Finite Element Analysis

What is a hub?

Before we can consider building a model of the hub we need to understand what it is... what does it do... and how does it interact with other components?The hub is made of a high grade steel and carries the wheel which is clamped on with a large single nut. At the other end is a pair of wheel bearings - these connect and locate the hub into the upright assembly.

The loads come from the road surface and follow a path through the tyre and wheel, into the hub and out through the wheel bearings and into the rest of the suspension and the car.
Let's hear what the Red Bull's senior structures analyst Lewis Butler has to say about it.
Okay, here we have a partially disassembled car that effectively has all of the structural components only within it, so, ordinarily there would be a lot more paraphernalia around the car in terms of bodywork for the aerodynamics. So as you can see here we have the wheel and that obviously carries all the forces from the wheel in through all the components inboard of that and into the chassis, and from there past the driver and into the main structure of the car. So, to show you a bit more detail … having removed the wheel we can now see some of the components that's associated with the load path that carries the load into the chassis. So the component in question: which is the hub - this component here. The wheel is held in place using the nut, which obviously you can see here, beyond that is the component that holds the brake disk which isn't actually here at the moment, it will actually sit around the outside of here. And then this goes inboard which carries loads via-bearings which are on the hub again, onto the upright which carries the brake calliper and also all of the suspension components. And these suspension members carry the loads into the chassis. The hub itself is effectively a turned piece of steel with some extra machining detail on it. And here we have the component in question; the front hub. Here is where the thread locates for the nut on this space here. The wheel sits in this gap, the flange is here; now this reacts the thrust load from the wheel and also from the bearings which are pre-loaded and the two bearings sit on this face here and this face here. And they react both radial and axial forces.

So now we know quite a bit about the hub. We know it is made from high grade steel and we've seen how it fits into the car upright assembly and transmits or carries the loads.
The wheel and disc bell are clamped hard against this face by the wheel nut on the end. And there are 2 wheel bearings here and here which are clamped together or "pre-loaded" with another large nut at the other end.