Gears App

Modeling an Idler Gearset
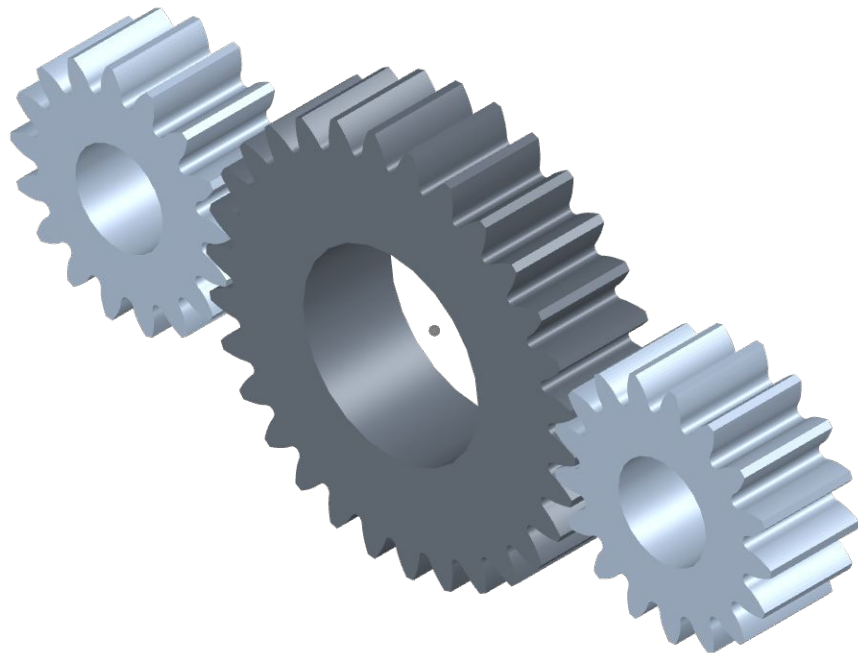
Overview

Learn how to model a spur idler gearset and simulate its powerflow.
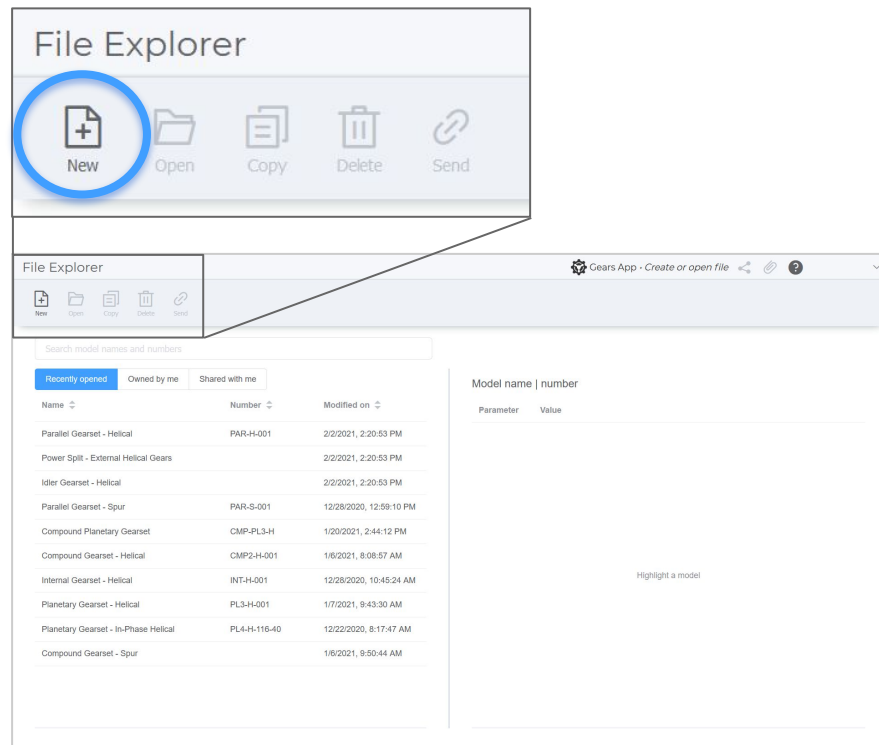
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MODELING

Create Model

1. In a web browser, open Gears App.

2. By default, the **File Explorer** will open to manage any existing models.

3. Create a new model by clicking the **New** ribbon button.

4. Once the new model opens, click the **Model Info** ribbon button to edit the model *name*.

**TIP:** Firefox or Chrome internet browser is recommended.

Create Gears

1. To create a new gear, from the **Model** ribbon tab, click the **External** button.

2. A new **Gear Modeler** tab opens.

3. Create the *Spur Pinion* as defined on the next slide. Two instances of this gear will be used.

4. Repeat these steps for the *Spur Wheel*. This will be used as the idler gear.

> **HINT:** Every gear created is automatically added to the Gear Library, an organization-wide collection of gears.

