NUMERICAL SIMULATION OF STEEL REINFORCED ELASTOMERIC EXPANSION JOINTS *ASSAFLEX RE SERIES*

Introduction

After A decade of experience in the field of manufacturing steel reinforced elastomeric expansion joints, AssaFlex experts decided to find out how to optimize the performance of an expansion joint system. What are the key points need to be especially noted to have an RE type expansion joint, properly installed? And what is the point in the installation procedure of projects in which the expansion joints are steel healthy after a 10 year course?

In order to get best results, a project called "Numerical Simulation of Faults in RE Series Expansion joints" was commenced.

Problem Definition

The project aimed to model an expansion joint system of type RE, in worst situation and find out the weaknesses of the system.

Most harsh weather conditions, loading based on ultimate limit state scenarios and considering the temperature to be on the peaks higher than what is normally considered were among the conditions of simulations. Furthermore, we considered aging of elastomer caused by weather and oxidation and the result it final has on the mechanical performance of the rubber.

After a million times of fatigue loading cycles and 8 temperature cycles some worst case mechanical scenarios were investigated, the result of which can be found in this document.

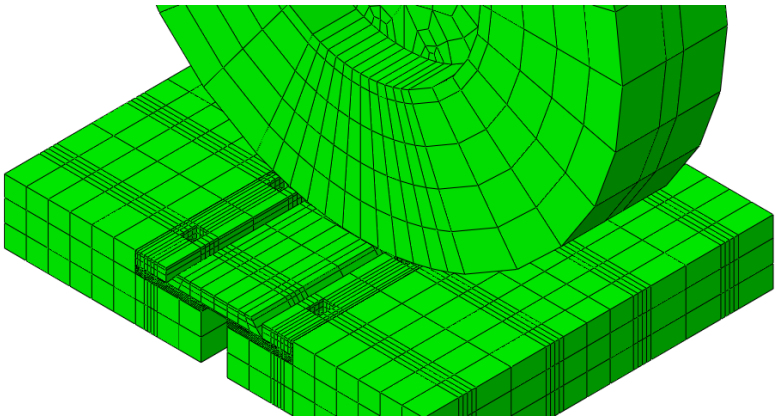


Figure 1 Loading by Vehicle Wheels

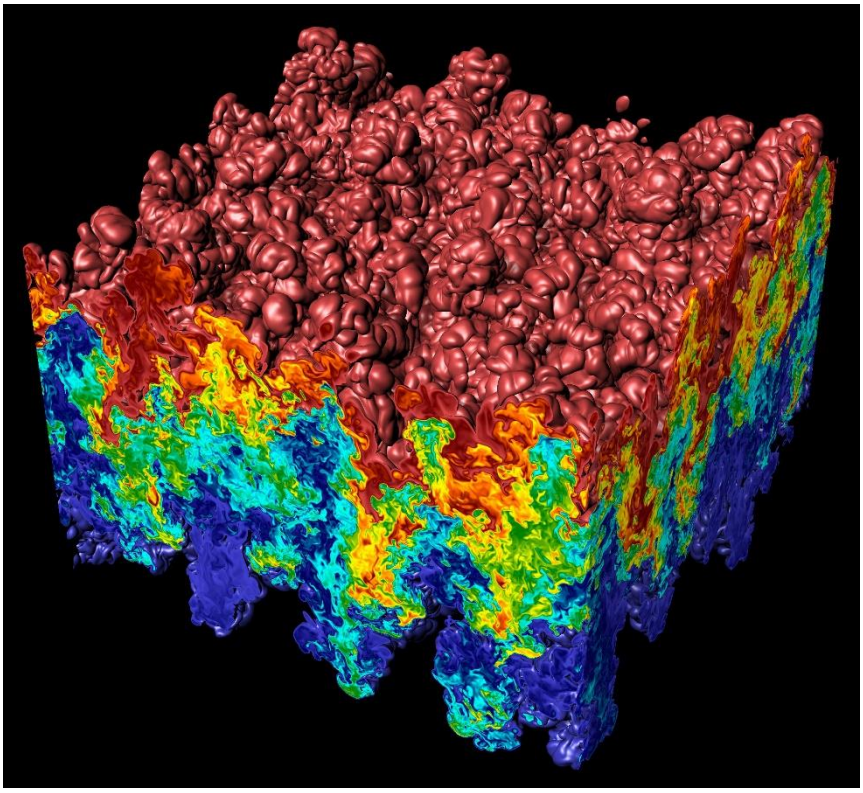


Figure 2 Aging Effects in the Elastomeric Material

One of the Main Results obtained during the investigations was the partial importance of chemical anchor bolts.

