

예제로 쉽게 배우는 Ansys LS-DYNA

4. SPH를 적용한 유체와 구조의 폭발해석

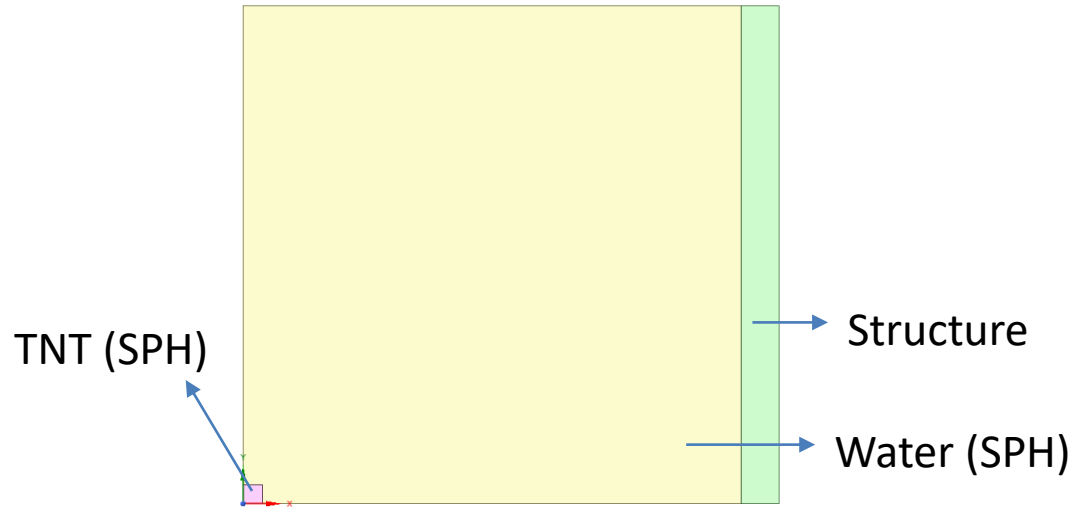
Contents

1. 요약
2. 전처리
3. 해석 & 후처리

1. 개요

1. 개요

해석 모델



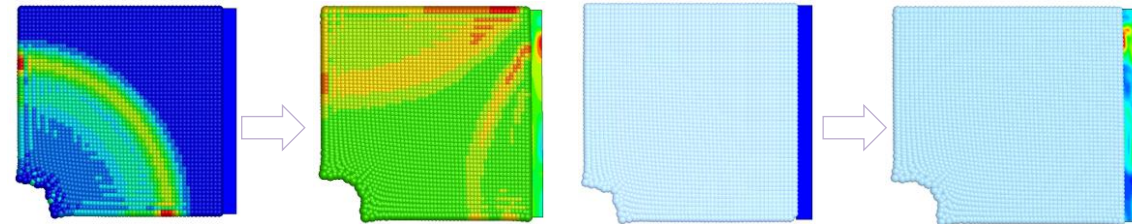
목표

Workbench LS-DYNA 사용자 환경을 익히고
SPH 기법을 적용하여 FSI 해석을 수행하고
해석 결과 살펴보기

과정

1. Workbench LS-DYNA Analysis System 생성
2. 단위 시스템 및 재료 속성 선택
3. 3D 모델 가져오고 SPH 격자 생성
4. 하중 및 구속조건, 해석 옵션 설정
5. 해석
6. 결과 확인 하기

