

MRF

(Multiple Reference Frame)

◆ MRF(Multiple Reference Frame)

특정 물체를 고정한 체로 회전하는 좌표 계를 도입, 원심력에 의한 효과를 부여하여 상대적인 움직임을 고려.

MRF and Navier-Stokes Equations of Motion:

The MRF transforms the fluid velocities from stationary to rotating frames using the following relation:

Stationary Frame

$$\frac{\partial \rho \vec{V}}{\partial t} + \nabla \cdot (\rho \vec{V} \vec{V}) = -\nabla p + \nabla \cdot \tau + S$$

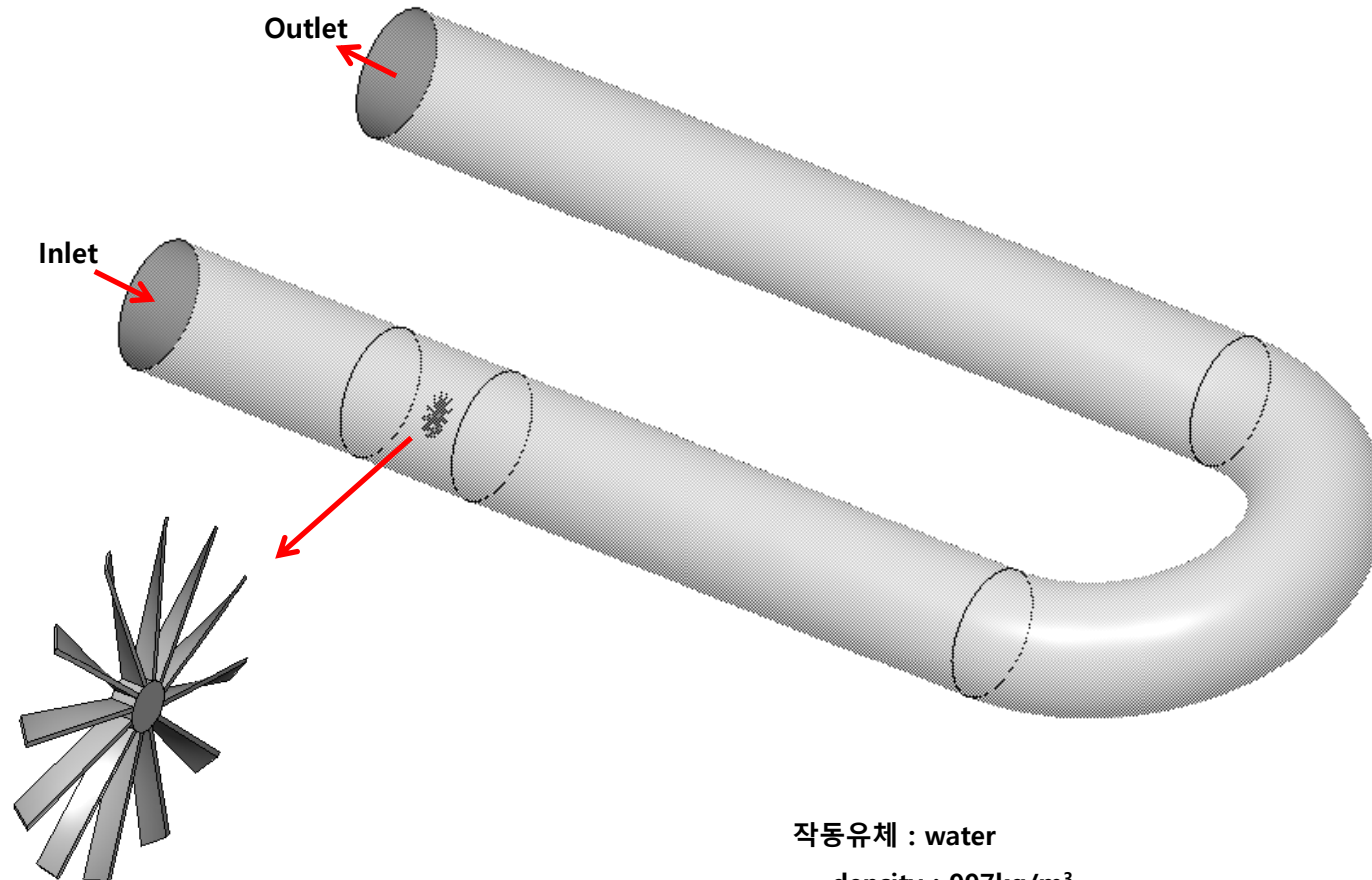
Rotating Frame

$$\frac{\partial \rho \vec{V}_r}{\partial t} + \nabla \cdot (\rho \vec{V}_r \vec{V}_r) = -\rho (2\vec{\Omega} \times \vec{V}_r + \vec{\Omega} \times \vec{\Omega} \times \vec{r}) - \nabla p + \nabla \cdot \tau + S$$

