

Introduction of Recycled Concrete in China

Xiao Jianzhuang

Vice President, Guangxi University



Academic Conference



Achievements



Summary

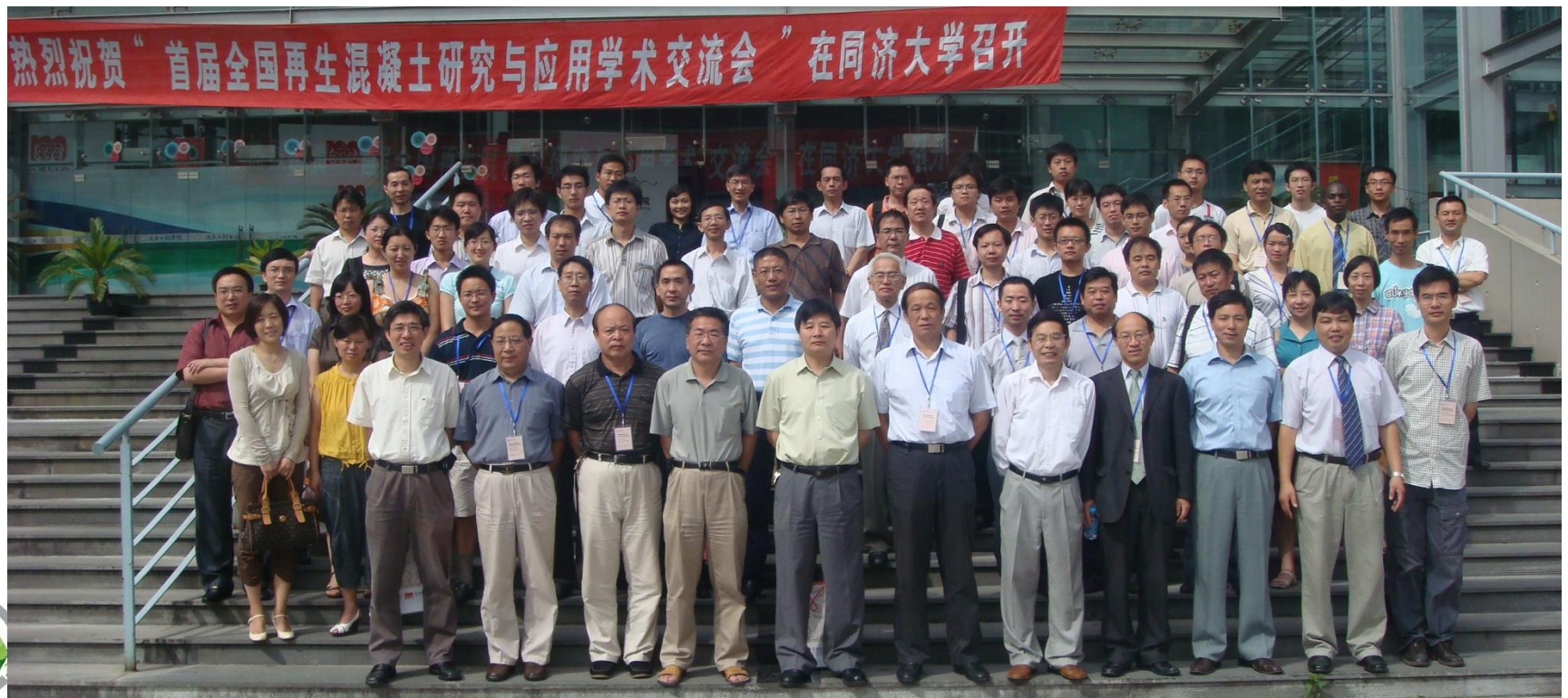


1. Academic Conference



- In 2008, **Recycled Concrete Committee** of Concrete and Prestressed Concrete Branch of China Civil Engineering Society was initiated and established.

The 1st national academic conference on the research and application of recycled concrete was held in Tongji University, Shanghai.



1. Academic Conference



- In 2010, “The 2nd national academic conference on recycled concrete” was held together with “The 2nd International Conference on Waste Engineering and Management” in Tongji University, Shanghai.