결과



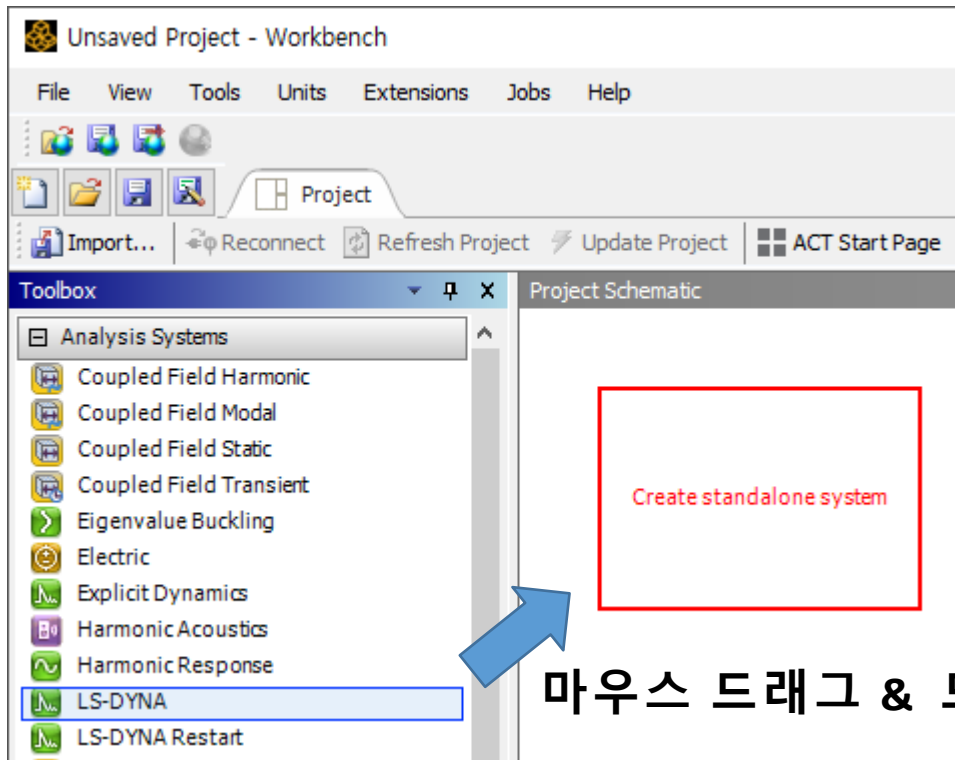
Pressure

Stress

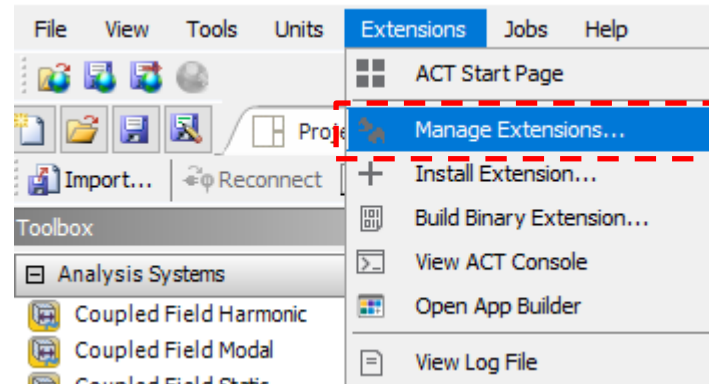
2. 전처리

2. 전처리

• Workbench LS-DYNA 해석 시스템 생성



마우스 드래그 & 드롭



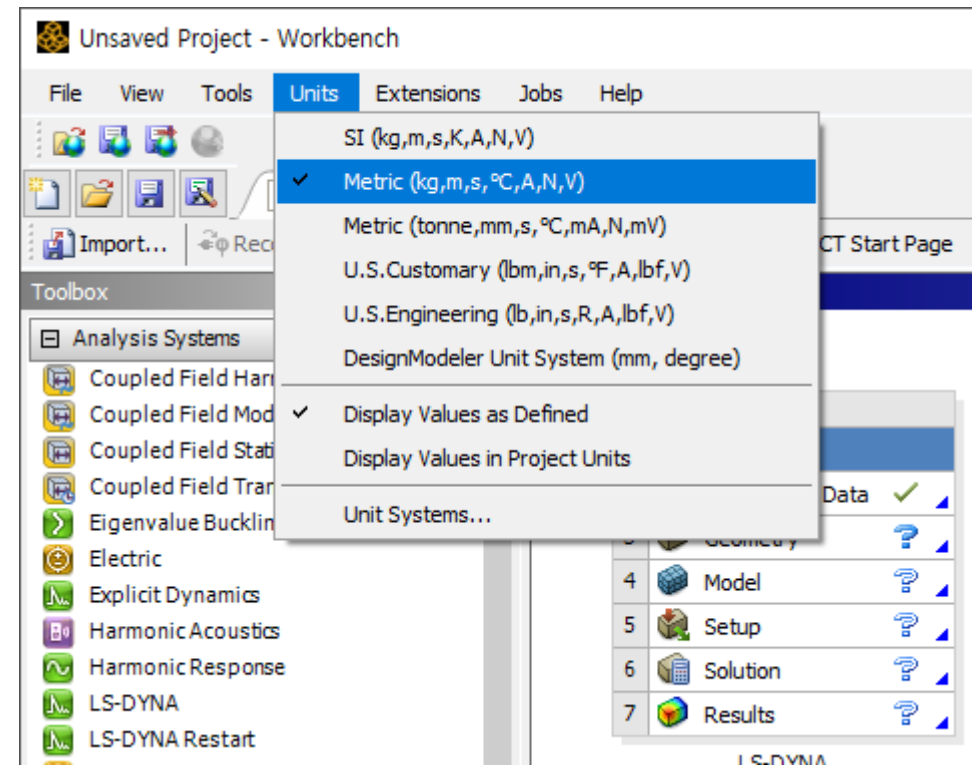
Loaded	Extensions	Type	Version
<input type="checkbox"/>	AqwaCosimulation	Binary	2023.1
<input type="checkbox"/>	EnSight	Binary	2022.2
<input type="checkbox"/>	EnSight Forte	Binary	2022.2
<input type="checkbox"/>	EulerRemapping	Binary	2023.1
<input checked="" type="checkbox"/>	keywordmanager	Binary	2022.2
<input type="checkbox"/>	RestartAnalysis	Binary	2023.1