> **TIP:** To insert a gear previously created, go to the Gear Library, find the gear, and click **Insert**.
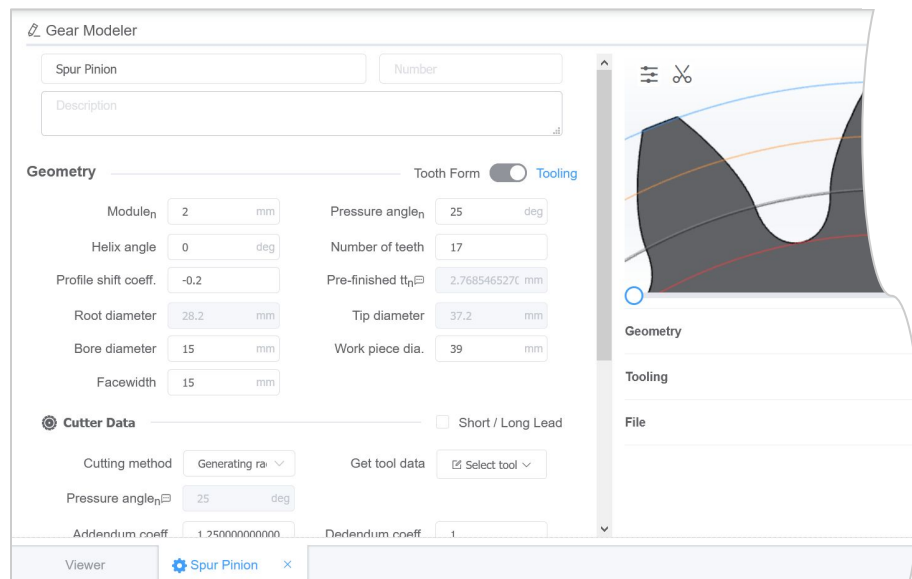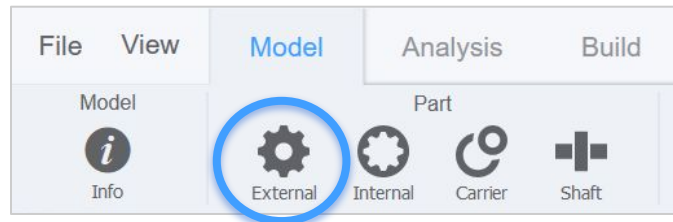
Gear Geometry

Name	Spur Pinion	-
Module$_n$	2	mm
Pressure angle$_n$	25	deg
Helix angle	0	deg
Number of teeth	17	-
Profile shift coeff.	-0.2	-
Bore diameter	15	mm
Work piece dia.	39	mm
Facewidth	15	mm

Cutter Data

Cutting method	Rack generation	-
Pressure angle$_n$	25	deg
Addendum coeff.	1.25	-
Dedendum coeff.	1.00	-
Protuberance size	0	mm
Protuberance angle	0	deg
Tip radius coeff.	max tip radius	mm

Name	Spur Wheel	-
Module$_n$	2	mm
Pressure angle$_n$	25	deg
Helix angle	0	deg
Number of teeth	30	-
Profile shift coeff.	-0.2	-
Bore diameter	30	mm
Work piece dia.	65	mm
Facewidth	15	mm

Cutter Data

Cutting method	Rack generation	-
Pressure angle$_n$	25	deg
Addendum coeff.	1.25	-
Dedendum coeff.	1.00	-
Protuberance size	0	mm
Protuberance angle	0	deg
Tip radius coeff.	max tip radius	mm

Duplicate Gear

1. Add another instance of *Spur Pinion* to the model by right-clicking it in the **Feature Tree** and select *Duplicate*.

2. Notice the duplicate gear appears in **Feature Tree** and **3D Viewer**.

3. For clarity, rename each gear by right-clicking it in the **Feature Tree** and select **Rename**.

   a. Input Pinion
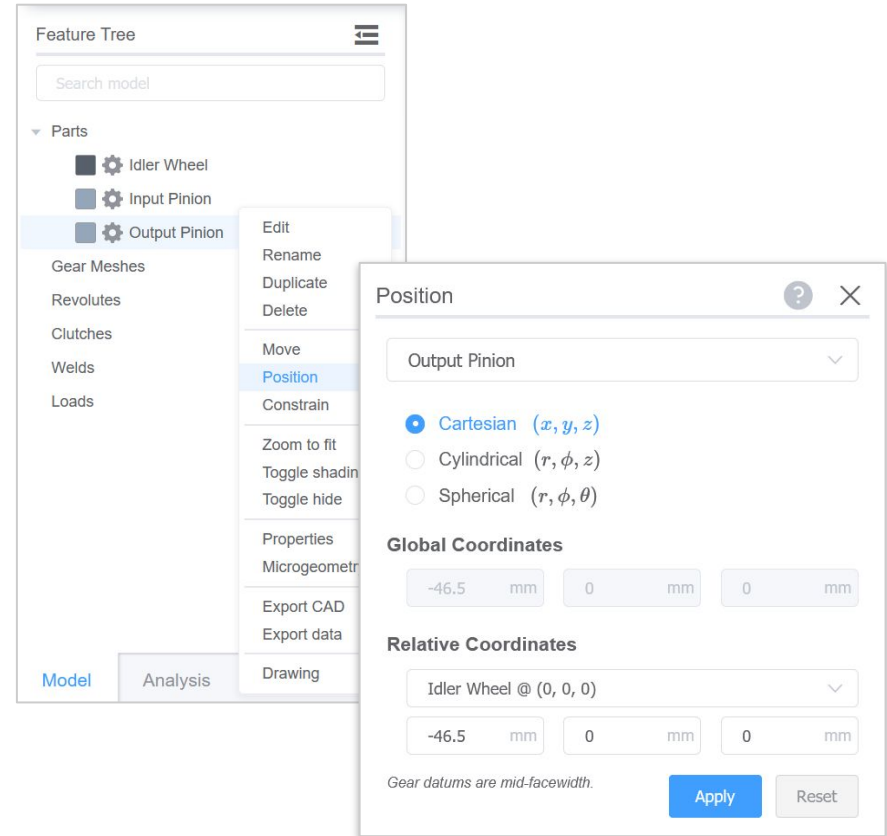   b. Output Pinion
   c. Idler Wheel