1. Academic Conference



- In 2012, “The 3rd national academic conference on recycled concrete” was held in Qingdao University of Technology, Qingdao



1. Academic Conference



- In 2014, “The 4th national academic conference on recycled concrete” was held in Beijing University of Technology, Beijing



1. Academic Conference



- In 2014, “The 4th national academic conference on recycled concrete” was held in Beijing University of Technology, Beijing

Topics:

- Production of recycled aggregate and preparation of recycled concrete
- Performance of recycled concrete material and component
- Design and construction of recycled concrete structure
- Research on improving the utilization level of recycled concrete
- Resources development of construction waste



1. Academic Conference



- In 2016, “The 5th national academic conference on recycled concrete” was held in Xi’an University of Architecture and Technology, Xi’an



1. Academic Conference



- In 2016, “The 5th national academic conference on recycled concrete” was held in Xi’an University of Architecture and Technology, Xi’an

Topics:

- Grading technology of recycled aggregate
- Approaches to prepare recycled concrete with high performance
- Structural design method and economic management
- Innovation and development of recycled concrete
- Measures for the future development of construction waste recycling in China



1. Academic Conference



- In 2018, “The 6th national academic conference on recycled concrete” was held in Nanjing University of Aeronautics and Astronautics, Nanjing



1. Academic Conference

- In 2018, “The 6th national academic conference on recycled concrete” was held in Nanjing University of Aeronautics and Astronautics, Nanjing

Topics:

- Modification technology of recycled aggregate
- The multi-way utilization technology of recycled concrete and the method to prepare it with high performance
- Innovation and development of recycled concrete
- Measures for the future development of recycled concrete in China
- Research and application of recycled concrete technology in China



1. Academic Conference



- In 2019, “The 7th national academic conference on recycled concrete” was held in Qingdao Agricultural University, Qingdao

第三届全国建筑固废学术交流会暨第七届全国再生混凝土学术交流会合影

2019.11.2 青島农业大学



1. Academic Conference



- In 2019, “The 7th national academic conference on recycled concrete” was held in Qingdao Agricultural University, Qingdao

Topics:

- The disposal and utilization of construction waste
- Source control technology of construction waste
- Coordinated disposal of construction and industrial solid waste
- Recycling and utilization of building solid waste filler
- Resource utilization of recycled filler from construction waste
- Modification and preparation technology of recycled aggregate



1. Academic Conference



- In 2020, “The 8th national academic conference on recycled concrete” was held in Harbin Institute of Technology, Harbin



1. Academic Conference



- In 2020, “The 8th national academic conference on recycled concrete” was held in Harbin Institute of Technology, Harbin

Topics:

- Modification and preparation technology of recycled aggregate and its industrial production
- Application of recycled aggregate in prefabricated buildings
- Research and application of recycled powder
- Application of recycled sand/powder in 3D printing concrete
- Study on workability, mechanical properties and durability of recycled concrete
- Mix design and basic mechanical properties of high performance recycled concrete
- Research and application of recycled concrete components and structures



1. Academic Conference



- In 2021, “The 9th national academic conference on recycled concrete” was held in Inner Mongolia University of Technology, Hohhot



1. Academic Conference



- In 2021, “The 9th national academic conference on recycled concrete” was held in Inner Mongolia University of Technology, Huhhot

Topics:

- Key technology of demolition and construction of building
- Disposal and resource utilization of construction waste
- Key technology and equipment for treating construction waste
- Disposal and utilization of construction waste with other solid waste
- Application management and policy support for construction waste
- Preparation technology and industrial production of recycled concrete



2. Academic Conference



- In 2023, “The 10th national academic conference on recycled concrete” was held in Fuzhou University, Fuzhou.

第十屆全國再生混凝土學術交流會暨第六屆全國建築固廢學術交流會嘉賓合影留念 福建·福州 2023年5月13日



Topics:

- Application of recycled aggregate in prefabricated buildings
- Research and application of recycled powder
- Application of recycled sand/powder in 3D printing concrete
- Study on workability, mechanical properties and durability of recycled concrete
- Mix design and basic mechanical properties of high performance recycled concrete
- Research and application of recycled concrete components and structures

2. Academic Conference



- In 2024, “The 11th national academic conference on recycled concrete” was held in Xinjiang University, Urumqi.



2. Academic Conference



- In 2024, “The 11th national academic conference on recycled concrete” was held in [Xinjiang University, Urumqi](#).

Topics:

- Construction solid waste disposal and resource utilization
- Construction waste source control technology
- Co-disposal of construction and industrial solid waste
- Utilization of solid waste recycled filler
- Resource utilization of construction residue

...





