Fatigue simulation and on-site real-time stress health analysis of steel structure on floating photovoltaic system

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1. Introduction

The 50kWp floating photovoltaic power system of structure type was installed in Soyang-river. Floating photovoltaic system is influenced by more complex environmental stress than ground-mounted photovoltaic system.[1][2] Stress health of steel structure on floating photovoltaic system was diagnosed by on-site real-time monitoring and its stability could predicted.

2. Fatigue simulation of steel structure on floating photovoltaic system

The steel structure and main junctions on 50kWp floating photovoltaic(PV) system installed is shown in Fig. 1~2. Damage point and life of fatigue were analyzed by ANSYS simulation such as Fig. 3.

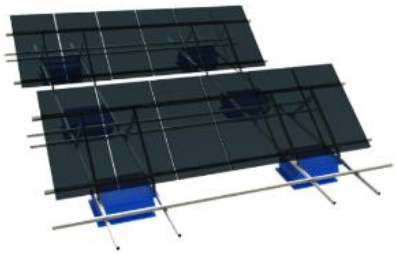

Fig.1 3kWp unit among 50kWp floating photovoltaic power system

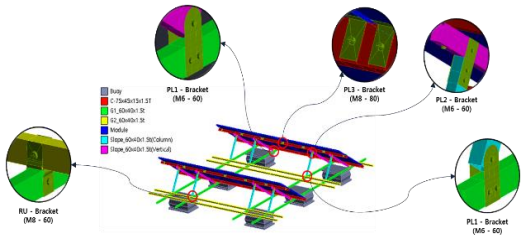

Fig.2 steel structure and main junctions

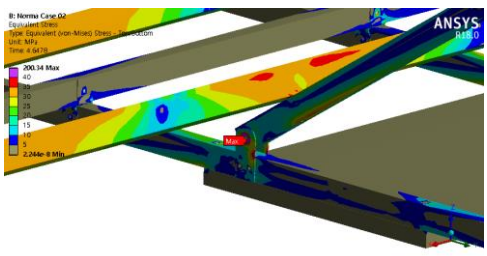

Fig.3 damage point by fatigue simulation

3. Design and setup of Stress Health Monitoring

The on-site real-time stress health monitoring (SHM) system for steel structure on the floating PV system was established. Based on damage data obtained from fatigue simulation of Fig. 3, strain gauge for stress health monitoring is installed in the effective fatigue stress point such as Fig. 4~5. Environmental sensors such as wind speed (m/s), ambient temperature (°C), and surface temperature on steel structure (°C) were installed such as Fig. 7.

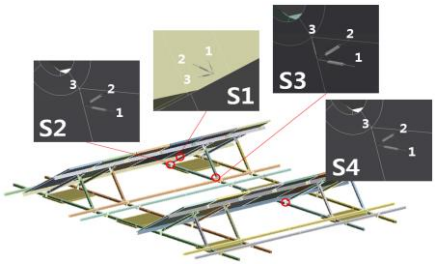

Fig.4 position of strain gauge on structure

Fig.5 strain gauge installed on steel structure

Stress-strain curve measured of the steel of structure is shown in Fig. 6

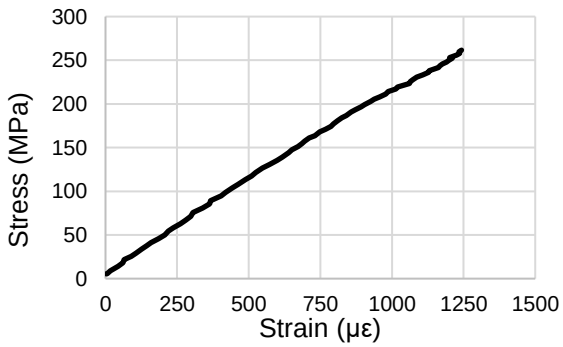

Fig.6 proportionality limit of the steel for structure measured

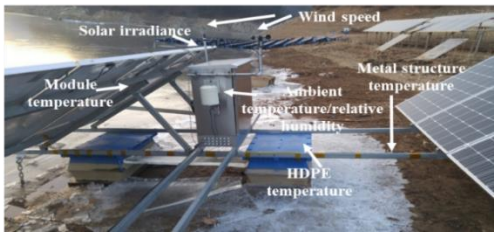

Fig.7 environment sensors for floating PV system

Stress health monitoring system is shown in Fig. 8.


