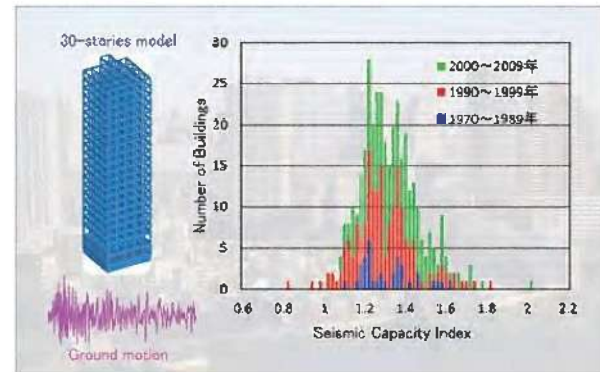


Evaluation of the Seismic Capacity of High-Rise RC Buildings

To date, more than 500 **high-rise RC buildings** have been built in Japan. Typically constructed buildings are demolished in about 30 to 60 years. On the other hand, large buildings, such as high-rise RC buildings, are expected to be used for as long as possible—at least 100 years—for economical and environmental reasons. As a result of such long-term use, it is more likely that these buildings will undergo a large earthquake at some point. Therefore, it is important to enhance **earthquake resistance** by strengthening such buildings.

In this study, we propose a method for expressing the seismic performance of existing high-rise RC buildings using a **seismic capacity index** based on limited published data. As shown in the figure, we can ascertain the percentage of high-seismic-performance buildings versus low-seismic-capacity buildings by analyzing the distribution of seismic capacity indexes across many buildings. Through this analysis, our intention is to highlight the need to enhance earthquake resistance by strengthening buildings.



Analysis model and distribution of seismic capacity indexes of buildings

About Researcher



AKITA Tomofusa, Dr.Eng.

Dr.Eng., 2008, Toyohashi University

Seismic Damper Using the Deformation Performance of Steel Materials

The reinforcement of beam-to-column connections with knee brace members has been used as an efficient **seismic retrofitting** measure for existing steel buildings. This is because the steel knee brace members have a very large axial stiffness due to a high elastic modulus of the steel material. However, such an advantage may lead to another problem. Attaching knee braces to a framework may greatly affect the framework's collapse mechanism under earthquake loading, while the beam-to-column connections are reinforced very well; this may induce undesirable collapse mechanisms with plastic hinges in column members. If a knee brace with moderate stiffness is available, the beam-to-column joint would be moderately reinforced without affecting the collapse mechanism.

The present study is to develop a **ductile knee brace** (Fig. 1) member with moderate axial stiffness to avoid the aforementioned disadvantage. In order to apply the concept of ductile kneepads used in heavy steel structures to wooden and lightweight steel structures, research is underway to scale down the knee braces and use thin steel plates.

Our research is aimed at developing **seismic dampers** and earthquake-resistant construction methods that can protect people from earthquake damage to buildings.



Fig. 1 ductile knee brace

About Researcher



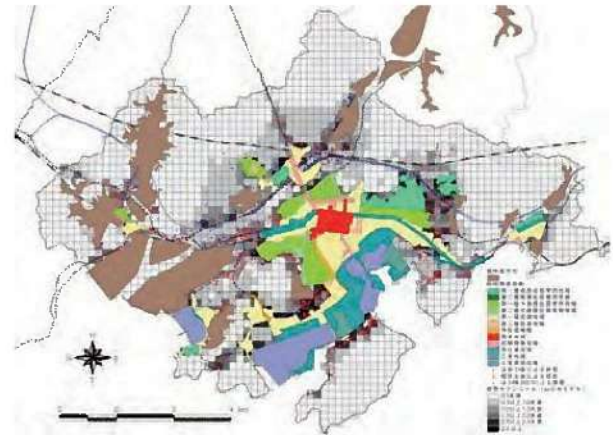
HONMA Sayuri, Dr. Eng

Dr. Eng., 2016, Chiba University

City Planning and Urban Design Methods for Compact Cities in an Era of Depopulation

This study targets suburban areas and associated city centers during an era of depopulation. We achieved local collaboration by forming a special city planning support organization, studied land use regulations and guidance techniques in suburban areas, and examined **urban regeneration techniques** in city centers. We also demonstrated methods for realizing city planning for entire cities.

