Center for Fire Science and Technology

Research Institute for Science and Technology

TOKYO UNIVERSITY of SCIENCE

Center for Fire Science and Technology has contributed to social safety and security as a central facility of international fire science and technology.
Recently, East Asia in particular has been undergoing rapid urbanization—even faster than Japan experienced in the past—and the occurrence and risk of deaths and serious injuries due to fires and explosions such as those due to combustion of petroleum products in modern urban facilities are greatly increasing. Education and research on fire safety science and technology at our institution must deal with these urgent circumstances while also predicting the changing nature of fire accidents in the future, and must create an innovative education and research system for preventing such accidents.
Furthermore, the center became a Designated Performance Appraisal Institution based on Building Standards Law, in 2019.

Tokyo University of Science

Center for Fire Science and Technology, Research Institute for Science and Technology

Research/Education

Advanced Fire Science research group

Academic Research and Education

Collaborative Research, Commissioned Research, Research Grant

Social Contribution

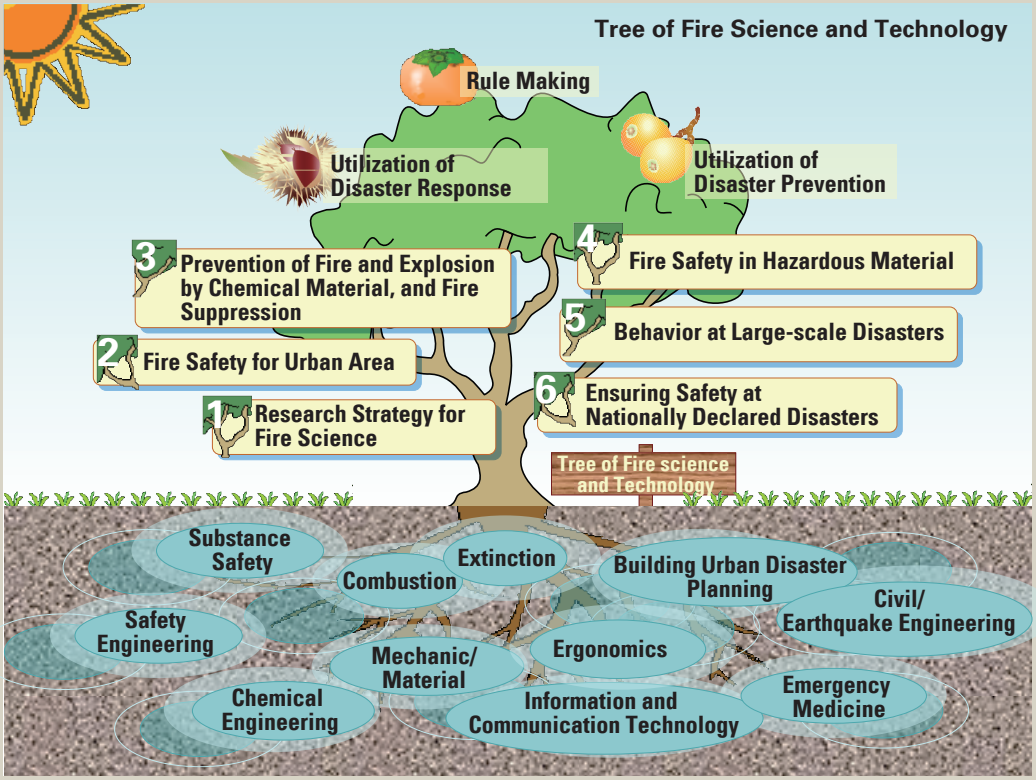
performance appraisal

Fire Safety and Technology group

Laboratory for Structural Fireproof Performance

Laboratory for Materials Performance

Performance Appraisal Committee



1 Research Theme

In many cities in Asia, there is a trend toward an increasing number of fires, which has accompanied modernization and the increasing height of buildings.
Global COE Program, 2008-2012 “Center for Education and Research on Advanced Fire Safety Science and Technology in East Asia”, MEXT-Supported Program for the Strategic Research Foundation at Private Universities, 2013-2017 “The Center for Fire Safety Information Based on Sharing of Expertise in Asia” Through these activities, we are promoting activities that contribute to reducing fire risks in Asia, and protect the safety of the people who live in cities. The main content of this program can be divided into the following two themes.

