



Report of the

First Planning Meeting of NHERI and NIED/E-Defense Collaborative
Research on Earthquake Engineering

held at

Kobori Research Complex

KI Building

Tokyo, Japan

July 13 and 14, 2017

Convened by

NHERI Network Coordination Office (NCO)

and

National Research Institute for Earth Science and Disaster Resilience (NIED)

July 2017

PREFACE

Following an agreement between the Japan Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the U.S. National Science Foundation (NSF), the First Planning Meeting for NEES/E-Defense Collaboration on Earthquake Engineering Research was held in 2004. This meeting laid the groundwork for an initial joint research program related to improving understanding of seismic effects and reducing the seismic vulnerability of bridges and steel buildings. The emphasis of the program was to conduct experimental research using the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) equipment sites and the three-dimensional full-scale earthquake testing facility (E-Defense) of the National Research Institute for Earth Science and Disaster Prevention (NIED). To formalize the “first-phase” collaboration, two Memorandums of Understanding (MOU) were executed, one between NSF and MEXT in September 2005 and the other between the NEES Consortium Inc. (NEES Inc.) and NIED in July 2005. In order to continue the collaboration to the “second phase,” the latter MOU was updated in May 2010 by the NEES Operation Center (NEEScomm) and NIED, to continue collaborative activities through 2015.

On July 13, 2017 a new phase of the research collaboration on earthquake engineering between US and Japan got off the ground with the signing of the Letter of Agreement between Purdue University [*on behalf of Natural Hazards Engineering Research Infrastructure (NHERI), and the NHERI Network Coordination Office (NCO)*] and the National Research Institute for Earth Science and Disaster Resilience (NIED) on earthquake engineering research using E-Defense and NHERI facilities. The First Planning Meeting was held July 13 and 14 of 2017 to discuss the details of the new research collaboration and implementation process. This meeting identified the scope of the first research collaboration under the framework of the NHERI and NIED agreement and the process for research collaboration for the coming years. In addition, a follow-up meeting to determine the initial research activities was recommended. In response, the Second Planning Meeting of NHERI/E-Defense Collaborative Research on Earthquake Engineering will be convened in sometime in late October or early November in 2017 in Tsukuba or Tokyo. Leading researchers from both countries as well as representatives from NSF, MEXT and other government agencies will be invited to attend this meeting to discuss in plenary and breakout sessions the future plans for NHERI and NIED/E-Defense collaboration.

This report contains a summary of the First Planning Meeting that was convened at the Kobori Research Complex, KI Building in Tokyo, Japan.

Conveners

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President, National Research Institute for Earth
Science and Disaster Resilience (NIED)

Dr. Masayoshi Nakashima,
President, Kobori Research Complex Inc.

Koji Suzuki
Executive Director, National Research Institute
for Earth Science and Disaster Resilience
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Prof. Julio Ramirez,
Director, NHERI Network Coordination Office
Purdue University

Dr. Koichi Kajiwara,
Director, Hyogo Earthquake Engineering
Research Center (E-Defense), National Research
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Resilience (NIED)

Prof. Stephen Mahin,
Director, NHERI Computational Modeling and
Simulation Center,
University of California, Berkeley

ACKNOWLEDGEMENTS

The conveners would like to thank the meeting participants for making the meeting a success by generously sharing their time, experience and ideas. The participants agree that the cordial and harmonious atmosphere at the meeting, and the candid and thoughtful discussions signal an outstanding future for NHERI and NIED/E-Defense Collaboration.

The meeting was held at the KI Building of the Kobori Research Complex Inc., in Tokyo, Japan. The participants would like to express their gratitude to President Masayoshi Nakashima for making the outstanding facilities available for this meeting.

NIED and the Kobori Research Complex Inc. hosted the meeting. The support of President Masayoshi Nakashima and the professional staff of the Kobori Research Complex Inc. contributed enormously to the success of the meeting.

Travel support for all the U.S. participants was made possible by a supplement to NSF Award CMMI-1612144 (NHERI Network Coordination Office). This support is greatly appreciated.

