Modelings 3D_FLUIDE, FLUI_STRU, 2D_FLUI_PESA

Summary:

This document describes for modelings 3D_FLUIDE, FLUI_STRU, 2D_FLUI_PESA :

- degrees of freedom carried by the finite elements which support modeling,
- the related meshs supports,
- supported loadings,
- nonlinear possibilities,
- CAS-tests implementing modelings.

Modelings 3D_FLUIDE (elements of volume) and FLUI_STRU (elements 2D of interaction fluid-structure) correspond to the linear formulation of the coupled problem allowing the study of the vibratory behavior of a structure in the presence of a nonviscous, compressible fluid [R4.04.01]. Free surface is taken into account by modeling 2D_FLUI_PESA (surface elements).

1 Discretization

1.1 Degrees of freedom

Finite element	Degrees of freedom (with each node top)
MEFL_… (3D_FLUIDE)	NEAR : pressure PHI : fluid potential of displacement
MEFL_FACE… (3D_FLUIDE)	PHI : fluid potential of displacement
MEFS_… (FLUI_STRU)	DX, DY, DZ : components of structure displacement PHI : fluid potential of displacement
MEFP_FACE… (2D_FLUI_PESA)	DZ : deflection of free surface PHI : fluid potential of displacement

1.2 Mesh support of the matrices of rigidity

Modeling	Mesh	Finite element	Remarks
3D_FLUIDE	TETRA4	MEFL_TETRA4	
	TETRA10	MEFL_TETRA10	
	PENTA6	MEFL_PENTA6	
	PENTA15	MEFL_PENTA15	
	HEXA8	MEFL_HEXA8	
	HEXA20	MEFL_HEXA20	
	HEXA27	MEFL_HEXA27	
FLUI_STRU	TRIA3	MEFS_FACE3	
	TRIA6	MEFS_FACE6	
	QUAD4	MEFS_FACE4	
	QUAD8	MEFS_FACE8	
	QUAD9	MEFS_FACE9	
2D_FLUI_PESA	TRIA3	MEFP_FACE3	
	TRIA6	MEFP_FACE6	
	QUAD4	MEFP_FACE4	
	QUAD8	MEFP_FACE8	
	QUAD9	MEFP_FACE9	

Notice 1:

Coupling with a structure with a grid in elements COQUE_3D force to net the interface fluid-structure with elements QUAD8 (and not QUAD9). The fluid massive field is thus with a grid in HEXA20 (and not HEXA27). Indeed, the coupling fluid-structure is only done on the degrees of freedom of displacement, for the solid.

Notice 2:

It is imperative that the normal external with the fluid field is always directed in the same direction. It is strongly advised to keep the convention of orientation of the structure towards the fluid for all modelings of interface fluid-structure, in particular FLUI_STRU .

1.3 Mesh support of the loadings

Modeling	Mesh	Finite element	Remarks
3D_FLUIDE	TRIA3	MEFL_FACE3	
	TRIA6	MEFL_FACE6	
	QUAD4	MEFL_FACE4	
	QUAD8	MEFL_FACE8	
	QUAD9	MEFL_FACE9	
2D_FLUI_PESA	TRIA3	MEFP_FACE3	
	TRIA6	MEFP_FACE6	
	QUAD4	MEFP_FACE4	
	QUAD8	MEFP_FACE8	
	QUAD9	MEFP_FACE9	

2 Supported loadings

Loadings available are following:

GRAVITY
Allows to apply a loading of type gravity.
Supported modeling: 2D_FLUI_PESA

VITE_FACE
Allows to specify the field speed vibratory imposed in loading on elements of border.
Supported modeling: 3D_FLUIDE

IMPE_FACE
Allows to specify the map of impedance imposed in boundary condition on elements of border.
Supported modeling: 3D_FLUIDE

ONDE_FLUI
Allows to apply an amplitude of pressure of sinusoidal incidental wave arriving normally at a face.
Supported modeling: 3D_FLUIDE

3 Non-linear possibilities

3.1 Laws of behaviors

The only relation of behavior available in DYNA_NON_LINE, for modeling FLUI_STRU under BEHAVIOR is RELATION 'ELAS' (Cf [U4.51.11]).

3.2 Deformations

Only linearized deformations keyword 'SMALL' under DEFORMATION are available in the relations of behavior (cf [U4.51.11]).

4 Example of implementation: CAS-tests

4.1 3D_FLUIDE

AHLV100B [V8.22.100]: A rectilinear guide of wave at anechoic exit whose propagation medium is “normal” air, is excited by a harmonically vibrating piston. Calculation consists in determining the field of acoustic pressure of the harmonic answer.
FDLV111A [V8.01.111]: Absorption of a wave of pressure created by a piston in a fluid column.

4.2 FLUI_STRU

FDLV111A [V8.01.111]: Absorption of a wave of pressure created by a piston in a fluid column.
FDNV100A [V8.01.111]: Analysis of the shaking of a water tank with elastic deformable wall.

4.3 2D_FLUI_PESA

FDNV100A [V8.01.111]: Analysis of the shaking of a water tank with elastic deformable wall.