Theme 1 Fire Risk Analysis by Building and Operation of a Fire Information Network

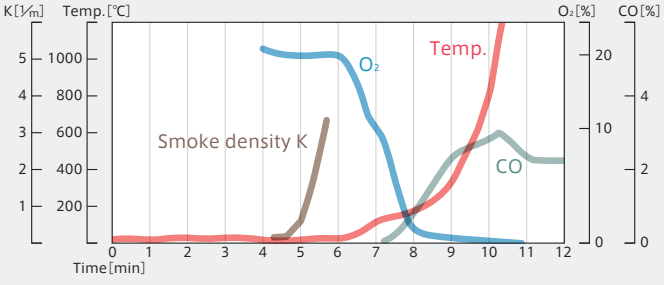
Many cities in Asia are in various stages of growth. Seoul and Shanghai have rapidly modernized based on a background of economic growth, with increasing building heights since the 1980s and 1990s and rapidly increasing use of underground spaces. However, there are also cities that have retained the traditional arrangement of buildings against the trend of urban modernization, with construction methods that resemble those in areas of Japan, with densely packed wooden houses and a high risk of fire.
Thus, if fire accidents become evident in some cities of the current Asian region, they can be recognized as a common problem. Furthermore, to implement effective measures, it is necessary to collect information about fire risks that are not only related to modern urban spaces but also rooted in regional characteristics and to share the accumulated expertise.
Under the first theme, this program will therefore operate the “Forum on Fire Safety in Asia” website along with the latest research results and explanations of experiment videos. Using the website content, research will be conducted together with researchers from around Asia on implementing measures for reducing fire risks in modern urban spaces and high-density traditional town arrangements in order to produce a more complete set of content for builders, firefighters, government, and engineers to resolve problems related to reducing fire risks.

Theme 2 Analysis of Fire Risk Issues

For this theme, we intend to gather information about fire accidents that have occurred in various cities in Asia into a “Center for Fire Safety Information in Asia,” and extract characteristics about fire accidents such as factors that led to increased human and property damage and problems that formed obstacles to evacuation and firefighting activities from the perspectives of specialists in various fields. Furthermore, we will explain factors, such as those that increased injuries and various factors based on fire science theory and experiments. To explain the combustion phenomenon related to the characteristics of materials and spaces in particular, investigations will be performed through experiments on materials and experiments using scale models of spaces.
Thus, by bringing together this information, the Center for Fire Safety Information in Asia website will be widely used as a source of information where the required information can be obtained immediately by users in the event that a similar fire accident occurs because it will have an explanation of the causative factors and the phenomenon as well as an accumulation of comments by experts about the factors for the spread of damage. This is expected to enhance fire safety in various cities in Asia.


58 killed in Shanghai as fire engulfs high-rise(2010)


Massive fire hits S. Korean high-rise(2010)



Example of the changing environment in a fire compartment : The concentration of carbon monoxide (CO) increases as the concentration of oxygen (O_2) decreases.


Ashulia factory fire death toll 117(Dhaka, 2012)

2 Fire Research and Test Laboratory, Center for Fire Science and Technology (CFSaT)

In March 2005, TUS opened the Fire Research and Test Laboratory, Center for Fire Science and Technology (hereinafter, CFSaT) as a research facility specializing in fire science that is equipped with world-class laboratories and equipment. CFSaT is located on the Noda campus.

The CFSaT building area is approximately 1500 m^2 with a total floor area of 1900 m^2 and a ceiling height of 18 m. The members of CFSaT designed this research facility with its cutting-edge equipment based on their experiences, enabling world-leading research to be conducted here as a center of fire science.

