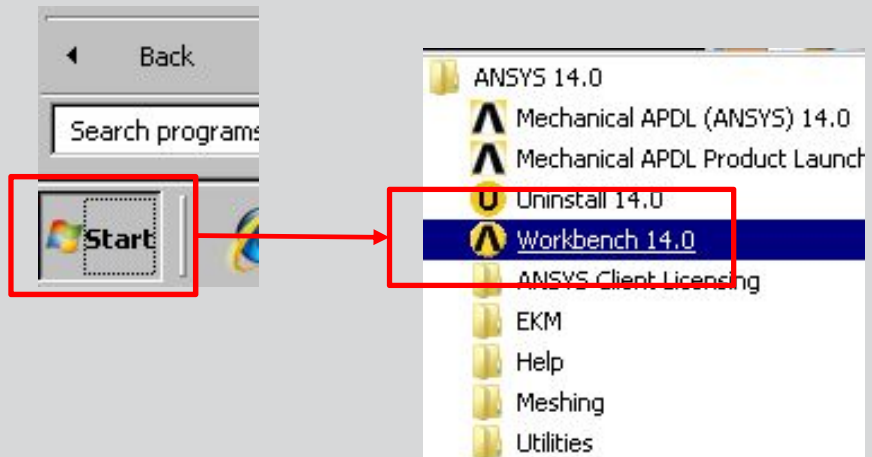
Hydro-Structural Design in Workbench

ANSYS Workbench

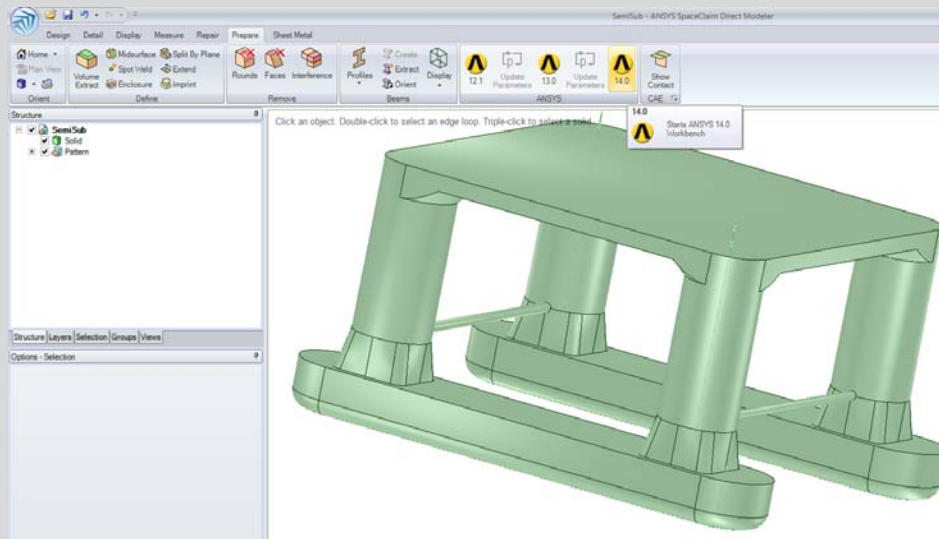
Launching ANSYS Workbench

There are two methods of launching Workbench:

- From the Windows start menu:

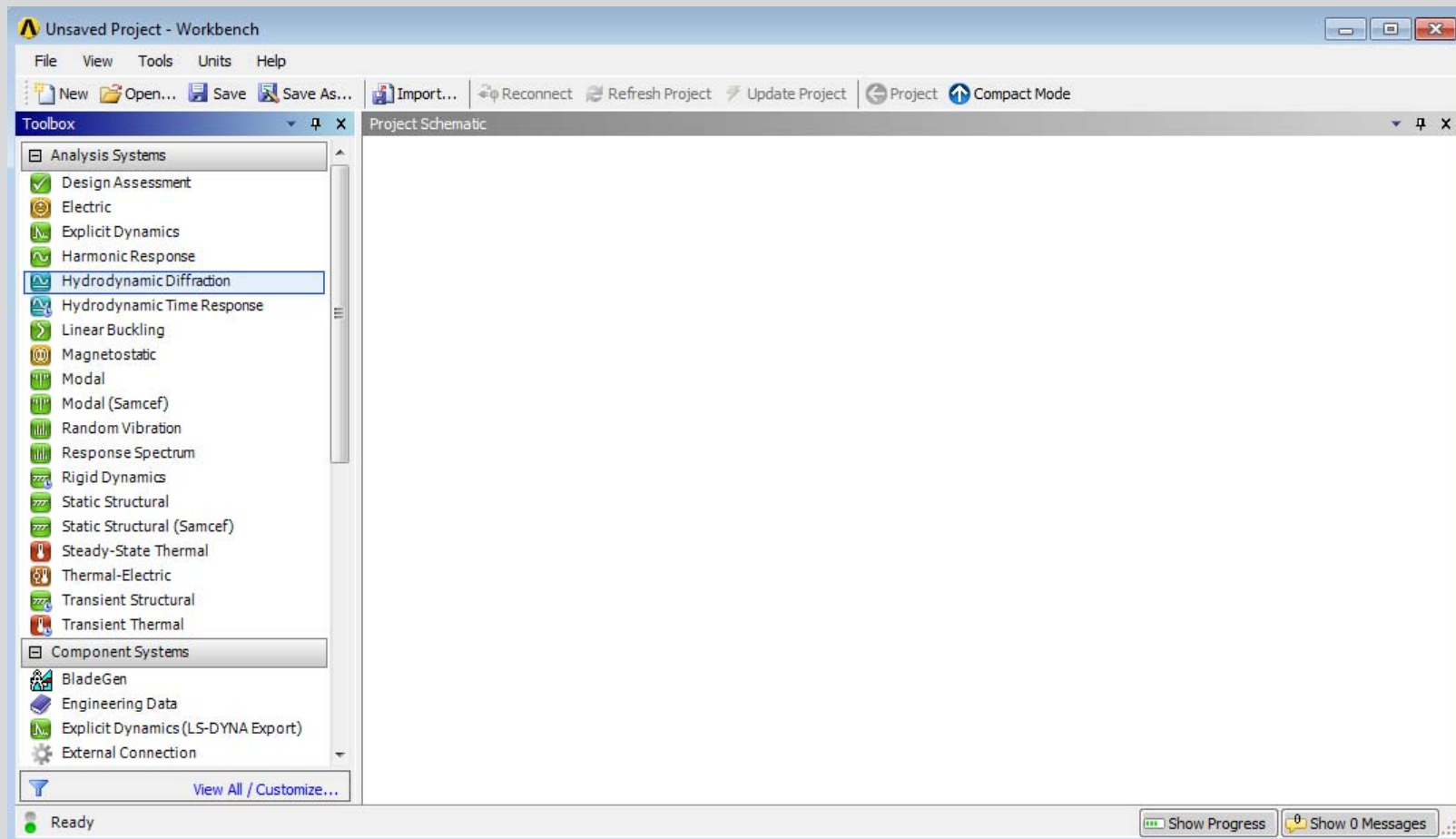


- From the CAD system



The Workbench Environment

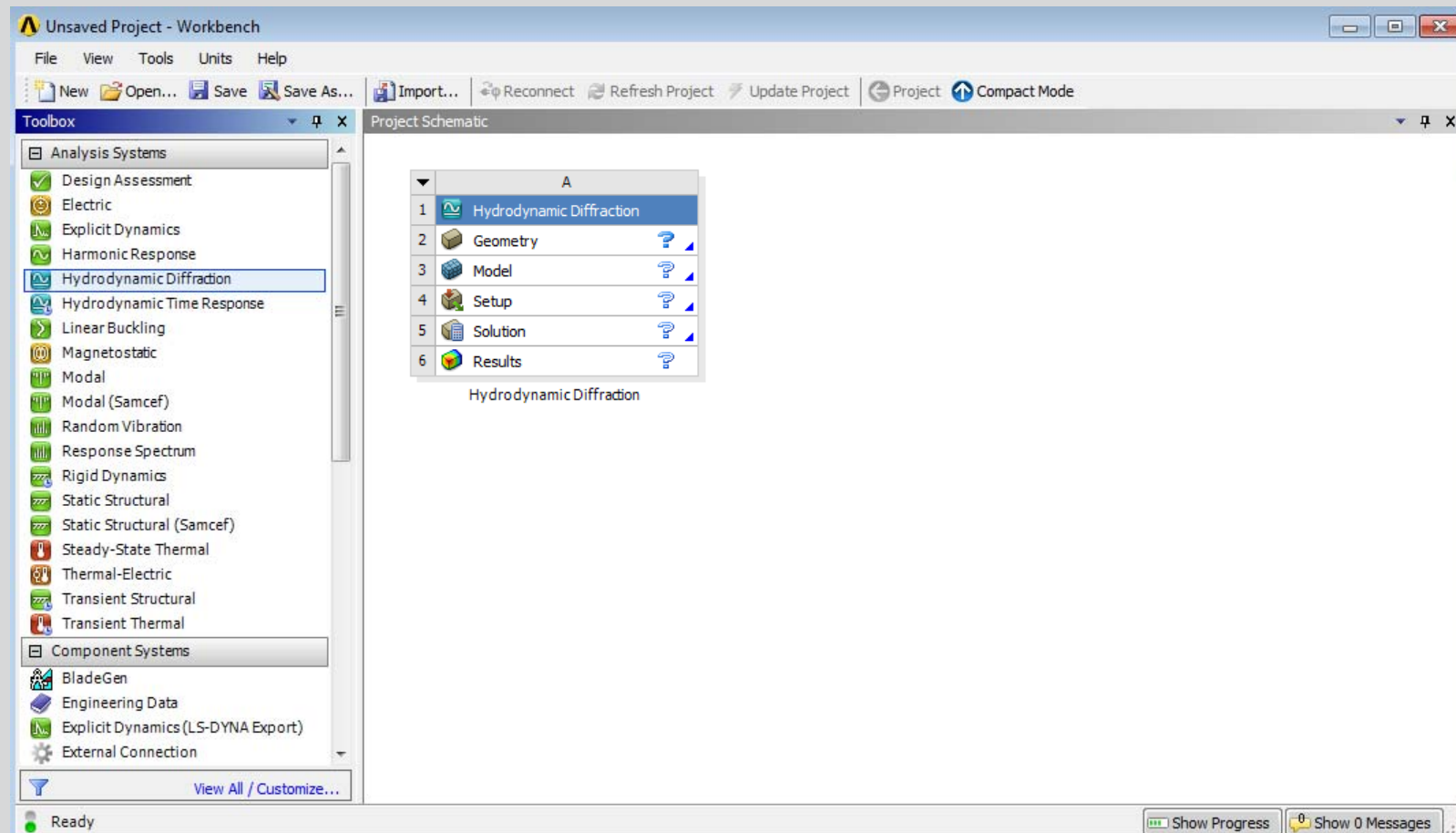
For most situations the Workbench GUI is divided into 2 primary sections.