Academic Conference



Achievements



Summary



2. Achievements

- The received funds on researches of recycled concrete

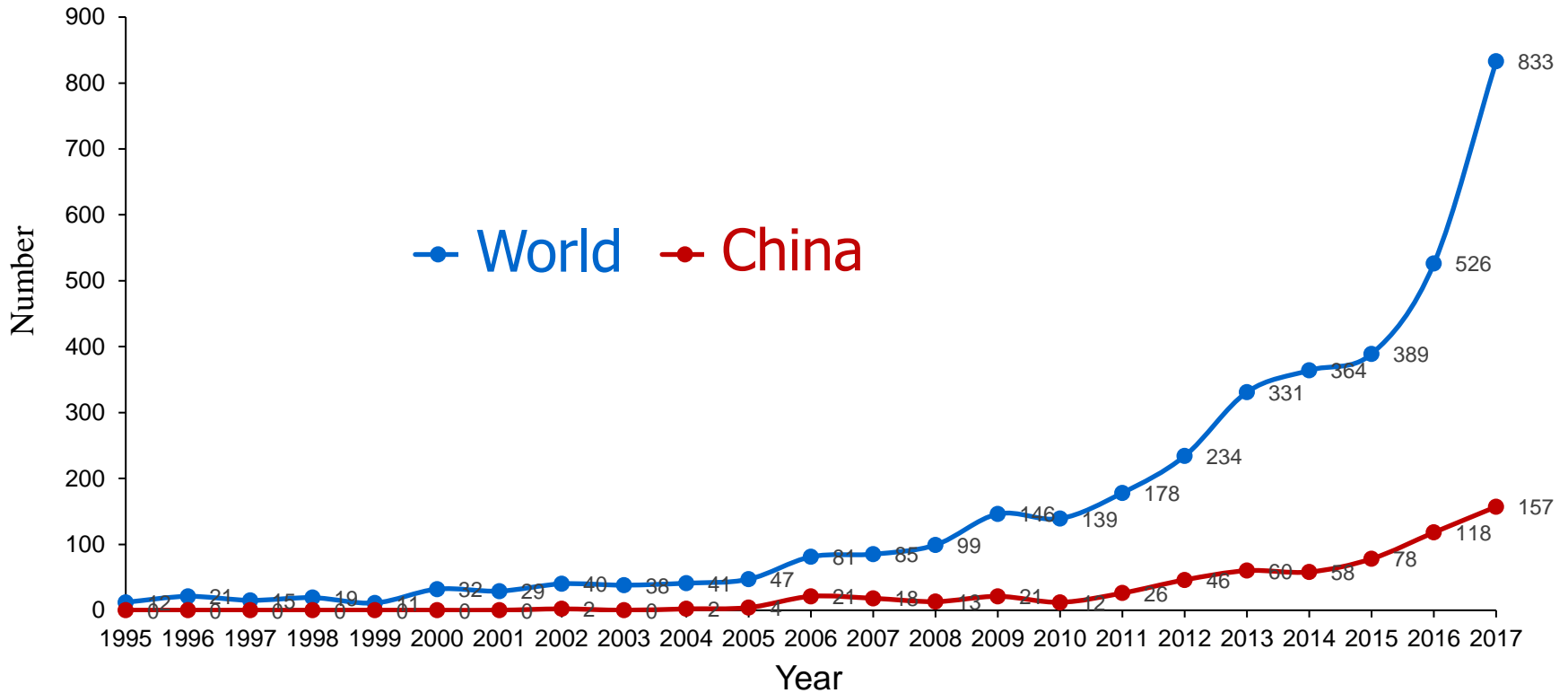
From 2008 to 2020, the members of Recycled Concrete Committee have received more than 60 projects from the National Natural Science Foundation of China, including General Program, Key Program, Major Program, National Science Fund for Distinguished Young Scholars.

The accumulative amount has exceeded 30 million yuan.