> **HINT:** Duplicate gears reference the same library gear. Changes to any instance of the gear affect all references.
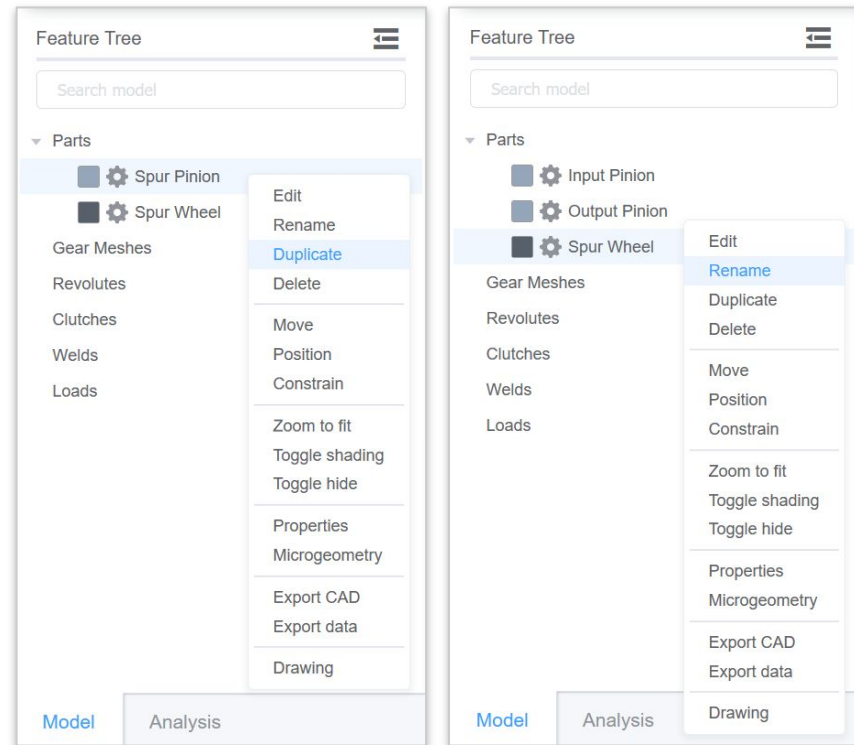
Position Gears

1. By default, gears are added to a model at the global origin (0, 0, 0).

2. Multiple positioning methods exist. Two are demonstrated here.

3. Right-click the *Output Pinion* in **Feature Tree** and select **Position**.

4. Set relative x-coordinate as -46.5mm from *Idler Wheel* and click **Apply**.
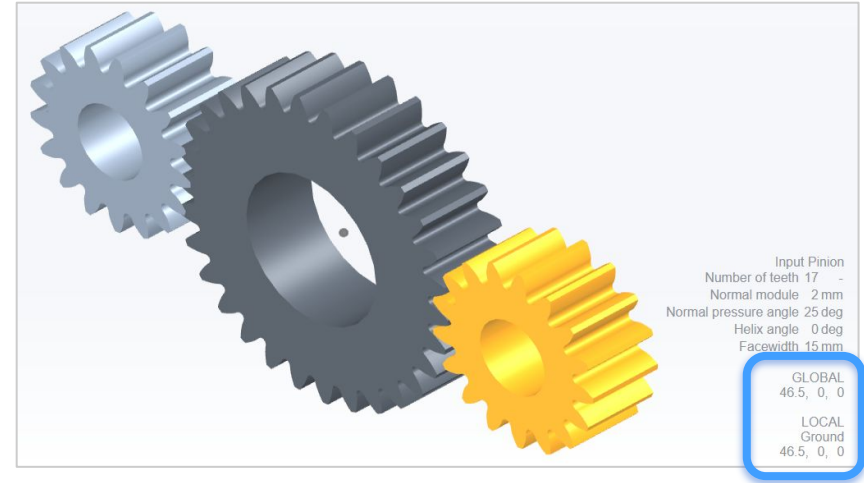
5. Exit the dialog.

> **TIP:** Ctrl + click two gears in 3D Viewer to see valuable information in the bottom right, including if the gears are "meshable" and the center distance for no backlash.