The Project Schematic

The Workbench project schematic is a graphical representation of the workflow defining a system or group of systems.

From the toolbox a selection can be dragged and dropped onto the schematic (or double clicked).



... The Project Schematic

By dropping applications and/or systems into various locations in the schematic, an overall analysis project is defined.

In the example below a **Hydrodynamic Time Response** system is dragged and dropped onto a **Hydrodynamic Diffraction** system.

The screenshot shows the ANSYS Workbench interface with the Project Schematic. The schematic consists of three main systems: A, B, and C. System A contains two Geometry components. System B is a Hydrodynamic Diffraction system containing Geometry, Model, Setup, Solution, and Results. System C is a Hydrodynamic Time Response system containing Geometry, Model, Setup, Solution, and Results. Blue arrows indicate dependencies between the systems. The Messages and Files panels are also visible at the bottom.

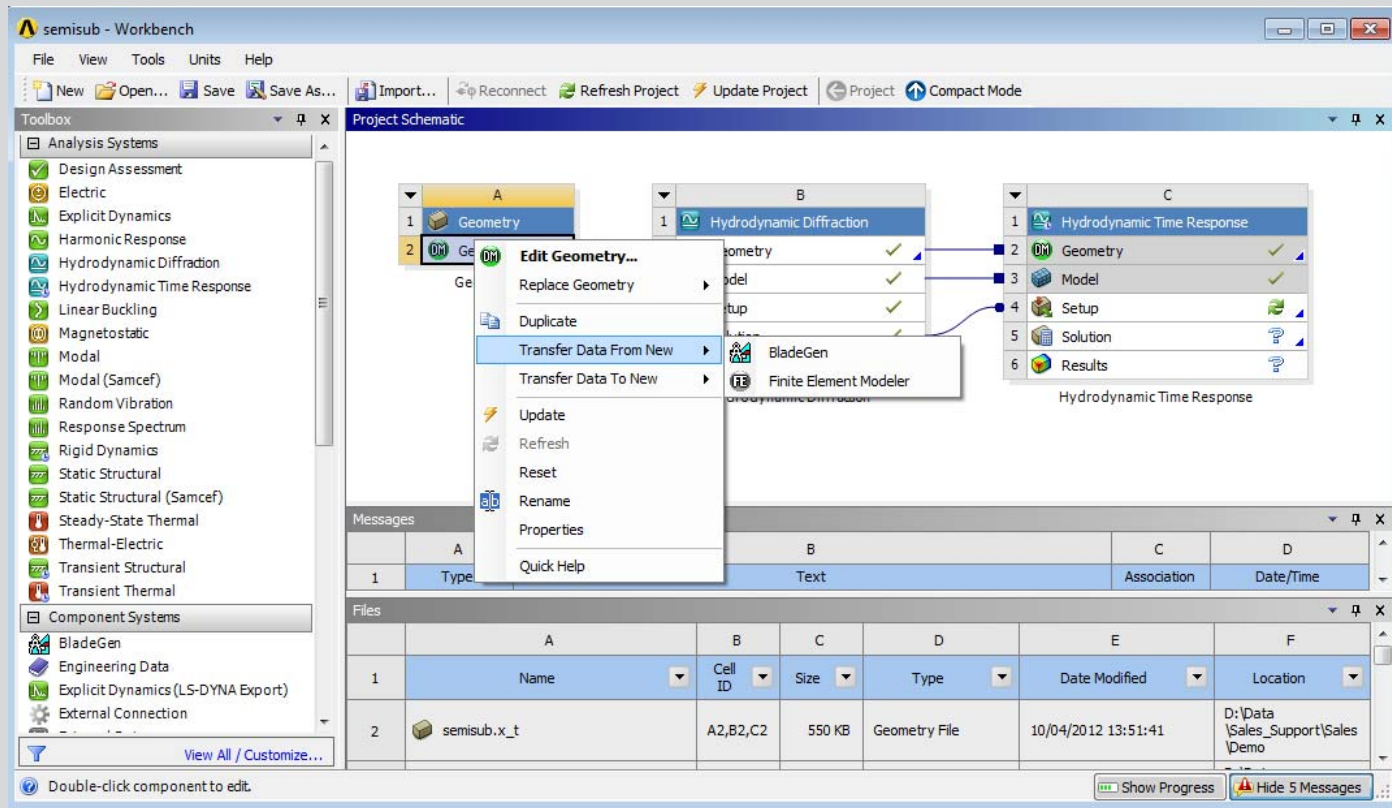
	A	B	C	D
1	Type	Text	Association	Date/Time

	A	B	C	D	E	F
1	Name	Cell ID	Size	Type	Date Modified	Location
2	semisub.x_t	A2,B2,C2	550 KB	Geometry File	10/04/2012 13:51:41	D:\Data\Sales_Support\Sales Demo

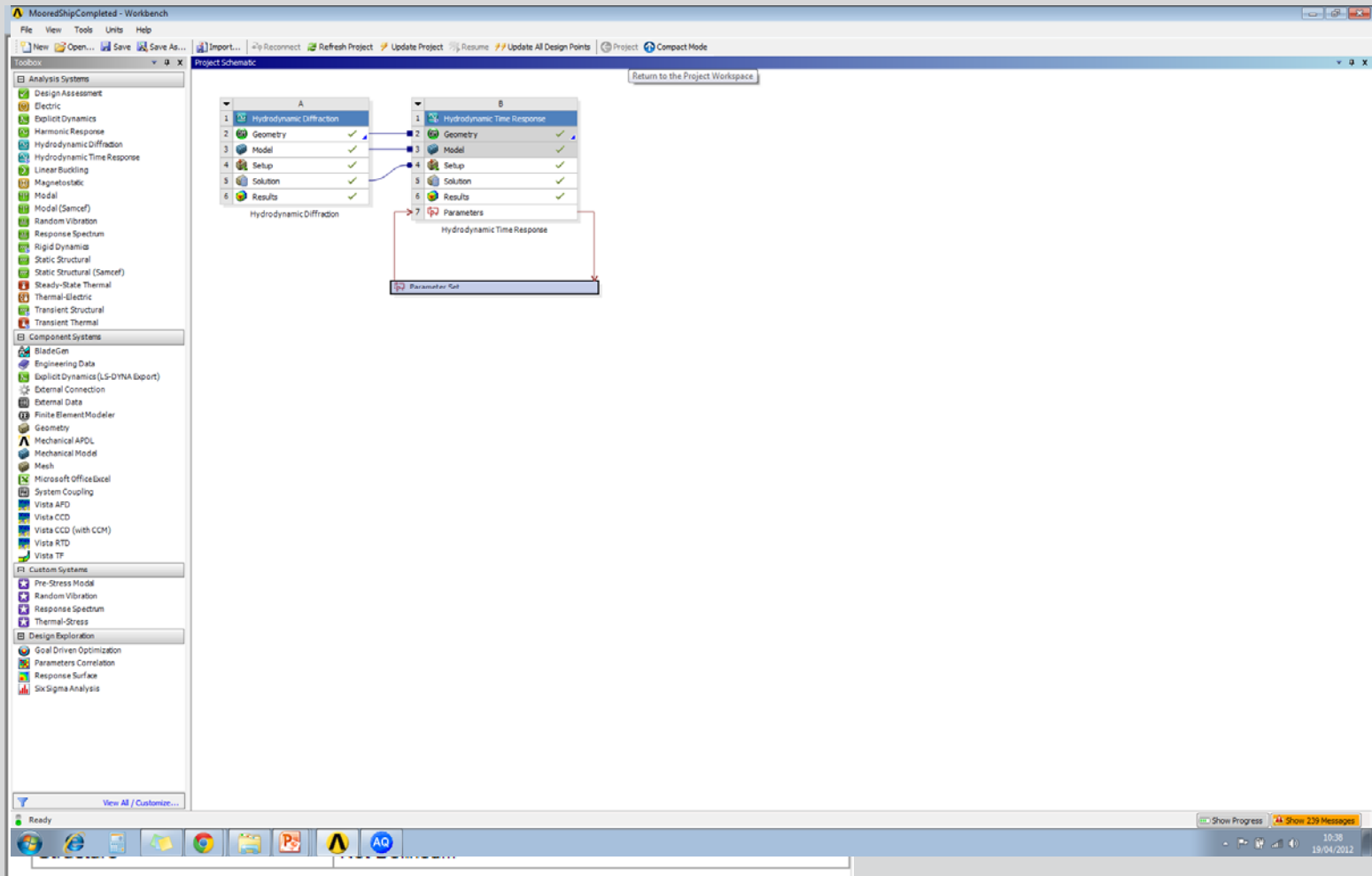
. . . The Project Schematic

A schematic can also be constructed by RMB and choosing to “Transfer Data To New” or “Transfer Data From New”.

