

Transcript for 4.2 Resolution of a Force into a Force and Couple

0:01

Hello. In today's video lecture, we're going to talk about the resolution of a force into a force and a couple. When we resolve a force into a force and a couple, we are finding a force and a moment that are statically equivalent to the original force. This allows us to shift the point of application of a force from its original point to a new point of interest while maintaining the same net effect on the object.

If we shift a group of forces into a single point, we can add up those forces and moments to find the equivalent force-couple system, which is a simplified version of the original system. We'll discuss that more in a future video.

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Here, I have a force acting on a wrench. Imagine we have this force applied to the wrench as shown. We might want to understand the force's effect on the bolt in the problem. We may want to know what effect the bolt experiences. To do this, we can resolve the force into a force and a couple—a pure moment acting about the center of the bolt.

To do this, we want to determine the equivalent force at the bolt and the equivalent moment. The force might cause the bolt head to shear, while the moment might cause the bolt to twist.

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To visualize the process of resolving a force into a statically equivalent force and couple, imagine the following. Draw a free-body diagram with the original force. Then pick a point where you want the equivalent force-couple system to act. Clearly identify that point. Here, it is the center of the bolt, and the distance between the force and this point will be important in our calculations.

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Next, imagine drawing two equal and opposite forces acting at that point. These forces have the same magnitude as the original force—one in the same direction, the other in the opposite direction.

We are adding zero net force because the two forces cancel each other out. This does not change the problem; the situation remains statically equivalent.

These two forces form a couple. The original force and the opposite force create a pair of equal and opposite but non-colinear forces. The remaining force is left over. This couple can be redrawn as a moment, leaving only the single force acting at the bolt. Remove the couple and replace it with the equivalent moment. Now we have a force and a moment, both acting at the bolt.

2:53

As a shortcut to the equivalent force-couple system, instead of drawing the equal and opposite forces, we can simply move the force to the new point. The pure moment will be equal to the moment that the original force exerts about the point of interest. If we move the force and compute its moment about the bolt, we can create that moment directly at the bolt.

This gives us an equivalent force and equivalent moment for the original scenario. Removing the original force, this becomes the resolution of a force into a force and a couple at a separate point.

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That's all for today's video lecture. Thank you for watching, and I hope to see you again.