The findings, recommendations and conclusions contained in this report are the consensus views of the meeting participants, and do not necessarily reflect opinions of any one individual or the policy or views of the National Science Foundation, NHERI or other organization in the U.S., nor of the Ministry of Education, Culture, Sports, Science and Technology, National Institute for Earth Science and Disaster Resilience (NIED) or the Kobori Research Complex Inc.

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SUMMARY OF THE FIRST PLANNING MEETING OF THE NHERI/E-DEFENSE COLLABORATION ON EARTHQUAKE ENGINEERING RESEARCH

The First Planning Meeting of the NHERI/E-Defense Collaboration on Earthquake Engineering Research was attended by 10 participants from the US and 15 from Japan. There was great interest on both sides in the research collaboration on the MEXT and NIED funded Tokyo Metropolitan Resilience Project, Sub-Project C: *Collection and Synthesis of Data Regarding Structural/Non-structural Combined Performance and Damage Evaluation*, under the direction of Prof. Akira Nishitani and Dr. Koichi Kajiwara, and the formal agreement between NHERI and NIED on earthquake engineering research using E-Defense and NHERI facilities.

The report includes the recommendations and resolutions reached by the participants. The appendices contain the list of participants, the meeting agenda, the materials presented during the plenary sessions, and reports summarizing the specific recommendations developed by the individual working groups where participants discussed in detail various scientific and engineering challenges that could be addressed during the NHERI and NIED/E-Defense collaboration, as well as recommendations regarding the next meeting venue and date.

Issues discussed

The First Planning Meeting was organized to:

- (1) Discuss the implementation of the Letter of Agreement (LoA) between NHERI and NIED,
- (2) Discuss possible US-Japan research collaboration related to the Tokyo Metropolitan Resilience Project, Sub-Project C, and
- (3) Discuss mechanisms for enhancing and extending the excellent collaboration already established between researchers in the US and Japan in the field of earthquake engineering

The list of participants can be found in Appendix 1, and the agenda for the meeting is in Appendix 2. In the meeting, the background of US-Japan collaboration related to the NEES/E-Defense Collaborative Research Program in Earthquake Engineering was discussed. The signing of the NHERI/NIED LoA took place at the beginning of the 1.5-day meeting. During the plenary session in Day 1, Prof. Hirata, PI of the overall project on Tokyo Metropolitan Resilience, presented the main goals of the project and introduced the three major projects under the overall research effort. The presentation by the Prof. Hirata was followed by a presentation by Prof. Nishitani PI with D. Kajiwara of Sub-Project C outlining the major goals of the Sub-Project C, its five research thrusts and the leaders. These two presentations were followed by presentations on each research thrust by the leaders. In preparation for the meeting the Japanese researchers shared presentations on the research thrusts of the Sub-Project C with the participants from the U.S. In the afternoon plenary session participants from the U.S. introduced NHERI and discussed possible areas of collaboration in line with the research thrusts of the Sub-Project C. The program was augmented with a 5 minute presentation by Lowes on the RAPID Facility. All the presentations during the plenary session are in Appendix 3.

Three working groups then met. In keeping with the Tokyo Metropolitan Resilience Sub-Project C meta-theme, the working groups focused on:

- (a) Monitoring and Data Sharing
- (b) Reinforced Concrete and Steel Structures
- (c) Densely populated residential district (Wood Structures) and Non-structural component

Implementing modalities of collaboration and data policies under the LoA were also discussed in the parallel meeting.

Following the discussions of the working groups, the participants gathered for a plenary discussion to further discuss the process for the collaboration, the findings and recommendations of the working groups, and to develop overall resolutions for the meeting.

Process for collaboration

The participants discussed the details of the process for collaboration on the Tokyo Metropolitan Resilience Project, Sub-Project C under the framework of the Letter of Agreement between NHERI and NIED on Earthquake Engineering Research using E-Defense and NHERI Facilities. This discussion was meant to clarify, streamline and facilitate the collaboration between researchers from the U.S. and Japan. To facilitate the discussion three examples of collaboration were analyzed using the same three questions:

1. Who should be the initial point of contact on the Japanese side?
2. What should be the agreement on data exchanges?
3. Who issues the Letters of Collaboration from the Japanese side?

The examples and answers to the three questions for each of the examples are provided next.

Example A: project collaboration during the preliminary phase in preparation to or following the E-Defense test under a given research thrust (team) i.e. Reinforced Concrete, where a US researcher applies to NSF for testing at NHERI facilities.