These selections will vary depending on which cell in a particular system you highlight.



Parameterisation



Workbench File Management

From the Workbench “View” menu activate the “Files” option to display a window containing file details and locations.

The screenshot displays the ANSYS Workbench interface. On the left, the 'Files' window is open, showing a list of files with columns for Name, Cell ID, Size, Type, Date Modified, and Location. The project schematic in the center shows a multi-cell model with cells A, B, and C, each containing a sequence of components like Geometry, Model, Setup, Solution, and Results.

Cell	Name	Cell ID	Size	Type	Date Modified	Location
2	semisub_x_1	A2,R2,C2	550 KB	Geometry File	10/04/2012 13:51:41	D:\Data\Sales_Support\Sales\Demo
3	Geom.agdb	A2,R2,C2	2 MB	Geometry File	16/04/2012 14:15:00	D:\Data\Sales_Support\Sales\Demo\semisub_files\lpo\Geom\PM
4	semisub_wbproj		265 KB	ANSYS Project File	17/04/2012 08:07:55	D:\Data\Sales_Support\Sales\Demo
5	AQW.aqdb	B3,C3	1 MB	AQWAWB Database	17/04/2012 09:45:38	D:\Data\Sales_Support\Sales\Demo\semisub_files\lpo\AQW\AQW
6	AQW.aqdb.mesh	B3,C3	774 KB	Default File	17/04/2012 09:45:38	D:\Data\Sales_Support\Sales\Demo\semisub_files\lpo\AQW\AQW
7	designpoint.lbdp		19 KB	Design Point File	17/04/2012 08:07:55	D:\Data\Sales_Support\Sales\Demo\semisub_files\lpo
8	Analysis.dat	B	1 MB	AQWIA Data Dec. File	17/04/2012 07:31:09	D:\Data\Sales_Support\Sales\Demo\semisub_files\lpo\AQW\AQW\Analysis
9	ANALYSIS.HYD	B	365 KB	AQWIA HYD File	17/04/2012 07:45:59	D:\Data\Sales_Support\Sales\Demo\semisub_files\lpo\AQW\AQW\Analysis
10	ANALYSIS.LIS	B	2 MB	AQWIA LIS File	17/04/2012 07:50:25	D:\Data\Sales_Support\Sales\Demo\semisub_files\lpo\AQW\AQW\Analysis
11	ANALYSIS.MES	B	175 B	.MES	17/04/2012 07:31:16	D:\Data\Sales_Support\Sales\Demo\semisub_files\lpo\AQW\AQW\Analysis
12	ANALYSIS.PAC	B	29 MB	AQWIA PAC File	17/04/2012 07:45:58	D:\Data\Sales_Support\Sales\Demo\semisub_files\lpo\AQW\AQW\Analysis
13	ANALYSIS.PAG	B	34 MB	AQWIA PAG File	17/04/2012 07:50:23	D:\Data\Sales_Support\Sales\Demo\semisub_files\lpo\AQW\AQW\Analysis
14	ANALYSIS.PLT	B	201 KB	AQWIA PLT File	17/04/2012 07:50:25	D:\Data\Sales_Support\Sales\Demo\semisub_files\lpo\AQW\AQW\Analysis
15	ANALYSIS.POT	B	4 MB	AQWIA POT File	17/04/2012 07:45:58	D:\Data\Sales_Support\Sales\Demo\semisub_files\lpo\AQW\AQW\Analysis
16	ANALYSIS.RES	B	731 KB	AQWIA Result File	17/04/2012 07:45:59	D:\Data\Sales_Support\Sales\Demo\semisub_files\lpo\AQW\AQW\Analysis

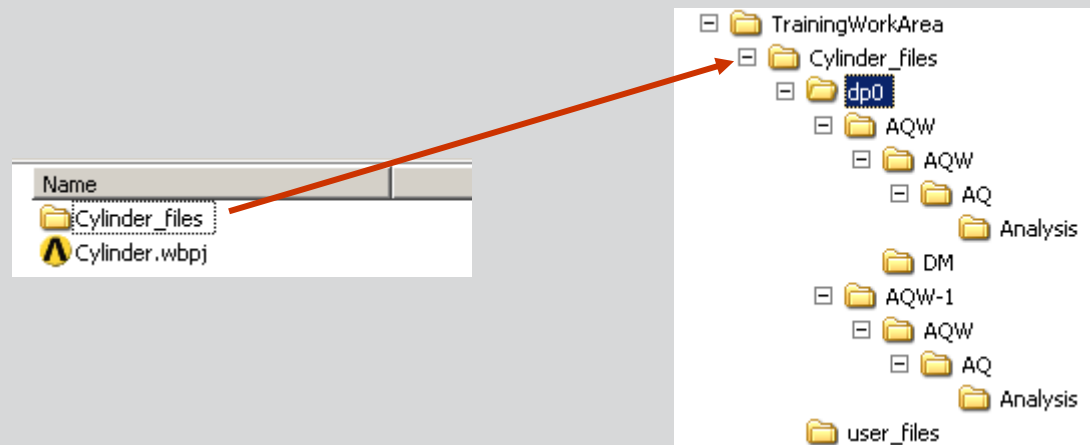
Workbench File Management

Workbench creates a project file and a series of subdirectories to manage all associated files.

When a project is saved a project file is created (.wbpj).

A project directory will be created using the project name. In this example the file is called “Cylinder.wbpj” so the directory created is “Cylinder_files”.

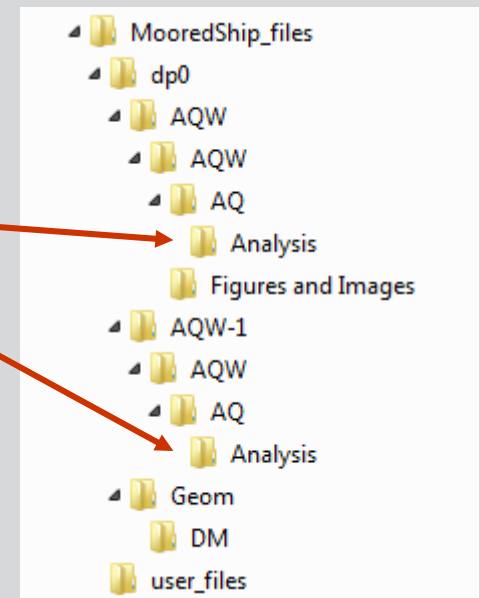
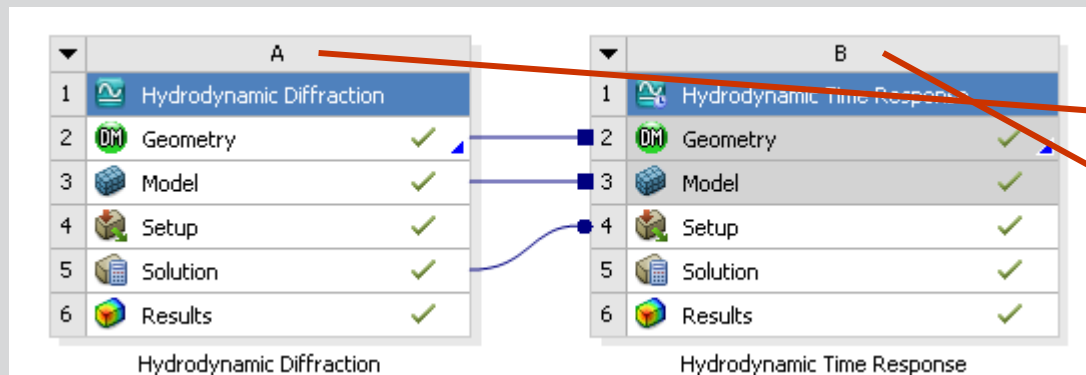
The subdirectories created are dependent on the Workbench applications used in the project.



Workbench File Management

Directory Structure:

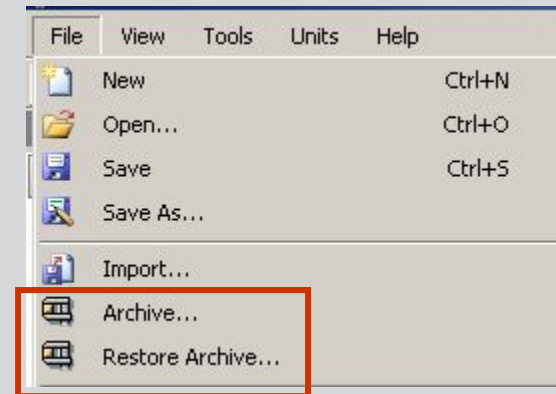
- **dpn**: this is the design point directory. This essentially is the state of all parameters for a particular analysis. In the case of a single analysis there will be only one “dp0” directory.
- **AQW-n**: contains subdirectories for each application in the analysis. In the example below the “AQW” directory will contain the database, and other associated files from the AQWA HD application. “AQW-1” directory will contain the results of the time response analysis. The “Analysis” subdirectory would contain the files associated with that particular solution.
- **user_files**: contains external user defined files that may be associated with a project. The user is free to use this directory as desired.



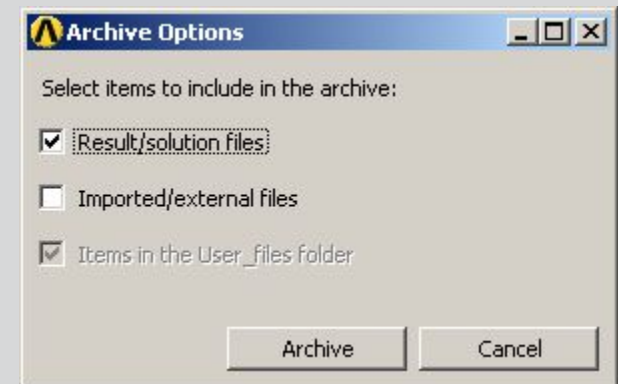
. . . Workbench File Management

Archive: quickly generates a single compressed file containing all pertinent files.