Position Gears

1. Click the *Input Pinion* in **3D Viewer**, and notice the display in lower right.

2. Select the GLOBAL x-coordinate field and set its value to 46.5mm.

3. Press Enter to accept the value and observe the updated 3D view.

Input Pinion
Number of teeth 17 -
Normal module 2 mm
Normal pressure angle 25 deg
Helix angle 0 deg
Facewidth 15 mm

GLOBAL
46.5, 0, 0

LOCAL
Ground
46.5, 0, 0

TIP: To quickly position gears without exact coordinates, right-click a gear in 3D Viewer and select *Move*.

Constrain Gears

1. From the **Model** ribbon tab, click the **Constrain** button to open dialog.

2. Click the **Mesh Search** button to automatically identify gears to mesh.

3. Confirm the selected gears to mesh, then click **Add Meshes**.

4. No other constraints are required for this model.

TIP: Ctrl + click two gears in 3D Viewer, then right-click to see options to constrain them.

HINT: Every component is considered to be rotationally unconstrained unless specified otherwise.
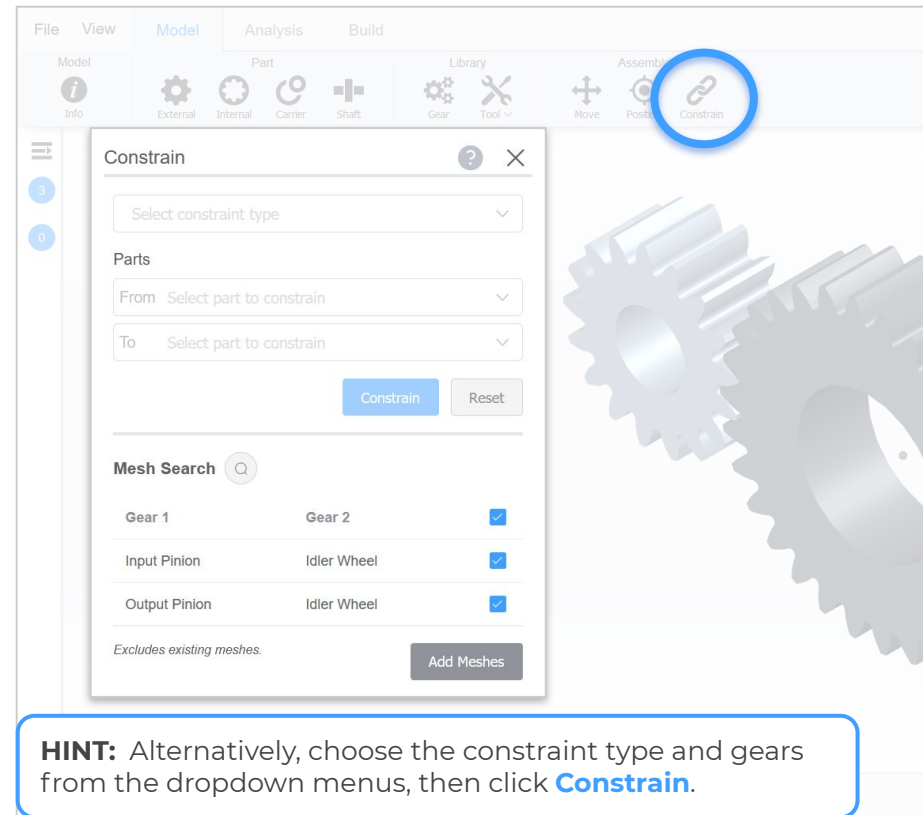

HINT: Alternatively, choose the constraint type and gears from the dropdown menus, then click **Constrain**.