2. Achievements

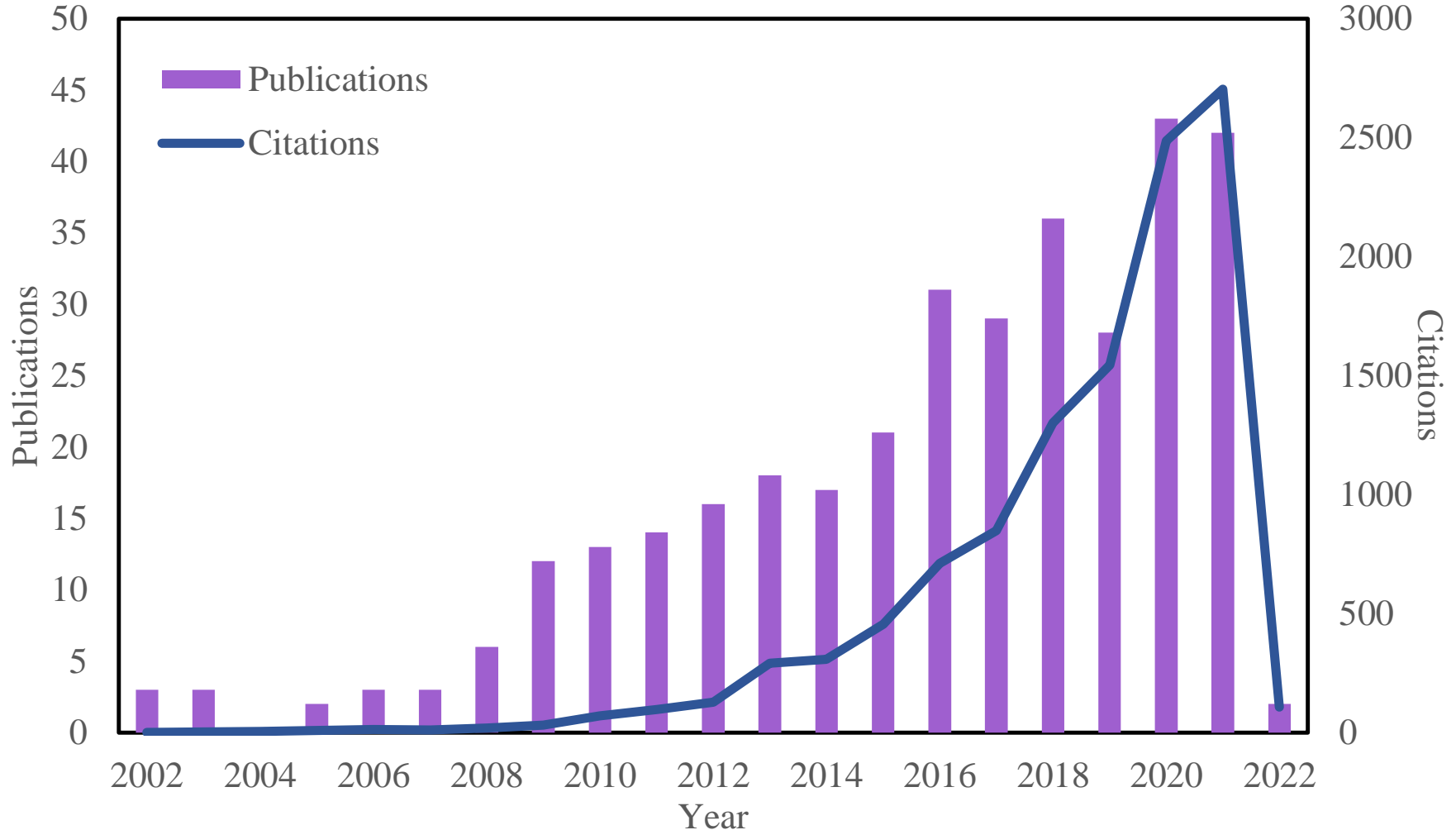
□ Research papers



Research papers on recycled concrete
(Data from Web of Science, before 2018.9.20)

The number of research papers on recycled concrete is increasing rapidly in China and the world





Citation report of the highlighted paper (*Data on Web of Science*, updated on 2nd Dec 2021.)



2. Achievements



Books on recycled concrete



2. Achievements

□ Patents

序号	发明名称	专利号	公告日	发明人
1	无机再生混凝土混合料及其制备方法	ZL03142200.4	2008.01.30	肖建庄;王军龙
2	地质聚合物再生混凝土及其制备方法	ZL200910049642.X	2012.07.04	肖建庄;孙振平
3	一种发光路面及其制备方法	CN201910690833.8	2019-11-01	肖建庄;黄国祥;刘琼;易超;林英龙
4	一种分解废弃混凝土装置	CN201821975693.6	2019-12-27	肖建庄;张青天;张鹏;丁陶;段珍华
5	一种建筑物有序化绿色拆除施工方法	CN201910823195.2	2019-09-02	肖建庄;曾亮
6	一种再生混凝土块材及其生产方法	CN201810043615.0	2018-09-21	马志鸣;肖建庄;段珍华;张青天
7	一种高工作性能再生混凝土的制备方法	CN201510405800.6	2015-12-09	肖建庄;陈恩慈
...



