Marine Ecosystem Experimental Chamber System
PART I : Engineering Design

Lei Jia, Yanjun Liu, Louis Legendre, Farooq Azam, Nianzhi Jiao*, et al.

Brief Introduction to MECS

The responses and feedbacks of the ocean to anthropogenic and climate changes are of critical importance for the sustainable development of human societies. The principal means to study such complex issues are field observations and laboratory experiments: the former is the closest to the natural environment, and the latter provides parameters that are not easily acquired by the former. In between the two approaches is the simulated in-situ seawater enclosure system termed “mesocosm”. Here we propose a new type of simulated experimental facility called Marine Ecosystem Experimental Chamber System (MECS), which is an array of land-based water columns with sizes of 30 to 50 m high and 5 to 8 m in diameter. Because there would be several water simulated water columns (e.g. 6), it would be possible to conduct real, large-scale experiments, i.e. with simultaneous controls and replicates.

The MECs would allow a wide range of experimental manipulations of environmental variables for complex studies such as the biological, carbonate and microbial carbon pumps. The MECS could even be used for scenario studies simulating geological events such as global warming or cooling, ocean acidification, sulfidation, hypoxia, etc. The MECS would also be appropriate for studying sustainable development practices, such as carbon sink engineering. In addition, the MECS could be used for public education.

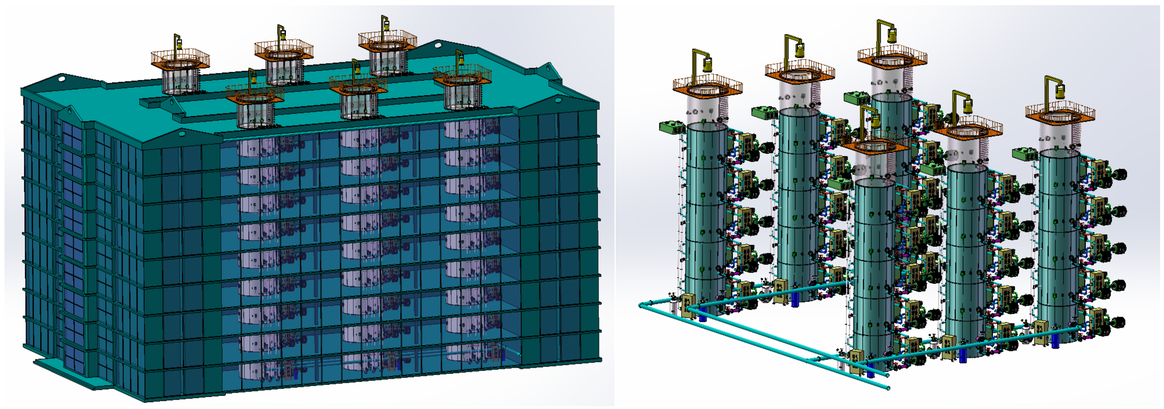

Figure 1 Overview of the Marine Ecosystem Experimental Chamber System (MECS)

Structure of MECS

The structural technical design of MECS comprises of 12 major operational modules (Figure 2), i.e. sea water incubation chambers, temperature control system, lighting system, ventilation system, charging system, stirring system, filtration system, sample collection system, on-line monitoring system for environmental parameters, biological parameters on-line monitoring system, database system and control system.