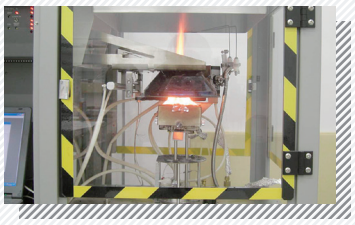
Facade of Fire Research and Test Laboratory

CFSaT is comprised of two major buildings, the Full-Scale Fire Test Hall and the Small Test Laboratories, according to their functionality. The Full-Scale Fire Test Hall is a large-scale laboratory with a floor area of 1000 m^2 and a ceiling height of approximately 18 m.

The Full-Scale Fire Test Hall is also equipped with essential tools for fire research such as smoke chamber for measurement of heat release rate and furnaces for fire resistance test. Utilizing the large-scale space, the building can be used for structural fire resistance tests of loaded full-scale structural members and frames, fire behavior tests of office spaces with combustible furniture fittings, smoke behavior tests of an atrium space, and burning behavior tests of vehicles.

The Small Test Laboratories are comprised of a multi-purpose experiment room, a cone calorimeter testing room, temperature and humidity controlled rooms, a library, an observation room, a data processing room, a conference room, a precision measuring equipment room and a storage room.

Laboratory Equipment



Cone Calorimeter (ISO 5660)

This device is used to examine ignitability and the exothermal properties of construction materials using thermal radiation. A test specimen is placed under the conical-shape electric heater which controls the intensity of thermal radiation to the specimen, and a pilot flame is applied to the specimen 10mm from its surface. The ignition time and the heat release rate can be measured per thermal radiation that can be set in the range of 0 to 50 kW/m^2.

PIV Combustion Field Measurement System

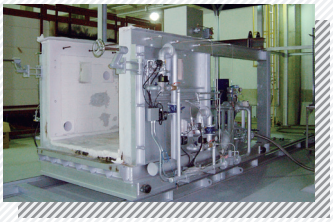
This system measures the instantaneous velocity and/or microscopic flow rate of, for example, the combustion field and the smoke plume motion. With this system, in the case of using a tracer (microscopic particles) and light source such as strobe light and laser, a picture of the reflection can be taken by an ultrafast camera to instantaneously obtain two-dimensional data of the flow rate on the target field.

FTIR Gas Analyzer (ISO 19702)

This unit is designed to be connected to the combustion and smoke generation tester and enables high-speed and continuous analysis of combustion gas. A measured value can be updated at short intervals (5 to 10 seconds). This unit specializes in measuring about 20 types of gas that is generated by combustion.

Structural Fire Resistance Furnace (Medium scale)

Heatproof Camera for Inner Observation

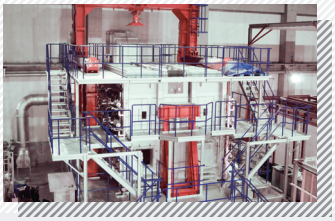


This unit is used to evaluate the fire resistance of various structural members such as columns, beams, floors and walls. The unit can control the heating temperature in the furnace and pressure difference based on ISO 834. The furnace, with dimensions of 1.5 m (W) x 1.5 m (D) x 1.5 m (H), can also provide immediate heating.

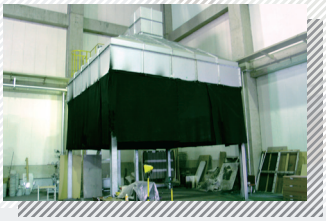
Structural Fire Resistance Furnace(Large scale, for Walls)

This unit is used to evaluate the fire resistance of walls and doors under fire and can control the heating temperature in the furnace and pressure difference based on ISO 834. There are 20 burners on the lateral side, and this can heat up to a 3.5 m x 3.5 m area.

Multiple Full-scale Furnace



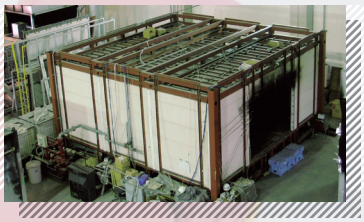
This device is used to measure the fire resistance of horizontal materials of buildings including beams, floors and roofs according to ISO 834 standard test. Put a full-scale specimen of 3 m (W) x 4 m (D) on the top the heater like covering it and then turn on the burner to heat the model from beneath. The furnace, with dimensions 3m (W) x 4m (D) x 3.5m (H) , can also be applied to immediate heat such as RABT temperature curve.