Answers:

Q1. Prof. Akira Nishitani and Thrust Leader (I-Wood: Prof. Nagae; II- Reinforced Concrete: Prof. Kusunoki; III- Steel: Prof. Kurata; IV- Non-Structural Components: Dr. Sato; and V: Data Acquisition, Processing and Utilization: Prof. Nishitani) should be contacted simultaneously.

Q2. Researchers on both sides agree on the form and nature of the exchange amongst themselves.

Q3. Letter to be cosigned by Prof. Nishitani and Dr. Kajiwara, Co-Pis of Sub-Project C.

Example B: payload project on the big test of one of the subprojects of Project C.

Answers:

Q1. Same answer as in *Example A*.

Q2. It is agreed that all data will be shared, but the researchers will respect the requirements of the other side.

Q3. Same answer as in *Example A*.

Example C: project funded by an agency in the USA to test on the E-defense table outside of the Tokyo Metropolitan Resilience Project.

Answer: applicants are directed to contact NIED Executive Director Koji Suzuki to work an agreement on access fee and any other details related to the project.

Resolutions

Based on the presentations, discussions and deliberations, the participants of the First Planning Meeting of the NHERI and NIED/E-Defense Collaboration on Earthquake Engineering Research formulated and unanimously adopted the following specific resolutions:

1. The research collaboration under the framework of the Letter of Agreement signed by Purdue University on behalf of NHERI and NIED should be implemented to collaborate as of the date of signing of the agreement (7/13/17).

It is envisioned that the implementation will cover the following areas:

(a) Research Collaboration: The participants agree that the NEES/E-Defense Collaborative Research Program in Earthquake Engineering was a resounding success and demonstrated the effectiveness of joint U.S. – Japan research in addressing high priority problems of mutual interest. Given an assessment of the current state of knowledge in the light of recent large earthquakes in Japan and elsewhere, it is believed that a continuation of the collaboration under the new Letter of Agreement of the NHERI NIED/E-Defense program is needed and beneficial. Specific reasons for the new collaboration include:

- the rapidly growing realization of the importance of the Resilient City meta-theme concept to both the U.S. and Japan, exemplified by the collaboration on the Tokyo Metropolitan Resilience Project-Sub-Project C
- the smooth and effective collaboration established between NEES and E-Defense,
- the new capabilities made possible by the funding of NHERI by NSF, and
- the significant opportunities to leverage the unique other equipment at NHERI facilities as well as intellectual and personnel resources offered by NHERI and E-Defense.

It is strongly believed that NHERI and NIED/E-Defense collaboration by the U.S. and Japan provides the strongest mechanism to accelerate the pace of discovery and development in engineering needed to realize the goals of the earthquake disaster resilient city.

(b) Data sharing: pursuant to Item 11 of the LoA, we agree that the data and metadata derived from the experiments of joint research shall be stored in an electronic data repository as it is recorded for immediate access by members of the joint research team. Unless otherwise agreed by NHERI and NIED, data publication from U.S. and Japan collaboration projects under the scope of the Tokyo Metropolitan Resilience Project, Sub-Project C shall be in accordance with NHERI Data Curation Guidelines until such time as specific policies and guidelines reflecting the special character of the NHERI and NIED/E-Defense collaboration are developed by the JTCC and approved by both NHERI and NIED. The public release of experimental data shall occur no later than two (2) years from the date of the experiment. It may be shortened by the JTCC with the approval of both NIED and NHERI. The agreement covers specifically the collaboration under the Tokyo Metropolitan Resilience Project, Sub-Project C.

(c) Intellectual Property: as per Item 9 of the LoA, NHERI and NIED will provide for the protection of prior existing intellectual property rights and the protection of any intellectual property rights arising out

of the joint research and any cooperative activities. The JTCC shall develop policies and guidelines on intellectual property rights and inventions for implementation on a project-by-project basis under the umbrella project of Tokyo Metropolitan Resilience Project, Sub-Project C, which shall be approved by both NIED and NHERI. Nothing in this Agreement will prejudice the rights and obligation of each Party under any existing or future international or multilateral agreement related to the protection of intellectual property.

