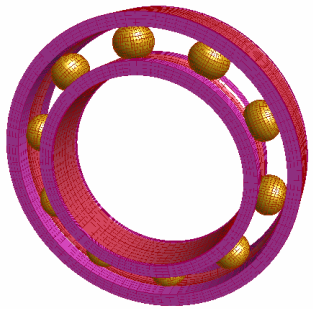

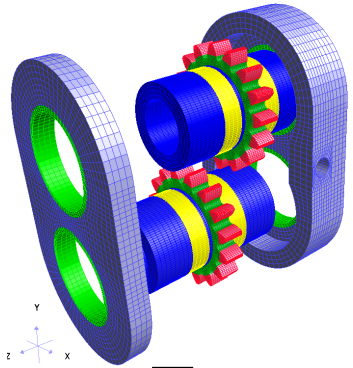

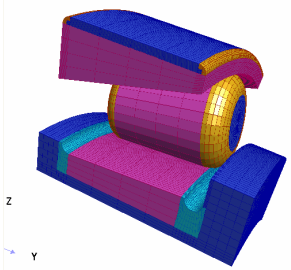

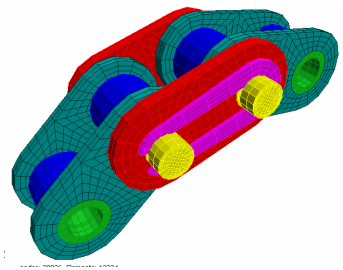

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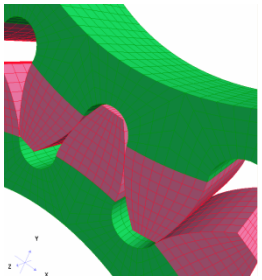

Future Trends Part – 4

Building Shaft & Rotor Models – the AIES way

Dr Ian McLuckie

May 2016

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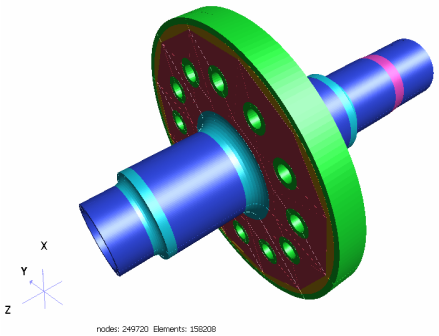

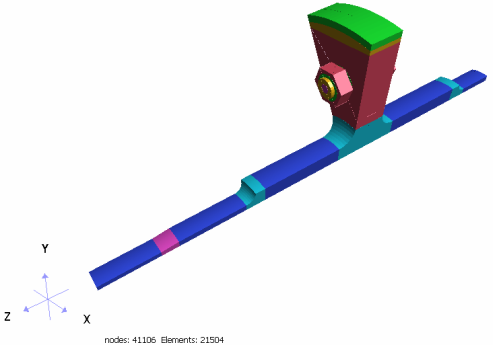

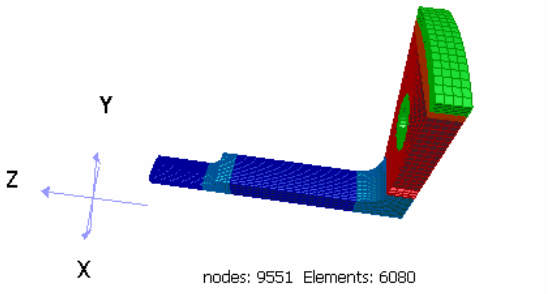

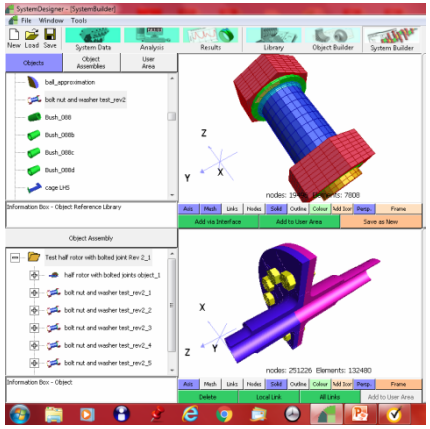

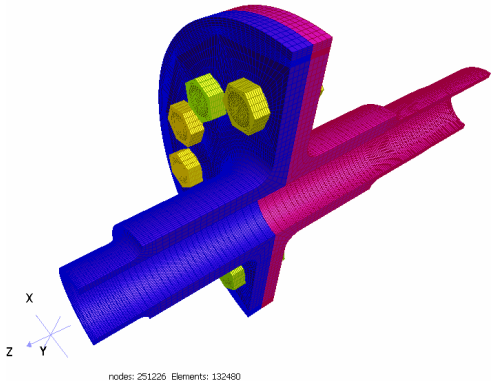

Rotor & Shaft Modelling the AIES way

Shaft modelling and Rotor Dynamics – see future papers regarding Rotor Dynamics

Within AIES Ltd we can build shafts and rotors for carrying out rotor dynamic studies or for transient loaded shaft and bearing systems. We will show here how to build a rotor with a bolted joint. The bolted joint includes bolts, nuts and washers also built in SystemDeveloper. The fasteners will be a subject of another paper (TBA). The shaft will be connected to REBs (Parts 2 & 3) or plain bearings but this will also be another paper (TBA). For plain bearings our Tribology solvers can also calculate the oil film coefficients if you wish. Housings can be represented with our EHD or TEHD solvers.