- File is zip format (.wbpz) and can be opened using the “Restore Archive . . .” utility in WB2.



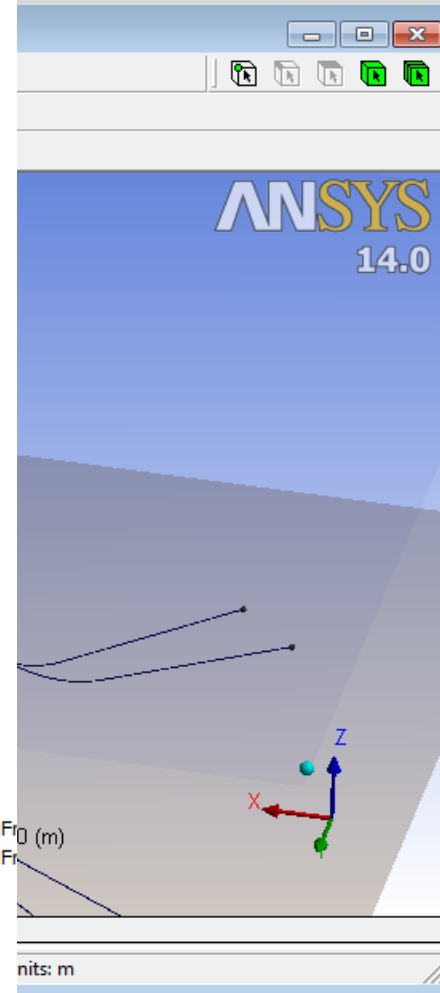
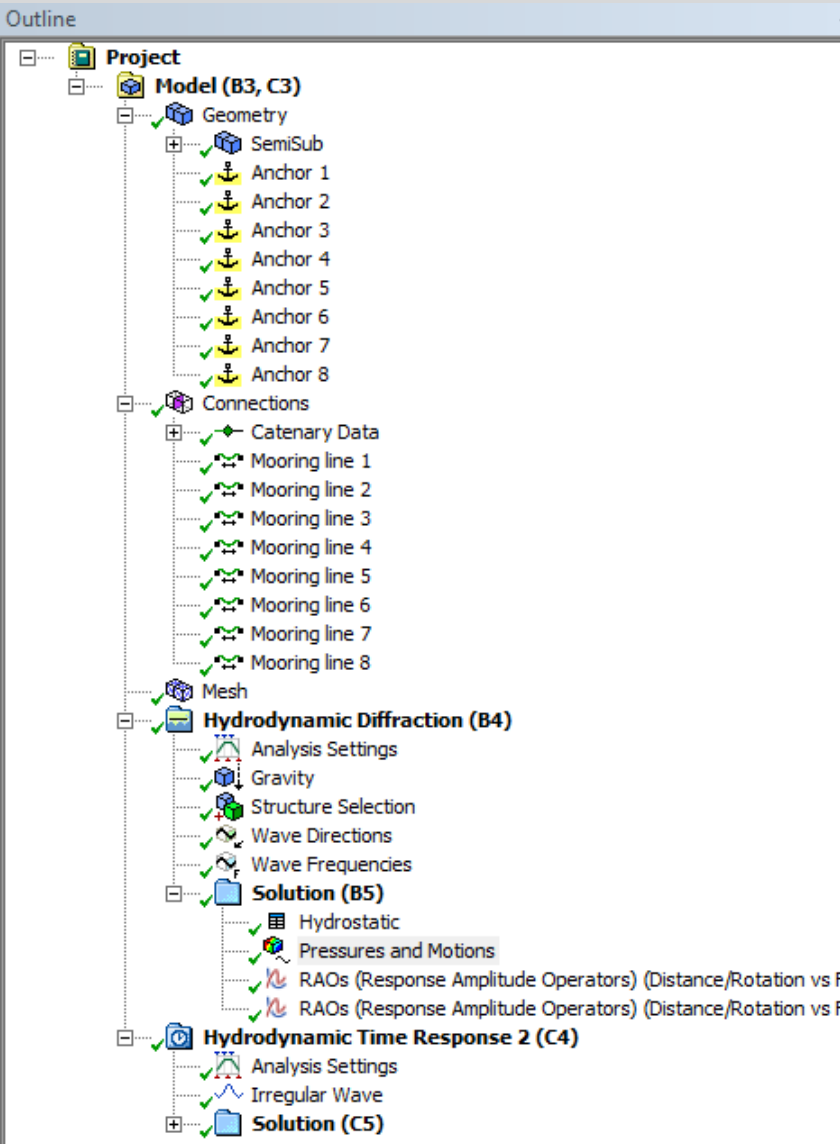
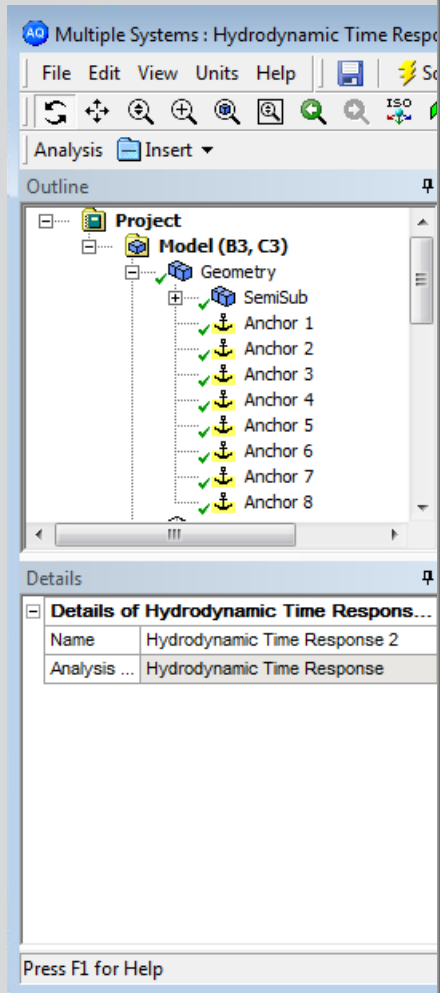
- Several options are available when archiving systems as shown here.



Launching Applications

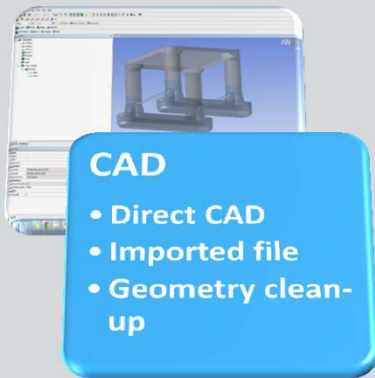
Data integrat
be launched

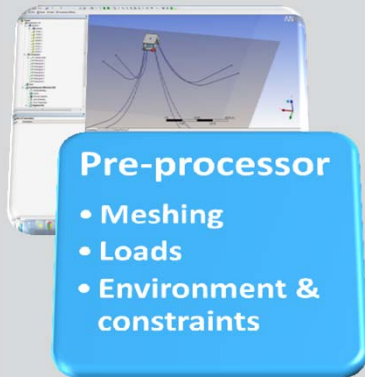
DesignModeler can
be launched by
double click.



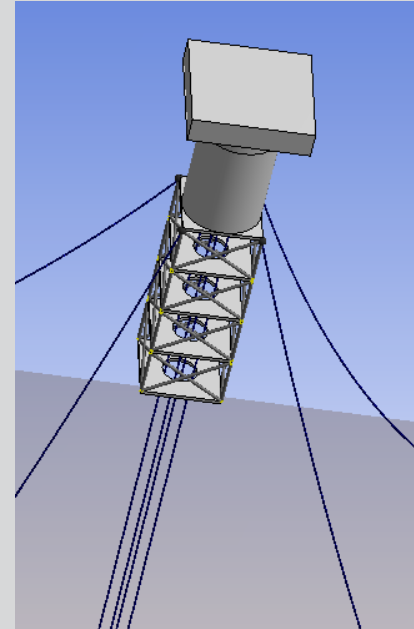
Modelling in ANSYS DesignModeler

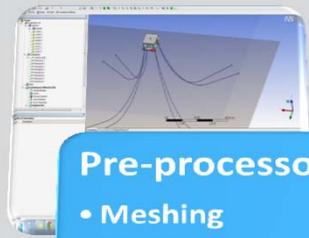
- **Import many native CAD formats**
 - IGES
 - Parasolid
- **Direct CAD links – (Bidirectional associativity and connectivity)**
 - Autodesk Inventor
 - CATIA V4 & V5
 - Solid Edge
 - SolidWorks
 - UG NX
 - Pro/ENGINEER
 - SpaceClaim
- **Any arbitrary shape**
- **Geometry definition with parametric dimensioning**
- **Geometry clean-up and simplification**





- **Diffracting or non-diffracting panels**
- **Morison elements**
 - TUBE
 - STUB
 - DISC
- **Point masses**
- **Mixed models**
- **Connection points**
- **Additional hydrostatic stiffness, damping and added mass**
- **Wind and current force coefficients**