Calorimetry Hoods (5 m × 5 m)

This unit is used to analyze the burning characteristics of combustible materials such as furniture, motorbike and others. The duct is equipped with devices for flow rate and gas sampling. The design heat release rate is 3 MW at maximum, and the smoke exhaust power is 600 m^3/min at maximum. A movable unit (4 m x 4 m) is also available.

Full-Scale Compartment for Fire Experiment (with sprinkler system)

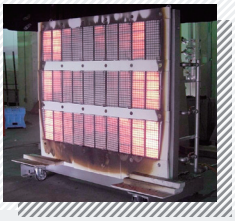


This fire compartment is 6 m (W) x 6 m (D) x 2.7 m (H) in actual size, and the sprinkler system can be attached to the ceiling. The compartment is mainly used to evaluate the suppression performance of sprinkler systems and also has used for experiments on smoke movement during sprinkler system activation.

Room Corner Testing Unit (ISO 9705)

This unit is comprised of a space of 2.4 m (W) x 3.6 m (D) x 2.4 m (H) with an opening of 0.8 m (W) x 2 m (H). It can be used to recreate a fire in a room with furniture which can be grown into a fully developed fire. In addition, flashover experiments can be performed with this unit by recreating fires that spread to entire rooms in a short time period, and then combustible gas concentration and temperature distribution data can be collected. The development of the fire can be captured by video camera.

ICAL Testing Unit (Heat Radiation Panel)



This unit is designed to elucidate the burning behavior of combustible materials under the condition where a certain heat flux was given through radiative heat transfer. The unit can also be used to investigate the behavior of members exposed to radiative heat. The panel heater has a heating area of 1.75 m (W) x 1.38 m (H). Members can be exposed experimentally to surface temperatures up to 950 ˚C and a heat flux of 50 kW/m^2.

Secondary Combustion Furnace

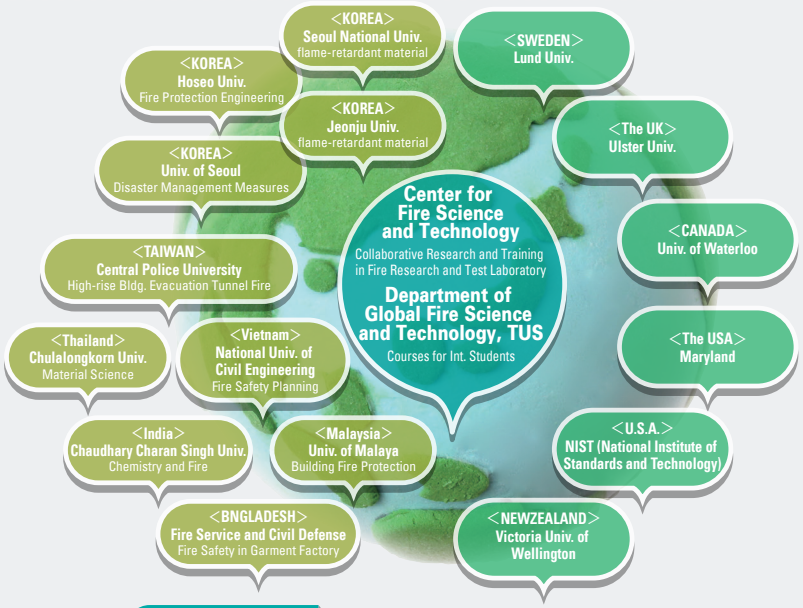
The smoke exhaust fan at the hood vacuums up the gas generated by combustion containing soot, and this furnace re-heats the smoke and soot to 800 ˚C to burn completely and then eliminates the smoke. There are 4 heating burners which can produce 4.8 Gkcal/h in total.

3 Promotion of International Exchange

FORUM for Advanced Fire Education / Research in Asia

In recent years, buildings that have a large potential fire risk are continuing to spread rapidly in various countries in Asia, as can be seen in fires in super high-rise buildings in various cities in Asia. To overcome this problem, it is necessary to have many human resources who can function as experts in fire safety science, and there is also an urgent need to nurture individuals who will be responsible for fire safety in the future. However, the current situation has fallen behind the needs in the various countries in Asia.