Review Mesh

1. From the **Model** ribbon tab, click the **Mesh** button to open tab.

2. Select a *gear mesh* from the dropdown to examine it.

3. Select a *plot type* from dropdown.

4. Interactively review gear mesh and plot by **scrolling with mouse** in the gear or plot areas.

5. Notice the gear mesh parameters available in the lower right quadrant.

> **TIP:** Right click a gear mesh from the Feature Tree and select Review Mesh to achieve the first two steps above.
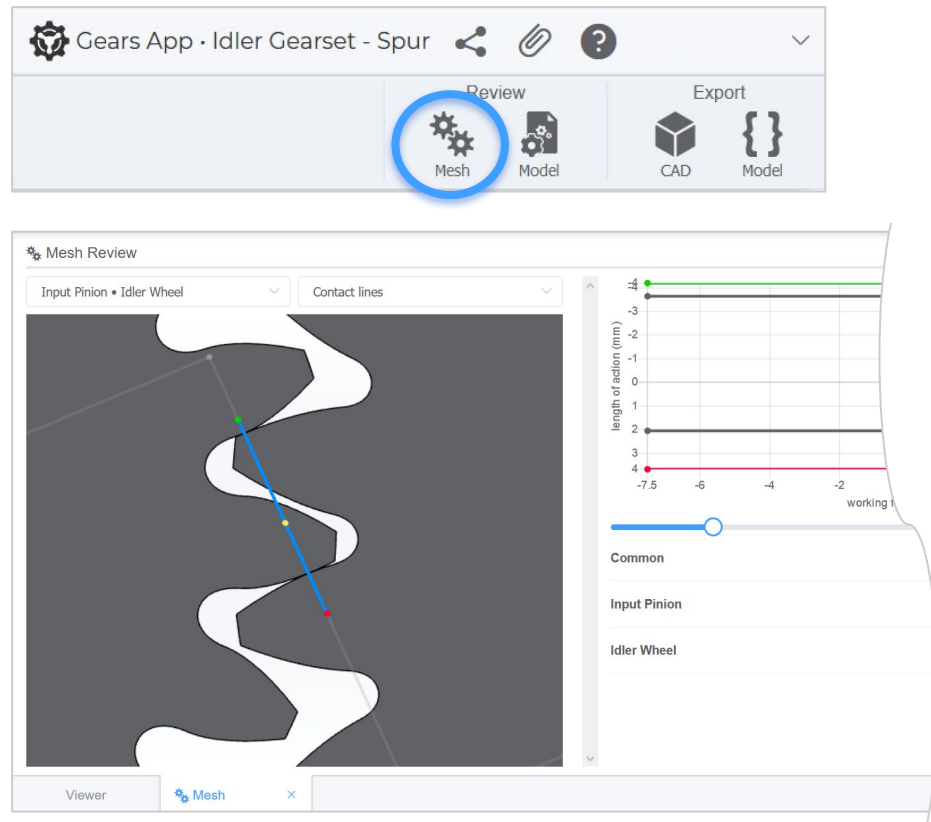
Reporting

1. From the **Model** ribbon tab, click the **Model** button to open a report tab.

2. Modeling report is auto-generated.

3. Review data for each gear, including assembly, constraints, and geometry.

4. Review data for each gear mesh, including common and individual gear parameters.

> **HINT:** Alternatively, click the File dropdown and choose Model Report to auto-generate the report.
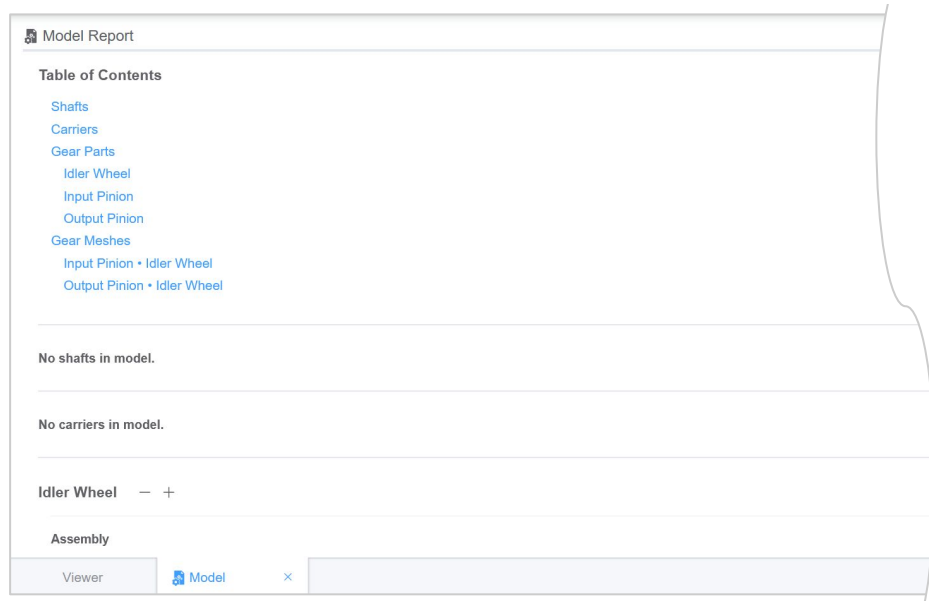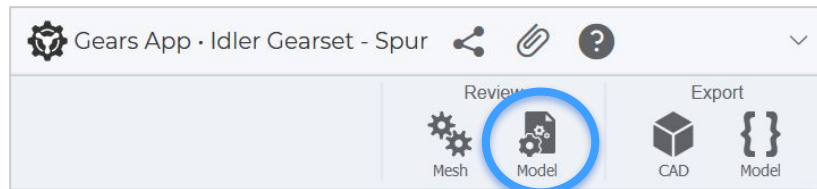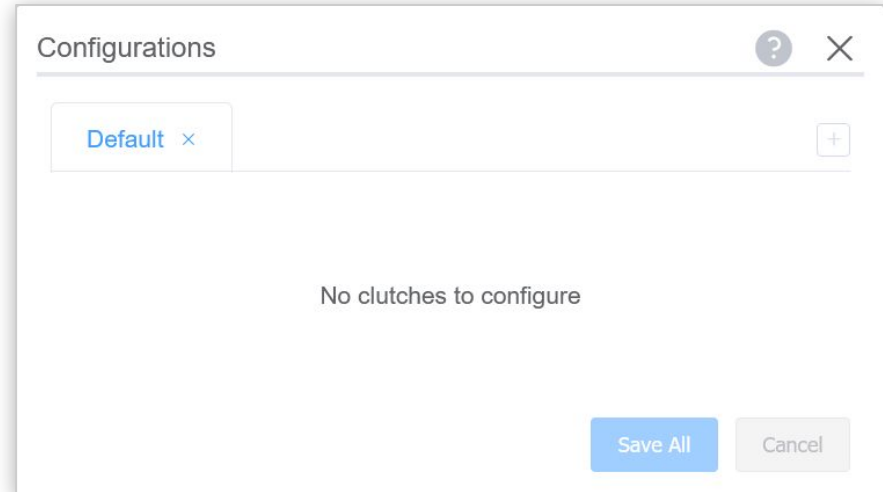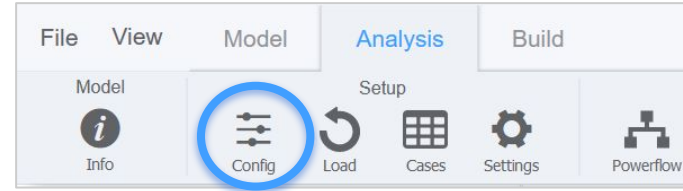
ANALYZING