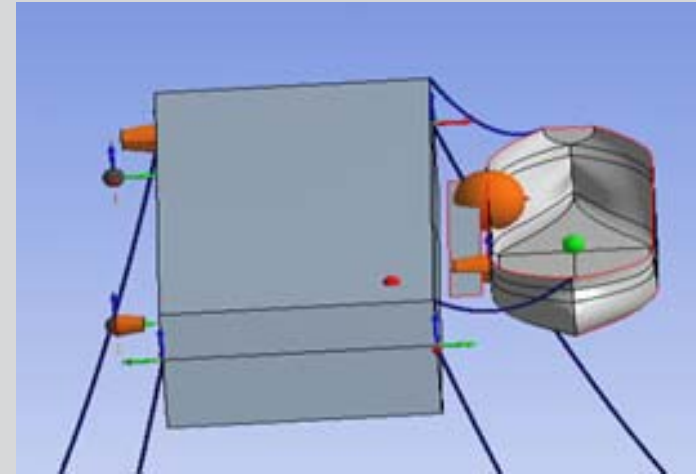


Pre-processor

- Meshing
- Loads
- Environment & constraints

Moorings

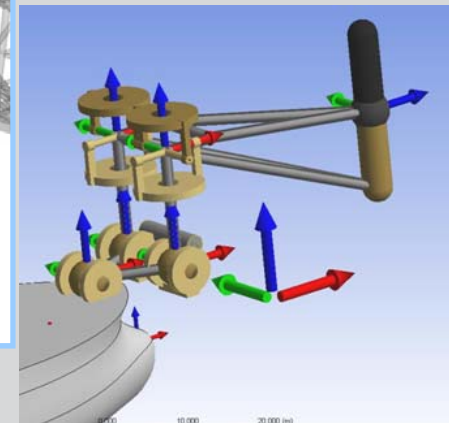
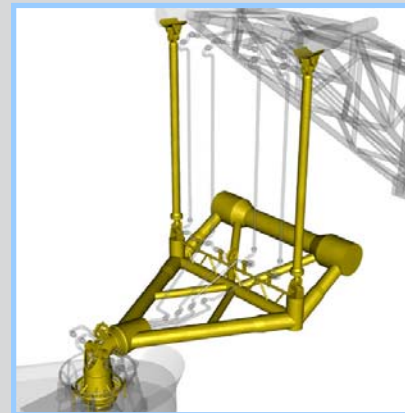
- Linear springs
- Elastic catenaries
- Intermediate buoys
- Clump weights
- Pulleys & winches

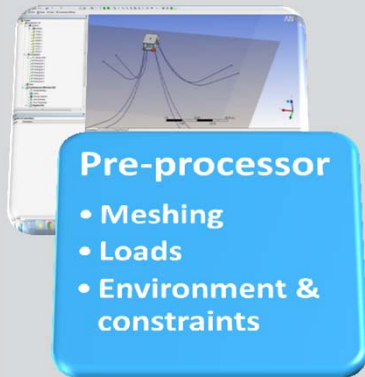


Fenders

Articulations

Stiffness matrix





Waves

- Regular / irregular
- Time history

Current

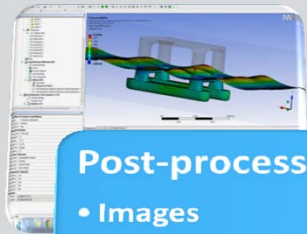
- Uniform
- Profile

Wind

- Uniform
- Spectra
- Time history

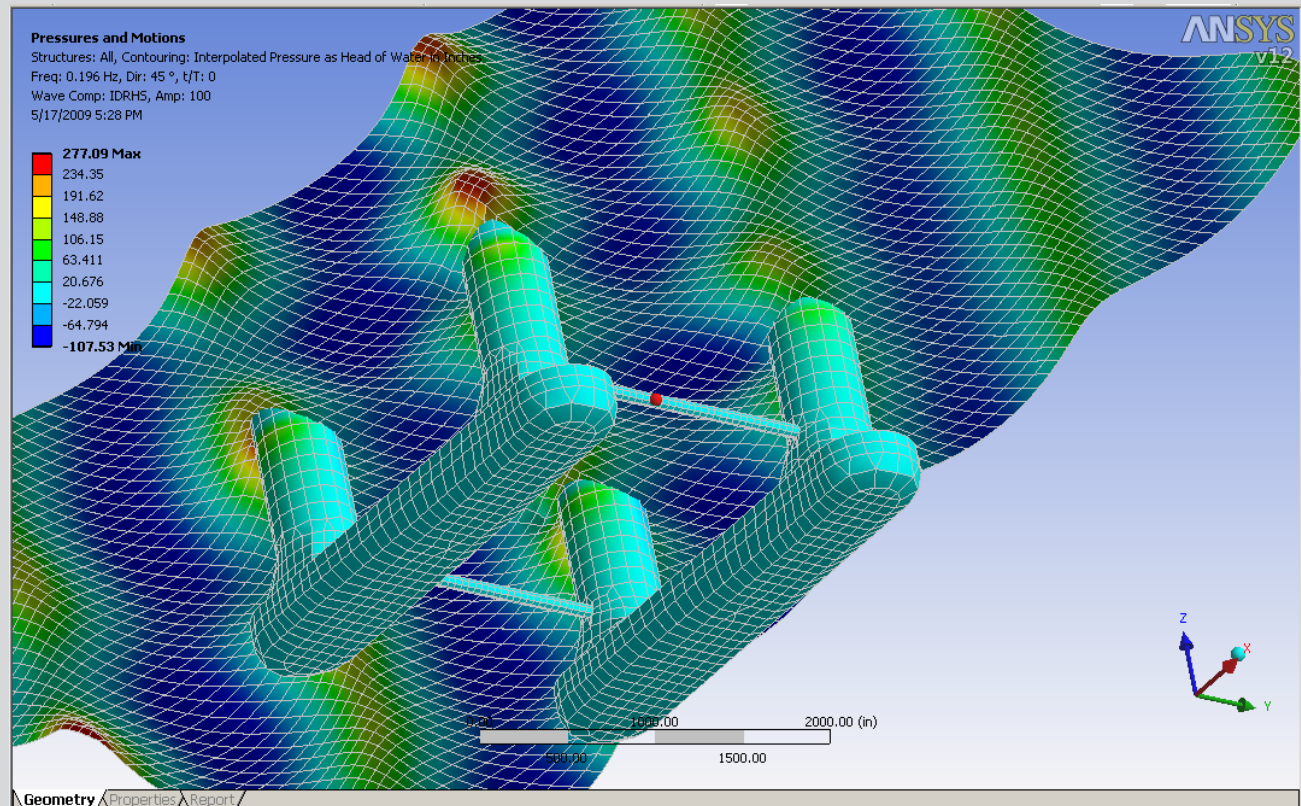
Wave Spectra

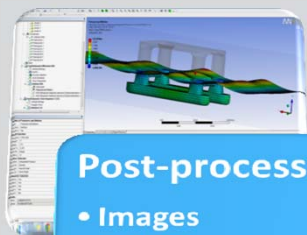
- Pierson-Moskowitz
 - JONSWAP
 - Gaussian
 - User-defined
 - Cross-swell
- Multiple simultaneous spectra
 - Interaction between spectra from different directions



Post-process

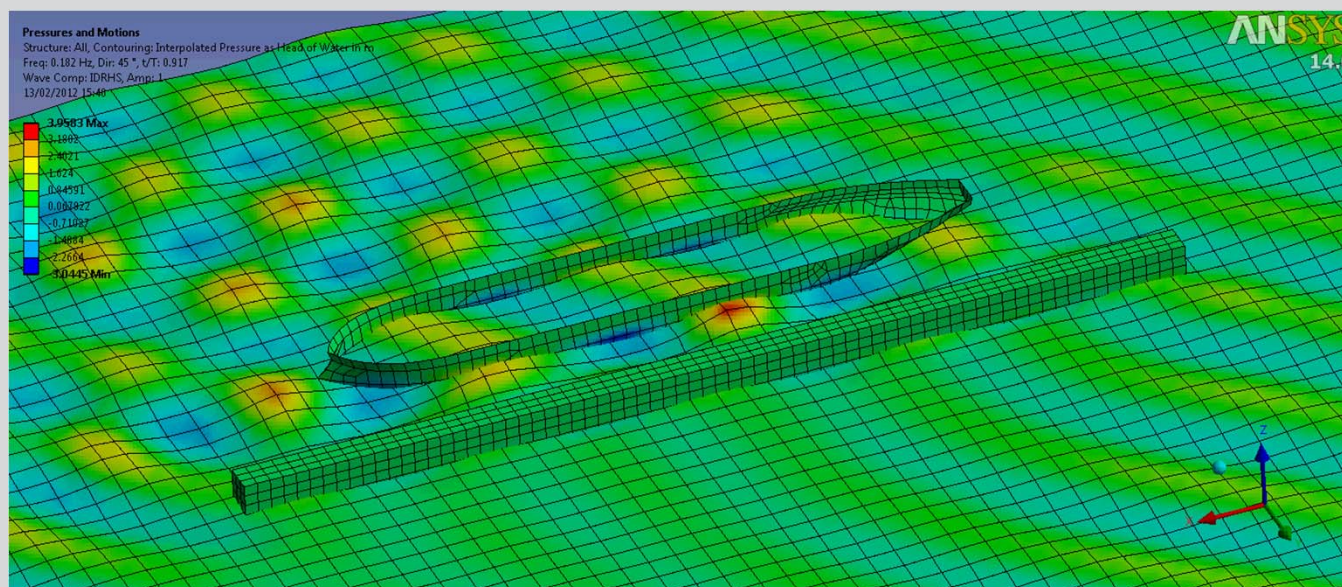
- Images
- Tables
- graphical
- Animations

