Electrical and Mechanical Analysis of Trafoconnect for Transformer

Raghav. R. Upasani, Nitin. Pandey, Ishant. Jain
1.M&P CoE, Raychem Innovation Centre, Raychem RPG Pvt Ltd, Vadodara, GJ, India

INTRODUCTION: Transformer is a vital component of a distribution system. It has to deliver Reliable Power in a safe & efficient manner. However, 8% of the transformers installed worldwide fail on account of improper connector systems.

Raychem's TRAFOCONNECT™[3] is precisely designed for medium voltage to keep the contact resistance low for the lifetime of the transformer. Its lighter & pretty simple to install as it uses the modern shear bolt technology, hence avoiding the skill & tool dependent crimping methodology. It significantly increases the reliability of the transformer.

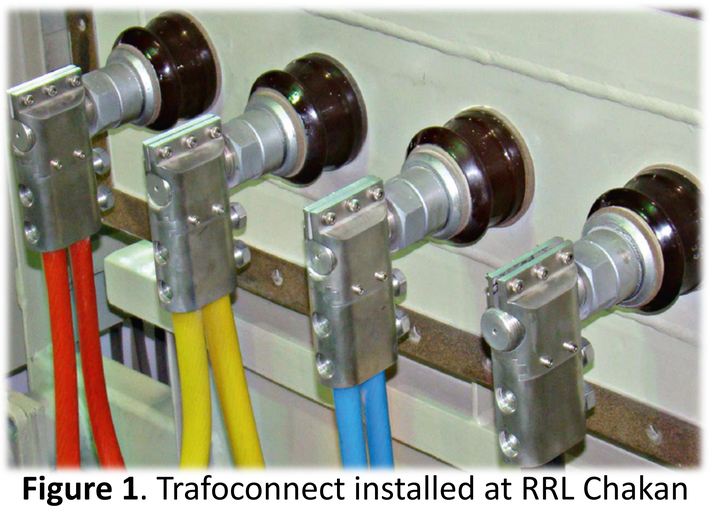

Figure 1. Trafoconnect installed at RRL Chakan

SHORT TIME CURRENT WITHSTAND TEST: 40kA current having peak of 100kA during first cycle of test is applied to understand distribution of Lorentz force, von mises stresses and deformation in the assembly as per IEC 61238.

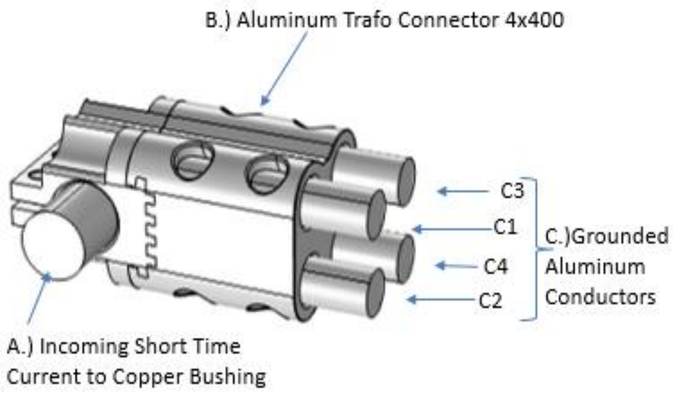

Figure 2. BC's to Trafoconnect

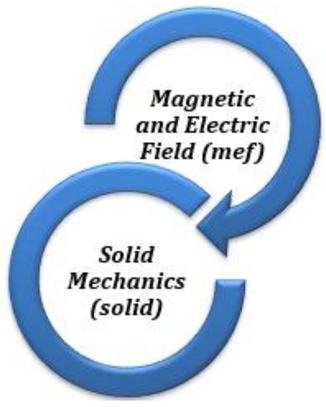

Figure 3. COMSOL™ Multiphysic interface for simulation

Input Parameters	Value
Incomer @ A.)	$40000*\sqrt{2}*(e^{(-t/0.045)}-\cos(2*pi*50*t)$ A
Outgoing @ C.)	to all outgoing conductors
Time	0.04 sec (2 cycles)

Table 1. Input Parameters for simulation

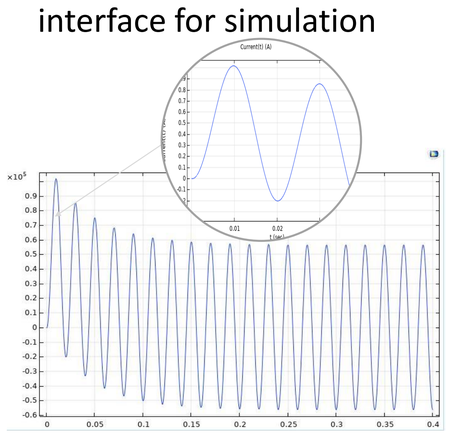

Figure 4. Input Waveform

TENSILE LOADING: A initial tensile load of 55 kg was applied to the assembly. Later it was steadily increased to 110 kg and was maintained for 1 min as per IEC 61238. Boundary conditions were applied to obtain optimum value of contact pressure of the shear headed bolt with the help of Multibody Dynamics (mbd) to analyze movement of the outgoing cable with the connector.

$$F = 539.55 + 39.97 * t \qquad 0 < t < 15\ sec$$
$$F = 1079.1 \qquad 15 < t < 75\ sec$$

RESULTS:

SHORT TIME CURRENT WITHSTAND TEST: The Lorentz force was maximum at the incoming bushing resulting into total displacement of 14 µm and von mises stress of 0.45 MPa against yield strength of Al.

