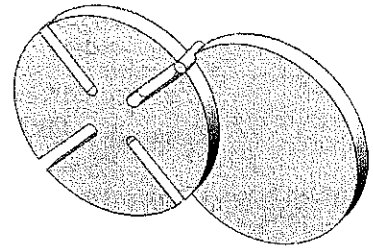


# Section 5.2

## Geneva Mechanism



### 5.2-1 Introduction

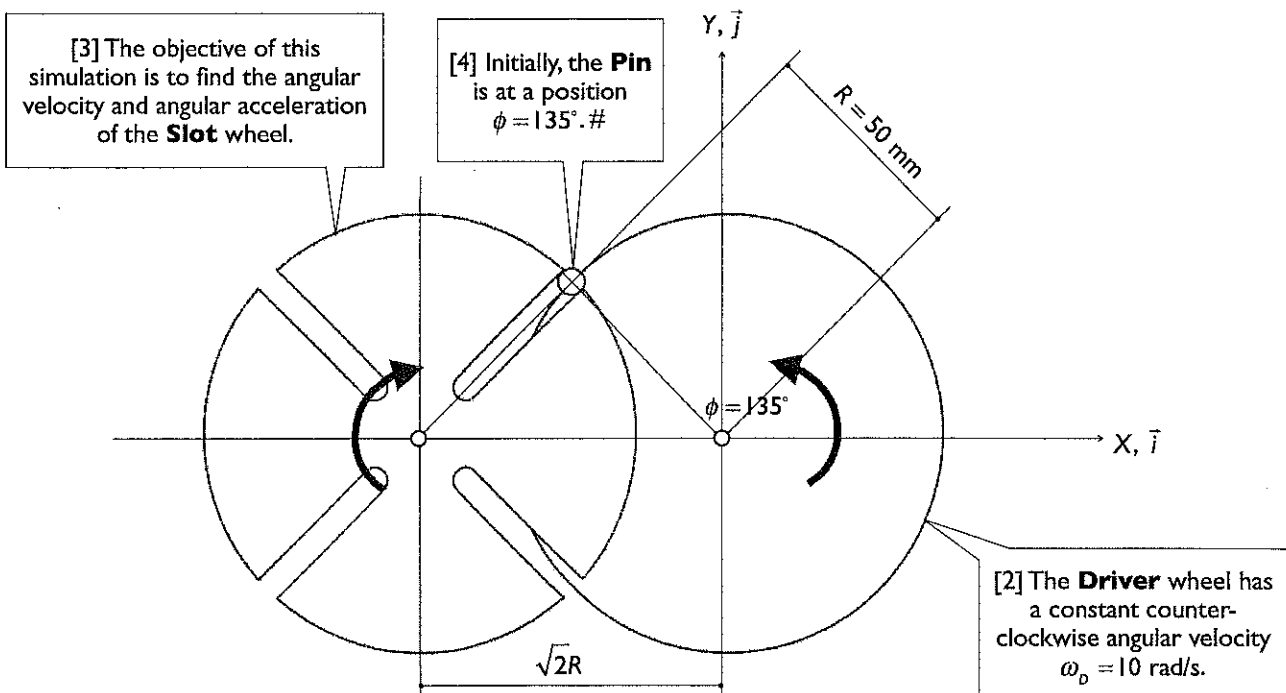
[1] A geneva mechanism translates a continuous rotation of a **Driver** wheel [2] into an intermittent rotation of a **Slot** wheel [3, 4]. This problem is adapted from Sample Problem 15.9, *Vector Mechanics for Engineers: Dynamics*, 9th ed. in SI Units, by F. P. Beer, E. R. Johnston, Jr., and P. J. Cornwell. Some of the quantities calculated by the textbook are: when  $\phi = 150^\circ$ ,

$$\text{The angular velocity of the \textbf{Slot} wheel} \quad \bar{\omega}_s = -4.08 \bar{k} \text{ (rad/s)} \quad (1)$$