Specifically, first we assessed the suburbanization phenomenon from the viewpoint of **land-use** law and clarified and present conditions from the relationship with the hollowing out of city centers. Second, after demonstrating a city planning organization for local collaboration and reviewing its practical effects, we demonstrated an urban regeneration technique for city centers. Third, we demonstrated a technique for supporting the conclusion of formal **agreements** when advancing the city planning enterprise. Fourth, we clarified city planning methods from the viewpoint of reconstruction of the planning units of local cities by municipal mergers or deregulation.



Mesh map of development potential and land use regulations

About Researcher



IKARUGA Shinji, Dr.Eng.

Dr.Eng., 1998, Kyushu University

WEB » <http://www.urban.kde.yamaguchi-u.ac.jp/>

Evaluation of Seismic Performance of Buildings and Development of New Structural Systems

In Japan, a country known for frequent earthquakes, one important area of performance for buildings is **seismic performance**. In this laboratory, which focuses primarily on reinforced concrete buildings, we study how to make reasonable assessments of the seismic performance of new and existing buildings.

In particular, we continue to develop economical and rational **seismic retrofitting methods** for existing buildings with poor seismic performance, for example steel brace retrofitting, external frame retrofitting, and installation of response control systems using dampers or base isolation. Using experimental laboratory equipment, we conducted **structural experiments** to evaluate the performance of retrofitting methods we have developed.

In addition, we also studied wall-type reinforced concrete buildings, which are primarily used in low-rise housing complexes and which have extremely high earthquake-resistant performance: old brick structures; and new reinforced masonry buildings with high strength.



Laboratory equipment and 1:2.5 scale reinforced concrete frame specimen retrofitted with steel braces

About Researcher



INAI Eiichi, Dr.Eng.

Dr.Eng., 1993, Waseda University

WEB >> <http://ds22n.cc.yamaguchi-u.ac.jp/~strlab/lab/index.html>

The Measurements of Indoor Air Quality (IAQ)

Chemical substances that cause indoor pollution can be grouped into VVOCs (Very Volatile Organic Compounds), VOCs (Volatile Organic Compounds), SVOCs (Semi-Volatile Organic Compounds) and POM (Particle Organic Matter). In particular, SVOCs that are released indoors consist primarily of flame-retardants and plasticisers, which are released from floor materials, walls and plastic products used for interior decoration. Plasticisers are additives used to improve the flexibility of polymer substances. However, SVOCs such as phthalate ester that has a high boiling point tend to attach to the surface of furniture and house dust instead of floating in the air and are, therefore, deposited indoors. Furthermore, there is a report stating that phthalate ester concentrations in house dust are related to asthma and allergies in infants. Therefore, my goal is to survey SVOCs concentrations in settled dust on floors and in indoor air and to test the emission rates of SVOCs released from building materials using a micro-chamber. The object of my study is to propose solutions to reduce indoor SVOC pollution from indoor building materials.



The measurement of SVOC emission rates from PVC sheets using a micro-chamber.

About Researcher



KIM Hyuntae, Ph.D.

Ph.D., 2012, Wasada University

Evaluation Methods for a Sustainable Urban Structure

My main research interests are constructing evaluation methods for **sustainable urban structures** and a support system for urban design in regional cities facing serious problems of depopulation, an aging population, and a low birthrate. Therefore, I aim to use GIS to support sustainable **urban planning** based on **spatial statistical evaluation** and forecasts about land use, development activity, environmental burden, and the income and expenditure budget. Moreover, in urban planning, residents' opinions should be reflected in the plans, for example in how the landscape will be developed and the design of the housing. Therefore, we developed a support tool to enable people to examine both spatial images after the construction work and project evaluation, using a cooperative approach. The support tool is aimed at citizens who can manage their planning area. It was frequently tested in workshops for planning in our previous research projects.



Interactive user interface to visualize the effects of introducing energy-saving and energy-generation technology into a residential area, and a spatial image of the future project site

About Researcher



KOBAYASHI Takeshi, Dr.Eng.

