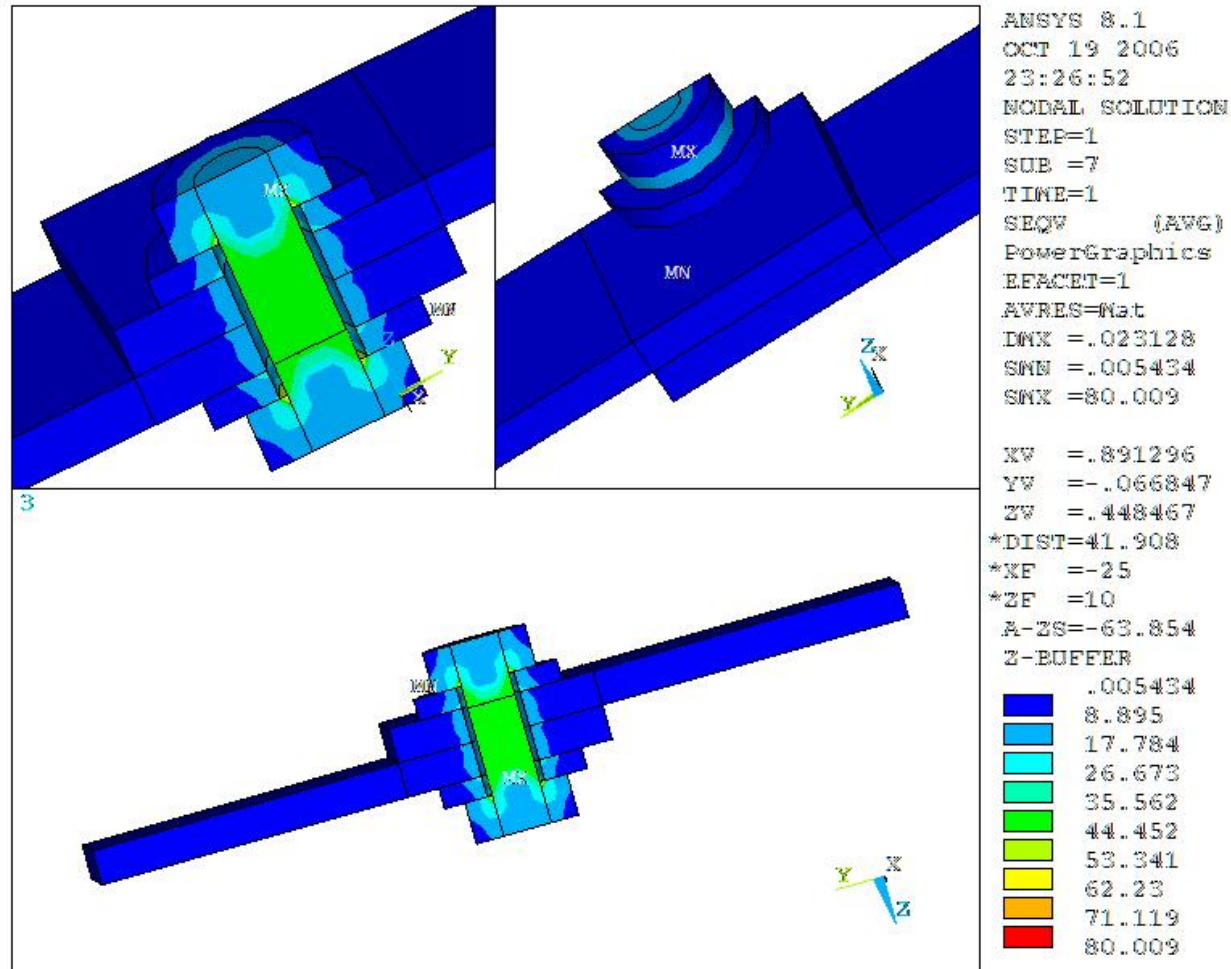