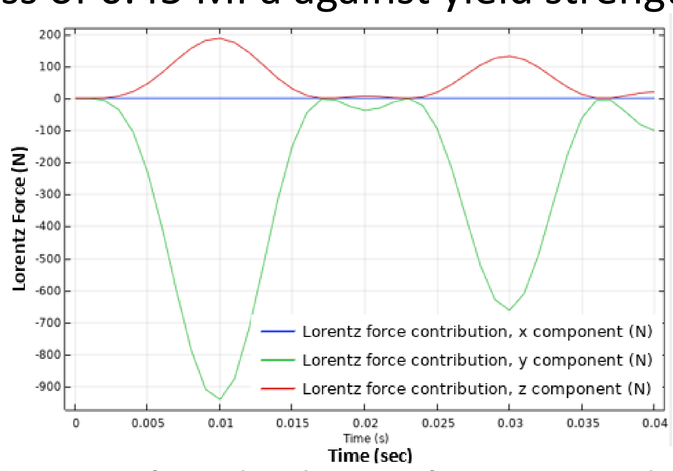

Figure 5. Lorentz force distribution of incoming conductor wrt time

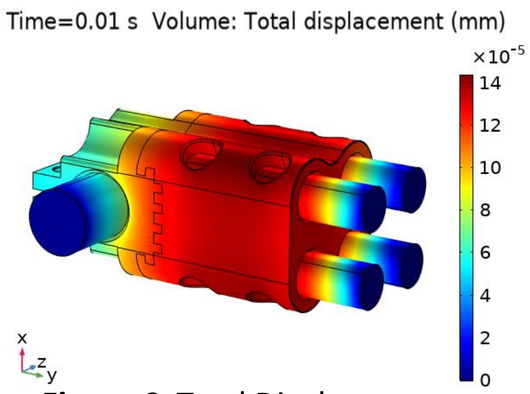

Figure 6. Total Displacement at 0.01 sec

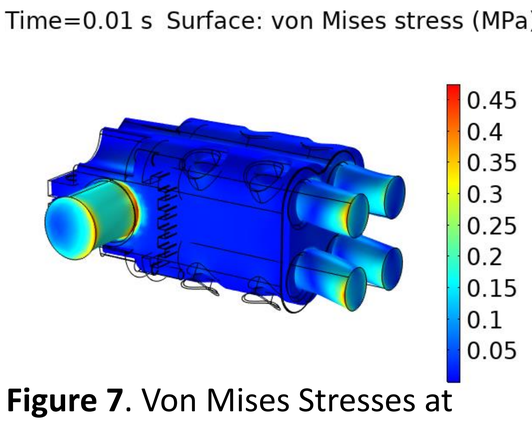

Figure 7. Von Mises Stresses at 0.01 sec

TENSILE LOADING: The displacement of the outgoing cable was 0.45 mm for the contact pressure of 10 MPa & maximum von mises stress induced was 0.5 MPa

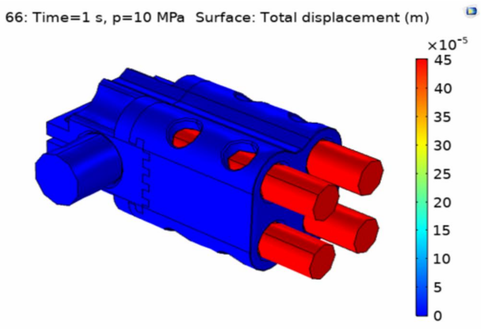

Figure 8. Total Displacement for tensile test

Contact Pressure (MPa)	Displacement of outgoing cable (mm)
8.3	8
9	0.6
10	0.45

Table 2. Displacement of outgoing cable with Contact Pressure

CONCLUSIONS:

1. For short time current withstand test, results are well within the limit as this value of Lorentz force decreases with every cycle & connector is confirmed to be strong enough to bear shock load generated due to faulty condition for a very short duration of time.
2. Displacement of the conductor with connector was found acceptable for the contact pressure of 10 MPa. Accordingly, shear headed bolt were selected which has a higher contact pressure to sustain 110 kg of load for a period of 1 min.

REFERENCES:

1. Xiangyu Guan, Naiqiu Shu, Bing Kang, Minghan Zou, Multiphysics Analysis of Plug-In Connector Under Steady and Short Circuit Conditions, IEEE Transactions on Components, Packaging and Manufacturing Technology (Volume: 5 , Issue: 3, March 2015)
2. COMSOL AC/DC Module user guide
3. Design Patent No: 293138