Keyword manager Extension 추가

2. 전처리

• 단위 시스템 확인

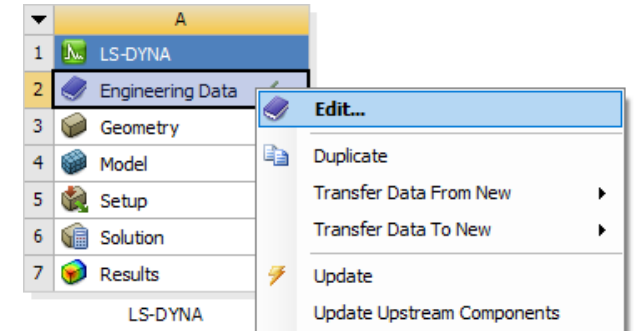
- 해석에 사용할 단위 시스템 선택
- 해석에서 주요하게 사용되는 단위들을 미리 정의된 단위 시스템 그룹을 선택함으로써 설정할 수 있음



2. 전처리

• 재료 모델 생성

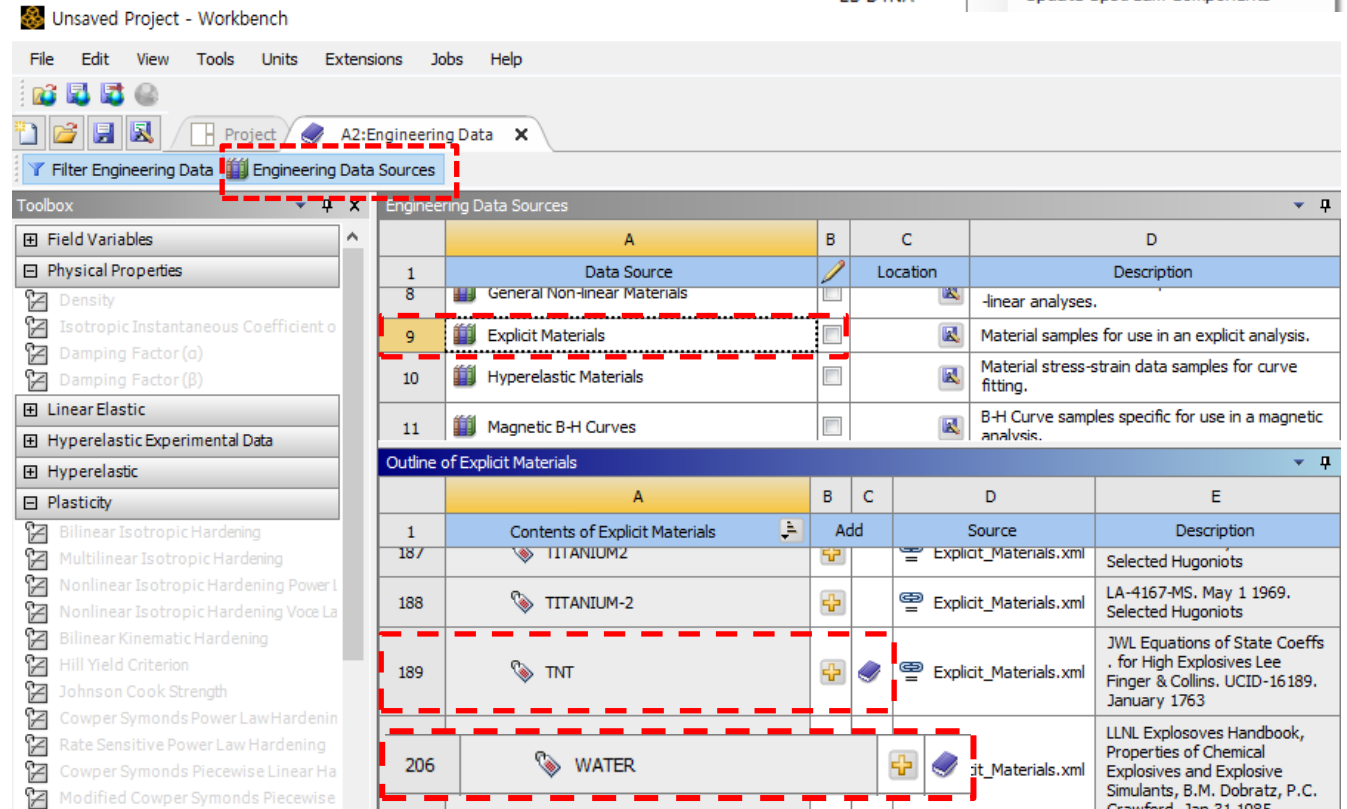
➤ Engineering Data에서 마우스 우클릭 후 “Edit” (또는 더블 클릭)