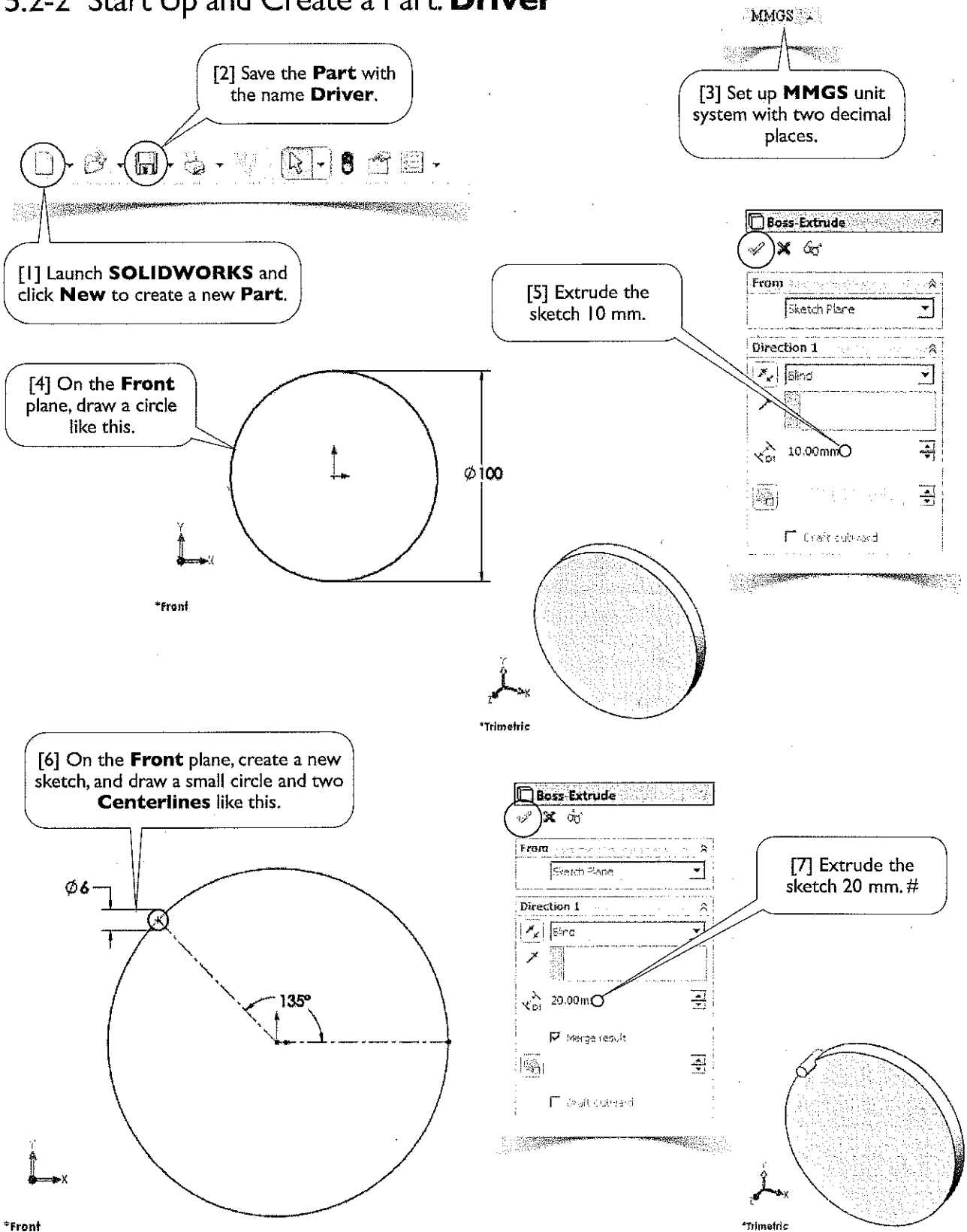
$$\text{The angular acceleration of the \textbf{Slot} wheel} \quad \bar{\alpha}_s = -233 \bar{k} \text{ (rad/s}^2\text{)} \quad (2)$$

Note that the negative signs indicate that both the angular velocity and angular acceleration are in a clockwise sense.

