T019: Sliding Dies

Introduction

This document describes how to use the sliding die capabilities within DEFORM.

Problem Description

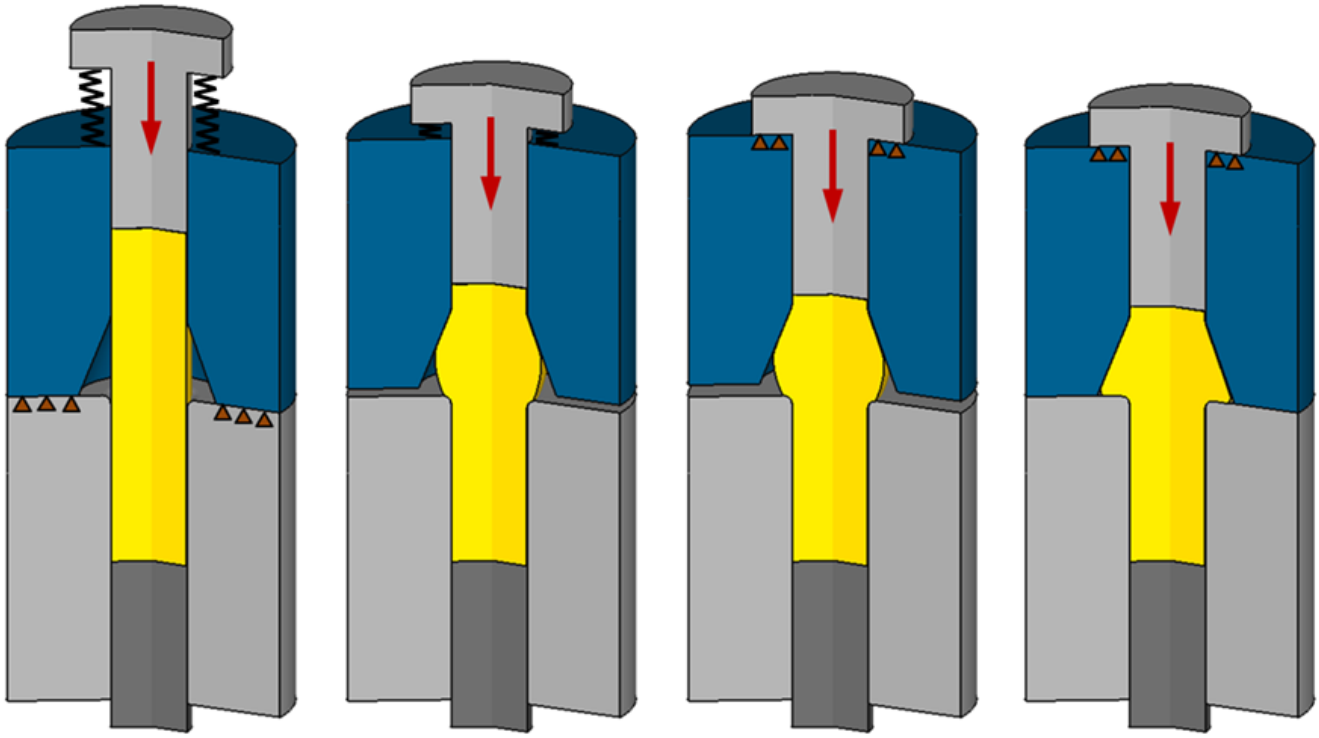
Customers often have questions about how to set up a simulation that utilizes sliding dies. This technical note describes the various options that must be defined when setting up this type of simulation.

Background Information

Certain manufacturing processes take advantage of sliding dies when forming parts.

There are typically three phases of sliding die movement (shown as the blue object below):