Dr.Eng., 2007, Yamaguchi University

Development of a Hygienic Air-Conditioning System to Prevent Mildew-Causing Condensation

Modern architecture is becoming increasingly airtight. The rise in indoor humidity causes the active proliferation of mildew and mites, resulting in a problem known as “damp house,” which in turn triggers the deterioration of buildings and **contamination of indoor air**. The use of **desiccant air conditioning** (air conditioning using absorbent materials), which facilitates easy control of indoor humidity, prevents mildew-causing condensation, and enables dehumidification, is drawing increasing attention. We have devised an air-conditioning system that incorporates desiccant air conditioning in a heat pump to conserve energy and are currently investigating its performance at an actual-scale facility. The practicality of the system is being investigated by performing a comparative study with existing systems, analyzing energy consumption during an entire cooling season, examining performance during heating and humidifying operations, and other means. The investigation is being conducted jointly with the Institute of Industrial Science at the University of Tokyo. We are also conducting research into a desiccant air-conditioning system capable of regenerating absorbent materials (expelling absorbed moisture) using high-temperature air obtained from **solar air heaters**.



Experimental facility for testing a desiccant air-conditioning system combined with a heat pump (Institute of Industrial Science at the University of Tokyo)

About Researcher



KOGANEI Makoto, Ph.D.

Ph.D., 1987, Kyushu University

WEB > <http://env.kde.yamaguchi-u.ac.jp/humanenv/index.html>

Consideration of the Relationship between Space and the Quality of Death

Steve Jobs, former CEO of Apple, once said, “And that is as it should be, because death is very likely the single best invention of life. It is life’s change agent. It clears out the old to make way for the new. Right now the new is you, but someday not too long from now, you will gradually become the old and be cleared away.” Due to the metastasis of his pancreatic cancer, he faced death sooner than we. On the other hand, are we able to consider death and “the end” in affirmative terms as he did? Is it not natural that we who wish to escape death cannot innovate? Data indicates that not less than 80% of Japanese people die in bed in a hospital. Does this numerical value indicate that we have thought about death and “the end” faithfully? I hope to research **space** and **architectural planning** from the viewpoint of **death** and “the end.”



Death in bed at a hospital

About Researcher



KOH Syohken, Dr.Eng.

Dr.Eng., 2007, Kyoto University

A study on thermal comfort and productivity of zero energy buildings

We study technologies necessary for designing and planning **zero energy buildings (ZEBs)**. We are comprehensively investigating technologies for achieving conversion to ZEBs by improving the efficiency of equipment using renewable energy and optimizing operation through load reduction by constructing passive methods such as the improvement of heat insulation performance.

Moreover, in order to achieve a thermal environment that considers the occupants' health and **thermal comfort** first, without their having to endure heat and cold for the sake of energy conservation, we select and operate air-conditioning equipment with the aim of achieving **energy saving** while maintaining it. We will provide zero energy buildings that combine thermal comfort and energy conservation.



The building with which Japan's first ZEB was achieved through renovation. We installed PV panels and solar collectors.

About Researcher



KUWAHARA Ryoichi, Dr. Eng.

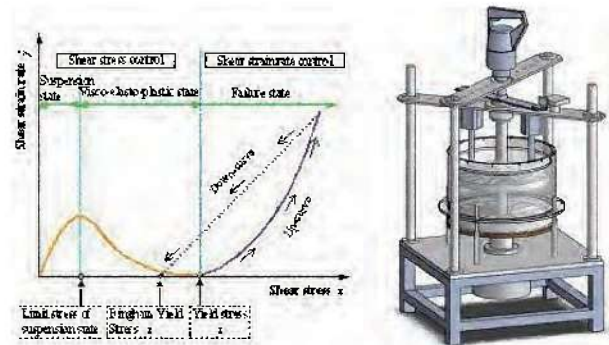
Dr. Eng., 2000, Niigata University

Rheological Model and Test Methods for Fresh Concrete

Fresh concrete's properties affect construction efficiency and hardened concrete's quality. Consequently, they need to be evaluated properly, predicted numerically, and optimized according to construction and structural conditions. Hence, one of our research interests is rheology and test methods for **fresh concrete**. We have been involved in the following projects:

- (1) clarification and **modeling of fresh concrete's rheological properties** by means of a microscopic approach;
- (2) development of a **rheometer** that can examine the effects of normal stress and measure shear deformation under shear load control in addition to shear flow under deformation rate control;
- (3) development of a **numerical flow simulation method** that can simulate shear behavior from deformation to flow;
- (4) development of a **non-destructive method of segregation** of fresh concrete by radial rays;
- and (5) prediction of the deterioration of hardened concrete due to segregation.