2. Regular planning meetings are needed.

It was agreed that it is important that regular joint planning meetings be held to plan future tests and projects around Sub-Project C directed by Prof. Nishitani and Dr. Kajiwara under the Tokyo Metropolitan Resilience Project led by Prof. Hirata, and accelerate exchange of information resulting from the joint NHERI NIED/E-Defense research. A near-term (October-November 2017) 1.5-day to 2-day planning meeting in Tsukuba or Tokyo is desired to refine research directions, identify additional topics, if any [e.g., nonstructural components, numerical simulation (i.e. blind competitions) etc.], and implement procedures for this new phase of collaboration between the U.S. and Japan. Availability on that period of time of the Japan side will be shared at the earliest possible date with the U.S. side to schedule the meeting and facilitate participation of the NSF representative. This first meeting should be followed by annual planning meetings at least until 2020. The venue of such meetings will be selected to meet the needs of the project collaboration. The possible goals of those meetings would be to: (1) identify the appropriate characteristics of the research to be performed, (2) establish research goals of the major joint test programs, (3) recommend needed ancillary and payload tests and analyses, (4) facilitate collaboration and (5) share the information obtained and promote dissemination of research findings and their use in education and practice. Material to be discussed and/or shared will be distributed to the participants in advance of the meeting.

3. Accelerate the transfer of technology.

Efforts to increase involvement of design professionals and dissemination of findings to various stakeholders should continue. It is clear that there is a significant benefit of involving design professionals in the formulation of research plans, conduct of research and interpretation of findings. Greater involvement would be expected to increase the value and impact of the research. Various means have successfully transferred research findings to regulatory and building officials, code agencies, professional engineers, financial service organizations, owners, and the public. Expanding these efforts are expected to accelerate the adoption and impact of the research findings.

4. Facilitate Data exchanges.

Efforts should be increased to take advantage of currently available data. Large efforts have been undertaken to carry out the tests that have been conducted at E-Defense and to analyze the data to validate underlying theory, improve analytical simulations tools and models, develop recommendations and guidelines that impact engineering design and evaluation. However, there is believed to be value in expanding the scope of such evaluations, especially by having groups of U.S. and Japanese researchers examine data from individual tests but perhaps more importantly to compare and contrast data obtained from multiple tests and numerical analyses. This effort is thought to have a high value for relatively modest cost.

5. Facilitate Personal Exchanges.

It is desired to increase collaboration by identifying existing and perhaps initiating new mechanisms that would enable exchange of researchers from the U.S. to Japan, and from Japan to the U.S. In particular, it is recommended that exchange of students and junior researchers to participate in particular efforts focusing on synthesizing, analyzing and interpreting available data, or participate in planning and conduct of tests would be highly beneficial.

Closure

The participants believe that the 1st Planning Meetings of the NHERI and NIED/E-Defense Collaborative Research Program on Earthquake Engineering was highly successful, and that NSF and MEXT should be congratulated for providing the earthquake engineering community with cutting-edge tools that will substantially accelerate progress towards the important goals of earthquake loss reduction. The attendees agree that the cordial and harmonious atmosphere at the meeting, and the candid and thoroughgoing discussions signal an outstanding future for NHERI and NIED/E-Defense Collaboration.

Funding agencies are encouraged to provide needed resources. Given the importance of the research proposed, and the benefits of leveraging resources available in the U.S. and Japan, appropriate funding agencies in the U.S. and Japan are encouraged to provide adequate funding and other support needed to realize the benefits of this new phase of the U.S. and Japan research collaboration under the umbrella of the agreement between NHERI and NIED on earthquake engineering research using E-Defense and NHERI Facilities.

The participants also appreciate and heartily thank the professional staff of the Kabori Research Complex Inc. and President Masayoshi Nakashima for their efforts in hosting this successful meeting.