➤ **Engineering Data Sources** 활성화

➤ Explicit Materials > **TNT** > Add

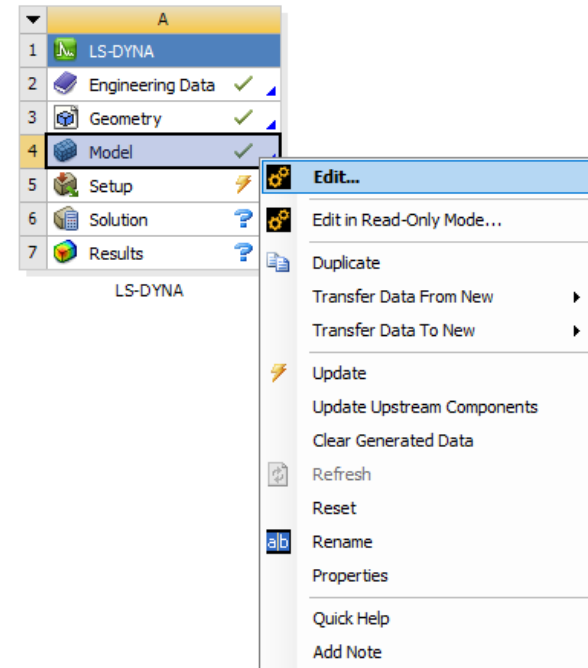
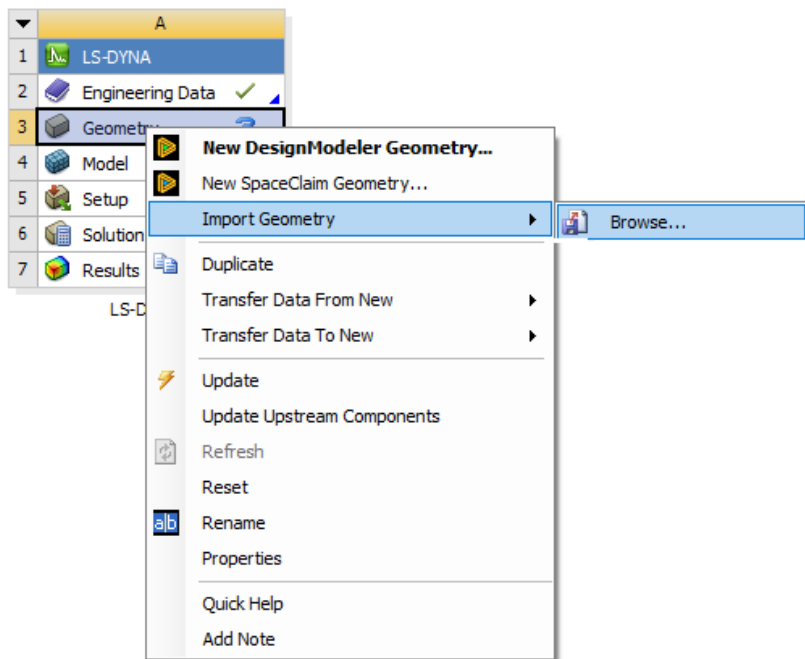
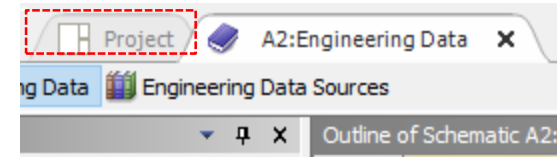
➤ Explicit Materials > **Water** > Add



2. 전처리

• CAD모델 가져오기 및 WB LS-DYNA 실행

- “Project” 탭을 클릭하여 Project 화면으로 전환
- “Geometry” 항목에서 CAD 모델 가져오기(“sph_geo.stp”)
- “Model”에서 마우스 우클릭 후 Workbench LS-DYNA 실행