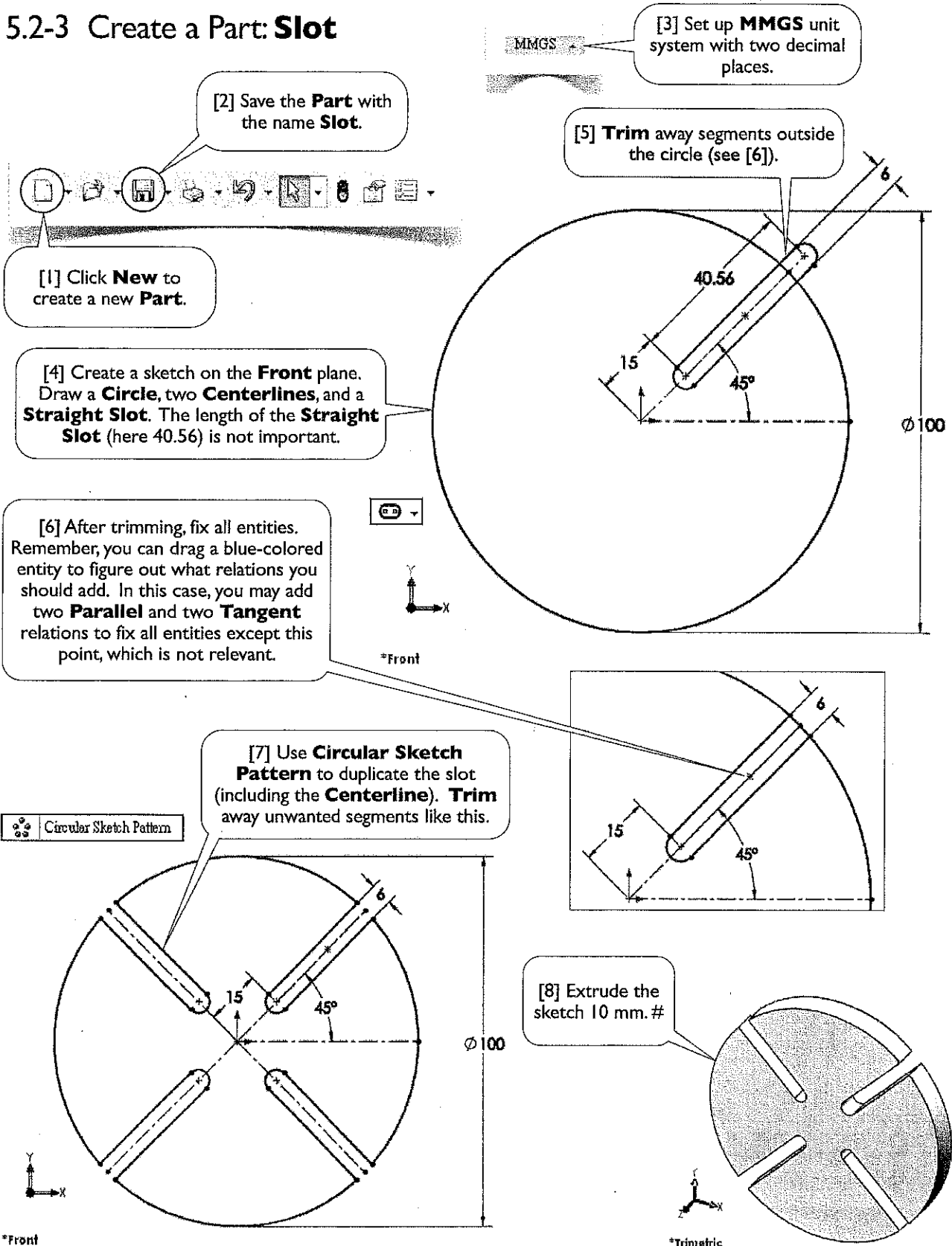
In this section, we'll perform a simulation for the Geneva mechanism and validate the results with the values in Eqs. (1, 2).



