Structural Mechanics Laboratory

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Spatial structures, such as the gyms for elementary and junior high schools, are often used as evacuation area or disaster prevention bases during a disaster, and so they have to be built to be resistant to seismic motions. These kinds of structure are easily accessed by the public, and needs to offer sufficient safety in regard to earthquakes, wind, and snow. The laboratory performs the following research themes; (1) analysis of seismic response characteristics of spatial structures subjected to severe seismic motion; (2) evaluation of seismic resistance capacity; (3) proposal of design methods with vibration control to reduce the damages; and recently (4) proposal of super light structures using low volume, recyclable materials and construction methods, and (5) a grid parallel computing system in order to provide effective analysis.

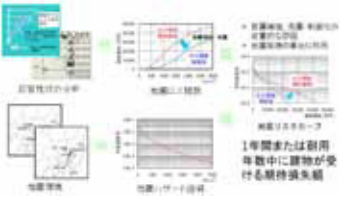
Theme 1 ▶ Evaluation of seismic performance of shell and spatial structures

As spatial structures vibrate in a different way from high-rise buildings, it is necessary to analyze the response characteristic and seismic capacity of spatial structures. We therefore perform the following researches; (1) analysis of seismic responses and collapse characteristics; (2) proposal of the equivalent static seismic load; (3) research of evaluation method of seismic performance based on the pushover analysis; (4) research of vibration control methods to reduce the responses for spatial structures (fig.1).

Shaking of a mid-story isolation dome during an earthquake (When seismic isolation is not used, the dome shakes severely, but the use of seismic isolation greatly reduces the response of the dome)

Theme 2 ▶ Evaluation of buckling strength of shell and spatial structures

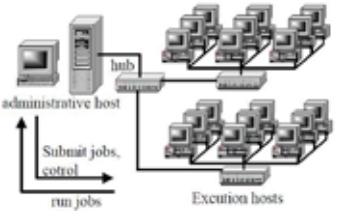
Shell and spatial structures can be realized using a lightweight construction, making their composite materials narrow and thin. This means that investigations into overall buckling and buckling for parts are important. We perform the following researches; (1) development of analysis programs that take buckling and turning into plastic of parts into account; (2) development of buckling design methods for spatial structures; (3) performing collaborative research of a visualization system with other Universities.



Outline of seismic risk analysis (allows for quantifiable evaluation of seismic retrofitting, base isolation and response control)

Theme 3 ▶ Development of seismic performance evaluation techniques based on seismic risk analysis

Seismic risk analysis is a stochastic method(fig.2). It is our aim to use seismic risk analysis to establish a method to quantifiably evaluate the seismic performance of a structure. Our research themes include; (1) a comparison of detached base isolation housing and seismic-resistant housing based on seismic risk analysis; (2) proposal of seismic retrofit method based on the minimum standard of lifecycle costs; (3) analysis of the capability to maintain functioning for school gyms and factories; (4) proposal of evaluation indexes for regional disaster prevention capabilities.



Outline of grid computing (A grid system connects multiple computers across a network, allowing them to perform parallel computations and achieving high speed operations. Applied to structural engineering)

Theme 4 ▶ Development of structural design approach using a grid computer system

Advanced structural analysis of large structures and seismic risk analysis requires faster computers. In order to realize high speed operations, we have therefore adopted a parallel grid computing system (grid system) as the foundation technology for the numerical analysis(fig.3), and research into how this would be used in the fields of architecture and civil engineering.