2. 전처리

• 단위 확인 및 재료모델 적용

➤ Workbench LS-DYNA가 실행되면 단위 시스템 재 확인

➤ 각 파트를 클릭 후 재료 물성 변경

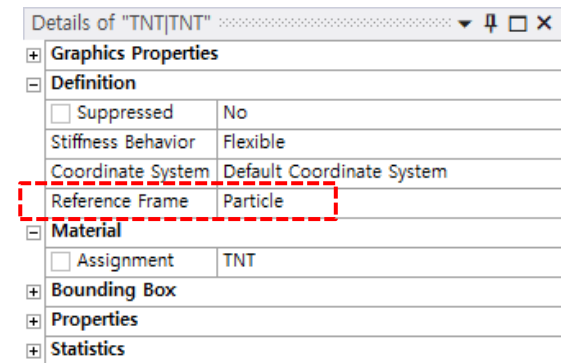
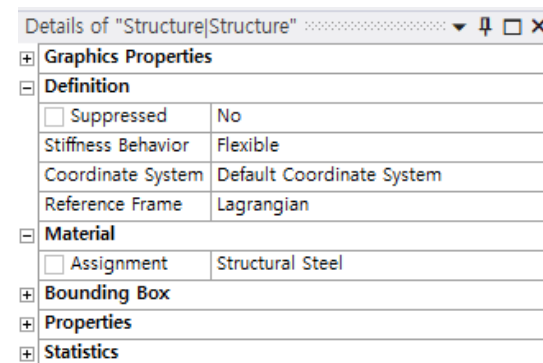
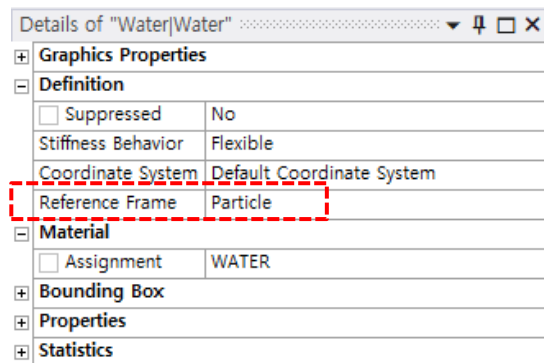
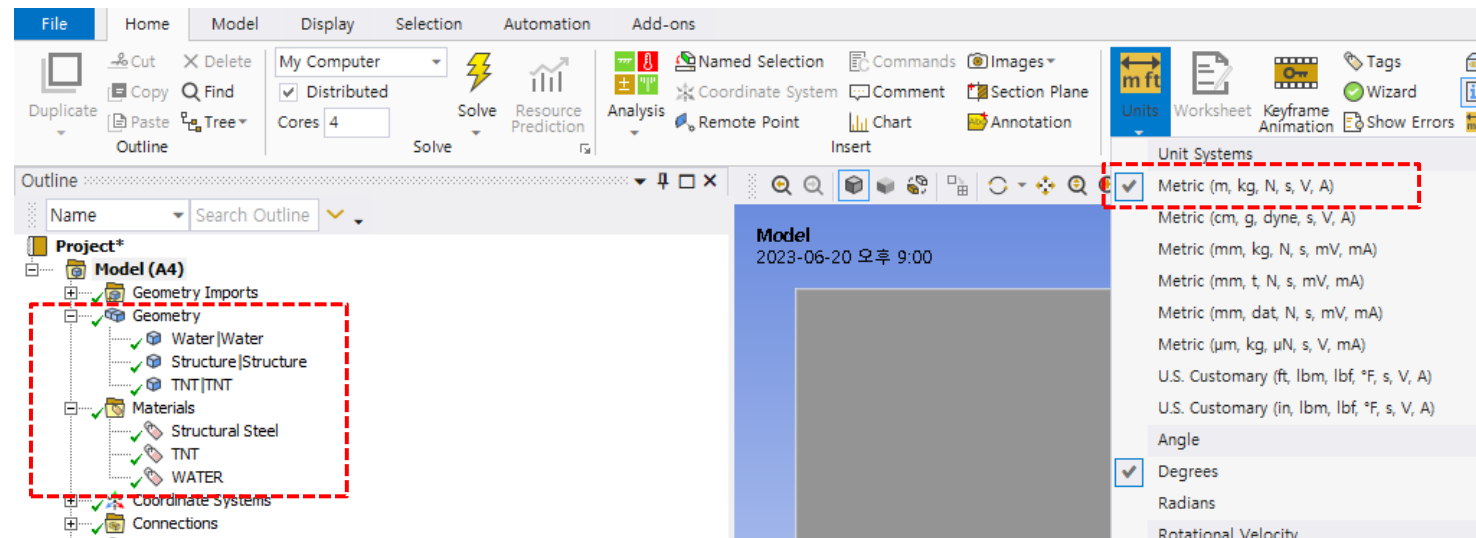
→ Water : WATER

→ Structure : Structural Steel

→ TNT : TNT

➤ SPH 파트

→ Reference Frame : Particle 설정



2. 전처리

• 해석 옵션 정의

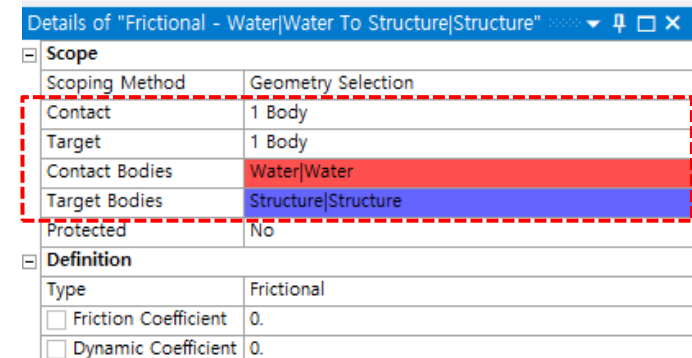
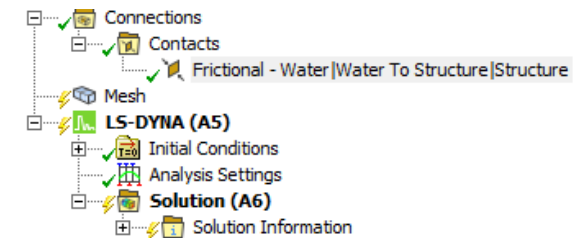
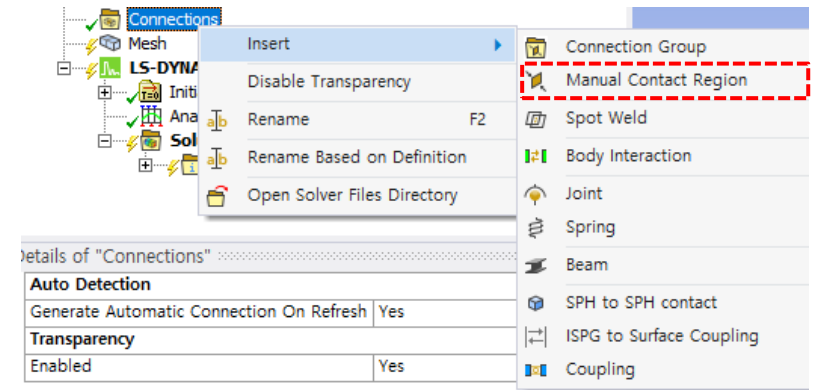
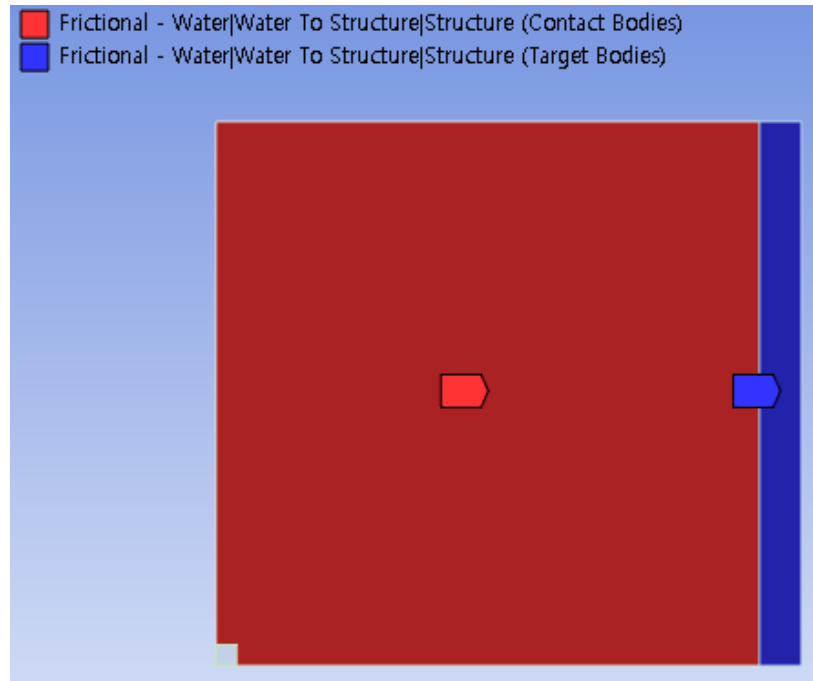
- End time 설정 : 0.01 s
- Unit System : **mks** 선택
- 다른 설정은 Default 사용