Configurations

1. From the **Analysis** ribbon tab, click the **Config** button to open dialog.

2. A **Default** configuration is added automatically.

3. Our model does not have clutches, so nothing else needs to be done.

HINT: To define a load case, as shown later, a configuration must be defined even if no clutches exist.

System Loads

1. To torsionally constrain the model, we must define the system loads.

2. From the **Analysis** ribbon, click the **Load** button.

3. Per the notification message, select a part in the **3D Viewer**.

4. Click the *Input Pinion* to add a load.

5. Repeat for the *Output Pinion*. Notice the loads shown in **Feature Tree**.

> **HINT:** To cancel the creation of a load, press Esc.

> **HINT:** Both the *input* and *output* loads must be defined to torsionally constrain the system with balanced powerflow.
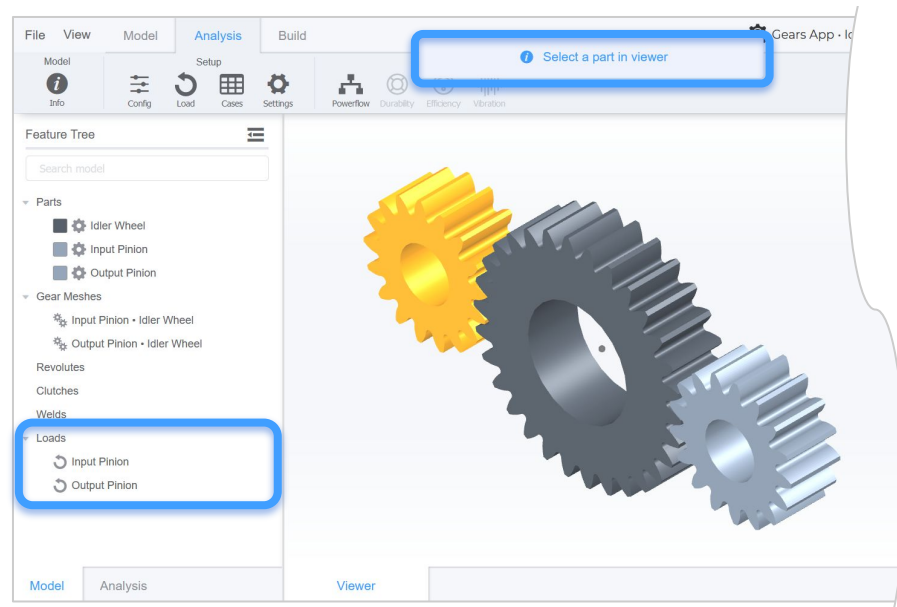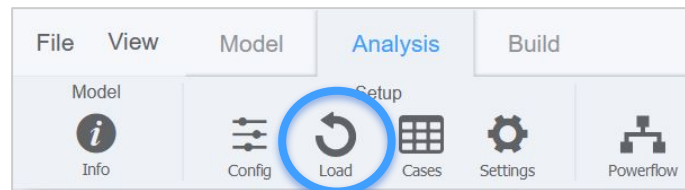
Duty Cycle