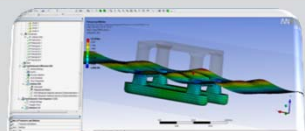




Post-process

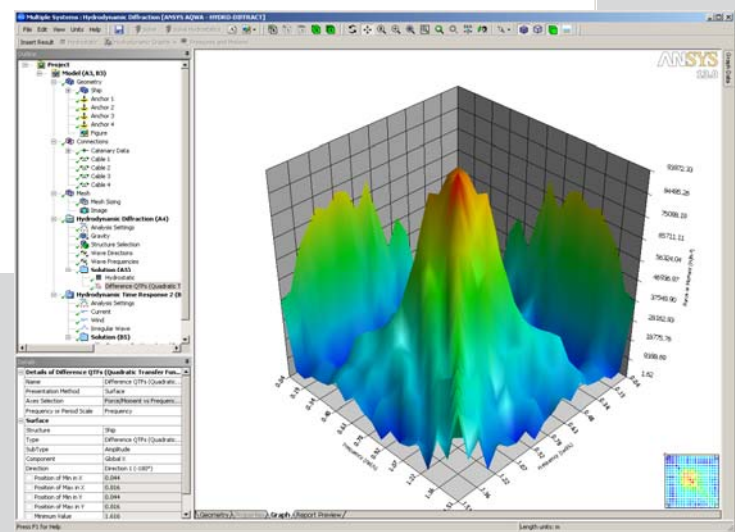
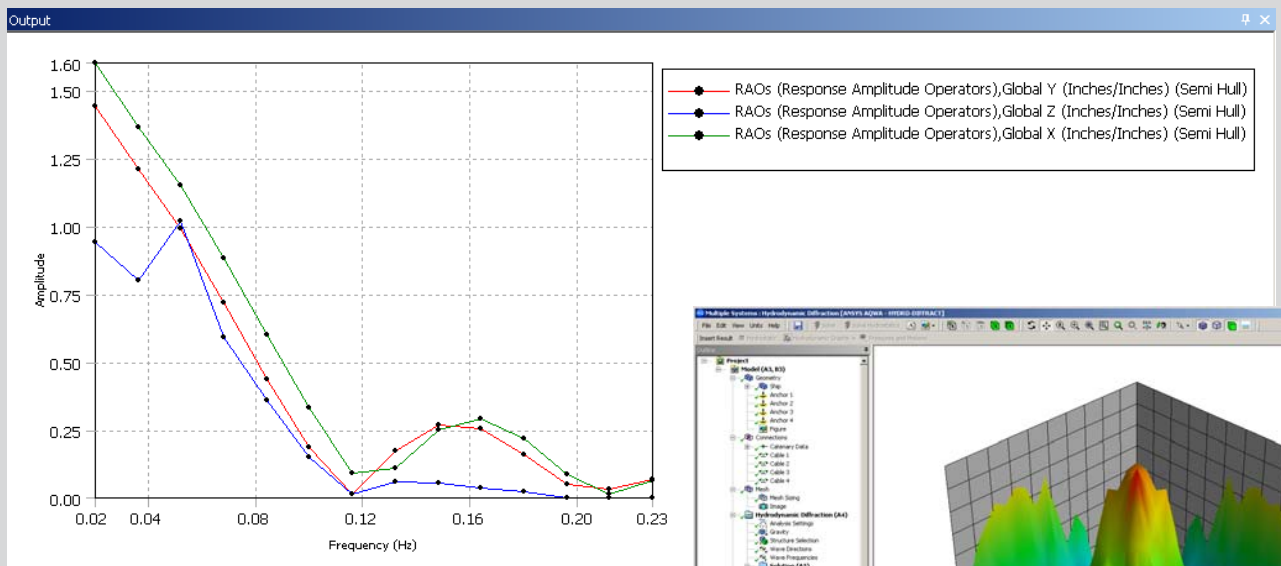
- Images
- Tables
- graphical
- Animations

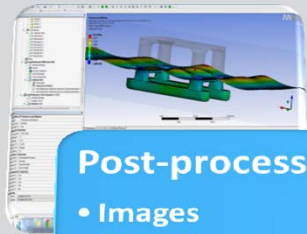




Post-process

- Images
- Tables
- graphical
- Animations





- Post-process**
- Images
 - Tables
 - graphical
 - Animations

Multiple Systems : Hydrodynamic Diffraction [ANSYS AQWA - HYDRD-DIFFRACT]

File Edit View Units Help | Solve Solve Hydrostatics | Report Preview | Send To | | PRINT | PUBLISH | Front Size

Outline

- Project
 - Model (A3, B3)
 - Geometry
 - Ship
 - Anchor 1
 - Anchor 2
 - Anchor 3
 - Anchor 4
 - Figure
 - Connections
 - Catenary Data
 - Cable 1
 - Cable 2
 - Cable 3
 - Cable 4
 - Mesh
 - Mesh Scoping
 - Image
 - Hydrodynamic Diffraction (A4)
 - Analysis Settings
 - Gravity
 - Structure Selection
 - Wave Directions
 - Wave Frequencies
 - Solution (A5)
 - Hydrostatic
 - Hydrodynamic Time Response 2 (B4)
 - Analysis Settings
 - Current
 - Wind
 - Irregular Wave
 - Solution (B5)
 - Structure Position, Actual Resp...

Details

Details of Project

Name	Project
Author	
Reference	
Project Title	
Description	
Data Folder Root	C:\ANSYS\UGM2010\Aqwa_13_...
Date Details	
Date of Creation	9/10/2010 6:06:47 AM
Last Modified	9/16/2010 11:22:39 AM

Geometry

TABLE 2
Model (A3, B3) > Geometry

Object Name	Geometry
State	Fully Defined
Details of Geometry	
Attached Assembly Name	C:\aqwa\aqwa_data\AQWAWD\ship.agdb
Sea Geometry	
Water Level	0 m
Water Depth	500 m
Water Density	1025 kg/m ³
Water Size X	1000 m
Water Size Y	1000 m
Import Preferences	
Import Solid Bodies	No
Import Surface Bodies	Yes
Import Line Bodies	Yes

Ship

TABLE 3
Model (A3, B3) > Geometry > Part

Object Name	Ship
State	Fully Defined
Details of Ship	
Part Visibility	Visible
Suppressed	Not Suppressed
Generate Internal Lid	No
Current Calculation Depth	0 m
Fixity Options	
Structure Fixity	Structure is Free to Move
Force Factors	
Drag Factor	1
Mass Factor	1
Slam Factor	0
Advanced Options	
Submerged Structure Detection	Program Controlled
Override Calculated GMX	No
Override Calculated GMY	No
Non-Linear Roll Damping	
Non-Linear Roll Damping	Excluded from Calculations

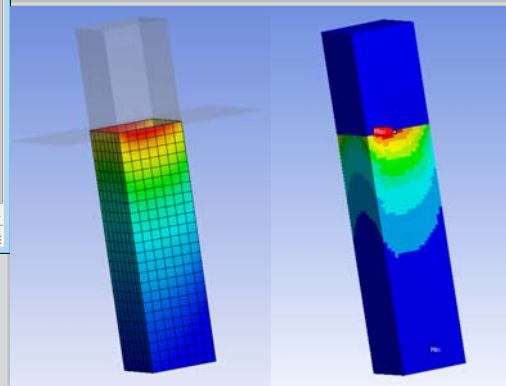
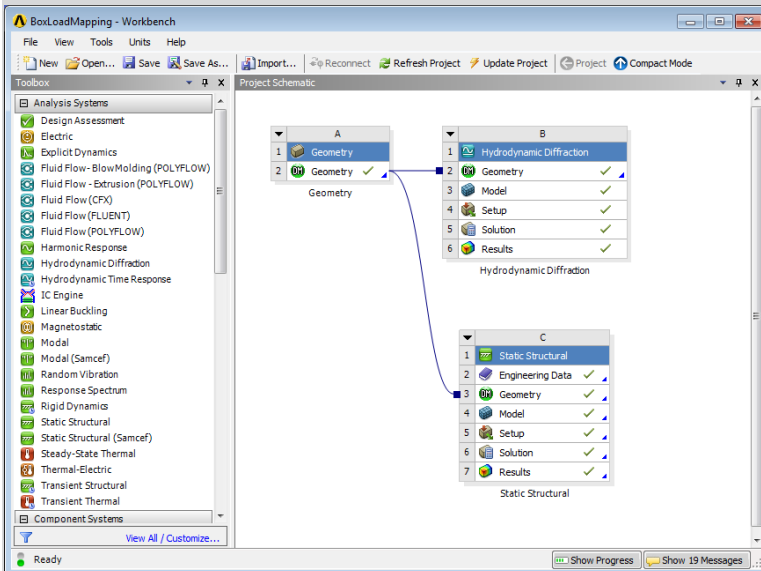
TABLE 4
Model (A3, B3) > Geometry > Ship > Point Mass