It was observed that at the maximum or minimum temperatures, an aged elastomer will have much more hardness consequently shear modulus. This will results a higher shear force needed to expand or contract an expansion joint. While the bolts are the elements that should be able to withstand the shear force needed to contract or expand the RE expansion joint, this is no doubt that an increased amount of shear force will lead to a much worse situation considered for the design of mechanical anchor bolts.

And this is the time for the chemical anchor bolts to play their key role. Fatigue loading of the system will also result in a damaged concrete wall for the mechanical anchor bolts, which is the reason why the whole shear force exerted on this elements, should be endured by the bolt –

reinforcement connection shown on the Figure-3.

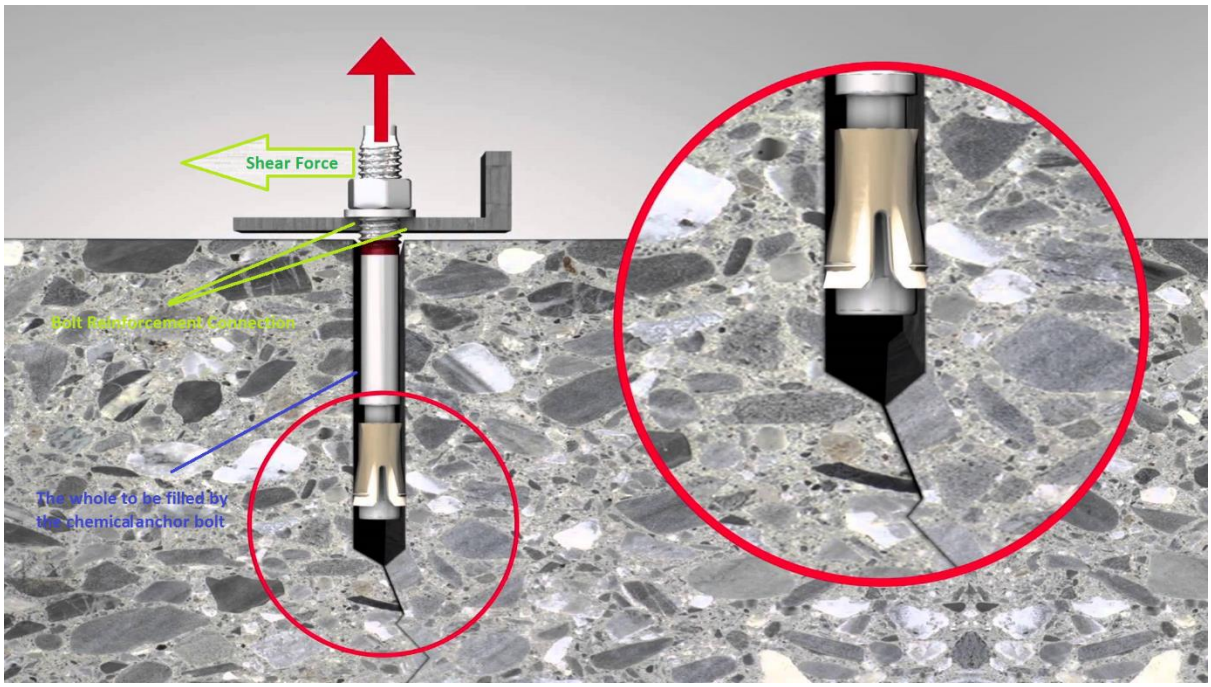
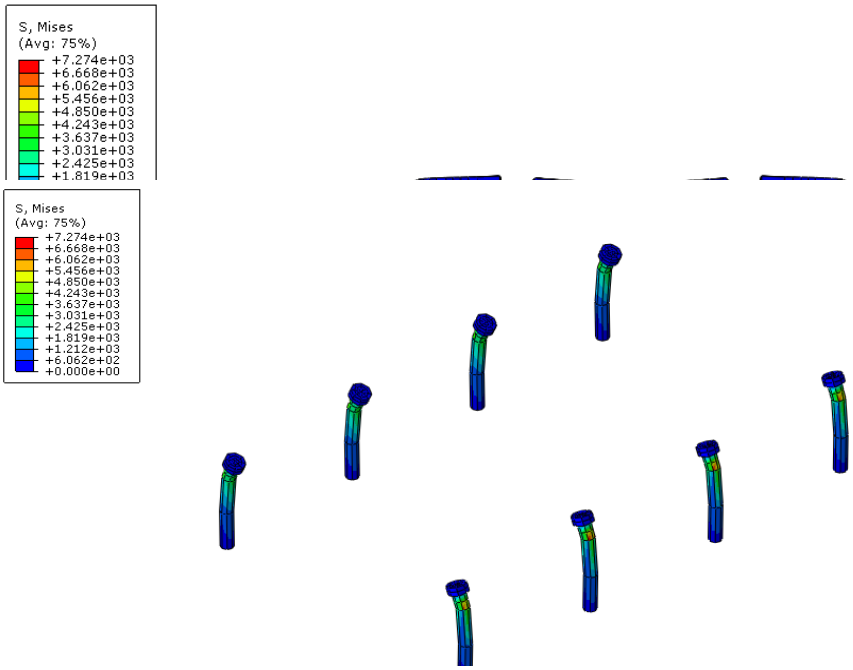