Appendix 1: List of Participants

Name	Affiliation	Position
<US Side>		
Juan Caicedo	University of South Carolina	Professor
Shirley Dyke	Purdue University	Professor
John van de Lindt	Colorado State University	Professor
Laura Lowes	University of Washington, Seattle	Professor
Steve Mahin	University California, Berkeley	Professor
Eduardo Miranda	Stanford University	Professor
Gilberto Mosqueda	University of California, San Diego	Professor
Santiago Pujol	Purdue University	Professor
Julio Ramirez	Purdue University	Professor
Ellen Rathje	University of Texas, Austin	Professor
<Japan Side>		
Kazuhiro Hayashi	Toyohashi Institute of Technology	Assistant Professor
Haruo Hayashi	NIED	President
Naoshi Hirata	NIED	Special Adviser
Koichi Kajiwara	NIED	Director of E-Defense
Masahiro Kurata	Kyoto University	Associate Professor
Koichi Kusunoki	University Tokyo	Associate Professor
Atsushi Morikawa	Kobori Research Complex Inc.	Deputy General Manager
Takuya Nagae	Nagoya University	Associate Professor
Masayoshi Nakashima	Kobori Research Complex Inc.	President
Akira Nishitani	Waseda University	Professor
Eiji Sato	NIED	Chief Researcher of E-Defense
Koji Suzuki	NIED	Executive Director
Kentaro Tabata	NIED	Chief Researcher of E-Defense
Yamato Tanaka	MEXT	Deputy Head of MEXT Disaster Mitigation Section
Joel Challender	NIED	Interpreter

Appendix 2: Meeting Agenda

First Planning Meeting of NHERI and NIED/E-Defense Collaborative Research on Earthquake Engineering

Dates and Times: from 9:30 AM of Thursday, July 13 to noon of Friday, July 14, 2017

Location: Akasaka KI Building
Kobori Research Complex
KI Building
6-5-30, Akasaka, Minato-ku, Tokyo, Japan

Program

DAY 1 (Thursday, July 13)

First Session (chaired by Nakashima and Mahin)

- 9:30 – 9:30 Welcome Remarks (NIED: Hayashi)
9:35 – 9:40 Greetings from Japan (MEXT: Tanaka) and USA (Ramirez)
9:45 – 10:00 Goal of meeting and general instructions (Mahin & Nakashima)

Second Session (chaired by Nishitani and Ramirez)

- 10:00 – 10:40 Engineering Challenges in Tokyo Metropolitan Resilience – Part 1
Overview (Nishitani, 7 min + 3 min discussion)
Wood (Nagae: 10 min + 5 min discussion)
RC (Kusunoki: 10 min + 5 min discussion)
10:40 – 10:55 Break

10:55 – 11:40 Engineering Challenges in Tokyo Metropolitan Resilience – Part 2

Steel + Protective Systems (Kurata: 10 min + 5 min discussion)

Nonstructural Elements (Sato: 10 min + 5 min discussion)

Monitoring and Assessment (Nishitani: 10 min + 5 min discussion)

11:40 – 12:00 Discussion on mechanisms of collaboration

12:00 – 13:00 Lunch

Third Session (chaired by Kajiwara and van de Lindt)

13:00 – 13:10 Introduction of Tokyo Metropolitan Resilience (Hirata)

13:10 – 13:20 Introduction of NEHRI and Possible Collaboration with Japan (Ramirez)

13:20 – 15:35 Wood (van de Lindt: 10 min + 5 min discussion)

RC (Pujol: 10 min + 5 min discussion)

Steel (Mosqueda: 10 min + 5 min discussion)

Control (Dyke: 10 min + 5 min discussion)

Nonstructural Elements (Miranda: 10 min + 5 min discussion)

Monitoring and Assessment (Caicedo: 10 min + 5 min discussion)

Simulation (Lowe: 10 min + 5 min discussion)

SimCenter (Mahin: 10 min + 5 min discussion)

Data Exchange (Rathje: 10 min + 5 min discussion)

15:35 – 15:45 Break

15:45 – 16:10 General discussion and instructions for breakout sessions

Fourth Session (chair not assigned)

16:10 – 18:10 First Round of Discussion for Scheme of US-Japan Collaboration

16:10 – 18:10 Separate Discussion for Mechanism of Collaboration

18:30 – 20:30 Dinner

DAY 2 (Friday, July 14)

Fifth Session (chair not assigned)

9:00 – 10:40 Second Round of Discussions for Scheme of US-Japan Collaboration and Preparation of Resolutions

10:40 – 10:50 Break

Sixth Session (chaired by Kajiwara and Ramirez)

10:50 – 11:40 Presentations of Resolution Drafts and Adoption of Resolutions

11:40 – 12:00 Closing Sessions (MEXT, NIED, NEHRI, etc.)