We are therefore continuing to develop the center for education and research into fire safety science that resulted from the Global COE Program, with the main aim of contributing to the development of fire safety science education in Asia, and we proposed the establishment of the FORUM for Advanced Fire Education / Research in Asia. The forum was established in December 2012 when the kickoff seminar was held in Japan.



Aims

- Establish an long-standing developmental education system for human resources through organic cooperative work and information exchange with organizations who perform fire education and research
- Conduct equal, equitable, and flexible cooperative work
- Be open to universities and research institutions which perform substantial education and research

Activities

- Hold periodic seminars, hosted in a rotation by the participating countries, offering mutual exchange and topical themes
- Use a website to promote exchanges, information sharing, and human resource exchanges between organizations and individuals, and to provide assistance for students studying abroad

4 Joint Usage / Research Center

The Ministry of Education, Culture, Sports, Science and Technology approved the Fire Science and Technology as a Joint Usage/Research Center in 2009. Our center has performed several kinds of global collaborative research. The main aim of the center is to contribute to the development of talented researchers who can then carry out advanced research in the field of Fire Science and Fire Safety both in Japan and around the world. In order to achieve this aim, we have developed collaborative research with universities and institutions nationwide on Fire Safety research and education. Our Joint Usage/Research Center project is able to develop links between theory and practice in Fire Science and Technology, and result in translational research which may contribute to the prevention of fire damage. Between 2009 and 2018, we collaborated on over 70 research projects classed as Joint Usage/Research Center projects, of which more than 20% were international.

5 Journal "International Journal for Fire Science and Technology"

Background and Perspective

A peer-reviewed English academic journal specializing in fire research, the "**International Journal for *Fire Science and Technology,***" has been published by CFSaT (part of Research Institute for Science and Technology, Tokyo University of Science) since 1981. Through this journal, the Center has distributed articles related on fire to various libraries, research institutes and universities worldwide. The journal became available online in 2007 via J-STAGE.

Applicable fields

Fire dynamics, Combustion (flame behavior, fire-reduction and so on), Fire physics and chemistry, Heat transfer, Fluid dynamics, Smoke movement and control, Risk analysis, Fire plume, Compartment fire, Human behavior in fire, Structural fire resistance, Behavior of structural frame and components in fire, Fire safety design, and Urban fire among others.

http://www.jstage.jst.go.jp/browse/fst/-char/ja/

6 Graduate School

Department of Fire Science and Technology

In April 2010, we established the Graduate School of Global Fire Science and Technology, the first graduate school in Asia specializing in fire science (master's course, Department of Fire Science), and we went on to established a doctoral course in April 2012.
The department of Graduate School of Global Fire Science and Technology is scheduled to be set up in April, 2018 under the Graduate School of Science and Technology by reorganization of the Graduate School.
This school provides education and research opportunities to students from Japan and abroad who wish to become professionals in fields such as architecture, fire prevention, materials, fire safety facilities, and property insurance, which are related to fire science and safety, or who wish to become experts in this field (fire department officials, fire protection engineers, etc.).
We are active in education and have a research laboratory that is fully equipped with apparatuses for building basic theory, with the aim of building a solid educational foundation for fire science in Asia.

Admissions Policy

1. In the master's course, our aim is to evaluate fire safety for controlling fire risks in city and building spaces and to use advanced research results related to establishing design systems based on these results to nurture high-quality expert professionals who can choose the effective measures. In the doctoral course, our aim is to nurture researchers who have advanced research capabilities and professional skills and who can create high quality fire safety technology.
2. We accept a wide range of international students to respond to the rapidly increasing fire risk associated with changing cities and building spaces, offer master's and doctoral courses, and nurture human resources who can effectively put fire science into practical use in their own country.
3. We welcome individuals who wish to work as professionals on the topics described in item 1, and we nurture highly skilled expert professionals in the master course and researchers who have advanced research skills and advanced specialist knowledge in the doctoral course.

Special Instruction

Lecture

Lectures are provided during the evening hours of weekdays at Kagurazaka Campus located in central Tokyo, as convenient to working-students.