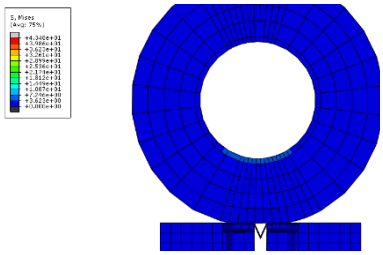
Figure 3 Illustration of Bolt Reinforcement Connection

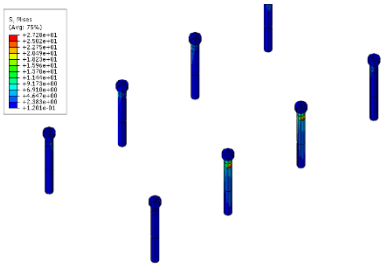
The stress in the anchor-reinforcement connection which can increase up to 7000 MPa will indeed exceeds from the yield stress of the anchor bolts and causes severe damages to it. Using a proper chemical bolt from the other side, will distribute the force over the whole connection of anchor bar – concrete hole and prevent damages occurring on the anchor bar.

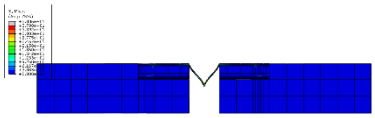
Improved versions of RE type expansion joints are also good choices when environment of the expansion joints are free of large size sand and debris.

This way the amount of shear force exerted to the anchor bolts will decrease significantly since the plan area of the elastomeric parts to be deformed are also decreased.









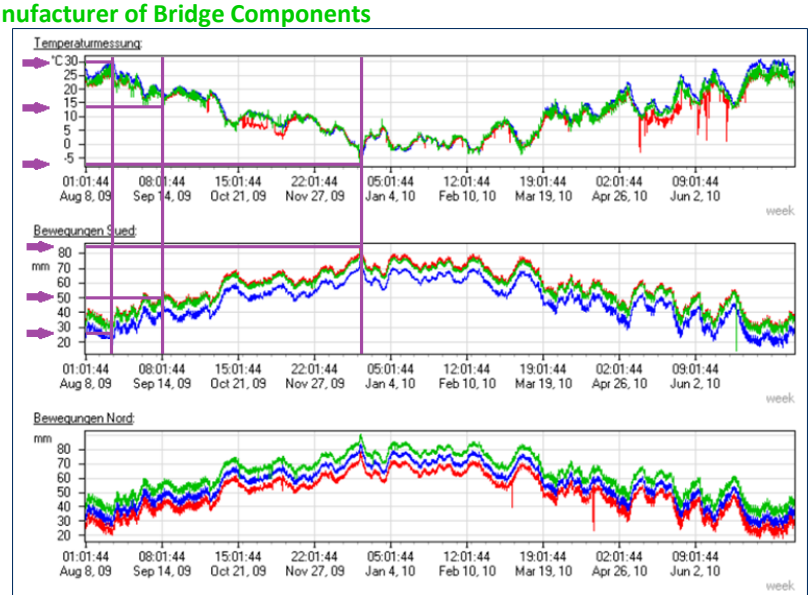


Figure 4 Effect of improper installation temperature on the total movement of an expansion joint

We also observed that the installation of the expansion joints in the temperatures other than the mean temperature of a location, can cause up to two times of movement on the expansion joint.

Furthermore the clients are highly recommended to get consulting services from the engineering office of AssaFlex were the installation temperature of the expansion joints is some something other than the mean temperature of the environment.

Conclusion

Usage of chemical anchor bolts manufactured for the same scenarios as expansion joints, can be a very strong reason to prolong the effective lifetime of an expansion joint system up to ten years.

Abrisham Bridge, Tehran, Iran, 2008