2. Achievements



□ Specification on recycled concrete

“Technical code on the application of recycled concrete” DG/T J08-2018-2007

“Recycled fine aggregate for concrete and mortar” GB/T 25176-2010

“Recycled coarse aggregate for concrete” GB/T 25177-2010

“Technical specification for recycled aggregate” JGJ/T 240-2011

“Code for

“C



Formed a national-industry-local standard system,
which guides the application of recycled concrete
effectively



2. Achievements

□ Recycled Concrete Committee



- **Recycled Concrete Committee** of Concrete and Prestressed Concrete Branch of China Civil Engineering Society continues to develop
- There are **63 members** from more than **50 universities and research institutes**
- More than 30 new members will be added

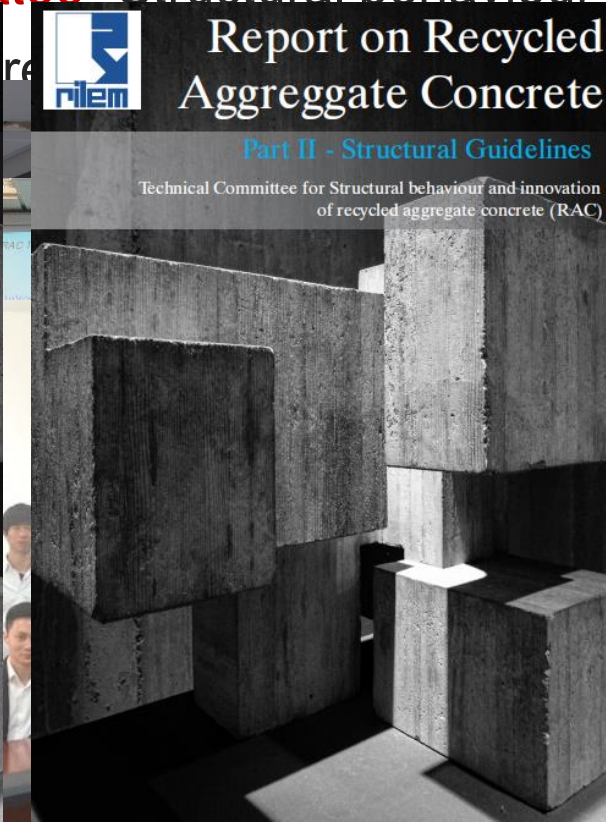
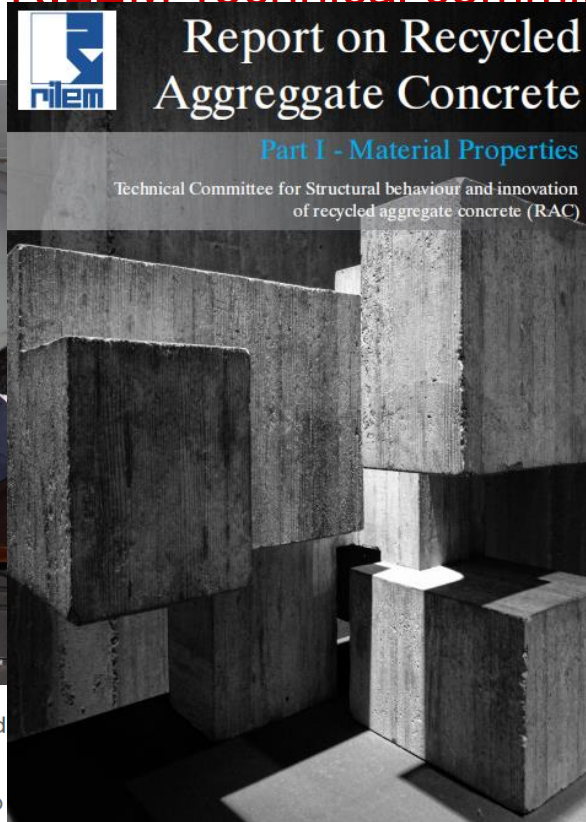


2. Achievements



□ RILEM Technical committee

In 2015, the **RILEM Technical committee** “Structural behaviour and innovation of recycled aggregate concrete” was established. There are 273 members from 20 countries around the world.