Press F1 for Help | Length units: m

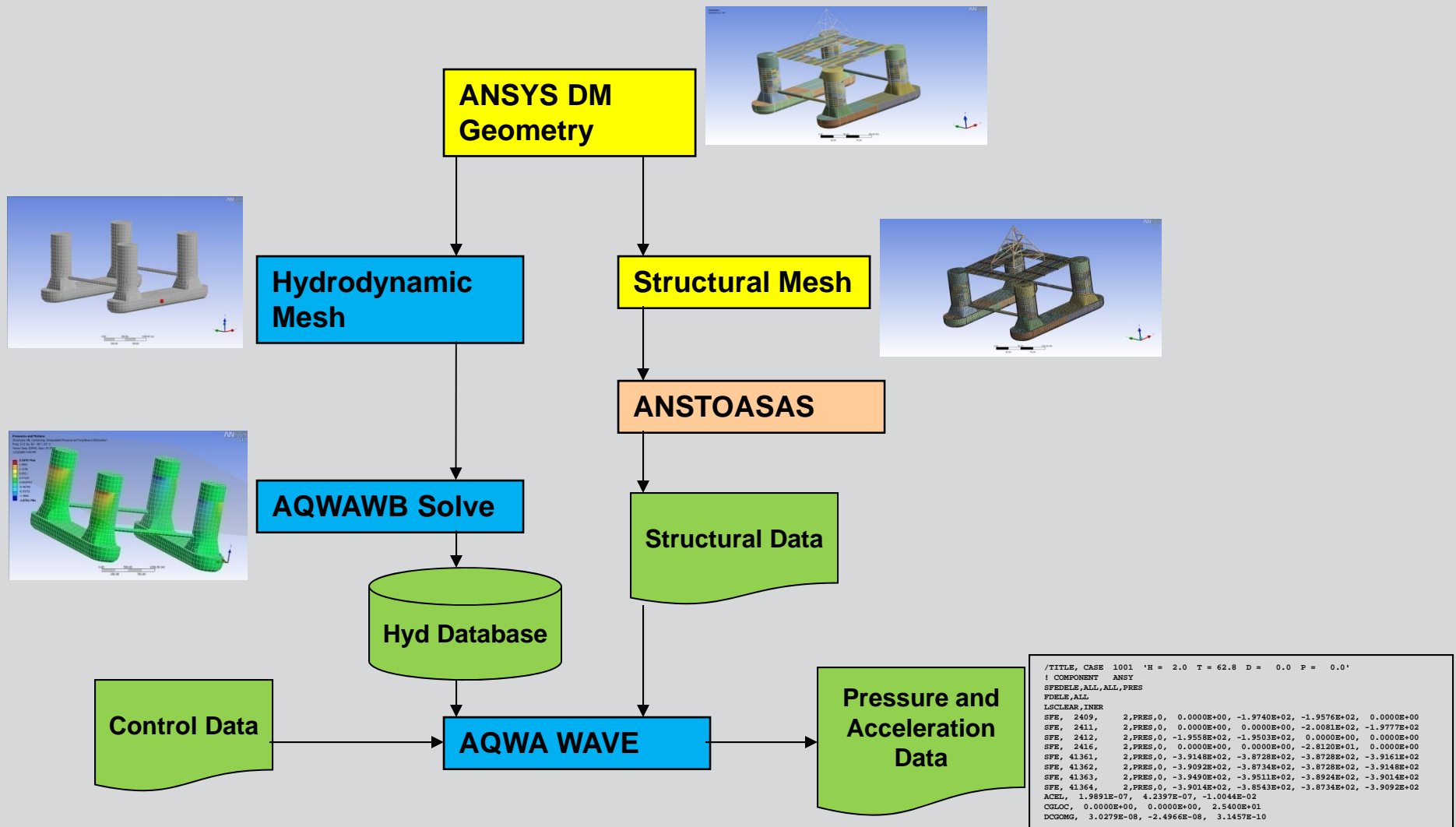
Load Mapping

Load Transfer/Mapping

Calculation and transfer of hydrodynamic loads to ANSYS for structural analysis



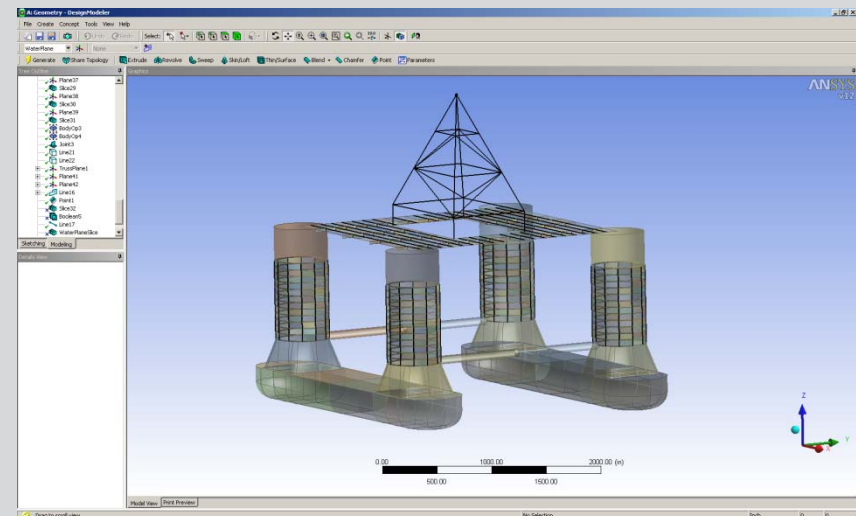
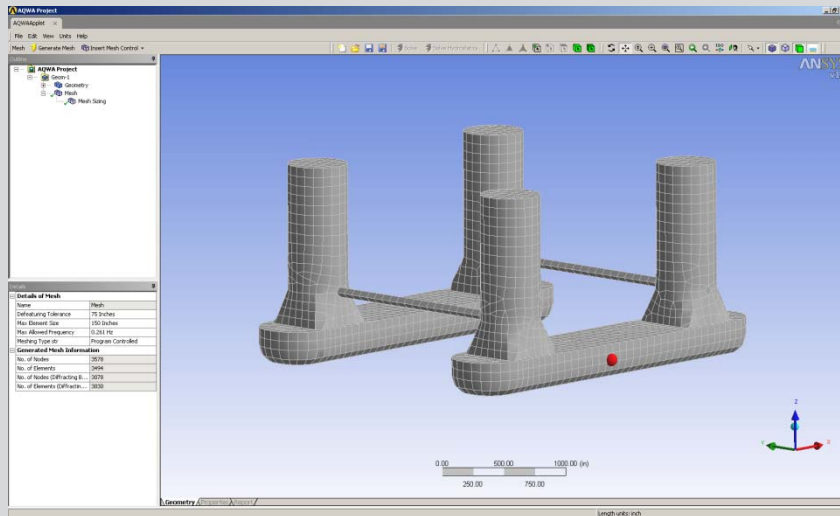
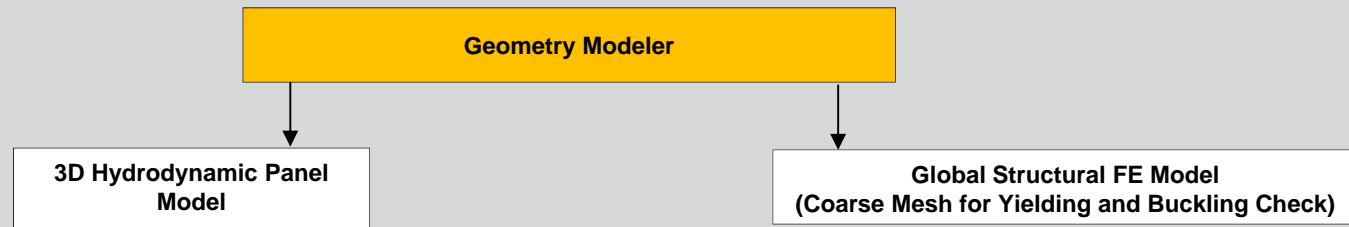
Pre-14 ANSYS Load Transfer Requirements



```

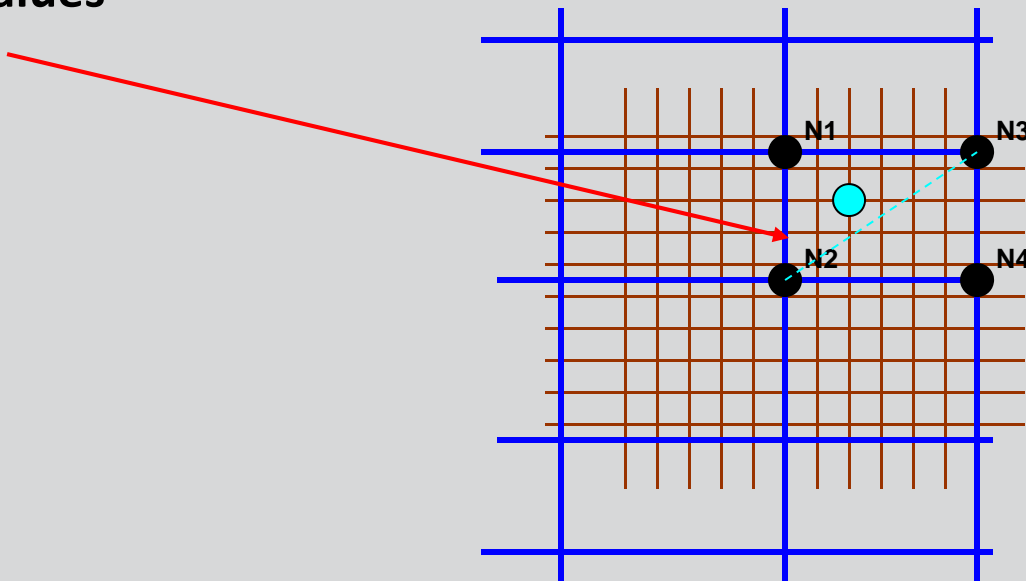
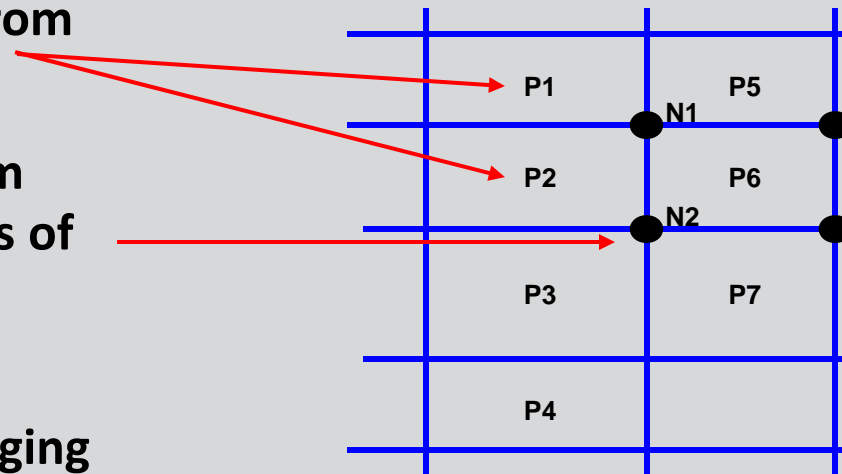
/TITLE, CASE 1001 'H = 2.0 T = 62.8 D = 0.0 P = 0.0'
1 COMPONENT ANSYS
SFEDELE,ALL,ALL,PRES
FDELE,ALL
LSCLEAR,INER
SFE, 2409, 2,PRES,0, 0.0000E+00, -1.9740E+02, -1.9576E+02, 0.0000E+00
SFE, 2411, 2,PRES,0, 0.0000E+00, 0.0000E+00, -2.0081E+02, -1.9777E+02
SFE, 2412, 2,PRES,0, -1.9558E+02, -1.9503E+02, 0.0000E+00, 0.0000E+00
SFE, 2416, 2,PRES,0, 0.0000E+00, 0.0000E+00, -2.8120E+01, 0.0000E+00
SFE, 41361, 2,PRES,0, -3.9148E+02, -3.8728E+02, -3.8728E+02, -3.9161E+02
SFE, 41362, 2,PRES,0, -3.9092E+02, -3.8734E+02, -3.8728E+02, -3.9148E+02
SFE, 41363, 2,PRES,0, -3.9490E+02, -3.9511E+02, -3.8924E+02, -3.9014E+02
SFE, 41364, 2,PRES,0, -3.9014E+02, -3.8543E+02, -3.8734E+02, -3.9092E+02
ACEL, 1.9891E-07, 4.2397E-07, -1.0044E-02
CGLOC, 0.0000E+00, 0.0000E+00, 2.5400E+01
DCGOMG, 3.0279E-08, -2.4966E-08, 3.1457E-10
  