## 5.2-2 Start Up and Create a Part: **Driver**



### 5.2-3 Create a Part: **Slot**



## 5.2-4 Create an Assembly: **Geneva**

[1] Click **New** and create an **Assembly**.

[2] In the **Head-Up Toolbar**, turn on **View Origins**.

[3] In the **Begin Assembly Property Box**, select **Driver** and click the assembly's **Origin**.

[4] Save the **Assembly** with the name **Geneva**.

[5] Set up **MMGS** unit system with two decimal places.

[6] In the **Assembly Toolbar**, click **Insert Components** and park **Slot** anywhere.

[7] Right-click **Driver<1>** and select **Float**.

[8] In **Assembly Toolbar**, click **Mate**.

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(1) Driver<1> (Default<<Default>\_Photo Works Display State>)  
 (-) Slot<1> (Default<<Default>\_Photo Works Display State>)

[9] We'll create these 7 **Mates** in [10-21].

Mates

- ☒ Coincident1 (Driver<1>,Front)
- ☒ Coincident2 (Driver<1>,Origin)
- ☒ Coincident3 (Driver<1>,Slot<1>)
- ☒ Coincident4 (Slot<1>,Top)
- ☒ Distance1 (Origin,Slot<1>)
- ☒ Coincident5 (Driver<1>,Right)
- ☒ Parallel1 (Slot<1>,Right)

[10] The **Assembly's** and the **Driver's Front** planes are **Coincident**.

[11] The **Assembly's** and the **Driver's Origins** are **Coincident**. Before clicking **OK**, uncheck **Align axes** (see [12]).

[13] The **Driver's** frontal face and the **Slot's** backside face are **Coincident** (see [14, 15]).

[16] The **Slot's Origin** and the **Assembly's Top** plane are **Coincident**.

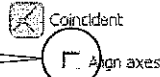
[17] The **Assembly's** and the **Slot's Origins** has a **Distance** of 71.414 mm. This distance is calculated by:  

$$\sqrt{2R^2 + (10 \text{ mm})^2} = 71.414 \text{ mm, where } R = 50 \text{ mm.}$$

[20] The **Assembly's** and the **Slot's Right** planes are **Parallel**. This is the initial configuration of the **Slot**. We'll suppress this **Mate** later.

[19] The **Assembly's** and the **Driver's Right** planes are **Coincident**. This is the initial configuration of the **Driver**. We'll suppress this **Mate** later.

[12] Uncheck **Align axes**.



[15] The **Slot's** backside face.

[14] The **Driver's** frontal face.

[18] Now, use your mouse to rotate the **Driver** and the **Slot**.



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[21] This is the initial configuration. Dismiss **Mate** box and turn off **View Origins**. #



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## 5.2-5 Create a **Motion Study**, Set Up **Contact** and **Motor**

[1] Click **Motion Study 1** tab.

[2] Select **Motion Analysis**.

[3] In **Motion Toolbar**, click **Contact**.

[4] In the **Graphics Window**, click the **Slot** and the **Driver**.

[5] Select **Steel (Greasy)** for both materials.

[6] Uncheck **Friction**.

[7] Click **OK**.

[8] Click **Motor**.

[9] Click this face of the **Driver**. This defines the **Motor Location** as well as the **Motor Direction**, see [10, 11].

[10] The **Driver** is the **Motor Location**.

[11] The normal of the face is the **Direction** of the **Rotary Motor**; i.e., Z-direction.