Other research interests include: (a) self-property recovery behavior and improvement technology for fire-damaged concrete, (b) an environmental performance assessment methodology for concrete, and (c) property clarification and development of application technology for geopolymers.



Left: Proposed rheological model. Right: Newly developed rheometer

About Researcher



LI Zhuguo, Ph.D.

Ph.D., 2000, Nagoya University

Application of a Biologically Inspired System to Computer Vision

Our research interest lies in how the **human vision system** is realized on several levels, ranging from low to high. We study three vision levels of **brain neuron network models** in the field of biology, low- and high-level functional vision models related to the closing of the eyes in the field of psychology, and **next-generation robots and interfaces** with a hardware vision system and an integrated vision model.

Ongoing research in our laboratory is focused on the following five areas:

- 1) Human vision realized through computer vision
- 2) Neuron network vision models in the brain
- 3) Next-generation vision interfaces
- 4) Next-generation vision robot with eye movement capability
- 5) Music information processing applied to vision models



A remote vision system with a three-dimensional vision interface and a vision robot with eye movement capability

About Researcher



MORITA Satoru, Ph.D.

Ph.D., 1993, Hokkaido University

WEB > <http://www.vision.kde.yamaguchi-u.ac.jp>

Temporal or Transitional Design Approach for Revitalization in Local City Centers

For many reasons, such as motorization, changes in purchasing behavior and so on, local city centers have been in decline for decades. Many vacant buildings and lots (hereinafter referred to as “**low unused land**”) have given rise to and created a “sponge-like” spatial structure. On the other hand, city areas have sprawled out and city centers have been abandoned. It is impossible to return our lifestyle to what it once was, but we need to take back city centers and restore them as Social Stock or as the Amassed Assets for the future. Based on the situation and philosophy above, my aim is to find the right way of **designing to revitalize local city centers** through the following **transitional approaches** within the fields of architectural and urban design.

- 1) To create “area value” not just by revitalizing each piece of low unused land, but by connecting them to make network of space and city functions.
- 2) To find optimal solutions for the use of space in each piece of low unused land by repeating social experiments which will be organized using temporal settings, and by maintaining liveliness.
- 3) To design an interface between the public and private realms so that people can interact with each other.

We regard **architecture as an envelope to wrap people’s activities in** and we try to create suitable configuration including temporal settings, which are useful for time axis transitions and are found in the conventional Japanese culture of using space.



State of liveliness created by an event held as a social experiment at a local city center in Kushikino, Kagoshima in 2017

About Researcher



OKAMATSU Michio, Ph.D

Ph.D., 2017, Kagoshima University

Participatory Social Housing Methods around the World

There is a general understanding that Japan is a developed country in terms of architecture. When we look at its planning methods for social housing, however, it seems to be only at a very early stage. The small supply of social housing – less than 4% of the total stock – is still diminishing to prioritize marketization for ownership, while the rich-poor gap is increasing. In addition, the traditional top-down way of supplying causes common problems like deterioration in security. Problems related to post-disaster housing for resettlement are particularly serious. Mass-supplied units are allocated randomly to families, and the single-household elderly often die in units alone because they have been separated from their old neighborhood friends and are reluctant to go out. Participatory social housing needs to be addressed to preserve existing communities and construct new ones.

Our research therefore explores the world's most advanced examples of participatory social housing (such as the cohousing 'People's Plan' in the Philippines, the cooperative housing in Switzerland, and the heritage preservation housing in France) to analyze their methods of architectural and organizational planning in order to realize both quantitatively more and qualitatively better housing for the vulnerable.

The social or ideological contexts are of course different, but the many issues are universal and international learning exchange is worthwhile.



We visit housing designed by people's organizations and conduct housing design workshops in informal settlement areas. This picture was taken in the Philippines.

About Researcher



SHIRAISHI Rei, Dr.Eng.

Dr.Eng., 2019, Kyushu University

WEB > <http://www.urban.kde.yamaguchi-u.ac.jp/>

Evaluation and Management Method for Urban Sustainability with a Focus on Urban Design

In order to suggest a better living environment and sustainable urban future, we are interested in **urban design management** that places an emphasis on urban spaces such as architecture, streets, and parks and open spaces. In this work, we are focusing on the following five areas: (1) developing planning methods through spatial analysis from the viewpoint of **TOD (transit-oriented development) and compact city design** in response to the need for a low-carbon society; (2) developing **town management and urban regeneration methods** for sustainable urban growth based on public-private partnerships and citizen participants; (3) predicting and understanding the morphological changes and characteristics of urban spatial structures based on urban planning systems; (4) evaluating and proposing methods for better utilizing urban space such as the areas around train stations, streets, and public spaces to cope with changing social needs; and (5) implementing **smart shrinking management** through the predictive imaging of shrinking cities.