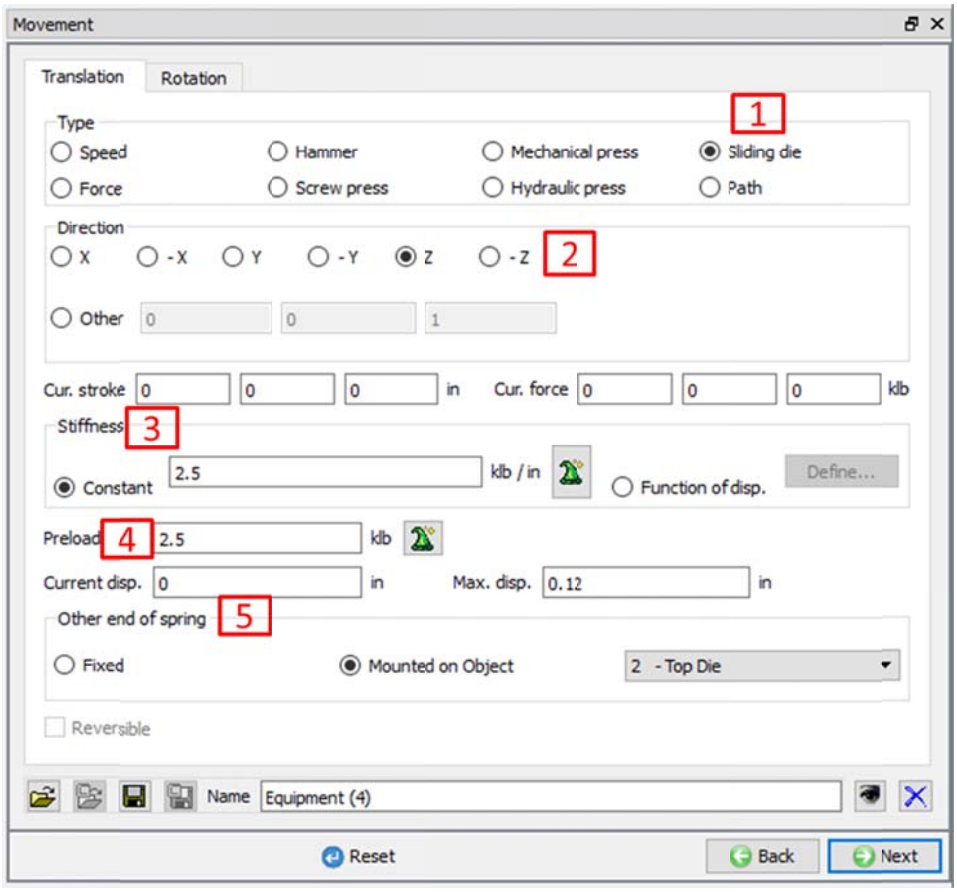
1. **Force on the die is below the preload** - die is stationary resting on a stop or another die
2. **Force on die exceeds preload** - die begins moving under spring load control
3. **Die hits a stop** - forming process completes with die stationary or being pushed by another die.



The goal is to be able to set up one simulation that can take all of the phases into account.

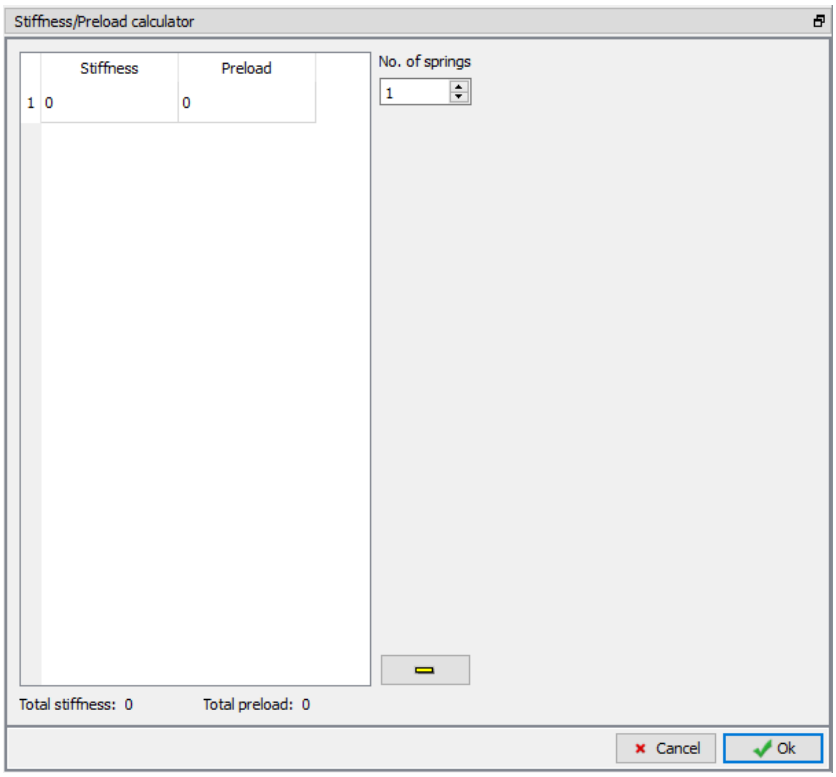
Solution

Let's walk through the sliding die setup for the cone head operation that is shown. For the sliding die object, go to the **Movement** button to see the following dialog.