[12] Type 95.493 (RPM), which equals to 10 rad/s, for **Speed**.

[13] Click **OK**.

The screenshots show the following details:

- Motion Study 1** tab selected.
- Motion Analysis** dropdown menu.
- Contact** button in the Motion Toolbar.
- Graphics Window** showing a 3D model of a Geneva mechanism with a slot and a driver.
- Contact** dialog box:
  - Message:** Select materials to use preset values for friction and elastic properties. To modify these properties, clear Material Selection.
  - Contact Type:** Solid Bodies, Curves.
  - Selections:** Use contact groups. Slot-1@Geneva, Driver-1@Geneva.
  - Material:** Steel (Greasy) for both materials.
  - Friction:** Unchecked.
  - Elastic Properties:** Impact, Restitution coefficient, Stiffness, Exponent, Max. Damping, Penetration.
- Motor** dialog box:
  - Motor Type:** Rotary Motor.
  - Component/Direction:** Face<1>@Driver-1.
  - Motion:** Constant Speed, 95.493 RPM.

## 5.2-6 Calculate and Animate Results

[1] In the **Assembly Tree**, under **Mates**, suppress **Coincident5** and **Parallel1** (see 5.2-4[19, 20], page 117).

[2] In the **Motion Toolbar**, Click **Motion Study Properties**.

[3] Type 1000 for **Frames per second**.

[4] Click **Use Precise Contact**.

[5] Click **Advanced Options...**

[6] Set **Maximum Integration Step Size** to 0.0001 seconds.

[7] Click **OK**.

[8] Click **OK**.

[9] Right-click this **Key Point** and select **Edit Key Point Time** and type 0.628 (s). The simulation will be one cycle ( $10 \text{ rad/s} = 0.628 \text{ s/cycle}$ ). Click **Time Scale Zoom Buttons** to enlarge the time scale (1.1-1.1[2], page 14).

[10] Right-click this **Key Point** and select **View Orientation>Front**.

[11] Click **Calculate**.

[12] Set **Playback Speed** to 3 sec. A cycle will play 3 sec.

[13] Make sure **Playback Mode** is **Loop**.

[14] Click **Play from Start**. Click **Stop** after viewing the animation. #

**Mates**

- ✓ Coincident1 (Driver<1>,Front)
- ✓ Coincident2 (Driver<1>,Origin)
- ✓ Coincident3 (Driver<1>,Slot<1>)
- ✓ Coincident4 (Slot<1>,Top)
- Distance1 (Origin,Slot<1>)
- Coincident5 (Driver<1>,Right)**
- Parallel1 (Slot<1>,Right)**

**Motion Study Properties**

**Animation**

**Basic Motion**

**Motion Analysis**

Frames per second: 1000

☒ Animate during simulation

☐ Replace redundant mates with bushings

Bushing Parameters...

3D Contact Resolution: Low High

☒ Use Precise Contact

Accuracy: Low High

0.0001000000

Cycle settings: (1 cycle=360°)

☒ Cycle rate ☐ Cycle time

1 cps

Plot Defaults...

Advanced Options...