We also promote urban design and management projects in collaboration with local communities and conduct field surveys of foreign cities by studying the unique sustainable forms and types of Asian cities.

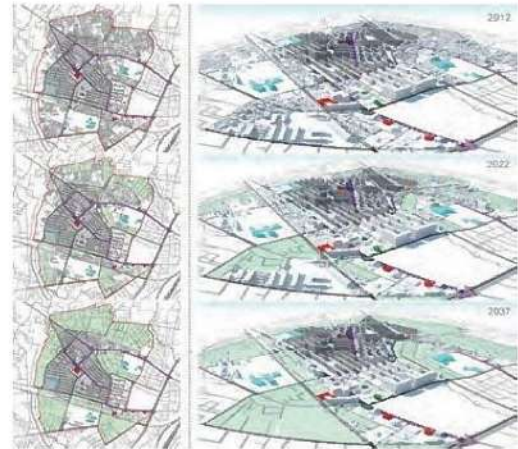


Image of a shrinking city based on population transitions

About Researcher



SONG Junhwan, Ph.D.

Ph.D., 2013, The University of Tokyo

Research on Traditional Folk Houses and Rural Villages

There are various forms of traditional folk houses and rural villages rooted in the natural features and climate of the areas in which they were located in Japan. In addition, traditional habitats that are peculiar to certain areas have been sustained by the wisdom and ingenuity of previous inhabitants.

However, many traditional folk houses and rural villages are facing a crisis as they disappear due to falling population and industrial decline. Therefore, we are now pursuing community development using traditional living environments that are specific to particular regions.

Our research interests are in **spatial composition**, **historical formative processes**, and **traditional dwelling systems** in rural villages as formed by regional customs that reflect local people's lives and livelihoods. Research now underway is focused on the following four areas:

- 1) Analysis of the spatial composition of traditional rural villages
- 2) Application of traditional sustainable habitat systems
- 3) Building of protective systems for cultural scenery
- 4) Examination of the sustainable value of traditional folk houses in our society



Rethatched roof of a traditional folk house in Yamaguchi prefecture

About Researcher



USHIJIMA Akira, Dr.Eng.

Dr.Eng., 2011, Kyushu University

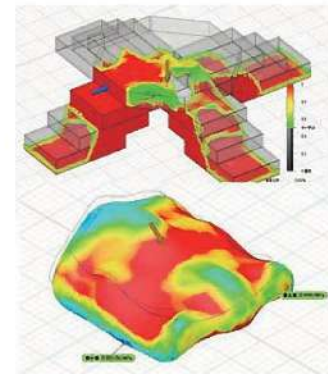
WEB > <http://www.nakazono.lab.kde.yamaguchi-u.ac.jp/>

Design Exciting Structures to be Safe and Secure as Symbols in the Cities of the Near Future

We wonder if architects will ever be able to easily realize their ideas without expert skills in structural mechanics. If so, we could live in cities dotted with symbolic, exciting structures. Such exciting structures we see in our minds, but cannot easily express as 2D figures, can be in fact designed using 3D CAD, 3D analysis and 3D printing. We aim to establish a method that will enable us to **easily design exciting structures** using recent computer technologies.

Of course, just drawing them in 3D space is not enough. They should also be safe and secure against earthquakes, typhoons, and so on. They must not only be **mechanically rational, but also economically reasonable**. Based on 3D simulation, we give them a skeleton and hull with appropriate dimensions.

To ensure a structure is safe and secure, we must understand the loads on it and their effects. We must also develop technologies that can reduce those effects. Furthermore, structures in certain situations must be **safe and secure even against external impacts and explosions**. We also study topics such as these.



A Composite Cubic Structure and a Complex Curved Structure are being designed using 3D CAD and 3D Simulation

About Researcher



YAMADA Kazuhiko, Dr.Eng., P.E.jp

Sc.M., 1993, Brown University