<END>

Appendix 3: Plenary Session Presentations and Working Group Resolutions

Plenary Session:

The individual presentations during the plenary session in Day 1 are available for downloading at:

[https://www.designsafe-ci.org/media/cms_page_media/902/Combined NHERI-NIED Plenary Session Presentations.pdf](https://www.designsafe-ci.org/media/cms_page_media/902/Combined_NHERI-NIED_Plenary_Session_Presentations.pdf)

Working Group Resolutions:

There were three working groups and one parallel meeting established at this meeting.

(a) Monitoring and Data Sharing

The members of this group were Akira Nishitani (coordinator), Ellen Rathje, Juan Caicedo, Laura Lowes, and Naoshi Hirata.

(b) Reinforced Concrete and Steel Structures

With group members Koichi Kusunoki (coordinator), Santiago Pujol, Masahiro Kurata, Gilberto Mosqueda, Shirley Dyke, and Steve Mahin.

(c) Densely Populated Residential District (Wood Structures) and Non-structural Component

The members of the group were Takuya Nagae (coordinator), Eduardo Miranda, John van de Lindt, and Eiji Sato.

(d) Parallel meeting to discuss mechanisms for collaboration on research and data sharing.

The participants at the meeting were Koichi Kajiwara, Kentaro Tabata, Koji Suzuki, Joel Challender, Julio Ramirez, Steve Mahin, and Ellen Rathje

The resolutions from the three groups follow in the same order.

NHERI/NIED Joint Meeting toward Collaboration

Resolution for Monitoring / Data-sharing

**Coordinator: Akira Nishitani,
Ellen Rathje, Juan Caicedo, Laura Lowes,
Naoshi Hirata**

1. For Sensor Installation:

Japan side is glad to have US researchers propose additional sensing systems. Sensor installation must be approved by NIED and Japanese research teams; approval will depend on issues, such as sensor space requirement, total weight of sensors, enough preparation time, etc.

2. For Data-sharing:

All the data relevant to the collaborative experiments will be shared among Japan and US teams. In regard to making the obtained data publicly accessible, both sides will respect the related requirements of each other.

3. Toward Good Collaboration:

Through meaningful collaboration, US and Japan can accomplish better research more rapidly. Meaningful collaboration is demonstrated by joint publications.



Thanks for your attention.

Scheme of US-Japan Collaboration

Reinforced concrete and Steel group

Kusunoki (Coordinator), Pujol, Kurata, Mosqueda,
Dyke, Mahin

Group (a) RC/Steel

- WG to conduct analysis and compare its results with previous experimental data. Preparation of organized reference dataset to evaluate analysis options.
- Blind analysis.
- Development of an analytical model for structural/non-structural member (Pipe, duct, ceiling system...).
- Establishment of metric for resilience that uses sensing information.
- Estimation of repair cost and recovery time.
- Real-time hybrid simulation methodology development for structural/non-structural subassemblies.
- Establishment of computer vision based method to identify damage.
- Component test (for Steel).

Group (a) RC/Steel

- Providing partial space for non-structural payload and/or special instrumentation.
- Alternative seismic isolation system and displacement restraining system
- Hybrid simulation for component test.
- Consideration of alternatives for comparative follow-up test.
- Evaluation of curtain walls used in US and Japan

2017/07/14 US-Japan workshop Resolution

Densely populated residential district and Non-structural component Group (1 and 4)

Typical 3-story wooden houses (current design base) will be set on their soil podiums.

*Blind prediction and monitoring competition for the extracted pilot residential system response and damage (soil, wood structure, utility function, indoor)

The system includes underground pipes of gas, water and sewer. Electricity is planned, too.

*Performance comparisons of different specifications. Development and testing of resilient utility system including US specifications such as water and gas lines.

One is frame structure, the other is wall structure.

*New technologies for improved performance and resilience of entire residential system.

The loss assessment and structural performance assessment will be the target.

*Implementation actions of developed loss assessment to the US society (A pilot San Francisco block) based on the advantage of remained 3 years and comprehensive investigation team.