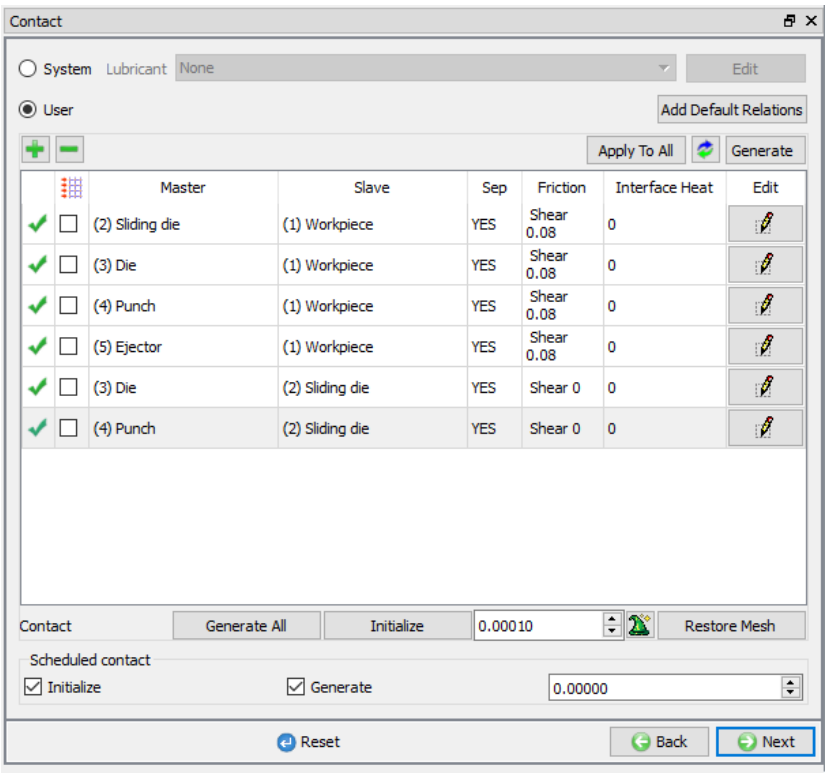
1. Set the object to **Sliding die**
2. Set the direction in which the die will slide once the spring preload is overcome. In this example, that would be the **Y** direction.
3. Set the stiffness of the spring. This can either be a constant value of a function of sliding die displacement.
4. Set the spring preload.
5. Specify whether the other end of the spring is fixed or mounted on another object. In this example, the other end of the spring is mounted on the **Punch**.

If multiple springs need to be modeled, you can use the to bring up the **Stiffness/Preload calculator** dialog. As shown below, this allows you to enter data for multiple springs.



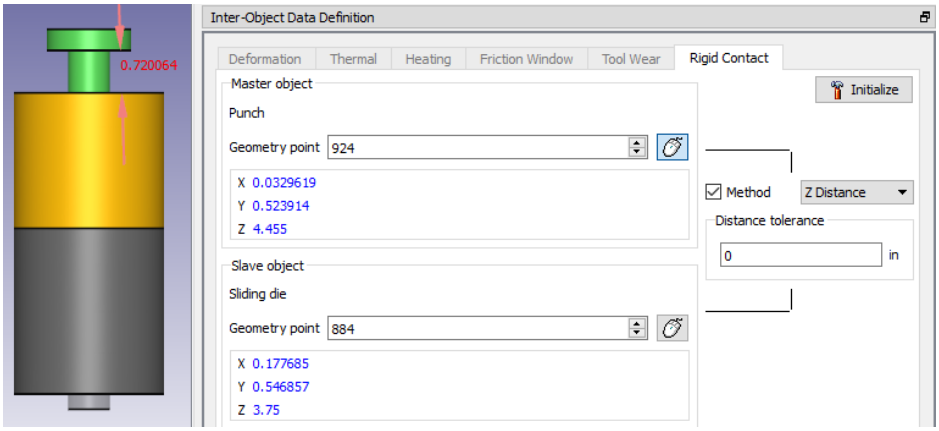
If the preload is applied by gas cylinders instead of physical springs, the **Stiffness** option can be set to a small value so that the force does not increase much as the die slides back.

For this example to run correctly, the rigid **Sliding die** needs to be able to contact with both the rigid **Punch** and **Die**. This is done by specifying Master-Slave relations between the Sliding die and these other objects. The Sliding die needs to be the **Slave** object in these relations.



In a 2D simulation, the program will automatically detect when these objects come into contact.

In a 3D simulation, the relations need to be defined like in 2D. In addition, reference points on the objects also need to be defined. For the relation of interest, go to the **Rigid Contact** tab to define the reference points. Also, specify the distance between these points where contact should occur.



These steps are all that is required to accurately model a sliding die within DEFORM.

Related Information

Setup files for the solution described above are available for download:

SlidingDie_2D_MountedOnPunch.KEY

SlidingDie_3D_MountedOnPunch.KEY

Almost all sliding die simulations fall into one of the four cases shown below. A test case containing the setup for each is available for download.