```

14.0 Load Mapping Process



...Load Transfer Requirements

- Panel pressures are extracted from database
- Nodal values are computed from weighted averaging of pressures of connected panels
- Finite element nodal pressures computed from weighted averaging of hydrodynamic nodal values





Load mapping to Mechanical/APDL

BoxLoadMapping - Workbench

File View Tools Units Help

New Open... Save Save As... Import... Reconnect Refresh Project Update Project Project Compact Mode

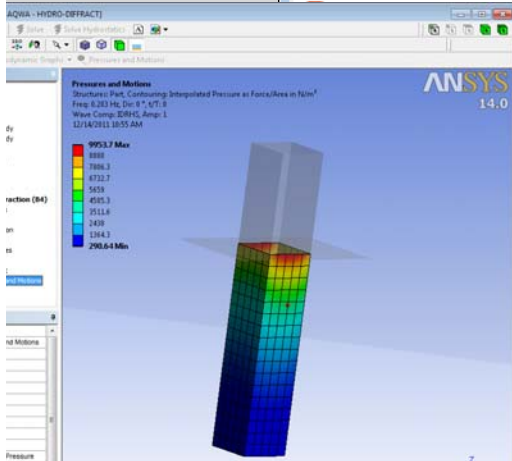
Toolbox

- Analysis Systems
- Design Assessment
- Electric
- Explicit Dynamics
- Fluid Flow - BlowMolding (POLYFLOW)
- Fluid Flow - Extrusion (POLYFLOW)
- Fluid Flow (CFX)
- Fluid Flow (FLUENT)
- Fluid Flow (POLYFLOW)
- Harmonic Response
- Hydrodynamic Diffraction
- Hydrodynamic Time Response
- IC Engine
- Linear Buckling
- Magnetostatic
- Modal
- Modal (Samcef)
- Random Vibration
- Response Spectrum
- Rigid Dynamics
- Static Structural
- Static Structural (Samcef)

Project Schematic

- A
 - 1 Geometry
 - 2 Geometry
- B
 - 1 Hydrodynamic Diffraction
 - 2 Geometry
 - 3 Model
 - 4 Setup
 - 5 Solution
 - 6 Results
- C
 - 1 Static Structural
 - 2 Engineering Data
 - 3 Geometry
 - 4 Model
 - 5 Setup
 - 6 Solution
 - 7 Results

Show Progress Show 19 Messages



ber 26, 2012

Release

Details of Mesh

Defaults

Physics Preference: Mechanical

Reference: 0

Naming

Inflation

Patch Conforming Options

Triangle Surface Mesher / Program Controls

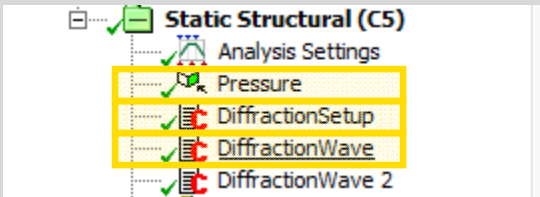
Advanced

Deformation

Statistics

Press F1 for Help

Tree Items For Pressure Mapping at 14.0



Details of "DiffractionWave"	
File	
File Name	C:\ANSYS\LoadMapping...
File Status	All data current
Definition	
Suppressed	No
Step Selection Mode	By Number
Step Number	1.
Target	Mechanical APDL
Input Arguments	
<input type="checkbox"/> ARG1	1024.
<input type="checkbox"/> ARG2	9.81
Step Number	1.
Target	Mechanical APDL
Input Arguments	
<input type="checkbox"/> ARG1	0.
<input type="checkbox"/> ARG2	2.
<input type="checkbox"/> ARG3	10.
<input type="checkbox"/> ARG4	0.

```

*DIM, _aqwaAnalysis, STRING, 248
waveDir = arg1
*DIM, runCommand, STRING, 248
waveHeight = arg2
_aqwaAnalysis(1) = arg3
wavePeriod = arg4
wavePhase = arg#
runCommand(1) = 'C:\Program Files\ANSYS Inc\v140\aqwa\bin\winx64\AQWA2NEUT'
*cfopen, run, txt
octype, _idwat, basic, ocean, , _idwav
write, runCommand(1), _aqwaAnalysis(1)
ocdata, 0, waveDir
/SYS, 0, 1e-003, 0
*octable, _wavePeriod, _wavePhase
*cfclose, _waveHeight, _wavePeriod, _wavePhase
/input, run, txt
ocread, _aqwaAnalysis(1), and
_aqwaAnalysis(1) = '%_aqwaAnalysis(1)%_1'

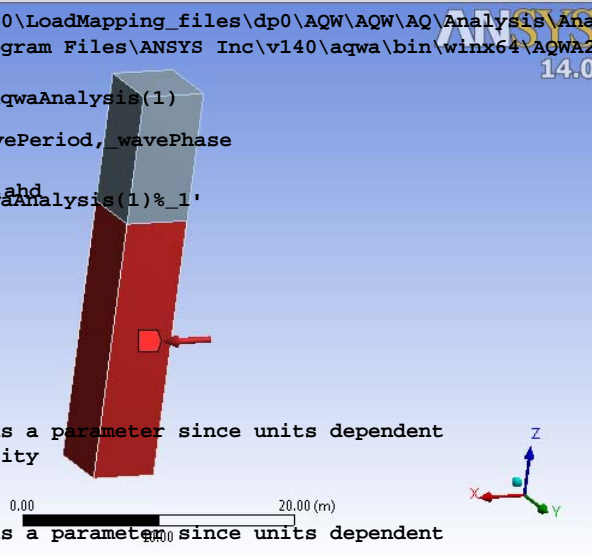
waveDir =
_aqwaDensity = arg1
waveHeight =
_aqwaGrav = arg2
wavePeriod =
wavePhase =
matwat = 2000
_idwat = 2001
_idwav = 2003

! This should be passed as a parameter since units dependent
mp, dens, _matwat, _aqwaDensity
_aqwaDensity =

! This should be passed as a parameter since units dependent
acel, 0, 0, _aqwaGrav
_aqwaGrav =

! Set up basic wave information
octype, _idwat, basic, ocean, , _idwav
ocdata, 1000.0, _matwat

/PREP7
_maxEtypes = ETYIQR(0,14)
*do, _et, 1, _maxEtypes
*if, ETYIQR(_et, 1), le, 0, cycle
*if, ETYIQR(_et, -2), eq, 154, then
keyopt, _et, 8, _idwat
*endif
*enddo
/SOLU
    
```



C: Static Structural - Mechanical [ANSYS Multiphysics]
 Equivalent Stress
 Type: Equivalent (von-Mises) Stress
 Unit: Pa
 Time: 1
 12/14/2011 11:46 AM

7.4448e6 Max
 6.6178e6
 5.7907e6
 4.9636e6
 4.1365e6
 3.3094e6
 2.4824e6
 1.6553e6
 8.2819e5
1114.6 Min

Details of "Equivalent Stress"

Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Shell	Top/Bottom
Layer	Entire Section
Definition	
Type	Equivalent (von-Mis...)
By	Time
Display Time	1. s
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Results	
Minimum	1114.6 Pa
Maximum	7.4448e+006 Pa
Minimum Occurs On	Surface Body
Maximum Occurs On	Surface Body
Minimum Value Over Time	

C: Static Structural - Mechanical [ANSYS Multiphysics]
 Equivalent Stress
 Type: Equivalent (von-Mises) Stress - Top/Bottom - Layer 0
 Unit: Pa
 Time: 2
 12/14/2011 11:44 AM

5.6465e6 Max
 5.0197e6
 4.3928e6
 3.766e6
 3.1391e6
 2.5123e6
 1.8854e6
 1.2586e6
 6.3173e5
4875.1 Min

Details of "Equivalent Stress"

Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Shell	Top/Bottom
Layer	Entire Section
Definition	
Type	Equivalent (von-Mis...)
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Results	
Minimum	4875.1 Pa
Maximum	5.6465e+006 Pa
Minimum Occurs On	Surface Body
Maximum Occurs On	Surface Body
Minimum Value Over Time	

Graph

Time [s]	Minimum [Pa]	Maximum [Pa]
1	1114.6	7.4448e+006
2	4875.1	5.6465e+006

Thank You



Fluid Dynamics

Structural Mechanics

Electromagnetics

Systems and Multiphysics

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