1. From the **Analysis** ribbon tab, click the **Cases** button to open dialog.

2. Specify a duty cycle with name *DC* and click **+ Duty Cycle** button.

3. To add load cases to the duty cycle, click its **Edit** ⊞ button.
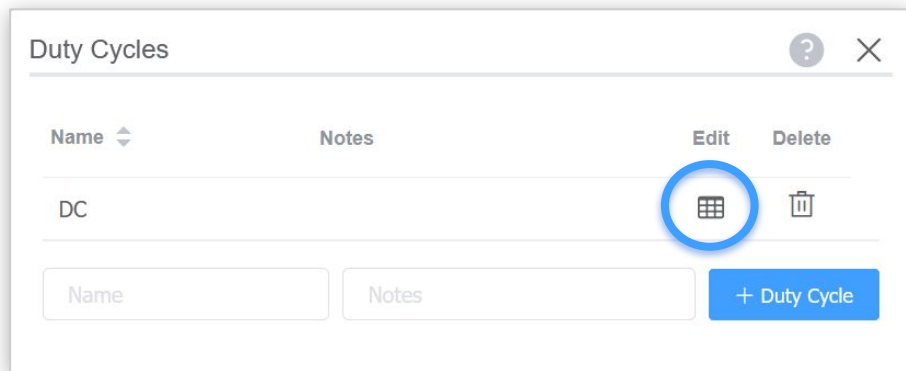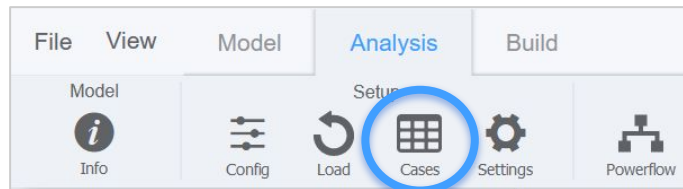
HINT: A *duty cycle* is a collection of *load cases*, i.e. discrete loads, preferably binned from real-world time series data.

Load Cases

1. Click the **Add Case** button to add a load case. Add two cases.

2. Edit the table of cases to define the load conditions for the model.

3. On completion, exit the dialog.

Name	Config	Hrs	Input Pinion			Output Pinion		
			rpm	Nm	kW	rpm	Nm	kW
LC1	Default	10	1000	5				
LC2	Default	10	-2000	5				

TIP: To edit the load cases of a duty cycle, double click the duty cycle in the Feature Tree on Analysis tab.

Load Cases | DC

|	Name	Config	Hours	Input P
				Speed (rpm)	Torque
☐	LC1	Default	10	1000	5
☐	LC2	Default	10	-2000	5

Delete

Run Powerflows

1. From the **Analysis** ribbon tab, click the **Powerflow** button to open dialog.

2. Click the **Run** ▶ button next to the duty cycle to simulate.

3. If the model has been properly defined, it will successfully solve.

4. If it failed to solve, review the prior steps in this tutorial.
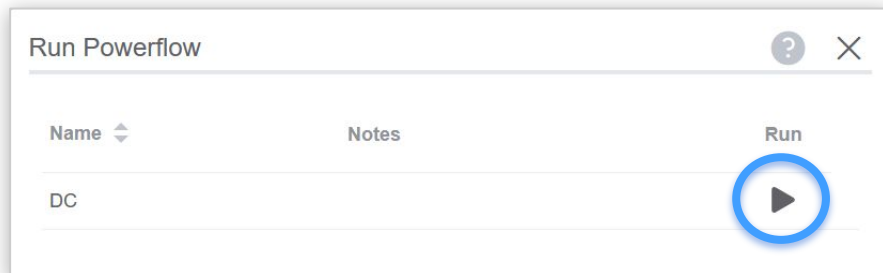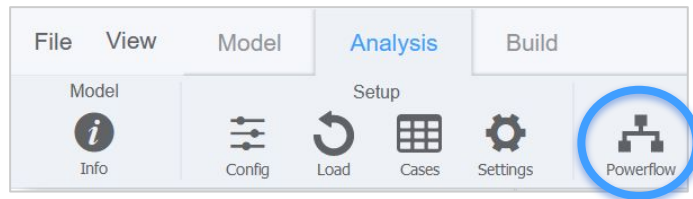
TIP: Run a duty cycle or load case from the Feature Tree by right clicking it in the *Powerflows* tree and clicking **Run**.

HINT: If the model is modified, outdated results will automatically update when accessing results.
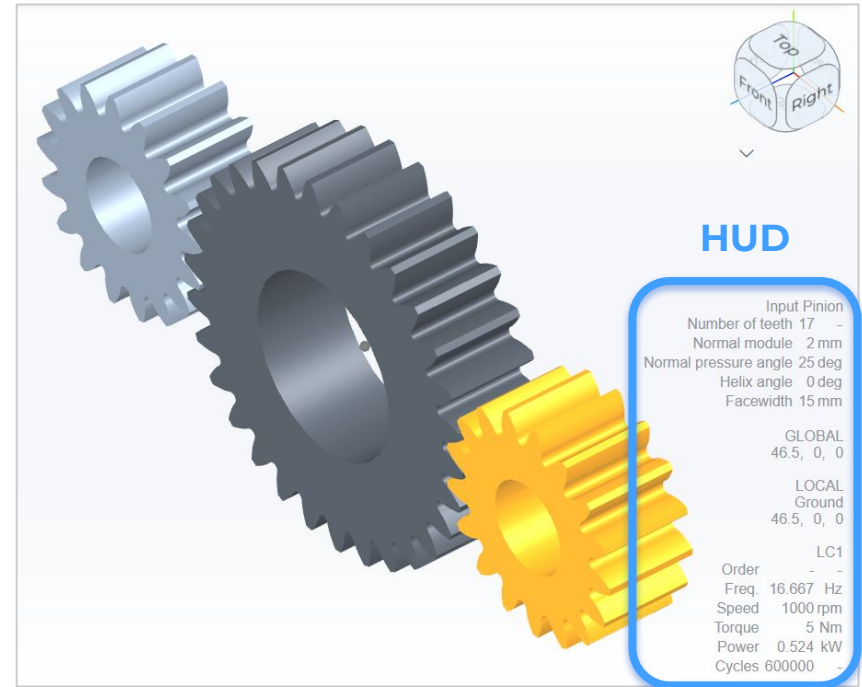
HINT: Notice the load cases in the Feature Tree show ✕ when unsolved and ⛂ when solved.