Building a Shaft or rotor assembly

We will talk now about model generation of the rotor assembly. It includes a bolted joint and fasteners that are also easily built in our software. In future papers we will include REBs and plain bearings.

Lets build the small shaft with its bolted flange.

Part of the shaft lends itself to having an axisymmetric start geometry. In fact all our Finite Objects start out as axisymmetric or plane stress or strain. So you can easily build axisymmetric models if that's what you want for your design analysis. There will be a paper on how you build these later on. The other part of the geometry, the flange lends itself to extrusion so we can build this easily as well. We build a sector or wedge. But we need to know how many bolts are in the flange as this determines the sector angle. As this method is generic we are actually building a flange class that can be scaled to any angle, so you could have as many bolts as you wish in the joint. Now just to recap:

We build the shaft by revolving the initial axisymmetric profile and we build the flange by extrusion.

Pretty simple really. We will build the half shaft assembly for bending , then build the full model by connecting cyclic models, you can then use this for bending and torsion studies. So start as follows:

1. Build the short shaft cyclic symmetry finite object assembly .
2. Build a half or full shaft with cyclic symmetric sectors .

Short Shaft Modelling the AIES way

Lets build the small shaft cyclic model with its bolt flange.

Firstly we build the shaft up to the light blue fillet of the flange. This fillet object can be of compound radii, elliptic or circular arc. **We don't defeature models at AIES as it's one of our USPs.**

This model can be revolved. We then make the bolt flange via extrusion and connect the two together or you can build the whole shaft together on the fly.

Next we build the short shaft cyclic symmetry finite object assembly. In future releases it will be possible to copy these cyclic models automatically, so you can automatically generate sized and scaled complete assemblies. The LHS figure below shows the cyclic model and how it is connected together to make a full shaft model; the same process is used to build a half model. Indeed you can build a half model and then connect the two halves to make a full model as the RHS figure below

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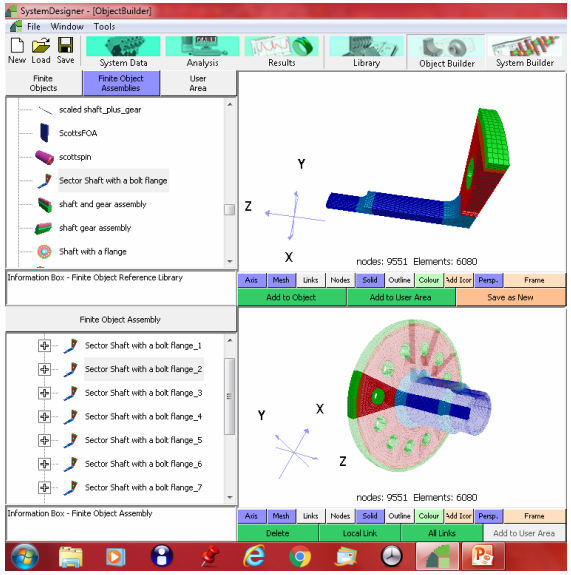
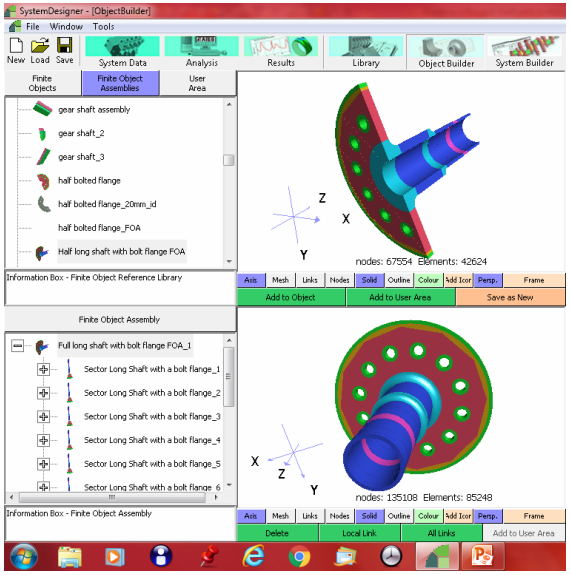




