Modelings DKT - DST - Q4G - DKTG - Q4GG

Summary:

This document describes for modelings DKT - DST - Q4G - DKTG - Q4GG :

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

They are usable for problems of plate into three-dimensional [R3.07.03] in linear mechanical analysis for all modelings and in nonlinear material for modelings DKT, DKTG and Q4GG only. Their use for problems of hull is usually allowed by considering that the plan of the element is comparable to a tangent facet with the average layer of the hull (attention, only the plane facets are allowed).

Thermomechanical calculations are chained starting from the finite elements of thermal hulls (see [U3.22.01]).

1 Discretization

1.1 Degrees of freedom

For three modelings of plate into three-dimensional the degrees of freedom of discretization are, in each node of the mesh support the six components of displacement (three translations and three rotations) to the nodes tops of the mesh support. These nodes are supposed to describe a tangent facet with the average layer of the hull.

Finite element	Degrees of freedom (with each node top)					
DKT/DKQ / DKTG	DX	DY	DZ	DRX	DRY MARTINI	DRZ
DST/DSQ	DX	DY	DZ	DRX	DRY MARTINI	DRZ
Q4G (Q4 γ) / Q4GG	DX	DY	DZ	DRX	DRY MARTINI	DRZ

1.2 Mesh support of the matrices of rigidity

The meshs support of the finite elements, in displacement formulation, can be triangles or quadrangles. In this last case, the meshs are supposed to be plane (4 nodes planar tops Co -):

Modeling	Mesh	Finite element	Remarks
DKT	TRIA3 QUAD4	MEDKTR3 MEDKQU4	
DKTG	TRIA3 QUAD4	MEDKTG3 MEDKQG4	
DST	TRIA3 QUAD4	MEDSTR3 MEDSQU4	
Q4G (Q4 γ)	QUAD4 TRIA3	MEQ4QU4 MET3TR3	
Q4GG	TRIA3 QUAD4	MET3GG3 MEQ4GG4	

1.3 Mesh support of the loadings

All the loadings applicable to the facets of the elements of plate are treated by direct discretization on the mesh support of the element in displacement formulation.

No mesh support of loading is thus necessary for the faces of the elements of plates.

For the applicable loadings on the edges of the elements of plate, a mesh support of the type SEG2 is usable:

Modeling	Mesh	Finite element	Remarks
DKT	SEG2	MEBODKT	
DST	SEG2	MEBODST	
DKTG	SEG2	MEBODKT	
Q4G (Q4 γ)	SEG2	MEBOQ4G	
Q4GG	SEG2	MEBOQ4G	

2 Assignment of the characteristics

For these elements of plate or hulls, it is necessary to affect geometrical characteristics which are complementary to the data of grid. The definition of these data is carried out with the order AFFE_CARA_ELEM associated with the keyword following factor:

HULL
Allows to define and affect on the meshs, the thickness, the coefficient of shearing, offsetting,…

For the study of structures comprising of multi-layer materials it is necessary to affect the characteristics of each layer (thickness, type of material) and their stacking (orientation of fibres). The definition of these data is carried out with the order DEFI_COMPOSITE .

3 Supported loadings

The loadings available are the following:

FORCE_ARETE

Allows to apply linear forces.

Supported modelings: DKT , DST , Q4G

FORCE_COQUE

Allows to apply surface efforts.

Supported modelings: DKT , DST , Q4G , DKTG , Q4GG

GRAVITY

Allows to define the acceleration and the direction of gravity.

Supported modelings: DKT , DST , Q4G , DKTG , Q4GG

PRES_REP

Allows to apply surface efforts.

Supported modelings: DKT , DST , Q4G , DKTG , Q4GG

PRE_EPSI

Allows to apply a loading of initial deformation.

Supported modelings: DKT , DST , Q4G , DKTG , Q4GG

The application of a thermal loading of dilation is carried out by defining the keyword factor AFFE_VARC under AFFE_MATERIAU [U4.43.03].