273-
Techn
Gene
Chair:
Subje
The are
Structural behaviour and

- Stress-strain relationship
- Hybrid RAC with natural aggregate concrete (NAC) components
- Performance under restraints by steel and FRP tubes or bars
- Component structural behavior (moment, shear, punching)
- Case-studies in structural applications of RAC
- Time-varying reliability models of RAC components



2. Achievements



Research Group for Recycled Concrete Structures and Construction

Director

Prof. Xiao Jianzhuang

Recipient of the National Science Fund for Distinguished Young Scholars, Humboldt Research Fellowship in Germany



MEMBERS

Duan Zhenhua, Zhao Zengfeng, Li Tan, DingTao, Xu Biwan (Tongji University)

Liu Chao (Xi'an University of Architecture); **Lei Ying** (Shanxi University); **Lei Bin** (Nanchang University) ;

Huang Yijie (Shandong University of Science and Technology); **Ma Zhiming** (Yangzhou University) ;

Fan Yuhui (Henan University of Science and Technology); **Ying Jingwei** (Guangxi University);

Zhang Kaijian, Zhang Qingtian (Fuzhou University); **Liang Chaofeng, Hou Shaodan** (Shaoxing University)

etc.

Overseas: Jiabin Li (Leuven University, Belgium); **Wengui Li** (University of Technology Sydney)

etc.

Tang Yuxiang; Hou Minjie; Lv Zhenyuan;

Chen Zixuan; Xia Bing; Hao Luceng; Zhang Hanghua
etc.



Young teachers

Students



2. Achievements



Basic research of RAC

- ✓ Idea of "model recycled concrete"
- ✓ improvement technology of recycled aggregate
- ✓ Mix design theory of recycled concrete

Recycling of construction waste

- ✓ Development of integration recycling process
- ✓ Localization of fixed or mobile equipment

Key technologies for application

- ✓ Develop standards of recycled fine aggregate, recycled coarse aggregate and the application technical specification of recycled concrete