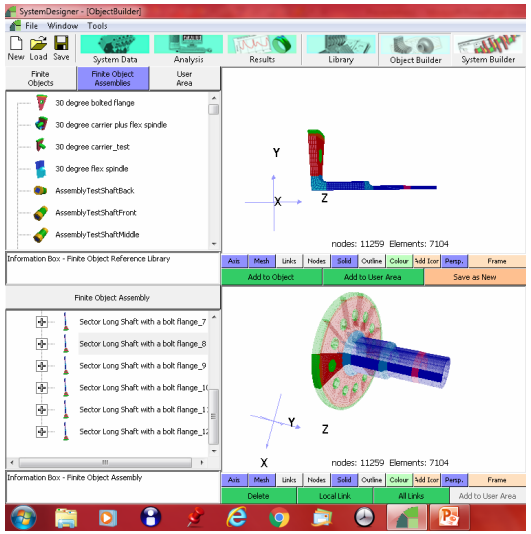
Long Shaft Modelling the AIES way

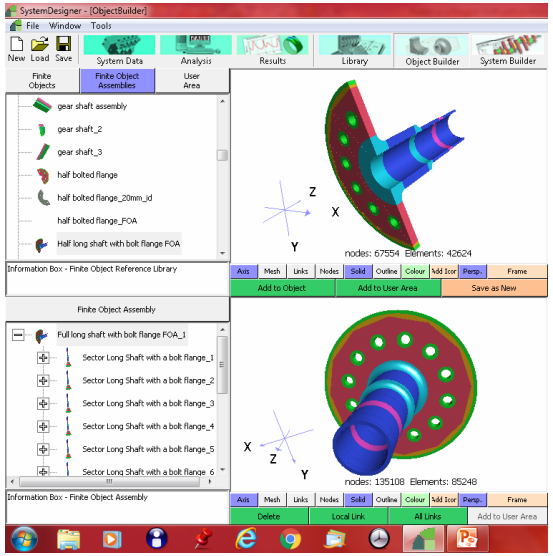
Lets build the long shaft cyclic model with its bolt flange.

Firstly we build the shaft up to the light blue fillet of the flange. This fillet object can be made up of compound radii, or elliptic or circular radii. **We don't defeature models at AIES as it's one of our USPs.** This model can be revolved. We then build the bolt flange via extrusion and connect the two together, or you can build the whole shaft altogether on the fly.

Next we build the long shaft cyclic symmetry finite object assembly .

In future releases it will be possible to copy these cyclic models automatically, so you could automatically generate sized and scaled complete assemblies. The LHS figure below shows the cyclic model and how it is connected together to make a full shaft model; the same process is used to build a half model. Indeed you can build a half model and connect the two halves to make a full model as the RHS figure below.

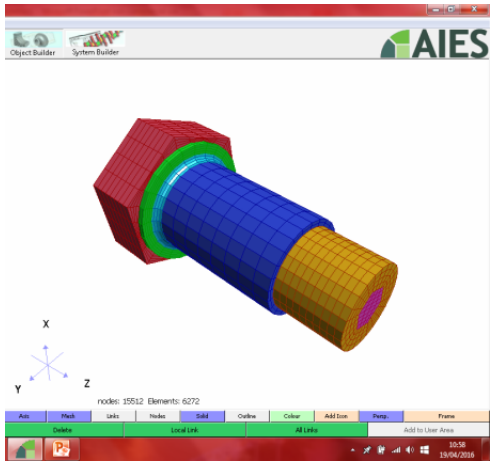


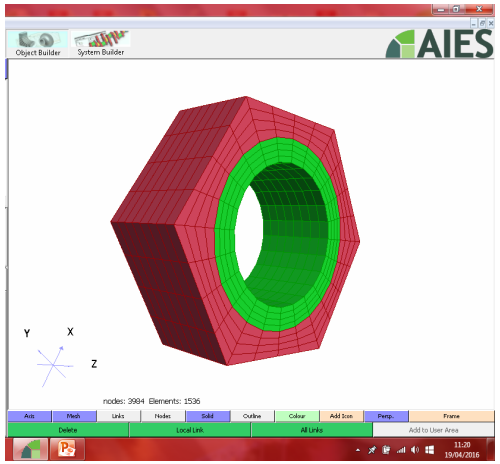


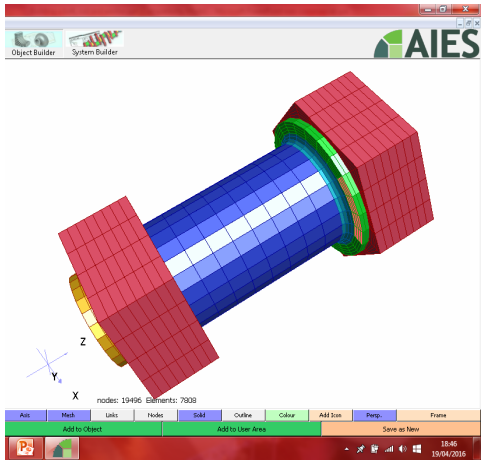
Fasteners Components @ AIES Ltd

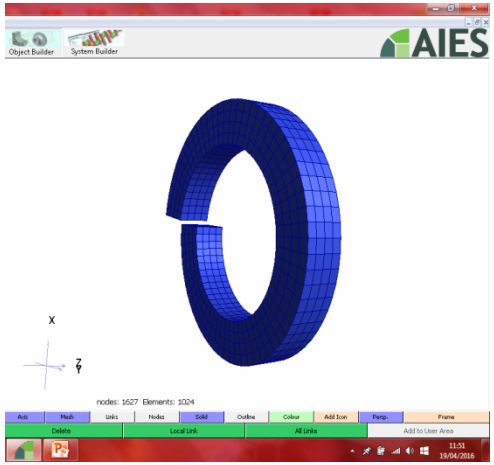
Fasteners built for dynamic and structural analysis.

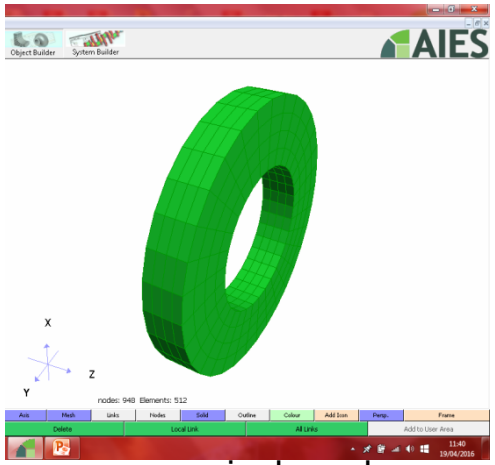
These fasteners, bolts, nuts and washers were built in our software. They are solid models, they can be built far more complicated than you see here, but remember they are scalable, parameterised and have the mesh fused with the model. Please note the spring washer was made from a single finite object.

