Parametric Piping Models

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The Idea

• Basic idea is to assign parametric objects to basic line or area objects in the SAP2000 model and then generate detailed mesh for each object, on-demand using physical dimensions and parameters of the respective objects.

• The object parameters as well as its location in overall model can be modified any time and mesh re-generated.
The Process

• The User
  – Draws simplified line model
  – Assigns the piping objects to the line objects
  – Set the properties of the piping objects

• The Program
  – Generates a Detailed Line Model
  – Generates a Detailed Shell Model
  – Generates a Mixed Model
Basic Object Types

- Pipes and Tubes
- Vessels
- Bends
- Joints and Connections
- Transitions
- Caps and Covers
- Pedestals
The Basic Line Model

- The line object model created in SAP2000
- Objects are assigned to various line objects
- Parameters for each object assigned in separate templates and forms
The Parametric Models

1. Pedestal
2. Cap
3. Pipe
4. Cap
5. Bends
6. Transition
7. Pipe
8. S-Bend
9. Pipe
10. Bend
11. Pipe and Transition
The Generated Model

The Model

The Mesh
Object Based Model

The Line Model

Meshed Model
The Detailed Line Model

The User Line Model

The Generated Line Model
Parametric Models

1. Pipe
2. Bend, Sharp
3. Pipe
4. Bend, Sharp
5. Pipe
6. Bend, Arc
7. Joint
1. Pedestal
2. Joint
3. Bend, Arc
4. Pipe
5. Bend, Arc
6. Pipe
7. Tube
8. Pedestal
1. Graded Tube
2. Transition
3. Pipe
4. Joint
5. Pipe
6. Transition
7. Transition
8. Pipe
Parametric Models

1. Tube Joint
2. Tube
3. Transition
4. Pipe
5. Pipe Joint
Mesh Clipping

A tool for Meshing of Junction and Intersections
Mesh Clipping

- Mesh clipping is used as the basic tool to create mesh at object intersections
- Four 3D Mesh Clippings are used
  - Mesh Clipped by Plane
  - Mesh Clipped by Pipe
  - Mesh Clipped by Tube
  - Mesh Clipped by Sphere
- Direct Mesh Intersection is computed using Triangle-Triangle Intersection
Mesh Clipped by Plane

• Given Mesh is clipped at the intersection of a Plane Defined by 3-Points
• Mesh above and below the plane is returned
Mesh Clipped by Pipe

- Given Mesh is clipped at the intersection of a pipe defined by diameter and centerline
- Mesh inside and outside the pipe is returned
Mesh Clipped by Tube

- Given Mesh is clipped at the intersection of a rectangular tube defined by b x h and centerline
- Mesh inside and outside the tube is returned
Mesh Clipped by Sphere

- Given Mesh is clipped at the intersection of a sphere defined by diameter and center
- Mesh inside and outside the sphere is returned
Object Intersections
Pipes and Plates Intersection
General 3-Pipe Junction
General 3-Pipe Junction
General Multi-pipe Junction
Cut Pipes Before Weld

Pipe 1

Pipe 2

Pipe 4

Pipe 3
Mesh Unwrapping

Mesh Intersection Result

Flat Sheet Equivalent For Cutting Etc.
Sheets Before Pipes

Pipe2
Pipe3
Pipe4
Sphere and Pipe Junction

Holes Cut by Pipes

The Assembly

The Subtracted Sphere
Basic Piping Objects
Nuclear Plant Piping

- U Expansion
- Double Offset Expansion
- Single Offset U
- Double Offset U
Pipe and Vessel Pedestals
PLATES
Parametric Model → OpenGL View → SAP2000 Model

Parametric Model → OpenGL View → SAP2000 Model
Parametric Model → OpenGL View → SAP2000 Model

Parametric Model → OpenGL View → SAP2000 Model
Parametric Model

OpenGL View

SAP2000 Model
CONNECTIONS
Parametric Model | OpenGL View | SAP2000 Model
---|---|---
Parametric Model | OpenGL View | SAP2000 Model
Parametric Model

OpenGL View

SAP2000 Model

Parametric Model

OpenGL View

SAP2000 Model
Parametric Model → OpenGL View → SAP2000 Model
Transitions
Parametric Model → OpenGL View → SAP2000 Model

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