Where: Velocity Relative to Rotating Frame = Absolute Velocity - Whirl Velocity

$$\vec{V}_r = \vec{V} - \vec{\Omega} \times \vec{r}$$

- Steady 상태로 가정이 가능할 경우에 사용 가능
- 모든 격자 유형에서 적용 가능(quad, hex, tet, prism, poly)

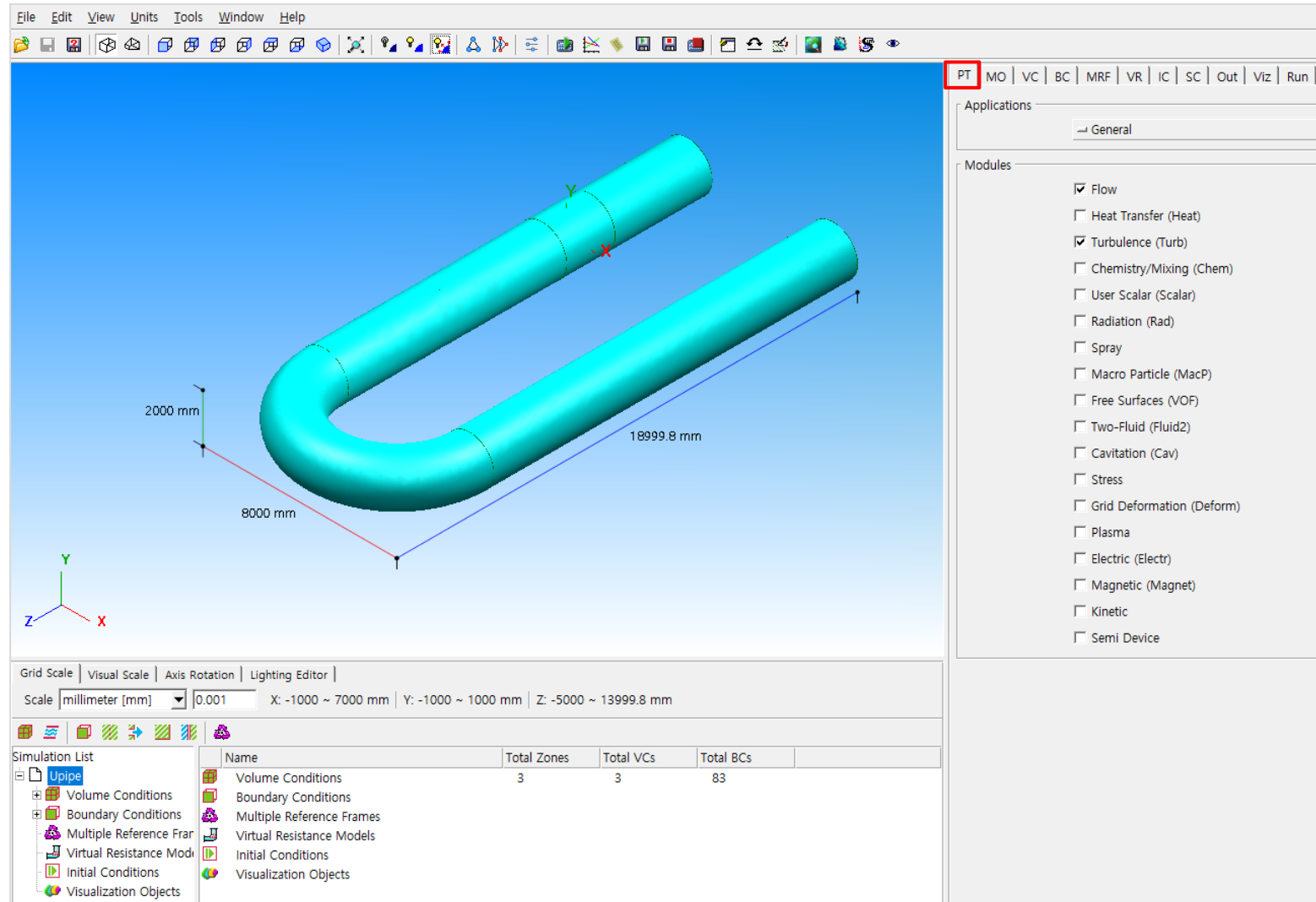


작동유체 : water

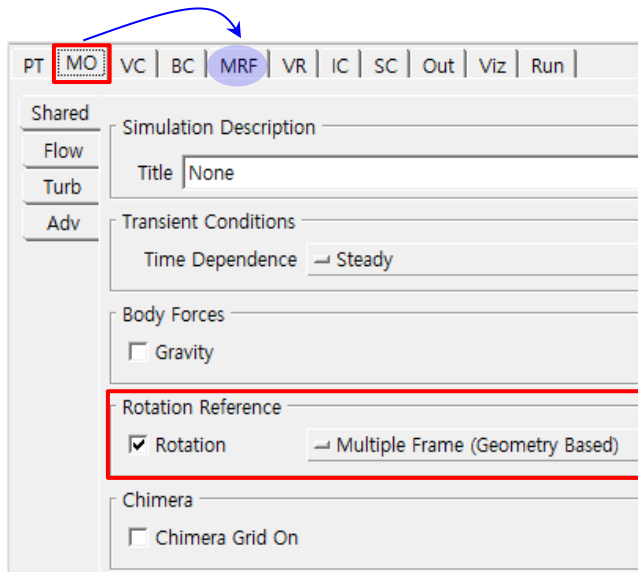
- density : 997kg/m^3
- viscosity(kinematic) : $1.589\text{E-}05\text{m}^2/\text{s}$