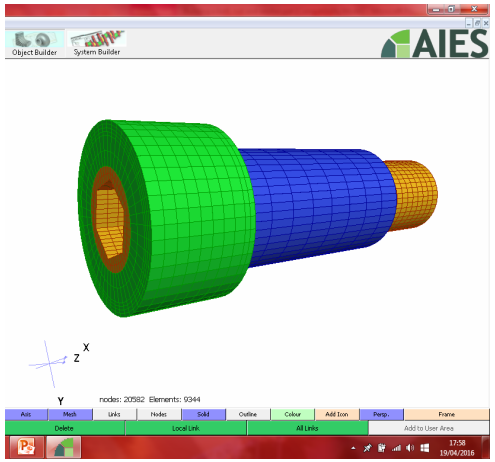












Building the Rotor Bolted Joint

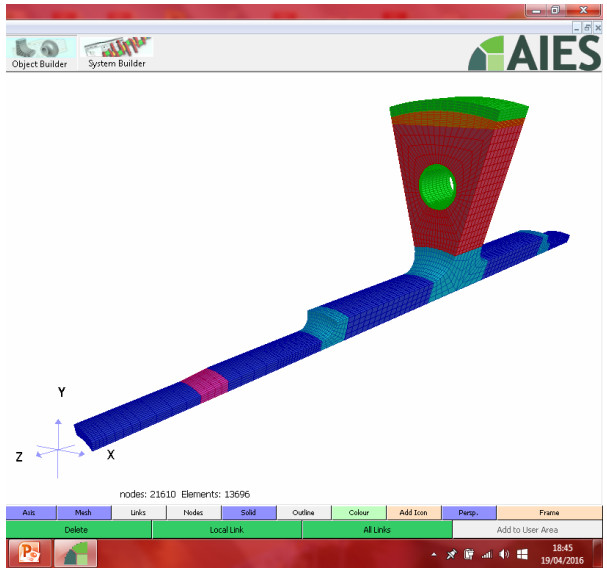
Components of the cyclic rotor bolted joint.

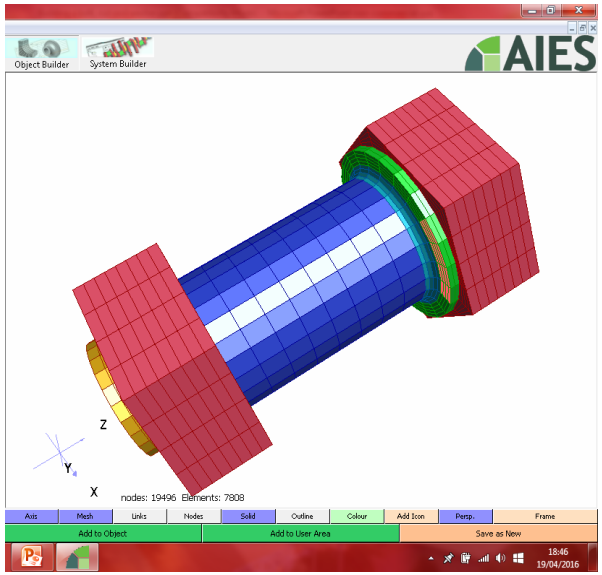
There are a number of ways of building a bolted joint. I am going to show two ways

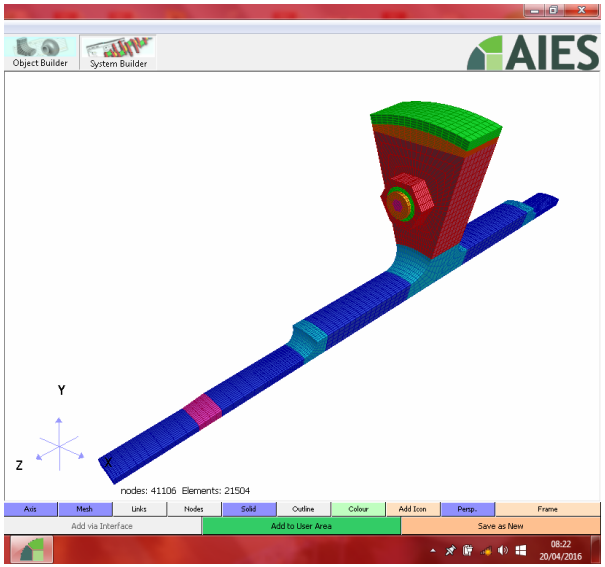
1.Build the cyclic symmetry model and then connect the nut and bolt via interface objects. Then build the half shaft, then the full shaft with the bolts and nuts already in the model.

2.Use the cyclic symmetry model (without bolts) and build the half model and full model as before in 1, then connect the bolts and nuts. This will probably take longer.