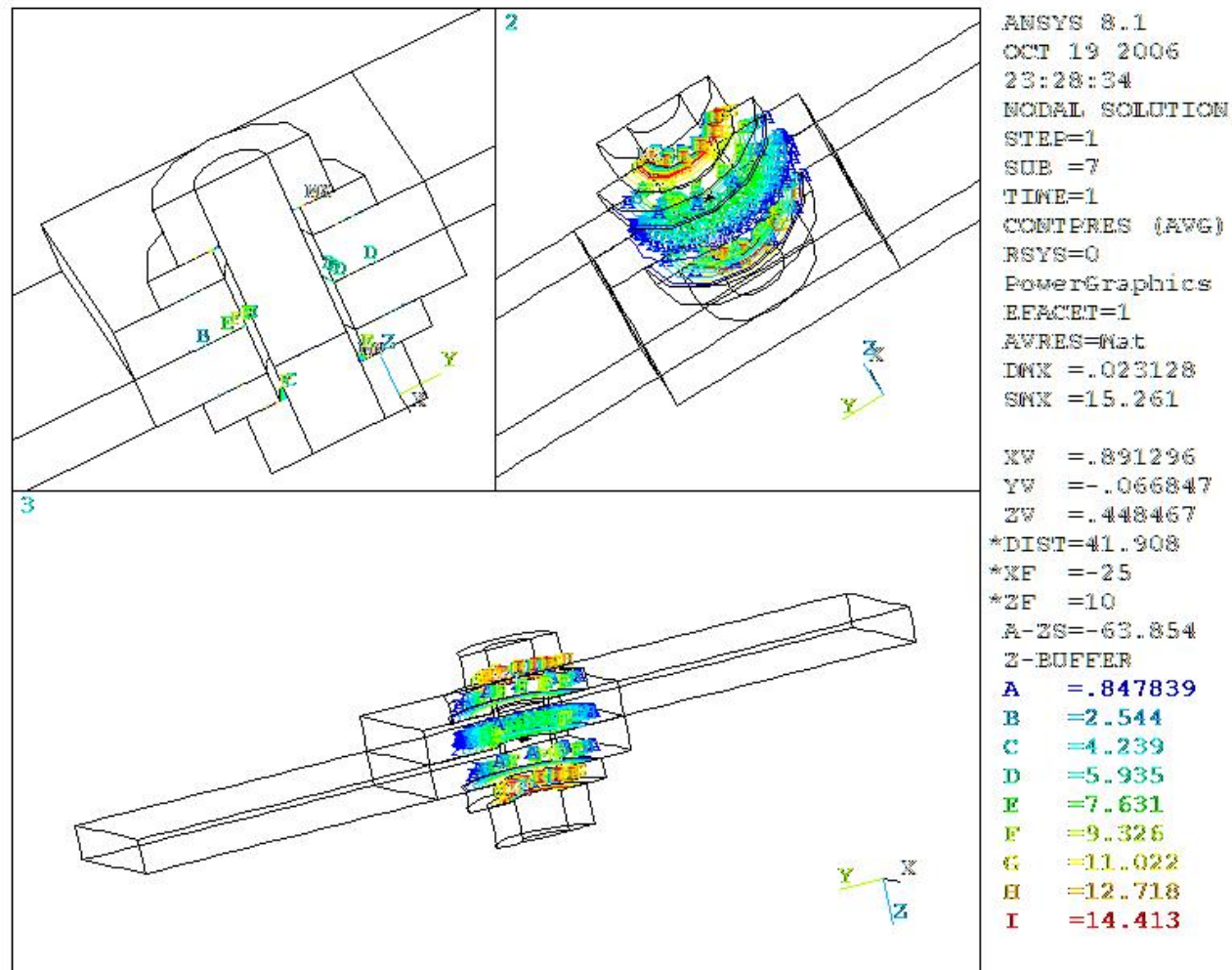