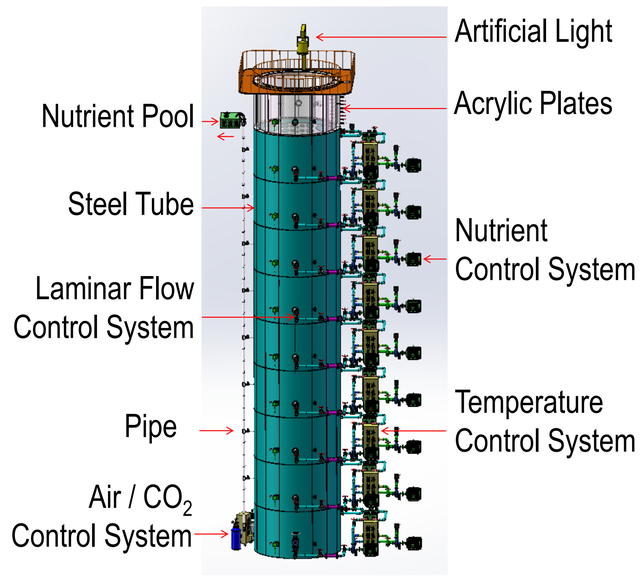

Figure 2 Representative diagram of the MECS structure

Structure of Single Section in MECS

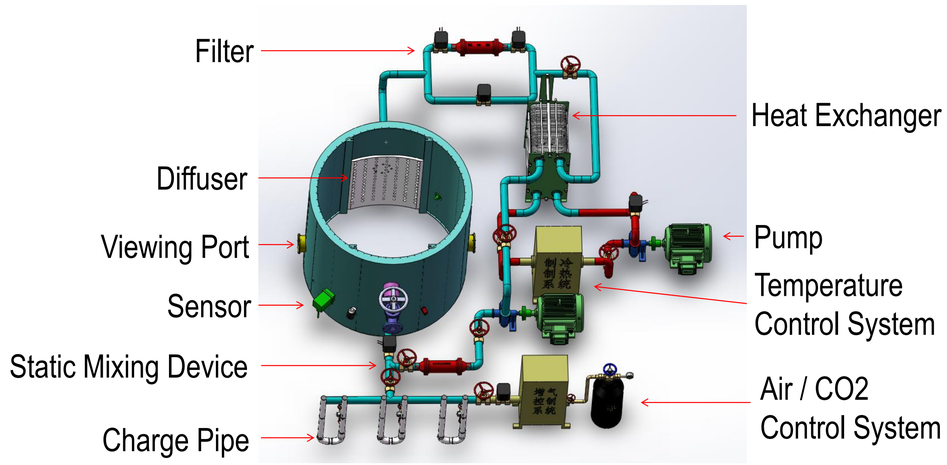

Figure 3 Representative diagram of single section in MECS

Monitoring System for MECS

This further enables an step-by-step monitor on various environment conditions, e.g. temperature, light intensity, pH value and CO_2, dissolved oxygen and nutrient level, in addition to the powerful function of automatic sampling, sample pretreatment, distribution, integrated data analysis and system management, as well as the automatic control process with high precision.

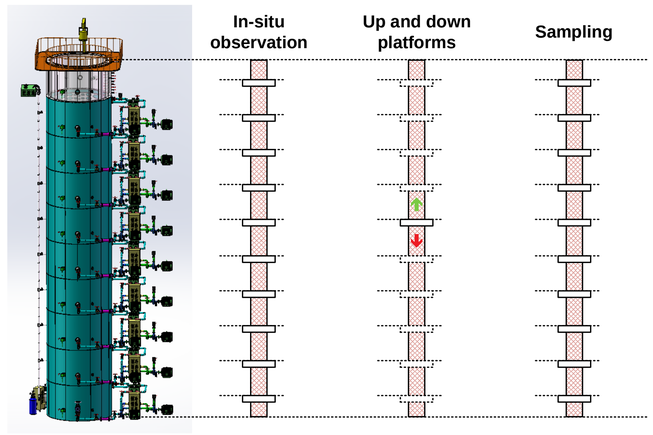

Figure 4 Monitoring system of the Marine Ecosystem Experimental Chamber System

Reliability Analysis of MECS

Using mapping software to establish MECS 3D model, we perform a reliability analysis about (A) hydrostatic pressure distribution, (B) deformation analysis, (C) stress analysis and (D) model analysis. Results showed that deformation is 1.086mm. The deformation is small relative to the main body of MECS and would not cause any damage to MECS.

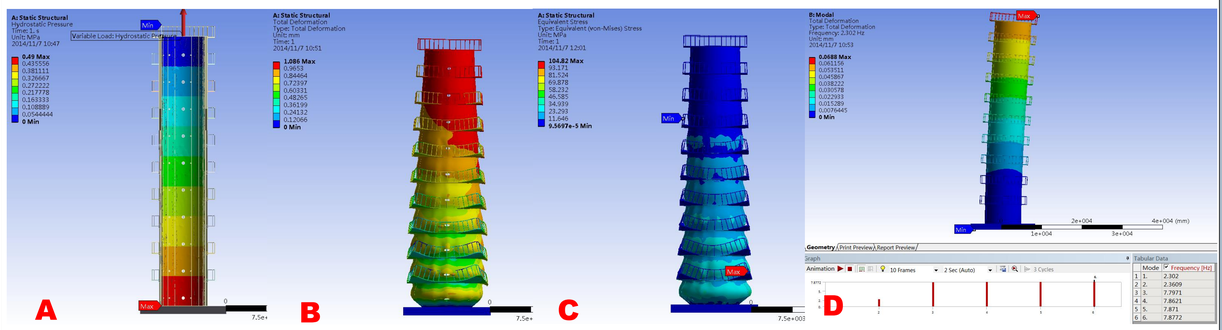

Figure 5 Influence of (A) Hydrostatic Pressure Distribution; (B) Deformation Analysis; (C) Stress Analysis; (D) Modal Analysis on reliability analysis of MECS

Call for contribution! (*Email: Jiao@xmu.edu.cn)