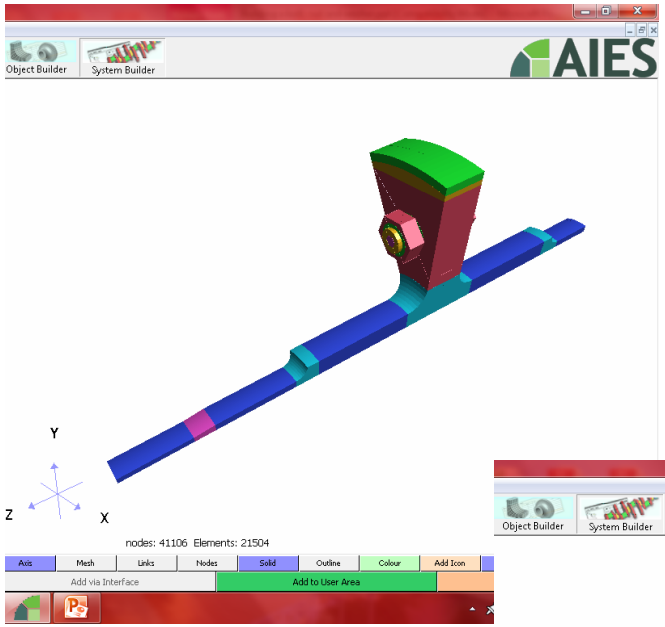
Note that the nuts and bolts in the rotor assemblies have been built by finite objects. You can see the rotor components and the assemblies cyclic symmetry model. This is then used to build the model in the first methodology.

