（ ※本報告書は英語で記述してください。ただし、産業利用課題として採択されている方は日本語で記述していただいても結構です。 ）

MLF Experimental Report	提出日 Date of Report June 13th, 2014
課題番号 Project No. 2013B0096 実験課題名 Title of experiment Measurement of stress distribution along rebar in reinforced concrete around cracks using pulsed neutron diffraction 実験責任者名 Name of principal investigator Hiroshi Suzuki 所属 Affiliation Japan Atomic Energy Agency	装置責任者 Name of responsible person Kazuya Aizawa, Stefanus Harjo 装置名 Name of Instrument/（BL No.） TAKUMI/ BL19 実施日 Date of Experiment March 28th – March 30th, 2014

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。（適宜、図表添付のこと）
Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.

Rectangular reinforced concrete

Rebar: Ferritic steel deformed bar with 13 mm diameter and approximately ~700 mm length

BCC, Lattice constant "*a*" ~ 0.2868 nm

Concrete: 50 mm×100 mm×400 mm

170 kg/m^3 Water, 310 kg/m^3 Cement (Ordinary Portland Cement), Water-Cement ratio 55%

1105.2 kg/m^3 Coarse aggregate (Gravel), 700.7 kg/m^3 Fine aggregate (Sand)

2. 実験方法及び結果（実験がうまくいかなかった場合、その理由を記述してください。）
Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.

The aim of this experiment is to measure the stress distribution along deformed rebar around cracks evolved in the concrete for ensuring that the TOF method is an alternative stress measurement method to the strain gauges in the structural engineering field.

The engineering diffractometer, TAKUMI, installed at BL19 in MLF (Materials and life Science Experimental Facility) of J-PARC (Japan Proton Accelerator Research Complex) was utilized. The reinforced concrete specimen mounted in the loading device was set up on the XYZθ positioner, oriented 45° to the incident beam. The gauge volume defined by the incident gauge definition slit and radial collimators was 5×5×10 mm^3. The high intensity mode with the low instrument resolution designed to be $\Delta d/d$=0.4 was selected, and diffraction patterns from the deformed rebar over the range of *d*-spacing from 0.5 to 2.7 Å were measured in the axial and lateral directions simultaneously using both detector banks installed at ±90^o. The average lattice constants in these directions were determined by multi-fitting procedure. The strain distributions were measured at 5 or 10 mm intervals along the deformed rebar under different tensile loadings, i.e. approximately 10 MPa, 75 MPa and 150 MPa.

2. 実験方法及び結果（つづき） Experimental method and results (continued)

Figure 1 shows the axial and lateral strain distributions along deformed rebar embedded in concrete under tensile loading. The axial and lateral stresses shown in Fig. 2 were derived from these strain distributions in assumption of equiaxial stress condition. As shown in Fig. 2(a), the compressive axial stress, about -50 MPa, due to drying shrinkage of concrete is observed at 10 MPa, whereas the small stress peak is appeared at the center of the specimen probably due to small cracks originally evolved in concrete. This stress peak is developed at 75 MPa since the cracks were propagated in concrete. Another stress peak is newly appeared at approximately -100 mm at 150 MPa due to nucleation of another crack at this position. Figure 2(b) shows the lateral stress distribution along rebar under tensile loading. The compressive stress, about -30 MPa, is observed in the lateral direction due to drying shrinkage of concrete. The lateral stress distribution does not clearly change even when increasing the applied stress. This is similar trend to the result in 2012B0058.

In this study, it was clarified that neutron diffraction can measure the change in the stress distribution along deformed rebar, associated with crack evolution in concrete. From the results in the present experiment and 2012B0058, neutron diffraction is recognized as a novel technique to assess the bond condition between deformed rebar and concrete.

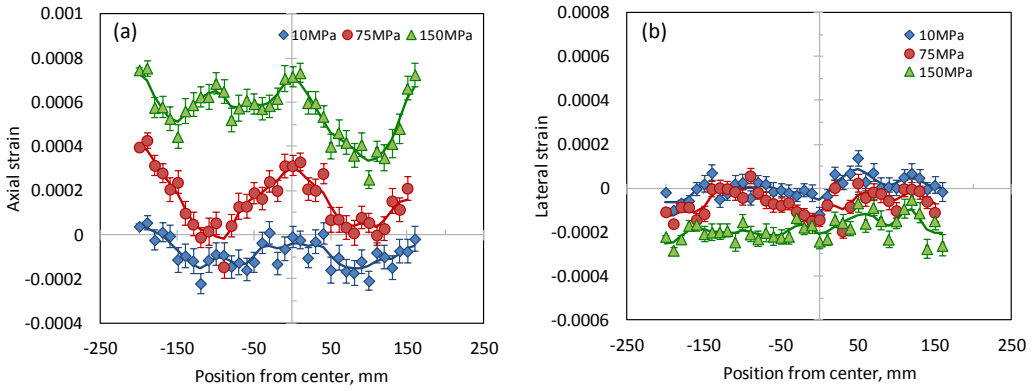

Fig. 1 Strain distributions in (a) axial and (b) lateral directions.

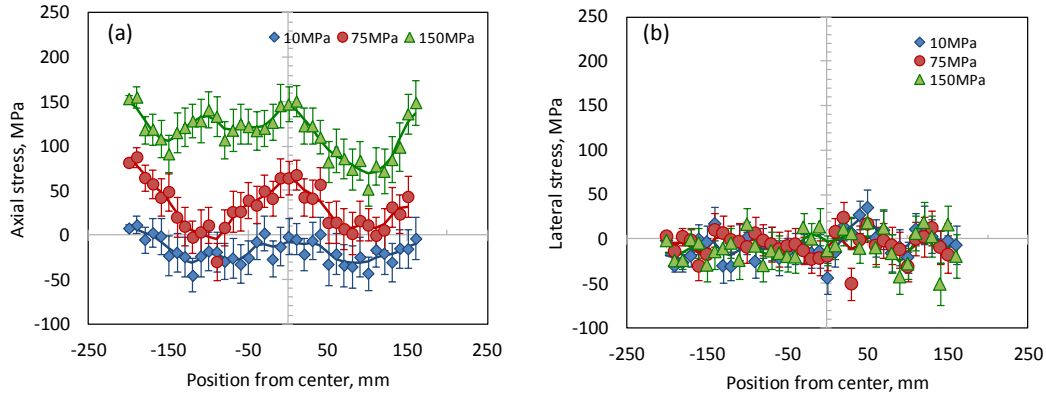

Fig. 2 Stress distributions in (a) axial and (b) lateral directions.