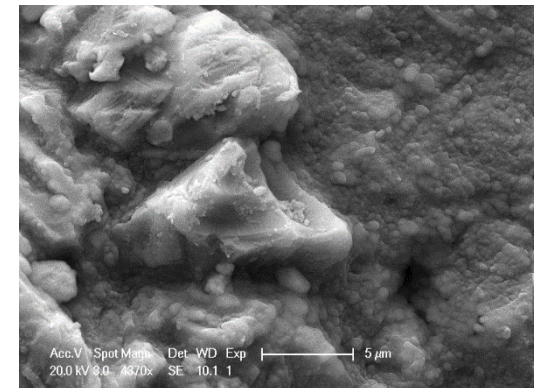
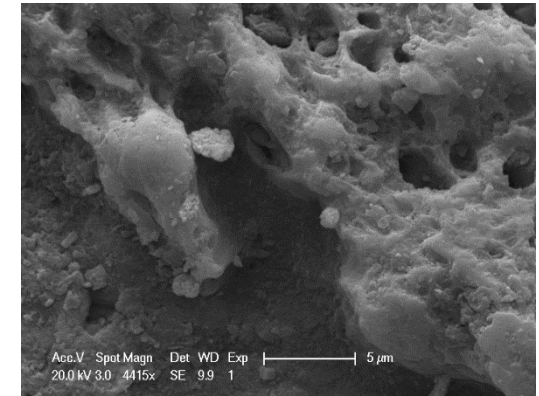
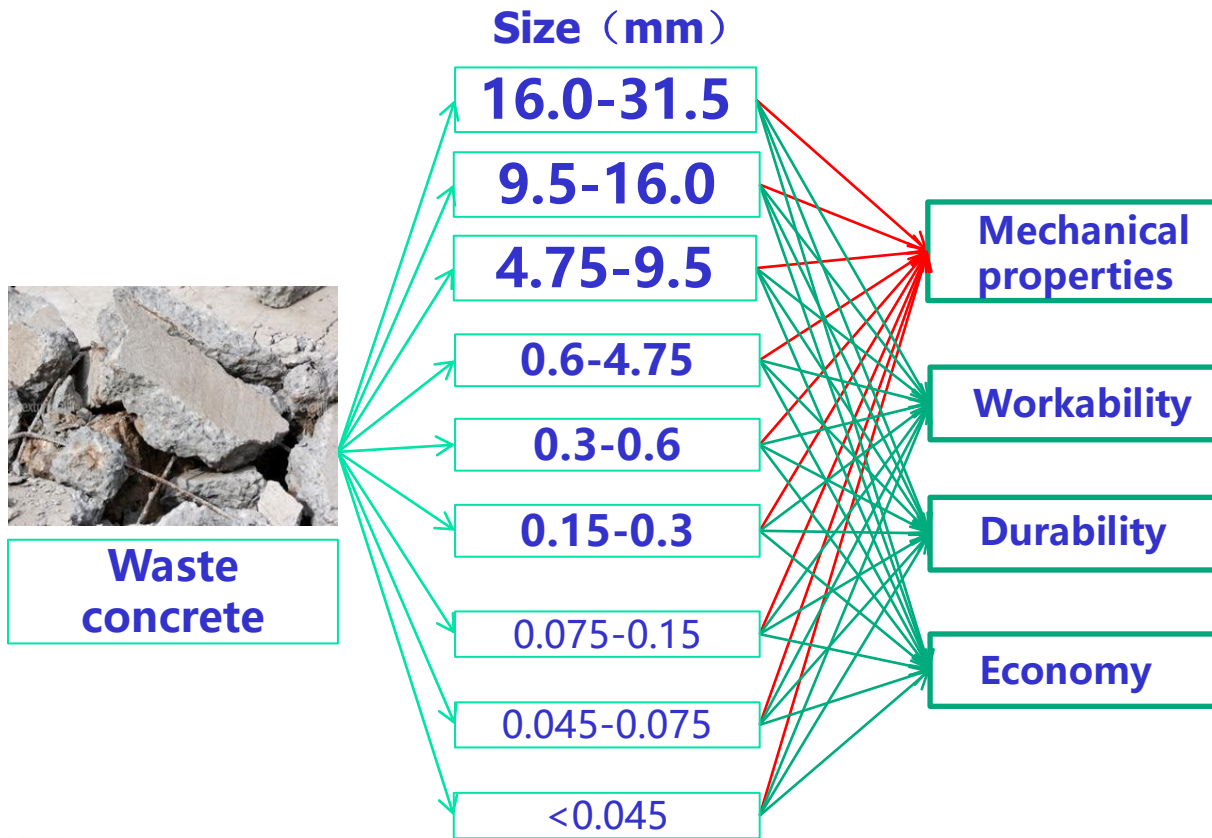
Application and management techniques

- ✓ Scientific and reasonable management mode of the whole recycling and application process
- ✓ Environmental benefit evaluation system based on LCA

2. Achievements



The effects of **recycled coarse/ fine aggregate and powder** on the mechanical properties, workability and durability of concrete were studied, and the performance control technology of recycled concrete was put forward



More than 10 papers published in *Cement Concrete Composites, etc.*

2. Achievements



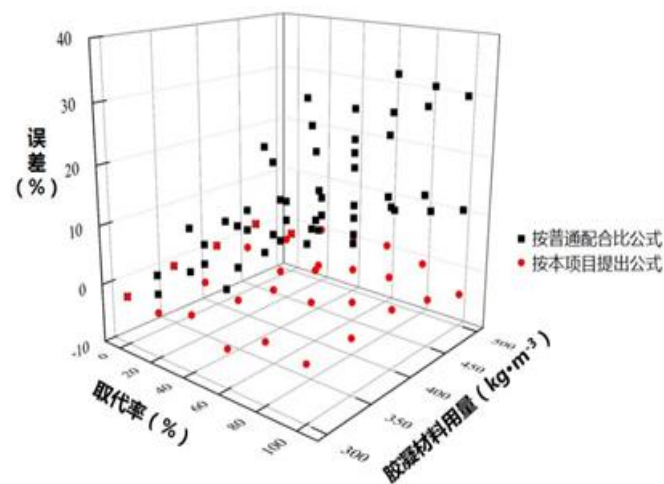
The calculation formula of strength of recycled concrete was established, and the software was developed.

Taking additional water consumption and replacement rate as parameters, the precise proportion design of C20-C60 recycled concrete was realized

RCAC

$$f_{Rg} = Af_{ce}(C/W - B) \left[1 - \underbrace{(7.607\omega_a)}_{\text{Water absorption}} - \underbrace{0.074\lambda_g}_{\text{Replacement ratio}} \right]$$

RFAC



More than 30 papers published in *Construction and Building Materials*, etc.