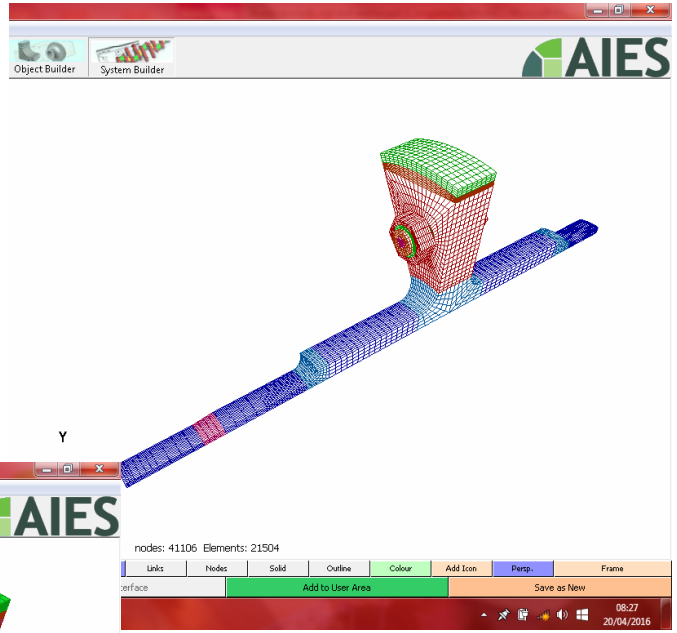


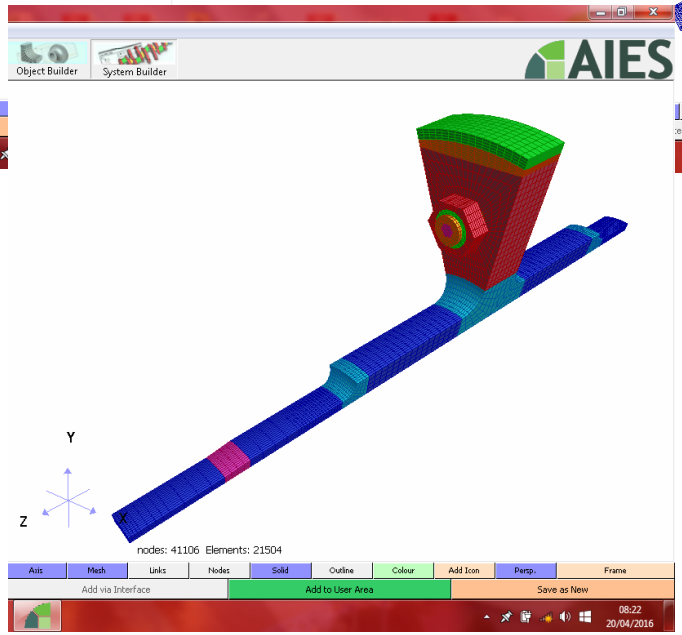




Building the Cyclic Rotor Bolted Joint







Your colour choice of Rotor Bolted Joint

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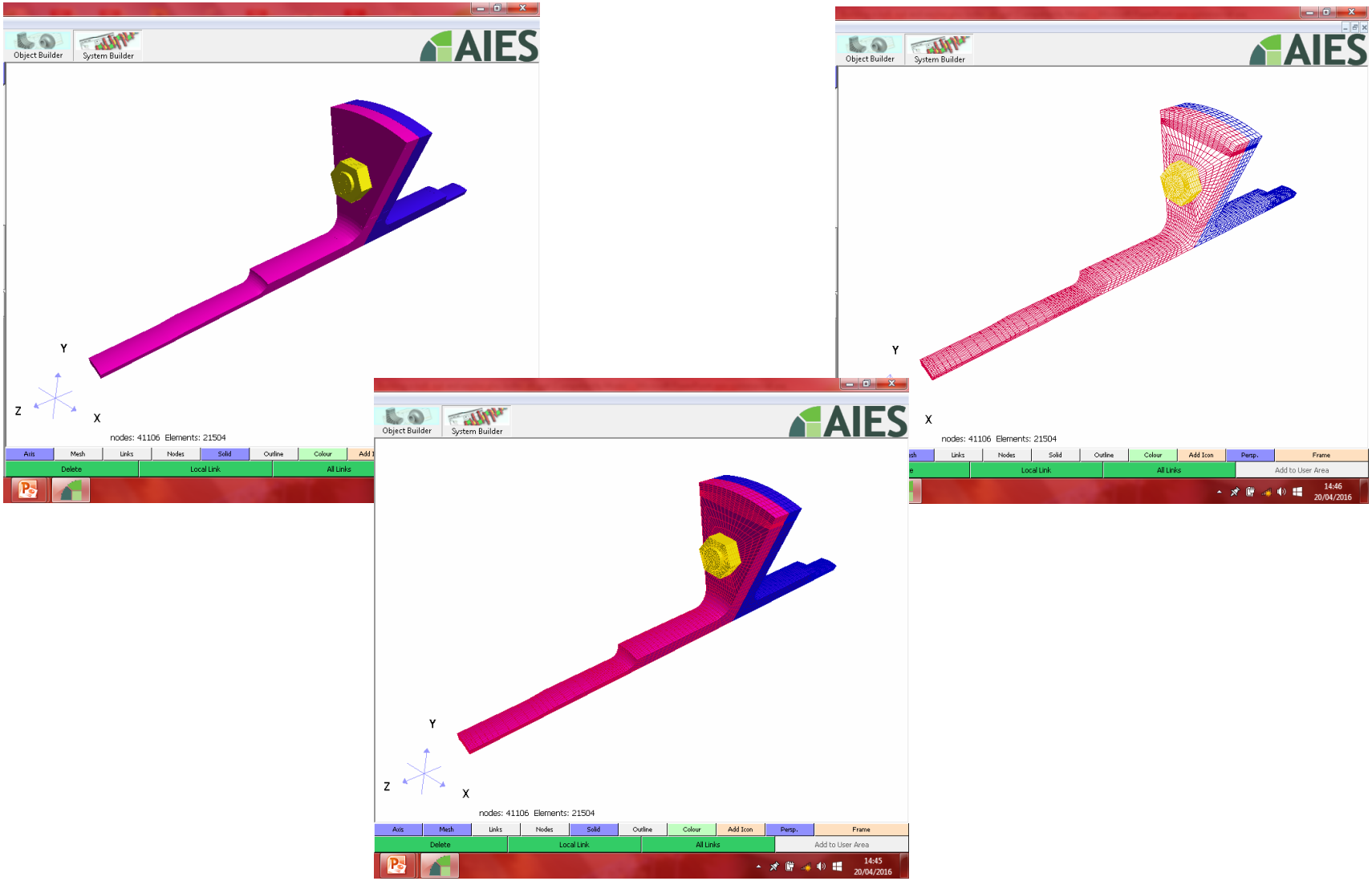

Half & Full Rotor Joint Before Fasteners

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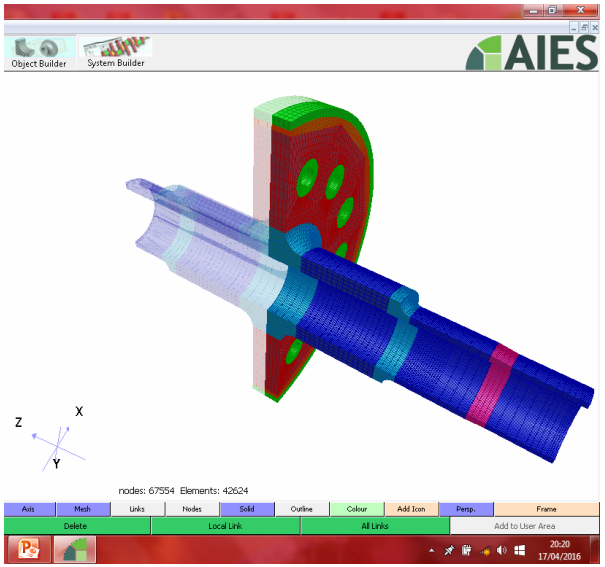