Step Controls	
End Time	0.003 s
Time Step Safety Factor	0.9
Maximum Number Of Cycles	10000000
Automatic Mass Scaling	No
Number of Cases	0
CPU and Memory Management	
Memory Allocation	Program Controlled
Number Of CPUS	1
Processing Type	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Solver Precision	Program Controlled
Unit System	mks
Explicit Solution Only	Yes
Invariant Node Numbering	Off
Second Order Stress Update	No
Solver Version	Program Controlled

2. 전처리

• 접촉 조건 정의

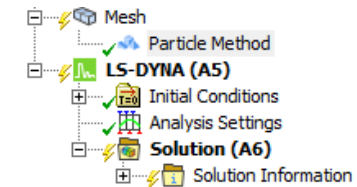
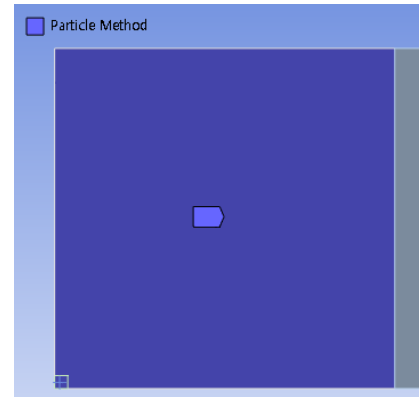
- “Connection”메뉴에서 자동 생성된 접촉 → Suppress 또는 Delete
- Connections > Insert > **Manual Contact Region** 생성



2. 전처리

• 격자 생성

- “Mesh”메뉴에서 Element Size를 **0.025 m**로 변경
- Mesh > Insert > Method 생성
 - “Water”, “TNT” Body 선택
 - Method : **Particle** 선택
 - Particle Diameter : 0.025 m
- “Mesh”에서 우클릭하여 “Generate Mesh”를 실행
- 생성된 격자 확인



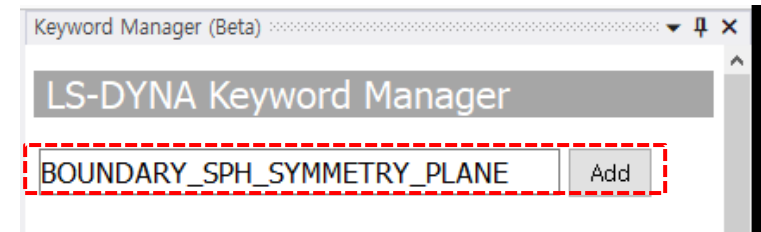
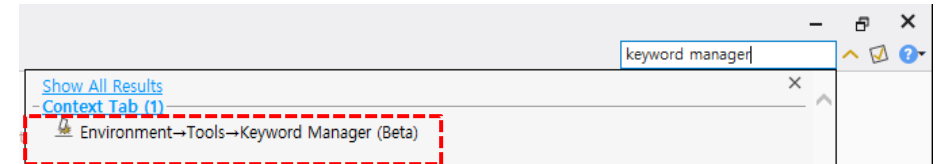
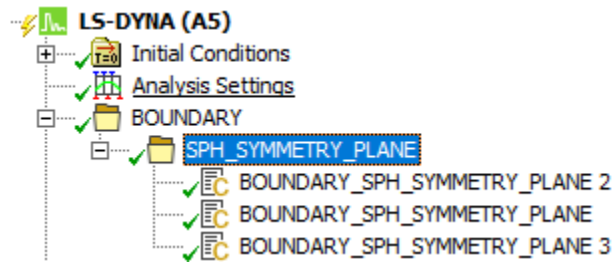
Details of "Particle Method" - Method	
Scope	
Scoping Method	Geometry Selection
Geometry	2 Bodies
Definition	
Suppressed	No
Method	Particle
Particle Diameter	2.5e-002 m
Control Messages	No