**General Options**

☐ Use these settings as defaults for motion studies

Show all Motion Analysis messages

**Advanced Motion Analysis Options**

Advanced Motion Analysis Options

Integrator Type: GSTIFF

Maximum Iterations: 25

Initial Integrator Step Size: 0.0001000000

Minimum Integrator Step Size: 0.0000001000

Maximum Integrator Step Size: 0.0001000000

Jacobian Re-evaluation

OK Cancel Help

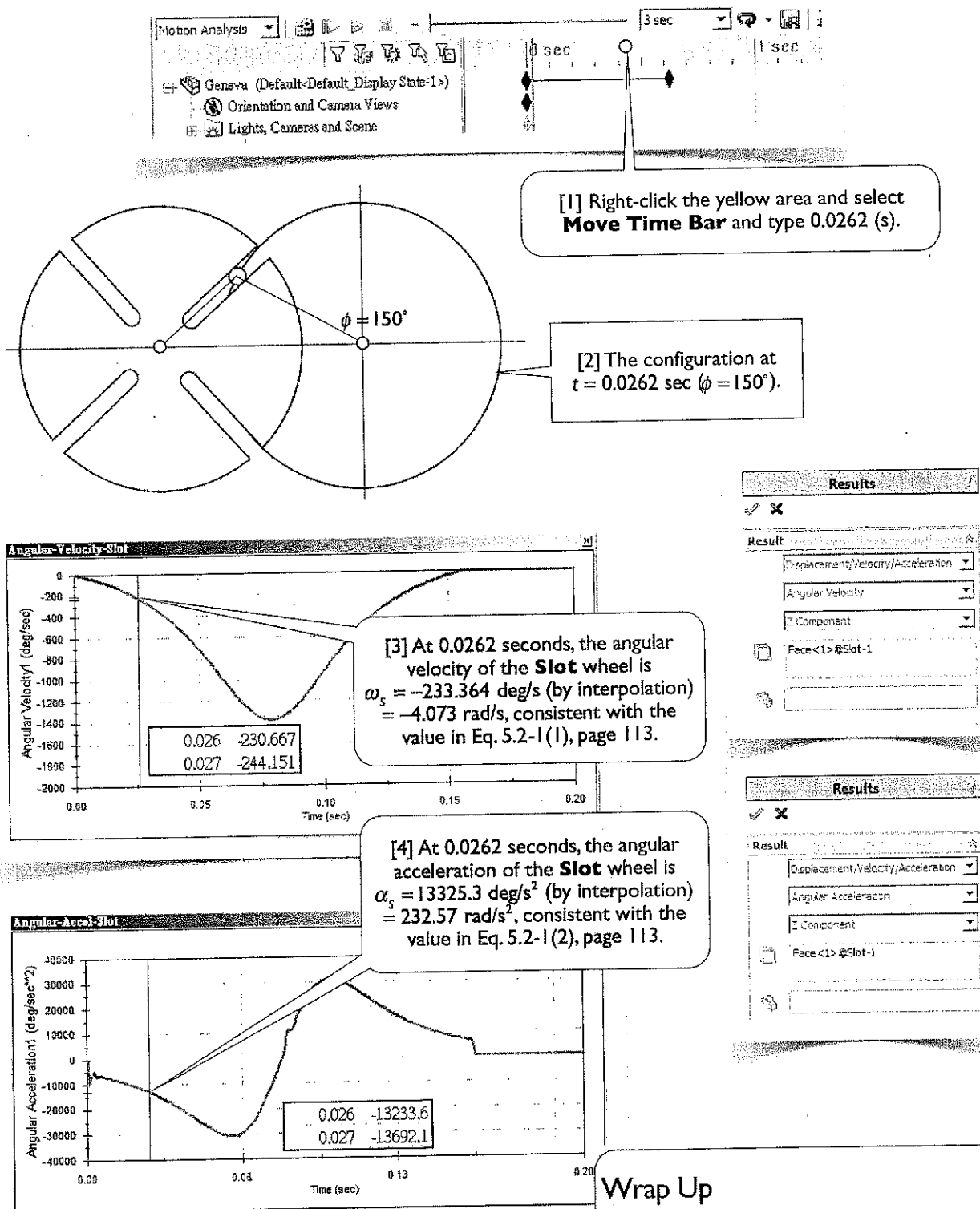
**Motion Analysis**

Geneva (Default<Default\_Display State>)

Orientation and Camera Views

Lights, Cameras and Scene

0 sec 3 sec 1 sec

5.2-7 Results: Angular Velocity and Acceleration of the **Slot**

## Wrap Up

[5] Save all files and exit **SOLIDWORKS**. #