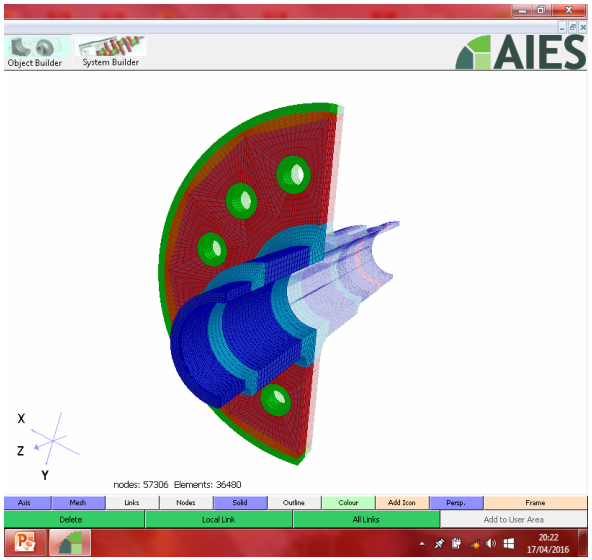

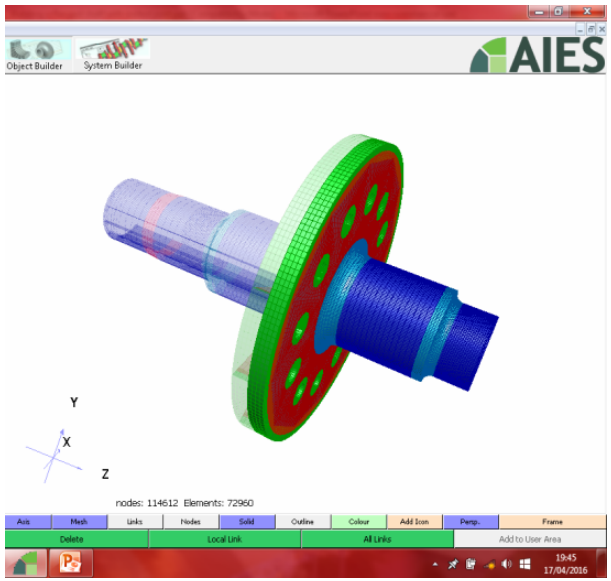

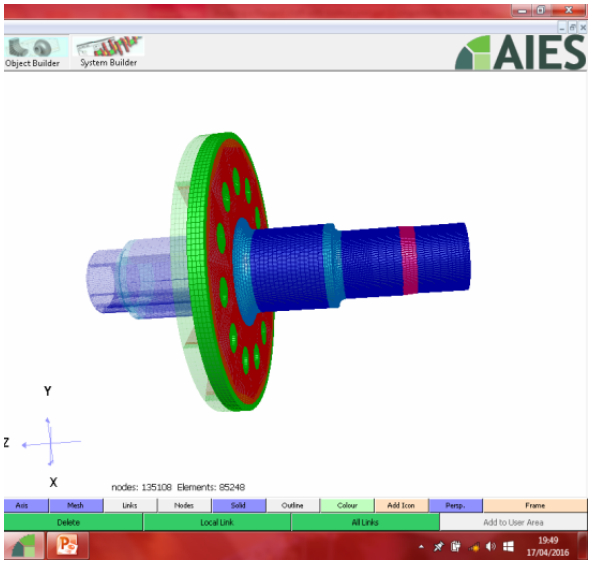

Half Rotor Bolted Joint For Bending

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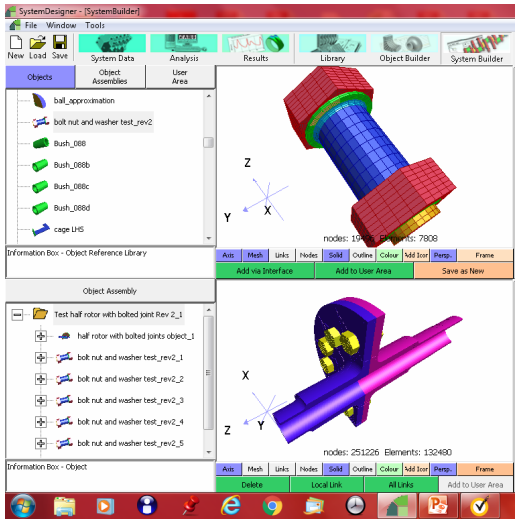