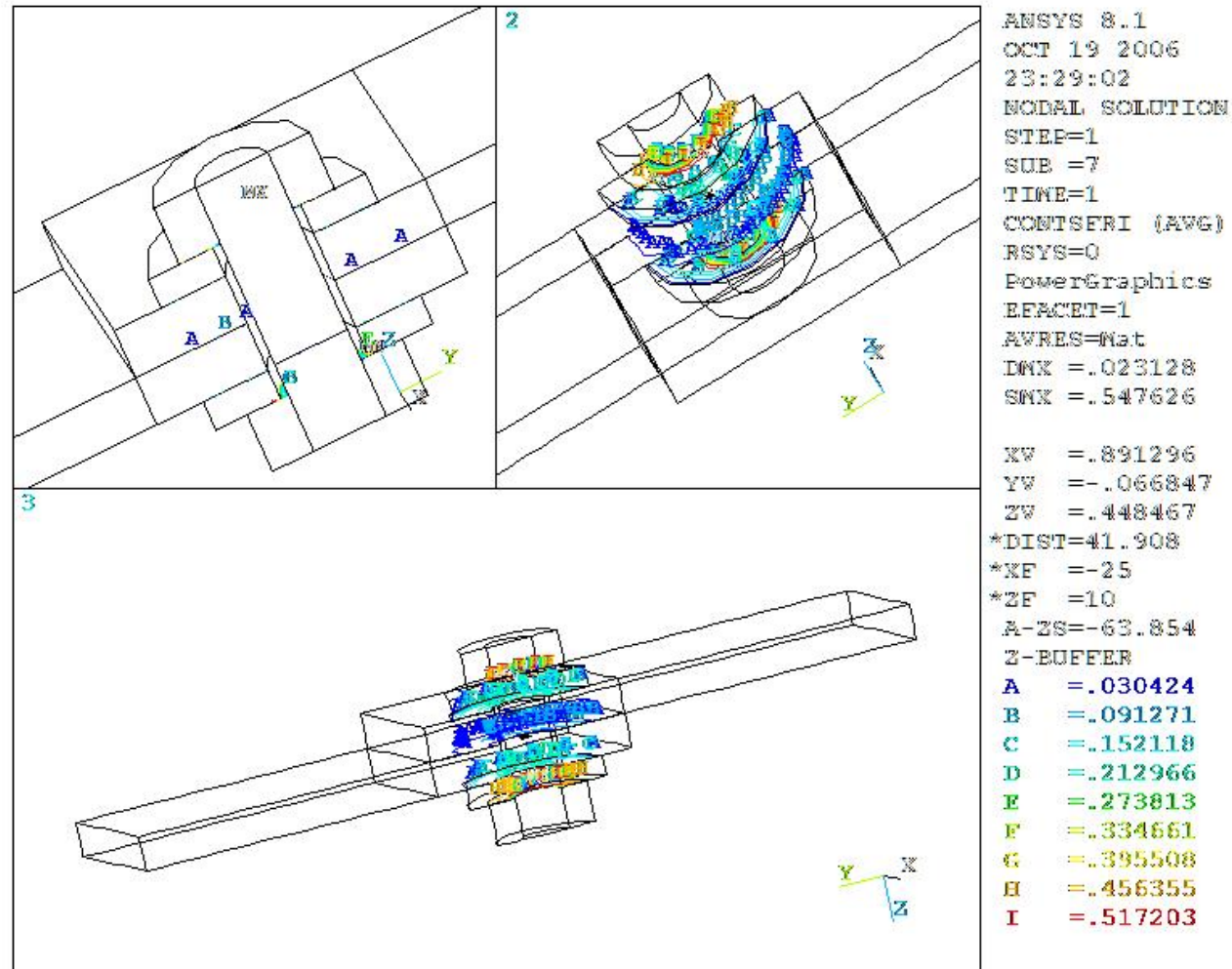
Contour Plot of Von-Misses Stress-2



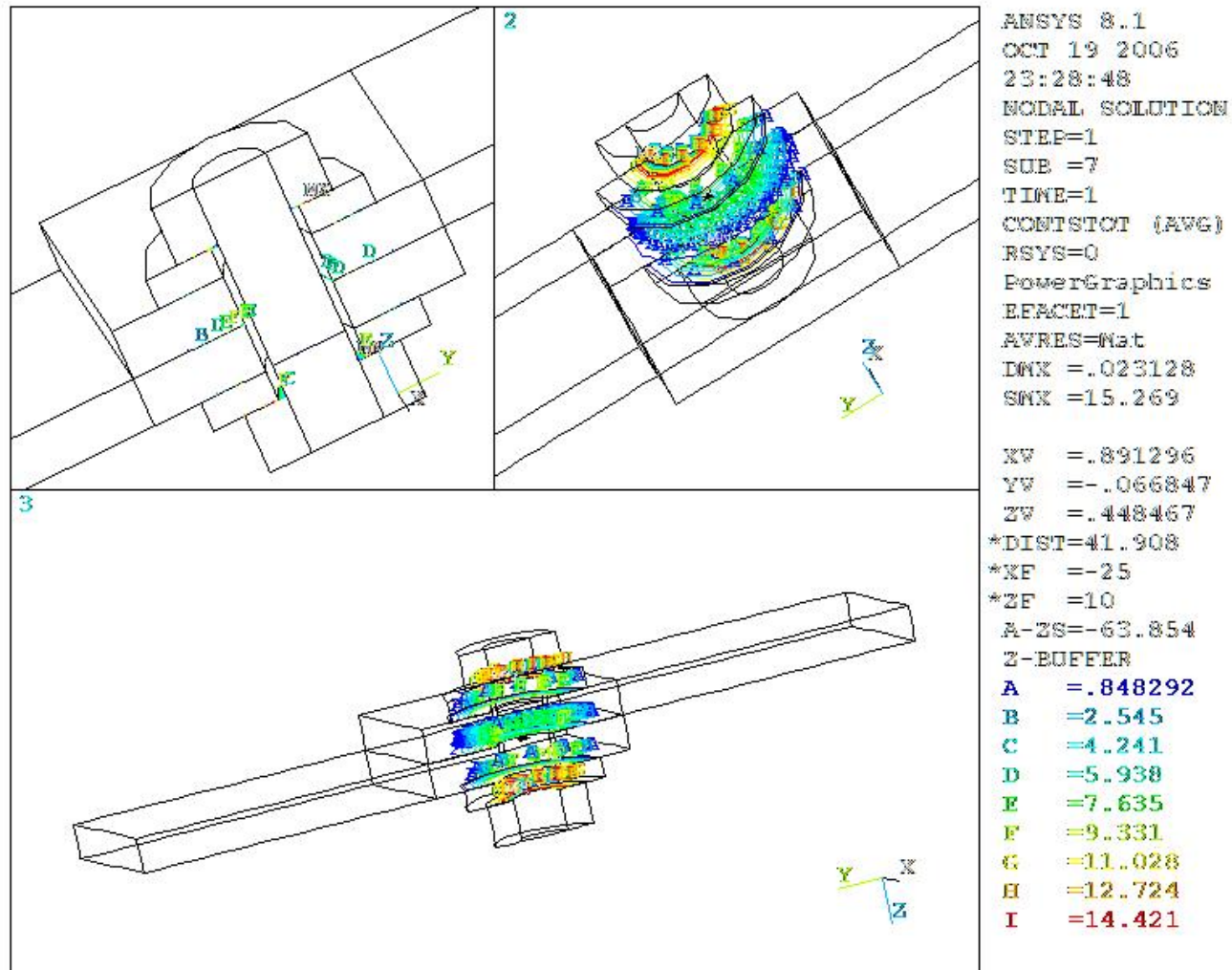
Contact Pressure Stress Outlines-2



Contact Friction Stress-2



Contact Total Stress-2





Conclusions

- n The joints with washer has lower max. Von misses stress, lower contact pressure, lower friction stress and lower contact total stress
- n Pretension loads is crucial to the joints contact conditions
- n Washer keeps the joints stress areas with more gentle stress gradients
- n Washer, similar to spring, plays role in keeping bolt pretension torque to a load greater than the cyclic load, which results in no much alternating load of the bolt.
- n Washer benefits to prevent joints vibration loosening because of reducing stress swing range of the joints, and retaining the pretension loads to be constant (to be testified)



Problems to be solved

- n Exploration of washer's material influence on joints
- n Bolted joints creep analysis
- n Fatigue corrosion impact (if possible)



Thanks!

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Questions?