2. 전처리

• 경계조건 설정

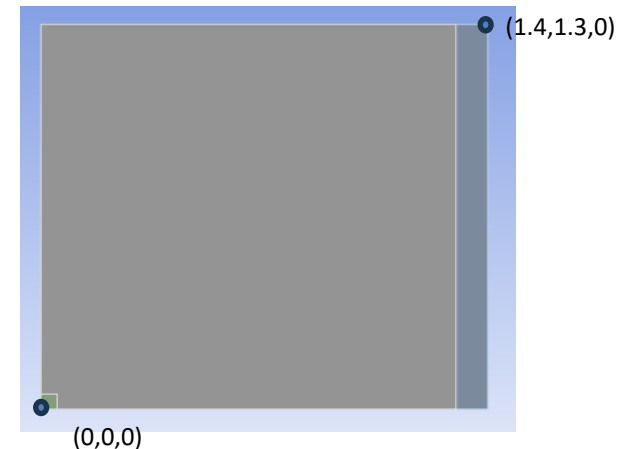
- Quick Launch 창 > **Keyword Manager** 입력 > 기능 활성화
- 검색창 > **BOUNDARY_SPH_SYMMETRY_PLANE** 추가
→ tail 및 head 좌표 입력



Details of "BOUNDARY_SPH_SYMMETRY_PLANE "	
Definition	
UnitSystem	mks
Card 1	
<input type="checkbox"/> x-coordinate of tail of a ...	0
<input type="checkbox"/> y-coordinate of tail	1.3
<input type="checkbox"/> z-coordinate of tail	0
<input type="checkbox"/> x-coordinate of head	0
<input type="checkbox"/> y-coordinate of head	1.2
<input type="checkbox"/> z-coordinate of head	0

Details of "BOUNDARY_SPH_SYMMETRY_PLANE 2"	
Definition	
UnitSystem	mks
Card 1	
<input type="checkbox"/> x-coordinate of tail of a n...	0
<input type="checkbox"/> y-coordinate of tail	0
<input type="checkbox"/> z-coordinate of tail	0
<input type="checkbox"/> x-coordinate of head	0
<input type="checkbox"/> y-coordinate of head	1
<input type="checkbox"/> z-coordinate of head	0

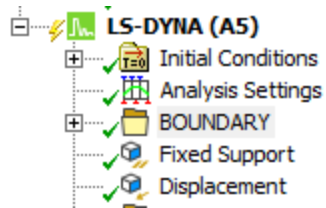
Details of "BOUNDARY_SPH_SYMMETRY_PLANE 3"	
Definition	
UnitSystem	mks
Card 1	
<input type="checkbox"/> x-coordinate of tail of ...	0
<input type="checkbox"/> y-coordinate of tail	0
<input type="checkbox"/> z-coordinate of tail	0
<input type="checkbox"/> x-coordinate of head	1
<input type="checkbox"/> y-coordinate of head	0
<input type="checkbox"/> z-coordinate of head	0



2. 전처리

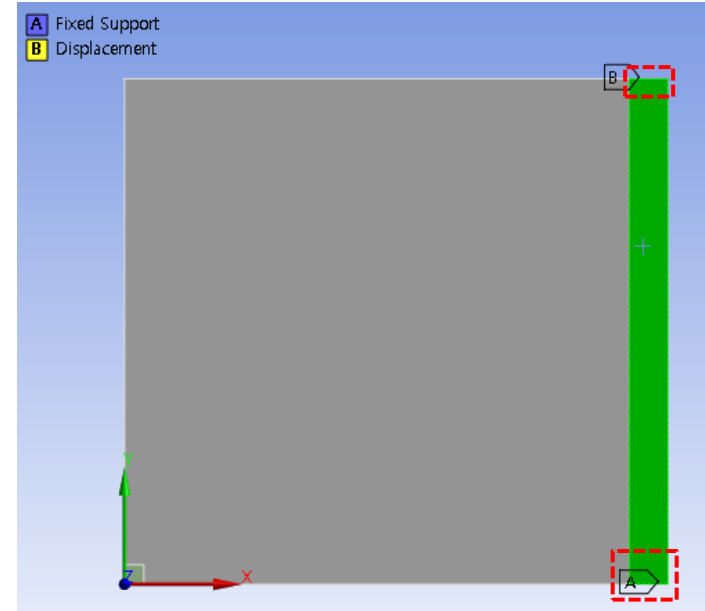
• 경계조건 설정

- Structure 파트 경계조건 설정
- LS-DYNA > Insert > **Fixed Support**
- LS-DYNA > Insert > **Displacement**