4 Non-linear possibilities

For modeling DKT only.

4.1 Law of behaviors

Only modelings 'DKT' and 'DKTG' have non-linear possibilities. Laws of behaviors specific to this modeling, usable under BEHAVIOR in STAT_NON_LINE and DYNA_NON_LINE are the relations of behavior in plane constraints available with modelings 'AXIS' and 'C_PLAN' (*cf.* [U4.51.11]).

4.2 Deformations

Deformations available, used in the relations of behavior under the keyword DEFORMATION for the operators STAT_NON_LINE and DYNA_NON_LINE are (cf [U4.51.11]):

/ **'SMALL'**

The deformations used for the relation of behavior are the linearized deformations.

/ **'PETIT_REAC'**

The increments of deformations used in the incremental relation of behavior are the linearized deformations of the increment of displacement in the reactualized geometry.

Note:

Attention, the calculation of the deformations using PETIT_REAC is only one approximation of the assumptions of great displacements. It requires to carry out very small increments of loading. To correctly take into account great displacements, and especially great rotations, it is recommended to use modeling COQUE_3D, with DEFORMATION='GROT_GDEP'.

5 List of the cases tests available

DKT

Linear statics

FORMA01B [V7.15.100]: Analysis of a piping comprising an elbow subjected to a specific force and an internal pressure.

SSLS100A [V3.03.100]: Circular plate embedded on its contour, subjected to a uniform pressure, a normal force and its actual weight.

Non-linear statics

SSNL501C [V6.02.501]: Quasi-static analysis of a beam fixed at the two ends, subjected to a uniform pressure, with a perfectly plastic elastic material.

Linear dynamics

SDLS03C: Research of the Eigen frequencies and the modes associated with a thin rectangular plate in simple support on its edges.

Non-linear dynamics

ELSA01D: Non-linear dynamic response of a piping in the shape of quadrant (elsa) subjected to a seismic loading.

DKTG

Linear statics

SSLS126A [V3.03.126]: Inflection of a reinforced concrete flagstone (model `GLRC_DAMAGE`) pressed on two sides: elastic mode of beam.
SSLS127A [V3.03.127]: Inflection of a reinforced concrete flagstone (model `GLRC_DAMAGE`) pressed on 4 sides: elastic mode of plate.
Non-linear statics
SSNS106A [V6.05.106]: Damage of a plate planes under varied requests.
Linear dynamics
SDNS106A: Transitory answer of a reinforced concrete flagstone.

DST
Linear statics
SSLS101F [V3.03.101]: Circular plate posed on the edge, subjected 3 loadings: actual weight, pressure and effort distributed constant.
HSLS01A [V7.11.001]: Analysis of a thin square plate embedded on its contour subjected to a heat gradient in the thickness.
Linear dynamics
SDLS03A: Research of the Eigen frequencies and the modes associated with a thin rectangular plate in simple support on its edges.

Q4G
Linear statics
SSLS101H [V3.03.101]: Circular plate posed on the edge under 3 loadings: actual weight, pressure and effort distributed constant.
HSLS01B [V7.11.001]: Analysis of a thin square plate embedded on its contour subjected to a heat gradient in the thickness.
SSLS100M [V3.03.100]: Circular plate embedded on its contour, subjected to a uniform pressure, a normal force and its actual weight.
Linear dynamics
SDLS03B: Research of the Eigen frequencies and the modes associated with a thin rectangular plate in simple support on its edges.
SDLS03D: Research of the Eigen frequencies and the modes associated with a thin rectangular plate in simple support on its edges.

Q4GG
Linear statics
SSLS126C [V3.03.126]: Inflection of a reinforced concrete flagstone (model `ELAS`) pressed on two sides: elastic mode of beam.
SSLS127C [V3.03.127]: Inflection of a reinforced concrete flagstone (model `ELAS`) pressed on 4 sides: elastic mode of plate.
Linear dynamics
SDLS123A [V2.03.123] – right Beam with damping of Rayleigh (Elastic Behavior)