- specific heat : 4179J/kg-K
- thermal conductivity : 0.613W/m-K

1. DTF 파일 Open

2. PT(Problem Type) : Flow, Turbulence 선택



3. MO(Model option) : Shared → Rotation Reference → Rotation(Multiple Frame) 활성화



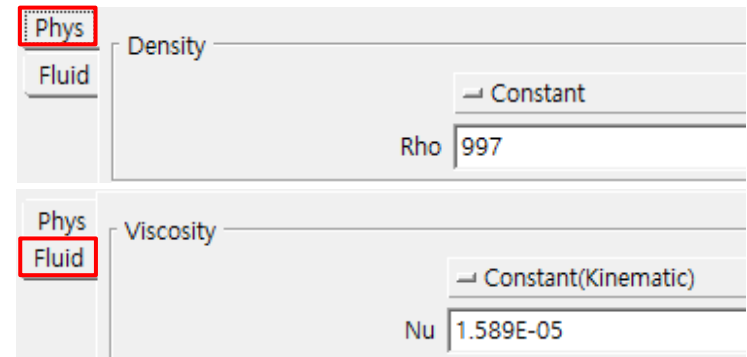
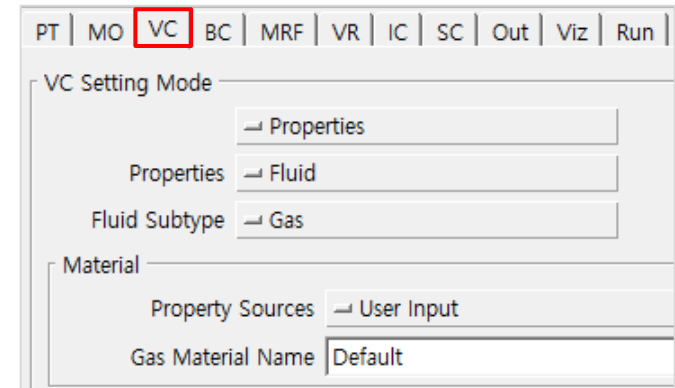
Rotation / Multiple Frame(Geometry Based)를 선택하면 MRF창이 활성화 됨.