Details of "Fixed Support"	
[-] Scope	
Scoping Method	Geometry Selection
Geometry	1 Face
[-] Definition	
Type	Fixed Support
Suppressed	No

Details of "Displacement"	
[-] Scope	
Scoping Method	Geometry Selection
Geometry	1 Face
[-] Definition	
Type	Displacement
Define By	Components
Coordinate System	Global Coordinate System
X Component	Free
<input type="checkbox"/> Y Component	0. m (ramped)
<input type="checkbox"/> Z Component	0. m (ramped)
Suppressed	No

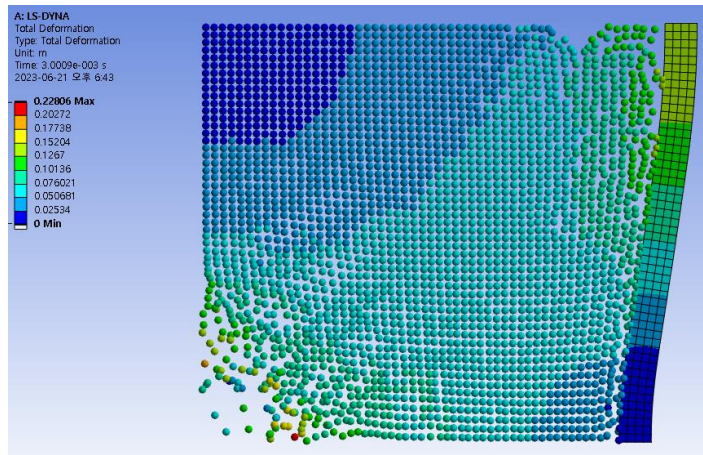
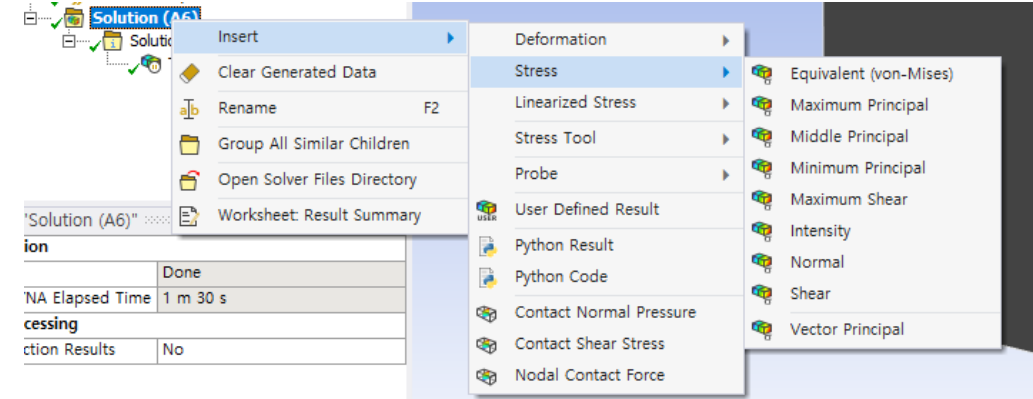
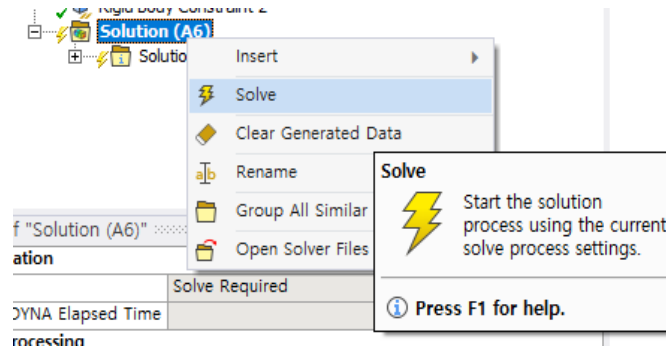


3. 해석 & 후처리

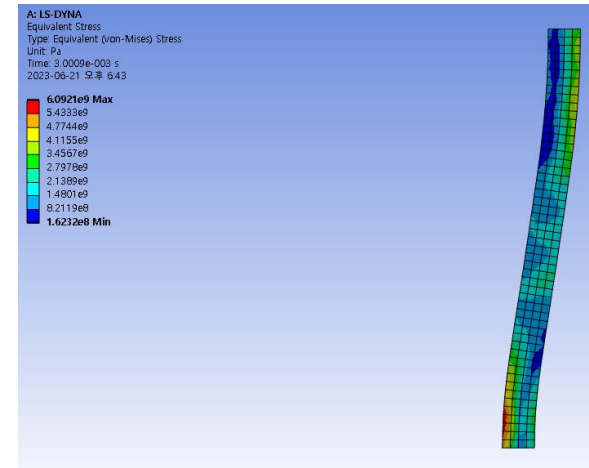
3. 해석 & 후처리

• 해석 후 결과 보기

- “Solution”메뉴에서 우클릭하여 “Solve” 실행
- “Solution”메뉴에서 원하는 결과 항목 추가하여 결과 확인



Displacement



Stress