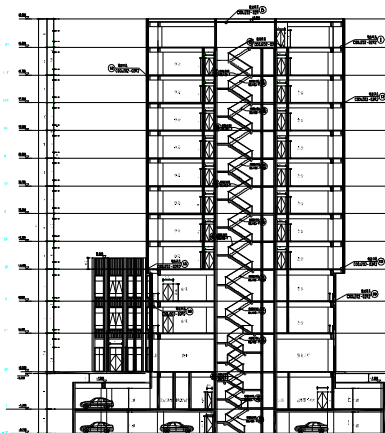
2. Achievements



- 25 provinces, cities and autonomous regions
- 85 construction solid waste recycling production lines



2. Achievements



层号	标高(m)	层高(m)	墙、柱		梁、板	
			混凝土等级	再生骨料取代率	混凝土等级	再生骨料取代率
屋面层	49.200					
12	45.600	3.650	RC40	30%	RC30	30%
11	41.650	3.950	RC40	30%		
10	37.750	3.900	RC40	30%		
9	33.850	3.900	RC40	30%		
8	29.950	3.900	RC40	30%		
7	26.050	3.900	RC40	30%		
6	22.150	3.900	RC50	10%		
5	18.250	3.900	RC50	10%		
4	14.350	3.900	RC50	10%		
3	9.850	4.500	RC50	10%		
2	5.350	4.500	C50			
1	-0.050	5.400	C50		C35	
地下一层	-5.500	5.450	C50		C30	
地下二层	-9.000	3.500	C50		C35	

注: RC表示再生混凝土。

- A 12 storey "recycled concrete structure building" in Shanghai
- Realizing the demonstration application of recycled concrete building from the whole process of **planning, design, construction and monitoring**



2. Achievements

□ The application of recycled concrete structures

The reconstruction building after earthquake, Sichuan, 2008



The 4-storey “Eco House” Shanghai 2010



The 12-storey High-rise RAC structures, Shanghai 2016



2. Achievements



- The application of recycled concrete structures

Science Museum of recycled concrete with **full utilization** of recycled aggregate



2. Achievements



□ The application of recycled concrete structures



“Shu Feng 468” project in Chengdu, 468 m, 101-storey

- As the tallest building under construction in the west of China, it has a planned area of 454,000 m².
- Recycled concrete is used in slabs



□ Awards

- National Award for Science and Technology Progress
- Science and Technology Progress Award of China Building Materials Association
- Provincial Award for Science and Technology Progress
- Huaxia Award for Construction Science and Technology





Academic Conference



Achievements



Summary



3. Summary

Summary of UK-China Bilateral Academic Exchange Conference

Size of convention

Attendance

UK: (offline)

China: 18 (offline) + (online)

Nearly twenty universities



3. Summary



Review and progress of recycled concrete research in China mainland

- **Grand scale**
- **Covering a wide range of fields**
- **Outstanding academic level**



3. Summary

Review and progress of recycled concrete research in China mainland



Material modification

- Quality of recycled aggregate
- Modification method
- New cement-based materials

...

Structural application

- Mechanical properties
- Safety & Durability
- Seismic performance

Sustainable development

- 3D printing with recycled sand
- Life cycle assessment
- Sustainable innovation in cement

...





ISO Projects — Registration of new projects

Dear Mr Jianzhuang Xiao,

In your capacity as project leader of ISO/AWI TS 21056, you are informed of the registration of the following new project(s) in your work programme.

Project reference	Committee	External relation	Stage
ISO/AWI TS 21056	ISO/TC 71/SC 3		English title: Recycled aggregate concrete — Additional provisions and guidance for specification, performance, and production French title: Titre manque

For any questions regarding project development processes (planning, optional steps, etc.), please contact your Technical Programme Manager.

For any questions or support regarding the ISO drafting rules, please contact your Editorial Manager.

Thank you and best regards,
ISO Central Secretariat



Funded by the
European Union



The [Reconmatic project](#) has been funded by the European Union under Grant Agreement No 101058580.

Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the HORIZON-RIA. Neither the European Union nor the granting authority can be held responsible for them.



THANK YOU FOR YOUR ATTENTION

Xiao Jianzhuang

Tongji University
Shanghai, China

April 27, 2023