- Experimental exercises and training are held on Saturdays utilizing dedicated large-scale laboratory facilities in Noda campus.

Target

- Enhancement of scientific knowledge for fire protection engineers
- Career enhancement for working-students
- Overseas students from Asian countries

Features

- Education and research system based on hands-on work by a team of professors with a wealth of experience
- Support internationalization by conducting lectures in English on most topics in the compulsory courses
- Hold entrance examinations twice per year, in summer and winter, and offer fall enrollment for international students

Timetable (Master's Course) Sample

Period	Time	Monday	Tuesday	Wednesday	Thursday	Friday	集中講義
1st Semester (Apr. ~)	18:00-19:30	Fire-Prevention Equipment Design	Urban Risk Management I	Building Fire Safety Design Exercise	Introduction to Disaster Prevention	Engineering for Fire Service	Experimental Study on Fire Dynamics*
	19:40-21:10	Outlook of Building Fire and Disaster Mitigation*	Laws and Regulations for Fire Safety*	Principles of Evacuation Safety Design	Human Safety Engineering for Building I*	Fundamentals of Fire Physics and Chemistry I*	
2nd Semester (Sep. ~)	18:00-19:30	Introduction to Fire Investigation*	Advanced to Chemical Fires	Structural Fire Safety Design*	Urban Disaster Mitigation and Preparedness*	Fire Regulation to Respective Characteristics of Various Buildings	Simulation Exercise on Smoke Movement and Evacuation*
	19:40-21:10	Risk Analysis and Safety Evaluation	Human Safety Engineering for Building II	Introduction to Material Design	Fluid Dynamics on Fire and Combstion	Fundamentals of Fire Physics and Chemistry II*	

* Lectures in English

Collaboration with Research Institutes in Graduate School Education

- Building Research Institute (BRI)
- National Research Institute of Fire and Disaster (NRIFD)

Course Curriculum

Doctoral Course

Personal development
- Research presentation exercise on fire science and technology
- Research technique exercise on fire science and technology
- Research paper writing exercise on fire science and technology

Research guidance
- Doctrate study 1A on fire science
- Doctrate study 2A on fire science
- Doctrate study 3A on fire science
- Doctrate study 1B on fire science
- Doctrate study 2B on fire science
- Doctrate study 3B on fire science

Master's Course

Research guidance
- Special study 1A on fire science
- Special study 1B on fire science
- Special study 2A on fire science
- Special study 2B on fire science

Fire protection engineering for policy making and planning
- Outlook of building fire and disaster mitigation*
- Introduction to fire investigation*
- Risk analysis and safety evaluation
- Engineering for fire service
- Fire regulation to respective characteristics of various buildings
- Laws and regulations for fire safety
- Urban risk management

Fire protection engineering for practical designing
- Introduction to material design
- Structural fire safety design*
- Fire-protection equipment design*
- Modeling of fire phenomena*
- Building fire safety design exercise
- Principles of evacuation safety design
- Fluid dynamics on fire and combustion

Basic theory and practice of fire science
- Simulation exercise on smoke movement and evacuation*
- Chemical fires*
- Experimental study on fire dynamics*
- Advanced fire extinguishing science
- Fundamentals of fire physics and chemistry I*
- Fundamentals of fire physics and chemistry II*
- Human safety engineering for buildings I*
- Human safety engineering for buildings II

Adult graduate students | University graduates | Students from overseas

Asterisks (*) indicates that those lectures are given in English.

7 Performance Evaluation

Starting of operation for the performance evaluation of wall, fire-door, and shutters.

Qualifying activity based on Building Standards Law

Authorization for fire-resistance/proof structure

The designated performance appraisal institution

Starting in 2019

Center of Fire Science and Technology, Tokyo University of Science

Contact Information

Center for Fire Science and Technology, Tokyo University of Science

http://gcoe.tus-fire.com/

Yamazaki 2641, Noda-shi, Chiba 278-8510, Japan

TEL +81-4-7124-1501(Key Number) FAX +81-4-7123-9763

5 minutes on foot from Unga station of the Tobu Urban Park Line

東京理科大学