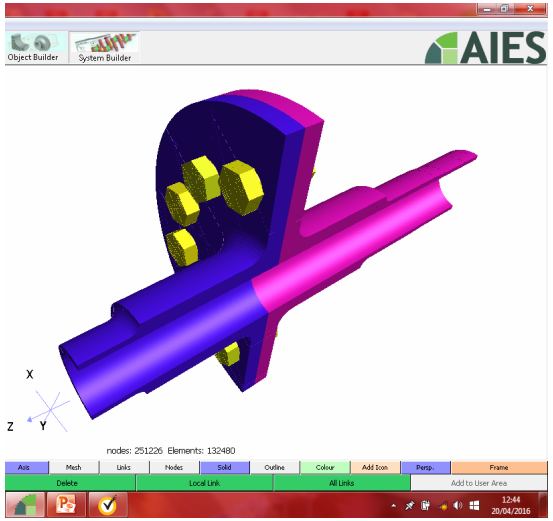

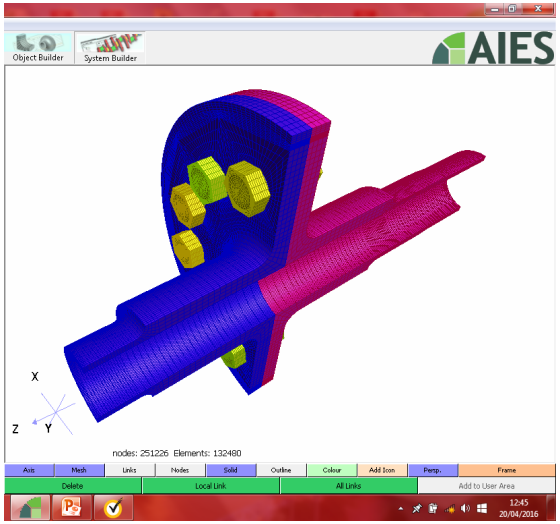

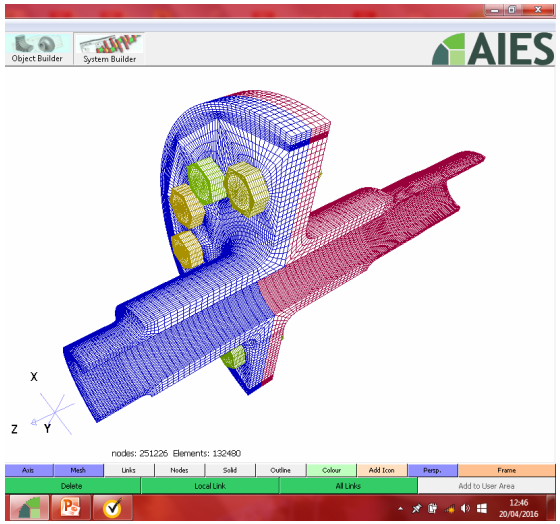

Other Object Assemblies @ AIES

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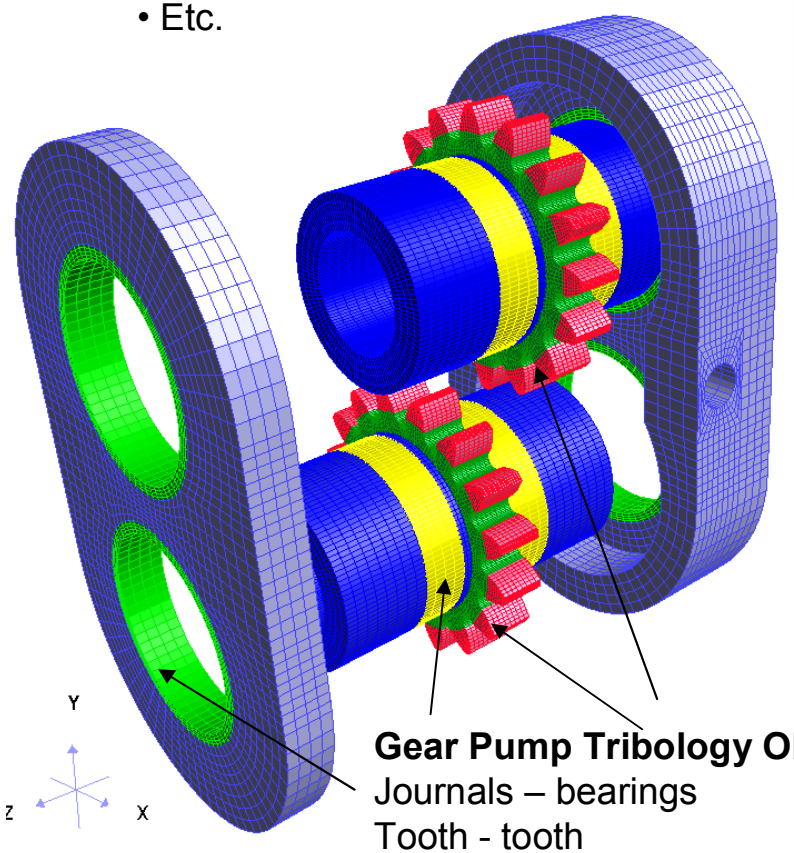
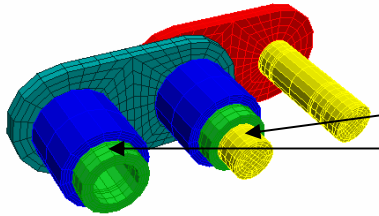
Tribological Interface objects

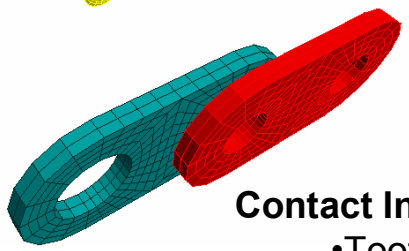
- Journals – bearings
- Pins – bushes
- Bushes – rollers
- Tooth – tooth
- Etc.



Gear Pump Tribology Objects
Journals – bearings
Tooth - tooth

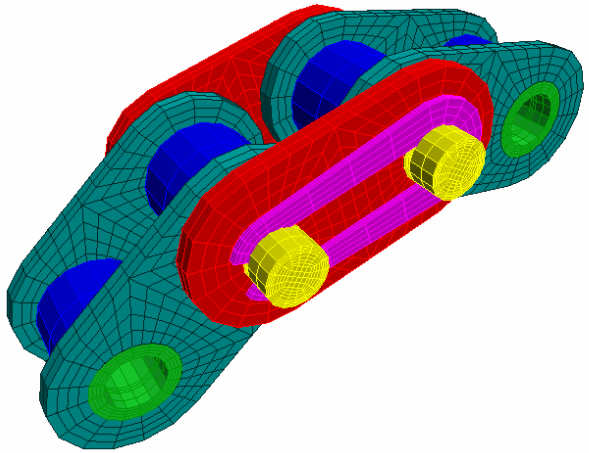


Chain Tribology Objects
Pins – bushes
Bushes - rollers



Contact Interface Objects

- Tooth – tooth
- Pin – sideplate
- Circlip – pin & sideplate
- Sprocket tooth - roller



Conclusions

I hope I have given you more food for thought. Something you may have thought as hypothetical is now achievable. If you have any questions or want to know more please contact us on Tel. +44 (0) 1858 414854 Mob. +44 (0) 7801 575725 or on info@aiesl.co.uk and sales@aiesl.co.uk or to me on ian.mcluckie@aiesl.co.uk

Thank you for your kind attention

Dr Ian McLuckie

May 2016