4. VC(Volume conditions)

- 전체 선택 후 group 지정
- Fluid subtype : Water 선택

Physics : density = 997 kg/m^3

Fluid : viscosity(Kinematic) = $1.589\text{E-}05 \text{ m}^2/\text{s}$



5. BC(Boundary conditions)

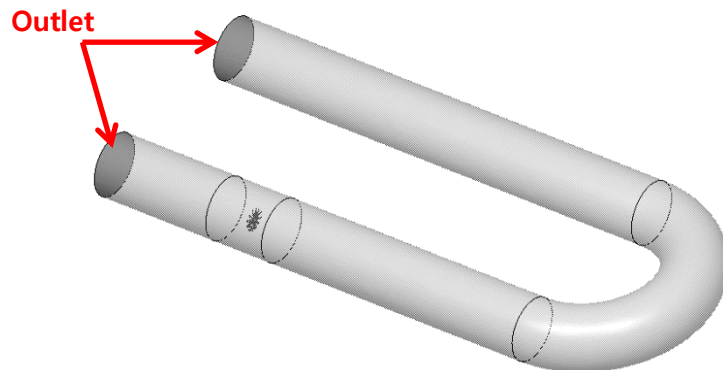
- BC Type : Outlet :

Flow : Sub Type : Far-field

Pressure= 0 Pa

Temperature=300K

U, V, W = 0



PT | MO | VC | **BC** | MRF | VR | IC | SC | Out | Viz | Run

BC Setting Mode
→ General

BC Type
→ **Outlet**
(External Face on Fluid Volume)

Flow
Turb

SubType → Farfield

Pressure
→ Constant
P 0 N/m²
Reference Pressure 100000 N/m²

Backflow Temperature
→ Constant
T 300 K

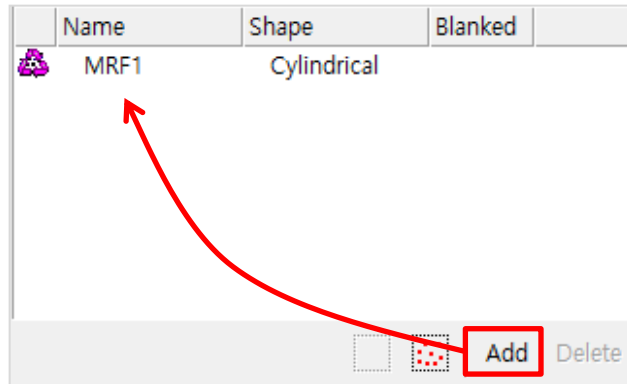
X-Direction Velocity
→ Constant
U 0 m/s

Y-Direction Velocity
→ Constant
V 0 m/s

Z-Direction Velocity
→ Constant
W 0 m/s

6. MRF(Multiple Reference Frame) 설정

- 하단 add를 클릭하면 MRF1이 생성 됨



- Center Location(mm)

P1(25, 0, 0)

- Normal Direction

Z=1

- Thickness

Thickness = 50mm

- Radius

Radius = 50mm

- Angular Rotation Speed

Omega = -30rad/s

PT | MO | VC | BC | **MRF** | VR | IC | SC | Out | Viz | Run

Multiple Reference Frame Model Setting

Select or add a Model in the Geometry List (left bottom).

Center Location

X 0 mm

Y 0 mm

Z 25 mm

Normal Direction

X-Component 0

Y-Component 0

Z-Component 1

Thickness

Thickness 50 mm

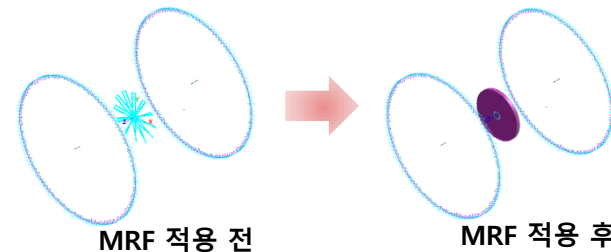
Radius

Radius 360 mm

Angular Rotation Speed

Omega -30 rad/s

1 radian = (180 degree) / π



7. SC (Solver Control)

- Max Iterations : 1000
- Residual Reduction Ratio : 0.0001

PT | MO | VC | BC | MRF | VR | IC | **SC** | Out | Viz | Run |

Iter | Spatial | Solvers | Relax | Limits | Start | Adv

Iterations

Maximum Iterations 10000

— OR —

Residuals

Residual Reduction Ratio 0.0001 - OR -

Minimum Residual 1E-18

Mass Balance

☐ Specify stopping criteria

8. Run

- Submit to Solver

PT | MO | VC | BC | MRF | VR | IC | SC | Out | Viz | **Run**

User Shared Library

File Name libUserAce.DLL Browse...

Parallel Run Controls

☐ Parallel Run

Parametric Study

☐ Parametric Study

Run and Monitor

Submit to Solver Stop

Save and Continue Save and Stop

View Residuals View Outputs

9. Results