Fig.8 control system for SHM

4. SHM analysis

The strain changes were observed under various environmental changes for 1-year like Fig. 9.


Fig.9 floating PV system in Soyang-river

The strain change measured at S1 point is shown under maximum wind speed 20m/s such as Fig. 10~11.

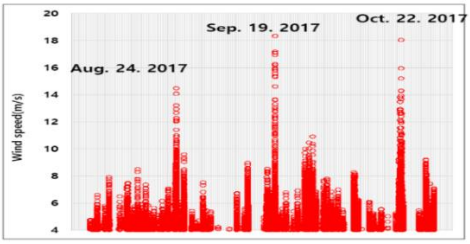

Fig.10 wind stress measured

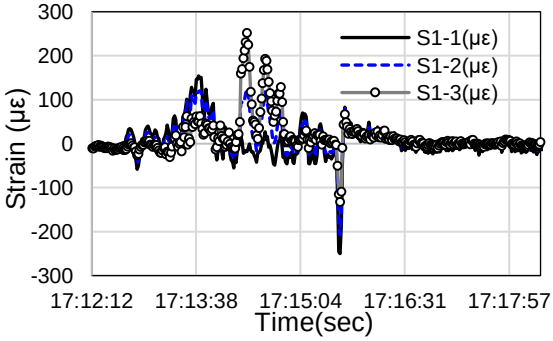

Fig.11 strain change under 20m/s condition

The stress-strain curve at the S1 point was changed within 100 MPa such as Fig. 12. S2 point was changed within 25 MPa such as Fig. 13.

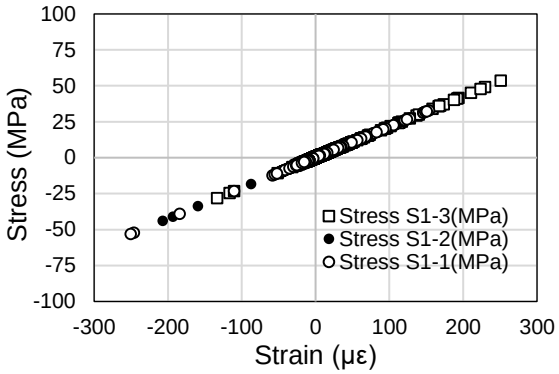

Fig.12 stress-strain curve at point S1

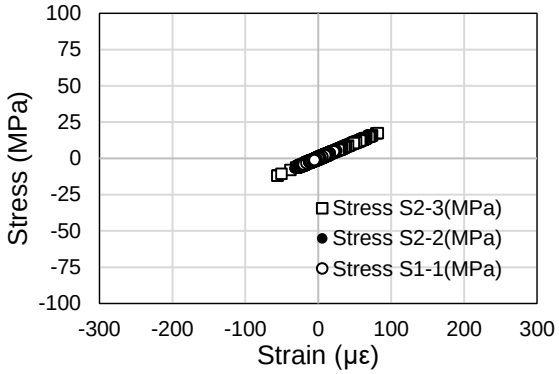

Fig.13 stress-strain curve at point S2

5. Conclusions

The health management of floating PV system was shown possible through the on-site real-time monitoring and simulation of fatigue stress.

Acknowledgment

This work was supported by the “Energy Core Technology Program” of the Korea Institute of Energy Technology Evaluation and Planning (KETEP) granted financial resource from the Ministry of Trade, Industry & Energy, Republic of Korea. (No. 20183010014260) (No. 20173010012910)

References

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