Results & Animation

1. To interactively review powerflow results, a load case must be *set*.

2. From the **Analysis** tab of **Feature Tree**, double click a load case in the *Powerflows* tree to *set* it.

3. Select a gear or gear mesh in **Feature Tree** to display certain results in HUD.

4. From the **Analysis** ribbon tab, click the **Animate** button to start animation.

> **TIP:** Animate a load case from the Feature Tree by right clicking it in the *Powerflows* tree and clicking **Animate**.

> **TIP:** With a load case set, view results for a gear by selecting it in the 3D Viewer.

HUD

Input Pinion
Number of teeth 17   -
Normal module 2 mm
Normal pressure angle 25 deg
Helix angle 0 deg
Facewidth 15 mm

GLOBAL
46.5, 0, 0

LOCAL
Ground
46.5, 0, 0

LC1
Order   - -
Freq. 16.667 Hz
Speed 1000 rpm
Torque 5 Nm
Power 0.524 kW
Cycles 600000

> **HINT:** Gear or gear mesh *order*, as shown in HUD, is based on the reference part in Settings, from the Analysis ribbon.

Reporting

1. From the **Analysis** ribbon tab, click the **Analysis** button to open a report tab.

2. Analysis report is auto-generated.

3. Review load case results for the gears and gear meshes, including angular velocities, torques, forces, and frequencies.

> **HINT:** Alternatively, click the File dropdown and choose Analysis Report to auto-generate the report.
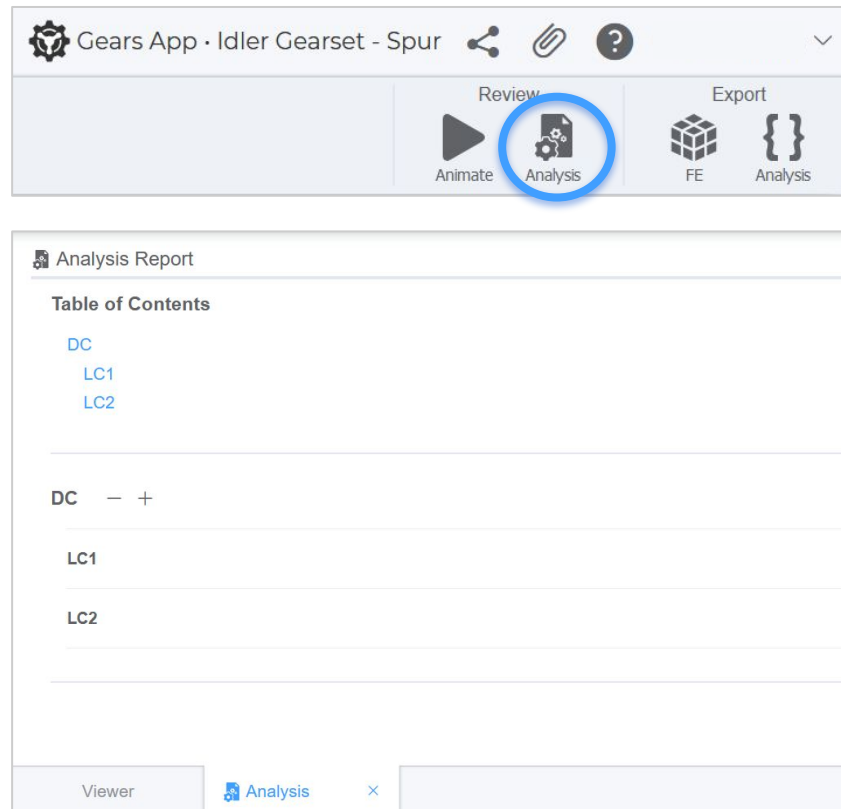
INTEGRATIONS

EXPORTS, CONSULTING, & MANUFACTURING

Export Data

Need to evaluate your gears in other software?

Learn how to export data to work with CAD, FE, and other software. Leverage the fully web-based ecosystem of the Gears App to streamline your gear design development.

See tutorial: *Model Data and Exports*

Design Review

Need an expert to review your design?

Learn how to request services to conduct a design review with independent consultants from our global network at Drivetrain Hub.

See tutorial: *Consulting and Manufacturing*

Manufacturing

Need to build your gear system?

Learn how to create mockups with our additive manufacturing service, and efficiently communicate with qualified global manufacturers to prototype and mass produce your gears.

See tutorial: *Consulting and Manufacturing*

What Next?

➔   Sign up and start using [Gears App](#).

➔   Keep learning with the [Tutorial Series](#).